



**Barcelona  
Supercomputing  
Center**  
*Centro Nacional de Supercomputación*



WorldEmission

# ESA – World Emission

## Validation of national emissions against satellite-based estimates

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\* includes colleagues from GMV, LSCE, ULB, Kayrros, MPI, SP, CITEPA, Cyl

13/05/2026

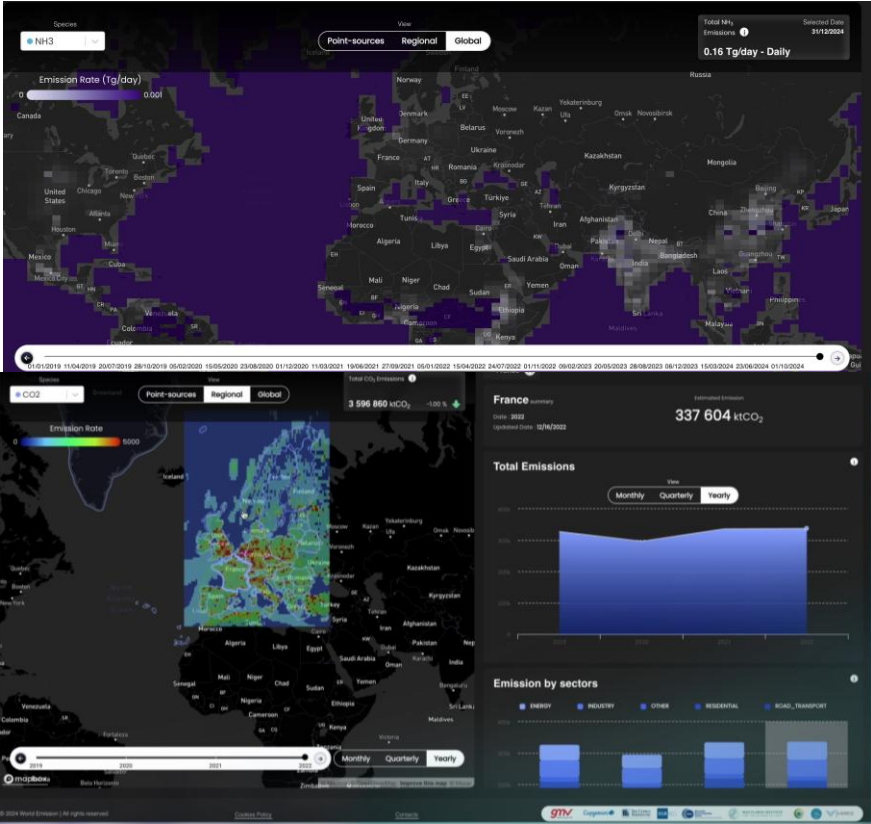
TFEIP 2026 Meeting (Copenhagen, 11-13 May 2026)

# Background and objectives

- World Emission is an applied research project **funded by the European Space Agency** running since **March 2022**. Current phase runs **until November 2026**.
- The project aims to provide an **enhanced global emission monitoring service** by developing top-down emissions estimates based on satellite data.
- These **satellite-based estimates are compared with bottom-up inventories** to define related product target requirements in close collaboration with end-user organisations.
- World Emission products are promoted among national inventory agencies to support the verification of **national emission inventories** (organization of online workshops every 6 months).

# World Emission products

Species/Levels	Point sources	Regional	Global
CO <sub>2</sub>		EU/China/EMME (gridded)	
CH <sub>4</sub>		Basins	
CO		EU/China/EMME (gridded)	
NH <sub>3</sub>		Hotspot areas	
NO <sub>x</sub>		EU/China/EMME/Shipping (gridded)	
SO <sub>2</sub>			
CH <sub>3</sub> OH			
C <sub>2</sub> H <sub>2</sub>			
C <sub>2</sub> H <sub>4</sub>			
C <sub>5</sub> H <sub>8</sub>			



Use of multiple satellite products:  
OCO-2, OCO-3, TROPOMI, GOSAT, IASI, MOPITT, CrIS

# World Emission Data Portal (demo)

WorldEmission

## World Emission Portal

Explore the evolution of emissions through different views to see the data from different angles. Observe, analyze & compare!

