Horizon 2020

Call: H2020-MSCA-IF-2017

(Marie Skłodowska-Curie Individual Fellowships)

Topic: MSCA-IF-2017

Type of action: MSCA-IF-EF-ST

(Standard EF)

Proposal number: 789630

Proposal acronym: DUST.ES

Deadline Id: H2020-MSCA-IF-2017

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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 previous steps in the submission wizard.

Proposal ID **789630** *Acronym* **DUST.ES**

1 - General information

Topic	MSCA-IF-2017
Call Identifier	H2020-MSCA-IF-2017
Type of Action	MSCA-IF-EF-ST
Deadline Id	H2020-MSCA-IF-2017

Acronym	DUST.ES
Proposal title	Addressing key uncertainties in mineral DUST EmiSsion modelling to better constrain the global dust cycle

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

Duration in months	24
Scientific Area	ENV

Please select up to 5 descriptors (and at least 3) that best characterise the subject of your proposal, in descending order of relevance.

Descriptor 1	*Atmospheric chemistry, atmospheric composition, air pollution, indoor air quality*
Descriptor 2	*Meteorology, atmospheric physics and dynamics*
Descriptor 3	*Scientific computing and data processing*
Free keywords	*dust emission, haboobs, dust sources, dust modelling, global modelling*

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Abstract

Mineral dust emission is ubiquitous in arid and semi-arid areas, representing a serious hazard for health, environment, and economy in many countries, in particular some of the least developed. Dust is a dominant contributor to the global aerosol load and plays a significant role in different aspects of climate and atmospheric chemistry. A key uncertainty in estimating present-day dust emissions is the contribution of human activities such as cultivation and grazing that disturb the soil. Recent research allowed representing natural and anthropogenic dust sources in global models based on high-resolution satellite data and land use maps. However, the accurate quantification of dust emissions and their attribution to natural and anthropogenic origin is currently hampered by deficiencies in dust emission modelling. Deficiencies include an incomplete representation of the physics of dust emission and a lack of skill to model certain atmospheric processes driving dust emission. DUST.ES will constrain present-day global dust emissions for both source types (natural/anthropogenic) taking into account (1) aerodynamic entrainment, a potentially important, yet previously neglected dust emission mechanism; and (2) moist convective dust storms (haboobs), intense dust events, which are unrepresented in global models, but have a big impact on society. DUST.ES will estimate the regional and global relative significance of dust emissions caused by different dust emission mechanisms, meteorological dust injection processes, and source type. Results of DUST.ES will be a cornerstone to the longer-term goal of quantifying the effects of anthropogenic dust sources in the present and future climate. The beneficiary (BSC) hosts the WMO Dust Storm Prediction Regional Center for North Africa, Middle East and Europe, ensuring that the results have an immediate and sizeable benefit in several areas of public and private sectors across Europe and beyond.

Remaining characters 38

Has this proposal (or a very similar one) been submitted to a Horizon 2020 Marie Skłodowska-Curie Individual Fellowship call, with the same supervisor and future host institution (and partner organization for Global Fellowships)? (•) Yes ( ) No

Please give the proposal reference or contract number.	
740347	

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Declarations

1) The applicant (future beneficiary) declares to have the explicit consent of all partner organisations (if applicable) 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 applicant (future beneficiary) hereby declares:

- it is fully eligible in accordance with the criteria set out in the specific call for proposals; and	☒
- it has the financial and operational capacity to carry out the proposed action.	☒

The applicant (future beneficiary) is only responsible for the correctness of the information relating to his/her own organisation. Where the proposal to be retained for EU funding, the applicant (future beneficiary) 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).

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List of participants

#	Participant Legal Name	Country
1	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	Spain

Proposal ID **789630** *Acronym* **DUST.ES** *Short name* **BSC**

2 - Administrative data of participating organisations

Future Host Institution

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
Small and Medium-sized Enterprises (SMEs) ..... no
Academic Sector ..... yes

Legal person ..... yes

Proposal ID **789630** *Acronym* **DUST.ES** *Short name* **BSC**

Department(s) carrying out the proposed work

Department 1

Department name: Earth Sciences Department ☐ not applicable

☐ Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona

Postcode: 08034

Country: Spain

If the location of the Department carrying out the proposed work is not the same as the location of the Host Institute, please note that although the proposal submission system calculates the budget of the project based on the location of the Host Institute, the budget of the project for the grant agreement will be calculated by using the country coefficient of the location of the Department carrying out the proposed work.

Proposal ID **789630** *Acronym* **DUST.ES** *Short name* **BSC**

Researcher

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

Last Name*	KLOSE	Last Name at Birth	
First Name(s)*	Martina	Gender*	○ Male ◉ Female
Title	Dr.	Country of residence*	United States
Nationality*	Germany	Nationality 2	
Date of Birth (DD/MM/YYYY)	15/10/1984	Country of Birth*	Germany
		Place of Birth	

Contact address

Current organisation name			
Current Department/Faculty/Institute/ Laboratory name			
☐ Same as organisation address			
Street	Windröschenweg 5		
Postcode/Cedex*	36391	Town*	Sinntal
Phone	*+xxx xxxxxxxxx*	Country*	Germany
Phone2 / Mobile	+491634707622		
E-Mail*	martina.klose@gmail.com		

ORCID ID	0000-0001-8190-3700		
Researcher ID			*The maximum length of the identifier is 11 characters (ZZZ-9999-2010) and the minimum length is 9 characters (A-1001-2010).*
Other ID	*Please enter the type of ID here*	*Please enter the identifier number here*	

Qualifications

University Degree giving access to PhD	Date of award (DD/MM/YYYY)	29/11/2010
Doctorate	Start date (DD/MM/YYYY)	01/01/2011
Doctorate	Date of (expected) award (DD/MM/YYYY)	06/10/2014
Full time research experience	Number of months	81

(Measured from the date when a researcher obtained the degree entitling him/her to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the researcher is recruited, even if a doctorate was never started or envisaged.)

Place of activity/place of residence (previous 5 years - most recent one first)

Indicate the period(s) and the country/countries in which you have legally resided and/or had your main activity (work, studies, etc) during the last 5 years up until the deadline for the submission of the proposal. Please fill in this section without gaps, until the call deadline (14/09/2017).

Period from	Period to	Duration (days)	Country
01/09/2015	14/09/2017	745	United States
14/09/2012	31/08/2015	1082	Germany
	Total	1827	

Proposal ID **789630** *Acronym* **DUST.ES** *Short name* **BSC**

Supervisor

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

Title: Dr. Sex: (•) Male ( ) Female

First name*: **Carlos** Last name*: **PEREZ GARCIA-PANDO**

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

Position in org.: Atmos. Composition Group Leader/AXA Prof. on Sand and Dust Storms

Department: Earth Sciences Department

[ ] Same as organisation address

Street: Jordi Girona, 29

Town: Barcelona Post code: 08034

Country: Spain

Website:

Phone: +34934137722 Phone 2: +xxx xxxxxxxxx Fax: +xxx xxxxxxxxx

Other contact persons

First Name	*Last Name*	*E-mail*	*Phone*
Dorota	CHMIELEWSKA	dorota.chmielewska@bsc.es	+34934134082

Proposal ID **789630** *Acronym* **DUST.ES**

3 - Budget

Is the Researcher eligible for family allowance? ○ Yes ◉ No

Participant Number	Organisation Short Name	Country	Country Coefficient	Number of Months	Researcher Unit Cost			Institutional Unit Cost		Total
					Living Allowance	Mobility Allowance	Family Allowance	Research, training and networking costs	Management and Overheads	
1	BSC	ES	0,976	24	108921,60	14400,00	0,00	19200,00	15600,00	158121,60
Total				24	108921,60	14400,00	0,00	19200,00	15600,00	158121,60

Partner Organisation from Third Country does not sign the Grant Agreement, does not recruit the researcher and does not directly claim costs from the action. The entire EC contribution is transmitted to the Host organisation located in Members States or Associated Countries.

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4 - Ethics issues table

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	

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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

Proposal ID **789630** *Acronym* **DUST.ES**

5 - Call specific questions

Eligibility Researcher (future fellow)

1. Were you in the last 5 years in military service? ○ Yes ◉ No

Other Questions

1. For communication purposes only, the European Commission REA asks for permission to publish the name of the researcher (future fellow) should the proposal be retained for funding. Does the researcher (future fellow) give this permission? ◉ Yes ○ No

2. Some national and regional public research funding authorities run schemes to fund MSCA applicants that score highly in the MSCA evaluation but which cannot be funded by the MSCA due to their limited budget. In case this proposal could not be selected for funding by the MSCA, do the researcher and supervisor consent to the European Commission disclosing to such authorities the results of its evaluation (score and ranking range) together with their names and contact details, non-confidential proposal title and abstract, proposal acronym, and host organisation? ○ Yes ◉ No

3. Is there a secondment in Member States or Associated Countries envisaged in Part B of this proposal? ◉ Yes ○ No

In which sector is the secondment in Member States / Associated Countries foreseen?

