# For Understanding Wood Production and Forest Carbon Accumulation:

## Ecological, Physiological, and Environmental Engineering Approaches

**Lab. Forest Utilization** Prof.: Osawa A; Associate Prof.: Okada N; Assistant Prof.: Dannoura M.

Many functions are expected of forests such as biodiversity conservation, enhancing water resources, disaster prevention, and, of course, wood production. To effectively utilize these functions, we need much information ranging from organization of woody cells to structure of the whole forest. Our research covers wood formation and quality, eco-physiological characteristics of trees, and structure of the entire forest, all of which are necessary for understanding wood production and carbon accumulation functions of the forest leading to its sustainable management.

### Stand development and carbon accumulation of forests

Patterns and mechanisms of stand development are bases for understanding forest functions related to wood production, carbon sequestration and accumulation, and are examined with tree-growth rings, mathematical models and ecological field studies. Carbon dynamics study in Circum-polar boreal forest is an example.

Litter traps for evaluating carbon dynamics in Siberian larch forest (L) and Canadian pine stand (R).

### Variation of wood structure leads to the species diversity of forests

We have not yet found the main factor deciding the maximum tree height. Wood structure is probably one of the keys to answering the question, because it affects the water transport to the canopy and then photosynthesis. Variation of wood structure may be a basis of species diversity.

Dry evergreen (more than 30m high, left) and dry deciduous (less than 20m high, right) forests in Thailand.

### Understanding forest carbon cycling

Forest is known to absorb $CO_2$ from the atmosphere. It not only fixes carbon, but it also releases $CO_2$ to the atmosphere through respiration, remaining of which is stored in the ecosystem. We study this carbon flow with gas analyses and the use of stable isotopes. Still little understood cycling of carbon in the belowground part of the ecosystem is being examined in deciduous broadleaf forests of Japan and France.

Labeling experiment with stable isotopes in a French pine forest

## Keywords

***Forest stand development, carbon dynamics, Space-filling by plant organs, boreal forest, ecological wood anatomy, maximum tree height, tropical trees, vessel arrangement, water potential, ground-based LIDAR, remote sensing, fine root dynamics, soil respiration, sustainable forest management***

## Recent publication


**A new approach to estimate fine root production, mortality, and decomposition using litter bag experiment and soil core techniques.** Osawa, A., and R. Aizawa. *Plant and Soil* . DOI: 10.1007/s11104-011-1096-6. (2012).

**Population changes of early successional forest species after shifting cultivation in Northwestern Vietnam.** Tran, V. D., A. Osawa, T. T. Nguyen, B. V. Nguyen, T. H. Bui, Q. K. Cam, T. T. Le, and X. T. Diep. *New Forests* 41: 247-262. (2011).

**Recovery of gestation structure and species diversity after shifting cultivation in Northwestern Vietnam, with special reference to commercially valuable tree species.** Tran, V.D., A. Osawa, and T.T. Nguyen. *ISRN (International Scholarly Research Network) Ecology*, Aricle ID 751472, 12 pages. Doi:10.5402/2011/751472. (2011)

**In situ assessment of the velocity of carbon transfer by tracing 13C in trunk CO2 efflux after pulse labelling: variations among tree species and seasons,** Dannoura M., Maillard P., Fresneau C., Plain C., Berveiller D., Gerant D., Chipeaux, C., Bosc A., Ngao J., Damesin C., Loustau D., and Epron D., *New Phytologist* 190: 181-192 (2011)

**Very fine roots respond to soil depth: biomass allocation, morphology, and physiology in a broad-leaved temperate forest.** Makita N., Hirano Y., Mizoguchi T., Kominami Y., Dannoura M., Ishii H., Finer L., and Kanazawa Y. *Ecological Research* 26: 95-104 (2011)

**Estimation of tree age in the humid tropics by vessel measurement: a preliminary study.** Ohashi S, Okada N, Abdul Azim AA , Yahya AZ, Nobuchi T. *Tropics*:107-112 (2011)

**Mixed-power scaling of whole-plant respiration from seedlings to giant trees.** Mori S., K. Yamaji, A. Ishida, S.G. Prokushkin, O.V. Masyagina, A. Hagihara, R.A.T.M. Hoque, R. Suwa, A. Osawa, T. Nishizono, T. Ueda, M. Kinjo, T. Miyagi, T. Kajimoto, T. Koike, Y. Matsuura, T. Toma, O.A. Zyryanova, A.P. Abaimov, Y. Awaya, M.G. Araki, T. Kawasaki, Y. Chiba, M. Umari. *Proceedings of the National Academy of Sciences (USA)* 107: 1447-1451. (2010).

