
ABSTRACT

The establishment and intensive management of forests for the production of timber can have significant effects on the soil carbon dynamics. The establishment of forest on organic soils under grasslands may lead to substantial losses in soil carbon, due to the site preparation for the planting of trees and other disturbances. This is gradually compensated by carbon accumulation in tree biomass as the forest grows until clearfelling at maturity may initiate another substantial carbon loss.

This study had two main aims. The first was to investigate the long-term effects of forest establishment on natural grassland as well as clearfelling and re-growth of the forest during second rotation, by looking at the changes in soil carbon stocks and soil carbon balance in a Sitka spruce (*Picea sitchensis*) in Harwood (N. E. England).

Secondly, to investigate the short-term effects of forest clearfelling on the fluxes of soil CO₂, N₂O and CH₄ and on the environmental factors (soil temperature, water content and water table depth) affecting them. The fluxes were initially measured in two mature stands (40-years old) during one growth season. One of the two stands was subsequently clearfelled while the other was kept intact and fluxes were measured for a further ten months after clearfelling. The relationships between these fluxes and the environmental factors were also examined.

The study also investigated the spatial variability of soil CO₂ emissions using geostatistical approaches. The soil CO₂ fluxes were measured with two methods, a closed dynamic chamber and a closed static chamber, giving the opportunity to compare their relative performance. A performance further investigation on this discrepancy between the two methods took place in lab experiments and on a soil monolith, excavated from the 40-year old stand and kept under controlled conditions in the greenhouse.