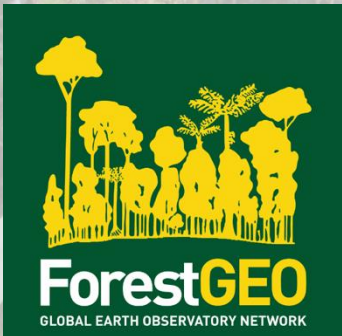


Functional pathways to building biomass in tropical forests

John L. Godlee,
Sean M. McMahon, Stuart J. Davies

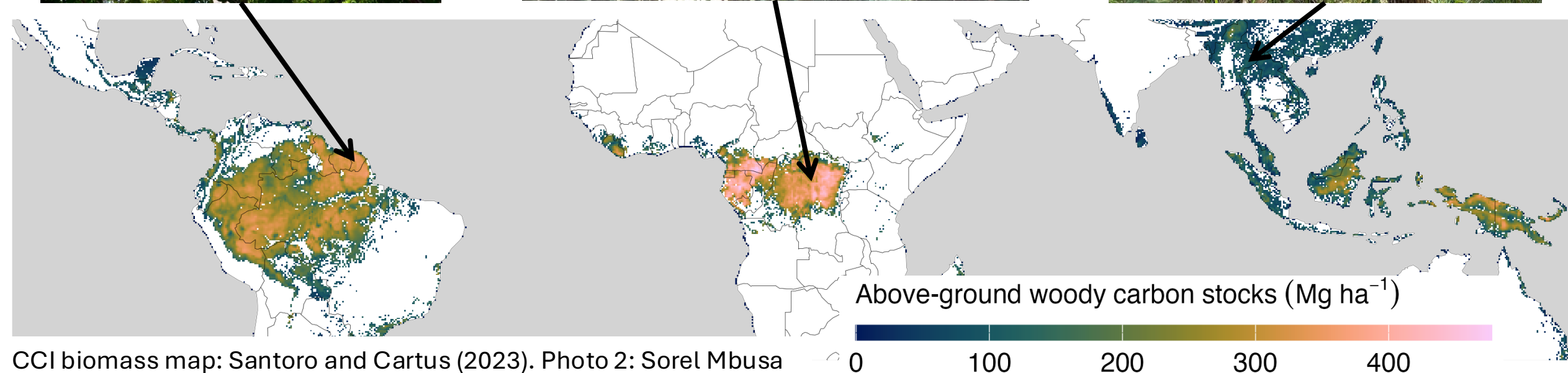
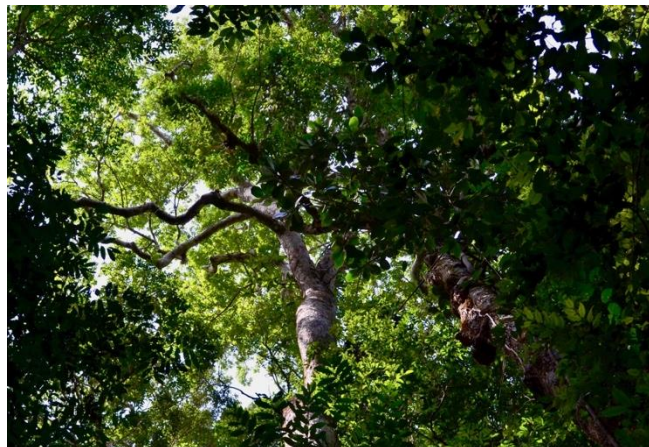


Background: The GEO-TREES initiative



Tropical forests are diverse. Variable in structure, function and biomass.

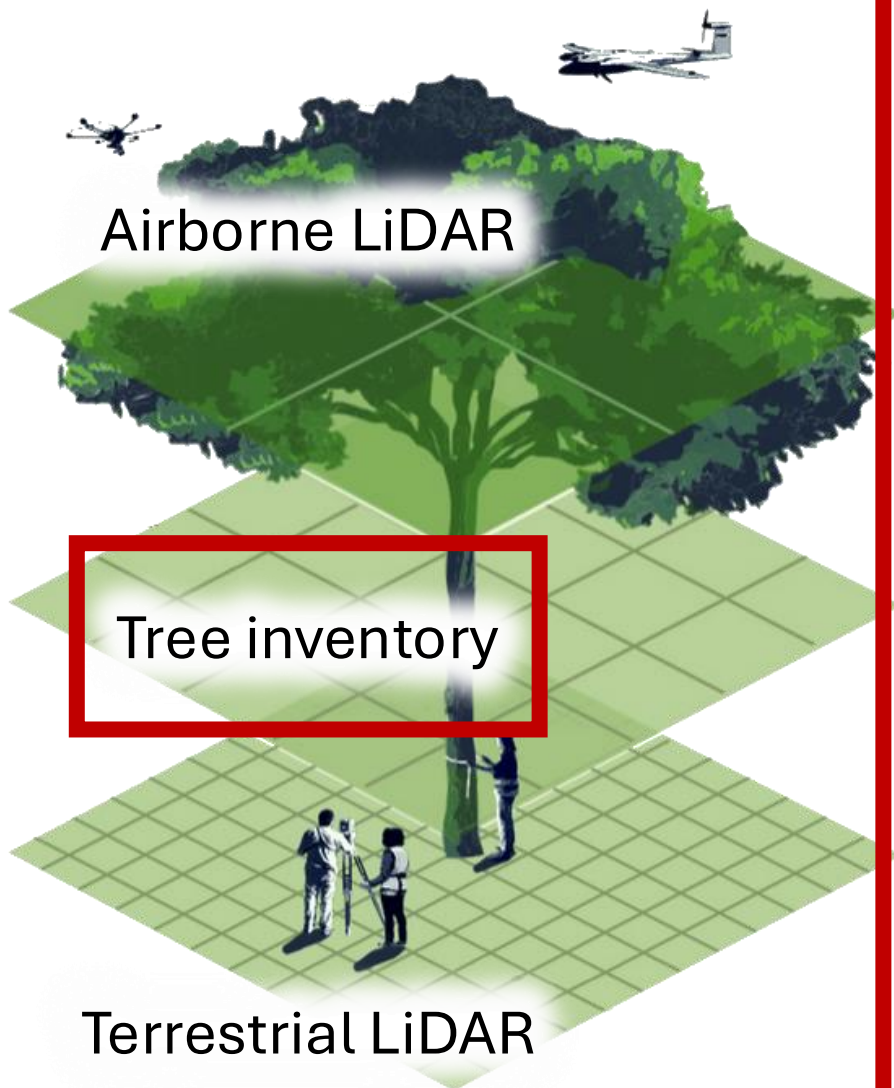
Species determine how environmental conditions translate into biomass and structure.



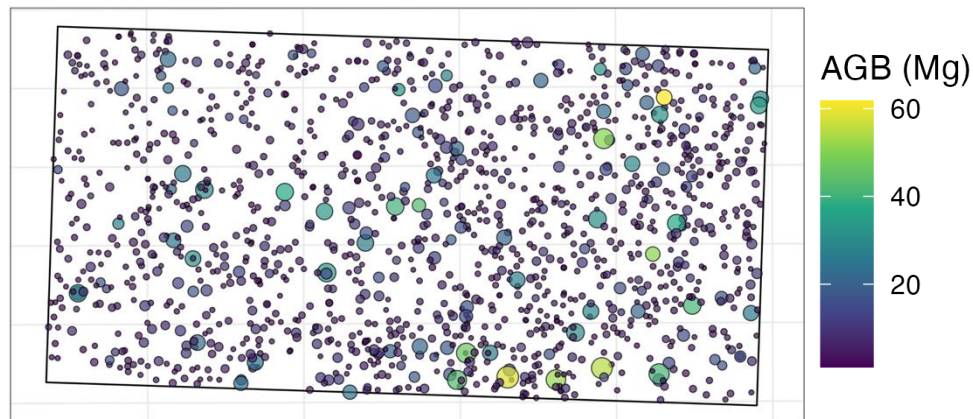
Background: The GEO-TREES initiative



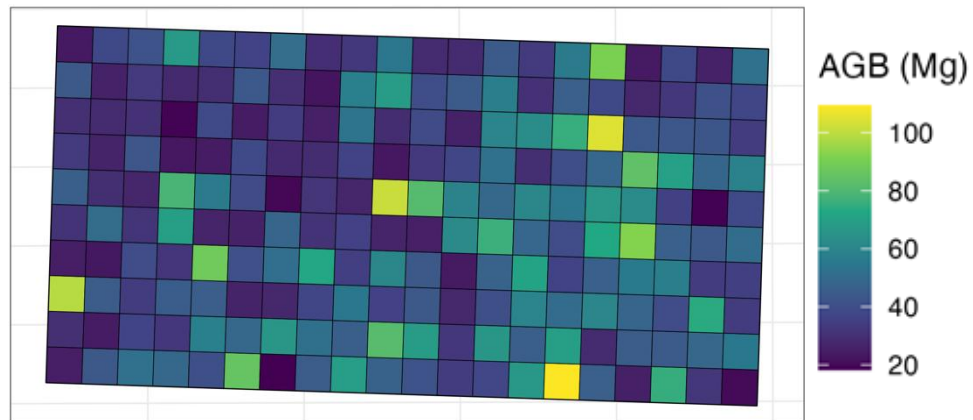
Three data streams:



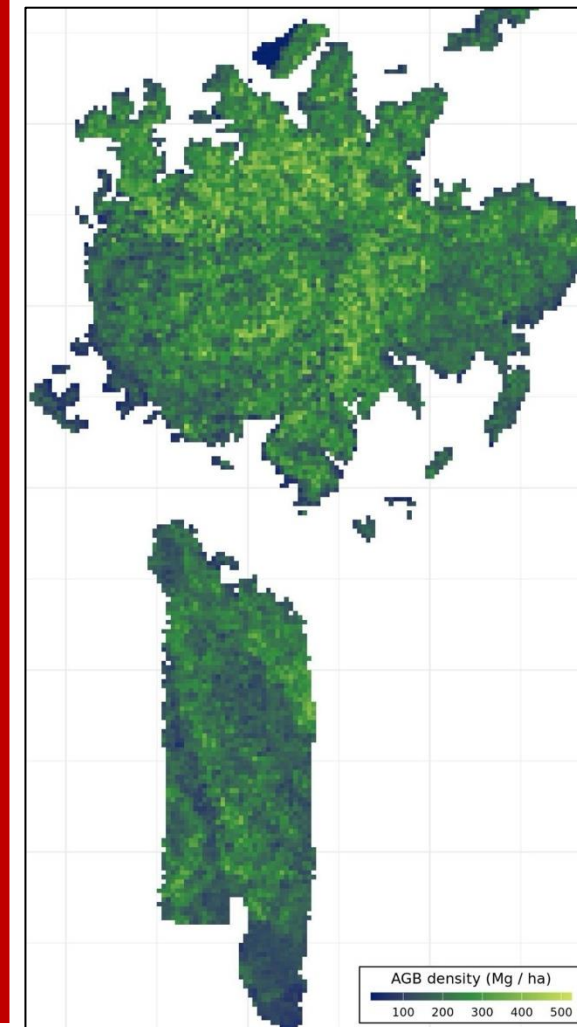
1. Tree-level AGB (≥ 5 cm)



2. 50x50 m quadrat AGB

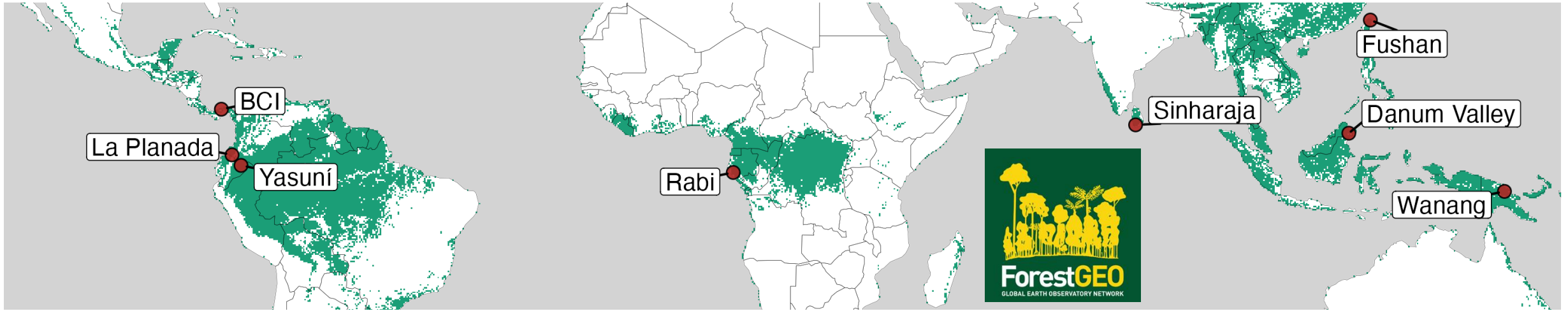


3. Landscape AGB



Methods: Sites and data

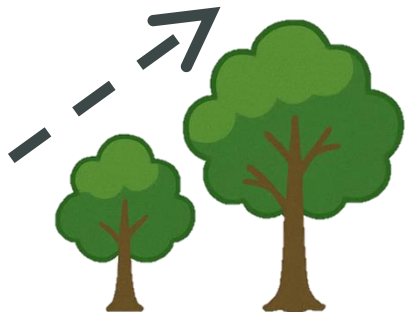
Do forests follow different “functional recipes” to achieve high biomass?



Community weighted means of species functional traits in 50×50 m quadrats

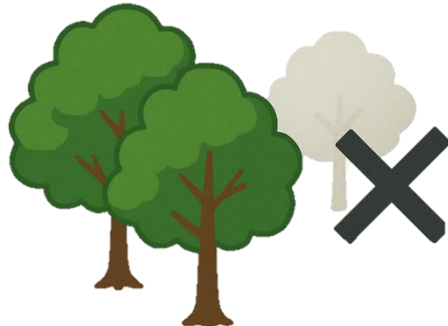
Potential growth rate

95th percentile basal area growth



Potential survival

Annual survival of 25% largest trees



Maximum size

99th percentile diameter



Wood density

Per species
(Zanne et al. 2009)

