THE SENSITIVITY OF TROPICAL CARBON CYCLE TO CLIMATE CHANGE: A MULTI-MODEL ANALYSIS

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The human caused perturbation of the carbon cycle is often recognized as a major factor controlling climate change, directly through emissions of greenhouse gases and indirectly via climate feedbacks on natural carbon sources and sinks. Current coupled-climate-carbon models used in the IPCC 4th and 5th Assessment Reports generally project a positive feedback between global warming and the reduction of terrestrial carbon sinks in the 21st century, which has important implications for mitigation policies designed to stabilize greenhouse gas levels. The magnitude of this positive feedback varies markedly among models. For example, by 2100 the climate-carbon cycle feedback is estimated to cause an excess of CO2 going from 20 ppmv to 200 ppmv among the models, which corresponds to an additional global temperature increase of 0.1◦C–1.5◦C (Friedlingstein et al., 2006). Such a large uncertainty in carbon-climate feedbacks is associated with the different sensitivities of simulated terrestrial carbon cycle processes to changes in climate and atmospheric CO2

A decrease in the tropical land carbon sink driven by climate change has been found previously to be the main process explaining the positive climate-carbon cycle feedback found in future projections (Cox et al., 2001; Friedlingstein et al., 2006). Its causes have to be found in a combination of reduced photosynthesis due to a warming, generally combined with an increase in soil aridity, as well as an increase in soil oxidation, due to the warming. Hence, it is crucial to better assess, using available long-term observations, the sensitivity of the tropical carbon cycle to climate. In this study, we evaluate the sensitivity of tropical carbon cycle to climate change using ten process-based terrestrial carbon cycle models used for the IPCC 5th Assessment Report. The simulated gross primary productivity (GPP) distribution and its sensitivity to climate change are compared with flux-tower based estimates by Jung et al. (2011) (JU11). The simulated net biome productivity (NBP) is compared with the long atmospheric CO2 record from Mauna Loa observatory.