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	2020……………………………………………………….……
Project Title:	Sensitivity of diabatically enhanced outflow on error representation in ensemble prediction……………………
Computer Project Account:	spdepick……………………………………………………….……
Principal Investigator(s):	Moritz Pickl………………………………………………
	Christian M. Grams…………………………………….
Affiliation:	Karlsruhe Institute of Technology (KIT)…………………
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Simon Lang...……………………………………….…….
Start date of the project:	01.01.2020………..…………………………………….……
Expected end date:	31.12.2022.…….………………………………………….……

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)	NA	NA	700.000	11.047
Data storage capacity	(Gbytes)	NA	NA	15.000	0

Summary of project objectives (10 lines max)

The project aims to investigate model error growth related to warm conveyor belt (WCB) activity in the ECMWF ensemble prediction system, with a focus on sensitivities on model uncertainty representations. By running ensemble simulations with activated/deactivated initial condition perturbations and stochastic physics perturbations, we will investigate how these uncertainty representations affect Lagrangian characteristics of warm conveyor belts.

Summary of problems encountered (10 lines max)

So far, no problems have emerged in the project.

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

Since the start of the project, the technical framework for the trajectory calculation within the IFS-suite has been implemented. A set of numerical experiments with the quasi-operational WCB-calculation has been started recently, which will be postprocessed and analyzed in the next months. A focus will be on global as well asregional statistics of WCB-characteristics in the different experimental setups.

List of publications/reports from the project with complete references

No results have been published within this project so far.

Summary of results

1) Implementation of trajectory tool into IFS-suite

So far, we have implemented a tool into the IFS-suite to quasi-operationally compute warm conveyor belt trajectories bases on the Lagrangian Analysis Tool (Lagranto; Sprengler and Wernli, 2015) in ensemble experiments. The implementation enables an efficient, semi-parallel computation of forward trajectories as well as a flexible selection of parameters to set up the calculations, such as where to start the trajectories, ascent criteria for WCB-identification, or time increments. The workflow consists of 4 steps: data retrieval, data pre-processing, trajectory calculation, and a conversion of trajectories to an Eulerian grid. A showcase for this workflow is depicted in Fig. 1, for an ensemble forecast with 21 ensemble members and a parallelization factor of 4.

2) Choice of model setup and parameters for trajectory calculation

As a first step, different setups of the WCB-calculation have been tested to identify the optimal settings to obtain a suitable dataset. The following parameters have been tested: native model resolution (TCO639 and TCO399), grid spacing of model output data for trajectory calculation (0.25°, 0.5° and 1.0°), and time increment for trajectory calculation (1h, 3h, 6h). Fig. 2 shows the sensitivities of the relative frequencies of outflow height (a) and the ascent rate (b) of all WCB-trajectories in the ensemble on selected configurations for one case study (forecast initial time: 20160307 00UTC; 51 ensemble members; leadtimes up to 168 hours). The best results are obtained with the high-resolution model run and 1-hourly and 0.25°-output data; However, decreasing the model resolution from TCO639 to TCO399 has a smaller impact than decreasing the temporal resolution from 1-hourly to 3- or even 6-hourly. Therefore, and because the model resolution is the most crucial in terms of computational costs, it seems reasonable to perform the analysis based on TCO399-simulations, but with temporally and spatially highly-resolved trajectory calculations.

