

Defining Capabilities and Requirements

Opportunity: Ground-based, airborne, and space-based atmospheric CO₂ measurements are now being assimilated into atmospheric transport models to estimate CO₂ emissions and uptake on scales spanning individual large power plants to nations.

Objectives: Develop top-down global atmospheric inventories for CO₂ that:

- reduce uncertainties in national emission inventory reports;
- identify additional emission reduction opportunities;
- provide nations with timely and quantified guidance on progress towards their emission reduction targets and pledges (Nationally Determined Contributions, NDCs); and
- track changes in the natural carbon cycle caused by human activities and climate change.

Approach:

- Review capabilities and plans

The Committee on Earth Observations (CEOS) Greenhouse Gas (GHG) White Paper defines the state of the art for atmospheric CO₂ and CH₄ and modeling systems and near term plans.

- Develop a Roadmap

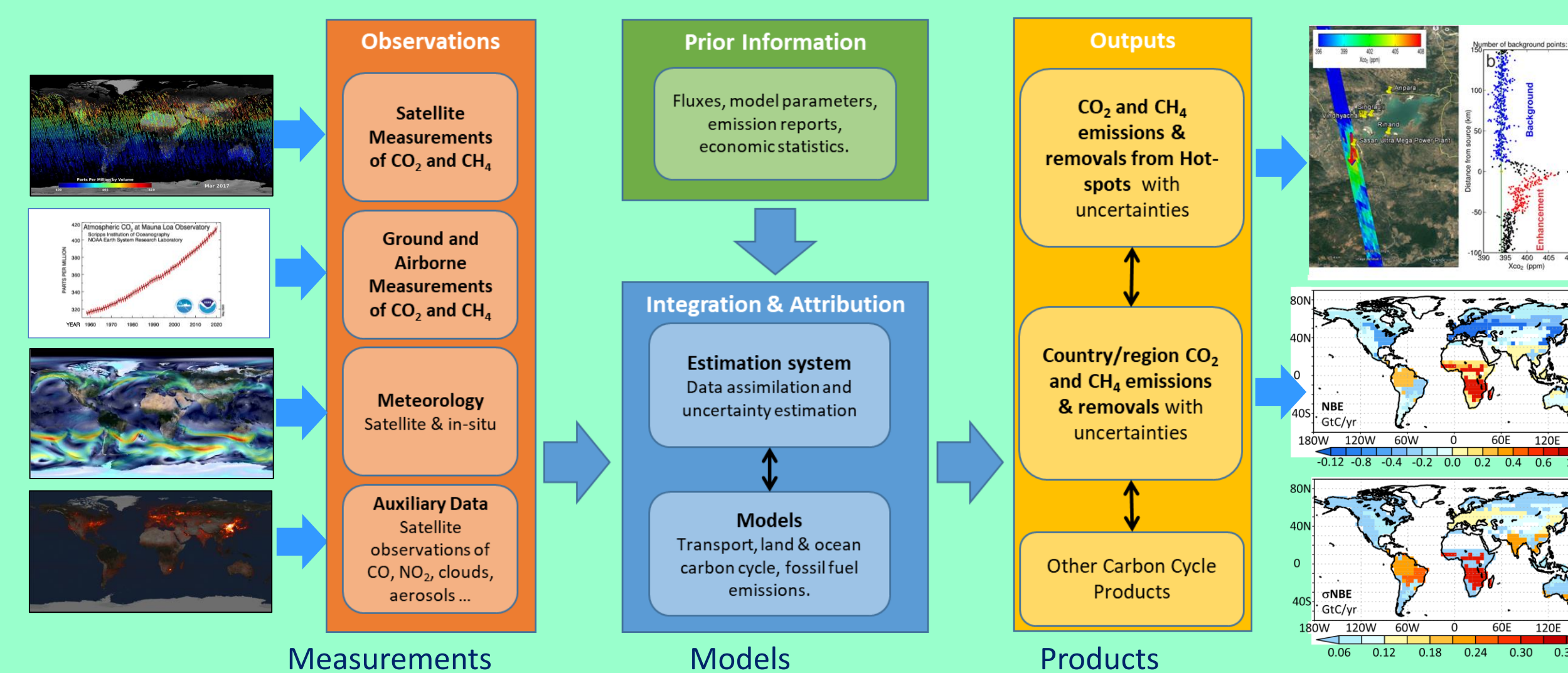
CEOS and Coordination Group on Meteorological Satellites (CGMS) established a joint Greenhouse Gas Task Team within the Joint CEOS/CGMS Working Group on Climate (WGClimate) to develop a GHG Roadmap to:

1. Work with the atmospheric CO₂ measurement and modeling communities, stakeholders and national inventory compilers to **define requirements** and plans for atmospheric flux inventories;
2. Produce **pilot atmospheric CO₂ and CH₄ flux inventories** that are available in time to inform the bottom-up inventories for the 2023 Global Stock Take (GST)
3. Use lessons learned from this prototype flux product to refine requirements needed to implement a **future, purpose-built, operational, atmospheric inventory system**



Developing Pilot Products

A System-level approach was adopted to develop the pilot atmospheric CO₂ and CH₄ inventory products

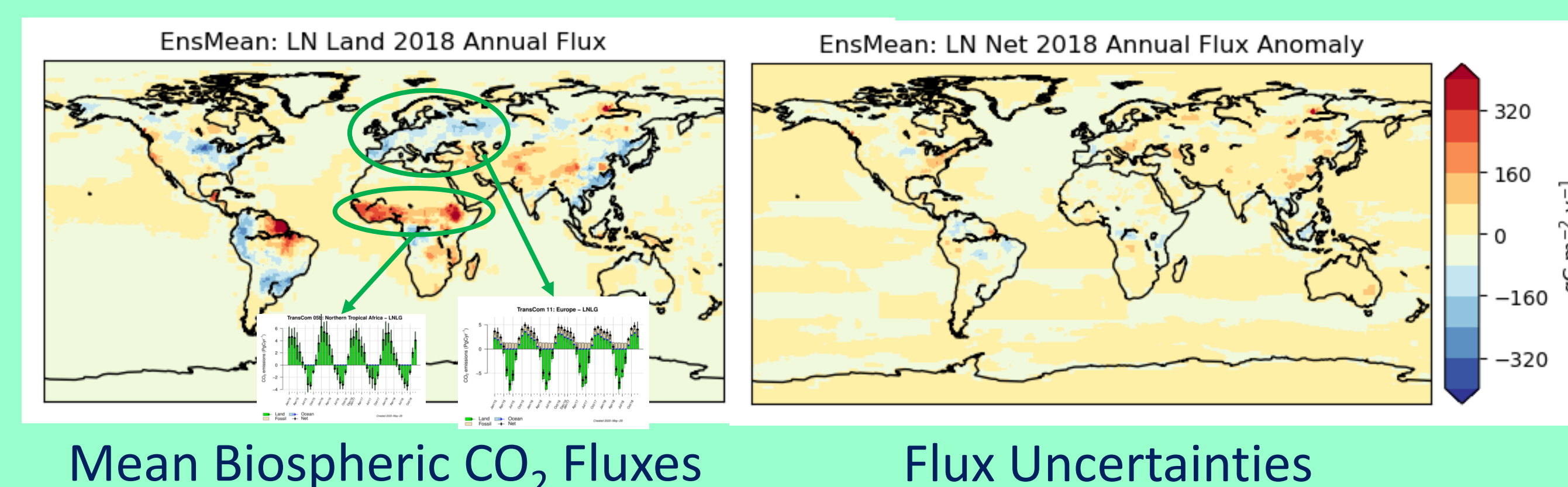


This approach integrates available:

- ground-based, airborne, and space-based CO₂ and CH₄ measurements along with other atmospheric and surface data to provide global coverage at the highest possible resolution;
- global, bottom-up statistical fossil fuel emissions inventories and estimates of uptake and emissions from the natural biosphere to define the prior state; and
- atmospheric inverse models that combine atmospheric transport with data assimilation systems and GHG inverse methods to derive the CO₂ and CH₄ emissions and uptake needed to maintain the observed concentrations in the presence of the winds.

