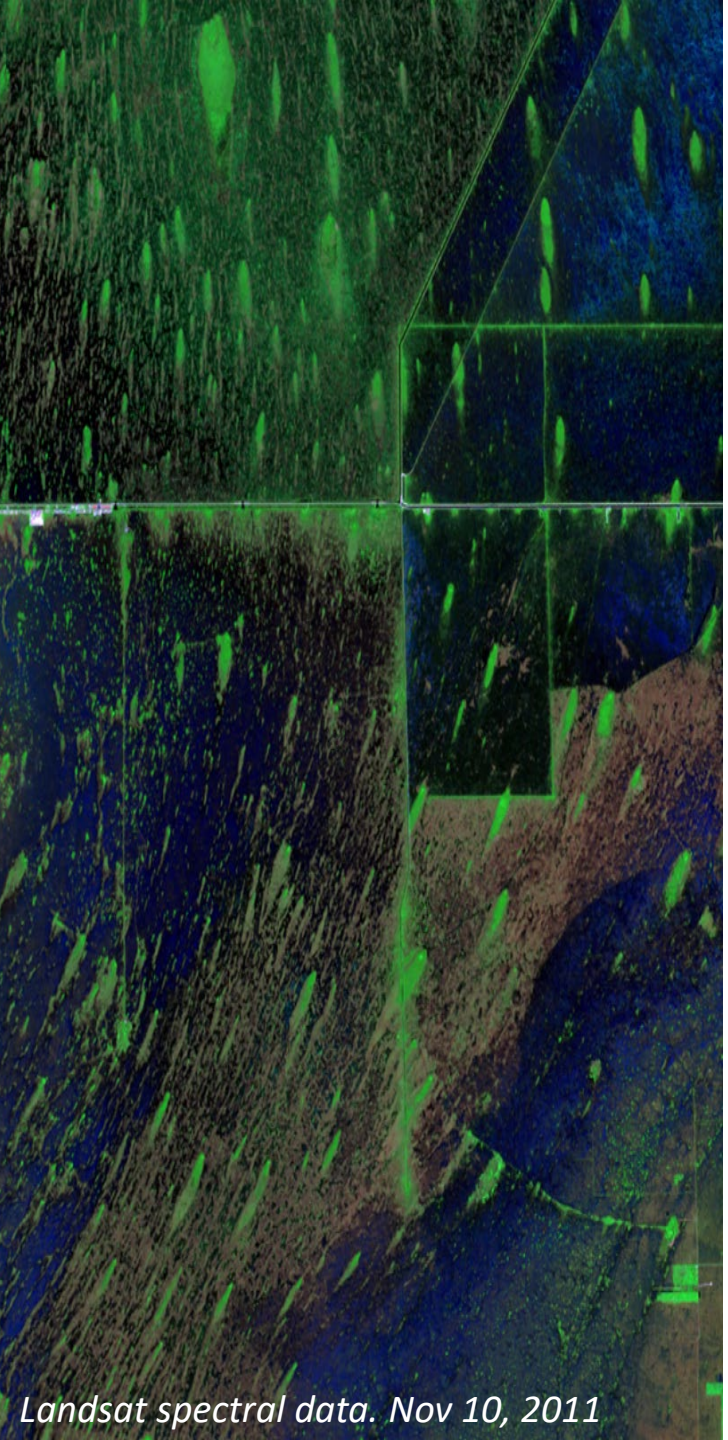

Landsat spectral data. Nov 10, 2011

Quantifying Spatial Patterns of Woody Vegetation Embedded in Everglades Freshwater Wetland Ecosystems

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FIU Institute of Environment
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Patterned Landscapes

Termite Mounds, Mozambique

Fairy Circles, Namibia

Ribbon Forests, USA

Tree Islands, USA

Which processes create these patterns?

