International Climate of the 20th Century Project

Newsletter: 4 May 2009

1. PLANS FOR C20C WORKSHOP 2010 – SAVE THE DATE

The CLIVAR International Climate of the Twentieth Century Project (C20C) will hold its fifth workshop 19-23 April 2010 in Beijing, China, hosted by the Institute of Atmospheric Physics (please note that the exact dates are not final). The goals of the workshop will be:

- Reports on findings from ongoing C20C experiments
    - "Traditional" AGCM
    - "Pacemaker" runs with regionally coupled models
- Potential contributions to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC)
    - Using existing or new C20C runs as baseline for global change attribution
    - Proposed new core project: "natural forcing only" C20C runs (see below)
- Continued collaborations with other projects
    - LUCID (see below)
    - WAMME (see below)
- Plans for C20C future

More information about the 5th C20C Workshop will be forthcoming soon.

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2. PROPOSED NEW C20C CORE PROJECT

The original intent of the C20C project was to determine the extent to which the observed climate anomalies of the past century or more can be attributed to variations in the sea surface temperature (SST). This was, in part, motivated by the development by the Hadley Centre of a global analysis of SST from 1870 to the present, and, in part, a desire to understand the role of SST in the evolution of climate on interannual and longer time scales. By using the observed SST over the entire period and the entire globe, however, it is not possible to separate the different contributions by the natural variations of SST and the anthropogenic changes in SST that have occurred since 1870.

The aim of the core project will be to determine the effects of anthropogenic forcings on the evolution of climate. It is proposed to address this by carrying out parallel sets of simulations with alternative datasets of SST, sea ice and atmospheric composition that have their anthropogenic components removed (runs with natural forcing only). Thus where HadISST1 or HadISST2 is used as the forcing SST data set, the runs would have the anthropogenic component removed from HadISST in one or more ways. These parallel ensembles of "Real World" and "World that might have been" simulations will be used to delineate the variability of regional climate including atmospheric circulation attributable to natural patterns of SST variability from the variability attributable to anthropogenic forcing. These runs can contribute to the IPCC AR5.

Such an activity would be coordinated in collaboration with the International Detection and Attribution Group (IDAG). Participants from IDAG will be invited to attend the Fifth Workshop where the experimental design will be agreed. Members of C20C are invited to

contact Peter Stott (peter.stott@metoffice.gov.uk) to express interest in this project as soon as possible. It is intended to circulate interested parties with information about possible approaches and issues to promote discussion and comment ahead of the Beijing meeting.

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3. PLANS FOR HADISST2

N.A. Rayner, J.J. Kennedy, H. Titchner and R.O.Smith

We aim to deliver version 2 of our globally complete SST and sea ice analysis, HadISST by October 2010. This will have higher spatio-temporal resolution than HadISST1 (Rayner et al, 2003) and will have multiple-realisations, allowing exploration of the effect of bias corrections and analysis uncertainty. HadISST2 will be based on data sets of SST and sea ice extent which are internally consistent and will commence in 1850.

We have developed a correction scheme to create a homogeneous gridded data set of in situ SST observations. For the first time, this applies bias corrections throughout the record since 1850 (i.e. not just 1871-1941 as before) and includes adjustments for the differences between observations made on board ship and measurements by drifting buoys. Satellite retrievals of SST from both the Advanced Very High Resolution Radiometer (AVHRR) and Along Track Scanning Radiometer (ATSR) series will be included. The ATSR series is being used to develop bias adjustments for the AVHRR series and the resulting combined satellite series will be blended with the in situ observations to form the basis for the HadISST2 SST analysis since 1982. Note that ATSR data was not used in HadISST1. Sea ice information from passive microwave retrievals and operational sea ice charts will be combined with as much historical information as is available to produce a more homogeneous sea ice extent analysis.

