

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: ...Investigating the stratospheric dynamics of high-top climate model configurations.....
.....

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

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

Affiliation: ...Consiglio Nazionale delle Ricerche, Italy.....

Name of ECMWF scientist(s) collaborating to the project (if applicable)
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Start date of the project: ...January 2022.....

Expected end date: ...December 2024.....

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) | 7 500 000 | 7 500 000 | 8 000 000 | 0 |
| Data storage capacity | (Gbytes) | 10 000 | 7 000 | 10 000 | 0 |

Summary of project objectives (10 lines max)

...In this project the effects of the representation of stratospheric processes are investigated with the EC-Earth3 model, developed for CMIP6 and used to perform sensitivity experiments by altering model fields with observations or alternative reference states.

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Summary of problems encountered (10 lines max)

...None to report

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

...Further simulations will be carried out by testing alternative nudging/initialization strategies, also considering shorter experiments (~ 10 years long) but with a larger number of realizations to better address sampling uncertainty.

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List of publications/reports from the project with complete references

...Serva et al., Changes in Stratospheric Dynamics Simulated by the EC-Earth Model From CMIP5 to CMIP6, JAMES, 2024.

Additional publications based on the set of coordinated simulations described below are currently in preparation.

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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.

...During the course of 2023, a set of multidecadal simulations were carried out following the protocol proposed for phase 2 of QBOi experiments (details to appear in https://gmd.copernicus.org/articles/special_issue760_1297.html, see Fig. 1 for an illustration of participating models). In short, experiments are meant to investigate the effects of nudging the stratospheric winds in the tropics (the quasi biennial oscillation, QBO) to specified conditions, namely an ‘observed’ run where the ERA5 reanalysis is used to correct modelled zonal wind a ‘no-QBO’ run where any interannual variability is artificially suppressed. A free-running simulation serves as control experiment.

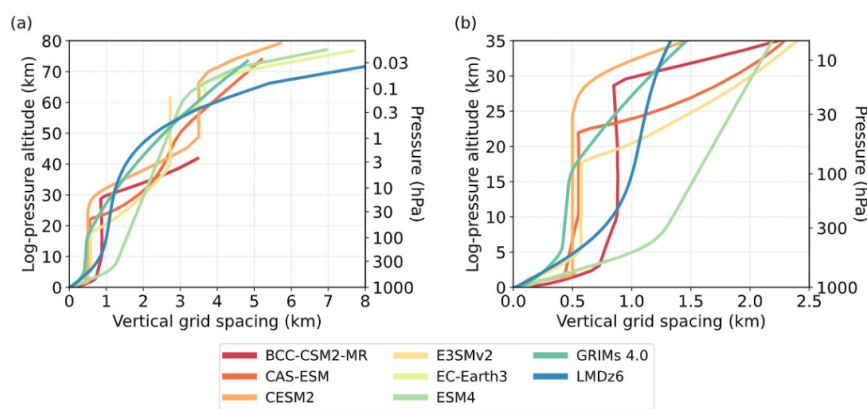


Fig 1: The vertical grid spacing of the models submitting data to the QBOi Phase 2 archive. Reproduced from the QBOi Phase 2 protocol description paper (Anstey et al., in preparation).

The EC-Earth model version used in this project only supports full-field nudging, meaning that winds are nudged towards observations at every grid-point. Notably, this is done with vorticity/divergence, such that both meridional and zonal components are changed. As shown in Fig. 2, results for the model are in agreement with other participating models. An analysis of the results in a multi-model setup is currently ongoing, and research papers are tentatively schedule for submission by the end of 2024. As explained above, some additional nudging experiments, following other strategies (e.g., upper-stratosphere only) will be performed within this project.

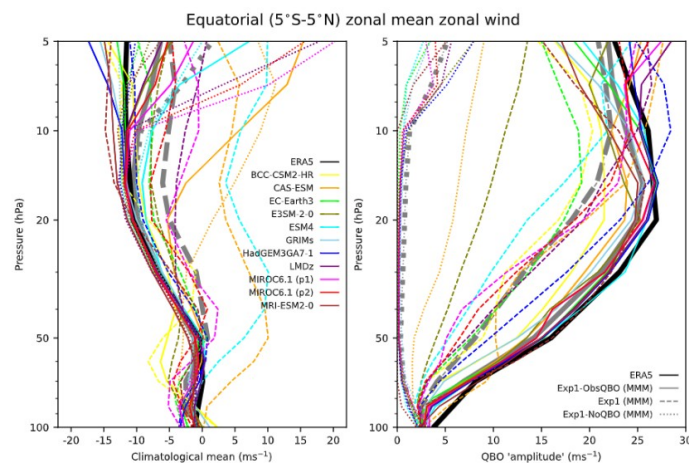


Fig.2: climatologies of zonal mean zonal wind for the ‘observed’ and ‘no-QBO’ experiments. Reproduced from the QBOi Phase 2 protocol description paper (Anstey et al., in preparation)