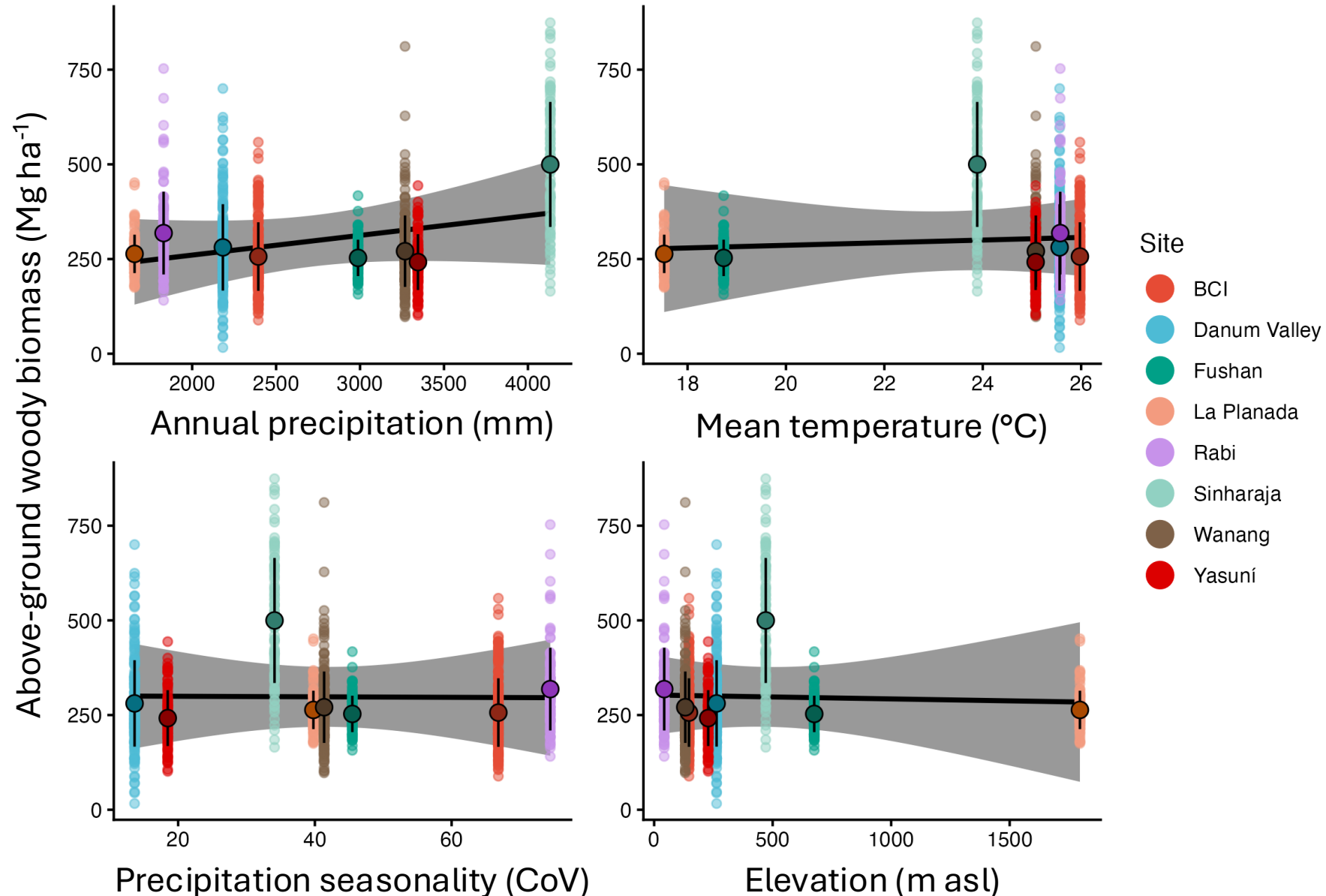


Results: Broad climatic gradients aren't informative

More within- than among-site variation in biomass stocks.

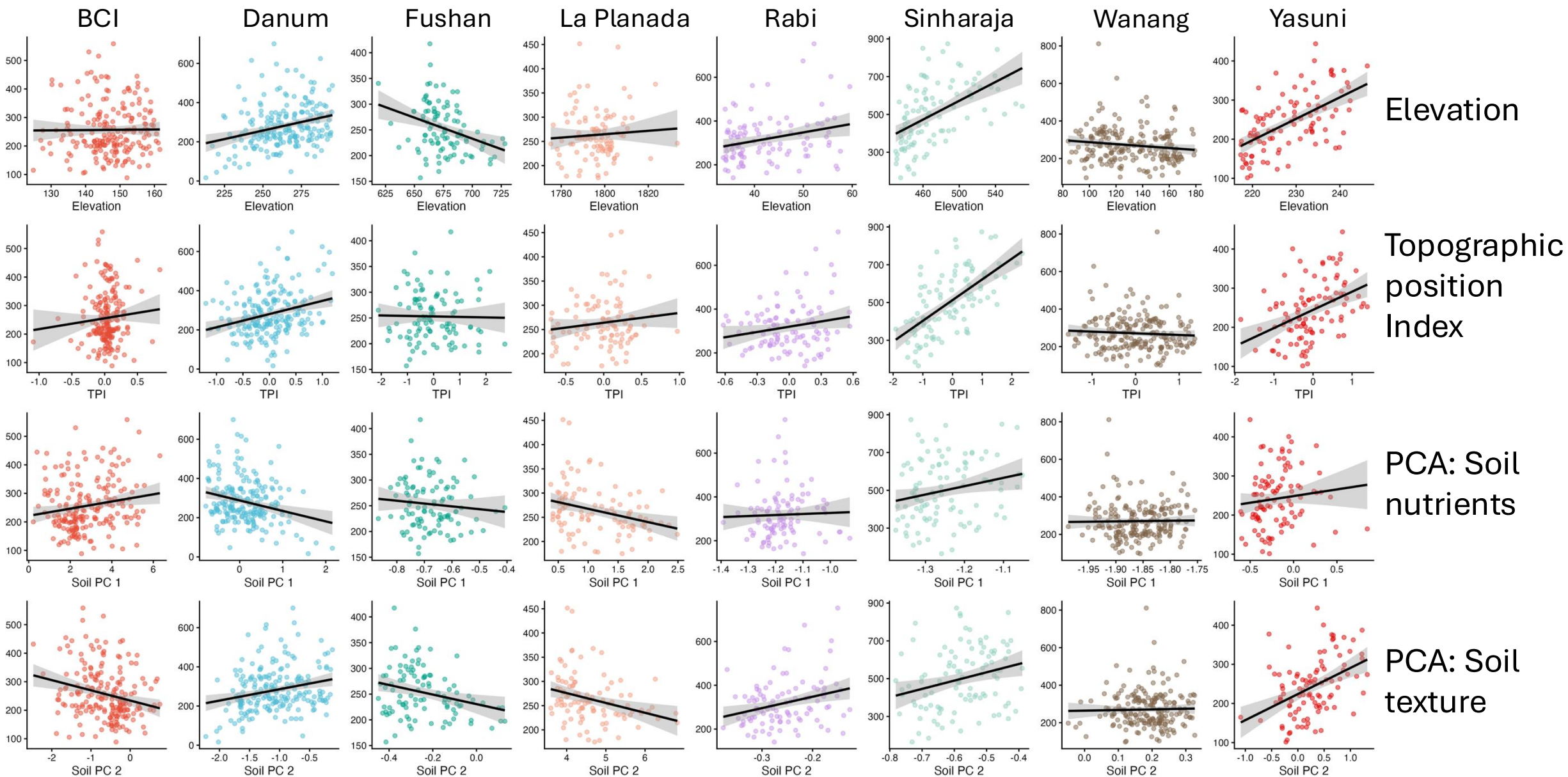
Climate gradient effects on biomass stocks are weak.

Modelling biomass at coarse scales misses fine-scale variation.



Results: Site-specific effects of local environment

Above-ground woody biomass (Mg ha^{-1})



Results: Composition is highly predictive of biomass

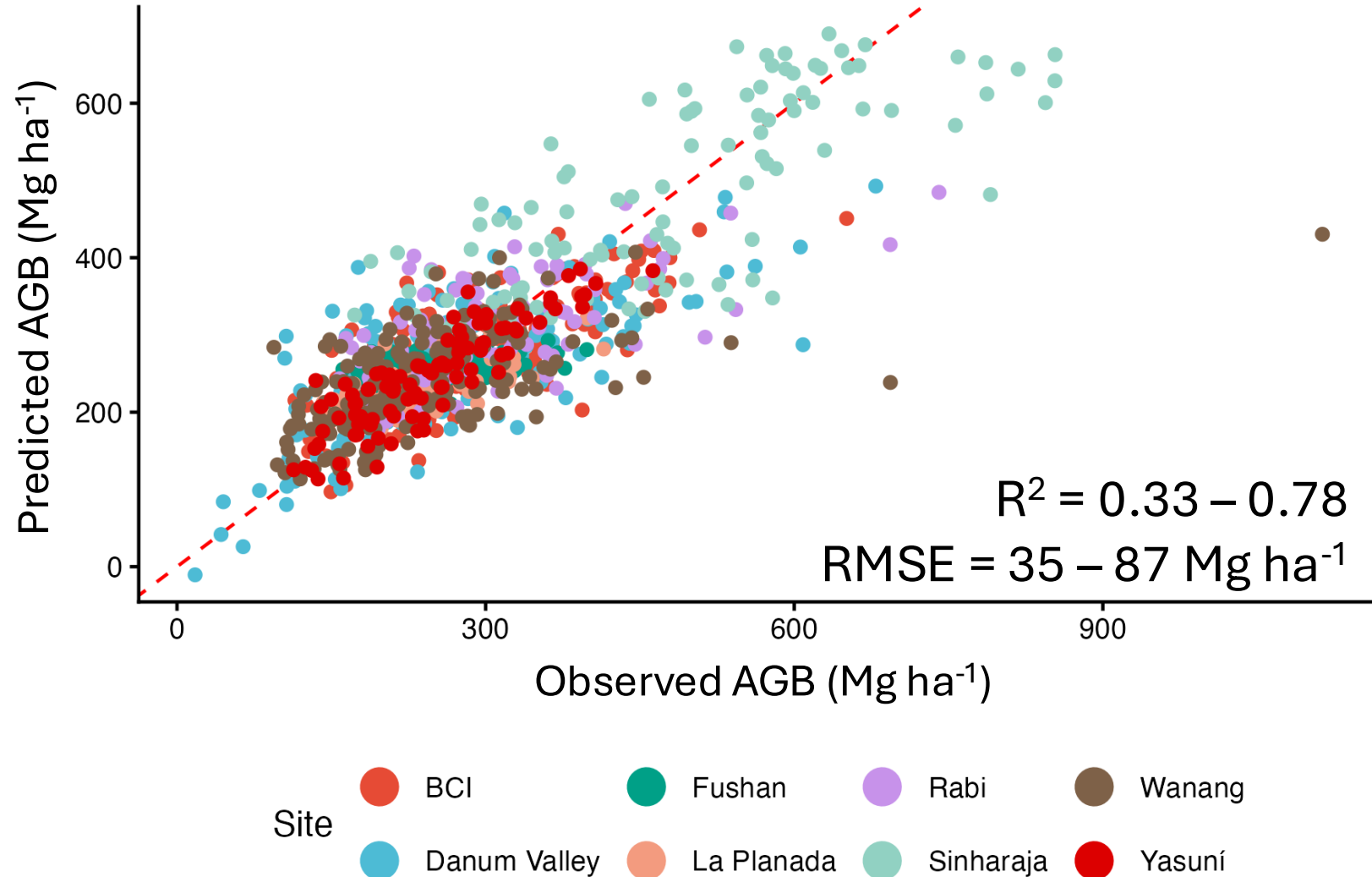
Simple linear models.

