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Mobile LiDAR Measurement for Aerosol Investigation in South-Central Hebei, China

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With the rapid industrialization and urbanization in China during the last decades, the increasing anthropogenic pollutant emissions have significantly caused serious air pollution problems which are adversely influencing public health. Hebei is one of the most air polluted provinces in China. In January 2013, an extremely severe and persistent haze episode with record-breaking PM2.5 outbreak affecting hundreds of millions of people occurred over eastern and northern China. During that haze episode, 7 of the top 10 most polluted cities in China were located in the Hebei Province according to the report of China's Ministry of Environmental Protection.
To investigate and the spatial difference and to characterize the vertical distribution of aerosol in different regions of south-central Hebei, mobile measurements were carried out using a mini micro pulse LiDAR system (model: MiniMPL) in March 2014. The mobile LiDAR kit consisting of a MiniMPL, a vibration reduction mount, a power inverter, a Windows surface tablet and a GPS receiver were mounted in a car watching though the sunroof opening. For comparison, a fixed measurement using a traditional micro pulse LiDAR system (model: MPL-4B) was conducted simultaneously in Shijiazhuang, the capital of Hebei Province. The equipped car was driven from downtown Shijiazhuang by way of suburban and rural area to downtown Cangzhou, Handan, and Baoding respectively at almost stable speed around 100Km per hour along different routes which counted in total more than 1000Km. The results can be summarized as: 1) the spatial distribution of total aerosol optical depth along the measurement routes in south-central Hebei was controlled by local terrain and population in general, with high values in downtown and suburban in the plain areas, and low values in rural areas along Taihang mountain to the west and Yan mountain to the north; 2) obviously high AODs were obtained at roads crossing points, inside densely populated area and nearby industrial emission sources; 3) under the heavy polluted condition, the height of planetary boundary layer (PBL) reduced to 500m.
This experimental measurement suggests that mobile LiDAR is capable of detecting the time and area dependent air pollution episode in regional scale. Especially, LiDAR offers active remote sensing of aerosol vertical properties, which makes it feasible to detect the PBL evolution playing a crucial role in the haze formation. With regular weekly/monthly/quarterly mobile detection, some hidden emission sources could be detected and the air pollution local pattern would be revealed.