- Need for a centralised overview to ensure continuity and coordination
- Need to split of CO$_2$ and CH$_4$ missions, but also keep combined overview
- Need for greater awareness of current and planned missions
  - ESA MIM Team (Symbios) developed with support and cooperation of incoming SIT Chair team (JAXA) a GHG Missions portal summarising all known missions
  - Technical support from GHG Task Team (Dave Crisp, Mark Dowell, John & Yasjka)
Greenhouse Gas Satellite Missions Portal

This Portal aims to provide a comprehensive and up-to-date list of all current and planned satellite missions with the ability to measure greenhouse gases. This includes those planned and operated by both public and commercial organizations, as well as NGOs. The Portal is based on data from the CEOS Earth Observation Satellite Missions List and is to support the analysis and planning of both measurement continuity by providing visualization and export capabilities such as export timelines and tables of missions and instruments. The CEOS Database team will undertake to ensure the Portal is both comprehensive and current so that it may be applied with confidence for these studies.

Missions are categorized under three headings according to their purpose and capabilities.

- The Portal aims to support coordination and planning of initiatives worldwide that are seeking to exploit these valuable data in support of emission reduction measures. It should assist those researching which data sources may be suitable for their information needs and can provide a basis for the high-level coordination needed among space agencies and other data providers to ensure that the data are provided in a consistent and timely manner. This includes providing long-term climate data records and processes such as the Global Satellite of the Earth Observation System (GOSAT).

- At the heart of the Paris Agreement is an understanding that governments will develop and meet their emission reduction targets. The global community recognizes the need for urgent and collective action on the mitigation of GHG emissions if we are to limit global warming. Data and knowledge of global GHG emissions, trends and sources will become increasingly important to support national and international climate policymaking. Transparent reporting processes will demand more and better data to satisfy society’s needs, and satellite earth observation (EO) has the potential to play a critical role in supporting policymakers in the transition between science and action. EO satellites are increasingly capable of monitoring GHG emissions with precision, accuracy, resolution, and coverage needed to support policymakers at all levels, from the sub-national to national level for the establishment and operation of national GHG inventories, through to the global reconciliation and accounting processes that will serve to review aggregated national reports with the latest global observations. Refer to the CEOS Global Satellite Portal for more information on relevant datasets.

This resource is a product of the overall Greenhouse Gas Roadmap being implemented by CEOS and WMO agencies.

Download GHG Mission Timelines

GHG Mission Timelines

Global GHG Mappers

Facility Scale Plume Monitors
Global GHG Mappers

Typically undertaken by CDSO space agencies, these missions are the most important sources of information for tracking emissions and removals of GHGs from natural as well as anthropogenic sources and on a spatial scale spanning large areas across continents. These sensors typically do not have the spatial resolution to attribute emissions from individual facilities but are the only sensors with the precision and accuracy needed to track fluxes from diffuse sources of CO2 from the biosphere and oceans, and of methane from natural wetlands and agricultural lands. Data from (Global GHG) Mappers are being used in national inventory development and to assess the completeness and accuracy of reporting country to the UNFCCC.

**CO2M**
- The Copernicus CO2M mission measures human-induced carbon dioxide and methane emissions. It deploys satellites to reduce uncertainties in fossil fuel combustion estimates of national and regional levels, offering an independent information source for policy assessment and tracking Europe’s de-esualization progress and emission reduction goals.

**Fengyun-3D**
- Fengyun-3D is an operational meteorology mission, playing a significant role in understanding and monitoring climate, atmosphere, climate change, and climate weather. It retrieves greenhouse gases (GHGs) such as CH4, CO2, and other atmospheric gases.

**Gaofen-6**
- Gaofen-6 is a hyperspectral mission that observes Earth’s environments, tracking environmental impacts, water quality, and atmospheric changes. It measures carbon dioxide and methane in the troposphere to understand the processes affecting these greenhouse gases (GHGs).

