European Commission

CEOS AC-VC #14

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Towards an operational capacity to monitor fossil fuel CO_2 emissions

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[(3)] Major international institutions

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Political Context and Challenges

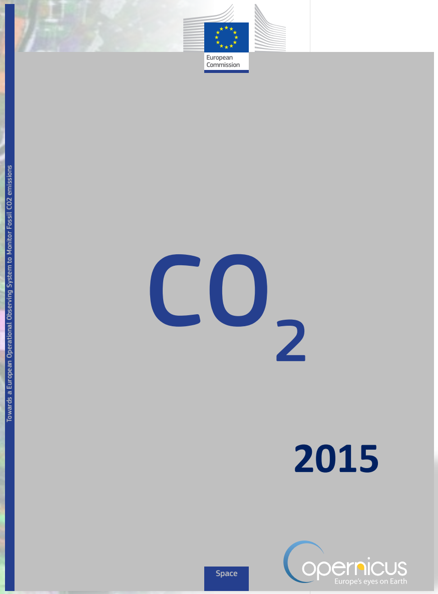
- UNFCCC Parties agreed for an "enhanced transparency framework" to be implemented bottom-up through national inventory reports (Paris Agreement, 2015) and complemented by a global CO_2 Monitoring and verification support capacity to fill in gaps of data.

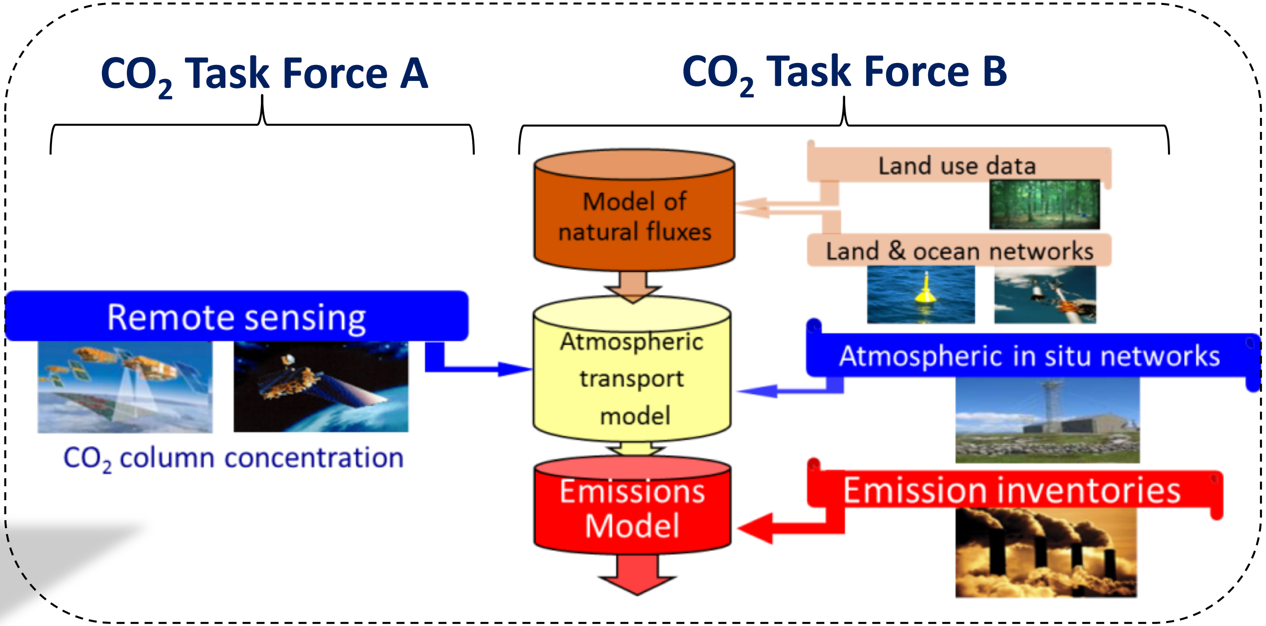
- The global CO_2 budget needs to provide input to the 5-yearly global stocktake exercise starting from 2023 established under the Paris Agreement.

- Analysis at local/regional level may help countries in evaluating the effectiveness of their CO_2 emission reduction strategies and possibly in defining revised Nationally Determined Contributions of the UNFCCC Parties.

- Need to provide independent evidence on and verification of nationally reported anthropogenic CO2 emissions and help assessing the uncertainties and gaps associated with the emission inventories.

