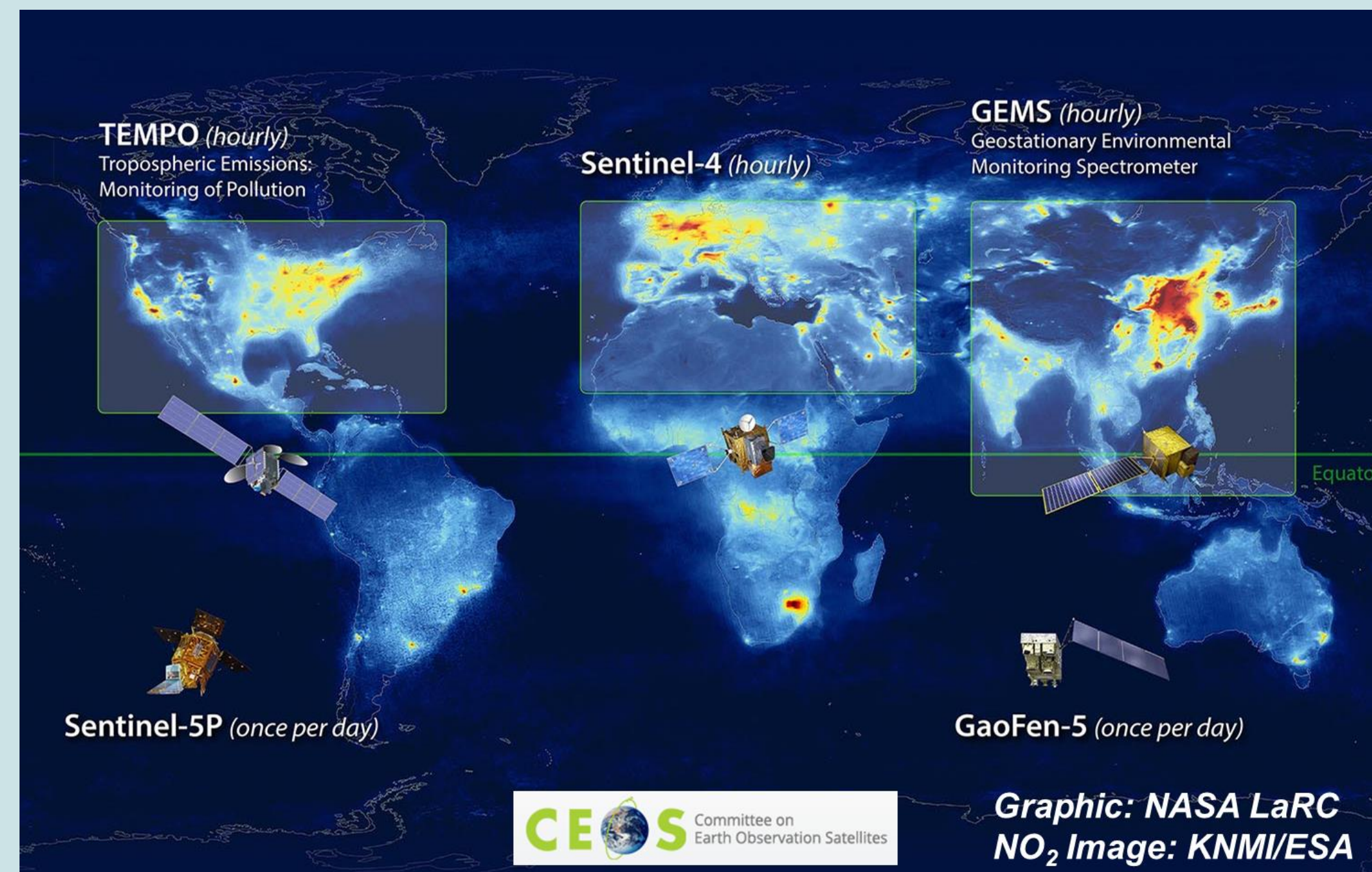


A new era of air pollution monitoring and the benefits of a global geostationary constellation



