WMO and CEOS: role of space-based observations in GGGW

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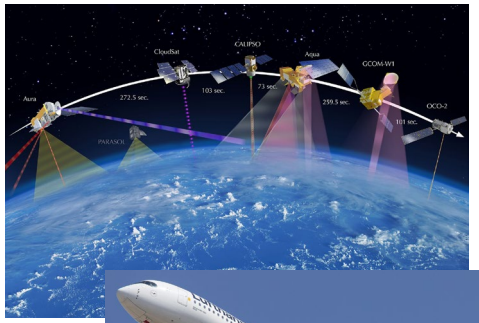
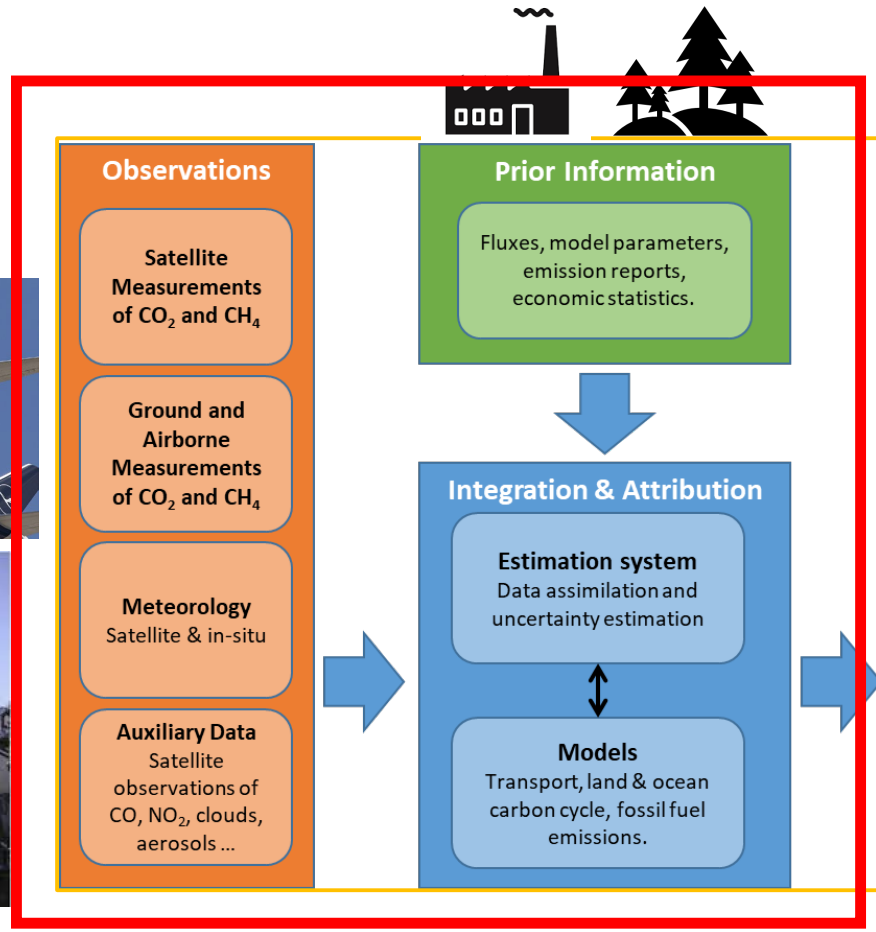
Global Greenhouse Gas Watch: outputs

- Monthly CO_2 net fluxes between the Earth surface and the atmosphere with 1x1 degree horizontal resolution delivered with a maximum delay of one month
- Monthly CH_4 net fluxes between the Earth surface and the atmosphere with 1x1 degree horizontal resolution delivered with a maximum delay of one month
- 3D fields of atmospheric CO_2 and CH_4 abundance with hourly resolution and the latency to be defined through user requirements and further consultation (tentatively on the order of a few days).
- N_2O abundances and net fluxes with resolution and latency still to be defined.

General principles of the observations-based emission estimates





GGGW will be supported by several global modelling centers

Policy and decision relevant information

Conceptual architecture of the system (implemented by the European Commission)

Potential uses and downstream applications

The downstream products may contain but are not limited to:

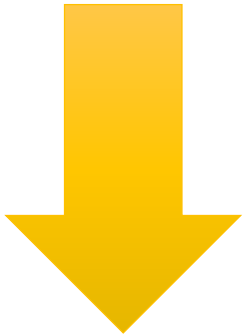
(1) Uptake of GHGs by different sinks and cycling through different components of the Earth System (e.g., aquatic/terrestrial biota, oceans, atmospheric sink for CH_4);

(2) GHG emissions from different sources (e.g., fossil fuel, biogenic, anthropogenic/non-fossil, biomass burning, oceans etc.) separately.

GGGW considers two types of users: “end users” who will use the WMO GGGW and the downstream cascade of added-value products for decision making; and the “research users” who will use the outputs for production of added-value products and services.

