Value of collaboration on Earth observations for climate action

World Space Forum

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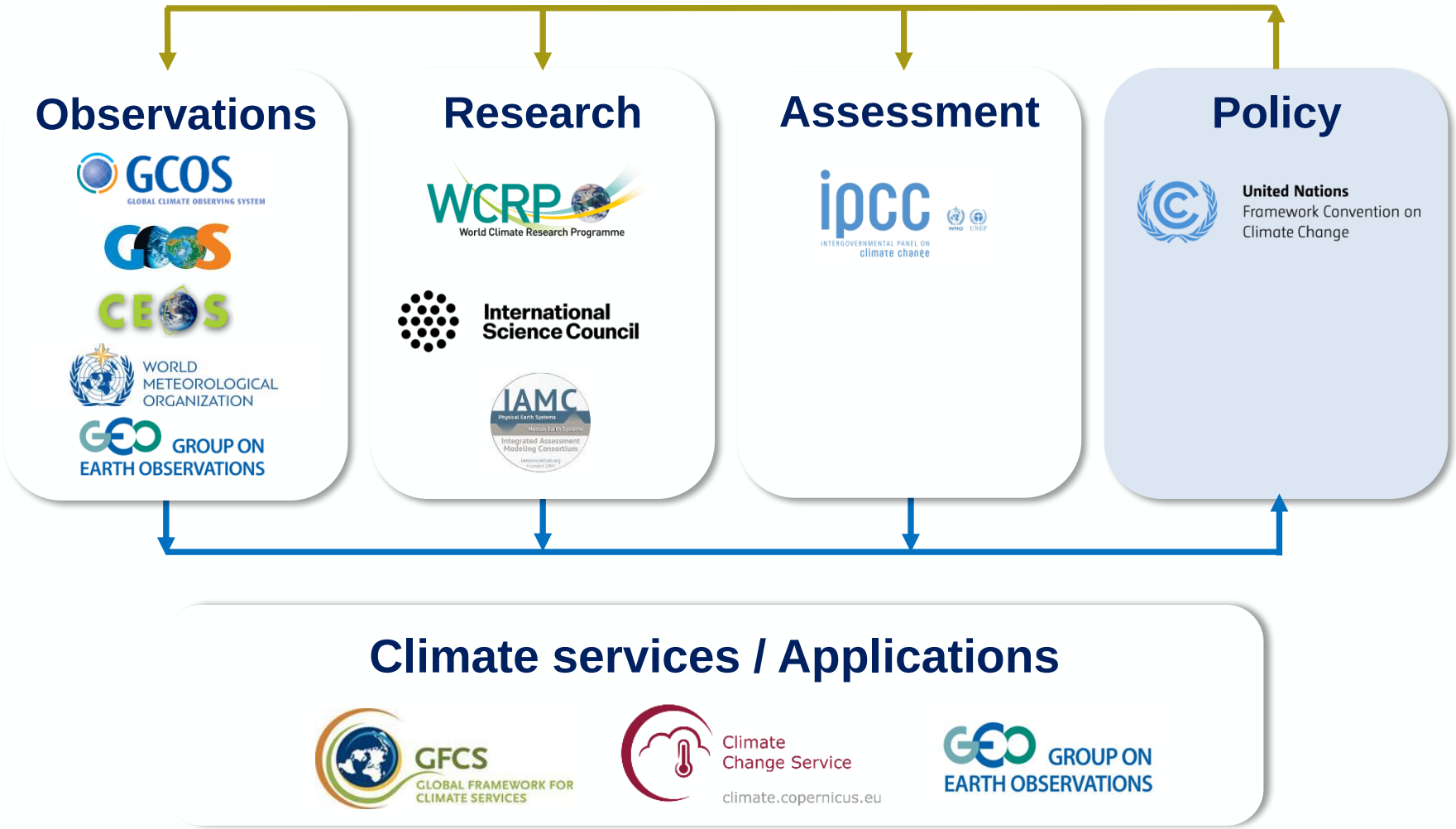
Dr Sara Venturini

