STRATOSPHERIC TEMPERATURE BEHAVIOUR IN THE SOUTHERN HEMISPHERE

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Abstract:

The observed stratospheric cooling has been driven mainly due to increasing concentrations of greenhouse gases and decreases in stratospheric ozone as a result of emissions into the atmosphere of halogenated substances that reduce the ozone content. In this work, an analysis of the temperature behaviour was made for the lower stratosphere (100 hPa - 30 hPa) and middle (30 hPa - 10 hPa) between 1979 and 2020, in the Southern Hemisphere (SH) and in the South Atlantic Magnetic Anomaly (SAA) area. The results were compared with the stratospheric temperature behaviour on the global scale obtained by models and observations. For this, we have worked with data of monthly averages anomalies of the stratospheric temperature obtained from NOAA Web-based Reanalysis Tool (https://psl.noaa.gov/cgi-bin/data/testdap/timeseries.pl); and with the data sets: ERA- Interim (Interim European Centre for Medium-Range Weather forecasts Reanalysis, denoted EI hereforth), JRA-55 (Japanese 55 year Reanalysis), MERRA (Modern-Era Retrospective Analysis for Research and Applications), 20CRv3(NOAA-CIRES-DOE 20th Century Reanalysis V3), NCEP/NCAR R1 (National Centers for Environmental Prediction -National Center for Atmospheric Research R1), NCEP/DOE R2 , ERA5 (Fifth Global Reanalysis of ECMWF, versión 5), MERRA-2, NCEP CFSR (NCEP Climate Forecast System Reanalysis). In addition, an analysis of the temperature profiles trends was made considering the following heights: 100 hPa (15.9 km), 50hPa (21.0 km), 30 hPa (24.8 km), 20 hPa (27.8 km) and 10 hPa (33 km). Linear least squares adjustments were made in each of the periods considered and trends and uncertainties were obtained. First, the entire period was considered; then, as a consequence of the volcanic events that occurred in 1982 (Chichon) and 1991 (Pinatubo), and in order to isolate their effects, the whole period was subdivided as follows: 1979-1981, 1984-1990, 1994-2006 and 2006-2020.

The whole period results confirmed a cooling of the SH stratosphere and an increase in stratospheric cooling with height, with values between -0.20 K/decade and -0.50 K/decade for lower stratosphere and between -0.30 K/decade and -1.10 K/decade for middle stratosphere. The datasets have different

tendencies values for each altitude, for instance at 30 hPa (24.8 km), trends have values between (-0.51±0.06) K/decade, for NCEP/NCAR R1dataset and (-0.21±0.05 K/decade) for Era-Interim dataset. At 100 hPa (15.9 km), the 20CRv3 dataset and Era-Interim dataset have positive tendencies in both zones analyzed: between (0.03±0.05) K/decade and (0.05±0.05 K/decade) for SH and (0.10±0.04) K/decade and (0.12±0.04) K/decade for SAA area. For the period 2006-2020, at 15.9 km, the different data sets analyzed in this work, have positive trends for SH. This warmings values vary between (0.29±0.13) K/decade, for Era-Interim and (0.85±0.13) K/decade, for NCEP/NCAR R2.

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