Co-ordinated by ECMWF

CO_2 Human Emissions

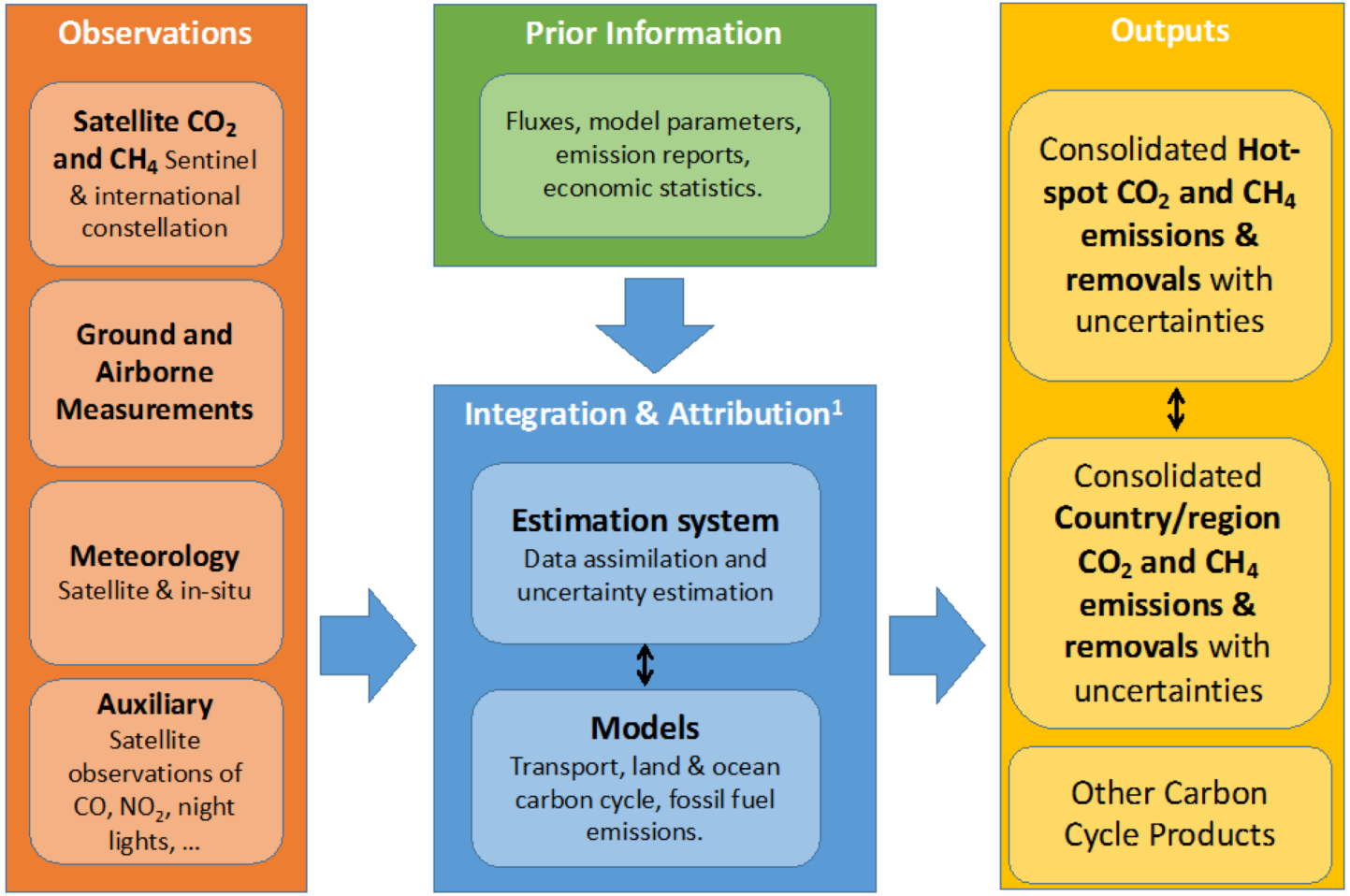
CO_2 HUMAN EMISSIONS (CHE)

