

# Canopy structural complexity as a continental predictor of primary production: Using NEON to transform understanding of forest structure-function

Emerging Frontiers No. 1550657



Jeff Atkins, Robert Fahey, Chris Gough, and Brady Hardiman



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# Physical structure and carbon cycling at the continental scale

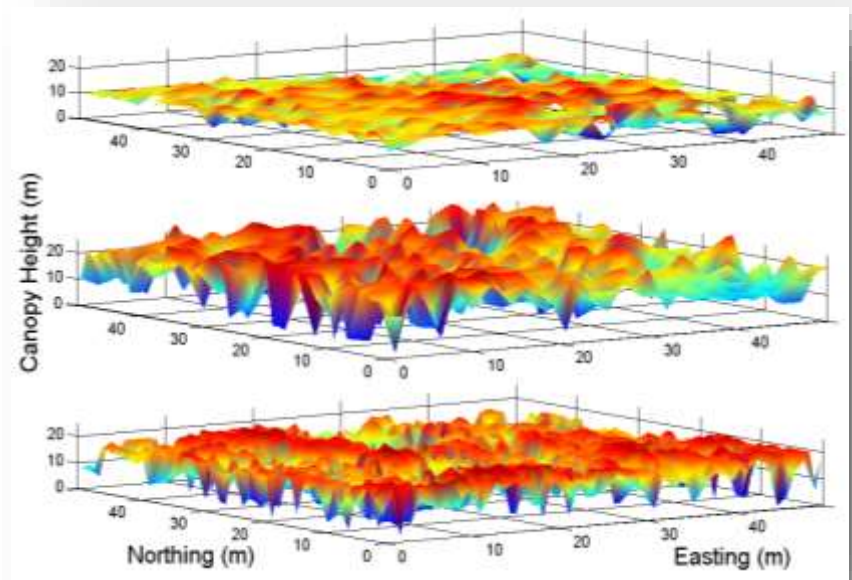
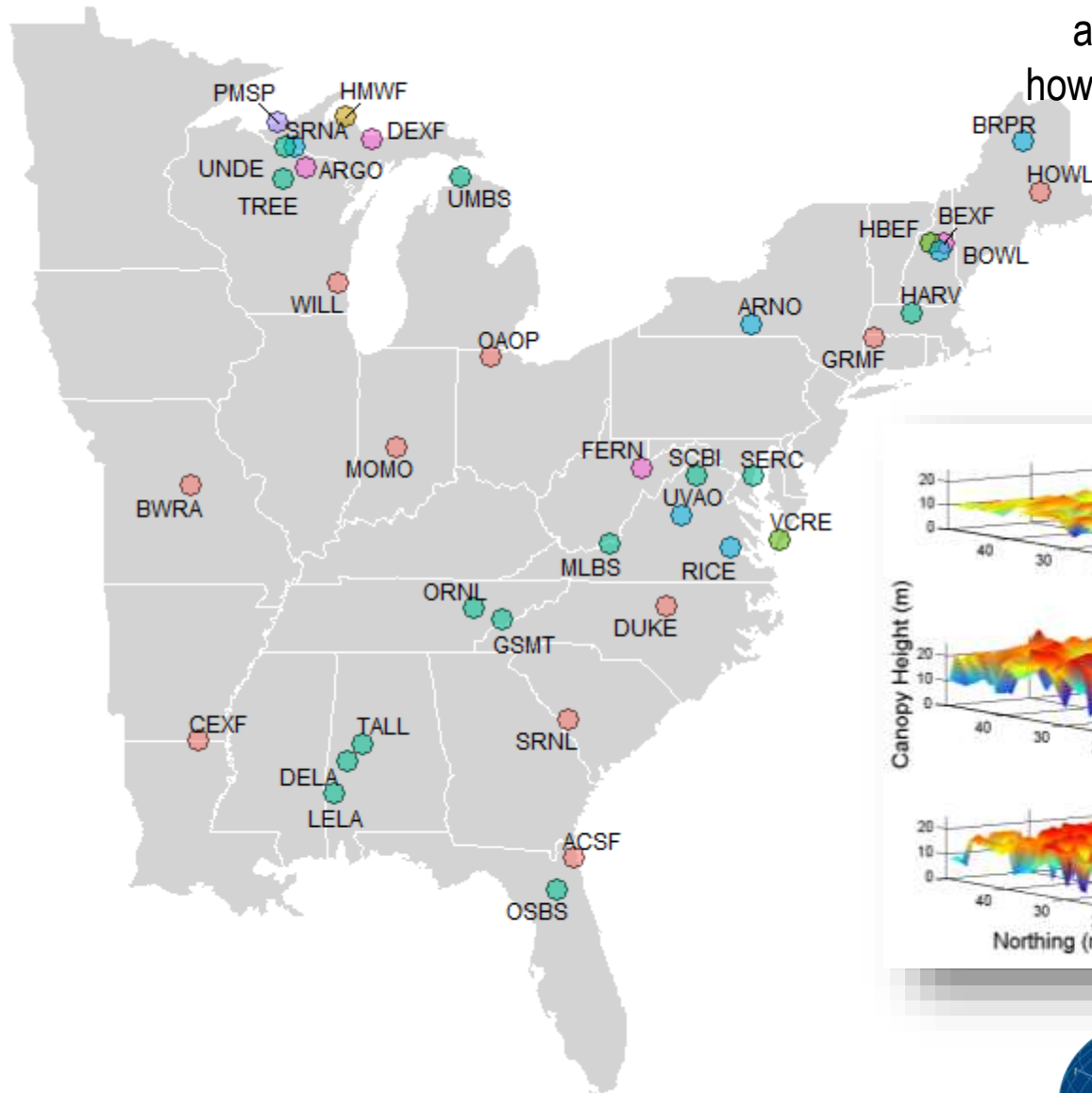


# Physical structure and carbon cycling at the continental scale

- Canopy structural complexity (CSC) varies at the continental scale
- Beyond LAI
- Scaling and model integration
- Cross-platform comparison



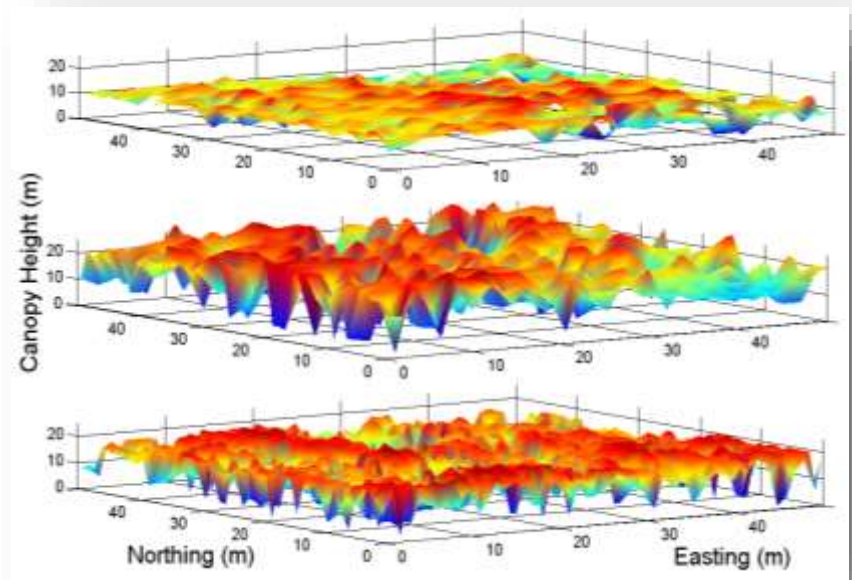
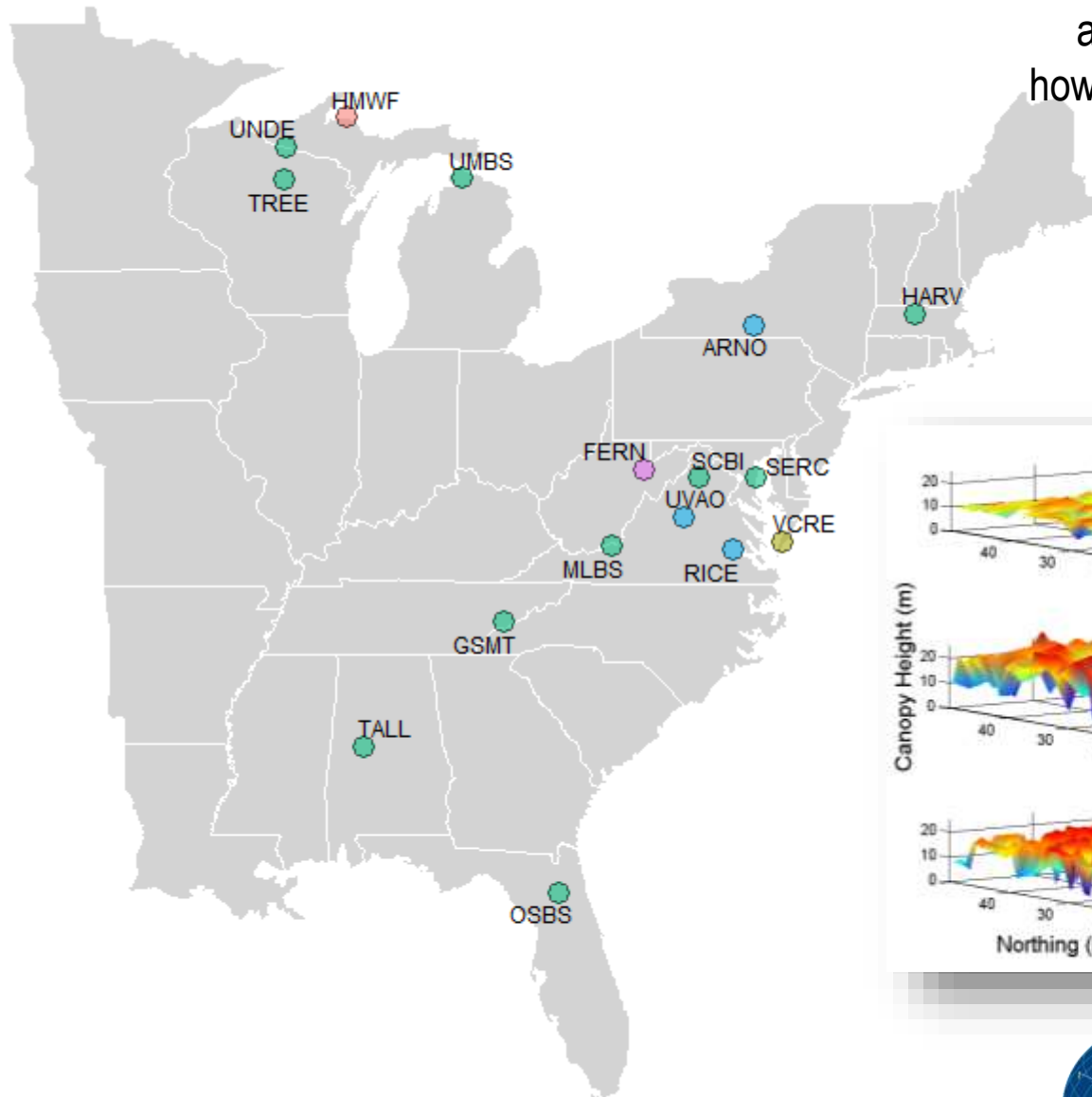
We are using NEON, LTER, Ameriflux, and other field station sites to examine how and why ecosystem structure relates to forest net primary production.



