

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 2025.....
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Project Title: EC-EARTH-V3 HYWAY - spnlwill
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Computer Project Account: nl4.....
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Principal Investigator(s): Dr J. E. Williams
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Affiliation: KNMI
Name of ECMWF scientist(s) collaborating to the project Jason Williams
(if applicable) Philippe Le Sager
Start date of the project: 2025
Expected end date: 2028

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)	None	None	6000000	3600000
Data storage capacity	(Gbytes)	None	None	3000	1000

Summary of project objectives (10 lines max)

To update the ECEarthV3 coupled Earth-System model with updated chemistry, reaction rate data and the introduction of molecular H₂ as a transported tracer for the purpose of investigating the impact of the transition towards the H₂ economy on air quality and climate. By conducting decadal simulations the model will be evaluated both with and without direct H₂ emissions and deposition terms in the first year of the project. Results will then become part of an ensemble study with the aim of investigating the largest uncertainties in the global H₂ budget.

Summary of problems encountered (10 lines max)

The hdf4 library on Atos did not allow the output from the TM5 model meaning that extensive updates were made to the writing routines such that output is now done as netCDF which took a few months to change and debug the code using the existing approaches implemented for previous projects. This has introduced delays in the simulations due to no budget and monthly mean output data being available for analysis. New emissions were introduced for Biomass Burning and Soil NO_x and tested. Direct emissions of H₂ have been provided and introduced into the model to allow for the future simulations using different scenarios. Due to the coupling involved with ECEv3 simulations being relatively expensive means that 60% of this years allocated resources have been used during the debugging phase. This means that usable results are quite low and the remaining project CPU budget used for production runs.

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

We will conduct a second decadal simulation where emission estimates derived in the project will be applied in ECEarthv3 for the derivation of the H₂ budget. In addition numerous experiments for chosen time slices will be performed in order to investigate the impact on the hydrogen economy on future air quality and climate. Comparisons will be made against selected measurement data at global scale. Results will be included in a multi-model ensemble for the purpose of deriving global budget terms for H₂ during both present day and future timeslices.

List of publications/reports from the project with complete references

None to date

Summary of results

In the first half year of this project (where ECMWF resources were provided from Jan 2025) we have performed multiple test simulations for 2009 using updated code, which has consumed 60% of the allocated resources. An investigation of the ability of the TM5 model to attain a realistic distribution of H₂ throughout the atmosphere from a cold-start was performed, and that the updates to the chemistry scheme and application of new emission estimates did not produce any spurious artifacts in the simulations. The changes made to the output routines were used to assess the performance of the model. The first decade of simulations are currently ongoing and will be analysed once completed, then submitted to the consortium such that comparisons against other models can be made.