Please check our wiki for help on navigating the form.

Horizon 2020

Call: H2020-SPACE-2018-2020

(Space 2018-2020)

Topic: DT-SPACE-06-EO-2019

Type of action: RIA

Proposal number: 870301

Proposal acronym: AQ-WATCH

Deadline Id: H2020-SPACE-2019

Table of contents

How to fill in the forms

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the steps in the submission wizard.

1 - General information

Topic	DT-SPACE-06-EO-2019	Type of Action	RIA
Call Identifier	H2020-SPACE-2018-2020	Deadline Id	H2020-SPACE-2019

Acronym	AQ-WATCH
Proposal title	Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health

Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &

Duration in months	*36*
Fixed keyword 1	Space and International cooperation
Fixed keyword 2	Environment, Pollution & Climate
Free keywords	*Air quality, health, satellites, model predictions, products and services*

Abstract

AQ-WATCH will develop a supply chain leading to the generation of seven downstream products and services that are innovative for improving air quality forecasts and attribution. These prototypes will be based on existing space and in situ observations of air quality and tailored to the identified needs of international users. The project will allow for the first time small and medium enterprises (SMEs) to integrate a very large number of datasets associated with earth's observations with advanced predictive models. These innovative products and services are aimed at improving public health and optimizing service provided by the energy sector in different regions of the world. The consortium supporting the project includes knowledge institutes, applied science organizations and business-oriented partners, and covers the required expertise to define the optimal functionalities of the products and services, and bring them to the market. The project will create opportunities for new environmental technologies. It will also upscale the portfolio of SMEs and reinforce their ethical and social responsibility in support of the world-wide effort to improve air quality.

Remaining characters 821

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

Please give the proposal reference or contract number.	
xxxxxx-x	

Declarations

1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal.	☒
2) The information contained in this proposal is correct and complete.	☒
3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).	☒

4) The coordinator confirms:

- to have carried out the self-check of the financial capacity of the organisation on http://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or	○
- is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or	◉
- as sole participant in the proposal is exempt from the financial capacity check.	○

5) The coordinator hereby declares that each applicant has confirmed:

- they are fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- they have the financial and operational capacity to carry out the proposed action.	☒
The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.	

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

Personal data protection

The assessment of your grant application will involve the collection and processing of personal data (such as your name, address and CV), which will be performed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the purposes and means of the processing of your personal data as well as information on how to exercise your rights are available in the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Detection and Exclusion system of the European Commission (EDES), the new system established by the Commission to reinforce the protection of the Union's financial interests and to ensure sound financial management, in accordance with the provisions of articles 105a and 108 of the revised EU Financial Regulation (FR) (Regulation (EU, EURATOM) 2015/1929 of the European Parliament and of the Council of 28 October 2015 amending Regulation (EU, EURATOM) No 966/2012) and articles 143 - 144 of the corresponding Rules of Application (RAP) (COMMISSION DELEGATED REGULATION (EU) 2015/2462 of 30 October 2015 amending Delegated Regulation (EU) No 1268/2012) for more information see the Privacy statement for the EDES Database.

2 - Participants & contacts

#	Participant Legal Name	Country	Action
1	MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV	DE	
2	BreezoMeter	IL	
3	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	FR	
4	ILMATIETEEN LAITOS	FI	
5	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	ES	
6	INERIS DEVELOPPEMENT	FR	
7	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	NL	
8	OctoGEO s.r.o.	CZ	
9	UNIVERSIDAD DE CHILE	CL	
10	UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH NONPROFIT CORPORATION	US	
11	BeiJing Computing Center	CN	
12	Beijing Municipal Institute of Labour Protection	CN	

2 - Administrative data of participating organisations

PIC	***Legal name***
999990267	*MAX-PLANCK-GESELLSCHAFT ZUR FORDERUNG DER WISSENSCHAFTEN EV*

Short name: MPG

Address of the organisation

Street HOFGARTENSTRASSE 8

Town MUENCHEN

Postcode 80539

Country Germany

Webpage www.mpg.de

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....05/04/2016 - no

SME self-assessment .....05/04/2016 - no

SME validation sme.....31/10/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Max Planck Institute for Meteorology ☐ not applicable

☐ Same as proposing organisation's address

Street: Bundesstr. 53

Town: Hamburg

Postcode: 20146

Country: Germany

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Guy** Last name: **BRASSEUR**

E-Mail: **gpbrasseur@gmail.com**

Position in org.: Group Leader and Former Director

Department: Environmental Modeling ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Bundesstr. 53

Town: Hamburg Post code: 20146

Country: Germany

Website: www.mpimet.mpg.de

Phone: +494041173209 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Chenbo	Guo	chenbo.guo@mpimet.mpg.de	*+494041173285*
Idir	Bouarar	idir.bouarar@mpimet.mpg.de	*+494041173411*
Antonio	Caltabiano	antonio.caltabiano@mpimet.mpg.de	*+494041173362*

PIC	***Legal name***
912749534	*BreezoMeter*

Short name: BreezoMeter

Address of the organisation

Street HaMeginim Ave 35,

Town Haifa,

Postcode 3326509

Country Israel

Webpage www.breezometer.com

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....31/12/2015 - yes

SME self-assessment .....31/12/2015 - yes

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: BreezoMeter ☐ not applicable

☒ Same as proposing organisation's address

Street: HaMeginim Ave 35,

Town: Haifa,

Postcode: 3326509

Country: Israel

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name: **Gabriela** Last name: **Adler**

E-Mail: **gabrielaa@breezometer.com**

Position in org.: Chief scientist

Department: BreezoMeter ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: HaMeginim Ave 35,

Town: Haifa, Post code: 3326509

Country: Israel

Website: www.breezometer.com

Phone: +xxx xxxxxxxxx Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Uri	Schechterman	uris@breezometer.com	+xxx xxxxxxxxx

PIC	***Legal name***
999997930	*CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS*

Short name: CNRS

Address of the organisation

Street RUE MICHEL ANGE 3

Town PARIS

Postcode 75794

Country France

Webpage www.cnrs.fr

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....18/11/2008 - no

SME self-assessment ..... unknown

SME validation sme.....18/11/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Laboratoire d'Aerologie ☐ not applicable

☐ Same as proposing organisation's address

Street: 14, Avenue Edouard Belin

Town: Toulouse

Postcode: 31400

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name: **Claire Granier** Last name: **Granier**

E-Mail: **claire.granier@aero.obs-mip.fr**

Position in org.: Senior Scientist

Department: Laboratoire de d'Aerologie ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: 14, Avenue Edouard Belin

Town: Toulouse Post code: 31400

Country: France

Website: http://www.obs-mip.fr

Phone: +33 5 6133 2710 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Nellie	Elguindi-Solmon	nellie.elguindi@aero.obs-mip.fr	*+33 5 61 33 27 10*

PIC	***Legal name***
999591306	*ILMATIETEEN LAITOS*

Short name: FMI

Address of the organisation

Street Erik Palmenin aukio 1

Town HELSINKI

Postcode 00560

Country Finland

Webpage www.fmi.fi

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Atmospheric Composition Research Department ☐ not applicable

☒ Same as proposing organisation's address

Street: Erik Palmenin aukio 1

Town: HELSINKI

Postcode: 00560

Country: Finland

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof.

Sex: (•) Male ( ) Female

First name: **Mikhail**

Last name: **Sofiev**

E-Mail: **mikhail.sofiev@fmi.fi**

Position in org.: Research professor, deputy of Modelling Group leader

Department: Atmospheric Composition Research Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Erik Palmenin aukio 1

Town: HELSINKI Post code: 00560

Country: Finland

Website: http://www.fmi.fi

Phone: +358 29539 1 Phone 2: +358 503290578 Fax: *+xxx xxxxxxxxx*

PIC	***Legal name***
999655520	*BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION*

Short name: BSC

Address of the organisation

Street Calle Jordi Girona 31

Town BARCELONA

Postcode 08034

Country Spain

Webpage www.bsc.es

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....01/03/2005 - no

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Earth Sciences - Atmospheric Composition Group ☐ not applicable

☒ Same as proposing organisation's address

Street: Calle Jordi Girona 31

Town: BARCELONA

Postcode: 08034

Country: Spain

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: (•) Male ( ) Female

First name: **Carlos** Last name: **Perez**

E-Mail: **carlos.perez@bsc.es**

Position in org.: Atmospheric Composition Groupd Leader

Department: Atmospheric Composition Group ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Calle Jordi Girona 31

Town: BARCELONA Post code: 08034

Country: Spain

Website: https://www.bsc.es

Phone: +34 934137722 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Marc	Guevara	marc.guevara@bsc.es	+xxx xxxxxxxxx
Sara	Basart	sara.basart@bsc.es	+xxx xxxxxxxxx
Mar	Rodríguez	mar.rodriguez@bsc.es	+xxx xxxxxxxxx
Dorota	Jouet	dorota.jouet@bsc.es	+xxx xxxxxxxxx

PIC	***Legal name***
950138766	*INERIS DEVELOPPEMENT*

Short name: INEDEV

Address of the organisation

Street PARC TECHNOLOGIQUE ALATA

Town VERNEUIL-EN-HALATTE

Postcode 60550

Country France

Webpage

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status.....08/07/2013 - yes

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Project Management ☐ not applicable

☒ Same as proposing organisation's address

Street: PARC TECHNOLOGIQUE ALATA

Town: VERNEUIL-EN-HALATTE

Postcode: 60550

Country: France

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Mr. Sex: (•) Male ( ) Female

First name: **Olivier** Last name: **Salvi**

E-Mail: **olivier.salvi@ineris-developpement.com**

Position in org.: Project Manager

Department: INERIS DEVELOPPEMENT ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: PARC TECHNOLOGIQUE ALATA

Town: VERNEUIL-EN-HALATTE Post code: 60550

Country: France

Website: www.ineris-developpement.eu

Phone: +33364225633 Phone 2: +33613879618 Fax: +33344556699

PIC	***Legal name***
999988909	*NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK*

Short name: TNO

Address of the organisation

Street ANNA VAN BUERENPLEIN 1

Town DEN HAAG

Postcode 2595 DA

Country Netherlands

Webpage www.tno.nl

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....30/09/2008 - no

SME self-assessment ..... unknown

SME validation sme.....30/09/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Climate, Air and Sustainability ☐ not applicable

☐ Same as proposing organisation's address

Street: Princetonlaan 6

Town: Utrecht

Postcode: 3484CB

Country: Netherlands

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: (•) Male ( ) Female

First name: **Martijn** Last name: **Schaap**

E-Mail: **martijn.schaap@tno.nl**

Position in org.: Principal scientist

Department: Climate and Sustainability ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Princetonlaan 6

Town: Utrecht Post code: 3584 CB

Country: Netherlands

Website: www.tno.nl

Phone: +31 88 866 2074 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Dick	Heslinga	dick.heslinga@tno.nl	*+31 888662037*

PIC	***Legal name***
902951758	*OctoGEO s.r.o.*

Short name: OctoGEO

Address of the organisation

Street Hálkova 34

Town Brno

Postcode 614 00

Country Czech Republic

Webpage https://octogeo.com/

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....no

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....no

Legal person .....yes

Industry (private for profit).....yes

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name: *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street: *Please enter street name and number.*

Town: *Please enter the name of the town.*

Postcode: *Area code.*

Country: *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr.

Sex: (•) Male ( ) Female

First name: **Petr**

Last name: **Pridal**

E-Mail: **info@octogeo.com**

Position in org.: Founder and CEO

Department: OctoGEO s.r.o. ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: Hálkova 34

Town: Brno

Post code: 614 00

Country: Czech Republic

Website: https://octogeo.com/

Phone: +420 530 332 976

Phone 2: *+xxx xxxxxxxxx*

Fax: *+xxx xxxxxxxxx*

PIC	***Legal name***
999447067	*UNIVERSIDAD DE CHILE*

Short name: UCHILE

Address of the organisation

Street Av. Libertador Bernardo O'Higgins 1058

Town SANTIAGO

Postcode 10

Country Chile

Webpage www.uchile.cl

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....yes

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....25/06/2008 - no

SME self-assessment ..... unknown

SME validation sme.....25/06/2008 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Center for Climate and Resilience Research, Universidad de Chile ☐ not applicable

☐ Same as proposing organisation's address

Street: Blanco Encalada 2002

Town: Santiago

Postcode: 8370449

Country: Chile

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof.

Sex: ○ Male ◉ Female

First name: **Laura**

Last name: **Gallardo**

E-Mail: **lgallard@u.uchile.cl**

Position in org.: Associate Professor, Director of Center of Excellence

Department: Center for Climate and Resilience Research, Universidad de Chile ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: Blanco Encalada 2002

Town: Santiago

Post code: 8370449

Country: Chile

Website: http://www.cr2.cl

Phone: +562 29784566

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Nicolas	Huneeus	nhuneeus@dgf.uchile.cl	+xxx xxxxxxxxx

PIC	***Legal name***
982967834	*UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH NONPROFIT CORPORATION*

Short name: UCAR

Address of the organisation

Street Table Mesa Drive 1850

Town Boulder Co

Postcode 80307 3000

Country United States

Webpage http://www2.ucar.edu/

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....no

Non-profit .....yes

International organisation .....no

International organisation of European interest .....no

Secondary or Higher education establishment .....no

Research organisation .....yes

Legal person .....yes

Industry (private for profit).....no

Enterprise Data

SME self-declared status.....09/10/1996 - no

SME self-assessment ..... unknown

SME validation sme.....09/10/1996 - no

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Atmospheric Chemistry Observations and Modeling (ACOM) Laboratory ☐ not applicable

☐ Same as proposing organisation's address

Street: 3450 Mitchell Lane

Town: Boulder

Postcode: 80301

Country: United States

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Dr. Sex: ○ Male ◉ Female

First name: **Gabriele** Last name: **Pfister**

E-Mail: **pfister@ucar.edu**

Position in org.: Scientist III & Deputy Director

Department: Atmospheric Chemistry Observations and Modeling (ACOM) Laboratory ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: 3450 Mitchell Lane

Town: Boulder Post code: 80301

Country: United States

Website: https://www2.acom.ucar.edu/

Phone: 3034972915 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Rajesh	Kumar	rkumar@ucar.edu	*+1 303 497 1413*
Barbara	Tunison	barbt@ucar.edu	*+1 303 497 2908*
Amy Smith	Smith	asmith@ucar.edu	*+xxx xxxxxxxxx*
Valerie	Koch	valeriek@ucar.edu	*+xxx xxxxxxxxx*

PIC	***Legal name***
902637963	*BeiJing Computing Center*

Short name: BCC

Address of the organisation

Street No.7,FengXian Middle Street

Town BeiJing

Postcode 100094

Country China (People's Republic of)

Webpage www.bcc.ac.cn

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....unknown

Non-profit .....unknown

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....unknown

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

No department involved

Department name: *Name of the department/institute carrying out the work.* ☒ not applicable

☐ Same as proposing organisation's address

Street: *Please enter street name and number.*

Town: *Please enter the name of the town.*

Postcode: *Area code.*

Country: *Please select a country*

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof. Sex: ○ Male ◉ Female

First name: **Tong** Last name: **Liu**

E-Mail: **liutong@bcc.ac.cn**

Position in org.: Executive Deputy Director

Department: BeiJing Computing Center ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: No.7,FengXian Middle Street

Town: BeiJing Post code: 100094

Country: China (People's Republic of)

Website: http://www.bcc.ac.cn/en/

Phone: +xxx xxxxxxxxx Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Bertrand	Bessagnet	bertrand.bessagnet@futuris-environment.co	+xxx xxxxxxxxx

PIC	***Legal name***
902644656	*Beijing Municipal Institute of Labour Protection*

Short name: BMILP

Address of the organisation

Street No.55 Taoranting Road, Xicheng District, Beijing

Town Beijing

Postcode

Country China (People's Republic of)

Webpage http://www.bmilp.com/

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....unknown

Non-profit .....unknown

International organisation .....unknown

International organisation of European interest .....unknown

Secondary or Higher education establishment .....unknown

Research organisation .....unknown

Legal person .....yes

Industry (private for profit).....unknown

Enterprise Data

SME self-declared status..... unknown

SME self-assessment ..... unknown

SME validation sme..... unknown

Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.

Department(s) carrying out the proposed work

Department 1

Department name: Central Laboratory ☐ not applicable

☒ Same as proposing organisation's address

Street: No.55 Taoranting Road, Xicheng District,

Town: Beijing

Postcode: *Area code.*

Country: China (People's Republic of)

Dependencies with other proposal participants

Character of dependence	***Participant***	

Person in charge of the proposal

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

Title: Prof.

Sex: ○ Male ◉ Female

First name: **Mo**

Last name: **Dan**

E-Mail: **bmilp_lab@126.com**

Position in org.: Director and Technical Manager

Department: Central Laboratory ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: No.55 Taoranting Road, Xicheng District, Beijing

Town: Beijing Post code:

Country: China (People's Republic of)

Website: http://www.bmilp.com/

Phone: +86-10-8352 2722 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

3 - Budget

No	Participant	Country	(A) Direct personnel costs/€	(B) Other direct costs/€	(C) Direct costs of sub-contracting/€	(D) Direct costs of providing financial support to third parties/€	(E) Costs of inkind contributions not used on the beneficiary's premises/€	(F) Indirect Costs / € (=0.25(A+B-E))	(G) Special unit costs covering direct & indirect costs / €	(H) Total estimated eligible costs / € (=A+B+C+D+F+G)	(I) Reimburse-ment rate (%)	(J) Max.EU Contribution / € (=H*I)	(K) Requested EU Contribution/ €
1	Max-planck-gesellschaft Zur Forderung	DE	202500	72000	0	0	0	68625,00	0	343125,00	100	343125,00	343125,00
2	Breezometer	IL	246400	20000	0	0	0	66600,00	0	333000,00	100	333000,00	333000,00
3	Centre National De La Recherche	FR	123690	10000	0	0	0	33422,50	0	167112,50	100	167112,50	167112,50
4	Ilmatieteen Laitos	FI	126500	10000	0	0	0	34125,00	0	170625,00	100	170625,00	170625,00
5	Barcelona Supercomputing Center -	ES	126000	10000	0	0	0	34000,00	0	170000,00	100	170000,00	170000,00
6	Ineris Developpement	FR	168000	20500	0	0	0	47125,00	0	235625,00	100	235625,00	235625,00
7	Nederlandse Organisatie Voor	NL	122870	7500	0	0	0	32592,50	0	162962,50	100	162962,50	162962,50
8	Octogeo S.r.o.	CZ	62400	7250	0	0	0	17412,50	0	87062,50	100	87062,50	87062,50
9	Universidad De Chile	CL	115200	10000	0	0	0	31300,00	0	156500,00	100	156500,00	156500,00
10	University Corporation For	US	129006	10000	0	0	0	34751,50	0	173757,50	100	173757,50	173757,50

11	Beijing Computing Center	CN	165000	26000	0	0	0	47750,00	0	238750,00	100	238750,00	0,00
12	Beijing Municipal Institute Of	CN	83200	35000	0	0	0	29550,00	0	147750,00	100	147750,00	0,00
	Total		1670766	238250	0	0	0	477254,00	0	2386270,00		2386270,00	1999770,00

4 - Ethics

1. HUMAN EMBRYOS/FOETUSES		Page
Does your research involve Human Embryonic Stem Cells (hESCs)?	○ Yes ◉ No	
Does your research involve the use of human embryos?	○ Yes ◉ No	
Does your research involve the use of human foetal tissues / cells?	○ Yes ◉ No	
2. HUMANS		**Page**
Does your research involve human participants?	○ Yes ◉ No	
Does your research involve physical interventions on the study participants?	○ Yes ◉ No	
3. HUMAN CELLS / TISSUES		**Page**
Does your research involve human cells or tissues (other than from Human Embryos/ Foetuses, i.e. section 1)?	○ Yes ◉ No	
4. PERSONAL DATA		**Page**
Does your research involve personal data collection and/or processing?	○ Yes ◉ No	
Does your research involve further processing of previously collected personal data (secondary use)?	○ Yes ◉ No	
5. ANIMALS		**Page**
Does your research involve animals?	○ Yes ◉ No	
6. THIRD COUNTRIES		**Page**
In case non-EU countries are involved, do the research related activities undertaken in these countries raise potential ethics issues?	○ Yes ◉ No	
Do you plan to use local resources (e.g. animal and/or human tissue samples, genetic material, live animals, human remains, materials of historical value, endangered fauna or flora samples, etc.)?	○ Yes ◉ No	
Do you plan to import any material - including personal data - from non-EU countries into the EU?	○ Yes ◉ No	
Do you plan to export any material - including personal data - from the EU to non-EU countries?	○ Yes ◉ No	
In case your research involves low and/or lower middle income countries, are any benefits-sharing actions planned?	○ Yes ◉ No	
Could the situation in the country put the individuals taking part in the research at risk?	○ Yes ◉ No	

7. ENVIRONMENT & HEALTH and SAFETY		Page
Does your research involve the use of elements that may cause harm to the environment, to animals or plants?	○ Yes ◉ No	
Does your research deal with endangered fauna and/or flora and/or protected areas?	○ Yes ◉ No	
Does your research involve the use of elements that may cause harm to humans, including research staff?	○ Yes ◉ No	
8. DUAL USE		**Page**
Does your research involve dual-use items in the sense of Regulation 428/2009, or other items for which an authorisation is required?	○ Yes ◉ No	
9. EXCLUSIVE FOCUS ON CIVIL APPLICATIONS		**Page**
Could your research raise concerns regarding the exclusive focus on civil applications?	○ Yes ◉ No	
10. MISUSE		**Page**
Does your research have the potential for misuse of research results?	○ Yes ◉ No	
11. OTHER ETHICS ISSUES		**Page**
Are there any other ethics issues that should be taken into consideration? Please specify	○ Yes ◉ No	

I confirm that I have taken into account all ethics issues described above and that, if any ethics issues apply, I will complete the ethics self-assessment and attach the required documents. ☒

How to Complete your Ethics Self-Assessment

5 - Call-specific questions

Extended Open Research Data Pilot in Horizon 2020

If selected, applicants will by default participate in the Pilot on Open Research Data in Horizon 2020[1] , which aims to improve and maximise access to and re-use of research data generated by actions.

However, participation in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. After the action has started, participants will formulate a Data Management Plan (DMP), which should address the relevant aspects of making data FAIR – findable, accessible, interoperable and re-usable, including what data the project will generate, whether and how it will be made accessible for verification and re-use, and how it will be curated and preserved. Through this DMP projects can define certain datasets to remain closed according to the principle "as open as possible, as closed as necessary". A Data Management Plan does not have to be submitted at the proposal stage.

Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be penalised for opting out.

We wish to opt out of the Pilot on Open Research Data in Horizon 2020.	○ Yes	◉ No

Further guidance on open access and research data management is available on the participant portal: http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/open-access-dissemination_en.htm and in general annex L of the Work Programme.

[1] *According to article 43.2 of Regulation (EU) No 1290/2013 of the European Parliament and of the Council, of 11 December 2013, laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006.*

Horizon 2020

Work Programme 2018-2019
Leadership in Enabling and Industrial Technologies – Space
Digitising and transforming European Industry and Services

Proposal full title:

Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health

Proposal acronym:

AQ-WATCH

Part B

DT-SPACE-06-EO-2019
International Cooperation Copernicus
Designing EO downstream applications with international partners
RIA Research and Innovation Action

Name of the coordinating person:
Prof. Dr. Guy P. Brasseur
Max Planck Institute for Meteorology
Hamburg, Germany

List of participants

Participant No.	Participant Organisation Name	Country
1 (Coordinator)	Max Planck Gesellschaft zur Forderung der Wissenschaften EV - **MPG**	Germany
2	**Breezometer**	Israel
3	Centre National de la Recherche Scientifique - **CNRS**	France
4	Ilmatieteen Laitos (Finnish Meteorological Institute)- **FMI**	Finland
5	Barcelona Supercomputing Center – Centro Nacional de Supercomputacion - **BSC**	Spain
6	INERIS DEVELOPMENT SAS- **INEDEV**	France
7	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek – **TNO**	Netherlands
8	OctoGEO s.r.o. - **OctoGEO**	Czech Republic
9	Universidad de Chile - **UCHILE**	Chile
10	University Corporation for Atmospheric Research, Nonprofit Corporation – **UCAR**	United States of America
11	Beijing Computing Center - **BCC**	China
12	Beijing Municipal Institute of Labour Protection - **BMILP**	China

List of Prime Users

No	Associated Prime Users	Country
1	Unconventional Renewable Energies Trade Association (ACERA)	Chile
2	State of Colorado	USA
3	Beijing Municipality	China

For Abbreviations used in this document please refer to Annex 1

Table of Contents

Summary: The objective of AQ-WATCH is to integrate space and in-situ Earth observations with modeling and information technologies to facilitate access by international partners to Copernicus and related data, specifically in the area of *air pollution* and related impacts (e.g., human health, renewable energy optimization). The project will develop supply chains that will lead to the production of innovative prototype products and services, and deliver novel high-resolution air quality forecasts and multi-sectoral source attribution. These products and services will reach a technological readiness level 7: "System prototype demonstration in operational environment at pre-commercial stage", and are expected to be brought to the market within 3 years after the completion of the project.

1. Excellence

1.1 Objectives

Overall Objective

AQ-WATCH will develop a supply chain leading to the generation of seven innovative downstream products and services for improving air quality forecasts and source attribution. These prototypes will be based on existing space and in situ observations of air quality and tailored to the identified needs of international users. The project will make it possible for small and medium enterprises (SMEs) to integrate for the first time a very large number of datasets associated with earth observations with advanced predictive models. These innovative products and services are aimed at improving public health and optimizing renewable energy in different regions of the world. The project consortium includes knowledge institutes, applied science organizations and business-oriented partners, and brings together the required expertise to define the optimal functionalities of these products and services, and to bring them to the market. The project will create opportunities for the development and widespread adoption of new environmental technologies. It will also upscale the technical portfolios of SMEs and reinforce their social responsibilities in support of the world-wide effort to improve air quality.

Specific Objectives

AQ-WATCH is an international consortium, which will co-develop and co-produce tailored products and services derived from space and in situ observational data with the purpose of improving air quality (AQ). The capabilities of these products and services will be demonstrated in three different regions of the world in order to establish their potential for their widespread adoption beyond the lifetime of the project. A prototype production chain will be initiated by proposing to three "prime users" chosen in different parts of the world (Colorado, USA; Santiago, Chile; Beijing, P.R. China), and a range of prototype products/services will be developed to help mitigate air pollution and their effects on health. A dialogue will be immediately established with these prime users to better identify their specific needs and to establish if the proposed products/services need to be modified or updated. Once agreement is reached for each region, initial prototype products and services will be co-designed, tested and evaluated in a joint effort with the prime users. Further feedback from the prime users on the operation of these products and services will lead to improved prototype products/services. The transition of the R&D product prototypes to a range of viable commercial product lines will happen within three years following the completion of the project. The flow of work converting observational data into proposed prototype products/services is shown in Figure 1.

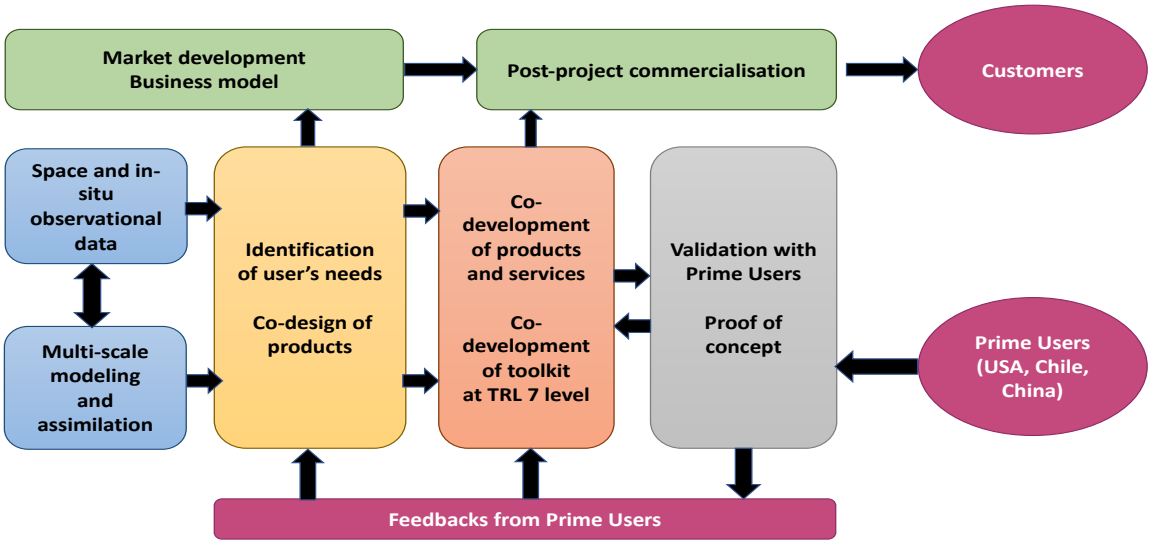


Figure 1. *The high-level structure of the AQ-WATCH Project highlights the flow between the process of identifying the user's needs, the process of adding value to available space and in-situ data and the evaluation of the products and services with prime users. The graph also shows how the ongoing feedback from the users will contribute to improving both the quality and usefulness of the products. The parallel activities to develop a business model to serve the market and the development of a commercialization strategy are also represented. More specific and detailed aspects are discussed and graphically represented in the following sections.*

Specific objectives of the project are:

[1] To design and produce new global and regional air pollution atlases that include the climatological distribution of chemical pollutants complemented by quantities such as the diurnal and seasonal variations, air quality and related health indices, premature mortality exceedance frequency, long-term trends, etc.

[2] To develop software packages with the capability to provide more accurate daily forecasts of air quality at the regional scale including tailored high-resolution fire smoke and wind-blown dust forecasts; downscaling of air quality forecasts to 1 km resolution in urban areas.

[3] To develop a source apportionment service to mitigate air pollution and hence increase the life expectancy of the population in different regions of the world, with special focus on the role of agricultural sources of air pollution and the potentially important effects of fracking operations.

[4] To co-design, co-produce and co-evaluate innovative prototype products and services with prime users in three regions of the world chosen for their specific levels of economic, social and environmental development.

[5] To develop a user-friendly toolkit offering to potential customers an ensemble of tools to design air pollution mitigation measures in different industrial sectors and in different regions of the world. This toolkit will establish the basis for the generalization and the wider adoption and commercialization of the prototype products and services.

The development of the AQ-WATCH prototype products and services will be facilitated by the development of a ***business model*** that will identify the possible sustainable markets (private sector and public services as well as individual citizens). This project plans to make full use of channels and networks that support a dialogue with stakeholders and thus promote the concept of participative science. AQ-WATCH will establish contacts with potential international end-users by building a community interested and capable of making the optimal use of the project results. It will provide information and technological briefings to the relevant governmental and regulatory authorities to make them aware of the results, products and services that will be produced by AQ-WATCH. After the completion of the project, interested SMEs will be able to start commercialization of the products and services, and to prepare for the wider business and market uptake.

The timing of this proposed project is particularly appropriate since a new generation of space instruments dedicated to air quality monitoring have recently been launched or are expected to be launched in the coming years. TROPOMI, which observes several chemical species (ozone (O_3), nitrogen dioxide (NO_2), formaldehyde (HCHO)) at a few kilometers-resolution, was launched recently onboard Sentinel-5p. SLSTR instruments onboard Sentinel-3A and Sentinel-3B provide the Aerosol Optical Depth (AOD) globally since July 2017 and November 2018, respectively. In the coming years, Europe with Sentinel-4, the United States with TEMPO and South Korea with GEMS will launch geo-stationary satellites that will provide continuous monitoring of species in different regions including O_3, NO_2, SO_2, HCHO in three of the most highly populated regions of the world. Information from space of small spatial patterns such as those encountered in urbanized valleys, roadways, major airports and sea harbors will become available. As the prototypes developed in the AQ-Watch project become operational they will add considerable value to the data provided by space instruments and contribute to international efforts aimed at ensuring an increasingly clean atmosphere.

In summary, our strategic objective is to develop innovative downstream applications to promote the use of Copernicus space observations worldwide and, through the sustained commercialization of smart products and services outside Europe, to increase innovation and enhance the capability of the European industry, specifically in small and medium enterprises in the environmental technology sector.

1.2 Relation to the work programme

AQ-WATCH addresses the work topic: **International Cooperation Copernicus – Designing EO downstream applications with international partners. DT-SPACE-06-EO-2019 – RIA Research and Innovation Action.** The work programme topic to which our proposal relates is **"Leadership in Enabling and Industrial Technologies – Space, Digitising and transforming European Industry and Services".** The proposal addresses the *specific challenges* (1.2.1) and *scope* (1.2.2) of the call issued by the European Commission as indicated in the following tables

1.2.1 Specific Challenges:

	Specific Challenges	Responses
1	Cooperation with international partners is key to promoting the uptake of Copernicus globally, exploiting possibilities for integrating in-situ, space data and information technologies.	The project includes 4 international partners (USA, Chile, China), who will have access to space and in situ observations and will run predictive models. They will use information technologies to exploit these tools. They will work in partnership with the European partners and co-develop the AQ-WATCH products and services.
2	Building the Copernicus full, free and open data policy: Facilitate access to Copernicus data and information for interested international partners.	For the Copernicus data and information AQ-WATCH will follow a full, free and open access policy including for the interested international partners. All the data produced during the project will be freely accessible through the *User Interface Platform (UIP)* on the project website
3	Cooperation with partner countries: Using Copernicus data to jointly develop algorithms, services and/or products, which serve local needs and/or enhance the Copernicus global product quality.	The participants from partner countries will be fully associated with the development of the prototype products/services. Their contribution will serve the project as a whole and will also respond to local needs. The participants will lead the dialogue with local prime users and contribute to the evaluation of the prototypes together with the prime users.
4	Use the Copernicus Data and Information Access Services (DIAS) or other existing data access solutions.	The DIAS service will be used to access most of the data needed to develop the prototype products and services. See WP 2 for more details. When data cannot be provided by DIAS, other data bases (e.g., national and regional air quality monitoring data bases and space project data bases)
5	Integrate third-party data (including in-situ data) and envisage data assimilation into models and products made available on the Copernicus platform of the Copernicus services.	Many in-situ data are provided only by national monitoring networks. They will be integrated with the Copernicus data to add value to the prototype products/services. Observational data will be assimilated in regional air quality models as initial conditions. They will also be used for model evaluation.
6	Shape the products according to the user's needs and openly demonstrate their values to the wider user community. Achieve this in an environment integrated at the level of the user, in order for the users to accept the innovative potential which the product promises. Give specific attention to the various processes in place in the user's workflows which incorporate EO information.	The prime users have been identified in the USA, China and Chile. They will be central to the dialogue that will lead to the design of the products, their co-development, and their evaluation according to international standards. Specific attention will be given to the user's practices and culture and to the work environment under which they operate. The project will make sure that the three prime users as well as the members of the Project Stakeholder Network (to be constituted by the AQ-WATCH project – see Section 3.2.1) understand and appreciate the potential for innovation in their country.
7	Address early on during the production development the transition of R&D product prototypes to viable commercial product lines after the end of the EU funded phase.	The project includes representatives from private SMEs who will not only contribute to the development of prototype products/services but also lead the development during the first phase of the project of a business model that will lead to the commercialization of the prototype products and services within 3 years after the completion of the EU funded phase.

1.2.2 Scope

	Scope	Response
1	Address a wide variety of applications stemming from the use of observation and their smart integration with other technologies. May include other space and non-space inputs.	The project will use Copernicus space observations of atmospheric composition as data representing land use, surface emissions of chemical species, in situ air quality measurements, several predictive chemical transport models, downscaling methodologies and an integrated attribution system to develop the AQ-WATCH products/services.
2	Applications should be sustained by a production process capable of delivering the user a product which is validated and accepted as a marketable product in the international partner country.	The objective of the project is to add value to the Copernicus space observations and other available products by using numerical models, statistical analysis and predictive methods (machine learning), data assimilation and attribution methodology to develop marketable products and services. The work packages describe how the know-how of the different partners and prime users will lead to the production processes and the delivery of prototype products.
3	International cooperation has a key role to play to enhance markets beyond borders by enabling space application providers to absorb market-related tacit knowledge and know-how of their partners.	The project is based on an international cooperation with partners and prime users from several countries (including USA, China, Chile). The members of the Project Advisory Board and of the Stakeholder Network represent several countries on all continents.
4	Validations and customisations are to be undertaken as the business case for the application is to be demonstrated.	The role of the international prime users together with the partners is to evaluate and customize the products/services to the needs of their regions. It is also to contribute to the development of a business case for these products/services in their region of the world.
5	Service level models are to be developed, with appropriate quality of service definitions for the application.	The prototype products/services are conceived to respond to local needs in different regions of the world. They will be tested in 3 regions, but they are designed and adaptable for high quality applications in other regions
6	Application products are expected to adopt open standards for data documentation, data models and services including data processing, visualization and cataloguing on a large scale.	The products and services will adopt open standards for documentation and services. The prototypes will be openly accessible for commercialization after the completion of the project.
7	Include joint calibration and validation or integration of local in-situ systems to enhance the quality of data and service products.	The prime users will contribute their local data and experience for validation and integration into the services. The joint validation exercises will provide important feedback on quality requirement. Information on the quality of the data will be documented and publicly available.
8	Exploit the added value of integration of EO observation technologies (satellite, airborne and ground-based) with positioning ones, and ICT (enhancing new frontiers opened by cloud computing) from international partner countries through development of applications, and encourage their insertion in the market	Several partners of the project (including the SMEs Breezometer and OctoGeo) are playing pioneering roles in deriving innovative products from EO based data and making them available on mobile and web applications. Their work makes full use of cloud computing technologies. The direct cooperation between the international prime users and the SMEs will enhance the market value of the AQ-WATCH products.

1.3 Concept and methodology

1.3.1. Concept

The rationale. According to the World Health Organization (WHO), 91% of the world population lives in areas where air pollution exceeds international guideline limits, and every year approximately 4.2 million people die prematurely from outdoor air pollution[1]. Among them are 600,000 children. The European Environmental Agency estimated in October 2018 that 422,000 premature deaths were caused in Europe by high atmospheric levels of particle matter of diameter smaller than 2.5 microns ($PM_{2.5}$). The Energy Policy Institute at the University of Chicago (EPIC) concluded from a detailed study[2] that, on average in the world, the loss in life expectancy due to particulate pollution was 1 year in 1998 and had reached 1.8 years in 2016. It is of the order of 3 years in China and of more than 5 years in India. Clearly, in terms of mortality, air pollution has become the most acute environmental problem facing humanity today and has surpassed the risk arising from cigarette smoking (see Figure 2).

From the point of view of human health, the most dangerous air pollutants have been found to be small liquid or solid particles, whose diameter is less than 2.5 microns ($PM_{2.5}$) and 10 microns (PM_{10}), respectively. Nitrogen oxides and ozone, which are present in large quantities in polluted areas, also play a detrimental role for human health. These pollutants increase the risk of a variety of serious diseases including cardiovascular and respiratory diseases, chronic obstructive pulmonary diseases (COPD), lung cancer, throat and sinus inflammation and chest pain. There is increasing evidence that air pollution represents a factor in some brain diseases including Alzheimer disease[3] and major depression specifically of teenagers[4]. Chemical substances have also been shown to considerably worsen various allergies through complex processes occurring at the cellular and molecular levels[5]

Figure 2 shows that, in some parts of the world (e.g., Asia), the effects of air pollution become increasingly acute. Mineral dust has also substantial impacts on health (asthma), specifically when it is mixed with anthropogenic pollution. Its deposition on solar panels reduces substantially the efficiency of the electrical power produced by solar energy. Dust storms have economic implications, through disruption of commercial activities, air transport, construction. and household cleaning.

Finally, every year, surface deposition of air pollutants such as ozone destroys crops worth billions of Euros and sufficient to feed millions of people. The worldwide economic loss associated with crop losses is estimated to represent a value of $14-26 billion annually.[6]

The available space and in situ observations together with data treatment, numerical modeling, machine learning and source apportionment approaches needs to be used more effectively to address this acute environmental problem affecting global society, with particularly acute impacts in emerging countries (Asia and Africa).

Observations of atmospheric composition. For many years, Europe has been actively involved in *space observations* of the chemical composition of the atmosphere. Advanced space programs have been developed by the Group on Earth Observations (GEO), the Committee on Earth Observation Satellites (CEOS), the European Space Agency (ESA), EUMETSAT, and the national agencies in the EU members states. Space observations have also been made available in other countries of the world, in particular in the United States of America as part of the NASA and NOAA programs. Information on the global distribution of gaseous species such as ozone, nitrogen oxides, sulfur dioxide, carbon monoxide and some organic molecules such as

[1] https://www.who.int/airpollution/en/
[2] Greenstone, M. and Qing Fan, Introducing the Air quality Life Index, Report of the Energy Policy Institute of the University of Chicago, November 2018.
[3] Kilian J. and M. Kitazawa, The emerging risk of exposure to air pollution on cognitive decline and Alzheimer's disease – Evidence from epidemiological and animal studies, Biomed. J., 41 (3) 141-162, 2018.
[4] Roberts S. et al., Exploration of NO_2 and $PM_{2.5}$ air pollution and mental healh problems using high-resolution data in London-based children from a UK longitudinal cohort study, Psychiatric studies, 271, 8-17, 2019.
[5] Takano H. and K. Inoue, Environmental pollution and allergies, J. Toxicol. Pathol.,30, 193-199, 2017.
[6] van Dingenen R. et al., The global impact of ozone on agricultural crop yields under current and future air quality legislation, *Atmos. Env., 43*, 2009, https://doi.org/10.1016/j.atmosenv.2008.10.033

formaldehyde are now available. The TROPOMI instrument on board Sentinel 5P, that was launched in October 2017, provides data at a spatial resolution of a few kilometers and detects the signature of urban areas and even of individual power plants in rural areas. Observations on aerosol particles have been available for several years, for example through the measurements of the atmospheric optical depth from instruments like MODIS. Table 1.3.1. provides a list of the available spaceborne instruments for atmospheric composition and Figure 3 an example of high-resolution observation of nitrogen dioxide (NO_2) by the TROPOMI instrument on board of the Copernicus Sentinel 5P satellite.

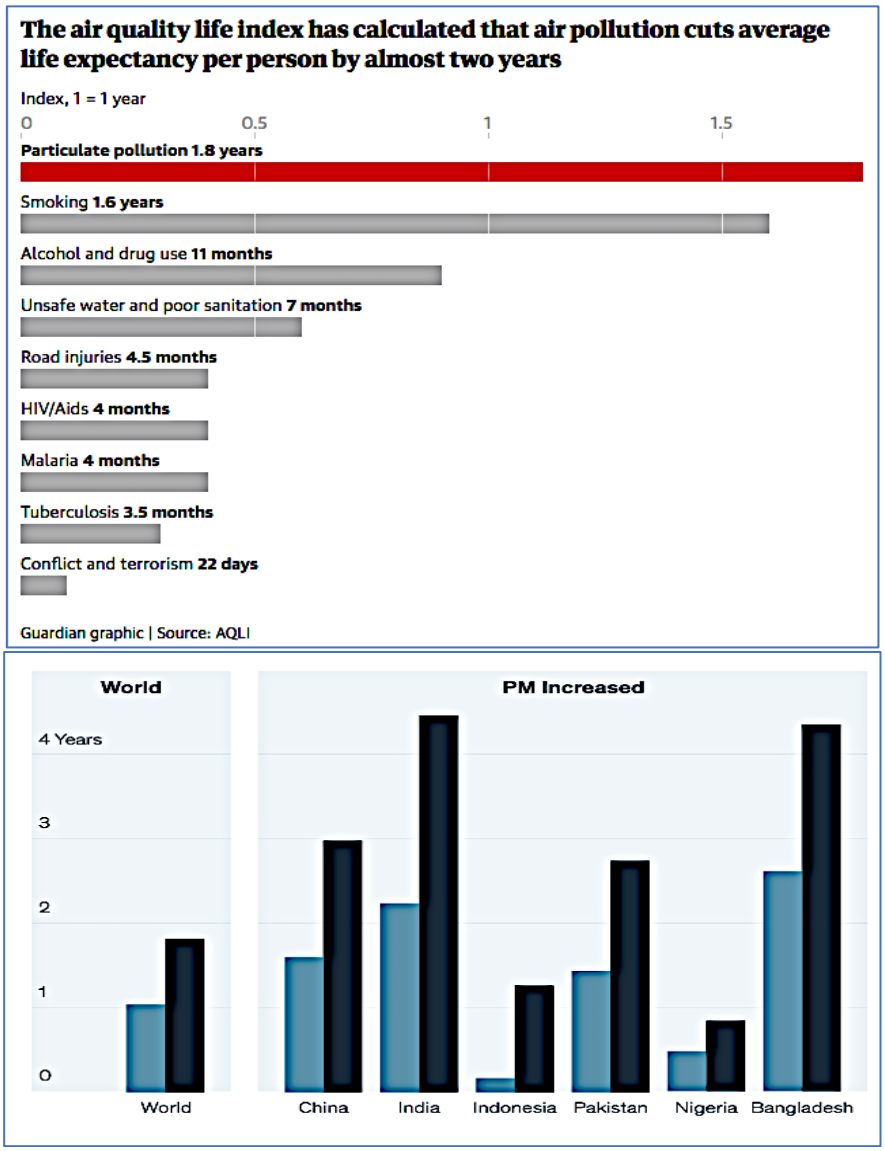


***Figure 2**. Top: Reduction in life expectancy due to particulate pollution compared to other causes. Bottom: Reduction in life expectancy in 1998 (turquoise bars) and 2016 (black bars) in the world and in different countries with high levels of air pollution.*

Space-based observations are complemented by *in-situ measurements* of chemical species at monitoring stations, that are usually (but not always) located in highly polluted areas. These observations correspond to a fixed location, but they have the advantage of providing the continuous evolution of the concentration at the surface. This is particularly useful to validate satellite data, which are not always sufficiently accurate to quantify air pollution near the ground. Many countries operate monitoring networks and make the data available through the web, often in near-real time.

