

Creative Commons Attribution 4.0 International (CC BY 4.0)

<https://creativecommons.org/licenses/by/4.0/>

Access to this work was provided by the University of Maryland, Baltimore County (UMBC) ScholarWorks@UMBC digital repository on the Maryland Shared Open Access (MD-SOAR) platform.

Please provide feedback

Please support the ScholarWorks@UMBC repository by emailing scholarworks-group@umbc.edu and telling us what having access to this work means to you and why it's important to you. Thank you.



Statistical and neural network-based AOD data fusion with Geostationary satellite instruments: GEMS, AMI, and GOCI-II.

Minseok Kim¹, Jhoon Kim¹, Hyunkwang Lim², Seoyoung Lee^{3,4}, Yeseul Cho¹, Yun-Gon Lee⁵, Sujung Go^{3,4}, and Kyunghwa Lee⁶

¹Department of Atmospheric Sciences, Yonsei University, Seoul, South Korea

²National Institute for Environmental Studies (NIES), Tsukuba, Japan

³Goddard Earth Sciences Technology and Research (GESTAR) II, University of Maryland Baltimore County, Baltimore, MD, USA

⁴NASA Goddard Space Flight Center (GSFC), Greenbelt, MD, USA

⁵Department of Atmospheric Sciences, Chungnam National University, Daejeon, South Korea

⁶National Institute of Environmental Research (NIER), Incheon, South Korea

Aerosol optical depth (AOD) data fusion for aerosol datasets obtained from the Geostationary Korea Multi-Purpose Satellite (GEO-KOMPSAT; GK) series was conducted through the application of both statistical and deep neural network (DNN)-based methodologies. The GK mission incorporates the Advanced Meteorological Imager (AMI) on GK-2A, as well as the Geostationary Environment Monitoring Spectrometer (GEMS) and Geostationary Ocean Color Imager-II (GOCI-II) on GK-2B. The statistical fusion approach rectified biases in each aerosol product by assuming a Gaussian error distribution. Utilizing Maximum Likelihood Estimation (MLE) fusion, the technique accounted for pixel-level uncertainties by weighting the root-mean-square error of each AOD product for individual pixels. A DNN-based fusion model was trained to align with Aerosol Robotic Network AOD values through fully connected hidden layers. The results of both statistical and DNN-based fusion generally surpassed the performance of individual GEMS and AMI AOD datasets in East Asia ($R = 0.888$; $RMSE = -0.188$; $MBE = -0.076$; 60.6% within EE for MLE AOD; $R = 0.905$; $RMSE = 0.161$; $MBE = -0.060$; 65.6% within EE for DNN AOD). Particularly, focusing on AOD around the Korean peninsula, encompassing all aerosol products, yielded significantly improved outcomes ($R = 0.911$; $RMSE = 0.113$; $MBE = -0.047$; 73.3% within EE for MLE AOD; $R = 0.912$; $RMSE = 0.102$; $MBE = -0.028$; 78.2% within EE for DNN AOD). The DNN AOD demonstrated effective handling of the rapid increase in uncertainty at higher aerosol loadings. Overall, the fusion AOD, particularly DNN AOD, closely matched with the performance of the Moderate Resolution Imaging Spectroradiometer Dark Target algorithm, exhibiting slightly less variance and a negative bias. Both fusion algorithms stabilized diurnal error variations and provided additional insights into hourly aerosol evolution.