☒ Academic ☐ Non Academic

Do you already know the organisation to which this secondment will be? ◉ Yes ○ No

Name: Karlsruhe Institute of Technology

Country: Germany

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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.*

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MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2017

PART B

"DUST.ES"

Addressing key uncertainties in
mineral **DUST E**mi**S**sion modelling
to better constrain the global dust cycle

This proposal is to be evaluated as:

[EF-ST]

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Part B-1

Part B-2

LIST OF PARTICIPATING ORGANISATIONS

Participating organisations	Legal Entity Short Name	Academic (tick)	Non-academic (tick)	Country	Dept./ Division / Laboratory	Supervisor	Role of Partner Organisation
Beneficiary							
Barcelona Supercomputing Center	BSC	X		Spain	Earth Sciences Department	Dr. Carlos Pérez García-Pando	
Partner Organisation							
Karlsruhe Institute of Technology	KIT	X		Germany	Institute for Meteorology and Climate Research – Troposphere Research Division	Prof. Dr. Peter Knippertz	Host of second-ment

1. Excellence

1.1 Quality and credibility of the research/innovation action

1.1.1 Introduction and state-of-the-art

Mineral soil dust created by the wind erosion of arid and semi-arid surfaces is the dominant contributor to the total aerosol mass in the atmosphere, significantly affecting radiative fluxes, cloud properties, atmospheric chemistry, ocean biogeochemistry, and human health[1]. While numerical models that predict the emission, transport, and deposition of dust have notably improved over the last decade, they still face numerous challenges. A central challenge is to constrain dust emission globally, a complex process that depends on the wind stress and the land-surface condition. The quantification of dust emission is highly interdisciplinary as it links meteorology, pedology, geomorphology, and geology.

Deficits of state-of-the-art global dust models include (1) an incomplete representation of the physics of dust emission, (2) a lack of skill to reproduce certain atmospheric processes that drive dust emission, and (3) a poor representation of small-scale dust sources and regions where anthropogenic changes in land use due to cultivation and grazing may have enhanced dust emission[2]. ***The proposed research aims to redress model deficits related to the dust emission mechanism and meteorological dust injection processes, and hence to reduce uncertainty in modelled dust emission along with its attribution to natural and anthropogenic origin.***

Dust emission mechanisms: Three mechanisms are known to be responsible for the emission of dust particles (*Fig. 1a*): (1) aerodynamic entrainment (AE), (2) saltation bombardment (SB), in which sand grains hop along the surface (a process called saltation) and release fine dust particles from the surface by abrasion, and (3) aggregate disintegration (AD), in which saltating soil aggregates fragment upon impact with the soil surface and thereby release dust particles[3]. Dust emission schemes used in regional and global models represent either SB or SB and AD[4,5,6]. AE is usually neglected in dust modelling as suggested by theoretical considerations and wind tunnel experiments. However, recent studies – including the experienced researcher's own – have shown that this mechanism can be significant[7,8]. While AE typically produces dust emissions much smaller than that generated by SB/AD, it can occur during weak mean winds and thus happen more frequently. ***The long-term global significance of aerodynamic dust emission compared to saltation-generated dust emission and the associated environmental effects are unknown***.

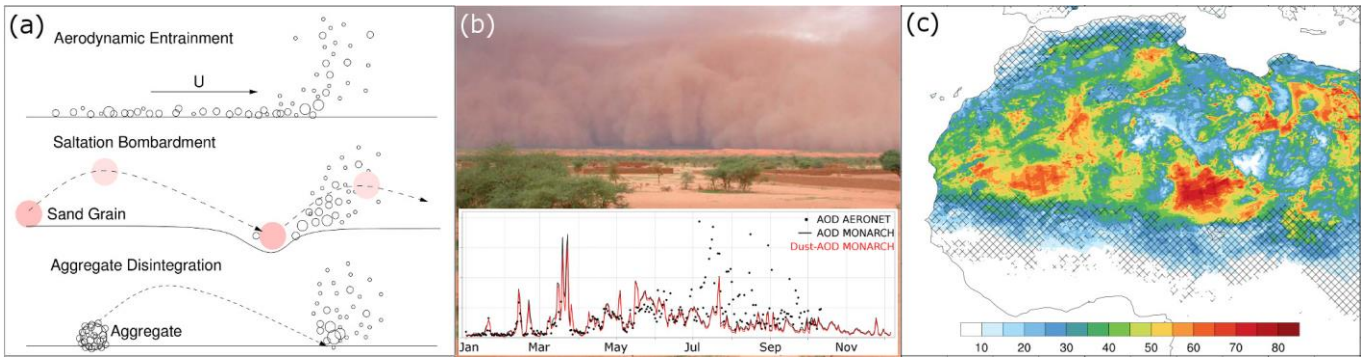


Fig. 1: *(a) Mechanisms of dust emission (from Shao, 2008[3]); (b) Leading edge of a haboob (from Knippertz and Todd, 2012[9]) and comparison between modelled (MONARCH – total: black line; dust contribution: red line) and measured (AERONET – black dots) aerosol optical depth (AOD) at Tamanrasset, Algeria, during 2015. Summertime moist-convective dust storms lead to substantial model-observation discrepancies in current models; (c) Frequency of occurrence that AOD exceeds a threshold of 0.2 for natural and anthropogenic (dash pattern) dust sources[2] in northern Africa.*

1 e.g. Ravi et al. (2011), *Rev. Geophys.*, 49, doi:10.1029/2010RG000328
2 Ginoux et al. (2012), *Rev. Geophys.*, 50, doi:10.1029/2012RG000388
3 Shao (2008), 2nd ed., Springer Netherlands, 452pp., doi:10.1007/978-1-4020-8895-7
4 Marticorena and Bergametti (1995), *J. Geophys. Res.*, 100, doi:10.1029/96JD02964
5 Shao (2004), *J. Geophys. Res.*, 109, doi:10.1029/2003JD004372
6 Kok et al. (2014), *Atmos. Chem. Phys.*, 14, doi:10.5194/acp-14-13023-2014
7 Macpherson et al. (2008), *J. Geophys. Res.*, 113, doi:10.1029/2007JF000800
8 Klose et al. (2014), *J. Geophys. Res. Atmos.*, 119, doi:10.1002/2014JD021688
9 Knippertz and Todd (2012), *Rev. Geophys.*, 50, doi:10.1029/2011RG000362

Meteorological dust injection processes: Due to the non-linear relation between wind and dust emission, small errors in modelled wind speed lead to large errors in dust emission, irrespective of the emission mechanism. Dust models show moderately good behaviour when dust outbreaks are caused by synoptic-scale systems. The modelling of moist-convective dust storms (MCS) or '*haboobs*' – immense dust storms produced by mesoscale downdrafts – remains a challenge, in particular for coarse-grid global models *(Fig. 1b)*. According to a recent field campaign, MCS are among the most important meteorological dust injection processes in the Sahara in summer, both in terms of cumulative duration and intensity[10]. Only few attempts have been made to parameterize MCS in a way that could in principle be used in large-scale models[11,12]. ***The inclusion of moist-convective dust storms in global models could significantly improve estimates of the amount, spatial distribution, and seasonal and interannual variability of global dust emission.***

Source attribution: Major dust sources are preferentially located in topographic depressions where a deep layer of alluvium has accumulated[13]. However, dust sources can also be generated by human activities, such as agriculture, that disturb the soil and make it vulnerable to wind erosion. ***The contribution of (anthropogenic) land use to present-day dust emission remains under debate, with values ranging from 10% to 50%[2,14,15,16].*** The uncertainty related to the anthropogenic soil dust fraction is partly caused by the poorly constrained wind friction velocity threshold for particle lifting, u_{*t}, which depends on soil texture, soil moisture, and surface roughness (due to topography, non-erodible elements such as pebbles and rocks, and vegetation). Most global dust models assume a spatially uniform dry threshold with variations depending only on soil moisture, omitting the influence of vegetation and other environmental factors on u_{*t}. This is particularly problematic for semi-arid regions and cultivated dust sources, which have a strong temporal variability in vegetation and crop cover. Recently, a correction factor to account for effects of surface roughness on u_{*t}, F_R, was derived at the global scale[17]. F_R is based on a combination of a static roughness for arid regions and a temporally varying roughness for semi-arid and cultivated regions. ***To better estimate the contribution of agricultural (cultivated) and natural sources to global dust emission***, ***such improved land-surface representations need to be combined with advanced dust models and observational constraints.***

1.1.2 Objectives and overview of the action

The overarching goal of DUST.ES is to constrain present-day dust emissions along with their attribution to natural and anthropogenic origin. DUST.ES will account for a previously neglected, yet potentially important dust emission mechanism (AE) and a major and unrepresented dust-producing atmospheric process (MCS). Specifically, the following questions will be addressed combining modelling and observations:

(A) What is the regional and global relative significance of AE compared to SB/AD?

(B) What is the contribution of MCS to the dust cycle regionally and globally?

(C) What is the contribution of anthropogenic (cultivated) dust sources to the dust cycle?

(D) How do the results obtained in (A) and (B) differ between natural and anthropogenic dust source regions?

To address the above questions, I (the experienced researcher) will use and further develop the dust module of the Multiscale Online Non-hydrostatic AtmospheRe CHemistry model[18,19] (MONARCH; previously known as NMMB/BSC-CTM), a model designed and developed by Dr. Pérez García-Pando (supervisor of the proposed MSCA) and his research group at BSC, in close collaboration with partners at other institutions such as NOAA, NASA, and University of California, Irvine. MONARCH contains advanced chemistry and aerosol packages, and is coupled online with the Non-hydrostatic Multiscale Model (NMMB), which allows running both global and high-resolution (convection-permitting) regional simulations. The model provides regional daily dust forecasts for Northern Africa, the Middle East, and Europe through the *World Meteorological Organization* (WMO) *Sand and*

10 Allen et al. (2015), J. Geophys. Res. Atmos., 120, doi:10.1002/2014JD022655
11 Miller et al. (2008), *J. Geophys. Res.*, 113, doi:10.1029/2007JD008550.
12 Pantillon et al. (2016), *J. Geophys. Res. Atmos.*, 121, doi:10.1002/2015JD024349
13 Prospero et al. (2002), *Rev. Geophys.*, 40, doi:10.1029/2000RG000095
14 Tegen et al. (2004), *Geophys. Res. Lett.*, 31, doi:10.1029/2003GL019216
15 Mahowald et al. (2004), *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL021272
16 Tegen et al. (1996), *Nature*, 380, 419–422, doi:10.1038/380419a0
17 Pérez García-Pando et al. (2017), Natural and anthropogenic contributions to the global dust budget. (in preparation)
18 Pérez et al. (2011), *Atmos. Chem. Phys.*, 11, doi:10.5194/acp-11-13001-2011
19 Badia et al. (2017), Geosci. Model Dev., 10, doi: 10.5194/gmd-10-609-2017

Dust Storm Warning Advisory and Assessment System (SDS-WAS) *Regional Center* hosted by BSC (Section 1.3.2), and contributes with global forecasts to the International Cooperative for Aerosol Prediction (ICAP) Multi Model Ensemble. The global model resolution in DUST.ES will be ~0.5° horizontally and 64 vertical layers.

