WORLD RESOURCES INSTITUTE

GLOBAL FOREST WATCH

GLOBAL FOREST WATCH CLIMATE

Global Forest Carbon Monitoring for the 21st century

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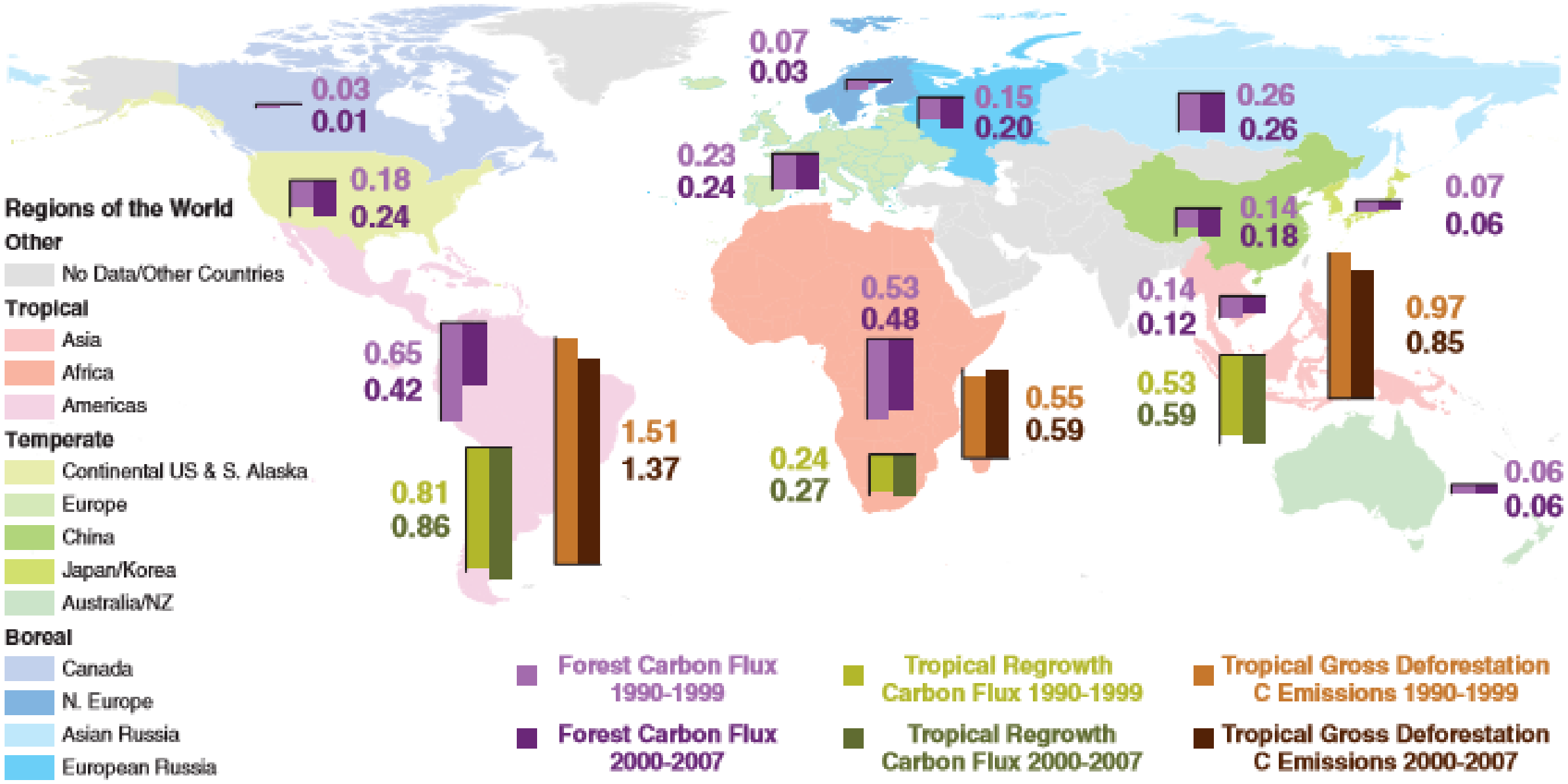
World Resources Institute

September 12, 2017

How well do we know GHG fluxes from forests?

NOT WELL AT ALL.

We need a better empirical basis for measuring and tracking GHG fluxes from forests and more detailed information to inform climate policy.



Source: Pan et al. 2011

What's needed for an independent, spatially explicit forest carbon monitoring system?

GLOBAL FOREST WATCH CLIMATE

- ❑ Changes in forest area
- ❑ Aboveground biomass density
- ❑ Type of disturbance causing loss
- ❑ Forest carbon sequestration
- ❑ Complete accounting of all emissions and removals (all pools, gross+net)

What's needed for an independent, spatially explicit forest carbon monitoring system?