**neon**<sup>TM</sup>  
National Ecological Observatory Network

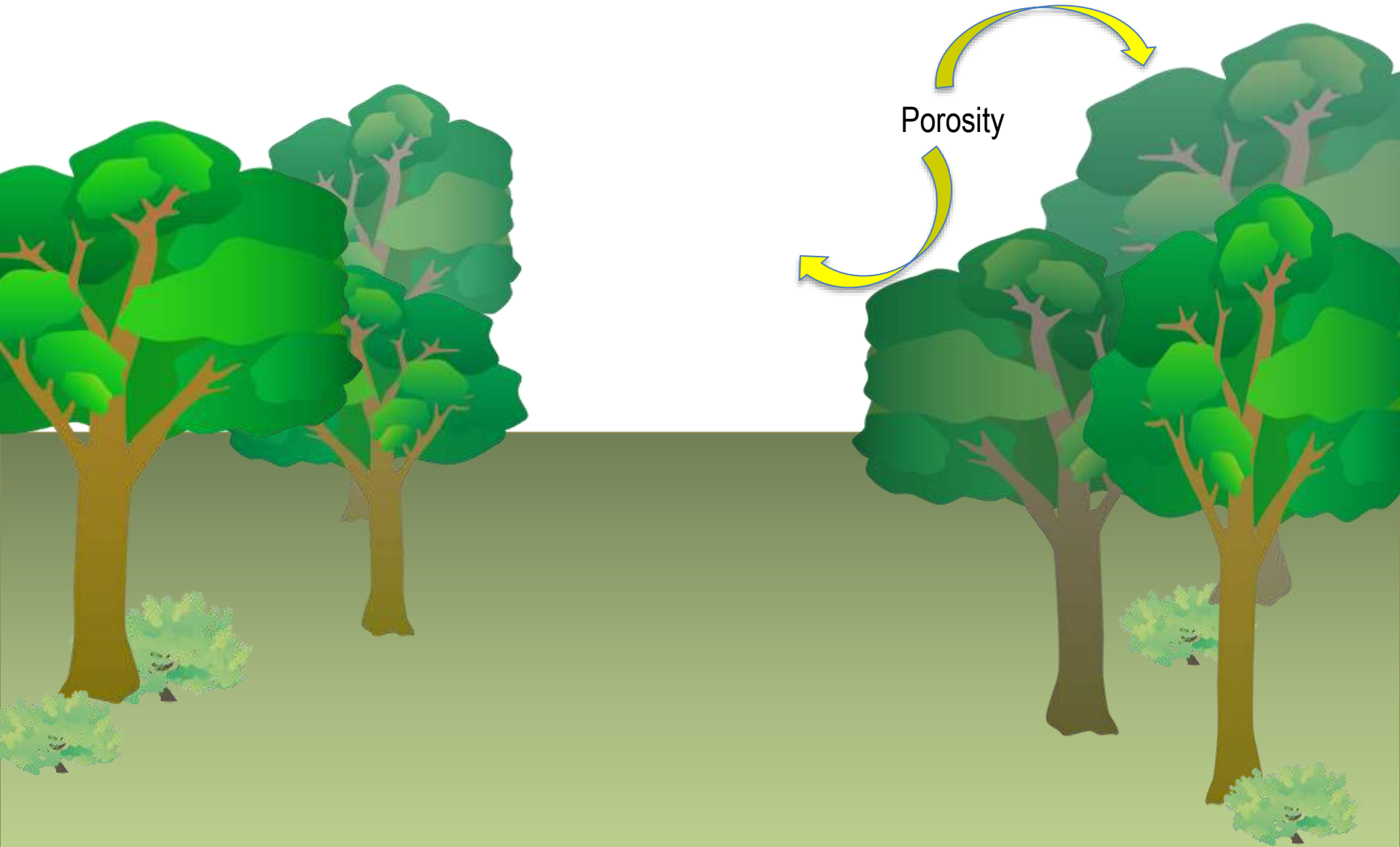


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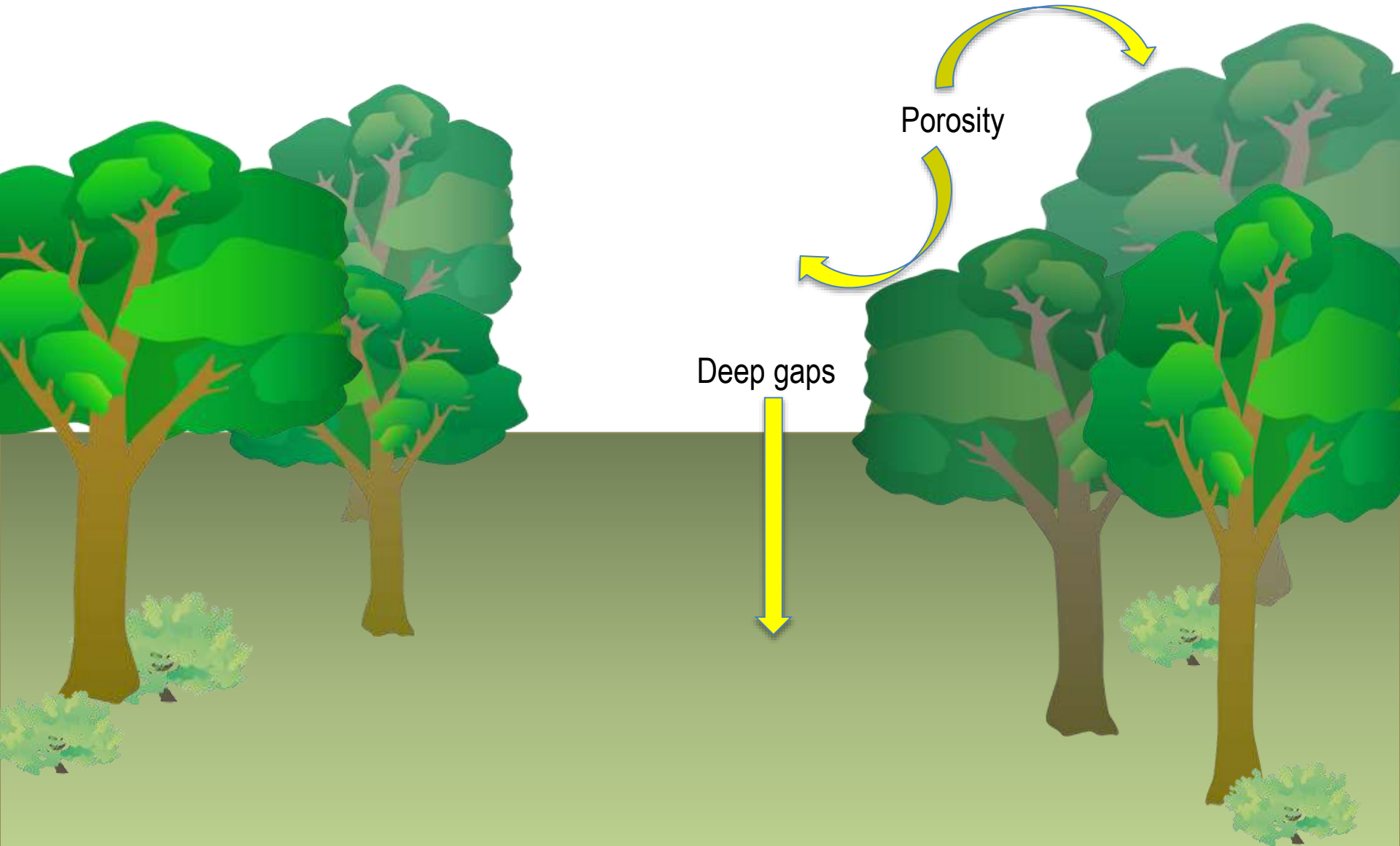


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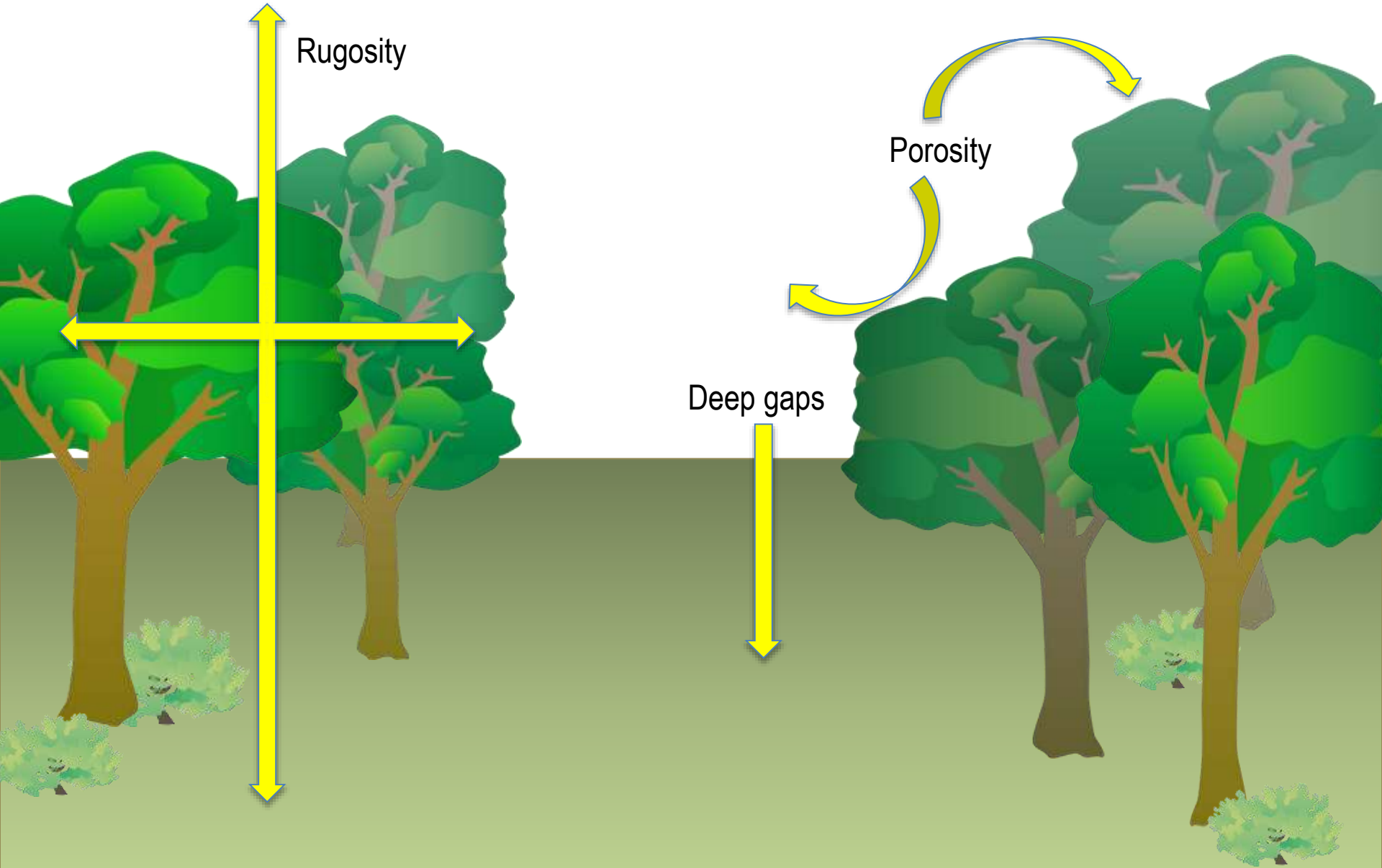
Let's talk about CSC, baby



Let's talk about CSC, baby

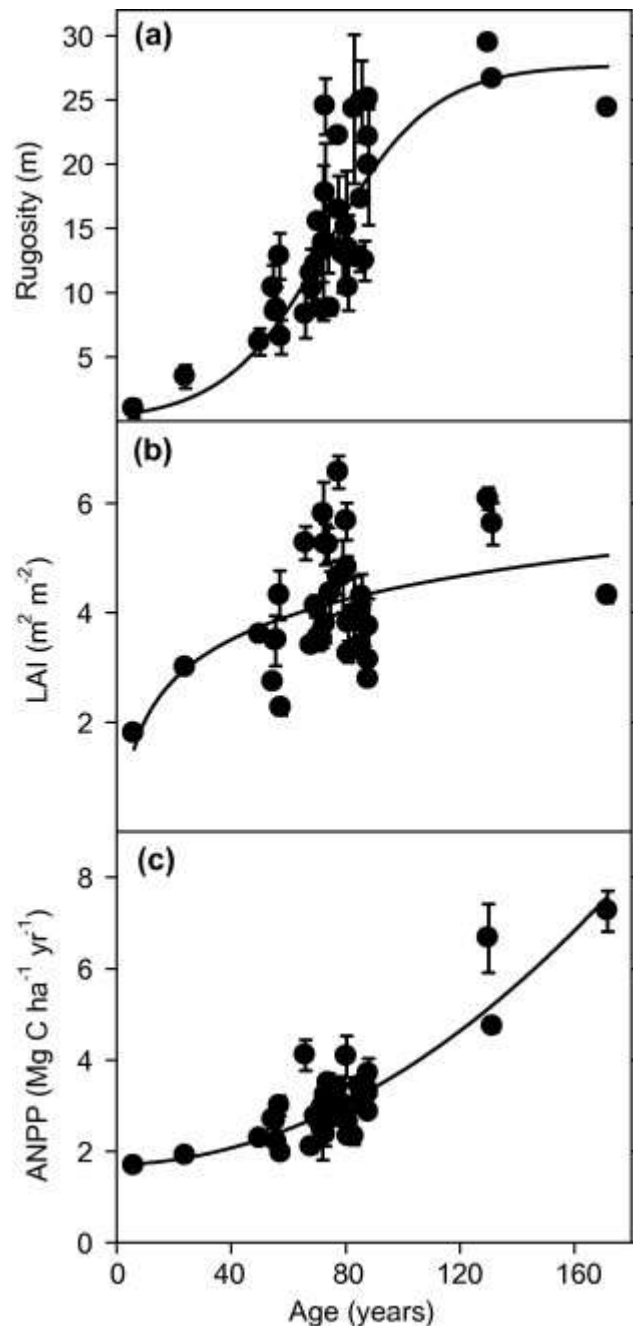


Let's talk about CSC, baby





# Rugosity



- Metric of canopy complexity
- Arrangement of leaves, rather than amount (LAI)
- LAI saturates, while Rugosity continues to increase with stand age

# Portable Canopy LiDAR (PCL)



Reigl 3100VHS-FLP - A near-infrared pulsed laser firing at 2000 Hz









# A Portable Airborne Laser System for Forest Inventory

Ross Nelson, Geoffrey Parker, and Milton Hom

## Abstract

A simple  
profile

were first ap  
Chish and C

*Forests* 2013, 4(3): 537-552; doi:10.3390/f4030537

Open Access

Article

Agricultural

## Canopy Structural Changes Following Widespread Mortality of Canopy Dominant Trees

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## Canopy-structure effects on surface roughness parameters: Observations in a Great Lakes mixed-deciduous forest

Kyle D. Maurer<sup>a</sup>, Brady S. Hardiman<sup>b</sup>, Christoph S. Vogel<sup>c</sup>, Gil Bohrer<sup>a,\*</sup>



CrossMark

*Ecology*, 92(9), 2011, pp. 1818–1827  
© 2011 by the Ecological Society of America

University, Columbus, OH 43210, USA

## The role of canopy structural complexity in wood production of a maturing northern deciduous forest

BRADY S. HARDIMAN,<sup>1,3</sup> GIL BOHRER,<sup>2</sup> CHRISTOPHER M. GOUGH,<sup>1,3</sup> CHRISTOPH S. VOGEL<sup>4</sup>

<sup>1</sup>Department of Evolution, Ecology, and Organismal Biology, Ohio State University, Columbus, OH 43210, USA

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*Forest Ecology and Management* 189 (2004) 307–315

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## The canopy surface and stand development: assessing forest canopy structure and complexity with near-surface altimetry

