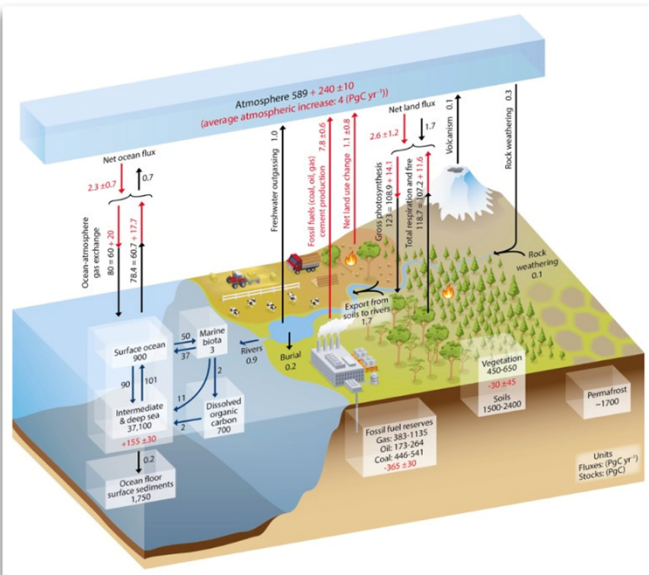
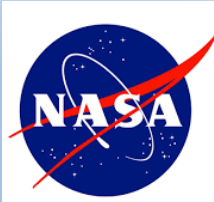
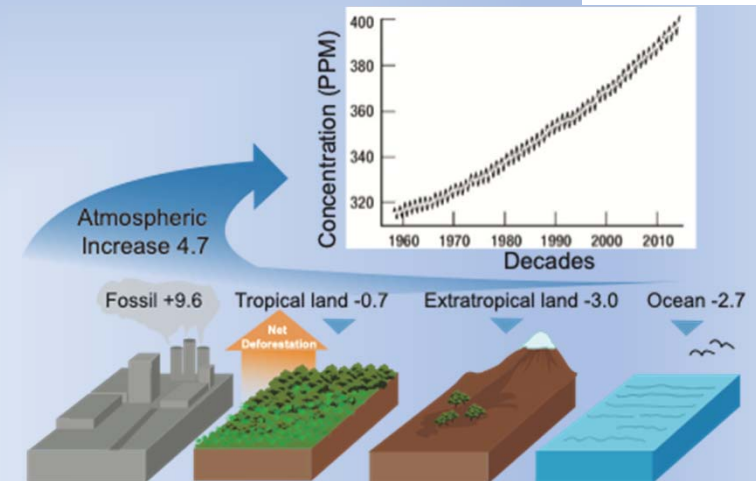


Quantifying and predicting terrestrial carbon exchange is one of ecosystem science's Grand Challenges



