Geophysical Research Abstracts, Vol. 8, 05529, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05529

Historical influence by land ecosystem uptake and land use change emission on the global carbon budget and climate change in the 20th century

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The terrestrial ecosystem and the physical climate system are strongly coupled through carbon exchange. However, major uncertainties in the magnitude of these feedbacks to climate change are still remaining. To solve these problems, we developed the coupled climate-terrestrial carbon cycle model and attempt to represent the interactive effect between the atmosphere and the terrestrial ecosystems, including the emission process associated with land use change, in the transient run of the 20th century. The terrestrial ecosystem carbon cycle model, Sim-CYCLE (Ito and Oikawa, 2002), derives the climate data from the CCSR/NIES/FRCGC Atmospheric General Circulation Model (AGCM) 5.7b and gives the LAI, carbon dioxide concentration and Net Carbon Budget (net ecosystem production minus carbon emission due to the land use change) to the AGCM through the variable coupler in the land surface model, MATSIRO. The additional components were attached to the Sim-CYCLE to simulate the influence of land use change on the global carbon budget according to the Grand Slam Protocol (Houghton et al., 1983). The net primary production (NPP) and heterotrophic respiration (HR) increased gradually during the 100 years. The net ecosystem production (NEP: NPP-HR) was almost positive and showed a net ecosystem uptake of atmospheric carbon dioxide. However, the net emission induced by the land use change degraded the global terrestrial carbon sequestration and occasionally made their budgets to be negative. The carbon emission under the land use change process occurred, intensively in Southern-east Asia and South America region. The cumulative global emission amounted to 44.5 PgC during 100 years. These supposed that the land use change have affected the global carbon budgets significantly and given the great positive feedback to the atmospheric carbon dioxide increasing during the 20th century.