IBFRA 2023 Conference

Excursion 1: New winds in research and management of forested peatlands

Friday 1.9.2023 at 9:00 - 18:30	
9:00	**Departure from Little Finlandia**
9.00 - 10:20	Bus trip to Lahti Pro Puu (Pro Wood) Center (Satamakatu 2, Lahti)
10:30 - 12:00	Guided tour of famous Pro Puu exhibitions and in Wood Architecture Park. Presentation of versatile wood design.
12:00 - 12:30	Bus trip to Vääksy, Asikkala
12:30 - 13:30	Lunch in Restaurant Majakkapaviljonki (Ämmäläntie 20, Asikkala) on the shore of Lake Päijänne and Vääksy canal.
13:30 -14:00	Bus trip to Ränskälänkorpi experimental and demonstration site (Evontie 690, Asikkala).
14.00 -16:30	Walking trip in Ränskälänkorpi. Presentations of the research activities & field coffee.
16:30 -18:30	Returning by bus to Helsinki (Little Finlandia)

HoliSoils Working together for forest soils

SOMPA

hiilineutraalisuomi.fi CANEMURE

www.IBFRA2023.org

LIFE-IP CANEMURE-FIN
LIFE17 IPC FI 002

RÄNSKÄLÄNKORPI

CANEMURE Demonstration and research site

The experimental design and first measurement results

Natural Resources Intitute Finland (Luke) and
Finnish Meteorological Institute (FMI)

30.3.2023

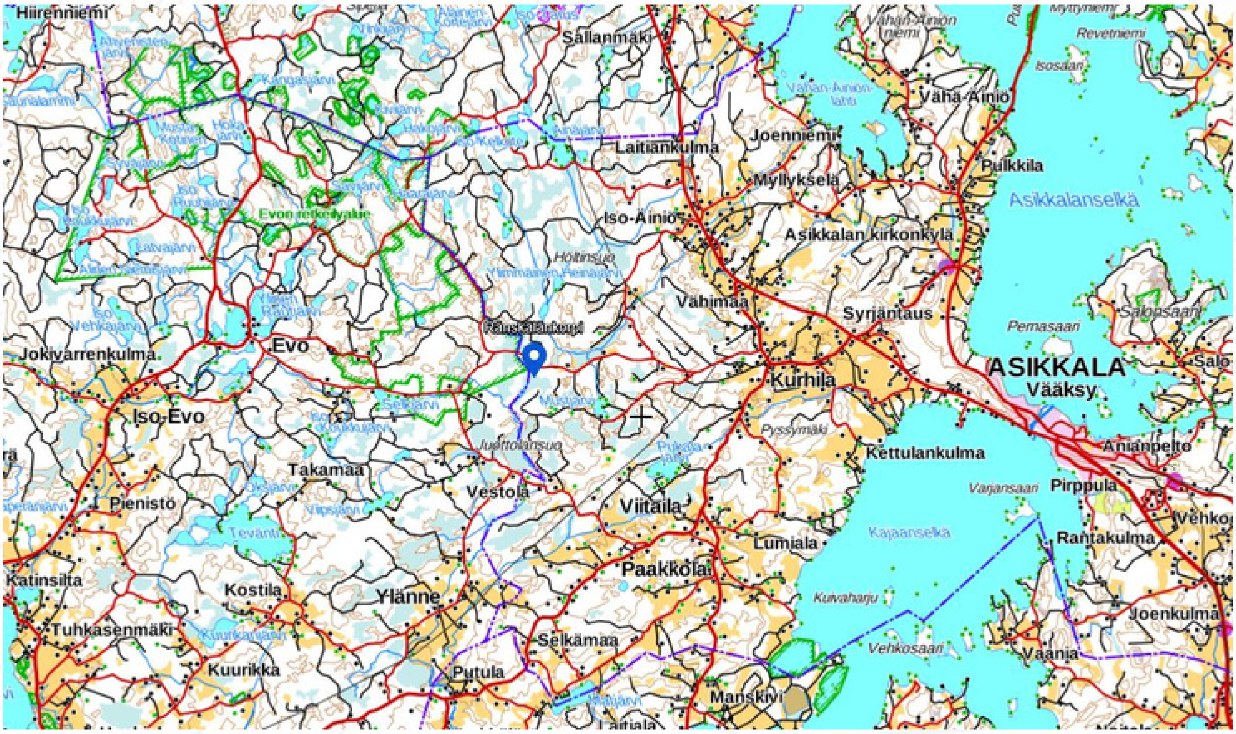
Asikkala, Päijät-Häme region, southern Finland

LIFE17 IPC/FI/000002 LIFE-IP CANEMURE-FINLAND Projekti on saanut rahoitusta Euroopan unionin LIFE-ohjelmasta. Sisältö edustaa ainoastaan CANEMURE-projektin näkemyksiä ja CINEA / Komissio ei ole vastuussa projektin sisältämän informaation mahdollisesta käytöstä.

