WORLD RESOURCES INSTITUTE

GLOBAL FOREST WATCH CLIMATE

PIXEL PERFECTION FOR CARBON DETECTION

Forest carbon data in high definition

NANCY HARRIS, WORLD RESOURCES INSTITUTE, WASHINGTON, D.C.

GLOBAL FOREST WATCH CLIMATE

"An interactive online mapping application of carbon density and loss from aboveground live woody biomass across the tropics from 2001 to 2014, estimated using a combination of ground and medium-resolution satellite data" [1,2,3,4,5]

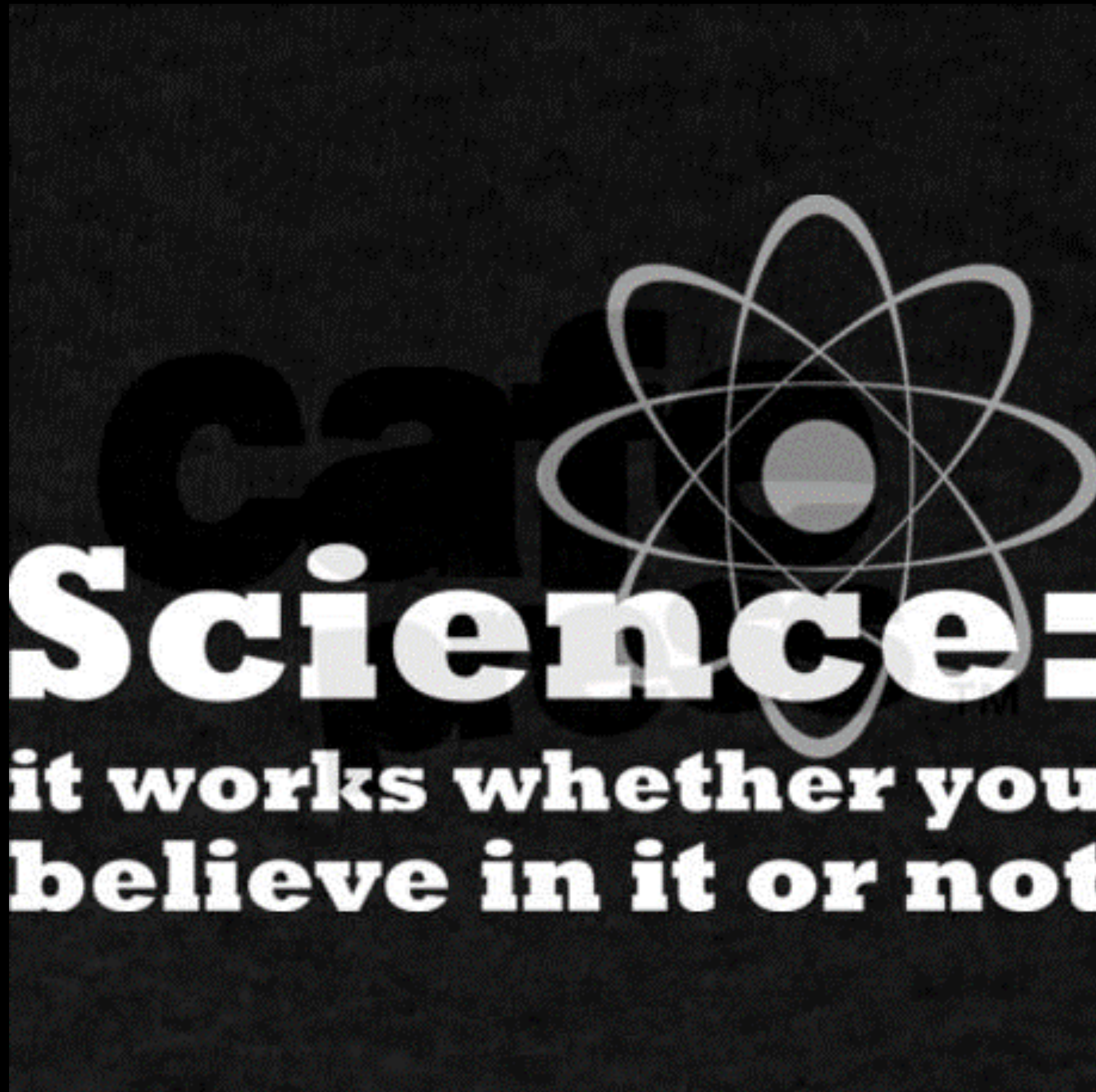
1 tree cover loss does not always equal deforestation

2 Multiple biomass maps are available for certain regions, see Saatchi et al, Baccini et al., Avitabile et al., Asner et al. and others

