

Changes Of Top-Of-Atmosphere Reflectance In The Arctic Within The Last Two Decades Using Satellite Data

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Within the last 25 years, the Arctic has shown a significant increase in near-surface temperature which is almost twice as large as the global average. This phenomenon is referred to as Arctic Amplification, whose underlying causes remain uncertain. Among the several factors that have been suggested to contribute to it, changes in atmospheric composition, cloudiness and sea-ice properties have been identified as potential actors of the interplay of processes and feedbacks.

In the framework of the national german project “ArctiC Amplification: Climate relevant Atmospheric and surfaCe processes and feedback mechanisms (AC)³”, we investigate the temporal and spatial variations of Top-Of-Atmosphere (TOA) reflectance, as seen from spaceborne satellite sensors, to assess their correlation with geophysical parameters.

We hypothesize that “long-term changes of solar reflectance at the TOA provide an early warning of Arctic climate changes at the surface”. In order to test this hypothesis, TOA reflectance for a time-span of 22 years have been computed over the polar circle from GOME, SCIAMACHY and GOME-2 instruments. The spectral regions have been carefully selected within the UV, visible and NIR spectral regions in order to disentangle and identify the signatures of clouds and surface types.

Annual, seasonal and latitudinal variations of TOA reflectance are found to correlate with sea-ice decline within the past two decades. A noticeable average increase of water-to-ice ratio is identified throughout the study period, which generally follows the temperature rise. The contribution of clouds is, however, more complicated. Their role in either warming or cooling the surface still depends on the relative changes in cloud optical and geometrical properties. Clouds can amplify and/or reduce feedbacks originated from other contributing factors. Therefore, a thorough analysis of cloud property trends is still necessary to determine if their variation provide a warning of Arctic Amplification.