Gainforest

Measuring and Rewarding Nature's Biodiversity with AI and Web3

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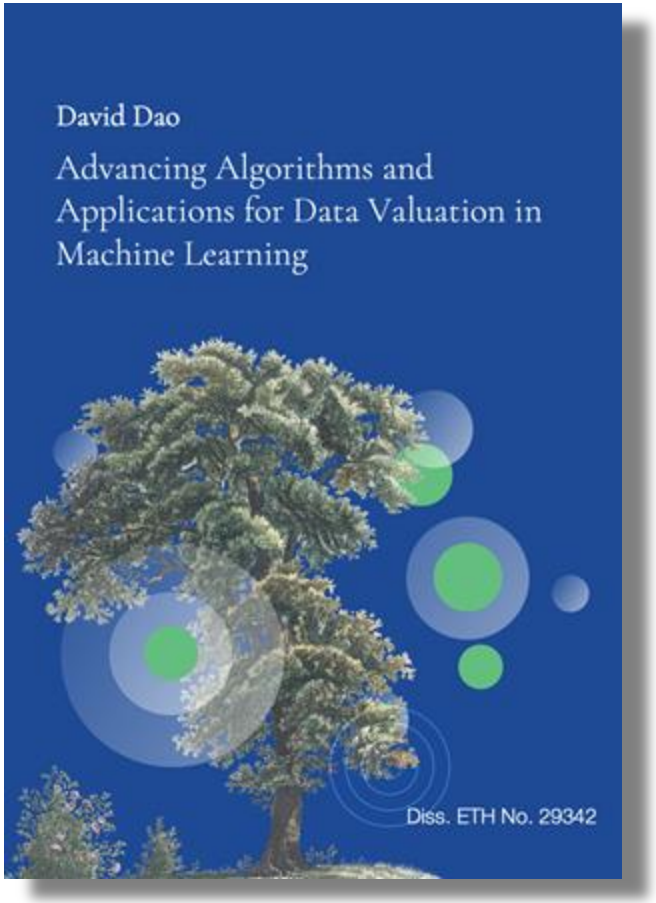
gainforest.earth

Listen


SUPPORTING
PROVISIONING
CULTURAL
REGULATING
Ecosystem Services
What Nature provides us for free
Food
Soil Formation
Photosynthesis
Biodiversity
Habitat
Stewardship
Aesthetic
Recreation
Education
Clean Air
Store Carbon
Purify Water
Control Flooding
Cool Temperatures
Pollination
Wood
Fish
Clean Water

About



Proposes *a principled framework for data valuation based on the Shapley value*

Develops *an efficient algorithm for computing the exact Shapley values for unweighted KNN classification*

How should we distribute $X to each data point to reflect its "value"?

The big idea: should other species have their own money?

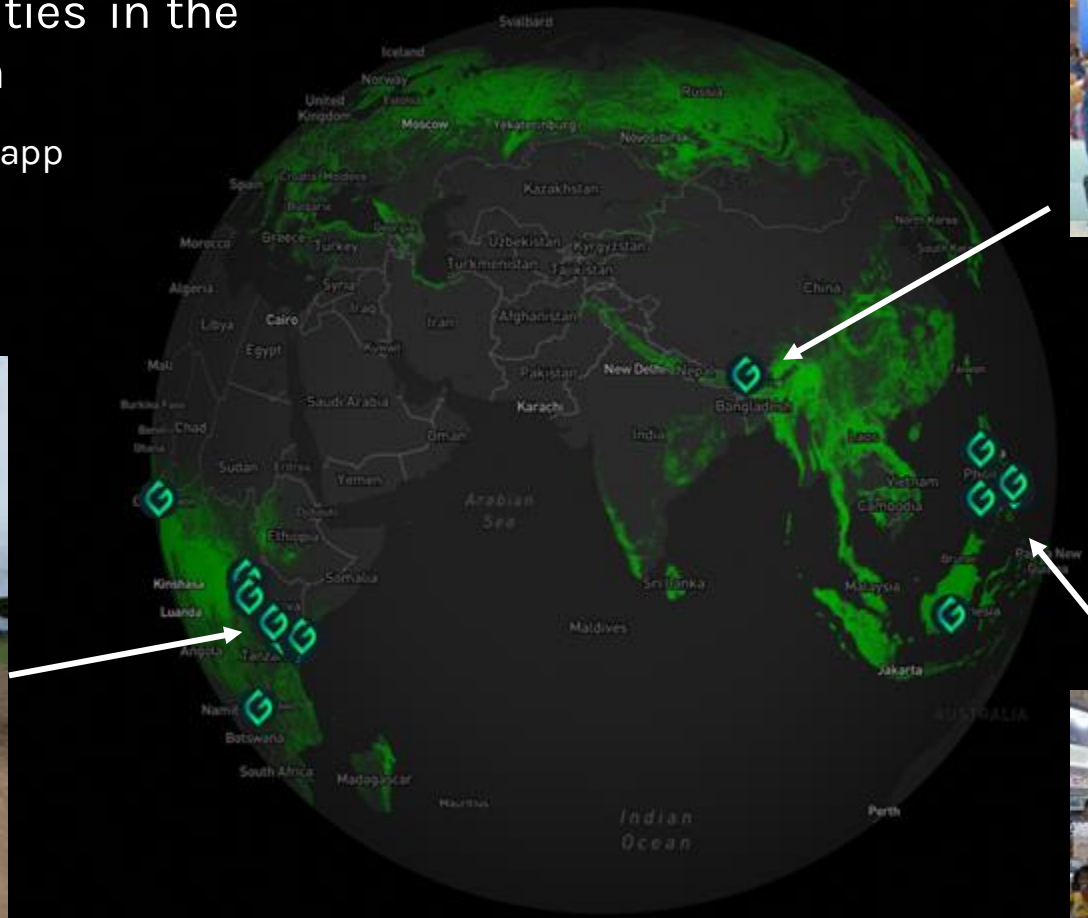
Are digital wallets for orangutans and a 'Bank for Other Species' harebrained fantasies, or genius ways to boost conservation funding?

