Improved tracking of recent changes in CO_2 and CH_4 in support of the U.S. GHG Center

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DEMONSTRATION AREAS

Demonstration Area: Human emissions, cyberinfrastructure

Use Case 1. *Improve access and latency to, gridding of anthropogenic CH_4 inventory*

Add. Interagency Opportunities. *Collaboration on low latency GHG, AQ emissions (e.g., through GRA²PES)*

International. *Make gridding tools open source, support capacity building in other countries, collaborating with State Department.*

REGIONAL

Demonstration Area: Natural sources/sinks, modeling and data assimilation

Use Case 2. *Complement anthropogenic GHG emissions with natural GHG emissions and fluxes*

Add. Interagency Opportunities. *Collaboration on quasi-operational modeling, development of consensus GHG products*

International. *Contribute to CEOS Strategy to Support the Global Stocktake and WMO IG3IS and Global Greenhouse Gas Watch initiatives.*

GLOBAL

Demonstration Area: Large emission events, Advancing measurement technology and cal/val

Use Case 3. *Identify and quantify emissions from large CH_4 leak events leveraging aircraft and satellite data*

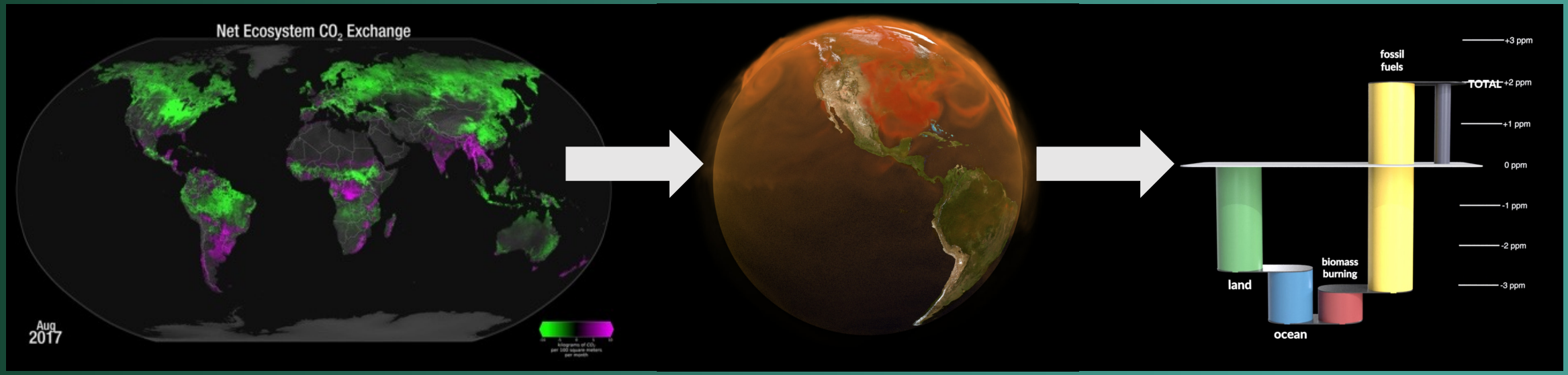
Add. Interagency Opportunities. *Collaboration on cal/val standards, coordinated measurement deployments*

International. *Explore contributions to UNEP IMEO/MARS initiatives to enable timely access of satellite plume mapping data for large/transient emissions detection and inter-comparison of plume mapping instruments with emissions release.*