Status June 2019

Richard Engelen on behalf of the CHE consortium

10/06/2019 – ECMWF

The End-to-End System: Core elements of the functional architecture

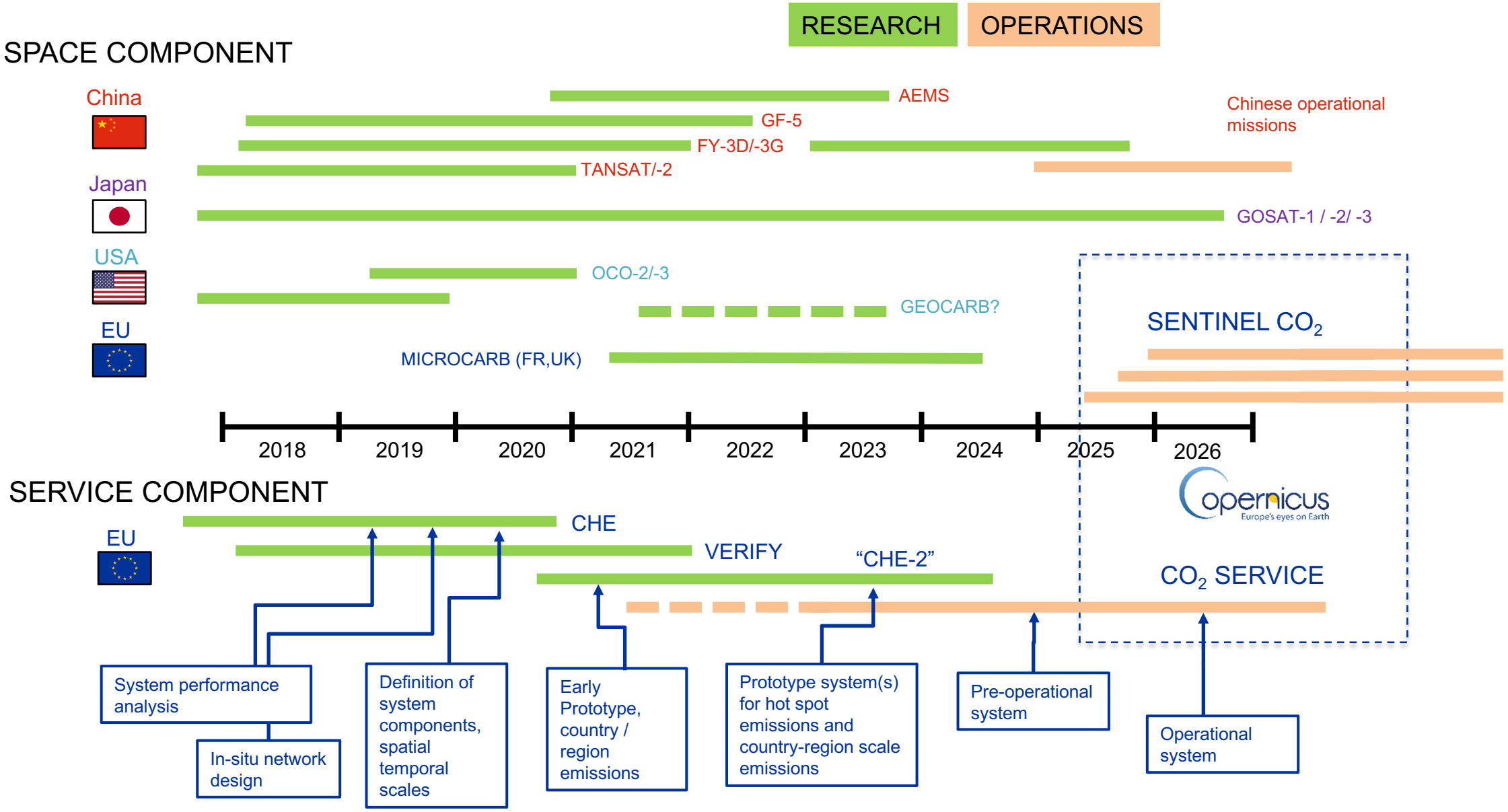


National uptake scheme

- Decision support
- Boundary conditions
- Cities & regions
- Commercial applications

1: Between biogenic and anthropogenic sources

ROADMAP FOR AN OPERATIONAL CO_2 EMISSIONS MONITORING SERVICE

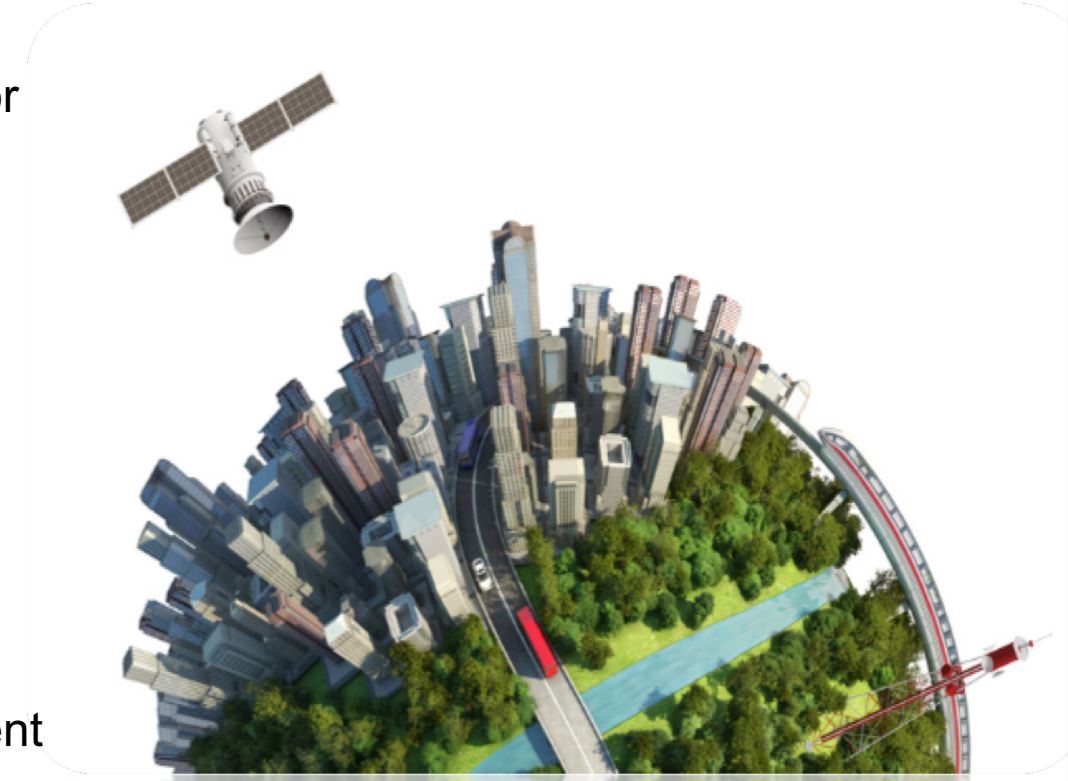


CHE-CO2 Human Emission Project (& its numbers)

Aim:
Build European monitoring capacity for anthropogenic CO_2 emissions

How:
CO_2 emission estimation system driven by Earth observations (remote sensing and in situ) combined with enhanced modelling system