About Gainforest

27 Communities in the Global South

maps.gainforest.app

Kenya



Bhutan

Philippines

EcoLabs
Colombia

Koko Dao
Colombia

Saving-planet
Kenya

Search for projects or country

Biodiversity Predictions

Predicted distribution of species habitats within 150km of the project area.

Predicted Birds

Yellow-Quilled Leafbird

Chloropsis flavipennis

Vulnerable

Steere's Pitta

Pitta steerii

Vulnerable

Celestial Monarch

Hypothymis coelestis

Vulnerable

ID:
1l13lk3MG_-uZAenAqLlp0EqvCwDOlgoL

Species: Rhizophora Apiculata
Plant height: 7.5m
DBH: 18.4cm

light mode | satellite mode | land cover off | tree cover

Satellite imagery date (Tropical regions only): **June 2023**

Listen again 😭


Co-Benefits?

We can’t value what we can’t measure

And we are failing to capture nature’s contributions

ETH *BiodivX*

$10M XPRIZE Rainforest Finalist

Join our Citizen Science

About *us*

Our experiences span cultural, artistic, scientific, and social science backgrounds - from inventing ways to sequence DNA from air to influencing and negotiating multilateral conservation agreements to working on the frontlines of human health connections and biodiversity.

We are team ETH BiodivX and we enter this competition as if it were no different than our daily work, because in fact, we have all dedicated our careers to solving the technical and environmental challenges of our time.

XPRIZE RAINFOREST | alana

The XPRIZE

01 About the $10M XPRIZE Rainforest

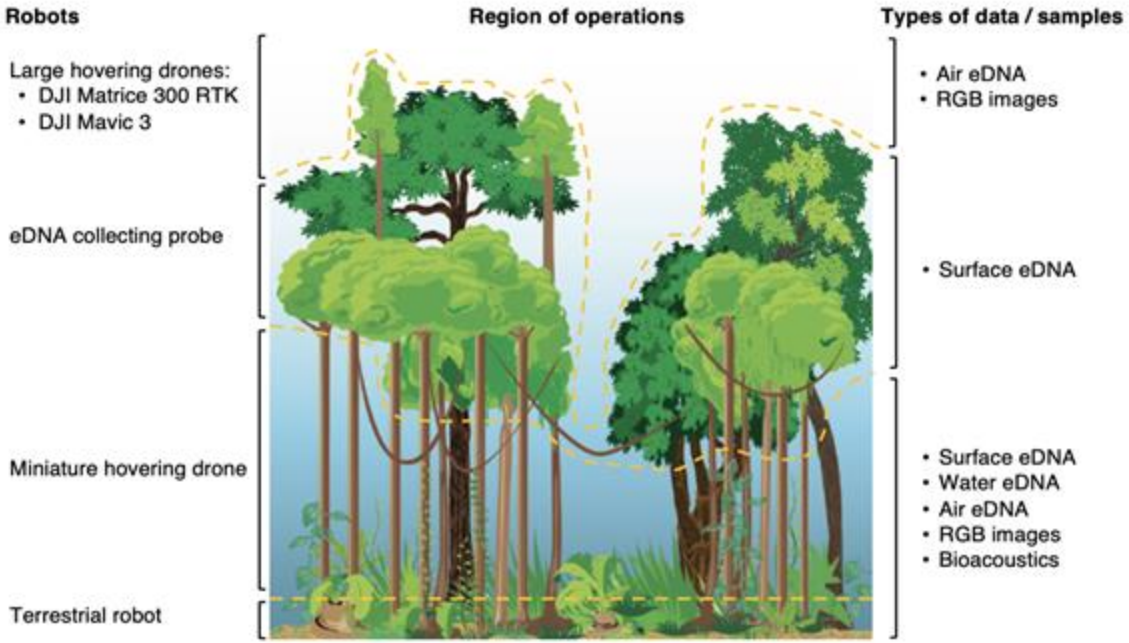
The $10M XPRIZE Rainforest is a five-year competition to accelerate the innovation of autonomous technologies needed for biodiversity assessment and to enhance our understanding of rainforest ecosystems.

