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## **Regional Performance of the IPCC-AR4 Models in Simulating Present-Day Mean Climate**

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Imperfect science in the formulation of climate models leads to uncertainties in their predictions that are difficult to reduce. Sometimes, this may create situations in which different models produce very different predictions. Potentially, one can overcome this problem by accepting that models perform differently and quantifying those differences. This enables users to make more informed decisions about which models are best suited for a particular problem and it allows addressing some more fundamental research questions.

Here, we introduce a metric of model performance which captures the ability of a model to simulate many different aspects of climate using a single cost function. The index is composed of the aggregated normalized errors between simulations and observations in about 40 different key climate quantities taken from the atmosphere, ocean, and land surfaces over the well-observed satellite-period 1979-1999. The combination of the various error quantities into one objective index takes into account covariances amongst different errors. In addition, we maximize observational certainties by combining multiple datasets for the same quantity to multi-observational means.

We apply the performance index to the output of 25 coupled models from IPCC-AR4 archives and to the multi-model mean. The results of the comparison are presented globally, for large hemispheric and continental scale regions (including those of the GEWEX continental scale experiment), and separately for land and ocean areas. Further, by modifying the original definition of the index and by considering only a suitably chosen sub-set of climate quantities, we test specific model components that are

more relevant for particular applications.