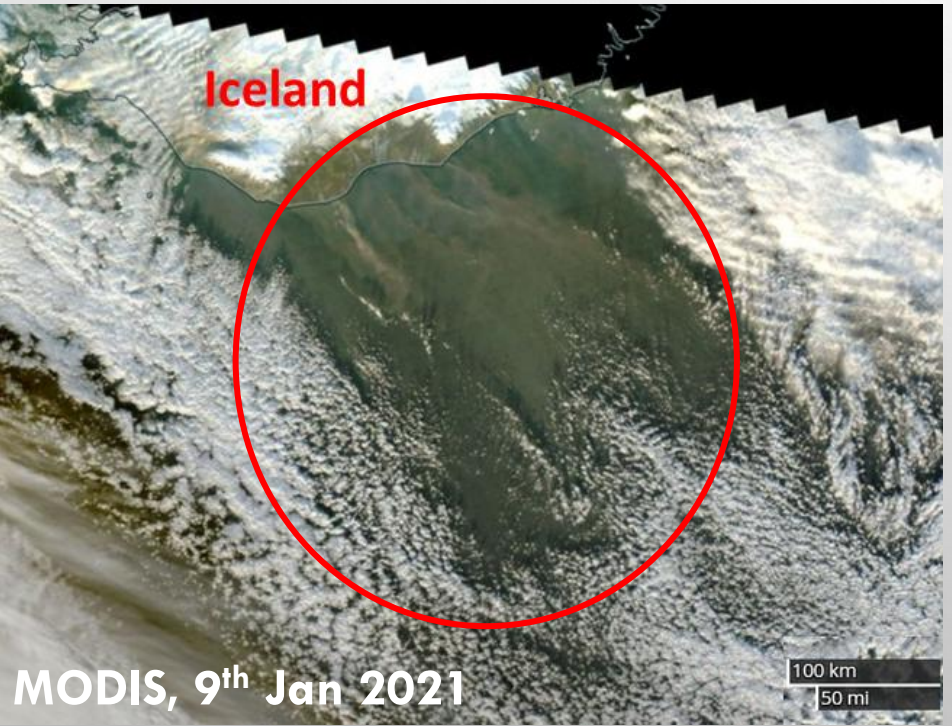
HIGH LATITUDE DUST RESEARCH: FROM OBSERVATIONS TO IMPACTS ON CLIMATE AND SOCIETY



PAVLA DAGSSON-WALDHAUSEROVA, PAVLA@LBHI.IS

O. ARNALDS, O. MEINANDER, A., BAKLANOV, A. VUKOVIC, S. NICKOVIC, J. KAVAN, B. CVETKOVIC, J-B. RENARD, B. MORONI, D. DJORDJEVIC, F. THEVENET, D. URUPINA, M. ROMANIAS, G. VARGA, A. SANCHES-MARROQUIN, B. MURRAY, J. BROWSE, C. BALDO, Z. SHI, H. OLAFSSON, M. HRABALIKOVA, AND MORE.. +

= *ICEDUST MEMBERS* >

PEEX-E-CONFERENCE, ACCC IW 2026

HELSINKI I 9 APR 2026

Key facts about HLD:

1. HLD contributes to the Arctic amplification – dust-albedo feedback (Boy et al., 2019, Meinander et al., 2022)
2. HLD was recognized as an important climate driver in Polar Regions in the IPCC report (SROCC, 2019) + AMAP (2021)
3. Dust hot spots in the Arctic are often located in ice-proximal areas with frequent floods bringing fine sediments from beneath the glaciers
4. HLD storms cause severe air pollution (even 1000x higher concentrations than health limits)
5. There are 135 dust days reported annually in Iceland and dust travels thousands of km inside the Arctic and >3,500 km towards Europe
6. HLD has impacts on atmosphere, cryosphere, marine and terrestrial environments, causing severe erosion and land degradation
7. HLD has impacts on socio-economic sectors (health, road safety, energy production, aviation, land degradation etc.)

13/11/2024: East Iceland. Jan Kavan

Swimming pool after dust storm

Damaged cars after dust storm

Snow-dust storms and dirty glaciers

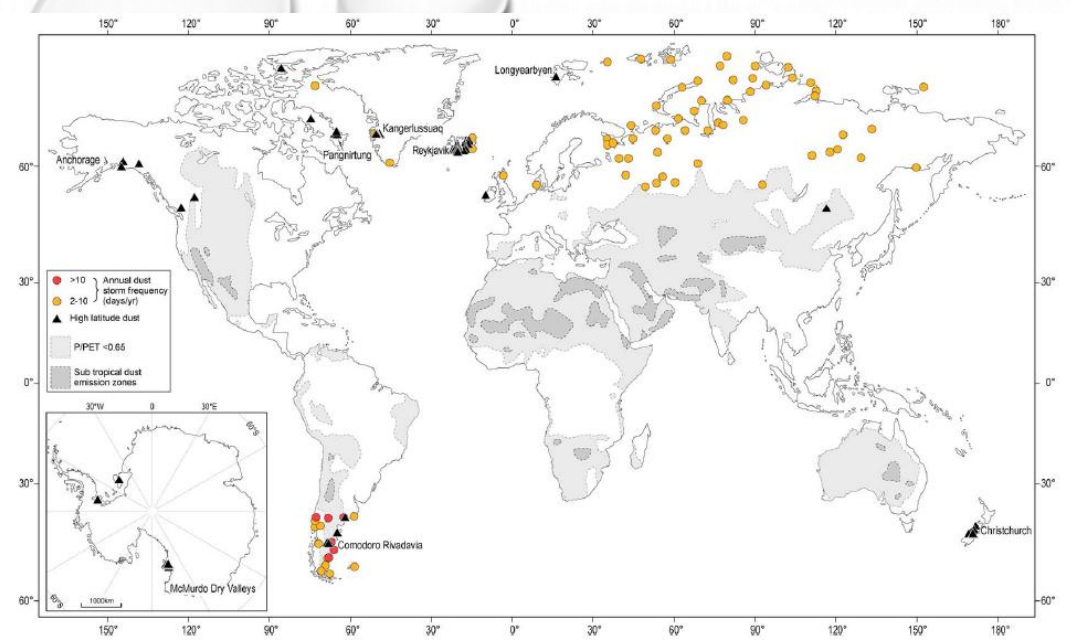


Figure 3. Global observations of high-latitude dust where filled circles indicate dust storm frequency based on visibility data, and black triangles indicate georeferenced published observations of dust storms (see text for details). Areas where the precipitation: potential evapotranspiration ratio <0.65 (aridity index) [*United Nations Environment Programme*, 1997] and subtropical dust emission zones are included for reference.