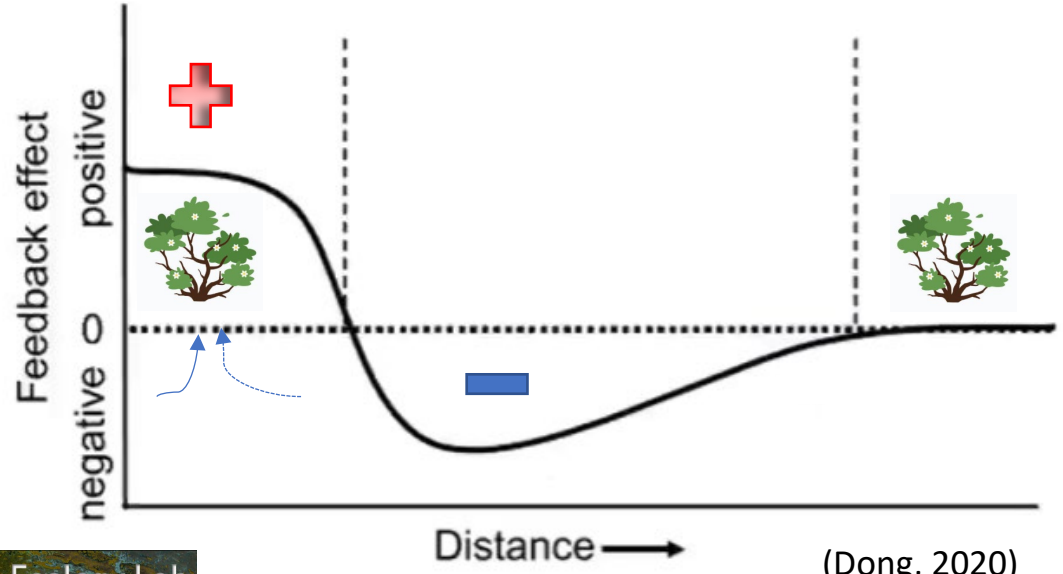
Sources:
Pringle and Tarnita, (2014)
Danita Delimont Photography
Google Earth

Self-organization

A process in which the spatial patterning at the global level of a system can emerge solely from local interactions among individual agents (Dong, 2020)

Scale-dependent patterns

- Regular (periodic) distribution of patches
- Similar size of patches
- Characteristic length scale due to inhibition



(Dong, 2020)

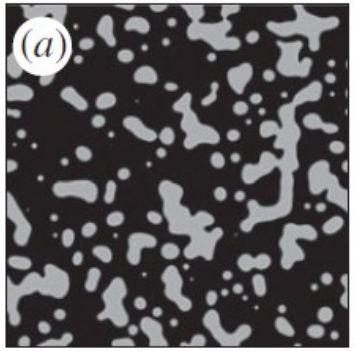
Scale-free patterns

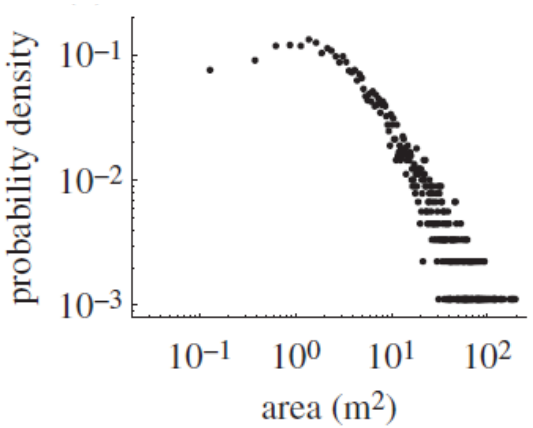
- Amorphous distribution
- Power law relationship between patch sizes and frequency - probability of finding a patch of a certain size is inversely proportional to a power of that size
- Short-range facilitation without inhibition and global resource competition

How do we quantify these patterns?

Irregular Pattern

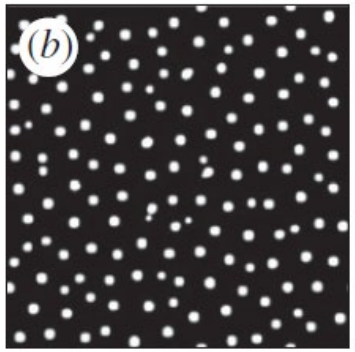
Facilitation dominated

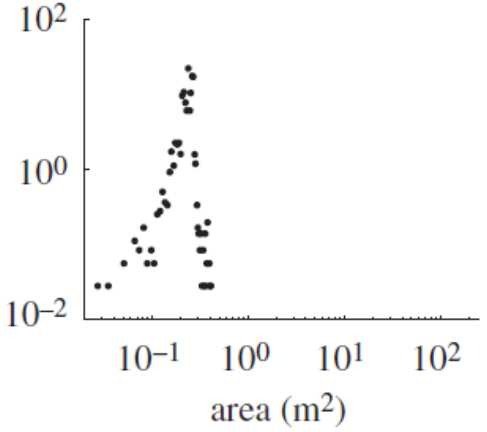




Regular Pattern

Competition dominated





Von Hardenberg (2010)

