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Cloud masking for aerosol retrieval over the Arctic using AATSR/SLSTR time-series measurements

Soheila Jafariserajehlou (1), Linlu Mei (2), Marco Vountas (3), Vladimir Rozanov (4), and John P. Burrows (5)

(1) University of Bremen, Environmental Physics (IUP), NW1, Germany (soheila.jafari1988@gmail.com), (2) University of Bremen, Environmental Physics (IUP), NW1, Germany (mei@iup.physik.uni-bremen.de), (3) University of Bremen, Environmental Physics (IUP), NW1, Germany (vountas@iup.physik.uni-bremen.de), (4) University of Bremen, Environmental Physics (IUP), NW1, Germany (rozanov@iup.physik.uni-bremen.de), (5) University of Bremen, Environmental Physics (IUP), NW1, Germany (burrows@iup.physik.uni-bremen.de)

The crucial role of clouds in extreme trends of warming over the Arctic, has highlighted the importance of precise cloud identification over high latitudes. Moreover, clouds represent of the major sources of error in satellite-based Aerosol Optical Thickness (AOT) retrievals over the Arctic, which contributes to uncertainties in the evaluation of aerosol effects on climate change. Since, misclassification of clouds and heavy aerosol loads contribute to either overestimation of AOT or loss retrieval coverage. However, cloud masking over the Arctic is a challenging task since all so far developed methods are affected by the unique atmosphere and surface conditions. Therefore, cloud identification from passive remote sensing is one focus in the recent DFG (German Research Foundation) funded project (AC)3 "ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes and Feedback Mechanisms".

In this study, a method based on a time-series technique is developed and used to identify clouds by utilizing Advanced Along-Track Scanning Radiometer (AATSR), one payload on the European Environmental Satellite (Envisat). Furthermore, the developed algorithm is successfully applied on Sea and Land Surface Temperature Radiometer (SLSTR) onboard Sentinel-3 measurements.

This method includes two steps. The first step is to separate the ground scenarios into cloud and cloud free conditions. The main assumption for this step is that clouds have larger spatial variability and less stability compared to cloud free conditions. The spatial variability is characterized by the standard deviation while the stability has been analyzed by the covariance values between the target image and a "reference image". After building up the reference image, cloudy pixels are distinguished from aerosol by applying covariance analysis over the channel which is less affected by aerosol particle, whereas the Top Of Atmosphere (TOA) reflectance is affected by clouds. The second step is to separate various types of aerosol load. This has been performed by Radiative Transfer (RT) simulations using the RT model SCIATRAN.

Additionally, selecting the proper wavelength regions to apply covariance analysis is studied through different channels. The results of applying this idea to case studies and the validation against 1) European Space Agency (ESA) standard cloud product from AATSR L2 nadir cloud flag, 2) One of existing methods based on clear-snow spectral shape, 3) Surface synoptic observations (SYNOP), 4) AERONET dataset will be presented.