How to achieve reliable, transparent and independent monitoring of greenhouse gas emissions from land activities for policy support

Paper for the 2016 Berlin Conference on Global Transformative Climate Governance après Paris.

May 2016

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Keywords: MRV, performance assessment, land-based emissions, carbon accounting

Abstract

We are undertaking analysis and case studies to develop proof of concept for publicly available, comprehensive, global, and independent spatial information systems on land cover and land use, their dynamics and the associated carbon stocks and flows (emissions). Current global monitoring systems provide an opportunity for comparative analysis. But there is also an increasing demand for more efficient and effective systems addressing different user needs and allowing for performance assessment of climate and development policies and their outcomes. Such assessments are increasingly important in the post-Paris world and with regard to the SDGs and other coordinated development efforts. For performance assessments, the baselines and underlying assumptions must be clear and transparent. While some authors ask for uniformed, standardized approaches, we contend that the increasing portfolio of aspects that need to be measured and assessed will have the consequence that different users will have different needs with regard to data type, time and scale resolution, and national circumstances. Getting performance assessment right is important for many aspects of global governance that will be discussed at this conference: Policy transformation will ultimately depend on possibilities to assess the outcomes; justice, fairness and equity will depend on clear and transparent data and rules of the game across multiple levels of government and policy action. A better analysis of discourse can be achieved in the light of unambiguous data. Here we will provide an update on the efforts, discuss them in view of current developments and the Paris climate agreements, and identify what needs to be done over the next 5 years (post-2015) and beyond (post-2020).

Introduction

The IPCC (2014) has established that global greenhouse gas (GHG) emissions must be cut by 41-72% below 2010 levels by 2050 for a likely chance of limiting the increase in global mean temperature to 2°C. This requires substantial changes in energy systems and land use. "T*he AFOLU [Agriculture, Forestry and Other Land Use] sector accounts for about a quarter (~ 10-12 GtCO2eq / yr) of net anthropogenic GHG emissions mainly from deforestation, agricultural emissions from soil and nutrient management and livestock (medium evidence, high agreement)*" (IPCC 2014) and hence is an important sector for mitigation actions. The IPCC (2014) further states: "*The most cost-effective mitigation options in forestry are afforestation, sustainable forest management and reducing deforestation, with large differences in their relative importance across regions. In agriculture, the most cost-effective mitigation options are cropland management, grazing land management, and restoration of organic soils (medium evidence, high agreement).*"

The eminent potential of forests for climate change mitigation has strongly been recognized in the Paris Climate Agreement. The Agreement endorses Reduced Emissions from Deforestation and Forest Degradation (REDD+), allows for alternative (non-market) policy approaches such as joint mitigation and adaptation, and emphasizes the importance of non-carbon benefits and equity for sustainable development. Countries should develop capacities and grow their national ambitions through their INDCs (later NDCs[1]) towards reaching the 2.0/1.5°C goal. Likewise, the UN Sustainable Development Goals (SDGs) emphasize climate, forests and bioenergy. The Green Climate Fund has begun its work but much needs to be done before large results-based funds will flow with transparency and accountability. In this political context, decision-makers at all levels need information and guidance for policy and action. They need to know how to achieve climate mitigation and adaptation through the implementation of NDCs, and how to increase ambition. They will need to mainstream climate policies across the sectors and levels of government. They will need to inform the Facilitative Dialogue in 2018 and the five-yearly Global Stocktakes starting in 2023. Aiming for these goals, they will increasingly look for tested, trusted, and reliable information, and for cost-efficient (policy) performance assessment methods and procedures that allow them to assess the state, dynamics and drivers of change of land resources, livelihoods, social protections and equity indicators.

Performance assessment is at the heart of policy development based on an interactive approach that acts flexibly upon feedback on policy measures and decision-makers act upon this feedback. This is not the reality in many countries and requires a major paradigm shift. We need to develop rigorous performance assessment methods for climate policy and practice that can (i) be done efficiently and (ii) be used for effective policy making.

[1] Intended Nationally Determined Contributions (INDCs) were submitted by 188 countries up to October 2015. Countries have to submit updated Nationally Determined Contributions (NDCs) before 2018, and then again every 5 years.

Independent Monitoring

Publicly available, comprehensive, global, spatial information systems on land cover, land emissions, land use and associated trends should be tailored to multiple uses relevant to varying users. Depending on the purpose and scope, information systems should include information that allows to:

- unambiguously assess areas, carbon densities, trends using a global consistent methodology and independently from specific country or industrial interests to become an independent source of information;
- develop a clear definition and separation of different land uses that are climate-/emissions- relevant (primary forests, afforestation and afforestation history (e.g. differentiate reforested areas from primary forests from those from degraded lands), sustainable and unsustainable forest management (equivalent to degradation?), cropland, grasslands and the sustainability of their management, soil restoration);
- minimize misclassification and have built-in feedback mechanisms to allow for data correction from ground-truthing and site-specific assessments;
- incorporate emission factors (EF) and carbon densities so that area /biomass maps can be transformed into maps of carbon stocks and emissions, and ideally should allow for scale adaptation to accommodate improving EF data availability (according to the stepwise approach).
- provide sufficiently high spatial resolution to be of use for individual land users; and also provide sufficiently high time resolution to be able to detect short term changes for various uses;
- provide assessments by geographical boundaries (countries, jurisdictions at large, projects). If different forest definitions could be accommodated, it could provide an independent assessment of national reports and support national reporting needs under the Warsaw framework.

