Persistent underestimate of seasonal cycle in U.S. inverse NEE estimates

Cui, Y. Y., et al. (2022). Evaluating global atmospheric inversions of terrestrial net ecosystem exchange CO2 over North America on seasonal and sub-continental scales. Geophysical Research Letters, 49, e2022GL100147. https://doi.org/10.1029/2022GL100147

Science Question

- Inverse estimates of net ecosystem-atmosphere exchange (NEE) of CO_2 are becoming increasingly informative.
- Independent evaluation of these estimates is essential to establish their validity and improve their quality.

Analysis

Inverse flux estimates from 9 inversion models used in the OCO2 v9 Model Intercomparison Project (MIP) were evaluated with independent aircraft data from the Atmospheric Carbon and Transport (ACT) – America project. Model-data biases and random errors were evaluated by season.

Results

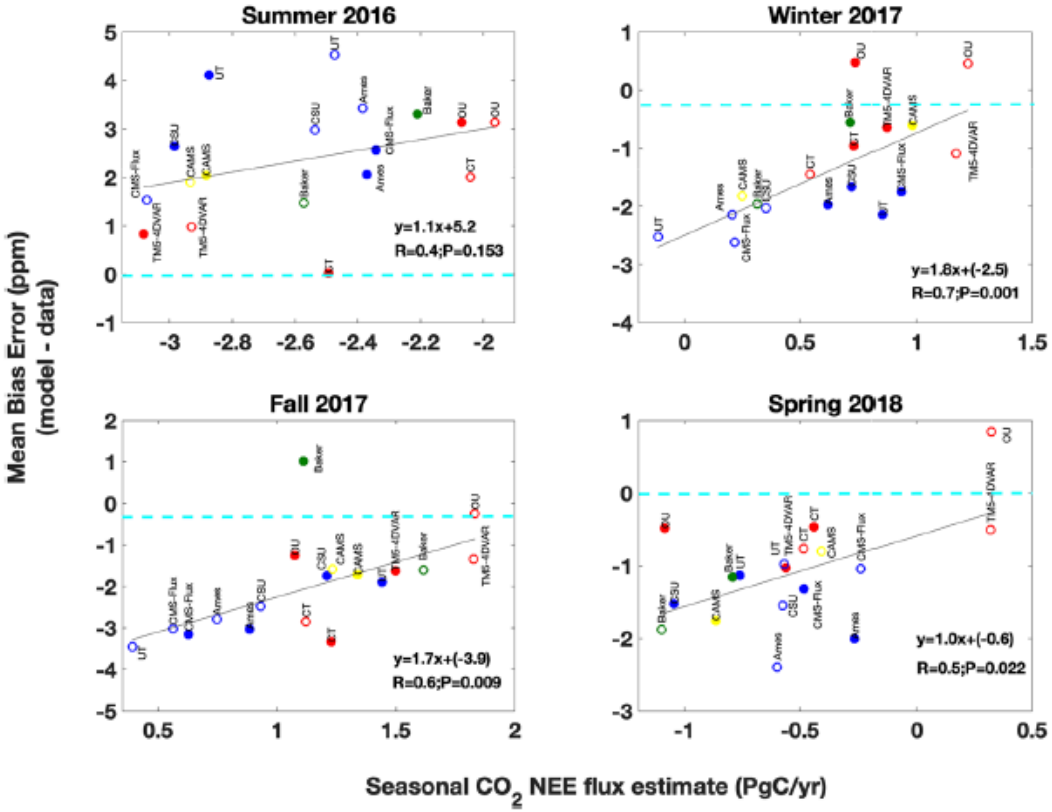
- We found that the seasonal amplitude of NEE in the central and eastern United States is underestimated by all inversions.
- Biases are largest for those inversions with the smallest seasonal flux amplitudes.
- These results were independent of whether the inversions used satellite or in situ data.
- TM5-based inversions were less biased than GEOS-Chem based inversions.

Significance

- The inversion systems may all be limited by biased ecosystem prior flux models. They appear to all have a common problem independent of atmospheric transport model, data type and inversion method.
- Biased seasonal fluxes likely lead to biased annual fluxes, but the errors may cancel.

Acknowledgements

This research was supported by the NASA Carbon Monitoring System (NNH20ZDA001N-CMS) under Award 80NSSC21K1060, and NASA's Earth Science Division Earth Venture Suborbital 2 program under Award (NNX15AG76G).



Differences between observed atmospheric CO_2 and atmospheric CO_2 expected with ecosystem fluxes derived from OCO2v9MIP flux estimates. The open circles denote inversions that used in situ data, and the solid circles denote inversions that used OCO2 data. Models using TM5 transport colored in red, and models using GEOS-Chem transport are colored in blue.