One model per site.

Predictors: axes from Principal Coordinates Analysis (PCoA) of composition dissimilarity matrix.

No information on traits or biomass, only relative abundance.

Which aspects of life history strategy drive high biomass?

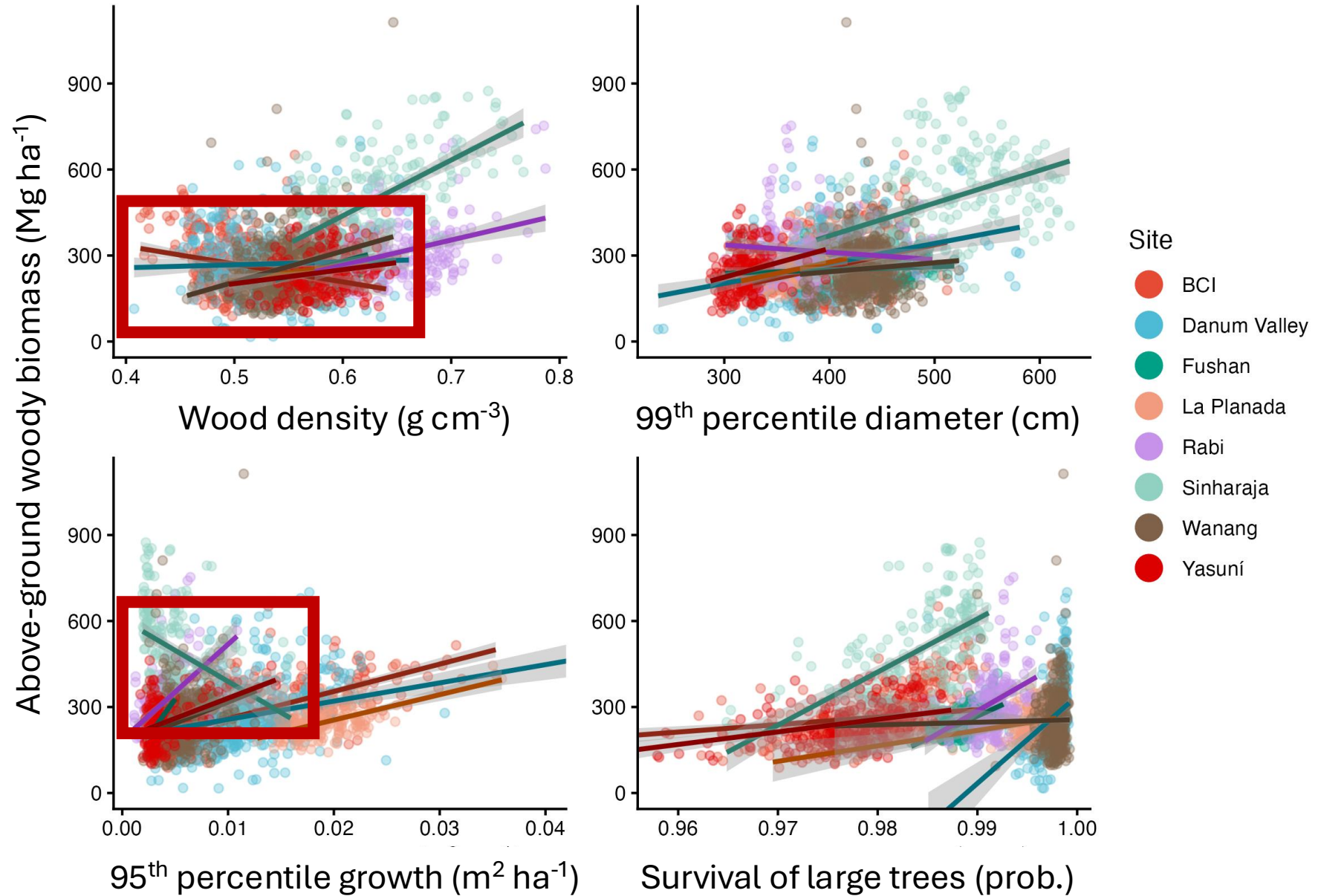


Results: Many different recipes for high biomass

Importance of different traits varies by site.

Among sites, similar biomass stocks can result from different trait values.

Negative effects of some traits at some sites implies co-variation of traits.



Results: Importance of community traits for biomass

Importance of growth and survival for biomass stocks varies among sites.

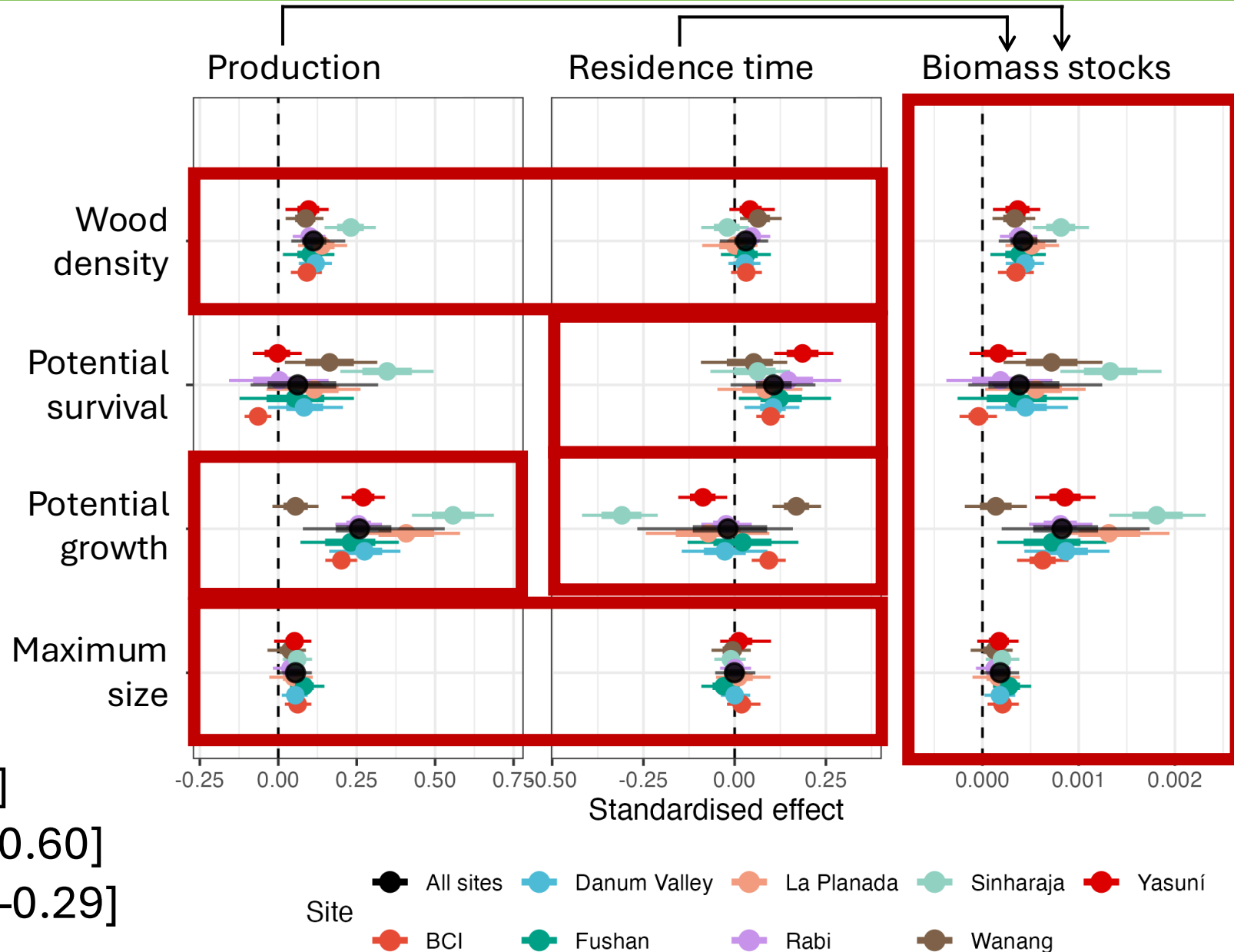
Wood density a consistent driver of high biomass stocks across sites.