The data delivered by the GGGW can directly be used in support of the global stocktake, while specific user tailored applications are outside of the scope of GGGW

modelled global GHG concentration fields at 1x1° resolution, and modelled monthly surface fluxes at 1x1° resolution



IG³IS can play a role here

Harmonized and standardized user-tailored products on a decision-relevant scale

Cg-19 Resolution: call for the development of the implementation plan

"(1) Emphasis on WMO's unique role in **establishing best practices** for measurement, data, and reporting standards, validation and intercomparison of information products, and other best practices needed to support global greenhouse gas monitoring infrastructure and actionable information services;"

"(4) Integration of the components of the Global Greenhouse Gas Watch within appropriate WMO-coordinated systems, the WMO Integrated Global Observing System (WIGOS), the WMO Information System (WIS), and the WMO Integrated Processing and Prediction System (WIPPS);"

"(7) A detailed analysis of the **expected cost of implementation** of the various elements of the Global Greenhouse Gas Watch, distinguishing between costs to the WMO Secretariat, costs to Members, and an **estimate of expected extra-budgetary resources**, including sources;"

Implementation plan should describe **HOW** the Concept of GGGW proposed to Congress will be implemented

Implementation plan: content

1. Introduction, background.
2. Existing components and gap analysis
3. Observing system
4. Modelling system
5. Prior information (emissions…)
6. Data management
7. R&D needs
8. User engagement and uptake of GGGW
9. Capacity development
10. Cost estimates, funding sources
11. Resource mobilization

To collect inputs 2 technical workshops were conducted:

- Modelling within GGGW (by invitation), 19-22 September, Bonn
- Observations within GGGW, 3-5 October, Geneva

Observations in GGGW concept

The list of observable parameters required for the realization of the GGGW is extensive, but clear priorities can be identified. Here the priorities are listed within five categories, from A (highest) to E (lowest):

A. Ground-based measurements of GHGs

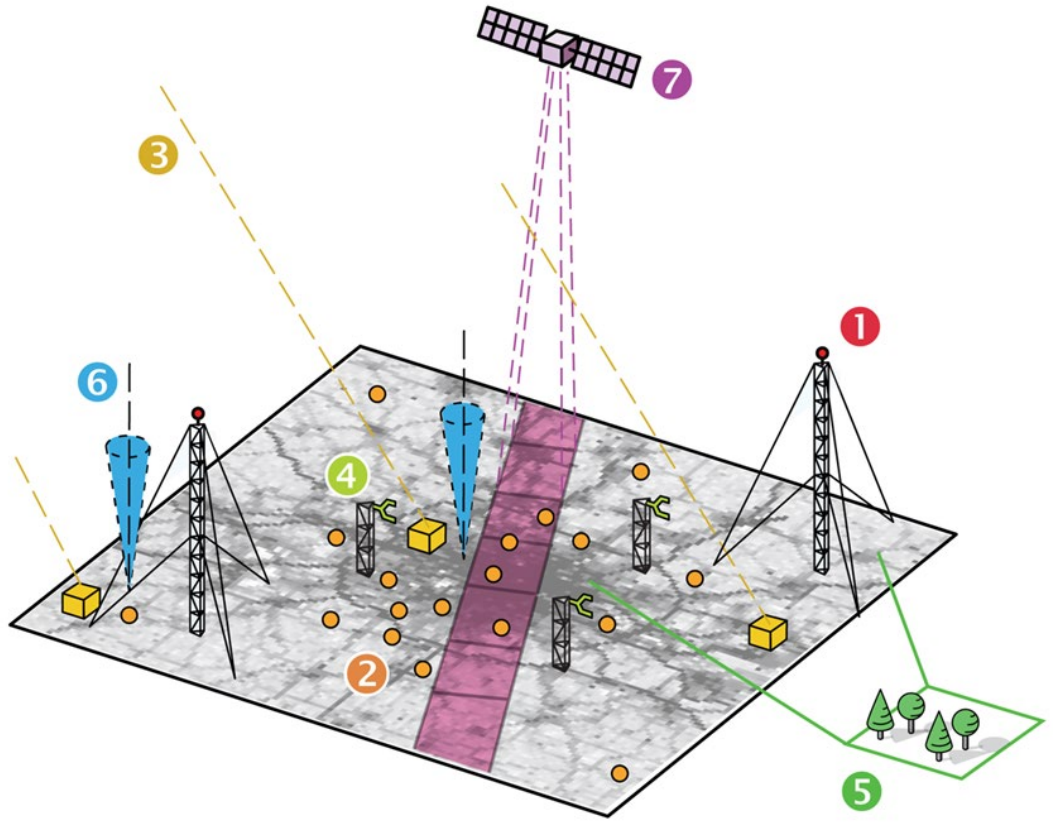
B. *Remote-sensing and vertically resolved observations of GHGs*

