

In situ observations of instabilities in the mesopause region using foil chaff technique

Y. Koizumi (1), M. Kubota (2), Y. Murayama (2), M. Abo (3), M. Uchiumi (4), K. Igarashi (2), N. Iwagami (1), T. Abe (5) and K.-I. Oyama (5)

(1) University of Tokyo, Japan, (2) National Institute of Information and Communications Technology, Japan, (3) Tokyo Metropolitan University, Japan, (4) Ariake National College of Technology, Japan, (5) Institute of Space and Astronautical Science, JAXA, Japan (koi@isas.jaxa.jp / Phone: +81-42-759-8182)

The WAVE2004 campaign was conducted using rocket-borne and ground-based instruments to study the formation process of waves in the airglow structures from both dynamical and chemical aspects. The sounding rocket S-310-33 was launched at 0:30JST on 18 January 2004, from Uchinoura Space Center in Japan, during the WAVE2004 campaign and vertical profiles of atomic oxygen density, electron density, airglow intensities, and horizontal wind were successfully observed. In this rocket experiment, foil chaff experiment was carried out for in-situ measurements of wind fields around the mesopause. The results indicate very strong northward winds above 89 km altitude and eastward winds below.

The atmospheric density and temperature derived from the descending speed of the foil chaff exhibit unusually strong variation with peaks at altitudes of 88 and 91 km. These results are inconsistent with the hydrostatic equilibrium assumed for the derivation of temperature profile. The reason is attributable to the incorrect descending speed derived by neglecting a vertical velocity component of winds induced by atmospheric gravity waves and other atmospheric phenomena such as turbulence.

The amplitude of vertical velocity due to the atmospheric gravity wave is calculated from the relative perturbation of sodium density observed by the Na lidar simultaneously. The estimated vertical wind velocity is negligibly small, so that the atmospheric gravity wave is less likely to be the main cause of the vertical wind velocity found in the foil chaff experiment. There is a high possibility that the vertical velocity is due to instabilities. We examine the existence of the instabilities from the Richardson number derived from horizontal winds observed by the foil chaff. We also discuss the relation between the instabilities and ripple structures observed by the all-sky imagers on the ground.