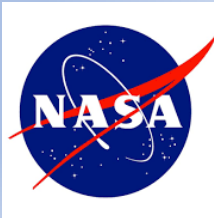
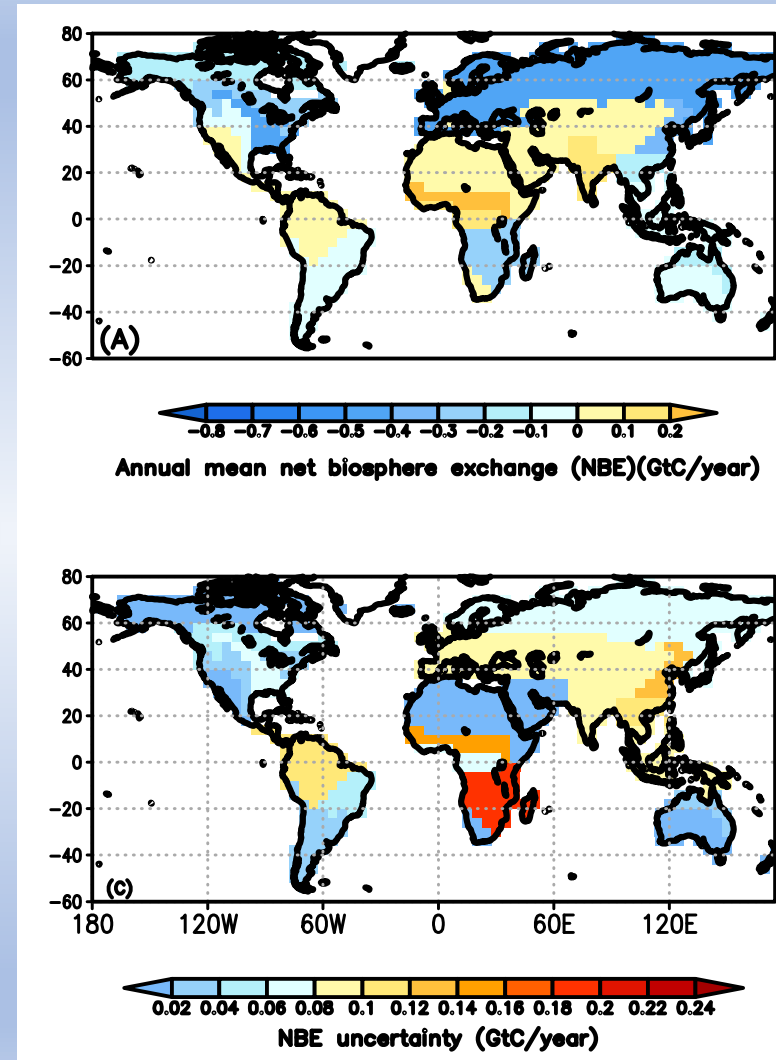
David Schimel and Junjie Liu
Carbon Cycle and Ecosystems
Jet Propulsion Lab
California Institute of Technology
Pasadena, CA 91101
and
Britton Stephens
National Center for Atmospheric Research
Boulder, Colorado, 80305



Decadal Survey: E-2a Quantify the fluxes of CO_2 and CH_4 globally at spatial scales of 100-500 km and monthly temporal resolution with uncertainty $< 25\%$ between land ecosystems and atmosphere and between ocean ecosystems and the atmosphere.

Credible Global CO₂ Flux Retrievals from the in situ and space systems depend on Aircraft Data

Liu et al, Earth System Science Data, 2020



Global aircraft observations (transects and profiles) are the gold standard for evaluating flux retrievals by comparing observed profile transects to posterior model-estimated vertical distributions of CO₂.