LOCAL

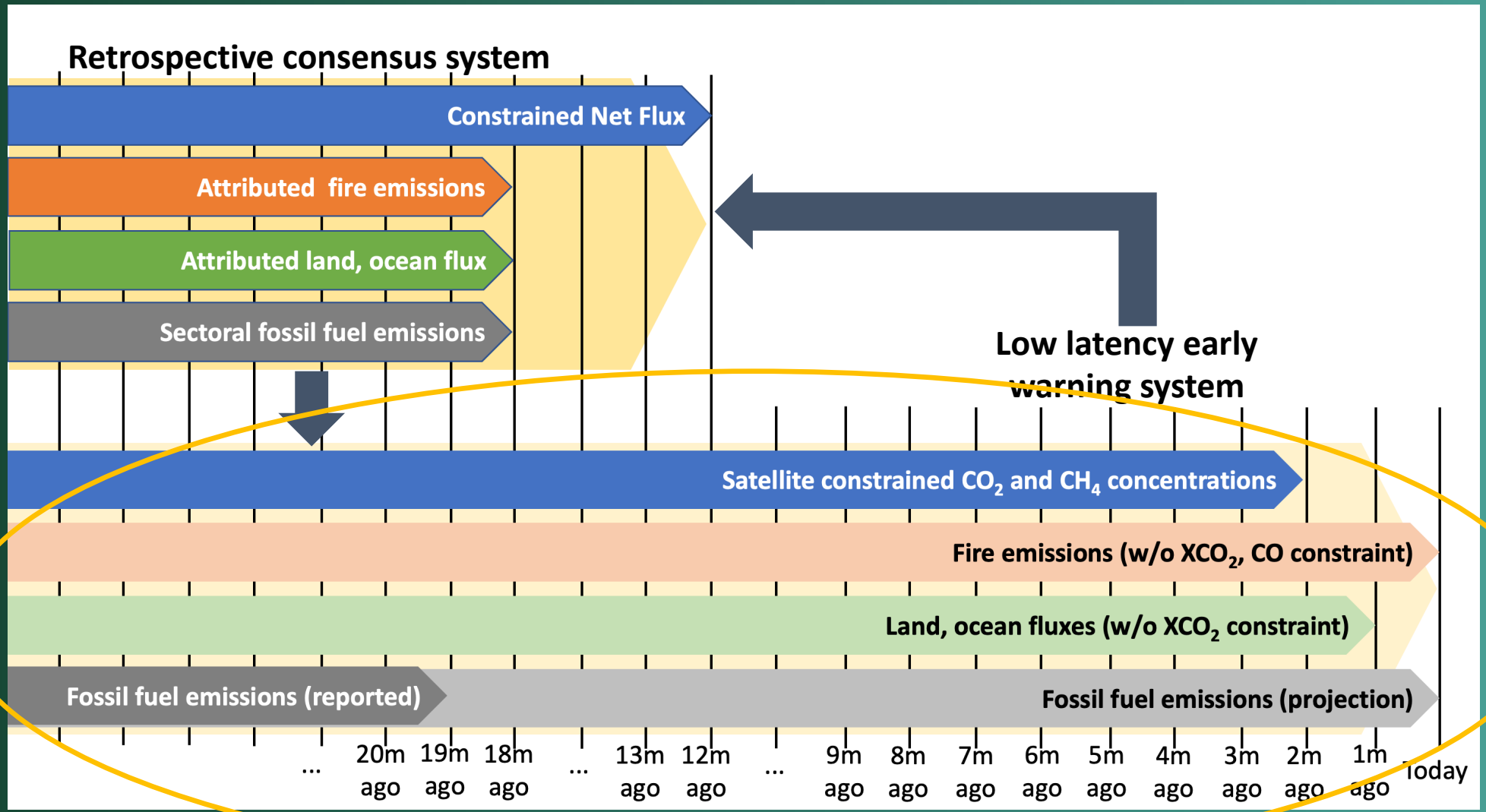
Demonstration Area 2: Natural Sources and Sinks, Modeling and Data Assimilation

Improved bottom-up estimates Refinement through atmospheric DA Improved GHG budgets



1. Improved delivery, quality, and resolution of natural source and sink estimates
2. Monitoring and early warning of changes in sources and sinks
3. Evaluation and refinement of source and sink observations using top-down constraints
4. Contribution to coordinated standards for model intercomparison and evaluation
5. Develop future workforce to ensure sustainability of model-based products

Toward a coherent GHG Modeling Strategy – complementary low latency and retrospective systems