Why:
To support the Paris Climate Agreement and its implementation



Project Duration:
39 month

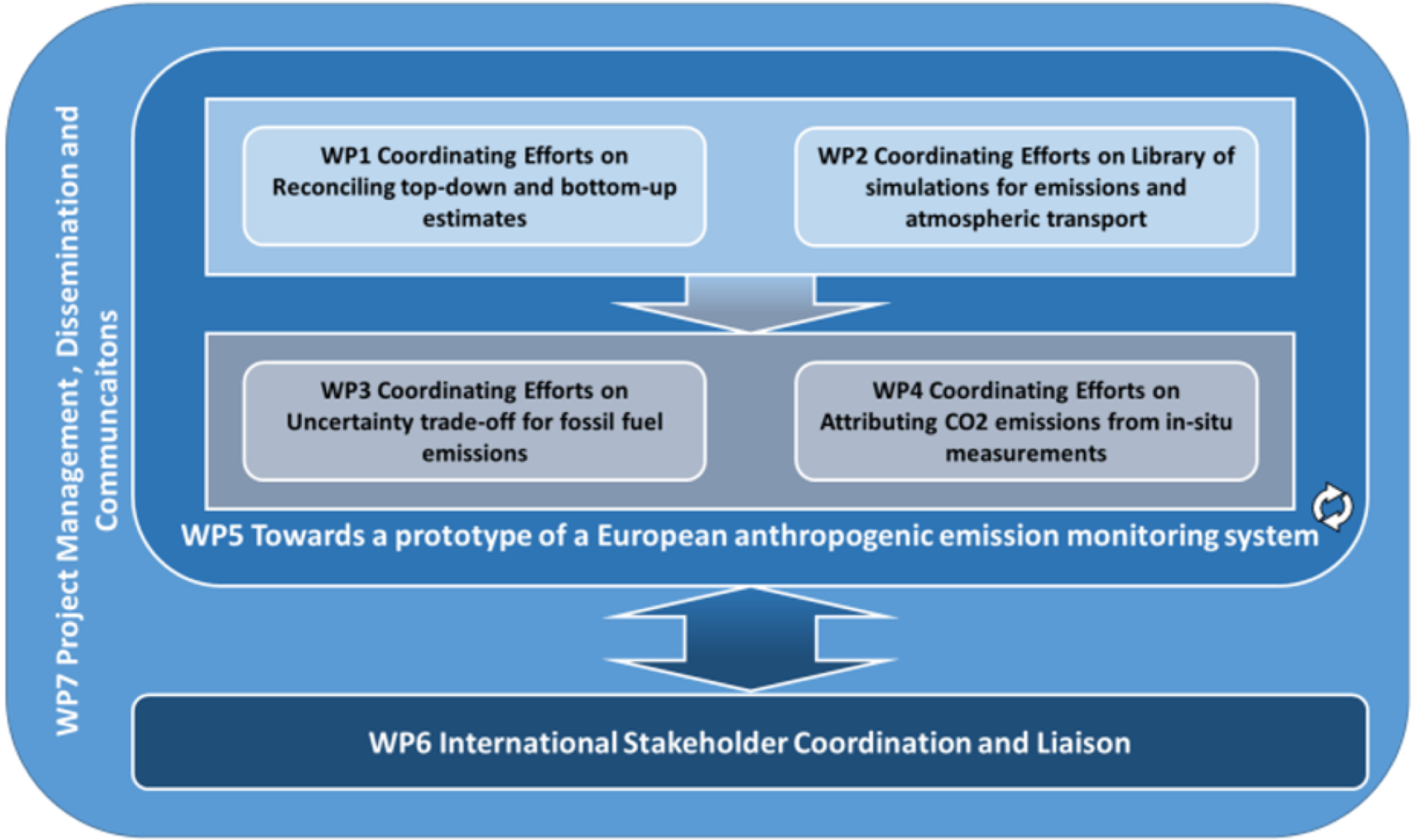
Project Funding:
3.75 ME (1.25 ME/year)

Consortium Numbers
22 partners Institutes

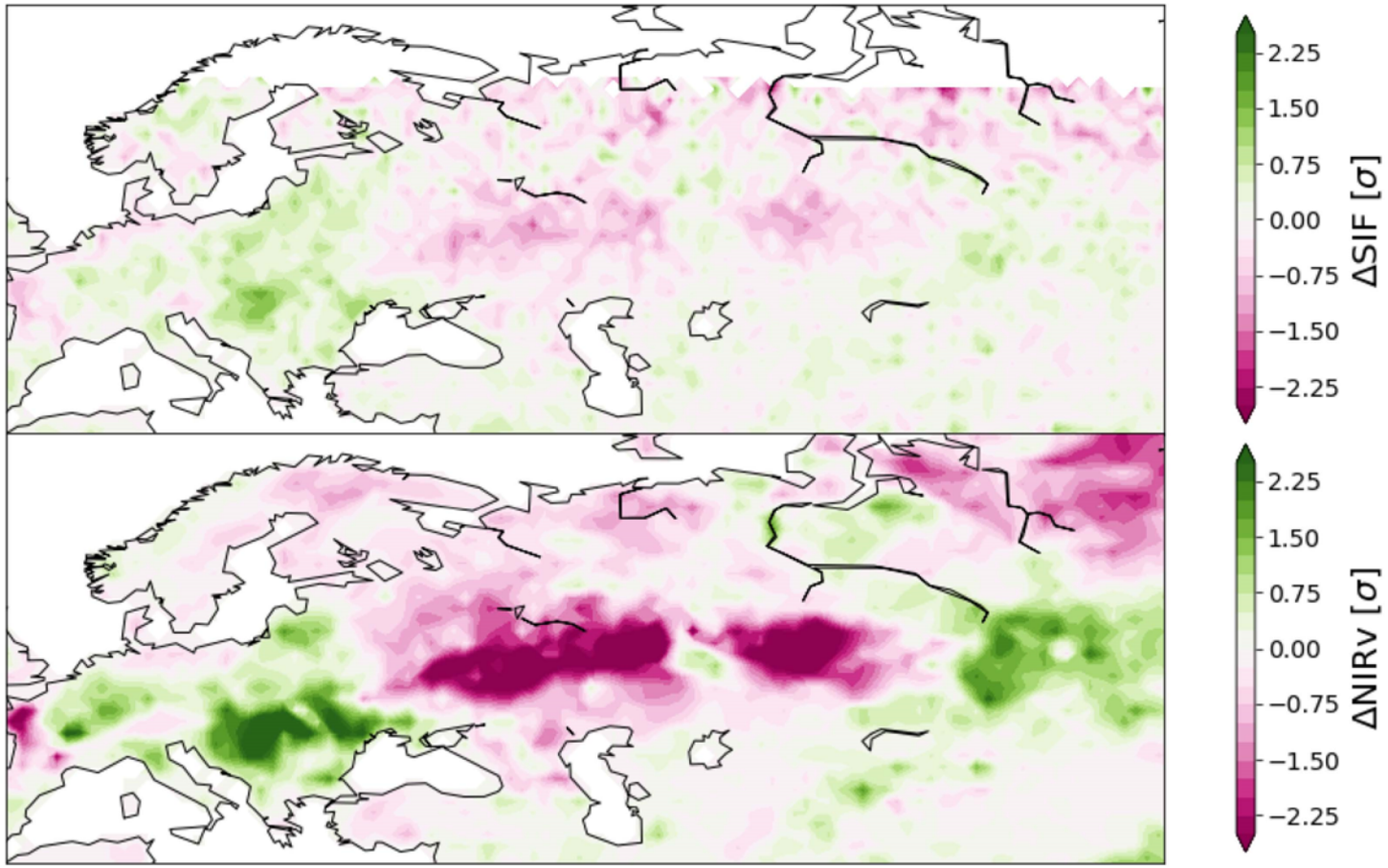
Work Content Numbers
7 work-packages:
5-Science development,
1-International liaison,
1-Management & Coms
7 Milestones
45 Deliverables

