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Comparing the efficiency of forest mitigation policies: Is sequestering more efficient than using wood?

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Reducing the net CO2 emissions is a key target worldwide, as shown, for instance, by the commitment of the Paris Agreement, and in this context, forests are being scrutinized for their capacity to act as carbon sinks and store large amounts of carbon over long periods. Quantifying the substitution effect of wood remains very difficult as it depends on many factors difficult to measure, such as the distribution of wood products into types of products having different lifetimes and which can substitute for different materials.

In Romania, forests have a large overall biomass stock, even in managed forests, since the management is operating at an intensity much lower than in many other European countries. Increased regionality in the global change effects requires a more local investigation. Therefore, we used a dynamic forest landscape model (LandClim model) to compare the three opposed mitigation strategies of forests and quantify their potential for sequestration of carbon and substitution of carbon in the context of global changes.

Under the mild climate RCP26 the carbon stocks were kept at levels roughly similar to the current stocks. The Set Aside 100% (SA100) managed stands stored the highest quantity of carbon, showing a capping of growth at the end of the 200 simulated years. Under the extreme climate RCP85, stocks increased for three decades but then plummeted. The highest stocks were obtained by the Set Aside 0% (SA0) management.

The cumulative harvest showed two surges under the climate scenario RCP26, first at the beginning of the simulation (2020-2060) and then during the 2170-2210 period. Under mild climate change RCP26, the effect of substitution from wood procurement clearly exceeds the increase in storage that can be expected. Under the RCP85 climate, harvest occurred exclusively during 2020-2070, then practically stopped when all stocks and fluxes became a lot more similar among management scenarios, given the catastrophic drop of stocks past 2080.

Wind-related disturbances had relatively constant consequences under RCP26, albeit with more fluctuations and a much higher intensity in SA100. SA0 and SA30 had similar magnitudes until 2120, and then wind-induced losses increased more strongly for Set Aside 30% (SA30). By 2210 the amounts of wind-induced carbon losses were 50% larger for SA100 than for SA30. Under scenario RCP85, the management strategy did not influence these losses which were near zero after 2080, as a result of the very small stocks.

The literature suggests no management strategies for carbon storage in mild climates, but in extreme climates cannot be a solution. Therefore, under the cloud of increased disturbance and pressure of climate change, the substitution strategy is more effective and safer than sequestration.