Horizon 2020

Call: H2020-MSCA-IF-2016

(Marie Skłodowska-Curie Individual Fellowships)

Topic: MSCA-IF-2016

Type of action: MSCA-IF-EF-ST

(Standard EF)

Proposal number: 740347

Proposal acronym: DUST.ES

Deadline Id: H2020-MSCA-IF-2016

Table of contents

Section	*Title*	*Action*
1	General information	
2	Participants & contacts	
3	Budget	
4	Ethics	
5	Call-specific questions	

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 **740347** *Acronym* **DUST.ES**

1 - General information

Topic	MSCA-IF-2016
Call Identifier	H2020-MSCA-IF-2016
Type of Action	MSCA-IF-EF-ST
Deadline Id	H2020-MSCA-IF-2016

Acronym: DUST.ES

Proposal title: Constraining present-day DUST Emissions from natural and anthropogenic Sources

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*

Descriptor 2: *Meteorology, atmospheric physics and dynamics*

Descriptor 3: *Scientific computing and data processing* Remove

Add

Free keywords: *dust emission, haboobs, dust sources, dust modeling, global modeling*

Proposal ID **740347** *Acronym* **DUST.ES**

Abstract

Mineral dust emission is ubiquitous in arid and semi-arid lands, 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 39

Has this proposal (or a very similar one) been submitted to a Horizon 2020 Marie Skłodowska-Curie Individual Fellowship call? ○ Yes ◉ No

Proposal ID **740347** *Acronym* **DUST.ES**

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) confirms:

- to have carried out the self-check of the financial capacity of the organisation on https://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 applicant (future beneficiary) 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 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

Your reply to the grant application will involve the recording and processing of personal data (such as your name, address and CV), which will be processed 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 processing of your personal data are available on 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 Warning System (EWS) only or both in the EWS and Central Exclusion Database (CED) by the Accounting Officer of the Commission, should you be in one of the situations mentioned in:
-the Commission Decision 2008/969 of 16.12.2008 on the Early Warning System (for more information see the Privacy Statement), or
-the Commission Regulation 2008/1302 of 17.12.2008 on the Central Exclusion Database
(for more information see the Privacy Statement) .

Proposal ID **740347** *Acronym* **DUST.ES**

List of participants

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

Proposal ID **740347** *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

NACE Code: 72 - Scientific research and development

Does this participant deliver doctoral degrees that are recognised as such by the relevant national authorities? ○ Yes ◉ No

Proposal ID **740347** *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 **740347** *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.

Researcher ID	orcid.org/0000-0001-8190-3700		
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	USDA-ARS Jornada Experimental Range		
Current Department/Faculty/Institute/ Laboratory name			

☐ Same as organisation address

Street	2995 Knox Street		
Postcode/Cedex	88003	Town	Las Cruces
Phone	+15756462660	Country	United States
Phone2 / Mobile	+15756429082		
E-Mail*	mklose@nmsu.edu		

Proposal ID **740347** *Acronym* **DUST.ES** *Short name* **BSC**

Qualifications

University Degree	Date of award (DD/MM/YYYY)	29/11/2010
Doctorate (in progress)	Date of award (DD/MM/YYYY)	
Doctorate	Date of award (DD/MM/YYYY)	06/10/2014
Full time postgraduate research experience	Number of months	69
Other Academic qualifications	Date of award (DD/MM/YYYY)	

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 (14/09/2016).

Period from	Period to	Duration (days)	Country
01/09/2015	14/09/2016	380	United States
15/09/2011	31/08/2015	1447	Germany
	Total	1827	

Proposal ID **740347** *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: +34934134050 Phone 2: *+xxx xxxxxxxxx* Fax: +34934137721

Other contact persons

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

Proposal ID **740347** *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.

Proposal ID **740347** *Acronym* **DUST.ES**

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	

Proposal ID **740347** *Acronym* **DUST.ES**

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 **740347** *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

For communication purposes only, the REA asks for permission to publish the name of the researcher (future fellow) should the proposal be retained for funding.

1. Does the researcher (future fellow) give this permission? ◉ Yes ○ No

2. 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

Proposal ID **740347** *Acronym* **DUST.ES**

Data management activities

A new focus within Horizon 2020 is data management, for example through the use of Data Management Plan (DMP).

DMPs detail what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved.

The use of a DMP is required for projects participating in the Open Research Data Pilot in the form of a deliverable in the first 6 months of the project (possible updates during the project).

