High-Resolution Global Maps of 21st-Century Forest Cover Change

M. C. Hansen,1,4 P. V. Potapov,1 R. Moore,2 M. Hancher,2 S. A. Turubanova,1 A. Tyukavina,1 D. Thau,2 S. V. Stehman,3 S. J. Goetz,4 T. R. Loveland,5 A. Kommareddy,6 A. Egorov,6 L. Chini,4 C. O. Justice,1 J. R. G. Townshend1

Quantification of global forest change has been lacking despite the recognized importance of forest ecosystem services. In this study, Earth observation satellite data were used to map global forest loss (2.3 million square kilometers) and gain (0.8 million square kilometers) from 2000 to 2012 at a spatial resolution of 30 meters. The tropics were the only climate domain to exhibit a trend, with forest loss increasing by 2101 square kilometers per year. Brazil’s well-documented reduction in deforestation was offset by increasing forest loss in Indonesia, Malaysia, Paraguay, Bolivia, Zambia, Angola, and elsewhere. Intensive forestry practices within subtropical forests resulted in the highest rates of forest change globally. Boreal forest loss due largely to fire and forestry was second to that in the tropics in absolute and proportional terms. These results depict a globally consistent and locally relevant record of forest change.

Changes in forest cover affect the delivery of important ecosystem services, including biodiversity richness, climate regulation, carbon storage, and water supplies (1). However, spatially and temporally detailed information on global-scale forest change does not exist; previous efforts have been either sample-based or employed coarse spatial resolution data (2–4). We mapped global tree cover extent, loss, and gain for the period from 2000 to 2012 at a spatial resolution of 30 m, with loss allocated annually. Our global analysis, based on Landsat data, improves on existing knowledge of global forest extent and change by (i) being spatially explicit; (ii) quantifying gross forest loss and gain; (iii) providing annual loss information and quantifying trends in forest loss; and (iv) being derived through an internally consistent approach that is exempt from the vagaries of different definitions, methods, and data inputs. Forest loss was defined as a stand-replacement disturbance or the complete removal of tree cover canopy at the Landsat pixel scale. Forest gain was defined as the inverse of loss, or the establishment of tree canopy from a nonforest state. A total of 2.3 million km2 of forest were lost due to disturbance over the study period and 0.8 million km2 of new forest established. Of the total area of combined loss and gain (2.3 million km 2 + 0.8 million km2), 0.2 million km2 of land experienced both loss and subsequent gain in forest cover during the study period. Global forest loss and gain were related to tree cover density for global climate domains, ecozones, and countries (refer to tables S1 to S3 for all data references and comparisons). Results are depicted in Fig. 1 and are viewable at full resolution at http://earthisenginepartners.appspot.com/science-2013-global-forest.

The tropical domain experienced the greatest total forest loss and gain of the four climate domains (tropical, subtropical, temperate, and boreal), as well as the highest ratio of loss to gain (3.6 for >50% of tree cover), indicating the prevalence of deforestation dynamics. The tropics were the only domain to exhibit a statistically significant trend in annual forest loss, with an estimated increase in loss of 2101 km2/year. Tropical rainforest ecozones totaled 32% of global forest cover loss, nearly half of which occurred in South American rainforests. The tropical dry forests of South America had the highest rate of tropical forest loss, due to deforestation dynamics in the Chaco woodlands of Argentina, Paraguay (Fig. 2A), and Bolivia. Eurasian rainforests (Fig. 2B) and dense tropical dry forests of Africa and Eurasia also had high rates of loss.

Recently reported reductions in Brazilian rainforest clearing over the past decade (5) were confirmed, as annual forest loss decreased on average 1318 km2/year. However, increased annual loss of Eurasian tropical rainforest (1392 km2/year), African tropical moist deciduous forest (536 km2/year), South American dry tropical forest (459 km2/year), and Eurasian tropical moist deciduous (221 km2/year) and dry (123 km2/year) forests more than offset the slowing of Brazilian deforestation. Of all countries globally, Brazil exhibited the largest decline in annual forest loss, with a high of over 40,000 km2/year in 2003 to 2004 and a low of under 20,000 km2/year in 2010 to 2011. Of all countries globally, Indonesia exhibited the largest increase in forest loss (1021 km2/year), with a low of under 10,000 km2/year from 2000 through 2003 and a high of over 20,000 km2/year in 2011 to 2012. The converging rates of forest disturbance of Indonesia and Brazil are shown in Fig. 3. Although the short-term decline of Brazilian deforestation is well documented, changing legal frameworks governing Brazilian forests could reverse this trend (6). The effectiveness of Indonesia’s recently instituted moratorium on new licensing of concessions in primary natural forest and peatlands (7), initiated in 2011, is to be determined.

