GEOS-Carb III: Delivering mature carbon flux and concentration datasets in support of NASA's Carbon Monitoring System

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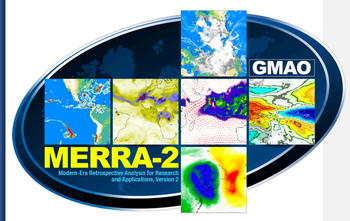
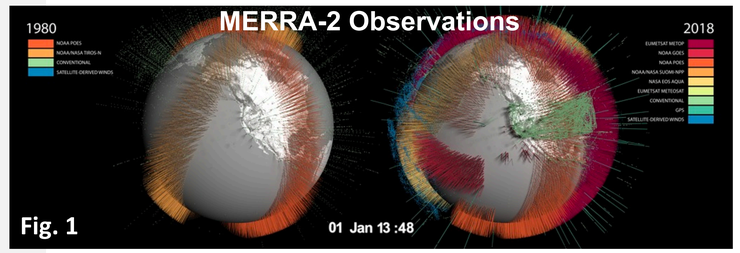
GMAO
Global Modeling & Assimilation Office

Building physically consistent flux and concentration products



An integrated view of the planet

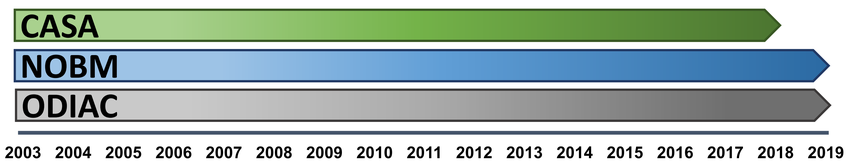
NASA's MERRA-2 reanalysis provides a record of climate from the 1980s to present, assimilating 6 million observations every 6 hours in recent years (**Fig. 1**) and helping drive our understanding of the modern carbon cycle.



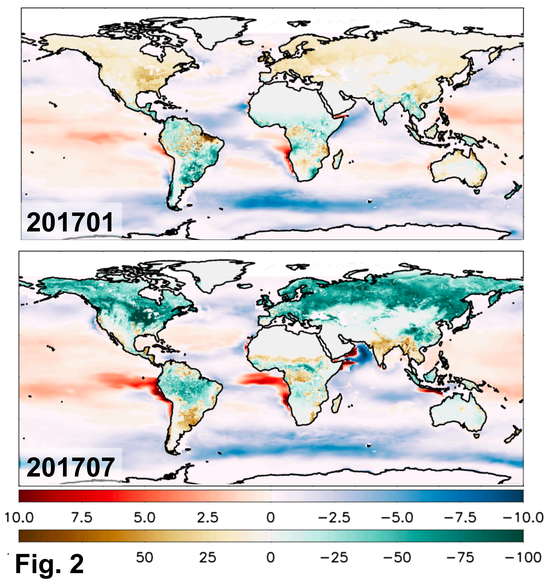
Data-driven bottom-up estimates of fossil fuel emissions, ocean, and land fluxes

Global land, ocean carbon flux

The CASA-GFED model incorporates NDVI while the NASA Ocean Biogeochemical Model (NOBM) assimilates ocean color data from satellites like MODIS (**Fig. 2**). Both models use MERRA-2 data for consistent climate forcing. These data are widely used by scientists working to better understand and predict atmospheric carbon.



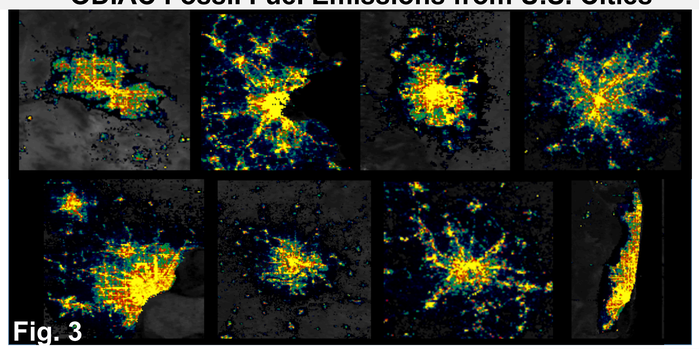
CASA + NOBM Carbon Flux (gC m^2 mon^{-1})



