SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2017……..……

Project Title: Trends in land surface induced potential predictability over the 20th century…….……

……..……

Computer Project Account: Nk2, nabv

Principal Investigator(s): Bart van den Hurk

Affiliation: KNMI

Name of ECMWF scientist(s) collaborating to the project (if applicable) Antje Weisheimer, Gianpaolo Balsamo

……..……

Start date of the project: 1 march 2017

Expected end date: 31 dec 2017

Computer resources allocated/used for the current year and the previous one

(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			300k	0
Data storage capacity	(Gbytes)			2000	?

Summary of project objectives

(10 lines max)

In consultation with Gianpaolo Balsamo and Florian Pappenberger I propose to carry out a study addressing the change of surface-induced (potential) predictability of regional climate features at seasonal time scale due to climate change. Background climatologies of soil moisture, snow cover and sea ice fractions will change in a warming world, which has a yet unexplored effect on potential skill of seasonal forecasts in selected regions of the world. A limited nr of studies addressing changes in predictability are reported in literature (e.g. DelSole et al. 2013; Dirmeyer et al. 2013), but yet changes in predictability patterns are crucial for many climate services, including flood/drought risk assessment, disaster risk response, forecast based emergency financing (Coughlan de Perez et al. 2014) etc. In the upcoming Land Surface, Snow and Soil Moisture Model Intercomparison experiment (LS3MIP, van den Hurk et al. 2016), carried out in the context of CMIP6, an experimental protocol addressing this predictability subject is included but not yet well designed die to a lack of pioneering studies. In addition, new implementations of prognostic sea ice cover in ECMWF seasonal forecasting systems warrant an exploration of the effect of significant climate trends on its contribution to predictability.
It is aimed to set up a model experiment with a version of EC-Earth or the ECMWF seasonal forecasting system resembling EC-Earth (depending on practical considerations) that isolates the land surface and sea ice contributions from the overall climate trends in potential predictability. These experiments requires a considerable number of ensemble seasonal forecasting experiments, and will follow the design described by DelSole et al. (2013).
The work will be reported in a peer reviewed scientific paper with EC-Earth and ECMWF co-authors, and enter the LS3MIP protocol for later execution.

Summary of problems encountered (if any)

(20 lines max)

No problems; see below for reason for not using the resources

Summary of results of the current year (from July of previous year to June of current year)

The activities in the context of this sabbatical project have been very productive. I have spent 3 months of research time at the ECMWF facilities on Shinfield Park. In that period I was granted a new user ID (nabv), that allowed me to carry out the simulations without making use of the special project requested.

It was very fortunate that a Control Experiment was already carried out by Antje Weisheimer: a seasonal reforecast of 4 startdates per year between 1900 and 2010 initialized from ERA20C, 4 months leadtime, 51 ensemble members. This experiment was duplicated for two time slices (Beginning of Century BOC, 1900-1929 and End of Century EOC, 1980-2009) for a 21 member ensemble, but with initial land surface conditions drawn from surrounding years. This scrambling procedure allowed to highlight the role of land surface initialization on the seasonal predictability.

The experimental protocol is illustrated in Figure 1 for soil moisture. It can be seen that for this quantity predictability decreases after realistic initialisation without a clear difference between BOC and EOC, while for the disturbed land surface experiments potential predictability increases with forecast lead time due to restoring feedbacks in the climate system.

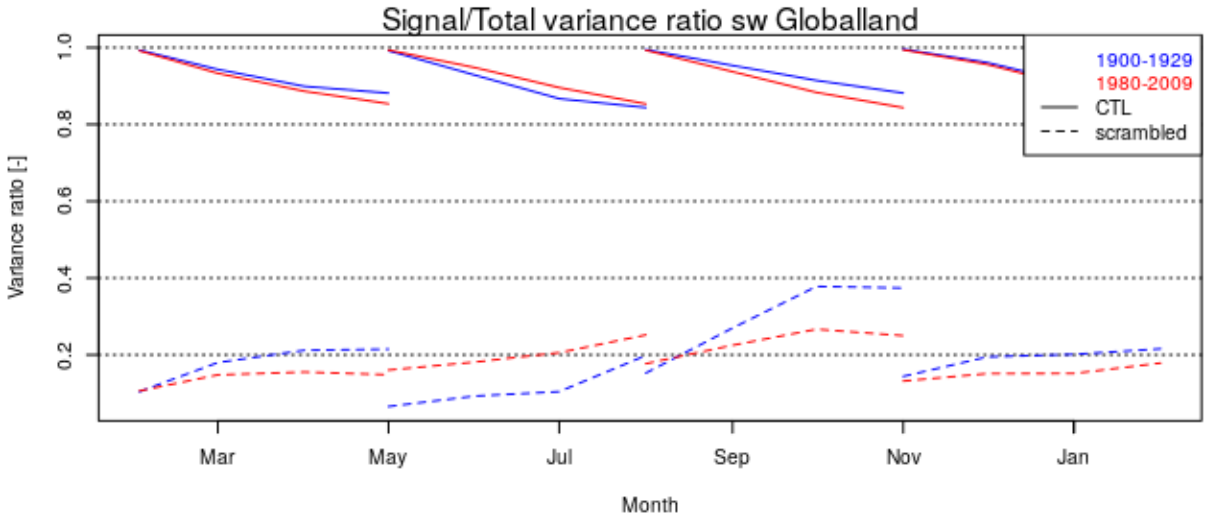

Figure 1: Potential predictability (expressed as the ratio between signal and total variance of an ensemble forecast) for 4-month seasonal forecasts initialised in BOC and EOC, for realistic and distorted initial states.

