Toward a global land use open data- a baseline for global land monitoring

Food and Agriculture Organization of the United Nations

The extent of forest in dryland biomes

Jean-Francois Bastin

Food and Agriculture Organization of the United Nations

DRYLANDS MONITORING WEEK 2015

From the 19th to the 23rd of January 2015, in Rome, FAO, WRI and IUCN with funding support of EU-ACP and GEF, organized a workshop on "Monitoring and assessment of drylands: forests, rangelands, trees and agrosilvopastoral systems".

Gathering 80 participants from countries and international organizations. This event led to the "**Rome Promise**" in which participants agreed to:

- Form an open-ended collaborative network or community of practice to advance monitoring and assessment of drylands, including understanding of their users
- Communicate the value and importance of drylands monitoring to relevant stakeholders, including policy makers and resource partners
- Develop a dynamic roadmap for collaborative action

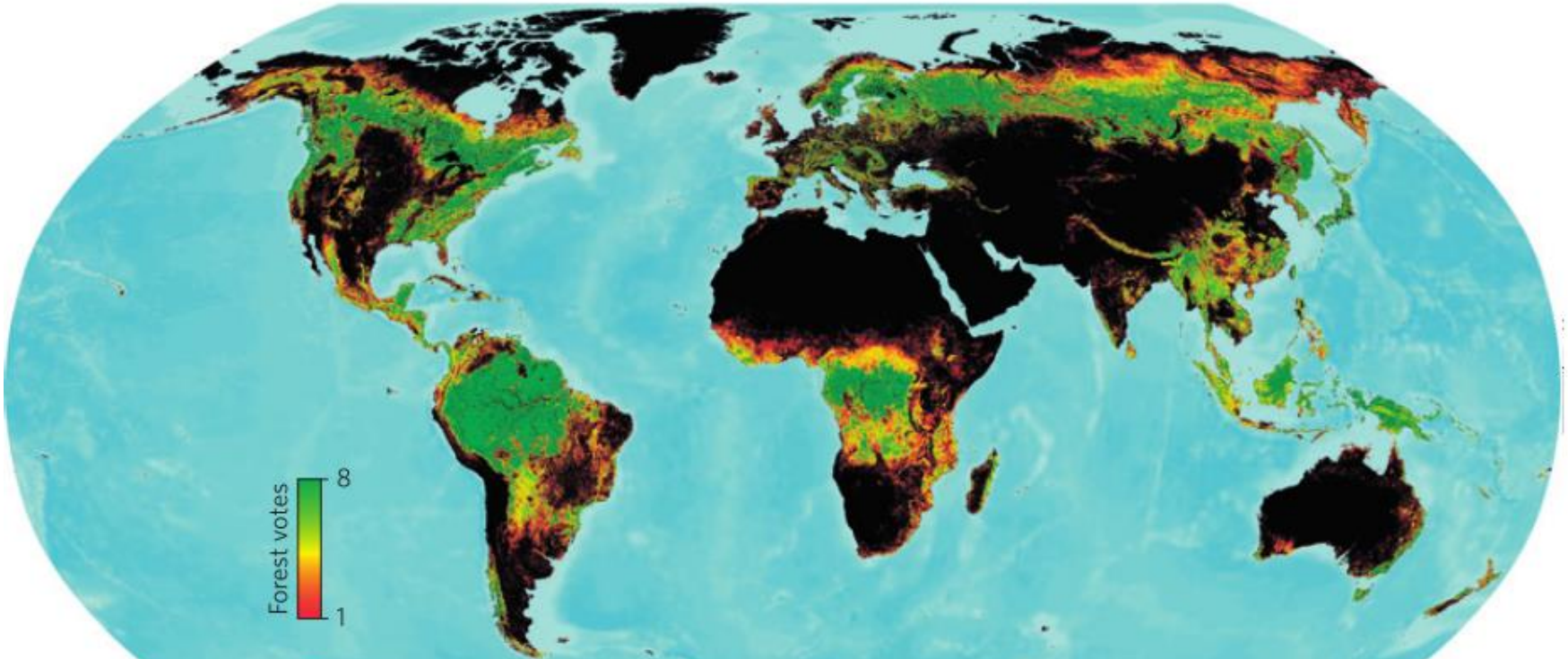
nature climate change

LETTERS

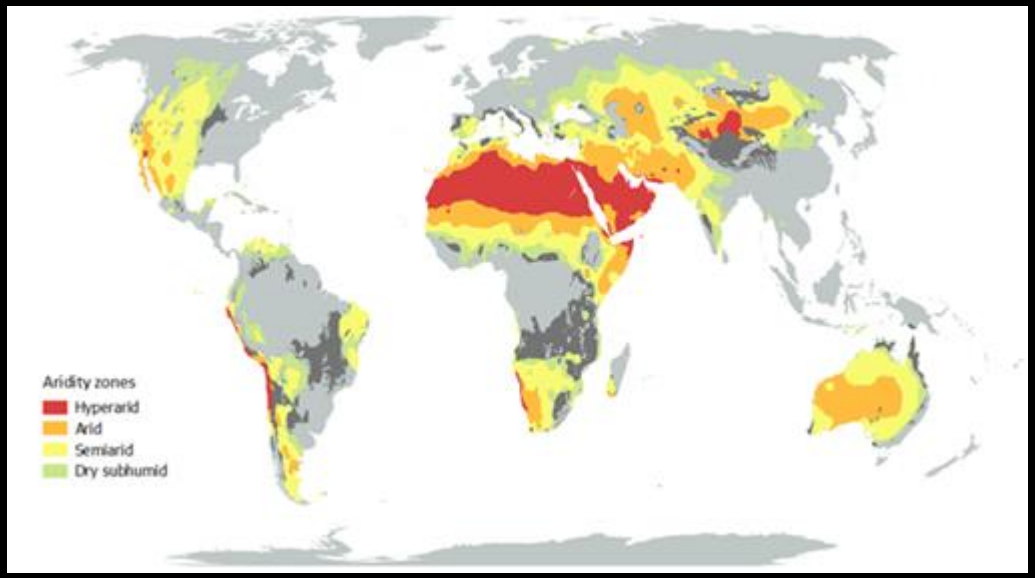
PUBLISHED ONLINE: 5 OCTOBER 2015 | DOI: 10.1038/NCLIMATE2816

Conservation policy and the measurement of forests

Joseph O. Sexton[1]*, Praveen Noojipady[1,2,3], Xiao-Peng Song[1], Min Feng[1], Dan-Xia Song[1], Do-Hyung Kim[1], Anupam Anand[1,4], Chengquan Huang[1], Saurabh Channan[1], Stuart L. Pimm[5] and John R. Townshend[1]



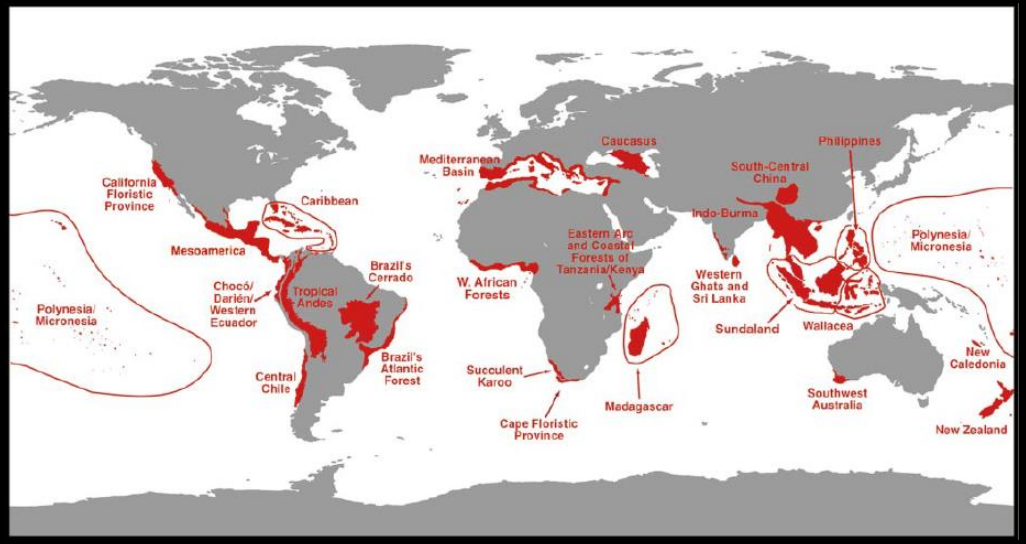
WHY do we care ?



- 41.5 % terrestrial lands
- About 2 billions people concerned
- Majority developing countries
- Local livelihoods dependent on vegetation resources

Sorensen (2009). *UNEP-WCMC*

- On the fore of the combat against desertification
- By 2100, +50% of terrestrial lands
- 7 of the 25 hotspots for biodiversity conservation