Climate Coordinator, GEO Secretariat

sventurini@geosec.org

Role of Earth observations

At the foundation of the UNFCCC and climate policy



Adapted from UNFCCC Secretariat, 2020

GEO in numbers

7

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113

COUNTRIES

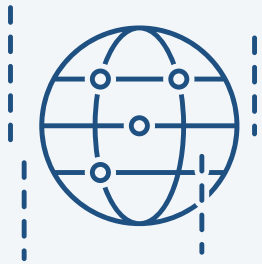
130+

PARTICIPATING ORGANIZATIONS

15+

ASSOCIATES

Modus operandi



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Routes to finance

GEO Flagships

The Global Forest Observation Initiative supports countries to develop national forest monitoring systems and green house gas measurement, reporting and accounting.

The GEO Global Agricultural Monitoring Initiative improves food security through timely and accurate predictions of crop yields and agricultural production at regional, national and global levels.

The GEO Biodiversity Observation Network coordinates the management and delivery of biodiversity and ecosystem observations to decision makers and the scientific community.

The Global Observation System for Mercury contributes to the monitoring of mercury and its compounds using Earth observations to support the Minamata Convention on Mercury.

GEO Climate Change Working Group

SG1
Coordination of climate action across GEO Work Programme & synergies with stakeholders

SG2
Engagement with UNFCCC and IPCC

SG3
Enhancing the use of EO for Mitigation

SG4
Enhancing the use of EO for Adaptation and Loss & Damage

GEO Milestone Events for Climate Action

16-17 June

GEO-GFOI Workshop + IPCC,FAO

21-23 June

GEO Virtual Symposium 2021

21-23 Sept

GEO Climate Policy + Finance Workshop

1-12 Nov

UNFCCC COP26

AFOLU-GHG Workshop

15-18-19 Nov

22-26 Nov

GEO Week 2021

2022

Regional stakeholder workshops

7-18 Nov

UNFCCC COP27

GEO Week 2021

Theme: Accelerating action
Speakers: +250
Total participants: ~1500
Countries: 93
Sessions: +60

GEO WEEK 2021

Accelerating action

Highlights

- Focus on Climate Action, Climate and Ocean, Nature-based Solutions
- Adoption of new engagement priority: Resilient Cities and Human Settlements
- Creation of Youth Community of Practice

GEO Climate Policy and Finance Workshop

Clarity on GEO's role

Increased awareness of the unique contribution of GEO activities to support national and global climate action.

Endorsement to initiate process for a prospective GEO mandate under the UNFCCC.

Climate finance action

Official launch of the GEO Climate Finance workstream: more hands-on work and engagements planned for 2022.

Collaboration

Improved collaboration with GEO members, participating organizations and new partners from the sustainable finance industry.

Download the full Workshop Report: Outcomes of the GEO Climate Policy and Finance Workshop (earthobservations.org)

GEO at COP26

- **GEO mentioned in the RSO negotiations conclusions for the first time since 2007: first step towards a GEO mandate** with reference to partnerships, biosphere observations, EO-based products, indicators, applications

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

12. The SBSTA noted the importance of building partnerships as a basis for strengthening understanding and collaboration at the national and regional level, including to facilitate cooperation on addressing key issues such as the ocean and cryosphere. In this regard, it recognized the work of WMO regional climate centres, and work by the Group on Earth Observations on developing relevant knowledge products, indicators, applications and services, notably biosphere observations for ocean and land.

13. The SBSTA encouraged Parties and relevant organi ons to support and catalyse the data ts for r ley ses daptatio p ns, SID

