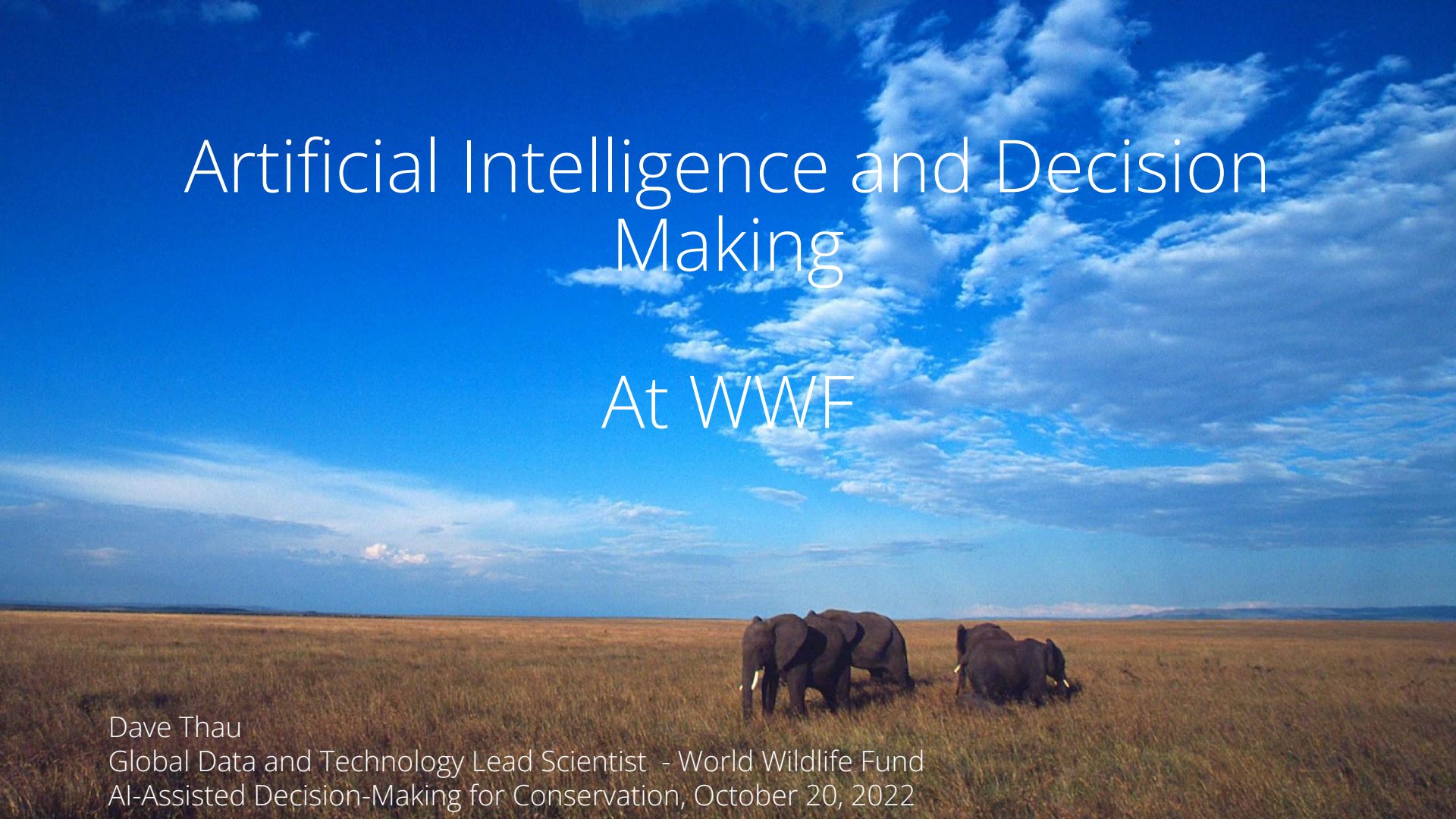

WWF

Artificial Intelligence and Decision Making

At WWF



Dave Thau
Global Data and Technology Lead Scientist - World Wildlife Fund
AI-Assisted Decision-Making for Conservation, October 20, 2022

WWF works in 100 countries around the world

Algeria Argentina Armenia Australia Austria Azerbaijan Belgium Belize Bhutan Bolivia Bosnia Herzegovina Brazil Bulgaria Cambodia Cameroon Canada Central African Republic Chile China Colombia Comoros Croatia Cuba Democratic Republic of Congo Denmark Ecuador Fiji Finland France French Guyana Gabon Georgia Germany Greece Guatemala Guyana Honduras Hong Kong Hungary India Indonesia Italy Japan Kazakhstan Kenya Korea Kyrgyzstan Laos Latvia Madagascar Malaysia Mexico Mongolia Morocco Mozambique Myanmar Namibia Nepal Netherlands New Caledonia New Zealand Norway Pakistan Panama Papua New Guinea Paraguay Peru Philippines Poland Portugal Republic of Congo Romania Russia Serbia Seychelles Singapore Slovakia Solomon Islands South Africa Spain Suriname Sweden Switzerland Tajikistan Tanzania Thailand Tunisia Turkey Turkmenistan Uganda United Kingdom Ukraine United Arab Emirates United States Uzbekistan Vietnam Zambia Zimbabwe

Where we work


Wildlife


Forests


Oceans


Freshwater


Climate &
Energy


Food


Finance


Markets


Governance
BLA BLA BLA...
ACT NOW!
THERE IS NO PLANET B
NATURE NOT FOR SALE
NOT PROFIT
CLIMATE JUSTICE NOW

THE NEW DEAL FOR NATURE AND PEOPLE

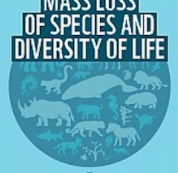
STOP AND REVERSE THE DOWNWARDS DECLINE OF BIODIVERSITY TO PROTECT AND RESTORE NATURE BY 2030, FOR THE BENEFIT OF PEOPLE AND THE PLANET, IN SUPPORT OF THE SUSTAINABLE DEVELOPMENT GOALS.

THE PROBLEMS

MASSIVE DESTRUCTION OF NATURAL SPACES

+

MASS LOSS OF SPECIES AND DIVERSITY OF LIFE



+

UNSUSTAINABLE PRODUCTION AND CONSUMPTION OF NATURE'S RESOURCES

THE TARGETS

ZERO LOSS OF NATURAL HABITATS

+

ZERO HUMAN-INDUCED EXTINCTION

+

HALVE FOOTPRINT OF PRODUCTION AND CONSUMPTION

THE SOLUTIONS

- PROTECT 30%
- SUSTAINABLY MANAGE AT LEAST 20%
- RECOGNIZE RIGHTS TO INDIGENOUS PEOPLES' LANDS

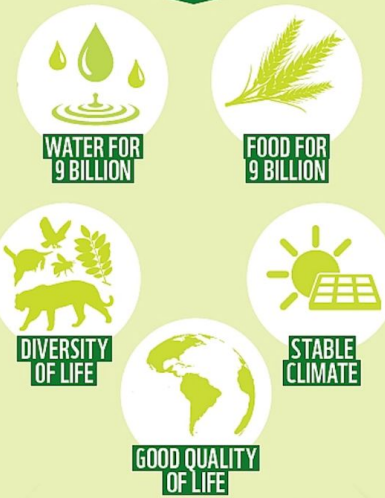
+

- STOP UNSUSTAINABLE WILDLIFE EXPLOITATION AND TRADE
- ENABLE VIABLE POPULATIONS

+

- TRANSITION TO SUSTAINABLE PRACTICES: INFRASTRUCTURE, AGRICULTURE, FISHING, EXTRACTIVES

THE BENEFITS



Many actors: Public, Private, NGO, Individuals, Funders

Many scales: Spatial, temporal

Many indicators: 1000s, at least

Many types of decisions - internal and external

CMP Conservation Actions Classification v 2.0

A. TARGET RESTORATION / STRESS REDUCTION ACTIONS

1. Land / Water Management

- 1.1 Site/Area Stewardship
- 1.2 Ecosystem & Natural Process (Re)Creation

2. Species Management

- 2.1 Species Stewardship
- 2.2 Species Re-Introduction & Translocation
- 2.3 *Ex-Situ* Conservation

