Expanding Geostationary Atmospheric Composition Satellite Constellation: Towards Global Coverage

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Outline of White Paper and this Presentation

01 **THE CHALLENGE**
Observation Gap

02 **CURRENT LANDSCAPE**
Limitations of existing observations

03 **CLOSING THE GAP**
Geostationary Solution

04 **CO_2 and CH_4 GAPS**
The case for Geo Obs. of GHG

05 **COMMERCIAL DATA**
Opportunities and Limitations

06 **GROUND TRUTH**
Strengthening ground-based monitoring in the global South

07 **SYNEGISTIC BENEFITS**
Integrated Observations plus Modeling

08 **A CALL TO ACTION**
Case for improved atmos. composition observations

Action: White paper expanding current AC-VC observations to the Middle East, Africa, South America and the Oceania Region
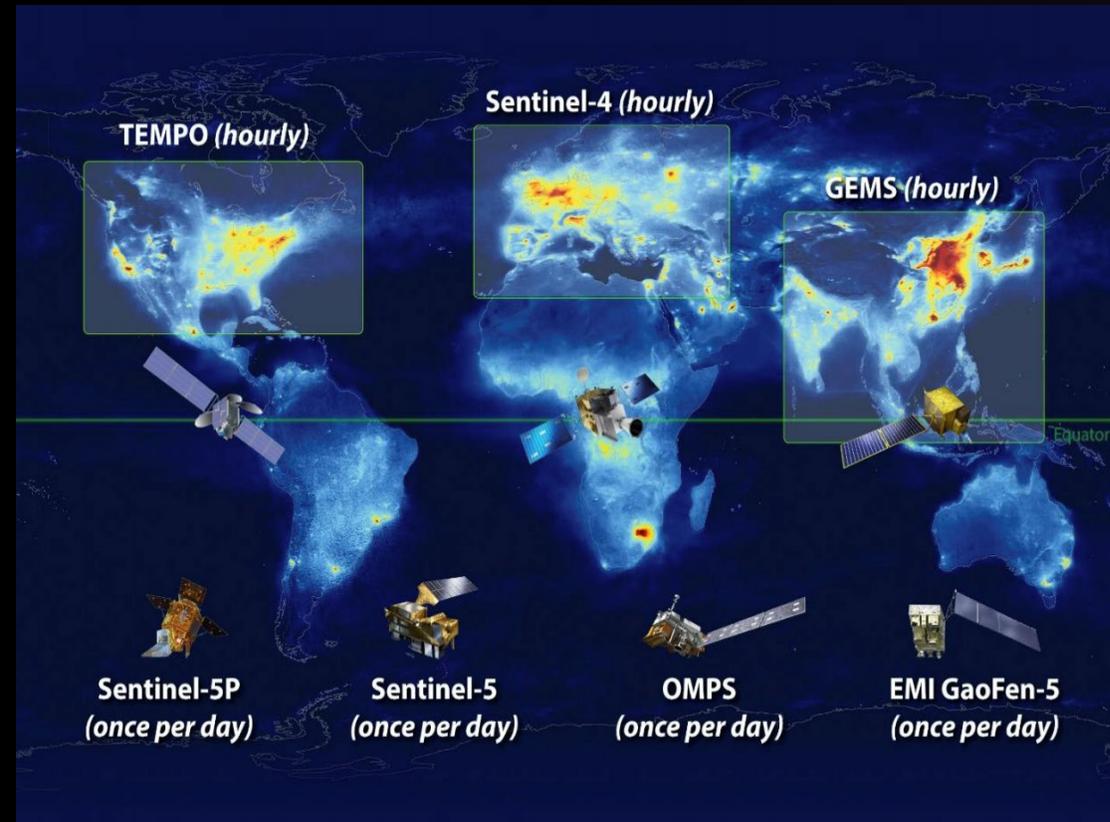
In 2024, the CEOS Atmospheric Composition Virtual Constellation (AC-VC) commissioned a team to work on a White Paper that calls for global coverage of air quality and greenhouse gas observations and complements the current virtual constellation of GEMS, TEMPO and Sentinel 4

A small team has been meeting bi-weekly to develop this white paper and submit a draft to the CEOS Strategic Implementation Team (SIT) at its October 2025 Meeting with a finalized White Paper by December 31, 2025

# The Challenge – Addressing the Gap in Observations

- Atmospheric composition is rapidly changing, driven by human activities.
- Changes impact climate, air quality, and human health.
- Accurate monitoring is essential for effective mitigation and adaptation.
- Evaluate the effects of regulations and mitigation strategies on air quality and GHG globally
- Establish geostationary satellites for measurements of CO_2 and CH_4
- Many parts of the Global South and highly populated regions of the Global North are not covered by the current constellation of geostationary satellites

The Current Landscape

- The CEOS Atmospheric Composition Virtual Constellation (AC-VC) provides valuable data.
- Polar-orbiting satellites offer global coverage, but limited temporal resolution.
- Gaps remain in observing diurnal cycles, rapidly changing events, and specific pollutants.

