Applicability of the Hansen Global Forest Data to REDD+ Policy Decisions

KEY MESSAGES:

- The Hansen Dataset provides a no-cost, transparent, and globally available historical record of forest loss
- The dataset is consistent with IPCC principles and can be part of a toolkit for meeting existing guidance for setting REDD+ reference levels

Introduction

Globally the destruction of tropical forests causes around 10% of global greenhouse gas emissions[1]; therefore, those who are concerned about mitigating climate change are working to end deforestation. Policy incentives to promote actions to reduce these emissions require appropriate data to ensure the effectiveness of these actions. However, availability, access to, and accuracy of these data can present a challenge for many countries without a history of collecting such information. This paper aims to describe a new globally available tool for evaluating the conversion of forests uses and its implications on policies aiming to reduce deforestation.

How the Hansen Dataset is a breakthrough

One year ago researchers released a global map of forest cover loss, known colloquially as the Hansen data, after the lead researcher, Dr. Matthew Hansen[2]. For a number of reasons, the Hansen Dataset is a scientific breakthrough[3]. First, the global nature of the data facilitates comparability across jurisdictions. Second, these data are annually updated at an unprecedented resolution of 30 by 30 meters, based on well-tested remote sensing technology. Third, these data are accessible and transparent, in that they are provided free of charge and the underlying data, methodology, uncertainty, and results are fully shared with any individual who would like to use the information. In these ways the Hansen Dataset helps ensure that a global understanding of forest cover loss meets the key Intergovernmental Panel on Climate Change (IPCC) principles: transparency, accuracy, consistency, comparability, and completeness (See Box 1 for definitions of these terms).

1 IPCC AR5 Synthesis Report. Available at http://www.ipcc.ch/

2 Hansen, M.C., P.V. Potapov, R. Moore, M. Hancher, S.A. Turubanova, A. Tyukavina, D. Thau, S.V. Stehman, S.J. Goetz, T.R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C.O. Justice, and J.R.G. Townshend. 2013. High-resolution global maps of 21st-century forest cover change. *Science* 342(6160): 850-853.

3 Available online at: http://www.earthenginepartners.appspot.com/science-2013-global-forest/download.html

BOX 1:

What do the terms used for the IPCC principles mean?

While the IPCC principles of transparency and accuracy reflect common use of these terms, the other principles carry connotations more specific to the IPCC:

- **Consistency** means that over time measurements are internally consistent from previous years. That is, the same methodologies are used for the base year and subsequent years, and consistent data sets are used for both greenhouse gas emissions and sequestration measurements. Many policy makers often make the mistake of using this term when they really mean comparability.
- **Comparability** means that the estimates can be compared among different jurisdictions and meet methodologies agreed by international bodies.
- **Completeness** means that all significant sources of emissions (or sequestration) are considered and that the jurisdiction has full geographic coverage, as appropriate.

Defining deforestation

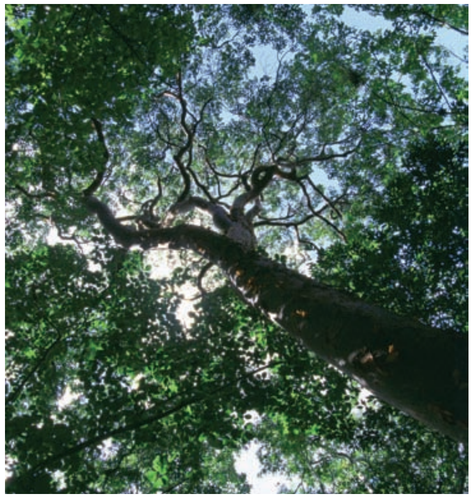
According to the IPCC, deforestation is the conversion of forest to non-forest—when caused by humans. This definition does not include the full removal of tree cover when trees are allowed to immediately regenerate[4]. Therefore, countries can be consistent with this definition while ignoring large-scale loss of diverse native forest cover such as conversion of natural forest to exotic tree plantations. In contrast, the Food and Agriculture Organization (FAO) describes cases of tree cover removal followed by artificial establishment of tree cover as "deforestation" followed by "reforestation." Given these competing definitions, it may be useful to differentiate "deforestation of natural forests" to include what many are concerned about in terms of deforestation, like the conversion of high diversity native forests to oil palm plantations.

Given this confusion, and the need for a comprehensive and consistent approach to track the biophysical phenomenon of changes in forest cover area, the Hansen Dataset avoids the term "deforestation" and tracks "forest loss" as occurring, regardless of cause, when the percent of tree canopy cover falls below a specific threshold (e.g. 30%) at the scale of a Landsat satellite pixel (30 x 30 meters). The Hansen Dataset can be used to detect "deforestation" as long as additional information is available to distinguish forest loss that qualifies as deforestation from that which does not, and depending on the definition of "deforestation" in use.