Globally complete fields from 1850 to date will be analysed using an Expectation Maximisation (E-M; Roweis 1998)) technique coupled with Reduced Space Optimum Interpolation (RSOI; Kaplan et al., 1998). This new analysis system is currently being tested on degraded output from "all forcings" simulations of the HadGEM1 coupled model, i.e. information from complete model fields is withheld where we have no observations and the data are corrupted with "observational error". We anticipate providing higher resolution information both through the use of a high resolution background climatology and through the addition of a high resolution local analysis of residuals from the broad-scale E-M RSOI analysis. Analysis resolution will be determined by data availability and will be homogeneous through time within any one analysis, but higher resolution versions may be produced for appropriate shorter periods, such as the recent few decades.

Multiple realisations of HadISST2 will be generated via the bias correction uncertainty and perturbations of the E-M RSOI scheme. HadISST2 will be compared to other SST analyses under the GCOS SST Working Group inter-comparison framework (see http://ghrsst.nodc.noaa.gov/intercomp.html) and any differences understood and publicised.

Initial user requirements have been sought by targeted questionnaire and will be refined through interactions with a set of "power users". Jeff Knight will represent the C20C community and we will value any input you can make to this process. We expect that a paper on HadISST2 will be submitted for publication in 2011.

References

Kaplan, A., M. Cane, Y. Kushnir, A. Clement, M. Blumenthal, and B. Rajagopalan, 1998: Analyses of global sea surface temperature 1856-1991, J. Geophys. Res., 103, 18567-18589.

Rayner, N.A., D.E. Parker, E.B. Horton, C.K. Folland, L.V. Alexander, D. P. Rowell, E.C. Kent, A. Kaplan, 2003: Global analyses of sea surface temperature, sea ice, and night marine air temperature since the late nineteenth century. *J. Geophys. Res.* Vol. 108 No. D14, 4407 doi:10.1029/2002JD002670

Roweis, S., 1998: EM Algorithms for PCA and SPCA, Neural Information Processing Systems 10 (NIPS'97) pp.626-632

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4. RECENT PROGRESS ON C20C-LUCID COLLABORATIONS

Fruitful discussions have taken place between C20C and the organizers of the Land-Use and Climate, IDentification of Robust Impacts (LUCID[1]), a project of the international Global Energy and Water Experiment (GEWEX) Land-Atmosphere System Study (GLASS) and the International Geosphere-Biosphere Program (IGBP) Integrated Land-Ecosystem-Atmosphere Process Studies program (iLEAPS). Nathalie de Noblet-Ducoudre, one of the organizers of LUCID, who also attended the 4th C20C Workshop, will take the lead on the C20C model integrations that are needed to address the effects of land-use and land-cover change on climate over the past century. The following describes the achievements of LUCID so far and the bold paragraph how this will use C20C integrations. Nathalie de Noblet will be contacting C20C participants shortly about taking part in this international project.

First results from the LUCID experiments
(Land-Use and Climate: IDentification of robust impacts)
Implications for experimental design in IPCC-AR5

N. de Noblet-Ducoudré, A.J. Pitman
J.-P. Boisier, Sh. Peng, F.T. Cruz
G.B. Bonan, E.L. Davin, V. Brovkin, M. Claussen, C. Delire, L. Ganzeveld, Gayler, B.J.J.M. van den Hurk, P.J. Lawrence, M.K. van der Molen, C. Müller, C.H. Reick, S.I. Seneviratne, B. J. Strengers, A. Voldoire

Under the auspicies of GEWEX-GLASS and IGBP-iLEAPS, a project called LUCID has been recently launched (de Noblet-Ducoudré and Pitman, iLEAPS Newsletter 4, 2007). LUCID (Land-Use and Climate, IDentification of robust impacts) is self describing: we are not trying to identify model-specific sensitivities to land cover change, rather we seek to explore, using methodologies that the major climate modelling groups recognise, those impacts of land cover change that are *robust* – that is, above the noise generated by model variability.

