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Representation of the Antarctic Oscillation and related precipitation in the MPI Earth System Model

Stella Babian, Henning W. Rust, Jens Grieger, and Ulrich Cubasch
Freie Universität Berlin, Meteorological Institute, Germany (stella.babian@met.fu-berlin.de)

The Antarctic Oscillation (AAO) is the dominant mode of atmospheric variability on the southern hemisphere. It is obtained via a principal component analysis (PCA) for geopotential height anomalies. In this study the 700hPa geopotential field are used to comply with the NOAAs definition of the AAO. Being the southern hemisphere's dominant mode, an adequate representation in earth system models is desirable.
This study evaluates to what extend the AAO and related precipitation is represented in the Max Planck Institute's earth system model (MPI-ESM). To this end the AAO spatial patterns (Empirical Orthogonal Functions, EOFs), spectral properties of the associated principal components (PCs) and AAO-related precipitation of MPI-ESM are compared to three reanalyses: the ECMWF's ERA-40 and ERA-Interim, and the NCEP/NCAR 40-year reanalysis project. Differences between MPI-ESM and ERA-Interim leading EOFs reveal that the three typical centres of action are less pronounced and slightly shifted in the model.
Spectral density estimates of the associated PCs show reduced variability in the MPI-ESM for periods between 4 to 5 months.
The relation between AAO and southern hemispheric precipitation is assessed via composites and correlation analysis. In both, model and reanalyses, a negative AAO index leads to a general increase of precipitation between 30°S and 50°S and a decrease south of 50°S. Differences between correlation maps are most prominent near Indonesia and Antarctica. In summary, the MPI-ESM underestimates the relation of AAO and southern hemispheric precipitation but gives the correct sign and spatial distribution of correlation values.