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**CO₂
Human
Emissions**

WP5 - TOWARDS A PROTOTYPE OF A EUROPEAN ANTHROPOGENIC EMISSION MONITORING SYSTEM

CHE-VERIFY General Assembly

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J. Flemming, Z. Kipling, J. Barré, S. Massart,
R. Engelen and all CHE partners

ECMWF
12/03/19

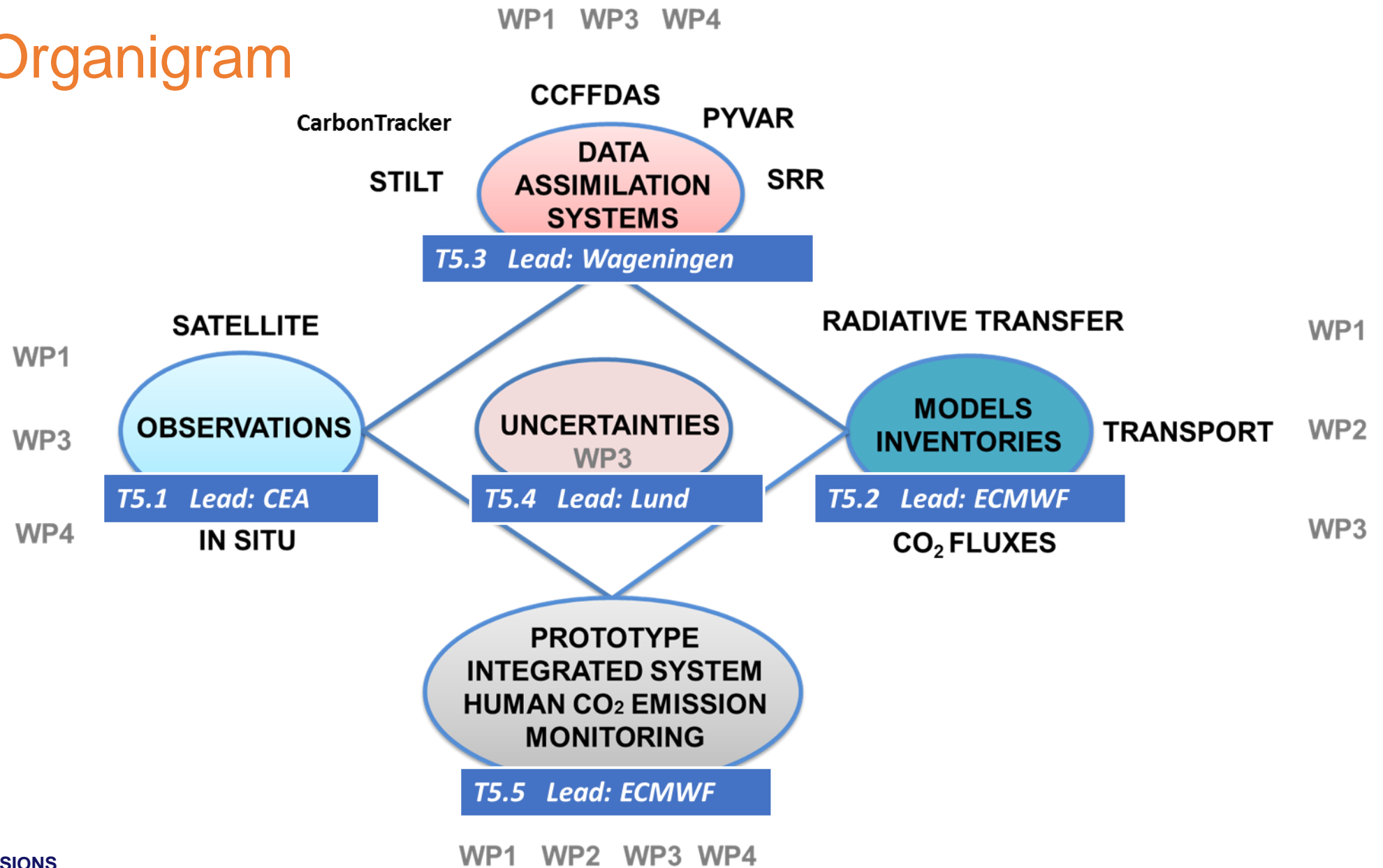
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776186.



