MIT A-Lab 2022 Project Proposal:
United Nations Mine Action Service Colombia - Land Release Impact Assessment Project

Identify and measure changes as a result of land Release operations in Colombia, using Machine Learning Models on ArcPro and Satellite Imagery.

Project Summary

1. The international community and evidence in several studies and documents portray there is an enabling role played by mine action with respect to other humanitarian actions, sustainable development, and peace and security.

2. However, in Colombia, it has been a real challenge to assess, with an evidence based approach, the impact of mine action interventions.

3. This project seeks to **identify and measure the impact of land release,** as result of operations carried out by UNMAS Colombia.

Project Context

Since 1990 more than 7000 civilians and 5000 members of the armed forces were recorded to have been killed or injured by landmines and explosive remnants of war (ERW) In Colombia , the latter of which consist of munitions which failed to detonate when fired. Anti-personnel mines of an improvised nature (APM/IN). The Peace Accord between the GoC and the Revolutionary Armed Forces of Colombia (FARC-EP) guerrillas, despite a consistent reduction of casualties between 2006 and 2017.

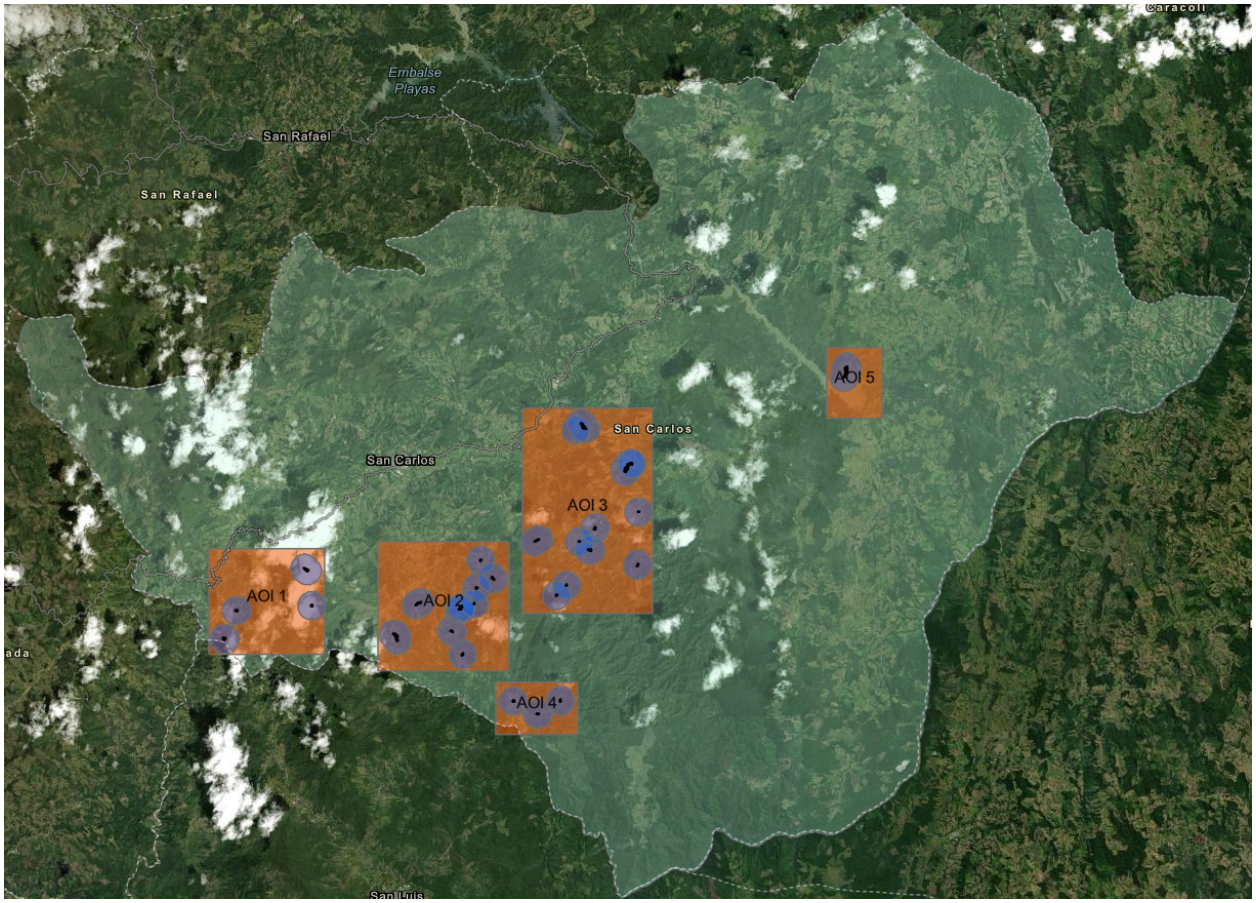
Humanitarian mine action partners in Colombia have cleared more than 4500 items of ERW, some 3077 Anti-personnel (AP), 1237 Unexploded Ordnance (UXO) among other devices since 2006. Newer contamination, such as APM/IN and ERW from fighting, poses a challenge to the national mine action programme as traditional humanitarian mine action advocacy, risk education and clearance approaches originally developed to deal with legacy landmine and ERW contamination from the Internal conflict of more than 50 years (1960-2016).