Box 2 provides a sense of how the IPCC definition of deforestation and Hansen's use of forest cover loss can very often overlap, but sometimes be different. This differentiation is critical to understanding many cutting-edge technologies that are measuring such changes at a global scale.

Challenges to using the Hansen Dataset

Like all measurement tools, the Hansen Dataset has limitations. Effective use of this dataset requires a clear understanding of what this dataset is and is not measuring.



The Hansen Dataset can be used as part of a functioning comprehensive carbon accounting system, but it needs information on the forest's carbon stocks (i.e. "benchmark biomass map") to do so effectively. These biomass maps are spatially-explicit datasets on the amount of carbon stored in the forest at a given point in time—usually the beginning of the reference period for which forest loss is tracked. The integration of Hansen data, a benchmark biomass map, and information about the proportion of biomass released as CO2 upon conversion, allows users to convert the *area* of forest loss into *greenhouse gas emissions*[5].

Globally, forest carbon fluxes are dominated by the loss and growth of natural forests, which represent over 93% of global forest cover[6]. However, the issue of differentiating natural and plantation forests is important for conservation considerations, like impacts on biodiversity, local communities, and ecosystem services. Therefore it is important to be able to differentiate between two different events which both appear as forest cover loss in the Hansen Dataset: first, when an existing plantation has reached maturity and is harvested; or second, when a natural forest is replaced with a non-native plantation. In places where plantation forestry is extensive, like the southeastern US, central Chile, eastern Brazil, China, and Russia, it can be challenging to use remotely sensed data to differentiate native and non-native forest cover. For any forest type, to understand the *carbon* implications of forest loss and gain, users do not need to differentiate between native and non-native forests, but they do need a good biomass map to calculation the greenhouse gas emissions.

Furthermore, it is important to note that any forest measurement data have sources of error, including the Hansen Dataset. By freely providing spatially explicit data as well as transparent information on uncertainty, the error of the Hansen Dataset can be quantified at any scale the data are applied to—an improvement over many forest monitoring systems. Sources of error in the Hansen Dataset include uncertainly in forest-grassland transition areas where tree cover is just on the margin of the remotely-sensed definition of a forest—that is, in areas where tree canopy is close to a specified threshold (e.g. 30% cover of trees at least 5 meters tall). Forest regrowth, which the Hansen Dataset also reports on, is particularly challenging to detect. This is a measurement at the scientific research frontier, and has higher uncertainty and error associated with it regardless of the data source.

Finally, it is important to note that the Hansen Dataset does not directly address degradation, although some researchers are using these data to inform their estimates of this source of global emissions[7].

Policy implications

Due to the climate change implications of deforestation, various policies are being developed to create financial incentives to reduce deforestation emissions. The most well-known is REDD+: reducing emissions from deforestation and forest degradation. The existing model for REDD+ is one in which first, jurisdictions (i.e. a national government) propose an emissions reference level based on historic data, and second, they are paid if they reduce their emissions below that level. The Hansen Dataset offers an opportunity to improve the scientific measurement of such an incentive system—either by direct use for countries needing to adopt a new dataset of forest loss and gain, or as a point of comparison for improving existing national datasets.

One of the most important implications is that through the Hansen Dataset anyone can

4 For a detailed comparison of different definitions of "deforestation" see: http://www.ipcc.ch/ipccreports/sres/land_use/113.htm

5 While these are the primary datasets involved, additional information is needed determine the proportion of forest biomass emitted and/or sequestered over time, and additional sources like soil carbon.

6 Food and Agriculture Organization. 2010. *Global Forest Resources Assessment 2010*.

7 Potapov, P., A. Yaroshenko, S. Turubanova, M. Dubinin, L. Laestadius, C. Thies, D. Aksenov, A. Egorov, Y. Yesipova, I. Glushkov, M. Karpachevskiy, A. Kostikova, A. Manisha, E. Tsybikova, and I. Zhuravleva. 2008. Mapping the world's intact forest landscapes by remote sensing. *Ecology and Society* 13(2): 51.

evaluate how global forest change is impacting climate change[8]. Such benchmarking can be done on many levels. For example, proposed REDD+ reference levels can be compared to the Hansen Dataset to ensure there is reasonable agreement. Policy-makers could establish a threshold, over which differences between a proposed reference level and the Hansen Dataset would require that the jurisdiction conduct a review to justify the reasons for the discrepancy, and where necessary to improve the data, assumptions, and methods used. Such transparency could improve confidence in the environmental credibility of the REDD+ system, which is important for garnering political and financial support.