EO for Adaptation

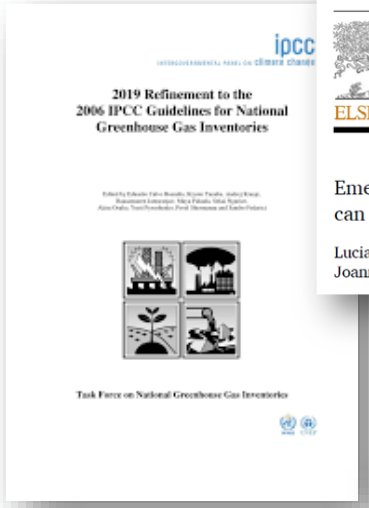
GEOGLAM
GLOBAL AGRICULTURAL MONITORING

Department for Environment Food & Rural Affairs

- GEOGLAM experts have worked with the government of Uganda to predict drought and monitor crop failure. **Early information triggered a disaster risk financing facility and a public works programme to offset agricultural losses** which saved millions of funds and thousands of households from food insecurity in 2017. Based on this success, **EO-based crop monitoring is now an operational part of the Ugandan National Early Warning Bulletin.**
- GEOGLAM is now building on their co-development experience to **develop supplementary technical guidelines for National Adaptation Plans (NAPs) to be submitted to UNFCCC.** Planned funding (about 170k USD) from UK government to continue developing NAP guidance and implementation via in-country workshops in 2022 in African LDCs.
- **GEOGLAM NAP Guidance will be blueprint for other GEO Work Programme activities** to address multiple challenges and sectors for NAPs, such as coastal zones, water management… (tbd) - public-private funding is needed

NAP GUIDELINES

EO for Mitigation



INFO NOTE on GHG inventories under the Paris Agreement and the role of Earth Observation

Collaboration between GEO and the IPCC Task Force on National GHG Inventories on the topics of land representation for GHG inventories, the role of remote sensing and field measurements, as well as uncertainty.

Indigenous peoples

CLIMATE ACTION/ DRR

WOMEN EMPOWERMENT/ EDUCATION

INDIGENOUS DATA SOVEREIGNTY

FOOD SECURITY

Engaging public and private sector

Mapping of satellite capabilities to measure GHG: joint report by GEO, ClimateTRACE, WGIC – launched at COP26 Earth Information Day

Download the report: **earthobservations.org**

Report aim and target audience

- **Mandate:** 2020 Forum on Innovation in Remote Sensing Technologies for accelerated climate action, sponsored by UK Climate Action Champion Nigel Topping, and ex VP Al Gore

- **Mapping:** To strengthen the understanding of **how Earth Observations can contribute to National GHG Inventories and the Global Stocktake,** by providing **a full picture** of currently available and upcoming GHG monitoring capabilities from space, provided by **both public and commercial satellite missions**

- **Target audience:** Policy Makers (UNFCCC National Focal Points and delegates), and EO Community

CLIMATE TRACE · GEO GROUP ON EARTH OBSERVATIONS · RACE TO ZERO · WGIC World Geospatial Industry Council · United Nations Climate Change