**Tutorial**

0:00 / 3:28

**Available tools \***

- Download**  
Click here to download time series, images & regional shapes  
CSV, JPEG, GeoTIFF, GeoJSON
- Documentation**  
Click here to access documentation for the selected specie
- Timeline**  
Navigate through the timeline to see emissions evolution for the specie you selected
- Additional Species**  
Click here to overlay additional species on the screen

Welcome to  
**WORLD EMISSION**

Select a Specie

<b>CO<sub>2</sub></b> Carbon Dioxide	<b>CH<sub>4</sub></b> Methane	<b>NH<sub>3</sub></b> Ammonia	<b>SO<sub>2</sub></b> Sulphur Dioxide	<b>NO<sub>x</sub></b> Nitrogen Oxides
<b>CO</b> Carbon Monoxide	<b>CH<sub>3</sub>OH</b> Methanol	<b>C<sub>2</sub>H<sub>2</sub></b> Acetylene	<b>C<sub>2</sub>H<sub>4</sub></b> Ethylene	<b>C<sub>3</sub>H<sub>6</sub></b> Isoprene

Confirm →

# World Emission users and engagement

## Objectives:

- To promote the World Emission products among NI agencies to support the comparison and/or verification of national emission inventories.
- Feedback collected to increase its usability, visualization, management, and access.
- World Emission hold three online workshops with a variety of participants (2022-2024).
- During Phase 3 of the project (since October 2024), the focused has been placed on the engagement with **European National Inventories** with an in-person/hybrid event in Paris in January 2025, follow up by 2 validation/feedback online workshops.



# Stakeholders Workshops

## World Emission Stakeholders and Relevant Organizations



## World Emission consortium



# National Inventories Conversations and Agreement Management, and Requirement Collection

## Follow-up meetings with National Inventory Agencies

**1st follow-up meeting** (May/**2025**) → Spain, France, Germany, Netherlands, Cyprus.

- Present **intercomparison results** between World Emission products and national emission estimates
- Collect requirements to improve usability, visualization, management and access to World Emission products

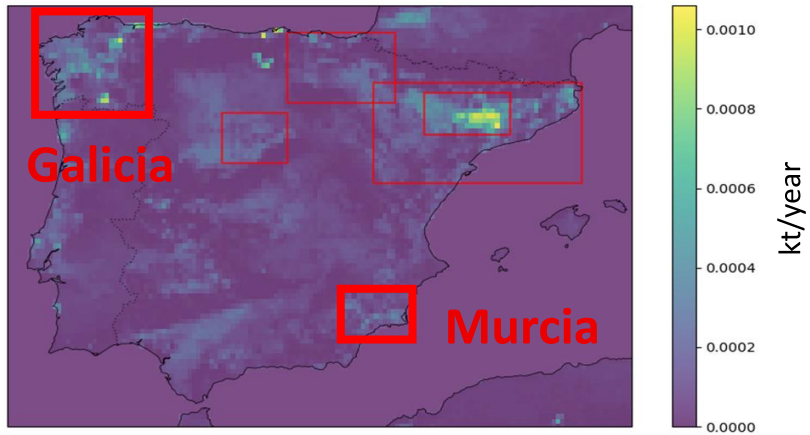
**2nd follow-up meeting** (Feb/**2026**) → Spain, France, Germany, Netherlands, Cyprus, Lombardia region (Italy)

- To present **updated intercomparison results** between World Emission products and national emission estimates (Total/Sectorial, focus on Regional (CO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub>))
- Provide **suggestions** to improve the new version of the data portal and access/usability of the products.

