

# Using LiDAR to estimate anthropogenic impacts on forest carbon stocks (in southern Bahia)

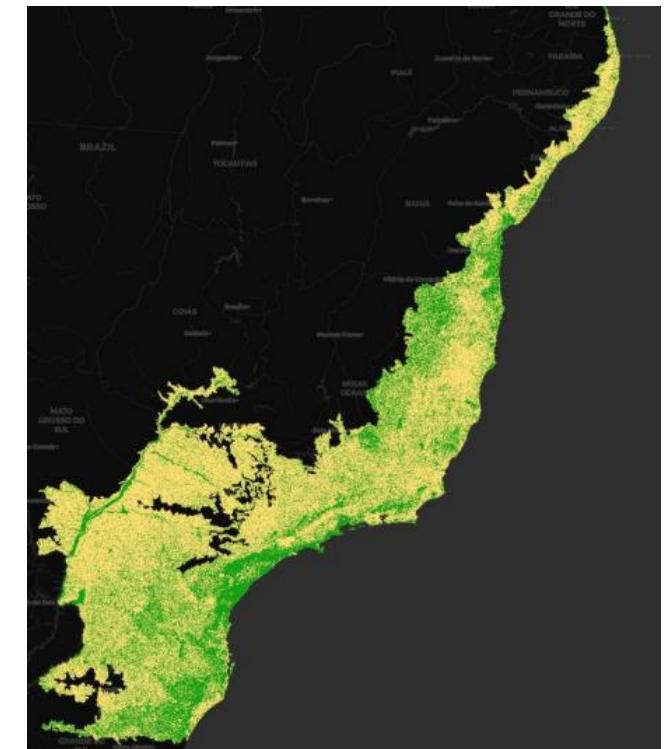
# 1. Introduction

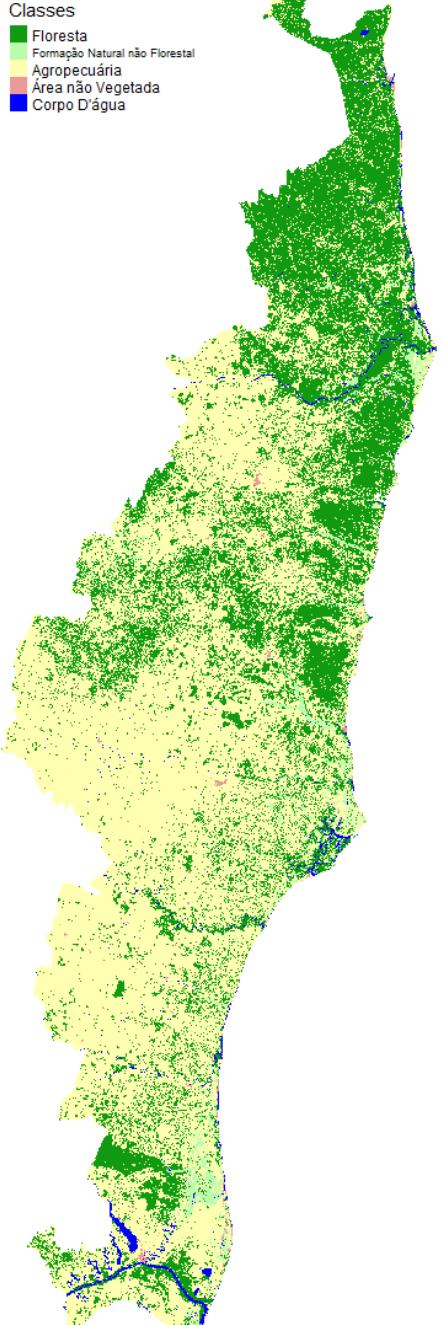
- **Tropical forests play a key role in mitigating climate change.**
- **25% of the total carbon stored in plant biomass**

## Atlantic Forest:

- **Original area** of 1.3 million km<sup>2</sup> <sup>1-3</sup>;
- **~24.3% of the original cover** remains<sup>4</sup>;
- Changes in: **structure, species composition, and degradation of remnants** <sup>5-8</sup>.

Figure 1. Anthropogenic and Natural Areas in the Atlantic Forest Biome – 2020



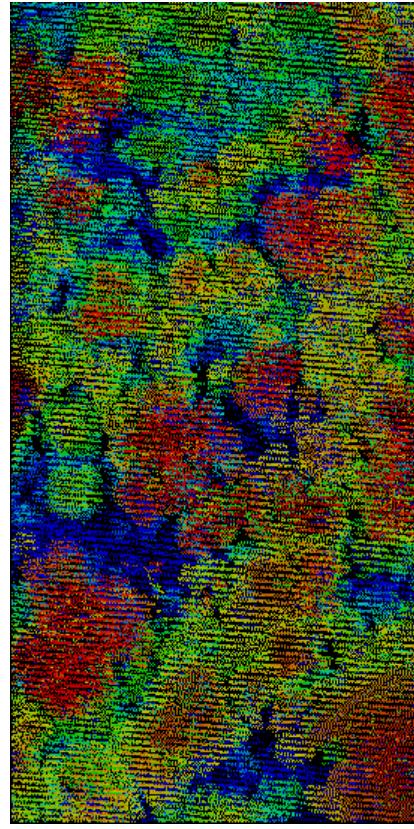
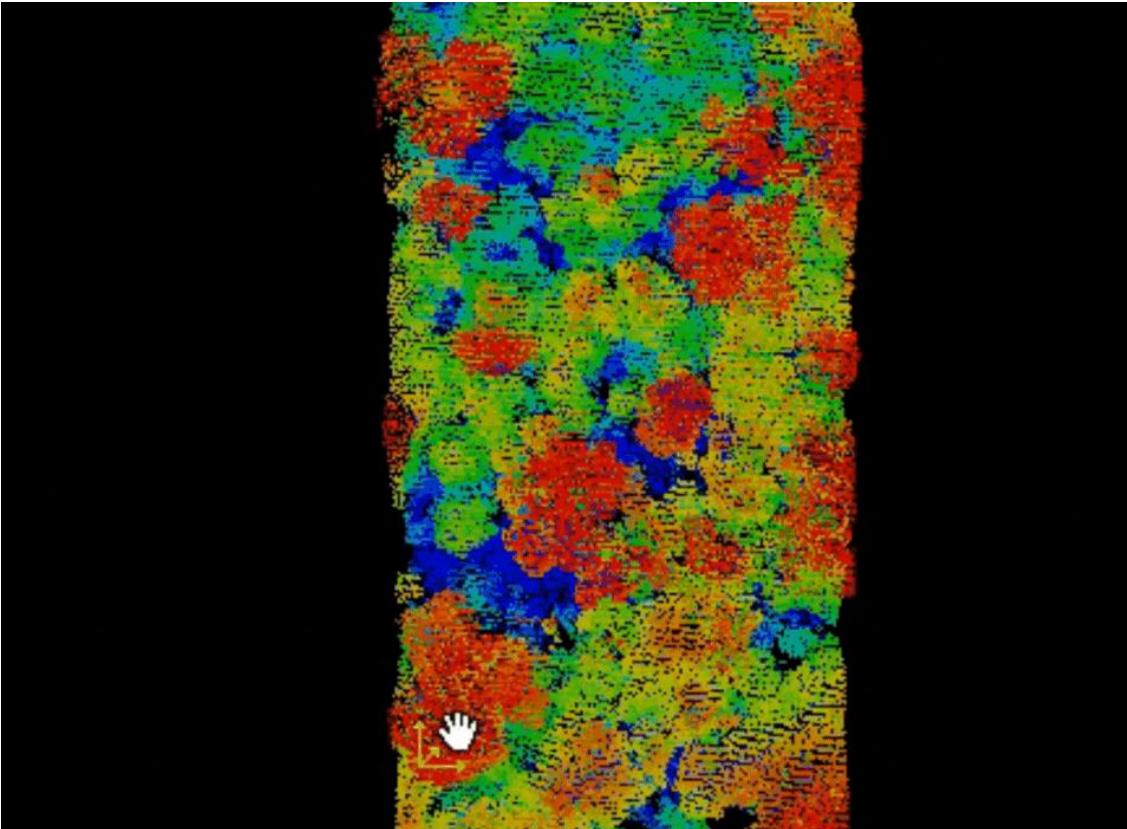


## 1. Introduction

- **Hileia Baiana:** Southern Bahia and northern Espírito Santo.
- High levels of biodiversity and endemism
- **Environmental impacts extend beyond deforestation:** Increase in wildfires, invasive species, changes in species composition, selective logging, defaunation, microclimatic changes.