Subtropical forests experience extensive forest land uses where forests are often treated as a crop and the presence of long-lived natural forests is comparatively rare (8). As a result, the highest proportional losses of forest cover and the lowest ratio of loss to gain (1.2 for >50% of tree cover) occurred in the subtropical climate domain. Aggregate forest change, or the proportion of total forest loss and gain relative to year-2000 forest area [loss+gain/2000 forest], equaled 16%, or more than 1% per year across all forests within the domain. Of the 10 subtropical humid and dry forest ecozones, 5 have aggregate forest change >20%, three >10%, and two >5%. North American subtropical forests of the southeastern United States are unique in terms of change dynamics because of short-cycle tree planting and harvesting (Fig. 2C). The disturbance rate of this ecozone was four times that of South American
Fig. 1. (A) Tree cover, (B) forest loss, and (C) forest gain. A color composite of tree cover in green, forest loss in red, forest gain in blue, and forest loss and gain in magenta is shown in (D), with loss and gain enhanced for improved visualization. All map layers have been resampled for display purposes from the 30-m observation scale to a 0.05° geographic grid.

Fig. 2. Regional subsets of 2000 tree cover and 2000 to 2012 forest loss and gain. (A) Paraguay, centered at 21.9°S, 59.8°W; (B) Indonesia, centered at 0.4°S, 101.5°E; (C) the United States, centered at 33.8°N, 93.3°W; and (D) Russia, centered at 62.1°N, 123.4°E.
The temperate climatic domain has a forestry-dominant change dynamic and a relatively low ratio of loss to gain (1.6 for >50% of tree cover). Oceanic ecoregions, in particular, are similar to the subtropics in the intensity of indicated forest land use. The northwest United States is an area of intensive forestry, as is the entire range of temperate Canada. The intermountain West of North America exhibits a loss dynamic, largely due to fire, logging, and disease (for example, large-scale tree mortality due to mountain pine bark beetle infestation, most evident in British Columbia, Canada (9)). Temperate Europe has a forestry dynamic with Estonia and Latvia exhibiting a high ratio of loss to gain. Portugal, which straddles the temperate and subtropical domains, has a complicated dynamic of forestry and forest loss due to fire; the resulting aggregate change dynamic is fourth in intensity globally. Elevated loss due to storm damage is indicated for a few areas. For example, a 2005 extratropical cyclone led to a historic blowdown of southern Sweden temperate forests, and a 2009 windstorm leveled extensive forest areas in southwestern France (10).

Fire is the most significant cause of forest loss in boreal forests (11), and it occurred across a range of tree canopy densities. Given slower regrowth dynamics, the ratio of boreal forest loss to gain is high over the study period (2.1 for >50% of tree cover). Boreal coniferous and mountain ecoregions are similar in terms of forest loss rates, with North America having a higher overall rate and Eurasia a higher absolute area of loss. Forest gain is substantial in the boreal zone, with Eurasian coniferous forests having the largest area of gain of all global ecoregions during the study period, due to forestry, agricultural abandonment (12), and forest recovery after fire [as in European Russia and the Siberia region of Russia (Fig. 2D)]. Russia has the most forest loss globally. Co-located gain and loss are nearly absent in the high-latitude forests of the boreal domain, reflecting a slower regrowth dynamic in this climatic domain. Areas with loss and gain in close proximity, indicating forestry land uses, are found within the entirety of Sweden and Finland, the boreal/temperate transition zone in eastern North America, parts of European Russia, and along the Angara River in central Siberia, Russia.

A goal of large-area land cover mapping is to produce globally consistent characterizations that have local relevance and utility; that is, reliable information across scales. Figure S1 reflects this capability at the national scale. Two measures of change, (i) proportion of total aggregate forest change relative to year-2000 forest area [(loss + gain)/2000 forest], shown in column q of table S3; and (ii) proportion of total change that is loss [loss/(loss + gain)], calculated from columns b and c in table S3, are displayed. The proportion of total aggregate forest change emphasizes countries with likely forestry practices by including both loss and gain in its calculation, whereas the proportion of loss to gain measure differentiates countries experiencing deforestation or another loss dynamic without a corresponding forest recovery signal. The two ratio measures normalize the forest dynamic in order to directly compare national-scale change regardless of country size or absolute area of change dynamic. In fig. S1, countries that have lost forests without gain are high on the x axis (Paraguay, Mongolia, and Zambia). Countries with a large fraction of forest area disturbed and/or reforested/afforested are high on the x axis (Swaziland, South Africa, and Uruguay). Thirty-one countries have an aggregate dynamic >1% per year, 11 have annual loss rates >1%, and 5 have annual gain rates of >1%.