Woody Vegetation in Everglades

- Everglades -two phase heterogeneous system with woody vegetation patches embedded in a herbaceous matrix
- Five major woody communities: Hardwood hammocks, Bayheads, Cypress, Pine, Mangroves

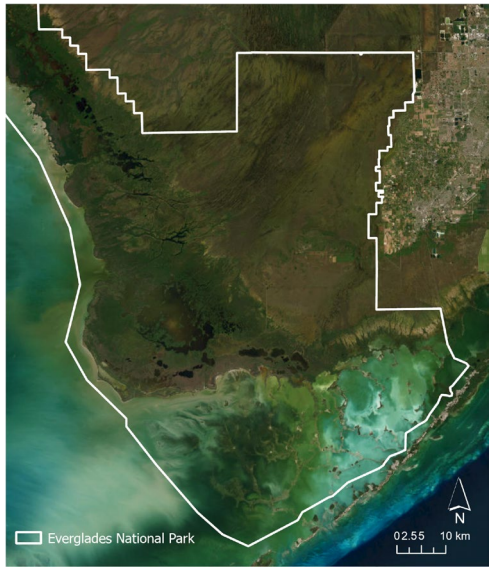


Image Source
Google Earth

Question. What is the spatial distribution and spatial configuration of cypress vegetation communities in Everglades National Park?

Objective. Quantify the distribution of patch sizes and mean patch tree height of cypress communities as a function of environmental factors.

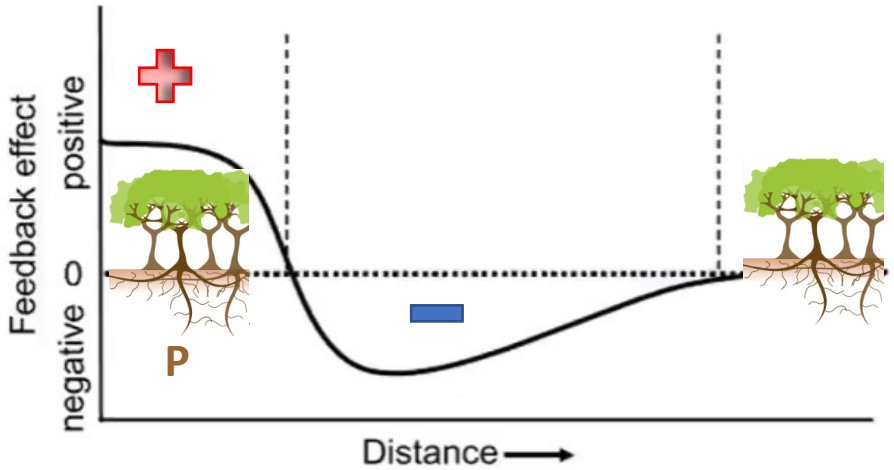
Expected Patterns

Cypress communities

Patch sizes will follow a power law or normal distribution, and this will vary with location in the landscape

-> normal distribution indicative of local facilitation and competition for P

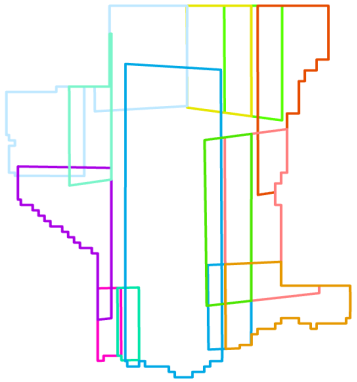
-> power law indicative of short range facilitation and competition at larger scale



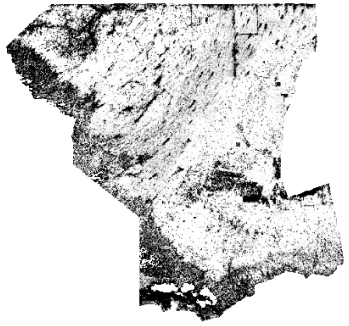
Larger and taller patches of cypress communities in deeper water and longer hydroperiods -> no resource limitation