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Geostationary Pollution Monitoring Virtual Constellation



With the launch of the Geostationary Environment Monitor Spectrometer (GEMS) in 2020, the Tropospheric Emissions: Monitoring of Pollution (TEMPO) in 2023, and the near-term launch of Sentinel 4, the Atmospheric Composition Virtual Constellation, as envisioned by the Committee on Earth Observation Satellites (CEOS), is on its way to being realized. These new, persistent, hourly, high spatial resolution measurements over the Northern Hemisphere help elucidate how air pollution is created, how it evolves over hours to days and weeks, and how it is dispersed throughout the atmosphere. These data will become a new tool for public health warnings and epidemiological studies linking impacts of air pollution on human health.

Extending the Geostationary Constellation to the Southern Hemisphere: With the Global North now largely covered, providing the same persistent, high-resolution measurements for the Global South would provide benefits for public health and atmospheric science, including:

- Offer persistent, hourly measurements over a broad geographic area
- Provide a more precise understanding of pollution sources and inventories
- Correlate measurements with populations to support epidemiological and environmental health assessment studies
- Monitor impacts to air quality due to economic development, emission controls, and climate change
- Improve global emission inventory data
- Feed and validate chemical and transport models to estimate global impacts of atmospheric emissions
- Quantify diurnal regional and sub-regional air quality across large geographical areas

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Implications for Public Health

Recognizing Health Burden

- With an estimated 12.6M annual deaths linked to living or working in unhealthy environments, **6.7M deaths are attributed to air pollution.** Notably, **99% of the world's population is exposed to poor air quality** that exceeds the WHO global air quality guidelines.
- Estimates suggest that poor air quality related to **PM2.5 exposure across sub-Saharan Africa is responsible for 22% of infant deaths.**