Brazil is a global exception in terms of forest change, with a dramatic policy-driven reduction in Amazon Basin deforestation. Although Brazilian gross forest loss is the second highest globally, other countries, including Malaysia, Cambodia, Cote d’Ivoire, Tanzania, Argentina, and Paraguay, experienced a greater percentage of loss of forest cover. Given consensus on the value of natural forests to the Earth system, Brazil’s policy intervention is an example of how awareness of forest valuation can reverse decades of previous widespread deforestation. International policy initiatives, such as the United Nations Framework Convention of Climate Change Reducing Emissions from Deforestation and forest Degradation (REDD) program (13), often lack the institutional investment and scientific capacity to begin implementation of a program that can make use of the global observational record; in other words, the policy is far ahead of operational capabilities (14). Brazil’s use of Landsat data in documenting trends in deforestation was crucial to its policy formulation and implementation. To date, only Brazil produces and shares spatially explicit information on annual forest extent and change. The maps and statistics we present can be used as an initial reference for a number of countries lacking such data, as a spur to capacity building in the establishment of national-scale forest extent and change maps, and as a basis of comparison in evolving national monitoring methods.

Global-scale studies require systematic global image acquisitions available at low or no direct

**Fig. 3. Annual forest loss totals for Brazil and Indonesia from 2000 to 2012.** The forest loss annual increment is the slope of the estimated trend line of change in annual forest loss.
Changes in Cytoplasmic Volume Are Sufficient to Drive Spindle Scaling

James Hazel, Kaspars Krutkamnelis, Paul Mooney, Miroslav Tomschik, Ken Gerow, John Oakey, J. C. Gatlin*

The mitotic spindle must function in cell types that vary greatly in size, and its dimensions scale with the rapid, reductive cell divisions that accompany early stages of development. The mechanism responsible for this scaling is unclear, because uncoupling cell size from a developmental or cellular context has proven experimentally challenging. We combined microfluidic technology with Xenopus egg extracts to characterize spindle assembly within discrete, geometrically defined volumes of cytoplasm. Reductions in cytoplasmic volume, rather than developmental cues or changes in cell shape, were sufficient to recapitulate spindle scaling observed in Xenopus embryos. Thus, mechanisms intrinsic to the spindle, specifically a limiting pool of cytoplasmic component(s), play a major role in determining spindle size.

O rganelles and other intracellular structures must scale with cell size in order to function properly. Maintenance of these dimensional relationships is challenged by the rapid and reductive cell divisions that characterize early embryogenesis in many organisms. The cellular machine that drives these divisions, the mitotic spindle, functions to segregate chromosomes in cells that vary greatly in size while also adapting to rapid changes in cell size. The issue of scale is epitomized during Xenopus embryogenesis, where a rapid series of divisions reduces cell size 100-fold: from the 1.2-mm-diameter fertilized egg to ~12-µm-diameter cells in the adult frog (1). In large blastomeres, spindle length reaches an upper limit that is uncoupled from changes in cell size. However, as cell size decreases, a strong correlation emerges between spindle length and cell size (2). Although this scaling relationship has been characterized in vivo for several different organisms, little is known about the direct regulation of spindle size by cell size or the underlying mechanism(s) (2–4). Spindle size may be directly dictated by the physical dimensions of a cell, perhaps through microtubule-mediated interaction with the cell cortex [i.e., boundary sensing (5–7)]. Alternatively, cell size could constrain spindle size by providing a fixed and finite cytoplasmic volume and, therefore, a limiting pool of resources such as cytoplasmic spindle assembly or length-determining components [i.e., component limitation (8, 9)]. Last, mechanisms intrinsic to the spindle could be actively tuned in response to systematic changes in cytoplasmic composition occurring during development [i.e., developmental cues (10, 11)].

To elucidate the responsible scaling mechanism(s), we developed a microfluidic-based platform to confine spindle assembly in geometrically defined volumes of Xenopus egg extract (12). Interphase extract containing Xenopus sperm nuclei was induced to enter mitosis and immediately pumped into a microfluidic droplet-generating device before nuclear envelope breakdown and the onset of spindle assembly. At the same time, a fluorinated oil/surfactant mixture was pumped into the device through a second inlet. These two discrete, immiscible phases merged at a T-shaped junction

References and Notes
10.  B. Gardiner et al., Destructive Storms in European Forests: Past and Forthcoming Impacts (European Forest Institute, Freiburg, Germany, 2010).
15.  H. Geist, E. Lambin, Bioscience 52, 143–150 (2002).

