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UK Research and Innovation



Schweizerische Eidgenossenschaft  
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Education and Research EAER  
State Secretariat for Education,  
Research and Innovation SERI



# CARE-C

Climate and Atmosphere Research Center.

## The Dust Doctoral Network (Dust-DN)

Franco Marengo, Kostas Fragkos and the Dust-DN partners

HARMONIA WG3 – 17 June 2025



CARE-C



THE CYPRUS INSTITUTE  
RESEARCH | TECHNOLOGY | INNOVATION



# Dust-DN partners

## Leading Partners



**THE CYPRUS INSTITUTE**  
RESEARCH • TECHNOLOGY • INNOVATION

Beneficiary and Coordinator

The Cyprus Institute (CyI)  
The Climate and Atmosphere Research Centre (CARE-C)



**UNIVERSIDADE DE ÉVORA**

Beneficiary

University of Évora (UE)



Beneficiary

National Observatory of Athens (NOA)



**Barcelona Supercomputing Center**  
Centro Nacional de Supercomputación

Beneficiary

Barcelona Supercomputing Center (BSC)  
Atmospheric Composition group  
Barcelona Dust Regional Centre



**TECHNISCHE UNIVERSITÄT DARMSTADT**

Beneficiary

Technische Universität Darmstadt (TUDA)  
Institute of Applied Geosciences



**KIT**  
Karlsruhe Institute of Technology

Beneficiary

Karlsruhe Institute of Technology (KIT)  
Department Troposphere Research  
Working Group on Mineral Dust



**University of Reading**

Employing associated partner (UKRI-funded)

University of Reading (UoR)  
Department of Meteorology



**pmod wrc**

Employing associated partner (SERI-funded)

Physikalisch-Meteorologisches Observatorium Davos / World Radiation Centre (PMOD-WRC)

## Associated Partners



**ETH zürich**

Swiss Federal Institute of Technology Zürich (ETHZ)



National Technical University of Athens (NTUA)



Aristotle University of Thessaloniki (AUTH)



Max Planck Institute for Chemistry (MPIC)



Rolls Royce (RR)



Met Office (MetO)



**جامعة خليفة**  
**Khalifa University**

Khalifa University (KU)



EY

Ernst and Young (EY)



Plataforma Solar de Almería (PSA)



**GRASP**

Generalized Retrieval of Atmosphere and Surface Properties (GRASP-SAS)



Centre of Excellence (ECOE)

Erastofanos Centre of Excellence (ECOE)



World Meteorological Organization (WMO)



**ZAUM**

Center of Allergy and Environment

Zentrum Allergie und Umwelt (ZAUM)



**UNIVERSITAT POLITÈCNICA DE CATALUNYA**  
**BARCELONATECH**

Universitat Politècnica de Catalunya (UPC)



**C-TRAIL**

Centro Académico Clínico de Alergia (C-TRAIL)



# Dust-DN partners



CA

Data: GTO, NOAA, U.S. Navy, NGA, GEBCO  
Image: Landsat / Copernicus

Google Earth



Funded by  
the European Union



UK Research  
and Innovation



Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,  
Education and Research EAER  
**State Secretariat for Education,  
Research and Innovation SERI**



CARE-C



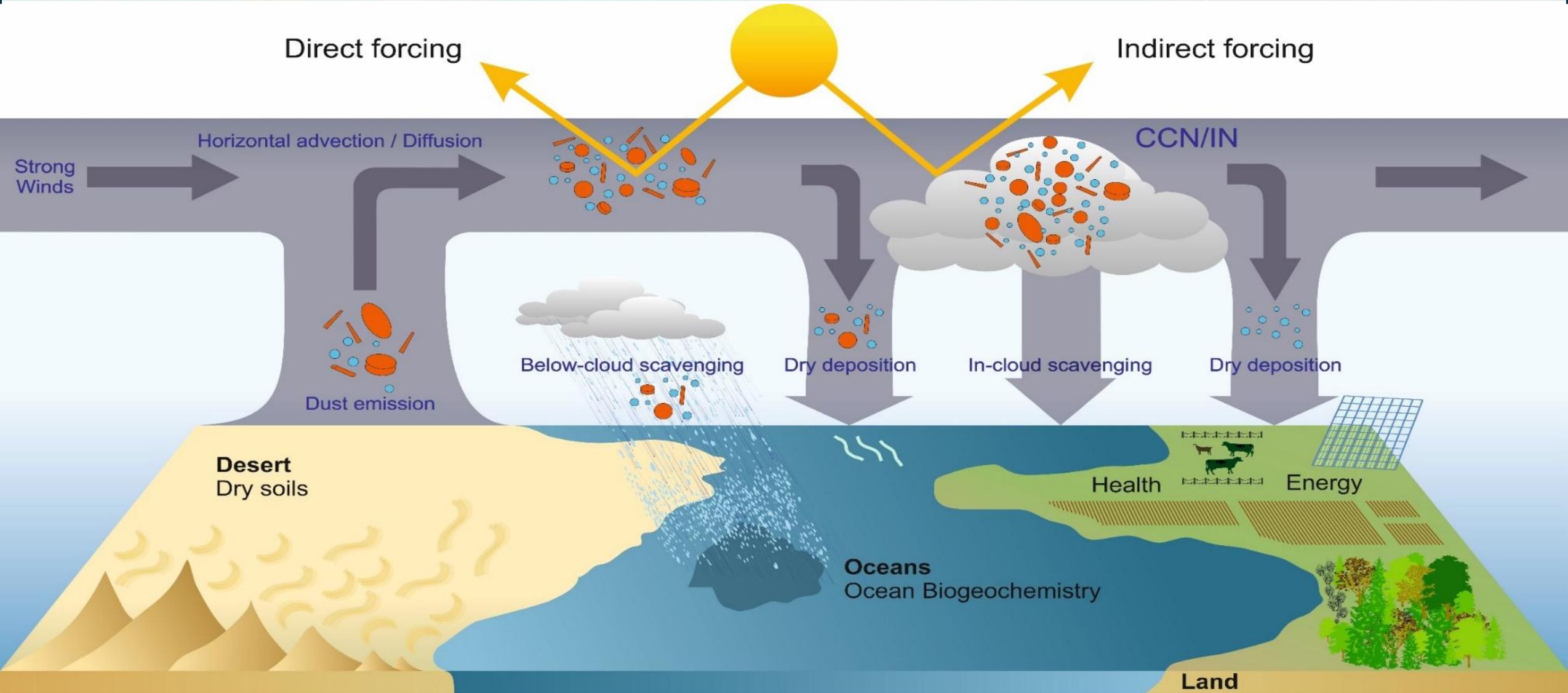
# Dust-DN motivation

- Atmospheric dust is not fully understood at the fundamental level (microphysical properties, dust emissions, source regions).
- Dust observations are missing near the major dust sources.
- Different techniques are still under development, with each giving a different picture of a phenomenon with multiple facets.
- Dust affects the environment, society, and several economic sectors (e.g. transportation and energy sectors).

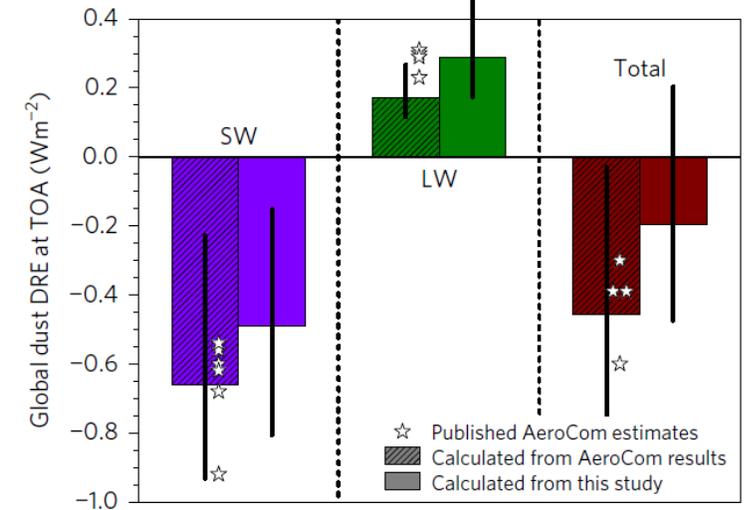
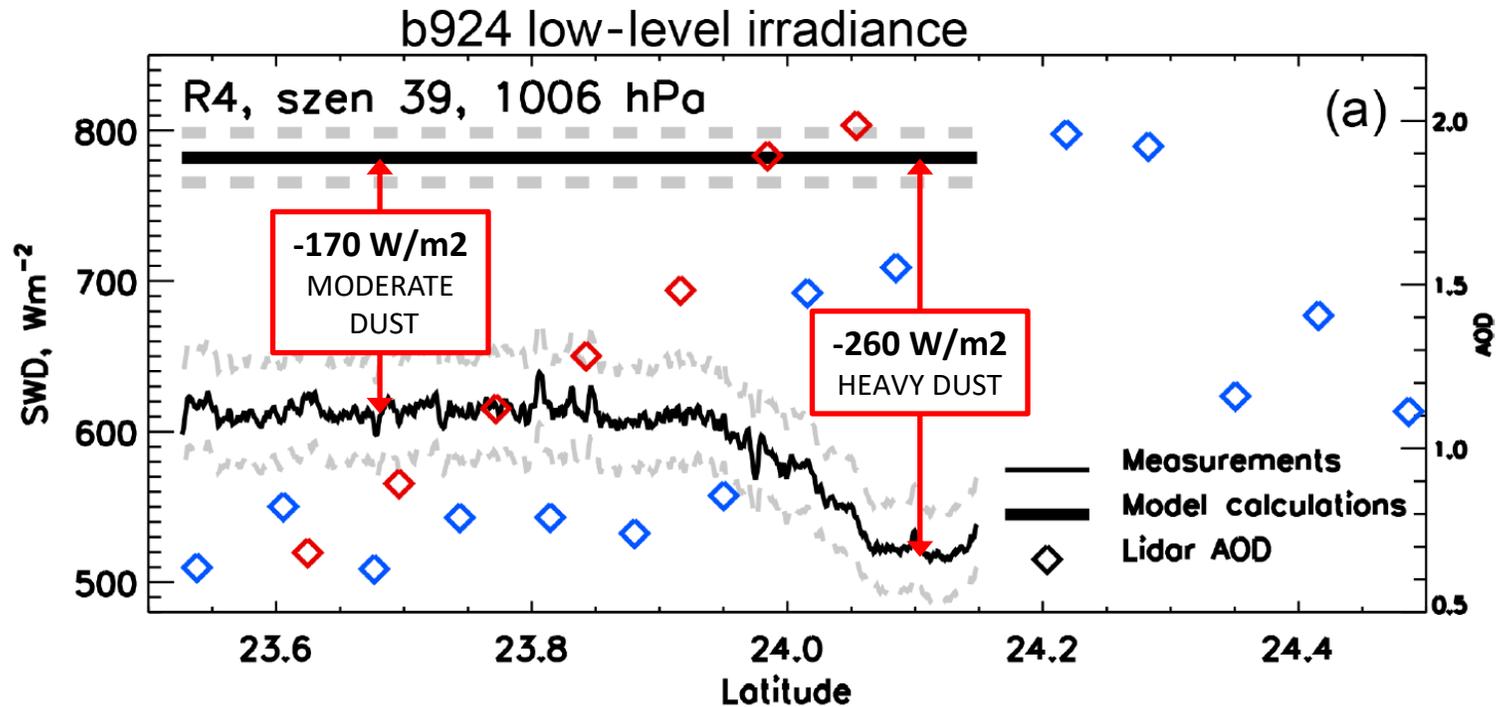


