VERBE

Towards a greenhouse gas emission monitoring and VERification system for BElgium

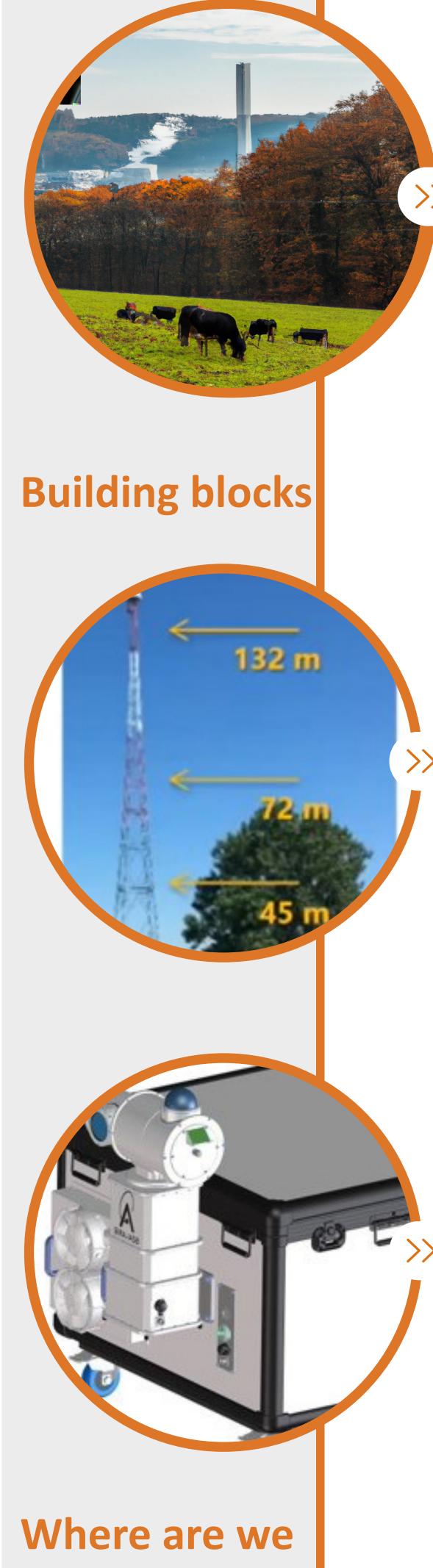## M. De Mazière[1], S. Callewaert[1], F. Desmet[1], B. Dils[1], N. Kumps[1], M. K. Sha[1], B. Gielen[2], B. Heinesch[3], J. Marshall[4], M. Ramonet[5]

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Objectives

The VERBE project addresses the need to develop an independent, top-down, temporally and spatially explicit greenhouse gas (GHG) emission monitoring and verification support (MVS) capacity for Belgium in support of government policies.

The national MVS will also contribute to the European MVS capacity that is called for in the context of the global stocktake process of the Paris Agreement, the European Union (EU) strategy to reduce GHG emissions, and the Belgian signature of the methane pledge to cut emissions by 30% from 2020 levels by 2030.

The MVS aims at:

(1) quantifying the GHG concentrations above Belgium at a subregional scale (of order 25 km^2),

(2) identifying and quantifying major sources and sinks,

(3) distinguishing between anthropogenic and biogenic sources and sinks.

Focus is on the greenhouse gases CH_4, CO_2, N_2O

Building blocks

Initially we will deploy and use

• Ground-based atmospheric observations of GHG near-surface, and total column concentrations, using in-situ PICARRO-type and remote sensing FTIR observations, at a site that is close to high emissions source(s)

• Complementary observations of CO concentrations

• Satellite and Copernicus Atmosphere Monitoring Service (CAMS) data

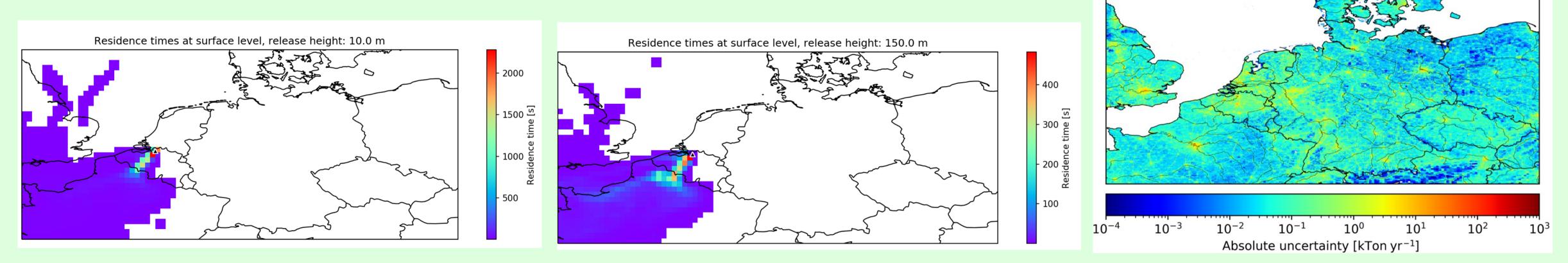• FLEXPART 10.4 Lagrangian Particle Dispersion Model; footprint analyses

• Regional modeling using WRG-GHG (WRF-Chem Weather Research and Forecast Model coupled with chemistry but run in its passive tracer mode) + inversion module using a priori emission inventories