The amount of data generated by satellites and, to a lesser extent, by ground-based monitoring stations is extremely large, so that advanced approaches now need to be developed and implemented to carefully and efficiently manage and analyse the data. ***One of the major challenges is to convert these extremely large amounts of data into simple and effective information that can be used to benefit citizens. This is a major***

operational objective of this project.

Table 1.3.1. Space instruments providing observations available to the AQ-WATCH Project.

	Instrument	Platform	Brief description
1	TROPOMI	Sentinel-5 Precursor	Launched 2017; NO_2, O_3, CO, HCHO, SO_2, UV aerosol index; Spatial resolution : 7x3.5km; 7x7 km
2	IASI	METOP-A METOP-B METOP-C	METOP-A, launched 2006; METOP—B, launched 2012, METOP-C, launched 2018; NO_2, SO_2, HCHO, O_3; Spatial resolution: 5x40 to 80x40 km
3	GOME-2	METOP-A METOP-B METOP-C	METOP-A, launched 2006; METOP—B, launched 2012, METOP-C, launched 2018; NO_2, SO_2, HCHO, O_3, UV aerosol index; spatial resolution: 40x40 km
4	SLSTR	Sentinel -3A Sentinel-3B	Sentinel-3A launched 2016; Sentinel-3B launched 2018; products: global AOD, Angström exponent, Fire radiative power; spatial resolution of 10x10 km^2 (L2, daily) and 1°x1° (L3, daily and monthly)
5	SEVIRI	METEOSAT	Several launches since 2002; Aerosol Optical Thickness (AOT) and Angström Exponent (AE). Spatial resolution: 10 x 10 km^2
6	ATSR-2	ERS-2	1995-2003; global AOD and time series; spatial resolution 1x1 km^2 sub-nadir, product on 10 x 10 km^2 1x1 degree.
7	AATSR	ENVISAT	2002-2012; global AOD and time series; spatial resolution 1x1 km^2 sub-nadir, product on 10 x 10 km^2.
8	MODIS	TERRA (NASA) AQUA (NASA)	Launched 1999 and 2002; Aerosols optical depth, land cover, leaf area index, fire burnt area; spatial resolution: 3x3 km^2, 10x10 km^2 and 1x1 degree for AOD
9	OMI	AURA (NASA)	Launched 2004; NO_2, O_3, CO, HCHO, SO_2; Spatial resolution: 13x24 km
10	MOPITT	TERRA (NASA)	Launched 1999; CO; Spatial resolution: 22x22 km
11	VIIRS	NPOESS	Launched 2013: aerosol optical depth, fire burnt area, land cover, leaf area index, spatial resolution: 3x3 km^2, 10x10 km^2 and 1x1 degree for AOD

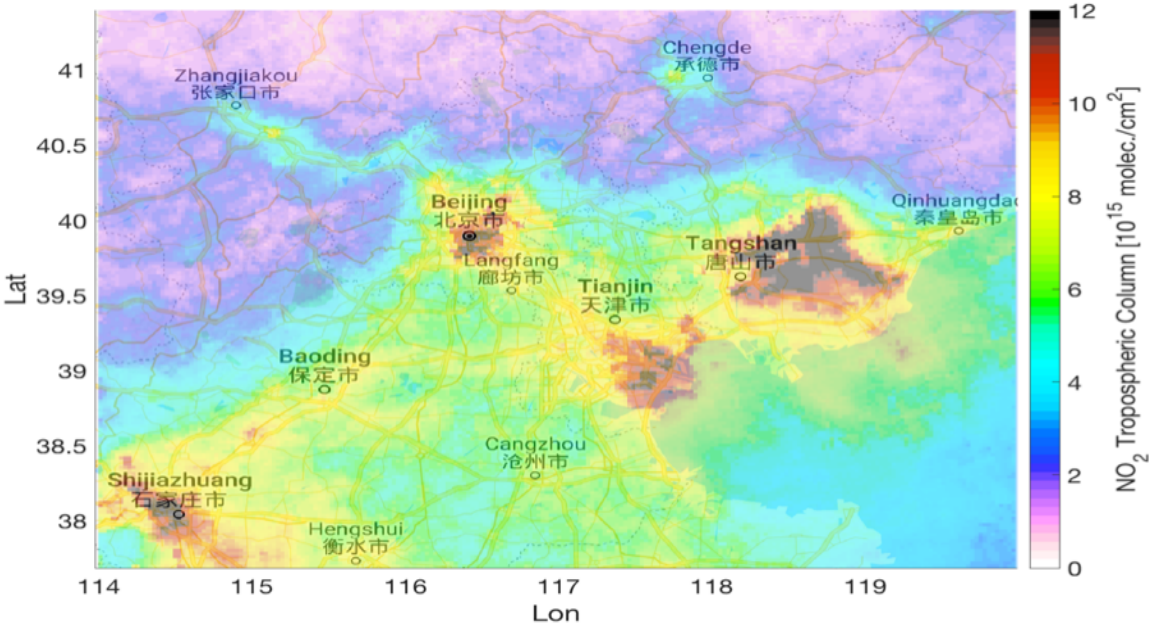


Figure 3. *High resolution observations of the nitrogen dioxide column over northeastern China, one of the test regions for the AQ-WATCH products and services. The observations are made by the TROPOMI instrument on board the European Sentinel 5 Precursor satellite (Copernicus Programme).*

Global and regional predictive models of air quality.

In the past two decades, substantial efforts have been conducted to develop *predictive models* at different spatial scales. The purpose of these models is to provide forecasts of air quality, which allows regional and local decision-makers to take actions and shut down the most intense chemical sources and hence avoid the occurrence of acute air pollution episodes. Global chemical transport models, such as the modeling system used by the **Copernicus Atmosphere Monitoring Service (CAMS)**, account for long-range effects, but produce chemical fields at a spatial resolution of as coarse as 40 to 100 km. Regional chemical transport models (e.g., WRF-Chem, CHIMERE, LOTOS-EUROS) provide predicted fields at higher spatial resolutions (typically 5 to 50 km), but over a limited spatial domain, and thus provide information at the scale of a region and a large metropolitan area. The performance of these kinds of global and regional models is considerably improved by *assimilating* space and in-situ observations. Different data assimilation approaches will be implemented and evaluated in this project. Models can provide short-term (up to 10 days) *predictions* for global and regional air quality and longer-term *projections* for the development of mitigation policies. Air quality forecasts are strongly sensitive to weather forecasts. Meteorological information from European and other weather satellites, available from meteorological centers such as the **European Centre for Medium-Range Weather Forecast (ECMWF)** in Reading, UK or from other meteorological centers, will be useful to initialize the AQ forecasts. Zero-dimensional box models (e.g., BOXMOX) complement global and regional models for the calculation of the formation of secondary species (e.g., ozone) in greater detail. These models will be used as part of the products that deliver urban air quality forecasts and attribute pollution events to specific emission sources (economic sectors and geographic locations). Table 1.3.2. provides a list of the numerical models that are available to the AQ-WATCH team, and Figure 4 shows a global forecast of NO_2 and aerosol optical depth made by the CAMS Project. These Copernicus global air quality forecasts and the CAMS retrospective analysis, which include information of space observations (4-D Var assimilation) will be used for the regional AQ-WATCH forecasts and for climatological analyses.

Table 1.3.2. Numerical Models available for the AQ-WATCH Project.

	Model	Partner Institution
1	SILAM	Finnish Meteorological Institute
2	MONARCH	Barcelona Supercomputing Center
3-4	WRF-Chem	Max Planck Institute for Meteorology, MPG and University Corporation for Atmospheric Research (UCAR)
5-6	CHIMERE	Beijing Computer Center and University of Chile
7	LOTOS-EUROS	The Netherlands Organisation for Applied Scientific Research (TNO)
8	SIRANE	Beijing Computer Center
9	BOXMOX	University Corporation for Atmospheric Research (UCAR)

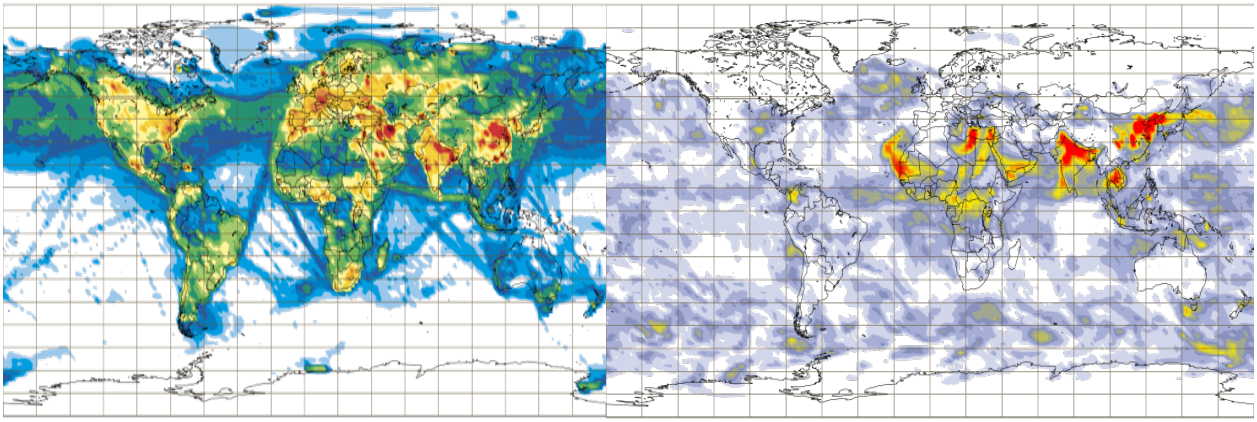


Figure 4. *Illustrative example of two global forecasts made for 5 February 2019 by the Copernicus Atmospheric Monitoring Service (CAMS).Left panel: nitrogen dioxide mixing ratio at the surface. Right panel: Aerosol optical depth at 550 nm. More quantitative information can be found at https://atmosphere.copernicus.eu*

Downscaling. **Citizens and SMEs often prefer to receive information for the relatively small area in which they live and/or operate. This information must be tailored to their specific needs and distributed directly to them, for example by social media, API's or through specialized mobile Apps**. There are now significant attempts to downscale the data provided by regional models into data that are valid at the city block and even the street scale. This is achieved for example by using specialized high-resolution urban models such as SIRANE[7] that will be used in the application in the metropolitan area of Beijing and will forecast air pollution levels at the city block level. This can also be achieved by using statistical methods based on artificial intelligence and machine learning approaches. This is accomplished operationally by one of the private partners involved in AQ-WATCH: The Breezometer SME provides on an Application Program Interface (API) detailed information (used for example by private citizen for outdoor exercising). **AQ-WATCH products will include specific information at spatial scale smaller than 1 km, which is considerably better than in most current applications.**

The concept. The idea behind the present proposal is to make efficient use of the large array of space and in-situ observations available together with new advanced multi-scale predictive models and downscaling techniques to produce easily accessible, tailored information on air quality and the related impact of air pollution on health at appropriate regional/urban scales. **AQ-WATCH will specifically address the pressing need of customers (e.g., local and regional authorities, health community, energy sector, cosmetic industry, mobility sector, urban developers) in different parts of the world in their efforts to limit the adverse impact of air pollution on the population.** The products and services to be developed and at the completion of the project to be launched in the market, will be conceived and co-designed in cooperation with 3 specific users (called *prime users* in the present proposal) in 3 different regions of the world (USA, Chile, China). Two of the three countries involved (USA and Chile) have signed official cooperative agreements with the European Commission about exchange of data under the Copernicus program. First, the *State of Colorado* in the USA where air pollution resulting from a mix of local anthropogenic emissions and agricultural activities affect people and can become considerably worse when large wild-fires develop in the mountains or further in western states or in Canada. Second, the *Unconventional Renewable Energies Trade Association* (ACERA) in Chile, where stagnant air masses between the Pacific Ocean and the high mountains of the Andes can contain large amounts of dust particles that are easily mobilized in this semi-arid region as well as high atmospheric concentrations of particles released by wildfires, soot produced by residential wood burning and other secondary anthropogenic gases and aerosols. These particles directly reduce the efficiency of electricity production by the solar panels deployed in the Atacama Desert and elsewhere in Chile. Third, the *Municipal Government of Beijing* in China. This urbanized area is particularly prone to intense haze episodes during winter, which result from a synergy between anthropogenic emissions and atmospheric processes, and is viewed by the Chinese authorities as being a major problem for both the economy and for individual citizens. Air pollution has become a top priority of the Chinese government, as President Xi Jinping declared on May 19, 2018: *"the top priority is winning the battle against air pollution to return the blue sky to the people"*.[8]

Together with the 3 international prime users, the proposed project will first identify the products and services that would best respond to stakeholder's needs and then determine if these products and services have a potential commercial value of interest to other users in the world. ***This proposal makes initial suggestions for the prototype products and services that should be developed, but, as the project develops and the commercial constraints become clearer, they are expected to evolve accordingly***. In broad terms, we propose to develop with international partners downstream applications and information services that will add value to space and in situ observational data, and can be categorized as follows:

1. Development in the form of atlases of global and regional climatological information on air quality based on the integration of space and ground-based observations.
2. Information and forecasts for decision-makers to help avoid acute regional air pollution episodes and for individual citizens to enable them to adapt their behavior to reduce the health impacts of such episodes.

[7] Soulhac, L. et al. The model SIRANE for atmospheric urban pollutant dispersion; part I, presentation of the model, *Atmos. Env., 45*, https://doi.org/10.1016/j.atmosenv.2011.07.008

[8] http://www.xinhuanet.com/english/2018-05/20/c_137191762.htm "Xi vows tough battle against pollution to boost ecological advancement"

3. Attribution of major pollution sources and development of policy recommendations for the mitigation of air pollution and its related health effects.

The Products. The AQ-WATCH prototype products and services to be developed in the present project will be initiated at the Technology Readiness Level TRL-2 "Technology concept formulated" and will reach the TRL-7 level "System prototype demonstration in operational environment at pre-commercial stage" towards the end of the project. This will be facilitated by the development of a ***business model*** for the seven proposed AQ-WATCH products/services that will identify the possible sustainable markets (private sector and public services as well as individual citizens). After the completion of the project, interested SMEs will be able to start commercialization of the products and services at TRL 8 in different regions of the world, and to prepare for the wider business and market uptake. The 7 AQ-WATCH products/services are the following:

(1) ***Global and regional atlases of air quality indices and reports.*** Graphical and numerical information on the regional climatology of air pollutants based on satellite information including air quality indices and health indices (e.g., premature mortality); Production of a global *atlas* of air quality with regional graphical information;

(2) ***Daily forecasts of air quality for metropolitan areas*****.** Daily forecast of air pollution at the regional scale based on an ensemble of predictive models as well as satellite and ground-based information;

(3) ***Dust and solar energy forecasts.*** Predictions of the degradation of air quality and reduction in visibility caused by dust mobilization and impact on solar energy systems;

(4) ***Wildfire and Visibility Service.*** Predictions of the degradation of air quality and reduction in visibility caused by the occurrence of wildfires and the development of a related regional alert system;

(5) ***Information service about air pollution resulting from fracking operations*****.** Model predictions of the potential impact on regional air quality (e.g., ozone levels) due to fracking operations and determination of the exposure of the local population to related emissions of hydrocarbons;

(6) ***Attribution service with focus on agricultural sources*****.** Information on the attribution of emission sources for different economic sectors with emphasis on the role of agricultural emissions;

(7) ***Emission mitigation service.*** Development of a demonstration model to allow future customers to assess the efficiency of alternative actions to mitigate air pollution. Development of strategy options for air pollution abatement and support of air quality policy.

The users and other stakeholders. A unique aspect of this proposal is the co-design and co-production process between scientists, software engineers, business partners and users. The scientific community has acquired a good experience in the analyzing of observations and in understanding fundamental processes that determine chemistry, atmospheric transport and exchanges between the atmosphere, land surface and the ocean. Software engineers have contributed to the development of models and the treatment of large data sets and, they will bring big data concepts to the project. Business partners have already developed products that have been either distributed via Apps to individual citizens or targeted to specific end-users, in particular large and medium corporations or public authorities. They have shown that revenues can be generated by such products. Finally, the participation of users is a novelty and a source of inspiration and innovation. The AQ-WATCH team will work directly with the three prime users to understand their needs and to identify new opportunities, to identify useful products and services, to evaluate them and to develop a real business model. To go beyond the recommendations received from the prime users, we will establish a Panel called the "Stakeholder Network" (SN) that will include additional potential customers and involve them in the key choices. The members of this Stakeholder Network will generally represent public services or private corporations. Finally, our partners and prime users in the 3 regions will involve individual citizens and discuss with them to better understand their needs and wishes, and thus adapt the AQ-WATCH products and services.

Sustainability of the Products and Services. Even though the seven products and services produced by AQ-WATCH will be tested by a limited number of users only in 3 specific regions of the world, the purpose of the project is to develop prototypes that can be universally implemented and commercialized in any region of the world. Any private enterprise that plans to commercialize some of the AQ-WATCH products/service within 3 years after the completion of the project, will have full access to open source data, models and products generated by the project as well as access to training sessions. The business model to be developed by AQ-WATCH will determine the conditions under which the commercial firms will obtain support from the

prototype developers to make the products and services fully sustainable.

Positioning of the Project. As stated above, AQ-WATCH is an attempt to assemble and further develop in an international context proven methodologies and existing tools with whom values will be added to available space and in-situ observations. These will be used to convert existing research and operational tools and data into commercially attractive toolkits. After the completion of the project, the content (or part of the content) of these toolkits will be commercially distributed by potential interested distributors, including the partners of the consortium. Within the consortium, *Breezometer* is a SME that is already present on the world market and has proven its ability to successfully and sustainably distribute information to different types of customers in the world. Their App providing air quality forecasts worldwide can be downloaded from App stores. *BCC* with its partner (third party) *Futuris Environment* and the support of *INEDEV* is active on the Chinese market to provide environmental and safety services to municipalities and companies, including air quality forecasts. Although the project can be qualified as a development project that supports European innovation, it is also an attempt to move tools used in the laboratory to commercially valuable products in developing the market. It clearly turns some ideas developed by research laboratories together with start-up companies such as the consortium member *OctoGeo* into commercial applications.

Relations with national or international research and innovation activities. The project will directly contribute to activities conducted by international organizations including the Global Atmospheric Watch (GAW) of the World Meteorological Organization (WMO), and the Air quality Program of the World Health Organization (WHO). It will also link with the Convention on Long Range Transboundary Air Pollution (specifically the Task Force on Hemispheric Transport of Air Pollution (HTAP)). The output of AQ-WATCH will directly serve the objectives of the "Monitoring, Analysis and Prediction of Air Quality" (MAP-AQ) initiative, a project sponsored by the International Atmospheric Chemistry Project (IGAC), which is also a core project of GAW at WMO, and with the IGAC core research project AMIGO (Analysis of eMIssions usinG Observations). The project, specifically through its partners in the private sector, is also linked to national and international innovation initiatives including its participation in industrial and high-tech international fairs.

1.3.2. Methodology

The Spiral Process. AQ-WATCH will develop dynamic interactions between the developers of the prototype products/services and the prime users in 3 regions of the world. The process by which value is added to space and in situ data will be modulated by the input of these users and will involve successive iterations during which feedback reactions will be collected and analyzed, and included in the new development. This spiral approach from the original data to marketable products is schematically represented in Figure 5.

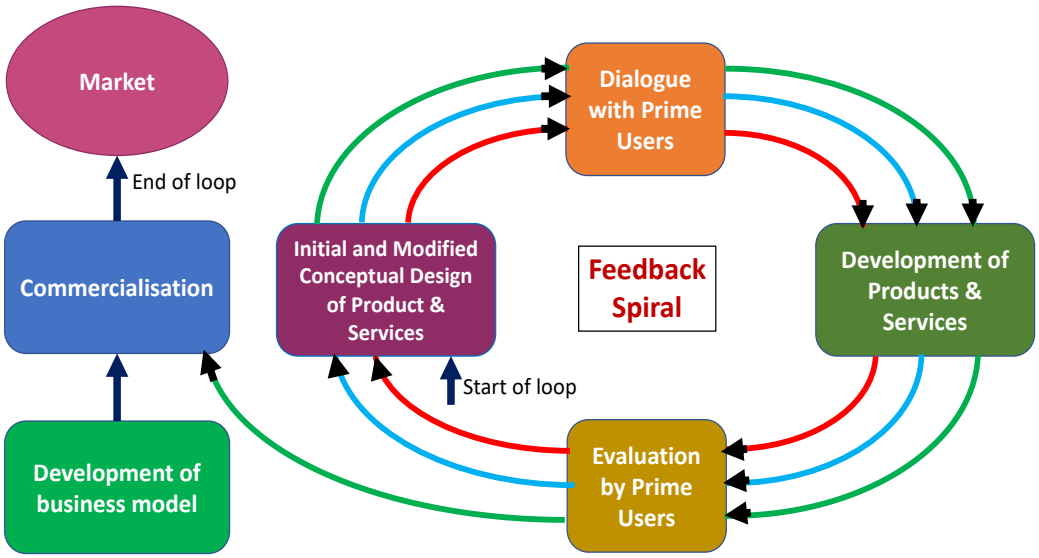


Figure 5. *Illustration of the spiral process to gather successive feedbacks from the prime users during the development phase of the prototype products and services.*

Dialogue, production and evaluation. AQ-WATCH will deliver 7 prototype products/services that will be developed by a multi-disciplinary consortium that includes atmospheric scientists, specialists in information technology and data management as well as SME business partners (Breezometer, OctoGeo and INEDEV). For each of the 7 prototype products and services, a *supply chain* will be established, starting from the identification of input (as provided by DIAS and other data bases), the application of methodologies and tools (e.g., models, analyses, visualization) and the release of deliverables after an appropriate international evaluation of the prototypes. The first step highlighted in the "spiral approach" (Figure 5) will be a consultation with identified prime users. In this dialogue, the proposed products/services will be discussed so that the needs of the users can be more clearly identified and the likelihood for commercialization of the prototypes be evaluated and enhanced. In the second step represented in more detail by Figure 6, space observations, in situ data and predictive models will be combined to initiate the operational development of the products and services. Tables 1.3.3 summarize for each prototype and service the different steps in the production processes from Technology Readiness *Level 2* towards Technology Readiness *Level 7*, the challenges to be faced and the expected outcome. The innovation achieved by the supply chain for each product and service, and specifically the novelty beyond existing products (innovative character) is highlighted. The challenges thatare expected are also indicated. These challenges are then addressed in more detail in the relevant work packages (see Section 3.1). Tables 1.3.3 and Figure 6 also indicate by which prime user(s) the prototype products will be evaluated, tested and improved, and which product or service will result from the production process.

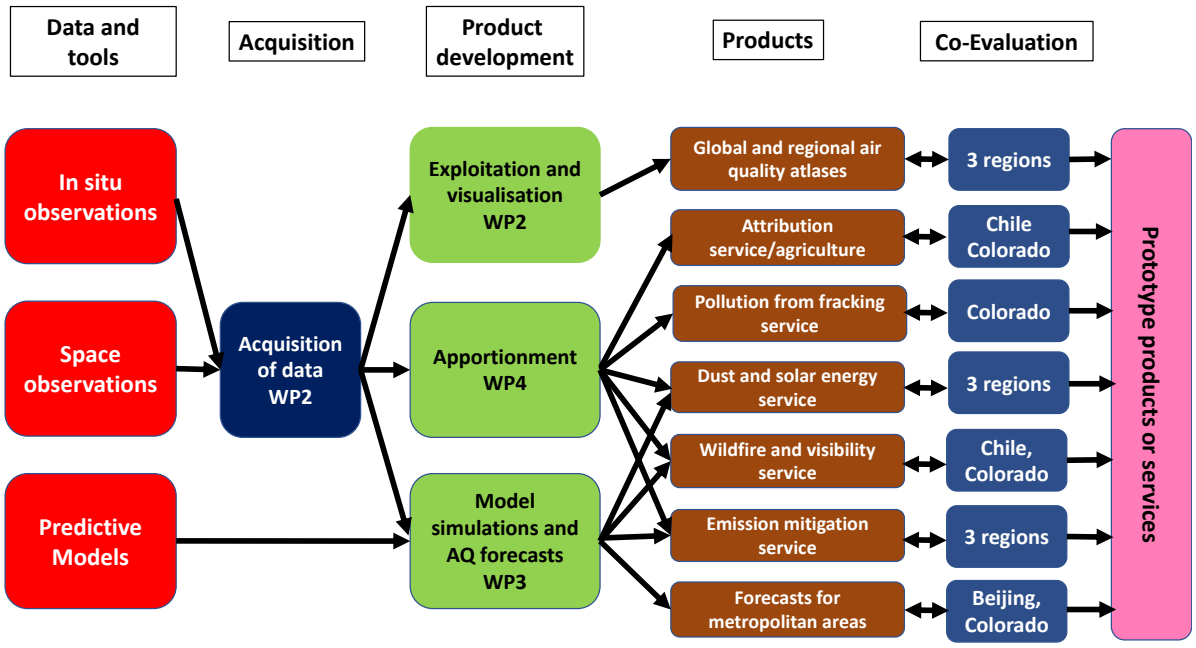


Figure 6. *Flow to add value to space and in situ observations towards the development and evaluation of 7 prototype products and services. These are described in Table 1.3.3.*

Table 1.3.3. Description of the methodology adopted for the development of the 7 prototype products and services

Prototype 1	Global and Regional Atlas of Air Quality (WP2)
Input via DIAS	Satellite data (TROPOMI, IASI, GOME-2, SLSTR, SEVIRI, MODIS, OMI, MOPITT, VIIRS, ATSR-2, AATSR) In situ data CAMS retrospective satellite-based reanalysis
Other input	In situ data from AQ monitoring stations
Tools	Statistical analysis Visualisation Narratives
Challenges	Conversion of column data to surface information and of AOD to PM, and trace gas columns

	to surface concentrations
Deliverables	Maps of surface emissions Maps of AQ climatology (ozone, PM, NO_2, CO, HCHO, SO_2) Maps of AQ health indices (AQI, AQHI, mortality) Maps of AQ evolution Time series for test regions
Evaluation	All three test regions
Innovative Aspects	Atlas of high-quality maps of yearly, monthly and daily averages of several pollutants with high-quality, easy to understand maps; development of a methodology based on machine learning to calculate surface concentrations from satellite data: the results will allow the calculation of air quality indices when no surface observations exist. Development of *oversampling methods* to increase the spatial resolution of satellite observations.

Prototype 2	**Forecasts of Air Quality for metropolitan areas (WP3)**
Input via DIAS	Satellite data (TROPOMI, SLSTR, IASI, MODIS, MOPITT, VIIRS, SEVIRI, GOES) In situ AQ data CAMS emissions CAMS global C-IFS & IFS
Other input	Local information on surface missions In situ data from AQ monitoring stations
Tools	Atmospheric Models: SILAM, LOTOS-EUROS, WRF-Chem-MPI, WRF-Chem-UCAR, CHIMERE-Chili, CHIMERE-China Emission Models: HERMES Online validation system Alert system
Challenges	Use a multi-model ensemble system
Deliverables	96-hour forecasts of ozone, NOx, CO, SO2, PM, etc.
Evaluation	Beijing, Colorado, Chile (with subset of models)
Innovative Aspects	More accurate local information and data that are freely accessible on apps and websites during the time of the project (commercial products and services after the end of the project) Very high-resolution air urban quality forecast (district, city blocks, street)

Prototype 3	**Dust and solar energy Service (WP3)**
Input via DIAS	CAMS global C-IFS & IFS Satellite data (SLSTR, MODIS, VIIRS, SEVIRI,) & in situ observations Satellite based surface roughness
Other input	Land use and soil data through Copernicus Land service
Tools	MONARCH, SILAM, CHIMERE-chili Radiation calculations
Challenges	Ensemble Radiation Dust load versus deposition (soiling)
Deliverables	72 hr Forecasts of dust (AOD, surface concentration) & radiation (DNI, GHI) Alerts
Evaluation	Beijing, Colorado, Chili with MONARCH
Innovative Aspects	The product will provide forecasts of dust beyond the state-of-the-art in regions where high-resolution forecasts are not available. The forecast will be done at a spatial resolution that is higher than the forecasts currently available. Design of a warning advisory system. Tailored solar

	energy-related products.

Prototype 4	Wildfire and Visibility Service (WP3).
Input via DIAS	CAMS global IFS FINN, QFED, IS4FIRES, GFAS based on MODIS, VIIRS, SEVIRI, GOES
Other input	Land use and vegetation data through Copernicus Land service?
Tools	WRF-CHEM-MPI/UCAR, SILAM Visibility calculations Toxic organics
Challenges	Ensemble FINN, QFED, IS4FIRES, GFAS – fire emission prediction Toxic organics
Deliverables	72 hr Forecasts of PM, O3, toxics, vis Alerts
Evaluation	Colorado, Chile
Innovative Aspects	The product will provide forecasts of dust beyond the state-of-the-art in regions where high-resolution forecasts are not available. The forecast will be done at a spatial resolution that is higher than the forecasts currently available. Attention will be given to prediction of regional fires, which is not available at the moment from any other source

Prototype 5	Information service about air pollution resulting from fracking operations (WP 4)
Input via DIAS	CAMS global IFS TROPOMI, IASI, GOME-2
Other input	Google maps Local information on surface emissions In situ data
Tools	LOTOS EUROS, SILAM Mechanisms for Ozone formation Mechanisms for Toxic & odorous organics dispersion
Challenges	Emission estimation using in-situ & satellite Evaluate fracking emissions
Deliverables	Assessment report of PM, O_3, toxics from fracking operations
Evaluation	Colorado
Innovative Aspects	There are currently no service providing systematic information on the impact of fracking on air pollution

Prototype 6	Attribution service with focus on agricultural sources (WP 4)
Input via DIAS	CAMS global C-IFS MODIS-AOD
Tools	LOTOS-EUROS Emission models: HERMES Tagging source appointment tool Health impact module
Challenges	Emission variability Validation with tracer information Detailing agricultural emissions

	Calculate health impact
Deliverables	Prototype service providing dominant source sectors and regions for PM in Colorado and Chile. Assessment report on the role of agricultural emissions for Colorado and Chile.
Evaluation	Colorado, Chile
Innovative Aspects	Development of an attribution service in regions where it does not exist. Assessment of the specific role of agricultural emissions and their timing does not exist yet in any operational system.

Prototype 7	**Emission mitigation service (WP4)**
Input via DIAS	CAMS global C-IFS MODIS-AOD
Tools	LOTOS-EUROS BOXMOX SIRANE Source response matrix/model
Challenges	Non-linearity ozone and PM Ask user for short vs long term mitigation and relevant indicators Health indicator calculation
Deliverables	Online tool for Colorado
Evaluation	Colorado, Chile, Beijing
Innovative Aspects	Development of a mitigation service in regions where it does not exist. High resolution information (information at the size of a city block in 2 districts of Beijing).

An illustrative example of a proposed prototype product. An example of the products that will be developed and tested (in dialogue with local users) is the high spatial resolution prediction system of air quality for 96 hours in the metropolitan area of Beijing.

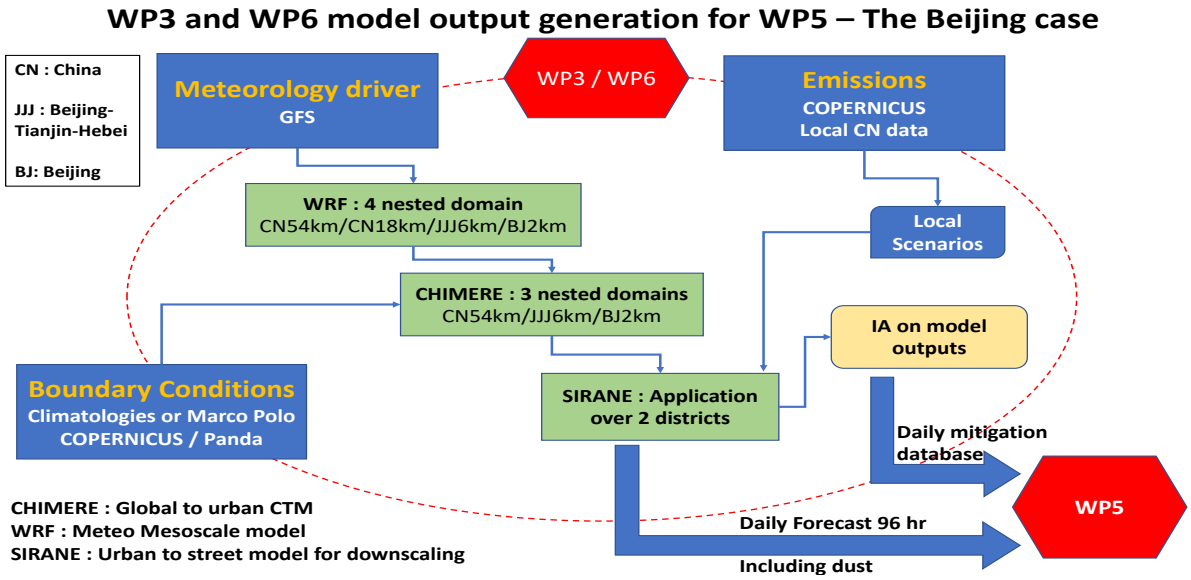


Figure 7: *Example of a forecast system for air quality at high spatial resolution that will be developed and evaluated in Beijing, China. This system uses Copernicus information (CAMS predictions and indirectly space observations) that will be downscaled to the size of city blocks in two districts of Beijing.*

As shown by Figure 7, the CHIMERE chemical transport model with meteorological inputs provided by the WRF model will be used to simulate air quality at a resolution of 54 km over the entire country. A nested

domain at higher spatial resolution will be embedded in CHIMERE and provides air quality forecasts at a resolution of 6 km in the Beijing-Tianjin-Hebei region. A further downscaling to a resolution of 1 km will be produced for the city of Beijing. Finally, the use of the SIRANE system will provide unique information at the size of city blocks and streets in 2 districts of Beijing. The system will directly use Copernicus products (e.g., CAMS predictions) as boundary conditions for the regional forecasts in the Beijing-Tianjin-Hebei domain. No multi-scale forecasting system currently available provide prognostic information at such high spatial resolution.

The different regions for prototype evaluation. The choice of the regions for evaluation of the prototype products and services is key for success. In order to open international markets for the future commercialization of the products and services developed by AQ-WATCH, we have invited 3 prime users in different parts of the world to test and evaluate our prototypes. The regions where these prime users are located have been carefully chosen. The first consideration was to identify regions with a range of different air quality issues and different levels of engagement of the regional stakeholders.

Colorado Northern Front Range, USA: The Colorado Northern Front Range Metropolitan Area (NFRMA) consists of the region north of Denver bounded by the Rocky Mountains to the West and the High Plains to the East. Air pollution in the Colorado Front Range is complex in its nature as the area is exposed to a diverse mix of local emissions as well as long-range transport of pollutants. In addition, the unique topography of the NFRMA leads to complex meteorology and flow patterns that significantly impact air quality in the region. The region has experienced large urban growth in recent decades, as well as dramatic increases in oil and gas drilling activities[9]. The Northern Front Range is also home to abundant livestock, and Weld County, in particular, is the top agricultural producing county in Colorado[10]. On top of this, biogenic emissions and occasional biomass burning events in the foothills of the mountains add to the mix of local pollution sources.

Air quality in the NFRMA remains a challenging problem despite emission reductions. The NFRMA has been designated by the U.S. EPA as a non-attainment area for the 8-hour ozone National Ambient Air Quality Standard (NAAQS) since 2007, with ozone exceedances typically occurring in the summer months when active photochemistry leads to high local ozone production, which can be transported to the pristine mountain areas by frequent mountain-valley flows[11]. Recent studies have demonstrated that, outside of wildfire episodes, local emissions from transportation and oil and natural gas extraction are the main drivers of summertime ozone[12].

Figure 8. *Differences between clean air and acute air pollution on the Tiananmen Square in Beijing, and map of air pollution in the vicinity of the city*

[9] Gilman et al., Source signature of volatile organic compounds from oil and natural gas operations in northeastern Colorado. Environmental Science & Technology 47(3): 1297–1305. DOI: 10.1021/es304119a, 2013; McDuffie et al., Influence of oil and gas emissions on summertime ozone in the Colorado Northern Front Range, J. Geophys. Res. Atmos., 121, doi:10.1002/2016JD025265, 2016; Baier et al., Higher measured than modeled ozone production at increased NO_x levels in the Colorado Front Range, Atmos. Chem. Phys., 17, 11273–11292, https://doi.org/10.5194/acp-17-11273-2017., 2017.

[10] Benedict et al., Impact of Front Range sources on reactive nitrogen concentrations and deposition in Rocky Mountain National Park. PeerJ6:e4759https://doi.org/10.7717/peerj.4759, 2018

[11] Pfister et al., Process-Based and Regional Source Impact Analysis for FRAPPÉ and DISCOVER-AQ 2014 (Vol. 2016000120) https://www.colorado.gov/airquality/tech_doc_repository.aspx?action=open&file=FRAPPE-NCAR_Final_Report_July2017.pdf,2017 and references therein

[12] Cheadle et al., 2017 Surface ozone in the Colorado northern Front Range and the influence of oil and gas development during FRAPPE/DISCOVER-AQ in summer 2014. Elem Sci Anth. 2017;5:61. DOI: http://doi.org/10.1525/elementa.254; Evans J. M. & Helmig, D. Investigation of the influence of transport from oil and natural gas regions on elevated ozone levels in the northern Colorado front range, J. Air. Waste. Manag. Assoc., 67(2), 196-2112017; Pfister et al., 2017, see [10]

Beijing Urban Area, China: The Beijing municipality is surrounded by high industrial emissions areas (mainly Hebei province) where for instance a large fraction of steel and coal production is performed in China. Beijing is a victim of its own topography because it is surrounded by mountains, ensuring that pollution remains trapped within the city limits, particularly in winter under cold and stable meteorological conditions and southerly winds. Air quality can worsen in spring and summer when temperature and humidity levels rise, and winds contribute to the smog by carrying pollutants from industrialized southern regions.

City officials converted coal furnaces in tens of thousands of homes to natural gas and relocated factories to other provinces in China. The road traffic emissions are also very important, and the public authorities have limited the access to vehicle ownership and plan to impose electric vehicles in the city center. Thanks to these measures the average $PM_{2.5}$ concentrations have decrease by up to 25%. However, the levels remain very high and additional measure are planned in the frame of the new 3-years plan to combat air pollution. To prepare the future regulations, agricultural ammonia emissions will be in the target of the governments as it has been the case in Europe within the last decade. Indeed, decreasing SO_2 emissions can lead to possible increases in ammonium nitrate concentrations. Issues related to ozone concentrations have often been neglected by policy makers, but now they have to be seriously considered as the surface concentration of this gas increases as a result of decreasing NO_2 emissions.

The region around Santiago de Chile*:* Every winter, Santiago de Chile experiences intense pollution events of particulate matter (PM) with episodic exceedance of local air quality limit standards in which hourly concentrations of $PM_{2.5}$ and PM_{10} reach up to 300 micrograms per m^3 and 500 micrograms per m^3, respectively. These episodes result from the combination of the topographic characteristics of the Santiago basin, the synoptic patterns favoring poor ventilation and intense anthropogenic emissions.

Currently, every day at approximately 20 LT (local time) during autumn and winter, the mayor of Santiago delivers a 24-hour forecast of AQ levels with respect to $PM_{2.5}$ and PM_{10}. According to the Chilean environmental regulation, five different episode levels can be declared by the authorities, namely Good, Regular, Alert, Pre-Emergency and Emergency. This air quality level forecast is based on model output as well as observations of the previous days taken from the eleven stations of the AQ monitoring network.

The Atacama Desert is endowed with one of the highest solar resources in the world. In fact, it is the region where the worldwide maximum surface solar radiation is reached and where the highest numbers of clear sky days occur. The latter has led to the installation of many astronomical observatories. Furthermore, the largest consumers of electricity in northern Chile come from the mining industries, which have a high demand for continuous supply. All of the conditions mentioned above, in particular the high levels of direct solar irradiance and short distance to consumption centers, make the region ideal for the development of solar power plants. Considering that Chile relies mostly on fossil fuels for the generation of electricity, which has a great impact on the environment, and that the Chilean government has set the goal for 2025 to have 20% of total electricity production from renewable sources, solar power plants may be a solution to reach that goal minimizing the impact on environment. Solar energy generation, specifically photovoltaic (PV) plants, are adversely affected by the presence of dust. Although, mineral dust emissions from the Atacama Desert represent approximately only 2% of global dust emissions, it is the largest source of natural dust in South America, in particular along the Andes mountain range. The regular occurrence of dust storms can impact solar power plants not only through the blocking of solar radiation but also through deposition on their mirrors.

1.4 Ambition

Air pollution remains a major public health issue contributing to 7.6% of all deaths in the world in 2016 (WHO web site). Worldwide, this environmental problem accounts for 43% of the diseases and deaths from chronic obstructive pulmonary diseases, 29% from lung cancer, 24% from strokes and 25% from ischaemic heart diseases. Progress towards ensuring that the air citizens breathe is clean and healthy has been slow. However, faster progress is possible and this drives our ambition. In their state-of-the-art approaches, cities and provinces usually monitor air quality from local stations, currently use air quality forecasts based on simple statistical methods and then take some limited and often ad hoc actions to reduce the emissions from the identified sources. With the new approaches available, such as high-resolution space observations, predictive global and regional chemical transport models, advanced data assimilation techniques and attribution methodologies, **it has become possible to envision a sustained reduction in air pollution and improvement in public health. This requires a global coordinated approach with some strong initiatives to be taken at the regional and**

local scales. AQ-WATCH aims to develop products and services that will be tested in specific regions, which have the potential to be generalized to other regions with sustained dissemination and commercialization effort and can contribute to the solution of the problem. Our ambition is to play an active role in achieving this.

A vision[13] for the successful and sustainable addressing of the air quality issue, specifically in developing countries, needs to include 5 related elements: (1) improved monitoring (2) better modeling, (3) more accurate interpretation of data, (4) more effective disseminating, (5) better training and educating. This requires the development of an international network of practitioners, scientists, environmental impact specialists and business partners that will develop and integrate products and services with direct benefits to peoples' health. The goal of AQ-WATCH is to work with international organizations like the World Meteorological Organization (WMO) and the World Health Organization (WHO) to provide the tools that will address several of these 5 objectives. Particular innovative emphases will include the development of climatological atlases that will provide in the different regions of the world detailed information on the level of air pollution and the related impacts on public health and premature mortality. Among other innovations are the development and evaluation of prediction and alert systems for the smoke emitted by wildfires and of dust originating in arid areas. An information system on the impact of fracking on air quality will also be established. Fracking is very common in regions such as Colorado, but could become soon a reality in some countries of Europe (e.g., Denmark, Lithuania, Rumania, United Kingdom, France).