Approach

Data



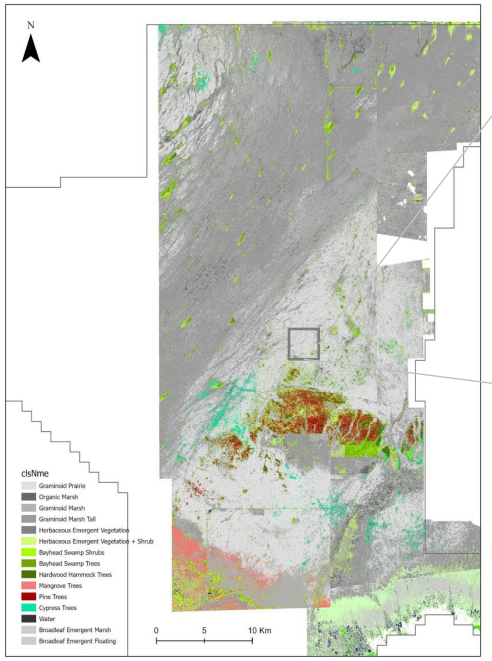
16 WV2/3 images
9 Vegetation Indices

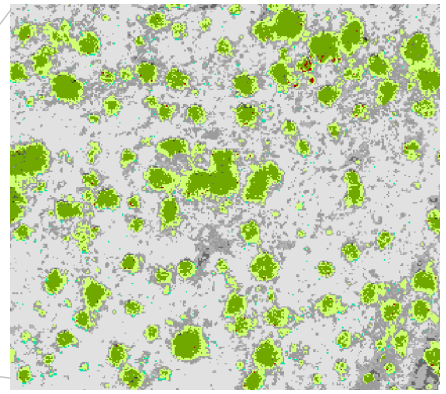


7 LiDAR metrics

Training points
RF classifier

Zmax – DTM = CHM



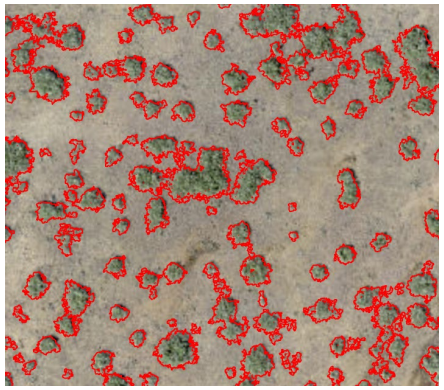


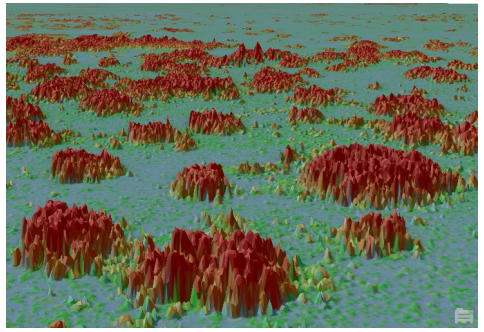
Spatial statistics :

