

Polar Atmosphere Lidar Observation System at Zhongshan Station, Antarctica

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The polar regions are key parts of the global general circulation of Earth's atmosphere with unique phenomenon and processes, as well as main entrances for the energy and particles of solar wind entering geospace. Chinese Zhongshan Station (69°22'24"S, 76°22'40"E) in Antarctica is near the shore of the continent and at the unique polar cusp latitude. Besides the distinctive local properties, its atmosphere should also experience a wide variety of coupling processes with the ionosphere since it crosses the aurora zone twice a day. Considering as an ideal place for polar atmosphere observation and research, the Polar Research Institute of China developed and deployed a Polar Atmosphere Lidar Observation System (PALOS) at Zhongshan Station, which is a synthetic lidar observation system covering all layers of neutral atmosphere and the first of its kind in Antarctic.

In PALOS, a Sodium (Na) resonance fluorescence Doppler lidar is established in 2019 to observe the Mesosphere and lower Thermosphere, which is capable of measuring the horizontal winds, temperature and Na number density around 75-110 km for both day and night. A pure rotation Raman lidar, a Rayleigh/Mie scattering lidar module and a coherent Doppler wind lidar are installed in 2020, which realize the high-precision measurement of troposphere-stratosphere-mesosphere temperature and boundary layer wind. The Raman lidar can observe diurnal temperature around ~0.5-15 km (night) and ~0.5-3 km (day), while the integrated Rayleigh/Mie module measures the temperature and atmosphere density around 40-70 km at night. The boundary layer atmospheric wind field from 30 to 800 meters is monitored by the Doppler wind lidar.

The deployment and the operation of PALOS are mostly supported by Chinese National Antarctic Research Expedition (CHINARE), and thousands of hours of observation data have already been accumulated, which can be used to study the basic characteristics of the polar atmosphere, the thermal/dynamic processes in middle and upper atmosphere, etc. When PALOS makes coordinated observation (Figure 1), simultaneously observed temperature profiles covering most part of the neutral atmosphere can be provided as shown in Figure 2. We have observed very active sporadic and thermospheric Na layers, which are associated with the activities of sporadic E layers (Es) and aurora. Continuous horizontal winds and temperature data covering multiple days in the mesopause region also reveals strong atmospheric wave activities above Zhongshan Station. More researches are in progress based on these valuable data set.



Figure 1. PALOS makes coordinated observation during polar night.

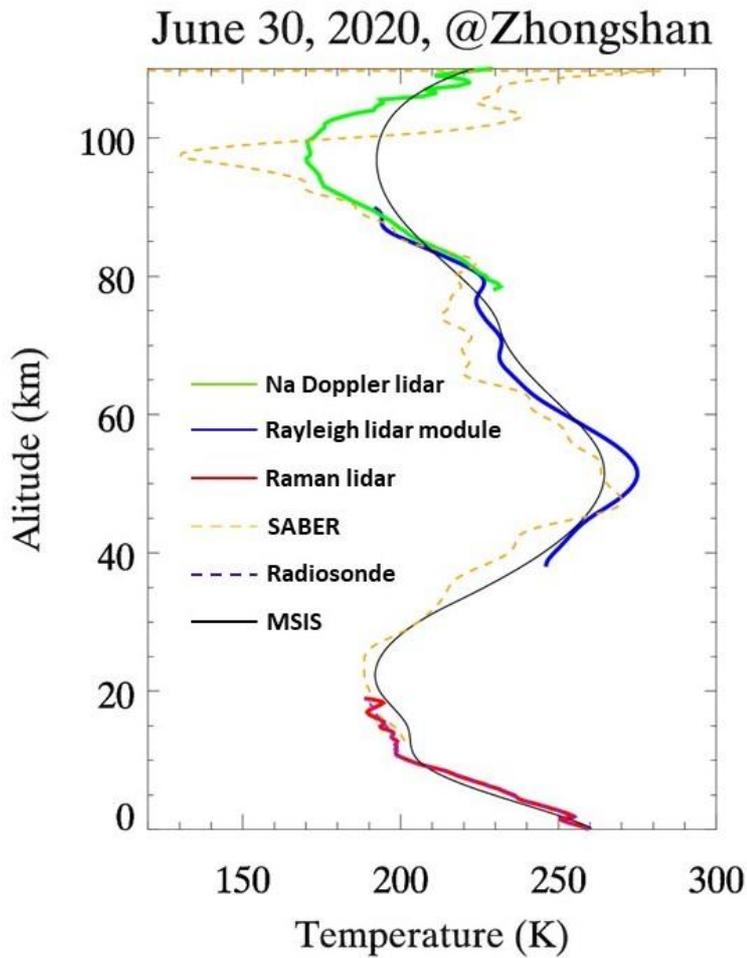


Figure 2. Simultaneously observed temperature profiles on June 30th, 2020.

References

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