SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA16202
STSM title:Morphochemical characteristics and mixing state of Icelandic dust reaching the Arctic (IceDeA)
STSM start and end date: 15/08/2020 to 30/08/2020
Grantee name: Beatrice Moroni

PURPOSE OF THE STSM:

Dust affects weather and climate in the Arctic region.The basic purpose of this STSM was to provide a contribution to the characterization of the main dust sources and products in Central-Southern Iceland with particular regard to the dust component capable of being transported over great distances towards Svalbard, an international observatory of climate change in the Arctic. The project was built around three main objectives of COST Action CA16202:

inDust O1: Establish a **network** involving research institutions, service providers, and end users of information on airborne dust.

inDust O2: Identify and exploit dust monitoring **observations** best suited to be transferred/tailored to the needs of end-users.

inDust O3 (slightly modified): Enhance the **cooperation** of the EU institutions (Italy, Germany) with the European Arctic remote areas institutions/observatories (Svalbard, Iceland).

The core of the mission was to carry out an intensive survey and sampling campaign of the local sediments, the resuspended dust and the aerosols in the main Icelandic deserts in the period of greatest frequency and intensity of dust emissions from Iceland towards the Arctic. The project has been conceived to integrate with other projects active on the ground, all focused on the determination of the type and extent of the Icelandic contribution amongst the High Latitude dust sources over long-range transport routes. In this respect the detailed characterization of sediments and dust particles in distinct size ranges was found to be the linking point between measurement and modeling of Icelandic dust production and transport to the Arctic. This led to the possibility of enhancing the cooperation with researchers of the Icelandic Aerosol and Dust Association (IceDust) participating to the SIOS (Svalbard Integrated Observing System) consortium and/or the SSF (Svalbard Science Forum) RiS portal.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSM:

Most of the work was carried out in the field (Fig. 1) and involved a team including the Host (Dr Pavla Dagsson Waldhauserova, PDW), a technician (Sigmundur Brink, SB), three students (Brian Barr, Alexandr Vítek, Nathalia Burdovà), and the Grantee of course.

At Vestmannayjar (VES) a quick survey of the island was performed thanks to Dr. Erpur Snær Hansen, director of the South Iceland Nature Research Centre. Contrary to our expectations, the high-volume air sampler located at Stórhöfði (63°23.885'N 20°17.299'W, 118 m asl) was found to be working and in good conditions. Glass fiber filters ideal for bulk chemical analysis were also available on site.

The dust hotspot in the Myrdalssandur desert (MYR) was visited on the way back from VES. There the Grantee was involved in replacing one monitoring camera with a new, more sensitive and functional instrument as a part of the activities carried out by the local research team (https://highlatitudedust.wordpress.com/cameras/). Sediment, dust and aerosol samples were collected in two distinct sites (Fig. 2).

Having a small dust event occuring at the desert, we not only collected the aerosol samples, but measured dust concentrations with DustTrak aerosol monitor.
The second field trip had its first stop at Grimsstadir (Fig. 1) to check on installed TSI DustTrak and Optical Particle Counter which is part of the HiLDA RiS project (https://www.researchinsvalbard.no/project/9119). The team then moved to the Askja Natural Reserve. Location of a new monitoring camera of the dust events occurring on the flood plain was discussed with the German colleagues of the HiLDA project present on site (Kornad Kandler, KK, and Kerstin Schepanski, KS). The camera was installed on Aug 25. The next day, Aug 26, was completely dedicated to sampling. The Grantee sampled in two sites on the Dyngjusandur (DYN) dust hot spot, which is one of the most active dust sources in Iceland with a direct LR transport towards the Arctic, specifically Svalbard. There we experienced massive local dust plumes (Fig. 3) that turned into a dust storm at the end of the day.
The last day before departure (Aug 28) was spent in Reykjavik at the Agricultural University of Iceland (AUI). There the Grantee had a meeting with Prof. Olafur Arnalds (OA) who introduced her to the properties of the loose sedimentary formations subject to resuspension in the dust hot spots, with special regard to issues related to their lateral/vertical variability. They also discussed with the Host the terms and contents of two papers to be submitted to the Special Issue of the journal *Atmosphere*, edited by the Grantee as Guest Editor, entitled “Long-Range Transport of Dust over the High-Latitude Regions”. A meeting with the HiLDA project members was also organized on the same day to see how Svalbard research can be implemented into the project and contribute each other. The last day was also dedicated to bibliographic search on local pedology and geochemistry.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

