SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

Project Title:	Land use change in the 21st century
Computer Project Account:	SPNLGLAC
Start Year - End Year :	2012- 2014
Principal Investigator(s)	Bart van den Hurk
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Other Researchers (Name/Affiliation):	Gianpaolo Balsamo, ECMWF

The following should cover the entire project duration.

Summary of project objectives

(10 lines max)

Via this study, a new set of dedicated climate model integrations will be carried out in parallel to the IPCC historic and future scenario runs. The experiments will be carried out with the EC-Earth climate model, built on the ECMWF IFS. The experimental set-up is designed to analyse (a) the specific contribution of land use change to global mean and regional climate change in the past and the future, (b) the amplification or damping feedback mechanisms that control these land use change impacts, and (c) the degree to which local land use change impacts affect climate variability in remote areas.

Summary of problems encountered

(If you encountered any problems of a more technical nature, please describe them here.)

Biases in the vegetation dynamics emerged in coupled ECEarth-LPJ simulations, used to explore the contribution of vegetation dynamics on climate variability and predictability at decadal time scales. The work focused on diagnosing this bias and set up a bias removal algorithm. This lead to serious delays in the actual decadal predictability runs.

Experience with the Special Project framework

(Please let us know about your experience with administrative aspects like the application procedure, progress reporting etc.)

The application procedure is quite straightforward, also the communication about deadlines and reports is very clear. However, the lack of feedback on the plans and reports makes it a bit unclear how the information provided is actually used.

Summary of results

(This section should comprise up to 10 pages and can be replaced by a short summary plus an existing scientific report on the project.)

After the work on exploring the effects of (static) land use change under future climate conditions (see previous progress report), work now concentrated on accommodating for dynamic interaction between vegetation and climate. In this phase the effect of allowing (interannual) variations in phenology (LAI) is explored. For this a coupled model set-up is constructed, where LAI-variations simulated by the DGVM LPJ-Guess are passed to EC-Earth, and where EC-Earth climate is used to drive LPJ-GUESS.

In this set-up a systematic drift in the simulated LAI emerged (Figure 1), particularly in the Amazon and high latitude forest areas. A close examination of this drift revealed that they are largely related to systematic drifts in the climate forcing provided by the atmospheric model in EC-Earth (Figure 2). EC-Earth generates too much precipitation at high latitudes, and the patterns of this positive drift coincide broadly with the spatial patterns of the LAI bias (not shown). In the tropics a positive bias in shortwave radiation (related to an underestimation of cloud cover) reduces the radiation constraints on LAI growth, enabling vegetation to accumulate more biomass and leaf foliage. These findings are incorporated in Weiss et al (submitted).

The results reflect that the scientific status of representing dynamic variability of vegetation phenology in coupled models is still in a preliminary stage, similar to the history of online coupling between atmosphere and the ocean more than a decade ago. Drift controls using flux corrections or adjustments of vegetation sensitivities to climate variability need to be implemented before adnaces in actual and potential predictability can be expected.

