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SO_2 retrieved from OMI and OMPS using optimal estimation technique and validation over China

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We retrieve sulfur dioxide (SO_2) vertical columns from the Ozone Monitoring instrument (OMI) and Ozone Mapping and Profiler Suomi National Polar-orbiting Partnership spacecraft (OMPS) using optimal estimation method (OEM) over China from 2013 to 2017. Comparison between OEM retrievals and the principal component analysis (PCA) product shows that a general good agreement between using the different algorithms is obtained with a correlation coefficient of 0.7249 and a slope of 0.8789 over eastern China. Validations with ground-based Multi Axis Differential Optical Absorption Spectroscope (MAX-DOAS) measurements show that a monthly averaged ground-based SO_2 results and coincident OMI SO_2 results using OEM agree very well. The seasonal cycle of SO_2 is consistent in both data sets with a maximum in winter, on average, 6×10^{16} molecules*cm^{-2} in Xianghe (a key pollution area), and a minimum in summer, which has a mean value of 2×10^{16} molecules*cm^{-2} there. Winter is the domestic heating season. Both show that SO_2 originates mainly form human sources rather than natural ones. The spatio-temporal distribution over China shows that the pollution is mainly concentrated in Beijing-Tianjin-Hebei area and Sichuan Basin. And the yearly averaged SO_2 results show that the SO_2 vertical columns are decreasing from 2013, 4.57×10^{16} molecules*cm^{-2}, to 2017, 0.89×10^{16} molecules*cm^{-2} in those key pollution areas. SO_2 and NO_2 are major aerosol precursors, and SO_2 and NO_2 respectively are sources of pollution mainly from coal-fired power plants and motor vehicle emissions. We also investigate the relationship between SO_2 emission and aerosol production in Beijing. A stronger correlation between the SO_2 concentrations and aerosol optical depths (AODs) measured by the MODIS satellite instrument than NO_2 concentrations with AODs obtained in winter suggests that anthropogenic SO_2 is the major contributor to the aerosol content during the period of the year.