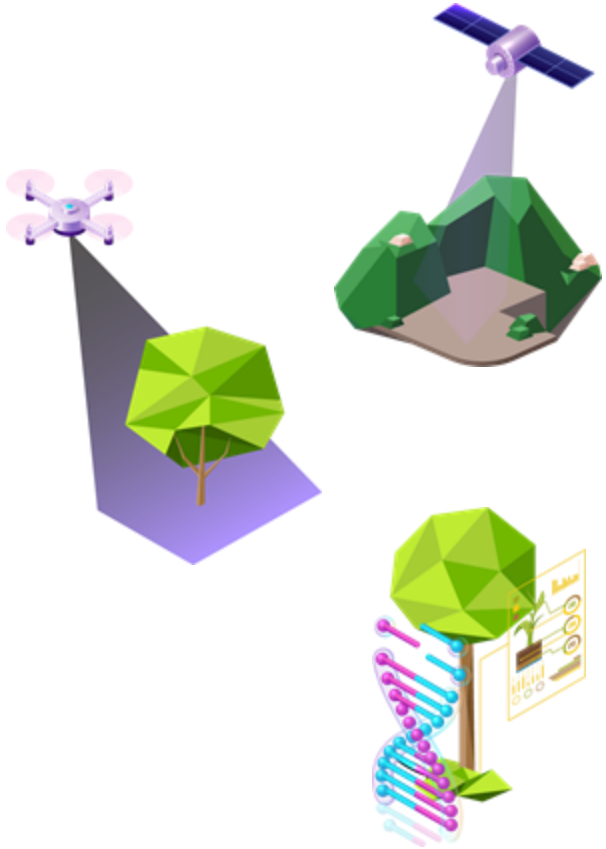
02 Our Solution

We collect large amounts of eDNA, images and sounds through autonomous drones and rovers - and analyze the data through a live dashboard, advanced AI algorithms and a global community of Indigenous citizen scientists.

Survey area in Central Catchment Nature Reserve
June 5 and 6, 2023

Data Sampling Strategy





Challenge:
Machine Learning applications for nature are
under-researched

Utilize multi-modal imagery sources

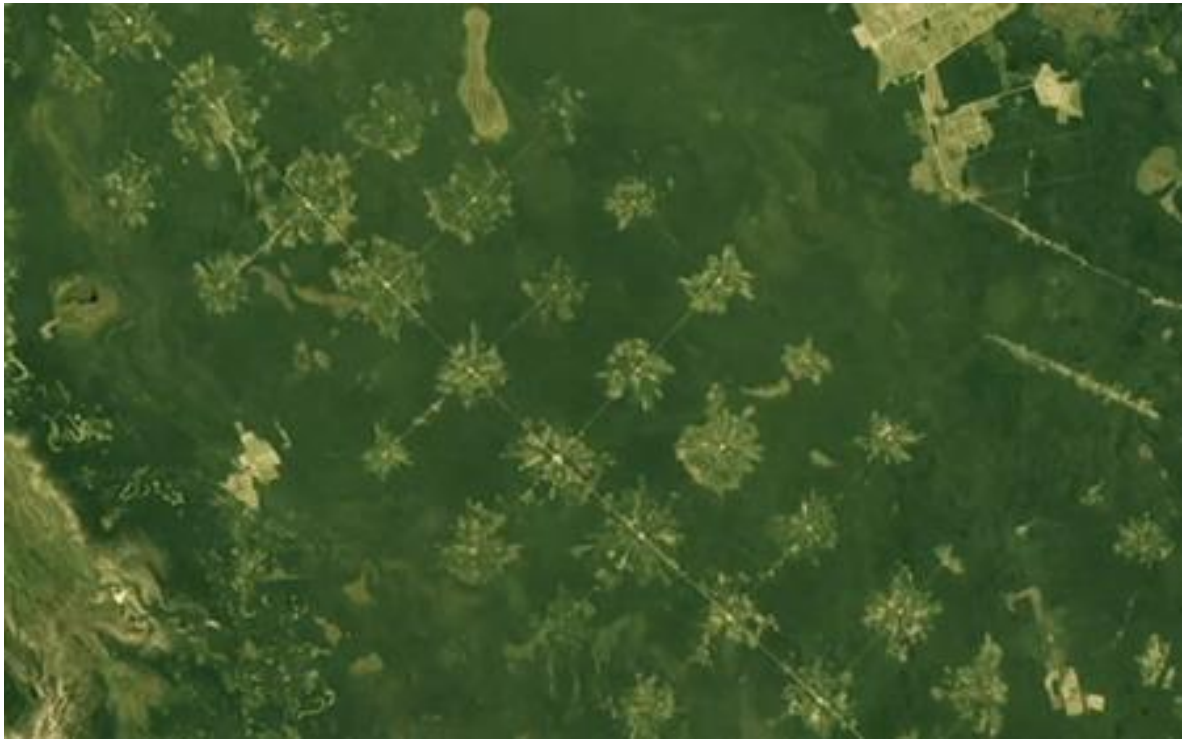
Left: Public data (Sentinel-2, LANDSAT-8)
>10m/px