# Desert Dust Atmospheric Cycle

Courtesy of Vassilis Amiridis



# Radiative impact



**Figure 4 | Constraints on the global direct radiative effect (DRE) of PM<sub>20</sub> dust.** The fine-size bias in current AeroCom models<sup>3,9,30,31</sup> causes an overestimation of SW cooling and underestimation of LW warming (hatched bars). We correct these biases using our constraints on the global size-resolved dust load (Fig. 2b) and extinction efficiency (Fig. 1b), resulting in a more positive (warming) DRE at the top-of-atmosphere. Error bars denote 95% CI.

## ATMOSPHERIC SCIENCE

## Climate models miss most of the coarse dust in the atmosphere

Adeyemi A. Adebiyi\* and Jasper F. Kok

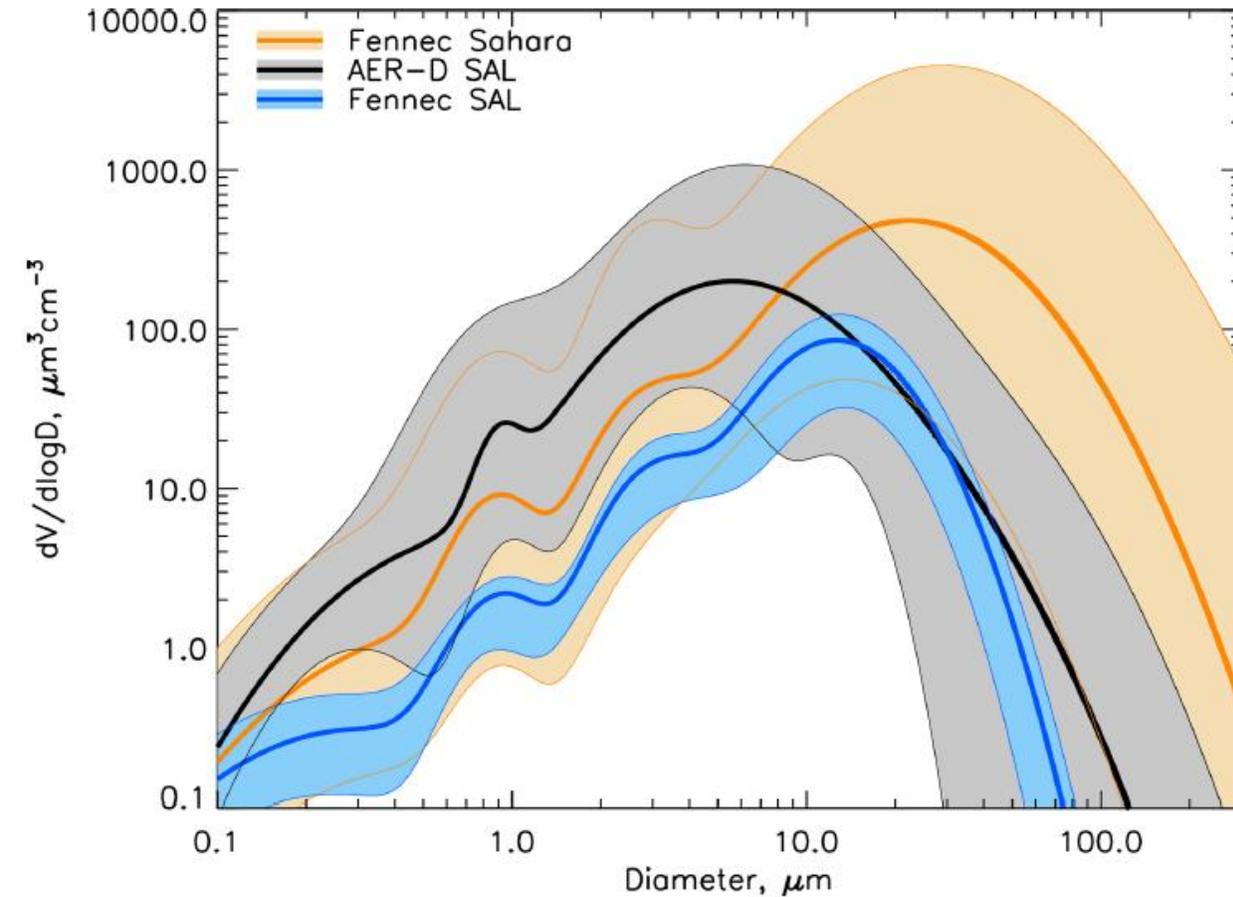
Coarse mineral dust (diameter,  $\geq 5 \mu\text{m}$ ) is an important component of the Earth system that affects clouds, ocean ecosystems, and climate. Despite their significance, climate models consistently underestimate the amount of coarse dust in the atmosphere when compared to measurements. Here, we estimate the global load of coarse dust using a framework that leverages dozens of measurements of atmospheric dust size distributions. We find that the atmosphere contains 17 Tg of coarse dust, which is four times more than current climate models simulate. Our findings indicate that models deposit coarse dust out of the atmosphere too quickly. Accounting for this missing coarse dust adds a warming effect of  $0.15 \text{ W}\cdot\text{m}^{-2}$  and increases the likelihood that dust net warms the climate system. We conclude that to properly represent the impact of dust on the Earth system, climate models must include an accurate treatment of coarse dust in the atmosphere.

## ATMOSPHERIC SCIENCE

## The mysterious long-range transport of giant mineral dust particles

Michèle van der Does<sup>1\*</sup>, Peter Knippertz<sup>2</sup>, Philipp Zschenderlein<sup>2</sup>,  
R. Giles Harrison<sup>3</sup>, Jan-Berend W. Stuut<sup>1,4</sup>

Giant mineral dust particles ( $>75 \mu\text{m}$  in diameter) found far from their source have long puzzled scientists. These wind-blown particles affect the atmosphere's radiation balance, clouds, and the ocean carbon cycle but are generally ignored in models. Here, we report new observations of individual giant Saharan dust particles of up to  $450 \mu\text{m}$  in diameter sampled in air over the Atlantic Ocean at 2400 and 3500 km from the west African coast. Past research points to fast horizontal transport, turbulence, uplift in convective systems, and electrical levitation of particles as possible explanations for this fascinating phenomenon. We present a critical assessment of these mechanisms and propose several lines of research we deem promising to further advance our understanding and modeling.



