

Altitude elevation of the eastward jet in the winter middle atmosphere over Alaska

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Observations of mesospheric temperature and wind by a Rayleigh lidar and MF radar at Poker Flat Research Range (65.1N, 147.5W) are conducted by NICT (National Institute of Information and Communications Technology) and the Geophysical Institute, the University of Alaska, Fairbanks. In this presentation, we present the characteristics of the disturbed conditions and the atmospheric waves in the mesosphere during stratospheric sudden warming (SSW) at Poker Flat. So far we analyzed the NICT Rayleigh lidar and MF radar data, and stratospheric assimilation data provided by the United Kingdom Meteorological Office on a period that extends from November 1998 to April 2009, which period covers one solar cycle of 11 years.

Over ten major SSWs occurred during analyzed period. Before major SSWs temperature increasing of 10 - 30 K in the lower mesosphere was observed by the NICT lidar, and intermittent reversals of East-West wind were also observed by the NICT MF radar at all major SSW events. Just before major SSWs disappear of temperature peak as stratopause and temperature was almost constant from 40 - 80 km altitude range was seen in the results of two-event observations by the NICT lidar. During major SSWs temperature decreasing of 10 - 20 K in the lower mesosphere was observed by the NICT lidar at two events. At all major events East-West wind reversal (eastward to westward) from 30 - 90 km altitude range was seen by the NICT MF radar observations. This wind reversal starts and descends from mesosphere to upper stratosphere and occasionally to troposphere.

Remarkable elevation of the center altitude of middle atmosphere jet occurred in 2003/2004, 2005/2006, 2008/2009 winters. Those events have a quasi-two-year cycle and the value of eastward wind speed is larger during the period of low solar activities. The elevation of the stratopause (~ 55 km to 70 km) also observed in the 2003/2004 winter.

In addition, we analyzed wind data observed by the NICT MF radar in order to investigate characteristics of atmospheric waves in the mesosphere. For example, following results were obtained about analysis of activities of short period waves of E-W direction in a 1998/1999 winter. Decreasing of activity of those waves was observed at two major SSWs. On the other hand increasing of activity was seen before those SSWs, during which enhancement of eastward wind occurred in the upper stratosphere. Decreasing of activity, however, also observed at the period of intermittent reversal of E-W wind (eastward to westward) in the mesosphere. High activity of short period waves after major warmings and existence of planetary wave with wavenumber 5 in upper stratosphere in 2003/2004 is not as usual.

We will analyze more data and discuss relationship between characteristics of planetary/tidal/gravity waves in the mesosphere, background wind and temperature in the mesosphere and large scale disturbance in the upper stratosphere such as SSWs in terms of long-term trend.

Keywords: Middle atmosphere disturbance, Atmospheric waves, Lidar, MF radar, Arctic region, Stratospheric sudden warming