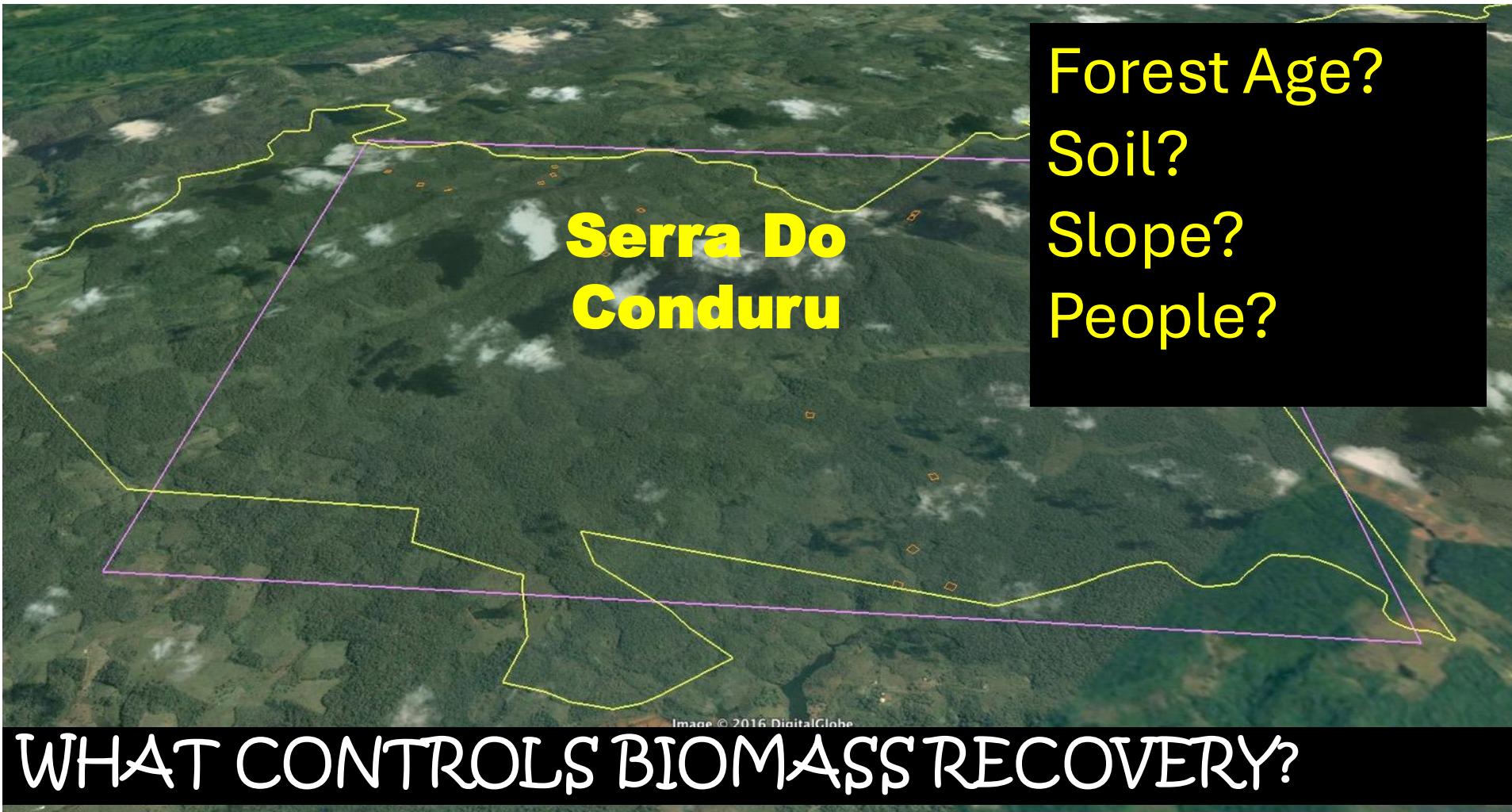
# 1. Introduction

**LiDAR (*Light Detection and Ranging*)**



## Landscape-scale lidar analysis of aboveground biomass distribution in secondary Brazilian Atlantic Forest

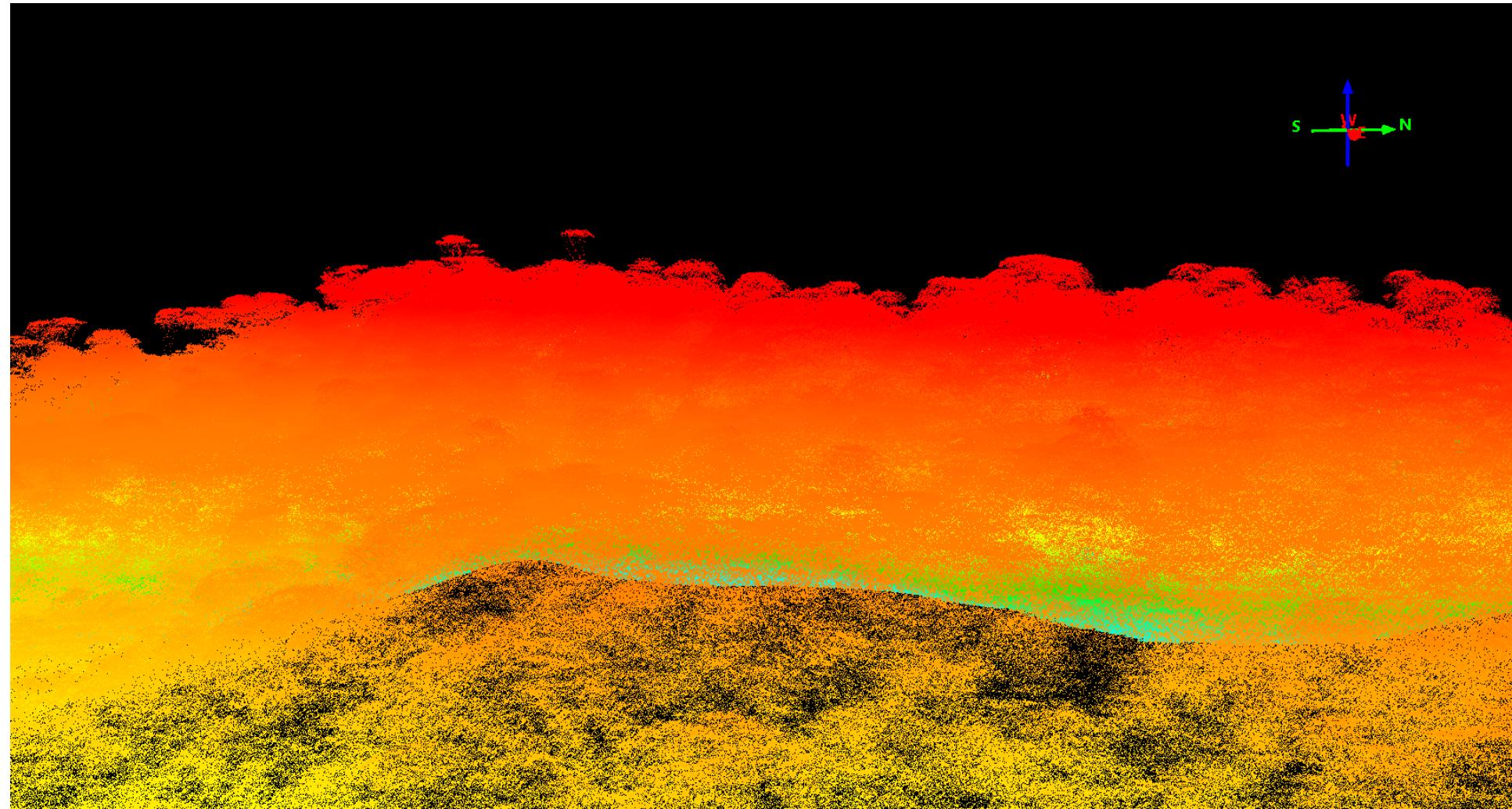
Justin M. Becknell<sup>1,2,7</sup> , Michael Keller<sup>3,4,5</sup>, Daniel Piotto<sup>6</sup>, Marcos Longo<sup>5</sup> , Maiza Nara dos-Santos<sup>5</sup>, Marcos A. Scaranello<sup>5</sup>, Rodrigo Bruno de Oliveira Cavalcante<sup>6</sup>, and Stephen Porder<sup>2</sup> 

