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Modulation of the Stratosphere-Troposphere Coupling in the Southern Hemisphere by Solar and Ozone Effects

Janna Abalichin (1), Anne Kubin (1), Ulrike Langematz (1), and Patrick Joeckel (2)
(1) FU Berlin, Institut für Meteorologie, Germany (janna.abalichin@met.fu-berlin.de), (2) DLR Oberpfaffenhofen, Germany

In this study we analyze the relative influences of solar decadal variability and ozone change on Southern Hemisphere (SH) interannual variability and the stratosphere-troposphere coupling in a simulation of the years 1960-2100 with the EMAC-FUB chemistry climate model. The relative role of both terms for the Southern Annular Mode (SAM) is assessed by decomposing the geopotential height anomalies fields into the respective contributions.
The solar signal in the SH stratospheric and tropospheric geopotential height fields shows an annular-mode-like character. It has a tendency to amplify the existing annular mode during maximum solar activity towards more positive values of the SAM-Index. For minimum solar activity the relationship is vice versa.
In addition, a notable difference is found in the spatial distribution of the SAM signature in the tropospheric fields accounting to the effect of ozone and greenhouse gases (GHG): while the SAM signature on the SH 700 hPa geopotential height at the end of the 20th century is quite similar in both simulations, it becomes more meridional in a future simulation with GHG increases and more pole-centered under “no climate change” conditions at the end of the 21st century.