

Land-Cover and
Land-Use Change Program



UNIVERSITY OF
ILLINOIS
URBANA - CHAMPAIGN

Land-Cover and Land-Use Change, Conflict, and Peacebuilding in Colombia

McKenzie F. Johnson (PI, UIUC), **Bin Peng** (Co-PI, UIUC), Kaiyu Guan (UIUC), Luz A. Rodriguez (Pontificia Universidad Javeriana)

Contact: binpeng@illinois.edu

2023 NASA LCLUC Science Team Meeting



I ILLINOIS

College of Agricultural, Consumer
& Environmental Sciences



INSTITUTE FOR SUSTAINABILITY,
ENERGY, AND ENVIRONMENT



Background of our project- Colombia's Civil Conflict

- Colombia's Civil Conflict: the longest civil war in South America (1964-2016), which has left as many as 220,000 dead, 25,000 disappeared...
- 2016 Colombian Peace Agreement Referendum and **the Peace Accord** ended **five decades of conflict** with the **Revolutionary Armed Forces of Colombia (FARC)** and represents the path to lasting peace
- 2016 Peace Accord that **disarmed and demobilized** the FARC, by far the largest existing armed group
- The 2016 accord was the product of four years of negotiations in Havana and won the **Nobel Peace Prize** for Colombian President Juan Manuel Santos (2010-2018)
- <https://nyti.ms/3NgkzYo>



Fifth Anniversary of Colombia's Peace Accord

PRESS STATEMENT

ANTHONY J. BLINKEN, SECRETARY OF STATE

NOVEMBER 24, 2021

On behalf of the people and Government of the United States, I congratulate Colombia on the fifth anniversary of the signing of the Peace Accord. Colombia's 2016 Peace Accord ended five decades of conflict with the Revolutionary Armed Forces of Colombia (FARC) and represents the path to lasting peace. The United States has a long history of supporting the Peace Accord, and we value its continuing implementation and achievements thus far.



PRESS RELEASE

SECRETARY-GENERAL >> STATEMENTS AND MESSAGES

SG/SM/21598

24 NOVEMBER 2022

Secretary-General, on Sixth Anniversary of Final Peace Agreement in Colombia, Greatly Encouraged by Government Commitment to Bolster Implementation

The following statement was issued today by the Spokesman for UN Secretary-General António Guterres:

The Secretary-General sends heartfelt wishes to the people of Colombia and the parties to the Final Peace Agreement on the sixth anniversary of its historic signing. He recalls his visit to Colombia exactly one year ago and he notes that hopes and expectations for a firm and lasting peace have only increased, both in



Photo from UN Verification Mission in Colombia

23 NOV 2021 | PUBLICATION

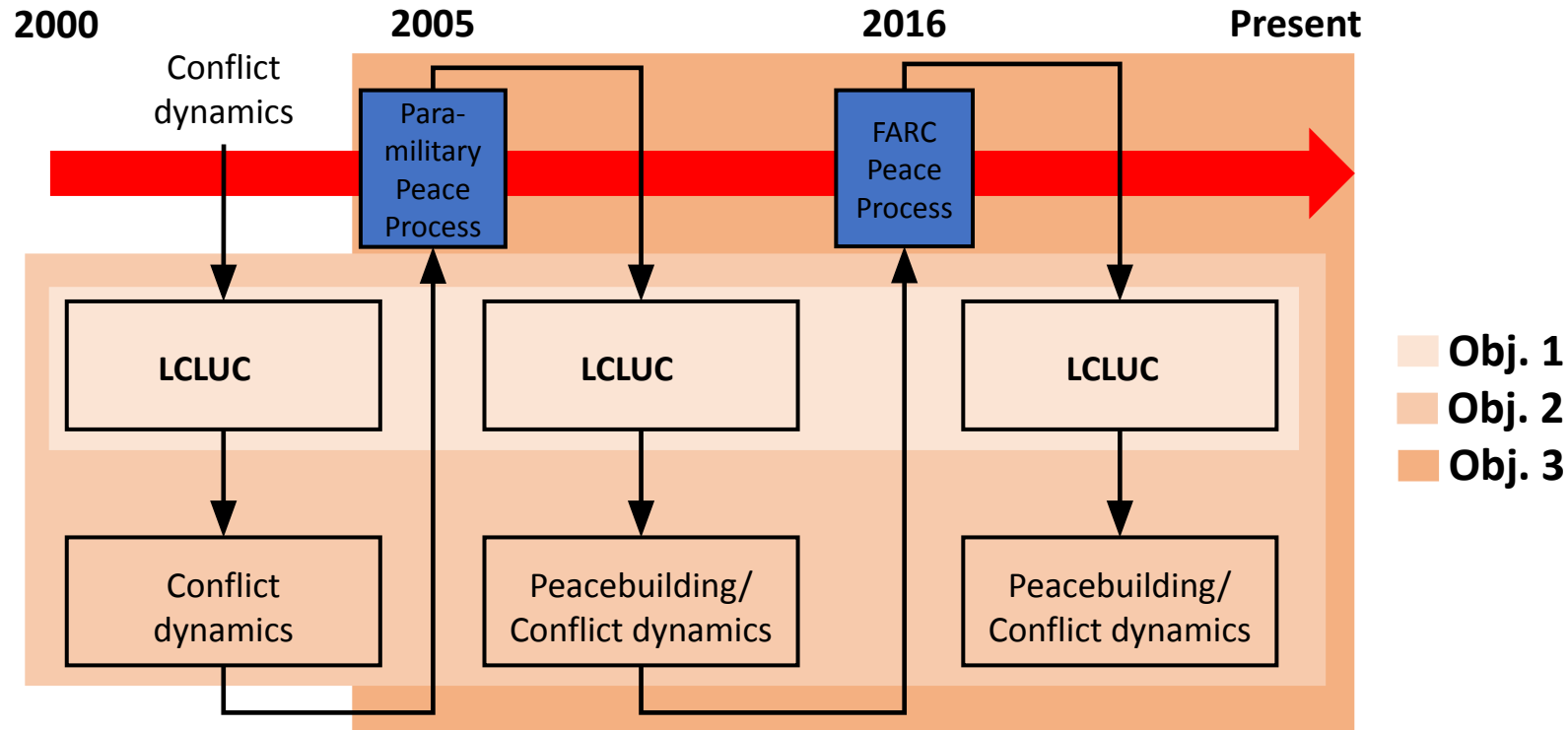
A Long Way to Go: Implementing Colombia's peace accord after five years