Myers et al. (2000). *Nature*

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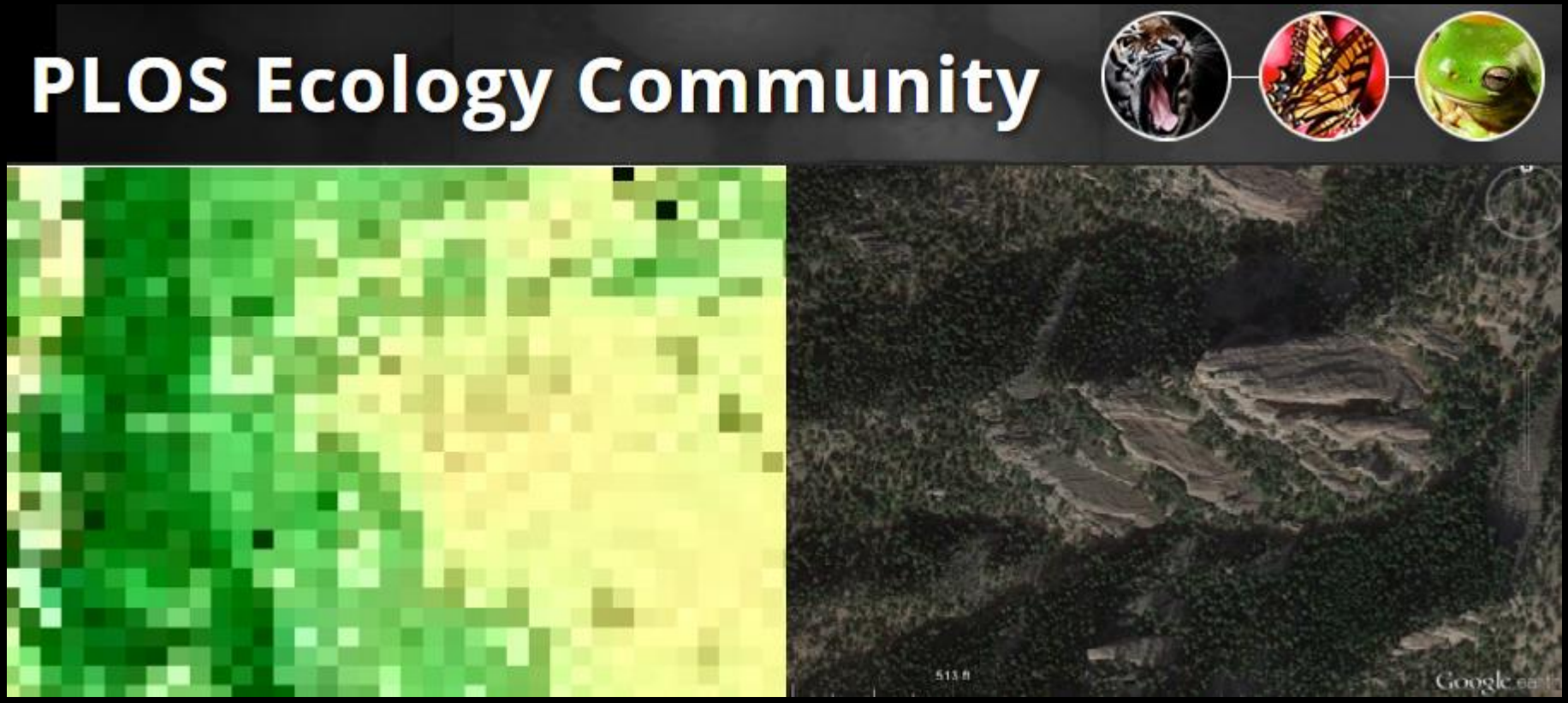
WHY is it not done yet ?

Issue 1 : « Open forest » and spatial resolution satellite images do not really get along



J.Atkins. PLOS Ecology&Community webpage

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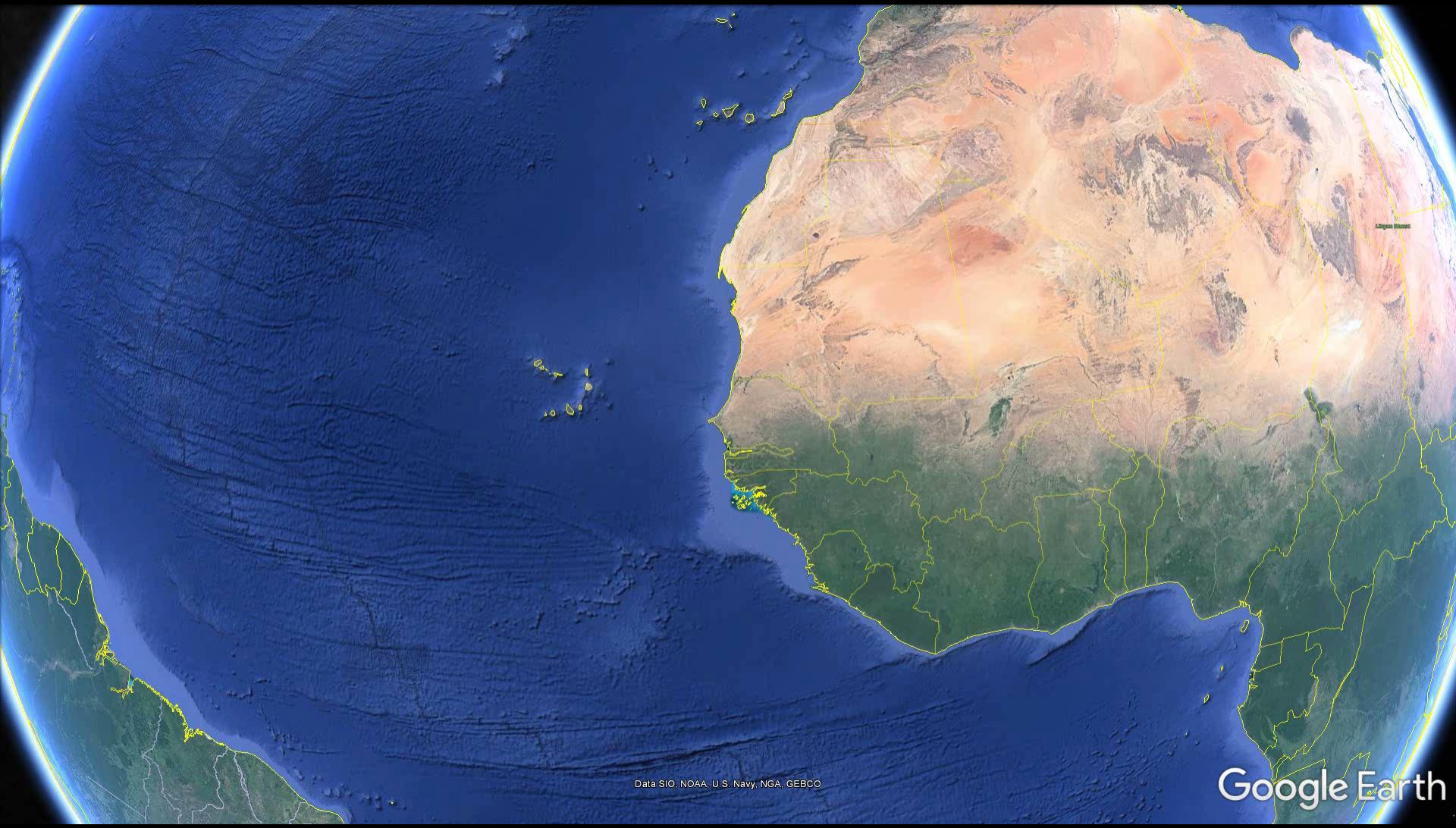
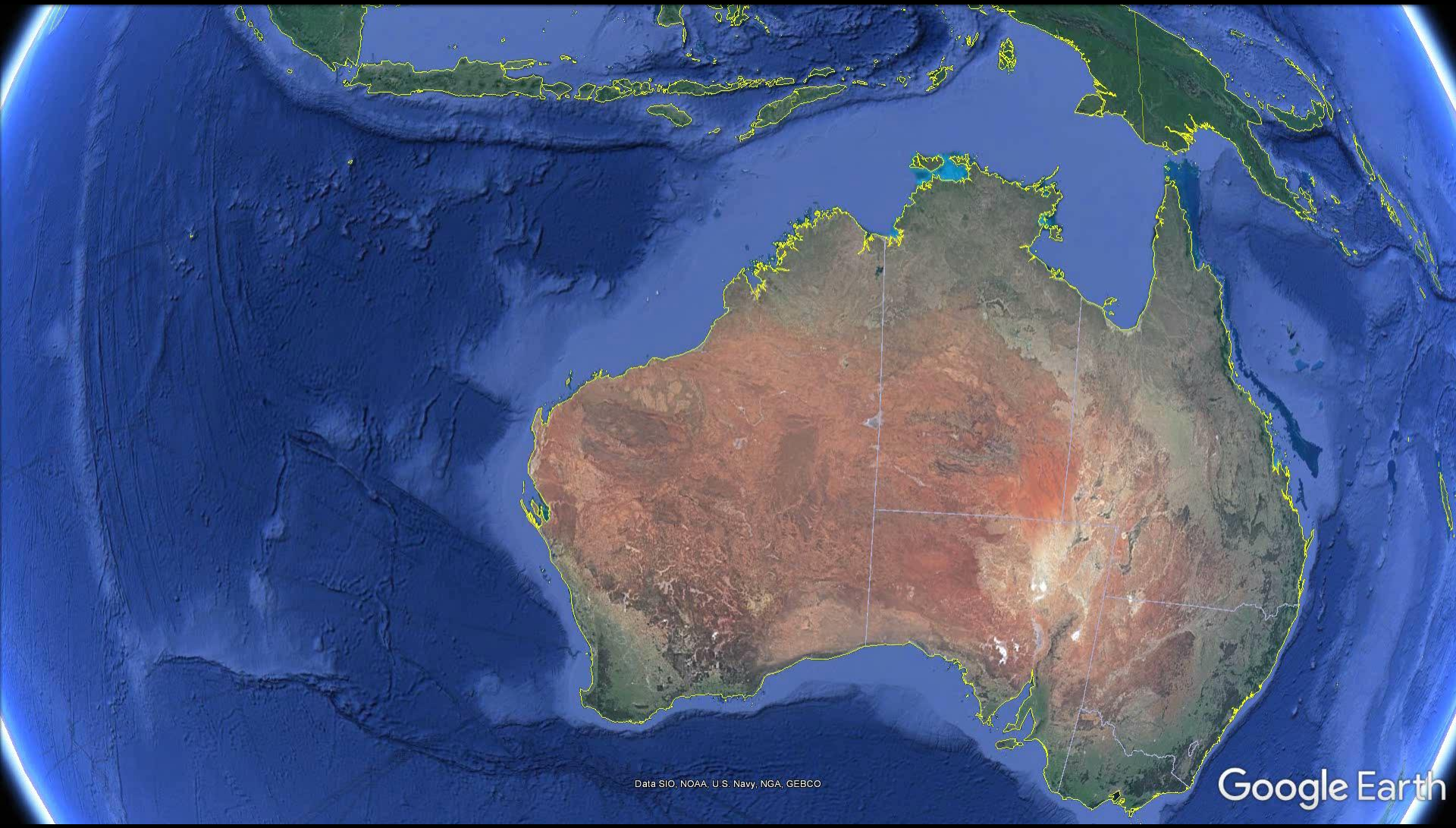

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth


Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google Earth

WHY is it not done yet ?

