

## Carbon cycling in an old-growth beech-oak forest of cool-temperate region, Mt. Hakusan

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Old-growth temperate deciduous forests were grown in a middle slope (840-1600 m) of Mt Hakusan, Gifu, central Japan. Mt Hakusan has erupted in the middle of 16 century, and no human disturbance occurred in these areas up to the middle of 20 century. The carbon balance of a forest varies dramatically at different successional stages. In general, a forest stand is expected to be a C source for several years at the beginning of secondary succession. Even-aged forests, such as coppiced forests or plantations, reach the peak of net ecosystem production (NEP) in a middle age (ca. 40-50 years) after disturbance in turn NEP declines as forest mature and finally reach to GPP/RE ratio = 1 (NEP=0). In contrast, old-growth natural forests with gap dynamics might have different pattern compared to even-aged mature forests. However, few studies of carbon cycling were conducted in old-growth forests especially in Japan. We set up a 1 ha permanent quadrat in an beech-oak old growth forest on Mt. Hakusan (1330 m) in 2011 to study carbon cycling and to estimate biometric-based NEP. Here, we introduced the preliminary study of soil respiration measurement and biometric-based annual NPP in the old growth beech-oak forest during 2012.

Above-ground net stand increment of the old-growth forest was  $3.3 \text{ t ha}^{-1} \text{ yr}^{-1}$ , and annual biomass increment is  $3.1 \text{ t ha}^{-1} \text{ yr}^{-1}$  with a few dead trees during 2012 (dry weight basis). Annual fine litter that produced during 2012 was  $4.0 \text{ t ha}^{-1} \text{ yr}^{-1}$ , and thus annual aboveground NPP was estimated as  $7.3 \text{ t ha}^{-1} \text{ yr}^{-1}$ . Aboveground biomass in the old-growth forest was extremely large ( $479 \text{ t ha}^{-1}$ ), and beech and oak contributed more than 95% biomass almost equally (beech:  $236 \text{ t ha}^{-1}$ , oak:  $220 \text{ t ha}^{-1}$ ) in 2011. However, annual total beech growth ( $2.3 \text{ t ha}^{-1} \text{ yr}^{-1}$ ) contributed 70% to the total annual stand increment of 2012 in the forest against to total oak growth ( $0.6 \text{ t ha}^{-1} \text{ yr}^{-1}$ ) contributed 18%. Aboveground NPP in the old-growth forest fell with in the data of Japanese cool-temperate deciduous forest stands ( $8.74 \pm 3.47 \text{ t ha}^{-1} \text{ yr}^{-1}$ ), and thus, growth of beech is rather high even in old-aged (may be more than 400 yrs) with large biomass.

Moreover, daily soil respiration (RS) was measured using soda lime method: 100- closed chambers (23.5 cm in diameter, ca. 16 cm in height) were used in each 10 by 10 m subquadrat in every month during growing season (June to November) in 2012. Daily soil respiration was exponentially correlated with soil temperature at 1 cm depth, and the Q10 value was 1.67. Annual RS was calculated based on the soil temperature monitoring in the field. Total annual RS (only in growing season) was  $3.19 \text{ tC ha}^{-1} \text{ yr}^{-1}$ , which was rather small compared to the other temperate forests (ranged from 4.5 to  $9.1 \text{ tC ha}^{-1} \text{ yr}^{-1}$ ). These data (high NPP and low RS) suggested that rather large C sinks in the beech-oak old-growth forest under study although we need to separate RS to autotrophic and heterotrophic respiration to estimate biometric-based NEP.

Keywords: Mt. Hakusan, Carbon cycling, Net ecosystem production, Net primary production, Soil respiration, Beech forest