

Global Greenhouse Gases research and monitoring at WMO

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World Meteorological Organization (WMO)

Presented to COP29 – Earth Information Day – Monday 11 November 2024



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METEOROLOGICAL
ORGANIZATION



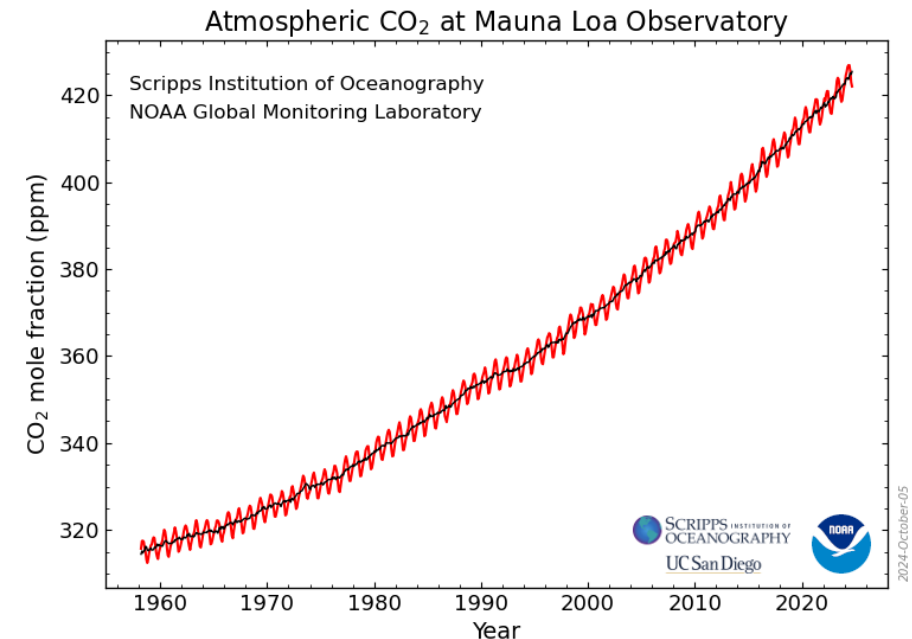
CO2 animation
14 Jan 2020 22:00:00.000

WMO efforts in coordinating greenhouse gas observations and research cover 50-year period

- The first WMO meeting of experts on Greenhouse Gas & Related Tracer Measurement Techniques was held at the Scripps Institution of Oceanography, in the United States, in 1975 (and since then a recurrent event every two years)
- Since 1989 greenhouse observations and research are coordinated by the **Global Atmosphere Watch Programme**



CO₂ mole fraction measured at NOAA
Mauna Loa observatory increased by about 90
ppm between 1975 and 2023 (27% increase)

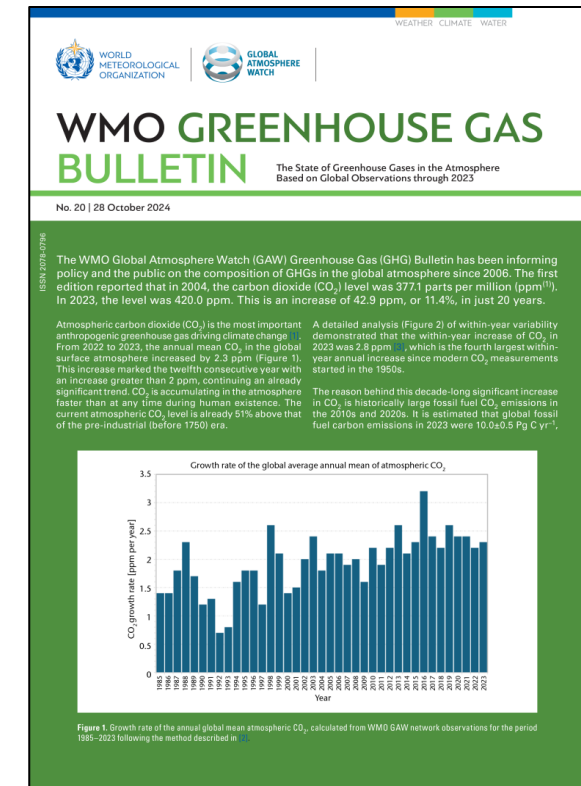


Greenhouse Gases in Global Atmosphere Watch Programme

- **GAW Scope:** Understand long-term changes of GHG levels in the global atmosphere
- Support implementation of the Global Climate Observing System (GCOS)
- WMO GHG Bulletin provides key information to the Conferences of Parties to the UNFCCC via SBSTA

20th GHG Bulletin launch on
the 28 October 2024

Global Greenhouse Gas averages
provide important insight on the human
impacts on climate

