ICOS Central Analytical Laboratory

UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386

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^{14}C and other tracers for fossil fuel CO_2

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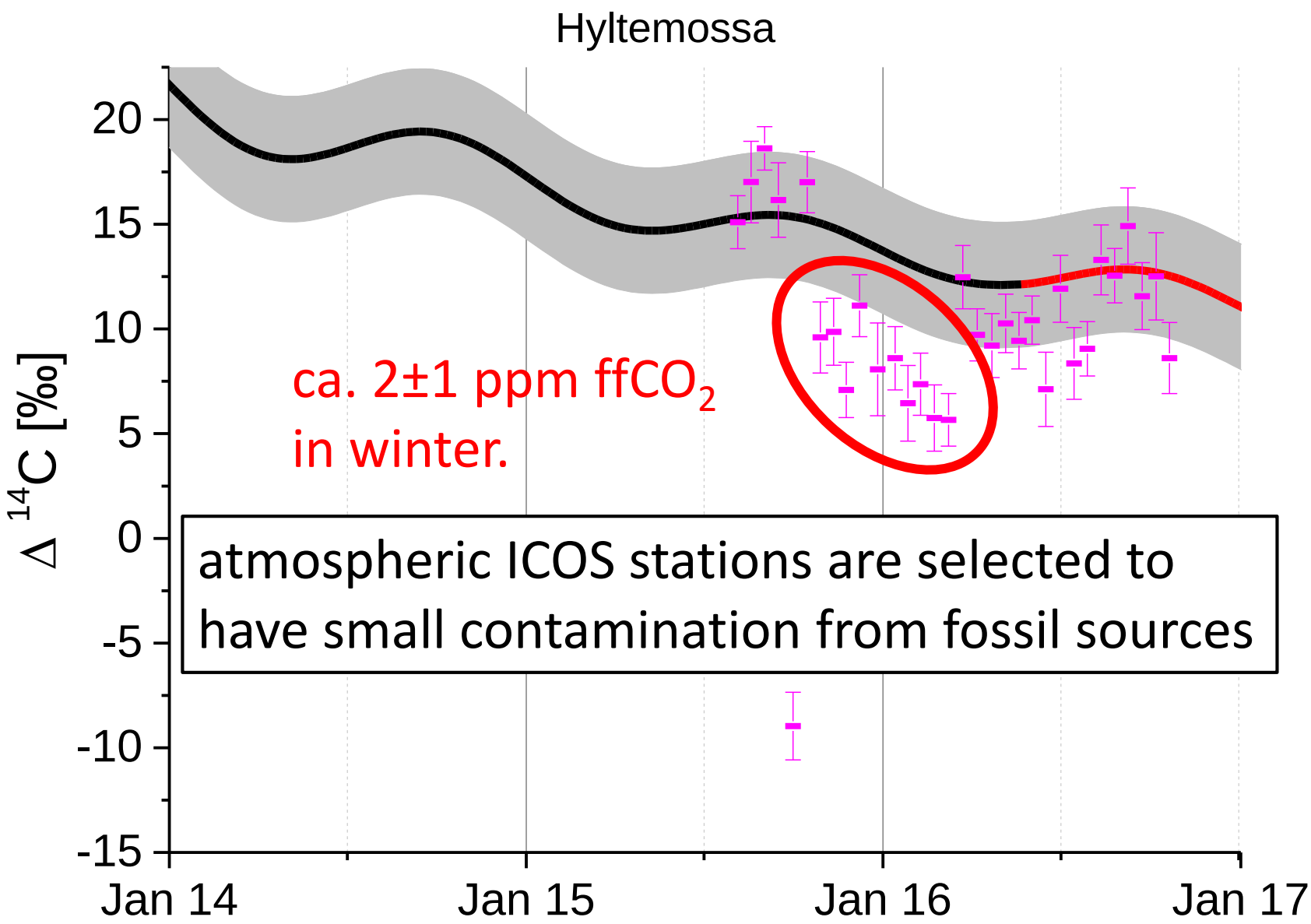
Bundesministerium für Bildung und Forschung

