Spatiotemporal variations of recent NO_2 concentrations and anthropogenic and meteorological drivers over typical urban agglomerations in China

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Nitrogen dioxide (NO_2) is an important pollution gas that can affect air quality and human health. In this study, spatiotemporal distribution of NO_2 concentrations throughout China, and specifically in twelve typical urban agglomerations, were statistically analyzed with ground−based NO_2 observations from June 2014 to May 2019. The WRF−CMAQ model were also applied to separate and quantify the emission−related and meteorology−related NO_2 variations. NO_2 concentration in Beijing−Tianjin−Hebei (BTH) urban agglomeration showed an upward trend in 2014−2015, and a downward trend after 2016, while NO_2 in Yangtze River Delta (YRD), Yangtze River Middle−Reach (YRMR) and Cheng−Yu (CY) urban agglomerations continued to decline until 2017. High NO_2 values were predominantly concentrated in urban agglomerations with high NOx emissions like BTH, Shandong Peninsula (SP), Central Plain (CP), Central Shaanxi (CS) and YRD urban agglomeration. The number of sites with NO_2 decreasing in 2018 accounts for 67.37% compared to 2015, especially in BTH and CP, with the decrease of more than 20 $\mu g \cdot m^{-3}$. High−high concentration centers of NO_2 pollution were observed in high NO_2 areas, while low−low aggregations were observed in the South and southwest of China. In general, anthropogenic emissions contributed dominantly to NO_2 variations, and the contribution in winter was greater than in summer. The reduction of emissions in the winter of 2018 led to emission−related NO_2 variations in YRD, YRMR, CY, and Pearl River Delta (PRD) urban agglomeration reaching −7.41, −9.15, −9.57, and −15.09 $\mu g \cdot m^{-3}$, respectively. While in the winter of BTH, meteorological influence on NO_2 was more obvious than that of other regions, leading variations of 4.42, 4.09, −9.77, and 5.99 $\mu g \cdot m^{-3}$, respectively between 2014 and 2018 in adjacent years. This study makes it possible to look into the differences in NO_2 concentrations among typical urban agglomerations and provide a more complete understanding of NO_2 exposures in China.

Keywords: NO2, urban agglomeration, spatiotemporal pattern, WRF−CMAQ, quantitative impact