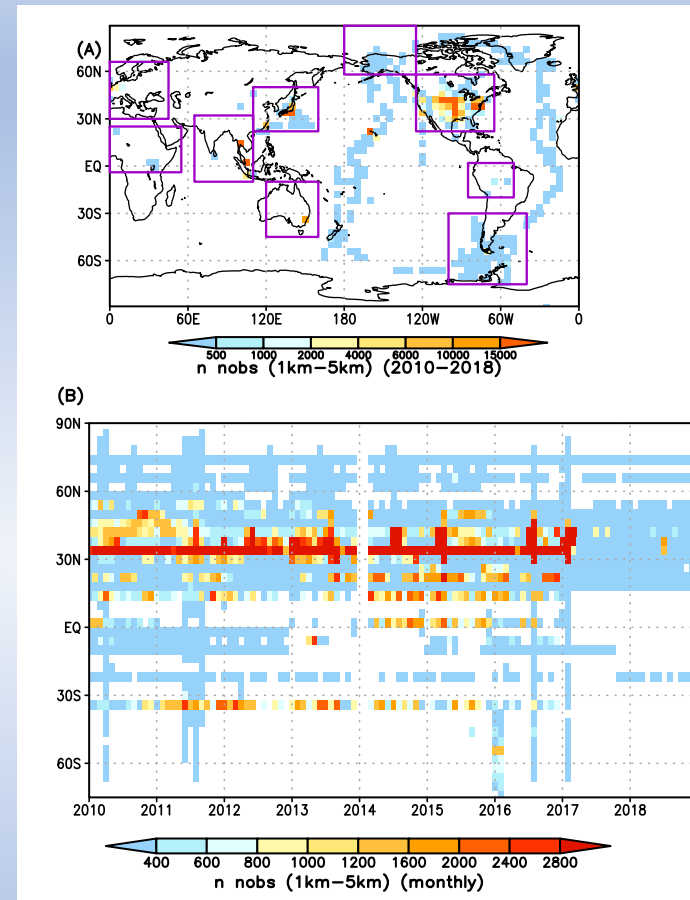
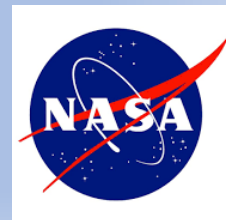
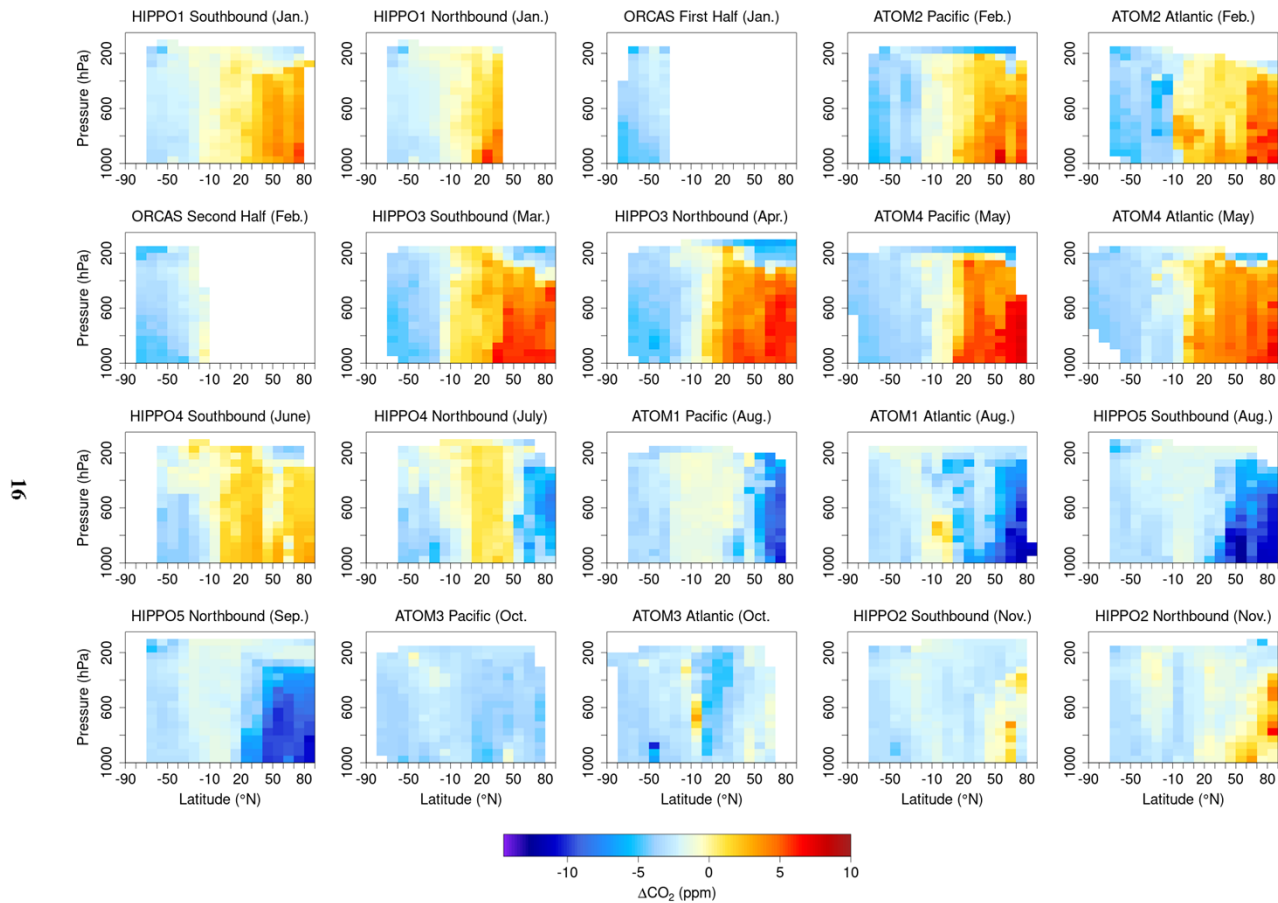


