IN SITU MEASUREMENTS OF SMALL-SCALE NEUTRAL AND PLASMA DYNAMICS IN THE POLAR SUMMER MESOSPHERE

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Since the beginning of the nineties our research group has launched a total of 40 sounding rockets carrying ionization gauges for the high resolution measurement of neutral density fluctuations and electrostatic probes for the high resolution measurement of plasma density fluctuations at high northern latitudes.
While small-scale fluctuations in the plasma may originate from either electrodynamics or neutral dynamic processes, neutral density fluctuations are a unique tracer for turbulent velocity fluctuations. Since such measurements are made at very high spatial resolution (<1 m) they can be used to derive the spectral content of the turbulence field from which, in turn, the turbulent energy dissipation rate can be reliably derived. Due to the laboratory calibrations, the ionization gauges also deliver absolute neutral density measurements that can be integrated to derive a neutral temperature profile. Since 2006, our payloads were equipped with the ECOMA particle detector that measures densities of the mesospheric aerosols with high spatial resolution. Such simultaneous measurements of the densities of the different plasma constituents (neutral air, electrons, ions, and aerosols) make it possible to derive, in particular, the Schmidt numbers with a high spatial resolution.
After a short introduction to the instrumental and analysis technique we will present an estimate of the Schmidt numbers, for the charged aerosols. We also present results of in situ measurements of neutral temperature and turbulence conducted simultaneously in the same volume. And we show results of simultaneous in situ measurements of the neutral and plasma density fluctuations at 79 °N that reveal an overlapping of the plasma instability and PMSE regions, as well as strong neutral density fluctuations from the lower thermosphere that cannot be of turbulent origin.

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