**Recovery process of a mountain forest after shifting cultivation in northwestern Vietnam.** Tran V. D., A. Osawa, and T.T. Nguyen. *Forest Ecology and Management* 259: 1650-1659. (2010).

## Recent publication (Continued)

**Permafrost Ecosystems: Siberian Larch Forests (Ecological Studies).** Osawa, A., O.A. Zyryanova, Y. Matsuura, T. Kajimoto, and R.W. Wein (eds.) Springer-Verlag, Berlin, 502p (2010)

**Seasonal patterns of root production of Japanese oak seedlings and dwarf bamboo grown in the rhizoboxes.,** Fukuzawa, K. Dannoura, M., Kanemitsu, S., Kosugi, Y., *Plant Biosystems*. (2010) http://dx.doi.org/10.1080/11263501003725971

**Partitioning of respiratory CO2 fluxes from a C3 turfgrass field.** Kosugi, Y., Itoh, M., Matsubara, T., Takanashi, S., Osaka, K., Mizota, Y., Dannoura, M., Shimamura, T., and Makita, M., *J. Agric. Meteorol.* (2010)

**Detecting invisible growth rings of trees inseasonally dry forests in Thailand: isotopic and wood anatomical approaches.** Ohashi, S., N. Okada, T. Nobuchi, S, Siripatanadilok, T. Veenin. *Trees –Structure and Function* 23:813-822 (2009)

**Detecting tree rings of Leguminosae in tropical seasonal forests by wood anatomy.** Ohashi, S., N. Okada, S. Siripatanadilok, T. Veenin. *Proceeding of FORTROP II International Conference* 2:1-13 (2009)

**Tracing of recently assimilated carbon in respiration at high temporal resolution in the field with a tuneable diode laser absorption spectrometer after in situ 13CO2 pulse labelling of 20-year-old beech trees.** Plain C., Gerant D., Maillard P., Dannoura M., Dong Y., Zeller B., Priault P., Parent F., and Epron D., *Tree Physiology* 30: 1515-1527 (2009)

**Biomass and distribution of roots in a Pinus densiflora forest estimated by methods of destructive block sampling,trench wall and ground penetrating radar.** Makita N., Hirano Y., Dannoura M., Yamase E., Aono K., Igarashi T., Ishii M. and Kanazawa Y. *Root Research* 18: 39-47 (2009)

**Fine root morphological traits determine variation in root respiration of Quercus serrata.,** Makita N., Hirano Y., Dannoura M., Kominami Y., Mizoguchi T., Ishii H. and Kanazawa Y. *Tree Physiology*, 29: 461-481 (2009).

**The development of an optical scanner method for observation of plant root dynamics.** Dannoura M., Kominami Y., Oguma H., and Kanazawa Y., *PlantRoot,* 2: 14-18 (2008).

**Detection of Cryptomeria japonica roots with ground penetrating radar.** Dannoura M., Hirano Y., Igarashi T., Ishii M., Aono K., Yamase K. and Kanazawa Y. *Plant Biosystems*, 142: 375-380 (2008).

**Biometric and eddy-covariance-based estimates of carbon balance for a warm-temperate mixed forest in Japan.,** Kominami Y., Jomura M., Dannoura M., Goto Y., Tamai K., Miyama T., Kanazawa Y., Kaneko S., Okumura M., Misawa N., Hamada S., Sasaki T., Kimura H., Ohtani Y., *Agric. For. Meteol.,* 148: 714-722 (2008).