

Second Carbon Pro Newsletter.

In this number of the Carbon Pro newsletter the field activities of project partners are described.

The aim of these activities is filling the gaps towards the definition of carbon balance through direct measurements in the selected target areas. All partners will collect data about the positive effects of forests and agricultural lands on climate change with the aim of valuating how they can contribute to reducing green house gases in the atmosphere. The objective is the creation of a common database for monitoring of the carbon stocking of trees and for collect data on CO₂ cycle. Above you can find a short description of each partner activities.

- **ITALY – AUTONOMOUS REGION OF FRIULI VENEZIA GIULIA**
- **ITALY – UNIVERSITY OF UDINE**
- **ITALY – VENETO REGION**
- **HUNGARY – HUNGARIAN METEOROLOGICAL SERVICE**
- **GERMANY – MUNICH TECHNICAL UNIVERSITY**
- **SLOVENIA – SLOVENIAN FORESTRY INSTITUTE**
- **CROATIA – FOREST RESEARCH INSTITUTE JASTREBARSKO**

ITALY – AUTONOMOUS REGION OF FRIULI VENEZIA GIULIA

The autonomous Region Friuli Venezia Giulia – forest management and fire fighting Department chose two kind of target areas to perform field measurements foreseen in Carbon Pro project:

- 1) fast growing artificial poplars (9 plots)
- 2) three natural forest reserves.

1) Measurements in Poplar plantations: in February 2007, technicians of the forest management and forest fire fighting department started measurements in a chronosequence of 3, 6, 9 years old poplar plantations located in cropland -plain area, about 20 Km south of Udine.

In each plot population density (trees/Ha), breast height diameters of 50 randomly chosen plants and high of 20 plants were measured.

Basal area and above ground biomass have been calculated and the data processed by the CO₂ fix model in order to obtain CO₂ sink capability.

Soil samples will be collected during next spring with collaboration of University of Udine, in order to know carbon sink capability of poplars' plantations soil compared to that of other crops.

2) Measurements in three natural forest reserves

In all forest reserves, during next spring (from April to July), data about species composition, breast height diameters (all trees with diameter above 7,5 cm), heights (150 plants), increments (500 plants), age of trees and dead wood will be collected and compared to inventories data already available.

The model to process data has not been chosen yet (perhaps CO₂ FIX).

The expected result is to know the carbon stock in natural reserve areas and simulate the carbon sink capability of unmanaged forest areas.



ITALY – UNIVERSITY OF UDINE

Concentrations of atmospheric CO₂ have been rising as a result of anthropogenic activities. Although a lot of emphasis is focused on decreasing emissions from fossil-fuel use, there is a recognition that the rate of emission can be mitigated by transferring CO₂ from the atmosphere to the biosphere.

The possible role of agriculture in the efforts to reduce atmospheric CO₂ in an interesting question. In this framework, techniques such as tillage and efficient use of fertilizers and irrigation have been proposed as ways to increase soil organic carbon (SOC) and decrease atmospheric CO₂.

The purpose of our experiment is to examine (i) the effect of land use change from a row crop (*Zea mays*; C4 plant) to a grassland (*Medicago sativa*; C3 plant) and (ii) the effect of two different management practices (tillage and no tillage) in both the systems (C3 and C4) on the carbon balance.

We are analyzing the effect of the land use change by making simultaneous, or paired, flux measurements (NEE) in each of the two system. Furthermore, we are analyzing the influence of different management practices on soil respiration, soil carbon input and soil carbon within intensive measurements plots (IMP). We selected two adjacent fields with the same soil types and similar cropping histories and subjected to the same synoptic weather conditions. The study area is located in Beano (Italy; 46°00' N 13°01' E). Both the field have been farmed conventionally with irrigated corn during the last decades in accordance with standard best management practices prescribed for production-scale maize system.

Our measurement started in fall 2006. The West field (G=grassland; 4.7 ha) will be a no-tilled grassland starting form February 2007, while the East field (C=cropland; 8.6 ha) will be conventional tilled maize. Within the West field, 12 small IMPs (4 treatments x 3 blocks), 10x10 m each, have been established for detailed process level studies on C dynamics, crop growth and biomass partitioning, soil respiration, belowground C deposition and crop residue decomposition.

The equipment used in the experiment is reported in table 1.

Tillage in the maize field was performed on 15/12/2006, tillage in the grassland was performed on 21/02/2006 followed by sowing.

In figure 1, the response of the maize plot to tillage quantified using soil respiration chambers is reported. The tillage increased carbon emission and at the end of the considered period (31/12/2006 – 31/01/2007), the total emission in the tilled plots was on average 393 kg C ha⁻¹ greater than in the no tilled plots. This emission correspond to a consumption of to about 760 litres/ha of diesel oil. This effect would have been increased if the emissions due to the use of the tractor had been taken into account.