The *ambition* of this project is to go beyond an improvement in the air quality prediction capability, and develop products and services that are not yet available but could effectively contribute to a substantial improvement of air quality and public helath. It proposes to go a step further by developing quantitative attribution methods to identify the sources that contribute most of the observed or predicted air pollution. A particular focus of this attribution system will be to assess the role and importance of agricultural sources, which have often been ignored, but may constitute a substantial contribution. Finally, our project will offer to decision makers simple modeling tools ("demonstration models") that will be easily used by environmental managers to assess the response of proposed reduction in the emissions from specific sectors (traffic, industrial, agricultural, residential, etc.)

The development of such pilot products that will be tested and evaluated in different regions of the world requires the integration of satellite and in situ (surface) observations, efficient treatment of large data sets, numerical models, machine learning, the implementation of attribution methods, knowledge dissemination and training, business development. Therefore, this comprehensive endeavor requires the engagement of an interdisciplinary group that includes different types of skills, as well as the contribution of groups located in different parts of the world.

2. Impact

2.1 Expected impacts

It is expected that the AQ-WATCH impact will be multifaceted and enduring. The work program has been devised and developed to build innovative and sustainable products and service lines that specifically meet the needs of its prime users and the wider stakeholder community. Moreover, it is envisioned that AQ-WATCH solutions will provide the underpinning information for policy makers to work towards reaching the UN sustainable development goals while at the same time boosting European competitiveness and creating new private sector activities.

2.1.1 Impacts as outlined in the call expectation

Establish sustainable supply chains for innovative EO value added products and services with demonstrated commercial value with international client communities;

AQ-WATCH will prepare the ground for further innovative and sustainable exploitation of earth observation data by designing, testing and tailoring novel downstream products and services with international partners

[13] Kumar, R., V.-H. Peuch, J. H. Crawford and G. P. Brasseur, Five steps to improve air-quality forecasts Nature 561, 27-29 (2018) doi: 10.1038/d41586-018-06150-5

(WP 1 to 4). The added value of the AQ-WATCH products and service portfolio will be openly demonstrated to a wider audience by applying the services on three continents (WP 5 and WP6).

During the project lifetime, a supply chain for the development of the prototype EO products and services will be established. At the same time, for each service line, a business model using the Business Model Canvas (see Task 7.2) will be developed to identify sustained markets and to outline critical conditions for success for the targeted customer groups. Any commercial licensing issues will be defined as part of the Joint Ownership Agreement (annex to consortium agreement) during the third year of the project. This agreement will be legally binding for a period of 3 years *beyond the project lifetime*. For the post-project period, the project Coordinator MPG with the support of the MPG Innovation GmbH will maintain the implementation of the Joint Ownership Agreement. See also Figure 12 in Section 3.3.

Within the consortium, Breezometer and BCC with its partner (third party) Futuris Environment are already present on the world market and have proven their ability to successfully and sustainably distribute information to different types of customers in the world. They will integrate the products and service into their existing business processes.

Complete integration, based on international standards, into the customer's existing business processes and processing chains, as well as the economic viability of the application is to be demonstrated;

The toolkit will adopt a range of possibilities to allow users to integrate the service products into their processing chains. For example, in Colorado, the AQ-Watch air quality alerts will be introduced as a source of information in the work protocol of the "warning system room" of the State of Colorado. The system will improve the efficiency, accuracy, consistency and timeliness of air quality warnings. It will provide visually appealing graphical information of the areas impacted by the smoke/haze as opposed to the current text-only warnings. Access will be granted through an internet portal, API's as well as smartphone Apps. The integration will be demonstrated for our three prime users as well as the project partners Breezometer and Octogeo. Open access to the products and adhering to international interoperability standards allow any (including unforeseen) interested user to access and test the information content provided. AQ-WATCH products will be available through the GEO Discovery and Access Broker (DAB) system[14]. The economic viability will be addressed by contrasting production cost estimates and the willingness to pay of the stakeholder community and the targeted customer groups in combination with different degrees of market penetration. The release of trail versions of the products will be considered with the purpose of attracting new customers.

Enhance the European industry's potential to take advantage of market opportunities and establish leadership in the field and to boost business activity;

The cooperative development of the service portfolio with international users provides the business-oriented partners from the consortium (INERIS DEVELOPPEMENT, BCC, OctoGEO, Breezometer, TNO) a competitive advantage. The two-way engagement ensures AQ-WATCH can adapt its approaches to be as relevant and useful for its users as possible. The novel prototypes combined with operational demonstration cases enables the project partners to take a leading position. Open access to the AQ-WATCH products facilitates the wider value adding European industry to incorporate the novel information and data provided into their ongoing operations or allow for new answering to new market opportunities. The project will support European industry, especially the leading companies engaged in Smart City and Smart Home development, environment protection, health and well-being sectors as well as information technology, to obtain a leadership position in air quality information services industry through expanding the service portfolio of the CAMS global system with tailored products towards international users.

Lead to new or improved products, processes or services on the market that are capable of generating within 3 years after the end of public funding a significant turnover for the participants, and create new jobs;

According to Murtuza Hyder, Power Analyst at ASDReports[15], Global Air Quality Control System (AQCS) market is set to grow from USD 9.7 billion in 2016 to around USD 12.8 billion by 2020, registering a

[14] A component of the GEOSS Common Infrastructure connecting user's requests to the resources shared by the GEOSS providers. See https://www.gepdab.net.

[15] https://www.asdreports.com/market-research-report-346414/air-quality-control-system-thermal-power-update-market-size-competitive

compound annual growth rate (CAGR) of 7.19%. The development of the AQCS automatically push the market of air quality monitoring.

Goldstein Research analyst[16] forecasts the global air quality monitoring services market size USD 7.02 billion by 2024 from USD 3.6 billion in 2016, and is anticipated to grow at a CAGR of 8.70% during the period 2016-2024. The global air quality monitoring system market (AQMS) is expected to reach 4.90 billion by 2022 from USD 3.92 billion in 2017, at a CAGR of 4.6%. At the same time, Markets and Markets[17] estimates that the global air quality monitoring system market (AQMS) is expected to reach 4.90 billion by 2022 from USD 3.92 billion in 2017, at a CAGR of 4.6%. In that context, AQ-WATCH will bring both new and improved products to the market that will generate a significant turnover.

The AQ-WATCH forecasting, nowcasting and alert systems will be provided on a higher spatial resolution (up to 1 km) than currently available. Novel services include the source apportionment and mitigation services providing policy relevant information on a daily basis. These services will provide much more detailed information than currently available by differentiating ~25 source contributions including the most important sectors (mobility, residential, energy, industry, agriculture, etc.) as well as different fuel use or emission processes within these sectors. The consortium includes a mixture of knowledge institutes, applied science organizations and business-oriented partners which cover the required expertise to bring products to the market and therefore exploit the outcomes of the project. A business plan between the members of the consortium to address this post-project period will be elaborated and should lead to the creation of jobs among the partners.

Lead to an improved quality of the Copernicus global product, thereby enhancing the utilisation of Copernicus data and information in a global environment and GEOSS.

Through the integration of CAMS global products into regional downscaling applications enriched by local information and in-situ observations (freely available from monitoring institutions) added value will be provided on top of the Copernicus data. The availability of high-quality information beyond the current state of the art, delivered by modern ICT techniques will add to the utilization of the Copernicus data and GEOSS world-wide. Finally, the AQ-WATCH consortium will share best practices and information products with the CAMS global service providers (coordinated by ECMWF) to allow for the enhancement of the CAMS global products themselves.

2.1.2 Impact beyond the call expectation

Societal impact

In terms of mortality, air pollution has become the most acute environmental problem facing humanity today. Many mega-cities worldwide face complex air pollution problems. Measured ambient $PM_{2.5}$ concentrations in Santiago and Beijing are 4-6 times higher than the upper threshold recommended by the European Air Quality Standards (25 micrograms/m^3), whereas reported ground-level ozone levels exceed by a large factor the World Health Organization guidelines. The challenges are not restricted to existing mega-cities. In many developing countries the fast urbanization combined with a lack of a regulation policy of environmental resources, makes the population increasingly vulnerable. Information on air quality is often not available or outdated and does not reflect the real air pollution status in many regions.

Ambient monitoring measurements available today are restricted to developed countries (US, Europe and China). The number of monitors and the measured species vary quite largely among different locations. Even worse, for many polluted regions air quality measurements are lacking or not available to the public. Air pollution monitoring from space is therefore an appealing yet challenging alternative. Satellite observations overcome the spatial and temporal limitations of ground-based measurements by offering a continuous view of key tropospheric pollutants, and can provide critical information for monitoring of air quality and emissions. Constraints from space combined with ground-based measurements, air quality modelling, and validation activities have been proved in the past, through e.g. the EU/PANDA and AMFIC projects, to considerably improve our quantitative understanding of the air quality situation in a region.

A crucial step towards the improvement of local and regional policy making is to provide accurate information on the current and future air quality situation, the understanding of the responsible economic activities and the

[16] https://www.asdreports.com/market-research-report-441600/global-air-quality-monitoring-services-market
[17] https://www.marketsandmarkets.com/PressReleases/air-quality-monitoring-equipment.asp

effectiveness of potential measures. AQ-WATCH develops novel products and services based on COPERNICUS information by working in the following directions:

1. improvement of air quality mapping and visualization using space and ground-based observations as well as cross-validation;
2. assimilation of observed and modelled Copernicus data into regional service lines;
3. improved downscaling of air quality analyses and forecasting using regional modelling
4. development of state-of-art source apportionment systems for anthropogenic and natural emission sources.

Even in the developed world where air quality policies have been effective, important issues remain. Agriculture is a major contributor to air pollution, but its contribution is not widely acknowledged and potentially underestimated. A shift to the use of natural gas as an intermittent solution for combatting climate change and securing energy supply has led to a large increase in natural gas production by fracking activities. These activities have an impact on regional air quality and human well-being. Within AQ-WATCH, we will address these sectors with particular attention.

Hence, through the delivery of high-quality information to its stakeholders AQ-WATCH contributes to:

- Reduction in the health impacts and healthcare costs from adverse effects of air pollution by enabling easy access to more accurate warning systems and allowing individuals, through air quality alerts, to reduce their exposure to air pollution via preventive measures.
- Provide personalized information on (forecasted) exposure to help an individual manage his/her life. Allows individuals to navigate and choose outdoor places to live, work, go to school, shop, travel, exercise, plan activities ahead, and better manage treatments – enhance disease management and medical decisions by allowing a patient's physician access to this information.
- Provide value for healthcare professionals, physicians and hospital to better manage the responses to air pollution.
- Provide value to policymakers and environmental managers to enhance prevention for communities at risk.
- Improved understanding of the causes of adverse air quality situations and information on the effectiveness of mitigation efforts in different sectors (reduction of environmental atmospheric emissions).

Further environmental and social impact

The improvement of air quality management is the main outcome of the AQ-WATCH project. It brings environmental and social benefits, and significantly contributes to several UN Sustainable Development Goals[18].

	**Goal 3: Ensure healthy lives and promote well-being for all at all ages** Improving air quality sciences and monitoring with AQ-WATCH contribute to preserve health lives and promote well-being.
	**Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation** "You cannot manage if You cannot measure!". AQ-WATCH results contribute to promote clean technologies having less contribution to air pollution.
	**Goal 11: Make cities inclusive, safe, resilient and sustainable** Often industry and cities are very close to each-other so that industrial pollution might affect citizens and communities. Thanks to the project, the impact of pollution will be better identified and therefore sustainably better managed.
	**Goal 12: Ensure sustainable consumption and production patterns** AQ-WATCH will contribute to provide methods and technologies to companies to be more conscious of their contribution to air quality at local and regional level.

[18] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

2.1.3 Major challenges for the project

AQ-WATCH will face a number of challenges and risks. One of them is related to the uncertainties in the post-project commercialization of the proposed downstream products and services. At this stage, in spite of the optimistic predictions of growth for the market of air quality products (see Section 2.1.1), it remains difficult to estimate with certainty that a dynamic market will develop for commercial products designed to combat air pollution at the international level. The development of the business model during the life of the project will identify the unique selling propositions (USP) and determine the strategy to best commercialize the AQ-WATCH products. The participation of 3 rather experienced SMEs in the development of air pollution products will be essential to address this challenge. Additional risks facing the project are listed in table 3.2.5.

To be commercially successful, the AQ-WATCH products and services must:

1. comply with or efficiently complement the existing legislation and institutional structures at EU and international levels,
2. be attractive and useful for customers and users,
3. be cost-effective and reasonably priced.

1. Regulatory and legal compliance at EU & international level

In terms of regulatory and legal compliance, the consortium does not anticipate any issues that would prevent successful implementation of the results. On the contrary, the project will efficiently contribute to the monitoring of the major environmental regulations and policies that have entered into force in many developing countries. The only restriction is the sensitive character of the information related to meteorology and to epidemiology. AQ-WATCH data and information will comply with the national regulation on that matter. The International Advisory Board and the "Stakeholder Network" will help the Project Office to pay attention that the outcomes of the project will be relevant and compatible with the current regulatory practices in all Member States and in the national regulation of the countries involved in the project.

2. Attractiveness and usefulness for customers

AQ-WATCH approach, as described in paragraph 1.3.1, is to co-develop with prime users the functionalities of the products and services that will constitute the toolkit. They will be tested in WP5 and the feedback provided by the prime users will insure that they meet the expectation from the market.

3. Cost effectiveness and pricing

With the experience of the business-oriented partners from the consortium and taking into account the feedback from the pilot-cases and the market segmentation that will be used to position the AQ-WATCH products and services, it is feasible to propose solutions that will meet the expectation of the end-users in terms of functionalities and price. The Business Model that will be developed in the project will pay attention to this specific challenge.

2.2 Measures to maximise impact

AQ-WATCH aims at providing a wide range of functionalities to a wide range of **end-users**. The users' needs and user scenarios may vary from user to user, so we need to identify all potential use cases, their added value and impact. This will help the consortium to justify the added value of AQ-WATCH when implementing dissemination and exploitation activities. The list of exemplary cases where user-driven products and services will be developed can be seen in section 1.3.1 (Concept).

In order for AQ-WATCH to realize its full potential and achieve all of the expected impacts, the consortium has identified five target groups for its dissemination, exploitation and communication activities. Considerable effort will be made to enlarge the innovation impact of the project through effective engagement with these Target Groups (TG).

- **TG1**: International client communities consisting of public services (including public authorities) and the private sector – the dedicated end-users from the 3 pilot regions and potential end-users,
- **TG2:** Policy and decision makers in regional government departments (strategic support or prescribers to potential end-users),
- **TG3:** NGOs and wider industries (potential users),

- **TG4:** The specific scientific community applying Copernicus facilities and beyond, as well as the future research community (research users and capacity building),
- **TG5:** Society at large, general public: e.g. journalists and the interested public

2.2.1 Dissemination and exploitation of results

The ***"plan for the dissemination, exploitation and communication of AQ-WATCH results"*** set out below describes the measures of dissemination and exploitation to be taken to address each of these target groups. Table 2.2.2 summarizes this plan with emphasis on communications measures suitable for multiple audiences. This plan illustrates how AQ-WATCH will respond to and will address the specific requirements of each target groups arising from their feedback or as identified by the Project Office (defined in Section 3.2).

TG1: International client communities consisting of public services and the private sector as end-users. This key audience requires detailed input from AQ-WATCH, the 3 pilot end-users are integrated into the project (WP6); Commitment Letters of the users can be found in the Annex of the proposal. AQ-WATCH will provide 7 user-driven products and services that will help the users monitor, improve and mitigate air quality in their regions. A toolkit that contains a smart alert system for extreme pollution events, daily multi-model forecasts (up to 96 hours), scenarios for air pollution changes in response to mitigation actions and other user-driven tools providing advanced graphical and numerical information at regional and sub-urban scale will be developed and co-designed with users (detailed service, see section 1.3). The three pilot regions are the Colorado Northern Front Range, Santiago de Chile and Beijing. This toolkit, which includes the prototype of the products and services, will be used to reach out to other potential international client communities and is intended to be commercialized within 3 years after the end of the project lifetime. The toolkit or some of its component will be adapted to each regional market and customer needs.

Apart from face-to-face contact and interactive workshops, visualizations of the results will be generated, and a User Interface Platform (UIP) with analysis of user needs through e.g. web-diagnostic tools allowing user to identify and select their favorite solutions will be established. The UIP that is linked to project website is not only a platform for TG1, but accessible for all potential audiences (System developed in Task 0.4 and content for users in Task 7.1).

TG2: Policy and decision makers in regional/municipal government departments (as strategic support to potential end-users). For this target group, AQ-WATCH will make an impact through the development of more accurate and effective tools, scenarios, visualizations and integrations of data and information on regional air quality allowing policy and decision makers to take appropriate actions and make more efficient mitigation strategies. To reach out to this group, in addition to the integrated pilot users in WP6, AQ-WATCH will approach and invite a selected number of policy makers from Europe to interactive workshops where they can address their needs and questions regarding air quality and risk assessment. To this end, AQ-WATCH will build on established channels between national climate services responsible for issuing the air quality and its related scenarios, and tailor communication and information for this specialist and/or non-specialist audience. Advanced didactic animations will be developed and made available on the project website. TG2 will also have access to the UIP and can directly test the toolkit created within the AQ-WATCH framework. Policy-relevant synthesis will be made available at the end of the project in the form of factsheets and presentations. Policy relevant findings will be made regularly available during project lifetime: these will consist of short documents that summarize the findings and recommendations of AQ-WATCH, exploring the issues being addressed and distilling the lessons learned from the research and providing policy advice through "policy briefs".

AQ-WATCH will interact with governmental organization such as UNECE[19], EMEP[17] as well as ICLEI[20] and the C40[21] and make effort to get in touch with public services as potential users and customers (Task 7.1).

[19] https://www.unece.org/env/lrtap/welcome.html.: United Nations Economic Commission for Europe, clean air division http://www.emep.int: scientifically based and policy driven programme under the Convention on Long-range Transboundary Air Pollution

[20] https://www.iclei.org: Local Governments for Sustainability - global network of 1,500+ cities/regions committed to building a sustainable future

[21] https://www.c40.org: Cities Climate Leadership Group, a network of 90 of the world's greatest cities taking bold climate action, leading towards a healthier and more sustainable future

AQ-WATCH will also engage with the UN Sustainable Development Goals (SDG) Knowledge Hub run by IISD (International Institute for Sustainable Development Goals), an independent think-tank that champions sustainable solutions to 21st century problems. SDG knowledge hub closely follows up the SDG progress, in addition to the UN SDG reports. The SDG Knowledge Hub is another key information distribution channel to the most relevant stakeholders (Task 0.4).

TG3: NGOs and wider industries (as potential users). AQ-WATCH will make an impact with companies and NGOs through the production of a range of scenarios of regional air quality and the risk framework relevant for the development of adaptation/mitigation policies. These will be presented in a progressive on-going series of papers and technical reports. These will be backed up by offering to undertake joint analyses with companies and NGOs on any data sets or background studies to these scenarios or other aspects of particular interest to them. Representatives from industry and NGOs from environmental sector, health, energy, cosmetic, IT environment that are linked to our SME partners (e.g. WRI, Blueair, L'Oréal, Dermalogica and Cisco) whose core-business directly relates to air quality issues will be invited to participate in workshops and to identify case studies. They will also be invited to join the Stakeholder Network (SN). This international network will cover additional economic and geographic sectors than those covered by the three pilot case studies (WP6). A range of factsheets will be tailored for the needs of a broader group of users from industry and NGOs, and will be written in an accessible way, therefore enabling exploitation and understanding of the results (Task 7.1 in collaboration with WP5 and WP6).

TG4: Specific scientific community using Copernicus facilities and beyond, and the future research community. AQ-WATCH will establish clusters with relevant H2020 EO projects and other international projects, such as InDust COST Action, DustClim, PAPILA, KLIMAPOLIS, ICARUS, HERA, the ERC AdG project IntelliAQ and various CAMS projects. A network of the clustered projects will be established by Task7.1 in collaboration with the other scientific WPs. This will allow experts to work closely together and will therefore save resources. At the same time, it will promote Copernicus services and data, and the efforts achieved by AQ-WATCH.

During the project lifetime, consortium partners will be involved in scientific presentations to scientific conferences (such as AGU, EPA national AQ conference and EGU) and/or the development of peer review articles in their research field domains. Partners responsible for dissemination activities will promote general project awareness through presentations on some of the main research topics. The success of these activities will be measured through the use of the AQ-WATCH solution (Task 7.2).

AQ-WATCH would like to stress their dissemination activities to early career researchers (e.g. master and PhD students) and SMEs, as well as into regional areas with limited access to research capabilities (e.g. Africa, south-east Asia and south America). For that purpose, the AQ-WATCH team will organize extensive and recurrent workshops in order to demonstrate the benefits of AQ-WATCH (Task 7.1). Section 3.2.1 and WP6 describe the current targeted stakeholders list. The regional consortium partners in the US, Chile and China, as well as the Users in WP6. already expressed their interest in participating in these capacity-building activities.

TG5: Society at large, general public (incl. journalists). For this target group, the AQ-WATCH website and advanced animations suitable for a wider audience in the form of explanatory videos will be the main tools for disseminating project results and communicating project progress. In addition, the following four measures will be implemented regularly throughout the project. ***Media briefs*:** A synthesis of the results will be made available both as they are produced and at the end of the project for the media to use as a basis for news items and articles. Press releases that summarize the highlight points will be distributed through the mailing list of the SDG Knowledge Hub. ***Public lectures and presentations*:** AQ-WATCH will develop special presentations for use in public lectures given by the Coordinator, WP-leaders and other team members to engage with the wider public in all the participating countries and regions. ***Project newsletters and flyers*:** The synthesis of the project effort and output will be rewritten in form of flyers to be distributed to the wider public at targeted events and made available at public spaces in research institutes. Societal high impact findings will be disseminated and communicated through newsletters and social media channels. The newsletter shall be distributed on a quarterly basis. ***Blogs, Twitter, YouTube, Vimeo and LinkedIn groups***: WP7 will actively advertise the project and its main findings making available of various social media channels, including answering questions and keeping discussions alive through discussion groups (Task 7.1 & Task 0.4).

Beyond the project lifetime: Exploitation and Sustainability of AQ-WATCH products

The results of this project will be a preoperational framework that will require additional effort to exploit their capacities fully. The duration and the calendar of the project have been designed to maximize dissemination activities and to elaborate a serious exploitation plan to prepare the future of the AQ-WATCH project beyond the project lifetime (Table. 3.1.2). The plan will be conditional on future funding opportunities and/or turnover for further developing and exploiting AQ-WATCH capabilities. For the SME partners, AQ-WATCH product maintenance and evolution beyond the project lifetime include some fixed costs such as infrastructure, user support or service evolution that will need additional resources to assure the project's future sustainability. For that purpose, we will identify and contact potential users interested in investing in the future maintenance and evolution of the platform by the end of the 2nd project year. Market and cost analysis, business and marketing plan for market uptake will be done in the 3rd project year and the commercialization of the products will take place after project closure.

This future-oriented exploitation of the project results will be based on various approaches depending on the potential users mainly from TG1, TG2 and TG3 and the results to be exploited:

-The "**community collaborative exploitation model**" targets small companies and small public institutions that are interested in accessing and using AQ-WATCH functionalities but do not have either the financial or technical capacity to buy and operate the whole solution. These entities are willing to collaborate with research communities in order to share the costs of AQ-WATCH maintenance and evolution after the project lifetime. This business model will depend on enlarging the Stakeholder Network (SN) around the framework and seeking for other funding resources (Task 7.2).

-The "**customised exploitation model**" is intended for large companies, international institutions or large public institutions that would like to use and purchase some or all of the AQ-WATCH components to be run independently at their premises. Our aim is to make the toolkit and all services associated with the future licenses as known as possible and ready for the market uptake after the commercialization of the products.

The price of these licenses would depend on the costs of the solution and the estimated number of potential customers, as well as the availability of any further public funding opportunities especially at the regional level. This business model is closer to a customised/individual market model. The business exploitation plan will analyse in detail, and list, the potential types of customers AQ-WATCH would like to address during the dissemination activities and after the project closure (Task 7.2).

Openness: Open standard, open data, open publications, open framework

Data: AQ-WATCH will make use of a large number of datasets that are publicly available, and will integrate them for common use for project partners and other users. Datasets will include atmospheric data mostly retrieved by satellites and accessible via the WEkEO Copernicus Data and Information Access Services (DIAS). WEkEO, expected to be fully operational by the end of 2019, will include all the satellite data used in the CAMS project, for example SLSTR, TROPOMI, IASI, GOME-2 on EUMETSAT/ESA satellites as well as OMI, MODIS, MOPITT, VIIRS, SEVIRI GOES from NASA/NOAA satellites. The CAMS retrospective reanalysis using these satellite data will also be accessed from WEkEO. In addition to satellite observations, AQ-WATCH will make use of ground-based measurements from different Copernicus partners, data services and measurement networks available in the three pilot regions. With the integration of the observational datasets, and by assimilating them into models, a range of new products will be developed that will be the primary source of information to users. These new datasets and services will include scenarios and air quality forecasts as described in Section 1.3, demonstrating an overview of the models used in AQ-WATCH and their outputs. As described below, all these new datasets will be available via a User Interface Platform (UIP) accessible from the project's website, and will remain operational also during three years beyond the project lifetime.

Management of Data: AQ-WATCH partners agreed that all data produced during the project will be open data. Thus, the project will contribute to the European Commission Open Research Data Pilot. Here we indicate the general rules that will be part of the Data Management Plan to be delivered at the beginning of the project (Task 0.3). Original model data generated within the project will be managed and stored by the project partners at their local high-performance computer servers and storage facilities. Working databases, comprised of subsets of the original model datasets and observational data from the DIAS, particularly WEkEO, will be setup at (i) the Finnish Meteorological Institute (FMI) for model-ready meteorological data, boundary/initial conditions and model results, and (ii) at CNRS, via ECCAD (one of the CAMS databases) for satellite, surface observations and surface emissions of the different compounds included in the AQ-WATCH models. Access to these working databases will be restricted to AQ-WATCH partners. Public and free access and visual data.

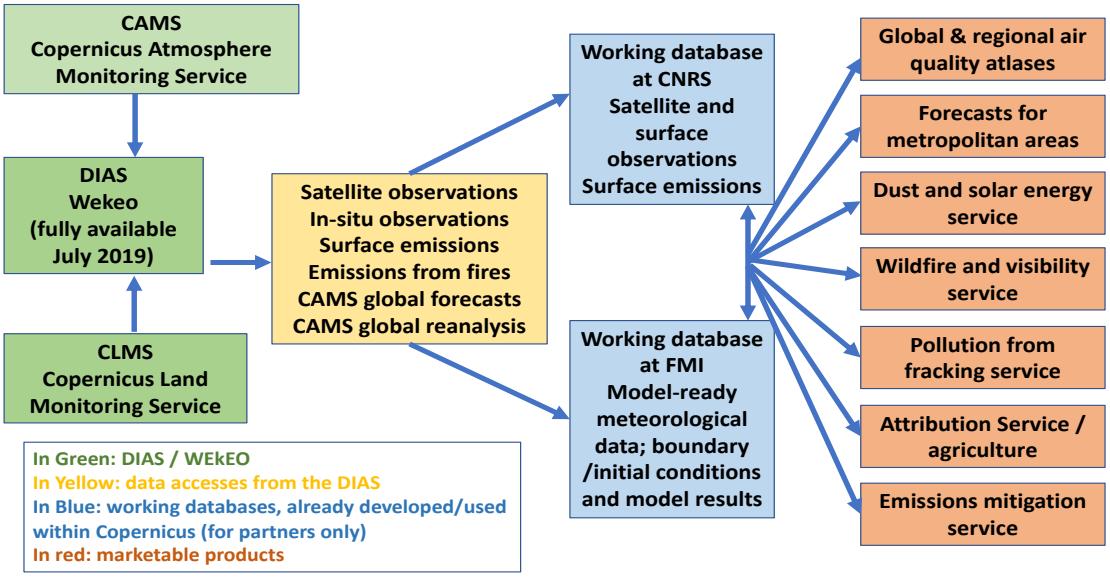


Figure 9: *Data management workflow and data processing to product portfolio. The input is represented by the green boxes and the output (prototype products and services) accessible through the User Interface Platform is represented by the red/brown boxes.*

Thus, the project will contribute to the European Commission Open Research Data Pilot. Here we indicate the general rules that will be part of the Data Management Plan to be delivered at the beginning of the project (Task 0.3). Original model data generated within the project will be managed and stored by the project partners at their local high-performance computer servers and storage facilities. Working databases, comprised of subsets of the original model datasets and observational data from the DIAS, particularly WEkEO, will be setup at (i) the Finnish Meteorological Institute (FMI) for model-ready meteorological data, boundary/initial conditions and model results, and (ii) at CNRS, via ECCAD (one of the CAMS databases) for satellite, surface observations and surface emissions of the different compounds included in the AQ-WATCH models. Access to these working databases will be restricted to AQ-WATCH partners. Public and free access and visual analysis of the products derived from these working databases will be possible via the User Interface Platform (UIP) accessible from the project's website, adopting the open access standards and formats (e.g. NetCDF), therefore allowing for better interoperability. Figure 9 shows the data management workflow in AQ-WATCH.

Publications: The knowledge gained within AQ-WATCH will be made public by the academic partners of AQ-WATCH through articles in leading peer-reviewed scientific journals. These papers will be aimed at an expert level and cover a wide range of the innovative aspects of the project. Concerning the measures to provide open access (OA) to peer reviewed scientific publications, AQ-WATCH will (a) adopt the "**Golden OA**" option (publications available directly from the publisher) for open access to peer-reviewed journal articles where possible, and funding is provided for this, (b) In parallel, "**Green OA option**" version will be available either on an author's institutional website, or in a repository) and will also be accessible by using the institutional and subject-based repositories that will be made publicly available through all the AQ-WATCH partners. Authors will avoid entering into copyright agreements with publishers that will not allow them to fulfil the EC Open Access requirement and (c) the abstracts and the publications will be made available in the **open access community ZENODO**, a free open repository powered by CERN and the European Commission, and **OpenAIRE**. The Project Office will manage this process, and publications will be advertised and logged

through the project website. All the published material will contain an acknowledgement to the research funding from Horizon 2020. These measures will also apply, where relevant, to other target groups.

Openness concerning business sector: Some AQ-WATCH components will be open source components and publicly accessible, while others will be proprietary in order to allow for further exploitation by the SMEs involved in the above-mentioned business plan. This model is directly in line with the open policy requested by the Commission and with the aim of creating business opportunities and jobs after the end of the project that the European Commission is also willing to support.

The AQ-WATCH Consortium includes three private companies (Breezometer, INERIS DEVELOPPEMENT, OctoGeo) with large experience on EO product exploitation and commercialization. Together in WP7, these companies will be the responsible parties for defining the business plan using the Canvas Model in project year 3 to guarantee the sustainability of the AQ-WATCH solutions after project funding. This plan will include market analysis, costs analysis and marketing activities (Task 7.2).

Showcase at Conferences: All the partners will attend conference sessions and give presentations to disseminate the AQ-WATCH results to the scientific community and to public services, for instance at the annual EGU and AGU conference, the UrbanSDG conference, the ICLEI Resilient Cities conference and the EPA National AQ Conference that will be held in 2022. The AQ-WATCH Work Package leaders will be proactive in organising breakout sessions and workshops at these major conferences.

Strategy for Knowledge Management and Protection

AQ-WATCH will adopt a strategy for knowledge management that encapsulates the guiding principles of H2020 on Intellectual Property (IP) management and will define a range of effective management protocols. Where appropriate the protection of the qualified knowledge/intellectual property (IP) that the partners bring to the project and then the subsequent knowledge generated (i.e., methodologies, datasets, results) will be regulated through the project Consortium Agreement (CA) and an additional Joint Ownership Agreement, and aligned with the specific requirements from the H2020 Model Grant Agreement. Specific procedures for governing access and use of IP, plus the type of IP right, will also be included in the CA. The additional Joint Ownership Agreement that to be negotiated and signed in the 3rd project year will explicitly regulate the ownership of the results and how qualified knowledge will be handled beyond the project lifetime. Fair and reasonable compensation, where applicable, will be defined according to the respective conditions. The detailed arrangement for knowledge management and protection is described in the section 3.2 (3.2.3 Innovation Management and Protection of IPR).

2.2.2 Communication activities

Through the communication activities, we want to raise public awareness about the use of air quality and environmental information to better understand the threats to our planet. AQ-WATCH aims to address these complex communication needs by these general objectives:

- To make project information and results available to a range of target audiences, including groups beyond the project, by synthesizing the new scientific knowledge gained in the project and by using a non-technical language that could also reach the general public.
- Overcome barriers to knowledge sharing between research, policy-making and SMEs in EO networks and environmental data acquisition, though a tailored publication strategy and communications that comprises face-to-face bidirectional exchange (workshops, seminars), target group specific dissemination material, awareness campaigns, and the use of social media.
- Use appropriate communication channels to ensure communication with policy-makers, the media, society, SMEs and the stakeholders, by combining classical media approaches with modern social media techniques and participative web actions.
- The Coordinator has a communication office at MPG/MPI-M with demonstrated experience in communicating the activities of previous projects. It will collaborate with the project team in the constant communication of the activities of the project. Communication will be done not only in English but also in Spanish (Chile) and in mandarin (China). All communication material will include the European Commission logo and will follow the recommendations of the EU. A more detailed communication measure plan can be found in Table 2.2.2.

Table 2.2.2: AQ-WATCH communication measures concerning different Target Groups (TG)

Target Group	Objective	Material/ content	Method/communication measures	Frequency
Project partners	Ensure an effective and integrated project communication and collaboration	• Progress and results of Tasks • Risks/benefits/ issues • Queries /questions	• Internal project wiki incl. forum (D0.1) • General Assemblies (GAs) • Work Package meetings • Web and teleconferencing, mailing	• Regular updates of wiki (@2 weeks) • Four project GAs • Annual WP meetings • PEB Skype every 3 month
Project Advisory board	Inform of progress and receive useful advices	• Progress and results of project • Risks/benefits/ issues • Queries /questions	• Internal project Wiki incl. Forum • General Assemblies (GAs), telco • Targeted communications	• Regular updates of Wiki(@2 weeks) • Four project GAs • Other contact as required
EC project officer	Ensure EC is fully informed of progress and respond to EC queries	• Overall project progress • Issues raised • Deliverable progress	• One page progress reports/summaries • Deliverable reports • Periodic reports	• Every six month throughout project • As per deliverable dates • As per reporting periods
Stakeholders & users addressed by case studies and beyond (TG1, TG2 & TG3)	Ensure maximum societal benefit; Respond to the needs of users and potential users; Ensure project design delivers useful results	• Project progress • Derived products and relevant user documentation • Smart applications • Promotional materials • Promotional channels	• User Interface Platform (UIP) • Newsfeed and blog on UIP • Case studies and factsheets • AQ-WATCH visualisations • User guides and training materials • Workshops, education/training activities • Commercial activities	• Monthly and real-time update of the project website • Newsfeed and blog • Workshops and training activities as appropriate • Timeline for commercial activities as appropriate
Governments and policy makers (TG2)	Greater understanding of Air quality, its impacts and risks framework	• Project results • Promotional materials • Smart applications	• Policy briefings • UrbanSDG , ICLEI, C40+ conference/events • Presentations to government departments • Through SDG Knowledge Hub	• In line with publications timetable • To be organised as appropriate • Annual events of ICLEI, C40 etc.
Specialist and wider research communities (TG4)	Share knowledge between projects; Maximise impact and exploitation; Clustering of projects; Capacity building, ensure knowledge is passed on through education	• Project progress and results • Methodologies of AQ-WATCH • Results and impacts	• UIP and project website • Sessions in scientific conferences • Joint workshops with other projects/communities • Peer-reviewed journal articles • User guides and training materials / activities • Capacity building measures	• Reg. update of the project website • Publication and dissemination of user documentation • At summer schools
Media and wider society (TG5)	Ensure project is visible to public; Provision of credible climate information Engagement with scientific process	• Relevant results and their implications • FAQs	• Project website, Press releases and media contacts • Advanced animations • Public lectures and presentations • Newsletters and flyers • Twitter, LinkedIn groups, YouTube •	• Monthly and real-time update of the project website Regular and proactive media activity and newsletters (quarterly)/flyers publication • Invitations to relevant events

3. Implementation

3.1 Work plan — Work packages, deliverables

The work plan is divided into eight complementary work packages. The management plan for the consortium is explained in Section 3.2.

The product development flow is described as follows: **WP1** identifies the User's needs through an initial consultation. As a result, a design of the expected products and services is performed. WP2 identifies the observational data that are needed and starts the mining and exploitation of the data. The results are provided to WP3 and WP4. WP3 adopts existing prediction models to the regions where prototype products is being developed, and produces prototype regional forecasts for these regions. The predictions are further downscaled using statistical methods based on machine learning and artificial intelligence. In an effort to develop long-term mitigation strategies, WP4 develops attribution methods to identify the most important sources of pollution affecting the users and scenario tools that illustrate the effectiveness of potential mitigation measures. In WP5 the pilot tools developed in WPs 3 and 4 are assembled into a new toolkit to provide prototype operational services. Both are then demonstrated in compelling pilot cases in WP6 and the feedbacks and conclusion of the demos are reintroduced as new requirements or modifications in the system design. Activities in the project are disseminated, exploited and communicated by WP7 with support from WP 0 (project overall coordination). Market development and the development of the business model will be the subject of WP7. The diagram in Figure 10 provides a simplified graphical presentation of the WPs adopted for AQ-WATCH as well and their interactions and the overall project flow. AQ-WATCH will follow the spiral development model (Figure 5) that is based on continuous refinement of the project components and integration through analyzing the requirements and improving the design and the implementation.

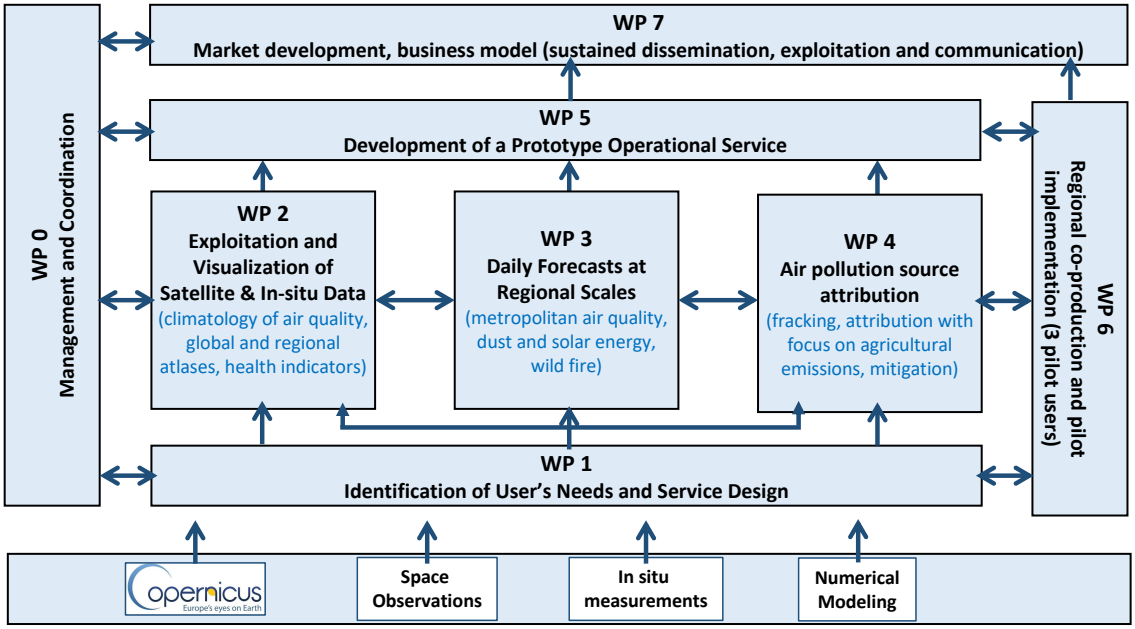


Figure 10. *The 8 work packages of AQ-WATCH and the interactions between them.*

The development is organized in loops that repeat phases of requirements gathering, system design, implementation and testing and application in pilot cases. In each loop, the project is improved and functionalities are extended (see Figure 10). In the first loop, we will start with setting up the system based on the background provided by the partners. Simultaneously, the products and services stated in this proposal will be complemented with the input of users. The items to develop will be prioritized jointly by users (Task 6.1) and developers (WP 1 and 6). In the first loop, we will start the implementation focusing on high priority items as identified in the present proposal. Pilot cases will be defined, and tests will be conducted to better elicit the current limitations. Requirements will be revisited with users and priorities will be reassessed. In the second loop, we will improve the original products and take into consideration the changes and additions suggested by the users. Pilot cases and

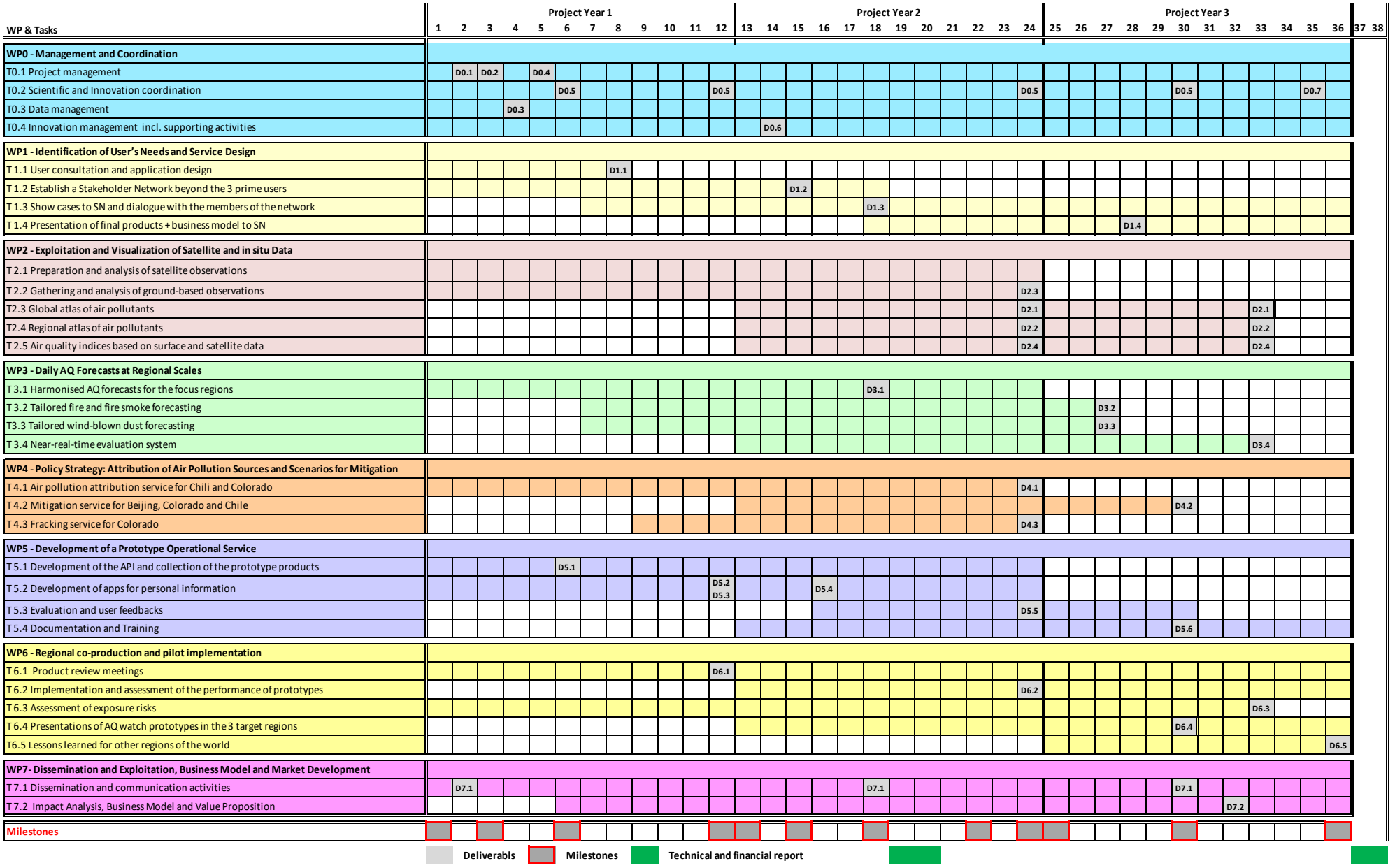
testing will reveal requirements for a consolidated solution. In the third loop, the requirements will again be revisited with users and priorities will be sorted. We will continue the implementations of products and services, complete the integration and provide the documentation for the complete solution. Pilot cases will conclude in well-documented compelling stories and will produce recommendations for operational deployment. The spiral development reduces the risks of implementing an application that does not respond to appropriately to the needs and desires of the users. As the technical aspects of the project proceed, we will also concentrate our efforts in developing the market for our prototype products and in creating a business model ensuring operational functionalities.