Other projects are invited to submit a DMP if relevant for their planned research.

Are data management activities relevant for your proposed project?	○ Yes	◉ No

Open Research Data Pilot in Horizon 2020

All applicants can participate in the Pilot on Open Research Data in Horizon 2020[1] on a voluntary basis. This Pilot aims to improve and maximise access to and re-use of research data generated by actions.

Participants in the Pilot will be invited to formulate a Data Management Plan (DMP). DMPs detail what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved.
Participating in the Pilot is flexible in the sense that it does not mean that all research data needs to be open. Rather, projects can define certain datasets to remain closed via a Data Management Plan (DMP).

Please note that participation in this Pilot does not constitute part of the evaluation process. Proposals will not be evaluated favourably because they participate in the Pilot on a voluntary basis.

We wish to participate in the Pilot on Open Research Data in Horizon 2020 on a voluntary basis	○ Yes	◉ No

[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.*

DOCUMENT 1

START PAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2016

PART B

"DUST.ES"

"Constraining present-day **DUST E**missions from natural and anthropogenic **S**ources"

This proposal is to be evaluated as:

[Standard EF]

TABLE OF CONTENTS

DOCUMENT 1

LIST OF PARTICIPATING ORGANISATIONS 3
1. EXCELLENCE 4
2. IMPACT 10
3. QUALITY AND EFFICIENCY OF THE IMPLEMENTATION 11

DOCUMENT 2

4. CV OF THE EXPERIENCED RESEARCHER 14
5. CAPACITY OF THE PARTICIPATING ORGANISATIONS 18
6. ETHICAL ISSUES 20

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 (level of novelty, appropriate consideration of inter/multidisciplinary and gender aspects)

1.1.1 Introduction and state-of-the-art

Mineral dust created by the wind erosion of arid and semi-arid surfaces is a 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 dust emission, 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.

Prolific dust sources correspond to topographic depressions where a deep layer of alluvium has accumulated[2]. However, agriculture disturbs the soil, making 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%***[3,4,5,6]. 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 when including cultivated dust sources, whose surface properties are distinct to those in uncultivated areas. Recently, a correction factor to account for effects of surface roughness on u_{*t}, F_R, was derived at the global scale[7]. F_R is based on studies at regional scale[8] and additional assumptions *(Fig. 1a)*, and is obtained based on a combination of a static roughness for arid regions and a temporally varying roughness for semi-arid and cultivated regions, both estimated from satellite data. Locations where F_R is close to 1 (little to no correction) correspond to environments where the dust optical thickness is frequently large[6] *(Fig. 1b)*. This demonstrates that roughness resulting from non-erodible elements in arid regions and vegetation in semi-arid regions is a strong control upon the locations where dust is emitted. To better constrain estimates of anthropogenic and natural dust emission, such improved land-surface representations need to be combined with advanced dust models***.***

Deficits of state-of-the-art dust models include (1) an incomplete representation of the physics of dust emission and (2) a lack of skill to reproduce certain atmospheric processes that drive dust emission. ***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.***

Three mechanisms are known to be responsible for the emission of dust particles (*Fig. 1c*): (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[9]. Dust emission schemes used in regional and global

[1] e.g. Ravi et al. (2011), *Rev. Geophys.*, 49, doi:10.1029/2010RG000328
[2] Prospero et al. (2002), *Rev. Geophys.*, 40, doi:10.1029/2000RG000095
[3] Tegen et al. (2004), *Geophys. Res. Lett.*, 31, doi:10.1029/2003GL019216
[4] Mahowald et al. (2004), *Geophys. Res. Lett.*, 31, doi:10.1029/2004GL021272
[5] Tegen et al. (1996), *Nature*, 380, 419–422, doi:10.1038/380419a0
[6] Ginoux et al. (2012), *Rev. Geophys.*, 50, doi:10.1029/2012RG000388
[7] Pérez García-Pando et al. (2016), Natural and anthropogenic contributions to the global dust budget. (in preparation)
[8] Pierre et al. (2012), *J. Geophys. Res.*, *117*, doi:10.1029/2011JD016950
[9] Shao (2008), 2nd ed., Springer Netherlands, 452pp., doi:10.1007/978-1-4020-8895-7