by Adam Isacson

10 NOTABLE FACTS FROM THIS REPORT

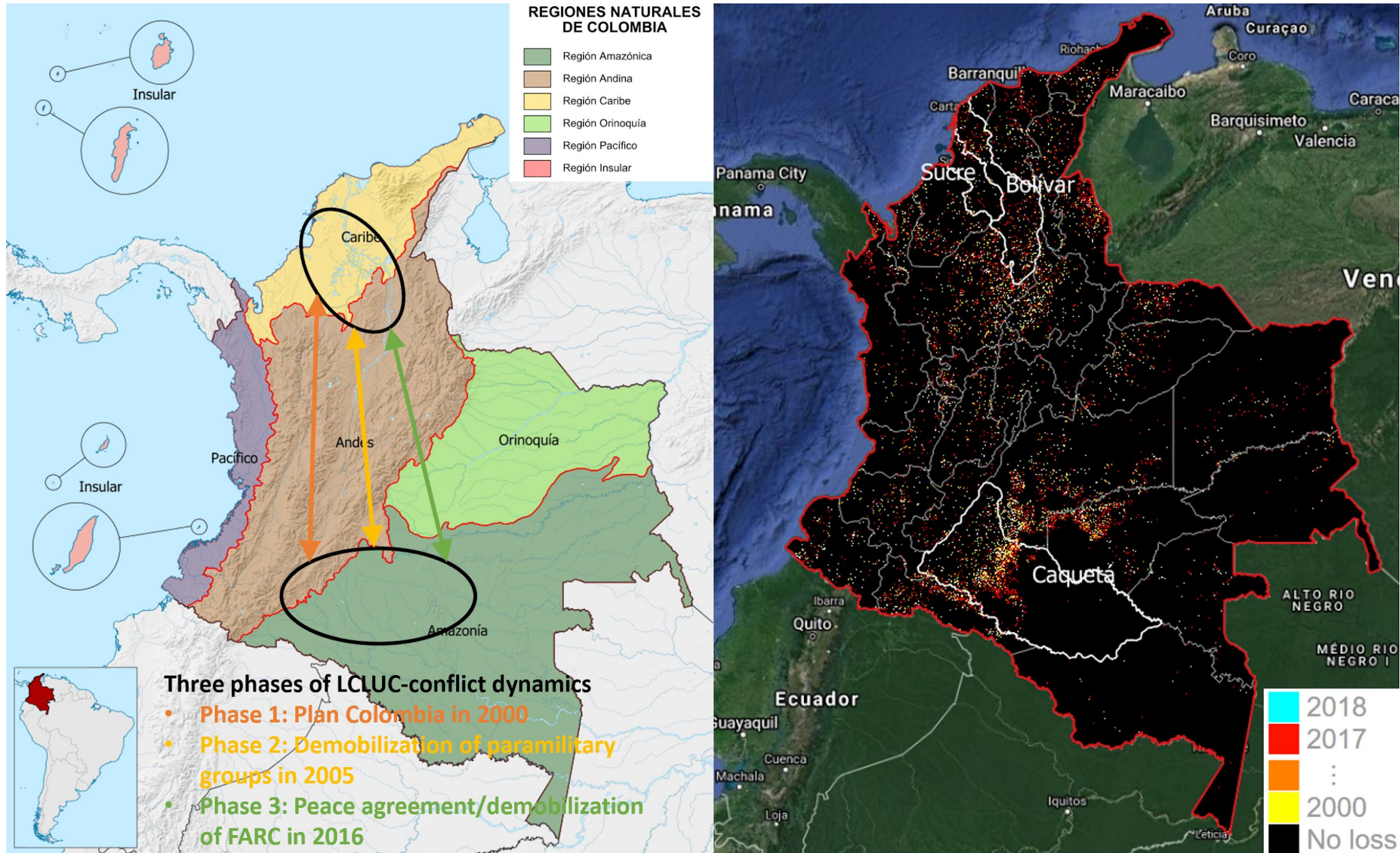
1. As of March 2021, Colombia was 29 percent of the way into the peace accord's implementation timetable, but had spent **just 15 percent** of what implementation is expected to cost.
2. One third of the way into the implementation process, the PDETs—the vital plans to bring the government into historically conflictive areas—are **only one-seventh funded**, and that's according to the most optimistic estimate.
3. A nationwide mapping of landholdings, expected to be complete by 2023, was **only 15 percent done** as of March 2021.
4. 2021 is on pace to be Colombia's **worst year** for homicides since 2013, and **worst year** for massacres since 2011.
5. Analysts' estimates coincide in finding significantly **less than 10 percent** of demobilized ex-FARC members taking up arms again. "Dissident" groups' membership is mostly new recruits.
6. Estimates of the number of social leaders murdered in 2020 range from 133 to 310. But the justice system only managed 20 convictions of social leaders' killers that year, while the Interior Minister argued that "more people die here from cell phone thefts than for being human rights defenders."
7. Of coca-growing families who signed up for a "two-year" package of **crop substitution assistance** three or more years ago, **just 1 percent** had received a complete package of payments by the end of 2020.
8. If the transitional justice tribunal is correct, half of the Colombian military's claimed combat killings between 2002 and 2008 may have been civilians whom soldiers executed and then falsely claimed were members of armed groups.
9. 20 of the transitional justice tribunal's 38 magistrates are women. 4 of 11 Truth Commissioners are women.
10. Since accord implementation began in fiscal 2017, U.S. assistance to Colombia has totaled about **US\$3.1 billion**, roughly half of it for the military and police.