The exact timing of the different work packages and their tasks is represented as a time chart in the Gantt chart below. The project has been designed as a three-year project to allow for a three complete development loops and for the dissemination of the products with the framework of a sustainable business plan.

Table 3.1a: List of work packages

WP No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
0	Management and Coordination	1	MPG	38.5	1	36
1	Identification of User's Needs and Service Design	1	MPG	15	1	36
2	Exploitation and Visualization of Satellite and in situ Data	3	CNRS	46	1	36
3	Daily AQ Forecasts at Regional Scales	4	FMI	55	1	36
4	Policy Strategy: Attribution of Air Pollution Sources and Scenarios for Mitigation	7	TNO	39	1	36
5	Development of a Prototype Operational Service	2	Breezometer	39	1	36
6	Regional co-production and pilot implementation	10	UCAR	40	1	36
7	Dissemination and Exploitation, Business Model and Market Development	6	INEDEV	34.5	1	36
				Total: 307		

Gantt chart (below): Timing of the different work packages and their components



Tables 3.1b: Work package descriptions

Work package number	0			Lead beneficiary			MPG, Co-lead INEDEV					
Work package title	Coordination and Management											
Participant number	1	2	3	4	5	6	7	8	9	10	11	12
Short name of participant	MPG	Breezometer	CNRS	FMI	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	30	2	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5
Start month	1			End month			36					

Objectives

0.1. Project management: Facilitating governance and strategic decision-making through project committees, boards, management procedures, and project management tools, performing technical, financial and contract management of the consortium, establishing and maintaining an effective working relationship between AQ-WATCH and the European Commission (EC).

0.2. Day-to-day scientific and innovation coordination: Carrying out the overall coordination necessary for reaching the scientific and innovation objectives, and elaborating research risk management.

0.3. Data management: Establishing data management linked to the Copernicus system (DIAS) at project level, fostering transparency and the promotion of data and meta-data standards, implementing open access data policies.

0.4. Implementing the innovation management, support dissemination and communication activities: Coordinating innovation management and monitoring the IPR relevant issues. Supporting WP6 and WP7 to deliver dedicated communication tools and materials, tailored dissemination and communication activities, and promotion of AQ-WATCH Toolkit and marketable products towards stakeholders and customers in several regions of the world outside Europe.

Description of work

The overall objective of WP0 is to set up and to provide an effective management framework for the AQ-WATCH project and to ensure the overall coordination of the project, the achievement of project objectives and the respect of contractual commitments. WP0 will also coordinate the data management, support WP7 in communication and dissemination activities, and support other WPs in the exploitation of research and innovation results for sustainable impact. The management tasks will be shared between the coordinator and the co-lead of WP0:

- **MPG**, the Coordinator of AQ-WATCH, will ensure the overall scientific and innovation, strategic, financial and contract management. MPG will establish the project office to ensure the day-to-day operational project management and interface with the EC and support to the entire consortium
- **INEDEV**, major contributor of WP7 and co-lead of WP0 will ensure the implementation of communication, dissemination, exploitation activities, development of business model and the sustainable impact of this innovative project

Task 0.1 (M1-M36) Project management [Lead: MPG, Participants: INEDEV]

0.1a) Establish and maintain top-level management structure and processes to ensure that the AQ-WATCH objectives and impacts are efficiently achieved on time and within the resources budgeted. The day-to-day management will be the responsibility of an experienced Project Manager and a dedicated Grant Manager from the grant office at MPG. Both of the Project Manager (18 PM) and Grant Manager (12 PM, in-kind contribution) are experienced and will work closely with the Coordinator and the Deputy Coordinator. The management activities include:

1) implementation and maintenance of the Grant Agreement and of the preceding Consortium Agreement;

2) overall legal, financial, administrative management and reporting;

3) organizing and implementation of project meetings;
4) appropriate planning and operational management of intellectual property and risks, and finally
5) monitoring, facilitating and handling of the resolution of any gender and ethics issues, and any disputes/complaints in accordance with the Consortium Agreement.

In more detail, **point 2)** will include the following activities:

- providing specific templates for collecting inputs to the required EC documents (DESCA 2020 model has been selected);
- monitoring of the progress and achievement within Tasks, interaction with Task Lead and WP Lead
- oversee the progress of all WPs and adapting, when required, changes in the work plan
- organizing the project-specific process for reporting (Deliverables, Milestones, Project Periodic Technical and Financial Reports, the Final Report and the Final Report on the EU Financial Contribution Distribution);
- preparing for and post-evaluating the reviews from the EC including support in the implementation of recommendations;
- ensuring communications between WPs and handling day-to-day requests from AQ-WATCH partners and external bodies
- organizing regular telecom and/or web-meetings with the WP-leaders and other meetings relating to the management of the project
- financial management: transfer of project funds to partners, providing of clarification on any budget / financial issues, overseeing and controlling the budget

0.1b) Liaise with the European Commission by maintaining regular and comprehensive contact with the EC. This will be partly fulfilled through the provision of short reports provided to the EC every six months, outlining project progress and developments, in addition to other updates and reporting measures. The aim is to ensure the appropriate follow-up of project obligations from Grant Agreement (formal reporting of: science results and finance, project reviews, communication, and management). The Coordinator will ensure that appropriate EC representative is invited to the General Assembly meetings and any other relevant project meetings. If there are any major difficulties within the project that cannot be resolved using the appropriate management structure, the Coordinator will liaise with the EC to seek advice and solution.

0.1c) Facilitate internal communication through regular and routine communications. The Intranet created by task 0.4b has a password-protected internal wiki that can be used to enable internal information exchange between researchers. This task will also ensure the implementation and maintenance of mailing lists for scientific contacts and administrative contacts.

0.1d) Manage the gender dimension and capacity building in AQ-WATCH. This will ensure that gender aspects and training of young specialists to fit for the business environment are fully considered and AQ-WATCH acts to promote gender equality and capacity building wherever possible. This will be done with the aid of a Gender and training Strategy for AQ-WATCH that will be produced and maintained under WP0.

Task 0.2 (M1-M36) Scientific and innovation coordination [Lead: MPG. Participants: Breezometer, CNRS, FMI, BSC, INEDEV, TNO, OctoGEO, UCHILE, UCAR, BCC, BMILP]

0.2a) Establish and maintain the scientific excellence and coordination of AQ-WATCH by ensuring that the scientific and innovation objectives and impacts are achieved. This will be the responsibility of the Coordinator, in close cooperation with the Executive Board (defined in 3.2). More specifically, WP0 will a) oversee the production of synthesis of scientific and innovation results at the topic level as well as at the project level, and b) ensure that consultation with the Stakeholder Network and Project Advisory Board (consisting of experts from science and industry) is properly established and maintained and their advice is well integrated into the project. The Coordinator has allocated 30 PM, the Deputy Coordinator 2 PM, the co-WP lead 3 PM and other members of Project Executive Board (PEB) 0.5 PM to WP0. This allocated time will ensure the scientific coordination through the PMB and furthermore that all WP partners have an overview over their tasks and all partners contribute to the scientific coordination and communication.

0.2b) WP0 will ensure that the four General Assembly meetings (the kick-off meeting, 2 review meetings and the final project meeting) will take place as planned. All partners will meet at these meetings. The purpose of these meetings will be to discuss progress of the project and any issues regarding the project and make any necessary consortium decisions.

0.2c) WP0 will manage the scientific risk by resolving any conflict relating to scientific and technical issues. This will mean acting on unforeseen events and adapting work packages as required. This will also mean to highlight possible scientific risks early on in the project, and work on any necessary mitigation.

0.2d) AQ-WATCH will pro-actively attempt to participate in scientific and innovation decision-making bodies, boards and panels. This will be to provide specialist advice and to promote the project, its methodologies, its results and its marketable products. The coordinator, the deputy coordinator and the WP0 co-leader will also promote AQ-WATCH at scientific and public as well as commercial events. These activities will ensure the continued awareness and exploitation of AQ-WATCH science and innovation during and after the project. The coordinator will provide overall coordination and linkages with associated projects and programmes. WP leaders will also use their knowledge and connections with other projects to assist in this task. All partners will ensure that any participation in events or links established with other projects are recorded and provided to the Project Office at MPG for their reporting on communication activities. AQ-WATCH will actively engage with governments and policy makers, health and environmental organizations – as potential user group – to communicate the impact and significance of AQ-WATCH results, and for this purpose, policy briefings will be written specifically for this audience. MPG and other partners have long and well-established engagement with governmental institutions (e.g. with BMBF in Germany or State of Colorado in the United States). Several partners have also strong links through operational climate services and industrial partners. These collaborations will ensure that AQ-WATCH science and innovation remain well aligned with international developments and requirements throughout the lifetime of the project.

Task 0.3 (M1-M36) Data management [Lead: MPG]

The data management will be the responsibility of the Coordinator and the Project Manager. The day-to-day data management will be carried out by the Project Manager in coordination with all scientific WPs and the data centers. The Project Office will also ensure the implementation of the Open Data policy of the project. A brief description of datasets and data standards that will be used in the project is given in section 2.2

0.3a) The Project Office will deliver a Data Management plan that a) details the way for how data produced at different modelling centres should be stored and made available for joint analysis, including a description of how to access the DIAS and other data infrastructure; b) provides documentation describing the data standard to ensure smooth data transfer from different modelling centres to the server hosted at the coordinating institute and to the Open Data source; and c) provides a description of standard post-processing tools and relevant software on the central servers. The documentation will be produced by the Project Manager, in consultation with WP leaders, and made available to all partners on the project intranet.

0.3b) Project Office will implement the Data Management Plan, ensure post-processing and data analysis are done at the respective WPs, and make sure that the AQ-WATCH data are properly documented and exchanged smoothly among the AQ-WATCH partners. The plan will also include the curation and preservation after the termination of the project.

The Coordinator will oversee the implementation of the Data Management plan.

Task 0.4 (M1-M36) Innovation management, supporting WP7 in dissemination and communication, and exploitation planning [Lead: MPG, Participants: INEDEV, Breezometer]

0.4a) Dissemination/exploitation, Innovation and IPR management. WP0 will prepare and oversee AQ-WATCH's exploitation, knowledge and innovation management activities. The Coordinator and WP7 lead INEDEV will take an overview of the WPs and the outcome of AQ-WATCH to provide effective management and with that exploitation during and after the project. A Project Dissemination and Exploitation Plan as outlined in Section 2.2 will be produced and regularly updated by WP7 based on the Project Periodic Reports to the EC. WP0 will support WP7 in disseminating the AQ-WATCH results to the scientific community, informing the general public and relevant target audiences about the toolkit and the final products, in particular through coordinating activities from all project partners. WP0 will support road mapping and exploitation planning for the toolkit and the marketable product in close cooperation with WP7 (and WP6 for pilot implementation) and the Project Executive Board. For any publications and data, WP0 will create and maintain the project open access community at ZENODO, and the peer reviewed articles will also be made available in OpenAire. In regard to Innovation and IPR Management, WP0 will, in close consultation with the Executive Board:

- Keep all partners informed, maintaining and monitoring the IPR rules stipulated in the Consortium Agreement (and its annex) and the EC Grant Agreement

- Make sure that all dissemination activities are in-line with the agreed publication policy in the Consortium Agreement
- Maintain the knowledge portfolio consisting of the research and innovation output of the project

0.4b) Outreach and Communication Tools

WP0, in close collaboration with WP7, will create multi-level communication tools to ensure that the impact of AQ-WATCH and the EC funding are communicated not only at the key stakeholder/end-user level, but also reaching out to other target groups), potential stakeholders, and the wider general public. The tools supporting external outreach and communication activities are listed below:

- AQ-WATCH project identity (logo, project templates etc.)
- AQ-WATCH project website to be hosted at MPG
- AQ-WATCH User Interface Platform - UIP (joint designing and development with WP7 and WP6)
- For internal communication: WP0 will create the project-specific wiki (intranet) based on the MPG-Redmine. The MPG-Redmine has been used at the MPG for managing many different internal and external projects. It allows not only an easy documentation of reports and meeting protocols, but can also be used to raise and trace issues and to exchange ideas and project results. Concisely, WP0 will work closely with WP7 and WP6 and provide overall support for dissemination, communication and exploitation activities. WP0 will also ensure the coherence of dissemination and communication activities.

Interaction with all Work Packages

WP0 will coordinate closely with WP7 and provide support, guidance and management assistance as well as leadership for all work packages and to AQ-WATCH as a whole. WP0 will receive regular summaries of the project's progress from each work package to allow the Coordinator and Deputy Coordinator to review the progress and provide work guidance, when needed, and include them all relevant reports. WP0 will also receive financial and administrative updates from all Work Packages.

Deliverables (brief description and month of delivery)
D0.1 Project management website: intranet+ public website **(M2)** [MPG, INEDEV]
D0.2 Project management guidelines **(M3)** [MPG]
D0.3 Data management plan **(M4)** [MPG]
D0.4 Gender and training Strategy **(M5)** [MPG]
D0.5 Reports on project progress (a short summary report to the EC, **M6, M12, M24, M30**) [MPG]
D0.6 Activating UIP and UIP handbook (**M14**) [MPG, INEDEV]
D0.7 Final summary report and suggestions for post-project sustainability (**M35**) [MPG]

Work package number	1		**Lead beneficiary**	MPG, co-lead CNRS							
Work package title	**Identification of User's Needs and Service Design**										
Participant number	1	2	**3**	4	5	6	7	8	9	10	11	12
Short name of participant	**MPG**	Breezometer	CNRS	FMI	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	5	1	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1.5	1.5	1.5
Start month	1		**End month**	36								

Objectives

1.1 Identification of the User's Needs and elaboration of the User Requirement Document
1.2 Identification of Improved Products based on Users' feedbacks
1.3 Identification of the final products for commercialisation consistently with the business model

Description of work

Task 1.1. (M1-M8) User consultation and application design [Lead: MPG, Participants: UCAR, BCC, BMILP, UChile, Breezometer]

A close collaboration will be established with the prime-users in order to develop products and services, building upon the specific user needs. Meetings will be held during the first 6 months of the project in each target region (Colorado, Chile, China) to better tailor the prototypes to the needs of the users. The meetings will include the following steps:

- Presentation of a scoping document that will describe the initial design of the proposed products and services to the 3 prime users.
- Elaboration of the user requirements and wishes from the prime users. The requirements for the source apportionment definition, product availability, quality, visualization and accessibility will be discussed and summarized in a user requirement document. Specific attention will be given to the various processes in place in the users' workflows and the strengths and weaknesses of these approaches. The discussions will be organized following a web-based questionnaire which will be used to collect requirements from additional interested users.
- The elaborated user requirements will be used to adapt the design of the prototypes towards the target regions. The design includes the selection of the input datasets for (calculation of) anthropogenic and natural emissions, land use, etc. Where available, it is foreseen to integrate regional emission information into the global CAMS data. The information from the Copernicus Land service will be screened for improved input on land use, vegetation cover and state, etc., which are important for calculating natural emissions and removal processes.

Task 1.2. (M1-M18) Establish a Stakeholder Network with membership beyond the 3 prime users [Lead: MPG, Participants: UCAR, BCC, BMILP, UChile, Breezometer, TNO, FMI, CNRS, INEDEV, BSC]

In addition to the 3 prime users, five potential users interested in AQ-Watch products and services will be invited to serve on an international panel called Stakeholder Network (s. SN list in section 3.2.1). This Panel will broaden to a larger spectrum of potential customers the discussion that will take place with the 3 prime-users. Making sure that AQ-Watch products meet the different users' and stakeholders' needs is absolutely critical to the success of the products and services provided by the project. The Stakeholder Network will allow identifying common user needs as well as specific sets of requirements that need to be considered during the development process of the AQ-Watch products. The Stakeholder Network will also provide a way to promote internationally the initiatives taken by the project and thus offer opportunities for commercialization of the products to users beyond the 3 target regions.

Task 1.3. (M7-M36) Presentation of show cases to Stakeholder Network and dialogue with the members of the network [Lead: Breezometer, Participants: MPG, UCAR, BCC, BMILP, UChile, Breezometer, TNO, FMI, CNRS, INEDEV, BSC, OctoGEO]

On the basis of a user-centered approach and in order to involve Stakeholders in the process of product development this task will organize 3 meetings of the Stakeholder network to present the planned products and services, request feedback and additional ideas. In addition to the dedicated face-to-face meetings, data-gathering techniques will be applied for establishing requirements, collect feedback and keep close contact with member of the Stakeholder Network during the course of the project. This will include questionnaires, web-survey tools and individual or group teleconferences.

Task 1.4. (M18-M36) Presentation of final products and of the business model to Stakeholder Network [Lead: Breezometer, Participants: MPG, UCAR, BCC, BMILP, UChile, Breezometer, TNO, FMI, CNRS, INEDEV, BSC, OctoGEO]

At the last meeting of the Stakeholder Network, present the final prototype products and services, discuss the business models and the initiatives taken towards the commercialization of the products.

Interaction with other WPs:

WP1 will coordinate and insure dynamic interactions between the developers of the prototype products and services in WP2, WP3 and WP4 and the prime users and the Stakeholder Network. WP1 will be therefore actively involved in the spiral process methodology described in Section 1.3.2 to support the successive evaluations of the products and services by the prime users (see WP6). WP1 will also serve as intermediate between the users and the developers of the AQ toolkits and services in WP5 and WP6. By establishing the Stakeholder Network and advertising the project products, WP1 will contribute to the dissemination and

exploitation activities as part of the WP7 business plan.

Deliverables (brief description and month of delivery)
D1.1. First version of the user requirements document **(M8)** [MPG]
D1.2. First report on the range of products and services following user requirements **(M15)** [MPG]
D1.3. Updated report on user requirements and service design **(M18)** [MPG]
D1.4. Detailed specifications of the range of products/services building upon user requirements **(M28)** [Breezometer]

Work package number	2			**Lead beneficiary**		CNRS, co-lead BSC					
Work package title	**Air quality atlas: Exploitation and Visualization of Satellite and In-situ Data**										
Participant number	1	2	**3**	4	5	6	7	8	9	10	11	12
Short name of participant	MPG	Breezometer	**CNRS**	FMI	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	5	2	**8**	6	8	0	0	9	1	1	3	3
Start month	1			**End month**		36						

Objectives
2.1 Preparation of an air-quality dataset using satellite data downloaded from the WEkEO DIAS (Copernicus Data and Information Access Services). WEkEO is still under development: before it is fully operational, the data will be accessed through the Copernicus Atmosphere Data Store (available in July 2019) and through the Sentinel Hub EO browser (sentinel-hub.com/explore.eobrowser). The Copernicus Atmosphere Service retrospective reanalysis will also be accessed through WEkEO. As soon as all the observations are available in WEkEO, all data used in the project will be accessed through this system, complemented by third-party data for parameters not covered by Copernicus.
2.2 Develop an atlas including visualization of satellite and in-situ data as well as air pollution maps to assist monitoring and analyses of air pollution.
2.3 Use of satellite, surface observations and the CAMS reanalysis to provide global and regional climatologies of air pollution including statistical information (means, diurnal and seasonal variability, long-term trends, exceedances)
2.4 Develop an innovative method to calculate health indices and mortality from outdoor pollution using satellite observations

Description of work
WP2 includes five tasks, in order to access the satellite and ground-based observations required for the project, and to build atlases of air quality at the global and regional scale. The final task will use the results of the other tasks, and will define a methodology to infer air quality indices and mortality rates. These products will be made available to the users through the toolkit developed in WP5.

Task 2.1 (M1-M24) – Preparation and analysis of satellite observations [Lead: CNRS, Participants: MPG, FMI, BSC, UCAR]
Collection of available atmospheric satellite data providing information on trace gas and aerosol concentrations, through the WEkEO when the system is fully available, and through the Copernicus Atmosphere Data Store/Sentinel European EO browser until WEkEO is fully operational. Multi-annual global data sets will be collected at the best available resolution from several satellite instruments, i.e. ATSR-2, AATSR, TROPOMI, IASI, GOME-2, SLSTR and SEVIRI on EUMETSAT/ESA satellites, MODIS, MOPITT, VIIRS, OMI from NASA/NOAA satellites. The available CO, NO_2, NH_3, SO_2, HCHO, O_3 and AOD datasets will be prepared for analysis and visualization. All the extracted data will be made available to the consortium for use in the different WPs through the ECCAD (eccad.aeris-data.fr) database: ECCAD is an

official database of the Copernicus Atmosphere Monitoring Service and has already been used by different projects as a working database.
Consistency between tropospheric columns as measured by satellites, the CAMS reanalysis assimilating several of these satellite data and surface in-situ observations will be assessed by comparing short- and long-term variations of the observations.

Task 2.2 (M1-M24) – Gathering and analysis of ground-based observations [Lead: UCL, Participants: UCAR, BMILP and BCC]

This task will gather all ground-based and in-situ observations of primary and secondary air pollutants from surface networks and in-situ observations available in the target regions of the project and in the surrounding regions. The collected data will be harmonized to international standards for data format, units and metadata in support of modelling and visualization activities within the project.
The project will use the current infrastructure and procedures at the international level offered by different Copernicus partners and data services, such as the Global Atmospheric Watch (GAW) from the World Meteorological Organization (WMO), the WMO Sand and Dust Storm Assessment system (SDS-WAS), the European EMEP and American NOAA-ESRL surface observation networks, the AERONET (AErosols RObotic NETwork) and the European Aerosols, Cloud and Trace Gases Research Infrastructure ACTRIS (actris.eu). For example, the Copernicus Atmosphere Monitoring Service is using the surface observations collected in ACTRIS for model assessments. All the in-situ observations needed in AQ-WATCH will be accessed from these sites and gathered in the ECCAD database for use by the different partners for the development of the prototypes.

Task 2.3 (M13-M30) - Global atlas of air pollutants [Lead:FMI; Participants: MPG, CNRS, UCAR, BSC, Octogeo]

The available long-term satellite records collected in Tasks 1.1 and 1.2 for trace gases, together with the CAMS retrospective reanalyses will be used to develop global maps of air pollution indicators, including climatologies, and, when possible, diurnal amplitudes, monthly and seasonal variability, inter-annual variability, exceedance frequencies, and long-term trends. The spatial and temporal distribution of PMs will be calculated, based on the distribution of the PMs components, available from the CAMS reanalysis: the calculated PM three-dimensional fields will be validated with satellite observations of Aerosol Optical Depth. The climatologies and other quantities available in the atlas, which will concern both gaseous and particulate compounds, will be made accessible to users as high-quality maps and detailed reports, and in easily accessible formats for a broad audience. High-quality visual analysis tools will include the display of three-dimensional distributions.

Task 2.4 (M13-M33) - Regional atlas of air pollutants [Lead: Octogeo, Participants: MPG, CNRS, FMI, U Chile, BCC, BMLIP]

The products provided by Task 2.3 will be provided on high spatial and temporal resolution as prototypes for the three target regions. The global atlas will be partly based on the satellite-based CAMS retrospective reanalysis, which provides three-dimensional fields at a spatial resolution of about 80x80 km. In this task, in order to obtain climatologies at a higher spatial resolution, we will use oversampling techniques, where the temporal averaging of satellite data will be done on a spatial grid finer than the pixel resolution on the instrument by combining the information from many consecutive overpasses. This technique works well over long time periods, and provides information at high spatial resolution, using the spatial offset and changing geometry of the satellite pixels from day to day. Oversampling techniques have been successfully used for various satellite data to reveal regional (urban) scale variations and point sources, that are typically not clearly visible in global gridded datasets. By using oversampling, high spatial resolution maps will be produced to assist the analysis and monitoring of air quality in the target regions. Several customized products and services tailored to the specificity and the needs of the region under consideration will be developed after consultation with the prime users and the partners of the other workpackages. Statistical information will be complemented by detailed analysis of extreme pollution events linked to the regional transport of trace gases and aerosols released during large wildfire events or the dispersion of aerosols such as dust particles following intense dust storms. The details of the methodology and the contents of the regional atlases will be further refined, after consultations with the prime users organized by WP1 during the first months of the project.

Task 2.5 (M13 – M33) – Air quality indices based on surface and satellite data [Lead: BSC, Participants: Breezometer, CNRS, FMI, OctoGeo, U Chile, UCAR, BCC, BMLIP]

Air quality indices will be calculated, using estimates of near-surface pollutant concentrations in the three target regions, based on a synergetic use of high-resolution satellite observations, in-situ measurements and

machine learning (ML) algorithms. The inference of the near-surface pollution from space observations is a very active area of research and remains a challenging task. Among the different approaches proposed by the scientific community over the past years to tackle this challenge, we retained in AQ-WATCH the recent and promising approach based on the use of ML algorithms. We will relate the tropospheric columns of chemical compounds to its near-surface concentrations by training a ML model based on a dataset comprising satellite observations and additional explanatory variables collocated with in-situ surface observations. This model should be able to estimate the surface concentrations from the satellite observations where no surface monitoring stations exist. As many sources of uncertainties are at stake, we will also consider the use of quantile regression in the training of the model, in order to provide a confidence interval of the surface concentrations in addition to their mean estimate. Besides the satellite-based observations that represent the main variables, we will consider any type of variables that may at least partly influence this relationship, which includes meteorological and landuse data, among other potentially useful ancillary variables. The crucial advantage of these ML models lies in their ability to be used at a very low computational cost, once they have been properly trained, profiting from the large amounts of data provided in near-real time by satellites. The training of the ML model will be performed using both the satellite and surface data acquired in tasks 2.1 and 2.2. We will consider additional sources of information, including meteorological data from ECMWF and land use data from the Copernicus Land Monitoring Service. The development of the method will focus on the three target regions, but the use of global datasets for the ancillary variables will be favored in order to allow generalization to other regions of the world. The preliminarily approach will focus on NO_2 and $PM_{2.5}$. However, it is worth mentioning that once an exhaustive multi-species dataset is built, the approach can be tested for other trace gases of interest in which enough in-situ surface observations are available. For NO_2 (and possibly other trace gases), we will focus on the use of the TROPOMI sensor onboard Sentinel-5p due to both its high spatial resolution and good signal-to-noise ratio. For aerosols, we will use AOD satellite-based observations from ATSR-2, AATSR, SLSTR and MODIS sensors.

The estimated surface concentrations of PM and NO_2, together with ozone surface concentrations from the CAMS reanalysis at a lower spatial resolution, will be used to calculate, at the regional scale, an air quality index, and air quality health index in the target regions. The air quality air health index is a multipollutant, no-threshold air quality health index based on short-term associations observed in daily time-series analyses: the calculation of AQI and AQHI will follow the standard definition of the indices used in different regions of the world. Mortality to long-term exposure to pollution will also be calculated, based on the surface concentrations estimated within this task, and using a software developed by the World Health Organization (WHO), i.e. AirQ+, a software tool for health risk assessment of air pollution.

Interaction with other WPs:
Based on the needs expressed by WP1, WP2 will provide tailored and analysed data to WP3 and WP4. The atlases developed by WP2 will be provided to WP5 to be included in the AQ-WATCH toolkit. They will also be tested in the target regions by WP6. WP2 will ensure a coordinated use of observations in collaboration with WP0.

Deliverables
D2.1. Global atlas of air quality updated every year **(M24, M33)** [FMI]
D2.2. Regional atlases for the quality updated every year **(M24, M33)** [OctoGeo]
D2.3. Methodology to calculate surface observations from satellite observations **(M24)** [BSC]
D2.4. Regional atlases of air quality indices based on satellite observations **(M24, M33)** [OctoGeo]

Work package number	3			**Lead beneficiary**			FMI, co-lead UCAR					
Work package title	**Daily AQ Forecasts at Regional Scales**											
Participant number	1	2	3	4	5	6	7	8	9	10	11	12
Short name of participant	MPG	Breezometer	CNRS	**FMI**	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per	5	0	0	14	12	0	3	0	6	4	7	5

participant												
Start month	1			**End month**			36					

Objectives

The overall goal of the WP is to develop and verify a set of high-resolution AQ products for the focus regions by combining the Copernicus data, satellite observations and modelling capability of AQ-WATCH.
In order to reach this goal, the following specific objectives have been set:

3.1 To develop a harmonized set of detailed AQ forecast and alert systems for the focus regions: US Colorado State, Chile, Beijing area with possibility of expansion to other regions
3.2 To develop the tailored fire and fire smoke forecasting services targeting the focus regions
3.3 To develop the tailored wind-blown dust services targeting the focus regions
3.4 To establish the near-real-time evaluation of the developed services using the operationally available satellite and in-situ data

Description of work

The three operational services of AQ-WATCH and their evaluation will be provided by the 7 different modelling teams, some focusing on specific regions and services, some providing unifying platforms (Table 3.1). The services will build on Copernicus products but provide much higher resolutions compare to the ~44 km (0.4°) of CAMS-global products. We shall also make use of the local knowledge on emission and high-resolution products of Copernicus Land services for the dust and fire products.

Table 3.1. AQ-WATCH models and effort distribution for the specific services: T.3.1. AQ (upper lines), T.3.2. fires (middle lines), T.3.3. dust (lower lines).

models \ regions	**US Colorado**	**Santiago, Chile**	**Beijing, China**
SILAM & IS4FIRES / **FMI**	0.2°glob → 0.1° 0.1° IS4FIRES + GFAS 0.2°glob → 0.1° SILAM dust	0.2°glob → 0.1° 0.1° IS4FIRES + GFAS 0.2°glob → 0.1° SILAM dust	0.125° MarcoPolo 0.1° IS4FIRES+ GFAS 0.2°glob → 0.1° SILAM dust
MONARCH / **BSC**	- - 0.2° MONARCH dust	- - 0.2° MONARCH dust	- - 0.2° MONARCH dust
WRF-Chem, MOZART, MOSAIC / **MPI-M (MPG)**	12 km and 4 km regional	0.1° 0.1° GFAS -	MarcoPolo-Panda, 0.25° Marcopolo-Panda, 0.25° MarcoPolo-Panda, 0.25°
LOTOS/EUROS / **TNO**	0.1°	0.1°	MarcoPolo-Panda, 0.25°
WRF-Chem WACCM / **UCAR**	12 km & 4 km regional 1° global; FINN & QFED	- -1° global; FINN & QFED	- -1° global; FINN & QFED
CHIMERE / **BMILP**	- -	- -	2 km 25km China, 2 km Beijing
CHIMERE / **UCHILE**	-	- 0.1° dust	- -

Task 3.1 (M1-M36) – Harmonised AQ forecasts for the focus regions [Lead: MPG, participants: FMI, TNO, UCAR, BMILP, BCC]

Setup of the AQ forecasts for the focus regions will generally follow the templates of Copernicus European and MarcoPolo-Panda Asian ensembles – but with much higher resolution and reliance on regional emission and observational information. The models (Table 3.1) will be established with harmonized grids over the focus areas using the best-available input data taken from Copernicus repositories (e.g., global CAMS emission, IFS meteorology) and refined with local information wherever available. To make use of the highest

resolution, the ensemble will be nested into global SILAM forecasts presently available at 0.2° or those from Copernicus, which are at 0.4° but with assimilation of some chemical and optical parameters.

Where available, the forecasts will use the up-to-date top-down emissions of GlobEmission, MarcoPolo-Panda and AirQast generated and regularly updated using satellite data.

All regions will be set in a similar way and, owing to the harmonized boundary conditions and global Copernicus data, the configuration will be easily adjustable and transferable if new market opportunities open in any part of the world.

The ensemble-based data fusion procedure will be established using the near-real-time satellite and in-situ data wherever available (the WP2 data flows). This cutting-edge technology is shown to sharply improve the AQ forecasts even in cases when observations are too sparse for constraining the models themselves via rigorous data assimilation procedures.

Task 3.2 (M7-M27) – Tailored fire, fire smoke and related visibility forecasting [Lead: UCAR, participants: FMI, MPG]

Preliminary market outlook showed high demand for modern fire, fire smoke and visibility forecasting services. Responding to the challenge, we shall set a tailored high-resolution service using Copernicus Global Fire Assimilation System GFAS and FMI Integrated System for vegetation Fires IS4FIRES. Two US systems NASA QFED and UCAR FINN have also global fire products. These systems are based on satellite information on active fires and largely complimentary to each other in terms of their products and their spatial and temporal profiles. In particular, IS4FIRES as well as FINN and QFED output is a set of individual fires / plumes, which allows its application in the high-resolution context. The (dis-)agreement of the total emission predictions between these systems will be used as a measure of uncertainty of the fire emission.

IS4FIRES also has a new 3D emission forecasting module, which is being prototyped, aiming at predicting the fire emission for up to a few days forward. This information will be provided to the WPs 5 and 6 (final products) and to the modelling ensemble of T.3.1 (AQ forecasts).

Task 3.3 (M7-M27) –Tailored wind-blown dust forecasting [Lead: BSC, participants: FMI, MPG, BMILP, BCC, UCL]

Wind-blown dust is the second high-resolution service developed within this WP as a response to the market outlook. The primary challenge is to generate the time-resolving and high-resolution dust emission fields in each region. Multi-model products (e.g., dust AOD and dust surface concentrations) will be derived using the participating models (Table 3.1) and implementing different dust emission schemes. The dust emission modules of the participating models will be adapted to the specific conditions of the focus regions using the best available input data taken from Copernicus repositories. The forecasts will form the basis for the dust alerts using the approaches of the SDS-WAS and for tailored solar energy-related products (Chile) using the approaches of ACERA.

Following the experience of the WMO Northern African and Middle-East regional Sand and Dust Storm Warning Advisory and assessment System SDS-WAS, we shall arrange connection of the AQ-WATCH ensemble to the regional centres in Asia (China) and the Americas (Barbados) in order to facilitate the best products and joint evaluation of the dust forecasts using the existing regional infrastructure, in-situ and remote-sensing information.

Task 3.4 (M13-M33) – Near-real-time evaluation system [Lead: FMI; Participants: all]

Since the services of AQ-WATCH will bring powerful innovation and aim at unprecedented resolution and level of details, it will be vital to ensure their real-time evaluation. We will utilise the experience of Copernicus European, MarcoPolo-Panda and SDS-WAS ensembles and establish a publicly available operational evaluation of the forecasts against available observations (provided by WP2). It is anticipated that the bulk of the operational information will come from European and US satellites, which will form the key difference of the planned evaluation system from the ones established in the areas with comparatively abundant in-situ observations. The most-important existing sources of data will be the low-orbit VIIRS, MODIS, OMI/GOME-2/TROPOMI, and SLSTR, provided by WP2.

The system will be built with two levels of products: a basic one for general users and the public and a more advanced level primarily oriented towards model developers and air quality professionals. The basic system will, in simple terms, demonstrate the reliability of the previous-days forecasts in order to show the credibility of the future predictions. The presentation details will be elaborated in WPs 5 and 6. The advanced part will

provide in-depth evaluation of the model performance against different types of the observations in order to provide the scientific basis for further improvements of the models, adjustment of the data fusion algorithms, etc.

Interaction with other WPs:
The needs from the prime-users will be provided by WP1 and the tailored data will be communicated by WP2. The forecast system will be used by WP4 to develop the attribution system. The products developed by WP3 will be assembled in the AQ-WATCH toolkit by WP5.

Deliverables
D3.1. Description of the high-resolution AQ forecasts for the focus regions **(M18)** [MPG]
D3.2. Description of the tailored fire and fire smoke forecast for the focus regions **(M27)** [UCAR]
D3.4. Description of the tailored wind-blown dust forecast for the focus regions **(M27)** [BSC]
D3.4. Quality assurance for the developed services and description of the near-real-time evaluation system **(M33)** [FMI]

Work package number	4			**Lead beneficiary**		TNO, co-lead: CNRS					
Work package title	**Policy Strategy: Attribution of Air Pollution Sources and Analysis of Emission Reduction Strategies**										
Participant number	1	2	3	4	5	6	7	8	9	10	11	12
Short name of participant	MPG	Breezometer	CNRS	FMI	BSC	INEDEV	**TNO**	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	1	0	8	1	6	0	**18**	0	3	1	1	0
Start month	1			**End month**			36					

Objectives The overall goal of the WP is to support the design of effective mitigation strategies to improve air quality and hence of the health of population in different regions of the world. This will be achieved through the development of a set of tools providing insight in the dominant source sectors and regions responsible for exceedances of air pollution limit values. In addition, an interactive 'play-around' service will be developed for stakeholders to assess the health impact of emission reduction in different sectors. The focus will be on the impact of agricultural activities and fracking operations. The following specific objectives have been set:

4.1 To establish a user driven service for (NRT) source apportionment information

4.2 To establish a user driven service for mitigation information on most effective emission reduction measures

4.3 To establish a fracking service for the assessment of the impact of fracking activities on air pollution

4.4 To improve the quality of the above mentioned three services, through validation, customization and targeted developments

Description of work
The work package is divided into three main tasks, each one targeted at the development of one pilot services: the source-apportionment service, mitigation service and fracking service. Below we describe the main work required for each of the three services. User requirements and design of the services will be taken from WP1. The process within each task/service development will follow the same loop. First, the service designs will be implemented to achieve a prototype of each service. As the quality assessment of the product is crucial for its acceptance and use, we will then perform benchmark tests specific for each of the three services using observations, mostly available through from WP2. These observations include standard in-situ air quality measurements (PM10, PM2.5, SO_2, NO_2, O_3, etc.) as well as remote sensing information (AOD, NO_2, NH_3)

and specific tracers (V/Ni, Levoglucosan, BC, etc.) for evaluation of the source attributions. Following the evaluation and user consultation, necessary developments will be performed to improve the quality of the service and value for the users. The improved service will then undergo one more round of evaluation and final user feedback. Any easy fixes to final user feedback will then be implemented before provision of the products to the toolbox.
The results will be visualized on the AQ-WATCH website and provided to WP5 through an application programming interface (API)

Task 4.1 (M1-M24) Air pollution attribution service for Chile and Colorado [Lead: TNO; Participants: BSC, UCAR]

A user driven operational source apportionment service for particulate matter, NO_2, CO and SO_2 will be set-up using the LOTOS-EUROS model (PM, NO_2, SO_2) (Manders et al., 2017) and the WRF-CHEM model (CO) using tagging techniques. The source apportionment service will be applied to the target regions of Chile and Colorado using the CAMS global emissions inventory updated to the most recent year by CNRS. Available national emission inventory, that will be considered to provide better quality information for the target regions, will be integrated with the CAMS inventory using the HERMESv3 system. This system allows to flexibly process different inventories and prepare the model ready emission information based on temporal profiles, height distributions and composition tables. National information on temporal profiles and composition information will be reviewed and integrated. The system will use the operational streams to C-IFS products for meteorology and atmospheric composition (boundary conditions), as set-up in WP3.
The service will provide daily source apportionment information for all major cities and monitoring stations in the modelling domains. The emission categories to be traced will be set according to the user requirements. Available NRT observations will be included for a first quality assessment. The technical functioning will be tested and the results provided through a provisional website. The time series allows for user required assessments on annual means, limit value exceedances, etc.
The service will initially be targeted at PM and ozone as these are the two main pollutants with the highest impact on human health and of great interest to policy makers due to their exceedances of limit values. Based on user feedback the service may be extended to NO_2 and SO_2. The results will be connected to a health impact module following the WHO method in order to assess the attributions to negative health impacts.
The results of the model calculations will be validated with available observations. In-situ observations (from WP2) of PM, speciated PM (BC, SO_4, etc.), O_3, NO_2 and SO_2 will be used for evaluating concentrations. The source attributions will be evaluated with tracers (V/Ni, Levoglucosan, BC, etc.) for specific emissions sources. These observations will be complemented with satellite observations (from WP2): MODIS AOD, TROPOMI NO_2 and SO_2.
Special attention will be given to the role of agricultural emissions. The agricultural emissions will be detailed in time and space based on available information of local agricultural practices. The cropping information will be taken from the Copernicus land service. NH_3 observations from IASI will be used to assess the emission and modelled concentration distributions in time and in space.
In the final stage of the project, an automated process will be developed to generate annual reports for each location. The reports should summarize the standard assessment providing annual daily source apportionment time series, annual averages, assessments for exceedances, model evaluation and quality statistics, etc.

Task 4.2 (M13-M30) Mitigation service for Beijing, Colorado and Chile [Lead: TNO; Participants: MPG, BCC, UChile]

The source apportionment tool will provide the users with insight to the dominant sources responsible for the air pollution in the preceding days. To allow the users to gain information on the effect of emission reduction measures a mitigation service will be developed for particulate matter and ozone. The tool will allow the user to visualize the effect of reducing emissions from different source sectors on the concentrations and on health indicators (using a health impact module following the WHO method). The relevant indicators will be chosen based on user requirements.
Two complementary approaches will be used. For linear processes, the results from the source attribution service will be used directly. A percentage reduction of a specific source sector will result in a similar reduction of its contribution on the concentrations. For components with a non-linear formation process (such as the photochemical formation of ozone) a more sophisticated approach will be needed.
Alongside the forecast, a series of simulations with controlled perturbations on emissions will be performed to simulate the effect of reducing emissions of key sectors over the selected regions. Different models and sectors will be used for the different target regions and species. For a selected district in Beijing, the SIRANE (Soulhac et al., 2017) model which is used to downscale the predictions up to street level will be used and

three sectors will be targeted: road traffic, industry and residential sectors. For Colorado the regional models LOTOS-EUROS and box model BOXMOX will be used and these will focus on PM and O_3 respectively. The source sectors that will be targeted will be defined based on the largest contributors in the region and user consultations. For Chile, the regional model LOTOS-EUROS will be used the focus will be on PM
For Beijing an algorithm based on Artificial Intelligence will be applied to the daily simulations to provide a daily database of source-receptor relationships. Similarly, for Colorado a simplified model will be built for the establishment of the source-receptor relationships that will allow calculation of the impact of gradual emission changes. The impact of non-linearity will be addressed by using different levels of emission reductions in the simulations.
For the three regions, a web tool will be developed to display the efficiency of emission reduction measures corresponding to the forecast period. The end user will visualize the results as is done in CAMS at the European level (https://policy.atmosphere.copernicus.eu/CAMS_ACT.html), but applied here at local scale for Beijing and regional scale for Colorado and Chile. The algorithms will be validated using dedicated tests with offline scenarios runs combining reductions in different source sectors.

Task 4.3 (M1-M24) Fracking service for Colorado [Lead: UCAR; Participants: TNO, MPG, FMI]

Within this task we will expand the source attribution service with a tool specifically targeted at one source sector. It will demonstrate the potential of add-ons to the source attribution service, where specific attention is given to one source sector and its impact on the environment. The proposed add-on in this project is dedicated to fracking. Fracking is gaining interest (also in Europe) with the demand for cleaner combustion sources (gas instead of coal), but is controversial due to its potential (negative) environmental impacts, which are not yet well understood. By setting up and validating a fracking service over the US where fracking is already implemented, we also will gain knowledge useful for the exploration of its potential in Europe.
The first step within this development will be a literature review on fracking emissions and their impact on air pollutant concentrations. Emission information for the Colorado region will be collected and prepared for ingestion into the LOTOS-EUROS, SILAM and WRF-CHEM models. The emissions will be evaluated through comparison with TROPOMI CH_4, NO_2 and HCHO as well as in-situ observations. Where required, we will use upper and lower bounds to explore the range of emission from these activities.
Fracking as a sector will be added explicitly to the source apportionment service for PM, O_3 and toxic concentrations. For this assessment both in-situ observations as well as satellite observations will be used.

Interaction with other WPs:

WP4 will receive information from WP1 about the detailed needs of the potential users. It will work closely with WP3 on modeling related issues and provide its products to WP5 in charge of the development of the toolkit. It will also interact with WP6 regarding the evaluation of products and services in the 3 target regions.

Deliverables

D4.1 Assessment report on the role of agricultural emissions for PM exceedances in Colorado and Chile, including description of source apportionment service **(M24)** [TNO]
D4.2 Report with description of mitigation service **(M30)** [TNO]
D4.3 Assessment report with description of fracking service and impact of fracking emissions on PM, O_3 and toxics **(M33)** [UCAR]

Work package number	5		**Lead beneficiary**		BreezoMeter, co-lead: BCC						
Work package title	**Development of a prototype Operational Service**											
Participant number	1	**2**	3	4	5	6	7	8	9	10	11	12
Short name of participant	MPG	**Breezometer**	CNRS	FMI	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	0	**19**	2	0	1	0	0	3	2	1	5	5
Start month	1		**End month**		36							

Objectives

The overall objective of WP 5 is to develop a toolkit that contains the different prototype products and services developed in WP2, 3 and 4 and prepare the documentation associated with them. WP5 will also support the evaluation of the prototypes by the prime users by developing Key performance indices. The main objectives of WP5 are to:

5.1 Release the developed applications for web and mobile air quality toolkit, targeted to air quality managers and to the public.