B. BEHAVORIAL CHANGE / THREAT REDUCTION ACTIONS

3. Awareness Raising

- 3.1 Outreach & Communications
- 3.2 Protests & Civil Disobedience

4. Law Enforcement & Prosecution

- 4.1 Detection & Arrest
- 4.2 Criminal Prosecution & Conviction
- 4.3 Non-Criminal Legal Action

5. Livelihood, Economic & Moral Incentives

- 5.1 Linked Enterprises & Alternative Livelihoods
- 5.2 Better Products & Management Practices
- 5.3 Market-Based Incentives
- 5.4 Direct Economic Incentives
- 5.5 Non-Monetary Values

C. ENABLING CONDITION ACTIONS

6. Conservation Designation & Planning

- 6.1 Protected Area Designation &/or Acquisition
- 6.2 Easements & Resource Rights
- 6.3 Land/Water Use Zoning & Designation
- 6.4 Conservation Planning
- 6.5 Site Infrastructure

7. Legal & Policy Frameworks

- 7.1 Laws, Regulations & Codes
- 7.2 Policies & Guidelines

8. Research & Monitoring

- 8.1 Basic Research & Status Monitoring
- 8.2 Evaluation, Effectiveness Measures & Learning

9. Education & Training

- 9.1 Formal Education
- 9.2 Training & Individual Capacity Development

10. Institutional Development

- 10.1 Internal Organizational Management & Administratior
- 10.2 External Organizational Development & Support
- 10.3 Alliance & Partnership Development
- 10.4 Financing Conservation

More details

https://www.conservationmeasures.org/

Forest Foresight

An early warning system to predict and prevent deforestation

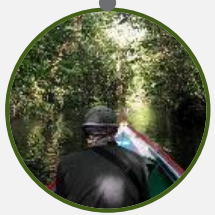
The power of prediction: enabling earlier interventions for forest conservation

Prediction and early detection models enable faster forest conservation

Prediction and early detection enable earlier interventions, cutting short the deforestation chain

Currently, interventions are often too late, due to long lead times and lack of proper follow-up

0

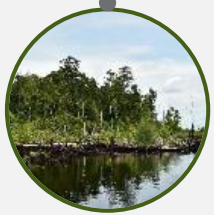


Healthy forest

1

Road & canal development

2



Illegal logging

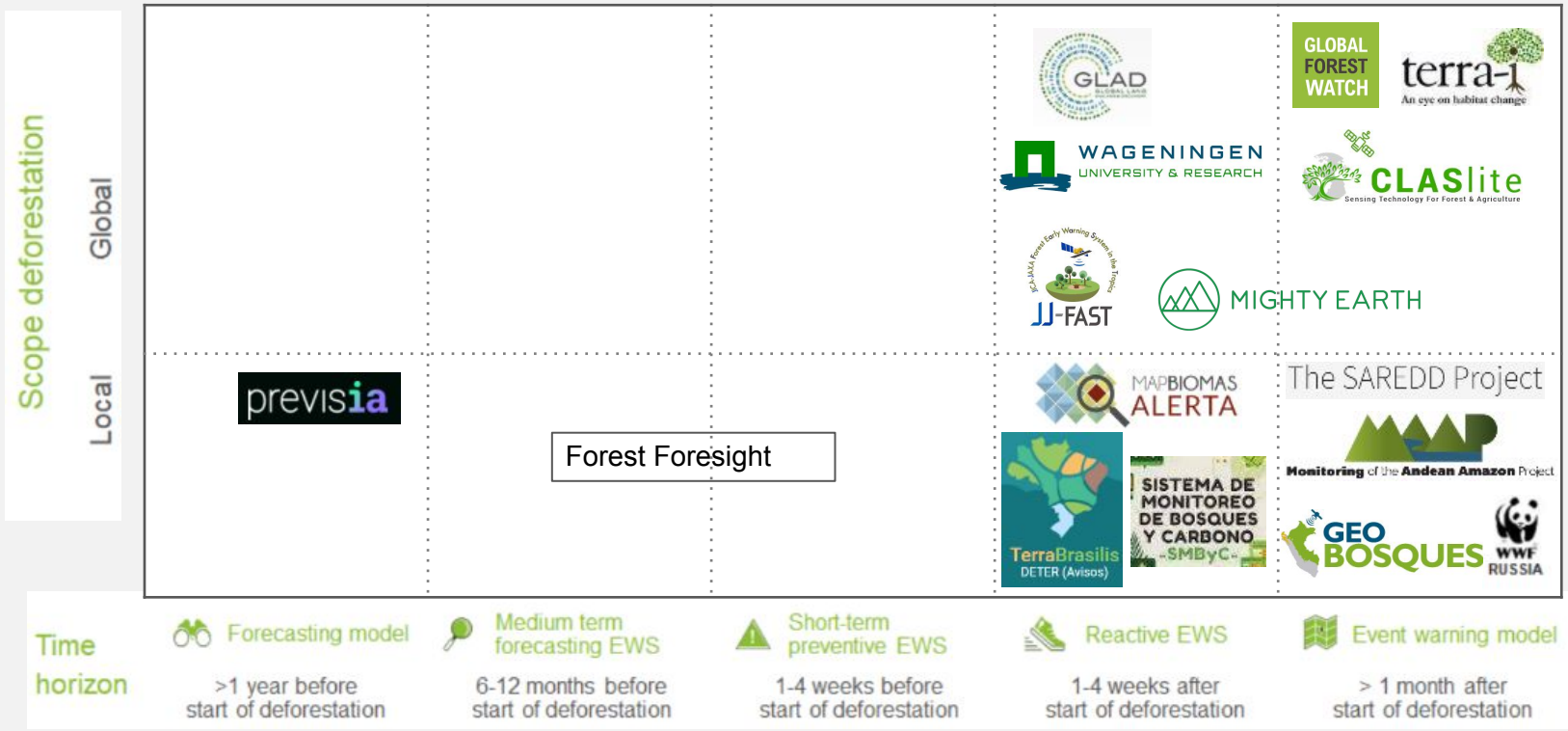
3

Land clearing and conversion

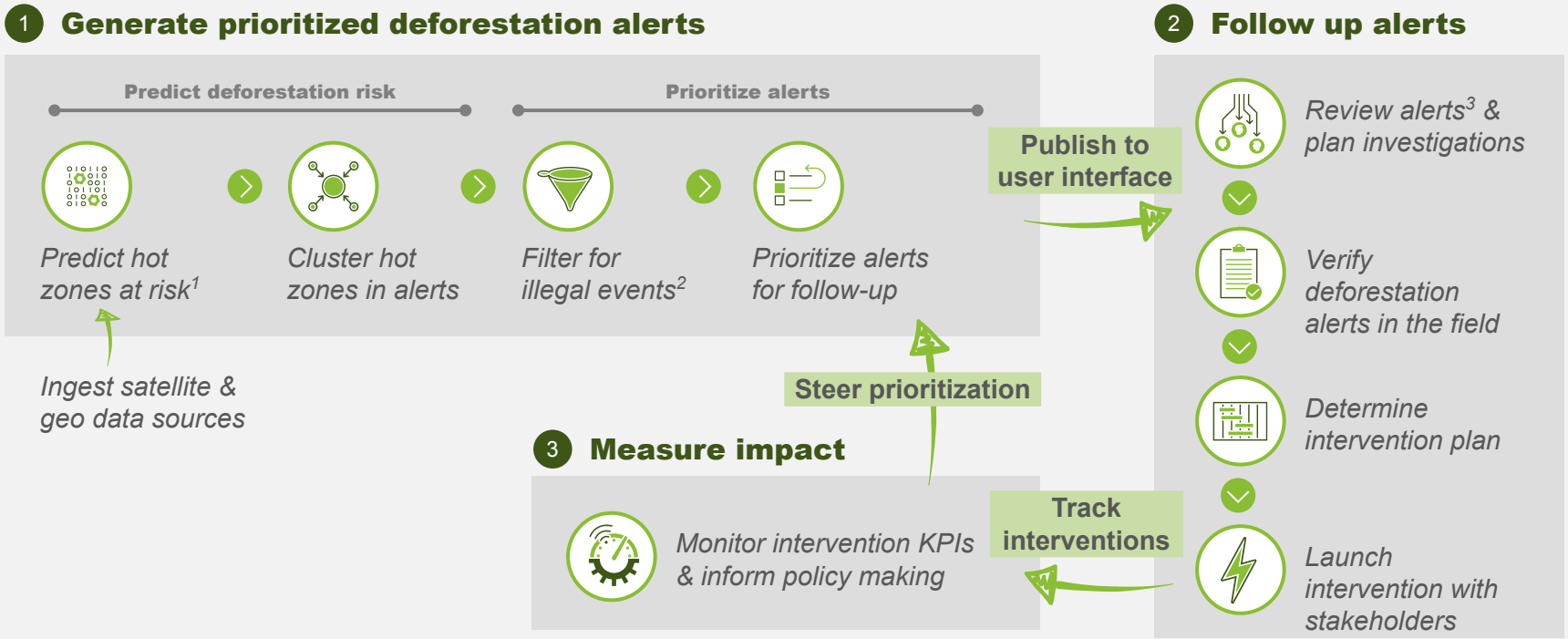
Source: Photos were taken near the Sebangau National Park border (Central-Kalimantan)

Existing forest monitoring systems

Existing forest monitoring systems



Forest Foresight: from data to interventions and tools to support rollout



1. Predictions on 15x15m, followed by down-sampling to 480x480m, 2. Exclude deforestation with permits, forest fires etc., 3. Includes desktop research to verify permits, area mgmt. plan etc.