344.25 Person Month
(Eq 8.8 FTE)

CHE structure



WP 1 example – Constraining biogenic fluxes with innovative satellite products

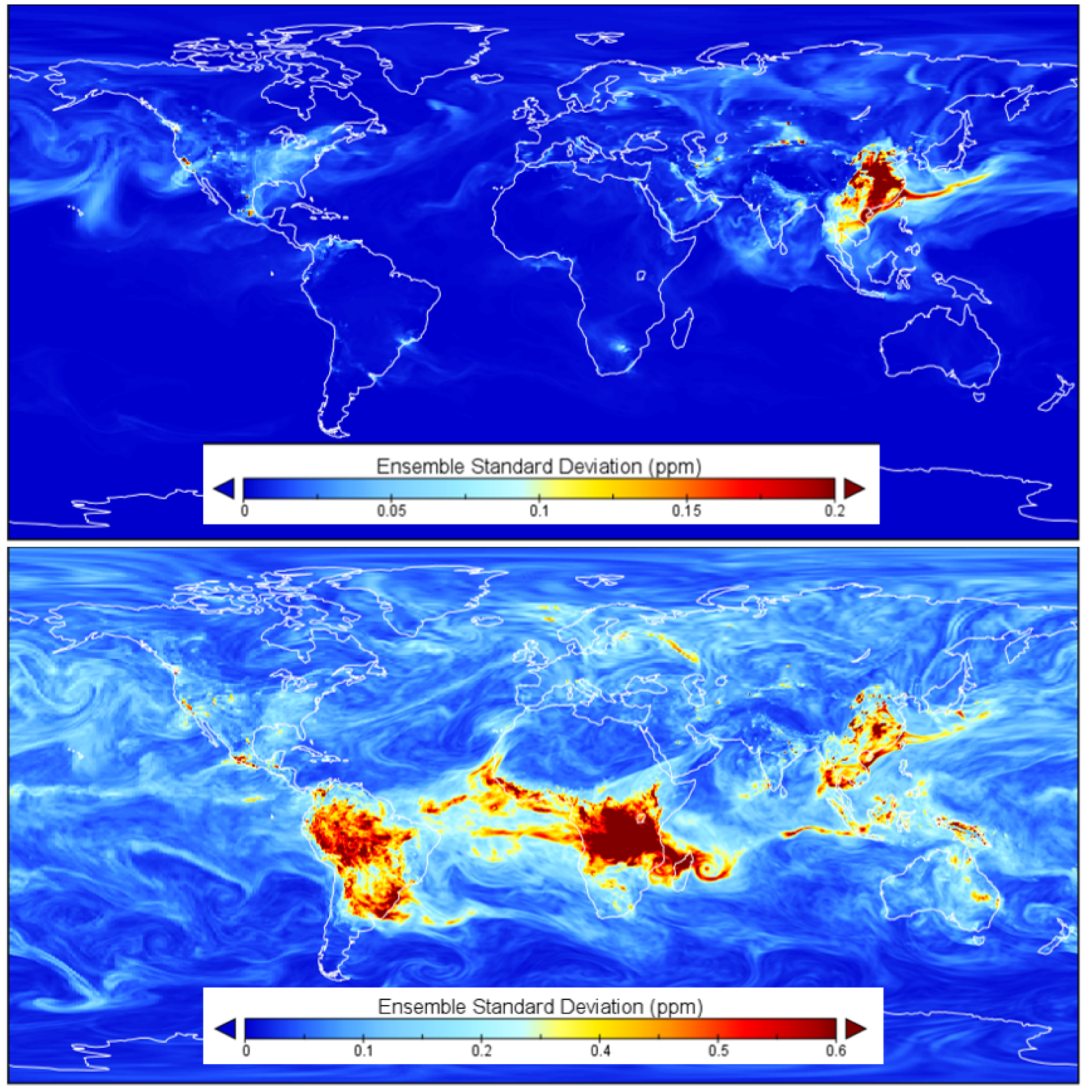


Exploring the use of remote-sensing observations of SIF and NIRv, both proxies for biogenic production, is important to better enable the separation between natural and anthropogenic fluxes.

These satellite observations have great potential to constrain slow processes in the natural carbon cycle.

Anomalies in SIF (top) and NIRv (bottom) during the drought in Russia in the summer of 2010. Results are averaged over the months July, August, September. Credit: L. Florentie