5.2 Enable an easy access to warning systems to allow individuals exposed to air pollution to take preventive measures, which could reduce health impacts and healthcare costs from adverse effects of air pollution.

5.3 Give an access to personalized information or variability forecast to help individuals manage their life. Users will be able to use tools to search locations, view personal exposures, or exposure reduction over time. The AQ-WATCH tools will allow individuals to navigate and choose outdoor places to live, work, go to school, shop, travel, exercise, plan activities ahead and better manage treatments. The system will allow patients' physicians access to air quality information, which should enhance disease management and medical decisions.

5.4 Introduce behavioral changes through air quality alerts (push notifications) with thresholds to be defined in accordance with national or local regulation, in coordination with local authorities.

5.5 Allow a better location of air quality issues, which represents a key value for healthcare professionals and policy-makers to better locate and enhance prevention for communities at risk.

The AQ toolkit will collect user feedback via closed end questions (ease of use, practicality, perceived impact on health, willingness to pay, etc.) which will feed back into further developments and improvements of the toolkit.

Description of work

The work in WP5 is divided in four tasks to ensure the development of the toolkit, its evaluation, and documentation/training activities for its use. Within the tasks, the developments achieved in the other WPs will be used to design an Application Programming Interface (API or access point to an app that can access a database) that could be disseminated and exploited as part of WP7 business plan.

The design of the toolkit will follow several rules:

- The mobile application will allow the data to be available anywhere, anytime, on any device.
- The design will be based on the customer/user goals defined in WP1 and further refined after user comments and advices.
- The development of the system will be iterative, and be constantly improved through research and testing.

These goals will be met through the development of a multi-channel location-based Application Programming Interface (API). An API is an easy way for the business user/customer to integrate the data, making this product easy to sell.

This WP will be fitted to different interface such as touch based devices, both Android and iOS. This design will be based on robust microservice architecture to enable unlimited scaling. The framework security will be ensured through different methods.

Task 5.1 (M1-M24) Development of the API and collection of the prototype products [Lead: Breezometer, Participants: OctoGeo, CNRS, BSC]

The API will be developed, in order to provide the toolkit including the prototype services developed in WP2, WP3 and WP4 to the users and the general public. An application Programing Interface will be developed, which will deliver these products in a user-friendly matter.

The APIs will use Representational State Transfer (REST) to expose endpoints via consistent and predictable URL schema. Each URL scheme lets users execute a query that return either data, or a descriptive error message. The REST is a software architectural style that defines a set of constraints to be used for creating web services.

The toolkit will include the following prototypes:

- Global and regional atlases of air quality, including health indices
- Forecasts for metropolitan areas, including high-resolution maps and development of alert systems
- Dust and solar energy forecasts
- Wildfire and visibility forecasts

- An information service about pollution resulting from fracking operations
- Attribution service with focus on agricultural emissions
- An emission mitigation service

At the beginning of the project, a meeting will be organized with the project partners in charge of the development of the prototype, in order to better formulate the design of the API, and how to better deliver the products to the users.

Task 5.2 (M1-M24) Development of apps for personal information [Lead: Breezometer, Participants: OctoGeo, CNRS]

Based on the prototype services, apps providing personalized information will be developed. They will use for example information on long-term changes in air quality from the atlases to better choose places to live and work, go to school or travel. Another app will be defined, based on the different forecasts in the toolkit, which will help individuals to better choose their transportation needs or their activities for the day. These apps could also be used by medical doctors to plan for possible medical issues linked to pollution episodes, for disease management and medical decisions.

Task 5.3 (M16-M30) Evaluation and user feedbacks [Lead: Breezometer, Participants: UChile, BMILP, UCAR]

In order to support the successive evaluations (spiral process) of the products and services by the prime users (see WP6), Key Performance Indicators (KPIs) will be defined and used, such as:

- *Internal validation by the partners and prime users*: the following KPIs will be used: (1) System availability (the system uptime fraction) (2) Error rates (3) Speed KPIs: Time to First Byte (TTFB) and Time to Interactive (TTI) The temporal evolution of these KPIs will be monitored over time in order to evaluate the success of the products and to identify strong and weak points.
- *External validation by the general public or non-specific users*: the degree of success of the different products will be quantified and evaluated using the following KPIs: (1) Daily active users (DAU), Weekly active users (WAU), Monthly active users (MAU), as well as stickiness ratio (DAU/MAU), (4) Bounce rate. These indicators will be refined based on feedback from the partners, prime users and the general public, and are indicative of the success of various parts of the products. Feedbacks from the evaluation will be shared with the different work packages who are developing the components of the toolkit.

Task 5.4 (13-36) Documentation and Training [Lead: CNRS, Participants: Breezometer]

Online documentation will be developed and tailored according to the skills of different types of users (partners, prime users and general public)

Users' manuals for each of the components of the toolkit will be developed in English to provide easy access to all the features of each prototype and to facilitate the commercialization of the products after the completion of the project.

Short videos in English will be developed for training purposes and evaluated by the prime users. Updated versions will be developed based on the comments of the users. Where relevant, the videos will be subtitled in Spanish and Mandarin.

Interaction with other WPs:

The pilot tools developed by the above WPs are assembled in a toolkit by WP5 in an attempt to provide prototype operational services. As a first step WP1 identifies the User's needs through an initial consultation, WP5 will develop a first version based on the users needs. WP5 will integrate all products from all WPs

Deliverables

D5.1 Detailed characterization and product specification report **(M6)** [Breezometer]
D5.2 Application prototype **(M12)** [Breezometer]
D5.3 Mitigation toolkit prototype for policy makers **(M12)** [Breezometer]
D5.4 A repost of the KPI results **(M16)** [Breezometer]
D5.5 Application programming interface (API) and a web design framework, fitted to different interface such as touch based devices, both Android and iOS. **(M24)** [Breezometer]
D5.6 Collected training documentation and handbook to be made available online **(M30)** [CNRS]

Work package number	6			**Lead beneficiary**		UCAR, co-lead: UChile					
Work package title	**Regional co-production and pilot implementation**										
Participant number	1	2	3	4	5	6	7	8	9	**10**	11	12

Short name of participant	MPG	Breezomete	CNRS	FMI	BSC	INEDEV	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	1	1	0	0	0	1	0	0	9	8	10	10
Start month	1			End month			36					

Objectives

6.1 To work with prime users in Colorado, Chile and China on the implementation and development of the proposed prototype products and services.

The pilot implementations will include Denver/Colorado, Santiago/Chile and Beijing/China, each region experiencing different AQ issues and different air quality policies and management structure so as to develop a tool that is applicable to a wide range of users.

6.2 To release the developed web and mobile AQ toolkit to air quality managers and the public.

The AQ toolkit will collect user feedback via closed end questions (ease of use, practicality, perceived impact on health, and willingness to pay, etc.) which will feed back into tool development/improvement.

Expected Impacts:

1. Reduction in the health impacts and healthcare costs from adverse effects of air pollution (including wildfire and dust events) by enabling easy access to more accurate warning systems and allowing individuals to reduce exposure to air pollution via preventive measures.
2. Personalized information or variability forecast will help an individual manage his/her life. Users can use tools to search locations, view personal exposures, and monitor exposure reduction over time. Allows individuals to navigate and choose outdoor places to live, work, go to school, shop, travel, exercise, plan activities ahead, and better manage treatments – enhance disease management and medical decisions by allowing a patient's physician access to this information.
3. Introduce behavior change through air quality alerts.
4. Provide value for healthcare professionals and policy-makers to better locate and enhance prevention for communities at risk.

Description of work

Task 6.1 (M1-M36): Product review meetings [Lead: UCAR, Participants: UChile, BCC, BMILP, Breezometer]

During regular product review meetings, the teams that are leading the different pilot implementations will regularly interact with the prime-users and provide them with the latest versions of the AQ-WATCH prototypes. They will gather feedback on the usability and value of the tool and identify the necessary changes and additions. Decision makers responsible for managing air quality in each target region will be engaged at every step in an iterative process. The test-driven development will help identify the most effective tools, visualizations and integrations of data and information.

Task 6.2 (M13-M36): Implementation and assessment of the performance of AQ-WATCH prototypes [Lead: UCAR, Participants: UChile, BCC, BMILP, Breezometer]

As a result of the dialogue with prime-users, the different prototypes will be tailored to the specific needs and standards of the different target regions. Further, AQ-WATCH will be tested for its usefulness in the development and evaluation of mitigation policies aiming to improve AQ and reduce the associated harmful health impact. The pilot users will contribute to local activity and emission data if available.

Task 6.3 (M1-M33): Assessment of exposure risks [Lead: UCAR, Participants: UChile, BCC, BMILP, Breezometer, MPG, INEDEV]

Together with prime-users, AQ-WATCH will estimate the population exposure to air pollutants and generate valuable information for decision-makers and the general public with estimates of the expected health impact. These estimates will be based on the AQ-WATCH atlases developed in WP2.

Task 6.4 (M13-M36): Presentations of AQ-WATCH prototypes in the 3 target regions [Lead: UCAR, Participants: UChile, BCC, BMILP]

Regional Workshops will be held for representatives of local environmental and health organizations. AQ-WATCH products and services and their capabilities will be presented to a larger user community.
- For Colorado such a workshop will include, for example, representatives from the American Lung Association, city governments, Regional Air Quality Council (RAQC) and Environmental Protection Agency (EPA).
For Chile, it will include, for example, representatives from ACERA, the city of Santiago, the Ministry of Environment.
For China, it will include among others representatives from the Beijing Environmental Protection Bureau, Chinese Center for Disease Control and Prevention and city governments.

Task 6.5 (M25-M36): Lessons learned for other regions of the world [Lead: UCAR, Participants: UChile, BCC, BMILP, Breezometer, INEDEV, MPG]

A document describing the most pressing air quality issues in the target regions and how the tools produced by AQ-WATCH will help in addressing these issues will be produced. The document will highlight the lessons learned during the course of the project and make suggestions (take-away messages) for the implementation and adaptation of the products and services to other regions of the world.
It will suggest how other regions facing similar problems could benefit from the experience and knowledge gained in the three target regions. Among problems facing other continents are the potential development of fracking in Europe and the emerging risks of dust storms or wildfires as a result of climate change.

Interaction with other WPs:

WP6 will test the prototype products and services produced by WP2, WP3 and WP4 in the 2 target regions and provide feedbacks to WP1, WP2, WP3 and WP4. Once tested the prototypes will be assembled by WP5. WP6 will connect with the coordination and management office through a link with WP0.

Deliverables

D6.1 1st Report on the review meetings with the 3 prime-users **(M12)** [UCAR]
D6.2 2nd Report on the review meetings with the 3 prime-users **(M24)** [UCAR]
D6.3 3rd Report on the review meetings with the 3 prime-users **(M33)** [UCAR]
D6.4 Report on the regional workshops on the presentation of the AQ-WATCH prototypes in the 3 target regions **(M30)** [UCAR]
D6.5 Report on the lessons learned during the course of the project and possible extensions to other regions **(M36)** [UCAR]

Work package number	7			**Lead beneficiary**		INEDEV, co-lead MPG					
Work package title	**Dissemination and Exploitation, Business Model and Market Development**										
Participant number	1	2	3	4	5	**6**	7	8	9	10	11	12
Short name of participant	MPG	Breezometer	CNRS	FMI	BSC	**INEDEV**	TNO	OctoGEO	UChile	UCAR	BCC	BMILP
Person months per participant	10	3	0	0	0	**16.5**	0	0	1	1	2	1
Start month	1			**End month**			36					

Objectives

Operating dedicated communication channels and tailored dissemination activities interacting with the main stakeholders and clustering with other projects to make sure that the results of AQ-WATCH will be used and implemented as soon as they are available. Establishing potential exploitation paths for the project results.
To achieve this objective this WP will implement the following actions l:

1) **Clustering with major EU and international projects** and initiatives relevant for the project to guarantee the use of available knowledge (state-of-the-art);
2) **Establishing contact with potential international end-users** by building a community interested and capable to make the best use of the project results;
3) **Providing information and technological briefings** to the competent authorities to make them aware of project results;

4) Providing support for **standardization activities;**
5) Preparing the **AQ-WATCH Plan for Use and Dissemination of Foreground Knowledge;**
6) Develop business cases in the regions of the world of the pilot-cases.

Description of work

This WP covers the outreach activities that will be implemented during the project to present the project results and reach the targeted communities. It also provides the exploitation planning for its results and its link to standardization.

Task 7.1 (M1-M36): Dissemination and communication activities [Lead: INEDEV, Participants: MPG and contributions from all partners]

In this task, we will establish communication channels with the major EU and international projects and initiatives as well as with competent authorities, communities and EU companies that have been identified as targeted end-users. The description on the targeted end-users can be found in section 2.2 (the Target Groups). These links will have two benefits:

- Timely and effective dissemination of AQ-WATCH results to the targeted and wider community,
- Collection of information on the on-going research projects and initiatives to avoid duplication of work, take advantage of available knowledge (state-of-the art) and therefore provide the necessary information to the project management to maximize the research investment.

For this activity, the consortium will build the AQ-WATCH Stakeholder Network by contacting the major air quality management projects (TG4), initiatives and networks involving public authorities (TG2 incl. UNECE member states[22], EMEP), cities and municipalities (ICLEI and C40 Cities initiative[23]), and industrial and service companies interested in air quality improvement (TG2 and TG3).

Targeted communication and dissemination activities will be addressed to increase visibility of project results among interested parties, in particular public authorities. Activities to be carried out will include:

- Co-editing the **project website** which is hosted at MPG;
- Supervising and co-editing the AQ-WATCH **User Interface Platform – UIP**;

A website connected to social media (Twitter, LinkedIn) will be developed by MPG to provide visibility to the project and access to public relevant non-IP-sensitive sources and results. INEDEV will take care of periodically providing information through the UIP on progress and achievements which can be accessed by the pilot users and registered stakeholders/potential users as the website will offer the possibility to join the AQ-WATCH Community.

- **AQ-WATCH social media appearance** on Twitter and LinkedIn;
- **AQ-WATCH promotional materials**: Different means of printed releases will be distributed, e.g. promotional project brochure/leaflet and/or flyers for the large non-specialist community as well as to the community of relevant stakeholders (i.e. to be also used for dissemination purposes). Printouts will be developed and distributed to partners (in order to be further distributed through their networks and channels), and at public events. In addition, project posters along with banners/roll-ups will also be developed in order to be used for events and exhibitions. The leaflets and brochures will be created shortly after the beginning of the project to raise awareness and provide visibility. Other leaflets will be created at midterm and final term of the project. Flyers, posters and banners will be updated on a regular basis.
- **Press releases, media briefing, storyboard through i.e. multimedia scroll telling, and newsletters to stakeholders**: In addition, it is envisioned to develop e-newsletters in order to provide up-to-date information about the project to relevant audiences. The newsletter will be sent to all relevant registered stakeholders and other stakeholders beyond the project community through social media. It will also be uploaded to the project website in relation with the main events and the main project results and achievements. The frequency will be adapted to the news flow.
  A synthesis of the results will be made available both as they are produced and at the end of the project in the form of factsheets and presentations for the media to use as a basis for news items and articles. These will be summarized in press releases and journalists will be offered opportunities to ask for supplementary information and to talk to relevant researchers responsible for the scenarios.
- **Workshops & Conferences**: The Consortium will engage with external end-users (primarily public

[22] https://www.unece.org/env/lrtap/welcome.html.html
[23] https://www.iclei.org ; https://www.c40.org/

authorities, cities and municipalities) in regional workshops organized throughout the duration of the project in the countries where the pilot cases will take place. A final conference will be organized at the last project meeting (month 35) targeting EU stakeholders.
In the meantime, the consortium partners will identify relevant third-party conferences and working groups where the outputs of the project can be promoted, shared and discussed. Partners will leverage their respective networks to identify relevant projects, contributors, and communities of interest (both physical and virtual) with whom project findings and results can be shared and discussed. It is hoped that they will integrate the project's findings into their on-going research and commercial activities. Our networking efforts in this regard will serve as a "force multiplier", generating greater interest in and attention to the project and its outputs.

- **Scientific papers and communication:** The Consortium will produce scientific papers based on the project results that will be published in relevant scientific journals and professional literature. All scientific publications will follow the Gold or Green open access policy and will be made available at OpenAire and the project open access community ZENODO. WP0 will be in charge of collecting publications and overseeing the IPR issues, where WP7 will communicate the publications and the scientific stories behind it.
- **Standardization:** International standards relevant for the AQ-WATCH activities will be used, and some recommendations will be derived from the pilot experience in particular, contributions to the activities of the Technical Body CEN/CLC/JTC 5 – Space and in particular into the revision of the CEN 17030:2018 are expected through organizations already involved in the standardization activities.
- **Project Media:** Project video interviews will be created, they will highlight to different media sources the project's objectives, its outcomes, scenarios, case studies etc. It will be envisaged to upload the videos in YouTube, Vimeo and other relevant sites on the internet in order to reach a wide range of communities possibly interested in the project outcomes.

All activities within this task will be carried out according to the dissemination plan that will be produced at the beginning of the project and updated when necessary during the project meetings. This document will describe a) What is to be disseminated and exploited (results of the project)? b) Who are the targets? c) What are the channels and means to reach the targets? and d) What to do in the project and when (action plan)?

Task 7.2 (M6-M36) Impact Analysis, Business Model and Value Proposition [Leader: INEDEV, Participants: Breezometer, UCAR, UChile, BCC, BMILP]

Based on the results of WP5 and WP6, a complete impact analysis will be developed, considering not only the research or commercial aspects, but also some other relevant impacts which could jeopardize the fast penetration of the final product in the market, such as regulatory issues related to data management, social acceptance and recommendations for future air quality policies. The impact analysis and market study will use the connections with the AQ-WATCH Community as the WP7 partners will organize consultations of the stakeholders.

The business model will be prepare the strategic introduction of the AQ-WATCH products and services in the market. It will allow to describe, design, challenge, invent, and pivot the future business.

Business Model Canvas is an effective tool for developing new or documenting existing business models[24]. It provides in a structured manner a guidance to address all components of the business model and define how the products and services will be delivered to the targeted customers, at the optimized costs and via an effective customer relationship.

Since the markets between Colorado, Chile and China are quite different in terms of regulations and data management, there will be a specific business model for each of these regions.
A business case sensitivity due to positioning (in terms of value chain or price of technological element provided) will also be performed to better elaborate pricing and exploitation strategies. Finally, the business model hypothesis for exploitation will be validated for each pilot-case using local market information (Beijing, Chile, Colorado). A benchmark will be implemented, identifying alternative products, how to keep

[24] Business Model Canvas: nine business model building blocks, Osterwalder, Pigneur & al. 2010 https://canvanizer.com/downloads/business_model_canvas_poster.pdf

a sustainable competitive advantage over time and the IPR protection policy. The business model will provide the best alternatives for a fast market penetration on each specific geographical market and for each target group.

Finally, a value proposition will assess the operational profitability of the solution. This will include a cost and willingness to pay analysis for the overall solutions developed in AQ-WATCH on a base-case scenario and introduce geographical variations. Scale, volume effects and localization factors will be also considered. This analysis will allow the partners to better pivot their future commercial exploitation of the developed technologies.

Interaction with other WPs:
WP7 will work in close cooperation with WP0, since the dissemination and exploitation of the results are important aspects for the project management and since the tools (UIP and website) used for WP7 activities will be developed in WP0 by MPG. The inputs for the dissemination activities (tasks 7.1) will come from all WPs. The inputs for the preparation of the exploitation and the Business Plan will mainly be provided by WP5 and WP6.

Deliverables (brief description and month of delivery)

D7.1 Project dissemination and exploitation plan (**M2** together with MPG, update in **M18**, **30**) [INEDEV]
D7.2 Impact Analysis, Business Models and Value Proposition (**M32**) [INEDEV]

Table 3.1c: List of Deliverables

Deliverable	Deliverable name	WP	Lead participant	Type	Dissem. level	Delivery date (months)
D0.1	Project management website	0	MPG, INEDEV	DEC	PU	2
D0.2	Project management guidelines	0	MPG	R	PU	3
D0.3	Data management plan	0	MPG	R	PU	4
D0.4	Gender and training strategy	0	MPG	R	PU	5
D0.5	Reports on project progress	0	MPG	R	PU	6, 12, 24, 30
D0.6	Activating UIP and UIP handbook	0	MPG, INEDEV	DEM, R	PU	14
D0.7	Final report and suggestions for post-project sustainability	0	MPG	R	PU	35
D1.1	First version of the user requirements document	1	MPG	R	PU	8
D1.2	First report on the range of products and services following user requirements	1	MPG	R	PU	15
D1.3	Updated report on user requirements and service design	1	MPG	R	PU	18
D1.4	Detailed specifications of the range of products/services building upon user requirements	1	Breezometer	R	PU	28
D2.1	Global atlas of air quality updated every year	2	FMI	DEM, R	CO	24, 33
D2.2	Regional atlases for the quality updated every year	2	OctoGeo	DEM, R	CO	24, 33
D2.3	Methodology to calculate surface observations from satellite observations	2	BSC	R	PU	24
D2.4	Regional atlases of air quality indices based on satellite observations	2	OctoGeo	DEM, R	CO	24, 33
D3.1	Description of the high-resolution AQ forecasts for the focus regions.	3	MPG	R	CO	18
D3.2	Description of the tailored fire and fire smoke forecast for the focus regions**.**	3	UCAR	R	CO	27
D3.3	Description of the tailored wind-blown dust forecast for the focus regions**.**	3	BSC	R	CO	27

D3.4	Quality assurance for the developed services and description of the near-real-time evaluation system.	3	FMI	R	CO	33
D4.1	Report with description of source apportionment service.	4	TNO	R	PU	24
D4.2	Report with description of mitigation service.	4	TNO	R	PU	30
D4.3	Assessment report with description of fracking service and impact of fracking emissions.	4	UCAR	R	PU	33
D5.1	Detailed characterization and product specification report	5	Breezometer	R	PU	6
D5.2	Application prototype	5	Breezometer	OTHER	CO	12
D5.3	Mitigation toolkit prototype for policy makers	5	Breezometer	R	CO	12
D5.4	A report of the KPI results	5	Breezometer	R	PU	16
D5.5	Application programming interface (API) and a web design framework, fitted to different interface such as touch based devices, both Android and iOS.	5	Breezometer	DEM, R	CO	24
D5.6	Collected training documentation and handbook to be made available online	5	CNRS	R	PU	30
D6.1	1st Report on the review meetings with the 3 prime-users	6	UCAR	R	PU	12
D6.2	2nd Report on the review meetings with the 3 prime-users	6	UCAR	R	PU	24
D6.3	3rd Report on the review meetings with the 3 prime-users	6	UCAR	R	PU	33
D6.4	Report on the regional workshops on the presentation of the AQ-WATCH prototypes in the 3 target regions	6	UCAR	R	PU	30
D6.5	Report on the lessons learned during the course of the project and possible extensions to other regions	6	UCAR	R	PU	36
D7.1	Project dissemination and exploitation plan	7	INEDEV	R	CO	2, 18,30
D7.2	Impact Analysis, Business Models and Value Proposition	7	INEDEV	R	CO	32

3.2 Management structure, milestones and procedures

3.2.1 Management Structure

In a project dealing with the development, evaluation, dissemination, exploitation and at the end commercialization of products and services in an international context, the governance and management structure will play a key role.

The governance and management of AQ-WATCH will focus on Operations Management and Sustainability of the project and is structured around five different boards: (1) the *General Assembly* (GA) that includes all partners; (2) a *Project Executive Board* (PEB) that is composed by the project core team and the coordinator; (3) a *Training and Gender Panel* (TGP) taking care of the training activities, capacity building and gender equality within the project; (4) a *Stakeholders Network* (SN) that consists of potential users that can benefit from the framework existence, and (5) a *Project Advisory Board* (PAB) that is composed of several external international personalities who have interests in the project goals, will review accomplishments and will advise on the directions of the project (Figure 11).

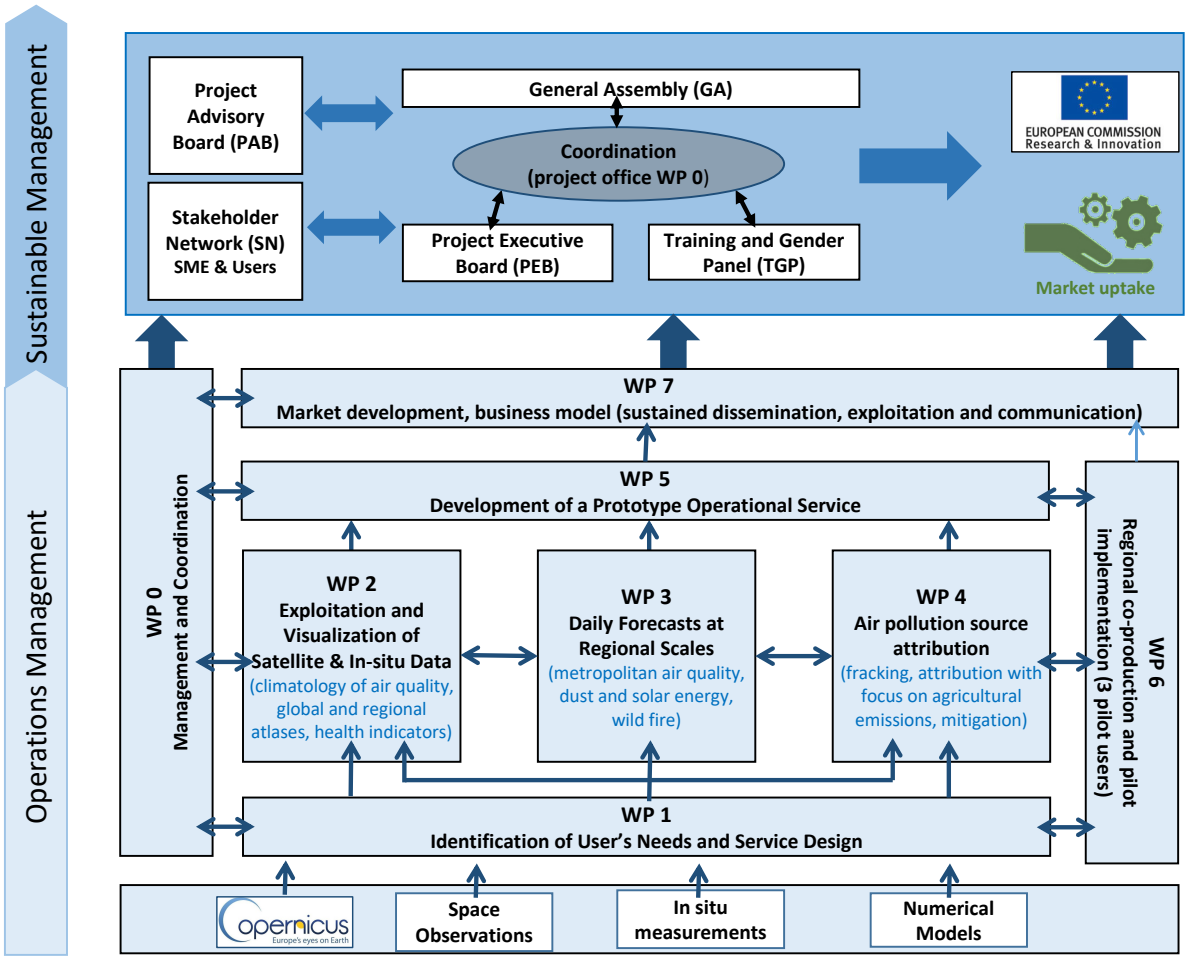


Figure 11. *Management structure (Operations management and sustainable management).*

The AQ-WATCH project management structure has two key approaches to distinguish the overall management concerning the governance requirements at the technical work package level (Operations Management), and decision-making processes with the effective dissemination and communication activities reaching out to the community outside of the project (Sustainable Management). The Operations Management approach will need to be extremely efficient and enable a rapid, coherent and well-accepted decision-making process with proactive participation of all partners. The overall AQ-WATCH management tasks will aim to implement a global project strategy and to optimize both the resource usage and the outcomes of the project. All functions and modalities of the five components and the collaboration will be defined in detail in the AQ-WATCH Consortium Agreement that will be agreed prior to the start of the project.

The Operations Management

The Operations Management of AQ-WATCH is the interdisciplinary field that addresses the efficiency and effectiveness of the operations among the WPs and of the consortium.

The Project Coordination and the Project Office: The Project Office will consist of the Coordinator (Prof. Dr. Guy Brasseur, MPG), the Co-Coordinator (Dr. Gabriela Adler, Breezometer), the Project Manager and the Grant Manager. As the Project Office will be based at the MPG, AQ-WATCH will be able to draw on its extensive in-house expertise in areas such as legal matters, finance, IT and communications. All the administrative, financial, technical and management aspects of AQ-WATCH will be coordinated by the MPG, at the delegation of the GA.

The Coordinator: Prof. Dr. Guy Brasseur, MPG, has coordinated the successful EU PANDA Project and has been participating in several other European funded projects including COPERNICUS CAMS (Copernicus Atmosphere Monitoring Service) 42 and 84. He is also the Coordinator of the H2020 MSCA RISE project PAPILA with focus on air quality in Latin America and the Caribbean by

combining the state-of-the-art models, high-resolution emission inventories, space observations and surface measurements to provide real time forecasts and analysis of regional air pollution in the relevant regions.

Guy Brasseur will be responsible for the overall coordination of the project and will act as the Point of Contact for the European Commission. He will ensure that AQ-WATCH delivers as expected, including a user-inspired toolkit and a research and application-friendly data management system for the consortium and the external scientific community.

The Deputy Coordinator: Dr. Gabriela Adler, Breezometer, will be responsible for the development of Prototype Operational Service (WP5), the implementation of business models as well as the promotion of activities, in cooperation with the Coordinator and WP7 leader, to engage users, stakeholders and policy makers to interact with AQ-WATCH. She will also be in charge of disseminating and commercializing AQ-WATCH results (Co-lead of WP7) to the scientific community, the government bodies, potential customers and the general public.

The Project Manager will be an experienced person with scientific background, who has participated in international projects, and has successfully managed dedicated international projects. The Project Manager will be responsible for ensuring the efficient day-to-day management of the project as well as the data management of the project.

The Grant Manager is an in-house senior research-service provider with over 12 years of experience advising and managing EU grant. The Grant Manger will be in-kind funded by MPG and will support all legal and financial issues, monitor and report the use of resources and provide financial and reporting guidelines to partners. Whilst the Coordinator will take care of the scientific, technical and strategic management of the project, the Project Manager and Grant Manager will work closely together and take care of the operational management including:

- Project administration and reporting, including support in the preparation of deliverables and milestones, technical and financial reporting and all financial and payment aspects
- Preparation and follow-up of project reviews and major project meetings, organization or support of project events
- Overall contract management of the project
- Helpdesk for all partners
- Supporting communication facilities and promotion of dissemination activities

The Consortium Agreement (CA) and the Joint Ownership Agreement (Annex to CA): The CA will be signed by all project beneficiaries prior to the start of the project. The CA is based upon DESCA 2020 and will formally set out the principles of management that underpin the project including, amongst others,

- the project management and governance structure including the terms of reference of all groups within the project,
- financial and budgetary provisions,
- dissemination rules,
- knowledge management and rules for the ownership and exploitation of intellectual property rights (the IP and the IPR, explicit arrangement will be defined in the Joint Ownership Agreement),
- The Consortium Agreement will also provide rules and terms of reference for any issue of legal nature concerning the cooperation among the parties as well as the intellectual property rights of individual participants and the consortium as a whole.

The Joint Ownership Agreement will be developed and signed by all members of the Consortium during the project lifetime.

Coordination, Communications and Reporting: The information flow among the Consortium members will be based on the following tools:

The **project website** (a dedicated domain will be opened for this project). This website will be divided in a public and an internal area (intranet), with a link to the UIP (User Interface Platform) for pilot and potential users. This will be jointly maintained by the Project Office and WP7.

The AQ-WATCH **internal communication strategy** will ensure the timely flow of information and maximum transparency within the consortium. In the project management intranet (Redmine, a Wiki tool for collaborative editing) of all the project relevant legal documents, reports produced and dissemination materials (i.e. posters, presentations and briefing paper) will be made available and communicated to the members. Materials obtained from outside of the project, such as strategic papers from the European Commission, Copernicus Service, GEOSS, WMO, WHO, WCRP, Stakeholder Network etc. will be made accessible under a separate index. All consortium members will have access to viewing these documents and to up- and downloading documents. The consortium members will also have access to the project calendar to be informed about the deadlines and upcoming project relevant events (both internal and external, incl. the significant conferences and workshops). A discussion forum (whiteboard) will be available to ensure the direct exchange of information and ideas within the consortium. The project manager will oversee the overall operation in the project wiki; whiteboard will be moderated by project manager and respective WP leaders.
A number of email lists will be created (one for each Board, the stakeholders network as well as a "global" list).

Project meetings consist of the following meetings:

- Kick-off and the annual meeting (General Assembly) will be a very important component for communication and exchange of ideas among scientists, external experts and stakeholders/users
- GA will meet twice a year as a baseline (Progress Meetings). Progress Meetings will be co-located with the annual meeting and through web-conference to make them more effective and to save costs. Normally these meetings would include the review of project documentation deliveries, milestones and WP and Task Group activities.
- PEB will meet every 3 months and before a GA meeting based on the web-solutions. PEB will outline the project goals and the expectation of the breakout groups
- Further workshops will be held on the work package level or on project level, i.e. the communication activities and training events relevant to stakeholders and users
- Project closure meeting (M35). Gantt chart in section 3.1 shows the project timeline and approximate schedule of the project meetings.

The following will be considered at the AQ-WATCH progress meetings:

- Progress of the project;
- Planning for future activities for next 6 months;
- Dissemination and user engagement through the PAB and Stakeholders Network;
- Use of the resources, approving the allocations of funding according to the work programme;
- Financial report;
- Knowledge and technology management – assessing the socio-economic impact of the knowledge and technologies generated, and using and disseminating that knowledge as widely as possible within the restrictions of the Consortium Agreement IPR;
- Identification of new opportunities – to include extension of the project, identification of future;
- Funding opportunities, and communication with other relevant funded projects or networks;
- Training activities, also concerning capacity building through AQ-WATCH project;
- Gender equality within the network if a problem is detected;
- Ethical issues relating to activities if a problem detected;
- The final part of the progress meetings will include GA formal decision and votes on the matters listed in the Consortium Agreement.

Locations of the project meetings will be proposed by the Coordinator to the PEB, aiming to minimize travel costs. Meeting locations will be rotated between the premises of the various participants. Alternatively, face-to-face meetings may also be collocated with project reviews given to the EU Commission in Brussels.

Work Package Management

Each work package leader will be responsible for the organization of the work within that WP. They will gather the information in their WP needed to prepare the periodic reports required by the European Commission. They will also find timely solutions for any problem that may arise. Each WP leader will

establish a Task Group formed by the task leaders and other people directly involved in the Task. This group may be dynamic and will meet as needed to review progress and discuss technical issues. All leaders of the WPs will report to the Project Executive Board (PEB) with updates on the status of their activities. The GA will have responsibility to solve any conflict that arises during the project execution and in the case that an agreement will not be achieved. The PEB will propose the measures to be reviewed and eventually adopted by the GA.

Sustainable Management of AQ-WATCH

General Assembly (GA)

The *General Assembly* (GA) is the ultimate decision body of AQ-WATCH. It will support the Project Executive Board (PEB) (see below) in major administrative and technical decisions and in the evaluation and planning of the main areas of the project. The GA is chaired by the Coordinator and consists of one representative from each consortium member. It will be responsible for decisions regarding research, innovation and development planning and work implementation, and will take the lead on issues of intellectual property rights (IPR) and user consultation, including liaisons with the Project Advisory Board. It will also decide upon the allocation of the project's budget to WP in accordance with the Grant Agreement, and will be empowered to review and change the budget share out. The GA will also take collective responsibility for monitoring the project progress in the individual work packages through regular GA meetings, resolving issues with the work package leaders. The GA will also be responsible for the successful completion of the project and the exploitation of the results. Each Participant will agree to nominate one representative and one proxy to the GA with due authorization to discuss, negotiate and decide on actions proposed by the PEB.

The GA will meet once in every 6 months. Decisions of the GA will be by a majority of those members present. The Chair will have an additional casting vote in the event of a tie. In case of urgent issues, web-meetings will be set up with recording function and electronic votes will be organized by WP0.

The GA will be responsible for the strategic, scientific and technical orientation of AQ-WATCH and shall ensure the successful implementation of the project. These tasks include:

1. Overseeing the strategic orientation of the project
2. Taking decisions about the scientific and technical orientation of the project
3. Monitoring the progress of the project and decision-making on the adoption of mitigation measures, if and when these are required. Any changes to Annex I of the EC-GA to be agreed by the European Commission
4. Identifying joint ownership and jointly formulate the Joint Ownership Agreement (Article 8.1)
5. Exploitation of project results, decisions on the conditions of access rights to the results and the background generated
6. Authorization of the dissemination of results
7. Entry of a new Party to the Consortium and approval of the settlement on the conditions of the accession of such a new Party; as well as Withdrawal of a Party from the Consortium and the approval of the settlement on the conditions of the withdrawal
8. The resolution of contractual issues according to the Consortium Agreement and the implementation of the Grant Agreement
9. Decisions on financial issues and budget allocations
10. Decisions on risk management and the sustainability of the project effort, during and after the AQ-WATCH lifetime
11. Advising the Project Executive Board (PEB) on any matters relating to the implementation of or adjustments to the work plan.

Project Executive Board (PEB)

The members of the PEB will be the Coordinator, who will be the Chair of the PEB, the Deputy Coordinator, the Project Manager and seven WP-leaders. The designated work packages are designed to complement and interact with each other. Each Work Package (WP0-WP7) will be co-led by two persons and all the WP leaders have been identified. The WP leaders will be responsible for coordinating the tasks within their WP (also s. work package management) and will support the scientific coordination of the project as a whole. They will ensure that the planned work at the WP level

is carried out as planned within the approved budgets, and that the deliverables are produced and milestones are attained on time. The WP leaders will furthermore ensure that a link is established with the AQ-WATCH project coordination and the decisions taken at steering level are implemented at WP level. The WP leaders will also assist exchanges with other projects and the scientific and user community. The PEB will be the supervisory body ensuring a successful execution of AQ-WATCH. It will provide overall management and oversight for the project. In particular, it will be the responsibility of the PEB:

1. to prepare and to draft the agenda of the meetings of the *GA*, including proposing recommendations for their consideration and approval, e.g. in the event of changes to the work plan or specific content, financial or IPR issues;
2. to execute and implement the decisions made by the *GA*;
3. to monitor the implementation of the AQ-WATCH work plan and to ensure that all the Work Packages are fully integrated and contribute to the objectives set out in the work plan;
4. to assist with the communication of the project outcomes as widely as possible both during and beyond the project;
5. to recommend resolutions for any disputes between partners;
6. to ensure the proper operation of consortium, including with regard to financial management, reporting and liaison with the EC;
7. to deliver the objectives, deliverables and milestones of AQ-WATCH;
8. to manage the risks, IPR issues and benefits of AQ-WATCH;
9. to report the progress of AQ-WATCH to and seek advice from the *Project Advisory Board (PAB), as may be required*, and to initiate interactions between PAB and the AQ-WATCH consortium.

The PEB will meet at the project inception, and then every 3 months as well as upon ad hoc request using tools such as teleconferences/web-meetings. Annually, the PEB meeting will coincide with the GA to allow face-to-face communication among WP leaders and between the WP leaders and the Project Office.

Decisions of the PEB will be a straight majority of the members present with the Chair having an additional casting vote in the event of a tie. Whilst the Project Office will act as a single point of contact with the General Assembly, the Project Advisory Board (PAB) and the Stakeholders Network (SN), the PEB will monitor and advise the actions taking place among these bodies.
The PEB will supervise the timely progress and execution of the project. It will monitor the evolution of the Project including the timely completion of each *milestone.* It will make sure that the achievements are documented in the corresponding reporting deliverable.

Table 3.2a: List of milestones

Milestone number	Milestone name	Related WP(s)	Due date (P. month)	Means of verification
M 1	Kick-off meeting	0	1	Minutes
M 2	Website available	0, 7	1	Website
M 3	First individual meetings with the 3 prime users to discuss their requirements	1	3	Short report
M 4	Stakeholder Network (SN) Committee established	1	6	Short report
M 5	Prototype of the source attribution service is demonstrated	4	12	Website/UIP
M 6	Prototypes of AQ forecasting ensemble are configured and demonstrated	3	15	Short report
M 7	Workshop for discussions of air quality/mortality rates indices adopted in different countries	2	18	Short report
M 8	Prototype of the mitigation service is demonstrated	4	18	Website/UIP
M 9	Business plan is discussed at the second annual meeting	7	22	Minutes
M 10	Reviews of the atlases by the partners and prime users	2, 6	24	Short report

M 11	Prototypes of fire and dust tailored services are demonstrated	3	24	Short report
M 12	Prototype of the fracking service is demosntrated	4	24	Short report
M 13	Draft of business plan including sustained business models and collaboration beyond project lifetime completed	7	28	Short report
M 14	Prototype of the evaluation system is demonstrated	3	30	Short report
M 15	Toolkit is completed	5	30	Short report
M 16	Presentation of the AQ-WATCH prototypes in the 3 target regions involving local stakeholders	6	30	Short report
M 17	Joint Ownership Agreement within and beyond project lifetime prepared and ready for signature. Involvement of MPG Innovation GmbH	0, 7	32	Short report

Stakeholder Network (SN)

The AQ-WATCH Project has identified a number of users who have accepted to directly contribute to the joint development and evaluation of prototype projects and services. Several users are full participants of the present proposals, while, in an effort to broaden the participation and the influence of the project, other potential users and customers will be invited to become members of the *AQ-WATCH Stakeholders Network* (SN). These additional potential users, (who are not full participants, and are located in different parts of the world), have a recognized interest and experience in adopting and promoting products; they are potential clients for these products. The SN is considered to be a central tool for implementing a *co-production* process, for developing a market strategy and a sustained business model and for developing *dissemination* activities. Users are the main targets of the pre-operational system that will result from the project activities. The SN membership will also include members of the GEOSS and COPERNICUS networks. The EO users will benefit from the results of this process. The list below includes the three prime-users organizations that have committed to take part at the project as well several additional potential customers who will be invited by AQ-WATCH to serve on the SN:

- **State of Colorado, USA**: *Gordon Pierce (*Program Manager at Air Pollution Technical Services); *Scott Landes* (Meteorology and Prescribed Fire supervisor)
- **ACERA (Renewable Energies Trade Association) Santiago, Chile**: *Carlos Finat* (Executive Director); *Darío Morales* (Director of Research)
- **Beijing Municipality, China**: *Zheng Dong* (Head of the Urban Management Section, Taoranting Substrict Office， Xicheng District); *Xin Bo* (Director of Atmospheric Environment Research Office, Appraisal Center for Environment & Engineering Ministry of Environment Protection, Beijing)
- Representatives from
    - the World Resources Institute,
    - the World Health Organisation
    - the European Lung Foundation
    - Blueair
    - L'Oréal
    - Dermalogica
    - Cisco

Project Advisory Board (PAB)

An *international Project Advisory Board* (PAB) consisting experts on Air Quality monitoring, analysis, prediction and related dissemination will be established to provide the GA and the PEB with relevant input and advice. The GA, assisted by the PEB, will have the responsibility for informing the PAB about progress made and future initiatives. The members of the PAB will be invited to the meetings of the GA. In addition, teleconferences will be organized during which PAB members will be able to provide comments and suggestions to the project team and ad-hoc advice when required. An important role of the PAB will be to serve as ambassadors of the Project to their respective constituencies. We

currently have agreements for participation in the PAB from the organizations listed below. Signed Confirmation Letters can be found in the Annex of this proposal.

