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: …The dynamics of the stratosphere in the OpenIFS climate model……..……

Computer Project Account: …SPITSERV……..……

Principal Investigator(s): …Federico Serva……..……

…Chiara Cagnazzo……..……

Affiliation: …CNR-ISMAR……..……

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

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Start date of the project: …January 2019……..……

Expected end date: …December 2021……..……

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)	50 000	50 000	3 000 000	2 000
Data storage capacity	(Gbytes)	6 000	0	21 000	0

Summary of project objectives (10 lines max)

…The aim of this Special Project is to study the sensitivity of the simulated climate of the OpenIFS model to different configurations and physical parameterizations. This will be done by performing multi-decadal, free-running experiments with the latest version of the model, and comparing with reanalysis or observational data.

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Summary of problems encountered (10 lines max)

…As of June 2020, the version of the OpenIFS model planned for use in the Project (43r3) is yet to be released. Given the significant changes introduced in this new version, it is therefore necessary to further postpone to execution of the simulations after the date of release. To ensure optimal use of allocated resources, the original allocation (6 M SBU) has been halved for 2020. Further changes could be possible and will be communicated in due course to the Special Projects desk.

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

…The free-running climate integrations will be started after the model release, having implemented the necessary changes to the source code, needed to have in output additional parameters from physical parameterizations.

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List of publications/reports from the project with complete references

…No new publications from the project available since the last progress report.

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Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

…As stated, it has not been possible to start the planned set of model simulations due to the release v43r3 of the OpenIFS model. As in the first year of the project, a reduction in the allocated resources has been agreed with ECMWF, in order to make an efficient use of them. In the

meantime, a small amount of the computing resources has been used in order to refine the model diagnostics in the EC-EARTH 3 model (using IFS 36r4), which is participating in the new CMIP6 project.

As an example, in Fig. 1 we report zonal mean plots for zonal wind and temperature, focusing for the latter in the tropical upper troposphere-lower stratosphere region.
Colors in Fig. 1a represents the drag exerted from parameterized nonorographic gravity waves, which will be a major interest in the Special Project. It is clear how they act to slow down the zonal wind, even if the resulting dynamics can be complex due to compensation between resolved and parameterized processes.

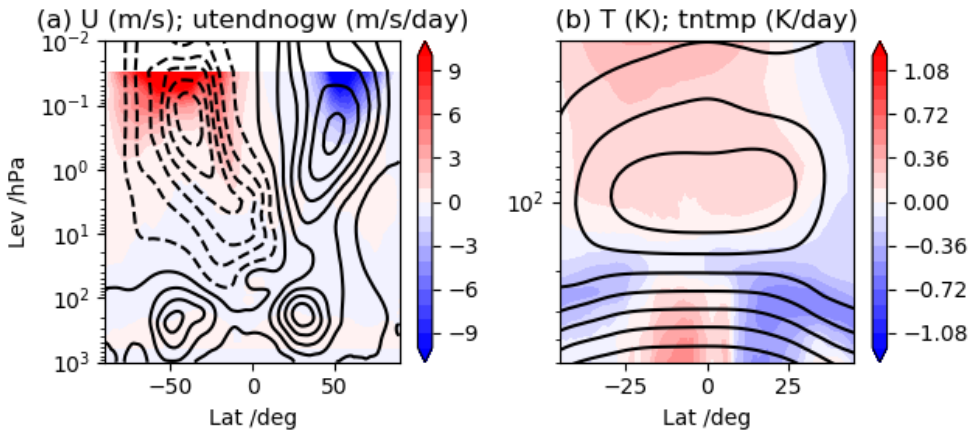

Figure 1: the zonal mean zonal wind (a), contoured every 10 m/s and temperature (b), contoured every 10 K. Parameterized physical tendencies, from gravity waves (a) and model physics (b), are shaded. Results are a monthly mean for January simulation.

In Fig. 2b, the vertical motions in the tropics can be seen, with regions of diabatic heating occurring where there is climatological ascent. The outputs for drafting these plots have been prepared following the protocol (Gerber and Manzini, 2016) for the CMIP6 initiative, in order to ease comparison with other high-top model results. The EC-EARTH model used for the simulations has 91 vertical levels and a series of changes compared to the standard IFS version (as it is needed to perform long integrations).

A set of sensitivity experiments with OpenIFS is planned, in order to characterize the model sensitivity to parameterized physics and horizontal and vertical configurations.

References

Gerber, E. P. and Manzini, E.: The Dynamics and Variability Model Intercomparison Project (DynVarMIP) for CMIP6: assessing the stratosphere–troposphere system, Geosci. Model Dev., 9, 3413–3425, https://doi.org/10.5194/gmd-9-3413-2016, 2016.

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