



## Introduction

- What are the fundamental factors that drive patterns of biodiversity on Earth?
- Hypotheses that have been validated in the terrestrial environment (Hobi et al 2017; Radeloff et al 2019) should be tested in the oceans

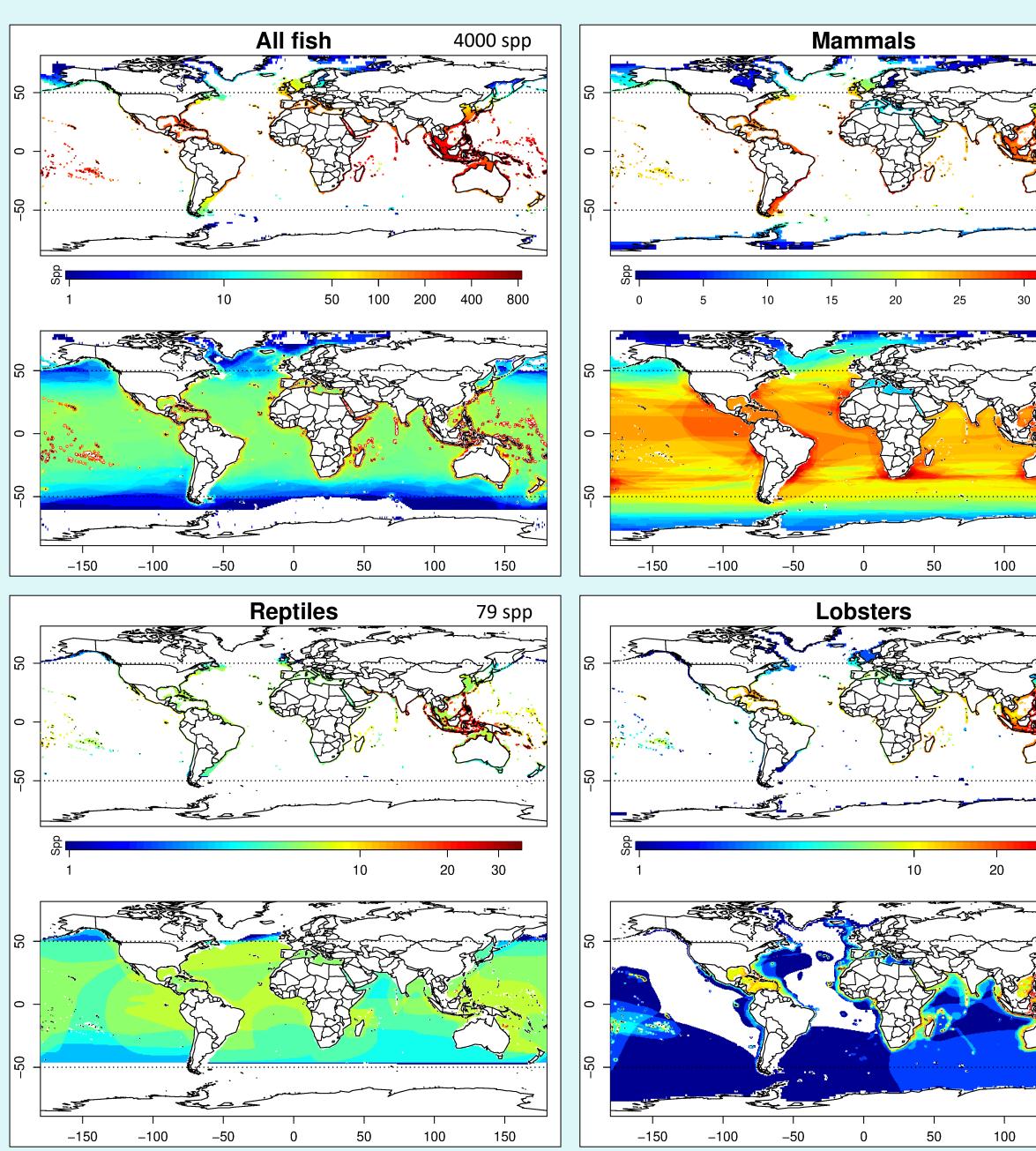
## Energy Biodiversity Hypotheses

- 1. <u>Environmental Stability Hypothesis</u>: lower intra-annual <u>variability</u> of available energy facilitates richness
- 2. <u>Available Energy Hypothesis</u>: Greater energy <u>availability</u> facilitates species richness
- 3. <u>Environmental Stress Hypothesis</u>: Higher <u>minimum</u> energy available facilitates higher species richness

