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Assessment of regional-scale primary production in terrestrial ecosystems to estimate the possible influence of future climate change on biodiversity

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In recent decades, climate change including global warming has progressed worldwide and their influences on ecosystem structure and function that provide various goods and services to humans' well-being are of the greatest concerns. The ecosystem function and services are tightly coupled with the biodiversity particularly via food web and biogeochemical cycles, and here carbon is one of the central elements that also affect atmospheric CO_2 concentration. Therefore mechanistic and quantitative understandings of the consequences among on-going climate change, ecosystem function, and biodiversity are urgent issues for seeking a better adaptation strategy. In order to tackle such tasks in the current environmental and ecological sciences, efforts have been made by numerous scientists and/or organizations to clarify the current status of and threats to biodiversity, responses of biogeochemical cycles to meteorological variables, and to construct climate change scenarios considering economic activities. However, to gain insights into the possible influence of climate change on biodiversity via altered ecosystem functions over broad temporal and spatial scales ranging from past to near-future periods and from landscape to global scales, further efforts to find the consequences are required, since the assessment of the influence of climate change on biodiversity is straightforward but difficult.

For decades in climate change science, carbon flux between the atmosphere and terrestrial ecosystems has attracted intensive attention as it connects the atmosphere and biosphere. Carbon flux in the biosphere is not only a process of biogeochemical material flux but also is an element to drive biological and ecological processes in ecosystems via food web beginning from photosynthetic carbon fixation by plants. Therefore focusing on photosynthetic production by plants, i.e. primary production of the ecosystem, may help us to estimate the possible influence of climate change on biodiversity. Photosynthetic carbon fixation, namely gross primary production (GPP), is a fundamental process of ecosystems and known to be highly sensitive to meteorological changes including radiation, temperature, precipitation and CO_2 concentration. Thus analysis of the effect of future climate change on ecosystem GPP in a biogeographical region, which is important from the viewpoint of the biodiversity conservation, such as "biodiversity hotspot" and "Global 200 Ecoregion", might enable us to discuss the relevance between climate change and biodiversity.

In ISI-MIP (Inter-Sectoral Impact Model Intercomparison Project) phase 1, we have estimated GPP by seven global biome models under future climate based on four RCPs (Representative Concentration Pathways for 2.6, 4.5, 6.0, and 8.5 W/m2 stabilization targets) and five global climate models. In present study, we analyzed these outputs to reveal the effect of future climate change on the ecosystem GPP in several biodiversity hotspots and will discuss the relevance between the climate change and biodiversity.