A frequency-tunable resonance scattering lidar observation at Syowa in Antarctic
~ Characteristics of calcium ion layer in the mesosphere and lower-thermosphere ~

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As a part of a prioritized project of the Antarctic research observations, a new resonance scattering lidar system with frequency-tunable alexandrite laser was developed and installed at Syowa Station (69°S, 40°E) by the 58th Japan Antarctic Research Expedition (JARE 58). The lidar transmitter is based on injection-seeded, pulsed alexandrite laser for 768-788 nm (fundamental wavelengths) and a second-harmonic generation (SHG) unit with two harmonic crystals for 384-394 nm (second harmonic wavelengths). The laser wavelengths are tuned in to the resonance wavelengths by a wavemeter that is well calibrated using a wavelength-stabilized He-Ne laser. A Nasmyth-Cassegrain f/8 telescope with a 0.8 m diameter primary mirror was used as a receiver. Photons were detected by a Hamamatsu photomultiplier tube (PMT) attached at the back of the telescope. The background was reduced using a band-pass filter with a FWHM of 1 nm. The lidar was operated at the Syowa for two years in 2017–2018 and the density profiles of atomic iron (Fe, 386 nm), atomic potassium (K, 770 nm), and calcium ion (Ca^+, 393 nm) and temperature profiles in the mesosphere and lower thermosphere (MLT) were successfully obtained.
In this presentation, we will focus on the Ca^+ measurements. The metal ion layers are produced by meteoric ablation. The meteoric metal ions have relatively long chemical lifetime in the MLT and behave as plasma affected by neutral atmosphere dynamics. Ca^+ is one of meteoric metal ion and only one ion, which can be measured its vertical profile from the ground by a lidar sounding. Density profiles of Ca^+, the first detection over Antarctic, were observed 6 nights in total in September and October for two years. Characteristics of the Ca^+ layer in spring at the high latitude in the southern hemisphere are shown by comparison with previous observation at Kühlungsborn (54N) in 1997-1998 [Gerding et al., 2000] and model prediction [Plane et al., 2018].

References

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