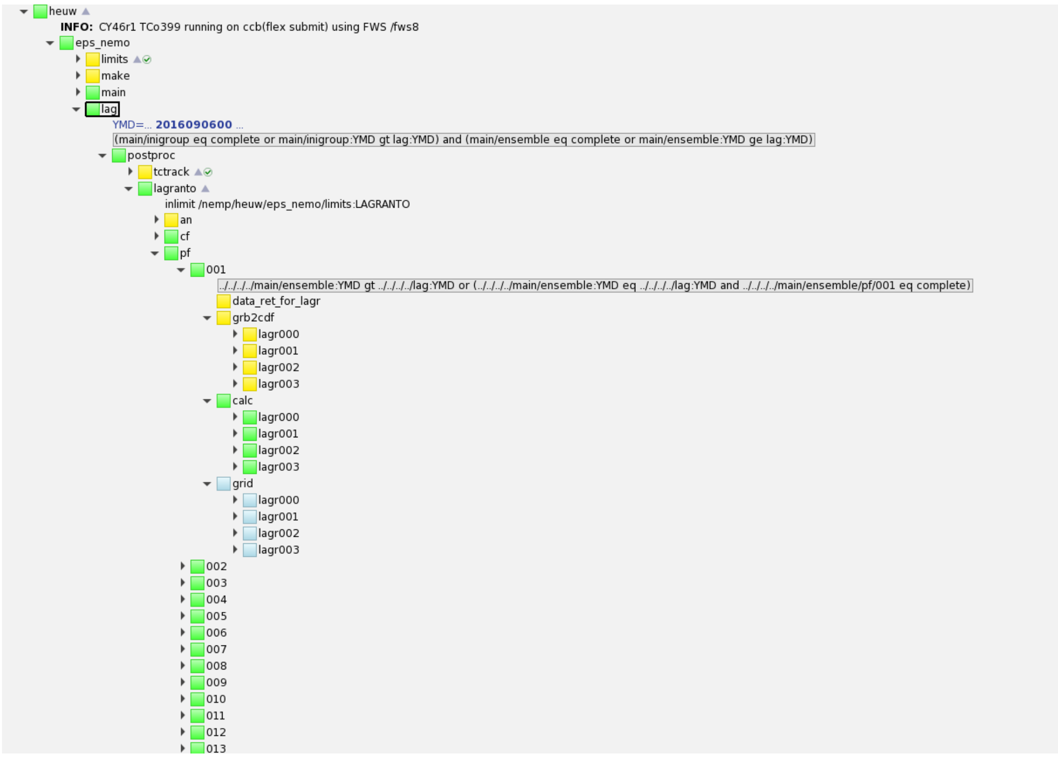

Fig. 1: Screenshot from ECFLOW illustrating the workflow of WCB calculation as implemented into the IFS-Suite. WCB-trajectories are computed independently for every ensemble member, with each task (data retrieval, data preprocessing, trajectory calculation and gridding) splitted into four parallel sub-tasks. Yellow colors denote that the task is finished, green means currently running, and blue waiting for the previous job to be finished.

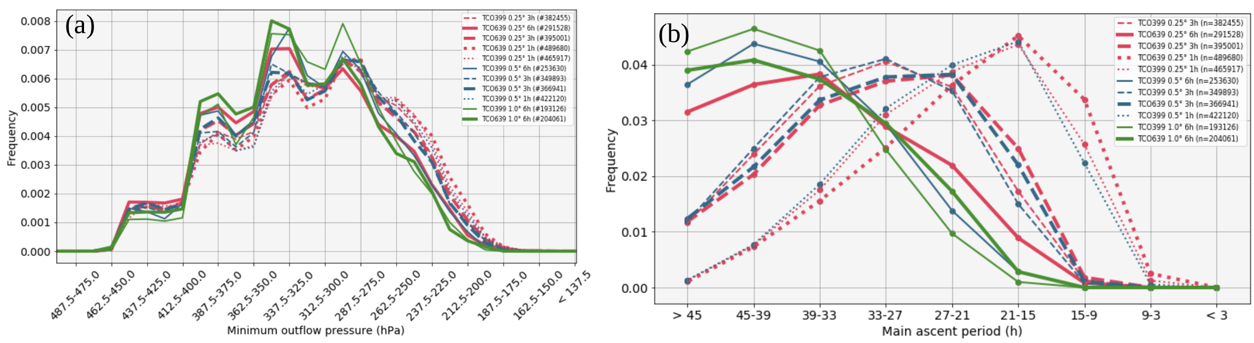

Fig. 2: Relative frequencies of outflow pressure (a) and ascent rate (b) of all Warm Conveyor Belt trajectories in the ensemble forecast (51 members, leadtimes up to 168 hours) over the North Atlantic for different model and lagranto-setups. The linewidth denotes the native model resolution (thin: TCO399, thick: TCO639); the line color shows the grid resolution of the model output (green: 1.0°, blue: 0.5°, red: 0.25°); the line style indicates the time increment for the trajectory calculations (solid: 6h, dashed: 3h, dotted: 1h).

3) Preliminary results from a case study

Preliminary analyses of simulations with an operational setup (**CTRL**), with deactivated stochastic physics (**no-SPPT**) and deactivated initial condition perturbations (**no-INI**) have been performed for single case studies. We thereby computed four different diagnostics on the WCB-trajectories: trajectory count, latent heating rate, outflow height, and ascent rate. Compared to CTRL, no-SPPT has overall less trajectories fulfilling the ascent criterion of 600 hPa in 2 days, and WCBs have lower heating and ascent rates as well as lower outflow heights. This points towards a sensitivity of WCBs on the SPPT-scheme. However, it is so far unclear if this is a systematic response, or if this behaviour only occurred in this case study.