

## DECADAL PREDICTION RESEARCH AT UNIVERSITY OF READING

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Decadal prediction research at Reading has several components:

1. Uncertainty in climate predictions arises from three distinct sources – scenario uncertainty, model uncertainty and internal variability - which we separate and quantify using the CMIP3 multi-model dataset. For forecasts of the next few decades the dominant contributions to the total uncertainty are model uncertainty and internal variability, which are potentially reducible by progress in climate science, and particularly by initialized decadal climate predictions. For decadal timescales and regional spatial scales, model uncertainty is larger than internal variability. This conclusion contradicts an influential figure recently published by Cox and Stephenson (2007). Furthermore, the signal to noise ratio for predictions of decadal mean and global mean surface temperature exceeds 1 for most regions and lead times indicating that these predictions will be of great value for decision makers.
2. An operational decadal forecast system requires ocean observations to create an analysis, and an ensemble of predictions. Two important questions are where additional ocean observations would optimally constrain predictions, and how to design efficient ensembles to sample the full range of forecast uncertainty. To answer these questions we compute ‘optimal perturbations’ or ‘singular vectors’, using two methods – Linear Inverse Modelling (e.g. Penland & Sardeshmukh (1995)) and Climatic Singular Vectors (e.g. Kleeman et al (2003)). The regions identified by these methods are the sensitive regions of the ocean where there is maximal growth of small perturbations. It is found, when analyzing the Atlantic domain in the HadCM3 model that these sensitive regions are located in the far North Atlantic, and are fairly shallow, which is promising for potential observations.
3. The UK Met Office Decadal Prediction System (DePreSys) is being analyzed in a case study approach. The reasons for the successes and failures of the forecast system in predicting North Atlantic heat content is being examined.
4. Further studies examining the sensitivity of predictability, for ocean and climate variables, to the initial ocean state are being performed. The impact of higher resolution on simulation of decadal variability and predictability using the UK-HiGEM model is also being explored.