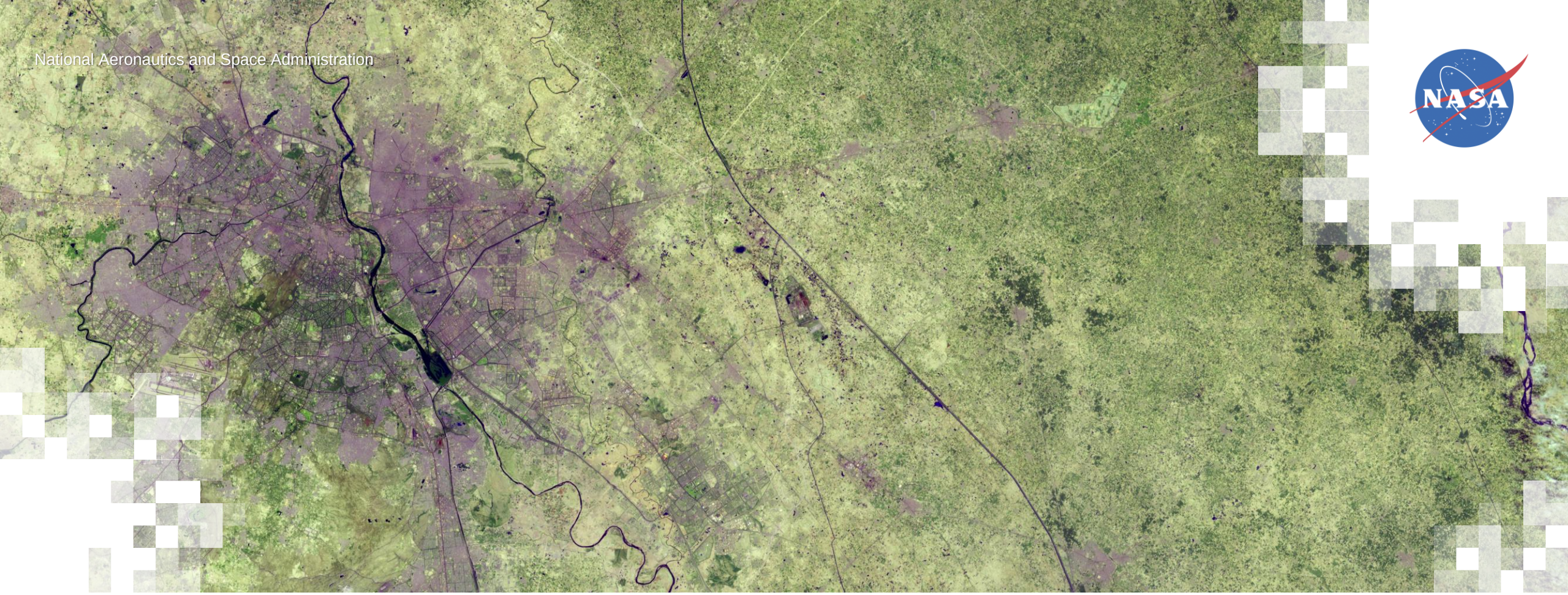


Remote Sensing for Monitoring Land Degradation and Sustainable Cities SDGs

Speakers: Amber McCullum, Pablo Ovalles, Alexander Zvoleff, Monica Noon, and Mariano Gonzalez-Roglich

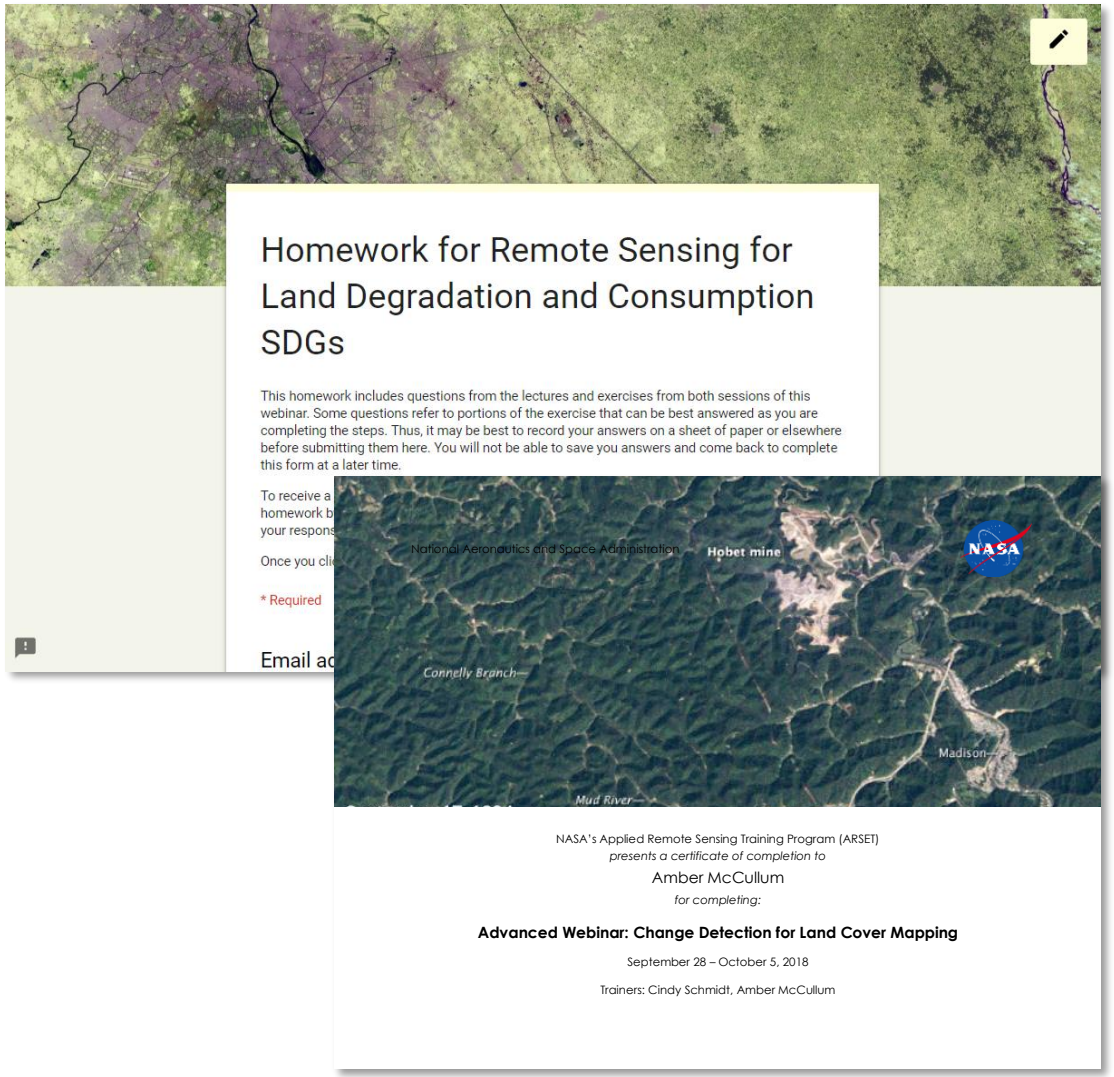
July 16, 2019

Course Structure

- Three, 1.5 hour sessions on July 9, 16, and 23, 2019
- The same content will be presented at two different times each day:
  - Session A: 10:00-11:30 EST (UTC-4)
  - Session B: 18:00-19:30 EST (UTC-4)
  - **Please only sign up for and attend one session per day**
- Webinar recordings, PowerPoint presentations, and the homework assignment can be found after each session at:
  - https://arset.gsfc.nasa.gov/land/webinars/land-degradation-SDGs19
- Q&A: Following each lecture and/or by email
  - amberjean.mccullum@nasa.gov
  - juan.l.torresperez@nasa.gov

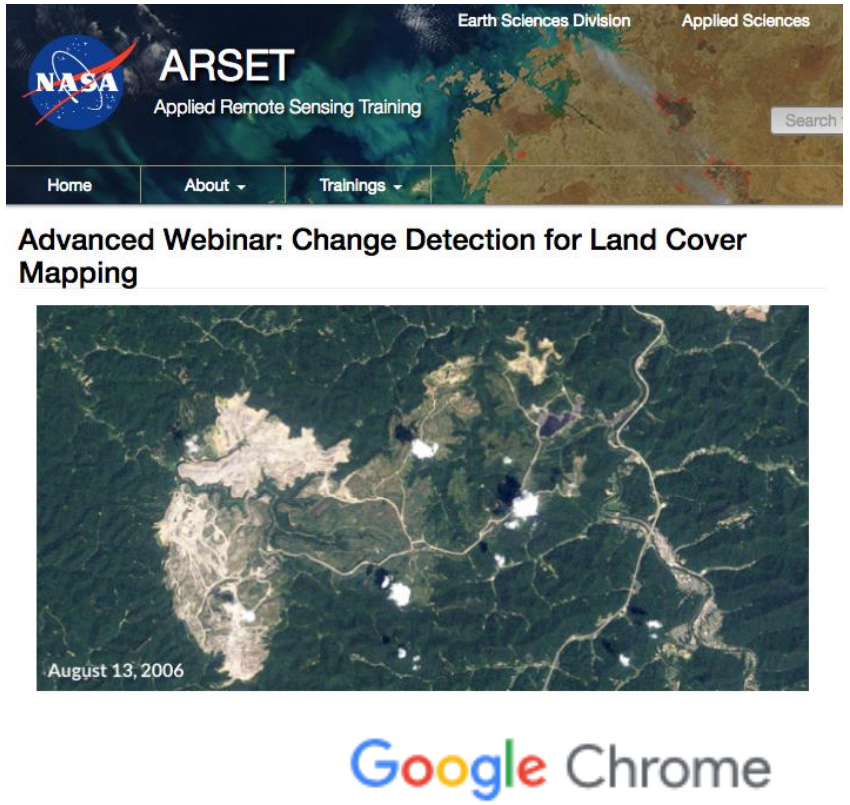
Homework and Certificates

- Homework
  - One homework assignment
  - Answers must be submitted via Google Forms
- Certificate of Completion:
  - Attend both live webinars
  - Complete the homework assignment by the deadline (access from ARSET website)
    - HW Deadline: Tuesday August 6th
  - You will receive certificates approximately two months after the completion of the course from: marines.martins@ssaihq.com



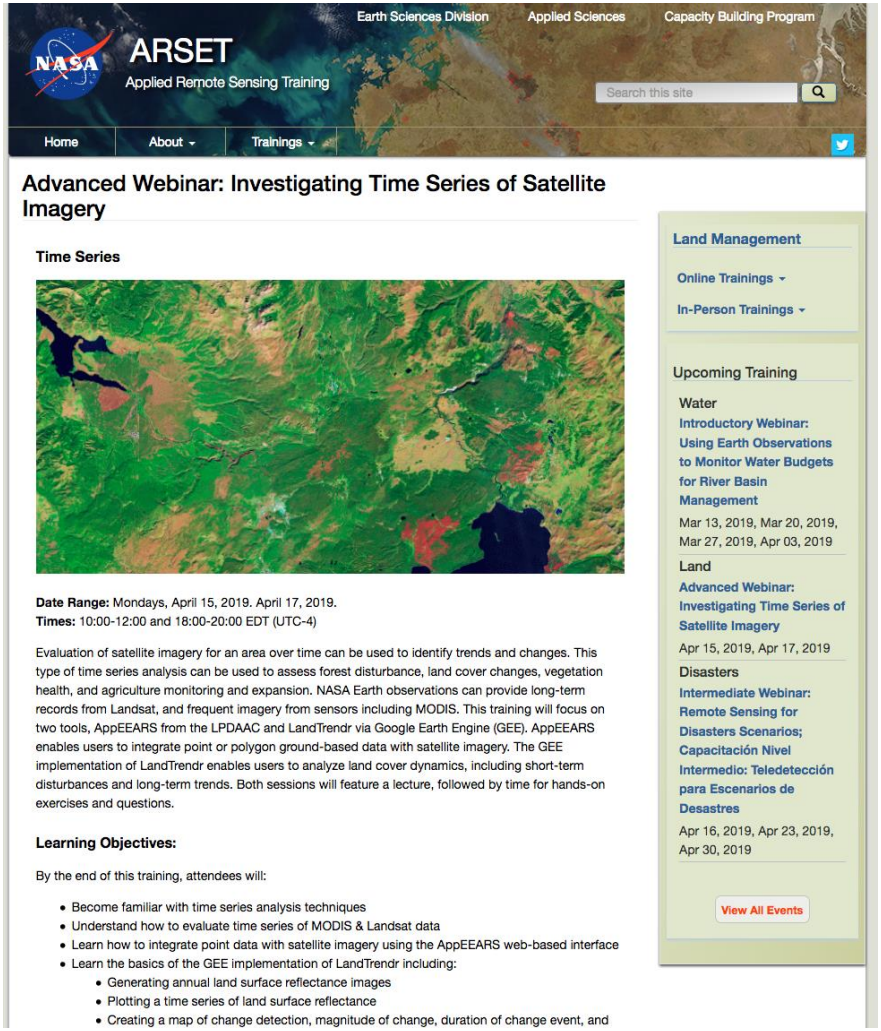
Prerequisites

- Complete Sessions 1 & 2A of Fundamentals of Remote Sensing, or equivalent experience
- Download and install QGIS. QGIS version 2.18.15
  - Use this exercise for help: Downloading and Installing QGIS
- Download, install, and register the Trends.Earth software. This is a QGIS plugin that only currently works with the Version 2 iterations of QGIS (not version 3 or higher).
  - Be sure to read the Before Installing the toolbox page prior to Installing the toolbox.



