A New Method of Determining the Date of the Polar-Vortex Breakup and Formation in the Stratosphere

Wookap CHOI[1] and Jihoon SEO[1, 2]

[1]*Seoul National University, Seoul, Korea*
[2]*Green City Technology Institute, Seoul, Korea*

Breakup and formation of the polar vortex is a dominant feature of the seasonal transition in the stratosphere, which significantly affects stratospheric O3 concentration and tropospheric weather. Previously several criteria for the vortex breakup have been suggested based on the potential vorticity (PV) and wind speed. Those have, however, focused mainly on the lower stratospheric vortex of which spatiotemporal evolution and decay are more continuous than those of the upper stratospheric vortex. A new method, which can also be applied in the upper stratosphere, is proposed to determine the timing of the polar-vortex breakup in spring and formation in fall in the stratosphere. To find a consistent criterion for the vortex breakup both in the lower and upper stratosphere, the date of the vortex breakup is defined as when PV gradient with respect to the equivalent latitude at the polar vortex edge becomes lower than that at the subtropical edge. With applying the new definition to the UK Met Office reanalysis data, the breakup days of the Arctic polar vortex on the 18 isentropic levels from 450 K to 1300 K were calculated. To test the validity of this new definition of the vortex breakup distributions of various trace species are analyzed including methane, nitrous oxide, water vapor, and ozone observed by Improved Limb Atmospheric Spectrometer (ILAS) and ILAS-II, and ozone observed by Polar Ozone and Aerosol Measurement (POAM) 2 and POAM 3. Distributions of trace species observed around the breakup time show that the new method is better than previous methods, particularly in the upper stratosphere.

Key words: polar-vortex, stratosphere, breakup, formation