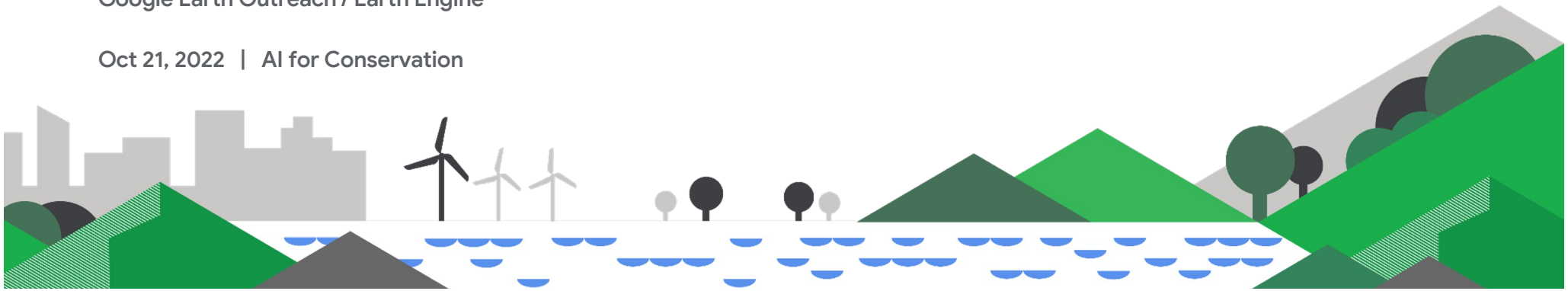
Dynamic World & Wildlife Insights

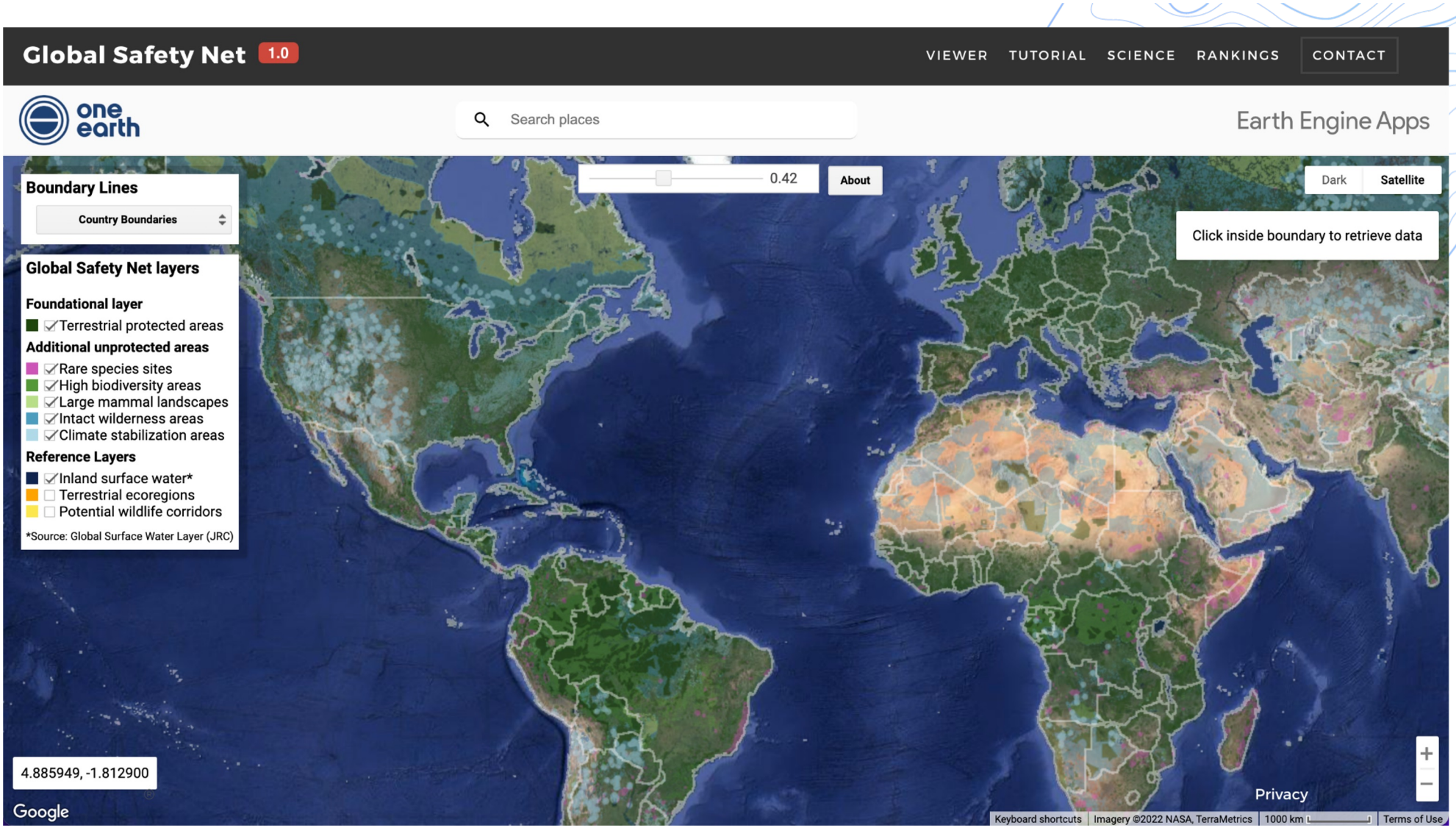
Tanya Birch

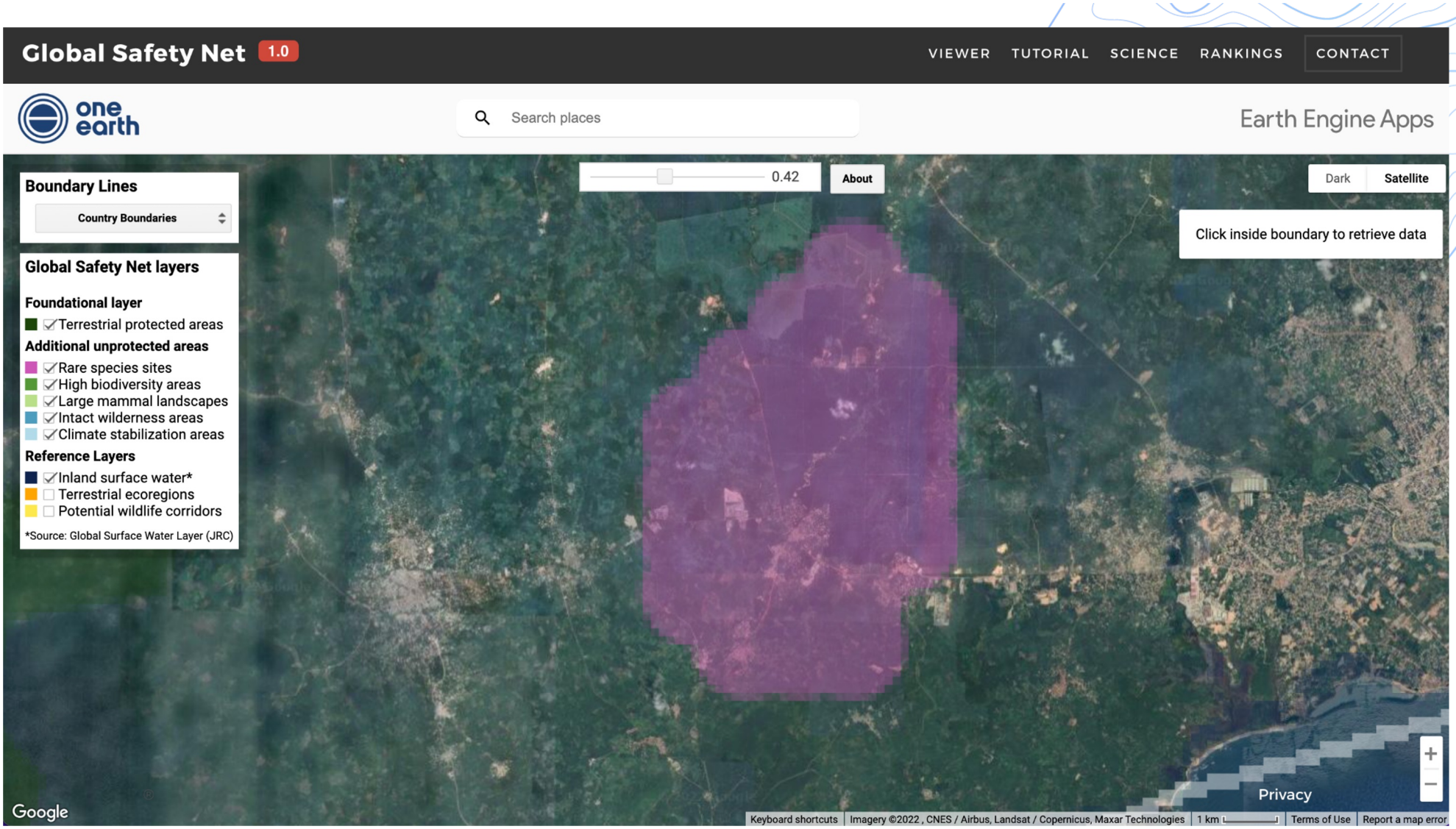
Sr. Program Manager, Forests & Nature

Google Earth Outreach / Earth Engine

Oct 21, 2022 | AI for Conservation




Global Safety Net
1.0
VIEWER
TUTORIAL
SCIENCE
RANKINGS
CONTACT
one earth
Search places
Earth Engine Apps
0.42
About
Dark
Satellite
Click inside boundary to retrieve data
Boundary Lines
Country Boundaries
Global Safety Net layers
Foundational layer
Terrestrial protected areas
Additional unprotected areas
Rare species sites
High biodiversity areas
Large mammal landscapes
Intact wilderness areas
Climate stabilization areas
Reference Layers
Inland surface water*
Terrestrial ecoregions
Potential wildlife corridors
*Source: Global Surface Water Layer (JRC)
4.885949, -1.812900
Google
Privacy
Keyboard shortcuts
Imagery ©2022 NASA, TerraMetrics
1000 km
Terms of Use