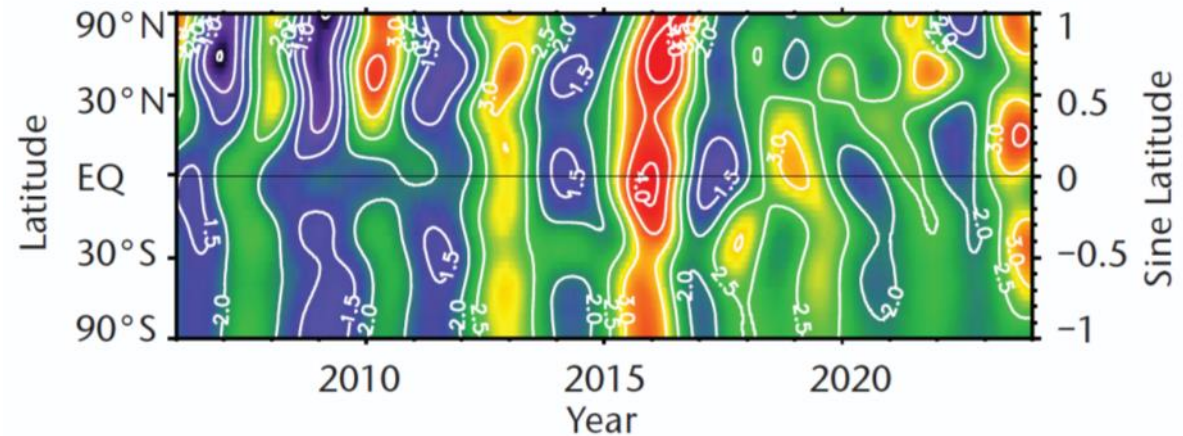
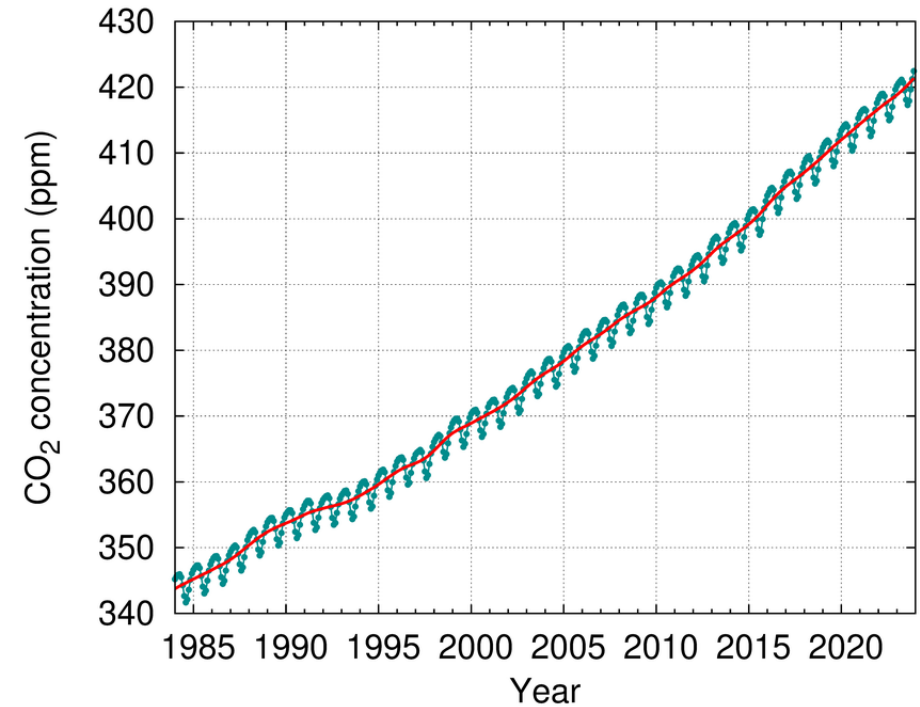


The Greenhouse gas levels reach new record in 2023

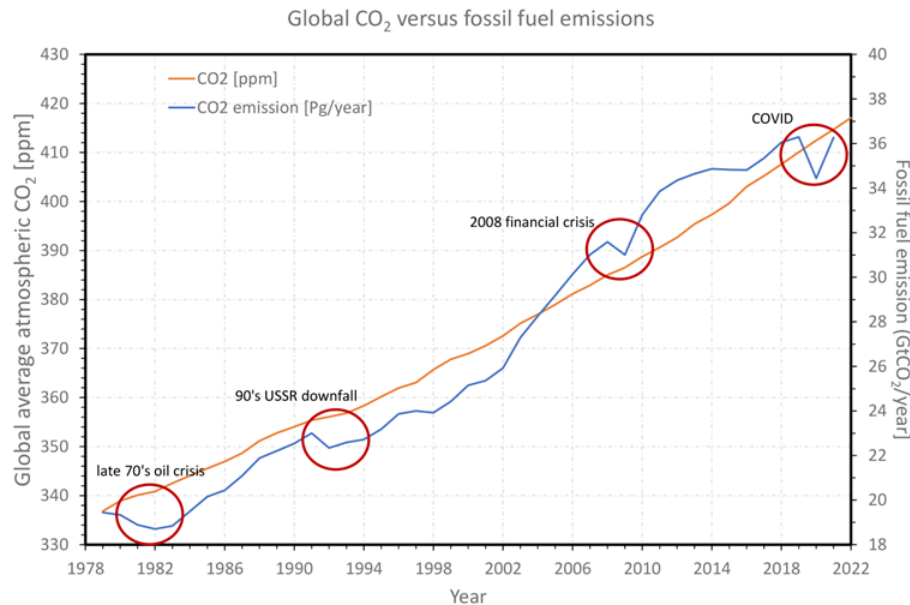
	CO ₂	CH ₄	N ₂ O
2023 global mean abundance	420.0±0.1 ppm	1934±2 ppb	336.9±0.1 ppb
2023 abundance relative to 1750 ^a	151%	265%	125%
2022–23 absolute increase	2.3 ppm	11 ppb	1.1 ppb
2022–23 relative increase	0.55%	0.57%	0.33%
Mean annual absolute increase over the past 10 years	2.4 ppm yr⁻¹	10.7 ppb yr⁻¹	1.07 ppb yr ⁻¹