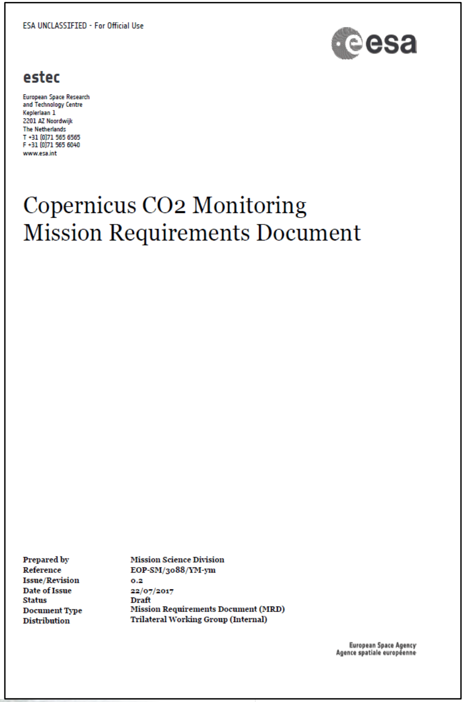
Functional Architecture – A holistic view





The crux of the matter is about increasing significantly the **density of high quality relevant observations**

Objectives and Requirements from the Space Component: Task Force A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Copernicus CO2 Monitoring
Mission Requirements Document

Prepared by	Mission Science Division
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Status	Draft
Document Type	Mission Requirements Document (MRD)
Distribution	Trilateral Working Group (Internal)

European Space Agency
Agence spatiale européenne

- XCO_2 precision: **0.5 – 0.7 ppm**
- Systematic bias **< 0.5 ppm**
- Spatial resolution about **4 km^2**
- Continuously sampled swath width **> 200 km**
- Revisit around **3 days** (poleward of 40 deg)
- A constellation of **N** satellites (N about **3** to **4**)
- Orbit equator crossing time **11:00 – 12:00 hrs**

Band	Spectral range [nm]	Spectral resolution [nm]	SNR at reference radiance
NIR	747–773	0.1	400 - 600
SWIR-1	1590–1675	0.3	300 - 500
SWIR-2	1925–2095	0.55	200 - 400

- Radiometric uncertainty < 3%
- Relative radiometric accuracy < 0.5%

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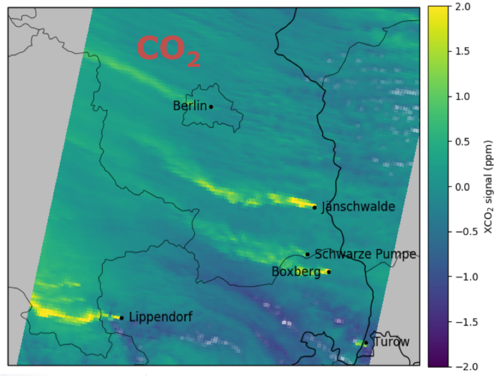
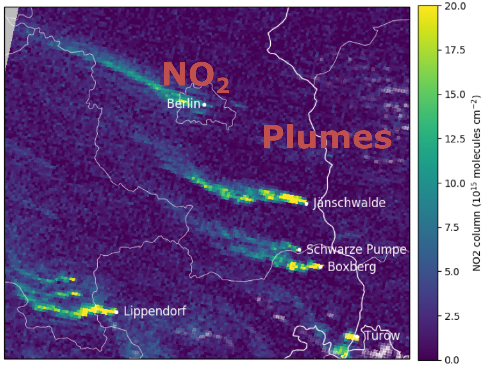
Consolidating Requirements: Main Open Points

- Complementary **NO_2** and/or **CO** observations for attribution of anthropogenic emission sources → Y/N?
- Complementary **aerosol/cloud observations** for light path correction → Y/N?
- Temporal/spatial coverage → **how many satellites**?





Functional Architecture – An integrated system approach: Task Force B

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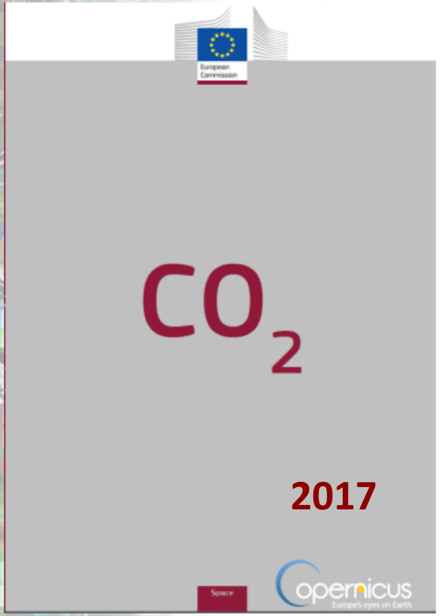

