

Initial reports of DELTA-2 campaign: Neutral wind profile in auroral thermosphere by TMA released from S-310-39 rocket (2)

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1. Introduction

Sounding rocket S-310-39 was launched from Andoya Rocket Range in Norway on January 26, 2009, with periodical releasing of TMA (Tri-Methyl-Aluminum) clouds (by Clemson University). Tracing of dotted line of TMA luminous clouds enables us to analyze thermospheric neutral wind in three-dimensional coordinates. Target of the DELTA-2 campaign was investigating thermospheric neutral wind, especially in perpendicular wind component, under a condition of thermospheric heating by auroral particle precipitations. Here, we used a technique established in thermospheric neutral wind measurement on lithium release experiment by S-520-23 sounding rocket as WIND campaign in 2007.

2. Method

Ground-based observations of TMA were carried out by a collaborative team of Clemson University, Hokkaido University, and Kochi University of Technology at Andoya and Tromso in Norway, as well as Abisko in Sweden. Image sequences of TMA luminous clouds were taken by three Clemson's special cameras (1 film camera: Hassel Blad and 2 digital cameras: Nikon D70, D80) as well as by digital cameras of Canon EOS KISS Digital N used in the WIND campaign for back-up. Here, the back-up digital cameras were used without infrared-cut filters because of the heritage of the lithium release experiment. The TMA trail emits continuous luminescence in wavelength and 50-degree FOV is enough for observation, therefore, general camera lenses (50 mm, F/1.4; 100 mm, F/2.0) without any filters were used. In case of Clemson's TMA cameras, sequential 18 s exposures every 20 s under a condition of F/2.8 and ISO=3200 were programmed for the Hassel Blad's film cameras, as well as 6 s exposures every 10 s under F/1.4 and ISO=1600 were programmed for two digital cameras. In case of the Japanese back-up cameras, 15 s exposures every 20 s were operated under a condition of F/5.6 and ISO=1600.

3. Results

The S-310-39 rocket was launched from Andoya Rocket Range to the geographical North at 0:15 UT on January 26, and at 190 s after the launch, just after the passage of Apex (about 150 km), TMA began to release and, during downleg of the flight, it was released periodically for 2 s every 4 s with being controlled by a valve on-board. Generated dotted line of TMA was visually confirmed from two sites (Tromso and Abisko) at the exact position of prediction in the sky, and successfully observed for about 25 minutes. Aurora condition during the experiment was under the preferred condition of more than 2.0×10^{11} electrons/m³ at 120 km altitude for every 4 beams of the CP2w mode of EISCAT Tromso radar, and intense aurora activities were continuously observed at Tromso and Abisko. At about 0:25 UT, a break-up of aurora was seen, then, the active aurora can be seen for about 30 minutes during and after the flight of the rocket. Launch window of this rocket was planned from January 14 to 28, however, only one chance of the night was available, because neither the strong wind in the launching site, the weather condition of three sites, nor the condition of aurora particle precipitations were upon satisfaction. Therefore, unfortunately, we have to launch the rocket under the condition of bad weather at Andoya, one of three ground sites.

4. Summary

An analyzing technique used in the lithium release experiment as well as a special software for triangulation were applied to the analyses of image sequences of the TMA trail obtained at two sites, and an initial result of thermospheric neutral wind measurement in case of active aurora condition will be presented in this paper. In addition, comparing the result by our method with that of Clemson's, accuracy of the both analyses will be discussed. Furthermore, comparing with simultaneous observations, especially with datasets of EISCAT radar and FPI at Tromso, under the condition of thermospheric heating by auroral current, a role of the perpendicular component of the neutral wind in auroral thermosphere will be studied.