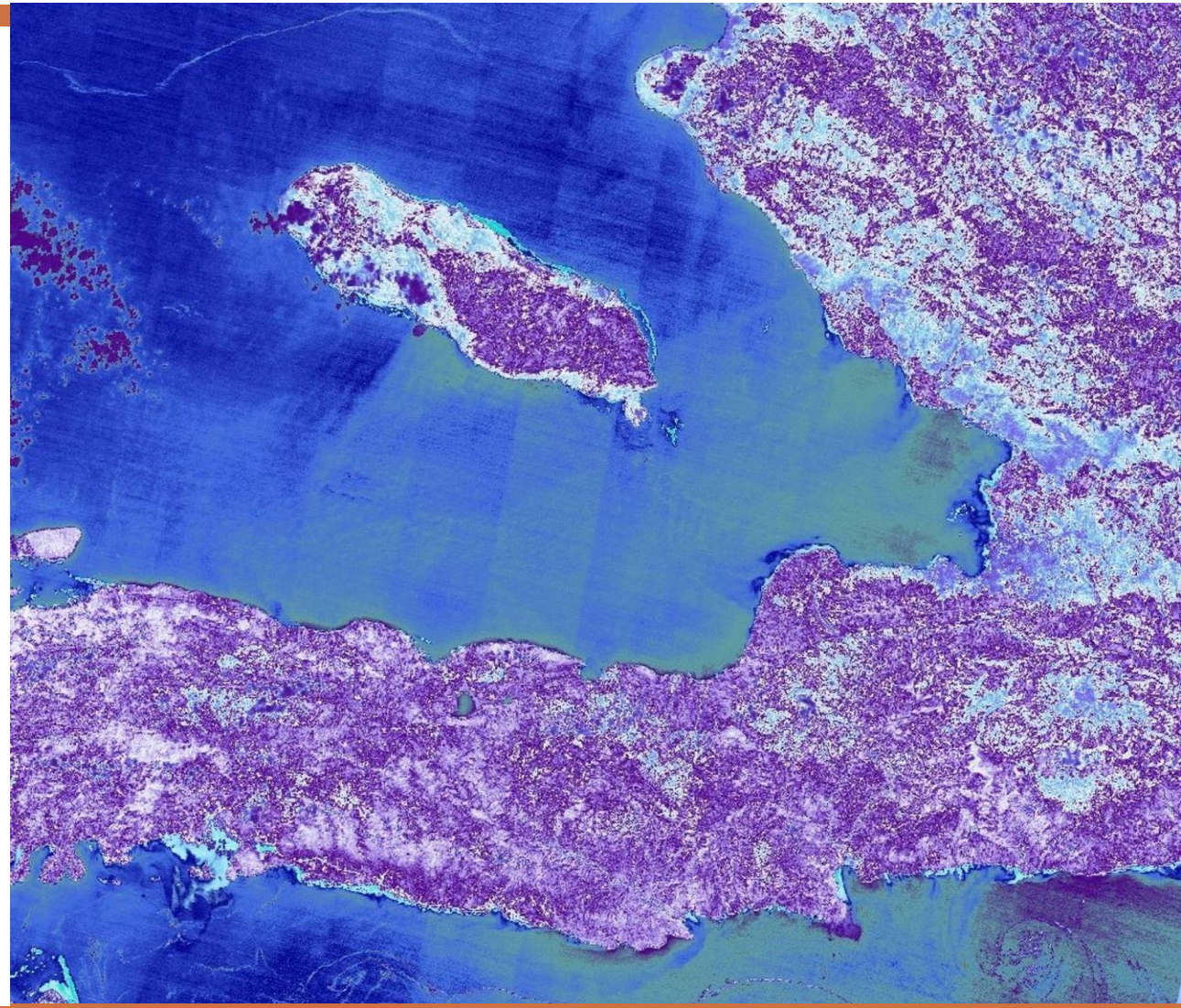
National Aeronautics and Space Administration

Haiti II
Agriculture

Evaluating the Success of Reforestation Practices in Haiti



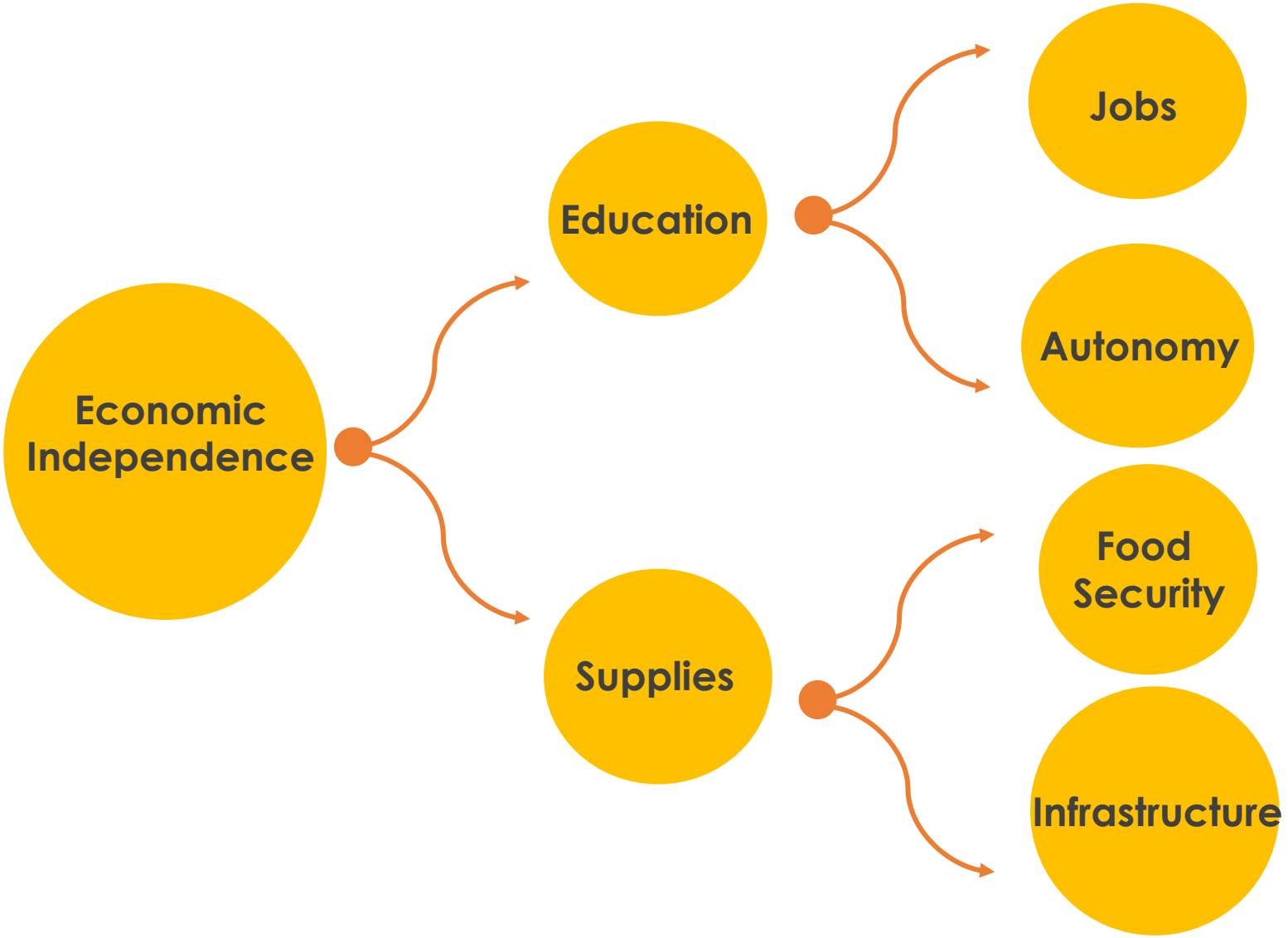
Kelli Roberts
Justin Meyer
Monique Howlett
Rajneesh Sharma

INTRODUCTION

- French colonization led to large scale deforestation
- Deforestation issues continued post-independence
- Nearly half of Haiti's population is food insecure

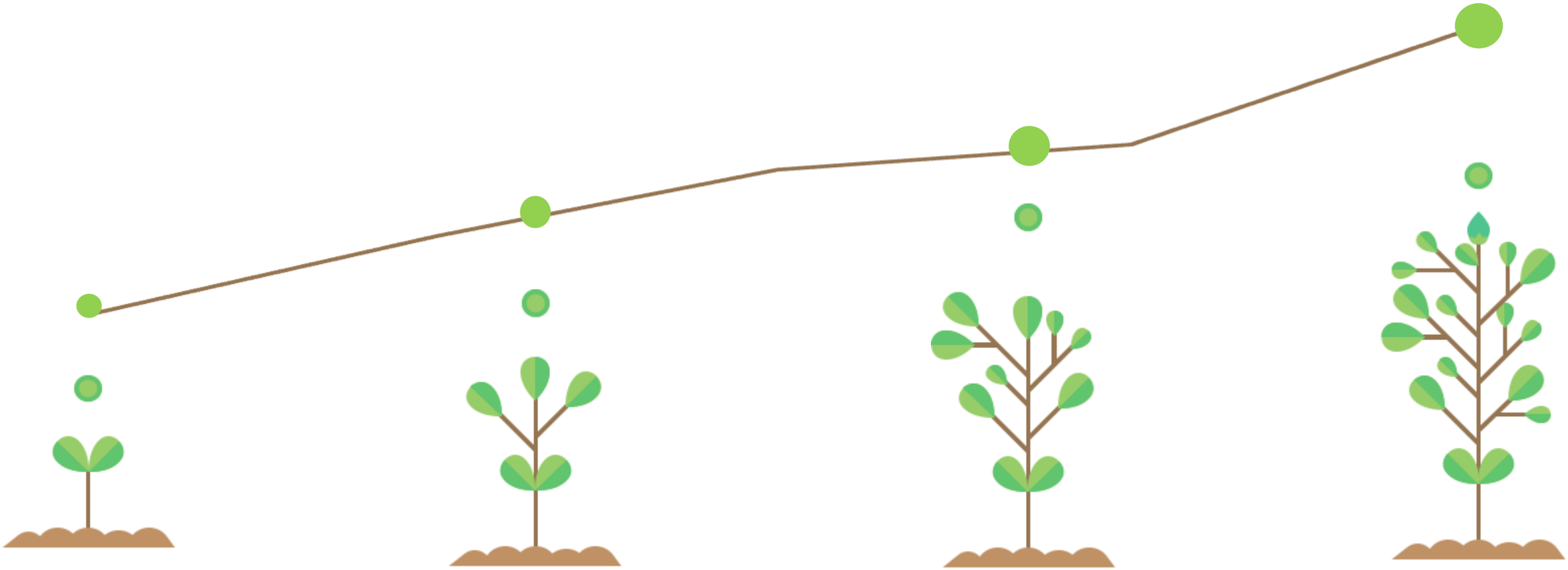
Image Credit: Jim Goetz

COMMUNITY CONCERNS



- Natural disasters & climate change impact resiliency to food insecurity
- Economic independence expands to multiple socioeconomic factors