2016


AGU PUBLICATIONS

Reviews of Geophysics

REVIEW ARTICLE

10.1002/2016RG000518

High-latitude dust in the Earth system

Joanna E. Bullard[1], Matthew Baddock[1], Tom Bradwell[2], John Crusius[3], Eleanor Darlington[1], Diego Gaiero[4], Santiago Gassó[5], Gudrun Gisladottir[6], Richard Hodgkins[1], Robert McCulloch[2], Cheryl McKenna-Neuman[7], Tom Mockford[1], Helena Stewart[2], and Throstur Thorsteinsson[8]

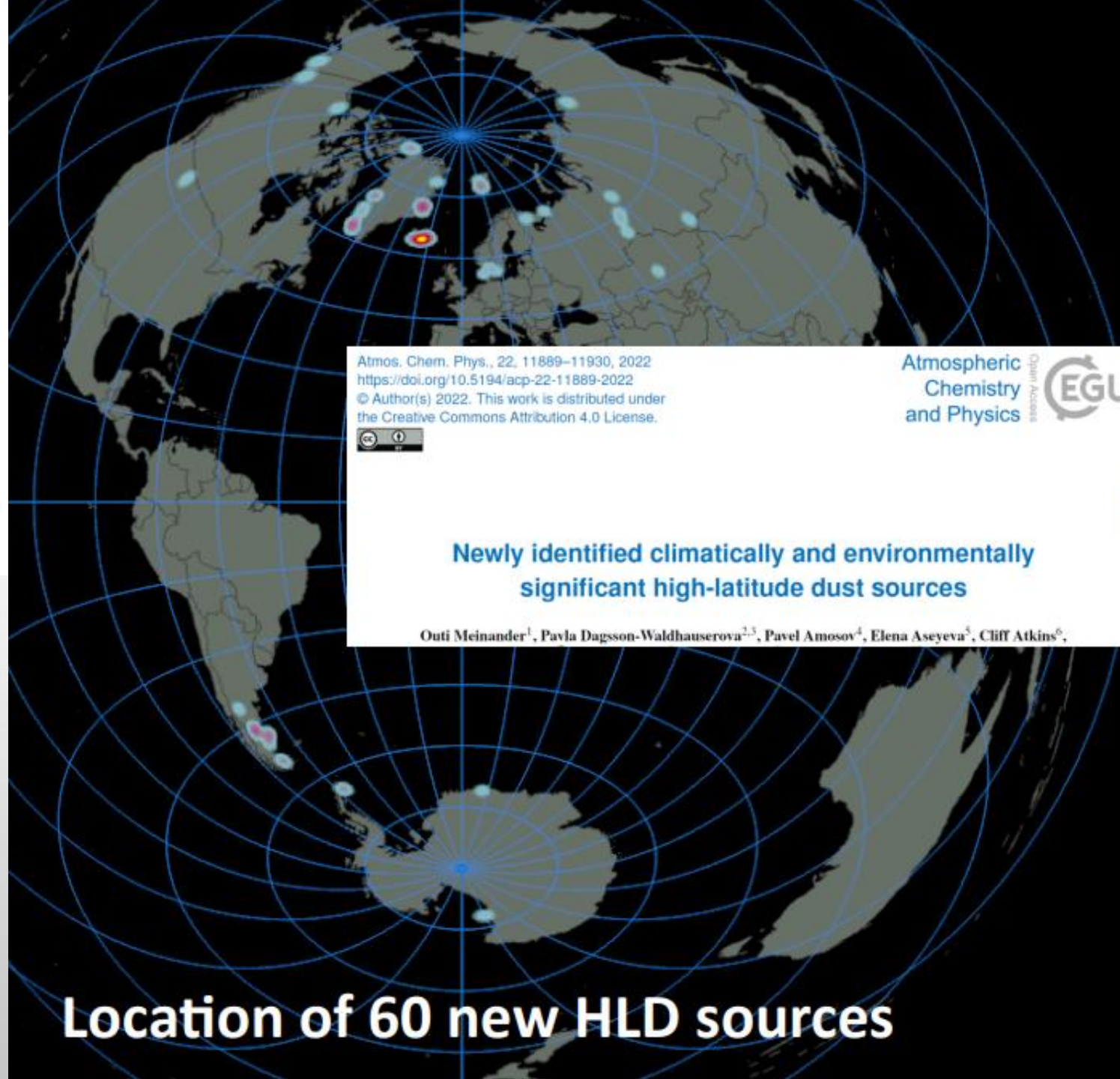
Key Points:
- High-latitude dust sources are located in paraglacial regions ≥50°N and ≥40°S

MAIN HLD SOURCES:

Northern Hemisphere (Alaska, Canada, Greenland, Iceland, Svalbard, Siberia, Scandinavia)

Southern Hemisphere (Antarctica, New Zealand, and Patagonia)

2022



Atmos. Chem. Phys., 22, 11889–11930, 2022
https://doi.org/10.5194/acp-22-11889-2022

Atmospheric Chemistry and Physics

Newly identified climatically and environmentally significant high-latitude dust sources

Outi Meinander[1], Pavla Dagsson-Waldhauserova[2,3], Pavel Amosov[4], Elena Aseyeva[5], Cliff Atkins[6],

HIGH LATITUDE DUST AREAS – UPDATED COLLECTION

Atmos. Chem. Phys., 22, 11889–11930, 2022
https://doi.org/10.5194/acp-22-11889-2022

Atmospheric Chemistry and Physics
Open Access
EGU
Research article

Newly identified climatically and environmentally significant high-latitude dust sources

Outi Meinander[1], Pavla Dagsson-Waldhauserova[2,3], Pavel Amosov[4], Elena Aseyeva[5], Cliff Atkins[6], Alexander Baklanov[7], Clarissa Baldo[8], Sarah L. Barr[9], Barbara Barzycka[10], Liane G. Benning[11], Bojan Cvetkovic[12], Polina Enchilik[5], Denis Frolov[5], Santiago Gassó[13,27], Konrad Kandler[14], Nikolay Kasimov[5], Jan Kavan[15,b], James King[16], Tatyana Koroleva[5], Viktoria Krupskaya[5,29], Markku Kulmala[17], Monika Kusiak[18], Hanna K. Lappalainen[1,17], Michał Laska[10], Jerome Lasne[19], Marek Lewandowski[18], Bartłomiej Luks[18], James B. McQuaid[9], Beatrice Moroni[20], Benjamin Murray[9], Ottmar Möhler[21], Adam Nawrot[18], Slobodan Nickovic[12,28], Norman T. O'Neill[22], Goran Pejanovic[12], Olga Popovicheva[5], Keyvan Ranjbar[22,a], Manolis Romanias[19], Olga Samonova[5], Alberto Sanchez-Marroquin[9], Kerstin Schepanski[23], Ivan Semenkov[5], Anna Sharapova[5], Elena Shevnina[1], Zongbo Shi[8], Mikhail Sofiev[1], Frédéric Thevenet[19], Throstur Thorsteinsson[24], Mikhail Timofeev[5], Nsikanabasi Silas Umo[21], Andreas Uppstu[1], Darya Urupina[19], György Varga[25], Tomasz Werner[18], Olafur Arnalds[2], and Ana Vukovic Vimic[26]