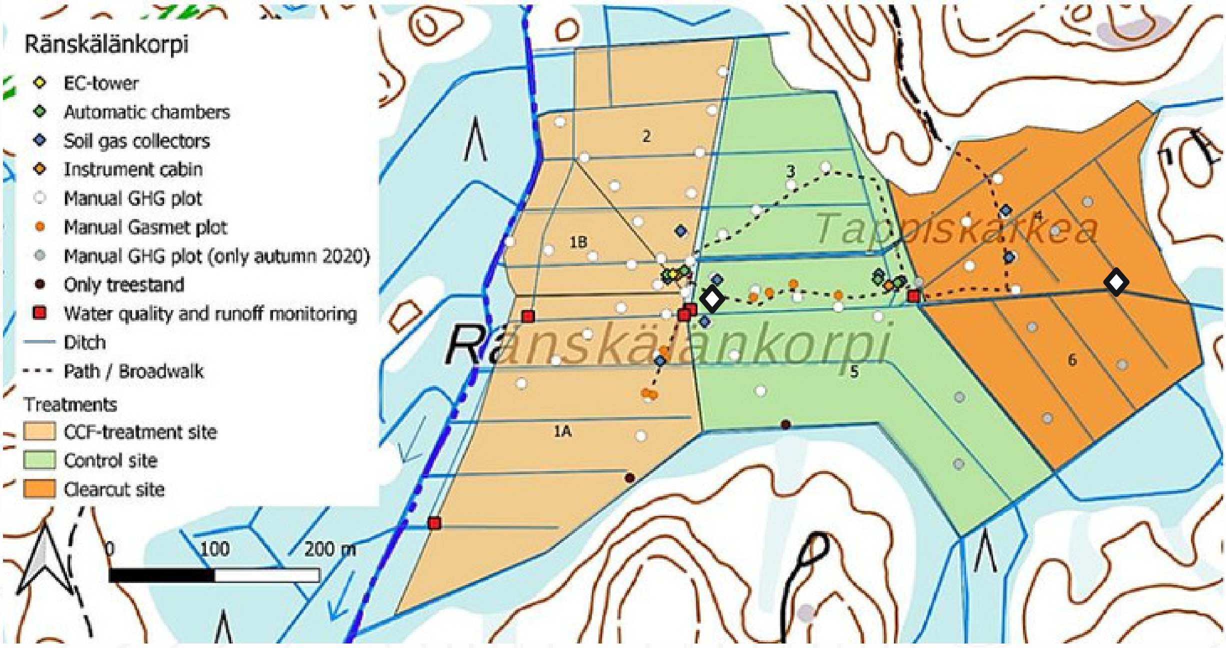
hiilineutraalisuomi.fi @hiilineutraali www.facebook.com/resurssiviisaus

hiilineutraalisuomi.fi
CANEMURE

Site location



Location of the Ränskälänkorpi study site in Asikkala, Southern Finland.



Experimental setup of the Ränskälänkorpi site. Permanent sample plots for tree stand measurements and coverage of understorey vegetation (n=45) and for GHG measurements (n=43, white circles) were established in 2019. EC-devices (measurement towers) were installed on the CCF-treatment site in 2019 and on the clear cut site in autumn 2021.

Ränskälänkorpi experimental peatland area (ca 25 ha) is located in Asikkala municipality in Southern Finland (N61°10.966' E25°15.985')(Figure 1.). The landowner of the area is UPM-Kymmene Oyj Ltd. The long-term (1981–2010) annual precipitation in the region averages 600 mm, the long-term mean annual temperature is +3.8 °C and the temperature sum 1.220 dd (+5C daily temperature as the threshold value). The mean temperatures for July and February are +16.6 and –7.6 °C, respectively. The area has been drained for forestry before 1960’s (exact year of drainage not known). At present the area is well-drained and represents mainly nutrient-rich Herb-rich (Rhtkg II) and

Vaccinium myrtillus (Mtkg II) site types drained peatland forest. About 5% of the area is poorer *Vaccinium vitis-idaea* (Ptkg II) type site located in the northernmost part of the area. The tree stand consists of a dominant tree layer of mature Norway spruce (*Picea abies*) mixed with Scots pine (*Pinus sylvestris*) and pubescent birch (*Betula pubescens*), and a patchy understorey of Norway spruce trees of varying age and height. Ground vegetation is sparse and consists of forest mosses (*Hylocomium splendens*, *Pleurozium schreberi, Dicranum polysetum* etc.), dwarf shrubs (mainly Vaccinium myrtillus and Vaccinium vitis-idaea), as well as forbs such as *Dryopteris carthusiana, Gymnocarpium dryopteris, Trientalis europaea, and Oxalis acetosella*.

