Special Virtual Issue:
Joint contents from the Journal of Plant Research and Ecological Research

EDITORIAL

Interdisciplinary approach for spatial and temporal dynamics of carbon cycle processes in terrestrial ecosystems: challenges and networking at the Takayama site on a mountainous landscape of Japan

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Forest ecosystems cover approximately 30% of the terrestrial area of the Earth and are expected to play crucial roles in regulating our environments including biodiversity and atmospheric CO_2 concentration. As the structure and functions of the forest ecosystems consist of multiple interactions of organisms, soil chemistry, and meteorological conditions, which are quite variable in time and space, challenges to understanding their processes and resulting dynamics of their functions have been made by various scientific disciplines/techniques such as ecology (including ecophysiology and biogeochemistry), hydrology, micrometeorology, simulation models, and remote sensing.

This research has focused particularly on carbon, which is one of the "common" elements of ecological processes involved in ecosystems such as photosynthesis, respiration, and biomass growth, and of the interaction between the atmosphere and ecosystems, as the carbon cycle regulates biological aspects of ecosystems and hence determines the exchange of CO_2 between the atmosphere and ecosystems. In recent decades, the carbon cycle and budget have been the central theme of environmental sciences by reflecting the ongoing climate change partly due to the rise in atmospheric CO_2. In order to achieve deeper understanding of the dynamics of the structure and functions of forest ecosystems over time and space, it is essential to conduct investigations on (1) the detailed ecological processes in the carbon cycle, (2) their interactions with the climate, (3) integrated analysis of ecological and meteorological process, and (4) observations of such structure and functions over time and space.

This special virtual issue involves such multidisciplinary and long-term challenges at the Takayama site (Fig. 1), which is located on a mountainous region in central Japan. The site mainly consists of a cool-temperate deciduous broadleaf forest (TKY) and an evergreen coniferous forest (TKC), which are parts of the AsiaFlux (http://asiaflux.net/) and Japan Long-Term Ecological Research (JaLTER, http://www.jalter.org/) networks. The history of TKY was initiated by the long-term observation of CO_2 exchange between the atmosphere and the deciduous forest, and ecological research for the carbon cycle processes in the forest, by numbers of scientists and students from several research institutes and universities (Saigusa et al. 2005; Yamamoto and Koizumi 2005; Ohtsuka et al. 2007, 2009). Efforts also have been made to link ecology, micrometeorology, modeling, and remote sensing to explore the multiscale investigations of the ecosystems and surrounding landscape, and this initiative is called Satellite Ecology (SATECO) (Muraoka and Koizumi 2009), which is now one of the interdisciplinary initiatives for cross-scale observation of ecosystems and for biodiversity–ecosystem–climate change observations in the Biodiversity Observation Network in Japan and in the Asia-Pacific (J-

BON, AP-BON; Muraoka et al. 2012). An open-minded research policy at the Takayama site then enabled us to establish international networks for education and research in terrestrial ecosystems among Japan, South Korea, and China, as the "A3 Foresight Program (funded 2007–2012 by JSPS in Japan, NRF in Korea, and NSFC in China)", as well as collaborative activity between Japan and Germany for mountainous forest and landscape research under climate change.

