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Proiect IDEI 111/5.10.2011 *"FOREST GHG MANAGEMENT"*
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1. Introduction. Scientific context

Although emissions of greenhouse gases (GHGs in eng. "GreenHouse Gases") have increased steadily over the past three decades, there are hopes that the land use sector (Land use and Land Use Change, LULUCF) may contribute to reducing these emissions through carbon sequestration in soils and bioenergy production (IPCC 2007, UNFCCC 2008). The terrestrial biosphere has absorbed 13% of emissions from burning fossil fuels generated by EU-25 in the last decade (Schulze et al. 2008) mainly through forests and meadows (pastures and meadows) acting as carbon traps.
The main elements that control GHG fluxes are numerous, both natural and human, but they interact in a complex manner. Their determination has become a priority for many researchers, as reflected by the numerous research programs devoted to this topic in the last decade, aimed at quantifying and understanding of GHG fluxes and factors that influence them. Meanwhile, the scientific community is being asked what forest management changes could be implemented to improve the balance and GHG mitigation effects, although many aspects of the GHG flows are still not well understood. Spatial and temporal variability of sources and sinks of GHGs in terrestrial ecosystems should be studied further. It is the purpose of the EU-funded project FP7 "GHG Europe" (www.ghg-europe.eu), which has the goal of determining how and to what extent can the carbon cycle GHG emissions in terrestrial ecosystems be managed. The underlying idea is to manage GHG fluxes through terrestrial ecosystems management.
With about 7 million hectares of forest, Romania has a rich potential for climate change mitigation through carbon sequestration. Romanian forests present special situations and features, such as the existence of many natural forests without strong anthropogenic influences and relatively important changes in land use - largely due to the restoration of forests by private owners in the past, and changing land agricultural. Changes in land use is a factor of great importance in terms of GHG emissions widely (Rounsevell et al. 2006, Smith et al. 2005). On the other hand, Romania's role in European studies has been recognized by including a team from the Institute of Forest Research and Management in the FP7 consortium GHG Europe, the working group WP3 "The impact of land management on regional balance of GHG selected regions rich in information, in Europe ". Its task is to establish a gradient of management in beech forests to study the impact on the budget management of GHG. This gradient covers a wide range of management methods, even aged trees from stands at relatively issued of many year and issued of many year, with soil conditions, growth and productivity whose variability is minimized. To this end, laboratory gas chromatography (being finalized) will enable to measure soil fluxes of the main gas CO_2, CH_4, and N_2O, sampled using respiration chambers.

2. Project goals and objectives

This project aims to extend the forest management gradient already existing (established during the FP-7 project) at relevant locations and conditions, specific to Romanian forests: reforested land or recently deforested and natural forests. The overall objective is to estimate the impact of forest management on GHG fluxes of forest ecosystems.
The project aims to create a complete gradient of management, including extreme situations quite rare and undocumented, and obtain data from experimental measurements of GHG fluxes and stocks. The gradient of GHG project management built in Europe is developed for beech, which is the main species in Romania in terms of growing stock, while widespread in Europe, thus having a great relevance both nationally and at European level. The gradient currently consists of 12 areas, representative of typical forest management, contrasting with frequency and intensity of silvicultural interventions executed over the life cycle stands.
But the current gradient lacks extreme conditions: first, natural or unmanaged stands, which constitute a reference without human influence; in this respect, Romania, with over 200,000 ha of natural forests is an appropriate place for such a study. In addition, there is a controversy in the scientific world about the secular forests and natural ability to function as carbon traps (Knohl et al. 2003 Luyssaert et al. 2008 Gleixner et al. 2009), many researchers considering these forests as rather neutral on carbon flux. The acquisition of experimental data of the project will allow further clarification of the status of natural forests in Europe and their behavior vis-à-vis GHG flows.

Phase's objectives (year)

The purpose of the current phase focused on the selection of the plots that will be the support of measurements of greenhouse gas fluxes, and their materialization, field identification and the training required to carry out measurements.

3. Results

3.1. Monitoring plots selection

The first activity of the project is to select the monitoring plots. Three major regions where distinguished (Fig. 1): the north-east (Bucovina), the centre (Mihăieşti) and the south-west (Masivul Semenic).

Selecting test plots is a crucial stage, because the plots will still determine the measurement results. Therefore, most attention was paid to these stages and discussions with renowned researchers in the field, from outside the country, are not finished. Were identified and selected a total of 10 test plots (tabelul 1):

(i) 4 plots in the southwestern region: 2 natural forests, 2 cultivated (managed) forests
(ii) 5 plots in the eastern region: 3 in natural spruce stands, 2 in a meadow
(iii) in the central region, one plot on clear-cut forest.

In the southern region, the experiment was set in a clear cut of 0.5 ha, illustration of the situation of land use change. The plot was placed in a beech stand, even aged, at an altitude of 55 m. For comparison, it is near to the plots used in the FP7, at a distance of approx. 200 m.