Project Purpose

Manually extracting features from raw data, such as digitizing footprints or generating land-cover maps, is time consuming. Deep learning automates the process and minimizes the manual interaction necessary to complete these tasks. However, training a deep learning model can be complicated, as it needs large quantities of data, computing resources, and knowledge of how deep learning works.

To automate the task of digitizing and extracting geographical features from remotely sensed imagery and point cloud datasets, Esri has released a series of pre-trained deep learning models that have been Trained on data across a variety of geographies. In some cases, the models are trained on a specific region or country and the results are less good when these models are run on imagery collected over different geographies.

This project aims to use the Esri machine learning (ML) tools to generate models that identify and measure changes as a result of Land Release operations in Colombia. These models will be analyzing before clearance and post clearance satellite imagery over pre-selected areas of interest (AOI).



Project Pitch

Students will submit **three deliverables** at the end of the project.

Deliverable 1 (Required) - Build 4 Machine Learning Models:

a. MIT team will build four ML Models that will be used to compare pre clearance and post clearance imagery over the AOIs to identify:
   i. New buildings
   ii. New Roads

iii. New Human Settlements
iv. New land cover classifications.

examples of guiding resources for the MIT team include:

Object Detection using Deep Learning
Classify Objects using Deep Learning
Classify Pixels using Deep Learning
Classify a point cloud using Deep Learning

b. Images of examples of these 4 change indicators will be provided for the MIT team to use to train the models.
c. An acceptable accuracy % of the models will need to be assessed during the course of the project, but as a rough threshold, we are aiming for above 80%.
d. Deliverable will be a PDF summary report cataloging the identified visual changes between the Before and After images of each pre-selected AOI.

Deliverable 2 (Optional, depending on resources and time) - Generate vector data from ML Models:

A. This deliverable will be an additional and appended summary table to the PDF report of deliverable 1, above, to produce a vector data set of change signatures with information in the attribute table detailing new/old signatures, including data of pre clearance image and date of post clearance image used in analysis.
B. This step is a matter of simple geospatial analysis to get the area sizes and do some basic statistics, using ArcPro to run the analysis,
C. This deliverable will be a table, grouped by AOI, listing each change indicator and the metric of change, e.g. number of new houses, km's of new roads etc.

Deliverable 3 (Required)- Write a Methodology Report

A. This deliverable will be a Methodology report detailing the steps the MIT team took to run the ML models that were used to produce the two deliverables, above
B. This deliverable will be in PDF form, and an example of this Methodology can be used by the MIT team as a guide to help see the kind of similar projects we have run with MIT in 2021/22, using the UNMAS Afghanistan Case Study.

Project Skills

1. The MIT team will have experience with ESRI's ArcGIS Enterprise and specifically a strong background in ArcPro.
2. The team will have machine learning experience.

Project Data

The students will be given access to high resolution images, hosted and only accessible through the UNMAS Global IMS servers These images will be processed using ArcPro desktop, which will be installed on the MIT team's laptops.

All processed images will be stored and cataloged on Global IMS Servers and will not be used or shared outside this environment.

Data Description

Satellite imagery:

- Before and After images will be provided of all preselected AOIs to run the ML Models
- A catalog of images of **agriculture, buildings, roads** and **urban development** will be provided to train the ML models.

Data Access and Computational Resources

- Students will be given controlled user accounts on the **Global IMS**, from where they will access the 2 image catalogs (Before and After images, plus the Training images).
- Students will have access to the full set of ESRI's ArcGIS Enterprise suite of geoprocessing and analytical tools, especially they will work with **ArcGIS Pro**, for which licenses will be provided for them to install on their own computers.

Primary Contact Information:

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