WP 2 example – Global ensemble of simulations



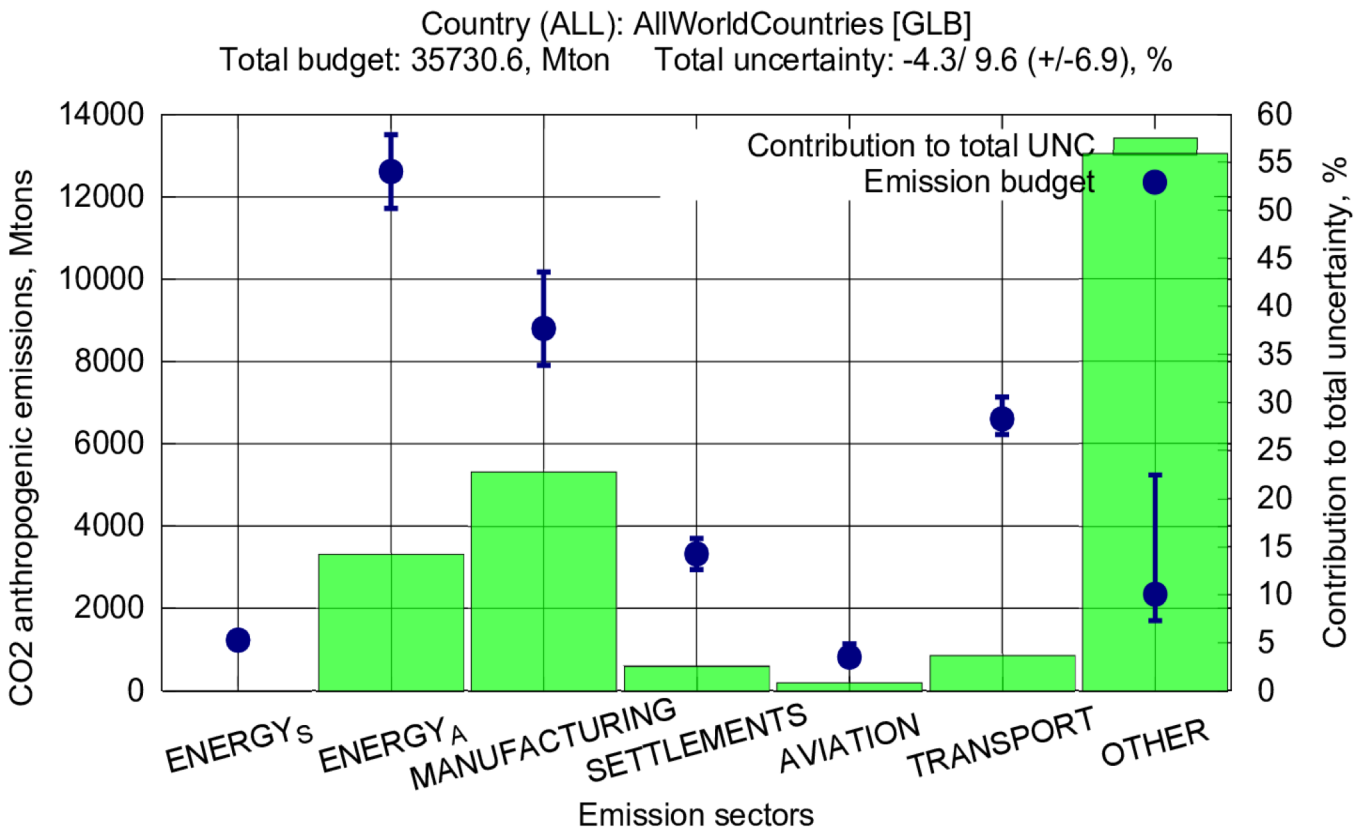
To assess the amplitude of various potential error sources, the ECMWF global model has been used in ensemble mode by perturbing various parameters.

The example shows the impact of perturbing the emissions (top) and the meteorology (bottom) on column-averaged CO_2 values.

Note: current emission perturbations are based on uncertainties in annual means, which are too small for day-to-day variability.

Spread in column-averaged CO_2 as a result of perturbing the emissions (top) and the meteorology (bottom) in an ensemble of global simulations. Credit: J. Norton.

WP 2 example – Uncertainty of emission inventories

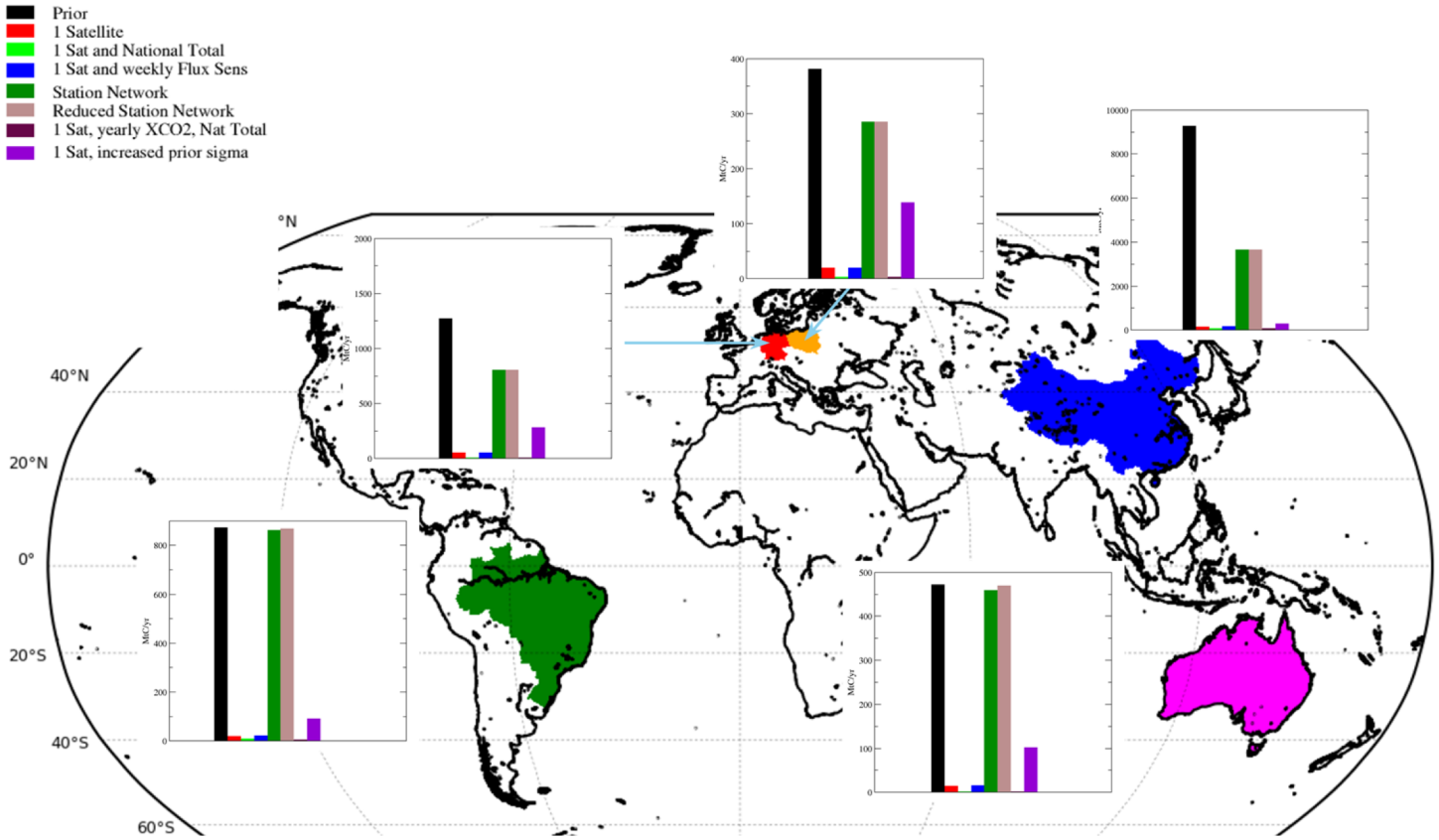


Fossil-fuel emissions are concentrated in cities or close to power plants - largest sources are electricity & heat production and road transport

