Specific Contract 4 (SC4) proposal

Feasibility and demonstration study of the potential use of National Forest Inventory data to estimate carbon stock changes in biomass in the European forests

1. Current role of European National Forest Inventories in greenhouse-gas emissions reporting under the LULUCF sector

Forest information is collected in almost all countries of Europe through National Forest Inventories (NFIs). This information is gathered through statistical sampling principles. Thus, only a small fraction of the land is inventoried, generally using sample plots on which many different measurements and assessments are made.

Although the NFIs are largely installed for other purposes than greenhouse-gas (GHG) emissions assessments, they do currently play a key role in the reporting under the Land Use, Land-Use Change and Forestry (LULUCF) sector which is an integral part of the reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP). In addition, it is worth to notice that in many European countries NFIs have been modified recently in order to provide more adapted information for GHG emissions reporting.

Good Practice Guidance (GPG) for LULUCF (IPCC, 2003) identifies five different pools within the forest ecosystem for which carbon stock changes must be reported: (1) aboveground biomass and (2) belowground biomass which are together defined as the living biomass pool, (3) dead wood and (4) litter which make up the dead organic matter pool, and (5) soil.

European NFIs mainly contribute to the GHG reporting by providing the fundamental data needed for the estimation of carbon stock changes covering not only living biomass, but increasingly also deadwood, litter and soil compartments, as it had been pointed out in the COST Action E43 (Cienciala *et al.,* 2008).

Two different methodologies are proposed in the GPG for LULUCF to estimate carbon changes in the living biomass pool, namely the stock change method (comparison of two stock estimates over a time period) and the default method (balance of biomass increment and total biomass removals, including mortality, over a time period).
Both methods are equally applied in European countries (Cienciala *et al.*, 2008), depending on the datasets available at national level. From a survey held in 2008 (MASCAREF Final Technical Report, in review) it appeared that almost half of the countries where the default method is applied use NFI data for both increment and removal estimates while NFI data are used in 83 % of the countries where the stock change method is carried out. Indeed, with the default method there is a need for reliable information about harvests and mortality and this is sometimes a challenge in NFIs. On the other hand, several interpolation and extrapolation issues are linked to the stock change method.

For the implementation of these two methods, the information collected by the European NFIs, such as tree data (dbh, circumference, tree height and species, growing stock, volume

increment and so on) and/or stand volumes, are converted into biomass, and subsequently carbon stocks, by applying a suitable set of biomass functions (BF) and/or biomass expansion factors (BEF).

For translating NFI data into carbon stocks or carbon stock changes, IPCC distinguishes three hierarchical tiers of methods that range from default data and simple equations (tier 1) to the use of country-specific data (tier 2) and models (tier 3) to accommodate national circumstances. These tiers, if properly implemented, successively reduce uncertainty and increase accuracy.
Tier 1 is the basic default estimation method using biomass expansion and conversion factors from the international literature, such as the JRC database, which now is a part of the Information System of the JRC Project GHG AFOLU:
http://afoludata.jrc.ec.europa.eu/index.php/public_area/home

2. SC4 description

The analysis of the most up-to-date state-of-the-art (MASCAREF final report, in review) reveals a large variability in the procedures implemented among the European countries for the estimation of the carbon changes in the living biomass, depending on the raw NFI data and the biomass functions/factors available.
Thus, the reporting at EU level requires a harmonisation effort as it was pointed out within the COST Action E43 and the MASCAREF project. Meeting this objective needs at first a status report on the assessment methodologies currently used in Europe.

In this feasibility study, we are only interested in the aboveground living biomass pool as a first step since NFI data are well suited for assessing this pool as explained above. Moreover, although dead wood is increasingly incorporated in NFIs, there are still substantial differences among European NFIs regarding the definition of this pool.

The main objective of the SC4 proposal is to show the potential use of NFI data to estimate carbon stock changes in aboveground biomass in the European forests. The proposed approach to meet this general objective is organised in three steps:

- First, the analysis, through a comparative study, of the estimation methods applied in four European countries located in different climatic regions;
- Then, the assessment of the variability in the estimates through a comparison of the results obtained (i) with the existing BF and BEFs at EU level (tier 1 method), and (ii) with the country specific factors (tier 2 and/or tier 3 method);
- At last, the inference of recommendations from the two previous tasks.