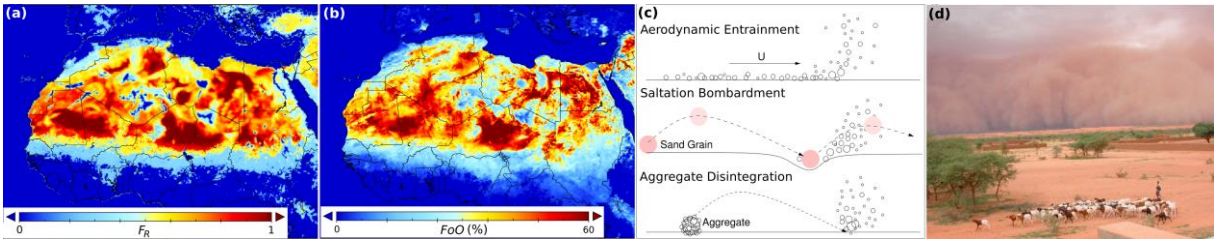

Fig. 1: *(a) The roughness correction factor, F_R, strongly resembles (b) the frequency of occurrence, FoO, of dust optical thickness greater than 0.2, suggesting that prolific dust sources correspond to regions where roughness and thus the emission threshold is low (from Pérez García-Pando et al., 2016[7]). Note that u_{*t} increases with decreasing F_R; (c) Mechanisms of dust emission (from Shao, 2008[9]); (d) Leading edge of a haboob (from Knippertz and Todd, 2012[10]).*

models represent either SB or SB and AD[11,12,13]. AE is usually neglected in dust modelling as suggested by theoretical considerations and wind tunnel experiments. However, recent studies have shown that this mechanism can be significant[14,15]. 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 global significance of aerodynamic dust emission compared to saltation-generated dust emission has not yet been determined and the associated environmental effects are not clear***.

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. However, the modelling of moist-convective dust storms (MCS) or '*haboobs*' – immense dust storms produced by mesoscale downdrafts *(Fig. 1d)* – remains a challenge, in particular for coarse-grid global models. 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[16]. Only few attempts have been made to parameterize MCS in a way that could in principle be used in large-scale models[17,18]. ***The inclusion of moist-convective dust storms in global models could significantly improve global dust emission estimates.***

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 take into account 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:

- What are the relative contributions of natural and anthropogenic (cultivated) sources to the dust cycle both regionally and globally?
- What is the regional and global relative significance of AE compared to SB/AD? How does this significance differ between natural and anthropogenic source regions?
- What is the contribution of MCS to the dust cycle regionally and globally? Does this contribution differ between natural and anthropogenic source regions?

[10] Knippertz and Todd (2012), *Rev. Geophys.*, 50, doi:10.1029/2011RG000362
[11] Marticorena and Bergametti (1995), *J. Geophys. Res.*, 100, doi:10.1029/96JD02964
[12] Shao (2004), *J. Geophys. Res.*, 109, doi:10.1029/2003JD004372
[13] Kok et al. (2014), *Atmos. Chem. Phys.*, 14, doi:10.5194/acp-14-13023-2014
[14] Macpherson et al. (2008), *J. Geophys. Res.*, 113, doi:10.1029/2007JF000800
[15] Klose et al. (2014), *J. Geophys. Res. Atmos.*, 119, doi:10.1002/2014JD021688
[16] Allen et al. (2015), J. Geophys. Res. Atmos., 120, doi:10.1002/2014JD022655
[17] Miller et al. (2008), *J. Geophys. Res.*, 113, doi:10.1029/2007JD008550.
[18] Pantillon et al. (2016), *J. Geophys. Res. Atmos.*, 121, doi:10.1002/2015JD024349

1.1.3 Research methodology and approach

To address the above questions, I will use and further develop the dust module of NMMB/BSC-CTM[19], an online multi-scale atmospheric chemistry and weather prediction system conceived by Dr. Pérez García-Pando and developed at BSC in collaboration with NOAA/National Centers for Environmental Prediction (NOAA/NCEP), the NASA Goddard Institute for Space Studies (NASA GISS), and other partners. NMMB/BSC-CTM is a non-hydrostatic model that can be run both as a global and a high-resolution regional model (the latter allowing convection-permitting simulations), each with embedded 1- or 2-way nests. Currently, the dust module includes three different saltation-based schemes[11,13,20], a new global high-resolution mapping of dust sources based on MODIS Deep Blue data and land-use databases that distinguish between natural and cultivated dust sources[6], static and dynamic roughness lengths estimated from satellite data[7], and separate tracers for natural and anthropogenic dust allowing for the calculation of their relative contributions to the dust budget. DUST.ES is structured around four scientific work-packages:

WP1 – *Implementation of a novel aerodynamic dust entrainment scheme*: I am the main developer of a novel physics-based parameterization for AE[21,22,15]. Modules containing the source code for the AE scheme are already available and will be coupled to NMMB/BSC-CTM. The detection of AE events from classical observations is difficult. I am currently carrying out comprehensive event-based measurements in the southwestern US, which allow discriminating between AE and SB/AD (Section 1.2). I will run regional simulations at different resolutions with the updated NMMB/BSC-CTM and use these measurements as a reference to constrain and further understand emission from AE.

WP2 – *Implementation of a scheme for moist-convective dust storms:* A new MCS scheme[18] will be coupled to the model's moist convection and SB/AD schemes. The MCS scheme will be calibrated with regional convection-permitting runs for North Africa in summer and applied to convection-parameterized runs on global scale. WP2 will be conducted in close collaboration with the main developers of the scheme, Dr. Florian Pantillon and Dr. Peter Knippertz, at KIT, which acts as a seconding institution. Evaluation and calibration of the MCS scheme is included in WP3.

WP3 – *Constraining the global dust cycle*: In collaboration with the NMMB/BSC-CTM developers, I will calibrate and evaluate the upgraded global model by comparing the simulated dust cycle to the standard suite of measurements: aerosol optical depth (AERONET, MISR, MODIS, MODIS Deep Blue), deposition, concentration, and the AERONET-retrieved aerosol size distribution. We will also use near-surface aerosol concentration in the US (IMPROVE network) and Sahel[23]. Both regions have anthropogenic dust sources and are affected by MCS. A key additional constraint will be the frequency of occurrence (FoO) that different thresholds of dust optical depth (from MODIS Deep Blue retrievals) are exceeded[7] (*Fig. 1b*). In addition to tracers for natural and anthropogenic dust, I will include tagging for dust emitted by AE and MCS. This will potentially allow the attribution of model errors to source (anthropogenic vs natural), mechanism (AE vs SB/AD) or atmospheric process (contribution of MCS).

WP4 – *Quantification of budgets and attribution:* Using the final model version, a long-term (~10 years) global simulation will be conducted. The expected working global model resolution is ~0.7° by 0.5° horizontally with 64 vertical layers. 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, Australia, or the US.

[19] Pérez et al. (2011), *Atmos. Chem. Phys.*, 11, doi:10.5194/acp-11-13001-2011
[20] Ginoux et al. (2001), *J. Geophys. Res.*, 106, 20,255-20,273, doi:10.1029/2000JD000053
[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] Marticorena et al. (2010), *Atmos. Chem. Phys.*, 10, 8899-8915, doi:10.5194/acp-10-8899-2010

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 not only novel, but also 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 NMMB/BSC-CTM 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 *World Meteorological Organization* (WMO) *Sand and Dust Storm Warning Advisory and Assessment System* (SDS-WAS) *Regional Center for Northern Africa, Middle East and Europe* (NA-ME-E). 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 by dust aerosols. 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 NMMB/BSC-CTM model, and running computationally demanding simulations. Therefore, a detailed understanding of the NMMB/BSC-CTM model and the skills to effectively make use of BSC's supercomputing facilities are fundamental for the success of the proposed research. I will be trained with a priority on

(a) The NMMB/BSC-CTM 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 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 become acquainted with NMMB/BSC-CTM quickly.
(b) The MareNostrum III 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 III. 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 by the Atmospheric Composition Group at BSC: 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.

I have been involved in aeolian research since I worked as a student assistant in 2007. My research interests include aeolian processes on all scales, their frequency, and impact on the 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. During the stage of scheme testing, the need for more detailed and standardized field data to support model evaluation and inform further model development became evident. This prompted me to gain first-hand experience in the field measurement of aeolian processes. As a DFG (German Research Foundation) Postdoctoral Research Fellow, I am currently collecting a comprehensive field data set on aeolian sediment transport and its drivers at the USDA-ARS (United States Department of Agriculture – Agricultural Research Service) Jornada Experimental Range in the Chihuahuan Desert in New Mexico, USA. The measurements are designed such that they allow for the identification of dust emission mechanisms and provide insights into their variation with soil-surface and atmospheric conditions with the overall goal to further develop dust models in the future.