# Examples of intercomparison results: Spain

**Product:** NH<sub>3</sub> Regional Emissions **Topic:** Spatial mapping

NH<sub>3</sub> bottom-up emissions (EMEP - 2023)



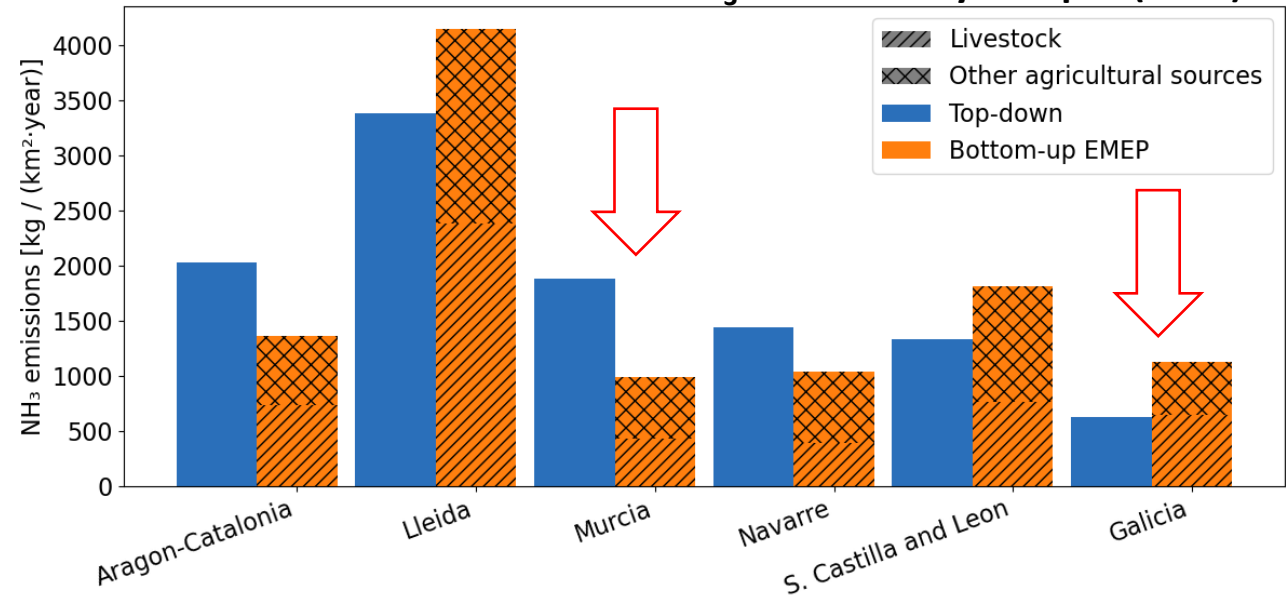
Regions with World Emission satellite-based estimates (NH<sub>3</sub> hotspots)

Mean annual temperature



(AEMET, 2026)

Satellite-based versus EMEP NH<sub>3</sub> emissions by hotspot (2023)



The agricultural EF considered in the EMEP/EEA guidelines (Tier 2) do not account for the **impact of temperature** on NH<sub>3</sub> emissions

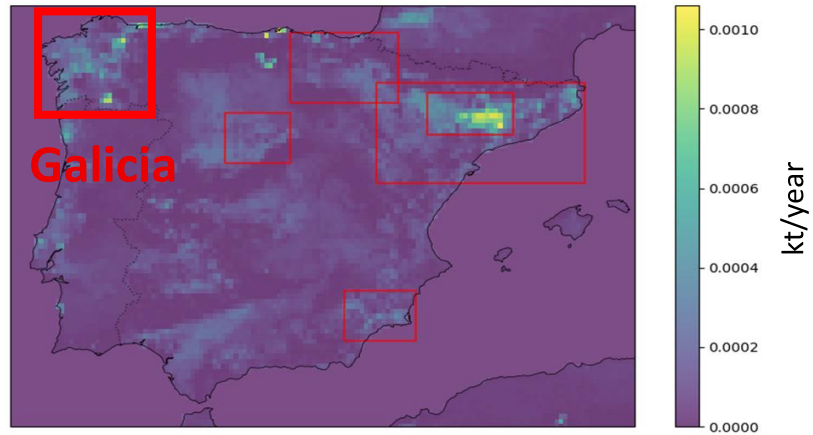
↑ temperature    ↑ NH<sub>3</sub> volatilisation    ↑ NH<sub>3</sub> emissions

