Increased soil greenhouse gases emissions negate soil carbon storage enhancement under elevated atmospheric CO_2

With the support by the National Natural Science Foundation of China, the research team directed by Prof. Zou JianWen (邹建文) at the Jiangsu Key Laboratory of Low Carbon Agriculture & GHGs Mitigation, and College of Resources & Environmental Sciences, Nanjing Agricultural University, recently reported that increased soil greenhouse gases (GHG) negate soil carbon storage enhancement under elevated atmospheric carbon dioxide (CO_2), which was published in *Ecology Letters* (2018, 21: 1108—1118.).

Soils contain the largest pool of terrestrial organic carbon (C) and nitrogen (N), and rising atmospheric CO_2 has altered soil C and N biogeochemical cycles. Soils are one of major sources of atmospheric methane (CH_4) and nitrous oxide (N_2O) that are the two other potent GHGs. Given that elevated atmospheric CO_2 can alter both soil C input and soil GHGs emissions, the elevated CO_2-enhanced soil C storage may have the risk of being offset by altered soil GHG fluxes. However, the net balance of GHGs exchange between terrestrial ecosystems and the atmosphere under elevated atmospheric CO_2 is poorly understood, which will limit our ability to predict terrestrial ecosystems feedback to climate change.

To predict to what extent elevated atmospheric CO_2 would alter terrestrial ecosystem C balance and its feedback to climate change, Zou's group synthesized 1655 paired measurements derived from 169 papers using the meta-analysis procedure to assess GHGs budget of terrestrial ecosystems under elevated CO_2. The results showed that an elevated CO_2-induced rise in radiative forcing of soil CH_4 and N_2O emissions could negate soil C enrichment or reduce mitigation potential of terrestrial net ecosystem productivity by as much as 69% under elevated CO_2. Their synthesis highlights that the capacity of terrestrial ecosystems to act as a sink to slow climate warming under elevated CO_2 might have been largely offset by its induced increases in soil GHGs source strength.

This synthesis study may first provide an insight into a complete GHG accounting of terrestrial ecosystem under elevated CO_2. A full understanding of the net balance of CO_2, CH_4 and N_2O exchange between terrestrial ecosystem and atmosphere under elevated atmospheric CO_2 would help to predict to what extent terrestrial ecosystems shape the climate.

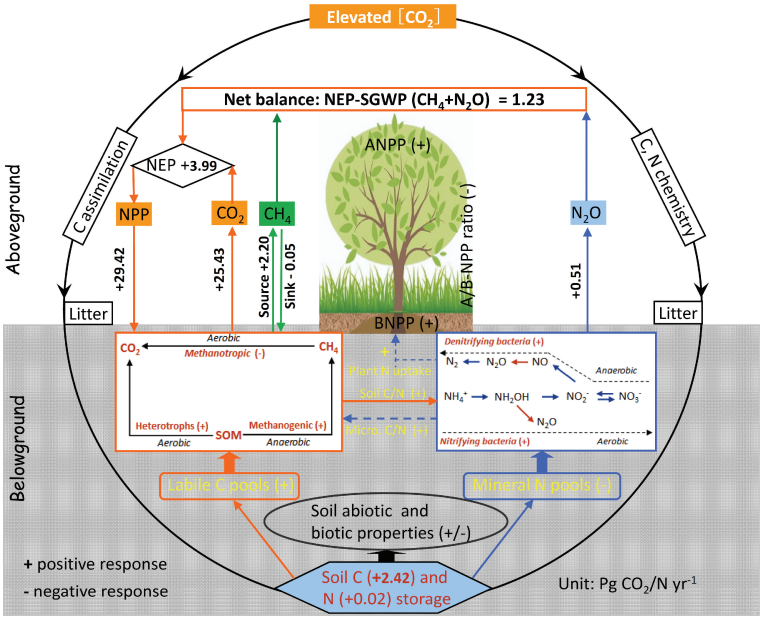

Figure A complete conceptual diagram illustrating the effects of elevated CO_2 on soil C and N pools as well as greenhouse gases fluxes. ANPP, Aboveground NPP; BNPP, belowground NPP. All the figures in bold within the panel show the source or sink strengths of elevated CO_2-induced GHG fluxes expressed as Pg CO_2-eq. yr^{-1}, as well as soil C sequestration potentials.