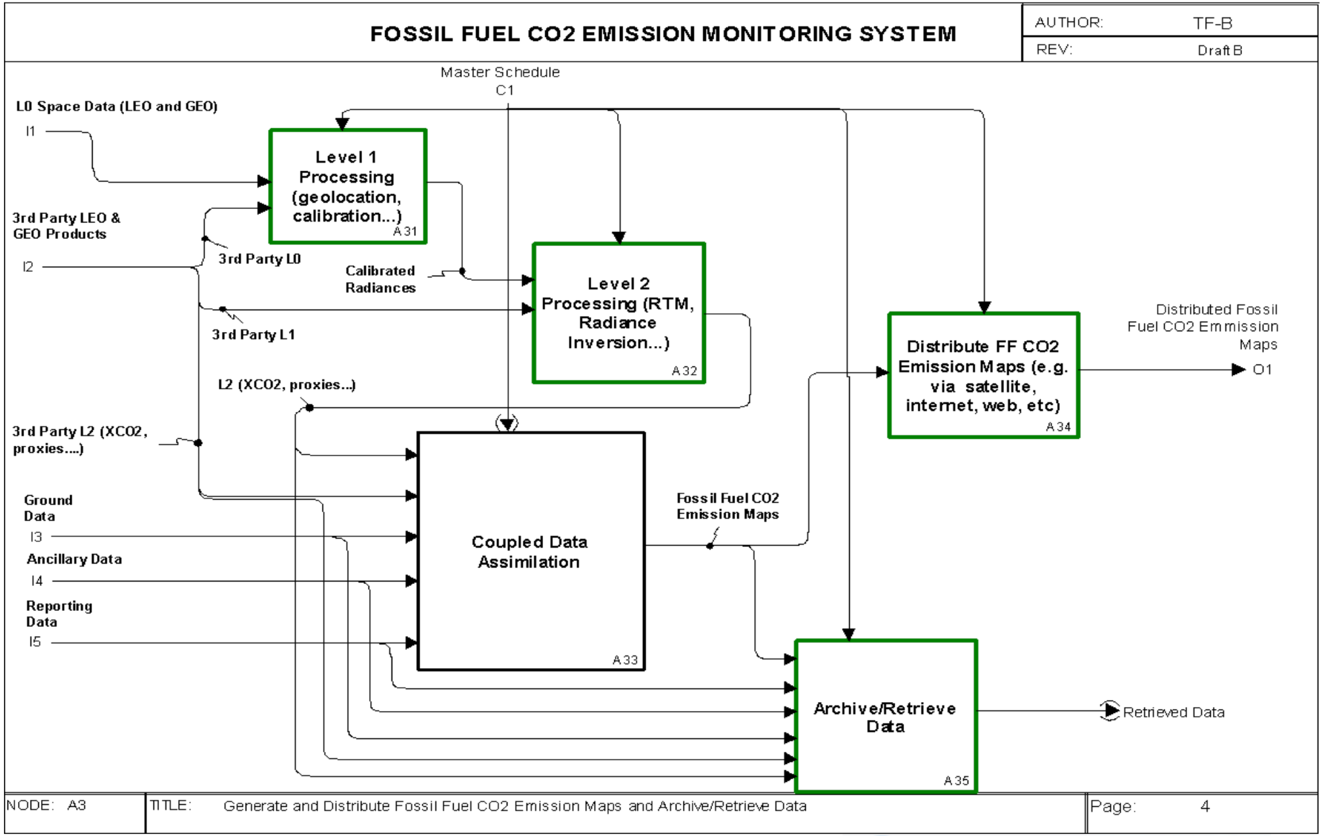

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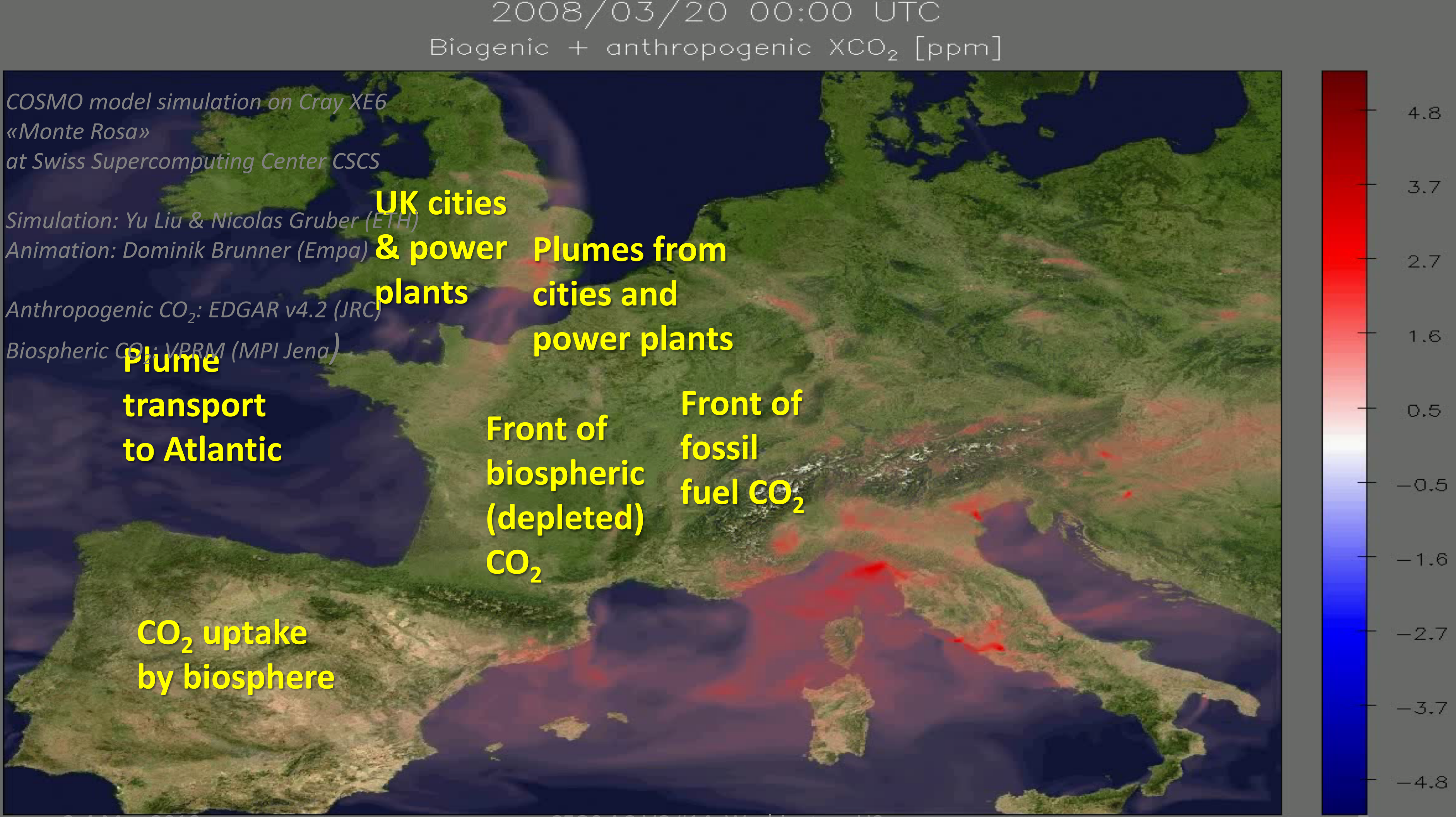
2008/03/20 00:00 UTC
Biogenic + anthropogenic XCO_2 [ppm]
COSMO model simulation on Cray XE6
«Monte Rosa»
at Swiss Supercomputing Center CSCS
Simulation: Yu Liu & Nicolas Gruber (ETH)
Animation: Dominik Brunner (Empa)
Anthropogenic CO_2: EDGAR v4.2 (JRC)
Biospheric CO_2: VPRM (MPI Jena)
UK cities & power plants
Plumes from cities and power plants
Plume transport to Atlantic
Front of biospheric (depleted) CO_2
Front of fossil fuel CO_2
CO_2 uptake by biosphere
4.8
3.7
2.7
1.6
0.5
−0.5
−1.6
−2.7
−3.7
−4.8

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High Level Requirements for the System