PARTNERS



1989
Haiti Fund, Inc
(CODEP Today)

1990
Partnership between
CODEP & HRP

1992-1993
Demonstration Forest
was planted

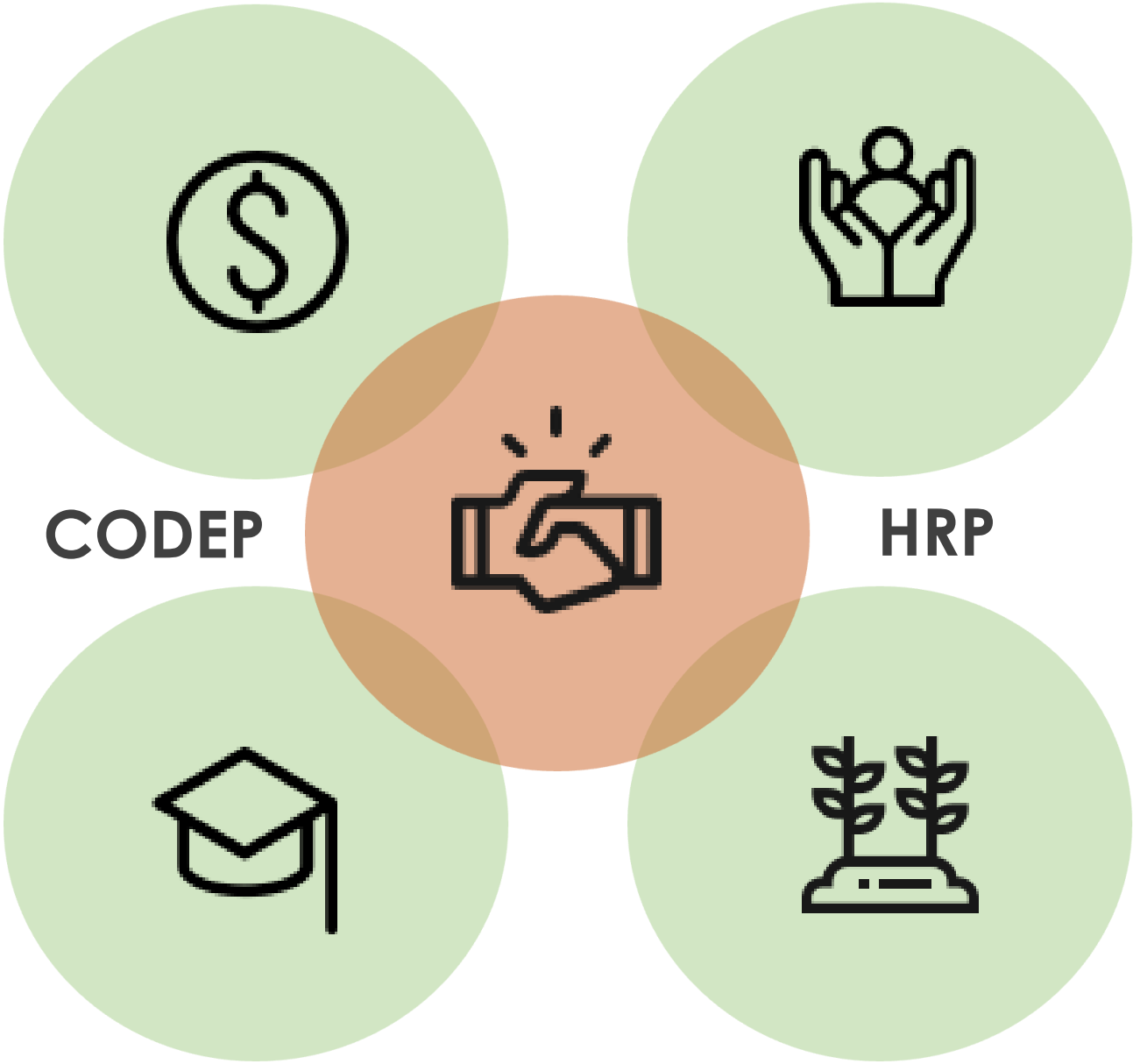
Today
15.52 million trees
have been planted

Image Credit: Slidesgo

PARTNERS

Financial Support

Leadership Development



CODEP

HRP

Technology + Education

Forestry + Agricultural Techniques

Icon Credit: Slidesgo

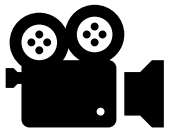
OBJECTIVES

- Habitat suitability model

- Develop static maps

- Write an animator guidebook

- Print a 3D elevation model



- Create a highlight video

STUDY AREA & STUDY PERIOD

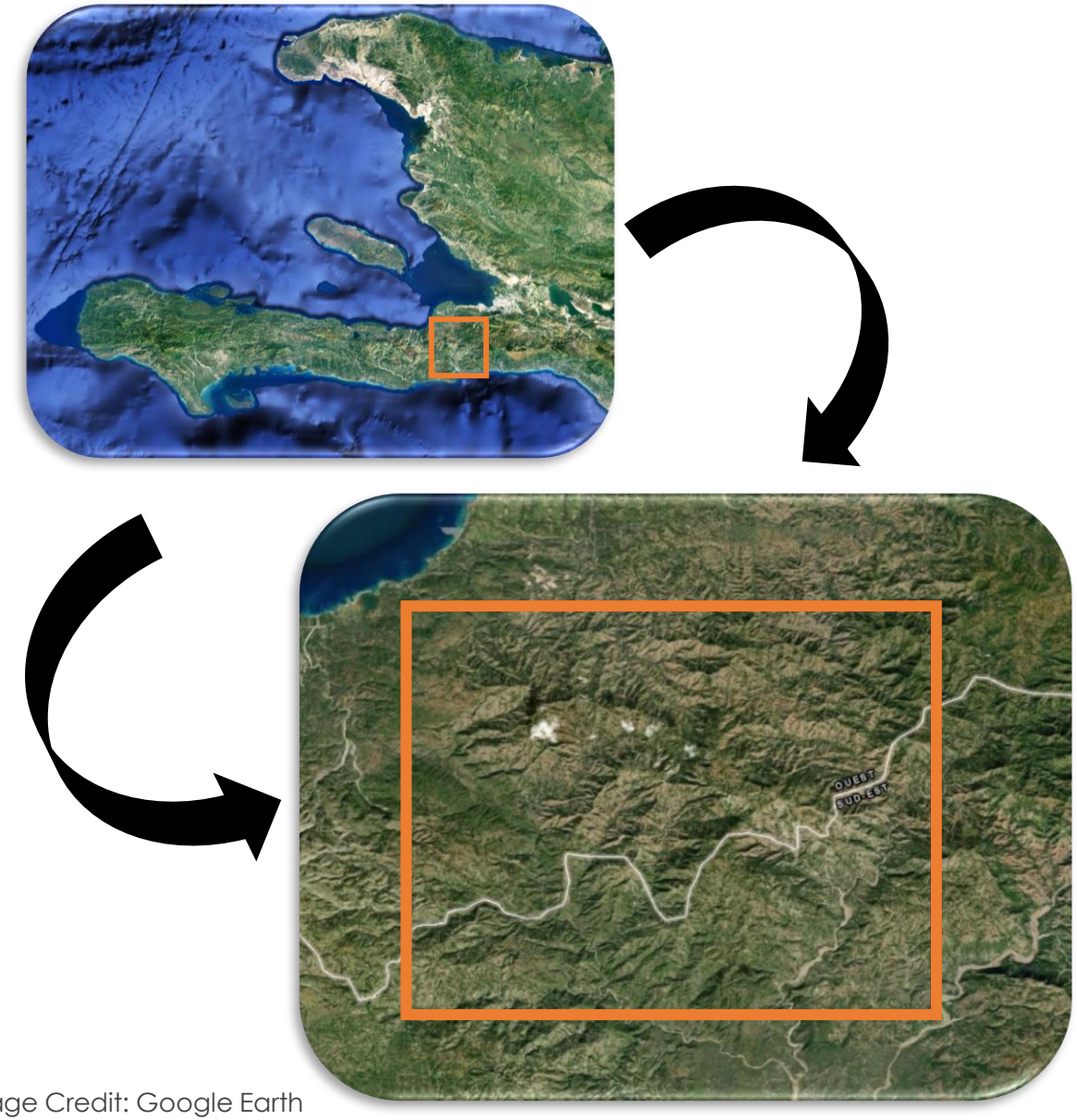


Image Credit: Google Earth

Study area (Fondwa) lies southwest of the capital of Haiti

Enlarged study area compared to previous term

Study period is from January 2015 to June 2022

STUDY AREA – Creation

- Removing control groups and planting zones from previous term's study area
- Southeast expansion towards the University of Fondwa and the Jacmel River
- Southwestern expansion to account for future animator zones

Image Credit: Google Earth

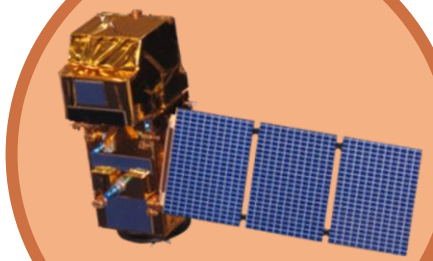
SATELLITES & DATA

PlanetScope/RapidEye
(NDVI/EVI)

CNIGS Airborne Lidar
(DEM)

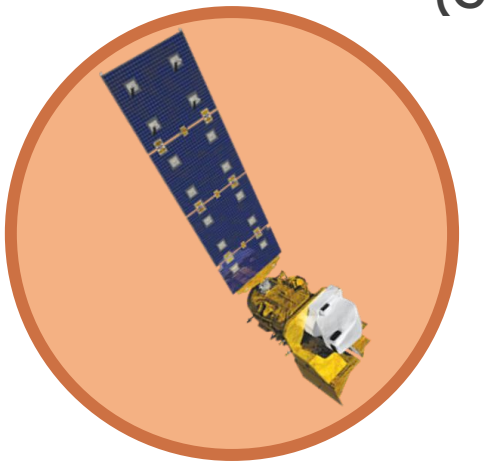
SoilGrids Database
(Soil health)

Digital Chart of the World
Server
(Geography)



Sentinel-2 MSI (NDMI)

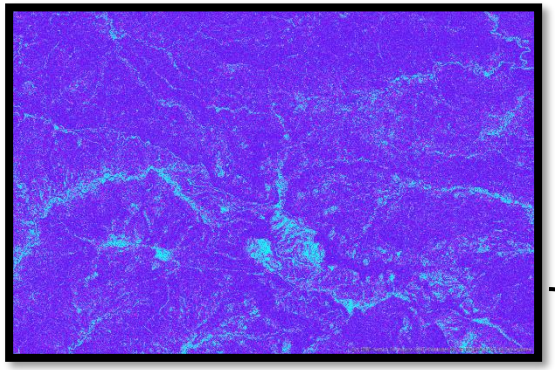
Landsat 8 OLI (Temperature)

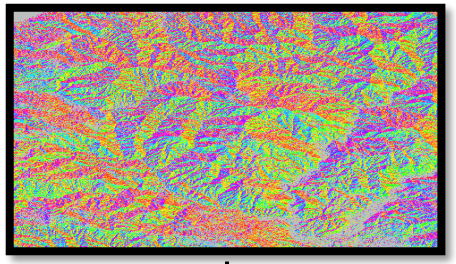


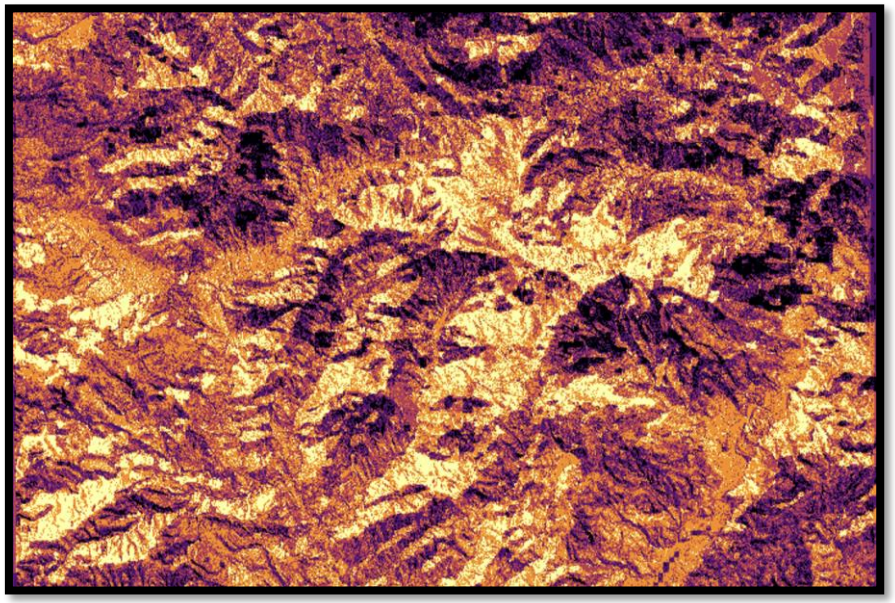
Landsat 9 OLI-2 (Temperature)

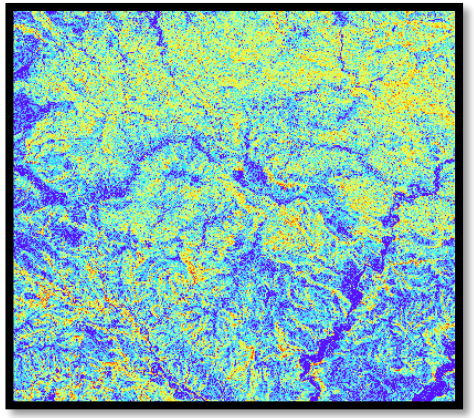
Image Credit: NASA + ESA

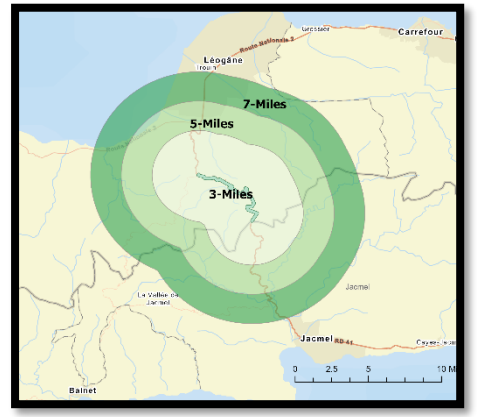
METHODOLOGY – Habitat Suitability Predictor Variables

