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JRC CONFERENCE AND WORKSHOP REPORT

JRC LULUCF Virtual Workshop 2021

LULUCF in transition: present and future challenges for reporting and accounting
7-8 June 2021

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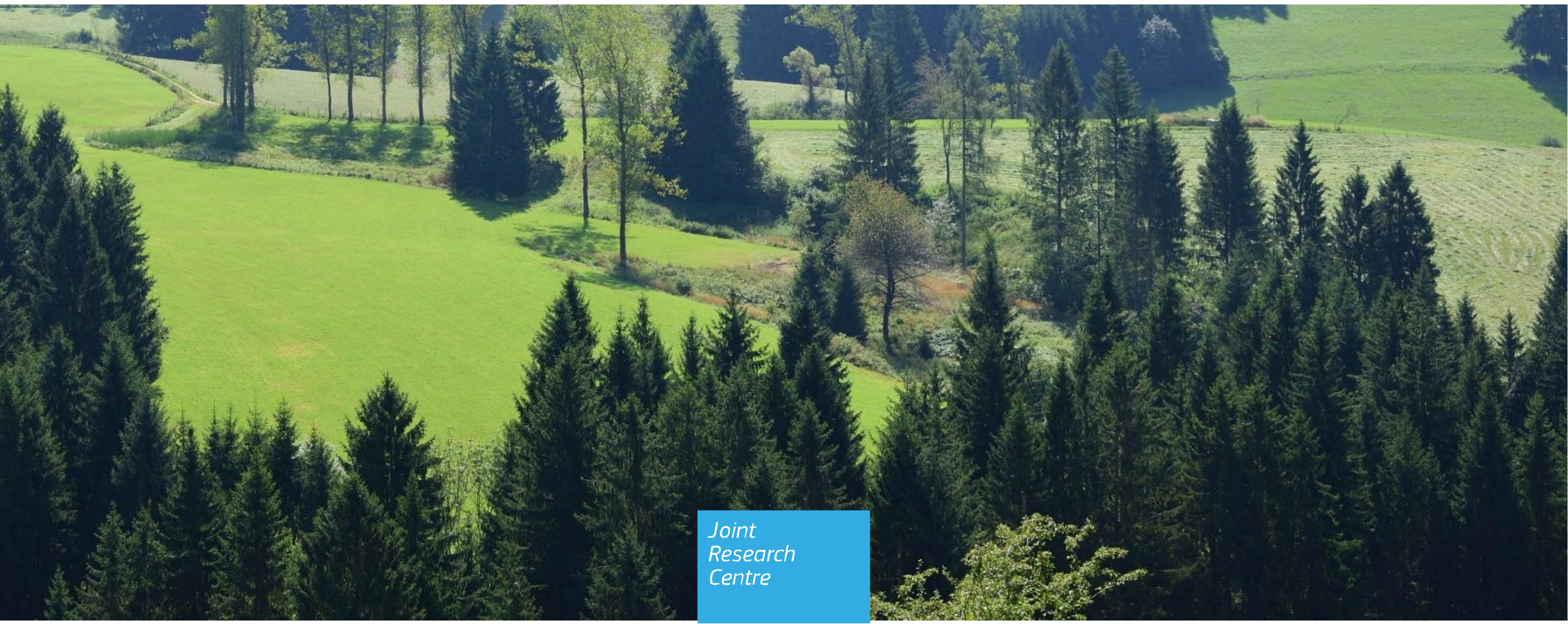

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Foreword

The EU is at the forefront in fighting climate change. Following the commitments relevant for the Paris Agreement, the EU has recently pledged to cut off 55% of greenhouse gas (GHG) emissions by 2030 compared to 1990 and to reach climate neutrality in 2050[1]. Currently, the Land Use, Land-use Change and Forestry (LULUCF) sector counterbalances about 8% of total GHG emissions from other sectors in EU[2]. Sectors like energy and transport are expected to significantly contribute to the emission reduction effort, but now the LULUCF sector also plays an increasing relevant role. However, to ensure the whole credibility of the LULUCF sector and enhance its mitigation potential, the EU and its Member States need to tackle several challenges related to transparency, robustness and comparability of both reporting and accounting of GHG emissions. Moreover, the current revision of the EU climate-related policies will also put the reporting and accounting of GHG emissions in this sector for the EU, as well as its alignment with international commitments for mitigation, under focus.

To address these challenges, the Joint Research Centre's organized the annual workshop on the topic of Land use, Land-use Change and Forestry (LULUCF) with the title *LULUCF in transition: present and future challenges for reporting and accounting.* The workshop was carried out in cooperation with Technopolis Group on the 7th and 8th of June 2021.

The aim of the workshop was to gather relevant experts and representatives from Member States (MS) to discuss the main challenges related to the reporting and accounting of the LULUCF sector, in compliance with current principles and requirements of the EU climate policy. The workshop had both a technical and scientific dimension, and it involved DG CLIMA, EEA, representatives from Member States and other countries outside the EU, together with scientists and researchers. In total, 128 participants registered to the event and a total of 115 participants joined the workshop including 19 speakers from around the EU who contributed with presentations on different LULUCF related topics.

The workshop was structured into three thematic sessions. Session 1 covered the present challenges for LULUCF reporting and accounting. In particular, this session provided an overview of the most recent LULUCF inventory at EU level, including preliminary outcomes of the QAQC process, and highlighted the main aspects related to closing the second commitment period of the Kyoto Protocol, with a specific focus on the Forest Management Reference Level and the need for technical corrections. Session 2 covered the future challenges for LULUCF reporting and accounting. This session outlined some crucial steps in the future development of GHG inventories and provided a room for discussing the main challenges to ensuring compliance with the LULUCF Regulation by 2030. Session 3 focused on the contribution from science to the reporting of LULUCF. This session covered topics such as (but not limited to) holistic management of soils, role of Earth Observation in the reporting of LULUCF, the accounting of emissions from natural disturbances, and synergies between the Common Agricultural Policy and LULUCF inventories. All sessions were followed by specific interactive polls to stimulate feedbacks from participants on the topics treated. At the end of each session, time was allocated to deepen the discussion.

In this report we summarise the main outcomes of the workshop through a synthesis of the presentations and of the discussions held during the two days virtual meeting. The agenda and the participant list are in the annexes. Full presentations can be found here: https://forest.jrc.ec.europa.eu/en/activities/lulucf/workshops/.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0550

[2] https://unfccc.int/documents/275968

Acknowledgements

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The authors thank Luisa Marelli, Alessia Maghella, Rositsa Obretenova and Annalisa Rossi from the JRC Unit D.1 (Bio-economy) for their valuable support in the organisation of the workshop.

Our sincere gratitude goes to all the speakers for their valuable input and revision of the contents of this report. Special thanks go to the moderators of the Interactive polls during the workshop.

Disclaimer

The authors and editors of this report made their best in ensuring a rigorous noting of all points raised during the discussion sessions also based on the transcription of the chat log. However, the authors and editors note that the contents of this report might not fully reflect the whole discussion as held during the event.

1 Introduction

The workshop was opened by **Ms. Luisa Marelli**, acting Head of Unit of the Bio-Economy Unit at the Joint Research Centre (JRC) of the European Commission (EC), who welcomed the participants and introduced the event.

First, Ms. Marelli presented the mission of the JRC as a science and knowledge service of the EC, supporting EU policies with independent evidence throughout the whole policy cycle. The JRC works for more than twenty EC policy departments and is localized in several sites in Europe. Its Bio-Economy Unit is located at the Ispra site, in Italy. Other sites are in Spain, Belgium, Germany, and the Netherlands. The JRC is composed of more than 3 000 people and provides more than 1 400 publications per year.

Further, Ms. Marelli introduced the six Units of Directorate D working with Sustainable Resources. The Units focus on integrating policy analysis for cross-cutting political priorities within a range of topics: circular economy; agriculture and Farm-to-Fork; climate action; zero pollution, e.g. plastics; biodiversity and ecosystems; blue economy; bioeconomy; fisheries; Africa & international partners; trade; Agenda 2030; and Earth Observation - UPTAKE across EU policies. They are also engaged in different initiatives, like the Knowledge Centre for Bioeconomy, the EU Observatory on Deforestation and Forest Degradation or the greenhouse gases inventories like LULUCF.

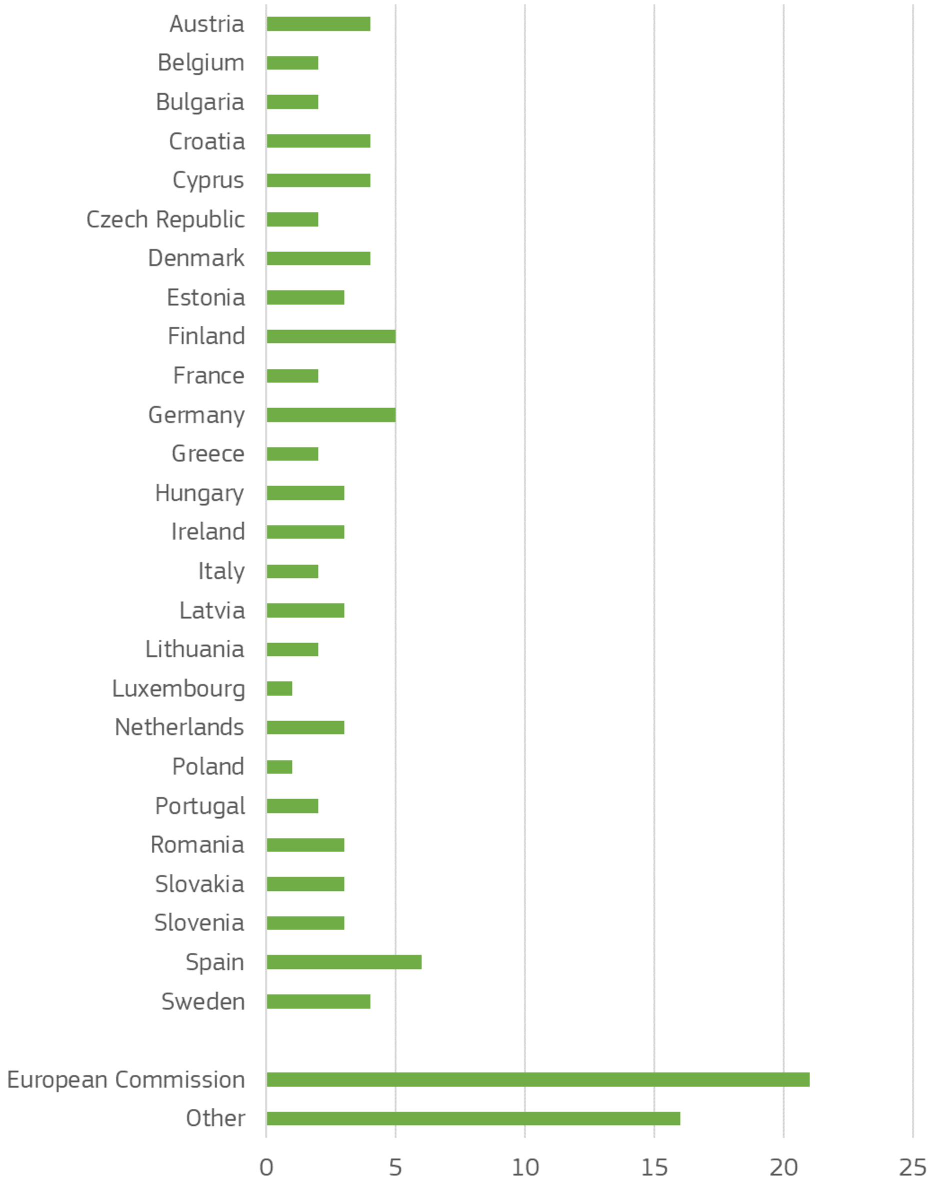
Following Ms. Marelli's introduction**, Mr. Giacomo Grassi**, Scientific Officer and Project Leader at the JRC, presented the current state of LULUCF in the EU climate targets and remarked that the progressive inclusion of LULUCF in the climate targets follows the increasing confidence on its numbers. The LULUCF sector is expected to compensate most of the remaining greenhouse gas emissions by 2050, which pose a challenge for all involved stakeholders, as well as an opportunity for the sector to contribute to climate neutrality.

Effective mitigation options in the forest sector include increasing the net carbon accumulation in existing forests and in new forest area, increasing the carbon stock in wood products, and further valorizing the substitution effects of wood in building and other products. Adequate monitoring of efforts towards reaching mitigation targets requires an integrated monitoring system (combining ground inventory and remote sensing data) and economic investments on cost-effective climate smart forestry practices. Additional challenges may originate at local scale if additional benefits from forests are to be ensured, such as for example, biodiversity conservation.

2 Participants

At the beginning of each of the two days, we mapped out, with the help of a poll, the number and role of the participants. Of a total of 128 registrations, 115 people actually attended the workshop representing the stakeholder categories of EU institutions, governmental bodies, research institutions/community, and other entities. The participants represented 32 different countries and the European Commission. Except for the European Commission (21 participants), all MS but Malta were represented with 78 participants in total. Other institutions and organizations were represented with a total of 16 participants. This is illustrated in Figure 1 below.

Figure 1 Overview of participants by country of institution



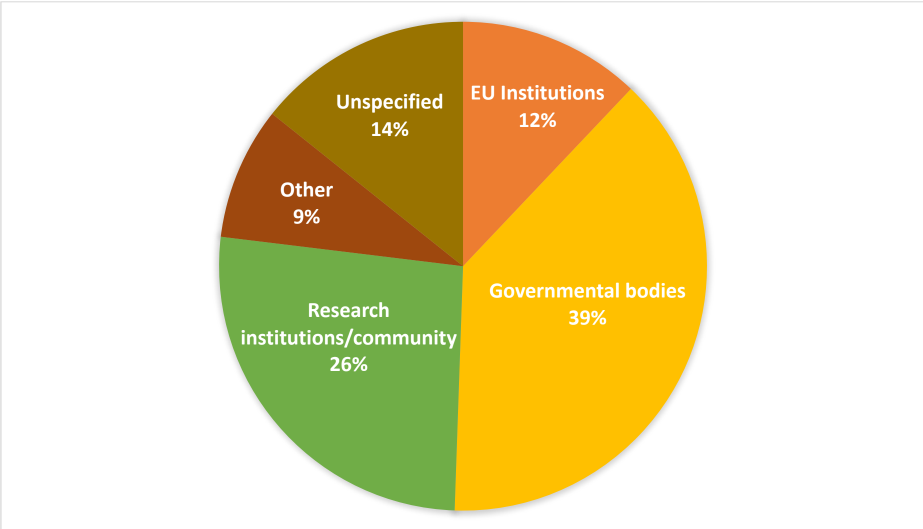
An interactive live polling software[3] was used to gather participants' views on several questions. The first group of four questions asked the participants to indicate their stakeholder category, the type of institution/organisation represented, the country of their organisation, and their role in the LULUCF inventory compilation.

Regarding the **stakeholder category,** on the first day, 91 participants responded to the poll. Stakeholders from the governmental bodies were the most represented (39%), followed by research institutions/community

[3] Mentimeter: https://www.mentimeter.com/

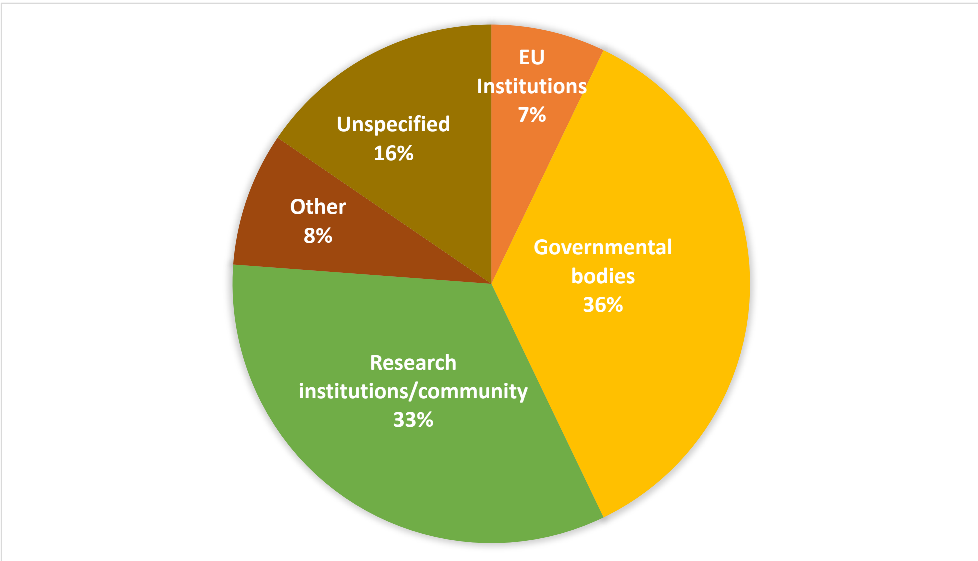
(26%) and EU institutions (12%), as illustrated by Figure 2 below. Furthermore, stakeholders who chose Other (9%) did not find themselves within the three options of type of institutions, while the unspecific category relates to the stakeholders that did not specify in the survey the type of category of belonging (14%).

Figure 2 Stakeholder category – Day 1



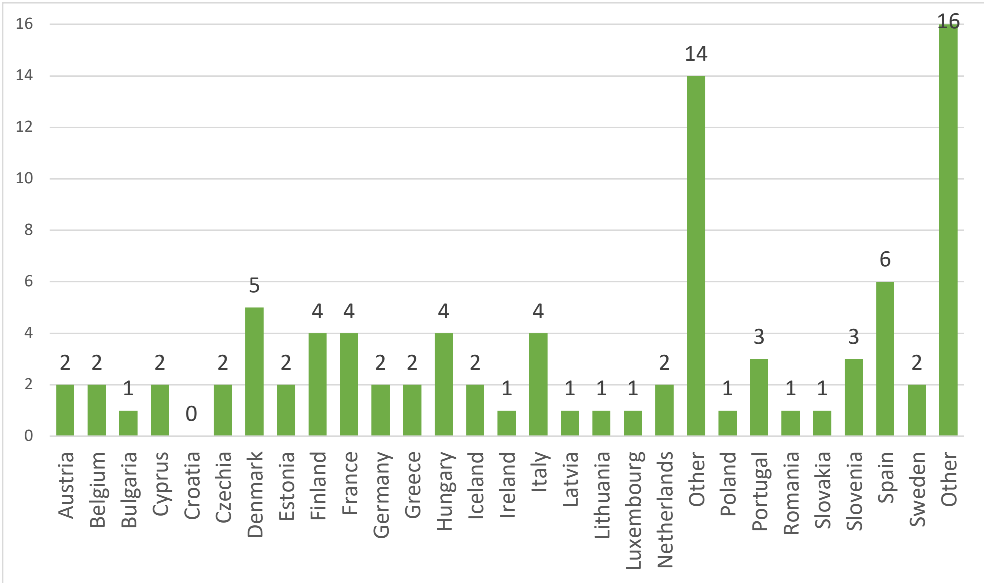
On the second day, 84 participants indicated their stakeholder category. Participants from the governmental bodies (36%) and Research institutions/community (33%) were the most represented, followed by Other (8%) and the EU institutions (7%) as illustrated in Figure 3.

Figure 3 Stakeholder category - Day 2



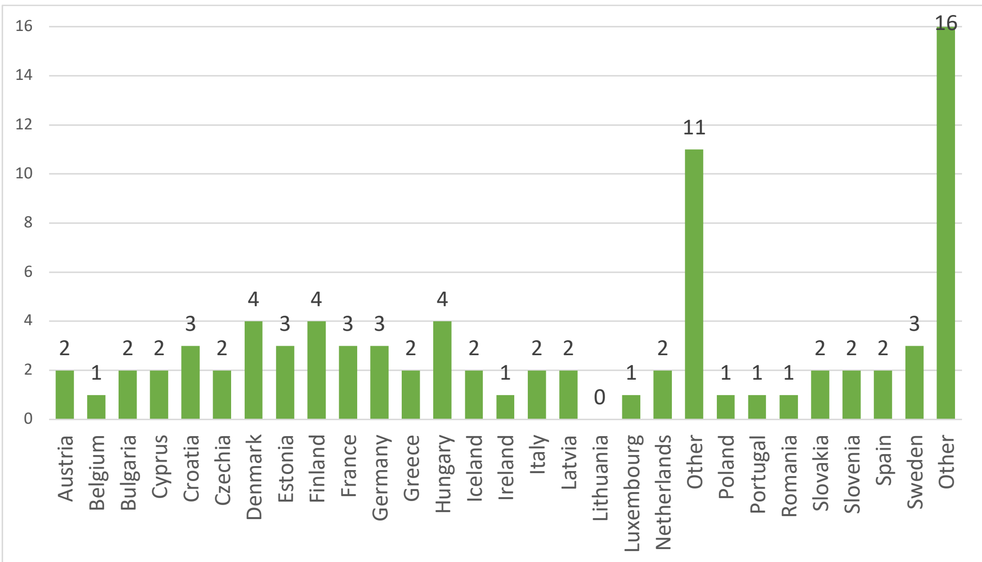
The second filter asked participants to indicate their **country.** On the first day, 91 participants indicated their country. Of the EU MS, Spain (6) and Denmark (5) are the most represented, followed by Finland (4), France (4), Hungary (4), and Italy (4) with equal representation. There is also a high representation of participants that have not indicated their country (16) and that responded the option Other (14). The makeup of responses is illustrated in Figure 4.

