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Latest tendency in the Antarctic ozone longitudinal distribution

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Significant ozone depletion was observed within the southern polar vortex during spring in the 1980s – early 1990s. Later, a stabilization in total ozone levels and ozone hole area has been observed. Atmosphere models predict a consequent recovery of the Antarctic ozone. Nevertheless, identification of the long-term processes is complicated by high interannual variability hiding their general regularities. In particular, a large stratosphere warming in 2002 resulted in significant increase in total ozone levels. The Antarctic ozone hole is formed inside polar stratospheric vortex, which is under influence of large-scale planetary waves. The components of the quasi-stationary wave (QSW) in the spring Southern Hemisphere (SH) stratosphere is mainly contributed by zonal wave number 1 which in turn determines the location of the total ozone extremes in spring: QSW minimum (maximum) is located in the South Atlantic (Australian) sector. In our work the satellite data of TOMS/Nimbus-7, TOMS/Earth Probe and OMI/Aura (http://ozoneaq.gsfc.nasa.gov/) have been used to investigate longitudinal distribution of the total ozone in Antarctic region. The gap in these satellite observations (1993-1995) was filled by the Multi-Sensor Reanalysis data (http://www.temis.nl/). Ozone distribution in the SH high and mid latitudes 80–50S were analyzed for southern spring season including months from September to November. The zonal distribution is considered along seven latitude circles from 80S to 50S with step of five degrees. To distinguish long-term processes and to obtain a quasi-stationary pattern, daily September – November ozone was averaged. Our previous study demonstrated a systematic eastward shift of the QSW minimum region. In this study, we extended the analysis to 2013 and obtained new results that exhibited a probable cessation in that eastward shift. Polynomial fit for all chosen latitudes is even evidence of a change in the tendency to opposite. It more time needs to confirm the stability of reverse westward shift. This analysis indicates the change in QSW minimum shift tendency in the early 2000s although this could not be clearly revealed from the data series available in the late 2000s. Our results show increasing distinctions between periods of different rate of eastward shift, which was described by linear trend. The calculated linear trend in the QSW minimum longitude decreased from 14–21 degrees per decade in 1979–2007 (in dependence on latitude) to 6–13 degrees per decade. The minimum in 2013 is significantly shifted westward where the shift at latitudes 50–60S reaches the start position for the minimum in 1979. Longitude of the QSW maximum does not demonstrate any clear tendency. Therefore, satellite data for the last years imply that quasi-stationary minimum in the Antarctic ozone distribution has not shifted farther eastward. This phenomenon could be connected with stabilization in ozone levels over the Antarctic region. Model studies indicate that ozone recovery over Antarctica may delay or reverse these tendencies and our results are possible evidence of such changes in the QSW. Our results suggest that the rate of eastward migration of the zonal ozone minimum over Antarctica has slowed and/or reversed in direction during the last decade, and this is potentially related to the expected recovery in Antarctic ozone levels.

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