Incorporating Scale and Predictability Information in Multi-model Ensemble Climate Predictions

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Total Proposed Cost: $461,330
Budget Period: January 1, 2010 - December 31, 2012

We propose to develop a new multi-model ensemble prediction system based on a theoretical framework that constrains the spatial structure of the multi-model weights and filters out unpredictable components from the analysis. Several previously proposed multi-model methods emerge naturally from this framework, including ordinary least squares, multi-model averaging, covariance localization, and ridge regression. Importantly, however, the framework provides a new way to impose realistic spatial coherence in the multi-model weights without invoking ad hoc smoothing after the fact. As a by-product, the proposed research will produce a set of maximally predictable components– i.e., a complete, uncorrelated set of components that maximize predictability over the full multi-model ensemble. These predictable components provide the basis for filtering out unpredictable components from the forecasts and are of theoretical and practical interest in their own right. Anticipated results from this research include:

- A state-of-the-art multi-model forecast system that constrains the spatial structure of the model weights and accounts for predictable structures in the respective models.
- A clear and rigorous assessment of whether the skill of the multi-model forecast system is substantially superior to simple pooling methods.
- A complete, uncorrelated set of maximally predictable components for each variable ordered such that the first maximizes predictability, the second maximizes predictability subject to being uncorrelated with the first, and so on.
- A comprehensive assessment of the skill of different state-of-the-art forecast models, especially how the CFS skill compares to other models.