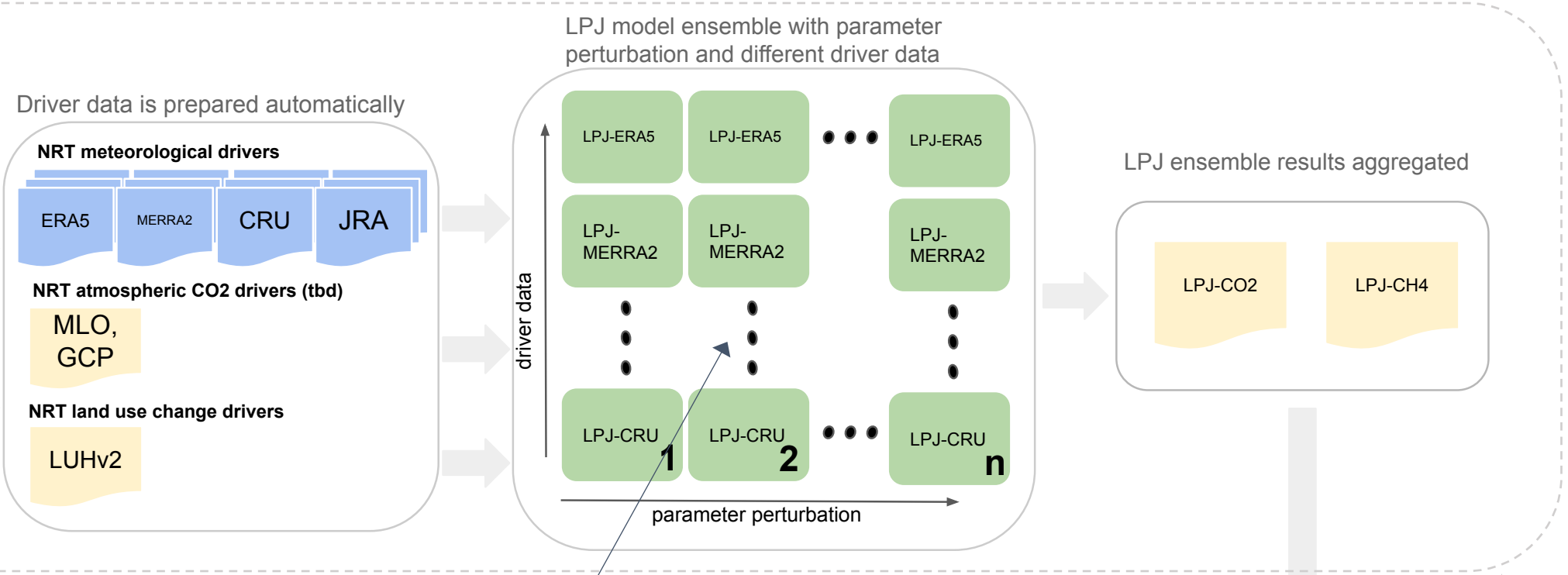


Low Latency Concentration Monitoring System

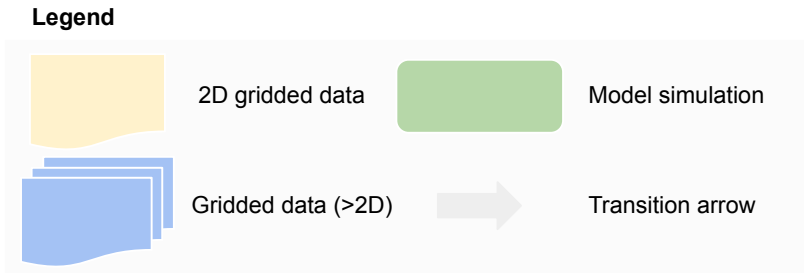
- Supports early detection of emissions changes, carbon-climate feedbacks
- Quantification of atmospheric growth rate, radiative forcing
- Preliminary information on drivers of change
- Supports researchers, retrospective systems

Modernized land model workflow

Emphasis within GHG Center activities on improving delivery of products. Example of effort to modernize land flux workflow