1.1.3 Research methodology and approach

In recent projects, the dust module of MONARCH was upgraded with new capabilities relevant to my proposed research, including (1) three different SB/AD schemes[4,6,23], (2) a global-scale 10 km resolution mapping of dust sources based on the Moderate-resolution imaging spectroradiometer (MODIS) "Deep Blue" aerosol retrievals and a land-use database that distinguishes between natural and cultivated dust sources[2], (3) a drag partition correction for u_{*t} based on a static roughness length for arid regions derived from satellite microwave backscattering (ASCAT) and visible/near-infrared reflectances (PARASOL)[20] and a dynamic roughness length for semi-arid and cultivated regions derived from MODIS leaf-area-index[17], and (4) separate tracers for natural and anthropogenic dust that allow for the calculation of their relative contributions to the dust budget.

To address the proposed questions, the work plan of DUST.ES is structured around four scientific work-packages:

WP1 – *Implementation and evaluation of a novel aerodynamic dust entrainment scheme*: I will implement a novel physics-based parameterization for AE[8,21,22], of which I am the main developer. The scheme estimates AE based on aerodynamic lifting and particle retarding forces and needs basic information about the atmospheric state and the soil surface condition as input. Three SB/AD schemes are currently implemented in MONARCH[4,6,23]. Modules containing the source code for the AE scheme are available and will be coupled to MONARCH. Separate tracers for dust emission due to SB/AD and AE will be added such that contributions of the different emission mechanisms to the total dust aerosol can be differentiated when both schemes are used. Time periods and areas for calibration of the AE scheme will be chosen such that AE can be isolated as much as possible from SB/AD. We will select time periods with weak mean winds (below saltation threshold) and without strong dust events reported as "present weather" in WMO synoptic station data. We will calibrate the model using near-surface dust concentration for an area with little non-dust background aerosol. A candidate area is Australia with dust concentration measurements available through the DustWatch Australia network.

WP2 – *Implementation and evaluation of a scheme for moist-convective dust storms:* A newly developed MCS scheme[12] will be coupled to the model's moist convection and SB/AD schemes, and tagging of MCS-dust will be included. The MCS scheme is based on the assumption that the downdraft mass flux from the convection scheme spreads out radially as a cylindrical cold pool. As the default, MONARCH uses an adjustment rather than a mass flux scheme to parameterize convection. We will therefore modify the MCS scheme such that the MCS radial outflow is based on atmospheric stratification rather than downdraft mass flux. The MCS scheme will be calibrated using MONARCH regional convection-permitting runs for 1 year for North Africa, where MCSs occur frequently in summer (cf. Fig. 1b), and applied to convection-parameterized runs. A horizontal resolution of ~2km with 70 vertical layers is planned for the regional model runs. Measurements of dust concentration and meteorological parameters in the Sahel[24] as well as sun photometer and satellite observations in Northern Africa will additionally be used to calibrate the newly coupled MCS-SB/AD scheme. WP2 will be conducted in collaboration with the developers of the MCS scheme, Dr. Florian Pantillon and Dr. Peter Knippertz, at KIT, which acts as the seconding institution.

WP3 – *Constraining the global dust cycle and its anthropogenic fraction*: The dust emission and dust load produced with the upgraded model will be further evaluated and constrained globally for a time period of 5 years using the extensive observational data and evaluation tools available at BSC. Global dust emission will be calibrated by bringing the modelled dust cycle into optimal agreement with a worldwide array of measurements: aerosol optical depth retrieved from satellite (MISR, MODIS) and ground-based remote sensing (AERONET); AERONET aerosol size-distributions; and measurements of near-surface dust concentration and deposition (e.g. IMPROVE network, AMMA International Program[24]). Using observations to constrain dust emission is necessary, because it is highly sensitive to wind speed, which depends on the model representation of regional features of

[20] Prigent et al. (2012), Atmos. Meas. Tech., 5, doi:10.5194/amt-5-2703-2012
[21] Klose and Shao (2012), *Atmos. Chem. Phys.*, 12, doi: 10.5194/acp-12-7309-2012
[22] Klose and Shao (2013), *Aeolian Research*, 8, doi: 10.1016/j.aeolia.2012.10.010
[23] Ginoux et al. (2001), *J. Geophys. Res.*, 106, 20,255-20,273, doi:10.1029/2000JD000053
[24] Marticorena et al. (2010), *Atmos. Chem. Phys.*, 10, 8899-8915, doi:10.5194/acp-10-8899-2010

the land-surface and hence on model resolution. Our optimization will follow *Cakmur et al.*[25] which provides an explicit and reproducible criterion to adjust for systematic model biases. We note that only the magnitude of the total global emission is adjusted and comparison of regional and seasonal variations between model and observations remains an independent assessment of the quality of the model. A key additional constraint for the calibration of our model will be the frequency of occurrence (FoO) that different thresholds of dust optical depth (taken from MODIS Deep Blue retrievals) are exceeded[2] (Fig. 1c). FoO is especially appropriate to constrain how often u_{*t} is exceeded under strong wind conditions, in particular for semi-arid regions and cultivated sources. FoO has already been used to calibrate a key empirical parameter of the drag partition scheme in MONARCH. In DUST.ES we will repeat this procedure. The model-observation agreement is expected to substantially improve after the model upgrade and this recalibration.

WP4 – *Quantification of budgets and attribution:* Using the constrained model version derived in WP3, a long-term (~10 years) global simulation will be conducted. MONARCH contains tracers for source type. Together with the newly included tracers for SB/AD, AE, and MCS dust, this will allow to attribute the simulated dust to source (anthropogenic vs natural), mechanism (AE vs SB/AD), and atmospheric process (contribution of MCS). The global dust budget (emission, transport, and deposition) will be computed from the simulations, and its temporal evolution will be analysed for (I) the relative significance of AE and SB/AD; (II) the contribution of MCS, and (III) the relative contribution of natural and anthropogenic sources to global dust emissions. Additionally, the spatial variability of the results will be investigated by focusing on particular regions, such as North Africa and Europe, Australia, Asia, or the US.

1.1.4 Originality and innovative aspects of the research program

All three components of DUST.ES, (1) the assessment of the significance of AE, (2) the representation of haboobs, and (3) the refined attribution of soil dust emissions to natural and anthropogenic sources, all on global scale, are highly novel and have the potential to stimulate further advances in aeolian and climate research. A few examples are given below:

(1) Dust affects climate through interaction with radiation and clouds, and by interacting with the carbon cycle. Particularly monsoon systems, on which millions of people rely for seasonal precipitation, are sensitive to changes in the amount of dust aerosol that is partly controlled by MCS. Also, the capability to model AE and SB/AD allows to investigate the different effects of persistent weak dust events (i.e. AE) and sporadic strong dust events (SB/AD) on climate and ecosystems.

(2) The inclusion of MCS in an operational model such as MONARCH has the potential to significantly improve short- and medium-range dust forecasting when dust storms are the strongest and have the biggest impact on society, especially close to cities. These improved prediction capabilities will create societal and economic benefits in different sectors, e.g. health, agriculture, solar energy production, road traffic, and aviation. Indeed, BSC hosts the WMO SDS-WAS Regional Center for Northern Africa, Middle East and Europe (Section 1.3.2). This will ensure that the innovations of this MSCA can immediately have a sizeable benefit for diverse areas of the public and private sectors.

(3) Calculations of radiative forcing since the pre-industrial era include the effect of anthropogenic aerosols except for the contribution of dust aerosol. Constraining the present-day contribution of anthropogenic dust sources is a cornerstone to the longer-term goals of quantifying their effects under present climate, and understanding their potential future variations and effects.

1.2 Quality and appropriateness of the training and of the two-way transfer of knowledge between the researcher and the host

This action will require developing and using the MONARCH model, and running computationally demanding simulations. Therefore, a detailed understanding of MONARCH and the skills to effectively make use of BSC's supercomputing facilities are fundamental for the success of the proposed research. I will therefore be trained with a priority on

(a) The MONARCH model, its structure, and usage by Dr. Pérez García-Pando: Training will focus on the dust modules and physics package, needed to implement the AE and MCS schemes (WP1, WP2). I have detailed

[25] Cakmur et al. (2006), J. Geophys. Res. Atmos., 111, D6, doi:10.1029/2005JD005791

knowledge about WRF-Chem, a related and similarly structured atmospheric modelling system, and have contributed source code to the official releases WRF-Chem V3.6 (2014) and V3.8 (2016). I should therefore become acquainted with MONARCH quickly.

(b) The MareNostrum 4 supercomputer by the Computational Earth Sciences Group at BSC: The proposed model simulations are only feasible in a high-performance computing (HPC) environment such as BSC's MareNostrum 4. I will be trained on MareNostrum's file and batch system, and available software and tools. I have utilized another HPC system during my PhD studies and will thus be able to acquire the necessary practice using MareNostrum in a short time.