km & daily scales

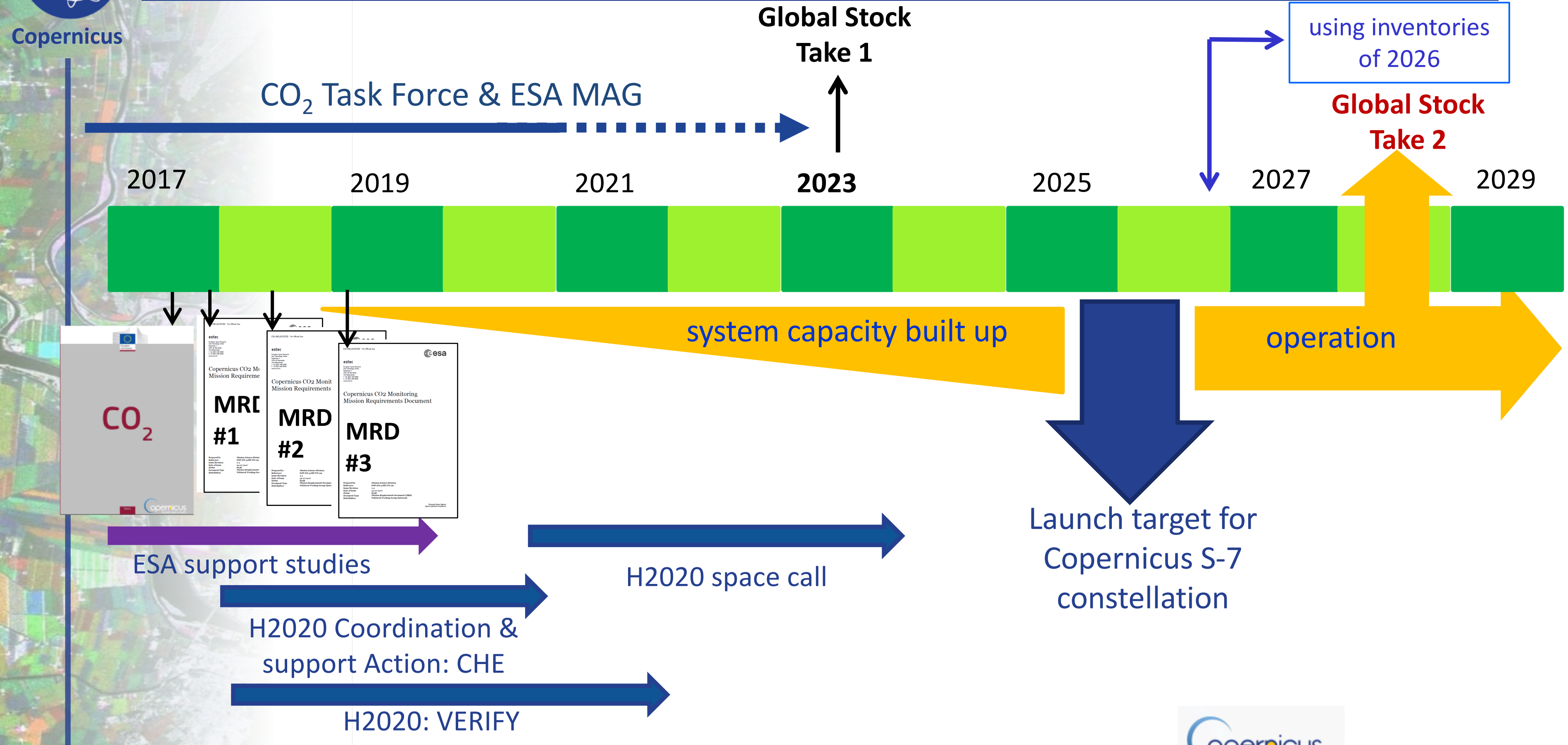
1. **Detection of emitting hot spots** such as megacities or power plants.
2. **Monitoring the hot spot emissions** to assess emission reductions/increase of the activities.
3. **Assessing emission changes against local reduction targets** to monitor impacts of the NDCs.
4. **Assessing the national emissions and changes** in 5-year time steps to estimate the global stock take.

Accuracy

Space & Time Resoltuion

200-400 ton/year

Towards an anthropogenic CO_2 Monitoring & Verification Support Capacity



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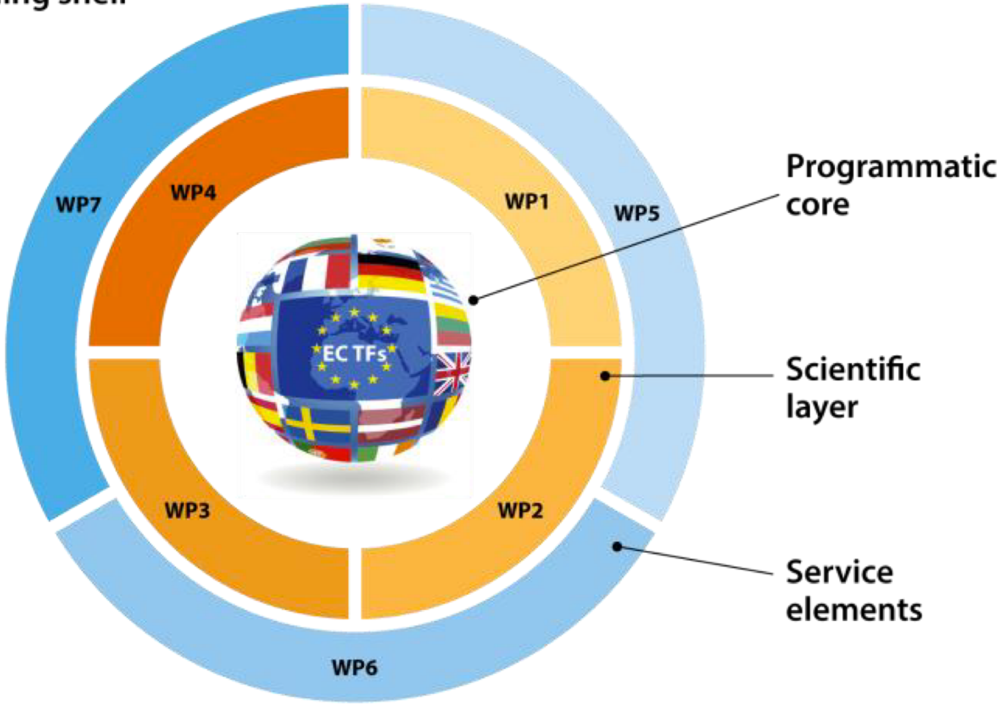
CHE main features of this coordination & support action