Figure 4 Participants by country - Day 1



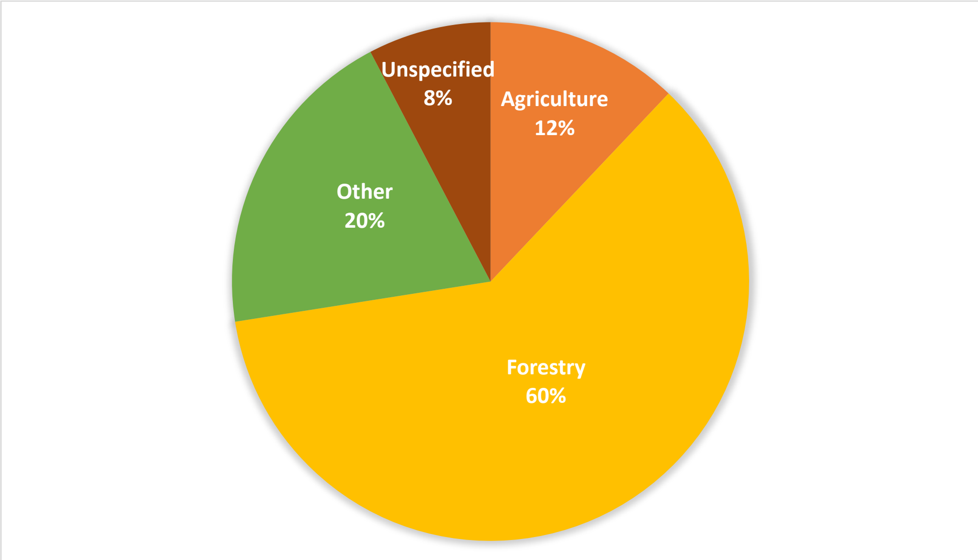
On the second day, 91 participants indicated their countries. Of the EU MS, Denmark (4), Finland (4), and Hungary (4) were most represented, followed by Croatia (3), Estonia (3), France (3), Germany (3), and Sweden (3). There is also a high representation of participants that did not specify their country (16) and stakeholders that chose Other as an option (11) (see Figure 5).

Figure 5 Participants by country - Day 2



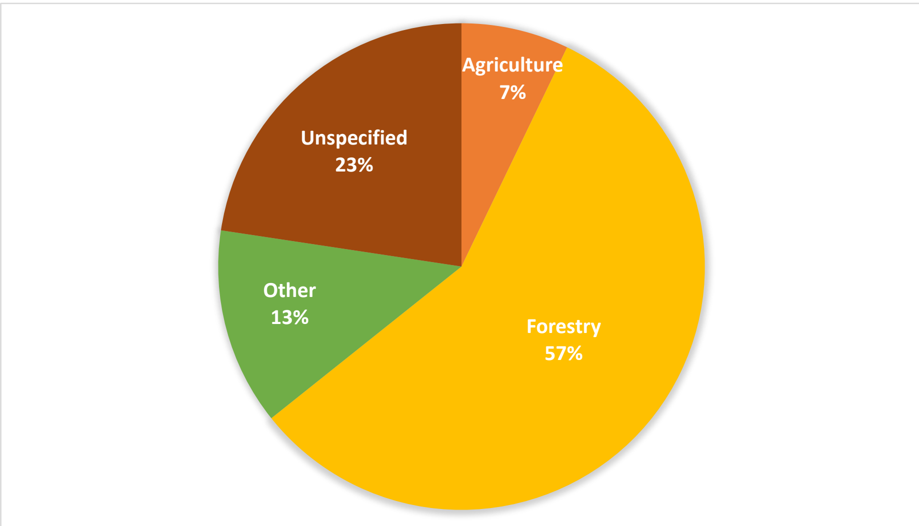
Further, the stakeholders were asked to indicate their **field of expertise**. 91 participants were present on the first day, although a few did not respond to the question (8%). Most represented is the expertise related to Forestry (60%), followed by the option Other (20%), and lastly Agriculture (12%), which is illustrated in Figure 6.

Figure 6 Field of expertise - Day 1



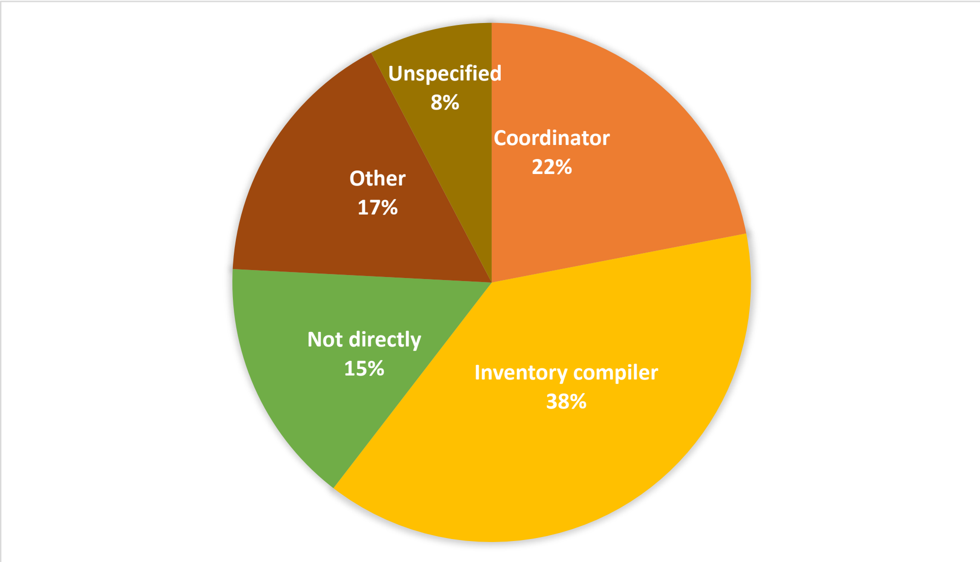
On the second day, 84 participants answered the poll in relation to the filter on their field of expertise. Similar to the first day, the Forestry sector is the most represented by 57% of the participants, followed by 23% that did not indicate their field of expertise, the option of Other (13%), and lastly, Agriculture (7%). Figure 7 below shows the makeup of responses from the participants.

Figure 7 Field of expertise - Day 2



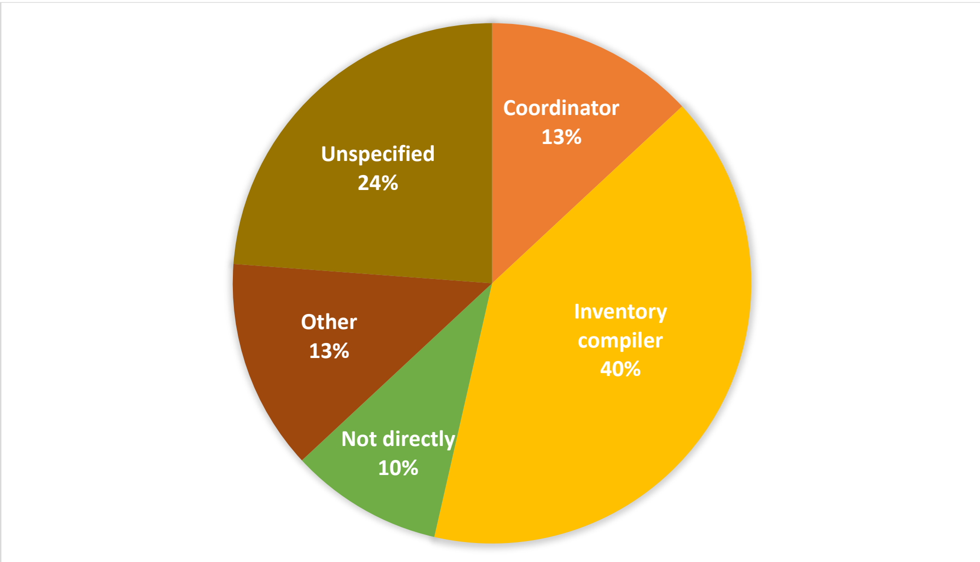
The participants were also asked to indicate their **role in the inventory compilation of LULUCF**. On the first day, 91 respondents participated. As illustrated by Figure 8 below, most represented was the Inventory compiler (38%), followed by the Coordinator (22%), and the Other option (17%). Some participants also responded that they did not directly have a role in the LULUCF inventory compilation (15%), and the rest are unspecified and as such, did not respond to the question (8%).

Figure 8 Stakeholders' role in LULUCF inventory - Day 1



On the second day, 84 stakeholders participated. Similar to the first day, the Inventory compiler role (40%) was the most represented, followed by an equal representation of the Coordinator (13%) and Other (13%). Only a few stakeholders (10%) indicated that they do not have a direct role in the LULUCF inventory. Additionally, almost one fourth (24%) of the stakeholders did not indicate any option and are thus presented under the category “Unspecified”, which is illustrated in Figure 9.

Figure 9 Stakeholders' role in LULUCF inventory - Day 2



3 Day 1: Present challenges for LULUCF reporting and accounting

3.1 Overview of LULUCF inventory at EU level

The overview of the LULUCF inventory at the EU level was presented by **Mr. Giacomo Grassi** and by **Mr. Raul Abad Viñas,** both from the JRC.

Mr. Grassi opened the presentation by stating that in 2019 the LULUCF sector for the countries of the EU, UK and Iceland a net sink of -234 Mt CO_2eq was reported, with an increase of 5% compared to 1990. When looking at the land use area trends since 1990, forest land, settlements and wetlands are the only land use categories that have increased by 5%, 26%, and 2%, respectively. Overall, the total area reported for all land use categories is ca. 459.000 kha.

Further, Mr. Abad Viñas presented the main hotspots in the LULUCF sector:

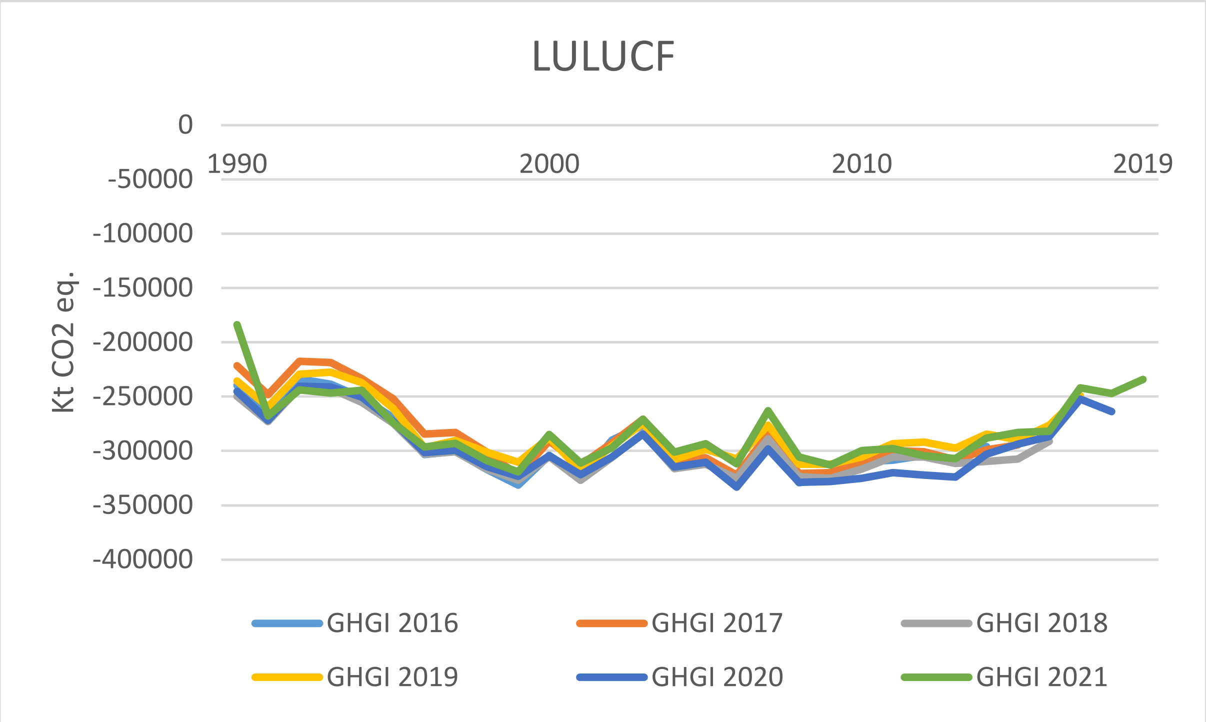
- Land use change represents 9% of the EU area, accounting for more than 28% of total absolute emissions and removals
- The area of organic soils presents in forest land, cropland and grassland represents 5% of EU area, and their emissions account for 37% of net total LULUCF removals
- Emissions from biomass burning, although with large inter-annual variability, reach between 2-15 Mt CO_2 eq/yr.

The completeness of the EU LULUCF inventory differs among the land use categories and carbon pools. For some categories such as Forest Land and specifically for the living biomass pool, there is a higher reporting share than for other land use categories.

Efforts implemented by MS to increase the Transparency, Accuracy, Completeness, Comparability, and Consistency (TACCC) have resulted in yearly recalculations made by the EU MS, as observed in Figure 10 below.

Mr. Abad Viñas remarked that for an inventory to be consistent, the same methodologies and consistent data sets should be used to estimate emissions or removals from sources or sinks across the time series.

Figure 10 Recalculations of the EU LULUCF sector: GHG inventories 2016-2021



Moreover, Mr. Abad Viñas presented the provisional accounting quantities (Mt CO_2eq) reported under the Kyoto Protocol (KP). He stressed that the real accounting of the KP activities will take place in 2022 with the submission of the last inventory under the second commitment period (CP2) of the Kyoto Protocol.

Moreover, he showed information related with the natural disturbance provision, which allows countries to exclude emissions resulting from natural disturbances under Afforestation, Reforestation, and Forest Management, if elected at the beginning of the CP2 of the KP and under certain conditions.

Regarding natural disturbances, he added that:

- 13 MS, the UK, and Iceland have stated the intention to exclude emissions resulting from Natural disturbances affecting Afforestation and Reforestation during CP2
- 18 MS, the UK and Iceland have stated the intention to exclude emissions resulting from Natural disturbances affecting Forest Management during CP2

He also clarified that the emissions from natural disturbances have not yet been excluded for the following reasons:

- They did not exceed the below ground level (BGL) + margin
- The areas were subject to salvage logging
- Or the requirements for excluding emissions from natural disturbances were not fulfilled

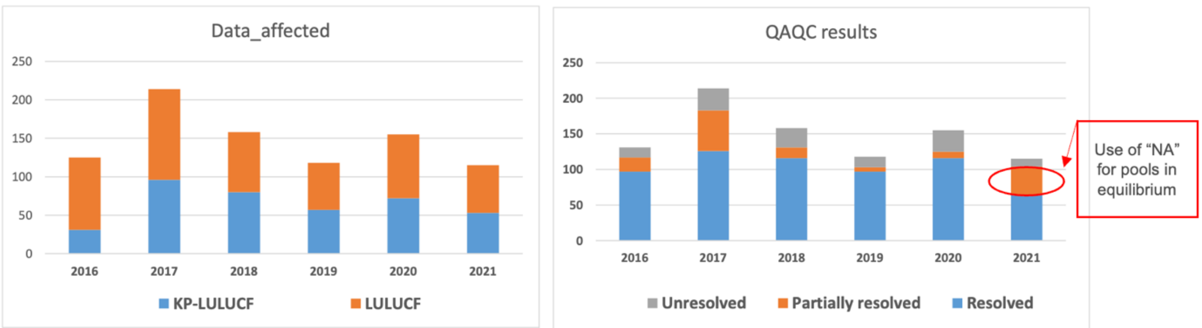
3.2 Results of 2021 QAQC checks and 2020 draft UN ARR of the EU GHGI for LULUCF

The results of the 2021 Quality Assurance Quality Control (QAQC) checks and the 2020 draft United Nations annual review report (UN ARR) of the EU Greenhouse Gas Inventory (GHGI) for LULUCF was presented by **Mr Raul Abad Viñas** from the JRC.

The EU QAQC plan describes the quality control procedures that take place before the EU inventory compilation and aim to check the consistency, completeness and correctness of the data reported by the MS. The EU GHGI is the direct aggregation of the GHGI data reported by MS, the UK and Iceland, and as such, issues included in individual inventories are also reflected within the EU GHGI.

Among others the QAQC checks aim to identify outliers in the trends of the activity data and emissions for the time series, ensure the consistency of the information included in the inventories as well as the reasons for the recalculations of activity data and emissions. Additionally, Mr. Abad Viñas presented unresolved issues of QAQC checks from previous years and UN Expert Review Team's (ERT) recommendations. Of about hundred and fifty identified issues per year, a hundred are annually resolved before the submission of the inventory to the United Nations Framework Convention on Climate Change (UNFCCC) (see Figure 11). The result is a steady increase in the quality following the TACCC principles for the LULUCF inventories which is undoubtedly also driven by MS' efforts.

Figure 11 QAQC checks for LULUCF & KP-LULUCF



Further, Mr. Abad Viñas concluded by remarking that UN reviewers recommend using the notation key "NA" to report carbon stock changes from carbon pools where carbon stock changes are neutral (see Figure 11). He also emphasised the importance of the collaboration during the QAQC checks and how some identified issues, if not timely resolved, end up in the EU GHG inventory affecting both MS and EU data.

Lastly, Mr. Abad Viñas also responded to questions from the audience. The first question inquired about the neutrality of carbon stock changes with normal statistical testing. Mr. Abad Viñas responded that there are several proven examples that the assumption of equilibrium should be better justified. A comment from a participant highlighted that the assumption of equilibrium does not mean that the annual estimate is not significant, but rather that, over time, the change is not significant and therefore the pool can be assumed in equilibrium.

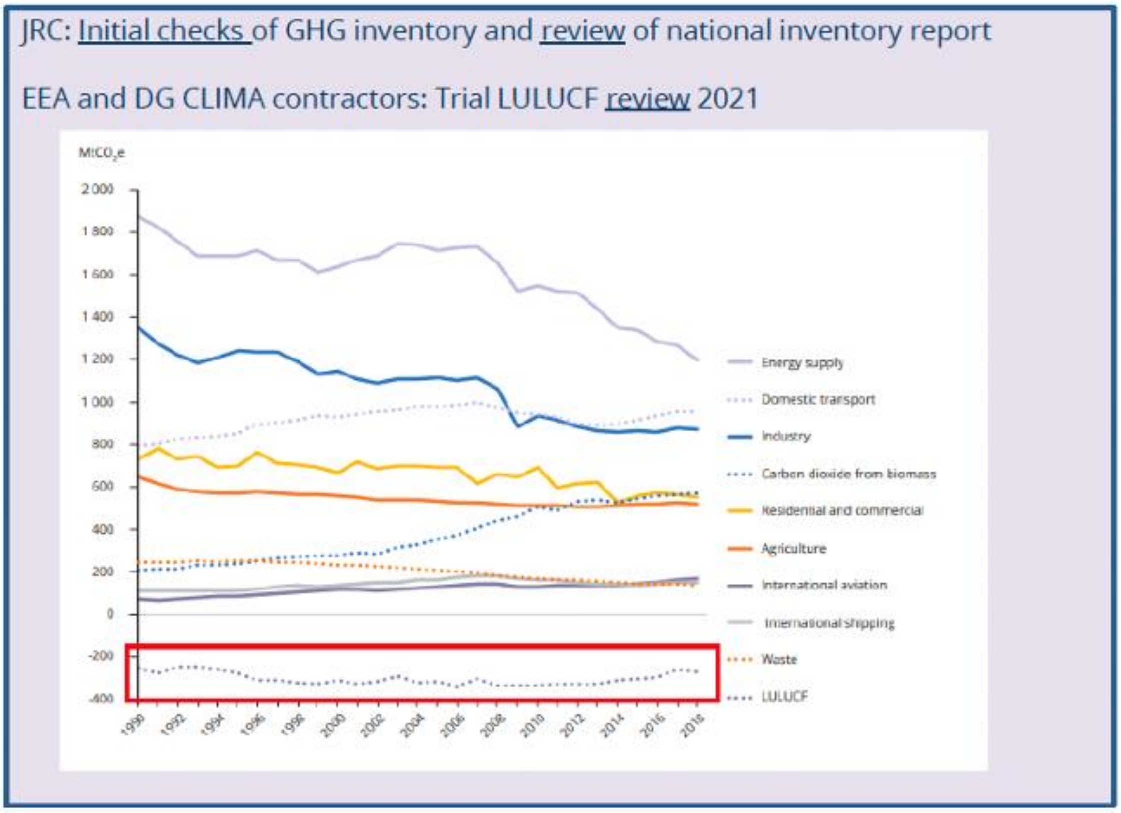
The last question from the audience asked about the nature of country specific issues in the delivery of the GHGI (i.e. lack of technical expertise or lack capacity). Mr. Abad Viñas responded that the reasons can vary among MS. For instance, the conduction of the land use matrix or the use of higher tier methods can be time and resource demanding.

3.3 MRV of LULUCF inventories – first results of the trial LULUCF review

The first results of the trial LULUCF review of the Monitoring, Reporting and Verification (MRV) of the LULUCF inventories were presented by **Ms. Claire Qoul** from the Climate Change Mitigation group of the European Environment Agency (EEA) and by **Mr. Peter Iversen,** an EEA expert in LULUCF.

Ms. Qoul started her presentation by introducing the EU GHGI process. The national inventory system is based on a coordination by the EC, the EEA, the European Topic Center on Climate Change Mitigation and Energy (ETC/CME), the MS, Eurostat, and JRC. The process starts when MS provide draft submission reports to the EC and to the EEA. These draft submissions are quality checked by the EEA with the ETC/CME with inputs from the JRC and complemented with European statistics for the IPCC CO_2 reference approach from Eurostat. The MS use the results of the quality checks to correct issues in the draft submissions and then yearly send the final version of the inventory in March. An overview of the GHG inventory process is reported in Figure 12.

Figure 12 EU greenhouse gas emission inventory process (current status 2021)



Ms. Qoul also provided an update of the recent activities that the EEA and ETC/CME are undertaking to support the review of the LULUCF inventory, including incorporating new employees working on LULUCF. Currently, close cooperation with the ETC/CME will ensure improvements and introductions of new checks on the quality of LULUCF information, and the development of LULUCF indicators and country profiles to present more structured data linked with the Forest Information System for Europe (FISE). Ms. Qoul also stressed that the trial review on LULUCF with 15 volunteering MS aimed at providing insight to strengthening initial checks. This trial will provide information to clarify procedures, build capacity within the EC, the EEA, and MS, and to gain experience on review outcomes. The scope of the review was limited to emissions and removals, and the outcome allows MS to use the outcome to improve their inventories. Coordination from the JRC and ETC/CME contributed to the progress of the work.

Following Ms. Qoul's presentation, **Mr. Peter Iversen** presented the main findings of the trial review and highlighted the most returning topics across of the inventories including the 14 points of attention to the mineral soils; 11 in biomass, eight in land identification and timeseries, eight in organic soils, and five in dead wood. He concluded by highlighting the voluntary nature of the trial review and the importance of lessons learned from the trial review for all parties involved.