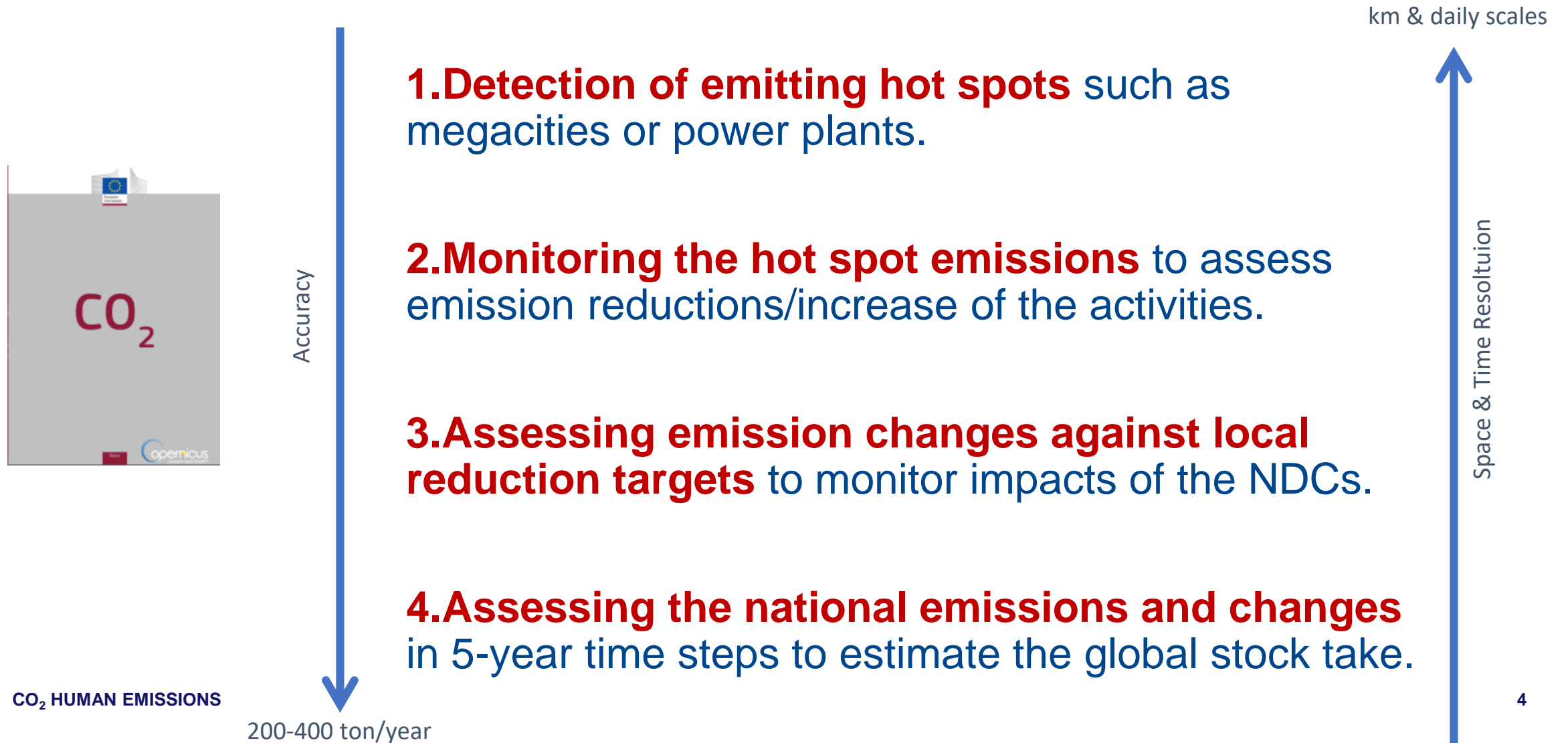
WP5 Objectives

1. **Integrate** research components from WP1 to WP4 to probe elements of future operational system:
(***synthesis**: The combination of components or elements to form a connected whole*)
2. Find **synergies** between different types of observations/models/DA approaches
3. **Design** the components for a future **prototype** based on user requirements on the estimation of emissions and their trends at the relevant spatial and temporal scales

