Planned C20C project on detection and attribution

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This document provides a very brief description of the plan for the C20C detection and attribution project, as discussed at the Fifth C20C Workshop. It finishes with a brief questionnaire (eight questions) on your intended participation in the project.

The two primary purposes of the project are:

- **to characterise historical trends and variability in the probabilities of damaging weather events, including the differences across climate models;**
- **to estimate the fraction of the historical, present, and future probabilities of damaging weather events that is attributable to anthropogenic emissions, and to characterise underlying uncertainties in these estimates.**

This project will comprise various ensembles of simulations run under different scenarios of external radiative forcing, land use, and sea surface temperatures. Along with the base scenario of past observed changes in the boundary conditions, other scenarios will examine the effect of leaving out changes in selected boundary conditions. Further details not in this document can be found in Section 3 of the report of the Fifth C20C Workshop (`http://www.iges.org/c20c/C20C_5th_Workshop_2010.pdf`**).**

Brief technical description

The core project will involve the simulation of two scenarios:

1. Generation of historical "industrial" reference (All-Hist) climate
    - It will cover at least the 1950-present (2011) period.
    - It will use HadISST over the historical period.
    - It will include observed (and in the future projected) changes in greenhouse gas concentrations, tropospheric aerosol concentrations (at least influencing the direct effect), volcanic aerosol concentrations, and solar luminosity. It will preferably include changes in land cover too.
    - It will consist of a 50-member initial condition ensemble.
2. Generation of historical "natural" counterfactual (Nat-Hist) climate
    - It will include only changes in volcanic aerosol concentrations and solar luminosity. All other forcings to be set to "pre-industrial levels".
    - SSTs will be coolled accordingly by substracting attributable anthropogenic warming estimated from CMIP5 historical simulations.
    - There will be at least three estimates of the scenario, sampling uncertainty in the attributable SST warming.
    - A 50-member initial condition ensemble will be run for each scenario estimate (i.e. 150 simulations for three scenario estimates).
    - Other details will be identical to setup of All-Hist industrial reference ensemble.

There are also ideas being proposed for extending the core experiment: by examining further estimates of possible attributable ocean surface warming; by extending the core ensembles into the near future (e.g. to 2020); by examining the attribution to anthropogenic greenhouse gases only; by examining the attribution to land surface changes only (would fold in with LUCID). Table 1 provides a list of the core experiment and some possible extensions.

Scenario	Description	SST and SIC	Period
Core			
All-Hist	Including changes in "all" known external forcings (anthropogenic and natural)	HadISST	1950-2011
Nat-Hist-1	Including changes in natural external forcings only	HadISST minus one estimate of anthropogenic signal	1950-2011
Nat-Hist-2	Including changes in natural external forcings only	HadISST minus another estimate of anthropogenic signal	1950-2011
Nat-Hist-3	Including changes in natural external forcings only	HadISST minus another estimate of anthropogenic signal	1950-2011
Possible additional Nat-Hists			
Nat-Hist-4, etc.	Including changes in natural external forcings only	HadISST minus another estimate of anthropogenic signal (4, etc.)	1950-2011
Possible extension into future			
All-Fut-A, etc.	Including changes in "all" known external forcings (anthropogenic and natural)	An estimate from DePreSys (A, etc.)	2012-2020
Nat-Fut-1A, etc.	Including changes in natural external forcings only	An estimate from DePreSys (A, etc.) minus an estimate of anthropogenic signal (1, etc.)	2012-2020
Possible attribution to anthropogenic greenhouse gases			
NonGHG-Hist-1, etc.	Including changes in all external forcings except anthropogenic greenhouse gases	HadISST minus an estimate of GHG signal (1, etc.)	1950-2011
NonGHG-Fut-1A, etc.	Including changes in all external forcings except anthropogenic greenhouse gases	An estimate from DePreSys (A, etc.) minus an estimate of GHG signal (1, etc.)	2012-2020
Possible attribution to anthropogenic land surface changes			
NonLand-Hist	Including changes in all external forcings except anthropogenic land use change	HadISST	1950-2011

Table 1: Summaries of the ensembles of simulations to be performed as part of this project. "Core" ensembles are definitely to be performed under this project; the other experiments listed represent ideas that may be considered later in order to build further on the Core experiment.

EFAQUAAAGHs (Expected FAQs Unless Answers Are Already Given Here)

Project specifications

1. *When will this project start?*
   The plan is to start around October 2012. A small group of modelling centres are currently running a pilot experiment. This pilot is serving as a trial run, to ensure things will run smoothly with the full-scale experiment. Results are to be presented and discussed at a meeting in September 2012, thus allowing the start of the full-scale experiment afterward. Furthermore, it is expected that by this time modelling groups will have satisfied most of their CMIP5 and CORDEX commitments.