Ms. Qoul and Mr. Iversen also responded to questions from the audience. The first question asked if they were expecting to repeat the trial review exercise. Mr. Iversen responded that this is not yet decided and that there is first a need to evaluate the outcome of the trial review.

The second question inquired after the process of unifying views of MS on the approach to determine loss and gain of biomass when converting to and from annual crops. Mr. Iversen responded that the EEA is still working on the issue and added that it would be useful to have a common approach for all MS that use national calculated values instead of the default value.

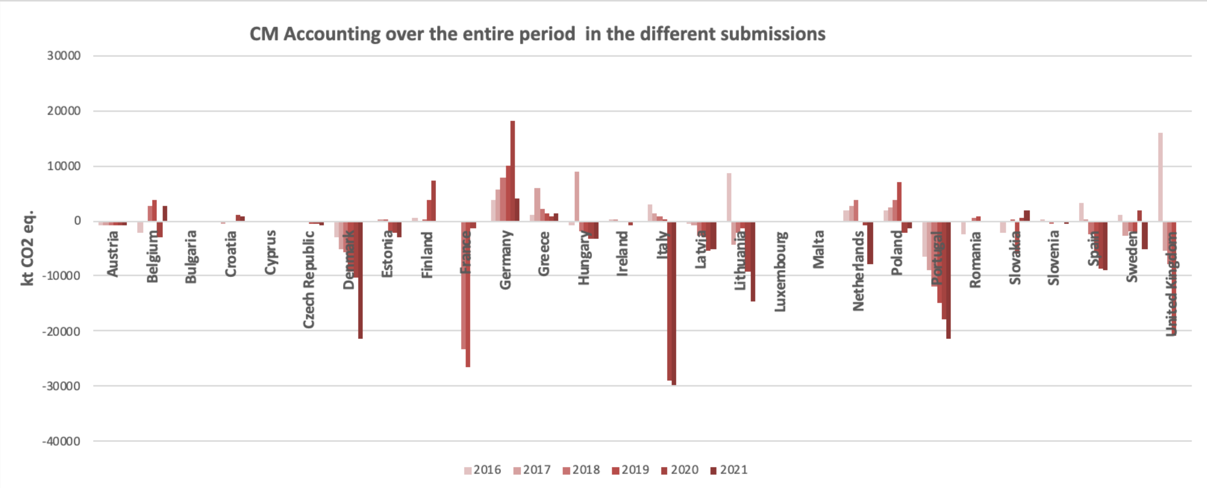
3.4 Review of 2021 submissions decision 529/2013

Mr. Simone Rossi, a researcher at the JRC, introduced the review of the 2021 submission under Decision 529/2013. He provided an update of the status of the submissions for this year. So far, 22 MS have submitted their data in the common platform, EIONET. Regarding the methodological information, 25 MS have completed their submission. Mr. Rossi mentioned that there has been a decrease in the number of complete submissions in the area Common Reporting Format (CRF) Tables, reaching a minimum in the last 6 years.

Mr. Rossi continued by highlighting that more specifically, when looking at the integrated table of cropland management, biomass and mineral soils pools are the most reported among the categories. Biomass burning is still in low numbers of reporting. The same applies for the case of grazing land management, with mineral soils and biomass as the most reported pools by MS. He also showed the comparison between the submissions from different years for the same country. Although adjustments have been made by MS, the graphics generally show that countries are following stable and consistent estimates, probably due to more robust and established methodologies that have been consolidated during the last period.

In this regard, Mr. Rossi also provided insights about the accounting for the graze and cropland management over the period of 2016-2021 showing that the submissions seem to be coherent with previous years. This is reported in Figure 13.

Figure 13 Accounting in the different submissions of Member States



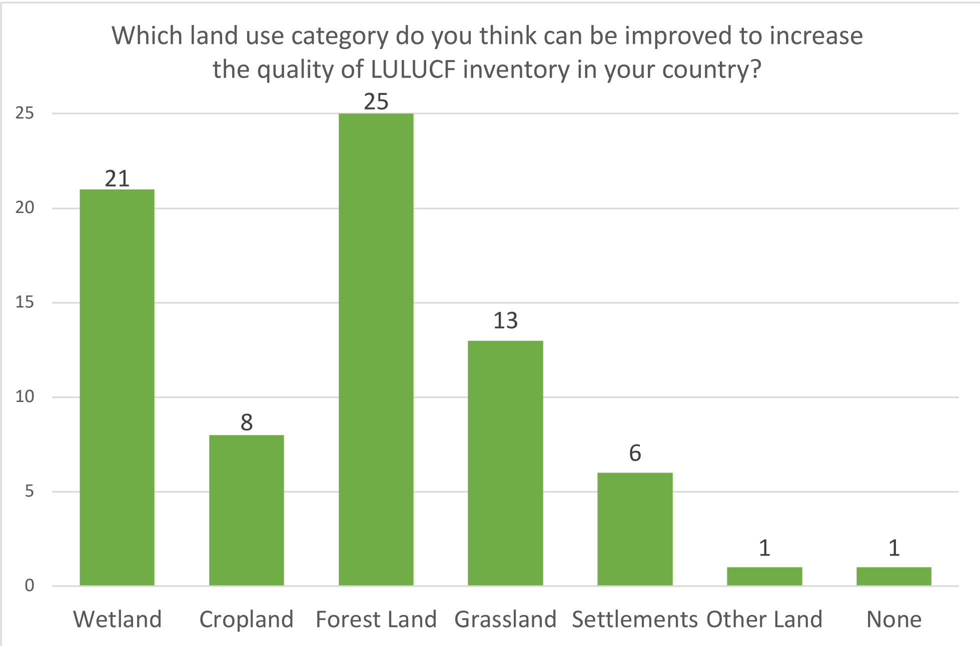
Mr. Rossi also responded to a question from the audience. The question inquired about the use of a reference level approach, rather than the net-net approach. Mr. Rossi clarified that MS are using the net-net approach with the reference year, and that the Regulation (EU) 2018/841 will make use of a reference period calculated for the period 2005-2009 rather than a single reference year. However, a projected reference level such as the one used for Forest land will not be used for managed cropland and managed grassland.

3.5 Synthesis of the interactive discussion of the first series of live polls

A set of poll questions were raised using *Mentimeter* to stimulate the discussion among the audience. The first series of poll questions was conducted by **Mr Raul Abad Viñas** from the JRC.

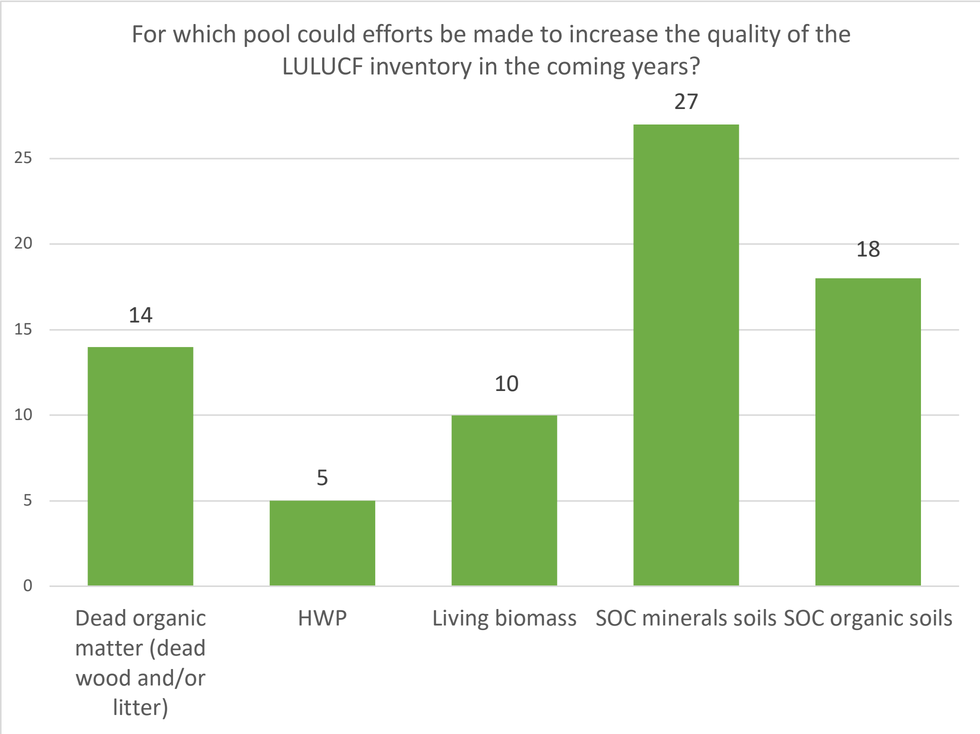
The **first poll question** asked the participants which land use category can be improved to increase the quality of LULUCF inventory in their country. 75 stakeholders responded. As illustrated in Figure 14 below, a majority of the participants believe that forest land can be improved the most (25), followed by wetland (21), then grassland (13), cropland (8), and settlements (6).

Figure 14 Respondents' answers to poll question 1



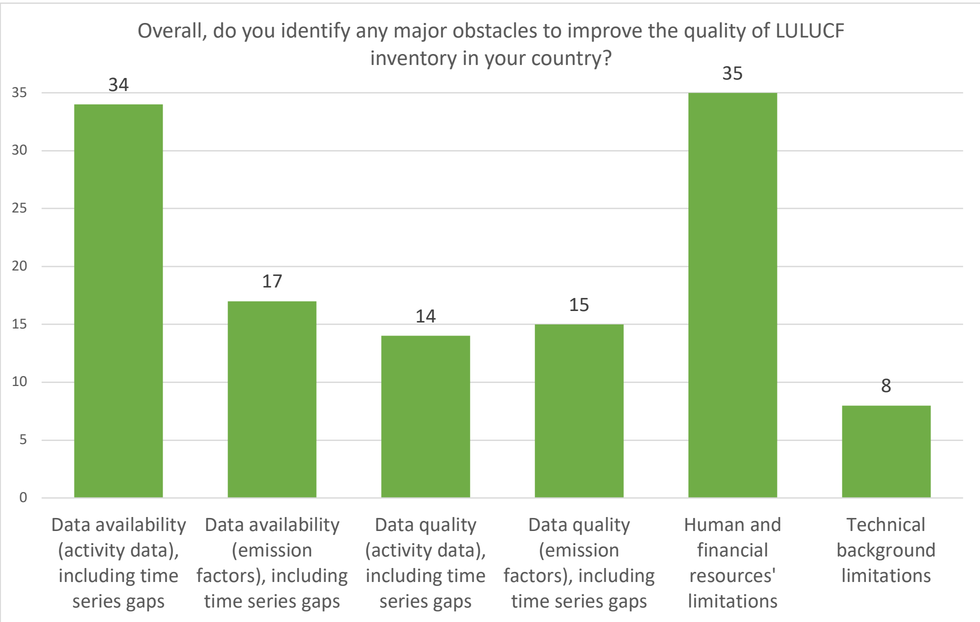
The **second poll question** asked the participants for which pool could efforts be made to increase the quality of LULUCF inventory in the coming years. 74 stakeholders answered. The most preferred option was soil organic carbon (SOC) in mineral soils (27), followed by SOC in organic soils (18) and dead organic matter (dead wood and/or litter) (14). The least favoured options were living biomass (10) and harvested wood products (HWP) (5). This is illustrated in Figure 15 below.

Figure 15 Respondents' answers to poll question 2



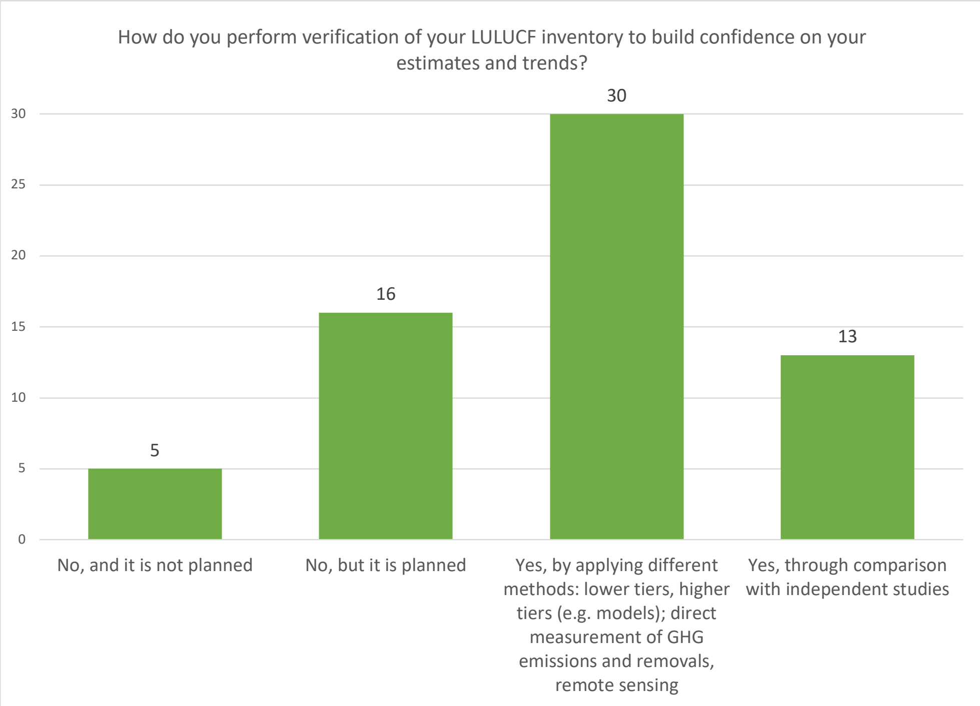
The **third poll question** asked participants if overall, they identify any major obstacle to improve the quality of LULUCF inventory in their country. This question offered multiple options. 75 stakeholders responded. As illustrated by Figure 16, the most favoured option was Human and Financial resources' limitation (35), closely followed by Data availability (activity data), including time series gaps (34). The least chosen option was the Technical background limitations (8). The other three options scored in a similar manner, around 14-17 preferences.

Figure 16 Respondents' answers to poll question 3



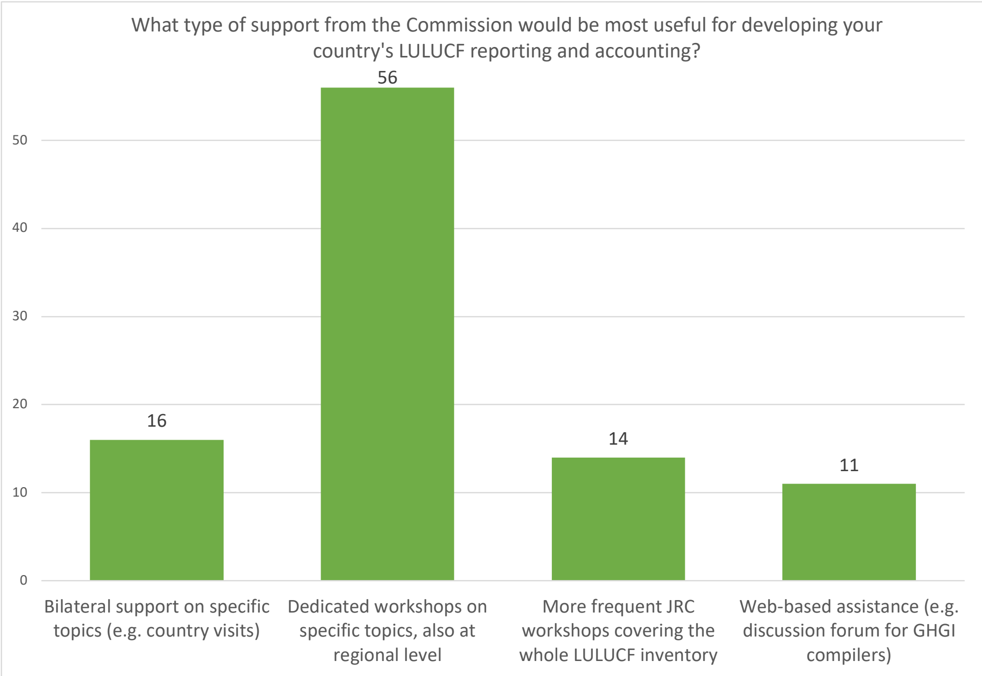
The **fourth poll question** asked participants how they perform verification on their LULUCF inventory to build confidence on their estimates and trends. 64 participants replied. Most respondents (30) agreed that they apply different methods. The options "No, but it is planned" and "Yes, through comparison with independent studies" received a similar number of preferences, between 13 and 16. A minority of them (5) replied that verification procedures are not planned. The distribution of preferences is presented in detail in Figure 17 below.

Figure 17 Respondents' answers to poll question 4



The **fifth poll question** asked participants about the type of support from the EC that would be most useful for developing their country's LULUCF reporting and accounting. This question offered multiple options and 70 stakeholders provided inputs. As presented in Figure 18, there was a clear consensus for dedicated workshops on specific topics, also at regional level (56) as a mean of support to the MS in their LULUCF reporting and accounting activities. The other options were also chosen rather equally, with bilateral support on specific topics (16) chosen as the second most popular option, followed by more frequent JRC workshops covering the whole LULUCF inventory (14), and web-based assistance (11).

Figure 18 Respondents' answers to poll question 5



3.6 Estimating conversion-induced carbon stock changes in mineral soils – a case study from Hungary

After the round of poll questions, **Mr. Zoltan Somogyi** from the University of Sopron, Forest Research Institute presented on the topic of estimating conversion induced carbon stock changes in mineral soils as a case study from Hungary.

Mr. Somogyi made two important points in the beginning of his presentation, namely that Hungary has already applied country specific estimates for carbon stock changes in mineral soils but are far from perfect, and that full uncertainty analysis for the LULUCF sector could not be conducted so far.

The project presented by Mr. Somogyi attempted to mitigate this situation. The processes involved in estimating country-level change of SOC are complicated due to the many types of conversions, the diverse nature of soil, the long process of achieving a new SOC balance after a conversion, the occurrence of both emissions and removals along the process, the lack of interest in soils by decision makers in comparison with biomass, the cost of monitoring, and the difficulties in upscaling point-based estimates. The theoretical guidance by IPCC (2006) emphasises that when developing an area specific carbon stock changes in soils, paired plots should be used so that they have similar histories and management as well as similar topographic position and soil properties, and they are in close proximity.

The project used data of a soil monitoring program which has been running in the country since 1992. This program applied a sampling in representative areas of geographical units using expert judgement and available local research data. SOC values were derived from soil organic matter (SOM) using the conversion factor 0.58.

The project looked specifically at the carbon stock change by conversion type whereby the conversions were simulated by comparing mean SOC data from one land use with those from another land use, e.g., forest land and cropland. Monitoring plots were grouped by both land use and soil type, and for each simulated land use change, differences of mean SOC values by soil type were compared. The results show that:

- when converting **from cropland to forestland**, the SOC content increases
- when converting **from grassland to forestland**, the SOC content also seems to increase
- when converting **from annual cropland to grassland**, SOC content increases
- when converting **from perennial cropland to annual cropland**, carbon is lost from the soil

It is underlined that the applied methodology ensured that only the areas that were considered could indeed be converted. In the case of Hungary, for example, it is cropland and grassland in the plane with rather poor soil that are converted to forestland and not those with good soils. As such, these latter soil types should be left out of the calculation. When upscaling the results, this was implemented so that the distribution of the different land use conversion by soil type were used in combination with the above area-specific SOC values. For example, in the case of the estimation of SOC changes due to converting land to forest land (i.e. afforestation), the area-specific SOC differences from cropland to forest land and from grassland to forest land by soil type were used in combination with the distribution of afforestation by soil type which is available from the afforestation data base.

The project also estimated SOC change over time in the monitoring plots in forests by using data from repeated measurements on the same plots. The data showed that, overall, forest soils have been a carbon sink, however, this is mainly due to forests on poor soils many of which could be established in an intensive afforestation campaign in the last eighty years, while the SOC change in forests with higher mean SOC value and long forest history over the period 1992-2016 appears to be negative.

After his presentation, Mr. Somogyi responded to questions from the audience. The first question was whether the project was at the research stage or if it had already been implemented in the GHGI. Mr. Somogyi responded that only some results for the forestry sector were already included in the most recent inventory report, but the goal is to implement the results in the inventory and that the calculation for the non-forest sectors is a goal for next year submission.

The second question was whether, besides soil characteristics, the project included geographical characteristics such as climate change and low vegetation. Mr Somogyi responded that due to lack of data, these characteristics had not been considered. The estimates are thus at country level at the moment.

The third questions asked to elaborate on the point of the land use history, legacy, and variability of the observed changes. Mr. Somogyi responded that the monitoring has been running for decades using the same plots, but it is difficult to know the direct land use changes to the various plots, so the data does not mirror these possible changes. However, the project estimated these changes by land use, and in case of forests, estimates were plotted against age to simulate the age-dependent processes.

The last question concerned the process of convergence between the various land uses. Mr. Somogyi responded that means were calculated from the data of all plots by soil types in a land use, e.g., cropland, and then the same procedure was repeated for another land use, e.g., forest land. The differences between the means for these two land-uses and same soil type can be assumed to indicate the carbon stock change due to land use change. If there are many soil types for a land-use type, the average of the changes calculated from all soil types, while also considering the distribution of soil types for the conversion, will give the presented results.

3.7 Closing the KP2: Forest Management Reference level and Technical Corrections

Mr Giacomo Grassi and **Mr Raul Abad Viñas** presented on the topic of Closing the KP2: Forest Management Reference Level and Technical Corrections.

Mr. Grassi emphasised that Forest Management Reference Level (FMRL) is a value of average annual net emissions and removals from Forest Management in the CP2 of KP, against which the net emissions and removals reported for Forest Management during CP2 will be compared for accounting purposes. In CP2, 28 parties submitted the FMRLs based on business-as-usual scenarios based on two methods: a) model-based projected business-as-usual or b) projections based on elaboration of historical data.