Global Safety Net
1.0
VIEWER
TUTORIAL
SCIENCE
RANKINGS
CONTACT
one earth
Search places
Earth Engine Apps
Boundary Lines
Country Boundaries
Global Safety Net layers
Foundational layer
Terrestrial protected areas
Additional unprotected areas
Rare species sites
High biodiversity areas
Large mammal landscapes
Intact wilderness areas
Climate stabilization areas
Reference Layers
Inland surface water*
Terrestrial ecoregions
Potential wildlife corridors
*Source: Global Surface Water Layer (JRC)
0.42
About
Dark
Satellite
Click inside boundary to retrieve data
Privacy
Google
Keyboard shortcuts
Imagery ©2022 , CNES / Airbus, Landsat / Copernicus, Maxar Technologies
1 km
Terms of Use
Report a map error


What wildlife live here?

©Will Burrard-Lucas

©eMammal, Akesai County Mammal Survey Project

©eMammal, Students Discover Kenya Project

Barriers

1

Slow data flow

Millions of photos collected. Data can take months or years to process

2

Data is siloed

Individual storage means risk of loss; data is not standardized for collaboration

3

No easy tools to gain insights

Camera trap data can be difficult to analyze

Ahumada, et al. 2019. *Environmental Conservation*. doi:10.1017/S0376892919000298


Wildlife Insights
Leveraging big data, cloud technology and machine learning to transform wildlife conservation

Solutions

1

Powered by AI

Identifies species and separates ‘blanks’
10x faster than other systems

2

Cloud-based data sharing

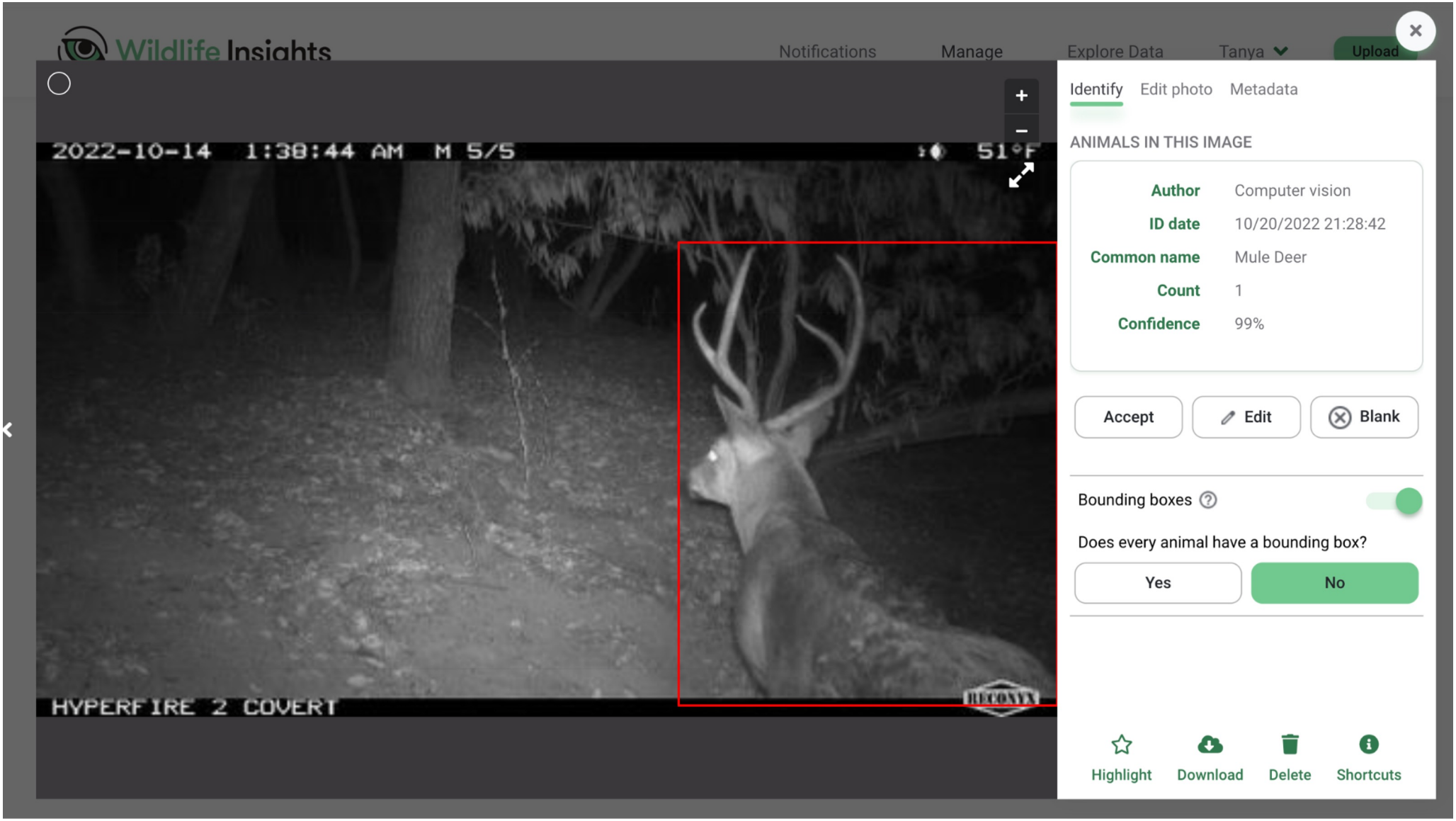
Easily share data to understand trends across projects and borders

