Please check our wiki for help on navigating the form.

Horizon 2020

Call: H2020-INFRAEOSC-2018-2020

(Implementing the European Open Science Cloud)

Topic: INFRAEOSC-07-2020

Type of action: RIA

Proposal number: 101015810

Proposal acronym: CLOUDator

Deadline Id: H2020-INFRAEOSC-2020-2

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	INFRAEOSC-07-2020	Type of Action	RIA
Call Identifier	H2020-INFRAEOSC-2018-2020	Deadline Id	H2020-INFRAEOSC-2020-2

Acronym	CLOUDator
Subtopic	Sub-topic a6: Additional research enabling services
Proposal title	Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud

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

Duration in months	*30*
Fixed keyword 1	
Free keywords	*Cloud, geospatial, interoperability, Earth, COVID-19*

Abstract

CLOUDator will break discipline silos and will create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC) through the application of state of the art of geospatial data services to Earth science competence centres in particular and to geoscience research in general. In addition to the research infrastructures currently present in EOSC we will bring the Copernicus Atmosphere and Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S) platforms currently widely used in Europe and innovative services will be made available in the EOSC portal using the most innovative Open Geospatial Consortium APIs that consider location and time. An architecture of services will implement and deploy for improving accessibility and processing of big data analytics in distributed systems. The new services will provide mechanisms to ensure the visibility and recognition of Copernicus data services and the tools to improve networking between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following open standards to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub, including discovery, accessing, processing and knowledge management services. The design of new services will be user oriented, engaging a wide range of stakeholders in society, the public sector, industry and SMEs, academia and agencies. In particular, the project will showcase the nexus and interactions between air quality, climate and health in a COVID-19 global pandemic showcase.

Remaining characters 343

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	CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTALES	ES	
2	UNIVERSIDAD AUTONOMA DE BARCELONA	Spain	
3	RASDAMAN GMBH	DE	
4	DEIMOS ENGENHARIA SA	PT	
5	52°North Initiative for Geospatial Open Source Software GmbH	DE	
6	EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS	UK	
7	SECURE DIMENSIONS GMBH	DE	
8	INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE	AT	
9	SINERGISE LABORATORIJ ZA GEOGRAFSKEINFORMACIJSKE SISTEME DOO	SI	
10	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain	

2 - Administrative data of participating organisations

PIC	***Legal name***
998880005	*CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTALES*

Short name: CREAF

Address of the organisation

Street UNIVERSITAT AUTONOMA DE BARCELONA

Town BELLATERRA

Postcode 08193

Country Spain

Webpage http://www.creaf.cat/

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.....09/03/2009 - yes

SME self-assessment ..... unknown

SME validation sme.....09/03/2009 - 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

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 **Joan** Last name **MASO**

E-Mail **joan.maso@uab.es**

Position in org. Mrs

Department CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTA ☒ Same as organisation name

☒ Same as proposing organisation's address

Street UNIVERSITAT AUTONOMA DE BARCELONA EDIFICI C

Town BELLATERRA Post code 08193

Country Spain

Website www.creaf.cat

Phone +34935811312 Phone 2 +xxx xxxxxxxxx Fax +34935814151

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Cristina	Garcia	c.garcia@creaf.uab.es	+xxx xxxxxxxxx
Meritxell	Batalla	meritxell.batalla@uab.cat	+xxx xxxxxxxxx
Ester	Prat	e.prat@creaf.uab.cat	+xxx xxxxxxxxx
Ivette	Serral	ivette@creaf.uab.cat	+xxx xxxxxxxxx

PIC	***Legal name***
999986484	*UNIVERSIDAD AUTONOMA DE BARCELONA*

Short name: UAB

Address of the organisation

Street CALLE CAMPUS UNIVERSITARIO SN CERDA

Town CERDANYOLA DEL VALLES

Postcode 08290

Country Spain

Webpage http://www.uab.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 .....yes

Research organisation .....yes

Legal person .....yes

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

Enterprise Data

SME self-declared status.....01/12/2008 - no

SME self-assessment ..... unknown

SME validation sme.....01/12/2008 - 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: Departament de Geografia ☐ not applicable

☒ Same as proposing organisation's address

Street: CALLE CAMPUS UNIVERSITARIO SN CERDANYOLA

Town: CERDANYOLA DEL VALLES

Postcode: 08290

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 **Alaitz** Last name **Zabala**

E-Mail **alaitz.zabala@uab.cat**

Position in org.: Researcher

Department: UNIVERSIDAD AUTONOMA DE BARCELONA ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: CALLE CAMPUS UNIVERSITARIO SN CERDANYOLA V

Town: CERDANYOLA DEL VALLES Post code: 08290

Country: Spain

Website:

Phone: +34935814343 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

PIC	***Legal name***
972352251	*RASDAMAN GMBH*

Short name: RASDAMAN

Address of the organisation

Street HANS HERMANN SIELING STRASSE 17

Town BREMEN

Postcode 28759

Country Germany

Webpage www.rasdaman.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.....31/12/2019 - yes

SME self-assessment .....31/12/2019 - yes

SME validation sme.....29/12/2010 - yes

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

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: **Peter**

Last name: **Baumann**

E-Mail: **baumann@rasdaman.com**

Position in org.: Researcher

Department: RASDAMAN GMBH ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: HANS HERMANN SIELING STRASSE 17

Town: BREMEN

Post code: 28759

Country: Germany

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
999623219	*DEIMOS ENGENHARIA SA*

Short name: DEIMOS ENGENHARIA SA

Address of the organisation

Street AVENIDA D JOAO II LOTE 1 17 01-8 B EDIFIC

Town LISBOA

Postcode 1998023

Country Portugal

Webpage www.deimos.pt

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.....01/07/2009 - no

SME self-assessment ..... unknown

SME validation sme.....01/07/2009 - 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

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: **Nuno**

Last name: **Catarino**

E-Mail: **nuno.catarino@deimos.com.pt**

Position in org.: Director

Department: DEIMOS ENGENHARIA SA ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: AVENIDA D JOAO II LOTE 1 17 01-8 B EDIFICIO TORRE ZEN

Town: LISBOA

Post code: 1998023

Country: Portugal

Website:

Phone: +xxx xxxxxxxxx

Phone 2: +xxx xxxxxxxxx

Fax: +xxx xxxxxxxxx

PIC	***Legal name***
997237407	*52°North Initiative for Geospatial Open Source Software GmbH*

Short name: 52°North GmbH

Address of the organisation

Street Martin-Luther-King-Weg 24

Town Münster

Postcode 48155

Country Germany

Webpage http://www.52north.org

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 .....no

Legal person .....yes

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

Enterprise Data

SME self-declared status.....13/03/2007 - yes

SME self-assessment ..... unknown

SME validation sme.....13/03/2007 - yes

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

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: **Simon** Last name: **Jirka**

E-Mail: **jirka@52north.org**

Position in org.: Project Manager

Department: 52°North Initiative for Geospatial Open Source Software GmbH ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: Martin-Luther-King-Weg 24

Town: Münster Post code: 48155

Country: Germany

Website: http://52north.org/

Phone: +49-251-396371-31 Phone 2: +xxx xxxxxxxxx Fax: +49-251-396371-11

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Matthes	Rieke	m.rieke@52north.org	*+49-251-396371-51*
Cornelia	Müller	c.mueller@52north.org	*+49-251-396371-0*
Andreas	Wytzisk	a.wytzisk@52north.org	*+49-251-396371-0*
Albert	Remke	remke@52north.org	*+49-251-396371-0*

PIC	***Legal name***
999916741	*EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS*

Short name: ECMWF

Address of the organisation

Street SHINFIELD PARK

Town READING

Postcode RG2 9AX

Country United Kingdom

Webpage www.ecmwf.int

Legal Status of your organisation

Research and Innovation legal statuses

Public body .....yes

Non-profit .....yes

International organisation .....yes

International organisation of European interest .....yes

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: Forecast Department ☐ not applicable

☒ Same as proposing organisation's address

Street: SHINFIELD PARK

Town: READING

Postcode: RG2 9AX

Country: United Kingdom

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: **Anna** Last name: **Ghelli**

E-Mail: **anna.ghelli@ecmwf.int**

Position in org.: Head of User Support

Department: Forecast Department ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: SHINFIELD PARK

Town: READING Post code: RG2 9AX

Country: United Kingdom

Website: www.ecmwf.int

Phone: +44 118 949 9425 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Cristian	Simarro	cristian.simarro@ecmwf.int	+xxx xxxxxxxxx
Xiaobo	Yang	xiaobo.yang@ecmwf.int	+xxx xxxxxxxxx
Daniel	Thiemert	daniel.thiemert@ecmwf.int	+xxx xxxxxxxxx

PIC	***Legal name***
996078063	*SECURE DIMENSIONS GMBH*

Short name: SECURE DIMENSIONS

Address of the organisation

Street WAXENSTREINSTRASSE 28

Town MUNCHEN

Postcode 81377

Country Germany

Webpage http://www.secure-dimensions.de

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.....20/03/2009 - yes

SME self-assessment ..... unknown

SME validation sme.....20/03/2009 - yes

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

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: **Andreas** Last name: **Matheus**

E-Mail: **andreas.matheus@secure-dimensions.de**

Position in org.: Managing Director

Department: SECURE DIMENSIONS GMBH ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: WAXENSTREINSTRASSE 28

Town: MUNCHEN Post code: 81377

Country: Germany

Website:

Phone: +49 89 3151813 Phone 2: *+xxx xxxxxxxxx* Fax: *+xxx xxxxxxxxx*

PIC	***Legal name***
999452596	*INTERNATIONALES INSTITUT FUER ANGEWANDTE SYSTEMANALYSE*

Short name: IIASA

Address of the organisation

Street Schlossplatz 1

Town LAXENBURG

Postcode 2361

Country Austria

Webpage www.iiasa.ac.at

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..... 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: **Steffen** Last name: **Fritz**

E-Mail: **fritz@iiasa.ac.at**

Position in org.: EOCS Center Head and Deputy Program Director

Department: Ecosystems Services and Management Program ☐ Same as organisation name

☒ Same as proposing organisation's address

Street: Schlossplatz 1

Town: LAXENBURG Post code: 2361

Country: Austria

Website: www.iiasa.ac.at

Phone: +432236807353 Phone 2: +432236807465 Fax: +432236807503

Other contact persons

First Name	***Last Name***	***E-mail***	***Phone***
Inian	Moorthy	moorthy@iiasa.ac.at	*+432236807465*
Sandra	Brozek	brozek@iiasa.ac.at	*+432236807362*
Monica	Manchanda	manchand@iiasa.ac.at	*+432236807410*
Linda	See	see@iiasa.ac.at	*+432236807423*
Elisabeth	Preihs	preihs@iiasa.ac.at	*+432236807253*

PIC	***Legal name***
955490450	*SINERGISE LABORATORIJ ZA GEOGRAFSKEINFORMACIJSKE SISTEME DOO*

Short name: SINERGISE LABORATORY FOR GEOGRAPHIC INFORMATION SYSTEMS LTD

Address of the organisation

Street CVETKOVA ULICA 29

Town LJUBLJANA

Postcode 1000

Country Slovenia

Webpage www.sinergise.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.....31/03/2019 - yes

SME self-assessment .....31/03/2019 - yes

SME validation sme.....04/09/2008 - yes

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

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: **Grega** Last name: **Milčinski**

E-Mail: **grega.milcinski@sinergise.com**

Position in org.: Developer

Department: SINERGISE LABORATORIJ ZA GEOGRAFSKEINFORMACIJSKE SISTEME ☒ Same as organisation name

☒ Same as proposing organisation's address

Street: CVETKOVA ULICA 29

Town: LJUBLJANA Post code: 1000

Country: Slovenia

Website:

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

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Matej	Batic	matej.batic@sinergise.com	+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 Science department ☐ not applicable

☐ Same as proposing organisation's address

Street: NEXUS II building, Jordi Girona 29

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: Mr. Sex: (•) Male ( ) Female

First name: **Pierre Antoine** Last name: **Bretonniere**

E-Mail: **pierre-antoine.bretonniere@bsc.es**

Position in org.: Developer

Department: Earth Science department ☐ Same as organisation name

☐ Same as proposing organisation's address

Street: NEXUS II buiding, Jordi Girona 29

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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	Centro De Investigacion Ecologica Y	ES	296800	20000	0	0	0	79200,00	0	396000,00	100	396000,00	396000,00
2	Universidad Autonoma De Barcelona	ES	84000	15000	0	0	0	24750,00	0	123750,00	100	123750,00	123750,00
3	Rasdaman Gmbh	DE	187739	59554	0	0	0	61823,25	0	309116,25	100	309116,25	309116,25
4	Deimos Engenharia Sa	PT	111800	19000	0	0	0	32700,00	0	163500,00	100	163500,00	163500,00
5	52°north Initiative For Geospatial	DE	144000	17586	0	0	0	40396,50	0	201982,50	100	201982,50	201982,50
6	European Centre For Medium-range	UK	178500	16000	0	0	0	48625,00	0	243125,00	100	243125,00	243125,00
7	Secure Dimensions Gmbh	DE	96800	13000	0	0	0	27450,00	0	137250,00	100	137250,00	137250,00
8	Internationales Institut Fuer Angewandte	AT	105269	16000	0	0	0	30317,25	0	151586,25	100	151586,25	151586,25
9	Sinergise Laboratorij Za Geografskeinf	SI	100800	21590	0	0	0	30597,50	0	152987,50	100	152987,50	152987,50
10	Barcelona Supercomputi ng Center -	ES	103500	10000	0	0	0	28375,00	0	141875,00	100	141875,00	141875,00

	Total	1409208	207730	0	0	0	404234,50	0	2021172,50		2021172,50	2021172,50

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.

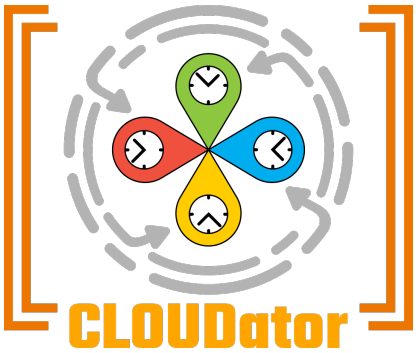
Furthermore, applicants also have the possibility to opt out of this Pilot completely at any stage (before or after the grant signature). In this case, applicants must indicate a reason for this choice (see options below).

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.*



COVER PAGE

Proposal Acronym: CLOUDator[1]
Proposal full title: Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud

Type: Research and Innovation Action

Work program topics addressed:
INFRAEOSC-07-2020: Increasing the services offer of the EOSC portal
Subtopic: (a6) Additional research enabling services

List of participants

Participant No	Participant organisation name	Country
1 (Coordinator)	Centro de Investigación Ecológica y Aplicaciones Forestales (CREAF)	Spain
2	Universitat Autònoma de Barcelona (UAB)	Spain
3	rasdaman GmbH (RAS)	Germany
4	DEIMOS Engenharia SA (DEIMOS)	Portugal
5	52°North Initiative for Geospatial Open Source Software GmbH (52N)	Germany
6	European Centre for Medium range Weather Forecast (ECMWF)	United Kingdom
7	Secure Dimensions GmbH (SECD)	Germany
8	International Institute for Applied Systems Analysis (IIASA)	Austria
9	Sinergise, laboratory for geographical information systems, Ltd. (SIN)	Slovenia
10	Barcelona Supercomputing center. Centro Nacional de Supercomputación (BSC)	Spain

[1] The project name CLOUDator plays with the Catalan word "Claudator" that means one of these symbols "[" and "]" (the French word is "claudateur"). The Latin etymology is: "*The one who closes"*. Moreover, the "[ ]" symbols represents the concept of an "array" in several programming languages and by extension a geospatial array of climate or atmospheric data ready for analysis. CLOUDator can also be decomposed in Cloud + Data *suggesting* a pretended etymology: "*the one that puts data into the cloud*".

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List of Acronyms

AAI	Authentication and Authorisation Infrastructure
ADS	Atmosphere Data Store
API	Application Programming Interface
ARD	Analysis Ready Data
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmosphere and Monitoring Service
CDS	Climate Data Store
DIAS	Data and Information Access Services
ECI	European Cloud Initiative
ECV	Essential Climate Variables
EO	Earth Observation
EOSC	European Open Science Cloud
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
FAIR	Findable, Accessible, Interoperable and Reusable
GDPR	General Data Protection Regulation
GEOSS	Global Earth Observation System of Systems
GUF	Geospatial User Feedback
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	International Organization for Standardization
IT	**I**nformation Technology
KPI	Key Performance Indicator
MVE	Minimum Viable Ecosystem
OGC	Open Geospatial Consortium
RDA	Resource Description and Access
SDG	Sustainable Development Goals
SDI	Spatial Data Infrastructure
SME	Small and medium-sized enterprises
SOS	Sensor Observation Service
WCPS	Web Coverage Processing Service
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service

1 Excellence

The current EOSC hub includes a set of *common services* and *thematic services* aligned. The common backbone of services provides a layer of technological cloud based resources that allows for thematic services to run on top. It addresses specific research communities such as the ESFRI research infrastructures network.

The gap: Competence centre silos

The EOSC hub names thematic research infrastructures as **separated** Competence Centres: "*Each Competence Centre fosters the use of advanced digital capabilities and services of the EOSC hub […] Each Competence Centre operates* ***independently from each other*** *but shares the needs in using common solutions from the EOSC hub service catalogue to setup* ***community-specific*** *services that can expand EOSC with science* ***discipline specific capabilities***"[2].

This initial implementation of the EOSC is fully focused on propelling the Competence Centres into the big data arena giving them a common set of basic tools. However, **an EOSC architecture that promotes discipline silos** is created. **We believe that this approach will *slow down the circulation of knowledge and will prevent cross-fertilization of multidisciplinary research* in the future if there is no compensation action**. This is precisely what the introduction of the FAIR principles in EOSC is trying to prevent, as stated by significant European Commission members in their position paper (Michel Schouppe and Jean-Claude Burgelman)[3].

Breaking silos to enable multidisciplinary research

CLOUDator heralds a new type of service for EOSC, focusing on fully unleashing the Copernicus potential and thereby fulfilling the DIAS promise for multidisciplinary research. The CLOUDator service will provide:

- A powerful, extensible, standards-based service for Copernicus Earth Observation services data
- Fully location-transparent federation of the CLOUDator service with tens of Petabytes of further data provided by DIASs and data centres worldwide
- An enabling "any query, any time" paradigm, for scientists to experiment combining data from different Earth science disciplines
- Immediately usable services for scientist without requiring remote sensing nor IT expertise
- Fine-grain, configurable access control and billing, allowing companies to contribute
- A set of showcases services exemplifying how this multidisciplinary environment is exploited in practice
- Increment scientific communication and feedback about the data

To this end, CLOUDator proposes **two new layers** of services in the EOSC hub architecture that enable **multidisciplinary research** among competence centres (see Figure 1) by recognizing that what happens in the same location and time relates disciplines and allows for finding answers to research questions to be answered such as global change, atmosphere composition or human risks and impacts. Thus, CLOUDator goes far beyond a simple transfer of scientific knowledge and responds to the concern of the European Cloud Initiative (ECI) in the need to support the exploitation of Earth observation data, enabling the **cross-fertilisation of spatial and temporal data** with other sources and facilitating its integration with digital research infrastructures[4].

[2] EOSC hub D8.1 Report on progress, achievements and plans of the Competence Centres https://documents.egi.eu/document/3485

[3] Relevance of the EOSC initiative and FAIR principles in the realm of Open Science and implementation phases of the EOSC. https://ec.europa.eu/research/openscience/pdf/eosc-fair_paper_schouppe-burgelman_2018.pdf

[4] https://ec.europa.eu/transparency/regdoc/rep/10102/2018/EN/SWD-2018-327-F1-EN-MAIN-PART-1.PDF, page 102

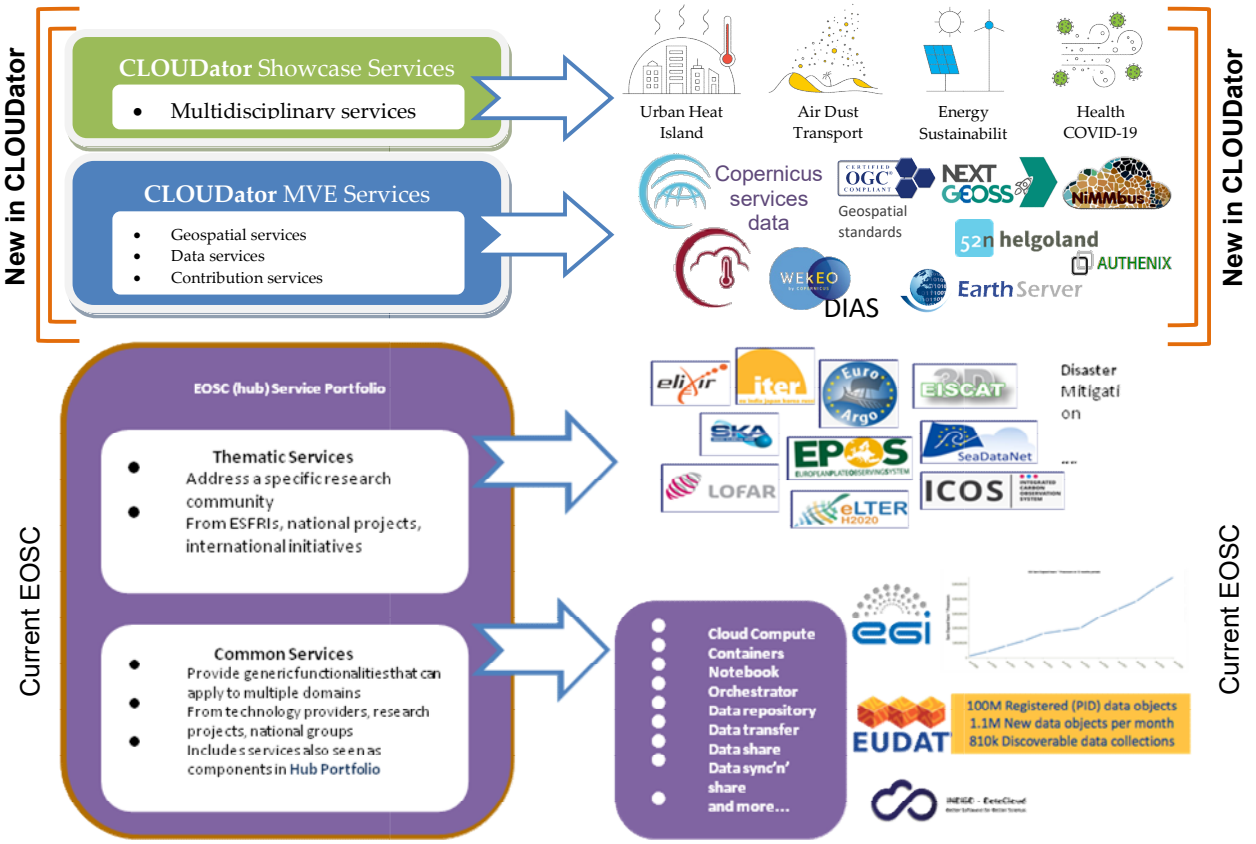


Figure 1: CLOUDator contribution to EOSC introducing two new layers to enable multidisciplinary research. The lower part (current EOSC) is extracted from Per Öster, EOSC-hub Project Director slides on the EOSC week.

In addition to the previous exposed gap, Europe has considerably invested in the space-based Earth Observation Copernicus program resulting in the Sentinel fleet and the Copernicus services**.** The Copernicus programme, led by the EU, is one of the most ambitious Earth Observation systems to date. While Petabytes of Sentinel data are made available to the scientific community for download, services have not been connected to EOSC**. CLOUDator aims at solving this issue too.**

1.1 Objectives

Overarching vision: CLOUDator will **break** discipline **silos** and create a **multidisciplinary layer of services for Earth sciences** in the European Open Science Cloud (EOSC) through the application of state of the art of **geospatial data services** to *Competence Centres* in particular and to geoscience research in general. In addition to the research infrastructures currently present in EOSC, we will bring the **Copernicus Atmosphere and Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S) data** and innovative services using the Open Geospatial Consortium (OGC) services, including the currently emerging new generation of OGC standards, that consider location and time for discovery, accessing, processing and knowledge management services. An architecture of services will be implemented and deployed for improving accessibility and processing of big data analytics in distributed systems. Novel innovative digital services will be applied to showcase the interaction between climate, air quality and human activities and risks and impacts in cities, dust transport, sustainable energy and COVID-19. The showcases will be user-oriented, engaging a wide range of stakeholders in society, the public sector, industry and SMEs, academia and agencies, and will become another layer of services contributed to EOSC.

Why is CLOUDator prepared for addressing this European challenge? CLOUDator partners have a unique combination of combination of experience in the deployment of geospatial web services for big data analytics and visualization for more than two decades and in building various digital platforms. They are leaders or participants in related H2020 research projects and have connections with other multidisciplinary initiatives such as INSPIRE and GEOSS. They are authors of relevant OGC standards and are active members in the geospatial community. In particular, ECMWF is the entrusted entity for two Copernicus services crucial for understanding the impacts of climate change and human activities on the planet.

How will CLOUDator address this European challenge? CLOUDator will scale up the EOSC portal services by creating a multidisciplinary environment by combining existing transversal digital services offering Petabytes of Copernicus data for the Earth sciences domains. All of these are based on a solid, strictly standards-based framework for integrating federated geospatial infrastructures with other research domains, available through the EOSC hub, while favouring interdisciplinarity and social innovation. By registering these services in the EOSC Portal, EOSC will be proven to be an effective cloud platform for solving current global challenges.

Where will CLOUDator address this European challenge? The CLOUDator services will illustrate the connections between environmental and human activities and in particular the interactions between climate, air quality and human activities and risks. One of the human risks studied is the COVID-19 pandemics. Health is an area where EU can benefit from the data revolution, increasing the quality of healthcare, while decreasing costs.

Objectives. CLOUDator contributes to EOSC by adopting four **General Objectives [[GO]]**.

- [[GO1]] **Enable multidisciplinary scientific research services offered by EOSC** in the domains of climate, air quality and human activities and risks
- [[GO2]] **Contribute multidimensional Earth data[5] services to the EOSC Portal and unleash the potential of combining Copernicus services with existing research infrastructures to meet researchers' needs** for global and local geoscience studies
- [[GO3]] **Increase the interoperability of Earth data-intensive research in Europe** by providing state of the art geospatial web services, thereby enabling multidisciplinary scientific research without the barriers of needing strong EO and IT skills.
- [[GO4]] **Contribute to self-sustained operational services in the EOSC by providing added value** and connecting the space investment with the research infrastructures and their users.

These general objectives will be achieved through several **Specific Objectives [[SO]]** that will be met within the project's life span. These are presented in
Table 1, Table 2, Table 3 and Table 4, together with the expected outputs and the tasks contributing to them. Thus, these tables can be used to monitor and measure the progress of CLOUDator project towards achieving the objectives.

[5] In this proposal "*Earth data*" is understood as data that represent variables describing the status and evolution of the Earth in the widest sense. These data have a link to a position to the Earth surface. Weather, Soil composition, Biodiversity, Pollution, etc. are examples of Earth data variables that enable *Earth sciences*. Sometimes these disciplines are called *Geosciences* (e.g., by the European Geosciences Union). Earth data are mainly obtained by *Earth Observation* (satellite, airborne or in-situ) and elaborated using scientific models. Due t4.o the relations to the Earth system, these data are also referred to as *Geospatial data*. There are particularities that differentiate these concepts but, in this proposal, they are used synonymously.

1.1.a Multidisciplinary scientific research. Specific objectives

Table 1: Specific objectives (SO) and related CLOUDator outputs for General Objective 1

[[GO1]] Enable multidisciplinary scientific research services offered by EOSC in the domains of climate, air quality and human activities and risks	
Specific Objectives	**CLOUDator Outputs**
[[SO11]] Contribute services for multidisciplinary research in EOSC	A layer of truly multidisciplinary modular and mature services integrated with the existing common services and thematic services in EOSC (Task 4.4: *EOSC portal integration*)
[[SO12]] Illustrate new multidisciplinary showcases in EOSC	Co-create multidisciplinary research with stakeholders (Task 3.1: *Co-create multidisciplinary showcases using multidimensional services and data*) A set of four showcase integrating climate change, air quality and human activities and risks in urban head island, dust transport, sustainable energy and health illustrating the potential of the multidisciplinary approach of services (Task 3.2: *Development of multidisciplinary showcases combining Climate change, Air Quality and Risks and impacts on human activities*)
[[SO13]] Demonstrate how services can be derived from showcases	Showcase transformed into permanent services for multidisciplinary research challenges (Task 3.3: *Transform multidisciplinary showcases into EOSC permanent services*)
[[SO14]] Create a satisfactory user experience and communicate feedback about data and services	Optimize user interfaces adapting them to the specific researcher needs defined during the co-creation process (Task 2.4: *User interfaces for multidisciplinary research*) Scientific communication and user feedback about data available in the EOSC portal with NiMMbus system (Task 4.3: *Scientific discussions and user feedback*)
[[SO15]] Demonstrate the added value of a multidisciplinary approach	Create four showcases based on research challenges. (Task 3.2: *Development of multidisciplinary showcases combining Climate change, Air Quality and Risks and impacts on human activities*) Study results on the added value of the multidisciplinary services contributed to EOSC (Task 3.4: *Assess the added value of the multidisciplinary approach and define business models*)

1.1.b Multidimensional services. Specific objectives

Table 2: Specific objectives (SO) and related CLOUDator outputs for General Objective 2

[[GO2]] Contribute multidimensional Earth data services in the EOSC Portal and unleash the potential of Copernicus services to meet researchers' needs for global and local geoscience studies	
Specific Objectives	**CLOUDator Outputs**
[[SO21]] Provide a Minimum Viable Ecosystem (MVE) of services based on location and time	Provide findable Earth data by integrating the NextGEOSS catalogue in EOSC Organize a set of self-managing actionable datacubes of satellite and climate data, federated with 10+ Petabytes of further DIASs and archives worldwide, queryable through OGC WCS/WCPS, connected to vector and metadata, accessible through a wide spectrum of clients, from NASA WorldWind over QGIS to python The Helgoland sensor service is available in EOSC, by implementing all the necessary EOSC requirements (Task 2.1: *Integrated CLOUDator Big Data Analytics services* and Task 2.3: *EarthServer federation integration*)
[[SO22]] Integrate Copernicus Atmosphere Monitoring Services (CAMS) and Copernicus Climate Change Service (C3S) in EOSC	Provide new space related data services for Atmosphere Monitoring (CAMS) and data services for Climate Change (C3S) in the EOSC portal (Task 2.2: *Multi-disciplinary CLOUDator services deployment, population and operation with data provided by CAMS and C3S*) Complement Copernicus with SAR, optical satellite imagery, climate variables, thematic products, DEMs (Task 2.3: *EarthServer federation integration)*
[[SO23]] Enable the creation of collaborative data	Enable collaborative data creation using the Geopedia approach in the EOSC portal (Task 2.1: *Integrated CLOUDator Big Data Analytics services* and Task 2.2: *Multi-disciplinary CLOUDator services deployment, population and operation with data provided by CAMS and C3S*). Collaborative data will be used in the COVID-19 showcase
[[SO24]] Connect EOSC services into GDPR compliant applications by considering all the steps of the research life cycle	Extend the current Authentication and Authorisation Infrastructure (AAI) system to allow the services to work together communicating data and respecting sensible and personal information and per-user access rules (Task 4.2: *Authorization, licences and GDPR*)
[[SO25]] Contribute to European leadership and sufficiency (scientifically and technically) in the geoscience domain	Connect a set of Copernicus services providing European generated Earth data ready for scientific exploitation (Task 2.2: *Multi-disciplinary CLOUDator services deployment, population and operation with data provided by CAMS and C3S*) Deploy a pan-European one-stop shop for all Copernicus data and further European data assets, ready for mix-and-match from simple browsing to complex analytics and fusion (Task 2.3: *EarthServer federation integration*)

1.1.c Interoperable research. Specific objectives

Table 3: Specific objectives (SO) and related CLOUDator outputs for General Objective 3

[[GO3]] Increase the interoperability of Earth data-intensive research in Europe on the Earth system by providing state of the art geospatial web services, thereby enabling multidisciplinary scientific research without the barriers of needing strong EO and IT skills	
Specific Objectives	**CLOUDator Outputs**
[[SO31]] Favour FAIR and data management principles	Prepare a white paper on how to use geospatial standards for improving FAIR practices in Earth data and develop training activities to use services respecting the FAIR principles (Task 5.6: *Training*)
[[SO32]] Integrate remote sensing, in-situ, collaborative data and modelling	Deploy the datacube approach as an architecture for data management services with seamlessly integrated data analytics, fusion, and visualization (Task 2.1: *Integrated CLOUDator Big Data Analytics services*) and data sources (remote sensing, in-situ and metadata) (Task 2.2: *Multi-disciplinary CLOUDator services deployment, population and operation with data provided by CAMS and C3S*)
[[SO33]] Foster interoperability and harmonization between services in EOSC	Contribute inputs to the architecture definition of EOSC by consolidating a set of interoperability standards and best practices and providing certification compliance with CITE tests (Task 4.1: *Interoperability and technical specifications in EOSC*) Conduct a set of dissemination and communication actions to promote interoperability of geospatial data (Task 5.2: *Communication in coordination with INFRAEOSC*)
[[SO34]] Advancing in European and international standardization in EOSC	Contribute to new standards and best practices elaborated in OGC and ISO. Set up a liaison between EOSC and the OGC (Task 5.5: *Collaborate with standards and best practices organizations*)

1.1.d Self- sustained operations. Specific objectives

Table 4: Specific objectives (SO) and related CLOUDator outputs for General Objective 4

[[GO4]] Contribute to self-sustained operational services in EOSC by providing added value and connecting the space investment with the research infrastructures and their users	
Specific Objectives	**CLOUDator Outputs**
[[SO41]] Encourage sharing of resources and opening up of services to researchers	Create and stimulate the use of geospatial services in the EOSC portal (Task 5.3: *Dissemination of the project resulting services* and Task 5.6: *Training*) Cooperation with other projects in the joint organization of EOSC activities and events (Task 5.4: *Organization of activities aligned and coordinated with other selected projects*)
[[SO42]] Define operational requirements for service persistence	Define governance and rules for participation in CLOUDator and the EarthServer federation (licensing, costs...) (Task 3.4: *Assess the added value of the multidisciplinary approach and define business models*) Provide a set of requirements for service persistence and reliability (Task 2.1: *Integrated CLOUDator Big Data Analytics services*)

[[SO43]] Propose business models based on the added value for the services	A sustainability plan for the continuity of the services after the end of the project (Task 2.5: *Sustainability options for EOSC services*) and demonstrated added value of the CLOUDator approach to multi-faceted, yet integrated Big Data Analytics services (Task 3.4: *Assess the added value of the multidisciplinary approach and define business models*)
[[SO44]] Coordinate dissemination activity beyond the project with other EOSC projects	A coordination strategy to communicate to stakeholders about CLOUDator at EOSC (Task 5.2: *Communication in coordination with INFRAEOSC*) A dissemination plan for the results of the project and their exploitation after the end of the project (Task 5.3: *Dissemination of the project resulting services*) Contribute to maintain the liaison between EOSC and the OGC (Task 5.5: *Collaborate with standards and best practices organizations*)

1.2 Relation to the work programme

CLOUDator addresses the topic INFRAEOSC-07-2020 "Increasing the service offer of the EOSC Portal" with the "(a6) Additional research enabling services" area (see Table 5).

Table 5: Relation of the project with what was specified in the topic call

Specific challenge topic	**How CLOUDator will address the challenge**
While the overall management and operation of the activities of the EOSC Portal is addressed in INFRAEOSC-03-2020, the challenge in this topic is to effectively **coordinate at pan-European level the provision** through the EOSC Portal of state-of-the-art research **enabling services** from a wide range of national, regional and institutional public infrastructures in Europe, covering diverse thematic domains, and further non-research resources in order to: 1) scale up the EOSC Portal; and 2) set up a model for interaction between service providers and the EOSC Portal operators through pan-European e-infrastructure entities, based on transparency and effectiveness of cost compensation.	CLOUDator is contributing two new layers of services. The first one is spatio-temporal services to enable multidisciplinary Big Earth Data research, without the need for deep knowledge in EO and IT. CLOUDator contributes transversal geospatial services for data discovery (a catalogue), data access (datacube and sensor data), data processing (and modelling) and data visualization. It also offers pan-European and global Earth data services coming from the Copernicus Atmospheric Monitoring Service (CAMS) and Copernicus Climate Change Service (C3S) as well as a collaborative data service for an Open Health Map. The second layer is composed of four exemplary services that illustrate the interactions of climate, air quality and human activities and risks. These services will be registered in the EOSC portal offering. In this layer, services quantifying impacts and interactions of climate and air quality in urban heat islands, air dust transport, energy sustainability and COVID-19 are being provided and registered.
Scope of topic	**How CLOUDator will address the scope**
In order to coordinate the provision through the EOSC Portal of state-of-the-art research purely enabling services across Europe, proposals should build on the competences of pan-European e-Infrastructures of diverse domains to **ensure multidisciplinary research** and synergies with national and regional programmes.	CLOUDator is structured to contribute a new base layer of services to unleash spatio-temporal Earth data at large for multidisciplinary research in EOSC, and a second layer to demonstrate the capacities in the multidisciplinary showcases. Each and every work package in the work plan of the proposal intensively works in this direction.
The **progressive federation of the services and resources** under the	CLOUDator contributes to the EOSC portal federation services by adding transversal geospatial services addressing many parts of the

awarded proposals, together with the progressive connection of ESFRI research infrastructures and thematic clouds developed under other parts of the Horizon 2020 programme, should allow the EOSC Portal to provide a catalogue that increasingly meets the researchers' needs covering the full research life cycle.	research life cycle such as data discovery (a catalogue), data access (datacube and sensor data), data processing (and modelling) and data visualization integrated in the EarthServer. It also offers pan-European and global Earth data services coming from the Copernicus Atmospheric Monitoring Service and Copernicus Climate Change Service as well as a collaborative data service for an Open Health Map. This work is accomplished in WP2.
All the grants awarded under this topic will be implemented in the same period so that they can work on potential synergies, and **coordinate in the overall service offering** as well as in **the communication and dissemination activities** to avoid overlaps and fragmentation. To this extent, proposals should foresee **dedicated activities for cooperation with the other selected projects** and earmark appropriate resources.	Coordination with other initiatives actively contributing to EOSC is important for CLOUDator. The project has three tasks directly contributing to it. From the management point of view Task 1.3 *Technical management and Quality Assurance* will manage the information flow connecting the project management with other EOSC project management and the EOSC secretariat. The communication of the project will be coordinated with other projects in the Task 5.2 *Communication in coordination with INFRAEOSC*. Finally, communication or dissemination activities organized by more than one EOSC-related project will be managed by Task 5.4 *Organization of activities aligned and coordinated with other selected projects*.
(a6) Additional research enabling services	**How CLOUDator will address the challenge area**
[…] Services should be of a **generic value to the whole research community**, such as text and data mining or **Copernicus services**.	Geospatial services and Copernicus data services in WP2 have generic value for the research community at large, far beyond Earth scientists, given the importance of such data for virtually every field of research. The added value is demonstrated in the showcases provided by WP3.
Scope of topic *(continues)*	**How CLOUDator will address the scope**
[…] The proposals have to be **flexible** in order to take into account all the relevant governance and business models, rules for participation, operational requirements, standards, etc. in accordance with topic INFRAEOSC-03-2020.	We will be flexible in order to take into account all the relevant governance and business models, rules for participation, operational requirements, standards, etc. The consortium already unites several distinct models, hence is prepared to embrace further ones. The task that deals with the EOSC registration into the EOSC Portal, and in charge of taking care of the EOSC requirements, is Task 4.4: *EOSC portal integration.*
Only platforms and services based on **mature systems** and technologies will be supported. An initial phase to reach the maturity needed for the integration to the EOSC Portal may be foreseen.	A mature Minimum Viable Ecosystem (MVE) of geospatial services (at least at TRL7) is contributed to the proposal from the beginning as a background from each respective partner (that will be enumerated in the GA). All services used are at high TRL, such as the Big Datacube engine, rasdaman, being in operational use on Petabytes. Further steps to connect to EOSC following the EOSC technical specifications are foreseen in WP2. The project will then test the MVE services in selected showcases in WP3 and produce other services. All proposed showcases are not new and already have mature user interfaces that will also be adapted to the EOSC requirements forming the second layer of services developed in WP3.
The **services** have to be **persistent** and adapt to the emerging needs of the EOSC users and the underlying technologies. They also need to be **modular** in order to be used with heterogeneous ICT services such as cloud, data management services, data archives, data processing, etc.	The proposed services will use the modular architecture developed in Task 2.1 *Integrated CLOUDator Big Data Analytics services* with internal and external interfaces all based on open standards. The contributed services are permanent and will remain permanent with the support of Task 2.5 *Sustainability options for EOSC services*. The four showcases developed in the project will also become permanent services through Task 3.3 *Transform multidisciplinary showcases into EOSC permanent services.*

They should be **intuitive** to be used by various users with different profiles and digital competence levels.	A wide range of visual and programmatic clients will be available offering intuitive user interfaces; this will encompass a range of 3rd party clients together with integrated clients and control panels developed in Task 2.4 *User interfaces for multidisciplinary research*. User feedback on the user experience will be collected in Task 4.3 *Scientific discussions and user feedback.*
They need to demonstrate **added value** to the EOSC Portal users and quality/reliability, through the use of certified mechanisms and standards including any accreditation and certification schemes anticipated under EOSC.	Added value of the services will be determined in Task 3.4 *Assess the added value of the multidisciplinary approach and define business models*. The testing and certification according to service standards is provided in Task 4.1 *Interoperability and technical specifications in EOSC*, and lessons learned will be disseminated in Task 5.5 *Collaborate with standards and best practices organizations.*
They should **comply with FAIR** (findable, accessible, interoperable and reusable) principles and standards produced under well-established initiatives (e.g. RDA).	OGC standards technically enable the implementation of the FAIR principles; WP2 and WP3 services will explicitly address FAIR principles. CREAF, RAS, 52N, and SECD have long-standing experience with these standards through active participation in OGC. A white paper on how to use geospatial standards for improving FAIR practices in Earth data and training activities to use services respecting the FAIR principles will be developed (Task 5.6 *Training*).
To the extent possible, services should facilitate the **re-use of research data** for innovation by diverse stakeholders, including the public and commercial sectors.	RAS, ECMWF and BSC have abundant experience in creating user-friendly, scalable services for stakeholders, including the public and commercial sectors. CLOUDator services and showcases transform remote sensing and climate data into interpretation ready data and services for a diversity of stakeholders beyond researchers (Task 3.1 *Co-create multidisciplinary showcases using multidimensional services and data*).
[…] Consortia must make active efforts to freely share, in a timely manner and as appropriate, standards, specifications and methodologies from their activities with the other projects awarded under the same topic in order to **foster** to the maximum extent **interoperability** between the different services.	Lack of interoperability prevents addressing grand societal challenges that require efficient data sharing and a multi-actor approach. Project participants unite a number of organizations devoted to the production of geospatial standards and implementations. CREAF, RAS, SECD, and 52N are already well-known standard *evangelists*. Agreements on standards with other projects have a specific Task 5.4 *Organization of activities aligned and coordinated with other selected projects*, and efforts to communicate this are foreseen in Task 5.5 *Collaborate with standards and best practices organizations.*
Grants awarded under this topic are expected to carry out an analysis regarding **energy consumption** and environmental impact of technologies used in the context of the project. The analysis should include an action plan in order to limit the carbon and energy footprint with a specific reference to key performance indicators and the standard EN 50600-4[6] together with a timeline for implementation of the defined milestones.	In Task 2.1. *Integrated CLOUDator Big Data Analytics services*, in collaboration with the management Task 1.2 *Technical Management and Quality Assurance*, will monitor and limit carbon and energy footprints. Energy consumption will be monitored, and efforts will be made to limit the energy consumption and opt for renewable energy-based data centres. Specifically, Big Datacube Analytics will demonstrate quantifiable energy savings through novel algorithms developed by RAS. User interfaces developed in Task 2.4: *User interfaces for multidisciplinary research* will present preliminary results to users, who will be able to approve them before computing at full resolution to prevent unnecessary executions. More information is provided in section 2.1.d.