This feasibility and demonstration study on the role of NFIs in carbon change assessment for the living biomass pool is a necessary first step to determine the unavoidable NFI variables when estimating carbon changes in forest living biomass. It will then contribute to the development of the following tasks:

- EFDAC E-forest database enrichment with variables needed to estimate biomass, carbon stocks and carbon stock changes;
- Creating spatial representations of the European forest biomass status, carbon stocks and carbon stock changes in forests in the same way as the tree species richness mapping undertaken in the SC3;

- Harmonisation of the existing national systems to better meet the requirements of international monitoring and reporting of GHG emissions. The results raised in WG1 and WG2 of the COST Action E43 can be used for this task, in particular the definitions of above- and below-ground biomass, for which several harmonisation issues were pointed out by the MASCAREF project;
- Creating new robust Biomass Functions (BF) and Biomass Expansion Factors (BEF) to be applied on countries which don't have any. The new BF and BEF created could also be applied at the European scale and thus contribute to enrich the JRC Project GHG AFOLU database;
- Developing higher-tier methods for carbon stock change in biomass if the new BF and BEF created are better adapted to GHG emissions reports;
- Providing appropriate support for countries for which NFIs have been established only recently (or are currently being developed) or providing support for countries which currently don't estimate forest biomass through NFI data;
- Carrying out studies related to other biomass pools, such as dead wood, once the feasibility and demonstration study for living biomass will be achieved.

3. Study location

The case studies will be elaborated and/or applied in selected regions of Europe under different climatic regions since the biomass estimation depends mainly on the local conditions (regions) and on the tree species. The larger our sample, the more accurate the results. A proposition to have a wide and diversified condition range could be:

- France as a leading country with various climatic conditions.
- one Scandinavian country: Finland, Sweden or Norway;
- one Mountainous country: Austria??
- one Mediterranean country or country under oceanic influence: Spain??.

This point has to be discussed among the EFDAC E-forest members.

4. Expected results

Such a study is one more step forward to meet the requirements described in the section 2 above. The most global and important result is certainly the enhancement of the quality of GHG reporting for LULUCF sector.

In this point, the SC4 proposal meets some of the recommendations raised in the final report of the MASCAREF project. On this basis, the specific objective of SC4 is to go further by developing a feasibility and demonstration study on the role of NFIs in carbon changes assessment for the aboveground biomass pool. This is a necessary first step to determine the unavoidable NFI variables when estimating carbon changes in forest living biomass. A further study could focus on the assessment of the belowground biomass which is usually estimated with high uncertainty.By pointing out the potential use of NFI data to estimate carbon stock changes in biomass in the European forests, this project gives an essential status report to carry out further biomass studies under the EFDAC E-forest platform.

But, this study goes much further in determining both raw and calculated NFI data to be provided to calculate carbon stocks and carbon stock changes in biomass at plot level, in order for instance to produce a spatial representation of the carbon sink in the above-ground living biomass of European forests.

Moreover the results of this project could also benefit to other burning issues since biomass estimation is also a step towards the assessment of the amount of fuel wood that could be used as a renewable energy in Europe.

5. Work Plan

Work progress could be monitored according to the working plan suggested in Table 1.

Table 1. Provisional Specific Contract milestones

Milestone	Description	Partner	Month
M0	Contract notification		T_0
M1	Case studies in 4 European countries	4 consortium members	$T_0 + 3$
M2	Comparative analysis of results	All (Short team)[1]	$T_0 + 4$
M3	Recommendations	All (Short team)[1]	$T_0 + 6$

[1] The short team has to be defined among the EFDAC E-forest members.

Considering the proposed services described above the SC4 involved costs could be around 80,000 €.

6. References

Cienciala, E., Tomppo, E., Snorrason, A., Broadmeadow, M., Colin, A., Dunger, K., Exnerova, Z., Lasserre, B., Petersson, H., Priwitzer, T., Sanchez, G. & Ståhl, G. 2008. Preparing emission reporting from forests: use of National Forest Inventories in European countries. Silva Fennica 42(1): 73–88.

IPCC 2003. Good Practice Guidance for Land Use, land-Use Change and Forestry. Penman, J., Gytarsky, M., Hiraishi, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F. (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/IGES, Hayama, Japan.

MASCAREF Final Technical Report - Study under EEC 2152/2003 Forest Focus regulation on developing harmonized methods for assessing carbon sequestration in European forests. In Review.