Bottom-up NH<sub>3</sub> emissions: **potentially underestimated in Murcia, overestimated in Galicia**

# Examples of intercomparison results: Spain

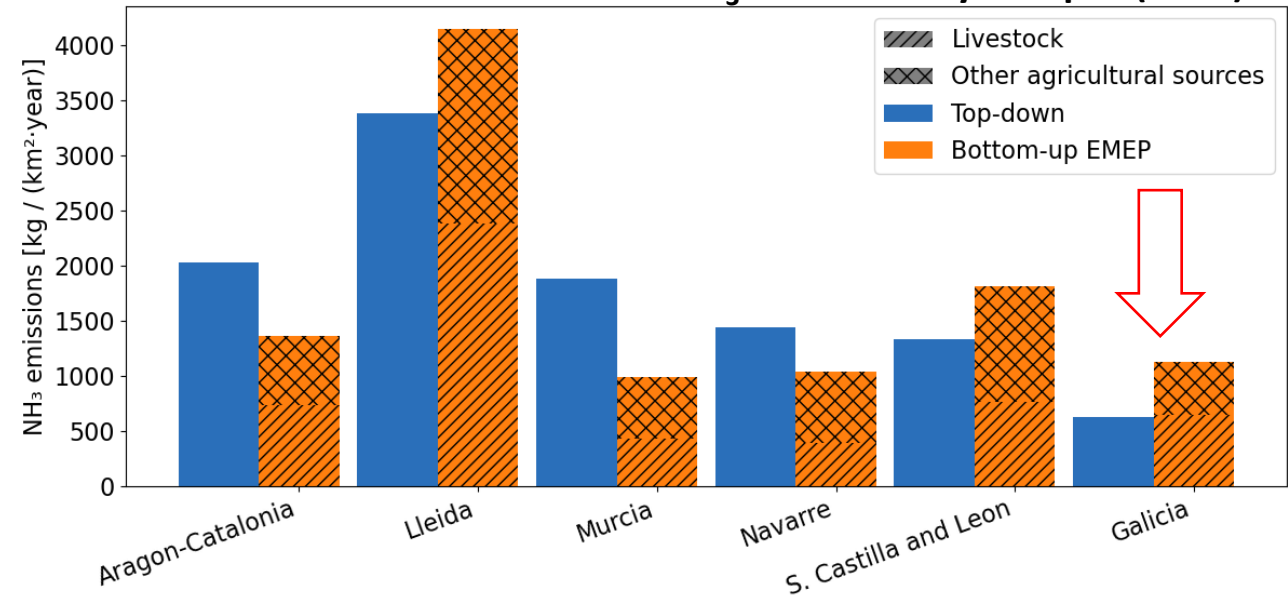
**Product:** NH<sub>3</sub> Regional Emissions **Topic:** Spatial mapping

NH<sub>3</sub> bottom-up emissions (EMEP - 2023)



Regions with World Emission satellite-based estimates (NH<sub>3</sub> hotspots)

Satellite-based versus EMEP NH<sub>3</sub> emissions by hotspot (2023)