The thickness of the peat layer consisting of sedge (Carex) and wood dominated peat, is mainly >1 m. The site is

divided
into three blocks (Figure 2) for demonstrating the impacts of different forest management treatments on tree stand development, hydrology, and GHG fluxes between the soil and atmosphere. Each block is divided into two sub-blocks according to site trophic status. Except for sub-block 6, each sub-block forms an artificial small catchment isolated by ditches. The study site consists of three different stand treatments: **selection cutting** (CCF, ca 10.0 ha), **clear-cutting** (ca 6.1 ha), and **non-harvested control area** (ca 7.3 ha). The harvesting treatments have been placed on the blocks in accordance with the ecosystem level GHG-exchange measurements (Eddy covariance-method, see chapter 2.3). The monitoring of the site was initiated in 2019 and the harvesting, according to treatments, was carried out in March and June 2021.

The tree stands were measured on 45 systematically arranged permanent circular sample plots. A total of 39 plots

were
located on eight radial transects extending 160–200 m from the eddy-covariance mast and 6 plots were placed on the planned clear-cut sub-block 4. All circular sample plots had an area of 200 m2. In August 2019 to May 2020, trees on the sample plots were measured for their locations relative to plot center, and tree species, stem diameter at the height
of 1.3 m (DBH), tree height, and crown length was recorded for all tallied trees.

The mean basal area (G) was 33,5 m2/ha and mean stand volume (V) was 290 m3/ha before selection cutting in sub-blocks1 and 2 and the post-harvest target remaining basal area was 12-15 m2/ha. In clear-cut area, the pre-harvest basal area was 31 m2 and stand volume was 270 m3/ha (Table 1). The harvestings were mainly done in the beginning of April 2021.

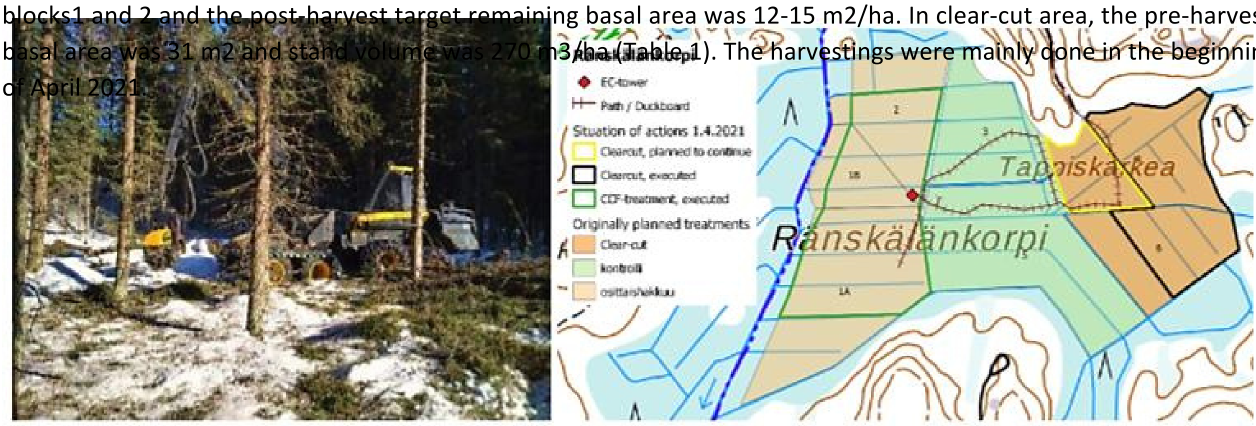


Figure 3. Selection harvesting and clear-cutting started in March 18, 2021. Green and black lines show, which part was harvested in winter conditions by April 1. Yellow line indicates an area, which was harvested in June 2021. Photo: Sakari Sarkkola.

