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African dust transport and deposition modelling verified through a successful citizen science campaign in Finland

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On 21–23 February 2021, dust from a sand and dust storm (SDS) in northern Africa was transported to Finland, north of 60°N. The episode was predicted 5 days in advance by the Finnish Meteorological Institute (FMI) global operational SILAM forecast (silam.fmi.fi), and its key features (e.g., spatial distribution of wet and dry deposition amounts and particle sizes) were confirmed and detailed by a retrospective analysis. SILAM is among the dust forecast models included in the Word Meteorological Organization Sand and Dust Storm Warning Advisory and Assessment System WMO SDS-WAS.

Dust deposition was observed on 23 February over a large area in the Southern and Central Finland from 60°N to >63.8°N. The ground was covered with snow making dust more easily detectable. The coloured snow caused people to contact FMI asking what is happening. FMI launched a citizen science campaign on Saharan dust with the help of social media, and people were asked to report their observations and to collect dust-containing snow and to extract the dust according to the guidelines. The campaign gained wide national interest in television, radio, newspapers and social media, and resulted in success in receiving citizen samples from 525 locations, with one to over ten samples in each.

The amounts of deposition calculated from the citizen samples were found to be up to 1.1 g/m^2 and such maximum amounts per unit area agree with the SILAM calculations. The SILAM model and particle magnetic properties confirmed that dust came from a wide Sahara and Sahel area, from 5000 km away. The median diameters of the dust particles were in the modes of <10 µm and >20 µm. The mineral composition was dominated by quartz, feldspars, and soft phyllosilicates such as micas and clay minerals.

To extract dust from snow, Meinander et al. (2023) protocol recommends: 1. Collect snow samples within one week of the deposition event to minimize post-deposition changes. 2. Evaporate snow under 75^{o}C to preserve the magnectic properties (particles should not be subjected to

temperatures higher than 90^{o}C). 3. Keep the remaining particles in the container in which the evaporation took place (e.g., a sheet of aluminium folio on a large oven tray and evaporating the snow in the oven) to best preserve all the particle sizes.

Reference: Meinander, O., Kouznetsov, R., Uppstu, A. et al. African dust transport and deposition modelling verified through a citizen science campaign in Finland. Sci Rep 13, 21379 (2023). https://doi.org/10.1038/s41598-023-46321-7.