# 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** | 2022 |
| **Project Title:** | Sensitivity of diabatically enhanced outflow on error representation in ensemble prediction |
| **Computer Project Account:** | spdepick |
| **Principal Investigator(s):** | Moritz Pickl<br>Christian M. Grams |
| **Affiliation:** | Karlsruhe Institute of Technology (KIT) |
| **Name of ECMWF scientist(s) collaborating to the project** (if applicable) | Simon T.K. Lang<br>Sarah-Jane Lock<br>Martin Leutbecher |
| **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) | 650.000 | 0 | 650.000 | 0 |
| **Data storage capacity** | (Gbytes) | 31.000 | 0 | 46.500 | 0 |

## Summary of project objectives (10 lines max)

The project aims to investigate the effect of ensemble configuration (i.e. model perturbations and initial condition perturbations) on diabatically driven, rapidly ascending air streams, such as warm conveyor belts in the extratropics and tropical convection. This is done by running sensitivity experiments with different model uncertainty schemes (e.g. SPPT, SPP,STOCHDP). Rapidly ascending air streams are detected in a Lagrangian framework using trajectory analysis.

## Summary of problems encountered (10 lines max)

No problems have emerged in this project.

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

All main research objectives have been completed and no continuation of the project is foreseen.

## List of publications/reports from the project with complete references

Pickl, M., S. T. Lang, M. Leutbecher, and C. M. Grams, 2022: The effect of stochastically perturbed parametrisation tendencies (SPPT) on rapidly ascending air streams. Quarterly Journal of the Royal Meteorological Society, 148 (744), 1242–1261, https://doi.org/10.1002/qj.4257.

## Summary of results

The analyses that have been done in the previous years have been expanded to additional schemes that represent model uncertainty. In particular, the sensitivities of rapidly ascending air streams have been tested for the stochastically perturbed parametrizations (SPP) scheme (described in Lang et al., 2022) and for the stochastically perturbed semi-Lagrangian departure points (STOCHDP) scheme (described in Leutbecher et al., 2017).

Regarding the SPP-scheme, similar results as for SPPT are found: SPP systematically increases the occurrence frequency of diabatically driven, rapidly ascending air streams. Compared to SPPT, this is effect is more pronounced in the tropical regions and less pronounced in the mid-latitudes. In contrast, the STOCHDP does not result in a comparable effect (see Figure 1).

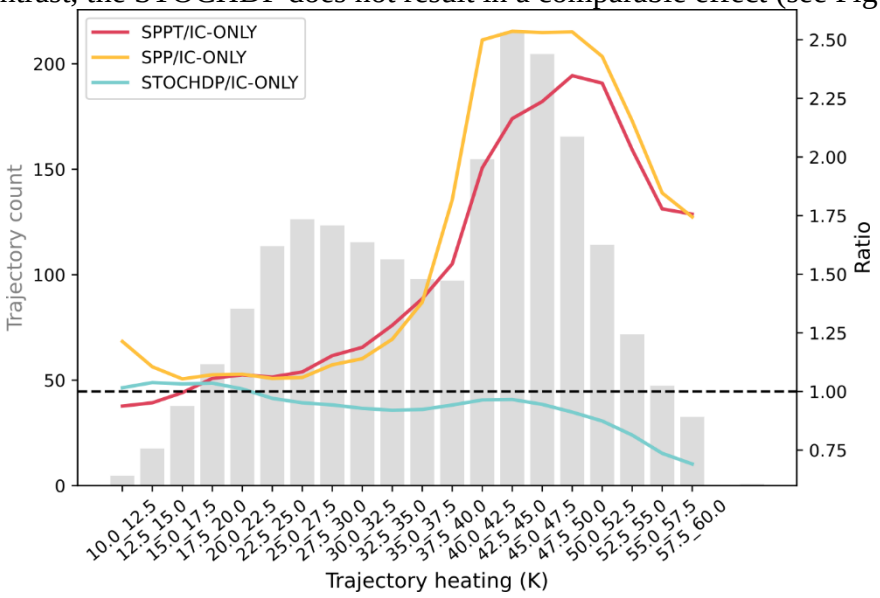


Figure 1: The histogram displays the frequency distribution of the trajectory count in discrete bins of trajectory latent heating (i.e. difference of maximum and minimum potential temperature along the trajectories) in the experiment SPPT. The colored lines show the ratio of the number of trajectories in the experiment SPPT (red), SPP (yellow) and STOCHDP (blue) against the experiment with an unperturbed model (IC-ONLY).