Objectives of our project

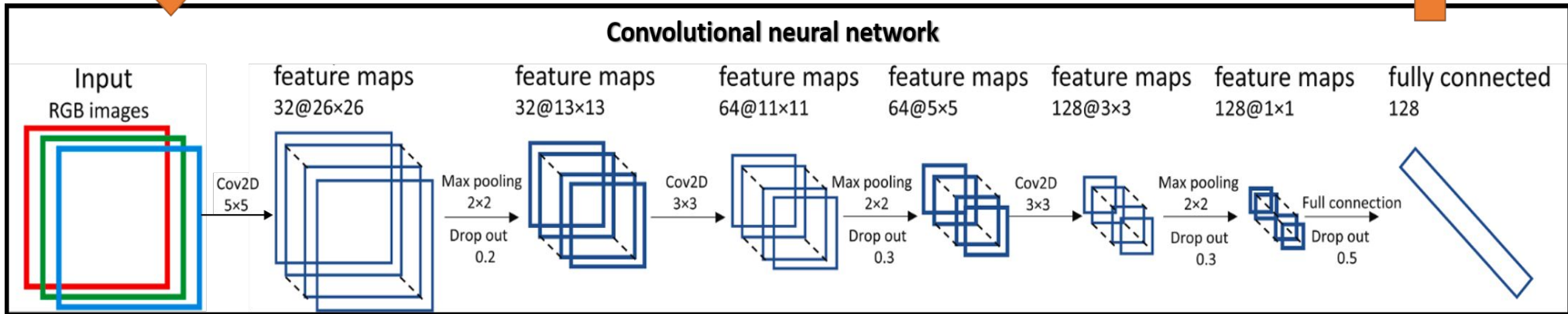
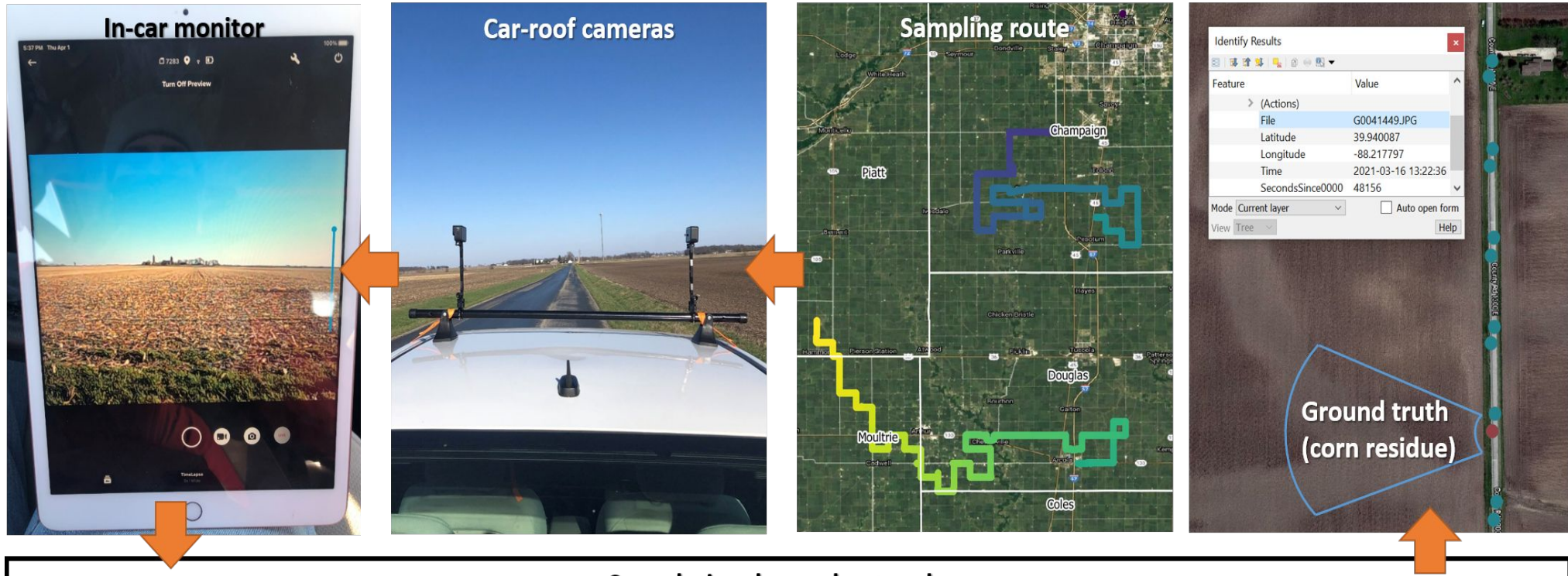


- **Obj. 1:** Identify patterns of LCLUC at **three distinct time periods** in the specified locations using satellite remote sensing data and analytics.
- **Obj. 2:** Determine how the **socio-political/economic drivers** of conflict shape and are shaped by LCLUC over time and across study regions.
- **Obj. 3:** Assess how LCLUC-conflict dynamics **impacted** LCLUC-peacebuilding dynamics, and with what **implications** for long-term peacebuilding and LCLUC.