By conducting the MSCA-IF at BSC, I will extend my dust modelling expertise from the process and event scales to global scales. 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 and 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 am currently acquiring expertise in the field measurement and monitoring of dust and related quantities, BSC has particularly strong capacities in the application of (dust) aerosol models. I will contribute to improved dust modelling and forecasting capabilities at BSC, of which both BSC and the WMO SDS-WAS Regional Center 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

1.3.1 Qualification and experience of the supervisor

Dr. Carlos Pérez García-Pando is Ramón y Cajal Researcher, AXA Professor on Sand and Dust Storms (SDS) 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 GISS 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/NCEP, 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 Regional Centres on SDS prediction 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: 26, i10-Index: 40, citations: 2616, 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 ~50 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) 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 NA-ME-E Regional Center (Section 1.1.4), 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.

BSC-ES maintains a near real-time online documentation with detailed information on past and ongoing projects, publications, meetings, codes, etc. This will instantly provide me with an overview about activities at BSC-ES, but will also inform BSC-ES staff about the MSCA, thus considerably accelerating my integration in the department. 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 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

My research attracted international interest, leading to collaborations with colleagues in ~10 countries, and resulted in 16 peer-reviewed publications (6 as the lead author; 2 currently under review after revisions; citations: 158, h-Index: 7, i10-Index: 6; source: Google Scholar), four of which will be reprinted as book chapters. I contributed as a collaborator to multi-institutional and multi-disciplinary projects and I am co-PI of a competitive research project funded by the U.S. Department of Defense. During my time as research associate at the University of Cologne, I was also in charge of administering research projects and have acquired the essential 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 Regional Centers for SDS prediction 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 its implementation 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 aerosols 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. This will facilitate outreach to the local public during the MSCA and further improve 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 Regional Center for SDS prediction, 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 and policy-makers, (3) the industrial sector, 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 Regional Centers, and the BSC:

(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*[24] 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.

[24] Dissemination and Exploitation, H2020 Online Manual

(2) Training courses and seminars organized for operational meteorologists by the WMO 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, will be of interest to decision-makers in the industrial sector, e.g. for land-management and solar energy production. The MSCA will make use of communication channels installed by the AXA Chair, such as biannual technical reports, to engage their interest in using products resulting from the MSCA[24], i.e. weather forecasts and reanalysis produced using the further developed NMMB/BSC-CTM. Exploitation will be supported by BSC's Technology Transfer Manger (Section 3.3.1).

(4) See Section 2.3.

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

In addition to the scientific community, national weather services, and the industrial sector, an aim is to inform the general public about dust and its impacts in the context of the MSCA[25]. 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 (http://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), 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 and dissemination*		
T0.1 Project management T0.2 Dissemination	D1 Scientific conference/workshop D2 Outreach activity	M1 Career Development Plan
WP1 – *Implementation of a novel aerodynamic dust entrainment scheme*		
T1.1 Familiarize with NMMB/BSC-CTM T1.2 Couple AE scheme to BSC-CTM T1.3 Model calibration	D3 Upgraded model version 1	M2 AE scheme implemented and tested
WP2 – *Implementation of a scheme for moist-convective dust storms*		
T2.1 Couple MCS scheme to NMMB physics package T2.2 Link scheme output to dust emission schemes T2.3 Model calibration	D4 Upgraded model version 2	M3 MCS scheme implemented and tested

[25] Communication, H2020 Online Manual

WP3 – *Constraining the global dust cycle*		
T3.1 Model evaluation and constraining	D5 Model evaluation results D6 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 haboobs to global dust emissions T4.4 Attribute dust emissions to source type	D7 10-year global simulation D8 Final report D9 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																								
T0.1																								
T0.2																								
WP1																								
T1.1																								
T1.2																								
T1.3																								
WP2																								
T2.1																								
T2.2																								
T2.3																								
Secondment																								
WP3																								
T3.1																								
WP4																								
T4.1																								
T4.2																								
T4.3																								
T4.4																								
Milestones	**M1**					**M2**						**M3**						**M4**						**M5**
Deliverables					**D1(1)**	**D2(1)**						**D2(2)** **D4**				**D1(2)**		**D5** **D6**		**D2(3)** **D7**			**D1(3)**	**D8** **D9**

3.2 Appropriateness of the allocation of tasks and resources

A time period of 6-7 months each is planned for each of WPs 1 to 4 (see Gantt Chart). This period includes time to become familiar with NMMB/BSC-CTM and the MCS parameterization in respectively WPs 1 and 2, time for the coupling of the schemes to the model, and for preliminary calibration of the schemes. In WP3, model evaluation and further constraining will be iterated until satisfying results are achieved. Two visits (secondment) at KIT are planned: (1) to be trained on the MCS scheme and (2) to discuss the scheme results. 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 extents over the duration of the project and dissemination actions are distributed over the 2 years.

