(44-220415-A) **Misrepresentation of the Temperature Sensitivity of Ecosystem Respiration in Terrestrial Biosphere Models Revealed by Atmospheric CO_2 Observations**

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Large uncertainty in current estimates of photosynthesis and respiration precludes an accurate assessment of the terrestrial carbon–climate feedback. While there is a proliferation of novel methods to constrain photosynthesis on regional scales, respiration remains stubbornly uncertain due to the lack of scalable measurements and the difficulty in disentangling atmospheric CO_2 signals. Bottom-up models thus remain the primary way to obtain large-scale respiration estimates, but wide divergence in model estimates hinders our understanding of the magnitude, distribution, and temperature sensitivity of ecosystem respiration. To address this issue, we seek to diagnose the causes of model divergence in estimates of respiration by evaluating carbon flux estimates from a large set of terrestrial biosphere models against in situ atmospheric CO_2 measurements over North America.

Surprisingly, we find that for a large subset of models, estimates of gross primary productivity (GPP) explain the observed variability in atmospheric CO_2 concentrations better than those models' estimates of net ecosystem exchange (NEE). Models for which NEE explains a lower portion of atmospheric CO_2 variability than does GPP tend to misrepresent the seasonal magnitudes of ecosystem respiration, due to widespread overestimation of the temperature sensitivity of ecosystem respiration. We further show that correcting the temperature sensitivity of ecosystem respiration improves these models' ability to explain observed atmospheric CO_2 variability. These results indicate that an improved representation of the temperature sensitivity of respiration is needed for robust projections of the terrestrial carbon cycle.

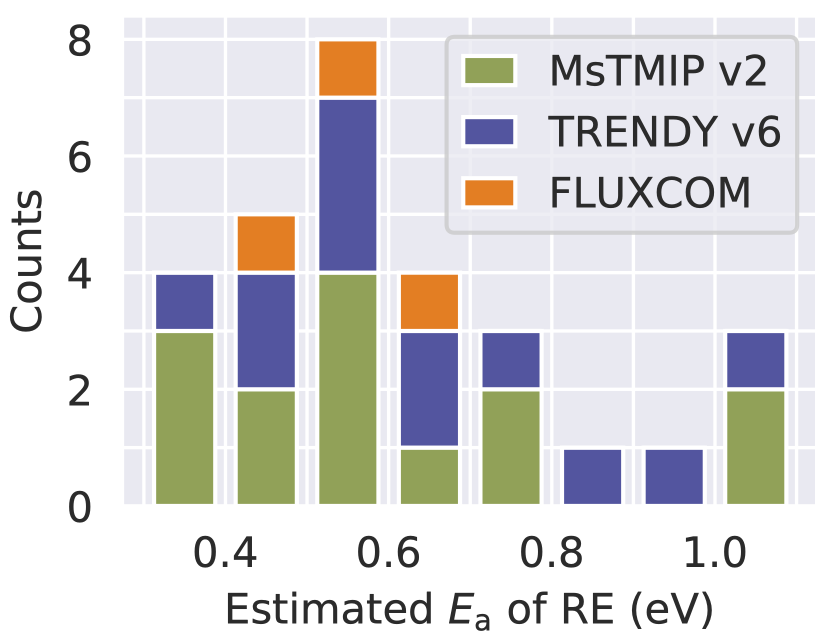

Figure 1. Temperature sensitivity of ecosystem respiration (RE) over North America, as represented by the activation energy (E_a), differs among terrestrial biosphere models from the MsTMIP v2 and TRENDY v6 ensembles and data-driven models from the FLUXCOM ensemble.