No consideration of Best Available Techniques in cattle EF

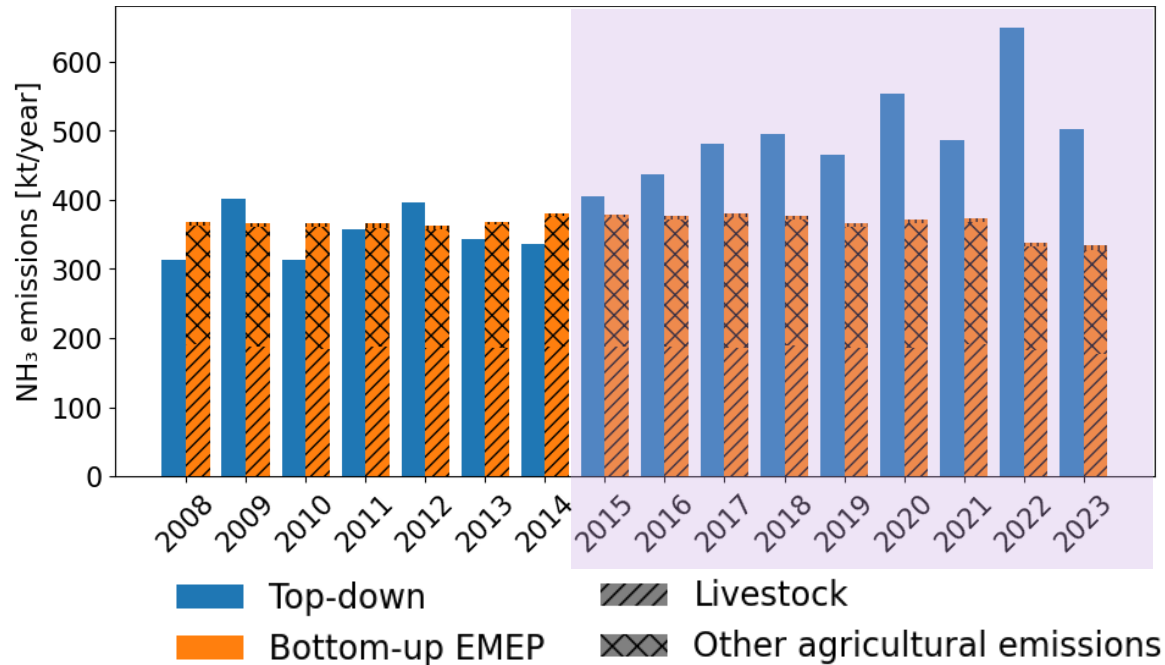
60% of NH<sub>3</sub> emissions in **Galicia** come from **cattle** farms

Bottom-up NH<sub>3</sub> emissions: **potentially overestimated in Galicia**

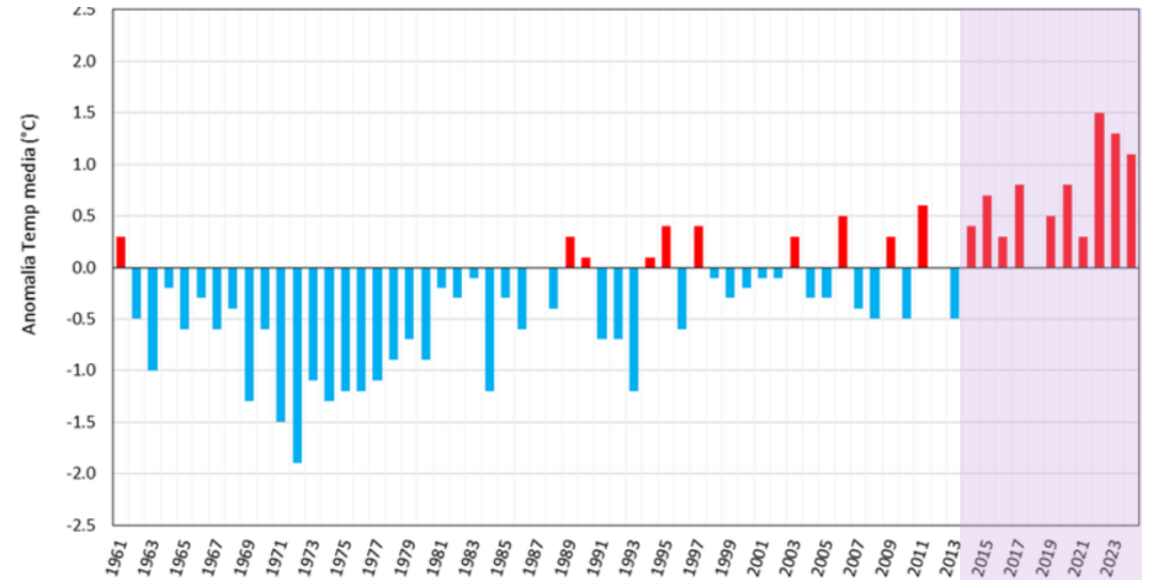
# Examples of intercomparison results: Spain

**Product:** NH<sub>3</sub> Regional Emissions **Topic:** Interannual trends

NH<sub>3</sub> emissions (2008-2023, SUM of all hotspots)