Further, Mr. Grassi made the following points:

- Consistency is the key principle in GHGI as it indicates that the same methodologies and consistent data sets are used for all years. When different methodologies are used, the parties have to show this in a transparent manner and with potential inconsistencies minimised
- Changes are encouraged as they are an essential part of improving inventory quality. On the one hand, a change in methodological elements used in the construction of FMRL triggers a methodological inconsistency which should be addressed through a Technical Correction. On the other hand, a deviation in policy assumptions under business-as-usual scenario from those assumed in constructing the FMRL does not represent a methodological inconsistency and requires no technical correction
- For projected FMRLs, it is good practice to provide information on main factors generating the accounted quantity and to show that model-based calculations used FMRL to reproduce the data for Forest Management or Forest Land for the historical period reporting in the submission
- It is good practice to document transparently that an event of change in Forest Management areas is not a result of change in activity, but a result of newly implemented policies
- A pool included in the FMRL is required to be reported and accounted
- When methodological inconsistency exists between the FMRL and the Forest Management reporting, parties are required to apply a Technical Correction to ensure consistency
- When documenting the calculation of the Technical Correction of a FMRL (FMRLcorr), information about the method used should be provided to avoid the expectation of net credits/debits linked to any inconsistency between the FMRLcorr and reporting for FM during the CP. Furthermore, the new model-based calculation should show that they can reproduce the data for FM or FL-FL for the historical period reported in the submission. The rationale behind the calculation should also be transparent
- Technical correction should be applied when accounting and information on these corrections and methodological consistency must be reported as part of the annual GHG inventories reports

A checklist to detect methodological inconsistencies and need for technical corrections is provided in Figure 19.

In sum, Mr. Grassi advised to follow the step-by-step procedure when convincing the review that the accounting is correctly executed: Step 1. check the FMRL submissions 2011 and the associated technical assessment report; Step 2. check for possible methodological inconsistencies; Step 3. perform the technical corrections; and lastly, Step 4. document the technical corrections and provide information on main factors generating the accounted quality (FM – FMRL).

Figure 19 Checklist to detect methodological inconsistencies and need for Technical Correction (TC)

<table>
<tr><th colspan="3">CHECK LIST TO DETECT METHODOLOGICAL INCONSISTENCIES AND NEED FOR TC</th></tr>
<tr><th colspan="2">Criteria</th><th>Action</th></tr>
<tr><td colspan="2">1 The method used for GHG reporting of FM or FL-FL changed after the adoption of FMRL</td><td rowspan="13">Calculate FMRL_{corr} ensuring consistency between reported FM and FMRL</td></tr>
<tr><td colspan="2">2. Any of the following methodological elements used for FMRL (as reported in the FMRL submission) changed after adoption of FMRL</td></tr>
<tr><td>Element</td><td>Addition /modification in GHG inventory</td></tr>
<tr><td>a) Pools and gases</td><td>New pools or gases</td></tr>
<tr><td>b) Area under FM</td><td>Recalculated historical data* on area</td></tr>
<tr><td>c) Historical data for GHG inventory</td><td>Recalculated historical data* for FL-FL or FM.</td></tr>
<tr><td>d) Forest characteristics and management</td><td>Recalculated historical data*</td></tr>
<tr><td>e) Historical Harvesting rates</td><td>Recalculated historical data*</td></tr>
<tr><td>f) Climate data assumed by models for projecting FMRL</td><td>Different observed climate data as compared to what assumed in FMRL</td></tr>
<tr><td>g) Harvested wood products</td><td>New/recalculated data and/or methods</td></tr>
<tr><td>i) Natural disturbances</td><td>New/recalculated data and/or method; inclusion of submitted (in 2015) or revised (later) background level and margin with assumptions different from FMRL</td></tr>
<tr><td colspan="2">3. Other possible methodological inconsistencies, e.g., the FMRL model's outputs are not capable of reproducing the historical data* reported for FM or FL-FL.</td></tr>
</table>

One question from the audience asked on policy assumptions. Mr Grassi responded that policy assumption could be included, but at the very beginning. In case one has higher harvest rate than expected, then this can be due to natural disturbance which can be potentially excluded or if it is not a result of a natural disturbance, it should be considered a deviation from policy assumptions and the impact should be accounted for.

Another question asked if it is possible to use the calculation of new FRL (under 841/2018) to calculate the technical corrections. Mr. Grassi responded that while it is not prohibited, he advised to look at the original submissions to see which methodological elements changed and if the FRL calculations may help the technical corrections.

A question asked about the good practice of justifying the accounting quantity if the harvest level is lower than predicted. Mr. Grassi responded that this justification is good practice and that the purpose is to show that accounting quantities reflect changes relative to the calculations and assumptions done in the FMRL submission.

Mr. Grassi and MS representatives also responded to a question regarding the review process of technical correction. The representative from Italy responded that they had been reviewed two years ago but did not receive any technical recommendation.

4 Day 2 – Part 1: Future challenges for LULUCF reporting and accounting

4.1 Points of attention for LULUCF reporting under Regulation 2018/841

The presentation "Points of attention for LULUCF reporting under the 2018/841 Regulation" opened the session and was presented by **Mr. Eric Arets**, LULUCF researcher and inventory compiler in the Wageningen Environmental Research institution in the Netherlands.

The presentation was based on the "Study on the requirements for compliance with the regulation on Land Use, Land Use Change and Forestry (LULUCF) and associated regulations", conducted for DG CLIMA and published by the European Commission[4]. The study was focused on an in-depth analysis of the requirements for compliance with the regulation on LULUCF and associated regulations with the following objectives:

- Assess the consistency across the legal texts and provide improved understanding of compliance needs
- Identify expected content to be provided in relation to compliance elements
- Identify datasets that could be used in the comprehensive reviews at the end of the compliance period

There exist many similarities between the GHGI reporting requirements and the requirements for the accounting categories under the LULUCF regulation (2018/842), but the study also revealed a number of inconsistencies between UNFCC reporting and accounting requirements. One of the inconsistencies is related to the required separation of carbon pools which under the LULUCF regulation (Annex I) requires a distinction to be made between above-ground biomass (AGB) and below-ground biomass, and between litter and dead wood, while this information cannot be provided in the LULUCF CRF tables (there only carbon stock change in living biomass is to be provided without the distinction in above (AGB) and below ground biomass (BGB), and dead organic matter without the distinction between dead wood and litter). Mr. Arets remarked that this could potentially create a transparency issue, particularly where MS use the option provided in Art 5(4) of the LULUCF regulation to exclude from accounting the changes in carbon stocks for those pools that are not a source. In this regard, he suggested that the methodologies used to assess the carbon stock changes in the different carbon pools need to be carefully described in the National Inventory Report (NIR) and in order to enhance transparency on this, also more explicitly provide the changes in carbon stocks for AGB and BGB and were relevant dead wood and litter in their NIR.

Similar issues occur in the wetland category where in the default CRF tables the subcategory land converted to wetlands is not divided per other land-use category (i.e. forest land converted to wetlands, cropland converted to wetlands, etc.), as needed for the classification in accounting categories and to be provided as part of the compliance report (format in Annex XX to the Implementing Act 2020/1208). Instead, it is first divided into land converted to peat extraction, land converted to flooded land and land converted to other wetlands. Similar inconsistencies occur in the reporting of CH_4 and N_2O emissions for land conversions where in the CRF tables all land converted to categories are included in an aggregated category, but for which different accounting rules apply (CRF Tables 4(II), 4(III), 4(V)). These inconsistencies and those in the wetlands CRF table can be solved by manually introducing additional subcategories in the CRF reporter for the subcategories under the "land converted to" subcategory and improved descriptions in the NIR.

Mr. Arets also provided insights about the methodologies for monitoring and reporting the LULUCF, which are described in the Annex V of the Governance Regulation (2018/1999). Mr. Arets remarked that time series consistency does not mean that all data need to be from the same source or obtained with the same remote sensing products, but that specifications need to be similar. The Governance Regulation also defines Tier 1 methodologies in accordance with the 2006 IPCC guidelines as the minimum requirement for the GHGI. In contrast to this Art 5(4) of the LULUF regulation allows to exclude from accounting the changes in carbon stocks for those pools that are not a source, except for above ground biomass, dead wood and HWP. Potentially this results in inconsistencies between the GHGI and reporting of accounted emissions and removals in the compliance report that need. Potential differences between the GHGI and accounting in the compliance report need to be explained and justified. This could be done either in an additional annex to the NIR or in an adapted format in the compliance report. The Governance regulation also requires the use of higher tiers for significant pools of key sources, namely, for carbon pools that account for at least 25-30% of emissions or removals in a source or sink category. An overview of data inputs and methods to derive land use classes for the three approaches as identified in the IPCC guidelines is provided in Figure 20.

[4] https://data.europa.eu/doi/10.2834/757934

Figure 20 Examples of different data inputs and methods to derive land-use classes for the three approaches identified in the IPCC guidelines (Source: Table 3.6a in Chapter 3 of IPCC 2019[5])

Method	Approach 1	Approach 2	Approach 3
Sample- based methods	• Single sample • Temporary sample units	• Samples collected from permanent units but changes only tracked across two consecutive sample periods.	• Permanent and consistent georeferenced ground plots. • Continuous and consistent samples using remote sensing data.
Survey-based methods	• Single census at one point in time • Repeat census but without reference to previous censuses.	• General surveys between two periods. • National census data that can refer a past period.	• Specific survey designs that identify activities through time for each land unit within a known region.
Wall-to- Wall methods	• Single map • Inconsistent maps developed at different times.	• Inconsistent maps through time combined with Approach 2-type samples (e.g. using maps as stratifications). • Maps developed using consistent methods changes tracked across two consecutive maps only not tracked through a time-series of maps.	• Tracking pixels / land units using time-series consistent data.

For carbon pools reported using Tier 1 methods and data, the MS will need to show that it is part of a land-use category that is not a key source. If the category is a key source or sink, it should be proved that the specific carbon pool is not significantly contributing to the emission or removals of the category.

Mr. Arets also responded to questions from the audience. The first question inquired if it was expected to report with a similar method under UNFCCC and EU regulation, and if so, to explain the two sets of reporting tables. Mr. Arets responded that the UNFCCC reporting is the basis for the LULUCF accounting categories and although the tables have a different structure, the data should be consistent. The formats to be used for the compliance report are provided in the annexes to the Implementing Act 2020/1208.

The second question inquired about the number of MS that had used the exclusion of pools in the development of FMRL for forest. Mr. Arets replied that he did not have access to the requested information, but that it is possible that the Commission could answer this question based on the technical assessment of the FRL's submitted by MS.

The MS of Italy remarked that already this year, the MS had submitted the reported and accounted emissions and removals with the format in an implementing act (2020/1208) to the Governance Regulation. He added that under the MMR and art 3.2 of the LULUCF decision 529/2013, the information related to the KP LULUCF accounting categories Cropland Management and Grazing land management needs to be reported. These are different from the LULUCF accounting categories as identified by the LULUCF Regulation (EU) 2018/841.

Another participant supported the discussion by adding the following link about approach 3 on land representation Chapter 3 and Chapter 4 of the MGD 3.0: https://www.reddcompass.org/documents/184/0/GFOI-MGD-3.0-en.pdf/f2e8da83-e597-4333-9d0d-9f481dfda325

4.2 LULUCF inventory developments

Mr. Raul Abad Viñas from the JRC, shared the preliminary results from the assessment of the LULUCF inventories, framed under the Task 2.a of the administrative arrangement FOMONPOL, which has the objective to support the quality improvement of LULUCF inventories for MS with regards to the new requirements under Reg. (EU) 2018/841.

The new regulation requires the use of higher tier methods for significant pools within key categories.

An overview of land use categories and land accounting categories is reported in Figure 21.

[5] https://www.ipcc-nggip.iges.or.jp/public/2019rf/vol4.html

Figure 21 Correspondence between Land Use Categories (LUC; table on left) and Land Accounting Categories (LAC; table on right)

To: / From:	Forest Land FL	Cropland CL	Grassland GL	Wetlands WL	Settlements SL	Other land OL
Forest Land FL	**FL-FL**	FL-CL	FL-GL	FL-WL	FL-SL	FL-OL
Cropland CL	CL-FL	CL-CL	CL-GL	CL-WL	CL-SL	CL-OL
Grassland GL	GL-FL	GL-CL	**GL-GL**	GL-WL	GL-SL	GL-OL
Wetlands WL	WL-FL	WL-CL	WL-GL	**WL-WL**	WL-SL	WL-OL
Settlements SL	SL-FL	SL-CL	SL-GL	SL-WL	**SL-SL**	SL-OL
Other land OL	OL-FL	OL-CL	OL-GL	OL-WL	OL-SL	**OL-OL**

Deforested Land
Afforested Land
Managed Forest Land
Managed Cropland
Managed Grassland
Managed Wetland
Other categories, excluded

A selection of five case studies was used to assess the impact on the result of the key category analysis when it is performed using land accounting categories or land use categories. The preliminary findings of the study showed that:

- Key category analysis based on land accounting categories may slightly differ from the key category analysis currently done under the UNFCCC, which is based on land use categories
- Although representing a small additional burden to GHGI compliers, it can be easily automatised
- Findings are not mutually exclusive but complementary.
- The analysis could serve to incentive deeper assessment of the main sources/sinks and therefore better use of resources
- There is an opportunity to move faster towards higher tiers methods for main sources/sinks

The new regulation requires the use of Tier 2 methods for estimating carbon pools that are significant within a key category. At the same time, there are many MS that assumes the equilibrium for carbon pools when they lack country-specific data, and the IPCC guideline lacks default factors. Consequently, there are carbon pools for which there are not quantitative estimates.

In the absence of a quantitative estimate, it is uncertain which carbon pools need to be reported with higher tiers. However, Mr. Abad Viñas presented a possible interim solution, namely the use as a proxy of the significant of a not-reported pool in a certain land use category, the average value of the significant from those MS that quantitatively reported the pool.

He added the following points of attention on future steps:

- For **Forest Land**, dead wood and litter appear as carbon pools that are not "formally" significant. Noting that recently more NFIs are collecting information on these pools, further efforts are expected to quantify their carbon stock changes.
- Lack of estimates for **Mineral soils** is often justified by the implementation of constant management practices over time, or when current management is currently less intensive than before. Overall, there is need for further information and verification approaches to support these arguments.
- **Grassland** areas are often considered as lacking woody vegetation, and not subject to management practices that could enhance carbon fluxes. Nevertheless, several pools seem to be significant for certain MS under this category.
- A number of MS will have to **move to higher tier methods to** comply with Reg. (EU) 2018/841. Mainly those using Tier 1 for living biomass and soil organic carbon in Croplands, but also "potential" not compliance cases appear for the reporting of these pools under Grassland.

Mr. Abad Viñas also responded to a question from the audience. The question concerned the need to use the key category based on land accounting categories. Mr. Abad Viñas responded that it is not necessary at the moment, clarifying that the analysis was made to understand the impact on the result of the analyses when using different categories.

4.3 Relevant updates in IPCC 2019 Refinement

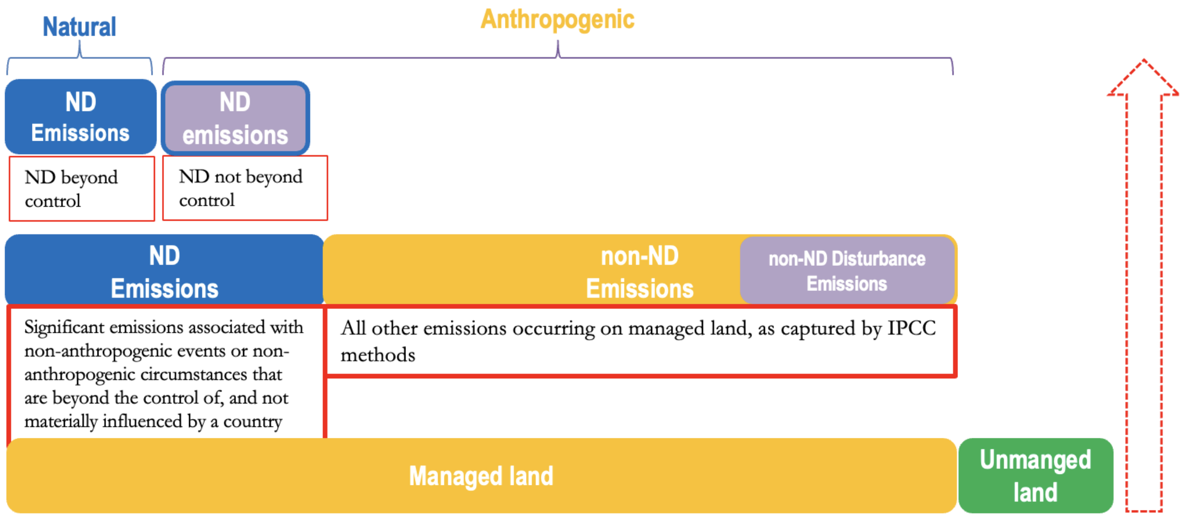
Updates of the IPCC 2019 Refinement were presented by **Mr. Sandro Federici** from the Technical Support Unit of the IPCC Task Force on National Greenhouse Gas Inventories.

In terms of the 2019 Refinement on Agriculture, Forestry, and Other Land Use (AFOLU), refinements have been made in all the chapters belonging to volume 4, apart from chapter 9. They include new and updated default data and two annexes of which annex 1 contain the mapping tables and annex 2 contain the new worksheets.

The structure on land representation will be based on three approaches, which will contain additional guidance provided to implement the good practices. For forest land, there will be new guidance on the use of allometric models and biomass density maps for estimation of biomass. Additionally, the refinements also include elaborated guidance on the application of Tier 3 methods and on inter-annual variability.

In terms of **natural disturbances** (see Figure 22), Mr. Federici remarked that in line with IPCC methodology, it is considered good practice to estimate and report the total GHG emissions and removals that occur on managed land, including those impacted by natural disturbances. In addition, GHG emissions and removals associated with natural disturbances may be disaggregated within the Managed Land Proxy (MLP) estimates when cause high interannual variability. Emissions and removals disaggregated as associated with natural disturbances only are expected to balance to zero across time, and as such, it is considered good practice to report their total across time. However, the estimation of CO_2 emissions and removals associated with natural disturbances is affected by the methodology of the reporting country has applied; an example on how the reporting of carbon stock changes in the Dead Organic Matter (DOM) pool differs according to different tier methods.

Figure 22 Natural disturbances – significant GHG emissions



Moreover, on the main updates in **agricultural land**, the IPCC has developed a Tier 2 methodology for SOC changes in cropland and has included new guidance for the estimation of SOC change in mineral soils associated with biochar amendments. Concerning Tier 1 methodologies, the refinement includes updated stock change factors (FLU, FMG, FI) and some clarifications for SOC changes in mineral soils.

In the case of **flooded land**, new guidance is provided for estimation of CH4 emissions from Land Converted to Flooded Lands and Flooded Land Remaining Flooded Land. Additionally, for Land Converted to Flooded Lands an optional approach to develop indicative estimates of the anthropogenic component of total CO_2 and non-CO_2 emissions from flooded lands is described.

Concerning the chapter of **livestock**, a new and advanced Tier 1 method has been developed to consider differing productivity systems (high and low). For Tier 2 methodology, the gross energy calculation has been extended to goat. Additionally, 50% of equations has been updated and 10 new equations have been added.

Finally, for the case of **harvested wood products (HWP)** the refinement maintains the existing approaches from the 2006 IPCC Guidelines, but includes elaborated and updated guidance on: delineation of the boundaries and essential differences among approaches; clarifications on estimating for emissions associated with HWP use for energy purpose; disaggregation of semi-finished HWP into 3 commodity classes; and updated and new parameters (e.g., default conversion factors and half-lives for HWP commodity classes).

Mr. Federici also addressed questions from the audience. A question inquired about the reporting of abandoned managed lands that are naturally converted to a unmanaged land. Mr. Federici responded that once a land is managed, it will always be reported as managed land as the impact in the land is long-term.

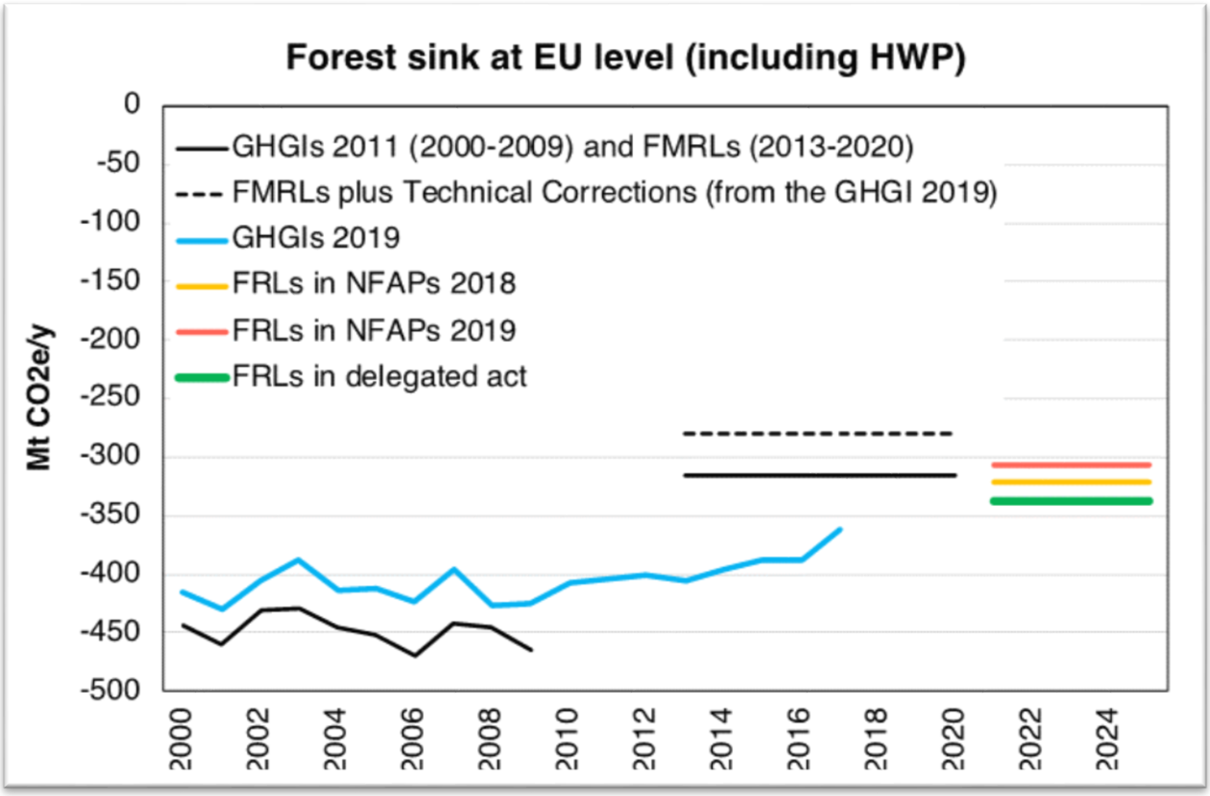
Another question asked whether a pest attack developed in small plots across large areas could be considered as "beyond control", in comparison to a natural disturbance affecting large area in one to few spots. Mr. Federici confirmed that it can be considered beyond control, so far as it meets all definitional requirements of natural disturbances including to determine, at an aggregated level, significant annual emissions.