Courtesy of Claire Ryder





## Models transport Saharan dust too low in the atmosphere: a comparison of the MetUM and CAMS forecasts with observations

Debbie O'Sullivan<sup>1</sup>, Franco Marengo<sup>1</sup>, Claire L. Ryder<sup>2</sup>, Yaswant Pradhan<sup>1</sup>, Zak Kipling<sup>3</sup>, Ben Johnson<sup>1</sup>,  
Angela Benedetti<sup>3</sup>, Melissa Brooks<sup>1</sup>, Matthew McGill<sup>4</sup>, John Yorks<sup>4</sup>, and Patrick Selmer<sup>4</sup>

<sup>1</sup>Met Office, Exeter, EX1 3PB, UK

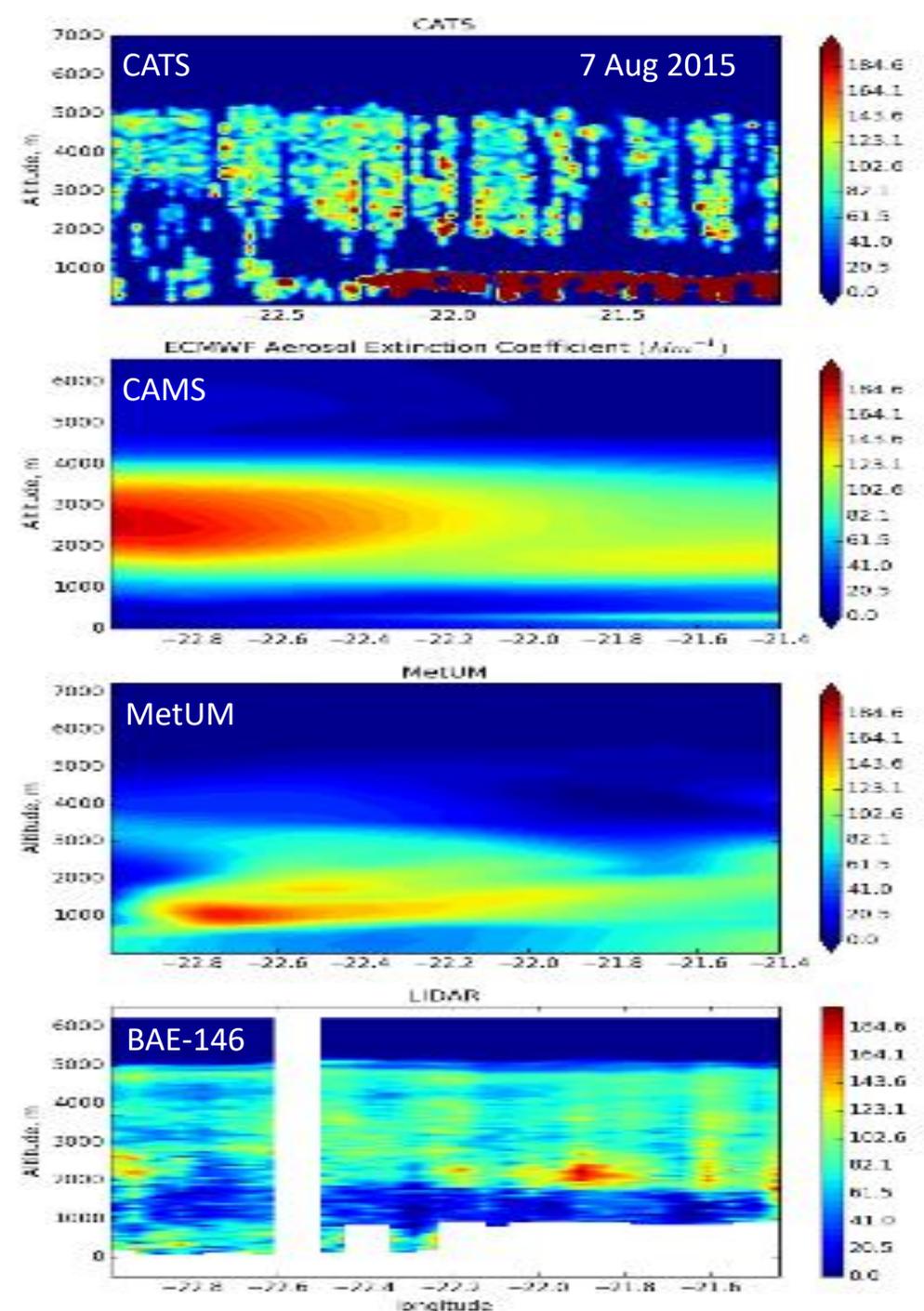
<sup>2</sup>Department of Meteorology, University of Reading, RG6 6BB, UK

<sup>3</sup>European Centre for Medium-Range Weather Forecasts, Reading, RG2 9AX, UK

<sup>4</sup>NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

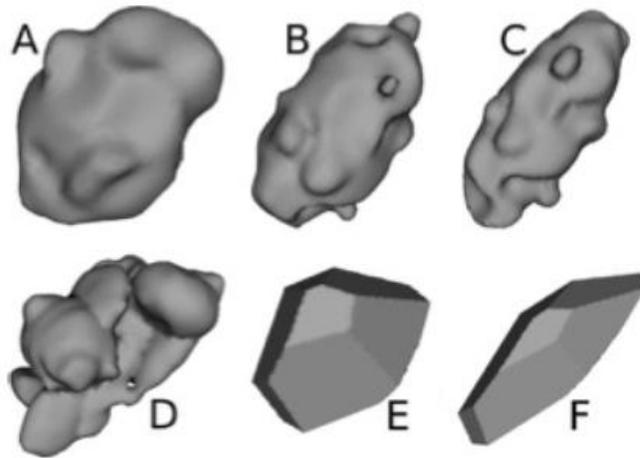
Highlighted the need to augment  
operational aerosol observations on a  
global scale for constraining models.

*AOD as the sole constraint is a limitation!*

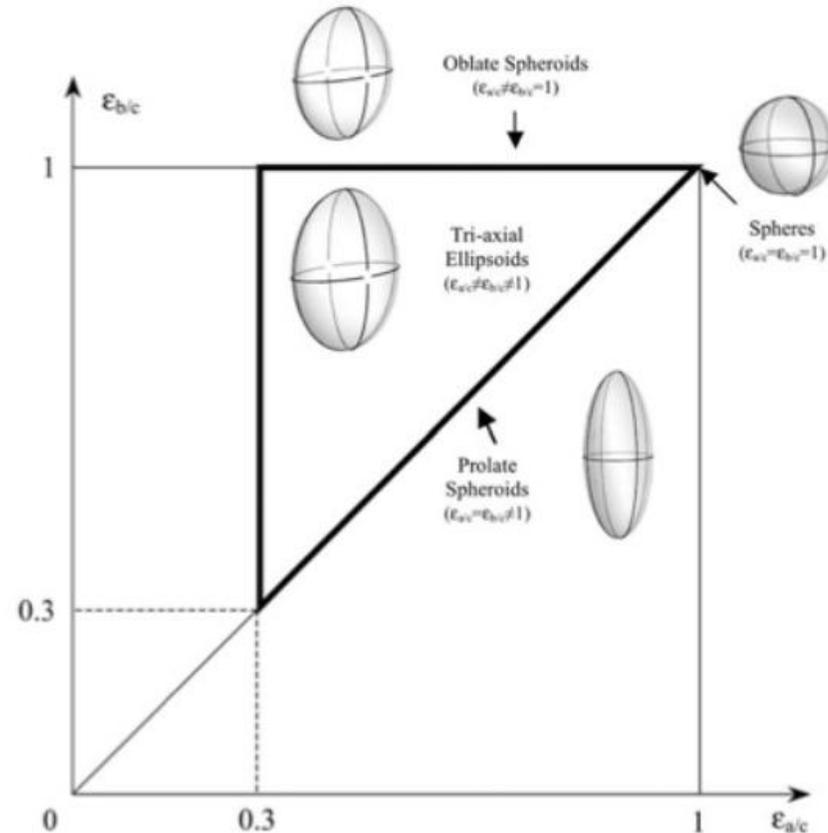


# Most models assume dust to be spherical or largely simplify shape effects

- Common **spherical** assumption
- **Spheroids** assumption
- Other **irregular** shapes



Gasteiger et al., 2011



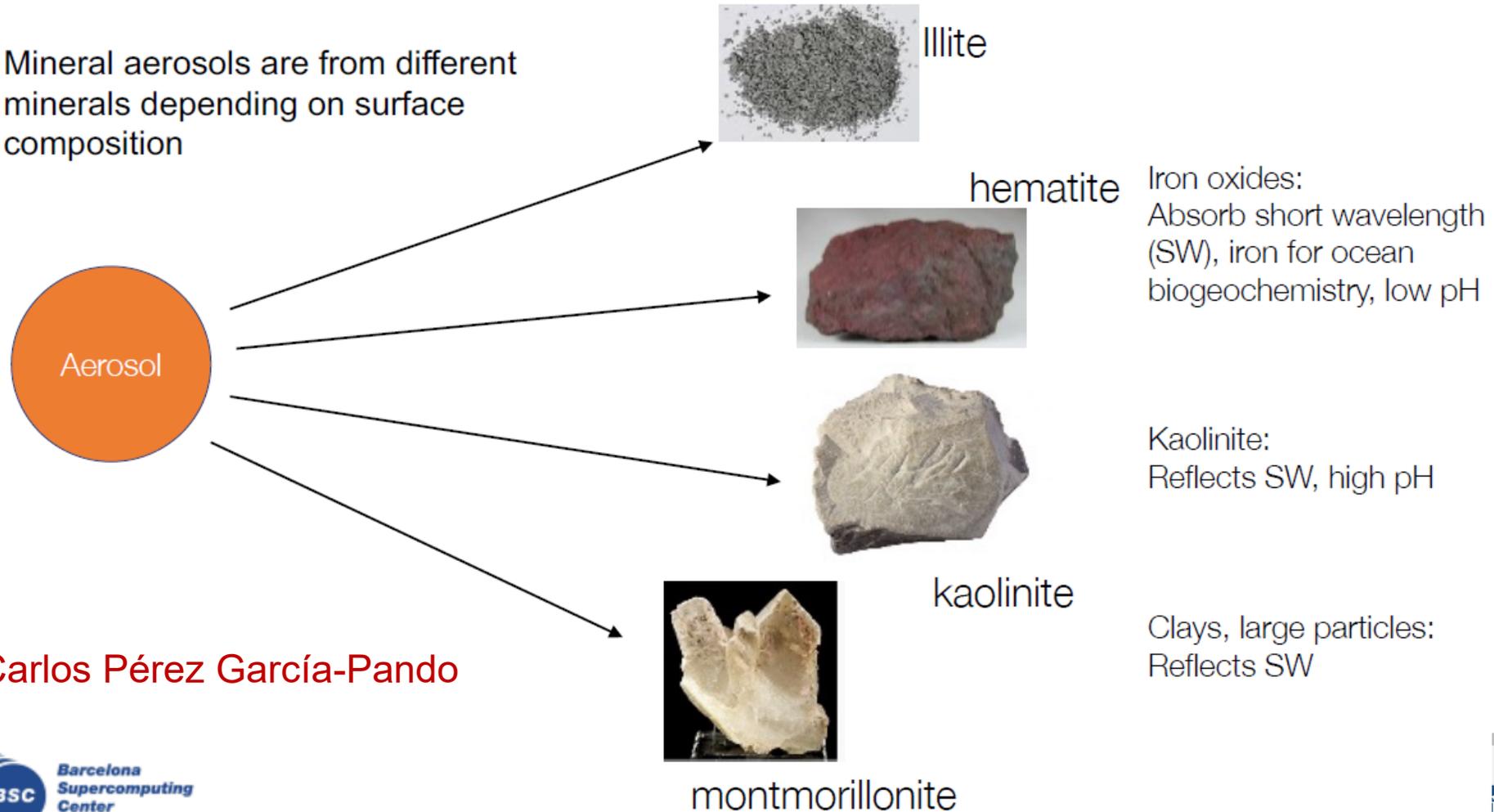
Meng et al. 2010

Courtesy of Carlos Pérez García-Pando

# Most models currently neglect dust mineralogical composition variations

- Traditionally: Model an 'average' mineral aerosol
- Mineral aerosols are from different minerals depending on surface composition