## To test these hypotheses in the oceans, species richness data and calculations of energy availability were combined

## Marine species richness

- Expert-defined ranges
- Separated by spatial region:
  - Coastal (<200 m bathymetry) •
  - Offshore (>200 m bathymetry)
  - 5% sample with spatial buffer used for offshore regressions  $\bullet$
- Fish separated by preferred habitat:  $\bullet$ 
  - All-fish, Pelagic, Demersal, Reef

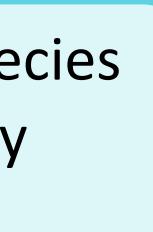


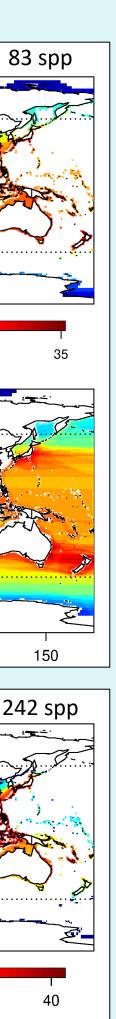
# Testing Energy Biodiversity Theories on Marine Species

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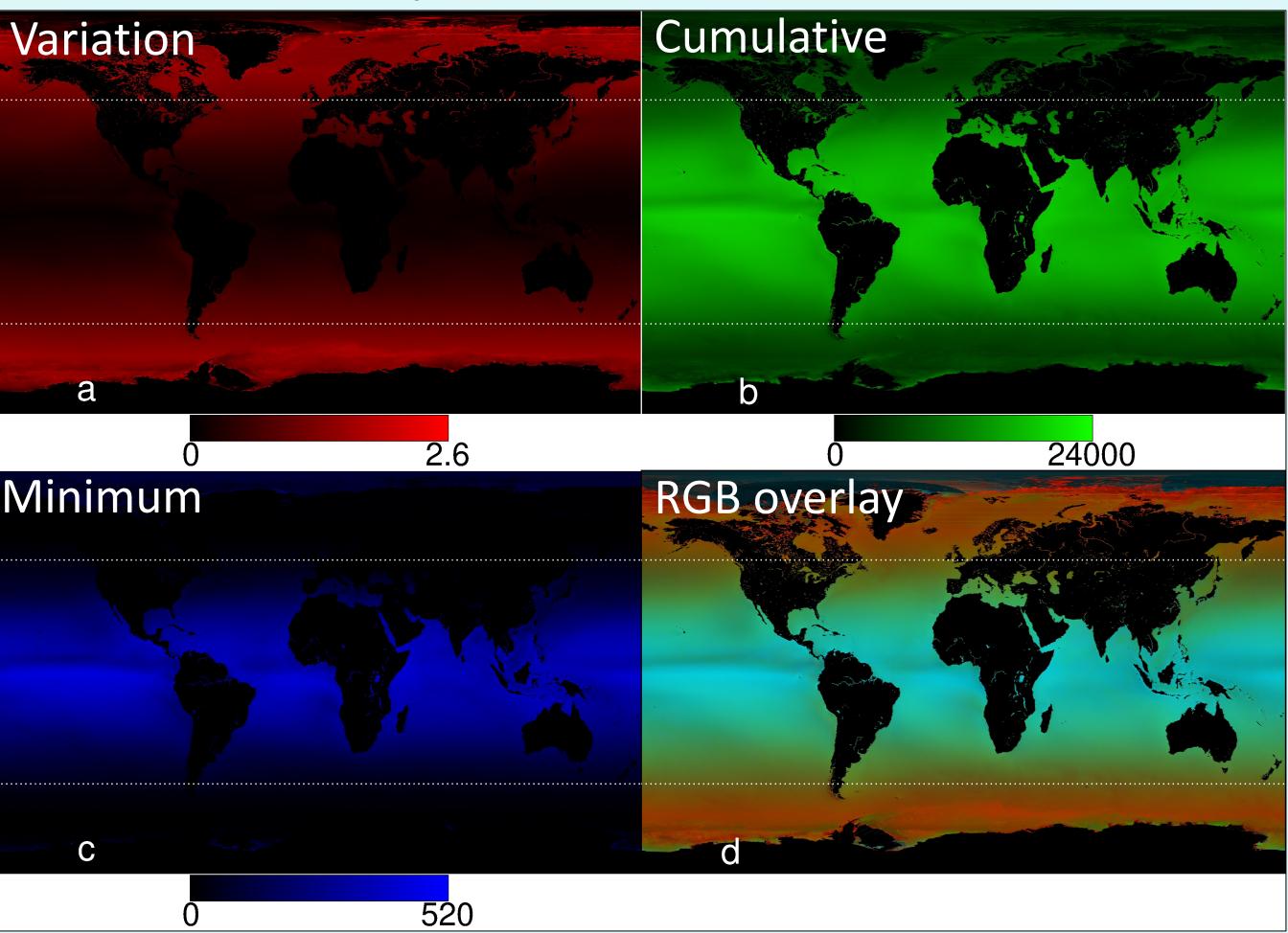
### Energy proxies

