CO_2 Source/Sink Information from OCO Column CO_2 Data

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NASA's Orbital Carbon Observatory (OCO) will hopefully be producing column CO_2 concentration data within the year. Unlike previous satellites, it has both good sensitivity down to the surface, where recently-emitted fluxes leave the largest signal, and a small (2.7 km^2) field of view, designed to find cloud-free scenes in even the cloudiest areas. Its sun-synchronous orbit takes measurements once a day at 1:30 pm local time, giving N/S ground tracks spaced roughly every 3º in longitude over a week. It thus has the potential to pin down near synoptic-scale CO_2 fluxes at truly regional scales (100s of km).

Here we use a variational data assimilation method to perform observing system simulation experiments (OSSEs) with the OCO data, solving for weekly surface CO_2 fluxes at a 2ºx5º resolution (lat/long). Carbon models are used to give realistic fluxes for the truth (used to generate the data) and the starting guess (Fig. 1a). New estimates of OCO column CO_2 retrieval errors from detailed radiative transfer simulations are added as measurement errors. RMS error statistics are collected over a full year's run by comparing the final estimate to the known truth. In glint mode, the OCO data is able to reduce errors in weekly regional fluxes by over 50% across much of the globe (Fig. 1b). Although we have used realistic cloud and aerosol coverage, as well as realistic orbital geometry and vertical weighting, in the calculation, the error reductions in Fig 1b are truly best-case, perfect-model values. The assimilation is considered to be perfectly "tuned": the assumed measurement and prior flux uncertainties have no errors in them. The transport model is assumed to be perfect and no measurement biases are added to the data. The success of the OCO mission will depend on how well these error sources can be identified and mitigated.

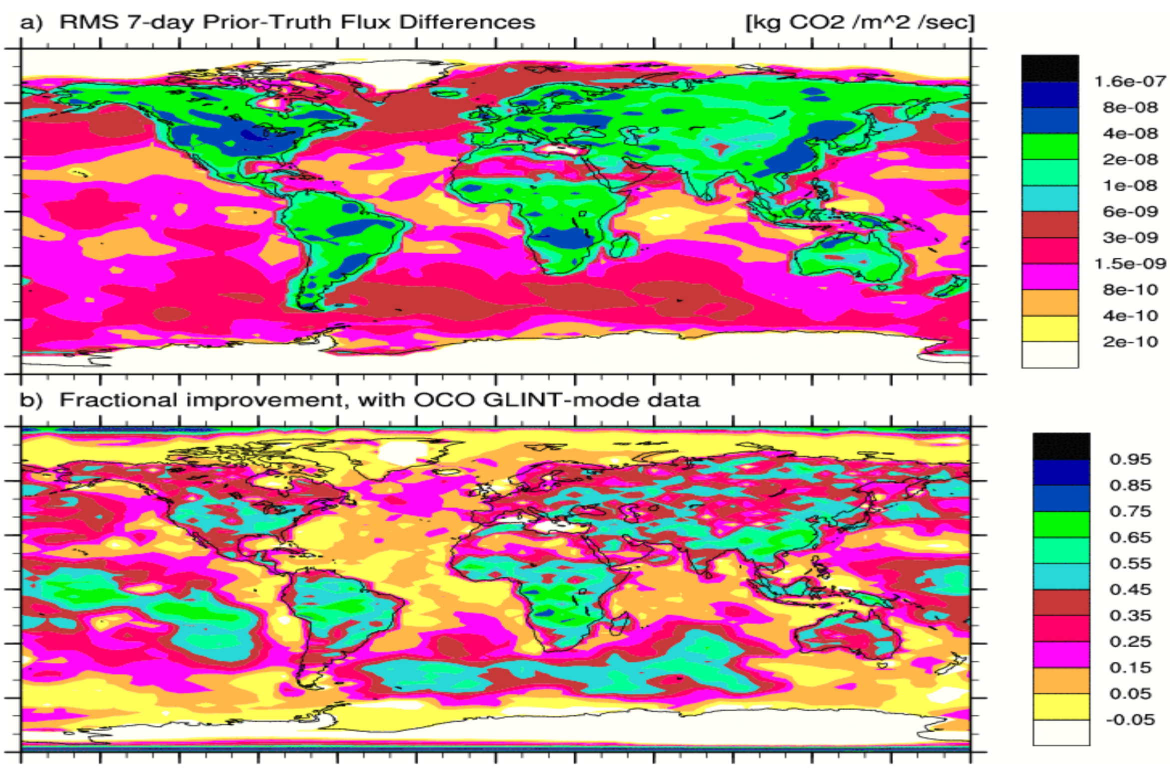

Figure 1. (a) The difference between the weekly true and *a priori* fluxes [kg CO_2 m^{-2} sec^{-1}], as RMS values over a full year, and **(b)** the fractional reduction in this due to assimilating OCO glint-mode measurements.