

Vegetation Dynamics and the Earth System

M. Claussen

Potsdam Institute for Climate Impact Research, and Institute of Physics, Potsdam University,
Germany (claussen@pik-potsdam.de)

In the classical literature, climate is considered as mean weather or weather statistics. However, climate is not only a “specific nature of the atmosphere; but this nature depends on the continuous interplay ... with the heat radiating dry earth which ... is covered by forest and herbs” (von Humboldt, Kosmos I, 1845). Accordingly, a wider definition of climate in terms of state and statistics of the climate system, which includes not only the atmosphere, but also the ocean, the ice sheets and the terrestrial and marine biosphere, has evolved. Here the perspective of vegetation as a key component of the climate system is pursued, and the role of vegetation dynamics in past climate changes is explored. In particular, the dynamics of the Sahara and the synergy between the so-called taiga-tundra feedback and the sea-ice albedo feedback is assessed. It is demonstrated that this synergy is able to amplify the precession of equinox such that annual mean temperatures are influenced. It is hypothesized that biogeophysical feedbacks (including their synergies with other feedbacks) overcompensate biogeochemical feedbacks to amplify climate change through the glacial – interglacial cycle. Human perturbation of vegetation presumably affected global mean climate only marginally as biogeophysical and biogeochemical effects of land cover change nearly compensate. In future, however, either biogeochemical or biogeophysical effects could, depending on the scenario under consideration, exacerbate greenhouse-gas induced climate change.