

# Forest Productivity Along an Elevational Gradient in the Upper Florida Keys

Jesus Blanco, Junnio Freixa

Southeast Environmental Research Center, Florida International University, 11200 SW 8<sup>th</sup> St, Miami, FL 33199, USA

## Introduction

### Background:

Forest productivity is driven by different environmental factors, such as topography, water and soil nutrient availability. In South Florida, hammocks are the key component of upland plant communities.

Hammocks of North Key Largo are found at elevations 70cm amsl where ground water salinity is low to intermediate, soils are shallow and rich in organic matter directly on top of Key Largo Limestone bedrock (Ross et al, 1992). The hammocks are arranged along an elevation gradient in which productivity increases with ground elevation.

Hammocks in the Florida Keys are in different stages of succession driven by natural and anthropogenic disturbances. Following a disturbance, early successional pioneer (deciduous) species colonize area and are gradually replaced by evergreen species (Ross et al, 2001).

The question is, "how does the relationship between elevation and forest productivity vary across stands of different ages?"

### Objective:

Use a remote sensing approach to examine relationship between ground elevation and canopy height, a proxy for productivity, in different age stands.

### Hypothesis:

Canopy height will increase with stand age and elevation.

## Methods

Upland forests of different successional ages (Young, intermediate and old).

Historical Aerial Imagery was utilized to determine stand age, expressed as time since last disturbance resulting in clearing of forest area.

Data from Florida Coastal LiDAR Project (2007) was used to create a digital elevation model and a canopy surface model at a resolution of 10m<sup>2</sup> per pixel.

One-hundred samples randomly selected for each age class from digital elevation and canopy surface models.

Linear Regression Analysis was used to analyze data.