Right: Commercial data (Planet Labs, MAXAR)
>50cm/px

Challenges:
Different sensors, reference systems, access levels and temporal info

Estância Shalom, Brazil

Utilize large time series

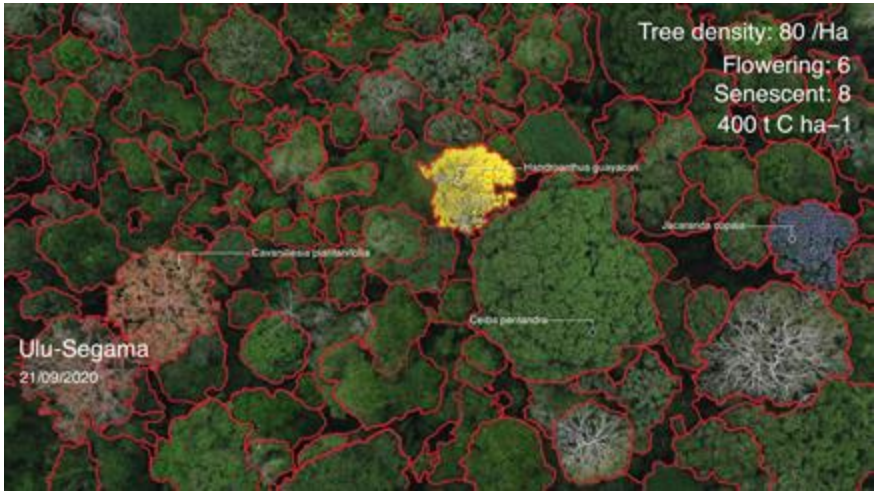


Challenges:

Largely unlabeled data:
E.g. deforestation exhibits visually recognizable patterns

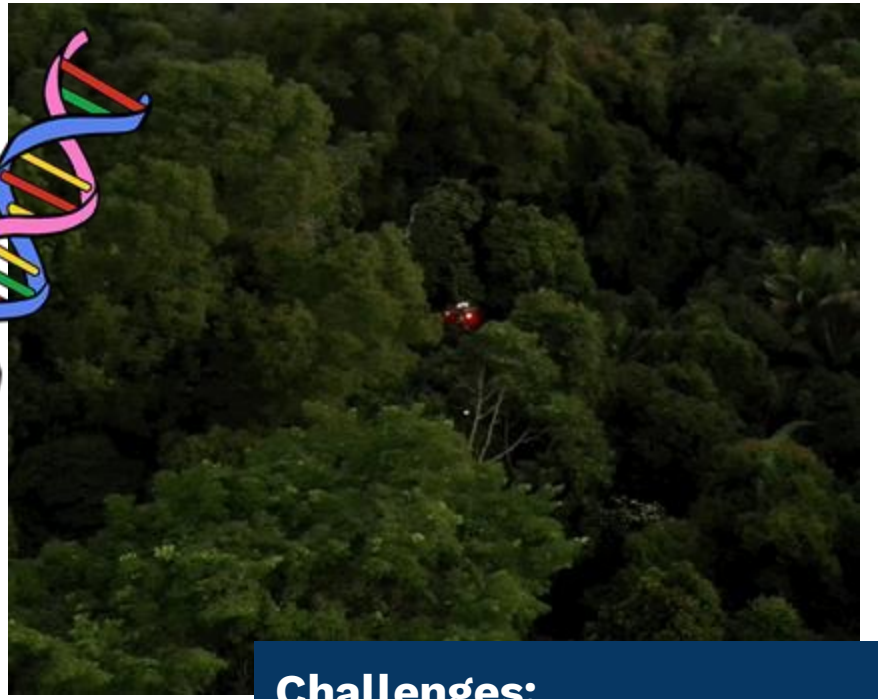
Irregular temporal steps:
Visual data depends on satellite revisiting rate and cloudfree image

Drone-Based Biomass Estimation



Challenges:
Limited labeled data for model training

Drone-Based Environmental DNA Sampling



Sample Strategies:
eDNA through water filtration
eDNA through surface collection
eDNA through air filtration

Challenges:
Collecting enough eDNA
Dense Canopy

Work from our collaborator Prof. Stefano Mintchev and Prof. Kristy Deiner

Drone-Based Biodiversity Measurements

Challenges:
Difficult Terrain
Network Connection

Work from our collaborator Prof. Stefano Mintchev in “Environmental Robotics”

The satellite-based estimates significantly overestimates AGB density by a factor of 10