Potential size not important. An outcome of growth and survival?

R^2 Production: 0.81 [0.79–0.83]

R^2 Residence time: 0.58 [0.55–0.60]

R^2 Biomass stocks: 0.25 [0.20–0.29]



Summary: Drivers of fine-scale variation in biomass

- Local environment matters, but differently depending on the forest.
- Community composition is a key predictor of biomass stocks. Forests are not functionally neutral.
- Forests use different “functional recipes” to accumulate biomass. Relative importance of traits varies among sites.
- Functional composition shapes forest structure.



Summary: Perspectives and next steps

- Ground truth data (e.g. GEO-TREES) are vital to understand the mechanisms of biomass accumulation.

Next:

- How do specific environmental factors determine the optimal trait combinations for biomass stocks?
- How does spatial grain affect the importance of community composition for biomass stocks?



Thanks and acknowledgements

Data contributors:

Salomón Aguilar
Robin Foster
Stephen Hubbell
Rolando Pérez
David Burslem
Michael O'Brien
Glen Reynolds
C.-H. Chang-Yang
Yu-Yun Chen
I-Fang Sun
Roy González
Natalia Norden
James Dalling
Alfonso Alonso
Pulchérie Bissiengou
Hervé Memiaghe

Nestor L. E. Obiang
Sisira Ediriweera
Vojtech Novotny
George Weiblen
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ForestGEO analytical workshop – Kenya 2025