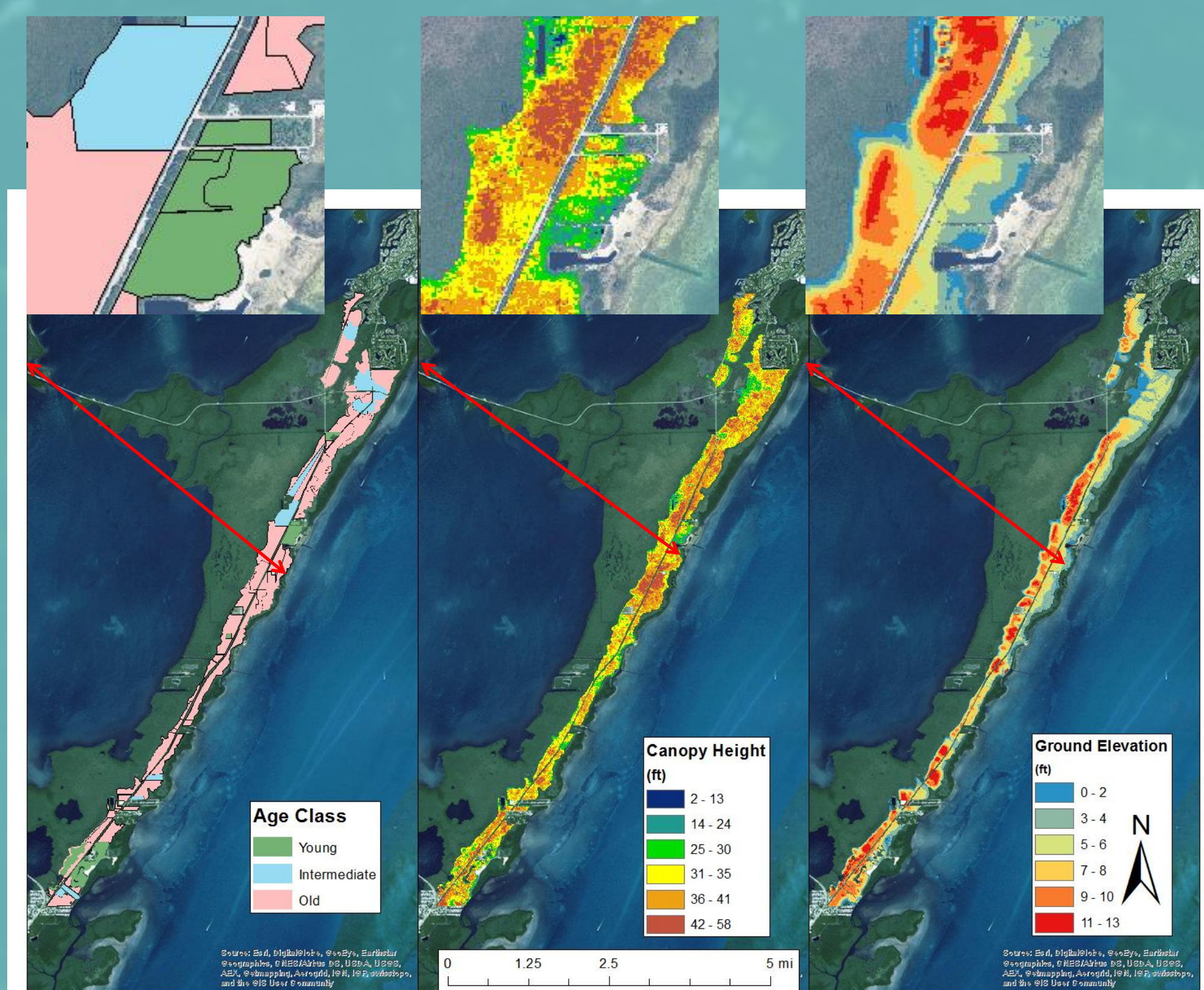
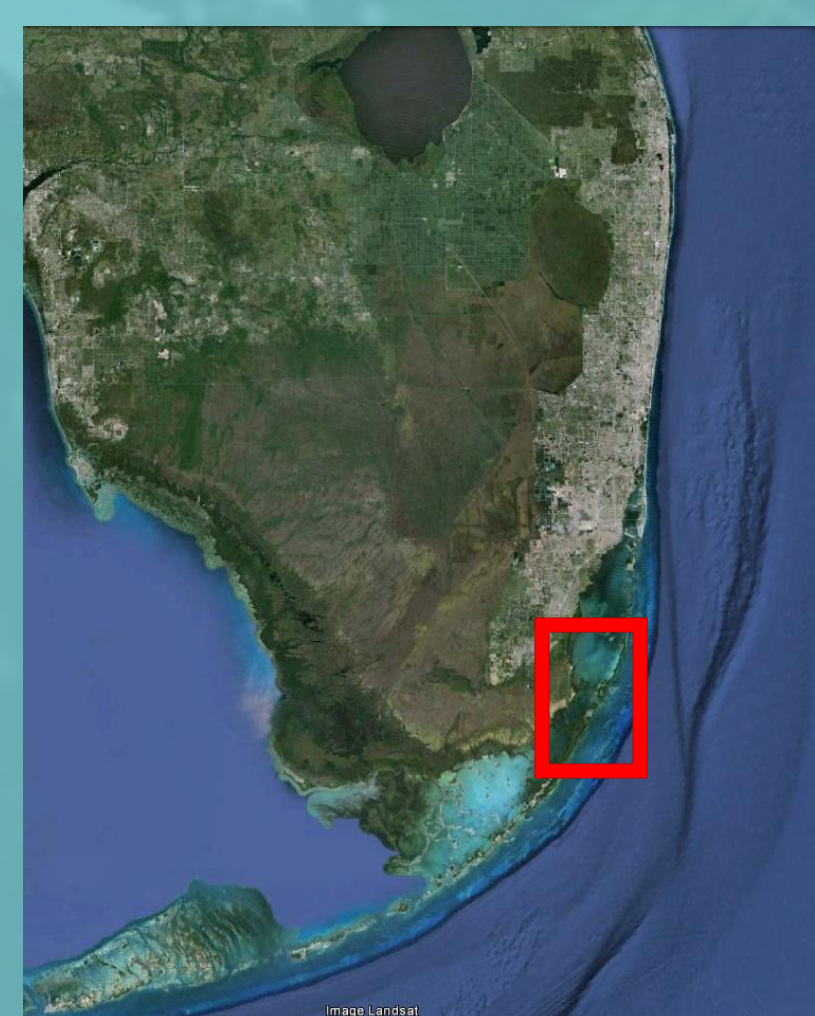
