

## Climatology of the middle atmosphere over Alaska in winter season: quantitative comparison with other indexes

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Purpose of this research is to clarify climatology of the middle atmosphere over Alaska in winter season. This work includes analysis and discussion about the role of atmospheric waves which affects disturbance of the middle atmosphere and about the relationship between disturbance of the middle atmosphere and activities of solar and lower atmosphere. So far we analyzed Rayleigh lidar and MF radar data at Poker Flat Research Range (65.1N, 147.5W) in Alaska, which are conducted by NICT (National institute of Information and Communications Technology) and GI/UAF (the Geophysical Institute, the University of Alaska, Fairbanks), and stratospheric assimilation data provided by the United Kingdom Meteorological Office on a period that extends from November 1998 to April 2012, which period covers over one solar cycle of 11 years.

We derived the results listed below:

- \* Over ten major stratospheric sudden warmings (SSW) occurred during analyzed period.
- \* Before major SSWs temperature increasing of 10 - 30 K in the lower mesosphere was observed by the lidar.
- \* 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 lidar.
- \* During major SSWs temperature decreasing of 10 - 20 K in the lower mesosphere was observed by the lidar at two events.
- \* Intermittent reversals of East-West wind were also observed by the MF radar at all major SSW events.
- \* At all major events East-West wind reversal (eastward to westward) from 30 - 90 km altitude range was seen by the 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 the 2003/2004, 2005/2006, 2008/2009 winters.
- \* The elevation of the stratopause (~ 55km to 70km) also observed in the 2003/2004 winter.

We compared occurrence time of these above and other phenomena which presented in papers during disturbed period in the Arctic middle atmosphere with the sun spot number and the QBO index in terms of SSW categorization. However, no clear relationship was found between occurrence time of disturbance in the Arctic middle atmosphere and two indexes. This results suggests that two SSW categorization, major or not, is not suited for quantitative comparison. Therefore we will do further analysis of the lidar and MF radar data, stratospheric assimilation data and some indexes in order to find most suitable value in quantitative comparison.

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