1.3 Concept and methodology

1.3.a Concept

1.3.a.1 Overall concept

The current EOSC architecture developed by the EOSC hub is creating an excellent ground to enable big data analytics. The concept is based on proposing a set of common services that provide access to computing resources to the scientific community. On top of that, Thematic Services provided by Competence Centres are connected, ensuring specific discipline research at a big data scale. A set of standard interfaces and technical specifications are imposed on the Competence Centres services to ensure interoperability.

We observe the following **problems in the current approach**:

- **Perpetuates fragmentation**[6]. Data infrastructures are split by scientific and economic domains, by countries and by governance models. Access policies for networking, data storage and computing differ. Disconnected and slow data and computing infrastructures hinder scientific discovery, **create silos and slow down the circulation of knowledge**. Data sharing mechanisms will not necessarily enable multidisciplinary research if there is not a connection or relation among the data created by specific disciplines.
- The **lack of interoperability** prevents addressing big societal challenges that require efficient data sharing and a multi-actor approach.
- There is **no consideration** of **multidisciplinary services** that enable research – for example, non-geo-scientists (biologists, forestry experts, social statistics, etc) cannot exploit geo data effortlessly.
- **Low-level, prohibitively complex access.** Earth data are provided as huge, incomprehensible sets of files with cumbersome formats and inadequate sizings. Access – for example, to the DIASs – still requires substantial remote sensing and IT skills. The quest is for user-oriented services which are powerful but easy to use. Also machine-to-machine access requires substantial programming effort.

Our proposal recognizes that many current Competence Centres in EOSC are already developing Earth science research and they should come together into a multidisciplinary environment catalysed by geospatial standards. CREAF has worked on mapping the different research networks and their relations in the ConnectinGEO project[7] reflecting on the ENVRI-community[8] as well on the harmonization standard efforts that they have embraced, such as: SeaDataNet, EPOS, ICOS and eLTER. Despite they are early adopters of the EOSC hub, we have not seen evidence of any demonstration of true multidisciplinary research.

Research infrastructures are not able to cover the whole world systematically with their in-situ observations networks and campaigns. To allow for a comprehensive coverage of the Earth on a regular basis, the European Commission and ESA are promoting the Copernicus programme which relies on vast amounts of data collected by satellites already complemented by the in-situ component[9]. Copernicus is the third largest data provider in the world. In order to cope with these big data flows, a robust and reliable data infrastructure is needed. The produced datasets are exposed via the Copernicus service portals that cover six thematic areas: land, marine, atmosphere,

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0178&from=en, page 4
[7] http://www.eneon.net
[8] https://envri.eu/
[9] https://ec.europa.eu/digital-single-market/en/blogposts/open-science-and-copernicus-story-mutual-support

climate change, emergency management, and security[10]. All these data are then stored, analysed, organized and used in a wide variety of applications including environmental protection, agriculture, healthcare, human risk analysis and emergency responses after natural disasters.

Despite the tremendous potential of the **Copernicus services data, it has not been connected to the EOSC** yet. CLOUDator provides **Copernicus Atmosphere and Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S)** data into EOSC and unleash it in full for scientists of all disciplines. Integrating Copernicus services and Information Access Services (DIAS) into the service catalogue of the EOSC and combining them with powerful datacube analytics, CLOUDator will enable researchers to easily access and reuse these services.

CLOUDator will introduce two new layers of services (see Figure 1) that will enable multidisciplinary research by recognizing that the location and time in the data produced from the Competence Centres are the glue that enables multidisciplinary research demonstrated in showcase services.

With the proposed MVE (Minimal Viable Environment) combination of services as Layer 1, the CLOUDator project will demonstrate the capabilities of EOSC to conduct research to tackle complex challenges. For the showcase services as Layer 2 (see Figure 2), the project will focus on the impacts of climate change and air quality to human activities and risks (urban heat island, air dust transport and the COVID-19 pandemic as well as the challenge of sustainable energy supplies). The showcase topics address some important concerns covered by the UN SDGs[11] (SDG11 – Sustainable cities and communities, SDG7 – Affordable and clean energy, SDG3 – Good health and well-being and SDG 13 – Climate action):

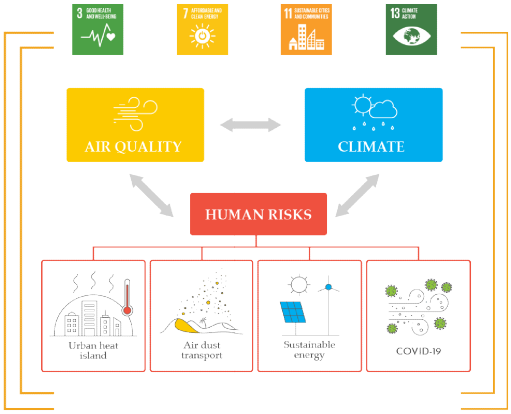


Figure 2: Focus of the CLOUDator showcases

- Improve urban health and promote investments in clean renewable energy
- Facilitate collaboration between energy and health sector decision makers
- Efficiently manage industrial emissions and excess urban heat

The showcases also contribute to the roadmap and key actions of the European Green Deal[12] in the following aspects:

- Clean, affordable and secure energy: Strategy on offshore wind
- Towards a zero-pollution ambition for a toxic free environment: Zero pollution action plan for water, air and soil

The concept is supported by previous successful experiences combining Earth data and geospatial standards to enable multidisciplinary applications such as:

- Spatial Data Infrastructure (SDI): An SDI is a data infrastructure implementing a framework of geospatial data, metadata, users, standards and tools that are interactively connected in order to use spatial data in an efficient and flexible way. It is commonly promoted by the government to

[10] https://www.copernicus.eu/en/services
[11] Accelerating SDG 7 achievement. Policy brief 10. Health and energy linkages - maximizing health benefits from the sustainable energy transition. https://sustainabledevelopment.un.org/content/documents/17486PB10.pdf
[12] https://ec.europa.eu/info/sites/info/files/european-green-deal-communication-annex-roadmap_en.pdf

stimulate transparency in environmental policies. The European Commission has invested a lot in the creation of the European SDI called INSPIRE that connects to national level SDIs.

- Global Earth Observation System of Systems (GEOSS): GEOSS is a set of coordinated, independent Earth observation, information and processing systems. GEOSS links systems using geospatial standards for monitoring the state of the Earth. GEOSS increases our understanding of Earth processes and enhances predictive capabilities that underpin sound decision-making. The main service of GEOSS: the GEO Discovery and Access Broker (GEO DAB) is included in the EOSC-hub and it is registered in the EOSC marketplace[13].
- The Digital Earth concept[14]: Digital Earth is a global initiative to construct a comprehensive virtual representation of the planet. It is a collaborative effort between Earth sciences, space sciences and information sciences to monitor and forecast natural and human phenomena. The use of geospatial standards enables the academic exchange, science and technology innovation, education, and international collaboration towards Digital Earth.
- Earth Critical Zone (ECZ): It is the place where natural interactions and processes takes place, a layer at the surface of our planet (the Earth Living Skin) where rock, soil, water, air and organisms interact. Earth science disciplines collaborate in the study of ECZ geolocated sites.

Indeed, some other elements registered in the EOSC marketplace recognize its geospatial component such as the EarthWatch, the EODC Data Catalogue Service, the AGINFRA+ Geoanalytics Visualization, the Remote Monitoring and Smart Sensing, etc[15].

All previous efforts show us a way forward in the consolidation of combining Earth data and geospatial standards to enable multidisciplinary applications proposed by CLOUDator.

1.3.a.2 Related concepts

As a starting point CLOUDator is based on two consolidated aspects that are fused in the methodology: multidimensional array and the data produced by Copernicus services.

Multidimensional data cubes

The multidimensional datacubes, originally invented[16,17] and early patented by the rasdaman team[18,19], have been pioneered by rasdaman since then. With its 160+ papers including high-ranking VLDB and SIGMOD, rasdaman has coined the research field of Array Databases. Today, datacubes are an accepted cornerstone for Analysis Ready Data (ARD). Given this importance and based on the trailblazing done by rasdaman, a series of epigones is appearing recently, as has been summarised in the 2018 Research Data Alliance (RDA) report[20]:

- Array DBMSs like SciDB, SciQL, PostGIS Raster, Oracle GeoRaster, EXTASCID, Teradata; more recently, venture-backed US TileDB is gaining traction and might soon become a serious contender to rasdaman.
- Enhanced Python programming interfaces like ODC (Open Data Cube, based on x-array), OPeNDAP, Ophidia, boost::geometry, Wendelin.core, ADAM: require substantial

[13] https://marketplace.eosc-portal.eu/services/geo-dab
[14] https://link.springer.com/chapter/10.1007/978-981-32-9915-3_20
[15] https://marketplace.eosc-portal.eu/services?service_id=&anchor=&sort=_score&q=geospatial
[16] P. Baumann: Language Support for Raster Image Manipulation in Databases. Proc. Int. Workshop on Graphics Modeling, Visualization in Science & Technology, Darmstadt/Germany, April 13-14, 1992, Springer 1993, pp. 236-245
[17] P. Baumann: On the Management of Multidimensional Discrete Data. VLDB Journal 4(3)1994, Special Issue on Spatial Database Systems, pp. 401-444
[18] P. Baumann, European Intl. Patent "Datenbanksystem zur Verwaltung von Arrays" (Germany, France, UK, Spain, Italy, Canada), PCT/DE 96/01583
[19] P. Baumann, US patent "Database System for Arrays" 6,272,501
[20] https://rd-alliance.org/system/files/Array-Databases_final-report_2018-03-19_0.pdf

coding skills and are insecure, less optimizable and scalable. ESA aims to provide ARD data cubes via ESA Data Cube facility service, but progress remains slow.

- Hadoop/Spark-based array tools (e.g., SciSpark, GeoTrellis): complex to use, inefficient.
- Google Earth Engine requires data to be uploaded to Google and is technically less elaborate, mainly relying on the virtually unlimited hardware resources and the global VPN of Google[21]).

Generally, such approaches are known to be poorer in functionality, less performant, and less scalable than a specialised full-stack implementation like rasdaman. Support of OGC to datacube standards is still scarce[22], with rasdaman standing out as reference and most comprehensive implementation today. The European EarthServer Datacube Federation[23] offers planetary-scale location-transparent access and analysis on multi-Petabyte assets, including DIAS Copernicus data, based on OGC standards such as WMS, WCS, and WCPS APIs plus with a variety of 3rd party clients. In the realm of Earth Observation data, the OGC coverage datacube and service suite is the accepted industry standard for spatio-temporal Big Data, adopted by further bodies like ISO and INSPIRE and implemented by a large and growing number of key tools.

Copernicus services data contributed to EOSC

As part of the delegation agreement with the European Union, ECMWF has implemented the Copernicus Atmosphere Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S). Access to the data from the two services is done via the Atmosphere Data Store (ADS) and the Climate Data Store (CDS) and the WEkEO Data and Information Access System (DIAS). All these data will be integrated into the EOSC portal as part of the datacube efforts. This is why the description of the content of both ADS and CDS is provided here.

CAMS aims at supporting policymakers, business and citizens with enhanced atmospheric environmental information. It delivers the following operational services: Daily production of near-real-time analyses and forecasts of global atmospheric composition; Reanalyses providing consistent multi-annual global datasets of atmospheric composition with a frozen model/assimilation system; Daily production of near-real-time European air quality analyses and forecasts with a multi-model ensemble system; Reanalyses providing consistent annual datasets of European air quality with a frozen model/assimilation system, supporting in particular policy applications; Products to support policy users, adding value to "raw" data products in order to deliver information products in a form adapted to policy applications and policy-relevant work; Solar and UV radiation products supporting the planning, monitoring, and efficiency improvements of solar energy production and providing quantitative information on UV irradiance for downstream applications related to health and ecosystems; Greenhouse gas surface flux inversions for CO_2, CH_4 and N_2O, allowing the monitoring of the evolution in time of these fluxes; Climate forcings from aerosols and long-lived (CO_2, CH_4) and shorter-lived (stratospheric and tropospheric ozone) agents; and Anthropogenic emissions for the global and European domains and global emissions from wildfires and biomass burning.

C3S, which cuts across all other Copernicus Services, delivers substantial economic value to Europe by informing policy development to protect citizens from climate-related hazards such as high-impact weather events; improving the planning of mitigation and adaptation practices for key human and societal activities; and promoting the development of new services for the benefit of society. It delivers the following operational services: Consistent estimates of multiple Essential Climate Variables (ECVs) covering a wide range of components of the Earth-system (atmosphere, land, ocean, sea-ice and carbon); Global and regional reanalyses (covering a comprehensive Earth

[21] https://www.sciencedirect.com/science/article/pii/S0034425717302900
[22] http://external.opengeospatial.org/twiki_public/CoveragesDWG/WebHome#Known_Implementations
[23] https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5ba56ec0d&appId=PPGMS

system domain: atmosphere, ocean, land, carbon); Products based on observations alone (gridded; homogenised station series; reprocessed Climate Data Records); A near-real-time climate monitoring facility; Multi-model seasonal forecasts; Climate projections at global and regional scales.

The service timescale spans decades to centuries (i.e., based on the instrumental record). It maximises the use of past, current and future Earth observations (from in-situ and satellite observing systems) in conjunction with modelling, supercomputing and networking capabilities.

1.3.a.3 Innovation activities linked with the project

Many partners of CLOUDator have been previously involved (or currently are) in projects directly related to the EOSC or the implementation of Big Data services. Table 6 includes the most relevant ones and a brief description. Section 4 includes a comprehensive list.

Table 6: Research and innovation activities linked with the project

Focus	Relevant projects/Activities and partners involved
Projects directly related to the EOSC	**COS4Cloud** (H2020): aims to integrate citizen science in the EOSC ecosystem (CREAF, SECD, 52N); **EOSC-hub** (H2020): brings together multiple service providers to create the EOSC Hub (RAS, BSC)
Projects related to other data hubs and platforms	**PARSEC** (H2020): supports SMEs from EO sector (food, energy, environment) using DIAS Copernicus datacubes. Is using Mundi DIAS and CreoDIAS as part of the EarthServer federation (RAS); **EOSC-hub** (H2020): Integrating and managing services for the European Open Science Cloud (RAS, BSC); **NextGEOSS** (H2020): European Earth observation data hub and platform to support the deployment of Earth observation-based applications and services (Deimos, UAB); **Marine-EO** (H2020): to implement a Cloud platform of EO services for the Marine environment monitoring (Deimos); **EO-VAS** (H2020): Earth Observation Design & Publishing Service that resulted in Sentinel Hub (SIN); **Landsense** (H2020): develops services for involving citizens in environmental monitoring, with the LandSense Platform (IIASA, SIN, SECD); **European Weather Cloud:** It is a federated community cloud and a joined initiative between ECMWF and EUMETSAT aimed at creating a federated infrastructure (ECMWF); **Data Cube Facility Service** (ESA): The main service for provision and distribution of satellite data offered by ESA (SIN); **DIAS ESA** (ESA) one of the four consortia to establish cloud infrastructure tailored to big EO data, focused to Sentinel missions (SIN)
Projects related to exploitation of Copernicus data and other services.	**Wekeo** (ESA DIAS): EU Copernicus DIAS reference service for environmental data, virtual processing environments and skilled user support (ECMWF); **Better** (H2020): implements a Big Data intermediate service layer focused on creating user-centric services to maximise exploitation of Copernicus data and information services (Deimos); **E-Shape** (H2020): Users' uptake of European EO resources, building on Copernicus and GEOSS through the development of co-design pilots (IIASA, CREAF, Deimos); **ConnectinGEO** (H2020): A gap analysis and prioritization study in the EO data and the creation of the European Network of Earth Observation Networks. (CREAF, 52N, IIASA)
Project where optimization of code to save energy is relevant	**ESCAPE** (H2020): Energy-efficient Scalable Algorithms for Weather Prediction at Exascale. (ECMWF, BSC); **ESiWACE** (H2020): Centre of Excellence in Simulation of Weather and Climate in Europe for Improving efficiency and productivity of numerical weather and climate simulation (ECMWF)

1.3.a.4 Governance and business models, rules for participation, operational requirements, standards in EOSC

CLOUDator is designed in a flexible way in order to take into account all the relevant governance and business models, rules for participation, operational requirements, standards, etc. in accordance with topic INFRAEOSC-03-2020. WP4 focuses on contributions to EOSC and requirements from EOSC. Task 4.4 *EOSC portal integration* specifically deals with the EOSC Portal requirements for the EOSC registration process. Task 4.1 *Interoperability and technical specifications in EOSC* deals with the implications of any interoperability and technical specifications that can come from the EOSC and how to combine them with geospatial standards. Task 4.2 *Authorization, licenses and GDPR* deals with authorization and licensing issues that can be changed by INFRAEOSC-03-2020. The new requirements can be anticipated by our link with the EOSC Working Group coordinated by the EOSC Working Group Panel (EWGP). The project is designed around flexible iterative loops and co-creation methodologies that will consider any new requirement that INFRAEOSC-03-2020 may introduce. The communication of the project will be done in coordination with other EOSC projects and Task 5.4 *Organization of activities aligned and coordinated with other selected projects* deals with the organization of dissemination activities aligned and coordinated with other selected projects such as INFRAEOSC-03-2020.

1.3.b Methodology

1.3.b.1 Overall methodology

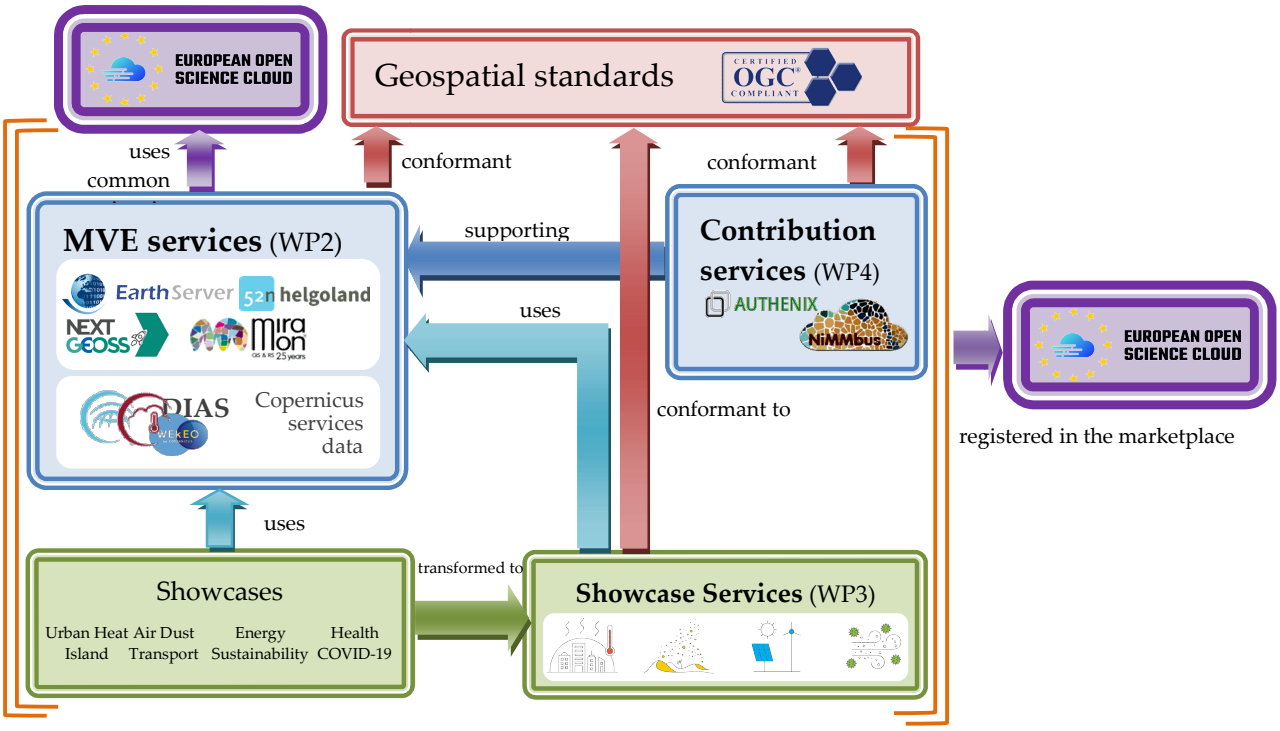


Figure 3: CLOUDator contributions to the European Open Science Cloud

The methodology is focused on producing multidisciplinary services by deploying two layers of services that will be provided during the project: Minimum Viable Ecosystem (MVE) services (WP2) and Showcase services (WP3). In addition, two services supporting the MVE services are presented as contributions to EOSC common services (WP4) (see Figure 3). All the services that will be deployed in EOSC are mature systems coming from partners' previous background.

1.3.b.2 First layer of services: Minimum Viable Ecosystem and Contribution services

First, we will focus on deploying a simple Minimum Viable Ecosystem with pre-existing mature geospatial services (initially at TLR 7), open data provided as part of the Copernicus programme and computing services (WEkEO) to ensure that the interactions among the different components yield a synergic benefit across all the participant actors. MVE will be available very soon in the project timeline (within the first year) and will be enhanced in incremental iterations. The MVE will be generic, interoperable, and flexible and will be able to serve the needs of the Earth Science communities and beyond. The MVE geospatial and data services will be tested in an operational environment, complete, qualified and certified reaching TRL 9. The first 6 services in Table 7 form the core of the MVE.

The last 2 services in Table 7, deployed in WP4, are two transversal contributions to EOSC that will complement the already existing EOSC common services in support of the EOSC hub requirements, such as authentication and authorization for services, geospatial user feedback and feedback.

As the contribution service for authentication and authorization, a combination of the current EOSC single sign on with the H2020 CLOUDator federation will be the starting point to provide authentication and authorization to the geospatial and data services as well as portals provided in the EOSC. It will be the goal to combine the EOSC and CLOUDator federated authentication with an extension service that allows applications and services to exchange personal information in a GDPR compliant way. To ensure the GDPR minimization principle, the extension will limit the personal information exchange based on different policies applicable to an application or service. In addition, the authentication extension generates a non-resolvable cryptoname-based identifier. Based on the unique cryptoname non-resolvable user profiles can be used for authorization. This is an important concept ensuring access rights management and harmonization across data and service providers independent from the actual operators. The use of unique cryptonames also ensures compliance with licensing conditions such as the annotation condition for CC-BY licensed data across different providers.

As a contribution to enable scientific discussion and user feedback in EOSC, and implementation of the Geospatial User Feedback approach that describes the user perspective on datasets/services is proposed. In the past, users of the data gained knowledge about and with the data, but they lacked the means to easily and automatically share this knowledge in a formal way. User feedback metadata complements producer's metadata and adds value to the resource description in a geospatial portal by collecting the knowledge gained by the user while using the data for the purpose originally foreseen by the producer or an innovative one. Not only that, but with proper extension, it can also be used to store code and algorithms (links to e.g., GitHub repositories), creating a system that brings together and links all the needed pieces: resources in the data portal (stored in GUF as citations), publications describing the usage of the resources, algorithms applied, lessons learned, and even problems encountered or alternate resources. All these elements can be described in a feedback item linked to the original data and thus exploitable for the portal itself or other users. In the EU H2020 NextGEOSS project, the NiMMbus system for Geospatial User Feedback and the NextGEOSS data hub have been fully integrated.

Table 7: MVE Geospatial services provided by the project

	[[SR1]] EarthServer.EU	[[SR2]] NextGEOSS data hub	[[SR3]] Helgoland Sensor Web Service	[[SR4]] MiraMon Map Browser
Current description	The EarthServer federation provides a single uniform data space of spatio-temporal Earth data and services: The European Copernicus Sentinel archives plus many more data assets are readily available for mix & match in a completely location-transparent way. EarthServer is an open community of large-scale Earth data providers. For these spatio-temporal raster data, the generic datacube engine, rasdaman, will be used. It offers OGC WMS, WCS, and WCPS APIs. The service established will tap into the European Datacube Federation, EarthServer, thereby making available the complete Copernicus archive, Petascale climate data sets, and a series of research institution's specific products.	NextGEOSS aggregates data providers, in Europe in a data catalogue. Private companies, public institutions, and even citizen scientists are doing their part. Users can work with open geo data to develop their own applications by following the API tutorials and documentation. This service will show how to integrate NextGEOSS in research and reporting workflows. The idea is to extend later the methods and the way to track and evaluate the performance and the KPIs for the development of this particular service to the rest of the CLOUDator services.	52N created the Helgoland Toolbox to facilitate the reuse of developments for Sensor Web client applications. It provides a range of modules that offer functionalities for building Web applications dealing with dynamic spatio-temporal data. The modules are used to build the Helgoland Sensor Web Viewer and additional applications (e.g. the BelAir app, smle, or the developments resulting from the TaMIS project). Recently it incorporates enhancement to connect to instances of the OGC SensorThings API, complementary mapping module based on open layers to support time-dependent background map layers, enhanced data export functionality, improvements in the diagram visualization, etc.	A long term developing effort to create a visualization, analysis and download service that runs in modern web browsers. It makes direct use of OGC standards such as WMS, WFS, SOS and GUF as well as ISO19115 metadata. The browser goes beyond common visualization and allow for dynamic use of the data based on the application of binary arrays and canvas, including analytical capacities and data quality. European Protected Areas managers use this technology as a result of the ECOPotential project: http://maps.ecopotential-project.eu/. Another public administration using this is the Andorran Government: http://www.incendis.ad/. It has been currently applied to the COVID-19 epidemic analysis: http://datacube.uab.cat/covid19/
Initial TRL	7	7	7	7
Expected TRL	9	9	8	8

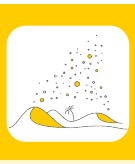
	[[SR5]] Collaborative mapping	[[SR6]] Atmosphere Data Store (ADS), Climate Data Store (CDS)	[[SR7]] Authenix	[[SR8]] Geospatial User Feedback (NiMMbus)
Current description	Built on the existing Geopedia application for collaborative mapping, we will collect data for COVID-19 at a high level of spatial granularity. Through a bottom up citizen-driven data collection approach similar to the concept of OpenStreetMap, we will develop the Open Health Map service to empower professionals to complement existing, national level COVID-19 related data sets with more detailed information and time series. Other datasets that can be crowdsourced are gatherings of people at certain locations (e.g., cultural, religious, sport, etc.), which are not currently available in any official data set. The system will be co-designed with the medical community, which will define the data sets that are currently missing but could be crowdsourced. From a medical perspective, these data sets are useful for correlation analysis and as inputs to machine learning algorithms to help provide new medical insights into COVID-19. An Open Health Map service will eventually become a more general spatial database containing crowdsourced information. The Open Health Map service will fully respect GDPR.	The ADS is a modular and distributed data and information system which provides access to CAMS datasets through unified web and API interfaces. In the current Beta version, data access is available to the Global Reanalysis, the Regional Analyses and Forecasts, the Solar Radiation Service, and the Inversion-optimised Greenhouse Gas Fluxes. Additional data are also available via a catalogue. The CDS provides a single point of access to a wide range of quality-assured climate datasets distributed in the cloud. CDS datasets include observations, historical climate data records, estimates of Essential Climate Variables (ECVs) derived from Earth observations, global and regional climate reanalyses of past observations, seasonal forecasts and climate projections. Access to data is open, free and unrestricted. Along with the data, the CDS includes a set of services for analysing and predicting the impacts of climate change. Users of the CDS can access these services to develop their own applications online.	A combination of the current EOSC single sign on with the H2020 CLOUDator federation will be the starting point to provide authentication and authorization to the geospatial and data services as well as portals provided in the EOSC. It will be the goal to combine the EOSC and CLOUDator federated authentication with an extension service that allows applications and services to exchange personal information in a GDPR compliant way. To ensure the GDPR minimization principle, the extension will limit the personal information exchange based on different policies applicable to an application or service. In addition, the authentication extension generates non-resolvable cryptoname based user identifier. Based on the unique cryptoname non-resolvable user profiles can be used for authorization. This is an important concept ensuring access rights management and harmonization across data and service providers independent from the actual operators. The use of unique cryptonames also ensures to comply with licensing conditions such as the annotation condition for CC-BY licensed data across different providers.	The NiMMbus system has been implemented as an interoperable solution to manage and store feedback items following the OGC Geospatial User Feedback (GUF) standard. NiMMbus can be used as a component in any geospatial portal as it allows citations to any resource to be described in such portal. A feedback item about a resource (or a group of them) can include many elements such as ratings, comments, usage or related publications. NiMMbus has been integrated so far in NextGEOSS Data Hub (and in other H2020 portals such as ECOPotential, GeoEssential and GroundTruth2.0). Some of these portals use MiraMon Map Browser [[SR4]] and include analytical or modelling tools. Thus, user feedback capabilities will be extended in CLOUDator to capture the reproducible knowledge created by users when exploiting the analytical features of the map browser or when creating additional lineage steps or quality elements related to a certain resource.
Initial TRL	7	7	7	7
Expected TRL	9	9	8	8

1.3.b.3 Second layer of services: Multidisciplinary showcase services

On top of the MVE, four scientific questions have been selected and research on the best way to improve and deploy showcases as services will be conducted. Showcases are user oriented and selected in order to exemplify the interaction between climate, air quality and human activities and risks, to address some important concerns covered by the UN SDG3, SDG7, SDG11 and SDG13). As soon as the MVE of services are ready and during the second year of the project, the showcases will evolve into mature showcase services that transfer the knowledge into an application that scientists, companies and decision makers can use alike. The showcase services use the MVE services and EOSC common services as a backbone. This is the role of WP3. The four showcases and their derived services are described in Table 8.

Table 8: Showcases and resulting services

[[SC1]]	**Risks to humans derived from climate, air pollution and heat in urban areas**	
Showcase: The Urban Heat Island (UHI) can be felt through increased temperatures in urban areas, which are the result of large amounts of impervious surfaces, a lack of vegetation and concentrated urban structures. Prolonged periods of heat wave in cities have already been shown to negatively impact human health and well-being; with climate change, the UHI effect will only be intensified in the future. At the same time, cities face problems with ambient air pollution, with many cities failing to meet EU and WHO air quality guidelines. By identifying where the current risks of both the UHI and air pollution are the highest in a city, urban planners can implement targeted strategies to combat both problems. The UHI hazard index is first calculated by considering those drivers that cause and reduce the UHI effect. Drivers that cause UHI hazard include meteorological (climate and seasonal scale) factors related to periods of high temperature (available from C3S) and the amount soil sealing and land cover colour. ***Resulting service:*** A spatially explicit UHI risk index is calculated using inputs from multiple domains including: meteorological (climate and seasonal scale) indicators (provided by the Copernicus Climate Change Service, C3S), maps of land cover and impervious surfaces from the Copernicus land monitoring service (or customised LULC maps produced ad-hoc using satellite imagery and the algorithms with best results), building information where freely available to determine shading effects, and demographic indicators, e.g., gridded population data sets available on the EOSC. The UHI hazard index is produced at a resolution of between 100 m to 1 km^2 (depending on data availability), and the UHI risk index is then calculated by considering the population at risk, the number of people employed at workplaces, etc. The resulting UHI risk index map is coupled with information on air pollution (available from satellites such as Sentinel-5 as well as modelled from available monitoring stations) to consider the effect of both risks. Data inputs can be selected, and land cover maps optimized.		
Disciplines: Climate - Air quality/pollution - Urban heat - Health		***Expected TRL: 7***
Main partners involved:	IIASA, ECMWF, RAS, DEIMOS	

[[SC2]]	**Climate change implications in dust transport and risks for humans in arid regions**	
Description: For countries in and downwind of arid regions, airborne sand and dust presents serious risks to the environment, property and human health. Impacts on health include respiratory and cardio-vascular problems, eye infections and in some regions, diseases such as meningitis and valley fever. Dust can carry irritating spores, bacteria, viruses and persistent organic pollutants. It can also transport nutrients to parts of the world oceans and affect marine biomass production. Other impacts include negative effects on the ground transport, aviation, agriculture and generation of solar energy. The Inter-Governmental Panel on Climate		

Change (IPCC) recognizes dust as a major component of atmospheric aerosol that is an essential climate variable. More and more dust particles are considered by atmospheric researchers to have important effects on weather through feedback on atmospheric dynamics, clouds and precipitation formation.

Resulting service: The Sand and Dust Storms Warning Advisory and Assessment System (SDS-WAS), under the umbrella of the World Meteorological Organization, aims 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 SDS-WAS collects and runs several Numerical Weather Prediction (NPW) models from worldwide partners (including CAMS) and delivers a wide range of products and services (e.g. https://sds-was.aemet.es/forecast-products/dust-forecasts), among them ensemble forecasts, forecast evaluation scores against observations, warning advisory systems and numerical data and plots dissemination.

Disciplines: Climate - Air quality - Dust transport - Health	***Expected TRL: 8***
Main partners involved:	BSC, RAS

[[SC3]] Impacts of climate change and air quality in renewable energy supplies

Description: Energy supply and demand are strongly influenced by weather conditions and their evolution in terms of climate variability and climate change. The energy network operators need to attain a balance between electricity supply and demand at all times. The increase of renewable energy sources in the energy mix is central to the global effort to move to less carbon-intensive economies that support the UN SDGs, but it also brings some challenges: the generation of and operational planning for renewable energy are strongly affected by weather, climate and air pollution (for solar), which cause wide variations in both energy supply and demand. The Global Framework for Climate Services (GFCS) is leading international efforts to enhance the quality, quantity and application of climate information and predictions in support of decision-making by renewable energy producers.

Climate predictions including both sub-seasonal (up to one month) and seasonal (for the forthcoming 6 to 7 months) have witnessed considerable improvements in the last decade, demonstrating the probabilistic forecasting can inform decision-making. In particular, understanding and quantifying climatic conditions from several weeks to several months can improve the decision-making of wind, hydropower and solar energy generation. It can also help to better predict energy demand, and therefore, to ensure that energy supply matches the actual demand of electricity.

In the case of wind energy, the showcase scope will be extended to support longer time-scale decision making. It will help wind farm builders in the selection of optimal sites for future (decadal timescale) wind farms, based not only on historical data (e.g. Global Wind Atlas) but also in regional scale climate change scenarios data produced by CORDEX and made available in the Climate Data Store. Based on this past and future data, wind energy production estimates will be produced, translated into several industry standard wind farm operation indicators. This application will help decision makers to easily compare energy production estimates for different possible site location options. The development of this application will be driven by the requirements of EDP, the main Portuguese energy producer and distributor, for the selection of offshore wind farms in the Portuguese coast.

Resulting service: The S2S4E is a Decision Support Tool (DST) providing prediction skill scores for different variables related to the different energy sectors. For example, wind resource time-series is used to calculate the Annual Energy Production (AEP), simulated by transforming the wind speed time series via the power curve of the wind turbine at the site. The estimate of the distribution of AEP allows comparing the suitability and nominal power capacity of different sites in terms of potential power generation. The LCOE as a field level (i.e. the present value of all costs divided by the present value of all energy produced over the energy project's lifetime) can be presented.

Disciplines: Climate – Wind – Air quality/pollution (for solar) – Renewable Energy	***Expected TRL: 8***
Main partners involved:	BSC, DEIMOS

[[SC4]]	**Climate and air quality interactions with human health risk for COVID-19**	

Description: In this showcase, spatial datasets (including from downstream services) from Copernicus such as land cover, weather/climate, air quality (e.g., Sentinel 5 derived NO2 concentration, CAMS datasets), as well as datasets from the medical/epidemics statistics (e.g., data from the COVID-19 dashboard from the Complexity Science Hub Vienna) and other relevant datasets (e.g., a population remoteness map derived from population accessibility) will be combined using statistical and machine learning methods. The Geopedia Open Health Map service describes measures taken at different administrative levels and reports of social gatherings clusters. This dataset will be used as a key layer for analyses to demonstrate how new relationships between disciplines impact each other.

COVID-19 health data (such as deaths, incidences, estimated undetected cases, etc.) will be combined with previous spatial datasets in order to determine the true factors which affect its spread.

Resulting service: A natural upgrade to these products would be to provide a service that enables flexibility to users in selecting areas, locations, graphical display of data and the possibility to map air quality to other societal variables. The showcase will be developed into a service where different methods of exploratory spatial analysis will be available, including simple correlation analysis as well as more complex methods such as Bayesian and multi-level analysis, econometric models and machine learning algorithms. The analysis service to be developed in this showcase will be co-created with the medical community and other stakeholders such as public authorities, regional and national decision makers as well as the research community at large.

Disciplines: Climate - Air quality - Health (COVID-19)	***Expected TRL: 7***
Partners involved:	IIASA, ECMWF, CREAF, UAB

1.3.b.4 Co-creation process with stakeholders

The overall development of showcases and their derived services is based on a co-creation methodology. Stakeholders are crucial in the project and will be defined in Task 3.1 *Co-create multidisciplinary showcases using multidimensional services and data* and task 5.1 *Target audience definition* to participate in several steps (see Table 9). At the beginning of the project, the showcase research questions will be presented to the stakeholders and feedback will be collected. On month 12 the showcase service definition will be presented to the stakeholders including the PAB and the EOSC Working Group Panel, to consider their feedback. The service will be presented and further analysed in month 18 coinciding with the registration in the EOSC marketplace. Feedback from the co-design sessions as well as feedback from users in EOSC will be considered in subsequent development iterations to have a perfect match between CLOUDator and EOSC expectations. Stakeholders will be requested to attend to the demonstration event by the end of the project and present their experiences.

1.3.b.5 Activities workflow

The methodology of this project integrates a fast deployment of MVE services in EOSC (WP2), the research cycle in defining showcases (WP3, Task 3.2), the showcase service co-creation refinement and deployment in the EOSC portal (Task 3.1 *Co-create multidisciplinary showcases using multidimensional services and data* and Task 3.3 *Transform multidisciplinary showcases into EOSC permanent services*) and the added value and business model description (Task 3.4 *Assess the added value of the multidisciplinary approach and define business models* and Task 2.5 *Sustainability options for EOSC services*) (Figure 4). The methodology is presented in a sequence to better understand the progress achieved in the project. Note that Figure 4 does not represent the actual timeline of the project, which has been designed with parallel activities and agile iterations.

The time frame of 30 months of the project is optimal for such an incremental and agile, fast methodology where MVE geospatial and data services will be deployed in parallel with the showcases. It requires dedicated planning to synchronize the deployment of Geospatial and Copernicus Services (data) and the co-creation and execution of showcases. Thus, the showcase services will be produced at the same time that the MVE services are adjusted and corrected. The proposed sequence of activities is presented in a timeline shown in Table 9.

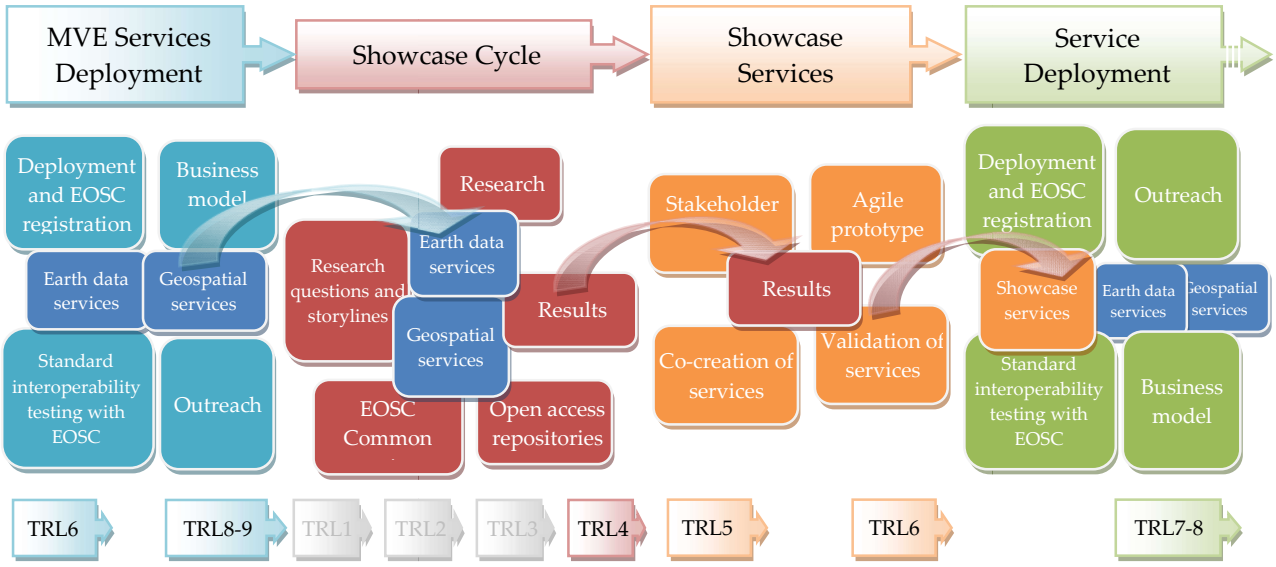


Figure 4: General methodology that integrates the research cycle, the service co-creation, the registration in the EOSC portal and business models.

