Geophysical Research Abstracts
Vol. 19, EGU2017-13772, 2017
EGU General Assembly 2017

Quantifying the Impact of Icelandic Dust Storms on High-Latitude Aerosol

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Using a combination of observations, meteorological climatologies and modelling we have developed an Icelandic dust storm emission inventory. Here we present results from a global modelling study quantifying the contribution of Icelandic dust to high-latitude: ice nucleating particles (INP), cloud condensation nuclei (CCN) and $PM_{2.5}$. Our results suggest that Icelandic dust cannot explain the formation and persistence of summertime mixed-phase Arctic marine clouds, as summertime marine clouds are too warm for Icelandic dust to serve as INP. However, in colder regions (such as Greenland) Icelandic dust may sporadically contribute to INP. The contribution of Icelandic dust to high-latitude CCN was shown to be complex. Indeed, our results indicate a decrease in high-latitude CCN in the aftermath of Icelandic dust storms. This decrease is due to the short-term increase of the Arctic atmospheric condensation sink and the resulting suppression of nucleation processes (a significant source of Arctic summertime CCN). Finally, Icelandic dust storms are shown to significantly contribute to high-latitude summertime $PM_{2.5}$ (and PM_{10}) both during ($\sim$100 $\mu g m^{-3}$) and in the aftermath ($\sim$10 $\mu g m^{-3}$) of dust events. Our results suggest that Icelandic dust storms (neglected in most global climate models) may in the short term increase aerosol optical depth (strongly correlated to $PM_{2.5}$) at high latitudes. Additionally, Icelandic dust storms are likely to contribute to poor air quality as well as reduced visibility in the Arctic boundary layer. Thus, we argue for the adoption of high-latitude dust emissions in climate and NWP models.