Each mineral has different properties and interactions with Earth System



Courtesy of Carlos Pérez García-Pando

# MSCA doctoral networks

## Implementation modes



All 3 modes compete within the same scientific panels



## What is a joint or double/multiple degree?



**Joint degree:** single diploma issued by at least 2 academic institutions located in 2 different countries and recognized officially



**Double/multiple degree:** 2 or more separate national diplomas issued by 2 or more higher education institutions located in different countries and recognized officially

2 double degrees in Dust-DN

Letters of pre-agreement to deliver joint/double doctoral degrees are mandatory in the proposal



# MSCA doctoral networks

## Doctoral Networks – Award Criteria

Criteria	Excellence	Impact	Implementation
Sub-criteria	Quality and pertinence of the project's <b>research and innovation objectives</b>	Contribution to <b>structuring doctoral training</b> at European level and strengthening European innovation capacity	Quality and effectiveness of the <b>work plan</b> , assessment of <b>risks</b> , and appropriateness of the <b>effort</b> assigned to work packages
	Soundness of the proposed <b>methodology</b>	Credibility of the measures to enhance the <b>career perspectives</b> of researchers and contribution to their <b>skills development</b>	<b>Quality, capacity and role of each participant</b> , including hosting arrangements and extent to which the <b>consortium as a whole</b> brings together the necessary expertise
	Quality and credibility of the <b>training programme</b>	Suitability and quality of the measures to <b>maximise expected outcomes</b> and impacts, as set out in the <b>dissemination and exploitation</b> plan, including <b>communication</b> activities	
	Quality of the <b>supervision</b>	The magnitude and importance of the project's contribution to the expected <b>scientific, societal and economic</b> impacts	
<b>Weighting</b>	<b>50%</b>	<b>30%</b>	<b>20%</b>
<b>Priority</b>	<b>1</b>	<b>2</b>	<b>3</b>



# HORIZON-MSCA-2023-DN-01 call statistics

- 1,066 proposals from 31 countries
- +12.7% compared to 2022
- 8 from coordinators in Cyprus
  
- 1,061 eligible (99.5%)
- 944 with evaluation score above the threshold (89%)
- Total budget requested: 3,246 M€
- Budget available: 456 M€ (14%)



**MSCA-DN-2023: Cumulative percentage of proposals above threshold, with a given score or higher (with funding range marked in green)**

Number of eligible proposals	136	18	385	82	256	13	81	90	1061
Cut off score for funding	96,2	95	96	96,4	96	97,6	97,2	96,2	
Score equal to or above	CHE	ECO	ENG	ENV	LIF	MAT	PHY	SOC	Grand Total
100	1,47%	0,00%	1,56%	1,22%	0,78%	0,00%	1,23%	1,11%	1,23% <b>13</b>
99	2,94%	0,00%	3,12%	1,22%	0,73%	0,00%	3,70%	4,44%	2,92%
98	7,35%	0,00%	6,49%	6,10%	6,64%	7,69%	8,64%	6,67%	6,69%
97	11,03%	0,00%	9,61%	8,54%	9,38%	15,38%	13,58%	8,89%	9,80%
96	13,97%	0,00%	12,47%	15,85%	12,11%	38,46%	16,05%	14,44%	13,38% <b>13%</b>
95	20,59%	5,56%	17,40%	21,95%	14,84%	38,46%	19,75%	14,44%	17,53%
94	23,53%	5,56%	22,34%	32,93%	17,58%	38,46%	24,69%	20,00%	22,05%
93	30,88%	5,56%	27,53%	35,37%	21,88%	38,46%	27,16%	21,11%	26,39%
92	35,29%	5,56%	31,17%	41,46%	25,39%	38,46%	32,10%	25,56%	30,35%
91	39,71%	11,11%	34,03%	41,46%	29,30%	46,15%	34,57%	27,78%	33,46%
90	44,12%	11,11%	37,92%	43,90%	33,59%	53,85%	38,27%	33,33%	37,51%
89	46,32%	11,11%	42,08%	45,12%	38,28%	53,85%	44,44%	36,67%	41,28%
88	50,94%	11,11%	45,74%	45,94%	43,36%	61,54%	50,62%	37,78%	45,52%
87	54,77%	11,11%	47,27%	47,27%	47,27%	61,54%	54,32%	41,11%	49,29%
86	58,20%	11,11%	53,52%	53,52%	53,52%	69,23%	61,73%	41,11%	53,35%
85	58,20%	11,11%	55,86%	55,86%	55,86%	76,92%	69,14%	43,33%	57,49%
84	59,77%	11,11%	58,20%	58,20%	58,20%	76,92%	71,60%	44,44%	59,66%
83	65,23%	11,11%	59,77%	59,77%	59,77%	76,92%	71,60%	46,67%	62,39%
82	65,23%	11,11%	65,23%	65,23%	65,23%	76,92%	74,07%	47,78%	64,94%
81	69,53%	11,11%	69,53%	69,53%	69,53%	76,92%	77,78%	50,00%	68,80%
80	72,27%	11,11%	72,27%	72,27%	72,27%	76,92%	80,25%	57,78%	72,38%
79	73,83%	11,11%	73,83%	73,83%	73,83%	76,92%	82,72%	62,22%	74,18%
78	75,78%	11,11%	75,78%	75,78%	75,78%	76,92%	85,71%	64,44%	75,78%
77	76,56%	11,11%	76,56%	76,56%	76,56%	76,92%	87,35%	66,67%	76,56%
76	78,52%	11,11%	78,52%	78,52%	78,52%	76,92%	90,90%	68,89%	78,52%
75	80,47%	11,11%	80,47%	80,47%	80,47%	76,92%	90,90%	71,11%	80,47%
74	82,03%	11,11%	82,03%	82,03%	82,03%	84,62%	92,72%	73,33%	82,03%
73	83,98%	11,11%	83,98%	83,98%	83,98%	92,31%	92,72%	75,56%	83,98%
72	86,72%	11,11%	86,72%	86,72%	86,72%	92,31%	92,72%	77,78%	86,72%
71	87,89%	11,11%	87,89%	87,89%	87,89%	92,31%	92,72%	79,99%	87,89%
70	88,67%	11,11%	88,67%	88,67%	88,67%	92,31%	92,72%	82,22%	88,67%

Dust-DN

**Evaluation Summary Report**

**Evaluation Result**  
Total score: 100.00 % (Threshold: 70 /100.00)

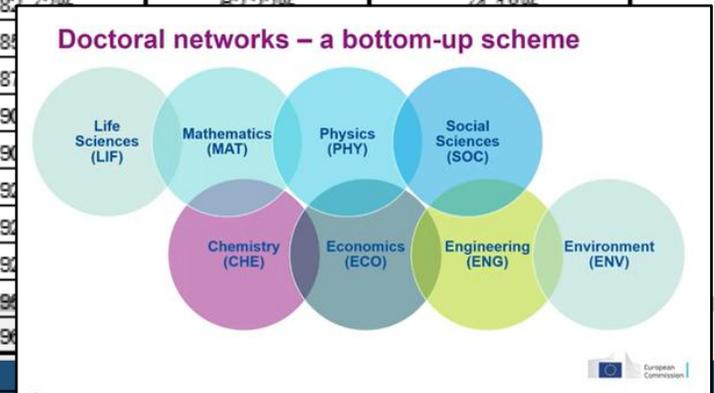
**Criterion 1 - Excellence**  
Score: 5.00 (Threshold: 3 / 5.00 , Weight: 50.00% )  
Weaknesses:  
- No significant weaknesses were identified.

**Criterion 2 - Impact**  
Score: 5.00 (Threshold: 3 / 5.00 , Weight: 30.00% )  
Weaknesses:  
- No significant weaknesses were identified.

**Criterion 3 - implementation**  
Score: 5.00 (Threshold: 3 / 5.00 , Weight: 20.00% )  
Weaknesses:  
- No significant weaknesses were identified.