Table 9: Master schedule for the MVE Geospatial Services and the Showcase Services that run in parallel

Month	MVE Geospatial Data Services (WP2)		Co-created Showcase Services (WP3)	
	Activity name	Actions	Activity name	Actions
1-2	Deployment roadmap requirements for integration to EOSC, and energy consumption	Co-creation with WP3	Research question presented to the stakeholders	Showcase presentation
3-4	Architectural design and initial deployment	Design and Deploy	Analytic study using MVE in WP2	Modelling
5-9	MVE geospatial and data services testing in EOSC	Integration		
10-11	Inclusion in the EOSC portal	Registration		
12	Service adjustments and correction iterations (input form WP3)	Agile loops	Showcases service definition with stakeholders and the PAB	Co-creation 1
13-18			Showcases service design and implementation	Coding
18			Showcases service revision with stakeholders Inclusion in the EOSC portal	Co-creation 2 Registration
19-26			Adjustments and correction (agile)	Agile loops
27-28	Demonstration	Demo	Demonstration	Demo
29-30	Reporting	Writing	Reporting	Writing

1.3.b.6 Consideration of the Gender and Sex dimension

Following the indications of the template this section does not discuss the gender balance in the team in charge of carrying out the project that will be further detailed all along of the Implementation section but to the content of the planned research and innovation activities.

The promotion of gender equality will be pursued during the course of the project contributing to the empowerment of women or other underrepresented groups by means of a) raising awareness outside the consortium/research team by taking gender issues into account during targeted dissemination activities, (b) giving special care of the language used in communication, dissemination, engagement and participatory activities, as well as the gender balance in the participatory activities, (c) documents will be written in a gender-neutral language and all digital products will use non-discriminating photos, images or languages; (d) branding colours will be chosen to be gender inclusive; (e) promoting active participation of female citizens in the participatory processes if any (supporting the exchange of experiences, information and advocacy); (f) raise the quality of the interventions and create an environment to favour the minorities. Special mention to the development of showcases and showcase services and inherent proposed process of co-creation, where inclusiveness at all levels will be sought, both in terms of gender and communities, taking account of the socio-cultural differences (WP3). In addition, empowerment of girls and women will be fostered through education and training in the EOSC systems (WP5). Finally, depending on the data collected in the showcases, and the objectives of the showcase services to be co-created, the gender dimension will be taken into account in the data collection strategies whenever it can influence the research results.

The integration of the gender dimension in CLOUDator will bring **tangible benefits** such as (1) higher accuracy in project results, (2) increase data quality, (3) help reduce gender bias in research, a major problem within the research community as for the society at global, but also **intangible benefits** such as (4) the research became socially relevant because it consider and impact on society itself (5) allow to tackle a problem not being traditionally addressed and (6) help researchers to identify new problems not being considered before.

1.3.b.7 Cost of a unit of access

Access costs are declared on the combination of unit cost and actual costs. The WEkEO DIAS (based on its current pricelist) will be used for hosting most of the CLOUDator as it offers the climate data required and Sentinel datacubes. RAS, as the “Big Data” maintainer, will operate the service for CLOUDator over its runtime. VM sizing will be adjusted, starting with a Small model of 8 vCores and 7 TB (~3400€/y) and upgrading as necessary, as by then CLOUDator will become part of the EOSC market place and, hence, likely attract further users. Catalogue, sensor service, and the Open Health Map will each have a D-light model VM (~800€/y). DEIMOS has estimated the cost of cloud deployment with high availability as 100 €/month for the first 6 months and 1200€/year for the rest of the project. 52N has estimated the cost of cloud deployment with high availability as a total of 1586€. SECD has estimated the cost of cloud deployment with high availability as a total of 10500€. SIN has estimated the cost of cloud deployment with high availability as a total of 1000€/month for the first year and 7000€/year for the rest of the project. Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of users are also considered.

Table 10: Total estimated eligible costs for units of access.

Participant		Other direct cost	Personal cost	Indirect costs	Eligible cost (€)
3	RAS	38754	28668	16855	84277
4	DEIMOS	3000	24600	6900	34500
5	52N	1586	12000	3396	16982
7	SECD	10500	26400	9225	46125
9	SIN	20000	16800	6700	46000
Total		73840	108468	43077	227885

1.4 Ambition

The main ambition of this project is **to move EOSC from specific discipline-silo research into truly multidisciplinary scientific research** in the domain of the Earth Sciences by adding services to EOSC based on location and time.

To do that, we have the ambition to use **location and time aware services as the enabler** for multidisciplinary research. This ambition is realized by another ambition: **bring interoperable, scalable geospatial services** to the Earth science community. EOSC is currently defining a set of international standards to bring order to its infrastructure. We have the ambition to include the relevant Open Geospatial Consortium **geospatial standards** (the emerging OGC API, WMS, WMTS, WCS, WCPS, WFS, SOS, SensorThings API and GUF) **as part of the EOSC technical specifications** to ensure integration of geospatial services with EOSC common services. We want to **simplify** the use of geospatial web services for scientists by integrating a high performance easy-to-use **client front-end** and user interfaces that hide the details of the service implementations.

EOSC has already integrated some of the ENFRI infrastructures providing in-situ observations. We will **bring high level remote sensing products** to complement the in-situ networks maintained by the research infrastructures to offer scientists a **global coverage** in a level of granularity that in-situ networks cannot provide.

We have the ambition to **prove EOSC as a proper solution** to face and solve global, complex and interrelated problems that will be more and more frequent in the near future.

Specifically, we have the ambition to:

- Bring data provided by **two Copernicus services** (CAMS and C3S) into EOSC services. We also have the ambition to apply the **multidimensional datacube** concept to **orchestrate** coverage services, catalogue services, sensor services and vector services **together in EOSC** and connect them to Earth science datasets provider both by the Remote Sensing and in-situ research infrastructures. Further, by way of an international federation all data of the federation partners, such as several DIASs and research data providers, will be immediately available.
- Implement the appropriate **visualization client** for each service, to reach the needs of **users with different expertise levels**. This will be achieved with an affordable effort thanks to the strict commitment to OGC standards and services supporting them.
- **Showcase multidisciplinary** research in four dedicated showcases combining **Climate Change and Air quality** to better monitor and manage the impact and **risks for human** activities. We have the ambition to implement these showcases in EOSC and transform them into permanent

services that **quantify the effects** of heat islands and air quality in cities, dust transport and storms and the impact that climate change will represent. We have the ambition to provide a service to determine climate change and air quality in renewable energy consumption and production. We have the ambition to aggregate the pandemic evolution into a collaborative map to improve the level of granularity in the data and collect other human behaviours that minimize propagation of pandemics and apply them to further waves of COVID-19 or any other virus pandemic. Through the analysis of the showcases, we have the ambition to assess the added value of the multidisciplinary approach and define business models that take advantage of it.

- Contribute to EOSC an improved approach to the current authentication and authorization services in EOSC to allow not only user access to services (the current situation) but service-to-service communication, respecting user privacy and GDPR to allow multiple services from different disciplines to be connected.
- Contribute a scientific discussion and user feedback standard service to EOCS to allow scientists to report back difficulties and experiences about the data and services they use. The service also allows knowledge to be organized by linking to resources, for example, to publications and reproducible usage descriptions (i.e., code stored in repositories such as GitHub).

2 Impact

2.1 Expected impacts

CLOUDator contributions to each of the expected impacts in INFRAEOSC-07-2020 work programme are listed here, as well as other relevant impacts not mentioned in the call, regarding the European role in research infrastructure and in the Earth sciences domain in particular. When possible, indicators and KPIs are provided to monitor the performance of the project in achieving the expected impacts as well as the expected value of the indicators and means of verification.

2.1.a Contribution towards the expected impacts stated in INFRAEOSC-07-2020 topic call

Details about how CLOUDator will contribute to the INFRAEOSC-07-2020 impacts are provided here in a tabular from for each of the impacts in Table 11.

Table 11: Contribution to the expected impacts

Scale up the EOSC Portal through a growing catalogue to the broadest possible set of high quality services and resources supporting the whole research life cycle from service providers across Europe and beyond
CLOUDator will provide a set of high quality services and resources through developments foreseen in WP2 that will build a Minimum Viable Ecosystem of **geospatial services layer** for the EOSC platform. New data provided by the **Copernicus Atmosphere Monitoring Service (CAMS)** and the **Copernicus Climate Change Service (C3S)** will be available in the EOSC portal and will provide additional multidimensional services for the European research community exemplified in the set of CLOUDator showcases. WP3 will also work on the development of the showcases in close relation with end users that will be transformed into permanent **services** that will be also added as a service into the EOSC portal. The inclusion of a **collaborative dataset creation** system based on Geopedia and on the Geospatial User feedback which is based on NiMMbus will become two special additions to the portal. All of these, will help to increase benefits of better use of data, including greater productivity and competitive markets in Europe.

KPI	Verification	Expected value
Number of MVI services registered in EOSC	EOSC portal	4
Inclusion of dataset from Copernicus Services	rasdaman offerings	10
Number of services added by the showcases	EOSC portal	4
Collaborative dataset creation service	EOSC portal	1
Geospatial user feedback service	EOSC portal	1

More scientific communities across Europe are equipped and have access to state-of-the art services (including storage and computing) for their research activities, increasing data-intensive research.

CLOUDator incorporates data from **2 Copernicus Services** into the EOSC hub, related to Atmosphere composition and to Climate Change, which will increase resources for those specific scientific communities. CLOUDator also supports epidemiologists into EOSC by providing the mechanism to create **collaborative geospatial databases for health** and, thus, contributing capacity for the European health data space. By contributing services: the robust MiraMon Map Browser software, the pioneer, worldwide leading datacube engine rasdaman and the 52N Sensor Web components (server and viewer), EOSC scientists will get **powerful Big Data Analytics Services** boosting progress in science, industry and transparent governance.

CLOUDator will also co-create the **multidisciplinary showcases services** together with stakeholders using multidimensional services and data. We will consider the needs of various users with different profiles illustrate the value of the services. CLOUDator will implement **user interfaces** adapted to research community and users' needs and will complement the services' documentation with experiences through a scientific dialogue and user feedback (connected to data) system in the EOSC portal.

KPI	Verification	Expected value
Number of users of data from Copernicus Services	rasdaman logs	200
Number of participants in the collaborative geospatial databases for health	EOSC portal – Open Health Map	30
Number of users of rasdaman, Helgoland and MiraMon	EOSC portal	200
Number of stakeholders participating in the showcase's co-creation	Showcases co-creation minutes	30
Number of contributions made in the NiMMbus system	NiMMbus system logs	100

Facilitate Open Science practices across the research community in Europe with services to connect, share and re-use all type of research outputs, fostering collaboration and enhancing scientific discovery.

CLOUDator services will support FAIR principles to ensure data stewardship across borders and disciplines. Petabytes of open data will become available in the rasdaman datacube. The same datacube will be used for making results and data models open so allowing combinations and re-uses. CLOUDator will **extend the current Authentication and Authorisation Infrastructure (AAI)** to allow services to work together communicating data and respecting sensible and personal information, adjusting login mechanisms to GDPR needs.

CLOUDator will help researchers in the implementation of FAIR and data management principles through white papers and **training activities**. Through collaboration with standards and best practices organizations, interoperability of Earth data will be disseminated and communicated.

CLOUDator will contribute to this impact also through the integration of geospatial services and Data in the **EarthServer** system, allowing for the integration of remote sensing, in-situ, collaborative data and modelling, and maintaining and strengthening European leadership in Big Earth Data services which are actively used in science, engineering, business, and agencies.

KPI	Verification	Expected value
Datacube engine and API available	EOSC portal	deployed
Current AAI system extended and running	EOSC portal	Done
OGC standards adopted in all datacubes	Datacubes documentation	Done
White paper on use of the services with FAIR principles	EOSC portal	Published
Training activities with FAIR principles	EOSC portal	Delivered
A set of communication actions to disseminate and communicate interoperability of geospatial data	Log sheet	5 actions in several forms
Integration of geospatial services and data in the EarthServer system	EarthServer system	Done

Support the collaboration in data provision and exchange across regional and national related infrastructures allowing the integration of data from a myriad of resources and research communities.

The geospatial services are designed to integrate data from different regions and nations in a single dataset. The integration of Copernicus services data is just the starting point. This is particularly the case for **collaborative datasets on health** related to COVID-19 pandemic as well as with the space based services that, by definition, does not have any physical borders.

CLOUDator will work in close collaboration with **standards and best practices organizations** to implement several features in EOSC platform that will facilitate and promote information exchange and data availability from distinct sources. CLOUDator will promote the interoperability of services by considering standardization in all the processes and by creating a **white paper on how to use geospatial standards** to improve FAIR practices. On a first level, CLOUDator will extend the current **AAI system** to allow services to work together communicating data and respecting sensible and personal information, taking into account authorization, licences and the pan-European GDPR. This will enhance EOSC use of protected (valuable) data and services by providing seamless authentication and authorization as a service.

CLOUDator will also provide a set of services working together in harmony by the integration of geospatial services and data in the **EarthServer platform** and European Datacube Federation.

KPI	Verification	Expected value
Number of participants in the collaborative geospatial databases for health	EOSC portal – Open Health Map	30
Current AAI system extended and running	EOSC portal	Done
Integration of geospatial services and Data in the EarthServer system	Other EarthServer members list CLOUDator data	Demonstrated live
Integration of the enhanced-ARD datacubes in the European Datacube Federation	Fusion queries across data centers	Demonstrated live
A set of communication actions to disseminate and communicate interoperability of geospatial data	Log sheet	5 dissemination actions
White paper on how to use geospatial standards for improve FAIR practices	EOSC portal	Published

Foster synergies between pan-European e-infrastructures operators, leading to harmonised services, improved use of resources and economies of scale across Europe.

CLOUDator will implement into EOSC services a set of already existing, multisource data and infrastructures, most of them developed within previous European funded projects. Key services interfacing with research infrastructures are the **NextGEOSS data hub** (developed within the NextGEOSS project) and the **52°North Sensor Web server/Helgoland Viewer** (developed by 52N for in-situ observations). Some of the infrastructures that CLOUDator will re-use and adapt to the EOSC platform are the **rasdaman data**

cube (developed by rasdaman GmbH) as well as the EarthServer federation, the scientific discussions and user feedback system **NiMMbus** (developed in the NextGEOSS project), the MiraMon map Browser (developed in the ECOPotential project) or the data provided by the Copernicus Atmosphere Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S). CLOUDator will engage existing research infrastructures to EOSC by going beyond layers (computing, data storage, use) and national and disciplinary silos, thus promoting the European leadership and sufficiency (scientifically and technically).

KPI	Verification	Expected value
Harmonised EOSC services following guidelines for interoperability in EOSC	EOSC Portal	5 EOSC services harmonised

Coordinate and incentivise institutional and public actors so that they open up their services and resources to researchers across Europe, through a transparent and quality assured process.
CLOUDator will incentivise institutional and public contribution to INSPIRE by adopting the same **geospatial standards** recommended and used by the infrastructure, facilitating information exchange and reuse by institutions and public actors improving the relations between government and science data. The project will enable the opening of both data and services in a way that services can communicate together in secured environment. CLOUDator will follow secure authentication policies so that services are secure and comply with the European authorisation and authentication policies. In Task 4.2, **authorization, licenses and GDPR issues** will be addressed in order to establish proper mechanisms for dealing with data communication and respecting sensible and personal information, which will provide transparent and quality assured processes.

KPI	Verification	Expected value
Interest from public actors in open up their services and resources	Acceleration on the deployment of some dataset	Two institutional or public actors sharing new resources

2.1.b Additional relevant impacts of CLOUDator

Apart from the impacts mentioned in the INFRAEOSC-07-2020 work programme described above, CLOUDator will also contribute to additional economic and institutional relevant impacts in the European research area that are listed below.

Table 12: Additional expected impacts

Increase the European leadership and self-sufficiency (scientific and technical) in the geoscience domain
With the launch of the first Sentinel satellites, Earth observation capabilities for the European Union increased, being the Copernicus one of the most important programs in the Earth observation sector today. CLOUDator will help in the exploitation of Copernicus data by the European research community by providing dedicated services for analysing, using and sharing geospatial information within the EOSC platform. A set of Copernicus services providing European generated satellite data ready for scientific exploitation will promote an **enhanced innovation capacity** of European researchers in the geoscience domain and will contribute to increase the European self-sufficiency and leading role in this field, by providing dedicated technologies for the scientific exploitation of European Earth observation data, including greater productivity and competitive markets.

KPI	Verification	Expected value
Number of datasets based on Copernicus services	rasdaman offerings	10

Multidisciplinary showcases to demonstrate the usefulness of the EOSC services
As already described, a complete Work Package (WP3) will be dedicated to showcase the capabilities of the EOSC infrastructure and the benefits this will provide to scientists, communities, decision makers and the commercial sector (see the EARSC Letter (LoS) in support this aim). Even if the Call's topic is not

requesting to create this impact, we believe that services can be provided in relation to showcases that are co-created considering all stakeholder types. The ultimate goal of the showcases is to help in estimating the added value of EOSC as a multidisciplinary environment, so that it can be extrapolated to the set of current and future services, instead of being a marketplace of isolated offerings for services and data as it is now.

KPI	Verification	Expected value
Number of showcase services	EOSC portal	4

Global effort against COVID-19

COVID-19 pandemic has resulted in an unprecedented global crisis. For the moment, it has led to a human, economic and financial impact that will have profound consequences in the short term. In this situation, questions are arising about how climate change will increase or decrease the spread of that kind of viruses in the future, or even whether there is a link between climate conditions and the severity of infections in a given place. A collaborative system will be created in CLOUDator to aggregate data from COVID-19 epidemic monitoring at the most detailed level possible. That data will be combined with those provided by the Copernicus Atmosphere Monitoring Service and the Copernicus Climate Change Service to estimate the socioeconomic impact of the pandemics at a local scale This will show the benefits in health, well-being, environment, transparent governance and public services of having a multidisciplinary cloud system.

KPI	Verification	Expected value
Collaborative detailed COVID-19 dataset	EOSC platform	Available
Combined COVID-19 and Copernicus data service	EOSC portal	Available

Scientific discussions and user feedback about data

The NiMMbus service will provide an innovative capacity in EOSC to create community: a place where scientists can provide comments about data usage, problems they have found and knowledge they have gained. Thus, not only services and data will be provided, but an enriched community-created database of feedback for products and data in EOSC. All this knowledge will create an impact in EOSC by increasing quality control of the data and providing an innovative form of peer review. Data search or service usage will be facilitated and simplified by the comments of the community, so researchers will benefit from **high quality services and resources supporting the whole research life cycle.** This will make a difference for EOSC towards the integration and use of data and services.

KPI	Verification	Expected value
Number of comments in the NiMMbus service	NiMMbus service	100

Recognition of geospatial standards as enablers for Earth Science research.

CLOUDator will give special importance to the adoption and dissemination of geospatial standards within the research community as enablers for Earth science research. CLOUDator aims to foster interoperability and harmonization between services in EOSC as a mean for improved Earth science research. For this reason, CLOUDator will contribute to the visibility of existing standards of OGC/ISO. In addition, they will actively drive own and other technically relevant specifications through the adoption process by discussing them with stakeholders in meetings, telecoms, email lists; facilitating meeting sessions. Finally, a white paper and a set of communication actions to disseminate and communicate interoperability of geospatial data will contribute to the recognition of geospatial standards as enablers for research in general and for Earth science in particular, promoting good practices in data sharing and reuse.

KPI	Verification	Expected value
Contribution to existing or new OGC, ISO, INSPIRE or GEOSS standards	Standard documentation	4 standards submitted to OGC with a beneficiary as co-author
Datacube standards promotion	Dissemination log	3+ presentations at dedicated open-source events
Datacube standards promotion	Book ISBN	1 book on datacube technology and standards.

Datacube standards adoption guidance	Datacube/services documentation	2+ specifications adopted where a beneficiary is co-author
Number of standards groups chaired	OGC website	3 SWG and 3 DWGs
A set of communication actions to disseminate geospatial interoperability	Log sheet	5 interoperability dissemination actions in several forms
White paper on how to use geospatial standards for improve FAIR practices	OGC website	Published

2.1.c Potential barriers/obstacles for achievement of the expected impacts

CLOUDator's approach will provide a set of multidisciplinary high-quality services on top of the existing common services and thematic services in EOSC in order to scale up the EOSC portal. The aim is to achieve a high impact with all the implementations, resulting in an important added value for EOSC. We are confident that this is possible to achieve with the resources requested and create the identified impacts. But we do not want to be overconfident and we have identified some possible barriers or obstacles that if not handled carefully might prevent us to reach all the expected impact. For each obstacle, mitigation measures are proposed to be implemented in case obstacles appear:

Table 13: Mitigation measures

Possible obstacle	Mitigation measure
The EOSC portal does not scale up because the number of services contributed by other projects and teams is too high and they eclipse our services that do not show up in searches and are difficult to discover.	Reinforce our own communication to make our services and the EOSC portal known.
Scientists are used to their research dynamics and procedures and even to their own methods and protocols, so adapting to new ways of working and new methodologies can be challenging for them. They may find new infrastructures and services too different to what they are familiar with or have not the time to learn about them and may give up on data intense research.	Reinforce our own training and also showcase the benefits with the showcases developed in the project.
Scientists do not want to open their data or model algorithms because they do not get recognition by doing that.	Provide a platform where acknowledgement and recognition are enabled by the authorization services and data remain under control of the contributing scientists.
Earth science scientists and other potential users of our services do not know about EOSC.	Use the same standards as public actors, such as INSPIRE, to enable automatic integration with public actors from EOSC.

To increase the use of the services offered and minimize the resistance or opposition in using them, a focused dissemination strategy will be designed, based on the development of training and support materials and activities, trying to facilitate the understanding and use of the services. Showcases developed in WP3 are specifically designed to this aim, since the application and benefits of the services will be demonstrated in a practical way in real scenarios and practical experience and feedback from users will be collected. Communication will be reinforced to make CLOUDator services and the EOSC portal known within the research community and mechanisms for acknowledgement and recognition of contributors will be enabled by the authorization services.

Finally, a detailed *Plan for the Exploitation and Dissemination of Project Results* (PEDR) will be designed during the project, taking into account all the obstacles mentioned before and addressing

targeted mitigation measures to be implemented during the project lifetime and after it is finished so that the impact of the project is maximized.

2.1.d Measures to limit the future carbon and energy footprint

CLOUDator will propose measures to effectively support and enhance the capacity of the project to limit the future carbon and energy footprint following the standard EN 50600-4 Information technology: Data centre facilities and infrastructures. The services developed within the project, as well as the work to be done rely almost entirely on computer networks and communication infrastructures that are pre-existing and, in some cases, maintained by broader entities than those of the partners themselves (as university networks, communication companies, European Commission, etc.). In this situation, the energy consumption depends on the kind of computer infrastructure used but also on the time and intensity of the computations done. The EN50600-4-2 defines the Power Usage Effectiveness (PUE) that PUE describes the energy efficiency relative to facilities with given environmental conditions. Unfortunately, PUE not be used to compare different data centres[24]. Instead we could request to computations power providers the EN50600-4-3 Renewable energy factor (REF) that describes the percentage of a renewable energy (RE) over total data centre energy. It is an effective KPI to monitor the use of RE and to increase the diversity of energy dependence and improve the sustainability of a data centre by enhancing the use of RE. Customers can use this KPI as a guide to select the best data centre.

In essence, in order to reduce the carbon and energy footprint CLOUDator will:

- Request the REF KPI and select the centre with higher value
- Use code optimization and data gravity methodologies. rasdaman provides code optimization algorithms that allow to distribute queries among computer centres, reduce data volume transfer and reduce the number of computer cycles to resolve operations.
- Use compiled code instead of interpreted code. Interpreted languages such as Python are much easy to use but they are not efficient. Python provide several libraries that connect to compiled code (such as C++) that are more efficient.

In general, optimization of code reduces the execution time. The time reduction is related with the energy efficiency. CLOUDator will elaborate KPIs for code optimization as proxy for energy consumption. Incremental improvements of our deployments will measure code optimization KPIs.

2.2. Measures to maximise impact

CLOUDator recognises the importance of dissemination and exploitation to steer the uptake of project results by the wider European research community. WP5 will present integrated, exploitable results from WP2, WP3 and WP4 to target audiences and will use the most suitable media and communication channels to support and maintain an active dialogue with stakeholder groups about these integrated results, keeping the public image of the project active, and generating feedback.

In the rest of this section, we explain the initial plan of the proposal to exploit the project results (including IPR), and more specifically how it will ensure the integration of services in the EOSC for the benefit of a broader set of user communities. Also, we explain how the Consortium will (1) enhance EOSC potential to support multidisciplinary research, (2) manage research data and (3) effectively disseminate and communicate the project activities and results to appropriate target audiences.

[24] https://ictfootprint.eu/en-50600-4-factsheet-0

2.2.a Dissemination and exploitation of results

2.2.a.1 Draft plan for the dissemination and exploitation of project results

A *Plan for the Exploitation and Dissemination of Project Results* (PEDR) will be developed and updated through CLOUDator's during and after the project lifetime. The plan will describe in detail which users can benefit from which results and the means, formats and channels to reach them in order to maximize the impact of CLOUDator and will play a key role in EOSC integration of services developed.

Table 14: Dissemination and exploitation strategy

Service	**Sub-service: *Target audience***	**Dissemination measures and actions**
Data management and analytics services	Coverage service (Rasdaman): *Research community and SMEs in geospatial data, life sciences, space sciences, statistics.* Sensor services (52N Sensor Web Server): *Research community and SMEs in geospatial data, life sciences, space sciences, statistics.* Catalogue services (NextGEOSS catalogue): *Research community and SMEs in geospatial data.* Visual analytics services (MiraMon and Helgoland): *Research community and SMEs in geospatial data, life sciences, space sciences, statistics, public bodies.* Geospatial User Feedback (NiMMbus) *Research community and SMEs in geospatial data, life sciences, public bodies.* Authetix *Research community and SMEs in geospatial data, life sciences, public bodies.*	Free on-line access through the EOSC portal. Outcomes provided to relevant H2020 projects and partners and communicated through social media channels. Networking with target audiences attending specific events and conferences; use email to distribute news to all stakeholders. Involvement of private sector organisations as customers of observation information. Active participation in events, committees, thematic weeks (view Events table below). Participation in other EOSC events organized by the EC**.** Elaboration of open access scientific literature -SCI journals-. Attendance to private-sector exhibitions and specialised fairs to demonstrate the usefulness of the software provided by the project (e.g., Earth observation). Free on-line access to guidelines, downloadable through the EOSC hub. Active promotion of CLOUDator through news-letters (like that of rasdaman), geo portals and magazines, as well as Social Media.
Copernicus data	Atmosphere Data Store (Copernicus Atmosphere Monitoring Service - CAMS): *Research community and SMEs in geospatial data, life sciences, space sciences, statistics.* Climate Data Store (Copernicus Climate Change Service – C3S): *Research community and SMEs in geospatial data, life sciences, space sciences, statistics, policy-makers.*	Free on-line access and download through the EOSC portal. Provision of the outcomes to other relevant H2020 projects and partners. Specific workshops for researchers. Participation in dedicated dissemination events such as workshops and symposia. Participation in the EC Open Research Data Pilot with the open data produced in the project. Attendance to private sector exhibitions and specialised show fairs (e.g. Geospatial World Forum) to demonstrate the utility of the data provided by the project. Elaboration of open access scientific literature - SCI journals-. Free on-line access to guidelines, downloadable through the EOSC hub.
Geopedia Open Health Map	Geopedia Open Health Map: *Research community in health sciences, policy-makers, citizen scientists.*	Free on-line access to health information, downloadable through the EOSC hub. Targeted promotional material. Participation in dedicated citizen-science events such as workshops and

		symposia. Dissemination through social media channels.
Showcases	*Research community, life sciences, space sciences, statistics.*	Provision of the outcomes to other relevant H2020 projects and partners. Specific workshops for researchers. Participation in dedicated dissemination events such as workshops and symposia. Elaboration of open access scientific literature -SCI journals-.
Showcase services	*Research community and SMEs in geospatial data, life sciences, space sciences, statistics, public bodies.*	Free on-line access through the EOSC portal. Provision of the outcomes to other relevant H2020 projects and partners. Specific workshops for researchers. Free on-line access to guidelines, downloadable through the EOSC hub.

Dissemination of results will involve all partners and will be prominently based on open access scientific or informative publications, and participation in meetings and workshops. The table exemplify dissemination efforts that will be pursued during CLOUDator. This table is somewhat flexible, since future events and conferences may change, or new opportunities may become available.

Table 15: Publications and events to disseminate results

Publications	**Leading partners**	**Journal or editor** (examples)
SCI publications. Exploitation of CLOUDator results for scientific audience through academic papers		
Copernicus data availability for sectoral applications	ECMWF	Geoscience Data Journal (RMetS - Wiley)
Generating the combined risks due to heat and air pollution using integrated data sets and the EOSC	IIASA	Sustainability, Environmental Science and Policy, Urban Design, Urban Science, Environment and Planning B, Urban Climate
Exploring the relationships between urban heat islands and air pollution	IIASA	Sustainability, Environmental Science and Policy, Urban Design, Urban Science, Environment and Planning B, Urban Climate
Exploring the relationship between incidences of COVID-19 and measures implemented at the sub-national scale	IIASA	Most high level journals: Science, Nature, PNAS, PLOS One, Lancet; Journals with spatial interest: Journal of Digital Earth, IJGI (MDPI)
Exploring the socioeconomic and health relationships with incidence of COVID-19	IIASA	Most high level journals: Science, Nature, PNAS, PLOS One, Lancet; Journals with spatial interest: Journal of Digital Earth, IJGI (MDPI)
Exploring the effects of COVID-19 on air pollution	IIASA	Atmosphere, Urban Climate, BAMS
The CLOUDator architecture, The EarthServer Federation, Building the Super-DIAS, A Database Approach to Federated Earth Data Management Graph-Theory Based Array Join Optimization A Field-Based Conceptual Framework for Coverages	RAS	Journal of Digital Earth, MDPI Remote Sensing, IEEE Big Data Conference, DEXA Conference SSDBM Conference, JSTARS, ER Conference

Using Sensor Web Standards for the Interoperable Exchange of Scientific Sensor Data in the EOSC	52N	Computers and Geosciences, MDPI Sensors
Geospatial User Feedback to help building a knowledge hub	UAB	ISPRS International Journal of Geo-Information, International Journal of Digital Earth
Technical publications		
OGC Technical Committee Meetings	SECD	OGC document repository
Best Practices Paper: Multidisciplinary research with EOSC Geospatial Services leveraging OGC APIs	CREAF	OGC document repository

Events (conferences, exhibitions, fairs). Based on CLOUDator partners' membership in umbrella organisations

Name of event	**Partner attending**
EO Systems: Companies, organizations and experts in earth observations, standards and spatial data	
Group on Earth Observations Exhibition - GEO	CREAF, 52N
GEO work plan symposium	CREAF
EuroGEO workshop	CREAF
ICLEI – Local Governments for Sustainability	IIASA
Geoscience, environmental science and ecology: Administration and government authorities, collaborative data projects, experts and researchers in the domain of environmental monitoring, land use/cover change, biodiversity	
EGU general assembly	CREAF, UAB, 52N, ECMWF, IIASA
IEEE Big Data conference	CREAF, RAS
BDVA – Big Data Value Association Symposium	52N
EDF – European Data Forum	SECD
INSPIRE conference	RAS, 52N
AGILE conference	52N
Geospatial Sensing / Geospatial Sensor Webs conference	52N, CREAF
FOSS4G conferences	CREAF, RAS
AGU Fall Meeting	IIASA
EMS Annual Meeting	ECMWF
Hawaii International Conference on System Sciences (HICSS)	RAS, SECD
GEO Symposium - annual events	SIN
ESA PhiWeek - annual conference	CREAF, RAS, SIN, IIASA
ISRSE (Int. Symposium on Remote Sensing of Environment)	IIASA
The Global Land Programme Open Science Meeting	IIASA
DEXA Conference	RAS
SSDBM international conference	RAS

ER Conference (Int. Conference on Conceptual Modeling)	RAS
Specific demonstration event: End users and distinct stakeholder groups.	
Specific demonstration event will be held on month 27-28 with representatives of the stakeholders, potential users, EC representatives and members of other EOSC projects. This event will be aligned to one of the previous public events, in order to maximize participation and visibility.	CREAF, UAB, DEIMOS, 52N, ECMWF, IIASA

There are many uncertainties on physical events in the near future and the previous list should be considered tentative. The consortium will follow closely the organisers and contemplate the option of attending the corresponding online virtual versions of such events.

2.2.a.2 Business plan

Two tasks are focussed to develop the value of the services and the showcases elaborated in the project: Task 2.5 will create a business plan of the services combining heterogeneous business models considering a balance between public finance with commercialization. Task 3.4 will assess the added value of the multidisciplinary approach and define business models.

2.2.a.3 Data management

In order to comply with H2020's Open Research Data Pilot, CLOUDator will develop and implement its own DMP where issues concerning the integrated data (see Table 16) will be further detailed. This DMP is not a fixed document but rather will evolve during the lifetime of the project. The first version will be delivered by Month 6 of the project (D1.3) and an updated version will be delivered at the final review (D1.5). Moreover, whenever datasets are added or there are changes in the project that affect the management of the data, the DMP will be updated accordingly. MVE will establish tools for automatic delivery of the data holding thereby easing DMP maintenance.

In addition, the CLOUDator consortium will conform to the Horizon 2020 Open Access mandates including giving priority to Gold Open Access or at the very least Green Open Access (or self-archiving) for all scientific publications produced. As a minimum, all publications will be available via Green Open Access, e.g. through OpenAIRE, ResearchGate and repositories supported by individual institutions. Although some funds have been set aside for Gold Open Access, CLOUDator consortium partners will be encouraged to publish via Gold Open Access, using in-kind contributions from their institutions to fund this where possible.

Four types of data will be created or collected in CLOUDator: data supporting services, source codes, collaborative based data through the Open Health Map and the Geospatial User Feedback items. They will be collected, processed, curated and preserved following international and European standards and obeying the most recent European Directives.

Table 16: FAIR Issues concerning the management of integrated data in CLOUDator

FAIR	Services source codes	Data
Findable (F)	Source codes for CLOUDator developed services will be findable through the GitHub repository.	All data will be registered in the NextGEOSS platform and will be available from the EOSC platform itself.
Accessible (A)	Each service developer will be responsible to assign a copyright license to their source code within the GitHub repository according to its intellectual property protection policy and the identified exploitation possibilities.	Data will be accessible through the CLOUDator as well as NextGEOSS data hub, with the restrictions imposed over the personal data concerning users' identification.

Interoperable (I)	Data will follow the reference standards in EO service developments: - Open Geospatial Consortium (OGC) standards - Standards produced by ISO/TC211 on Geospatial Information, notably ISO 19115:2003 - ISO/TC211 ISO 19119 – Geospatial Services - W3C Semantic Web standards - INSPIRE Implementing Rules on interoperability of spatial data sets and services as well as the corresponding technical guidance recommendations	Data will follow the reference standards in service EO developments: - Citizen-science profile for OGC's Sensor Web Enablement - OGC 09-146r8 family: Coverage data and service model standards, CIS and WCS/WCPS - OGC 15-097, OGC 15-098: Geospatial User Feedback Standard
Reusable (R)	Each service developer will be responsible to assign a copyright license to their source code within the GitHub repository according to its intellectual property protection policy and the identified exploitation possibilities. The services will be in the EOSC Portal	Data protection terms will be applied to data by the users themselves.

2.2.a.4 Strategy for knowledge management and protection

Following *Your Guide to IP in Horizon 2020*[25] guideline, four different strategies of protection and knowledge sharing of the project's outcomes have been foreseen, each of them linked to different measures. These strategies and measures will be further developed and detailed in the PEDR and addressed separately in both the Grant and Consortium agreements. These strategies are:

- **Not protected results**. Fully open dissemination. The knowledge transfer will be ensured through workshops, guides, tutorials, user feedback and dissemination materials that will be available via the CLOUDator portal.
- **Protected open results**. The CLOUDator consortium has identified the existence of related Intellectual Property rights and will undertake the measures to make them publicly available (Open Data) under the best sharing conditions:
  - *Publication of scientific articles under copyrights*: the project will reserve some budget to ensure that all scientific publications are published with '*gold*' open access options and are immediately provided in open access mode by the scientific publisher. If not possible, the project will self-archive the published article or the final peer-reviewed manuscript in an online repository ('*green*' open access).
  - *Participating collaborators copyright rights*. CLOUDator Open Health Map will allow their users to choose the degree of protection (attribution, share-alike, non-commercial, etc.) of the content they will contribute, while ensuring compatibility with the EOSC Rules of Participation. This will be granted through a specific agreement between CLOUDator and its users in the Terms of Service and will be compliant with European and National laws.
  - *Database rights.* CLOUDator foresees to open the data collected in the project through a Creative Commons License (CC-BY). Through this license, CLOUDator will waive its rights on the database use and legally allow the public to share, adapt and create on its database,

[25] http://www.iprhelpdesk.eu/sites/default/files/documents/EU-IPR-Guide-to-IP-in-Horizon-2020-EN.pdf

while maintaining the singularity of the licenses and copyright rights applied to some contents, data protection rights, or eventual patents contained in the database.

- **Protected results**. Developments, results and outputs that will be used within the project but will not be open and available outside the project. The intellectual property rights generated jointly in the project (foreground) will be protected legally, and rules of transfer and licensing will be agreed. The exploitation and commercial management of the services generated by the project will be settle in the consortium agreement. In case of extensive commercialization, a Freedom To Operate analysis will be performed previously.
- **Trademarks**. Each partner in the consortium provides services as a background. Even if the services will be evolved during the project to match the EOSC requirements as well as to reach the necessary level of integration in WP2, they will maintain their independence and the original partners will retain their trademark. The project aims at making CLOUDator an umbrella brand associated to a set of positive concepts on type of information, software, code and data quality, which will identify the project and be joint the partner trademark. This common branding will also contribute to the exploitation of the services provided by the project in the future.

The Consortium's partners will identify and agree on their background (tangible, intangible, IPR and any other rights) needed for the action implementation and will sign a written Agreement on Background, included and considered in the Consortium and Grant Agreements signature.

A consortium agreement should be made that protects all parties and ensures the management of project results. This agreement shall cover at least the following matters: (i) The contributions made and envisaged by each of the parties; (ii) The detailed plan of the tasks to be carried out by each of the parties; (iii) The technical means provided by the parties; (iv) The expected contribution of each party; (v) Mechanisms for monitoring the agreement. Roles, composition, frequency and coordination mechanisms; (vi) Agreements on intellectual property rights that ensure internal and external confidentiality decided by the coordinating bodies of the agreement, consider pre-existing intellectual property rights contributed to the project (background), define the rights to use, intellectual property generated by the parties, but outside the project (sideground), delimit the intellectual property rights generated jointly in the project (foreground), legal protection of results, rules of transfer and licensing of results, rights to access results, exploitation and commercial management of the services generated by the project; (vii) Penalties for non-compliance of the agreement; (viii) Jurisdiction in event of a dispute. Including alternative dispute procedures for settling disputes without litigation, such as arbitration, mediation, or negotiation.

2.2.b Communication activities

Communication objectives in CLOUDator will be focused in promoting the services implemented in the project to help scaling up the EOSC role among the European research community, as well as in promoting the EOSC hub throughout the global scientific community. Contacts with international standardization bodies and international geo communities will also be important in order to facilitate and promote the open science practices beyond the academia. Networking activities will be foreseen to be aware of the new standards that potentially can be adopted by the services in the platform. Communication activities will be foreseen for private sector as well, for public sector and decision making. Specific actions will be designed to address the public sector, with clear messages to incentivise institutional and public actors so that they open up their services and resources to researchers across Europe. The communication strategy will foresee coordinated joint communication activities with all the grants awarded under this and other EOSC related topics, to disseminate the project's results beyond the Consortium, maximising the projects' effort to demonstrate the benefits of the services and strategies developed and its integration in EOSC.

Table 17: Summary of communication activities planned throughout the life cycle of the project

Communication activity	Leader, WP and task		Verification KPIs	Expected result
Communication objective 1. To build and maintain the CLOUDator brand equity as a European leading brand in services and products for state-of-the-art research, and in top EO infrastructures. **Target Audience:** All CLOUDator target audiences.				
Communication Plan	CREAF	WP5 (Task 5.2)	% total actions	100%
Branding and merchandising products	CREAF	WP5 (Task 5.3)	Nº of products	5
Media Strategy	CREAF	WP5 (Task 5.2)	Nº appearances	50
Project web portal	CREAF	WP1 (Task 1.1)	Nº unique visitors	2000
Promotional strategy through science and technological digital magazines, blogs, portals, and press releases	CREAF	WP5 (Task 5.2)	Nº mentions in technology & science media	10
Communication objective 2. To promote the uptake of the new services and products of CLOUDator. **Target Audience:** EOSC and scientific community, EO community, private companies, and public bodies.				
List of commercial and exploitation partners for the outputs	DEIMOS	WP5 (Task 2.5)	N partners Pilot partners secured	10 3
LinkedIn activity in target groups	CREAF	WP5 (Task 5.2)	N followers	150
Specific promotional material and information packs about the key services and products	CREAF	WP5 (Task 5.3)	N of promotional material & information packs	5
Attend exhibitions to demonstrate the utility of data, services and showcases	CREAF	WP5 (Task 5.3)	N commercial contacts	25
Open software publication in its FOSS repositories, rasdaman.org/52N	RAS/52N	WP2 (Task 2.1)	N of contributions	100
Communication objective 3. To build solid relations between the EOSC framework, the standards and EO communities and the CLOUDator project. **Target Audience:** EOSC community, OGC, Earth Sciences, Global EO System and Data Portals.				
EOSC community	BSC	WP5 (Task 5.6)	N groups	2
EGU, Earth science conferences	CREAF	WP5 (Task 5.2)	N of abstracts	10
Copernicus event (ESA living planet)	ECMWF	WP5 (Task 5.2)	N of events	2
Participation in the creation of the OGC and ISO standards useful for EO	CREAF 52N	WP5 (Task 5.5)	N standards and best practice	3
Communication objective 4. To raise awareness of the benefits that new services offered to the research community in EOSC, EO industry and decision makers. **Target Audience:** EOSC and scientific community, EO community, private sector (especially SMEs), public bodies, specialized journalists.				
Promotional strategy through broad science and technological, EO digital magazines, blogs and portals	CREAF	WP5 (Task 5.2)	N mentions in key media	10
Networking and lobbying with researchers, companies, EO experts and decision makers attending events	All	WP3 (Task 3.1) WP5 (Task 5.2 and 5.4)	N contacted people	100
Peer-reviewed publication	All	All	N of publications	14
Training	ECMWF, UAB, RAS	WP5 (Task 5.6)	N of activities	2

A Communication Plan will be developed at the beginning of the project. It will be designed to be coherent and complementary to the PEDR. The Communication Plan will contain specific strategies for the use of communication channels such as social media, promotional material, and general communication and project/result branding guidance, following the guidelines for communicating EU research and innovation. Communication activities will adopt different interaction forms depending on the combination of audience (who), channel (how), reason (why), message (what) and time (when). It will attract the research community in Earth sciences, private sector, the public bodies, and the Earth observation community to integrate and benefit from the CLOUDator results (services, data, and showcases). In harmony with the project's key objectives, the communication objectives are present throughout the project (see Table 17). Specific communication activities are expressly included on several work packages and involve all consortium partners. The main communication strategy will be coordinated by ECMWF with the CREAF support.