- Patch size
- Patch height
- Patch density

Analyze distribution of patch size and mean patch height

Model size and height as a function of hydrologic variables





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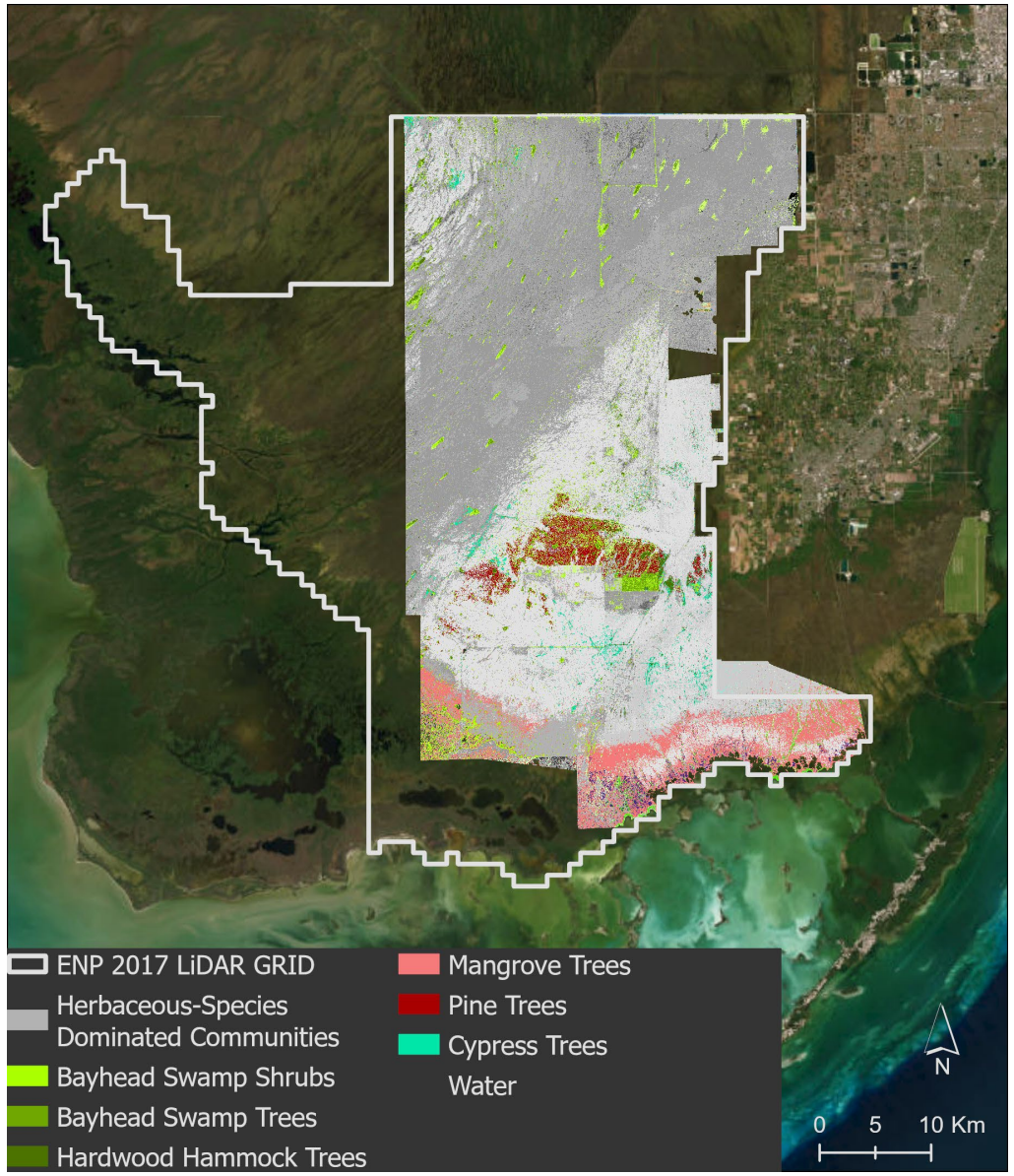
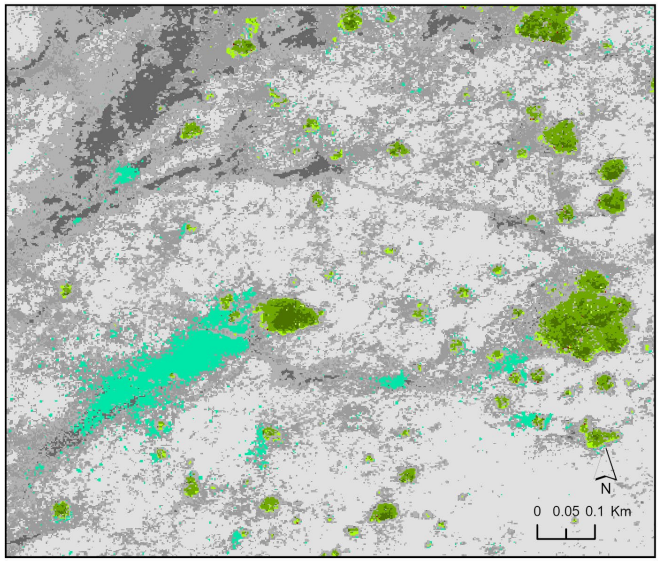
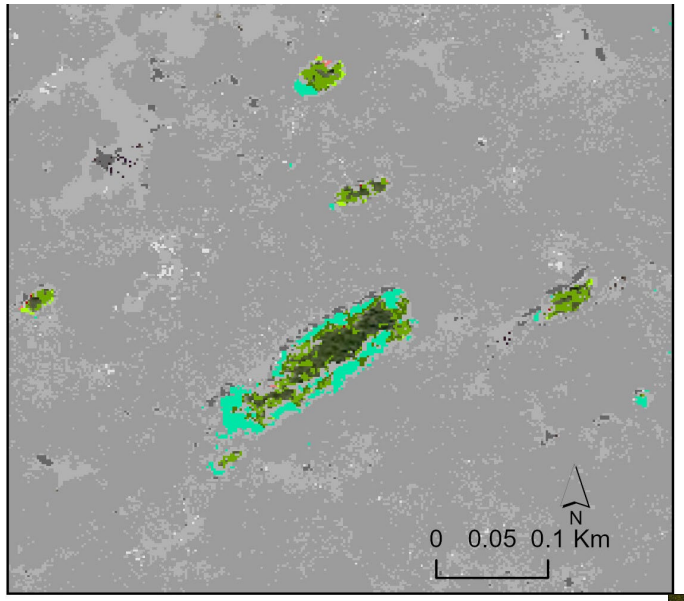
Preliminary Results