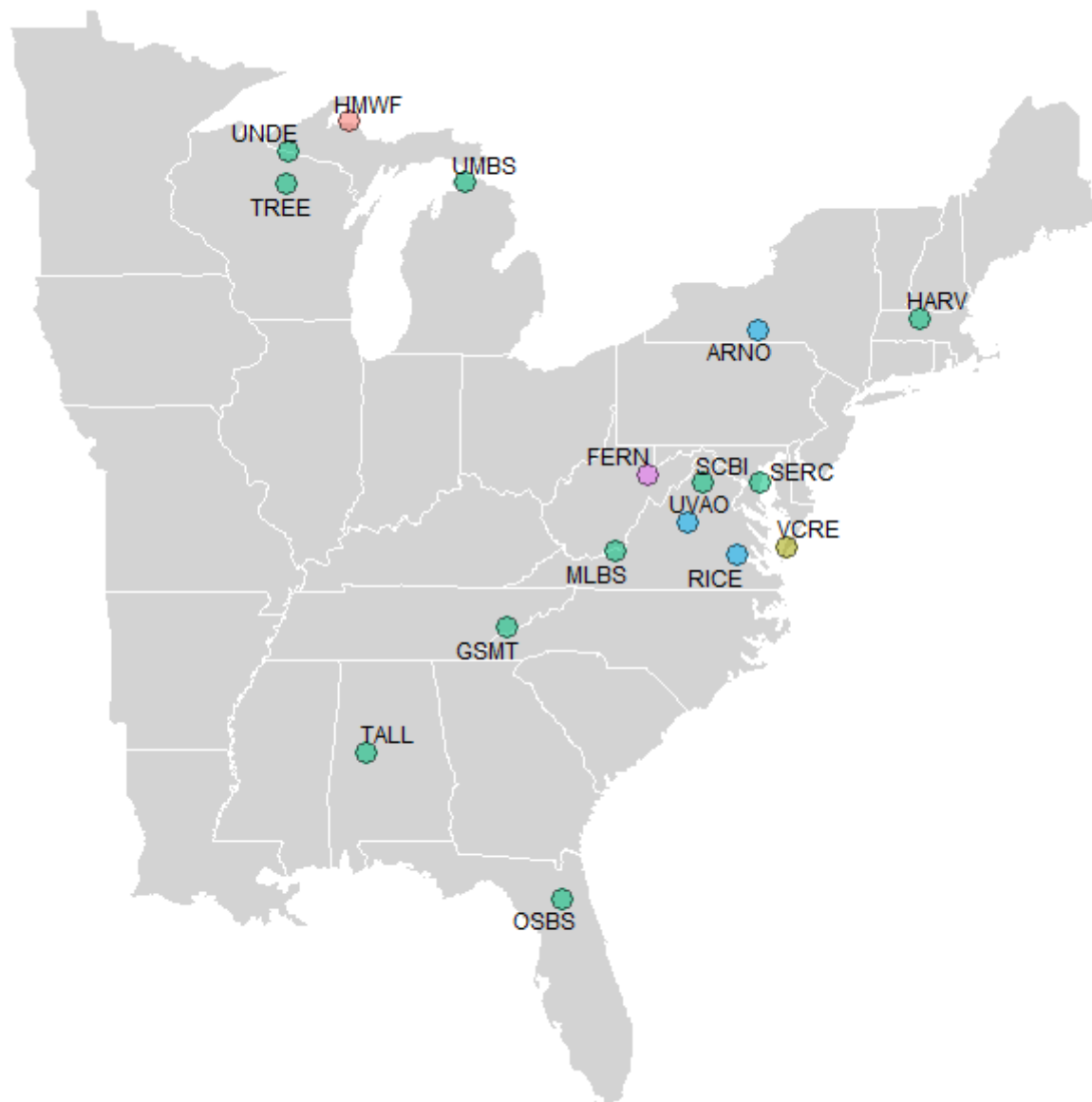
Geoffrey G. Parker<sup>a,\*</sup>, Mary E. Russ<sup>b</sup>

<sup>a</sup>Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD 21037, USA

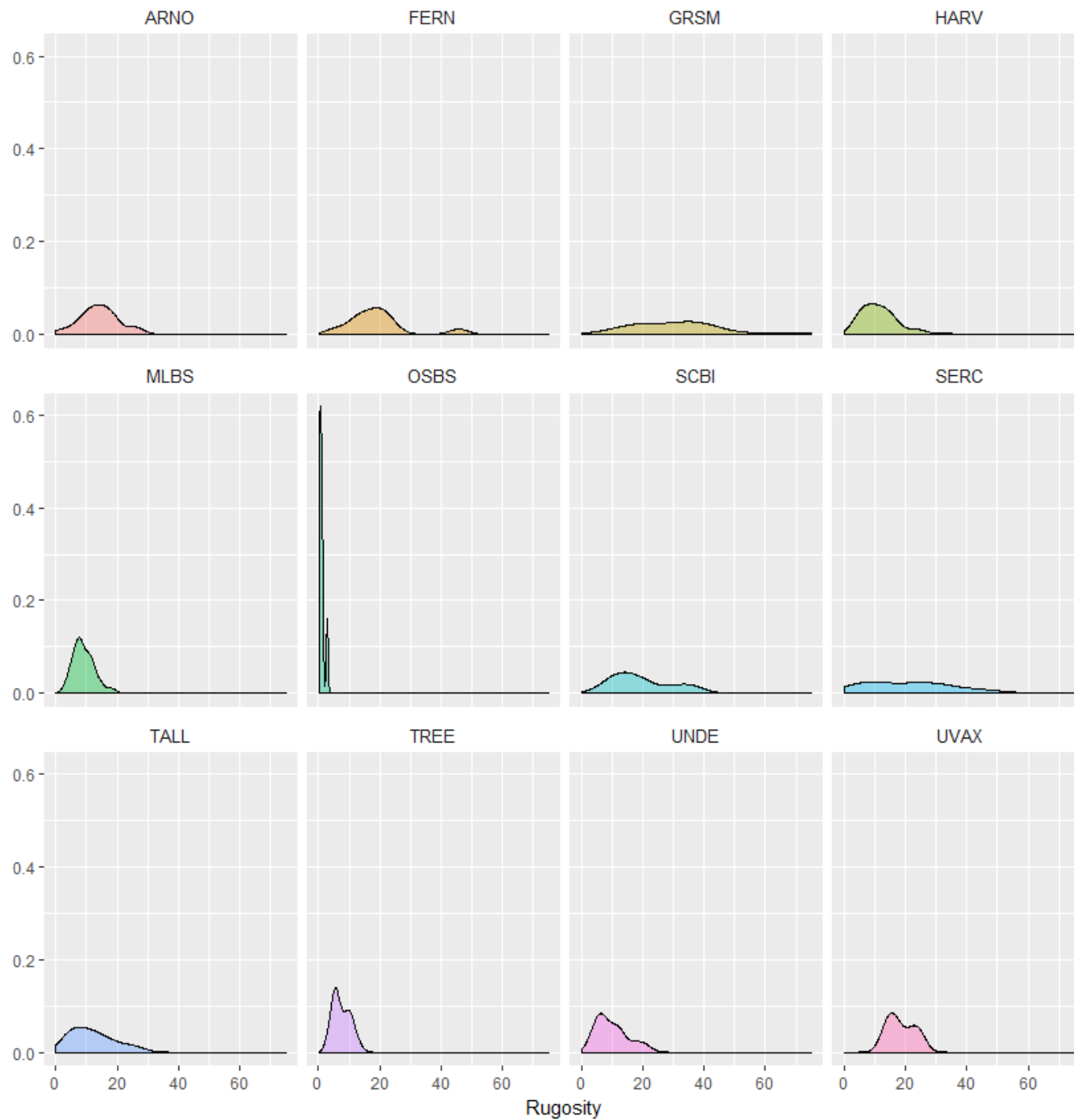
<sup>b</sup>College of Life Sciences, 1211 Symons, University of Maryland, College Park, MD 20742, USA

Received 11 March 2003; received in revised form 20 May 2003; accepted 1 September 2003