# Closing the Gap: The Global Geostationary Satellite Solution (hourly)
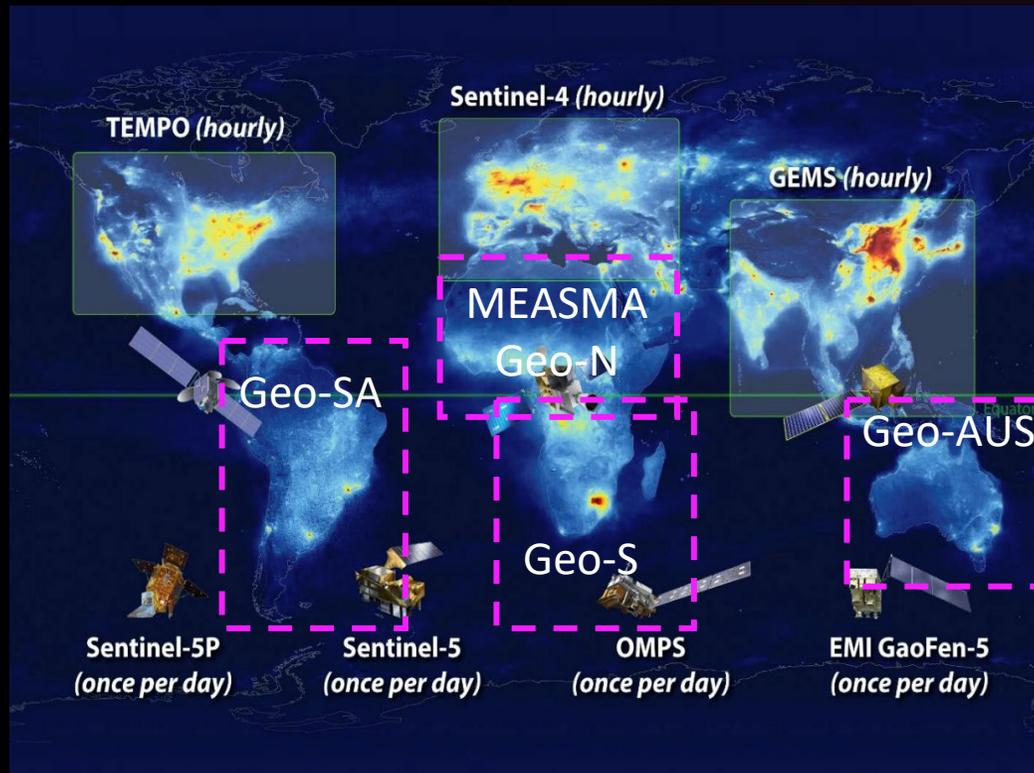
- Four new geostationary satellites in the next decade
- Continuous, wide-area coverage over the Global South.
- Complementing and enhancing existing constellation
- Identifying pollution hotspots and tracking transboundary pollution to and from the Global South
- Significant ownership and participation at the regional level to build capacity.