1. Development and exploitation of the dust monitoring system in Iceland

We were able to verify that the VES high volume sampler works and is in use by the Icelandic Met Office (IMO). Since dust is frequently transported here from different dust sources in Southern Iceland, the intent is to activate standard samplings at regular time intervals and / or targeted samplings and measurements during the dust events at VES. To this aim IMO has been contacted for details on future utilization of this instrument also for our purposes The Grantee, on turn, has expressed her interest and the availability from her Home Institution to carry out ICP-AES and ICP-MS analyses on these samples to partially contribute to HLD project objectives of PDW (as co-proposer).
This action fulfills inDust O1 objective as it points at establishing a better integrated network between our research institutions and the IMO service provider for the development and the optimization of ground-based dust monitoring observations made available to different end-users (local health and environmental agencies, general public) for the benefit of the Icelandic population and the European community through health/dust warnings and rising awareness on the impact of Icelandic dust on health, weather and climate.

2. Development and exploitation of ground-based dust monitoring measurements and analyses

The sampling campaign covered two main Icelandic deserts as the source areas of the dust LR transported to the Arctic. It was performed during local dust events. We obtained aerosol samples, resuspended dust samples and sediment samples from distinct hot spots. The aerosol samples will undergo SEM and ICP-MS analyses of portions of the filters. The sediment samples, on turn, will be resuspended in the dust generation/resuspension/sampling chamber in use at the Home Institution, and separated using an Andersen multistage sampler into eight different particle size classes. The separates will be analyzed at the Home Institution for bulk chemistry, mineral chemistry and for mineralogy by ICP-MS, SEM-EDS and XRD methods, respectively. This approach will allow us to study in detail the nature and composition of dust in different particle size ranges and, therefore, to establish any relationships between the nature of particles and their mobility / transport capacity from the hot spots. This is expected to be the topic of a dedicated paper to be completed next year.
This action fulfills inDust O2 objective. In fact the detailed characterization of Icelandic dust as a distinct aerosol type in the Northern hemisphere dust scenario is the starting point for identification of the different emission sources and the quantitative assessment of their respective contribution to the dust load on the Arctic. Research results will be made directly available to expert end-users (climate and environmental researchers, dust modeling and remote sensing communities) to contribute to dust forecast and Arctic protection. In particular, in situ dust monitoring observations in Iceland will serve to better simulate the atmospheric cycle of Icelandic dust (e.g., DREAM_iceland operational model), while integration between in situ observations and satellite-based measurements (e.g., those by NOA) will serve to better understand the parameterization of Icelandic dust LR transport towards the Arctic and Europe and implement dust forecast products.

3. Establishing a network of researchers

Thanks to this STSM the Grantee had the opportunity to meet and plan further activities with the following IceDust Associations members: PDW, OA, SB from Iceland (additionally three students engaged in the HLD project), and KK, KS from Germany. Direct cooperation within this pool of experts is focused on the

relationships between the properties of Icelandic dust emissions and the aerosol properties at a receptor site in the Arctic (Ny-Ålesund, Svalbard). In this regard the Grantee has just obtained the submission of a manuscript by the Host research team to the above mentioned Special Issue of *Atmosphere* (https://www.mdpi.com/journal/atmosphere/special_ issues/dust_high_latitude_regions). A second contribution, titled "Potential source contribution function analysis of long-range transport of Icelandic dust over the Arctic", is a joined paper by the Grantee and the Host research groups based on discussions held both at AUI and during the field trip. These results clearly point to the active cooperation between our EU Institutions operating in the framework of different European Arctic remote areas institutions/observatories (inDust O3 objective).

FUTURE COLLABORATIONS (if applicable)

We believe in collaboration with our German colleagues of HiLDA project by combining our data on resuspension tests with their observations on the ground and with their transport models.
A distinct area of cooperation, which emerged after the meeting with Prof. Arnalds, regards student mobility to and from Iceland. As a teacher involved in many mobility projects assisting young student training in STEM disciplines, the Grantee obtained a contact with Prof. Christian Schultze who is the local international manager of mobility projects.