## 2016 Field Season

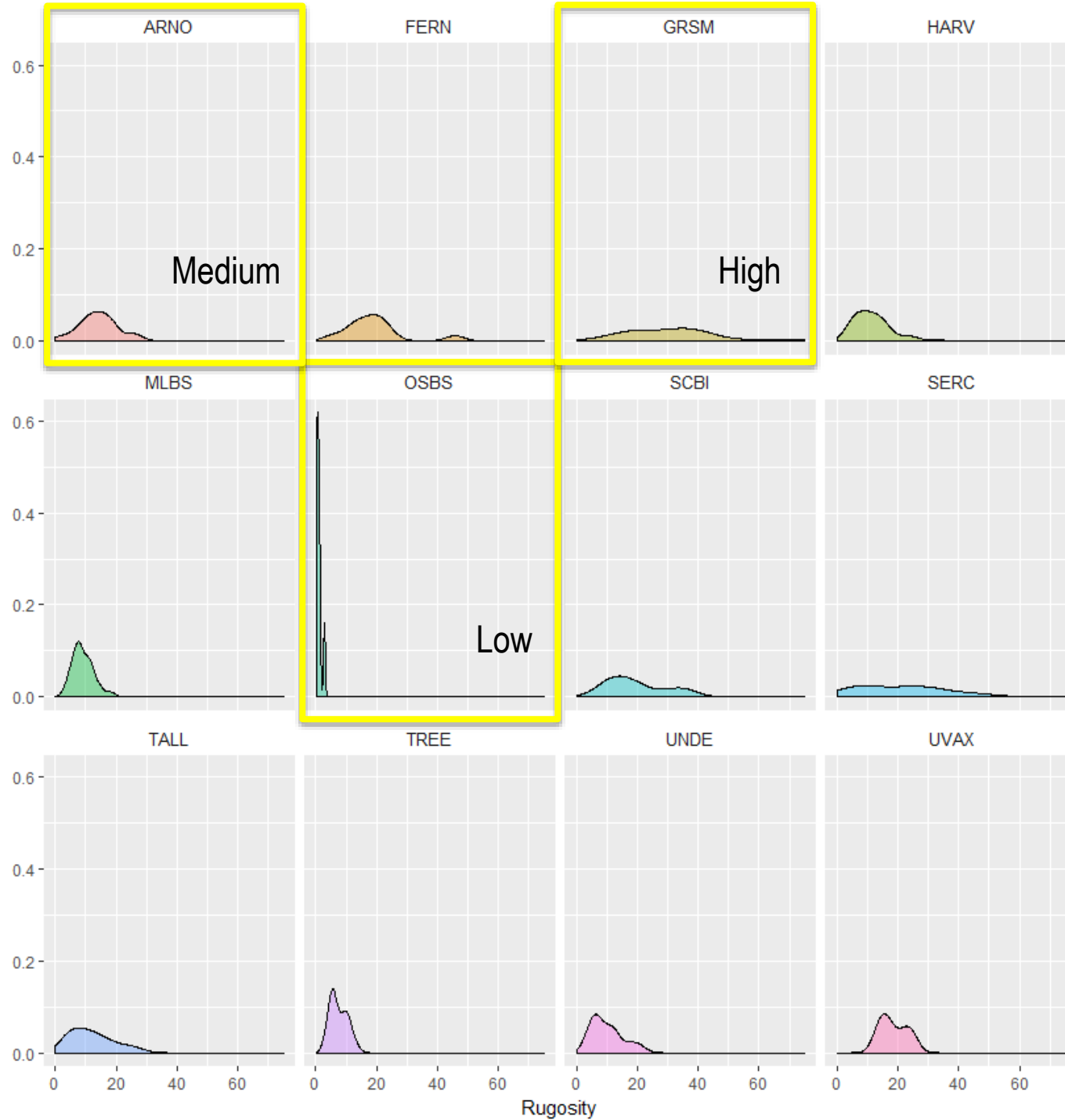


Frequency Distribution





Frequency Distribution

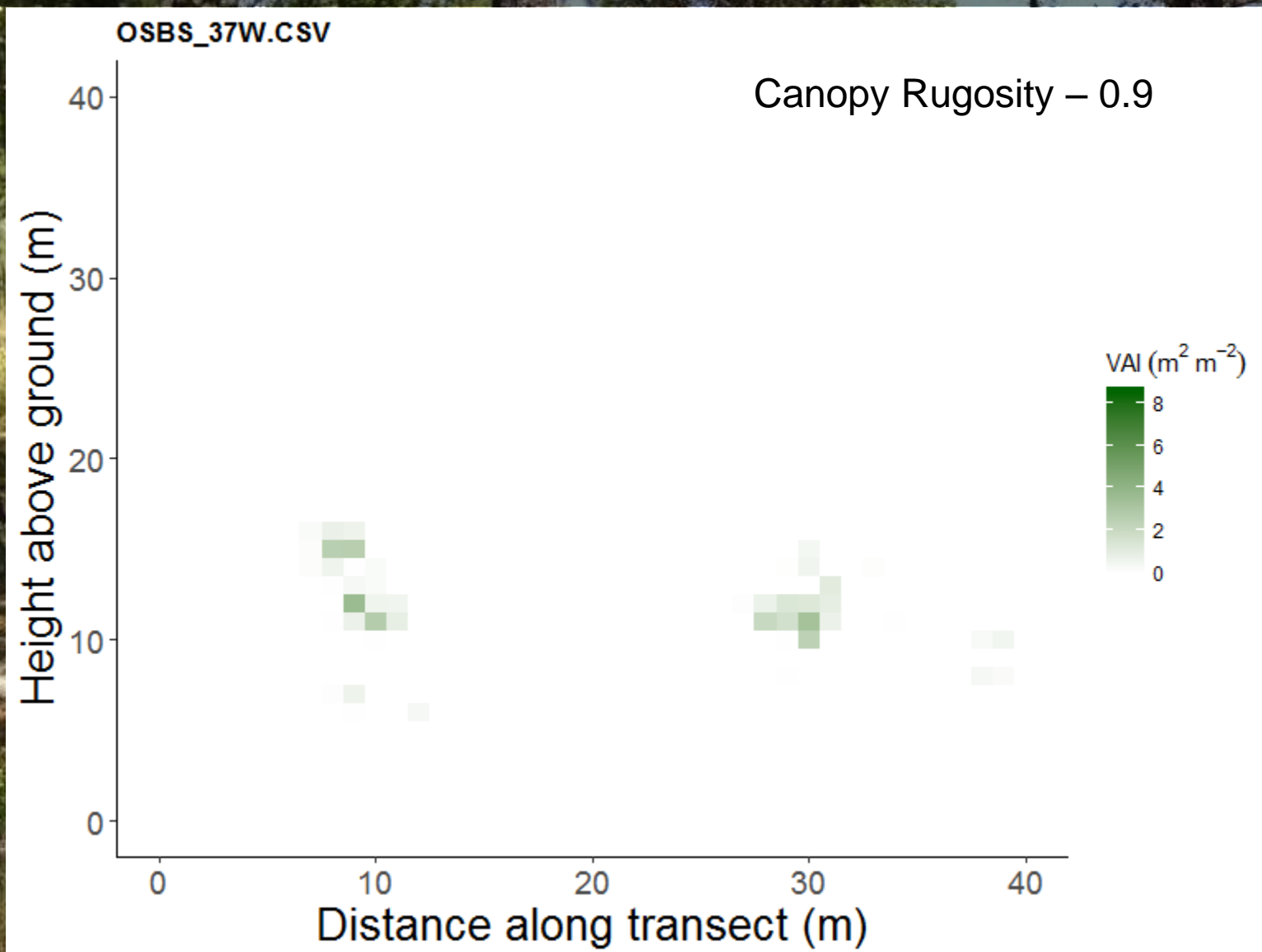


# Ordway-Swisher Biological Station





# Ordway-Swisher Biological Station



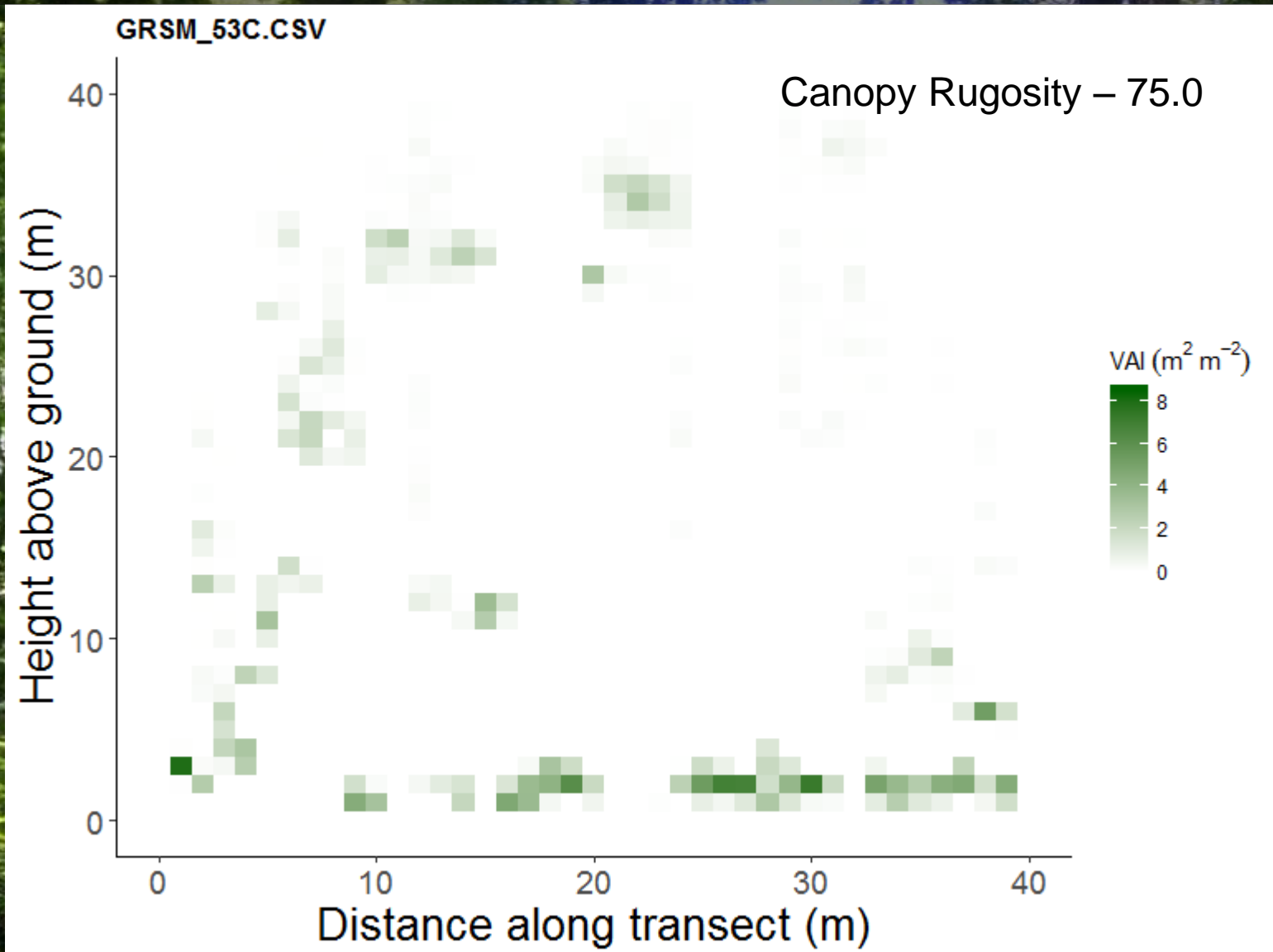


# Great Smoky Mountains



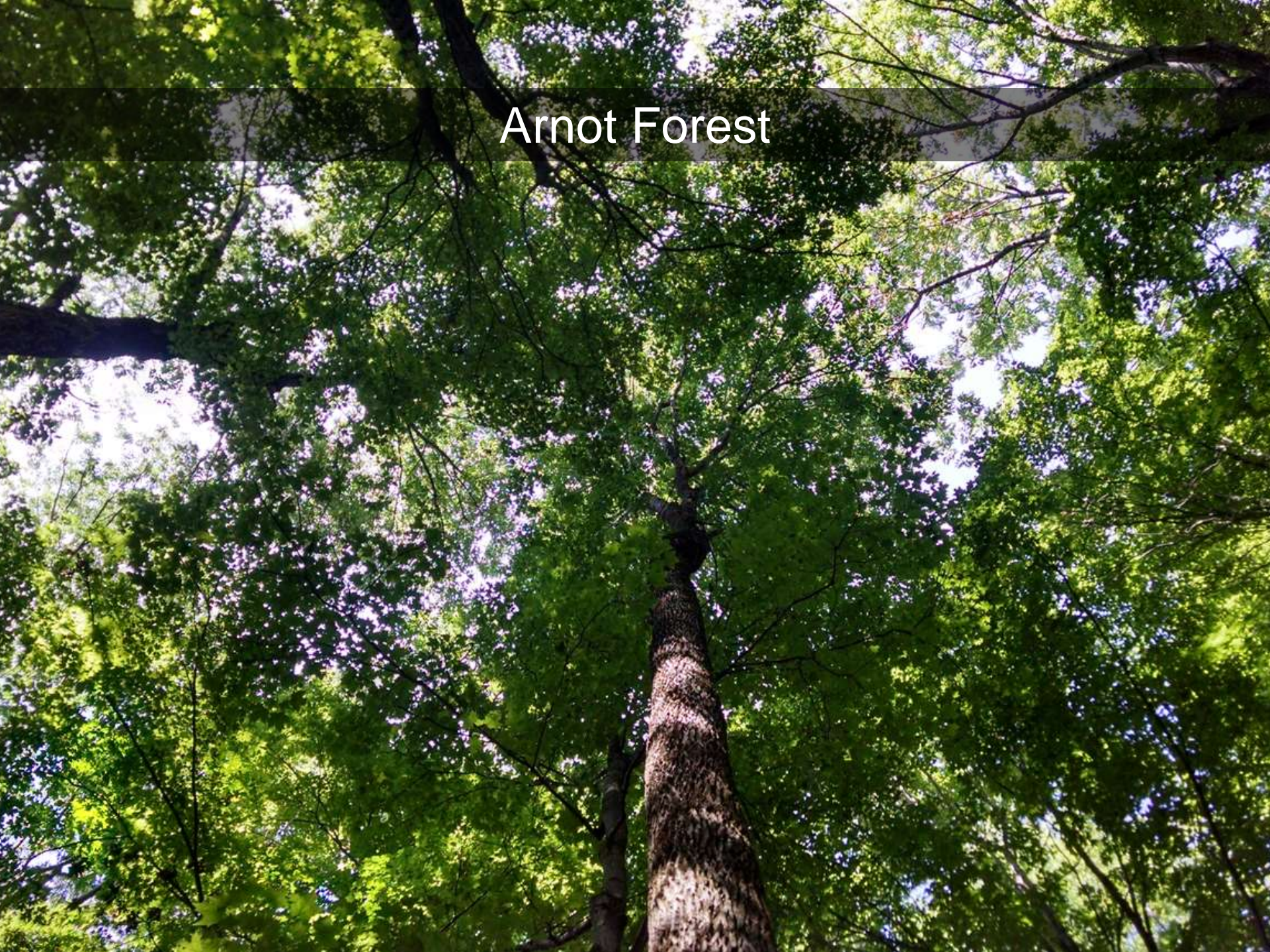


# Great Smoky Mountains



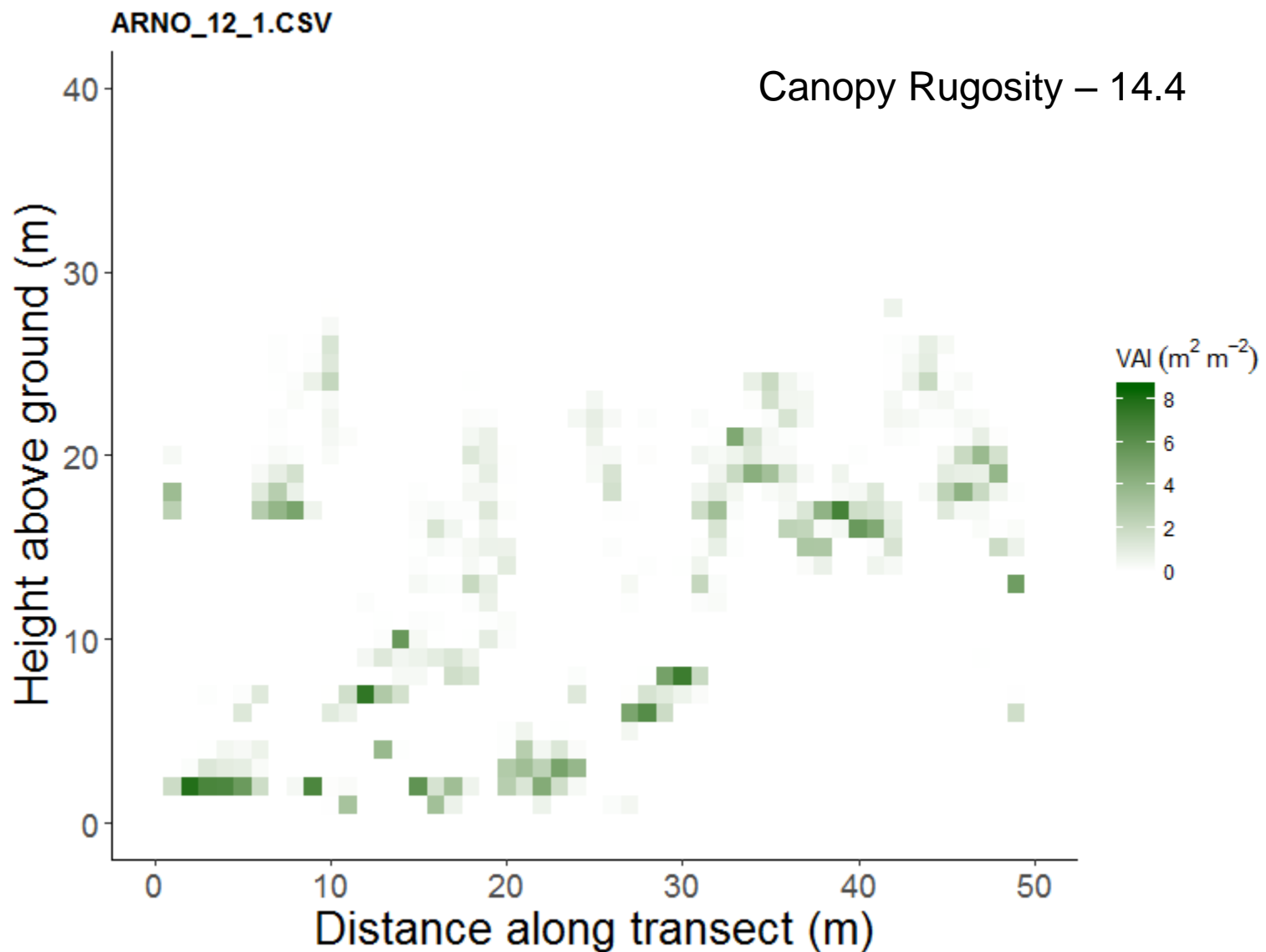


# Arnot Forest





# Arnot Forest



# Beyond LAI . . .

## Resource efficiency and acquisition



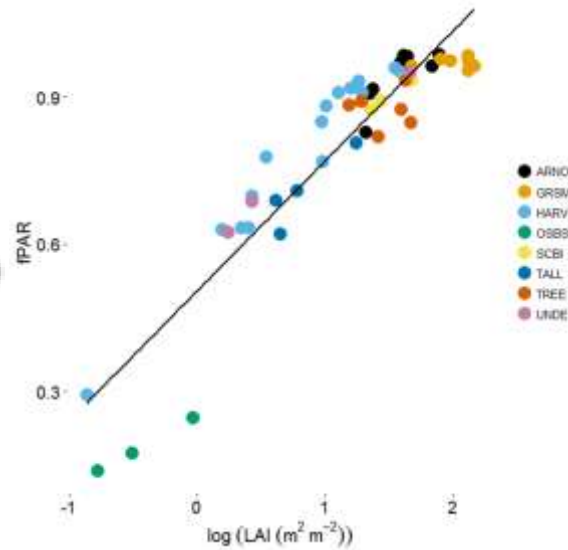
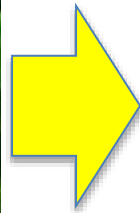
fPAR

