

## **A new method to retrieve cloud-edge top heights over Arctic Sea using cloud-shadow based on MODIS**

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Cloud top height plays an important role in the earth's radiation budget and climate change. However, the accurate cloud top height retrieval based on satellite data over the Arctic Ocean remains a challenge. Especially, it is more difficult to retrieve cloud-edge top heights (CETH) based on Moderate Resolution Imaging Spectroradiometer (MODIS) in spite of its high spatial resolution. Clouds cast shadows over sea ice surface, there is geometric correlations between clouds and cloud shadows, higher cloud top height faces with larger cloud shadows; thus, this method can determine CETH. Based on this concept, geometric relationships were established between clouds and their shadows using satellite data and satellite-solar geometries. In this paper, we use Geometry-based cloud-shadow detection method to retrieve the CETH according to MODIS data over Arctic oceanic region. In details, we first calculate the distances of cloud shadows according to the reflectance data from MODIS and then determine the CETH by using cloud-shadow detection methods, and finally examine the precision of CETH estimation by compared to Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) data. In this study, 16 cases in August 2016 and 2018 over Arctic oceanic region are analyzed, the mean difference and standard deviation of the differences between CETH obtained using cloud-shadow detection methods and CALIPSO are -101.068m and 1.363km respectively, while the bias and STDE of MODIS CETH – CALIPSO CETH are -1376.41m and 1.799km respectively. Therefore, it indicates that cloud-shadow detection methods can be used to improve the accuracy of CETH of MODIS over Arctic oceanic region.