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*Editorial*

# Satellite Observation of Atmospheric Compositions for Air Quality and Climate Study

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Atmospheric compositions, including greenhouse gases ($CO_2$, $CH_4$, $O_3$, $N_2O$), polluted trace gases (CO, $NO_2$, and $SO_2$), and particles (aerosol), have played important roles in impacting air quality, public health, and climate. Recent advances in remote sensing technology, especially the development of hyperspectral space-borne satellite sensors, enable us to make more accurate measurements of these species over the globe with high spatial and temporal coverage.

This special issue consists of 8 articles that are involved in the study of atmospheric particles (i.e., aerosol), atmospheric trace gases (i.e., $CO_2$, $CH_4$, $O_3$, $N_2O$, and $N_2O$), and precipitation from satellite observations using different sensors, such as AVHRR, IASI, GOSAT, OMI, and GOME, and model simulations. These studies include retrieval method, validation of satellite retrieval results, data analysis of spatiotemporal variation, and its relations with emissions and transport, as well as trend study.

The aerosol optical thickness (AOT) is closely related to the particulate matter (PM), an important parameter to air quality. X. Zhao used nearly 30 years' data of aerosol optical thickness (AOT) derived from National Ocean and Atmospheric Administration (NOAA) Advanced Very High Resolution Radiometer (AVHRR) to study the AOT trends over 17 megacities in the coast zone and found that the AOT around a megacity in the fast developing countries has relatively high value and a positive trend, but low value and a negative trend in industrialized countries. G. Mordas et al. studied the aerosol optical properties in Vilnius, Lithuania, and the impact of long-range transport on them using satellite data, air trajectory modeling, and ground observations and found that the cleanest air masses originate from the Atlantic Ocean and Scandinavia. While Sahara dust transport can make a major contribution to coarse particle loadings in the study area, small particles mostly come from the industrialized region of Europe or local sources.

G. Grieco et al. described a retrieval system that uses the Atmospheric Sounding Interferometer (IASI) data to retrieve atmospheric states and trace gases such as $CO_2$, CO, $CH_4$, and $N_2O$ over the Mediterranean. Limited comparison based on one-month data on July 2010 showed the retrieved trace gases are in agreement with the ground measurements of the Global Atmosphere Watch network. D.-R. Kim et al. used $CO_2$ data from the Greenhouse gases Observation SATellite (GOSAT) and from the chemical-transport model GEOS-Chem to investigate long-range transport of air masses with high concentration of $CO_2$ in Asia over the period June 2009–May 2011. The analysis highlighted that the number of days with $CO_2$ concentration exceeding the mean by more than one standard deviation is 11.1% of the total in the study period. More than 45% of the elevated $CO_2$ concentration can be explained by emission sources in the mainland of East Asia. Some validation of GOSAT $CO_2$ against the ground-based measurements of the TCCON station at Gosan, Korea, was also made.

X. Qin et al. used the measurements of atmospheric column-averaged methane ($XCH_4$) from GOSAT, spanning from January 2010 to December 2013, and trajectory model HYSPLIT to study the spatiotemporal variation of $XCH_4$ in China, particularly over Sichuan Basin in south-west China, and found that Sichuan Basin presents a higher $XCH_4$ concentration than other regions in China, which is also 21.6 ppb higher than the paddy area in the same latitude zone. The high $XCH_4$ is mainly influenced by the regional rice paddies emissions in summer and the abnormally high $XCH_4$ in winter is due to the impact of the regional topography.

Z. Ul-Haq et al. used OMI data to study tropospheric $NO_2$ trends over South Asia during the last decade (2004–2014) and found a 14% increase over this period and this increase is likely linked to the increasing mote vehicle fleet, industrial and agricultural activities, and expansion and increase in biomass fuel usage in the region. Y. Liu et al. used the tropospheric ozone ($O_3$) data from the GOME satellite and the ERA-interim reanalysis dataset to study the spatiotemporal characteristics of tropospheric ozone over East Asia. Based on EOF analysis, they found two dominant spatial patterns (EOF1 and EOF2) can explain ~90% of the total variance in the average ozone concentration in the troposphere. One belt of enhanced ozone concentrations around 40°N is evident from EOF1 mode, which is strongly related to the vertical transport from stratosphere to troposphere. Asian summer monsoon also plays an important role to the variance with an opposite-sign pattern on the north and south side of 35°N, as evident in the EOF2 mode.

The work of J. Trammell et al. addressed the relationship between atmospheric temperature and precipitation and examined the capability of the NASA GISS model to capture the observed trends of precipitation increase over wet areas and decrease over dry areas. Their model simulations showed consistent but weaker trends as compared to the observations, and no trend is evident in the control simulations that do not take into account the change of greenhouse gases, suggesting an impact of global warming on temporal variations of precipitations over wet and dry areas.

These articles reflect the recent advances in satellite observation of atmospheric composition and their applications in air quality and climate study, and we believe they would be of great interest to the readers of this journal.

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