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Date: 2024.03.21 18:35:20 CET





# Dust-DN partners

- 6 EU beneficiaries (Cyl: coordinator)
- 2 employing associated partners (funded by UKRI and SERI)
- 15 unfunded associated partners
- of which, 5 non-academic partners
- 9 countries represented
- one UN agency
  
- *Funded partners: **Cyl**, UÉ, NOA, BSC, TUDa, KIT, UREAD, PMOD-WRC*
- *Unfunded partners: NTUA, AUTH, MPIC, RR, MetO, KU, EY, PSA, GRASP-SAS, ECoE, WMO, ZAUM, UPC, C-TRAIL*



# The Climate & Atmosphere Research Center (CARE-C)

Prof. Jean SCIARE, CARE-C Director



## Dust-DN PhD supervisors



Franco Marengo

Theo Christoudias

Jean Sciare



Fill the gap of **OBSERVATIONS**

For a better **PREDICTION**

of the **REGIONAL IMPACTS**



Environmental Observations Dept



Environmental Predictions Dept



Environmental Impacts Dept



HPC

Construction, Test, and Operation of a large range UAV-sensor systems to probe the Environment

Weight  $\uparrow$  -40 Kg

USRL Wing(span) 6 m

UAV private airspace Permanent NOTAM

Aerial views of the UAV runway

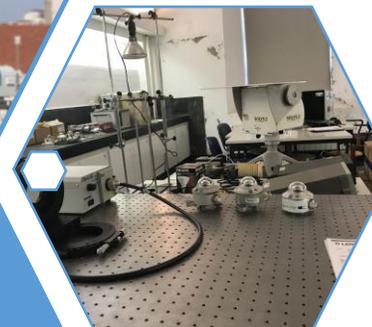
Latitude: 35°05'41.74 N  
Longitude: 33°04'53.34 E  
Altitude: 300m above sea level  
UAV runway (Nov. 2015)



UNIVERSIDADE DE ÉVORA



Maria João Costa



Atmospheric sciences observatory  
Regional network of atmospheric observational sites

Regional network of solar radiation stations  
Solar radiation sensors lab



Mobile air quality station  
Bioaerosol and aerobiology lab  
Health and environment lab



Paulo Canhoto



Célia Antunes



CREATE

CENTER FOR SCI-TECH RESEARCH IN EARTH SYSTEM AND ENERGY



CARE-C



THE CYPRUS INSTITUTE

# The ReACT research group



Vassilis Amiridis

& the ReACT team:



Eleni Marinou, Alexandra Tsekeri, Thanasis Georgiou, Anna Kampouri, Eleni Drakaki, Sotirios Mallios, Stergios Misios, Peristera Paschou, Ioanna Tsikoudi, Kelly Voudouri, Emmanouil Proestakis, Anna Gialitaki, Konstantinos Rizos, Maria Tschla, Spyros Metallinos, Kyriakoula Papachristopoulou, Dimitra Kouklaki, Iliana Koutsoupi, Ioanna Mavropoulou, George Katoufas, Stavroula Papatheochari

## In numbers:

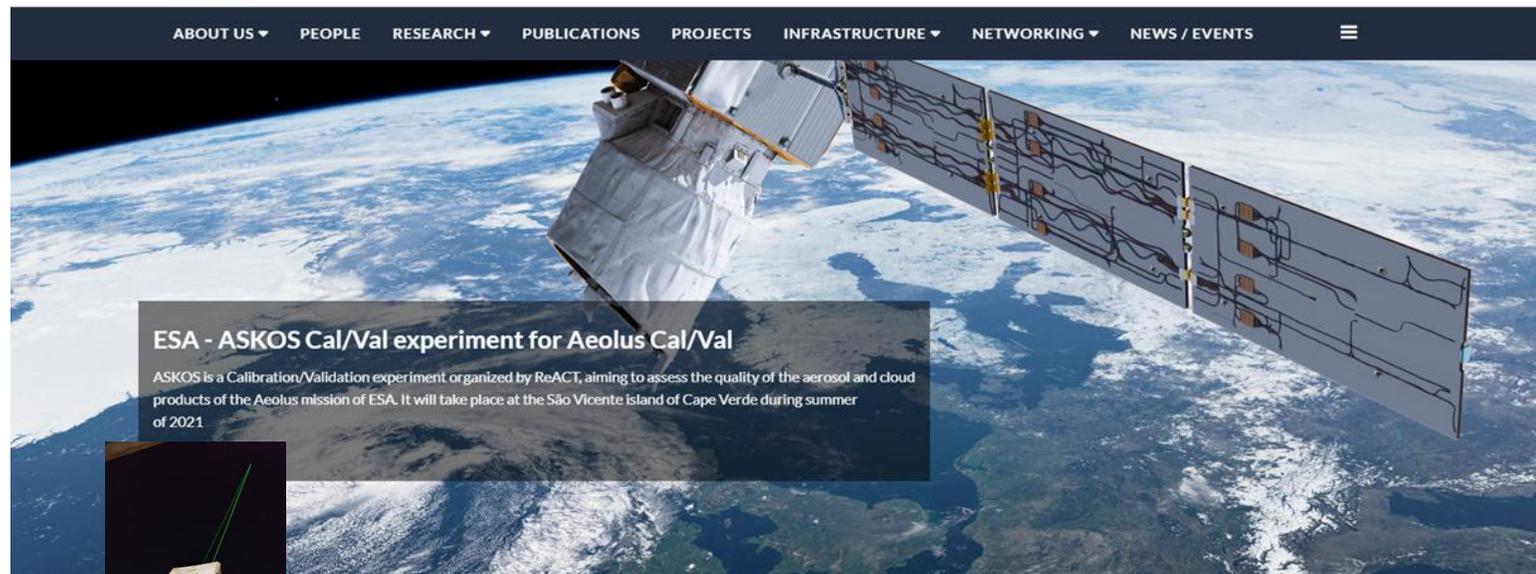
25 researchers / 6 technical support and admin

14 ESA projects / 8 EC projects (including 2 ERCs, 1 TWINNING, 2 Marie Curie)



## Scientific mission:

- ✓ Atmospheric monitoring to study the impact of aerosols and clouds on climate and weather
- ✓ Development of new lidar and radar remote sensing technologies to enhance ground-based and satellite capacity for Earth Observation
- ✓ Optimization of Earth System Models through process studies, new parameterizations and data assimilation
- ✓ Improvement of scattering and radiative transfer simulations



# Atmospheric Composition Group (BSC)



Barcelona  
Supercomputing  
Center  
Centro Nacional de Supercomputación



+ More than 40 researchers from different countries, including post-docs, PhD and MSc students.

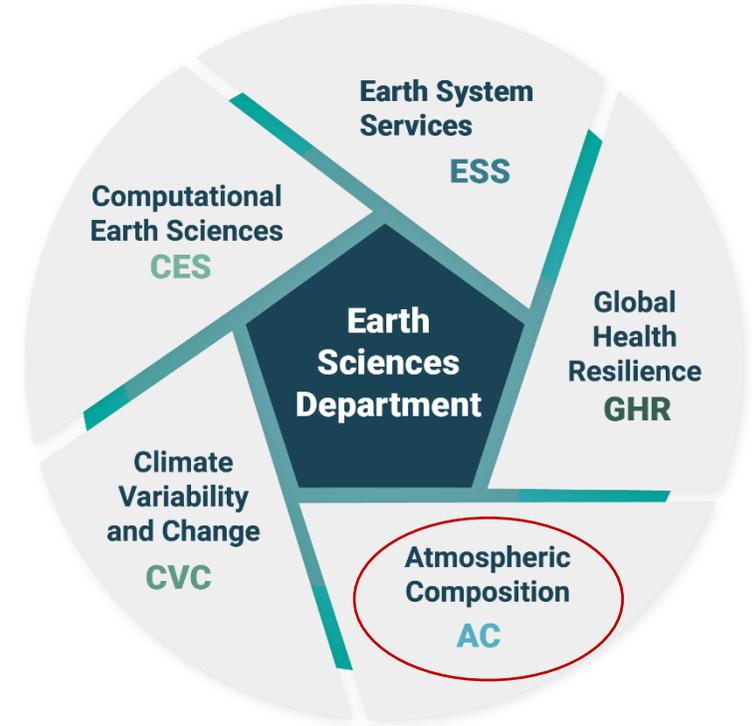
**Our aim is to understand, constrain and predict the spatiotemporal variations of atmospheric pollutants across scales along with their effects upon air quality, health, weather and climate.**

+ Strong focus on **mineral dust research and its multiple impacts on the Earth System.**

+ Model development and application (MONARCH, EC-Earth).

+ Highly collaborative environment, links with other research groups, participation in national and international projects.

**Key people:** Dr. Carlos Pérez García Pando (DC11), group leader, and Dr. María Gonçalves Ageitos (DC12), leader of the dust, aerosols and climate team.



## Infrastructure and capabilities:

+ HPC environments (Marenostrum5 supercomputer, other clusters and devoted data archive).

+ Tailored training program for Early Research Career students, links with the UPC University, participation in internal seminars.



