Copernicus CO2 Initiative

European Commission
Hugo Zunker

IG3IS Symposium #1 and User Summit
WMO, Geneva, Switzerland
13-15 November 2018

Space

Copernicus EU

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www.copernicus.eu

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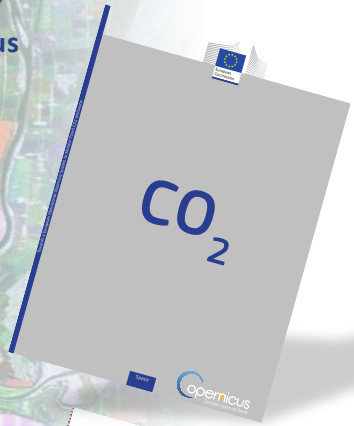
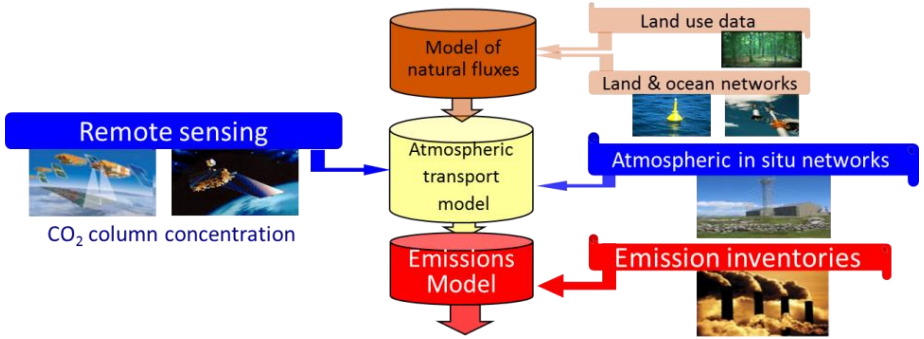
Europe's eyes on Earth

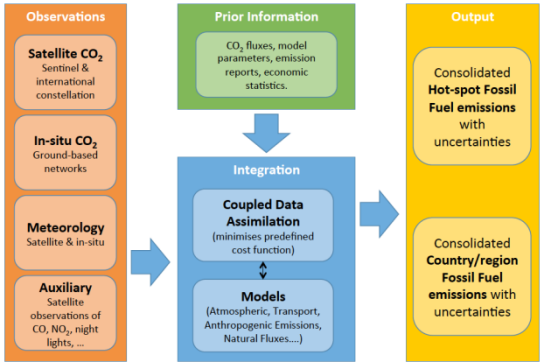
Architecture – Basis for Future Implementation

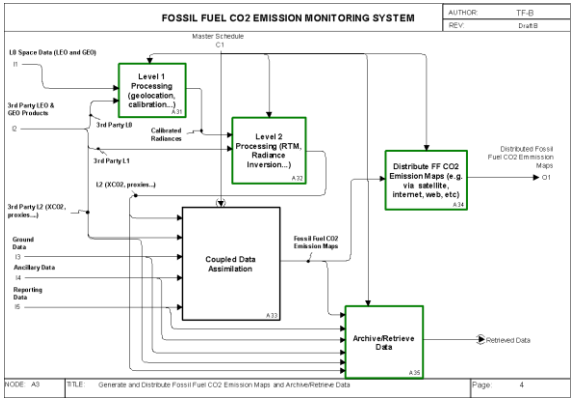


2015



2017





http://copernicus.eu/news/report-operational-anthropogenic-co2-emissions-monitoring

http://edgar.jrc.ec.europa.eu

Boundary conditions

- Emphasis on systems: inventories, space-borne and in-situ observations, data assimilation framework, inversion system, transport models, decision support system
- Emphasis on operational intent – from the outset
- Fundamentally underpinned by strong user requirements based on international commitments and corresponding EU Policy implementation
- Fundamental added value of international engagement on multiple aspects of system implementation/development