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EXTRA

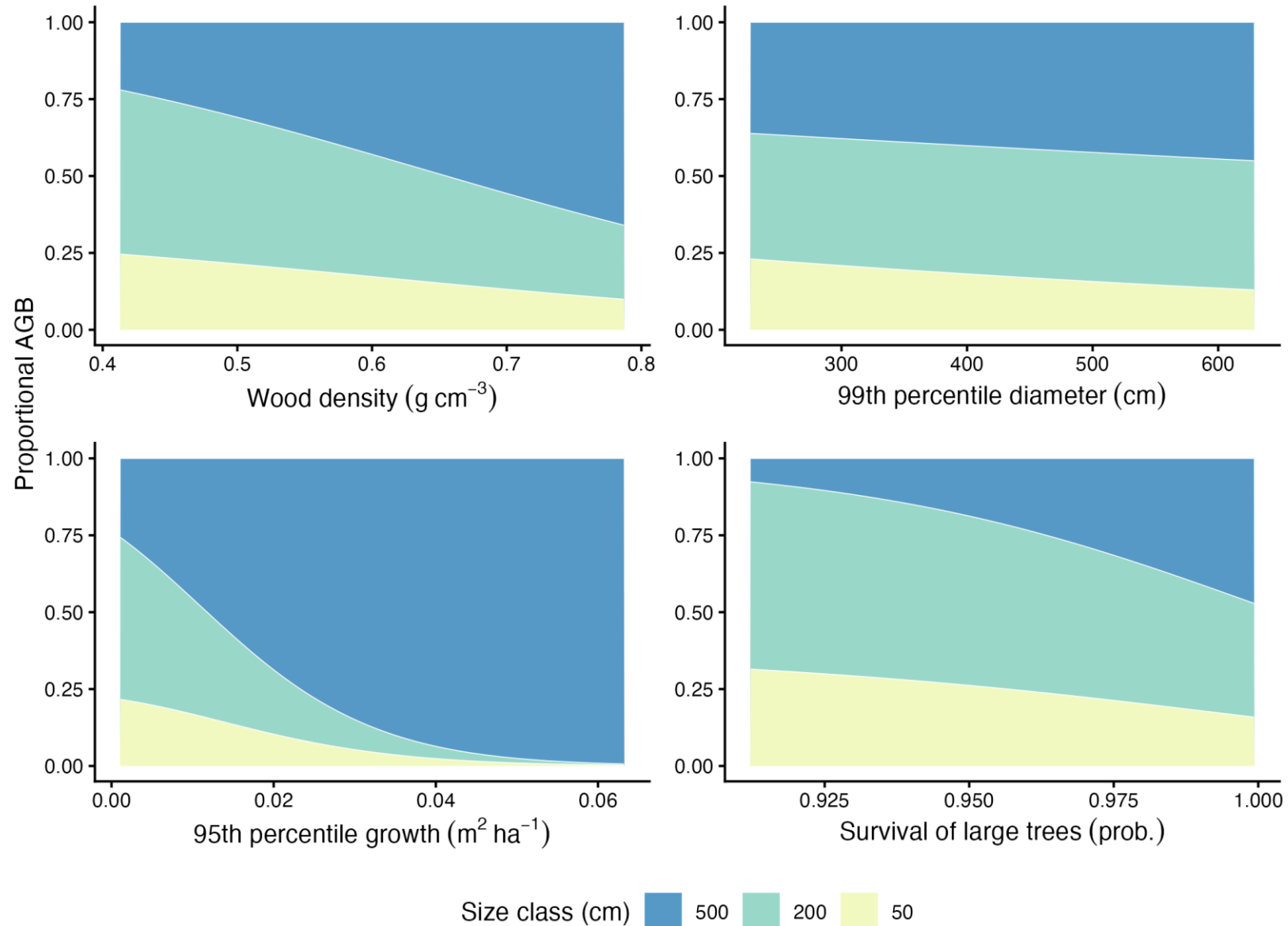
EXTRA

Results: Community traits and biomass distribution

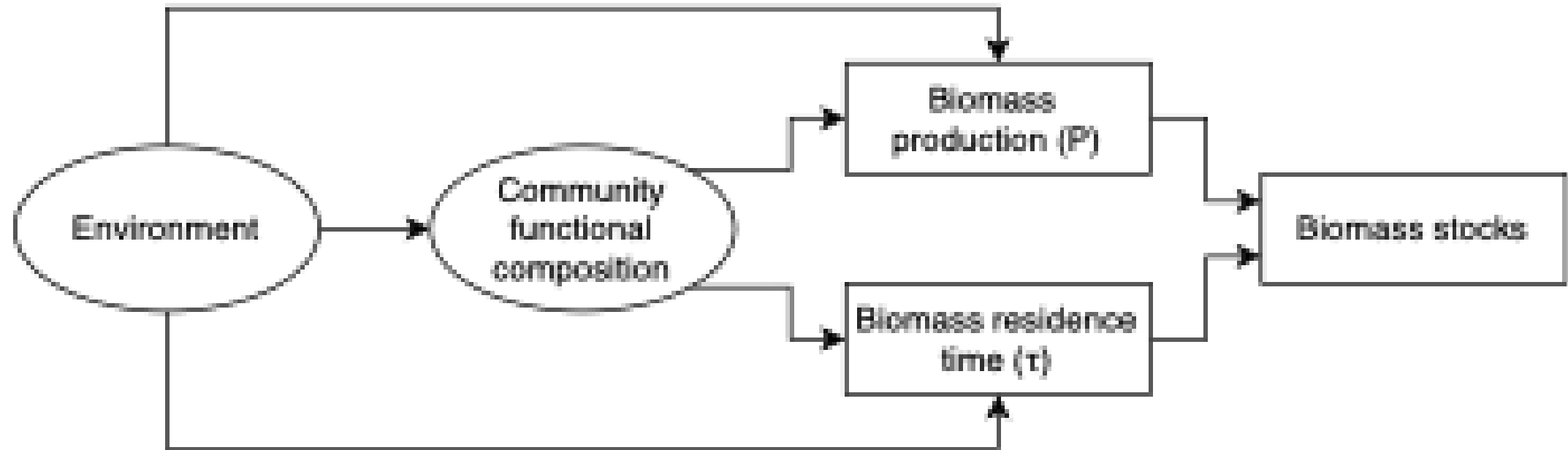
Response: proportional biomass stock in diameter size classes.

Consistent effects across sites.

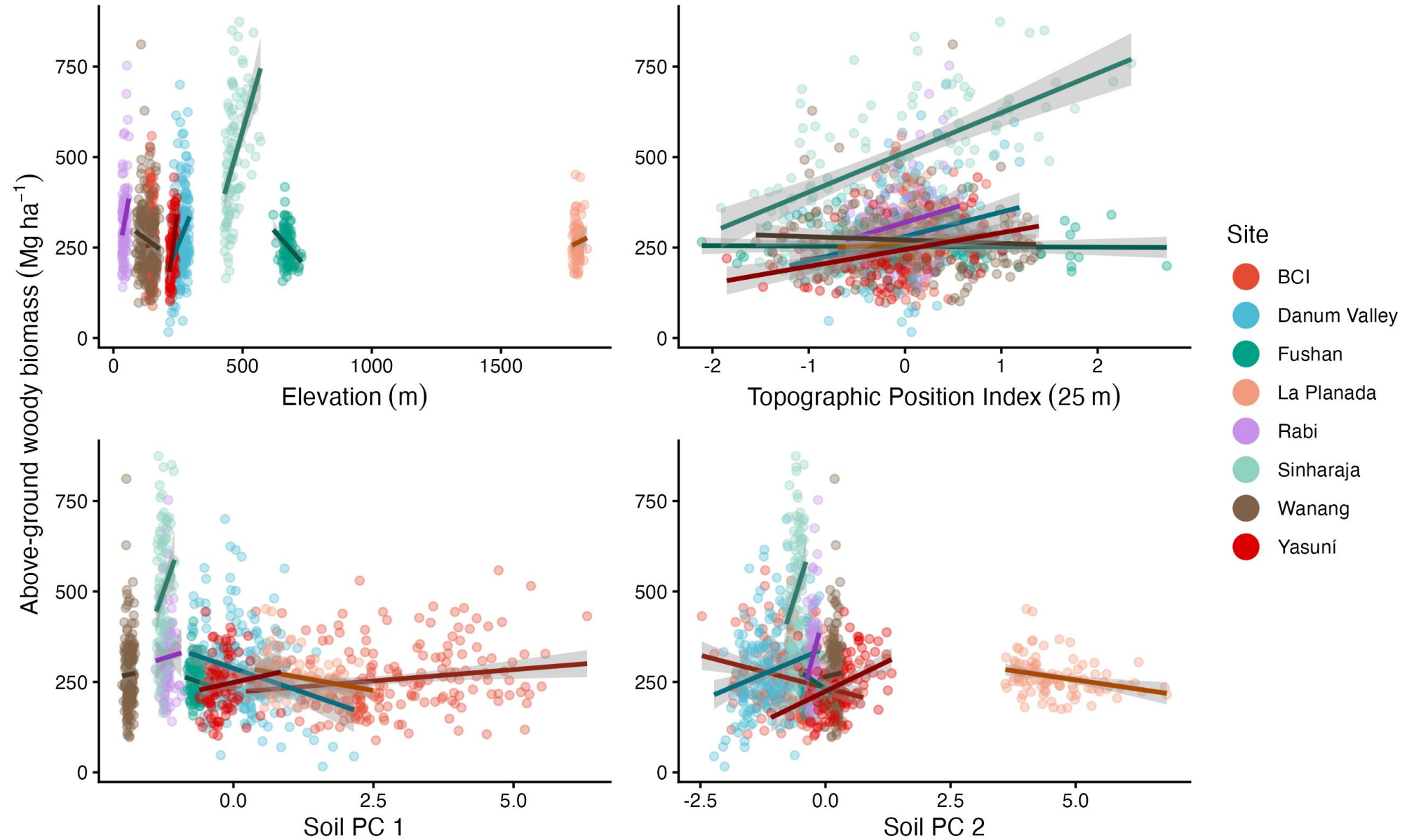
Greater wood density, growth rate, and survival rate leads to proportionally more biomass in large stems.



