

Factors responsible for spatial and temporal variation of soil CO₂ efflux in a 50 year recovering tropical forest, Peninsular Malaysia

ABSTRACT

Environmental abiotic and biotic factors are important in controlling soil CO₂ efflux in forest ecosystems of different ages, as they play an important role in soil respiration. In understanding the spatial and temporal variation of soil CO₂ efflux after several years of forest logging, there is a need to quantify the changing soil properties, environmental factors, and the total above and below ground biomass. This study was conducted in a 50-year old recovering tropical lowland forest in Peninsular Malaysia, measuring soil CO₂ efflux using the continuous open flow chambers technique connected to a multi gas-handling unit and infrared gas analyser. The aim of this study was to determine the spatial and temporal variation of soil CO₂ efflux in relation to changes in soil properties, environmental factors and forest carbon in a recovering forest. The efflux rates of about 389.20, 634.78, 564.81, 537.92 and 428.72 mg m⁻² h⁻¹, respectively, varied across the days and months, increasing from February and attaining the maximum in March and then gradually decreasing from April to June. The soil properties revealed a considerable amount of soil organic carbon, total organic carbon, and soil organic carbon stock, while the total above ground biomass, below ground biomass, soil pH, nitrogen to carbon ratio were found to provide nutrients for microbial activities in soil and to emit soil CO₂. The multiple linear regression model indicated that the soil temperature and moisture explained the spatial and temporal variation in soil CO₂ efflux; likewise, the changes in the soil properties and forest carbon significantly increased the soil CO₂ efflux indicating a strong positive correlation ($R^2 = 0.93$).

Keyword: Biomass; Forest ecosystem; Microbial; Soil CO₂ efflux; Spatial and temporal variation