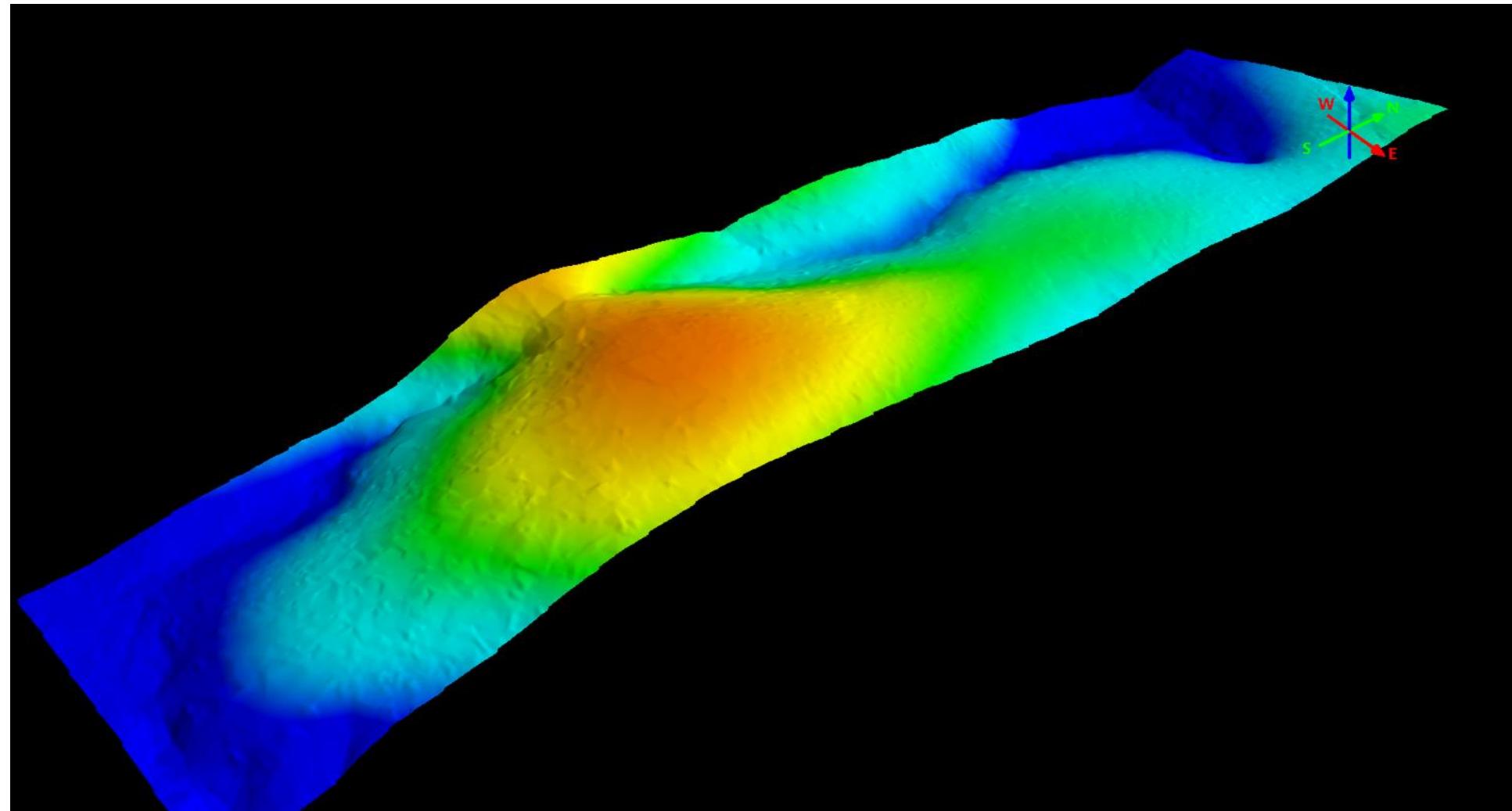


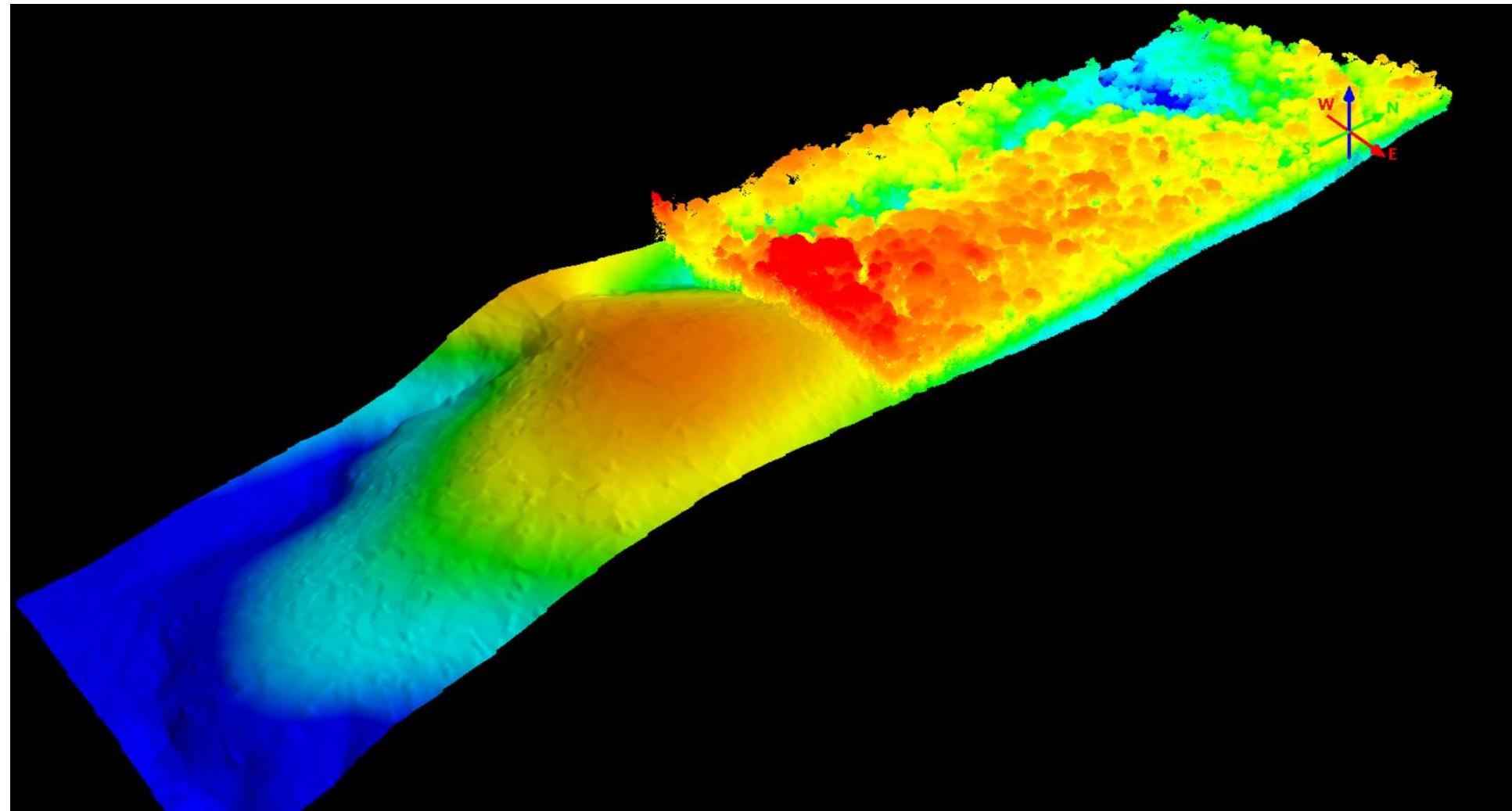


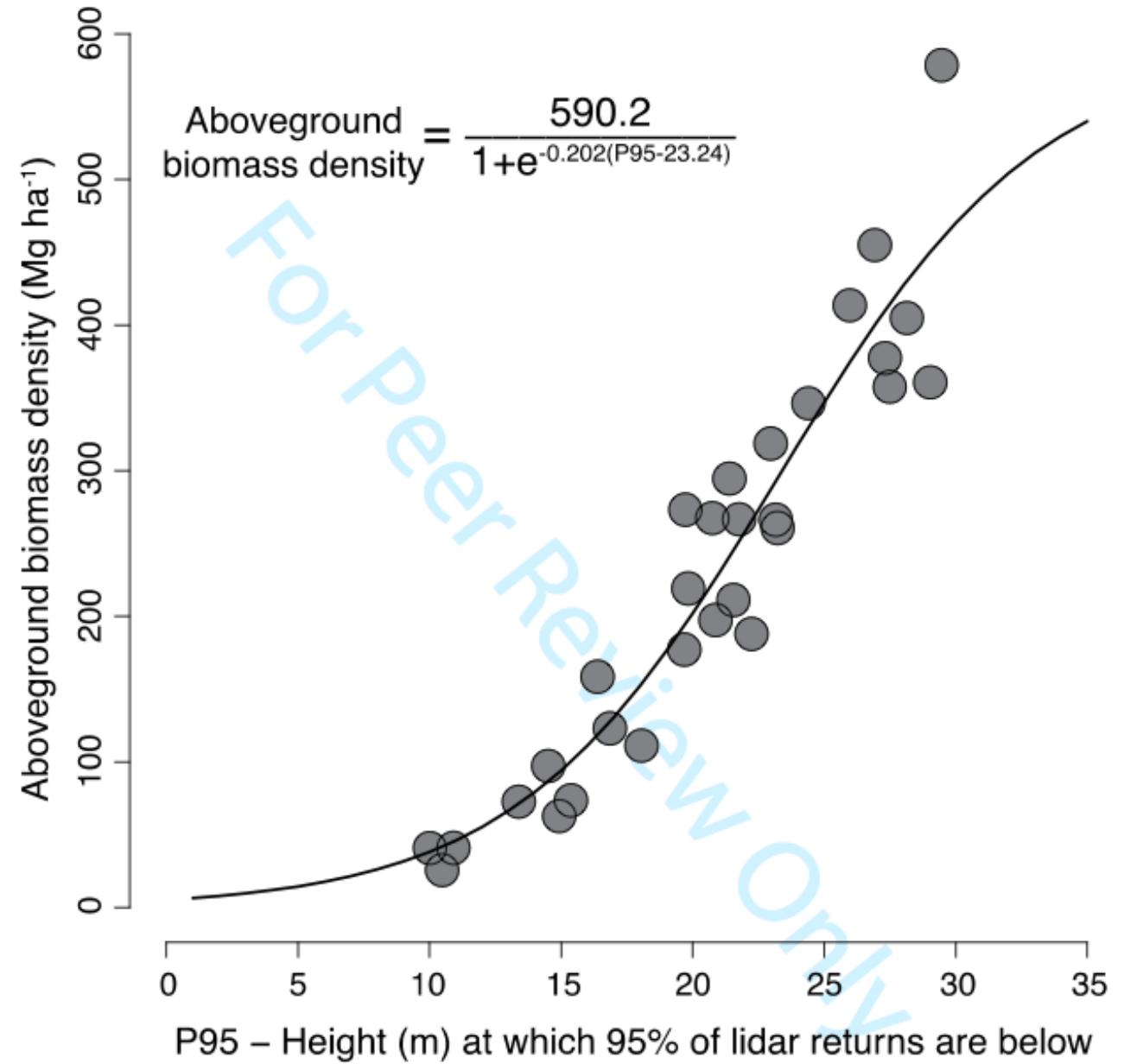




