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Uncertainties in multi-model climate projections

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Future climate projections rely mostly on Global Climate Models (GCMs). As the number of GCMs increases, the problem how to effectively deal with the multi-GCM information arises. Typically, one chooses several GCMs to develop a set of climate change scenarios to be used in the climate change impacts analysis, the choice of GCMs being based on the ability of the GCMs to reproduce the present climate. Alternatively, one can employ a climate scenario emulator (generator), which estimates joint probability density function of climatic characteristics based on the multi GCM information and then generates an arbitrarily large set of climate scenarios to be used in the probabilistic assessment of a response of the weather-dependent system to the climate change. In the both above cases, the quality of the GCMs plays an important role: as a criterion for choosing a subset of GCMs in the first case, and as the basis for defining the GCM-specific weights in the scenario emulator in the latter case.

The present contribution is made within the PRASCE project, which aims at the development of the probabilistic climate change scenario generator. In this generator, the scenarios from available GCM simulations (IPCC-AR4 database) will be "mixed" using GCM-specific weights based on their performance in reproducing the present climate. Prior to defining the scenario generator, the performance of GCMs and uncertainties in defining the scenarios are analysed in the present contribution.

The tests discussed here include: 1) Validation of individual GCMs in terms of their ability to reproduce annual cycle and spatial patterns of the present climate near surface climatic characteristics (validation with respect to CRU gridded data). 2) Multi-GCM projections of future climate. 3) Analysis of the uncertainties in developing the climate change scenarios: (a) regression uncertainty in single-GCM based standardised scenario (= scenario being related to the 1K rise in global mean temperature) scenario, (b) between GCM uncertainty. In addition, the GCM-related uncertainties in developing the climate change scenarios will be compared with the spatial variability of scenarios derived from the set of RCM simulations. This comparison will show the significance of high resolution RCM based spatial signal in changes in relevant climatic characteristics.

The results will be presented in maps showing both mean or median value of the validation statistics (in the case of the validation tests) or expected changes in analysed climatic characteristics, and the uncertainty in the mapped characteristic. The maps will serve to identify (i) the regions where the GCMs tend to fail/succeed in reproducing the present climate, and (ii) the regions of low/high uncertainty in climate change projections. Based on these results, the regions with major and statistically significant changes in climatic characteristics will be identified.

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