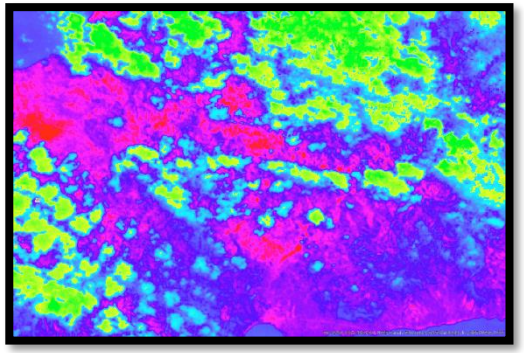


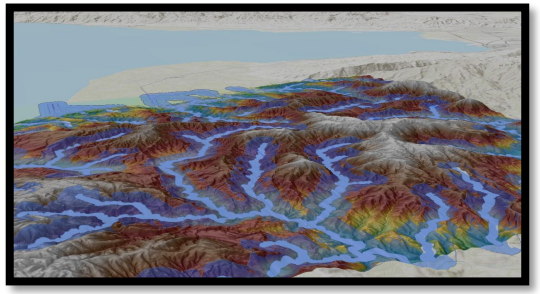


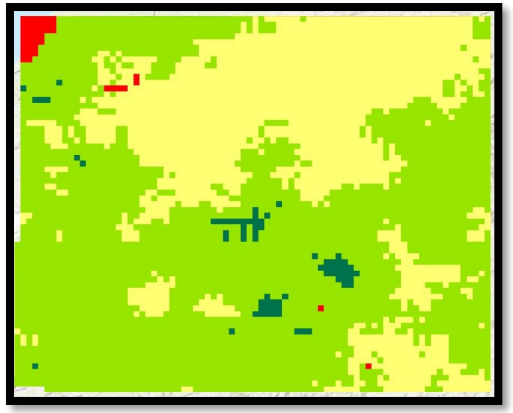








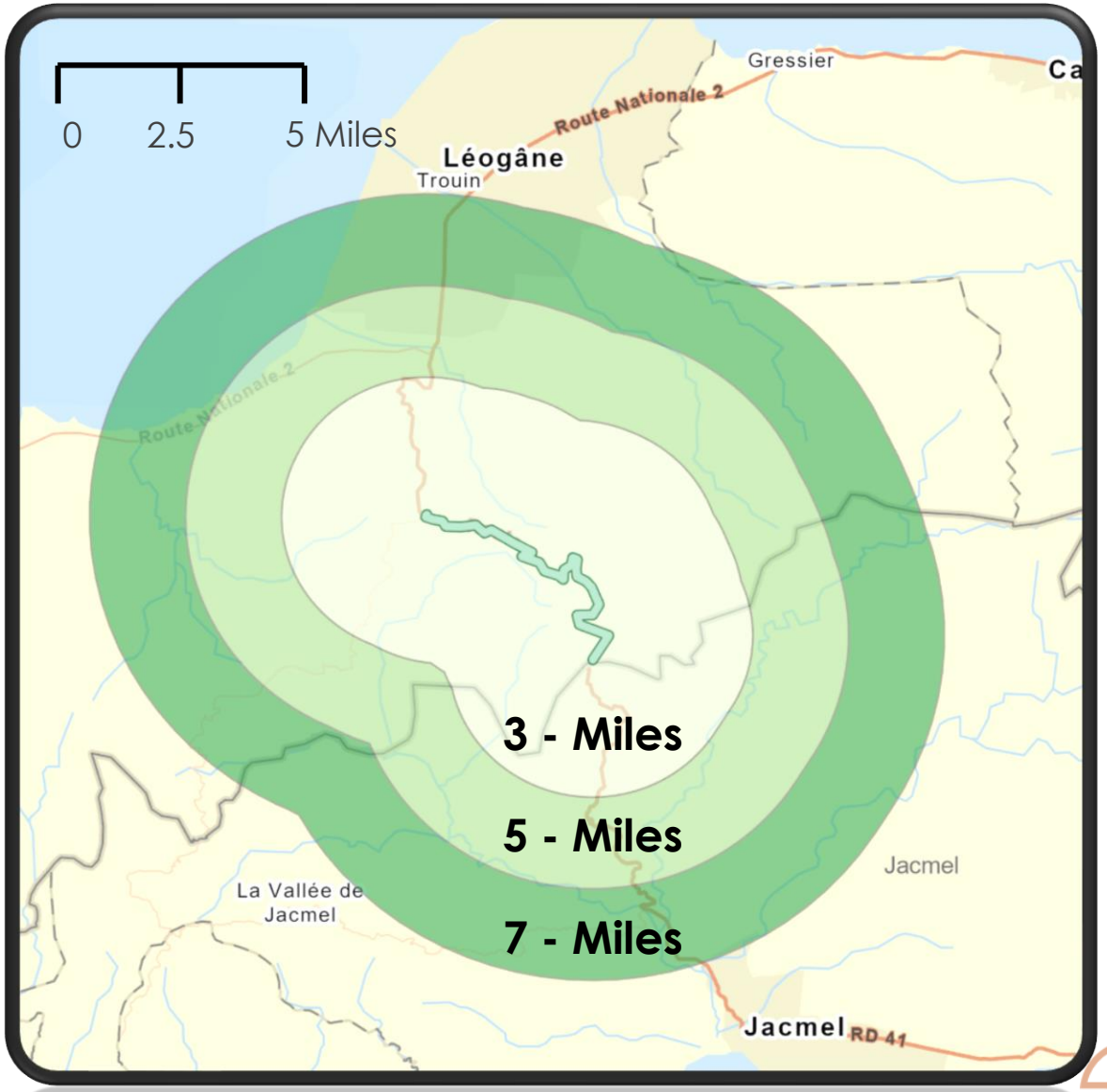




METHODOLOGY – Buffers

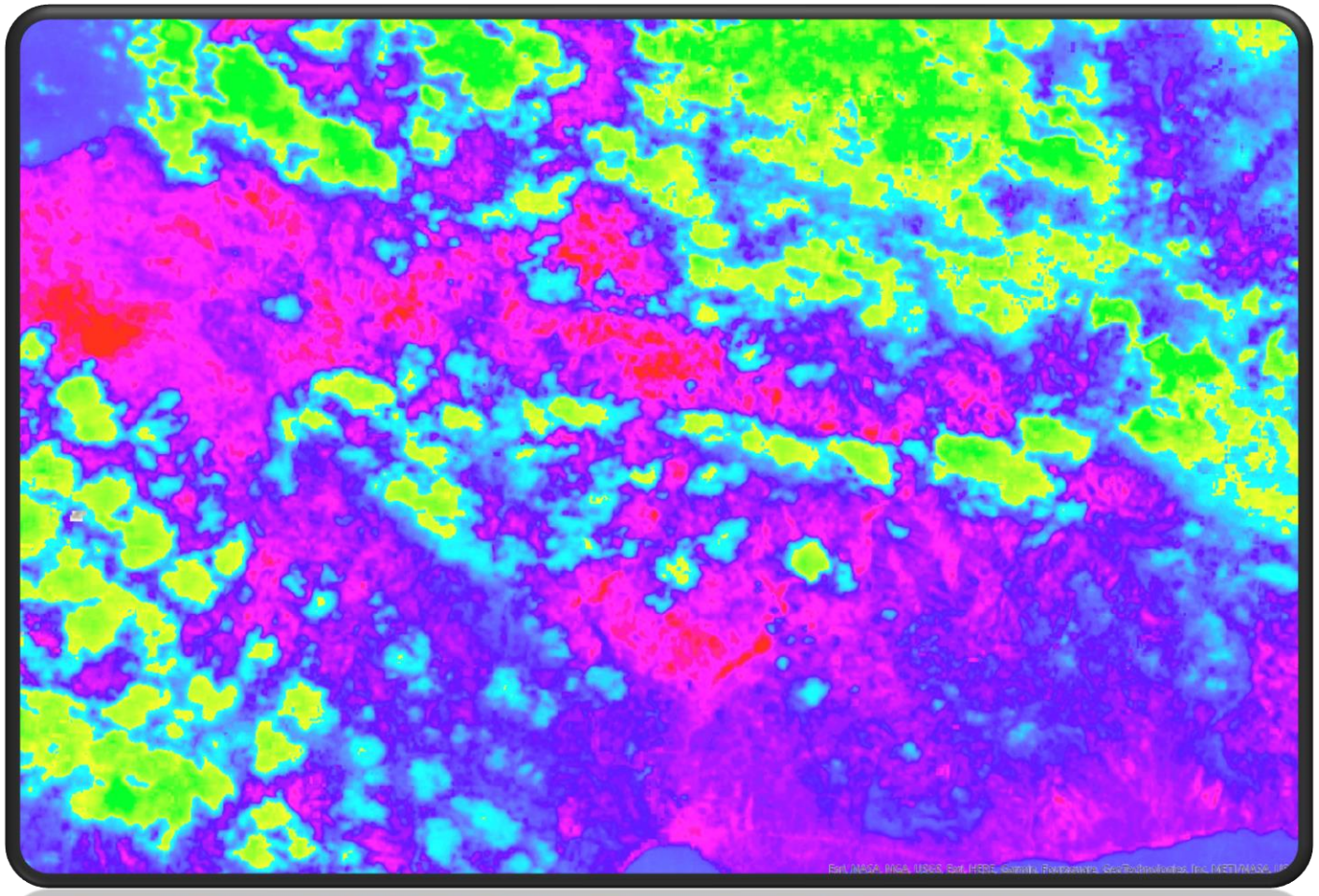
- Multi-layer buffering around Route-4, the Jacmel Road

3 miles → 5 miles → 7 miles



METHODOLOGY – Surface Temperature

- Temperature is a top factor for vegetation growth
- Using median data from rainy season showed temperature hot-spots
- Landsat 8 & 9 raster data were exported as Surface Temperature (ST)

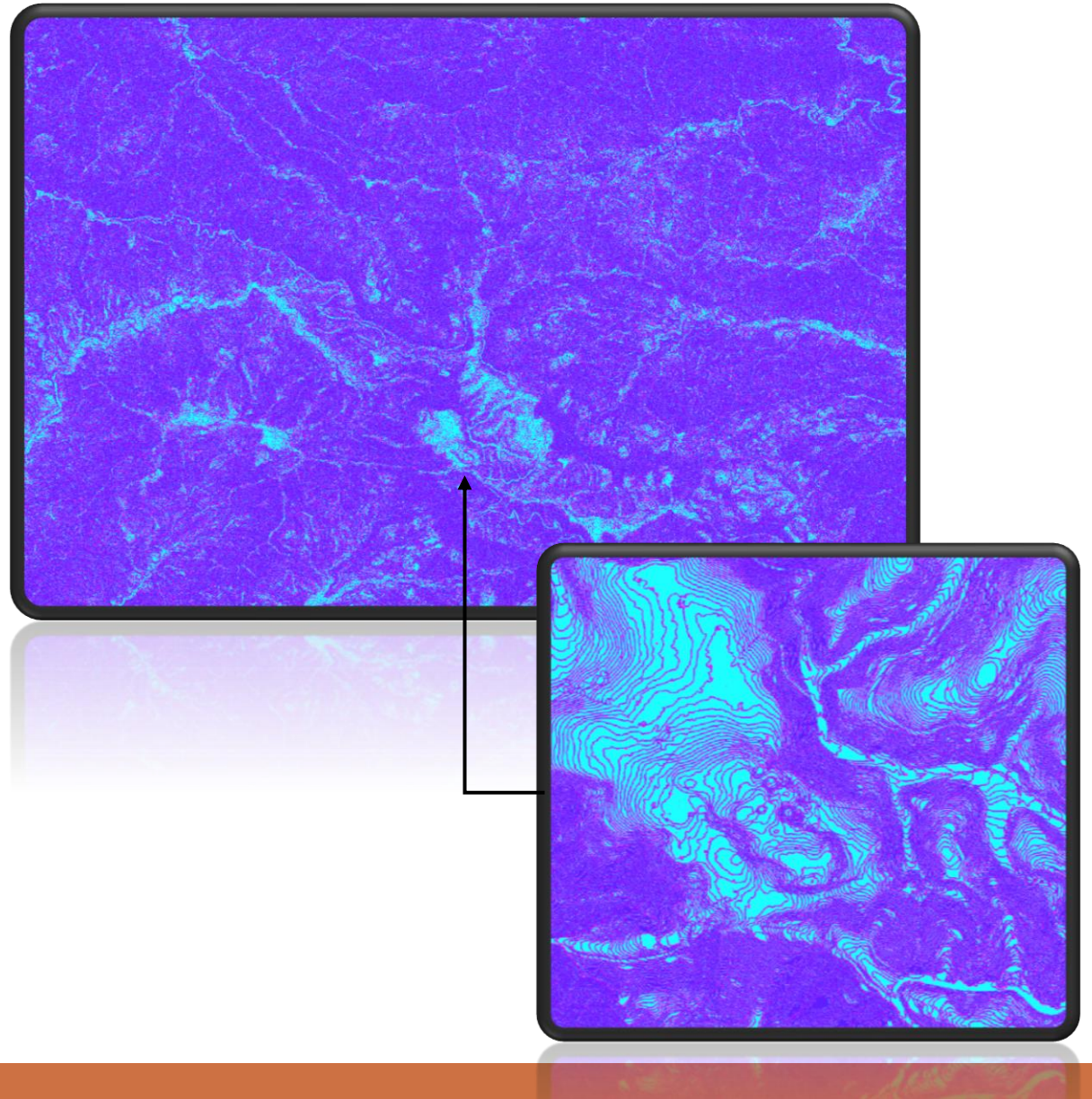


Temperature:

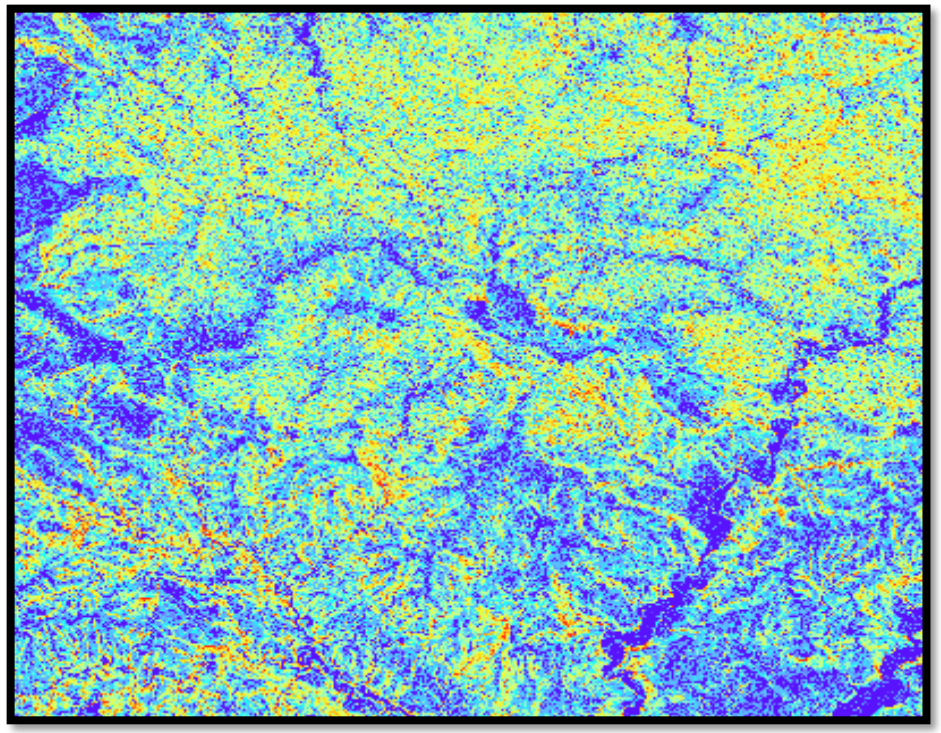
Median: 75 °F

METHDOLOGY – Roughness

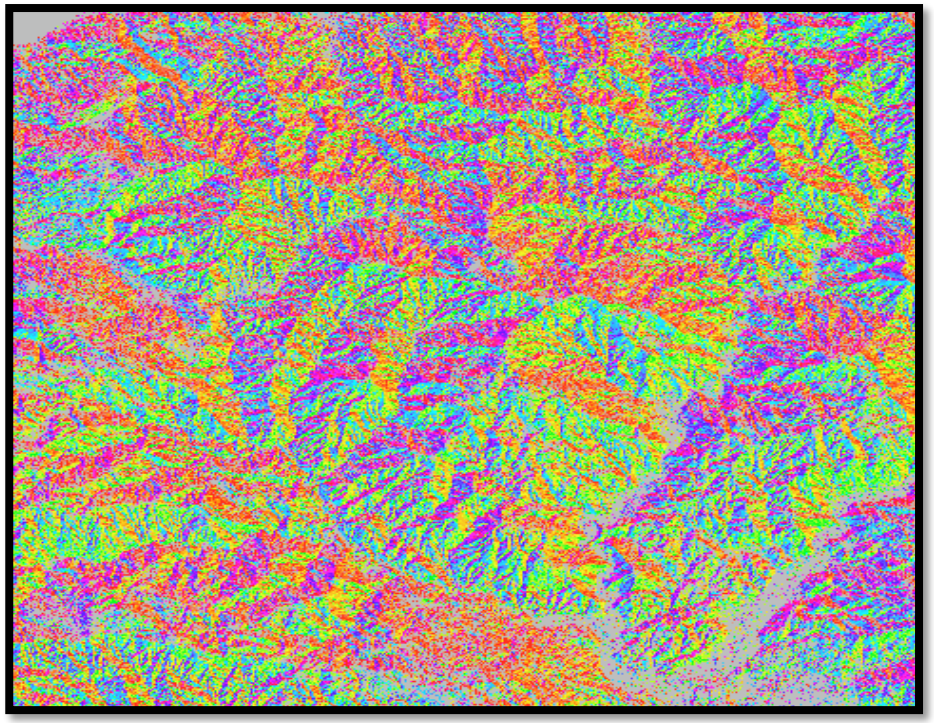
- Roughness is an indication of how rugged or difficult terrain is to navigate
- Indicates sudden change in elevation and difficulty of traversal
- Areas of low roughness may prove easier to grow in



METHODOLOGY – Slope & Aspect



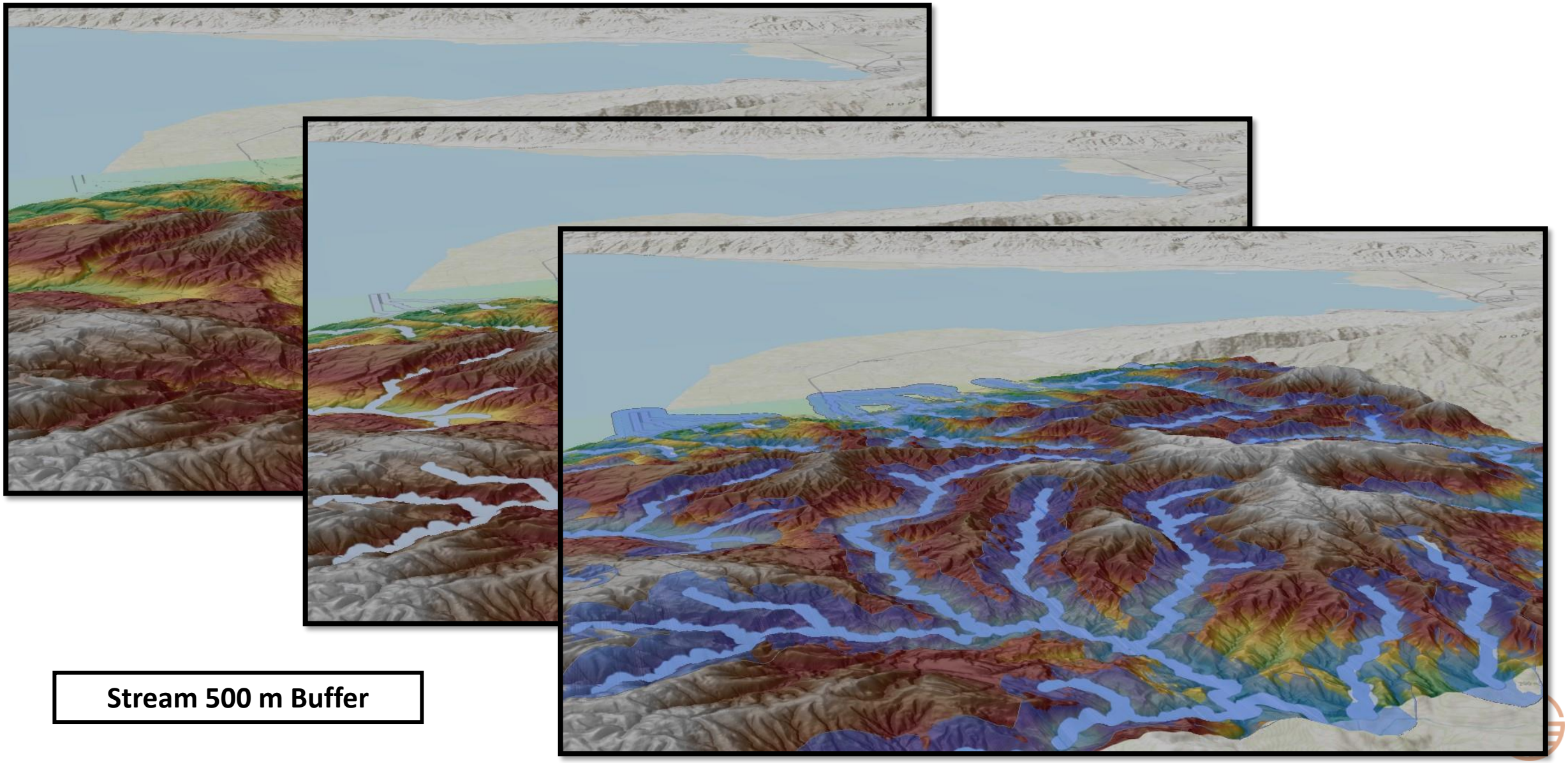
Slope



Aspect

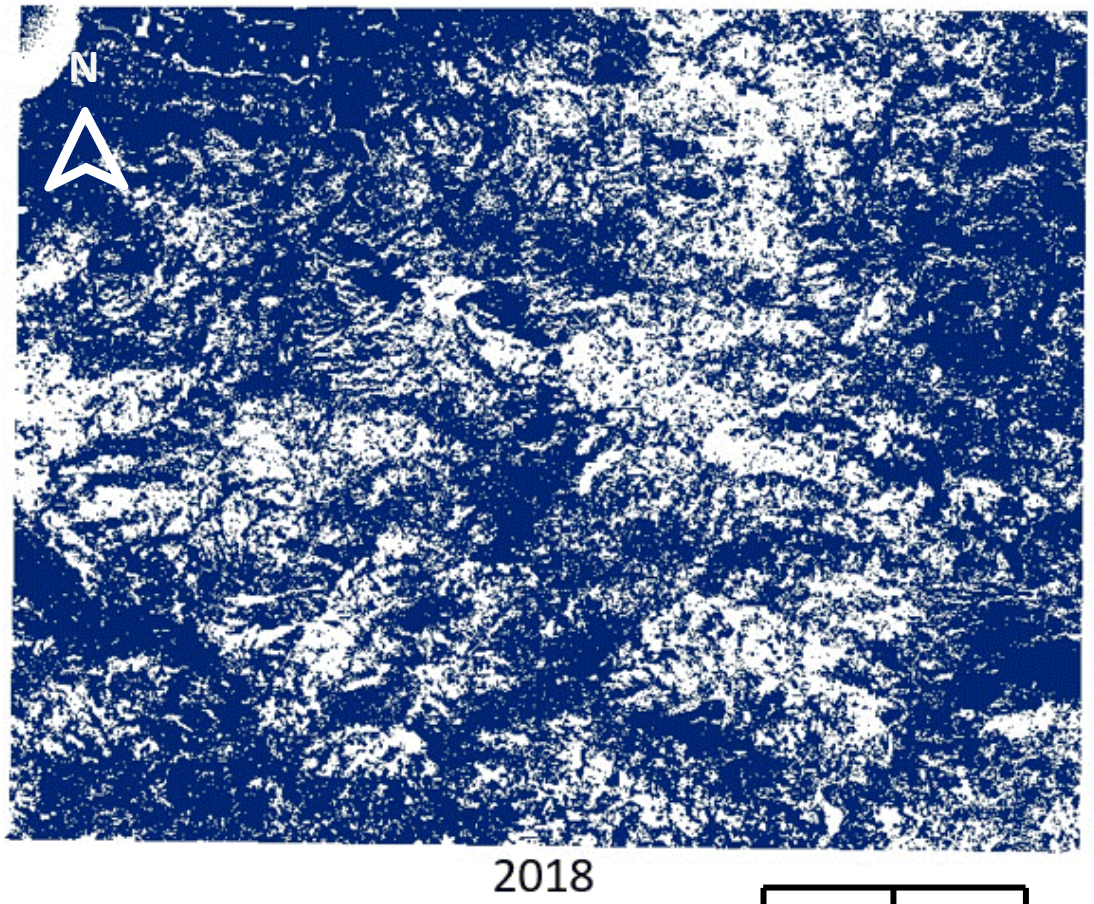
- Derived from the CNIGS Digital Elevation Model (DEM)
- Previous term found these to be top contributors