Towards an anthropogenic CO_2 Monitoring & Verification Support Capacity

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Global Stock Take 1

using inventories of 2026

Global Stock Take 2

CO_2 Task Force & ESA Mission Advisory Group

2017 2019 2021 **2023** 2025 2027 2029

system capacity built up

operation

ESA studies

ESA S-7 Phase A/B1

Launch target for Copernicus S-7 constellation

H2020 CSA: CHE

H2020: CHE Follow-on

H2020: VERIFY

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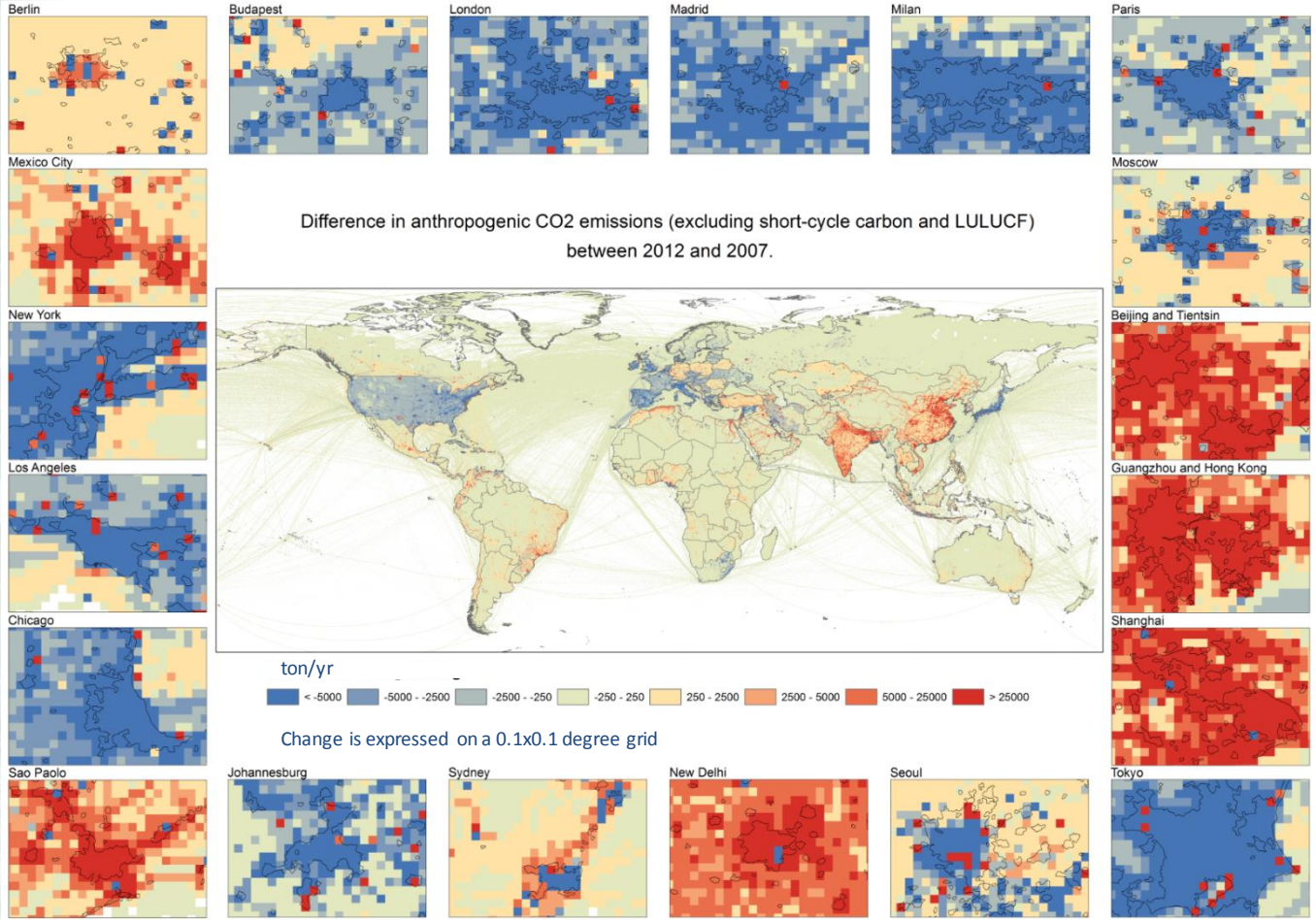
Fossil CO2 Emission Difference 2012-2007



