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Changes of top–of–atmosphere reflectance and cloud optical properties observed from space: Implications for Arctic climate change

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Abstract

Clouds play a significant role in Arctic Amplification, either by scattering or absorbing shortwave and longwave radiations depending on their optical properties. The Top–Of–Atmosphere (TOA) reflectance, RTOA, measured from observations by hyperspectral and multispectral spectrometers flown on satellites, is a unique measure of the spectral dependence of the amount of reflected and absorbed solar radiation. Appropriate inversion of RTOA yields cloud micro/macro-physical properties.

The decreasing sea ice extent especially in the sunlit months is expected to increase the cloud cover and the RTOA. The observed RTOA values from harmonized GOME, SCIAMACHY and GOME-2A didn't show any signs of increasing brightness over the Arctic region which makes clouds a primary suspect. To understand the changes in cloud optical properties and their affects on the RTOA, long-term ESA Climate Change Initiative (CCI) cloud product is analyzed. The CCI dataset exploits the AVHRR heritage channels in the VIS-IR region in retrieving the cloud properties. Upon observing the long-term trends, it is been noticed that liquid cloud optical depth is increasing over most of the Arctic region. In addition, the applicability of CCI over the Arctic region is checked by validating the Liquid Water Path from AVHRR CCI against the ground based ARM measurements. Preliminary results showed a good agreement between ARM and CCI with some exceptions.