The benefits of investing in geostationary atmospheric composition monitoring extend far beyond the scientific realm. By improving our ability to predict and respond to environmental challenges, we can realize significant economic savings in areas such as healthcare, agriculture, and resource management. Reducing the economic impact of disasters and extreme weather.
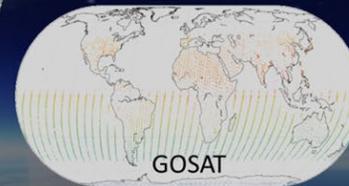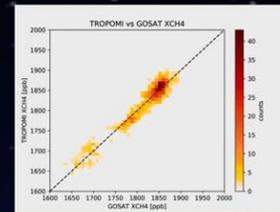
CO_2 and CH_4 Measurement Gaps
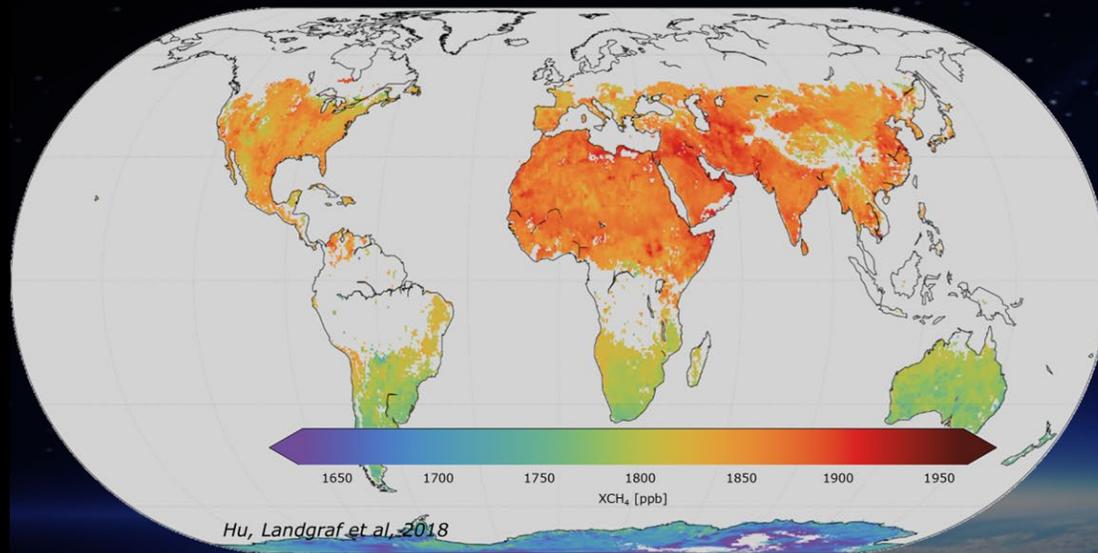
- CH_4 sources are highly localized .
- Existing constellation lacks continuous CO_2 and CH_4 high temporal measurements.
- Geostationary satellites with appropriate sensors can fill this gap.
- Improved monitoring of methane leaks and other sources.

A geostationary satellite equipped with advanced sensors can provide the necessary temporal resolution to track these gases effectively, enabling better monitoring of methane leaks from oil and gas operations, wetlands, and other key sources

Commercial Data Utilization

Leverage the Analysis Ready Data (ARD)* concepts for Geostationary Air Quality/Greenhouse Gas Observing Satellites and include relevant Product Family Specifications (PFS)

- **Enables Easier Commercial Data Integration:** ARD standards reduce the burden on commercial users to pre-process and harmonize data from different sources. This promotes wider adoption of commercial satellite data products, as users can focus on analysis and application rather than data preparation.
- **Facilitates Interoperability:** ARD ensures data from different sensors and platforms (including commercial and public) can be easily combined for synergistic analysis. This is crucial for comprehensive monitoring of air quality and greenhouse gases.
- **Supports Time-Series Analysis:** ARD specifications for temporal consistency are vital for tracking changes in air quality and greenhouse gas concentrations over time. This is particularly relevant for long-term monitoring programs.
- **Promotes Data Quality and Trust:** The CEOS-ARD assessment process provides a mechanism to verify and validate data quality, enhancing user confidence in the reliability of commercial data for critical applications.
- **Potentially Lowers Costs for Users:** By shifting the burden of pre-processing to data providers, ARD can potentially reduce the costs associated with data preparation and analysis for commercial users.
- **Geostationary Applications**: ARD helps bring standardization and quality control to data obtained from geostationary sensors, which could then be more easily incorporated with data from polar orbiting satellites or ground based sensors.

*Definition: Analysis Ready Data (ARD) are satellite data processed to a minimum set of requirements, organized for immediate analysis, requiring minimal additional user effort, and ensure interoperability (time & other datasets) by the CEOS-ARD WG.

Strengthening Ground-Based Monitoring in the Global South

Credit: Ali Omar

- Existing ground-based networks (e.g., AERONET, TCCON) need expansion.

- Establishment of strategically located "super sites."

- Focus on comprehensive instrumentation and local capacity building.

- Engage diaspora scientists in the north to reach local institutions (AMS Townhall)

The stark disparity in atmospheric composition monitoring between the Global North and the Global South creates an issue, as these regions are often disproportionately impacted by pollution and climate change but lack the resources to monitor and mitigate the impacts effectively.