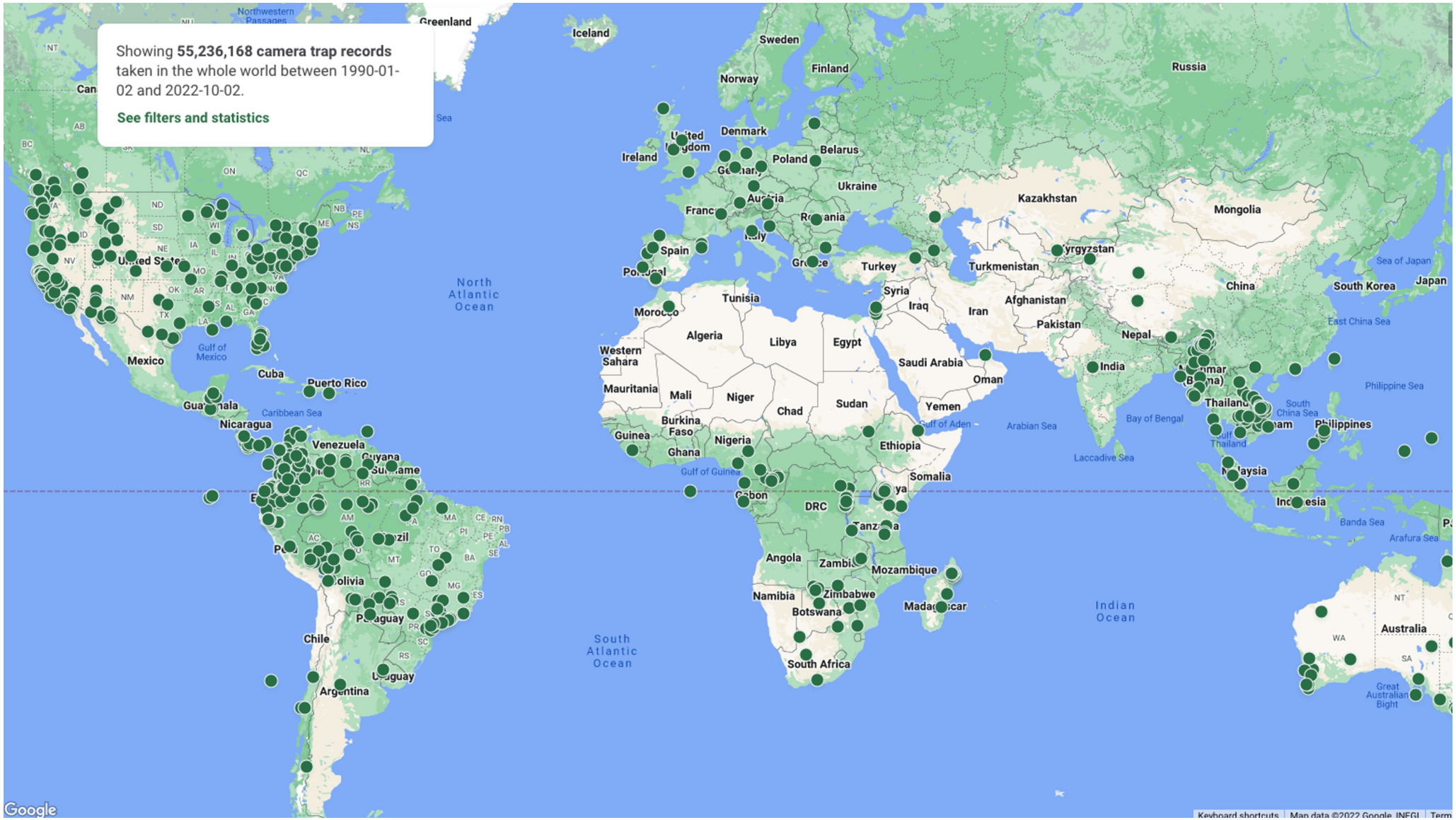
3

Automated analytics

Anyone can run science-based models and generate reports

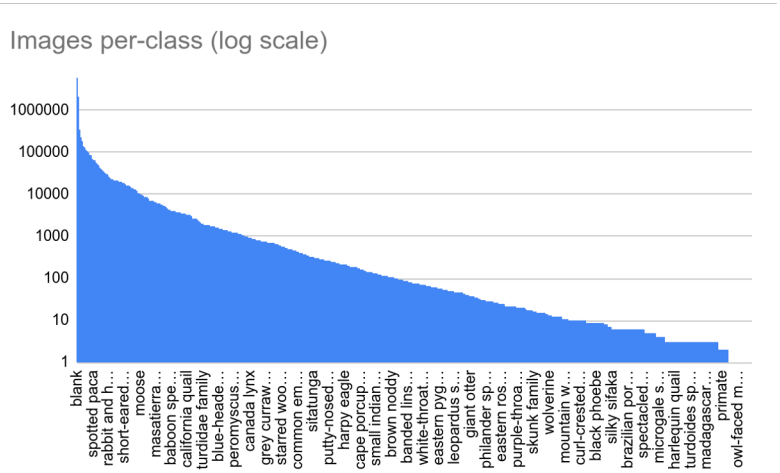
Ahumada, et al. 2019. *Environmental Conservation*. doi:10.1017/S0376892919000298


Wildlife Insights
Notifications
Manage
Explore Data
Tanya
Upload
2022-10-14 1:38:44 AM M 5/5
51°F
HYPERFIRE 2 COVERT
Identify
Edit photo
Metadata
ANIMALS IN THIS IMAGE
Author
Computer vision
ID date
10/20/2022 21:28:42
Common name
Mule Deer
Count
1
Confidence
99%
Accept
Edit
Blank
Bounding boxes
Does every animal have a bounding box?
Yes
No
Highlight
Download
Delete
Shortcuts


Showing 55,236,168 camera trap records taken in the whole world between 1990-01-02 and 2022-10-02.
See filters and statistics
Greenland
Iceland
Sweden
Finland
Norway
Russia
Ireland
Denmark
Poland
Belarus
Ukraine
Kazakhstan
Mongolia
Spain
Turkey
Turkmenistan
China
South Korea
Japan
Sea of Japan
East China Sea
Tunisia
Syria
Iraq
Iran
Afghanistan
Pakistan
Nepal
India
Philippine Sea
Algeria
Libya
Egypt
Saudi Arabia
Oman
Western Sahara
Mauritania
Mali
Niger
Chad
Sudan
Yemen
Gulf of Aden
Arabian Sea
Bay of Bengal
Laccadive Sea
Burkina Faso
Guinea
Nigeria
Ghana
Ethiopia
Somalia
Gulf of Guinea
DRC
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Botswana
South Africa
Madagascar
Indian Ocean
South Atlantic Ocean
North Atlantic Ocean
Mexico
Gulf of Mexico
Cuba
Puerto Rico
Caribbean Sea
Nicaragua
Venezuela
Guyana
Suriname
Brazil
Peru
Bolivia
Paraguay
Chile
Argentina
Uruguay
Australia
Great Australian Bight
Arafura Sea
Banda Sea
Google

Imbalanced data, geospatially sparse, and noisy labels

Top 10 classes (out of 1,000) account for 70% of the data



User data has to be vetted for quality

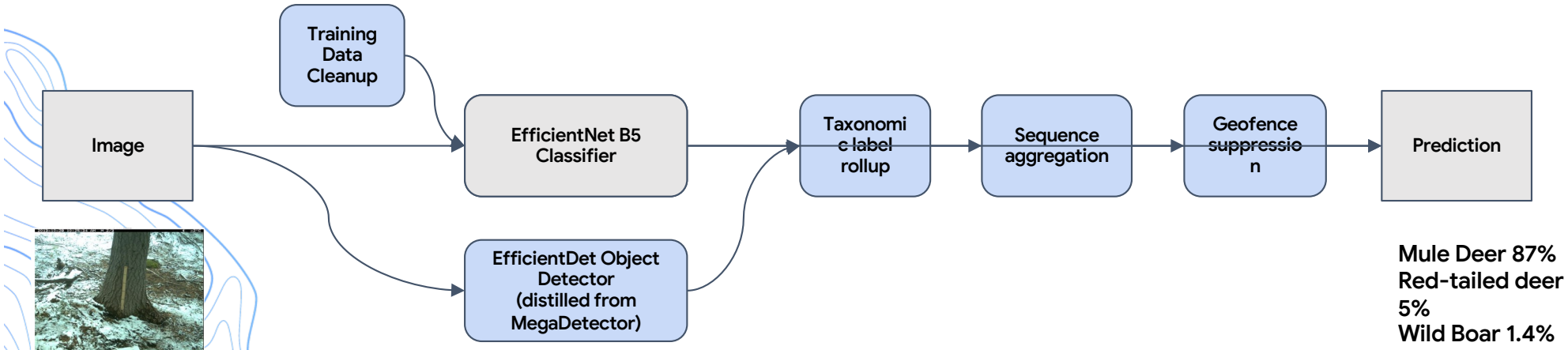
Classification Model → Classification System

2019 - beta launch

- 8.7M images
- 614 classes

2021 - GA

- 15M images
- 1000 classes



Results: recall increase w/ similar precision

Overall performance

- 20% increase in animal recall
- 13.5% increase in recall@species-level
- 44% decrease in unclassified images

	Overall	Animals			Blanks	
	% Classified	Recall (any taxonomic level)	Precision (any taxonomic level)	Species recall	Recall	Precision
Classifier	0.8302	0.6854	0.8597	0.6229	0.8081	0.9538
Classifier + Geofence	0.8272	0.6931	0.8694	0.6028	0.8081	0.9538
Classifier + Label Rollup	0.8823	0.7787	0.8537	0.6229	0.8081	0.9538
Classifier + Detector	0.8939	0.8121	0.864	0.6228	0.8056	0.9583
Classifier + Sequence	0.9047	0.7761	0.8239	0.7069	0.8073	0.9555
Classifier + Label Rollup + Geofence + Detector (production model)	0.9036	0.8225	0.8566	0.6027	0.8056	0.9583
Classifier + Label Rollup + Geofence + Detector + Sequence	0.9339	0.8292	0.8213	0.6884	0.8054	0.9585

CDFW is using AI predictions to reduce their workload

For some projects, staff are trusting the model to identify blanks and reducing the # of images to review.

CDFW now has close to 30 million images in Wildlife Insights and **for the first time** is beginning to explore data across the organization.

Eyes on Recovery

Using Wildlife Insights to measure the impact of the 2019-20 bushfires on Australia's wildlife

Summer 2019-20 bushfires in Australia burned **19 million hectares** (>73,000 sq. miles)

3 billion animals impacted

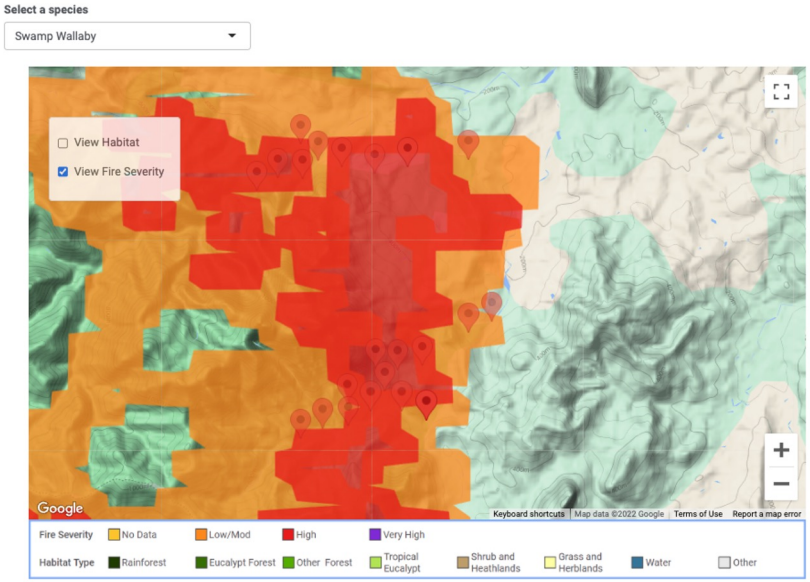
Unclear whether **species were recovering**

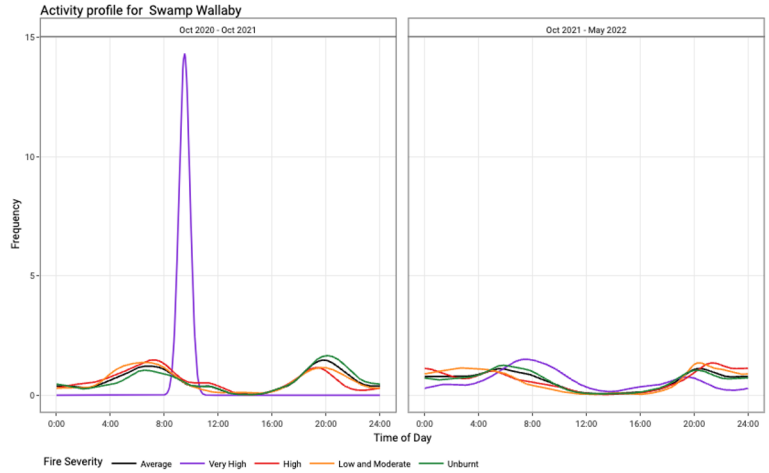
Wildlife Insights

WWF

CONSERVATION INTERNATIONAL

Google





18 partners set out **1000+ cameras**

3 million images collected to date

~500 hours of staff time saved per project location

Improving understanding of fire impacts on priority species; and **informing management actions**

Development

...much more than we can do!

