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The role of fog in haze episode in Tianjin, China: a case study for November 2015

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Abstract. A severe haze episode that heavy fog appeared in its later stage emerged in Tianjin, east-central China, from November 27 to December 2, 2015. With meteorological data and pollutants monitoring data, the characteristics of this event and the role of fog in haze were investigated. During this process, the visibility was less than 600 meters, especially in the haze and fog coexisting period (below100 meters). The peak value of $PM_{2.5}$ mass concentration appeared in the haze only period was 446 μg/m^3. The fog played a role in scavenging and removing $PM_{2.5}$ during haze and fog coexisting period. The surface high humidity province can match well with the high $PM_{2.5}$ concentration region in pollutants removal period. The fog top height was reduced to about 200 meters by cold air. Although the cold air has arrived in Tianjin high altitude, the saturated layer below 200 meters maintained for nearly 12 hours. The heavy fog prevented the momentum in upper atmosphere from transmitting downward and caused the high altitude cold air difficult to reach the ground. The latent heat flux was transmitted upward ahead of sensible heat flux in pollutants removal period, indicating the increasing tendency of mechanical turbulence after fog dissipation. Turbulent kinetic energy (E_{tk}) and the surface mean kinetic energy (E) also enhanced after fog dissipation. It demonstrates that the termination of haze was delayed by heavy fog.

Keywords: Tianjin; Haze, Fog; Turbulence; Dissipation Mechanism

1. Introduction

As a result of the economic growth and urbanization in recent decades, particulate pollution and air quality degradation have become serious environmental issues in north-central China (Cheng et al., 2010; Quan et al., 2011; Zhao et al., 2011; An et al., 2013; Han et al., 2014; Wang et al., 2014; Ran et al., 2016). In clean air, fog particles are composed purely of water drops or ice crystals, which impact on transport and aviation due to the reduction of visibility. In polluted air, the coexistence of haze and fog particles can be greatly harmful to human health besides transportation. The

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