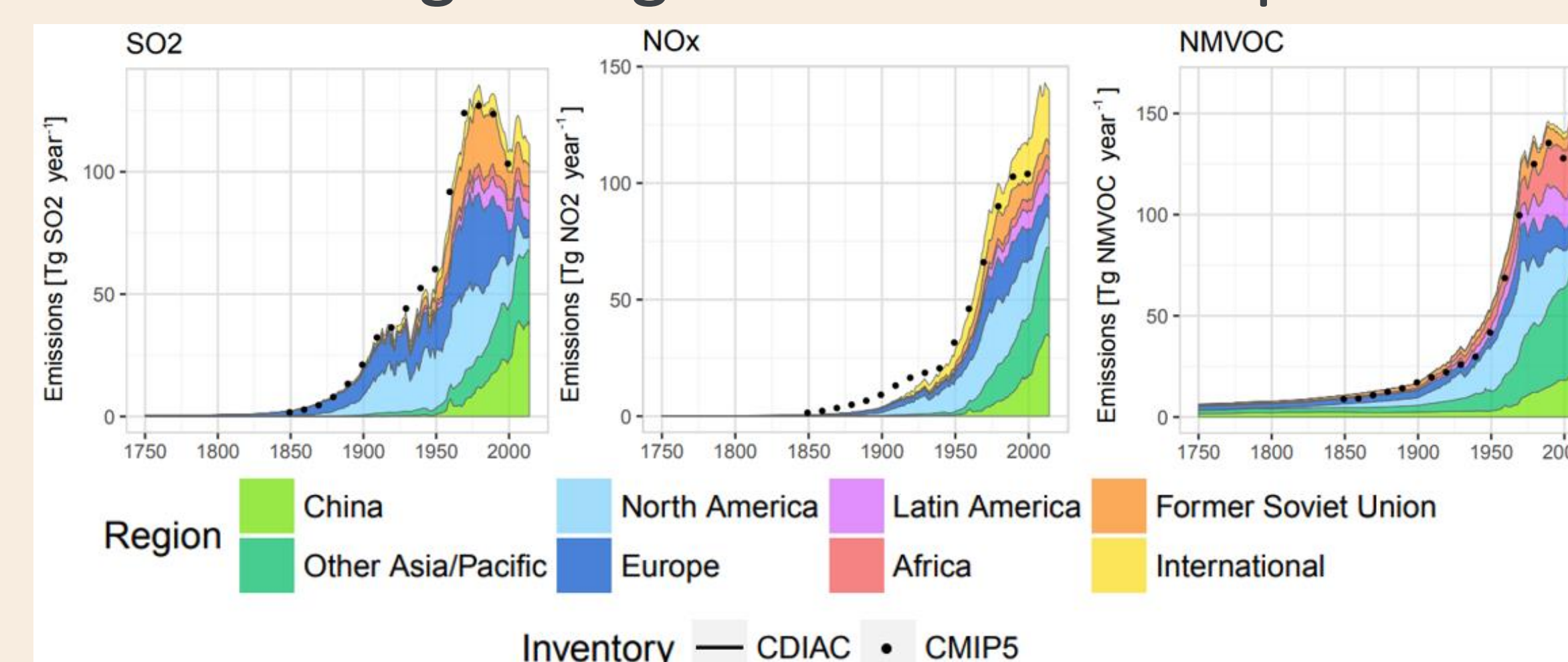
Existing Gaps

- Across Latin America, Africa, and Asia geographies and health systems, there is **sparse air quality monitoring, limited trained staff, and inadequate financial resources** dedicated to mitigating risk of air pollution exposure.
- **High spatiotemporal measurements of air pollutants from geostationary satellite instruments** in the Southern Hemisphere would aid in adopting multi-sectoral and region-specific policy approaches **for reducing emissions and improving air quality and health outcomes.**

Promoting One Health Action:

- Leveraging innovative data and tools like hourly, high-spatial resolution data, in multidisciplinary and multi-sectoral collaborations can **help us identify air pollution sources.** This information can be applied to evaluate health impacts, **provide timely information (maps) to decision-makers, and support community education campaigns.**
- With the launch of the *One Health Joint Plan of Action 2022-2026*, which promotes "integrating environment into One Health", progress toward the three primary SDG indicators can be analyzed: **SDG3 (3.9.1: mortality rate attributed to air pollution), SDG7 (7.1.2: proportion of population with primary reliance on clean fuels and technology), and SDG11 (11.6.2: annual mean levels of fine PM).**