Additional possible requirements would be to identify drivers (such as mining, logging, unsustainable practices), allow for an assessment of additionality, allow identifying hotspots for mitigation (identifying high density carbon areas that need to be protected or high-potential-gain areas e.g. Central Asia; deforested drylands, degraded dry forests that need to be prioritized for restoration) and adaptation priorities (e.g. managing climate risk) and issuing alerts /early warnings.

It is clear that no single monitoring system will be able to supply all these functionalities. It seems therefore important that monitoring systems, so far often supply-driven (i.e. realizing what is technically possible), be designed from the demand side – by asking what functionalities users and stakeholders need, we will be able to suggest and implement solutions that are tailor-made to the users' most important needs. The aim of independent information systems is to provide objective information to specific user groups (beneficiaries) and to enable the user groups to use

this information for decision making. Accounting systems will be crucial in any future climate policy framework as without them, results- based finance will be difficult to disburse reliably. Designing them in ways that the increasingly complex objectives as listed above can be met is a challenge.

We currently address these questions through an assessment of existing monitoring systems, an analysis of the various users' needs through a survey and in workshops, and case studies in order to be able to develop specific criteria to assess tools and data sets for their ability to contribute to financial and technical efficiency and effectiveness of monitoring systems, and improve their ability and flexibility to provide a wide array of services to different users, including the assessment of non-carbon co- benefits such as biodiversity and livelihoods.

Preliminary results from case studies

We are currently developing case studies with the objective to demonstrate how to enable, catalyze or fasten progress towards more reliable, accurate, precise, time-consistent and globally comparable information on land emissions. The case studies are supposed to show how adequate and independent information is already or can be made available for stakeholders for decision making.

In case study 1, **global contribution of AFOLU GHG emissions (2000-2005) - patterns, uncertainties and drivers**, we look at the feasibility to develop global, spatially explicit AFOLU GHG emission maps that also inform on the associated uncertainties, and we are assessing the relative contribution of the sources behind these emissions at different scales (continental, regional, national). For this, we make use of the latest available state-of-the-art global and spatially explicit GHG emission datasets for key drivers behind AFOLU emissions (i.e. deforestation, degradation (fire and wood harvesting), soil emissions from crops, soil emissions from paddy rice and livestock). This should help countries locating the hotspots of national land use emissions and to prioritize regional and national mitigation initiatives, e.g. decide which greenhouse gases, where, and which drivers to tackle first. The case study brings together various independent datasets, and, for the first time, runs a spatially explicit (0.5°) analysis on AFOLU GHG emissions (CO2, CH4, N2O), with associated spatially explicit uncertainties, based on Monte Carlo simulations. This work helps developing a framework to harmonize data sets, avoiding inconsistencies in definitions and assumptions about data availability. The resulting maps will offer global benchmark information on the location of AFOLU GHG emission hotspots, in a spatially explicit manner, against which countries can contrast the evolution of their AFOLU GHGs emissions and the effectiveness of their mitigation activities. These maps also show where uncertainties still challenge mitigation planning, where data gaps are most pronounced, and how the use of independent datasets can help countries and regional approaches to better plan and define emission reduction targets in the land use sector broadly. The study is global in nature and will derive the information (i.e. estimations,

uncertainties, gaps) on how these data can be used for regional and national purposes. We aim at assessing the utility of the produced data at continental and country level.

The goal of case study 2, **shedding light on forest change, deforestation and degradation datasets,** is to: (1) consolidate estimates of deforestation in the evergreen closed canopy forests of the humid tropics by comparing several existing datasets of forest area loss; (2) demonstrate how to measure forest degradation by logging and fire in the evergreen closed canopy forests of the humid tropics by proposing some methodological tools, and (3) promote a dialogue among data producers.

Contemporary satellite and technological developments have stimulated a large number of mapping projects to monitor land use and change. These projects have considerably improved the availability of forest change maps. At the same time, these mapping activities have resulted in many data for individual countries or regions that have used different methodological approaches and different definitions of what constitutes for example a “forest” or “deforestation”. Therefore, the accurate quantification of forest area change from deforestation (conversion to agriculture) and forest degradation (by fire and logging) continues to manifest methodological challenges. While more and more datasets become available, data integration and interpretation are among the most critical current needs to develop transparent and effective mitigation plans. The case study presents methods how to compare and validate three existing key forest loss datasets using a common reference; and demonstrates how to map forest degradation by fire and logging. The end product will be a comparison and a dataset for deforestation and degradation activities. We also intend to provide better understanding of the agreements and disagreements between datasets, including accuracies and confidence intervals.