Carbon dioxide (CO₂)

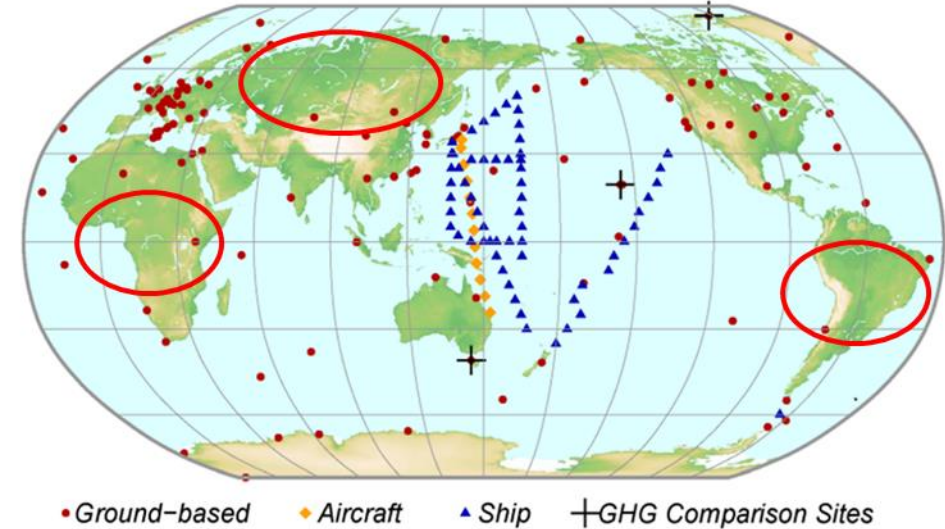
- 420.0±0.1 ppm in 2023
- 2.3 ppm increase from 2022 to 2023
- 51% increase since preindustrial time (1750)
- 11.4% increase within last 20 years
- **Twelfth consecutive** year with an increase greater than 2 ppm
- Large increase within a year (2.8 ppm) driven by the biomass burning and reduced carbon uptake by the terrestrial biosphere



How to bridge the gap between global average & Timely decision-relevant-scale applications ?

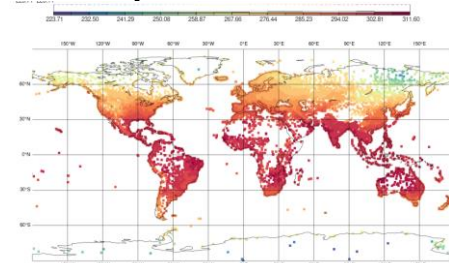


- Global averages Carbon dioxide concentrations show constant increase
- Societal impact is detectable on emissions



146 CO₂ measuring stations

- Research funded observations have sustainability issues
- Gaps need to be filled on a systematic operational basis
- Timely measurements allow to expand climate services



30000+ Temperature stations

The G3W Flagship in a

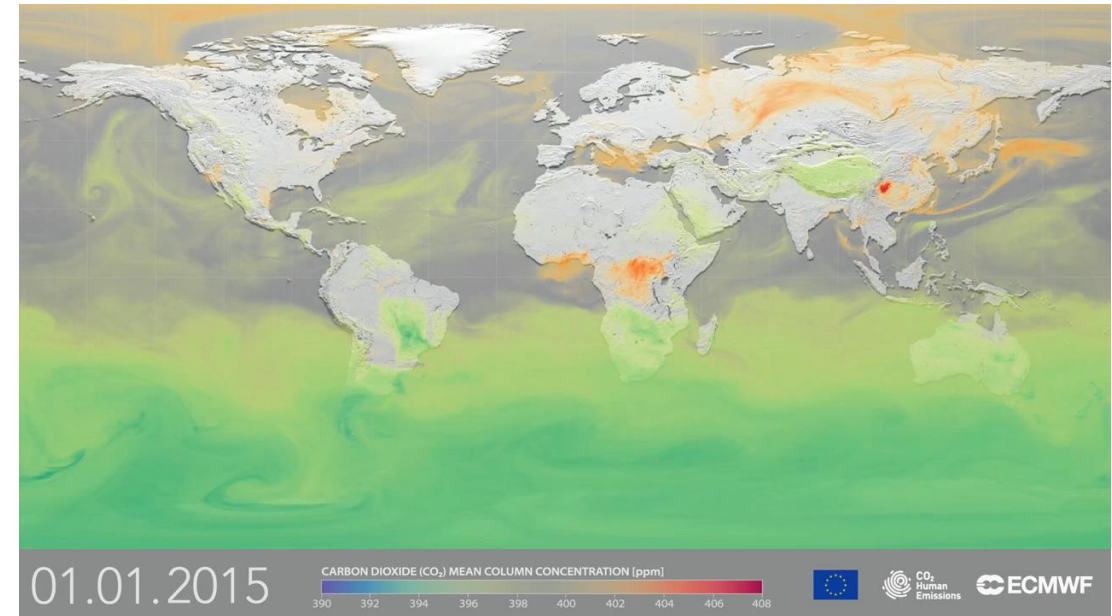


What: The **Global Greenhouse Gas Watch - G3W** fills critical information gaps optimally combining **Earth Observations** with **Earth System Models** to **reduce the uncertainty in** assessing the efficacy of **Climate Action**.

