

# An Investigation of the Impact of Complex Terrain on the Structure of PBL by Vehicle-based Doppler Wind Lidar

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Taiwan an island is in the subtropics off the southeastern coast of China. Its PBL structure is controlled by local circulations which are highly associated with the complex topography. The Taiwan island terrain is dominated by the almost north – south-orientated Central Mountain Range with an average height of about 2 km and a peak of 3952 m. The western side of Taiwan is flanked by gently sloping plains and small hills. The precipitous topography complicates the flow patterns of local circulations such as the sea-land breeze and mountain-valley breeze, both are highly affected by the surface obstacles and land use in the PBL.

Profiling the PBL by radiosondes or ground-based lidars is limited over complex terrain because of the relatively large spatial variance of PBL. To investigate the influence of complex terrain on the PBL and the regional circulation in Central Taiwan, vehicle-based Doppler lidar were applied to measure the spatial (vertical and horizontal) distribution of aerosols and winds. The Taichung Basin and Yulin-Chiayi Plain are selected as the areas to employ the vehicle-based aerosol and wind lidars to measure the east-to-west cross-section of aerosol and wind of the PBL. The PBL cross-section observed over the Taichung basin and Yulin-Chiayi Plain indicated the significant changes of the PBL structure including terrain-induced vertical mixing of aerosol, wind shear, and return flow of the local circulation.

The Doppler wind lidar mounted on a pickup truck measures the Doppler shift between the reference and backscattered radiations to provide horizontal and vertical wind profiles at distances from 50 m up to 10 km. The wind lidar was mounted with two fixed global navigation satellite system (GNSS) antennas. Double antennas are used for determining the exact heading angle with an accuracy of 0.1°. The attitude correction system uses a micro-electromechanical systems (MEMS) inertial – satellite integrated navigation system. This integrated navigation system is equipped with MEMS gyroscope, accelerometer, and multi-mode and multi-frequency GNSS receiver. The motion and the attitude of the trunk were removed from wind measurements accordingly. The motion corrected wind profiles are well agreed with radiosondes launched at Tianzhong Weather Station.

The spatial distribution of aerosols and winds observed by the Doppler lidar indicates the the inhomogeneity of PBL is dominated by the complex terrain. Several distinct aerosol layers associated with significant wind shears can be frequently observed in the PBL. The height of mixing or stable aerosol layers are found in general are shallower in the coastal area than those in the inland. And that can be frequently noticed the height of near surface layer quickly rise from around 200 meters to 500m-600 meters right after crossing Dadu Plateau (near the coastal area) when the local circulation is dominated by sea breeze, which indicate Dadu Plateau plays an important role on the structure of PBL of Taichung basin. The wind directions in the top of the PBL are also frequently found to be opposite to the wind direction in the bottom of the PBL, which indicated the existence the return flow of local sea-land and mountain-valley circulation.

**Keywords: Wind 、 Aerosol、 Lidar、 PBL、 local circulation**