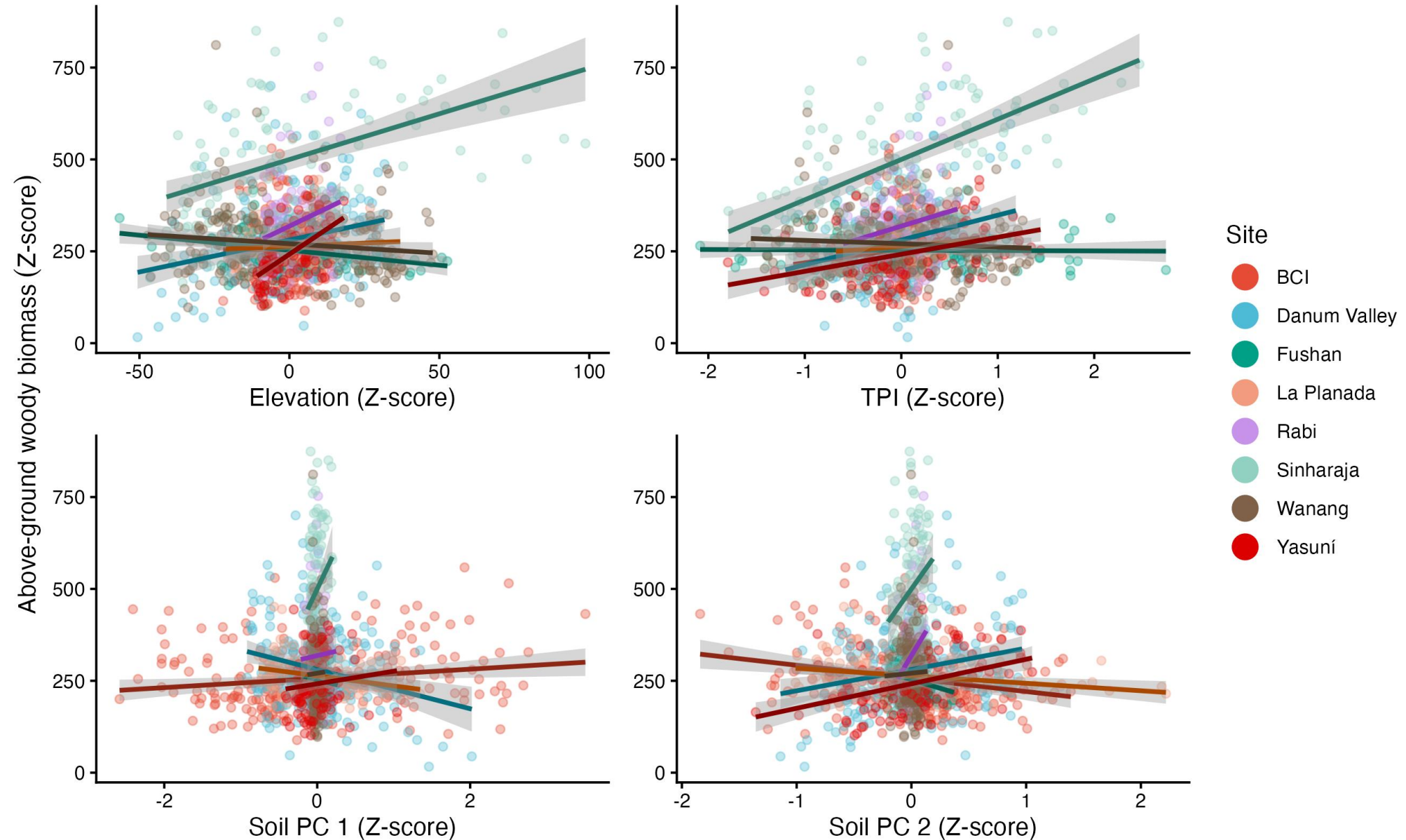
Methods: Structural Causal Model



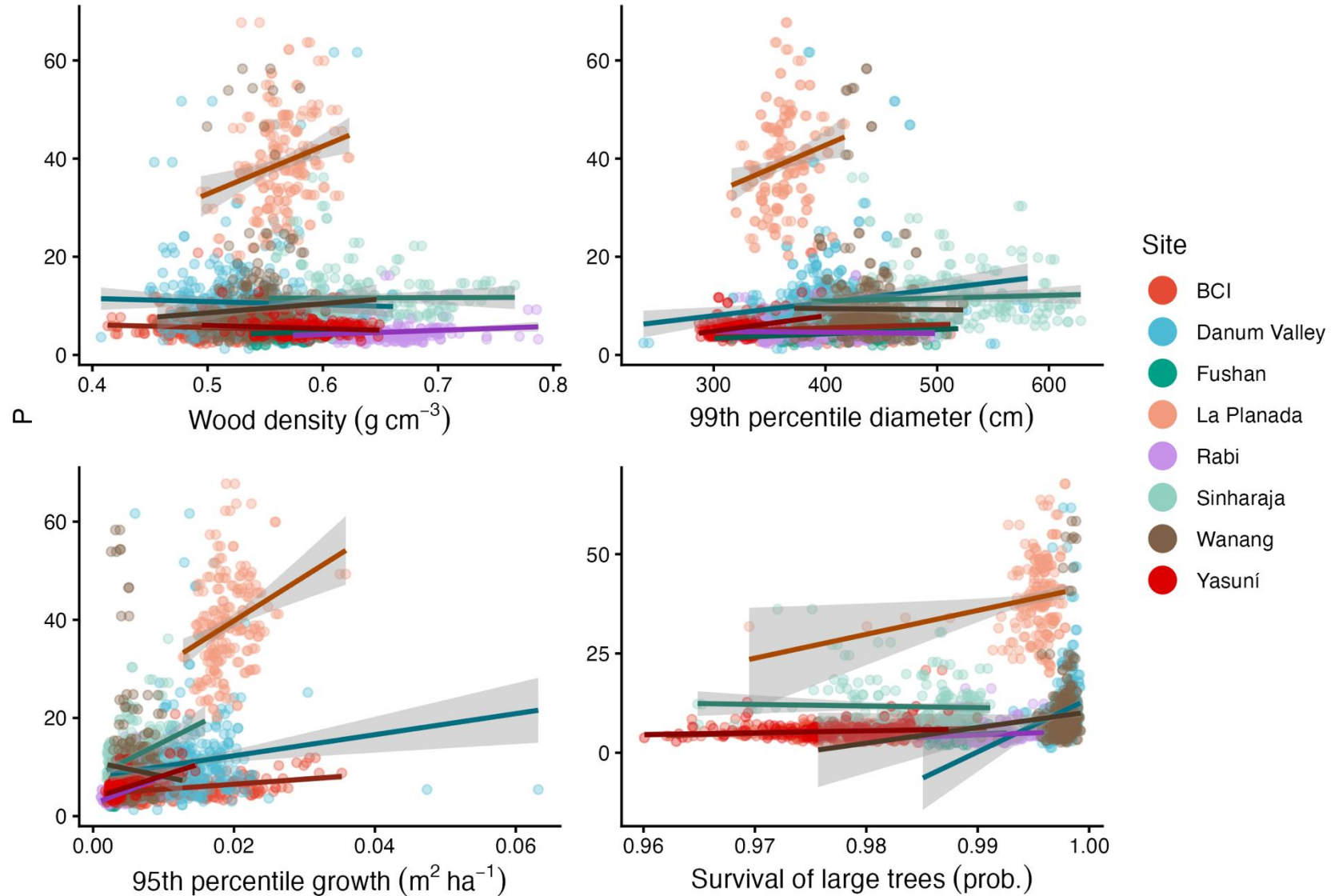
Results: Effect of local environment on biomass



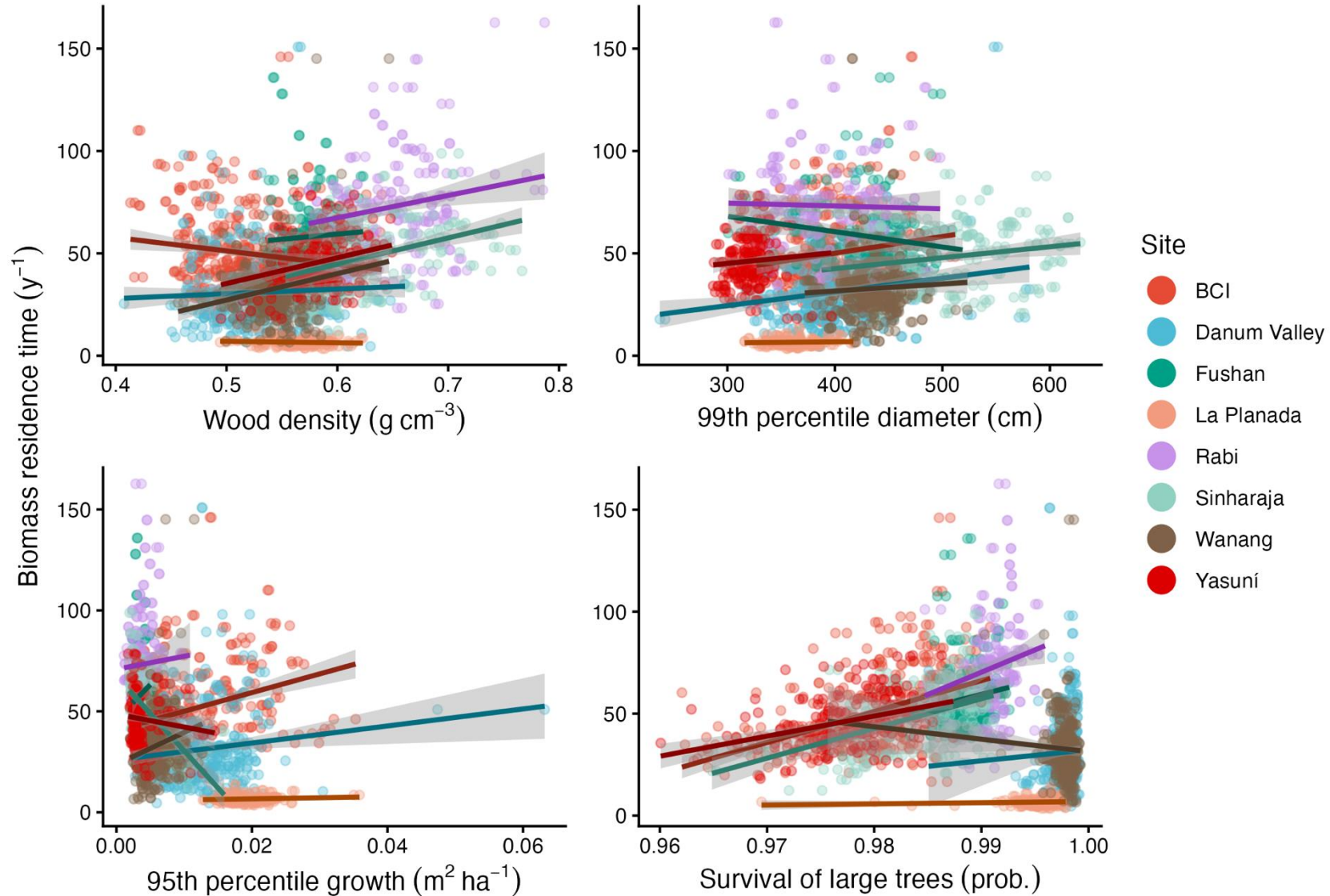
Results: Effect of local environment on biomass