High uncertainty of global total GHG emissions:
i) increasing share of emissions from countries with less developed statistical infrastructure,
ii) decreasing share of emissions from the well measured activities (e.g. coal power plants).

Global human CO2 emissions in 2015: budget, uncertainties & contributions. Credit: M. Choulga & G. Maenhout.

WP 3 example – CCFFDAS analysis of various constraints



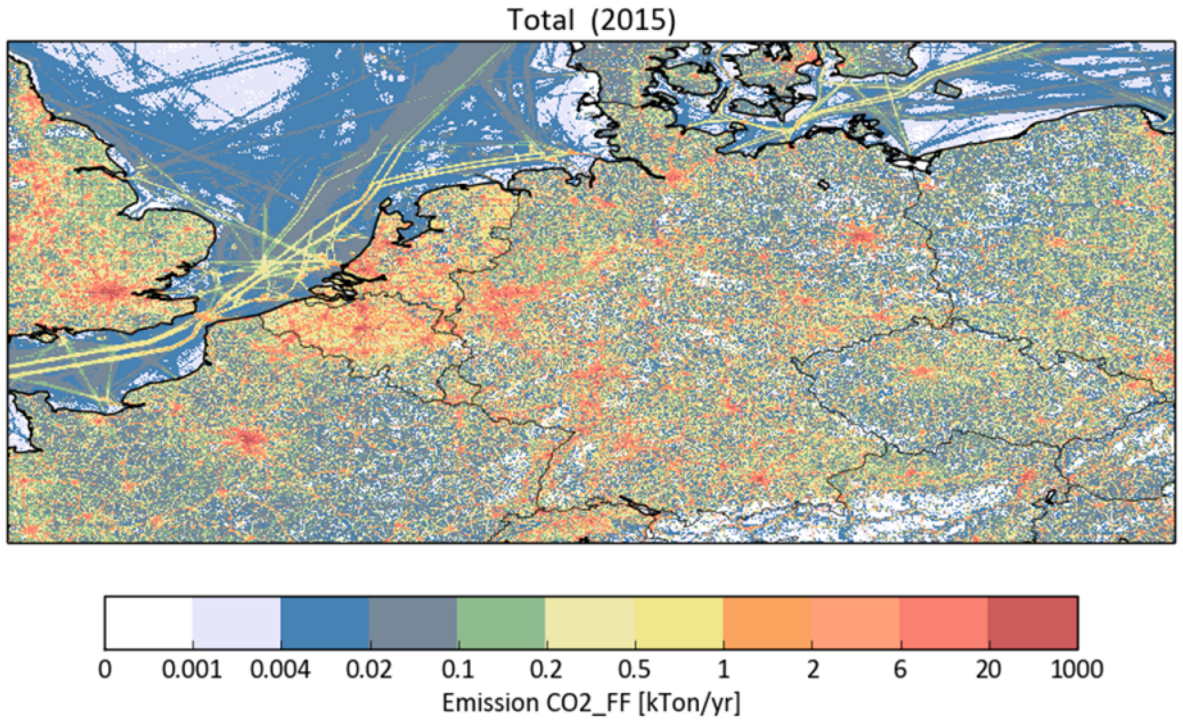
A parameter estimation system (CCFFDAS) is used to assess the impact on uncertainty reduction from various observational constraints.

This provides insight in the relative importance of various observation system options.

The figure shows first preliminary results to illustrate the assessments that can be done using a CCFFDAS system.

Uncertainty reduction as a function of various observational configurations in a CCFFDAS inversion system. Credit: T. Kaminski.

