Column 2

Variations of Short-Lived Climate Pollutants in Hanoi, Vietnam

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Emissions of air pollutants have been increasing significantly in Asian countries due to the rapid development of industry and economy. Long-range, transboundary transport of these pollutants probably affects the atmospheric environment and the regional climate in this region (Kita et al. 2009). Climate change, air pollution, and sustainable development are inter-linked, and co-benefits of cutting short-lived climate pollutants (SLCP) will avoid global warming higher than 1.5 °C and negative trade-offs (CCAC 2019; IPCC 2018). Therefore, identification of SLCP emission/production/transportation sources is critical for planning mitigative measures to reduce SLCP.

In this study, simultaneous observation of black carbon (BC), tropospheric ozone (TO₃) and particulate matter 2.5 (PM_{2.5}), which are significant climate forcers, was carried out at VNU Vietnam Japan University in Hanoi to clarify the concentrations and variations of SLCP in Hanoi and Northern Vietnam. The research applied HYSPLIT trajectory model to distinguish contribution source regions of SLCPs to Hanoi and deployed remote PM_{2.5} stations surrounding Hanoi and coastal region in Northeast sector of Northern Vietnam to compare upwind and downwind concentrations.

Figure C2.1 shows the maximum episodes of BC and PM_{2.5} observed in winter-time, especially in January with periods lasting from 1 day to 1 week. Monthly averaged concentrations of BC, TO₃ and PM_{2.5} were in range of 1–3 µg/m³, 20–50 ppbv and 18–65 µg/m³, respectively (Fig. C2.2). BC concentration was estimated

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Fig. C2.1 Timeseries of BC, TO_3 and $\text{PM}_{2.5}$ in Hanoi in Jan. and Feb., 2019

from 4% to 6% of $\text{PM}_{2.5}$ in all seasons of 2019. Diurnal variations of these species suggested that major part of them were emitted or produced in Northern Vietnam region. BC and $\text{PM}_{2.5}$ were remarkably increased during rush hours or night-time in diurnal variation. In contrast, TO_3 was often high at noon and depleted to zero at night. Seasonal variation as shown in Fig. C2.2 indicated that BC and $\text{PM}_{2.5}$ increased with winter monsoon, and TO_3 actively produced in summer, indicating that air transport in association with the winter monsoon affected concentration of BC and $\text{PM}_{2.5}$ in this region. Due to observed enhances of BC and $\text{PM}_{2.5}$ in 2019, the comparison analysis with local and regional transport features focused on winter-time (Fig. C2.3). These high rises were mostly associated with trajectories from South China Sea, and detailed analyses of relation between these rises and the calculated trajectory routes revealed that these rises were actually attributed to emissions from North East coastal region of Northern Vietnam.

In REAS inventory data set (Kurokawa and Ohara 2020), national BC emissions in Vietnam was estimated as 59 Tg/y in 2015, second largest in ASEAN countries. Given the significant climate forcing of BC, this study strongly suggests that mitigation measures to reduce BC in Vietnam can considerably improve both regional climate change and air quality in the Northern Vietnam region.

Fig. C2.2 Monthly average of BC, PM_{2.5} and TO₃ in Hanoi in 2019

Fig. C2.3 Relation of PM_{2.5} concentration with air mass transport trajectories and residence time in areas around Northern Vietnam

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