Analytics launching in 2023 → State of Wildlife Report by CI

Offline desktop client

Model improvement experiments

- Embedding the taxonomic tree in the loss
- Penalizing errors based on the the taxonomic distance
- Ensemble meta-model learning
- Classification in cropped images / bounding boxes
- Weak-segmentation
- Incorporating visual confusion in the loss
- Attention-based sequence augmentation
- Per-region models
- Improved class balancing
- Model report card - per project diagnostics

White lipped peccary

White-lipped and collared peccaries (Tayassu pecari and Pecari tajacu, respectively) are primarily fruit-eating mammals in Neotropical rain forests. Recent studies have shown that their role as fruit predators and disperses affects the biodiversity of certain forest habitats.

The white-lipped peccaries (WLP) are the only rainforest ungulates which form large social herds (50-300 individuals), so their effects on forest habitats can be dramatic. Extirpation of either peccary species from a forest area would undoubtedly cause habitat alterations and additional biodiversity losses. READ MORE

Status


Mato Grosso, Brazil

Projected Business-as-Usual Land Needs

2010 - 2050

+40% Population Growth

+56% Crop Demand

+88% Beef/Lamb Demand

+68% Meat/Dairy Demand

+70% Wood Products Demand

+120 Mha
Expansion of Urban Areas

+400 Mha
Expansion of Pastureland

+ 200 Mha
Expansion of Cropland

WORLD RESOURCES INSTITUTE

Cropland decreased from 0.45 to 0.21 hectare per capita between 1961 - 2016.

#GeoForGood22

Land Cover is the Earth's basemap for science, policy and action.

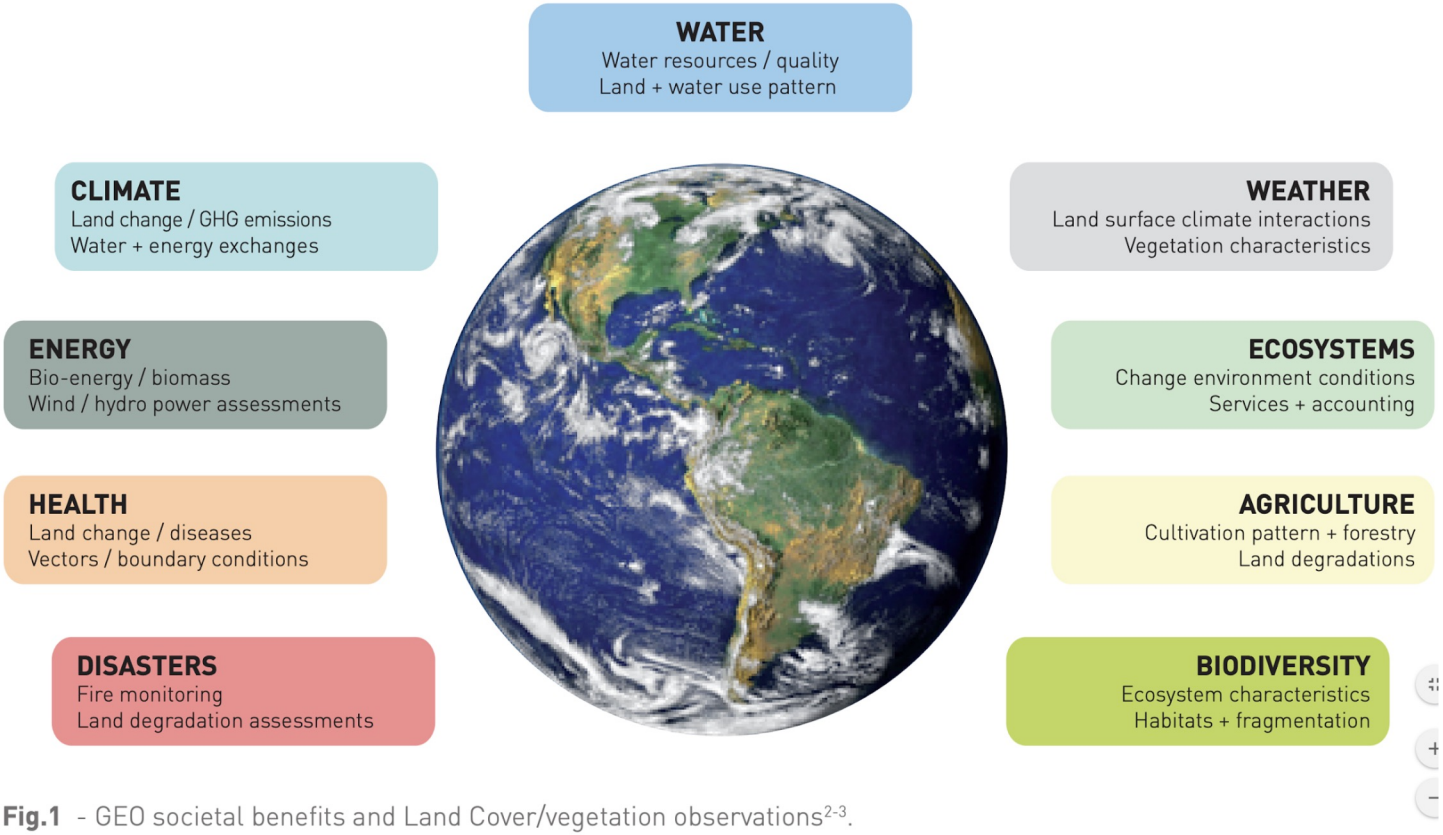


Fig.1 - GEO societal benefits and Land Cover/vegetation observations[2-3].

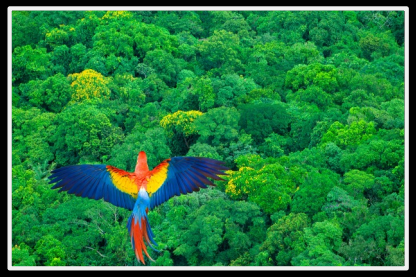
http://www.fao.org/3/a-i5232e.pdf

#GeoForGood22

Water

Flooded Vegetation

Built-up Areas



Trees

Crops

Bare Ground

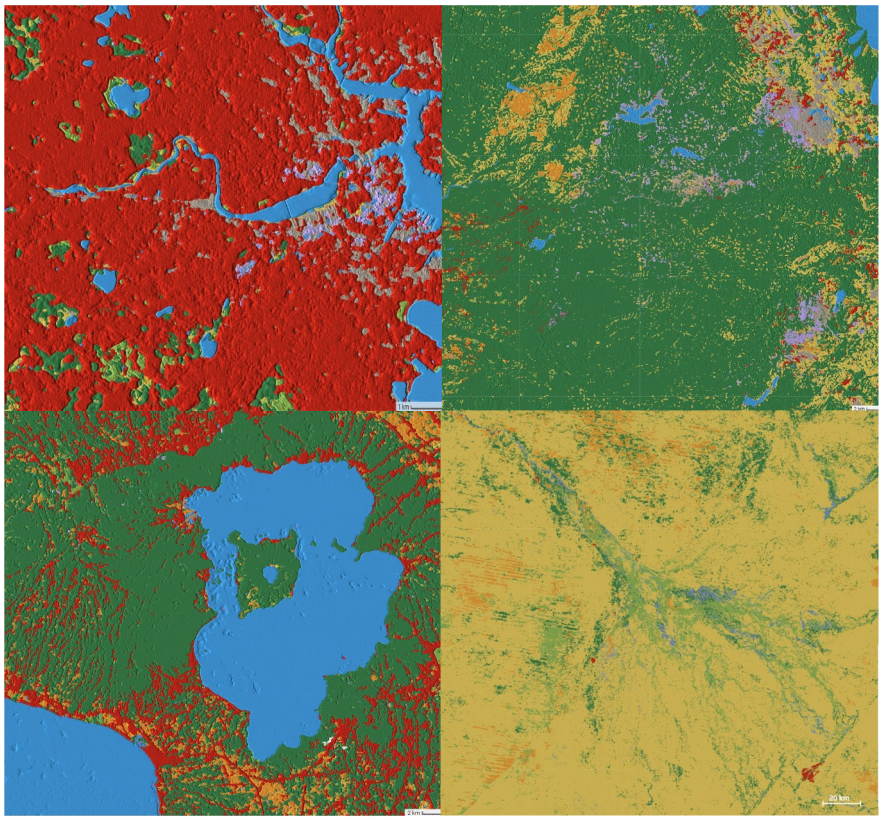
Grass

Shrub/Scrub

Snow/Ice

Google

Land Cover data just got real-time.