How: **Timely Policy-relevant information** on GHGs concentrations and fluxes allowing to assess both the **Natural & Human** influence on climate change <https://wmo.int/activities/global-greenhouse-gas-watch-g3w>

Why : an **Earth System Approach** is a must-have because **Earth's climate responds to the laws of Climate Physics** and depends Atmospheric GHGs, NOT on Claimed Offset of Carbon emissions or to Good-will of Pledges.

“We can not manage what we do not measure” – GHG needs to be handled

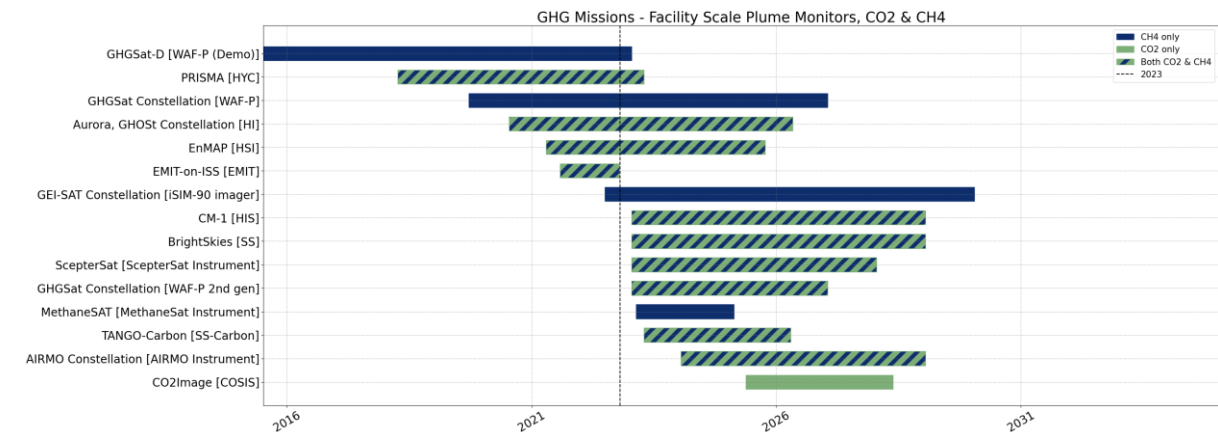
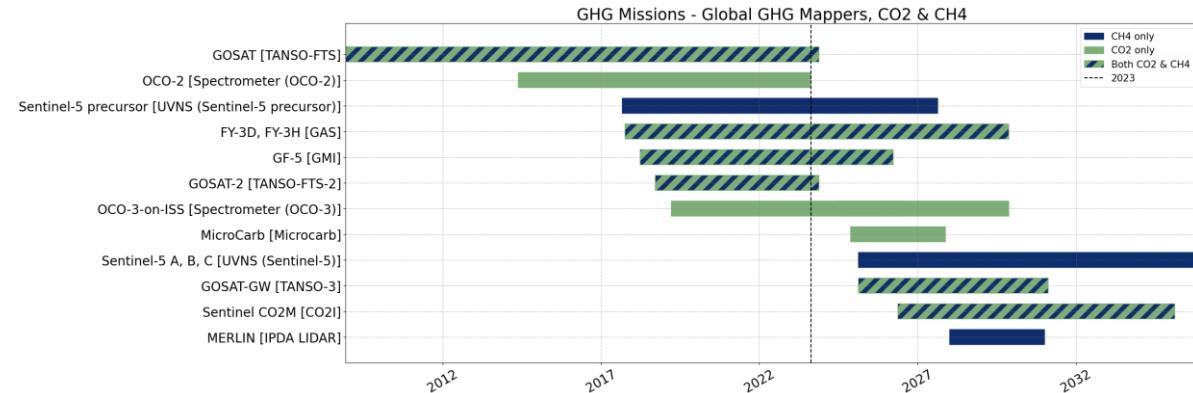
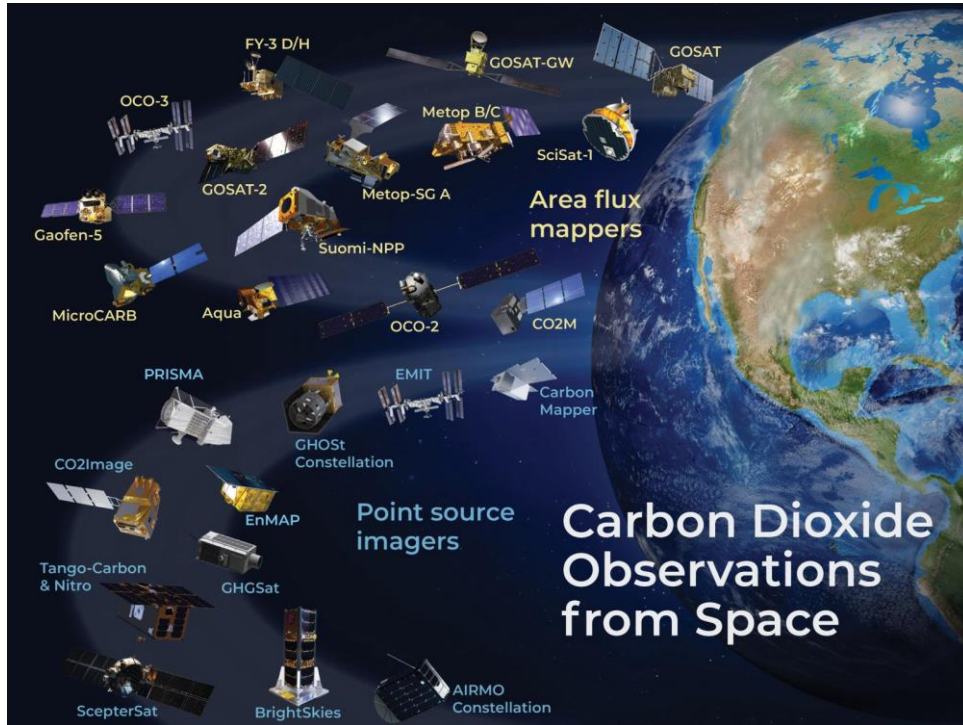