Technical foundation underlying FF

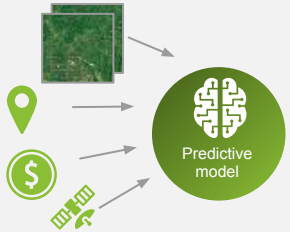
Predict hot zones at risk

1. Collect historic satellite images, analyze and label changes in forest cover

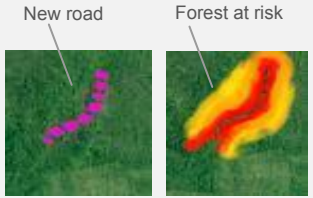
2. Collect input data and generate data set with static and dynamic indicators

- Topological data
- Socio-economic data
- Satellite data and land cover data

3. Train machine learning models (XGBoost) based on historical data, using static and dynamic inputs



4. Use machine learning model to generate a map of forest cover at risk and validate on historic data



Dynamic indicators

- Distance to degradation
- Distance to deforestation
- Landscape heterogeneity metrics
- …

Static indicators

- Population density
- Distance to population center
- Distance to roads
- …

Several open-source indicator generators used, local data added after

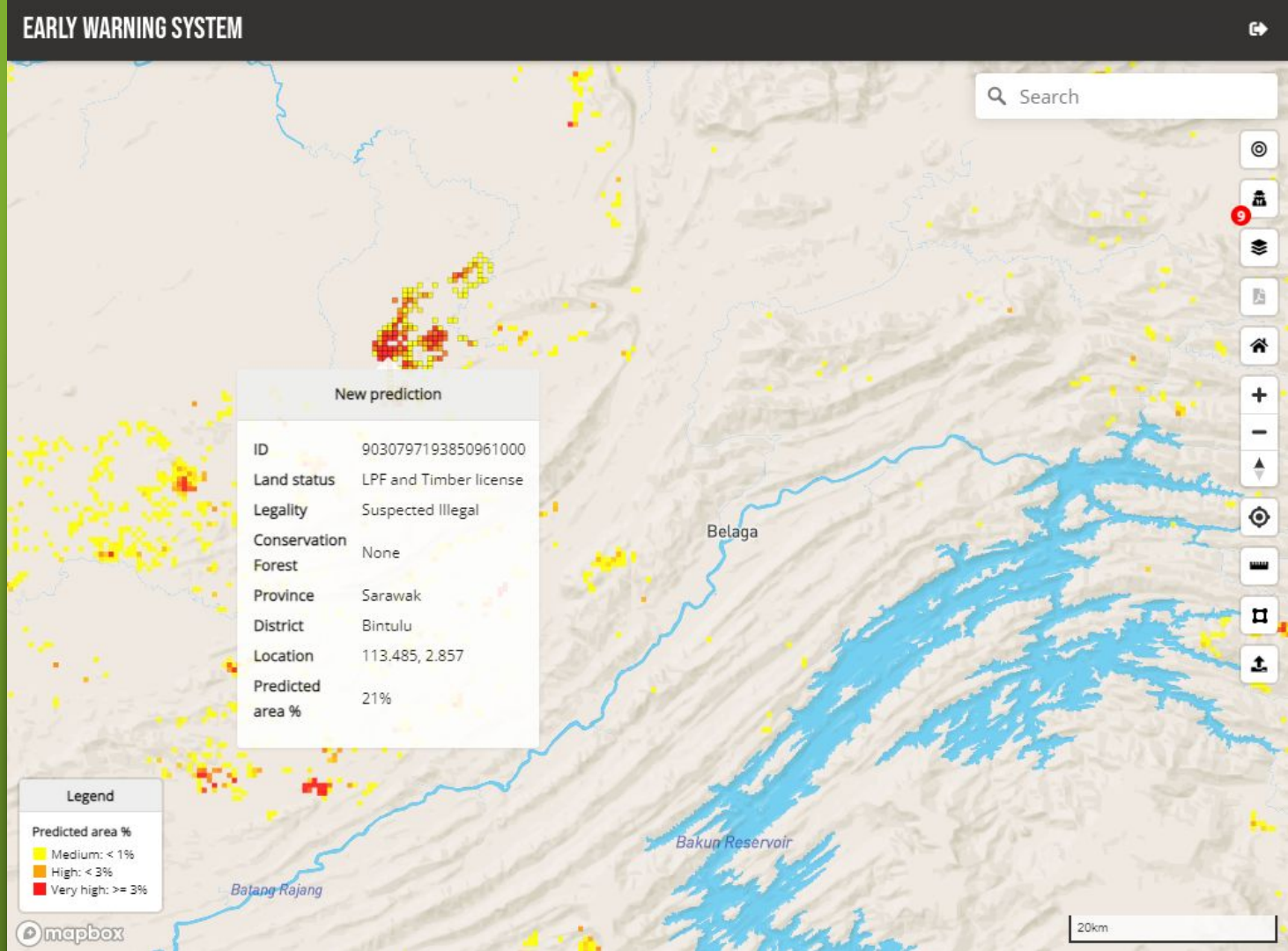
Indicator generator	For dynamic or static data?	Definition	Output indicator	Source
Distance	Either	Calculates Euclidean distance from a vector or raster feature	Distance from target feature (e.g. roads, waterways)	SciPy
Slope of terrain	Static	Computes slope of land from digital elevation model	Slope	NumPy
Indicator formatters (x 9)	Either	Series of tools that process indicators into usable format for data pipeline	Many (e.g. elevation, population density, month of deforestation)	OpenCV, SciPy, NumPy
Percent land cover[1]	Dynamic	Proportion of total landscape area occupied by each land cover class	For each land cover class, % of class in 1km^2 grid cell	McGarigal 2015
Edge density[1]	Dynamic	Proportion of the lengths of all edge segments in the landscape to the total landscape area	For each land cover class, meters per hectare of patch edge in 1km^2 grid cell	McGarigal 2015
Patch density[1]	Dynamic	Number of patches of each land cover patch type divided by total landscape area	For each land cover class, number of patches per 100 hectares in 1km^2 grid cell	McGarigal 2015
Shannon's Diversity Index[1]	Dynamic	Proportion of the landscape occupied by each land cover patch type	For all classes, Shannon's Diversity Index in 1km^2 grid cell	Shannon and Weaver 1949
Aggregation Index[1]	Dynamic	Proportion of maximum like adjacencies between pixels of each land cover patch type based on the single-count method.	For each land cover class, percent of like, single-count adjacencies in 1km^2 grid cell	He et al. 2000

1. Definitions and open-source python versions adapted from University of Massachusetts Amherst FRAGSTATS 4.2 statistical pattern analysis program Important FRAGSTATS indicators selected from Cushman et al. 2017