Accessing Course Materials

https://arset.gsfc.nasa.gov/land/webinars/land-degradation-SDGs19



Earth Sciences Division | Applied Sciences | Capacity Building Program

ARSET
Applied Remote Sensing Training

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Advanced Webinar: Investigating Time Series of Satellite Imagery

Time Series

Date Range: Mondays, April 15, 2019. April 17, 2019.
Times: 10:00-12:00 and 18:00-20:00 EDT (UTC-4)

Evaluation of satellite imagery for an area over time can be used to identify trends and changes. This type of time series analysis can be used to assess forest disturbance, land cover changes, vegetation health, and agriculture monitoring and expansion. NASA Earth observations can provide long-term records from Landsat, and frequent imagery from sensors including MODIS. This training will focus on two tools, AppEEARS from the LPDAAC and LandTrendr via Google Earth Engine (GEE). AppEEARS enables users to integrate point or polygon ground-based data with satellite imagery. The GEE implementation of LandTrendr enables users to analyze land cover dynamics, including short-term disturbances and long-term trends. Both sessions will feature a lecture, followed by time for hands-on exercises and questions.

Learning Objectives:

By the end of this training, attendees will:

- Become familiar with time series analysis techniques
- Understand how to evaluate time series of MODIS & Landsat data
- Learn how to integrate point data with satellite imagery using the AppEEARS web-based interface
- Learn the basics of the GEE implementation of LandTrendr including:
  - Generating annual land surface reflectance images
  - Plotting a time series of land surface reflectance
  - Creating a map of change detection, magnitude of change, duration of change event, and

Land Management

Online Trainings

In-Person Trainings

Upcoming Training

Water
Introductory Webinar: Using Earth Observations to Monitor Water Budgets for River Basin Management
Mar 13, 2019, Mar 20, 2019, Mar 27, 2019, Apr 03, 2019

Land
Advanced Webinar: Investigating Time Series of Satellite Imagery
Apr 15, 2019, Apr 17, 2019

Disasters
Intermediate Webinar: Remote Sensing for Disasters Scenarios; Capacitación Nivel Intermedio: Teledetección para Escenarios de Desastres
Apr 16, 2019, Apr 23, 2019, Apr 30, 2019

View All Events

Prerequisites:

Attendees that do not complete prerequisites may not be adequately prepared for the pace of the course.

- Complete **Sessions 1 & 2A of Fundamentals of Remote Sensing**, or equivalent experience
- Complete the **Advanced Webinar: Change Detection for Land Cover Mapping**
- Install Google Chrome: **https://www.google.com/chrome/**
  - For the Google Earth Engine exercise, Chrome should be used to make sure all features work
- Sign up for the Google Earth Engine Code Editor: **https://signup.earthengine.google.com/**

Audience:

Advanced users of remote sensing data within local, regional, state, federal, and non-governmental organizations involved in land management and conservation efforts. Professional organizations in the public and private sectors engaged in environmental management and monitoring will be given preference over organizations focused primarily on research.

Registration Information:

There is no cost for the webinar, but you must register to attend the sessions. Because we anticipate a high demand for this training, please only sign up for one session. Sessions will only be broadcast in English - Session A will cover the same content as Session B. Professional organizations in the public and private sectors engaged in water resources management and monitoring will be given preference over organizations focused primarily on research.

- **Register for Session A, 10:00-12:00 EDT (UTC-4) »**
- **Register for Session B, 18:00-20:00 EDT (UTC-4) »**

Course Agenda:

Agenda_41.pdf

April 15, 2019

This session will include a review of MODIS and Landsat, a review of change detection, an overview of time series analysis methods, and an AppEEARS hands-on exercise.

Application Area: Land
Available Languages: English
Instruments/Missions: Terra, Landsat, MODIS, Aqua
Keywords: Ecosystems, Land-Cover and Land-Use Change (LCLUC), Satellite Imagery, Tools

Course Outline

Session 1: SDG 15

- ARSET and the SDGs
- SDG 15 Overview
- Trends/Earth for 15.3.1
- Exercise (default data)

Session 2: SDG 15

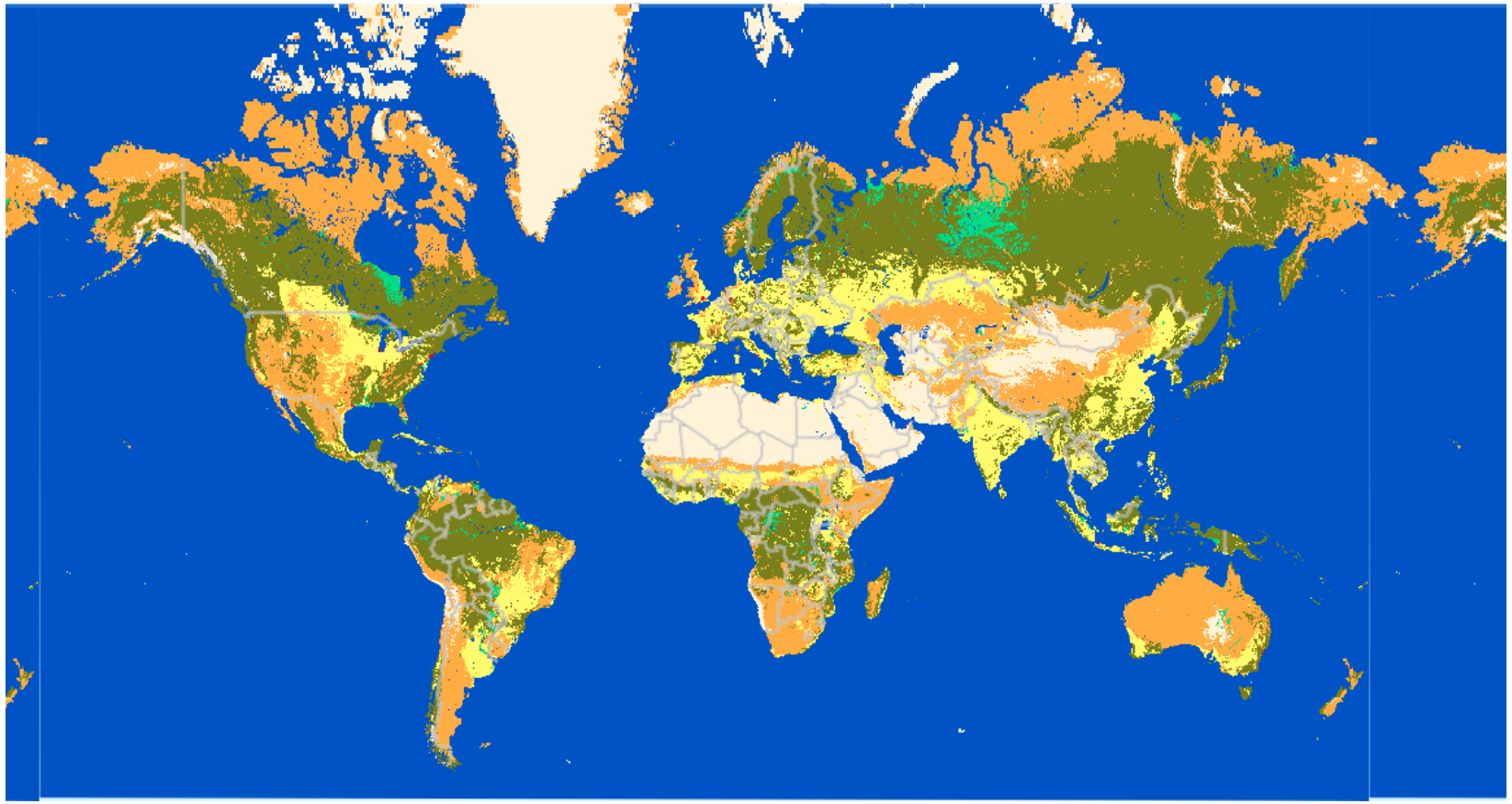
- Global Datasets
- Country/local data example
- Exercise (local data)

Session 3: SDG 11

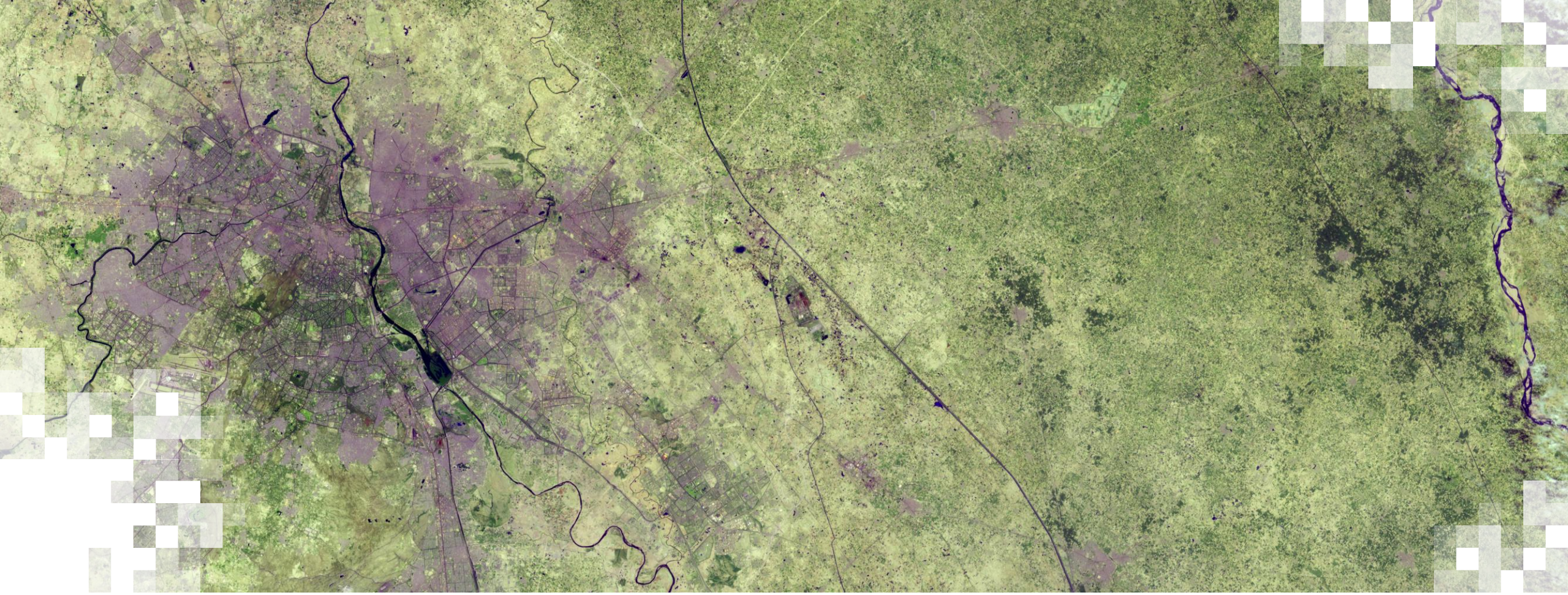
- SDG 11 Overview
- Trends/Earth for 11.3.1
- Exercise (urban mapping)

Session 2 Agenda

- CI - Global Dataset Limitations
- Pablo Ovalles - Case Study Example of country measuring and reporting
- CI - Exercise using local data in Trends.Earth



Global land cover. Image Credit: ESA



Guest Speakers:

Alexander Zvoleff, Pablo Ovalles, Monica Noon, Mariano Gonzalez-Roglich

Conservation International, trends.earth@conservation.org

TRENDS.EARTH

LAND DEGRADATION

CONSERVATION INTERNATIONAL

gef

Google Earth Engine

United Nations Convention to Combat Desertification

VITAL SIGNS

NASA

LUND UNIVERSITY

CSE Centre de Suivi Ecologique

Tanzania Forest Conservation Group
Shirika la Kuhifadhi Misitu ya Asili Tanzania

Africa Innovations Institute

TRENDS.EARTH - MONITORING LAND CONDITION

- Identification of degraded lands
- Can set baselines, and track progress
- Best global datasets
- Allows use of best-available local information

Supports all three components of SDG Indicator 15.3.1

Land Productivity

Land Cover

Carbon Stocks

TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

1. **Land Productivity** — **Net Primary Productivity**

2. Land Cover — Land Cover Change

3. Above and Below Ground C — Soil Organic Carbon

TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

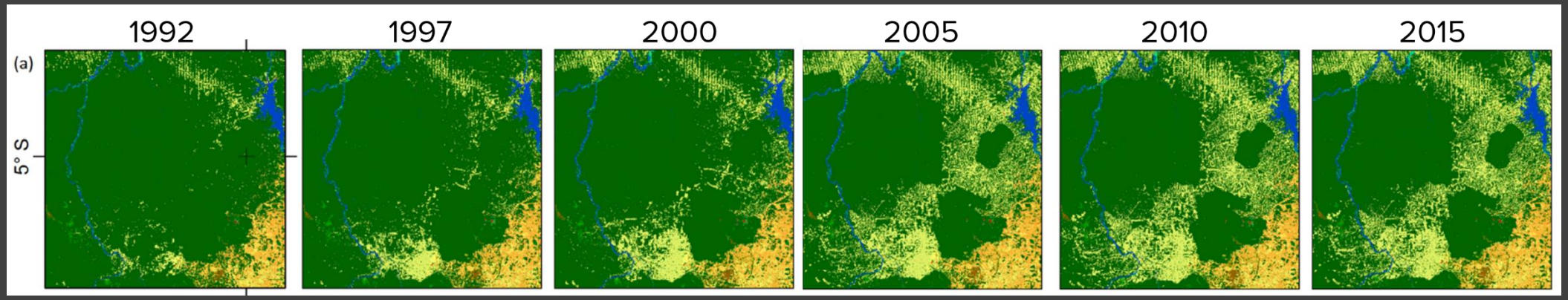
1. Land Productivity — Net Primary Productivity