EDDY COVARIANCE

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Description	Number	Sampling rate	Averaging
Young 81000V	1	20 hz	1/2 hour
Licor 7500 (CO ₂ , H ₂ O)	1	20 hz	1/2 hour
Soil temperature (0-10)	3	10 s	1/2 hour
Soil temperature (10-20)	3	10 s	1/2 hour
Soil temperature (20-30)	3	10 s	1/2 hour
TDR	3	10 s	1/2 hour
Soil heat flux	6	10 s	1/2 hour

METEO

2

Description	Number	Sampling rate	Averaging
Rain	1	10 s	1/2 hour
Wind speed	1	10 s	1/2 hour
Wind direction	1	10 s	1/2 hour
Incoming shortwave radiation	1	10 s	1/2 hour
Outcoming shortwave radiation	1	10 s	1/2 hour
Incoming longwave radiation	1	10 s	1/2 hour
Outcoming longwave radiation	1	10 s	1/2 hour
Incoming PPFD	1	10 s	1/2 hour
Outcoming PPFD	1	10 s	1/2 hour
Net radiation	1	10 s	1/2 hour
Air temperature	1	10 s	1/2 hour
Air humidity	1	10 s	1/2 hour
LAI	1	10 s	1/2 hour

SOIL RESPIRATION SYSTEM		3	
Description	Number	Sampling rate Averaging	
Number of chambers	12	2 h	
Soil temperature (0 cm)	12	10 s	1/2 hour
Soil temperature (3 cm)	12	10 s	1/2 hour
TDR	4	10 s	1/2 hour
CO ₂ and H ₂ O (during measurement)	1	1 s	10 s
Air pressure (during measurement)	1	1 s	10 s
Air humidity (during measurement)	1	1 s	10 s
Air temperature (during measurement)	1	1 s	10 s

Table 1 – Equipment at the Beano site

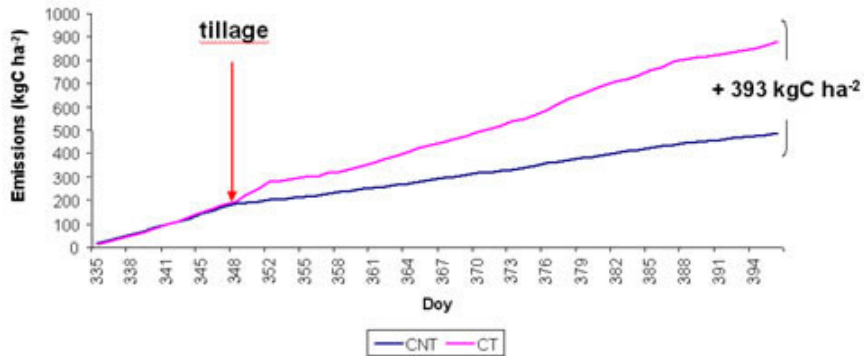


Figure 1 - Response of an agricultural system to tillage quantified using soil respiration chambers (CT = tilled plots, pink; CNT = no tilled plots, blue). The tillage was performed on 15/12/2006.

ITALY – VENETO REGION

Veneto Region has identified eleven Target Areas (TA) that include two different Vegetation Types (VT) and three Management Type with five Management Strategies (MS).



- VT1: Spruce and Fir forests -> TA 1-8
 - MT: Coniferous high forest
 - MS1: Business as usual (100% annual increment harvested)
 - MS2: Less forestry (50% annual increment harvested)
 - MS3: More forestry (> 150% annual increment harvested)
 - MS4: No forestry (< 10% annual increment harvested)
- VT2: Beech forests -> TA 9-11
 - MT: Beech high forest
 - MS5: Timber (timber production)
 - MS6: Transitory silvicultural system (ex-coppices)

- MT: Coppices
 - MS: Firewood (firewood production)

Aboveground tree biomass (using allometric equation based on WBE model): Veneto Region has foreseen to make in the Spruce and Fir forests (TA 1-8) and in the beech forests (TA 9 and 11) this kind of measurement during May – June:

- Relascope plots (1 plot/ha) to obtain complete Dbh distribution with size classes 1 cm
- Height measurement in order to obtain H-Dbh relationship
- Core sampling: mean annual increment, age and wood density

Target area 10: Beech Forest -> specific aboveground biomass analysis
The measurement have been made in Rubbio (municipality of Bassano del Grappa, VI), at 1075 m.s.l. The vegetation is a typical mountainous beech forest, ex coppices, recently assigned to the timber production and managed as high forest; the surface of the compartment is about 13.5 ha.
Veneto region had cut 41 trees with Dbh between 7 and 32 cm.
For all the trees cut we have measured:

- Diameter at 10-15 cm height
- Diameter at breast height
- Total length

Then we have divided the stem in different pieces in order to obtain the volume of each pieces; for all this pieces we have captured about 2% of the total volume. We have also captured 1-2 branch with different diameter (with leaves), for all the cut trees; altogether we have 50 branches.
Now we proceeding with laboratory analysis in order to determine:

- Volume, fresh weight and dry weight for each piece
- Fresh weight and dry weight of the wood and the leaves of all the branches