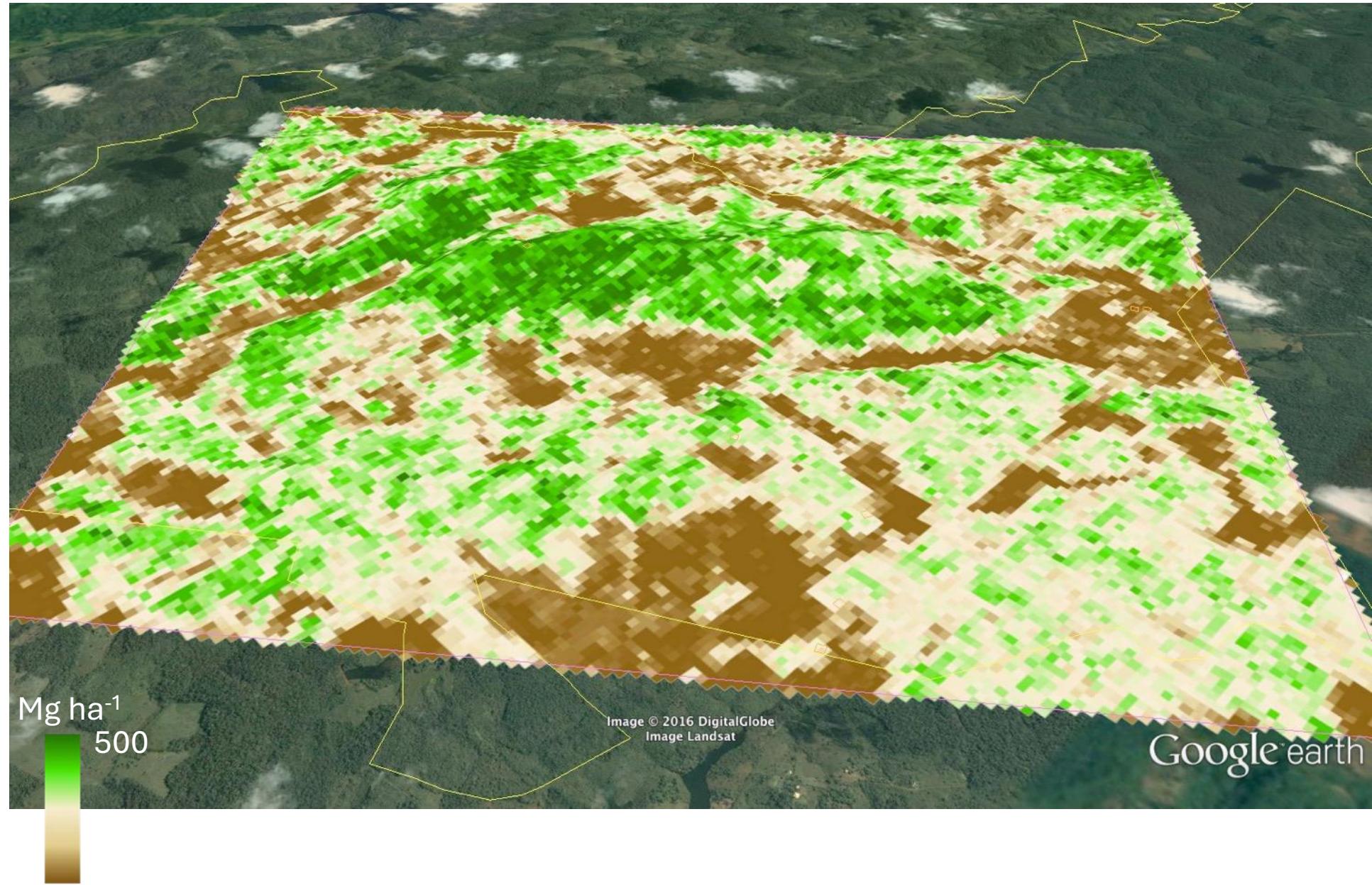


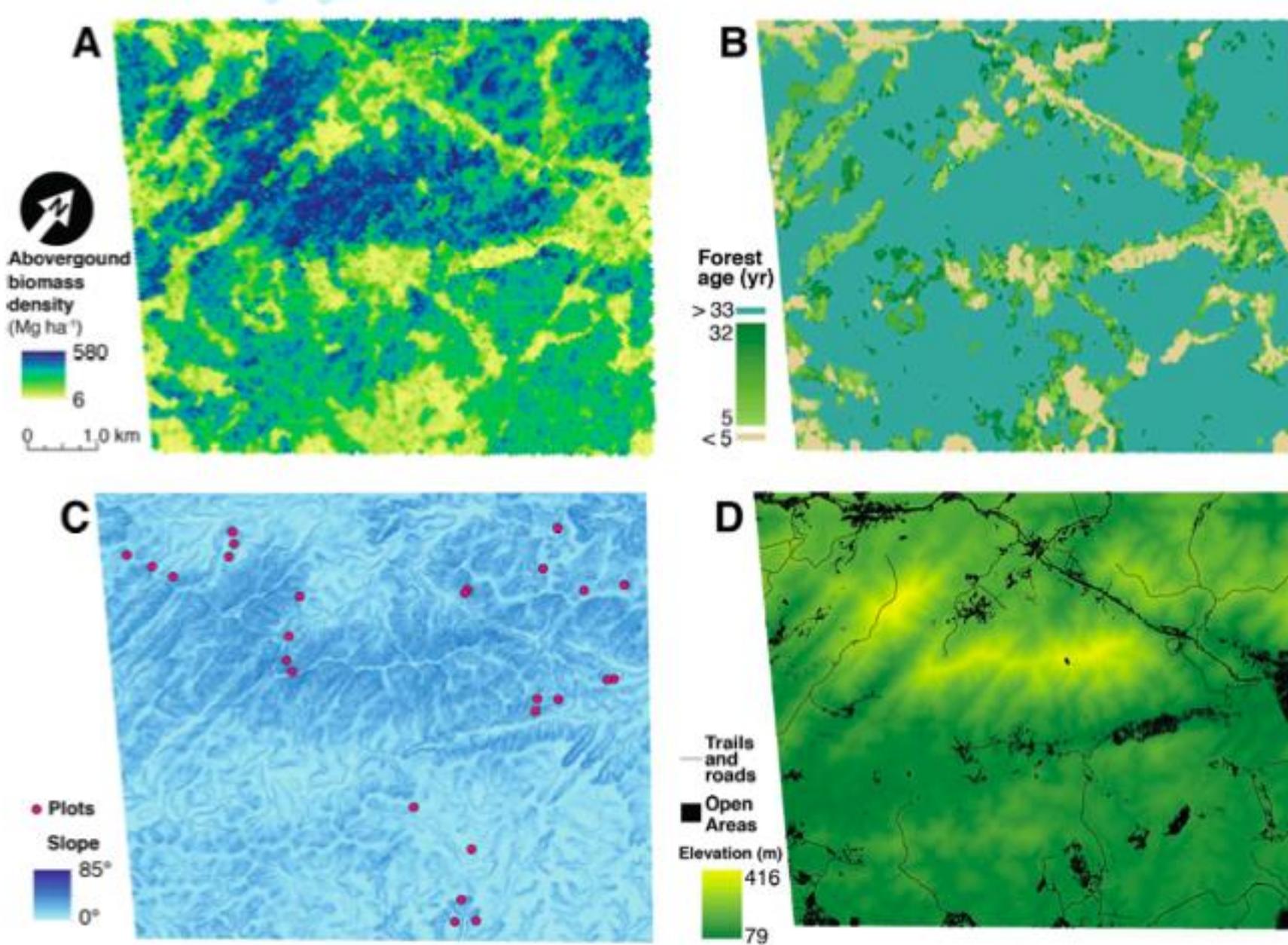


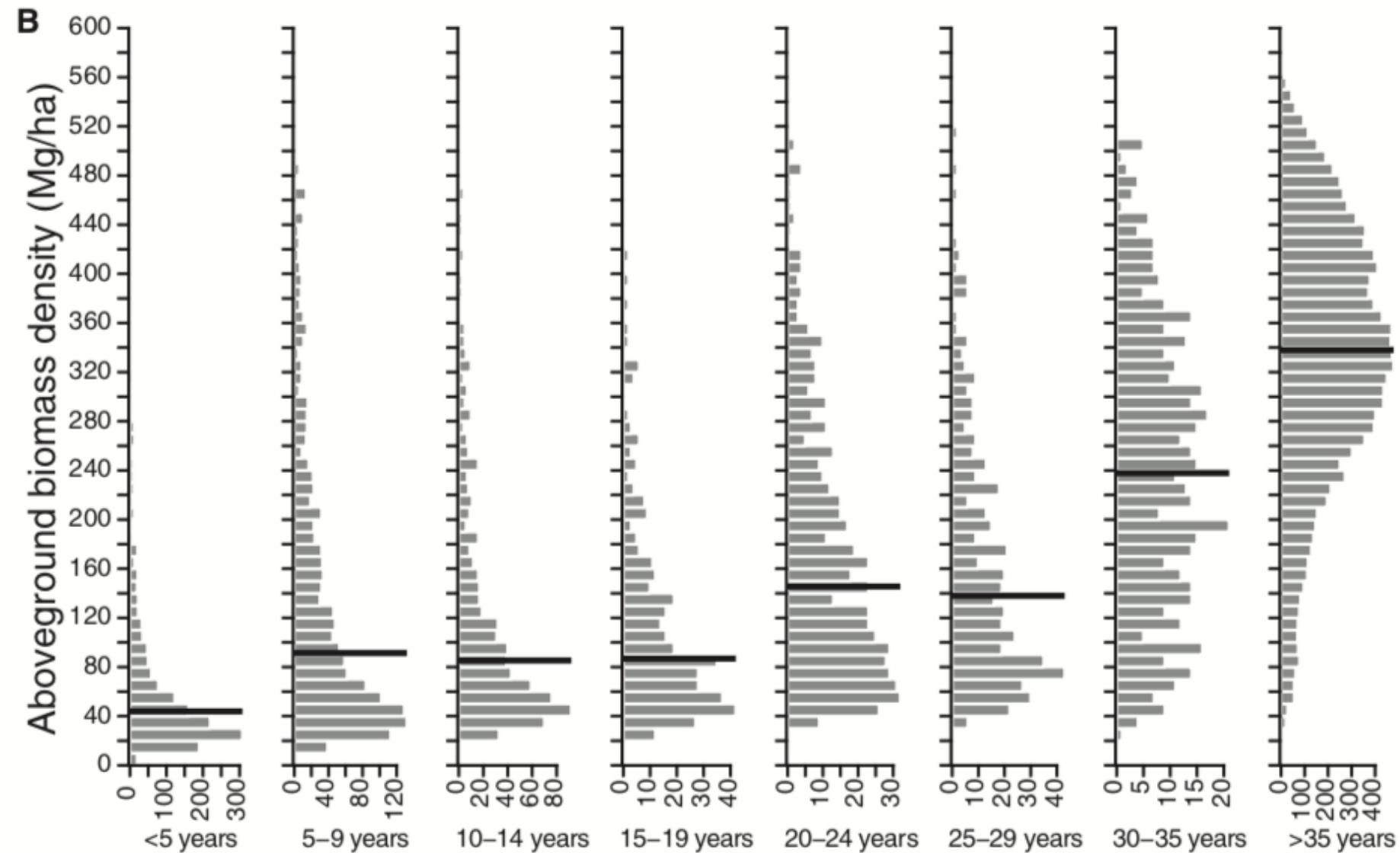


