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Deliverable D4.0.2: Design specification for the coordinated time-slice experiments

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	

ENSEMBLES RT4

Deliverable D4.0.2: Design specification for the coordinated time-slice experiments

1. Framework for ENSEMBLES RT4 Coordinated Experiments

Broad aims:

a. Understanding climate, and climate forecast uncertainty (WP4.4), at a mechanistic/process level, particularly in terms of the role of specific feedbacks (WP4.1), the regional patterns of climate change (WP4.2), and the factors governing the frequency and characteristics of extreme events (WP4.3).

b. Add value to information available from core ENSEMBLES hindcasts, forecasts and scenario integrations.

c. Need a simple core set of computationally cheap experiments so that they can be done by all groups (including where possible different model resolutions etc).

Proposed scientific focus

With respect to climate forecast uncertainty, coordinated experiments focus on understanding model uncertainty (rather than scenario uncertainty or initial condition uncertainty) since that is where such experiments can most obviously add value. A major but not exclusive scientific focus should be understanding the factors that determine the land sea-warming contrast. The ratio of warming over land to warming over ocean varies between about 1.2 and 1.9 in IPCC TAR models. This level of uncertainty is comparable to that in global mean temperatures (i.e. climate sensitivity) and has significant implications for climate impacts. Analysis to date points to the potential importance of land surface and cloud feedbacks but the reasons different models give different ratios are not understood. This topic has clear relevance to all four work packages in RT4. The relevance to WP4.1 and WP4.2 is obvious. For WP4.3 the focus could be understanding (how patterns of mean change are related to changes in the frequency of extreme events such as heat waves and droughts. For WP4.4 the focus would be understanding and quantification of model uncertainty.

Proposed experiments

a. AGCM experiments

I. Core set: control and 2xCO2 experiments using common time invariant, SST and ice fields as lower boundary conditions, taken from a coupled experiment with the Hadley Centre model. (See boundary conditions). The purpose of using common

lower boundary conditions is to remove some sources of inter-model variance (e.g. sea ice-albedo feedback) in order to better understand others.

II. Enhanced set: additional experiments to involve perturbations which may influence, e.g., cloud or land-surface feedbacks, effect of SST or sea-ice anomalies etc.

b. AGCM-slab experiments

Selected experiments from the core set to be repeated with the same AGCM coupled to slab ocean model to examine impact of interactive SST. A limitation of AGCM experiments is that prescribed SST allows no interactive response of the ocean to changing climate, and this limitation can sometimes give the wrong answer (e.g. Douville, Climate Dynamics, in press; Sutton and Mathieu, QJRMS, 128, 1259-1275, 2002). Some improvement, or at least understanding of sensitivity, can be achieved by using experiments in which the atmosphere model is coupled to a slab ocean. In this case the ocean heat flux convergence (aka Q-flux) must be specified. The core set of experiments could be repeated with some agreement as to how to specify the Q-flux (and possibly the change in Q-flux) in order to provide maximum insight. (Note that an ensemble of slab model experiments with perturbed model parameters has already been conducted at the Hadley Centre with versions of the HadCM3 model. The ENSEMBLES RT4 coordinated experiments would expand the scope of these experiments to include structural uncertainty.) These experiments could involve use of Q-flux anomalies.

2. Experimental Design for the Core AGCM Experiments

Boundary conditions:

UREADMM (CGAM) has supplied boundary conditions. There is no interannual variability in boundary conditions to aid analysis of extreme events (better statistics).

For control experiments, climatological monthly mean SST and sea-ice concentrations derived from HadISST observations for 1961-1990 and CO_2 at average concentration for 1961-1990. For perturbed experiments ($2xCO_2$), monthly mean SST anomalies are added to climatological fields used for control experiments. SST anomalies are derived from 1% pa CO2 CMIP-type integration with HadCM3 model. The difference between two 30 year means: a) mean for period with CO_2 values near present day b) mean for period with values near 2 x present day CO_2 are used. For

perturbation experiments, sea ice extent is taken from HadCM3 model of 30 year mean for period with values near 2 x present day CO_2.

Duration of experiments:

For each of control and perturbed experiments, 2 x 25 year integrations with different initial conditions will be performed. This helps to sample any drifts. e.g. associated with memory in land surface. The first 5 year of each integration will be ignored and this gives 40 years of data to analyse for each experiment. It was suggested to use of a 360 day calendar if possible.

Diagnostics and data:

Common data will be archived at CGAM. All data must be in CF compliant netCDF format. It is the responsibility of each group to provide the data in the correct format. Data should be placed in a suitable location (e.g. www or anon ftp site) from where it can be retrieved by CGAM. CGAM will manage a password protected www site giving access to the archive. Some groups have completed the experiments and data have been transferred to the database and others are in the processes of running the experiments.

A web page has been set up and all information relevant to RT4 coordinated experiments has been put there and can be accessed through http://www.cgam.nerc.ac.uk/research/ensembles-rt4/coord_exp/design.html.