https://acp.copernicus.org/articles/22/11889/2022/

- **Active HLD sources cover > 1,670, 000 km^2** (excluding Antarctica)
- About **1-5% of the global dust budget** (~100 Tg yr^{-1} of global dust budget)
- Depostion of fine **HLD onto snow/ice** in the Arctic is **580% higher than** of **BC** (anthropogenic + wildfire)

Summary of HLD climate impacts:

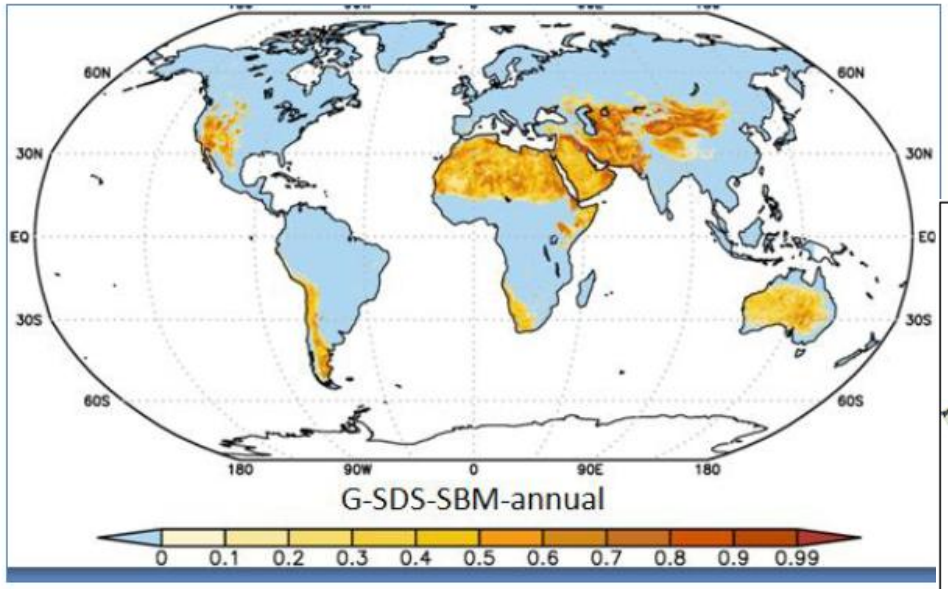
-cryosphere (albedo, insulation)

-atmosphere (radiative forcing, ice nucleation in clouds, atmospheric chemistry)

-marine environments (iron bioavalibility –> increase CO2 uptake by phytoplankton)

HIGH LATITUDE DUST AREAS IDENTIFICATION

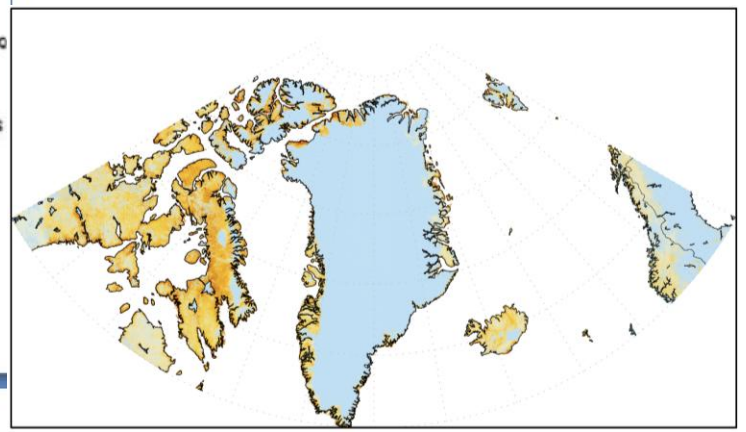
Vukovic, 2019. Sand and Dust Storms Source Base-map

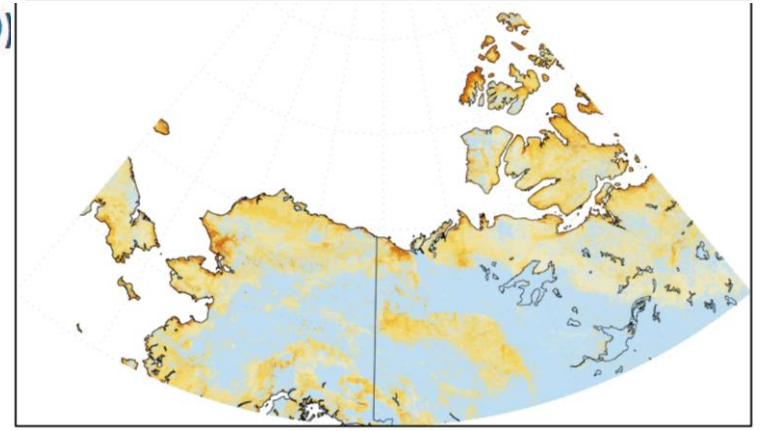


UNCCD 1km global dust mask (Ana Vukovic, 2019)

https://maps.unccd.int/sds/

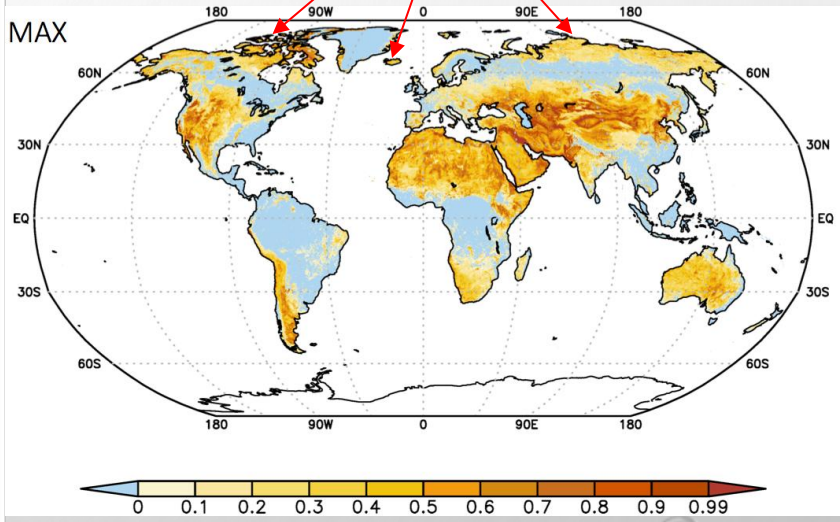
Ana Vukovic (2019)





