

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 year2024.....

Project Title:Linear response theory and stochastic parametrizations for the investigation of response and sensitivity. A case study with an intermediate-complexity model.....

Computer Project Account: ...spitlemb.....

Principal Investigator(s): ...Valerio Lembo (ccvl).....

Affiliation:CNR-ISAC.....

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

Start date of the project:01-01-2024.....

Expected end date:31-12-2026.....

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)			2900000	1380337
Data storage capacity	(Gbytes)			91500	0

Summary of project objectives (10 lines max)

The sensitivity of internal variability to external forcings, as it can be distinguished from the long-term climate response, is studied in model PlaSim-LSG, with and without a Stochastically Perturbed Parametrization Tendencies (SPPT) scheme (Buizza et al. 1999). The computational advantage provided by such EMIC-class models is exploited to investigate the asymptotic response of the modelled climate in a systematic way. An experimental protocol adopting the LRT in the context of climate modelling (Ragone et al. 2016) is tested in its performance to predict the asymptotic response of a chosen observable, highlighting several crucial aspects of the climate forced response, such as the equilibrium climate sensitivity, the transient climate response etc., the reduction of the Atlantic Meridional Overturning Circulation (AMOC) or the emergence of the North Atlantic cold bloc (cfr. Lembo et al. 2020).

Summary of problems encountered (10 lines max)

The main issue was porting and installing the PlaSim-LSG modelling system to Atos. This required some trial and error, and requesting support from the Helpdesk. A second issue was related to the fact that a relatively small amount of even the coarsest resolution runs could be launched in parallel. The model is in fact relatively fast (about 700 years per day with 8 cores), but the output is large (189 MB per year) and the HPCPERM threshold for the storage is easily. This requires moving the outputs either to ECFS very often or elsewhere.

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

So far, we started carrying out the remaining simulations with the T21 regarding the 1% CO2 increase per year (1pct_xCO2_t21 in the special project request). Given that some of them were already carried out elsewhere while the project request was in the review phase, this only consisted of the 1pct_8CO2_t21 ensemble. We are planning to complete them and transfer the outputs to ECFS. In addition to that, we are planning to transfer the already performed experiments to ECFS, which amounts roughly to 25000 Gbytes.

List of publications/reports from the project with complete references

Summary of results

The first major task required porting the adopted version of the PlaSim-LSG model to Atos, setting the right compiler and compiler's flags and make it run. Once this was achieved, the first tests were carried out to assess the model's performances and scalability. We verified that the scaling was coherent with what illustrated in the project proposal, as this what achieved with a different HPC system.

We then performed the remaining set of simulations from the 1pct_xCO2_t21 ensemble. The runs are slowly proceeding because the outputs are being produced and temporarily moved to the scratch folder. From there, they are moved to the ECFS, but this requires a large amount of time and the employment of computational resources that are being preserved for the actual model runs. Roughly 50% of the computational resources have been employed for these runs. We are planning to complete 1pct_8CO2_t21 before the end of summer and move to historical runs in the last part of the year.