- The AGB density (kg/ha) per polygon was overestimated for **all of the 6 sites** with a factor ranging up to 10 times the field data

Site no.	Ground Truth	Filtered	Over estimation
1	19	176	×9.2
2	27	160	×5.9
3	24	47	×2.0
4	24	62	×2.6
5	17	19	×1.1
6	29	141	×4.9

"Tackling the Overestimation of Forest Carbon with Deep Learning and Aerial Imagery"
Reiersen, Dao *et al.,* CCAI ICML 2021

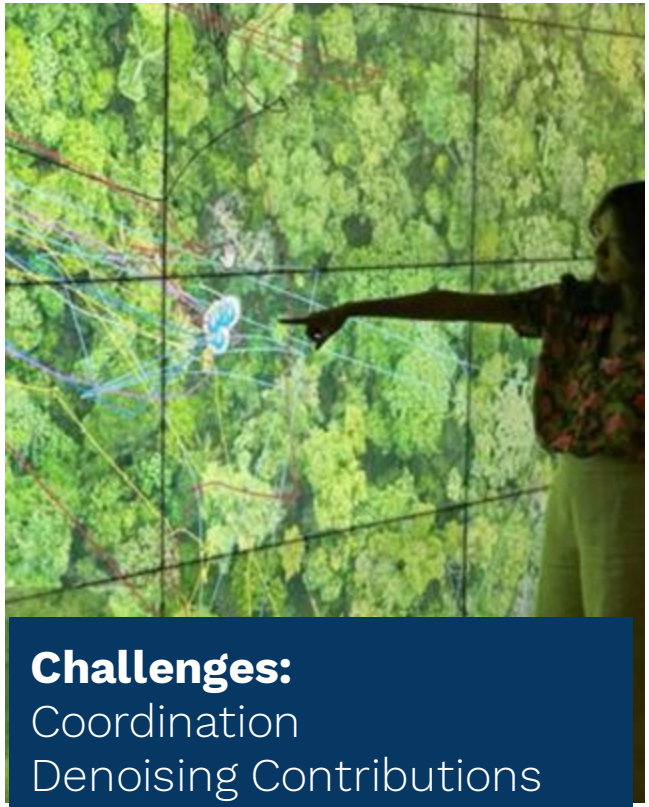
The crucial role of Indigenous communities in MRV

Participatory Mapping

Strategy Games

Citizen Science + AI

We encouraged our local community citizen scientists to share a selfie while labelling and rewarded them 1 USD for participating in our two days workshop. They were from Kenya, Philippines, Argentina, Malaysia, Singapore, India, Indonesia, Uganda and many more countries.



Challenges:
Coordination
Denoising Contributions


Number of citizen scientists that identified at least one species: 30

Thank you!

Follow us on

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@gainforestnow

Appendix

More research, etc …

Challenge

Automated forest validation opens up possibility of *untruthfully* reported imagery

