Geophysical Research Abstracts
Vol. 17, EGU2015-10355-11, 2015
EGU General Assembly 2015

Albedo changes on Vatnajökull associated with dust events, Iceland

Monika Dragosics, Throstur Thorsteinsson, and Finnur Pálsson
Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland (mod3@hi.is)

Deposition of aerosols on the glacier surface changes the albedo, thus enhances melt rates and affects the glacier mass balance.
There are extensive sources for particles in Iceland; volcanic sandy deserts and glacial outwash plains cover more than 22% of the country. (Arnalds et al., 2001) Particles from these sources get airborne and transported on to the ice caps in several dust storms in most years, causing changes in albedo and surface energy balance.
Long-term observations of atmospheric dust over the last 60 years show a high frequency of dust events in Iceland, with more than 34 dust days per year (Dagsson-Waldhauserova et al., 2013).
Volcanoes are sources of large quantities of particles during an eruption, and for some years (even decades or centuries) after, due to re-suspension. Volcanic eruptions are frequent in Iceland, often with subsequent deposition of volcanic tephra on glaciers. The most recent are the eruptions of Eyjafjallajökull and Grímsvötn in 2010 and 2011. The evolution of surface albedo is measured with in-situ automatic weather stations (AWS), during summer, on a few locations on icelandic ice-caps. To detect dust events on Brúarjökull outlet (NE Vatnajökull ice-cap), drops in albedo are compared with energy balance results from the measured values of the AWSs, temperature, dust storm occurrence (recorded at manned weather stations in the lowlands), and visible changes on satellite observations (MODIS images) as in-situ samples. A dust deposition event is detected by comparing the MODIS images of 20 May and 28 May 2012 and explains a drop in albedo on 21 May, lasting to June 4 from 0.86 to 0.51. The in-situ samples are: snow surface samples from Vatnajökull with impurities collected in October 2013, representing the deposition of one summer over the ice cap; and two firn cores of about 8 meters depth from Brúarjökull, taken in June 2014. The firn cores were analysed to detect dust layers and to measure mass, volume, density of each dust layer as well as turbidity (in ppm). Four dust layers were identified that show the years 2013, 2012, 2011 and 2010. The dust layers of 2012 and 2011 are melted together due to the negative mass balance in 2012 at the core site; this shows up in the high turbidity up to 400ppm.
These annual dust layers represent the quantity and frequency of dust storms per year corresponding to variations in albedo. In 2010 dust from all annual layers since starting of mass balance measurements (1993) were melted together because of the highly negative mass balance due to the Eyjafjallajökull tephra cover. In this year the albedo dropped very quickly in spring compared to the years before. It is very important at what time of the year an eruption takes place. Eyjafjallajökull and Grímsvötn were both occurring during spring therefore there is a larger impact on the energy balance in the following summer compared to an event happening in the autumn or winter time when the tephra gets snow covered quickly after.

References:
Arnalds O., Gisladottir F.O., and Sigurjonsson H., 2001: Sandy Deserts of Iceland: An overview. Journal of Arid Environments 47, 359-371.
Dagsson-Waldhauserova P., Arnalds O. and Olafsson H., 2013: Long-term frequency and characteristics of dust storm events in Northeast Iceland (1949-2011). Atmospheric Environment 77, 117-27.