

Contribution of zonal wavenumber one and two planetary waves to the three week total ozone reduction over Rio Gallegos (Argentina) in November 2009

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Unusually low total ozone was observed for three weeks in November 2009 over the southern part of South America. The ozone reduction was measured at the Rio Gallegos by lidar. The observation showed ozone concentration reductions on 13-14 November in the lower stratosphere and on 22-23 November in the upper troposphere (Wolfram et al., 2012). These ozone reductions at different altitudes and the close dates resulted in a three week reduction of total ozone.

In order to examine variation in the Antarctic polar vortex in November 2009, we calculated the Antarctic polar vortex boundary on the equivalent latitudes with ERA-Interim reanalysis dataset. And to clarify the wave activity for the deformation and decay of the polar vortex, we analyzed the time evolutions of waves on the geopotential height and Eliassen-Palm flux. The analyses indicated that for wavenumber 1 at 50 hPa negative anomaly stayed over Rio Gallegos after the phase shifted at the beginning of November, then amplified in the middle of November, which are considered to be associated with upward wave propagation from the troposphere. For wavenumber 2, a slowdown of eastward phase speed and phase shifts occurred, which are also associated with wave propagation from the troposphere. As a result negative anomaly of both the wavenumber stayed over Rio Gallegos. We also compared the 2009 wave activity and those of climatology for the 33 years from 1979 to 2011 and show a large anomaly of 2009. We also made a simulation of ozone variation by using MIROC3.2-CCM nudged toward ERA-Interim data. An experiment of the 1980 meteorology and the 2000 Equivalent Effective Stratospheric Chlorine amount resulted in a similar ozone loss over Rio Gallegos in November.

Key words: ozone, chemistry transport model, stratospheric dynamics

References

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