GOSAT Inversion Intercomparison Phase-II

- Inter-annual variability of CO₂ sources and sinks estimated with multiple inversion systems

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The first phase of GOSAT CO₂ inversion inter-comparison was carried out to evaluate the full spread of GOSAT-based CO₂ flux estimates by allowing the participants to use inversion systems and GOSAT column-averaged CO₂ (XCO₂) retrieval datasets of their choice. Here, in the second phase of the inversion inter-comparison, we will step further to explore differences in the result inversion systems and evaluate their impact on CO₂ flux estimates as uncertainty in flux estimation. For this, the participants are asked to use common input data that consists of a GOSAT XCO₂ retrieval dataset, a surface CO₂ observation dataset, and an a priori flux dataset. This second phase study takes advantage of a five-year analysis period (2009-2014) during which GOSAT XCO₂ networks are continually available to investigate the robustness of the inversion estimated carbon cycle response to major weather events, such as heat waves, droughts, and heavy precipitation occurring in connection with ENSO variability in this period.

1. Motivation

GOSAT inversion intercomparison Phase-I

- Houweling et al. 2015 JGR-A

- Allowed participants to use inversion systems and GOSAT XCO₂ datasets of their choice
- Focused on 2009 - May 2010 (1st year of GOSAT observation)
- Evaluated full spread of GOSAT-based CO₂ flux estimates

1. Motivation

GOSAT inversion intercomparison Phase-II

- XCO₂ data products
- Inversion systems
- Inversion results

- Transformed to inversion results
- "Good" quality, bias corrected XCO₂
- Use both land and ocean retrievals

GOSAT inversion intercomparison Phase-II

- Inter-compared the full spread of satellite-based flux estimates with regard to inversion systems differences

2. Previous GOSAT-based inversion studies

2010 NH severe heat wave and other anomalies

Land surface water mass anomalies (GRACE)

- Bhi heat wave
- Amazonian dry spell
- Deficit precipitation over Amazon (Baloch et al. 2010)

3. Experimental protocol

Common input dataset: CO₂ concentration and a priori flux

- ACOS B3L LITE XCO₂ retrieval dataset
- Use "good" quality, bias corrected XCO₂
- Use both land and ocean retrievals
- NOAA OdenPack G3 surface observations
- 44 sites out of 215 were selected for their data continuity over 2009-2014 period
- Remaining data will be used for inversion validation
- CarbonTracker 2015 a priori fluxes
- CASA-GFED4 Vs. historical, CGSAC FE
- Use both land and ocean retrievals

Inversion systems and variance-covariance matrices

- Use your best system setups (including observation rejection/filtering schemes)

- No common variance-covariance matrices for observation and prior flux uncertainties to be shared among the participants
- Use your own approaches to define them
- To maintain weight of CO₂ obs. within a comparable range among the participants: minimum values for the diagonals of matrices R are set to: ACOSB3L5 XCO₂: 2.0 ppm
- OdenPack G3: surface CO₂: 1.0 ppm
- To avoid over-constraining prior fluxes, participants are asked to adjust balance between R and R̃ (prior flux covariance) such that posterior reduced R̃ has an upper bound of 1.

Inversion results submission

Results to be submitted:
- Fluxes estimated from satellite XCO₂ only (on 1°x1° mesh, monthly)
- Fluxes estimated from surface CO₂ measurements only
- Fluxes estimated from both satellite XCO₂ and surface CO₂ measurements
- A posteriori flux uncertainty for T3C2 22 reg. > 1 large reg.
- A posteriori concentration due to flux optimization
- A posteriori concentration sampled on specified locations for evaluation
- TCCON and aircraft measurements

Schedule/plan

"Guinea pig" experiment by a few volunteers
- Fix the protocol and release by the end of August 2016
- Data submission due: December 2016
- First summary report at EGU spring 2017 assembly

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