4.4 Forest Reference Levels for 2021-2025

Ms. Anu Korosuo, a project officer at the JRC, gave the presentation on Forest Reference Levels for 2021-2025, focusing on the policy report published by the JRC[6]. She remarked the LULUCF regulation is an integrated part of the climate commitment and works with the flexibility of the Effort Sharing Regulation (ESR).

Ms. Korosuo began by explaining that the Forest Reference Level (FRL) is the benchmark for measuring MS' efforts in managed forests towards meeting the EU targets under the 2030 Climate and Energy Package. The FRL represents the projected GHG emissions and removals in managed forest land for each MS in the period 2021-2025 if the management practices were continued as in the period 2000-2009 (Figure 23). The question is what is going to happen in the future for the GHGI. If the GHGI shows a sink lower than the FRL, then it will be accounted for as a debit.

Figure 23 Development of the forest sink at the EU level (sum of all Member States' values), and its relation to the FRLs (according to LULUCF regulation) and to the FMRLs (according to the Kyoto Protocol). The technical corrections added to the FMRLs are from the GHGI 2019 and are not yet the final ones for the period 2013–2020. The FRLs proposed by the Member States in the draft NFAPs in 2018 are shown in yellow, the revised FRLs proposed in the revised NFAPs in 2019 are shown in red, and the FRLs as included in the delegated act are shown in green. The EU values shown include Croatia (not EU Member State when FMRLs were submitted) and the United Kingdom. Source: Korosuo et al. 2021[6].



The assessment process was long and focused on FRLs for the period 2021-2025. The results show that there is already substantial increased ambition compared to FMRL under the KP. Based on the work of a dedicated expert group (LULUCF Expert Group) in the last two years, the EC at first gave technical recommendations for MS to revise and improve their FRLs and accounting plans, and then deeply assessed the final accounting plans as submitted by MS. The JRC Science for Policy report was published with details by MS on processes and the main assumptions. The main challenges were on modelling age dynamics and continuation of forest management practices, ensuring consistency between historical estimates (GHG inventories) and national

[6] https://op.europa.eu/s/teHj

projections, and transparency of input data and model assumptions / outcomes. Seventeen MS got their FRLs approved, 6 MS amended, and 5 MS recalculated their estimations. Main reasons for recalculations were inconsistencies with GHG inventories (area, pools, and gases) and biased simulation of harvest intensity.

The first key learning outcomes show that the most challenging aspects were data availabilities, projections vs. consistency with the GHGI, inclusion of all carbon pools and gases; and natural disturbances as an increasingly crucial question in climate change mitigation and adaption (especially related to Czech Republic but also some other countries).

The second key learning outcomes show that MS could now report their own projections which is a notable improvement from the previous experiences under the KP; MS driven process required careful checking of assumptions, active participation by MS and other experts which creates a mutual learning opportunity and pushes for future collaboration; and the National Forest Action Programmes (NFAP) provide a wealth of data and information on national models and data, often not previously available to international community.

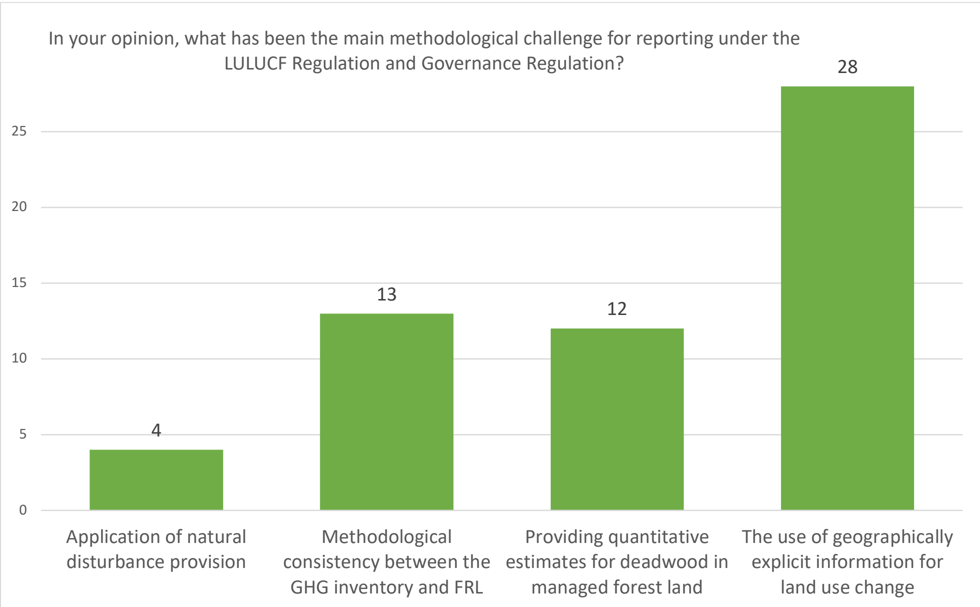
Ms. Korosuo also responded to questions from the audience and the chat. One question asked if harvest intensity is a prerequisite for estimating FRL. Ms. Korosuo responded that the regulation should not restrict the FRL unnecessarily. In the report, the harvest intensity is used to model how much is harvested when the forest develops over time in a model and is a useful tool to see how the results develop.

Another question asked how it would look like for percent of volume of harvest or harvest increase. Ms. Korosuo remarked that the results show the number of countries, but the percentage was not calculated for the harvest increase.

4.5 Synthesis of the interactive discussion of the second series of live polls

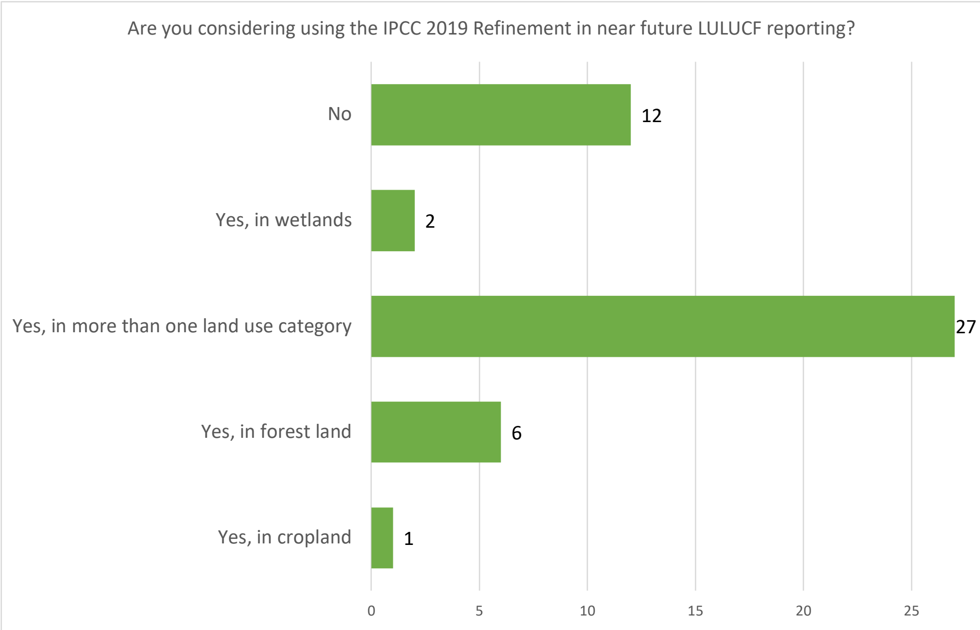
The second series of poll questions was provided by **Mr Viorel NB Blujdea** from the JRC. The **sixth poll question** asked the participants to decide on the main methodological challenge for reporting under the LULUCF Regulation and Governance Regulation. 57 stakeholders answered this question. Figure 24 shows that the stakeholders agreed that the main methodological challenge for reporting is the use of geographically explicit information for land use change (28). The least important methodological challenge is the application of natural disturbance provision (4). The two other options of methodological consistencies between the GHG inventory and FRL (13) and providing quantitative estimates for deadwood in managed forest land (12), were considered almost equally important.

Figure 24 Respondents' answers to poll question 6



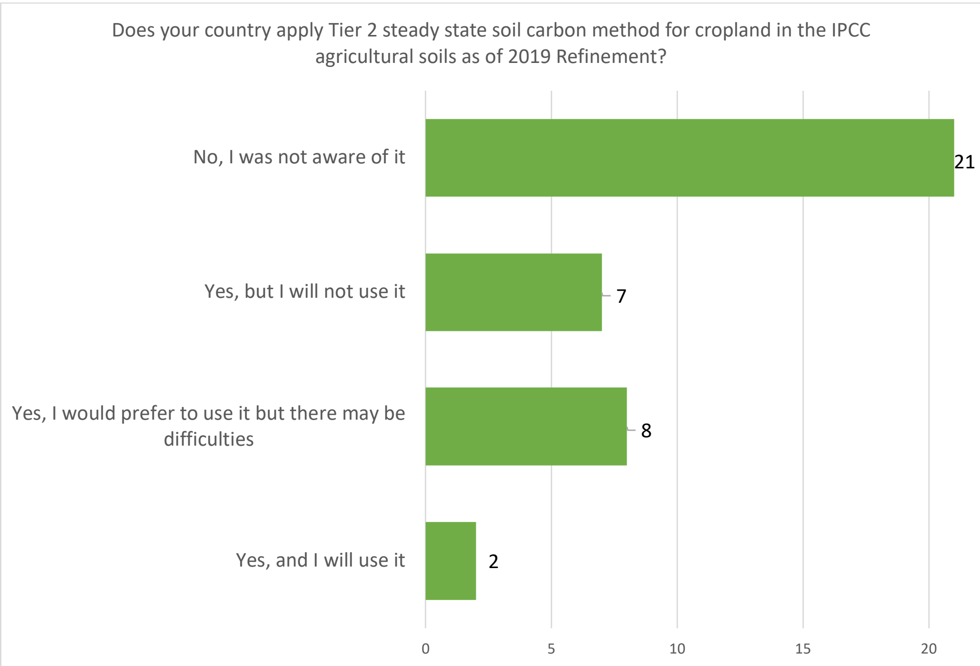
The **seventh poll question** asked the participants if they are considering using the IPCC 2019 Refinement in near future LULUCF reporting. 48 participants responded to this question. As illustrated in Figure 25, the most favoured response among the options were positive in more than one land use category (27), followed by the opposite response of 'No' (12). Participants favoured the least the option of 'Yes, in cropland' (1), followed by 'Yes, in wetlands'. (2).

Figure 25 Respondents' answers to poll question 7



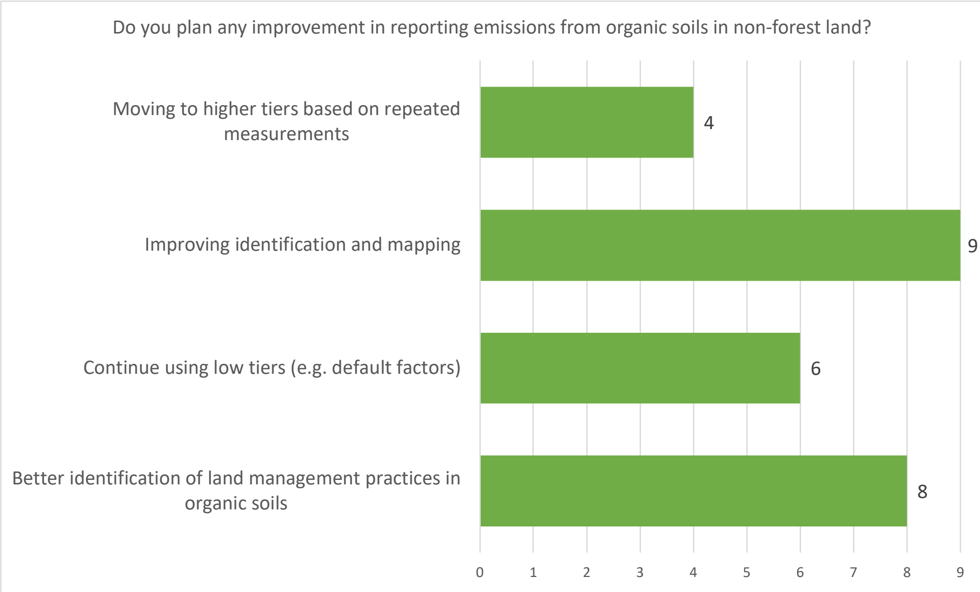
The **eighth poll question** asked the participants if their country apply the Tier 2 steady state soil carbon method for cropland in the IPCC agricultural soils as of 2019 Refinement. 38 participants answered this question. Of the options, a majority of the respondents were not aware of the tier 2 steady state soil carbon method (21), followed by 8 participants that would prefer to use it but believe there may be difficulties. Only 2 participants answered that they are planning to use it. A large majority of participants did not respond to the question and are marked as unspecified. This result is presented in Figure 26 below.

Figure 26 Respondents' answers to poll question 8



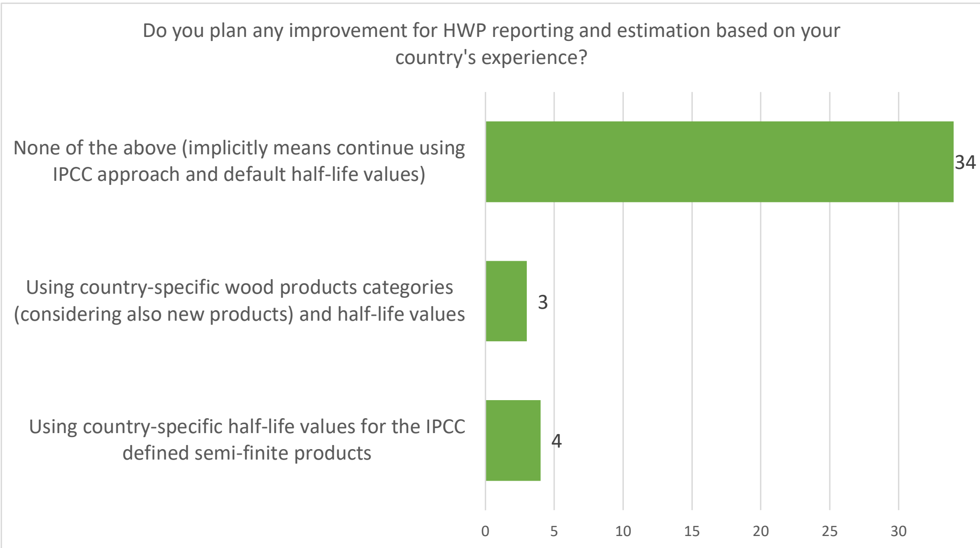
The **ninth poll question** asked the participants if they are planning any improvements in reporting emissions from organic soils in non-forest land. 27 participants answered this question. The most chosen option is ‘Improving identification and mapping’ (9), followed by ‘Better identification of land management practices in organic soils’ (8). The least favoured options were ‘Moving to higher tiers based on repeated measurements’ (4) followed by ‘Continue using low tiers (e.g default factors) (6). This result is presented in Figure 27 below.

Figure 27 Respondents' answers to poll question 9



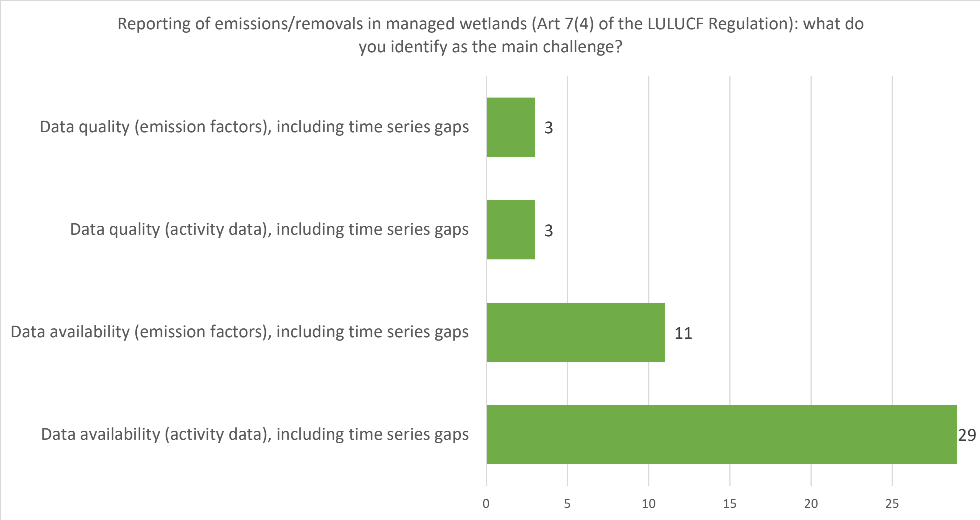
The **tenth poll question** asked participants if they plan any improvement for HWP reporting and estimation based on their country's experience. In total, there were 41 responses. The responses show a clear support for the option 'None of above (implicitly means continue using IPCC approach and default half-life values)' (34). The least favoured option was using country-specific wood products categories (considering also new products) and half-life values (3), followed by using country-specific half-values for the IPCC defined semi-finite products. This result is illustrated in Figure 28 below.

Figure 28 Respondents' answers to poll question 10



The **eleventh poll question** asked participants what they identify as the main challenge in relation to the reporting of emissions and removals in managed wetlands. 46 stakeholders replied. Most respondents identified data availability (activity data), including time series gaps (29) as the main challenge, followed by data availability (emission factors), also including time series gaps (11). The last two options, referring to data quality (3 preferences each), are the least favoured as presented in Figure 29 below.

Figure 29 Respondents' answers to poll question 11



5 Day 2 – Part 2: Science for GHG inventories

5.1 HoliSoils – Holistic management practices, modelling & monitoring for European forest soils

Mr. Aleksi Lehtonen, an associated professor from the Natural Resources Institute in Finland, provided a presentation about HoliSoils, holistic management practices, modelling and monitoring for European forest soils.

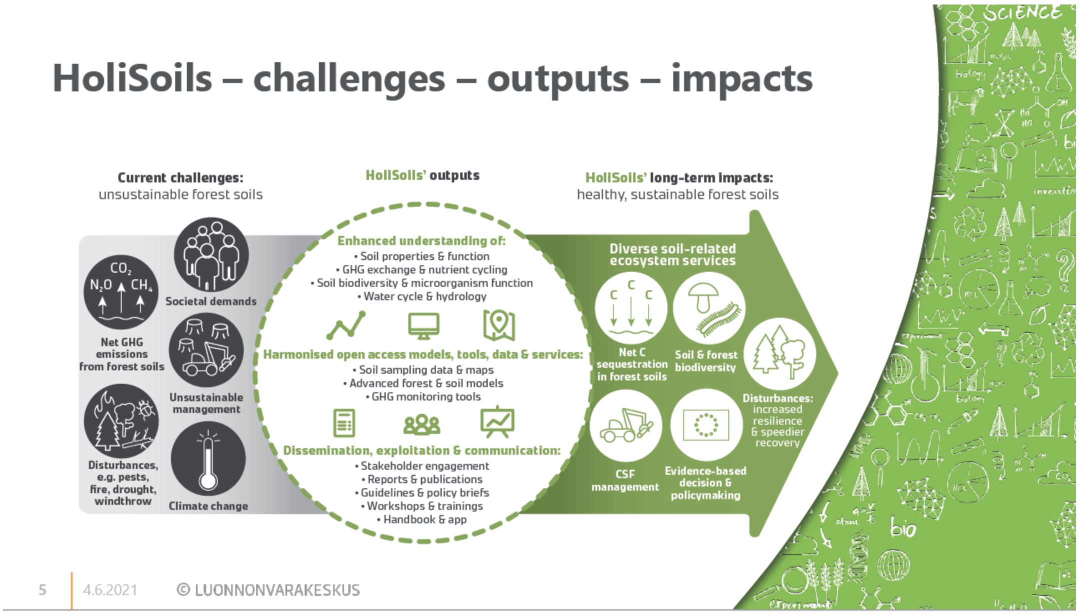
The main objectives of the project HoliSoils are:

- Achieve advance knowledge of soil properties, processes, biodiversity, and activity of soil microbiota, all of which influence soil-based ecosystem services
- Develop and improve state-of-the-art soil models, harmonise them into a monitoring framework for estimation of C and GHG fluxes, nitrogen (N), and base cation stocks in forest soils, and integrate them into forest ecosystem models
- Develop standardised sampling and monitoring protocols for GHG reporting, harmonise legacy soil data from multiple sources and make them available to end-users through a web portal, and develop and apply digital soil mapping methods to facilitate model upscaling to the European scale
- Determine the effects of management on soil functionality, biodiversity, nutrient stocks, organic matter quality and stabilisation processes to develop holistic Climate Smart Forestry (CSF) management, taking into account soil productivity, GHG exchange, water availability, erosion, and soil with aim to study their soil-related CC mitigation and adaptation potential on mineral and organic (forested peatland) soils
- Determine effects of natural disturbances on soil functioning and resilience, identify good management practices for preventing soil degradation, and map soil vulnerability
- Study the impacts, trade-offs, and synergies of CSF management scenarios for soils and forest on the Europe-wide GHG balance and water budget under future climate conditions and disturbance regimes
- Boost collaboration between universities, research institutes, and intergovernmental bodies such as the EU, UNFCCC, IPCC, and FAO, and facilitate the transfer of developed approaches knowledge, and tools globally to operators within the forest sector via multi-actor approach.

The output of the project will support GHG inventories, such as monitoring programmes, guidelines and protocols, harmonisation of a European-wide GHG inventory guideline for GHG monitoring, high resolutions maps of key model inputs and harmonised soil data within an associated web portal.

An overview of the project is provided in Figure 30.

Figure 30 HoliSoils - challenges - outputs - impacts



Mr. Lehtonen also responded to questions from the audience. The first question inquired about the process of the collection of observations to validate the models. Mr. Lehtonen responded that they are building the project on existing research, as many of the partners have been intensively measuring observations. They are prioritising fields with extensive amounts of data.