Meinander et al. (2022)

Northern dust belt



SDS index

WMO

United Nations
Convention to Combat
Desertification

NORTHERN AFRICA-MIDDLE EAST-EUROPE (NA-ME-E) REGIONAL CENTER

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)

WMO SDS WAS || Asia Regional Center || America Regional Center

United Nations Convention to Combat Desertification

- **WMO** IS ONE OF 19 MEMBERS OF THE UN COALITION COMBATING SDS (**UN SDS COALITION**)
- **ICELAND** IS PART OF THE NORTHERN AFRICA, MIDDLE EAST AND EUROPE NODE OF THE **WMO SDS WAS**
- **ICELAND** IS THE LARGEST DESERT IN EUROPE OUTSIDE THE CASPIAN SEA AREA
- **HIGH LATITUDE DUST NETWORKS (ACTIVE TODAY):**
  - **ICEDUST** – ICELANDIC AEROSOL AND DUST ASSOCIATION
  - UARCTIC THEMATIC NETWORK ON HLD
  - CAMS NATIONAL COLLABORATION PROGRAMME ICELAND
  - *NORDDUST - COUNCIL OF MINISTERS - NORDIC WORKING GROUP FOR CLIMATE AND AIR (NKL) - MINISTRY OF ENVIRONMENT, DENMARK - PAST*

Icelandic Aerosol and Dust Association

ICEDUST ASSOCIATION

- 57 research institutions from 22 countries
- >110 members
- > 60 scientific papers published
- Member of the **European Aerosol Assembly** since 2022
- **11th HLD Workshop NOSA Assembly 9-12 Feb 2027**

AEROSOL ASSOCIATIONS OF THE **EUROPEAN AEROSOL ASSEMBLY**

Czech Aerosol Society
AT

The Finish Association for Aerosol Research
FAAR

Association Francaise d'Etudes et Recherches sur les Aérosoles
ASFERA

Israeli Association for Aerosol Research
IAAR

Italian Aerosol Society
IAS

Nordic Society for Aeosol Research
NOSA

Gesellschaft für Aerosolforschung
GAeF

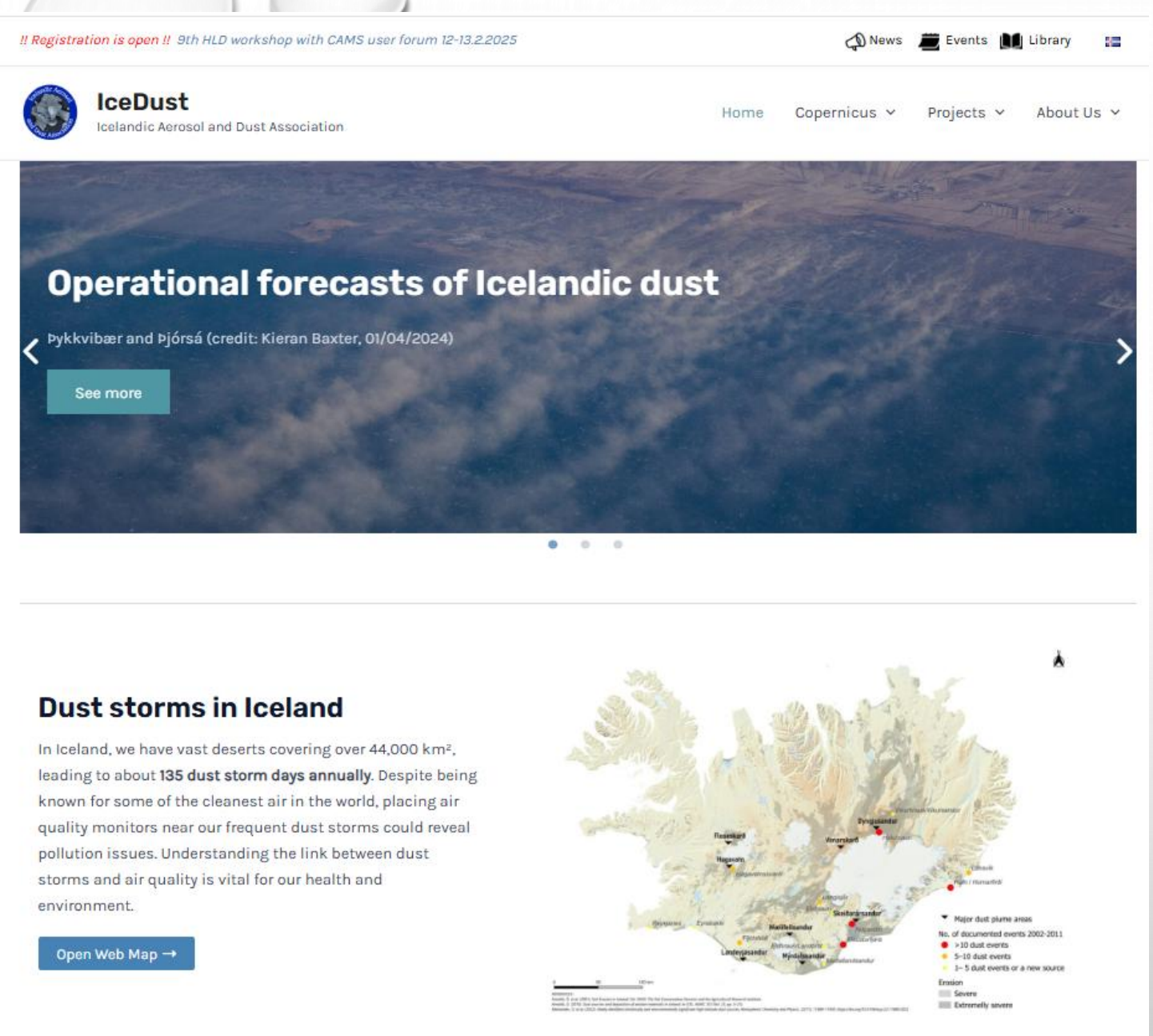
Hellenic Association for Aerosol Research
HAAR

Hungarian Aerosol Society
HAeS

Asosiación Espanola de Ciencia y Tecnología de Aerosoles
AECyTA

The Aerosol Society
AS

Icelandic Aerosol and Dust Association (IceDust)