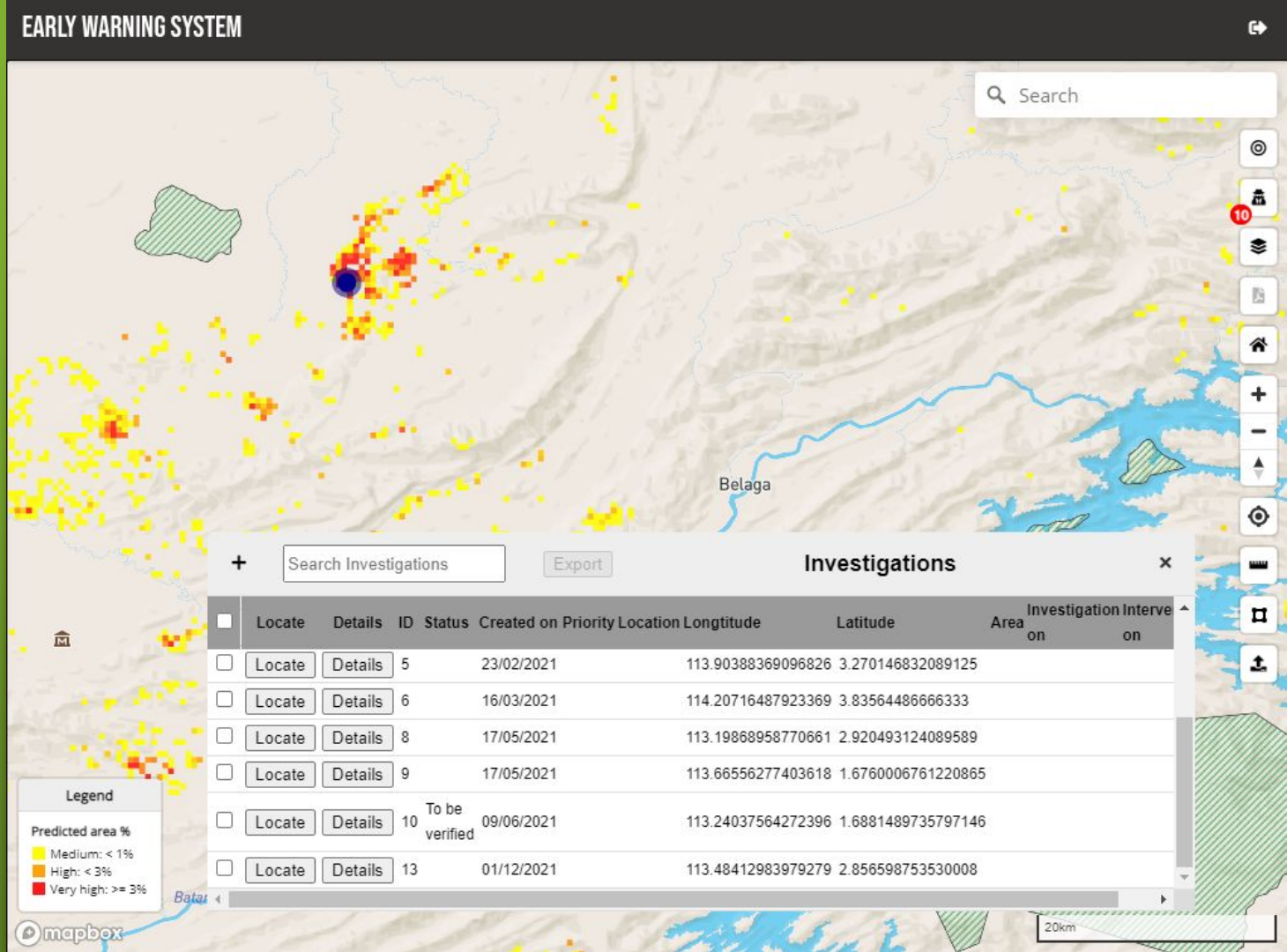
Additional data sources beyond satellite data

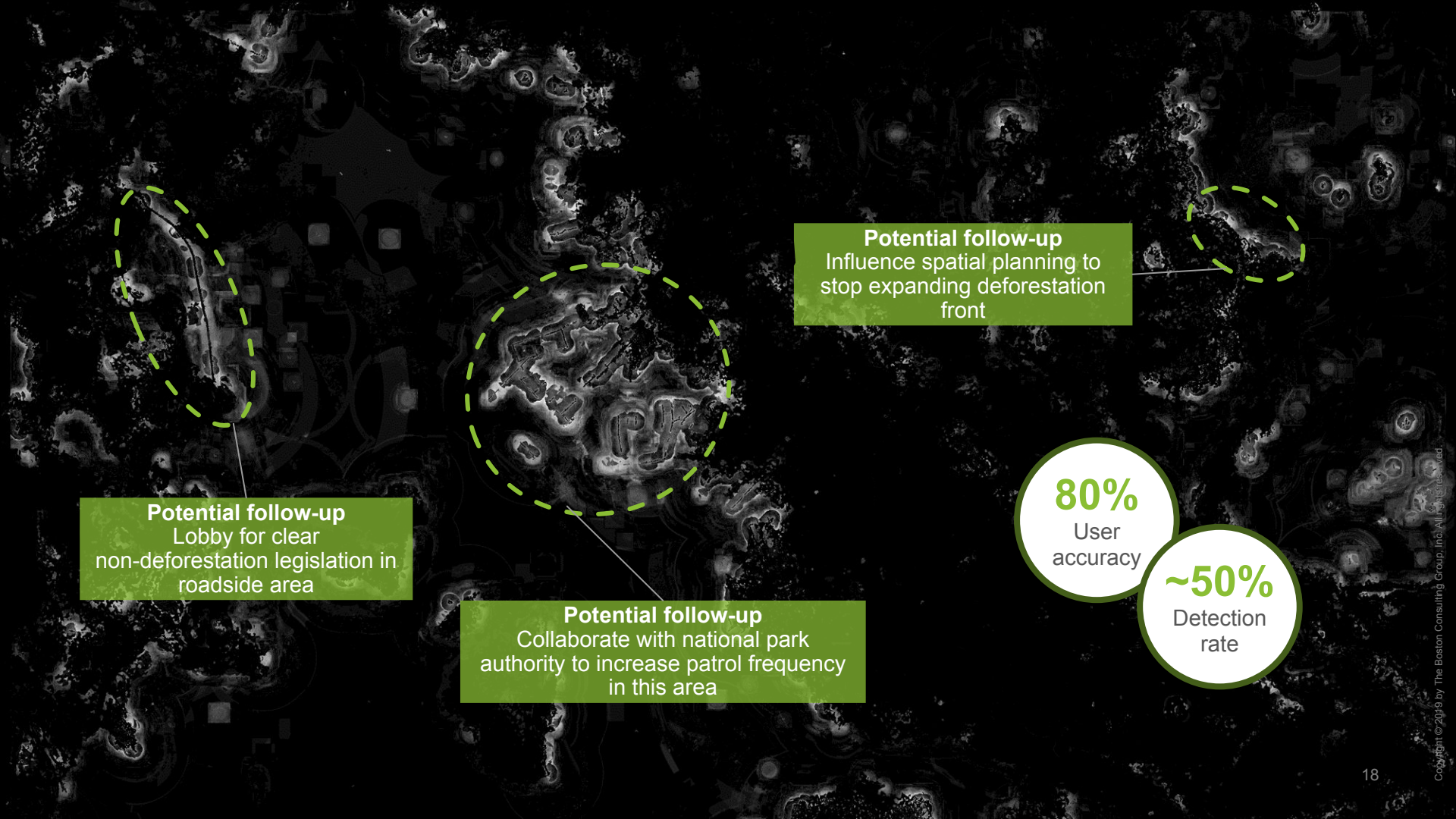
Data Source	Description	Typical example	Purpose
Deforestation change detection	Tracks deforestation every 6-12 days, typically very detailed (e.g. 30mx30m)	University data, purchased data	• Predict deforestation • Monitor deforestation
Vegetation baseline map	Land cover map	Ministry data	• Predict deforestation
Geographical datasets: • Coastline • Elevation • Admin boundaries (e.g. districts) • Roads and Waterways • Villages/settlements • Population density	Several geographical datasets that can be used to make better predictions, typically publicly available	ASTER, Open Street Map, Ministry data	• Predict deforestation
Forest fires	Shows forest fires in last 7 days	NASA	• Show on dashboard
Land status and legality	Spatial planning to show where deforestation is illegal	Ministry data	• Show on dashboard • Prioritize predictions
Concessions • Timber • Palm oil • Cacao • Mining	Concession data to help make better predictions (e.g. near palm oil mills), or show where deforestation is legal	CIFOR, GFW, Ministry data	• Predict deforestation • Show on dashboard
Logging roads	Location of logging roads	CIFOR, Ministry data	• Predict deforestation
Soil map (e.g. peat)	Soil type maps	Ministry data	• Predict deforestation
Protected areas, HCVA	Location of protected areas or High Conservation Value areas	WDPA, Ministry data	• Show on dashboard • Prioritize predictions
Species habitats	Species maps	Ministry data or WWF data	• Prioritize predictions
Carbon stock	Above ground carbon stock	Ministry data	• Prioritize predictions

Dashboard visualizes predictions of 'deforestation hot zones'



When potentially illegal deforestation is spotted, users can create investigations to follow up the alert



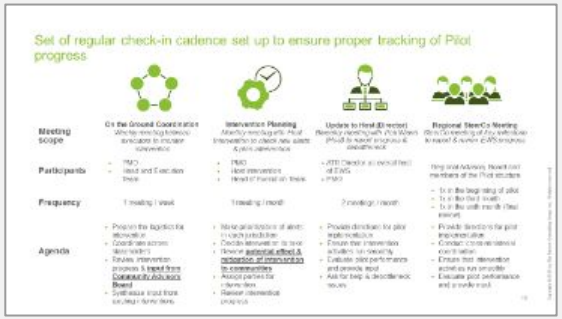


Setup of local governance critical to FF success

Designed roles & responsibilities for relevant stakeholders

Set up team to coordinate stakeholders, organize trainings…

Organize regular meeting cadence for each phase



Align governance scheme and set up steerco, user board etc.