Table 1. Stand basal area (BA, m2/ha) and total stand volume (V, m3/ha) before and after harvestings in the managed areas of Ränskälänkorpi experiment. The harvestings were carried out in spring 2021. Over 90 % of the harvesting outturn was Norway spruce.

	Before harvesting		After harvesting	
Treatment	BA, m2	V, m3/ha	BA, m2	V, m3/ha
Selection harvest (7.5 ha)	33,5	290	12,0-15,0	100-115
Clear-cutting (6.4 ha)	31,0	270	0	0

Research

Ecosystem level GHG exchange measurements above canopy
In August 2019, micrometeorological flux measurements of carbon dioxide and evaporation in the eastern border of the planned selection harvest (CCF) area were started. Main electricity, a small cabin for instrumentation, scaffolds for the mast and a telescopic carbon fiber mast, which may be elevated up to 32 m, were constructed. We measure eddy-covariance fluxes above the canopy at height of 29 m. Instrumentation include 3-D sonic anemometer and a fast response CO2-H2O gas concentration analyzer LI-COR.

First measured winter season (2019–2020) was mild and that continued over February 2020 as well. The data shows a period when air temperature is close to or above zero and forest act as net sink of CO2 during daytime. Freezing air temperatures usually prohibit photosynthesis. Negative value indicates net flux downwards (CO2 uptake by the forest). The average net CO2 fluxes at noon was calculated, during dark hours and daily 24h averages for 15-day periods.

The western part of the forest was harvested by selection cuttings and the western part by clear-cutting in March 2021. During the harvest, EC measurement mast was not in operation. EC flux measurements restarted 25.3.2021. Another EC measurement device was setup in the clear-cut area in Autumn 2021 and the measurements will be started in November 2021.

Figure 4. In 2019, six automated chambers for forest floor greenhouse gas flux measurements were made operational at Ränskälänkorpi site. Photo: Tuomas Laurila.

First measured winter season (2019–2020) was mild and that continued over February 2020 as well. The data shows a period when air temperature is close to or above zero and forest act as net sink of CO2 during daytime. Freezing air temperatures usually prohibit photosynthesis. Negative values of net ecosystem exchange (NEE) indicate net flux downwards i.e. the CO2 uptake by the forest. The post-harvest summers 2021 and 2022 were warm and dry.

The average net CO2 fluxes at noon and during dark hours as well as daily 24h averages were calculated. The first preliminary results of CO2 fluxes before and after the CCF-harvesting are presented in Figure 5. On average, the site was net carbon source before and after the cutting treatment, but the source decreased after treatment compared to the pre-harvest fluxes as well as to the fluxes from unmanaged control sites. The pre-harvest net carbon source was about 3600 kg/ha/year. The source decreased to close to zero since November and during springtime the site turned to net sink of CO2. In clear-cut area, however, the site remained significant net source of carbon mainly throughout the year after harvesting (figure 6).