WP5 Organigram

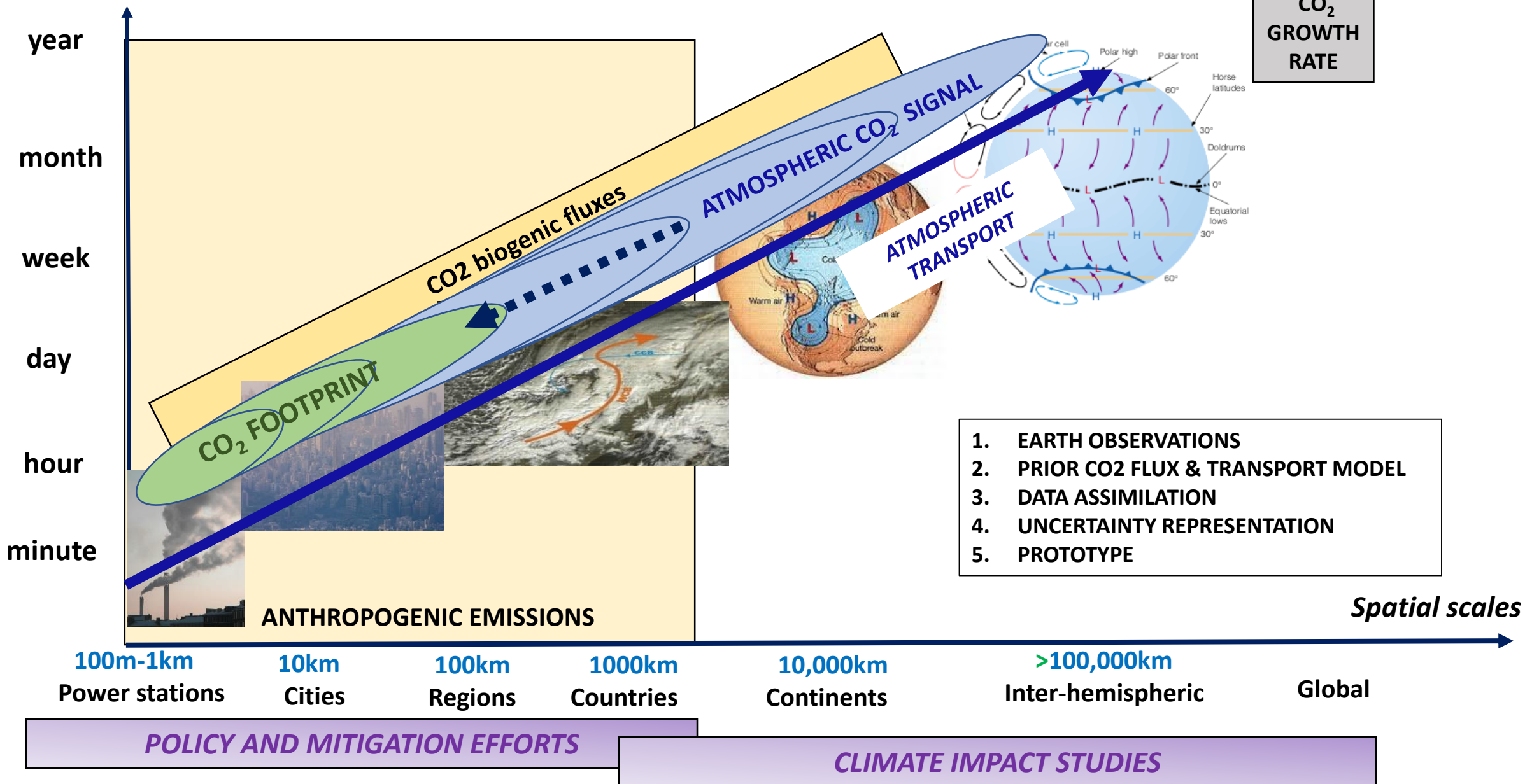


High level requirements for prototype from Task Forces