**Airto Constellation**
- The mission aims to monitor diverse and remote locations for GHG emissions, especially CH4. By 2030, it aims to identify all super emitters, particularly, within the Oil & Gas industry, contributing to improved greenhouse gas monitoring efforts.

**Aurora**
- The Aurora mission is a precursor to Geo2M, capturing 405 spectral bands from visible to shortwave infrared. This advanced capability observes key greenhouse gases (GHGs) like CO2, CH4, H2S, and more, enabling greenhouse gas monitoring efforts.

**Brightskies**
- The Brightskies mission employs hyperspectral observations to track environmental impacts, water quality, and atmospheric changes. Its application involves measuring carbon dioxide and methane in the stratosphere and understanding the source and sink processes affecting these greenhouse gases (GHGs), contributing to our understanding of climate dynamics and environmental changes.

**Carbon Mapper**
- The mission’s goal is to pinpoint, quantify, and monitor CH4 and CO2 emissions as individual facility sources, promoting global accessibility and transparency of methane and CO2 data. The application includes fast methane leak detection for facility operators and regulators, aiding in curtailing methane intensity for oil and gas supply chains.

**OISAT**
- The OISAT mission aims to monitor the global distribution of greenhouse gases (GHGs), including CO2 and CH4, at a 10° x 10° resolution. Its goal is to verify the effectiveness of GHG emission reduction measures and contribute to

**OSAT-2**
- The OSAT-1 mission aims to extend the GHG monitoring record initiated by GO2M. Its goal is to measure the global distribution of greenhouse gases (GHGs) such as CO2 and CH4 at a 10° x 10° resolution, reducing the uncertainties of GHG.

**MERLIN**
- The MERLIN mission aims to achieve high precision and accuracy in obtaining spatial and temporal gradients of atmospheric CH4 columns on a global scale. It seeks to enhance knowledge of both natural and anthropogenic cycles.

**EMIT**
- EMIT’s mission goal is to fill the crucial gap in dust source information, enabling scientists to create a comprehensive mineral map of Earth’s dust-producing regions. By providing this missing data, EMIT supports improved understanding and management of dust-related environmental impacts and atmospheric processes.

**EnMAP**
- The EnMAP mission aims to measure, derive, and analyze essential parameters for Earth’s surface, including agriculture, biodiversity, soil, wetlands, coastal areas, and inland waters. It assesses ecosystem status and responses to environmental changes, adding carbon emissions accounting and monitoring land surface changes like forest degradation and deforestation.

**GEI-SAT Constellation**
- As part of a dedicated constellation, GEI-SAT will aim to provide near-real-time coverage of any sub-pixel point on the globe (using moderate resolution) to identify CH4 emission sources. This high- frequency monitoring enhances our ability to understand and mitigate methane emissions impact on climate change and the environment.
MIM Database Entry

- More details per entry
- Global GHG Mappers (usually public)
- Facility Scale Plume Monitors (mixed)
- Operational Sounders
- Links through to MIM profile for each
Already in use!

- Being deployed in the IMEO Roadmap document
- Further comments and updates welcome
- Ready to demo at COP-28 and beyond
- Includes various types of mission operators, i.e., public, philanthropic, private, NGO & mixtures
Other GHG related observations

- Besides column-averaged mixing ratios of CO$_2$ & CH$_4$
- Also other relevant gases and/or related products:
  - Plume mappers looking at local enhancements of (mainly) CH$_4$ (& CO$_2$)
  - NO$_2$ leading to plumes of CO$_2$
  - Biomass, vegetation indices, landcover, deforestation maps and other land products
- Or other input in support of models
  - Vegetation SIF
  - Nightlights
  - Inundation maps

**Credits:**
- EMPA
- Guanter

**Images:**
- Europe at Night: Courtesy: DMSP and NASA
- NO$_2$ plumes: Credits EMPA
- Tropomi SIF: Credit Guanter

**Slide 7: 19th AC-VC meeting, 24 October**