The in-depth knowledge of BSC scientists about NMMB/BSC-CTM, the model evaluation tool, 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. Further, 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 (WP0)	*Low* – Project management is supported by BSC project managers.
2. AE scheme cannot be coupled with NMMB/BSC-CTM (WP1)	*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 NMMB/BSC-CTM, and Dr. Pérez García-Pando with the dust module.
3. MCS scheme cannot be coupled with NMMB/BSC-CTM (WP2)	*Low* – Necessary input quantities are available and I will be supported by the scheme and model developers from KIT.
4. Dust emissions cannot be attributed to source type (WP4)	*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.
5. Model evaluation is complicated, as classical observations do not allow for a differentiation of AE and SB/AD (WP1, WP3)	*High* – Particular data sets will not allow for a differentiation of AE and SB/AD; Contingency plan: Combine information from different data sets, e.g. space-based remote sensing and in-situ measurements.

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 III – 29th fastest supercomputer worldwide in June 2013; 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 3.3.1).

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.

DOCUMENT 2

4. CV of the Experienced Researcher

Personal data

Name:	Dr. Martina R. Klose
Birthday and -place:	15 October 1984, Schlüchtern, Germany
Work contact:	USDA-ARS Jornada Experimental Range 2995 Knox Street (Room 156) (P.O. Box 30003, MSC3 JER, NMSU) Las Cruces, NM 88003, USA email: mklose@nmsu.edu, phone: +1 (575) 646 2660
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 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 Thesis (1 year project): "Development and Implementation of a Dust Emission Scheme for Convective Atmospheric Conditions"

Work experience

since 09/2015	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

Grants and Awards

2016	DAAD (German Academic Exchange Service) travel grant to participate in the 9th International Conference on Aeolian Research
2015	DFG Postdoctoral Research Fellowship

Involvement in projects

Co-PI	U.S. Army Engineer Research and Development Center – Basic Research "Resolving the size distribution of mineral dust aerosols", 2017-2018
Collaborator	DFG Collaborative Research Centre 1211 "Earth-Evolution at the Dry Limit", 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

2016	Convener of session "Modeling Aeolian Transport", 9th International Conference on Aeolian Research, Mildura, Australia
2015 – 2016	Invited presentations at Oxford University, Oxford, UK (2015) and the NASA Goddard Institute for Space Studies, New York, NY, USA (2016)
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 workshop "Dust devils on Earth and Mars", International Space Science Institute (ISSI), Bern, Switzerland
2014	Organizer of 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

Journals	Aeolian Research, Asia-Pacific Journal of Atmospheric Sciences, Atmospheric Chemistry and Physics, Earth Surface Processes and Landforms, Geophysical Research Letters, Icarus, IEEE Transactions on Geoscience and Remote Sensing, 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

*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.*, revised.

Flaounas, E., V. Kotroni, K. Lagouvardos, **M. Klose**, C. Flamant, and T. M. Giannaros (2016), Assessing atmospheric dust modelling performance of WRF-Chem over the semi-arid and arid regions around the Mediterranean, *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-307, revised.

*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.*, accepted.

Shao, Y. and **M. Klose** (2016), A note on the stochastic nature of particle cohesive force and implications on threshold friction velocity for aerodynamic dust entrainment, *Aeolian Research*, 22, doi:10.1016/j.aeolia.2016.08.004.

***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, and 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.

Klose, M. and Y. Shao (2016), A numerical study on dust devils with implications to global dust budget estimates, *Aeolian Research*, 22, doi:10.1016/j.aeolia.2016.05.003.

*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 (2016), History and applications of dust devil studies, *Space Sci. Rev.*, doi: 10.1007/s11214-016-0239-2.

Deetz, K., **M. Klose**, I. Kirchner, and U. Cubasch (2016), Numerical simulation of a dust event in northeastern Germany with a new dust emission scheme in COSMO-ART, *Atmospheric Environment*, 126, 87-97, doi: 10.1016/j.atmosenv.2015.11.045.

