Logging residue produces greenhouse gases in boreal forests

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Living trees are recognized as sources of greenhouse gases carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). However, less is known about greenhouse gas exchange in deadwood during its decay, and especially in logging residue. During the logging process, logging residue is produced in large amounts. Even though residue can be harvested for energy production, significant amounts of logging residue is still left in forests. In Finland, 30% of the logging residue is recommended to be left on the logging site. It has been estimated, that in the European Union, annually over 200 million cubic meters of logging residue is produced, which of approximately one sixth is produced solely in Finland. As an example, only 2.7 million cubic meters of logging residue was recovered from Finnish forests and used for energy production in 2018.

We hypothesized that logging residue left in forests produces various greenhouse gases – CO₂, CH₄, and N₂O – during its decay. We studied greenhouse gas exchange in logging residue of spruce (Picea abies) and birch (Betula sp.) with focus on logs with average diameter of 5 – 10 cm. Residue was collected from 18 different research areas, covering approximately 47 hectares of spruce-dominated forest in Central Finland. All research areas were clear cuts, with known cut ages; the studied logs had decayed between 0 and 10 years. The study was carried out in 2019 during an eight-month period from May to December. In addition to greenhouse gas flux, dry matter content of logs was determined. All studied logs were a source of CO₂, with CO₂ flux correlating with log decay time and dry matter content. CO₂ emission was observed to be dependent on ambient temperature. In general, we detected low CH₄ emissions from logging residue; opposite to CO₂, no clear trend was found between CH₄ flux and log decay time or dry matter content. N₂O results were similar to CH₄, with low overall emissions. Dry matter content of logs correlated well with log decay time, with dry matter content decreasing as the logs were more decayed. Our study is an important step in understanding greenhouse gas exchange in logging residue and decaying wood in forests.