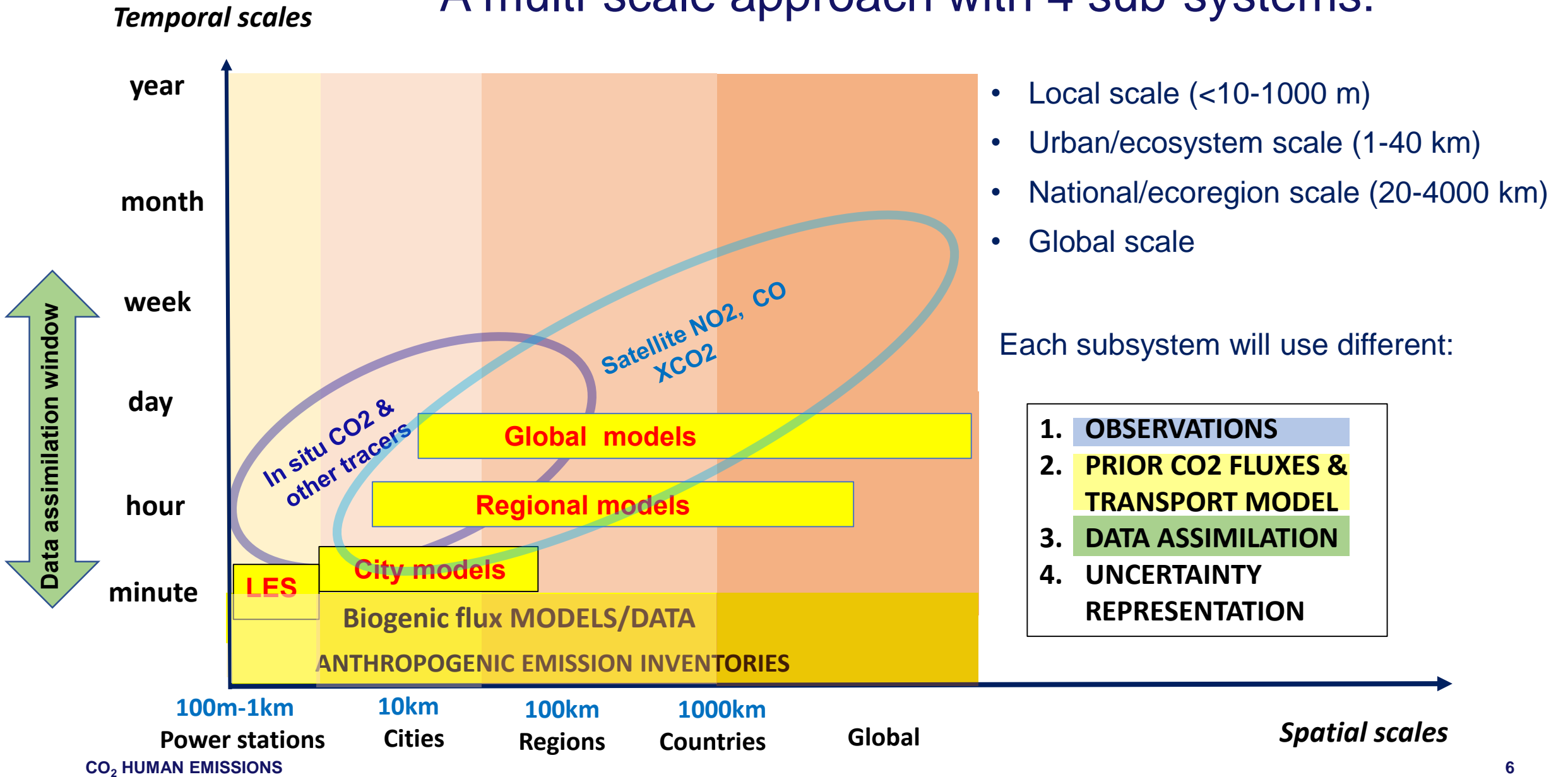


A multi-scale approach: overview

Temporal scales



A multi-scale approach with 4 sub-systems:

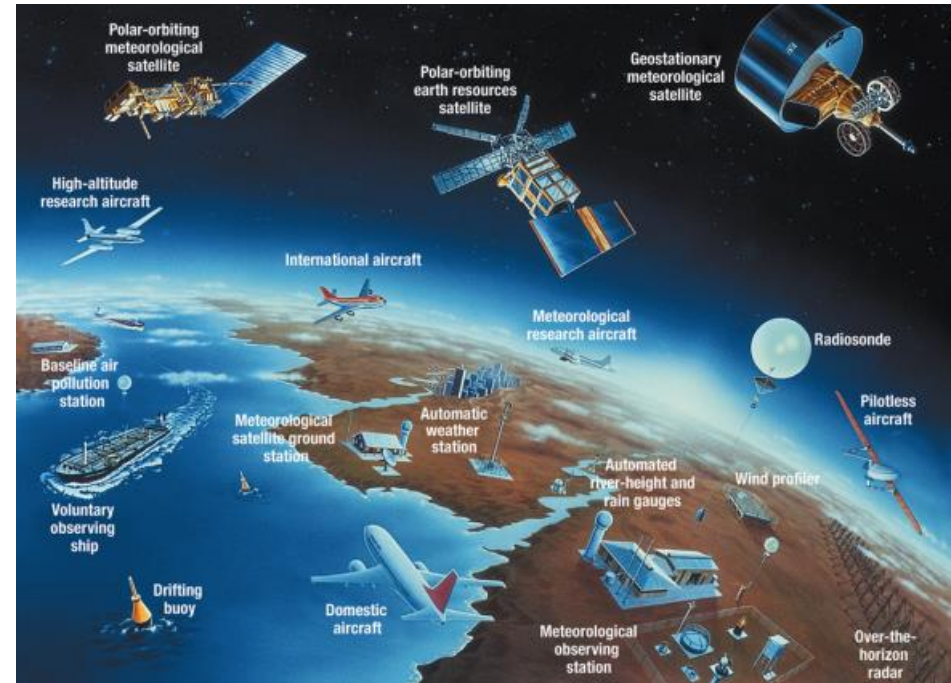


Outline of synthesis report T5.1:

Earth Observations

Task leader : Frédéric Chevallier (CEA)

1. **Satellite CO₂ retrievals**
(WP1,WP3)
2. **Satellite retrievals of co-located species**
(WP3)
3. **In situ observations of additional trace species of fossil CO₂** (WP3, WP4)
4. **Observations of the weather and surface**
(WP1, WP3, WP4)
5. **Verification observations**
(WP1,WP3,WP4)