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Supplementary Text
Figs. S1 to S8
Tables S1 to S5
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Supplementary Materials for

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*Corresponding author. E-mail: mhansen@umd.edu

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This PDF file includes:

- Materials and Methods
- Supplementary Text
- Figs. S1 to S8
- Tables S1 to S5
- References (24–40)
Materials and Methods

The study area included all global land except for Antarctica and a number of Arctic islands, totaling 128.8Mkm$^2$, or the equivalent of 143 billion 30m Landsat pixels. For this study, trees were defined as all vegetation taller than 5m in height. Forest loss was defined as a stand-replacement disturbance. Results were disaggregated by reference percent tree cover stratum (e.g. >50% crown cover to ~0% crown cover) and by year. Forest degradation (24), for example selective removals from within forested stands that do not lead to a non-forest state, was not included in the change characterization. Gain was defined as the inverse of loss, or a non-forest to forest change; longer-lived regrowing stands of tree cover that did not begin as non-forest within the study period were not mapped as forest gain. Gain was related to percent tree crown cover densities >50% and reported as a twelve year total. In this study, the term “forest” refers to tree cover and not land use unless explicitly stated, e.g. “forest land use”.

The global Landsat analysis was performed using Google Earth Engine, a cloud platform for earth observation data analysis that combines a public data catalog with a large-scale computational facility optimized for parallel processing of geospatial data. Google Earth Engine contains a nearly complete set of imagery from the Landsat 4, 5, 7, and 8 satellites downloaded from the USGS Earth Resources Observation and Science archive (25). For this study, we analyzed 654,178 growing season Landsat 7 Enhanced Thematic Mapper Plus (ETM+) scenes from a total of 1.3 million available at the time of the study. Growing season data are more appropriate for land cover mapping than imagery captured during senescence or dormant seasonal periods (26). Automated Landsat pre-processing steps included: (i) image resampling, (ii) conversion of raw digital values (DN) to top of atmosphere (TOA) reflectance, (iii) cloud/shadow/water screening and quality assessment (QA), and (iv) image normalization. All pre-processing steps were tested at national scales around the globe using a method prototyped for the Democratic Republic of Congo (27). The stack of QA layers was used to create a per-pixel set of cloud-free image observations which in turn was employed to calculate time-series spectral metrics. Metrics represent a generic feature space that facilitates regionalscale mapping and have been used extensively with MODIS and AVHRR data (2,4) and more recently with Landsat data in characterizing forest cover loss (27,28). Three groups of per-band metrics were employed over the study interval: (i) reflectance values representing maximum, minimum and selected percentile values (10, 25, 50, 75 and 90% percentiles); (ii) mean reflectance values for observations between selected percentiles (for the max-10%, 10-25%, 25-50%, 50-75%, 75-90%, 90%-max, min-max, 10-90%, and 25-75% intervals); and (iii) slope of linear regression of band reflectance value versus image date. Training data to relate to the Landsat metrics were derived from image interpretation methods, including mapping of crown/no crown categories using very high spatial resolution data such as Quickbird imagery, existing percent tree cover layers derived from Landsat data (29), and global MODIS percent tree cover (30), rescaled using the higher spatial resolution percent tree cover data sets. Image interpretation on-screen was used to delineate change and no change training data for forest cover loss and gain.

Percent tree cover, forest loss and forest gain training data were related to the time-series metrics using a decision tree. Decision trees are hierarchical classifiers that predict class membership by recursively partitioning a data set into more homogeneous or less
varying subsets, referred to as nodes (31). For the tree cover and change products, a
bagged decision tree methodology was employed. Forest loss was disaggregated to
annual time scales using a set of heuristics derived from the maximum annual decline in
percent tree cover and the maximum annual decline in minimum growing season
Normalized Vegetation Difference Index (NDVI). Trends in annual forest loss were
derived using an ordinary least squares slope of the regression of $y=\text{annual loss}$ versus
$x=\text{year}$. Outputs per pixel include annual percent tree cover, annual forest loss from 2000
to 2012, and forest gain from 2000 to 2012. To facilitate processing, each continent was
characterized individually: North America, South America, Eurasia, Africa, and
Australia.