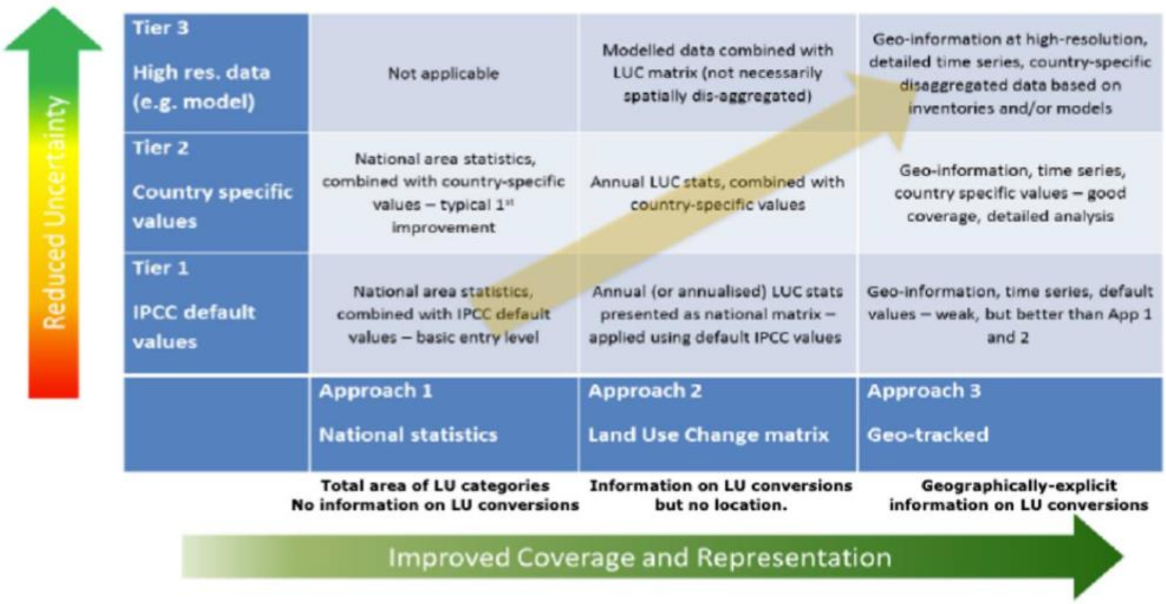
The second question built on a paper recently published in Nature (https://www.nature.com/articles/s41586-021-03306-8) which showed that CO_2 fertilisation produces an increase of biomass in forests but not in SOCs. The publication stated that “Ecosystem models do not reproduce this trade-off, which implies that projections of SOC may need to be revised”. In this regard, the participant inquired if the Holisoils project will look at this effect. Mr. Lehtonen responded that within the project they are not looking at CO_2 fertilisation, and that their core objectives are related with the management practices in the soil.

5.2 Synergies between the CAP new delivery model and LULUCF inventories

Mr. Emanuele Lugato, a project officer from the JRC, presented the synergies between the new Common Agricultural Policy (CAP) and LULUCF inventories.

Within the main features of the new CAP, Mr. Lugato focused on the increase in the budget for climate action of up to 20-30%, as well as on an enhanced conditionality and new eco-schemes for climate, environmental and biodiversity actions. Moreover, the CAP new delivery model will move from the compliance to the performance. The new CAP is moving from the traditional check on the spot control to a new earth observation system that allows for the recognition of the crop as well the detection of activity on land (see Figure 31). In this regard, the new CAP will bring spatial explicit information in agricultural managed areas, which will be used to measure its performance in terms of uptake, but not in quantitative GHG emissions/removals. Mr. Lugato highlighted that this is precisely where the main synergies between the CAP and LULUCF may develop.

Figure 31 Overview of IPCC tiers and approaches used for reporting GHG emissions and removals and land representation



Additionally, the emission relevance of organic soils has put them at the core of both the CAP new delivery model and LULUCF. In this context, the SEPLA project aims to create an inventory of wetlands and peatlands to address the monitoring of their preservation and restoration using remote sensing. The SEPLA project aims at developing spatial explicit and higher approaches (Tier 3) that can interoperate in LULUCF reporting and the Good Agricultural and Environmental Conditions (GAEC) evaluation in the future CAP.

Mr. Lugato concluded his presentation by highlighting two main key points:

- an interoperable monitoring framework working for CAP and LULUCF should be the way forward
- SEPLA will be a good experiment to link CAP and the LULUCF community

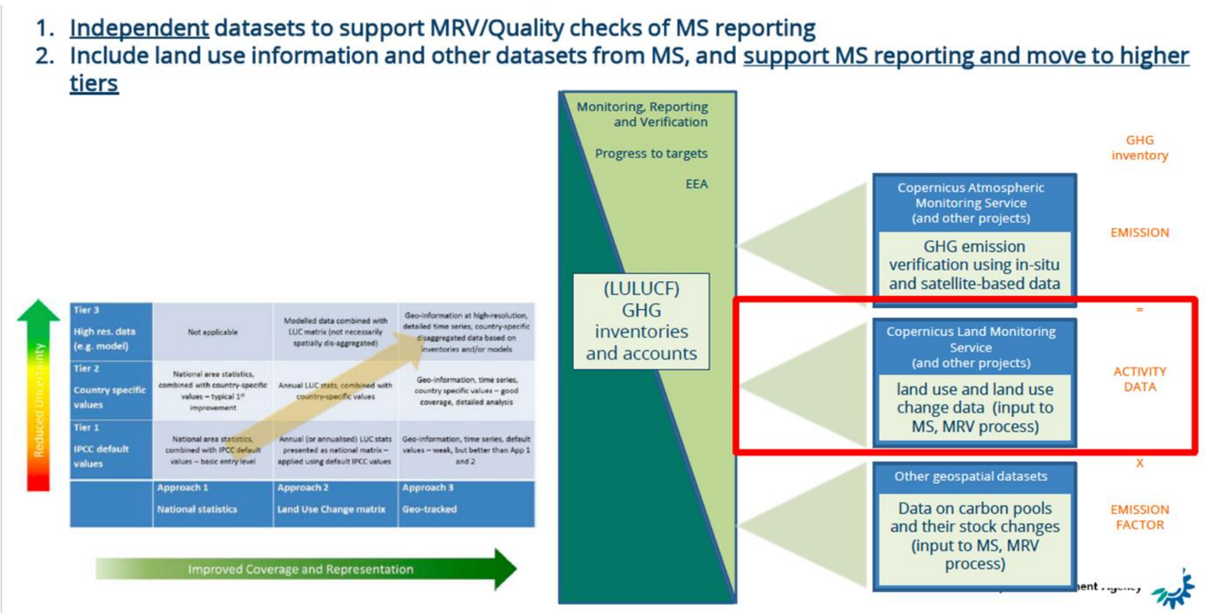
A facilitated discussion followed his presentation. One participant supported Mr. Lugato's discussion by adding that there is an issue with the link between CAP derived measures and related data into GHGI, as well as a lack of robust data collection systems under the CAP. The participant added that the Integrated Administration and Control System (IACS) or the Land-parcel Identification System (LPIS) are not (fully or partially) available at country level. In their national experience, several consistency problems between the LPIS data, IPCC categories and UNFCCC rules appear in the process.

5.3 On the role of Copernicus products in support of LULUCF inventory compilation

5.4 On the role of Copernicus products in support of LULUCF inventory compilation

Mr. Tobias Langanke, expert on Copernicus and LULUCF at the EEA, presented the planned role of Copernicus products in support of LULUCF inventory compilation. Mr. Langanke provided first an overview of the ongoing activities around Copernicus products and LULUCF (see Figure 32).

Figure 32 Two main function of Copernicus geospatial products (mainly via CLC + Core) to support LULUCF



On the side of GHG verification, EEA is currently performing a study and a survey to MS on using inverse modelling for verification of LULUCF GHG inventories, implemented by the ETC/CME. EEA is also developing supporting activities for the setup of a MRV system for MS's GHG reporting, as well as exploring the potential of in-situ data for inventory support.

On the side of the Copernicus land monitoring service (CLMS), the EEA has developed the Corine Land Cover+ (CLC+) system. The two main functions of the Copernicus products in the LULUCF context, are to provide independent datasets to support MRV or Quality checks of MS reporting, and to support MS reporting with the aim to move to higher tiers.

Within the new opportunities of these package of products, the CLC+ is the suite of products which are well suited to address some of the needs of the LULUCF sector. CLC+ aims to be a generic multipurpose successor for CLC, and more agile and flexible to support multiple EU policies. The main parts of CLC+ are the CLC+ Backbone, which is a set of raster and vector products, and CLC+ Core, a grid-based database solution. CLC+ Core will harmonize various inputs datasets with their different classification nomenclatures, to one flexible, grid-based system that uses the EAGLE model as a common ontology. The EAGLE model allows object-oriented descriptions of land cover, land use and additional characteristics. The main function of the CLC+ Core database is then, to provide specific derived datasets (instances) to support LULUCF.

In relation to non-CLMS geospatial datasets, EEA's work is focused on soil carbon datasets and the use of data from FISE in the MRV process. Another new (CLMS) dataset under consideration is High-Resolution Vegetation Phenology and Productivity (HR-VPP), which is currently in the process of becoming available.

Mr. Langanke also responded to questions from the audience. The first question asked about the spatial and temporal resolution used in the HR-VPP. Mr. Langanke responded that there are products updated in near real-time, as well as seasonal or yearly products. The spatial resolution is 10m. Further information is available at the following link: https://land.copernicus.eu/pan-european/biophysical-parameters/high-resolution-vegetation-phenology-and-productivity.

The second question asked about the applicability of the spatial and temporal resolution for vegetation phenology on a global scale. Mr. Langanke responded that currently it is limited to Europe (EEA39 countries).

The third question concerned the process of validating and coordinating the CLC+ data and land use data with higher resolution and variability than the national inventories. Mr. Langanke commented that there are cases in which countries have high resolution and variability data. To harmonise the data, they approach it on a case-to-case basis, taking into consideration the availability of land use data for each country.

5.5 Case study 1 – Spain (FPA Copernicus User Uptake Action 2019-2-49 in Spain: Developing support for monitoring and reporting of GHG emissions and removals from LULUCF)

Mr. Jose Manuel Álvarez-Martínez, Postdoc researcher from the University of Cantabria, and **Ms. Maria José Alonso Moja**, Coordinator of the Clean Air Unit of the Spanish Ministry of Ecological Transition and Demographic Challenge, introduced a case study of within the FPA of Copernicus User Uptake Action 2019-2-49 in Spain.

The Framework Partnership Agreement on Copernicus User Uptake (FPCUP) Action 2019-2-40 aims to develop support for the monitoring and reporting of GHG emissions and removals from LULUCF in selected MS on the basis of Regulation (EU) 2018/841 (see the case of Spain in Figure 33).

Mr. Alvarez-Martínez introduced the four main objectives of the project at the EU level:

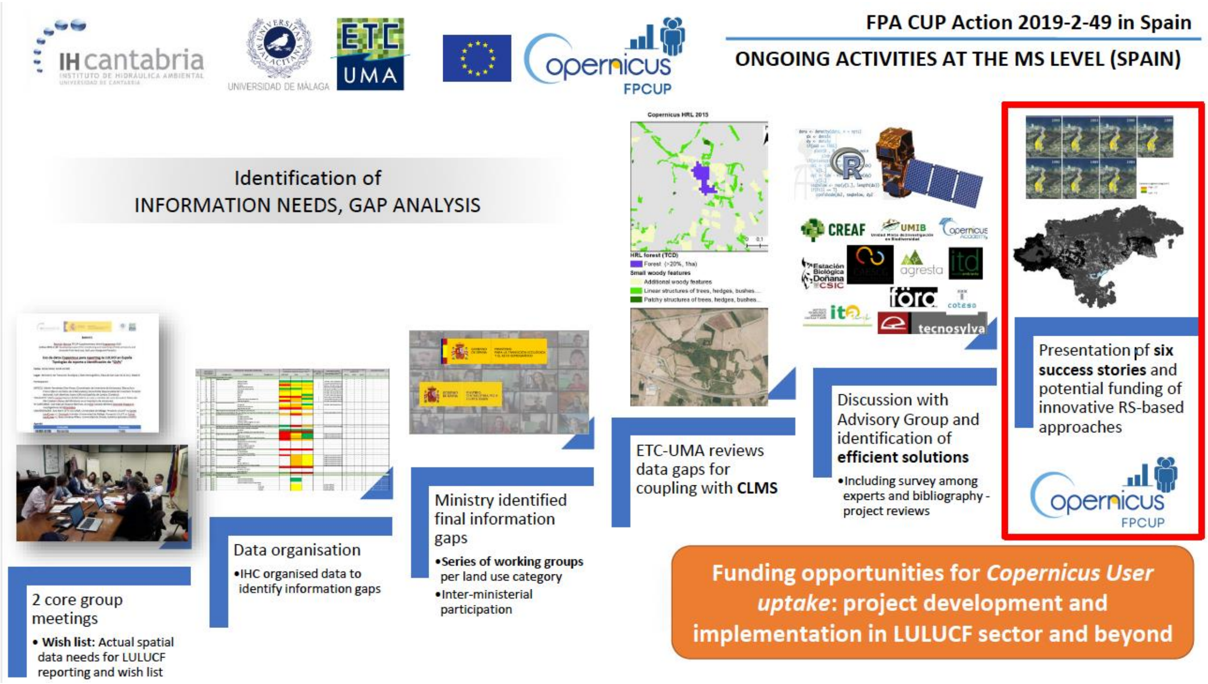
- Understanding of the reporting system of each National Emissions Inventory System, (i.e. spatial information used, needs and gaps) though stakeholder engagement fostering and active Copernicus User Uptake
- Analysis on which Copernicus datasets can be used by MS to support LULUCF emission calculations
- Methodological proposal about improvements of LULUCF reporting by including Sentinel and other Copernicus data into ad hoc modelling frameworks
- Standardized MS and pan-European approached for proposed solutions.

Furthermore, three objectives were in focus:

1. Validation of the National Emissions Inventory
2. Achieve more specificity in the LULCC types to be mapped and carbon pools by using spatial datasets available at the regional, national and EU levels
3. Update of the LULC database using RS and auxiliary information, including future scenarios and uncertainty

Regarding implementation at the Spanish regional level, Mr. Álvarez-Martínez explained that they studied the technical needs of data for LULUCF reporting in communication with the Ministry of Ecological Transition and Demographic Challenge. Then, they defined the gaps of information for LULUCF reporting and analysed how the gaps could be closed with the help of the CLMS data and Spatial modelling and monitoring methodologies. Finally, they gathered the good practices and organised national-level workshops with stakeholders to demonstrate Copernicus solutions for LULUCF reporting. Additionally, they have created an advisory research working group aiming to improve the LULUCF monitoring.

Figure 33 Activities at MS level (Spain)



Mr. Alvarez-Martínez also responded to questions from the audience. The first question asked if they had performed analysis at the national level. Mr. Alvarez-Martínez answered that they are currently developing specific solutions for selected Gaps by working at the NUTS2 level for attempting to demonstrate the capabilities of Copernicus data and services for upscaling these solutions at geographical ranges and temporal resolutions.

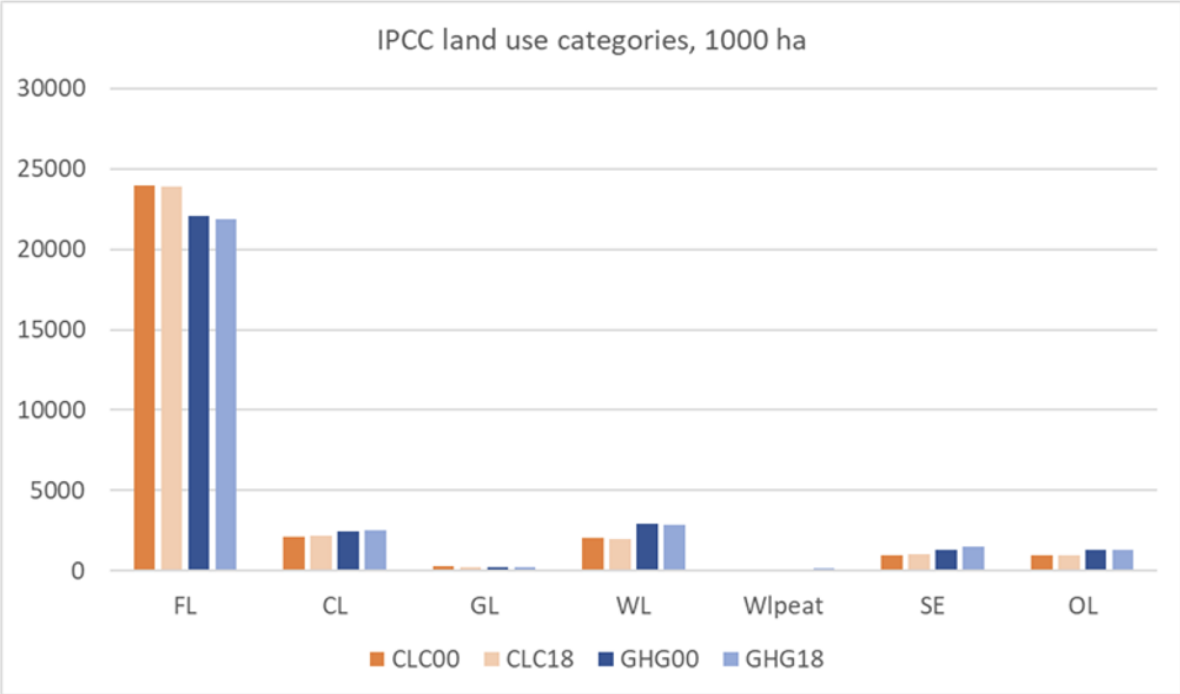
The second question inquired about the collaboration with the inventory team in Spain. Mr. Alvarez-Martínez remarked that their main objective within the project was to engage the national authorities. They will shortly present the success stories in cooperation with their partners, ETC-ULS-UMA, the Advisory Research Group created for the project (i.e. Spanish research centres and technological private companies) and the Ministry of Ecological Transition and Demographic Challenge, with the further objective of creating a permanent LULUCF panel work that will continue and reinforce into the future the goals achieved by the FACUP project in Spain.

5.6 Case study 2 – Finland: Experiences with Copernicus data in detection and monitoring land use and land use A41

On the topic of the Experiences with Copernicus data in detection and monitoring land use and land use change A41, **Ms. Tarja Tuomainen**, Senior scientist at the Natural Resources Institute Finland (LUKE), presented the case of Finland. The Natural Resource Institute Finland (LUKE) has focused on the GHGI, providing information on methods and data with respect to the Regulation (EU) 2018/841. They assessed the potential of the Copernicus Data to be used in LULUCF reporting by comparing IPCC land use classification and EU LULUCF accounting categories to the Copernicus land classification in Finland. Moreover, they compared the Finnish GHGI land use and land use change area data to Copernicus HR CLC data and then estimated emissions and removals based on the Corine land area data, compared with the GHGI data, and assessed the differences. Furthermore, the project classified IPCC land use categories and sub-categories for IPCC land use categories and constructed a time series.

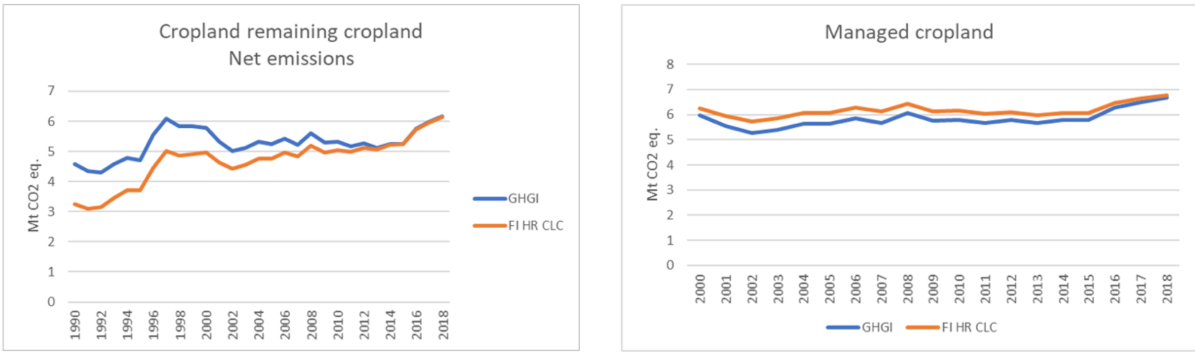
The first results show that there are real data compared with Corine and GHGI from 2000-2018 (Figure 34). The forestland data shows that CLC areas with tree cover are forests, and GHGI trees are also on wetland, settlements, and other land.

Figure 34 Result 1 in the use of Copernicus data in the detection and monitoring of land use and land-use change



The second results show that there is a big difference from 1990 to 2018 for cropland remaining cropland, but since there are no land use data for earlier year, the project used the land use change data from 2000-2018 (Figure 35). This time series is a challenge due to the lack of data to ensure consistency.

Figure 35 Result 2 in the use of Copernicus data in the detection and monitoring of land use and land-use change



Ms. Tuomainen also highlighted six main findings:

- **Different classifications**: CLC is land cover data and in the IPCC classification, the land use is the determining factor and the land cover secondary
- **Misclassification:** Grassland areas were at the same level on both datasets, but the contents were different as abandoned fields with trees tended to be classified as forest land in Corine and intensively cultivated fields were still in Cropland category in GHGI and grasslands in CORINE
- **Emissions and removals**: The area need to be linked to appropriate carbon stocks and emission factors. When area estimates and carbon stock changes are estimated based on different data sources, there is a risk to break the linkage.
- **Time series**: CLC data covers from year 2000, meaning that the first ten years of the time series are lacking, but required for the GHGI.

- **Placing events for right years:** Annual land-use change areas are average between two CLC rounds, where the aim is to report annual changes in occurrence year, especially afforestation and deforestation.
- **Uncertainty:** All above mentioned issues should be considered when the uncertainties are estimated despite the challenging task to include all relevant components from different sources.

Lastly, she stressed that Finland's current sampling-based method sued to monitor land use and land use change and fulfils the requirements for spatially explicit land-use conversation data. Furthermore, development work has been done to catch the land use changes and news ways to use national spatial data are explored.

Ms. Tuomainen also answered a question regarding the importance of a detailed land use map when the National Forest Inventory (NFI) cover the area with a reliable emission estimate, and especially as emissions are reported and not areas. She answered that the project reports on emissions and removals and the area is the activity data. As a result of the accounting rules and Finland's vast forest regions, the afforestation and deforestation in Finland becomes especially important.