2. **Land Cover** — **Land Cover Change**

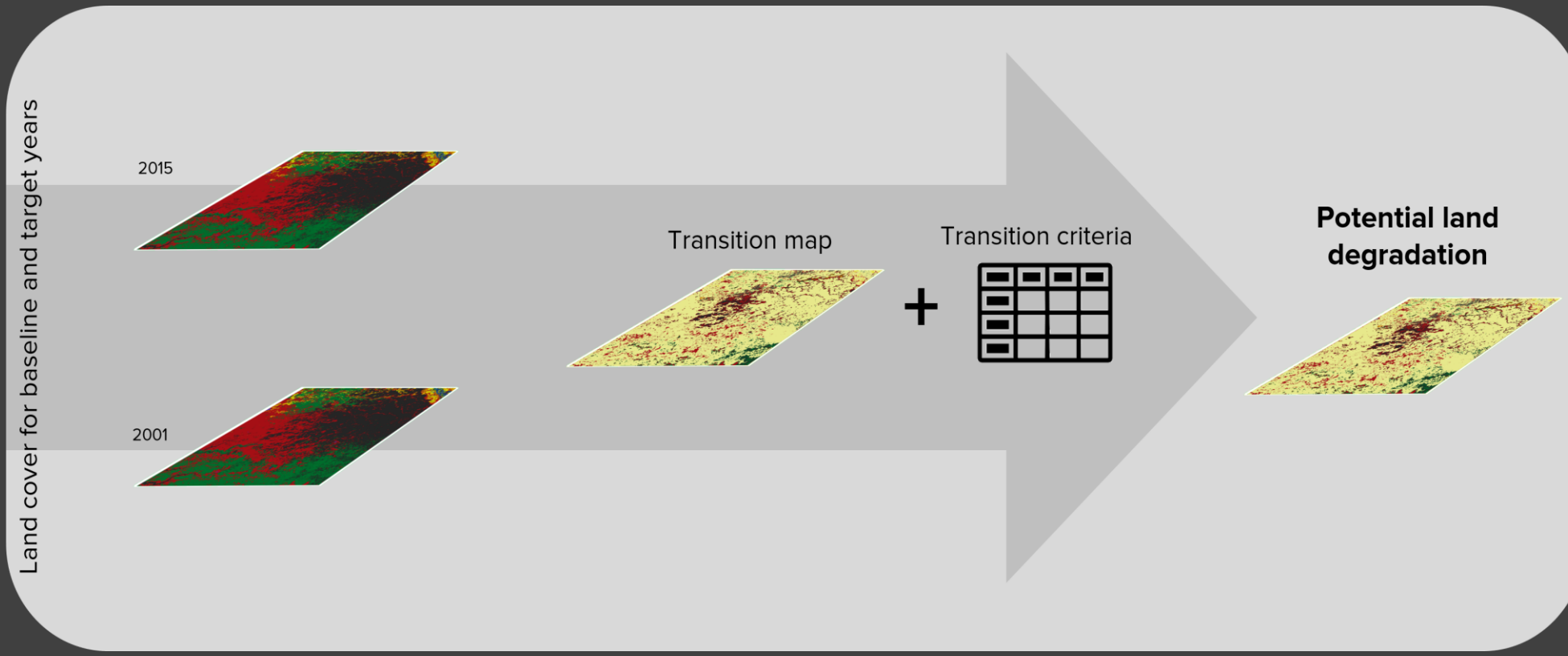
3. Above and Below Ground C — Soil Organic Carbon

TRENDS.EARTH - LAND COVER CHANGE

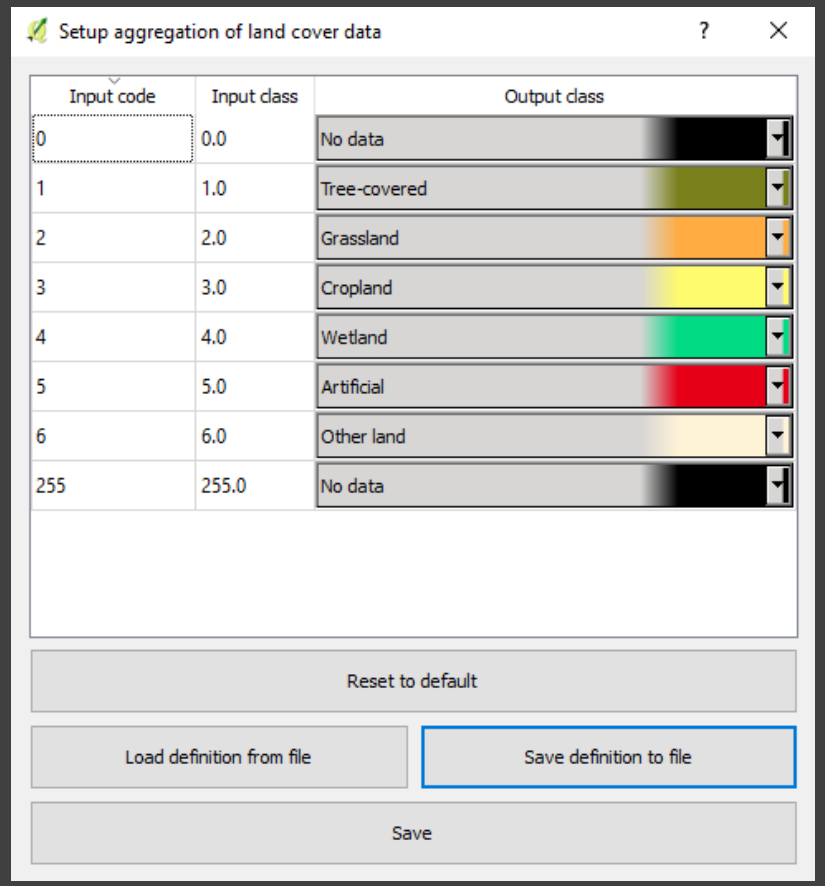
- …describes changes in the observed biophysical character of the earth's surface to help identify areas that may be subject to change. A transition from one land cover type to another may be considered an improvement, a neutral change or degradation, depending on the perspective of the country in question.

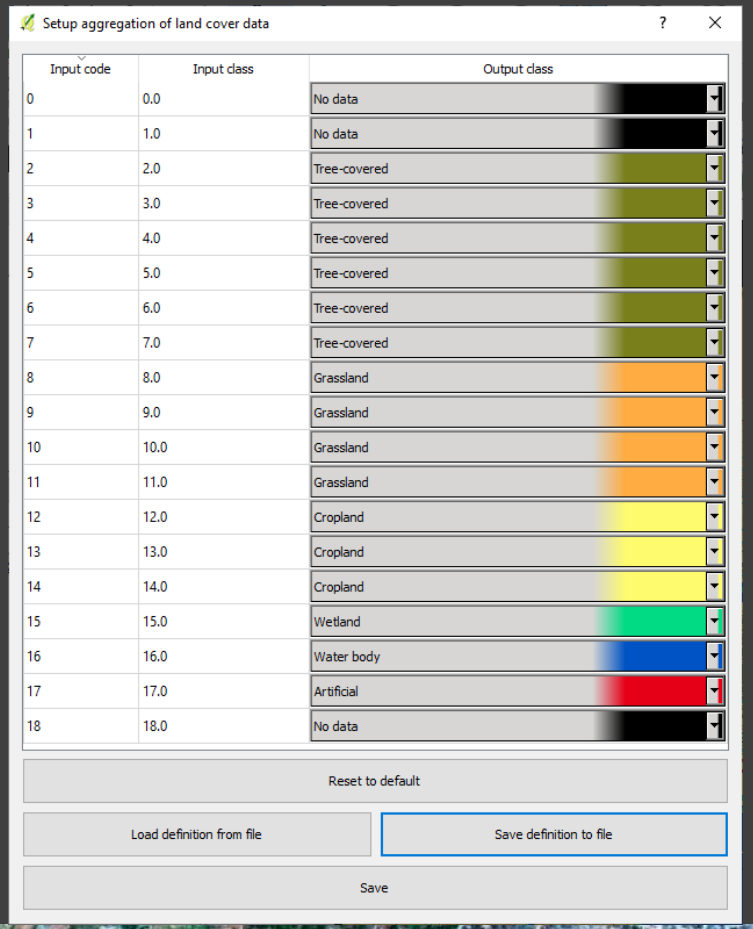


TRENDS.EARTH - LAND COVER CHANGE



TRENDS.EARTH - CUSTOM LAND COVER CHANGE





TRENDS.EARTH - CUSTOM LAND COVER CHANGE

Using default 300 m land cover

Trends.Earth SDG 15.3.1 summary table

TRENDS.EARTH
tracking land change

Summary of SDG 15.3.1 Indicator

	Area (sq km)	Percent of total land area
Total land area:	204,510.3	100.00%
Land area improved:	55,718.1	27.24%
Land area stable:	98,041.3	47.94%
Land area degraded:	49,986.6	24.44%
a with no data:	764.3	0.37%

not imply official endorsement or acceptance by Conservation International Foundation, or its partner
e terms of Creative Commons Attribution 4.0 International License (CC BY 4.0).

r contact the team at trends.earth@conservation.org.

Trends.Earth SDG 15.3.1 summary table

TRENDS.EARTH
tracking land change

Summary of SDG 15.3.1 Indicator

	Area (sq km)	Percent of total land area
Total land area:	204,483.5	100.00%
Land area improved:	55,529.7	27.16%
Land area stable:	98,655.6	48.25%
Land area degraded:	49,897.2	24.40%
Land area with no data:	401.0	0.20%

The boundaries, names, and designations used in this report do not imply official endorsement or acceptance by Conservation International Foundation, or its partner organizations and contributors. This report is available under the terms of Creative Commons Attribution 4.0 International License (CC BY 4.0).

For more information on Trends.Earth, see http://trends.earth, or contact the team at trends.earth@conservation.org.

Using default 30 m land cover

CONSERVATION INTERNATIONAL TRENDS.EARTH

TRENDS.EARTH - LAND COVER CHANGE

Land cover in target year

Land cover in initial year	Tree-covered	Grassland	Cropland	Wetland	Artificial	Bare land	Water body
Tree-covered	0	-	-	-	-	-	0
Grassland	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

Legend

Degradation	Stable	Improvement
-	0	+

*The "Grassland" class consists of grassland, shrub, and sparsely vegetated areas (if the default aggregation is used).

TRENDS.EARTH - LIMITATION WITH GLOBAL DATASETS

What are the limitations with global datasets?

- Resolution
- Accuracy

Why it is beneficial to have local datasets?

