



## Intensification of coupling between El Niño–Southern Oscillation and global carbon cycle under greenhouse warming

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El Niño–Southern Oscillation (ENSO) is the most important driver for interannual variation in the global carbon cycle. However, the relationship between ENSO and the carbon cycle can be modulated by climate change due to anthropogenic forcing because the effects of ENSO on the carbon cycle are susceptible to mean climate state. We show here that the sensitivity of the terrestrial carbon flux to ENSO will be significantly enhanced under greenhouse warming (by approximately 50%) in comparison to the pre-industrial and future projections (i.e. Extended Concentration Pathway 4.5: ECP4.5), suggesting an amplification of carbon–climate interactions. Decomposing the contributions of the changes in carbon sensitivity to ENSO reveals that the response of land surface temperature to ENSO and the sensitivity of gross primary production to local temperature are largely enhanced under greenhouse warming, thereby leading to the amplification of ENSO–carbon cycle coupling. It is evident that soil moisture depletion leads to increasing temperature responses in a given ENSO event under a warm climate. Our findings suggest that the ENSO-related carbon cycle, a dominant natural variability, will be significantly enhanced by hydroclimate changes caused by anthropogenic forcing.