Geophysical Research Abstracts
Vol. 21, EGU2019-8807, 2019
EGU General Assembly 2019

Effects of forest management practices on climate change mitigation at local scale: The Monte Morello case study (Italy)

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In the CoP21, the world leaders defined a global agreement to combat climate change with the aim to achieve global greenhouses gas (GHG) emissions neutrality in the second half of 21th century and to hold global warming well below 2°C relative to pre-industrial levels. To contrast the climate change, the European Union adopted the Climate and Energy Framework (2014) which sets targets for the 2030: at least 40% cuts in GHG emissions from 1990 levels; at least 27% share for renewable energy; and at least 27% improvement in energy efficiency. In this global context, the forest management practices contribute to climate change mitigation through three ways: (1) afforestation or reforestation, where carbon is stocked, and offsets are generated through the reestablishment of forest area; (2) avoiding emission from deforestation and degradation; (3) improved forest management (IFM) aimed to increases the carbon stocked in the forest and in the wood products.
The aim of the present study is to investigate the effects of two different forest management practices – selective thinning and thinning from below – on carbon stock (C-stock) and sequestration (C-sequestration) in a degraded black pine forest in Italy (Monte Morello forest, Tuscany region). In the selective thinning scenario, all crown-volume competitors trees are harvested, standing dead trees and lying deadwood of first decay classes are removed during cutting, while in the thinning from below scenario only small and leaned trees and standing dead trees are harvested, while the lying deadwood is not removed.
The results show that both the silvicultural treatments have decreased the C-stock in above-ground and below-ground biomass, and deadwood, but at the same time have increased C-sequestration in above-ground biomass. After the traditional thinning the C-stock decreases of 145 tCO_2 ha-1 (96% of changes are in the above-ground and below-ground biomass and 4% in deadwood), while after the selective thinning the C-stock decreases of 220 tCO_2 ha-1 (95% of changes are in above-ground biomass and 5% in deadwood). Conversely, considering that the annual increment is 10 and 13 m3 ha-1 yr-1 respectively after thinning from below and selective thinning (which means 15 and 18 tCO_2 ha-1 yr-1), 10 and 12 years are needed to restore the carbon lost. Therefore, we can affirm that the two-investigated thinning have a positive effect on the climate change mitigation in the long-term period.
In the Monte Morello forest (1,035 ha), the carbon credits (CC) – generated over a 15-year IFM period (period between two thinning) – would be 1,200 with the thinning from below and 5,124 with the selective thinning, for a global earning of 62,200 € and 165,400 € respectively.
Finally, it can be affirmed that: i) the selective thinning performs better than traditional ones since it generates a higher annual increment which means higher C-sequestration capacity and more CC; (2) the C-sequestration capacity can be risen not only with afforestation or reforestation, but even with the application of sustainable IFM practices, which improve both C-sequestration and other ecosystem services (e.g. biodiversity conservation, timber and water provision).