Philippe Ciais, Observed regional carbon budgets imply reduced soil heterotrophic respiration

The regional partition of the global land carbon uptake remains uncertain. Also, poor quantification of the processes controlling regional fluxes limits the predictive capacity of earth system models to assess carbon-climate feedbacks. The carbon budget of nine large regions is analyzed from new regional observational datasets and scaled-up to the globe, providing the first bottom-up estimate of the global net land carbon uptake to be -1.3 ± 0.6 Pg C yr-1, the negative sign indicating a removal of carbon from the atmosphere. This estimate was obtained by combining regional inventories of carbon stock changes and lateral fluxes transported by rivers to oceans, and by wood and crop trade. Our bottom-up land carbon uptake is consistent with the classical 'top-down' estimate based on closure of the global CO2 budget1. From the breakdown of regional carbon budgets into component fluxes, here we show that soil heterotrophic respiration (SHR) represents only 77 ± 3% of Net Primary Production, well below the currently accepted2 fraction of 90±5%. This result implies that a significant fraction of carbon from NPP is channeled to lateral fluxes instead of being made available for SHR. A lower than previously thought SHR relative to NPP implies a lower carbon sequestration capacity for soils in the future, compared to what is assumed in current Earth System Models assumptions. When accounting for the processes that channel NPP to lateral fluxes using an emulator of different Earth System Models, higher atmospheric CO2 (by 19 to 77 ppm) and warmer temperatures (by 0.1 to 0.4°C) are projected by 2100 for the RCP8.5 emission scenario, compared to currently predicted values. This calls for better representing the processes controlling the return of carbon from NPP to the atmosphere by other pathways than soil respiration.