Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

PEM025-15 Room: Function Room A Time: May 27 16:00-16:15

DELTA-2 campaign: consideration about accuracy of TMA neutral wind analyses and temporal variation of the wind profile

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1. Introduction
DELTA (Dynamics and Energetics of the Lower Thermosphere in Aurora)-2 sounding rocket campaign was carried out in auroral-zone lower thermosphere over Northern Europe on January 26, 2009. TMA (Tri-Methyl-Aluminum) was periodically released from a sounding rocket, producing dotted line of TMA luminous clouds in the sky. Triangulation analyses enable us to reveal thermospheric neutral wind profile in three-dimensional coordinates under a condition of thermospheric heating by auroral activities, so as to obtain vertical wind in the heating region. Here, based on a technique established in Lithium release experiment of the WIND campaign (2007), temporal variation of neutral wind profile in auroral ionosphere was obtained in detail.

2. Observation
Ground-based observations of TMA were carried out at Andoya (Norway), Tromso (Norway), and Abisko (Sweden). Sounding rocket S-310-39 was launched 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 140 km), TMA release began. Being controlled by a valve on-board, TMA was periodically released in the down leg. The dotted line of TMA was clearly imaged at Abisko and Tromso in almost exact predicted position in the sky, respectively, and successfully observed for 25 minutes. Auroral condition was simultaneously observed by EISCAT radar, FPI, and all-sky camera at Tromso.

3. Results
During sustainable period of patch-like TMA structures, three-dimensional wind vectors could be derived from several TMA parches, revealing vertical wind components in the altitude range from 122 km to 134 km. After merging these patches into a trail, zonal and meridional neutral wind profile at each one minute bin was analyzed under horizontal wind assumption from 89 km up to 134 km for ten minutes. As a result, southeast-ward wind with the maximum of 112 m/s (at 130 km altitude) in an altitude range between 120 km and 134 km, as well as northeast-ward wind with the maximum of 79 m/s (at 92 km altitude) in the range between 89 km and 103 km were derived. The summarized wind profile for ten minutes is in good agreement with the analyses by Clemson Univ.

4. Summary
The TMA patches were rapidly diffused and merged with adjacent patches, resulting in a difficulty of tracking temporal variations of barycentric positions of the patches at later than a few minutes from TMA releases. An analyzing technique applied to Lithium release experiment and a special software for triangulation were used for analyses of TMA trail, deriving temporal variations of wind profiles for ten minutes. In this analytical approach, possible errors were caused by: accuracies of back-ground star location, distortion correction function of lens used, measurements of median line of TMA trail, selectability of corresponding positions on trail,

discrepancies of imaging time and exposure for two sites, and duplicates of coordinates along the line of sight. In this paper, further information will be presented with previous analyses and above mentioned analytical error will be verified, as well. Availability in revealing disturbance structures in lower thermosphere during intense auroral activities will be discussed. In addition, comparing with simultaneous ground-based observations, final result of TMA chemical release experiment of the DELTA-2 campaign will be shown.

References:
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Keywords: DELTA-2 campaign, TMA, polar region, lower thermosphere, aurora, neutral wind