METHODOLOGY – Watershed

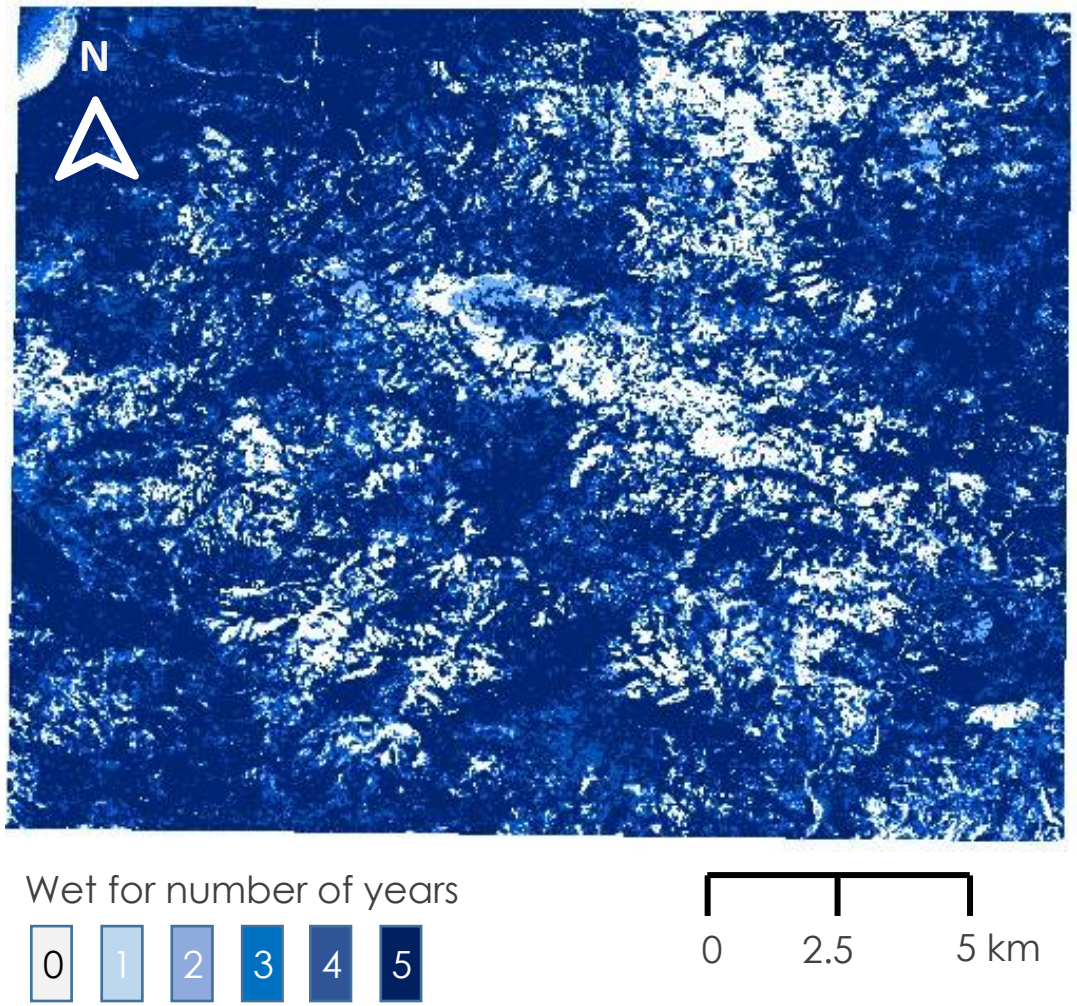


Stream 500 m Buffer

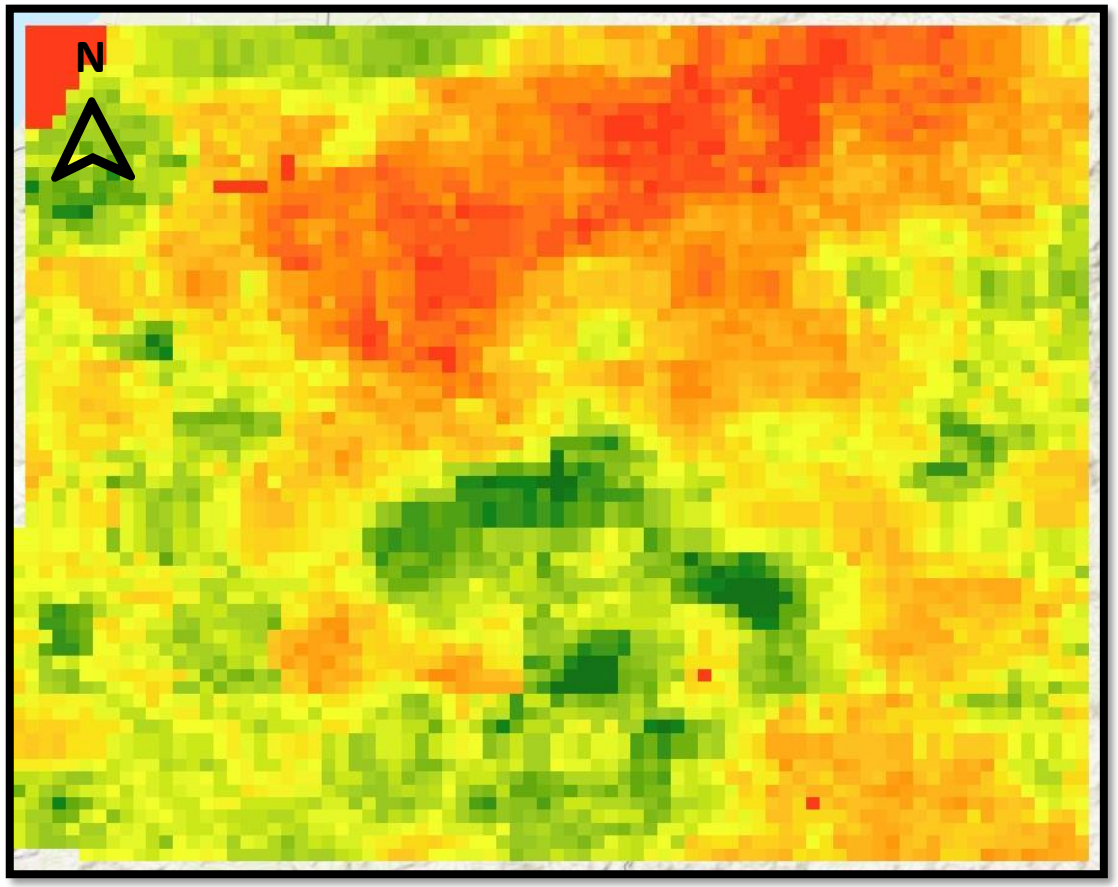
METHDOLOGY – NDMI



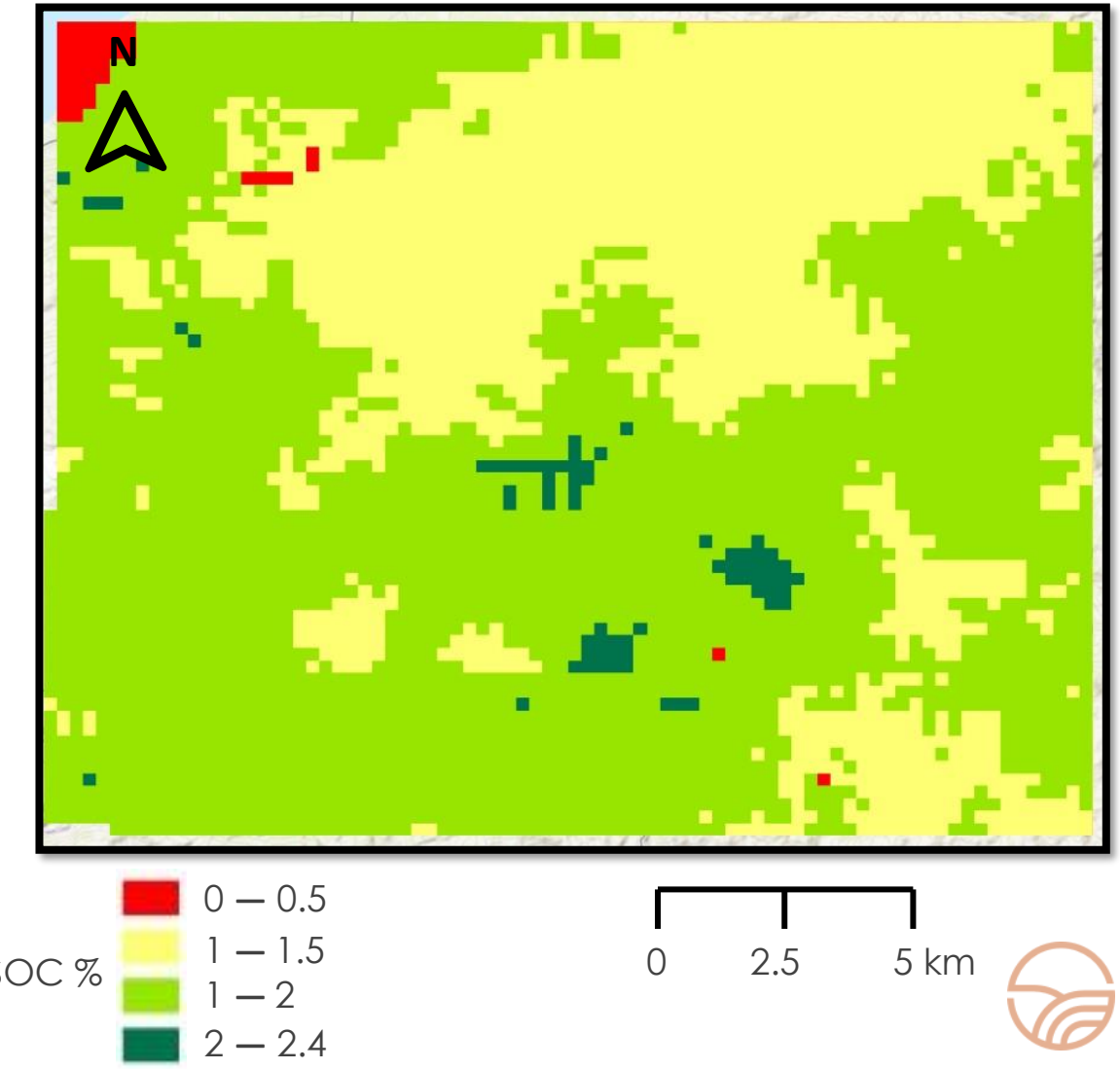
Frequency of wetness over the years



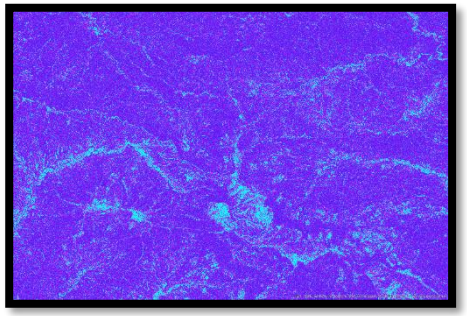
METHDOLOGY – Soil Organic Carbon



SOC stock classes



METHODOLOY – Weighing Our Model

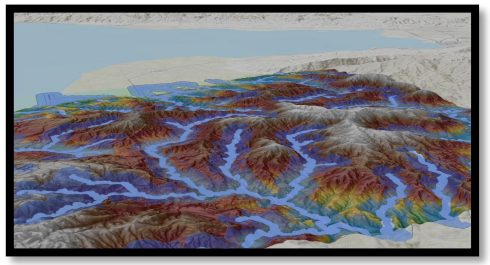


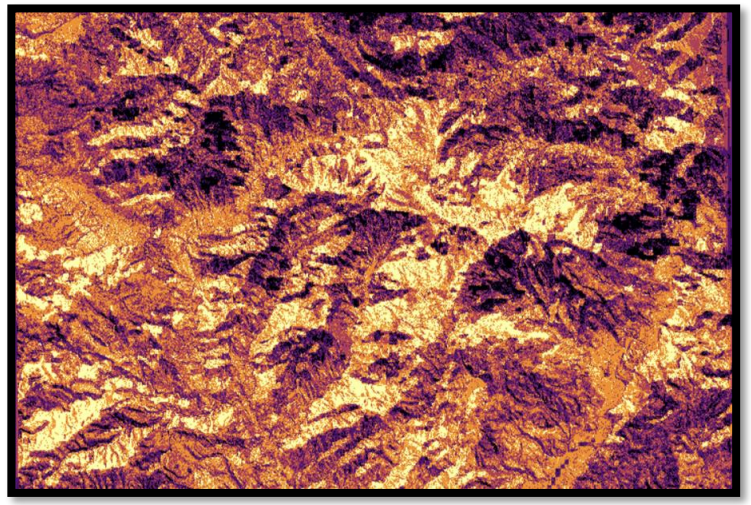
Weight = -1
Range = [0,1]