CARE-C

# Institute for Applied Geosciences, Technical University Darmstadt



- **Institute for Applied Geosciences:**

- 9 working groups ([www.iag.tu-darmstadt.de](http://www.iag.tu-darmstadt.de))
- Wide range of modern geoscience research – focus on water, energy and environment
- Advanced analytical and microscopy labs
- Highly international environment

## Working group “Atmospheric Aerosol” – Head: Prof. Dr. Konrad Kandler ([konrad.kandler@tu.darmstadt.de](mailto:konrad.kandler@tu.darmstadt.de))



- Focus on aerosol and mineral dust
- Field and laboratory experiments, aircraft measurements
- Instrument and analytical developments
- Specialized lab for electron microscopy



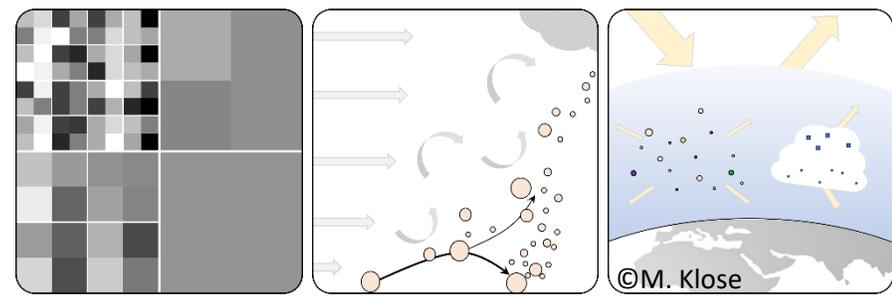


# Institute of Meteorology and Climate Research @

- KIT is the “**research university**” in the Helmholtz Association, Germany’s largest research organization
- KIT’s Atmospheric Sciences are **ranked #1 in Germany** by the Shanghai Ranking of Academic Subjects
- **Institute of Meteorology and Climate Research – Troposphere Research (IMKTRO)** at KIT:
  - 12 research groups ([imk-tro.kit.edu](http://imk-tro.kit.edu))
  - One of the biggest mobile atmospheric observation systems  **KITcube** integrated atmospheric observation system
  - One of five development partners of the **ICON** model ([icon-model.org](http://icon-model.org)) 



## Research group “Mineral Dust” – Head: Dr. Martina Klose ([martina.klose@kit.edu](mailto:martina.klose@kit.edu))



- Theory and parameterization of dust processes
- Numerical modeling and model development
- Field and laboratory experiments



Dust sources **CARE-C** Dust processes Dust impacts

©DustGroup@KIT



# University of Reading

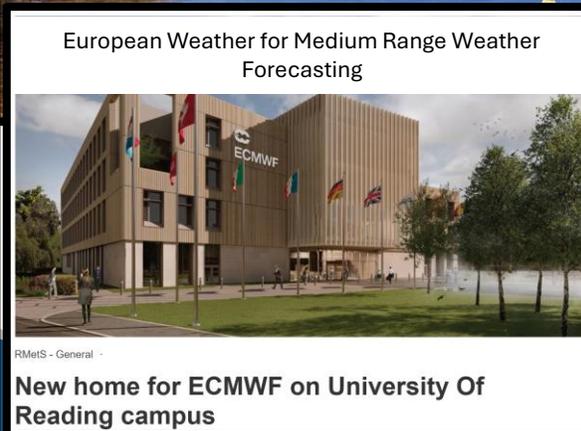
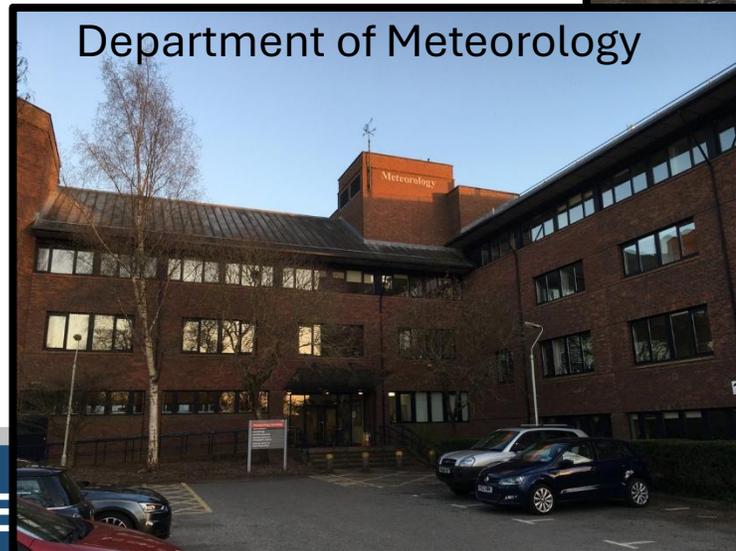
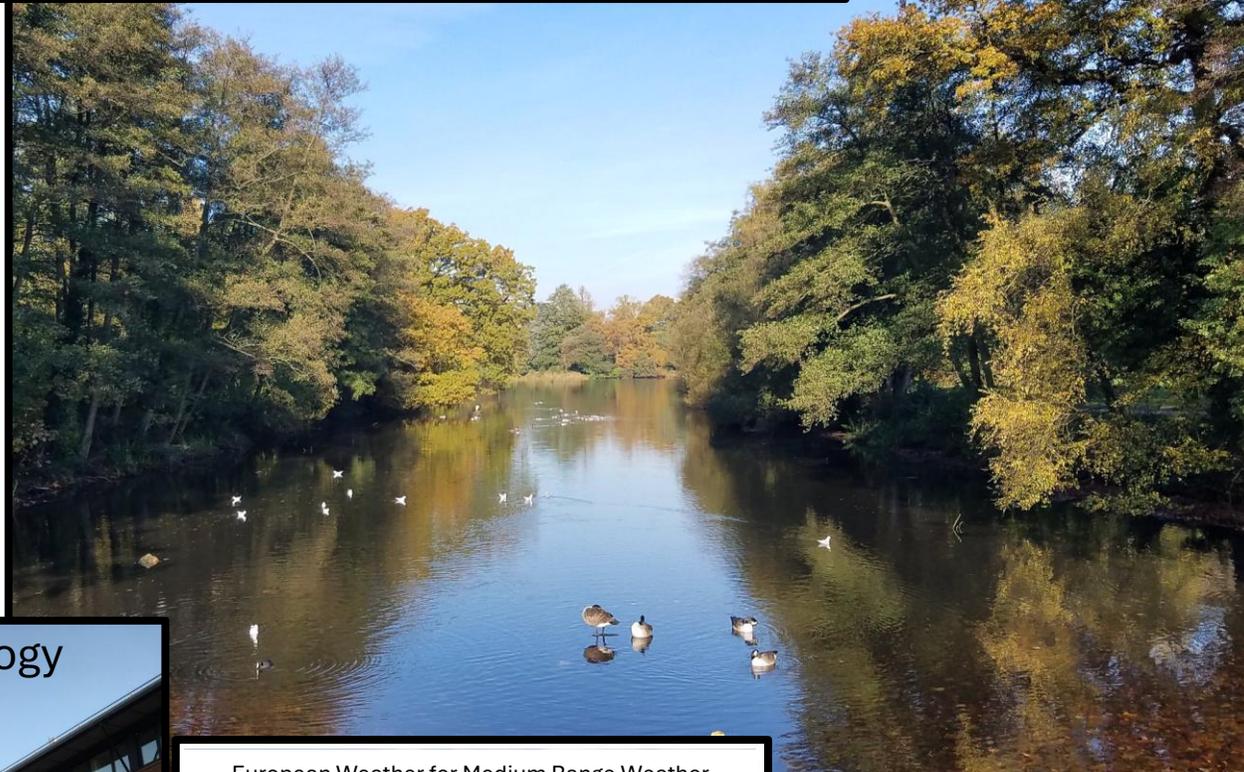
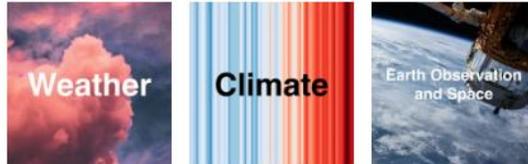
UoR Campus



## Department of Meteorology

- >200 academics & research staff
- >150 students
- ~80 PhD students
- Ranked 2<sup>nd</sup> in world for Meteorology & Atmospheric Sciences

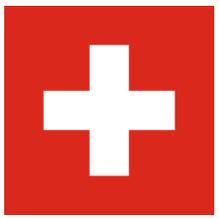
### OUR RESEARCH DIVISIONS AND GROUPS



CARE

THE CYPRUS INSTITUTE

# PMOD World Radiation Center



S. Kazadzis



WORLD RADIATION CENTER



ETH Zurich, Switzerland  
M. Wild



Department of Environmental Systems Science  
• Institute for Atmospheric and Climate Science

## Research area

- Global Energy and Water Cycle
- Radiation and surface energy budget of the Earth
- Global Dimming, Global Brightening
- Global climate change
- Global climate modelling and projections

QS World University Rankings 2025 (ETHZ)

All disciplines (global): 7<sup>th</sup>

Earth and Marine Sciences (global): 1<sup>st</sup>

Environmental Sciences (global): 7<sup>th</sup>

<https://www.pmodwrc.ch/>

<https://usys.ethz.ch/en/>



Infrared Radiometry

The Infrared Radiometry (IRS) Section maintains and operates the World Infrared Standard Group of Pyrometers (WISG)



Solar Radiometry

The Solar Radiometry (SRS) Section maintains and operates the World Standard Group which represents the World Radiometric Reference (WRR) ...



Ultraviolet Radiometry

The objectives of the World Calibration Center for UV (WCC-UV) are to assess the data quality of the Global GAW UV network, and to harmonise UV measurements ...



Atmospheric Turbidity

The World Optical Depth Res. & Calib. Center (WORCC) develops accurate radiometric references for spectral solar radiometry which are used to determine optical depth.