Our objective is therefore to ***identify*** and ***quantify*** the impacts of land-use induced land-cover changes on the change of climate between the pre-industrial epoch and present-day. We use a) multi-model and b) ensemble simulations to ***assess the robustness of the identified***

[1] http://www.ileaps.org/index.php?option=com_content&task=view&id=99&Itemid=134

changes. Assessments of the impacts of land cover change ***will explore the mean climate***, ***climate variability*** and ***climate extremes***. Assessment will also be made on the potential impact that land-use induced land-cover change can have on the sea-surface temperatures and on ocean circulation. Among the final objectives is to build the case, if the case can be proven, to ensure land-cover changes are properly included in any future assessments by the IPCC.

Experimental design

Three sets of simulations have been designed to be run by different climate models. Our intent is to identify robust changes via simulations that first use prescribed sea-surface temperatures and sea-ice extent, but then move rapidly to coupled model simulations since these are the tools now used for climate projection. Our strategy is to perform fixed SST experiments first, to (we hope) establish the value of the subsequent more expensive simulations.

1) The first set includes snap-shot simulations with prescribed sea-surface temperatures and sea-ice extent of the present-day climate (1992-2002) and of pre-industrial times (1870-1900). Simulations differ by the land cover distribution that reflects the observed changes in both crops and pasture between both time periods (figure 1). To assess the robustness of the results we have conducted ensemble simulations. The first conclusions from these simulations are briefly discussed below as well as in Pitman et al. (subm.).
2) ***Transient simulations over the past 150 years (1870 to 2002), with prescribed SSTs and sea-ice will hopefully be run following the protocol designed within the C20C project. This will be a very important step towards assessing whether land-use induced land-cover changes have indeed mattered in the past.***
3) Then finally, within the European project ENSEMBLES, IPCC simulations have started to be re-run with coupled atmosphere-ocean general circulation models, from 1850 till 2100 following two different economical scenarios. These simulations should be run with and without land-use induced land-cover changes.

First results

Seven climate models have run the first set of snap-shot simulations we have designed. The results analyzed so far have pointed to four main conclusions.

1. All models do simulate significant regional changes in surface heat fluxes and other variables, in response to the prescribed land-cover changes (LCC). But these changes vary not only in magnitude, but also in sign. Three models for example simulated statistically significant decreases in the northern hemisphere summer latent heat flux, while increases were found in three others. Five models simulated statistically significant cooling in summer in near-surface temperature over regions of LCC and one simulated warming.
2. There is no statistically significant export of LCC perturbations. The impacts therefore remain limited to the area experiencing the surface change in all models.
3. The magnitude of the simulated regional changes resulting from LCC perturbation is as large as the magnitude resulting from changes in sea-surface temperatures, sea-ice extent and atmospheric CO_2 concentration (figure 2).
4. The regional dispersion of the models' responses increases when LCC is included, specially in the temperate areas of the northern hemisphere (figure 2).

Preliminary studies undertook to understand why the models differ point to two major reasons :

1. We provided to all models the exact same crop and pasture maps (fractional coverage of

0.5° grid cells for both 1872 and 1992), but modellers implemented them differently into their own land-surface models. The individual pre-industrial maps already differ in the relative extent covered by trees, herbaceous vegetation types and desert. Therefore, although almost all models adopted the same methodology to increase the fraction of anthropogenic vegetation (they reduced natural vegetation types proportionally), it matters how much of each type is present at pre-industrial times within a grid square. If the main vegetation type is grass, changing this to crops has a very different impact to removal of trees, in part due to links to the snow albedo feedback on seasonal scales.

2. The representation of phenology (seasonal cycle of Leaf Area Index - LAI) differs from one model to the other. Some prescribe the seasonal cycle of LAI and therefore prevent interannual variations, others compute it. Among the latter, some have specific crop phenology, others assume they behave as natural grassland.

More work is needed to determine whether these discrepancies between models are indeed the reason why their sensitivity to LCC differs.