^{14}C signal at „class 1“ stations



RINGO Task 1.2

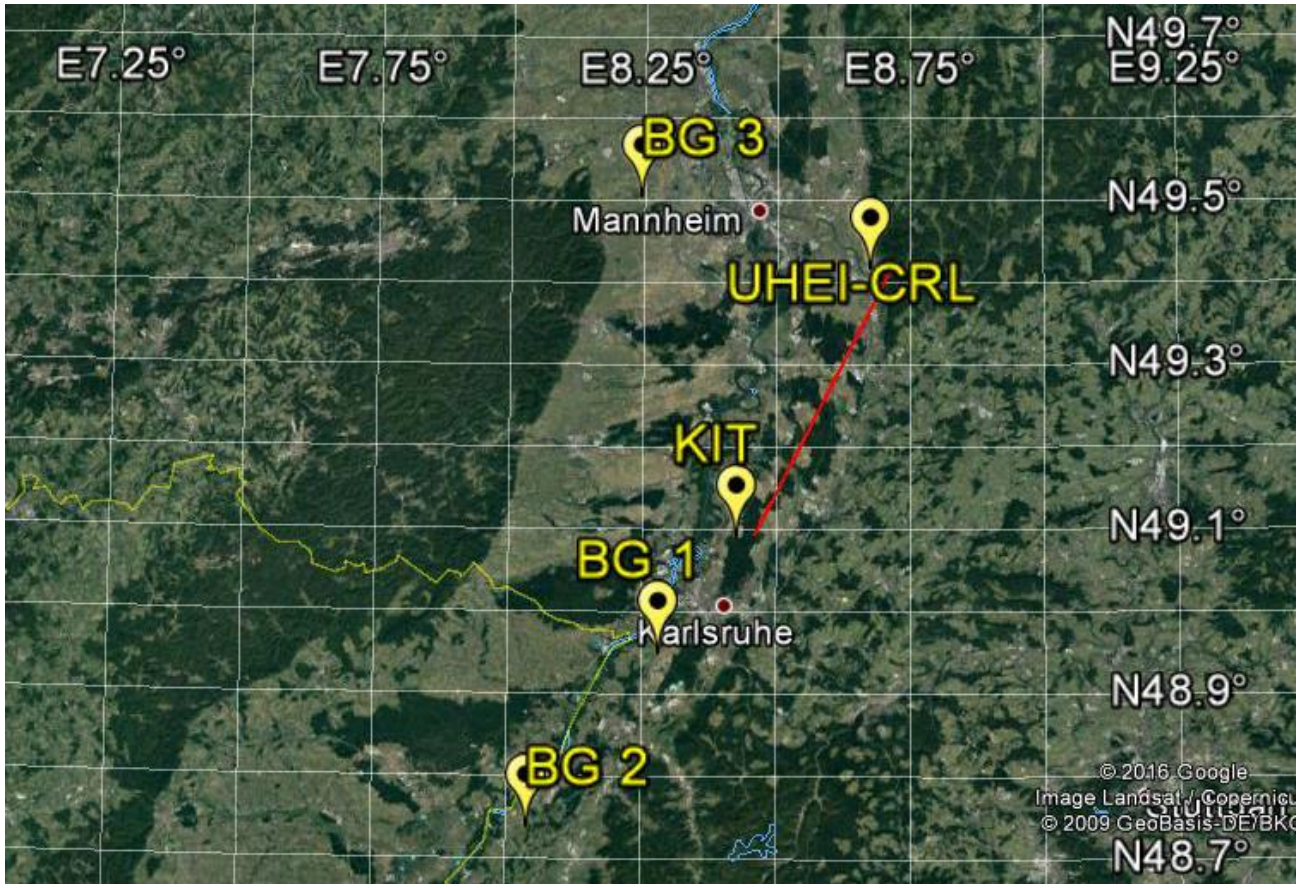
Task 1.2: Developing ICOS RI readiness to provide information on fossil fuel emissions

This task aims for a:

1. Critical assessment of the added value of integrated $^{14}CO_2$ samples for the determination of the *national total $ffCO_2$* emissions
2. Dedicated sampling strategy for the *regional $ffCO_2$* signal, optimizing the benefit of $^{14}CO_2$ measurements for (verification and) potential improvement of existing $ffCO_2$ emissions inventories

up- and downwind of sources

$^{14}CO_2$ and other tracers will be sampled/measured up- and downwind of an emission area if they are connected by one trajectory.



