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Evaluation of the present and future general circulation over western Europe simulated by the IPCC AR5/CMIP5 GCMs with the help of a circulation type classification

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Downscaling methods forced by General Circulation Model (GCM) simulations are not able to correct the biases in the general circulation simulated by the GCMs. Moreover, since the GCMs have a coarse spatial resolution, they have difficulties to simulate reliably ground variables like temperature and precipitation which are affected by topography, land use and local features. So, we can attempt that they simulate better the large-scale atmospheric circulation.
That is why it is of special interest to evaluate the GCM simulations of atmospheric circulation for current climate by comparing them with the NCEP-NCAR 1 and the ECMWF reanalysis data over 1961-1990. This analysis is done over western Europe for summer (JJA) and winter (DJF) for the GCMs (available on http://cmip-pcmdi.llnl.gov/cmip5/) proposed by the IPCC for its upcoming report (AR5).
The method used is an automated circulation type classification based on the daily geopotential height at 500 hPa. It is a leader-algorithm correlation based method taking part of the COST733CAT classification catalogue. Unlike the usually used methods based on the monthly mean circulation, this approach allows a precise analysis of each circulation type. So, it gives much more information on the ability of the GCMs to simulate the different circulation types and consequently the climatic variability of a region.
In order to allow a direct comparison between the GCM simulations and the reanalysis data, the classification is done first only for the reanalysis dataset over 1961-1990. Then, the main types individualised here are imposed for the classification of the GCM outputs. Since the circulation types are the same, the comparison between the datasets can be made on the basis of the differences of the frequency distribution throughout the classes. Moreover, the mean intraclass repartition of the circulation situations may differ from one dataset to another. So, the study of this mean and its standard deviation gives an idea of the differences between the reanalysis and the GCMs within each class.
Firstly, this approach is applied to current climate (1961-1990) for evaluating the ability of the GCMs driven by the historical experiment to simulate the climate of the last decades over western Europe. In fact, if one GCM is not able to reproduce reliably the main characteristics of the current climate, its future projections may be questionable.
Then, the best matching GCMs are retained and the same approach is applied to the future simulations driven by RCP concentrations or emissions (2011-2040, 2041-2070 and 2071-2100). So, the evolution of the frequency of the circulation types and maybe the appearance of new types can be analysed under climate change conditions. Moreover, it is interesting to compare the uncertainty of the current climate simulations to the projected changes for future climate. If the uncertainty is of the same order or higher than the projected changes, the reliability of the simulations for future climate may be very questionable.