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The influence of thinning on soil CO_2, N2O and CH4 fluxes in a degraded peri-urban forest

Gianluigi Mazza (1), Alessandro Elio Agnelli (2), Ugo Chiavetta (1), and Alessandra Lagormarsino (2)

(1) CREA, Reserch Centre for Forestry and Wood, Italy (ugo.chiavetta@crea.gov.it), (2) CREA, Research Centre for Agriculture and Environment, Italy

Forest ecosystems generally act as a net sink for CO_2, contributing to climate change mitigation by removing atmospheric CO_2 and storing it in different carbon pools (i.e. biomass, soil, dead organic matter, litter). Forest degradation, implying a decrease in canopy cover, growth rate and regeneration, contributes to atmospheric greenhouse gas (GHG) emissions through decomposition of remaining plant material and soil C, no more balanced by the C storage capacity in woody biomass and soil. The absence of proper silvicultural practices can determine an increase of degradation symptoms with many dead, fallen and/or damaged trees due to unstable structural conditions. Since appropriate forest management can reduce emissions from forest degradation contributing to climate change mitigation, it is important to estimate the magnitude of this service to include it into climate policy.
This study is based on LIFE FoResMit project mitigation options that include reducing emissions from forest degradation, enhancing the sequestration rate in restored stands in a peri-urban pine forest. The objective of this study was to investigate how soil temperature, soil moisture, C and N pools in forest floor and soil influenced the GHGs production under different thinning treatments.
CO_2, CH4 and N2O emissions have been monitored together with C and N pools in forest floor and soil before and after the thinning intervention. Fluxes of GHGs were measured using the static chambers method and gas chromatographic techniques. In addition CO_2 emissions were monitored also with portable instruments (PP system) for evaluating the litter contribution to total soil respiration. C and N pools have been measured in three horizons of forest floor according to litter degradation process and at two soil depths.
The first results showed an increase of CO_2 emissions during thinning operations. The pine forest appeared as a CH4 sink and its uptake increased especially after selective thinning ($P<0.01$). N2O emission peaks were found during thinning also in the control plots and within 6 months N2O fluxes showed a flat trend with values close to zero. Thinning reduced total soil respiration of about 8.5 %. Environmental factors as well as C and N content in deep forest floor horizons and soil showed a significant influence on GHG fluxes, especially regarding CO_2 emissions and CH4 uptake. Comparing six months before and after the thinning interventions GWP (Global Warming Potential) was reduced of about 10-20 % under selective thinning.
In conclusion, local policies should encourage an appropriate forest management, which can help both to reduce emissions from forest degradation and to increase carbon removals. Including forest degradation in the new climate change agreements will help ensure the sustainability of ecosystem services.