$\Rightarrow$ **Final aim:**

Derive improved a posteriori emission inventories ("top-down" quantification of emissions), as a complement to the National Inventory Report (NIR) based on bottom-up estimates of emissions.
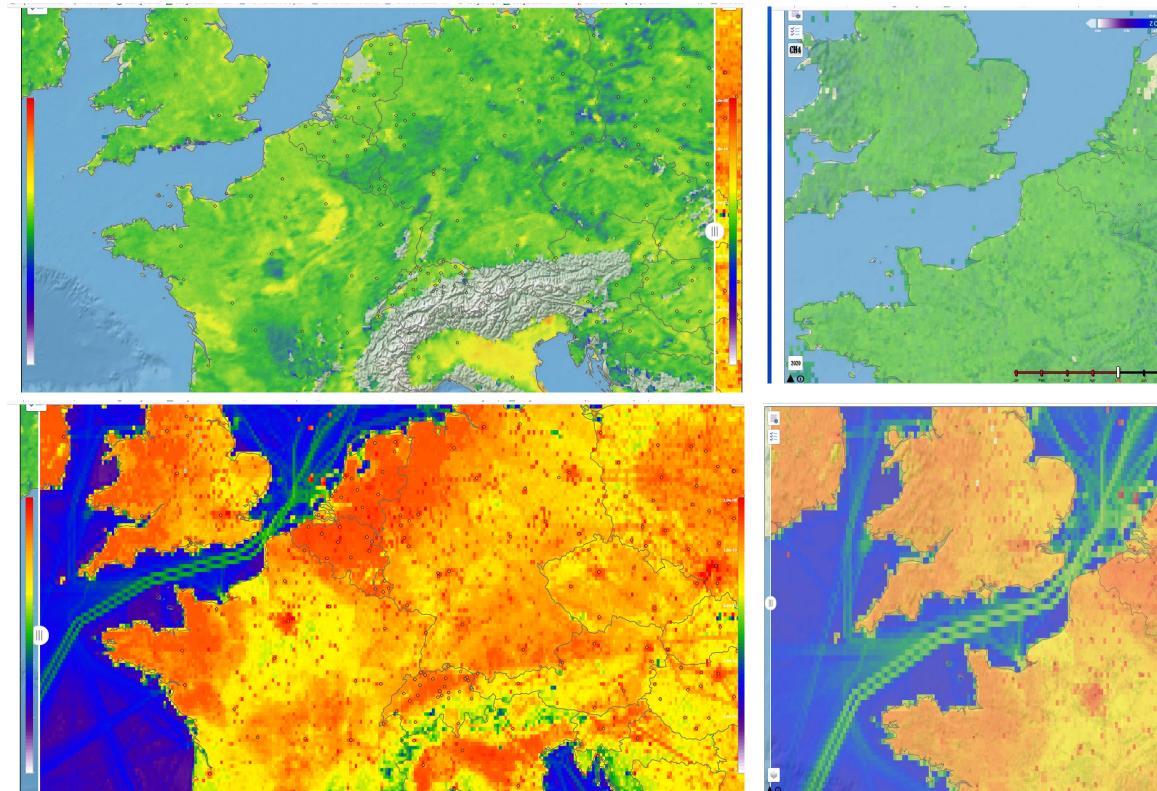
• Interaction with stakeholders, starting with discussions with persons responsible for NIR

$\Rightarrow$ Set up high-spatial-resolution emission inventories for Belgium by scaling existing emission inventories with most recent NIR total emission data for Belgium

• Preparation of campaign instruments and determination of suitable location(s) for observations.

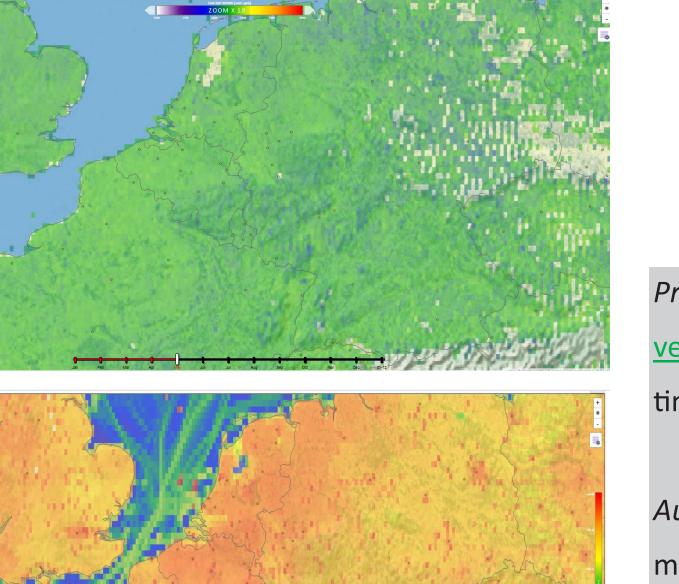E.g., footprint analyses in neighbourhood of Antwerp and ICOS ecosystem site of Brasschaat.

⇨ Match footprints of potential sites with emission uncertainties, *e.g.* from Super *et al.* (TNO Inventory)

⇨ Look for appropriate tower

⇨ Set up observations campaign end of summer 2023, including PICARRO in-situ and FTIR remote sensing observations of surface and along-tower and total column concentrations of CH_4, CO_2 and N_2O.

• Analysis of GHG concentration gradients in satellite and CAMS gridded data in comparison to spatial structure in available emission inventories .

Where are we now ?

CH_4 concentrations from S5P L3 data (2017-2021 average)

EDGAR CH_4 anthropogenic emissions (v7-2021)