In any case, LCC will be included in IPCC-AR5 and results from LUCID suggest that there is a risk of increased regional dispersion of impacts from model to model when compared to AR4 outputs in regions of LCC. LUCID cannot help prevent these uncertainties (by putting more constraints on the climate models) within the given time frame of IPCC, but may help to better understand them. LUCID results do not suggest that including LCC will cause changes remote from the perturbation.

Figures

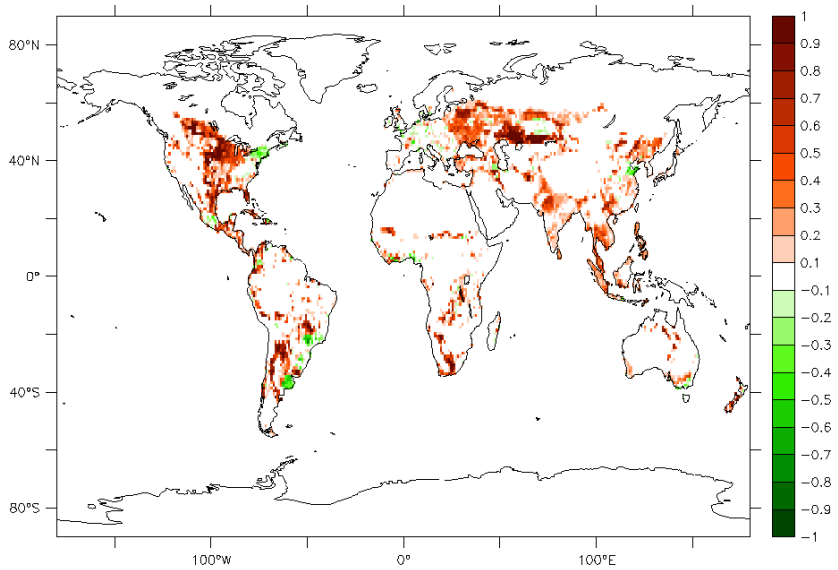

Figure 1: changes in extent of anthropogenic areas (crops + pasture) between present-day and pre-industrial time periods. Red colors represent increased anthropogenic cover, while greens correspond to abandoned land (fractions of a grid-cell).

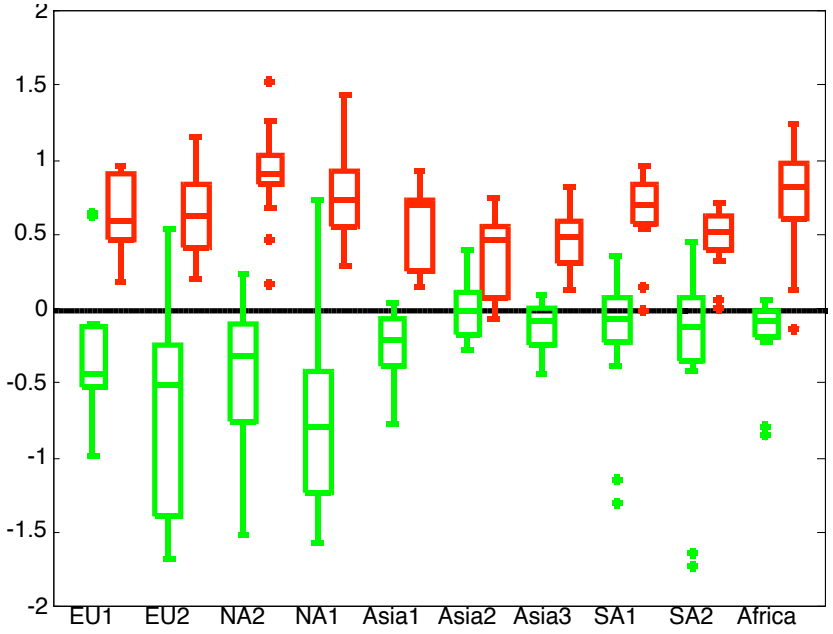

Figure 2: box and whisker plots over 10 specific regions that illustrate the simulated surface air temperature changes in June-July-August (°C) in response to changes in sea-surface temperature, sea-ice extent and atmospheric CO_2 (red) and LCC (green). Regions are : EU1 (47-56°N, 22-46°E), EU2 (47-53°N, 46-63°E), NA2 (48-54°N, 100-115°W), NA1 (40-47°N, 90-102°W), Asia1 (42-47°N, 116-129°E), Asia2 (23-29°N, 71-80°E), Asia3 (12-18°N, 99-105°E), SA1 (15-18°S, 46-53°W), SA2 (22-28°S, 61-67°W), Africa (26-32°S, 20-27°E)