Weight =1
Range = [1,-1]

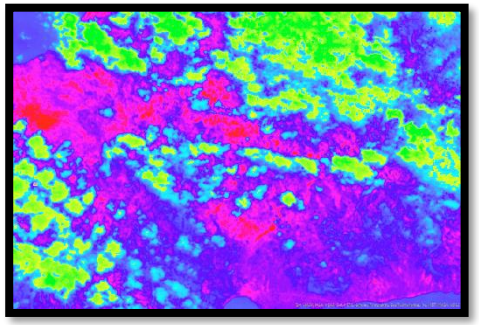
Weight = 0.2
Range = [0,5]

Weight = 1
Range = [0,1]

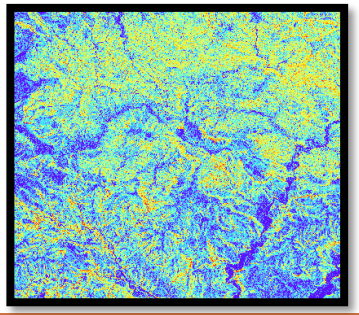




Context for Accessibility Purposes

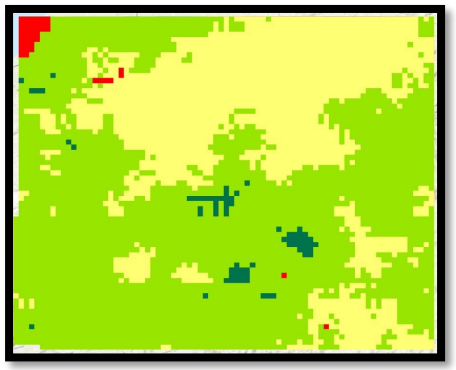


Weight = 1
Range = [0,1]

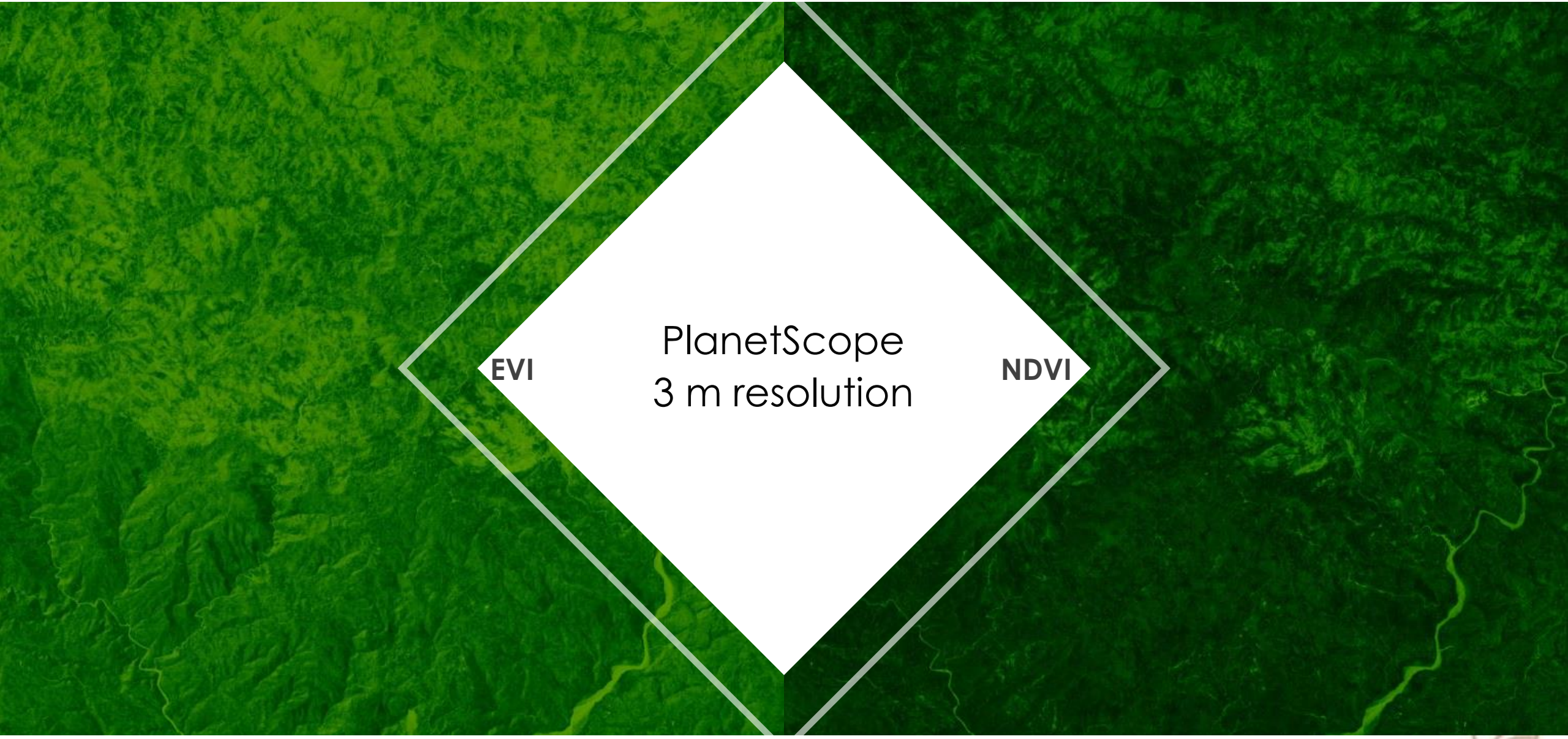


Weight = 1
Range = [-1,1]

Weight = 0.2
Range = [0,5]