CHE capacity building shell



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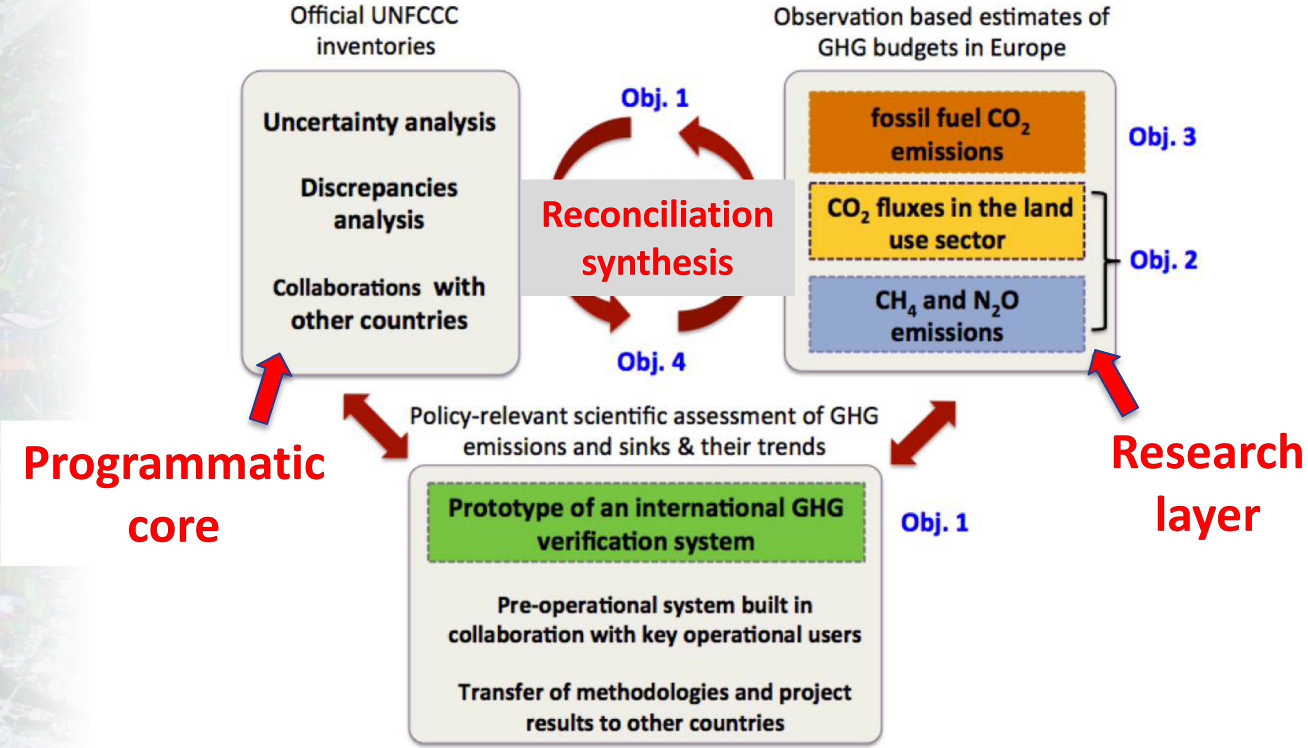
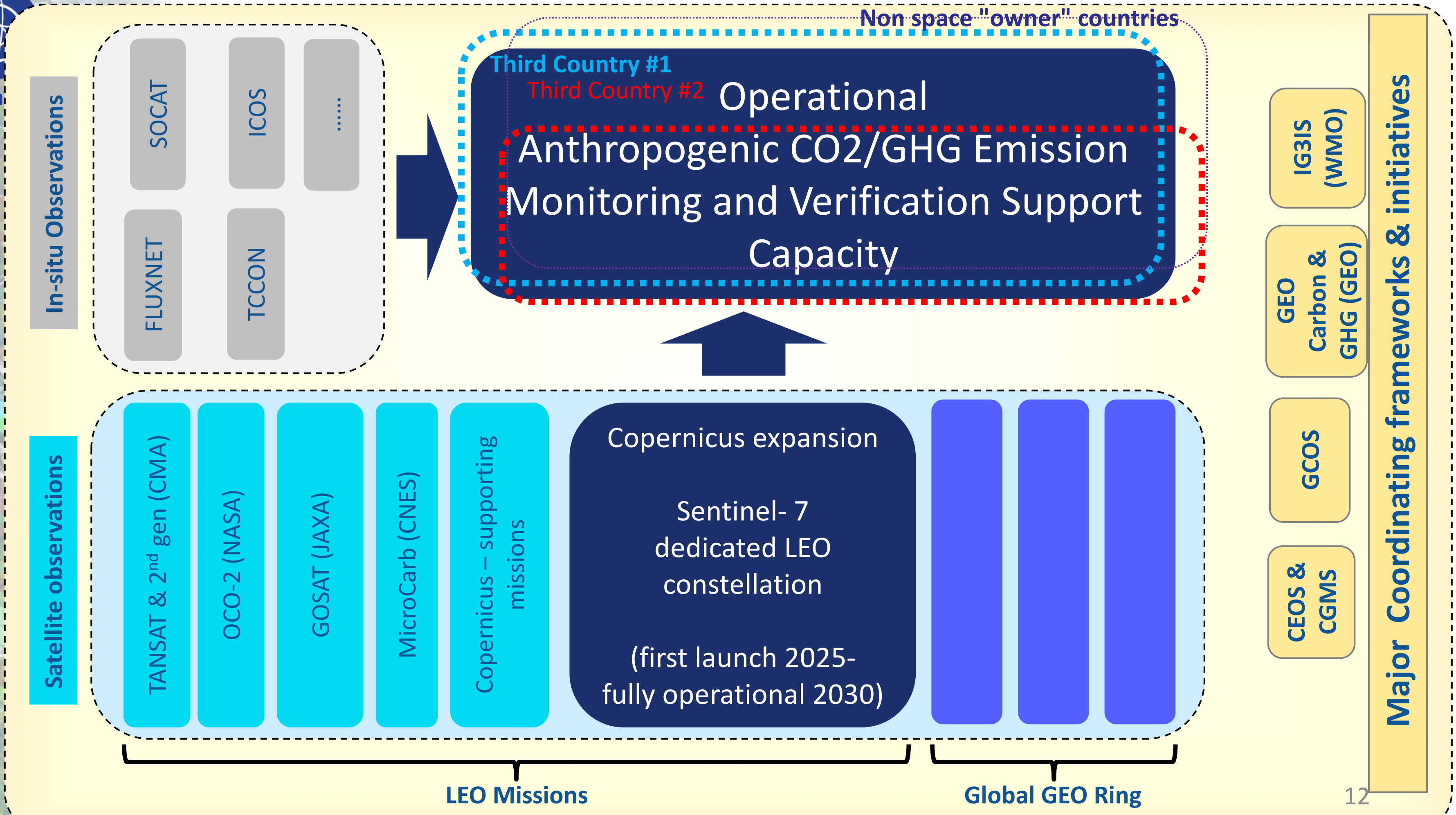


