Data
Models
Inventories

PARIS

Process Attribution of Regional Emissions

GA 101081430, RIA

Inventory compiler meeting feedback report

Deliverable D2.2	
Delivery due date Annex I	Month 22 - November 2024
Actual date of submission	04/06/2025
Lead beneficiary: MO	Work package: 2 Nature: Report Dissemination level: PU
Responsible scientist	A.J. Manning, UKMO
Contributors	S. Henne, EMPA
Internal reviewers	S. Walter, UU
Version: 1	

Horizon Europe Cluster 5: Climate, energy and mobility
"This project has received funding from the European Union's Horizon Europe Research and Innovation programme under HORIZON-CL5-2022-D1-02 Grant Agreement No 101081430 - PARIS".

Table of content

1. Changes with respect to the DoA (Description of the Action)

2. Dissemination and uptake

3. Short Summary of results

4. Evidence of accomplishment

4.1 Introduction | Background of the deliverable

Each year Annex 1 Parties report their greenhouse gas emissions to the United Nations Framework Convention on Climate Change (UNFCCC) in the form of a National Inventory Report (NIR) or National Inventory Document (NID). The reported emissions are listed by gas and by source sector. These emissions (referred to as 'bottom-up') are collated using national data on emission activity and default or country-specific emission factors. The aim of PARIS is to provide an alternative, supportive estimate of national emission using measurements (referred to as 'top-down') of atmospheric gas concentrations. These measurements are converted into estimates of emissions using atmospheric transport models and inverse models.

A key aim of PARIS is to encourage national inventory compilers to utilize the top-down estimates to help them improve their reported estimates. In order for this to begin to happen, inventory teams need to understand the strengths and limitations of inverse modelling and so a second key aim of PARIS is to provide a forum for open discussion about the two approaches. Through these discussions and by comparing the two sets of results there is the potential to identify areas where further investigation may lead to an improvement in the inventory. This is the motivation of the annual meetings with the national inventory compilers in our 8 target countries across Europe.

4.2 Scope of the deliverable

Meetings with seven national inventory teams were conducted between autumn 2024 and spring 2025 (see Table). Each meeting was attended by at least one member of the PARIS inverse modelling teams along with the national lead from the PARIS project, and an inventory representative.

Country	PARIS presenter	Date	Location
UK	Alistair Manning	19th Nov 2024	Virtual
Switzerland	Stephan Henne	27th May 2024 19th Feb 2025	In-person Virtual
Netherlands	Alistair Manning	29th Oct 2024	Virtual
Germany	Stephan Henne	16th Sep 2024	In-person
Norway	Alistair Manning	12th Nov 2024	In-person
Italy	Alistair Manning	31st Oct 2024	In-person
Hungary	Stephan Henne	12th Dec 2024	Virtual
Ireland	Alistair Manning	03rd Jun 2025	Virtual

A summary of the discussion with the national inventory teams is provided along with an assessment of next steps and areas of special interest.

4.3 Content of the deliverable

The PARIS inventory meetings were largely framed around forming initial contacts and relationships between the inverse modellers and the national inventory teams. In most countries the inventory compilers were relatively new to atmosphere-based constraints on national emissions. In these cases, this initial discussion was centred around knowledge transfer and explaining the value of inversions and their potential uses, as well as their limitations and uncertainties. A focus was placed on the type of information (e.g., country totals vs. sector attribution, spatial attribution) that can be expected from the current observational network. This required tailored discussions for every country and gas.

General areas that caused confusion or required more explanation are first described. Several meetings began initially with scepticism that atmospheric measurements coupled with inversion models can estimate national emissions at all. This is partly because many measurement sites are located far away from emission sources and the concept that these emissions can be detected at these remote receptors required further explanation and demonstrable examples.

Notable examples that were shown included the UK revision of their mobile air-conditioning and refrigeration inventory model following discovery of a large discrepancy between the top-down and bottom-up estimates, and the localisation of a known UK point source even when this prior information was not provided to the inversions. The concept of atmospheric boundary conditions and the importance of properly quantifying the levels of gases in the incoming air to the country or region also required explanation. It was described that quantification of boundary conditions is helped by cooperation between neighbouring countries because wider measurement networks lead to better constraints for the whole

region and/or by the use of larger scale (global) model products (e.g., Copernicus inversion enhanced greenhouse gas concentrations).