Earth Engine uses a lazy computation model in which a sequence of operations may
be executed either interactively on-the-fly or in bulk over a complete data set. We used
the former mode during development and debugging, and the latter mode during the
computation of the final data products. In both cases all image processing operations
were performed in parallel across a large number of computers, and the platform
automatically handled data management tasks such as data format conversion,
reprojection and resampling, and associating image metadata with pixel data. Large-
scale computations were managed using the FlumeJava framework (32). A total of 20
terapixels of data were processed using one million CPU-core hours on 10,000 computers
in order to characterize year 2000 percent tree cover and subsequent tree cover loss and
gain through 2012.

**Supplementary Text**

**Comparison with FAO data**

The standard reference for global scale forest resource information is the UNFAO’s
Forest Resource Assessment (FRA) (33), produced at decadal intervals. There are several
limitations of the FRA reports that diminish their utility for global change assessments,
including (i) inconsistent methods between countries; (ii) defining “forest” based on land
use instead of land cover thereby obscuring the biophysical reality of whether tree cover
is present; (iii) forest area changes reported only as net values; and (iv) forest definitions
used in successive reports have changed over time (34).

Several discrepancies exist between FAO and earth observation-derived forest area
change data. For example, the large amount of tree cover change observed in satellite
imagery in Canada and the USA does not conform to the land use definitions applied in
the FRA for these countries. While there is significant forest change from a biophysical
perspective (i.e., forest cover), there is little or no land use change, the main criterion
used in the FRA report. Additionally, China, and to a lesser extent India, report
significant forest gains that are not readily observable in time-series satellite imagery,
including this analysis (Fig. S3). Large country change area discrepancies such as these
preclude a significant correlation between FAO and Landsat-based country data at the
global scale. However, regional differences in strength of agreement exist, and examples
are illustrated in Fig. S3 and Tab. S4. The region with the highest correlation between
FAO and Landsat net change is Latin America. Deforestation is the dominant dynamic,
and a number of countries, including Brazil, employ earth observation data in estimating
forest area change for official reporting. There is much less agreement for African
countries, though the correlation improves when lowering the tree cover threshold to
include more change. The lack of agreement in Africa reflects the difficult nature of
mapping change in environments with a range of tree cover as well as the lack of
systematic forest inventories and mapping capabilities for many African countries.
Southeast Asian countries exhibit changes primarily in dense canopy forests. However,
there is little correlation between Landsat-based change estimates and FAO data. The
forestry dynamics and differing governance and development contexts within this region
may lead to inconsistencies between countries. European data have the least correlation
of the regions examined, with comparatively little net area change reported in either our
Landsat analysis or in the FAO FRA.

The importance of forest definition and its impact on change area estimation is seen
for countries located in boreal and dry tropical climates. Our estimate of Canada’s net
change from the Landsat-based study doubled when including forest loss across all tree
cover strata, largely due to extensive burning in open boreal woodlands. Countries such
as Australia, Paraguay and Mozambique have similar outcomes related to disturbances
occurring within a range of tropical forest, woodland and parkland environments.

Gross forest area gain and loss for >50% tree cover were also compared to FAO
roundwood production data summed by country from 2000 to 2011 (Fig. S4). FAO data
are available at http://faostat.fao.org/. The national coniferous and non-coniferous"total roundwood" production data (in cubic meters) were multiplied by 0.225MgC/m^3
and 0.325 MgC/m^2 respectively, and then added together to give national total
roundwood production in Megatons of carbon. Tab. S4 illustrates the strength of the
relationship between FRA roundwood production and Landsat-derived gross forest area
gain and loss for selected regions. While Africa and Southeast Asia have extremely poor
correlations, Landsat-derived forest area gain for Latin America and both forest gain and
loss for Europe exhibit strong correlations. The FRA roundwood production data
correlate well with satellite-based tree cover change area estimation for forestry land use-
dominated countries.

The FAO comparison reflects the confusion that results when comparing tabular
data that apply differing criteria in defining forest change. Deforestation is the
conversion of natural forests to non-forest land uses; the clearing of the same natural
forests followed by natural recovery or managed forestry is not deforestation and often
goes undocumented, whether in the tropical or boreal domains. Understanding where
such changes occur is impossible given the current state of knowledge, i.e. the FAO FRA.
While countries such as Canada and Indonesia both clear natural forests without
conversion to non-forest land uses, Indonesia reports over 5,000km^2 per year of forest
area loss in the FRA while Canada reports no change. Consistent, transparent and spatio-
temporally explicit quantification of natural and managed forest change is required to
fully understand forest change from a biophysical and not solely forest land use
perspective.

