

Ensemble analysis and utilisation: principles and practice

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The CMIP multi-model ensembles have been widely utilised for climate research and probabilistic prediction, but the properties and behaviour of such "ensembles of opportunity" are not well understood. Here we discuss some theoretical and practical aspects of the probabilistic interpretation of the ensemble. We present the underlying rationale which leads to the statistically indistinguishable paradigm, which supports the natural probabilistic interpretation of ensemble outputs and which has been widely adopted in many fields. This leads directly to new insights about the evaluation of ensemble performance. A variety of analyses will be presented which indicate that the CMIP3 ensemble generally provided a reliable sample at least on global scales. These results challenge several recent claims regarding the purported inadequacy of the ensemble. We explain the proper accounting for observational errors, which have typically been ignored in such exercises. We will also provide a simple explanation of the strong performance of the ensemble mean, which has been previously noted to outperform most, and sometimes all, individual models. These results reconcile well with the previous analysis of reliability. We calculate the effective dimension of the distribution of models, and discuss how this bears on the preferred sample size. If available, results from CMIP5 will be shown.