

REQUEST FOR A SPECIAL PROJECT 2021–2023

MEMBER STATE: JRC

Principal Investigator¹: Dr. Ernest Koffi (EC-JRC)

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Project Title: Extend and improve CH₄ flux inversions at global and European scale

If this is a continuation of an existing project, please state the computer project account assigned previously.	SP spjrc4dv	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2021	
Would you accept support for 1 year only, if necessary?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>

Computer resources required for 2021-2023: (To make changes to an existing project please submit an amended version of the original form.)	2021	2022	2023
High Performance Computing Facility (SBU)	150000		
Accumulated data storage (total archive volume) ² (GB)	1500		

Continue overleaf

¹ The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.

² These figures refer to data archived in ECFS and MARS. If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.

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Extended abstract

The completed form should be submitted/uploaded at <https://www.ecmwf.int/en/research/special-projects/special-project-application/special-project-request-submission>.

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Following submission by the relevant Member State the Special Project requests will be published on the ECMWF website and evaluated by ECMWF as well as the Scientific Advisory Committee. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages). Large requests asking for 10,000,000 SBUs or more might receive a detailed review by members of the Scientific Advisory Committee.

Project description

EC-JRC performs detailed inverse modelling studies of atmospheric CH₄ at global and European scale, using the TM5-4DVAR inverse modelling system and - for high resolution inversions - the recently developed coupled FLEXPART-COSMO / TM5 4DVAR inverse modelling system ("FLEXVAR"). This special project (SP) largely builds on the previous SP "Improve European and global CH₄ and N₂O flux inversions (2018-2020)" and aims at further extending and improving the global and European CH₄ flux inversions.

Extend and improve estimates of global CH₄ emissions

The global CH₄ flux inversions (as provided by JRC in MACC-III [Bergamaschi et al., 2013] and ESA GHG cci projects) will be further improved (using updated satellite retrievals from GOSAT [Parker et al., 2020]) and extended in time coverage. These global flux inversions will also serve as benchmark for the evaluation of the CAMS CH₄ inversion / assimilation products in the framework of the support of JRC of the Copernicus services (administrative arrangement between JRC and DG GROW), updating and extending the previous evaluations [Koffi and Bergamaschi, 2018].

Further develop, test and apply coupled FLEXPART-COSMO / TM5 4DVAR inverse modelling system ("FLEXVAR") with high spatial resolution.

The recent development of the coupled FLEXPART-COSMO / TM5 4DVAR inverse modelling system ("FLEXVAR") is considered an important step to improve flux inversions at the European and regional scale, as it allows simulations / inversions at significantly higher spatial resolution (with FLEXPART currently driven by meteorological fields from the COSMO-7 model at horizontal resolution of ~7 km) as compared to TM5-4DVAR with European zoom (resolution of ~100 km). Therefore, FLEXVAR should better represent especially regional atmospheric monitoring stations, which are essential to improve regional emission estimates.

The objective of this special project (SP) is to continue / finalize the FLEXVAR model developments performed during the previous SP.

The specific objective for the further development of FLEXVAR include:

- development and test of different approaches to estimate / parameterize the model representation error (including e.g. modelled or observed meteorological data)
- development and test of different approaches to describe the boundary conditions (“baseline”) for the limited domain model FLEXPART
- development and test of conjugate gradient / Lanczos algorithm to estimate the posteriori uncertainties.

The FLEXVAR system will be thoroughly tested and various sensitivity inversions performed, analysing the sensitivity e.g. on specific model settings, observational data, and prior emission estimates. Furthermore, the FLEXVAR inversions will be compared with the FLEXPART Extended Kalman Filter system [Brunner et al., 2012] and regular TM5-4DVAR inversions [Bergamaschi et al., 2018].

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