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, and N. Webb (2015), A tribute to Michael R. Raupach for contributions to aeolian fluid dynamics, *Aeolian Research*, 19, 37-54, doi: 10.1016/j.aeolia.2015.09.004.

Klose, M., Y. Shao, X. L. Li, H. S. Zhang, M. Ishizuka, M. Mikami, and 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.

Li, X. L., **M. Klose**, Y. Shao, and 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.

Shao, Y., **M. Klose** and K.-H. Wyrwoll (2013), Recent global dust trend and connections to climate forcing, *J. Geophys. Res., 118*, doi:10.1002/jgrd.50836.

Klose, M. and Y. Shao (2013), Large-eddy simulation of turbulent dust emission, *Aeolian Research, 8*, 49-58, doi: 10.1016/j.aeolia.2012.10.010.

Klose, M. and 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.

Klose, M., Y. Shao, M. K. Karremann, and A. H. Fink (2010), Sahel dust zone and synoptic background, *Geophys. Res. Lett., 37*, L09802, doi:10.1029/2010GL042816.

Shao, Y., A. H. Fink, and **M. Klose** (2010), Numerical simulation of a continental-scale Saharan dust event, *J. Geophys. Res., 115*, doi:10.1029/2009JD012678.

**will be reprinted as chapters in book "Dust Devils", Space Science Series of ISSI, Eds. Reiss et al., Springer*

Presentations at conferences/workshops (selection, 10 of 20)

Klose, M. and 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., S. Peterson, N. Webb, J. Van Zee, B. Cooper, S. Van Pelt, G. Okin, J. Karl (2016), Deducing dust emission mechanisms from field measurements, 9th International Conference on Aeolian Research, Mildura, Australia (poster presentation)

Klose, M. and Y. Shao (2015), Top-soil removal through direct aerodynamic dust entrainment, DesertLand II, Ghent, Belgium (poster presentation)

Klose, M., Y. Shao, H. Butler, and J. Leys (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, and H. Butler (2014), Convective turbulent dust emission, 8th International Conference on Aeolian Research, Lanzhou, China, (oral presentation)

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

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

Klose, M. and 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 demand 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 2011 and 2015, BSC has recruited 75 pre-doctoral students, 51 Postdocs and Senior Scientists, 83 technical support staff and 31 management staff members, 146 from Spain, 39 from EU countries and 55 from outside Europe. BSC counts more than 380 staff members from around 40 countries. Recruitment is based on principles of merit, transparency, competition and gender balance, and the centre has been 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 Commitment 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 III, with 48,128 cores and 1.1 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	Since 2005, BSC has been involved in 154 completed projects/actions (41 individual grants/fellowships/ personnel support; 9 EU-FP6; 38 EU-FP7; 3 EU-Other; 63 National), 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 ITN and 4 MSCA-IF. Noteworthy, two of these MSCA-IF are currently conducted at BSC-ES, which will host the proposal on hand. Projects: Total of 90 ongoing projects are funded by the European Commission (FP7, H2020): e.g. Euroserver, DEEP, PRIMAVERA; SPECS, EUDAT, PRACE 3IP; 20 at BSC-ES (1 EU-FP7, 7 EU-H2020, 7 EU-Other, 5 National)
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.*, in press.

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.

ENDPAGE

MARIE SKŁODOWSKA-CURIE ACTIONS

Individual Fellowships (IF)
Call: H2020-MSCA-IF-2016

PART B

"DUST.ES"

"Constraining present-day **Dust E**missions from natural and anthropogenic **S**ources"

This proposal is to be evaluated as:

[Standard EF]

Digitally signed by sealingservice.grants.ec.europa.eu
Date: 2016.09.13 03:41:35 CEST
Reason: Acknowledgment of Receipt

This electronic receipt is a digitally signed version of the document submitted by your organisation. Both the content of the document and a set of metadata have been digitally sealed.

This digital signature mechanism, using a public-private key pair mechanism, uniquely binds this eReceipt to the modules of the Participant Portal of the European Commission, to the transaction for which it was generated and ensures its full integrity. Therefore a complete digitally signed trail of the transaction is available both for your organisation and for the issuer of the eReceipt.

Any attempt to modify the content will lead to a break of the integrity of the electronic signature, which can be verified at any time by clicking on the eReceipt validation symbol.

More info about eReceipts can be found in the FAQ page of the Participant Portal. (http://ec.europa.eu/research/participants/portal/page/faq)