# VERBE

## Towards a greenhouse gas emission monitoring and VERification system for Belgium

DURATION
**1/09/2022 – 1/12/2026**

BUDGET
**724 813 €**

PROJECT DESCRIPTION


Summary:

The VERBE project aims at developing a top-down, temporally and spatially explicit (at a scale of order 25 km2) greenhouse gas (GHG) emission monitoring and verification support (MVS) capacity for Belgium, that does not depend on bottom-up estimates, and supports climate change mitigation commitments and policies. The MVS capacity to be developed will build on existing ICOS ecosystem- and atmospheric-type infrastructure, data, tools and expertise, use of complementary satellite and Copernicus Services analyses and data, as well as existing expertise with the WRF-GHG model[1].
Additional infrastructure for monitoring of atmospheric GHG concentrations in Belgium will be implemented based on a network design study for identifying the most relevant location(s) according to the IG3IS guidelines (https://ig3is.wmo.int/). Also an inverse modelling capacity adhering to the Community Inversion Framework (CIF) will be developed for Belgium.

The top-down approach consists of an ensemble of ground- and space-based observations, complemented with inverse modelling tools; the latter require accurate meteorological data and atmospheric transport models (e.g., Lagrangian Particle Dispersion Models (LPDM)).

To develop the MVS capacity, CH4 will be addressed first, then CO2; first steps will be taken to prepare for N2O MVS capacity development.

The project includes the most relevant Belgian ICOS partners as well as foreign expert teams for complementing the Belgian expertise. It is envisaged to consult the relevant stakeholders in Belgium, in particular the agencies responsible for the National Inventory Reporting (NIR), to identify the major knowledge gaps.

Through this project, Belgium will join the small pool of countries that have established a MVS capacity at the national level. The project will result in accurate and more timely information about national GHG emissions to complement and improve the NIR, based on an extended ICOS-type infrastructure including ground-based in-situ and remote sensing observations of atmospheric GHG concentrations, complementary satellite observations and model data, and ancillary data. It will support the establishment of national climate change mitigation policies and their verification, in compliance with the Belgian commitments to the European and worldwide agreements, as well as the global stocktake process.


Methodology

1) In first instance it will be necessary to analyze where the most important knowledge gaps for Belgium as to GHG emissions are, in order to design the appropriate observations and inverse modelling infrastructure accordingly. This will be done in collaboration with the Belgian major stakeholders and partners responsible for the National Inventory Reporting (NIR).

2) Next a network design study will be carried out to identify the most suitable locations for implementing local ground-based observations. The heterogeneity of the emissions and surface properties in Belgium make this a challenging task.

[1] https://www.bgc-jena.mpg.de/bgc-systems/pmwiki2/uploads/Download/Wrf-ghg/WRF-GHG_Techn_Report.pdf

3) Ground- and tall-tower-based in-situ and remote sensing observations of the concentrations of the targeted GHGs will then be implemented based on the results of the design study. The planned atmospheric observation system will rely on the existing ICOS[2] and TCCON/COCCON[3] observation networks and expertise in Belgium and surroundings, and complementary state-of-the-art instruments like the PICARRO or other ICOS-compliant and a COCCON-type instrument.

4) The WRF-GHG model and associated modules of CIF will be adapted for application to the Belgian territory and surroundings, designing a customized state vector for this application. The model will be applied to constrain the spatially-resolved regional emissions based on the available ground- and satellite-based observations of GHG atmospheric concentrations.

Link

The VERBE project supports the initial phase of the FEDtWIN research profile 'A BElgian greenhouse gas emissions Monitoring and Verification System' or 'BE-MVS' developed in collaboration between BIRA-IASB and the Global Change Ecology consortium of the University of Antwerpen.

[2] *ICOS: Integrated Carbon Observation System*
[3] *TCCON/ COCCON: Total/ Collaborative Carbon Column Observing Network*

## CONTACT INFORMATION

**Coordinator**

**Martine De Mazière**
Royal Belgian Institute for Space Aeronomy (BIRA-IASB)
Sources and sinks of atmospheric constituents - Infrared Observations
martine.demaziere@aeronomie.be

**Partners**

**Bert Gielen**
Universiteit Antwerpen (UAntwerpen)
Global Change Ecology
bert.gielen@uantwerpen.be

**Bernard Heinesch**
Université de Liège (ULiège)
Gembloux Agro-Bio Tech, TERRA
bernard.heinesch@uliege.be

## LINKS

**https://verbe.aeronomie.be/**