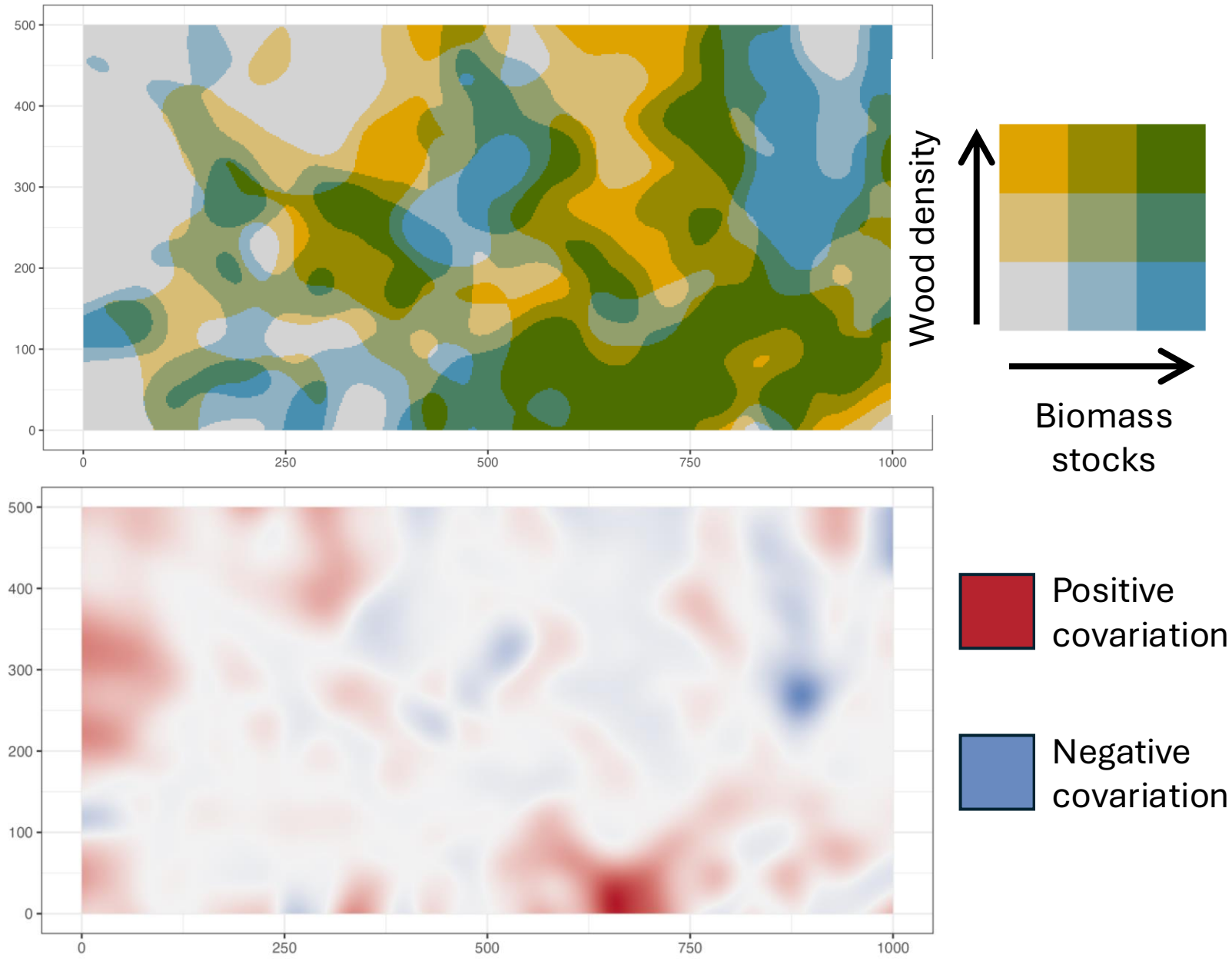
Results: Trait covariation with production



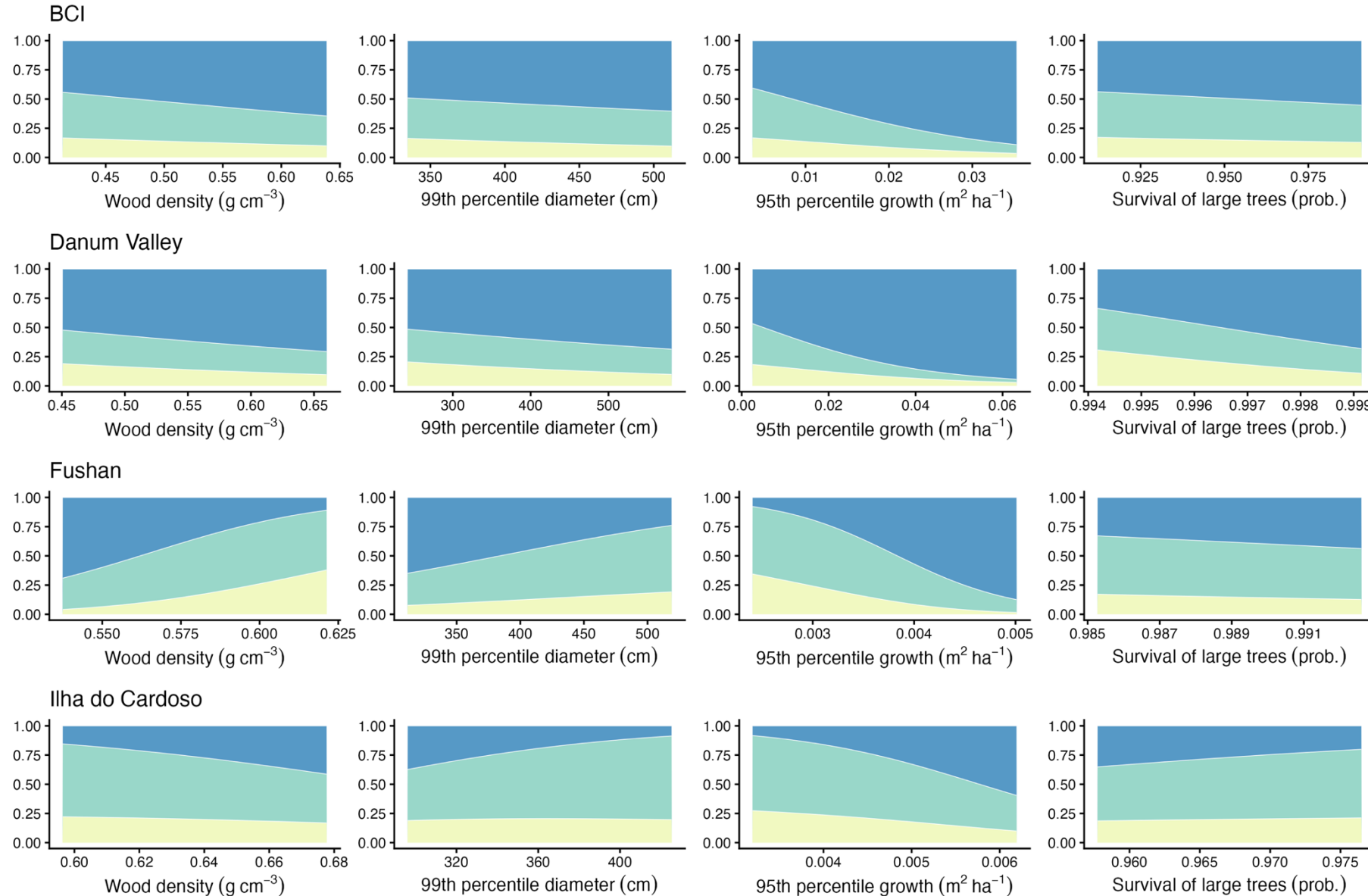
Results: Trait covariation with residence time



Results: Spatial patterns in traits and biomass



Results: Community traits and biomass distribution



Results: Community traits and biomass distribution