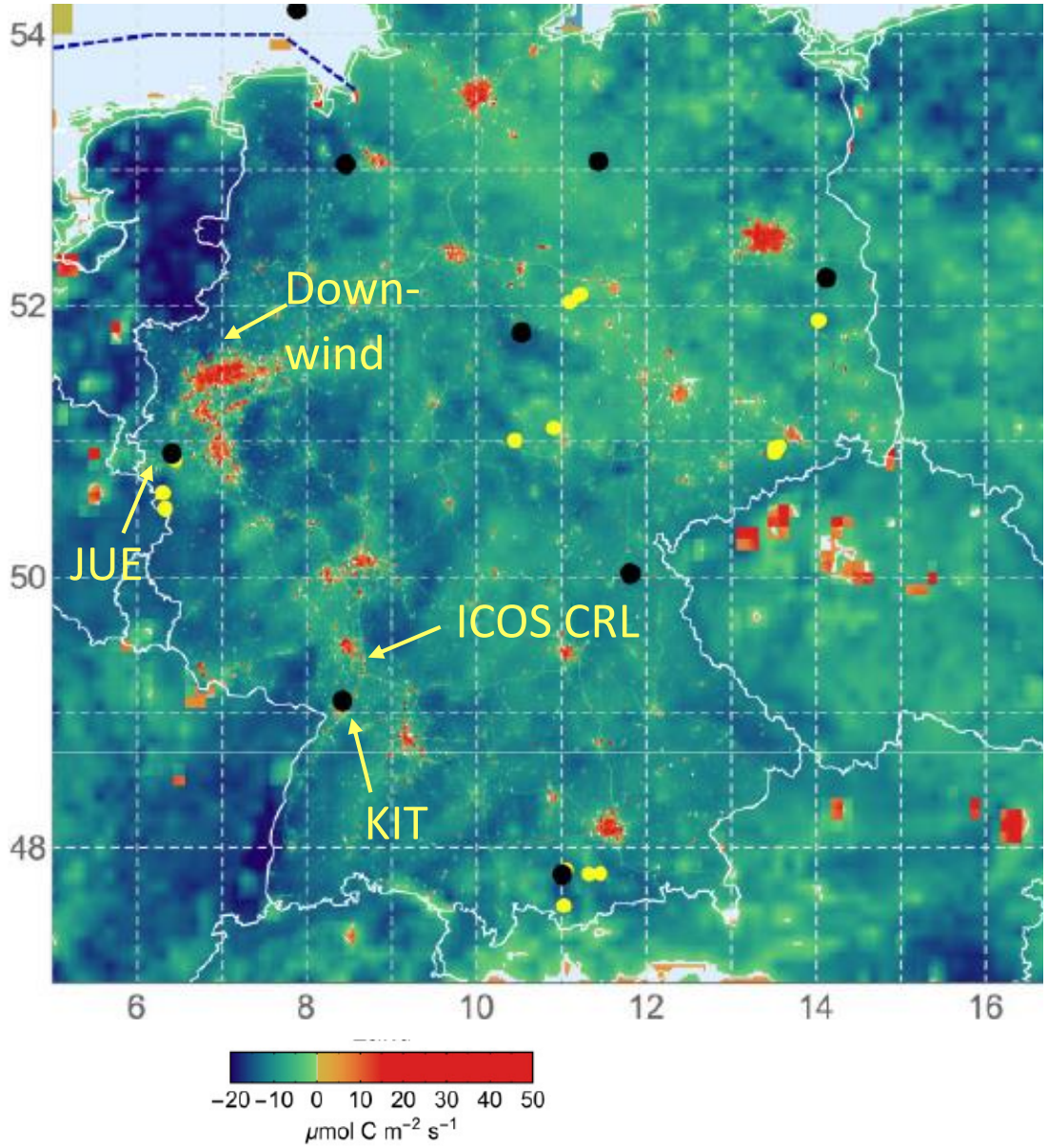
test regions:

- Paris
- Rotterdam
- Rhine valley

Partner:

LSCE, CP, Uni Groningen & Wageningen

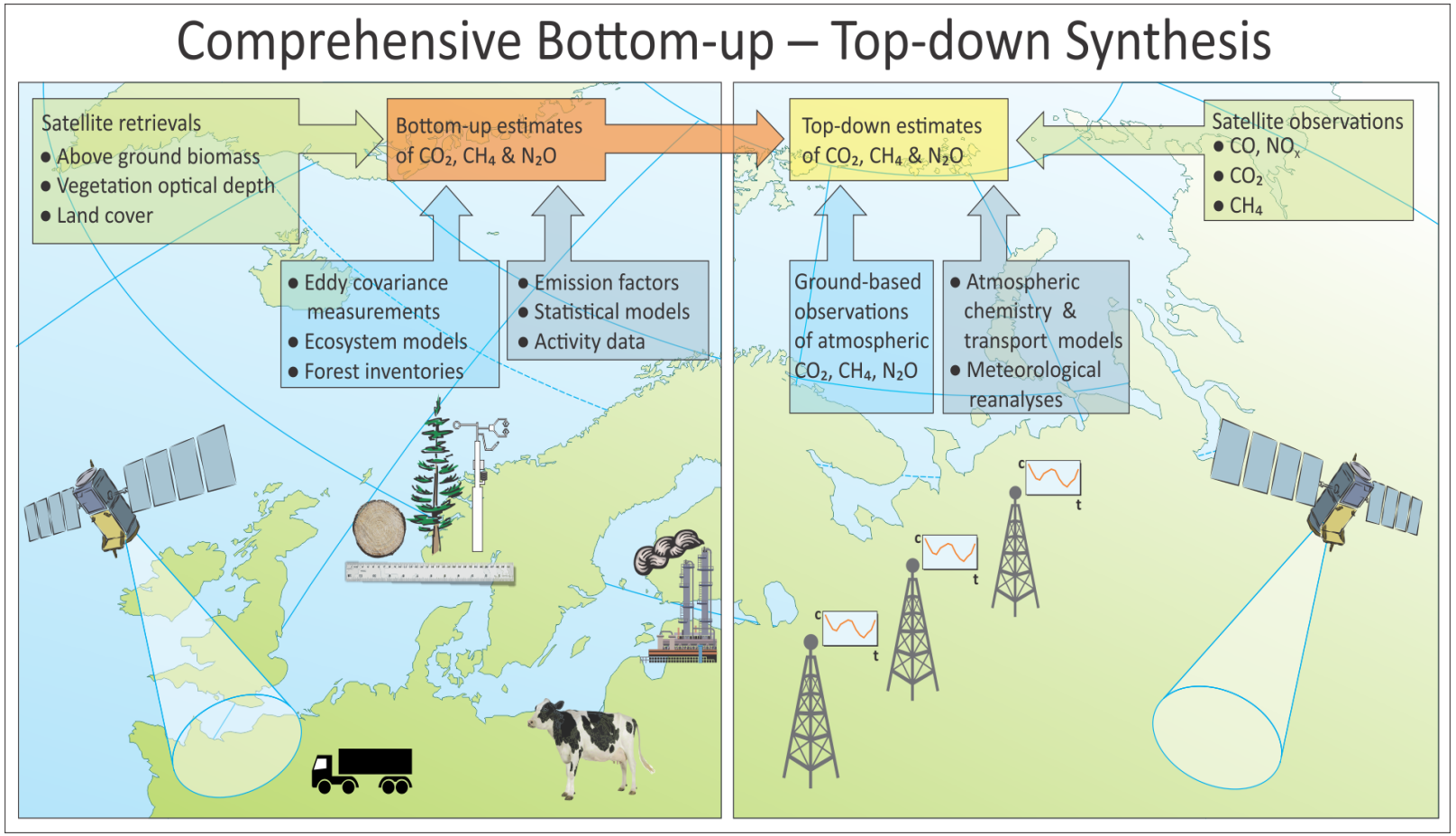
CO_2 daytime flux map in summer



Do we have sufficient signal in the Rhine valley?

Verify

Observation-based system for monitoring and verification of greenhouse gases (CO_2, CH_4, N_2O)



