

REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

MEMBER STATE: United Kingdom

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

Project account: **SPGBTSP**

Additional computer resources requested for	2019
High Performance Computing Facility (units)	6000000
Data storage capacity (total) (Gbytes)	1250

Continue overleaf

¹ The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

Units in the project have so far been spent to create a set of ensemble climate simulations. For several different configurations of EC-Earth with different combinations of stochasticity turned on (in the atmosphere, ocean, sea-ice and land), we integrated 3 ensemble members for 65 years, covering 1950-2014; these form part of Oxford's contribution to the PRIMAVERA Project.

One of the recurring lessons from the PRIMAVERA Project, prior to our experiments, had been that robust changes across models and resolutions were typically only visible given a sufficiently large sample size, i.e. a sufficiently large ensemble. This, and our own experience of analysing the impact stochasticity in other coupled experiments, informed our decision to create this larger ensemble, with an associated large cost of units.

Our analysis of these experiments so far has motivated the current application for extra units, for two main reasons. One of our configurations used a new, atmospheric scheme (the 'Independent SPPT scheme'). Our experiments are the first test of this scheme in long, coupled, climate simulations; they revealed that the impact of the scheme on ENSO is very strong, leading to unrealistically strong ENSO events. Despite this, the scheme improves the mean state and variability of the model in many other aspects. We wish to further explore a damped version of this scheme, to try to isolate these benefits without excessively disturbing ENSO.

The second main motivation for this application was from the experiments conducted with stochastic ocean and sea-ice schemes turned on. These show interesting impacts on atmosphere-ocean interactions, especially along the Southern Ocean currents and the Kuroshio extension. Another lesson from the PRIMAVERA Project so far has been the importance of increased ocean resolution, with climate models undergoing a 'step-change' as one moves towards an eddy-resolving ocean. Discussion with various PRIMAVERA partners has motivated our desire to assess the impact of our ocean and sea-ice schemes in short simulations with a 0.25° ocean; all our experiments so far used a 1° ocean.

The units asked for would allow us to comfortably carry out these two experiments. While there are still a number of units remaining in this year's budget, most of these are ear-marked for the extension of existing ensemble members to 2050, as part of the PRIMAVERA protocol. Therefore, the units and storage space asked for would be crucial to allow us to carry out the experiments discussed.

Estimation of required extra units was done by reference to the SBU cost of the ensembles carried out already. These showed that a 65 year coupled, stochastic simulation (along with a full post-processing and CMORization) costs ~1.7 million SBUs. Therefore, ~5 million SBUs would be required for a full, 3-member ensemble. The extra 1 million units would go towards the shorter 0.25° stochastic ocean simulation. Storage space asked for is essentially temporary; EC-Earth output needs to be stored temporarily while it is being transferred to our local storage servers. Once data has been validated (upon arrival), it will be deleted promptly from ECMWF storage. Once again, the requested storage space (10Tb) is informed by the volume of data produced from previous experiments.