

Validation of MERRA-2 Reanalysis Aerosol Products Using Ground-based Observations in Phimai, Thailand, and Factors that Affect Aerosol Optical Depth over the Indochina Peninsula

*Takeru Ohno¹, Hitoshi Irie¹, Arlindo M da Silva², Ravi C Govindaraju²

1. Center for Environmental Remote Sensing, Chiba University, 2. Global Modeling and Assimilation Office, NASA Goddard Space Flight Center, Greenbelt, Maryland

Biomass burning (BB) occurs during the dry season (December–April) over the Indochina Peninsula (ICP), resulting in poor air quality. We validated the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) aerosol optical depth (AOD) and absorption aerosol optical depth (AAOD) data using a sky radiometer, and aerosol extinction coefficient (AEC) data using Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) at the SKYNET Phimai site (15.18°N, 102.56°E) from 2009 to 2019. The validation analysis showed high correlation coefficients for the three MERRA-2 aerosol products. Compared with ground-based observations, the AOD, AAOD, and AEC were underestimated by 17%, 38%, and 62%, respectively. During the dry season, the height of the maximum AEC value near the ground from MERRA-2 was higher than that from MAX-DOAS. This was likely caused by uncertainty in the MERRA-2 model, such as its vertical profile simulation. Therefore, we expect that the validation analysis could contribute to the accuracy of MERRA-2 simulations conducted in regions affected by BB and anthropogenic emissions. We also analyzed factors that influence AOD over northwest ICP (NWIC), northeast ICP (NEIC), and south ICP (SIC) based on the validated MERRA-2 AOD data. Seasonal variation analysis showed that the major drivers of seasonal variation over the three regions were the organic carbon (OC) AOD and sulfate AOD. The OC AOD was dominant during the dry season, accounting for up to 50% of total AOD in March. The sulfate AOD was high throughout the year, accounting for more than 25% of the total AOD. In particular, the sulfate AOD over the NEIC was ~75% of the total AOD from September to November, indicating the strong impact of sulfate transport from China. Negative trends in AOD were found at Phimai and over the NEIC (1.0% and 1.2% year⁻¹, respectively).

Keywords: MERRA-2, Biomass Burning, AOD, Indochina Peninsula, Validation, SKYNET