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ABSTRACT

Connecting Aerosol Size Distributions at Three Arctic Stations

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Aerosols play an important role in the Earth energy balance through direct interactions with the incoming solar, as well as through processes that involve clouds and also outgoing terrestrial radiation. Previous studies of aerosols in the arctic have shown that there is a distinct annual cycle of aerosol properties, with the greatest mass concentrations during the arctic haze period in the spring. In the arctic summer, on the other hand, the condensation sink is at minimum due to effective wet removal processes, allowing for events of aerosol nucleation to take place. Little is known about the spatial extent of these events as no previous studies have directly compared and linked aerosol measurements from different arctic stations during the same times. One of the questions that rises - not only concerning the aerosol nucleation events - is to what extent are the measurements from a single field station representative, i.e. whether they represent a very large area, possibly the entire arctic area, or maybe are rather local and specific for the measurement site.

In this study three different datasets of aerosol size distributions from Mt. Zeppelin in Spitsbergen, Station Nord in northern Greenland and Alert in the Canadian arctic, are analyzed for the measurement period of 2012-2013. All stations are 500 to 1000 km from each other, and the travel time from one station to the other is typically between 2 to 5 days - according to the back-trajectory calculations. The meteorological parameters along the trajectories are analyzed in order to estimate their role in the modification of the aerosol size distribution while the air is traveling from one field station to another. In addition the exposure of the air to open waters assessed, due to the increased fluxes of heat, moisture, gases and particles, that are expected to affect the aerosol size distribution more than when the air is traveling over a frozen sea.

The results show that the general characteristics of the monthly median aerosol size distributions are not very different in all three stations, with Alert and Station Nord being more similar. This is more pronounced when looking into the cases for which the trajectory calculations indicated that the air traveled from one of the latter stations to the other. The probable causes for the measurements at Mt. Zeppelin to be less in-line with the other stations are the greater exposure to ice-free water all year round. In addition, the instrument at Mt. Zeppelin sometimes samples free

tropospheric air, which is affected by the long-range transport of aerosols much more than the mostly decoupled boundary layer below, where the other two stations reside.