Dr. Vincent-Henri Peuch: Head of Copernicus CAMS Services, ECMWF
Prof. Dr. Alexander Baklanov: Scientific Officer of Research Department, WMO
Prof. Dr. Jhoon Kim: Professor at the Department of Atmospheric Sciences, Yonsei University, South Korea. Lead of the Geostationary Environment Monitoring Spectrometer (GEMS) project
Prof. Dr. Pieternel Levelt: Head of R&D Satellite Observations, PI of the TROPOMI satellite, KNMI
Dr. Rosemary Munro: Competence Area Manager, EUMETSAT
Dr. Shen Yan, Deputy Director, National Meteorological Information Centre, China Meteorological Administration
Dr. Terry J. Keating, United States Environmental Protection Agency, Washington D.C., senior scientist and Co-Chair of the Task Force on Hemispheric Transport of Air Pollution

Training and Gender Panel (TGP). A training and gender Panel will develop and oversee the training actions and gender equality questions associated with AQ-WATCH. It will provide advice to the PEB on its implementation. In addition to training activities to be provided to users, the consortium is aware of the significance of building capabilities throughout the society in climate science through proactive training activities, conferences and workshops. Through these, the project will provide scientific advice and guidance to post-graduate researchers and young engineers about future research on air quality and atmospheric composition analysis and forecasting and assessment by using space and in situ observation data. This will encourage young academics to consider job opportunities beyond the academic world, for instance conducting climate service to relevant sectors such as health and eco systems. TGP will thus also contribute to the UN Sustainable Development Goal 13, among others (13.3 'Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning' through its outreach and dissemination activities).

3.2.2 Reporting, Communication and Quality Assessment

Project Periodic Report. The WP leaders will provide the Project Office with the WP reports 21 days in advance of the delivery date of the Project Periodic Report to the Commission (3 reporting periods of 12 months are expected). The PEB and Project Office will assess the report drafts and prepare the consolidated technical and financial Report to the Commission.

Preparation of Deliverables: Deliverables will be generated by the designated WP groups. Each deliverable will be prepared under the supervision of the WP Task Leader, who will be responsible for ensuring that a deliverable is prepared correctly and on time. Sufficient time for comments and revision by all interested participants and the consortium shall be allowed (s. deliverable review below). After acceptance, copies of the deliverable will be forwarded to the Commission and to the rest of the participants by the Project Office. ***Deliverables Review***. The WP leaders will provide their deliverable review to another two consortium participants (acting as reviewers) 21 days in advance of the final delivery date. Participants may introduce some changes or comments to the report and through feedback given to the WP leader in order to update the report and send it to the whole consortium. When everyone agrees, the Project Office will send the deliverable review to the Commission.

Minutes of Meetings. The Minutes of Meetings shall include motion votes and agreed actions, and define who is responsible for each action, with a deadline for the execution of the action. They will be distributed to the project team and agreed by all parties. All formal minutes of meetings, which include project representation (including Project Executive Board meetings, work package and inter-work package meetings, inter-project meetings, internal coordination meetings), will be promptly distributed to all participants by the Coordinator/Project Office and made available on the project Wiki.

Informal Communications. The Project Office will archive all email communication related to the project and email list activity. A document archive will be implemented connected to the project internet site in order to organize the project documents, managed by the project manager. This archive will be accessible by the participants with authorized access. Major results will be available with different types of security depending on the criticality and the IPR of the consortium.

Planning Process. Planning will normally take place by consensus within the GA. The agreed planning will be followed by the PEB meetings. Planning activities involving the interaction with other SPACE

projects will be done by the Coordinator (as first Point of Contact). For sustained contacts, the PEB may delegate in most cases this responsibility to a team of partners. Reporting will be done through Management Reports, which will be submitted by each WP Leader to the Project Office based on a template. The Coordinator will consolidate them into an overall periodical Report for the Project, which will be submitted to the Consortium internally. If required, use will be made of red/yellow/green flag procedures to ensure that major problem areas are quickly identified and resolved.

Definition of Inter-Project Relations: AQ-WATCH will cluster and maintain interaction with other relevant SPACE and EO projects. The PEB will also participate in consultation meetings and/or domain strategy activities, which are expected to be organized by the Commission services, in order to discuss research needs and explore synergies for cooperation with other relevant EU projects. Specialists from AQ-WATCH will also participate in the presentations and workshops organized by the project line. Technical documentation will be exchanged with other EU projects if useful. The Project will establish relations with other EU programs related to EO.

3.2.3 Innovation Management and Protection of IPR

In AQ-WATCH, on behalf of the GA, the Project Office and the PEB will be responsible for the monitoring of overall Innovation Management including the IPR issues. There is no plan to have any patentable products during the project lifetime, some of the key results of AQ-WATCH (toolkit) will be for commercial use and therefore the licensing issue will take place in the 3rd project year. **The data and knowledge gained within project lifetime will principally be made openly accessible (following EC open data pilot, the golden and green OA rules) for the public good, the product ready for the "First of a kind commercial system (TRL 8)" will be licensed according to the Joint Ownership Agreement (annex to CA).** The overall objective of AQ-WATCH is, jointly with international partners (incl. users and stakeholders), to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals.

AQ-WATCH will put in place the following measures to protect the existing IPR of the partners and to allow for the possibility of discoveries that should be protected. The arrangements for the management of IPR issues will be specified in the Consortium Agreement, where the background knowledge and provisions for protecting IPR will be identified and regulated. The development of a dissemination and exploitation plan will be the responsibility of the Coordination, the WP7 and the PEB and will focus on maximizing the impact of the results through the wide use of all of the project's outcomes. This plan will be approved and updated by the GA. This **Innovation Management Plan** includes four elements:

- Identifying of pre-existing knowledge: **Decide and agree on what is needed**
  Identification of "Background" and settle rules and obligations concerning access rights
  Beneficiary and consortium level, to be defined in the Consortium Agreement prior to the start of the project
- **Project results**:
  Peer reviewed Publications: Reviewing draft publications and proactively monitoring the results to determine if any IPR issues arise and if any IPR protection is needed
  Toolkit/services (incl. descriptions): Identify the qualified knowledge jointly developed during the project lifetime, define the products that shall be commercialized;
  where applicable, regulate the Compensation for IP that is created only by single or few participant(s);
  define the option for commercial licensing issues in the "Joint Ownership Agreement", also for the period after the termination of the project
  Project level and WP level, responsible by WP leaders, PEB and Coordination
- **Establishing the AQ-WATCH dissemination strategy**, **implementing and updating the dissemination plan** (D7.2)
  Project level, responsible by Coordination and PEB
- **Developing an exploitation strategy and plan** for consideration by the PEB (D7.2)
  Project Level, responsible by Coordination and PEB

The implementation of the elements will be monitored by the Project Office including the Coordinator, and reported in the GA and the technical reports.
The project will be able to call on the IPR expertise of the Coordinator (MPG Legal Office) and the Deputy Coordinator (MEITAR, Legal service for Breezometer) and other partners as required. It will also be able to call on external advisers (PAB). Through the measures of Innovation Management, it will be able to delay the submission for publication of any articles including results that might need IPR protection for up to six months.

IPR protection in particular: Each of the partners will have the right to exclude specific pre-existing knowledge (Background) from the other partners' access, as far as the restrictions are announced before the signature of the Grant and Consortium Agreements or before the effective joining of a new partner and as far as this does not preclude successful achievement of the project objectives. Foreground intellectual property will be identified at the point of creation and steps taken to ensure its protection. Partners will respect their own, and each other's protection protocols/IP Rights.
In the event the creation of a new piece of knowledge as a result of the work of a single partner of the project and solely the result of individual intrinsic skills rather than shared knowledge, this partner will be the exclusive owner of the results. We propose that the owner will grant access rights to the other partners, where necessary for their execution of the project or to the their own results. For the case in which the designated owner of the results waives its option to start registration proceedings the coordinator will follow a procedure outlined in the CA to allow other project partners the opportunity to obtain or maintain such protection. In those cases where two or more partners, but not all partners, are involved in the creation of new knowledge the ownership and access arrangements will be covered in the Joint Ownership Agreement and access rights will be agreed on a case by case basis subject to the same conditions apply to those for single partners. In the event the creation of a new piece of knowledge as a result of the joint work of all participants, the access results will be agreed on a case by case and will be jointly owned by the consortium. Access rights will be considered on a case by case basis and where appropriate after consultation with the partners concerned, to ensure that a partner's legitimate interests are not compromised. Any commercialization and commercial licensing issues will be defined in the Joint Ownership Agreement, and where applicable, a fair and reasonable Compensation for exclusive owner of the qualified knowledge will be agreed by the GA and regulated in the Joint Ownership Agreement. These paragraphs will be legally binding for a period of 3 years beyond the project lifetime. During this post-project period, the project Coordinator MPG with the support of the MPG Innovation GmbH will maintain the implementation of the Joint Ownership Agreement.
IP awareness training will be available through MPG for personnel working on the project; and the partners' legal teams will be engaged to provide support and advice on IPR matters. Nevertheless, the overall aim of the knowledge management strategy and protection will be to maximize the chances of effective exploitation of the project's research results.

The AQ-WATCH's peer reviewed publication will be made freely and openly available for use by the research community and the general public. The dissemination strategy will prioritize the publication of results in appropriate open access journals and repositories. As a result, the scientific output of the project will also be made available through AQ-WATCH's members participation in ZENODO and through the EC open repository OpenAIRE.

The first draft of the exploitation strategy will be distributed in month 2 to GA for approval (D7.1, updated in month 18 and 30). The final technical report will include the exploitation plan for beyond project completion (Month 36).

3.2.4 Conflict Resolution

Any dispute, controversy or claim arising within the AQ-WATCH consortium will first be considered by the Coordinator and the PEB. If it remains unresolved, it will be submitted to mediation in accordance with the WIPO Mediation Rules. The coordinator will have a mediator role and strive for an amicable solution. However, if the mediation is unsuccessful, the Project Executive Board (PEB) will arbitrate. If the conflict concerns an IPR related matter, the PEB will discuss potential solutions to

reach an agreement between the participants concerned. In case of a major conflict with possible contractual implications, the PEB will make a recommendation to the General Assembly (GA), who will take the final decision according to rules described in the Consortium Agreement. The place of mediation shall be Brussels unless otherwise agreed upon. The language to be used in the mediation shall be English unless otherwise agreed upon. If, and to the extent that, any such dispute, controversy or claim has not been settled pursuant to the mediation within 60 calendar days of the commencement of the mediation, the courts of Brussels shall have exclusive jurisdiction.

3.2.5 Management of critical risks for implementation

The purpose of risk management is to ensure that adequate and timely risk identification to be performed by the PEB. The sooner risks are identified, the sooner a mitigation and contingency plan can be developed and implemented, in order to avoid significant impact on the progress of AQ-WATCH. The risk management will include four major steps and the day-to-day maintenance of the risk registers will be undertaken by the Project Office.

Step 1: Risk Identification. Already in the proposal stage, 16 potential operational and technical risks have been identified (Tab. 3.2.5) and are listed in the Risk Register. During the project lifetime, further potential risks that are identified by participants, external advisors, stakeholder and end-users will be recorded in the AQ-WATCH Risk Register.

Step 2: Risk Assessment. Classification of the risks with the likelihood (high/significant, medium/minor and low/minimum) and analyzing the potential impact (WP level, project level or wider level).

Step 3: Risk Mitigation and Contingency Plan. The risk owner, i.e. the WP leader or Coordinator, will be appointed to coordinate and develop an adequate mitigation and contingency plan. The measurement of effectiveness and feasibility of such plans will be carried out to ensure that after the execution of the plans the risk exposure is at least reduced and preferably eliminated. The mitigation plans described below are preventive actions to remove the cause of the risks and to reduce the probability of the risk (or to reduce the impact of the risk), whereas the contingency plan are recovery actions to solve the problem and to reduce the impact after the risks have been dealt with. The risk owner will communicate the risks encountered and their action plans to deal with them to the PEB (project executive board).

Step 4: Risks control and monitoring. During the PEB meeting, the risk register will be monitored and the results of the mitigation and contingency actions will be evaluated. The results will be reported to the GA.

Table 3.2.5: Critical risks for implementation (both operational and scientific)
** On primary charge of the mitigation/contingent plan:*
C=Coordinator; DC=Deputy Coordinator; WPL=WP leader; Pm=Project manager; Pa=Partner

Description of risk	WP	Likeli-hood	Proposed risk-mitigation measures and contingency plan	Respons.*
R1: Key staff members assigned become unavailable for any reason	All	low	The coordination and all WPs have appropriate succession plan, with deputy coordinator has been appointed and all WPs will have WP leader and deputy	C WPL
R2: Delay in recruitment of project personnel	All	medium	Recruitment of qualified researchers can be problematic. However, the consortium has a wide network to advertise positions. Recruiting plan and channel for job advertisement will be prepared on time	Pa
R3: Individual partners are unable to complete their assigned tasks	All	low	The Project Office will communicate with WP leaders regularly, to gain early sight of issues and to ensure that the problem is managed by reassigning tasks/resources.	Pm WPL C
R4: Delay in providing in-situ data	2-6	low	Monthly telco to ensure a timely overview, work with partners to address this problem and follow progress	C WPL Pm
R5: Delay in deliverable of satellite products	2-6	low	Work with partners to address this problem and follow progress through monthly telco	C WPL Pm
R6: Non timely delivery of report codes, dataset	2-6	medium	Monitor progress to avoid situation, project manager will keep following	Pm WPL

R7: Failure to run model codes	3-6	medium	Ensure early communication among the partners to prepare for change in software	WPL Pa
R8: DIAS is not operational	2-6	low	Use other sources if accessible	WPL Pa
R9: Some specific emissions are not mature in CAMS database	2-6	medium	Use other emission inventories or make a series of assumptions based on literature	WPL Pa
R10: The size of data storage for model predictions is insufficient	2-6	low	Timely double-check and communication among WPL-Partners-Project office to ensure sufficient space provided by other consortium partner(s); where applicable, buy space from cloud services	WPL Pa Pm
R11: Uncertainty in the software development for toolkit and no timely reaction	5-6	low	To quantify and evaluate the degree of success of the different products, appropriate Key Performance Indicators (KPIs) will be used. These KPI will be based on aggregated data on the use of the products	WPL DC C
R12: End-user fatigue leading to lack of engagement, inability to discover climate information required by users	6, 7	low	Pilot users are part of the project, joint design and user tailored service will be created early in the project to make the added value of AQ-WATCH toolkit and service clear and attractive	C DC WP7 Pm
R13: Start-up company OctoGeo goes bankrupt	5-7	low	Timely communication; in worst case scenario negotiate participation of other company	C DC
R14: Start-up company OctoGeo is merged by a larger corporation controlled by new shareholder	5-7	low	Timely communication to minimize the impact; negotiate with the new shareholder about the continuation of its participation in the project or look for participation of another company	C DC
R15: Difficulty with some regional partners, i.e. delay in testing product / services by international partners	6, 7	medium	Draft some test cases or transfer them to another test region	C WPL
R16: Beyond the project life, price for commercialization too high	7, 8	medium	Business plan should be done timely and within project lifetime to ensure a clear process and the price for commercialization; research and document the best practices and legal processes for a smooth transfer from scientific results to commercialized marketable products	C DC Pa

3.3 Consortium as a whole

The AQ-WATCH consortium and work scope are designed to ensure the complete achievement of the project objectives and the targeted products enhancing the innovation and the business opportunities. The project consortium is formed by a strong, well-balanced and complementary partnership of research and academic institutions, independent international organizations, public services, SMEs – the data producers and data consumers. The consortium will be supported by a Project Advisory Board (PAB) and a Stakeholder and User Network (SN) of prominent experts from international organizations and relevant user groups, policy-makers and government bodies. These will support AQ-WATCH's research and commercialization activities and critically assess the project progress and outputs from scientific and user perspectives. The partners are from 7 European Countries and the affiliated country Israel as well as three third countries, the USA, Chile and China. Among the international partners, Chile (03.2018) and the USA (10.2015) have signed the **Copernicus Cooperation Arrangement** that provides added-value to the European Union and these partner countries in a reciprocal manner.

AQ-WATCH will build a complete value chain from fundamental research through applied science, joint application development, prototypes and finally marketable innovation under one roof to ensure efficiency of operation. The consortium is based on strong existing collaborations among leading contributors in the field, transparency in the product and services design and strong commitment to the implementation of the results. In the latter process the invited stakeholder and users will play a predominant role. The following figure is showing how the partners complement each other and can respond to different project needs (Figure 12).

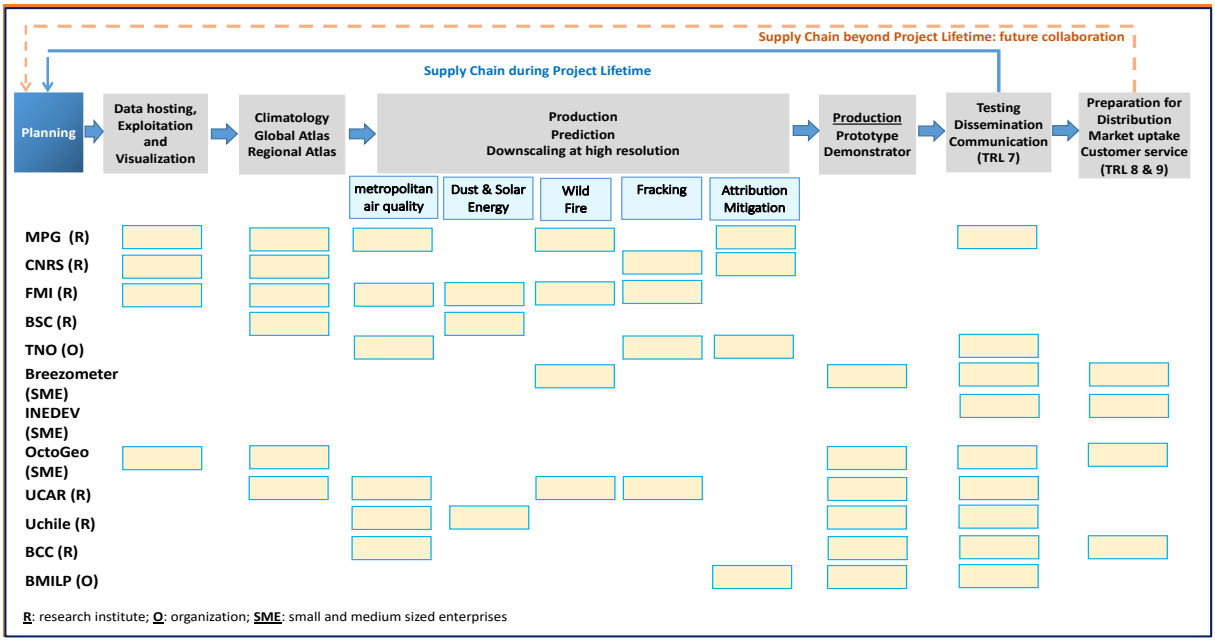


Figure 12 *Expertise and complementarity of the beneficiaries in the consortium. Supply chain from the concept to the development of prototypes at TRL 7.*[25] *(during the project lifetime) and at TRL 8 & 9 beyond the project lifetime.*

The consortium is aware of the Treaty of Amsterdam amending the Treaty on European Union (1999) and will ensure and promote overall equality, especially the gender balance. According to the respective institutional provisions, all partners commit to support career building of female students and research scientists. In addition, all partners will utilize mechanisms at the recruiting stage to encourage female applicants.

International collaboration: The participation of at least one partner from a country that has signed a Copernicus Cooperation Arrangement is mandatory in this call. As a result, the consortium includes partners from two of those eligible countries (UCAR from the USA and UChile from Chile), as well as two Chinese partners to facilitate the application of AQ-WATCH products in a global context. The four partners could enthuse three pilot users on the regional level in these three countries. The four international partners will not only maintain collaboration with the pilot users, but also enrich the consortium with their expertise concerning specific aspects of prediction for air quality in metropolitan areas with downscaling and alert system. The participation of the international partners and the pilot users in USA, Chile and China will strengthen both the impact and the exploitation of the AQ-WATCH results and will bring greater European added value for the excellence of science and innovation. While the two partners in the USA and Chile will require EC funding due to their eligibility, the two Chinese partners will not request any EC contribution. Their support to AQ-WATCH will be funded both by in-kind contribution from the respective institute and from funding by the Chinese Ministry of Science and Technology (MOST).

Involvement of Industry and SMEs: Three SMEs are involved in AQ-WATCH to ensure the development of user-driven and user-friendly application and to enable market uptake upon product maturity. The three SMEs will carry out different tasks.

Breezometer (located in Haifa, Israel) provides accurate air quality data in a format as simple, intuitive, and actionable as weather data. The company develops prototypes and creates toolkits including actionable insights and warning systems to cities, businesses and general public. Breezometer will be the main developer of AQ-WATCH's prototype (WP5) that can be integrated not only into Breezometer's own but also the running business processes of end-users. To ensure the business uptake

[25] TRL stands for Technology Readiness Level: TRL 7 –system prototype demonstration in operational environment; TRL 8 –system complete and qualified; TRL 9 –actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

of the project results, Breezometer, as the deputy coordinator of AQ-WATCH, will play a major role in the project. **INEDEV** is the INERIS Development (located in Verneuil-en-Halatte, France), a joint-stock company founded by the National Institute of Industrial Environment and Risks (INERIS). INEDEV is specialized in the field of consulting industrial safety and environmental protection businesses and projects in an international context, supports stakeholder in decision-making and implementation of action plans. INEDEV is well connected to business, policy makers and international organizations with intensive activities in China and Africa over the last 5 years. The major task of INEDEV will be the development of business model for AQ-WATCH results and to pursue a sustained project achievement through effective dissemination and communication activities (WP7).
The start-up enterprise **OctoGeo s.r.o.** (located in Brno, Czech Republic) was selected by Copernicus Accelerator as "the Start-up of the Month" for July 2018. With over 10 specialists, OctoGEO s.r.o. has the expertise in applying scientific research into geo industry. Apart from the OpenMapTiles Satellite, which is currently being combined with detailed aerial photos from the EU INSPIRE programme, the company has also developed other high-tech products such as a unique colour toning algorithm and a globally cleaned elevation dataset. Within AQ-WATCH, OctoGeo will be in charge of the development of visualization tools (WP2 and WP5).

3.4 Resources to be committed

The total requested EC contribution for AQ-WATCH is 1.999.770 €. All 12 Partners will together contribute a total of 307 person-months to the project.

Financial planning approach

The majority of the funding for AQ-WATCH is required for personnel costs, since the project will rely on the expertise and skills of the partner organizations involved. The budget has been calculated using an estimation of the costs associated with the experts that have been identified to deliver the project's objectives.

All partners will contribute at least a minimum of 0.5PM to the project management activities. Two partners co-leading coordination activities have been allocated two additional PM to synthesize the results for dissemination and communication and for working closely with the Coordinator. WP 1 for identification of user needs and service design is the springboard of the scientific approach and has moderate PM requirements, whereas WP 2-4 request higher number of PMs to conduct the major science activities of AQ-WATCH and produce forecasts and assessment data/reports. WP5 for the development of prototype, WP6 for the pilot run with users and WP7 request adequate efforts to ensure the technical development, user acceptance and a sustained project achievement through effective business development. For the management work package WP0, we planned 38.5PM in order to secure a successful project management and overall coordination of AQ-WATCH. Among the 38.5PM, 20PM comes from in-kind contribution of the coordinating institute.

Budget for other direct costs represents 12% of the total requested EC contribution. These include

- Travel costs to attend project meetings, WP meetings, end-user workshops, workshops with clustering projects, major conferences and training activities
- Organization of project annual meetings and financial support for travel and subsistence for PAB members and international experts
- Organization and implementation of dissemination, outreach and communication activities, as well as exploitation of results

The budget distribution among the WPs:

	WP0	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total
Requested EC contri.*	141.820	130.029	333.571	346.425	270.338	275.000	214.629	287.959	1.999.770
Weighting in WP	7%	7%	17%	17%	14%	14%	11%	14%	100%

** No EC contribution for Chinese partners BCC/BMILP*

Table 3.4a: Summary of staff effort

	WP0	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total Person-Months per Participant
1 MPG	30,0	5,0	5,0	5,0	1,0		1,0	10,0	57,0*
2 Breezometer	2,0	1,0	2,0			19,0	1,0	3,0	28,0
3 CNRS	0,5	0,5	8,0		8,0	2.0			19,0
4 FMI	0,5	0,5	6,0	14,0	1,0				22,0
5 BSC	0,5	0,5	8,0	12,0	6,0	1,0			28,0
6 INEDEV	2,0	0,5					1,0	16,5	20,0
7 TNO	0,5	0,5		3,0	18,0				22,0
8 OctoGEO	0,5	0,5	9,0			3,0			13,0
9 UChile	0,5	1,5	1,0	6,0	3,0	2,0	9,0	1,0	24,0
10 UCAR	0,5	1,5	1,0	4,0	1,0	1,0	8,0	1,0	18,0
11 BCC	0,5	1,5	3,0	7,0	1,0	5,0	10,0	2,0	30,0
12 BMILP	0,5	1,5	3,0	5,0		5,0	10,0	1,0	26,0
Total	38,5	15,0	46,0	56,0	39,0	38,0	40,0	34,5	307,0

** 30PM through institutional co-funding of the Coordinator (in-kind contribution), among WP0, WP1 and WP7*

Table 3.4b: Other direct costs' items *(travel, equipment, other goods and services, large research infrastructure) – "for each participant if the sum of the costs for' travel', 'equipment', and 'goods and services' exceeds 15% of the personnel costs for that participant"*

Partner 1 MPG	Cost (€)	Justification
Travel	65000	- Organizations of kick off meeting, 2 annual meetings and final project meeting: 20k€ in total - Travel and subsistence for PAB members and Chinese partners to participate at the General Assembly (6 experts): 35k€ - Conference attendance at UrbanSDG, ICLEI/C40+, international IGAC conferences, EGU, AGU: 10k€
Other goods and services	7000	- Open access publication 5k - Web tools for User Interface Platform 2k
Total	72000	

Annexes

Annex 1 – Abbreviations used in AQ-WATCH proposal

Annex 2 – Letters of support from PAB members; Commitment letter from prime users

4.1. Participants (applicants)

4.1.1 MAX PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V. (MPG)

DESCRIPTION OF THE LEGAL ENTITY

The **Max Planck Society (MPG)** is Germany's most successful research organization established in 1948. The 85 Max Planck Institutes and facilities (as of 2019) conduct basic research in the service of the general public in the natural sciences, life sciences, social sciences, and the humanities. Max Planck Institutes focus on research fields that are particularly innovative, or that are especially demanding in terms of funding or time requirements.

Based on this general concept, the **Max Planck Institute for Meteorology (MPI-M [1] , www.mpimet.mpg.de)** develops and uses Earth System Models and critical observations to support its overall mission: To understand Earth's changing climate. Research activities within the MPI-M are centred in three departments: The Atmosphere in the Earth System; The Land in the Earth System and The Ocean in the Earth System. The institute also hosts independent research groups focused on Stratosphere and Turbulent Mixing Processes as well as Environmental Modelling in the Earth System. The International Max Planck Research School on Earth System Modelling (IMPRS-ESM) – jointly run by the MPI-M and the Universität Hamburg – manages the institute's contribution to doctoral training. The MPI-M has a long history in the development and application of coupled comprehensive climate/earth system models (ESMs). To satisfy the extensive computational needs of MPI-M, the institute built strategic partnership with the German Climate Computing Centre (DKRZ), the German collaborator of the Earth System Grid Federation (ESGF). MPG is also the major shareholder of the DKRZ.

MAIN TASKS IN AQ-WATCH

MPG/MPI-M[1] will be the scientific and management coordinator of AQ-Watch (WP0) and strongly support WP7 for communication and dissemination activities up to and including exploitation planning. MPG will also lead WP1 to identify user's needs and conduct service design with all partners involved in the project, further scientific contribution will be made to Task 2.1, Task 3.1 and Task 4.2.

KEY PERSONS

Guy P. Brasseur (male) – the Coordinator of AQ-WATCH and lead of WP0 – is a former Director of MPI-M in Hamburg and a Professor at the Universities of Hamburg and Brussels. He is a part-time Associate Director of the National Center for Atmospheric research in Boulder, Colorado, USA and the founder of Climate Service Center in Hamburg (GERICS). Currently he leads the Environmental Modeling team at MPI-M. Brasseur co-authored several books and published 195 scientific papers in

[1] In the entire proposal the operating institute MPI-M will be referred to as "MPG" in order to keep coherence

peer-reviewed journals. He was the Lead Author of the 4th IPCC Assessment that was awarded the 2007 Nobel Peace Prize. Brasseur has been participating in numerous EU funded projects such as FP5-FP7, H2020 and Copernicus. He was the Coordinator of the FP7 project PANDA, in which Chinese and European partners collaborated to study the air quality in China by using space observations. He is coordinating the H2020 MSCA RISE project PAPILA (2018-2021) and the BMBF collaborative project KLIMAPOLIS (2017-2022) with focus on air quality in Latin America and the Caribbean by combining the state-of-the-art models, high-resolution emission inventories, space observations and surface measurements to provide real time forecasts and analysis of regional air pollution in the relevant regions.

Idir Bouarar (male) – lead of WP1 – is an atmospheric scientist at the Environmental Modeling Group of the Max Planck Institute for Meteorology. He holds a PhD in Environmental Sciences and has 12 years of experience in atmospheric modelling. His current research activities focus on modelling of air pollution on global to regional scales. Combination of satellite data with in-situ observations for the evaluation of long-term trends in emissions and air pollution and analysis of pollution events are also some examples of his current research projects. Bouarar has co-authored 22 reviewed articles in the field of atmospheric modelling and has supervised a number of activities related to multi-model air pollution forecasting and model evaluation with in-situ and satellite observations. He is in charge of the implementation and provision of daily air quality forecasts for China and South America using the regional WRF-Chem model. Idir will be involved in WP2 and WP3.

Angelika Heil (female) – completed her PhD studies in 2006 at the Max Planck Institute for Meteorology. One focus of her research is to combine satellite information to compile biomass burning emission inventories. For several years, she has contributed to the development of the near-real-time satellite-based Global Fire Assimilation System (GFAS) within Copernicus Atmosphere Services (CAMS). A second focus of her research is to use regional or global chemistry climate models to predict the impact of emissions on atmospheric chemistry, air pollution and human health. Her recent activities within the ESA Climate Change Initiative (CCI) focuses on analysing factors contributing to uncertainty and bias in satellite-based burned area estimates. In addition, she is responsible for analysing user requirements for satellite fire products in interaction with the wider climate research user community. Angelika will be involved in WP1.

Nico Caltabiano (male) – holds a PhD in Oceanography by the University of Southamopton, UK, and is currently the project manager for the BMBF-funded Klimapolis project, which focus on urbanization and climate change issues in metropolitan regions of Brazil. He is a former Deputy Executive Director of the Climate Variability, Predictably and Change (CLIVAR) project of the World Climate Research Programme (WCRP). Caltabiano will be involved in WP0, he will contribute to the overall project management including data management of AQ-Watch in WP0. Together with the WP leaders for Policy Strategy and Market Development, he will also support the dissemination/exploitation and communication activities in WP7.

RELEVANT PUBLICATIONS (UP TO 5)

Brasseur, G. P., et al. (2019): Ensemble Forecasts of Air Quality in Eastern China – Part 1. Evaluation of the MarcoPolo-Panda Prediction System, Version 1, Geosci. Model Dev., 12, 33-67, 2019.

Bouarar, I. et al. (2018), Influence of anthropogenic emission inventories on simulations of air quality in China during winter and summer 2010, Atm. Env., 236-256, 198, 2019.

Brasseur, G. P., and D. J. Jacob, *Modeling of Atmospheric Chemistry*, 540 pages, Cambridge University Press, Cambridge, UK, 2017.

Bouarar, I., Brasseur, G. P., and X. Wang (Eds.) (2017), Air Pollution in Asia: An Integrated Perspective, Springer, ISBN 978-3-319-59489-7, 2017.

Brasseur, G. P., J. Orlando, and G. Tyndall (Eds), *Atmospheric Chemistry and Global Change*,654 pages, Oxford University Press, New York, 1999.

RELEVANT PROJECTS (UP TO 5)

PAPILA (EU H2020 project): Prediction of Air Pollution in Latin America. The objective of the project is to establish a sustained network of partners with complementary expertise, which will develop and implement an analysis and forecast system for air quality with downscaling capability for Latin America and the Caribbean region, and assess the impact of air pollution (background and peaks) on health and on the economy.

PANDA (EU FP7 project): PArtnership with chiNa on space Data. The objective of PANDA was to establish a team of European and Chinese scientists who will jointly use space observations and in-situ data as well as advanced numerical models to monitor, analyse and forecast global and regional air quality. An ensemble forecasting system has been successfully implemented within PANDA in collaboration with the EU FP7 MarcoPolo project, and provides daily air quality forecasts for China since 2016 using nine regional and global sophisticated chemistry transport models.

KLIMAPOLIS (German BMBF project): MPI-M is leading this project which aims to address the questions of co-evolution of urbanization, climate change and air pollution in several metropolitan areas of Brazil. The objective is to co-design with city officials and assess win-win solutions that will lead to the development of smart cities, resilient to climate change and air pollution. This will be achieved by integrating complimentary expertise through staff exchange between Brazil and Germany, training courses and joint workshops.

CAMS (EU/ECMWF projects): Copernicus Atmospheric Monitoring Service. The CAMS projects provide continuous data and information on atmospheric composition on both the global and regional (Europe) scales. The service describes the current situation, forecasts the situation a few days ahead, and analyses consistently retrospective data records for recent years. It also supports many applications in a variety of domains including health, environmental monitoring, renewable energies, meteorology and climatology. MPI-M has coordination and technical roles in several CAMS contracts including CAMS_42 on global reactive gases aspects, CAMS_84 on validation of global and regional products and CAMS_74 on quantitative estimates of climate forcings.

AQ-WATCH

INFRASTRUCTURE

- Large programming department for software infrastructure development tasks within MPI-M;
- Easy access to computing and support resources of DKRZ (German Climate Computing Centre, s. description on third party below);
- The MPI-M has for a long time benefited from a close integration of its systems with those of DKRZ, offering the MPI-M seamless access to the DKRZ-managed machines such as the Bull machine "mistral", a supercomputer with a peak performance of 3.14 Petaflops consisting of approx. 3,000 compute nodes, 100,000 compute cores, 240 Terabytes of memory, and 54 Petabytes of disk. “Mistral” will also be used for CMIP6 simulations;
- MPI-M maintains a close cooperation with the German weather Service DWD (Deutscher Wetterdienst) for the development of the comprehensive modelling framework ICON (ICOsahedral Nonhydrostatic) for numerical weather prediction, climate simulation and process studies.

4.1.2 BreezoMeter

DESCRIPTION OF THE LEGAL ENTITY

BreezoMeter's is a SME founded in 2014, BreezoMeter’s mission is to help people and businesses improve the health and quality of life for millions of people worldwide, by providing the most accurate environmental information such as air quality and pollen data in a format as simple, intuitive, and actionable as weather data. Today, millions of people make informed decisions on well-being using BreezoMeter's air quality and pollen data and services (see https://breezometer.com/) . BreezoMeter aims to reach more than 6 billion people (85% of the world’s population) who live in areas where WHO air quality guidelines are exceeded. BreezoMeter provides real-time, dynamic, location-based air quality data to help people cope with air pollution, an invisible killer that takes almost 10 million lives a year, according to the World Health Organisation. BreezoMeter covers 83 countries and is available as an API/DaaS. Clients include Dyson, Cisco, Dermalogica, Veolia, L'Oréal Paris and HELLA. Its multidisciplinary team of environmental engineers, atmospheric scientists, algorithm engineers, physicist and software engineers is located in Haifa, Israel. BreezoMeter is the go-to partner for integrating air quality data into products, technologies and apps. A wide range of industries – like smart home, digital healthcare, fitness, cosmetics, automotive, and more – can easily integrate air pollution information using our API.

MAIN TASKS IN AQ-WATCH

BreezoMeter will lead the WP5 for development of a Prototype Operational Service that includes development of the toolkit with different products and services incl. an alert system and a catalogue of the products to be delivered to the users. The toolkit will be designed to:

- Be Responsive, mobile optimized to have the data available anywhere, anytime, on any device.
- Focus on the customer/user goals and needs by using User Centered Design. This will be done throughout the development cycle, from planning down to implementation.
- Be iterative, this includes cycles of research, testing and improvement as part of the core of this product development.
- Meet the user/customer's requirements. Using personalization and game mechanics this product will increase user adoption and overall public awareness to environmental issues.

This WP will be in charge of developing a multi-channel location-based Application Programming Interface (API). An API is an easy way for the business user/customer to integrate the data, making this product easy to sell.

BreezoMeter will also contribute to WP7 for a sustained development of the project results and function of Deputy Coordinator of AQ-Watch.

KEY PERSONS

Gabriela Adler Katz (female) – lead of WP5 – is the Chief Scientist of BreezoMeter and the head of the algorithm group at BreezoMeter. Adler worked at the National Oceanic and Atmospheric Administration (NOAA) Boulder CO, designing an optical instrument for measuring atmospheric aerosols (Particulate Matter PM), and conducted research on emissions from wildfires. Adler's PhD focused on chemical and physical processes of gases and particulate matter in the atmosphere. Adler is a director of a mulitisplagroup in BreezoMeter, including modelers, environmental engineers and software engineers web designers and ML experts.

RELEVANT PUBLICATIONS AND PRODUCT, SERVICES (UP TO 5)

Global real-time, location based (250-500m resolution) **air-quality data**, accessible through a simple REST API - Documentation | Sample dataset

Air Quality Heatmap tile overlay, updated hourly, providing intuitive experience to understand the air-pollution globally - Documentation | Sample

Global air-quality Forecast data, updated hourly, and location based (250-500m resolution), accessible through a simple REST API - Documentation | Sample dataset

Real-time, location based (500m resolution) **pollen data for Japan**, accessible through a simple REST API

Daily Forecast Pollen data for the USA, for Grass, and 9 different tree types.

Pollen Heatmap tile overlays for real-time and forecast pollen data, providing intuitive experience to understand the pollen conditions for Trees, Grass, and Weed plants globally.

INFRASTRUCTURE

BreezoMeter currently uses:

- 1000 instances each hour to calculate air pollution
- processing 2 TB hourly
- using app engine with microservices architecture for client facing infrastructure, allowing us to auto scale to any demand

AQ-WATCH

- using different types of databases (mysql, datastore, storage, bigquery) for different types of processing.
- Has broad experience using the cloud with custom or managed services to take full advantage of cloud infrastructure.

For the AQ-WATCH project BreezoMeter would be served by Google App Engine a Google level scalable PAAS solution that would allow us to scale up and down according to the requirements (from ten of thousands of users a day to ten of thousands users a seconds).By using the google cloud infrastructure BreezoMeter benefits from all of google security, scalability and stability without any extra work or maintenance

EXPLANATION ON OPERATIONAL CAPACITY (IF APPLICABLE)

Since established in 2014, BreezoMeter has been a multidisciplinary company in its core. Because air pollution changes dramatically in space and time, we believe that only by combining hands of:
Software engineers, Environmental engineers, Atmospheric scientists, Algorithm engineers, Physicist, Web Developers, Mobile developers, Full stack developers, Designers. We can truly face the challenge of making the invisible visible and provide accurate air quality information, in real time at users' location.

4.1.3 National Centre for Scientific Research CNRS)

DESCRIPTION OF THE LEGAL ENTITY

The National Centre for Scientific Research (in French: Centre National de la Recherche Scientifique) is a public organisation for scientific and technological research and is under the authority of the French Ministry for Research. CNRS is the largest fundamental research organisation in Europe. Measured by the amount of human and material resources it commits to a great range of disciplines, CNRS is the hub of research activity in France. It is also an important breeding ground for scientific and technological innovation. The main tasks of CNRS are: the development of knowledge, its transfer to and its application in enterprises and all domains contributing to the progress of society, the dissemination of information and of scientific and technical culture to the public, and especially towards young people, the participation in early training and life-long training, training by research, and quality in the research management. CNRS was the first French research organisation to sign the European “Charter of Researcher” in 2005.
The scientists leading the CAMS-81 consortium and working in the project are part of two different departments, the "Laboratoire d'Aérologie", and the "Observatoire Midi-Pyrénées. the Laboratoire d'Aérologie (LA), is a Joint Research Unit of University between CNRS and the University of Toulouse. The laboratory has a long and well-known experience in the field of atmospheric sciences. The scientific objectives of LA concern the observation, the understanding and the numerical modelling of dynamic, physical and chemical processes controlling the evolution of the atmosphere. CNRS-OMP (Midi-

Pyrénées Observatory) is a group of CNRS laboratories dedicated to research on the Universe, the Earth, and the environment. These missions cover a large panel from research, observation, education, diffusion of scientific knowledge, to international cooperation. CNRS-OMP is a unit under the umbrella of CNRS and its National Institute for Earth Sciences and Astronomy (INSU), of the French National Center for Space Studies (CNES), of the French National Research Institute for Sustainable Development (IRD), and the French Meteorological Center (Meteo-France). One of the height units of OMP is SEDOO (Observatoire Midi-Pyrénées Data Service, SEDOO): this service data centre is dedicated to environmental data management and data distribution for international and multidisciplinary projects.

MAIN TASKS IN AQ-WATCH

CNRS will lead WP2 on the exploitation and visualization of satellite and in-situ data. CNRS will provide surface emissions at the global scale for the simulations performed in WP3. It will also provide up-to-date surface emissions at different spatial scales for WP4 which focuses on sources apportionment. CNRS will participate in WP6 on the training of users and transfer of knowledge.CNRS will also support WP0, mainly to data management: CNRS is developing and managing the ECCAD (Emissions of Atmospheric Compounds & Compilation of Ancillary Data), one of the databases of the Copernicus Atmosphere Service. ECCAD will be used in AQ-WATCH as a working database.

KEY PERSONS

Claire Granier (female) – lead of WP2 – is a « Directeur de Recherche" at the Laboratoire d'Aérologie/CNRS in Toulouse. She has a large experience in leading projects dealing with surface emissions and the distribution of pollutants. She is the coordinator of the Copernicus Atmosphere Monitoring Project CAMS-81 (surface emissions) since September 2017. She is the scientific director of the ECCAD (Emissions of Atmospheric Compounds & Compilation of Ancillary Data) database and she is the director of databases of the GEIA (Global Emissions InitiAtive) international project. She is the co-chair of a new project called AMIGO (Analysis of eMissions using Observations) of the international IGAC (International Global Atmospheric Chemistry) project.

Nellie Elguindi (female) is a research associate at the Laboratoire d'Aérologie/CNRS in Toulouse. After her PhD in regional climate studies at the University of Delaware, she has worked on studies linking climate change, air pollution and data analysis in different laboratories in France, Italy and in the USA. She has worked on the precursor of the CAMS/Copernicus project, i.e. MACC (Monitoring Atmospheric Composition and Climate), and she is now responsible for the development of the global anthropogenic emissions for CAMS.

Sabine Darras (female) is an engineer at the Observatoire Midi-Pyrénées/CNRS in Toulouse. She is the service manager of the CAMS-81 project of the Copernicus Atmosphere Monitoring Project focusing on emissions from anthropogenic and natural origin. She is the project manager for the development of the ECCAD database, for which she coordinates the developments, the project requirements and specifications. She is an expert in formatting and standardization of in databases.

RELEVANT PUBLICATIONS (UP TO 5)

Granier, C., B. Bessagnet, T. Bond, A. D'Angiola, H. Denier van der Gon, G. Frost, A. Heil, J. Kaiser, S. Kinne, Z. Klimont, J.-F. Lamarque, C. Liousse, T. Masui, F. Meleux, A. Mieville, T. Ohara, K. Riahi, M. Schultz, S. Smith, A. M. Thomson, J. van Aardenne, and G. van der Werf, Evolution of anthropogenic and biomass burning emissions at global and regional scales during the 1980-2010 period, Climatic Change, doi 10.1007/s10584-011-0154-1, 2011.

Granier, C., T. Doumbia, L. Granier, K. Sindelarova, G. Frost, I. Bouarar, C. Liousse, S. Darras and J. Stavrakou, Anthropogenic surface emissions in Asia, peer-reviewed book "Air Pollution in Eastern Asia: An Integrated Perspective", Springer - ISSI Series, DOI 10.1007/978-3-319-59489-7, 2017.

Granier, C., T. Doumbia, L. Granier, K. Sindelarova, C. Liousse, S. Darras, I. Bouarar, H. denier van der Gon, G.J. Frost, G. Janssens-Maenhout, M. Crippa, J. Stavrakou, R. Hoesly, and S. Smith, Trends in anthropogenic emissions from 1960 to 2015, Proceedings of the 2017 International Emissions Inventory Conference - Applying Science and Streamlining Processes to Improve Inventories, Baltimore, MD, August 2017.

Sun, W., M. Shao, C. Granier, Y. Liu, C. Ye, J. Zheng, Long-term Trends of Anthropogenic SO2, NOx, CO and NMVOCs Emissions in China, Earth Future, 6, 1112-1133, doi:10.1029/2018EF000822, 2018.