Google

Google WORLD RESOURCES INSTITUTE

Dynamic World

Data Product and AI Model

01 Global Land Use Land Cover Dataset

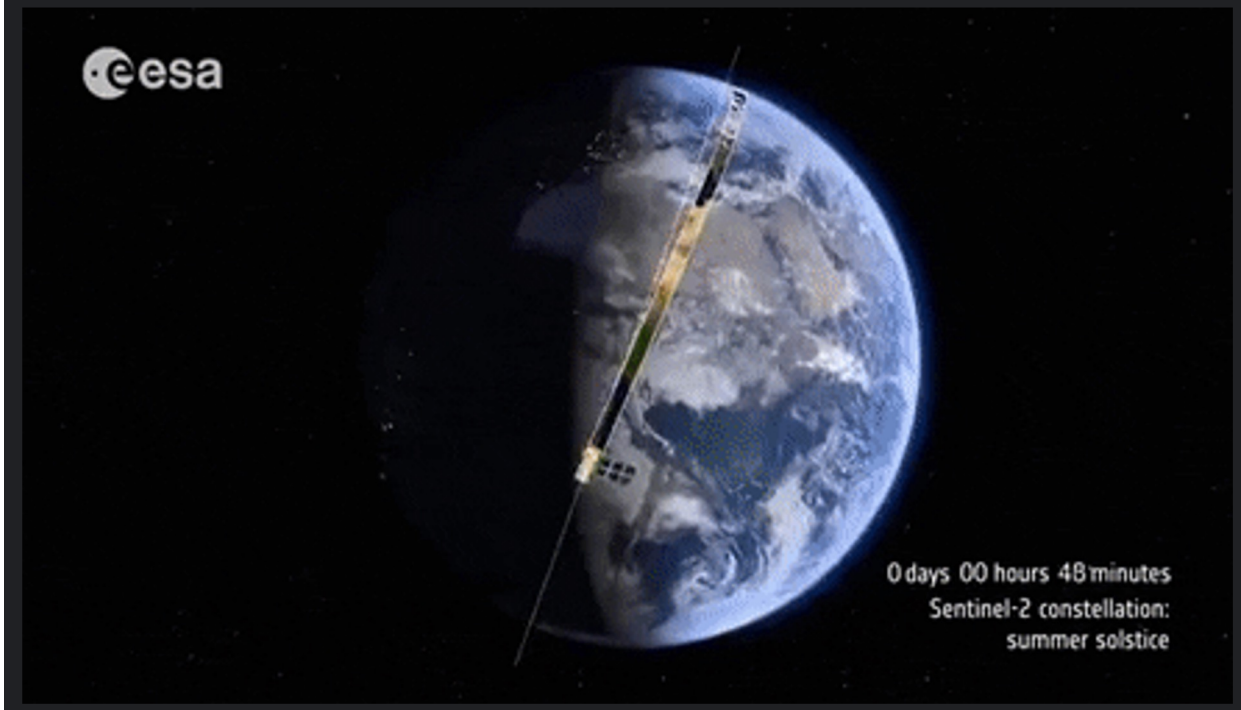
02 10m resolution based on ESA Sentinel-2

03 Near Real Time 2-5 day global availability

04 Free, Open License (AI model and dataset)

05 Peer reviewed scien

nature SCIENTIFIC DATA



Sentinel-2A & Sentinel-2B in orbit constellation

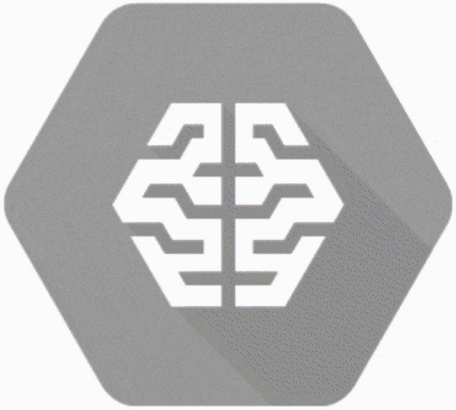
Sentinel-2

- S2A launched 2015, S2B 2017
- 10m spatial resolution
- 5 days revisit time
- 12 TBytes of data per day
- Open, full, and free data policy

- Dynamic World uses S2-L1C Top of Atmosphere (12 bands)