Attack vectors

Reported Land-Use

true time
true location

Detected Forest Cover

medium

wrong time
true location

high

true time
wrong location

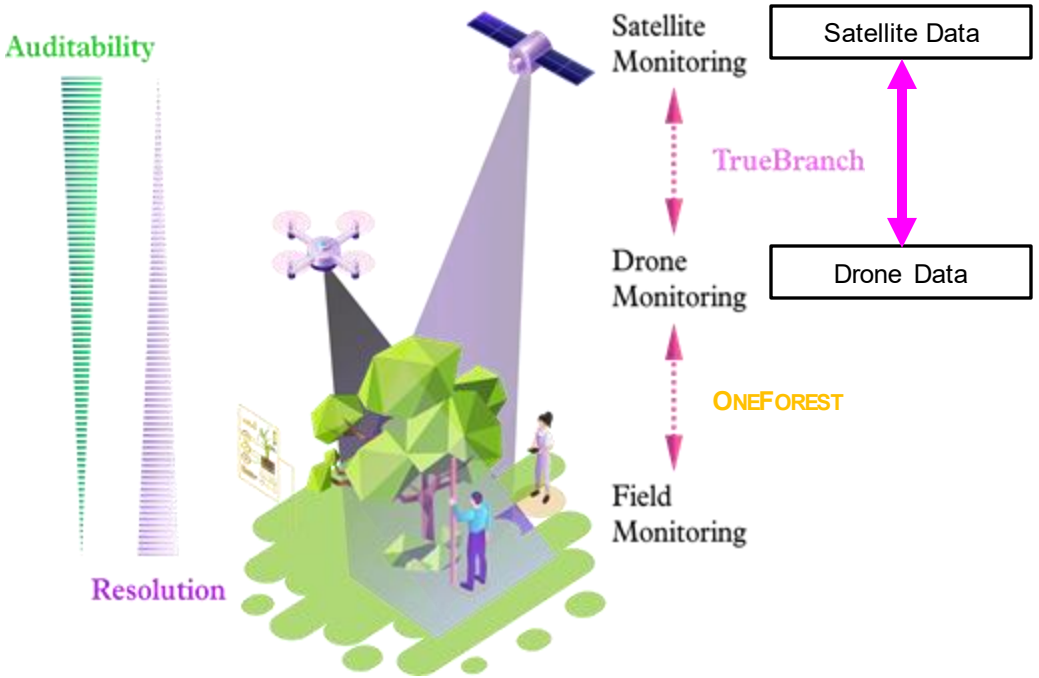
high

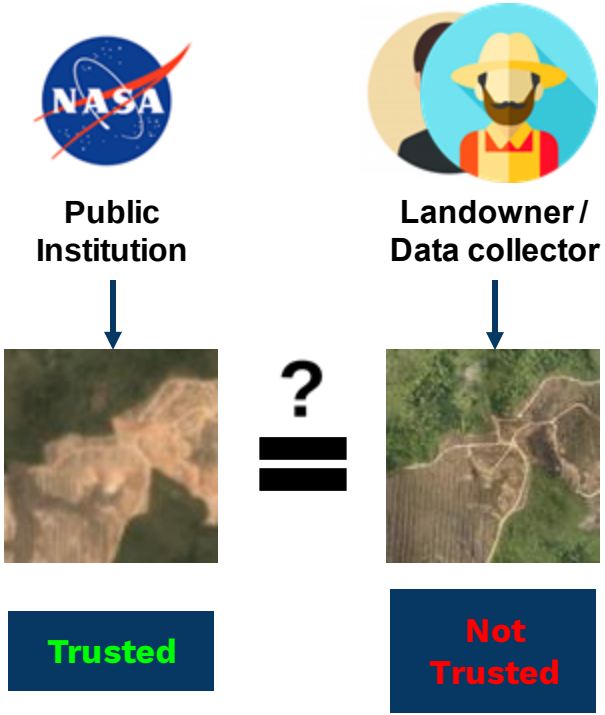
modified image

high

Simona Santamaria*, David Dao*, Björn Lütjens*, TrueBranch: Metric Learning-Based Verification of Forest Conservation Projects, 2020 ICML Workshop (CCML), *equal contribution, https://arxiv.org/abs/2004.09725

Novel opportunities through data fusion

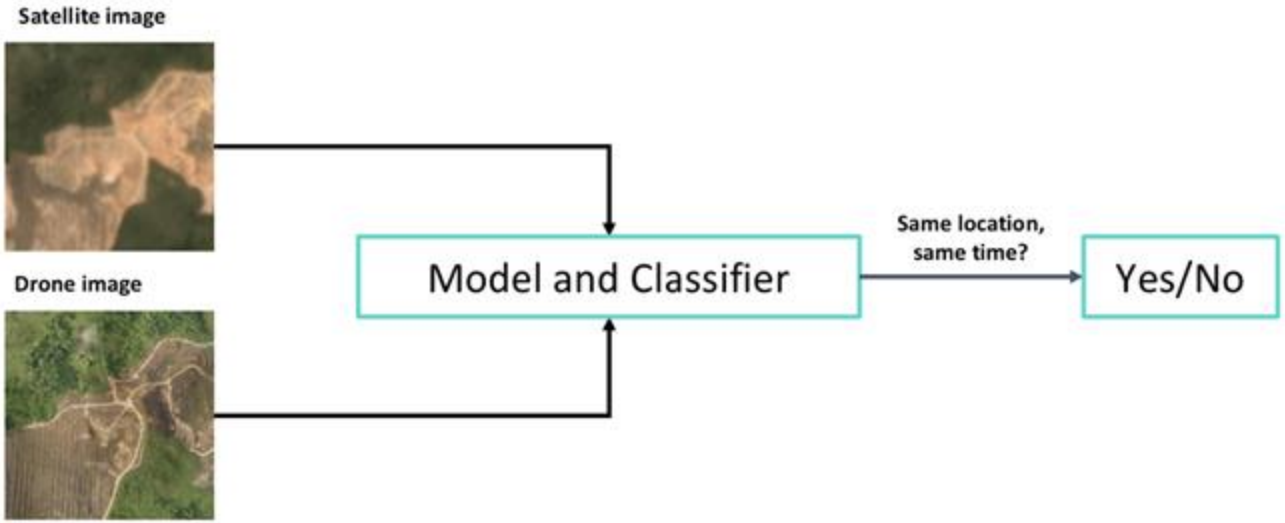




Classifying truthfulness

How to distinguish truthful imagery from untruthful imagery?

