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Large Ensembles of Regional Climate Projections

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Projections of regional climate change have great utility for impact assessment at a local scale. The CORDEX climate projection framework presents a method of providing these regional projections by driving a regional climate model (RCM) with output from CMIP5 climate projection runs of global climate models (GCM). This produces an ensemble of regional climate projections, sampling the model uncertainty, the forcing uncertainty and the uncertainty of the response of the climate system to the increase in greenhouse gas (GHG) concentrations.

Using the weather@home project to compute large ensembles of RCMs via volunteer distributed computing presents another method of generating projections of climate variables and also allows the sampling of the uncertainty due to internal variability. weather@home runs both a RCM and GCM on volunteer's home computers, with the free-running GCM driving the boundaries of the RCM. The GCM is an atmosphere only model and requires forcing at the lower boundary with sea-surface temperature (SST) and sea-ice concentration (SIC) data. By constructing SST and SIC projections, using projections of GHG and other atmospheric gases, and running the weather@home RCM and GCM with these forcings, large ensembles of projections of climate variables at regional scales can be made.

To construct the SSTs and SICs, a statistical model is built to represent the response of SST and SIC to increases in GHG concentrations in the CMIP5 ensemble, for both the RCP4.5 and RCP8.5 scenarios. This statistical model uses empirical orthogonal functions (EOFs) to represent the change in the long term trend of SSTs in the CMIP5 projections. A multivariate distribution of the leading principle components (PC) is produced using a copula and sampled to produce a timeseries of PCs which are recombined with the EOFs to generate a timeseries of SSTs, with internal variability added from observations. Hence, a large ensemble of SST projections is generated, with each SST projection having a probabilistic definition, as it occurs at a percentile in the distribution of warmings due to GHG increases in the CMIP5 ensemble.

This talk will present the statistical model of SST and SIC, the weather@home model and some initial results from the regional climate projections achieved by computing a large ensemble of weather@home models using the SST and SIC projections for RCP4.5 and RCP8.5.