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Toward a new seamless science for a detection of terrestrial ecosystem responses under changing climate

SAIGUSA, Nobuko[1*]

[1]National Institute for Environmental Studies

Global warming caused by human-induced greenhouse gas emissions has impacts on atmospheric, oceanic, and terrestrial carbon cycles, and on ecosystem processes in various time scales. If the earth's ecosystem has a global effect of negative feedback to climate change, it means that the ecosystem has a function to stabilize the earth system by providing increasing sinks. If there is a positive feedback that accelerate global warming, such process should be monitored, evaluated, and mitigated. Examples of negative feedback in terrestrial ecosystems are a fertilization effect of plants under higher atmospheric CO_2 concentration, and an increased productivity and reproductive success under warmer environment and longer growing season length. A potential positive feedbacks is an accelerating greenhouse gas emission from permafrost.

Studies on ecosystem change in the global and continental scales have been conducted using satellite remote sensing and ecosystem process models to bring meaningful predictions and suggestions. Now more reliable verification of such predictions and direct detections of actual changes in ecosystems are required based on long-term ground observations. A major difficulty is that it needs a very long-term, highly comprehensive, and consistent monitoring that covers productivity, decomposition, nutrient cycle, plant invasion, changes in species composition, succession, etc.

In this presentation, recent studies on global warming effects in terrestrial ecosystems will be reviewed, and progress on carbon budget estimations based on integrated observing and analysis systems are introduced. In particular, such projects as "The US National Ecological Observatory Network" (NEON; http://www.neoninc.org/) and "Integrated Carbon Observation System" (ICOS; http://www.icos-infrastructure.eu/) in Europe are introduced to discuss future needs of long-term, consistent, and operational ecosystem monitoring to detect changes in ecosystems and biogeochemical cycles due to climate change.

Keywords: Carbon cycle, Global warming, Terrestrial ecosystem, Global monitoring