Identification of Transfer Functions to Facilitate Probabilistic Climate Forecasting

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Background:

The need to produce objective, probabilistic forecasts of climate change on the decadal to centennial timescale is widely acknowledged. Progress is being made towards quantifying uncertainties using both perturbed-physics ensembles (e.g. Forest et al., 2002, Knutti et al., 2002, Allen & Stainforth, 2002) and model based projections scaled by observations (e.g. Stott and Kettleborough, 2002). In both methodologies, the use of observations are critical to obtaining an objective forecast.

To date the focus has been on large scale, global changes. Stott & Kettleborough (2002) used observations of changes in global mean temperature in the latter half of the 20th century to produce a probabilistic forecast of global temperature change in the 21st century. Allen and Ingram (2002), while investigating the global hydrological cycle, presented a model based, but physically justified, transfer function through which they produced a probabilistic forecast of global precipitation constrained by the same global temperature observations.

Objectives:

This subproject aims to explore the CMIP II dataset to find transfer functions which can be used in probabilistic climate forecasting. The goal is to find correlations between regional variables of interest and well observed variables which can be used as constraints. Initially this will focus on potential transfer functions between regional precipitation and global temperature. This will expand in terms of both forecast variable and constraining (i.e. observed or observable) variable, as well as multi-variable correlations. In effect this represents an attempt to map some specific areas of the modelled climate's response manifold.

If such transfer functions can be found they will be useful in making constrained probabilistic forecasts of different variables and on smaller scales than have hitherto been possible. They will also be important for designing and weighting (Allen, Kettleborough and Stainforth, 2002) large perturbed-physics ensembles such as those being undertaken by climate*prediction*.net (Stainforth et al., 2002).

Methodology:

The initial analysis will use the monthly and annual mean precipitation and temperature data from the full CMIP II ensemble, from both the control and perturbed simulations. The correlation coefficient of regional precipitation change with global temperature change will be examined on both an annual and seasonal basis. Further exploration will look for correlations between regional precipitation and regional temperature and between other variables allowing a link between observed and forecast quantities.

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