Synergistic Benefits: Integrated Observations
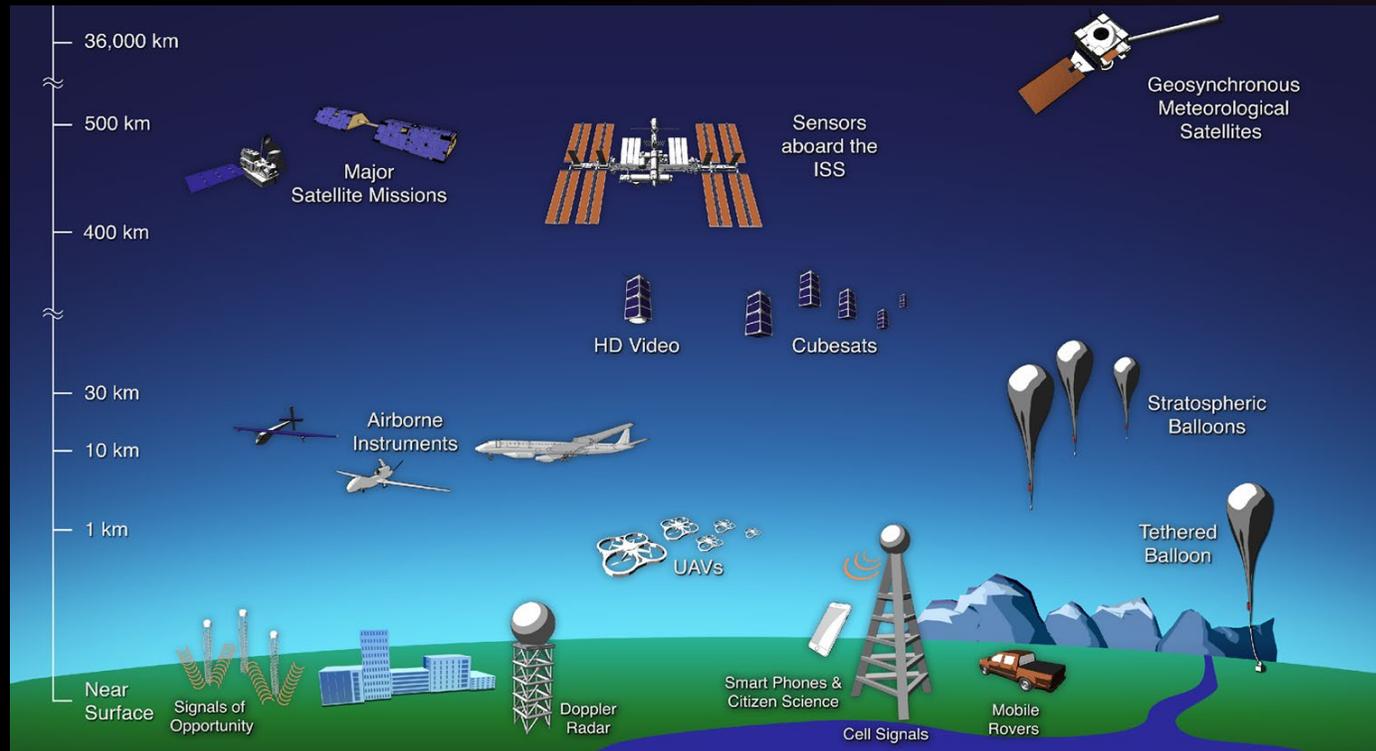
o Combining geostationary, polar-orbiting, and ground-based data.
o Creating a more complete and accurate picture of atmospheric composition.
o Data fusion techniques and algorithms.
o Artificial intelligence and machine learning methods to squeeze more information out of the data
o A complete global geostationary constellation affords a great opportunity
o Improvements in modeling and forecasting skill

Improvements in modelling skill have significant economic and social benefits

Schedule

White Paper Outline and Assignments
Approved
Mar 19

Submit
Final White
Paper to
CEOS AC-
VC
Dec 31

AMS / Townhall on African Air Quality/
Engage AfMS
Jan 31

2025												2025
Q1			Q2			Q3			Q4			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Today

First Draft of the White Paper — **55 days** — Apr 2 - Jun 13

21st CEOS AC-VC Joint with IWGGMS — 5 days — Jun 9 - Jun 13

Second Draft of the White Paper — **36 days** — Jun 16 - Aug 4

Third Draft of White Paper including Secondary Co-authors — **45 days** — Aug 5 - Oct 6

22nd CEOS AC-VC Meeting — 5 days Oct 15 - Oct 21

COSPAR 2025 Scientific Symposium — 5 days — Nov 2 - Nov 7

AGU Fall Meeting — 5 days — Dec 15 - Dec 19

Call to Action

○ Urgent need for improved atmospheric composition monitoring.

○ Geostationary satellites are a vital complement to existing systems.

○ Invest in geostationary atmospheric composition monitoring for a sustainable future.

Join our team if you want to participate
Write to: ali.h.omar@nasa.gov

THANK YOU!