Geophysical Research Abstracts
Vol. 21, EGU2019-9053, 2019
EGU General Assembly 2019

Ozone hole induced southern hemispheric climate change signals in ICON-ART climate simulations

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We use the ICOsahedral Nonhydrostatic model with Aerosols and Reactive Trace gases (ICON-ART) for studies investigating Southern Hemisphere (SH) climate change signals caused by the ozone hole. We perform multi-decadal timeslice integrations using a simple stratospheric chemistry scheme in conjunction with the climate physics configuration of ICON-ART. In interactive simulations, modelled ozone is coupled back to the radiation scheme. We perform two integrations: One integration considers polar ozone chemistry (thus showing the ozone hole), while the other does not (and therefore has no ozone hole). We characterise both integrations against ERA-Interim and ERA-20C pre and post-ozone hole climatologies. The model, unlike the reanalysis, solely shows the ozone hole impact and thus allows an unambiguous attribution of the ozone hole impact on the climate system.

We characterise the climatic changes induced by the SH ozone hole using empirical orthogonal functions (EOFs). We analyse the coupling between the stratosphere and the troposphere and how the coupling is changed by the existence of the ozone hole in ICON-ART, including the impact on surface climate. Further, we investigate changes in spatial annual mode structures and variability at different altitudes.

We find a significant heating of the Antarctic Peninsula surface temperature due to the ozone hole (in agreement with other studies). Further, we observe an increased variability of annular mode indices as well as as an increased persistence of strong annular mode events for the no ozone hole integration, thus leading to differences in the apparent downward propagation of the annular mode.