- 57 research institutions from 22 countries
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ICEDUST ASSOCIATION Ice-dust.com

University of the Arctic (UArctic)

https://www.uarctic.org/activities/thematic-networks-and-institutes/thematic-networks-success-stories/the-past-has-shown-that-safety-climate-and-environment-have-revolved-around-high-latitude-dust/

UArctic

GIVE

Home > Activities > High Latitude Dust

Thematic Network on High Latitude Dust

Related news

- 9th High Latitude Dust Workshop 2025
- Polar Winter School on snow measurements and arctic air pollution
- How dust from Europe's largest desert is impacting the climate
- UArctic at the 2024 Arctic Circle Assembly

See All News

Related articles

- Information and past activities

Related files

- Thematic Network on High Latitude Dust presentation

Contacts

- Pavla Dagsson-Waldhauserova (Lead)
- Outi Meinander (Vice-Lead)

Goals

UArctic Thematic Network on High Latitude Dust (HLD) is an international scientific network committed to the support of research in the field of aerosol science focused on dust at high latitudes, with a main focus on Polar Regions. We are researchers, educators and innovators

Icelandic Aerosol and Dust Association

High Latitude Dust

Network

https://www.uarctic.org/activities/thematic-networks/high-latitude-dust/

ICELAND INCLUDED IN THE UN SDS TOOLBOX

United Nations Convention to Combat Desertification

Land & life | Our work & impact | Science | News & stories | Events | Convention

Home / Land & life / Sand & dust storms

Sand and Dust Storms Toolbox

Overview | Coalition | News & stories | Toolbox | Resources

- Getting started
- Mapping SDS sources
- Observation, monitoring, forecasting & early warning
- Risk and vulnerability assessment
- Source control and management
- Impact mitigation
- About the toolbox

Sand and Dust Storms Toolbox

The SDS Toolbox provides tools, guidance and information which can be used to identify the sources of sand and dust storms, develop and implement management policy, plans and strategies, assess risks and vulnerabilities to SDS, understand how to observe, monitor, forecast and provide warnings of SDS and develop and implement ways to mitigate the impacts of sand and dust storms.

INTRODUCTION
Getting started
EXPLORE THE TOOLBOX

MODULE 1
Mapping SDS sources
EXPLORE TOOLS AND GUIDANCE

MODULE 2
Observation, monitoring, forecasting & early warning
EXPLORE TOOLS AND GUIDANCE

MODULE 3
Risk and vulnerability assessment and mapping

MODULE 4
Source control and management

MODULE 5
Impact mitigation

Dust storms and health

Find out more about health risks of windblown dust, particularly its impact on respiratory health and what to do during a dust storm.

Source: *Windblown Dust and Dust storms & your health - Department of Ecology, Washington State, ecology.wa.gov.*

WMO Airborne Dust Bulletins

The World Meteorological Organization publishes anually a report on the incidence and hazards of sand and dust storms, which have a major impact on air quality, health, the environment, agriculture and economies.

The latest Airborne Dust Bulletin can be found here: WMO Airborne Dust Bulletin No. 8 – July 2024.

Operational forecasts of Icelandic dust

Iceland has several SDS source locations with dust storms occurring across all months of the year. Operational forecasts of near surface dust for Iceland are available for a 72 hr. period at three hour increments from dustforecast.lbhi.is. The forecasts can be useful in avoiding dust events while traveling by road and planning visits within the country.

Icelandic Aerosol and Dust Association (IceDust)

Iceland has the largest desert in Europe and experiences an average of 135 dust days per year. The Icelandic Aerosol and Dust Association (IceDust) provides (1) a venue for collaboration on aerosol research in Iceland, (2) a mechanism for communication between researchers focusing on dust events in Iceland and (3) a source of information for the general public on aerosol processes linked to air pollution, atmosphere-cryosphere interactions, volcanic ash resuspension, health and environmental effects of particulate matter.

More information on IceDust can be found at https://ice-dust.com and https://icedustblog.wordpress.com

Thematic Network on High Latitude Dust

The Thematic Network on High Latitude Dust, an activity of the University of the Arctic (UArctic), provides a mechanism for sharing research and networking on dust at high latitudes. Thematic Network encompasses more than 110 scientists working in 53 institutions across 21 countries, holds periodic meetings and, through a link with IceDust, provides access to publications on dust and Iceland.

https://www.unccd.int/land-and-life/sand-and-dust-storms/toolbox/public-information?fbclid=IwY2xjawIgbltleHRuA2FlbQIxMAABHdcRWPIXM8imebhm48e9Dn_SSh2toLMzA31llF1pmWowj7We4K6tMePi-Q_aem_j1zy5ZwKv8oNdX1KBx7dUQ

https://www.unccd.int/land-and-life/sand-and-dust-storms/toolbox/research-information-sources?fbclid=IwY2xjawIgbl5leHRuA2FlbQIxMAABHdcRWPIXM8imebhm48e9Dn_SSh2toLMzA31llF1pmWowj7We4K6tMePi-Q_aem_j1zy5ZwKv8oNdX1KBx7dUQ

Sand and dust storms

WORLD METEOROLOGICAL ORGANIZATION

"Sand and dust storms (SDS) are common natural hazards occurring when strong winds lift sand and dust from dry soils into the atmosphere, transporting particles over vast distances"

"3.8 billion people are affected by sand and dust storms around the world"

ipcc
INTERGOVERNMENTAL PANEL ON climate change

"Climate change impacts on dust and sand storm activity remain a critical gap"

World Health Organization

"Sand and dust storms contribute to air pollution, posing a significant public health concern, particularly for respiratory and cardiovascular diseases"

UN environment programme

"Sand and dust storms are a global environmental problem"

United Nations Climate Change

"2025–2034 the Decade on Combating Sand and Dust Storms"

Copernicus Atmosphere Monitoring Service

CAMS National Collaboration Programme – Iceland

Title of Project: Air Quality Monitoring and CAMS Integration in Iceland, Phase 2

Contractor and Subcontractors: Agricultural University of Iceland, Icelandic Environment and Energy Agency, Natural Science Institute of Iceland

WPs:

- **WP20** Direct use
- **WP50** In situ

Project Duration: 36 months
Start Date: July 1, 2025
End Date: June 30, 2028

Pavla Dagsson-Waldhauserová[1], Michaela Hrabalíková[2], Hlynur Árnason[3], Slobodan Nickovic[1,4], Bojan Cvetkovic[4], Ana Vukovic[5]

[1] Agricultural University of Iceland, [2] Natural Science Institute of Iceland, [3] Icelandic Environment and Energy Agency
[4] Republic Hydrometeorological Service of Serbia – SEEVCCC, [5] Faculty of Agriculture, University of Belgrade, Serbia