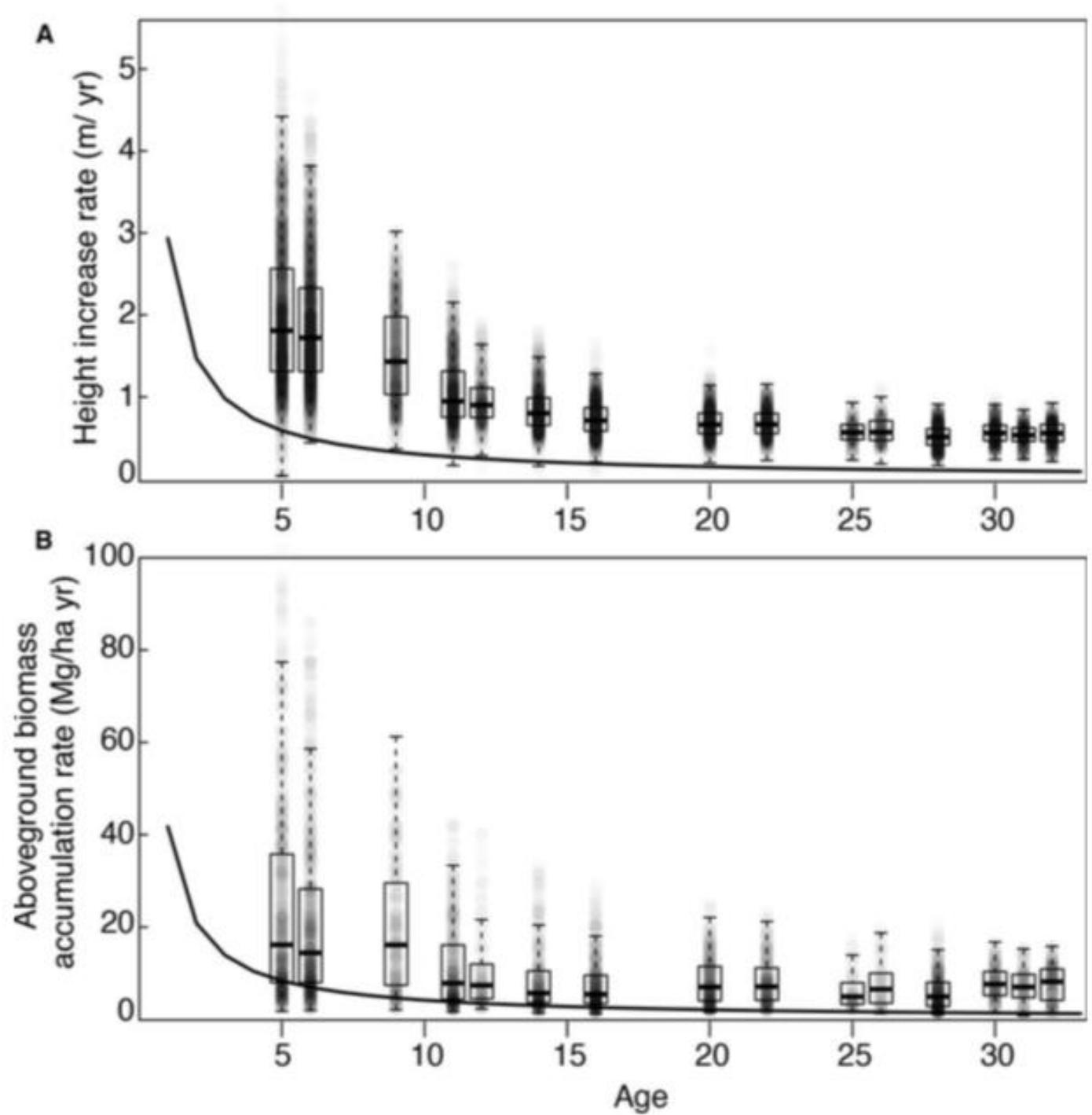




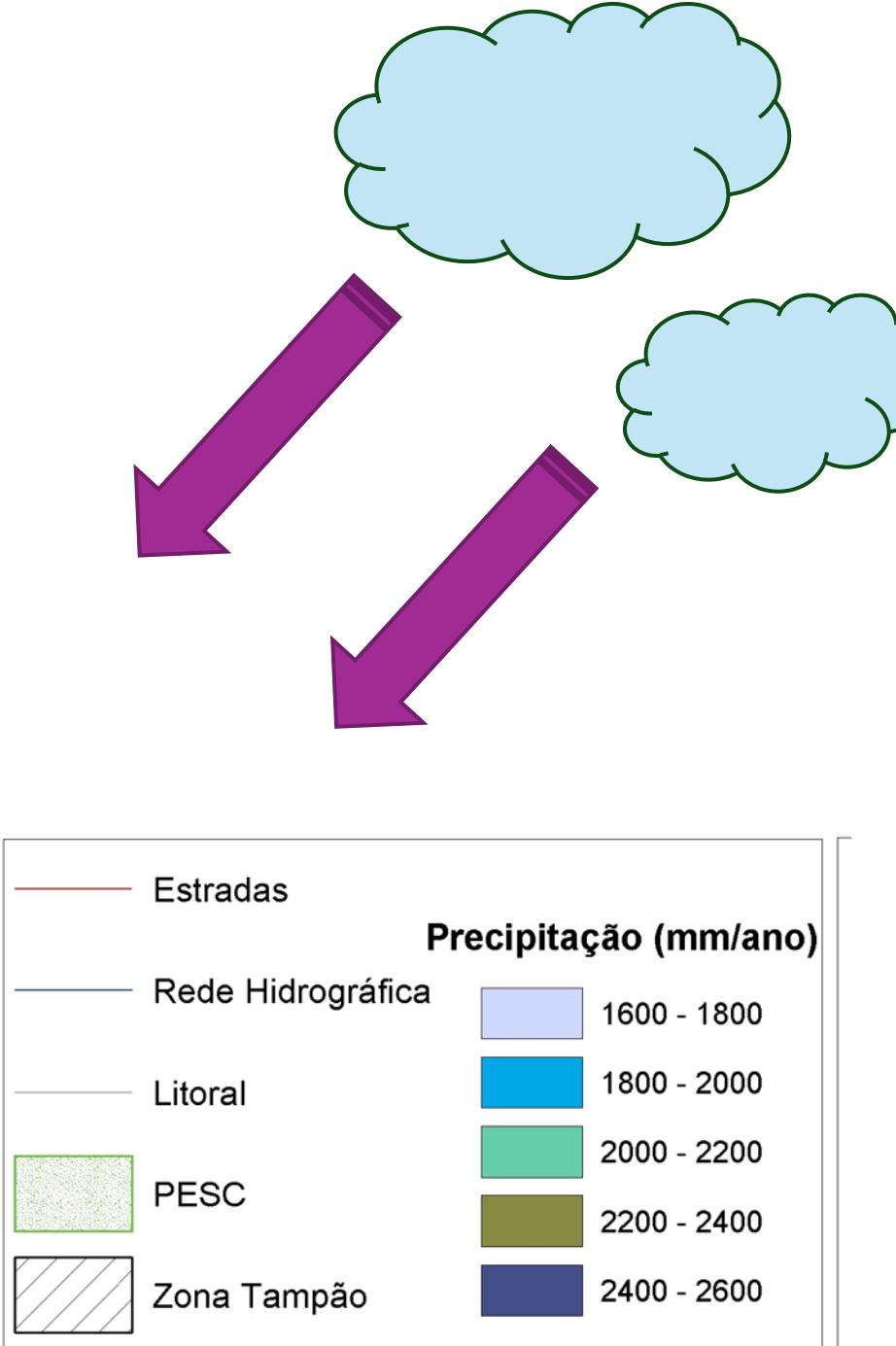
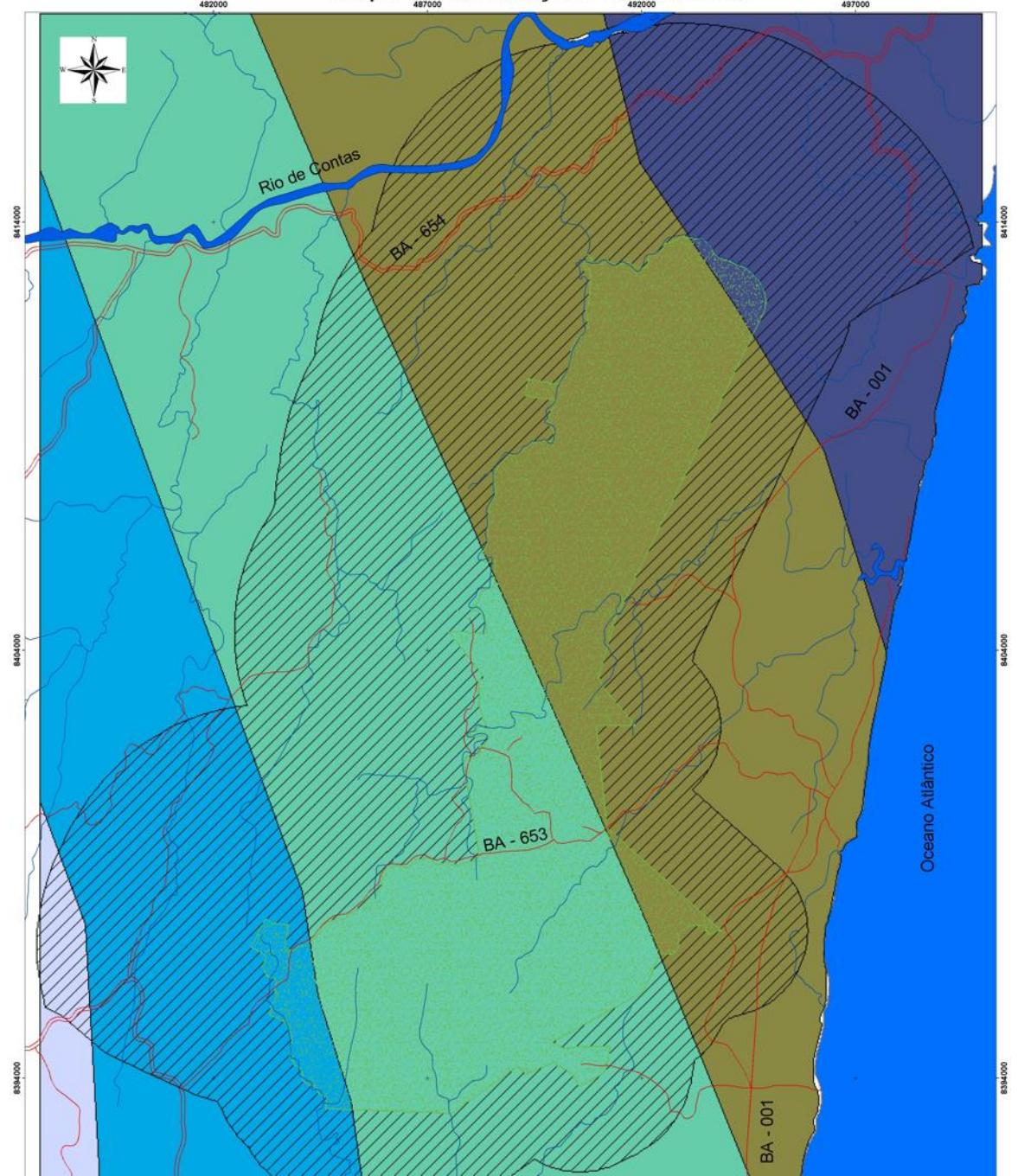