3 C stock and C loss estimates may be biased for some countries due to non-statistically based estimators

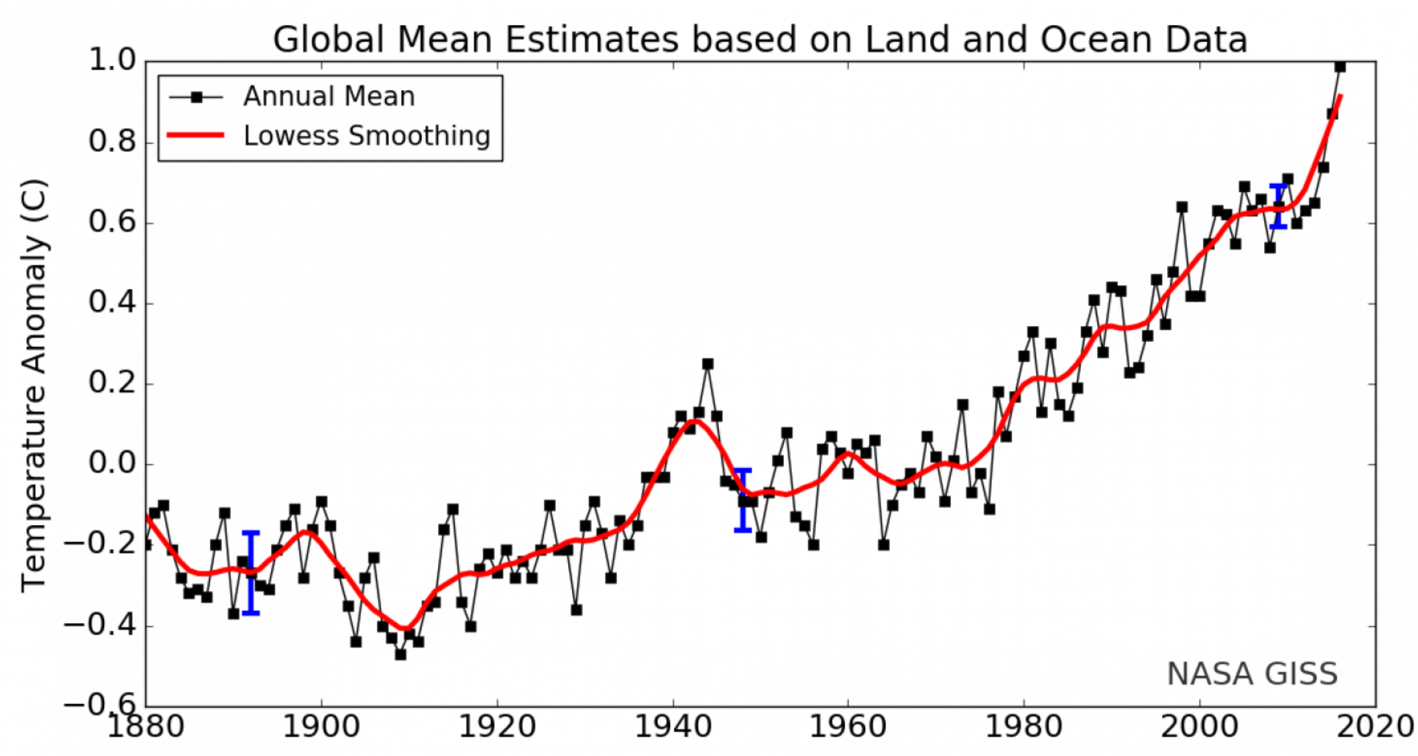
4 other C pools are currently excluded from calculations, although default values may be added in the future

5 the inclusion of the time dimension of carbon flux varies both by C pool and by C accounting method



Cafepress.com

U.S. scientists officially declare 2016 the hottest year on record. That makes three in a row.



ABOUT WRI | WRI is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity and human well-being.

SIX GOALS, FOUR CENTERS OF EXCELLENCE

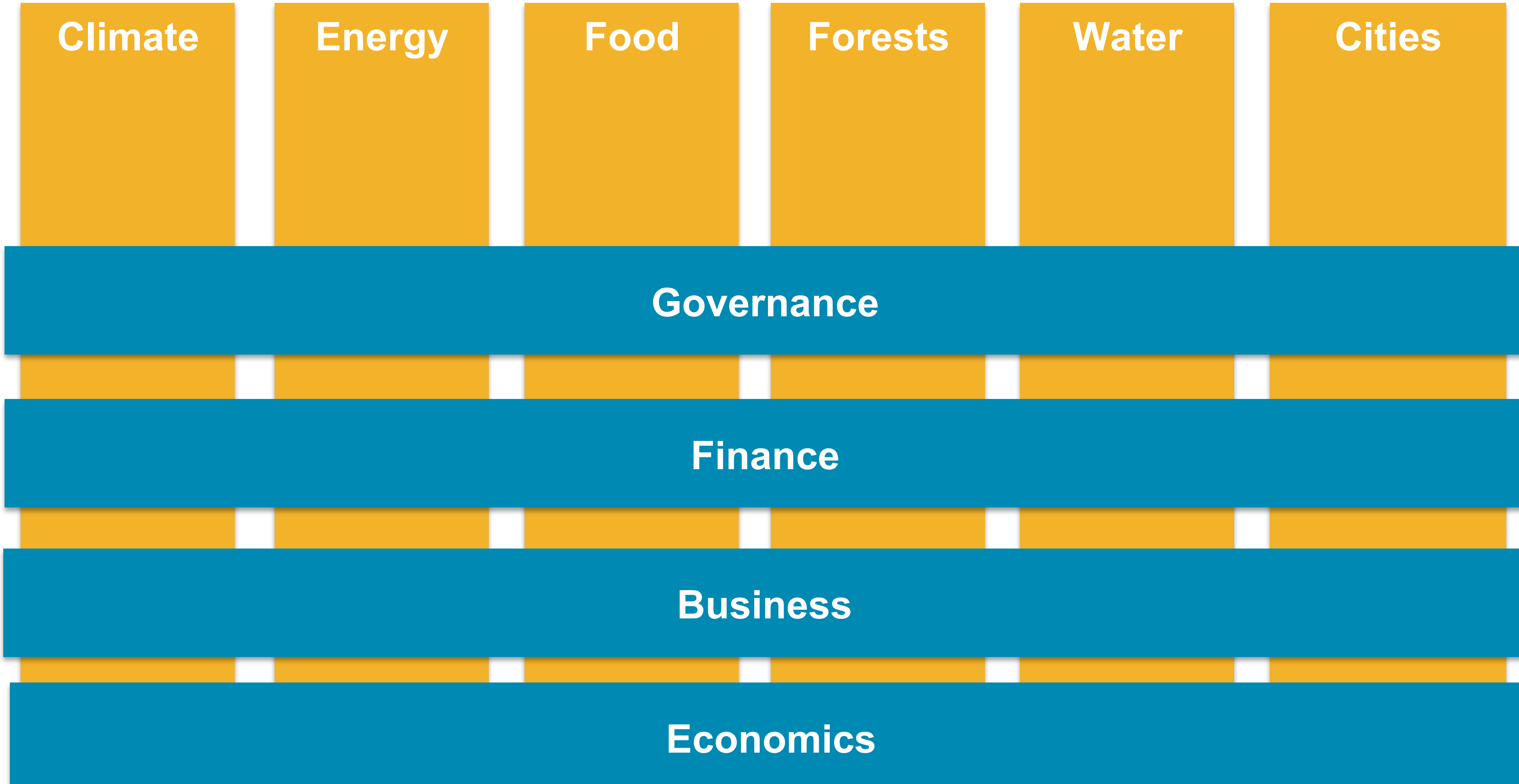


Photo: Ollivier Girard/CIFOR

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Supplementary Materials
www.sciencemag.org/content/342/6160/846/suppl/DC1
Materials and Methods
Supplementary Text
Figs. S1 to S20
Tables S1 to S3
References (*28–54*)