- Higher accuracy, precision and finer resolution
- Validated products

Why we support custom/local data in Trends.Earth

- Better inputs = better outputs
- Ownership of the outputs

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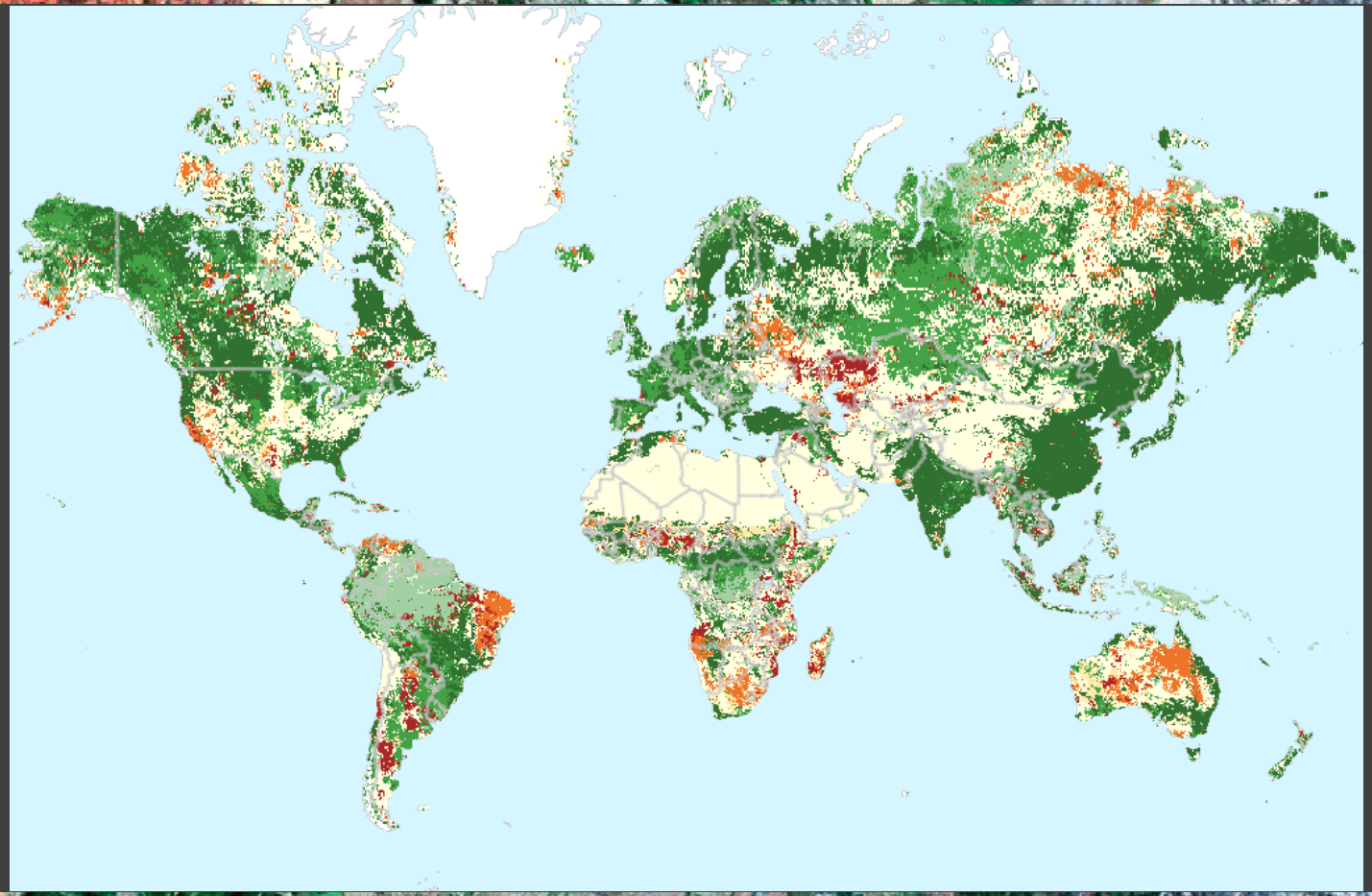
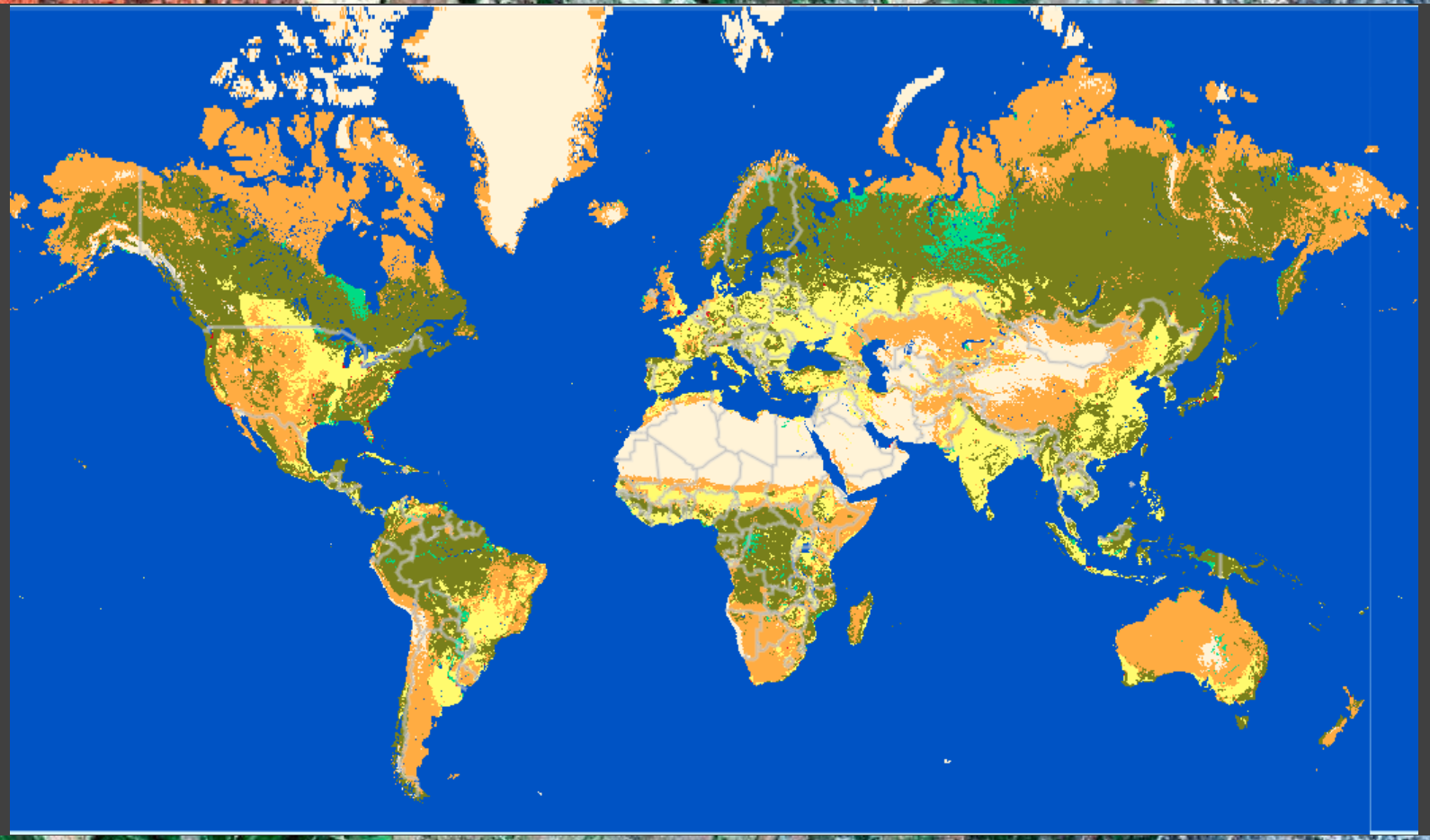
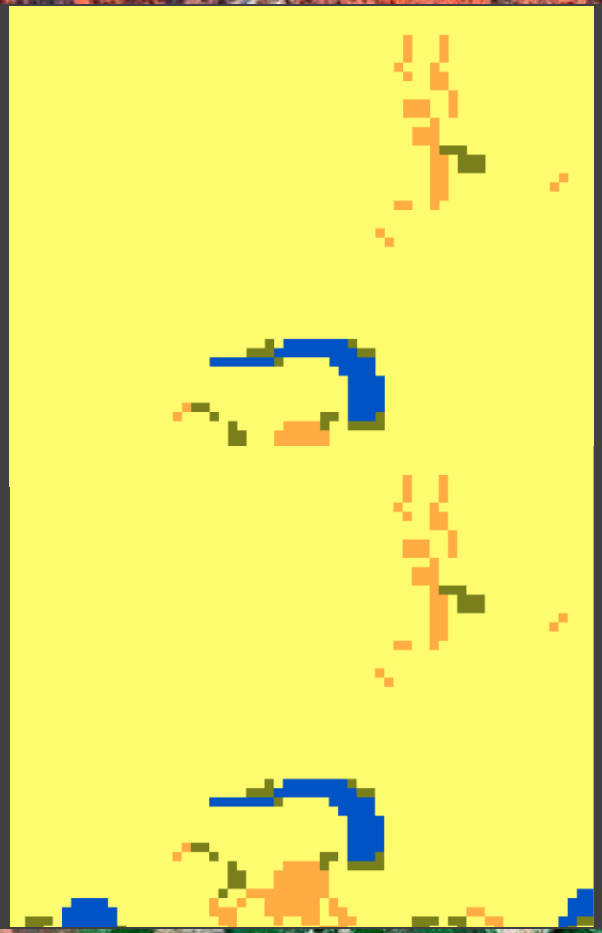
TRENDS.EARTH - LAND PRODUCTIVITY