Source: European Space Agency

First we worked with NatGeo in labelling 24k Sentinel-2 scenes

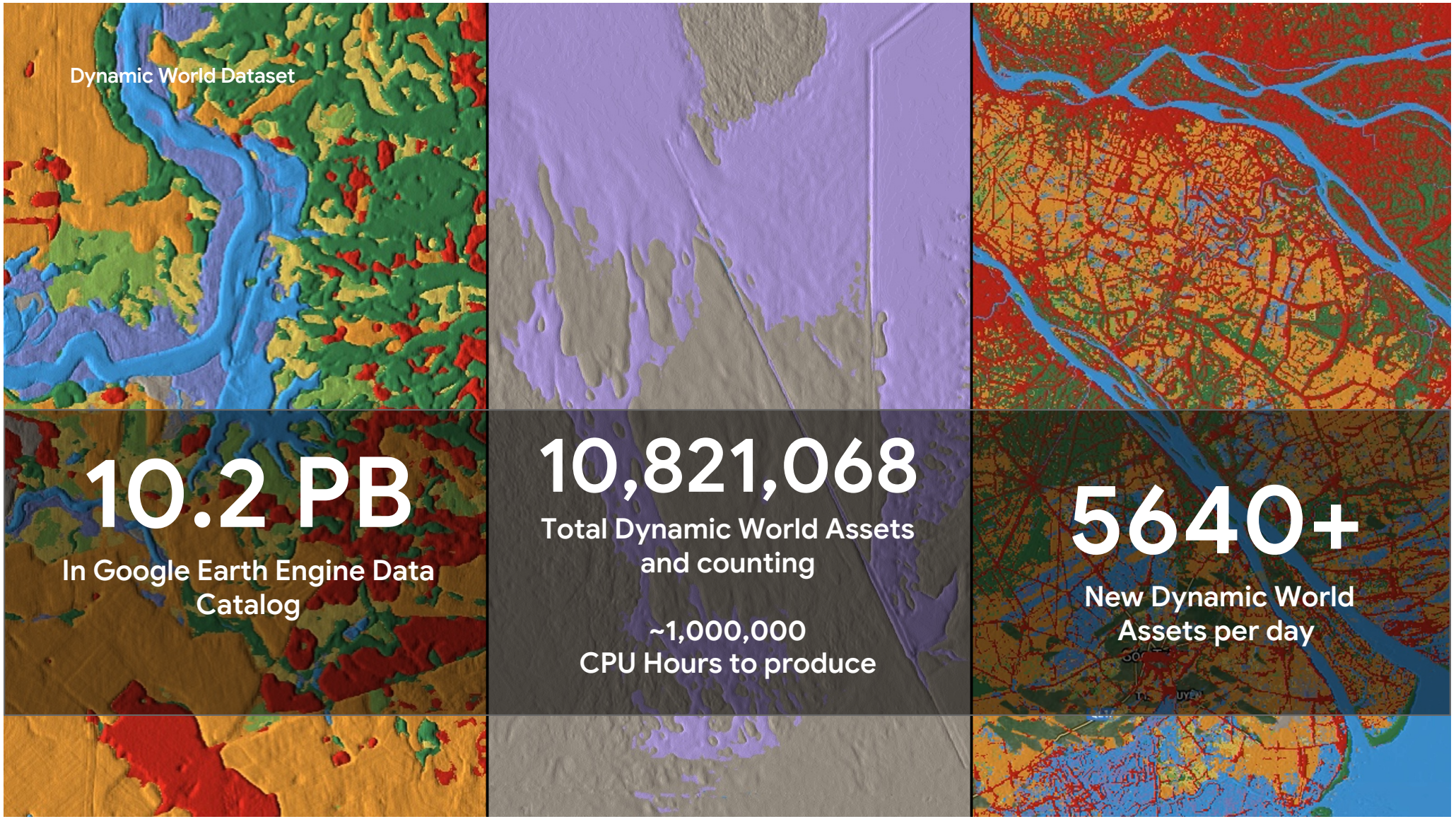


Google

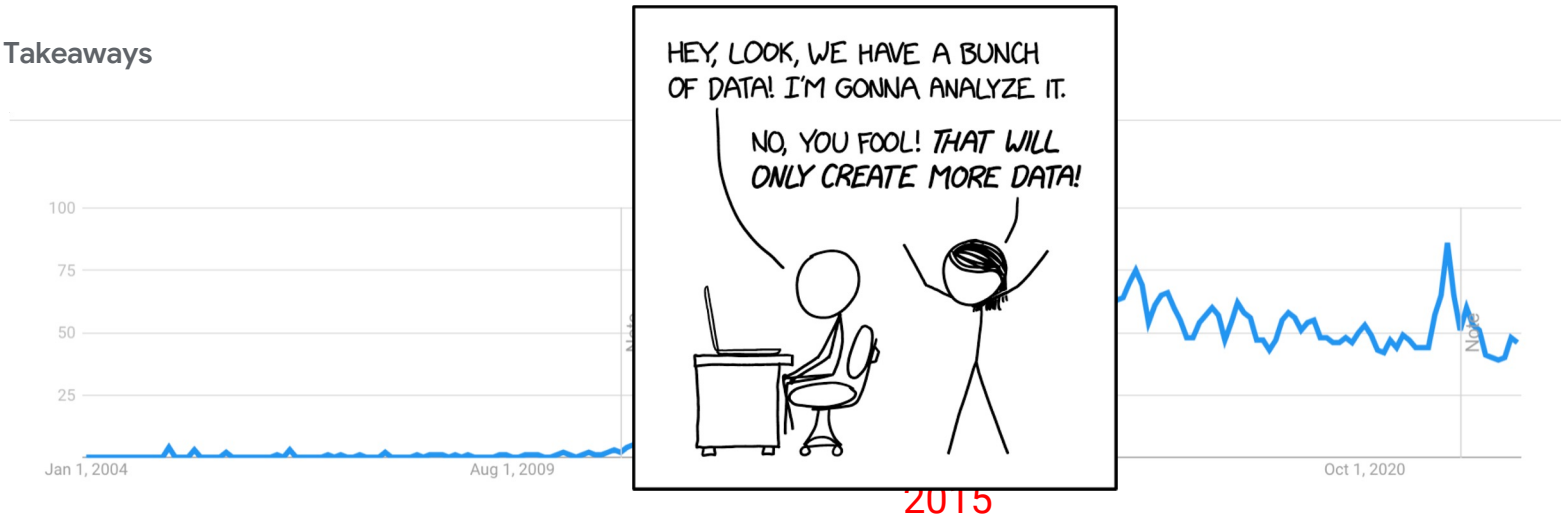
Then we ran the model backwards and forwards

Google

Dynamic World data available from June 23, 2015 to….2-5 days ago.


Dynamic World Dataset
10.2 PB
In Google Earth Engine Data Catalog
10,821,068
Total Dynamic World Assets and counting
~1,000,000
CPU Hours to produce
5640+
New Dynamic World Assets per day

The Takeaways



- Per-pixel **probabilities** across 9 classes
- Input for **derivatives**

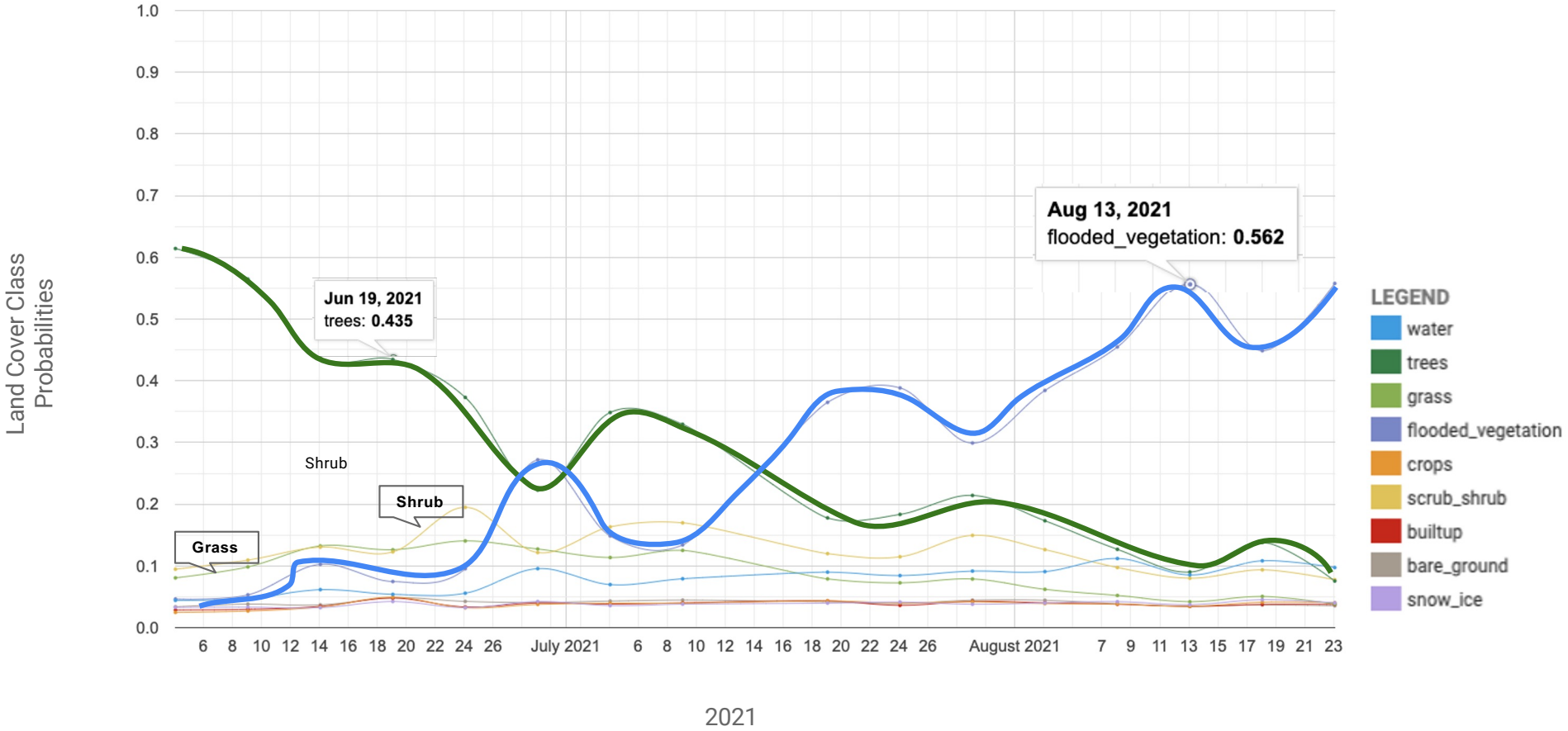
"Map with you, not for you"

Google WORLD RESOURCES INSTITUTE

Per-pixel **probabilities** across 9 classes

Water	0.04499815497547388
Trees	0.23571428004652262
Grass	0.0990055596921593
Flooded vegetation	0.03684693947434425
Crops	0.41711383406072855
Shrub/Scrub	0.04767815116792917
Built	0.04229519609361887
Bare Ground	0.03698766604065895
Snow/Ice	0.03931811661459505