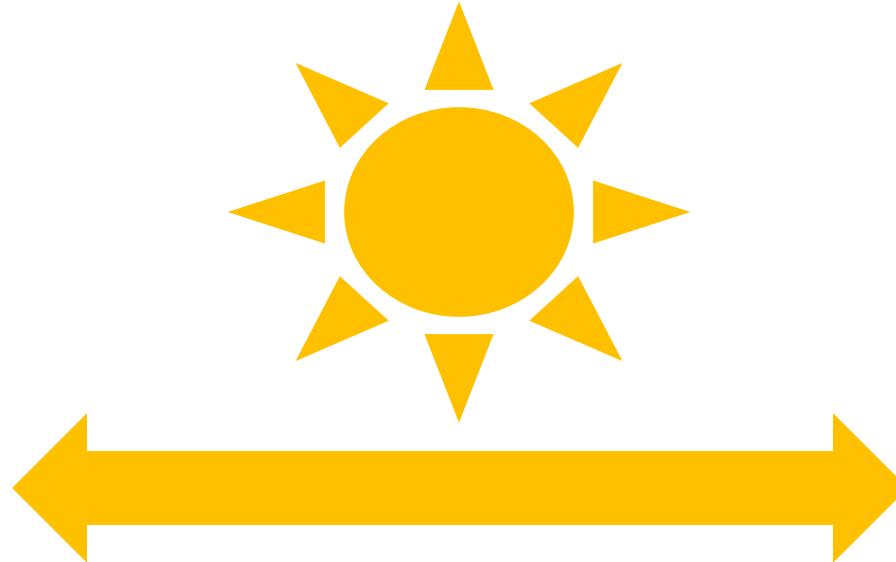
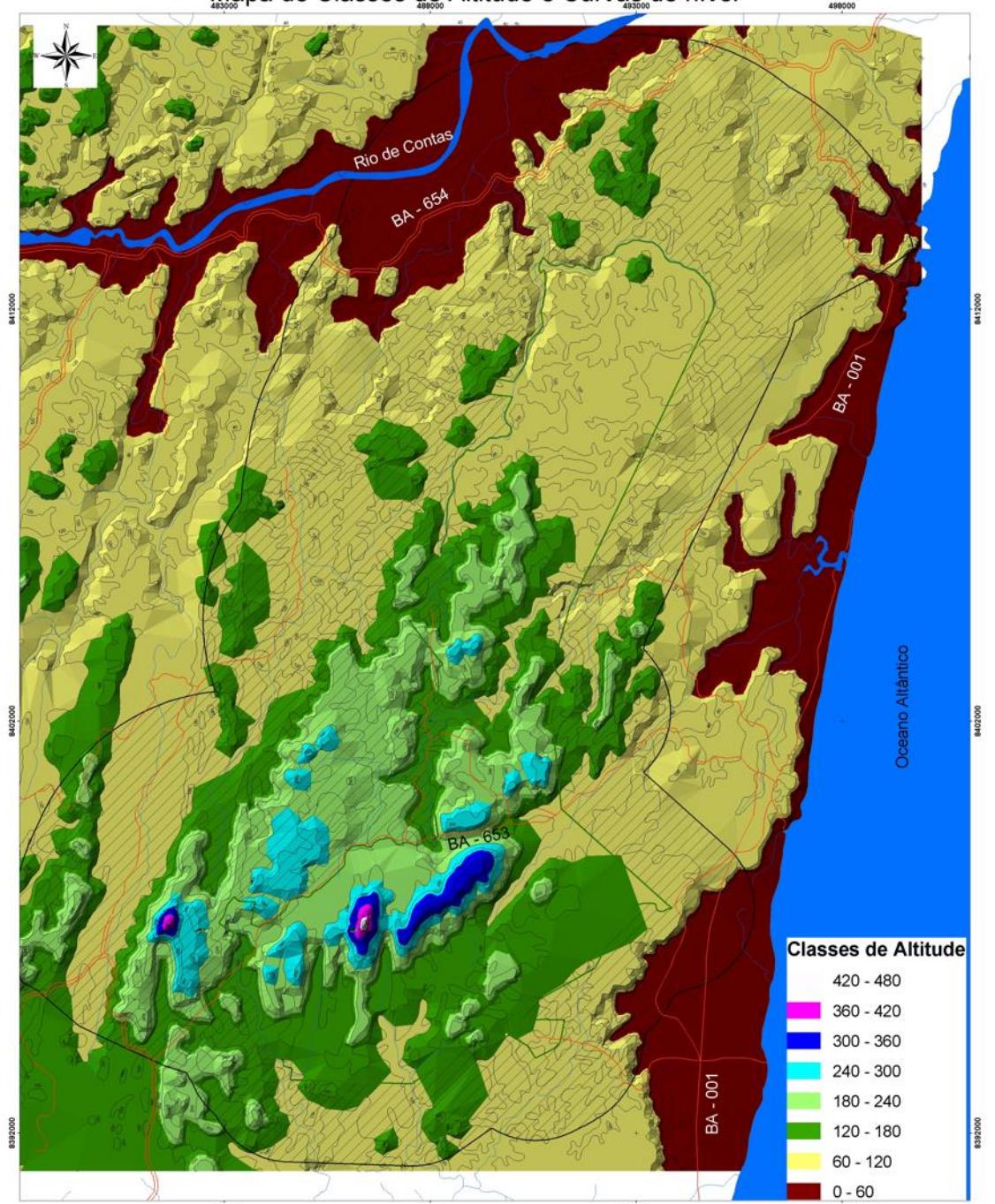




Parque Estadual da Serra do Conduru - PESC  
Mapa da Distribuição Pluviométrica



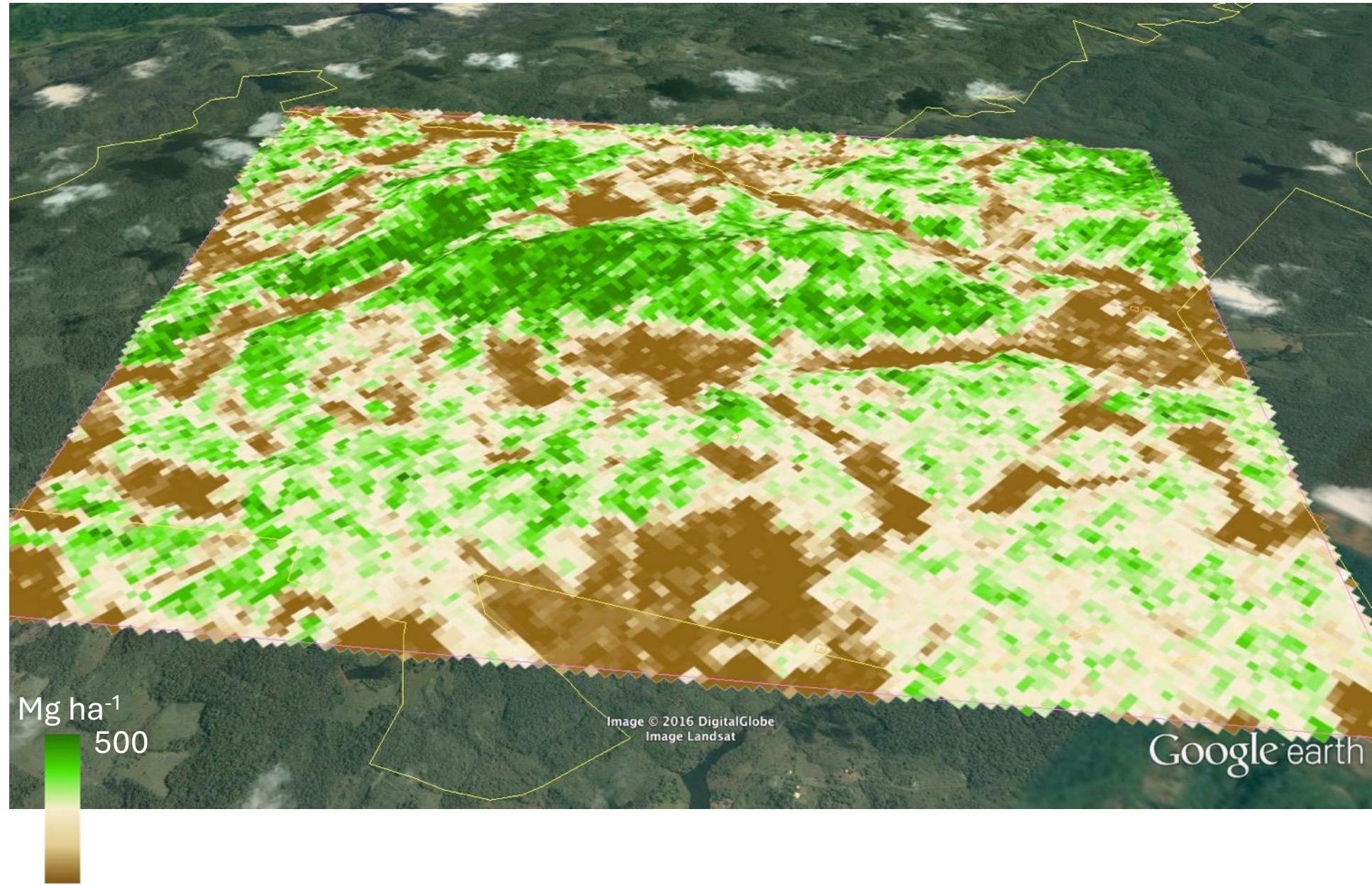
Parque Estadual da Serra do Conduru - PESC  
Mapa de Classes de Altitude e Curvas de nível