In addition to the practical training on the model and its application, I will be trained on

(c) The representation of global dust sources developed by Dr. Pérez García-Pando (WP4).
(d) The MCS scheme during a secondment at KIT by Dr. Knippertz (WP2).
(e) The dust model evaluation tools available at BSC by BSC's Atmospheric Composition Group: It will advance model evaluation (WP3) in terms of speed and quality, because model results can be compared with a large and diverse observational data basis using comparatively little time and effort.
(f) General scientific tools and methods by BSC's Education and Training Unit during regular department-wide seminars.
(g) The Spanish language through language courses offered at BSC.

I have been involved in dust research since I worked as a student assistant in 2007. My research interests include aeolian processes on all scales, their frequency, and impacts on Earth and other planets. My major research focus is to understand the physics of dust emission and to advance its parameterization in numerical models. I pioneered the development of a stochastic dust emission scheme for AE by dry convective turbulence using theory and large-eddy simulation. I also conducted regional-scale simulations of dust events. I developed a new method to estimate the contribution of dust devils to the regional and global dust budget, which is – for the first time – based on a dust devil population. During a two-year postdoctoral research fellowship, I gained first-hand experiences in the field measurement of aeolian processes and their drivers as well as practical knowledge about the laboratory processing of sediment samples. I also developed a new tool to collect physical samples of the loose erodible material present on a soil surface that is available for entrainment by wind.

By conducting the MSCA-IF at BSC, I will extend my dust modelling expertise from the process and event scales to global scales and will obtain insight into state-of-the-art modelling practices. I will learn more about the model representation of dust sources and moist convection, in-depth model evaluation techniques along with data used for evaluation, especially remote-sensing data, other aerosol types and their numerical modelling, and the implementation, execution, and maintenance of operational models. This MSCA-IF will decidedly contribute to and benefit from the AXA Chair program on Sand and Dust Storms (SDS), recently awarded to Dr. Pérez García-Pando. This 15-year program aims to improve our understanding of SDS and their variability; quantify dust effects upon weather, climate, atmospheric chemistry, and ocean biogeochemistry; develop and distribute skillful SDS short- and medium-range forecasts and long-range dust predictions/projections; assess SDS impacts upon key sectors of society and economy; and promote capacity building, technology transfer, dissemination, and public engagement.

While I have a strong background in the theory and parameterization of dust emission processes, and have gained experience in the field measurement and monitoring of dust and related quantities, BSC has particularly strong capacities in the application of (dust) aerosol models and the study of aerosol environmental effects. I will learn from BSC's broad dust and aerosol modelling expertise and in turn contribute to improved dust modelling and forecasting capabilities, of which both BSC and the WMO SDS-WAS Regional Center (see Section 1.3.2) will benefit. Aside of the two-way transfer of skills, I will augment BSC's research network through my professional contacts and in turn benefit from BSC's extensive network of collaborations.

1.3 Quality of the supervision and of the integration in the team/institution

Dr. Carlos Pérez García-Pando is Ramón y Cajal Researcher, AXA Professor on Sand and Dust Storms, and leader of the Atmospheric Composition group at BSC. His research focuses on understanding the physical and chemical processes controlling atmospheric aerosols, and evaluating their effects upon climate, ocean biogeochemistry, air quality, and health. His core area of expertise is atmospheric mineral dust. He is also a model developer with a large experience in HPC and operational forecasting. Between 2009 and 2016 he worked at the NASA Goddard Institute for Space Studies and Columbia University, where he served as PI and co-PI in competitive research

projects funded by the U.S. Department of Energy, NASA and NOAA, with collaborators at NOAA/National Centers for Environmental Prediction, NOAA/Geophysical Fluid Dynamics Laboratory, Princeton University and Cornell University. Aside of his significant research achievements related to dust-radiation interactions, dust-mineralogy, and dust effects on health, he led an international multi-institutional initiative to develop a unique unified (regional and global) prediction model for weather, atmospheric aerosols, and chemistry that today provides operational forecasts widely used by the international scientific community, weather services, companies, and air quality managers. He also played a seminal role in the design, creation, and successful implementation of the WMO SDS-WAS Regional Center in Spain (see Section 1.3.2), the only operational dust forecasting service in the region fully recognized by WMO.

Dr. Pérez García-Pando's work resulted in 50 peer-reviewed papers (67% in Q1, h-Index: 28, i10-Index: 46, citations: 3186, source: Google Scholar), 20 chapters in books/proceedings/reports, 150 contributions to conferences/workshops/seminars (26 as invited speaker) and the edition of a book of proceedings. He organized an international conference and a workshop on SDS. He participated in 27 international (US and EU) and national projects (in 6 of them as PD, PI or co-PI). He co-advised 3 PhD students, 3 Master students, and 1 Postdoc. His work was highlighted among others by NASA and the European Centre for Medium-Range Weather Forecasts (ECMWF), and covered by international media such as The Guardian. Dr. Pérez García-Pando was recently awarded with an AXA Chair to support an ambitious mineral dust research program at BSC (see Section 1.2).

1.3.2 Hosting arrangements

During the fellowship, I will be integrated in the Earth Sciences Department at BSC (BSC-ES), led by Dr. Francisco Doblas-Reyes, and in particular in the AXA Chair program led by Dr. Pérez García-Pando. BSC-ES is organized around four closely interacting groups (*Atmospheric Composition (AC), Climate Prediction, Computational Earth Sciences, and Earth System Services*) comprising ~60 employees, including scientific, technical, and support staff. The excellence of the department is illustrated by its high publication rate with more than 150 papers – several of very high impact – in the past 5 years, the participation and/or coordination of EU-FP7, H2020, and national projects (e.g. IS-ENES2, QWeCi, SPECS, PREFACE, EUCLEIA, S2S4E, InDust COST Action, DustClim) and the close collaboration with the industrial sector. The AXA Chair on SDS is transversal within BSC-ES. Hence, I will benefit not only from scientific exchange within the AC group, but also from synergies with the other groups. BSC-ES also hosts (together with the Spanish Weather Service, AEMET) the WMO SDS-WAS Regional Center (sds-was.aemet.es; dust.aemet.es), which coordinates research and operational communities to enhance the ability of countries to deliver timely and quality SDS forecasts, observations, information, and knowledge to users. The center was launched in 2007 following concerns on SDS raised by WMO member states to enhance their capacities for SDS warning advisory and assessment.

BSC-ES maintains a near real-time online documentation with detailed information on past and ongoing projects, publications, meetings, codes, etc. This will guarantee the instant exchange of information about activities within the department, including the MSCA, and will maximize opportunities for collaboration. Group meetings are held approximately weekly by the AC group, two-weekly by the AXA Chair, and monthly by the department. Seminars within the AC group and department-wide additionally foster interaction and scientific exchange within and between the groups. Furthermore, BSC is committed to the principles of the *European Charter for Researchers* and *The Code of Conduct for the Recruitment of Researchers*, and has been awarded the *Human Resources Excellence in Research* logo in 2015, proofing it a favourable working environment.

As demonstrated by the long list of past and ongoing projects, BSC-ES, Dr. Pérez García-Pando, and the WMO SDS-WAS Regional Center at BSC have a large active network of collaborations with over 50 institutions worldwide. The groups also work closely with several private companies, especially in the fields of agriculture, transportation, and energy, that access the operational air quality and dust products made available online. By working with Dr. Pérez García-Pando at BSC-ES, I will benefit from existing networks and will have the possibility to contribute to and participate in future projects.

1.4 Capacity of the researcher to reach or re-enforce a position of professional maturity/independence

Only 3 years after obtaining my doctoral degree, I have several years of experience in dust research, which resulted in 18 publications in peer-reviewed international journals between 2010 and 2017 (7 as the lead author; 4 reprinted as book chapters; citations: 245, h-Index: 8, i10-Index: 7; source: Google Scholar), the participation in 16 international and 2 national conferences/workshops, the organisation of 1 international workshop, and several

invited visits/presentations at renowned research institutions around the world. I contributed as a collaborator to multi-institutional and multi-disciplinary projects and I was granted as a co-PI a competitive research project funded by the U.S. Department of Defense. I am a lead author in a recent volume reviewing current knowledge about dust devils and identifying knowledge gaps. I am an invited session convener and scientific committee member for the upcoming 10th International Conference on Aeolian Research, a major international conference in the field of dust research. During my time as research associate at the University of Cologne, I was also in charge of administering research projects and have acquired the corresponding management skills.

Building upon my previous expertise, the new competences I will gain through the MSCA-IF at BSC (see Sections 1.2 and 2.1), would set me up in Earth-system research on all spatio-temporal scales with a focus on, but not limited to, dust and would place me in an optimal position to attract and compete for funding worldwide. I would greatly benefit from being embedded in Dr. Pérez García-Pando's AXA Chair program and its networks and projects within Spain, Europe, and outside of Europe, and could learn from the AXA Chair and BSC about project management and science communication and dissemination, not only in the scientific community, but also to stakeholders and the general public. BSC's important role in the WMO SDS-WAS Regional Centers raises the prospect of any model improvements developed within the MSCA to be used in future operational forecasting; it will give me the opportunity to network with WMO and partners, and potentially initiate future collaborations. In agreement with the *European Charter for Researchers*, a Career Development Plan (CDP) will be prepared together with the MSCA supervisor at the start of the fellowship to support implementation of the project and to maximize its career impact.

2. Impact

2.1 Enhancing the potential and future career prospects of the researcher

Through the proposed MSCA-IF, I will gain and/or improve competences in HPC, model development, global modelling, model evaluation, remote sensing data, project management, and science dissemination addressed to different audiences. I will learn new research approaches both at BSC and KIT. I will widen the scope of my research and gain a more comprehensive picture of the role of dust aerosol in the Earth system, which will link my research to other research disciplines. I will have the opportunity to co-advice PhD students and contribute to international and interdisciplinary project proposals – both valuable experiences for my future career. To prepare for the MSCA-IF, I have already started to learn the Spanish language and will continue to improve my language skills through courses offered at BSC. This will facilitate outreach to the local public during the MSCA and further advance my general communication skills.