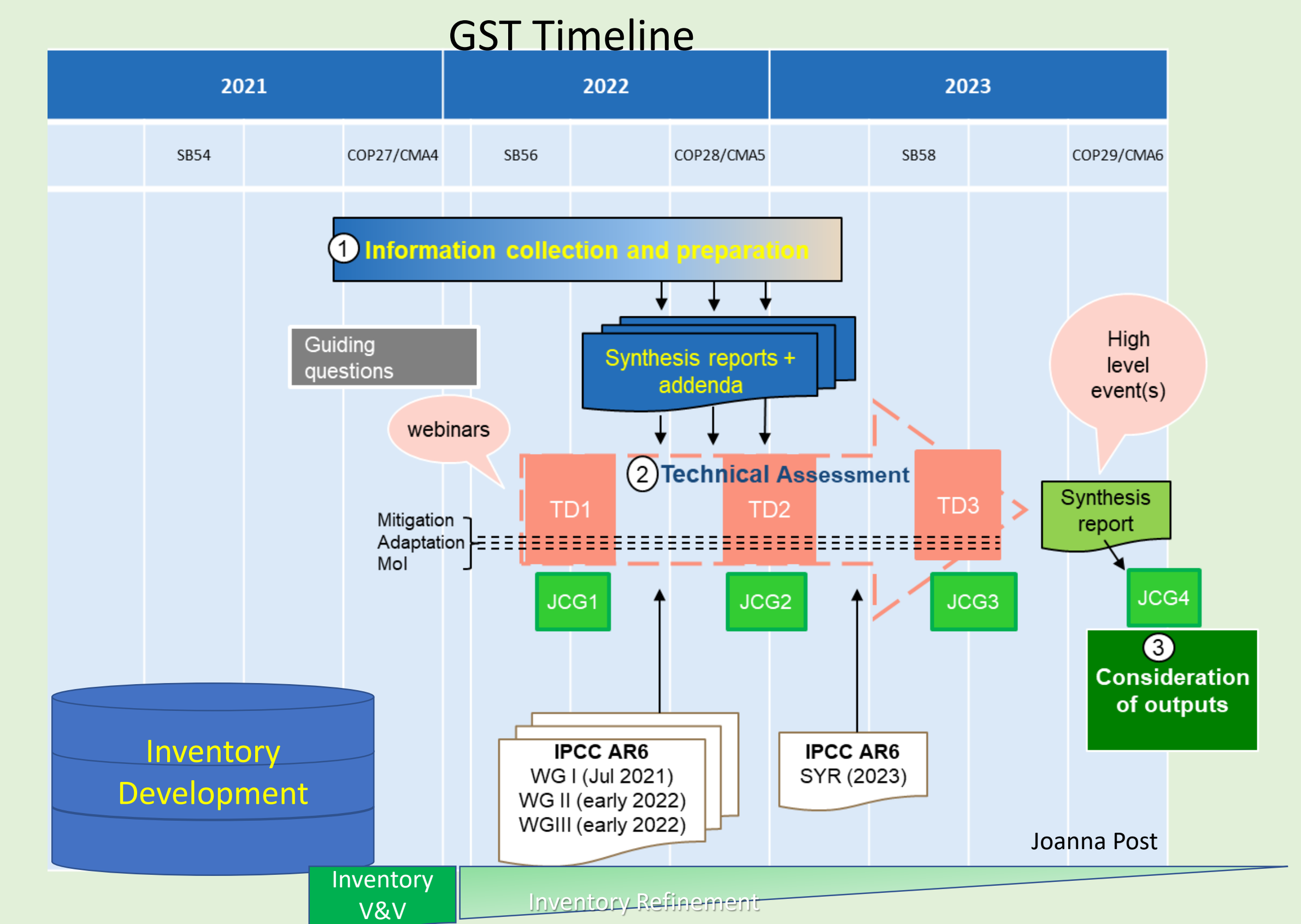
These Tools will produce two types of pilot products:

- **Global, gridded maps** of natural and anthropogenic CO₂ emissions and uptake, with **uncertainties** at a resolution of ~200 by 200 km.
- These results will be less source specific, but more inclusive than existing statistical inventory methods.
- Emission estimates from a series of **emission hot spots**, including large urban areas (i.e. Los Angeles, Tokyo, Beijing, Delhi, and Paris) and large power plants.



Working with Users

Initial Products from these efforts will be delivered at the end of 2021 to support the inventory development process for the 2023 Global Stocktake (GST)



The WGClimate GHG Task Team will work with its partners in CEOS, CGMS, and WMO to:

- Deliver a global, gridded pilot top-down atmospheric inventory for CO₂ emission and uptake, along with sample products for local sources (urban areas, power plants) along with their uncertainties;
- Work with stakeholders (UNFCCC, IPCC) and national inventory communities to find the best ways to integrate these atmospheric inventories with conventional, bottom-up statistical inventories to:
 - Identify large discrepancies that might be due to omitted processes or rapid changes in the emissions that are not captured by the usual process;
 - Define net national CO₂ emission totals, accounting for AFOLU as well as fossil fuel emissions; and
 - Refine emission factors and activity data on national to sub-national scales.
- Provide capacity building for users in the national inventory community to foster their use of these products.