23 April 2013; accepted 30 September 2013
10.1126/science.1239552

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

M. C. Hansen,[1*] 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,[1] C. O. Justice,[1] J. R. G. Townshend[1]

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 practiced 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 km^2 of forest were lost due to disturbance over the study period and 0.8 million km^2 of new forest established. Of the total area of combined loss and gain (2.3 million km^2 + 0.8 million km^2), 0.2 million km^2 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://earthenginepartners.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 km^2/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 km^2/year. However, increased annual loss of Eurasian tropical rainforest (1392 km^2/year), African tropical moist deciduous forest (536 km^2/year), South American dry tropical forest (459 km^2/year), and Eurasian tropical moist deciduous (221 km^2/year) and dry (123 km^2/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 km^2/year in 2003 to 2004 and a low of under 20,000 km^2/year in 2010 to 2011. Of all countries globally, Indonesia exhibited the largest increase in forest loss (1021 km^2/year), with a low of under 10,000 km^2/year from 2000 through 2003 and a high of over 20,000 km^2/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 forestry 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

[1]Department of Geographical Sciences, University of Maryland, College Park, MD 20742, USA. [2]Google, Mountain View, CA, USA. [3]Department of Forest and Natural Resources Management, State University of New York, Syracuse, NY, USA. [4]Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA 02540, USA. [5]Earth Resources Observation and Science, United States Geological Survey, 47914 252nd Street, Sioux Falls, SD 57198, USA. [6]Geographic Information Science Center of Excellence, South Dakota State University, Brookings, SD, USA.
*Corresponding author. E-mail: mhansen@umd.edu

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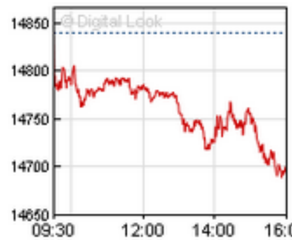
Dow Jones 15 min delay



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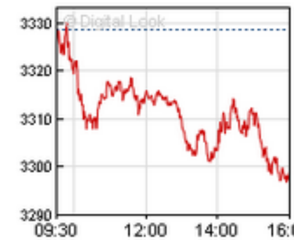
14700.95	-138.85	-0.94

Waiting for winners/losers data

Nasdaq 15 min delay



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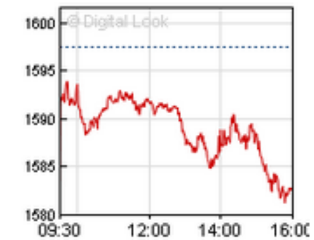
Waiting for winners/losers data

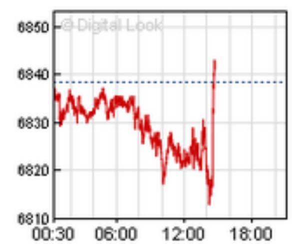
S&P 500 15 min delay



value	change	%
1582.70	-14.87	-0.9

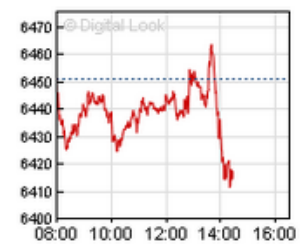
Waiting for winners/losers data

BBC Global 30



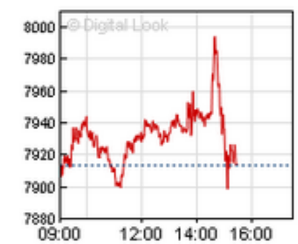
value	change	%
6841.26	+2.66	+0.04

FTSE 100 15 min delay



value	change	%
6414.95	-36.34	-0.56

Dax 15 min delay



value	change	%
7913.17	-0.54	-0.0

Market reports
- London
- Paris
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Top winner and loser (FTSE 100)

Glencore International		
327.05p	+12.75	+4.06
Shire Plc		
1935.00p	-85.00	-4.21

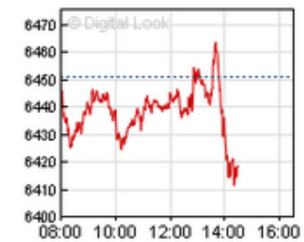
Top winner and loser (Dax)

Infineon Technologies AG		
6.54	+0.55	+9.0
Thyssen Krupp AG		
13.32	-0.42	-3.0

Stock markets			time (ET)
FTSE 100	6417.80	-33.49	Thu 09:28
Dow Jones	14700.95	-138.85	Wed 16:04
Nasdaq	3299.13	-29.66	Wed 16:00
Dax	7920.30	+6.59	Thu 09:28
Cac 40	3828.21	-28.54	Thu 09:28
S&P 500	1582.70	-14.87	Wed 16:01
BBC Global 30	6838.22	-0.38	Thu 09:43

Currencies			time (ET)
Sterling - US Dollar	1.5544	-0.0010	Thu 09:30
Sterling - Euro	1.1888	+0.0080	Thu 09:40
Euro - US Dollar	1.3076	-0.0104	Thu 09:40
US Dollar - Yen	97.7880	+0.3930	Thu 09:40

FTSE 100
Latest



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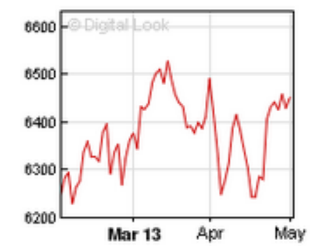
*All charts show local time

3 Months



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Asia Pacific

	£1 buys	change	%
Japanese Yen	152.04000	+0.55000	+0.36
Australian Dollar	1.51660	+0.00300	+0.20
New Zealand Dollar	1.83380	+0.00400	+0.19
Hong Kong Dollar	12.06400	-0.00700	-0.06
Singapore Dollar	1.91980	+0.00200	+0.10