Issue 2 : Very high spatial resolution is problematic with automated approaches
→ Considering angles of acquisition conditions (sun-view-sensor geometries)

For details see
Barbier et al. (2011). *Remote Sensing of Environment*
Bastin et al. (2014). *Ecological Applications*

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WHY is it not done yet ?

Issue 2 : Very high spatial resolution is problematic with automated approaches
→ Considering vegetation specificities (phenology and reflectance)

What do we propose?

Working directly on Very High Spatial Resolution images with human operators

→ An approach equivalent to National Inventories done in developped countries from photo-interpretation of pictures taken by planes

→ Close to Geo-WIKI approaches

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UN-REDD

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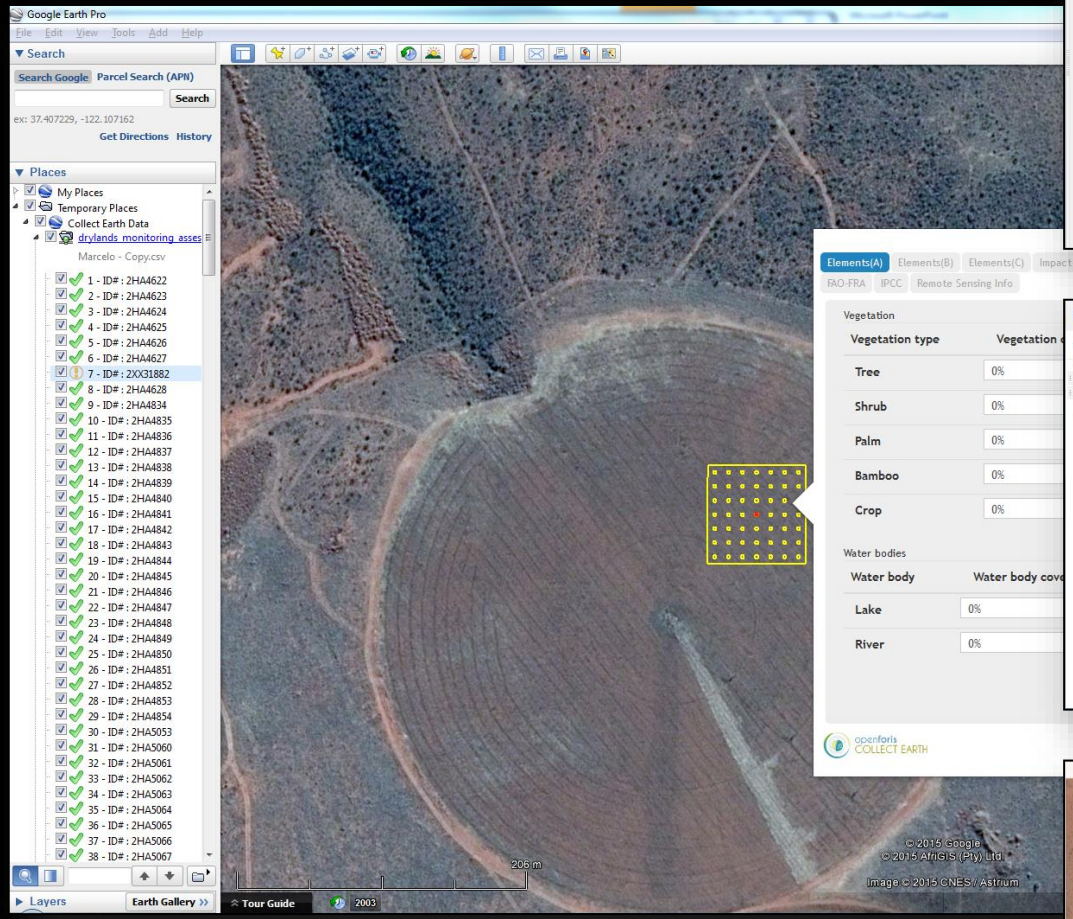
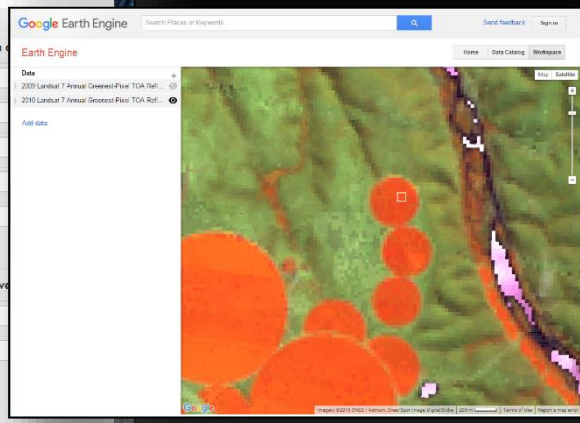
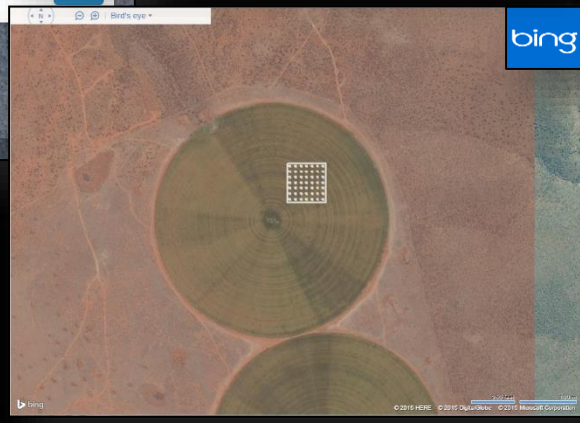
Google Earth

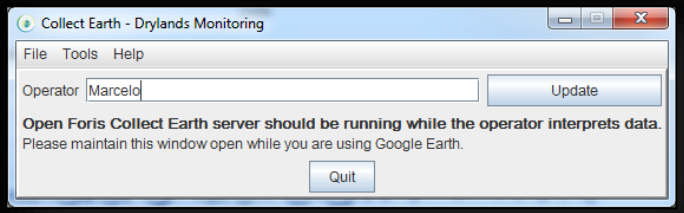
How did we proceed ?

