Simulating land-atmosphere feedbacks in the earth climate system: recent progress in a dynamic vegetation model

Takeshi Ise[1]

[1] Japan Agency of Marine-Earth Science and Technology

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The ongoing anthropogenic climate change is immensely altering structure and function of the terrestrial biosphere, including forest ecosystems. In turn, the changing ecosystems have a strong potential to modify the climate through changes in biogeochemical cycles (e.g., C storage) and biophysics (e.g., albedo and hydrological cycling). Forest ecosystems will have particularly significant impacts onto the climate due to their large terrestrial coverage, vast C stock, and prominent biophysical characteristics. To reproduce the two-way interaction between vegetation and climate, climate models should be integrated with dynamically responding vegetation models. Here we present our recent progress, concerns, and future directions in simulations of vegetation processes by the terrestrial biosphere model (TBM) sSEIB (a simplified version of SEIB-DGVM) that is coupled to a climate system model (Center for Climate System Research-Frontier Research Center for Global Change general circulation model, CCSR-FRCGC GCM). sSEIB explicitly reproduces the ecophysiological, population, and community dynamics based on an individual-based forest model representation. The model is also fully coupled to the global biogeochemical cycling that in turn affects atmospheric CO2 concentrations. The GCM-coupled sSEIB successfully reproduced the current global distributions of vegetation types and plant production. A preliminary climate change experiment with the stand-alone sSEIB showed significant responses of terrestrial vegetation and soil C storage.