FF global team

+ Future partnerships

FF local (Kalimantan)

MOTION DETECTING CAMERAS AND AI

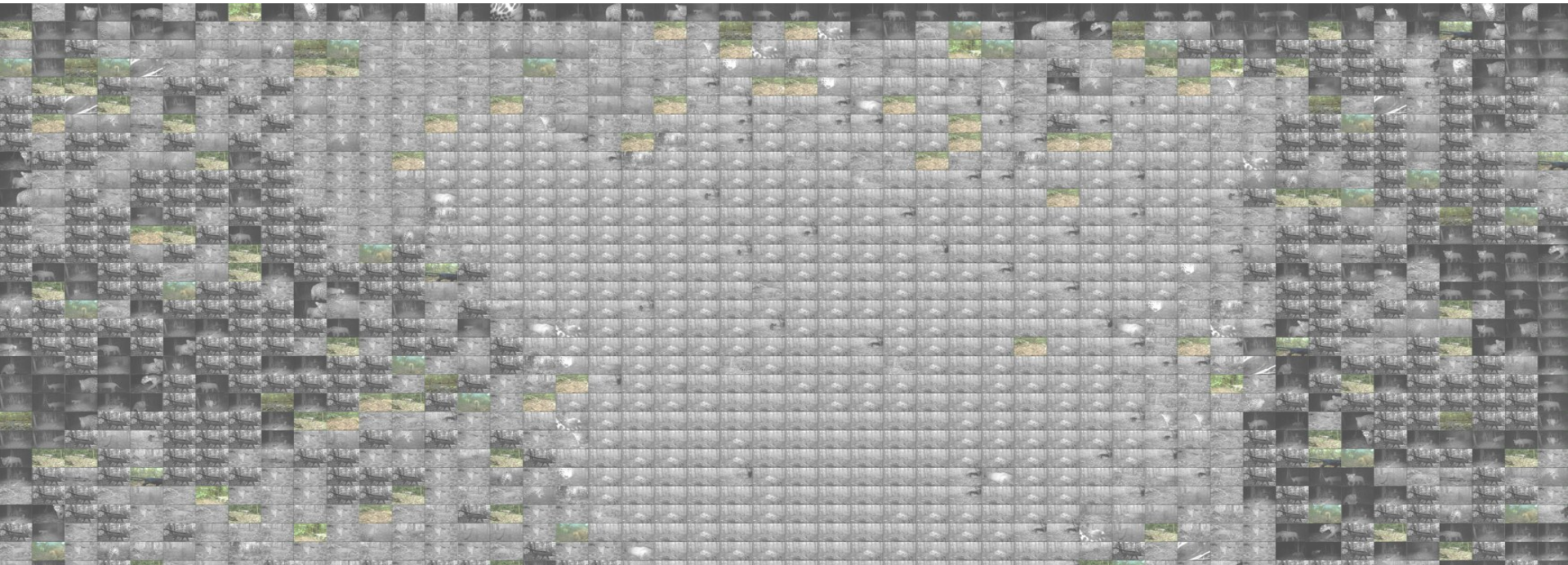
Motion sensitive cameras are everywhere

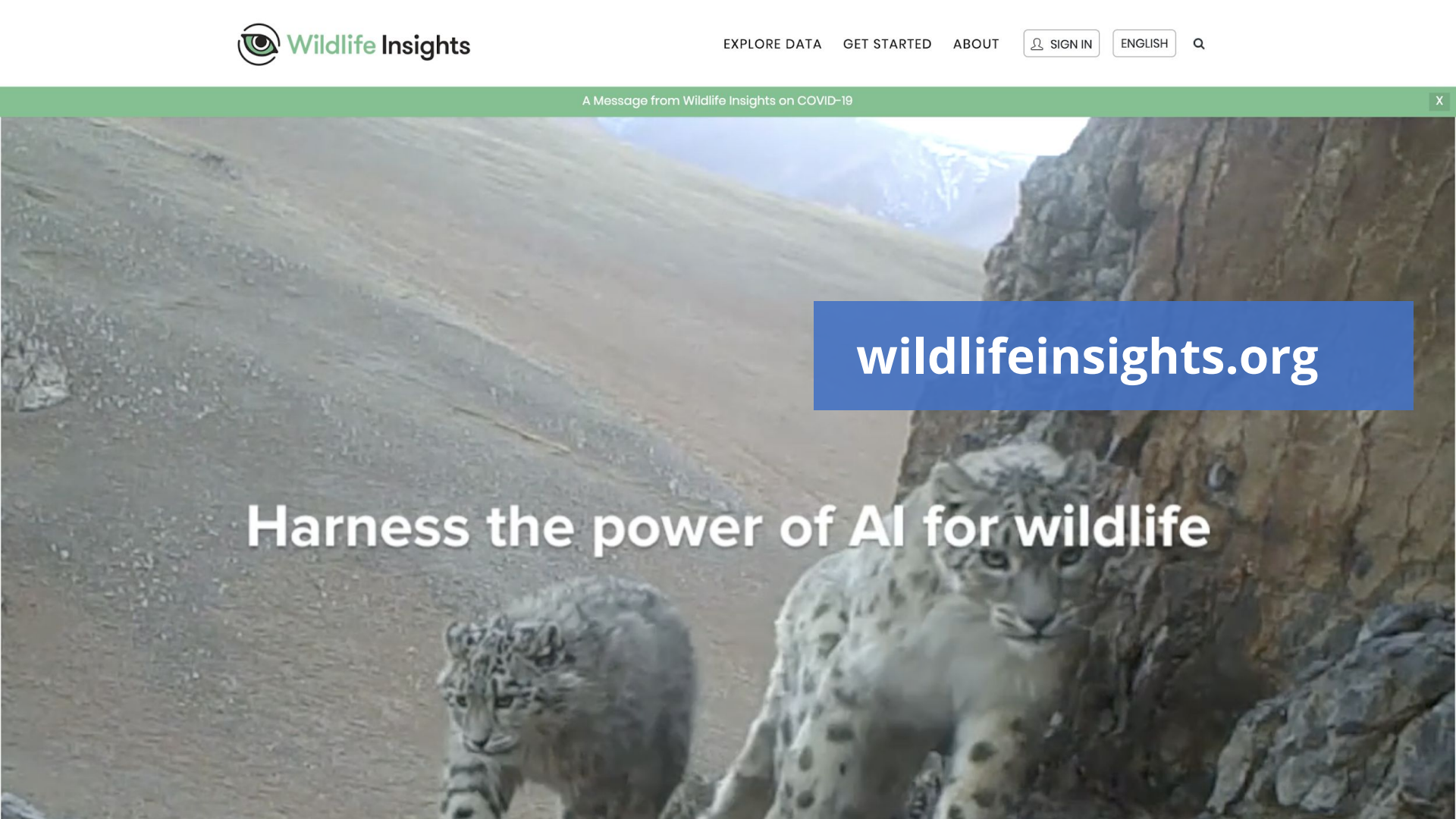
1,000s of projects

100,000s of cameras

Many 10,000,000s of images

Steenweg et al. 2017




Wildlife Insights
EXPLORE DATA
GET STARTED
ABOUT
SIGN IN
ENGLISH
A Message from Wildlife Insights on COVID-19
X
wildlifeinsights.org
Harness the power of AI for wildlife


