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Fusing Aerosol Optical Depth Data from Geostationary Korea Multi-Purpose Satellites (GEO-KOMPSAT) Using Statistical and Deep Neural Network Approaches.

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As part of the Geostationary Korea Multi-Purpose Satellites (GEO-KOMPSAT; GK) mission, South Korea has launched two geostationary earth orbit satellites including GK-2A, and GK-2B. GK-2A carries a sensor named Advanced Meteorological Imager (AMI), which has spectral bands from visible to infrared for observations of weather variables. GK-2B carries two sensors. One of them is an ultraviolet-visible hyperspectral spectrometer named Geostationary Environment Monitoring Spectrometer (GEMS), and the other is a band (visible-shortwave infrared) observing ocean color imager named the 2nd-generation Geostationary Ocean Color Imager (GOCI-II). Regarding the retrieval of aerosol optical properties, each geostationary instrument has distinct characteristics derived from individual specifications. In this study, we perform data fusion of aerosol optical depth (AOD) with datasets from GEO-KOMPSAT using both statistical and deep neural network-based methods. The statistical fusion initially corrects the bias of each aerosol product by assuming a Gaussian error distribution and then employs maximum likelihood estimation (MLE) fusion, accounting for pixel-level uncertainty by weighting the root mean square error (RMSE) of each AOD product for every pixel. Meanwhile, a deep neural network (DNN) proves to be a powerful tool to consider the nonlinearity of

retrieval uncertainties from various instruments. Hence, we propose a DNN-based AOD fusion approach utilizing the same input data as the statistical AOD fusion. AERONET AOD from Nov. 2021 to Oct. 2022 is used to calculate bias and uncertainties of the GEMS, AMI, and GOCI-II. This AERONET data also serves as a target for the DNN-based approach. The statistical and DNN-based fusion algorithms are applied from Nov. 2022 to Mar. 2023 and validated. Both fused AOD datasets exhibit Pearson's correlation coefficient over 0.9 and mean bias error under 0.04. The DNN-based fusion method demonstrates better performance in estimating high aerosol loading. Both fusion algorithms stabilize diurnal error variation and provides better insights into hourly aerosol evolution. The application of aerosol fusion to future geostationary satellite projects such as TEMPO and GeoXO can enable the production of high-quality global aerosol data