CAMS NCP ICELAND TO IMPROVE AIR QUALITY MONITORING IN ICELAND

S2, Sept 5, 2024, 13:03

Activities on aerosol and dust

National Collaboration Programme – Iceland

Pavla Dagsson-Waldhauserová[1], Michaela Hrabalíková[2], Hlynur Árnason[3], Slobodan Nickovic[1,4], Bojan Cvetkovic[4], Ana Vukovic[5]

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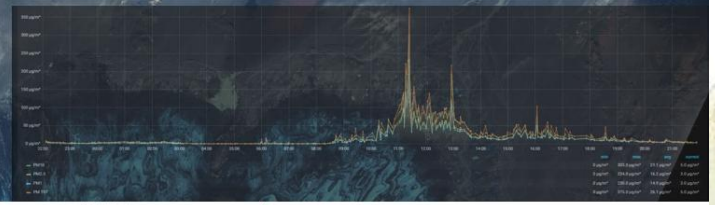
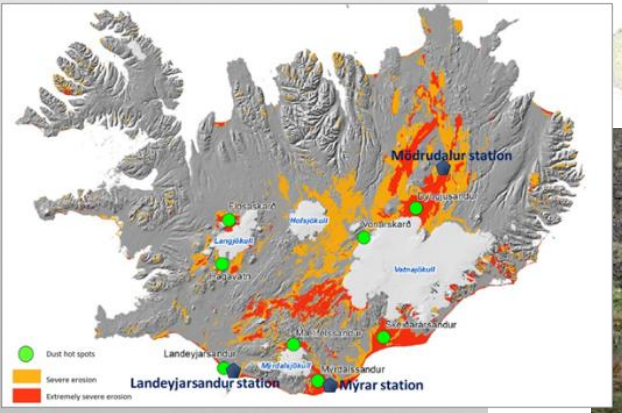
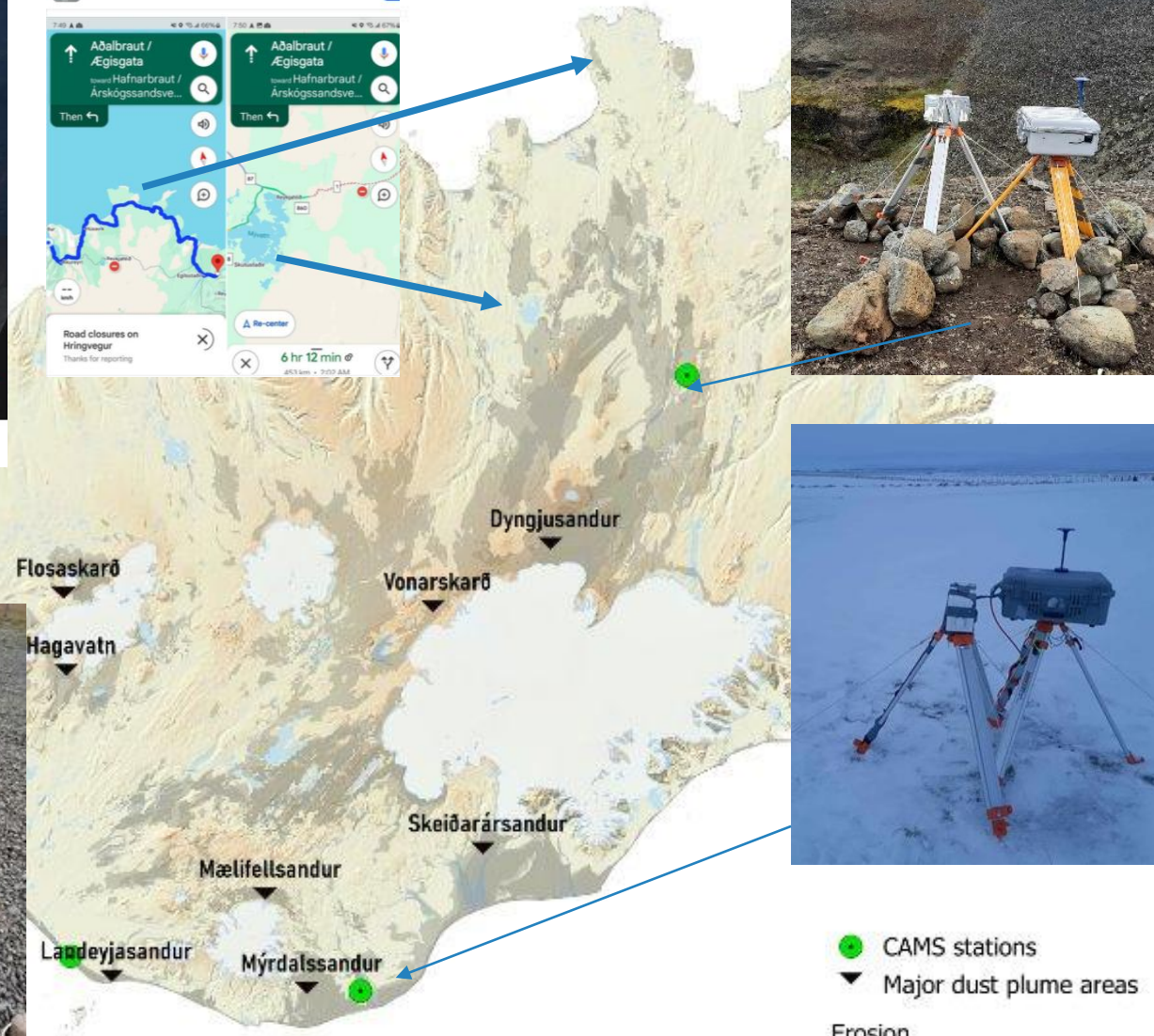


