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Predicting feedbacks in a climate model ensemble

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The results from a grand ensemble of perturbed climate models (climateprediction.net) are used to constrain estimates of climate sensitivity to greenhouse gas forcing. Both the amplitude of the seasonal cycle and the radiative budget of control simulations are used as predictors for the response of the model in a double carbon dioxide experiment.

The work expands on the method described in Knutti et al. (2006) which used a neural network approach to predict sensitivity given the amplitude of the seasonal cycle in various geographical regions. Although this approach is sucessful in predicting response in the Northern mid and high latitudes, it cannot predict the amplitude of feedbacks in regions without a significant seasonal cycle.

It is observed that in tropical regions, the amplitude of temperature feedbacks is somewhat constrained by the radiative balance of the control simulation. Hence, in addition we include top of atmosphere data for clear sky and cloudy sky radiative budgets of shortwave and longwave radiation as inputs to the neural network.

With additional data available since the publication of Knutti et al. (2006), we are also able to constrain the input dataset to those simulations not requiring a large artificial heat flux into the oceans to remain stable at pre-industrial carbon dioxide levels, while still maintaining the predictive ability of the method.