2. *When will the core project be completed?*
   This has yet to be determined and will depend on responses to the questionnaire below.

3. *What is the plan for data distribution?*
   We are working with NERSC to host the model output from the project on the `earthsystemgrid` (the same facility as used by CMIP5, for instance). If we are happy with all of the data being stored on tape (access delay of minutes to hours) then this should be a free service; if we want some stored on disk for instantaneous access then we may have to pay a fee.

Forcings

4. *What external forcings need to be included?*
   The "All-Hist" Simulations must be forced with varying sea surface temperatures and sea ice concentrations, varying greenhouse gas concentrations, varying sulphate aerosol forcing (with no restrictions on how this is implemented), varying stratospheric aerosol forcing, and varying solar luminosity. There is a very strong preference for sulphate aerosol forcing to include indirect effects, and also a very strong preference to include variations in each of carbonaceous aerosols, organic aerosols, stratospheric ozone, and land cover change.

5. *Will the forcing data be provided?*
   Sea surface temperature and sea ice concentration data for all scenarios will be provided in the HadISST format; provision in other formats will depend on demand. Provision of other forcing data sets will depend on demand and feasibility. It may be possible to take advantage of forcing fields provided for the CMIP5 project as well as of the LUCID project's land cover data set.

6. *Will all models use the same forcing data sets?*
   There is currently no plan for all models to use the same radiative forcing data sets. There is a possibility of the LUCID project becoming involved with this attribution project, in which case it would be desired for all models to use the same land cover data (LUCID has worked on producing data that can be used by most models). All models will use the same sea surface temperature and sea ice concentration data (HadISST2 if available, otherwise HadISST1.1) for the All-Hist simulations. For the Nat-Hist worlds, the HadISST data will still underlie the sea surface temperatures and sea ice concentrations used by all models, but the estimates of attributable ocean warming removed from that HadISST may differ across models.

7. *How will the attributable SSTs and SICs be estimated?*
   The estimates of attributable sea surface temperature will be made using a standard multiple regression analysis of changes in observed SSTS against SSTs in CMIP5 simulations of coupled atmosphere-ocean models following various scenarios of historical external forcing. Further details can be found in Section 3 of the report on the Fifth C20C Workshop (`http://www.iges.org/c20c/C20C_5th_Workshop_2010.pdf`). Sea ice concentration will be estimated using an algorithm that inverts the algorithm used to relate SST and SIC in HadISST. Further details will be available very shortly in a paper submission.

Satisfying project requirements

8. *Do we need to satisfy all of the stated requirements for a contribution to the core experiment?*
   In order to investigate some of the expected subjects of study, as well as to facilitate cross-model comparison, it is hoped that these criteria can be met. However, we expect this dataset to be used for a wide variety of studies, and a reduced contribution would probably still be useful for some of those studies.

9. *Is there a restriction on the spatial resolution of the model?*
   The is no restriction. As a trade-off between resolving synoptic systems without overburdening computing resources, 100km could be a suggestion. An interesting research question though is the importance of model resolution, so it would be useful to have a range of resolutions (especially will the same underlying model).

10. *Do we need to perform 50 simulations per model?*
    This number has been chosen as a sufficient size to resolve the probability distributions of most tail events of interest, whilst remaining feasible. It is hoped that this criterion can be met, but a reduced contribution would probably still be useful for some applications.

11. *Are we expected to commit to the suggested extension experiments too?*
    Some of these suggested extensions are likely to be done, others are less certain at this stage. In any case, participation in these additional experiments will undoubtedly depend on the ability and research priorities of the various modelling groups.

Questionnaire for modelling groups

Below are eight quick questions for the modelling groups which are members of the C20C project. These are intended as a survey to establish the approximate degree of participation, timeline, and scope for the project. Responses are to reflect intentions: they do not need to reflect absolute final decisions on participation.

1. Are there further specifics about the project that you need/would like to know?

2. How likely is it that you will contribute climate model simulations to this project?

3. How likely is it that you will be able to satisfy the requirements of the core experiment?

4. Which possible extensions are of interest and would you be likely to contribute to (possibly including new ideas not listed above)?

5. In order to highlight possible duplication before we start the project, could you indicate which model(s) you intend to run for this project, including some details about the configuration (e.g. spatial resolution)?

6. Given a start in October 2012, when do you think you would have the core experiment completed (including transfer of output to the data portal)?

7. Are there forcing data sets (beyond SSTs and SICs) that you would need supplied?

8. Are there issues with a project data portal for your institute (e.g. commercial restrictions) that need to be taken into account?