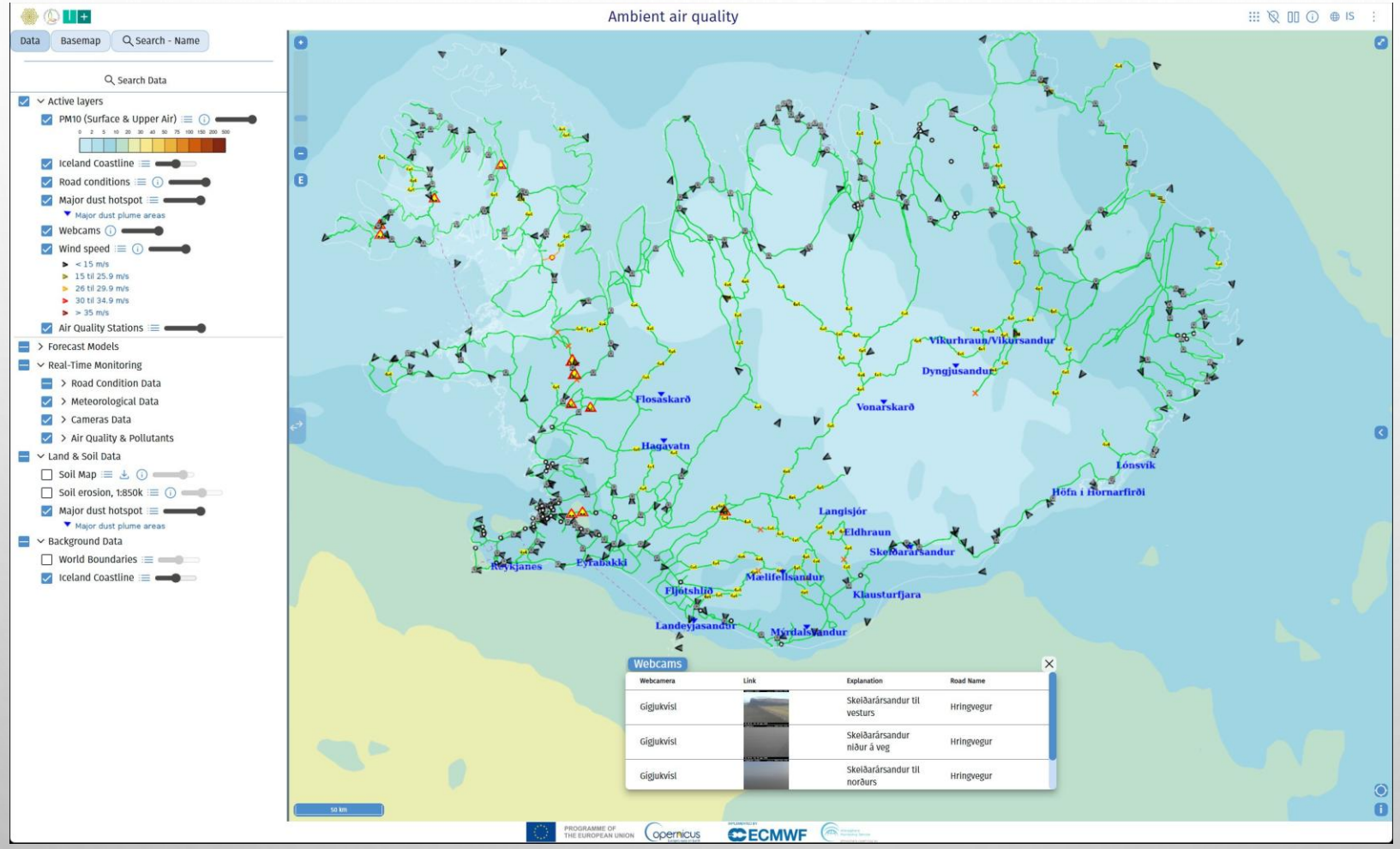
PROGRAMME OF THE EUROPEAN UNION | Copernicus | ECMWF | Landbúnaðarháskóli Íslands Agricultural University of Iceland | Natural Science Institute of Iceland





https://atmosphere.copernicus.eu/iceland

CAMS NCP ICELAND – AQ WEB APPLICATION



https://kort.gis.is/mapview/?application=loftgaedi_prufa

FLOODING IN THE DESERT

1 NIGHT 25-28 CM OF NEW SEDIMENT

Fluvio-aeolian environment exists!

Where does the dust come from?

Glaciers, not volcanoes

BLACK DUST GETS BRIGHTER WITH SMALLER SIZE

Light-absorbing capacity of volcanic dust from Iceland and Chile

frontiers | Frontiers in Earth Science

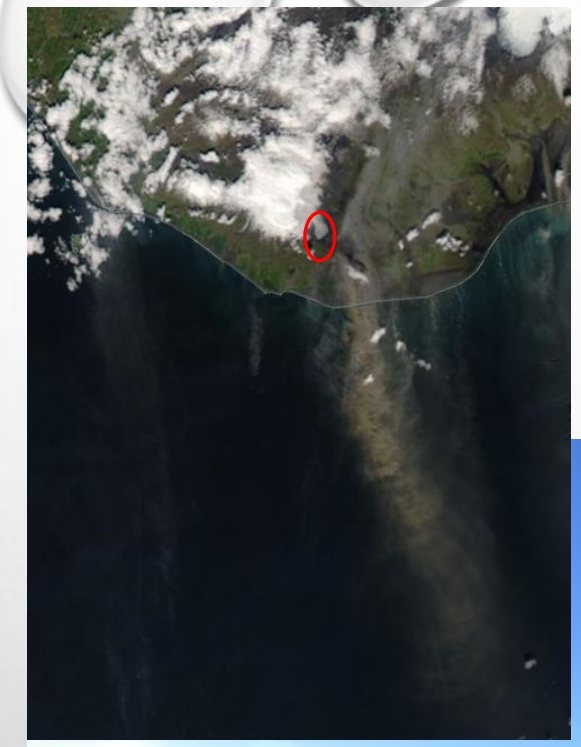
Taru F. A. Koivusalo[1*†], Pavla Dagsson-Waldhauserová[1,2], Maria Gritsevich[3,4,5] and Jouni Peltoniemi[4]

FINNISH GEOSPATIAL RESEARCH INSTITUTE – GONIOSPECTROMETER

THE **ALBEDO OF ICELANDIC VOLCANIC SAND WAS 0.03-0.06** IN THE VISIBLE SPECTRUM OF 400-700 NM.

Figure 5. Samples in measurement trays. In a) Volcanic sand from Iceland 2016 can be seen as un-sieved, above 500 µm, above 250 µm and above 125 µm. In b) the same sample as in a but sieved to under 125 µm. Picture c) shows glaciogenic silt sample. In d) from left to right Chile sample 1 un-sieved, above 500 µm, above 250 µm, above 125 µm, below 125 µm and lastly the Chile sample 2.

https://www.frontiersin.org/journals/earth-science/articles/10.3389/feart.2024.1348082/full