End-to-end System requirements to monitor CO2

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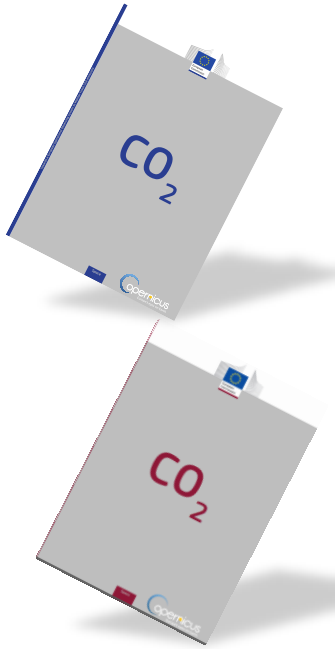
Accuracy

200-400 ton/year

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.

km & daily scales

Space & Time



Operational Anthropogenic CO_2 Emissions Monitoring & Verification Support Capacity

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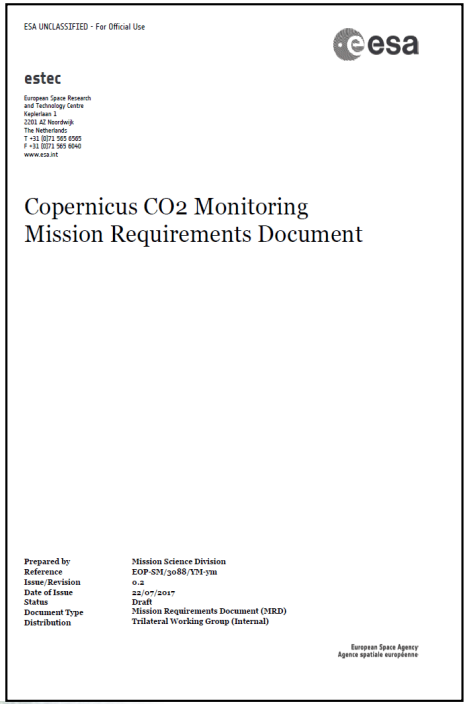
Objectives and Requirements from the Space Component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Copernicus CO2 Monitoring
Mission Requirements Document

Prepared by	Mission Science Division
Reference	EOP-SM/3088/YM-ym
Issue/Revision	0.2
Date of Issue	22/07/2017
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 km²**
- 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%

Joint efforts Internationally

United Nations

Framework Convention on Climate Change

FCCC/SBSTA/2017/L.21

Distr.: Limited
12 November 2017

Original: English

Subsidiary Body for Scientific and Technological Advice
Forty-seventh session
Bonn, 6–15 November 2017

Agenda item 8
Research and systematic observation

Research and systematic observation

9. The SBSTA recognized the progress made by the satellite community (see para. 4(e) above), in close collaboration with GCOS, in the development of the essential climate variable inventory.[16] It noted the usefulness of the essential climate variable inventory for climate services. It invited CEOS and CGMS to report on progress at future sessions of the SBSTA, as appropriate.

10. The SBSTA noted with appreciation the information provided in the submission referred to in paragraph 4(a) above on the Global Framework for Climate Services (GFCS).[17] It invited WMO to report on progress in implementing the GFCS at future sessions of the SBSTA, as appropriate.