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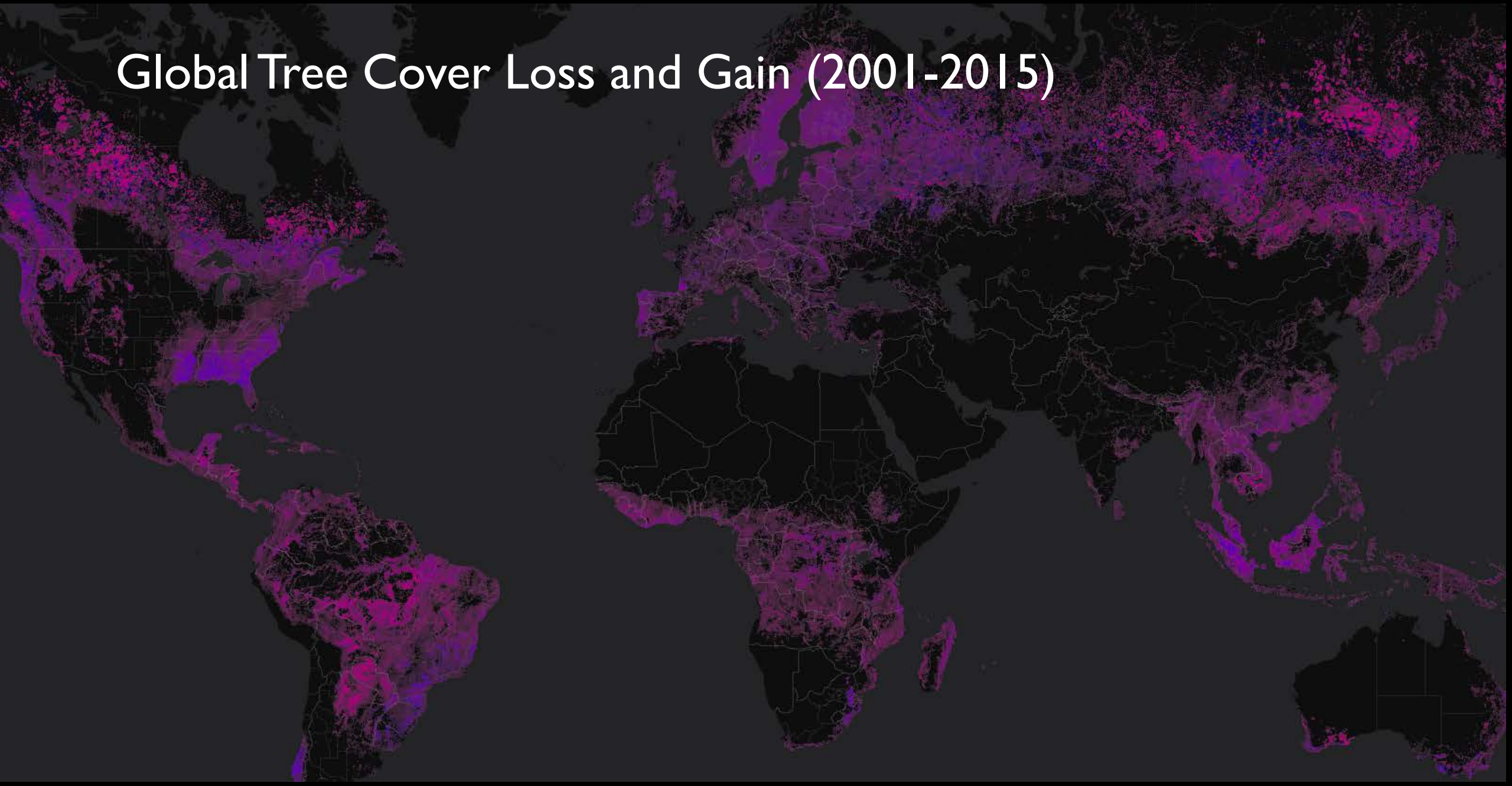
- ✓ Changes in forest area
- ❑ Aboveground biomass density
- ❑ Attribution of observed change
- ❑ C flux in undisturbed forests
- ❑ Complete GHG accounting (all pools, gross+net)

Global Tree Cover Loss and Gain (2001-2015)



Source: Hansen/UMD/Google/USGS/NASA

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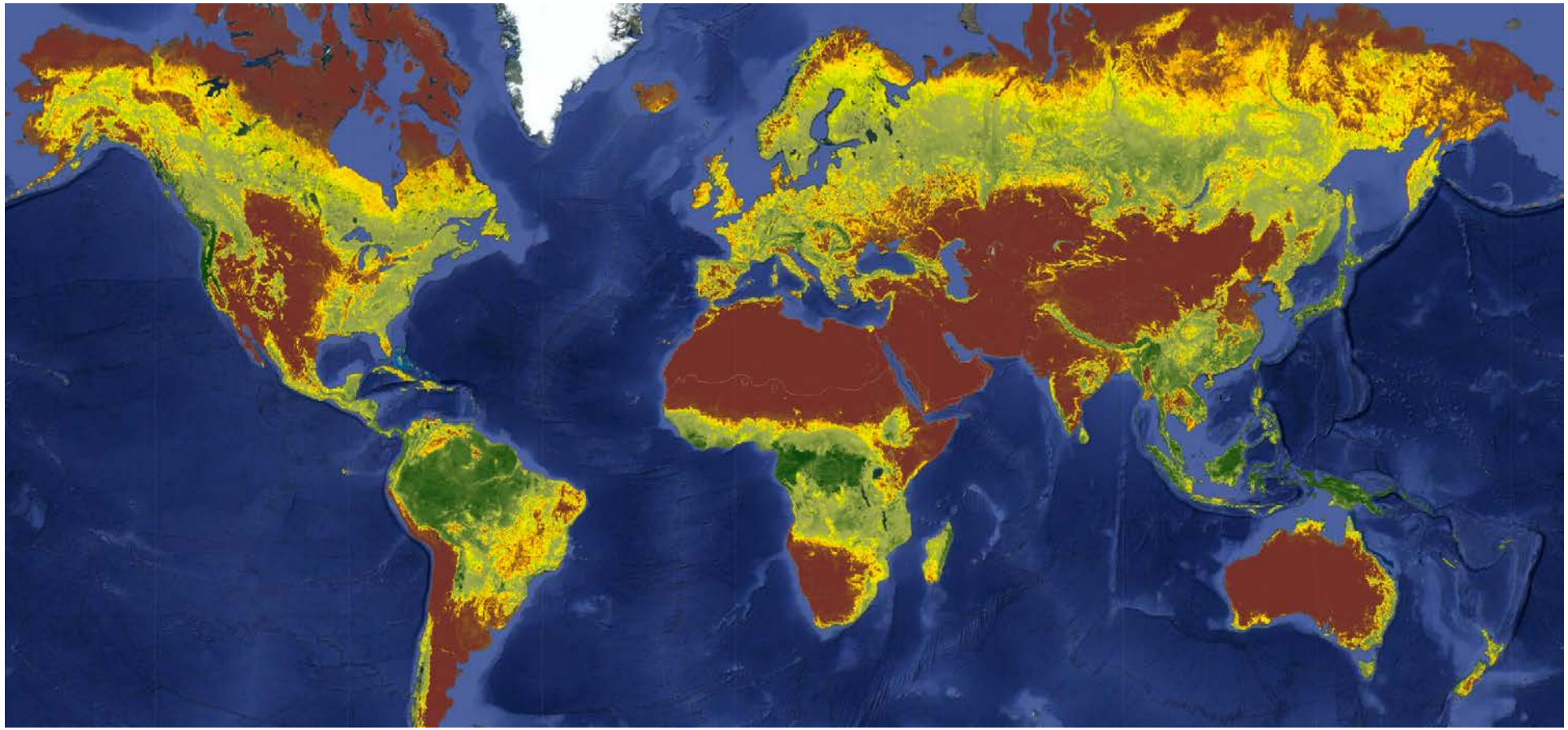
Global aboveground biomass at 30m



