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Reducing Model Systematic Error through Super Modelling

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Numerical models are key tools in the projection of the future climate change. However, state-of-the-art general circulation models (GCMs) exhibit significant systematic errors and large uncertainty exists in future climate projections, because of limitations in parameterization schemes and numerical formulations. The general approach to tackle uncertainty is to use an ensemble of several different GCMs. However, ensemble results may smear out major variability, such as the ENSO. Here we take a novel approach and build a super model (i.e. an optimal combination of several models): We coupled two atmospheric GCMs (AGCM) with one ocean GCM (OGCM). The two AGCMs receive identical boundary conditions from the OGCM, while the OGCM is driven by a weighted flux combination from the AGCMs. The atmospheric models differed in their convection scheme and climate-related parameters. As climate models show large sensitivity to convection schemes and parameterization, this approach may be a good basis for constructing a super model. We performed experiments with a small set of manually chosen coefficients and also with a learning algorithm to adjust the coefficients. The coupling strategy is able to synchronize atmospheric variability of the two AGCMs in the tropics, particularly over the western equatorial Pacific, and produce reasonable climate variability. Different coupling weights were shown to alter the simulated mean climate state. Some improvements were found that suggest a refined strategy for choosing weighting coefficients could lead to even better performance.