Annual temperature anomalies in Spain (ref period: 1990-2020)



(AEMET, 2025)

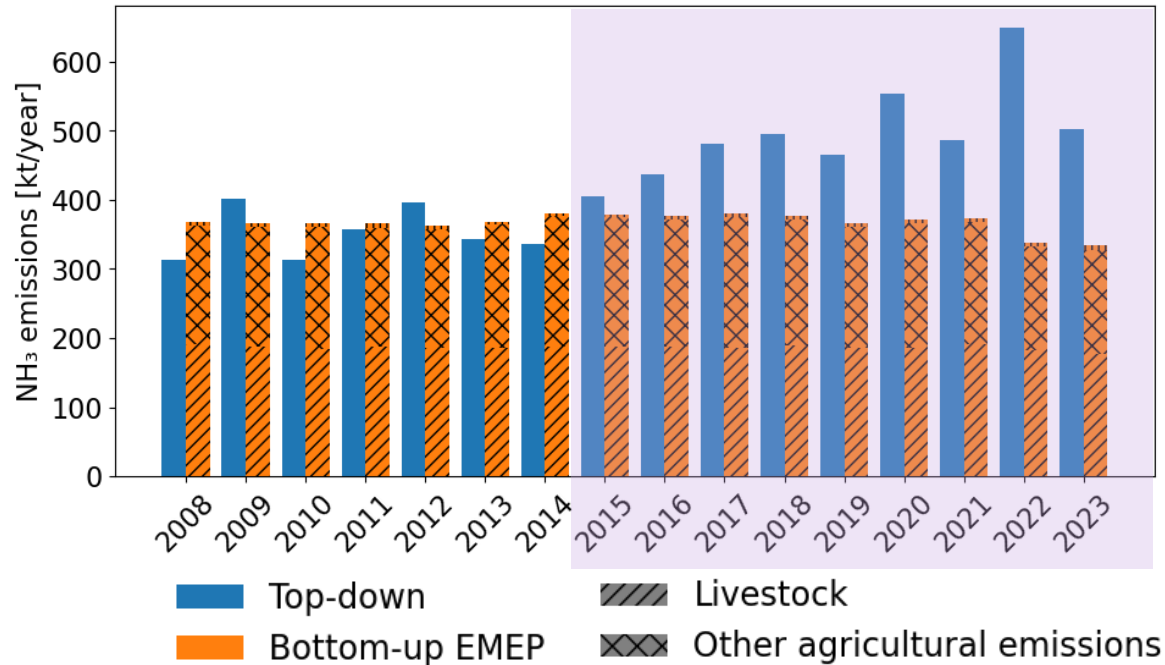
The agricultural EF considered in the EMEP/EEA guidelines (Tier 2) do not account for the impact of temperature on NH<sub>3</sub> emissions

Potential NH<sub>3</sub> emissions increase linked to climate warming not reflected in official EMEP inventory