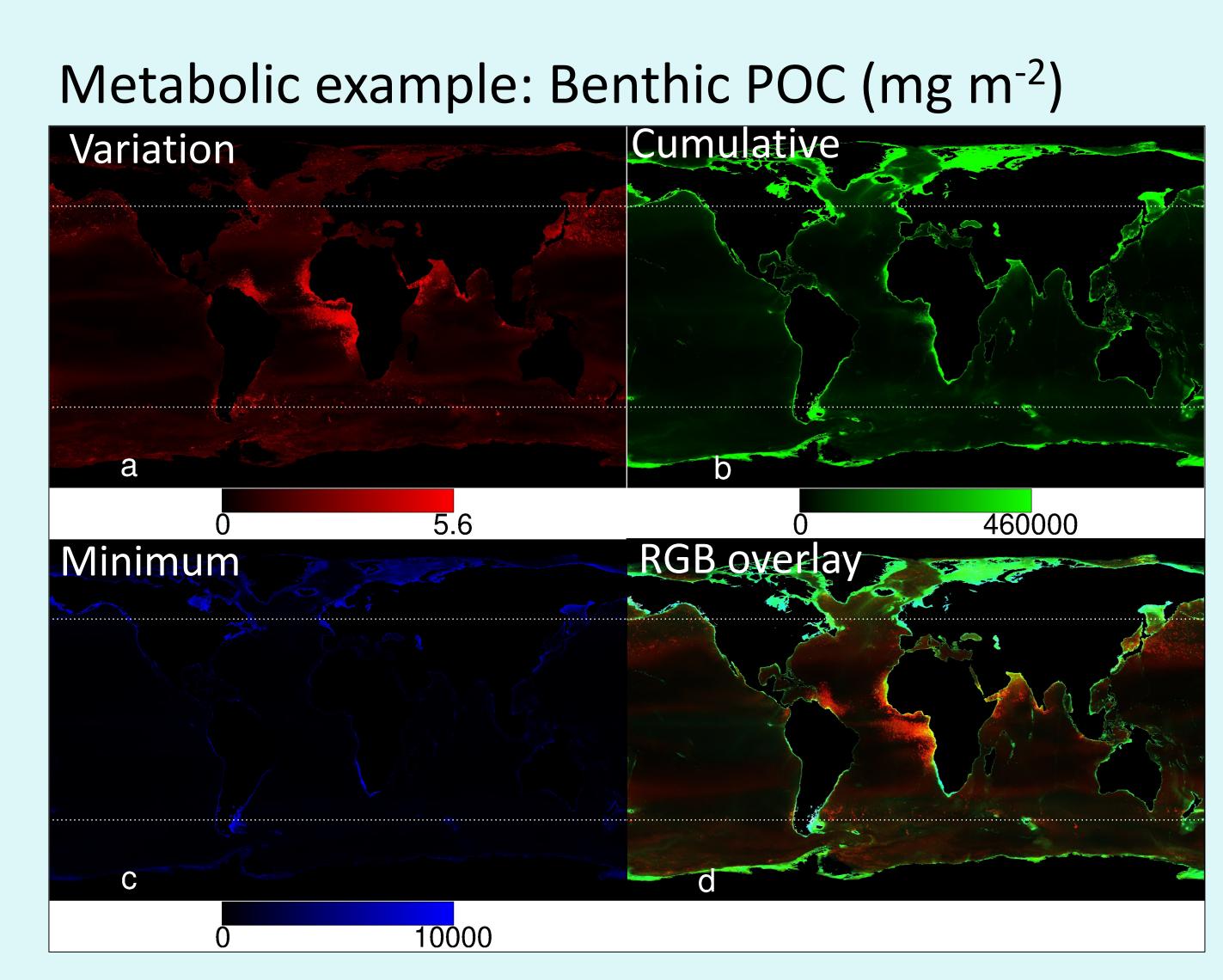
- MODIS Aqua satellite data used to calculate energy proxies: Radiative: PAR, SST
- <u>Metabolic</u>: Chlorophyll, Primary productivity (VGPM), benthic POC • Coefficient of variation, cumulative, and minimum energy over an average year energy curve (2003-2019)
- Excluded polar points (> 50 and < -50 latitude) due to satellite measurement limitations