DATA — GLOBAL FOREST WATCH — USERS

Space agencies
National
Regional
Local
Crowd

Make complex data
easy to understand,
decision-relevant,
and in near-real time

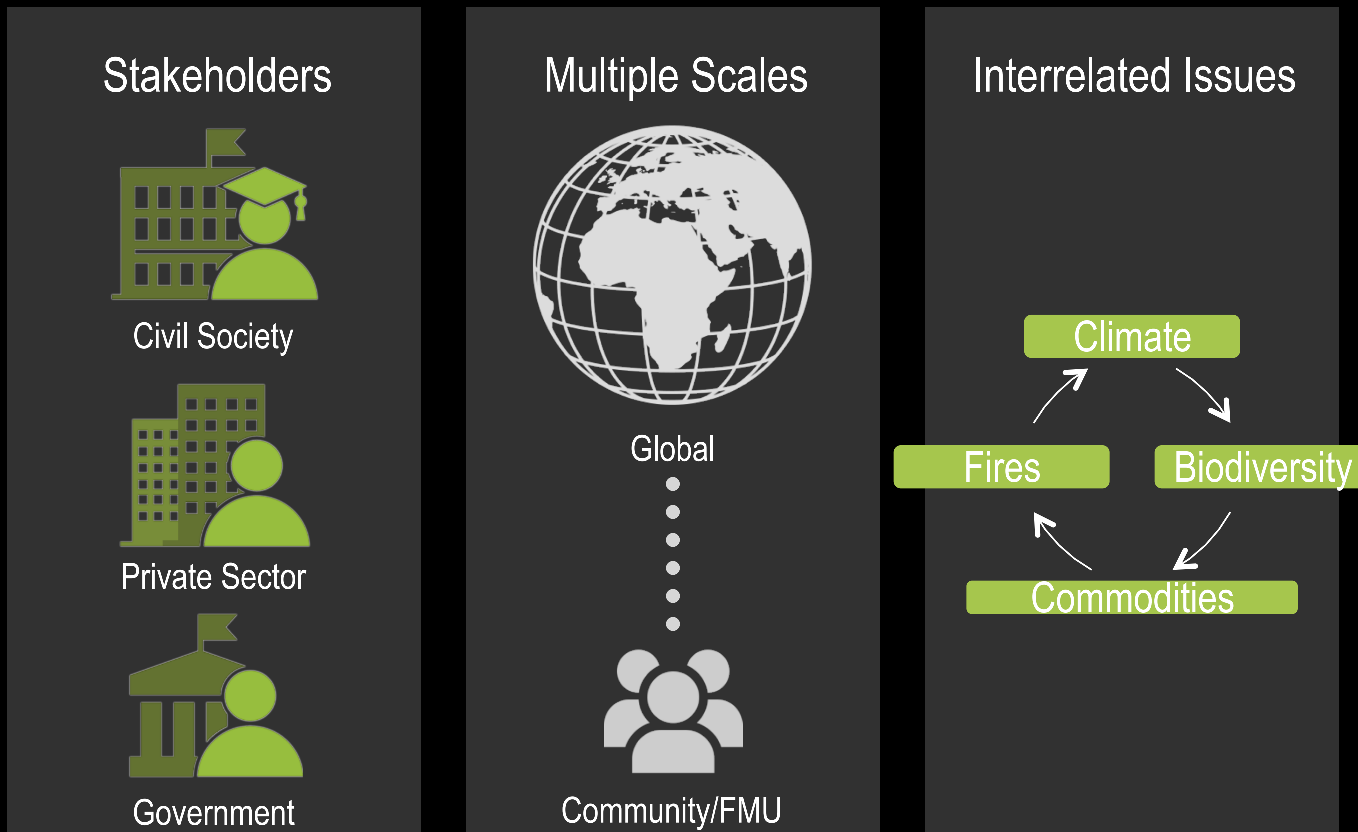
Governments
Business
Civil society
Communities
Educators

