



International Center for Tropical Agriculture  
*Since 1967 / Science to cultivate change*

# CIAT Asia & Big Data

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Beijing, China

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# CIAT Asia line of research in Big Data

Local

National

Regional

Global

Sustainable Development Goal Monitoring  
and Evaluation

Site specific Agro-climatic advisory

Extreme climatic event and early warning for agricultural activities

Synthetic Counterfactual Variables and Impact  
Assessment

Early warning for deforestation and land cover change

M&E and Impact assessment

Modeling and RS based warning systems

ICT and Agro-climatic advisory

## Early warning for deforestation and land cover change

**Potential link with:**

**CAAS Disciplinary Cluster:** Agricultural Resources and Environment

**CAAS Disciplines:**

Agricultural environmental monitoring and evaluation

Agricultural and forestry biomass transformation engineering

**Mega-Program #3 (Green Agriculture)**

1. Construction of early warning system and drought risk management under the context of climate change
2. Ecological function and its restoration of biodiversity on agro-ecosystem



RESEARCH  
PROGRAM ON  
Forests, Trees and  
Agroforestry



WORLD  
RESOURCES  
INSTITUTE

heig-vd

Haute Ecole d'Ingénierie et de Gestion  
du Canton de Vaud

KING'S  
College  
LONDON



## Biodiversity

Soils microbiology and Agro-ecology

Integrating agro-biodiversity into forests biodiversity conservation

National planning for biodiversity conservation

- GAP
- Climate change

## Ecosystem services

### Farm level

Carbon, water and nutrient footprint assessment of CSA practices

### Landscape level

Off-site benefits of CSA practices for agriculture, drinking water, hydro-power, tourism and biodiversity conservation

### National level

Cross-sectorial integration  
Planning and monitoring systems

## Drivers of change

Land use  
change  
monitoring



Climate  
change

Adoption and information services

# Terra-i, the bottom line

- Near real-time system, producing maps every 16 days
- Monitor all types of vegetation across the tropics