The case study reveals how to measure the impact of plantations development on forests, with oil palm and pulpwood being an example. It addresses how to monitor zero-deforestation commitments made by the corporate sector in the palm oil and pulpwood industries by overlaying information on concessions over the deforestation and degradation datasets as required by certification bodies and auditors to verify zero-deforestation pledges.

A “side case study” is focusing on forest degradation to address the question of how degradation can be detected by using different datasets.

Stakeholder satisfaction with tropical deforestation and degradation datasets is low, despite the increasing availability of such products. Until now, datasets for forest change highlighting areas of deforestation and degradation have not been compared, and accuracies have not been verified against a common standard. This leads to confusion as to which dataset should be used or how they should be combined and/or merged with other datasets to yield improved estimates of deforestation and degradation. Crowd-sourcing could be a powerful tool to reduce costs while being instrumental to assessing uncertainties at both the regional / national level. The case study will bring together various independent datasets of forest change, for the first time assessing uncertainties. The employed methodology of integrating remote sensing data, crowdsourcing and ground truth data collection is applicable across the entire rainforests of the humid tropics and

across in other regions of the globe. This part of the project also highlights issues relating to national ownership. National sensitivities around comparing the different datasets could be addressed by focusing the discussion on which datasets fit to which purposes, emphasizing that while there is no "wrong" data, data can be used inappropriately for the intended purpose.

Case study 3, **global forest biomass uncertainties and their integration with national and regional estimation and reporting**, will provide an independent assessment of global forest biomass uncertainties to allow users to understand the feasibility and risks of each data set to be used for the users' purposes. For this, we will use the latest global spatially explicit available forest biomass maps and extensive ground data from national forest inventories, research forest plots and new crowd-sourcing approaches (i.e. Geo-Wiki). This assessment will support countries to improve their national forest biomass and emissions estimates as well as navigate them towards regions that would benefit from further data collection efforts.

Case study 3 will bring together data from "top-down" global biomass mapping research (i.e. from the remote sensing community), and a set of "bottom up" data streams from ground measurements and inventories to try to derive a best estimate for the purpose of estimation and reporting. Based on uncertainty analysis, the study will develop a tool to integrate the so far largely independent data streams to contribute to make better use of the data available at country and regional levels. Focus areas will be tropical countries and Europe. The comparison and integration of the different datasets will allow to better assess uncertainties of the global maps in areas where appropriate reference data are available, identify the best map for the case study and evaluate integration approaches aimed at providing improved estimates using national plot or other reference datasets. In a second step, the impact of biomass uncertainties on carbon emissions from deforestation can also be assessed.

The joint use of global and local estimates is central to the study. The developed tools and methods will be tested with users in specific country and regional circumstances and, once tested, will be applicable in many more circumstances (i.e. all countries, regions etc.). As demonstrated, best guess biomass maps can be compiled including information not publically accessible. Without sharing original data, such kind of information can be used to improve independent estimates of biomass.

Case study 4, **contributing to improved emission factors for forest and agriculture with biophysical soil models**, aims at improving accessibility and increasing transparency of Tier 3 methods (e.g. soil models) to estimate soil GHG emissions and removals. Tier 3 approaches are the more sophisticated, spatially explicit models a country can use for emission estimates. Soils are an important carbon pool that cannot be neglected in accurate assessments of GHG sources and sinks, and in view of their potential for mitigation. Many stakeholders would like to see more Tier 3 approaches to be used for the estimation of soil GHG emissions. More and more soil models are used for producing inventories. But using models does not necessarily improve estimates of soil emissions and could lead to increased loss of transparency for the estimates. This case study looks at selected country examples analyzing models, methods and data they use.

Lessons learnt from Annex 1 countries will be derived for non-Annex 1 countries, and guidance will be provided on how estimates involving soil models can be made more transparent.

This case study addresses especially the estimation of soil emissions and associated trends. The investigated information systems will enable users to reconcile model-derived estimates. Models are typically also used to assess mitigation options by running scenarios to prioritize effective and efficient climate action. Tier 3 methods are typically applied at national level. However, modeling tools are often developed internationally and for global application. The results of the case study can easily be transferred to other regions and models because it addresses general principles for increasing transparency.

Outlook

The case study results will be analyzed in a final synthesis in which we will assess weaknesses, risks and gaps across the analyzed cases, datasets and web portals to understand to what extent they would be feasible, efficient and effective in addressing the identified gaps, risks and weaknesses. We believe that providing evidence on reduced emissions and development outcomes through independent monitoring is going to be essential in any future climate and development policy context, e.g. with regard to climate reporting under the Paris Agreement, or development reporting (including climate) under the UN Sustainable Development Goals. Given our general objective of a proof of concept for a publicly available, comprehensive, global, and spatial information system on land cover, land emissions, land use, we will develop recommendations and identify follow-up research and development needs.

Acknowledgement

The work is funded by the European Commission DG CLIMA study contract N° CLIMA.A.2/ETU/2014/0008, Strengthening Independent Monitoring of GHG Emissions from Land Activities for Publishing, Comparing and Reconciling Estimates.

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