Augmented visual interpretation









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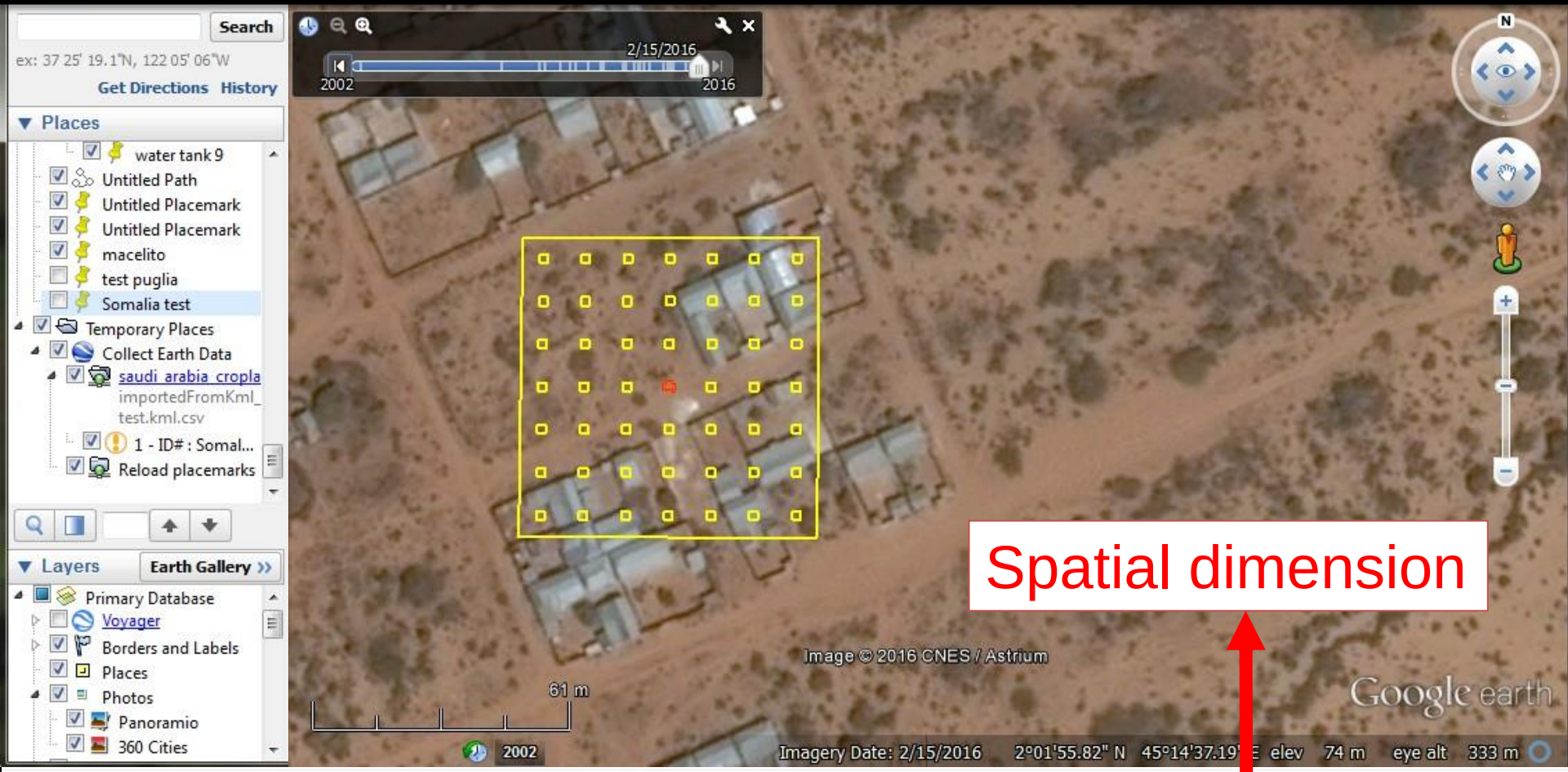
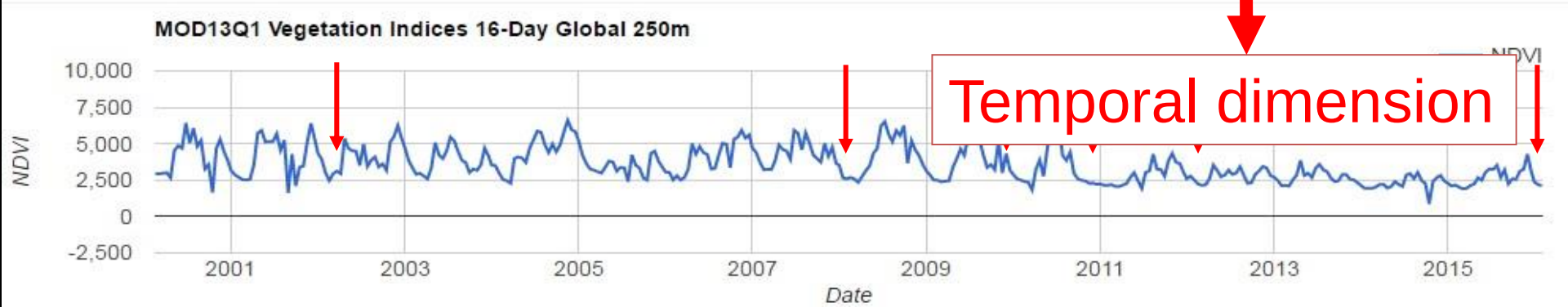
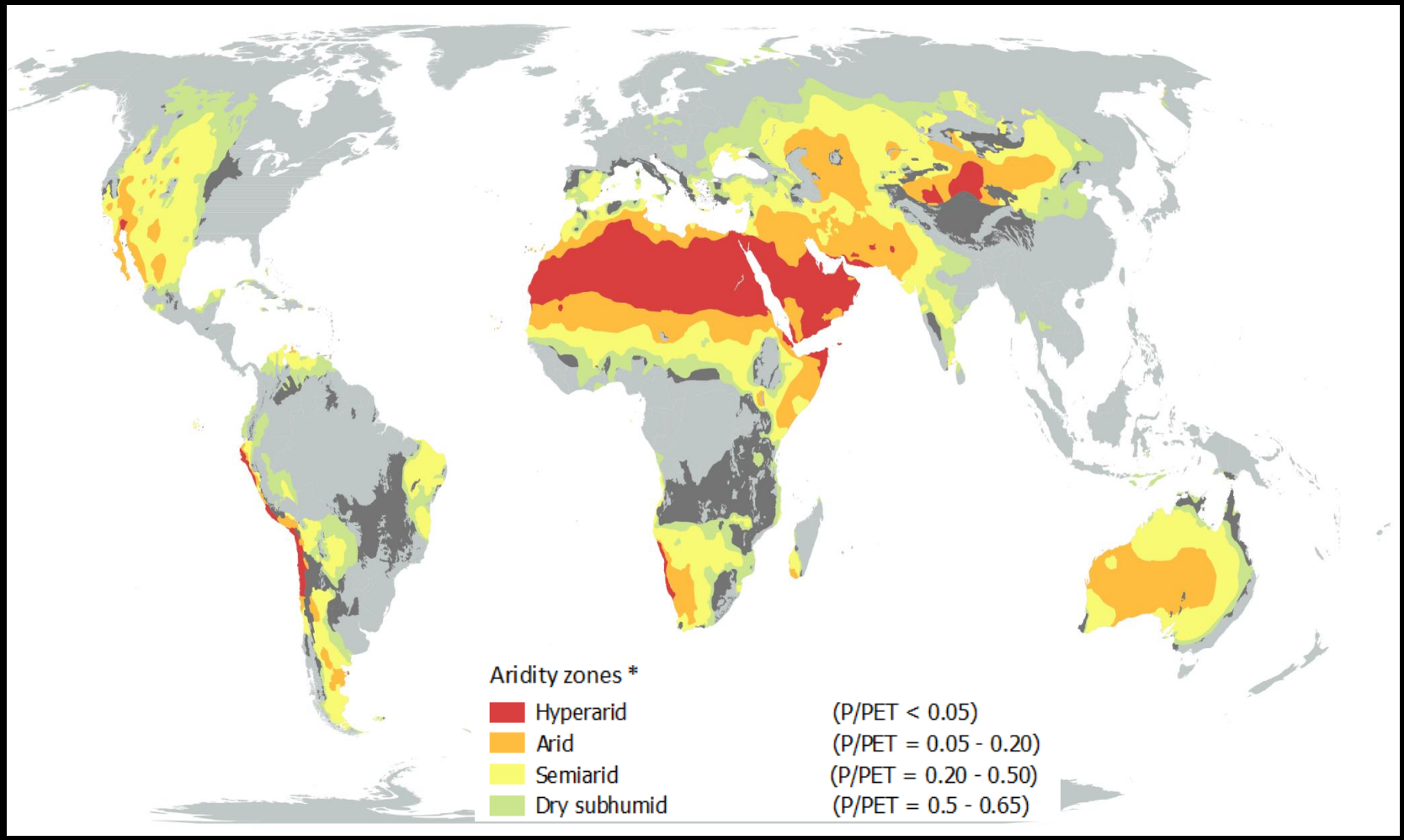
Combining Very High spatial and temporal resolution data





How to use collect earth for the drylands assessment?



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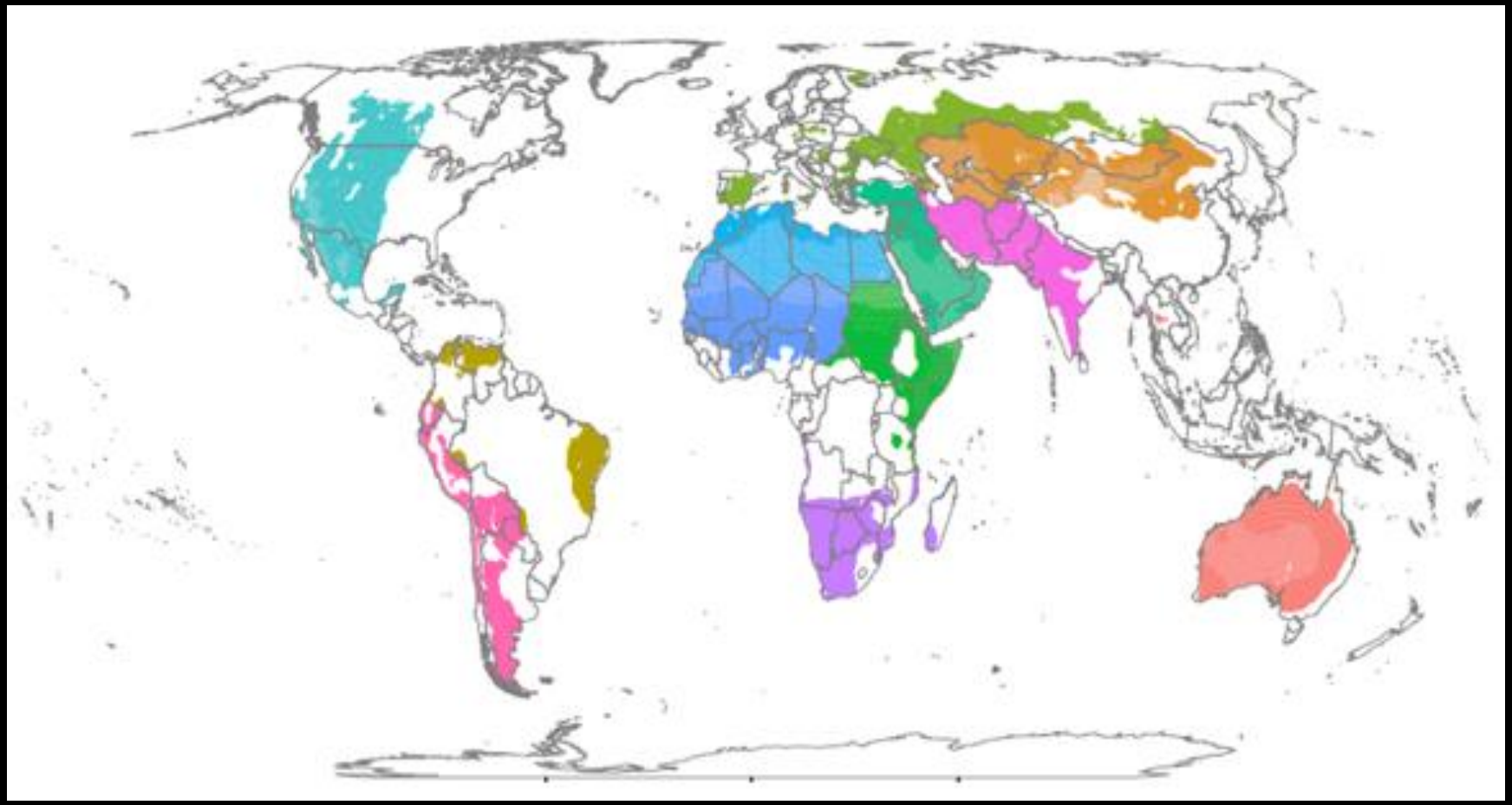
How did we proceed ?