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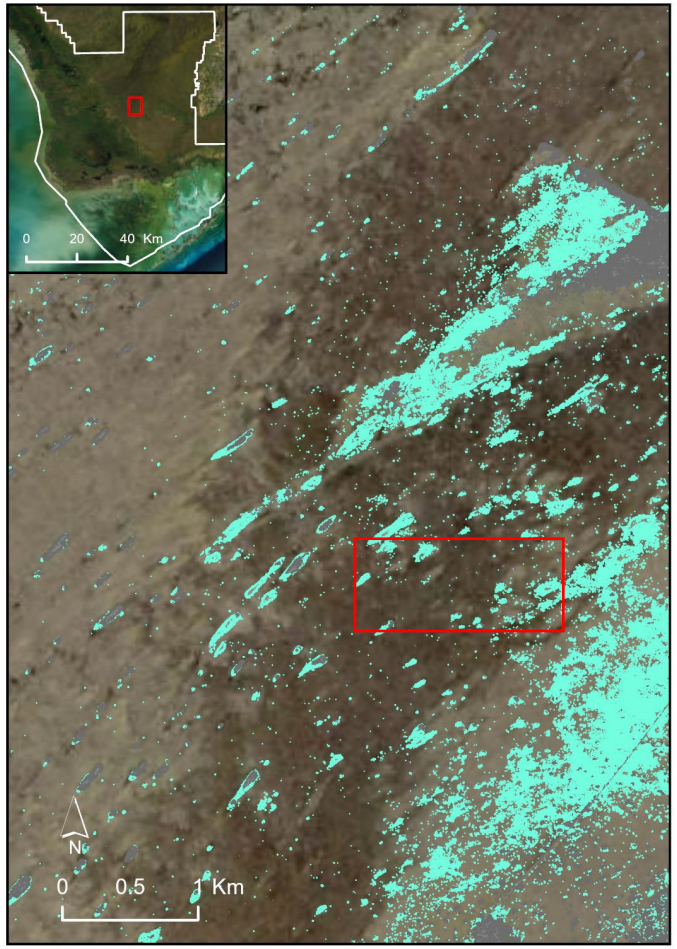
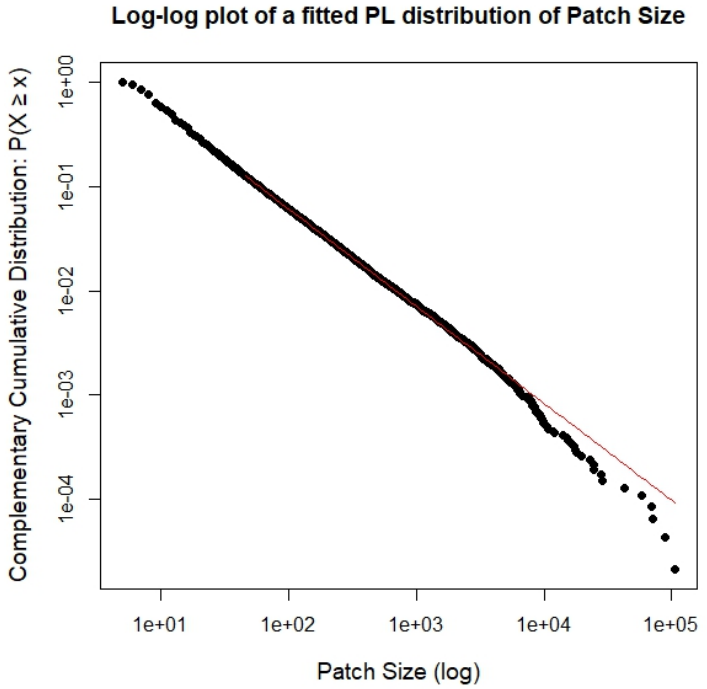
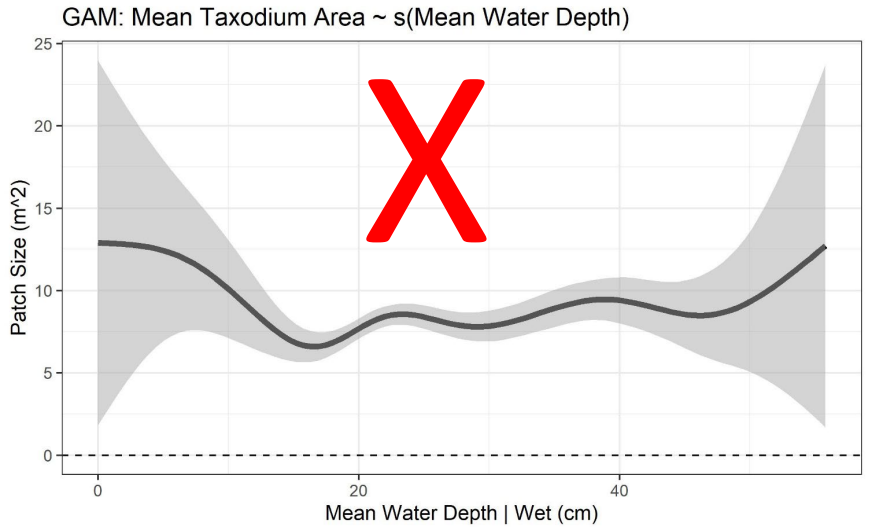