# Beyond LAI . . .

## Resource efficiency and acquisition



fPAR



Residual Analysis

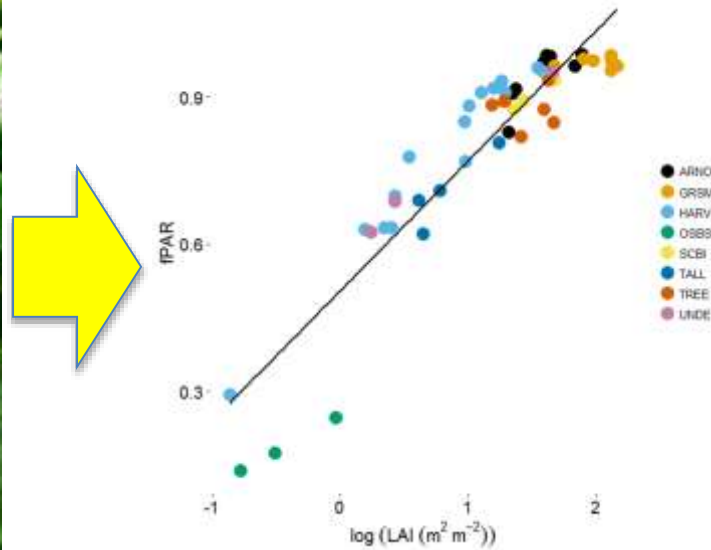


# Beyond LAI . . .

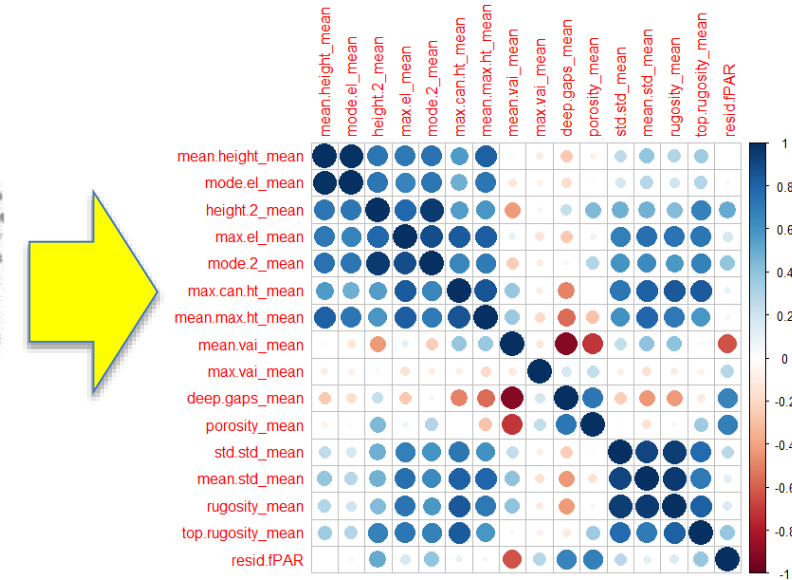
## Resource efficiency and acquisition



fPAR



Residual Analysis



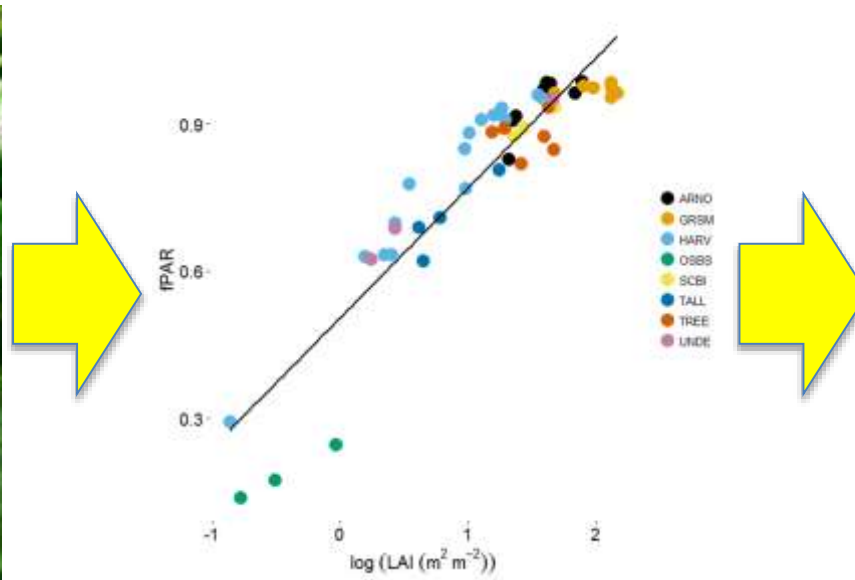
Correlation

# Beyond LAI . . .

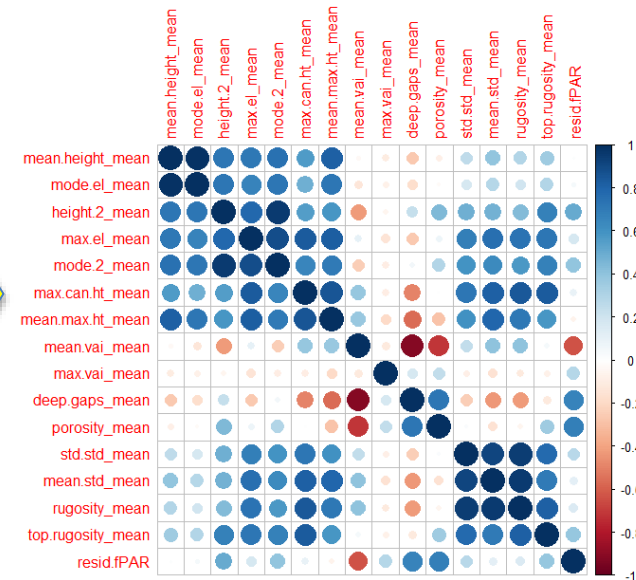
## Resource efficiency and acquisition



fPAR



Residual Analysis



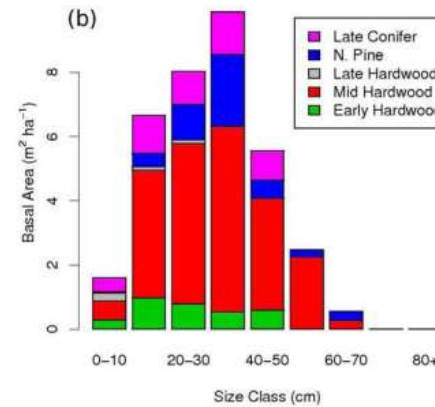
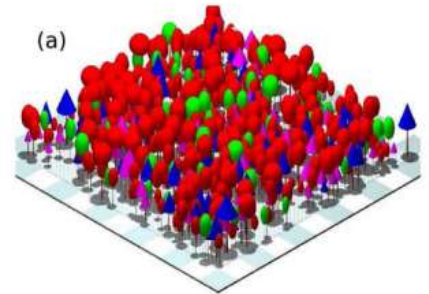
Correlation

Greater than 94% of variance in fPAR  
from LAI, Deep Gaps, and Porosity

# Scaling and model integration



Scaling  
(e.g. Landsat, etc.)



Model Integration  
(e.g. ED2)



# Scaling and model integration

## B53J-07: Comparison of Aerial and Terrestrial Remote Sensing Techniques for Quantifying Forest Canopy Structural Complexity and Estimating Net Primary Productivity



Friday, 16 December 2016

14:55 - 15:10



📍 Moscone West - 2006

## B53I-0624: Canopy structural complexity influences forest canopy reflectance: linking terrestrial lidar with Landsat observations



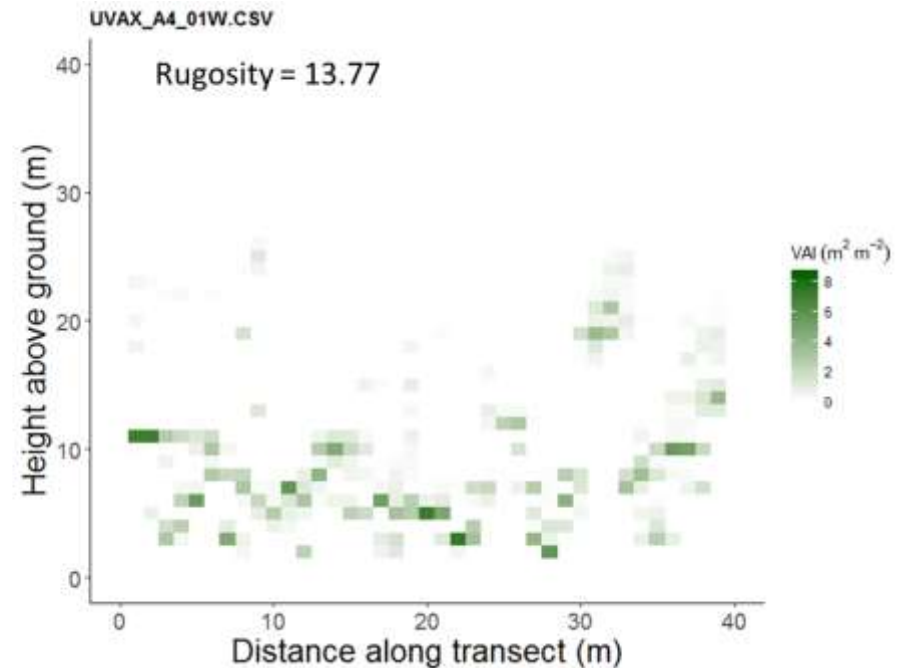
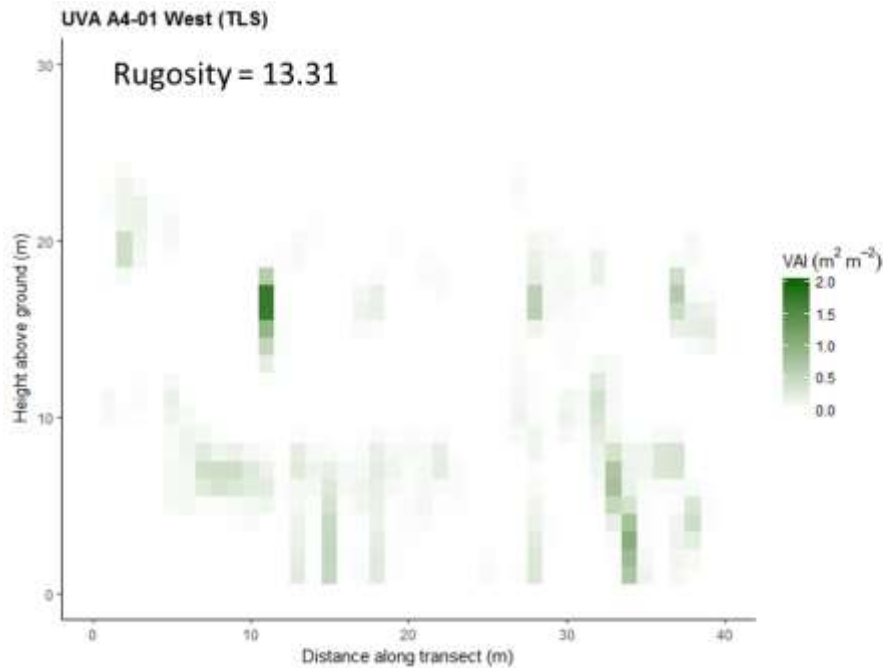
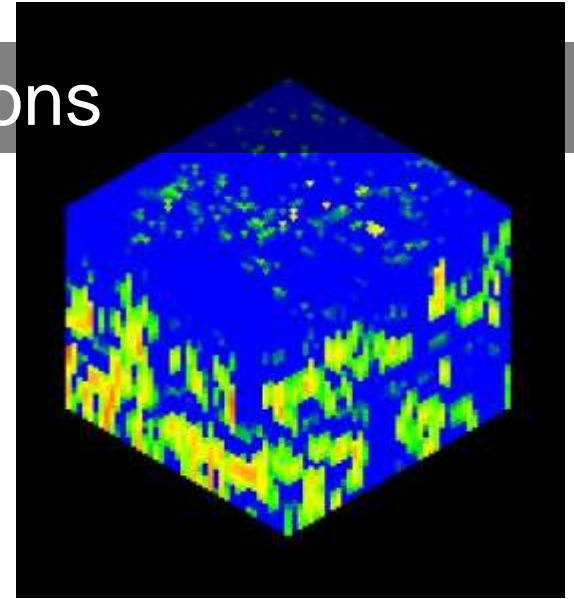
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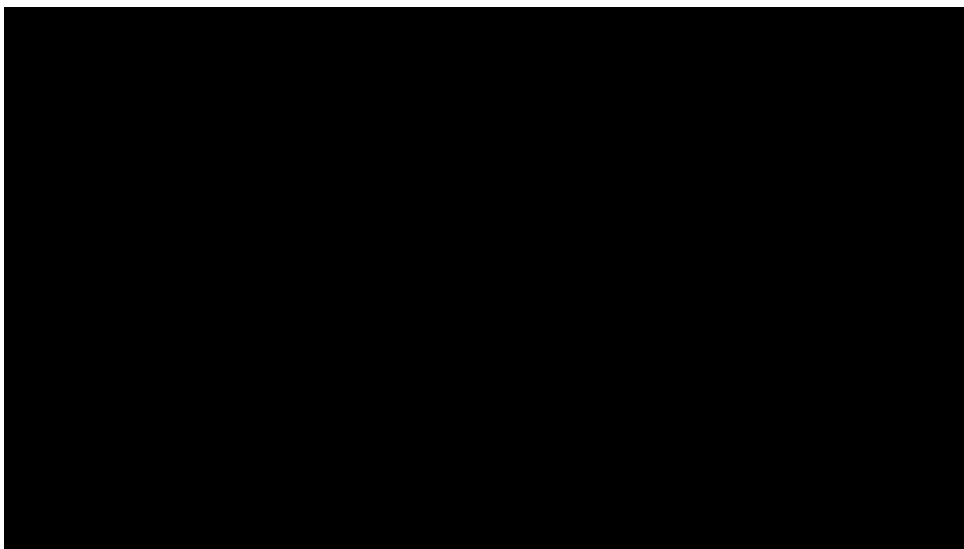
13:40 - 18:00