3. Implementation

3.1 Work plan — Work packages, deliverables

3.1.a Brief presentation of the overall structure of the work plan

The overall structure of the work plan is designed to minimize the silos and enabling collaborative work creating. It is structured in five WP (see Figure 5). WP1 is dealing with the management of the project as a whole, the relation with the EC and with other EOSC activities and bodies.

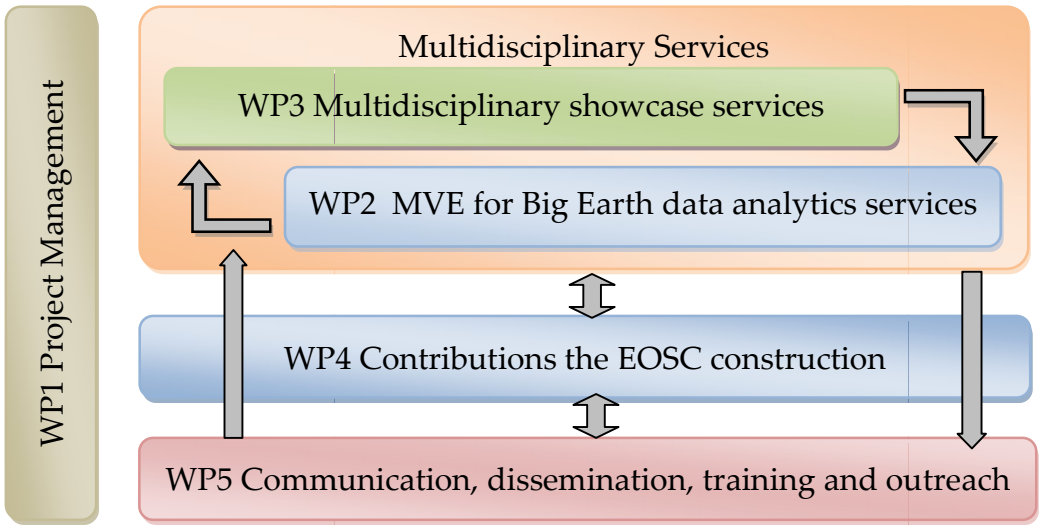


Figure 5: Relations between Work Packages in the work plan (simplified)

The time frame of 30 months of the project needs to be optimized using a fast methodology where WPs run in parallel to provide services: The WP2 deals with a Minimum Viable Ecosystem (MVE) that is geospatially enabled by data from the two Copernicus Services (CAMS and C3S) and connecting with in-situ observations.WP3 deals with co-created showcase that will be converted into showcases services later in the project. WP4 deals with contributing to enhance of EOSC and collaborating in its working groups. Finally, WP5 provides a dissemination and communications layer for the EOSC community, the scientific community, companies and public bodies. The work plan tables specify the organization that lead WPs and tasks. At the beginning of the project individuals will be selected with this responsibility taking into account gender balance.

The development of the CLOUDator services after the deployment of the MVE phase will follow an agile and collaborative approach. This means that an intense interaction with possible users will

take place in combination with frequent, incremental iterations. This will ensure a comprehensive capturing of needs, the validation of the incremental development steps as well as the communication among WP3 showcases that acts as the users of the WP2 MVE services and provides input for an interactive approach in WP2. The logistics for this iterative approach will the use virtual meetings, organising individual development sprints and for managing needs, user feedback, bugs, source code, issue track, etc. Specifically the following tools will be considered: 1) GitLab/GitHub/Track (source code repository, issue management, continuous integration), 2) Wiki functionality on either GitLab or Fosswiki, and 3) Web meetings (e.g. GoToMeeting).

3.1.b Timing of the different work packages and their components

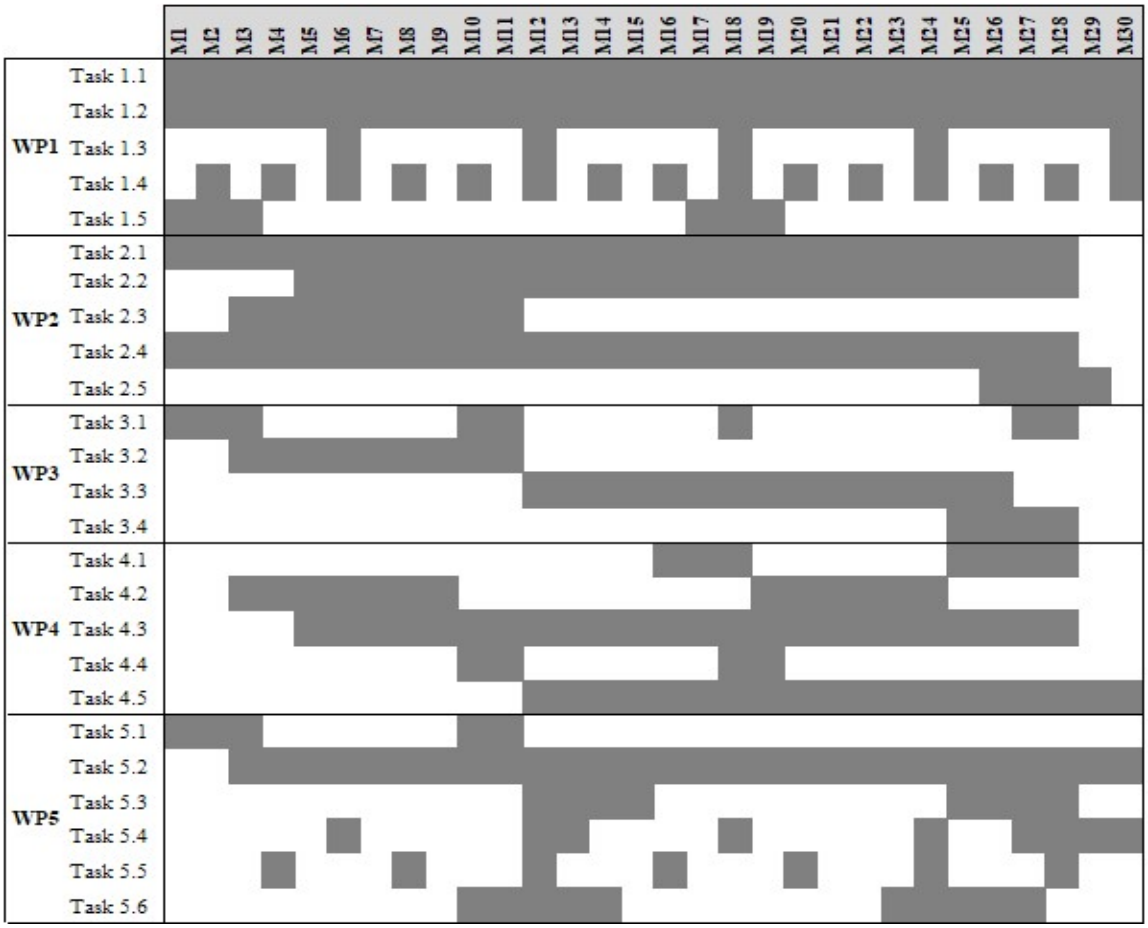


Figure 6: Gantt chart of the timing of the work packages and tasks.

3.1.c List of work packages (table 3.1a)

WP No	Work Package Title	Lead Participant		Person-Months	Start	End
		No	Short Name			
WP1	Project management	1	CREAF	30.0	1	30
WP2	MVE for Big Earth data analytics services	3	RAS	80.0	1	29
WP3	Multidisciplinary showcase services	8	IIASA	59.0	1	28
WP4	Contribution to the EOSC construction	5	52N	51.0	3	30
WP5	Communication, dissemination, training, outreach	6	ECMWF	42.0	1	30
				262.0		

3.1.d Description of each work package (table 3.1b)

WP number	WP1		Lead beneficiary				CREAF			
Work package title			Project management							
Participant number	1	2	3	4	5	6	7	8	9	10
Short name	CREAF	UAB	RAS	DEIMOS	52N	ECMWF	SECD	IIASA	SIN	BSC
Person months	30									
Start month	1		End month				30			

Objectives: Provide efficient and effective management of the project, management of the WPs and coordination between participants, efficient exchange of information with the project team and a communication channel for the EC. Provide strategic coordination to guarantee timely delivery of all project deliverables. Uphold quality assurance measures for all project results and deliverables. Coordinate the participation of the PAB. Create a Data Management Plan, describing the lifecycle and sustainability of all data collected, generated and processed.

Description of work:

Task 1.1 Consortium Administrative Management (Leader: CREAF, Duration: M1- M30)
Provide administrative management related to aspects like finance, coordination mailing lists and Web sites set-up, coordination structure bodies, effort invested and on time deliveries:

- Preparation and managing of the consortium agreement between the contractors
- Establishment of the General Assembly and of the related bodies
- Constitution of the Steering committee and the Innovation Management Task Force.
- Establishment of the necessary internal and external communication channels (Web site, Wiki, email list and teleconference facilities), ensuring branding colours to be gender inclusive.
- Monitor of the overall legal, contractual, ethical, financial and administrative management of the project
- Monitor effort expended and project resource usage
- Coordinate the organization of presentations and yearly reporting to the European Commission and the technical reviews
- Guarantee communication between the PAB and the Steering Committee and the Plenary
- Guarantee communication and coordination with other EC projects
- Guarantee communication and coordination with other committees, components, forums, standards bodies and the stakeholder network, etc.
- Financial administration, including coordinating payments; compile and provide annual cost statements
- Manage the cost of a unit of access consumed by users of our services in EOSC.
- Ensure equal opportunities among the members of the different teams looking after the proper implementation of gender & diversity policies.

Task 1.2 Technical Management and Quality Assurance (Leader: CREAF, Duration: M1-M30)

- Coordination of the technical activities of the project
- Organize and support of the external communication and visibility of the project, by means of particular actions decided within the project boards
- Establish and supervise the adoption of the measures related to the open access and the data management
- Monitor effort expended and project resource usage with Task 1.1
- Coordinate the preparation of technical outputs for reporting to the European Commission

- General technical coordination and planning of global direction of the project
- Freely share, standards, specifications and methodologies with the other projects awarded under the same topic to foster interoperability between the different services
- Manage accreditation and certification of standard components

This task supervises timely and the quality of the project deliveries:

- Periodical review of the time schedule (deliverable, milestones, meetings) in the PMB and the PTB
- Periodical analyse the energy consumption and environmental impact of the cloud systems and the plan to limit the carbon and energy footprint
- Coordinate the edition of and submission of the project progress reports and deliverables. The editor of the deliverable will send the deliverable to the Plenary for review, editors will review the comments and the coordination will do the final validation.
- Ensure that all documents are be written in a gender-neutral language and all digital products will use non-discriminating photos, images or languages

Task 1.3 Management and synchronization and information flow with other selected EOSC projects (Leader: CREAF, Duration: M6-M30)

The coordination of the consortium will articulate active efforts to freely share, in a timely manner and as appropriate, standards, specifications and methodologies from their activities with the other projects awarded under the same topic and other related EOSC call, in order to foster to the maximum extent interoperability and multidisciplinary research between the different services. A list of the projects will be created, and regular contracts will take place. The coordination team will participate in meetings that the EOSC related project could organize. The coordinator will include standard practices in Task 4.1, authorization in Task 4.2, helpdesk in Task 4.5 and communication and dissemination in Task 5.4.

Task 1.4 Risk Management (Leader: CREAF, Duration: M2-M30)

Throughout the duration of the project, internal risks (as described in Table 3.2b) will be constantly evaluated. The risk evaluation methodology will consist in: (i) risk identification – areas of potential risk identified and classified; (ii) risk quantification – the probability of events will be determined and the consequences examined; (iii) risk response – methods will be produced to reduce or control the risk; (iv) risk control and report – documenting lessons learnt. Risks to progress will be assessed at reviews meetings and contingency plans will be proposed.

Task 1.5 Data Management Plan (Leader: CREAF, Duration: M1-M19)

In order to align with open data policies and have a plan to make data open, we will formulate a Data Management Plan (DMP), which will 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. The Data Management Plan will be created as an initial version and later regularly updated during the project. In particular, the DMP will address:

- the handling of research data during & after the end of the project,
- what data and services will be collected, processed and/or generated,
- which methodology and standards will be applied to data, metadata and service integration/federation,
- systems used for sharing data and making it openly accessible, and
- data curation and preservation during and after the project.

Deliverables

D 1.1 (M04) Project Advisory Board composition and communication channels (CREAF)
D 1.2 (M24) Cooperation with other relevant project and initiatives report (CREAF)
D 1.3 (M06) Data management plan, draft (CREAF)
D 1.4 (M08) Action plan to limit the carbon and energy footprint (BSC)
D 1.5 (M26) Data management plan (CREAF)

WP number	WP2		Lead beneficiary				RAS			
Work package title			MVE for Big Earth data analytics services							
Participant number	1	2	3	4	5	6	7	8	9	10
Short name	CREAF	UAB	**RAS**	DEIMOS	52N	ECMWF	SECD	IIASA	SIN	BSC
Person months	15.0		16.0	10.0	13.0	7.0	2.0		17.0	
Start month	1			End month			29			

Objectives: WP2 establishes, as the CLOUDator MVE of geospatial services, a federated Big Earth Data Analytics services for use by WP3 and external users. An integrated Big Data services will be established from pre-existing, proven services (T2.1); the CLOUDator service will be deployed, populated, and operated (T2.2); in T2.3 CLOUDator will get connected to the EarthServer federation, thereby gaining access to the complete Sentinel datacubes. Based on these achievements, sustainability options for CLOUDator in EOSC will be investigated (T2.5). Development and operation will have an initial ramp-up phase to early make available basic services, followed by iterative cycles for further enhancement and agile feedback on WP3 requirements.

Description of work:

Task 2.1 Integrated CLOUDator Big Data Analytics services (Leader: RAS, Participant: CREAF, DEIMOS, 52N, SECD, Duration: M1-M28)

Pre-existing, proven components will be combined in an architecture that and enhanced to form modular geospatial data management services (on raster, vector, and meta data) with seamlessly integrated data analytics, fusion, and visualization services. The resulting services will have demonstrated compliance with OGC standards and FAIR (findable, accessible, interoperable and reusable) principles[26].

Components of the CLOUDator services, all offering OGC compliant, compatible APIs:

- **Raster data**: Multi-dimensional raster data, often called "**datacubes**", include 1-D sensor timeseries, 2-D imagery, 3-D x/y/t image timeseries and x/y/z geophysical voxel data, and 4-D atmospheric and ocean data, to name but a few examples. All these n-D data will be served by the rasdaman datacube engine developed by RAS. It offers interoperable service OGC WMS, WMS-T, WCS, and WCPS service APIs allowing for flexible access, extraction, visualization, analytics, and fusion. Intelligent ingestion procedures automate continuous feeding of datacubes from more than 110 file formats. In addition to the rasdaman W*S services, 52N will provide the Helgoland SOS/SensorThings API (STA) server on top of the stored time series data. This is relevant for a broad use in INSPIRE where coverages can be offered through WCS, SOS and SensorThings API implementation, and this use case shows that both is possible from a homogenised data store.
- **Vector data** (such as for administrative boundaries) will be provided via the SIN GeoPedia component which implements required GIS, search, and visualization techniques for embeddable, interactive maps. It will be enhanced with a WFS API to seamlessly integrate in the standards-based CLOUDator environment. GeoPedia can cascade WMS, i.e., it can forward raster requests to rasdaman and combine the vector and raster maps into a single visual map.
  Aside from map visualization a purpose of these vector data is to allow region-based analytics, such as "NDVI change over France".
- **Metadata** will be addressed by DEIMOS through the NextGEOSS catalogue based on the OGC CS-W standard.

[26] See, e.g., Nature, OpenAire, go-fair, force11, and others.

- **User management and security** will be established and implemented by SECD, integrating all services through a single sign-on suitable for both human-centric browsers and m2m connection.
- Service availability & usage monitoring will be provided by DEIMOS.

Integration. Each of the tools engaged will offer OGC compliant APIs, so these will form the basis for tool integration. All components together will support FAIR principles.

- raster/vector integration: Rasters will be integrated into vectors via GeoPedia WMS; vectors will be integrated into rasters through polygon clipping implemented in rasdaman.
- remote sensing and in-situ integration: same underlying data made available through WCS and SOS/STA.
- metadata connection: The catalogue will link into raster and vector objects; the datacubes will link back to their corresponding catalogue entry.

Timing. Until MS03 (M8), the partners will jointly establish an initial deployment roadmap. This will include enhancements, such as pub/sub APIs for asynchronous capabilities in rasdaman and WFS support in GeoPedia. In parallel, the pre-existing tools will be deployed by MS03 to have a quick basic service online. After that, incremental roll-out will follow a "release early, release often" policy with continuous integration.

Software development will make use of state of the art tools for repositories, regression-based unit and integration testing, and auto-documentation. By MS02 the corresponding infrastructure will be established in the initial project phase. Attention will be given to maximize service persistence, reliability and to select the optimum platform in energy efficiency.

Task 2.2 Multi-disciplinary CLOUDator services deployment, population and operation with data provided by CAMS and C3S (Leader: ECMWF, Participant: CREAF, RAS, 52N, SIN, Duration: M5-M28)

The platform technologists, hosting partners, and data providers will jointly establish the CLOUDator service as an operational service with significant added value to users. Through this close collaboration a co-design approach will be enabled whose results will continuously be fed back into Task 2.1.

Data. The following data sets will be provided by CLOUDator:

- Core emphasis will be on the Copernicus Climate Change Service (C3S) and Copernicus Atmosphere Monitoring Service (CAMS), today accessible via the Climate Data Store and Atmosphere Data Store, respectively. Data will not be copied, but rather registered into rasdaman as actionable datacubes using the technology advanced in Task 2.1. This n-D raster datacubes service will be deployed and operated by RAS.
- Sensor data will be collected by exploiting free, open sources through 52N and fed into the multi-dimensional datacube service.
- Model data etc. suggested by WP3 partners will be ingested as far as storage available allows.
- Vector data will be provided through GeoPedia holding already thousands of thematic layers, including administrative boundaries, points of interest, economic indicators, etc. All Earth data available in EOSC will be referenced in the NextGEOSS catalog by CREAF, having a lead role in NextGEOSS.

Access control. Unified user management will be established in the hosting environment by SECD, integrating all components under a single sign-on framework for all components, supporting different architecture options like human and m2m access. Further important aspects include ensuring GDPR compliant processing and storage of personal information across services and applications.

Hosting. The integrated CLOUDator service will be deployed and operated based on a devops approach (a set of practices that combines software development (Dev) and IT operations (Ops)) in a collaboration of all WP2 technology partners.

The WEkEO DIAS (based on its current pricelist[27]) will be used for hosting CLOUDator as it offers the climate data required (in addition to the Sentinel datacubes made available in Task 2.3). RAS will operate the "Big Data" service of CLOUDator over its runtime. VM sizing will be adjusted, starting with a WEkEO Small

[27] https://www.wekeo.eu/web/guest/price-list

model of 8 vCores and 7 TB and upgrading as necessary, as by then CLOUDator will become part of the EOSC market place and, hence, is expected to attract massively more users. Catalog, sensor service, and health map each will order a WEkEO D-light model VM. The GeoPedia service will be hosted by SIN.

Task 2.3 EarthServer federation integration
(Leader: RAS, Participant: CREAF, SECD, Duration: M3-M11)

RAS will integrate the CLOUDator service in the 20+ Petabyte common information space of the EarthServer federation (which already offers the full Sentinel archives and many more thematic products). Further, the Euro Data Cube will be unleashed to CLOUDator by adding it to the federation (done by RAS and SIN, Euro Data Cube partner). Effectively, thus

- CLOUDator makes available all the federation offerings to its users, with complete location transparency and without extra storage or processing needs by CLOUDator,
- all other federation members in turn advertise the CLOUDator offering.

Hence, as CLOUDator datacubes will have a main emphasis on climate variables as provided through ECMWF substantial extra value is added to the federation that today mainly offers satellite imagery. CLOUDator applications will demonstrate this added value through federated data fusion.

Moreover, this task will contribute to the further evolution of EarthServer (RAS is key player) through technology contributions and by establishing a consensual, democratic, open, transparent governance structure and rules created through a representative stakeholder peer group.

Task 2.4 User interfaces for multidisciplinary research (Leader: CREAF, Participant: 52N, SIN, Duration: M1-M28)

A spectrum of visualization clients will be provided under the lead of CREAF, ranging from simple map access (OpenLayers, Leaflet) over Virtual Globes (NASA WorldWind, Microsoft Cesium) and Web GIS (QGIS) to high-end analytics (python, R) and visualization (paraview, MiraMon, GeoPedia, Helgoland Viewer). Thanks to the strict commitment to OGC standards CLOUDator can tap right into the large body of existing 3rd party tools supporting OGC standards. To this end, visualization tools MiraMon (CREAF), GeoPedia (SIN), and Helgoland (52N) will be advanced and integrated.

While all WP2 tasks support the WP3 showcases this is particularly true for this Task 2.4.

Task 2.5 Sustainability options for EOSC services (Leader: DEIMOS, Participant: RAS, 52N, Duration: M26-M29)

This task will create a business plan allowing combination of both research (free) and commercial (paid) models striving for a balance between public finance with commercialization. It will investigate on operational requirements for service persistence, reliability and energy efficiency, and also cost and revenue opportunities after the end of the project and prepare governance structures to secure sustained operation of the services after project end.

Deliverables
D 2.1 (M04) Deployment roadmap requirement for integration to EOSC (RAS)
D 2.2 (M14) MVE service deployment factsheets (CREAF)
D 2.3 (M12) Federation patterns for EOSC services and applications factsheet (RAS)
D 2.4 (M28) Services usage statistics (DEIMOS)
D 2.5 (M29) Sustainability plan (DEIMOS)

WP number	WP3		Lead beneficiary				IIASA			
Work package title			Multidisciplinary showcase services							
Participant number	1	2	3	4	5	6	7	8	9	10
Short name	CREAF	UAB	RAS	DEIMOS	52N	ECMWF	SECD	**IIASA**	SIN	BSC
Person months	4.0	3.0	6.0	6.0	4.0	6.0		13.0		17.0
Start month	1			End month			28			

Objectives: Develop a set of showcases based on the MVE services deployed in WP2. Since all showcases are reasonably mature, the objective is to initiate a co-creation dialogue with relevant stakeholders by presenting four showcases to the stakeholders, determine the best procedure to respond to the scientific challenge they pose and produce a useful service that will remain as a permanent service registered in the EOSC portal. Aiming at ensuring a responsible development of the showcases, inclusiveness at all levels will be sought, both in terms of gender and communities, taking account of the socio-cultural differences. The WP also analyses the added value that the service brings to EOSC.

Description of work:

Task 3.1 Co-create multidisciplinary showcases using multidimensional services and data (Leader: CREAF, Participant: DEIMOS, ECMWF, IIASA, BSC, Duration: M1-M28)

This task will first identify a set of target scientists that will use geospatial and data services, as well as policy-makers who would use results generated by the services, considering the needs of users that have different profiles and digital competence.

Specifically, this process will consist of:

- Identifying a set of target stakeholders that will use geospatial and data services, including scientists and policy makers. The process of identifying stakeholders will consider the needs of various users with different profiles and digital competence levels, as well as in terms of gender and community/discipline balance. The PAB and the EOSC Working Group Panel will be also considered in this process.
- Co-create the development of the showcases already defined in this proposal to illustrate the value of the integrating services and disciplines in facing global challenges. This will also include policy makers.
- Regularly translate user/stakeholders needs into implementable requirements for the services integrated in EOSC.
- Demonstrate how user-created processes and data can be integrated into the EOSC infrastructure.

This activity will rely on the base components developed as part of WP2. The outcome of this task will be the complete definition in terms of integration of services and technological solutions of the 4 showcases already introduced in the proposal.

Task 3.2 Development of multidisciplinary showcases combining Climate change, Air Quality and Risks and impacts on human activities (Leader: IIASA, Participant: UAB, RAS, BSC, Duration: M3-M11)

Considering the inputs from Task 3.1 and the MVE of services provided by WP2, this task will be responsible for the scientific and technical work to develop the best procedure and model to elaborate the showcases and respond to the scientific questions they pose.

The task will:

- Determine the risks to humans derived from climate, air pollution and heat in urban areas using UHI

indicators.

- Study the climate change implications in dust transport and risks for humans in arid regions.
- Study the impacts of climate change and air quality in renewable energy supplies both from the production and consumption point of view.
- Model the climate and air quality interactions with human health risk for COVID-19.

These four showcases demonstrate the breadth of multidisciplinary research; they will be disseminated in WP5.

In particular, for the COVID-19 showcase, a collaborative database on health will be populated, aggregating time series of data on the COVID-19 pandemic evolution at the maximum level of granularity possible and precisely georeferenced into a global database useful for monitoring the evolution of epidemics as well as global pandemics. Other contributed collaborative data about people's behaviours will be considered.

Feedback about the MVE services will be extracted and communicated to WP2 for the correction and improvement of the geospatial services deployed there. The showcase development will focus on selecting models and services that give good results on a continuous basis as a precursor to transforming them into permanent services.

Task 3.3 Transform multidisciplinary showcases into EOSC permanent services (Leader: BSC, Participant: CREAF, RAS, DEIMOS, 52N, ECMWF, Duration: M12-M26)

The results of the modelling performed in Task 3.2 will be transformed into four permanent services in this task. The services will be:

- A service that is capable of calculating Urban Hazard and Risk Indices due to heat and coupling these with air pollution indices for city heath analytics and city management.
- A Sand and Dust Storms Warning Advisory and Assessment System that predicts the evolution of aerosol related episodes with climate change and its effects on human activities.
- An Annual Energy Production (AEP) system that considers climate and air quality aspects in the production and consumption of energy and applies it to offshore wind fields.
- An Open Health Map (OHM) that represents the evolution of the COVID-19 pandemic and correlates it to human activities (air quality) and climate patterns.

These four services will be registered in the EOSC portal in Task 4.4 and disseminated accordingly through all tasks in WP5.This task will be strongly advised by the EOSC Working Group Panel (EWGP) of the project.

Task 3.4 Assess the added value of the multidisciplinary approach and define business models (Leader: DEIMOS, Participant: IIASA, SIN, Duration: M25-M28)

This task will estimate the added value of the showcases integrated in EOSC giving particular attention to the benefits of a multidisciplinary approach versus an approach based on isolated Competence Centres.

During this activity, the added value from the perspective of research organisations will also be evaluated. In particular, the relevance of EOSC-based geospatial services for making research processes more efficient will be investigated. The task will also consider the benefits of having a science and policy link. In addition, consideration of the value-added created by open data will be integrated.

This task will also define the operations requirements in terms of governance and rules for participation (licensing, cost, etc.) for the four permanent services. The results of the task will be summarized in a deliverable about the added value of showcasing EOSC.

Deliverables
D 3.1 (M21) Co-creation meetings compendium (CREAF)
D 3.2 (M22) Roadmap to transform showcases into showcase services (IIASA)
D 3.3 (M28) Added value of the EOSC showcases (DEIMOS)

WP number	WP4		Lead beneficiary			52N			
Work package title			Contributions to the EOSC construction						
Participant number	1	2	3	4	5	6	7	8	9	10
Short name	CREAF	UAB	RAS	DEIMOS	52N	ECMWF	SECD	IIASA	SIN	BSC
Person months	18.0	12.0		6.0	4.0		8.0	1.0		2.0
Start month	3			End month			30			

Objectives: Collaborate to the EOSC construction by working to include geospatial interoperability into EOSC technical specifications, reinforcing the authentication and authorization by allowing services to communicate and provide a proposal for a common service on scientific discussion and user feedback. Coordinate the efforts in registering all the proposed services in WP2 and WP3 in the EOSC portal and canalize all the EOSC requirements to WP2 and WP3. In particular, plug in the ESC helpdesk to provide support to all proposed services in the project.

Description of work:

Task 4.1 Interoperability and technical specifications in EOSC (Leader: 52N, Participant: CREAF, DEIMOS, SECD, SIN, Duration: M16-M28)

This task contributes in the requirements analysis of the MVE services and contributes inputs to the architecture definition by consolidating a set of interoperability standards and best practices. We plan to consider at least the following standards: OGC API, WMS, WMTS, WFS, WCS, WCPS, SOS, SensorThings API (including MWTT, AMQP). The task deals with the implications interoperability and technical specifications that can come from EOSC (and in particular from INFRAEOSC-03-2020) and how to combine them with geospatial standards.

The task focuses on the preparation for a draft proposal on how to include these standards in the EOSC technical guidelines including the possibility enabling the validation and certification of implementations passing the official OGC CITE tests. The proposal will be presented to EOSC Working Group Panel (EWGP), collects feedback and writes the final version.

In collaboration with WP5, the consortium will freely share, in a timely manner and as appropriate, standards, specifications and methodologies from their activities with the other projects awarded under the same topic in order to foster to the maximum extent interoperability between the different services.

Task 4.2 Authorization, licences and GDPR (Leader: SECD, Participant: DEIMOS, IIASA, Duration: M3-M24)

One of the main project goals is to foster multidisciplinary actives based on EOSC data and services. EOSC offers federated identity management with single-sign-on with session management based on HTTP cookies. It will also deal with authorization and licensing issues that can be changed during INFRAEOSC-03-2020 project. This task focuses first on providing an extension service to the EOSC authentication providing OAuth2 and OpenID Connect based session management by leveraging tokens and GDPR compliant personal information exchange available to applications and services.

Next, this task will establish service overarching authorization based on token scopes to ensure that multidisciplinary activities can access required data. Finally, this task will build a licensing ontology service that supports license harmonization when combining data from different disciplines, licensed via Creative Commons.

Task 4.3 Scientific discussions and user feedback (Leader: UAB, Participant: CREAF, Duration: M5-M28)

This task comprises two main activities:

a/ Implement a system to report new showcases, tell success stories and provide feedback on showcases:

This task will develop an improved user feedback system as part of the EOSC to store knowledge. The development will be based on the NiMMbus system implementation which follows OGC Geospatial User Feedback (GUF) model and will be matured in order to extend GUF capabilities to include knowledge elements. These elements need to store code, usage elements, publications, models and models parameters. All these elements combined create the knowledge that user create while interacting with pilot portals and services and when developing the showcases. During the concept development and implementation, all partners will participate in order to ensure the system covers the specific needs of all the showcases. The knowledge elements can be stored and shared (if needed) based on open access principles to any other user willing to explore and reuse them. The implemented system will allow users to report new showcases, tell success stories and provide feedback on showcases.

b) Connect the showcases and feedback to the actual services in EOSC to illustrate their added value:

Once matured, the NiMMbus system needs to be connected to the actual services used by showcases in EOSC. Then, partners will engage external users to provide user feedback and knowledge items on the resources and services used in the showcase. As a result, this task will help to illustrate the multidisciplinary scenarios' added value, as well as to increase the interactions among several communities allowing user engagement.

Task 4.4 EOSC portal integration (Leader: BSC, Participant: CREAF, 52N, Duration: M10-M19)

Task 4.4 will integrate the CLOUDator geospatial and data services in the EOSC Portal. This includes achieving compliance with the requirements and standards mandated by EOSC. Notably, the RAS and SIN products are already registered in the EOSC portal, easing seamless integration.

CLOUDdator will duly consider relevant governance and business models, rules for participation, operational requirements, standards, etc. coming from INFRAEOSC-03-2020, as required in the EC call, as well as from all the EOSC WG gathered in the project under the EOSC Working Group Panel. This activity is connected to Task 5.4.

This task will develop the necessary steps to integrate generic geospatial and data services into the EOSC. This involves compliance with the EOSC requirements and technical specifications requested by EOSC. It involves registration and adopting the authentication and authorization protocols. For example, the rasdaman datacube security suite will be linked into this framework for allowing versatile protection down to single pixel level.

Task 4.5 EOSC services helpdesk (Leader: CREAF, Participant: DEIMOS, Duration: M12-M30)

All technology providers, in particular partners providing the user-facing tools, will team up to operate a helpdesk for WP3 as well as external users. This will include all necessary components required by EOSC starting by:

- Email helpdesk
- Online webinars, tutorials, and how-to documentation
- Face-to-face seminars, as far as feasible.

Particular emphasis will be put on supporting the data, processing and visualization needs of the showcases in all aspects. Goal is to enable users to perform analysis and modelling on atmosphere and climate data in a reproducible and transparent way, accepting that the various users follow with different profiles and digital/EO competence levels.

Deliverables

D 4.1 (M14) Draft geospatial technical guidelines (52N)
D 4.2 (M16) Authentication and authorization improvements (SECD)
D 4.3 (M29) Services feedback success stories and statistics (UAB)
D 4.4 (M26) EOSC Marketplace registration metadata (CREAF)
D 4.5 (M27) Technical guidelines for Earth Science usage of geospatial standards (52N)

WP number	WP5		Lead beneficiary				ECMWF			
Work package title			Communication, dissemination, training and outreach							
Participant number	1	2	3	4	5	6	7	8	9	10
Short name	**CREAF**	UAB	RAS	DEIMOS	52N	**ECMWF**	SECD	IIASA	SIN	BSC
Person months	13.0	5.0	3.0	4.0	3.0	4.0	1.0	4.0	1.0	4.0
Start month	1			End month			30			

Objectives: This WP has a range of objectives related to the communication about the project and the uptake of its results by specific communities to support the project uptake, namely: a) to effectively raise awareness of, and generate interest in the project among relevant stakeholders and target audiences, b) to support the uptake of project results among the scientific community and c) to promote the adoption of the training about EOSC in the academia and empower women through education and training in the EOCS systems. Thus, communication objectives in CLOUDator will be focused in promoting the services, data and showcases developed in the project to help scaling up the EOSC. The Gender dimension will be considered in the development of the activities foreseen in the six tasks.

Description of work:

Task 5.1 Target audience definition (Leader: ECMWF, Participant: CREAF, Duration: M1-M11)

A Communication Plan and a Plan for the Exploitation and Dissemination of Project Results (PEDR) will be developed at the beginning of the project. Starting from this, it will be perfected, refined and maintained during the project.

Based on the initial dissemination and communication strategy (e.g. target audiences and communication media) developed for the proposal, this task will devise the comprehensive strategy i) for ensuring awareness and understanding of the activities and results among relevant target audiences (including decision and policy makers), ii) for supporting action by the EOSC community via community engagement and by actors in developing countries, and iii) for properly selection of stakeholders. The strategy will identify relevant target audiences, users and stakeholders and match communication and dissemination channels, specific messages, timing and resources while strategically building on the consortium partners' existing links, networks and platforms, elaboration of the communication messages and sound timing for the identified actions.

Task 5.2 Communication in coordination with INFRAEOSC (Leader: CREAF, Participant: DEIMOS, IIASA, UAB, Duration: M3-M30)

Communication strategy will foresee coordinated joint communication and dissemination activities with all the grants awarded under this topic and other EOSC related topics.

- Contact the other INFRAEOSC projects to articulate a common communication and dissemination plan and methodology. Share standards, specifications and methodologies among project protecting the flow of information.
- Disseminate the project's results beyond the Consortium and the direct target audiences. Communicate how to contribute to the collaborative open health map and stimulate participation in it.
- Communicate how to contribute user feedback an experience with data in NiMMbus.

Task 5.3 Dissemination of the project resulting services (Leader: CREAF, Participant: UAB, RAS, DEIMOS, 52N, IIASA, SIN, BSC, Duration: M12-M28)

This task will disseminate the project results (added services and showcase set) in close collaboration with

WP1 (management) and support the uptake in WP4 (sustainability). The dissemination activities will include participation in scientific conferences (EGU, AGILE, Geospatial Sensing, INSPIRE Conference, GI Science), writing scientific papers (in peer-reviewed journals and other means), in face-to-face events as well as online efforts (such as Task Forces and Working Groups) to exchange best practices. End users and distinct stakeholder groups will be engaged during dedicated events in line with the comprehensive strategy. The task will organize a big demonstration event on month 27-28 with representatives of the stakeholders, potential users, EC representatives and members of other EOSC projects.

The task will create the dissemination support for the set of scientific research showcases. Social media will play an important role in stimulating awareness; RAS regularly feeds 35 LinkedIn groups and reaches altogether over 460,000 named users in science, industry, and agencies. Newsletters, press releases, geoportals, and geo magazines, like GISCafé, GEO Community, Directions Magazine and EOMAG will be served with articles.

Task 5.4 Organization of activities aligned and coordinated with other selected projects (Leader: CREAF, Participant: RAS, ECMWF, IIASA, SIN, BSC, Duration: M6-M30)

This deals with the organization of dissemination activities aligned and coordinated with other selected project such as INFRAEOSC-03-2020. For example, focused activities will be sought with the PAB and related projects, such as with H2020 PARSEC, a startup/SME business accelerator, to inform the 100+ SMEs pampered by PARSEC about the novel EOSC capabilities. These activities will allow CLOUDator services and the EOSC portal to be known within the research community and mechanisms for acknowledgement and recognition of contributors. These events will adopt different interaction forms depending on the combination of audience (who), channel (how), reason (why), message (what) and time (when).

Task 5.5 Collaborate with standards and best practices organizations (Leader: 52N, Participant: CREAF, UAB, DEIMOS, Duration: M4-M28)

This task will develop a set of communication actions to disseminate and communicate interoperability of Earth data together with the Standards joint initiative SJI. The project will work in OGC technical committee domain and standards working groups (and will participate in their meetings) to advance the relevant standards and disseminate information among the 500+ OGC members about the EOSC geospatial services. The OGC-based services used in the project will seek to acquire/maintain official OGC compliance.

Several partners are engaged in the ongoing activities of the OGC on a new common OGC API; contribution will be pursued further and resulting specifications will be implemented so as to make them available for the EOSC user community. Thus, we will significantly contribute to this ongoing standardisation process in order to also reflect the requirements for a deployment within the EOSC. In ISO TC211 WG6, RAS will continue its lead in shaping the 19123-1 and 19123-2 coverage standards. Likewise, the successful work of RAS on the adoption of INSPIRE coverage services by the EU member states will be continued.

Participate in the RDA working groups defining the FAIR principles and other relevant standards to bring best practices to EOSC. The collaboration of the EOSC Working Group Panel (EWGP) will be very relevant in this case, specially the FAIR WG.

Task 5.6 Training (Leader: ECMWF, Participant: UAB, RAS, 52N, SIN, SECD, Duration: M10-M27)

To maximize the use of CLOUDator services a bundle of educational activities is foreseen:

- A helpdesk for both project-internal and external users, staffed with technically qualified personnel.
- A set of 5 – 6 online training courses, addressing different communities, will be established by didactically and technically experienced partner staff.
- Demonstration sites will be established, similar to the existing OGC datacube standards education portal, https://standards.rasdaman.com .
- Live events, like webinars and hackathons, will serve to present this material interactively to the various target audiences, and allow for direct problem solving.
- White papers and training activities to help researchers in the implementation of FAIR and data management principles.

The Copernicus Climate Change Service implemented by ECMWF runs the User Learning Services which deliver customized training activities for the range of user communities across Europe and worldwide utilizing a portfolio of training resources to build specialized learning pathways. As part of this project we will leverage the ECMWF expertise in training and the learning platform to create a series of learning activities in order to provide a range of opportunities to develop the knowledge needed to proficiently use the products and the platform.
To empower user groups across Europe, we propose the creation of up to 5 to 6 training resources which highlight the benefits of the data provided via the portal and their use in real life case studies. Additional two or three microlearning resources will be provided which will cover the onboarding to the platform. These learning resources will be hosted on the learning platform managed by ECMWF. They will be used for online learning as well as for blended learning activities. Blended learning is an approach to education that combines online educational materials and opportunities for interaction online with traditional place-based classroom methods. We propose to run two blended training events in year 2 of the project. It is proposed that the face-to-face phase is hosted at ECMWF.

Online resources will be available to universities to be inserted in curricula in order to stimulate a new generation of users who can via the EOSC portal advance their scientific studies. This implies:

- Training the users into the platforms and geospatial services offered in EOSC as well as the EOSC infrastructure as a whole.
- Generating courses about the potential of CAMS and C3S datasets in scientific studies.
- Exploring how to include EOSC in the university curriculum and bodies of knowledge to stimulate a new generation of users that can use EOSC in advanced stages of scientific studies.