Three of the seven target countries (UK, Switzerland, Germany) already have installed, or are installing, national capacities for top-down emission estimation. Because these countries already were familiar with many of the principles, discussions with these inventory teams focussed much more on the detailed results presented in the draft annex reports. Integration/comparison of PARIS results with the national projects will be required in future meetings to avoid any confusion with results from different top-down estimates. Wherever possible, synergies between PARIS and national projects will need to be exploited during the next phase of PARIS.

Certain aspects of inversions that can be helpful to inventory teams were highlighted. It was shown that by looking at suites of gases (for examples multiple HFCs) rather than at gases individually, information about emissions becomes even more meaningful. It was shown that with enough measurement information, not only can national totals be derived with inversions, but spatial maps can also be inferred. Examples of where spatial maps might be useful to national inventories were highlighted.

It was also important to hear from the inventory teams about what was important for them, how they derive their reported emissions, the sources of data they use and the unique information they have about their nation's emissions, both in terms of location and sector attribution. In particular, sectoral attribution of emissions, either directly derived in the inversion or indirectly interpreted from spatial distributions, would be very valuable for the inventory teams as these would allow the identifications of more specific source processes that may be in disagreement between the two approaches. In multiple countries, there was a desire to see emissions derived over wider areas, not just those in a single country, particularly for neighbouring countries with whom the inventory teams often have close collaboration.

Overall, these discussions were very valuable, laying the foundations for future conversations with the inventory teams. There was a strong willingness to interpret inversion results within the processes laid out in the inventory guidelines. Language is an important aspect to note – these meetings worked well only because, at each meeting, there was a PARIS member participating who could facilitate discussion in the native language of the inventory team. The meetings were thought to be more effective in an in-person setting.

4.3.1 Individual country meeting summaries:

United Kingdom

The interaction between the Department of Environment, Strategy and Net Zero (DESNZ), Ricardo (national inventory compiler) and the UK inverse verification team (UK Met Office and the University of Bristol) has been ongoing for more than 20 years. Inverse verification results are compared with the proposed inventory at two National Inventory Steering Committee (NISC) meetings each year. These meetings give all interested parties time to discuss the results and for the outcomes to feed into the ongoing UK inventory improvement plan. At the upcoming NISC meetings we will discuss the inclusion of the PARIS results for the UK NID submission in 2026.

Switzerland

The interaction between the Swiss inventory team, led by the Federal Office for the Environment (BAFU) and the inverse modelling group at Empa has been ongoing for more than one decade, leading to an established Annex of top-down results in the Swiss reporting to UNFCCC. Annual meetings between the teams happen independent of PARIS. During the May 2024 meeting, BAFU was informed by Empa about the kind of product PARIS will produce for other European countries and for Switzerland. National inverse modelling for Switzerland applies high spatial resolution for the Swiss/Alpine domain, that cannot be matched by the current inversions employed in PARIS. Hence, current PARIS results for Switzerland are not at a quality that they could readily be used in addition to the existing national top-down activity. With the envisaged increase in resolution for PARIS inversions this should improve in the 2025 interactions. Nevertheless, the suite of PARIS products were presented to the Swiss inventory team in Feb 2025 and it was agreed to work on further integration of national high-resolution work and PARIS European-scale efforts.

Netherlands

We presented the Dutch inverse estimates, compared to the 2024 inventory values, to several key people in the Dutch inventory team. Some members of the inventory team were very familiar with inverse modelling and asked probing questions about the details and assumptions of the inverse approach. They expressed specific interest in understanding Dutch emissions within the wider geographical area context, in particular Belgium and German emissions. One area of discussion focussed on the ability of the inverse models, and their limitations, in attributing emissions to neighbouring countries with common borders. The PARIS emission results, interpreted within the Dutch inventory team, were included in the 2025 Netherlands NID for the very first time, a significant success for the PARIS project.

Germany

The presentation of PARIS results to the German inventory team was organised as a joint meeting between members of the German ITMS (Integrated Greenhouse Gas Monitoring System) project, PARIS, and different members and partners of the inventory team (UBA, Thünen Institute). DWD leads ITMS and is partner in PARIS. Next to PARIS inverse estimates, those derived by the ITMS project were discussed. Synergies between ITMS and PARIS were analysed. The inventory team informed about bottom-up estimates and spatially resolved inventory developments.