The combination of BSC being a first-class research institute with international networks, providing operational weather forecasting services, hosting a WMO SDS-WAS Regional Center, and fostering collaborations in the industrial sector, allows for the spreading of any research achievements to a wider-than-normal audience. The secondment at KIT will even enhance international networking and science dissemination. Altogether, this will promote my research in a unique and most efficient way, providing me with the best possibilities to pursue a career in academia, while at the same time opening up new opportunities for collaborations in the public and private sectors, including weather services. After completion of the MSCA-IF, I will have gained the necessary scientific, administrative, and soft skills for professional maturity. I plan to apply for an ERC starting grant subsequent to the MSCA-IF to establish my own independent research group.

2.2 Quality of the proposed measures to exploit and disseminate the action results

The MSCA will be integrated within the AXA Chair program on SDS. Dissemination actions taken by the AXA Chair program are targeted to four major audiences interested in SDS research outcomes: (1) the scientific community, (2) national weather services, (3) the industrial sector and policy-makers, and (4) the general public. The MSCA will take advantage of and contribute to dissemination strategies installed within the AXA Chair program, the WMO SDS-WAS Regional Centers, and the BSC. This will maximize the visibility of DUST.ES and exploitation of the project outcomes. Exploitation will be supported by BSC's Technology Transfer Manger (Section 3.3.1).

(1) Research results will be published in at least two scientific papers and presented at international conferences, such as EGU, AGU, or ICAR, to foster discussion with experts in the field. Publications will be *open-access*[26] to maximize the impact of DUST.ES. In the context of the AXA Chair impact research, DUST.ES outcomes will also be communicated to and discussed with researchers in other disciplines on which dust has an impact, e.g. health scientists. This will promote MSCA research outcomes in the scientific community. The MSCA-IF will also contribute to a scientific conference on SDS planned to be held in Barcelona in the framework of the AXA Chair program.

(2) Training courses and seminars organized for operational meteorologists by the WMO SDS-WAS Regional Center at BSC and its operational dust forecast will be used as platforms to promote MSCA achievements to national weather services, thus potentially impacting on governments and policy-makers.

(3) Improved dust predictions, which will be one of the outcomes of the proposed MSCA, can directly inform decision-makers in the industrial sector, e.g. for land-management and solar energy production, as well as policy-makers in the EU and worldwide. The "sustainable management of natural resources" and "decarbonising the energy system" through, e.g., solar power, are key *Societal Challenges* in the Horizon 2020 Work Program 2016-2017[27] upon which mineral dust emissions have an effect. For example, the removal of nutrient-rich top-soil from agricultural fields can lead to land degradation and the deposition of dust aerosol on solar panels may result in reduced solar energy output. The MSCA will make use of communication channels installed by the AXA Chair, such as biannual technical reports, to engage the interest of industry and policy-makers in using products resulting from the MSCA, i.e. weather forecasts and reanalyses produced using the further developed MONARCH.

(4) See Section 2.3.

2.3 Quality of the proposed measures to communicate the action activities to different target audiences

In addition to dissemination/exploitation of the MSCA to the scientific community, national weather services, and the industrial sector (Section 2.2), another aim is to inform the general public about dust and its impacts in the context of the MSCA[28]. In addition to the transfer of knowledge, this will increase awareness of the public about research and innovation funded by and conducted within the EU. A focus will be on providing information about dust phenomena, their causes, direct impacts on human daily life, and indirect impacts on climate and environment. A direct way of communicating achievements of the MSCA is to promote the operational forecast performed at BSC (dust.aemet.es), which will utilize model improvements developed within the MSCA in the future. Dust forecasting will be explained and illustrated in a way understandable for non-specialists, and will be compiled in short communications. Platforms for these communications are Twitter (@Dust_Barcelona, @BSC_CNS), science-related blogs, the BSC webpage, newsletters, or magazines such as the EU Research and Innovation magazine HORIZON. Participation in MareNostrum Open Days organized annually by BSC will inform the local public (up to ~6K visitors per year) about the MSCA contents and outcomes. The MSCA will be supported by BSC's Communications Team (Section 3.3.1) and again benefit from being an integral part of the AXA Chair at BSC and AXA dissemination actions and press releases, tailored at conveying scientific knowledge to the public.

3. Quality and Efficiency of the Implementation

3.1 Coherence and effectiveness of the work plan

DUST.ES is composed of one work package (WP) for management, dissemination, and outreach (WP0) and four scientific work packages (WPs 1-4, see Section 1.1.3). The tasks (T) to be completed within each WP and associated deliverables and milestones are described in the following table. The planned project schedule is illustrated in the subsequent Gantt Chart.

Tasks	Deliverables	Milestones
WP0 – *Management, dissemination, and outreach*		
T0.1 Project management	D1 Career Development Plan	M1 Project implemented

[26] Dissemination and Exploitation, H2020 Online Manual
[27] H2020 Work Program 2016-2017, Societal Challenges, Sections "*Climate Action, Environment, Resource Efficiency and Raw Materials*", "*Secure, Clean and Efficient Energy*", and "*Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy*"
[28] Communication, H2020 Online Manual

T0.2 Dissemination and communication of DUST.ES activities to different target audiences	D2 Scientific conference/workshop D3 Outreach activity (e.g. press release, short communication, participation in Open Day) D4 Final Report	M6 Project concluded
WP1 – *Implementation and evaluation of a novel aerodynamic dust entrainment scheme*		
T1.1 Familiarize with MONARCH T1.2 Couple AE scheme to MONARCH T1.3 Evaluate and calibrate coupled AE scheme	D5 Upgraded model version 1 D6 Calibration results – AE scheme	M2 AE scheme implemented and tested
WP2 – *Implementation and evaluation of a scheme for moist-convective dust storms*		
T2.1 Couple MCS scheme to MONARCH physics package and SB/AD schemes T2.2 Conduct high-resolution regional simulation for calibration T2.3 Calibrate MCS-dust scheme with regional simulations and observations	D7 Upgraded model version 2 D8 High-resolution regional simulation D9 Calibration results – MCS-dust scheme	M3 MCS scheme implemented and tested
WP3 – *Constraining the global dust cycle*		
T3.1 Conduct 5-year model run T3.2 Evaluate and constrain modelled global dust cycle	D10 Optimized global dust model D11 Journal article on WPs 1, 2, 3*	M4 Final model calibrated and evaluated
WP4 – *Quantification of budgets and attribution*		
T4.1 Long-term model run T4.2 Analyse relative significance of AE and SB/AD T4.3 Determine contribution of MCS to global dust emissions T4.4 Attribute dust emissions to source type	D12 10-year global simulation D13 Final report D14 Journal article on WP4*	M5 Natural and anthropogenic emissions quantified

* Within the two-year project, at least two first-author journal papers are projected. Research achievements for two additional publications before the end of the project and/or at a later stage are anticipated.

Gantt Chart

WP	Task	Months after project start																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
WP0		M1																							M6
T0.1		D1																							D4
T0.2						D3.1	D2.1				D3.2						D2.2			D3.3				D2.3	
WP1							M2																		
T1.1																									
T1.2				D5																					
T1.3							D6																		
WP2													M3												
T2.1										D7															
T2.2											D8														
T2.3													D9												
Secondment																									
WP3																			M4						
T3.1																									
T3.2																			D10 D11						
WP4																									M5
T4.1																					D12				
T4.2																									
T4.3																									
T4.4																									D13 D14

3.2 Appropriateness of the allocation of tasks and resources

A time period of 6 months each is planned for WPs 1 to 4 (see Gantt Chart). This period includes time to become familiar with MONARCH and the MCS parameterization in WPs 1 and 2, time for the coupling of the schemes to the model, and time for scheme calibration. Two visits (secondment) at KIT are planned within WP2: (1) at an early stage to be trained on the MCS scheme and discuss scheme coupling; and (2) at the final stage of WP2 to discuss the calibration results. In WP3, model evaluation and constraining of the predicted global dust emissions will be iterated until satisfying results are achieved. Additional time to conduct and evaluate a final model run as well as time for a detailed analysis of the model results are reserved for WP4. WP0 extends over the duration of the project and dissemination and communication actions to the different target audiences are distributed over the 2 years.

The in-depth knowledge of BSC scientists about MONARCH, the model evaluation tools, and the dust source parameterization, together with the expertise of KIT scientists regarding the MCS scheme, ensure training in sufficient detail as well as support throughout the duration of the project whenever needed. The HPC resources available at BSC guarantee that the proposed computationally intensive research can be conducted timely.

3.3 Appropriateness of the management structure and procedures, including risk management

3.3.1 Organization and management structure

The Project Management Office at BSC will support the MSCA-IF with regard to financial and administrative matters and will ensure that the MSCA grant agreement follows the EU Horizon 2020 contractual rules and the Spanish fiscal and social security laws. I will also have access to support by BSC's Technology Transfer Manager (orientation/help with science exploitation, development of contracts, agreements, and seeking new opportunities), Communications Team (support with outreach activities, organization of events and press releases), Legal assessment (BSC has an agreement with an external office that gives advice on legal issues), and Education and Training (BSC has a dedicated unit and is committed to provide researchers with high-quality training in scientific, technical, and other skills). Work progress will be reviewed by Dr. Pérez García-Pando in bi-weekly meetings, using the MSCA work plan and the CDP as a reference. In the case of any delays, he will increase assistance as required. Work progress in WP2 will also be discussed with Dr. Knippertz both during and between visits at KIT.

3.3.2 Research and/or administrative risks

The following table lists potential risks that could occur in DUST.ES. Also given are the anticipated risk levels and reasoning as well as corresponding contingency plans.

