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Analyzing GCM performances by means of tropospheric stability indexes

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The current approach to assess the quality of simulations of the current climate by Global Climate Models (GCMs) is to calculate several performance metrics like the Model Performance Index, which describes the deviation from measurements or reanalysis data. Input values are common climatological parameters like temperature, humidity and wind in standard pressure levels. The analysis is done globally as well as for regional domains. In regions where precipitation is mainly related to convective processes, like the Arabian Peninsula, another approach seems to be feasible. Here we assess GCM performances by the models ability to simulate the convective environment, described by stability indexes. Though there might not be a direct relationship between parameters characterizing tropospheric stability and precipitation because these measures do not provide information about often small scale processes leading to the initiation of convection, it is of crucial importance that conditions for convection are described properly.
The climatology of the convective environment for the region of interest, the Arabian Peninsula, is described by stability indexes namely the K Index, the Total Totals Index, the Vertical Totals Index, the Cross Totals Index, the Showalter Index and the Sweat Index, derived from 12 UTC radiosoundings stored in the IGRA archive. Though values of the indexes derived from reanalysis data like NCEP are also the result of the assimilation procedure, reanalysis data provide some information about the effect of spatial smoothing due to the model representation. Therefore, we also apply these daily data as a reference for the models by interpolating them to the radiosonde stations. In order to characterize the point in time when indexes are calculated, also 12 UTC reanalysis data are analyzed.
For daily data of 17 models stored in the CMIP3 archive, input parameters from the 20C3M simulations representing the models current climate were interpolated to radiosonde stations, too, and the respective stability indexes were calculated. Comparison of stability indexes is done by trend analysis on a monthly base as well as comparing probability distribution functions by applying a bootstrap approach. Time series of the individual parameters are compared by Lomb-Scargle Periodograms because of the non equidistance of the radiosondes from the IGRA archive. In addition correlation matrices of the different indexes are calculated to characterize their interplay in reference and model data.
With this approach we want to shed more light on the representation of the convective environment in an arid region and may provide assistance for choosing the appropriate model for downscaling approaches.