A diverse spectrum of users and use cases

GLOBAL FOREST WATCH

GLOBAL FOREST WATCH COMMODITIES

GLOBAL FOREST WATCH FIRES



GLOBAL FOREST WATCH CLIMATE

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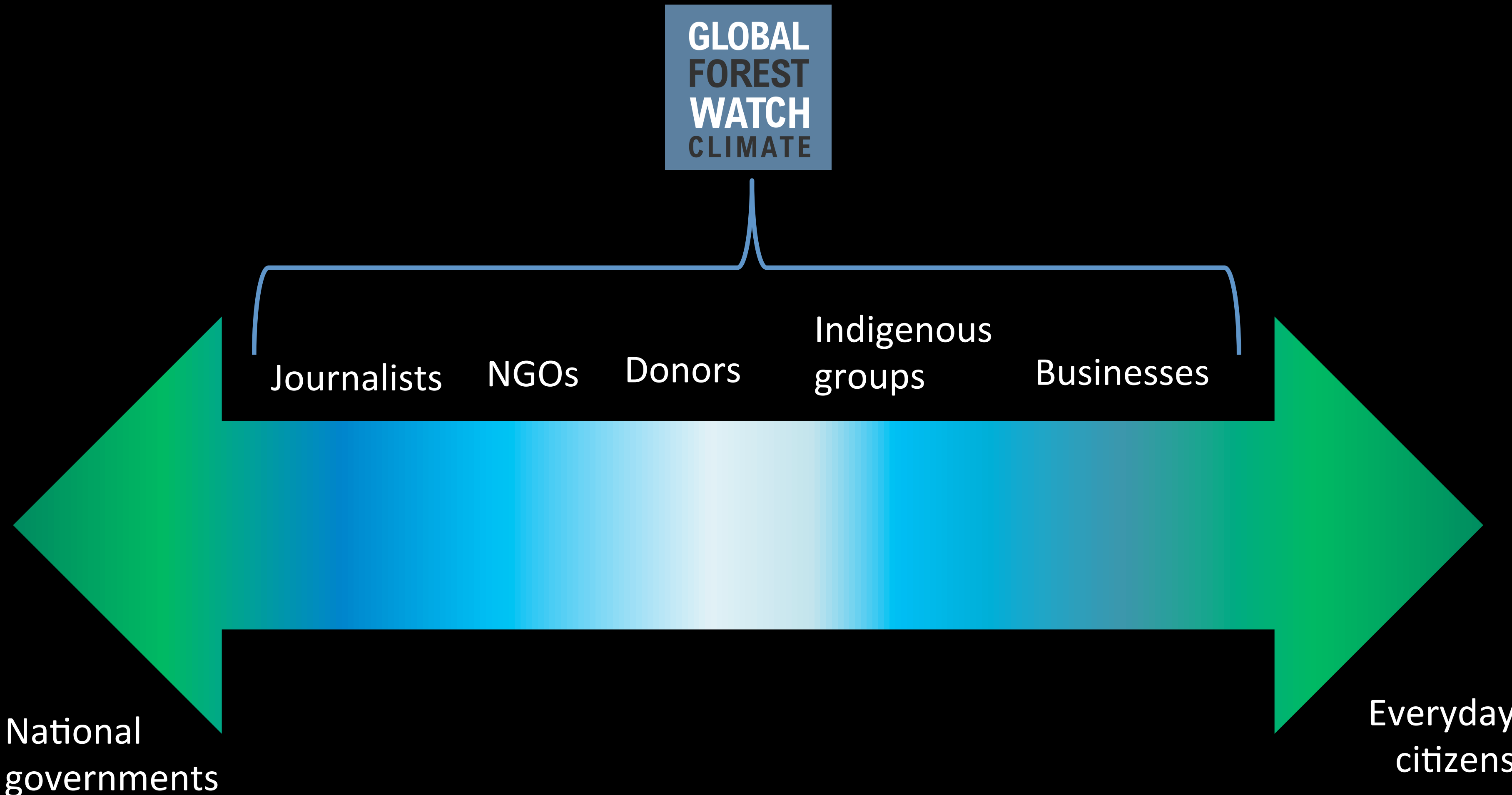
TARGET USERS



Different Land Use Processes ✚ **Fluxes occur differently for each process** ✚ “Natural” forest sink

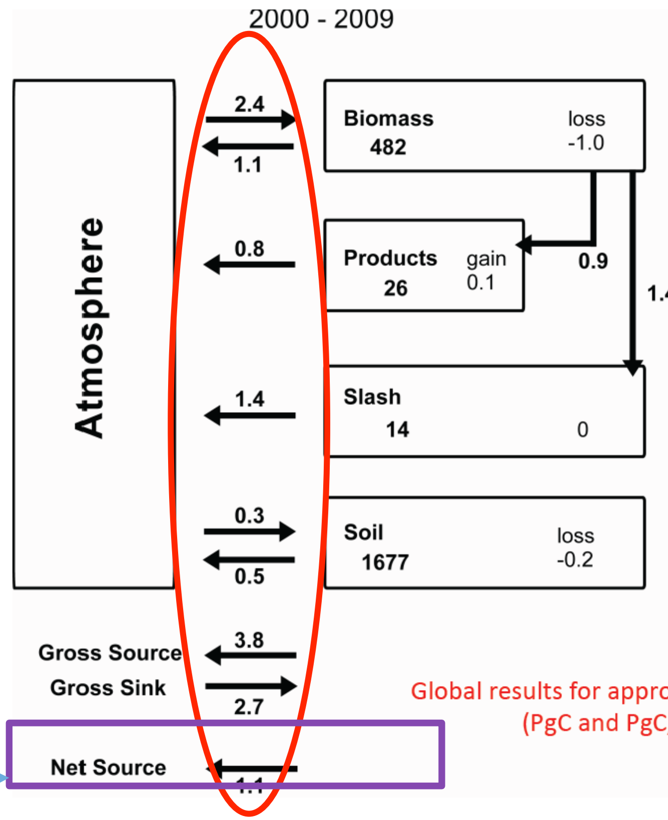
Changes in land use

Emphasis on forests

Changes in area
- Croplands (clearing and abandonment)
- Pastures
- Shifting cultivation

Changes in carbon stocks (C/ha) within forests
- Wood harvest & recovery
- Fire management

✚



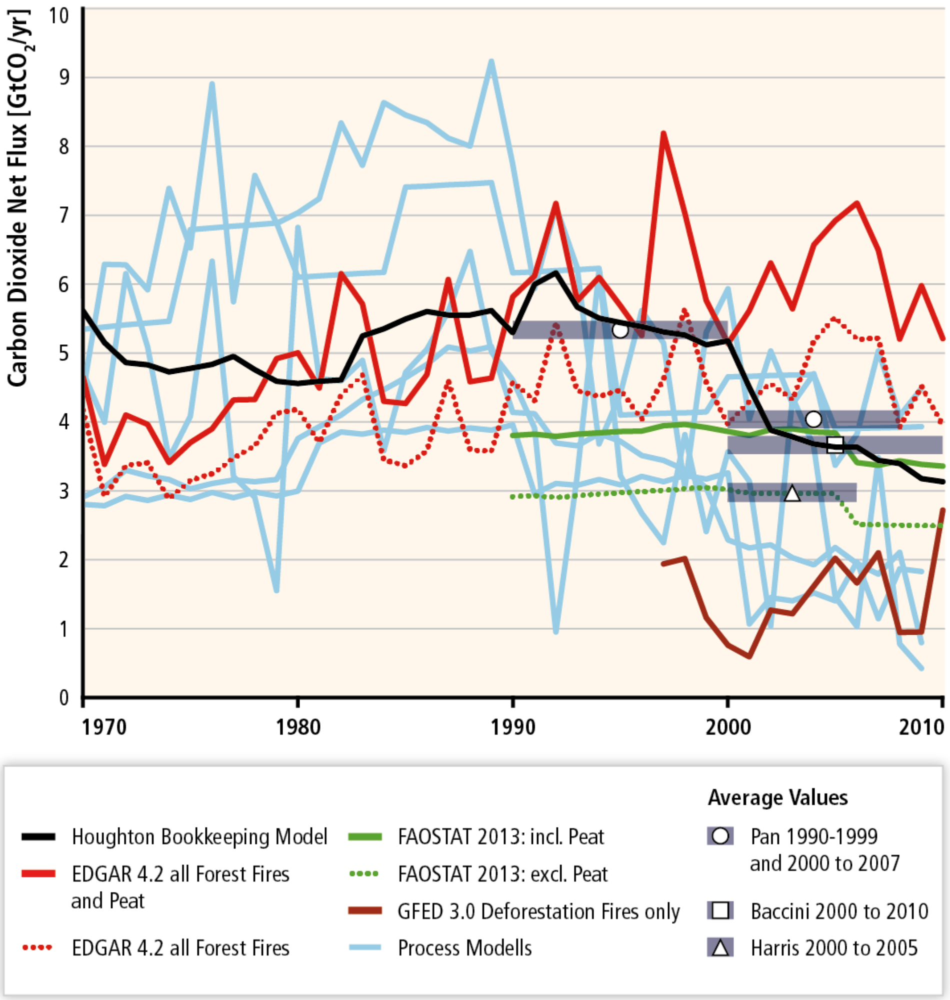
Global results for approximately 1990 (PgC and PgC/yr)

