

Trans-boundary air pollution in a Southeast Asian megacity: Case studies of the synoptic meteorological mechanisms and impacts on air quality

ABSTRACT

Local and regional sources contribute to degraded air quality in many urban areas, however, the influence of trans-boundary air pollution on surface PM_{2.5} is still poorly characterized in Southeast Asia (SEA) megacities. This study, for the first time, utilizes multi-platform datasets to elucidate two trans-boundary PM_{2.5} episodes in Ho Chi Minh City (HCMC), Vietnam, over the periods 25–29 Oct 2013 and 05–08 Oct 2015. Both events persisted with limited diurnal fluctuations and more than 60% of the Air Quality Index (AQI) values at an unhealthy level. PM_{2.5} concentrations during the events were 100% and 115% higher on average compared to local accumulation periods in the same months, highlighting the importance of trans-boundary pollution to local HCMC air quality. Backward trajectories, MERRA-2 AOD data, and CALIPSO images revealed the origin and synoptic meteorology conditions facilitating both trans-boundary pollution events. Anthropogenic PM_{2.5} emissions in continental East Asia fed the 2013 event, which was then transported by strong northeasterly winds triggered by an upper-level ridge near the Tibetan Plateau and a low-pressure system in western Pacific Ocean. In contrast, the 2015 event was the result of Indonesia biomass burning (BB), which was enhanced and transported by a westward propagating Western Pacific Subtropical High triggered by a strong El Niño event. Future climate change will likely increase the number of extreme El Niño events, leading to the increase of transboundary Indonesia BB events to HCMC. This study lays the groundwork for detailing the impact of trans-boundary pollution on local air quality in SEA megacities.