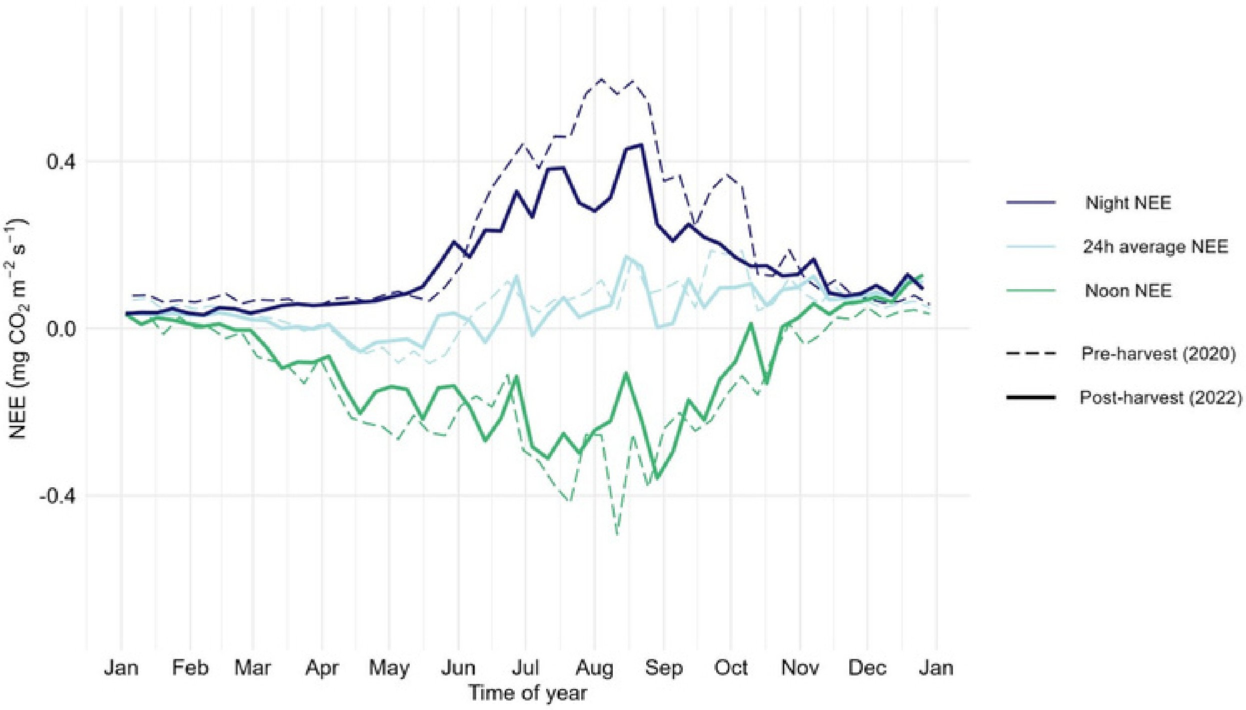


Figure 5. Daily averages of CO2 fluxes at noon (blue lines), during dark night hours (green lines), and daily averages (light blue) at Ränskälänkorpi during year 2020 before CCF-harvest treatment (dashed lines) and after harvesting in year 2022 (solid lines).

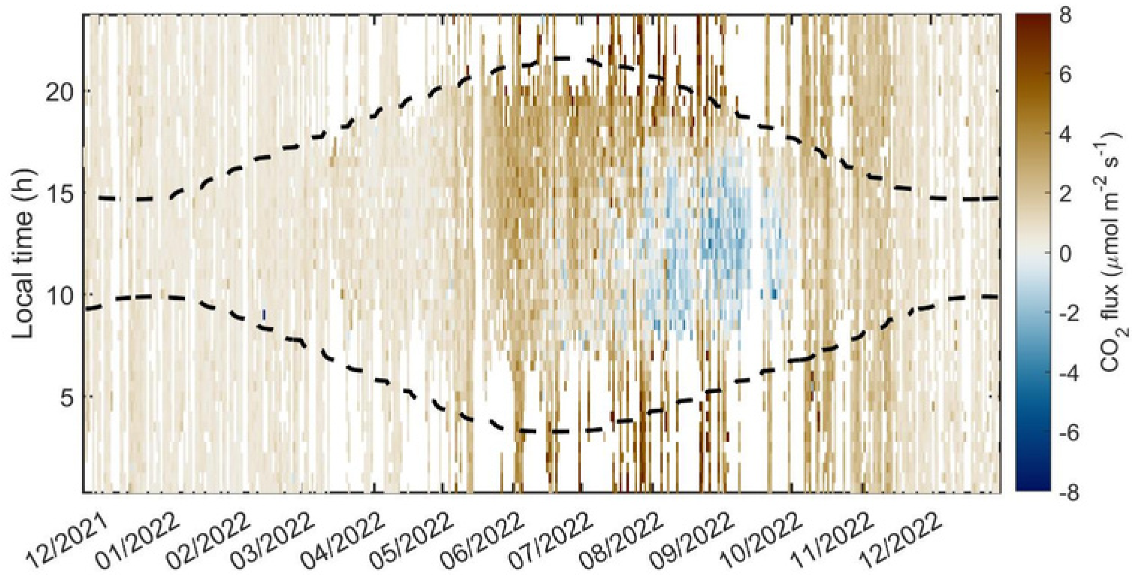


Figure 6. Greenhouse gas (for instance carbon dioxide, CO2) exchange between the Ränskälänkorpi clearcut and the atmosphere is continuously monitored with the eddy covariance instrumentation. During late summer, photosynthesizing clearcut vegetation turns the area to a weak sink of CO2 (blue area in the figure with negative fluxes), but in general the clearcut is a strong source of CO2 to the atmosphere (brown area, positive fluxes) due to decomposing organic matter. Black dashed lines denote sun rise and set and white areas show periods with missing observations.

Chamber measurements of soil GHG fluxes

Automated chambers for CO2, CH4 and N2O flux measurements: An automatic chamber measurement (cabin and automatic chambers) system was constructed and installed at the site in summer 2019. Forest floor gas exchange, including vegetation, soil, and tree roots, are monitored using six transparent polycarbonate soil chambers connected to an instrument cabin. Initially, all six chambers measure in the mature forest, but after harvesting, three of the chambers will measure the fluxes on Clearcut- area.

