

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-mean CO₂ (X_{CO2}) retrieval datasets of their choice. Here, in the second phase of the inversion inter-comparison, we will step further to explore differences in the existing 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 that consists of a GOSAT X_{CO2} retrieval dataset, a surface CO₂ observation dataset, and an a priori flux dataset. This second-phase study takes advantage of a five-year-long analysis period (2009-2014) during which GOSAT X_{CO2} retrievals 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

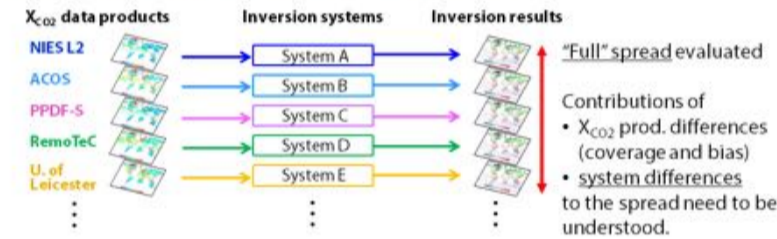
AGU PUBLICATIONS
 Journal of Geophysical Research: Atmospheres
 RESEARCH ARTICLE
 An intercomparison of inverse models for estimating sources and sinks of CO₂ using GOSAT measurements
 Houweling et al. 2015
 JGR-A

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

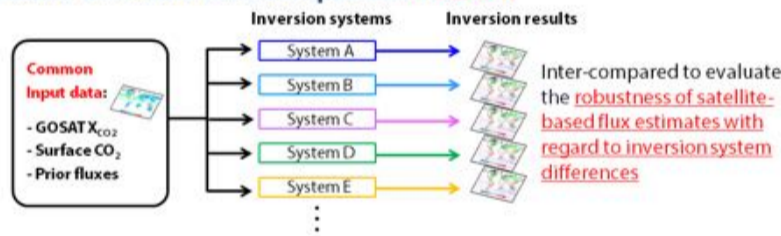


1. Motivation

GOSAT inversion intercomparison Phase-I



GOSAT inversion intercomparison Phase-II



1. Motivation

Focus of GOSAT inversion intercomparison Phase-II

- Will look at inter-annual variability of inversions over 2009-14 (5 yr) period
- Will evaluate the robustness of inversions' responses to major weather events related to ENSO variability over the period

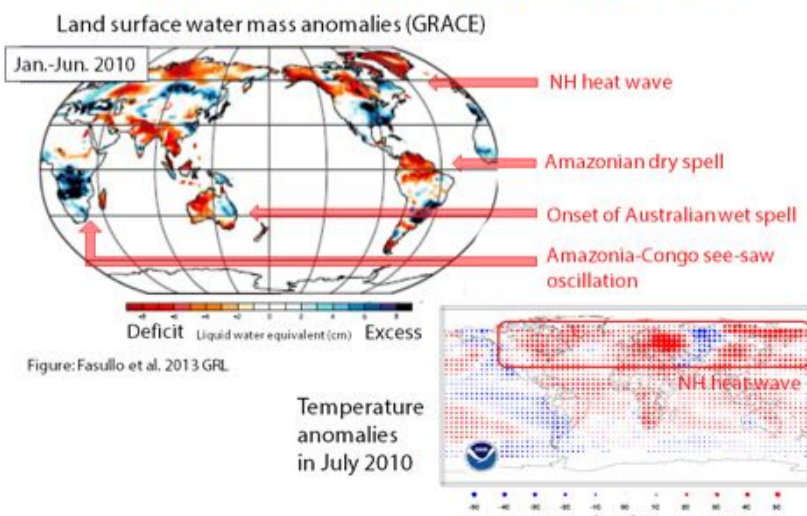
2009: transitioned to warm phase (El Nino)
 2010: transitioned to cold phase (La Nina)
 2011: transitioned to neutral then to cold phase
 2012: transitioned to neutral
 2013: neutral throughout

Important weather anomalies over the study period

- 2010 NH severe heat wave (Guerlet et al. 2013 GRL)
- 2010 W. Siberian fire
- 2010-11 dry / wet spells over Amazonia (Gatti et al. 2014, Doughty et al. 2015)
- 2009-13 Australian record drought / flooding (Fasullo et al. 2013 GRL, Detmers et al. 2013 GRL)
- 2010 record cold spell
- Precipitation see-saw oscillation between Congo and Amazonia (Mabuchi et al. 2016)