0 400+ Mg/ha

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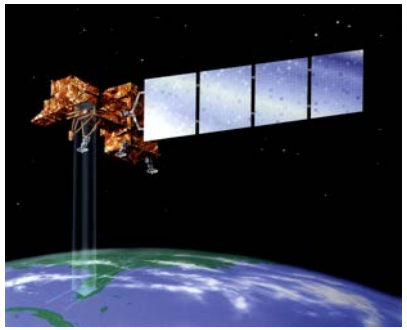
Methodology: datasets

Datasets we use:

- Ground-based measures of biomass density

- GLAS Lidar observations from ICESat satellite (70 m footprints)

- Spatially continuous data, including Landsat satellite imagery (30 m resolution)



Landsat 7 satellite

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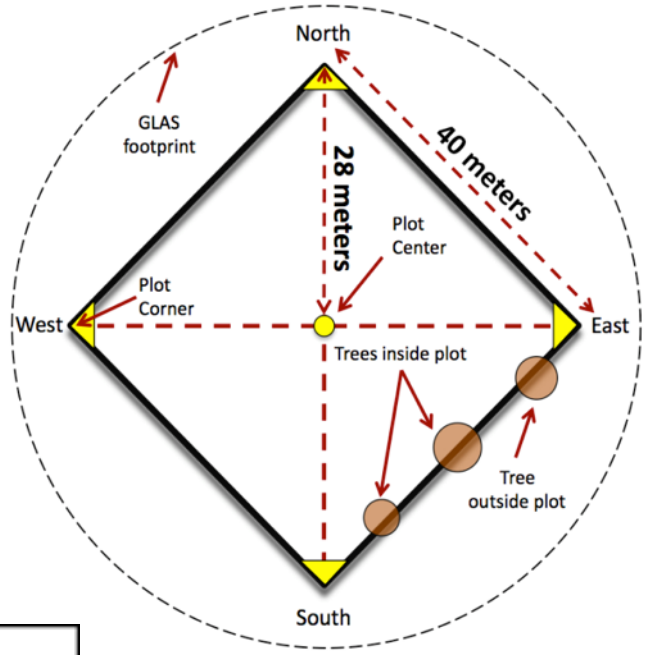
Pan-tropics: field biomass to LiDAR

- Field plots = 40m x 40m square
- Measure DBH of all trees inside plot
- Using DBH-based allometry, get biomass for plots



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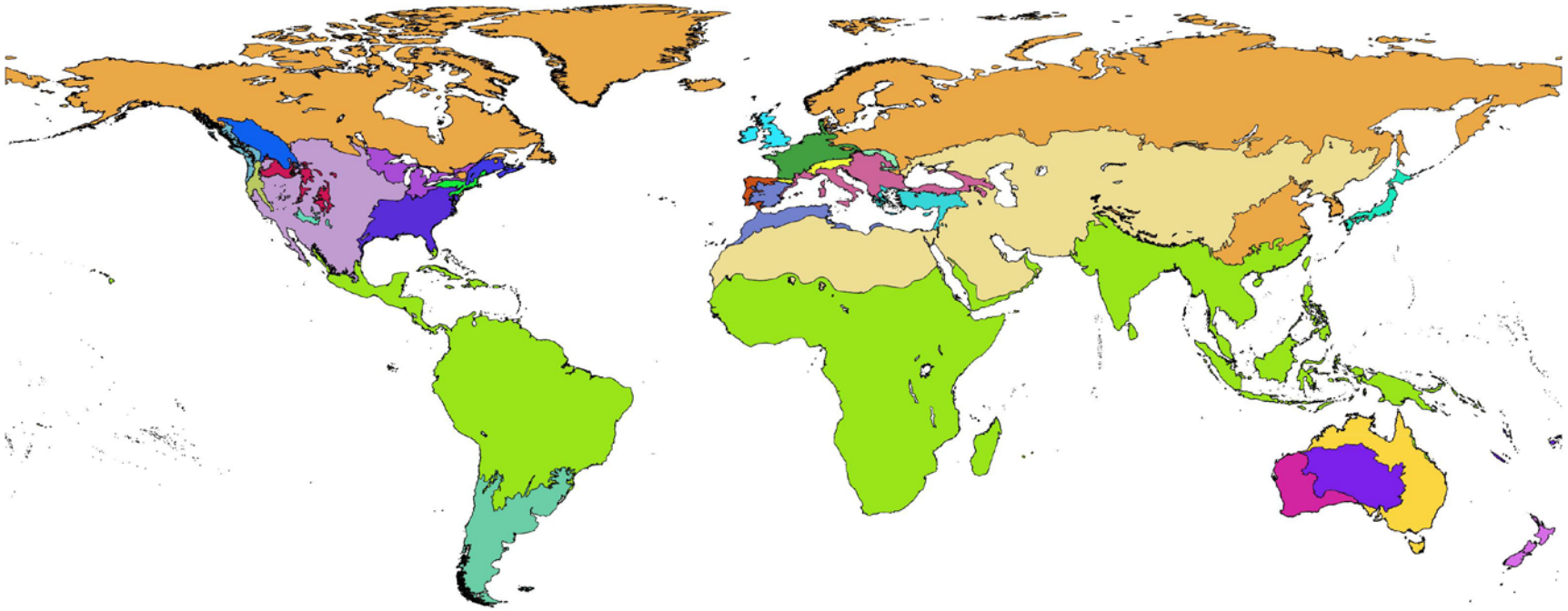
Global map: field biomass to LiDAR