Risk	**Risk level, reasoning, contingency plan**
1. Mismanagement	*Low* – Project management is supported by BSC project managers.
2. AE scheme cannot be coupled with MONARCH.	*Low* – I have previously coupled the scheme to WRF-Chem, a similar atmospheric modelling system, for preliminary tests. Also, as the developers, I am very familiar with the AE scheme, BSC staff with MONARCH, and Dr. Pérez García-Pando with the dust module.
3. MCS scheme cannot be coupled with MONARCH.	*Low* – Preliminary tests suggest that the MCS scheme can be coupled to the default MONARCH convective adjustment scheme. If coupling fails anyhow, MONARCH will be run using a mass flux convection scheme, which is also available. The scheme and model developers from KIT and BSC will provide support.
4. Model calibration for AE is complicated, as classical observations do not allow for a differentiation of AE and SB/AD.	*High* – The differentiation between AE and SB/AD is the subject of ongoing research and an as-yet unsolved problem. Contingency plan: Combination of meteorological criteria and information from different dust data sets, e.g. space-based remote sensing and in-situ measurements, will isolate the processes as much as possible.
5. Dust emissions cannot be attributed to source type.	*Low* – Source maps are available; If problems with AE and MCS modelling arise and persist, then results using an SB/AD scheme only will be used.

3.4 Appropriateness of the institutional environment (infrastructure)

Aside of its excellence in research and (inter)national reputation (Section 1.3.2), BSC hosts unique HPC facilities (MareNostrum 4 – 13th fastest supercomputer worldwide and 3rd fastest in Europe in June 2017; MinoTauro – traditional CPU cores combined with GPU accelerators) and technical support (Computational Earth Sciences group – technicians providing advice on HPC facilities). The combination of outstanding HPC facilities and high-quality user support constitutes an excellent infrastructural basis (see also Section 5). I will get access to all key research facilities, infrastructure, and equipment. I will get office space and supplies within BSC-ES, Edificio Nexus II, Jordi Girona Street 29, Barcelona. BSC staff will provide training as outlined in Section 1.2 and support project management and outreach (Section 3.3).

During the secondment at KIT, I will be hosted by the Institute of Meteorology and Climate Research – Troposphere Research Division (IMK-TRO). IMK-TRO has long been active in model development and application, in particular mesoscale chemistry-transport modelling and weather forecasting in collaboration with the German weather service (DWD). IMK-TRO also conducts observational research and created a unique measurement system (KITcube). KIT has own HPC facilities (Steinbuch Centre for Computing), which will be made available if needed. KIT will provide training and support as described in Section 1.2 and I will have access to office-space and all necessary facilities.

In summary, BSC and KIT possess all resources and qualifications needed for a most efficient implementation of the MSCA, both in terms of infrastructure as well as personnel, and will fully support the proposed MSCA.

4. CV of the Experienced Researcher

Personal data

Name:	Dr. Martina R. Klose
Birthday and -place:	15 October 1984, Schlüchtern, Germany
Contact:	email: martina.klose@gmail.com phone: +49 163 4707622
Web:	http://orcid.org/0000-0001-8190-3700 https://scholar.google.com/citations?user=3DJgPE0AAAAJ&hl=en&oi=ao https://www.researchgate.net/profile/Martina_Klose2

Education

01/2011 – 10/2014	Doctoral studies, Dr. rer. nat. (October 2014), University of Cologne, Germany Title: "Convective Turbulent Dust Emission: Process, parameterization, and relevance in the Earth system" Grade of dissertation: 0.3 (very good) Grade of oral examination: 0.0 (with distinction)
10/2004 – 11/2010	Diploma (Master equivalent) with distinction, Meteorology, University of Cologne, Cologne, Germany Thesis (1-year project): "Development and Implementation of a Dust Emission Scheme for Convective Atmospheric Conditions"

Work experience

From 11/2017	Beatriu de Pinós Postdoctoral Research Fellow, Barcelona Supercomputing Center, Barcelona, Spain
09/2015 – 08/2017	DFG (German Research Foundation) Postdoctoral Research Fellow, USDA-ARS Jornada Experimental Range, Las Cruces, NM, USA
01/2011 – 08/2015	Research associate, Institute for Geophysics and Meteorology, University of Cologne, Cologne, Germany
04/2007 – 12/2010	Student assistant, Institute for Geophysics and Meteorology, University of Cologne, Cologne, Germany
10/2005 – 04/2007	Student assistant, Evaluation of teaching, Faculty of Mathematics and Natural Sciences, University of Cologne, Cologne, Germany

Teaching experience

Tutorials	Numerical simulation of the atmosphere (Bachelor course), Theory and practical training Mathematical methods (Bachelor course) Atmospheric modeling (Master course)
Other	Co-supervision of 6 student assistants, 2 Master and 3 Bachelor theses

Prizes and Awards

2017	Beatriu de Pinós Postdoctoral Research Fellowship
2016	DAAD (German Academic Exchange Service) travel grant to participate in the 9th International Conference on Aeolian Research
2015	DFG Postdoctoral Research Fellowship
2014	1st prize ISAR Photo and Video Contest, International Society for Aeolian Research (ISAR); Category: Dust processes

Involvement in projects

Co-PI	U.S. Army Engineer Research and Development Center – Basic Research "Resolving the size distribution of mineral dust aerosols", 2017
Collaborator	DFG Collaborative Research Centre 1211 "Earth-Evolution at the Dry Limit" (www.sfb1211.de), 2016-2020
Collaborator	DFG Collaborative Research Centre 806 "Our way to Europe" (www.sfb806.de), Phase 2, Subproject E6, 2013-2017
Collaborator	DFG project "Development of a dust-iron modeling system and a benchmarking regional dust-iron budget study", 2013-2016

Miscellaneous

2018	Invited convener of session "Dust dynamics and processes: emission, dispersal, and deposition" and scientific committee member, 10th International Conference on Aeolian Research, Bordeaux, France (to be held in June 2018)
2018	Co-convenor of session "Aeolian processes and landforms" at the European Geosciences Union General Assembly, Vienna, Austria (to be held in April 2018)
2016	Convener of session "Modeling Aeolian Transport", 9th International Conference on Aeolian Research, Mildura, Australia
2015 – 2017	Invited visits/presentations at - Oxford University, Oxford, UK (2015) - NASA Goddard Institute for Space Studies, New York, NY, USA (2016) - King Abdullah University of Science & Technology, Thuwal, Saudi Arabia (2016) - Karlsruhe Institute of Technology, Karlsruhe, Germany (2017) - Barcelona Supercomputing Center, Barcelona, Spain (2017) - University of Cologne, Cologne, Germany (2017) - Desert Research Institute, Las Vegas, NV, USA (2017)
2014 – 2016	Contributions to official releases of the Weather Research and Forecasting Model with Chemistry (WRF-Chem) Versions 3.6 and 3.8 (wrf-model.org)
2015	Co-convener of session "Mineral dust aerosols: from small-scale insights to large-scale understanding", AGU Fall Meeting, San Francisco, CA, USA
2015	Invited participant in international workshop "Dust devils on Earth and Mars", International Space Science Institute (ISSI), Bern, Switzerland
2014	Organizer of international workshop "Paleoclimate modeling and aeolian dust as climate proxy", University of Cologne, Cologne, Germany

2011	1-week research stay at Griffith University, Brisbane, Australia
2010	2-week research stay at Seoul National University, Seoul, Korea, and 2-week research stay at Kyoto University, Kyoto, Japan

Peer-review activities

International Journals	Aeolian Research, Asia-Pacific Journal of Atmospheric Sciences, Atmospheric Chemistry and Physics, Atmospheric Measurement Techniques, Earth Surface Processes and Landforms, Geomorphology, Geophysical Research Letters, Icarus, IEEE Transactions on Geoscience and Remote Sensing, Journal of Advances in Modeling the Earth Systems, Journal of Geophysical Research – Atmospheres, Space Science Reviews, Tellus B
Funding organizations	U.S. National Science Foundation, U.S. Army Research Laboratory's Army Research Office

Professional Memberships

European Geosciences Union (EGU)
American Geophysical Union (AGU)
International Society for Aeolian Research (ISAR)

Publications

Articles in international peer-reviewed journals

[Journal Impact Factor (IF) in year of publication, source: Journal Citation Reports; Citations (#), source: Google Scholar (12 Sep 2017); Quartile]

18. Klose, M., T. E. Gill, N. Webb, J. Van Zee (2017), Field sampling of loose erodible material: A new system to sample the full particle-size spectrum, *Aeolian Res.*, doi:10.1016/j.aeolia.2017.08.003. *[IF: 2.30, 5-yr IF: 2.99; #0; Q1]*
17. Flaounas, E., V. Kotroni, K. Lagouvardos, M. Klose, C. Flamant, T. M. Giannaros (2017), Sensitivity of the WRF-Chem (V3.6.1) model to different dust emission parametrization: Assessment in the broader Mediterranean region, *Geosci. Model Dev.*, doi:10.5194/gmd-10-2925-2017. *[IF: 3.46, 5-yr IF: 5.07; #1; Q1]*
16. Neakrase, L. D. V., M. Klose, T. N. Titus (2017), Terrestrial subaqueous seafloor dunes: Possible analogs for Venus, *Aeolian Res.*, doi:10.1016/j.aeolia.2017.03.002. *[IF: 2.30, 5-yr IF:2.99; #1; Q1]*
15. *Neakrase, L. D. V., M. R. Balme, F. Esposito, T. Kelling, M. Klose, J. F. Kok, B. Marticorena, J. Merrison, M. Patel, G. Wurm (2016), Particle lifting processes in dust devils, *Space Sci. Rev.*, doi:10.1007/s11214-016-0296-6. *[IF: 7.50, 5-yr IF: 7.18; #8; Q1]*
14. *Spiga, A., E. Barth, Z. Gu, F. Hoffmann, J. Ito, B. Jemmett-Smith, M. Klose, S. Nishizawa, S. Raasch, S. Rafkin, T. Takemi, D. Tyler, W. Wei (2016), Large-Eddy Simulations of dust devils and convective vortices, *Space Sci. Rev.*, doi:10.1007/s11214-016-0284-x. *[IF: 7.50, 5-yr IF: 7.18; #3; Q1]*
13. Shao, Y., M. Klose (2016), A note on the stochastic nature of particle cohesive force and implications on threshold friction velocity for aerodynamic dust entrainment, *Aeolian Res.*, 22, doi:10.1016/j.aeolia.2016.08.004. *[IF: 2.30, 5-yr IF:2.99; #7; Q1]*
12. *Klose, M., B. C. Jemmett-Smith, H. Kahanpää, M. Kahre, P. Knippertz, M. T. Lemmon, S. R. Lewis, R. D. Lorenz, L. D. V. Neakrase, C. Newman, M. R. Patel, D. Reiss, A. Spiga, P. L. Whelley (2016), Dust devil

sediment transport: From lab to field to global impact, *Space Sci. Rev.*, doi:10.1007/s11214-016-0261-4. *[IF: 7.50, 5-yr IF: 7.18; #6; Q1]*