📍 Moscone South - Poster Hall

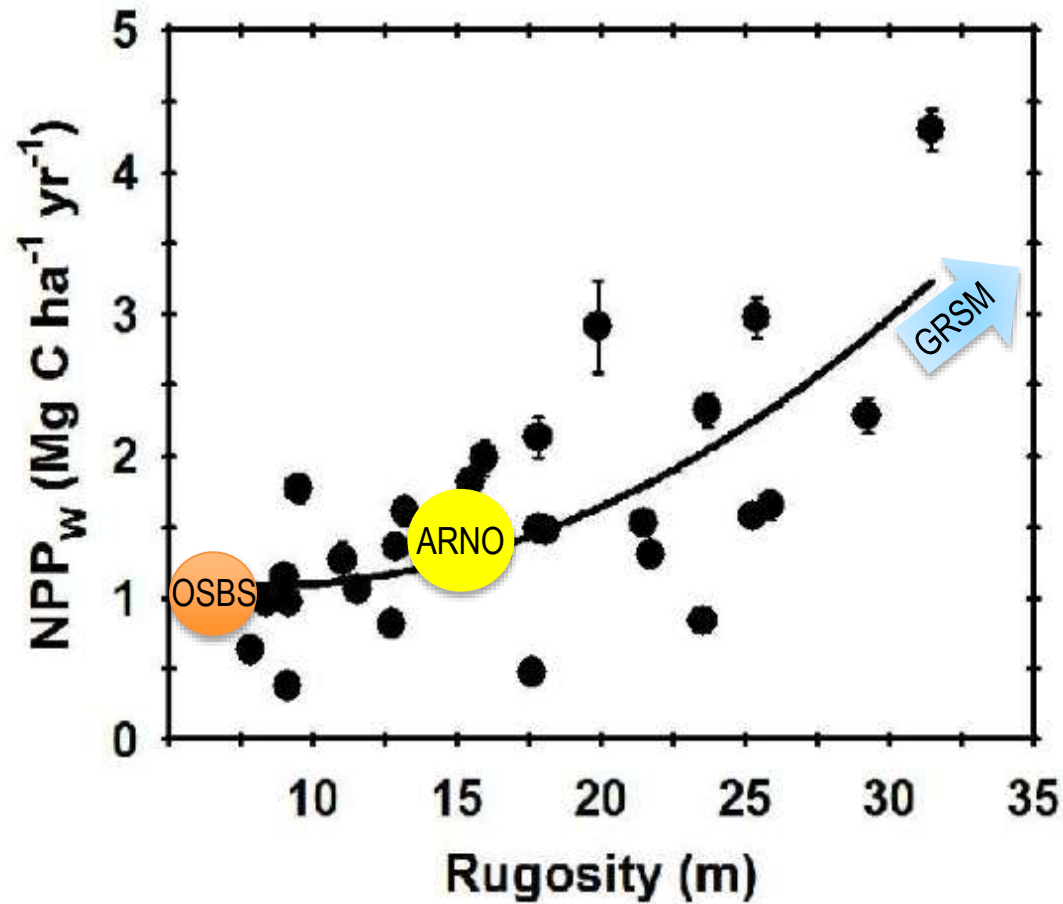
# TLS-PCL Comparisons







# CSC and NPP relationships?





Award No. 1550657

## Special thanks . . .

Cynthia Scheuermann, the Gough lab (Ellen, Ben, Jeff-Ben), Courtney Meier, Tim Morin, Atticus Stovall, Jason Tallant, Jan van Aardt, Kyla Dhalin, Shawn and Tony, Tim Fahey, Brenden McNeil, Cynthia Ragland, Michael Cramer, Gary Belovsky, Eric Nagy and all at MLBS, UMBS, Krista Teixeira, Ty Lindberg, SCBI, Hank Shugart, Stephen Costes and OSBS, Josh Mantooth, Mike Dietze, Kevin Burns and Treehaven, Alan Strahler and the TLS RCN, the VCU Rice Rivers Center and many, many others.

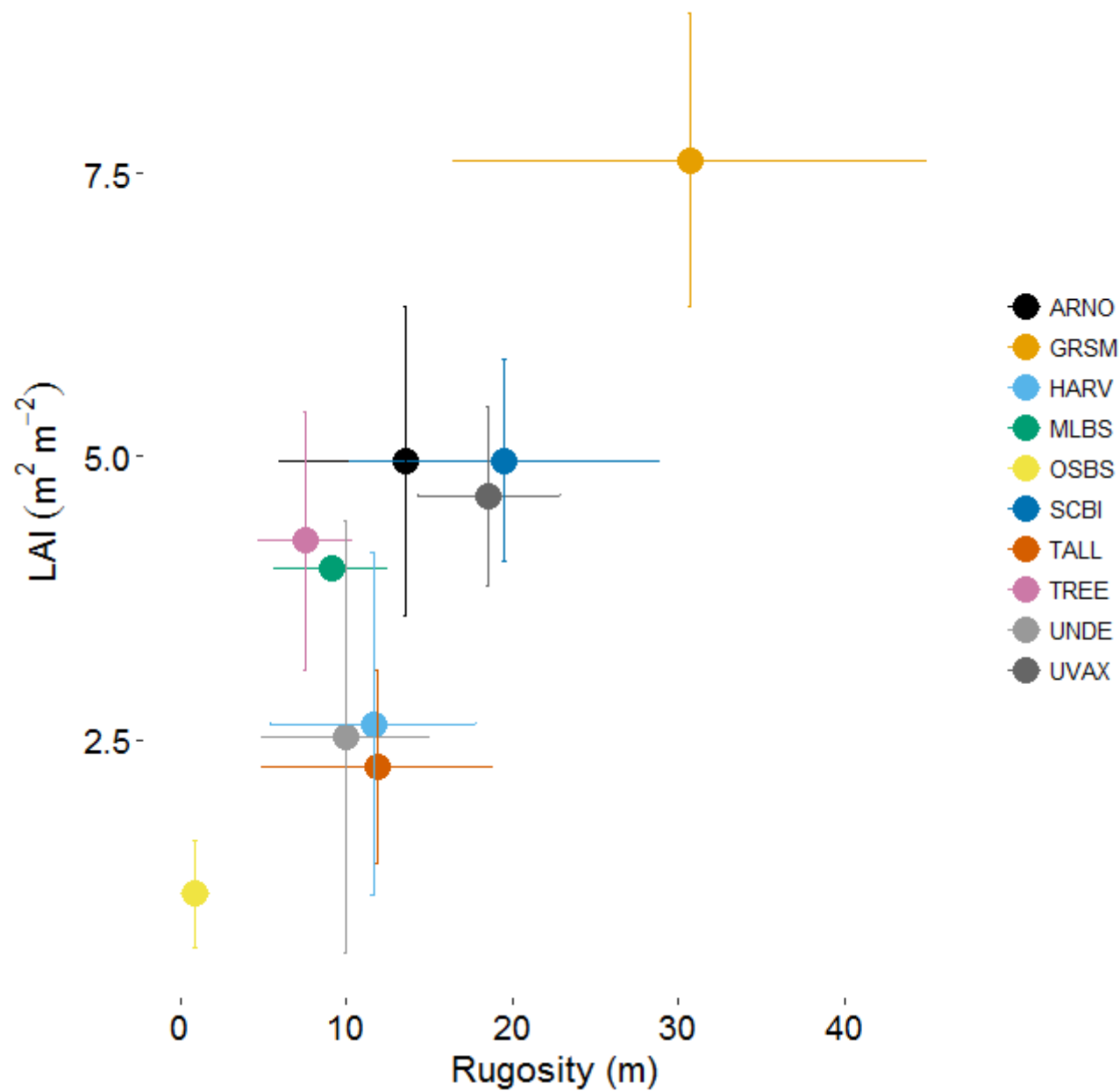


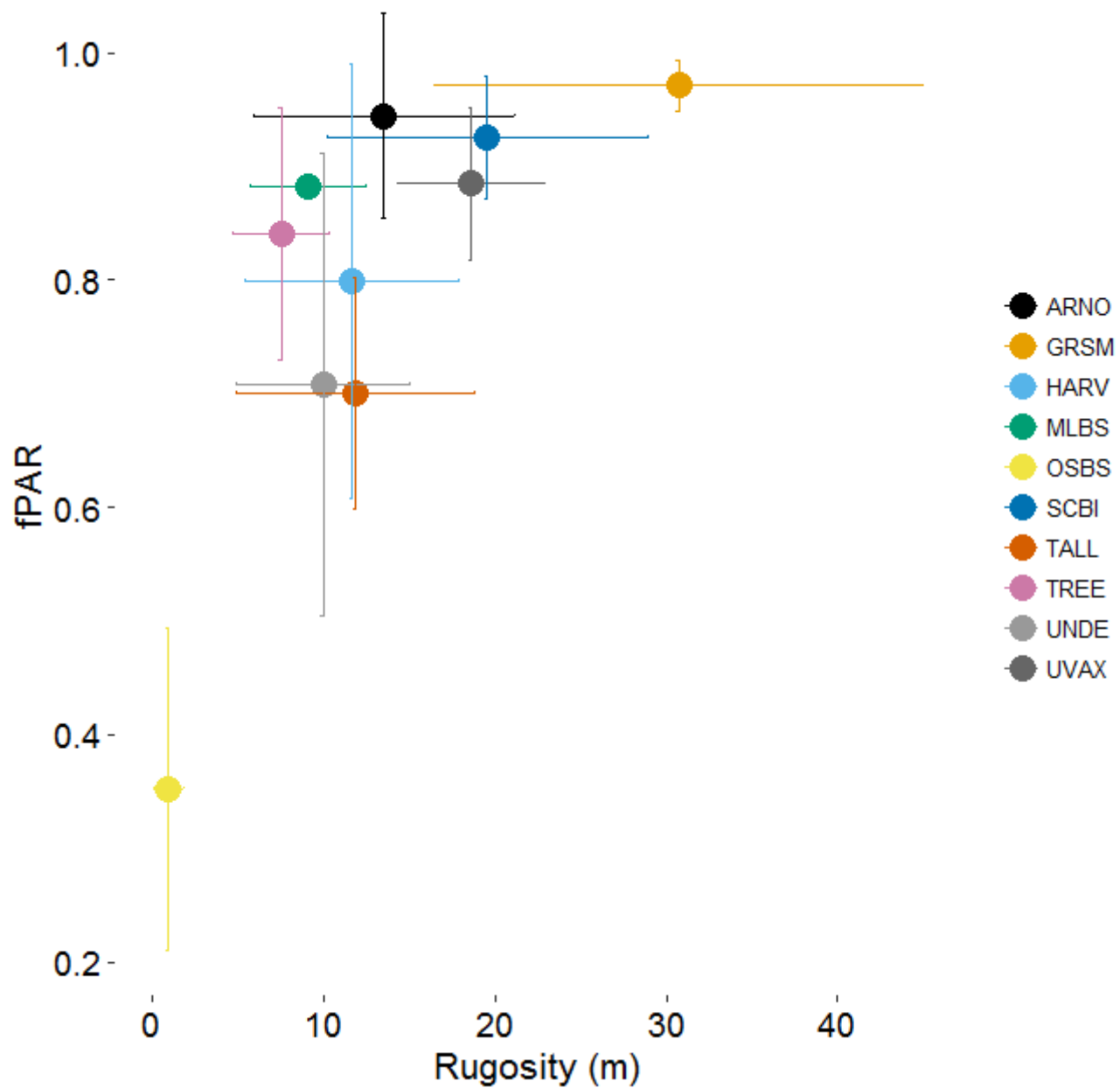
Questions?