➔ Use available data to **reduce uncertainties** on official UNFCCC inventories

➔ Establish a **dialogue between inventory agencies and carbon cycle scientists**



Non space "owner" countries
Third Country #1
Third Country #2
Operational
Anthropogenic CO2/GHG Emission Monitoring and Verification Support Capacity
In-situ Observations
SOCAT
ICOS
......
FLUXNET
TCCON
Satellite observations
TANSAT & 2nd gen (CMA)
OCO-2 (NASA)
GOSAT (JAXA)
MicroCarb (CNES)
Copernicus – supporting missions
Copernicus expansion
Sentinel- 7 dedicated LEO constellation
(first launch 2025- fully operational 2030)
LEO Missions
Global GEO Ring
IG3IS (WMO)
GEO Carbon & GHG (GEO)
GCOS
CEOS & CGMS
Major Coordinating frameworks & initiatives

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Way Forward for the CO2 Task Force: 3 dedicated working groups

- Reviewing inputs from system simulations to assess the system performance.
- Apportionment of requirements between system elements.
- Identifying critical issues affecting the system design.
- Engage stakeholders on the further adjustment of the requirements, including the functionality needed for decision-making – basis for decision support system.

1

- Outlining options for the physical realisation of the functional architecture, including conducting a survey of existing capabilities, need for developments, re-use.
- Make initial assessment of options of governance arrangement for a system.
- Implementation planning .