## Aerosol and Solar radiation research

- World Aerosol Optical Depth Research and Calibration Center
- WMO GAW PFR aerosol Network



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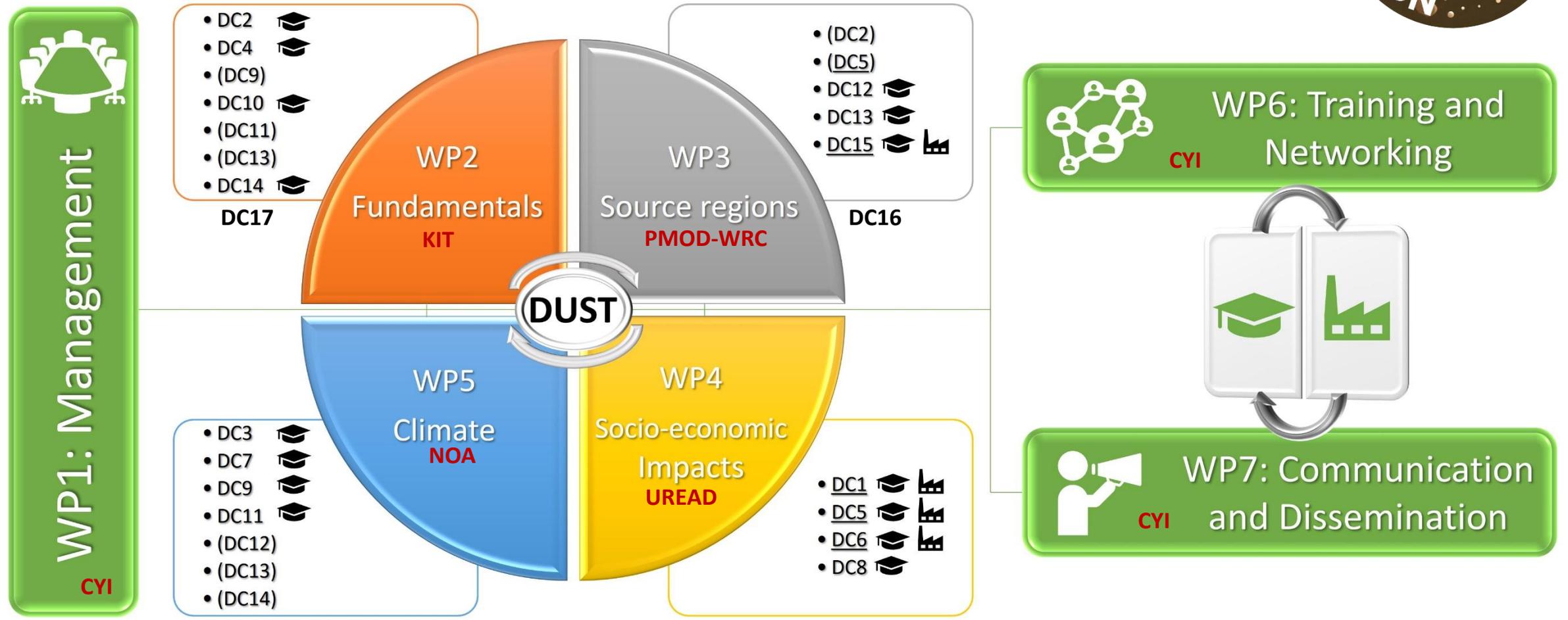
# Dust-DN associated partners

 <p>Swiss Federal Institute of Technology Zürich (ETHZ)</p>	 <p>National Technical University of Athens (NTUA)</p>	 <p>Aristotle University of Thessaloniki (AUTH)</p>
 <p>Max Planck Institute for Chemistry (MPIC)</p>	 <p>Rolls Royce (RR)</p>	 <p>Met Office (MetO)</p>
 <p>Khalifa University (KU)</p>	 <p>Earnst and Young (EY)</p>	 <p>Plataforma Solar de Almería (PSA)</p>
 <p>Generalized Retrieval of Atmosphere and Surface Properties (GRASP-SAS)</p>	 <p>Eratosthenes Centre of Excellence (ECoE)</p>	 <p>World Meteorological Organization (WMO)</p>
 <p>Zentrum Allergie und Umwelt (ZAUM)</p>	 <p>Universitat Politècnica de Catalunya (UPC)</p>	 <p>Centro Académico Clínico do Alentejo (C-TRAIL)</p>





# Work Packages





# Dust-DN Research Objectives

1. Understanding of the fundamentals of dust microphysical properties and processes → WP2
2. Identifying the influence of source regions on atmospheric dust properties → WP3
3. Socio-economic impacts of dust on health, aviation and energy production → WP4
4. Dust in the global climate system → WP5





# Our partners' unique facilities

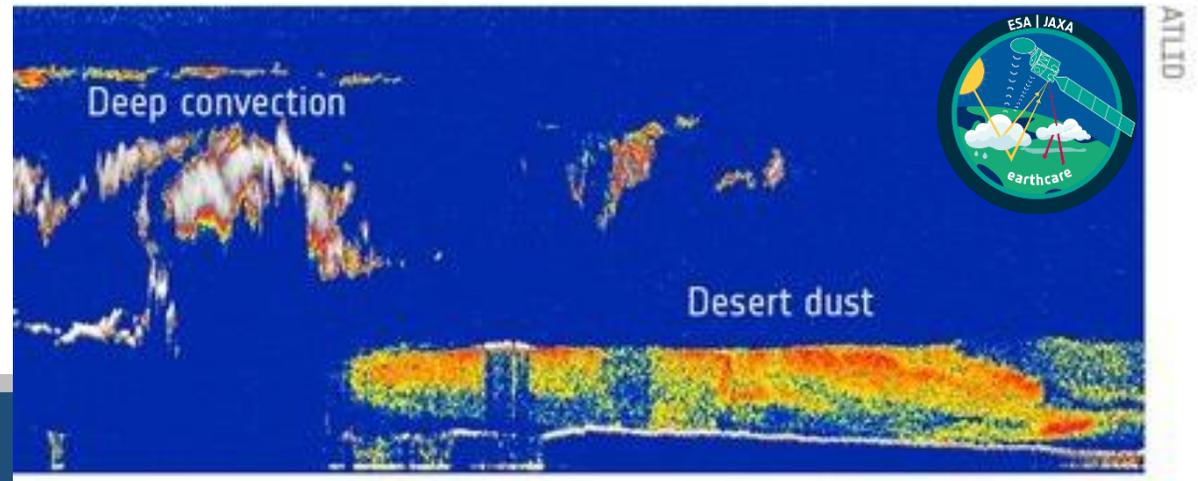
1	High Performance Computing (HPC) facilities of (a) BSC (Marenostrum), (b) Cyl (Cyclone) and (c) KIT (HoreKa), combined with advanced simulations using the (a) MONARCH + EC-EARTH, (b) WRF-Chem, and (c) ICON-ART models, respectively
2	The Unmanned Systems Research Laboratory (USRL) of the Cyl
3	The Cyprus Atmospheric Observatory (CAO) of the Cyl
4	The remote sensing facilities of NOA at the Panhellenic Geophysical Observatory of Antikythera (PANGEA), Greece
5	The Electron Microscope Center at TUDa
6	The particle settling laboratory facilities at UREAD
7	The solar radiation and aerosol measurement facilities of the WMO World radiation centre PMODWRC (includes the Global Atmospheric Watch - Precision Filter Radiometer network)
8	Concentrating technologies and solar energy generation facilities at PSA
9	Évora Atmospheric Sciences Observatory (EVASO), Biochem lab and cell culture lab, Solar Radiation Monitoring stations of Évora and Beja, Portugal (BSRN compliant), at UÉ
10	Fixed and mobile laboratory for controlled cell exposure to aerosols at ZAUM
11	The Cyprus Atmospheric Remote Sensing Observatory (CARO) of ECoE





# Leveraging on novel spaceborne missions

- NASA **EMIT** (Earth Surface Mineral Dust Source Investigation), operating since 2022, and where BSC partners are part of the Science Team.
- ESA/JAXA **EarthCARE** (Earth Clouds, Aerosol and Radiation Explorer), launched in May 2024, and where NOAA and Cyl are part of the calibration and validation team.



# Understanding of the fundamentals of dust microphysical properties and processes



DC	Beneficiary	University	Project title
2	Cyl+TUDa	Cyl+TUDa	Dust particle shape, aspect ratio and orientation: new information from UAV campaigns
4	UREAD	UREAD	Atmospheric Sedimentation of Non-Spherical Dust Particles: Developing knowledge for improvement of models
10	NOA	AUTH	New scattering database for desert dust, with realistic size, shape and refractive index measured in-situ
14	KIT	KIT	Size-dependent turbulent dust transport in idealised and realistic high-resolution simulations
17	NOA	AUTH	Ice nucleating dust particle concentration profiling and effects on ice crystal formation

# Identifying the influence of source regions on atmospheric dust properties



DC	Beneficiary	University	Project title
12	BSC	UPC	Modelling the effects of dust upon regional climate with constrained dust-source mineralogy
13	TUDa	TUDa	Variability of dust composition, shape and size distribution across the Mediterranean, based on single-particle analysis
15	PMOD-WRC	ETHZ	Identification of dust properties from different sources using sun-photometry and their effects on spectral solar irradiance
16	Cyl	Cyl	Quantification and characterisation of dust microphysical properties in the Mediterranean and Middle East, through the novel Aerotape technology



# Socio-economic impacts of dust on health, aviation and energy production



DC	Beneficiary	University	Project title
1	Cyl	Cyl	Modelling impacts of aeolian dust towards air quality policy planning
5	UREAD	UREAD	The impact of mineral dust on Aircraft Engines in the Middle East
6	UÉ	UÉ	Modelling and assessment of the impact of atmospheric dust on solar resource for energy applications
8	UÉ	UÉ	Assessment of the respiratory health impact of atmospheric dust



# Dust in the global climate system

DC	Beneficiary	University	Project title
3	Cyl	Cyl	Global dust estimation from novel space missions
7	UÉ+UREAD	UÉ+UREAD	Enhancing the understanding of dust direct radiative effect
9	NOA	NTUA	Modelling of dust transport processes. Bridging the gap between theory, observations, and models
11	BSC	UPC	Modelling super-coarse dust and its effect upon climate





# Individual PhD projects on solar radiation within Dust-DN



# DC 15: Identification of dust properties from different sources using sun-photometry and their effects on spectral solar irradiance



## Hosts

PMOD World Radiation Center  
& ETH Zurich, Switzerland

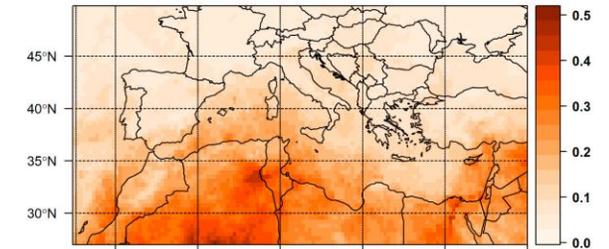
S. Kazadzis & M. Wild

**Motivation:** The direct radiative forcing efficiency of dust aerosol is an important indicator to measure the climate effect of dust and is determined by the microphysical properties of dust, which vary with dust source regions. Spectral measurements of solar irradiance could provide information on the differences of the aerosol microphysical properties, considering different dust origins (e.g. Sahara, middle East, central China).

