What Controls Recent Changes in the Global Carbon-climate Feedback Process?

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The global atmospheric CO_2 growth rate is determined by reflecting the net effect of emissions and uptake from anthropogenic and natural carbon sources. Therefore, an evaluation of the global CO_2 growth rate should be preceded to understand the global carbon-climate process. In this study, the long-term changes in the global CO_2 growth rate for the period 1991-2020 were analyzed by using various observations from 42 global sites and model simulations to evaluate the recent changes in the global carbon-climate feedback process. Results showed that the annual CO_2 growth rate is recently increasing by the magnitude of 0.046 ppm yr^{-2}. A comprehensive assessment of the contribution of carbon cycle components to the observed atmospheric CO_2 growth rate changes reveals that strengthening the increasing atmospheric CO_2 growth rate is related to the weakening terrestrial carbon absorption in the recent decade. Weakening terrestrial carbon uptake is mainly related to a slowdown in Net Primary Productivity (NPP; 0.087 Pg C yr^{-1}). Overall, this study suggests land ecosystems could not sufficiently play a role in offsetting anthropogenic carbon emissions due to significant climatic warming.

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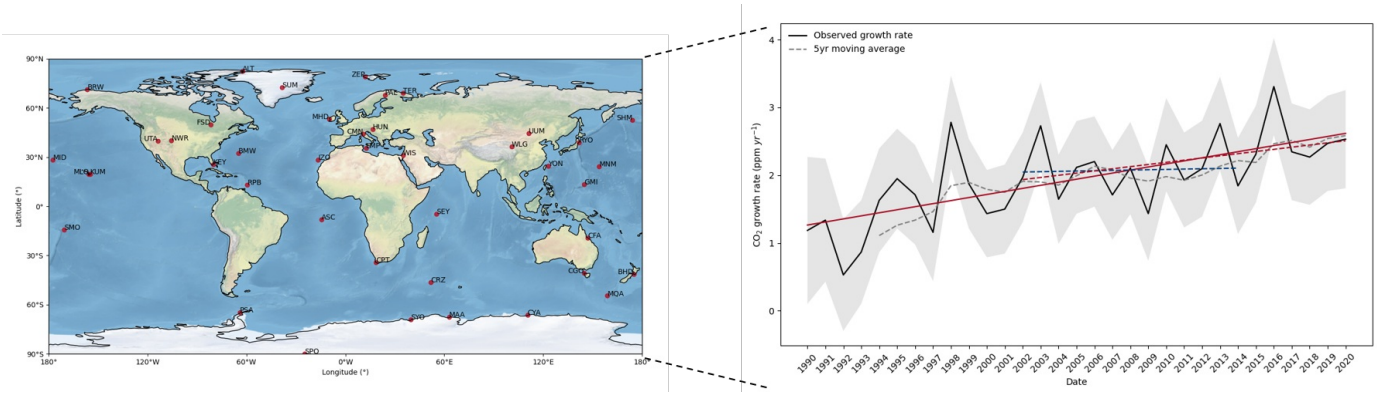

Figure 1. Time series of global annual CO2 growth rate (right) calculated from 42 global observation sites (left).