A protocol for developing a carbon stock product based on the OCO-2 MIP activities

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1. Net C stock changes depend on the net biosphere exchange (NBE) and other anthropogenic (e.g., farming) and natural (e.g., rivers) fluxes of carbon.

2. This poster describes progress on estimating net stock changes based on OCO-2 MIP estimates of NBE.
Schematic diagram of the terrestrial carbon cycle

Legend
- Cement and fossil fuel
- Ecosystem metabolism
- Biomass burning
- Harvested Wood
- Harvested crop
- Water cycle mediated

DIC, DOC, POC to the ocean
Landfill
Wood harvest
Crop harvest
Crop
fungus

Oxidation of reduced carbon into CO₂
BB CO₂
BB CO
Biofuel CO₂
Biofuel

DIC, DOC, POC to the ocean
Estimates of lateral fluxes

- Model estimates: We will estimate lateral C flux from rivers to ocean using the DLEM model.

- Inventory estimates: We will apply inventory based methods to estimate lateral crop and wood harvest fluxes.

- Still investigating how to account for spatial differences in the sink due to neglecting atmospheric chemistry.

- Suggestions of other gridded datasets of lateral flux estimates are welcome!

Figure 2. Schematic illustration of carbon fluxes between a land grid box, the atmosphere, and adjacent grid boxes.

Legend

- anthropogenic fluxes
- ecosystem metabolism
- “natural” combustion
- water cycle C fluxes

Lateral fluxes

- Crop harvest
- Wood harvest
- River fluxes (POC, DOC, DIC)
Our starting point:
The OCO Model intercomparison project (MIP)

- ~10 groups running flux inversions of OCO-2 and in situ data. Ensemble helps quantify systematic errors (transport model, prior constraints)

- Have several experiments that assimilate different datasets
  Most relevant are in situ (IS) and OCO-2 land nadir + land glint (LNLG) flux inversions

- Recently completed OCO-2 v9 MIP “MIPv9” covers 2015-2018.

- Inversions are starting now for MIPv10, which covers 2015-2020. Will have a combined LNLGIS inversion
MIP results - 1°x1° maps

- Maps show (2015-2018) annual net fluxes across IS and LNLG ensembles (illustration purposes, under consideration)

**Mean across IS and LNLG ensemble (for illustration purposes)**

- At 1x1 deg, few regions show net sinks or sources greater than 1 standard deviation of model spread (hatching).

- Boreal forests have greatest confidence, tropics show least.

- However, this is largely due to limited information content and inversion configuration, constraints improve with aggregation… next slide

**Standard deviation across IS and LNLG ensemble (for illustration purposes)**

Figure 1. Global maps of (top) mean NBE and (bottom) standard deviation in NBE at 1x1 degree spatial resolution across all ensemble members in both the IS and LNLG experiments. Hatching shows where the mean sink/source exceeds one standard deviation.
MIP results - Country level results

- Aggregating reduces uncertainties.
- NBE estimates for large extratropical countries (Canada, USA, Mexico) are reasonably precise.
- Smaller countries will have considerable uncertainties. We are working to refine with MIPv10. Providing regional NBE estimates may also be an option.

Figure 2. $1^\circ\times1^\circ$ map and country level NBE for all ensemble members in both the IS and LNLG experiments. Bar plots show mean +/- 1 standard deviation

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