Spatiotemporal variabilities of ammonia in China as seen from IASI and AMoN

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Ammonia (NH_3) contributes to the formation of $PM_{2.5}$ and deposits to ecosystems, causing a series of health and environmental concerns. China is one of the largest NH_3 emitters owing to its intensive agricultural productions. While NH_3 emissions are not regulated in China, efforts are being made to include NH_3 in future emission control plans. Current NH_3 emission inventories in China have significant uncertainties and vary by a large extent. Satellite observations of NH_3 serve as a great tool to analyze the spatiotemporal variabilities of NH_3 on a national scale and can be used to constrain emission inventories. In this work, monthly averaged total columns of NH_3 from the Infrared Atmospheric Sounding Interferometer (IASI) are compared against surface concentrations measured at 48 sites of the China Ammonia Monitoring Network (AMoN). The IASI version 2.2r satellite pixels are screened by a 25-km spatial window centered on each AMoN site and oversampled on high-resolution grids (0.02×0.02˚). Results suggest that satellite total columns show increased sensitivity and correlation with surface concentrations under high NH_3 conditions. Seasonal differences in the correlation are not significant, while higher sensitivity of columns to surface concentrations is observed in spring and summer. Among the six regions studied, the Central and Northeast regions of China show the best correlations (r=0.86 and 0.64, respectively). This can be partly attributed to larger percentages of farmland, grassland and urban sites in these locations, which generally see better correlations than mountain and desert sites. Due to the early morning overpass time, IASI may miss NH_3 peaks from harvesting activities in fall. IASI matches best with AMoN in areas where the background NH_3 is high and large spatial gradients of NH_3 do not exist. In cases where IASI and AMoN do not correlate well, the spatial window used for filtering need to be revised, and site-specific criteria may need to be adopted. Ongoing analyses are investigating wind field and trajectory analyses as potential ways to refine the comparison. Site-to-site variabilities will also be discussed in the context of meteorological variables such as boundary layer height using the ERA5 atmospheric surface reanalysis data (0.25×0.25˚). Our work emphasizes the importance of considering the heterogeneity of NH_3 at the surface when applying satellite measurements to study NH_3 emissions.

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