- WHRC field-based allometry
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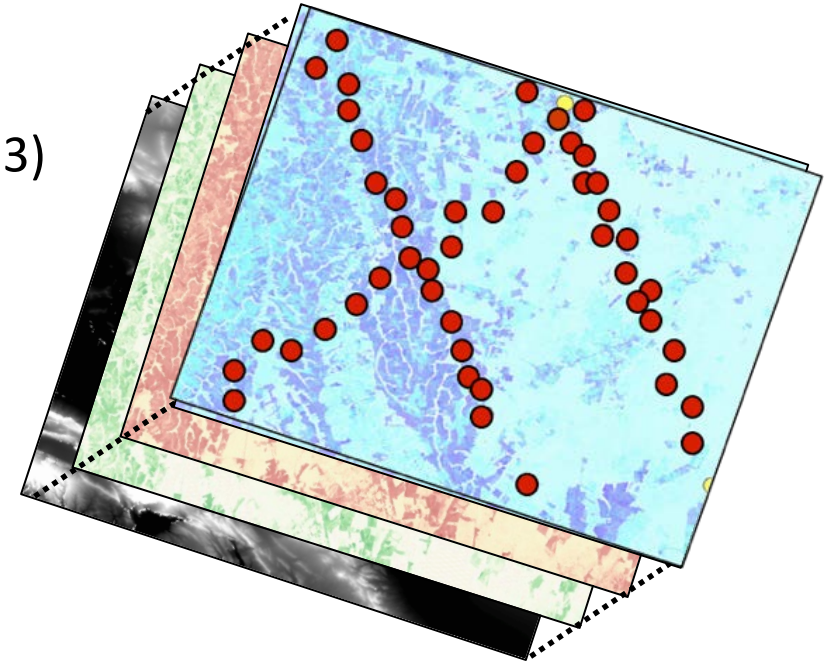
- Alberti et al. (2013)
- Anderson et al. (2006)
- Beets et al. (2011)
- Brovkina et al. (2015)
- Duncanson et al. (2010)
- González-Ferreiro et al. (2013)
- González-Roglich and Swenson (2006)
- Hudak et al. (2012)
- Hyde et al. (2007)
- Lim et al. (2003)
- Lu et al. (2012)
- Lucas et al. (2008)
- Neigh et al. (2013)
- Nelson et al. (2017)
- Patenaude et al. (2004)
- Popescu et al. (2011)
- Shang et al. (2014)
- Simonson et al. (2016)
- Skowronksi et al. (2007)
- Suganuma et al. (2006)
- Sun et al. (2011)
- Takagi et al. (2015)
- Tsui et al. (2012)
- Wang et al. (2013)
- Wang et al. (2015)
- Yavaşlı et al. (2016)

Relating LiDAR-based biomass to spatially continuous data

- Landsat 7 data:
  - Bands: Red, NIR, SWIR1, SWIR2
  - NDVI, NDII
  - Percent tree cover (Hansen et al. 2013)
- Gridded biophysical variables
  - Climate, precipitation variables
  - Hijmans et al. (2005)
- Elevation data (SRTM)



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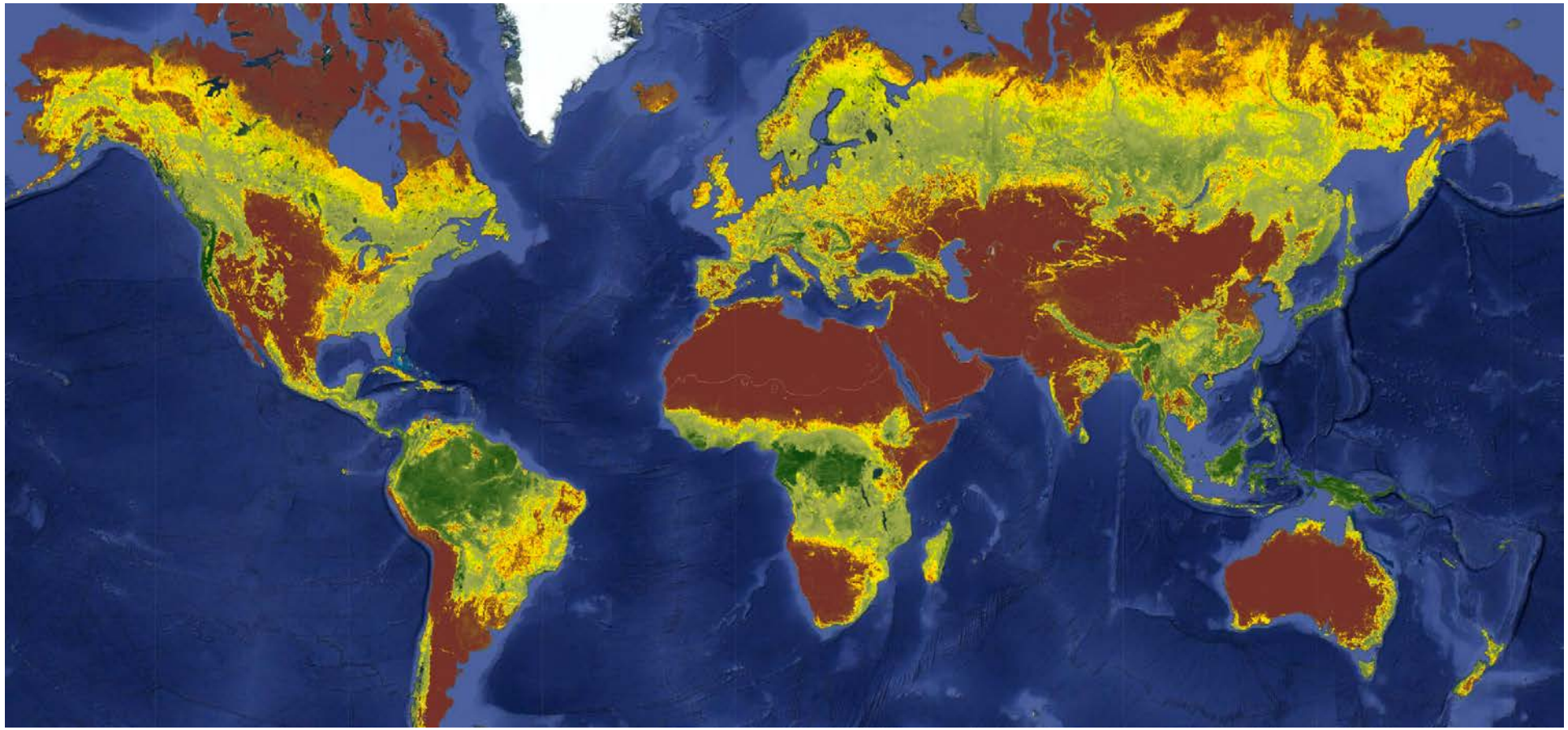

