Extreme dust storms in Iceland

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Iceland, an island in the North Atlantic Ocean, is an active source of dust from glaciogenic and volcanic sediments. Frequent strong winds drive the soil into suspension and transport the dust several hundreds of km over the N-Atlantic Ocean and the Arctic Ocean.

We observed 1033 dust days from the meteorological observations in NE Iceland in 1949-2011. A total of 192 dust events were severe in the sense that the visibility was less than 5 km. An annual mean of 55 days of atmospheric dust observation was reported for the first decade of the 2000s in Iceland (our data and Georgsdottir, 2012). We chose two of the most severe dust storms for each region - N and S Iceland - with different dust sources and deposition areas. The South-Iceland Dust Storm (SDS) occurred on slope of the Eyjafjallajokull volcano five months after the eruption on September 14th 2010. The major source of resuspended material was volcanic ash and the deposition area was over the North Atlantic Ocean and further over Europe. We measured an aeolian particle transport with BSNE wind erosion samplers (Fryrear, 1986), total particle number with saltation sensor (SENSIT) and employed an automatic weather station *in situ* during this event. The North-Iceland Dust Storm (NDS) took place in outwash plains north of Vatnajokull glacier on September 17th 2008. The major source was glaciogenic dust and the deposition area was over the Arctic Ocean and Greenland. We calculated PM_{10} mass concentration from *in situ* meteorological and visibility observations. The aim of this study was to quantify aerosol particle transport of volcanic aerosol during extreme dust storms when the conventional aerosol measurements *in situ* fail. An attempt is made to detect the deposition area of dust storms by calculating forward trajectory and determining the Absorption Aerosol Index.

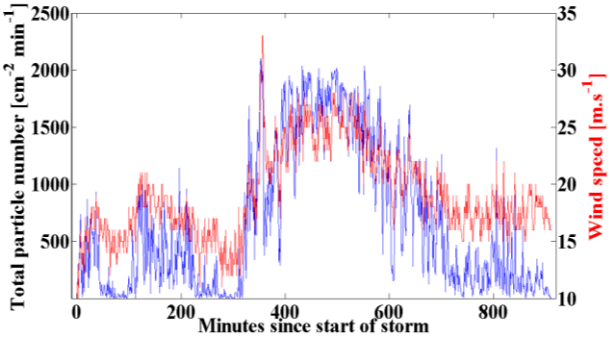

Figure 1. Total particle number measured with saltation sensor and mean wind speed during the SDS.

The SDS lasted for 23 hours and we measured max wind speed of 38.7 ms^{-1}, max total particle number of 2,100 cm^{-2}min^{-1} and max saltation of 6,825 counts min^{-1} (Fig. 1). Total aeolian particle transport was calculated as 11,000 kg m^{-1} (Arnalds et al., 2013). The desposition area extended from the North Atlantic Ocean to Ireland, Great Britain and several trajectories arrived as far as to the Czech Republic. The NDS was observed for seven days with reduced visibility to 1500 m and calculated mean PM_{10} concentration of 231 µg m^{-3}. Depostion area was over the Greenland sea and air parcels travelled over northwestern Greenland (Fig. 2).

Icelandic dust storms are frequent and among the most severe dust storms observed on Earth (Arnalds et al., 2013). Fine glaciogenic particles can be rapidly activated and resuspended after recurrent flooding and travel over 1800 km within 24 hours. Deposition area is in the Arctic environment. Freshly deposited volcanic material under severe meteorological conditions such as in Iceland prolongs impacts of volcanic eruptions.

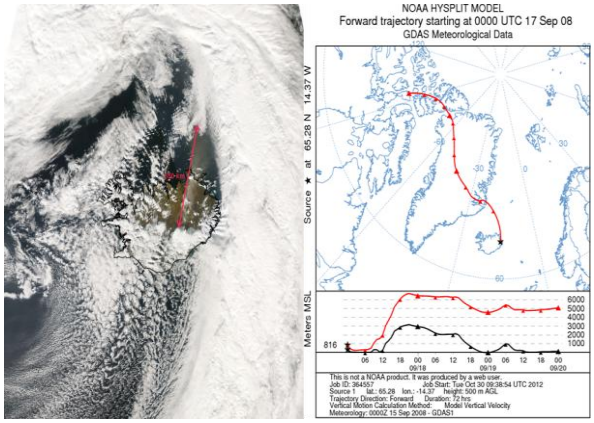

Figure 2. MODIS Aqua picture (left) and NOAA HYSPLIT 72-hr forward trajectory for air parcels released in Egilsstadir (right) during the NDS.

Arnalds, O., Thorarinsdottir, E.F., Thorsson, J., Dagsson-Waldhauserova, P., Agustsdottir, A.M. (2013) *Nature Scientific Reports* **3**, 1257.

Fryrear, D.W. (1986) *Journal of Soil and Water Conservation* **41**,117-120.

Georgsdóttir G.I. (2012) *M.Sc. thesis*, Faculty of Earth Sciences, University of Iceland Press.