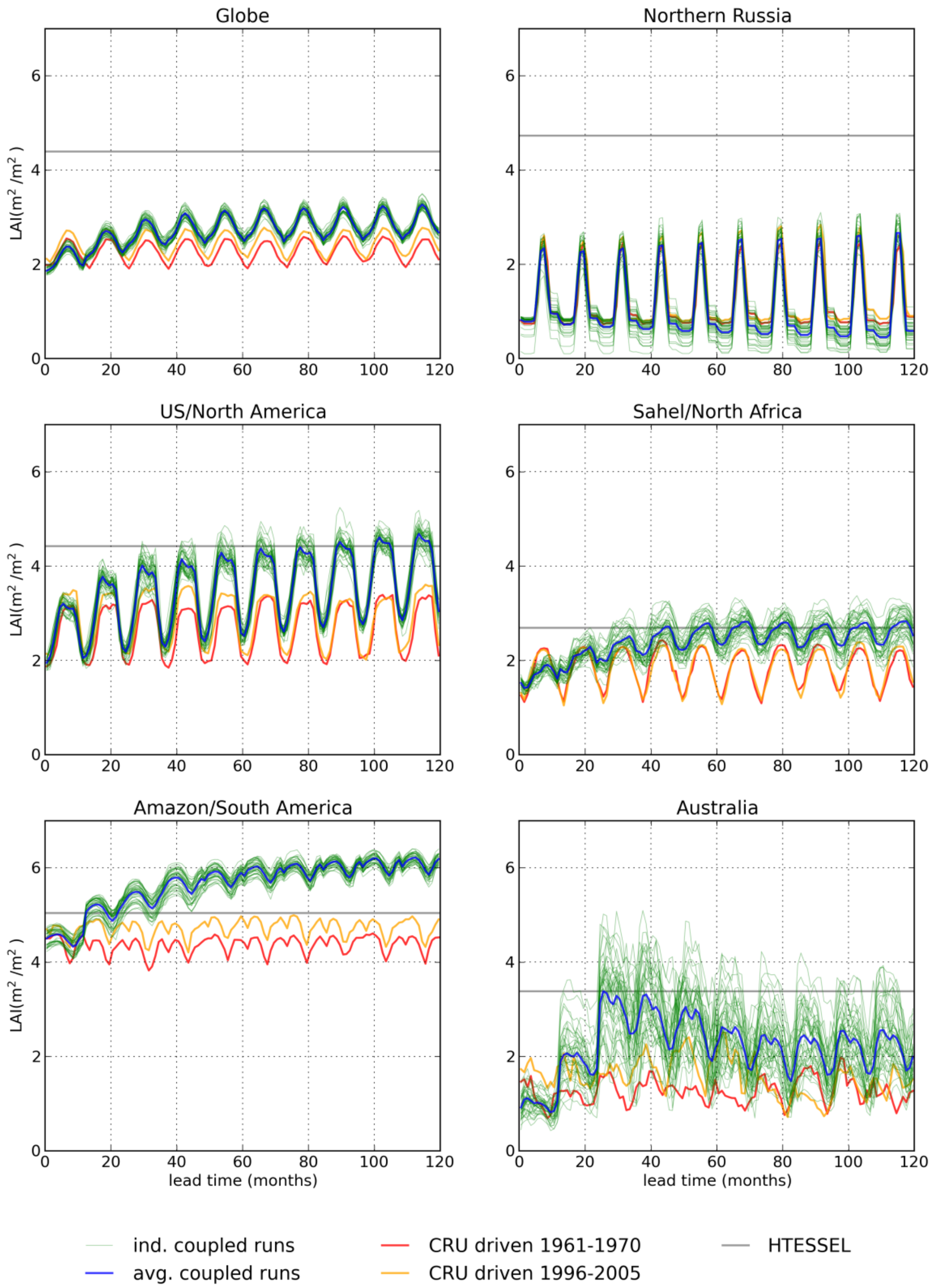

Figure 1: Ensemble mean LAI of high vegetation as function of forecast lead time generated with LPJ-GUESS. Each panel shows a different region. Green lines in different shades denote coupled EC-Earth 2.4 simulations, with each line representing a different start date. Blue lines show values averaged over 8 start dates between 1961 and 2000. Orange and red lines represent LAI values generated by LPJ-GUESS driven by CRU climate data for the 1960-1970 and 1995-2005 periods, respectively. Straight grey lines are the LAI-values in the default HTESSEL configuration in V2.3.