Animation source: Copernicus Earth Observation Programme / ECMWF CAMS

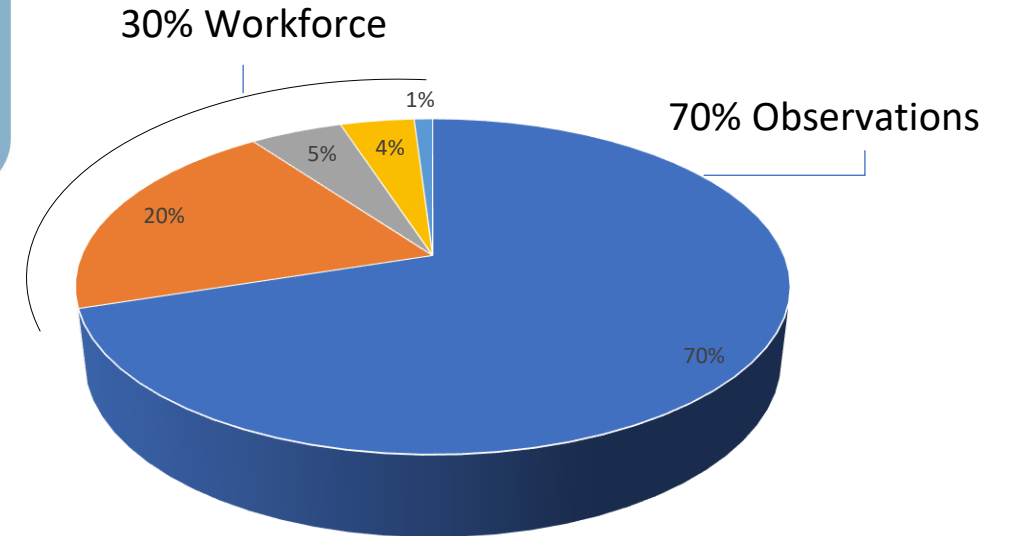
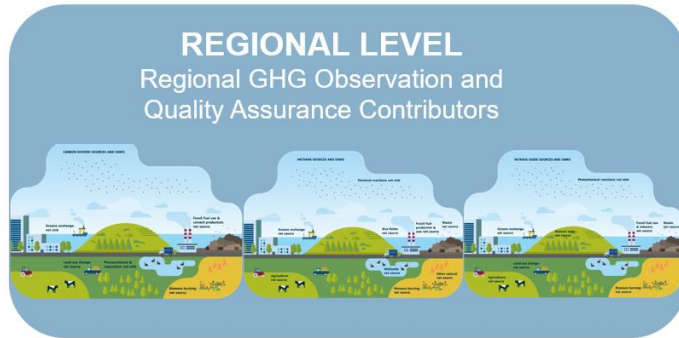


G3W is synchronizing with Space Agencies investments

- The **G3W Implementation and Pre-operational Phase**, link with **Space-based Remote Sensing** efforts.
- Thanks to Satellites Coordination mechanism.