Deliverables
D 5.1 (M03) Communication plan (CREAF)
D 5.2 (M12) Plan for the exploitation and dissemination of project results (PEDR) (CREAF)
D 5.3 (M29) Communication and dissemination activities (CREAF)
D 5.4 (M19) White paper on how to use geospatial standards for improve FAIR practices in Earth data (52N)
D 5.5 (M29) Training materials (ECMWF)

3.1.e List of Deliverables (table 3.1c)

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date (in months)
D 1.1	Project Advisory Board composition and communication channels	1	CREAF	DEC	PU	M04
D 1.2	Cooperation with other relevant project and initiatives report	1	CREAF	R	PU	M24
D 1.3	Data management plan, draft	1	CREAF	R	CO	M06
D 1.4	Action plan to limit the carbon and energy footprint	1	BSC	R	CO	M08
D 1.5	Data management plan	1	CREAF	R	PU	M26
D 2.1	Deployment roadmap requirement for integration to EOSC	2	RAS	R	CO	M04
D 2.2	MVE service deployment factsheet	2	CREAF	DEC	PU	M14
D 2.3	Federation patterns for EOSC services and applications factsheet	2	RAS	DEC	PU	M12
D 2.4	Services usage statistics	2	DEIMOS	OTHER	PU	M28
D 2.5	Sustainability plan	2	DEIMOS	R	CO	M29
D 3.1	Roadmap to transform showcases into showcase services	3	IIASA	R	CO	M04
D 3.2	Co-creation meetings compendium	3	CREAF	R	CO	M21
D 3.3	Added value of the EOSC showcases	3	DEIMOS	R	PU	M28
D 4.1	Draft geospatial technical guidelines	4	52N	R	PU	M14
D 4.2	Authentication and authorization improvements	4	SECD	DEM	PU	M16
D 4.3	Services feedback success stories and statistics	4	UAB	R	PU	M29
D 4.4	EOSC Marketplace registration metadata	4	CREAF	OTHER	PU	M26
D 4.5	Technical guidelines for Earth Science usage of geospatial standards	4	52N	R	PU	M27
D 5.1	Communication plan	5	CREAF	R	PU	M03
D 5.2	Plan for the exploitation and dissemination of project results (PEDR)	5	CREAF	R	CO	M12
D 5.3	Communication and dissemination activities	5	CREAF	R	PU	M29
D 5.4	White paper on how to use geospatial standards for improve FAIR practices in Earth data	5	52N	R	PU	M19
D 5.5	Training materials	5	ECMWF	OTHER	PU	M29

3.1.f Inter-relation of the project components

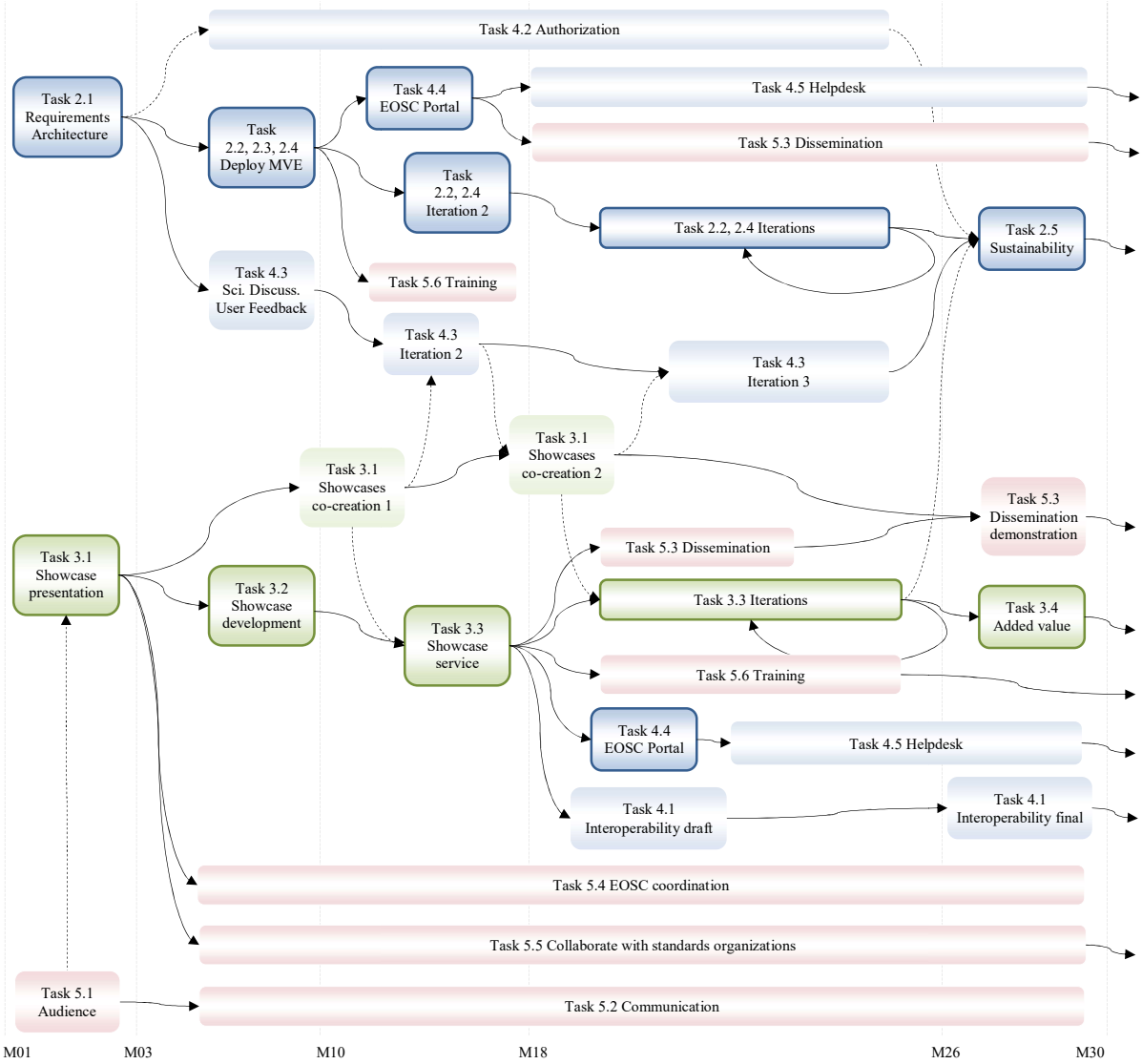


Figure 7: Graphical representation of the components showing how they inter-relate

3.2 Management structure, milestones and procedures

3.2.a Organisational structure and the decision-making

CLOUDator proposes a gender balanced management structure (Figure 8) based on a coordination group, five Work Packages about development, innovation, testing, management, dissemination / exploitation and communication all organized in a Steering Committee (SC), a Project Advisory Board (PAB), an EOSC Working Group Panel (EOSCPanel) and a Standards Joint Initiative (SJI). This structure allows an efficient working procedure allowing the coordinator to delegate the responsibility for the organisation, execution and reporting of the project to the WP leaders.

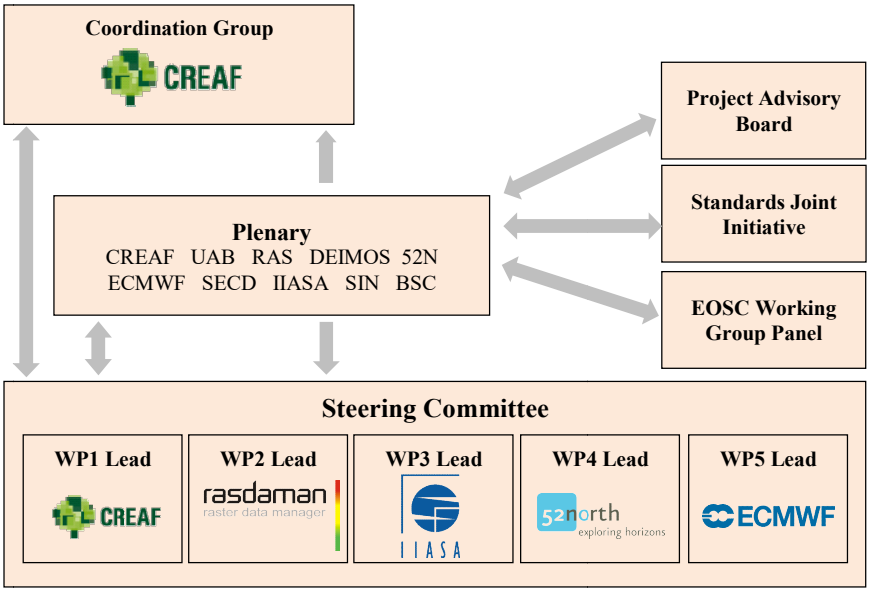


Figure 8: CLOUDator Governance Structure

The structure also brings added quality to the overall project management as the WP leaders and the advisory members have proved experience in leading research and/or development projects. This structure is built to support a wide dissemination of the project results, particularly through the panels of research peers, agencies, and industry associates. This will increase chances of growth of CLOUDator into a sustained global network within EOSC. The proposed management structure is flexible to be able to adapt to INFRAEOSC-03-2020 and INFRAEOSC-07-2020 granted projects in terms of relevant governance and business models, rules for participation, operational requirements, standards, etc.

Coordination group: The coordination group comprises the Coordinator and project manager with support from the European Projects, Contracts, and Communication departments in CREAF. This group will take overall responsibility for the consortium agreement, the management of the project, all the reporting (scientific, technical, financial and administrative) and keeping permanent contact with the European Commission. It will also coordinate the communication and outreach strategies with each identified audience, the Steering Committee, the Project Advisory Board, the EOSC Working Group Panel and the Standards Joint Initiative.

Work Package (WP) and Task leaders: Each WP and each task has a leader assigned. The WP and Task leaders have the necessary background, experience, and time available to properly coordinate the activities of the teams involved in the task. Task leaders will regularly report to the WP leaders and are responsible for organizing and deliver the practical work in their WP. The main goal of the project monitoring is to identify possible deviations from the schedule, budget or work plan. The detailed Gantt chart, the process diagrams and the risk register (by WP and Task) detailed in this proposal in Table 3.2b will aid in project monitoring from day 1.

The **Steering Committee (SC)** will be formed by the WP leaders and will act as a single point of contact with the Plenary and the Project Advisory Board. The **Steering Committee** will meet with specific participants if this is required.

The following decisions shall be taken by the Steering Committee as will be defined in the Consortium agreement based on the DESCA model:

(a) Plenary meeting dates and places
(b) Plenary meeting preparations
(c) Setting Plenary extraordinary meetings
(d) Request for guidance from the Project Advisory Board to the Plenary
(e) Approve deliverables and reports to the European Commission
(f) Clarify each Party's responsibility and work load for the various Work Packages
(g) Agree on press releases and joint publications by the Parties with regard to the Project

(h) Propose on the plan for using and disseminating foreground
(i) Measures to keep the project schedule and review of milestones achievements
(j) Measures to coordinate the creation and deliver the deliverables to the commission on time
(k) Risk detection and mitigation strategies and countermeasures
(l) Changes to Annex I the EC-GA that affect one Work package
(m) Additions to Attachment 1 (Background included)
(n) Additions to Attachment 6 (List of Third Parties)

The **Plenary** is the ultimate democratic decision body of CLOUDator supporting the SC in major administrative and technical decisions and in the evaluation and planning of the main areas of the project. It will be responsible for decisions regarding coordination and support planning and work implementation, and will take the lead on issues of 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 Plenary will also take collective responsibility for monitoring the project progress in the individual work packages through regular Plenary meetings, resolving issues with the work package leaders. The Plenary will also be responsible for the successful completion of the project and the exploitation of the results.

The coordinator will chair the **Plenary** and each Participant will agree to nominate a representative and a proxy to the Plenary with due authorisation to discuss, negotiate and vote on actions proposed by the SC or the Plenary itself.

The first meeting of the Plenary (kick-off meeting of the Project) will take place in the first two months after the official start of the Project. The Plenary shall have full day meetings every six months (physical meetings or virtual). The European Commission, its advisors, and subcontractors may participate as observers at the meetings of the Plenary.

The Plenary (as will be defined in the Consortium agreement based on the DESCA model) shall be responsible for:

(a) Ensuring that all work meets functional requirements,
(b) Providing strategic technical, financial or exploitation and dissemination guidance
(c) Changes to Annex I of the EC-GA to be agreed by the European Commission
(d) Changes in the budget distribution between Parties share out.
(e) Deciding on the alterations of this Consortium Agreement,
(f) Identifying joint ownership (Article 8.1)
(g) Appointment of Work Package leaders
(h) Entry of a new Party to the Consortium and approval of the settlement on the conditions of the accession of such a new Party
(i) Withdrawal of a Party from the Consortium and the approval of the settlement on the conditions of the withdrawal
(j) Declaration of a Party to be a Defaulting Party
(k) Remedies to be performed by a Defaulting Party
(l) Termination of a Defaulting Party's participation in the Consortium and measures relating thereto
(m) Withdrawals from Attachment 1 (Background included)
(n) Additions to Attachment 2 (Background excluded)
(o) Additions to Attachment 4 (Listed Affiliated Entities)
(p) Proposal to the European Commission for suspension of all or part of the Project
(q) Proposal to the European Commission for termination of the Project and the Consortium Agreement

Project Advisory Board (PAB): This group will comprise leading representatives from science disciplines, EOSC technical experts, decision makers and open data providers. They will facilitate independent scientific and technical advice and feedback to achieve the project objectives, the integration of multidisciplinary research, the communication with possible stakeholder groups and the dissemination of research findings and exploitable services. The PAB will be expected to encourage the promotion and wide awareness of CLOUDator amongst their respective communities. The PAB will attend and meet at the major Project Meetings once a year. The final composition of the PAB will be determined when the project starts, continuing the tentative list of people that have already expressed they willingness to be part of it: Dr. Antonio Bombelli (ENEA) and Bart De Lathouwer (OGC).

Standards Joint Initiative (SJI): The SJI will actively promote standards, specifications and methodologies that support multidisciplinary research on Earth Sciences and from the activities and results achieved with the other projects under the same topic and under the umbrella of EOSC. The SJI will be initially chaired by the coordinator and composed by members of the Open Geospatial Consortium, the EOSC Secretariat, the European Commission (or representatives appointed by them) and will meet in conjunction with events to advance standards such as OGC Technical Committee meetings.

EOSC Working Group Panel (EWGP): This panel will supervise the participation of CLOUDator in the EOSC Working Groups, i.e. Landscape, FAIR, Architecture, Rules of participation, Skills and Training and Sustainability. There will be no limit to the number of CLOUDator participants nominated to participate in the EOSC Working Groups, with minimum of one representative per each WG. WG coordinators will be contacted to take part in the EWGP, i.e., Landscape: Jan Hrušák, FAIR: Sarah Jones, Architecture: Jean-François Abramatic, Rules of Participation: Juan Bicarregui, and Sustainability: Rupert Lück & Stephan Kuster. Participants in the EOSC WGs will be responsible to inform the WGs about the project evolution and influence the further development of EOSC. In the same way, CLOUDator participants will report back to the project Plenary about the information gathered in the WG and to progress in developing the EOSC.

3.2.b Management procedures

The whole management of the project will favour innovation which requires an understanding of both market and technical problems, with a goal of successfully implementing appropriate creative ideas.

Coordination: The success of the project will depend upon careful planning, allocation and administration of the resources, assessment of the risks, and anticipation of the challenges that may arise, constant monitoring of progress and respect of deadlines, quality control, reporting, and communication. Overall management of the project is under the responsibility of the project coordinating group (CREAF), but important management tasks are also performed by the WP leaders. The coordination of CLOUDator is covered by WP1. The tools used for communication are developed and applied in WP5 underscoring the importance of dialogue, engagement and dissemination to CLOUDator, and supporting the integrative dissemination and exploitation activities of the other WPs.

Operational and financial management: All contractual, administrative and financial matters are in the responsibility of the coordinator. The administrative and financial responsibility will cope with detailed budget management, transferring the Commission grant to the partners in a timely manner, and all contractual matters with the Participants. It will follow on the implementation of the Consortium Agreement, and address all questions that might arise in the course of the project. Specifically, the following topics will be covered: (1) overall administrative and financial management of the coordination, (2) keeping track of budgets, (3) management of consortium-level

legal and ethical issues, (4) preparation of financial and administrative reporting to the Commission, and (5) knowledge and innovation-related activities, intellectual property issues, (6) facilitating communication between the Commission and partners. All project developments and procedures will be fully documented at the end of the reporting periods set by the commission. Deliverables will be reviewed and quality controlled by two members of the consortium that are not authors before delivery. At the end of the reporting periods the coordination group will prepare a consolidated overview of the budgetary situation of the project, on the basis of the cost statements they have received from the partners. This report will be submitted to the Commission. The payments that have been made will also be reported. The coordinator will also compile interim short project reports with participant contributions every six months and distribute them.

Scientific management and monitoring progress: This covers the coordination of all scientific and technical activities. It will monitor the project planning and progress, ensure that deadlines are met and resolve bottlenecks, prepare deliverables and frequently assess the use of resources and budget. It also organizes project meetings and internal reviews, and maintains the documentation and quality plan. At the level of the WPs, those functions are assumed by their Leaders; the project coordinator being responsible for the overall oversight of those issues at the project level. The project coordinator also takes responsibility for preparing project reports, reporting to the Commission, taking action to resolve conflicts and/or deal with contingencies. The coordinator is responsible for the CLOUDator strategy of active collaboration with other EU-funded or international projects, through the Research Panel and individual collaborative actions (such as jointly hosted field work).

Internal Communication: The communication strategy adopted in the project aims at keeping all the partners fully informed about the status of the different ongoing and upcoming activities. The target is to reach maximum transparency for all parties involved and hence increase synergy. All reports produced (such as meeting and project reports, visit reports, publications, etc.) will be communicated to the coordinator who will be responsible for channelling this information to other partners when appropriate. Similarly, the coordinator will distribute relevant information obtained from sources outside the project (other H2020 projects, from the Commission, agencies and industries) to the partners. The dissemination mechanism will be a combination of email, project webpage, and a common document repository. CLOUDator will use face-to-face management meetings, scientific project meetings and targeted workshops, along with video conferencing, email, telephone, as well as a web-based internal communications software (e.g. GoToMeeting). A project collaborative Foswiki site will be developed within WP1 at the beginning of the project and will be continuously updated and enhanced throughout the project duration. The coordinator will manage it but the participants will be encouraged to use it and generate content.

The Foswiki will contain all information about the project:

- Project periodic reports.
- Interim reports
- Deliverables drafts and final.
- Milestone and schedules
- Rick assessment materials
- Minutes of meetings and recordings
- Relevant documents
- Pages for internal coordination of WPs
- Pages to coordinate tasks
- Templates to facilitate reporting,
- Links

External Communication: Communications are handled in WP5, coordinated by ECMWF and supported by the coordinator, and will ensure regular communication and collaboration with existing projects and activities to ensure a gradual harmonisation of messaging around the EOSC activities. The coordinator will deliver all technical platforms of communication (e.g. workshops organization, website, webinar software). This work is done in close collaboration with science and industry partners. All partners contribute person-months to WP5, ensuring that CLOUDator has the appropriate resources at hand for effective communication. A detailed "Engagement Strategy" was presented before which includes best-fit communication methods/avenues depending on the audience and desired effect. The EC will be kept informed of project progress via regular presentation of CLOUDator to the EC project officer.

Plenary Meetings and innovation detection: There will be a kick off meeting (M1), attended by all partners and most of the participating scientists and developers, to launch the project and to facilitate contact among partners and the Commission, as well as to establish good working relationships. Project meetings will be scheduled prior to the reporting periods and every 6 months. Generic agenda items will always include a:

(1) review of the progress in the work packages and work tasks towards the outcomes
(2) feedback/input from the Project Advisory Board and the EOSC Working Groups Panel
(3) outcomes of the project: detection of unforeseen outcomes and how to respond to an external or internal opportunity,
(4) analysis of emerging new ideas and opportunities and how to adjustment of the work plan for subsequent phases of the project to best meet CLOUDator goals and respond to changing trends or detected new outcomes and related research,
(5) exchange of (technical) expertise and data between partners,
(6) review of the milestones and deliverables for upcoming phases of CLOUDator,
(7) other activities established in the Consortium Agreement.

In addition to full day meetings, they will meet using teleconference two months and one month in advance of each Validation exercise for a go/no go readiness assessment of each service. These latter checks are essential to ensure sufficient organizational support and to make sure that Services Testing and demonstration events are useful to their fullest extent. Additional meetings may take place, if necessary. Plenary meeting may be collocated to Steering committee meetings.

Decision making: Decisions will be taken by consensus and the coordinator will ask for unanimous consent in all decisions. If a dispute arises and no consensus is possible, alternatives will be found. If none of the alternatives passes, the Plenary will resolve the matter by vote (one vote per consortium partner). Majority and casting vote mechanisms will be specified in the consortium agreement following the DESCA model.

3.2.c List of milestones (table 3.2a)

Milestone number	Milestone name	Related work package(s)	Due date (in month)	Means of verification
MS01	MVE services starts	WP2	M01	The kick of meeting has happened
MS02	Showcase presented	WP3	M02	Showcase documented in D3.1
MS02	Architecture of the services interactions defined	WP2	M04	Requirements for service persistence, reliability and energy consumption and architecture designed documented in D2.1
MS03	MVE initial services available	WP2	M09	Endpoints ready to use
MS04	Showcases analytical work concluded	WP3	M10	First co-creation meeting preparation materials
MS05	MVE services registered in the EOSC Marketplace	WP2	M11	A query in the EOSC Portal returns results
MS06	First stakeholders meeting done	WP3	M11	First co-creation session minutes available
MS08	Proposal for Geospatial standards in EOSC draft	WP4	M14	Draft geospatial technical guidelines
MS09	Showcases services ready for revision	WP3	M17	Second co-creation meeting preparation materials
MS10	Showcase services registered in the EOSC Marketplace	WP2	M18	A query in the EOSC Portal returns results
MS12	Demonstration event	WP5	M28	Minutes of the final event recorded
MS13	Outcomes and sustainability defined	WP5	M30	All tasks in the project has concluded

The management of the project is designed as an equilibrium between the Plenary that will focus on innovation, opportunities, information, knowledge, etc. and the Steering Committee that will focus on deficiencies, delays and risks. As part of the Steering Committee the known risks in the project will be logged and review regularly assessing the probability, timeliness and impact. The more probable, the closer to happen and the more impact it can create with more attention will be scrutinized in every meeting. The following table contains the critical risks known today as well as the way the project will address it if it might happen.

3.2.d Critical risks for implementation (table 3.2b)

Like-lihood	Description of risk	Work package(s) involved	Proposed risk-mitigation measures
Medium	The related EOSC projects generate delays that create a schedule that is out of synchronization with us.	WP1	Increase communicational among coordinators of the projects and agree on acceleration strategies.
Low	Governance and business models, rules for participation, operational requirements, standards, from topic INFRAEOSC-03-2020 become too demanding for the resources foreseen.	WP2, WP3, WP4	Apply some level of flexibility and move efforts to contemplate and implement the new requirements. Apply experience of gained by other projects with more resources. WP leaders and partners have long-standing experience in the field and will continuously assess this risk.
Low	EOSC Common services and other external EOSC services are not working properly.	WP2, WP4	Regular communication among WP leaders and a tool-supported incident management system.
Mediu m	Services are so successful that the cost of exploitation in the cloud exceeds the initially foreseen costs.	WP2, WP3	Negotiate with the EC a way to balance the budget. Optimize the code. Look for other cloud providers that can offer better prices.
Medium	Scientists refuse to move their research into the EOSC and prefer to work on their premises.	WP3, WP5	Collect evidence of the benefits of working in the cloud and propose them challenges that are not possible to solve without big data infrastructures.
Low	Attacks compromise the Big Data services	WP4	Strong security expertise in the consortium.
Low	Scientists hesitate to learn new APIs	WP5	Thanks to the open standards scientists can continue using their well-known tools and services. A task is dedicated to educating internal and external users on the best use of the APIs.
Low	Data privacy and protection laws are not implemented sufficiently	WP4, WP1	This item will be under continuous observation, by a key expert (SECD) in the consortium. More work on authentication services will be applied to handle this aspect.
Low	Data produced or acquired are not of sufficient quality	WP2, WP3	A combination of automated and manual procedures will be put in place to provide ARD of sufficient quality.
Medium	Services used in the project do not have a good fit and lack interoperability, thereby endangering the overall stack	WP2, WP4	Strictly confine to services offering open standards APIs. Require interoperability testing and passing of OGC conformance tests by all tools.

3.3 Consortium as a whole

The CLOUDator consortium will be led by CREAF, which has proved experience, available networks and the required administration structure to perform coordination successfully. CREAF has coordinated tens of EU projects in the past including H2020 ConnectinGEO and WaterInnEU and FP7 GeoViQua that where led by the proposing team. In the EOSC calls, CREAF is leading the architecture and communication WP of the H2020 COS4Cloud project and is member of the EOSC Architecture working group[28]. CREAF is participating in the definition of the EuroGEO infrastructure composed by the DIASs and the European Open Data Cloud. CREAF has worked previously with most of the members of consortium.

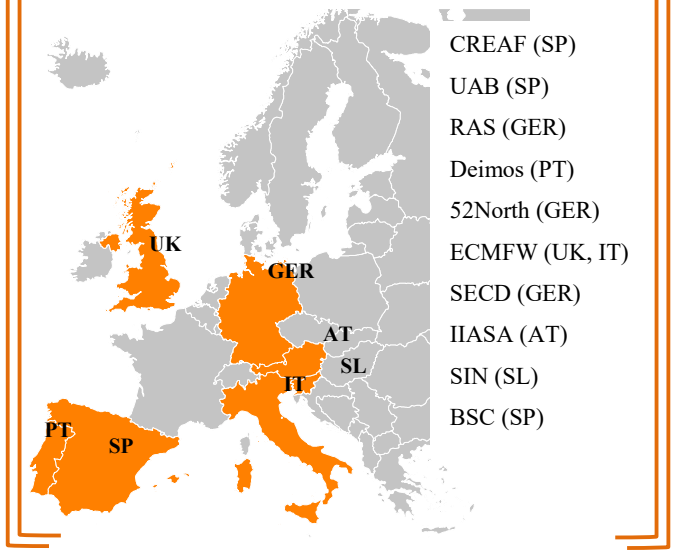


Figure 9: Map of CLOUDator Consortium (orange)

Half of the partners in the consortium are already involved with EOSC: BSC is currently involved in various European data infrastructures and projects, such as EUDAT CDI, RDA 4.0, EOSC-hub and EOSC-Synergy, contributing with services, experience, community engagement and outreach. The RAS datacube concept[29] was registered in the EOSC portal as well as the Sentinel hub owned by SIN[30]. CREAF, 52N and SECD are participating in the H2020 COS4Cloud to contribute citizen science to EOSC.

Figure 9 shows how it is represented by a variety of countries. The consortium partners engage a wide diversity of research, stakeholder and policy networks in their operations, working on a global scale to ensure wide external project collaboration. Partners are capable to provide services, register them in the EOSC portal, demonstrate showcases, propose standards and technical specifications and generate the necessary communication and dissemination. In fact, half of the partners are currently involved in active projects contributing to EOSC.

Each partner is selected for their unique contribution to CLOUDator: ECMWF is the connection to the Copernicus services, BSC contributes two showcase services based on Copernicus, RAS contributes the rasdaman datacube to expose Copernicus data, Deimos contributes the NextGEOSS data hub for Copernicus data discovery, CREAF contributes user interfaces with the MiraMon Map Viewer, UAB contributes the scientific discussion and user feedback service, 52N contributes the in-situ component service, SECD contributes know-how on authorization and Authenix, SIN provides the technological support to the Open Health Map and IIASA provides the experience in collaborative mapping and COVID-19 health analysis and leads the showcase services. As all partners have previous connections and have work with some others in previous occasions, synergies will rapidly grow during the project. Table 18, demonstrates excellent complementarity

[28] https://www.eoscsecretariat.eu/working-groups/architecture-working-group
[29] https://marketplace.eosc-portal.eu/services/rasdaman-eo-datacube
[30] https://marketplace.eosc-portal.eu/services/sentinel-hub

across the diverse areas required for the successful implementation of CLOUDator. How this expertise and provision is matching the project objectives (in section 1.1) is provided in Table 19.

The Figure 10 shows how the budget is divided among the organization types. There is a good balance of universities, research centres, international organizations and companies. Two international organizations participate in the consortium: ECMFW partner is an international organisation of European interest with headquarters are in UK and offices in Italy; IIASA is an international research institute located in Austria. The industrial and commercial involvement represents the 48% of the resources and the 50% of the participant organizations. This will ensure exploitation of the results in the last part of the project as well as after the end of it. The industrial and commercial contribute existing services to the project but they retain their IPR and trademark. Companies and SMEs see the EOSC participation as business opportunity to expand their markets in the future by exploiting the project results.

Table 18 reflects the major expertise and contributions to the project.

Table 18: Relevant expertise and complementarily of the CLOUDator partners

Expertise and provision	**CREAF**	**UAB**	**RAS**	**DEIMOS**	**52N**	**ECMWF**	**SECD**	**IIASA**	**SIN**	**BSC**
Previous project in EOSC	✓		✓		✓		✓		✓	✓
MVE lead services	✓	✓	✓	✓	✓	✓	✓		✓	
Showcases lead services				✓		✓		✓		✓
Datacubes expertise	✓	✓	✓	✓						✓
Authentication and authorization	✓	✓	✓				✓			✓
Analysis Ready Data			✓			✓				
Standards and interoperability	✓	✓	✓		✓		✓	✓		
Dissemination departments	✓	✓	✓	✓		✓		✓		✓
Stakeholders consultation	✓		✓	✓		✓		✓		
Commercial (Companies and SME)			✓	✓	✓		✓		✓	
Research centre	✓									✓
International organizations						✓		✓		
University		✓								

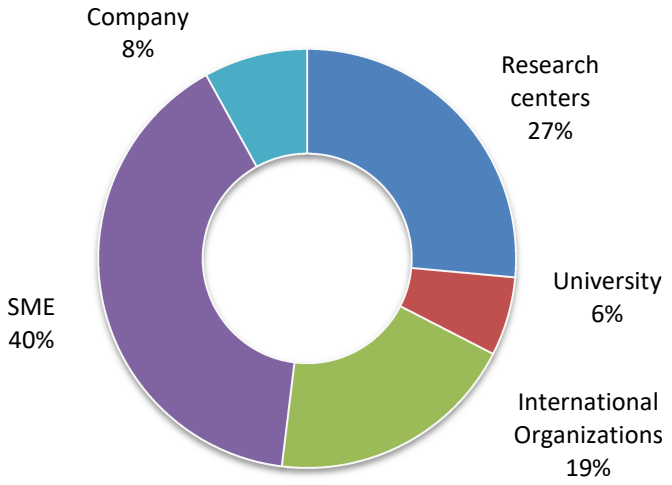


Figure 10: Budget share among the different organisation profiles.

Table 19 reflects how the members of the consortium respond to the objectives of the project.

Table 19: How the Consortium Matches the Objectives of CLOUDator

CLOUDator objectives	How consortium matches objectives
[[GO1]] Enable multidisciplinary scientific research services offered by EOSC in the domains of climate, air quality and human activities and risks	The consortium is in a strong position to forge a set of multidisciplinary showcases services in the domains specified in the CLOUDator project, with the experience in previous projects of urban areas, climate monitoring and COVID-19, impact of climate in energy supplies (BSC, DEIMOS), air quality and dust transport (BSC), socioeconomics (IIASA), climate (ECMWF), etc. The mentioned participants will use their background in the development of the four showcase services during the project
[[GO2]] Contribute multidimensional Earth data services in EOSC Portal and unleash the potential of Copernicus services to meet researchers' needs	Improvements in accessibility and processing of big data analytics will be ready for scientific exploitation to meet researchers' needs, with the experience and services contributed as background by CREAF, UAB, RAS, DEIMOS, 52N, SECD and SIN ECWMF will make available the data from the Copernicus Atmosphere Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S) as a rasdaman datacube in EOSC portal
[[GO3]] Increase the interoperability of the Earth data-intensive research in Europe on the Earth system	CREAF, RAS, 52N and SECD are the partners that will contribute to existing or establish new standards for OGC and ISO. These partners are already deeply involved in interoperability tasks in other EU projects and in the OGC. Especially SECD will participate with their expertise in GDPR for an easy use of the geospatial services
[[GO4]] Contribute to self-sustained services in the EOSC by providing added value	Half of the participants in the consortium are industrial/commercial (RAS, DEIMOS, 52N, SECD, SIN) and they will ensure the exploitation of the services after the end of the project as well as the sustainability of the services. CREAF and UAB have a demonstrated trajectory of sustaining their components through the research cycle. This is consistent with the need to continue the exploitation of the results of the project after the end

3.4 Resources to be committed

For this Horizon 2020 Research and Innovation action project, lasting 30 months, a total cost of 2033672€ was assessed and a total amount of 2033672€ is requested for funding. The resources to be committed are balanced and distributed among the different participants in the consortium as can be seen in Figure 11. An 8% of the personal costs are dedicated to management (WP1). 74% of the PM are devoted to the research and innovations that develop and deploy different services in WP2, 3 and 4 and 16% to dissemination, communication and exploitation tasks (WP5) in support to the project (more details in Figure 12).

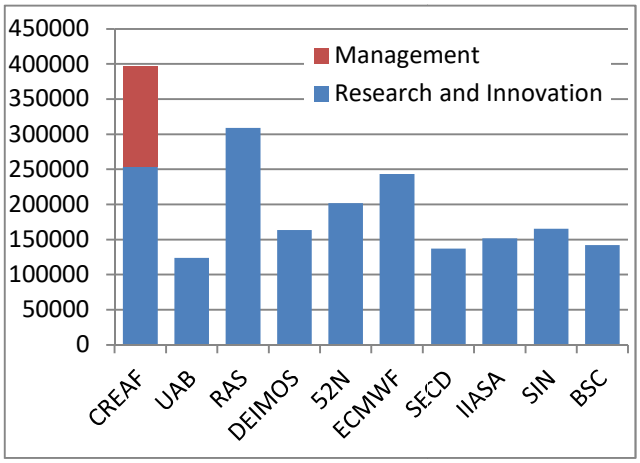


Figure 11: Distribution of budget per participant (in €)

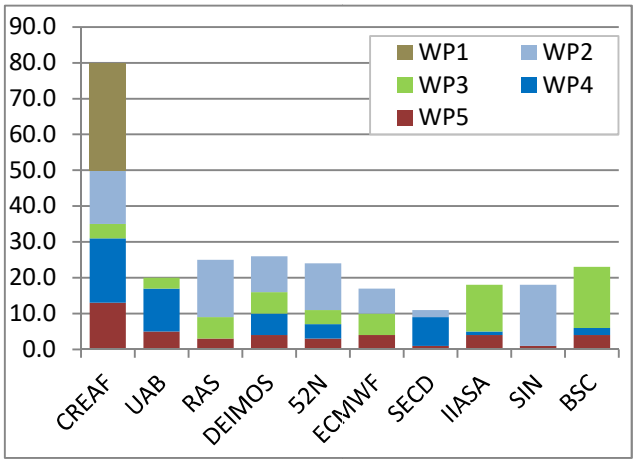


Figure 12: Distribution of efforts per participant and work package (in PMs)

3.4.a Summary of staff effort (table 3.4a)

The following table shows the number of person/months over the whole duration of the planned work, for each work package, for each participant. The work-package leader for each WP shows the relevant person-month figure in bold.

	WP1	WP2	WP3	WP4	WP5	**Total PM per Participant**
CREAF	**30.0**	15.0	4.0	18.0	13.0	80.0
UAB			3.0	12.0	5.0	20.0
RAS		**16.0**	6.0		3.0	25.0
DEIMOS		10.0	6.0	6.0	4.0	26.0
52N		13.0	4.0	**4.0**	3.0	24.0
ECMWF		7.0	6.0		**4.0**	17.0
SECD		2.0		8.0	1.0	11.0
IIASA			**13.0**	1.0	4.0	18.0
SIN		17.0			1.0	18.0
BSC			17.0	2.0	4.0	23.0
Total Person Months	30.0	80.0	59.0	51.0	42.0	262.0

3.4.b Other direct cost items (table 3.4b)

For all participants for which the sum of the costs for' travel', 'equipment', and 'goods and services' exceeds 15% of the personnel costs we provide a table 3.4b fragment with a justification. We consider that in this project requires allocating specific budget for the "access providers" that is detailed in the computing cost forms attached to this proposal an explained in section 1.3.b.6.

2 UAB	Cost (€)	Justification
Travel	12000	Project meetings attendance, conferences attendance for academic dissemination
Equipment		
Other goods and services	3000	Open access publication fees
Total	15000	

3 RAS	Cost (€)	Justification
Travel	12800	4x2x600€ project meetings attendance, 2x2x2000€ intl stds meetings
Equipment		
Other goods and services	46754	38754€ datacube infrastructure (compute, storage, software) cost, 4000€ for 2 open access publication fees, 4000€ for 2 fair booths per year, eg: ESA PHI week, INTERGEO, AGIT
Total	59554	

4 DEIMOS	Cost (€)	Justification
Travel	16000	Project meetings attendance, conferences attendance
Equipment		
Other goods and services	3000	Access provider cost
Total	19000	

8 IIASA	Cost (€)	Justification
Travel	16000	Project meetings attendance, conferences attendance
Equipment		
Other goods and services		
Total	16000	

9 SIN	Cost (€)	Justification
Travel	11590	Project meetings attendance and conference attendance
Equipment		
Other goods and services	20000	Compensation for the use of infrastructure for the purpose of hosting and processing of data for Sentinel Hub (12000€ for cloud infrastructure, mostly DIAS-es) and Geopedia (8000€ for own private cloud facilities hosted at Sinergise's premises)
Total	31590	

Table of contents:

4. CLOUDator consortium

4.1. Participants (applicants)

4.1.1 CREAF

Partner Full Name	CENTRO DE INVESTIGACION ECOLOGICA Y APLICACIONES FORESTALES	
Short Name	CREAF	
Type	Research Organisation	
Country	Spain	
Website	www.creaf.cat	

Short Profile

The Centre for Ecological Research and Forestry Applications (CREAF) is a public research institute created in 1987 and located in Catalonia. CREAF's main objective is to generate knowledge and create new methodological tools in the fields of environmental sciences and ecology. CREAF's research activities are broader than a core on function and diversity of natural ecosystems and also include research and development on big data tools, remote sensing pre-processing and analysis, geospatial standards, data quality and citizen science. Its profile matches the tasks in the proposal due to the CREAF experience in data visualization and collective data creation. CREAF Grumets research team is a multidisciplinary group of people that developed the MiraMon GIS&RS data visualization and analysis tool that has been moved to the web using the most advanced international standards and imaginative innovation strategies. CREAF is deeply involved in the use of big data including Earth Observation in the global scale and collaborates actively with global partnerships such as The Global Earth Observation System of Systems (GEOSS), the Intergovernmental platform for Biodiversity and Ecosystem Services (IPBES), Pyrenean Observatory of Climate Change (OPCC); A Long-Term Biodiversity, Ecosystem and Awareness Research Network (ALTER-Net); European Innovation Partnerships EIP-WATER, GEOBON etc. as well as the geospatial standards specification bodies such as the Open Geospatial Consortium and the ISO TC 211. CREAF is participating in the definition of the EuroGEO infrastructure composed by the DIASs and the European Open Data Cloud. In addition CREAF is sensitive to the connection and dissemination of scientific work into policy makers and the society and works for the consolidation of indicators towards the Sustainable Development Goals. CREAF in the EOSC by is leading the architecture and the communication of the COS4Cloud project and being member of an EOSC working group.

Relevance of partner activities to the Project

CREAF is deeply involved in GEO tasks and activities and in the geospatial standards specification. CREAF already works to improve the EOSC infrastructure in COS4cloud and works with the EuroGEO infrastructure composed by the DIASs and the European Open Data Cloud. CREAF will catalyze the use of the new generation of geospatial standards and API building blocks in EOSC. Given the role of CLOUDator coordinator, CREAF has proven experience in the management of many EU projects, like ConnectinGEO or WaterInnEU.

Tasks Assigned and Role in the Project

CREAF is the coordinator of the project (WP1) and will participate in many of the project's tasks. CREAF will mainly contribute with visualization and analytics tools in the Integrated CLOUDator Big Data Analytics services (WP2), the co-creation and transformation into EOSC permanent services of multidisciplinary showcases (WP3), the contribution to the EOSC construction (with interoperability, EOSC services helpdesk and user feedback implementation in WP4) and the dissemination to the standards bodies and EOSC groups (in WP5).

Leader of Work Packages/Tasks

CREAF is leader of WP1 (Multilayer Management) and all the tasks within this Work Package. In addition, CREAF leads tasks 2.4, 3.1, 4.5, 5.2 and 5.4.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
ECOPotential - Improving future ecosystem benefits through Earth Observations. A Remote sensing and in-situ data ecosystems services quantification for selected protected areas. H2020-EU.3.5.5. (2015-2019)	Terrestrial and marine ecosystems provide essential services to human societies. Anthropogenic pressures, however, cause serious threat to ecosystems, leading to habitat degradation, increased risk of collapse and loss of ecosystem services. Knowledge-based conservation, management and restoration policies are needed to improve ecosystem benefits in face of increasing pressures.
GEO Essential - Essential Variables workflows for resource efficiency and environmental management. H2020-SC5-15-2015 (2017-2020)	It creates cross-thematic workflows to evaluate, predict and monitor natural resources to inform via Earth Observations the Sustainable Development Goals (SDG). Existing structures and platforms are analysed in order to identify substantial gaps and synergies for addressing the needs of environmental policy in agriculture, soil, water, biodiversity, energy, light and raw materials. Solutions for improvements are provided in cooperation with GEO and Copernicus programmes. GEOEssential creates a Knowledge Base infrastructure to facilitate the collection and formalization of the knowledge (i.e. user needs, gaps recognition and recommendations for closing C24, best practices, Community of Practice lexicon, etc.) stemming from the European NetworkEarth Observation Networks and from other significant Earth Observations (EO) initiatives and programs at the National and European levels.
COS4Cloud - Co-designed Citizen Observatories Services for the EOS-Cloud. H2020-EU.1.4.1.3. (2019-2023)	COS4CLOUD aims is to design, prototyped and implemented services that address the Open Science challenges shared by Citizen observatories of biodiversity, as well as other environmental quality monitoring platforms. The innovative services will be designed, prototyped and implemented for improving the data and information quality using deep machine learning, automatic video recognition, advanced mobile app interfaces, and other cutting-edge technologies, based on data models and data protocols validated by traditional science. The new services will

	provide mechanisms to ensure the visibility and recognition of data contributors and the tools to improve networking between various stakeholders. Novel innovative digital services will be developed through the integration of CS products, generated by different providers, following open standards to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub, including a discovery service, to both traditional and citizen scientists. The design of new services will be user oriented, engaging a wide range of stakeholders in society, government, industry, academia, agencies, and research to co-design service requirements. As a result, COS4CLOUD will integrate citizen science in the European Open Science Cloud, bringing Citizen Science (CS) projects as a service for the scientific community and society at large.
BestMap - Behavioural, Ecological and Socio-economic Tools for Modelling Agricultural Policy. H2020-EU.3.2.1.3. (2019-2023)	BESTMAP develops a new modelling framework using insights from behavioural theory, linking existing economic modelling with individual-farm Agent-Based Models. Using these new modular and customizable tools BESTMAP quantitatively models, map and monitor co-designed policy scenarios' impacts on the environment, climate system, delivery of ESS, as well as socio-economic metrics (e.g. jobs). BESTMAP outputs will improve and contribute to existing tools used by the EC such as the Modular Applied GeNeral Equilibrium Tool (MAGNET) and Common Agricultural Policy Regionalised Impact model (CAPRI). Finally, BESTMAP will use a range of external communication and dissemination methods, including online policy dashboard, workshops and training, to help build capacity for EC staff and policy makers at EU institutions, national, regional and local decision makers and expert personnel, as well as other researchers.
E-Shape - EuroGEOSS Showcases: Applications Powered by Europe. H2020-EU.3.5.5 (2019-2023)	The project aims at setting-up and promoting a sustainable organization dedicated to users' uptake of European EO resources, building on Copernicus and GEOSS through the development of co-design pilots (i.e. application-oriented products, services or solutions) built on a user-centric approach and delivering economic, social and policy value to European citizens. It has also the ambition through the development of 27 pilots organized in 7 showcases to deliver information that will also contribute to the three GEO engagements (SDGs, Paris Agreement and Sendai Framework). CREAF is participating in the myEcosystem showcase on the mySPACE pilot especifically through integrating and jointly using information from remote sensing with other sources of information.

