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

2018

Project Title:

The Impact of Stochastic Parametrisations in Climate Models: EC-EARTH System Development and Application

Computer Project Account:

Spgbtpsp

Principal Investigator(s):

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Oxford

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Start date of the project:

2018

Expected end date:

December 2020

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

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			13,000,000	2,346,589
Data storage capacity	(Gbytes)			6000	2000

Summary of project objectives

In the previous project with the same name, we succesfully implemented a number of new stochastic schemes into the EC-Earth climate model, effectivelly adding a level of stochasticity to each component of the model (atmosphere, land and ocean). Extensive evaluations were carried out of the impact these schemes have on an individual level, in particular to first-order diagnostics (mean state changes, energy budget, hydrological budget and basic atmospheric circulation). The main objective of this project is to use the information obtained from these evaluations to firstly tune the EC-Earth model to produce a better mean-state when using stochastic schemes, and following this, to test the impact of these schemes when used together. In addition, we aim to carry out further second-order diagnostics of the impact of the schemes. In particular, we will be evaluating the impact of the schemes on North Atlantic regime structures, ENSO and the Asian summer monsoon.

Summary of problems encountered (if any)

The main technical hurdle so far has been to do with transfer of model output data back to our local storage server in Oxford. This is work in progress for which we are receiving excellent technical support from ECMWF.

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

The primary work carried out in the first 6 months of this special project has been the preparation of and carrying out of a long, coupled integration of EC-Earth using stochastic physics. This was done in two stages.

Firstly, two test simulations were done, 20 years each in length, to test the raw impact of the atmospheric stochastic schemes SPPT and our new `independent SPPT' scheme in coupled mode. These simulations covered the period 1990-2010 and used historical forcings. Figures 1 and 2 below show the impact on the energy budget of these schemes relative to a 'Control' simulation without stochastic physics covering the same period and using the same tuning parameters. Figures 3 and 4 show percentage changes of some key global mean quantities. These results confirmed the impact of the schemes that had also been seen in atmosphere-only simulations previously. Both schemes notably effect both evaporation and cloud liquid water in particular, notably impacting the energy budget. Since the deterministic run had been tuned to achieve realistic energy budgets, this necessitated a re-tuning of the stochastic schemes. This was done using tuning simulations carried out in previous experiments.

Once this process was complete, we carried out a longer, 65 year coupled integration of the SPPT scheme. This was done as part of the PRIMAVERA project, and so a large amount of work went into ensuring the version of EC-Earth we used was in line with the set-up for that project. This includes a more thorough post-processing to bring the metadata of the output in line with CMIP6 standards. This involved the installation and testing of a new software package called ece2cmor3, developed for EC-Earth.

After this had been succesfully implemented, a PRIMAVERA style 65-year simulation was performed, covering the period 1950-2015. This simulation is still being post-processed as of submission of this report, so we have not been able to analyse the output as of yet. This will be carried out, along with further such simulations for our other stochastic schemes (independent SPPT, stochastic land, stochastic ocean, and a combination of these) in the next reporting period.

