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Characteristics and Results of Cloud Retrieval Algorithm for Geostationary Environment Monitoring Spectrometer

Bo-Ram Kim[1], Gyuyeon Kim[2], Minjeong Cho[2], and Yong-Sang Choi[2]
[1]Korea Aerospace Research Institute, National Satellite Operation and Application, Korea, Republic of (brkim@kari.re.kr)
[2]Ewha Womans University, Seoul, Republic of Korea

The cloud retrieval algorithm used by the Geostationary Environment Monitoring Spectrometer (GEMS) to monitor atmospheric conditions over East Asia is presented in this paper. In the UV-VIS range, cloud increase radiance and shorten the beam bath length. We defined cloud products as the effective cloud fraction, which represents the reflecting impact of clouds, and the cloud centroid pressure, which indicates the height at which clouds reflect. The absorption in the O_2-O_2 absorption band, which results from collisions of oxygen molecules in the atmosphere with generally constant concentrations, is used by the algorithm to determine the characteristics of clouds. Input data include observed radiance, irradiance, observation geometry, and surface information (reflectance and pressure). We evaluate the algorithm's sensitivity to each input data. Moreover, we perform a monthly comparison and analysis of the actual cloud retrieval products acquired from GEMS with TROPOMI (Tropospheric Monitoring Instrument), investigating the algorithm's seasonality. Additionally, events showcasing prominent cloud features, such as high concentrations of air pollutants, typhoons, and sea fog, are chosen for performance evaluation through comparisons between GEMS results and those from TROPOMI, Advanced Meteorology Imager, and Cloud-Aerosol Lidar with Orthogonal Polarization. In comparing GEMS cloud retrieval results with those of other satellites, distinct variations based on land and ocean surfaces were observed, overshadowing the impact of seasonal differences. However, the CCP exhibited reduced accuracy during thick cloud in the summer season. This feature was consistently seen in event analysis, especially in cases of typhoons with diverse cloud shapes. In thin-cloud regions, CCP was comparable to other satellites; in thick-cloud regions, significant differences were seen. Besides, the investigation showed that GEMS had a tendency to identify clouds over highly reflective, low-altitude sea fog, resulting in CCP values that were comparable to surface pressure. This special quality made it possible to accurately characterize the characteristics of sea fog.