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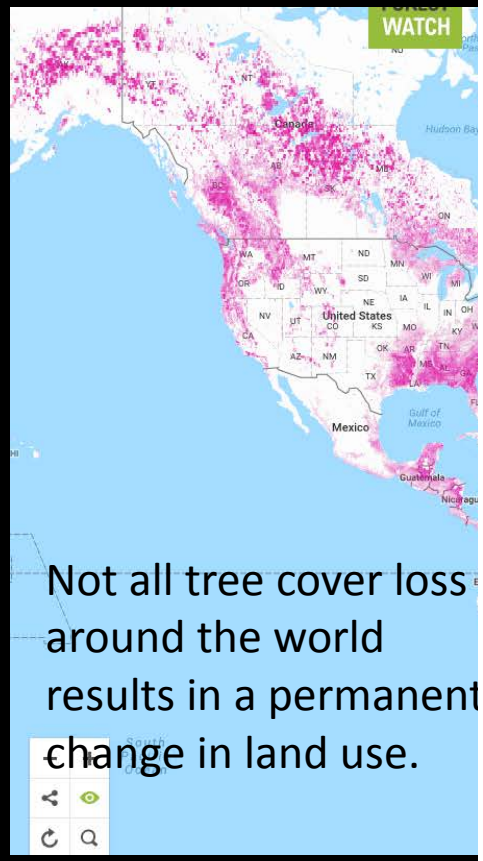
TREE COVER LOSS → DEFORESTATION



Not all tree cover loss around the world results in a permanent change in land use.

Wood-fiber Plantations

Oil Palm Plantations

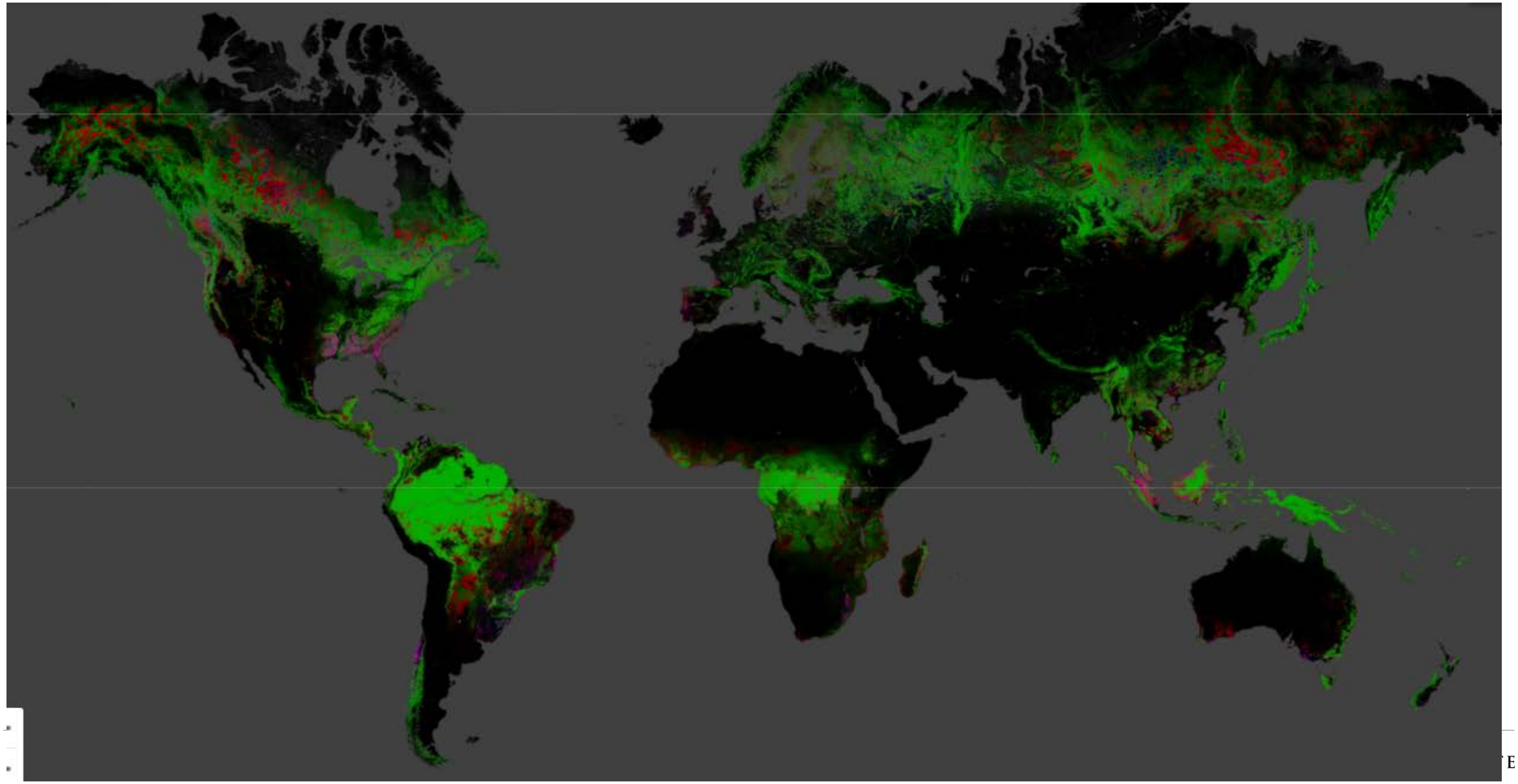
Other Forestry Activity

Tree cover loss can also occur within managed forests and tree farms, with no subsequent change in land use.

