Co-ordinated by ECMWF

CO_2 Human Emissions

WP5 OVERVIEW

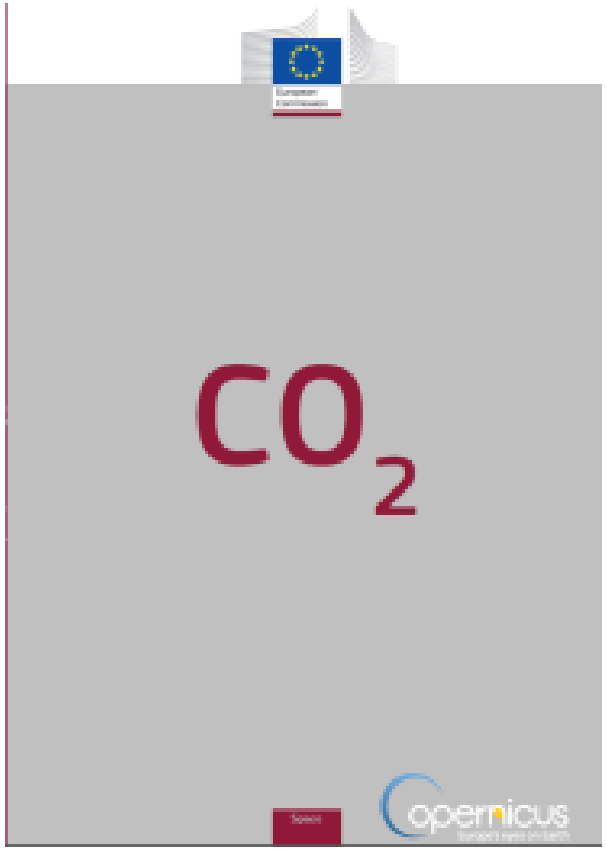
Towards a prototype to monitor fossil fuel emissions

WP leaders: Anna Agusti –Panareda and Gianpaolo Balsamo

ECMWF
06/02/2018

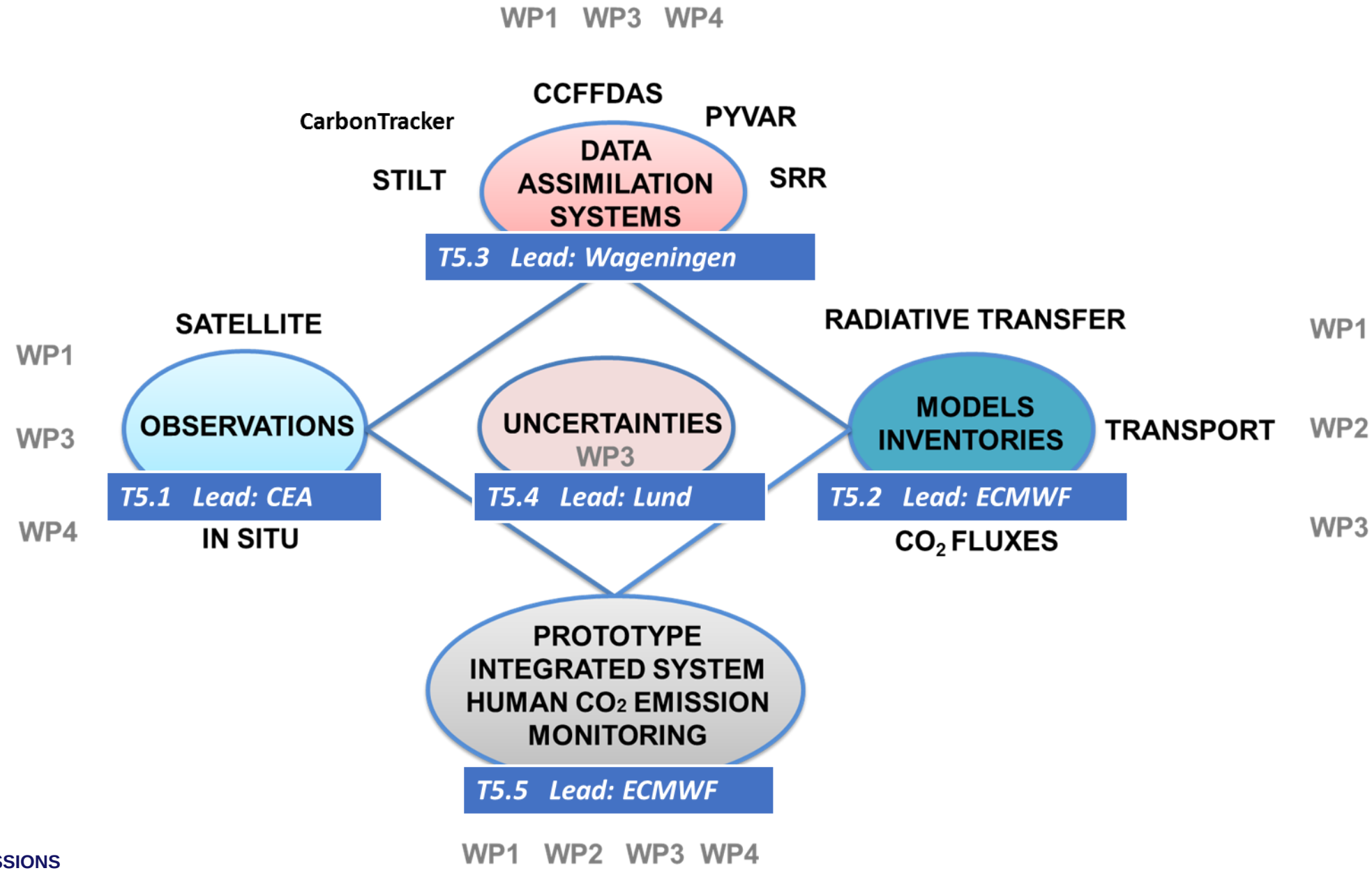
Capabilities for operational monitoring system

