

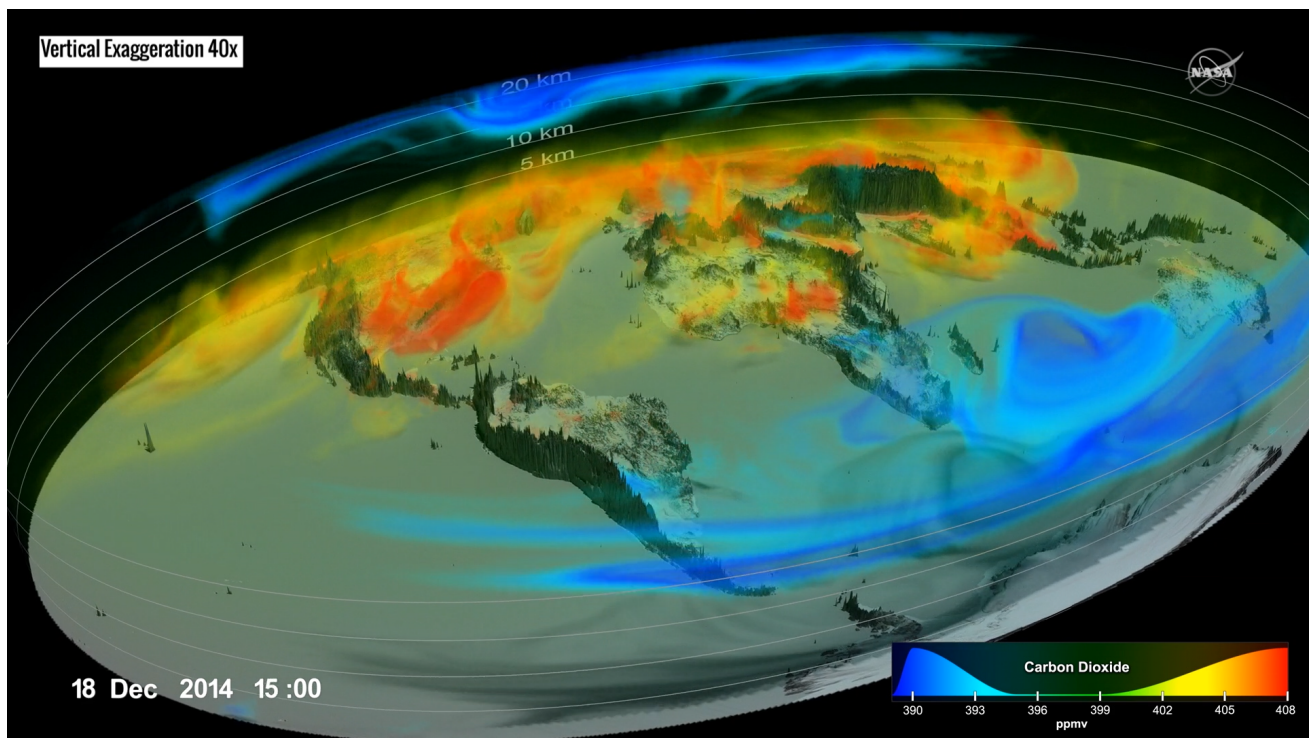
## Assimilating NASA's Atmospheric Composition Observations in the GEOS Earth System Model

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The Goddard Earth Observing System (GEOS) modeling and assimilation system is used to support NASA's Earth Observations. Built using the Earth System Modeling Framework, GEOS includes coupled modules to represent physical, chemical and biological processes in the Earth System. Global applications span spatial scales as fine as a few km and temporal scales from hours to months and decades. Routine products include weather analyses and forecasts, seasonal analyses and forecasts, and reanalyses. Research products include global, high-resolution simulations and studies of observational impacts in current and future systems. Built around the FV3 dynamical core, GEOS routinely includes simulations, analyses and forecasts of atmospheric composition, using data from NASA's EOS satellite fleet (Terra, Aqua, and Aura) and other sources. Modern-Era Retrospective Analysis for Research and Applications 2 (MERRA-2) is the first global reanalysis that includes aerosols and ozone from research instruments. GEOS is used to support NASA's carbon-cycle science, including assimilation of Orbiting Carbon Observatory 2 (OCO-2) data. Reactive chemistry studies began with a focus on the climate impacts of ozone change and is now transitional to studies of air pollution and its impacts. This talk will give an overview of this work, with remarks on its relevance to Next Generation Global Prediction System (NGGPS) and other activities within NOAA.



**Figure 1.** Assimilated 3D carbon dioxide ( $\text{CO}_2$ ) fields on 13 Dec 2014. The assimilation combines retrievals of total-column  $\text{CO}_2$  from the OCO-2 instrument with GEOS model forecasts. Blue colors represent low concentrations ( $\sim 393$  ppmv and lower), associated with biospheric uptake near the surface and aged air in the stratosphere, while reds represent high concentrations (403 ppmv and higher), associated with transport from regions of strong emissions.