An 8-year, high-resolution reanalysis of atmospheric CO$_2$ mixing ratios based on OCO-2 and GOSAT-ACOS retrievals

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The NASA GMAO reanalysis blends OCO-2 and GOSAT-ACOS retrievals (top) with GEOS model predictions (bottom) to estimate the full 3D state of CO$_2$ every 3 hours (middle).

This poster describes monthly atmospheric growth rates derived from the reanalysis and an application to aircraft data with the potential to aid bias correction.

Aircraft-based analysis

Systematic model and satellite retrieval errors with coherent regional and seasonal patterns limit our ability to infer surface fluxes from satellite retrievals.

Here, we assimilate aircraft data from ACT-America into the GEOS model and compare the results to an OCO-2 overpass. The assimilation indicates that the model PBL was too high. Overall, the mean difference with OCO-2 v7b is reduced from 0.59 ppm to 0.28 ppm.

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Fig 1. Global average mixing ratios from (blue) GEOS with no assimilation and (green) reanalysis of GOSAT-ACOS data.

Fig 2. Global total fluxes computed as the change in monthly means from Fig 1. Note the change in Jan. thru Mar.

Atmospheric growth rate

Since OCO-2 and GOSAT-ACOS observe the column integral of CO$_2$ and have a 16-day repeat cycle, they have the potential to better constrain atmospheric growth rates on sub-annual time scales than data restricted to the PBL. Here, we compute monthly growth rates and show that the satellites suggest the model has too much outgassing in boreal winter.

Fig 3. Same as Fig 1, but now with (red) reanalysis of OCO-2 data.

Fig 4. Same as Fig 2, but now with (red) reanalysis of OCO-2 data.