1. Detection of emitting hot spots (e.g. megacities, power plants).
2. Monitoring the hot spot emissions to assess emission reduction of the activities.
3. Assessing emission changes against local reduction targets to monitor impacts of the Nationally Determined Contributions.
4. Assessing national emissions and changes in 5-year time steps to estimate the global stock take.



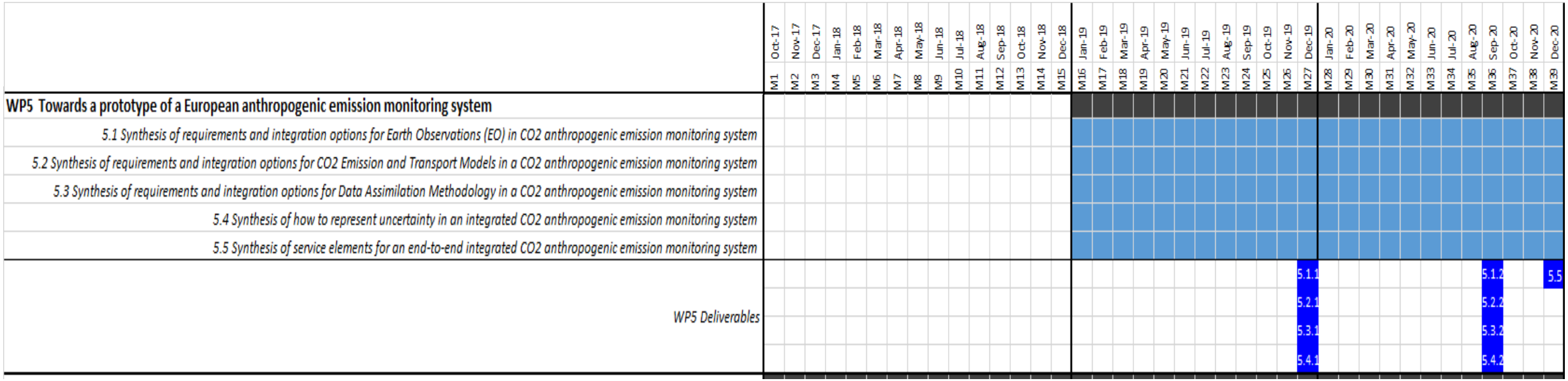
Extracted from report by CO_2 monitoring Task Force – sub-task B (European Commission)

WP5


WP1 WP3 WP4
CCFFDAS
CarbonTracker
PYVAR
DATA ASSIMILATION SYSTEMS
STILT
SRR
T5.3 Lead: Wageningen
SATELLITE
WP1
WP3
WP4
OBSERVATIONS
T5.1 Lead: CEA
IN SITU
UNCERTAINTIES
WP3
T5.4 Lead: Lund
RADIATIVE TRANSFER
WP1
MODELS INVENTORIES
TRANSPORT
WP2
T5.2 Lead: ECMWF
WP3
CO2 FLUXES
PROTOTYPE INTEGRATED SYSTEM HUMAN CO2 EMISSION MONITORING
T5.5 Lead: ECMWF
WP1 WP2 WP3 WP4

