CATS CENTRE FOR THE ANALYSIS OF TIME SERIES

Challenges in the Extraction of Decision Relevant Information from Multi-Decadal Ensembles of GCMs

D. Stainforth, Grantham Research Institute, London School of Economics and Political Science.

Abstract

Debates over how to effectively stimulate greenhouse gas emission reductions rage on. At the same time increasing effort is being invested in climate change adaptation. Nations and industries are focusing on the issue and much of the $100B annual fund which has been proposed as support from the developed world to the developing world from 2020 onwards, is likely to be focused on adaptation efforts. This is leading to an increasing demand for climate predictions; predictions not just of global mean temperature but of a wide range of variables at regional and local scales. Complex climate models are the principle tools used to provide this information.

Uncertainty analysis is of course critical in such endeavours and consequently an increasing number of climate ensembles have been generated. These have explored different aspects of uncertainty and sources of error. They range in size from O(10-100) in activities such as the CMIP III multi-model ensemble, to O(10,000-100,000) in the climate*prediction*.net project. We now have far more data regarding GCM model error than we have ever had before but the key questions of model interpretation remain; supplemented by ones relating to ensemble interpretation. How do we relate model output and real world behaviour in extrapolatory problems in complex non-linear systems? How do we combine model output with physical understanding to provide robust guidance for societal decisions? How do we relate model diversity and real world behaviour?

Much effort is currently being expended on the production of regional, even local, scale probability distributions. Here I will discuss the fundamental challenges in the production of model based probability forecasts on multi-decadal timescales and at spatial scales which could be potentially relevant for practical decisions. These include (i) the extrapolatory nature of the problem combined with (ii) model deficiencies and how they can be characterised, while focusing on (iii) issues related to the lack of independence in multi-model ensembles and (iv) the difficulties in creating relevant model metrics given the non-linear nature of the system. As part of (iii), I will discuss the ad hoc shape of model parameter space; an issue which has significant implications for the role of emulators in these problem.

LSE