2022

# The Global Greenhouse Gas Watch (GGGW) - top-down estimation of GHG fluxes

**Presented to CGMS-51 Plenary session**

**Lars Peter Riishojgaard, WMO Secretariat**

Coordination Group for Meteorological Satellites

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*Lars Peter Riishojgaard, WMO Secretariat*

***on behalf of:***

**WMO Joint Study Group on Greenhouse Gas Monitoring (SG-GHG):**
**Michel Jean, Chair, Greg Carmichael, Vice-Chair**
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**SG-GHG Task Team members** *(in addition to names listed above)*:
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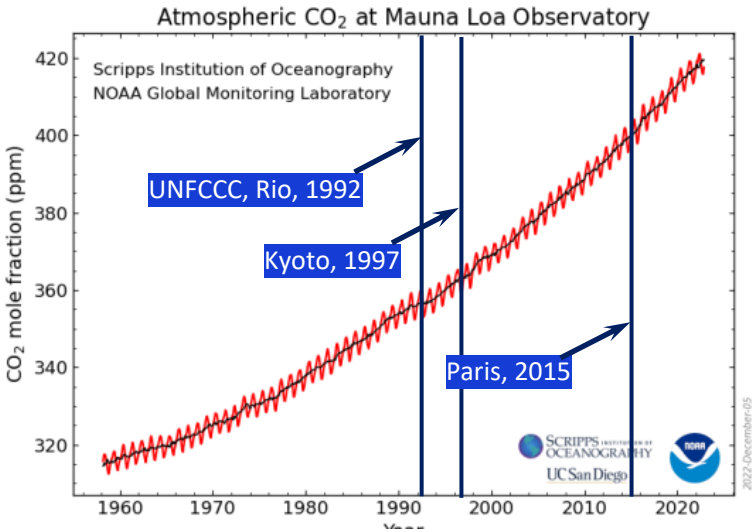
# Problem Statement

- The Paris Agreement has been adopted with the aim of limiting climate change via reducing net anthropogenic greenhouse gas (GHG) emissions;
- Paris focuses on accurate reporting of anthropogenic GHG emissions*;* however, GHG fluxes driven by natural processes are often much larger and are not explicitly taken into account;
- Natural fluxes respond to anthropogenic emissions and climate change in ways not yet understood;