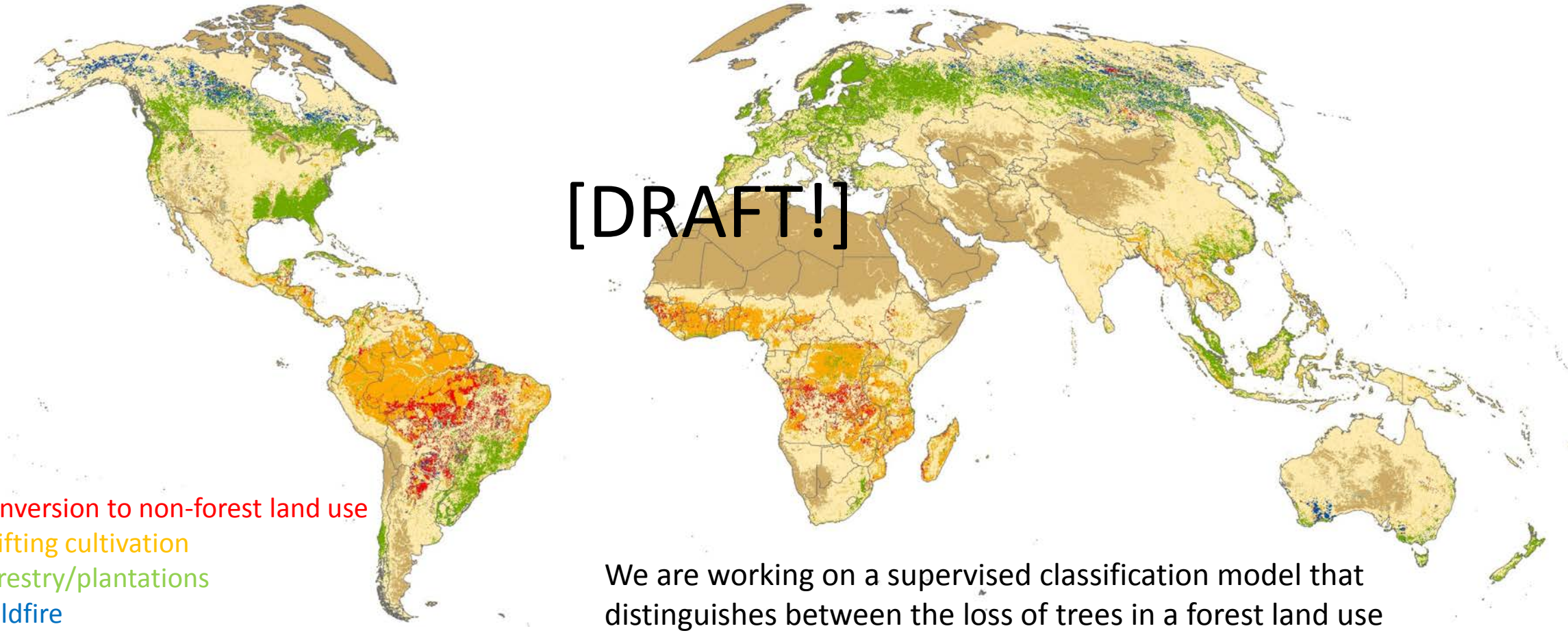
Conversion (example: Pasture)

Wildfire

EXPLORE LOSS/GAIN DYNAMICS THROUGH TIME



BASIC ATTRIBUTION MODEL, 10X10 KM GRID



[DRAFT!]

Conversion to non-forest land use
Shifting cultivation
Forestry/plantations
Wildfire
Mixed cause/uncertain

We are working on a supervised classification model that distinguishes between the loss of trees in a forest land use versus the conversion of natural forests to a non-forest use.

