

Comparison of soil CO₂ efflux in tropical forests of different ages, Peninsular Malaysia

ABSTRACT

The forest age, environmental abiotic and biotic factors are important in controlling soil CO₂ efflux in forest ecosystems, as they play an important role in soil respiration. The aim of this study was to determine the environmental factors associated with each forest age and their impact on the soil CO₂ efflux rate. This study was conducted in 10-, 30-, 50- and 70-year-old recovering tropical lowland forests in Peninsular Malaysia, measuring soil CO₂ efflux using the continuous open flow chamber technique connected to a multi gas-handling unit and infrared gas analyser. The forest biomass and soil properties were quantified using the Kjeldahl method and Walkley-black wet oxidation technique. The results show that soil CO₂ efflux was higher in the 10-year-old forest than the older forests and lowest in the 70-year-old forest. Soil CO₂ efflux ranged from 92.09 to 634.78, and 106.77 to 536.00 mg m⁻² h⁻¹ between February and June, and September and December for all forests. The higher soil CO₂ efflux in the 10-year-old forest was significantly positively correlated with high soil temperature ($R=0.96$) compared to the spatial and temporal variation in the 30-, 50- and 70-year-old forests. The entire spatial and temporal variation in soil CO₂ efflux can be largely accounted for by the soil properties, forest carbon input and environmental factors. In conclusion, soil CO₂ efflux, soil properties, microclimate condition and forest biomass varies significantly with forest age. Soil CO₂ efflux decreases with forest age, and increases the carbon use efficiency. The environmental factors, dominated by soil temperature, affect soil CO₂ efflux substantially.

Keyword: Biomass; Forest ecosystem; Stand density; Soil carbon; Soil CO₂ efflux; Soil temperature