Changes in global terrestrial ecosystem respiration with future warming: a probabilistic approach

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The atmospheric increase in CO_2 concentration and consequent climate change rendered the terrestrial biosphere as an increasing carbon sink. Although several studies have warned that the land sink may slow down or reverse in a future warmer world, no study projected the future changes in the carbon fluxes by using statistical methods. Here we combined a biosphere model BEAMS and a large-ensemble warming climate simulations of d4PDF data set in order to investigate the changes in the frequency distributions of global terrestrial ecosystem respiration (TER) in 1960–2010 and future +2K and +4K warmer than pre-industrial climate simulations. This is a pioneer study that performs a probabilistic approach to analyze the future changes in TER. The biosphere model outputs indicate that both magnitude and interannual variability of TER increase with climate warming, with larger relative increase in the high latitudes. The increase in TER variability exhibits bipolarity and corresponds to higher TER in the tropics and northern high latitudes. The TER increase in the present climate is attributed to the CO2 fertilization effect-driven increase in plant biomass. However, in future +2K and +4K climates, temperature contribution to the anthropogenic TER effect is projected to increase exponentially according to Q10 function. The disproportional increase in TER with warming towards high latitudes that are a massive reservoir of soil carbon highlight the need in the urgent action for stronger mitigation policies. The estimation of unaccounted land carbon fluxes, e.g. permafrost thawing and subsequent decomposition of organic matter, fires, etc. would further contrite to deepening the understanding of the impact of anthropogenic activities on the terrestrial carbon fluxes.

Keywords: d4PDF, biosphere model, TER