The first results of the CH4 and N2O emissions showed that all the sites remained net sink of methane and the sink did not change after CCF. However, clear cutting decreased the CH4-sink considerably (Figure 7.). For N2O, the emissions were highest on the fertile nitrogen-rich CCF site (Rhtkg, block 1) before and after harvesting, but the emissions at lower level during the first post-treatment year (Figure 8.). On other sites, which were poorer, the N2O emissions were marginal.

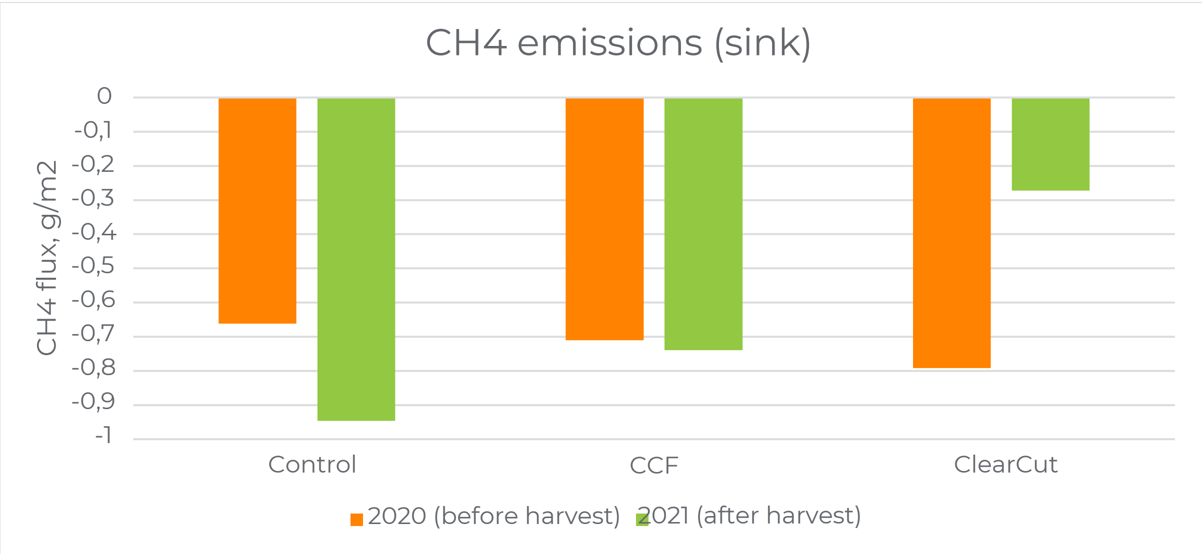


Figure 7. Mean annual methane (CH4) net emissions from soil by treatments before harvesting (2020) and after harvesting (2021) measured by chamber method. Negative values indicate the net sink of CH4.