The G3W financial needs: A Region-First Approach



The G3W initiative aims at supporting the systematic observations and monitoring infrastructure for Greenhouse Gases

The costs estimate is **1 B\$** over 2024-27
(with targets at 500 M\$, 300 M\$)

- Observing system surface-based infrastructure
- Observing systems integration, modelling and data management
- Capacity building and capacity development for G3W input and uptake
- Regional Pilot Projects and supporting research for G3W emerging priorities
- Central coordination by WMO secretariat including public-private-partnerships (PPP) development

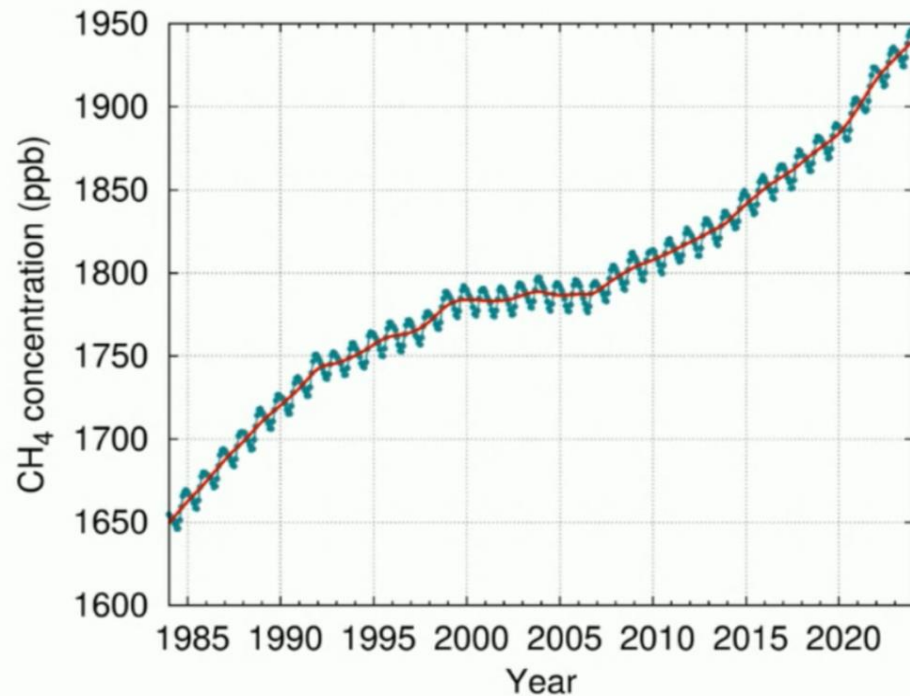


G3W : leveraging Climate Action partnerships on Methane

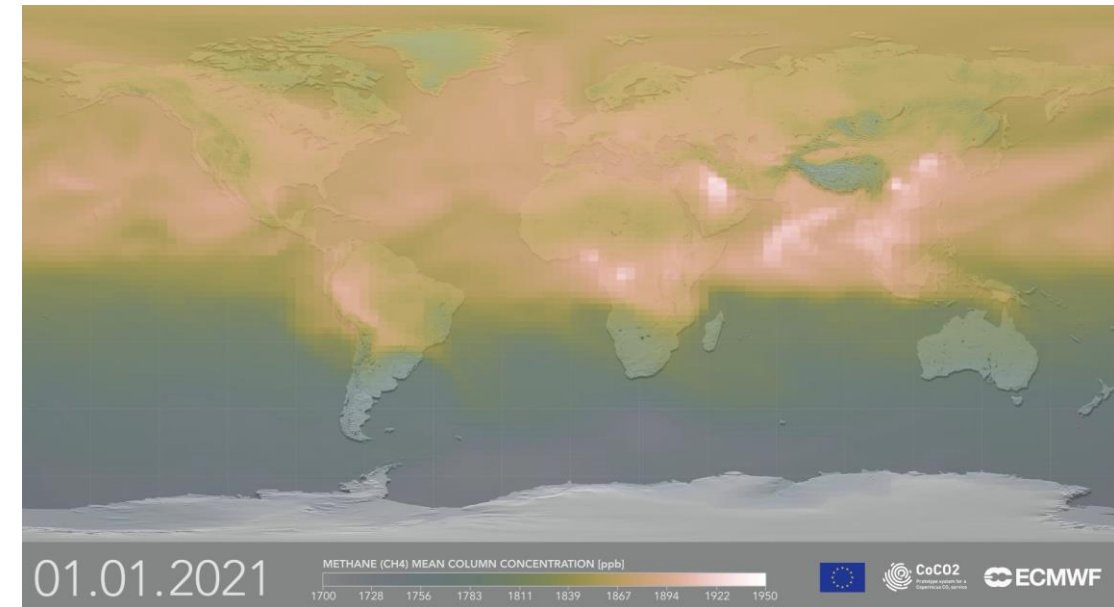
COP28 Global Methane Pledge – 155 Countries

- <https://www.globalmethanepledge.org>

COP29 and COP30 must raise the urgency.



Methane is connected to Climate-Change also via the **Cryosphere** (e.g. **Permafrost** / **Wetlands** linking GHGs with the other **WMO priorities**)



Animation source: Copernicus Earth Observation Programme / ECMWF CAMS

Greenhouse Gases in focus at COP29:

WMO GHG bulletin

CEOS/CGMS roadmap

G3W



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GLOBAL
ATMOSPHERE
WATCH

WEATHERCLIMATEWATER

WMO GREENHOUSE GAS
BULLETIN

The State of Greenhouse Gases in the Atmosphere
Based on Global Observations through 2023

No. 20 | 28 October 2024

The WMO Global Atmosphere Watch (GAW) Greenhouse Gas (GHG) Bulletin has been informing policy and the public on the composition of GHGs in the global atmosphere since 2006. The first edition reported that in 2004, the carbon dioxide (CO₂) level was 377.1 parts per million (ppm¹). In 2023, the level was 420.0 ppm. This is an increase of 42.9 ppm, or 11.4%, in just 20 years.