~50,000 Taxodium patches

Size: 5 to 100,000 m^2



Effect of Mean Water Depth (5 years: 2010-2015) and Taxodium Patch Size (m^2)



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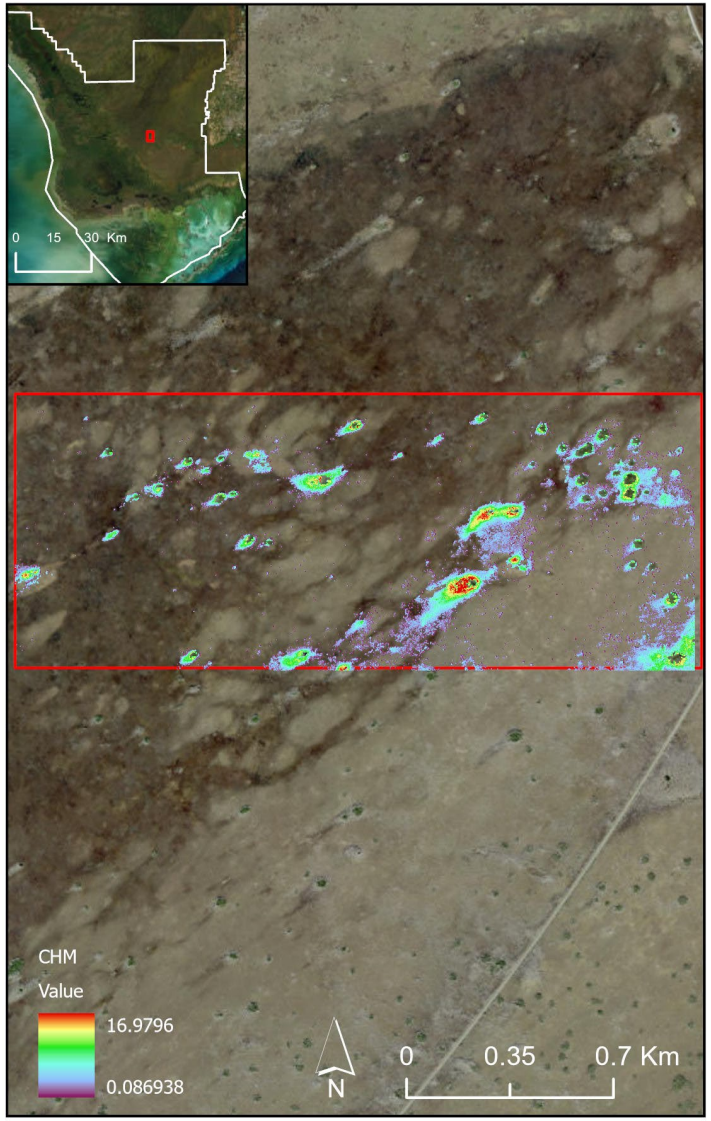
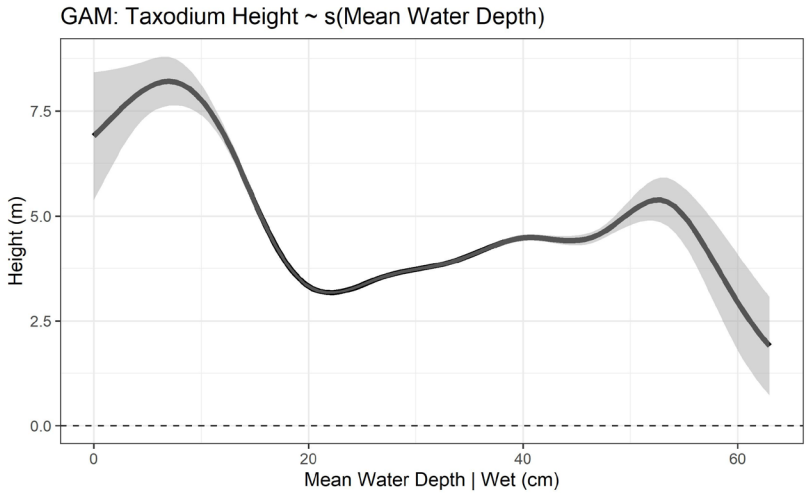
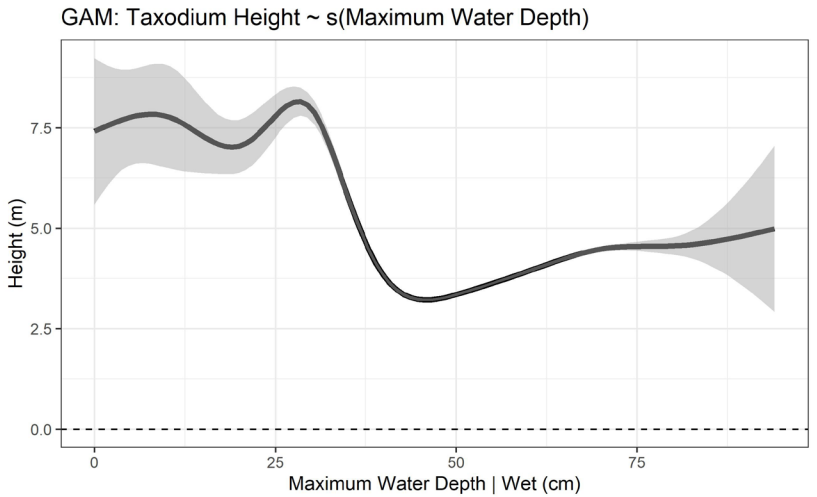
Preliminary Results