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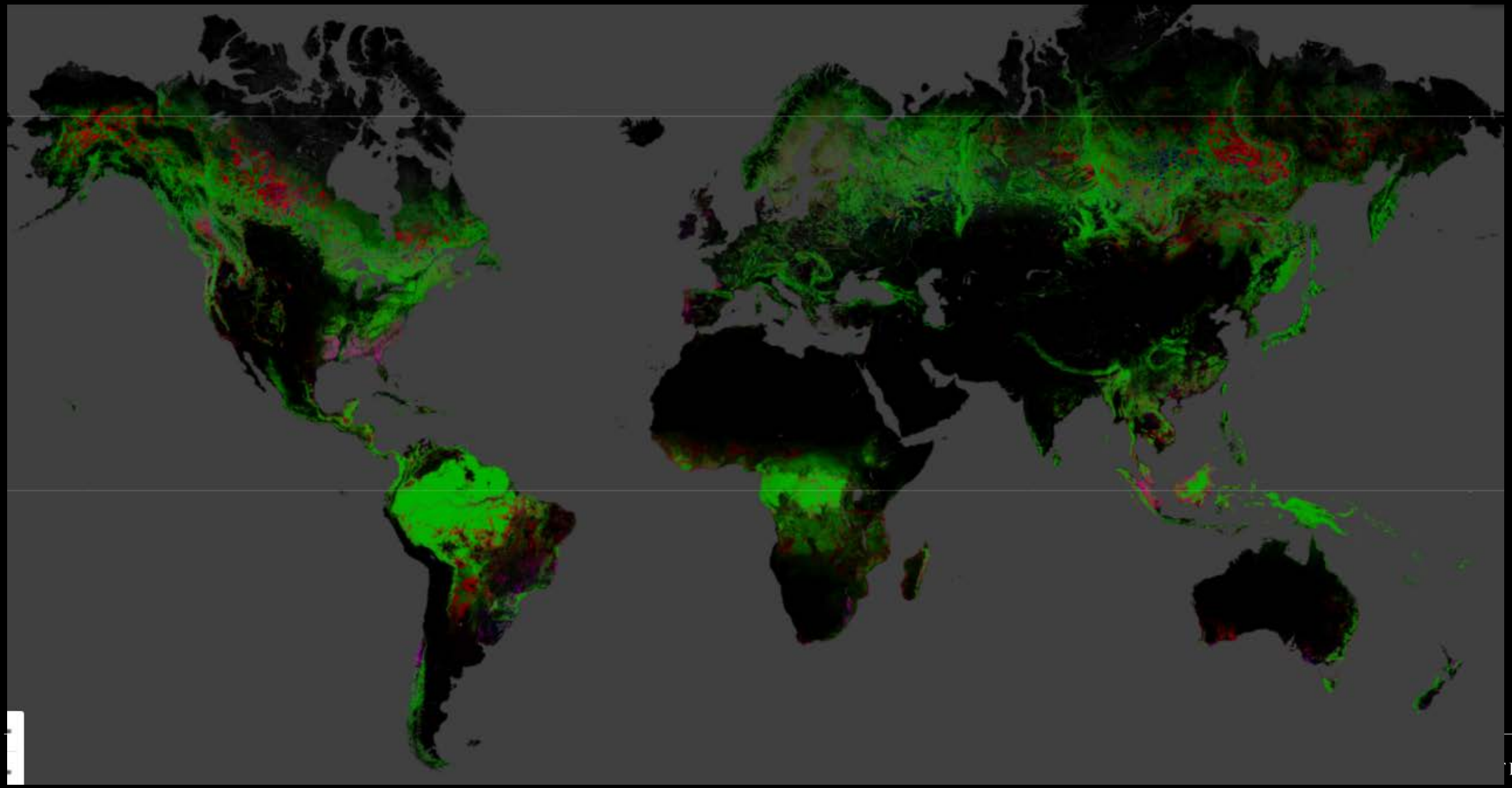
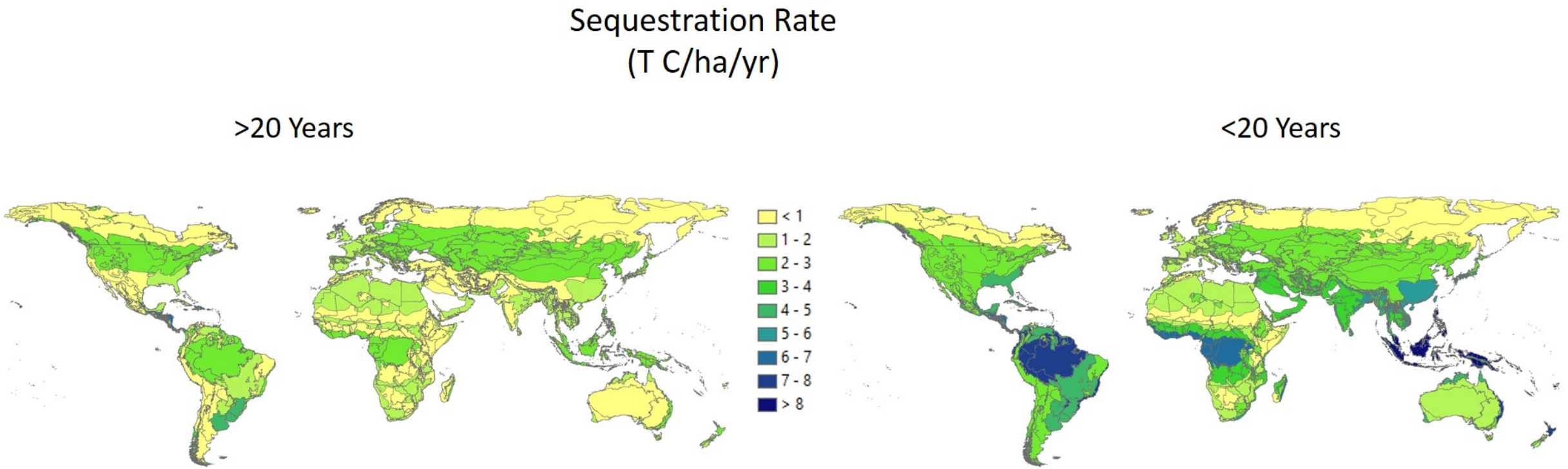
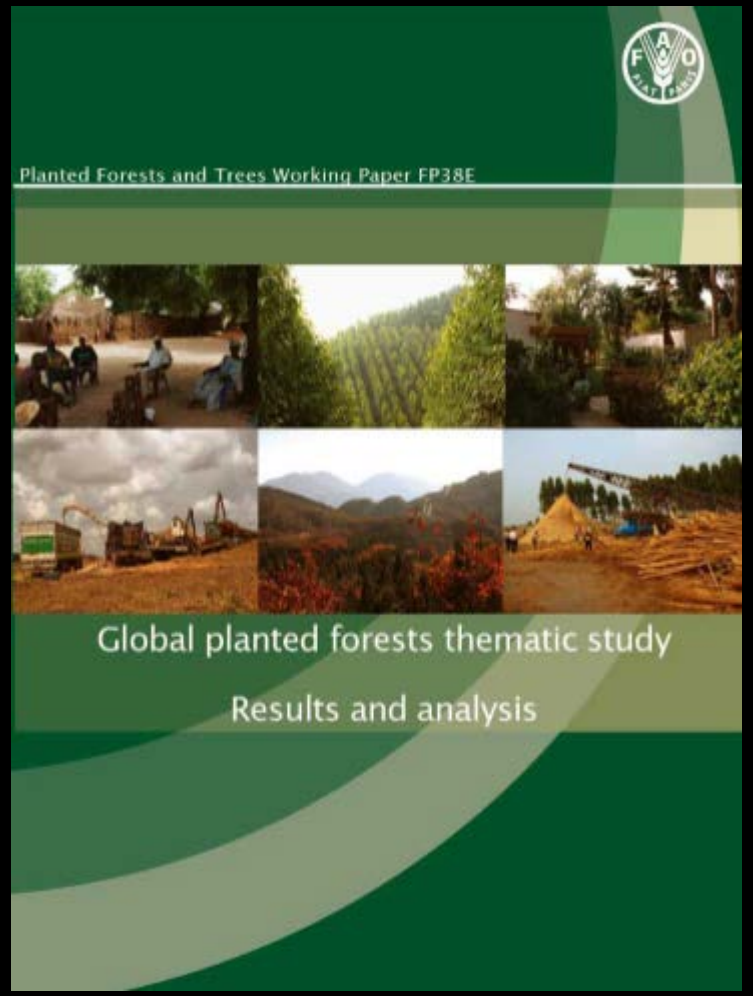
REMEMBERING PHOTOSYNTHESIS

