1st TERRABITES Symposium
Hamburg, Germany, 9-11 February 2010
TERRABITES-60

Interactions between nitrogen deposition, land cover conversion, and climate change determine contemporary carbon cycle of Europe

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European ecosystems are thought to sequester significant amounts of carbon, but, neither the rate nor the contributions of the underlying processes are known. In the past 50 years, atmospheric nitrogen deposition has more than doubled, carbon dioxide concentrations have risen by more that 100 ppm. Moreover, climate has gradually changed and the extents of forest and grasslands have increased at the expense of agricultural land. In this study, we estimate the responses of European land ecosystems to the aforementioned environmental changes using results from four ecosystem process models: BIOME-BGC, JULES, ORCHIDEE and O-CN. All four models project that European terrestrial ecosystems sequester carbon at a rate of about 100 Tg C yr-1 (1980-2007 mean) with strong interannual variability ($\pm$85 Tg C yr-1) and a substantial inter-model uncertainty ($\pm$45 TgC yr-1). Decadal budgets suggest that there has been a slight increase in terrestrial net carbon storage from 85 Tg C yr-1 in 1980-1989 to 114 Tg C yr-1 in 2000-2007. Our study suggests physiological effect of rising CO2 in combination with nitrogen deposition and forest re-growth as an important explanatory factor for this sink. Responses of the European carbon balance to changes in single drivers differed between models with and without considering nitrogen dynamics. Simulated ecosystem responses were more consistent for the two models accounting for terrestrial carbon and nitrogen dynamics than for the two models which only accounted for carbon cycling but included the effects of land use change. Studies of the interactions of carbon and nitrogen dynamics with land use changes are needed to further improve the quantitative understanding of the driving forces of the European land carbon balance.