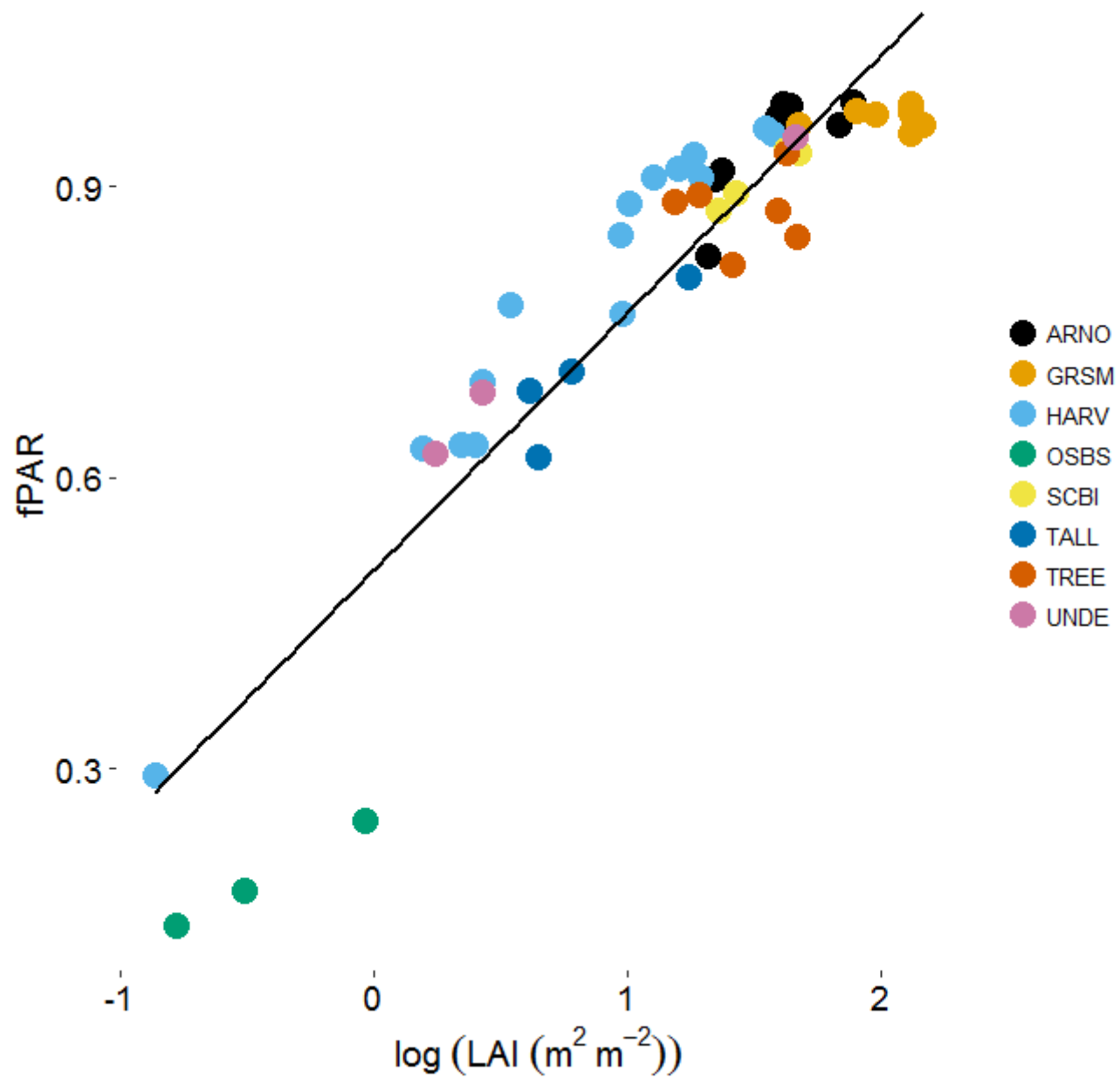
# LASER QUEST



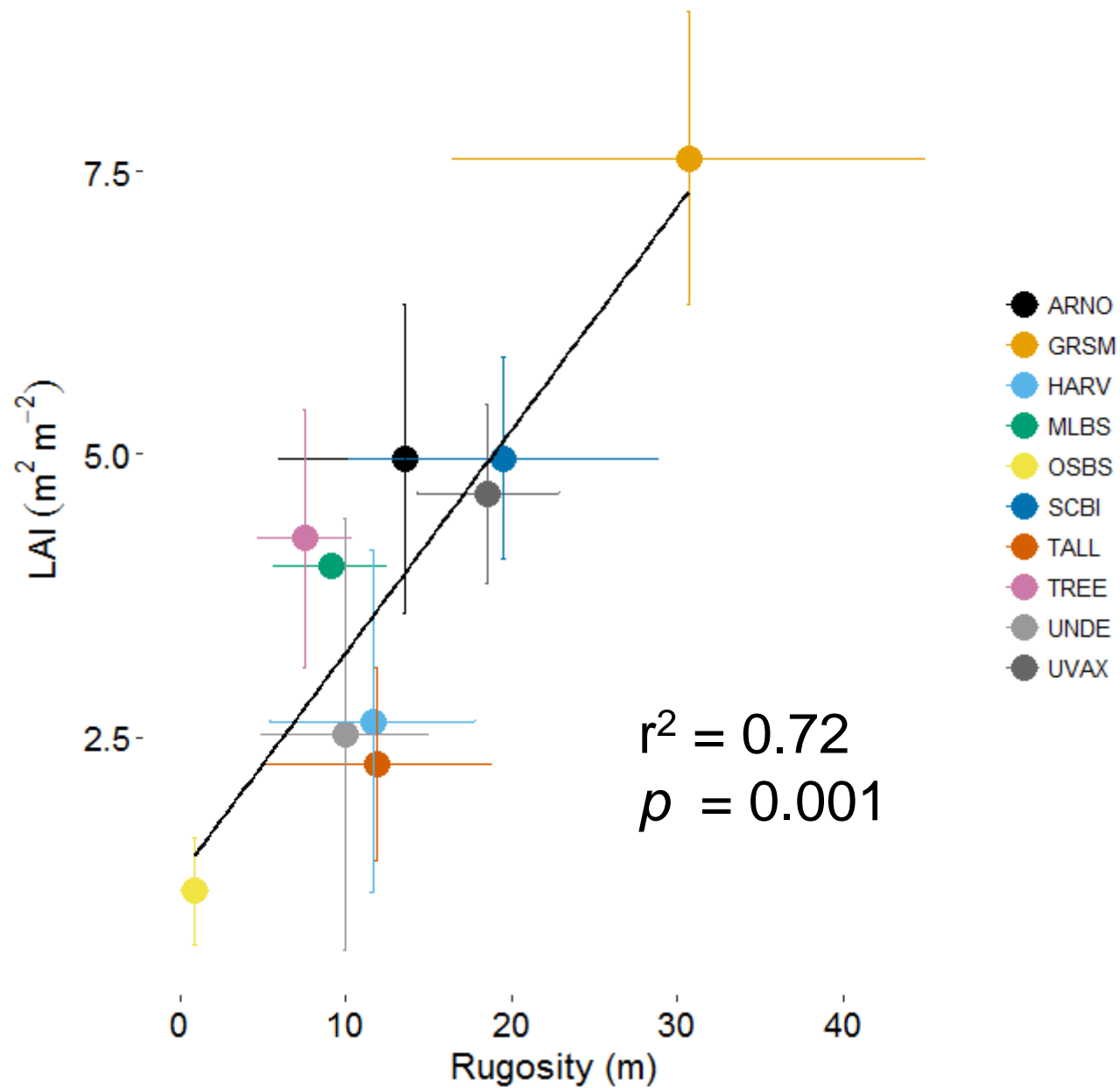


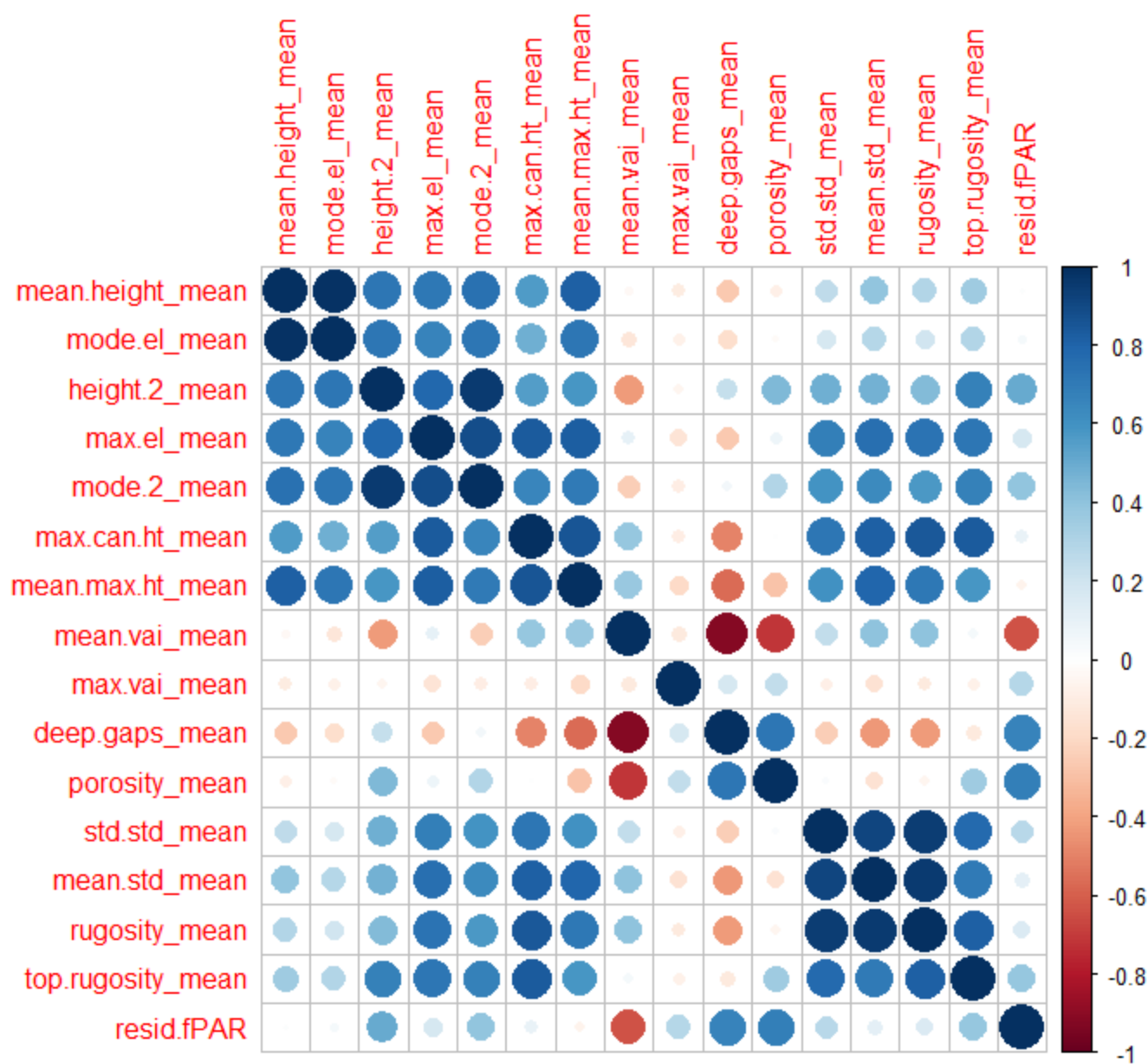




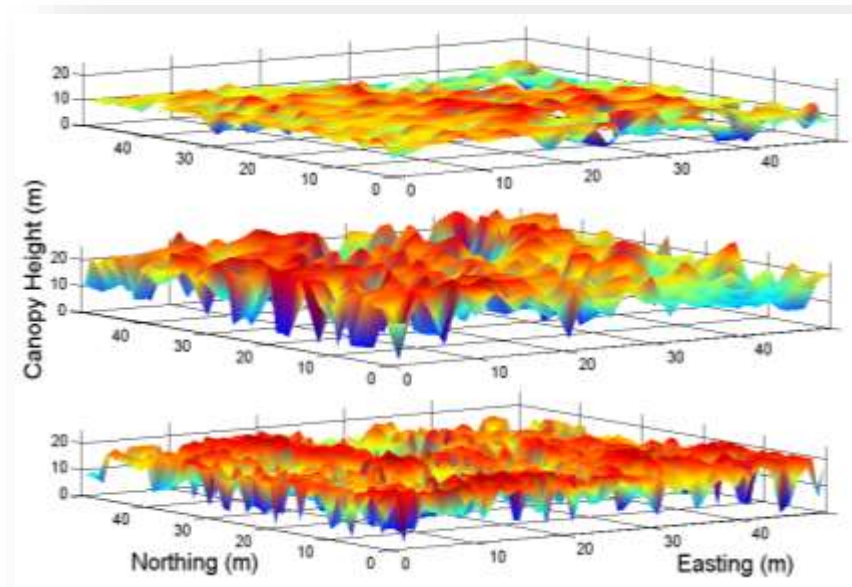
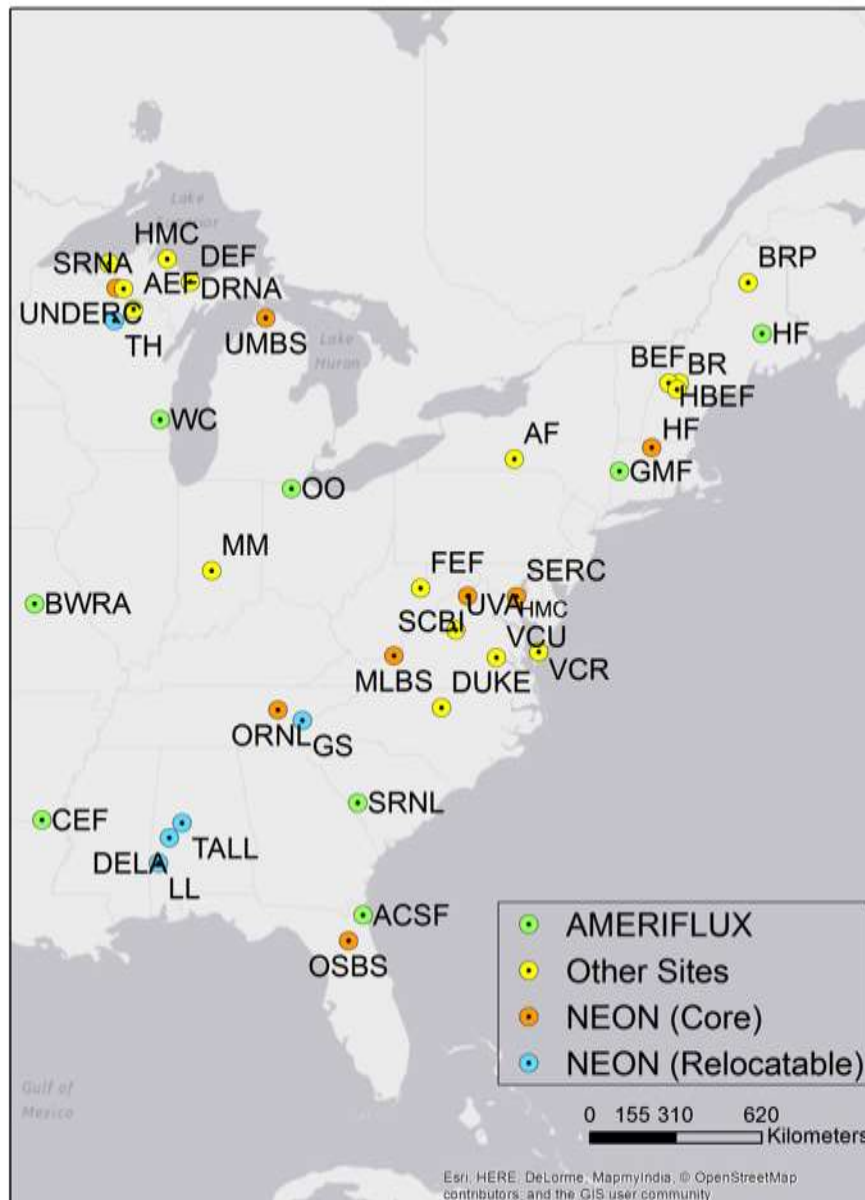