15 partner institutions and 239 operators, +210 000 plots



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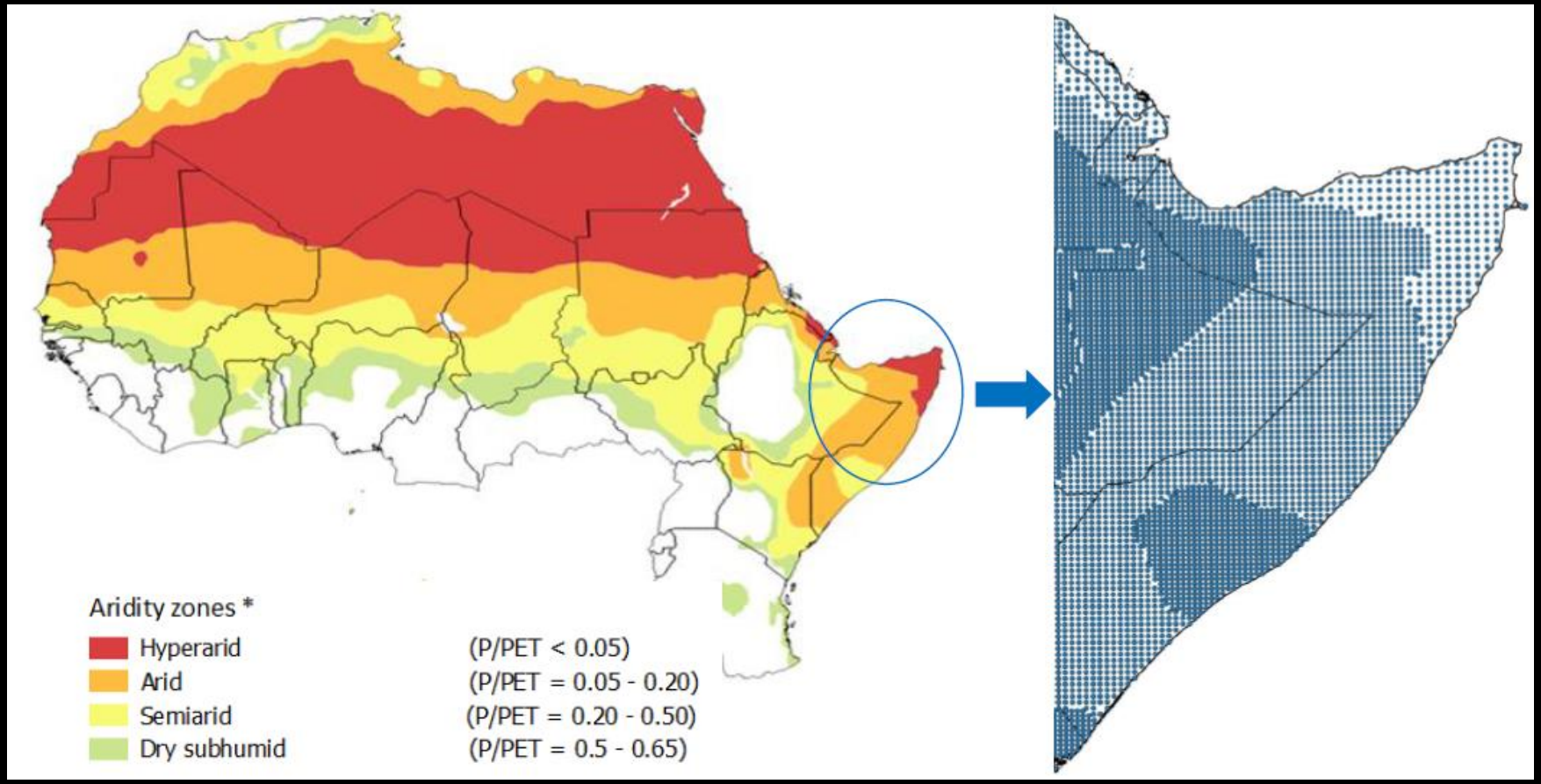
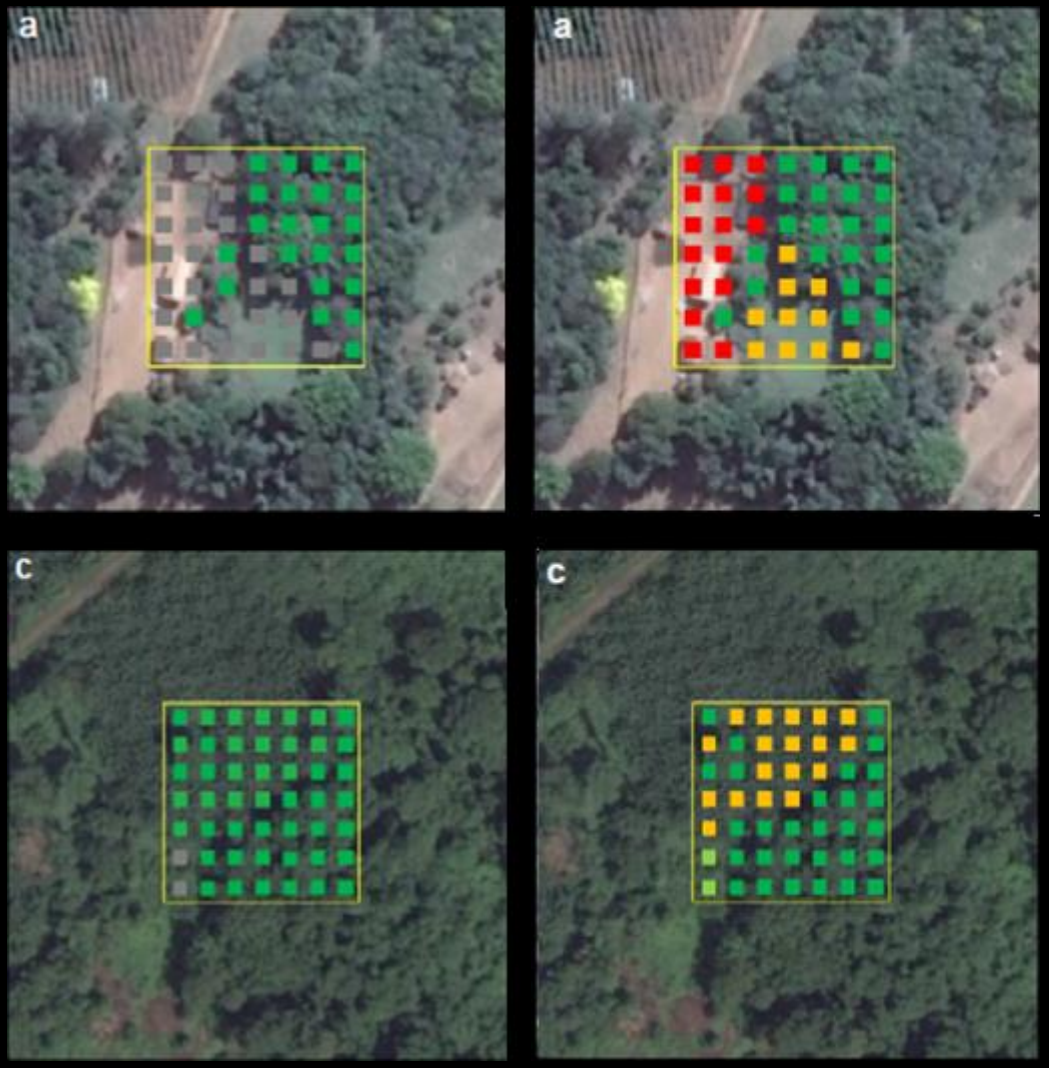
How did we proceed ?

Systematic and stratified sampling design



Assessing tree cover and forest land use



1 Harmonized data collection

4 Ensuring transparency

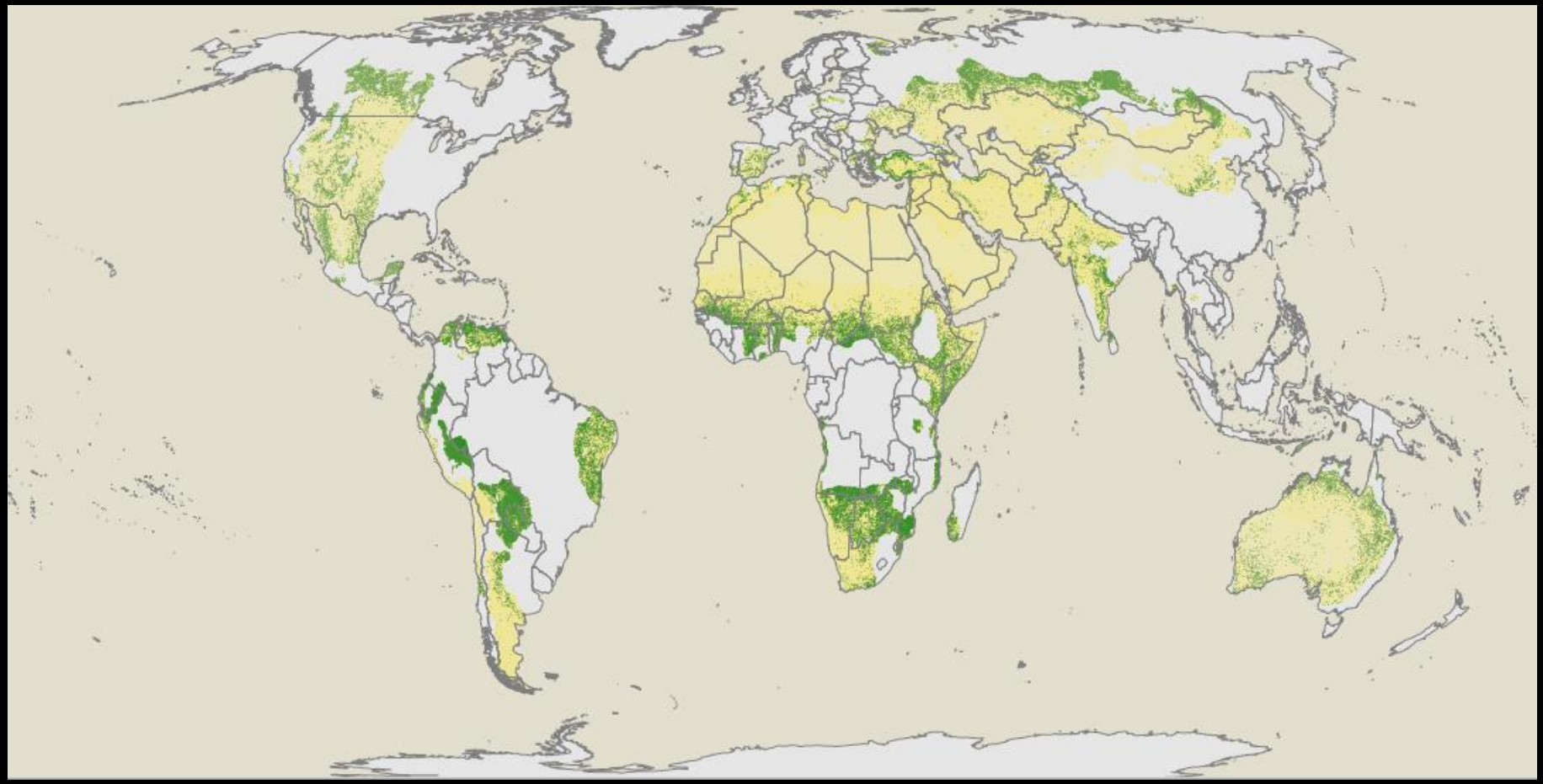
2 Data cleansing

3 Uncertainty analysis

7,4%

Main results (1)

