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Influence of the characteristics of atmospheric boundary layer on the vertical distribution of air pollutant in China's Yangtze River Delta

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Air pollution occurring in the atmospheric boundary layer is a kind of weather phenomenon which decreases the visibility of the atmosphere and results in poor air quality. Recently, the occurrence of the heavy air pollution events has become more frequent all over Asia, especially in Mid-Eastern China. In December 2015, the most severe air pollution in recorded history of China occurred in the regions of Yangtze River Delta and Beijing-Tianjin-Hebei. More than 10 days of severe air pollution (Air Quality Index, AQI>200) appeared in many large cities of China such as Beijing, Tianjin, Shijiazhuang and Baoding. Thus, the research and the management of the air pollution has attracted most attentions in China.

In order to investigate the formation, development and dissipation of the air pollutions in China, a field campaign has been conducted between January 1, 2015 and January 28, 2015 in Yangtze River Delta of China, aiming at a intensive observation of the vertical structure of the air pollutants in the atmospheric boundary layer during the time period with heavy pollution.

In this study, the observation data obtained in the field campaign mentioned above is analyzed. The characteristics of the atmospheric boundary layer and the vertical distribution of air pollutants in the city Dongshan located in the center of Lake Taihu are shown and discussed in great detail. It is indicated that the stability of the boundary layer is the strongest during the nighttime and the early morning of Dongshan. Meanwhile, the major air pollutants, PM2.5 and PM10 in the boundary layer, reach their maximum values, 177.1μg m-3 and 285μg m-3 respectively. The convective boundary layer height in the observations ranges from approximately 700m to 1100m. It is found that the major air pollutants tend to be confined in a relatively shallow boundary layer, which represents that the boundary layer height is the dominant factor for controlling the vertical distribution of the air pollutants. In the observations, several strong temperature inversion layers are also found in the surface layer and the middle part of the boundary layer, which lead to the suppression of the vertical mixing of the air pollutants. The jet stream occurring in the boundary layer also contributes to the prevention of the vertical dissipation of the air pollutants. It is also observed that the temporal and spatial evolution of the air pollutants and the hygroscopic growth of the aerosols in the boundary layer are heavily dependent on the humidity of the air.