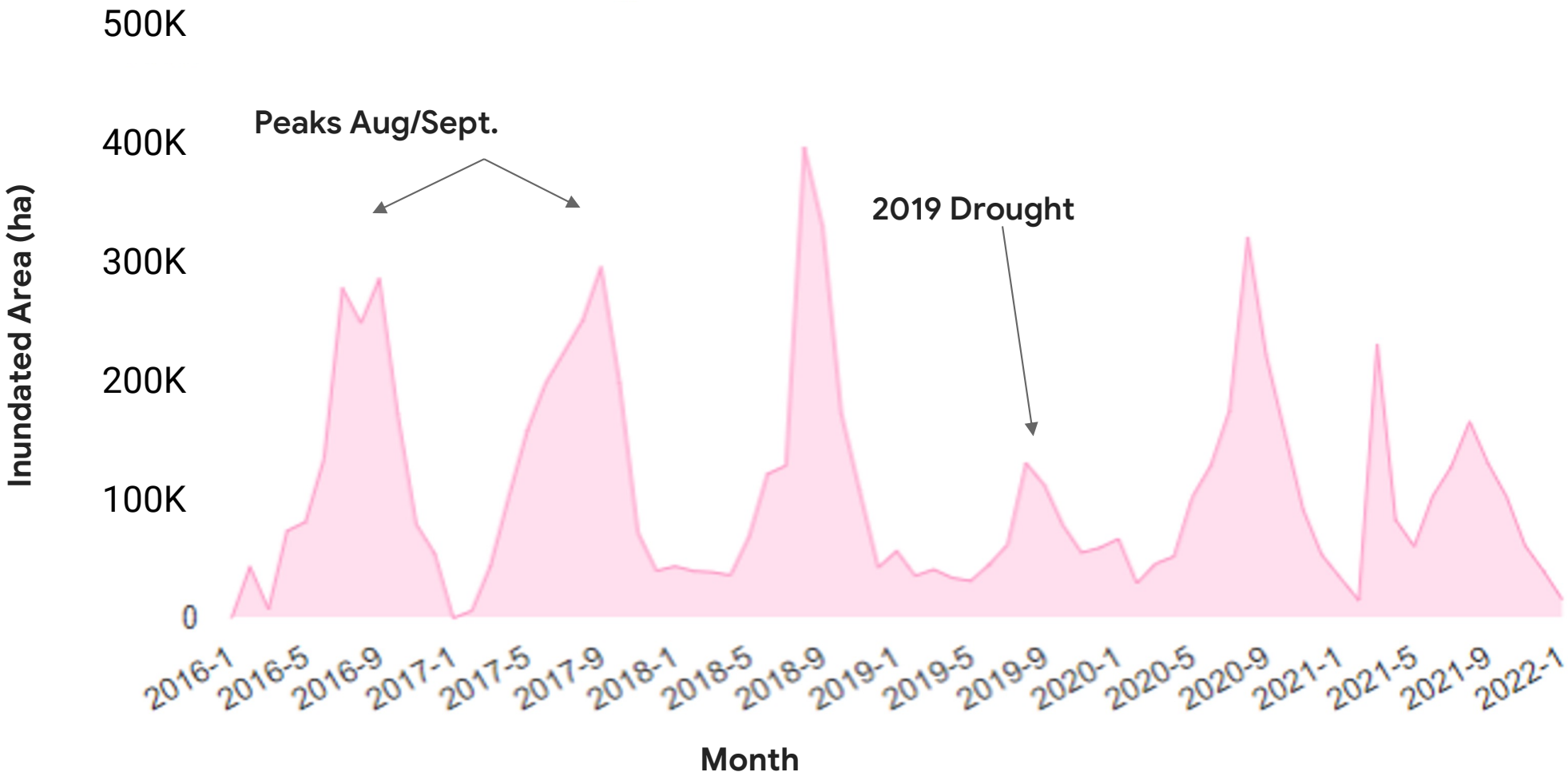

January



Google

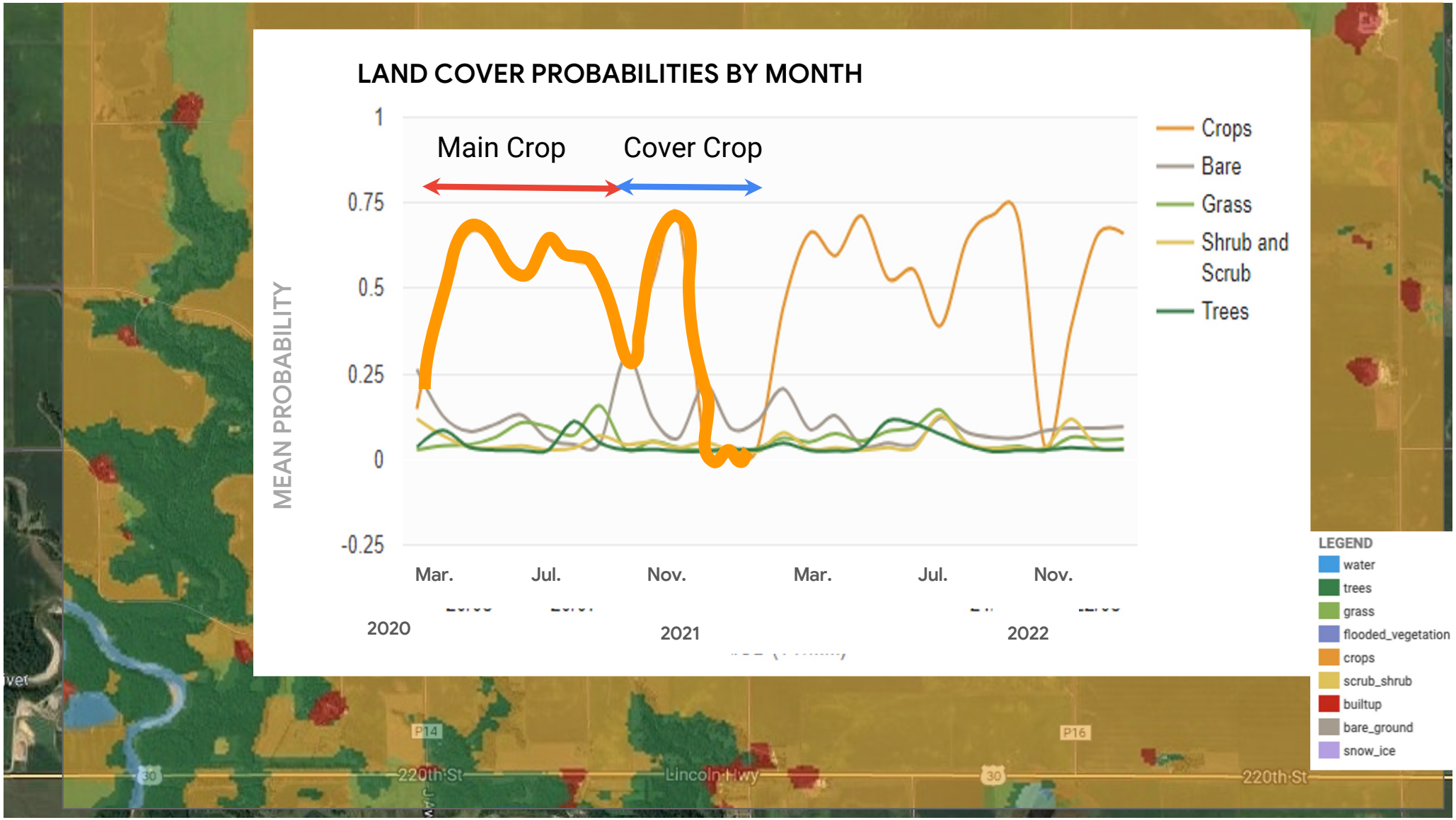
WORLD RESOURCES INSTITUTE

Inundated Area over the Okavango Delta



Google

WORLD RESOURCES INSTITUTE


LAND COVER PROBABILITIES BY MONTH
Main Crop
Cover Crop
MEAN PROBABILITY
1
0.75
0.5
0.25
0
-0.25
Mar.
Jul.
Nov.
Mar.
Jul.
Nov.
2020
2021
2022
Crops
Bare
Grass
Shrub and Scrub
Trees
LEGEND
water
trees
grass
flooded_vegetation
crops
scrub_shrub
builtup
bare_ground
snow_ice
P14
P16
30
220th St
Lincoln Hwy
30
220th St

S.1251 - Growing Climate Solutions Act of 2021

117TH CONGRESS
1ST SESSION

S. 1251

AN ACT

To authorize the Secretary of Agriculture to develop a program to reduce barriers to entry for farmers, ranchers, and private forest landowners in certain voluntary markets, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

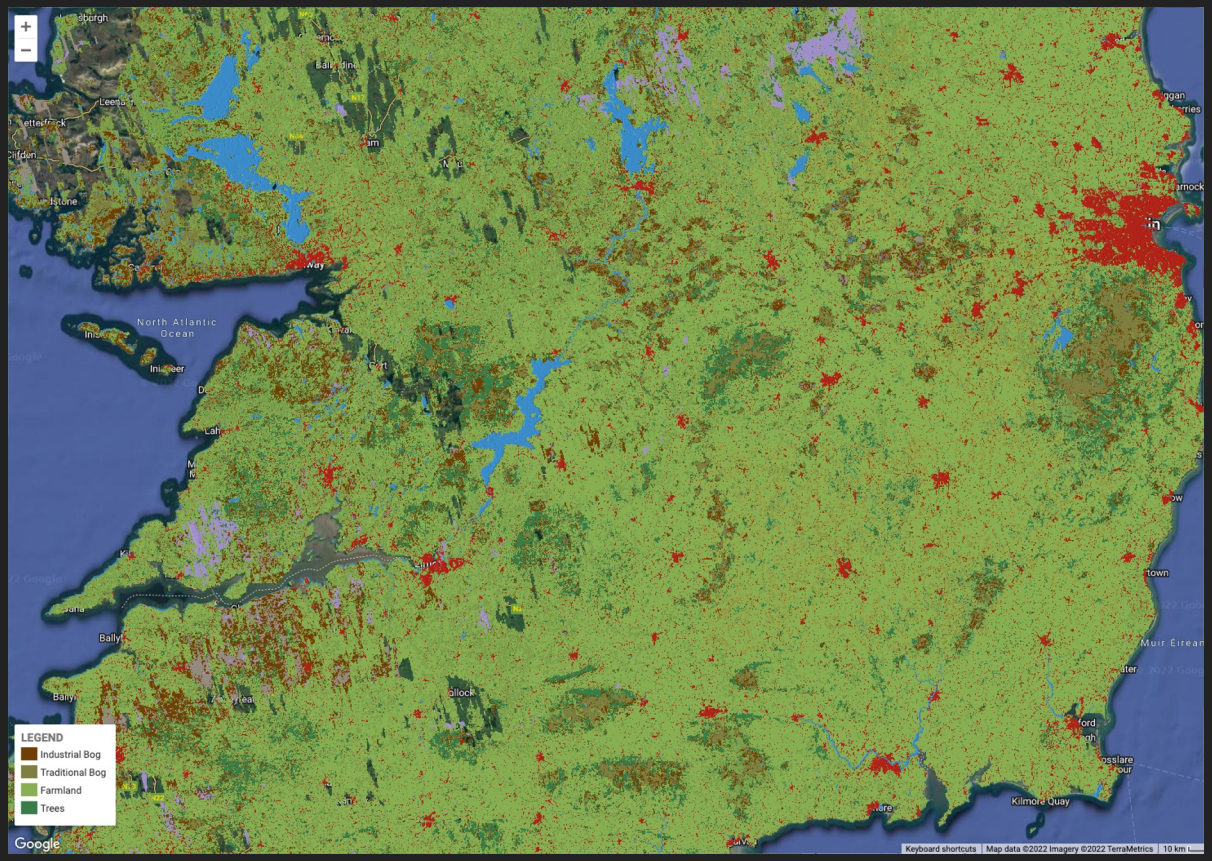
THE WHITE HOUSE

BRIEFING ROOM

FACT SHEET: President Biden Announces New Actions to Address Putin's Price Hike, Make Food More Affordable, and Lower Costs for Farmers

MAY 11, 2022 • STATEMENTS AND RELEASES

- **Increase the number of counties eligible for double cropping insurance.** Double cropping allows farmers to plant a second crop on the same land in the same year, helping boost production without relying on farmers to substitute crops or cultivate new land. But it is not free from risk and some farmers who practice double cropping cannot obtain crop insurance. The Biden-Harris Administration is seeking to expand insurance for double cropping to as many as 681 additional counties, bringing the total number of counties where this practice qualifies for crop insurance to as many as 1,935, so more American farmers have the financial security they need to start or expand double cropping.