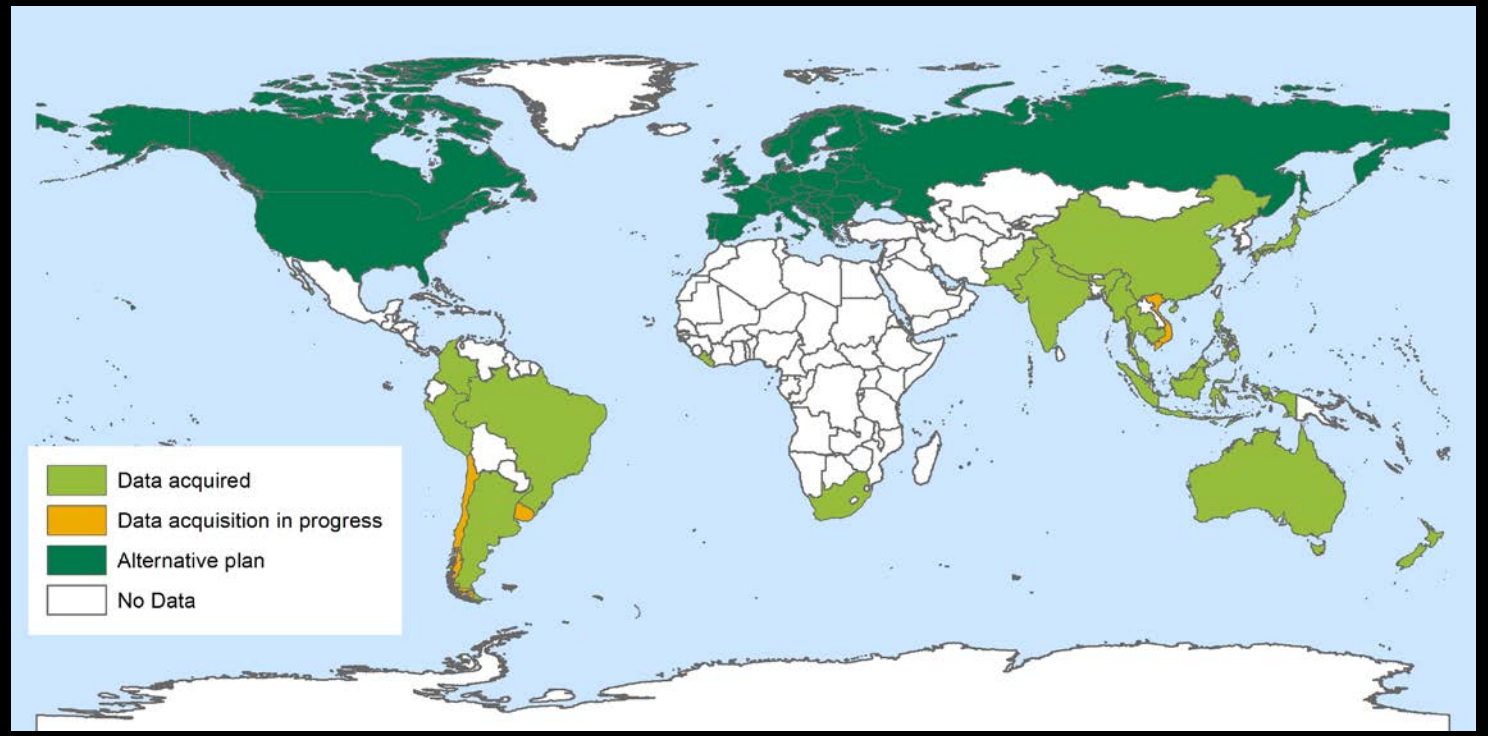


SEQUESTRATION RATES IN NATURAL FORESTS (IPCC)



SEQUESTRATION RATES IN PLANTED FORESTS





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ABOVEGROUND BIOMASS → TOTAL GHG IMPACTS

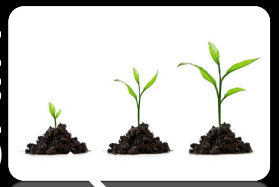
CARBON POOLS

- ✓ Aboveground biomass
- ✓ Belowground biomass
- ✓ Dead organic matter
- ✓ Soil organic carbon (peat, mineral soils)
- ✓ Wood products

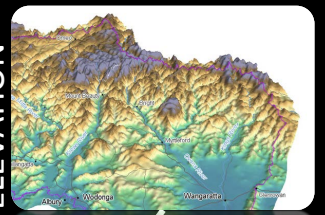
GREENHOUSE GASES

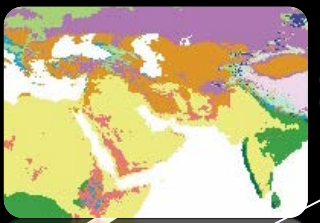
- ✓ CO_2
- ✓ CH_4 (fires)
- ✓ N_2O (fires)


LOSS


GAIN

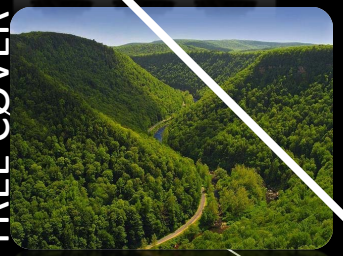

BURNED AREA


ELEVATION


CLIMATE ZONE

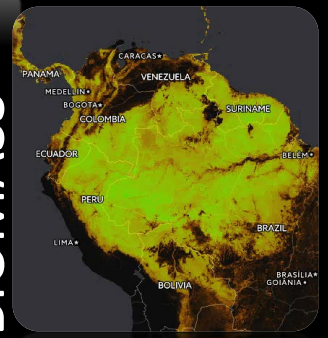

SOIL


PLANTATIONS


TREE COVER


INTACT FOREST

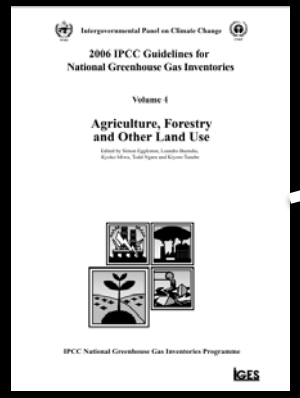

PEATLANDS

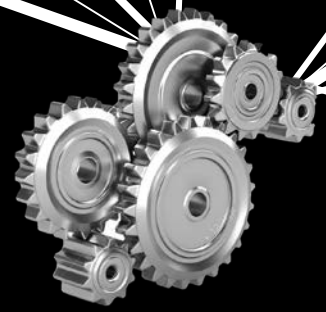


BIOMASS


TYPE OF DISTURBANCE

IPCC GUIDELINES:
"GAIN-LOSS" METHOD





GROSS CARBON LOSS (EMISSIONS)
GROSS CARBON GAIN (REMOVALS)

NET GHG FLUX (Mt C02e)

NEXT STEPS

- Finish attribution model
- Complete model framework
- Generate global results
- Sensitivity analysis