Forest cover



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Main results (1)

- **1,324 Mha** (± 7.4%) of area covered with more than 10% of tree cover, and **1,079 Mha** (± 3.5%) as forest Land-Use according to FAO-FRA definition

  → An area equivalent to Tropical or Boreal forest extent

- **About two-third** of these areas present a closed canopy (tree cover ≥ 40%; 777 Mha / 724 Mha)

Main results (2)

- **Comparing apples with apples**

Source	Global FRA RSS (2010)	Globcover (2009)	Hansen et al. (2013)	Sexton et al. (2013)	FAO - GFS (2016)	
Product	Landsat	MODIS	Landsat	Landsat	Very high resolution	
Method	sampling	wall-to-wall	wall-to-wall	wall-to-wall	sampling	
Year	2005	2008	2000	2010	2015	2015
Forest land use	Yes	Yes	-	-	Yes	-
Forest cover	-	-	≥10%	≥10%	-	≥10%
Africa	67	83	216	114	286	364
Asia	43*	148	154	200	213 (97*)	299
Europe	22*	49	97	116	63 (26*)	92
N-America	166	155	173	196	204	238
Oceania	29	28	55	55	114	124
S-America	123	46	205	268	197	208
Total	450	509	900	949	1079 (917*)	1327

→ Increase from **400 to 500 Mha**

→ Extent doubled in Africa and Australia

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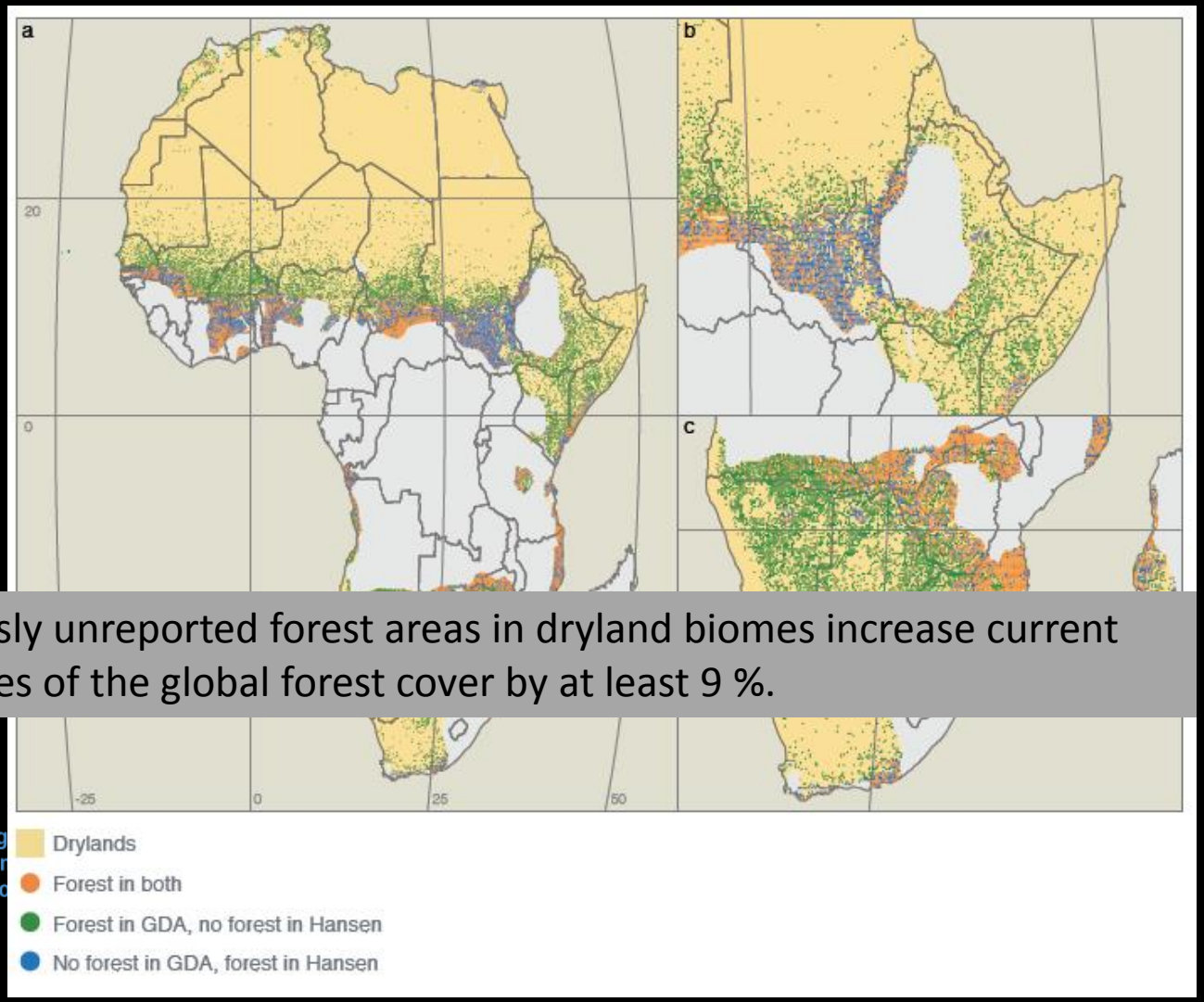
Main results (2)

- **Comparison with Hansen's map for illustration purpose**



Previously unreported forest areas in dryland biomes increase current estimates of the global forest cover by at least 9 %.

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KEY POINTS

- A new role for FAO ?
- A new tool and a new big data in between ground data and remote sensing
- User and Policymaker friendly
- Independent from any environmental layer
- 1st global use of VHR images
- Version 0 - will only improve in time with re-assessments

The near future :

A version 0 at global level : Please use the data on drylands, question it, and help us making it better!