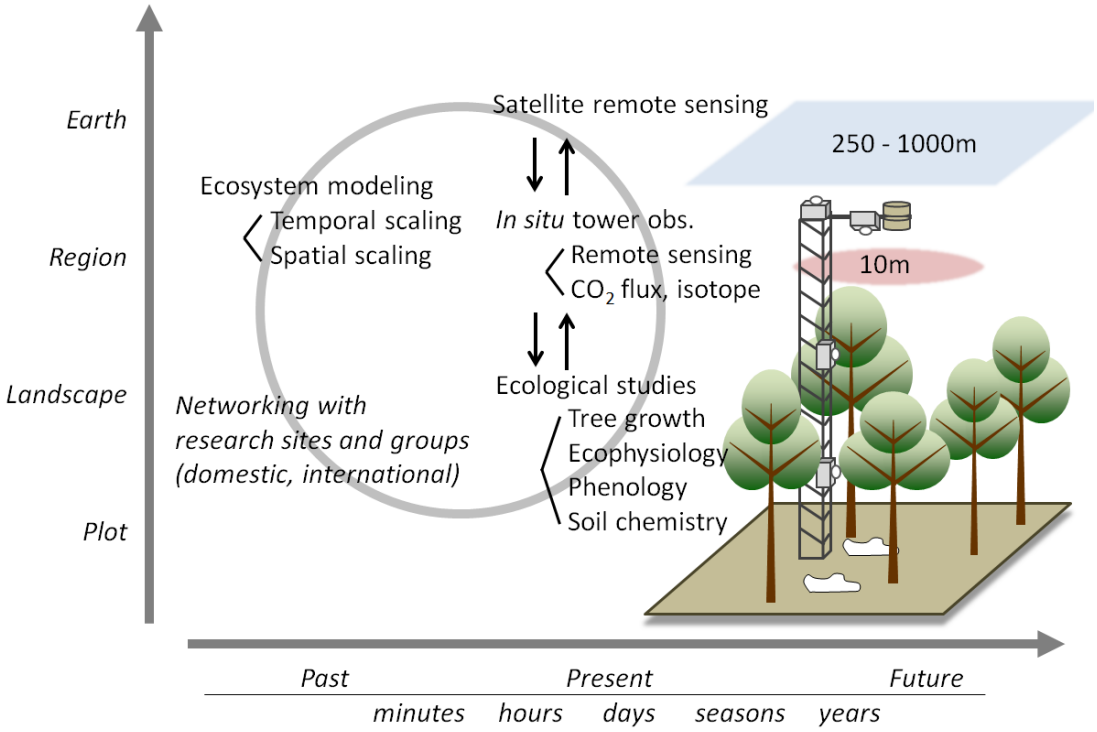

Fig. 1 Multidisciplinary research and networking at the Takayama site to explore cross-scale mechanisms and consequences of forest and landscape structure and functions.

The articles listed in this special virtual issue are part of those activities published in the Journal of Plant Research (Botanical Society of Japan) and Ecological Research (Ecological Society of Japan). We selected two review articles from the Journal of Plant Research (Current Topics in Plant Research), five articles from a special issue in the Journal of Plant Research by the A3 Foresight Program (2010, vol. 123, issue 4: "The carbon cycle process in East Asia"), and seven articles from a special issue for the 20th anniversary of the Takayama site in Ecological Research (2015, vol. 30, issue 2: "Long-term and interdisciplinary research on forest ecosystem functions: challenges at Takayama site since 1993"). The articles are mostly from the Takayama site but also include some from Korea, China, and Germany, where the researchers have developed collaborative networks for research and education. Ecological studies on the carbon cycle of forest ecosystems have been developed by detailed measurements of tree biomass growth and soil carbon dynamics (Noh et al. 2010; Ohtsuka et al. 2010; Matsushita et al. 2015), leaf and canopy ecophysiological characteristics that are tightly linked with ecosystem productivity in the Takayama site (Noda et al. 2014) and grasslands (He et al. 2010), atmospheric approach to reveal the temporal changes in carbon exchange between the atmosphere and forests (Saitoh et al. 2010; Ishidoya et al. 2015), and model analyses to clarify the functional contribution of leaf and canopy phenology on the forest carbon balance (Muraoka et al. 2010; Saitoh et al. 2014) or to evaluate the ecosystem services on a regional scale (Ruidisch et al. 2014). The re-

views provide our vision for cross-scale multidisciplinary research of the Satellite Ecology concept (Muraoka and Koizumi 2009), the importance of open-field warming experiments on the forest carbon cycle (Chung et al. 2013), the sensor and site network for phenology observation (Nasahara and Nagai 2015), and the overview and challenges at the Takayama site by model integration (Ito et al. 2014).

We will be grateful if the articles can provide valuable knowledge and information to colleagues in related research fields and can bridge multiple research disciplines for further networking among scientists and research sites for future studies.

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