The resulting 2m temperature predictability, shown in Figure 2, shows a clear increasing trend between BOC and EOC. Both for the realistic and the disturbed initial conditions EOC metrics show higher values than BOC metrics. An important explanation for this is the general warming trend that took place during the 1980-2009 era. The trend in this time period is much stronger than in the 1900-1929 time frame, adding significantly to the signal variance in that period. Results indeed show little difference in potential predictability of T2m between BOC and EOC after detrending the temperature data (Figure 3).

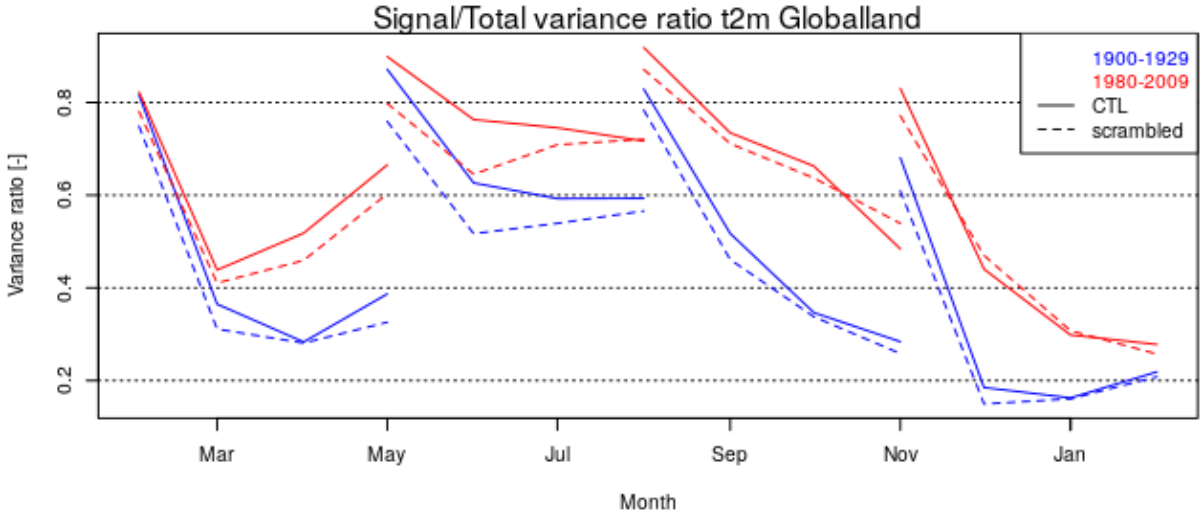

Figure 2: As figure 1 for 2m temperature over land

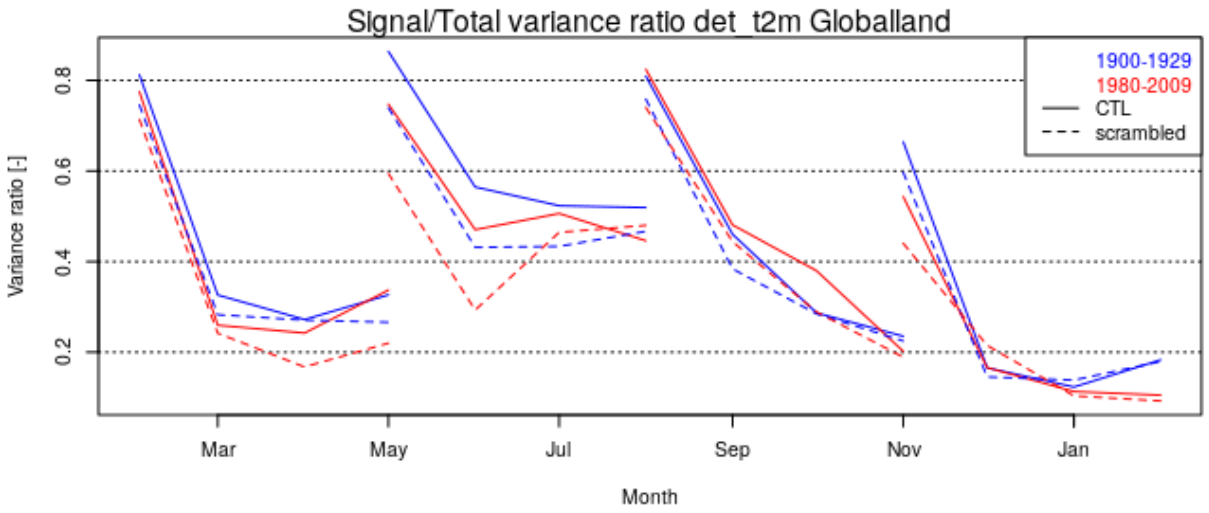

Figure 3: As Figure 2, for detrended temperature

List of publications/reports from the project with complete references

One publication planned (Van den Hurk, Weisheimer, Balsamo)

Summary of plans for the continuation of the project

(10 lines max)

The Special Project resources have not been used. Also, with the current set-up of the infrastructure (where access via the nabv ECMWF account is arranged) it is unlikely that the resources will be used in the near future. In spite of this it is planned to complete the analyses of the simulations, particularly addressing the specific conditions that lead to low/high predictability, the impact on extremes and heatwave days, and the potential predictability of the snow/runoff system. These analyses will be completed in the near future and documented in a scientific paper.