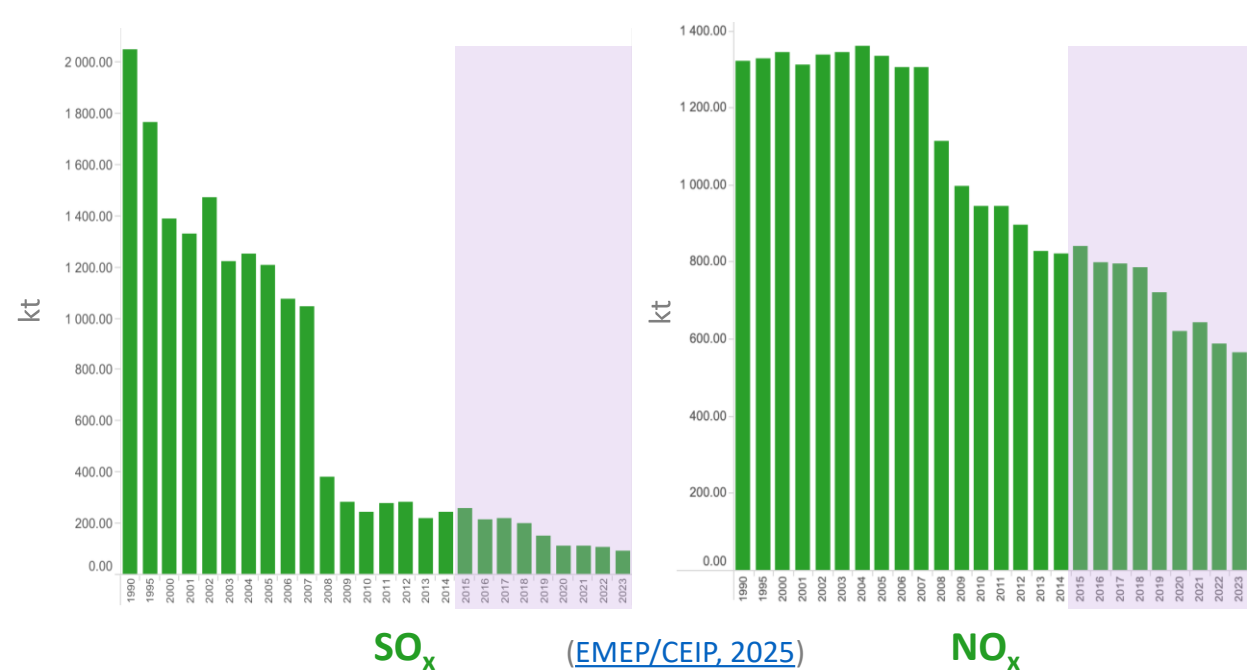
# Examples of intercomparison results: Spain

**Product:** NH<sub>3</sub> Regional Emissions **Topic:** Interannual trends

NH<sub>3</sub> emissions (2008-2023, SUM of all hotspots)



SO<sub>x</sub> and NO<sub>x</sub> emissions in Spain (1990-2023)



The inverse modelling approach uses a **constant NH<sub>3</sub> lifetime** across time and space and this may not properly reflect **changes in atmospheric composition** on observed NH<sub>3</sub> satellite columns

↓ SO<sub>2</sub>/NO<sub>2</sub> levels, ↓ sulphate/nitrate, ↓ NH<sub>3</sub> uptake, ↑ NH<sub>3</sub> concentrations ~~↑~~ ↑ NH<sub>3</sub> emissions



# Feedback Outcomes

## General lessons learned

- The intercomparison exercises has proven to be **very helpful for both national agencies and satellite-based emission data providers.**
- Potential areas for improvement were identified and considered for future implementations (e.g. data access, documentation, specific country requirements for small size countries)
- **In depth discussions** between inventory compilers and researchers developing satellite-based emissions are fundamental to:
  - “flag inconsistencies” → “identify factors driving inconsistencies” → “permanent improvements”

## Unique selling points (according to Inventory Agencies)

- Only multi-inversion project that offers sectoral disaggregation for numerous atmospheric species.
- Data offers includes NETCDF and CSV files at varying temporal resolution.
- Data organised in a very well maintained “One Stop Shop”, very convenient for inventory compilers.

# Next: Emissions Monitoring from Space and Ground Conference

**Venue:** ESA–ESRIN, Frascati (Roma, IT) – 26-30 Oct 2026

**Organisers:** ESA, CAMS, EEA, EC

**Format:** Plenary sessions, breakout groups, project meetings, posters, ...

## **Purpose:**

- Bring together the EO community and key stakeholders working on GHG and air-pollution emissions monitoring.
- Facilitate a strong Science-to-Policy dialogue with European policymakers.

## **Focus Areas:**

- State-of-the-art EO-based emission estimation for multiple use cases.
- EO data and solutions supporting policy implementation—from R&D to operations.
- Updates on relevant EU policies and building a shared emissions terminology.
- Special emphasis on **national GHG and air pollutants inventories** and how EO-based inversions can support verification and QA/QC.



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# Thank you!

*The authors would like to acknowledge J. Pérez-Illarbe, C. Ramos and all the members from the National Inventory team from MITECO for the information provided on the emission inventory and their feedback on the analysis of the results for Spain*

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