The transparency and quality of the Hansen Data could provide an entry point for countries with limited forest monitoring capacity to jumpstart REDD+ monitoring. Since REDD+ has been introduced as a policy tool to reduce emissions from deforestation, millions of dollars have been spent preparing jurisdictions to measure and monitor the greenhouse gas emissions from their forests. As a global and freely-available dataset offering comprehensive accounting of both natural and planted forests, the Hansen Dataset now provide a baseline measurement that any jurisdiction can use. This can help free-up resources which could now be spent on creating the in-depth measurement and monitoring needed to supplement remotely sensed data or even measure additional ecosystem services from the forest. Furthermore, the spatially explicit nature of the Hansen Dataset can help link deforestation with changes in other ecosystem services, such as habitat loss.

The remote sensing technology used to develop the Hansen Dataset allow for the results to be used quite flexibly. These data can scale down to a very local level, or be used globally. This means that regardless of the scale of policy implementation, the Hansen Dataset can provide information on forest cover loss in that area. This can be important for REDD+ to work on multiple scales and for implementation by a wide range of actors on the ground. For example, these data could be used to monitor government land conversion projects, the land use impacts of corporate sustainable production actions, or the efforts of local communities. These last elements, however, would require further research to understand and categorize the

BOX 2:

Differentiating between deforestation and forest cover loss

1. A forest is converted to agricultural crops.

Hansen: Forest loss | *IPCC: Deforestation*

2. A native forest is converted into an exotic plantation forest.

Hansen: Forest loss and subsequent regrowth | *IPCC: Not deforestation in countries that define plantations as forest land use*

3. A plantation forest is cut and another rotation is planted.

Hansen: forest loss and subsequent regrowth | *IPCC: Not deforestation*

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8 For example, go to http://www.globalforestwatch.org for freely available live maps of deforestation.
9 See http://commodities.globalforestwatch.org

causes or drivers of forest loss. The Hansen mapping team is aware of this limitation, and is working to improve the link between activities on the ground and forest cover loss results in the dataset. Recent applications of the data show how this could work[9].

Because the Hansen Dataset detects forest loss annually, and tracks all forest cover transitions, it remains flexible enough to apply to multiple REDD+ accounting periods and frequencies. Since the Hansen Dataset uses measurements that have occurred continuously over time since 2000, it provides information at multiple time intervals, which can be helpful for identifying trends in land use change. Political decisions on timing should be informed by such technical considerations.

Consistency of Hansen Dataset with existing REDD+ methodological guidance

Two methodological approaches for REDD+ are those under the Carbon Fund of the Forest Carbon Partnership Facility (CF) and the UN Framework Convention on Climate Change (UNFCCC). Here's how the Hansen Dataset may be consistent or inconsistent with this guidance.

Under the UNFCCC, countries must meet the IPCC principles of transparency, accuracy, consistency, and completeness in developing their reference levels and verifying their emissions reductions. The Hansen Dataset can, if appropriately applied, be used to meet those principles. UNFCCC guidance suggests that reference levels should be based on historical data, which is consistent with the data sources used by the Hansen Dataset, which date back to 2000. Additionally, reference levels and performance must be expressed in terms of tons of carbon dioxide emissions, so participants could translate the units of area from the Hansen Dataset to emissions by using emissions factors that reflect the amount of carbon in the forest and the percent of those carbon stocks lost due to disturbance. Finally, the UNFCCC aims to separate anthropogenic and non-anthropogenic emissions, which requires further analysis of the Hansen Dataset, although inspection of the spatial patterns of loss, and geographic context often provides supplemental information on this.

The Hansen Dataset can also be used to meet some of the requirements under the World Bank Forest Carbon Partnership Facility's Carbon Fund (CF) methodological framework. Countries developing submissions to the CF, could justify the use of the Hansen Dataset in providing an optimal combination of quality and affordability at the time and spatial scales for which they are developing REDD+. However, the CF methodological framework asks, where appropriate, for participants to differentiate between forest classes within the measured jurisdiction, information that the Hansen Dataset alone cannot provide.

Conclusions

The Hansen Dataset offers a critical new tool for measuring the success of global forest conservation efforts. When effectively combined with other datasets, these data can be used to measure and monitor forest carbon emissions consistent with a variety of international standards.

For more information, please contact:

Pipa Elias | pipa.elias@tnc.org

Peter Ellis | pellis@tnc.org

Bronson Griscom | bgriscom@tnc.org

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