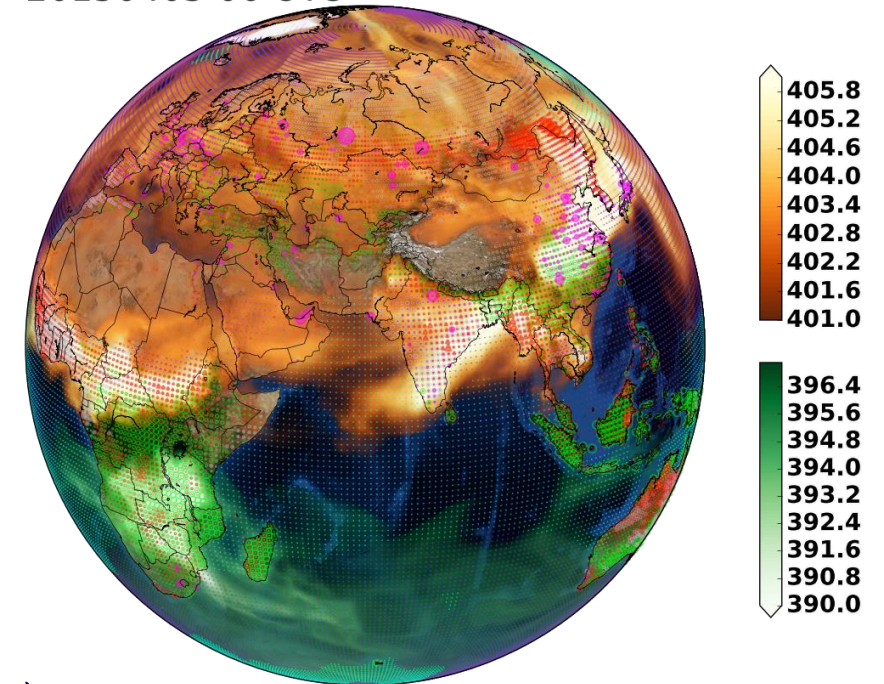
WMO Integrated Global Observing System (WIGOS)
(Graphic: WMO)

Outline of synthesis report T5.2: Prior information and models

Task leader: Anna Agusti-Panareda (ECMWF)

- 1. Multi-scale transport models**
(WP2, WP4)
- 2. Anthropogenic emission inventories and FF emission models**
(WP2, WP3)
- 3. Biogenic flux models and data-based products**
(WP2, WP3)
- 4. Atmospheric chemistry modelling requirements**
(WP2, WP3)

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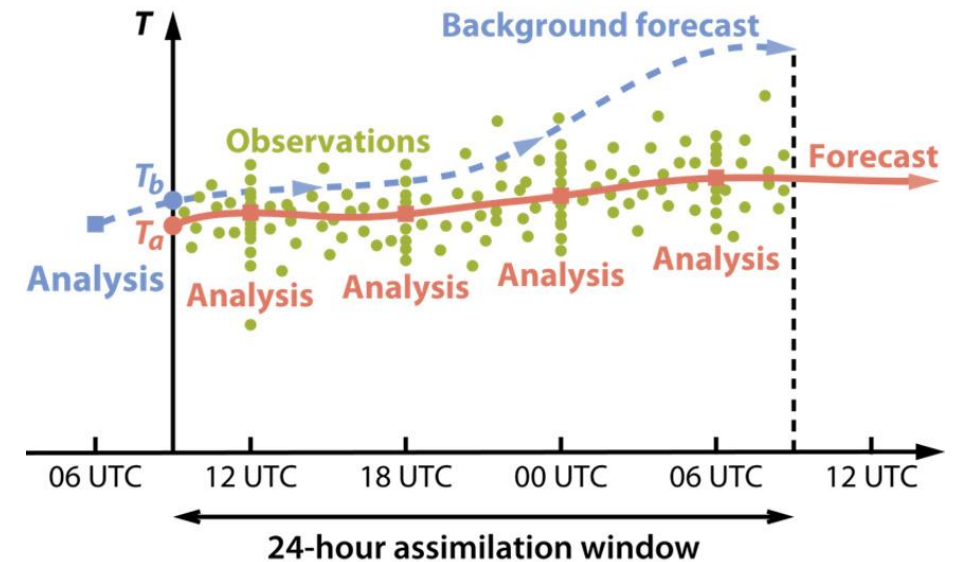


*CO₂ forecast with Integrated Forecasting System (IFS)
(Graphic: Anna Agusti-Panareda, ECMWF)*

Outline of synthesis report T5.3: Data assimilation methodology

Task leader : Wouter Peters/Maarten Krol (Wageningen University)

