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	2021
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 D. MacLeod 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)			15,000,000	3,287,682
Data storage capacity	(Gbytes)			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 remainder of this year, we aim to carry out a mix of further sensitivity experiments to understand the impact of SPPT on climate sensitivity. In addition, high resolution experiments with stochastic ocean and sea-ice schemes will be performed.

List of publications/reports from the project with complete references

No publications have been made yet based on the reporting period under question.

Summary of results

The work so far in the project has been to carry out the necessary experiments to assess the impact of SPPT on equilibrium climate sensitivity in EC-Earth3. Previous experiments, carried out in the Climate SPHINX Project, had shown that transient sensitivity changes when including SPPT under an RCP8.5 scenario. However, the final impact on equilibrium sensitivity was unclear.

In order to understand this further, three simulations have so far been performed using, in part, the units of this project. Firstly, a pre-industrial control simulation with SPPT. Secondly, an abrupt 4xCO2 simulation with SPPT. Thirdly, a 1%-co2-per-year simulation. The experiments used the CMIP6 configuration of the model, and we will therefore be comparing our simulations with the corresponding official (deterministic) EC-Earth3 contributions to CMIP6. Currently only preliminary analysis has been performed, with the goal being to perform a full analysis of the changes to climate feedbacks, by using a radiative kernel computation. Changes to cloud behaviour and ENSO will be of particular interest.

We have included two figures showing some of the preliminary work. Figure 1 shows the surface temperature evolution in pre-industrial conditions and the 1%-co2 simulations; the impact of AMOC, which undergoes large, centennial timescale oscillations in this version of EC-Earth3, has been regressed out. Figure 2 shows the impact of SPPT on the El Nino phase of ENSO in both

abrupt 4xCO2 and 1%-co2 simulations. These figures were made by Virna Meccia (CNR), who is one of the people collaborating with us for this work, along with Paolo Davini (CNR).

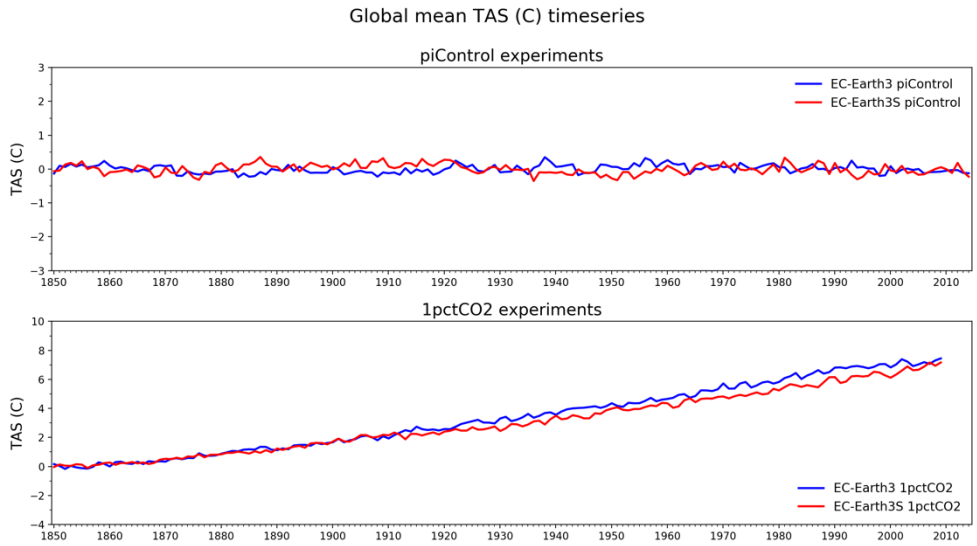

Figure 1: Timeseries of global means of surface temperature; piControl (top), 1pctCO2 (bottom). Without SPPT (blue) and with SPPT (red).

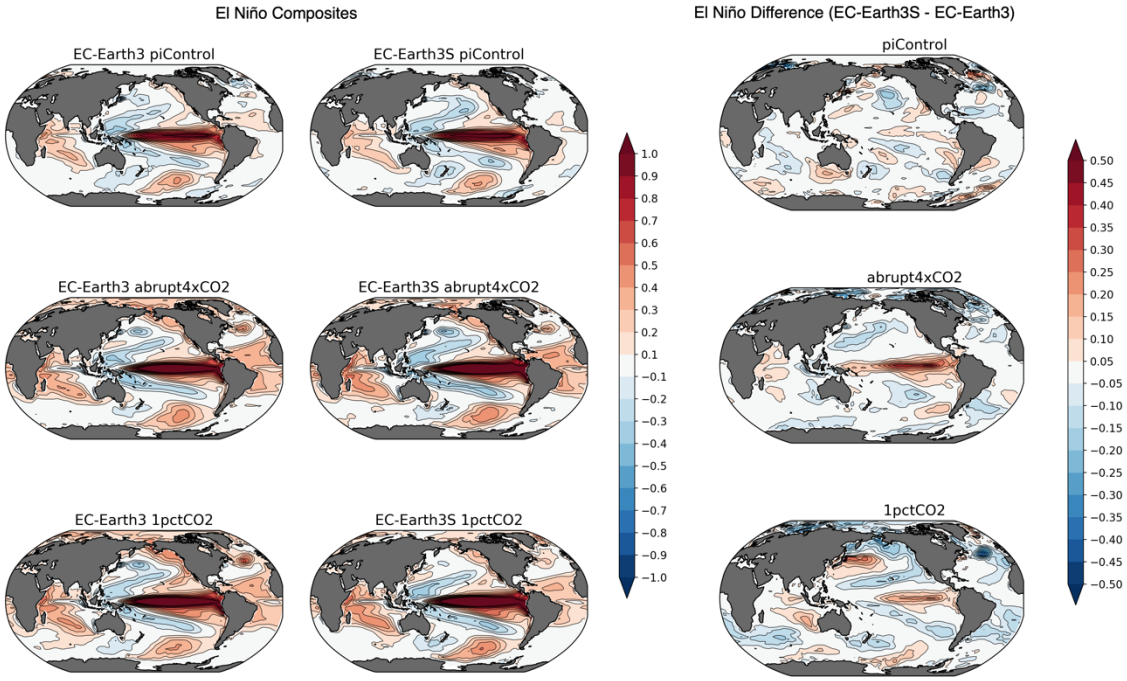

Figure 2: Composites of El Nino events for piControl, abrupt4xCO2 and 1pctCO2 experiments. EC-Earth3: without SPPT. EC-Earth3S: with SPPT. Differences between the two are shown on the right.