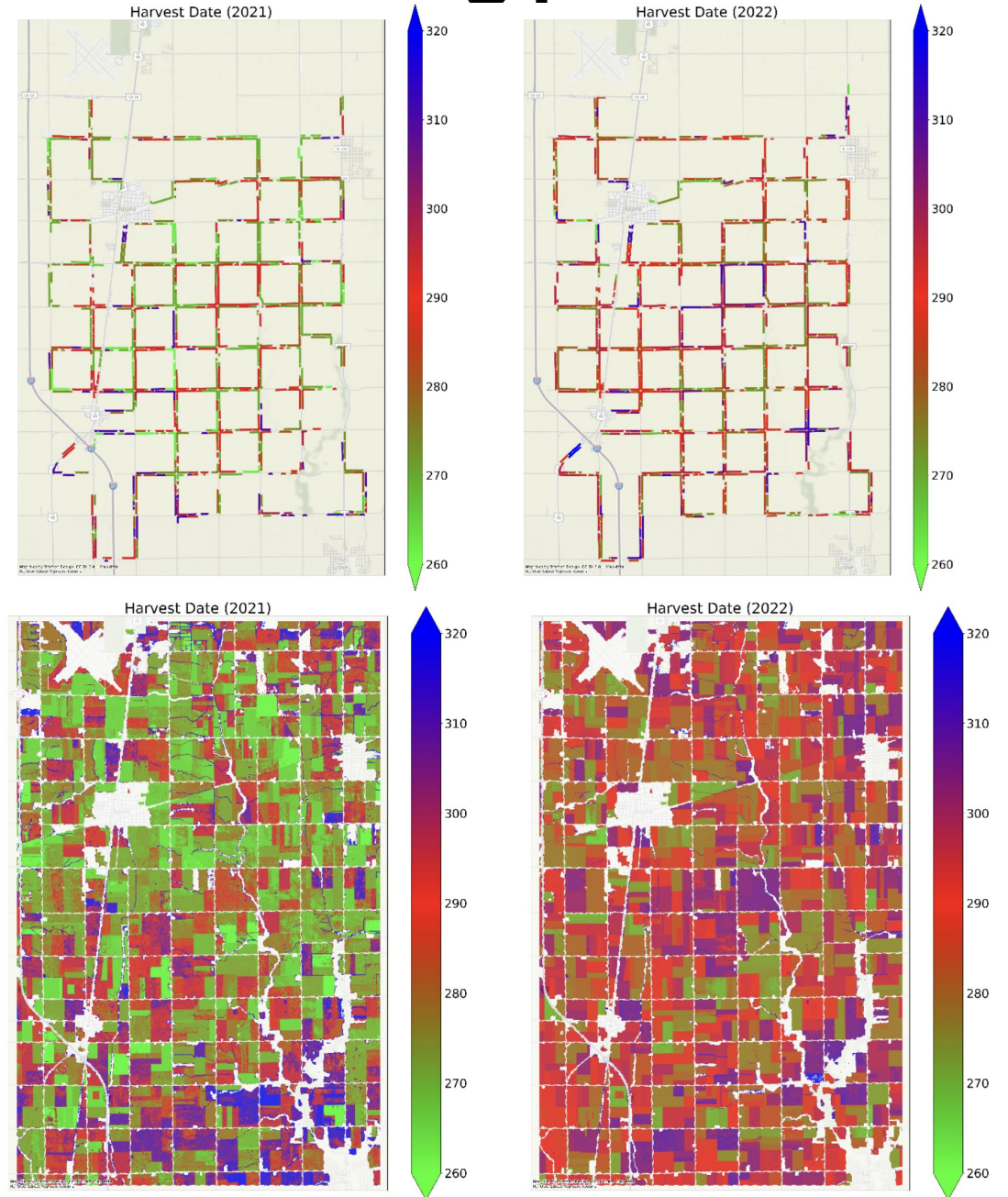
