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Aerosol retrieval based on 10 years of passive remote sensing satellite measurements over the Arctic – validation and trend analysis

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The Aerosol Optical Thickness (AOT) retrieval over the Arctic region is a challenging task due to uncertainties and difficulties in its prerequisites, mainly (i) cloud masking methods and (ii) modeling the underlying snow/ice surface. In the past this led to a large data gap over the Arctic which hampered our understanding of the direct/indirect aerosol effect on Arctic and global climate change. For the purpose of improving our knowledge, we present, for the first time, long-term AOT maps of snow and ice covered areas based on satellite remote sensing.

In this study, a previously developed aerosol retrieval algorithm over snow/ice, (Istomina et al., 2012; in IUP, University of Bremen) is used to retrieve AOT for a period of 10 years, 2002-2012, over the Arctic and to analyze its spatial and temporal changes. This algorithm is based on a multi-angle approach and uses pre-computed look-up tables to retrieve AOT.

The algorithm has been improved with respect to cloud masking (based on clear snow spectral shape) using the ASCIA cloud identification algorithm (Jafariserajehlou et al., 2019). The modified AOT retrieval algorithm is applied to observations from Advanced Along-Track Scanning Radiometer (AATSR) on European Space Agency's (ESA) measurements. The retrieved dataset provides long-term AOT at a spatial resolution of 1 km^2 over snow/ice covered surface in the extended Arctic region (60°- 90°) during polar day. The results show that Arctic haze events appearing every late-winter and early spring are very well captured in AATSR derived AOTs. To validate the retrieved AOTs, results are compared with ground-based AERONET data. The comparisons revealed partially excellent agreement but also limits of the retrieval algorithm are discussed. In addition, some preliminary results of a trend analysis of the long-term record will be presented. It is foreseen to use the results in the trans-regional research project $(AC)^3$ investigating Arctic amplification.

References

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