Tabelul 1. General characteristics of the stand location chosen for the experiment

Region	District	U.P.	u.a.	Sp. comp.	Stand structure	Canopy closure	Age	Forest type	Altitudine mean
SudVest	Nera	II	123 A	10 FA	uneven, natural	0.8	190	Natural, beech	1200
		III	22	10 FA	uneven, natural	0.8	170	Natural, beech	1250
	Văliug	I	68 A	8 FA 2 BR	uneven, managed	0.8	140	Natural, beech	1050
		I	68 B	10 FA	uneven, managed	0.5	130	Cultivated, beech	1250
		I	70 B	10 FA	uneven, managed	0.6	115	Cultivated, beech	1250
		I	71	10 FA	uneven, managed	0.8	70	Cultivated, beech	1100
NordEst	Pojorâta	-	-	MO	Meadow	0	10	-	1050
	Giumalău, rezervația	III	120A	10 MO	uneven, natural	0.8	180	Natural, spruce	1100
Sudică	Mihăiești		212F	7 Fa 3 DT	even, managed	0	0	Cultivated, beech	550

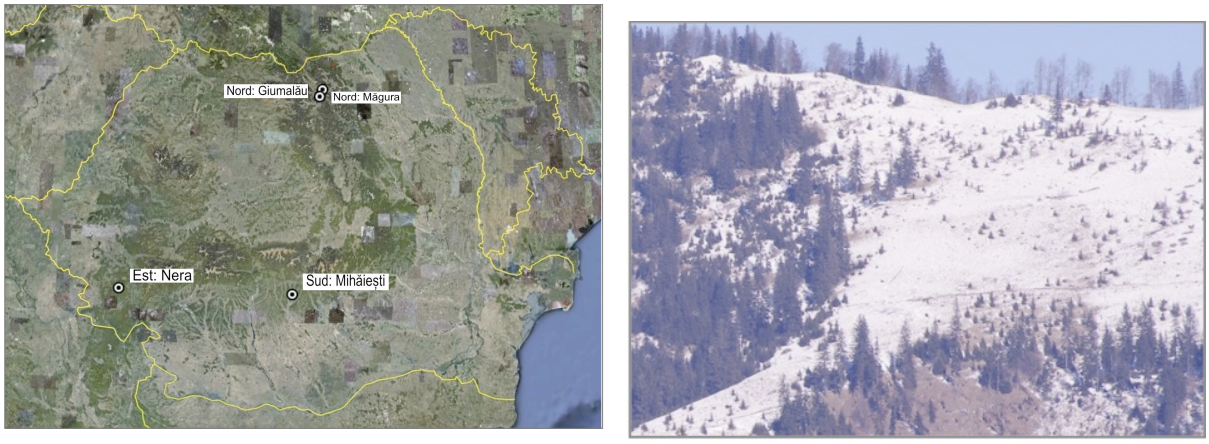

Fig 1. Left: location of the GHG monitoring plots in three main regions. Right: Magura peak pasture with afforestation (North-east)

In the South West locations were chosen for the experiment in two sites: in the natural forest, the forest Reserve "springs Nera" and in a cultivated managed stand with equivalent stationary conditions and as close to those of natural forest as possible (v. Fig. 1).

First were investigated in the field the beech stands of the Nera Reserve. The reserve "springs Nerei" has a large area - 5028 ha, and covers a large elevational gradient - from about 650 to about 1400 m. Because of this, the Reserve meet a wide variety of stationary conditions covering three altitude zones from the beech forests of the hill (pure) in the mountainous beech forests and then to

the high altitude beech forests (in Semenic Mountains, the upper altitudinal beech forest is by depriving floor and mixtures of conifers).

In these managed stands have been applied transformation cuts to change the management type from even-aged to uneven-aged or pluri-aged in the last 50 years. The district Văliug is emblematic of Romania, being one of the most important places where the transformation works occured, with an area of about 9000 ha. This treatment is as intensive as possible, while being closest to the natural laws of forest ecosystem functioning ("close-to-nature" forestry). Because of the conversion to uneven-aged treatment, many stands have acquired a structure close to that of the uneven stands.

In the Eastern region were established three plots in natural spruce forest massif, and two abandoned lands in Giumalău (Magura), where afforestation is very active.

Giumalău sample plot is approx. 10 km southwest of the Magura plot, and the Secular Forest Reserve is located in Giumalău, Forest Department Pojorâta. The reserve has a 1700 m elevation and an area of approx. 300 ha, of which 164 ha as strictly protected area, under strict protection status in 1943.
The plots installed on wooded pastures were chosen for the spatial representativeness of this phenomenon, which is occuring at large scale in Romania. The limit of the forest is determined by the grazing and by cutting the small trees (mainly spruce, birch or Alnus) that invade the abondonned pasture.

3.2. Echipment installation

Proper installation of the equipment had to be postponed due to weather conditions in the last 6 months. Severe drought resulted in a marked strengthening of the soil, which has become too hard for the respiration chamber fixed components to be installed, with the risk being to break them or to affect the tightness. Thus, we preferred a postponement, so that after the first rain or snow will melt, the conditions necessary to properly insert the rings will be met and all the chambers will be installed.

Fig. 2. Respiration chamber

4. Conclusions

Sampling location were selected, plots were materialized and the equipment started to be installed. From the start, we chose couples managed stands / natural, to highlight the impact of management on stocks and GHG fluxes, novelty even internationally. Further, it will complete the installation, when weather conditions permit. Once the installation action, it will start measuring / monitoring network established on GHG emissions, in assessing carbon stocks in forest areas and forest vegetation.