WP 4 example – Ensemble of high-resolution emission data sets

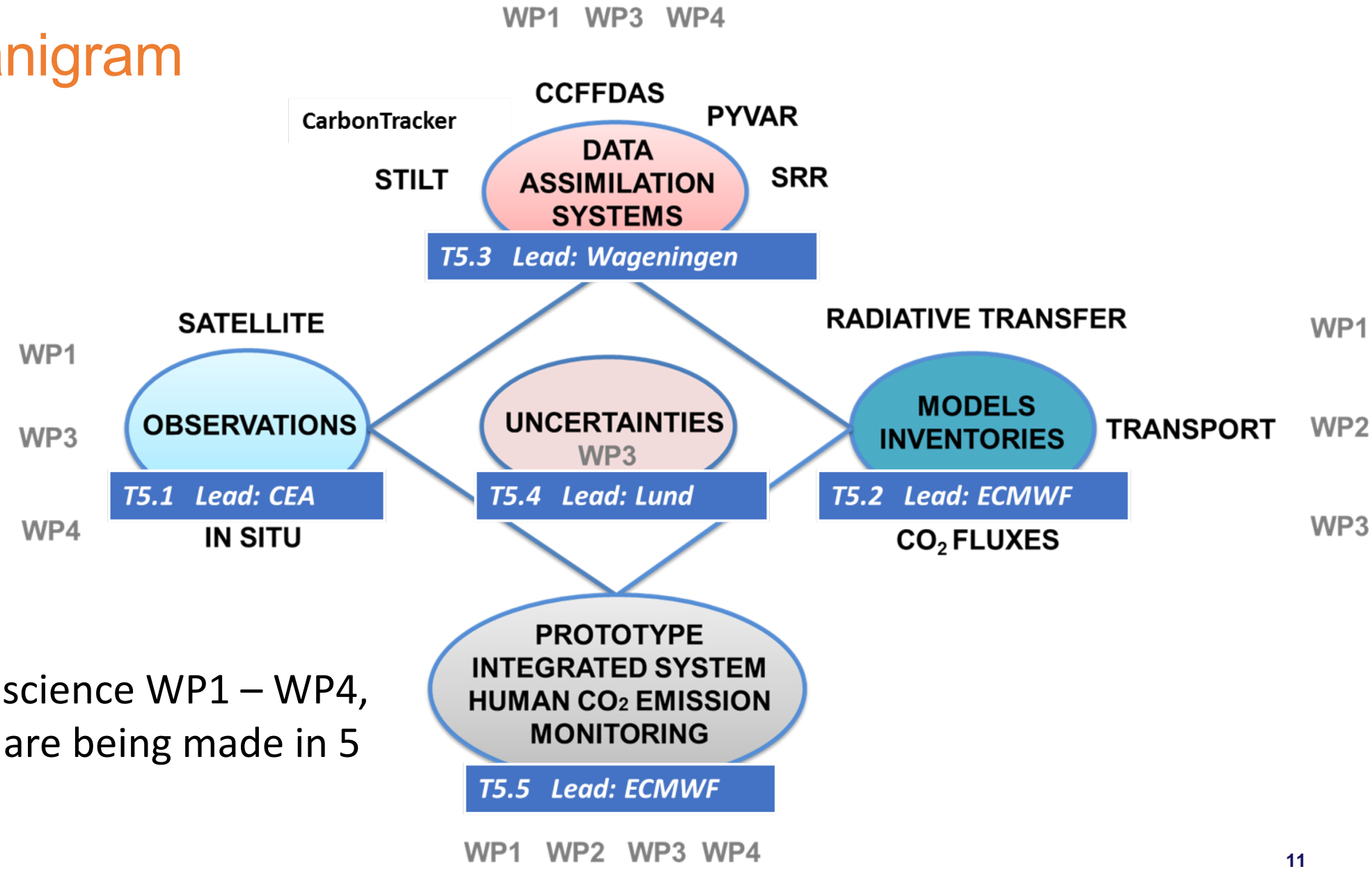


To support the studies on in situ network design for the European region, ten 1×1 km^2 scenarios of CO_2 and CO emissions associated with anthropogenic activities in Europe over a full year (2015) have been constructed.

Four key parameters have been perturbed: activity data, emission factors, spatial distribution proxies and temporal distribution proxies.

High-resolution (1 x 1 km2) CO2 fossil fuel emission map for 2015. Credit: H. Denier van der Gon.

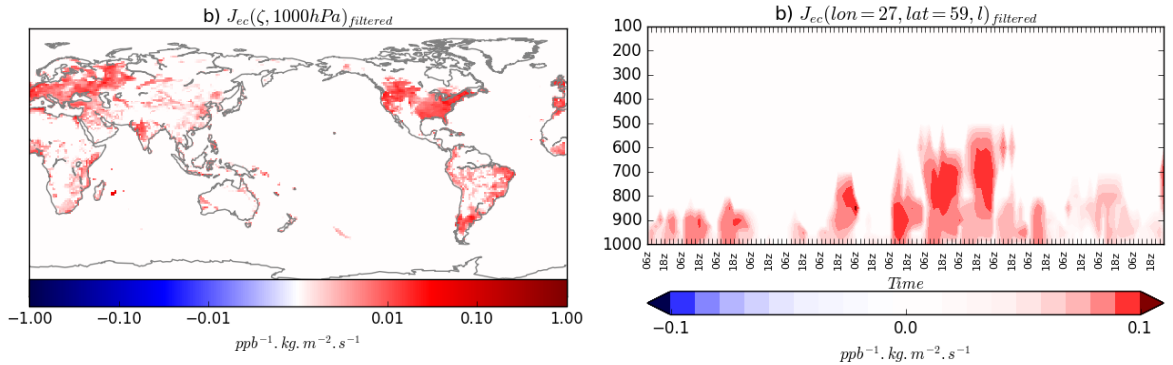
WP5 Organigram

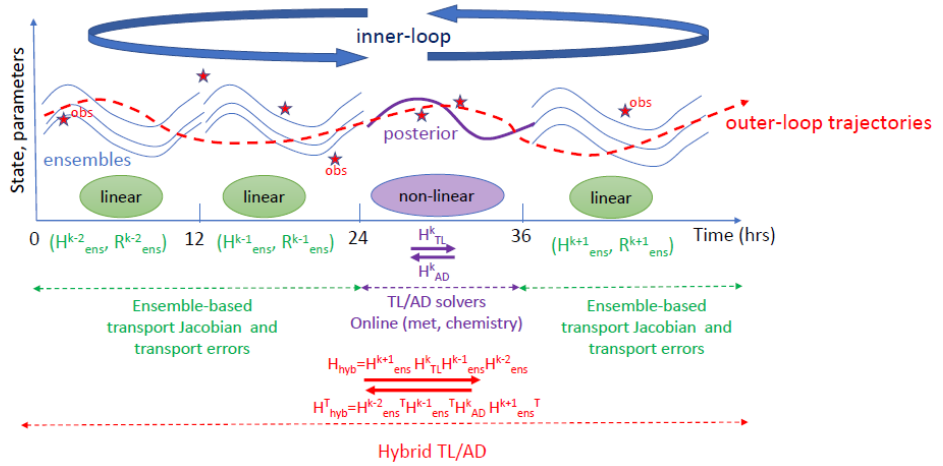


Using results from science WP1 – WP4, recommendations are being made in 5 topical areas.