WP5 tasks/deliverables

- 5 tasks : Jan 2019-Dec 2020
- 5 deliverables: Synthesis reports on requirements for integration of building blocks
  - Preliminary report: Dec 2019 (M27)
  - Final report: Sep 2020 (M36)
  - Final report on prototype : Dec 2020 (M39)



T5.1 Requirements and integration options for observing system

Led by Frederic Chevallier (LSCE)

- What are the observations required to characterize and monitor fossil fuel signal associated with emission hotspots?

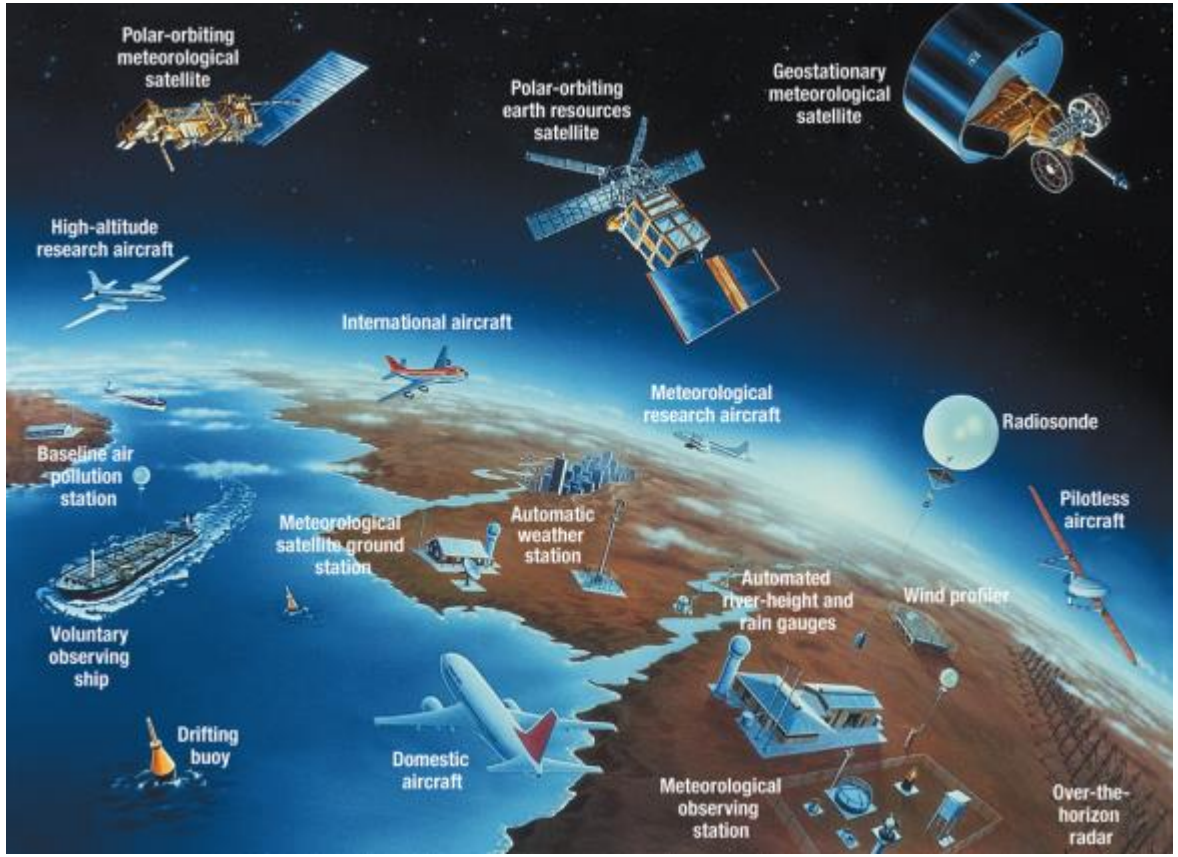
  Instrument sensors, satellite orbits and ground-based networks

- Can we design an observing system to monitor fossil fuel signal with homogeneous temporal and spatial sampling at global scale given sun-lit and cloud-free requirements of current satellites?

  Spatial and temporal coverage and resolution

- How can we monitor random and systematic errors in the observing system?