**Goal:** Improvement of our knowledge on different dust sources effects on spectral solar radiation and contribution towards reducing the global radiative forcing aerosol uncertainties, based on their large spatial extend and the high contribution to the total aerosol load of the planet. Improvement on satellite measurement-based aerosol algorithms for different dust areas.

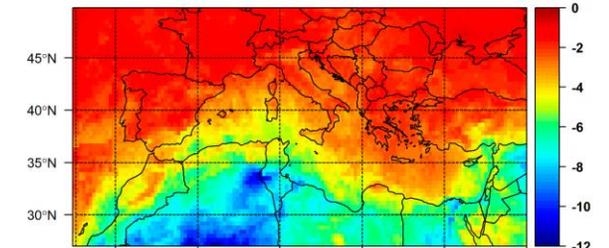


Mean MIDAS DOD at 550nm of Extreme Dust Events in 2003-2017



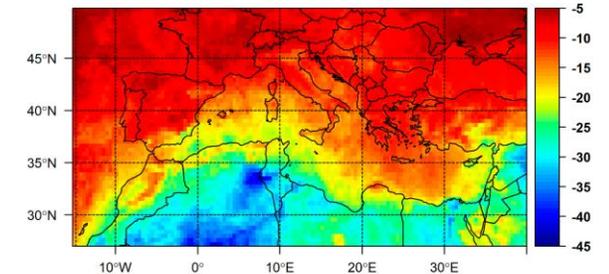
(a)

Mean GHI % attenuation of Extreme Dust Events in 2003-2017 %



(b)

Mean DNI % attenuation of Extreme Dust Events in 2003-2017 %



Extreme dust event Aerosol optical depth (up) and Mean Global (middle) and direct (down) irradiance % attenuation due to high dust aerosol events in the Mediterranean from 2003 to 2017 (taken from Papachristopoulou et al., 2022)

## Secondments

BSC/Spain, GRASP/France, ECoE/Cyprus



# Modelling and assessment of the impact of atmospheric dust on solar resource for energy applications (DC6)



## Enrolment

PhD programme on Earth and Space Sciences, University of Evora, Portugal

## Institutions

- University of Évora, Portugal
- PMOD / World Radiation Center, Switzerland



## Secondments

- Plataforma Solar de Almería, Spain
- Earnst and Young (EY), Cyprus



## Motivation and objectives

Develop new parameterizations for Direct Normal Irradiance (DNI) and Circumsolar Normal Irradiance (CSNI) under extreme atmospheric dust conditions and assess the impact on power generation of solar energy systems, aiming to improve solar resource assessment and solar radiation prediction for energy applications.

## Research approach and work plan

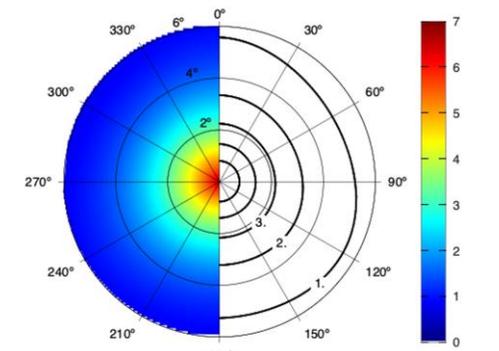
- Radiative transfer modelling (RTM) using dust properties obtained from remote sensing methods
- Develop a prototype pyrheliometer with variable field of view (FOV) for experimental validation
- Propose DNI and CSNI parameterizations for fast calculation
- Evaluation of transposition models for Global Tilted Irradiance (GTI) using the proposed parameterizations
- Assess the impact of extreme dust events on solar energy generation



PhD work plan based on the University of Évora and planned secondments at the PMOD/WRC (7 months), CIEMAT/PSA (1 month) and EY (2 months).



Radiometric station at Évora, Portugal

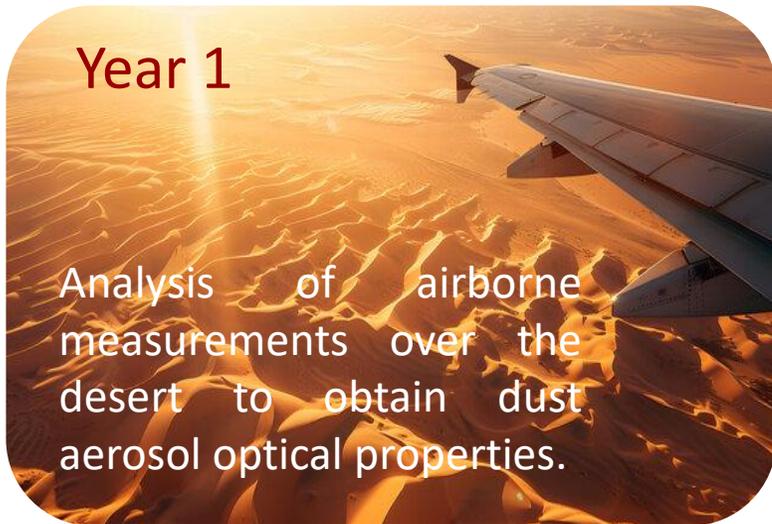


Example of RTM results for CSNI analysis

# Enhancing the understanding of dust direct radiative effect (DC7)



**Motivation and objective:** Mineral dust particles cause a radiative effect on climate. Recent work shows that super-coarse dust particles cause a net climate warming, and that radiative closure cannot be achieved without their inclusion. The aim will focus on the radiative balance over the Sahara using data from field campaigns, to explore sensitivities and the extent to which super-coarse and giant dust influences warming/cooling of the planet.



**Year 1:** University of Reading, U.K with a 2-week secondment to the Cyprus Institute.



**Years 2 and 3:** University of Évora, Portugal.



Double degree:



PhD programmes: “Earth and Space Sciences” | “Atmosphere, Oceans and Climate”

Supervision:

Maria João Costa

Claire Ryder



CARE-C





# Training and networking (T&N)

1. Training through research + Career Development Plan
2. Two network-wide summer or winter schools
3. Three network-wide workshops (back-to-back with the schools)
4. Virtual networking





# Dust-DN Supervisory Board

- The decision-making body of Dust-DN
- A senior representative of each Beneficiary (with voting rights)
- A senior representative of each EAP (with voting rights)
- The WP leaders (can advise the decision-making process)
- Two representatives of the DCs (can advise the decision-making process)





# Dust-DN coordination and management



Franco  
Marengo  
CARE-C

Dust-DN  
Principal  
Investigator



Kostas  
Fragkos  
CARE-C

Dust-DN  
Project  
Manager



Spyros  
Christou  
GS

Doctoral  
Networks  
coordination



Chrysanthia  
Leontiou  
GS

Head of CYI  
Graduate  
School





# Dust-DN project status

- Grant agreement signed in Summer 2024
- Doctoral Candidates selection in Autumn 2024
- Official project start: 1 November 2024
- 6 Doctoral Candidates have already started
- 4 Doctoral Candidates expected to start June-July
- 7 Doctoral Candidates expected to start August-September





# A great educational and scientific project

- 17 visionary PhD projects on mineral dust
- Will enhance the potential of our unique techniques / facilities
- Will further develop the partners' synergies and complementarities
- Will advance the science of atmospheric dust
- Will train **the dust experts of tomorrow**



# Feel free to follow us!

- Project website: <https://dust-dn.cyi.ac.cy>
- Short videos: [https://www.youtube.com/playlist?list=PLUFjfGLSv8dWlxF0gyj4RUhGx9f5lo5\\_W](https://www.youtube.com/playlist?list=PLUFjfGLSv8dWlxF0gyj4RUhGx9f5lo5_W)



## Social media:



[https://www.youtube.com/@Dust-DN\\_project](https://www.youtube.com/@Dust-DN_project)



<https://bit.ly/3WLJze7>



<https://bit.ly/4gXnT6l>



[https://x.com/Dust\\_Dn](https://x.com/Dust_Dn)



<https://bsky.app/profile/dust-dn.bsky.social>

## Network-wide Schools

All doctoral candidates will participate in the two summer/winter schools. The schools will address:

- scientific lectures, providing advanced knowledge on the key scientific questions and how to address them
- lectures on the latest research in the field
- familiarisation with the network and its members
- cutting-edge research in the field
- the creation of a network of researchers
- the dissemination of research results
- enjoyable social activities
- social networking

## Dust-DN workshops

All doctoral candidates will also participate in the three Dust-DN workshops (one per academic year), to:

- Have the opportunity to present and discuss their research with peers and senior researchers within the network and beyond.
- Develop their presentation skills in an informal setting, to discuss their science interests, and to network.
- Strengthen collaboration on the network's scientific objectives, on the doctoral projects by the recruited researchers, on the synergies among the partners, and on bespoke contributions from selected invited participants.

The doctoral candidates will contribute in designing the scientific format and content of the workshops, and will be invited to chair its sessions.



## Thank you for your attention.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under the Marie Skłodowska-Curie grant agreement No 101168425, as well as two national agencies: UKRI in the United Kingdom and SERI in Switzerland.

Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