5. MAJOR PAPERS THAT ARE OUTCOMES OF THE MARCH 2007 EXETER MEETING

The following are now all available on line in Climate Dynamics. Paper journal versions will appear through 2009.

Scaife, A.A., F. Kucharski, C.K. Folland, J. Kinter, D. Fereday, S. Grainger, K. Jin, J.R. Knight, S. Kusunoki, M.J. Nath, T. Nakaegawa, P. Pegion, S. Schubert, P. Sporyshev, J. Syktus, A. Voldoire, J.H.Yoon and T. Zhou, 2008: The CLIVAR C20C Project. Part 1: Selected 20th century changes. *Clim. Dyn.* DOI 10.1007/s00382-008-0451-1 *(on line*)

Kucharski, F., A.A. Scaife, J.H. Yoo, C.K. Folland, J Kinter, A Fereday, A. Fischer, K.E. Jin, M.J. Nath, P.Pegion, P.V. Sporyshev, A Voldoire, J.H. Yoon, T. Zhou and S Schubert, 2008: The CLIVAR C20C Project: Part 2: Skill of simulating Indian monsoon rainfall on interannual to decadal timescales. Does GHG forcing play a role? *Clim. Dyn*. 10.1007/s00382-008-0462-y. *(on line)*

Zhou, T., Wu, B., Scaife, A.A., Li, L., Fischer, A., Voldoire, A., Wang, B., Folland, C.K., Fereday, D., Kucharski F., Kinter, J., Jin, J.E., Nath, M.J. Lau, N-C., Pegion, P, Kusunoki, S., Nakaegawa, T., and J. Syktus, 2008:. The CLIVAR C20C Project: which components of the Asian-Australian Monsoon variability are forced and reproducible? *Clim. Dyn.* 10.1007/s00382-008-0501-8 *(on line)*

Another paper on Southern Hemisphere atmospheric circulation modes led by Simon Grainger is well advanced but not yet submitted.

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6. COLLABORATIONS WITH WAMME

At the 2008 Annual Meeting of the American Meteorological Society (AMS), there was a special session on the West African Monsoon Modeling Experiment (WAMME[2]) to which Chris Folland and Jim Kinter provided a briefing on C20C modelling activities. There was interest expressed in collaborating. C20C groups are encouraged to make contact with the WAMME organizers if there is some interest in providing data from their model integrations.

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7. C20C PUBLICATION LIST UPDATES

The list of publications that are related to the C20C project is posted on the C20C web page[3]. Participants are encouraged to review the list and let Jim Kinter know if there are any papers that should be added to the list.

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[2] http://wamme.geog.ucla.edu/initiative.html
[3] http://grads.iges.org/c20c/c20c_related_papers.pdf

8. AMS 2008 PAPERS AVAILABLE

C20C organized a special three-part session of the 20th Conference on Climate Variability and Change, sponsored by the AMS, and organized by the AMS Committee on Climate Variability and Change, which was held 22-23 January 2008, as part of the 88th Annual Meeting in New Orleans, Louisiana. The call for papers resulted in a very interesting program spread over three sessions. The extended abstracts and recordings of the presentations are available from the AMS:
Session I: http://ams.confex.com/ams/88Annual/techprogram/session_20936.htm
Session II: http://ams.confex.com/ams/88Annual/techprogram/session_21208.htm
Session III: http://ams.confex.com/ams/88Annual/techprogram/session_21209.htm