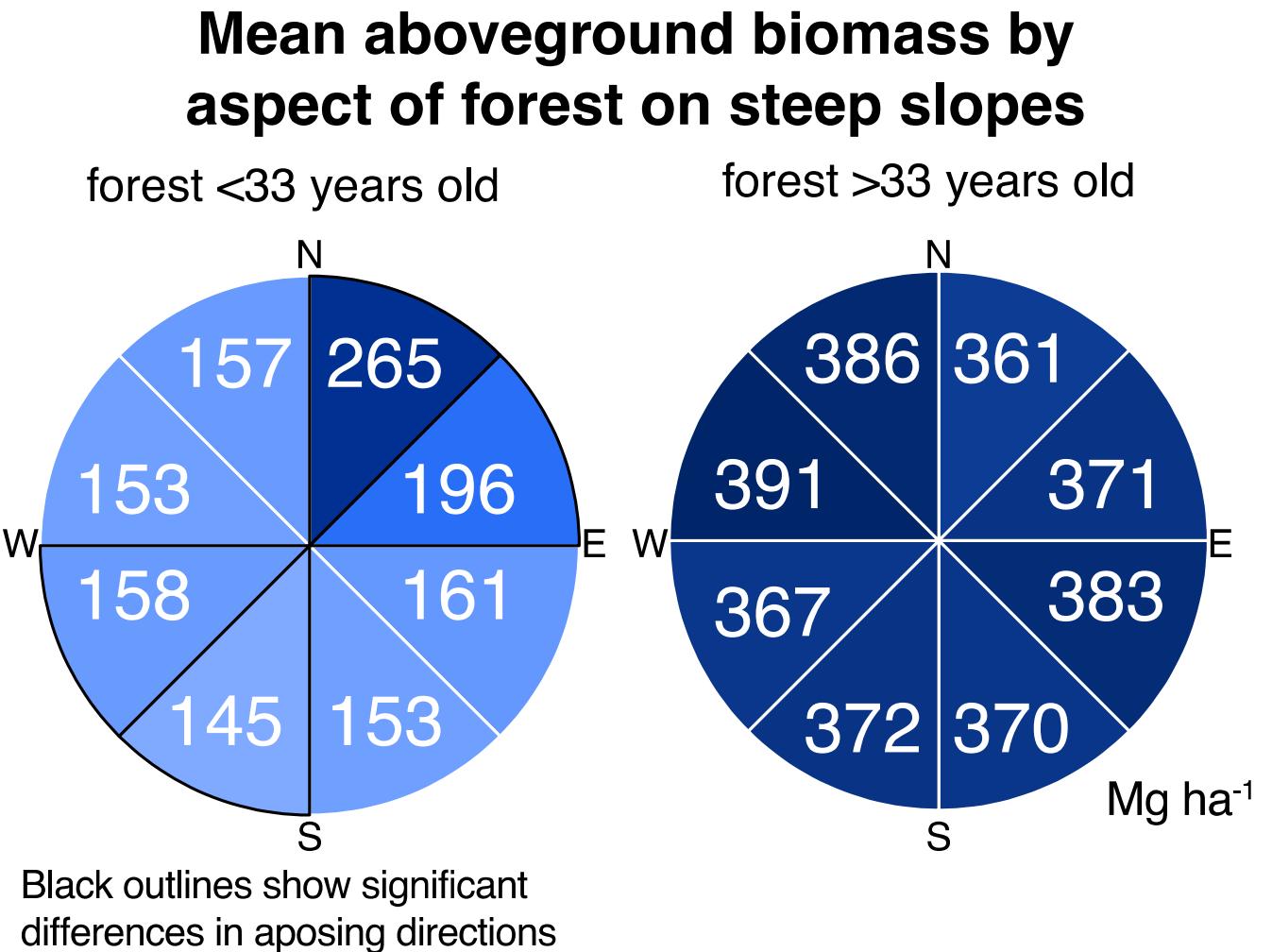
# Hypothesis

Secondary forests [younger than 30 years old in areas with slopes greater than 24%] facing north and east will have significantly higher biomass than those facing south and west because these forests receive more light and more rain





**Biomass by aspect**  
 Each segment represents the mean aboveground biomass density of slopes facing that direction.  
 Segments outlined in black are significantly different than the segment facing the opposite direction.



# Conclusions 1

- Recovery of forest structure is fast BUT: high variability in both height and biomass across the landscape within forests of similar age
- Regression model that accounted for spatial autocorrelation and included forest age, slope, and distance to roads explained 62% of the landscape variation in ABD

# Using LiDAR to estimate anthropogenic impacts on forest carbon stocks (in southern Bahia)

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## 2. Material and methods

- Veracel Station Private Natural Heritage Reserve (RPPN Veracel);
- 6,069 hectares between Porto Seguro and Santa Cruz Cabrália;
- Established in 1988;
- Largest private reserve in the Northeast and the second largest in the Atlantic Forest;
- Tropical rain forest
- History of selective logging until 1970.

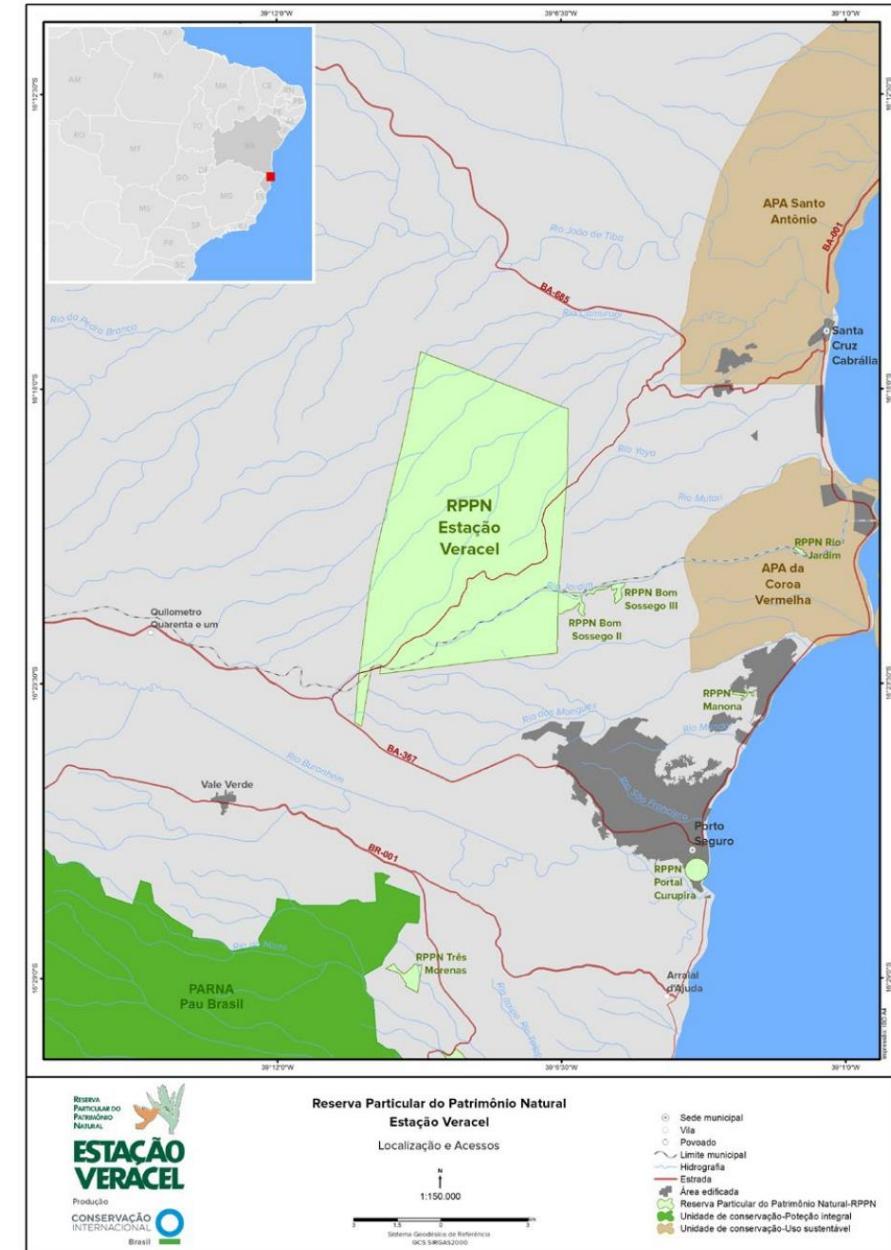


Figura 1: Localização e acessos da RPPN Estação Veracel.

## 2. Material and methods

### LiDAR DATA

LiDAR data were obtained by the company Fototerra in the second half of 2020, covering the entire area of RPPN Estação Veracel. The mapping was done with Teledyne Optech's ORION H300 LiDAR Sensor with Applanix Inertial System (IMU+GPS), model POS AV 39; GNSS ProMark 500 receiver (L1/L2) in the aircraft SÊNECA II EMB-810C with flight height of 610 m, field of view of 45° and overlap in 30%. The acquired cloud totaled 1.23 billion points, with a density of 12.7 points/m<sup>2</sup> and four returns.

## 2. Material and methods

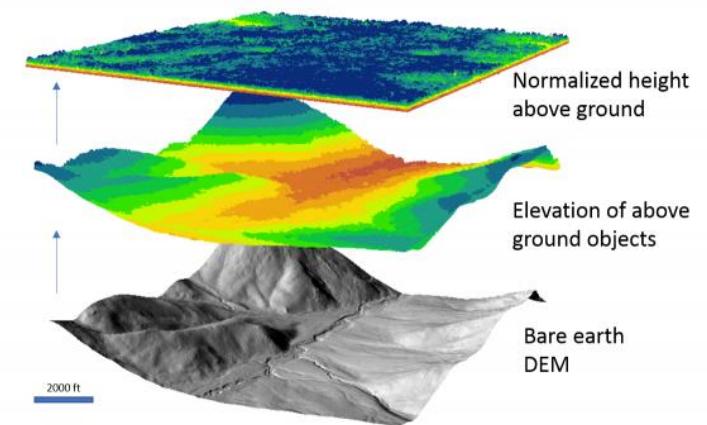
### Data processing and metrics extraction

Carbon biomass estimation was based on the model by Becknell et al. (2018).