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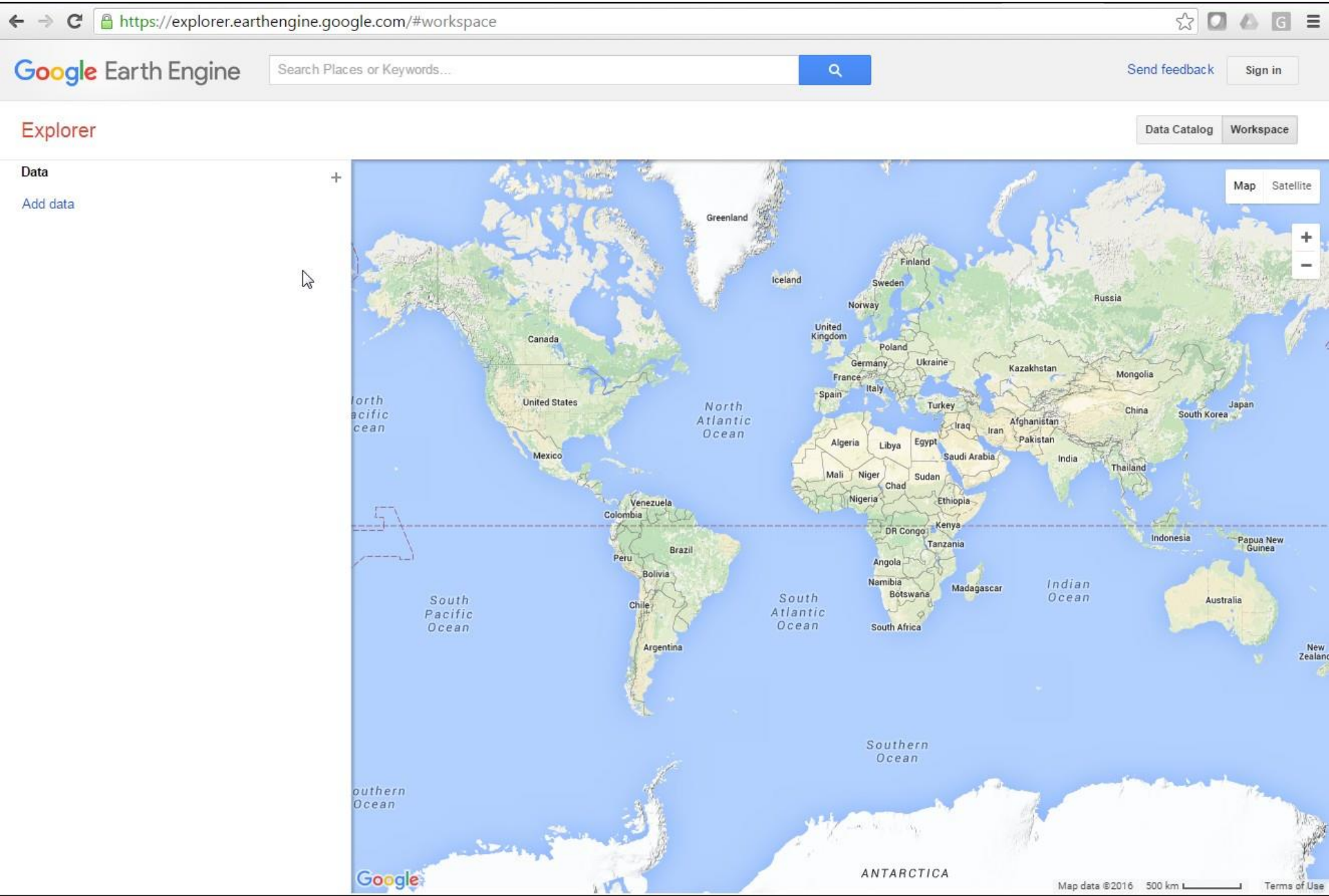
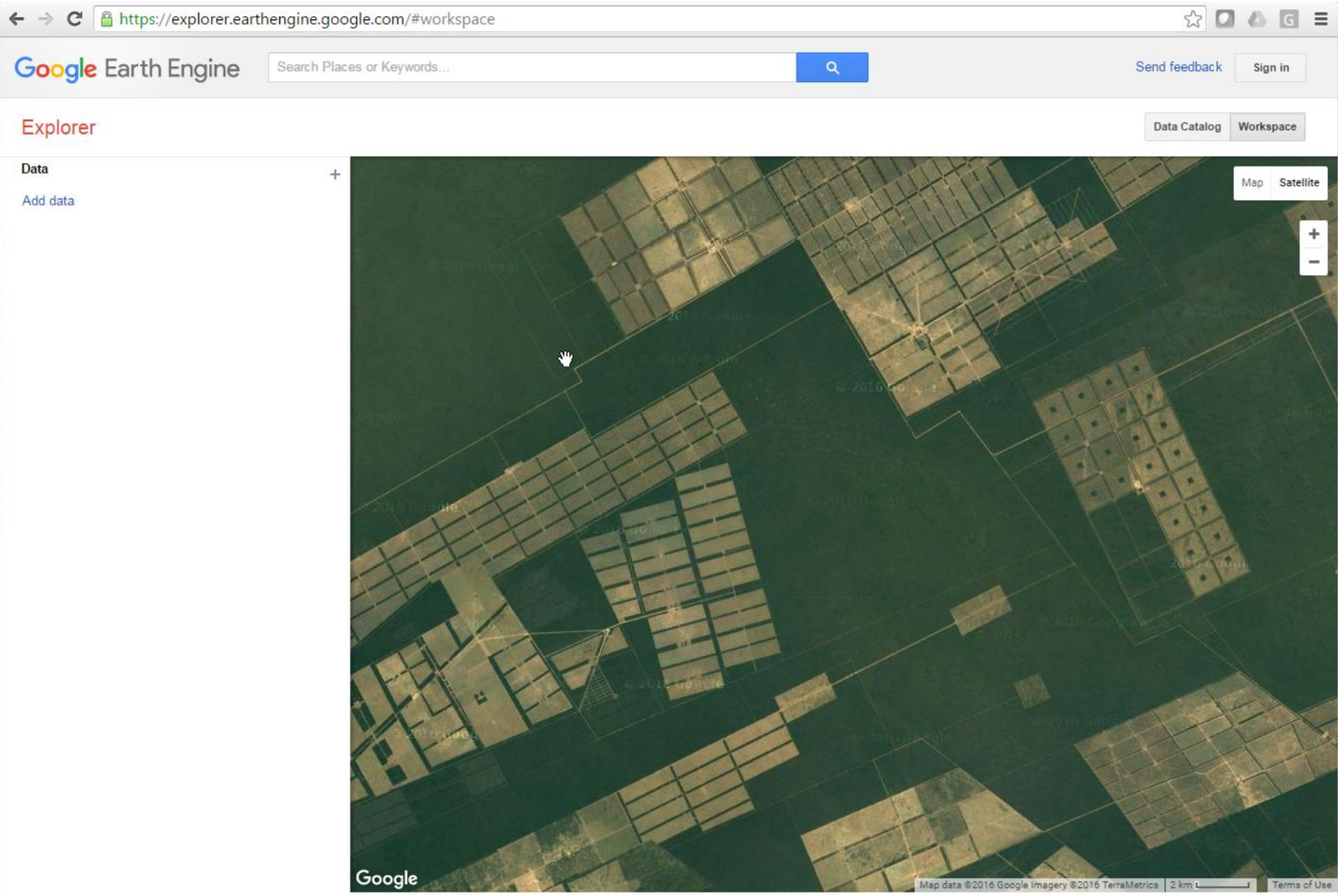
Now that we know where the trees can grow in drylands , let’s act!

Thank you for your attention

Google Earth Engine



Google Earth Engine



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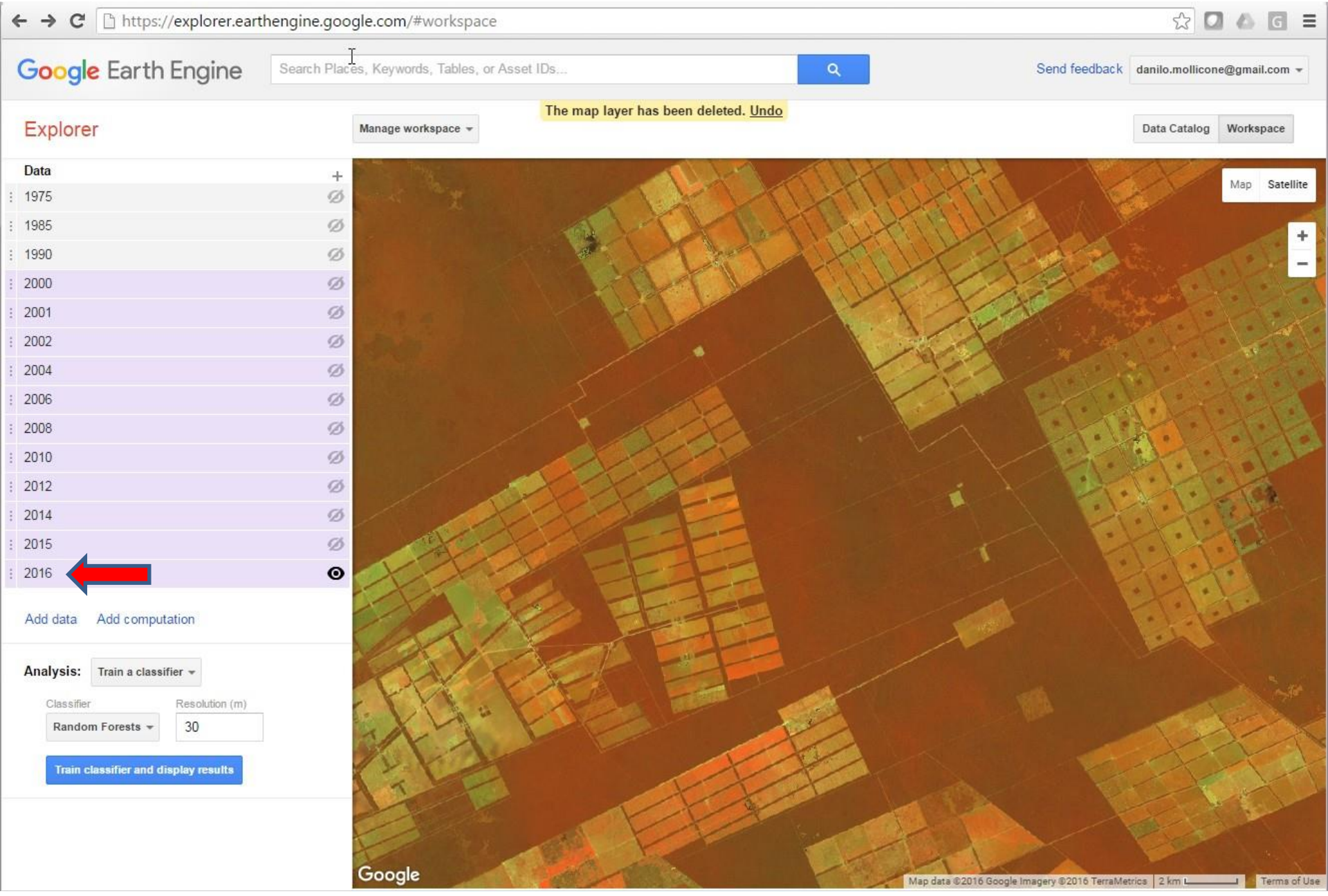

For more details

remote sensing

MDPI

Article

Collect Earth: Land Use and Land Cover Assessment through Augmented Visual Interpretation

Adia Bey [1,*], Alfonso Sánchez-Paus Díaz [1], Danae Maniatis [2,3], Giulio Marchi [1], Danilo Mollicone [1], Stefano Ricci [1], Jean-François Bastin [1,4], Rebecca Moore [5], Sandro Federici [1], Marcelo Rezende [1], Chiara Patriarca [1], Ruth Turia [6], Gewa Gamoga [6], Hitofumi Abe [1], Elizabeth Kaidong [6] and Gino Miceli [5]

[1] Food and Agricultural Organization of the United Nations, Forestry Department, Rome 00154, Italy; alfonso.sanchezpausdiaz@fao.org (A.S.-P.D.); giulio.marchi@fao.org (G.M.); danilo.mollicone@fao.org (D.M.); stefano.ricci@fao.org (S.R.); jeanfrancois.bastin@fao.org (J.-F.B.); sandro.federici@fao.org (S.F.); marcelo.rezende@fao.org (M.R.); chiara.patriarca@fao.org (C.P.); hitofumi.abe@fao.org (H.A.)

