Actions for sustainable forest ecosystems under air pollution and climate change

Takeshi IZUTA^{a,†}

(^a Institute of Agriculture, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, Japan)

In the 21st Century, air pollution and climate change are very serious environmental problems for forest ecosystems all over the world. Therefore, many researches are needed for understanding the responses of forest ecosystems to air pollutants such as ozone (O₃), a main component of photochemical oxidants, and climate change such as elevated atmospheric CO₂ and air temperature. The 28th IUFRO (International Union of Forest Research Organizations) Biennial Conference of Research Group 7.01 (Impacts of Air Pollution and Climate Change on Forest Ecosystem) entitled “Actions for Sustainable Forest Ecosystems under Air Pollution and Climate Change” was held in Fuchu, Tokyo, Japan (Tokyo University of Agriculture and Technology) on 22–26 October, 2017. At this biennial conference, we had an excellent opportunity to discuss close relationships among air pollution, climate change and forest ecosystems.

This special issue of *Journal of Agricultural Meteorology* is dedicated to the original articles derived from the organized sessions of the 28th IUFRO Biennial Conference of Research Group 7.01 as follows: (1) Asian forest ecosystem under changing environment, (2) Developing detection, monitoring and evaluation, (3) Ecophysiological and genetic understanding of plant responses, (4) Water and nutrient cycles in forest ecosystems, (5) Modelling and risk assessment, and (6) Forest

ecosystems under multiple stressors. The following briefly introduces the 5 original articles in this special issue.

Marozas *et al.* (2019) evaluated the differences in gas exchange characteristics and chlorophyll fluorescence of tree species prevailing in Lithuania (Scots pine, Norway spruce and Silver birch) and their physiological responses to water stress. Under moderate drought conditions, all tree species demonstrated reduced photosynthetic rate, lower stomatal conductance, transpiration rate, water use efficiency (WUE) and instantaneous carboxylation efficiency. No significant changes of maximal chlorophyll fluorescence (F_v/F_m) among the tree species were detected during the different weather conditions. Scots pine demonstrated the highest tolerance whereas Norway spruce had the highest sensitivity to drought conditions. Silver birch was the least sensitive to temperature and humidity conditions. Baumgarten *et al.* (2019) investigated species-specific sap flux, transpiration and water use efficiency of growth (WUE) at mixed hemi-boreal forest ecosystems during temporary moderate dry periods in the main growing season in Lithuania. They assumed that Scots pine trees are less affected by temporarily drought events than Norway spruce. Birch trees (silver birch and downy birch) exhibited significantly highest sap flux during dry periods at the water limited site whereas quite low WUE

Photo 1. Participants of IUFRO Tokyo 2017.

[†]Corresponding Author: izuta@cc.tuat.ac.jp

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was not different between the forest sites with different drought susceptibility. Therefore, birch trees may compete with Scots pine trees at the study sites in terms of water consumption and growth in the future. Yamaguchi *et al.* (2019) investigated the atmospheric deposition of long-range transported particulate matter (PM) on the needle surface of mature Japanese cypress (*Chamaecyparis obtusa*) grown in Nagasaki, Japan. They indicated that the long-range transported PM including Pb, Ni, Cu, Zn and As, originated from the anthropogenic sources in China, and deposited on the needles of *C. obtusa* grown in Nagasaki. Watanabe *et al.* (2019) investigated the effects of O₃ on soil respiration rate of Siebold's beech seedlings (*Fagus crenata*) grown under different soil-nutrient conditions. No significant effect of O₃ on soil respiration was mainly attributable to no response of fine root dry mass to elevated O₃. Soil nutrient supply decreased soil respiration rate in August. Their results emphasize the importance of fine roots in the response of soil respiration to elevated O₃. Manaka *et al.* (2019) conducted a monthly sampling survey of the Ganges River in Bangladesh during 2011–2014 and measured the chemical composition of the river water. Their results suggest that water during the rainy season, which has high partial pressure of CO₂ ($p\text{CO}_2$), temperature and water current velocity, releases CO₂ into the atmosphere more efficiently (150 mol m⁻² year⁻¹) than that during the dry season (20 mol m⁻² year⁻¹). In addition, they collected groundwater samples in Bangladesh and observed surprisingly high $p\text{CO}_2$ values. Groundwater in this area is likely to transport abundant dissolved inorganic carbon to the ocean.

I hope this special issue will help readers to realize that further multidisciplinary researches on the effects of air pollution and climate change on forest ecosystems are needed for effective actions towards sustainable forest ecosystems.

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