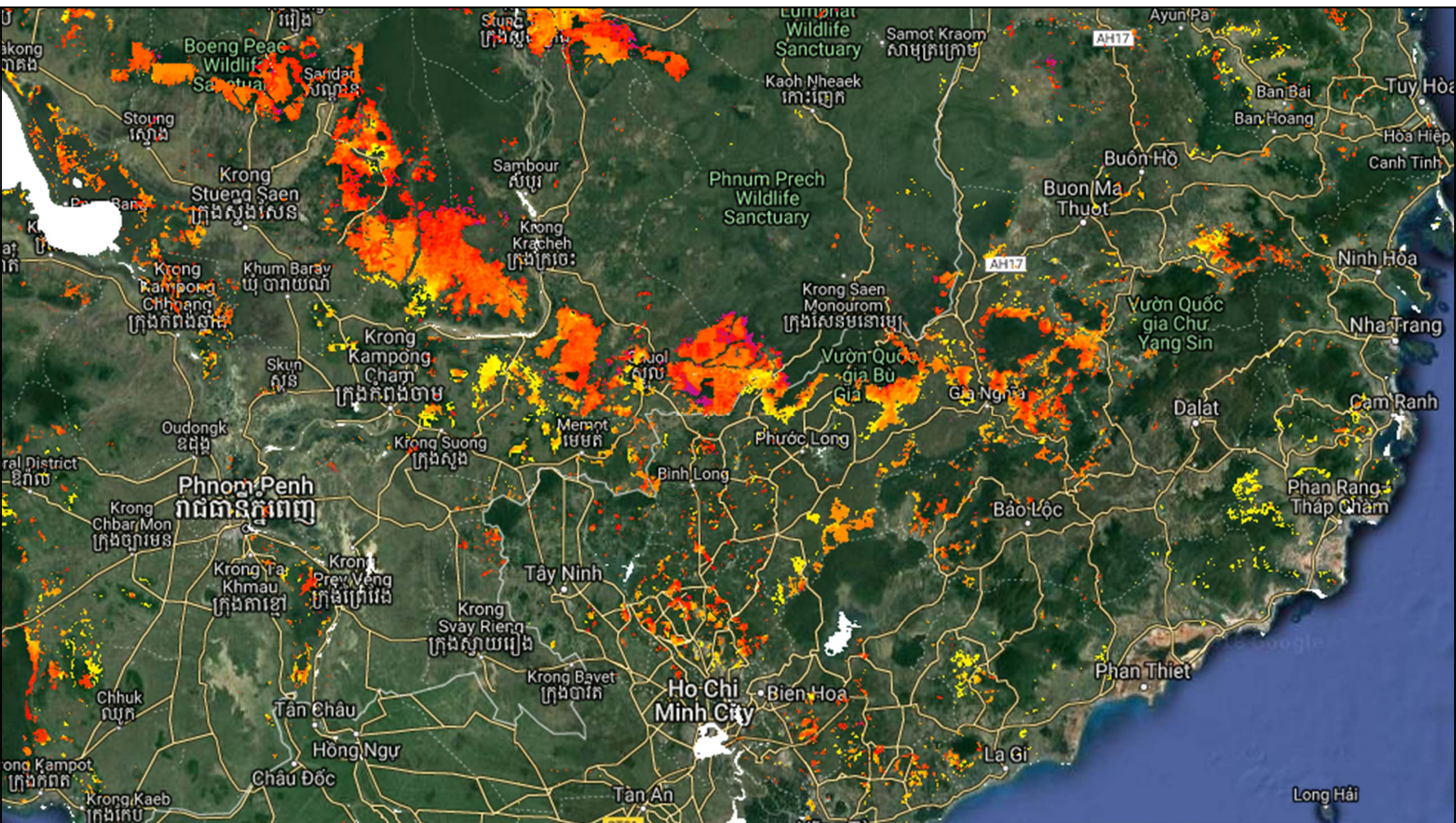
## Pan-Tropical system

- Tool detecting natural vegetation loss in the whole tropics
- Monitor all types of vegetation across the tropics
- Imagery spatial resolution: 6.25 Ha
- Based on MODIS MOD13Q1 product (vegetation index) and Global Precipitation Measurement (rainfall)

## National system

- Tool detecting natural vegetation loss at local scale
- Imagery spatial resolution: 0.01 Ha
- Based on Sentinel 1 (SAR) Sentinel 2 (Optical) and Landsat 7 & 8 (Optical) and Global Precipitation Measurement (rainfall)