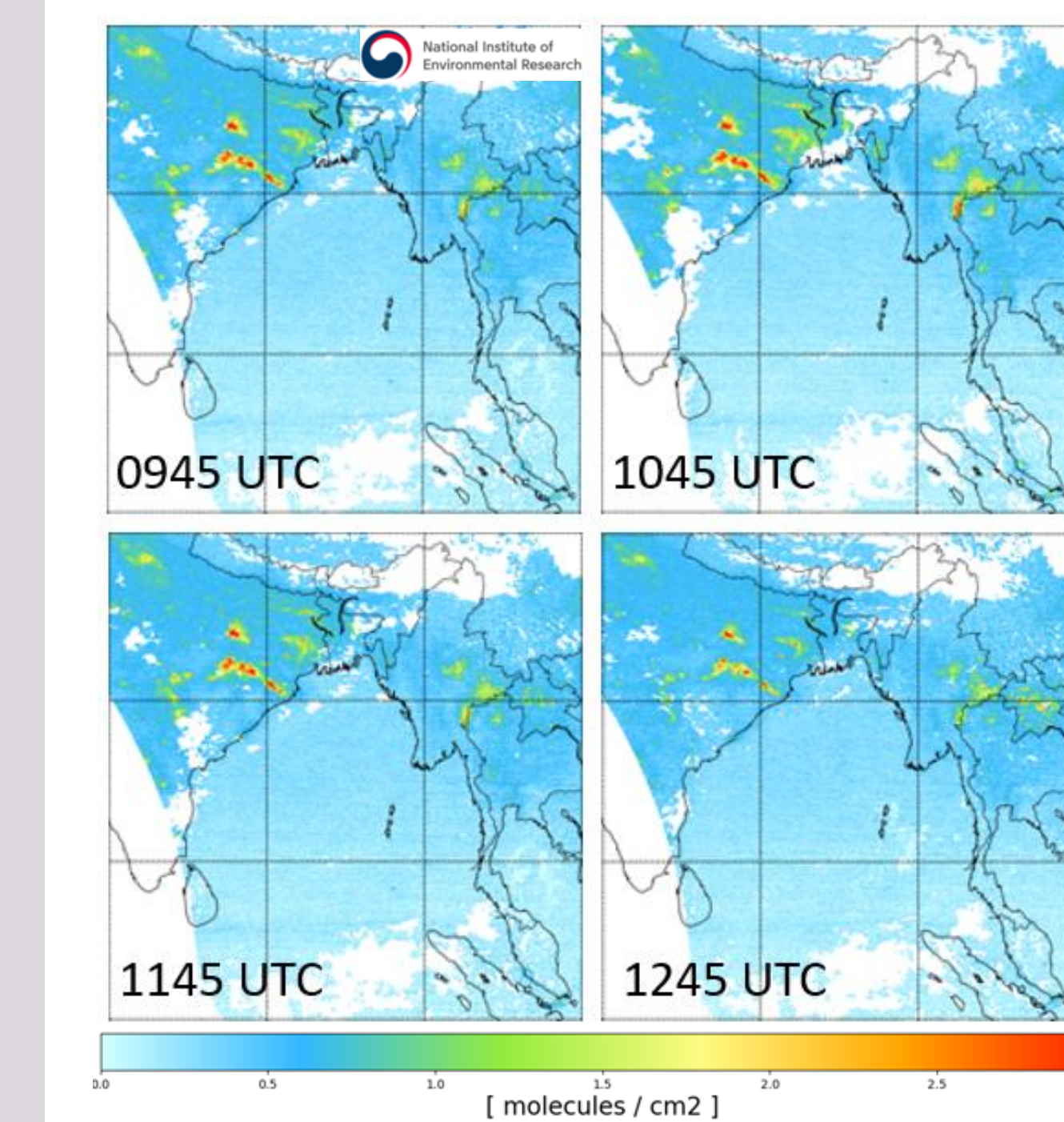
Emissions are growing in Southern Hemisphere



[R.M. Hoesly et al., GMD - Historical \(1750–2014\) anthropogenic emissions of reactive gases and aerosols from the Community Emissions Data System \(CEDS\) \(copernicus.org\)](#)