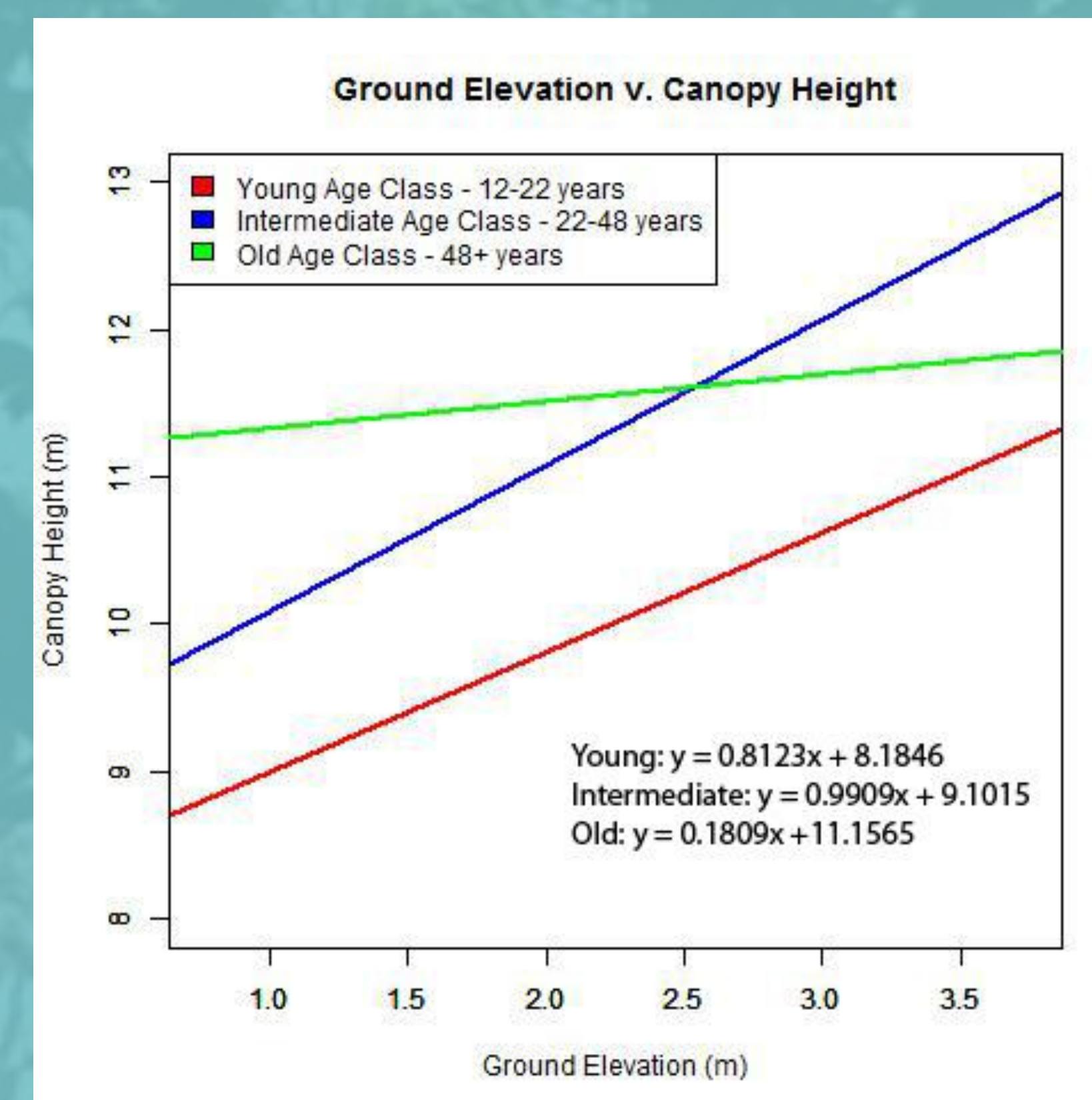