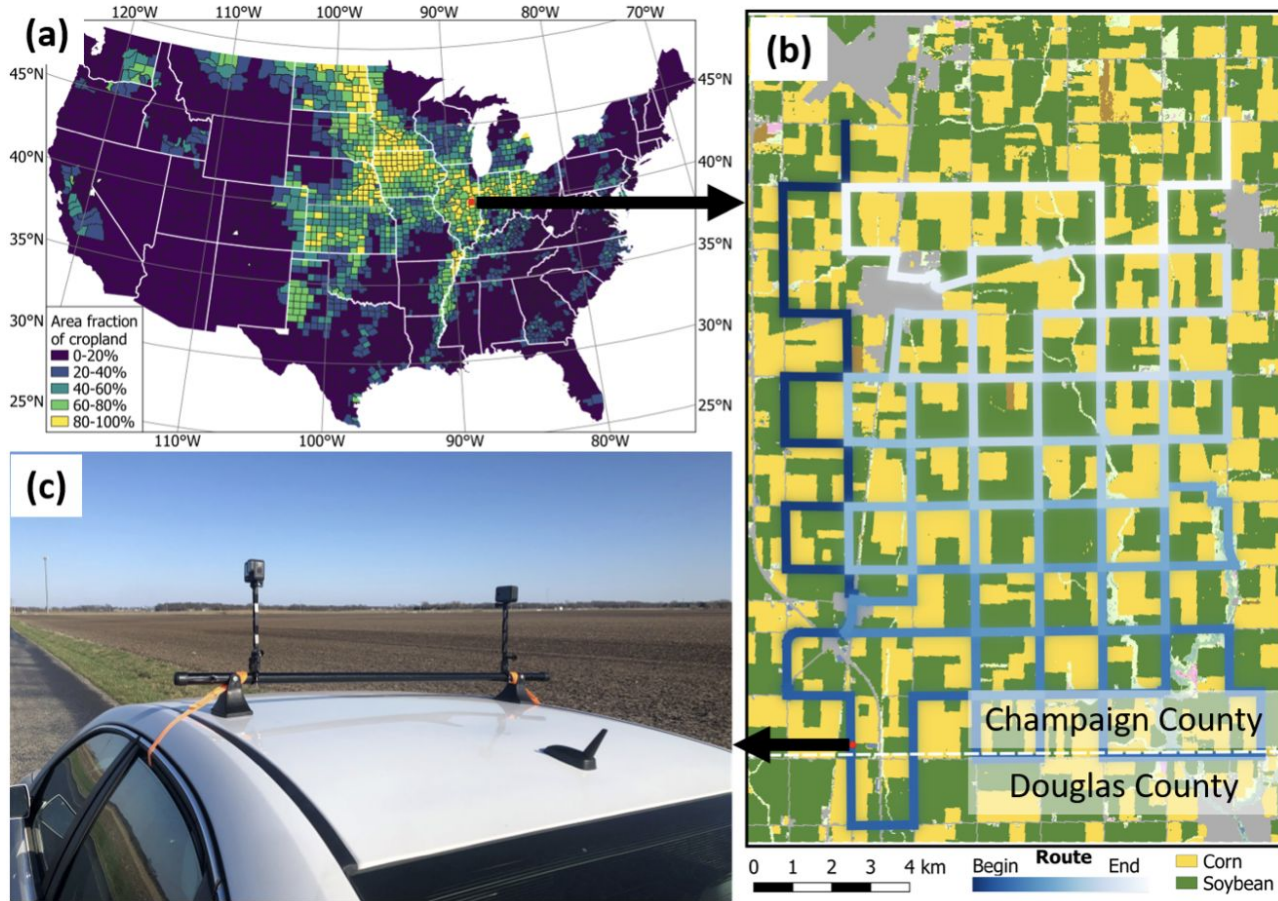
Study region of our project



