

## Decadal Climate Prediction: Overview of progress and issues

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Studies of previous multi-model ensemble climate projections (Boer 2004; Hawkins and Sutton 2008 (submitted)) were used to illustrate the potential for decadal prediction. The latter study was used to illustrate sources of uncertainty in global and regional projections of decadal averaged surface temperature at different lead times, demonstrating in particular the importance of both internal variability and modelling uncertainty at time scales out to 2-3 decades ahead, while uncertainty associated with future emissions played an increasingly important role at longer lead times. This study shows that reducing the contribution of internal variability (through initialisation) has potential to reduce uncertainty substantially in the first decade.

Early attempts at initialised decadal hindcasts and forecasts were then reviewed. Experiments from Smith et al (2007) showed statistically significant improvements in projections of global mean surface temperature out to a decade ahead, due to skill in projecting ENSO in the first year, and upper ocean heat content at longer lead times. Smith et al and Keenlyside et al (2008) found evidence of improved regional hindcast skill arising from initialisation in some regions, notably in the North Atlantic in the latter case. Pohlmann et al (2008, submitted) found improvements in multiyear mean hindcasts of the North Atlantic MOC and SST, and of global SST, in initialised hindcasts. All of these studies also included external forcing agents in their hindcasts, comparing these against parallel simulations with identical radiative forcing, but lacking initialisation. They all assimilated observations as anomalies relative to the model climate, including three dimensional ocean temperature and salinity analyses in the case of Smith et al and Pohlmann et al, and SST in the case of Keenlyside et al. New projections using HadCM3 (Smith et al, started from 2007) showed a significant impact on the North Atlantic MOC out to 30 years ahead, arising from the initialisation of large positive salinity anomalies in the North Atlantic.

Some potential impacts on decadal predictions from model improvements were illustrated, relating to enhanced horizontal resolution and an improved representation of the stratosphere. The uncertainty in regional aerosol forcing was used to make the point that uncertainty in external forcing (while of secondary importance for global decadal projections) could play a significant role at the regional scale. Together with the role of initialisation, these factors were proposed as important issues to be considered in coordinated decadal prediction studies for IPCC AR5 and beyond.