スギ人工林の成長に伴う土壌炭素循環のダイナミクスと シミュレーションによる予測

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Soil carbon dynamics with the stand development of Japanese cedar (Cryptomeria japonica) plantation and the model simulation

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Summary

On the present earth, fossil fuels are being consumed in a large quantity, and so the atmospheric CO_2 concentration has increased rapidly during last several decades. It is important to study the change in the ability of the forest to act as a carbon sink under global warming, as the forest is expected at present to store some parts of increasing amount of CO_2 i
which is a major greenhouse gas.

Under such the condition, the meeting in Kyoto (1997) and Haag (2000) were convened, these showed the direction to cut down total CO_2 emission for developed and establish national carbon budgets. Therefore, it is improtant to exactly comprehend absorbing carbon ability in forests and estimate the volume absorbing carbon in future. The simulati n f ar n dynamics is most paid attention an   o   nee to i   late the forest carbon dynamics exactly in various environment.

the carbon cycling in Japanese cedar (*Cryptomeria japonica*
developmetal stage by field observation. On the other hand, I attempted to analyze the carbon cycling in cedar plantation by model simulation.

In field observation (Chapter II), this study was carried out in Japanese cedar plantations in Fusedani, Yuki-cho, Hiroshima Prefecture, west Japan. Six study stands, Plots I, II, III, IV, V and VI, were established in plantations with different stages, of which forest ages were 5, 10, 22, 28, 36 and 60-year-old, respectively. The study was a   ed ut s   ultaneously in all plots (Plots I to VI) from January 1995 to August 1996. I studied the plant biomass, environmental condition (soil temperature and moisture condition), litterfall rate, soil carbon accumulation, soil respiration rate, loss rate of A_0 layer and dead roots and analyzed the

compartment model.

The amount of biomass and litterfall rate increased swiftly with the growth of Japanese cedar, which were approximated by a simple logistic function of stand age. The accumulation of A_0 layer decreased from 21 t ha^{-1} to 5 t ha^{-1} during ten years following clear-cutting, and then recovered to nearly the same level as before clear-cutting within twenty years after clear-cutting, although the amount of soil carbon in mineral soil recovered for more than forty years after clear-cuttin   tal an   ineral soil respiration rates increased rapidly after clear-cutting and gradually decreased in y ung s ands and stabilized in old stands. The relative decomposition rate of the A_0 layer and organic matters in mineral   l   ⚘   ⚘   ⚘ due to the relatively high soil temperature rather than so   o st re ontent   ter the canopy closing up, the relative decomposition rates of the A_0 layer and humus in mineral soil stabilized at $0.14\sim 0.16$ y^{-1} and $0.005\sim0.013$ y^{-1}, respectively. Consequently, the soil carbon cycling was strongly affected by clear-cutting, e.g., the amount of soil carbon rapidly decreased due to the cessation of litterfall and increase of relative decomposition rate of A_0 layer and humus, and rec ered graduall   e d e l ⚘ e d ar cutting with the growth of the ce r plantati n   an   in soil carbon cycling with stand development was caused by the change in partly soil temperature and moisture content and most in the amount of cedar litterfall, which changed significantly in the early stage of the stand following clear-cutting, and became slower and leveled off in the late stage with stabilization of the environmental conditions and litterfall rate.

sideration of forest management and without). Both simulated soil temperatures decreased gradually, and both simulated soil moisture contents in A_0 layer and mineral soil increased by degree with forest age.

Simulated mineral and total soil respiration rate with consideration of the mana ement increased at once from 3.09 and 4.50 to 8.46 and 9.90 t C ha^{-1}y^{-1} just after clear-cutting, respectively, because soil temperature was higher than before clear-cutting and the dead root was occurred by clear-cutting. After that, these decreased gradually and stabilized 2.5 and 4.1 tC ha^{-1}

o 2.4 and 2.8 tC ha^{-1} (10-year-old), respectively, and these recovered later with forest development and the recover of litterfall rate. Simulated carbon accumulation in A_0 layer with consideration of the management and without stabilized about 11 and 10 tC ha^{-1} in mature forest, respectively. In simulated carbon accumulation in mineral soil with consideration of the management and without, both carbon accumulation decreased from 110 to 90 tC ha^{-1} until 20-year-old after clear-cutting because the carbon bai o