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	2015/16…………………………………………….……
Project Title:	Seasonal forecasts of the 20th Century: Reliability, attribution and the impact of stochastic perturbations……
	…………………………………………………….……
Computer Project Account:	spgbawsf …………………………………….……
Principal Investigator(s):	Dr. Antje Weisheimer………………….………
	…………………………………………………….……
Affiliation:	University of Oxford ………………….……
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Dr. Antje Weisheimer ……………….……
	……………………………………………….……
Start date of the project:	January 2015……………………….……
Expected end date:	December 2016……………………….……

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)	28 750 000	28 750 000	25 000 000	12 600 000
Data storage capacity	(Gbytes)	24 000	24 000	24 000	

Summary of project objectives

(10 lines max)

This special project was requested in order to perform extended seasonal re-forecast (or hindcasts) sets and sensitivity experiments for the entire 20th Century. Being in possession of such an unprecedented dataset will allow us to assess the reliability of seasonal forecasts in the context of the attribution extreme weather event to anthropogenic influence, but also to investigate the impact of stochastic perturbations on the model performance. In addition, it will be possible for the first time to quantify whether the skill of seasonal forecast changes throughout the century, as studies showed that, for example, there is higher skill in predicting the North Atlantic Oscillation for the 1980-2000 period than for the 1960-1980 period (*Shi et al, 2015, GRL*).

Summary of problems encountered (if any)

(20 lines max)

No problems encountered

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

During the current year we have performed all experiments as planned. In particular, we have completed seasonal retrospective forecast experiments with prescribed observed SSTs (uncoupled hindcasts) using ERA-20C as initial and lower boundary conditions for start dates from 1900 to 2010 and with an ensemble size of 51 members.

The unprecedented length of this hindcast data set enabled us to study several research questions related to decadal variability in forecast skill of the NAO and the potential use of these model simulations for improved assessments of the attribution of extreme weather and climate events.

These seasonal forecasts show significant positive seasonal correlation skill of the winter North Atlantic Oscillation over the entire forecast period. However, the predictive skill exhibits distinct multi-decadal variability: periods of significant skill occur in the earlier parts of the 20th Century and during recent decades, while the mid-century period is characterised by intrinsically lower levels of forecast skill and weakly negative values of the North Atlantic Oscillation. These mid-century decades stand out as an important period on which to test the performance of future seasonal forecast systems. Our analysis showed that probabilistic forecast for winters with a North Atlantic Oscillation in a strongly negative phase or in positive phases are highly skilful. However, the model does not perform as well for weakly negative phases, for reasons not yet fully understood. Finally, we have proposed and demonstrated how seasonal forecast reliability can be of importance for increasing confidence in statements of extreme weather and climate event attribution to anthropogenic climate change.

The results of this project have been written up for publication and are currently under revision for the Quarterly Journal of the Royal Meteorological Society. A copy of the submitted manuscript (to be treated confidentially) is attached to this report.

List of publications/reports from the project with complete references

Weisheimer, A., N. Schaller, C. O'Reilly, D.A. MacLeod and T.N. Palmer (2016): Atmospheric seasonal forecasts of the 20th Century: multi-decadal variability in predictive skill of the winter North Atlantic Oscillation and their potential value for extreme event attribution. *Q. J. R. Meteorol. Soc.*, under revision.

Summary of plans for the continuation of the project

(10 lines max)

The seasonal hindcasts generated and analysed in this project used ECMWF's atmospheric re-analysis spanning the 20th Century (ERA-20C) for the initialisation of the model atmosphere. No consistent ocean re-analysis data existed at the time to initialise also the ocean component of the forecasting system. Instead, prescribed analysed SSTs were used as a lower boundary condition. With the advent of ECMWF's coupled re-analysis of the 20th Century (CERA-20C), the extension of these long seasonal hindcasts sets to the coupled ocean-atmosphere system becomes feasible. A new Special Project application will be submitted that focuses on using CERA-20C for exactly this.