SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2023
Project Title:	The Impact of Stochastic Parametrisations in Climate Models: EC-EARTH System Development and Application
Computer Project Account:	spgbtpsp
Principal Investigator(s):	T. N. Palmer K. J. Strommen H. M. Christensen S. Juricke A. Weisheimer
Affiliation:	University of Oxford Physics Department Parks Rd, Oxford OX1 3PU
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Antje Weisheimer
Start date of the project:	2021
Expected end date:	2023

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)	10,000,000	300,000	9,000,000	0
Data storage capacity	(Gbytes)	10,000	2000	10,000	0

Summary of project objectives (10 lines max)

The central aim of the project is to implement stochastic parametrisation schemes in multi-year integrations of the EC-Earth climate model and investigate their impacts on the modelled climate. Stochastic schemes are developed for all components of the EC-Earth model (atmosphere, ocean, sea-ice and land) and tested in different combinations. Model evaluation is focused both on basic mean state biases, long-term climate dynamics (e.g. ENSO), response to forcing (i.e. climate sensitivity) and the representation of key regional phenomena crucial for modulating local climate (e.g. Euro-Atlantic weather regimes, the Indian summer monsoon etc.)

Summary of problems encountered (10 lines max)

No problems were encountered so far in this incarnation of the project.

Summary of plans for the continuation of the project (10 lines max)

In the final year of the project, ensemble experiments will be carried out with only one of the stochastic sea-ice and ocean schemes active, to understand which of the schemes (ice or ocean) are crucial to obtain the impact on Arctic-midlatitude teleconnections found when using both at once.

List of publications/reports from the project with complete references

Strommen, K., Juricke, S., and Cooper, F.: Improved teleconnection between Arctic sea ice and the North Atlantic Oscillation through stochastic process representation, Weather Clim. Dynam., 3, 951–975, https://doi.org/10.5194/wcd-3-951-2022, 2022

Summary of results

The project has been focused in two directions: (i) the impact of SPPT on climate sensitivity in EC-Earth3, and (ii) the impact of stochastic ice and ocean schemes on Arctic-midlatitude teleconnections. Work carried out on these topics was described in the previous progress report.

The main update since the last reporting period is that the paper concerning topic (ii) has been published: see the List of Publications.

Unfortunately, the experiments that we planned to carry out using the units allocated for 2022 were not performed. The research group of the lead principal investigator, Prof. Tim Palmer, began disbanding in 2022 in response to his retirement. While the one remaining PI (K. Strommen) had planned to carry out a limited subset of experiments anyway, a combination of his personal family circumstances and disruptions caused by the move to the new Atos machine meant that these plans became unfeasible. For the same reason, no further analysis has taken place on the two main topics since the last reporting period: last year's progress report is therefore still the most up to date summary of the scientific results emerging from this special project.

However, we emphasise that the experiments carried out in 2021 (year 1 of the current special project) have turned out to already be sufficient to answer almost all the key questions related to topic (i) on the impact of SPPT. We aim to convert our findings here into a published manuscript in the next year. Furthermore, we aim to carry out the last remaining experiments related to topic (ii) in the current project year (2023): this involves answering the question of what the relative roles of the stochastic ice and ocean schemes are in generating the improved Arctic-midlatitude teleconnection seen in Strommen et al. (2022) (see List of Publications). Because EC-Earth3 is now running stably on Atos, we expect this should now be feasible. The results will be described in next year's final report.