2

- Provide a detailed assessment of activities and infrastructure requirements for in-situ observations (taking advantage of current EU investments and international partnerships)
- Provide a overview of a strategy for calibration and validation of the system and it's implications on the observing component

3

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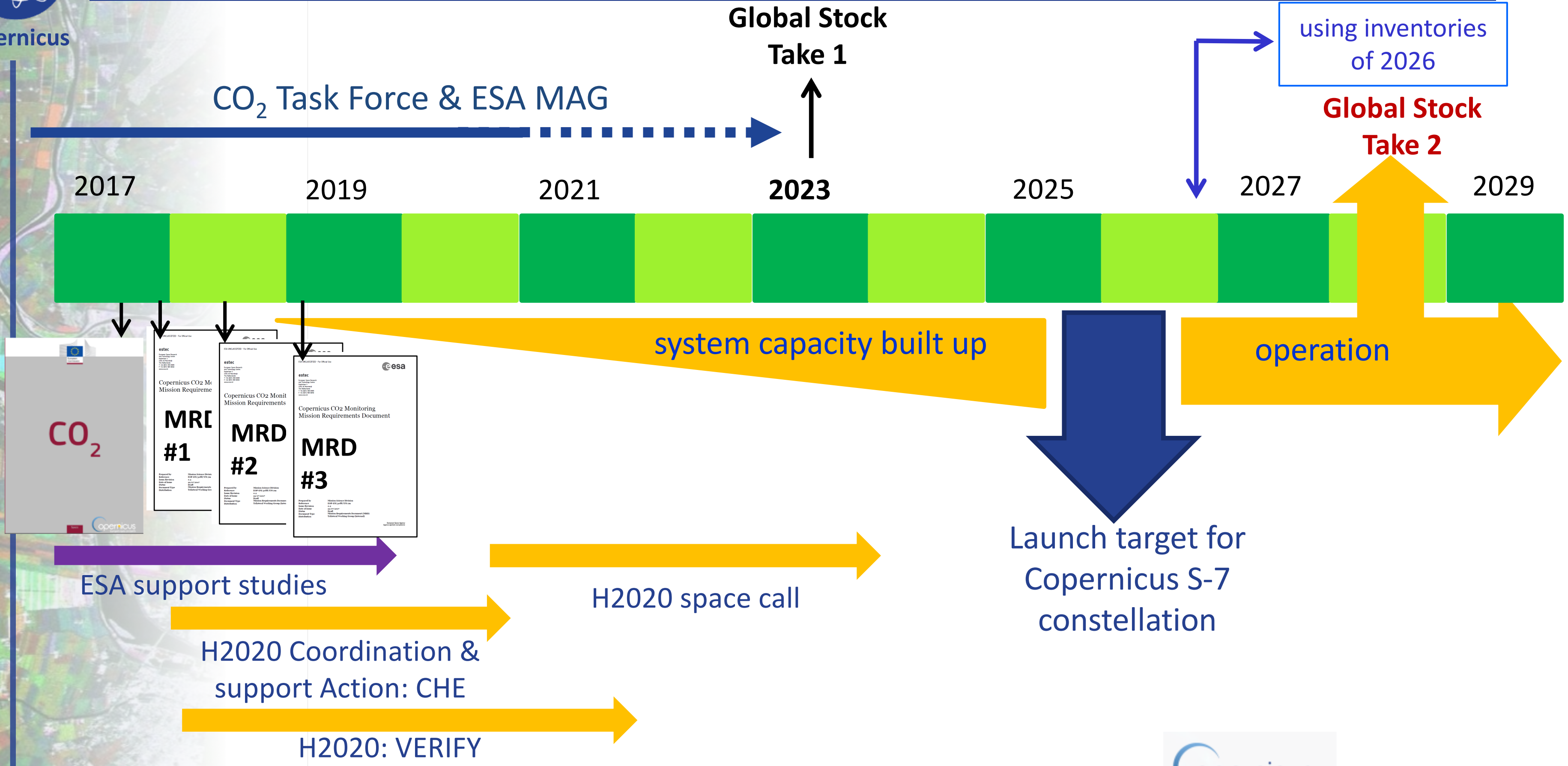
Towards an anthropogenic CO_2 Monitoring & Verification Support Capacity



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Thank you

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Space

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Activity 1

- It includes activities such as the requirements apportionment throughout the systems as well as observation system simulations
- It will depend considerably on the timing and output from the (H2020) research programme projects
- We also need to establish the best mechanism interact/provide input requirements from the TF to the projects
- Importantly, this also include item on DSS which is ill-defined in last report and which is required to complete the Architecture definition
- First output should be a cumulative roadmaps of Research projects deliverable (and TF/Programme needs) – up and including the definition of a sandbox version of the system

Activity 2

- It addresses the further development of the Architecture to identify it’s physical realization (later iterative process with Activity 1)
- It should start with a current capability and infrastructure assessment across European institution
- It should address various options for governance of the system, involving all relevant European Institutions

Activity 3

- It includes two sub-elements:
  - detailed assessment of the need for the operational system of in-situ observations and network, identify existing infrastructure and gaps, both with the EU and not.
  - to define a first order strategy for cal/val and quality control of the system (which should be mission independent) and highlight the main resources/infrastructure needs to implement this strategy
- It should also identify a first order budget requirement for the In-situ and cal/val elements