

# 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** .....2019.....

**Project Title:** .....  
 Top-down estimate of chlorofluorocarbon emissions in Europe using a mesoscale inverse modeling technique  
 .....

**Computer Project Account:** SPITGRAZ.....

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

**Affiliation:** Institute of Atmospheric Sciences and Climate - National Research Council (ISAC-CNR)

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

**Start date of the project:** 17/12/2018.....

**Expected end date:** 31/12/2020.....

**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
<b>High Performance Computing Facility</b>	(units)	1000	0	600000	0
<b>Data storage capacity</b>	(Gbytes)	5000	0	20000	0



**Summary of project objectives** (10 lines max)

The main goals are :

European emissions estimation of main Chlorofluorocarbons (CFCs), CFC-11, CFC-12.

Estimate the trend of emissions from 2000 to 2019, of different species (HFC-23, CCl4, CH3CCl3).

Allocate the source distribution over the European domain.

Increasing understating of type of sources, by product, banks o direct emissions.

Estimate the pro capita emissions of single countries.

**Summary of problems encountered** (10 lines max)

During the first six months, we had a problem in compiling both WRF-ARW and FLEXPART models.

Additional problems were related to the compilation of inversion system.

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

With the aim to increase the robustness of results, additional sensitivity tests are planned. Once we get a better setting, we may extend the model cascade run (dispersion and inversions) over all period available, and to the other species. Moreover, we may increase the understanding of emission trend estimate and type of emission sources allocated.

**List of publications/reports from the project with complete references**

No publications / reports but an oral presentation : “Estimating CFC-11 emissions over Western Europe from atmospheric observations” at CFC-11 Symposium 25-27 March 2019, Vienna, Austria

**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.

We use the in-situ high-frequency observations from four atmospheric monitoring stations, in conjunction with Lagrangian dispersion model and a Bayesian atmospheric inverse modelling system. We run FLEXPART model in backward simulations with four receptors over global domain for four European stations, from 2000 to 2018. During the first six months, we estimated the emissions of CFC-11 and CFC-12 for Western Europe (Ireland, UK, France, Germany, Belgium, Luxembourg, The Netherlands, Denmark, Italy, Switzerland, Austria, Spain and Portugal) using atmospheric inverse modelling. With the aim to evaluate the model performance, we run several sensitivity tests. Briefly, 1) we performed the inversion using two different kind of a priori fields, a uniform a prior and population distribution fields; 2) we test different stations geometry. The tests highlighted nice model stability, with less than 20% of emissions variability between different model settings.

Our preliminary inversion results show Western EU emissions of CFC-11 and CFC-12 declined from 2008 to 2018. The Central EU countries show significant emissions per head of population. All model processes have been performed in an external machine.

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