11. Klose, M., Y. Shao (2016), A numerical study on dust devils with implications to global dust budget estimates, *Aeolian Res.*, 22, doi:10.1016/j.aeolia.2016.05.003. *[IF: 2.30, 5-yr IF: 2.99; #6; Q1]*
10. *Lorenz, R., M. R. Balme, Z. Gu, H. Kahanpää, M. Klose, M. V. Kurgansky, M. R. Patel, D. Reiss, A. Pio Rossi, A. Spiga, T. Takemi, W. Wei (2016), History and applications of dust devil studies, *Space Sci. Rev.*, doi: 10.1007/s11214-016-0239-2. *[IF: 7.50, 5-yr IF: 7.18; #9; Q1]*
9. Deetz, K., M. Klose, I. Kirchner, U. Cubasch (2016), Numerical simulation of a dust event in northeastern Germany with a new dust emission scheme in COSMO-ART, *Atmos. Environ.*, 126, 87-97, doi: 10.1016/j.atmosenv.2015.11.045. *[IF: 3.63, 5-yr IF:3.95; #2; Q1]*
8. Shao, Y., W. Nickling, G. Bergametti, H. Butler, A. Chappell, P. Findlater, J. Gillies, M. Ishizuka, M. Klose, J. F. Kok, J. Leys, H. Lu, B. Marticorena, G. McTainsh, C. McKenna-Neuman, G. S. Okin, C. Strong, N. Webb (2015), A tribute to Michael R. Raupach for contributions to aeolian fluid dynamics, *Aeolian Res.*, 19, 37-54, doi: 10.1016/j.aeolia.2015.09.004. *[IF: 2.28, 5-yr IF: 2.68; #3; Q1]*
7. Klose, M., Y. Shao, X. L. Li, H. S. Zhang, M. Ishizuka, M. Mikami, J. F. Leys (2014), Further development of a parameterization for convective turbulent dust emission and evaluation based on field observations, *J. Geophys. Res. Atmos., 119*, 10,441-10,457, doi:10.1002/2014JD021688. *[IF: 3.43, 5-yr IF: 3.67; #19; Q1]*
6. Li, X. L., M. Klose, Y. Shao, H. S. Zhang (2014), Convective turbulent dust emission (CTDE) observed over Horqin Sandy Land area and validation of a CTDE scheme, *J. Geophys. Res. Atmos., 119*, doi:10.1002/2014JD021572. *[IF: 3.43, 5-yr IF: 3.67; #11; Q1]*
5. Shao, Y., M. Klose**,** K.-H. Wyrwoll (2013), Recent global dust trend and connections to climate forcing, *J. Geophys. Res., 118*, doi:10.1002/jgrd.50836. *[IF: 3.44, 5-yr IF: 3.71; #22; Q1]*
4. Klose, M., Y. Shao (2013), Large-eddy simulation of turbulent dust emission, *Aeolian Res., 8*, 49-58, doi: 10.1016/j.aeolia.2012.10.010. *[IF: 2.84, 5-yr IF: 3.04; #32; Q1]*
3. Klose, M., Y. Shao (2012), Stochastic parameterization of dust emission and application to convective atmospheric conditions, *Atmos. Chem. Phys., 12*, 7309-7320, doi:10.5194/acp-12-7309-2012. *[IF: 5.51, 5-yr IF: 5.56; #40; Q1]*
2. Klose, M., Y. Shao, M. K. Karremann, A. H. Fink (2010), Sahel dust zone and synoptic background, *Geophys. Res. Lett., 37*, L09802, doi:10.1029/2010GL042816. *[IF: 3.51, 5-yr IF: 3.55; #40; Q1]*
1. Shao, Y., A. H. Fink, M. Klose (2010), Numerical simulation of a continental-scale Saharan dust event, *J. Geophys. Res., 115*, doi:10.1029/2009JD012678. *[IF: 3.30, 5-yr IF: 3.62; #31; Q1]*

**reprinted as chapters in book "Dust Devils", Space Science Series of ISSI, Eds. Reiss et al., Springer (see below)*

Book chapters

Lorenz, R., M. R. Balme, Z. Gu, H. Kahanpää, M. Klose, M. V. Kurgansky, M. R. Patel, D. Reiss, A. Pio Rossi, A. Spiga, T. Takemi, and W. Wei (2017), History and applications of dust devil studies, In: Dust Devils, *Space Science Series of ISSI*, Eds. Reiss et al., Springer, ISBN 978-94-024-1133-1.

Spiga, A., E. Barth, Z. Gu, F. Hoffmann, J. Ito, B. Jemmett-Smith, M. Klose, S. Nishizawa, S. Raasch, S. Rafkin, T. Takemi, D. Tyler, W. Wei (2016), Large-Eddy Simulations of dust devils and convective vortices, In: Dust Devils, *Space Science Series of ISSI*, Eds. Reiss et al., Springer, ISBN 978-94-024-1133-1.

Neakrase, L. D. V., M. R. Balme, F. Esposito, T. Kelling, M. Klose, J. F. Kok, B. Marticorena, J. Merrison, M. Patel, G. Wurm (2016), Particle lifting processes in dust devils, In: Dust Devils*, Space Science Series of ISSI*, Eds. Reiss et al., Springer, ISBN 978-94-024-1133-1.

Klose, M., B. C. Jemmett-Smith, H. Kahanpää, M. Kahre, P. Knippertz, M. T. Lemmon, S. R. Lewis, R. D. Lorenz, L. D. V. Neakrase, C. Newman, M. R. Patel, D. Reiss, A. Spiga, P. L. Whelley (2016), Dust devil sediment transport: From lab to field to global impact, In: Dust Devils, *Space Science Series of ISSI*, Eds. Reiss et al., Springer, ISBN 978-94-024-1133-1.

Presentations at international conferences (selection, 12 of 24)

Klose, M., N. Webb, T. E. Gill (2017), Can dust emission mechanisms be determined from field measurements?, European Geosciences Union General Assembly, Vienna, Austria (PICO presentation)

Klose, M., T. E. Gill, N. Webb (2017), Field sampling of loose erodible material: A new method to consider the full particle-size range, European Geosciences Union General Assembly, Vienna, Austria (poster presentation)

Klose, M, S. Peterson, N. Webb, J. Van Zee, B. Cooper, S. Van Pelt, T. E. Gill, G. Okin, J. Karl (2016), Disentangling dust emission mechanisms – a field study, American Geophysical Union Fall Meeting, San Francisco, USA (poster presentation)

Klose, M., Y. Shao (2016), A numerical study on dust devils with implications to global dust budget estimates, 9th International Conference on Aeolian Research, Mildura, Australia (oral presentation)

Klose, M., Y. Shao, H. Butler, J. Leys (2016), Saltation bombardment versus direct aerodynamic entrainment: A case study for Australia, 9th International Conference on Aeolian Research, Mildura, Australia (poster presentation)

Klose, M., Y. Shao (2015), Relevance of convective turbulent dust emission (CTDE) in the Earth system, European Geosciences Union General Assembly, Vienna, Austria (oral presentation)

Klose, M., Y. Shao, X. L. Li, H. S. Zhang, M. Ishizuka, M. Mikami, J. F. Leys, H. Butler (2014), Convective turbulent dust emission, 8th International Conference on Aeolian Research, Lanzhou, China, (oral presentation)

Klose, M., Y. Shao (2013), Turbulent dust emission modeling for ideal and real conditions, American Geophysical Union Fall Meeting, San Francisco, USA (oral presentation)

Klose, M., Y. Shao (2013), Large-eddy simulation of turbulent dust emission, European Geosciences Union General Assembly, Vienna, Austria (oral presentation)

Klose, M., Y. Shao (2011), Parameterization of dust emission for convective atmospheric conditions, EGU General Assembly, Vienna, Austria (oral presentation)

Klose, M., Y. Shao (2010), Dust emission scheme for convective atmospheric conditions, 7th International Conference on Aeolian Research, Santa Rosa, La Pampa, Argentina (oral presentation)

Klose, M., Y. Shao, A. H. Fink (2009), Numerical simulation of a Saharan dust storm event, 9th EMS/9th ECAM, Toulouse, France (poster presentation)