Report outline

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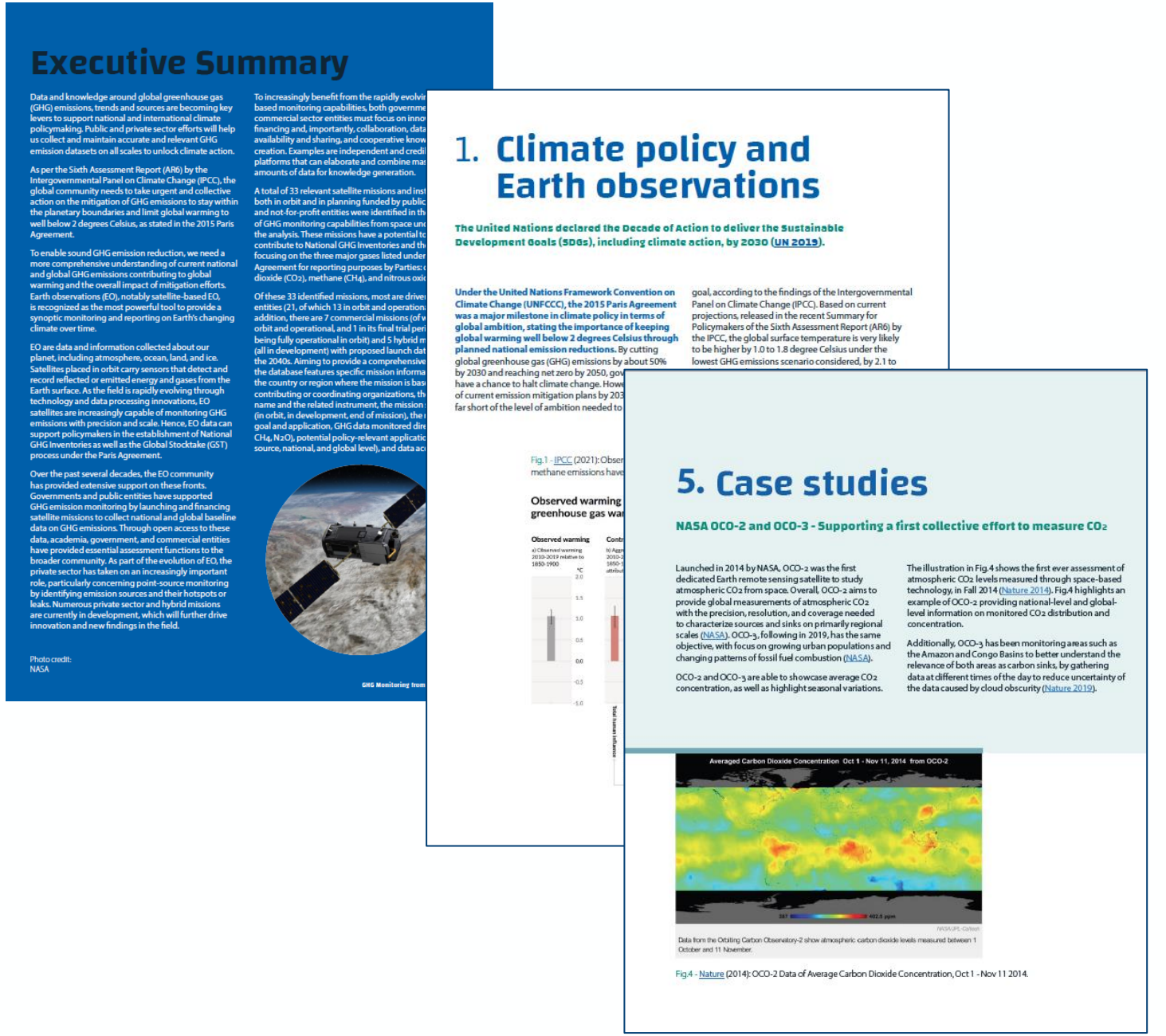

Executive Summary

Data and knowledge around global greenhouse gas (GHG) emissions, trends and sources are becoming key levers to support national and international climate policymaking. Public and private sector efforts will help us collect and maintain accurate and relevant GHG emission datasets on all scales to unlock climate action.

As per the Sixth Assessment Report (AR6) by the Intergovernmental Panel on Climate Change (IPCC), the global community needs to take urgent and collective action on the mitigation of GHG emissions to stay within the planetary boundaries and limit global warming to well below 2 degrees Celsius, as stated in the 2015 Paris Agreement.

To enable sound GHG emission reduction, we need a more comprehensive understanding of current national and global GHG emissions contributing to global warming and the overall impact of mitigation efforts. Earth observations (EO), notably satellite-based EO, is recognized as the most powerful tool to provide a synoptic monitoring and reporting on Earth's changing climate over time.

EO are data and information collected about our planet, including atmosphere, ocean, land, and ice. Satellites placed in orbit carry sensors that detect and record reflected or emitted energy and gases from the Earth surface. As the field is rapidly evolving through technology and data processing innovations, EO satellites are increasingly capable of monitoring GHG emissions with precision and scale. Hence, EO data can support policymakers in the establishment of National GHG Inventories as well as the Global Stocktake (GST) process under the Paris Agreement.

Over the past several decades, the EO community has provided extensive support on these fronts. Governments and public entities have supported GHG emission monitoring by launching and financing satellite missions to collect national and global baseline data on GHG emissions. Through open access to these data, academia, government, and commercial entities have provided essential assessment functions to the broader community. As part of the evolution of EO, the private sector has taken on an increasingly important role, particularly concerning point-source monitoring by identifying emission sources and their hotspots or leaks. Numerous private sector and hybrid missions are currently in development, which will further drive innovation and new findings in the field.