1. **Methodology:** Ensemble/4DVar/hybrid (WP1)
2. **Window length requirements** (WP1, WP3, WP4)
3. **Coupled data assimilation** (WP1)
4. **State vector:** model parameter and flux estimation (WP1, WP3, WP4)

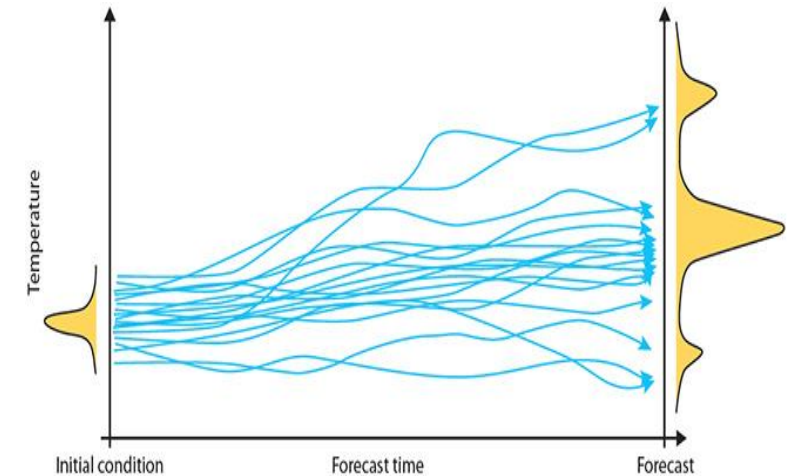


*Schematic form of the ERA-CLIM data assimilation
(Graphic: ECMWF)*

Outline of synthesis report T5.4: Uncertainty representation

Task leader: Marko Scholze (University of Lund)

- 1. Component uncertainties** (WP2, WP3, WP4)
- 2. Methodologies for uncertainty estimation** (WP1, WP3, WP4)
 - Reconciliation of top-down and bottom up
 - OSSEs and QND studies
 - Assessment of error propagation
- 3. Requirements on the MVS capacity** (WP1, WP3, WP4)
 - Robust uncertainty estimation to capture all sources of uncertainty
 - Evaluation of posterior fluxes against independent data and diagnostics/metrics



*An ensemble of forecasts produces a range of possible scenarios. The distribution of the ensemble members gives an indication of the likelihood of occurrence of those scenarios.
From Sarah-Jane Lock (Graphic: ECMWF)*

Outline of synthesis report T5.5:

Prototype design

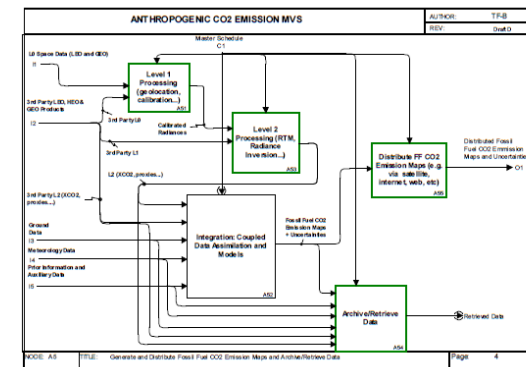
Task leader: Gianpaolo Balsamo (ECMWF)

1. Blueprint of a multi-scale system

- a. Local
- b. Urban
- c. National
- d. Global

2. Recommendations for system configuration

- a. Operational readiness
- b. Reliability/robustness, computational cost/efficiency
- c. Potential and further research



Living document to integrate recommendations across WPs

- Open to all CHE partners (via confluence website or email)
- Updated during preparation of quarterly progress reports by WP5 task leaders
- To be included in next Quarterly Management Report to communicate progress to EC

