Characterizing the structure of the boundary layer under heavy pollution over urban area, Beijing, China

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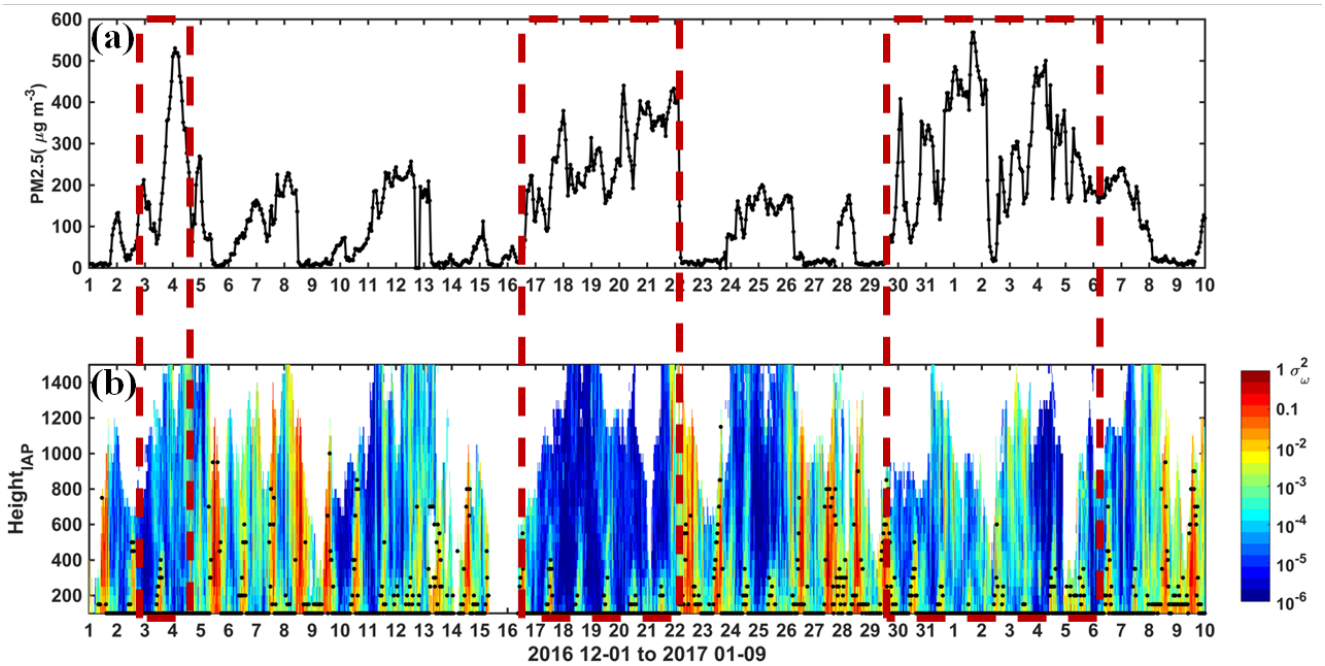
The boundary layer (BL) structure not only controls the transportation, accumulation and diffusion of primary pollutants but also affects the generation and transformation of secondary aerosols. A better understanding of the interactions between the occurrence of air pollution and the structure of the BL is very important for the air-pollution-relevant investigations. Although the influence of the vertical structure of the BL on air pollution has been recognized in many previous studies, understanding this influence remains limited due to the lack of sufficient field observations, especially for high-temporal-resolution vertical observations. Recently, Lidar techniques have become the most valuable and popular systems to detect the atmosphere because of their higher spatiotemporal resolution. As a result, many techniques have been developed to determine the BL structure by using the remote sensing instruments, such as radar wind profilers, aerosol lidars, and ground-based microwave radiometers. In this study, the BL structure was studied by using a Doppler lidar, a Depolarization lidar and the 325-m meteorological tower in Beijing during the winter 2016-2017, in particular during heavy polluted episodes. The height of BL was estimated by using lidar data. The characteristics of wind, temperature and relative humidity at 15 levels, turbulence transport and radiation balance at three levels (47, 140 and 280 m) were analyzed by using the observational data collected on the 325-m meteorological tower.

Keywords: remote sensing instruments, heavy polluted episodes, Beijing, boudary layer structure



(a) $PM_{2.5}$ at Aoti surface station (red box: heavy polluted episodes);
(b) Velocity variance, σ_w^2 (m^2 s^{-2}), calculated from the Doppler wind lidar data , from 1 December 2016 to 10 January 2017. Derived boundary layer depths, based on the threshold method, are depicted as black dots.