## Radiative example: PAR (E m<sup>-2</sup>)





### Acknowledgements

I acknowledge my funding sources that made this project possible, including the Marion R. Okie Fellowship and Robertson funds, and the research support given by my committee / co-authors (Matt Oliver, Kimberly Oremus, Volker Radeloff, and Gabriel Reygondeau)

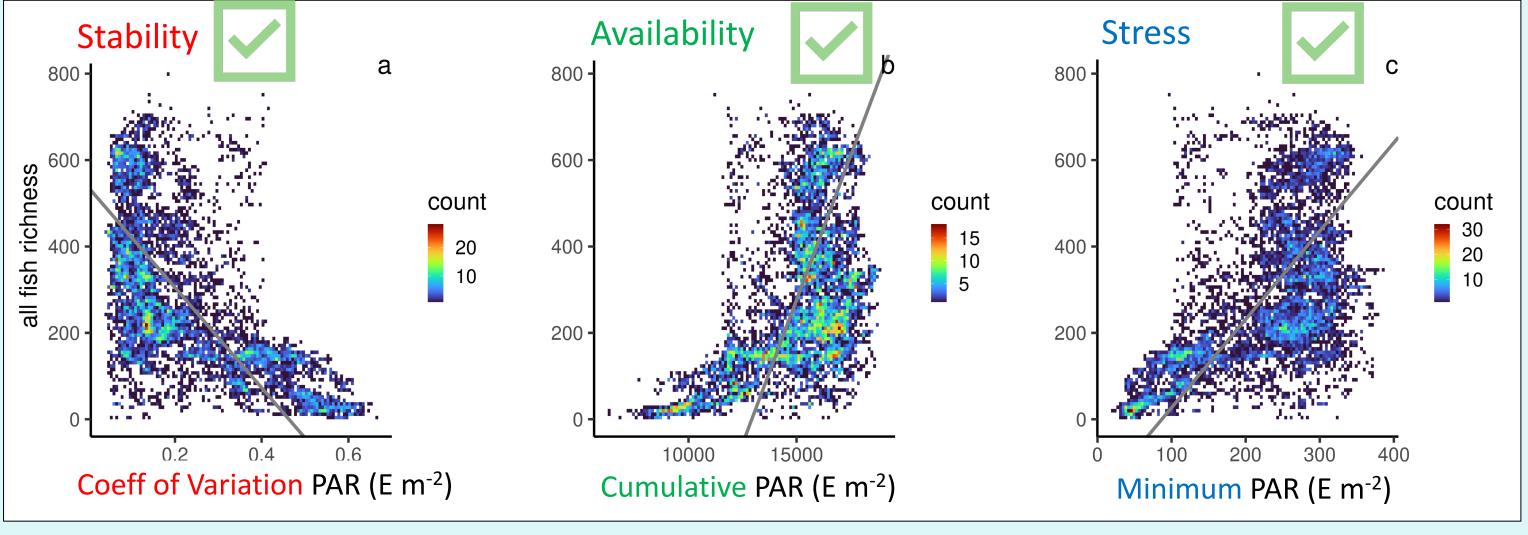
### References

- Hobi, Martina L., Maxim Dubinin, Catherine H. Graham, Nicholas C. Coops, Murray K. Clayton, Anna M. Pidgeon, and Volker C. Radeloff. 2017. "A Comparison of Dynamic Habitat Indices Derived from Different MODIS Products as Predictors of Avian Species Richness." Remote Sensing of Environment 195 (June): 142–52. https://doi.org/10.1016/j.rse.2017.04.018.
- Radeloff, V. C., M. Dubinin, N. C. Coops, A. M. Allen, T. M. Brooks, M. K. Clayton, G. C. Costa, et al. 2019. "The Dynamic Habitat Indices (DHIs) from MODIS and Global Biodiversity." *Remote Sensing of Environment* 222 (March): 204–14. https://doi.org/10.1016/j.rse.2018.12.009.

## 2D density plots and model II regressions • Pixel matched energy indices and fish richness data

- Model II regressions (Ranged Major Axis, p < 0.01)
- Correlation coefficient (r) with parametric p value < 0.01
- Considered <u>sign (+/-)</u> and <u>significance</u> of regressions

## PAR (E m<sup>-2</sup>) and all fish in coastal region



## **Regression results summary**

	Co	astal		Offshore					
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	Metabolic	×		×		Metabolic		×	
Demersal fish	Radiative	×	×	×	Demersal fish	Radiative			
	Metabolic	×				Metabolic	×		
Reef	Radiative								
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## Results show that the biodiversity energy hypotheses are broadly applicable to marine species