**Recent global forest mapping research**
The FAO and others have turned to earth observation data, specifically Landsat
imagery, to provide a more consistent depiction of global forest change. Sample-based
methods have enabled national to global scale estimation of forest extent and change
(35,2,3). Such methods result in tabular aggregated estimates for areas having sufficient
sampling densities, but do not allow for local-scale area estimation or spatially explicit
representation of extent and change. While exhaustive land cover mapping using Landsat
data has been prototyped using single best-date image methods (36,37) based on the National Aeronautics and Space Administration (NASA)-United States Geological Survey (USGS) Global Land Survey data set (38), data mining of the Landsat archive to quantify global forest cover change has not been implemented until this study.

Validation

The validation exercise was performed independently of the mapping exercise. Areas of forest loss and gain were validated using a probability-based stratified random sample of 120m blocks per biome. Boreal forest, temperate forest, humid tropical forest and dry tropical forest biomes and other land constituted the five major strata, and were taken from our previous study on global forest cover loss (2). The map product was used to create three sub-strata per biome: no change, loss and gain. The sample allocation for each biome was 150 blocks for no change, 90 for change and 60 for gain (1,500 blocks total). Each 120m sample block was interpreted into quartiles of reference change as gain or loss (i.e., the proportion of gain or loss was interpreted as 0, 0.25, 0.50, 0.75, or 1), where reference change was obtained as follows. Image interpretation of time-series Landsat, MODIS and very high spatial imagery from GoogleEarth, where available, was performed in estimating reference change for each sample block. Forest loss estimated from the validation reference data set totaled 2.2Mkm$^2$ (SE of 0.3Mkm$^2$) compared to the map total of 2.3Mkm$^2$. Forest gain estimated from the validation sample totaled 0.9Mkm$^2$ (SE of 0.2 Mkm$^2$) compared to the map total of 0.8Mkm$^2$. Fig. S5 shows the results as mean map and validation change per block for the globe and per FAO climate domain. Fig. S6 illustrates the mean per block difference of the map and reference loss and gain estimates. Comparable map and reference loss and gain results were achieved at the global and climate domain scales.

Estimated error matrices and accuracy summary statistics are shown in Tab. S5. For loss, user’s and producer’s accuracies are balanced and greater than 80% per climate domain and the globe as a whole. Results for forest gain indicate a possible underestimate of tropical forest gain with a user’s accuracy of 82% and a producer’s accuracy of 48%. However, the 95% confidence interval for the bias of tropical forest gain (expressed as a % of land area) is 0.01% to 0.35%, indicating high uncertainty in the validation estimate. A possible overestimate of boreal forest gain is also indicated. Overall, the comparison of individually interpreted sample sites with the algorithm output illustrates a robust product at the 120m pixel scale.

The annual allocation of change was validated using annual growing season NDVI imagery from the MODIS sensor. All validation sample blocks were interpreted and if a single, unambiguous drop in NDVI was observed in the MODIS NDVI time series, a year of disturbance was assigned. Only 56% of the validation sample blocks were thus assigned. The sample blocks interpreted represented 46% of the total forest loss mapped with the Landsat imagery, a fraction similar to the 50% ratio of MODIS to Landsat-detected change in a previous global forest cover loss study (39). For the interpreted blocks, the mean deviation of the loss date was 0.06 years and the mean absolute deviation was 0.29 years. The year of disturbance matched for 75.2% of the forest loss events and 96.7% of the loss events occurred within one year before or after the estimated year of disturbance.

A second evaluation of forest change was made using LiDAR (light detection and ranging) data from NASA’s GLAS (Geoscience Laser Altimetry System) instrument onboard the IceSat-1 satellite. Global GLAS release 28 (L1A Global Altimetry Data and
the L2 Global Land Surface Altimetry Data) data were screened for quality and viable GLAS shots used to calculate canopy height (40). For forest loss, GLAS shots co-located with Landsat forest loss by pixel were identified. The Landsat-estimated year of disturbance was subtracted from the year of the GLAS shots and populations of ‘year since disturbance’ created. Significant differences in height before and after Landsat-derived forest loss indicate both a reasonable approximation of forest loss and year of disturbance. Fig. S7 shows the results by ecozone, all of which passed Wilcoxon-Mann-Whitney significance tests (non-parametric alternative of t-test) for pairs of +1\-1 and +2\-2 years.