- Image Registration: Matching Drone images with Satellite images



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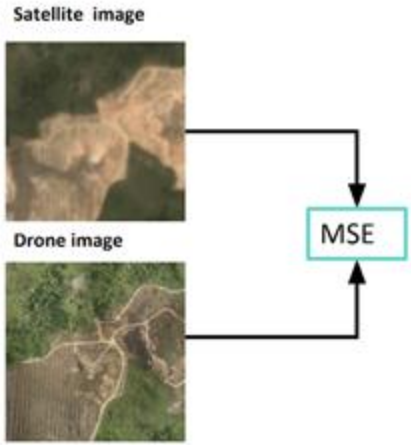
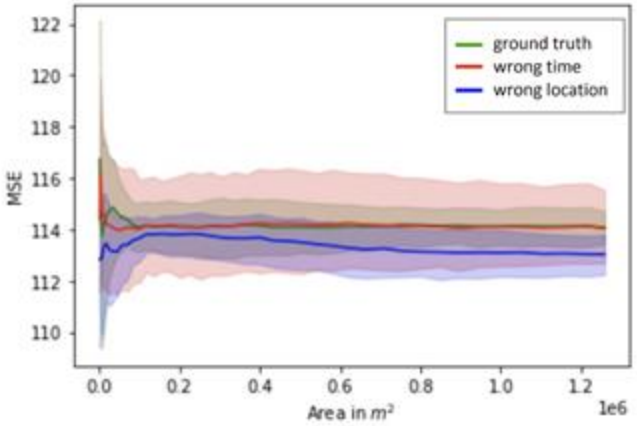
Classifying truthfulness

- Nominal distance metrics of MSE in pixels space



$$MSE = \frac{1}{mn} \sum_{i=0}^{n-1} \sum_{j=0}^{m-1} [A(i,j) - B(i,j)]^2$$



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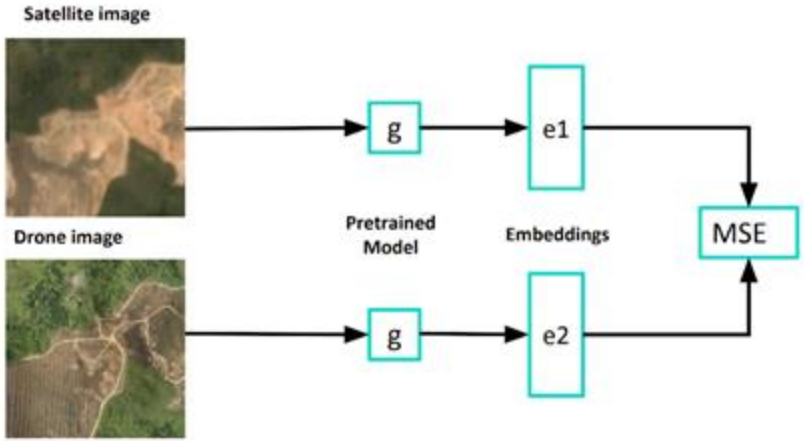
Classifying truthfulness

- Nominal distance metrics of MSE in feature space



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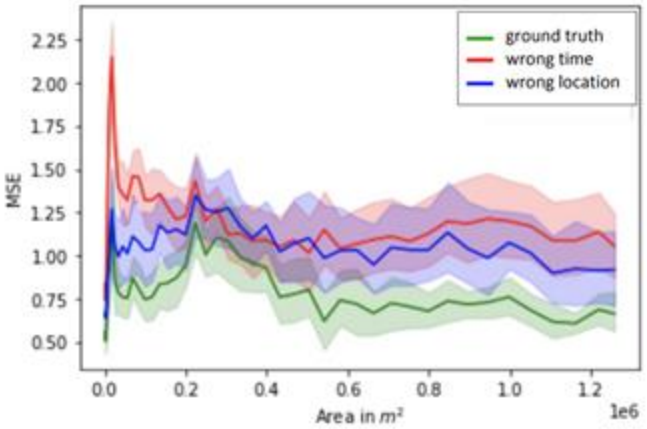

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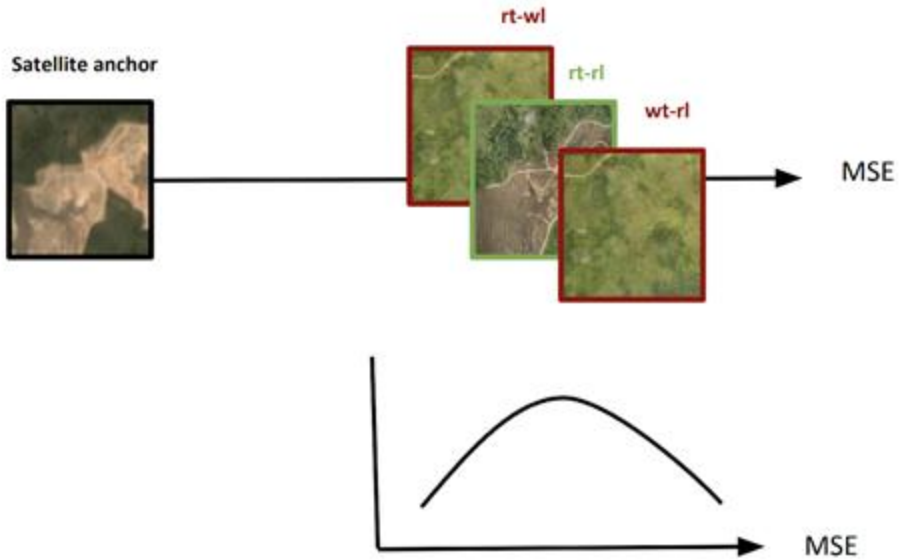
Classifying truthfulness