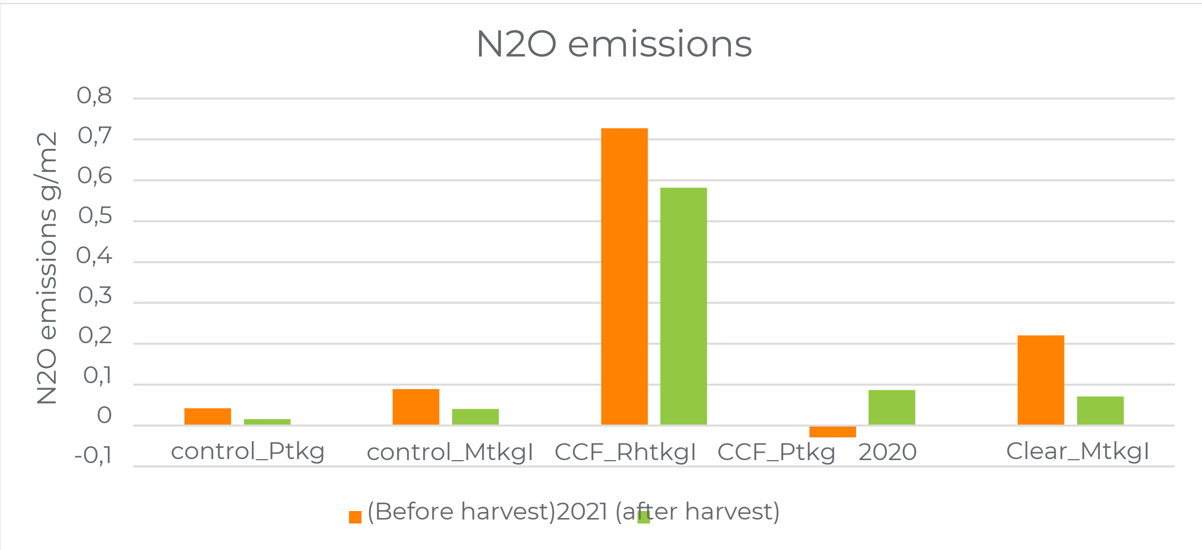


Figure 8. Mean annual nitrous oxide (N2O) net emissions from soil by treatments and site types (Rhtkg, Mtkg, Ptkg) before harvesting (2020) and after harvesting (2021) measured by chamber method. Negative values indicate the net sink of N2O.

Hydrological measurements

Water table level was monitored both manually and continuously by automatic data loggers. The manual measurements are done from the plastic tubes on each permanent point of manual GHG measurements (n=43) during the gas measurement campaigns. The automatic monitoring is carried out by Trafag-water pressure sensors and Odyssey Capacitance Water loggers. Together five different units of sensors were installed on the CCF-, non-harvested and clear-cut areas. Both logger types provide continuous water table data for modelling purposes.

The measured water table depths showed that the water tables were at very deep level before harvesting and they raised after harvestings. However, eventhough the water tables raised aftere harvesting, the they remained at deep level due to dry summer and effective drainage network.