This is the only thing that gets reported.

?

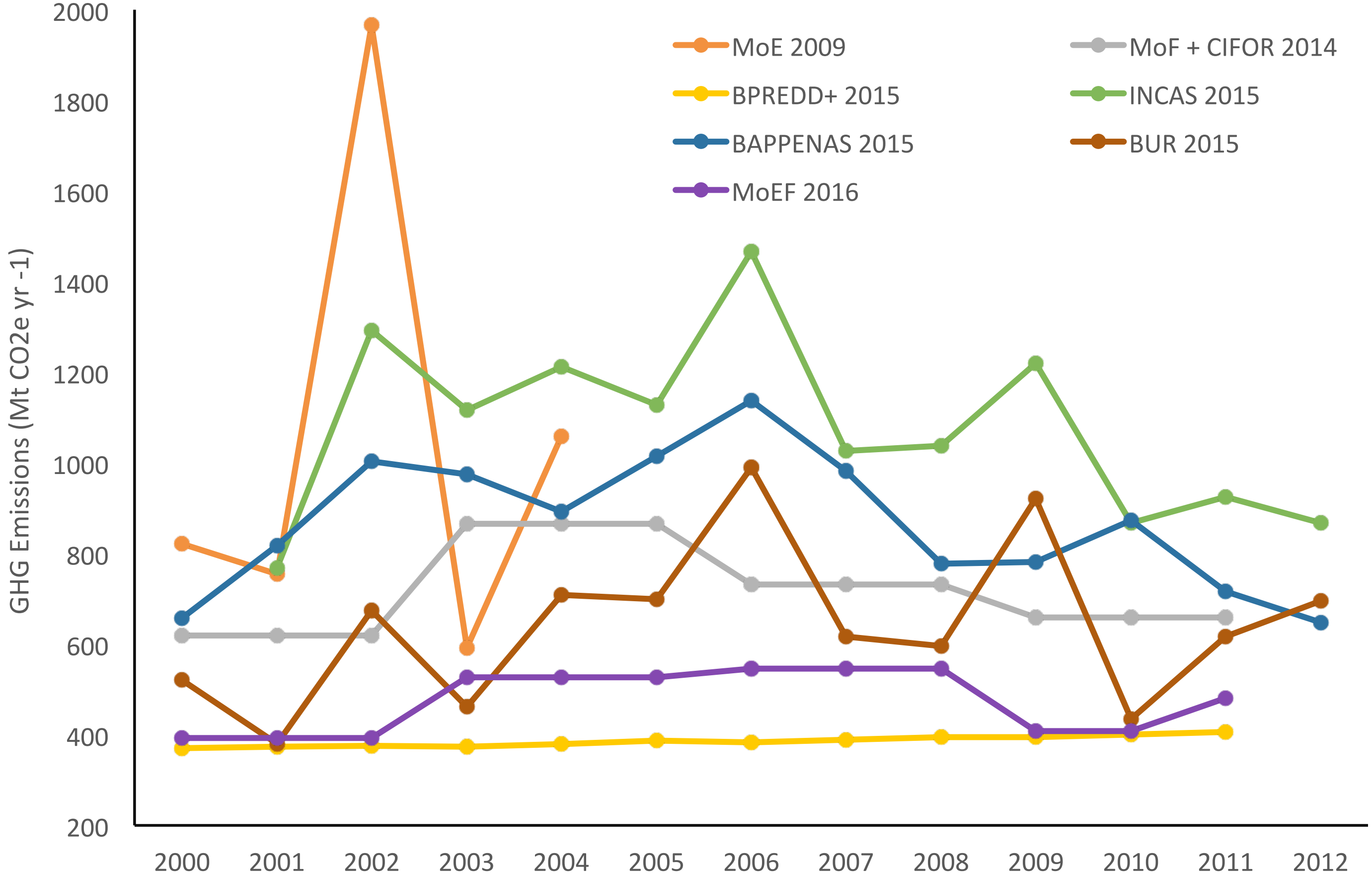
Land use and flux graphics: Woods Hole Research Center