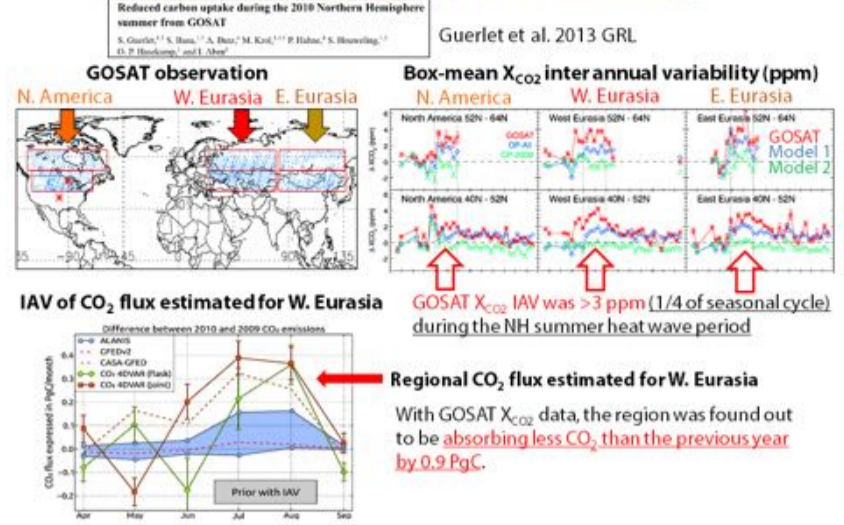
2. Previous GOSAT-based inversion studies

2010 NH severe heat wave and other anomalies

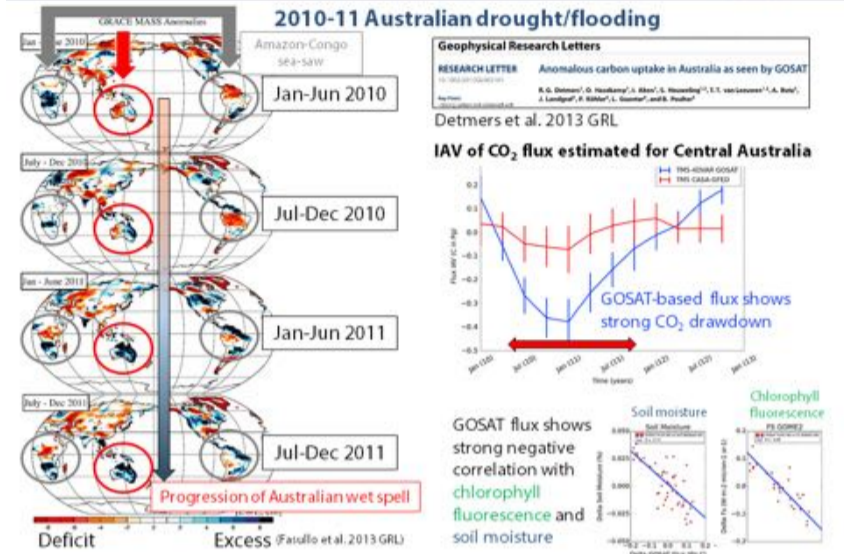


2. Previous GOSAT-based inversion studies

2010 NH severe heat wave seen by GOSAT / RemoTeC X_{CO2}



2. Previous GOSAT-based inversion studies



3. Experimental protocol

Common input dataset: CO₂ concentration and a priori flux

- ACOS B3.5 LITE X_{CO2} retrieval dataset
 - use "good" quality, bias-corrected X_{CO2}
 - use both land and ocean retrievals
- NOAA ObsPack GV plus surface observations
 - 44 sites out of 205 were selected for their data continuity over 2009-2014 period
 - Remaining site data will be used for inversion validation
- CarbonTracker 2015 a priori fluxes
 - CASA-GFED 4.1s, OIF ocean, ODIAC FF, and GFED 4.1s fire (downscaled to CT specifications)
 - 3-hourly fluxes on a 1° × 1° mesh used

3. Experimental protocol

Inversion systems and variance-covariance matrices

- Inversion system:** use your best system setups (including observation rejection/filtering schemes)
- Variance-covariance matrices**
 - 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 matrix **R** are set to:
 - ACOS B3.5 X_{CO2}: 2.0 ppm
 - ObsPack GV+ surface CO₂: 1.0 ppm
- To avoid over-constraining prior fluxes, participants are asked to adjust balance between **R** and **B** (prior flux unc.) such that posterior reduced X² has an upper bound of 1.

3. Experimental protocol

Inversion results submission

- Results to be submitted**
 - Fluxes estimated from satellite X_{CO2} only (on 1° × 1° mesh, monthly)
 - Fluxes estimated from surface CO₂ measurements only
 - Fluxes estimated from both satellite X_{CO2} and surface CO₂ measurements
- A posteriori flux uncertainty for TC3 22 reg. + 9 large reg.
- A posteriori concentration used in flux optimization
- A posteriori concentration sampled at 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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