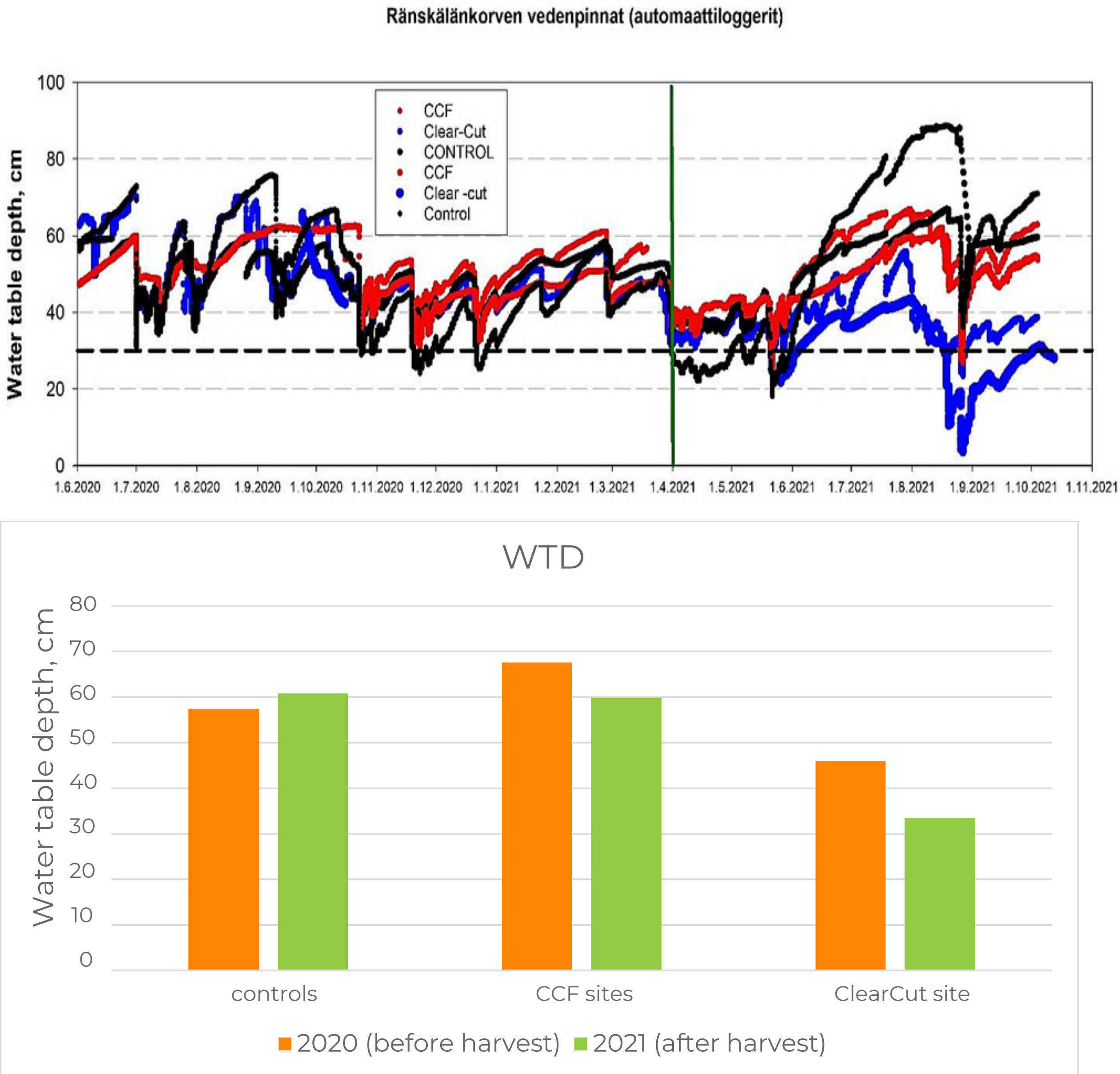


Figure 9ab. Water table levels in the harvested areas and non-managed control areas measured by automatic Odyssey Water Table loggers in 7.5.2020-1.10.2021 (upper figure). The dashed line indicates the minimum mean water table level sufficient for tree growth in late growing season and the green solid line depicts the date of the harvestings in spring 2021. Mean summertime water table depths by treatment before harvestings (2020) and after harvestings (2021) in figure b.

Sapflow and dendrometer measurements
Sapflow and dendrometer measurement devices were installed at the harvest and non-harvested block to monitor the transpiration and diameter variation of trees. Altogether, 24 trees are monitored, of which 16 are in harvest (9 spruces, 4 pines, 3 birches), and 8 spruces in the control. Sapflow is measured with a heat pulse velocity sap flow and stem water content sensor. 6. Other measurements

Other measurements
Understorey vegetation survey was conducted by visually assessing the projection coverage of field layer species (dwarf shrubs, herbs, graminoids and tree and shrub seedling sand saplings up to 0.5 m height) and that of moss species, litter on the ground as well as a proportion of the surface covered by a tree or trump-root system. **Pre-harvest inventory of the tree seedlings** was done from three small permanent circular seedling plots (4 m2) established within each of the permanent measurement plots in in the CCF- and control blocks (together 120 seedling plots). In order to get estimate about the seedling number i.e., the regeneration potential, and their technical quality, all seedlings (< 1,3 m height) within the plots were invented. The seedlings were invented in autumn 2020 and next inventory will be done in 2022. **Production of fine roots** is measured using ingrowth cores. The cores were filled with local peat sieved through a 2-mm soil sieve to remove existing roots. Altogether, 20 cores per location were installed in the areas that will be later CC- or CCF-areas to capture their before-treatment fine-root production levels. The cores will be recovered after 2-year incubation in the autumn of 2021. In addition, **above-ground litter production** is measured with conventional litter traps. **Peat samples** were collected in November 2020 from the permanent measurement plots (n=43), and they were pooled according to sub-blocks (1–6) for the analyses of physio-chemical peat properties.

More information:

Laurila, T., Aurela, M., Hatakka, J., Hotanen, J-P., Jauhiainen, J., Korkiakoski, M., Korpela, L., Koskinen, M., Laiho, R., Lehtonen, A., Leppä, K., Linkosalmi, M., Lohila, A., Minkkinen, Kari; Mäkelä, Timo; Mäkiranta, Päivi; Nieminen, Mika; Ojanen, Paavo; Peltoniemi, Mikko; Penttilä, T., Rainne, J., Rautakoski, H., Saarinen, M., Salovaara, P., Sarkkola, S., Mäkipää, R. 2021. Set-up and instrumentation of the greenhouse gas measurements on experimental sites of continuous cover forestry. Natural resources and bioeconomy studies 26/2021: 51 p. https://jukuri.luke.fi/handle/10024/547443

LUONNONVARAKESKUS
ILMATIETEEN LAITOS

LIFE-IP CANEMURE-FIN
LIFE17 IPC FI 002

LIFE17 IPC/FI/000002 LIFE-IP CANEMURE-FINLAND Projekti on saanut rahoitusta Euroopan unionin LIFE-ohjelmasta. Sisältö edustaa ainoastaan CANEMURE-projektin näkemyksiä ja CINEA / Komissio ei ole vastuussa projektin sisältämän informaation mahdollisesta käytöstä.

hiilineutraalisuomi.fi @hiilineutraali www.facebook.com/resurssiviisaus

hiilineutraalisuomi.fi
CANEMURE