Forest gain was not allocated annually, but over the entire study period. To compare GLAS-derived change in height with Landsat-derived gain, gain-identified pixels with no tree cover for year 2000 and co-located with GLAS data were analyzed. Additionally, only clustered gain was analyzed, specifically sites where six out of nine pixels within a 3x3 kernel were labeled as forest gain. Fig. S8 illustrates the results. All climate domains except for the boreal passed Wilcoxon-Mann-Whitney significance tests for 2004 and 2008, the beginning and end years for GLAS data collection. The growth-limiting climate of the boreal domain would preclude the observation of regrowth over such a short period.
Table S1. Climate domain tree cover extent, loss and gain summary statistics (km²), ranked by total loss.

<table>
<thead>
<tr>
<th>Climate Domain</th>
<th>Total Loss</th>
<th>Total Gain</th>
<th>Treecover 2000</th>
<th>Loss within treecover</th>
<th>Total loss / total land area (excluding water) (%)</th>
<th>&gt;25% tree cover loss / year 2000</th>
<th>&gt;50% tree cover loss / year 2000</th>
<th>&gt;75% tree cover loss / year 2000</th>
<th>Total gain / year 2000</th>
<th>&gt;50% loss + total gain / 2000</th>
<th>&gt;50% tree cover (%)</th>
<th>Previous column less double counting pixels with both loss and gain (%)</th>
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<td>a) Tropical</td>
<td>1105786</td>
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<td>35866276</td>
<td>4175597</td>
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<td>13241470</td>
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<td>4.9</td>
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Fig. S1.
National and climate-domain scale intercomparisons using ratio measures of aggregate forest change \( \frac{(\text{loss}+\text{gain})}{2000 \text{ forest}} \) versus percent of aggregate forest change that is forest loss \( \frac{\text{loss}}{(\text{loss}+\text{gain})} \). Countries exhibiting a statistically significant trend in forest loss during the study period are indicated (e.g. *** for \( p<0.05 \)). Only countries with \( >1000 \text{ km}^2 \) of year 2000 \( >50\% \) tree cover are shown. For this figure, forest is defined as tree cover \( >50\% \). Regional groupings are highlighted, with magenta= USA and Canada, green=Latin America, blue=Europe, red=Africa, brown=South Asia, purple=Southeast Asia, orange=East Asia, and cyan=Australia and Oceania. Refer to Tab. S1 and S3 for values.
Fig. S2

Ecozone and climate-domain scale intercomparisons using ratio measures of aggregate forest change ((loss+gain)/2000 forest) versus percent of aggregate forest change that is forest loss (loss/(loss+gain)). Ecozones exhibiting a statistically significant trend in forest loss during the study period are indicated (e.g. *** for p<0.05). For this figure, forest is defined as tree cover >50%. Colors refer to climate domains; NAM=North America; SAM=South America; EAS=Eurasia; AFR=Africa; AUS=Australia and Oceania. Refer to Tab. S1 and S2 for values.
Fig. S3
FAO FRA net forest area change, 2000 to 2010, versus Landsat-derived net change, 2000 to 2012. Colors denote regional groupings of Fig. S2.
Fig. S4
FAO FRA roundwood production in megatons of carbon totaled per country from 2000 through 2011 versus total Landsat-derived forest area loss and gain from 2000 to 2012. Colors denote regional groupings of Fig. S2.
Fig. S5
Sample-based estimation of forest cover loss and gain, including all tree cover strata in loss estimation. Map is from the Landsat-derived map product. Reference is from validation data derived from multi-source image interpretation. Mean and two standard error range are shown at global and climate domain scales.
Fig. S6
Sample-based difference of map minus reference forest loss and gain per block, including all tree cover strata in loss estimation. Map is from the Landsat-derived map product. Reference is from validation data derived from multi-source image interpretation. Mean and two standard error range are shown at global and climate domain scales.
Fig. S7
GLAS-derived vegetation heights for Landsat-derived forest loss pixels. GLAS median and quartiles are displayed by number of years from Landsat-estimated year of disturbance.
Fig. S8
Median and quartile GLAS-derived vegetation heights for areas of Landsat-derived zero percent tree cover in 2000 that were mapped as forest gain within the 2000 to 2012 study period.
Table S4.
Regression results for selected regions comparing 2000-2010 FAO FRA net change and 2000-2011 FAO roundwood production versus 2000-2012 global Landsat-derived gross forest area gain minus gross forest area loss for two tree cover thresholds (>1% and >50%).