HUNGARY – HUNGARIAN METEOROLOGICAL SERVICE

Hungarian Meteorological Service, in co-operation with the Department of Meteorology, Eötvös Loránd University (Budapest), started a long-term monitoring program for the biosphere-atmosphere exchange of carbon dioxide in 1997. The base of the measurements is a TV-transmitter tower in a rural part of Western Hungary (Hegyhátsál, 46°57'N, 16°39'E, 248 m asl). The eddy covariance system is mounted at 82 m elevation above the ground on the tower. High elevation was chosen to monitor a typical ensemble of different ecological systems, rather than a single species. The footprint area of the tower is covered with agricultural fields with a few forest patches in a composition typical for the large part of the country. This monitoring system contributes to the Carbon-Pro efforts to estimate the carbon balance of the agricultural regions. The available data show high correlation between the carbon uptake and certain environmental factors (primarily temperature and precipitation).



Grasslands cover significant area of Eastern Europe. Though their agricultural significance is well recognized, their carbon budget is poorly known. Grasslands might have a great potential for carbon sequestering, but this potential is strongly depend on the management practice (e.g. grazing, tillage, no-tillage, hay production, etc.). The immediate vicinity of the Hegyhátsál tall tower monitoring site is covered by semi-natural grass which offers a good opportunity to study the question. In the framework of Carbon-Pro an eddy covariance system was installed at 3 m elevation above the grass field (see photo) in late 2006 which has been providing continuous net ecosystem carbon exchange data for the managed grassland.

In the photo: Eddy covariance system over the managed semi-natural grassland at Hegyhátsál (photo: Anikó Kern)

GERMANY – MUNICH TECHNICAL UNIVERSITY

TUM has selected three areas for intensive carbon measurement and evaluation:

- The Bavarian Alps representing mountain forest,
- the Swabian uplands with high productive forestry, and
- the warm-dry Spessart region covered by oak forest.

Within each region a network of research plots was established. The networks are used to measure the growth and yield of the different managed forest types to compare them in regard to their carbon mitigation potentials. Detailed analysis are undertaken on selected plots to improve the estimates of carbon pools in plant and soil. In example forest regeneration experiments are used to detect the influence of silvicultural management techniques on the carbon pools of soil, forest regeneration and ground vegetation during stand regeneration. The data are used to improve existing carbon balance models, which are applied for carbon balances on stand and higher spatial levels.



Influence of game on forest regeneration: Left side no regeneration (with game) – right side regeneration and consequently improved carbon mitigation (no game)

SLOVENIA – SLOVENIAN FORESTRY INSTITUTE



Slovenian Forestry Institute is performing the following field measurement:

CO₂ fluxes in beech stands
meteorological parameters
soil moisture measurements
for selected research object SFI field teams are performing above ground, below ground and tree structure inventories.

The measurements are performed on the permanent plots on Pohorje and Kocevski Rog area. Beside field measurements the upgrade of the project database is prepared. On the basis of project results we are expecting a better understanding of carbon cycle for the identified cross-border areas.

Photo: Open-path Eddy Covariance System (Campbell Scientific) at the SFI garden in Ljubljana – testing phase.

CROATIA – FOREST RESEARCH INSTITUTE JASTREBARSKO

The main target area, on which measurements will be held, is located south-west of Zagreb in Pokupski basin forest complex, near the town Jastrebarsko. Researchers from FRI selected two different 'forest types'. The first one is representative of typical continental lowland forest in Croatia – naturally regenerated commercial Common oak forest. The other one is Common oak plantation, actually a provenance trial of 1,5ha formed by planting oak seedlings on formerly agricultural land.

Planned activities:

Several forest compartments of different age forming a chronosequence will be selected. All compartments are within the same management type, naturally regenerated commercial Common oak forest. Width of every age class within the chronosequence is 20 years. Example of young (35-year old, age class II) Common oak forest is shown in Picture 1. Picture 2 shows old oak forest (age 135, age class VII) at the beginning of the regeneration process.

In order to determine the amount of carbon stored in forest, five 'carbon pools' will be sampled and estimated. Five pools are: soil; (fine) litter; coarse woody debris ($D = 3\text{cm}$); belowground woody biomass (fine and coarse roots); and aboveground woody biomass. Carbon pools will be sampled and measured according to standardized scientific methods for each compartment.

- In Common oak plantation measurements of carbon content in five pools will be carried out (see picture 3).
- Typical forest inventory on sample plots will be carried out to estimate the reliability of existing forest inventory data.
- 'Eddy covariance system' will be installed on the location in the young Common oak forest compartment for measuring carbon fluxes between forest and atmosphere (Picture 1).



Picture 1. Young Common oak forest (location of planned Eddy covariance system).



Picture 2. Old Common oak forest at the beginning of the regeneration with shelterwood method.



Picture 3. Twenty-years old Common oak provenance trial acting as an oak plantation.

Expected results:

- Estimate of carbon stocks in the main forest type (Common oak forests).
- Beginning of measurements of carbon fluxes with the aim of estimating forest management influence on carbon storage in Common oak forests.