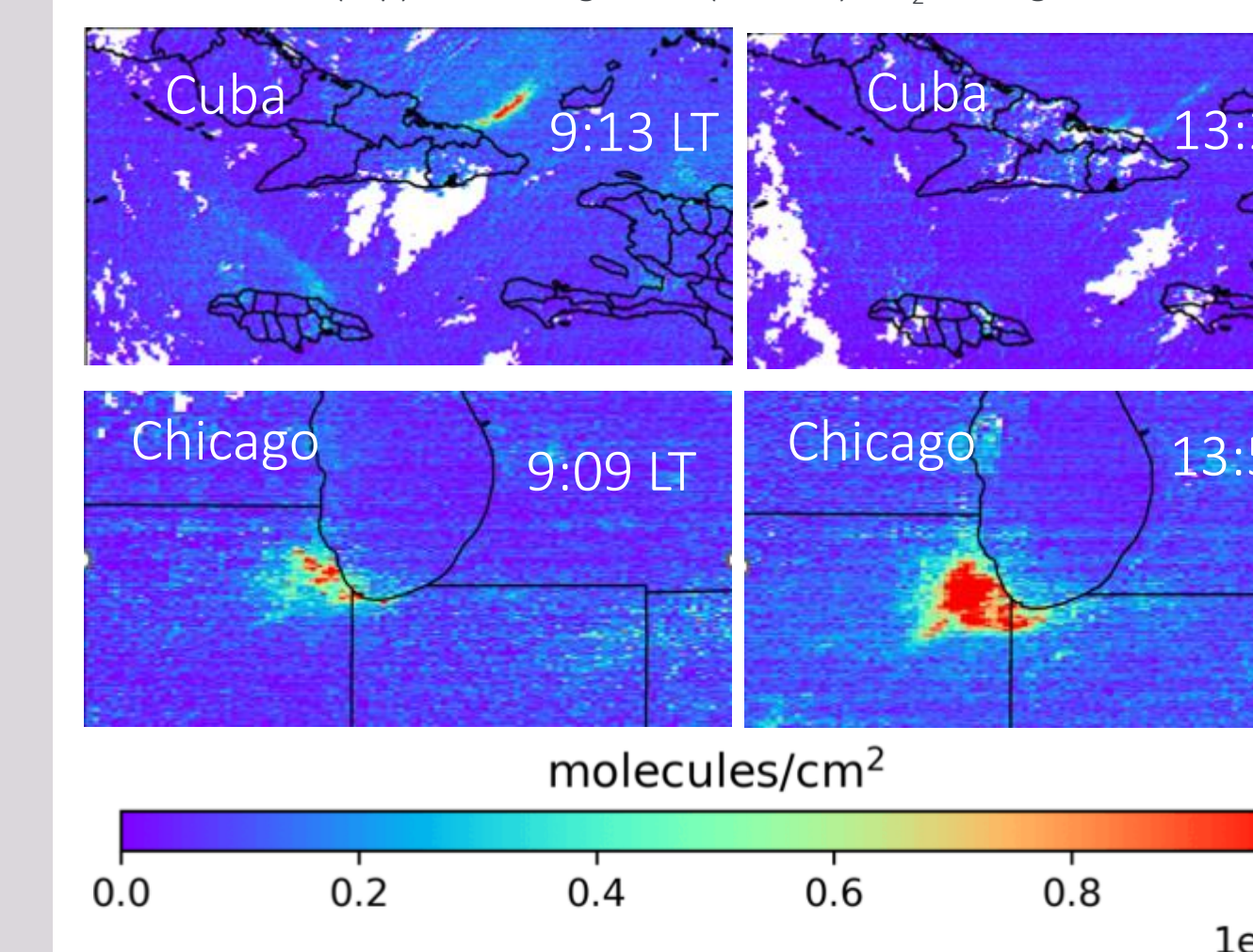
Global reactive gas emissions inventory estimates indicate that the Southern Hemisphere is a growing contributor to atmospheric emissions. Uncertainties of emissions inventories, especially for lesser industrialized countries, are high. Frequent, high spatial resolution measurement would better define and improve emission inventories.

Hourly Measurements Captures Air Quality and Emissions Variability



TOP: India and SE Asia NO₂ on March 23, 2023 from GEMS

Bottom: Cuba (top) and Chicago area (bottom) NO₂ on August 28 from TEMPO



0.0 0.2 0.4 0.6 0.8 1.0 1e16 molecules/cm²

Hourly, high spatial resolution measurements from GEO capture changes in emissions throughout the day.

GEMS data from March 23, 2023 captures NO₂ pollution from industrial sources in India as well as agricultural burning along the India/Myanmar border. These emissions vary greatly throughout the day.

Preliminary TEMPO data from August 28, 2023 shows NO₂ levels from early morning being very different than in the afternoon, which is best captured with hourly measurements.

Liu, Xiong, et al., TEMPO Post Launch Acceptance Review – Preliminary Data, 2023

Realizing A Global GEO Constellation

As demonstrated by the CEOS Virtual Constellation for Atmospheric Composition, the technology exists to extend this observing platform for the rest of the Earth.

Air pollution is already a significant contributor to public health issues including premature death. Global, high spatiotemporal data on air pollution levels and emissions are critical to understanding impacts due to further industrialization, enhancements of emissions due to climate change, and impacts to mitigations.

Air pollution knows no boundaries: Emissions from one continent impact the others. A more complete picture of atmospheric composition in the Southern Hemisphere will improve inventories and models.

Supports the One Health approach, which promotes the interconnectedness of humans, animals, and the surrounding environment.

Data enables true, multidisciplinary approach to this global health issue: including atmospheric scientists, data scientists, health professionals, regulators, decision makers, and the general public.