Evaluate ability to transition from HEC to cloud



Ability to expand to multi-model approach

Diagnostic plots and model intercomparison

ILAMB

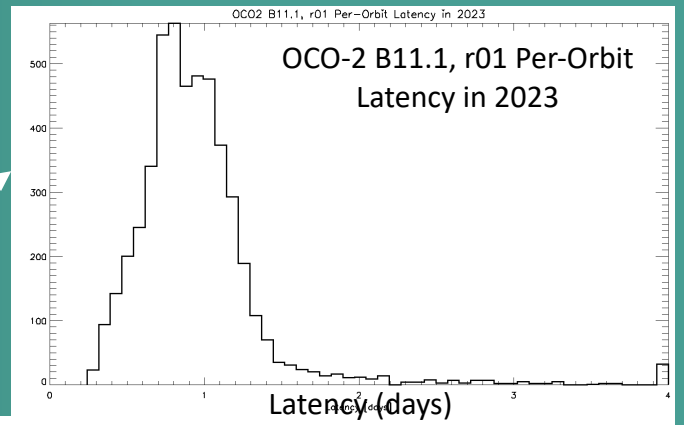
Interactive and real-time visualization

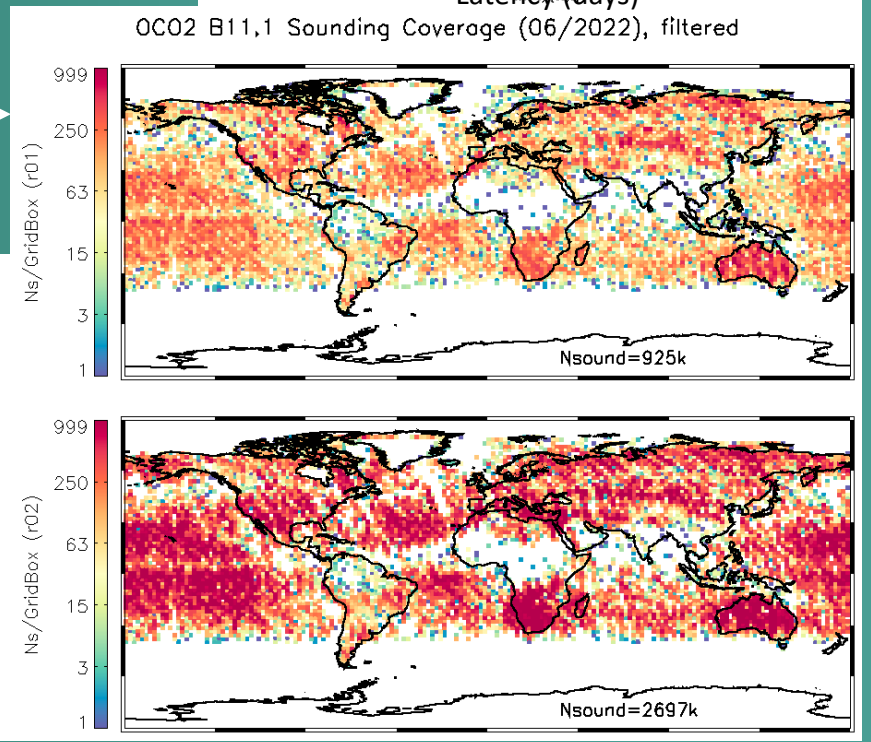
veda

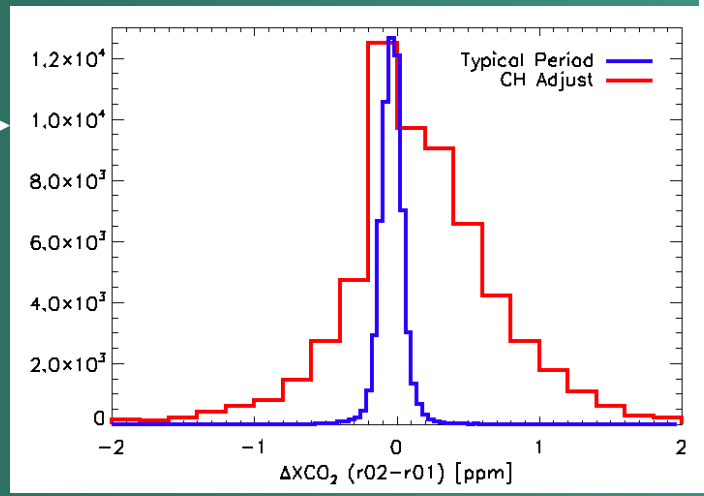
Expediting assimilation of XCO_2 retrievals

One of the major drivers of latency in CO_2 systems is availability of high quality, bias-corrected retrievals – currently 1-2 months behind real time for OCO. A preliminary analysis shows that an alternate strategy of bias correcting the lesser used forward stream may help reduce latency from months to days for global applications.