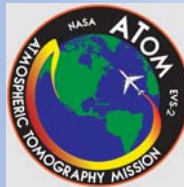
Figure: 2 The spatial and temporal distributions of aircraft observations used in evaluation of posterior NBE. (A) The total number of aircraft observations between 1–5 km between 2010–2018 at each 4° x 5° grid point. The rectangle boxes show the range of the nine sub regions. (B) The total number of monthly aircraft observations at each longitude as a function of time.



2 X Four Seasons of Data from Global Transects



Stephens et al,
AMTD, in review



Aircraft observations highlight regions with skillful model estimates and regions and seasons with significant errors.

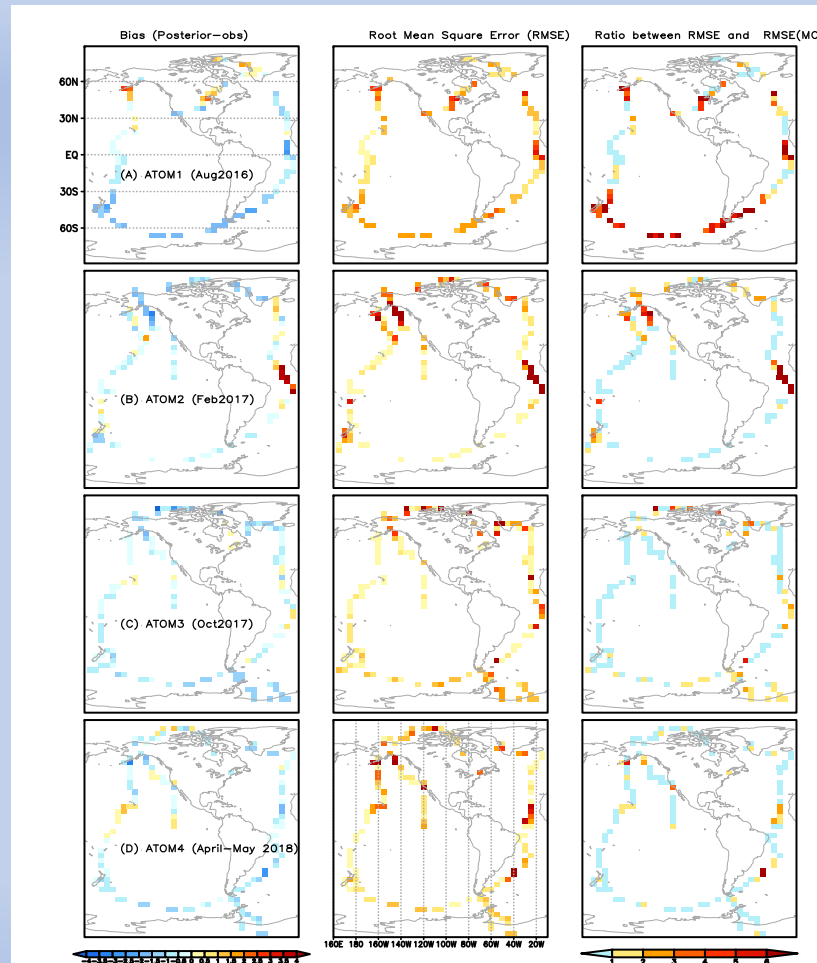


Figure: 10 Left column: the mean differences between posterior CO_2 and aircraft observations from ATOM 1–4 aircraft campaigns between 1–5 km (A–D). Middle column: the Root Mean Square Errors (RMSE) between aircraft observations and posterior CO_2 between 1–5 km. The color bar is the same as the left column. Right column: the ratio between RMSE and RMSE_{MC} based on ensemble CO_2 from the Monte Carlo uncertainty estimation method.

Global profile transects must be sustained over the life of OCO-2/3 class missions to assess uncertainty and diagnose errors in critical flux retrievals. These data require long duration A/C with significant payload and endurance.