TRENDS.EARTH - LAND COVER



TRENDS.EARTH - LAND COVER



2008

300m

ESA CCI LC

2008

30m

SLEEK/RCMRD

2014

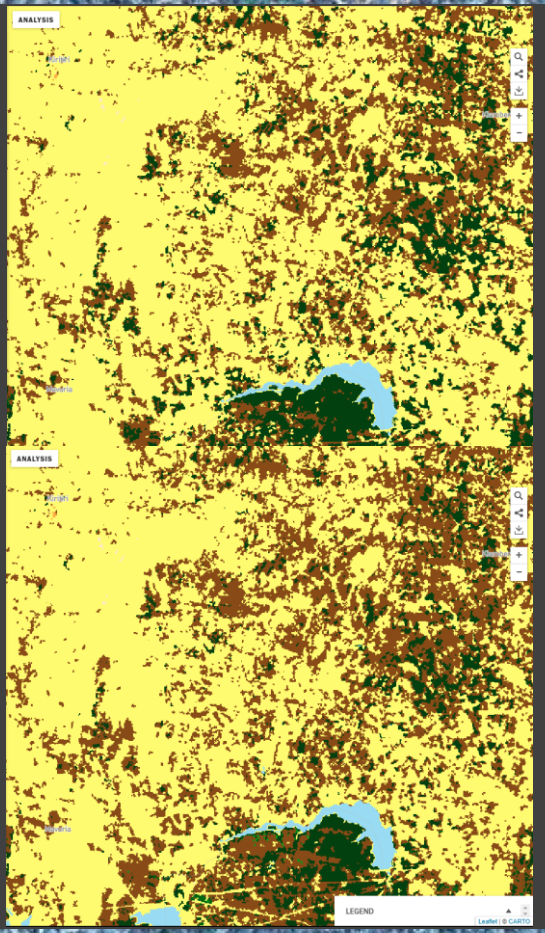
300m

ESA CCI LC

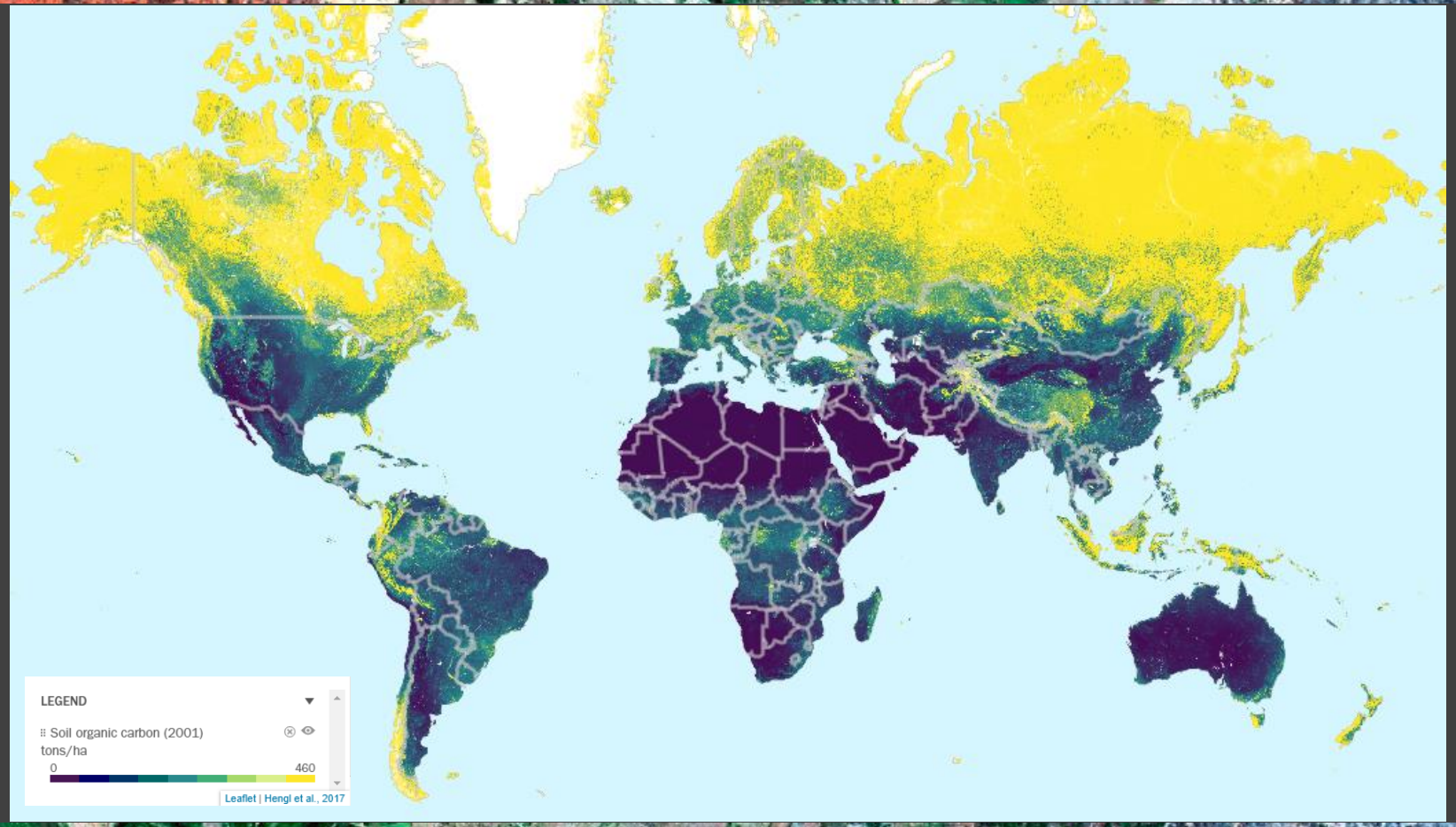
2014

30m

SLEEK/RCMRD



TRENDS.EARTH - CARBON STOCKS



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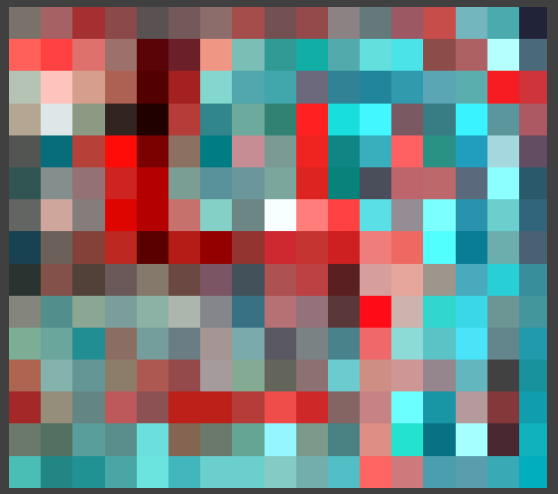
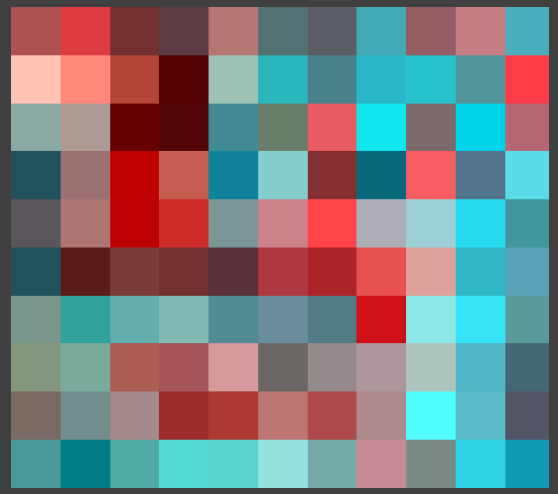
TRENDS.EARTH - RESOLUTION (IMAGERY)

1 x 1 m

4 x 4 m

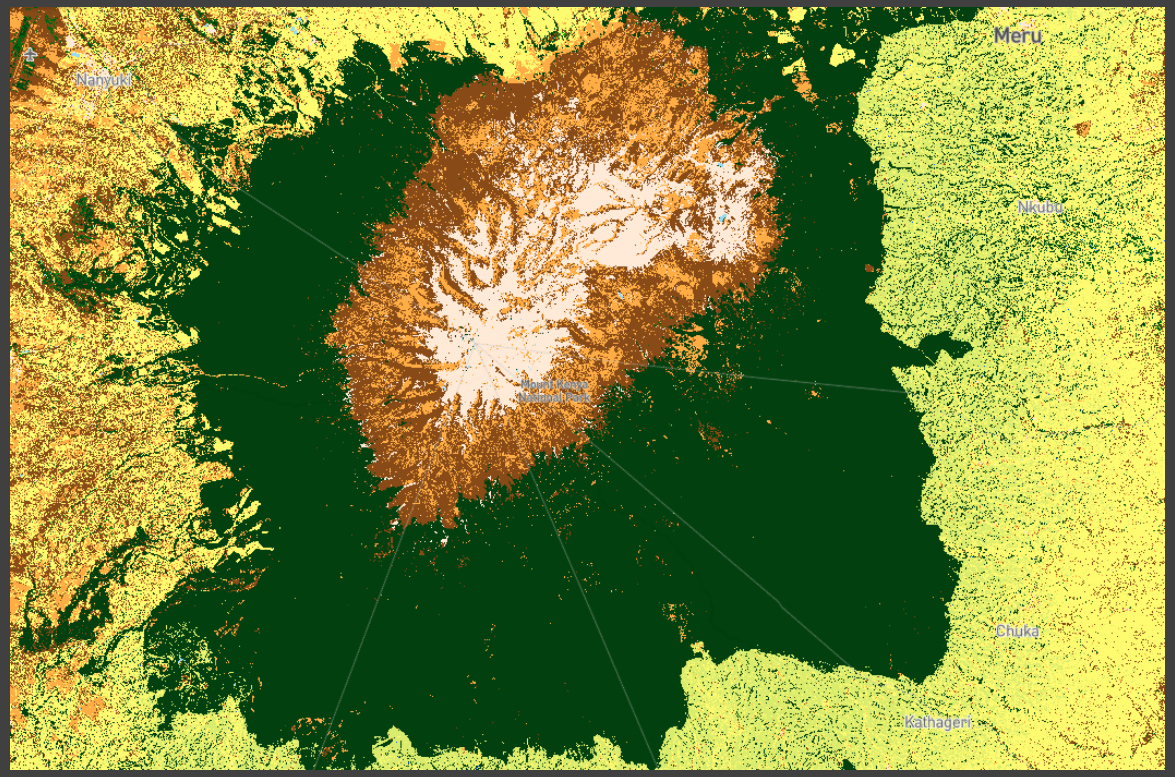


20 x 20 m
(SPOT)

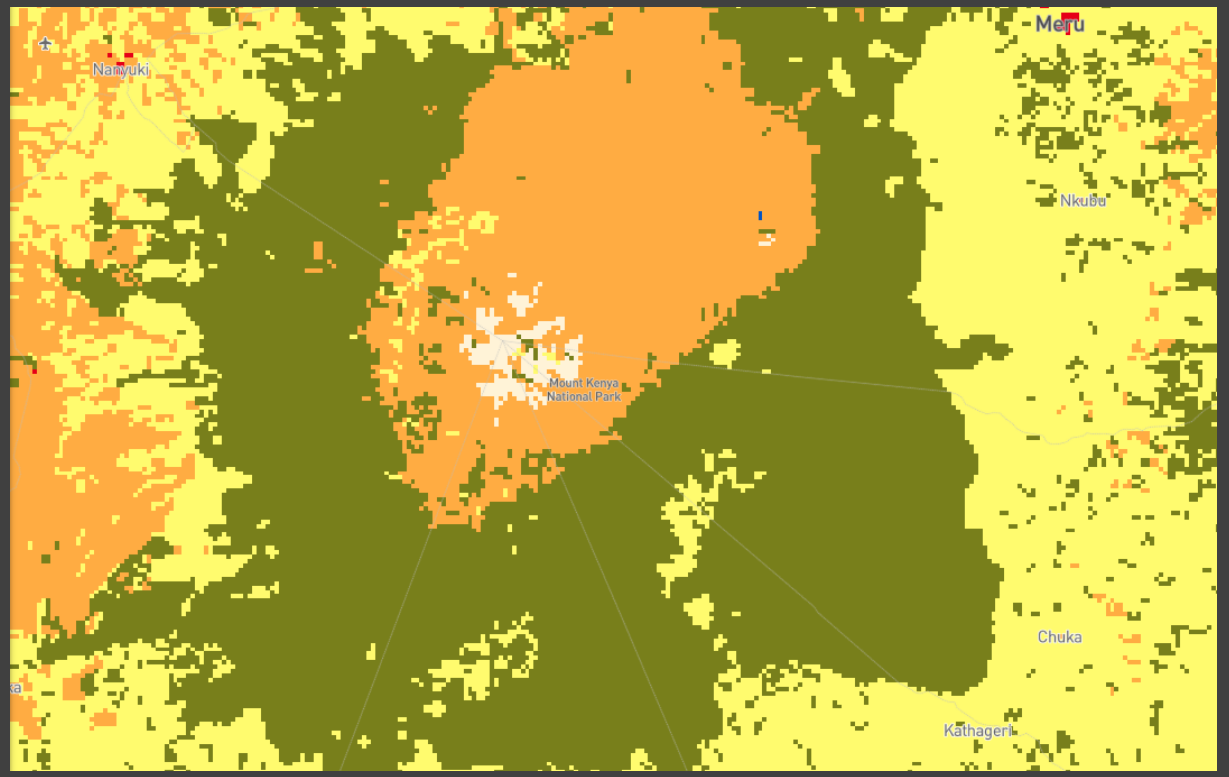


30 x 30 m
(Landsat TM)

TRENDS.EARTH - RESOLUTION (CLASSIFIED LAND COVER)

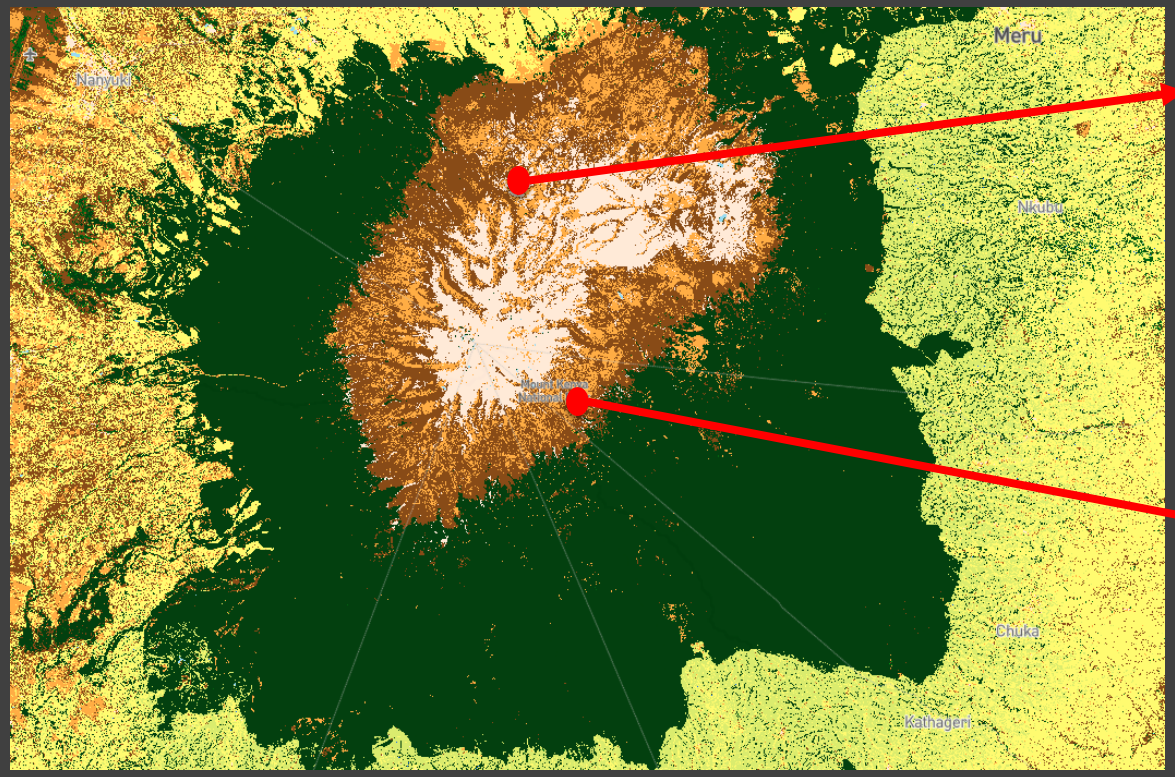


Sentinel - 20m

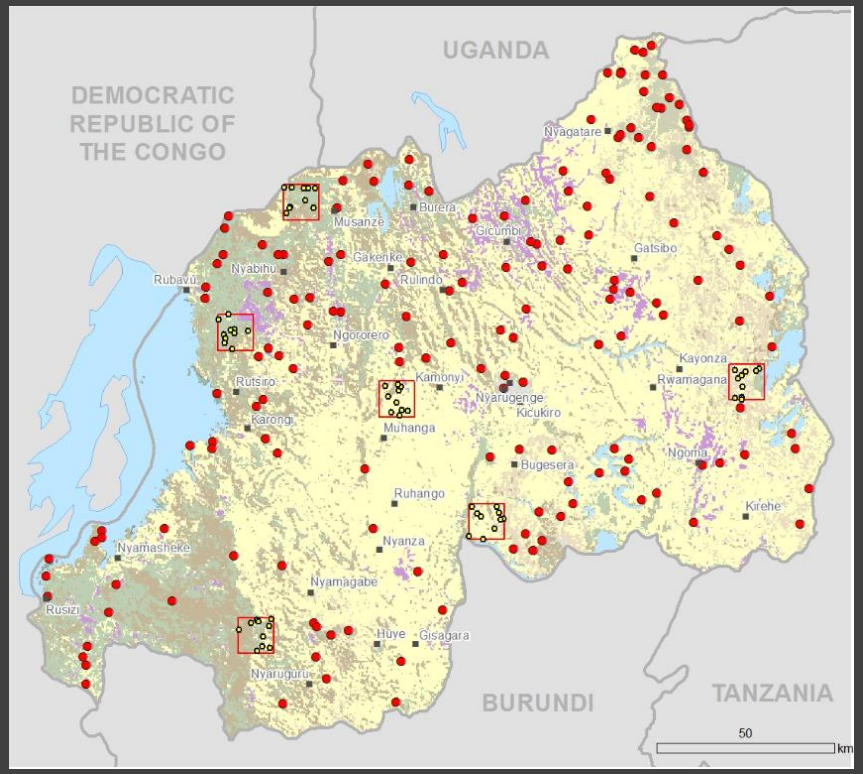


ESA-LLC-CI - 300m

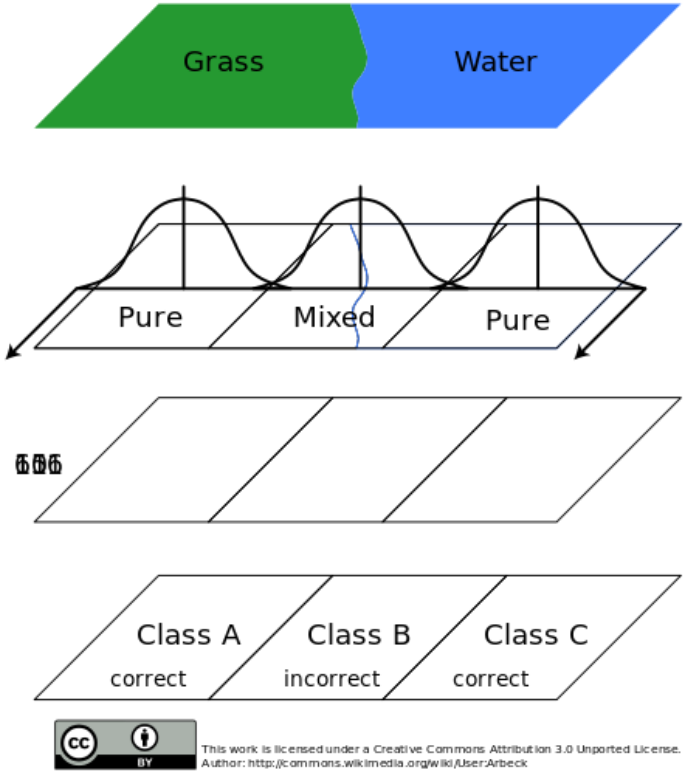
TRENDS.EARTH - RESOLUTION (CLASSIFIED LAND COVER)