Atmospheric carbon dioxide (CO₂) is the most important anthropogenic greenhouse gas driving climate change. From 2022 to 2023, the annual mean CO₂ in the global surface atmosphere increased by 2.3 ppm (Figure 1). This increase marked the twelfth consecutive year with an increase greater than 2 ppm, continuing an already significant trend. CO₂ is accumulating in the atmosphere faster than at any time during human existence. The current atmospheric CO₂ level is already 51% above that of the pre-industrial (before 1750) era.

A detailed analysis (Figure 2) of within-year variability demonstrated that the within-year increase of CO₂ in 2023 was 2.8 ppm, which is the fourth largest within-year annual increase since modern CO₂ measurements started in the 1950s.

The reason behind this decade-long significant increase in CO₂ is historically large fossil fuel CO₂ emissions in the 2010s and 2020s. It is estimated that global fossil fuel carbon emissions in 2023 were 10.0±0.5 Pg C yr⁻¹.

ISSN 2078-0798

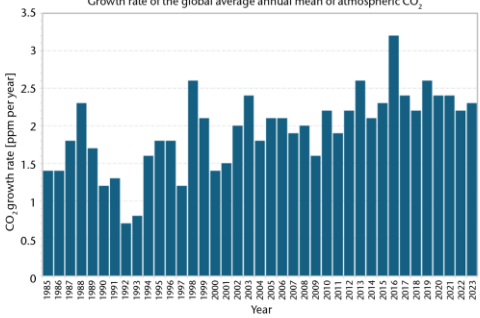


Figure 1. Growth rate of the annual global mean atmospheric CO₂, calculated from WMO GAW network observations for the period 1985–2023 following the method described in [1].



CGMS



CEOS

ROADMAP FOR A
COORDINATED IMPLEMENTATION OF
CARBON DIOXIDE AND METHANE
MONITORING FROM SPACE

Issue 2, Version 1.0
October 2024



World Meteorological Organization
EXECUTIVE COUNCIL
Seventy-Eighth Session
10 to 14 June 2024, Geneva

EC-78/Doc. 3.2
Submitted by:
Chair
11.VI.2024
APPROVED

AGENDA ITEM 3:STRATEGIC PRIORITIES

AGENDA ITEM 3.2:Global Greenhouse Gas Watch

IMPLEMENTATION PLAN FOR THE GLOBAL GREENHOUSE GAS WATCH

DRAFT RESOLUTION

Draft Resolution 3.2/1 (EC-78)

Implementation Plan for the Global Greenhouse Gas Watch

THE EXECUTIVE COUNCIL,

Recalling the WMO Strategic Plan 2024–2027,

Recalling also Resolution 5 (Cg-19) – Global Greenhouse Gas Watch, which requested the Commission for Observation, Infrastructure and Information Systems (INFCOM), the Commission for Weather, Climate, Hydrological, Marine and Related Environmental Services and Applications (SERCOM), and the Research Board (RB), via the Joint Study Group, to further develop the concept of the Global Greenhouse Gas Watch (G3W) through a detailed implementation plan, building on existing capabilities and ongoing activities under the Global Atmosphere Watch (GAW), including the Integrated Global Greenhouse Gas Information System (IG³IS), and other relevant international framework, and bring the draft plan to the Executive Council for its review and approval,

Recalling further the observing network design principles, in particular, principle 13: Advancing Environmental Sustainability, in the *Manual to the WMO Integrated Global Observing System* (WMO-No. 1160), Appendix 2.1,

Having examined Recommendation 7.2/1 (INFCOM-3),

Recognizing the WMO role as a coordinator of activities undertaken by Members built on its neutral position on national governments' climate change policies including their efforts to estimate and reduce greenhouse gas (GHG) emissions,

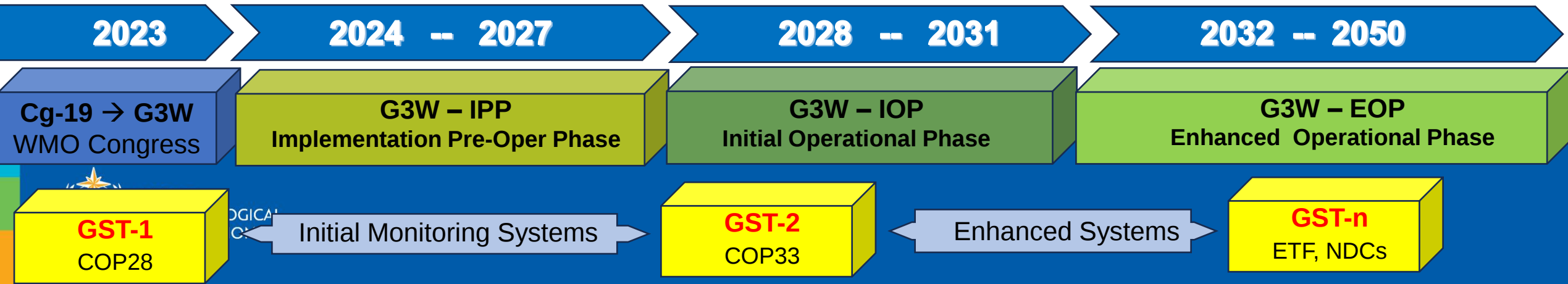
Recognizing also the significant policy implications of greenhouse gas monitoring data; it is thus recommended for any greenhouse gas monitoring to be carried out with full transparency, in accordance with Resolution 1 (Cg-Ext(2021)) – WMO Unified Policy for the International Exchange of Earth System Data, and its call for free and unrestricted international exchange of Earth system data,