C. Ocean carbon cycle observations

D. Direct GHG flux observations

E. Higher tier observations

The minimum GGGW system should have adequate observations from at least categories A, B and C. An adequate number of stations should provide observations of the lowest tier (category E), based on the overall network design



Tall towers (1), street level mid-cost sensors (2), roof level stations (3), eddy covariance flux stations (4), ecosystem parameters (5), total column GHG and meteorology (6) and satellite (7) observations, in many parts including co-emitted species (from: ICOS Cities)

Workshop recommendations: Status of observations and gaps

Spatiotemporal data gaps: over the Tropics, in Africa, over the open oceans, Arctic ecosystems, lack of vertically resolved measurements

Validation gap: Ground-based remote sensing even more sparse than in situ, satellite cross-validation

Operational concerns: No exhaustive inventory of available measurements, not timely for satellite validation, lack of definition of "good enough" measurements, planning of missions

Financial gap: no money for maintenance, research-based funding

Manpower gap: not enough trained staff to support measurements

Communication gap: unclear use of observations

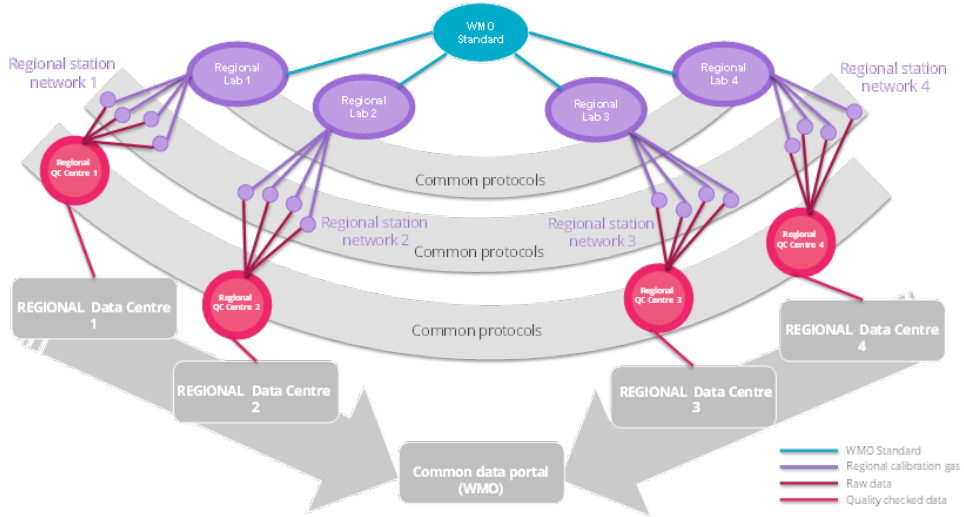
Satellite agencies can help in:

- addressing spatial and temporal gaps
- ensuring sustainability of the satellite observations
- assisting with the training of personal
- communication regarding use of integrated observing system in support of the decision-making products generation

Workshop recommendations: Integration and standardization

- Key aspect of integration is the integration of remote-sensing **and** in situ information for the **same** variables
- Integrated system needs an “all domains approach” which somehow retains the specific requirements of each individual domain (land, ocean, atmosphere).
- Multi-purpose measurements programme: inclusion of additional variables to constrain better priors (inundation datasets, higher frequency burned area, anything that improves the temporal profile of priors, vegetation type)
- Calibration is important, needs to be globally available (distributed calibration facilities)
- Existing standards need to be used as much as possible
- Metadata standards and metadata reporting needs to be consisted across and within domains

A tiered observing network, that includes a ‘reference’ quality component throughout the world can help provide a framework for integrated observing systems



Workshop recommendations: Data systems and data utilization

- **Data exchange** is important for GGGW implementation;
- **Data management** needs to be funded as an integral part of GGGW;
- **Guiding principle: FAIR and Open**: leverage the existing WMO standards(WIS2 and WIGOS); maintenance of standards, sensitive to user communities, cloud friendly
- Metadata/data reporting practice **for uncertainty reporting** and provenance are needed
- **Data access** can be federated, but sufficiently centralized
- **Timeliness can be improved**; will be easier if different data streams can be accommodated: (i) quick turn-around “NRT” data, as is, within days of measurement time; (ii) Final, quality-controlled data within months of measurement time;
- Sustainability (also of data management systems) is important

Satellite agencies can provide free and unrestricted access to as much relevant data as possible with the latency of 3 days

Communication of the value of integrated system (both in situ and satellite) is critical for user support

Next steps

15 Oct: recommendations of the workshops are summarized

By 30 Oct: high level action items are formulated for each section

By 20 Dec: sections cross check by the Study Group

By 28 Feb: finalization and submission to Infrastructure Commission

June: presentation to the Executive Council

20 Oct: Section leads are established

By 30 Nov: details of the short-terms actions are drafted

By 20 Jan: community review

April: recommendations of the Infrastructure Commission

Active promotion of the initiative at diverse events, including COP28 and resource mobilization

Thank you

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