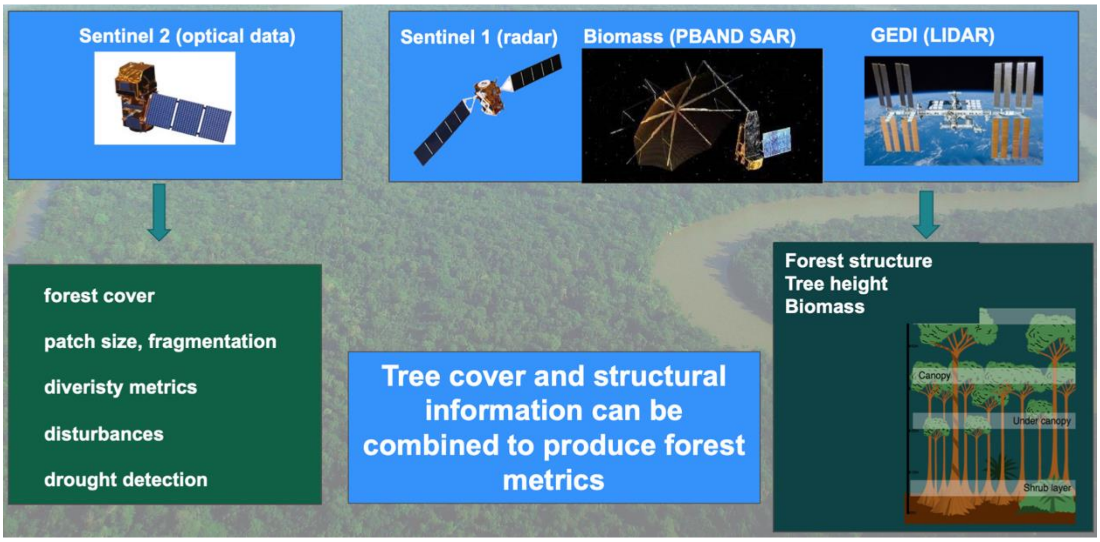
Another question asked for clarity on how the project converted the Corine legend to the IPCC land use categories. Ms. Tuomainen explained that with a comparison they discovered that in Finland that there are some categories that needed to be checked if they were in GHGI. A comment from the audience on this topic remarked that the accounting requires the detailed data in the reporting of emissions. The land use is to support the data method.

5.7 Perspectives of remote sensing for the monitoring of forest resources

Mr. Alessandro Cescatti and **Mr. Giacomo Grassi**, both Scientific officers and Project leaders at the JRC, presented "Perspectives of remote sensing for the monitoring of forest resources" highlighting the need for a standardised methodology across the entire EU. Mr. Cescatti emphasised that this will facilitate obtaining spatially explicit information on forest resources to support implementation of multiple forest-related strategies and policies.

Mr. Cescatti presented the current development of technology of sensors in space that includes high-resolution optical data on forest cover, patch size and fragmentation, diversity metrics, disturbances, and support the detection of drought or changes in forest health. The Copernicus Sentinels are examples of high-resolution sensors which gives seasonal and spatial distribution or vegetation metrics. In addition, Lidar and radar technologies may provide information on the vegetation structure and of the vertical distribution of leaves. These aspects are depicted in Figure 36.

Figure 36 Increasing constellation of sensors



Furthermore, Mr. Cescatti mentioned the published paper “Global maps of twenty first century forest carbon fluxes”[7] that looks at what is feasible in terms of the assessment of gross and net GHG fluxes from forests in Earth observations in the future. Following a similar methodology and logic, the paper on “Spatially-explicit annual estimates of harvested forest area”[8] tried to understand what we can see from space when addressing the harvest rate within EU. As a result of strong reactions to these papers, Mr. Grassi continued by highlighting to the stakeholders that these papers should be viewed as scientific papers and not as a direct input to EU policies. He emphasised that the premise of the paper as a scientific publication means that it is not direct input to policy measures, has a strong disclaimer, and aims to feed the scientific debate.

Furthermore, Mr. Grassi remarked that there were misunderstandings in comparing the papers with country statistics. The analysis aimed to measure clear-cuts, not the total harvest, as it is written several times in the text. The analysis can be used to detect forest disturbances, such as extreme events based on anomaly in harvest rate and detect major ongoing events like bark beetle outbreaks and major windstorms. They emphasise that to improve the method, georeferenced data is needed.

Furthermore, Mr. Gassi and Mr. Cescatti emphasised that the methods for the detection of disturbances is based on spatio-temporal anomalies in forest cover losses, therefore it maps the major disturbance events but not the “background” level of natural disturbances. The approach is a preliminary estimation, but there is no better data for the EU currently available. Recent country-based evidence suggests that the study underestimates the absolute level of natural disturbances but captured well the trend. There is a critical role of surface data for the production and validation of remote sensing products. Valuable source of detailed surface data remains unexploited due to the different methodologies and time frequency between countries and limited availability of data, in particular the accurate plot coordinates.

To conclude, the presenters’ key points were:

- There is a demand for robust, spatially explicit, and timely forest data
- The sample-based approaches in isolation cannot become the operational way to meet this high demand, and only satellite data can truly optimise the full image
- Earth observation is leading us a revolutionary way and with a successful integration and cooperation among communities and the National Forest agencies and the EU institutions, the success of this integration is near

After their presentations, Mr. Grassi and Mr. Cescatti responded to questions from the audience. One of them question asked to clarify whether the approach included only clear-cut or also clear-cut including deforestation. Mr. Cescatti answered that it also includes deforestation, but the majority was harvest as deforestation is limited in Europe.

Another question asked how the study distinguished forest loss from temporary unstocked areas. Mr. Cescatti responded that harvest is detected in the Global Forest Change dataset as a change in tree cover. The loss is detected when one goes from forest state with high tree cover to sudden decline of tree cover due to harvest operations and/or natural disturbances.

A comment hinted to an issue with quality control in relation to the paper, and another comment suggested that the study “misused” the original dataset. Mr. Grassi responded that information can be shared with stakeholders that proves that the change in the sensitivity in the underlying Global Forest Change (GFC) dataset was totally undocumented. It is abundantly clear that the lack of documentation of this important change in the most widely used forest dataset globally is a glaring error by the dataset developers. The JRC study used in the scientific correct way the documentation available at that time, like dozens of similar studies (e.g. those led by the Global Forest Watch, i.e. the main user of the GFC dataset, or the New York Declaration on forests).

[7] https://doi.org/10.1038/s41558-020-00976-6
[8] https://doi.org/10.1038/s41586-020-2438-y

5.8 Estimating and reporting of emissions/removals from living biomass/DOM and HWP associated with windthrow

Mr. Sebastian Rüter, Head of Unit on the Impact of Wood Utilization on Environment and Climate at the Thünen Institute of Wood Research, presented on the estimating and reporting of emissions and removals from living biomass/DOM and HWP associated with windthrow.

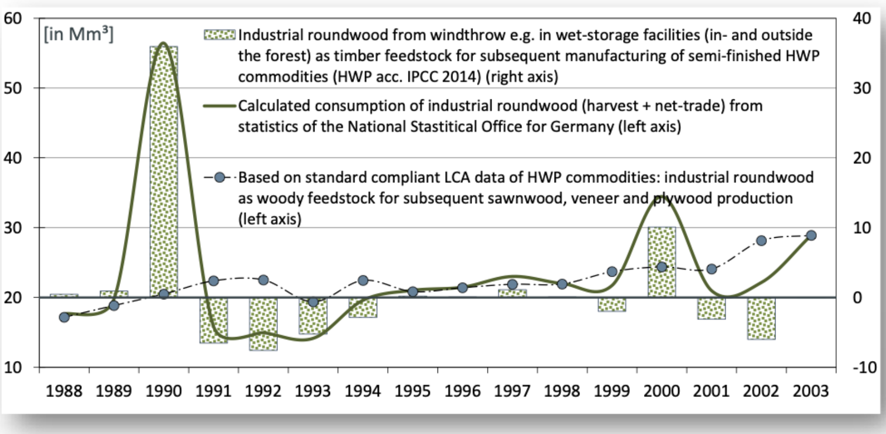
Mr. Rüter began his presentation showing the stock-difference method for estimating carbon stock changes of living biomass and DOM, which is based on the NFI information. This method covers remaining forest areas and forest management, and forest-associated land use-changes. One of the key outcomes of this method is that the reductions of living biomass are recorded as losses of merchantable wood. A second method for this estimation is the gain-loss method, which is based on activity data such as harvest, land-use change, and natural disturbances that are available annually. The main challenge with the method is the different sources of data with heterogenous quality, the varying temporal representativeness and validity.

The information on the carbon losses from forest and feedstock for wood products for the case of the loss of merchantable wood derives from NFI every few years, including woody biomass losses along the value chain. Regarding industrial roundwood production and the manufacturing of semi-finished wood products, the information can be derived from the forest management units or from annual industry statistics on the consumption of timber feedstock, and from production statistics of manufacturing industries and national statistical offices.

Further, Mr. Rüter presented the IPCC standard estimation method for HWP where the carbon inflow is calculated by applying statistical data of manufacturing (forest-based) industries and annual production data for the commodities sawnwood, wood-based panels, and paper and paperboard. Different conceptual frameworks for estimating HWP were also mentioned as relevant. The first conceptual framework "focuses on the estimation of CO_2 emissions and removals arising from HWP on the basis of changes in carbon stocks within the defined HWP pools" (stock-change and production approaches). The second conceptual framework "focuses on identifying and quantifying actual CO_2 fluxes from and to the atmosphere from HWP" (atmospheric flow approach).

Mr. Rüter concluded his presentation by providing a comparison of calculated harvest consumption with feedstock demand for relevant HWP production in Germany (Figure 37). Due to windthrow, there was a surplus of industrial roundwood as feedstock for subsequent HWP production; the timber was salvage logged, stored, and in subsequent years processed, while the overharvest got compensated by reduced fallings in the years after these disturbances. Additionally, in line with IPCC KP Supplement and 2019 Refinement, data on industrial roundwood enters the HWP estimates as feedstock commodity only, in order to avoid double counting.

Figure 37 Comparison of calculated harvest consumption with feedstock demand for relevant HWP production



Source: Rüter (2017)

- **Due to windthrow** (in 1990 "Wiebke" and 2000 "Lothar"), there was a tremendous **surplus of industrial roundwood** as feedstock for subsequent HWP production: the **timber was salvage logged**, stored and **in subsequent years further processed**, whilst the **overharvest got compensated by reduced fellings** in the years after these disturbances
- In line with IPCC KP Supplement and 2019 Refinement, industrial roundwood enters HWP estimates as **feedstock commodity** only (production approach), *inter alia* to **avoid double counting**

Mr. Rüter also responded to a question from the audience about the definition of the reporting of salvage logging. He clarified that salvage logging refers to the loss of timber, which is reported in the year of salvage logging and therefore enters as carbon loss data.

5.9 Accounting emissions from natural disturbances: challenges and methodological issues

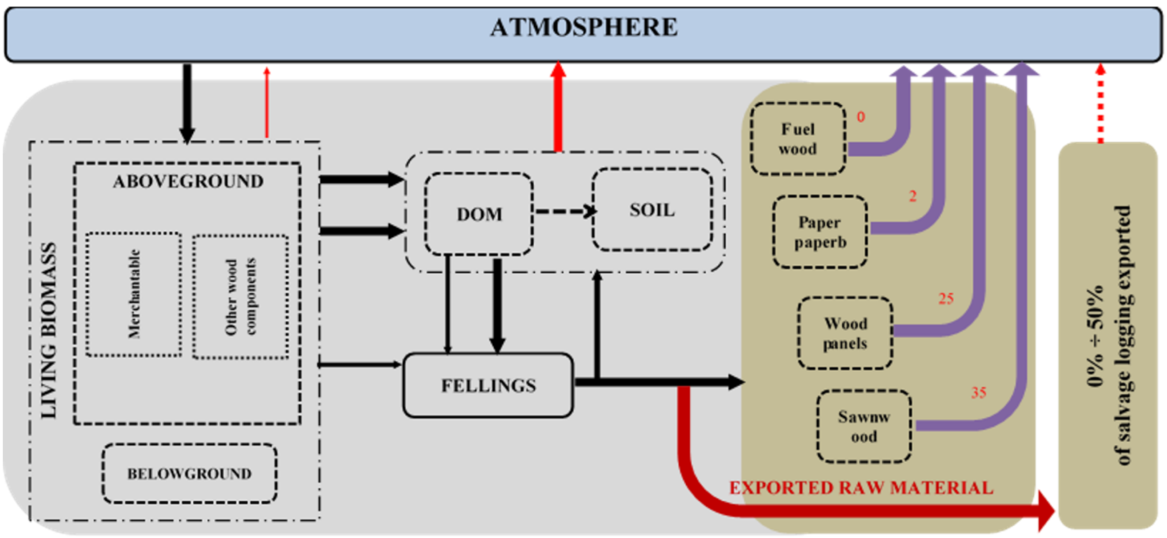
The last presentation of the workshop was carried out by **Mr. Roberto Pilli** from JRC. He presented the challenges and methodological issues of accounting emissions from natural disturbances.

Mr. Pilli began by remarking that the impact of the natural disturbances determines variations of about 10-15% of the forest carbon sink at the EU level, and even more at the national level. Additionally, there exists a lack of understanding on how to face the immediate and counterfactual effects of natural disturbances and forest management.

Further, Mr. Pilli used the case of the tropical windstorm named Vaia in 2018 as an example to quantify the potential effect of the storm on the Italian forest carbon sink in a modelling approach (Figure 38). He remarked that the storm broke down at least 9.5 106 m3 of merchantable wood in Northern Italy (≈ 45 kha), corresponding to more than 70% of the total roundwood removed in Italy in the same year. For the comparison within the modelling approach, several scenarios were used (see Pilli et al. 2021[9]):

- a business-as-usual scenario, based on the historical (until 2018) and theoretical (from 2019 to 2030) evolution of the forest carbon sink in combination with;
- a second scenario (e.g. Vaia Storm) including:
    - the direct effect of the windstorm on the forest carbon pools
    - the indirect effects of salvage logging on HWP pool, considering different share of raw wood directly exported to other countries
    - the overall forest mitigation potential at national level, including the effect of fire disturbances

Figure 38 Modelling framework: Carbon budget model (CBM) + HWP module (IPCC Tier 2)



The results of the model show that the overall total forest carbon sink decreased by 14% in 2019 and 10% in 2020. The HWP compensate the decreasing carbon sink accounted under the forest pools. Additionally, for 2022, estimations show that the final carbon sink at national level including HWP mitigation potential, will likely be higher than the values attributed to second scenario excluding HWP, and higher than the first scenario including HWP contribution.

Mr. Pilli concluded by pointing out that the results demonstrate a cascading effect induced by forest windstorms on different carbon pools. Furthermore, when fully accounted, the overall effect of this flux is a stabilisation of

[9] https://doi.org/10.1007/s13595-021-01043-6

the total carbon sink, which may slightly decrease, or increase compared with the first scenario. The overall estimate of the historical and future carbon sink is also linked to the total amount of harvest at national level. However, there is a lack of reliable statistics making the data sources highly uncertain.

Moreover, the study showed that the relative contribution of the HWP to the total carbon sink can compensate the negative carbon balance attributed to Dissolved Organic Matter (DOM) pool, due to salvage logging. The annual inflow to the HWP pool depends on (the total amount of removals; the relative share of industrial round wood; and on the fraction of domestic production attributed to each commodity. The sensitivity analysis on different level of harvest provided by salvage logging and directly exported to other countries, highlights the need to carefully assess all these quantities. Mr. Pilli finalises by remarking that the study has missing components, such as the indirect consequence of probably insect outbreaks following wildfires or windstorms.

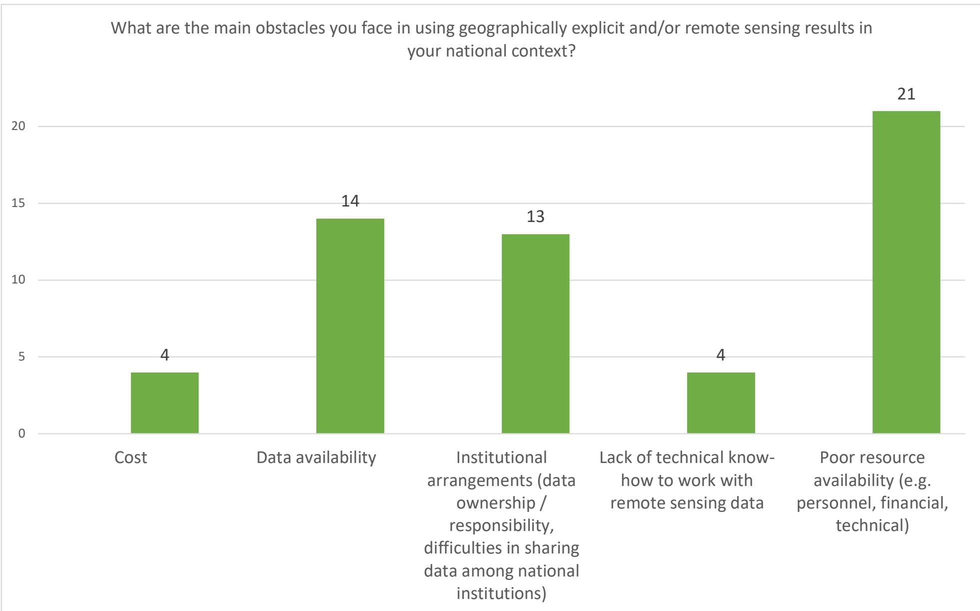
Mr. Pilli also responded to questions from the audience. One participant asked about the definition of natural disturbances, whereby Mr. Pilli responded that the presented case study focused on the Vaia Storm event, Therefore, available information was collected about fires in relation to this case within the literature.

5.10 Synthesis of the interactive discussion of the third series of live polls

Following the last presentation by Mr. Pilli, the participants were asked the last set of poll questions. The third series of poll questions was provided by **Mr Simone Rossi** from the JRC.

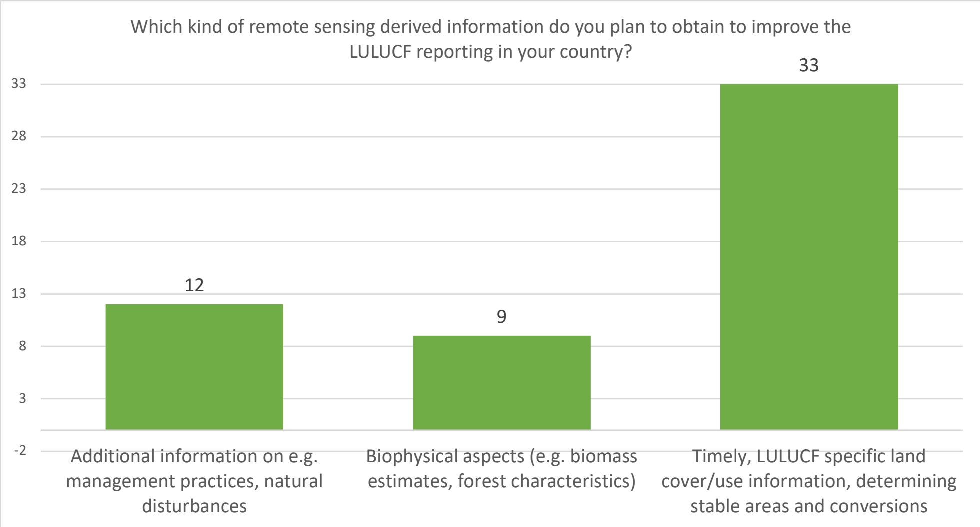
The **twelfth poll question** asked participants to decide on the main obstacles they face in using geographically explicit and/or remote sensing results in their national context. 37 respondents participated in this part of the poll, allowing for multiple-option answers. Figure 39 shows that the majority of respondents agreed that the main obstacle is poor resource availability (e.g. personnel, financial, technical) (21), followed by Data availability (14), and Institutional arrangements (data ownership/responsibility, difficulties in sharing data among national institutions) (13). The last two options were the least favoured with an equal share of responses (4 preferences respectively).

Figure 39 Respondents' answers to poll question 12



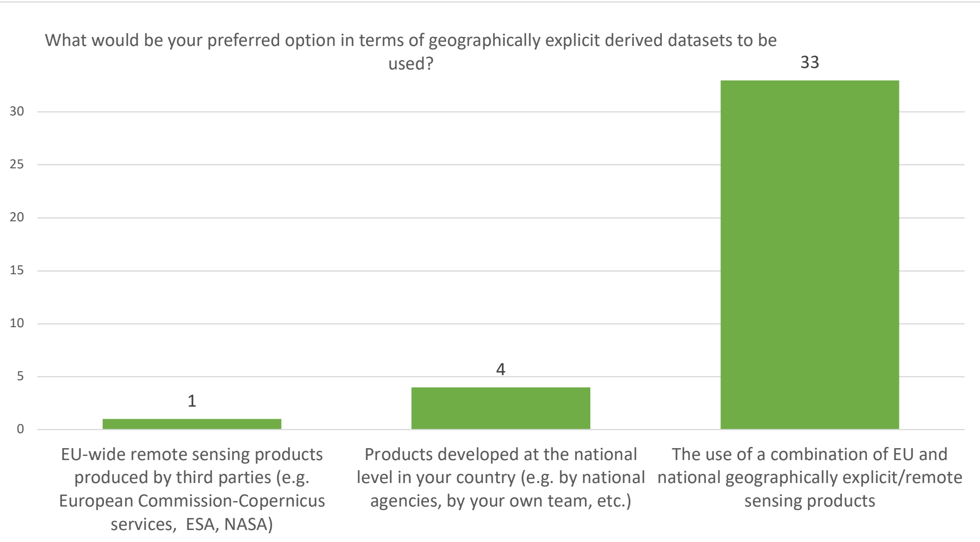
The **thirteenth poll question** asked participants what kind of remote sensing derived information they plan to obtain to improve the LULUCF reporting in their country. 39 participants answered this question which allowed for multiple options. As Figure 40 below indicates, most respondents chose ‘Timely, LULUCF specific land cover/use information determining stable areas and conversations’ (33) as their preferred option, followed by the option ‘Additional information on e.g. management practices, natural disturbances’ (12), and lastly, ‘Biophysical aspects (e.g. biomass estimates, forest characteristics) (9).