CONSERVATION
INTERNATIONAL


NORTH
CAROLINA
Museum of
Natural Sciences


Smithsonian Institution


ZSL
LET'S WORK
FOR WILDLIFE


WCS


WWF


MOL
MAP OF LIFE


Google

Goal

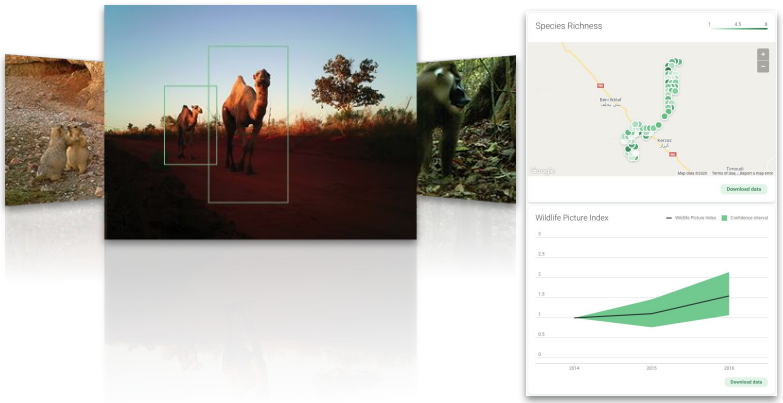
Provide wildlife professionals a software platform to identify, manage and analyze camera trap data

Wildlife Insights

Deploy Field Sensors

Organizations deploy sensors (mostly camera traps) in situ

Upload | **Identify** | **Analyze**



Images and metadata are uploaded to the Google Cloud, and AI identifies what's in the image. Analytics are automatically calculated.

Manage & Act

Reports are produced to provide insights to decision-makers and stakeholders

Exploring data

wildlifeinsights.org

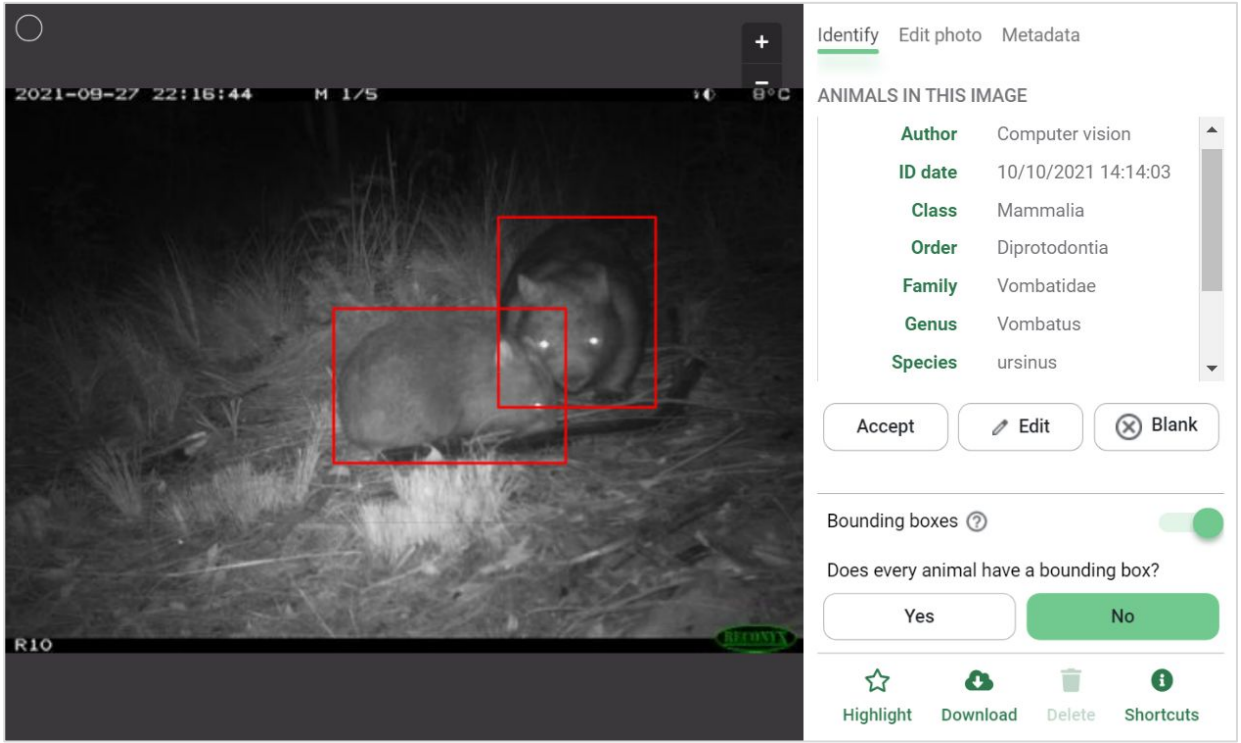
Eyes on Recovery

Using Wildlife Insights to measure the impact of the 2019-20 19 million hectare bushfires on Australia's wildlife

Google WWF CONSERVATION INTERNATIONAL

Abby Hehmeyer & Arno Lyet (WWF US), Emma Spencer (WWF AUS)

Data processed in Wildlife Insights



2.5 million images used to train WI computer vision model for Australia

Excellent feedback from AUS users: **5x increase in image processing speed**

~500 hours of staff time saved per project site location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For project developers
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ARIES

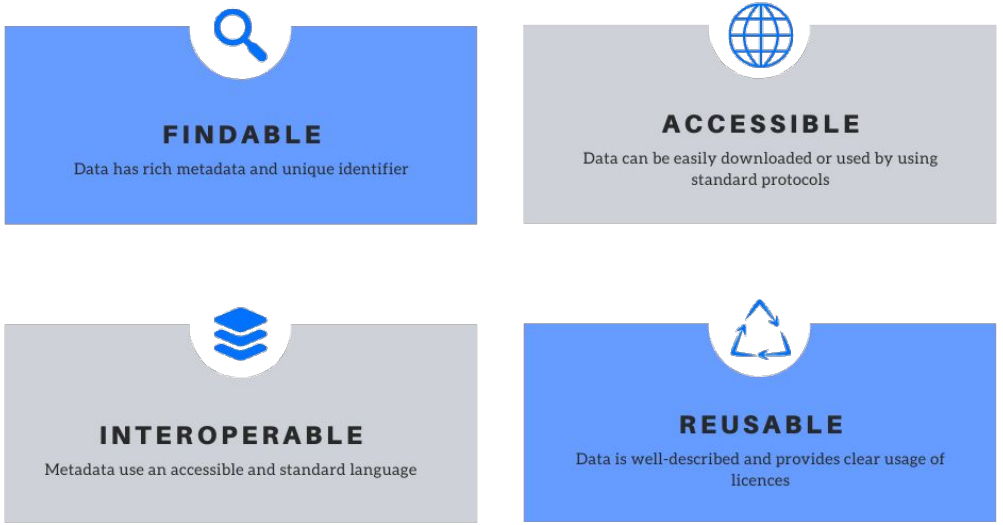
ARtificial Intelligence for Environment & Sustainability

bc3

BASQUE CENTRE
FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

Sustainability, that's it!

Interoperability: A core challenge to the global ecosystem services community



1. Semantics

The language used to describe scientific observations must be flexible and shareable, without ambiguity. It must efficiently address all the "W's of information – *what*, *where*, *when*, *why, and how* – without becoming too large or complex to learn and use.

2. Open, linkable data

Making data and models FAIR is complex and requires understanding of – and agreement on – the nature of *all* scientific information, including, but not limited to, adopting URIs and open standards.

3. Open, linkable models

While today's dialogue on interoperability focuses on data, it can help to see models and model components as other ways to make scientific observations. This enables a single,

4. Software infrastructure

We believe in contributions that can start making positive change immediately. Our theoretical semantic integration work is complemented by an open-source software stack

ARIES for SEEA Explorer

Beta

The SEEA Ecosystem Accounting standard on the ARIES platform. A collaboration between UNSD, UNEP and BC3. Powered by k.LAB semantic web technology.