Global Uncertainty

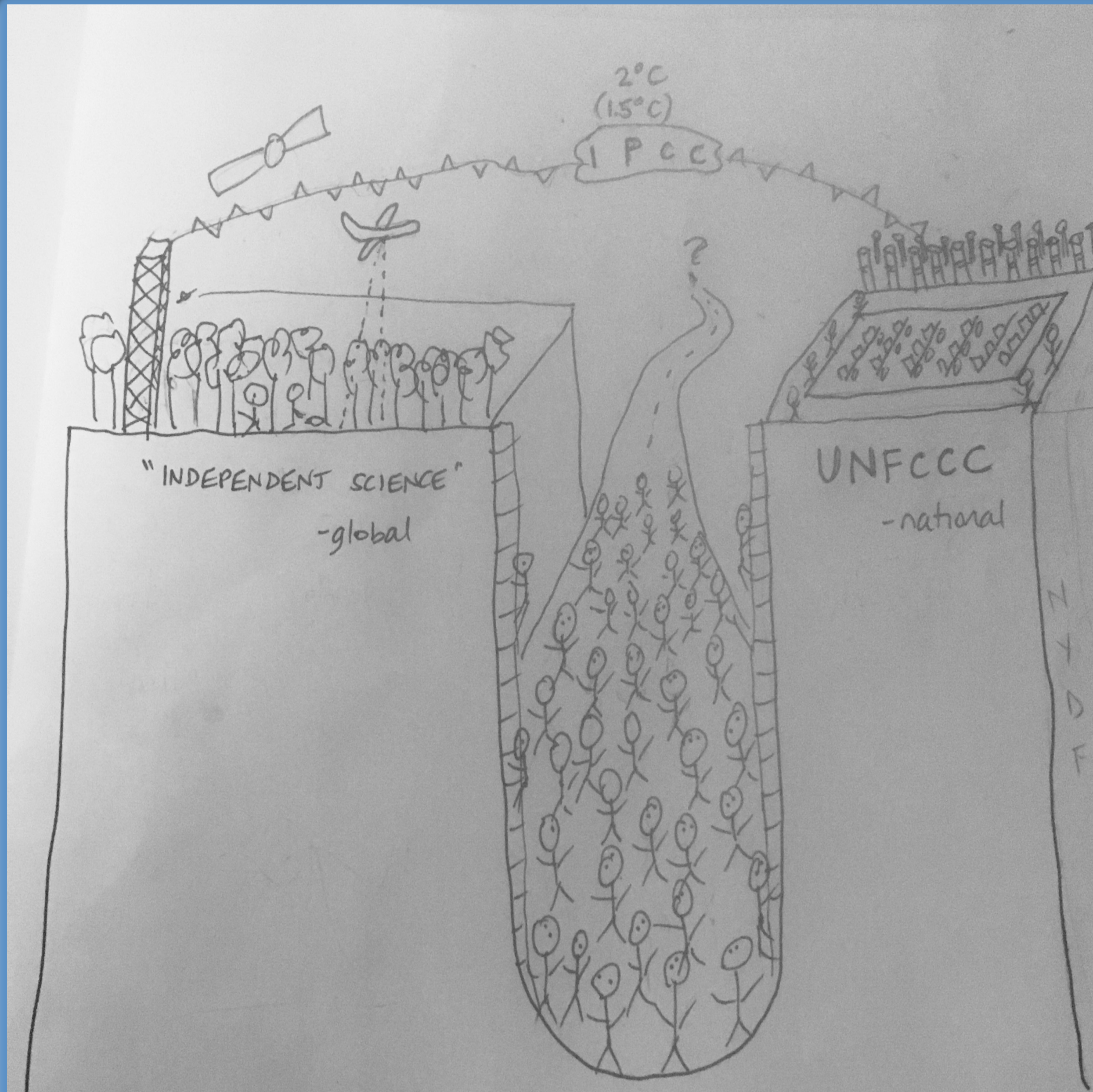


IPCC AR5 Chp 11

National Uncertainty – Indonesia as a case study



Austin et al. A Review of Land-based Greenhouse Gas Emissions Estimates in Indonesia. *in prep*


2°C
(1.5°C)
IPCC
?
"INDEPENDENT SCIENCE"
-global
UNFCCC
-national
NYDF

COP21 MAJOR OUTCOMES

LONG-TERM GOAL
for net zero carbon this century

STRENGTHEN CLIMATE ACTIONS
every 5 years

ENHANCED TRANSPARENCY
and accountability

GLOBAL FOREST WATCH CLIMATE

ADAPTATION
to help most vulnerable

FINANCIAL SUPPORT
especially for least developed countries

UNFCCC'S 2018 "GLOBAL STOCKTAKE" UNDER THE PARIS AGREEMENT

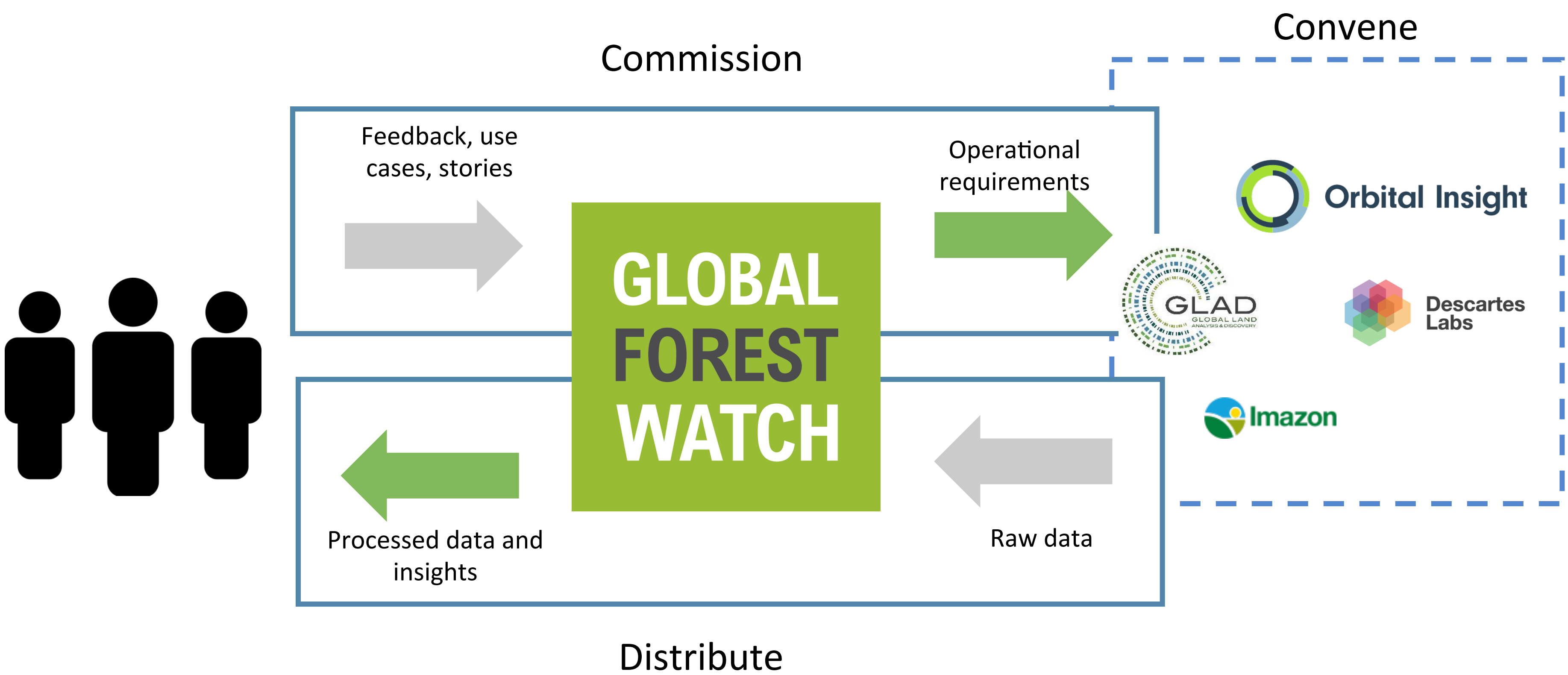
- "Collective moment of review" every five years, beginning in 2023, also a "facilitative dialogue" to take stock in **2018**
- Informed by science, progress made in implementation, assess how far is left to go, what opportunities exist for enhanced action
- develop a list of existing information sources, including national reports, reports from UNFCCC subsidiary bodies and scientific inputs (i.e. the IPCC special reports).