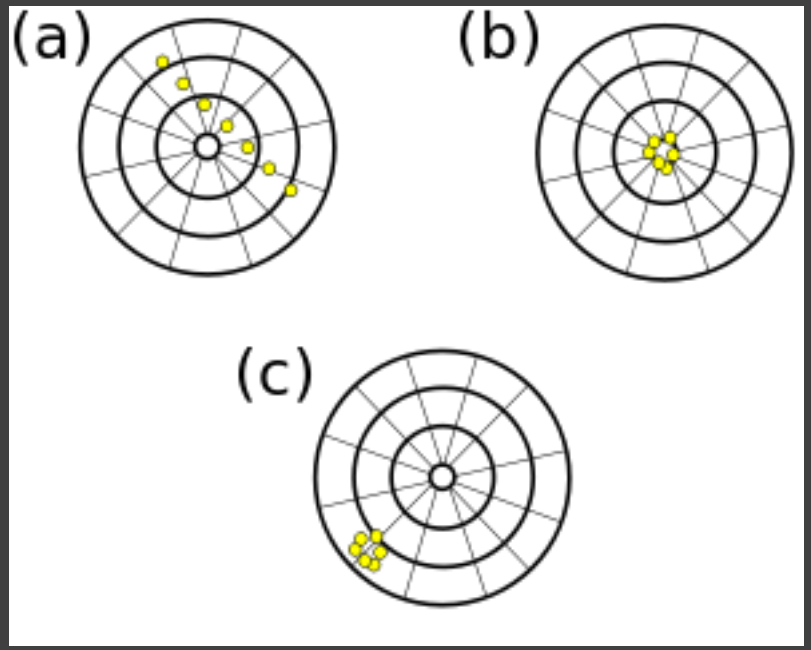
TRENDS.EARTH - VALIDATION



Example of stratified sampling framework



- VALIDATION



(a) Is neither precise nor accurate (b) is precision and accuracy (c) is precise but inaccurate.

TRENDS.EARTH - LIMITATION WITH GLOBAL DATASETS

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TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

1. Land Productivity — Net Primary Productivity

2. Land Cover — Land Cover Change

3. Above and Below Ground C — Soil Organic Carbon

TRENDS.EARTH - EXERCISE

- QGIS Plug-in: Trends.Earth
- Website: http://trends.earth/
- Outputs: http://maps.trends.earth

TRENDS.EARTH - IMPACTS

- 142 countries trained
- > 3,000 users registered
- > 35,000 analysis performed
- Uses in external projects and research

United Nations
Convention to Combat Desertification

TRENDS.EARTH - FUTURE DIRECTIONS

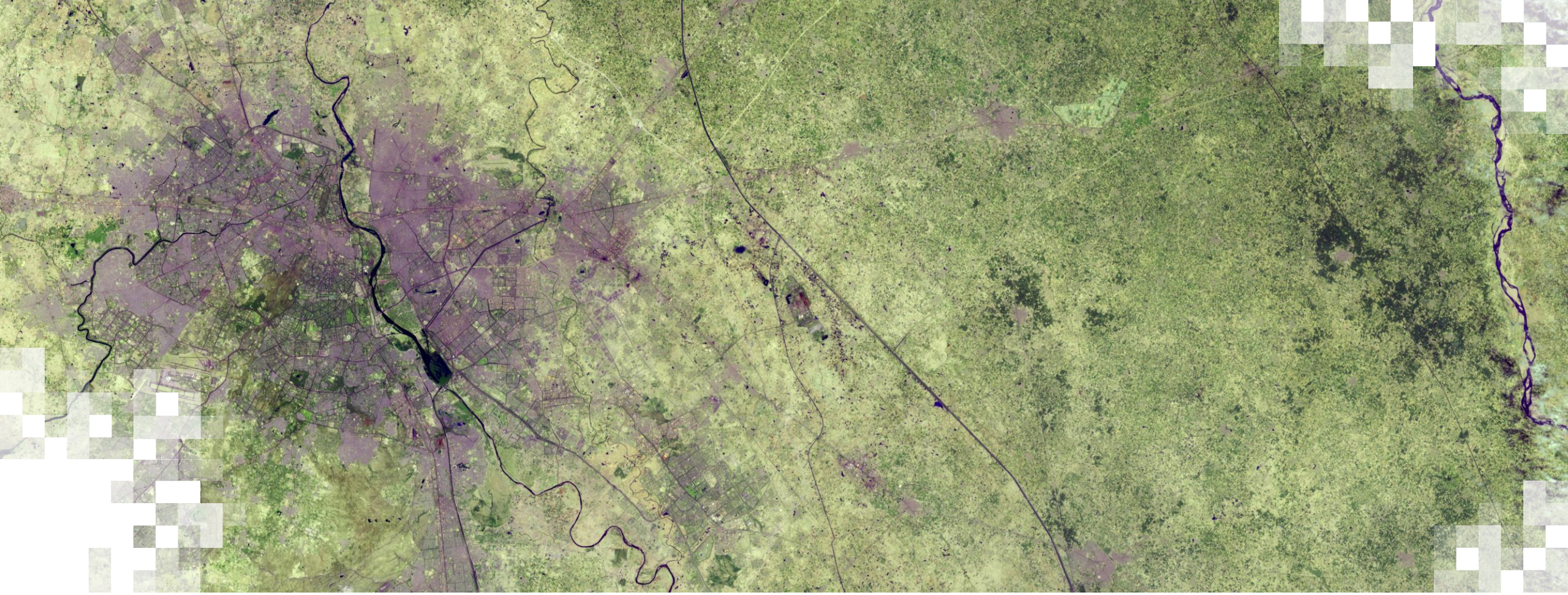
- Increasing spatial resolution of indicators
- Linking with SLM databases
- Linking with mobile applications
- Piloting in Bolivia
- Continuing capacity building

United Nations
Convention to Combat Desertification

WOCAT
World Overview of Conservation Approaches and Technologies

LandPotential.Org

USAID USDA



Experiences Using the Trends.Earth Tool to Calculate Land Degradation

Cases in Latin America with an Emphasis on the Dominican Republic

Pablo Ovalles, Consultant for the Global Mechanism

Experiences Using the TRENDS.EARTH Tool to Calculate Land Degradation

- Introduction
- Background
- Calculating Land Degradation with Trends-Earth
- Examples from the Dominican Republic
- Promoting Trends.Earth on a National and Regional Level
- Conclusions

Introduction

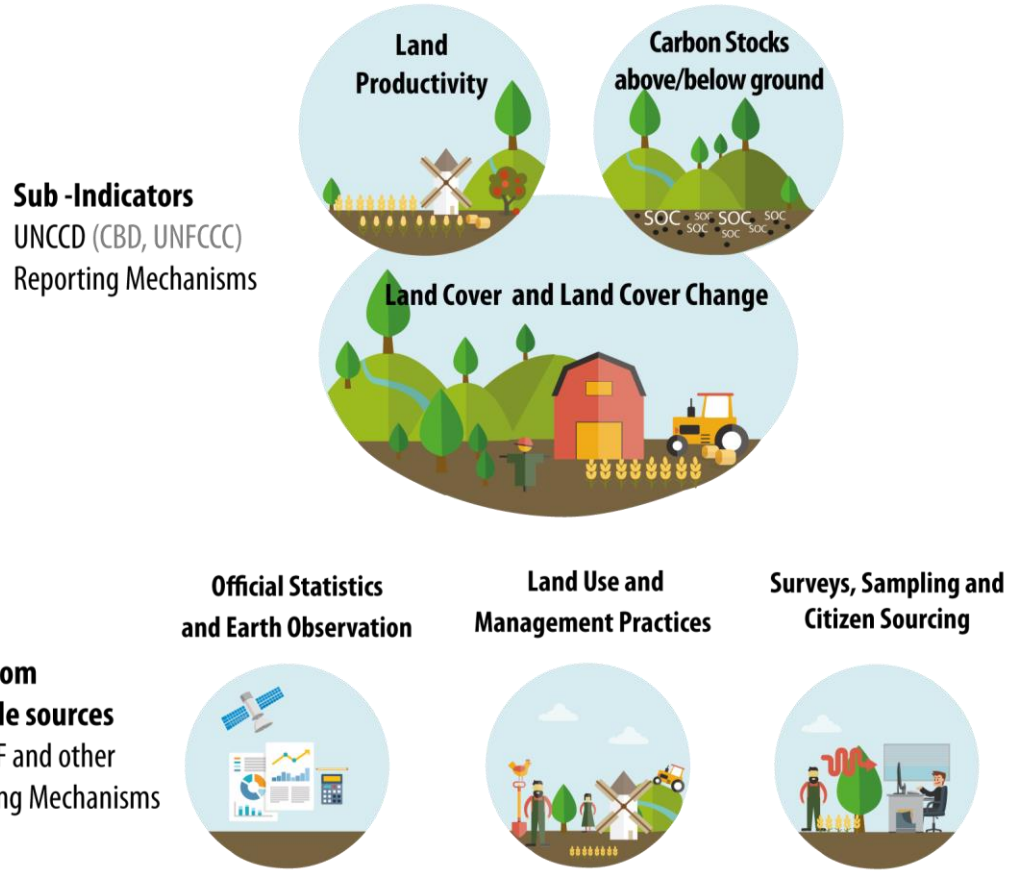
- Within the framework of national reporting requirements for the United Nations Convention to Combat Desertification and Drought, a workshop on the use of this new tool was held with the goal of helping countries in the region of Latin America to improve the quality of the information they report regarding land degradation, and to also make the process quicker and easier

- This tool, known as Trends.Earth, was developed in partnership with Conservation International, the University of Lund, and the National Aeronautics and Space Administration (NASA), with support from the Global Environment Fund (GEF)

Background

This was the first experience in the Dominican Republic and several Latin American countries using three basic indicators of land degradation in the framework of the National Program for the Establishment of Land Degradation Neutrality (LDN) Targets

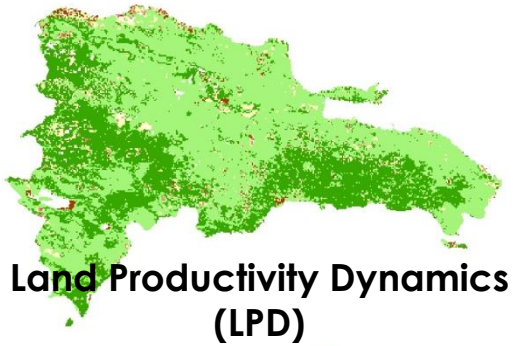
Together, these three indicators provide abundant information regarding the condition of land-based natural capital and land-based ecosystem services