Context: where, when

Sestao, Bizkaia, Euskadi, 48910, España

Map boundaries | 40.0 | m

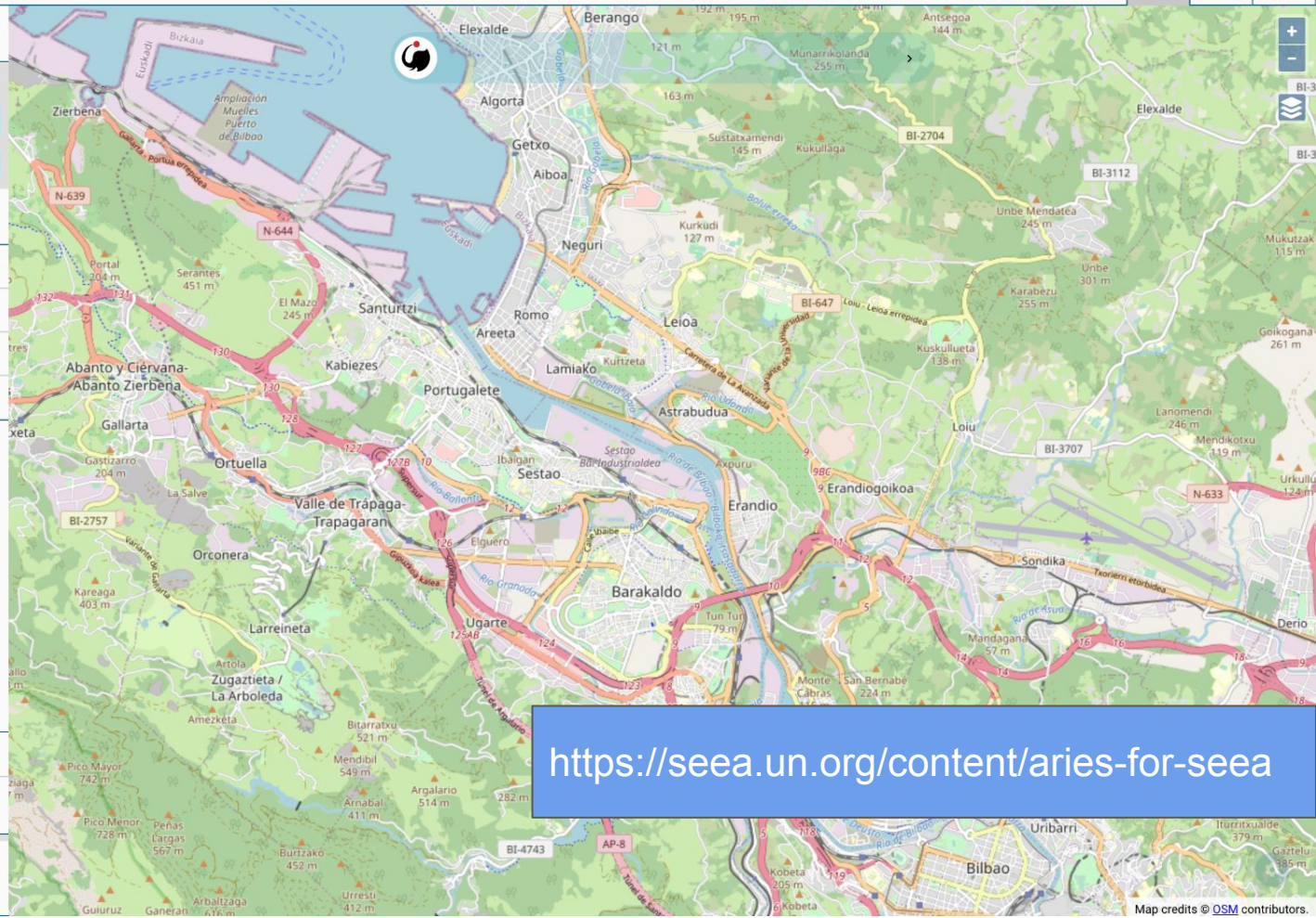
Years 2012 To 2019

Study setup

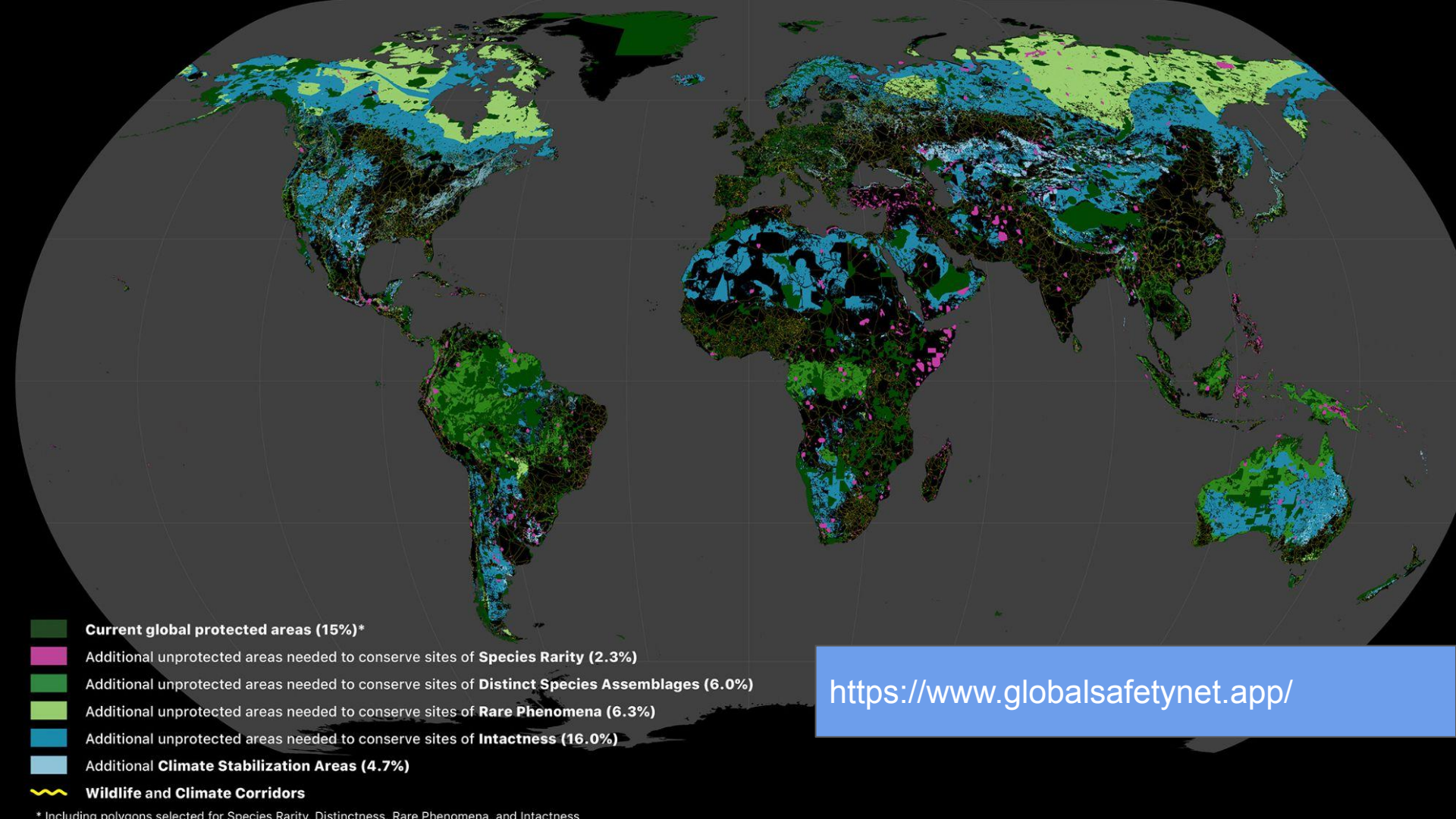
- Extent accounts
- Condition accounts
- Ecosystem services accounts (physical)
- Ecosystem services accounts (monetary)
- Spatial and temporal aggregation