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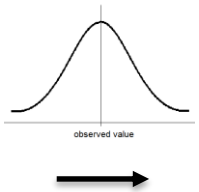
Assessing tree cover

Uncertainty analysis

Step 1 :
Error distribution due to visual interpretation

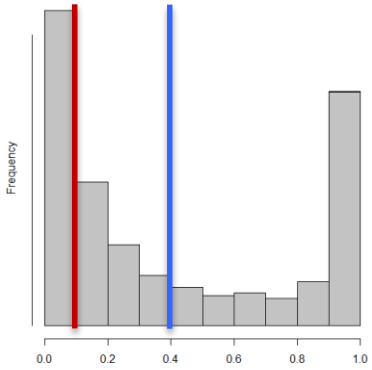
Obs	AVI
TC_A	TC_1
TC_B	TC_2
…	…
TC_Z	TC_3



Step 2 : propagate error on TC estimation

AVI	Obs + Err1	Obs + Err2		Obs + Err100
TC_1	TC_1 + err1	TC_1 + err2		TC_1 + err100
TC_2	TC_2 + err1	TC_2 + err2		TC_2 + err100
…	…	…		…
TC_3	TC_3 + err1	TC_3 + err2		TC_3 + 100

Step 3 : define TC threshold



10 %	Area	Area err1	Area err2		Area err100
40 %	Area	Area err1	Area err2		Area err100

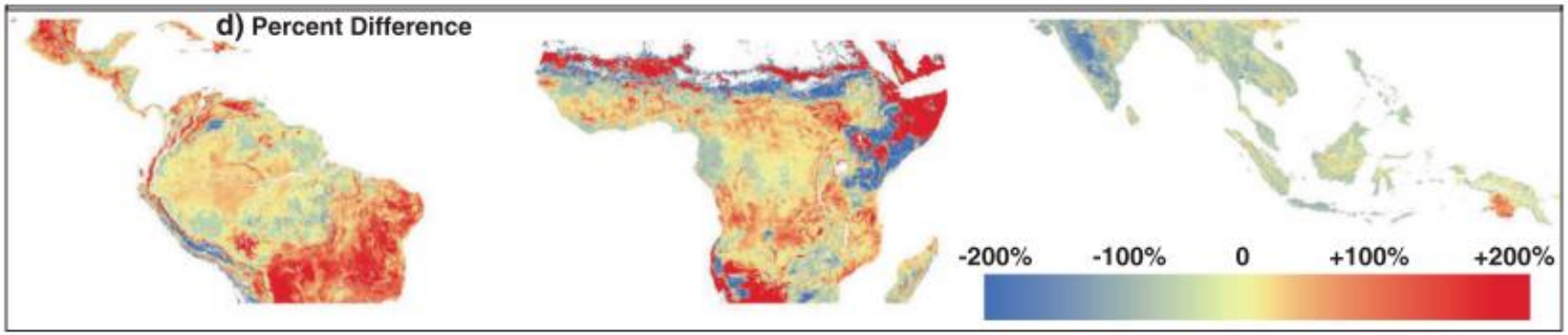
Mitchard *et al. Carbon Balance and Management* 2013, **8**:10
http://www.cbmjournal.com/content/8/1/10

CARBON BALANCE AND MANAGEMENT

RESEARCH Open Access

Uncertainty in the spatial distribution of tropical forest biomass: a comparison of pan-tropical maps

Edward TA Mitchard[1*], Sassan S Saatchi[2], Alessandro Baccini[3], Gregory P Asner[4], Scott J Goetz[3], Nancy L Harris[5] and Sandra Brown[5]



Uncertainties

- Uncertainties calculated here for the total forest area calculated from (1) forest land-use assessment and from (2) the tree cover assessment.
- Uncertainties are calculated combining “sampling error” and “measurement error”

$$\sigma^2 = \sum_{i=1}^{I} A_i^2 f_i \frac{\pi_i(1-\pi_i)}{n_i - 1} + \sum_{i=1}^{I} A_i^2 \left(\frac{n_i - 1 - f_i}{n_i - 1}\right) \tau_i^2$$

Sampling error Measurement error

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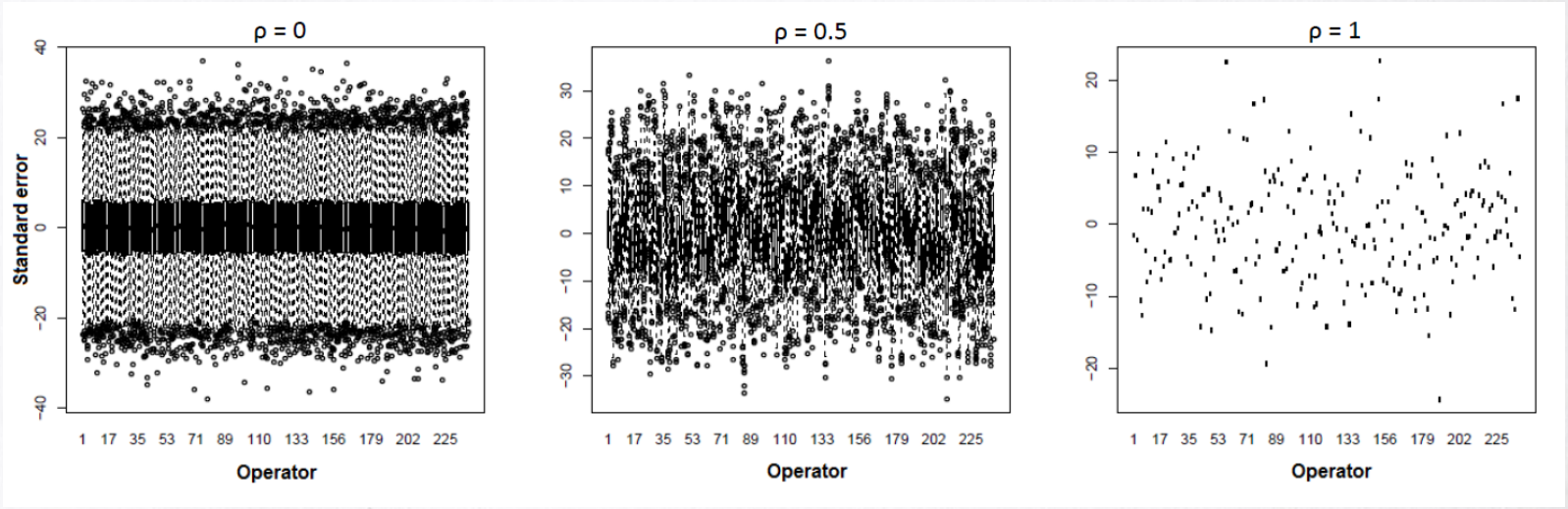
Measurement error – Tree Cover

- Standard deviation of the measurement estimated calculating the Root Mean Square Difference (Montesano et al. 2009) between ground and collect earth (RMSD = 8 %)
- Propagation on forest area estimation : Implementing the SD, following a Gaussian distribution centered on 0, we also account for an operator effect of ρ=0.5 :



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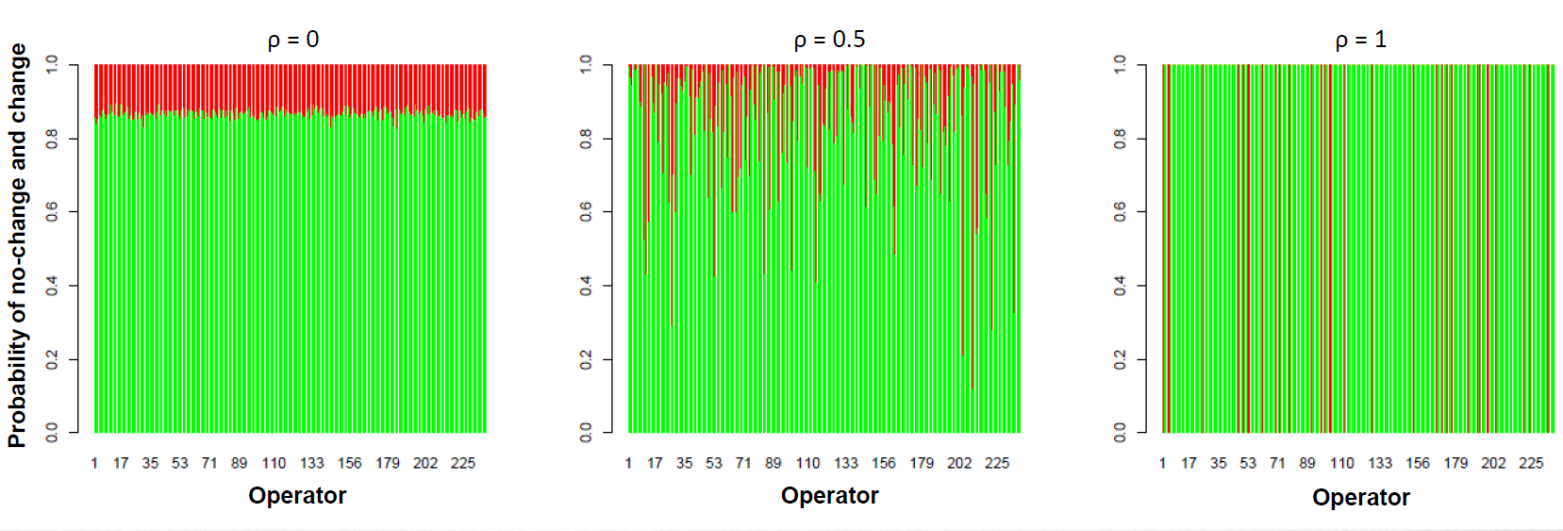
Measurement error – Forest land use

- Based on the percentage of agreement/disagreement comparing ground with Collect Earth (Agreement = 87%)
- Propagation on forest area estimation : Selecting 13 % of land-use to switch from forest/non-forest and non-forest/forest, accounting for an operator effect of ρ=0.5 :



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Results on uncertainties

- On forest estimation based on Tree Cover threshold of 10% :

1,326 **± 98 Mha (± 7.4%)**

- On forest estimation based on Tree Cover threshold of 10% :

1,079 **± 38 Mha (± 3.5%)**

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