Geophysical Research Abstracts
Vol. 14, EGU2012-4677, 2012
EGU General Assembly 2012

Freshwater greenhouse gas emissions and their implications on landscape level carbon balances in India

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Methane (CH4) and carbon dioxide (CO_2) emissions from global freshwaters are important sources of greenhouse gases to the atmosphere. It has been estimated that about 0.65 Pg of C (CO_2 equiv.) yr^{-1} in the form of CH4 and 1.4 Pg C yr -1 in the form of CO_2 is being emitted from global freshwaters. Therefore, including freshwater emissions in the greenhouse gas budgets in the national or global levels could significantly reduce the estimated land carbon sink, but present estimates suffer from lack of data, in particular from tropical freshwaters. Hence, we attempted to test the validity of the land carbon sink estimate in India, a tropical country with a large number of natural and man-made water bodies. We measured the CH4 and CO_2 fluxes and surface water concentrations from a wide variety of inland freshwaters like lakes, ponds, rivers, reservoirs, open wells, canals and springs in three South Indian states, Tamil Nadu, Kerala and Andhra Pradesh. We observed that almost all of these freshwater systems emitted varied amounts of CH4 and a majority of them emitted CO_2, similar to other tropical locations in South America. We extrapolated the measured fluxes for the whole of Indian inland waters by using the total area of different categories of inland waters in the national wetland atlas of India. By comparing our estimates of aquatic fluxes with the national greenhouse gas budget, we show that the land carbon sink of India is substantially overestimated. Thus, freshwater emissions are important components of greenhouse gas budgets on a landscape level and it is necessary to incorporate them in national and global greenhouse gas budgets to accurately quantify the land carbon sink.