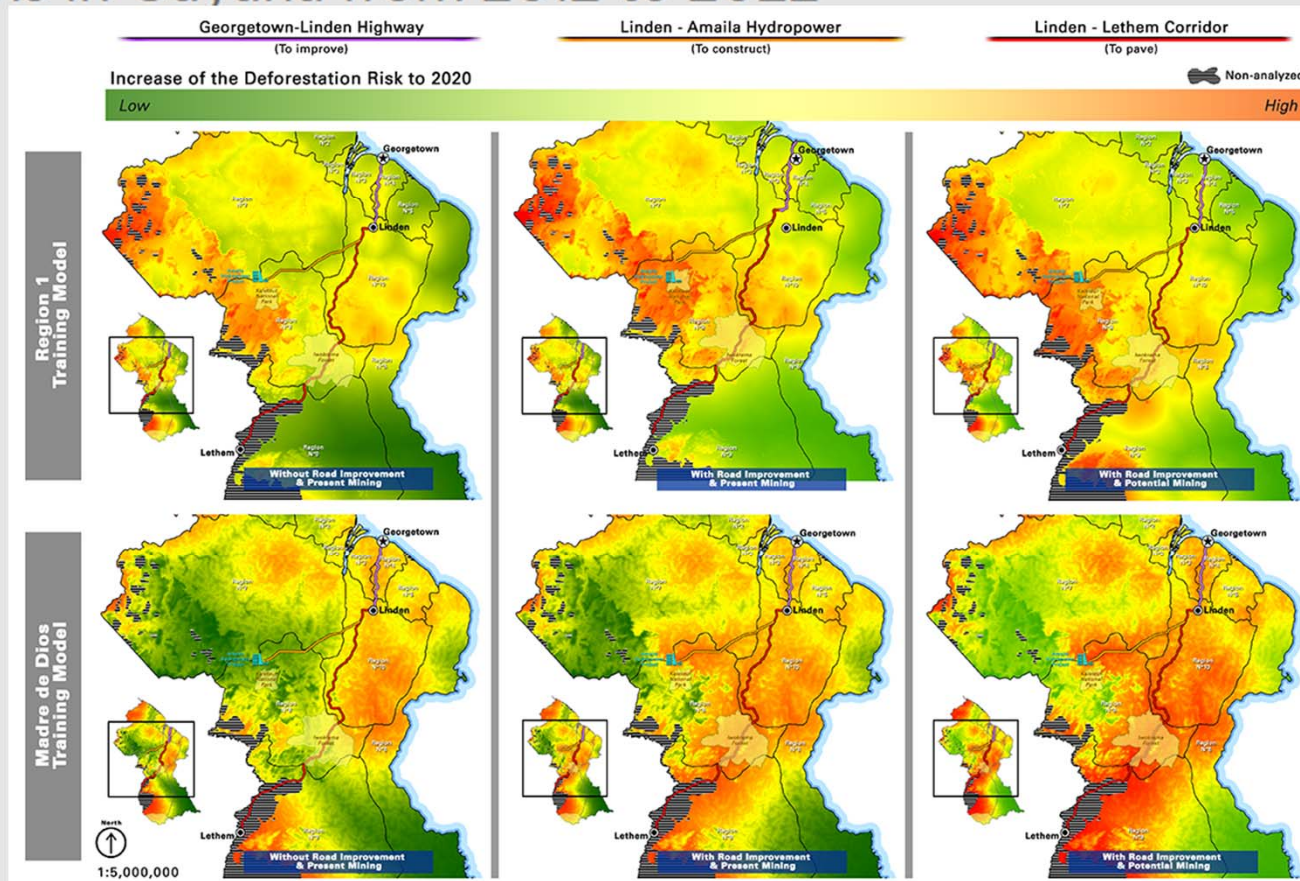






# Uses of the pan-tropical product

## Potential Impact of Road Projects on Habitat Loss and Greenhouse Gas Emissions in Guyana from 2012 to 2022



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# Uses of the national high resolution product

Terra-i provides new detections of forest loss every 16 days

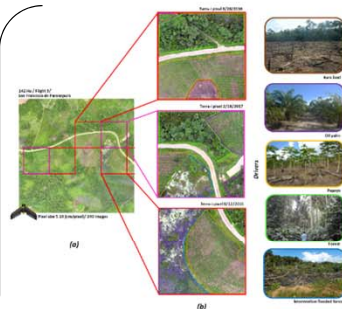
Action on the ground is possible before too much damage is done

Used by government **Peru** National monitoring with focus on illegal mining, **Colombia** land cover change impact on biodiversity, **Honduras** National monitoring and **Vietnam** Coffee encroachment. Potential project in the Philippines and Bolivia



Data production

Communication to local actors



Field checking



Feedback



# Big Data and Remote Sensing for Synthetic Counterfactual Variables and Impact Assessment

**Potential link with:**

**CAAS Disciplinary Cluster:** Agricultural Information and Economics

**CAAS Disciplines:** Rural development and policies

## **Mega-Program #3 (Green Agriculture)**

1. Construction of early warning system and drought risk management under the context of climate change
2. Ecological function and its restoration of biodiversity on agro-ecosystem

# Motivation

- Estimating impact of agricultural projects and policies continues to be a vexing problem.