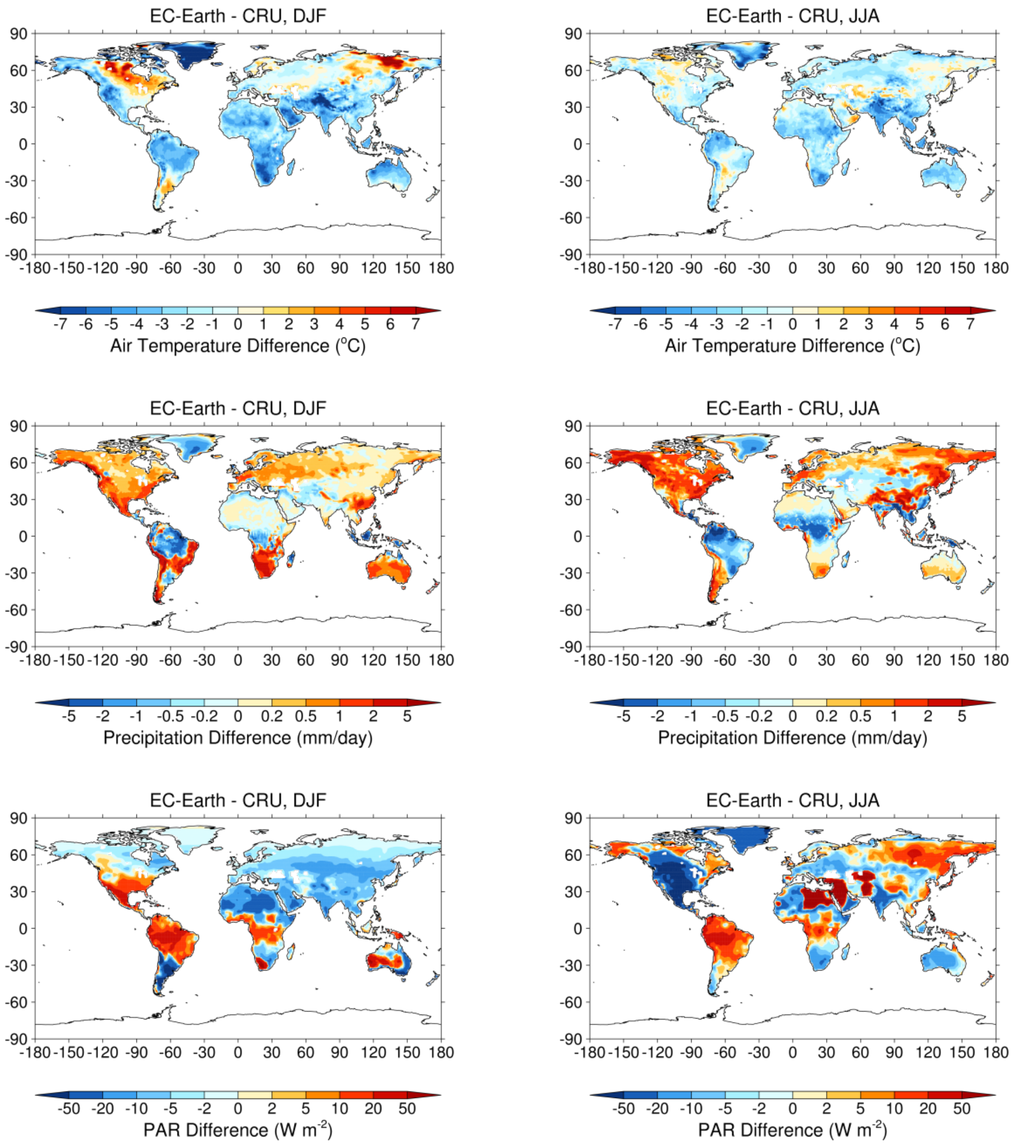

Figure 2. Differences in the 1971-2000 climatologies of surface temperature, total precipitation and PAR between the coupled EC-Earth simulation and the LPJ-GUESS simulation driven by CRU for boreal winter (DJF) and summer (JJA).

List of publications/reports from the project with complete references

Martina Weiss, Paul Miller, Bart J.J.M. van den Hurk, Twan van Noije, Simona Ştefănescu, Reindert Haarsma, Lambertus H. van Ulft, Wilco Hazeleger, Philippe Le Sager, Benjamin Smith2 and Guy Schurgers (2014): Contribution of dynamic vegetation phenology to decadal climate predictability; revision submitted J. Climate

Future plans

(Please let us know of any imminent plans regarding a continuation of this research activity, in particular if they are linked to another/new Special Project.)

At KNMI the work on vegetation related predictability is reduced to a low level due to changes in staff. Within the EC-Earth consortium this work will be continued, and potentially will lead to new experiments for instance in the context of the CMIP6 dedicated MIP on Land Surface, Snow and Soil Moisture (LS3MIP).