Recognizing further the disparities in Greenhouse Gas observation capabilities among Members, the implementation plan underscores the importance of enhancing technology and expertise globally,

COP29 Messages from Greenhouse Gas efforts at WMO

The Global Greenhouse Gas research & monitoring efforts at WMO builds on 50-year experience and on a network of scientific and technical experts. The GAW GHG bulletin published its 20-year edition built upon the research efforts.

- WMO efforts aim at a systematic expansion of the Climate Infrastructure that supports Science & Services, interacting via the WMO channels, with the 193 Members, the UN-Family, the IPCC, and States/non-States actors.
- G3W aims to become Operational on the pathway of the Weather enterprise with engagements of all Nations, and advocates reinforcing the GHG research efforts under the GAW and the WCRP programmes.
- Estimating Greenhouse Gases with an Earth System Approach is necessary for supporting the Paris Agreement guiding GHG mitigation efforts for realizing the Climate goals. **"One can only manage what is measured"**.



2023

2024 -- 2027

2028 -- 2031

2032 -- 2050

Cg-19 → G3W
WMO Congress

G3W – IPP
Implementation Pre-Oper Phase

G3W – IOP
Initial Operational Phase

G3W – EOP
Enhanced Operational Phase

GST-1
COP28

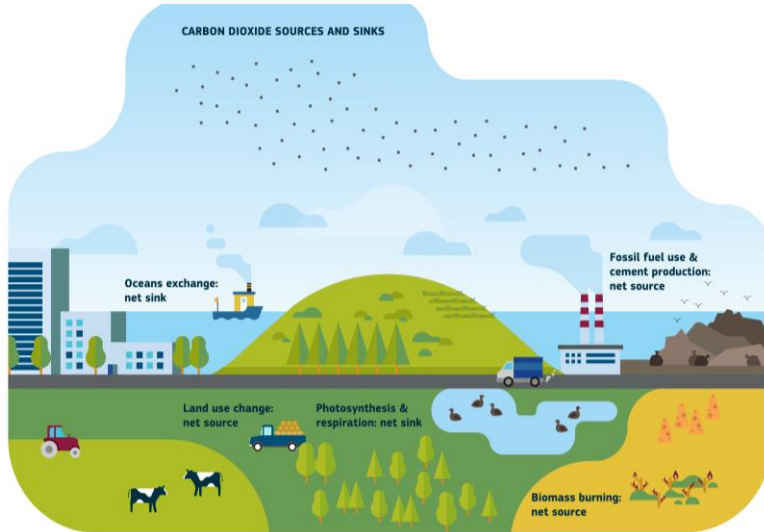
Initial Monitoring Systems

GST-2
COP33

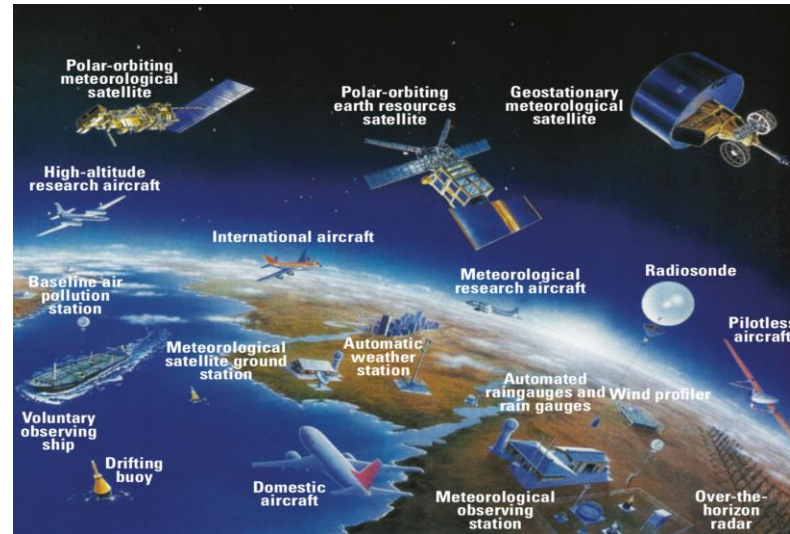
Enhanced Systems

GST-n
ETF, NDCs

“for Measuring, Understanding, and Managing the Earth’s Climate”



CO₂, Carbon dioxide



GHGs Earth's Observing Systems is building on Weather experience

UN family

IPCC-IOC-
UNEP-UNFCCC-
WHO-WMO-WTO

UNFCCC

COP-SBSTA

WMO

WIGOS-WIS-WIPPS

Public-Private Partnerships





Thank you



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Take Home 🏠 message

CLIMATE ACTION NEEDS

SCIENCE DRIVEN – CONSENSUS BASED

CLIMATE DATA – INFORMATION - KNOWLEDGE

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