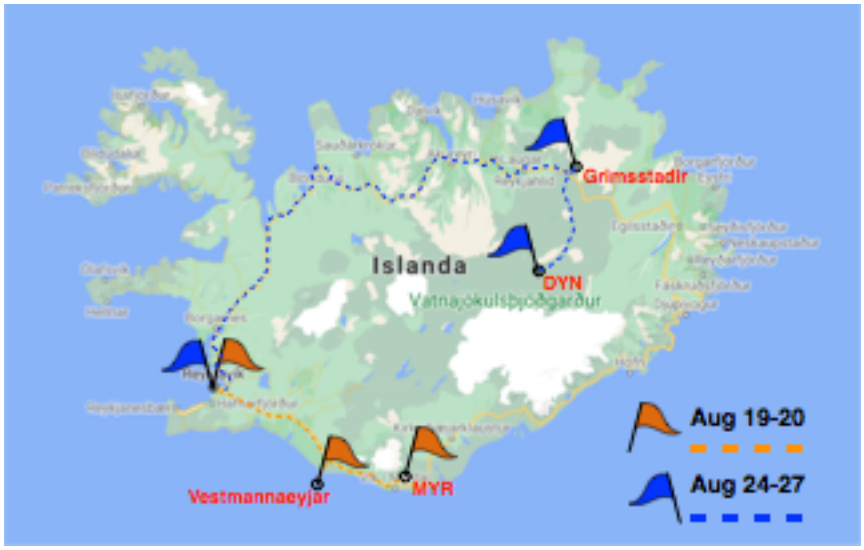

Figure 1. Location and duration of the field trip activities.

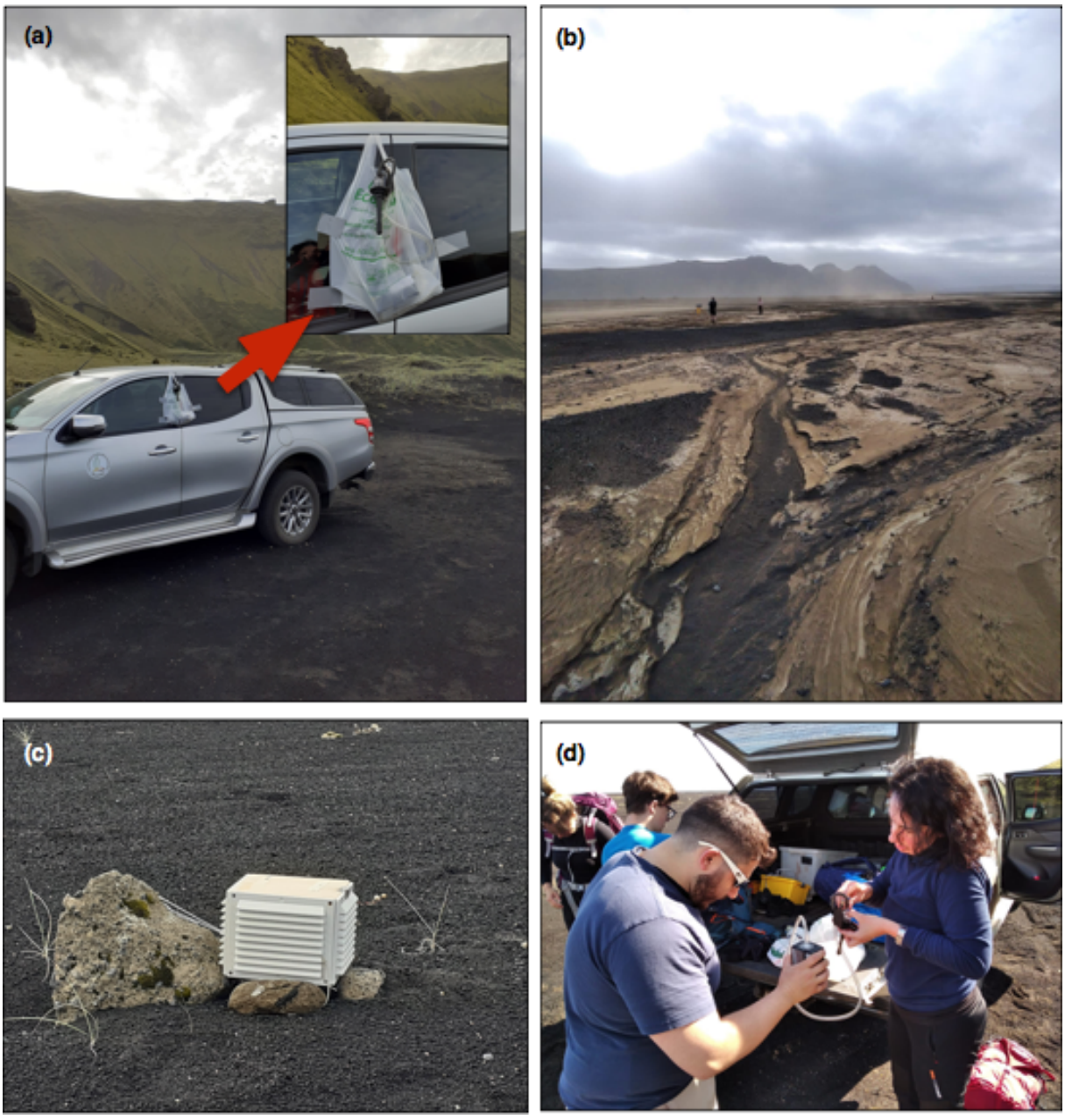

Figure 2. Sediment, suspended dust and aerosol samplings in the left margin of the desert (63°29'20.238"N 18°46'47.118W; a, c) and in the flood plain (63°30'53.982"N 18°39'51.832W; b, d) at MYR. Peak values of almost 800 µg m^{-3} aerosol mass concentration were measured.

