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Arctic Haze Analysis

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The Arctic atmosphere is perturbed by nature/anthropogenic aerosol sources known as the Arctic haze, was firstly observed in 1956 by J. Murray Mitchell in Alaska (Mitchell, 1956). Pacyna and Shaw (1992) summarized that Arctic haze is a mixture of anthropogenic and natural pollutants from a variety of sources in different geographical areas at altitudes from 2 to 4 or 5 km while the source for layers of polluted air at altitudes below 2.5 km mainly comes from episodic transportation of anthropogenic sources situated closer to the Arctic. Arctic haze of low troposphere was found to be of a very strong seasonal variation characterized by a summer minimum and a winter maximum in Alaskan (Barrie, 1986; Shaw, 1995) and other Arctic region (Xie and Hopke, 1999). An anthropogenic factor dominated by together with metallic species like Pb, Zn, V, As, Sb, In, etc. and nature source such as sea salt factor consisting mainly of Cl, Na, and K (Xie and Hopke, 1999), dust containing Fe, Al and so on (Rahn et al.,1977). Black carbon and soot can also be included during summer time because of the mix of smoke from wildfires.

The Arctic air mass is a unique meteorological feature of the troposphere characterized by sub-zero temperatures, little precipitation, stable stratification that prevents strong vertical mixing and low levels of solar radiations (Barrie, 1986), causing less pollutants was scavenged, the major revival pathway for particulates from the atmosphere in Arctic (Shaw, 1981, 1995; Heintzenberg and Larssen, 1983). Due to the special meteorological condition mentioned above, we can conclude that Eurasian is the main contributor of the Arctic pollutants and the strong transport into the Arctic from Eurasia during winter caused by the high pressure of the climatologically persistent Siberian high pressure region (Barrie, 1986).

The paper intends to address the atmospheric characteristics of Arctic haze by comparing the clear day and haze day using different dataset, including satellite remote sensing, ground-based observations and modelling. The key question is which information should be used for analysis and how to integrate the source information. The behavior of different atmospheric parameters as described in the paper is consistent and the analysis using satellite atmospheric parameters is in line with synoptic charts. Hence the different data sources are complementary and the results support each other (Mei et al., 2011). In the paper, Aerosol Optical Depth (AOD) from both satellite retrieval data and ground-based measurements were analyzed the characteristic, especially the absorption. We also discuss the effect of Arctic haze to the Arctic temperature, snow albedo and arctic flux in details.