“Yields decreased after the program was put into place. The drought came at the wrong time, otherwise they would have been up.”

Yields decreased, but they were about 20% higher than they would have had the policy not been put into place.

“Yields are way up! Clearly, this policy (or program) is working!”

It was a good year, but thanks to the policy, yields were 20% higher than they would have been otherwise!

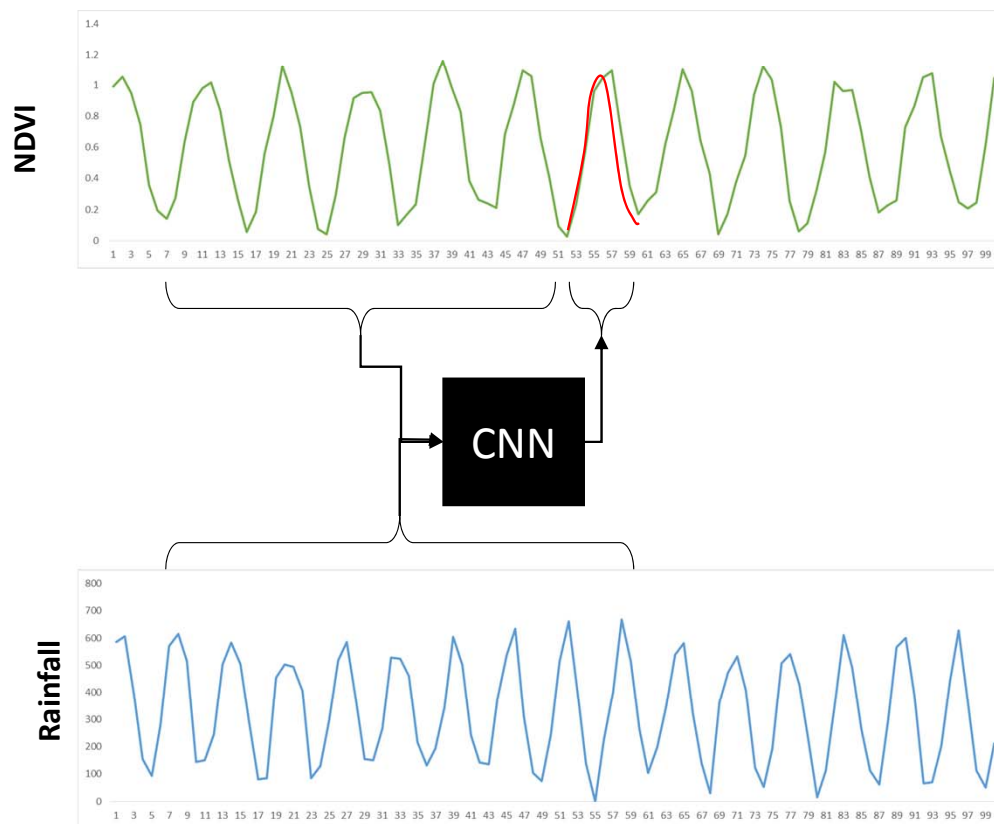
# Convolutional Neural Networks & Synthetic Controls

A Convolutional Neural Network (CNN) identifies recurrent patterns in training data.

The CNN can be trained with time series data to *learn* to predict temporal outcomes based on previous patterns.