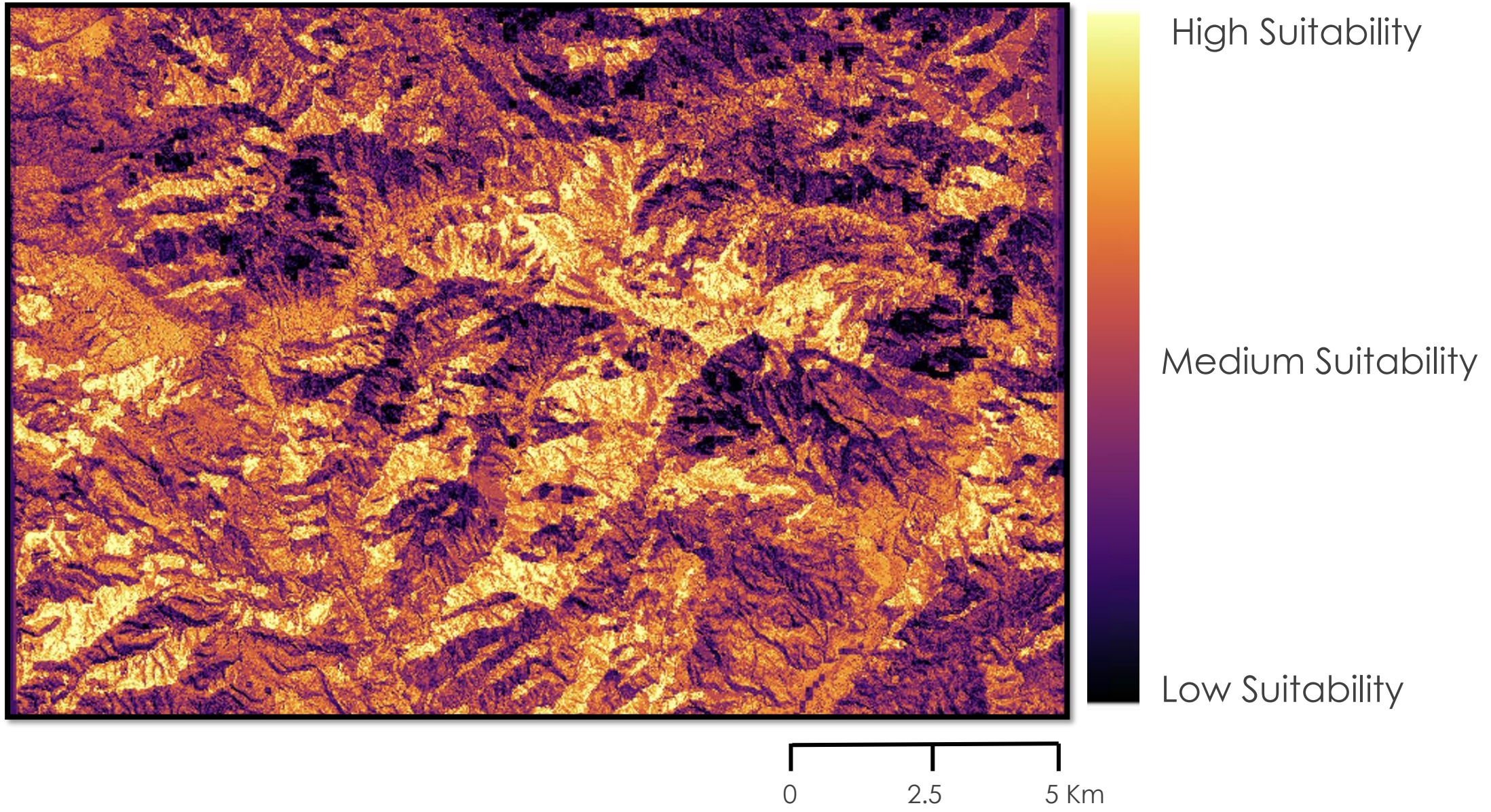


METHODOLOGY – EVI vs NDVI



mage Credit: Planet Labs

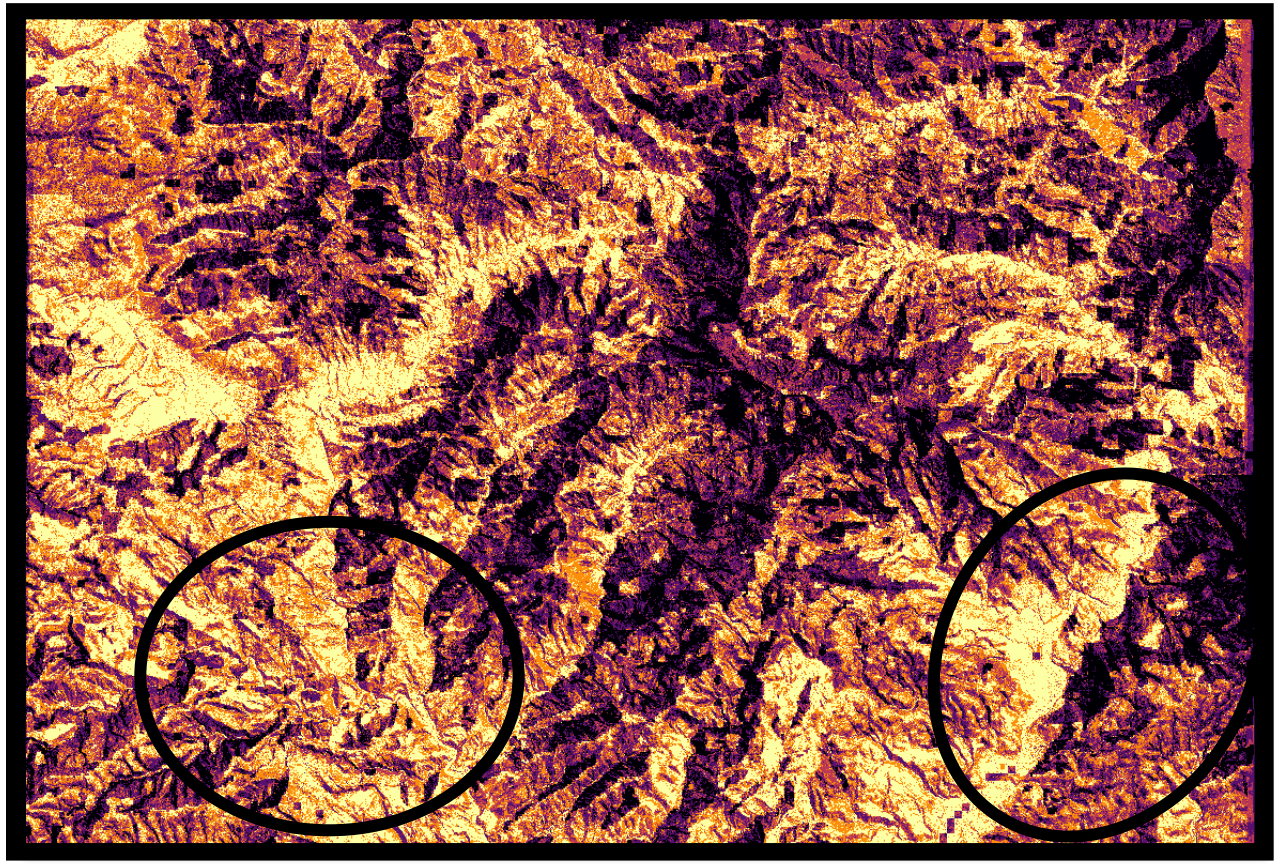
RESULTS – Habitat Model

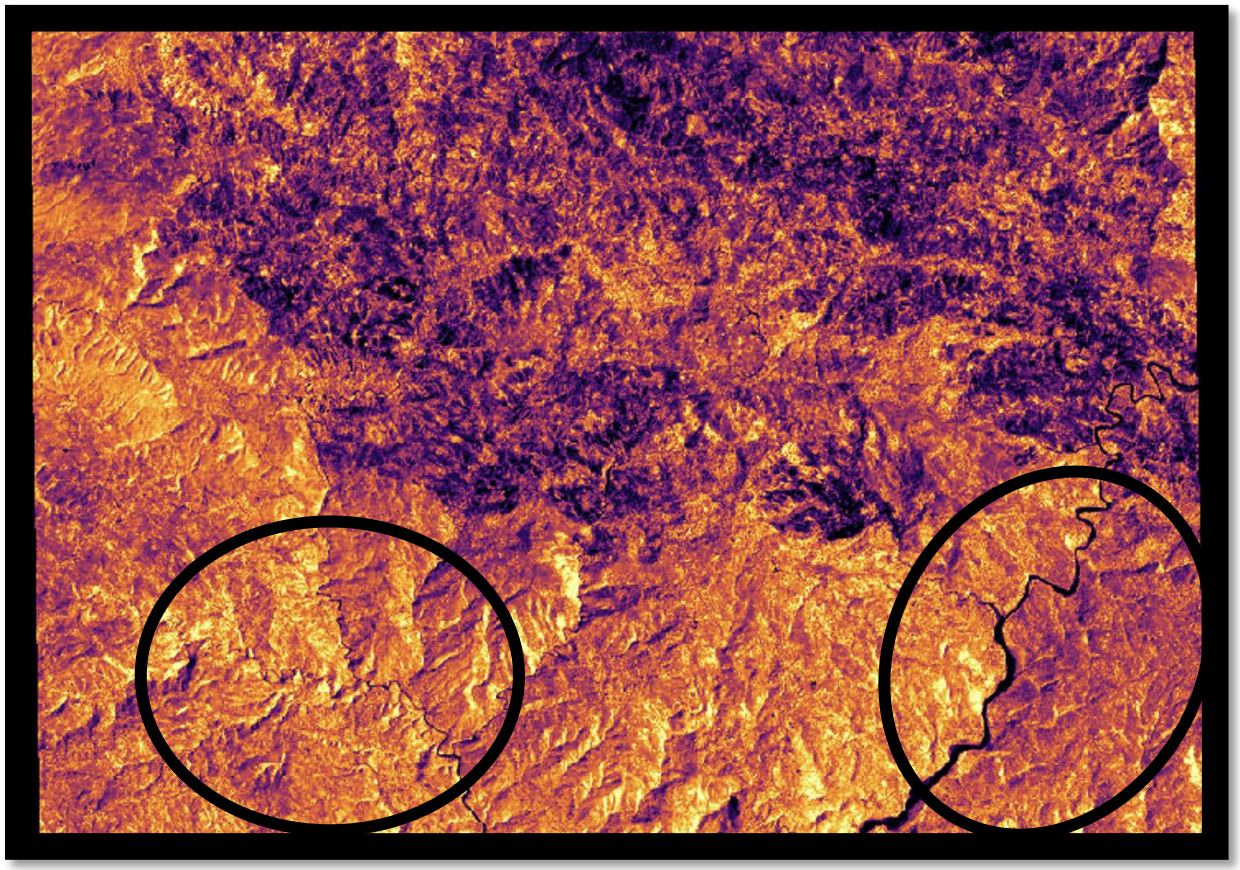


RESULTS – Confirmation of Model

HSM

EVI



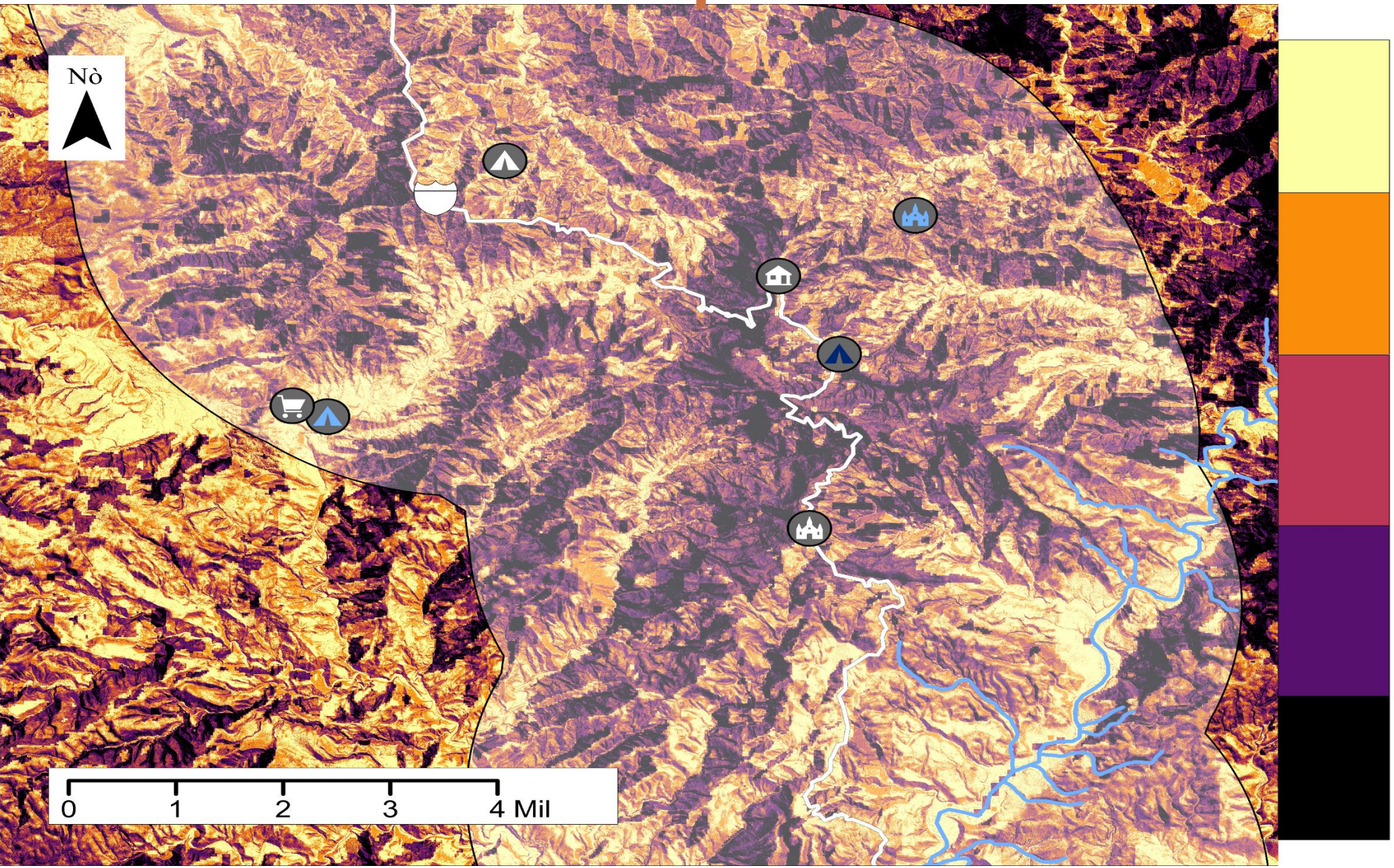


N

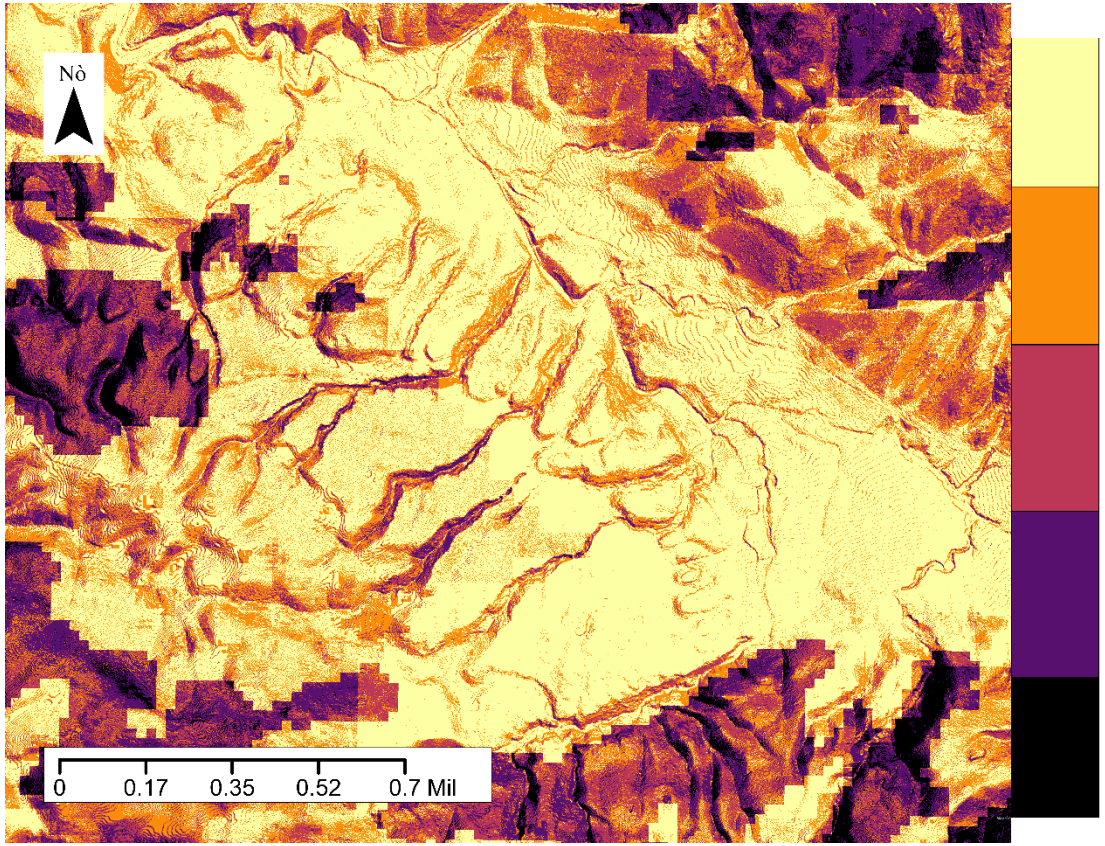
0 2.5 5 Km

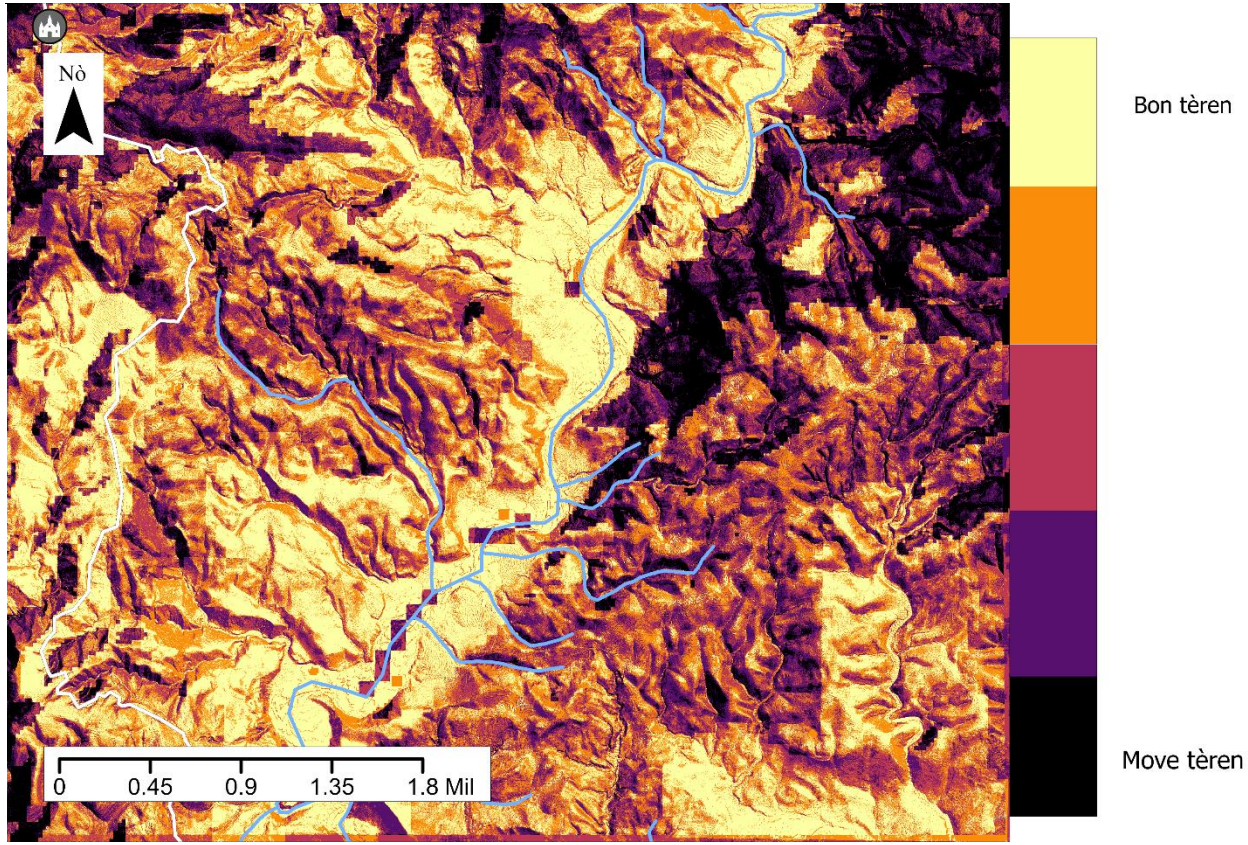
0 2.5 5 Km

RESULTS – Static Maps



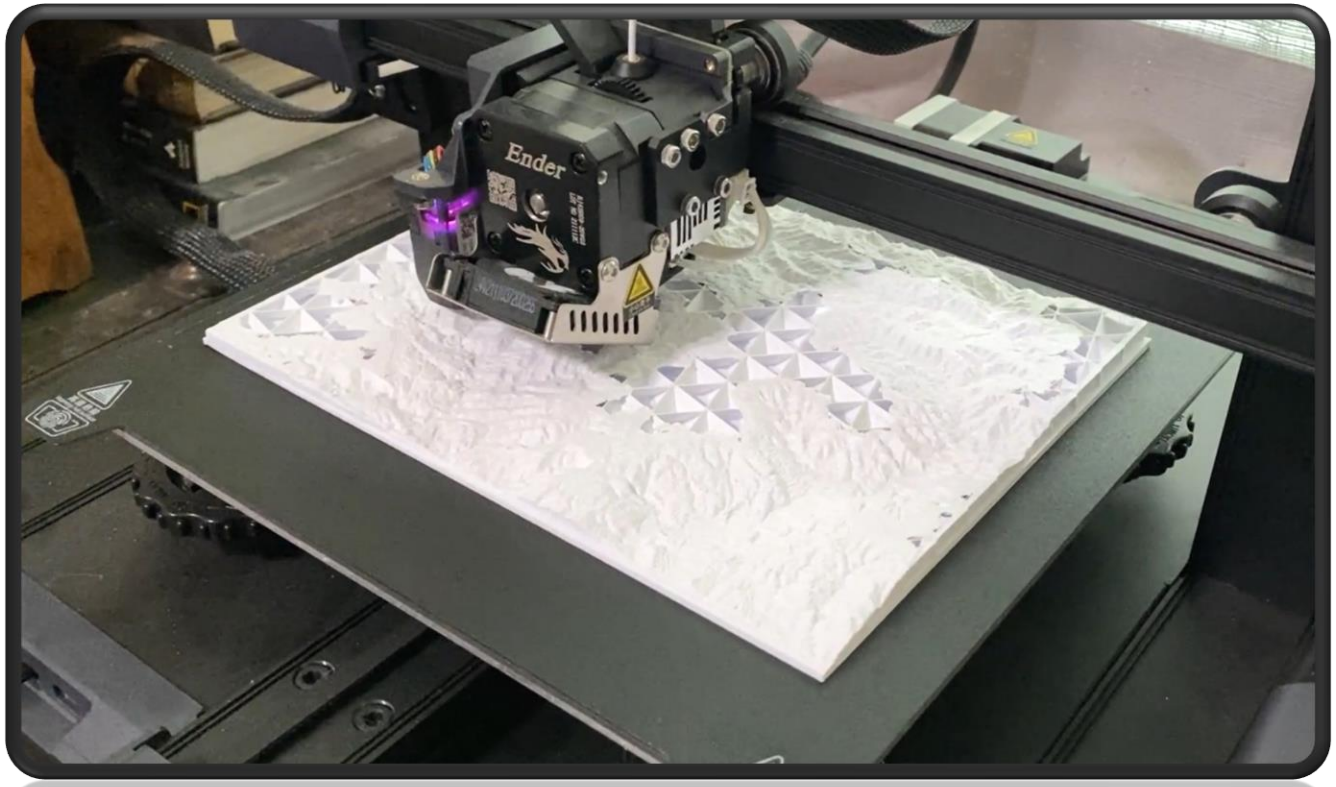
RESULTS – Static Maps





RESULTS – 3D Printed Model

Fusion 360 render



In progress of an 18-hour long print

Image Credit: Justin Meyer

CONCLUSIONS

January 2015 – June 2022

Habitat Suitability

- Highly suitable: along the Jacmel River and Southwest areas
- Low-mid EVI and higher suitability best for **mango trees**
- Low-mid EVI and lower suitability best for **Haitian Catalpa**
- Areas with low-mid EVI and middle suitability best for **Eucalyptus**