To increasingly benefit from the rapidly evolvi based monitoring capabilities, both governme commercial sector entities must focus on inno financing and, importantly, collaboration, data availability and sharing, and cooperative know creation. Examples are independent and credi platforms that can elaborate and combine mas amounts of data for knowledge generation.

A total of 33 relevant satellite missions and inst both in orbit and in planning funded by public and not-for-profit entities were identified in th of GHG monitoring capabilities from space unc the analysis. These missions have a potential to contribute to National GHG Inventories and th focusing on the three major gases listed under Agreement for reporting purposes by Parties: dioxide (CO_2), methane (CH_4), and nitrous oxi

Of these 33 identified missions, most are drive entities (21, of which 13 in orbit and operation addition, there are 7 commercial missions (of w orbit and operational, and 1 in its final trial peri being fully operational in orbit) and 5 hybrid m (all in development) with proposed launch dat the 2040s. Aiming to provide a comprehensive the database features specific mission informa the country or region where the mission is bas contributing or coordinating organizations, th name and the related instrument, the mission (in orbit, in development, end of mission), the goal and application, GHG data monitored dire CH_4, N_2O), potential policy-relevant applicatic source, national, and global level), and data ac

Photo credit: NASA

GHG Monitoring from

1. Climate policy and Earth observations

The United Nations declared the Decade of Action to deliver the Sustainable Development Goals (SDGs), including climate action, by 2030 (UN 2019).

Under the United Nations Framework Convention on Climate Change (UNFCCC), the 2015 Paris Agreement was a major milestone in climate policy in terms of global ambition, stating the importance of keeping global warming well below 2 degrees Celsius through planned national emission reductions. By cutting global greenhouse gas (GHG) emissions by about 50% by 2030 and reaching net zero by 2050, gov have a chance to halt climate change. Howe of current emission mitigation plans by 203 far short of the level of ambition needed to

goal, according to the findings of the Intergovernmental Panel on Climate Change (IPCC). Based on current projections, released in the recent Summary for Policymakers of the Sixth Assessment Report (AR6) by the IPCC, the global surface temperature is very likely to be higher by 1.0 to 1.8 degree Celsius under the lowest GHG emissions scenario considered, by 2.1 to

Fig.1 - IPCC (2021): Obser methane emissions have

Observed warming greenhouse gas wa

Observed warming

5. Case studies

NASA OCO-2 and OCO-3 - Supporting a first collective effort to measure CO_2

Launched in 2014 by NASA, OCO-2 was the first dedicated Earth remote sensing satellite to study atmospheric CO_2 from space. Overall, OCO-2 aims to provide global measurements of atmospheric CO_2 with the precision, resolution, and coverage needed to characterize sources and sinks on primarily regional scales (NASA). OCO-3, following in 2019, has the same objective, with focus on growing urban populations and changing patterns of fossil fuel combustion (NASA).

OCO-2 and OCO-3 are able to showcase average CO_2 concentration, as well as highlight seasonal variations.

The illustration in Fig.4 shows the first ever assessment of atmospheric CO_2 levels measured through space-based technology, in Fall 2014 (Nature 2014). Fig.4 highlights an example of OCO-2 providing national-level and global-level information on monitored CO_2 distribution and concentration.

Additionally, OCO-3 has been monitoring areas such as the Amazon and Congo Basins to better understand the relevance of both areas as carbon sinks, by gathering data at different times of the day to reduce uncertainty of the data caused by cloud obscurity (Nature 2019).

Data from the Orbiting Carbon Observatory-2 show atmospheric carbon dioxide levels measured between 1 October and 11 November.

Fig.4 - Nature (2014): OCO-2 Data of Average Carbon Dioxide Concentration, Oct 1 - Nov 11 2014.