Key SEEA EA outputs

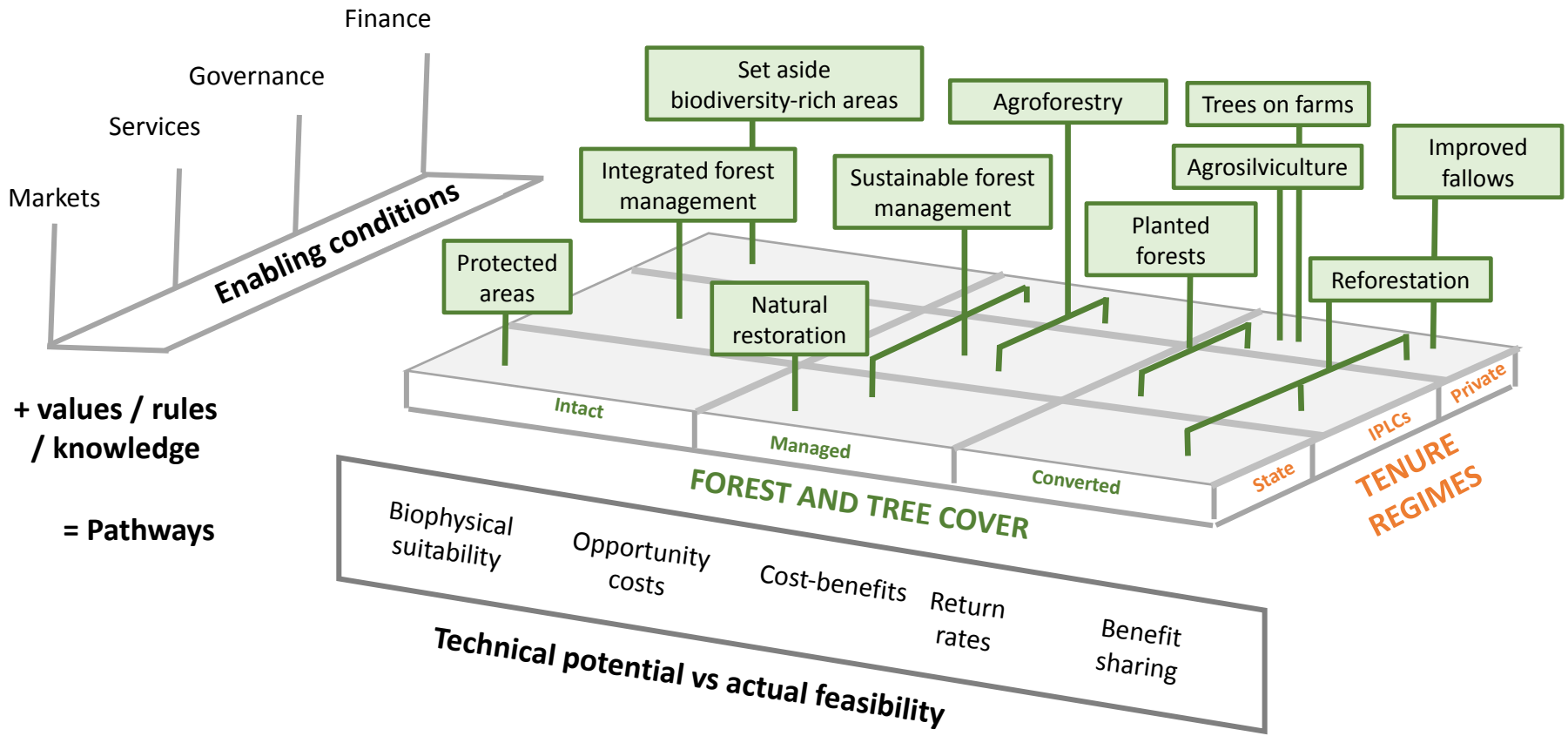
Maps | Tables | Comments



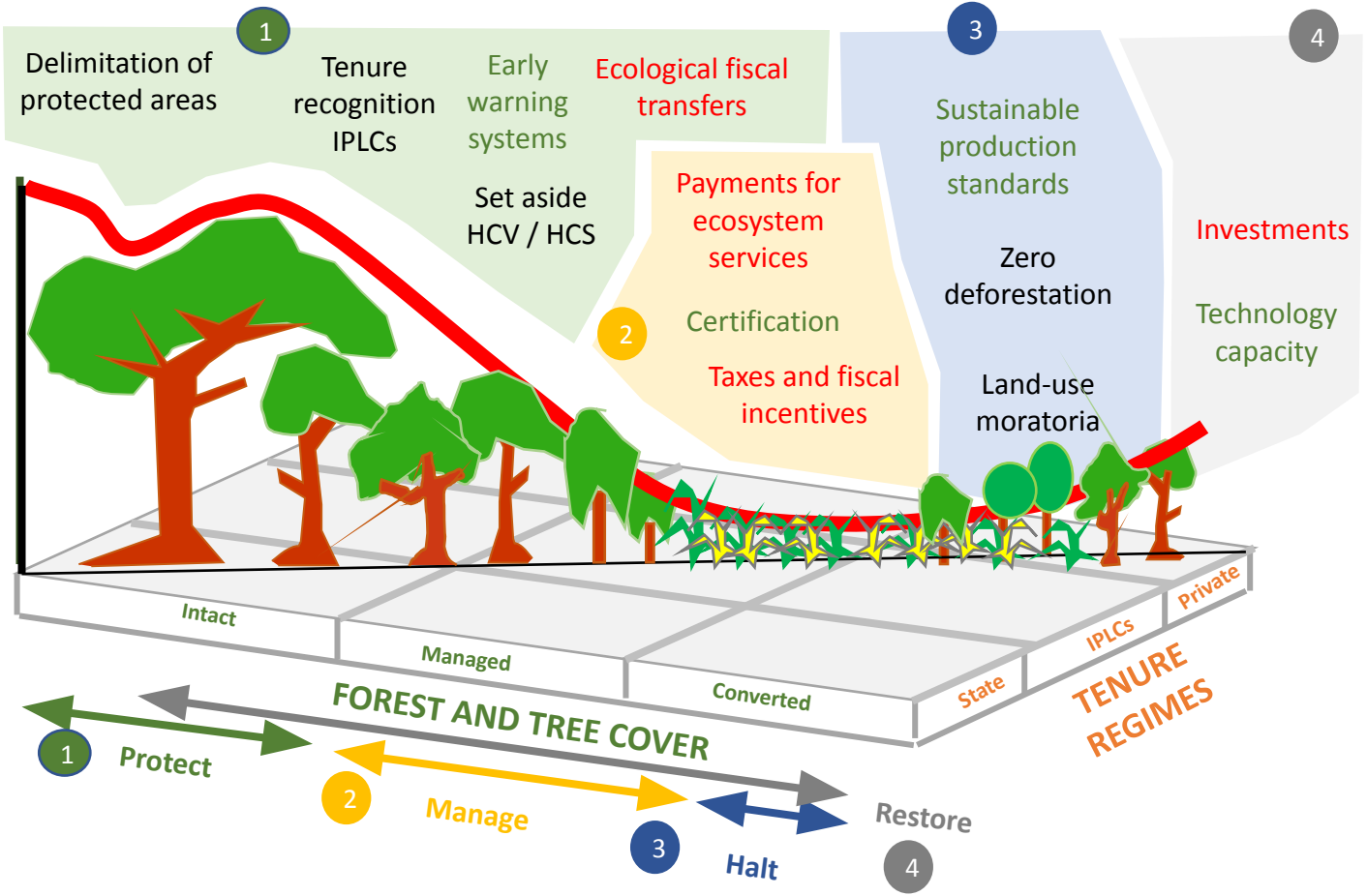
Moving From Where to How


Current global protected areas (15%)*
Additional unprotected areas needed to conserve sites of Species Rarity (2.3%)
Additional unprotected areas needed to conserve sites of Distinct Species Assemblages (6.0%)
Additional unprotected areas needed to conserve sites of Rare Phenomena (6.3%)
Additional unprotected areas needed to conserve sites of Intactness (16.0%)
Additional Climate Stabilization Areas (4.7%)
Wildlife and Climate Corridors
* Including polygons selected for Species Rarity, Distinctness, Rare Phenomena, and Intactness
https://www.globalsafetynet.app/

MULTIPLE FOREST-BASED OPTIONS, POTENTIAL AND FEASIBILITY



MEASURES ADAPTED TO PLACE-SPECIFIC CONDITIONS



Examples of measures

State regulations, **private policies**, and **hybrid initiatives**

. **Institutional**
. **Technical**
. **Economic**

60 YEARS OF ACTION FOR NATURE AND PEOPLE

As part of our 60th anniversary

Big Outstanding Challenges

- Social Metrics (e.g. poverty, climate resilience, language)
- Data privacy and sovereignty versus FAIR principles
- Connecting Global and Local (See GLASSNET for example)
- Digital Sustainability (See the Coalition for for Digital Environmental Sustainability - CODES)
- The big one - Impacts: measuring and inferring what works and why


WWF
Thanks!


WWF