

Study of dynamics of the middle atmosphere by MST radars

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MST (Mesosphere-Stratosphere-Troposphere) radars such as the MU radar is only a tool providing vertical profiles of three dimensional winds in a wide height region with high resolution and good accuracy. In particular, accurate estimates of vertical fluxes of horizontal momentum by the MST radars allow us to investigate quantitatively the effects of gravity waves on the global circulations.

One of the significant problems that current climate models have is the parameterization of gravity waves. Several practical parameterizations schemes have been proposed for orographically forced waves with zero ground-based phase velocities. However, we have still insufficient knowledge of non orographic sources of gravity waves, such as momentum flux spectrum as a function of phase velocity and wave numbers. These gravity waves with non-zero ground-based phase velocities are important for the middle atmospheric dynamics by driving the quasi-biennial oscillation in the equatorial middle atmosphere and maintaining the zonal wind reversal below and above the mesopause in middle latitudes. To obtain the gravity wave spectra, further studies using MST radar observations are important.

Recently, other tools are available to examine gravity waves. High-resolution climate models have an ability to simulate gravity waves explicitly. However, the reality must be confirmed by the observations with high resolution. Satellite observations by the GPS occultation method are valuable to catch global distribution of gravity waves. However, the observations provide only thermal structure of gravity waves and hence have limitation for examining the effects of gravity waves on the global circulations. Therefore, MST radar observations are still significantly important in a sense that they can compensate the shortage of the recent tools of gravity wave study, although radar observation is possible only at the location.

From this view point, we proceed with the project to install the first MST radar in the Antarctic (Program of the Antarctic Syowa MST/IS radar; PANSY). I will review the studies of middle atmosphere dynamics by the MU radar and introduce the current status of PANSY.