Aerosol, Surface and Cloud retrieval using passive remote sensing over the Arctic

The large trends in warming over the Arctic at the rate of two to three times faster than the global average in recent decades, has received much attention from the global and regional climate change research community. This phenomenon referred to as Arctic Amplification is associated with several parameters and feedback mechanisms among which, Arctic aerosol is known to be at play.

The Aerosol Optical Thickness (AOT) retrieval over the Arctic region is a challenging task and the difficulty is twofold: i) uncertainties and issues in prerequisites of retrieval, mainly cloud masking methods and modeling the underlying snow/ice surface; ii) retrieving aerosol over bright surface with strong contribution to TOA reflectance. These obstacles led to a gap over the Arctic in global AOT products which hampered our understanding of the direct/indirect aerosol effect on Arctic and global climate change.

In this work, for the purpose of improving our knowledge and the existing algorithms, first we focus on the two major obstacles in the retrieval of aerosol over snow/ice surface: a) cloud masking and the newly developed cloud identification algorithm called ASCIA (Jafariserajehlou et al., 2019) , b) snow surface properties (Jafariserajehlou et al., 2021). Second, we apply the outcome of studying the two mentioned pre-requisites to improve the previously developed aerosol retrieval algorithm called AEROSNOW (Istomina et al., 2012; at IUP, University of Bremen). The retrieval algorithm is based on a multi-angle approach and uses pre-computed look-up tables to retrieve AOT using observations from Advanced Along-Track Scanning Radiometer (AATSR) on European Space Agency's (ESA). Third, we create a long-term data record for AOT over the Arctic circle using the improved version of AEROSNOW. We present, for the first time, long-term AOD maps for a period of 10 years (2002-2012) in the Arctic region over snow and ice covered areas. We validate the retrieved AOT against ground-based AERONET measurements. The comparisons revealed partially excellent agreement especially in haze episodes for which the algorithm is adopted, but also limits of the retrieval algorithm are discussed.