Related Publications (the 5 most significant)

1. **Masó J.**, Zabala A., Pons X. (2020) Protected Areas from Space Map Browser with Fast Visualization and Analytical Operations on the Fly. Characterizing Statistical Uncertainties and

Balancing Them with Visual Perception. International Journal of Geo-Information 9 (300): 1-30. https://doi.org/10.3390/ijgi9050300
2. Closa G., **Masó J.**, Zabala A., Pesquer L., Pons X. (2019) A provenance metadata model integrating ISO geospatial lineage and the OGC WPS: Conceptual model and implementation. Transactions in GIS 23(5): 1102-1124. https://doi.org/10.1111/tgis.12555
3. Giuliani G., **Masó J.**, Mazzetti P., Nativi S., Zabala A. (2019) Paving the Way to Increased Interoperability of Earth Observations Data Cubes. Data 4(3): 113. DOI: 10.3390/data4030113.
4. **Masó J.**, **Serral I.**, Domingo-Marimon C., Zabala A. (2020) Earth observations for sustainable development goals monitoring based on essential variables and driver-pressure-state-impact-response indicators. International Journal of Digital Earth 13(2): 217-235. https://doi.org/10.1080/17538947.2019.1576787
5. Fritz S., See L., Carlson T., Haklay M., Oliver J., Fraisl D., Mondardini R., Brocklehurst M., Shanley L.A., Schade S., Wehn U., Abrate T., Anstee J., Arnold S., Billot M., Campbell J., Espey J., Gold M., Hager G., He S., Hepburn L., Hsu A., Long D., **Masó J.**, McCallum I., Muniafu M., Moorthy I., Obersteiner M., Parker A.J., Weissplug M., West S. (2019) Citizen science and the United Nations Sustainable Development Goals. Nature Sustainability 2: 922–930. https://doi.org/10.1038/s41893-019-0390-3

Key Personnel

	**Dr. Joan Masó (male)** is a Principal investigator of CREAF in the interoperability, quality and certifications tasks. (PhD in Geography, MSc in Physics, and a MSc in Electronic Engineering all in the UAB). Gardels gold medal in the Open Geospatial Consortium. Coordinator of GeoViQua FP7 project (research project about visualization of quality information in GEOSS), H2020 ConnectinGeo. Participant in H2020 ECOPOTENTIAL. Chair of the Citizens Science GEOSS working group.
	**Ivette Serral (female)** is a technician at CREAF. BSc in Environmental Sciences and MSc in GIS for the UAB, with more than ten years of experience in GIS and imagery research and European and national related projects management. At CREAF she is related to geospatial data standards projects, to MiraMon GIS software applications and development, and GIS & RS methodologies. She participated in the coordination of the GeoViQua FP7 project (2007-2013) and the ConnectinGEO H2020 (2015-2017). She is participating in ECOPOTENTIAL H2020 (2015-2019).
	**Núria Julià (female)** Degrees in Biology and in Computer Sciences, MSc in Remote Sensing and GIS) is researcher at CREAF since 2002. The main objective of her research is the web services and the collaborative portals. She is a co-developer of the OGC WMS, WFS and WCS server and client. She is a co-editor of Web Map Tiling Service Standard. She has participated in some OGC API Sprint development activities. Núria has a large experience and knowledge in databases, C and JavaScript. She is a developer of the CaMM metadata catalogue and tools for automatically computation forest fire risk for a web portal on-fly.

	**Meritxell Batalla (female)** is a technician at CREAF with a BSc in Environmental Sciences for the UB and an MSc in Remote Sensing and GIS. She develops her research activity since 2011 as GIS technician. Her experience focuses on the management of databases, the use of GIS tools and geospatial modelling. She has collaborated in several research projects, mainly related to the modelling of climate and vegetation, as well as its dissemination through map browsers under OGC standards. She has co-developed the Andorran Climate Digital Atlas and the Pyrenean Digital Climate Atlas.

Significant infrastructure/Technical Equipment/Products/Tools

High-capacity repository and processing server clusters to store and distribute the data generated, high-speed Internet connection (CREAF is connected to RedIRIS, the academic and research Spanish network that provides advanced communication facilities), printers, colour A0 plotter, A0 scanner, etc.

MiraMon Geographical Information System software for imagery publication and distributed processing.

4.1.2 UAB

Partner Full Name	UNIVERSITAT AUTÒNOMA DE BARCELONA
Short Name	UAB
Type	University
Country	Spain
Website	www.uab.cat

Short Profile

Universitat Autònoma de Barcelona was founded in 1968 and since 2009 is recognized as a campus of international excellence by the Ministries for Education (MEC) and for Science and Innovation (MICINN) of the Spanish Government. UAB is in the 10th position worldwide, the 2nd at European level, and the first Spanish university in the ranking QS Top 50 under 50 that classifies Top 50 universities of the world younger than 50 years old. GRUMETS research group, aims to propose new algorithms, methodologies and operational tools for Remote Sensing (RS), Cartography, and land dynamics, agriculture and water management through RS applications. The group has broad experience in image processing of remote sensors and researching in RS methods and big data management with images of low, medium and high spatial resolution from both satellite and airborne sensors. Moreover, the group has broad experience in standardization, metadata and user-feedback documentation. Grumets is member of the Copernicus Academy network since 2019. The members of the research group have published hundreds of scientific papers, participated in more than hundred research projects and contracts, and have obtained several national and international awards. Previous experience of the group matches the tasks in the proposal about community feedback mechanism, remote sensing methods, data and metadata standards, desktop big data tools development (www.miramon.cat) and link to communities and users.

Relevance of partner activities to the Project

UAB already works to include the NiMMbus OGC Geospatial User Feedback (GUF) system in several projects such as NextGEOSS and ECOPOTENTIAL. Efforts are being made to extend GUF in order to contain certain facets of knowledge such as publications and reproducible usage code (e.g. process and code description as well as platform to run it).

Tasks Assigned and Role in the Project

UAB will mainly contribute to task “4.3 Scientific discussions and user feedback”, but will also have a role in tasks: “3.2 Development of multidisciplinary showcases combining Climate change, Air Quality and Risks and impacts on human activities”, “5.2 Communication in coordination with INFRAEOSC”, “5.3 Dissemination of the project resulting services”, “5.5 Collaborate with standards and best practices organizations” and “5.6 Training”.

Leader of Work Packages/Tasks

UAB is leader of task 4.3 Scientific discussions and user feedback.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
NextGEOSS - Next Generation GEOSS for Innovation Business. H2020-EU.3.5.5. (2016-2020)	The NextGEOSS project, a European contribution to GEOSS, proposes to develop the next generation centralised hub for Earth Observation data. A central component of NextGEOSS is the strong emphasis put on engaging the communities of

	providers and users, and bridging the space in between, with special focus on developing innovative EO-based applications and encouraging and stimulating data exploitation by businesses.
ECOPotential - Improving future ecosystem benefits through Earth Observations. A Remote sensing and in-situ data ecosystems services quantification for selected protected areas. H2020-EU.3.5.5. (2015-2019)	Terrestrial and marine ecosystems provide essential services to human societies. Anthropogenic pressures, however, cause serious threat to ecosystems, leading to habitat degradation, increased risk of collapse and loss of ecosystem services. Knowledge-based conservation, management and restoration policies are needed to improve ecosystem benefits in face of increasing pressures.
NEWFORLAND - Los nuevos bosques ibéricos bajo el Cambio Global: Un enfoque multiescala. (2019-2021)	Forests are expanding in Mediterranean Europe due to strong socioeconomic changes affecting land cover (LC) transitions, although Climate Change (CC) is challenging this recovery. New forests (NF) established in former croplands may differ in their landscape attributes and functioning respect to pre-existing ones (whether or not subjected to timber exploitation) due to land use legacies. The expansion of NF may affect biodiversity conservation and key ecosystem functions and services (habitat provision, fragmentation, carbon sequestration) although vulnerability of NF to CC has been seldom explored. NEWFORLAND is aimed to analyse NF expansion in the Iberian Peninsula under Global Change (GC) from a multiscale perspective.
Support to the implementation of the Copernicus land continental and local component, full operations phase: service specifications and ensuring continuity of the existing GIO land services. (2015-2017)	The European Environment Agency (EEA) is a European Union public body governed by Regulation (EC) No 401/2009 of the European Parliament and of the Council of 23 April 2009. The EEA role is to support the European Union in the development and implementation of environmental policy by providing relevant, reliable, targeted and timely information on the state of the environment and future prospects. The EEA is the hub of the European Environment Information and Observation Network (Eionet), a network of around 350 organisations across Europe, through which it collects and disseminates environment-related data and information, including European Topic Centres. The EEA and Eionet contribute to the European Shared Environmental Information System (SEIS), a distributed, integrated, web-enabled information system based on a network of public information providers sharing environmental data and information. It builds on existing e-infrastructure, systems and services in the Member States and EU institutions. EEA plays a key role in the development of the Copernicus services, in particular in the technical coordination of the Copernicus Land Monitoring Services.
PHENOTANDEM - Harmonizing remote sensing and citizen science vegetation phenology observations	PhenoTandem harmonizes new phenology products derived from high resolution optical remote sensing (Sentinel-2) with the traditional phenological in-situ observations done by volunteers. Since current in-situ observation cannot always be perceived from space, the innovation consists in co-designing

European Space Agency (2019-2020)	with citizen scientists a new protocol that will make in-situ observations interoperate with remote sensing products. This will burst the spatial distribution of remote sensing phenology products sensible to the effects of the climate change in nature while increasing data quality through in-situ validations. We will generate a new observation protocol of in-situ phenology and we will request RitmeNatura.cat existing participants and new volunteers to use it in the next spring and fall observation campaign. The outcomes of the project will be transferred to the RitmaNatura.cat network for future use and to the remote sensing community as innovative services.

Related Publications (the 5 most significant)

1. Pesquer L., Domingo-Marimon C., **Pons X.** (2019) Spatial and spectral pattern identification for the automatic selection of high-quality MODIS images. Journal of Applied Remote Sensing 13 (1): 014510. https://doi.org/10.1117/1.JRS.13.014510
2. Vidal-Macua J.J. Ninyerola M., **Zabala A.**, Domingo-Marimon C., Gonzalez-Guerrero O., **Pons X.** (2018) Environmental and socioeconomic factors of abandonment of rainfed and irrigated crops in northeast Spain. Applied Geography 90: 155-174. https://doi.org/10.1016/j.apgeog.2017.12.005
3. Masó J., **Zabala A.**, Serral I., **Pons X.** (2018) Remote Sensing Analytical Geospatial Operations Directly in the Web Browser. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences XLII-4: 403-410. https://doi.org/10.5194/isprs-archives-XLII-4-403-2018
4. Padró J.C., **Pons X.**, Aragonés D., Díaz-Delgado R., García D., Bustamante J., Pesquer L., Domingo-Marimon C., González-Guerrero O., Cristóbal J., Doktor D., Lange M. (2017) Radiometric Correction of Simultaneously Acquired Landsat-7/Landsat-8 and Sentinel-2A Imagery Using Pseudoinvariant Areas (PIA): Contributing to the Landsat Time Series Legacy. Remote Sensing 9 (12): 1319. http://dx.doi.org/10.3390/rs9121319.
5. Yang X. , Blower J.D., Bastin L., Lush V., **Zabala A.**, Masó J., Cornford D., Díaz P., Lumsden J. (2013) An Integrated View of Data Quality in Earth Observation. Philosophical Transactions of the Royal Society A 371: 20120072. http://dx.doi.org/10.1098/rsta.2012.0072

Key Personnel

Dra. Alaitz Zabala Torres (female) is a researcher at the Department of Geography at UAB (European PhD degree in Geography in 2010). Her main research interests are metadata, geographical information standardization, data quality and user-feedback metadata, as well as lossy compression effects on remote sensing and resulting cartography and image classification. She is, UAB leader for H2020 NextGEOSS project (European data hub) and participated in H2020 ECOPotential (EO for ecosystems services), FP7 GeoViQua project (visualization of quality information in GEOSS) and FP7 SPACE GEO-PICTURES (a collaborative emergency response tool) as well as some other national and local projects related with remote sensing and geospatial standards. She was also participant in TestBed12 and TestBed 13 (2016 and 2017). Main developer of the NiMMbus system, that is being extended in NextGEOSS project to be the Geospatial User Feedback service of the developed Data Hub. In 2010 she spent half a year at ESA-ESTEC (Noordwijk, The Netherlands). Expert in JPEG2000 format. She also

	teaches in a RS and GIS master and several other grad and under-grad studies in the UAB.
	**Dr. Xavier Pons (male)** (PhD degree in 1992) is Full Professor at the Department of Geography of UAB focusing on Remote Sensing (satellite and airborne) and the development of RS toolsets, both in terms of data structure and organization and in terms of software writing. He has participated, and leaded in many cases, more than 60 research projects. Recent works include descriptive climatology models, land use change analysis, study of information extraction impacts of lossy image compression (JPEG2000, etc), Remote Sensing studies about water usage in forest and crops, and metadata and standards development and testing. His publications in these fields have had an important impact and have been referenced by more than 1,600 papers. Among the projects he has leaded, the operational application, under continuous improvement during more than 10 years, of HR RS imagery and meteoclimatic data for agricultural and water monitoring in Barcelona (crop mapping, evapotranspiration, snow cover, etc). Dr. Pons was recipient of an ICREA Academia Excellence in Research grant (2011-2015) and has been rewarded again with the same grant (2016-2020). He is participant in H2020 NextGEOSS, H2020 ECOPotential (EO for ecosystems services) and participated in FP7 GeoViQua project (research project about visualization of quality information in GEOSS) and FP7 SPACE GEO-PICTURES (a collaborative emergency response tool) as well as some other national and local projects related both with remote sensing and geospatial standards.

Significant infrastructure/Technical Equipment/Products/Tools

Seven servers with 48 TB storage per unit and a total of 192 TB used for temporary processes and final data and products ready for big data time series data as remote sensing images and climatic data. Several Remote Sensing tools and software needed for remote sensing images analysis. High-speed Internet connection (connected to the Spanish network that provides advanced communication the universities).

Moreover, two field radiometers with detectors in the range of visible, near infrared and shortwave infrared, divided into ranges (200-1100 nm) and (900 -2500 nm) are available. It is an USB2000+ spectrometer and a near infrared spectrometer NIRQuest256-2.5, both from Ocean Optics. This information will be used for some pilot cases, specially “Pilot for Land application Setup & Execution”.

Moreover, a receiving station for Meteosat Second Generation (MSG) was installed and launched, in 2007, taking advantage of the free data for research groups. Every 15 minutes we receive the MSG images that are imported into MiraMon software format, for a further internal CREAF-UAB staff use. Besides MSG images, we can also receive images from other meteorological satellites (Metop, GOES, etc.) and processed products as well. This information will be used as ancillary data for some pilot cases, as that the current MSG resolutions could help in various fields of interest including radiometric correction of other sensors, Vegetation index calculations, active fires, aerosols studies and climate change, among others.

4.1.3 RAS

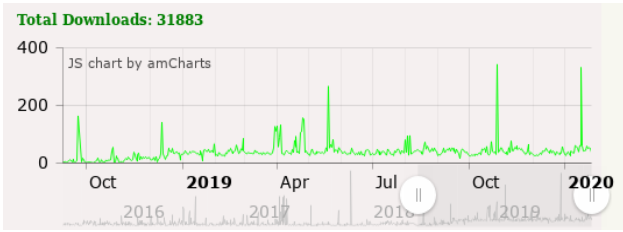
Partner Full Name	rasdaman GmbH	
Short Name	RAS	
Type	SME	
Country	Germany	
Website	www.rasdaman.com	

Short Profile

Independent research spinoff rasdaman GmbH has been established in 2010 for giving commercial support for the rasdaman datacube technology developed by the rasdaman team in academia. rasdaman has pioneered actionable datacubes and is world technology leader in this domain.

Among large and aggressively growing number of customers are SMEs, large industry (including agriculture and defence), research centers, and agencies. Customers include Airbus, European Union Satellite Center, Coramaps, CreoDIAS, Mundi, CODE-DE, Alfred-Wegener-Institute, and many more.

Further, Peter Baumann and the rasdaman team critically shape Big Data standards in OGC (20 standards), ISO (3 standards), and INSPIRE (national delegate). ESA recognizes rasdaman as "currently the world leading environment in this domain and the standard working horse for OGC standardisation on these innovative data access interfaces." As such, rasdaman is a critical component for **European technology independence**.



Early on, rasdaman GmbH has forked open-source *rasdaman community* (OGC reference implementation, 30,000+ downloads, see Figure) from its *rasdaman enterprise* (proprietary scalability boosters), adopting a dual-licensing model.

Selected awards: For its technology leadership rasdaman has received numerous innovation awards, including: DIN Innovator Award 2019; US TechConnect World Innovation Award 2019; NATO Defence Innovation Award 2018, Data Science category; OGC Gardels Award for Peter Baumann's "exemplary contributions to the OGC's consensus standards process".

Relevance of partner activities to the Project

RAS brings in its particular competencies in Big Data Analytics; Flexible services on massive spatio-temporal datacubes; Standards-compliant services; and many years of successful standardization in OGC, ISO, and INSPIRE.

Tasks Assigned and Role in the Project

RAS is WP2 leader, datacube technology provider (in WP2) and helpdesk giving support on datacube platform and standards topics, communication and outreach, training standardization (in WP5).

Leader of Work Packages/Tasks

RAS is leader of WP2 (Multidimensional services and data) and tasks 2.1, 2.3 and 5.3.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
PARSEC - Promoting the internAtional competitiveness of European Remote Sensing companies through Cross-cluster collaboration. H2020-EU.2.3.2.2. (2019-2021)	Led by EARSC, PARSEC supports SMEs from the Earth Observation (EO) sector and key emerging industries (food, energy, environment) with access to capital, knowledge, market and technology services, in particular: DIAS Copernicus datacubes. *Link with CLOUDator: In PARSEC, rasdaman runs the datacube service of Mundi DIAS and CreoDIAS which, via the EarthServer federation, will be available to CLOUDator. Conversely, PARSEC SMEs will tap into the CLOUDator datacubes, resulting in cross-fertilization through applications and use cases.*
EOSC-hub - Integrating and managing services for the European Open Science Cloud. H2020-EU.1.4.1.3. (2018-2020)	EOSC-hub brings together multiple service providers to create the Hub, a single contact point for European researchers and innovators to discover, access, use and reuse a broad spectrum of resources for advanced data-driven research. For researchers, this means broader access to services supporting their scientific discovery and collaboration across disciplinary and geographical boundaries. The project mobilises providers from the EGI Federation, EUDAT CDI, INDIGO-DataCloud and other major European research infrastructures to deliver a common catalogue of research data, services and software for research. Under ESA lead in the EO Pillar the **EOSC datacubes** are operated by rasdaman. *Link with CLOUDator: rasdaman contributes the CreoDIAS datacube which will be federated with CLOUDator.*
OGC Testbed-15. Testbed 15: Innovating Geospatial Data Processing, Analysis, and Visualization. OGC's Innovation Program	**OGC** T-15 has explored new levels of interoperable geospatial data processing in an international effort, sponsored by ESA, US NGA, etc. to prepare concepts for future standardization. Specifically, rasdaman has contributed **data-centric security** and EU/US **federated datacube clouds**. *Link with CLOUDator: standardization impact, collaboration with further potential international federation members.*
BigDataCube, Germany (2018-2020)	BigDataCube has paved the way for commercial datacube services by exemplarily establishing a public/private partnership between the CODE-DE Copernicus archive and cloudeo AG. *Link with CENTURION: rasdaman has established the datacube frontend to CODE-DE and federated it with DIASs and cloudeo (geo service SME), has implemented access control.*

Related Publications (the 5 most significant)

1. **Baumann P.**, Rossi A.P., Bell B., Clements O., Evans B., **Hoenig H.**, Hogan P., Kakaletris G.1, Koltsida P., Mantovani S., Marco Figuera R., **Merticariu V.**, **Misev D.**, Pham Huu B., Siemen S., Wagemann J. Fostering Cross-Disciplinary Earth Science Through Datacube Analytics. In. P.P. Mathieu, C. Aubrecht (eds.): Earth Observation Open Science and Innovation - Changing the World One Pixel at a Time, International Space Science Institute (ISSI), 2017. https://doi.org/10.1007/978-3-319-65633-5_5
2. **Baumann P.** (2017) Geo Raster Data Management. In: T. Özsu, L. Liu (eds): Encyclopedia of Database Systems, Springer.
3. **Baumann P.**, Manolescu-Goujot I., Trani L., Ioannidis Y.E., Barnaföldi G.G., Dobos L., Bányai E. Proceedings of the 28th International Conference on Scientific and Statistical Database Management, SSDBM 2016, Budapest, Hungary, July 18-20, 2016. ACM 2016
4. Andrejev, **Baumann P.**, **Misev D.**, Risch T. Spatio-Temporal Gridded Data Processing on the Semantic Web (2015) IEEE Intl. Conf. on Data Science and Data Intensive Systems (DSDIS 2015), Sydney, Australia, December 11-13, 2015
5. **Baumann P.** (1994) On the Management of Multidimensional Discrete Data. VLDB Journal Special Issue on Spatial Database Systems 4(3): 401 – 444. https://doi.org/10.1007/BF01231603

Key Personnel

Dr. Peter Baumann (male), founder & CEO of rasdaman GmbH and Professor of Computer Science at Jacobs University: He has pioneered datacubes with the invention of rasdaman, documented by international (EU, US, Canada) patents and 160+ book chapters and papers on datacubes and Array Databases.
Baumann has 20+ years experience in international project management, including ESA and EU FPx / H2020 projects, particularly leading FP7 EU EarthServer and H2020 EarthServer-2. Baumann and his team are critically shaping standards and the open-source landscape in the field of Big EO Data; highlights include:

Standardization:

- ISO:
  - ISO IS 9075-15:2019 Multi-Dimensional Arrays (SQL/MDA) – *the only SQL part ever contributed by EU*
  - ISO IS 19123-2 Coverage Implementation Schema – *implemented by leading OS and proprietary tools*
  - ISO WD 19123-1 Coverages Foundation
- Open Geospatial Consortium (OGC):
  - Editor, Coverage data and WCS service model standards suite
  - Chair of BigData.DWG, WCS.SWG, Coverages.DWG
- INSPIRE: German delegate, WCS drafting team member

Science:

- Chair, IEEE Geoscience and Remote Sensing Society (GRSS) Earth Science Informatics (ESI) Technical Committee
- Research Data Alliance: Chair, Big Data Interest Group (IG); chair, Geospatial IG
- Chair, CODATA Germany
- Charter member, Open-Source Geospatial Foundation (OSGeo)

	**Dr. Dimitar Misev** (**male**): Head of Product Development and a substantial code contributor to both rasdaman community and enterprise. He holds a PhD degree in Computer Science from Jacobs University where he has written the ISO SQL/MDA standard under supervision of Peter Baumann.
	**Vlad Merticariu** (**male**), Director Application Engineering: rasdaman core developer, with specific emphasis on spatio-temporal application building, ETL tasks, and customization. He holds a BSc in CS from Jacobs University and, in parallel to his employment, is finalizing his PhD thesis until summer 2019. He is particular expert in distributed data management and query processing, as well as query compilation to heterogeneous hardware.
	**Heike Hoenig** (**female**), Director Marketing at rasdaman GmbH: She holds a Magister in Germanistics from Oldenburg University and has 20+ years of experience in journalism, PR and marketing (such as doing market studies). In EU EarthServer 1 & 2, as well as several running projects, she performs all outreach work for rasdaman GmbH, such as trade fairs, newsletters, and social media where she currently reaches 468,000 named recipients. Further, she has played a key role in the concept of the 1h TV documentary "Big Earth Data" and publishes frequently in German lead print newspaper, Frankfurter Allgemeine.
Significant Products/Tools	
The company's flagship product is the rasdaman scalable datacube federation engine which is in international use on dozen-Petabyte assets, in science, industry, and agencies.	

4.1.4 DEIMOS

Partner Full Name	DEIMOS Engenharia SA	
Short Name	DEIMOS	
Type	Company	
Country	Portugal	
Website	https://elecnor-deimos.com/delegacion/deimos-engenharia/	

Short Profile

DEIMOS Engenharia is a company set up by DEIMOS Space and a group of Portuguese Investors in 2002. DEIMOS Engenharia provides all the capabilities and expertise of DEIMOS Space, thanks to the transfer of key personnel, technology and expertise from DEIMOS Space to DEIMOS Engenharia. DEIMOS staff is well known to ESA, as they have been involved in programs with ESA for many years, in particular in Earth Observation Programs. DEIMOS staff has been highly involved in the development of key facilities of different Payload Data Segments. DEIMOS Engenharia has performed, and is still involved, in several Galileo Projects: Message Generation Facility (MGF), Mission Support Facility (MSF), which includes the Final Offline Assessment Tool (FOAT), and Independent Orbits and Clocks Estimator (IOCE). These projects are by the nature of the Galileo system rather complex in terms of technical expertise requirements, safety and dependability aspects and bureaucratic aspects. In parallel, DEIMOS has also been involved and/or leading projects in the hybridisation of multiple sensors (INPOS, ULTRANAV), development of Enhanced Code Galileo Receiver (ENCORE), and developed a Galileo ready GNSS receiver platform (GNSSPLAT). DEIMOS Engenharia has also a wide experience in supporting Earth Observation Missions, having been involved in the specifications, design, development and validation of the SMOS L1 Processor Prototype and the SMOS Near Real Time Processor as well as providing onsite support during the 6 month SMOS Commissioning campaign that ended in May 2010. Moreover, DEIMOS is now finishing the implementation of the Ground Processor Prototypes for Sentinel 3 MWR and SLSTR instruments, as well as the System Performance Simulator for Sentinel 3. In addition, DEIMOS Engenharia has developed and is still involved, in several Earth Observation data application services namely DesertWatch Extension and AquaPathSoil. The DesertWatch Extension project aims at providing a tool for Portuguese, Brazilian and Mozambican users for the generation of Land Use classification and desertification indices based on EO data (medium, high and very high resolution). In the AquaPathSoil, DEIMOS developed together with ISTMARETEC a service for water irrigation forecast for agricultural users combining DEIMOS1 EO data and physical models for evapotranspiration. DEIMOS Engenharia participates/participated and leads/lead several FP7/H2020 projects in both Earth Observation and GNSS fields, including SenSyF, a clouddistributed environment and tools for supporting EObased services; CoReSyF, a dedicated system to support coastal research activities, using and improving the SenSyF ecosystem; EGEM, for generic development in reflectometry for Earth Observation; and COREGAL, a dedicated instrument development project for Biomass monitoring with reflected GNSS signals.
DEIMOS has also been developing support systems for the development and deployment of EO based applications and services, in particular in previous FP7/H2020 activities coordinated by DEIMOS, such as SensyF, Co-ReSyF, NextGEOSS, MELOA, BETTER and NextLand.

Relevance of partner activities to the Project

DEIMOS is responsible for cataloguing new data providers, maintenance and the operations of the NextGEOSS Data Hub, a service offered in CLOUDator. DEIMOS also has extensive experience in developing Earth observation services in the area of Agriculture monitoring, Marine, Urban

planning and renewable energy in the scope of H2020 and ESA funded projects. DEIMOS has experience in developing commercial EO services and developing business models in H2020 projects, like NextGEOSS, NextLand and ESA funded project like ECOMI.

Tasks Assigned and Role in the Project

DEIMOS is

- Leading the service offering of NextGEOSS Data Hub (in WP2)
- Co-creating the showcases related to air quality and climate with urban heat island and energy supply (in WP3)
- Developing sustainability plan and business models (tasks 2.5 and 3.4)
- Contributing to the EOSC construction (WP4)
- Communicating and disseminating the results of the project in WP5.

Leader of Work Packages/Tasks

DEIMOS is leading tasks 2.5 and 3.4.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
NextGEOSS - Next Generation GEOSS for Innovation Business. H2020-EU.3.5.5. (2016-2020)	DEIMOS is leading the NextGEOSS project which consists of 27 partners and has been developing an European DataHub and a set of Platform Services (Data Discovery and Access , Data Cataloguing , Service Cataloguing , User Management, Cloud Integration , Analytics and Operations Dashboards). The NextAtlantic project will depend of the NextGEOSS Data Discovery and Access service to get API access to the Copernicus Data products. The NextGEOSS maintains the metadata of the data products and provides an Open Search Interface for easy discovery(2 step search). The metadata of the sentinel products are already catalogued in NextGEOSS DataHub and will be used for the NextAtlantic project. DEIMOS is responsible for developing data Harvesters to harvest the metadata from several data sources. The NextGEOSS Cloud Integration Service will be used to integration NextAlantic services in cloud infrastructure (in DIAS). This service has been developed as an cloud agnostic way to enforce interoperability between several cloud providers. The service operationalisation of the NextAtlantic will also leverage on the Implementation of he User Management , Service Desk and the Analytics services. In the way, the evolution of the NextAtlantic services will be faster and reliable.A set of NextGEOSS Platform services is planned to integrated in other GEOSS related activities like- EuroGEOSS (E-SHAPE) and AtlanticGEOSS.
Marine-EO - Bridging Innovative Downstream Earth Observation and Copernicus enabled Services for Integrated maritime environment, surveillance and	DEIMOS is leading one of the selected consortiums to implement a Cloud platform to support the development of end exploitation of EO services for the Marine environment monitoring. The services are deployed over a common web based platform able to manage the use and submission of a wide range of requests for EO-based services, promoting the

security. H2020-EU.2.1.6.3. (2017-2020)	development and testing new solutions addressing a set of common challenges: development, testing and validation of a bundle of COPERNICUS-based services, bringing incremental or radical innovations in the field of maritime awareness, accompanied with "support" services that will standardize the way EO is used for maritime awareness, in regards of operational, technological, semantic and legal interoperability issues. There are three downstream services that are being offered as part of this procurement, Marine environment status in Hot Spots, Detection of Fish farm threats and the Detection of Vessels and Icebergs in Arctic Areas. These services are developed and maintained by the service providers of this consortium (IPMA, PML and K-SAT). The end users trigger these services from the HMI after a successful requirement analysis. A set of EO data processing tools available to the users. The result of these services are viewed by the users in the web portal with options to download. The operationalisation of the NextAtlantic services will be based on the work carried in Marine-EO (User Management, Analytics , Service Desk, Service Catalogue etc.).
Co-ReSyF - Coastal Waters Research Synergy Framework. H2020-EU.2.1.6. (2016-2018)	The CoReSyF H2020 project will implement a dedicated data access and processing infrastructure, with automated tools, methods and standards, base to support research applications using Earth Observation (EO) data for monitoring of Coastal Waters, leveraging on the components deployed SenSyF. The main objective is to facilitate the access to Earth Observation data and preprocessing tools to the research community, towards the future provision of future Coastal Waters services based on EO data. Through CoReSyF's collaborative front end, even young and/or inexperienced researchers in EO will be able to upload their applications to the system to compose and configure processing chains for easy deployment on the cloud infrastructure. They will be able to accelerate the development of high performing applications taking full advantage of the scalability of resources available in the cloud framework. The included facilities and tools, optimized for distributed processing, include EO data access catalogue, discovery and retrieval tools, as well as a number of preprocessing and toolboxes for manipulating EO data. Advanced users will also be able to go further and take full control of the processing chains and algorithms by having access to the cloud backend and to further optimize their applications for fast deployment for big data access and processing. The CoReSyF capabilities will be supported and initially demonstrated by a series of early adopters that will develop new research applications on the coastal domain, will guide the definition of requirements and serve as system beta testers. A competitive call will be issued within the project to further demonstrate and promote the usage of the CoReSyF release. These pioneering researchers in will be given access not only to the platform itself, but also to extensive

	training 3 NextGEOSS Next Generation GEOSS for Business & Innovation, vol II SEP210342427, v201670308 material on the system and also on Coastal Waters research themes, as well as to the project's events, including the Summer School and Final Workshop. Based on the work performed in Co-ReSyF DEIMOS is also developing master thesis on Workflow Validations and Orchestration of OGC services, exploiting the capabilities to package, deploy and orchestrate geographic services running on different platforms (e.g. the different Copernicus DIAS) and exposing standard interfaces.
ECOMI - E-commerce platform for Micro geo-services	The E-commerce platform for Micro geo-services (ECOMI) is a new H2020 project lead by DEIMOS starting in 2020. The platform aims to deliver an e-commerce platform for micro geo-services creating opportunities for the EO service providers to commercialise their services in the EO market space, bringing together EO service providers and potential end users in a marketplace with a consolidated solution. The project will be executed for the duration of 2 years and during this period, the platform will be pre-operational and open to the community of EO service providers for exploitation. After the end of the project, the platform will be commercially sustainable with a strong community of EO service providers and the end users and other key stakeholders.
BETTER - Big-data Earth observation Technology and Tools Enhancing Research and development. H2020-EU.2.1.6.3., H2020-EU.2.1.6.1.2. (2017-2020)	The main objective of BETTER is to implement an EO Big Data intermediate service layer devoted to harnessing the potential of the Copernicus and Sentinel European EO data directly from the needs of the users. BETTER aims to implement and incorporate generic Big Data tools with user experience, expertise and resources to deliver an integrated Big Data intermediate customized service layer for large volume EO and non-EO datasets access, retrieval, processing, analysis and visualization. BETTER developments will be driven by a large number of Big Data Challenges to be set forward by the users deeply involved in addressing the Key Societal Challenges.

Related Publications (the 5 most significant)

1. Almeida N., Catarino N., Gutierrez A., Martinho F., Rosado H., **Andrade J.**, Caumont H., Gonçalves P., Brito F. SenSyF: Processing Framework for Sentinel Data. Presented at Big Data From Space Workshop 2014 (BiDS'14), 1214 November 2014, ESRIN, Frascati, Italy.
2. Rosado H., Catarino N., Gutierrez A., Almeida N., Leitão P.C., Almeida C., Jauch E. SenSyF Agricultural Service for Sentinel Data. Presented at Sentinel 2 for Science workshop, ESA-ESRIN, Frascati, Italy, 20 22 May 2014.
3. Almeida N., Catarino N., Gutierrez A., Martinho F., Rosado H., **Andrade J.**, Caumont H., Gonçalves P., Brito F. SenSyF: Processing Framework for Sentinel Data. Presented at Sentinel 2 for Science workshop, ESAESRIN, Frascati, Italy, 20 22 May 2014.
4. A framework of facilities. International Innovation magazine, Sep 2013, p.8991.
5. For documentation on SMOS scientific results, see: http://smos.com.pt/project_results.html.

Key Personnel	
	**Dr. Nuno Grosso (male)** is a Project Engineer and Business Developer in the Aerospace & Defense Portugal Business Unit at DEIMOS Engenharia. Nuno Grosso obtained the B.A. (5 years degree) and a PhD, both in Environmental Engineering from Universidade Nova de Lisboa (PT). His PhD research focused on the application and development of atmospheric pollution remote sensing algorithms. His other research work covered different areas, from the development of GIS web applications for Land Use/Land Cover to Remote Sensing and GIS applied to 2 NextGEOSS Next Generation GEOSS for Business & Innovation, vol II SEP210342427, v201670308 Water Resources and Flood Risk Assessment, where he developed skills in hydrological modelling in a climate change context, working in several national projects (e.g., ADAPTACLIMAEPAL and CIRAC). Furthermore, he has been involved in international research projects where he developed visualization and analysis applications dealing with large volumes of satellite and model data in the scope of several ESA projects (e.g., AirCast, PM#GRID, VA4D). He has several conference articles dealing with remote sensing, water resources, GIS and air quality. Nuno was responsible for the Agriculture support service in the FP7 SenSyF project, and is Technical Coordinator of the H2020 CoReSyF project , BETTER and NextLand.
	**João Andrade (male)** is a senior software engineer of the EO Ground Segment Systems business unit at DEIMOS, experienced in projects involving processing platforms, archive and big data - namely SenSyF, Co-ReSyF, Hydrology-TEP, SimOcean, Marine-EO and NextGEOSS. He was involved in the development phase of the SenSyF project, more specifically, in the development of a Service Development Kit (SDK) which is integrated in the project's framework. He worked on the version 2 of the SDK for the same project and is responsible for the technical part of the Agriculture Service, which is a demonstrative service of SenSyF (S6). He was involved in the integration of WOIS (Water Observation and Information System) on the Hydrology-TEP Platform. He is currently responsible for the updates on the CKAN catalogue and improvements in the harvesters (data connectors) to get and store within SIMOcean project, and is the Systems Engineer of NextGEOSS. He is also responsible for the development and improvement of the NextGEOSS Data Connectors. He is involved in other projects containing archive solutions for big data (CKAN and/or Archive4EO) such as CHEOPS Archive, Marine-EO and RPASMAR. In the scope of the project RPASMAR, he is also part of the operational team. The deployment of support services, based on JIRA Service Desk, is also under his responsibility in different projects such as NextGEOSS and Marine-EO.

	**Koushik Panda (male)** is a Senior Project Engineer at DEIMOS. He is involved in the technical coordination team of NextGEOSS Project and Project Management of Co-ReSyF and ECOMI Project. He has 9+ years of professional experience in the area of Data warehousing, Data Analytics, Data Management and Data Anonymization. He has experience in handling large international projects, namely in requirement analysis, conceptualization of functional and technical specifications for large and complex systems with end-to-end delivery of solutions. He has also worked on building services related to Data Governance areas. Koushik Holds an International MBA Degree from Nova School of Business and Economics , Catolica Lisbon and MIT Sloan. Koushik is also working in the business development activities at DEIMOS.
	**Sara Gomes (female)** is an Innovation Analyst at DEIMOS. She holds a Masters degree in International Management (major in Digital Business) at Nova School Economics; Msc Project developed in the scope of NextGEOSS (H2020), at Deimos Engenharia. She has been involved in marketing and innovation activities in the scope of H2020 projects. She develops communication strategies and content for H2020 projects, while creating integrated campaigns for communication and dissemination opportunities. She is also conducting sustainability assessments within the scope of current projects, and for future H2020 proposals.
	**Carlos Luque (male)** has gained deep knowledge in many relevant aspects of a space mission, during his 14 years working in the space industry. The fact that he has always been willing to take over on-site positions has allowed him to explore and interact with many different actors in the space industry. He started his career developing code in both FOS and PDGS sides of the ground segment (C/C++). The next 4 years, he participated in the construction of the GAIA spacecraft in Toulouse as he was in charge of the management of the onboard system database (ORACLE). During those early years of his career, he also worked in flying operational procedures, their design with MOIS and their validation in the reference platform. Wanting to get the whole picture he pointed his career towards the system validation, operations, and customer interactions. For several years, he participated in the operation preparations on FOS side of PAZ and SEOSAT satellites at INTA (Spanish National Institute for Aerospace Technologies) while the ground segment validation campaigns were taking place (Miconys). Finally some years ago, feeling very much attracted to the need for solutions that appear in everyday operations, he took the opportunity to work as part of the PDGS during the first years of satellite operations for Sentinel 2. In that frame, he has spent the last three years managing the interactions between the client and the developers in the context of the E2ESPM, a tool developed by Deimos which operation worked as a service that he ran and provided to Thales (JIRA). Carlos is leading the NextGEOSS Data Hub operations activities.

Significant infrastructure/Technical Equipment/Products/Tools

The following hardware infrastructure is available at DEIMOS Engenharia: Local Area Network (LAN) capable of serving up to 100 workstations, laptops, tablets and servers; LAN 1Gigabit

certify; Redundancy Internet Service Provider (ISP) with failover backup system; Permanent broadband connection to the Internet (100 Mbps); Dedicated Firewall to prevent unauthorized access to private network and others security layers; External FTP Server; Printers (monochrome and color), copier, fax and scanner; Laboratory facilties (Oscilloscope, regulated power supply, RF cables, splitters, LNAs, high frequency digital I/O board; GNSS antennas and receivers; Dedicated GNSS Radio Frequency FrontEnds; Pender GRPCITEST, LEON PCI Virtex Development Board; Xilinx Virtex boards). For meetings, teleconferences and video-conferences DEIMOS offers: 4 meeting rooms which can hold an average of 68 persons (the biggest meeting room has the capacity to have up to 15 persons sitting down); 1 IP Videoconference system (Point-to-Point HD Video Communication: H.323, SIP), with up to 720p resolution; Redundancy Web Meeting/Teleconference System (Zoom, Arkadin and Internal Teleconference System). The following software infrastructure is available at DEIMOS: Network security, monitor, configuration and management tools; Antivirus; Intranet tools for internal use; Web Collaboration tools (e.g. Confluence, mediaWIKI); C, C++, JAVA, Perl, Python and Fortran compilers and debuggers tools for MS Windows and GNU/Linux; OS available for workstations, laptops, tablets and server: GNU/Linux, Mac OS, Microsoft Windows, Android; Databases: Oracle, MySQL, PostgreSQL, and Microsoft SQL Server; System Modelling, Design and Simulation Tools: Octave and Matlab/Simulink; FPGA programming SW (Xilinx) and associated Virtex and DSP Virtex environment; Requirements Management Tools (e.g. IBM Rational Doors); Graphics and Diagramming tools (e.g. Microsoft Visio, yEd); Version control software (e.g. CVS, Subversion, git); Project Management Software (e.g. Rational Plan); SPR Management (e.g. Mantis, Redmine, JIRA); Office software: Google Docs, LibreOffice, OpenOffice and Microsoft Office.