1. Identify CHE research activities relevant for each WP5 task

WP	Partners	Activity	Recommendations	Application	WP5 contribution

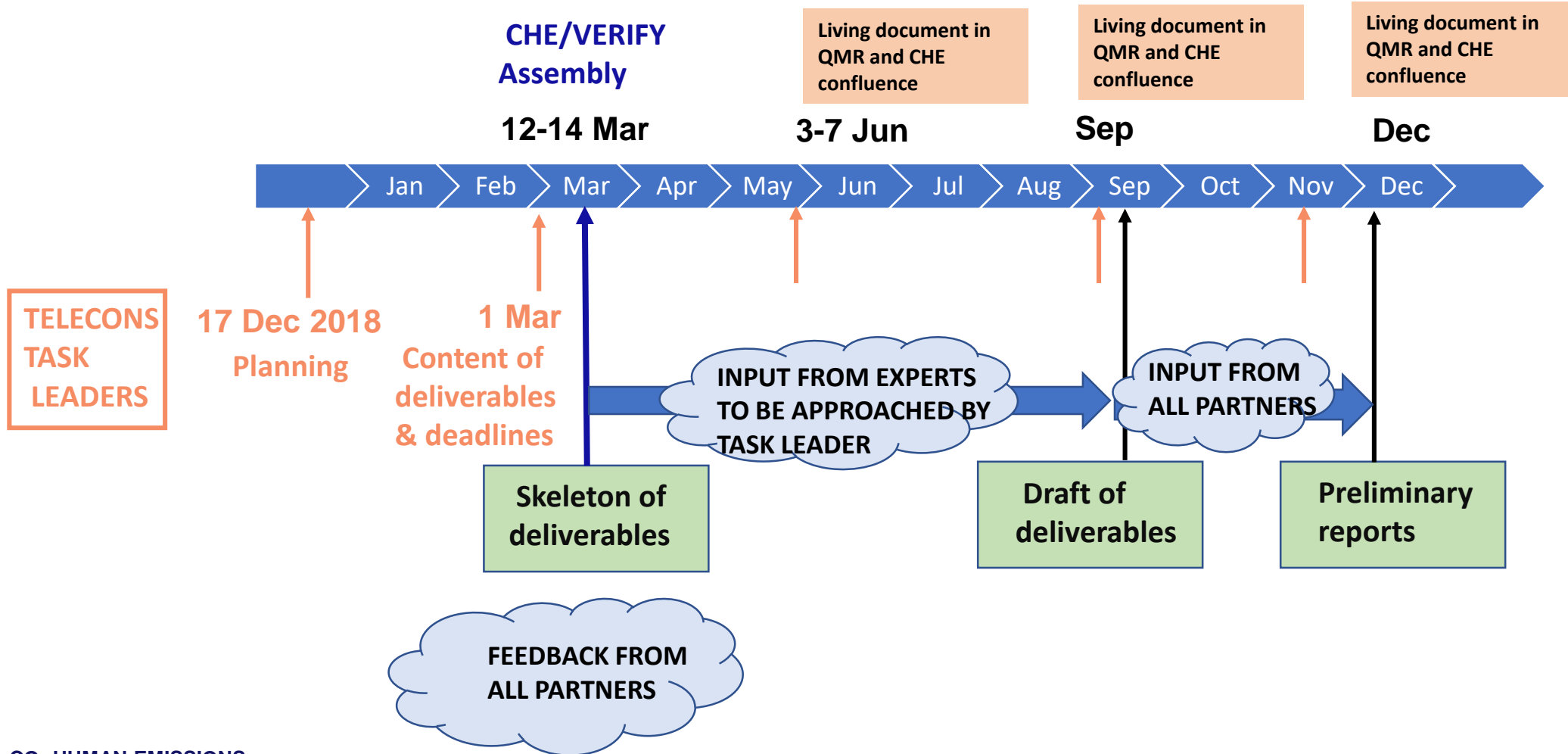
2. Link activities across WPs to prototype report

Activity across WP	Recommendation for prototype	WP links	Links with VERIFY & ESA studies	WP5 report	Contact lead
			<ul style="list-style-type: none"> • SMARTCARB • PMIF • ATMOS • CCFFDAS 		

3. Provide concrete recommendations on options available for prototype

Building block	Components	Options	Operational readiness	Gaps, risks, uncertainties	Future research required

Planning and timeline for 2019



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ECMWF
12/03/19

