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	2015
Project Title:	Constraining stochastic parametrisation schemes through coarse graining
Computer Project Account:	spgbtpcs
Principal Investigator(s):	Prof Tim Palmer Dr Hannah Christensen
Affiliation:	University of Oxford
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Dr Antje Weisheimer
Start date of the project:	Jan 2015
Expected end date:	Dec 2017

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)	n/a	n/a	2,000,000	39,616
Data storage capacity	(Gbytes)	n/a	n/a		

Summary of project objectives

Stochastically Perturbed Parametrisation Tendencies (SPPT) is an attractive stochastic parametrisation scheme due to its ease of use and beneficial impact on ensemble forecast reliability. However, despite its popularity, the SPPT scheme remains ad hoc in its assumptions. For example, the imposed spatial and temporal correlations have not been derived from theory or observation, and have simply been tuned to give the best results. SPPT also does not distinguish between different parametrisation schemes, and assumes the errors from each scheme are perfectly correlated. This project seeks to address these shortcomings using coarse graining experiments: a high resolution data set will be coarse grained to the resolution of a NWP model, and the characteristics of the 'error' between high resolution data set and NWP tendencies will be calculated

Summary of problems encountered (if any)

Unfortunately, the project has been very slow to get started. We want to compare tendencies from the IFS Single Column Model (SCM), which is driven using the high-resolution data set, to those derived from the dataset itself. Comparing the two will enable us to derive error structures which can be compared to SPPT. However, we have been unable to get started with running the SCM - we were informed of a 'bug' in the current release of the SCM (CY38) that made the time-stepping highly inaccurate unless very small steps were taken. We understand that the next release of the SCM (CY41) will soon be available for use (as part of the next openIFS release), after which we hope to make rapid progress.

Summary of results of the current year (from July of previous year to June of current year)

We have completed a systematic study to test the performance of SPPT with different imposed spatial (z1, z2) and temporal (t1, t2) correlations. We varied these four parameters in SPPT and performed 16 perturbed parameter experiments with different values for these parameters. We allowed t1 to vary between 1 and 48 hours, and t2 to vary between 48 and 120 hours (operational setting are 6 and 72 hours respectively). We allowed z1 to vary between 100 and 800 km, and z2 to vary between 800 and 1500 km (the operational settings are 500 and 1000 km respectively). Latin hypercube sampling was used to ensure the parameter space was evenly sampled. A Gaussian process emulator (GPE) was used to predict the forecast skill for intermediate parameter values.

We found an increase in skill for large values of (z1, z2, t1, t2), though the optimum parameter values are dependent on the chosen metric. The attached figure shows the GPE for a skill metric defined to be the sum of the RPSS at days 1, 5 and 10 for each of T850, U850, U200 and Z500, evaluated globally. It is evident that SPPT can be improved by tuning the values of parameters within the scheme, but that using these 'brute force' techniques to do so is complicated by the sensitivity to choice of metric. This demonstrates the importance of performing coarse graining experiments to measure the characteristics of the error term in SPPT.

List of publications/reports from the project with complete references

n/a

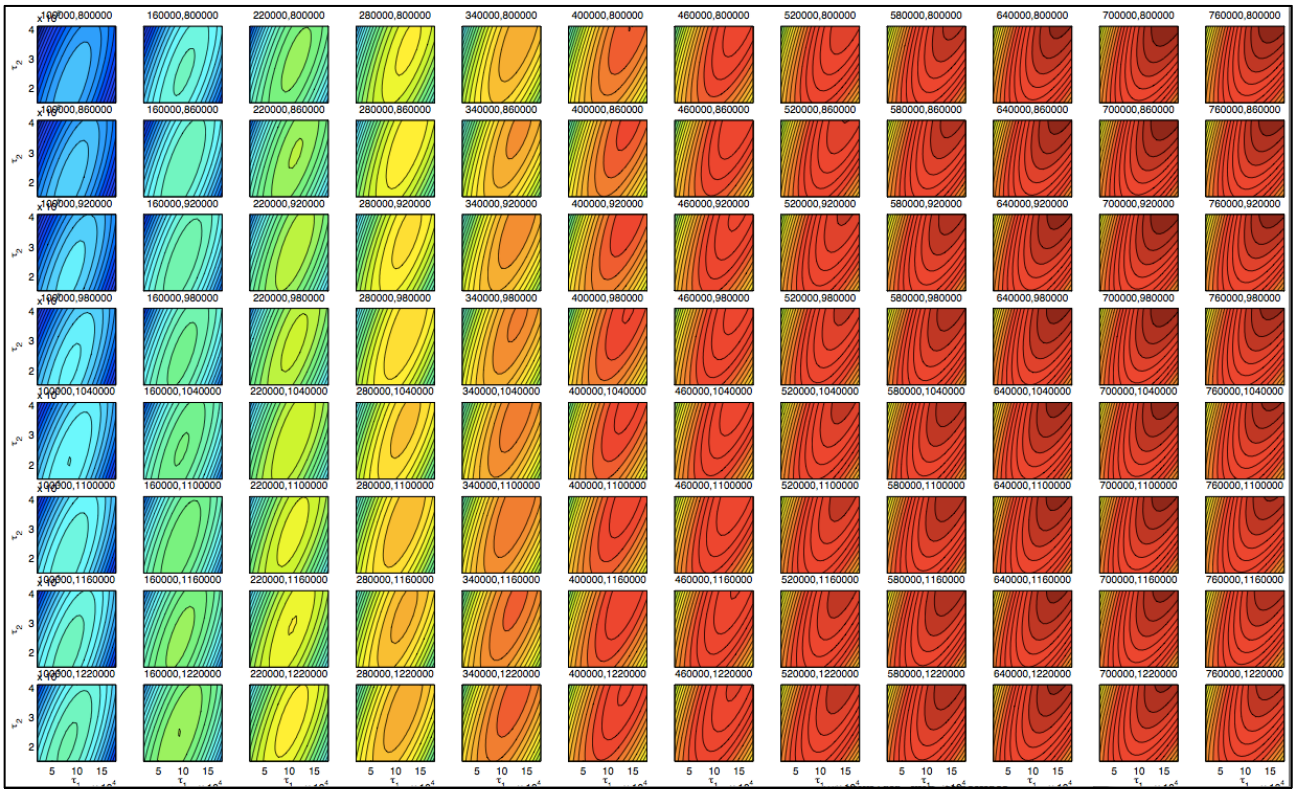

Fig1: Gaussian Process Emulator for skill of SPPT forecasts with different values of (z1, z2, t1, t2). Moving left to right the sub figures have increasing values of z1. Moving top to bottom the subfigures have increasing values of z2. Each subfigure has x-axis corresponding to increasing t1, and y-axis corresponding to increasing t2. Red colours correspond to high skill, while blue corresponds to low skill

Summary of plans for the continuation of the project

Once the SCM is available, a similar technique will be followed as used in Shutts and Palmer (2007). Since the aim is to constrain SPPT for use operationally in the IFS, the high resolution data will be coarse grained to the current resolution of the IFS ensemble prediction system (EPS) – T639 or approximately 30km. We will use the high resolution CASCADE dataset as the ‘truth’ data. We will use the data to measure the spatial and temporal correlations of the noise term in SPPT and the degree to which the error between different parametrisation schemes is correlated. Having measured the characteristics of the error term, this information will be incorporated into the EPS system, and the resultant forecasts tested against the operational system.