PLANETWATCH BY ENLAPS

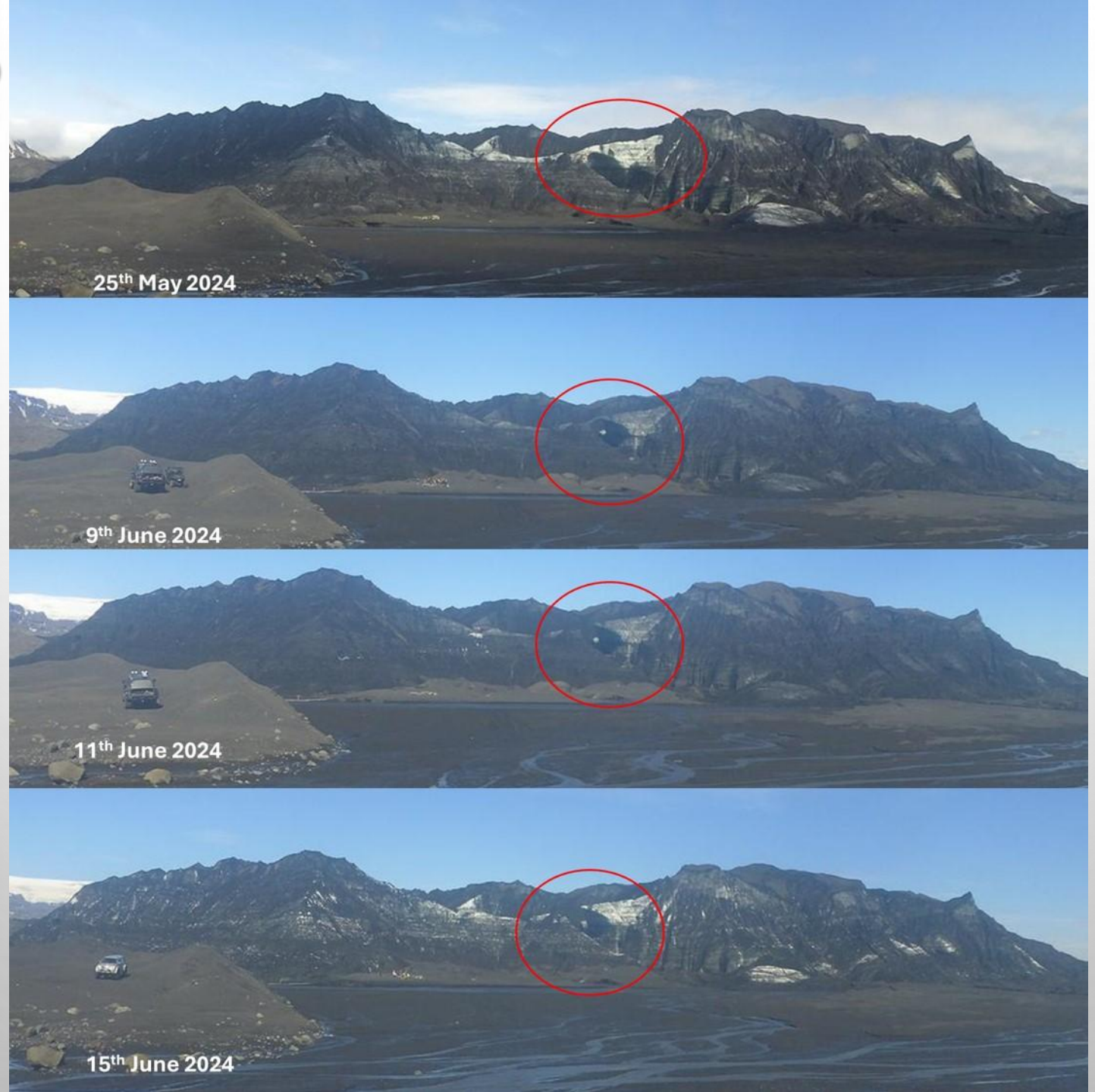
#PlanetWatch by Enlaps
https://enlaps.io/planet-watch

International Year of Glaciers Preservation, initiated by UNESCO and the WMO (World Meteorological Organization)

Already deployed in over 100 glaciers monitoring projects

https://my.tikee.io/projects/242808/timelapse

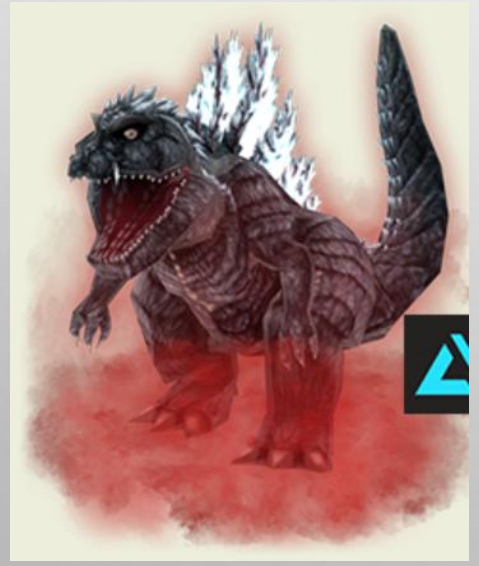
Collapse of ice cave in Kötlujökull on 10th June 2024



DUSTHILA

DUST CHANGING THE HIGH LATITUDES

DUSTHILA is coming!
2026-2029 – Iceland, Antarctica, Greenland, and Svalbard >>
>>Arctic Dust forecast model



rannís

Project grant: 2612250-051

Icelandic Research Fund

1.1 Project

Title in English*
Dust Changing the High Latitudes

Title in Icelandic*
Áhrif ryks á heimskautasvæðum

Abstract in English*

Earth´s climate is changing and high latitude regions experience the most pronounced climate changes. High Latitude Dust (HLD) is an important climate driver in Polar Regions (Intergovernmental Panel on Climate Change, IPCC SROCCC, 2019). HLD accelerates climate change via dust-snow/glacier feedback (albedo reduction, melting after dust deposition) and directly and indirectly (cloud microphysics) affects the radiative properties in the atmosphere. There is a crucial need and gap in understanding the HLD-climate interactions, but only limited in situ measurements and dust forecasting are available (Arctic Monitoring and Assessment Programme, AMAP 2022 report, and WGI IPCC AR6). UN Coalition on Combating Sand and Dust Storms (UNCCD) identifies dust storms, including HLD, as a hazard that affects 11 of the 17 Sustainable Development Goals. HLD storms impair the air quality causing damages to health, affect the economy by disrupting transportation, and disturb vulnerable ecosystems. DUSTHILA project is to fill this gap with i. continuous comprehensive observation of HLD with in situ measurements in Iceland, Antarctica, and new measurements in Greenland and Svalbard; ii. Arctic dust forecast for the Arctic region; and iii. coordination of HLD research with the IceDust Association

Dyngjusandur, NE Iceland

= Bodele of the North

Waiting for the HLD

Thank you for your attention!

pavla@lbhi.is

➢ **11th HLD Workshop + NOSA Assembly**

9-12 Feb 2027

Feel free to send me an email for questions and recommendations