climate.globalforestwatch.org

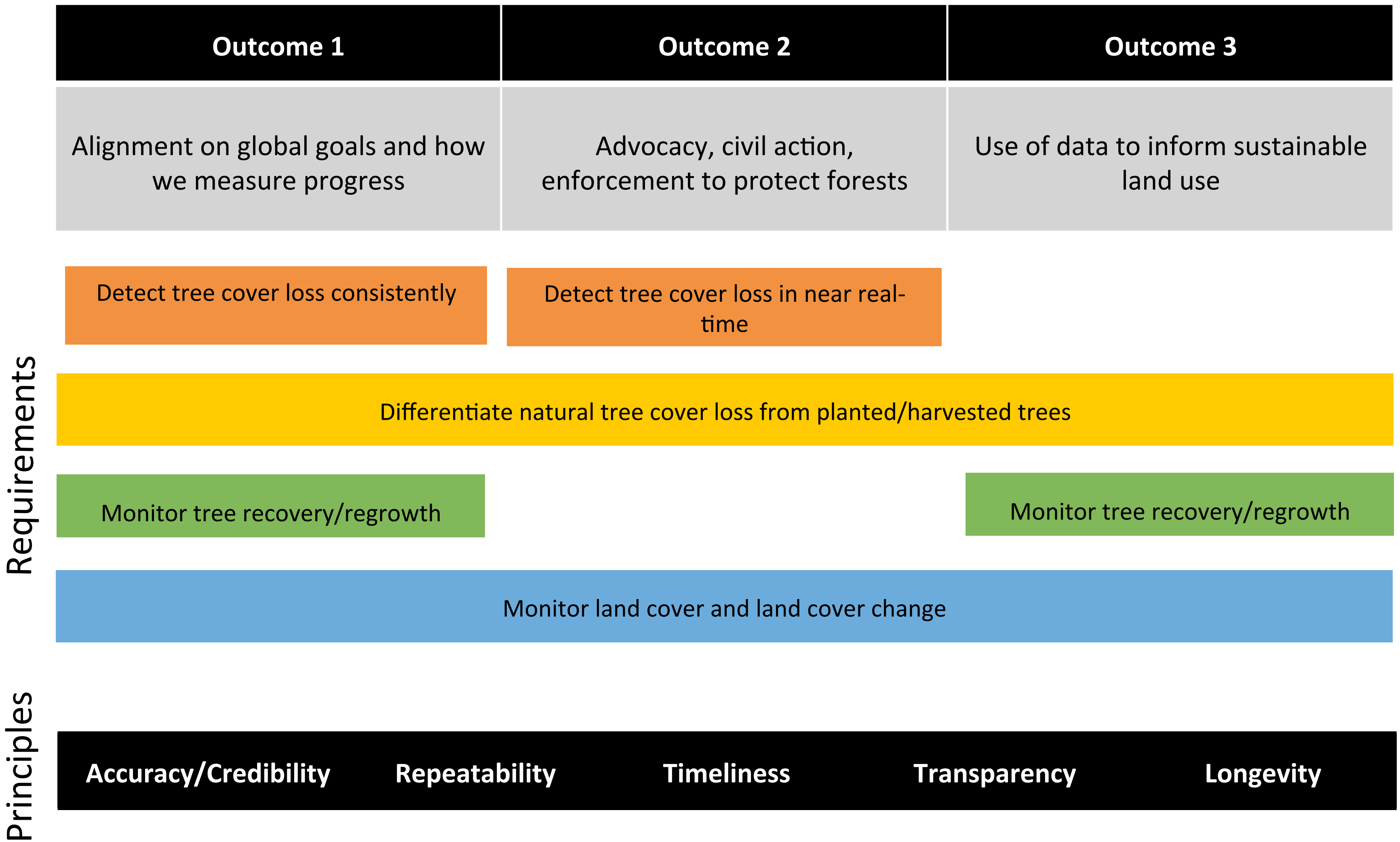
CHALLENGES

- Research timelines ≠ operational timelines
- Striking the right balance between global and local
- Forest monitoring for what?
- Critics – nothing's perfect
- Climate change not "urgent"; global carbon cycle science "too wonky"
- Long-term funding questions

GFW: Convener, commissioner, distributor



Mapping data requirements onto outcomes



E. O. WILSON

"We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

FROM *CONSILIENCE: THE UNITY OF KNOWLEDGE* (1998)