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ENSO effects on stratospheric ozone: A nudged model perspective

Peter Braesicke (1), Oliver Kirner (2), Stefan Versick (1), and Patrick Joeckel (3)

(1) KIT, IMK-ASF, Karlsruhe, Germany (peter.braesicke@kit.edu), (2) KIT, SCC, Karlsruhe, Germany, (3) DLR, IPA, Wessling, Germany

The El Niño/Southern Oscillation (ENSO) phenomenon is an important pacemaker for interannual variability in the Earth's atmosphere. ENSO impacts on ozone have been observed and modelled for the stratosphere and the troposphere. It is well recognized that attribution of ENSO variability is important for trend detection. ENSO impacts in low latitudes are easier to detect, because the response emerges close (temporally and spatially) to the forcing. Moving from low to high latitudes it becomes increasingly difficult to isolate ENSO driven variability, due to time-lags involved and many other modes of variability playing a role as well. Here, we use a nudged version of the EMAC chemistry-climate model to evaluate ENSO impacts on ozone over the last 35 years. In the nudged mode configuration EMAC is not entirely free running. The tropospheric meteorology is constrained using ERA-Interim data. Only the upper stratosphere and the composition (including ozone) are calculated without additional observational constraints. Using lagged correlations and supported by additional idealised modelling, we describe the ENSO impact on tropospheric and stratospheric ozone in the EMAC system. We trace the ENSO signal from the tropical lower troposphere to the polar lower and middle stratosphere. Instead of distinguishing tropospheric and stratospheric responses, we present a coherent approach detecting the ENSO signal as a function of altitude, latitude and time, and demonstrate how a concise characterisation of the ENSO impact aids improved trend detection.