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Impacts of model averaging techniques on CMIP5 precipitation evaluation and projection

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Reliable precipitation projections are essential for informing policy decisions of climate change adaptation. Due to large uncertainty in GCM structure or initial conditions, multi-model ensemble is gaining its popularity for investigating impacts of climate change. However, how many models should be utilized to generate the ensemble has seldom been investigated, as well as the uncertainty from different model averaging techniques. The first aim of this study is to assess the performance of 22 CMIP5 models in terms of three statistical indices, i.e. the root-mean-square error, correlation coefficient and relative bias. Second, the number of models for ensemble is dealt with three different model averaging techniques, namely Bates-Granger averaging (BGA), Bayesian Model Averaging (BMA) and equal weight averaging (EWA). Thirdly, future annual and seasonal precipitation projections from the multi-model ensembles with different model averaging techniques and from individual CMIP5 models are compared. The Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks-Climate Data Record (PERSIANN-CDR) is used as reference dataset. The final results show that the best five models are generally enough to produce the ensemble. The root-mean square error, relative bias, correlation coefficient of the ensembles with BGA, BMA and EWA improve to a great extent compared with the best individual model. The ensembles can reduce uncertainty from GCMs for tendency detection and quantity projection of annul precipitations in the future under RCP2.6, RCP4.5 and RCP8.5. The seasonal projections from multi-model ensembles will generally increase from the value below the 25th percentile of projections from 22 individual CMIP5 models to the value between the mean and 75th percentile of individuals' projections. Uncertainty can rise from different model averaging techniques.
Keywords: model averaging techniques; precipitation; PERSIANN-CDR; climate change; CMIP5 models