Irish Peatbog Classifier

Oliver Guinan

- Ground-truthed data on traditional vs industrial peat bogs in Ireland
- Dynamic World as feature vector for Random Forests classification
- Derivative dataset
- EE Script

LEGEND
Industrial Bog
Traditional Bog
Farmland
Trees

Responsible Innovation

Following AI Principles at Google

Applying Ethical Principles

- WRI/Google team worked with independent consultant BSR to identify risks
- Designed safeguards to minimize risk
- Collaboration with ally organizations (WRI) to address potential harm.
- Open science & open data

Learn more

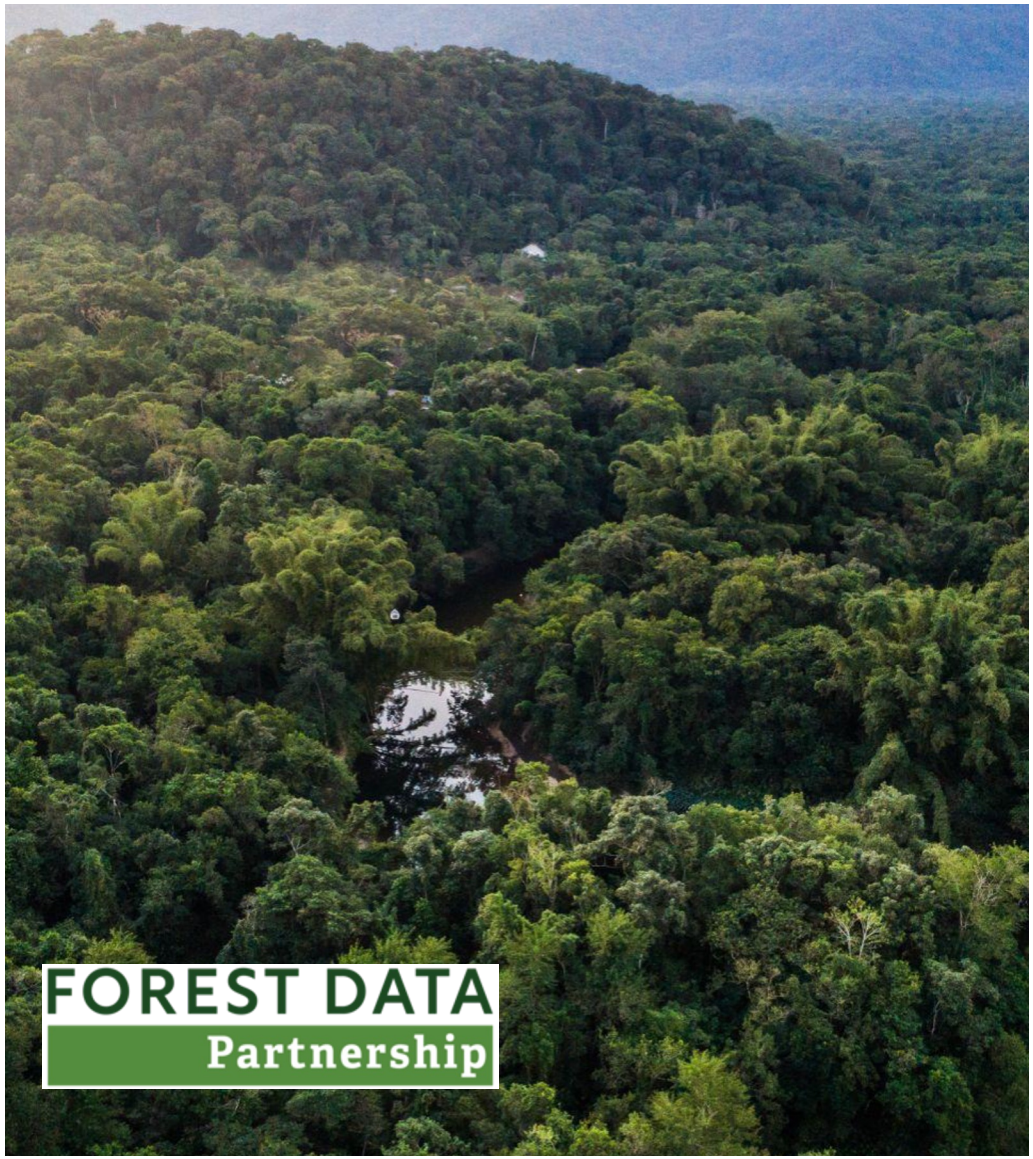
- Google I/O Talk
- Case Study

Forest Data Partnership

End commodity-driven deforestation and accelerate restoration

The Forest Data Partnership strengthens collaboration and application around global monitoring of commodity-driven deforestation, forest degradation and restoration efforts across the globe.

forestdatapartnership.org



What we hear people ask for.

Related to forests, nature, biodiversity

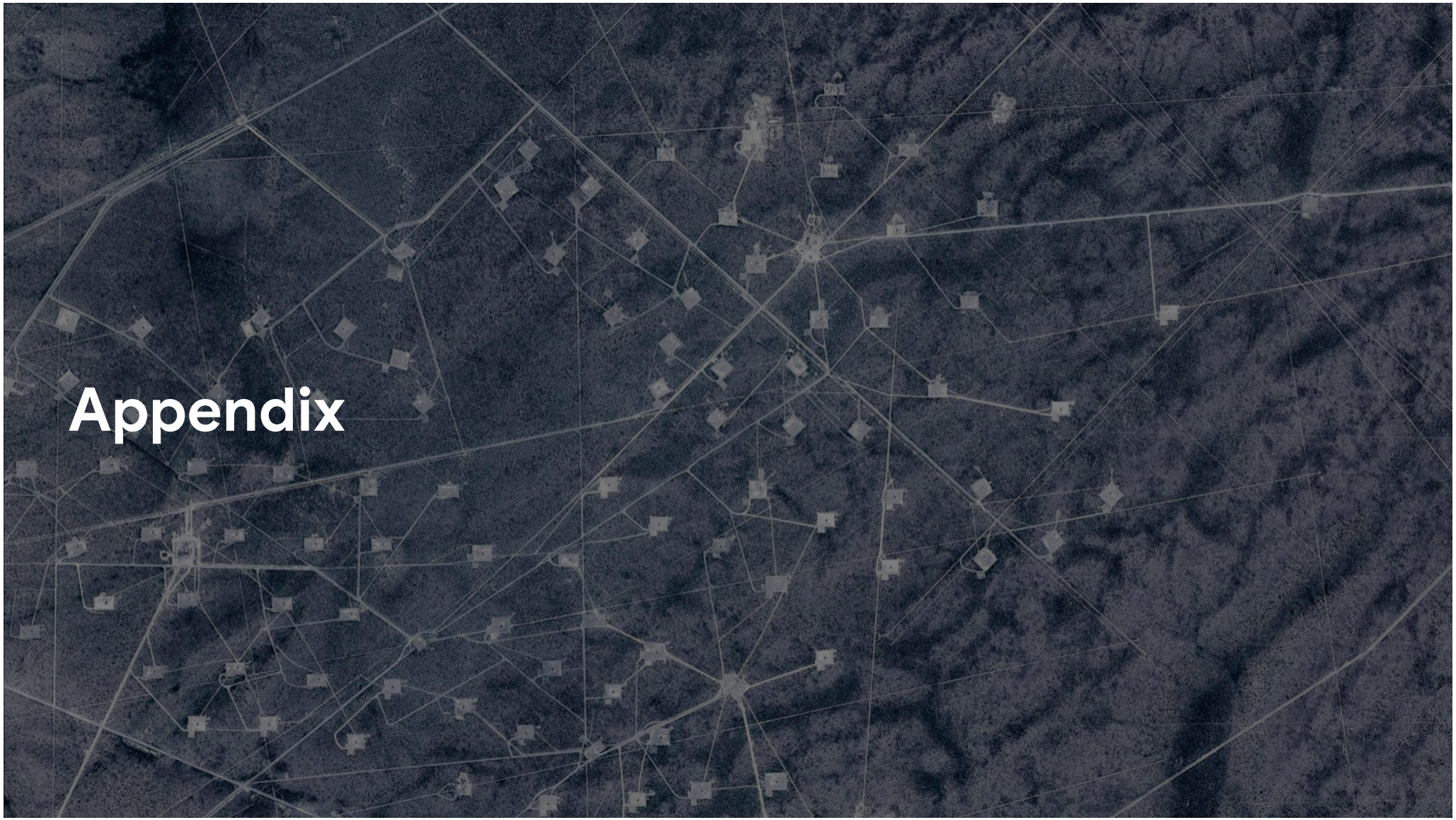
Mapping Forests

- Forest / plantation NRT
- “I want to map ____”
- Deforestation Risk Modeling
- Reforestation
- Forest species composition
- Groundtruth data (carbon, crops, everything)
- Smallholder farmer incentivization

Biodiversity

- All the sensors! Acoustic → Soundscapes, eDNA, cameras, drones, and and and.....platforms!
- Species risk modeling


Thank you!


Appendix