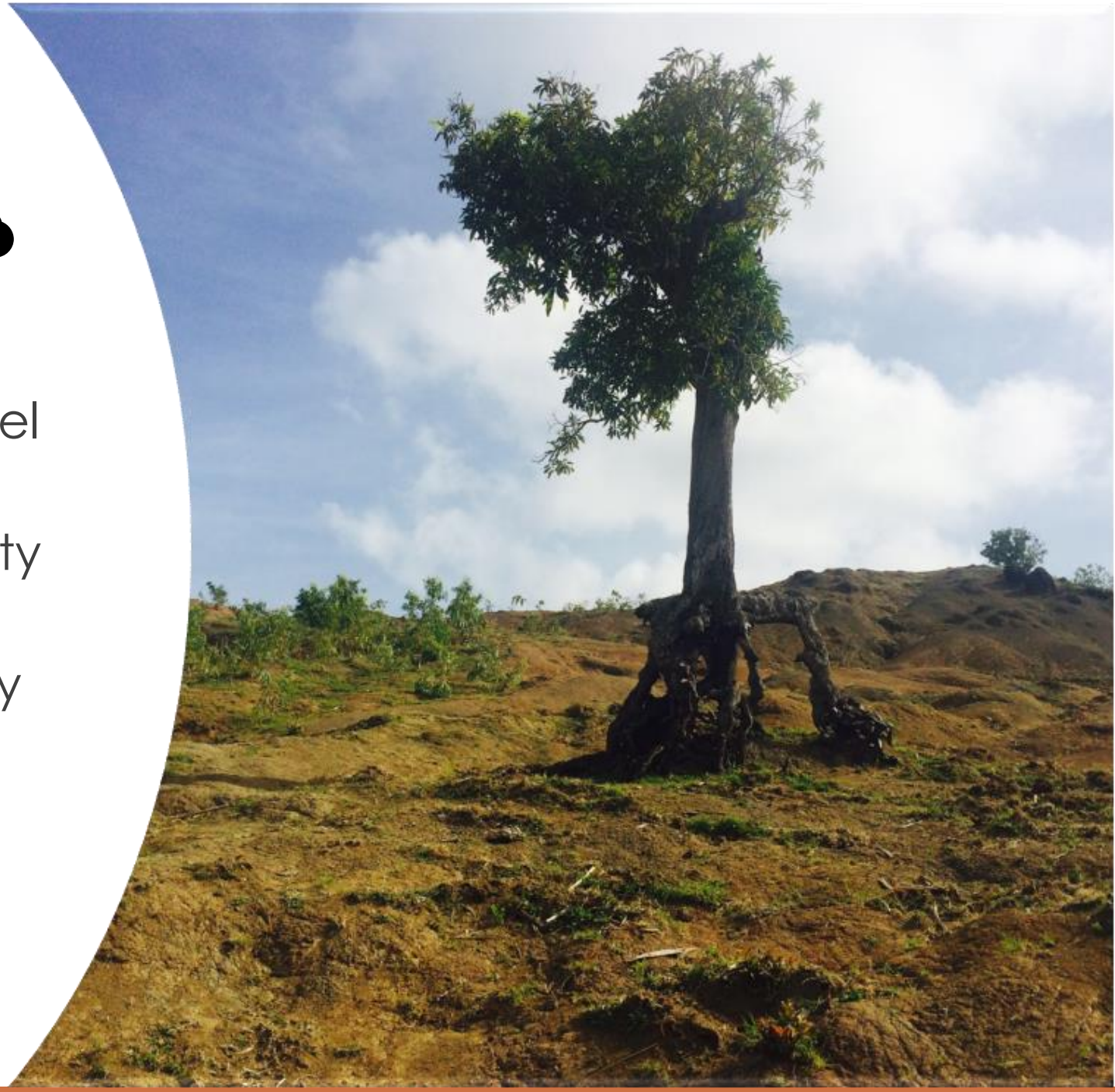


Image Credit: Jamie Rhoads

ERRORS & UNCERTAINTIES

- Eucalyptus has a lower average EVI
- Limited Sentinel-2 imagery
- Alternative to precipitation data

Image Credit: Jim Goetz

FUTURE WORK

Image Credit: Jamie Rhoads

- Continuation of vegetation analysis to monitor impacts
- Refine and update printed static maps
- Design all maps with local community needs in mind

ACKNOWLEDGEMENTS

Project Partners

- Bill Hathaway - Board Chair
- Michael Anello - Field Specialist
- Jamie Rhoads - Board Member
- Hunter Brown - GIS Specialist

Science Advisors

- Dr. Marguerite Madden
- Dr. Kunwar Singh

DEVELOP Node Leadership (GA - Athens)

- Sarah Payne – Center Lead/Fellow

Past Contributors

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- Taylor Simkins
- Nohemi Huanca-Nunez

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