A COORDINATED GLOBAL GREENHOUSE GAS (GHG) MONITORING INFRASTRUCTURE IN SUPPORT OF RESEARCH NEEDS

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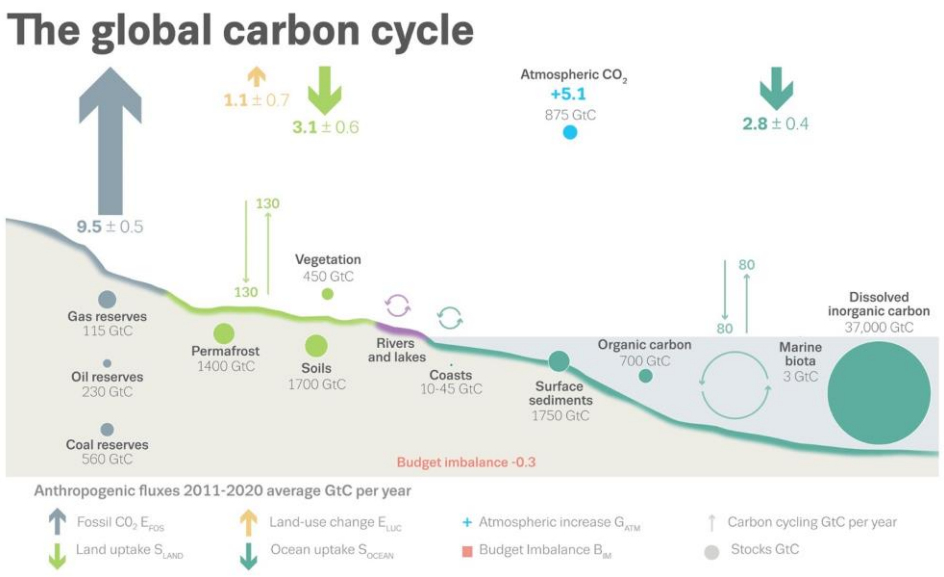
Greenhouse gas monitoring provides critical input to scientific research and support for the implementation of the Paris Agreement

In order for the 1.5-degree goal of the Paris Agreement to remain within reach, mitigation action – reducing net anthropogenic emissions of CO2, CH4 and N2O - is urgently needed. However, to plan mitigation measures and monitor the implementation of the Agreement, also natural sources and sinks of GHGs need to be accounted for. It is well known that for instance atmospheric CO2 growth rates would have been much larger if natural sinks in the land biosphere and ocean had not removed over half of the anthropogenically emitted CO2 over the last 150 years.

On a global basis, very significant investments are made in GHG monitoring capabilities – surface- and space-based observations pertaining to both atmosphere, ocean and land as well as surface; modeling and data assimilation capabilities, also encompassing atmosphere, ocean and land surface with various levels of integration and coupling. However, GHG monitoring currently relies primarily on research activities and funding. The effort thus remains fragmented, with no guaranteed sustainability.



GCB, Friedlingstein et. al., 2020

What is missing?

- An integrated, internationally coordinated global approach allowing existing capabilities to complement and leverage each other for optimal overall impact;
- Integration of space-based and surface-based observations into a unified observing system used best characteristics of both;
- International data exchange providing systematic and universal access to observational data;
- Agreed standards, file formats and file specifications for international exchange of model output for both operational and research purposes
- Sustainable financing for systematic observations in countries with limited capacity.

PROPOSED COORDINATED GLOBAL GREENHOUSE GAS (GHG) MONITORING INFRASTRUCTURE

Components

- Integrated GHG observing system (surface- and space-based);
- Timely international exchange of all observations and model data;
- Near-real time, continuous modeling and data assimilation tracking atmospheric CO2, CH4 and N2O and related fluxes;
- Framework for intercomparison of output, possibly also for collaboration on algorithms, model components;
- Coupling with ocean land surface models.

Output data

- Time-continuous best estimates of global, 3-D fields of GHG concentrations based on all available observations;
- Comprehensive set of discrepancies between model priors and all observations ("observation minus background" residuals) to support source and sinks estimation and component model improvement.

Benefits of coordinated global GHG monitoring infrastructure

- Leveraging of all existing GHG monitoring capabilities for common goals;
- Maximizing return on investments;
- Avoiding fragmentation of effort, both scientifically and politically;
- Consolidation of design for integrated global GHG observing system of both ground-based and space-based assets;
- Potential access to funding for observing systems in developing countries.

Research and development enabled by output data

- Reduction of remaining uncertainties in GHG sources and sinks;
- Improved understanding of time evolution of sources and sinks;
- Improved prediction and projection of effects of mitigation action.

Contribution to Paris Agreement

- Support for work of IPCC;
- Enhanced Transparency Framework;
- Input to Global Stocktake;
- Monitoring of implementation;

The WMO World Weather Watch as a paradigm

GHG monitoring would benefit from coordinated, global approach similar to the one taken for weather prediction and climate monitoring, with:

- An integrated global observing system (surface- and space-based)
- Near-real time international exchange of all observations
- Multi-center modeling and data assimilation with open access to output
- Global coordination of verification and validation of model output

Moving forward (Recommendations from GHG Monitoring Workshop hosted by WMO in May 2022):

- **Consensus on need for a fully integrated, globally coordinated Greenhouse Gas Watch that encompasses**
  - Integrated observing system, ground-based and space-based assets
  - Multi-center modeling and data assimilation systems (transport driven by NWP, including geospatially disaggregated sources and sinks terms);

- **Consensus that the World Weather Watch would be a useful paradigm for large parts of such a framework**; however, important elements of it are outside WMO's core mandate and expertise, e.g. land surface and ocean observations and modelling;

- **Immediate actions:**
  - WMO to call for round table discussion with relevant parties
  - Seek to expand observing networks in priority regions including the tropics, the Southern Ocean and the Arctic;
  - Establish collaboration between existing GHG modeling centers to provide access to common observational datasets and opportunities for intercomparison (lessons learned from NWP, Air Quality forecasts, …);
  - Initiate activities to support the current UNFCCC assessment cycle.

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