Analysis of the ozone reduction event over the southern tip of South America in November 2009

*Hideharu Akiyoshi[1], Masanao Kadowaki[2], Haruna Nakamura[3], Takafumi Sugita[1], Toshihiko Hirooka[4], Yayoi Harada[5], Akira Mizuno[6]

1. National Institute for Environmental Studies, 2. Japan Atomic Energy Agency, 3. Fujitsu FIP Corporation, 4. Department of Earth and Planetary Sciences, Kyushu University, 5. Meteorological Research Institute, 6. Institute for Space-Earth Environmental Research, Nagoya University

A reduction of the total ozone over the southern tip of South America lasting 3 weeks occurred in November 2009. Analyses of the ERA-Interim reanalysis data and the total ozone observed by the OMI indicate that the total ozone reduction event was caused by a migration of the polar vortex toward the South American continent at the time of the vortex breakup. The vortex migration is associated with an enhanced wave flux from the troposphere at 120–150˚W and 50–60˚S to the west of the South American continent to the stratosphere over the southern part of the continent, which led to a large negative geopotential height anomaly in the lower stratosphere. In November, a blocking pattern was diagnosed from the 500 hPa geopotential height over the west of the South American continent. These results suggest a relation between the long-lasting reduction of the total ozone over the southern tip of South America and the blocking phenomenon in the troposphere of the Southern Hemisphere through wave propagation from the blocking region in 2009.

The total ozone, the geopotential height at 50 hPa and 500 hPa, the wave activity flux, the polar vortex migration and elongation, and the blocking pattern in the Southern Hemisphere November for 1979–2015 as well as 2009 were investigated. The results show that the relation between the blocking pattern in the troposphere and the large polar vortex migration and elongation in the stratosphere is also evident in November 1987, 1994, 1997, 2001, and 2011. Especially, in November 1994, 1997, and 2011, the blocking pattern and the polar vortex migration occurred near the South American continent.

These results indicate that the migration of the Antarctic polar vortex to the southern tip of South America in November occurred occasionally in the past. They also suggest that diagnosis of blocking pattern in the Southern Hemisphere troposphere may be useful for prediction of the direction of polar vortex migration in the stratosphere, and hence, prediction of high UV radiation risk over the southern tip of South America in early summer.

This research was supported by JST/JICA, SATREPS, the Environment Research and Technology Development Fund.

Keywords: ozone hole, South America, polar vortex, blocking, November 2009, ERA-Interim reanalysis data