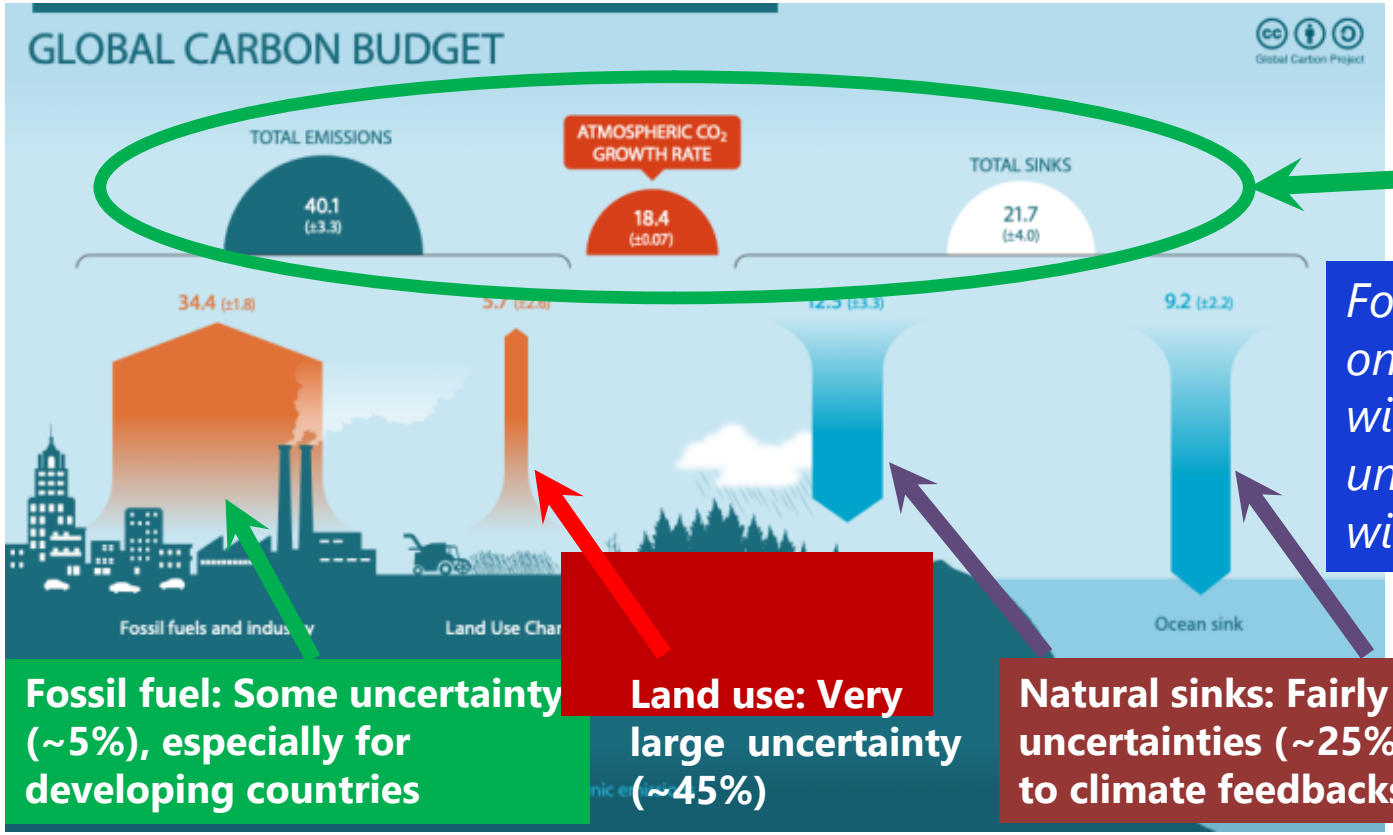
- ”Emissions” can be positive as well as negative (GHG removals), but
- Accounting for negative emissions (carbon *offsets* and carbon *credits*) is problematic, poorly regulated and ineffectively monitored, leading to risk of overestimation of impact, double counting,…;

*The climate responds to the atmospheric GHG concentrations, not to what we claim to be doing to reduce or offset our GHG emissions;*



# How well do we understand the $CO_2$ fluxes ?

*(Graphic by the Global Carbon Project)*




**Top level global budget is well understood**

*Focusing our efforts only on the areas with low uncertainties (green) will not work!*

**Fossil fuel: Some uncertainty (~5%), especially for developing countries**

**Land use: Very large uncertainty (~45%)**

**Natural sinks: Fairly large uncertainties (~25%); subject to climate feedbacks**

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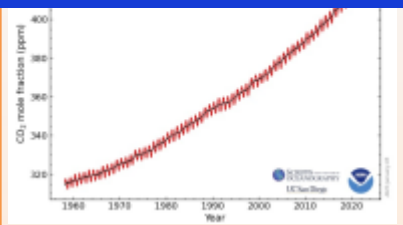
# Two ways to look at greenhouse gas concentration changes:
*(both will be needed!)*

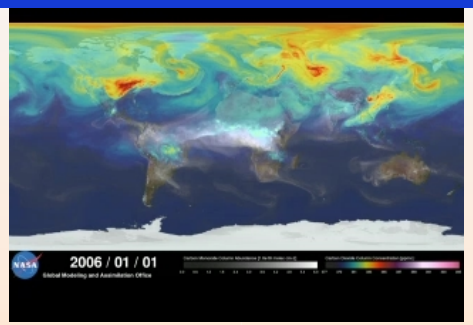
Bottom-up: *Add up individual sources and sinks carbon and estimate their overall contribution;*

- Can provide very accurate estimation of anthropogenic ***emissions***;
- Bulk data national only, 1-2 years delayed;
- Does not work well in developing countries;
- Not applicable to most natural sources/sinks;

Almost all activities under IPCC and the Paris Agreement are based on bottom up

Global infrastructure required for top-down GHG flux estimation is very similar to WMO-coordinated infrastructure for weather prediction and climate analysis;