Development of a comprehensive database: public, private & hybrid missions for GHG monitoring from Space

Database of the GHG Monitoring capabilities from space across Public, Private and Hybrid missions

COUNTRY/REGION, ORGANIZATION, MISSION AND INSTRUMENT					GHG MONITORED DIRECTLY			POTENTIAL POLICY-RELEVANT APPLICATION			DATA ACCESS
Country/ Region	Organization	Mission (Instrument)	Status	Mission Goal and Application	CO_2	CH_4	N_2O	Point-Source level	National level	Global level	Open access / Limited access / Paid subscription
PUBLIC MISSIONS: 21											
Canada	CSA ESA NASA	SciSat-1 (ACE)	In orbit	Mission Goal: To monitor and analyze the chemical processes that control the distribution of ozone in the upper troposphere and stratosphere. Application: SciSat-1 can measure the vertical resolutions of all major GHGs identified for monitoring under the Paris Agreement.	✓	✓	✓			✓	Open access
China	NRSCC NSMC-CMA	FengYun-3D (GAS)	In orbit	Mission Goal: Operational meteorology with substantial contribution to ocean and Ice monitoring, climate monitoring, atmospheric chemistry and space weather. Application: Retrieve GHGs in the atmosphere.	✓	✓	✓		✓	✓	Limited access
China	CNSA	Gaofen-5 (GMI)	In Orbit	Mission Goal: Hyperspectral observations of Earth's environments to track environmental impacts, water quality, and atmospheric change. Application: To measure carbon dioxide and methane in the troposphere and understand the source and sink processes that affect these GHGs.	✓	✓		✓			Limited access
China	NRSCC NSMC-CMA	TanSat (ACGS)	In orbit	Mission Goal: To retrieve the atmosphere column-averaged CO_2 dry air mole fraction (XCO_2) with precisions of 1% on national and global scales. Application: To improve the understanding on the global CO_2 distribution and its contribution to the climate change. Additionally, to monitor the CO_2 variation on seasonal time scales.	✓	✓		✓	✓	✓	Limited access
Europe	EC ECMWF ESA EUMETSAT	Copernicus Carbon Dioxide Monitoring/ CO_2M	In development	Mission Goal: The CO_2M will focus on measuring carbon dioxide and methane emissions, which are released into the atmosphere specifically through human activity. Application: Reduce current uncertainties in estimates of emissions of CO_2 from the combustion of fossil fuel at national and regional scales. Produce an independent source of information to assess the effectiveness of policy measures, track their impact towards decarbonising Europe and meeting national emission reduction targets. Note- this mission will deploy a constellation of satellites.	✓	✓		✓	✓	✓	Open access

Three GHGs are generally recognised as the critical drivers of climate change: **carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O).**

Relevant missions

33 identified missions, most are driven by public entities

- **Public missions:** 21 in total, 13 in orbit and 7 in development, 1 completed;
- **Private missions:** 7 commercial missions, 1 in orbit and operational, and 1 in its final trial period before being fully operational in orbit;
- **Hybrid:** 5 missions (all in development) with proposed launch dates until the 2040s.

Key Policy Messages from the Report

1. **Satellite observations reduce uncertainty in GHG emission monitoring** by providing data across a range of spatial, temporal, and spectral resolutions or scales;

2. **Government space agencies have the capability to collect national and global baseline data** for all relevant GHGs in a sustained manner with measurement availability ranging into the 2040s;

3. **Private sector companies are speedily entering the market** and bringing additional point-source emissions monitoring capabilities for specific GHGs;

4. **Hybrid models are increasingly emerging** and leveraging respective strengths;

5. **Collaboration, innovation, and financing are key levers** for GHG monitoring from space;

6. **Open data, open science and open knowledge are essential** to drive on-the-ground solutions

7. **New opportunities are arising for analysing secondary remote sensing measurements** with frontier IT technologies which call for transparency and capacity development.

GEO GROUP ON EARTH OBSERVATIONS

CLIMATE TRACE

WGIC World Geospatial Industry Council

Based on these findings, we call for continued cooperation between public and private sector to fully maximize complementary capacities and synergies to support policy makers in the race to net zero emissions going forward.

Thank you!

@la_Venturini
sventurini@geosec.org