Planetary waves spectrum in stratosphere-mesosphere during SSW 2018

Gennadi Milinevsky1,2,3, Yuke Wang1, Andrew Klekociuk4,5, Oleksandr Evtushevsky2, Wei Han1, Asen Grytsai2, Oleksandr Antyufeyev6, Yu Shi1, Oksana Ivaniha2, and Valerii Shulga1,6

1International Center of Future Science, College of Physics, Jilin University, Changchun, China (genmilinevsky@gmail.com)
2Taras Shevchenko National University of Kyiv, Physics Department, Kyiv, Ukraine (o.m evtush@gmail.com)
3National Antarctic Scientific Center, Ministry of Education and Science of Ukraine, Kyiv, Ukraine
4Australian Antarctic Division, Kingston, Australia (Andrew.Klekociuk@awe.gov.au)
5University of Melbourne, Melbourne, Australia
6Institute of Radio Astronomy, National Academy of Sciences of Ukraine, Kharkiv, Ukraine (shulga@rian.kharkov.ua)

The planetary wave activity in the stratosphere–mesosphere during the Arctic major Stratospheric Sudden Warming (SSW) in February 2018 is discussed on the basis of the microwave radiometer (MWR) measurements of carbon monoxide (CO) above Kharkiv, Ukraine (50.0°N, 36.3°E) and the Aura Microwave Limb Sounder (MLS) measurements of CO and temperature. From the MLS temperature zonal analysis, eastward and westward migrations of wave 1/wave 2 spectral components were differentiated, to which less attention was paid in previous studies. Abrupt changes in zonal wave spectra occur with the zonal wind reversal on 10 February 2018. Eastward wave 1 and wave 2, observed before the SSW onset, disappear during the SSW event, when westward wave 1 becomes dominant. This is consistent with previous studies showing that westward wave 1 in the mesosphere is present after the onset of major SSW events with an elevated stratopause. Analysis of the wavelet power spectra of mesospheric CO variations show statistically significant periods in a band of 20–40 days using both MWR and MLS data. Approximately 10-day periods appear only after the SSW onset. Since the propagation of upward planetary waves is limited in the easterly zonal flow after the zonal wind reversal, forced planetary waves may exist after the onset of SSW due to the instability of the zonal flow in the mid-latitude mesosphere.

This work was partly supported by the projects 19BF051-08, 20BF051-02 Taras Shevchenko National University of Kyiv and by the International Center of Future Science, Jilin University (JLU), under the contract with the JLU. This work also contributed to the State Institution National Antarctic Scientific Center of the Ministry of Education and Science of Ukraine research objectives and to Project 4293 of the Australian Antarctic Program.