Darras, S., C. Granier, C. Liousse, D. Boulanger, N. Elguindi, and Hung Le Vu, Emissions of Atmospheric Compounds & Compilation of Ancillary Data, IGAC News issue 61, 2018. Publication on the ECCAD database, available at: https://eccad.aeris-data.fr

RELEVANT PROJECTS (UP TO 5)

CAMS-81 (EU Copernicus project): CAMS-81 is a project of the Copernicus Atmosphere Monitoring Service aiming at providing and analyzing surface emissions for the Copernicus Atmosphere Service. The project started in September 2017 and will end in August 2020. Emissions from anthropogenic and natural (biogenic, soils, termites, volcanoes and oceans) are considered from the year 2000 to the most recent year.

DATAbASE (French CNRS project): DATAbASE is a project funded by CNRS which will start in the Spring of 2019. The goal of the project is to evaluate the anthropogenic emissions of terpenoid species in cities, linked to transportation and residential wood combustion. Such sources are currently not taken into account and could have a significant impact on ozone and secondary aerosols.

PAPILA (EU H2020 project): Prediction of Air Pollution in Latin America. The objective of the project is to establish a sustained network of partners with complementary expertise, which will develop and implement an analysis and forecast system for air quality with downscaling capability for Latin America and the Caribbean region, and assess the impact of air pollution (background and peaks) on health and on the economy

PANDA (EU FP7 project): PArtnership with chiNa on space Data. The objective of PANDA was to establish a team of European and Chinese scientists who will jointly use space observations and in-situ data as well as advanced numerical models to monitor, analyse and forecast global and regional air quality.

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INFRASTRUCTURE

ECCAD (Emissions of Atmospheric Compounds & Compilation of Ancillary Data) database, which is managed and developed at CNRS. A new version of the database was developed at the end of 2017 and has now more than 800 users from all world countries.

4.1.4 ILMATIETEEN LAITOS (FMI)

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

DESCRIPTION OF THE LEGAL ENTITY

The Finnish Meteorological Institute (FMI) is a research and service governmental organization (http://en.ilmatieteenlaitos.fi/). The main objective of the Finnish Meteorological Institute is to provide the Finnish nation with the best possible information about the atmosphere above and around Finland, for ensuring public safety relating to atmospheric and airborne hazards, and for satisfying requirements for specialized meteorological products. FMI employs about 630 people, about 330 of which are involved in research and development. The FMI scientists have published more than 350 reviewed articles per year in international scientific journals during the last few years. Scientists from the Atmospheric Composition Department and Climate Research Programme of FMI will be involved in the project. Relevant current activities of FMI involve research in air chemistry and aerosol physics, including a National and two Nordic Centres of Excellence, assessment and modelling of airborne pollutants from the local to global scales (recent relevant EU- and ESA - projects are SERV-FORFIRES, GLORIA, CAMS-50, EUNADICS-AV, eLUP, ShipNoDEff, HENVINET, CAMS-81 and TRANSPHORM, etc). FMI also contributes to European and global research and operational programmes on monitoring the atmospheric composition (e.g., EMEP, HELCOM/EGAP, WMO/GAW, AMAP)..

MAIN TASKS IN AQ-WATCH

Three departments of FMI will participate in the AQ-WATCH: Atmospheric Composition Modelling group will coordinate the WP3 and provide the AQ model forecasts and reanalyses of the SILAM modelling system to the relevant services. The service lines of the WP3 are in the main expertise area of the group.

Teams of Remote Sensing and Climate departments will be responsible for the satellite data analysis and development of the corresponding services in WP2 leading a task in that WP.

KEY PERSONS

Mikhail Sofiev (male) – Lead of WP3 – is a Research Professor in Atmospheric Composition Research department at the FMI and an Adjunct Professor at University of Helsinki. He has 27 years of experience in development and application of air pollution models at various scales – from mesoscale to global for a wide range of tasks. M.Sofiev if a member of WMO Scientific Advisory Group on Applications and Finnish Emergency Response team. He is coordinator of SILAM modelling team, fire information

system IS4IRES, and a national forecasting system for allergenic pollution. M.Sofiev is an author of 216 scientific publications; 119 of them are published in peer-reviewed international and national journals and series (h-index=36, i10-index=91, Google Scholar, 2018.08.20). M.Sofiev is a supervisor of 15 academic theses (14 completed). He participated in over 40 international research and application projects, in particular led the development of the SILAM model and global fire emission assessment system IS4FIRES.

RELEVANT PUBLICATIONS (UP TO 5)

Sofiev, M., Vira, J., Kouznetsov, R., Prank, M., Soares, J., Genikhovich, E. (2015) Construction of the SILAM Eulerian atmospheric dispersion model based on the advection algorithm of Michael Galperin, *Geosci.Model Developm.* 8, 3497-3522, doi:10.5194/gmd-8-3497-2015

Sofiev, M., Winebrake, J.J., Johansson, L., Carr, E.W., Prank, M., Soares, J., Vira, J., Kouznetsov, R., Jalkanen, J.-P., Corbett,J.-J. (2018) Cleaner fuels for ships provide public health benefits with climate tradeoffs. *Nature Comm.* DOI: 10.1038/s41467-017-02774-9, www.nature.com/naturecommunications.

Beukes, J.P., Van Zyl, P.G., Sofiev, M., Soares, J., Liebenberg-Enslin, H., Shackleton, N., and Sundström, A.-M. (2018) The use of satellite observations of fire radiative power to estimate the availabilities (activity patterns) of pyrometallurgical smelters. *The Journal of South-African Institute of Mining and Metallurgy*. 118, 619-624. http://dx.doi.org/10.17159/2411-9717/2018/v118n6a9.

Soares, J., Sofiev, M., Hakkarainen, J. (2015) Uncertainties of wild-land fires emission in AQMEII phase 2 case study. *Atmosph.Environ.*, doi:10.1016/j.atmosenv.2015.01.068.

Sofiev, M., Ermakova, T., and Vankevich, R. (2012) Evaluation of the smoke injection height from wild-land fires using remote sensing data, *Atmos. Chem. Phys.*, **12**, 1995–2006, doi:10.5194/acp-12-1995-2012, www.atmos-chem-phys.net/12/1995/2012/

RELEVANT PROJECTS (UP TO 5)

EXHAUSTION (2019-2023) Exposure to heat and air pollution in EUrope – cardiopulmonary impacts and benefits of mitigation and adaptation. H2020, Task leader

ServForFires (2018-2021) Integrated services and approaches for Assessing effects of climate change and extreme events for fire and post fire risk prevention, ERA4CS

GLORIA (2017-2020) Global health risks related to atmospheric composition and weather. Finnish Academy, WP leader

CAMS-50 (2015-2020) Copernicus Atmospheric Monitoring Service, regional AQ forecasting ensemble, task leader

NeGI NCOE (2014-2017). Ensemble-based methods for environmental monitoring and prediction. WP leader

INFRASTRUCTURE

FMI operates its own supercomputer that currently includes two identical CRAY systems with ~5000 CPU each. The computers are equipped with high-performance 1PB lustre system, ~0.7 PB of disk

storage and practically unlimited tape archive. The expansion of the system planned in the second half of 2019 will establish connection to the Centre of Scientific Computing of Finland, which will roughly double the computational capacity with own resources and also provides direct access to even larger facilities of CSC.

EXPLANATION ON OPERATIONAL CAPACITY (IF APPLICABLE)

FMI is the operational state-owned meteorological service, which operates on 24/7 basis and has all necessary capabilities for that.

4.1.5 BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (BSC)

DESCRIPTION OF THE LEGAL ENTITY

The Barcelona Supercomputing Centre (BSC) is the Spanish national supercomputing facility and a hosting member of the PRACE distributed supercomputing infrastructure. The Center houses MareNostrum, one of the most powerful supercomputers in Europe, and is one of the first eight Spanish 'Severo Ochoa Centre of Excellence" awarded by the Spanish Government. The mission of BSC is to research, develop and manage information technologies in order to facilitate scientific progress. BSC combines HPC service provision, and R&D into both computer and computational science (life, earth and engineering sciences) under one roof.

The BSC Earth Sciences Department (ES-BSC) is structured around four groups (Climate Prediction, Atmospheric Composition, Computational Earth Sciences, and Earth System Services), with more than 90 employees, including technical and support staff. The department focuses on multiscale (global to urban) air quality and meteorological modelling, global and regional mineral dust modelling as well as global and regional climate modelling. The department has a wide experience in running operational atmospheric forecasting systems and delivering timely and quality forecasts, observations, information and knowledge to users.

The ES-BSC currently hosts the CALIOPE air quality forecast system (http://www.bsc.es/caliope), the Barcelona Dust Forecast Center (http://dust.aemet.es/) and the WMO Regional Center Northern Africa-Middle East-Europe for the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) (http://sds-was.aemet.es/), and has developed the AIRE air quality forecast system for Mexico City in close collaboration with the Mexico City's Secretariat of the Environment (http://www.aire.cdmx.gob.mx/pronostico-aire/pronostico-calidad-aire.php). The department also facilitates knowledge and technology transfer of state-of-the-art research and develops services for renewable energy, urban development, infrastructure, transport, insurance, health and agriculture. Another major activity in the ES-BSC is the development of the online multi-scale NMMB-MONARCH Chemical Transport Model, which has participated in the AQMEII-Phase2 intercomparison exercise and provides routine products of global aerosols to the ICAP multi-model

AQ-WATCH

ensemble. The ES-BSC also works in the development and improvement of the High-Elective Resolution Modelling Emission System (HERMES), an open source, parallel and stand-alone multiscale atmospheric emission model that processes and estimates gas and aerosol emissions for use in chemistry transport models.

MAIN TASKS IN AQ-WATCH

BSC contribution to the AQ-WATCH project will be to develop tailored wind-blown dust services targeting the focus regions (WP3, task 3.3). The centre hosts the Barcelona Dust Forecast Center (http://dust.aemet.es/) and the WMO Regional Center Northen Africa-Middle East-Europe for the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) (http://sds-was.aemet.es/), and has a wide experience in providing dust-related multi-model ensemble products and developing warning advisory systems for airborne dust. BSC will also contribute to prepare model ready emissions for air quality modelling (WP3 and WP4,task 3.1 and task 4.1). For this, the in-house High-Elective Resolution Modelling Emission System (HERMES) will be used. HERMES is an open source, parallel and stand-alone multiscale atmospheric emission model that processes and estimates gas and aerosol emissions for use in chemistry transport models (https://earth.bsc.es/gitlab/es/hermesv3_gr/). Finally, the BSC will also participate in WP2 (task 2.5) by studying the relationships between satellite columns and surface concentrations with machine learning techniques.

KEY PERSONS

Carlos Pérez García-Pando (male) will participant in WP3. His research focuses on understanding the physical and chemical processes controlling atmospheric aerosols and trace gases, and on evaluating their effects upon climate, ocean biogeochemistry, air quality and health. His core area of expertise is mineral dust. He is also a model developer with a large experience in supercomputers and operational forecasting. After obtaining his PhD in 2006, he created the mineral dust research line at the Barcelona Supercomputing Center (2006-2009) where 1) he played a central role on the creation and implementation of the World Meteorological Organization Regional Centers on Sand and Dust Storm Prediction in Spain, and 2) he conceived and initiated the developments of MONARCH, the unified prediction model for weather, atmospheric aerosols and chemistry currently developed by the Atmospheric Composition Group. In 2009, he moved to the US where he worked as Visiting Scientist at the NOAA/National Centers for Environmental Prediction (2009), Earth Institute Fellow at the International Research Institute for Climate and Society, Columbia University (2009-2011) and the NASA Goddard Institute for Space Studies and Columbia University (NASA GISS; 2009-2011), and Associate Research Scientist at NASA GISS (2012-2016). In October 2015, he was awarded with an Chair of 15 years duration funded by the AXA Research Fund to develop his cross-disciplinary dust research program at BSC. In 2016 he was also awarded with Spanish the Ramon y Cajal fellowship, being ranked #1 by the Earth Sciences panel. In 2016, he re-joined BSC as Head of the Atmospheric Composition Group and AXA professor on Sand and Dust Storms, where he coordinate the work of ~20 people including senior researchers, postdocs, PhD students and technical support staff. In 2017, he was awarded with an ERC Consolidator Grant entitled FRAGMENT, which has started in October

2018. He was also awarded with the Agustín de Betancourt y Molina prize for young researchers by the Spanish Royal Academy of Engineering.

Oriol Jorba (male), participant in WP3, is a Co-Group leader of the Atmospheric Composition group of the ES-BSC holds a PhD degree on Environmental Engineering. His research expertise includes high resolution mesoscale meteorology and air quality, development of online meteorology-chemistry models, boundary layer, atmospheric chemistry studies and environmental impact assessment. He has lead the research project on the development of the multiscale chemical weather forecasting system NMMB-MONARCH (CGL2008-02818, CGL2013-46736) at BSC which is the official model used by the Barcelona Dust Forecast Center (BDFC), the World Meteorological Organization (WMO) Regional Meteorological Center specializing in Atmospheric Sand and Dust. He has participated in projects funded by the European Commission on air quality, specifically in aerosols, (APPRAISAL, EARLINET, FIELD-AC, ACTRIS1, ACTRIS2) and in the application of atmospheric modeling in HPC (IS-ENES, IS-ENES2, RETHINK big). He has been a Spanish representative member of the management committee of COST Actions ES1002 and ES1004, and is part of the International Technical Meeting on Air Pollution Modelling and its Application (ITM) scientific committee since 2012. He is an active member of the International Cooperative for Aerosol Prediction (ICAP).

Herve Petetin (male) will participant in WP2. Petetin olds an engineering diploma from the Ecole Centrale de Lille (ECL, France, 2008), a M.Sc. in Mechanics and fluid dynamics from the University of Science and Technology Lille 1 (USTL, France, 2009), a M.Sc. in Atmospheric physics and chemistry from the University of Paris Est Creteil (UPEC, France, 2010) and a Ph.D. in Atmospheric physics and chemistry from the University of Paris Diderot (UPD, France, 2014). His doctoral thesis, entitled "Fine aerosol in a European megacity – Simulation of the sources", was conducted at the Laboratoire Inter-universitaire des Systemes Atmospheriques (LISA, France) and AIRPARIF, the local agency in charge of monitoring and forecasting the air quality in the Paris region. Utilizing both detailed in-situ measurements of aerosol chemical speciation from several research campaigns (PARTICULES, MEGAPOLI, FRANCIPOL) and the CHIMERE regional chemistry-transport model, he investigated several features of fine aerosol (PM2.5) pollution the Paris region, including source apportionment, evaluation of emission inventories and formation regime of secondary inorganic aerosols. Over the period 2014-2018, he worked as a postdoctoral researcher at Laboratoire d'Aerologie (LA, France) in the French branch of the IAGOS European Research Infrastructure which operates worldwide meaurements of ozone and carbon monoxide on-board in-service aircraft since 1994. Based on this unique dataset of about 100,000 vertical profiles, he investigated the climotogical vertical distribution and trends of these two important gaseous pollutants, through both the entire troposphere and the planetary boundary layer. Using the FLEXPART particle dispersion model coupled to global carbon monoxide emission inventories, he also get expertise on the long-range transport of anthropogenic and biomass burning plumes. As part of the scientific team of IAGOS, he was involved in the TOAR (Tropospheric Ozone Assessment Report, 2015-2018) international panel of experts on tropospheric ozone (IGAC initiative) that recently assessed the state-of-the-art knowledge on this pollutant. Over the

last years, he developed a new expertise on machine learning through several well-recognised Massive Open Online Courses (MOOCS), including “Machine learning” (Coursera, Stanford) and “Statistical learning” (Lagunita, Stanford). In 2018, he obtained a postdoctoral funding at the BSC from the STARS program (Marie-Sklodowska-Curie Action COFUND program) for working on the improvement of the air quality forecasts with machine learning techniques.

Marc Guevara (male) will participate in WP3 and WP4. Guevara holds B.S. in Industrial Engineering (Technical University of Catalonia, Spain, October 2010) and PhD in Environmental Engineering (Technical University of Catalonia, Spain, December 2014). He is a postdoc researcher with 8 years’ experience in the areas of emission and air quality modelling. He currently coordinates the ES-BSC Emission Working Group. His main expertise includes high resolution emission modelling (development, evaluation and improvement), air quality modelling, geographic information systems and environmental impact assessment. He coordinates the development of the in-house HERMES emission model, an open source, parallel and stand-alone multiscale atmospheric emission model that processes and estimates gas and aerosol emissions for use in chemistry transport models. He is co-chair of the Emissions Working Group of the FAIRMODE community. He coordinates the development and implementation of an air quality forecast system for the Mexico City's Environment Secretary. He coordinates the Service Evolution work package of the Copernicus CAMS_81 – Global and Regional emissions service. He has participated in the Spanish air quality-related CALIOPE-And project and the FP7 Framework programme APPRAISAL, as well as in several national technology transfer projects related with air quality impact assessment. He has coauthored 14 papers in international scientific journals, 1 book-chapter and several communications to International conferences.

RELEVANT PUBLICATIONS (UP TO 5)

Badia, A., O. Jorba, A. Voulgarakis, D. Dabdub, C. Pérez García-Pando, A. Hilboll, M. Gonçalves and Z. Janjic (2017). Description and evaluation of the Multiscale Online Nonhydrostatic AtmospheRe CHemistry model (NMMB-MONARCH) version 1.0: gas-phase chemistry at global scale. Geoscientific Model Development, 10, 609-638, doi:10.5194/gmd-10-609-2017.

Benedetti, A., J. S. Reid, P. Knippertz, J.H. Marsham, F. Di Giuseppe, S. Rémy, S. Basart, O. Boucher, I.M. Brooks, L. Menut, L. Mona, P. Laj, G. Pappalardo, A. Wiedensohler, A. Baklanov, M. Brooks, P.R. Colarco, E. Cuevas, A. da Silva, J. Escribano, J. Flemming, N. Huneeus, O. Jorba, S. Kazadzis, S. Kinne, T. Popp, P.K. Quinn, T. T. Sekiyama, T. Tanaka and E. Terradellas (2018). Status and future of numerical atmospheric aerosol prediction with a focus on data requirements. Atmospheric Chemistry and Physics, 18, 10615-10643, doi:10.5194/acp-18-10615-2018.

Di Tomaso, E., N.A.J. Schutgens, O. Jorba, and C. Pérez García-Pando (2017). Assimilation of MODIS Dark Target and Deep Blue observations in the dust aerosol component of NMMB-MONARCH version 1.0. Geoscientific Model Development, 10, 1107-1129, doi:10.5194/gmd-10-1107-2017.

Guevara, M., Tena, C., Porquet, M., Jorba, O., and Pérez García-Pando, C.: HERMESv3, a stand-alone multiscale atmospheric emission modelling framework – Part 1: global and regional module, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-324, in review, 2019.

Pérez, C., K. Haustein, Z. Janjic, O. Jorba, N. Huneeus, J.M. Baldasano, T. Black, S. Basart, S. Nickovic, R.L. Miller, J. Perlwitz, M. Schulz M. and Thomson (2011). Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model – Part 1: Model description, annual simulations and evaluation. Atmospheric Chemistry and Physics, 11, 13001-13027, doi:10.5194/acpd-11-13001-2011

Complete list of publications of the ES-BSC: https://earth.bsc.es/wiki/doku.php?id=publications:publications

RELEVANT PROJECTS (UP TO 5)

WMO SDS-WAS center (agreement with the State Meteorological Agency): WMO sand and dust storm warning advisory and assessment system (SDS-WAS) regional center. The SDS-WAS mission is to enhance the ability of countries to deliver timely and quality sand and dust storm forecasts, observations, information and knowledge to users through an international partnership of research and operational communities. The Centre's web portal became a place where visitors could find the latest dust-related observations and the most up-to-date experimental dust forecasts: http://sds-was.aemet.es.

FRAGMENT (ERC-2017-COG-773051): FRontiers in dust minerAloGical coMposition and its Effects upoN climate. The goal of the project is to understand and constrain the global mineralogical composition of dust along with its effects upon climate.

SOLWATT (H2020-LCE-2017-792103): Solving Water Issues for CSP Plants. The overall purpose of the project is to upscale, implement and demonstrate cost-effective technologies and strategies that bring about a significant reduction of water of CSP plants while ensuring excellent performance of electrical power production.

K-Dust (private contract with the Kuwait Institute for Scientific Research): Kuwait Dust Forecasting System. The goal of the project is to implement a state-of-the-art dust forecasting system for Kuwait at the Kuwait Institute for Scientific Research (KISR). At the end of the project, KISR will have the capacity to operate the BSC dust forecasting system and to provide routine and accurate dust forecasts over Kuwait.

DustClim (H2020-SC5-2014-2015-690462): Dust Storms Assessment for the development of user-oriented Climate Services in Northern Africa, Middle East and Europe. The main objective of DustClim will be to develop dust-related services tailored to specific socio-economic sectors (air quality, aviation and solar energy) from an advanced dust regional model reanalysis for Northern Africa, Middle East and Europe.

INFRASTRUCTURE

The BSC hosts the MareNostrum 4, a supercomputer based on Intel Xeon Platinum processors at 2.1 GHz from the Skylake generation. It is a Lenovo system composed of SD530 Compute Racks, an Intel Omni-Path high performance network interconnect and running SuSE Linux Enterprise Server as

operating system. It consists of 48 racks housing 3456 nodes, each one equipped with 48 cores and 96Gb of memory (2Gb per core) (www.bsc.es/marenostrum/marenostrum).

4.1.6 INERIS DEVELOPPEMENT SAS (INEDEV)

DESCRIPTION OF THE LEGAL ENTITY

INERIS DEVELOPPEMENT is a simplified joint stock company whose founder and sole shareholder is the National Institute for Industrial Environment and Risks (INERIS). The company was founded in late May 2013. The head office is based in Verneuil-en-Halatte (FRANCE), on the site of INERIS, which allows to include the expertise of the Institute in the majority of projects carried out by INERIS DEVELOPPEMENT.

Through its subsidiaries and networking activities, INERIS DEVELOPPEMENT can mobilize a network of experts from industry, research centers and universities in France and abroad. This network is useful to achieve the mission of INERIS DEVELOPPEMENT and provides services based on specific knowledge and experiences acquired in different world regions.

In addition to Europe, INERIS DEVELOPPEMENT performs projects in China, Africa and Canada. The interactions in particular with the authorities and institutions in charge of environmental protection and industrial safety in these regions of the world give a unique capacity for business development.

MAIN TASKS IN AQ-WATCH

INEDEV will lead the WP7 for dissemination and communication activities, market establishment and the development of business models. INEDEV will also co-lead the management work package WP0, INEDEV will support the coordination activities with focus on communication, dissemination, and exploitation of the project results and maintain a sustainable impact of the project.

KEY PERSONS

Olivier SALVI, (male) – lead of WP7 – graduated in 1994 as Engineer in Environment and Industrial Risk (Ecole des Mines d'Alès). Working at INERIS, the French National Institute in charge of Industrial risk and environment protection between 1995 and 2013, he was in charge of research programmes in the field of Risk Assessment and Management (1995-2001), and research programme portfolio in the Accidental Risks Division (about 5 M€ / year) (2001-2007). He is now the CEO of INERIS DEVELOPPEMENT, the company in charge of the international development of INERIS activities. Salvi was co-founder and acting General Manager of the European Virtual Institute for Integrated Risk Management (EU-VRi) until 31/07/2017. He is very experienced in supervising research projects under FP5, FP6, FP7 and Horizon 2020. He personally initiated and co-ordinated several European projects in the field of industrial safety and risk management, with application in various sectors such as industrial safety, nanotechnologies, renewable energies and policy making.

Since its creation in 2005, Salvi is the Secretary General of the European Technology Platform on Industrial Safety (ETPIS, www.industrialsafety-tp.org).

RELEVANT PUBLICATIONS (UP TO 5)

Jovanovic, O. Renn, O. Salvi, Eds. (2011). 3rd iNTeg-Risk Conference: New Technologies & Emerging Risks / Risk vs. Risk: Managing Risk-Benefits Tradeoffs in Complex Systems, Stuttgart (Germany). Steinbeis Edition 2010, ISBN: 978-3-938062-91-3

Merad M., Rodrigues N., Salvi O., Urbanization control around industrial SEVESO sites: the French context. International Journal of Risk Assessment and Management, 2008, vol. 8, n° 1-2, pp. 158-167

Co-editor of the Special Issue of Journal of Hazardous Materials: Outcomes of the ARAMIS project (Accidental Risk Assessment Methodology for IndustrieS in the framework of SEVESO II directive), New stakes and opportunities in the control of major accident hazards. Vol. 130, including the several papers, in particular:

Salvi O., Debray B., 2006, A global view on ARAMIS, a risk assessment methodology for industries in the framework of the SEVESO II directive. Journal of Hazardous Materials, 2006, vol. 130, n° 3, pp. 187-199.

Salvi O., Gaston D., 2004, Risk assessment and risk decision-making process related to hazardous installation in France, Journal of Risk Research, 2004, vol. 7, n°6, pp. 599-608

Salvi O., Key Note Speech, How to improve the control of major accident hazards? 2nd International conference on risk analysis and crisis response, 19-21 October 2009, Beijing, China.

Tixier J., Dusserre G., Salvi O., Gaston D., 2002, Review of sixty-two risk analysis methodologies, Journal of Loss Prevention in the Process Industries. Vol. 15. pp 291-303.

RELEVANT PROJECTS (UP TO 5)

Olivier SALVI has been involved in the development and coordination of the following projects and initiatives:

iNTeg-Risk - Early recognition, monitoring and integrated risk management of emerging, new technology related risks (GA CP-IP 213345-2) Duration: 54 Months - Partners 63 (Large collaborative project FP7) - Budget/EC Grant: approx. 19.5/13.6 M€ - www.integrisk.eu-vri.eu

SCAFFOLD - Innovative strategies, methods and tools for occupational risk management of manufactured nanomaterials in the construction industry - Duration: 36 Months – Partners: 14 (Focus research project FP7) - Budget/EC Grant: approx. 3.7/2.5 M€ - www.scaffold.eu-vri.eu

ETPIS (European Technology Platform for Industrial Safety, www.industrialsafety-tp.org). The platform is an open forum in the field of industrial safety gathering more than 600 experts from industry, research organization, policy makers, NGOs… ETPIS helps to coordinate the investment in research by supporting the identification of research challenges and by organizing technical event such as workshops and brokerage events.

AQ-WATCH

SRA-Europe (Society for Risk Analysis Europe, www.sraeurope.org). SRA-E is a scholarship association in the field of risk analysis which is the regional group of SRA International (www.sra.org).

INFRASTRUCTURE

INEDEV will mobilize in the project a high-level network in Beijing and China to facilitate the implementation of the pilot-case in Beijing. This network includes the institutes of the Beijing Academy of Sciences and Technologies (BJAST) and the governmental institutions that will ease the access and use to the data.

4.1.7 NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK (TNO)

DESCRIPTION OF THE LEGAL ENTITY

TNO is the Netherlands Organisation for Applied Scientific Research. TNO is the largest fully independent Research, Development and Consultancy organisation in the Netherlands with a staff of about 3,000 and a total annual turnover of more than 500 million Euros. It derives a significant portion of its contract R&D from foreign private sector, governments and international organisations. TNO's primary tasks are to support and assist trade and industry including SME's, governments and others in technological innovation and in solving problems by rendering services and transferring knowledge and expertise. TNO participates in many EU programmes aiming at technological development. TNO has conducted co-operation agreements with many foreign research institutes and companies in Western, Central and Eastern Europe, USA, Canada, Japan and India.

The expertise group Climate, Air and Sustainability (CAS) is an expert center and contract research unit for industry and government in the field of sustainable development and environmentally oriented process innovation. The expertise group investigates the processing of anthropogenic pollutants in the atmosphere and their influence on the environment and climate change. TNO has multiple decades of experience in quantifying emissions from various technologies and their characteristics, constructing emission inventories using all this input, and the impacts of legislation on the emission characteristics. TNO also has decades experience in translating emissions into air pollution concentrations at local, national and European scale as well as impact assessments using various modelling tools, including local and regional scale air quality models at European level. TNO has ample experience with the use of observed air pollutant concentrations in ambient air, amongst others in comparison to modelled values.

MAIN TASKS IN AQ-WATCH

Within AQ-WATCH TNO will be responsible for the coordination of WP4 on source attribution and mitigation scenarios. TNO has la vast experience in impact assessment and scenarios. Sector specific studies for the most import emission sectors have been performed. In addition, structural transitions in the energy (efficiency, renewables, hydrogen) and agricultural sectors (land use change) have been

addressed. Since the development of their source apportionment tool in LOTOS-EUROS they have been involved in the source attribution of pollution with models and contributed to relevant working groups such as the Fairmode (Forum for air quality modelling in Europe) group on source apportionment. The key persons involved have experience with the coordination of EU projects and workpackages.

Besides the coordination of WP4, the main tasks involve the set-up of a source attribution service over Chili and Colorado and the set-up of a mitigation service over Colorado. In line with these tasks, TNO will participate in the production of air quality forecasts over Chili and Colorado with their LOTOS-EUROS model in WP3. These tasks fit well with the expertise of the TNO expertise group CAS and their experience in setting up operational air quality forecasts over Europe (CAMS-50) and China (EU-Marcopolo).

KEY PERSONS

Martijn Schaap (male) – Lead of WP4 – is a senior researcher on air quality at TNO and part time Professor in atmospheric chemistry at the Free University of Berlin. He has nearly 20 years of experience on chemistry transport modelling. He coordinates the development of the LOTOS-EUROS air quality model. His research focuses on particulate matter and the nitrogen cycle. In the last years he has performed and coordinated projects on source apportionment and the assimilation of observations into the air quality model. He has coordinated the EU FP7 project EnerGEO and contributed to numerous other EU projects such as AIR4EU, MACC, CAMS, PASODOBLE, MEGAPOLI, MarcoPolo. He is part of the Fairmode user group on source apportionment. Finally, he has coordinated the development of the TOPAS (TNO Operation Pollution Allocation Service, topas.tno.nl) system which provides source contributions for both sectors and countries.

Renske Timmermans (female) has been working in the field of atmospheric measurements, dynamics and chemistry for 20 years. Currently as scientist and project leader on regional air quality modelling at TNO. She has participated in both national and international projects with a focus on air quality forecasts and data assimilation of both ground based and satellite observations. As a project leader Renske has coordinated several national and international TNO projects on air quality modelling over Europe and she has been work package leader in the EU project PASODOBLE. She is coordinating the tasks from TNO in the regional ensemble air quality forecast service within Copernicus (CAMS-50) and was coordinating the source attribution study in the EU project Marcopolo. As a team coordinator she is responsible for the organisation of work within the Climate, Air quality and Earth Observation team at TNO.

Richard Kranenburg (male) has been working 10 years in air quality modelling at regional and local scales. He contributes to the development of the LOTOS-EUROS model and has largely developed the technical core of the source apportionment service TOPAS (TNO Operation Pollution Allocation Service) which provides source contributions for both sectors and countries over Europe. Richard was also responsible for the set-up of several operational services, such as the air quality forecasts over China in the EU project Marcopolo and the dust service within SDS-WAS.

AQ-WATCH

RELEVANT PUBLICATIONS AND PRODUCT, SERVICES (UP TO 5)

Timmermans, R. Kranenburg, A. Manders, C. Hendriks, A. Segers, E. Dammers, Q. Zhang, L. Wang, Z. Liu, L. Zeng, H. Denier van der Gon and M. Schaap (2017). Source apportionment of PM2.5 across China using LOTOS-EUROS, Atmospheric Environment, 10.1016/j.atmosenv.2017.06.003

Hendriks, C.; Kuenen, J.; Kranenburg, R.; Scholz, Y.; Schaap, M., (2015). A shift in emission time profiles of fossil fuel combustion due to energy transitions impacts source receptor matrices for air quality, Environmental Science: Processes & Impacts, DOI: 10.1039/C4EM00444B

Kranenburg, R., Segers, A. J., Hendriks, C., and Schaap, M., (2013). Source apportionment using LOTOS-EUROS: module description and evaluation, Geosci. Model Dev., 6, 721-733, doi:10.5194/gmd-6-721-2013.

Schaap, M., Dammers, E. (2018). Assessing the ammonia emission distribution across Germany using remote sensing observations. Atmospheric Environ. submitted.

TOPAS, TNO Operational Pollution Apportionment Service, http://topas.tno.nl

RELEVANT PROJECTS (UP TO 5)

MARCOPOLO (EU-FP7): The EU Marcopolo projects was aimed at providing up-to-date air quality information for China. This has been achieved by setting-up an operational air quality forecast service and the development of a new satellite based emission inventory for China. TNO was responsible for the source attribution of main sources responsible for the air pollution over China. TNO also contributed to the provision of air quality forecasts through the set-up of operational LOTOS-EUROS air quality forecasts for China.

CAMS-71 (Copernicus): This project within the Copernicus Atmospheric Monitoring Service programme is aimed at the development of products for policy support. As part of this service TNO performs source attribution analyses for pollution events over Europe. The analyses are based on the LOTOS-EUROS model with its tagging source apportionment tool.

CAMS-95 (Copernicus): This project within the Copernicus Atmospheric Monitoring Service programme is a use case project aimed to provide a dedicated source attribution service for PM in German cities based on existing copernicus services. TNO is the coordinator of the project and contributes to the set-up of the attribution service for a selection of cities in Germany.

CAMS-50 (Copernicus): Within this Copernicus Atmospheric Monitoring Service project, operational regional air quality forecasts and analyses are produced for Europe. TNO in cooperation with KNMI participates with the LOTOS-EUROS model to the ensemble of regional models. TNO is mostly involved in the developments of the model and together with KNMI is responsible for the operational forecasts and analyses.

PASODOBLE (EU-FP7): Within PASODOBLE a portfolio of innovative services on air quality was developed in coordination with local actors in more than 30 regions and cities throughout Europe. TNO was workpackage leader of the WP providing operational air quality forecasts for 5 regions over Europe. TNO also contributed with forecasts over central Europe at 7x 7 km resolution, the identification of

sources responsible for exceedances and integration of ground based and satellite observations with model values for improved aerosol forecasts and analysis.

INFRASTRUCTURE

TNO has access to a high performance cluster (HPC) on which all model calculations are performed.

4.1.8 OctoGEO s.r.o. / MapTiler.com (OctoGEO)

DESCRIPTION OF THE LEGAL ENTITY

OctoGEO s.r.o. (https://octogeo.com/) is a technology start-up (SME) from the Czech Republic specialized in processing and visualizations of global Earth Observation data. The growing team works on processing of petabytes of data covering entire planet using a computer cluster and has developed unique technologies in this area.

Our MapTiler.com product is an alternative to Google Maps targeting businesses. It offers satellite and street maps made from open data that can be easily adapted for the user's own purposes, do not contain advertisements, respect the privacy of end-users and function in closed corporate environments and even offline.

In two years we have gained customers such as **NASA, Siemens, SBB, Bosch, Amazon, Oracle,** etc. Millions of people see and use our maps every month now.

Our team has been awarded with two "**Space Oscars**" (Copernicus Masters awards).

The European Space Agency has invited us talk at the EO innovation conference called **PhiWeek** (see the talk online).

We have formed partnership with Airbus DS - and are now incubated in **ESA BIC Prague / Brno**, after becoming startup of the month in the Copernicus Accelerator programme.

MAIN TASKS IN AQ-WATCH

The company is going to work on interactive web based visualizations of the data on top of maps.

We will improve our tools usable for processing EO data from satellites and in-situ measurements for turning the geodata into formats optimized for fast displaying in web and mobile applications - using an animation for showing the temporal part of air pollution and weather development over defined time period.

Our vector tile basemaps and global satellite layers will help to attractively display the data in geographical context - in the language of the visitors (58 languages including Chinese).

KEY PERSONS

Petr Pridal (male) – is an entrepreneur, programmer and consultant. He gained his Ph.D. in the field of cartography and geodesy and holds a master degree in computer science. After solely developing a software downloaded by 8 million people, he worked on Google SoC, and on contracts for major

enterprise companies all over the world. He gave an invited talk at the Stanford University and has over a decade of experience in processing geospatial data and running a successful business.

RELEVANT PUBLICATIONS AND PRODUCT, SERVICES (UP TO 5)

MapTiler https://www.maptiler.com/ - Cloud, Cluster, Desktop, Engine

MapTiler Maps https://www.maptiler.com/maps/

INFRASTRUCTURE

Our team maintain and operates a high-available map hosting infrastructure with two core data centers and over 140 caching servers on five continents. The infrastructure servers over 30 million unique visitors and more than 3 billion requests a month. We utilize powerful cloud infrastructure for cluster processing - available to us thanks to partnership with Google.

We also use DIAS Mundi via ESA BIC incubation.

4.1.9 UNIVERSIDAD DE CHILE (UChile)

DESCRIPTION OF THE LEGAL ENTITY

The University of Chile (UCL) is the oldest higher education institution in Chile. Generating, developing, integrating and communicating knowledge in all the areas of knowledge and culture is the mission and basis of the activities of the University. In terms of its scientific and academic contributions, the University of Chile alone is responsible for a third of all scientific publications, making it the leading Chilean institution in terms of scientific publications, and eighth in Latin America (Ranking Scimago 2018). It is placed among the 400 best higher educational establishments in the World Ranking of Universities (University Shanghai Jiao Tong, 2018).

Among the many research centers hosted by the UCL is the Center for Climate and Resilience Research (www.cr2.cl). The CR2 focuses on improving our understanding of the Climate System and at finding ways to strengthen the resilience of our society. To achieve the center articulates its research on five broad areas: Governance, Land Use Change, Water and Extremes, Coastal Zones, and Resilient Cities. In addition to these broad areas of research two integrative questions are adressed, namely Changing Fire Regimes and Atmospheric Pollution. Natural scientists convened at CR2 address interactions in the regional climate system in a quantitative manner, by means of paleorecords, in situ and remote measurements, and model simulations. Social scientists at (CR)2 use comparative studies and multi-criteria evaluations to examine attainable adaptation, mitigation, and practices to confront the expected climate changes. Scientists at CR2 conduct their research oriented towards addressing with an integrated approach pressing issues for Chile.

MAIN TASKS IN AQ-WATCH

The main tasks conducted by the group from the University of Chile (UChile) at the Centre for Climate and Resilience Research (CR2) will be: a) prepare and make available ground observations on air quality and local emission inventory in Chile, b) apply the modeling system WRF-Chimere to forecast the air quality and dust concentrations in Chile, c) estimate the health impact of air pollution contributing to the AQ health indices (AQHI) and AQ life indices (AQLI) and d) work closely together with the prime user (Unconventional Renewable Energies Trade Association, ACERA) to define potential products of interest for the solar power plant industry.

The CR2 has access to multiple platforms of regular measurements such as weather and air quality stations through its close collaboration with the Chilean Weather Service and the Chilean Ministry of Environment. Furthermore, CR2 has already experience in making large weather related databases available for the scientific community as well as the general public through web platforms (PONER LINK EXPLORADOR CLIMATICO). This work will be part of WP2 (Air quality atlas: Exploitation and Visualization of Satellite and In-situ Data). The group at CR2 has already implemented the modeling system WRF-CHIMERE to simulate the dispersion of urban pollutants for central Chile. A preliminary emission inventory was developed for this purpose and within the framework of this project an improved emission inventory will be developed, not only for central Chile but for the entire country in particular for regions of interest for the solar power industry. This will allow to apply the modeling system to the different needs established in the project. This work will be part of WP3. At present, CR2 is conducting research to estimate the health impact of fine particular matter. The results of this work will contribute to health related products of WP6. Finally, as part of its involvement in WP6, CR2 will actively participate in the identification of the needs and the products of interest for the Chilean Prime User.

KEY PERSONS

Laura Gallardo (female) – associate professor at the Department of Geophysics of the Faculty of Physical and Mathematical Sciences of the University of Chile and director of the Climate and Resilience Science Centre CR2. She obtained a PhD in Chemical Meteorology from the University of Stockholm in 1996.

Her lines of research are atmospheric modelling and data assimilation, air quality in mega cities and short-lived climate pollutants. At the University of Chile he teaches courses on atmospheric chemistry, global change modelling, inverse modeling and atmospheric sciences. She is part of the H2020 MSCA RISE project PAPILA (2018-2021) with focus on air quality in Latin America and the Caribbean by combining the state-of-the-art models, high-resolution emission inventories, space observations and surface measurements to provide real time forecasts and analysis of regional air pollution in the relevant regions.

Nicolas Huneeus (male) – assistant professor at the Department of Geophysics of the Faculty of Physical and Mathematical Sciences of the University of Chile and associate researcher of the Climate

and Resilience Science Centre (CR2). He obtained a PhD in Atmospheric Physics from the University of Lille in 2007.

His research focuses on modelling of the dispersion in the atmosphere of anthropogenic as well as natural pollutants in particular regarding urban air quality and regional transport. He is member of the Scientific Steering committee of the Global Emissions InitiAtive (GEIA) and of the Regional Steering Group (RSG) of the Pan American node of the World Meteorological Organization Sand and Dust Storm Warning Advisory and Assessment System (WMO SDS-WAS). Dr. Huneeus also participates in the H2020 MSCA RISE project PAPILA (2018-2021) with focus on air quality in Latin America and the Caribbean by combining the state-of-the-art models, high-resolution emission inventories, space observations and surface measurements to provide real time forecasts and analysis of regional air pollution in the relevant regions.

RELEVANT PUBLICATIONS (UP TO 5)

Mazzeo, A., Huneeus, N., Ordoñez, C., Orfanoz-Cheuquelaf, A., Menut, L., Mailler, S., Valari, M., Denier van der Gon, H., Gallardo, L., Muñoz, R., Donoso, R., Galleguillos, M., Osses, M., and S. Tolvett (2018): Impact of residential combustion and transport emissions on air pollution in Santiago during winter. Atmospheric Environment, 190, 195–208. http://doi.org/https://doi.org/10.1016/j.atmosenv.2018.06.043.

Gallardo L, Barraza F, Ceballos A, Galleguillos M, Huneeus N, Lambert F, et al. (2018): Evolution of air quality in Santiago: The role of mobility and lessons from the science-policy interface. Elem Sci Anth. ; 6(1):38. DOI: http://doi.org/10.1525/elementa.293

Benedetti, A., Reid, J. S., Knippertz, P., Marsham, J. H., Di Giuseppe, F., Rémy, S., Basart, S., Boucher, O., Brooks, I. M., Menut, L., Mona, L., Laj, P., Pappalardo, G., Wiedensohler, A., Baklanov, A., Brooks, M., Colarco, P. R., Cuevas, E., da Silva, A., Escribano, J., Flemming, J., Huneeus, N., Jorba, O., Kazadzis, S., Kinne, S., Popp, T., Quinn, P. K., Sekiyama, T. T., Tanaka, T., and E. Terradellas (2018): Status and future of numerical atmospheric aerosol prediction with a focus on data requirements, Atmos. Chem. Phys., 18, 10615-10643, https://doi.org/10.5194/acp-18-10615-2018.

Huneeus, N., Basart, S., Fiedler, S., Morcrette, J.-J., Benedetti, A., Mulcahy, J., Terradellas, E., Pérez García-Pando, C., Pejanovic, G., Nickovic, S., Arsenovic, P., Schulz, M., Cuevas, E., Baldasano, J. M., Pey, J., Remy, S. and B. Cvetkovic (2011) Forecasting the North African dust outbreak towards Europe in April 2011: a model intercomparison, Atmos. Chem. Phys., 16, 4967-4986, doi:10.5194/acp-16-4967-2016.

Andrade, M., N. Rojas, M. Melamed, O. Mayol-Bracero, M. Grutter, L. Dawidowski, J. Antuña-Marrero, C. Rudamas, L. Gallardo, R. Mamani-Paco, M. Andrade, and N. Huneeus (2016): Fostering a collaborative atmospheric chemistry research community in the Latin America and Caribbean Region. Bull. Amer. Meteor. Soc. doi:10.1175/BAMS-D-14-00267.1, 97:10, 1929-1939.

RELEVANT PROJECTS (UP TO 5)

PAPILA (EU H2020 project): Prediction of Air Pollution in Latin America. The objective of the project is to establish a sustained network of partners with complementary expertise, which will develop and implement an analysis and forecast system for air quality with downscaling capability for Latin America and the Caribbean region, and assess the impact of air pollution (background and peaks) on health and on the economy

CR2-Atmospheric Pollution (FONDAP 11000915): Centre for Climate and Resilience Research – Atmospheric Pollution. The goal of this project is to analyze the relationship between atmospheric pollution and climate change in Chile, and the governance processes related to this.

