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Downscaling analysis of GCMs via the objectively classified synoptic systems

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Assessment of the GCMs' future climate projections first requires evaluating the GCMs' skills on the basis of their simulations of the present. Regional downscaling of the GCMs allows carrying out such an evaluation through comparison with the well-known regional climates. We suggest a downscaling method that enables an evaluation of GCMs by the daily synoptic systems simulated over a given region. In the present work, the example is shown for the Eastern Mediterranean (EM). For the region considered, an objective synoptic systems' classification method was applied to two models, ECHAM4/OPYC3 and HadCM3, for the period 1960-1990. For every EM specific synoptic system, its specific frequency of occurrence has a strong seasonal course. Therefore, the suggested approach helps both to evaluate a model on its simulations of the typical regional seasonal weather and point on the seasons for which modeling for specific physical processes is to be improved.

We compare the modeled frequencies of occurrence for the EM synoptic systems with those of the NCEP/NCAR reanalysis. The synoptic downscaling analysis was carried out for the region 27.5N-37.5N/30E-40E. The meteorological fields of geopotential height, temperature, u- and v-wind components at 1000 hPa, at 1200 UTC served an input for the regional daily synoptic systems classification. The GCMs outputs were first regridded into the NCEP/NCAR grid, since the limited, manually classified NCEP/NCAR dataset served a training set for the objective classifications carried out for both NCEP/NCAR reanalysis and GCMs [Alpert et al., 2004a]. Then, the average seasonal course of the frequency of occurrence for each daily synoptic system was calculated for 1960-1990, based on the method described in Alpert et al. [2004b]. The typical EM winter synoptic systems are Cyprus Lows supplying most of the EM rain-

fall. For the spring, typical are the Sharav Lows - transient, hot, small-scaled cyclones from NE Africa, bringing very hot weather, frequently accompanied with dust. The EM summer is characterized by the persistent Persian Trough inducing northwesterly airflows that mitigate the diurnal temperature differences over S. Levant. In the autumn, the Red Sea Trough (RST) dictates the mostly dry weather over the EM.

In general, both considered GCMs depicted seasonal courses for the frequency of occurrence of all typical EM synoptic systems closely to that of the reanalysis. However, there are the differences between reanalysis and simulations, common for both GCMs. In the same time, there are some specific synoptic systems well simulated by one of the GCMs while another fails. Common “”good news” is the averaged annual numbers of the daily synoptic systems simulated by both GCMs. However, while analyzing the annual trends, both models success in depicting the Sharav Low’s and eastern Cyprus Low’s trends and fail in simulations of the northern Cyprus Low’s and increasing RST’s trends. The latter is a critical point for the EM region, because the RST frequencies have nearly doubled for the considered period as follows from the reanalysis and is confirmed by the drying EM climate.

References:

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