Geophysical Research Abstracts
Vol. 13, EGU2011-759, 2011
EGU General Assembly 2011

Simulation of carbon-use efficiency, respiration components and NPP allocation of Amazonian rainforests: do vegetation models get the right results for the right reasons?

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Bottom-up carbon budget studies where individual components of the carbon cycle are measured separately have only recently been established in Amazonia. These studies provide data that flux towers are incapable of providing such as total NPP and its allocation into different components. Thus, they are of great value for the evaluation and improvement of terrestrial ecosystem models. We assessed the ability of four terrestrial ecosystem models to simulate observations of carbon budget components from such bottom-up approaches at five Amazonian rainforests, including one throughfall manipulation experiment. Preliminary results show that most of the models simulate carbon use efficiency satisfactorily, although they tend to overestimate GPP and NPP compared to the observations. Models showed considerable differences in the break-down of total autotrophic respiration into leaf, wood and root components, with root respiration being especially variable across models. Allocation schemes were also found to vary widely across models. The ratio of aboveground to belowground NPP, for example, varied by a factor of three across models. This study underlines the importance of integrating observational data from tropical forest monitoring plots within an ecosystem model framework, in this case to highlight the cross-model uncertainty associated with two fundamental processes: autotrophic respiration and NPP allocation.