Figure 1: Impact of SPPT on energy budget

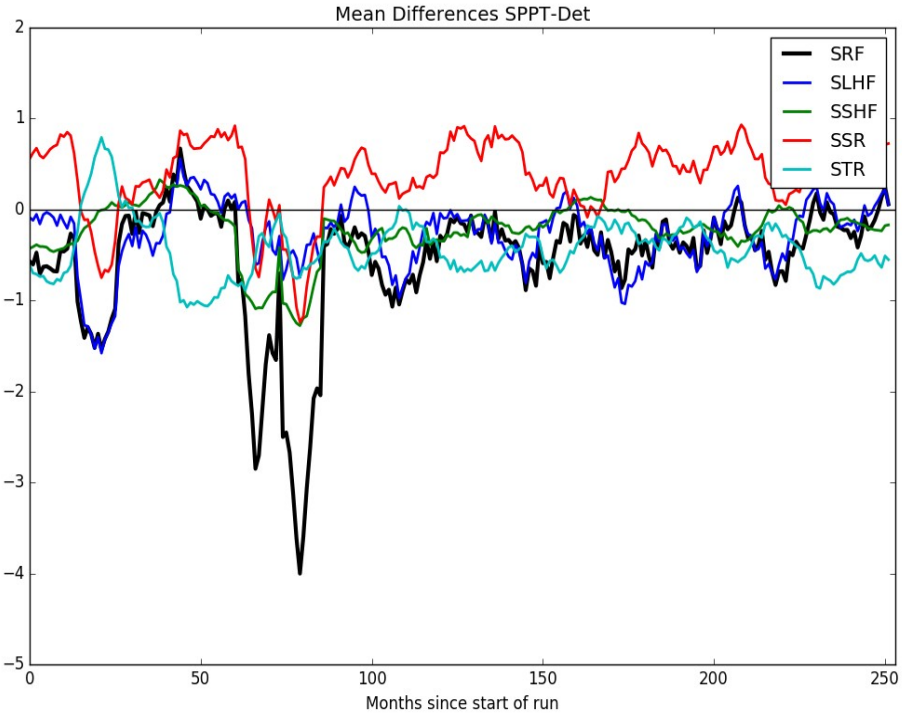


Figure 2: Impact of ISPPT on energy budget

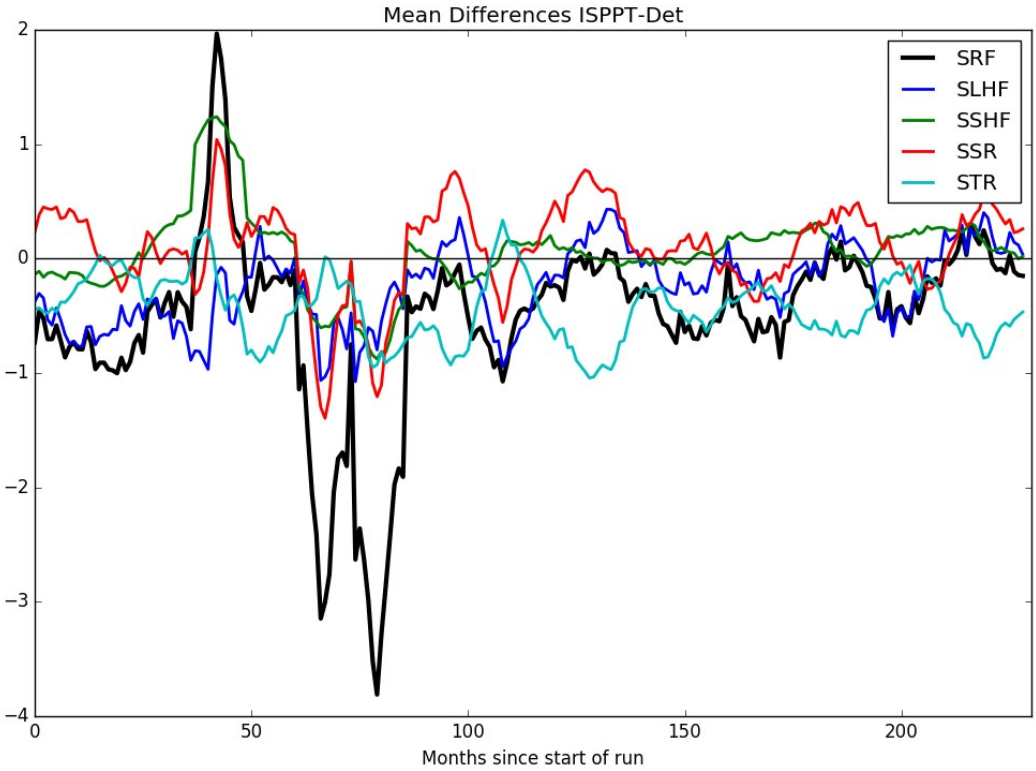


Figure 3: Impact of SPPT on global means

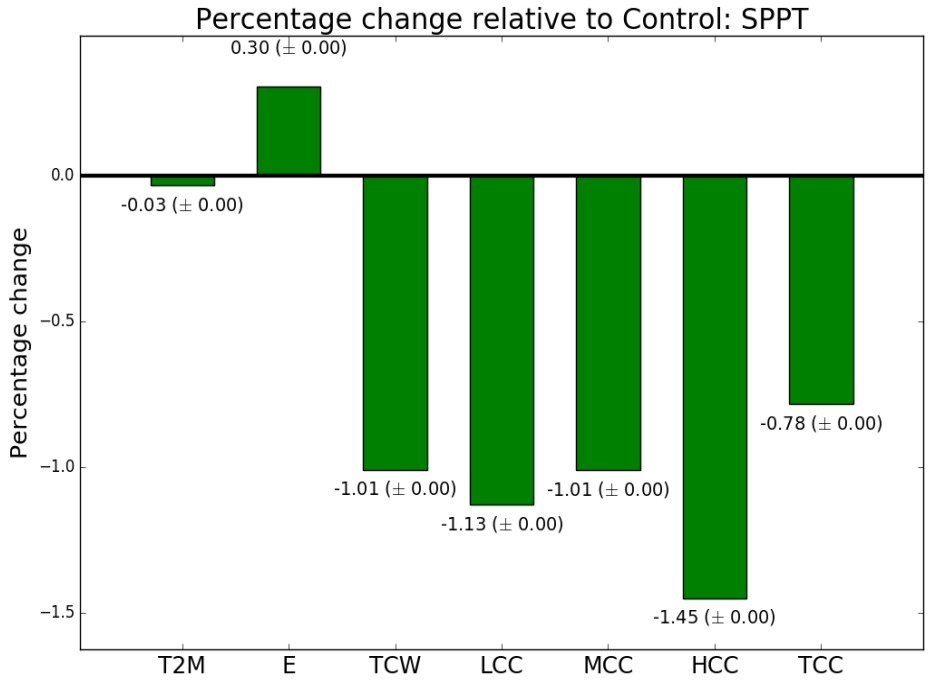
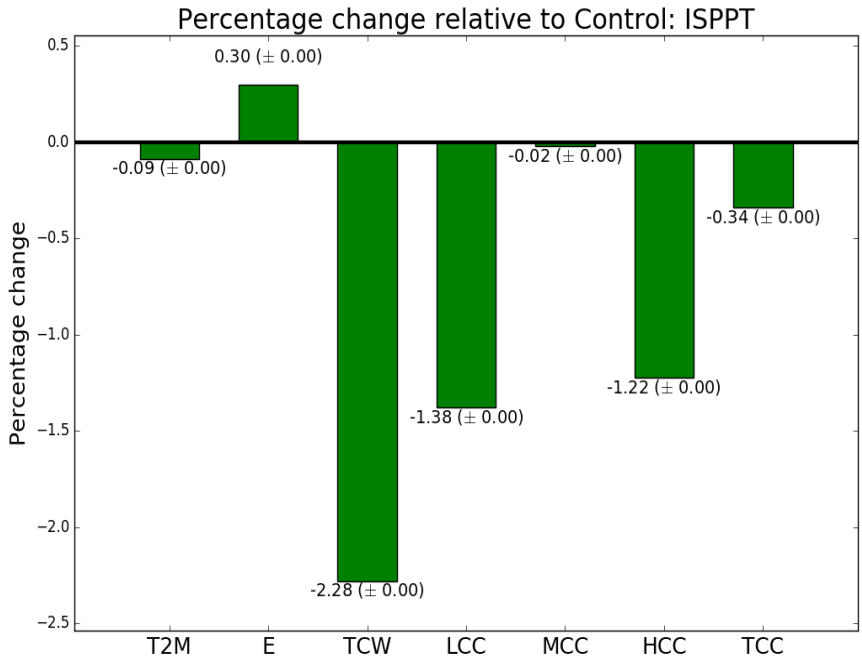


Figure 4: Impact of ISPPT on global means



List of publications/reports from the project with complete references

None

Summary of plans for the continuation of the project

(10 lines max)

We will analyse the PRIMAVERA style simulations carried out with SPPT, and perform additional such simulations using our new stochastic schemes. These will all then be analysed fully.