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<th>Region</th>
<th>Net area change FRA vs. &gt;1%</th>
<th>FRA vs. &gt;50%</th>
<th>Roundwood production FRA vs. gain area</th>
<th>FRA vs. loss area</th>
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<td>Europe (excluding Russia)</td>
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Table S5.
Accuracy assessment of 2000 to 2012 forest loss and gain at global and climate domain scales.

**Global (n=1500)**

Loss error matrix expressed as percent of area (selected standard errors are shown in parentheses)

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Overall accuracy = 99.6% (0.7%)

Gain error matrix expressed as percent of area (selected standard errors are shown in parentheses)

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<td>Producer’s</td>
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Overall accuracy = 99.7% (0.6%)
Climate domains

**Tropical (n=628)**

Loss error matrix expressed as percent of area (selected standard errors are shown in parentheses)

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Overall accuracy = 99.5 (0.1)

Gain error matrix expressed as percent of area (selected standard errors are shown in parentheses)

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</table>

Overall accuracy = 99.7 (0.1)
**Subtropical** \( (n=295) \)

Loss error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Loss</th>
<th>No Loss</th>
<th>Total</th>
<th>User’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>Loss</td>
<td>0.56</td>
<td>0.15</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>No Loss</td>
<td>0.14</td>
<td>99.16</td>
<td>99.30</td>
</tr>
<tr>
<td>Total</td>
<td>0.70</td>
<td>99.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer’s</td>
<td>79.4 (7.4)</td>
<td></td>
<td>99.8 (0.1)</td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.7 (0.1)

Gain error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Gain</th>
<th>No Gain</th>
<th>Total</th>
<th>User’s (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>Gain</td>
<td>0.71</td>
<td>0.12</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>No Gain</td>
<td>0.15</td>
<td>99.02</td>
<td>99.17</td>
</tr>
<tr>
<td>Total</td>
<td>0.86</td>
<td>99.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer’s</td>
<td>82.4 (5.1)</td>
<td></td>
<td>99.9 (0.1)</td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.7 (0.1)
## Temperate (n=298)

Loss error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Loss</th>
<th>No Loss</th>
<th>Total</th>
<th>User’s (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>1.01</td>
<td>0.14</td>
<td>1.15</td>
<td>88.2 (5.4)</td>
</tr>
<tr>
<td>No Loss</td>
<td>0.07</td>
<td>98.79</td>
<td>98.85</td>
<td>99.9 (0.1)</td>
</tr>
<tr>
<td>Total</td>
<td>1.08</td>
<td>98.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer’s</td>
<td>93.9 (4.1)</td>
<td>99.9 (0.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.8 (0.1)

Gain error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Gain</th>
<th>No Gain</th>
<th>Total</th>
<th>User’s (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>0.36</td>
<td>0.22</td>
<td>0.58</td>
<td>62.0 (15.0)</td>
</tr>
<tr>
<td>No Gain</td>
<td>0.11</td>
<td>99.31</td>
<td>99.42</td>
<td>99.9 (0.1)</td>
</tr>
<tr>
<td>Total</td>
<td>0.47</td>
<td>99.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer’s</td>
<td>76.5 (14.5)</td>
<td>99.8 (0.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.7 (0.1)
**Boreal** (n=258)

Loss error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Loss</th>
<th>No Loss</th>
<th>Total</th>
<th>User’s (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>Loss</td>
<td>3.47</td>
<td>0.47</td>
<td>3.94</td>
</tr>
<tr>
<td></td>
<td>No Loss</td>
<td>0.23</td>
<td>95.83</td>
<td>96.06</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.70</td>
<td>96.30</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Producer’s</td>
<td>93.9 (1.7)</td>
<td>99.5 (0.1)</td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.3 (0.2)

Gain error matrix expressed as percent of area (selected standard errors are shown in parentheses)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Gain</th>
<th>No Gain</th>
<th>Total</th>
<th>User’s (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map</td>
<td>Gain</td>
<td>0.87</td>
<td>0.26</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>No Gain</td>
<td>0.01</td>
<td>98.85</td>
<td>98.86</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>0.88</td>
<td>99.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Producer’s</td>
<td>98.4 (1.1)</td>
<td>99.7 (0.1)</td>
<td></td>
</tr>
</tbody>
</table>

Overall accuracy = 99.7 (0.1)
References and Notes


10. B. Gardiner et al., *Destructive Storms in European Forests: Past and Forthcoming Impacts* (European Forest Institute, Freiburg, Germany, 2010).


Conclusions Proposed by the President (United Nations Framework Convention on Climate Change Secretariat, Bonn, Germany, 2005).