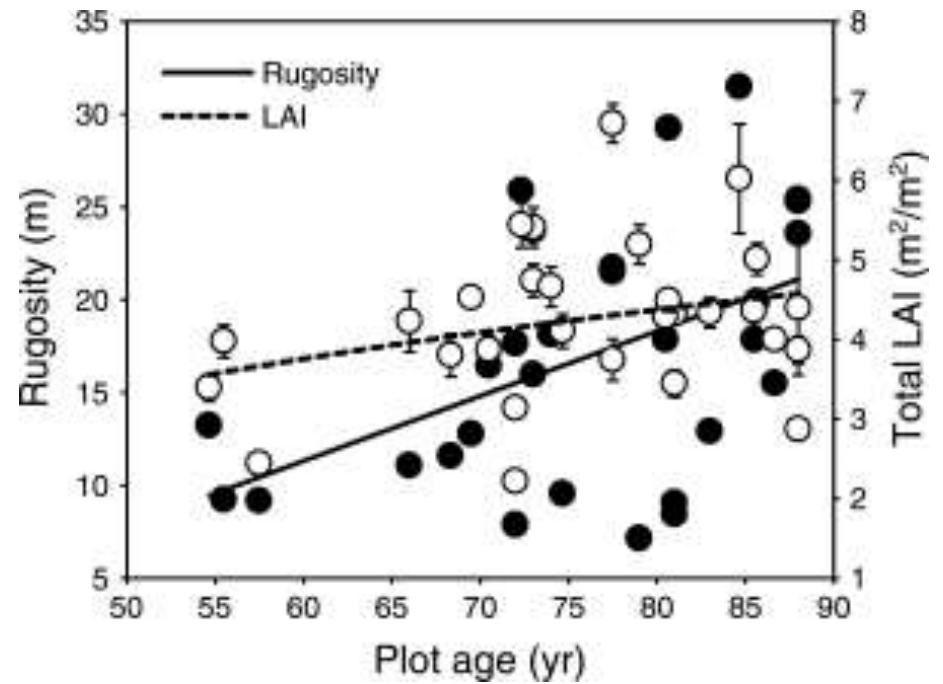
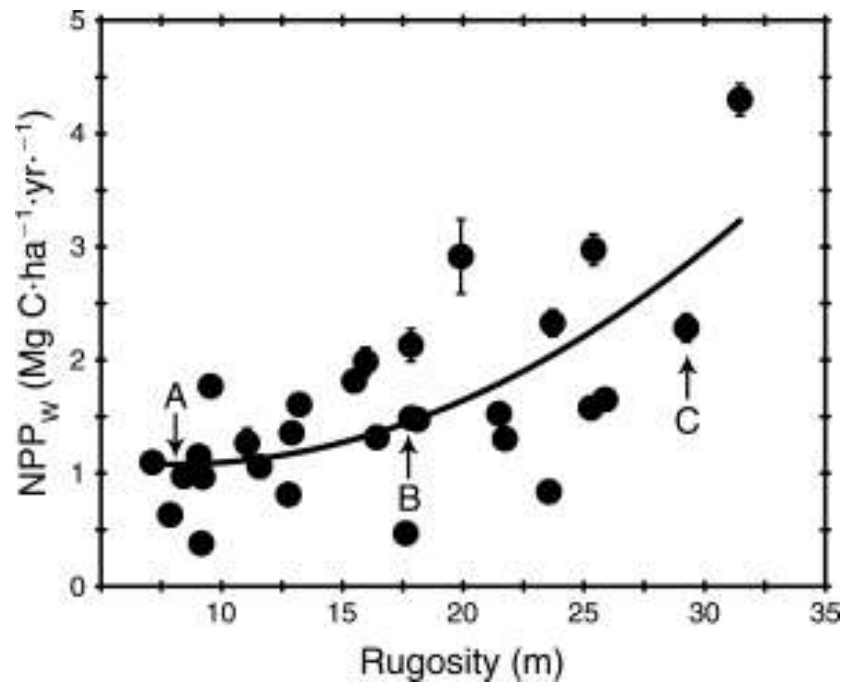




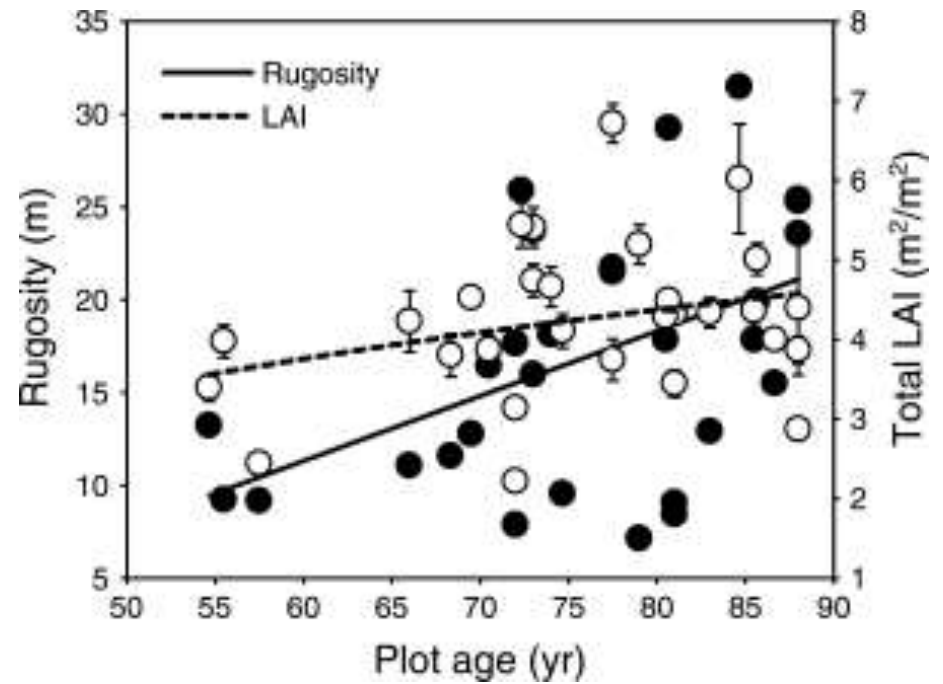
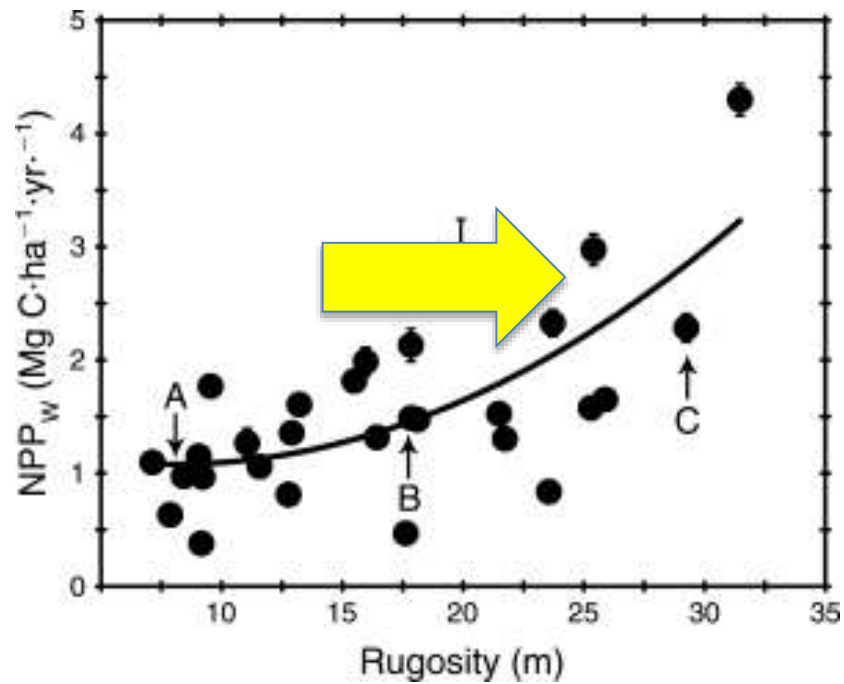
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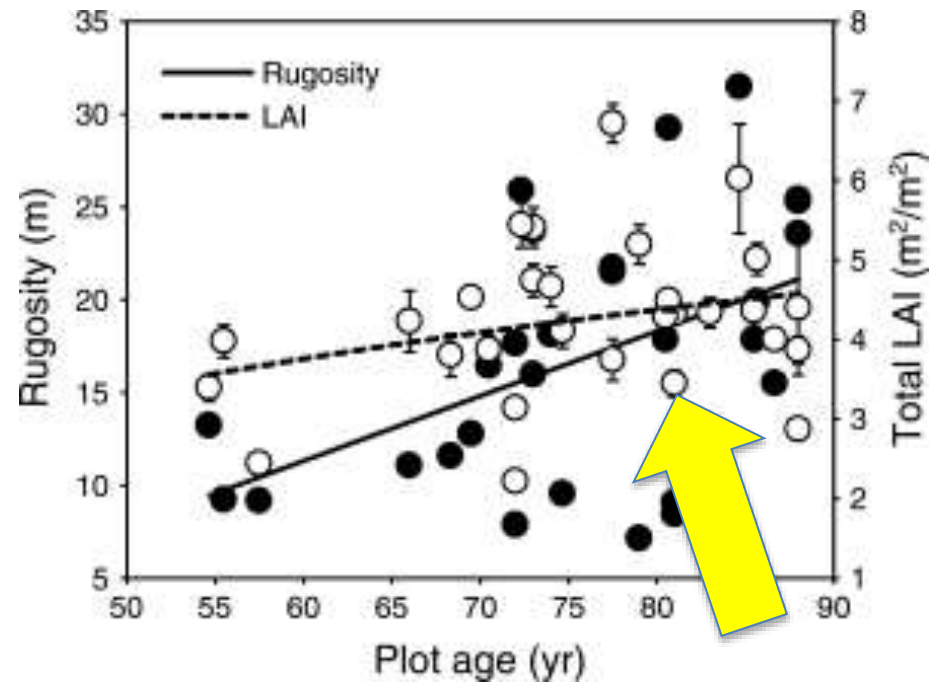
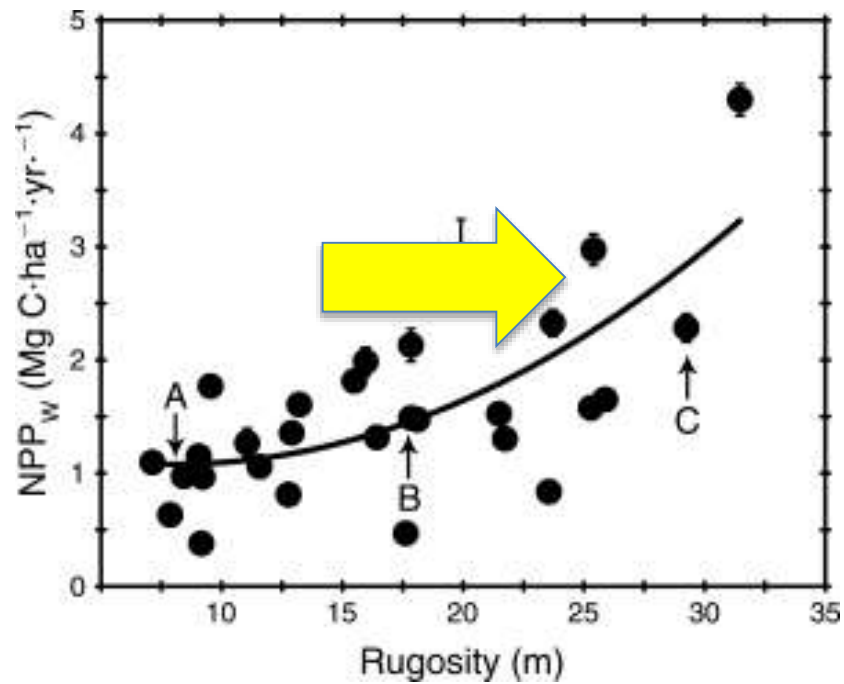




From Hardiman et al. 2011 (Ecology)



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