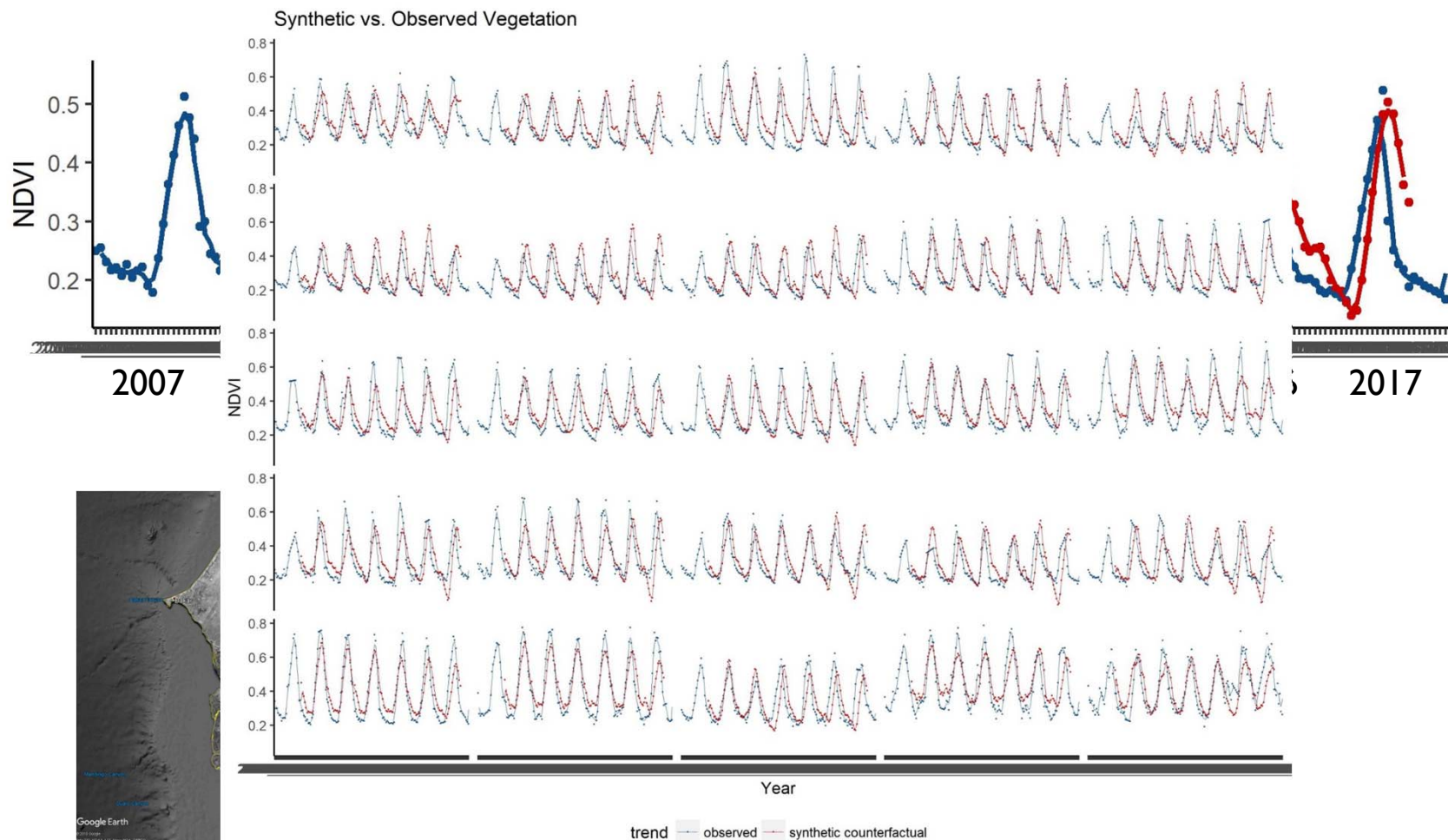
The synthetic outcomes predicted by a CNN are **not** hardcoded but derived from the training data.

This CNN uses 5 years of MODIS MOD13Q1 NDVI data previous to the predicted year and 6 years of rainfall precipitation data (5 years previous to the predicted year + the predicted year) to predict one year of NDVI data.