  Independent evaluation and calibration



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

T5.2 Requirements and integration options for CO_2 emission and transport models

Led by Anna Agusti-Panareda (ECMWF)

- What are the processes and model resolution required to interpret assimilated observations ?

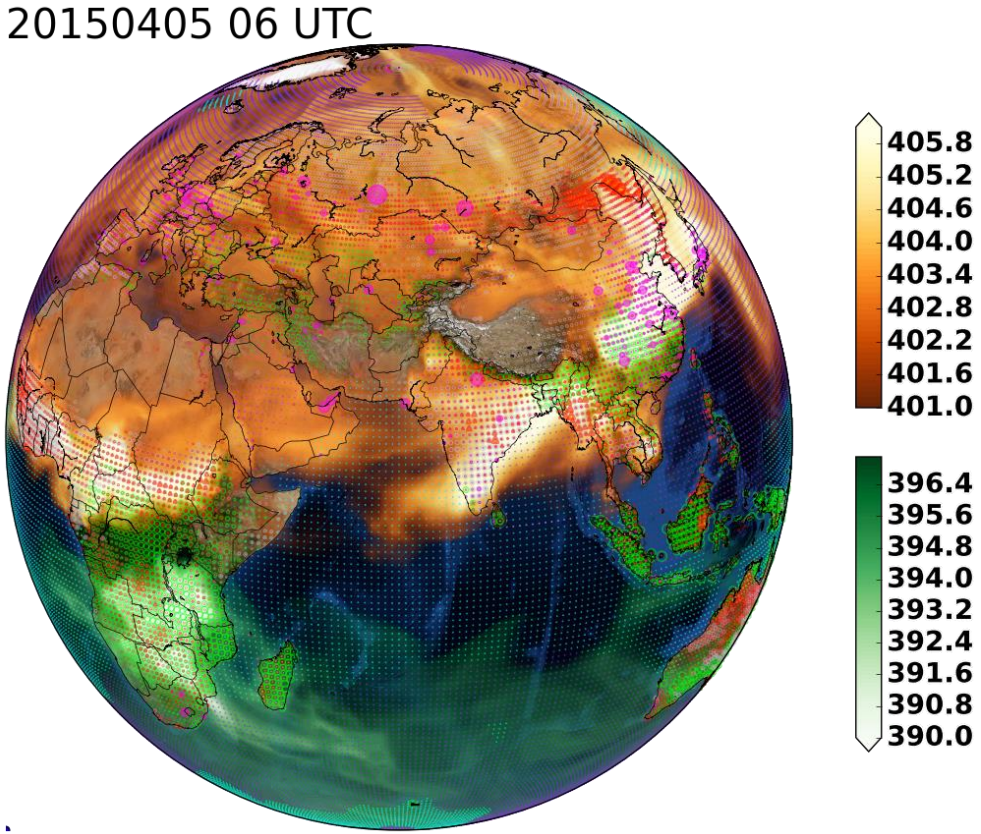
  Complexity and information in models

- How do we couple the different model components to ensure consistency and synergy between them?

  Online versus offline model components and their interactions

- How can we monitor random and systematic errors of different model components?

  Independent evaluation of model biases, mass conservation, impact of averaging/interpolation/gridding and sub-gridscale variability



Simulation of XCO_2 [ppm] from CAMS CO_2 forecast (Graphic: ECMWF)

T5.3 Requirements and integration options for data assimilation (DA) methodology

Led by Wouter Peters (Wageningen University)

- Can we estimate atmospheric CO_2 concentrations, CO_2 fluxes and model parameters relevant to fossil fuel emissions in the same DA system ?