- OCO-2 forward stream data are typically available within a few days, though without bias correction and radiometric calibration.
- The forward stream processes less soundings than the retrospective stream, but mainly in regions with dense coverage. In regions with sparse coverage, most soundings are preserved.
- XCO_2 is usually remarkably consistent between forward & retrospective streams. The main exception is a "Cold Head Adjust" These episodes occur 1-2x per year, and last 4-6 days typically. Care must be taken not to assimilate these forward stream data.







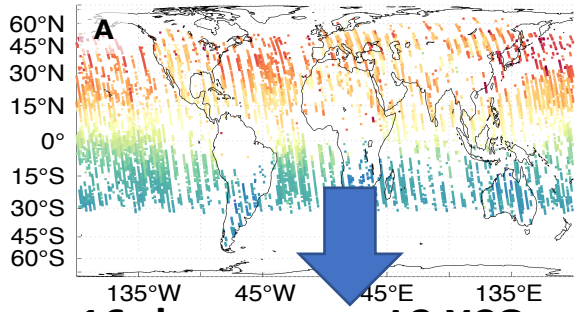
GEOS-GHG – Quasi-operational GHG Monitoring

- Bias-corrected OCO-2 retrievals assimilated into the GEOS Constituent Data Assimilation System (CoDAS) to produce gap-filled 3-dimenstional CO_2 fields
- When OCO-2 data are unavailable, gaps are filled:
  - All previous good quality OCO-2 retrievals
  - MERRA-2 wind and atmospheric transport fields (~6M obs per 6-hr period)
  - Observationally-informed flux package (e.g. night lights, NDVI, FRP, surface growth rate)
- Currently distributed as an OCO-2 L3 product
- Flexible system, also used for CH_4 analysis based on TROPOMI

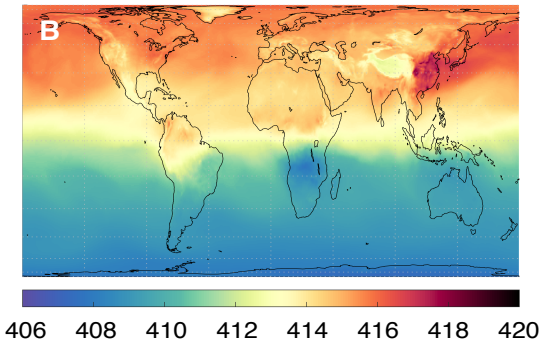
The GEOS-GHG system will support the GHG Center and contribute to WMO's GGGW by providing:

- 3D assimilated fields of CO_2, CH_4
- 2D CO_2 and CH4 anomalies
- Standardized evaluation of low latency land model ensemble
- Mass fluxes to support inverse approaches
- GHG Radiative forcing
- Target latency is ~1m behind delivery of OCO data, resolution of 12-50km depending on product

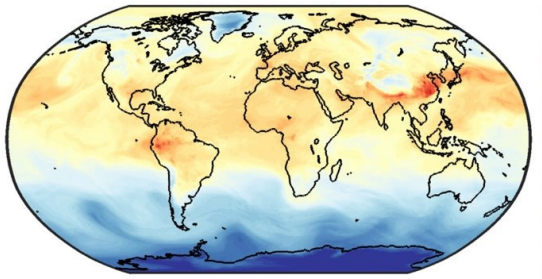
16 days OCO-2 XCO_2



16-day average L3 XCO_2



Assimilated TROPOMI XCH_4



THANK YOU!