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:
Inverse modelling as tool to support F-gases emission monitoring in Europe
……..……

……..……

Computer Project Account:
… spitgraz
……..……

Principal Investigator(s):
Francesco Graziosi……..……

……..……

Affiliation:
University of Urbino
……..……

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

……..……

Start date of the project:
01/01/2025……
……..……

Expected end date:
…31/12/2028……
……..……

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)	10000	--		
Data storage capacity	(Gbytes)	1500	--		

Summary of project objectives (10 lines max)

The project aims to estimate national emissions of fluorinated gases (F-gases) like hydrofluorocarbons and sulphur hexafluoride, which are potent greenhouse gases. Using atmospheric observations and inverse modeling, the project provides "top-down" emission estimates by refining prior data from national inventories or independent datasets. Key inputs include high-frequency atmospheric observations, particularly from central Europe, and the FLEXPARTv10.4 transport model driven by ECWMF ERA5 data. The first year focuses on model setup and testing, while the following years extend the inversion process over 10 to 20 years, emphasizing perfluorocarbons and sulphur hexafluoride. This work aims to enhance the accuracy of national inventories and offer an independent quality assessment.

Summary of problems encountered (10 lines max)

No main problem encountered

……
……
……
……
……....

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

The continuation of the project involves expanding the collection of input data to enhance the accuracy and robustness of the model. This includes gathering additional high-frequency atmospheric observations and refining prior emission estimates. The project will also conduct more sensitivity tests to evaluate the impact of various model parameters, such as emission fields, wind field resolutions, and station geometries. These efforts aim to improve the model's performance and reliability in estimating F-gas emissions, ultimately leading to more precise assessments of national emissions inventories.

List of publications/reports from the project with complete references

……
……
……
……

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.

In the initial months of the project, we have made progress in establishing the groundwork for accurately estimating national F-gas emissions. A key achievement was setting up the model chain, compiling the transport model and inversion system integrated.

We extracted and processed both wind fields, the coarse and the high resolution meteo field data from ECMWF-ERA5 dataset, though an external cluster, essential for precise atmospheric transport modeling, which enhances the simulation of F-gas dispersion.
To do this I retrieved and processed first the coarse resolution at 1° x 1° latitude and longitude grid fields at 1 hour over the global domain. From these meteo filed I run the first stage of inversion, to be sure the model was set correctly. In the meantime, I downloaded and process also high-resolution wind field over Europe, at 0.25 x 0.25 latitude and longitude resolution and 1-hour spatial resolution. I downloaded 10 months of meteo field at coarse resolution and 6 months of high resolution meteo filed.
After that I collected the surface-based measurements of F-gas over European domain. I compared and analysed the observed timeseries to check the consistency of the scale of measurement and the agreement between the observations.
Successively I processed the concentration in accordance with the model time step
Part of the time were dedicated to retrieved and build the a prior emission field and collect the information regarding the possible source location.
Additionally, various a priori emission fields were gathered from national inventories and independent datasets, serving as initial estimates for the model to improve upon.

Preliminary sensitivity tests were conducted to determine the optimal release altitude for mountain station measurements, crucial for fine-tuning the model's accuracy. These foundational efforts have set a strong basis for the project's continuation, allowing us to expand data collection and perform more advanced modeling in the future. This progress paves the way for providing more reliable F-gas emission estimates, supporting informed environmental decision-making.