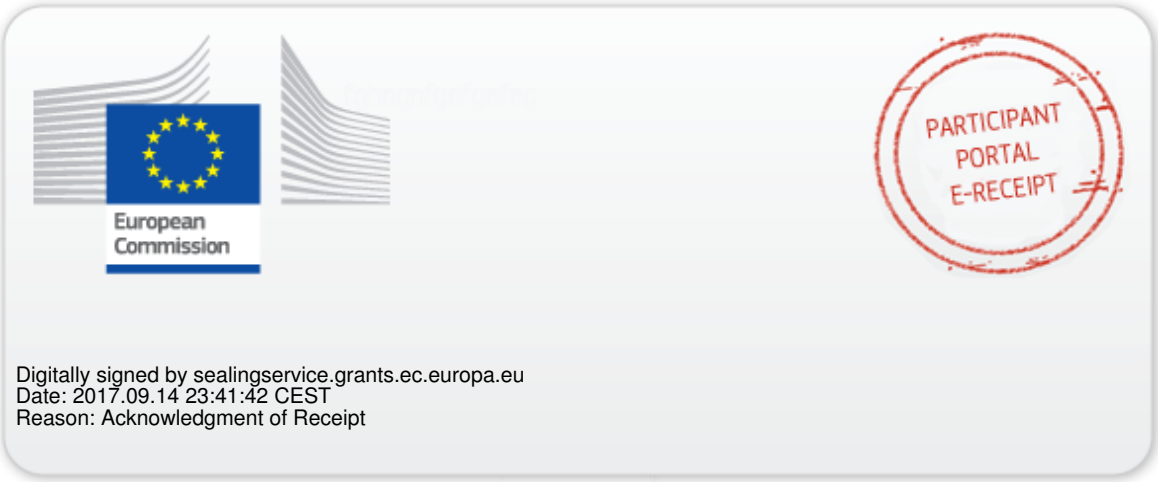
5. Capacity of the Participating Organisations

Beneficiary: BARCELONA SUPERCOMUTING CENTER - CENTRO NACIONAL DE SUPERCOMUTACIÓN	
General Description	Established in 2005, the Barcelona Supercomputing Center (BSC) serves as the national supercomputing facility in Spain. BSC hosts 1 of the 6 European Tier-0 supercomputers and is among the best supercomputing centres in the world. BSC strives to be a first-class research centre in scientific fields that require high-performance computing (HPC) such as Life Sciences, Earth Sciences, and Engineering. BSC has brought together a critical mass of first-rate researchers, HPC experts and cutting-edge HPC technologies to foster multidisciplinary scientific collaborations and innovations. Between 2013 and 2017, BSC has recruited 86 pre-doctoral students, 111 Postdocs and Senior Scientists, 132 technical support and 47 management staff members, 255 from Spain, 71 from within and 50 from outside Europe. BSC counts more than 470 staff members from ~40 countries. Recruitment is based on principles of merit, transparency, competition, and gender balance, and the centre was awarded with the badge of Human Resources Excellence in Research (HRS4R) in 2015. The applicant will be enrolled at the BSC Earth Sciences Department (BSC-ES).
Role and Profile of key persons (supervisor)	Dr. Carlos Pérez García-Pando (supervisor) is Ramón y Cajal Researcher, AXA Professor on Sand and Dust Storms, and leader of the Atmospheric Composition group at BSC-ES. He is a leading expert in dust and more generally aerosol research and has vast experience in the development of Earth-system models.
Key Research Facilities, Infrastructure and Equipment	BSC hosts and manages a range of HPC systems, including MareNostrum 4, with 148,176 cores and 13.7 Pflops capacity. Additionally, BSC manages Minotauro, a Sandy Bridge's cluster with NVIDIA GPUs, providing more than 100 TFlops.
Independent research premises?	Yes. All key research facilities, infrastructure, and equipment will be available for the fellow.
Previous Involvement in Research and Training Programmes	Between 2005 and 2017, BSC has been involved in more than 150 completed projects (i.a. 41 individual grants/fellowships/personnel support; 9 EU-FP6; 51 EU-FP7; 13 other EU funding, e.g. ESA, Copernicus; and many national projects), for example: (1) Marie Curie ITN (SCALUS: FP7-PEOPLE-ITN-2008-238808); (2) Marie Curie IEF (MDRAF: FP7-PEOPLE-2013-IEF-622662); (3) APPRAISAL – Integrated assessment for regional and local air quality policies; (4) FIELD_AC – Fluxes, interactions and environment at the land-ocean boundary. Downscaling, assimilation and coupling; (5) Mont-Blanc – European Approach towards energy efficient high performance.
Current involvement in Research and Training Programmes	Collaborations with universities: BSC closely collaborates with Universidad Politècnica de Catalunya (UPC) including a joint Master degree in Environmental Engineering. Excellence Programs and Networks: Severo Ochoa Excellence Programme (Research seminars series); RES training sessions; NVIDIA CUDA/GPU excellence center (PUMPS summer school); PRACE Advanced Training Center; HiPEAC (ACACES summer school, Computing system weeks and HiPEAC conferences) and H2020-EINFRA-Centers of Excellence for computing applications. Research Fellowships: BSC is currently awarded with 6 early-stage postdocs (4 Juan de la Cierva and 2 Beatriu de Pinós), 12 seniors (5 Ramón y Cajal, 3 I3 and 6 ICREA) and is supporting 4 MSCA-ITN and 5 MSCA-IF. Noteworthy, three of these MSCA-IF are currently conducted at BSC-ES (NeTNPPAO, ACRoNNim, SPFireSD), which will host the proposal on hand. BSC is also the main beneficiary of a MSCA COFUND program for postdoc fellows, which foresees the implementation of a training programme (STARS; H2020-MSCA-COFUND-754433). Projects: 111 ongoing projects are funded by the European Commission (FP7, H2020, Copernicus, COST Action), e.g. Euroserver, DEEP, PRIMAVERA; EUDAT, PRACE 3IP; 37 at BSC-ES (4 EU-FP7, 21 EU-H2020, 12 EU-Other), and 8 national projects.
Relevant Publications and/or research/innovation products	(1) *NMMB/BSC-Dust forecasts:* http://dust.aemet.es; (2) *Pérez et al. (2011)*, Atmospheric dust modeling from meso to global scales with the online NMMB/ BSC-Dust model – Part 1: Model description, annual simulations and evaluations, *Atmos. Chem. Phys.*, 11, 13001-13027; (3) *Pérez García-Pando et al. (2014)*, Soil dust aerosols and wind as predictors of seasonal meningitis incidence in Niger, *Environ. Health Perspect.*, 122 (7), 679-686; (4) *Perlwitz et al. (2015)*, Predicting the mineral composition of dust aerosols – Part 1: Representing key processes, *Atmos. Chem. Phys.*, 15, 11593-11627; (5) *Pérez García-Pando et al. (2016)*, Predicting the mineral composition of dust aerosols: Insights from elemental composition measured at the Izaña Observatory, *Geophys. Res. Lett.*, 43, 10520-10529.

Partner Organisation: KARLSRUHE INSTITUTE OF TECHNOLOGY	
General description	The Karlsruhe Institute of Technology (KIT) was established in 2009 by the merger of the University of Karlsruhe, founded in 1825, and the Karlsruhe Research Centre, founded in 1956. With more than 9,000 employees and an annual budget of about 785 million EUR, KIT is one of the biggest research and education institutions worldwide. Within KIT, the Institute of Meteorology and Climate Research – Troposphere Research Division (IMK-TRO) has long-standing experience in the development and application of numerical models in the fields of mesoscale chemistry-transport modelling and numerical weather forecasting. IMK-TRO is also strongly involved in national and international observational research, for example through the newly developed KITcube facility, which comprises a large suite of ground-based in situ and remote sensing instruments.
Key Persons and Expertise (supervisor)	Prof. Dr. Peter Knippertz (secondment supervisor) is a full professor of meteorology and leader of the group for atmospheric dynamics at IMK-TRO. He is a recognized authority in mineral dust research as well as an expert of the meteorology and climate of northern Africa. Dr. Florian Pantillon is a post-doctoral researcher at IMK-TRO. He has expertise in the representation of convective processes in numerical weather models.
Key Research facilities, infrastructure and equipment	KIT hosts the Steinbuch Centre for Computing (SCC), which operates several facilities for high-performance computing including the 216 TFlop ForHLR I supercomputer. Meteorological researchers are major users of the facility, and the director of IMK-TRO, Prof. Dr. Christoph Kottmeier is a member of the Steering Committee for the SCC. In addition, the group led by Dr. Bernhard Vogel at IMK-TRO is the main developer of the aerosol and atmospheric chemistry module ART (aerosols and reactive trace gases) for the numerical weather prediction models COSMO and ICON, which are used operationally by the German weather service (Deutscher Wetterdienst).
Previous and Current Involvement in Research and Training Programmes	IMK-TRO is strongly involved in the Bachelor and Master degrees in Meteorology within the faculty of physics at KIT. IMK-TRO furthermore leads the newly founded KIT Climate and Environment Centre. Researchers at IMK-TRO have been and are currently involved in numerous national and international research programmes. In particular, Prof. Dr. Knippertz has led the ERC project *Desert Storms* from 2010 to 2015 and since 2013 leads the EU-FP7 project *DACCIWA (Dynamics-Aerosol-Chemistry-Cloud Interactions in West Africa)*. Dr. Pantillon was awarded a *Severo Ochoa mobility grant* for visiting researchers at BSC in 2015.
Relevant Publications and/or research/innovation product	(1) *Knippertz, P. and J.-B. Stuut* (Eds.) (2014), Mineral Dust – A Key Player in the Earth System, *Springer*; (2) *Pantillon et al.* (2015), A parameterization of convective dust storms for models with mass-flux convection schemes. *J. Atmos. Sci.*, 72, 2545-2561; (3) *Pantillon et al.* (2016), Modeling Haboob Dust Storms in Large-Scale Weather and Climate Models, *J. Geophys. Res. Atmos.*, 121, 2090-2109.

6. Ethical Issues

No ethical issues are expected.



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