- MSE in pixel space and RESISC-45 feature space not sufficient



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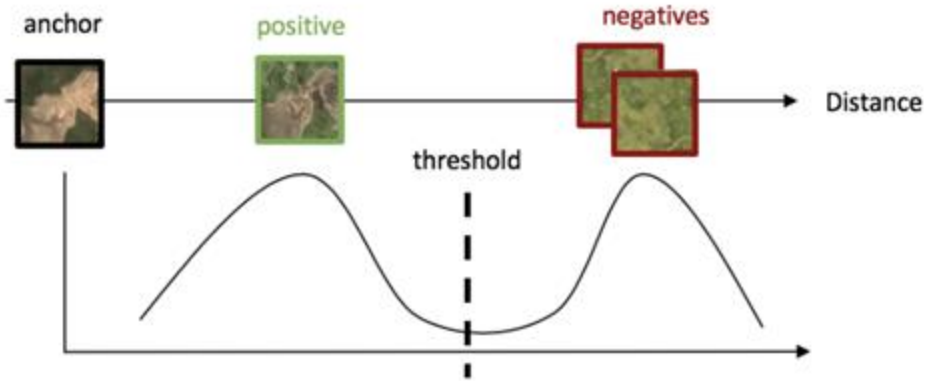
Metric Learning

The distance between the anchor and positive image is decreased while the distance between the anchor and negative image is increased.



$$L(a, p, n) = max(|f(a) - f(p)|^2 - |f(a) - f(n)|^2 + \alpha, 0)$$

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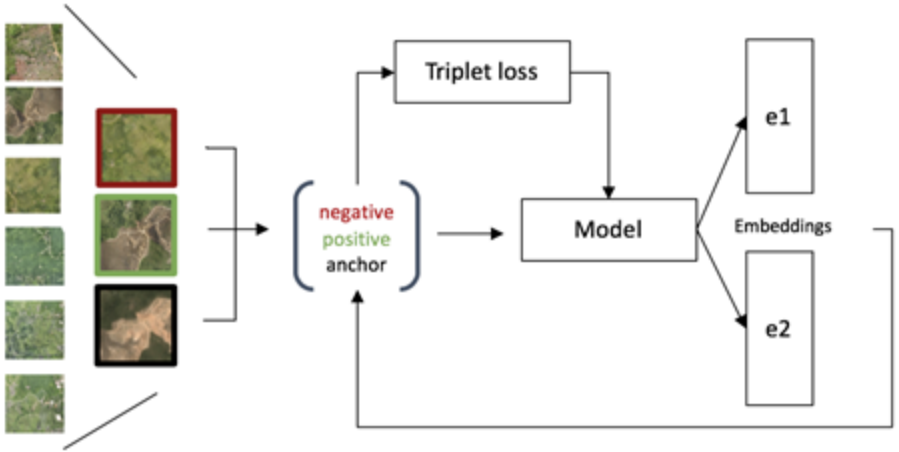
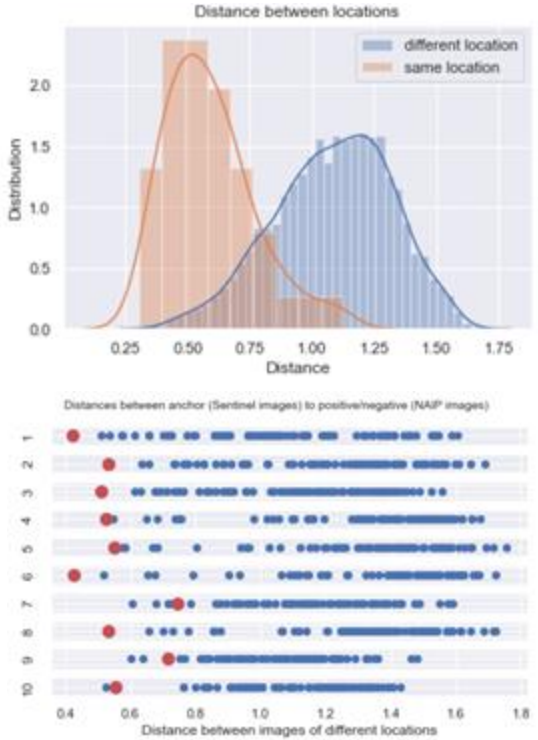
TrueBranch: Metric Learning-based Verification





TrueBranch enables the verification of truthfully reported drone imagery from untrusted parties

Simona Santamaria*, David Dao*, Björn Lütjens*, TrueBranch: Metric Learning-Based Verification of Forest Conservation Projects, 2020 ICML Workshop (CCML), *equal contribution, https://arxiv.org/abs/2004.09725