Session: C29 Poster: W142A

Quantifying uncertainty in multi-decadal climate projections of surface temperature change

Daniel Rowlands[†]; David Frame; Tolu Aina; Nicolai Meinshausen; Milo Thurston; Myles Allen
[†] AOPP, University of Oxford, United Kingdom
Leading author: rowlands@atm.ox.ac.uk

The IPCC AR4 'likely' uncertainty estimate for 21st century global surface temperature change of -40% to +60% of the CMIP3 ensemble mean, is a clear indication that ensembles of opportunity do not span the full range of anticipated uncertainties. As a result, alternative approaches have been developed to test and challenge this estimate. To date these have been based on simplified low dimensional climate models and statistically generated ensembles in the absence of large ensembles of AOGCM simulations of transient climate change. Here we present results from the climateprediction.net BBC climate change experiment, the first multi-thousand-member AOGCM ensemble exploring uncertainties in transient climate change. The ensemble explores uncertainties arising from perturbations to atmosphere, ocean and sulphur-cycle parameters, natural forcing and initial conditions in the UK Met Office HadCM3L climate model. This provides a systematic exploration of uncertainty in the HadCM3L response to historical forcing up to 2000 and the SRES A1B scenario out into the 21st century. One of the key questions we have considered is how observational constraints (also known as metrics or diagnostics) from the recent past can help us constrain the uncertainty in future projections of surface temperature change. Much research points toward simple measures based on time-averaged climatology providing a weak constraint, and so we have considered observational constraints based on the transient evolution of temperature over the past 50 years, similar to those used in detection and attribution studies. We argue that using a transient constraint is potentially more powerful since, especially for mitigation, it captures the very ability of a model to respond correctly to time changing forcing that we are interested in for the future. Based on this observational constraint consisting of the regional temperature response over the period 1961-2010, we find a likely range of 1.4-3.1K for global mean warming in 2050 relative to 1961-1990. This uncertainty estimate should be interpreted as a 66% confidence interval, reflecting the range of warming shown by ensemble members that provide an adequate simulation of the observations at this level of significance. Reducing this range further requires the application of additional constraints based on climatology, which are contestable since they can project rather weakly onto the forecast warming that we are trying to constrain, and other transient diagnostics for which the anthropogenic influence is unclear. We therefore produce the first AOGCM evidence of high response worlds consistent with the observed climate change over the past 50 years, with potential wide ranging implications for climate change impacts.