下部熱圏/中間圏/成層圏の気温/風速/微量成分の衛星観測に向けて

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Satellite observation proposals of temperature, wind, and compositions at lower thermosphere, mesosphere, and stratosphere

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Temperature dataset (such as ECMWF) at mesosphere is known to have significant bias against the ground based Rayleigh lidar observations, which should mean our limited understandings of upper-stratosphere/mesosphere temperature field, planetary wave activities (such as stratospheric sudden warming), gravity waves braking and mixing, and Brewer-Dobson circulation, Quasi-Biannual-Oscillation and Semi-Annual-Oscillation. It also means our lack of mesospheric temperature observation limit the accuracy of operational weather forecast, long-term weather forecast, long term O3 layer and climate change predictions. Satellite observations of mesospheric temperature profile have been carried out by scientific satellite sensors such as Aura/MLS and TIMED/SABER, but it is well known that these sensors had some temperature bias in the mesosphere.

Temperature can be measured by using O2 emission line in the mm and sub-mm wavelength region, and it is theoretically accurate because the oscillator strength of diatomic molecule is more reliable compared to those of multi atom molecules such as CO2, and mixing ratio of O2 is much more uniform at high altitude. In this paper, we discuss the sensitivity of temperature, line of sight (LOS) wind velocity, H2O, and O3 at the 485-489 GHz frequency region, where 487.249 GHz O2 line and 488.1 GHz H2O line exist. Two instruments are assumed, one is the 4K cooled SMILES-2 with Tsys = 250 K (SSB: Single Side Band), the other is Schottky mixer instrument with Tsys = 600 K (DSB, 70 K cooled). Temperature and wind speed in the lower thermosphere can be measured as good as 5 K, 5 m/s and 5 km vertical resolution by using 2.06 THz O-atom emission by using 4 K cooled Hot Electron Bolometer system or 70 K cooled Schottky mixer system. The observation of submm (488, 557, 624 GHz) and 2.06 THz should enable a breakthrough observation of global temperature, wind speed and composition.