Figure showing different age classes, canopy surface model, and digital elevation model.

## Results & Discussion



Canopy height increases with elevation in all age classes.

However, the relationship between elevation & canopy height varies among age classes.

Change in productivity with elevation is smaller in old forest than in young and intermediate forests.

Differences between regression slope may be explained by the following:

- Shorter canopies in young age not enough time has passed since disturbance for forest to reach maximum height.
- Intermediate forest canopy is taller than old age class at 2.5m above sea level; taller canopy may be attributed to early successional pioneer species that may not survive to old age.
- Old age class is nearly flat across all elevations; Forest may have reached maximum height given available resources.
- Studies in Mexico have shown that trees may be exploiting water sources deep in bedrock (Estrada-Medina et al, 2012).

## Conclusion

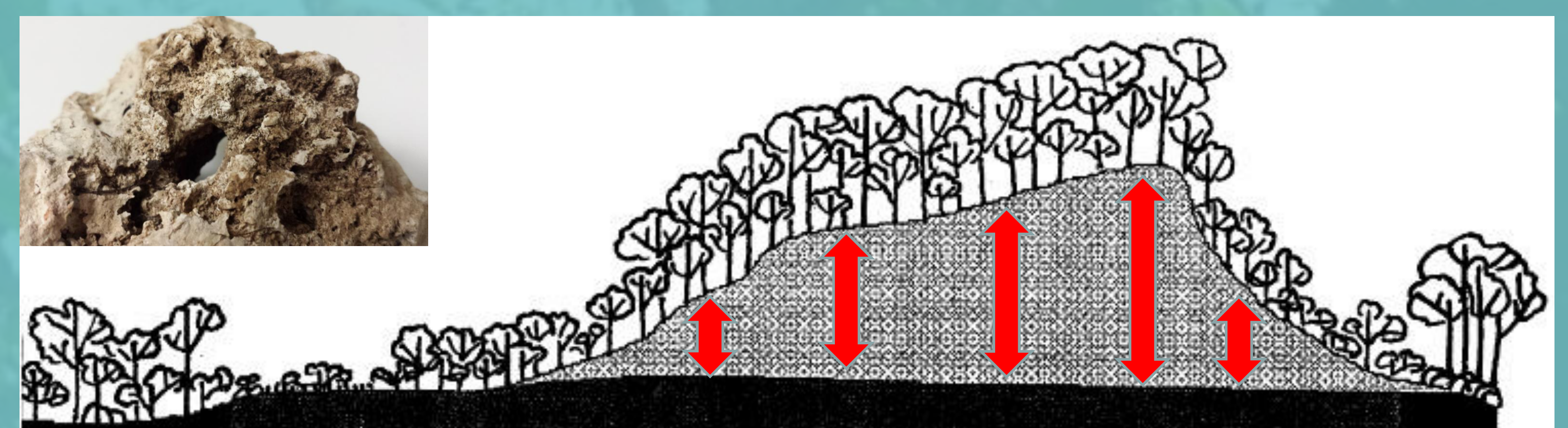
Forest productivity increases with elevation, however relationship weakens as forest matures.

Thus, as sea level rises ground elevation above mean sea level will decrease, and will affect forest productivity.

## Further Research

Are hardwood hammocks of North Key Largo utilizing water stored in the limestone bedrock?

Does the volume of the unsaturated zone play a role in forest productivity?



Ross, M. S., J. O'Brien, & L. Flynn. 1992. Ecological site classification of Florida Keys terrestrial habitats. *Biotropica* 24:488-502.  
Ross, M. S., M. Carrington, L. J. Flynn, & P. L. Ruiz. 1999. Forest succession in tropical hardwood hammocks of the Florida Keys: effects of direct mortality from Hurricane Andrew. *Biotropica* 33:23-33.  
Estrada-Medina, Hector, Graham, Robert C., Allen, Michael F., Jimenez-Osornio, Juan Jose, Robles-Casolco, Said. 2012. The importance of limestone bedrock and dissolution karst features on tree root distribution in northern Yucatan, Mexico. *Plant and Soil* V362:N1-2 37-50