$$\text{AGB} = 590.21 + e^{-0.202(P95 - 23.24)} \text{ (Mg/ha)}$$

(Eq. 2)

where P95 is the 95th percentile of height

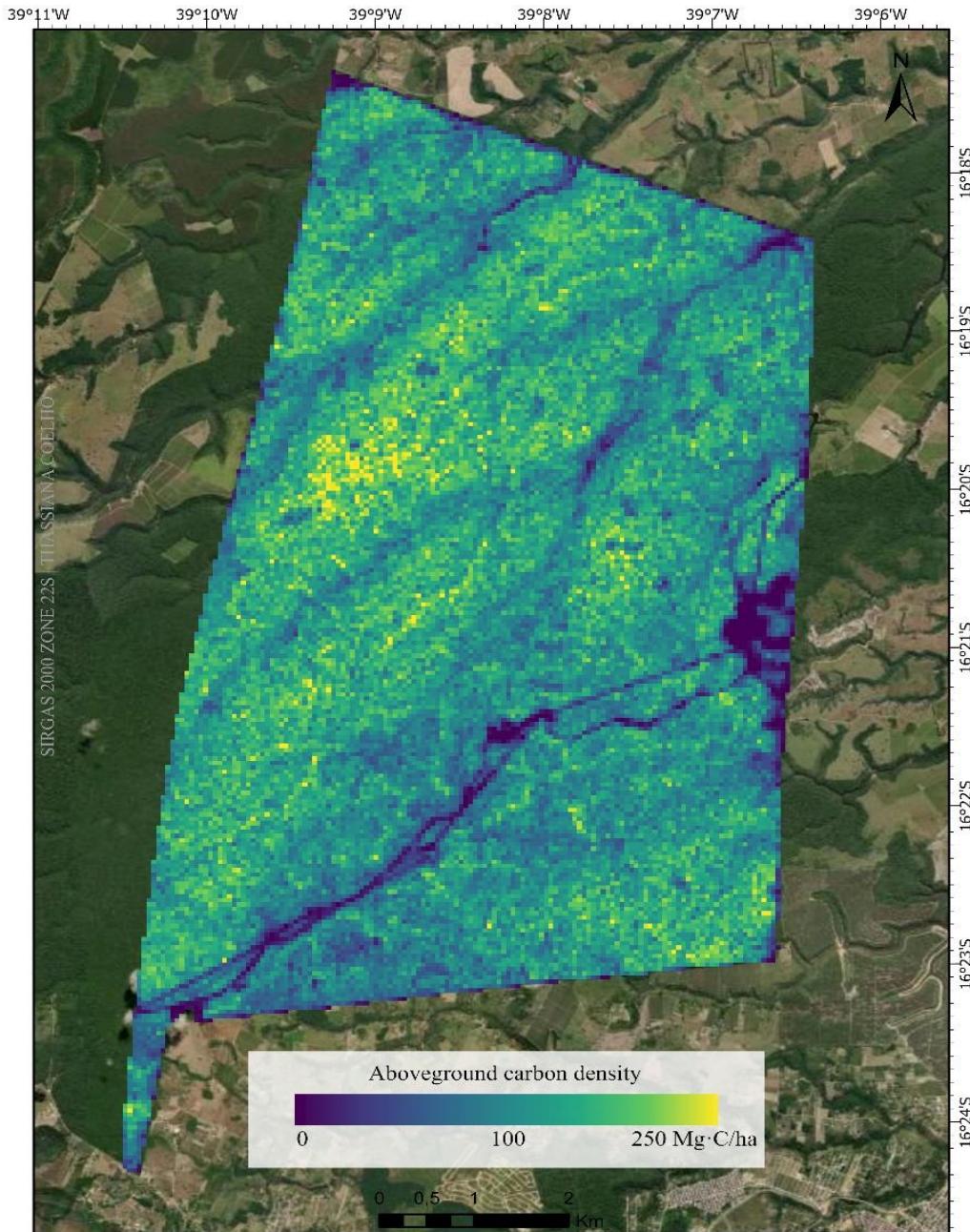


### 3. Results and Discussion

~3,1 Tg.C (1Tg =  $10^6$ Mg)

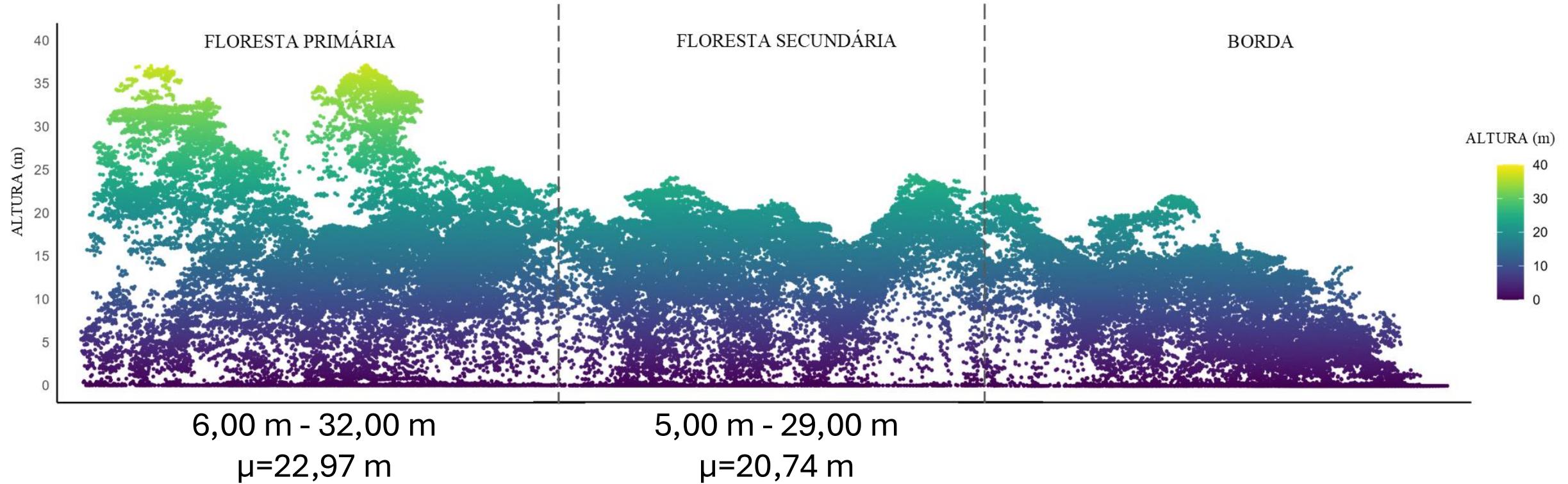
PF: 2,4 Tg.C

SF: 0,67 Tg.C



### 3. Results and Discussion

- Figure 02. Point cloud profile by forest type

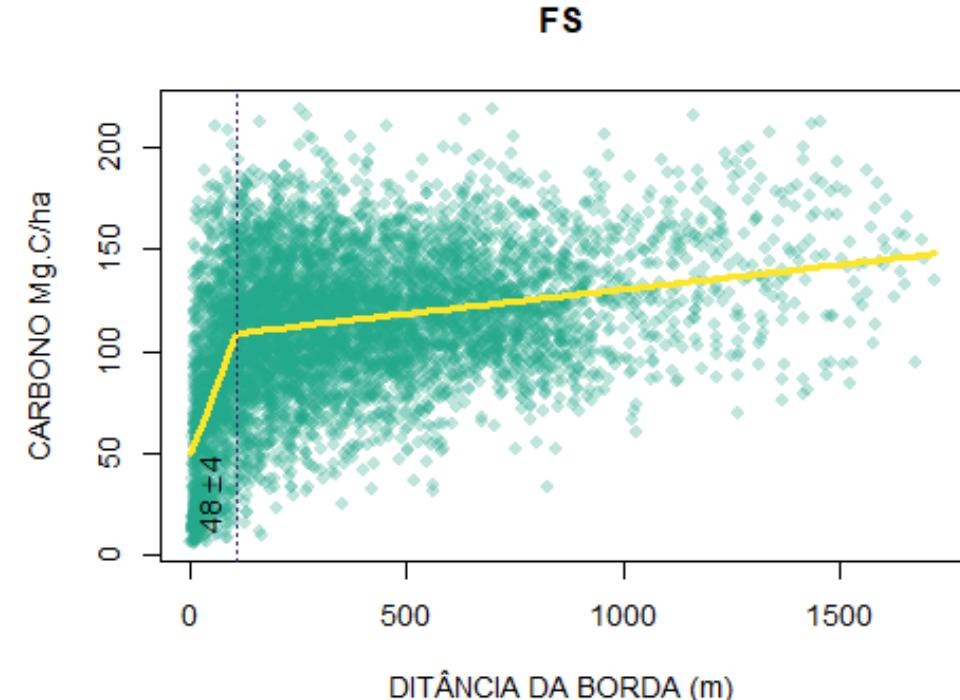
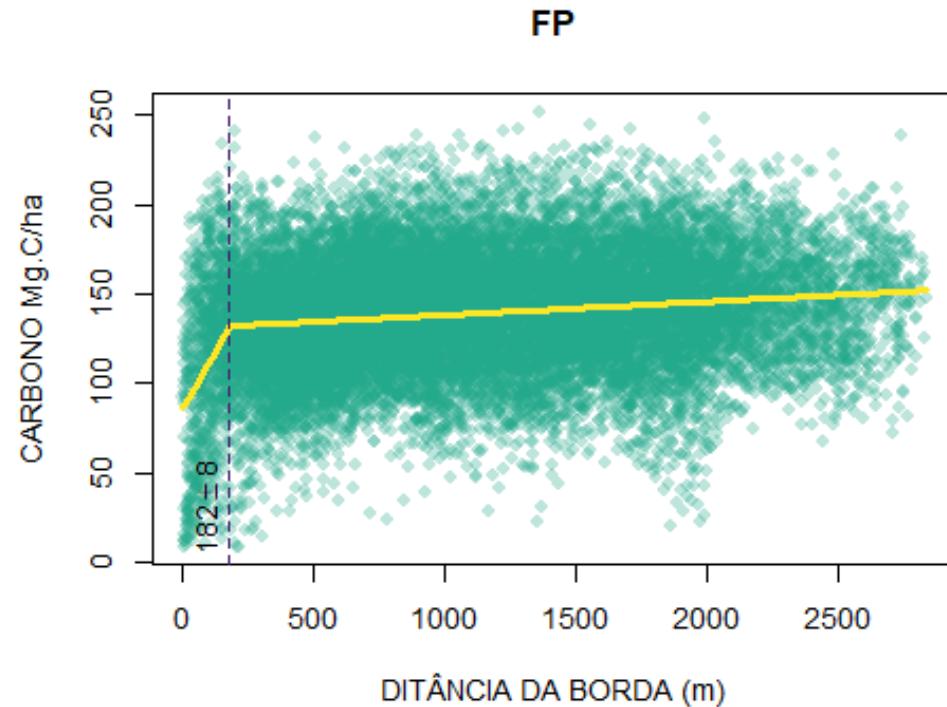


### 3. Results and Discussion

#### Carbon loss due to forest degradation and edge effects

- DISTANCE  $\leq$  182 m  $\rightarrow \Theta = 25,07\%$
- DISTANCE  $>$  182 m  $\rightarrow \Theta = 0,75\%$

- DISTANCE  $\leq$  48 m  $\rightarrow \Theta = 56,63\%$
- DISTANCE  $>$  48 m  $\rightarrow \Theta = 2,40\%$ .



# Conclusions 2

- Clear spatial relationship between edge effects and forest carbon stocks at Veracel Reserve
- Forest fragmentation (edge effect) impacts biomass storage in both mature and secondary forests



**VERACEL**



**DecisionES**  
Porto Seguro  
Jun 30th to Jul 4th BR  
2025  
Symposium on  
Ecosystem Services,  
Forest Management and  
Decision Making