Global fossil fuel emissions

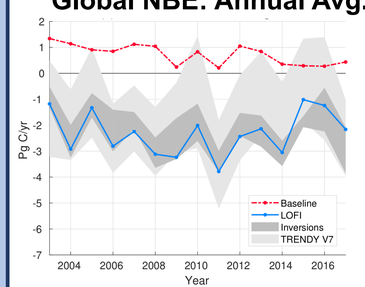
ODIAC uses night light observations to estimate fossil fuel emissions at 1-km resolution, globally. Guess the U.S. city below (**Fig. 3**)!

ODIAC Fossil Fuel Emissions from U.S. Cities



Concentration products built around surface and satellite GHG data

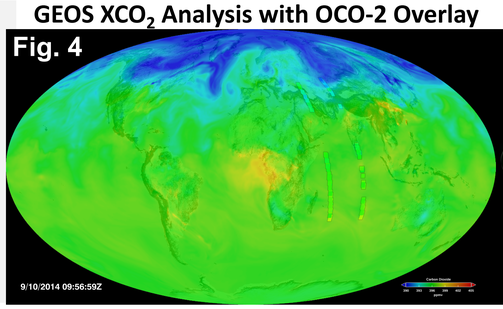
Global NBE: Annual Avg.



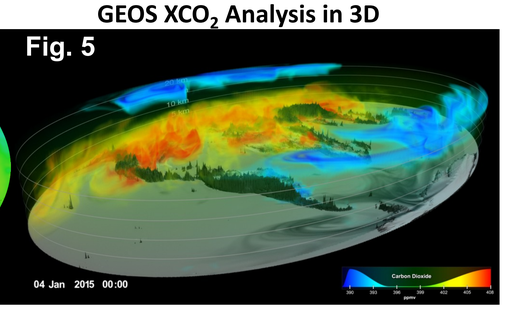
Carbon concentrations

We add surface obs. to further improve land flux (**Fig. 3**) and use this package in the GEOS GCM. Assimilating satellite data provides a data-driven three-dimensional picture of atmospheric CO_2 (**Fig. 4, 5**).

GEOS XCO_2 Analysis with OCO-2 Overlay

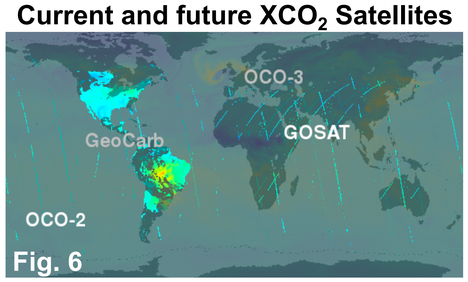


GEOS XCO_2 Analysis in 3D



Planning for the next generation of space-based observations

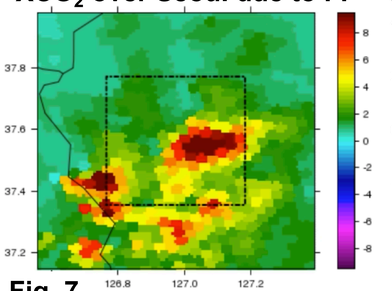
Current and future XCO_2 Satellites



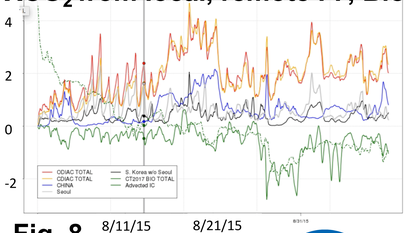
Supporting new NASA missions

CMS-supported modeling capabilities are helping to support future missions by examining the impact of new data (**Fig. 6**), new assimilation techniques, and the sensitivity of observations to emissions (**Fig. 7, 8**).

XCO_2 over Seoul due to FF



XCO_2 from local, remote FF, Bio



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