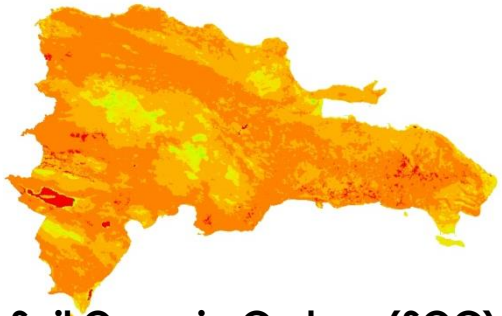
Background

Baseline for the Establishment of National LDN Targets

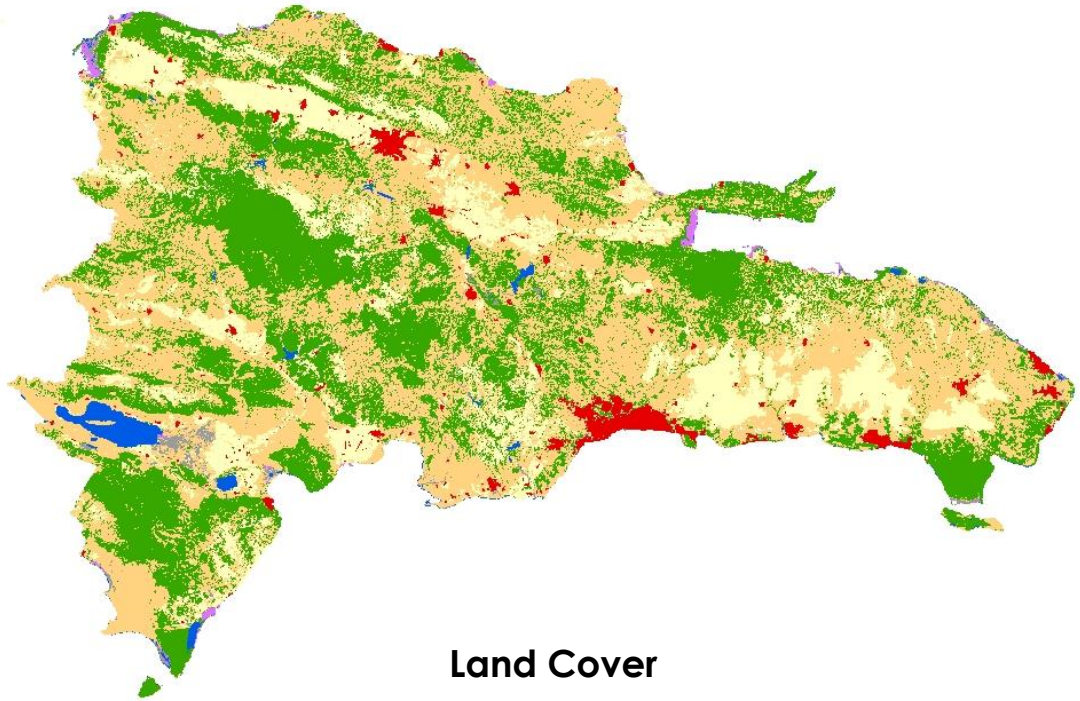
To calculate land degradation, local data were combined with equal parts global data. Even so, it was a torturous process requiring extensive spatial analysis and assistance from experts in the use of GIS tools.



Land Productivity Dynamics (LPD)



Soil Organic Carbon (SOC)

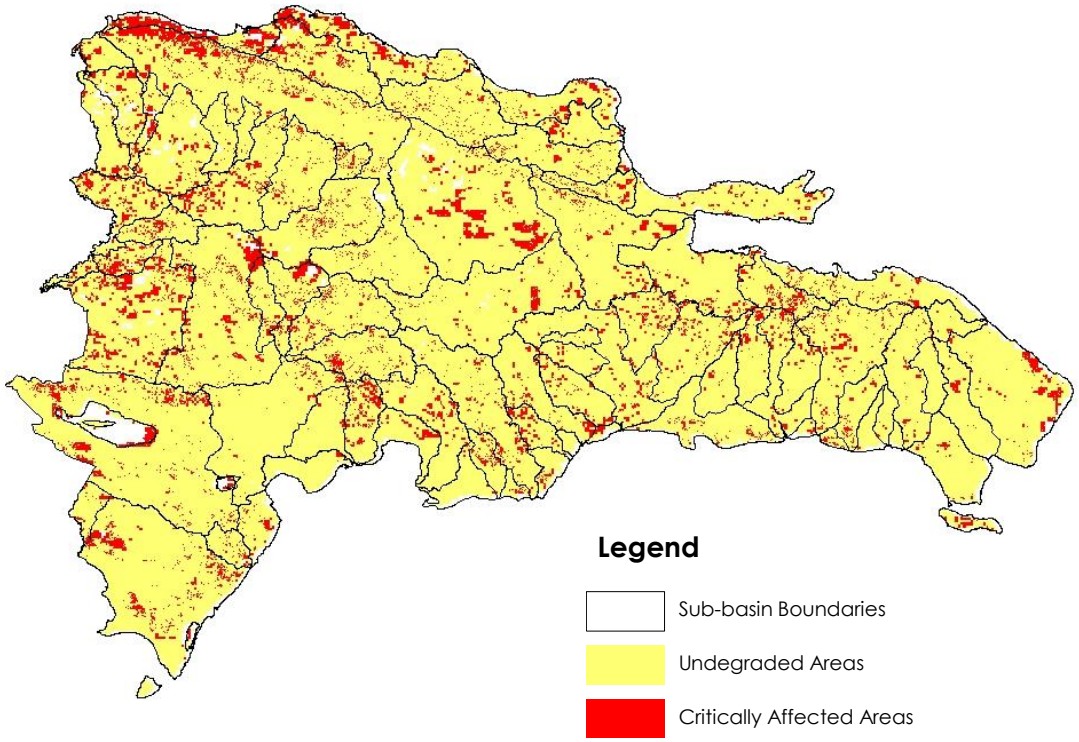


Land Cover

Background

In the Dominican Republic, an estimated 4,960 km_2 (1950 sq. mi.) or roughly 10% of its territory were found to be critically affected by land degradation processes.

Researchers used static LPD for one year as well as SOC, in addition to other indicators such as soil erosion.



Background

The areas most critically affected by land degradation were located precisely in the arid and semi-arid regions of the country

Calculating Land Degradation with Trends.Earth

Convention member states committed to using new tools and more current global data with the goal of improving land degradation estimates for use in national reporting

Calculating Land Degradation with Trends.Earth

TRENDS.EARTH
tracking land change

Trends.Earth is a platform for monitoring land cover changes using satellite observations in an innovative way, combining cloud computing with a desktop interface. (QGIS).

The 3 sub-indicators used for monitoring progress towards achieving Land Degradation Neutrality (LDN) as outlined in SDG Target 15.3 were calculated using Trends.Earth. This tool has also helped countries analyze data and prepare their reports to the UNCCD much more quickly and precisely.

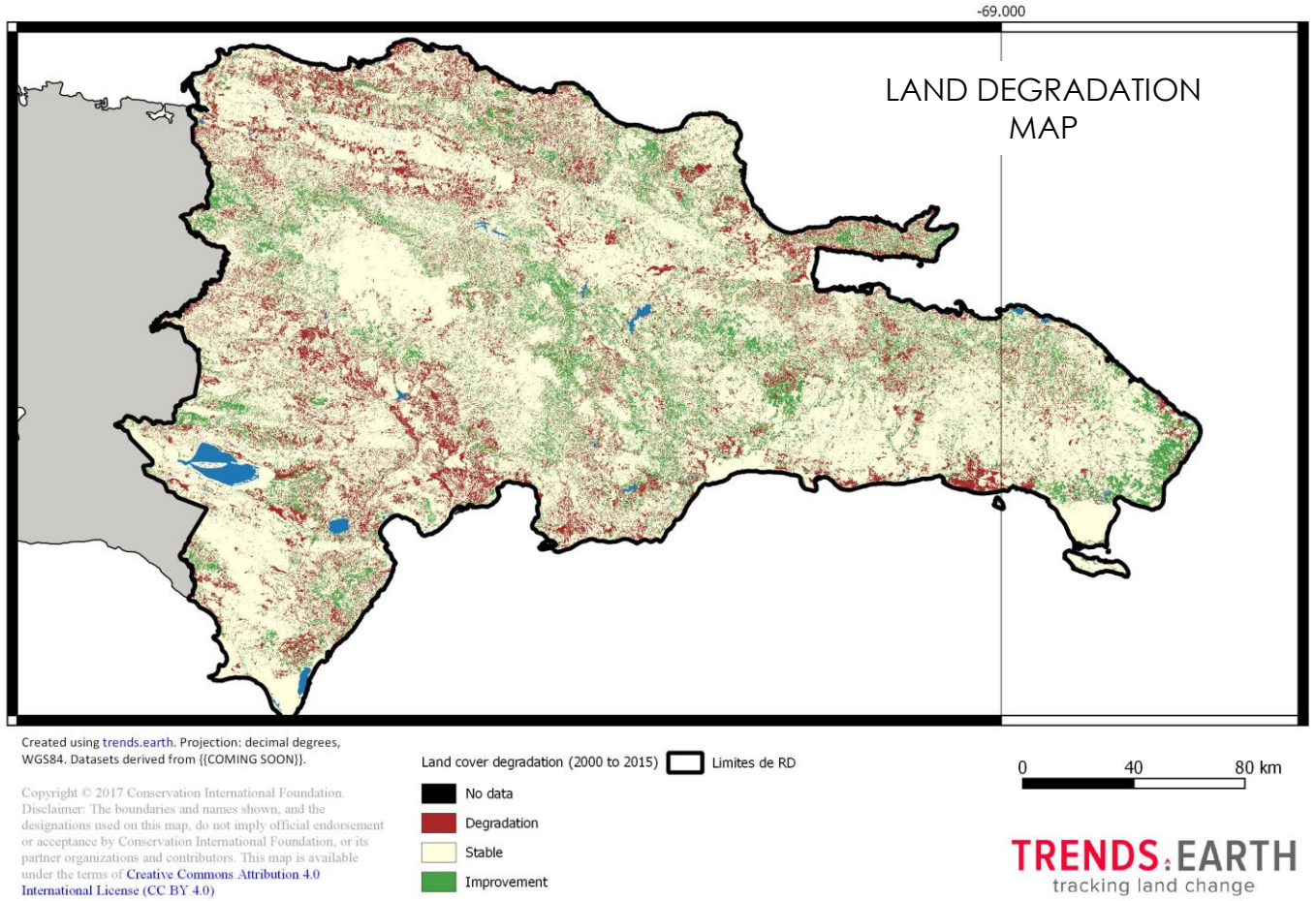
Calculating Land Degradation with Trends.Earth

The combination of Trends.Earth and the QGIS interface made it considerably easier to calculate the three main indicators of land degradation and generate statistics as well as maps of degraded areas for reporting to the Convention.

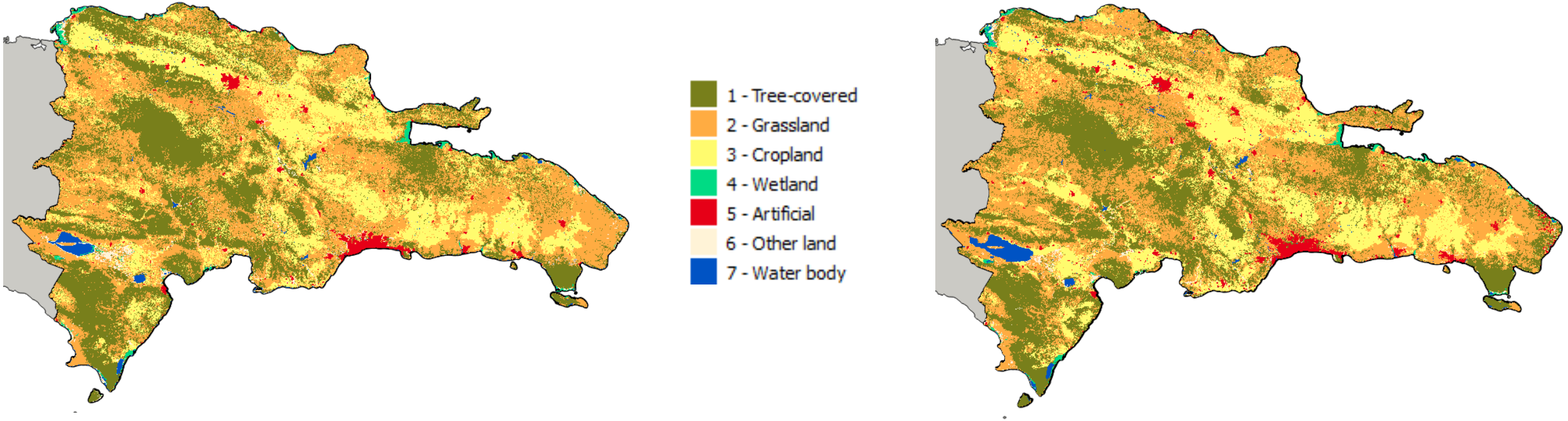
It allowed the creation of indicators using locally-sourced data such as land cover. Various countries decided to use these sources which they already had at their disposal for the period being reported.

Calculating Land Degradation with Trends.Earth

For example, in the Dominican Republic, just like other countries in the region, Trends.Earth made it possible to calculate the indicator for land cover degradation. In this case, researchers used land cover maps made with Landsat images for the period covered in the report.



