

Links between LUCID and C20C

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1. Background

The ambitions of the LUCID project are to identify and quantify the robust biogeophysical impacts of land-use induced land-cover changes (hereafter LULCC) on the historical climate (de Noblet-Ducoudré and Pitman, iLEAPS Newsletter N°4, 2007). To that end a first set of snap-shot ensemble simulations have been carried out by 7 international modelling groups. Models have been forced with 30 years (+ 1 year of spin-up) of observed SSTs and SIC (1870-1900) for the pre-industrial era and for present-day (1972-2002). The main results show that the impacts of LULCC are very large regionally, as large as (sometimes larger than) the impacts of the combined changes in atmospheric CO₂ and in SSTs and SIC (Pitman et al. 2009, de Noblet-Ducoudré et al. in prep.). We therefore conclude that LULCC should be accounted for whenever regional interpretations of past (as well as future) changes, and/or detection / attribution studies are carried out.

The other interesting feature of our results is that the dispersion among the models' responses to LULCC is substantially larger than their response to changes in SSTs and SIC. This results from a) the different strategies individual models have used to incorporate LULCC into their own original land-cover map, b) the land-surface parameterizations that differ from one model to the other. An implication of this result is that it will be very challenging to include LULCC in an identical way in model simulations.

2. Proposed simulations

Having demonstrated the importance of LULCC on regional climates in various parts of the world using snap-shot simulations, we now plan to evaluate their impact on the historical climate since pre-industrial times. To that end we envisage two groups of experiments :

- the first one will use observed SSTs and SIC since the year 1870, throughout the entire 20th century. Such experiments should benefit from the experience of the C20C project and follow the protocol this group has designed (apart from LULCC) ;
- the second one will use fully coupled atmosphere-ocean models and will be carried out later on, building on the CMIP5 experimental protocol.

We propose here to coordinate with the modelling groups involved in C20C to carry out the first group of simulations. It will involve :

- a) two sets of simulations : the first one will keep its land-cover constant throughout the entire period (prescribed to its pre-industrial state) ; the second one will vary its land-cover from year to year ;
- b) ensemble simulations will be carried out to ensure the statistical robustness of the results.

3. Proposed analysis

Global diagnostics will be carried out by the LUCID group as they've done for the snap-shot simulations.

But complementary diagnostics, based on the C20C groups experience are more than welcome. We therefore address a call to the C20C participants for suggestions.

4. Time table

TASK	Delivery date	Comments
Distribution of crop and pasture datasets, with implementation protocol	Mid January 2011	Those are the CMIP5 datasets already available to all groups
Finalising list of models involved <i>(but list will never be closed)</i>	End of January 2011	About 7 models have already declared interest.
Conference call with all modelling groups	End of January 2011	Objective is to discuss the experimental protocol and anticipate potential problems and/or delays
Experimental protocol	End of January 2011	Suggestion : C20C protocol with & without land-use changes.
List of outputs requested	End of January 2011	LUCID outputs but request for outputs from C20C diagnostic sub-groups
Launch of simulations	Throughout February 2011	Help can be provided by LSCE for inclusion of vegetation maps
Call among the largest C20C and CMIP5 communities to undertake specific diagnostics using the LUCID-C20C runs	mid-March 2011	The objective is to make the models' outputs available for specific diagnostics
Modelled outputs available for analysis	First results requested for the end of May 2011. Delayed results will also be considered and included later on	Results could be presented during the iLEAPS science conference in September 2011 (18-23) in Germany. Otherwise the IGBP open science in London in March 2012.
Small group workshop in France	Summer 2011	Informal discussions on preliminary results and analysis. Coordinate diagnostics to be presented in above-mentioned conferences

		and papers to be written.
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5. Discussion

The LUCID co-ordinators were under the impression that very few models were interested but they do not know whether most models were indeed represented at the conference.

There is an absolute necessity to have a rather large variety of various land-atmosphere models participating in order to obtain a sample representative of the CMIP5 models. Encouragement and/or support from the C20C community to really encourage groups to undertake these simulations would be greatly welcomed.

6. References

Pitman, A. J., de Noblet-Ducoudré N., et al., **2009**: 'Uncertainties in climate responses to past land cover change: First results from the LUCID intercomparison study'. *GEOPHYSICAL RESEARCH LETTERS*, VOL. 36, L14814, doi:10.1029/2009GL039076.