The top and bottom 10 monthly light-absorbing aerosol deposition anomalies over the Greenland ice sheet during 2003-2016 and their corresponding changes in atmospheric aerosol pattern

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Nowadays, the melting of the Greenland ice sheets (GrIS) along the ongoing climate change is one of large concerns for many people. It is well known from previous studies (e.g., Qian et al., 2015, and references therein; Yasunari et al., 2015) that the snow-darkening by deposited light-absorbing aerosols (i.e., LAA: dust, black carbon, and organic carbon) is one of the factors for accelerating melting. In this presentation, we examine the top and bottom 10 monthly LAA deposition flux anomalies over GrIS during 2003-2016 and associated changes in atmospheric circulations and LAA loading patterns, using the NASA' s MERRA-2 re-analysis data (Bosilovich et al., 2015; Randles et al., 2016).

Here we define the areas for the LAA deposition anomalies over GrIS as the grid points where the monthly mean snow mass (i.e., snow water equivalent, SWE) over glaciated surface is greater than 500 kg m^{-2} within a domain including GrIS (287°E-339°E; 59°N-85°N). The monthly LAA deposition flux anomalies were calculated from the their monthly climatologies for 2003-2016. Then, we selected the top and bottom 10 months of dust, BC, and OC deposition flux anomalies for higher and lower cases of the LAA depositions over GrIS, respectively. To discuss the atmospheric LAA conditions for the higher and lower LAA deposition time periods, we also used column mass densities of dust, BC, and OC and calculated the composites of their column mass densities for the top and bottom 10 LAA deposition months. The differences of the composites for each LAA component can tell us the possible LAA source information which could contribute to generate higher LAA deposition flux anomalies over GrIS during 2003-2016.

For dust, higher atmospheric dust amount changes over Middle East and North Africa were seen for the composite difference of the column mass density of dust between the cases of the top and bottom 10 dust deposition anomalies over GrIS. This implies that these two sources could mainly contribute to make the higher dust deposition months over GrIS during 2003-2016. For OC, some hot spots were seen over the eastern part of the Lake Baikal, Eastern Siberia, and Canada. Probably smokes from biomass burnings over these areas significantly had responsibilities to highly increase OC depositions over GrIS. For BC, although increased BC column mass densities were seen over Eastern Siberia and Canada as were seen for the OC case, broadly increased BC were also seen over Alaska, the Indo-Gangetic Plains, South East Asia, and Central Africa. This implies that the source attributions of higher BC deposition months over GrIS are more complicated, compared to dust and OC source attributions.

References

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