Methodologies of our project-Mobile sensing platform



Methodologies of our project-Mobile sensing platform



Methodologies of our project-Satellite Remote Sensing

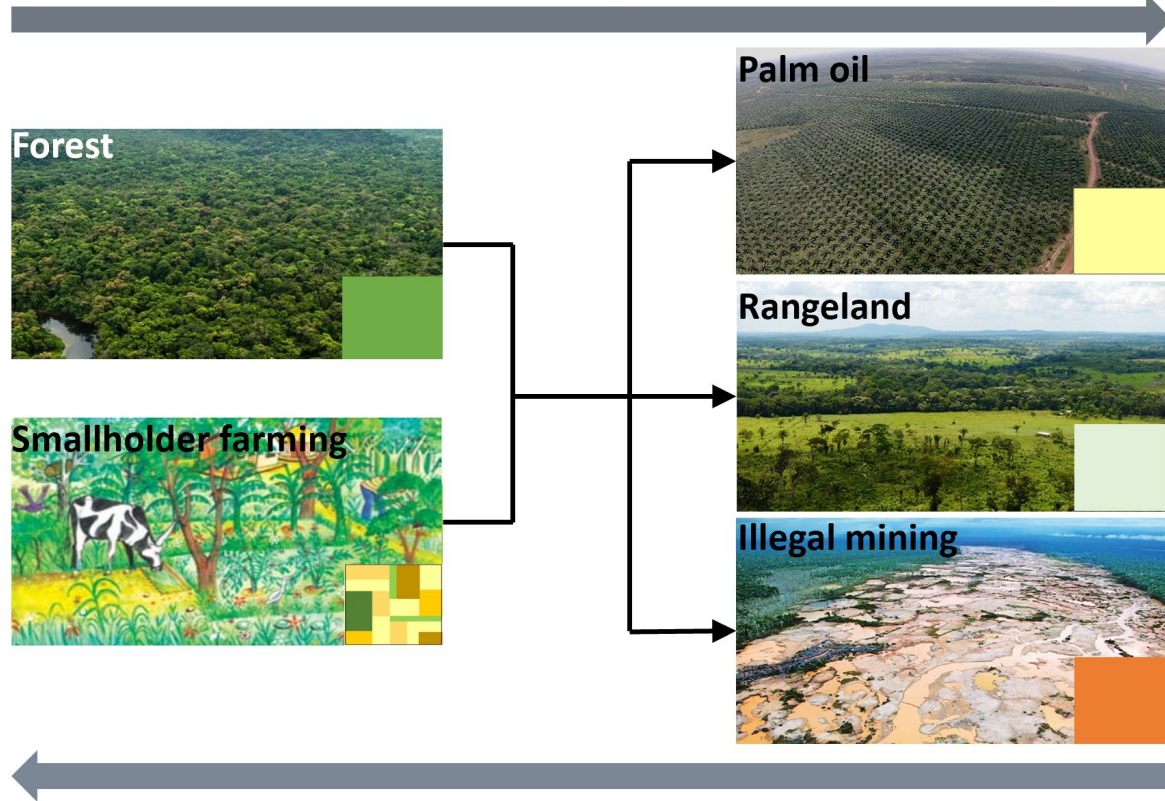
Land cover and land use categories

- Forest
 - Native forest
 - Plantation forest
 - Palm oil
 - Other plantation forest
- Grassland
 - Grazing land
 - Other grassland
- Cropland
 - Corn
 - Rice
 -
- Bare land
 - Mining
 - Other bare land
- Shrub/Bushes
- Built-up/urban area
- Wetland
- Open Water



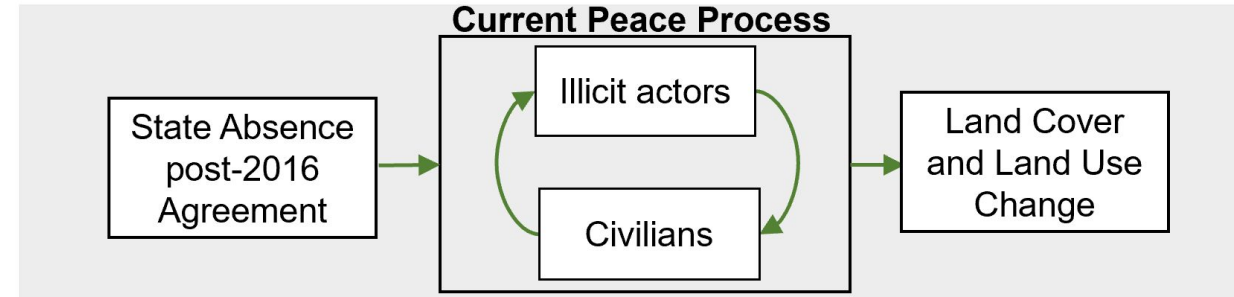
Methodologies of our project-Social Science Survey and Analysis

Unstable Peacebuilding Trajectory: Extension of agricultural frontier for monocrops, mining, and illicit crops undermines stability via smallholder farmer displacement and environmental insecurity

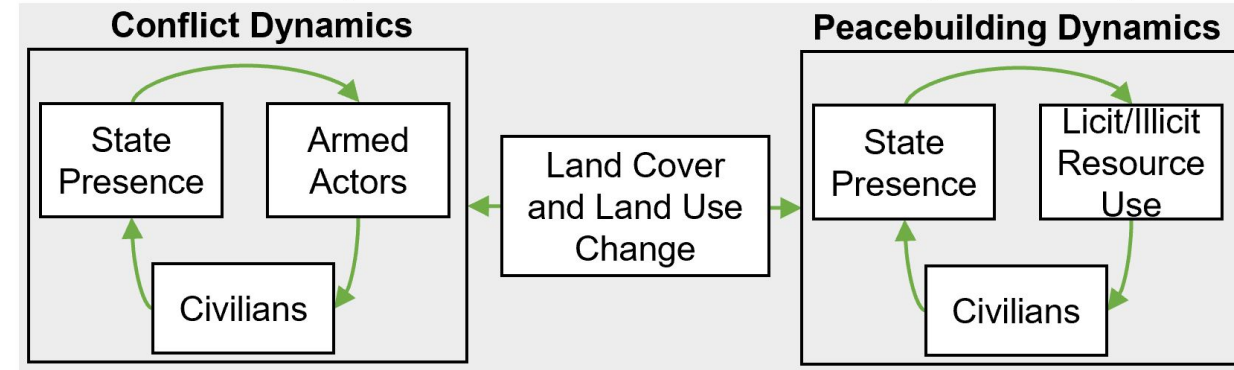


Stable Peacebuilding Trajectory: requires stabilizing the agricultural frontier (stopping deforestation) and helping small-scale farmers engage in diversified agriculture

A. Conventional conceptual framework of conflict-LCLUC-peace linkages



B. Proposed conceptual framework of conflict-LCLUC-peace linkages



Progress of our project so far....

(Due to the instability issues caused by 2022 election,
our project officially starts in 2023)

- **First trip for ground label data collection using a mobile sensing platform in Colombia and preliminary analysis**
- **Compiling a Legal Database for Colombia**



