

Interactive role of terrestrial biosphere in the climate system

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Processes in terrestrial ecosystems, to large extent, are controlled by climate and CO₂ concentration. In turn, geographical distribution of ecosystems and plant physiology strongly affect heat, moisture, and momentum fluxes between land surface and atmosphere. These interactions form different feedback loops between terrestrial biosphere and climate, which modulate substantially the climate system dynamics on different time scales. Research on climate-vegetation interaction is mostly concentrated on “hot spots” where the interaction is the most significant: boreal forests, North Africa, and Amazon forest. Boreal forests, even deciduous ones, significantly reduce the albedo of snow-covered surfaces. Simulations with different climate models reveal that positive feedback between forest and surface air temperature in the boreal region is not strong enough to establish multiple steady states. Nonetheless, the simulations show a significant cooling trend due to historical land cover changes, mainly as a result of temperate and boreal deforestation.

In general, the climate models agree that tropical deforestation exerts a net regional warming while an effect on extratropical regions is more uncertain. In the Sahel/Sahara region, several models are able to simulate „green Sahara“ phenomenon during the mid-Holocene. Some models reveal multiple steady states in the region due to strong interaction between vegetation and monsoon precipitation. Sensitivity simulations show that some expansion of vegetation cover into the Sahara is possible under CO₂-induced climate changes. Other examples of vegetation-atmosphere interactions in the most recent climate model intercomparison (CMIP5) will be presented.