# NDVI 2007-2017 vs Synthetic NDVI 2012-2017



Millions of synthetic observations  
generated each year

## Early warning system for drought risk (e.g. at planting, during grain filling), harvest delays and risks of lodging.

### Potential link with:

#### CAAS Disciplinary Cluster:

Agricultural Information and Economics  
Agricultural Resources and Environment

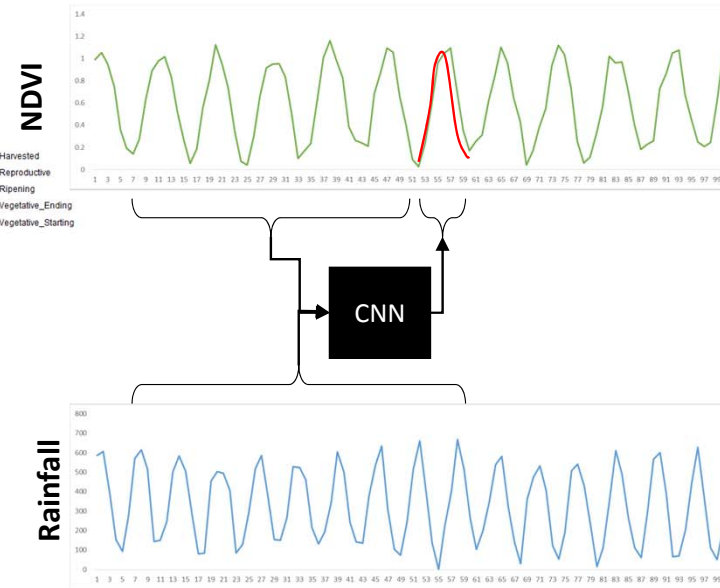
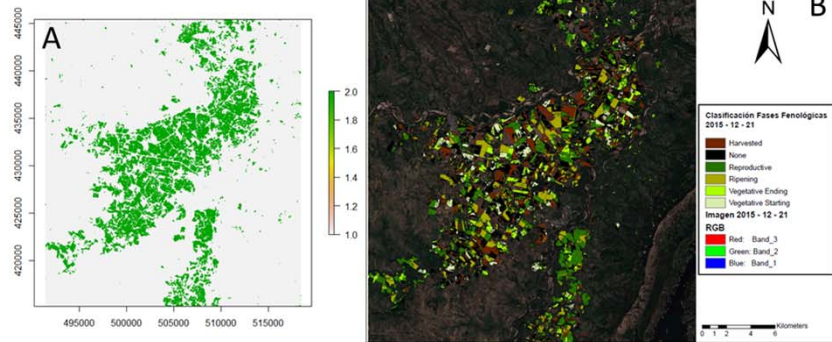
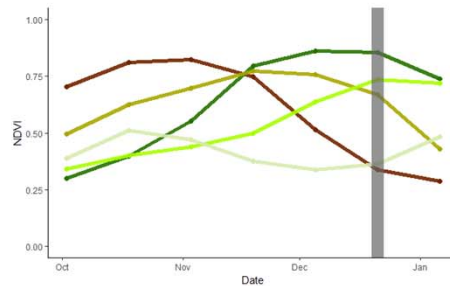
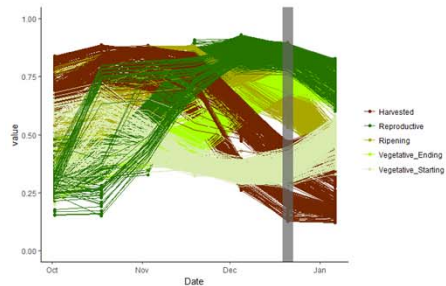
#### CAAS Disciplines:

Agricultural product market and trade  
Agricultural region planning

### Mega-Program #3 (Green Agriculture)

1. Construction of early warning system and drought risk management under the context of climate change
2. Ecological function and its restoration of biodiversity on agro-ecosystem

Early warnings on drought risk (e.g. at planting, during grain filling), harvest delays and risks of lodging.



Seasonal  
weather  
forecast

Crop, phenology & location  
specific early warning






**Centro Internacional de Agricultura Tropical**  
*Desde 1967 Ciencia para cultivar el cambio*

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