FONDECYT (1181139): Transport of mineral dust in northern Chile and its deposition on the Andean Cryosphere. The goal of this study is to examine the transport of dust from the Atacama Desert in northern Chile to the glaciers and snow covered areas of the subtropical Andean mountains and estimate the deposition flux in these regions. Additionally, this work will also address the transport of dust emissions in a future warmer and dryer climate scenario with a southward aridity extension to Central Chile.

Project with the Ministry of Environment: Mitigation of Black Carbon in the update of the national determined contribution. The goal of this project is the design and implementation of a methodological approach to determine a goal of quantified reduction of black carbon, which can be integrated with the goals of short-lived climate pollutants under Chile's determined national contribution to the Paris Agreement.

INFRASTRUCTURE

- Easy access to TFlops of supercomputing capacity and TBytes of massive storage to execute the complex simulations at the National Laboratory of High Performance Computing (NLHPC);
- CR2 maintains a close cooperation with the Chilean weather Service DMC (Direccion Meteorológica de Chile) and the Chilean Ministry of Environment ensuring access to multiple platforms of regular measurements such as weather stations and air quality stations.
- Multiple instruments to characterize the atmospheric dynamics and composition both remotely and in-situ such as standard weather stations, SODAR, photometers, ethalometers, etc.

4.1.10 UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH NONPROFIT CORPORATION (UCAR)

DESCRIPTION OF THE LEGAL ENTITY

UCAR is a nonprofit consortium of more than 115 North American colleges and universities focused on research and training in the Earth system sciences. UCAR members constitute a self-governing body representing nearly all the academic programs in Earth system science in North America. It provides a

clear voice for our membership, in collaboration with the broader community, to convey the value of our research, education, and partnerships to policymakers and decision makers.

UCAR manages the **National Center for Atmospheric Research (NCAR)** on behalf of the National Science Foundation (NSF). Founded in 1960 to fulfill this role, UCAR is administrator of the financial, human resources, facilities, and information technology functions that are essential to NCAR.

NCAR provides the university research and teaching community with tools such as aircraft and portable ground-based systems to observe the atmosphere and with the technology and assistance to interpret and use these observations, including supercomputer access, computer models, and user support. NCAR has seven labs that collectively cover a breadth of research topics in the Earth system sciences, from the effects of the Sun on Earth's atmosphere to the role of the ocean in weather and climate prediction. The work proposed here will largely be conducted in the Atmospheric Chemistry Observations and Modeling (ACOM) Lab and the Research Applications Lab (RAL).

MAIN TASKS IN AQ-WATCH

UCAR will be the leader of WP6 and co-ordinate the interaction with the pilot users. They will be responsible for the implementation and testing of the developed tool in Colorado and the interaction and information exchange with the Colorado Department of Public Health and Environment (CDPHE). UCAR will conduct air quality forecasts for Colorado that will feed into the tool and also provide emission inputs for WP 4.

KEY PERSONS

Gabriele Pfister (female) – Lead of WP6 – is Deputy Director of the Atmospheric Chemistry Observations and Modeling (ACOM) Laboratory, which requires strong organizational skills and also knowledge of the different research foci of the Laboratory, which range from laboratory experiments and instrument development, to field missions to global and regional chemical transport model development. Her research is strongly focused on the integration of measurements from satellite, aircraft and ground with models to investigate the links between local, regional and global atmospheric composition. She has made significant contributions to improving wildfire emission estimates and evaluating their impact on radiative forcing and air quality, to assessing the role of long-range pollution transport, and to understanding the relative contributions of natural and anthropogenic emissions and transport processes to local air quality. She is an active developer on the regional chemistry transport model WRF-Chem and PI on the NSF/State of Colorado FRAPPÉ aircraft field mission, which was a collaborative effort between air quality managers from the State of Colorado and scientists from a large number of research organizations and universities across the U.S. to study air quality in the Colorado Front Range. She is also team member other NASA field campaigns (more recent missions including SEAC4Rs, DISCOVER-AQ and KORUS-AQ and the upcoming FIREX-AQ mission). Gabriele Pfister is further part of projects that use data assimilation of satellite aerosol products and post-processing methods to, e.g. improve the U.S. National Air Quality Forecast Capability (NAQFC).

Rajesh Kumar (male) – is a Project Scientist II in the Research Applications Laboratory (RAL) of UCAR/NCAR. His research synergistically integrates ground- and satellite-based air quality monitoring with atmospheric composition and modeling capabilities to address a number of air quality issues including transport and transformation of air pollution, the relative importance of local and foreign emissions, deterministic and probabilistic air quality predictions, aerosol-climate interactions, heterogeneous atmospheric chemistry, chemistry-climate interactions, projection of future air quality, and impact of air quality for public health and food security. He has led the development a chemical data assimilation system to improve initialization of air quality models using satellite data, design a novel ensemble to quantify uncertainties in air quality forecasts, improve representation of heterogeneous chemistry and photolysis processes in WRF-Chem, and evaluating the impacts of changing emissions and climate on air quality. He is currently serving as a PI/CO-PI on several national and international projects focused on improving air quality forecasts in the U.S., and India.

RELEVANT PUBLICATIONS (UP TO 5)

Pfister, G., S. Walters, J.-F. Lamarque, J. Fast, M. Barth, J. Done, G. Holland, and C. Bruyere, (2013): Prediction of Future Summertime Ozone over the U.S., *J. Geophys. Res.*, 119, 5559–5582, *doi:*10.1002/2013JD020932.

Pfister G. G. et al (2017). Using observations and source specific model tracers to characterize pollutant transport during FRAPPÉ and DISCOVER-AQ. Journal of Geophysical Research: Atmospheres, 122. https://doi.org/10.1002/2017JD027257

Kumar, R., Barth, M. C., Madronich, S., Naja, M., Carmichael, G. R., Pfister, G. G., Knote, C., Brasseur, G. P., Ojha, N., and Sarangi, T (2014).: Effects of dust aerosols on tropospheric chemistry during a typical pre-monsoon season dust storm in northern India, *Atmos. Chem. Phys.*, 14, 6813-6834, doi:10.5194/acp-14-6813-2014, 2014.

Kumar, R., Barth, M. C., Pfister, G. G., DelleMonache, L., Lamarque, J. F., Archer-Nicholls, S., Walters, S. (2018). How will air quality change in South Asia by 2050? J. Geophys. Res, 123. https://doi.org/10.1002/2017JD027357.

Kumar, R. et al. (2019), Towards improving short-term predictions of fine particulate matter over the United States via assimilation of satellite aerosol optical depth retrievals, accepted for publication in Journal of Geophysical Research – Atmospheres.

RELEVANT PROJECTS (UP TO 5)

NSF/NCAR Front Range Photochemical Experiment (FRAPPÉ): This air quality campaign has been funded by the National Science Foundation (NSF) and the State of Colorado and took place in Colorado in 2014 jointly with the NASA DISCOVER-AQ campaign. The joint campaigns constitute one of the most comprehensive air quality campaigns in the U.S. and focused on characterizing the drivers behind summertime ozone pollution in the Colorado Front Range. The results enable more accurate predictions of air quality and ultimately the development of robust control strategies. (https://www2.acom.ucar.edu/frappe).

Development of the community Weather and Research Forecasting Model with Chemistry (WRF-Chem) model and accompanying pre-processing tools: Contributions include the addition of chemical packages, photolysis and deposition schemes, upper boundary conditions; various pre-processing tools for generating input files such as anthropogenic, wildfire and biogenic emissions; and providing a user helpdesk. (https://www2.acom.ucar.edu/wrf-chem).

Chemical Data Assimilation and Analog-Based Uncertainty Quantification to Improve Decision-Making in Public Health and Air Quality: One of the key tools used by decision makers across the U.S. to protect the public from adverse health effects caused by poor air quality is the National Oceanic and Atmospheric Administration (NOAA) operational air quality forecasting system, the National Air Quality Forecasting Capability (NAQFC). To enhance this decision-making activity, this project aims to improve the accuracy of NOAA/NCEP short-term predictions of ground-level ozone and particulate matter less than 2.5 μm in diameter ($PM_{2.5}$) and to provide reliable quantification of their uncertainty, by exploiting NASA Earth Science Data with chemical data assimilation and analog-based approaches. In this project, we have developed a new capability to assimilate Moderate Resolution Imaging Spectroradiometer (MODIS) aerosol optical depth (AOD) retrievals in the Community Multiscale Air Quality (CMAQ) model using the Community Gridpoint Statistical Interpolation (GSI) system. The chemical data assimilation is found to significantly improve PM2.5 forecasts over the U.S. In addition, an analog-ensemble has been designed that reduced the biases in surface ozone and PM2.5 forecasts by more than 85%.

Enhancing Decision-Making Activity in the area of air quality in Delhi: The Ministry of Earth Sciences (MoES) in the Government of India has taken several actions in the recent years to mitigate the risk that acute air pollution episodes pose to human health in Delhi. However, the errors in air quality predictions, lack of information on their uncertainties, and nonexistent knowledge of the relative contribution of Delhi and non-Delhi emission sources to air quality in Delhi limits the ability of decision-makers to impose temporary emission control measures in time to avert potential poor air quality episodes. To address these issues, we are working with the Indian Institute of Tropical Meteorology (IITM) on a collaborative project that has the following three objectives

Objective 1: Drastically improve initialization of aerosol and chemical species in WRF-Chem via assimilation of satellite retrievals of aerosol optical depth (AOD).

Objective 2: Drastically improve deterministic and probabilistic air quality predictions at 10 monitoring stations in Delhi.

Objective 3: Quantify the contribution of Delhi and non-Delhi emission sources to air quality in Delhi.

A preliminary air quality forecasting system has been developed at NCAR and transitioned to the IITM for operational air quality forecasting in Delhi.

INFRASTRUCTURE

UCAR has supercomputing facilities that are more than adequate to carry out the computing aspects of the proposed work: Major Equipment: Available for use is a 5.4-petaflops SGI ICE XA Cluster,

called Cheyenne, which has 145,152 2.3 GHz E5-2697 v4 cores and 313 TB of memory. Cheyenne has an integrated centralized file system and data storage system that provides 31 PB of local storage. Two data analysis and visualization systems (Geyser and Caldera) support large-scale data analysis and visualization activities. High Performance Storage System (HPSS): HPSS currently holds more than 320 PB of storage in support of CISL computing facilities and NCAR research activities. The HPSS environment is ideally suited for long term data preservation. High-speed networks: NCAR has deployed dual 100-Gbps network loops connecting its Boulder facilities, the NCAR-Wyoming Supercomputing Center (NWSC) in Cheyenne, and the University of Wyoming in Laramie. The NCAR network also provides highspeed, reliable, secure network connectivity among its five Boulder campuses, supporting over 117 logical networks, approximately 210 monitorable network devices, and over 3000 network-attached devices, plus management commitments to additional municipal and wide-area networks. Computing Centers: NCAR manages a sophisticated computing center at the NCARWyoming Supercomputing Center (NWSC) in Cheyenne, Wyoming. The NWSC houses the Yellowstone environment. NCAR provides 24x7 on-site operational support to NWSC. Other: The Atmospheric Chemistry Observations & Modeling (ACOM) at the National Center for Atmospheric Research (NCAR) provides computational support for staff and visitors ranging from desktop systems to small clusters running Linux, Mac OSX, or Microsoft Windows operating systems. Additional resources to facilitate research include several computational, graphical, and productivity software packages, printers, and highspeed network access. Other resources available to the investigator include the overall facilities and administration of UCAR/NCAR that include office space and support staff.

4.1.11 BEIJING COMPUTING CENTRE (BCC)

DESCRIPTION OF THE LEGAL ENTITY

Beijing Computing Centre (a state-owned enterprise, hereinafter referred to as **BCC** or the centre, http://www.bcc.ac.cn/en/), established in 1973, is one of the earliest professional institutions for computer application service in China. BCC is now affiliated with Beijing Academy of Science and Technology. Being China industrial cloud initiative and leader, BCC is mainly committed to high-performance computing, cloud computing, and big data service. BCC has numerous outstanding talents with public computing service for interdisciplinary fields, such as Intelligent manufacturing, biomedicine, computer vision, AI. BCC has developed big data driven risk management control tools and service platform for Beijing government. BCC has had a close cooperation with INERIS and BMILP over 3 years in the field of air quality control with high performance computing and CHIMERE models. Since 2018, BCC is hosting a forecasting system using CHIMERE and SIRANE driven by the

mesoscale meteorological model WRF. This system is operated by the Chinese private company FUTURIS ENVIRONMENT with seconded staff.

MAIN TASKS IN AQ-WATCH

BCC will be mainly involved in WP3 on air quality predictions at the regional scale in China with downscaling over the provinces encompassing Beijing and the establishment of an alert system for dust episodes, as well as in WP6 for the downscaling at the district up to the street level. BCC will be involved in the elaboration of the mitigation services based on brute force emission scenarios to create a database that will feed the prototype/toolkit developed in WP5.

KEY PERSONS

Bertrand Bessagnet (male) – is a professor and served as a chief scientist at the National Institute for Industrial Environment and Risks (INERIS), which he joined in 2001 after completing two master degrees in Chemical Engineering and a PhD in the field of atmospheric chemistry and physics in 2000. He has been the Head of the Unit "Air quality modelling and environmental mapping" (10-15 Engineers) responsible for the development and implementation of numerical tools for monitoring and managing the quality of air. He is Chief Scientist and Director of Research in charge of developing scientific activities on air quality and international partnerships. In 2015, he obtained the highest university degree (HDR) the diploma to supervise researches and PhD students.

Bertrand Bessagnet contributed at the national level to the development of the Chemistry Transport Model CHIMERE, in close collaboration with the National Centre for Scientific Research (CNRS). He was the main developer of the model. He participated in the management of the platform PREV'AIR, the official national system for air quality forecasting in France (www.prevair.org), and regularly provided expertise to the French authorities (Ministry of Ecology) for the management of pollution episodes. He coordinated a number of European and national projects, including the EURODELTA project, an intercomparison exercise of European models in the frame of the Convention of the Economic Commission for Europe of the United Nations (UNECE) on long range transport of air pollutants.

He has developed a partnership with the Beijing Academy of Science and Technology on air quality management and he is developing collaborations with other Chinese institutions. He has numerous collaborations with institutions like NCAR in the USA, Max Plank Institute in Germany, IIASA in Austria, US EPA and INERIS-like institution throughout Europe thank to his involvement in the UNECE convention. He has published more than 100 publications on atmospheric sciences focussing on air quality and Particulate Matter, with an h-index of 32. He supervises PhD and is regularly invited in PhD defence panels in Europe. He is editor of the journal "*Atmosphere*". In 2014 he has been invited to give a series of conferences in China on air quality management.

In October 2018, he becomes the CTO of the Chinese company FUTURIS ENVIRONMENT Ltd. based in Hangzhou (China). His core expertise is air quality management and modelling, pollutant emissions, climate change, meteorology and programming.

In AQ-Watch Bertrand Bessagnet will be involved in all WP where the BCC is participating, as seconded researcher for the duration of the project.

Liu Tong (Female) – PhD and full professor. She is the BCC Executive Deputy Director since 2015 and has been previously in charge of the Research Strategy at the Beijing Academy of Science and Technology (BJAST). She is specialized in Big Data algorithm and cloud platform design. She will be in charge of data processing and system development in this project.

Zuo Qi (Female) – Associated Professor with a Master degree. She is specialized in Big Data algorithm and cloud platform design, she will work on system development in this project.

Wu Lucheng (Male) – holds a Master degree and works as assistant Professor. He is specialize in information analysis algorithm and will be responsible for the system development in AQ-Watch.

Li Shuyan (Male) – Associated professor with a Master degree. He is specialized in cloud platform design and will participate in the system development of AQ-Watch.

Guo Yanyan (Female) - holds a Master degree and works as assistant Professor. She is specialize in information analysis algorithm. She will participate in the system development of AQ-Watch.

RELEVANT PUBLICATIONS (UP TO 5)

Cheng, X. Q. et al. (2014). Survey on Big Data System and Analytic Technology, Journal of Software, 25(9):1889-1908.

B. Bessagnet, et al. A statistical physics approach to perform fast highly-resolved air quality simulations – A new step towards the meta-modelling of chemistry transport models, Env. Mod. & Soft., accepted for publication, 2019.

B. Bessagnet, L. Menut, A. Colette, F. Couvidat, M. Dan, S. Mailler, L. Létinois, V. Pont, L. Rouïl, (2017). An Evaluation of the CHIMERE Chemistry Transport Model to Simulate Dust Outbreaks across the Northern Hemisphere in March 2014. Atmosphere, 8, 251, 2017. DOI: 10.3390/atmos8120251

B. Bessagnet, G. Pirovano, M. Mircea, C. Cuvelier, A. Aulinger, G. Calori, G. Ciarelli, A. Manders, R. Stern, S. Tsyro, M. G. Vivanco, P. Thunis, M. T. Pay, A. Colette, F. Couvidat, F. Meleux, L. Rouil, A. Ung, S. Aksoyoglu, J. M. Baldasano, J. Bieser, G. Briganti, A. Cappelletti, M. D'Isidoro, S. Finardi, R. Kranenburg, C. Silibello, C. Carnevale, W. Aas, J. C. Dupont, H. Fagerli, L. Gonzalez, L. Menut, A. S. H. Prevot, P. Roberts, L. White (2016), Presentation of the EURODELTA III intercomparison exercise - evaluation of the chemistry transport models' performance on criteria pollutants and joint analysis with meteorology. Atmos. Chem. Phys., 16, 12667-12701, 2016 DOI: https://doi.org/10.5194/acp-16-12667-2016

Terrenoire, E., B. Bessagnet, L. Rouil, F. Tognet, G. Pirovano, L. Letinois, M. Beauchamp, A. Colette, P. Thunis, M. Amann, L. Menut (2015). High-resolution air quality simulation over Europe with the chemistry transport model CHIMERE. Geosci Model Dev 8, 21-42, 2015 DOI: https://doi.org/10.5194/gmd-8-21-2015

RELEVANT PROJECTS (UP TO 5)

BJSRC project funded by Beijing Academy of Science and Technology (BJAST): Development and application of safety big data and cloud service platform for Beijing government. BJSRC has been implemented in 16 districts of Beijing since Sep. 2017, and provides public services such as risk assessment, risk management, emergency ability assessment, and emergency plan management. http://124.127.245.19:9000/gov. [This new project will benefit from the platform design and information service model for the big data industry for public service, especially for the high-concurrency, high- availability DaaS (Data as a service) development and data ETL algorithm.]

BJFSMGD project funded by Beijing Fangshan District government: Development and application of an IOT-based service platform for 60,000 devices real-time running status monitoring and on-board diagnostic system in Fangshan district, Beijing. http://bjfsmgd.bcc.ac.cn:8081/ . [This new project will benefit from the platform design and data processing of sensors, including the sparse expression of sense data, hot and cold data management.]

INFRASTRUCTURE

BCC operates China top level super-computing systems and provides, as governmental owned company, computational and cloud-based services for the Beijing Government and for private companies. This position is key for the further exploitation of the AQ-Watch results on the Chinese market.

4.1.12 BEIJING MUNICIPAL INSTITUTE OF LABOR PROTECTION (BMILP)

DESCRIPTION OF THE LEGAL ENTITY

Beijing Municipal Institute of Labor Protection (BMILP, http://www.bmilp.com) was established in 1956. It is one of the first batch of research institutes carrying out scientific research on safety and environment in China. BMILP leads research and expertise activities requested by public authorities and industrial operators in the fields of the urban public and workplace safety and risk, labor protection, human living environment and occupational health. It contains a series of national, provincial (municipal) key laboratories, test platform, training base and technical centres, as well numbers of experts. A large part of BMILP activities is devoted to air quality management: monitoring, modelling and controlling methodologies, technologies, tools are developed to better understanding and manage indoor and outdoor air pollution. Since 2013, BMILP has had a close cooperation with INERIS, as well with BCC later, in urban and community scale air quality research and management. A coupled multi scales (global-province- urban- district) forecasting system based on CHIMERE and SIRANE has been built up and running in the BCC hosted super-computers. Some pilot studies on fine management of air quality in local community scale (e.g. Xicheng District and Niulanshan Town, Beijing) have been conducted. These works provide a unique research experiences on supporting local authorities and

enterprises on their air quality management, and good interactive relationship between consortium partners and end-users in Beijing for the pilot-studies in the AQ-WATCH project.

MAIN TASKS IN AQ-WATCH

BMILP will be responsible for the implementation and testing of the developed toolkit in China and the interaction and information exchange with the pilot users in China. They will also gather observations, emissions (the best available data) and other relevant proxy for emission improvement and deploy FUTURIS ENVIRONMENT mobilemicro-sensors in the district (background area, and traffic site) to verify the model and improve the emissions.

KEY PERSONS

Mo Dan (Female) – Ph.D and Associate Professor. Research focuses on air pollution monitoring, characterization and source apportionment. She will be coordinating AQ-Watch with the Chinese partners and the pilot user and will be responsible for the design of air quality monitoring protocol and technical programme for high-resolution air quality monitoring in local scale by using micro-sensors. In AQ-Watch Dan will be involved in all WP where the BMILP is participating.

Xiaohui Ji (Female) and **Ding Ding (Female)** – both hold Master degrees in analytical chemistry. Their work at BMILP focuses on air pollution monitoring, characterization and source apportionment. They will be in charge of utility of micro-sensors and data analysis in AQ-Watch.

Yu Wang (Female) – holds a Master degree in analytical chemistry. Also from the filed of air pollution monitoring, characterization and source apportionment she will work on calibration of micro-sensors in AQ-Watch.

Yan Dou (Female) – holds Master degree in environmental and industrial hygiene. She is specialized air pollution monitoring and modeling. She will be responsible for the local scale air quality simulation in AQ-Watch.

RELEVANT PUBLICATIONS (UP TO 5)

Baihuan Feng, Xiaoming Songa, Mo Dan, Jie Yu, QiongqiongWang, Mushui Shu b, Hongbing Xua,Tong Wang a, Jie Chena, Yi Zhanga, Qian Zhaoa, RongshanWua, Shuo Liua, Jian Zhen Yue,Tong Wang b,Wei Huang. High level of source-specific particulate matter air pollution associated with cardiac arrhythmias. Science of the Total Environment (2019) 657, 1285–1293

Yu Wang, Ding Ding, Mushui Shu, Zhiyong Wei, Tong Wang, Qi Zhang, Xiaohui Ji, Pengyao Zhou, Mo Dan*. Characteristics of indoor and outdoor fine phthalates during different seasons and haze periods in Beijing. Aerosol and Air Quality Research, 2018, available on line, doi: 10.4209/aaqr.2018.03.0114

WeiWei Chen, Daniel Q. Tong, Mo Dan, ShiChun Zhang, XueLei Zhang, YuePeng Pan. Typical atmospheric haze during crop harvest season in northeastern China: A case in the Changchun region. *Journal of Environmental Sciences*, 2017, 54, 101-113

Daniel Tong, Mo Dan*, Tong Wang, Pius Lee. Long-term dust climatology in the western United States reconstructed from routine aerosol ground monitoring. Atmos. Chem. Phys., 2012, 12, 5189–5205

Ding Ding, Mo Dan, Tong Wang. Characteristics of organic carbon and element carbon in indoor and outdoor $PM_{2.5}$ in Beijing. Chinese Environmental Science, 2017， 37（6），2377-2382 (in Chinese)

RELEVANT PROJECTS (UP TO 5)

XCAQFM & NLSAQFM projects funded by Beijing Xicheng District and Liulanshan town goverments: Investigate PM2.5 pollution, emission strength of local sources and their contributions to air pollution in the target community areas in Xicheng district and Niulanshan Town, Beijing. [This new project will benefit from the collected data (observation data of air pollutants and emission data of local sources), experience and close connections with Xicheng authorities from the XCAQFM project to applicate and evaluate the performance of the tools, platforms and methodologies developed by this new project.

INFRASTRUCTURE

BMILP has a superstation for air quality monitoring equipped with various reference online monitors for particulates (TEOM, Thermo Fisher Ltd.), gases (nitrogen oxides, sulfur dioxide, ozone, carbon monoxide), and black carbon(MAPP, Thermo Fisher Ltd.), organic carbon(OC)/elemental carbon (EC) (carbon analyzer, Sunset Ltd.), various particle samplers and micro sensors for air pollutants. It operates a testing laboratory which was the first laboratory accredited by the American Industrial Hygiene Association in China mainland and can conduct testing for indoor (including workplace, public place and homes) and outdoor air pollutants and particle species.

4.2. Third parties involved in the project

4.2.1 Beijing Computing Center (BCC)

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	No
Does the participant envisage that part of its work is performed by linked third parties	No
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	**Yes**
BCC has been hosting a forecasting system using CHIMERE and SIRANE driven by the mesoscale meteorological model WRF. The private company FUTURIS ENVIRONMENT based in Hangzhou, China operates this system. Bertrand Bessagnet is a staff member of FUTURIS ENVIRONMENT who will be seconded against payment for the duration of the project to BCC to work on the AQ-WATCH project, according to the Article 11 of the GMGA. BCC will fund the project and the seconded researcher from third party on its own and will not request EC contribution to carry out the performance committed in this proposal.	
Does the participant envisage that part of the work is performed by International Partners (Article 14a of the General Model Grant Agreement)?	No

Section 5: Ethics and Security

5.1 Ethics

All research activities under Horizon 2020 are to be carried out in compliance with fundamental ethical principles. These principles are based on the explicit European commitment to human rights, firmly enshrined in the treaties and in particular the European Charter of Fundamental Rights. AQ-Watch will not raise any highly sensitive ethical issues, or involve any potential vulnerable groups, and no personal data will be processing for research purposes. During the project lifetime, the project office will regularly monitor the potential ethics issues and ensure any of these issues will be identified and appropriately handled.

AQ-Watch confirms to rigorously apply the ethical standards and guidelines set out in Horizon 2020, the European Charter for Researchers, Code of Conduct for the Recruitment of Researchers and EC regulations personal data processing, regardless of the country in which the research will be carried out.

5.2 Security

AQ-Watch does not include any research or innovation actions raising security issues.

AQ-Watch will not generate any 'EU-classified information' as background or results.

Annex 1: Abbreviations used in this document

ACERA	Unconventional renewable energies trade association in Chile
AGU	American Geophysical Union
AMFIC	FP6 project on air quality monitoring and forecasting in China
AOD	Aerosol atmospheric depth
API	Application programming interface
BMBF	Federal Ministry of Education and Research (Germany)
C40	Cities Climate Leadership Group
CA	Consortium Agreement
CAMS	Copernicus Atmosphere Monitoring Service
CEOS	Committee on Earth Observation Satellites
COPD	Chronic obstructive pulmonary diseases
DALY	Disability adjusted life years
DESCA	Development of a Simplified Consortium Agreement
DIAS	Copernicus data and information access services
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EGU	European Geophysical Union
EMEP	European Monitoring and Evaluation Programme
EPA	United States Environmental Protection Agency
EPIC	Energy Policy Institute at the University of Chicago
EO	Earth observation
ESA	European space agency
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GA	General Assembly
GAW	Global atmospheric watch
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
ICLEI	Local Governments for Sustainability
IGAC	International atmospheric chemistry project
IISD	International Institute for Sustainable Development
IP	Intellectual Property
IPR	Intellectual Property Rights
LT	Local time
MAP-AQ	Project “monitoring analysis and prediction of air quality”
MS	Milestone
NAAQS	National Ambient Air Quality Standard

NASA	National Aeronautics and Space Administration
NetCDF	Network Common Data Form
NFRMA	Colorado Northern Front Range Metropolitan Area
NGO	Non-governmental organizations
OA	Open Access
R & D	Research and development
RAQC	Regional Air Quality Council
PANDA	FP7 project empowering collaboration of Chinese and European partners to study air quality in China
PAB	Project advisory board
PM	Person-month
$PM_{2.5}$ / PM_{10}	Atmospheric particulate matter with a diameter 2.5 or 10 micrometers
PV	Photovoltaic
SDG	Sustainable Development Goal
SDG	Sustainable Development Goals
SME	Small and middle sized enterprises
SN	AQ-WATCH's stakeholder (and user) network
SO_2	Sulphur Dioxide
TG	Target group(s)
TGP	Training and gender panel
TRL	Technology Readiness Level
UIP	User Interface Platform
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UrbanSDG	Urban Sustainable Development Goal of the UN SDG solutions network
WCRP	World Climate Research Programme
WIPO	World Intellectual Property Organization
WHO	World Health Organization
WMO	World Meteorological Organisation

Commitment Letter to participate at AQ-Watch project as Pilot User (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, Carlos Finat, Executive Director of the Chilean Association for Renewable Energies (ACERA A.G.) confirm the interest of my organization to participate as part of the AQ-Watch project as coordinator to identify Pilot Users within Chile suitable to test some of the products or services to be elaborated by the project.

We are well aware of the aim of the project that AQ-Watch will deliver an innovative toolkit of pilot products and services, using space and in situ observations of air composition. The topic and the objectives of the project are of great interest to my organization ACERA A.G. We are willing to collaborate with AQ-Watch project partners and will participate in the pilot phase facilitating the test by members of ACERA of some of the major products and services offered in the toolkit to be elaborated by the project. This possibly includes several of the following products:

- **Climatological information on regional air quality**
- **Prediction for a metropolitan areas with downscaling and alter system**
- **Dust and solar energy service**
- **Wild fire service**
- **Fracking service**
- **Attribution service with focus on agriculture**
- **Mitigation service**

We will also be interacting with AQ-Watch concerning **training sessions**, providing feedback on the trainings, and for the promotion of the AQ-Watch tools to other end-users.

We agree that this commitment will appear in the work package and management description of the proposal to the EU. And we hereby confirm our interest in attending the annual project meetings and coordinating actions to give feedback and advice on the products and services. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

We will not charge the project for participation. We understand that travel and subsistence for our participation will be fully covered by the project.

We are looking forward to working with the AQ-Watch project.

With best regards,

Carlos Finat
Executive Director

ACERA A.G.

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

5 March 2019

Dr. Guy Brasseur
Max Planck Institute for Meteorology
Bundesstr. 53
20146 Hamburg
Germany

Commitment Letter to participate on AQ-Watch project as Pilot User (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

The Colorado Department of Public Health and Environment, Air Pollution Control Division, is providing this letter to confirm our interest in participation in the Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health (AQ-Watch) project as a Pilot User, should the project be selected for funding by the European Commission.

We are well aware of the aim of AQ-Watch to deliver a free innovative toolkit of pilot products and services, using space and in situ observations of air composition. This possibly includes several of the following products:

- Global and regional climatology of air quality
- Forecasts of air quality for metropolitan areas
- Dust and solar energy forecasts
- Wildfire and visibility service
- Information service about air pollution resulting from fracking operations
- Attribution service with focus on agricultural sources
- Emission mitigation service

These topics and the objectives of the project are of great interest to our Department, particularly as the North Front Range area of Colorado is currently designated by the U.S. Environmental Protection Agency as a non-attainment area for ozone. Along with air quality forecasting, which AQ-Watch products could enhance, we are also required to evaluate and determine emissions mitigation strategies to reduce ambient air ozone concentrations. Smoke influences from wildfires are also concerning for the area, from both local and distant events. We are willing to collaborate with all AQ-Watch project partners, and will participate in the pilot phase to test some of the major products and services offered in the toolkit to be evaluated and developed by the project.

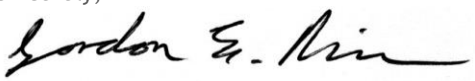
We will also commit to interact with AQ-Watch concerning training sessions, providing feedback on the trainings, and for the promotion of the AQ-Watch tools to other end-users.

We agree that this commitment will appear in the work package and management description of the proposal to the EU. And we hereby confirm our interest in attending the annual project meetings, and giving feedback and advice on the products and services. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

We will not charge the project for participation as a Pilot User. We understand that travel and per-diem funds for our participation may be fully covered by the project.

We look forward to working with you and the AQ-Watch project.

Sincerely,



Gordon E. Pierce
Technical Services Program Manager
Air Pollution Control Division

cc. Scott Landes, CDPHE
Kevin Briggs, CDPHE
Gabriele Pfister, NCAR

Commitment Letter to participate at AQ-Watch project as Pilot User
(H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, ***Xin Bo (Senior Engineer) , Department of Environmental Impact Numerical Simulation, Appraisal Center for Environment & Engineering Ministry of Environmental Protection ,Director of Atmospheric Environment Research Office,***confirm my interest in participation of AQ-Watch as Pilot User should the project be selected for funding by the European Commission.

We are well aware of the aim of the project that AQ-Watch will deliver an innovative toolkit of pilot products and services, using space and in situ observations of air composition. The topic and the objectives of the project are of great interest to my organization ***Department of Environmental Impact Numerical Simulation, Appraisal Center for Environment & Engineering Ministry of Environmental Protection.***. We are willing to collaborate with all AQ-Watch project partners, and will participate in the pilot phase to test some of the major products (e.g 1, 2, 7) and services offered in the toolkit to be elaborated by the project. This possibly includes several of the following products:

1. Climatological information on regional air quality
2. Prediction for a metropolitan areas with downscaling and alter system
3. Dust and solar energy service
4. Wild fire service
5. Fracking service
6. Attribution service with focus on agriculture
7. Mitigation service

We will also be interacting with AQ-Watch concerning training sessions, providing feedback on the trainings, and for the promotion of the AQ-Watch tools to other end-users.

We agree that this commitment will appear in the work package and management description of the proposal to the EU. And we hereby confirm our interest in attending the annual project meetings, and giving feedback and advice on the products and services. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

We will not charge the project for participation. We understand that travel and subsistence for our participation will be fully covered by the project.

We are looking forward to working with the AQ-Watch project.

With best regards,

Xin Bo Xin BO

Department of Environmental Impact Numerical Simulation, Appraisal Center for Environment & Engineering Ministry of Environmental Protection ,Director of Atmospheric Environment Research Office

ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Europäisches Zentrum für mittelfristige Wettervorhersage | Centre européen pour les prévisions météorologiques à moyen terme

Date: 8 February 2019

Dr. Vincent-Henri Peuch
Deputy Director, Copernicus Services
Head, Copernicus Atmosphere Monitoring Service
European Centre for Medium-Range Weather Forecasts
Shinfield Park, Reading, Berkshire, RG2 9AX
Direct line: +44 118 949 9102
e-mail: Vincent-Henri.Peuch@ecmwf.int

To: Prof. Guy Brasseur

Subject: Confirmation of Participation at the Project Advisory Board (PAB) of AQ-Watch project (H2020 DT-SPACE-06-EO-2019)

Dear Prof. Brasseur,

Herewith I, Vincent-Henri Peuch, Head of the Copernicus Atmosphere Monitoring Service (CAMS), confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project. Such downstream activities are essential for maximising the societal and commercial value that can build on CAMS full free and open outputs.

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Dr. Vincent-Henri Peuch
Deputy Director, Copernicus Services
Head, Copernicus Atmosphere Monitoring Service

EUMETSAT - Postfach 10 05 55 - 64205 Darmstadt - Germany

Professor G. Brasseur

Max-Planck-Institut für Meteorologie
Bundesstr. 53
20146 Hamburg
Germany

Your reference Votre référence	Your letter dated Votre lettre du	Our reference Notre référence	Darmstadt
		EUM/RSP/LET/19/1060234	26 February 2019

Subject: AQ Watch - Project Advisory Board Acceptance Letter

Dear Professor Brasseur,

Herewith I, Rosemary Munro, Competence Area Manager – Atmospheric Chemistry, confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project.

The innovative products and services include:

- **Climatological information on regional air quality**
- **Prediction for a metropolitan areas with downscaling and alter system**
- **Dust and solar energy service**
- **Wild fire service**
- **Fracking service**
- **Attribution service with focus on agriculture**
- **Mitigation service**

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

Headquarter Address:
EUMETSAT
Eumetsat-Allee 1
64295 Darmstadt
Germany

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Web: www.eumetsat.int

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Rosemary Munro

Competence Area Manager – Atmospheric Chemistry
EUMETSAT

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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Ref.: 03840/2019-L0 RES-ARE

Our ref.: 03840/2019 RES-ARE

Annex(es): -

To: Prof. Dr. Guy P. Brasseur
Max Planck Institute for Meteorology (MPI-M)
BUNDESSTRASSE 53
20146 Hamburg, Germany

08 February 2019

Subject: Confirmation of Participation at the Project Advisory Board (PAB) of AQ-Watch project (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, Prof. Alexander Baklanov, scientific officer of the WMO Research department, confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project.

The innovative products and services include:

- Climatological information on regional air quality
- Prediction for a metropolitan areas with downscaling and alter system
- Dust and solar energy service
- Wild fire service
- Fracking service
- Attribution service with focus on agriculture
- Mitigation service

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

Yours sincerely,

(A. Baklanov)
Scientific Officer
Atmospheric Environment Research Division

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

OFFICE OF RESEARCH AND DEVELOPMENT

Confirmation of Participation in the Project Advisory Board (PAB) of AQ-Watch project (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

As a senior scientist with U.S. EPA's Office of Research and Development and as Co-Chair of the Task Force on Hemispheric Transport of Air Pollution under the Convention on Long-range Transboundary Air Pollution, I accept your invitation to be an external expert of AQ-Watch's project advisory board should the project be selected for funding by the European Commission.

I am aware that the objective of AQ-Watch is, jointly with international partners, to use space and in situ observations of atmospheric composition to develop user-inspired products and services that will allow the improvement of air quality and, hence the health of the population and ecosystems in different regions of the world. I understand that one of the objectives of the project is to Copernicus data into innovative products for local users, such as:

- Climatological information on regional air quality
- Prediction for a metropolitan areas with downscaling and alter system
- Dust and solar energy service
- Wild fire service
- Fracking service
- Attribution service with focus on agriculture
- Mitigation service

I agree that my name will be mentioned in the proposal under the description of the PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

I will handle the communication confidentially and will not distribute any information which is of classified nature. I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project. I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Terry J. Keating, Ph.D.

Confirmation of Participation at the Project Advisory Board (PAB) of AQ-Watch project (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, Jhoon Kim, P.I. of Geostationary Environment Monitoring Spectrometer(GEMS), confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project.

The innovative products and services include:

- **Climatological information on regional air quality**
- **Prediction for a metropolitan areas with downscaling and alter system**
- **Dust and solar energy service**
- **Wild fire service**
- **Fracking service**
- **Attribution service with focus on agriculture**
- **Mitigation service**

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Jhoon Kim
Department of Atmospheric Sciences, Yonsei Univerity
Seoul, Korea

Royal Netherlands
Meteorological Institute
Ministry of Infrastructure
and Water Management

> Return address PO Box 201 3730 AE De Bilt

Prof. Dr. Guy Brasseur
Max Planck Institute for Meteorology
Bundesstrasse 53
20146 Hamburg
GERMANY

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Contact
Pieternel Levelt
pieternel.levelt@knmi.nl

Our reference

Your reference

Enclosure(s)

Date 1 March 2019
Subject Confirmation of Participation at the Project Advisory Board (PAB) of AQ-Watch project (H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, Pieternel Levelt, head of the R&D Satellite Observations department of the Royal Netherland Meteorological Institute and professor in Remote Sensing of the Earth Atmosphere at Delft University, confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project.

The innovative products and services include:

- Climatological information on regional air quality
- Prediction for a metropolitan areas with downscaling and alter system
- Dust and solar energy service
- Wild fire service
- Fracking service
- Attribution service with focus on agriculture
- Mitigation service

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Pieternel Levelt

Head of R&D Satellite Observations at KNMI
Professor in Remote Sensing of the Earth Atmosphere at Delft University

国家气象信息中心资料室

Climate Data Centre, National Meteorological Information Centre

Confirmation of Participation at the Project Advisory Board (PAB) of AQ-Watch project

(H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, Dr. Yan Shen, a meteorologist, confirm my interest in participation of AQ-Watch should the project be selected for funding by the European Commission and accept your invitation to be an external expert of AQ-Watch's project advisory board.

I am well aware of the overall objective of AQ-Watch is, jointly with international partners incl. Stakeholders/end-users, to use space and in situ observations of air composition to develop user-inspired products and services that will allow the improvement of air quality and hence of the health of population and ecosystems in different regions of the world. Turning Copernicus data to innovative products that facilitate local users and enhance the Copernicus global product quality is one of the ultimate goals of the project.

The topic and the objectives of the project are of great interest to me and to my organization in the field of the analysis and forecast of the atmospheric composition.

I agree that my name will be mentioned in the proposal under the description of PAB. And I hereby confirm my interest in attending the annual project meetings, and giving my feedback and advice on the project progression, its outcomes, the procedures and the methodologies and any other relevant documentations provided by the consortium. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) ofthe project.

I will handle the communication confidentially and will not distribute any information which is of classified nature.

I will not charge the project for this activity. I understand that my travel and subsistence for PAB activities will be fully covered by the project.

I am looking forward to supporting the AQ-Watch project. And I wish you all the best with your proposal.

With best regards,

Yan Shen

Climate Data Centre, National Meteorological Information Centre

北京市西城区人民政府陶然亭街道办事处

Commitment Letter to participate at AQ-Watch project as Pilot User
(H2020 DT-SPACE-06-EO-2019)

Dear Professor Brasseur,

Herewith I, ***Dong Zheng, Chief of Urban Management Section,*** confirm my interest in participation of AQ-Watch as Pilot User should the project be selected for funding by the European Commission.

We are well aware of the aim of the project that AQ-Watch will deliver an innovative toolkit of pilot products and services, using space and in situ observations of air composition. The topic and the objectives of the project are of great interest to my organization ***Taoranting Substrict Office , Xicheng District People's Government of Beijing Municipality***. We are willing to collaborate with all AQ-Watch project partners, and will participate in the pilot phase to test some of the major products (e.g 1, 2, 7) and services offered in the toolkit to be elaborated by the project. This possibly includes several of the following products:

1. Climatological information on regional air quality
2. Prediction for a metropolitan areas with downscaling and alter system
3. Dust and solar energy service
4. Wild fire service
5. Fracking service
6. Attribution service with focus on agriculture
7. Mitigation service

We will also be interacting with AQ-Watch concerning training sessions, providing feedback on the trainings, and for the promotion of the AQ-Watch tools to other end-users.

We agree that this commitment will appear in the work package and management description of the proposal to the EU. And we hereby confirm our interest in attending the annual project meetings, and giving feedback and advice on the products and services. If necessary, the feedback will be provided as a briefing to the Project Executive Board (PEB) of the project.

北京市西城区人民政府陶然亭街道办事处

We will not charge the project for participation. We understand that travel and subsistence for our participation will be fully covered by the project.

We are looking forward to working with the AQ-Watch project.

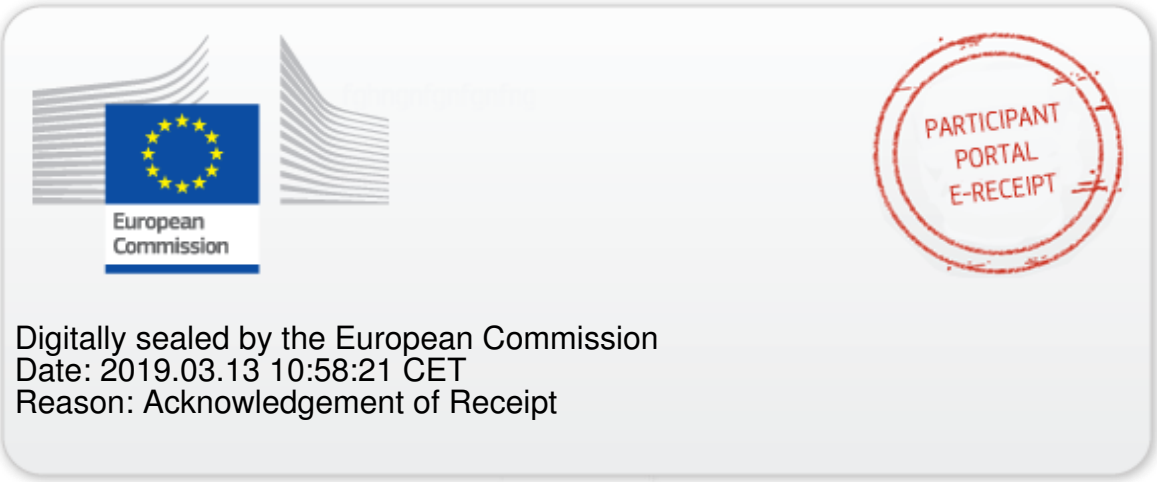
With best regards,

Dong Zheng

Chief of Urban Management Section

Taoranting Substrict Office

Xicheng District People's Government of Beijing Municipality



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