4.1.5 52N

Partner Full Name	52°North Initiative for Geospatial Open Source Software GmbH	
Short Name	52N	
Type	SME	
Country	Germany	
Website	www.52north.org	

Short Profile

The 52°North GmbH has been founded in 2006 as a German company limited by shares ("Gesellschaft mit beschränkter Haftung – GmbH"). Shareholders with the indicated shares are the University of Münster (Münster, Germany) - 26%, the University of Twente (Twente, The Netherlands) - 26%, Environmental Systems Research Institute Inc. - Esri (Redlands, California, USA) - 24%, and con terra GmbH (Münster, Germany) - 24%. 52°North acts as a non-profit organization based on its shareholders agreement. Shareholders receive neither profit shares nor other payments from company funds.

52°North coordinates activities of partners from research, industry, and public administration. Its mission is to foster the development of new concepts and technologies in Geoinformatics, in particular Sensor Web, Web-based Geoprocessing, Earth Observation, and Citizen Science (e.g. the enviroCar platform). The company has a long and outstanding record in the Geo-IT domain and is significantly contributing to the development of international standards. For example, 52°North is involved in the OGC and in the advancement of the INSPIRE directive. A pro-active innovation strategy is a central element of 52°North's activities. This becomes manifest in European and national research projects as well as the company's involvement in OGC Testbeds. This is complemented by consulting and software development projects helping customers to integrate up-to date technological developments into their operational infrastructures. 52°North focuses on the development of open source software to promote the use of its developments and to motivate external developers to contribute to the advancement of 52°North software. Whenever possible, all software developed by 52°North is put under an open source license.

Relevance of partner activities to the Project

As a project partner of Cos4Cloud, 52°North is already contributing to the advancement of the EOSC infrastructure to better support citizen science data. In addition, 52°North has a broad range of experience in relevant interoperability standards for processing and managing all kinds of observation data (including citizen science data). This is complemented by its comprehensive suite of open source implementations to support the creation of interoperable spatial data infrastructures.

Tasks Assigned and Role in the Project

Tasks assigned to 52N are: contribution on the handling of observation data via Sensor Web and Internet of Things technologies (in WP2); data visualisation and exploration, interoperable tools for data processing and analysis workflows in WP4; transformation of multidisciplinary showcases into EOSC permanent services (task 3.3) and dissemination and contribution to international standardisation activities (tasks 5.3 and 5.5).

Leader of Work Packages/Tasks

52N is leading WP4 (Contributions to the EOSC construction) and tasks 4.1 and 5.5.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
Creating Interfaces (2018-2021)	The Creating Interfaces project explores socio-technical interfaces at the food-water-energy (FWE) nexus in cities near water. Aiming to increase urban sustainability, resilience, and quality of life, this project works to build local capacity through innovative approaches in coordinated knowledge creation, governance and exchange. The project investigates novel approaches in participatory knowledge generation and citizen science and their implementation. The role of 52°North in this project comprises especially the design and development of a Citizen Science Toolbox. Creating Interfaces is funded by the German Federal Ministry of Education and Research (BMBF) as part of the the Sustainable Urbanisation Global Initiative (SUGI)/Food-Water-Energy Nexus. This programme is jointly established by the Belmont Forum and the Joint Programming Initiative Urban Europe.
COS4Cloud - Co-designed Citizen Observatories Services for the EOS-Cloud. H2020-EU.1.4.1.3. (2019-2023)	This H2020 project aims to design and implement services for solving typical the Open Science challenges that have to be addressed by citizen observatories dealing with biodiversity. Within this project, 52°North contributes especially to the management of the project's agile collaborative software development process and to the work on interoperability aspects of citizen science data.
enviroCar	The enviroCar project was initiated as an internal project of the 52°North Community with the aim to build a citizen science platform for collecting and integrating traffic data that can be derived from standard on-board sensors of cars. For this purpose, 52°North has created a corresponding data collection app, a server for data management, and a Web site for data access and visualisation. Based on this foundation, 52°North is addressing several research questions as part of projects such as CITRAM (funded by the German Federal Ministry of Transport and Digital Infrastructure).
OGC Testbeds	52°North is a regular participant of testbed activities organised by the Open Geospatial Consortium. Besides a strong focus on architectures for Web-based Geo-Processing, 52°North has also contributed in the past to activities investigating the application of Sensor Web technologies to citizen science, observations from social networks, and volunteered geographic information.

Related Publications (the 5 most significant)

1. Bröring A., **Jirka S.**, **Rieke M.**, Pross B. (2014) OGC Testbed-10 CCI VGI Engineering Report. OGC, Wayland, MA, USA.
2. Kotsev A., Schleidt K., Liang S., Van der Schaaf H., Khalafbeigi T., Grellet S., Lutz M., **Jirka S.**, Beaufils M. (2018) Extending INSPIRE to the Internet of Things through SensorThings API. Geosciences 8(6): 221. https://doi.org/10.3390/geosciences8060221

3. Stasch C., Pross B., Gräler B., Malewski C., Förster C., **Jirka S**. (2018) Coupling sensor observation services and web processing services for online geoprocessing in water dam monitoring. International Journal of Digital Earth 11(1): 64-78. https://doi.org/10.1080/17538947.2017.1319977
4. Drost S., **Rieke M.**, **Jirka S.**, Vogt A., Kirstein V.R., Wytzisk A. (2019) An Event-Driven Architecture Based on Copernicus Satellite Data for Water Monitoring. In Accepted Short Papers and Posters from the 22nd AGILE Conference on Geo-Information Science. Limassol, Cyprus.
5. 52°North Open Source components (https://github.com/52North): Open source software products comprising client and server implementations of Sensor Web technologies (including OGC Sensor Observation Service (SOS) 2.0 and OGC SensorThings API), Web-based Geo-Processing functionality (including OGC Web Processing Service (WPS) 2.0), and from Citizen Science projects (e.g. enviroCar and Creating Interfaces).

Key Personnel

Dr. Simon Jirka (male) works as community leader, senior consultant and project manager for the Sensor Web group of 52°North. His activities are focused on spatial data infrastructures, especially on Sensor Web architectures as well as sensor discovery mechanisms. Besides his contribution to several European projects such as Cos4Cloud (H2020), ConnectinGEO (H2020), SeaDataCloud (H2020), BRIDGES (H2020), ODIP II (H2020), and Creating Interfaces (JPI Urban Europe) he is also involved in the Sensor Web Enablement initiative as well as the further activities of the Open Geospatial Consortium (OGC). Furthermore he regularly leads professional services projects in the fields of consulting and software development.

Matthes Rieke (male) works as a software architect and research associate at 52°North. Previously he worked as research associate at the Institute for Geoinformatics (University of Münster). He is code manager of several 52°North software components and is actively involved in several research and development activities (including OGC Testbed activities and the H2020 project BRIDGES). His research interests are focused on spatial data infrastructure technologies, web-based geoprocessing concepts, and the integration of remote-sensing as well as in-situ observation data.

Henning Bredel (male) is a senior software engineer and consultant at 52°North. Henning Bredel has comprehensive knowledge on spatial information infrastructures (including Sensor Web technology) and the organisation of collaborative software development processes. He is involved in several professional software development projects of 52°North. Furthermore, he leads the contribution of 52°North to the H2020 project COS4CLOUD.

Significant infrastructure/Technical Equipment/Products/Tools

52°North does not plan to provide an infrastructure or technical equipment. However, 52°North will offer its open source implementations for use by the project partners. Furthermore, the 52°North demo servers will be available for the demonstration of project results.

4.1.6 ECMWF

Partner Full Name	EUROPEAN CENTRE FOR MEDIUM RANGE WEATHER FORECAST	
Short Name	ECMWF	
Type	International Organisation	
Country	Italy and UK	
Website	www.ecmwf.int	

Short Profile

The European Centre for Medium-Range Weather Forecasts (ECMWF) is an independent international organisation supported by 34 Member and Cooperating States, recognised as a world-leading centre for global numerical weather prediction (NWP). ECMWF is both a research institute and a 24/7 operational centre, producing and disseminating medium- and extended-range weather forecasts to its member states, worldwide commercial customers and international organisations (including the UN/WFP and IAEA). Moreover, ECMWF's objectives also include the development of scientific and technical research directed to the improvement of these forecasts, and the collection and storage of appropriate meteorological data. To that effect, ECMWF operates a supercomputer facility that is one of the largest of its type, with the currently deployed 2 Cray XC-40 clusters ranked within the Top500 list, and an associated perpetual archive of meteorological data featuring more than 300 PiB. In 2019, ECMWF has signed a four-year contract with Atos for the supply of its BullSequana XH2000 supercomputer. The Atos system will be hosted in the new ECMWF data centre in Bologna, Italy. Furthermore, ECMWF pursues scientific and technical collaborations with satellite agencies, the European meteorological community and the world climate and weather prediction communities, as well as providing services for the European Commission.

ECMWF is the entrusted entity for the European Union's Copernicus Climate Change Service(C3S) and the Copernicus Atmosphere Monitoring Service (CAMS). The C3S responds to environmental and societal challenges associated with human-induced climate change. The service will give access to information for monitoring and predicting climate change and will, therefore, help to support adaptation and mitigation. The CAMS provides continuous data and information on atmospheric composition. The service consists of daily global forecasts of atmospheric composition, daily forecasts of European air quality, global and regional reanalyses, as well as services on solar radiation, greenhouse gases and emissions.

In 2014, ECMWF initiated a 10-year "scalability programme" with the aim of modernising its forecast models and product chain for the era of exascale computing. Within this programme, ECMWF is exploring different computational models and I/O paradigms, as well as building collaborations with various hardware vendors, research centres and universities. ECMWF has dedicated many internal resources to this programme, to develop a full Exascale NWP system, and is now an integral part of ECMWF's 2016-2025 strategy. ECMWF as a supercomputing Centre provides access to the HPC and High-Performance Data Analytics (HPDA) and Cloud facilities in order to enable distributed, but also highly efficient computing capabilities to the project. Furthermore, ECMWF offers climate and weather data to the project, which will be used to couple the simulations for optimizing vessel routes.

Relevance of partner activities to the Project

ECMWF is the entrusted entity for the European Union's Copernicus Climate Change Service(C3S) and the Copernicus Atmosphere Monitoring Service (CAMS).

Copernicus (https://climate.copernicus.eu/): It is the EU's flagship programme for monitoring the Earth. Copernicus delivers operational data and information services on a range of topical areas. ECMWF manages both the atmosphere service and the climate change service. ECMWF is also involved in the marine and emergency services, particularly by running the computational centre and hosting the information system for the European Flood Awareness System (EFAS). CAMS provides consistent and quality-controlled information related to air pollution and health, solar energy, greenhouse gases and climate forcing, everywhere in the world. C3S provides provide authoritative information about the past, present and future climate, as well as tools to enable climate change mitigation and adaptation strategies by policy makers and businesses.

Operational forecasting is the primary purpose of ECMWF. Atmospheric and ocean forecasts, both deterministic and as part of a stochastically perturbed ensemble, are provided twice daily. Business as usual (BAU) include daily operations which produce on average 32 million output fields taking 60 TiB, which are post-processed into 90 million products, totalling 12 TiB, all produced and processed in one-hour time critical windows and distributed to 1,150 different world-wide destinations.

ECMWF has an excellent track record for training. Every year we train around 300 people on our products, numerical weather predication and computing. ECMWF offers an extensive learning programme which includes face to face and blended courses and webinars. Since 2019, we have a learning platform which contains freely available learning resources. Moreover, the Copernicus Climate Change Service implemented by ECMWF, runs the User Learning Services which deliver customized training activities for the range of user communities across Europe and worldwide utilizing a portfolio of training resources to build specialized learning pathways. As part of this project we will leverage the ECMWF expertise in training and the learning platform to create a series of learning activities in order to provide a range of opportunities to develop the knowledge needed to proficiently use the products.

Tasks Assigned and Role in the Project

ECMWF's main role is the provision of support for Copernicus open data (C3S and CAMS) in task 2.2 and the development and delivery of learning activities (in many tasks of WP5). Also ECMWF will participate in the co-creation of a multidisciplinary showcase services in WP3.

Leader of Work Packages/Tasks

ECMWF leads WP5 (Multimedia Communication, dissemination, training and outreach) and also tasks 2.2, 5.1 and 5.6.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
ESCAPE - Energy-efficient Scalable Algorithms for Weather Prediction at Exascale. H2020-EU.1.2.2. (2015-2015)	Developing world-class extreme-scale computing capabilities for European operational numerical weather prediction and future climate models. Coordinated by ECMWF.
ESiWACE - Centre of Excellence in Simulation of Weather and Climate in Europe. H2020-EU.1.4.1.3. (2015-2019)	Improving efficiency and productivity of numerical weather and climate simulation on high-performance computing platforms by supporting the end-to-end workflow of global Earth system modelling in HPC environments. Co-coordinated by ECMWF.
European Weather Cloud	It is a federated community cloud and a joined initiative between ECMWF and EUMETSAT aimed at creating a

	federated infrastructure to be shared between the intergovernmental agencies and their Member States. The aim of this program is to integrate multiple services provided by ECMWF, EUMETSAT, and Copernicus Services and ease their provision and dissemination to member states, to increase the socio-economic benefit of weather forecast data and to exploit opportunities and address challenges linked to open polices and market changes. The final objective is to enable easier and faster collaboration between the aforementioned entities through this common platform which comprises mostly of open-source tools.
WEkEO	The European Commission has launched a new initiative called DIAS to provide a single access point to all Copernicus data and information, alongside processing resources, tools and other relevant data. As key organisations in the Copernicus Programme, EUMETSAT, ECMWF and MERCATOR OCEAN have combined their long-standing experience to develop the WEkEO Copernicus DIAS service. WEkEO is the EU's Copernicus DIAS reference service for environmental data, virtual environments for data 7 [proposal acronym] template WP18-20 v20180201 processing and skilled user support. WEkEO DIAS Service is implemented by EUMETSAT, ECMWF and MERCATOR OCEAN.

Related Publications (the 5 most significant)

1. The Climate Data Store : https://cds.climate.copernicus.eu/#!/home
2. The Atmosphere Data Store: https://ads.atmosphere.copernicus.eu/#!/home
3. ECMWF learning platform: https://learning.ecmwf.int
4. C3S User Learning Services: https://uls.climate.copernicus.eu

Key Personnel

	**Xiaobo Yang (male)** is the team leader of the Data Support team in the User Services section at ECMWF. The team provides support to all C3S and CAMS users and ECMWF commercial customers. Xiaobo leads activities ranging from data licensing activities, data access and policies, technical support, quality monitoring and reporting.
	**Dr. Anna Ghelli (female**) leads the User Services section at ECMWF. The section provides user support to data users for both the C3S and CAMS services and the ECMWF real time products. Moreover, the User Services coordinates the training activities of C3S and ECMWF. Anna has been involved in the modernisation of the learning activities and she is managing the C3S User Learning Services.

	**Cristian Simarro (male)** is a Computing and Software Support Analyst in the User Services section of the Forecast department. His work includes to provide general and specific support and advice to Member State, Co-operating State and ECMWF users on using the ECMWF software, computing facilities and access to the data.

Significant infrastructure/Technical Equipment/Products/Tools

ECMWF maintains and operates a multi-petaflop world-class HPC facility (HPCF) in a production environment for weather forecasting. The HPCF is amongst the most powerful supercomputers in Europe, featuring two Cray XC-40 systems (Anemos and Ventus), in a resilient dual-cluster configuration with a 21 PiByte Cray Sonexion storage system, with the ability to cross mount the Lustre file systems between the HPC halls. Each subsystem consists of around 3600 dual-socket compute nodes (Intel "Broadwell" Xeon) per system, providing 140,000 cores, a number of Cray Development and Login nodes. ECMWF has for several years also been operating test clusters to explore manycore (Xeon phi) and GPGPU (nvidia) architectures.

ECMWF deployed, maintains and expands a cloud infrastructure based on Openstack with a capacity of 1200vCPUs, 12 TB RAM and 0.7 PB of object/block storage based on Ceph. The cloud infrastructure is part of the European Weather Cloud project. The cloud infrastructure has high speed direct access to ECMWF's HPC and High-Performance Data Analytics (HPDA). ECMWF's Internet connection comprises dual links to JANET, the United Kingdom's Research and Education network. JANET has high speed connections to the rest of the Internet, especially to the GÉANT network, which provides a high-speed backbone between most research networks within Europe.

ECMWF has a software stack built over several decades. This includes not just the scientific codes used to make the forecasts, but the entire infrastructure to accept, process and move data from its arrival through to the dissemination of products to customers. This infrastructure contains the libraries for (de)compression of meteorological data to/from the internationally recognised formats, data manipulation and transformations, a post-processing infrastructure, and all the required data-management functionality including an effective domain-specific HSM solution, handling hundreds of terabytes daily.

The Climate Data Store (CDS) and Atmosphere Data Store (ADS) provide a single point of access to a wide range of quality-assured climate datasets (CDS) and atmosphere data (ADS) distributed in the cloud. CDS datasets include observations, historical climate data records, estimates of Essential Climate Variables (ECVs) derived from Earth observations, global and regional climate reanalyses of past observations, seasonal forecasts and climate projections. The ADS datasets include Global Reanalysis, the Regional Analyses and Forecasts, the Solar Radiation Service, and the Inversion-optimised Greenhouse Gas Fluxes. Access to data is open, free and unrestricted. The CDS and ADS have been designed to support a wide range of users with different needs, by facilitating the processing of large data volumes as well as the creation of simple visualisations based on multiple data sources.

4.1.7 SECD

Partner Full Name	SECURE DIMENSIONS GmbH	
Short Name	SECD	
Type	SME	
Country	Germany	
Website	www.secure-dimensions.com	

Short Profile

Secure Dimensions GmbH (SECD) was founded in 2009. The business is coined as Holistic GeoSecurity which covers most of all dimensions regarding security for enterprise systems. SECD projects relate to the design of security architectures, security assessments of existing architectures as well as the implementation of software to demonstrate novel concepts of coupling traditional standards for federated authentication with Web-technology. An additional focus of this business is on privacy by design to build systems that represent data privacy as defined in the GDPR – General Data Protection Regulation (EU) 2016/679 (GDPR).

SECD has been involved in different EU funded projects dating back to 2012: COBWEB, LandSense and Cos4Cloud. All are concerned with Citizen Science and in all projects, SECD's role was to bring expertise in security and data privacy. What has started in the COBWEB project, was finished during the LandSense project, and will transition into the Cos4Cloud project is coined as "Authentication as a Service" (AaaS). As a core service in the LandSense Engagement Platform, AaaS brings together citizens and traditional scientists via federated identity management supporting login from social media as well as academic institutions via eduGAIN. With developing the AaaS, one of the biggest challenges was to fully understand the opportunities as well as the restrictions and implications introduced by the GDPR. For the Cos4Cloud H2020 project, SECD will provide an Authorization Server as well to support GDPR compliant authentication.

Relevance of partner activities to the Project

With expertise in geospatial data access protection and GDPR, SECD is a relevant partner in the consortium to meet the key objectives.

Tasks Assigned and Role in the Project

SECD is

- Contributing to the development and operation of GDPR compliant services and applications and controlling access to the geospatial data, mainly in WP4
- Participating in the integration of the Big Data services (in WP2)
- Collaborating with standards and best practices in task 5.5.

Leader of Work Packages/Tasks

SECD is leading task 4.2.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
COBWEB - Citizen Observatory Web. FP7-ENVIRONMENT (2012-2016)	Authentication, Privacy and Security aspects in the context of Citizen Science.

LandSense - A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring. H2020-EU.3.5.5. (2016-2020)	Authentication, Privacy and Security aspects in the context of Citizen Science. Operating a core infrastructure component to support different use cases with federated and GDPR compliant authentication.
COS4Cloud - Co-designed Citizen Observatories Services for the EOS-Cloud. H2020-EU.1.4.1.3. (2019-2023)	Authentication, Privacy and Security aspects in the context of Citizen Science. Operating a core infrastructure component to support different use cases with federated and GDPR compliant authentication.

Related Publications (the 5 most significant)

1. LandSense Engagement Platform: https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b8e3f5cf&appId=PPGMS

Key Personnel

Dr. Andreas Matheus (male) holds a German Dr. degree in computer science from the Technische Universität München and a German Dipl.-Ing. degree in Electrical Engineering from the Gerhard Mercator Universität. He is an active member in the Open Geospatial Consortium (OGC) since 2001, chair of the OGC Security Working Group and a re-elected member of the OGC Architecture Board since 2006. He wrote the OGC standards "GeoXACML" and "OGC Web Services Security" as well as many OGC Engineering Reports covering the topic of security for geospatial systems as well as Data Centric Security.

His expertise in GDPR compliance operation of service and application in the context the Citizen Science was gained through participation in H2020 projects like LandSense and Cos4cloud.

He is the founder of Secure Dimensions GmbH.

Significant infrastructure/Technical Equipment/Products/Tools

SECD operates AUTHENIX.eu – Authentication for Citizen Science – that enables a GDPR compliant login on a federated environment. As a community service to the project with which the interoperable interaction between partner services and applications can enhance the EOSC and the productivity of the project.

4.1.8 IIASA

Partner Full Name	International Institute for Applied Systems Analysis	
Short Name	IIASA	
Type	International Organisation	
Country	Austria	
Website	www.iiasa.ac.at	

Short Profile

The International Institute for Applied Systems Analysis (IIASA) is a scientific research institute, founded in 1972 and located in Laxenburg, near Vienna, Austria. IIASA conducts policy-oriented research into problems of a global nature that are too large or too complex to be solved by a single country or academic discipline. The Center for Earth Observation & Citizen Science (EOCS), which is part of the Ecosystems Services and Management Program, devises new approaches and technologies to apply Earth observation to tackle challenges such as food security, climate change, natural hazards, inequality, etc. The EOCS group has extensive experience in application design and development, with the Geo-Wiki flagship crowdsourcing tool as one of the key products. Many of the ongoing EOCS' projects bring together the field of Earth observation and citizen science, including several citizen observatories funded by the EU, which are developing new services such as land cover change detection, quality assurance of citizen science data and habitat threat detection by citizens. Currently there are over 15,000 registered users in the Geo-Wiki network. Many successful citizen science campaigns have been run over the last decade to crowdsource data on land cover, cropland, agricultural field size, deforestation, building damage assessment and poverty mapping.

Relevance of partner activities to the Project

IIASA is already working successfully with the project coordinator in the E-Shape project to showcase examples of European EO resources, bringing their expertise in databases and application development to the project. IIASA is also working closely with project partner Sinergise on the development of the LandSense Engagement Platform as well as in the Crowd2Train project, funded by the European Space Agency, to develop an application on crop type recognition. IIASA is a member of the Complexity Science Hub (CSH) Vienna, where IIASA staff member Prof Stefan Thurner is the president. He is currently responsible for COVID-19 related research, which will provide tools, expertise and data to the COVID-19 showcase; some examples are currently available on the CSH Corona website: https://csh.ac.at/covid19/.

Tasks Assigned and Role in the Project

IIASA is

- Leading WP3 "Multidisciplinary showcase services"
- Contributing to the Open Health Map service
- Leading the COVID-19 showcase
- Contributing to dissemination in WP5: Communication, dissemination, training and outreach

Leader of Work Packages/Tasks

IIASA is leading WP3 (Multidisciplinary application showcases) and task 3.2.

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
LANDSENSE - A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring. H2020-EU.3.5.5. (2016-2020)	IIASA is the coordinator of this project and leads two WPs. The aim is to develop tools and services for involving citizens in environmental monitoring. Involving 19 partners, the project has three main themes: urban dynamics, agriculture and forest/habitat dynamics, in which different pilots are running with citizens. The LandSense Engagement Platform is used for visualization and downloading of data collected by citizens. IIASA has developed two mobile apps (PAYSAGES, Natura Alert), an interactive web app (Natura Alert) and a land use/land cover campaigner service built on the LACO-Wiki online land cover validation tool.
CrowdLand - Harnessing the power of crowdsourcing to improve land cover and land-use information. FP7-IDEAS-ERC (2014-2020)	This European Research Council (ERC) grant was focused on assessing the data quality of citizen science data and motivations for participation, with case studies in Austria and Kenya. The project developed two mobile apps (FotoQuest Go and Picture Pile) and led to further developments of the Geo-Wiki platform.
E-Shape - EuroGEOSS Showcases: Applications Powered by Europe. H2020-EU.3.5.5 (2019-2023)	This project aims to set up and promote a sustainable organization dedicated to user uptake of European EO resources, building on Copernicus and GEOSS through the development of co-design pilots (i.e., application-oriented products, services or solutions) built on a user-centric approach and delivering economic, social and policy value to European citizens. It also has the ambition, through the development of 27 pilots organized in 7 showcases, to deliver information that will also contribute to the three GEO engagements (SDGs, Paris Agreement and Sendai Framework). IIASA is contributing to showcase 1, pilot 3 on vegetation index crop insurance in Ethiopia, which will provide a geodata-driven risk-mitigation insurance product to smallholder farmers in Ethiopia, offering a basic safety net against weather-related perils. IIASA's role is to develop a mobile app for field validation and to provide training and e-support to transfer knowledge to Ethiopian partners.
CSH COVID19 Info Point	This information dashboard has compiled many different data sets about health and COVID-19 for visualization, which is available at: https://csh.ac.at/covid19/. For example, the traffic light application allows viewers to see the number of COVID-19 cases by district in Austria (https://csh.ac.at/covid19/corona-ampel/) while the dashboard provides many other examples.
Mayor's Medical-Scientific Fund (Medizinisch-wissenschaftlicher Fonds des Bürgermeisters) - Monitoring Resilience and Visualization of Capacities in the Austrian	This project will advise and inform the Austrian Federal Minster of Health on short term forecasts on infection numbers and will relate them to healthcare system capacities and assessing resilience.

Healthcare System in the COVID-19 Crisis
Related Publications (the 5 most significant)
1. **See L.**, **Fritz S.**, Perger C., Schill C., McCallum I., Schepaschenko D., Karner M., Kraxner F., Obersteiner M. (2015) Harnessing the power of volunteers, the Internet and Google Earth to collect and validate global spatial information using Geo-Wiki. Technological Forecasting and Social Change 98: 324–335. https://doi.org/10.1016/j.techfore.2015.03.002 2. Desvars-Larrive A., Dervic N., ….., **Thurner S.** A structured open dataset of government interventions in response to COVID-19, in review. MedRxiv preprint 3. **Thurner S.**, Klimek P., Hanel R. Why are most COVID-19 infection curves linear?, in review. MedRxiv preprint 4. Lo Sardo R., **Thurner S.**, Klimek P. (2019) Quantification of the resilience of primary care networks by stress-testing the health-care system. Proceedings of the National Academy of Science USA 116 (48): 23930-23935. https://doi.org/10.1073/pnas.1904826116 5. Klimek P., Aichberger S., **Thurner S.** (2016) Disentangling genetic and environmental risk factors for individual diseases from multiplex comorbidity networks. Scientific Reports 6: 39658. https://doi.org/10.1038/srep39658
Key Personnel

	**Dr. Steffen Fritz (male)** is Deputy Program Director of the Ecosystem Services and Management (ESM) Program, and Head of the Center for Earth Observation and Citizen Science (EOCS) with around 20 staff. He joined IIASA in 2007 and has been the driving force behind Geo-Wiki.org, a global land cover and land use validation tool that aims to investigte and reduce the uncertainties in global land cover data via citizen science. Dr. Fritz is the Principal Investigator of the ERC-funded CrowdLand project and the H2020-funded LandSense and WeObserve projects, where EOCS currently has around 20 ongoing projects.
	**Stefan Thurner (male)** joined IIASA on 1 January 2010 and is currently affiliated with the ESM program. His research focus is on the dynamics and the control of complex networked systems, in particular, the resilience and systemic risk of financial markets and economic networks, and mining networks of medical data in Austria. He pioneers the use of large-scale, data-driven agent-based models for policy implications. He is actively engaged in several big-data analytic initiatives. He is full professor for Science of Complex Systems at the Medical University of Vienna, where he chairs the Section for the Science of Complex Systems and is the president of the Complexity Science Hub Vienna. Since 1995, Prof. Thurner has published more than 200 scientific articles covering areas of fundamental physics, mathematics, complex systems, life sciences, economics and social sciences. He is actively researching on COVID-19 at present.

	**Linda See (female)** is a Senior Research Scholar and joint Deputy of EOCS. She has worked on citizen science and crowdsourcing in relation to land cover/land use data collection for training and validation of land cover products. In the past she led the LACO-Wiki project (funded by the Austrian Agency for the Promotion of Science) to develop an online land cover validation tool (https://laco-wiki.net) and is currently a WP lead in the ERANET-funded FloodCitiSense project. In both the LandSense and FloodCitiSense projects, she has helped to coordinate the IT developments, i.e., the mobile and web applications.
	**Anto Subash (male)** is an application developer in the EOCS research group, joining IIASA in January 2017. He is responsible for the ICT support of EOCS as well as web mapping and application development, including the Natura Alert apps (for LandSense) and the FloodCitiSense mobile app. Mr. Subash received his Masters degree in Computer Applications in 2012 from Anna University, Chennai, India. Prior to IIASA, he worked for Transperfect Translations as a software developer where he worked on translation and document collaboration products used by enterprise customers.

Significant infrastructure/Technical Equipment/Products/Tools

IIASA has an 80 core (20 node) HPC cluster for non-interactive scientific windows-based processing with a collection of commercial and open source products targeted to mathematical, statistical, GIS and other scientific solutions. For interactive scientific processing in the MS Windows environment, IIASA has a load balanced server cluster consisting of three physical servers. The Solaris Unix scientific computing infrastructure includes multiple servers for the execution of user-provided software or non-interactive use of a range of preinstalled software.

4.1.9 SINERGISE

Partner Full Name	Sinergise, laboratory for geographical information systems, Ltd.	
Short Name	SINERGISE	
Type	SME	
Country	Slovenia	
Website	www.sinergise.com	

Short Profile

SINERGISE is a SME with extensive expertise in developing advanced geospatial information systems based on web technology. It has experts in the field of user needs and system design, software development, database administration and system infrastructure. SINERGISE has successfully completed several large-scale projects involving spatial data capture and spatial data analysis for customers in Europe and Africa. Their products can be grouped in agriculture, real estate and, since a few years, cloud geospatial services. Agriculture-related systems include those covering Common Agriculture Policy (CAP) legislation (LPIS - land parcel identification system, on-the-spot controls, control with remote sensing, rural development, etc.) as well as agro-environmental and animal/crop disease applications. Real-estate management deals with land administration, cadastre, deeds (land titles and mortgages) and computer aided mass appraisal (CAMA). Cloud geospatial solutions started with Geopedia, crowd-sourcing platform, and matured with Sentinel Hub, an award-winning satellite imagery archiving, processing and distribution service, which powers earth observation applications in Europe, Africa, US and Australia and at this moment processes two hundred million requests per month, crunching more than quadrillion satellite imagery pixels from Sentinel, Landsat, Planet, Pleiades and other missions.

SINERGISE has past experience in international research (FP7, H2020), European Space Agency funded projects and commercial projects. It has on-going relationships with several groups of users (e.g. Ministries for agriculture, Ministries for lands), which will help them to access relevant users and get relevant feedback. Sentinel Hub itself has users from various domains and is currently serving thousands of users around the world.

In 18 years of operations SINERGISE built solutions for large governmental clients in Europe (United Kingdom, France, Slovenia, Croatia, Turkey, Macedonia, Montenegro, Czech Republic, Azerbaijan, Moldova) and Africa (Nigeria, Ghana, Tanzania, Mauritius), almost all of them still being supported nowadays. Altogether there are more than 2 million people annually using SINERGISE tools and its technology helps to manage more than 50 million property records and more than 700 million EUR of transactions annually.

Relevance of partner activities to the Project

SINERGISE already operates satellite imagery processing services, Sentinel Hub, within the EOSC infrastructure and 4 out of 5 DIAS-es.

SINERGISE will provide access to global archives of Sentinel, Landsat, MODIS and other satellite missions.

Tasks Assigned and Role in the Project

SINERGISE will be mainly involved in Earth Observation data processing and dissemination and in Non-EO data management within Geopedia world infrastructure (in WP2 and task 5.3).

Leader of Work Packages/Tasks

No tasks leaded

Previous Projects/Activities (the 5 most relevant)

Project Name	Relevance to the Project and Main Role
Data Cube Facility Service	ESA awarded a consortium lead by Sinergise a development and operation of the services for data cube-based operations. These are based on Sentinel Hub and XCube, an open-source data cube library developed by Brockmann Consult. Euro Data Cube, a resulting service, is destined to become the main service for provision and distribution of satellite data offered by ESA. (read more...)
DIAS	ESA and Copernicus jointly awarded four consortia to establish cloud infrastructure tailored to big EO data, focused to Sentinel missions, Copernicus services but also offering other datasets. DIAS users will be able to get immediate access to several years of archives of all Sentinel missions as well as advanced EO services, making it possible to develop scalable EO applications in a seamless manner. Sinergise is partner in three consortia: - ATOS Integration with T-System as cloud provider developing Mundi Web Services (more…), - Creotech Instruments with CloudFerro as cloud provider developing CREODIAS (more…), - Serco Europe with OVH as cloud provider developing ONDA (more…) In all these consortia, *SINERGISE* is responsible for "View services" - web services for streaming of Sentinel data.
Perceptive Sentinel - Big Data knowledge extraction and re-creation platform. H2020-EU.2.1.6.3., H2020-EU.2.1.6.1.2. (2018-2020)	Perceptive Sentinel will exploit vast open EO data collection available by Copernicus, Landsat and other missions to provide relevant information using machine learning techniques on multi-spectral and multi-temporal datasets. (read more…)
EO-VAS - Earth Observation Value Adding Services – EO Design & Publishing Service. H2020-EU.2.1.6., H2020-EU.2.3.1. (2017-2019)	SINERGISE and GEOVILLE have won H2020 SME Phase-2 project "EO-VAS: Earth Observation Design & Publishing Service". The project has resulted in Sentinel Hub, a Copernicus Award winning service for processing of satellite imagery.
LandSense - A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring. H2020-EU.3.5.5. (2016-2020)	The LandSense Citizen Observatory aims to aggregate innovative EO technologies, mobile devices, community-based environmental monitoring, data collection, interpretation and information delivery systems to empower communities to monitor and report on their environment. (read more...)

Related Publications (the 5 most significant)

1. Peressutti D., **Batic M.**, Zupanc A., Aleksandrov M., Lubej M., Bollinger D., Veerman O., Mathieu P-P. (2019) Query Planet – Machine Learning with EO Big Data at Scale, Living Planet Symposium

2. **Milcinski G.**, Kolaric P., Mocnik R., Repse M., Kadunc M., Snuderl M. (2019) Cube-less DataCube Service Based on Cloud-native Architecture, Living Planet Symposium
3. Aleksandrov M., **Batic M.**, Lubej M., **Milcinski G.**, Peressutti D., Zupanc A., Zupanc M. (2019) Blue Dot Water Observatory, Living Planet Symposium
4. **Milcinski G.**, Landgraf G., Hogan P., Sacramento P. (2017) Integration of Web World Wind and Sentinel Hub - a Global 4D Big Data Exploration and Collaboration Platform, BiG Data From Space
5. See L., Mooney P., Foody G., Bastin L., Comber A., Estima J., Fritz S., Kerle N., Jiang B., Laakso M., Liu H-Y., **Milcinski G.**, Nikšic M., Painho M., Podor A., Olteanu-Raimond A-M., Rutzinger M. (2016) Crowdsourcing, Citizen Science or Volunteered Geographic Information? The Current State of Crowdsourced Geographic Information. International Journal of Geo-Information 5(5): 55. https://doi.org/10.3390/ijgi5050055

Key Personnel

Grega Milcinski (male), Chief *Executive* Officer, BSc. in Physics, a co-founder and CEO of Sinergise, has been leading software development teams for more than 20 years, out of these more than 15 years in the field of geospatial data. He held roles of consultant, project manager, business analyst and architect of land administration systems in Europe (Slovenia, Croatia, Macedonia, Azerbaijan, Moldova, France) and Africa (Nigeria, Mauritius, Ghana). BSc. in Physics and additional general management programme education proved to be a good combination of problem solving and managerial skills to benefit company's customers, making it possible to successfully finish a number of projects. He authored and co-authored several papers in the field of remote sensing services, land administration and agriculture policy.

Dr. Matej Batič (male), PhD in Physics, big data expert, has over 10 years of experience in research and commercial projects related to large amounts of geospatial data. At Sinergise Matej successfully completed and participated in several EU projects focused to management and distribution of EO data. One of these, LandSense, is focused to use of crowd-sourcing to acquire data about land cover throughout the world. He is leading a research arm of Sentinel Hub project, trying to get added value information from the mass of data. Matej was involved into several land cover and crop classification projects in Slovenia, Turkey and Azerbaijan.

Significant infrastructure/Technical Equipment/Products/Tools

Most of the processing today is happening in the cloud, DIAS-es.

SIN is operating its services on several cloud infrastructures:

- Sentinel Hub deployed on Mundi, CreoDIAS, Onda (in process), WEkEO (in process), CODE-DE (in process), AWS-EU 1 region and AWS-US West region;
- Global Mosaic mass-processing engine operating on AWS-EU 1 region;
- Access to cloud-hosted global multi-year archives of S1 GRD and S2 (L1C and L2A).

The current production operations of Sinergise regularly use between 50 and 5.000 VMs, depending on the needs, ensuring the performance at appropriate cost. Sinergise's processing is accessing a repository of more than 10 PB of data stored on various clouds.

In addition to above, SIN is operating its own virtualised infrastructure located at its premises, consisting of:

- multiple redundant load balancers providing load balancing and high availability for application servers;
- two redundant firewalls;
- multiple virtualized application servers, setup in high-availability mode;
- primary master database with live replication to hot standby database;
- backup servers for storing database snapshots and archive logs;
- triple redundancy storage cluster for binary data storage (map tiles, binary files, etc.) exceeding 20 TB;
- support servers for logging and monitoring;
- replicated and redundant 500 Mbit Internet connection.

4.1.10 BSC

Partner Full Name	Barcelona Supercomputing center- Centro Nacional de Supercomputación	
Short Name	BSC	
Type	Research Organisation	
Country	Spain	
Website	https://www.bsc.es/	

Short Profile

The Barcelona Supercomputing Center - Centro Nacional de Supercomputación (BSC), created in 2005, has the mission to research, develop and manage information technology in order to facilitate scientific progress. At the BSC, more than 650 people from 44 different countries perform and facilitate research into Computer Sciences, Life Sciences, Earth Sciences and Computational Applications in Science and Engineering. The BSC is one of the four hosting members of the European PRACE Research Infrastructure as well as 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 Science, Earth and engineering sciences) under one roof and currently has over 700 staff from 44 countries. BSC has collaborated with industry since its creation, and participates in various bilateral joint research centers with companies such as IBM, Microsoft, Intel, NVIDIA and Spanish oilcompany Repsol. BSC has been extremely active in the EC Framework Programs and has participated in over 100 projects funded by it. BSC is a founding member of HiPEAC, the ETP4HPC and other international fora.

The department involved in this proposal is the Earth Sciences Department of the BSC (ES-BSC) was established with the objective of carrying out research in Earth system modelling. The ES-BSC activities are focused on global climate modelling and prediction are based on research, development and predictions with the EC-Earth climate forecast system. It also undertakes research on the development of dynamical and statistical methods for the prediction of global and regional climate on time scales ranging from a few weeks to several years, with a special focus on technologies that allow high-resolution modelling. The formulation of the predictions includes the development and implementation of techniques to statistically downscale, calibrate and combine dynamical ensemble and empirical forecasts to satisfy specific user needs in the framework of the development of a climate service.

The assessment of the sources of predictability and the limitations of current climate prediction systems to exploit them, especially over Europe, inspires many of the publications by the unit. Besides contributing to the 5th phase of the Coupled Model Intercomparison Project (CMIP) critical for the UN IPCC Fifth Assessment Report (AR5), global climate research activities at ES-BSC enable provision of various historical reconstructions and initial conditions to the EC-Earth community for analysis of climate dynamics and for seasonal to decadal climate predictions. The ES-BSC is already active in the planning and design of the future coupled climate model intercomparison project, CMIP6, and is preparing to make key contributions including the groundbreaking high-resolution climate simulations with EC-Earth. Over the years, the department has been active in numerous European Projects including, in FP7 and H2020 not only as partner but also as coordinator. It is also currently involved in at least five COPERNICUS projects coordinating two of the actions.