Relationship between Mean and Max Water Depth (5 years: 2010-2015) and *Taxodium* tree height (m)



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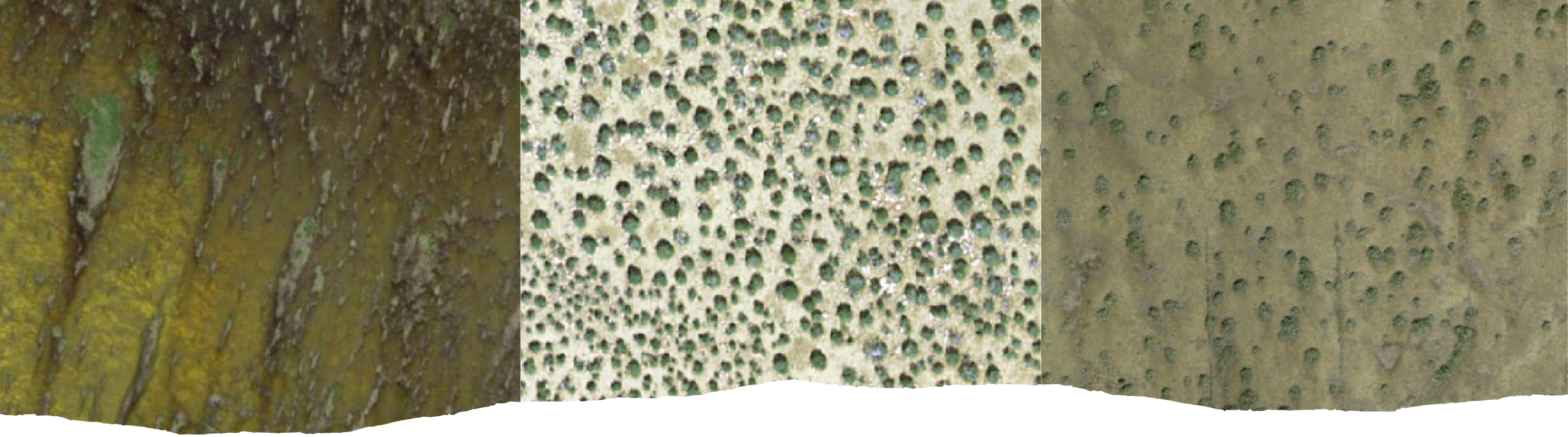

Next Steps

- Quantify the dispersion patterns of freshwater woody vegetation communities with regards to patch size, tree height and density at multiple spatial scales.
- Time series analysis
- High performance computing

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Acknowledgements