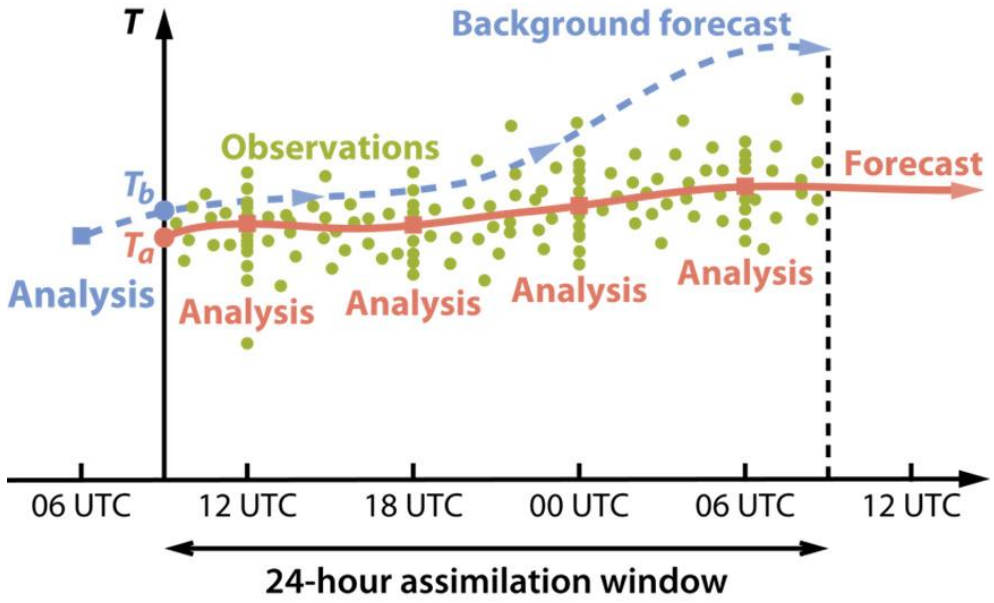
  Specification of control vector

- What is the optimal DA window considering linearity of required observation operators and potential integration with NWP?

  Optimal length of assimilation window

- How can we integrate assimilation of CO_2 and related tracers into NWP methodology ?

  Requirements for time/space discretization, covariances between weather + trace gases, weighting of different data volumes+frequencies



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

T5.4 Representation of uncertainty in the integrated monitoring system

Led by Marko Scholze (Lund University)

- How can we ensure that the prescribed errors and their covariances are realistic and consistent for all system components?

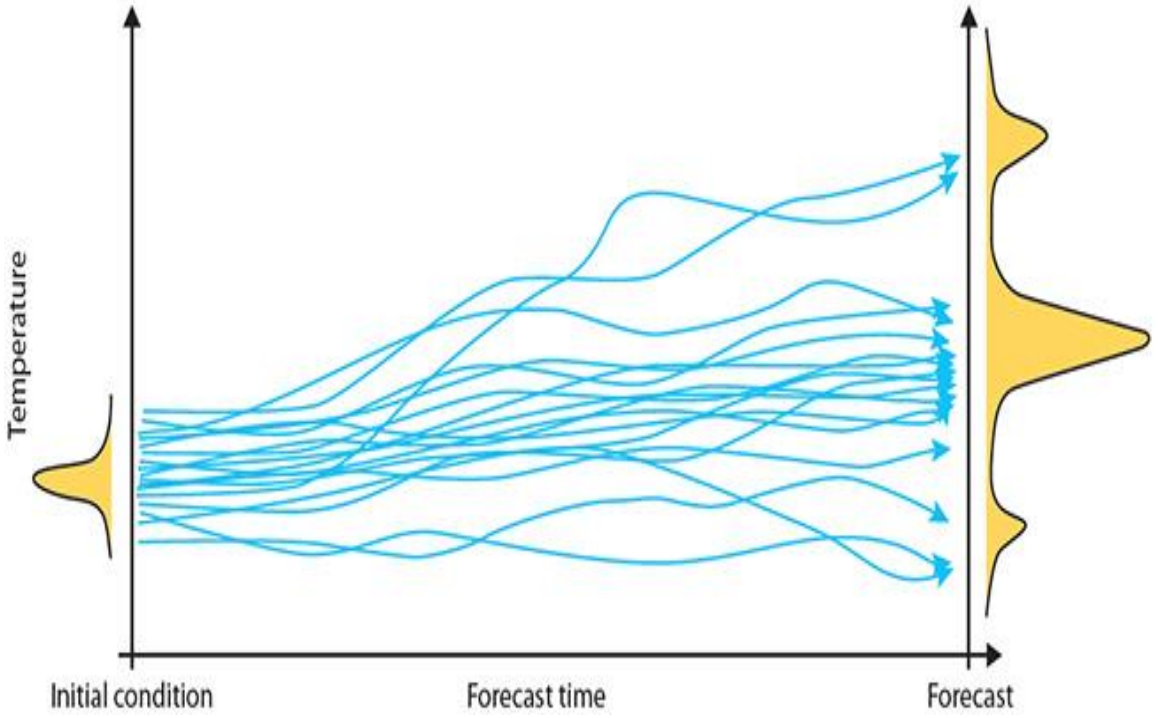
  Error characterization and monitoring of input priors, forcing data, observations, observation operators, and output posterior estimates; comparison against independent observations

- How can we deal with systematic errors?