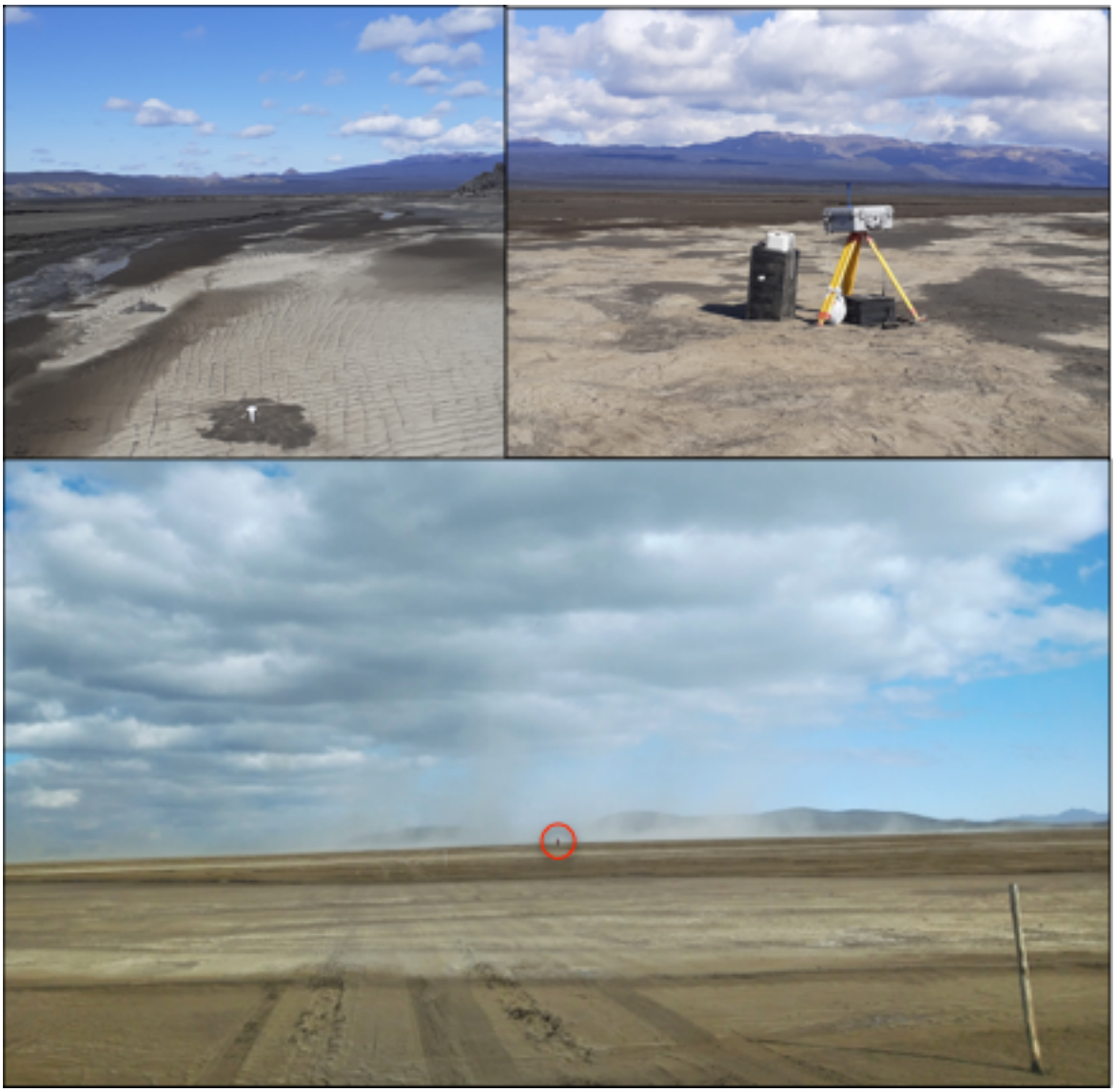

Figure 3. Sediment, suspended dust and aerosol samplings at DYN (64° 54' 28.3428" N 16° 39' 4.1544" W). The red circle marks the Grantee while sampling. Peak dust concentrations of 400 µg m^{-3} were captured by the DustTrak monitor, but the concentrations were likely significantly higher in the center of the dust storm.