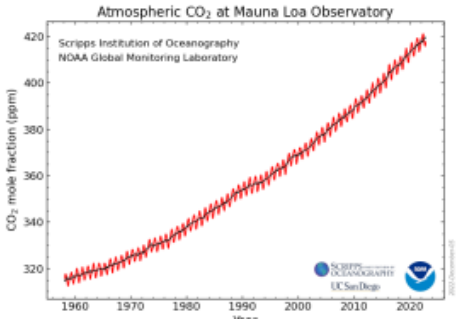


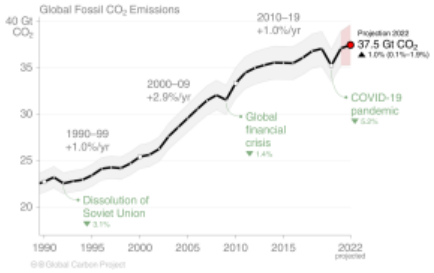


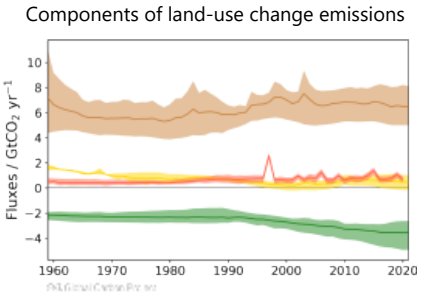

- Direct link to "centralized accounting";
- Global coverage, spatially disaggregated;
- Estimates of *net* ***fluxes*** rather than of emissions;

Top-down technology mature, used by Parties individually, not yet in context of Paris Agreement

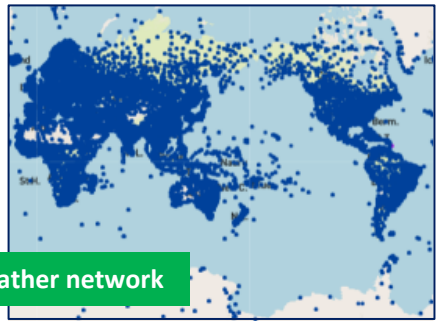
# So far, greenhouse gas monitoring mostly undertaken in research mode



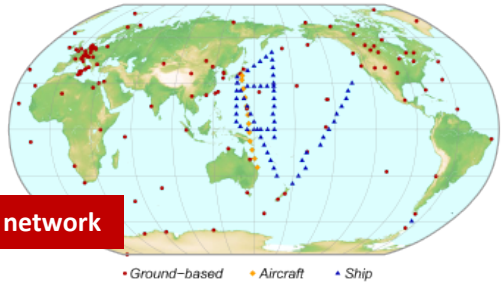




*"We do not yet have an integrated global system that operates the way weather prediction and climate analysis is done."*

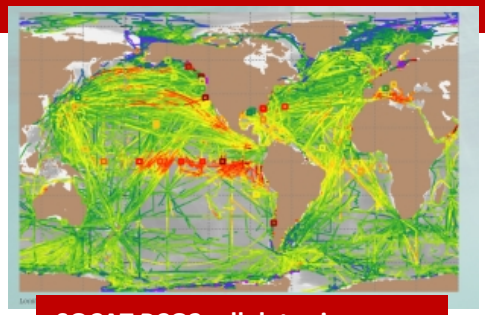


**Weather network**

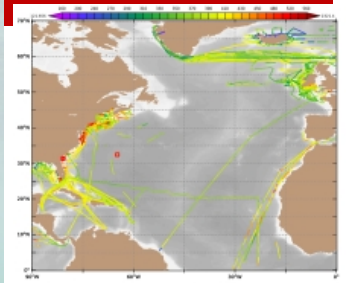
*Research efforts have provided much insight, but cannot guarantee sustained funding, cannot deploy a truly global observing system, fund operational modeling and data assimilation and do not lead to near-real time exchange of data*




**Greenhouse gas network**



**SOCAT PCO2; all data since 1970**



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# WMO Greenhouse Gas Monitoring Symposium, Jan 30- Feb 1

- 170 on-site participants (+Secretariat staff), 500 online;
- 57 oral presentations, 81 posters, five panel sessions;

*Symposium website*

- **Consensus Symposium Statement**
- Discussed by all participants during final session; finalized via two rounds of email comments after the event;
- *Clear and unequivocal call for WMO to take the lead in developing this initiative*, in coordination with other relevant agencies and entities;
- Available on the website and as EC-76/INF04-3(2);

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# WMO with many partners developed concept for a ***Global Greenhouse Gas Watch*** building on experience from Global Atmosphere Watch and World Weather Watch