  Online versus offline bias corrections

- Are there any assumptions/limitations in the uncertainty propagation in FFDAS ?

  Linearity and missing processes in models



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)

T5.5 Service elements of end-to-end monitoring system

Led by Gianpaolo Balsamo (ECMWF)

- Can we propose a distributed/consistent processing chain integrating all building blocks?

  Blueprint of integrated end-to-end monitoring system

- What are the key performance indicators of input/output channels and verification process of monitored target ?

  Verification strategy

- Is there any bottleneck that could hamper operational implementation and efficiency of monitoring system?

  Operational constraints, e.g. computing resources, data access, timeliness in delivery

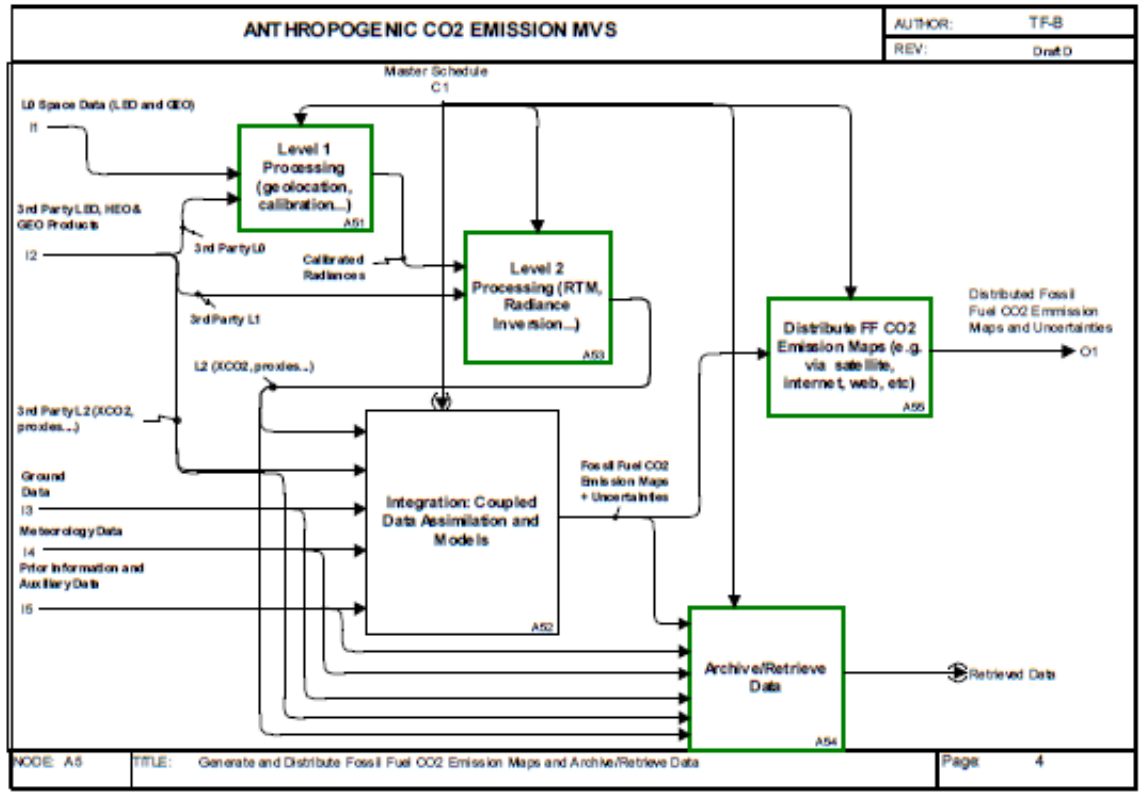


Diagram of Anthropogenic CO_2 emission Monitoring and Verification Support (MVS) from report by CO_2 monitoring Task Force – sub-task B (Graphic: European Commission)

WP5 preparation stage in 2018

- Feedback from External Advisory Board (EAB) and External Expert Group (EEG) on challenges to be addressed

- Telecon and/or meeting with task leaders and relevant partners to discuss workflow around each synthesis/task
  - Define steps to address each of the challenges
  - Establish collaboration between research groups

(Graphic: LANSA blog)


CO_2
Human
Emissions