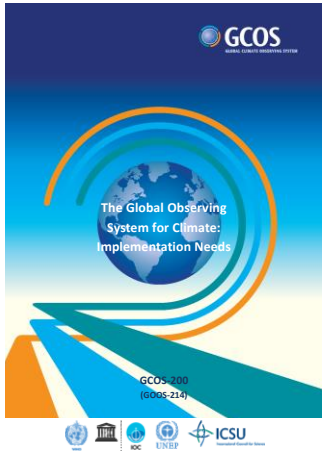
11. The SBSTA invited the UNFCCC secretariat to communicate with the WMO secretariat, including with regional centres, to inform work on climate services.

12. The SBSTA noted the increasing capability to systematically monitor greenhouse gas concentrations and emissions, through in situ as well as satellite observations, and its relevance in support of the Paris Agreement.[18]

Considerable support in the RSO negotiations from Japan and EU delegations

Especially for Conclusions 9 & 12

Global Climate Observing System: Implemenation Plan (GCOS-200)



Action T71:	Prepare for a carbon-monitoring system
Action	Preparatory work to develop a carbon monitoring system to be operational by 2035; Development development of comprehensive monitoring systems of measurements of atmospheric concentrations and of emission fluxes from anthropogenic area and point sources to include space-based monitoring, in situ flask and flux tower measurements and the necessary transport and assimilation models
Benefit	Improved estimates of national emissions and removals
Time frame	Initial demonstration results by 2023 – complete systems unlikely before 2030
Who	Space agencies
Performance indicator	Published results
Annual cost	US$ 10–100 billion

"Specifically CEOS and CGMS will undertake, over the next few years, dedicated preparatory work in a coordinated international context…:

- The definition of an architecture of space component elements to address the requirements of a CO_2 and GHG monitoring system , … This will provide a global holistic perspective both from the point of view of existing and planned space segment assets as well and that for an optimum global constellation.
- The documentation of best practices on the relationships between individual space agencies and their counterparts working on the modelling aspects, the inventories and in-situ data provision, …
- The further consolidation of partnerships and collaborations between the relevant international entities including: the relationship between CEOS and CGMS on the space component aspects, the partnership with the WMO and GEO on the broader framework, … and finally the relationships with GCOS itself, UNFCCC and IPCC TFI process in better defining the role for space-based observation in the inventory guideline process."

European Commission CEOS Chair 2018: GHG monitoring Priority

Specific Chair Initiative : Laying the foundation for an international CO2 and GHG monitoring system

Three specific activities are foreseen for advancing this effort in 2017-2018:

1. Facilitate the completion and follow-on activities of the **AC-VC whitepaper on defining an optimum constellation for CO2 and GHG monitoring**, including the joint competences of CEOS and CGMS, and in the general framework of the continued implementation of the CEOS Carbon Strategy
2. **Advance the relationship with CGMS for an operationally implemented and sustained observation capability**. Consider establishing a formal working relationship between CEOS and CGMS as with the successful ongoing relationship on Systematic Observations of ECVs in support of UNFCCC.
3. **Place the space segment in the broader context of a fully sustained system for CO2 monitoring**. Individual CEOS Agencies have counterparts in their individual countries/regions who have responsibility for Inventories, the required modelling, in-situ infrastructure and the ground segment elements.