Relevance of partner activities to the Project
The BSC and especially the Earth Sciences Department have a valuable experience in participating in H2020 and Copernicus projects, having been involved in more than 30 projects in the last 4 years. Regarding technical and scientifical expertise, by its implication in several data management and standardization projects in European and national projects, the apportation of BSC is valuable to the project by its strong links with the scientific community dealing with air quality and meteorological and climate forecast and the IT engineers linked to the projects. We were also involved in a data pilot use case in the EUDAT project using the same type of data as the one of this proposal.
Tasks Assigned and Role in the Project
The BSC will participate in the project defining and delivering multi-disciplinary show cases based on air dust transport and sustainable energy sectors (WP3), integrating pre-existing tools in the EOSC ecosystem and taking advantage of their consolidated user database and scientific developments. The BSC will also lead the EOSC market place integration (task 4.4) and participate in disseminating the project resulting services (in WP5).
Leader of Work Packages/Tasks
BSC is leading tasks 3.3 and 4.4.
Previous Projects/Activities (the 5 most relevant)

Project Name	**Relevance to the Project and Main Role**
IS-ENES-3 - Infrastructure for the European Network for Earth System modelling - Phase 3. FP7-INFRASTRUCTURES (2009-2013)	IS-ENES3 will deliver the third phase of the distributed e-infrastructure of the European Network for Earth System Modelling (ENES). IS-ENES3 will be initiated as the European climate modelling community faces the challenges of contributing to the next assessment report of the Intergovernmental Panel on Climate Change through the 6th phase of the Coupled Model Intercomparison Project.
ESCAPE-2 - Energy-efficient SCalable Algorithms for weather and climate Prediction at Exascale. H2020-EU.1.2.2. (2018-2021)	ESCAPE-2 will develop world-class, extreme-scale computing capabilities for European operational numerical weather and climate prediction, and provide the key components for weather and climate domain benchmarks to be deployed on extreme-scale demonstrators and beyond. This will be achieved by developing bespoke and novel mathematical and algorithmic concepts, combining them with proven methods, and thereby reassessing the mathematical foundations forming the basis of Earth system models.
COPERNICUS Service agreement C3S512_Quality Assurance for the Climate Data Store	The Evaluation and Quality Control (EQC) function of the Copernicus Climate Change Service (C3S) ensures that the service meets the needs of a range of users for high-quality data and information, and in proposing the necessary evolution of the service itself, while shaping the research agenda to attend the most important challenges detected. The ITT that this offer addresses, asks for the development and implementation of an EQC framework for climate projections, seasonal forecasts, reanalysis and observations (both in-situ and satellite), and the facilities available in the

	CDS to manipulate them, identifying the gaps that must be filled by the EQC to respond to identified user expectations. The offer described in this proposal aims at developing a solution for the EQC function to respond to the needs identified in previous contracts using a continuous user-engagement process. This offer will address the challenges posed by providing: an overarching EQC service for the whole CDS and an independent quality assessment for a number products (seasonal forecasts, climate projections and in-situ observations).
COPERNICUS Service agreement CAMS 84 Global and regional a posteriori validation, including focus on the arctic and Mediterranean areas	CAMS is providing operational services, which requires a regular and guaranteed delivery of validation reports. In the current MACC-VAL project all partners are individually responsible for the download and processing of the model fields, the generation of the validation plots and maintenance of the verification websites. During CAMS-84 we will progressively migrate to a common (centralised or partly distributed) processing environment based on common software. In order to achieve this, we included partner S&T who has a long experience on validation and quality control software development, including e.g. the validation tools and website developed for NORS (these tools are currently used in VAL for the NDACC observations).
Service agreement For the conduct of development and improvement activities of products and services provided by the regional centers of dust and sand storms of the World Meteorological Organization (WMO) with the Spanish Meteorological Agency (AEMET)	The activities carried out are aimed to the evolutionary development and improvement of the WMO Regional Centers for Dust and Sand Storms for North Africa, the Middle East and Europe, and are aimed at the redesign and improvement of the portals through which information is disseminated, as well as the improvement of forecasting systems and historical data.

Related Publications (the 5 most significant)

1. Evaluation and Quality Control Function of the Copernicus ClimateChange Service. https://meetingorganizer.copernicus.org/EMS2019/EMS2019-522.pdf
2. Operational Dust Prediction. https://link.springer.com/chapter/10.1007/978-94-017-8978-3_10
3. Orlov A., Sillmann J., Vigo I. (2020) Better seasonal forecasts for the renewable energy industry. Nature Energy 5: 108-110. doi:10.1038/s41560-020-0561-5
4. Soret A., Torralba V., Cortesi N., Christel I., Palma Ll., Manrique-Suñén A., Lledó LL., González-Reviriego N., Doblas-Reyes F.J. (2019) Sub-seasonal to seasonal climate predictions for wind energy forecasting. Journal of Physics: Conference Serires 1222. doi:10.1088/1742-6596/1222/1/012009

Key Personnel	
	**Pierre Antoine Bretonnière (male)** holds a Masters Degree in "Mathematical and Mechanical Modelling" from the Matmeca engineer school in Bordeaux (France). Graduated in 2010, he has worked in several climate research institutes (CERFACS - Toulouse - France, Catalan Institute of Climate Sciences - Barcelona - Spain and the Earth Sciences Department of the Barcelona Supercomputing Center). His work focuses on climate models outputs, data management and model coupling. He was the person in charge of the data management plan in the SPECS FP7 project and has participated in several other European projects (PRIMAVERA, QA4SEAS,...). He has also worked recently in several Copernicus projects leading tasks on data management and quality control. He coleads the Data and Diagnostics Team of the BSC Earth Sciences Department.
	**Francesco Benincasa (male)** holds a Masters Degree in "Software Engineering" from the "Alma Mater Studiorum - Bologna University" (Italy) in 2004. After working in the private sector on web and databases development and automatic shop applications, he started his experience in supercomputing and data manipulation (SCS, CINECA spin-off - Bologna - Italy) oriented to biomedical simulations, participating to several FP6 and FP7 European projects. Since 2010 he is at the Barcelona Supercomputing Center (BSC) working on air quality data management, processing and visualization. He is in charge of data processing and management and web development and maintenance of the WMO SDS-WAS NA-ME-E Regional Center (SDS) and the Barcelona Dust Forecast Center (BDFC), both projects operated by a consortium of BSC and AEMET (Spanish Meteorological Agency) under the umbrella of the World Meteorological Organization (WMO) with the goals to improve the understanding of sand and dust storms phenomena through air quality models comparison and evaluation (SDS) and to provide an operational daily dust forecast over the mediterranean area (BDFC). He coleads the Data and Diagnostics Team of the BSC Earth Sciences Department.

Significant infrastructure/Technical Equipment/Products/Tools

BSC hosts MareNostrum, the most powerful supercomputer in Spain. At the end of June 2017 begun operating MareNostrum 4, which when fully installed will have a peak performance of 13.7 Petaflops. Its calculation capacity is distributed in two completely different blocks. The general-purpose block has 48 racks with 3,456 nodes. Each node has two Intel Xeon Platinum chips, each with 24 processors, amounting to a total of 165,888 processors and a main memory of 390 Terabytes. The second element of MareNostrum 4 is formed of clusters of three different emerging technologies that will be added and updated as they become available. These are technologies currently being developed in the US and Japan to accelerate the arrival of the new generation of pre-exascale supercomputers.

MareNostrum is managed by the BSC Operations team, which gives support scientists in the usage of MareNostrum, as well as to help them to improve their applications to get better research results. MareNostrum is also part of the PRACE Research Infrastructure as one of the 6 Tier-0 Systems currently available for European scientists.

4.2. Third parties involved in the project (including use of third party resources)

No third parties involved

5. Ethics and Security

5.1 Ethics

All activities of the CLOUDator project will take into consideration the current international and national legislation and regulations of the countries where they will be carried out. The project, although not directly related to any of these issues, will include – but not limited to – the respect of the following EC legislation, international conventions and declarations:

- The Charter of Fundamental Rights of the EU
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

No ethically sensitive issues, as they have been defined by the European Commission will be involved in this project (objectives and methodology) or in the implementation of the project results. The only special action that this project consortium foresees to implement in relation to the ethical issues is referred to the information/data that will be gathered during project implementation. All personal and professional data will be addressed by the consortium to ensure that they do not contravene national laws on the protection of this type of data. The project will ensure that the systems developed will also conform to both current legislation and that anticipated in the future. “Trust and confidence” is an important attribute that will be addressed by the systems to be developed, because we are aware that the treatment of both personal and business confidential information is a key issue for exploitation.

The CLOUDator consortium confirms that the ethical standards and guidelines of Horizon2020 will be rigorously applied, regardless of the country in which the research is carried out.

Regarding the Data Privacy, the Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 – short GDPR – provides the legal framework to collect, process and exchange personal data. The CLOUDator project will be compliant with the GDPR Regulation in all phases of the project. In particular during the development phase, the concept of privacy by design will ensure that the flow of required personal data is identified as early as possible to ensure GDPR compliant multidisciplinary and community overarching activities.

5.2 Security[1]

CLOUDator will apply state of the art protection mechanisms to ensure safety of all data in the project; in particular apply encryption for storing personal data. The project will not involve:

- activities or results raising security issues
- 'EU-classified information' as background or results

[1] See article 37 of the Model Grant Agreement. . For more information on the classification of Information, please refer to the Horizon 2020 guidance: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/secur/h2020-hi-guide-classif_en.pdf.

Annex I. Letters of support

Open Geospatial Consortium Europe iVZW
Researchpark Haasrode, Technologielaan 3
3001 Heverlee
www.opengeospatial.org

To:
Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Brussels, 7 June 2020

Dear Dr. Joan Masó,

I am very pleased to learn that you are coordinating the **CLOUDator** (Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 “Increasing the services offer of the EOSC portal”.

The aim of CLOUDator is to **create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC)** through the application of state of the art of geospatial data services to serve the needs of geoscience research, increasing the **interoperability** of the geospatial data-intensive research in Europe and contributing to **self-sustained services** in the EOSC.

CLOUDator will integrate the **Copernicus Atmosphere and Monitoring Service** (CAMS) and the **Copernicus Climate Change Service** (C3S) platforms and other services will be made available in the EOSC portal using the most innovative **Open Geospatial Consortium compliant services** that considers **location and time**. An architecture of services will improve the **accessibility** and **processing of big data analytics** in distributed systems, in addition to ensure the visibility and recognition of Copernicus data services and the tools to improve **networking** between various stakeholders.

For the Open Geospatial Consortium (OGC), the value of the proposal resides in the effort in **use OGC standards in the Cloud** to enable multidisciplinary Earth Science and at the same time **connect** with the **public sector initiatives** such as the current **European Spatial Data Infrastructure** (INSPIRE) as well as the **Global Earth Observation System of Systems** (GEOSS). The **OGC is committed to enable Earth Science** research with geospatial standards. The OGC is also sensible to the role of standards in federating clouds in a seamless storage and processing environment. To this effect the **OGC runs the University Domain Working Group**

(DWG), the **Earth Systems Science DWG** and the **Earth Observation Exploitations Platforms DWG**.

We are pleased to see the project **showcasing** the scientific use of the geospatial services offered by EOSC in the interactions between **air quality**, **climate change**, **human activities**.

Therefore, the **OGC** will be **very pleased to support** the project by: **Supporting the family of geospatial standards development**, define requirements for the testing facilities for geospatial services compatible to OGC standards as part of the Compliance Interoperability & Testing Evaluation (CITE) program that maintains a Test, Evaluation, And Measurement (TEAM) Engine to validate and certify standard implementations. As stated, the **OGC would be pleased to see EOSC services certified using our validation tools**. The OGC would like to be considered for **being part of the project Advisory Board** of the project and influence its evolution.

The OGC is a non-profit, international, voluntary consensus standards organization that is leading the development of standards for geospatial and location-based services. The (currently) 500 member organizations (**companies, government agencies and universities**) participate in OGC **consensus processes**, providing a venue to deploy the results of research to **'geo-enable' the Web**, wireless and location-based services, and mainstream IT.

Yours faithfully,

Bart De Lathouwer,
President OGC
10 June 2020

http://codata-germany.org

CODATA Germany * Berlin * Germany

Joan Masó Pau
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Berlin, May 20, 2020

Dear Dr. Joan Masó,

I am very pleased to learn that you are coordinating the Cloudator (CLOUD with ATmosferic data fOr Research) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 “Increasing the services offer of the EOSC portal”.

CODATA-Germany is the German National Committee of CODATA, the Committee on Data of the International Science Council (ISC). CODATA promotes global collaboration to advance Open Science and to improve the availability and usability of data for all areas of research.

The main objectives of CODATA Germany are:

- Networking of individuals and institutions in the widest sense for information, communication and cooperation on national as well as on international level.
- Elaborating strategic aims for development of scientific aspects of databases and information systems under special consideration of promoting dialogue between commerce, science and administration.
- Promoting knowledge exchange especially by organizing events dealing with the technical, scientific, administrative and organizational development on all fields that are relevant to scientific data and information systems.

CODATA-Germany is an association (e.V.) registered in Berlin, Germany.

The aim of Cloudator is to incorporate Copernicus and geospatial data services into the European Open Science Cloud (EOSC) to serve the needs of geoscience research, increasing the interoperability of the geospatial data-intensive research in Europe and contributing to self-sustained services in the EOSC. Cloudator integrates the Copernicus Atmosphere and Monitoring Service (CAMS) and the Copernicus Climate Change Service (C3S) platforms and other existing mature modular geospatial services connected to the Copernicus services. An architecture of services will improve the accessibility and processing of big data analytics in distributed systems, in addition to ensure the visibility and recognition of Copernicus data

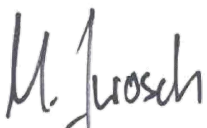
services and the tools to improve networking between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following open standards to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub (including discovery, processing and knowledge management services). In particular, the project will showcase the scientific use of the geospatial services offered by EOSC in the domains of air quality, climate change, health and its socioeconomics impacts.

We are convinced that Cloudator represents an important building block towards opening up data for enhanced exploitation and use. With its specific emphasis on Germany and its embedding in Europe we particularly applaud to this activity in the context of EOSC. Therefore, depending on capacities CODATA Germany will actively support the project by:

- Being part of the stakeholders network of Cloudator
- Being involved in the Cloudator Community
- Defining best practices on geospatial standards applied to science.
- Knowing about the results of the showcases developed during the project on air quality, climate change, health and its socioeconomics impacts.
- Knowing about the project evolution and receive regular information about the progress.
- Being part of the project Advisory Board of the project and influence its evolution.

Looking forward to remaining in the loop about the result of the proposal evaluations and how we can start collaborating.

Yours sincerely,



Prof. Dr. Monika Jarosch

COMPLEXITY SCIENCE HUB VIENNA

Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)

Vienna, June 3, 2020

Dear Dr. Joan Masó,

We are pleased to learn that you are coordinating the **CLOUDator** (Enabling Earth Sciences multi-disciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 “Increasing the services offer of the EOSC portal”.

The aim of CLOUDator is to **create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC)** through the application of state of the art of geospatial data services to serve the needs of geoscience research, increasing the **interoperability** of the geospatial data-intensive research in Europe and contributing to **self-sustained services** in the EOSC.

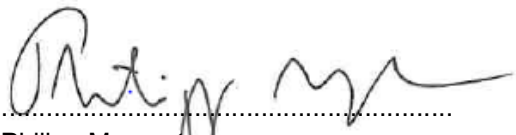
CLOUDator will integrate the **Copernicus Atmosphere and Monitoring Service** (CAMS) and the **Copernicus Climate Change Service** (C3S) platforms and other services will be made available in the EOSC portal using the most innovative **Open Geospatial Consortium APIs** that considers **location and time**. An architecture of services will improve the **accessibility** and **processing of big data analytics** in distributed systems, in addition to ensure the visibility and recognition of Copernicus data services and the tools to improve **networking** between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following **open standards** to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub (including discovery, processing and knowledge management services). In particular, the project will **showcase** the scientific use of the geospatial services offered by EOSC in the domains of **air quality**, **climate change**, **health** and its **socioeconomics impacts**, with one showcase focused on COVID-19.

Therefore, the Complexity Science Hub Vienna will be very pleased to support the project by:

- Being part of the co-design process of the proposed Open Health Map service to crowdsource data on COVID-19 measures, gatherings in the community and the COVID-19 showcase, which could greatly benefit medical research in gaining new insights into COVID-19;
- Knowing about the results of the showcases developed during the project on air quality, climate change, health and its socioeconomics impacts;
- Knowing about the project evolution and receiving regular information about the progress.

Please inform us of the result of the proposal evaluation and how we can collaborate in the future.

Yours sincerely,



.....
Philipp Marxgut
Secretary General

CNR - National Research Council of Italy
Institute of Atmospheric Pollution Research
http://www.iia.cnr.it
DIVISION OF FIRENZE

To:
Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Sesto Fiorentino, 12/06/2020

Dear Dr. Joan Masó,

I am very pleased to learn that you are coordinating the **CLOUDator** (Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 "Increasing the services offer of the EOSC portal".
The aim of CLOUDator is to **create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC)** through the application of state of the art of geospatial data services to serve the needs of geoscience research, increasing the **interoperability** of the geospatial data-intensive research in Europe and contributing to **self-sustained services** in the EOSC.
CLOUDator will integrate the **Copernicus Atmosphere and Monitoring Service** (CAMS) and the **Copernicus Climate Change Service** (C3S) platforms and other services will be made available in the EOSC portal using the most innovative **Open Geospatial Consortium APIs** that considers **location and time**. An architecture of services will improve the **accessibility** and **processing of big data analytics** in distributed systems, in addition to ensure the visibility and recognition of Copernicus data services and the tools to improve **networking** between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following **open standards** to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub (including discovery, processing and knowledge management services). In particular, the project will **showcase** the scientific use of the geospatial services offered by EOSC in the domains of **air quality**, **climate change**, **health** and its **socioeconomics impacts**.

Therefore, the Division of Florence of the Institute for Atmosheric Pollution Research of CNR (CNR-IIA) will be very pleased to support the project by:

- Testing and validating the data and services provided by CLOUDator.
- Being part of the project Advisory Board of the project and influence its evolution.

Please, inform us of the result of the proposal evaluations and how we can start collaborating.

Yours sincerely,

[Paolo Mazzetti – Head of the Division of Florence of CNR-IIA]

Area di Ricerca di Sesto Fiorentino
Via Madonna del Piano, 10
50019 Sesto Fiorentino, Firenze, Italy

From:

Geoff Sawyer
Secretary General of the European association of Remote Sensing Companies (EARSC)
26 rue de la loi, 1040,
Brussels, Belgium

To:

Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Dear Dr. Joan Masó,

I am very pleased to learn that you are coordinating the **CLOUDator** (Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 "Increasing the services offer of the EOSC portal".

The aim of CLOUDator is to **create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC)** through the application of state of the art of geospatial data services to serve the needs of geoscience research, increasing the **interoperability** of the geospatial data-intensive research in Europe and contributing to **self-sustained services** in the EOSC.

CLOUDator will integrate the **Copernicus Atmosphere and Monitoring Service** (CAMS) and the **Copernicus Climate Change Service** (C3S) platforms and other services will be made available in the EOSC portal using the most innovative **Open Geospatial Consortium APIs** that considers **location and time**. An architecture of services will improve the **accessibility** and **processing of big data analytics** in distributed systems, in addition to ensure the visibility and recognition of Copernicus data services and the tools to improve **networking** between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following **open standards** to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub (including discovery, processing and knowledge management services). In particular, the project will **showcase** the scientific use of the geospatial services offered by EOSC in the domains of **air quality**, **climate change**, **health** and its **socioeconomics impacts**.

Therefore, EARSC will be very pleased to support the project by:

- Knowing about the results of the showcases developed during the project on air quality, climate change, health and its socioeconomics impacts.
- Knowing about the project evolution and receive regular information about the progress.
- Distributing information about the CLOUDator project to the Earth observation industrial community.

Please, inform us of the result of the proposal evaluations and how we can start collaborating.

Yours sincerely,

Geoff Sawyer

Brussels, 05/06/2020

To: Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF, Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Rome (Italy) 09/06/2020

Dear Dr. Joan,

I am very pleased to know that you are coordinating the **CLOUDator** (Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 "Increasing the services offer of the EOSC portal".

The use of Geospatial data has been significantly increasing in the last years and will do it further in the next ones. Therefore, there is a growing need for Geospatial data analysis and services, as well as interoperability, accessibility and open data policy.

In this frame it will be really important to create a multidisciplinary layer of services for Earth science in the EOSC Cloud as CLOUDator is planning to do. In particular I see very important to support the exploitation of the Copernicus Services, like CAMS and C3S, as well as other geospatial services offered by EOSC in the domains of air quality, climate change, health and its socioeconomics impacts.

Joan, we have known each other since many years, and we had the chance to work together in the frame of GEO (the Group on Earth Observations) and ConnectinGEO, a previous H2020 project you coordinated in an excellent manner (such as several others), so I am sure that – if CLOUDator will be funded – it will be a success!

Therefore, I will be very pleased to support your project by promoting the use of CLOUDator services within the relevant stakeholders' community. I am also available to be part of the project Advisory Board, if you think useful.

Please, inform me about the result of the proposal evaluation and when and how we can start collaborating.

I wish all the best to you and your consortium for this new adventure!

Warm regards

Antonio Bombelli
Researcher, ENEA - Italian National Agency for New Technologies, Energy, Energy and Sustainable Economic Development (www.enea.it)
Nominated Expert at the Italian Ministry of Foreign Affair

From:

Thierry Ranchin
Coordinator of the H2020 e-shape project
MINES-ParisTech – PSL University/ARMINES
1 rue Claude Daunesse – CS 10207
06904 Sophia Antipolis cedex, France
To:

Joan Masó Pau
Coordinator of CLOUDator proposal
CREAF
Fac. Ciències UAB
08193 Bellaterra (Barcelona)
Spain

Sophia Antipolis, June 15th 2020

Dear Dr. Joan Masó,

I am very pleased to learn that you are coordinating the **CLOUDator** (Enabling Earth Sciences multidisciplinary overarching communities in the European Open Science Cloud) proposal to be submitted to the forthcoming H2020 call INFRAEOSC-07-2020 "Increasing the services offer of the EOSC portal".

The aim of CLOUDator is to **create a multidisciplinary layer of services for Earth science in the European Open Science Cloud (EOSC)** through the application of state of the art of geospatial data services to serve the needs of geoscience research, increasing the **interoperability** of the geospatial data-intensive research in Europe and contributing to **self-sustained services** in the EOSC.

CLOUDator will integrate the **Copernicus Atmosphere and Monitoring Service** (CAMS) and the **Copernicus Climate Change Service** (C3S) platforms and other services will be made available in the EOSC portal using the most innovative **Open Geospatial Consortium APIs** that considers **location and time**. An architecture of services will improve the **accessibility** and **processing of big data analytics** in distributed systems, in addition to ensure the visibility and recognition of Copernicus data services and the tools to improve **networking** between various stakeholders. Novel innovative digital services generated by different providers will be integrated in the EOSC portal, following **open standards** to ensure their interoperability, and offered in agile, fit-for-purpose and sustainable site available through EOSC hub (including discovery, processing and knowledge management services). In particular, the project will **showcase** the scientific use of the geospatial

services offered by EOSC in the domains of **air quality**, **climate change**, **health** and its **socioeconomics impacts**.

Therefore, the H2020 e-shape project (EuroGEO Showcases: Application Powered by Europe) will be very pleased to support the project by:

- Exchange expertise on integration and use of CAMS and C3S services on Cloud based environment
- Exchanging about the CLOUDator family of services for our scientific work
- Supporting the family of geospatial standards
- Share experience about the deployment and grow of the EOSC
- Support interoperability experiments with the aim of sharing experience about integration of CLOUDator and other systems.
- Collaborating with CLOUDator in defining the stakeholders requirement for Earth observation in terms of spatial, temporal resolution and other gaps in EO.
- Investigating how to our current activities and operational data infrastructures can complement the CLOUDator systems.
- Sharing our practices on geospatial standards applied to science.
- Knowing about the results of the showcases developed during the project on air quality, climate change, health and its socioeconomics impacts.
- Knowing about the project evolution and receive regular information about the progress.

Please, inform us of the result of the proposal evaluations and how we can start collaborating.

Yours sincerely,

Thierry RANCHIN

Signature numérique de Thierry RANCHIN
DN : cn=Thierry RANCHIN, o=MINES ParisTech, ou=Centre O.I.E., email=thierry.ranchin@mines-paristech.fr, c=FR
Date : 2020.06.15 14:31:42 +02'00'

Participant number	3	Organisation short name	RAS	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	rasdaman	Unit of access[1]	

Calculation of the Unit Cost (UC) for Virtual Access[2]

from:		to:	

A. Direct eligible costs of providing virtual access over the last year[4] excluding personnel costs	Describe the direct eligible costs[3] for providing access to the installation over the reference period (usually the last closed financial year[4] preceding the current one). All contributions to capital investments of the installation are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
	Total A	**0.00**
	of which subcontracting (A')	

B. Personnel direct eligible costs needed to provide virtual access over the last year[4]	Category of staff [4]	Person-Months	Personnel Costs (€)
	Total B		**0.00**

C. Indirect eligible costs: 25% x ([A-A']+B)	0.00
D. Total access eligible costs over the last year[4] = A+B+C	0.00
E. Total quantity of access provided to all normal users of the installation (i.e. both internal and external) over the last year[4]	1
F. Unit cost =D/E	**0**
G. Unit cost charged to the project	**0**
H. Quantity of access offered under the project (over the whole duration of the project)	0
I. **Access Cost on the basis of UC for the access offered under the project = G x H**	**0.00**

[1] The unit of access must be used and indicated only when the access policy of the infrastructure requires the identification of users. In this case the EU financial support to virtual access covers the access costs incurred by the installation for the provision of access to the identified users under the grant.

[2] See Decision authorising the use of unit costs for the actions involving virtual access (http://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf). In case of combination of unit cost and actual costs, all the cost categories and cost items reimbursed on actual costs basis must be excluded from the calculation of the unit cost.

[3] Direct costs (other than personnel) for providing access can only include:
- Costs of contracts for maintenance and repair for the functioning of the installation (if not capitalised).
- Costs of consumables specifically used for the installation.
- Costs of contracts for installation management, including security fees, insurance costs, quality control and certification, specifically incurred for the functioning of the installation.
- Costs of energy power and water supplied for the installation.
- Costs of software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services.
- Costs of specific scientific services included in the access provided or needed for the provision of virtual access by the installation.

[4] In exceptional and duly justified cases, a different reference period can be agreed with the Commission

[5] Personnel costs for the provision of access can only include costs of administrative, technical and scientific staff directly assigned to the functioning of the installation and to the generic support of users.

Participant number	3	Organisation short name	RAS	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	rasdaman	Unit of access[1]	

If access costs are declared on the basis of actual cost or on the basis of a combination[6] of unit cost and actual costs, please use the following table to estimate the actual costs for virtual access.

Access provision period (usually the project life-time) **from:** 01/01/2021 **to:** 01/07/2023

A. Estimated direct eligible costs of providing virtual access during the project life-time excluding personnel costs

Describe the direct eligible costs[7] that will be charged to the grant for the provision of virtual access over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
Initial Cloud Deployment	3 428.88
Cloud deployment with High Availability	35 325.00
Total A	**38 753.88**
of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide virtual access during the project life-time

Category of staff[1]	Person-Months	Personnel Costs (€)
Senior Developer / Deployment Expert	4	28 668.00
Total B		**28 668.00**

C. Indirect eligible costs 25% x ([A-A']+B)	**max**	16 855.47
D. Estimated eligible access costs = A+B+C		84 277.35

[6] Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of user (e.g. help desk). These costs will be charged to the grant as direct personnel costs (hours worked for the grant must be recorded).

[7] When the access policy requires the identification of users, the EU financial support to virtual access covers the access costs incurred by the installation for the provision of virtual access to the identified users under the grant.

Participant number	4	Organisation short name	DEIMOS	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	NextGEOSS hub	Unit of access[1]	eduGAIN

Calculation of the Unit Cost (UC) for Virtual Access[2]

from:		to:	

A. Direct eligible costs of providing virtual access over the last year[4] excluding personnel costs	Describe the direct eligible costs[3] for providing access to the installation over the reference period (usually the last closed financial year[4] preceding the current one). All contributions to capital investments of the installation are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
	Total A	**0.00**
	of which subcontracting (A')	

B. Personnel direct eligible costs needed to provide virtual access over the last year[4]	Category of staff [4]	Person-Months	Personnel Costs (€)
	Total B		**0.00**

C. Indirect eligible costs: 25% x ([A-A']+B)	0.00
D. Total access eligible costs over the last year[4] = A+B+C	0.00
E. Total quantity of access provided to all normal users of the installation (i.e. both internal and external) over the last year[4]	1
F. Unit cost =D/E	**0**
G. Unit cost charged to the project	**0**
H. Quantity of access offered under the project (over the whole duration of the project)	0
I. **Access Cost on the basis of UC for the access offered under the project = G x H**	**0.00**

[1] The unit of access must be used and indicated only when the access policy of the infrastructure requires the identification of users. In this case the EU financial support to virtual access covers the access costs incurred by the installation for the provision of access to the identified users under the grant.

[2] See Decision authorising the use of unit costs for the actions involving virtual access (http://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf). In case of combination of unit cost and actual costs, all the cost categories and cost items reimbursed on actual costs basis must be excluded from the calculation of the unit cost.

[3] Direct costs (other than personnel) for providing access can only include:
- Costs of contracts for maintenance and repair for the functioning of the installation (if not capitalised).
- Costs of consumables specifically used for the installation.
- Costs of contracts for installation management, including security fees, insurance costs, quality control and certification, specifically incurred for the functioning of the installation.
- Costs of energy power and water supplied for the installation.
- Costs of software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services.
- Costs of specific scientific services included in the access provided or needed for the provision of virtual access by the installation.

[4] In exceptional and duly justified cases, a different reference period can be agreed with the Commission

[5] Personnel costs for the provision of access can only include costs of administrative, technical and scientific staff directly assigned to the functioning of the installation and to the generic support of users.

Participant number	4	Organisation short name	DEIMOS	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	NextGEOSS hub	Unit of access[1]	eduGAIN

If access costs are declared on the basis of actual cost or on the basis of a combination[6] of unit cost and actual costs, please use the following table to estimate the actual costs for virtual access.

Access provision period (usually the project life-time) **from:** 01/01/2021 **to:** 01/07/2023

A. Estimated direct eligible costs of providing virtual access during the project life-time excluding personnel costs

Describe the direct eligible costs[7] that will be charged to the grant for the provision of virtual access over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
Cloud Deployment with High Availability	3 000.00
Total A	**3 000.00**
of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide virtual access during the project life-time

Category of staff[1]	Person-Months	Personnel Costs (€)
Senior Developer / Deployment Expert	6	24 600.00
Total B		**24 600.00**

C. Indirect eligible costs 25% x ([A-A']+B)	**max**	6 900.00
D. Estimated eligible access costs = A+B+C		34 500.00

[6] Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of user (e.g. help desk). These costs will be charged to the grant as direct personnel costs (hours worked for the grant must be recorded).

[7] When the access policy requires the identification of users, the EU financial support to virtual access covers the access costs incurred by the installation for the provision of virtual access to the identified users under the grant.

Participant number	5	Organisation short name	52N	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	Helgoland	Unit of access[1]	eduGAIN

Calculation of the Unit Cost (UC) for Virtual Access[2]

from:		to:	

A. Direct eligible costs of providing virtual access over the last year[4] excluding personnel costs	Describe the direct eligible costs[3] for providing access to the installation over the reference period (usually the last closed financial year[4] preceding the current one). All contributions to capital investments of the installation are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
	Total A	**0.00**
	of which subcontracting (A')	

B. Personnel direct eligible costs needed to provide virtual access over the last year[4]	Category of staff [4]	Person-Months	Personnel Costs (€)
	Total B		**0.00**

C. Indirect eligible costs: 25% x ([A-A']+B)	0.00
D. Total access eligible costs over the last year[4] = A+B+C	0.00
E. Total quantity of access provided to all normal users of the installation (i.e. both internal and external) over the last year[4]	1
F. Unit cost =D/E	**0**
G. Unit cost charged to the project	**0**
H. Quantity of access offered under the project (over the whole duration of the project)	0
I. **Access Cost on the basis of UC for the access offered under the project = G x H**	**0.00**

[1] The unit of access must be used and indicated only when the access policy of the infrastructure requires the identification of users. In this case the EU financial support to virtual access covers the access costs incurred by the installation for the provision of access to the identified users under the grant.

[2] See Decision authorising the use of unit costs for the actions involving virtual access (http://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf). In case of combination of unit cost and actual costs, all the cost categories and cost items reimbursed on actual costs basis must be excluded from the calculation of the unit cost.

[3] Direct costs (other than personnel) for providing access can only include:
- Costs of contracts for maintenance and repair for the functioning of the installation (if not capitalised).
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- Costs of energy power and water supplied for the installation.
- Costs of software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services.
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[5] Personnel costs for the provision of access can only include costs of administrative, technical and scientific staff directly assigned to the functioning of the installation and to the generic support of users.

Participant number	5	Organisation short name	52N	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	Helgoland	Unit of access[1]	eduGAIN

If access costs are declared on the basis of actual cost or on the basis of a combination[6] of unit cost and actual costs, please use the following table to estimate the actual costs for virtual access.

Access provision period (usually the project life-time)	**from:** 01/01/2021	**to:** 01/07/2023

A. Estimated direct eligible costs of providing virtual access during the project life-time excluding personnel costs

Describe the direct eligible costs[7] that will be charged to the grant for the provision of virtual access over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	**Eligible Costs (€)**
Cloud Deployment with High Availability	1 585.92
Total A	**1 585.92**
of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide virtual access during the project life-time

Category of staff[1]	**Person-Months**	**Personnel Costs (€)**
Senior Developer / Deployment Expert	2	12 000.00
Total B		**12 000.00**

C. Indirect eligible costs 25% x ([A-A']+B)	**max**	3 396.48
D. Estimated eligible access costs = A+B+C		16 982.40

[6] Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of user (e.g. help desk). These costs will be charged to the grant as direct personnel costs (hours worked for the grant must be recorded).

[7] When the access policy requires the identification of users, the EU financial support to virtual access covers the access costs incurred by the installation for the provision of virtual access to the identified users under the grant.

Participant number	7	Organisation short name	SECD	Short name of Infrastructure	
Installation number		Short name of Installation	AUTHENIX	Unit of access[1]	eduGAIN

Calculation of the Unit Cost (UC) for Virtual Access[2]

from:		to:	

A. Direct eligible costs of providing virtual access over the last year[4] excluding personnel costs	Describe the direct eligible costs[3] for providing access to the installation over the reference period (usually the last closed financial year[4] preceding the current one). All contributions to capital investments of the installation are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
	Total A	**0.00**
	of which subcontracting (A')	

B. Personnel direct eligible costs needed to provide virtual access over the last year[4]	Category of staff [4]	Person-Months	Personnel Costs (€)
	Total B		**0.00**

C. Indirect eligible costs: 25% x ([A-A']+B)	0.00
D. Total access eligible costs over the last year[4] = A+B+C	0.00
E. Total quantity of access provided to all normal users of the installation (i.e. both internal and external) over the last year[4]	1
F. Unit cost =D/E	**0**
G. Unit cost charged to the project	**0**
H. Quantity of access offered under the project (over the whole duration of the project)	0
I. **Access Cost on the basis of UC for the access offered under the project = G x H**	**0.00**

[1] The unit of access must be used and indicated only when the access policy of the infrastructure requires the identification of users. In this case the EU financial support to virtual access covers the access costs incurred by the installation for the provision of access to the identified users under the grant.

[2] See Decision authorising the use of unit costs for the actions involving virtual access (http://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf). In case of combination of unit cost and actual costs, all the cost categories and cost items reimbursed on actual costs basis must be excluded from the calculation of the unit cost.

[3] Direct costs (other than personnel) for providing access can only include:
- Costs of contracts for maintenance and repair for the functioning of the installation (if not capitalised).
- Costs of consumables specifically used for the installation.
- Costs of contracts for installation management, including security fees, insurance costs, quality control and certification, specifically incurred for the functioning of the installation.
- Costs of energy power and water supplied for the installation.
- Costs of software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services.
- Costs of specific scientific services included in the access provided or needed for the provision of virtual access by the installation.

[4] In exceptional and duly justified cases, a different reference period can be agreed with the Commission

[5] Personnel costs for the provision of access can only include costs of administrative, technical and scientific staff directly assigned to the functioning of the installation and to the generic support of users.

Participant number	7	Organisation short name	SECD	Short name of Infrastructure	
Installation number		Short name of Installation	AUTHENIX	Unit of access[1]	eduGAIN

If access costs are declared on the basis of actual cost or on the basis of a combination[6] of unit cost and actual costs, please use the following table to estimate the actual costs for virtual access.

Access provision period (usually the project life-time)	**from:**	01/01/2021	**to:**	01/07/2023

A. Estimated direct eligible costs of providing virtual access during the project life-time excluding personnel costs

Describe the direct eligible costs[7] that will be charged to the grant for the provision of virtual access over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	**Eligible Costs (€)**
Cloud Deployment with High Availability	10 500.00
Total A	**10 500.00**
of which subcontracting (A')	

B. Estimated personnel direct eligible costs needed to provide virtual access during the project life-time

Category of staff[1]	**Person-Months**	**Personnel Costs (€)**
Senior Developer / Deployment Expert	3	26 400.00
Total B		**26 400.00**

C. Indirect eligible costs 25% x ([A-A']+B)	**max**	9 225.00
D. Estimated eligible access costs = A+B+C		46 125.00

[6] Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of user (e.g. help desk). These costs will be charged to the grant as direct personnel costs (hours worked for the grant must be recorded).

[7] When the access policy requires the identification of users, the EU financial support to virtual access covers the access costs incurred by the installation for the provision of virtual access to the identified users under the grant.

Participant number	9	Organisation short name	SIN	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	GeoPedia	Unit of access[1]	eduGAIN

Calculation of the Unit Cost (UC) for Virtual Access[2]

from:		to:	

A. Direct eligible costs of providing virtual access over the last year[4] excluding personnel costs	Describe the direct eligible costs[3] for providing access to the installation over the reference period (usually the last closed financial year[4] preceding the current one). All contributions to capital investments of the installation are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	Eligible Costs (€)
	Total A	**0.00**
	of which subcontracting (A')	

B. Personnel direct eligible costs needed to provide virtual access over the last year[4]	Category of staff [4]	Person-Months	Personnel Costs (€)
	Total B		**0.00**

C. Indirect eligible costs: 25% x ([A-A']+B)	0.00
D. Total access eligible costs over the last year[4] = A+B+C	0.00
E. Total quantity of access provided to all normal users of the installation (i.e. both internal and external) over the last year[4]	1
F. Unit cost =D/E	**0**
G. Unit cost charged to the project	**0**
H. Quantity of access offered under the project (over the whole duration of the project)	0
I. **Access Cost on the basis of UC for the access offered under the project = G x H**	**0.00**

[1] The unit of access must be used and indicated only when the access policy of the infrastructure requires the identification of users. In this case the EU financial support to virtual access covers the access costs incurred by the installation for the provision of access to the identified users under the grant.

[2] See Decision authorising the use of unit costs for the actions involving virtual access (http://ec.europa.eu/research/participants/data/ref/h2020/other/legal/unit_costs/unit-costs_virtual-access_infra.pdf). In case of combination of unit cost and actual costs, all the cost categories and cost items reimbursed on actual costs basis must be excluded from the calculation of the unit cost.

[3] Direct costs (other than personnel) for providing access can only include:
- Costs of contracts for maintenance and repair for the functioning of the installation (if not capitalised).
- Costs of consumables specifically used for the installation.
- Costs of contracts for installation management, including security fees, insurance costs, quality control and certification, specifically incurred for the functioning of the installation.
- Costs of energy power and water supplied for the installation.
- Costs of software licence, internet connection or other electronic services for data management and computing supplied specifically for the installation when they are needed to provide virtual access services.
- Costs of specific scientific services included in the access provided or needed for the provision of virtual access by the installation.

[4] In exceptional and duly justified cases, a different reference period can be agreed with the Commission

[5] Personnel costs for the provision of access can only include costs of administrative, technical and scientific staff directly assigned to the functioning of the installation and to the generic support of users.

Participant number	9	Organisation short name	SIN	Short name of Infrastructure	wekeo
Installation number		Short name of Installation	GeoPedia	Unit of access[1]	eduGAIN

If access costs are declared on the basis of actual cost or on the basis of a combination[6] of unit cost and actual costs, please use the following table to estimate the actual costs for virtual access.

Access provision period (usually the project life-time)	**from:** 01/01/2021	**to:** 01/07/2023

A. Estimated direct eligible costs of providing virtual access during the project life-time excluding personnel costs

Describe the direct eligible costs[7] that will be charged to the grant for the provision of virtual access over the project life-time (e.g. maintenance, utilities, consumable costs). All contributions to capital investments of the infrastructure are not eligible unless otherwise specified in the Work Programme, in which case only the portion used to provide virtual access under the action can be eligible.	**Eligible Costs (€)**
External cloud Infrastructure maintenance (mainly DIAS)	12 000.00
Internal cloud Infrastructure maintenance (mainly Geopedia)	8 000.00
Total A	**20 000.00**
of which subcontracting (A')	

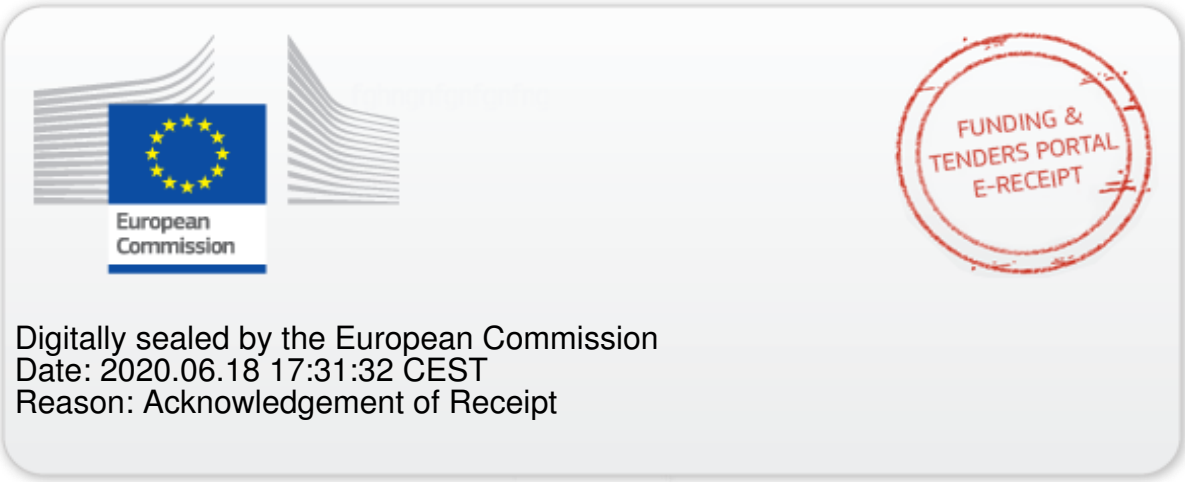
B. Estimated personnel direct eligible costs needed to provide virtual access during the project life-time

Category of staff[1]	**Person-Months**	**Personnel Costs (€)**
Senior Developer / Deployment Expert	3	16 800.00
Total B		**16 800.00**

C. Indirect eligible costs 25% x ([A-A']+B)	**max**	9 200.00
D. Estimated eligible access costs = A+B+C		46 000.00

[6] Personnel costs for technical and scientific staff directly working for the provision of virtual access, including for the generic support of user (e.g. help desk). These costs will be charged to the grant as direct personnel costs (hours worked for the grant must be recorded).

[7] When the access policy requires the identification of users, the EU financial support to virtual access covers the access costs incurred by the installation for the provision of virtual access to the identified users under the grant.



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