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
Project Title:	Implementation of a new method for eddy diffusivity parameterizations in WRF-Chem model
Computer Project Account:	spcrgas2
Principal Investigator(s):	Goran Gašparac
Affiliation:	Croatia Control Ltd.
Name of ECMWF scientist(s) collaborating to the project (if applicable)	-
Start date of the project:	1.1.2024.
Expected end date:	31.12.2026.

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)	20 000 000	-	20 000 000	-
Data storage capacity	(Gbytes)	3000	-	5000	-

Summary of project objectives (10 lines max)

Implement new proposed scheme in the WRF-Chem model, perform sensitivity analysis and finally test new scheme against different chemical parametrizations. Preliminary results with only WRF model showed increase of modelling performance for wind speed in the lower boundary layer. The main objective is to see how and to which extent is this reflected to the surface concentrations of NOx, SOx, PM, etc.

Summary of problems encountered (10 lines max)

During the second year of the project, work on the implementation of the new scheme continued, but significant technical challenges persisted. The scheme, although successfully compiled in the standalone WRF version, still requires substantial code adaptation and validation within the coupled WRF-Chem system. The main difficulty remains in integrating the modified turbulent mixing parameterizations consistently across various chemical modules and vertical mixing routines. Additional complications stem from the tight interdependence of physics and chemistry modules, where minor changes often lead to runtime or instability issues. Debugging the modified version is time-consuming due to long compile and run times. Due to these persistent technical barriers and limited time resources, model simulations with the modified scheme have not yet been initiated on HPC.

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

In the following period, the focus will be on finalizing the implementation of the new eddy diffusivity scheme within the WRF-Chem framework. Once the code is stabilized, a series of sensitivity simulations will be performed to compare the default and modified YSU schemes. The simulations will be validated against available observational datasets, including mast-mounted, surface, and airborne measurements.

List of publications/reports from the project with complete references

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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.

Although no full model simulations were completed during the reporting period, significant progress has been made in adapting and verifying the new eddy diffusivity parameterization within the WRF-Chem framework. The focus was on code-level development and step-by-step implementation testing. Several partial test cases were run on a local machine to verify the stability of the modified vertical diffusion scheme and its interaction with chemical parameters. The implementation is ongoing, and final validation runs with full chemistry are expected to start in the following months, depending on system stability. Measurement datasets and input files are fully prepared for current second year of the project.