Calculating Land Degradation with Trends.Earth

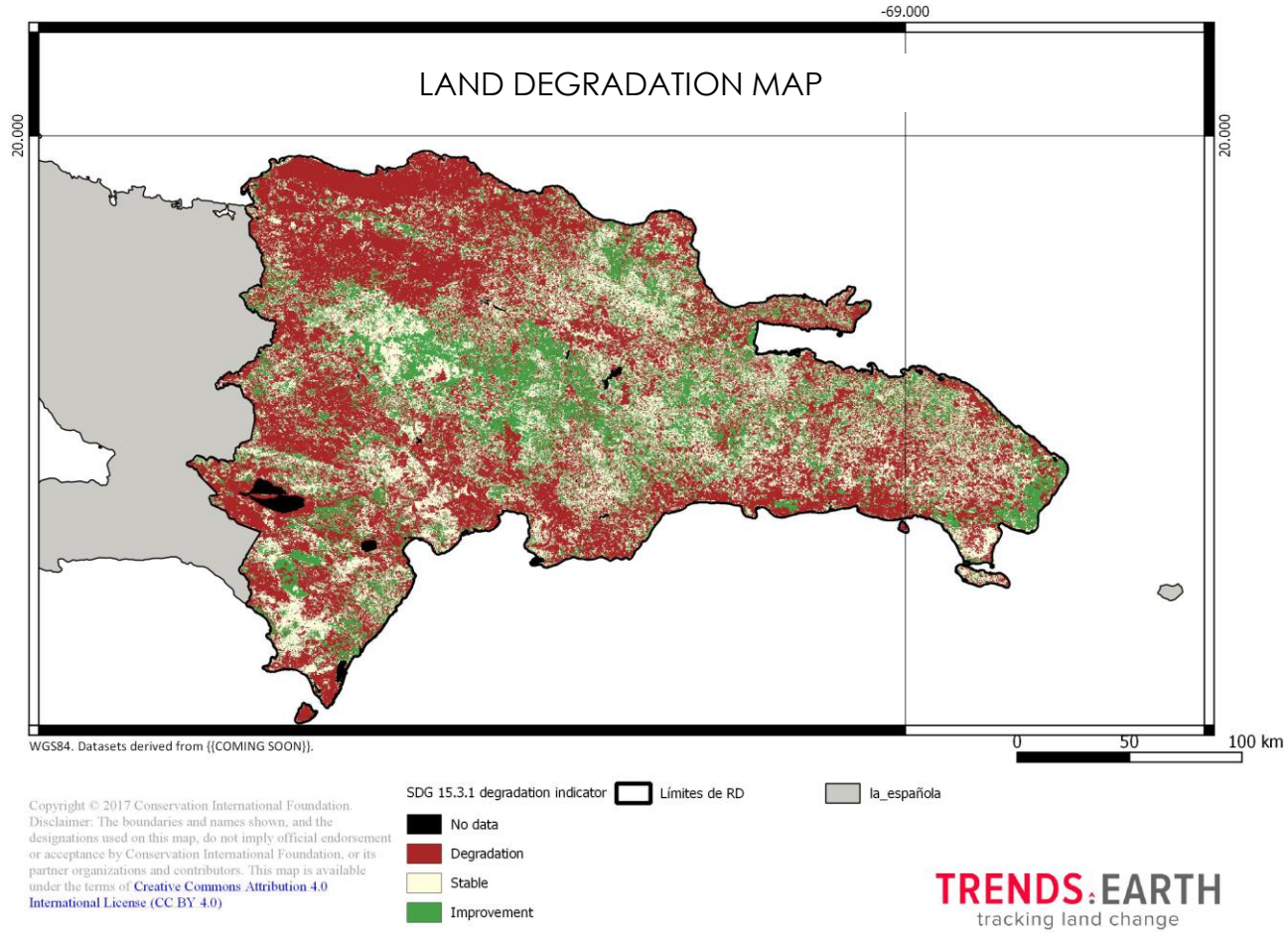


Many countries – particularly island nations that had land cover maps – opted to use these sources. In the case of the Dominican Republic, which has a great variety of ecosystems, global sources generated great uncertainty. With Trends.Earth, researchers were able to reclassify easily.

Calculating Land Degradation with Trends.Earth

	Area (sq km)	Percent of total land area
Total land area:	47,587.3	100.00%
Land area improved:	10,306.3	21.66%
Land area stable:	13,959.2	29.33%
Land area degraded:	23,109.4	48.56%
Land area with no data:	212.4	0.45%

The Trends.Earth tool made it possible to combine local and global data sources to determine the percentage of degraded land in each country and to automatically generate maps and statistics for use in national reports. This was the case for the Dominican Republic, as well as the majority of countries without local LPD and SOC data.



Promoting the Use of Trends.Earth on a National and Regional Scale

During the of preparation of the final national report, a workshop was held in the Dominican Republic with the goal of training people in the use and application of the Trends.Earth tool. It was aimed at different institutions that deal with land use. Mariano Gonzalez-Roglich participated online in this training.

Promoting the Use of Trends.Earth on a National and Regional Scale

27 countries in Latin America, both English and Spanish speaking, used the Trends.Earth tool to calculate land degradation indicators, thereby achieving satisfactory compliance with the submission of their national reports in a short amount of time.

There were different levels of training. Although, the majority of them were general trainings on the efficient use of the tool, in some cases, such as Haiti, Ecuador, Guatemala, Paraguay, and Colombia, the trainings were more specific and covered certain processes step by step. Nicaragua felt motivated to join the process after the deadline for submitting reports had passed and provided support in order to become acquainted with the tool and complete a land degradation evaluation.

Promoting the Use of Trends.Earth on a National and Regional Scale

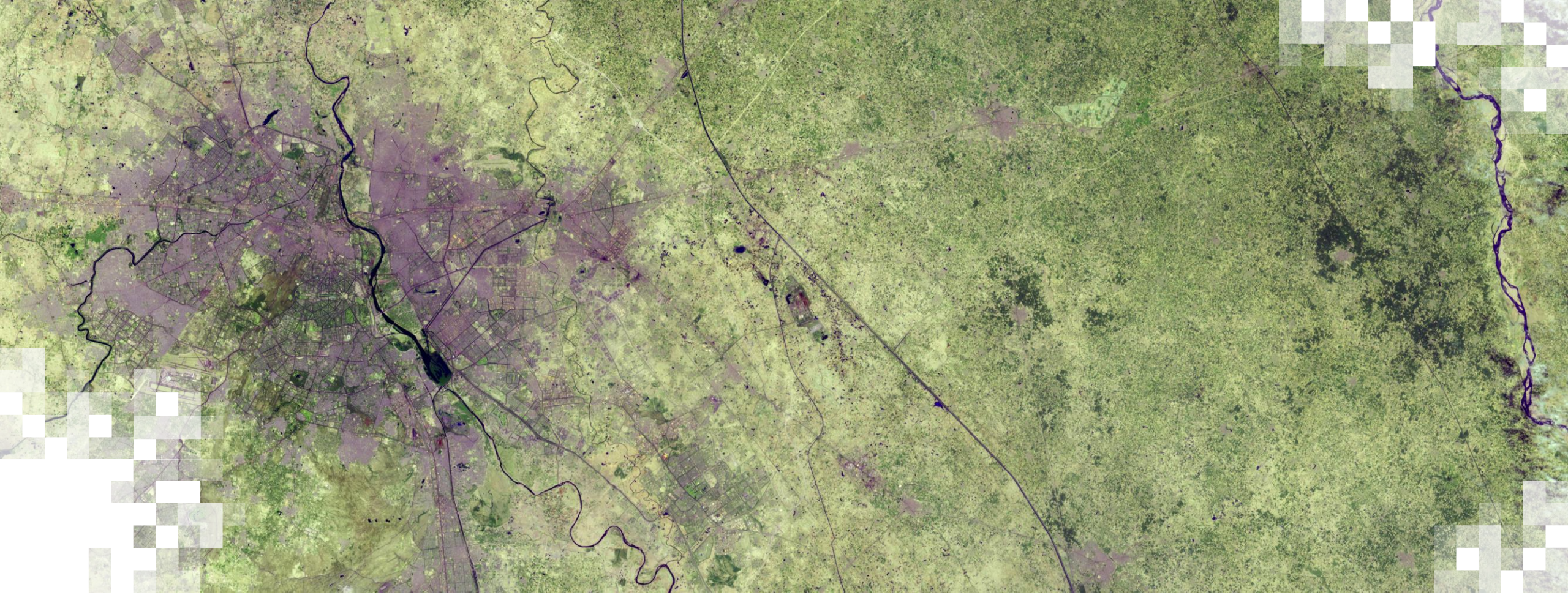
Some of the countries in the region did not attend the training held in Brazil, so they were unfamiliar with the tool.

Nevertheless, the greatest difficulty was encountered in gain vs. loss analyses of Soil Organic Carbon (SOC) for each type of land cover change.

Land Conversion		Net change of an area	Change in the Soil Organic Carbon Reserve (SOC) (2000-2015)				
De	A	km²	Initial SOC Reserve (t/ha)	Final SOC Reserve (t/ha)	Total Initial SOC Reserve (t)	Total Final SOC Reserve (t)	Change in SOC Reserve (t)
Tree-cov	Grassland	3.739,54	115,16	91,51	43.064.400	34.220.500	-8.843.900
Tree-cov	Cropland	728	115,16	95,33	8.383.500	6.939.900	-1.443.600
Praderas	Áreas cul	1.154,68	90,41	115,99	28.521.500	36.591.200	8.069.700
Praderas	Tierra de	1.999,55	90,41	95,03	18.078.000	19.061.700	983.700
Praderas	Superfici	222,32	90,41	68,52	2.010.000	1.523.400	-486.600
Tierra de	Áreas cul	862,65	93,47	115,83	8.063.200	10.005.900	1.942.700
Tierra de	Praderas	1.620,59	93,47	91,51	15.147.700	148.300	-14.999.400
Tierra de	Superfici	113,46	93,47	68,52	1.060.500	777.400	-283.100

Conclusions

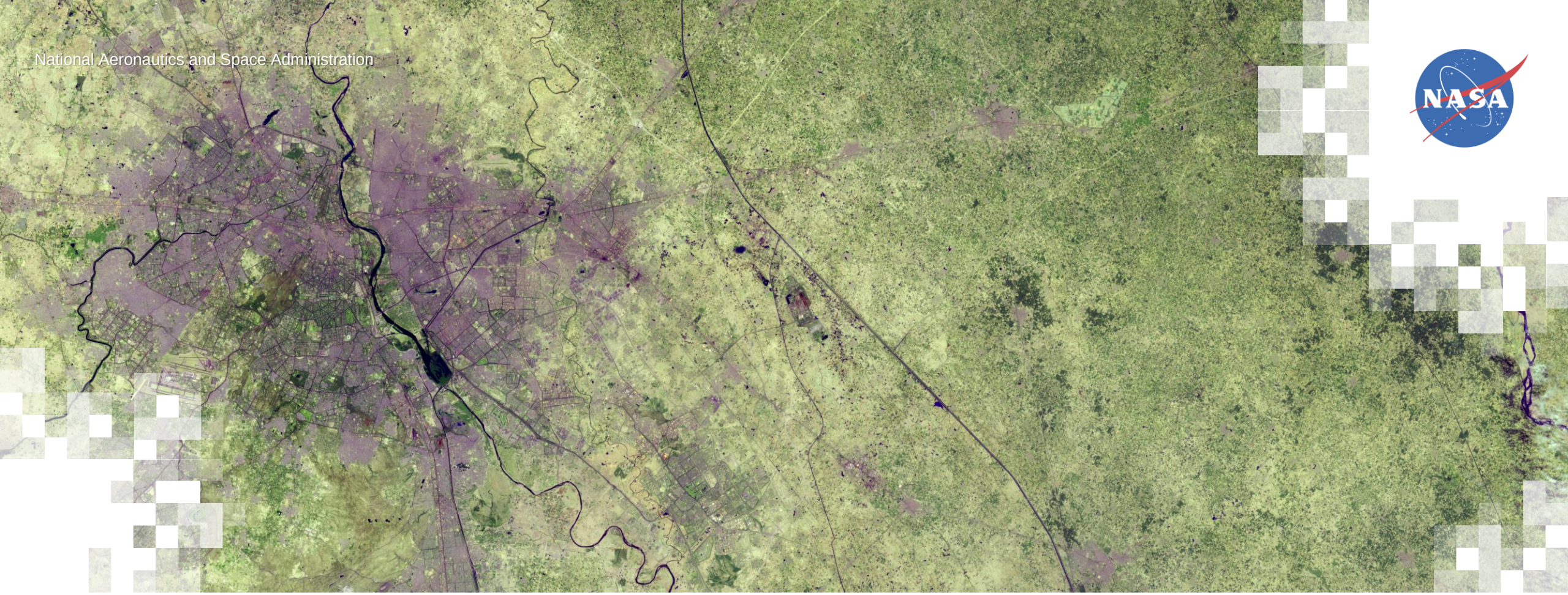
- Seeing how Trends.Earth allows the use of spatial data from local sources, it's recommended that island nations have local data available due to their size and the great diversity of their ecosystems.
- The Trends.Earth tool considerably expedited the preparation of land degradation indicators. However, there is still a need for capacity building in the countries that use it. It is also advisable to conduct more complete data analysis and consider other options for analysis.
- In the future, calculations of indicators on a sub-regional (Departmental or Provincial) level should be incorporated automatically.
- Finally, countries need to develop a deeper understanding of the level of detail of the sub-indicators, especially SOC and LPD, as well as knowledge of methodologies to validate them on a local level.



Trends.Earth Exercise

Contacts

- ARSET Land Management & Wildfire Contacts
  - Amber McCullum: AmberJean.Mccullum@nasa.gov
  - Juan Torres-Perez: juan.l.torresperez@nasa.gov
- General ARSET Inquiries
  - Ana Prados: aprados@umbc.edu
- ARSET Website:
  - http://arset.gsfc.nasa.gov



Thank You

Next Session: July 23rd, 2019

7/16/2019