Ground label data collection using a mobile sensing platform in Colombia



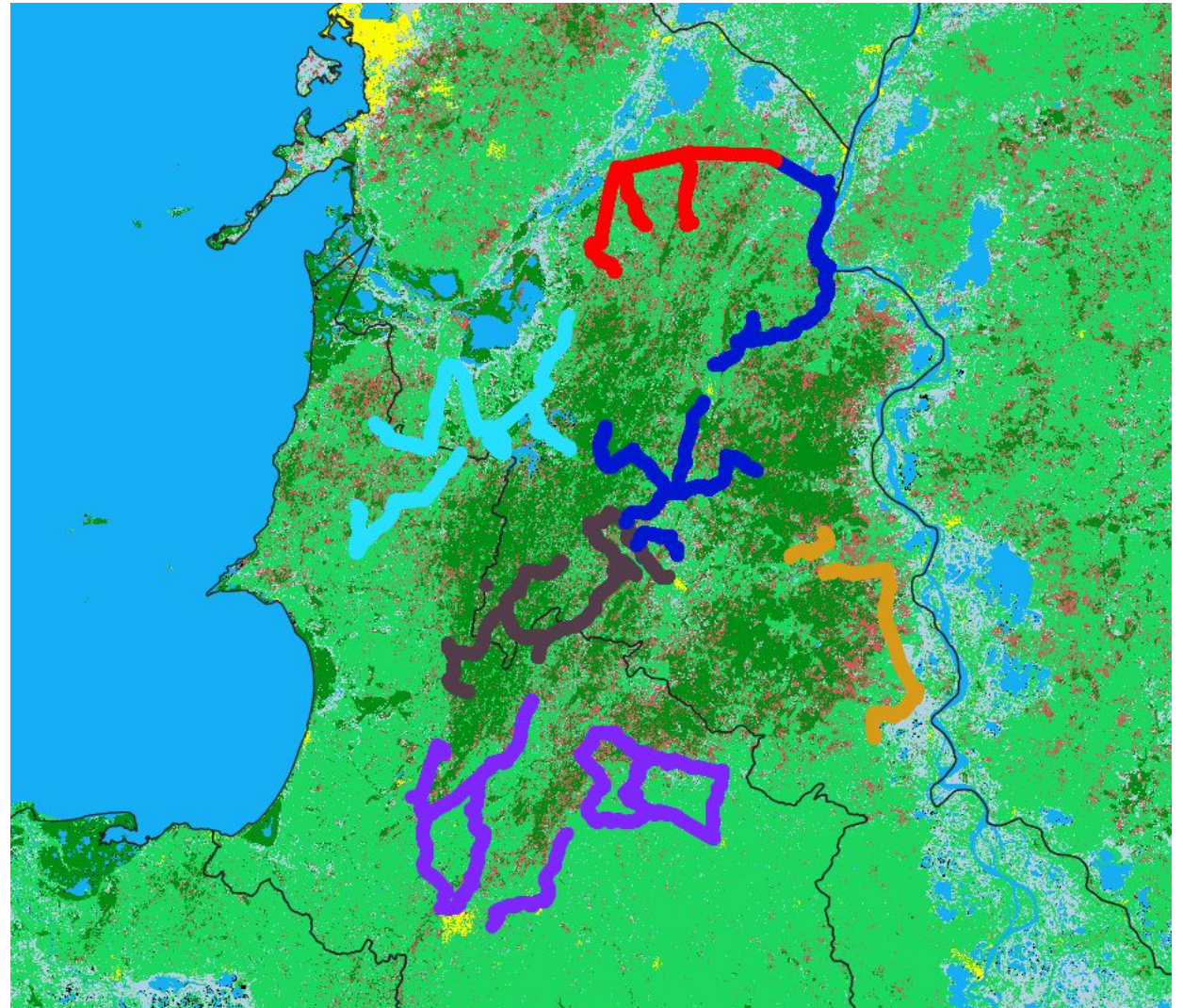
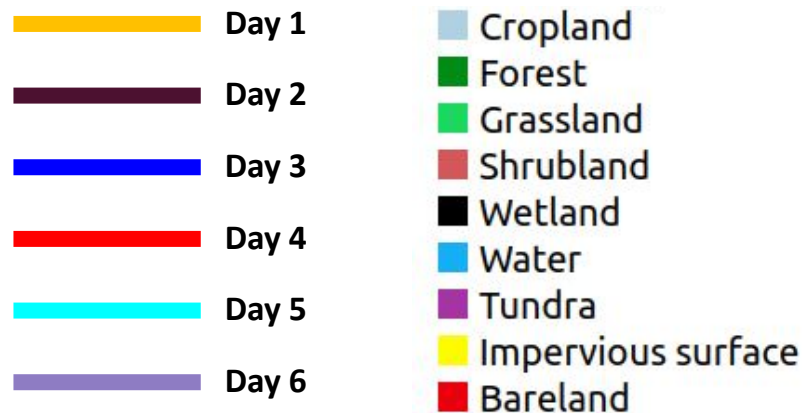
Executed 7-day field trip collecting images from vehicle-mounted camera system

Difficult Logistics

- Montes de Maria experiencing political instability
- Security of the field team was a primary concern
 - Two research assistants in the field and a driver plus MS student from University of Illinois
 - Local collaborators critical in order to assess security along the routes

Overview of the routes

- 6-day street-view photos in Colombia (March 11-March 17, 2023, no route on March 12)
- Around 70,000 images in total
- More than 10,000 images per day



