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A Computational Framework for Supermodeling As Inter-model Data Assimilation

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It has been shown that the performance of coupled ocean-atmosphere models can be improved, in the context of ENSO-prediction, by allowing different models to exchange different flux components at the ocean-atmosphere interface. On theoretical grounds, we expect improvement from the run-time coupling of different models generally, as compared to what might be obtained simply by averaging model outputs, even with carefully chosen weights. It is therefore desired to allow a handful of climate models to exchange information from a given set of corresponding variables freely as the models run.

The computational requirements for running a collection of different models in synchrony on the same platform may appear preclusive. However, NCAR's Data Assimilation Research Testbed (DART) can serve as an inter-model coupler, since supermodeling can be viewed as inter-model data assimilation. The DART software assimilates measurement data into a running model. The "measurement" data, however can come from another model running in identical twin mode. Therefore, DART can be extended to let models assimilate data from each other. DART's ability to run an ensemble of models simultaneously for ensemble Kalman filtering is used here instead to construct an actual multimodel. A variable in any climate model, either in the atmosphere or ocean component, can be "nudged" by a corresponding variable from any other model. Relatively few operations are involved in the coupling, so the computational cost is simply the sum of the costs of running the different models. Contrary to the premonitions, an interactive multimodel with full global climate models (GCMs) may thus be readily achievable using current software. The coupling is illustrated using simple models defined by ordinary differential equations. Since the DART software is constructed so as to be readily transportable between models of very different types, no significant difficulty is foreseen in applying the modified DART to climate models.