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:	Assessing sources of seasonal forecast skill over Europe in summer using relaxation experiments
Computer Project Account:	spbgorei
Principal Investigator(s):	Christopher O'Reilly Tim Woollings Laure Zanna
Affiliation:	University of Oxford
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Antje Weisheimer
Start date of the project:	Jan 2016
Expected end date:	Dec 2018

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)	12000000	12000000	12000000	205000
Data storage capacity	(Gbytes)	20000	<20000	20000	<20000

Summary of project objectives
(10 lines max)

The objective of the project is to investigate potential sources of skill in seasonal forecasts over Europe during the summertime. Our plan is to investigate sources of skill using various prescribed SST experiments and a series of relaxation experiments to assess the forcing of seasonal circulation anomalies over Europe.

Summary of problems encountered (if any)
(20 lines max)
N/A

Summary of results of the current year (from July of previous year to June of current year)
This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

Much of the last year has been spend analysing the extratropical response to summertime precipitation anomalies – in observations, simplified models and the IFS. We have found that in observations, the most dominant link between tropical precipitation and the European circulation is strongly linked to ENSO. The teleconnection mechanism was tested in barotropic model simulations, which indicate that the observed link between the 1st EOF of tropical precipitation and the Euro-Atlantic circulation anomalies is largely consistent with linear Rossby wave dynamics. The barotropic model response consists of a circumglobal wave-train in the extratropics, which is primarily forced by divergence anomalies in the eastern tropical Pacific. The westward group propagation of the Rossby wave anomalies is found to be crucial in determining the circulation response over the Euro-Atlantic sector. The mechanism was also analysed in the ECMWF System 4 seasonal forecasting system. Whilst System 4 is well able to reproduce and skillfully forecast the 1st EOF of tropical precipitation, the extratropical circulation response is absent over the Euro-Atlantic region, which seems to be related to biases in the upper-level Asian jetstream.

These results have been written up into a paper entitled "The impact of tropical precipitation on summertime Euro-Atlantic circulation via a circumglobal wave-train", which is currently in review for publication in the Journal of Climate (see below, please get in touch if you would like to read the submitted manuscript: Christopher.oreilly@physics.ox.ac.uk).

In addition to this work, we have carried out a number of relaxation experiments to further understand the teleconnection mechanism in the IFS – in particular why the model does not match the observed teleconnection pattern. These experiments have been performed with relaxation towards reanalysis in separate regions along the extratropical waveguide, both up and downstream of the Euro-Atlantic sector. An example of the anomaly correlation coefficient for the relaxed and control (i.e. not relaxation) simulations is shown in Figure 1.

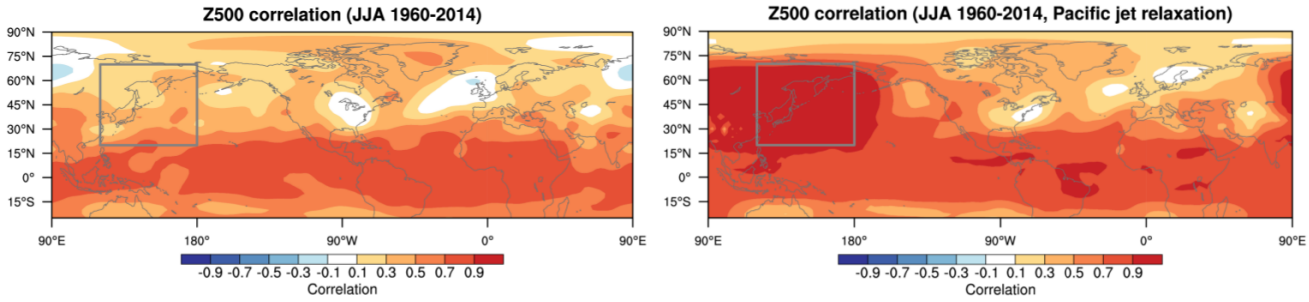

Figure 1: *Z500 Anomaly correlation coefficient of ensemble hindcast simulations (25 members), initialised on May 1st. The control simulation (left) is forced with prescribed SST and sea-ice and the lower boundary. The relaxation experiment (right) has all fields within the grey box – in the region of the Pacific Jetstream – relaxed towards reanalaysis data. Therefore, correlation skill is high by design in this region, however, there are also noticeable increases in skill upstream of the relaxation region.*

The relaxation experiments are currently being analysed, in particular the westward propagation of the signal along the Pacific Jetstream and the influence on European predictability. This work is ongoing.

List of publications/reports from the project with complete references

O'Reilly, C. H., T. Woollings, L. Zanna, and A. Weisheimer, "The impact of tropical precipitation on summertime Euro-Atlantic circulation via a circumglobal wave-train", *submitted to J. Climate.*

Summary of plans for the continuation of the project

(10 lines max)

There are a number of analyses that we are currently performing on the ensemble experiments that we have performed. These are focussed on understanding the ENSO teleconnection in the forecast model and observations. The relaxation experiments have shed some light onto this, however, more experiments are required and are currently being undertaken.