Forest plantation - Oil palm



Forest plantation - Teak



Grassland - grazing land



Cropland



Shrub / bushes



Built-up / urban area



Wetland

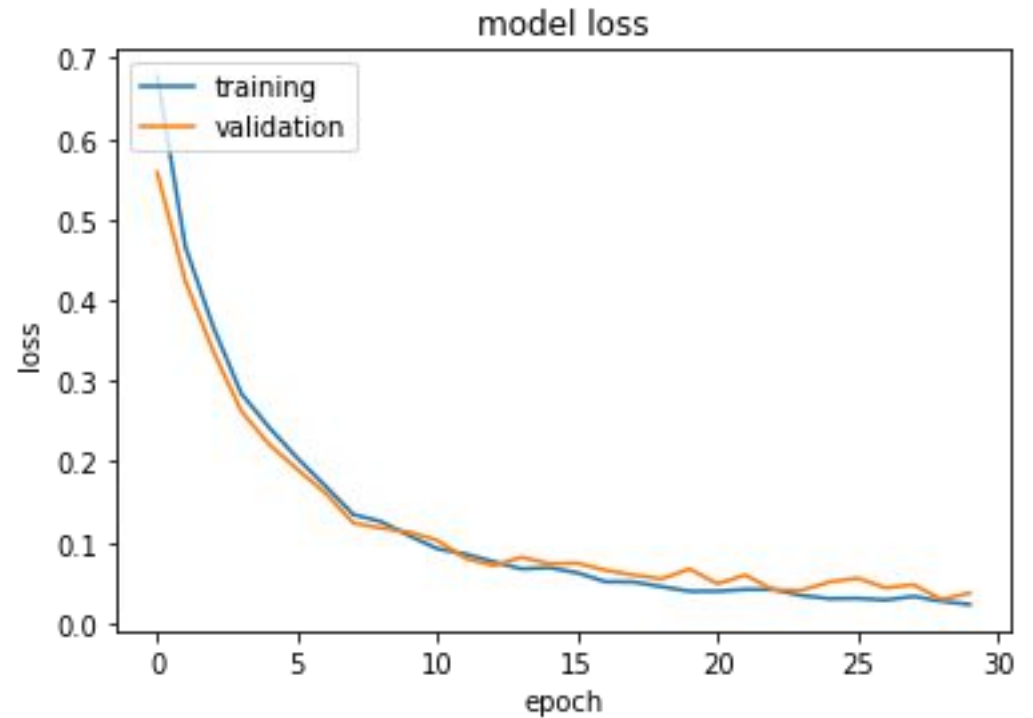
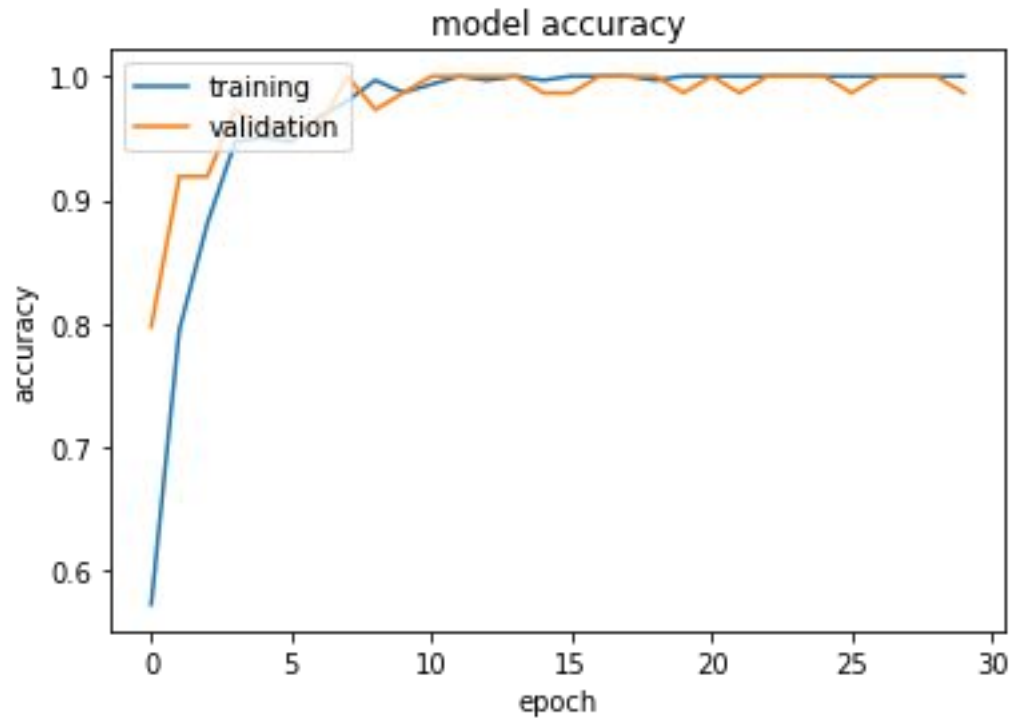


CNN model for palm oil labeling from photos

- Dataset:
 - Original size: 3888 x 5184->down sampling
 - **Palm oil**: 112 original images → 224 after data augmentation (rotate and flip)
 - **Others**: 119 original images → 238 after data augmentation (rotate and flip)
 - Training : Validation : Testing = 0.7 : 0.15 : 0.15
- Models: Imagenet-pretrained VGG16 (one type of CNN for image labeling in CV)
- Hyperparameters:
 - **RGB** or Grayscale
 - Input shape
 - 768 x 1024
 - **384 x 512**

Pre-trained model - VGG16: 30 epochs

- Model: VGG16 (thirteen convolutional layers, five max pooling layers, and three dense layers) + 1 extra dense layer
- Testing dataset accuracy: 1.0



Nearing Completion: Legal Database for Colombia

- 1.5 years of student work compiling laws and policies related to land cover land use change
 - Analysis of what the law/policy does and its potential to impact LCLUC
- Used to examine how policy change shapes LCLUC
- This summer we are validating the database
- Unique compilation of laws and policies for Colombia that are otherwise difficult to assess

Next steps...

- **Developing advanced ML/DL models for photo labeling**
- **Scaling photo-based ground truth to satellite for LCLUC mapping**
- **Conducting second field campaign for data collection in summer of 2023**



Thanks!

Any questions & suggestions are welcome...