Norway

We presented the limited Norwegian estimates of methane and explained that the pre-2024 coverage of the observational network prevents us from resolving the Norwegian emissions with sufficient skill. However, with the expanded network including Birkenes we hope that it will be possible in future years. We suggested that the inverse estimates will always find the Norway – Swedish border very difficult to correctly attribute emissions and that a combined product (Norway + Sweden + Denmark + Finland) would be a more robust result. This will be discussed with the other Nordic countries in their next joint meeting. The UK results were also described, showing how, with sufficient observations, the inventory can be helped to improve. This meeting was very much along the lines of setting the scene for future meetings and results.

Italy

We had a positive and open discussion about the pros and cons of inverse modelling and inventories, and the national inventory teams seemed open to using inversion-derived results to inform inventory improvement plans. The in-person meeting worked really well and was much better than a video call as having native speakers from PARIS was essential to the success of the meeting. The lack of sensitivity in the current observational network to the south of Italy was clearly communicated. Additionally, derived emissions for the south of Italy could be strongly influenced by uncertainty in the southern boundary conditions at present. It was communicated that the inclusion of data from the new Sicily site (from April 2024) should go a long way to help with this for some HFCs and some PFCs, and the inclusion of data from Lampedusa may also help for methane. It was communicated that deriving Italian N_2O and SF_6 emissions is not currently robust, as there are insufficient observations. The point sources identified for HFC-23 (NW Italy) and HFC-365mfc (port in NE Italy) were noted with interest. The inventory teams conveyed that the HFC-134a inventory values have been strongly revised over the last few years.

Hungary

For the 2024 interaction, PARIS results for Hungary were limited by the fact that only methane and nitrous oxide observations from a single site in Hungary were available for inverse modelling. Halocarbon flask sampling in Hungary commenced in 2024 as part of PARIS and for the 2025 interaction more robust results are expected. This limitation was clearly explained to the inventory team, and it was general consensus that inclusion of PARIS results into national reporting can only happen for the 2026 submission, when additional observational constraint becomes available.

Ireland

12 people from the Irish inventory team met with the PARIS consortium representatives in spring 2025. They were very complimentary of the work and were interested in developing a greater understanding of the benefits that top-down emission estimates offer. They were particularly interested in methane and nitrous oxide. They have growing numbers of cattle and expected to see a positive trend in methane, whereas the PARIS estimates are lower and rather flat compared to the inventory, although identifying such a small positive trend is not possible given the uncertainties in the top-down estimates. They are looking forward to seeing the impact of the new ICOS observations at Malin Head, Carnsore Point and Valencia Island. The spatial maps were of particular interest and comparisons with the Irish inventory maps for N_2O and CH_4 would be of great interest. There was interest in a further meeting in November 2025 where the latest annex would be presented. How the work would continue beyond the PARIS timeframe was also raised.

4.4 Conclusion and possible impact

Draft Annexes to the National Inventory Reports were used to guide discussions with the national inventory compilers of the focus countries of the project.

This document is used to capture the areas for which national inventory teams are interested to learn more about inversion-derived emissions, and to capture areas that require more attention in the inversions to be more useful to the national inventory teams.

The impact of this document is to enable continual improvement in both inversions and emission inventories and to foster a productive collaboration between inverse modellers and the national inventory teams.

Overall, the individual discussions with inventory compilers from the PARIS target countries, together with the delivery of draft annexes to each of the eight countries (D2.1, https://horizoneurope-paris.eu/wp-content/uploads/sites/914/2025/02/PARIS-D2.1-Draft-Annexes-to-National-Inventory-Reports-all-final.pdf), represent key milestones within the PARIS project. These activities lay the groundwork for continued engagement with inventory teams and mark significant progress toward integrating inversion results into national inventory compilation processes.

5. History of the document

Version	Author(s)	Date	Changes
0.1			
	A. Ganesan	08/01/2025	Extended draft
	A. Manning, S. Henne	10/01/2025	Add country specific discussion
	S. Henne	30/01/2025	Feedback
	A. Manning, S. Walter	04/06/2025	Finalising and upload