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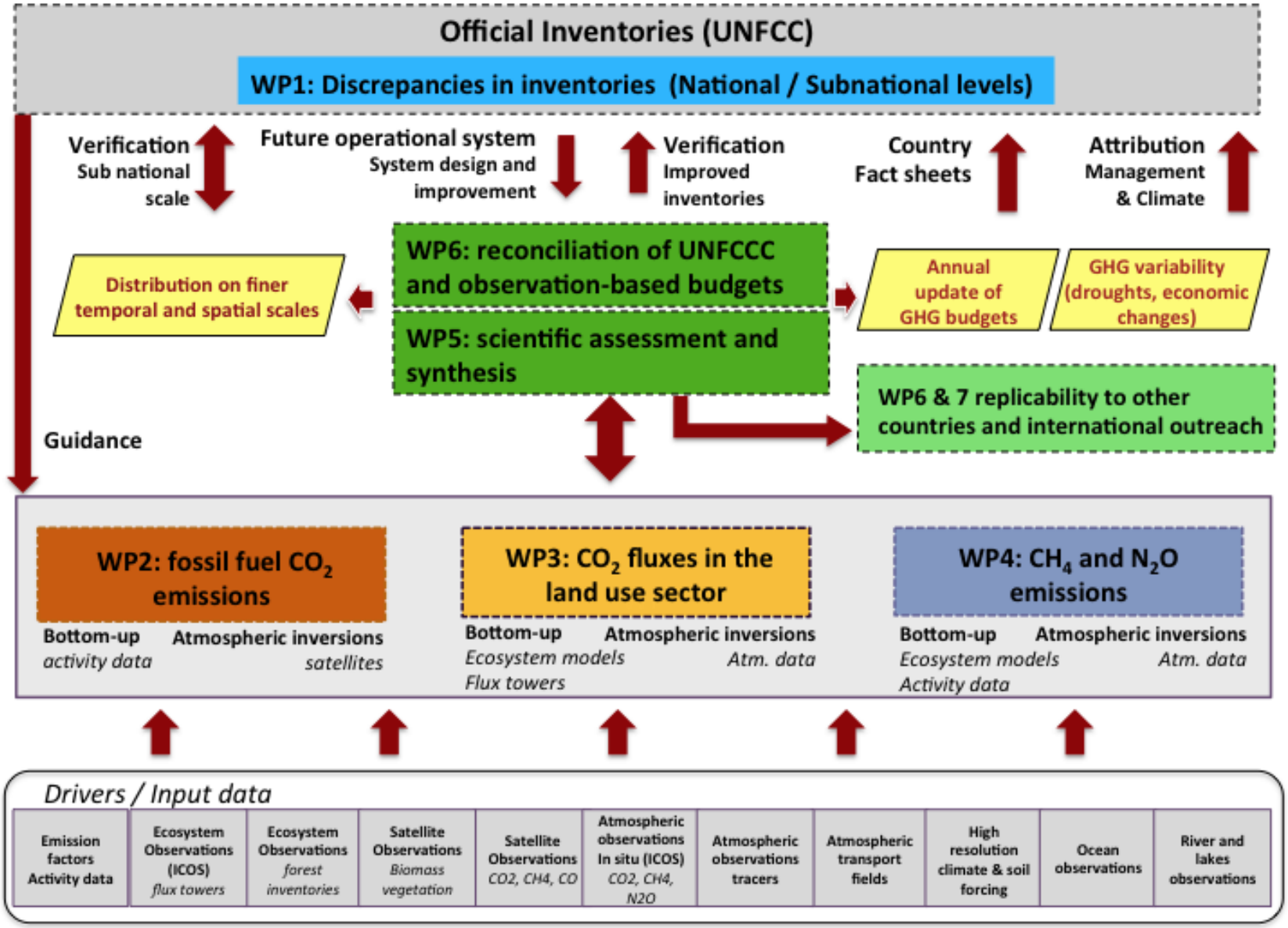
Verify structure

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION HORIZON 2020



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$ffCO_2$ emissions in Verify

Task 2.1: Bottom-up emission estimates for anthropogenic CO_2 and co-emitted tracers

Task 2.2: Assessment of atmospheric $CO/ffCO_2$ and $NO_2/ffCO_2$ ratios and independent $^{14}CO_2$-based $ffCO_2$ emission estimates

Task 2.3: Annual to weekly budgets and trends of fossil CO_2 emissions at the national scale across Europe using CO and NO_x satellite measurements

Task 2.4: Exploring the potential of new data, upcoming instruments, and new methods to improve the pre-operational $ffCO_2$ estimation system

Tracers for $ffCO_2$

To increase the temporal resolution of $ffCO_2$ estimates co-emitted/consumed tracers like CO, NO_x or APO are used

APO= Atmo. potential Oxygen

$$APO = O_2 + (-1.1/0.2095) \times (350\text{-}CO_2)$$

Using the emission ratio R between the co-emitted tracer and $ffCO_2$ we can estimate $ffCO_2$ based on the continuously measured proxy species

CO based $$ffCO_2 = \frac{CO_{obs} - CO_{bg}}{R_{CO:CO_2}}$$

APO based $$ffCO_2 = \frac{APO - APO_{bg}}{R_{APO:CO_2}}$$

APO has the advantage that the ratio R for typical combustion processes varies less than for CO.

$R_{CO/CO2}$ = 5 to 25 ppb/ppm

$R_{APO/CO2}$ = -1.3 to -1.4 per meg/ppm

Summary

- $ffCO_2$ signal at ICOS class 1 stations is small
- RINGO will critically assess the added value of integrated $^{14}CO_2$ samples
- A methodology to monitor emission hot-spots using $^{14}CO_2$ will be developed in RINGO
- Co-emitted/consumed tracers like CO, NO_2 and APO can improve the temporal resolution of the $ffCO_2$ estimate
- A solid understanding of tracer/$ffCO_2$ ratios are key to derive reliable $ffCO_2$ estimates
- Collaboration with emission-modellers suggested