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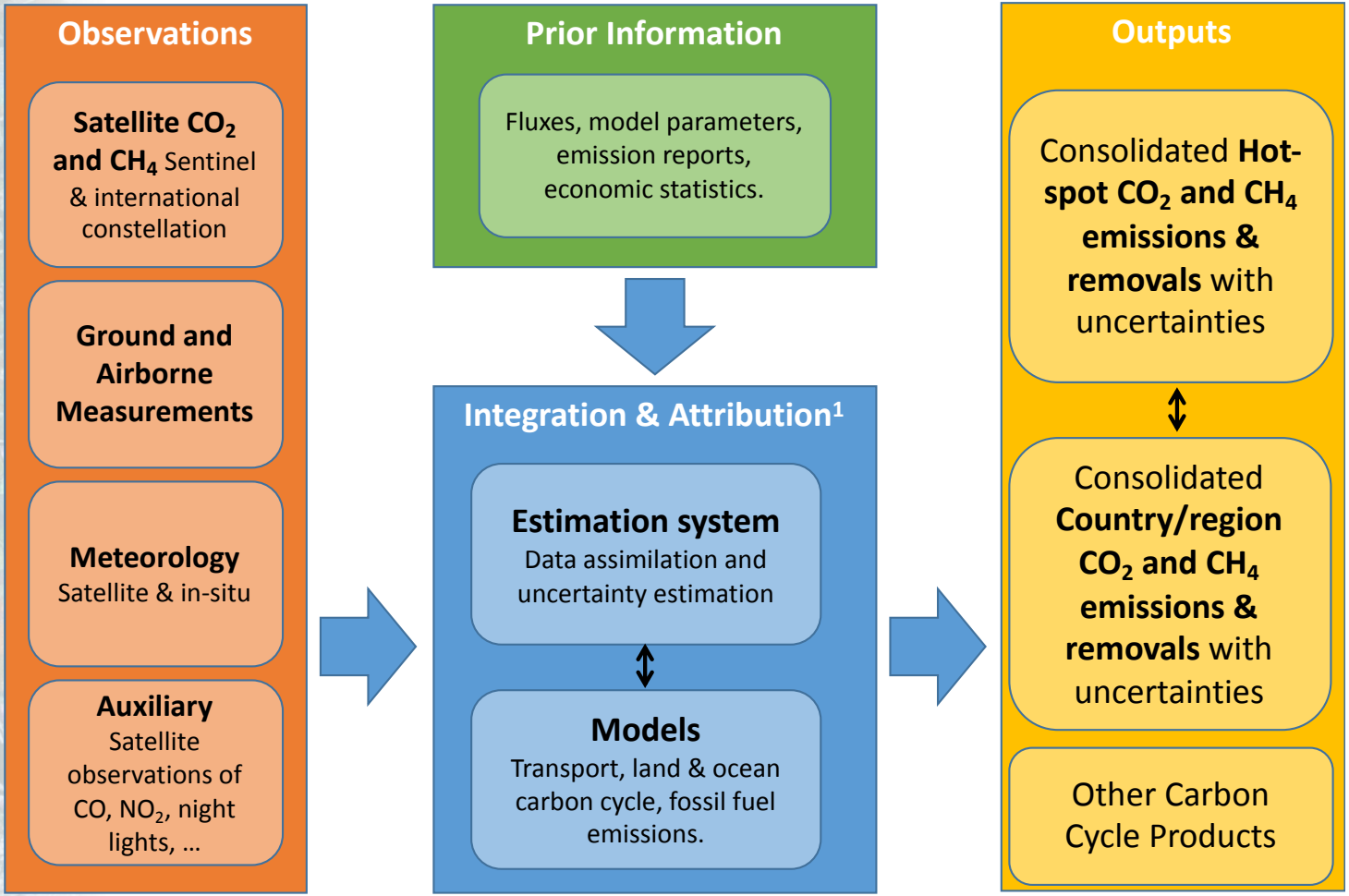
Consensus System Perspective