## Key components

- Integrated global greenhouse gas observing system (surface- and space-based) operating under WMO Res. 1, with near-real time international exchange of all observations;
- 24/7 operational GHG modeling (multiple model systems), converting observations into flux estimates;
- Routine internationally coordinated intercomparison and verification of model output;

## Primary output

- Time-continuous global fields of CO2, CH4 and N2O concentrations;
- Consolidated, top-down, monthly estimates of GHG fluxes at global 100 x100 km resolution (1 x 1 km goal);

## Users of GGMI output

- Parties to the Paris Agreement (GST);
- Regional and local users, e.g. via IG3IS;
- Participants in voluntary carbon markets, ;
- Science community working on GHG budgets;
- IPCC, for emissions pathways, future scenarios;

In order to provide authoritative data to UNFCCC Parties and other users, GGGW estimation will be conducted

- Openly - with participation from all interested Parties;
- Transparently – with free and unrestricted access to all input and output data as well as verification results;
- Using documented (preferably published) methodologies and algorithms.

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# 19th World Meteorological Congress, (May 22-June 2 2019)

- *Endorsed the concept for the WMO-coordinated Global Greenhouse Gas Monitoring Infrastructure, based on an Executive Summary developed by the Joint Study Group on Greenhouse Gas Monitoring;*
- ***Requested development of a detailed, costed implementation Plan***
- *Requested the Secretary-General:*
  - *To allocate the necessary resources…*
  - *To further strengthen close collaboration and coordination with relevant United Nations agencies and other international partners …*

# Some GGGW development activities planned for Q3/4 of 2023

- Greenhouse gas modeling/assimilation workshop (for entities with pre-operational capabilities), Bonn, September 2023;
  - Agreement on data exchange, run-time procedures, metrics of skill, common input data, data requirements, ….
- Greenhouse gas observing workshop (open), Geneva October 3-5 2023;
  - First step toward consolidated design of an integrated global observing system, addressing requirements for top-down global greenhouse gas monitoring, consisting of both surface- and space-based assets;
  - Near-real time data exchange, current status, expected capabilities;
  - Expected technology development (space- and surface-based),
- Private sector engagement (ongoing);
  - Strong interests in GGMI from many corners: Philanthropy, venture capitalists (technology development), logistics companies (deployment), banks, hedge funds (carbon markets)

# Main drivers behind GGGW development

- The development that would lead to GGGW in its current form started in the WMO Secretariat (late 2021), but the idea that globally coordinated, routine monitoring of GHGs would be needed was much older, captured at various levels of maturity, e.g. in:
  - GEO carbon strategy (2011);
  - Copernicus red/green/blue reports (2015/16/17);
  - IG3IS resolution from Congress-17 in 2015;
- Current development of GGGW responds to the 2022 GCOS Implementation Plan (action F5), supported by SBSTA-57 and referenced by COP-27, and to Consensus Statement from the WMO International Greenhouse Gas Symposium in Jan/Feb 2023;
  - Satellite community has been very actively engaged in both

# Engagement with satellite community

- GGGW development already discussed in many venues, including
  - CEOS-CGMS WG-Climate (May 2022);
  - CGMS-50 (June 2022);
  - CEOS-SIT Technical Workshop in (Sep 2022);
  - CEOS-SIT (March 203)
  - CGMS-WG II (April 2023);
- Engagement focusing on several areas:
  - Development of a concept for an integrated global greenhouse gas observing system responding to GGGW requirements;
  - Possibility of reducing data latency for existing and planned GHG missions;
  - Improved utilization of (e.g.) hyperspectral IR sounders for GHG monitoring;
  - Role of GSICS in GGGW, also w.r.t. use of surface-based measurements;
  - Use of GGGW output for satellite data QC;

# Request to CGMS:

- Continue engaging with WMO Joint Study Group on Greenhouse Gas Monitoring as it is developing the draft Global Greenhouse Gas Watch Implementation Plan *(P. Counet is SG member nominated by CGMS);*
- Engage in the development of requirements for an integrated (i.e. both space-based and surface-based assets) global greenhouse gas observing system, via WG-Climate and WG-II;
- Help SG-GHG develop requirements for data latency for GHG observations, via WG-Climate, WG-II, WG-III.