Introduction to the DELTA campaign

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The large-scale circulation in the high latitude thermosphere has been investigated with many modeling studies and from satellite observations. In comparison, meso-scale (1-1000 km) phenomena such as the thermospheric response to auroral disturbances are not well understood. Recent rocket observations in the polar thermosphere were concentrated on wind measurements, and thereby a strong wind and its shear were observed to exist in the lower thermosphere. However, a cause of such a wind structure is not fully identified mainly because of uncertainty in the neutral temperature estimation necessary for the modeling study, and therefore the existing empirical models are sometimes uncertain.

The 'Dynamics and Energetics of the Lower Thermosphere in Aurora' (DELTA) rocket was successfully launched from Andoya Rocket Range at 0033 UT on December 13, 2004. The objective of DELTA campaign is to study the upper atmospheric dynamics and energetics associated with the auroral energy input, which is thought to dominate the above-mentioned spatial structure of the neutral wind. The onboard instruments successfully made in-situ measurements of neutral atmospheric temperature and density as well as auroral emission rate, electron density and temperature. Various optical and radar instruments on the ground were coordinated to make a remote observation of the polar lower thermosphere in and around the launch site so that those can provide information on the auroral activity and its spatial distribution, neutral wind, and atmospheric heating in the longer time scale. In particular, the simultaneous observations of the neutral wind, plasma density, temperature, and ion drift by the EISCAT UHF radar at Tromsoe and the neutral wind and temperature by Fabry-Perot Interferometer (FPI) in Skibotn played an important role in this campaign. The ALOMAR Sodium Lidar was also successfully operated to get Na temperature and line-of-sight velocity. The coordinated observations of thermospheric neutral and ionospheric plasma parameters by a sounding rocket, FPI, and EISCAT is the first attempt in the world, and it will provide the most detailed description of the atmospheric response to auroral disturbances.

Both the rocket and the EISCAT radar observations show that the auroral energy input probably due to the electron precipitation really existed for the rocket flight in the vicinity of its trajectory. The NTV (Nitrogen Temperature of Vibration) instrument on the rocket provides a good estimation of the molecular nitrogen temperature on the auroral energy input. The Langmuir probe identifies that at a time of the rocket flight, the electron density was remarkably high, which is possibly an evidence of the auroral electron precipitation. In this presentation, we will give an introduction to this sounding rocket campaign which includes both the in-situ observations by the rocket data and the ground-based measurements.

This campaign was conducted as an international project that included DELTA members from Japan, EISCAT Scientific Association in Europe, Lancaster University in UK, Colorado State University in the US as well as Andoya Rocket Range.