1: Between biogenic and anthropogenic sources

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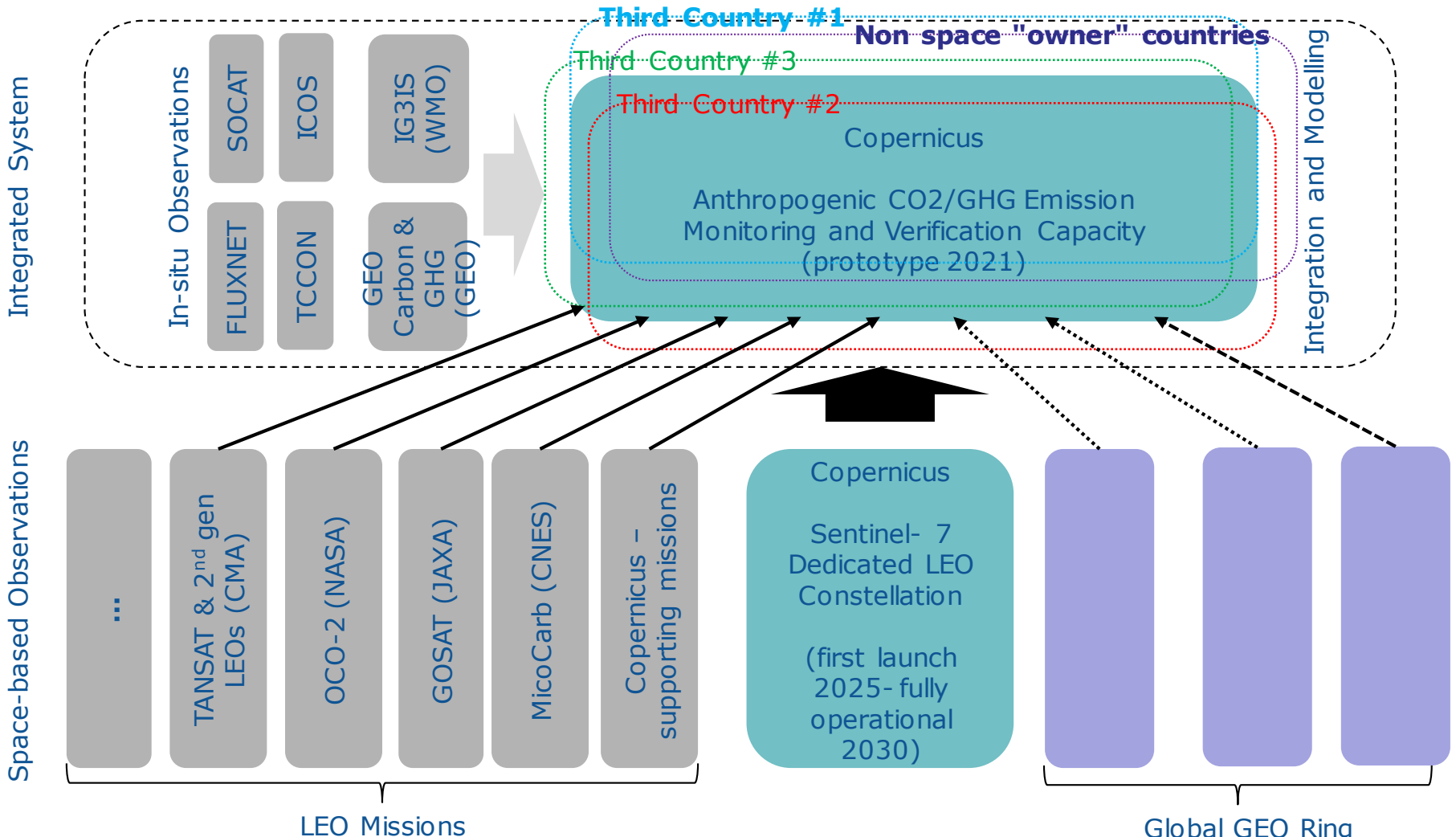
Integrated System
In-situ Observations
SOCAT
ICOS
IG3IS (WMO)
FLUXNET
TCCON
GEO Carbon & GHG (GEO)
Third Country #1
Non space "owner" countries
Third Country #3
Third Country #2
Copernicus
Anthropogenic CO2/GHG Emission Monitoring and Verification Capacity (prototype 2021)
Integration and Modelling
Space-based Observations
...
TANSAT & 2nd gen LEOs (CMA)
OCO-2 (NASA)
GOSAT (JAXA)
MicoCarb (CNES)
Copernicus – supporting missions
Copernicus
Sentinel- 7 Dedicated LEO Constellation
(first launch 2025- fully operational 2030)
LEO Missions
Global GEO Ring

Thank you for your attention

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