Figure 40 Respondents' answers to poll question 13



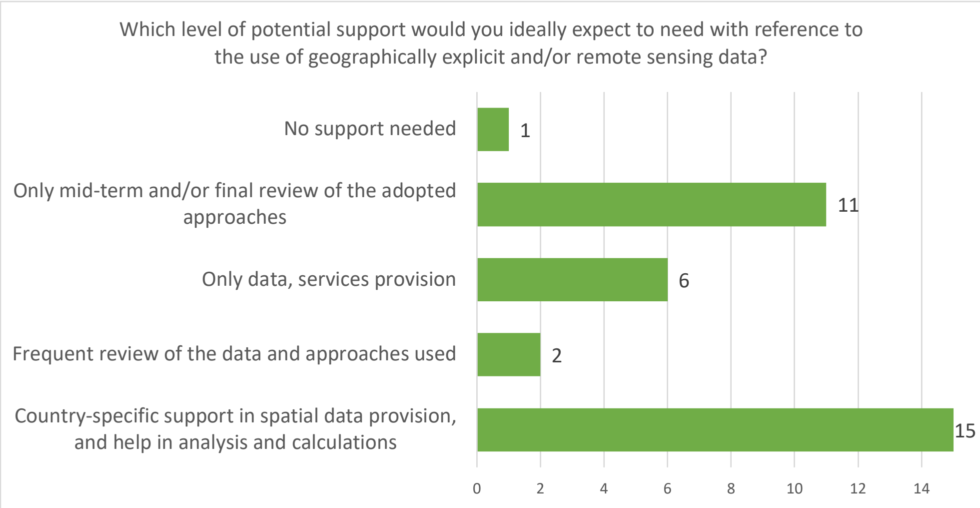
The **fourteenth poll question** asked participants about their preferred option in terms of geographically explicit derived datasets to be used. 38 participants answered this question. Of the options, participants agreed that the use of combination of EU and national geographically explicit/remote sensing products were mostly preferred (33). The other two options got low support with 'EU-wide remote sensing products produced by third parties (e.g. EC-Copernicus services, ESA, NASA) (1) as the least preferred option. The result is indicated in Figure 41 below.

Figure 41 Respondents' answers to poll question 14



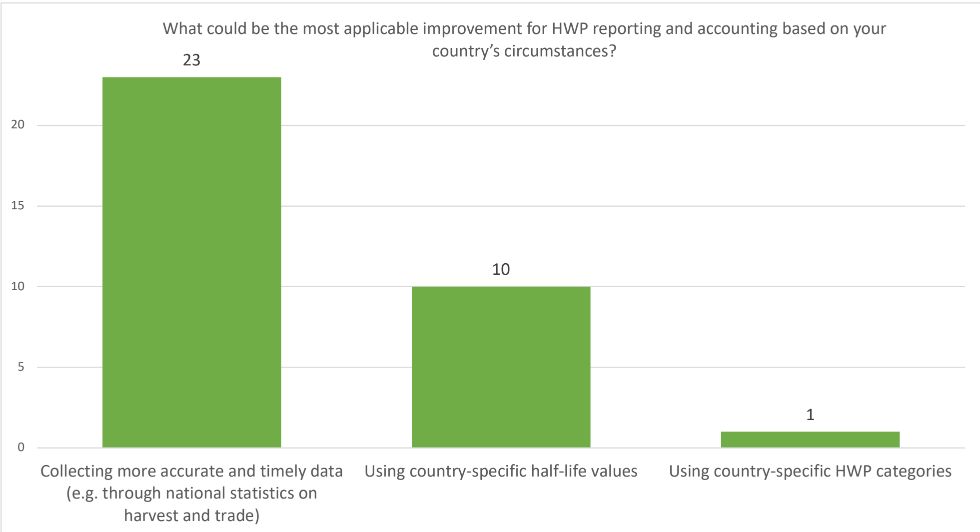
The **fifteenth poll question** asked participants which level of potential support they would ideally expect to need with reference to the use of geographically explicit and/or remote sensing data. 35 participants provided an answer. As Figure 42 below shows, the respondents' most preferred option is country-specific support in spatial data provision and help in analysis and calculation (15) of the options chosen, followed by only mid-term and/or final review of the adopted approaches (11). While one participant chose that no support is needed, two stakeholders answered that least support is needed for the frequent review of the data and approaches used.

Figure 42 Respondents' answers to poll question 15



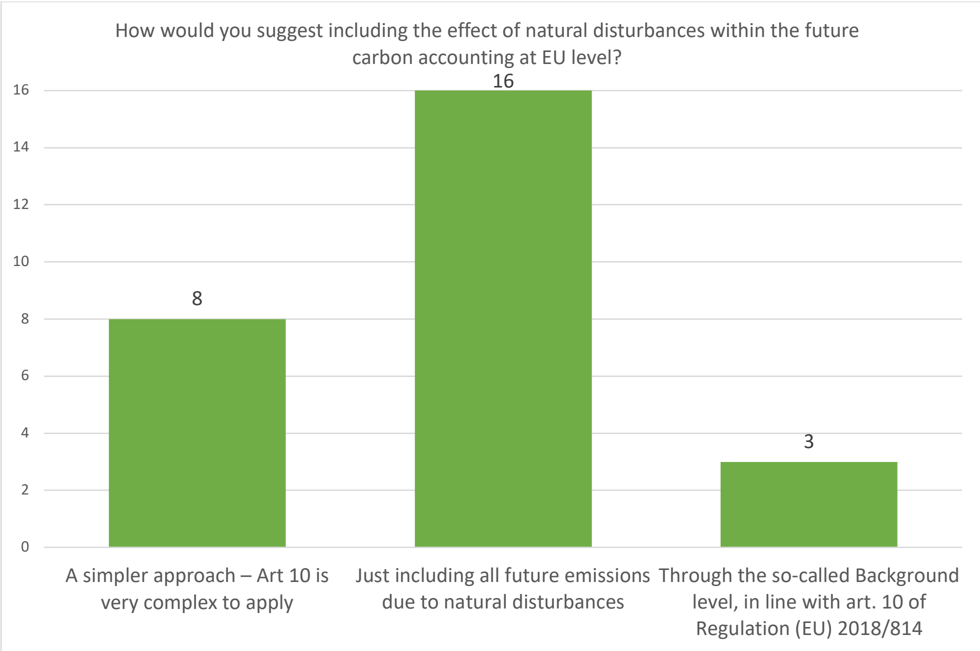
The **sixteenth poll question** asked the participants what the most applicable improvements for HWP reporting and accounting could be based on their country's circumstances. 34 stakeholders answered this question. Of the stakeholders that participated, the most support was given to collecting more accurate and timely data (e.g. through national statistics on harvest and trade) (23), followed by using more country-specific half-life values (10). The least preferred option, only supported by one stakeholder, was the option to use country specific HWP categories (1). The results can be seen in Figure 43 below.

Figure 43 Respondents' answers to poll question 16



The **last poll question** asked the participants how they would suggest including the effect of natural disturbances within the future carbon accounting at EU level. 27 stakeholders answered this question. The respondents agreed that just including all future emissions due to natural disturbances was the most preferred option (16), followed by a simpler approach as article 10 is very complex to apply (8), and lastly through the so-called Background level, in line with Article 10 of Regulation (EU) 2018/814 (3). Figure 44 below shows the distribution of the poll results.

Figure 44 Respondents' answers to poll question 17



6 Conclusions

At the end of the second day of the workshop, there was a general session dedicated to the conclusions where **Mr. Grassi** from the JRC summarised the two-days' workshop with the following key points:

- LULUCF reporting is becoming increasingly important which is emphasised by the high participation of experts and stakeholders in this workshop
- There is a need to check the consistency between the future UNFCCC requirements on LULUCF reporting, which will undergo changes under the Paris Agreement, and the requirements of the EU LULUCF Regulation.
- The FRL is a step forward in terms of the credibility of LULUCF to further understand the evolution of forest sinks and the desire to simplify this complex system in the future
- Promising projects with country-specific cases emphasise the ongoing work and potential of LULUCF
- The relation between science and policy is complex, but ultimately needed to increase the confidence in the estimates

Lastly, Mr. Grassi thanked the organizers and the speakers for their contributions as well as the participants for their valuable inputs, questions and comments during the workshop.

List of abbreviations and definitions

AFOLU	Agriculture, Forestry, and Other Land Use
AGB	Above ground biomass
AR	Afforestation, Reforestation
BGB	Below Ground Biomass
BGL	Back Ground Level
CAP	Common Agricultural Policy
CH_4	Methane
CLC+	Corine Land Cover
CLMS	Copernicus land monitoring service
CO_2	Carbon dioxide
CP2	Second Commitment Period of the Kyoto Protocol
CRF	Common Reporting Format
CSC	Carbon Stock Changes
CSF	Climate Smart Forestry
DOM	Dead Organic Matter
EC	European Commission
EEA	European Environment Agency
ERT	United Nations Expert Review Team
ESR	Effort Sharing Regulation
ETC/CME	European Topic Center on Climate Change Mitigation and Energy
EU	European Union
FAO	Food and Agriculture Organization
FISE	Forest Information System for Europe
FPA	Framework Partnership Agreement
FMRLcorr	Forest management corrected
FPCUP	Framework Partnership Agreement on Copernicus User Uptake
FRL or FMRL	Forest Reference Level, Forest Management Reference Level
GAEC	Good Agricultural and Environmental Conditions
GFC	Global Forest Change
GHG	Greenhouse Gas
GHGI	Greenhouse Gas inventory
HR-VPP	High-Resolution Vegetation Phenology and Productivity
HWP	Harvested Wood Products
IACS	Integrated Administration and Control System
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KP	Kyoto Protocol
LUKE	Natural Resources Institute Finland

LULUCF	Land use, Land use Change and Forestry
LPIS	Land-parcel Identification System
MLP	Managed Land Proxy
MRV	Monitoring, reporting and verification
MS	Member State
N_2O	Nitrous oxide
NFAP	National Forest Action Programmes
NFI	National Forest Inventory
NDVI	Normalized Difference Vegetation index
NIR	National Inventory Report
QAQC	Quality Assurance Quality Control
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
TACCC	Transparency, Accuracy, Completeness, Comparability, and Consistency
UN	United Nations
UN ARR	United Nation Annual Review Report
UNFCCC	United Nations Framework Convention on Climate Change

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Annexes

Annex 1. Final agenda for Day 1: Monday 7 June 2021

Agenda		
Present challenges for LULUCF reporting and accounting		
14.00 – 14.10	**Welcome**	Luisa Marelli, JRC Giacomo Grassi, JRC
14.10 – 14.25	**Overview of LULUCF inventory at EU level**	Giacomo Grassi, JRC Raúl Abad Viñas, JRC
14.25 – 14.40	**Results of 2021 QAQC checks and 2020 draft UN ARR of the EU GHGI for LULUCF**	Raúl Abad Viñas, JRC
14.40 – 15.10	**MRV of LULUCF inventories - first results of the trial LULUCF review**	Claire Qoul, European Environment Agency Peter Iversen, European Environment Agency
15.10 – 15.25	**Coffee break**	
15.25 – 15.55	**Review of 2021 submissions decision 529/2013**	Simone Rossi, JRC
15.55 – 16.30	**Interactive poll**	Moderated by Raúl Abad Viñas, JRC
16.30 – 16.50	**Estimating conversion-induced carbon stock changes in mineral soils - a case study from Hungary**	Zoltan Somogyi, University of Sopron Forest Research Institute
16.50 – 17.00	**Discussion session**	
17.00 – 17.20	**Closing the KP2: Forest Management Reference Level and Technical Corrections**	Giacomo Grassi, JRC Raúl Abad Viñas, JRC
17.20 – 18.00	**Technical discussion around Forest Management Reference Level and Technical Corrections (Interested participants only)**	

Annex 2. Final agenda for Day 2: Tuesday 8 June 2021

Agenda		
	Future challenges for LULUCF reporting and accounting	
09.00 – 09.30	Points of attention for LULUCF reporting under Regulation 2018/841	Eric Arets, Wageningen Environmental Research
09.30 – 10.00	LULUCF inventory developments	Raúl Abad Viñas, JRC
10.00 – 10.15	Coffee break	
10.15 – 11.00	Relevant updates in IPCC 2019 Refinement	Sandro Federici, JRC
11.00 – 11.20	Forest Reference Levels for 2021-2025	Anu Korosuo, JRC
11.20 – 12.10	Interactive poll	Moderated by Viorel Blujdea, JRC
12.10 – 12.30	Discussion session	
12.30 – 14.00	Lunch break	
	Science for GHG inventories	
14.00 – 14.20	HoliSoils - Holistic management practices, modelling & monitoring for European forest soils	Aleksi Lehtonen, Luke
14.20 – 14.40	Synergies between the CAP new delivery model and LULUCF inventories	Emanuele Lugato, JRC
14.40 – 15.20	On the role of Copernicus products in support of LULUCF inventory compilation	John van Aardenne & Tobias Langanke, European Environment Agency
	Case study 1 – FPA Copernicus User Uptake Action 2019-2-49 in Spain: Developing support for monitoring and reporting of GHG emissions and removals from LULUCF	Jose Manuel Álvarez- Martínez, University of Cantabria & María José Alonso Moja, Spanish Ministry of Ecological Transition and Demographic Challenge
	Case study 2 – Finland: Experiences with Copernicus data in detection and monitoring land use and land-use change	Tarja Tuomainen, Luke
15.20 – 15.45	Perspectives of remote sensing for the monitoring of forest resources	Alessandro Cescatti & Giacomo Grassi, JRC
15.45 – 16.00	Coffee break	
16.00 – 16.20	Estimating and reporting of emissions/removals from living biomass/DOM and HWP associated with windthrow	Dr. Sebastian Rüter, Thünen Institute of Wood Research
16.20-16.40	Accounting emissions from natural disturbances: challenges and methodological issues	Roberto Pilli, JRC
16.40-17:00	Interactive poll	Moderated by Simone Rossi, JRC
17.00-17.50	Discussion session	
17.50-18.00	Conclusions	

Annex 3. Final list of attending participants

Number	Name	Organisation	Role in the workshop
1	Albert Ciceu	N/A	Participant
2	Aldis Butlers	Latvian State Forest Research Institute "Silava"	Participant
3	Aleksi Lehtonen	Natural Resources Institute Finland (Luke)	Speaker
4	Alessandro Cescatti	Joint Research Centre	Speaker
5	Alessia Maghella	Joint Research Centre	Organizer
6	Ali Nadir Arslan	Finnish Meteorological Institute	Participant
7	Ana Pina	Agência Portuguesa do Ambiente, Portugal	Participant
8	Anaïs Valance	French Ministry of Agriculture and Food	Participant
9	Andre Guns	Walloon Agency for Air and Climate	Participant
10	Andreas Gensior	Thuenen Institute of Climate-Smart Agriculture	Participant
11	Andreas Schellenberger	Federal Office for the Environment, Switzerland	Participant
12	Anu Korosuo	Joint Research Centre	Speaker
13	Areti Christodoulou	Department of Forests, Ministry of Agriculture, Rural Development and Environment, Cyprus	Participant
14	Arnór Snorrason	Icelandic Forest Research	Participant
15	Arta Bardule	Latvian State Forest Research Institute "Silava"	Participant
16	Bostjan Mali	Slovenian Forestry Institute	Participant
17	Bostjan Petelinc	Ministry for agricultural, forestry and food of Republic of Slovenia	Participant
18	Paciurea Brindusa	National Environmental Protection Agency	Participant
19	Kevin Keegan	Department of Agriculture, Food & the Marine, Ireland	Participant
20	Carmen Schmid	Umweltbundesamt (Environment Agency Austria)	Participant
21	Charlie Clark	Ministry for the Environment, New Zealand	Participant
22	Claire Qoul	European Environment Agency	Speaker
23	Colas Robert	Citepa	Participant
24	Demetris Demetriou	The Cyprus Institute	Participant
25	Andre Deppermann	IIASA	Participant

26	Fulvio Di Fulvio	IIASA	Participant
27	Detelina Petrova	Ministry of Environment and Water, Bulgaria	Participant
28	Despoina Vlachaki	National Technical University of Athens	Participant
29	Efisio Solazzo	Joint Research Centre	Participant
30	Eirik Waagaard	EFTA Surveillance Authority	Participant
31	Elisabeth Pagnac	Ministry for an ecological transition, France	Participant
32	Emanuele Lugato	Joint Research Centre	Speaker
33	Emil Cienciala	IFER - Institute of Forest Ecosystem Research	Participant
34	Eric Arets	Wageningen Environmental Research	Speaker
35	Erik Karltun	SLU	Participant
36	Esther Thürig	Swiss Federal Institute for Forest, Snow and Landscape Research WSL	Participant
37	Eve Suursild	Estonian Environment Agency	Participant
38	Florian Claeys	European Commission, DG CLIMA	Participant
39	Frank Detener	Joint Research Centre	Participant
40	Giacomo Grassi	Joint Research Centre	Speaker
41	Gintaras Kulbokas	Lithuanian State Forest Service	Participant
42	Giulia Fiorese	Joint Research Centre	Participant
43	Goran Kovač	Hrvatske šume d.o.o. (Croatian forest Ltd.)	Participant
44	Greet Maenhout		Participant
45	Guido Pellis	ISPRA	Participant
46	Hanna-Lii Kupri	Estonian Environmental Research Centre	Participant
47	Hans Petersson	Swedish University of Agricultural Sciences	Participant
48	Harry Vreuls	RVO	Participant
49	Hayden Montgomery	Global Research Alliance	Participant
50	Helen Karu	Estonian Environment Agency	Participant
51	Hrvoje Marjanović	Croatian Forest Research Institute	Participant
52	Igor Stankic	Ekonerg - energy research and environmental protection institute	Participant

53	Iván Martínez	Ministry for the Ecological Transition and the Demographic Challenge	Participant
54	Giannos T	N/A	Participant
55	Ivan Barka	National Forest Centre	Participant
56	Jose M. Álvarez-Martínez	Environmental Hydraulics Institute IHCantabria	Speaker
57	Jóhann Þórsson	SCSI	Participant
58	Juan José Rincón Cristóbal	Climate Change Atelier, S.L.	Participant
59	Judit Szakálas	National Land Center	Participant
60	John van Aardenne	European Environment Agency	Participant
61	Katarzyna Kowalczewska	European Environment Agency	Participant
62	Kevin Keegan	Department of Agriculture, Food & the Marine, Ireland	Participant
63	Kleanthi Pavlidou	General Directorate of Forest and Forest Environment, Greece	Participant
64	Lærke W. Callisen	European Commission, DG CLIMA	Participant
65	Leone Tinganelli	Soil Conservation Service of Iceland	Participant
66	Lora Stoeva	Forest Research Institute - Bulgarian Academy of Sciences	Participant
67	Luisa Marelli	Joint Research Centre	Speaker
68	Modestas Mačiulskas	State Forest Service, Lithuania	Participant
69	Malin Kanth	Naturvårdsverket	Participant
70	Marcin Żaczek	IOS PIB	Participant
71	Marina Vitullo	SPRA	Participant
72	Matteo Vizzarri	Joint Research Centre	Organizer
73	Mattias Lundblad	Swedish University for Agricultural Science	Participant
74	Mélanie Juillard	Citepa	Participant
75	Michal Sviček	National Agriculture and Food Centre - Soil Science and Conservation Research Institute, Slovakia	Participant
76	Maria J Sanz	Basque Centre for Climate Change (BC3)	Participant
77	María José Alonso	MITERD	Speaker

78	María del Mar Esteban	Tecnologías y Servicios Agrarios, S.A., S.M.E., M.P. (TRAGSATEC)	Participant
79	Melina Menelaou	Ministry of Agriculture, Rural Development and Environment, Cyprus	Participant
80	Nele Rogiers	Swiss Federal Office for the Environment, Forest Division	Participant
81	Normunds Struve	N/A	Participant
82	Paula Ollila	Natural Resources Institute Finland (Luke)	Participant
83	Peter Iversen	European Environment Agency	Speaker
84	Peter Weiss	Umweltbundesamt, Austria	Participant
85	Radka Maskova	IFER - Institute of Forest Ecosystem Research	Participant
86	Raul Abad Viñas	Joint Research Centre	Speaker
87	Raul Radu	INCDS National Research and Development Forestry Institute	Participant
88	Rene Colditz	European Commission	Participant
89	Roberto Pilli	Joint Research Centre	Speaker
90	Sandro Federici	IPCC TFI TSU	Speaker
91	Sebastian Rüter	Thünen Institute of Wood Research	Speaker
92	Steen Gyldenkærne	Dept. Env. Sci. Aarhus University	Participant
93	Shane Flanagan	DAFM	Participant
94	Simon Kay	European Commisison	Participant
95	Simon Poljansek	Ministry of agriculture, forestry and food, Slovenia	Participant
96	Simona Bosco	Joint Research Centre	Participant
97	Simone Rossi	Joint Research Centre	Speaker
98	Sini Niinistö	Statistics Finland	Participant
99	ens.b310	N/A	Participant
100	Signe Borgen	N/A	Participant
101	Zoltan Somogyi	University of Sopron Forest Research Institute, Hungary	Speaker
102	Stefan Nielsen	Danish Energy Agency	Participant
103	Sven van Baren	Wageningen University & Research	Participant

104	Tijl Naveau	Flemisch Environment Agency (VMM)	Participant
105	Tarja Tuomainen	Natural Resources Institute Finland (Luke)	Speaker
106	Tiago Carreira Seabra	Agência Portuguesa do Ambiente, Portugal	Participant
107	Tibor Priwitzer	National Forest Centre, Slovakia	Participant
108	Tim Mirgain	Administration de l'envrionnement, Luxembourg	Participant
109	Tobias Langanke	European Environment Agency	Participant
110	Ulrike Döring	Federal environment Agency	Participant
111	Viktoria Peteri	Ministry for Innovation and Technology, Hungary	Participant
112	Viorel Blujdea	Joint Research Centre	Participant
113	Vivian Kvist Johannsen	University of Copenhagen	Participant
114	Vlatka Palčić	Ministry of Economy and Sustainable Development, Croatia	Participant
115	Wolfgang Stümer	Thünen Institute of Forest Ecosystems	Participant

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