東南アジア熱帯地域の土壌利用変化に対する土壌呼吸の長期変動
Soil CO_2 efflux dynamics with land-use changes in Southeast Asia

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Land use changes greatly affect carbon cycle of forest ecosystem. Since the 1970s, about 35% of tropical primary forests were lost due to disorderly commercial logging, plantation development such as oil palm and rubber in Southeast Asia. These rapid land use changes cause serious environmental problems such as soil erosion, decrease in soil fertility, and decrease in productivity. As a result, there will be a major change in the regional biochemical cycles.

Soil is an important source of information on the global carbon budget and it is a carbon sink, and soil respiration (R_s) is one of the most important elements of the carbon cycle in terrestrial ecosystems. Land use changes influence the dynamics of R_s. However, most studies on the effects of land use change on R_s focused on the boreal, temperate and subtropical ecosystems. In Southeast Asia, we have addressed the response of R_s to the land use changes, but mostly it is a short period with little spatial or temporal repetition, especially there are few long-term observations in lowland rainforests with no seasonal changes in temperature.

To examine the long-term response of R_s to land use change in Southeast Asia, we selected 4 research sites of different land use type, primary forest (PF), secondary forest (SF), oil palm plantation (OP), and rubber plantation (RP). In 2010, we installed total 30 soil collars (diameter 32 cm) in each site. The 30 collars were distributed in two rows, each with 15 collars and at 5 m intervals. R_s was measured every two weeks using a portable automatic opening and closing chamber system developed by the National Institute for Environmental Studies.

R_s showed synchronicity seasonal change among all sites, suggesting that it is controlled by both soil temperature and moisture. The apparent temperature sensitivity of R_s (Q_{10}) decreased from 4.86 in NF to 2.09 in SF, 2.14 in OP, 3.79 in GP. In addition, the annual average soil respiration rate decreased about 38% in SF, about 33% in OP and about 40% in GP compared with NF. Our results indicate that logging and/or conversions of primary forests to plantations lead severe soil degradation.

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