More of beyond state-of-the-art

- Use of S-5p to study combined CO_2/NO_2 inversions
- Ensemble Data Assimilation
- Use of ^{14}C to separate anthropogenic signal
- Hybrid long-window 4D-Var





European Commission

esa

EUMETSAT

ECMWF

Copernicus
Europe's eyes on Earth

CO_2 Task Force

CO_2 MAG

WORLD METEOROLOGICAL ORGANIZATION
WEATHER CLIMATE WATER

GAW

IG3IS Integrated Global Greenhouse Gas Information System

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

WMO IOC INTERNATIONAL COUNCIL FOR SCIENCE UN environment

CEOS Committee on Earth Observation Satellites

GEO

United Nations
Framework Convention on Climate Change

European Commission

HORIZON 2020
The EU Framework Programme for Research and Innovation

VERIFY

TRACE
TRAcking Carbon Emissions

Others…

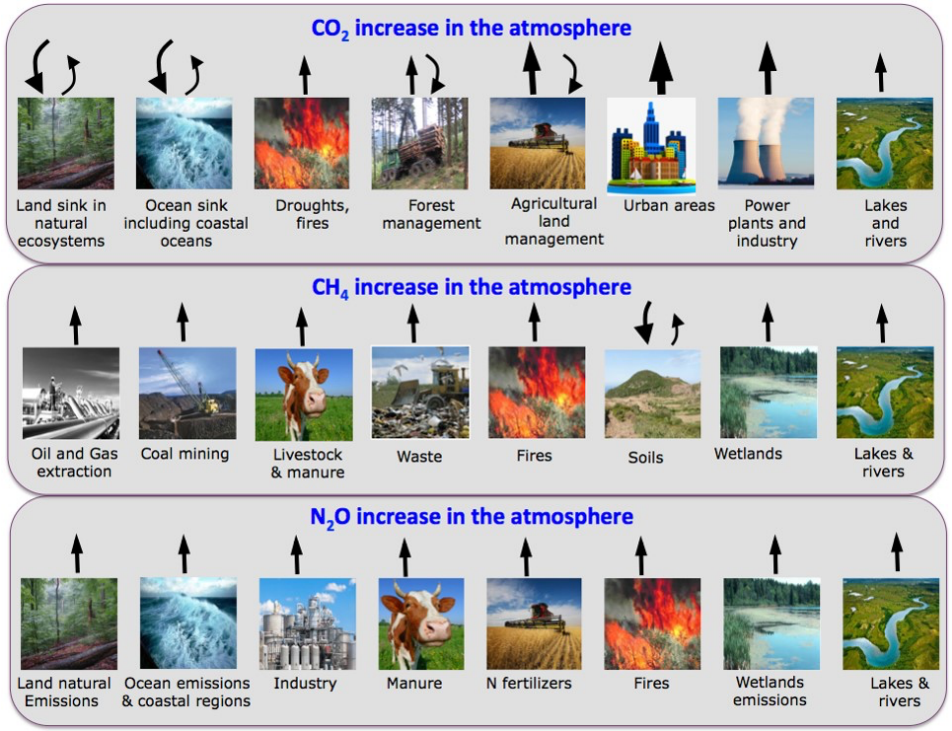
EU Member States

VERIFY Project (& its numbers)

Aim:
Quantify more accurately carbon stocks and the fluxes of carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) across the EU

How:
Based on independent observations and modelling in support of inventories that rely on statistical data.

Why:
To support the Paris Climate Agreement and its implementation



Project Duration:
48 month

Project Funding:
10 ME (2.5 ME/year)

Consortium Numbers
40 partners Institutes

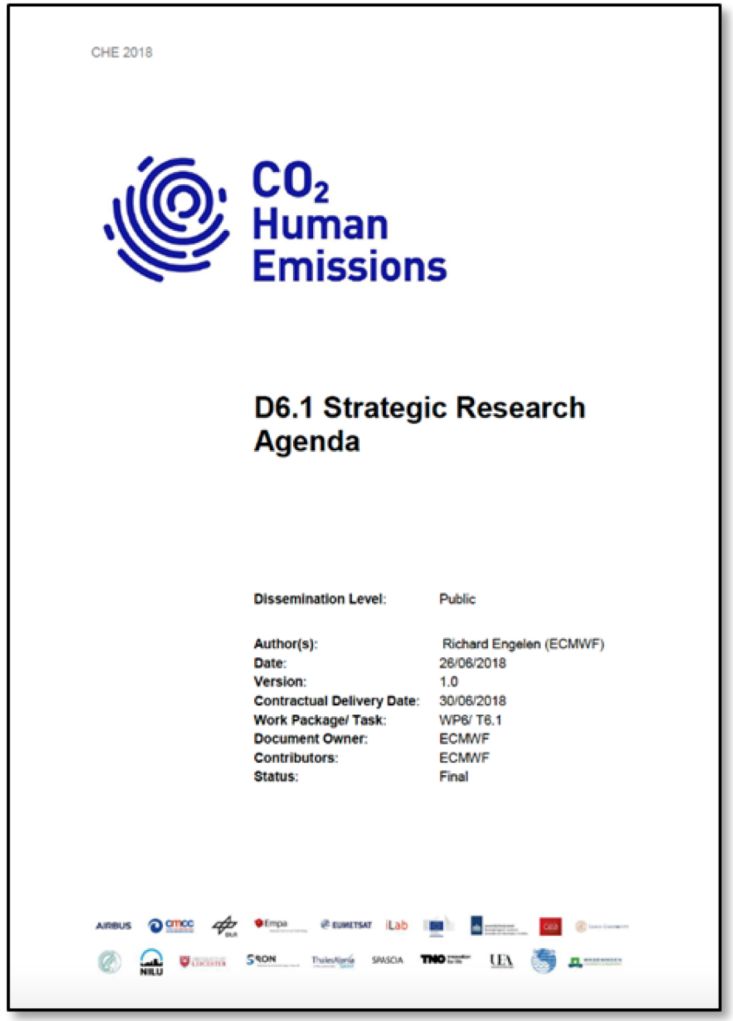
Work Content Numbers
9 work-packages:
3-Verification science,
1-Inventories
1-Synthesis & Products
2-Policy relevance & Intl program input
1-Ethics
1-Management & Coms
44 Milestones
103 Deliverables

1078.85 Person Month
(Eq 22.5 FTE)

Still to come…

Main outcomes from CHE are recommendations to the European commission for the design of the foreseen anthropogenic CO2 emissions monitoring & verification support capacity.

Science results are also made available, e.g., nature runs and emission data sets.


CHE 2018

CO_2 Human Emissions

D6.1 Strategic Research Agenda

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Service provision

Operational development

Draft infrastructure of Copernicus MVS capacity – June 2019