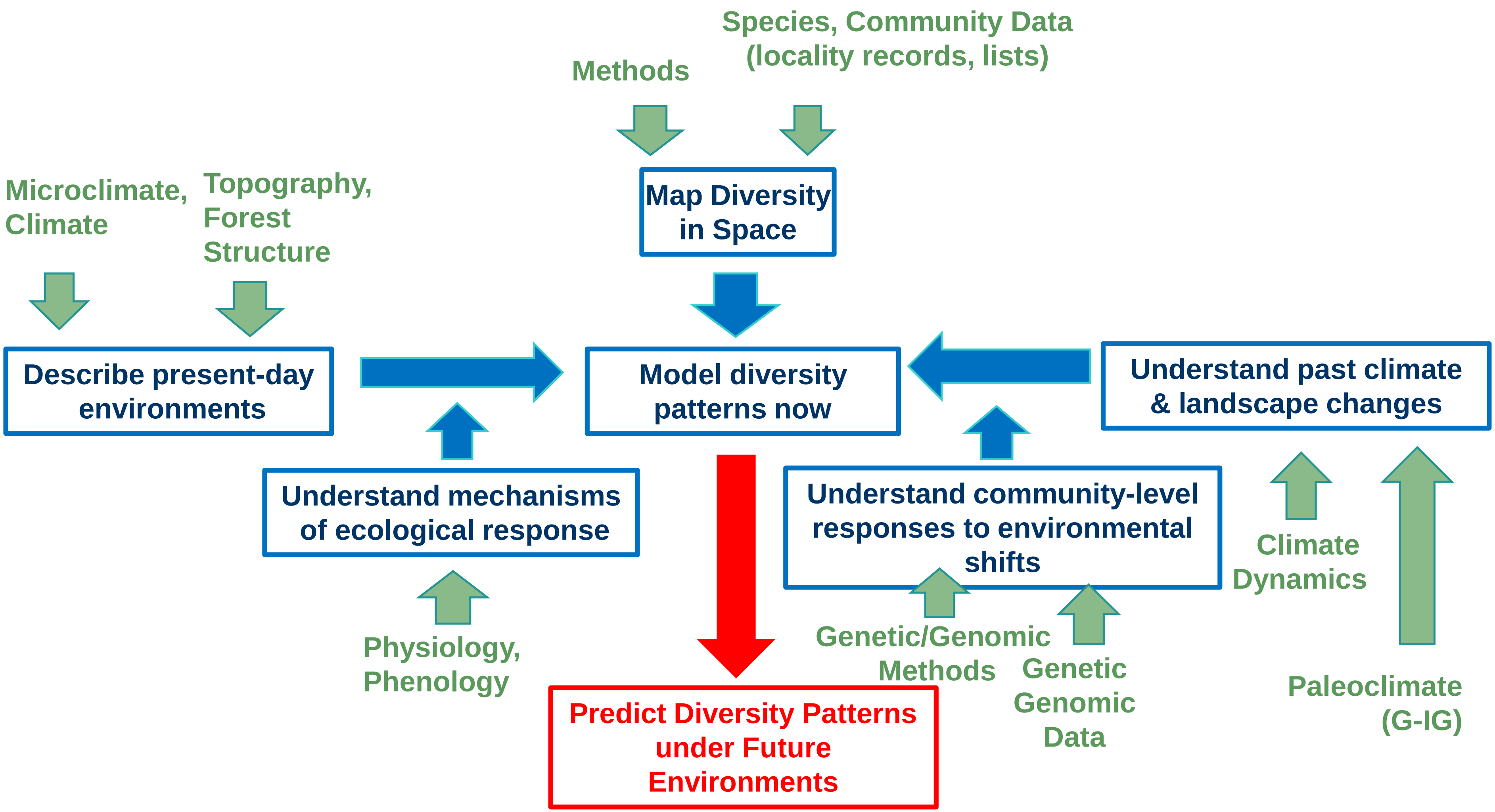
A multidisciplinary framework for biodiversity prediction in the Brazilian Atlantic Forest hotspot

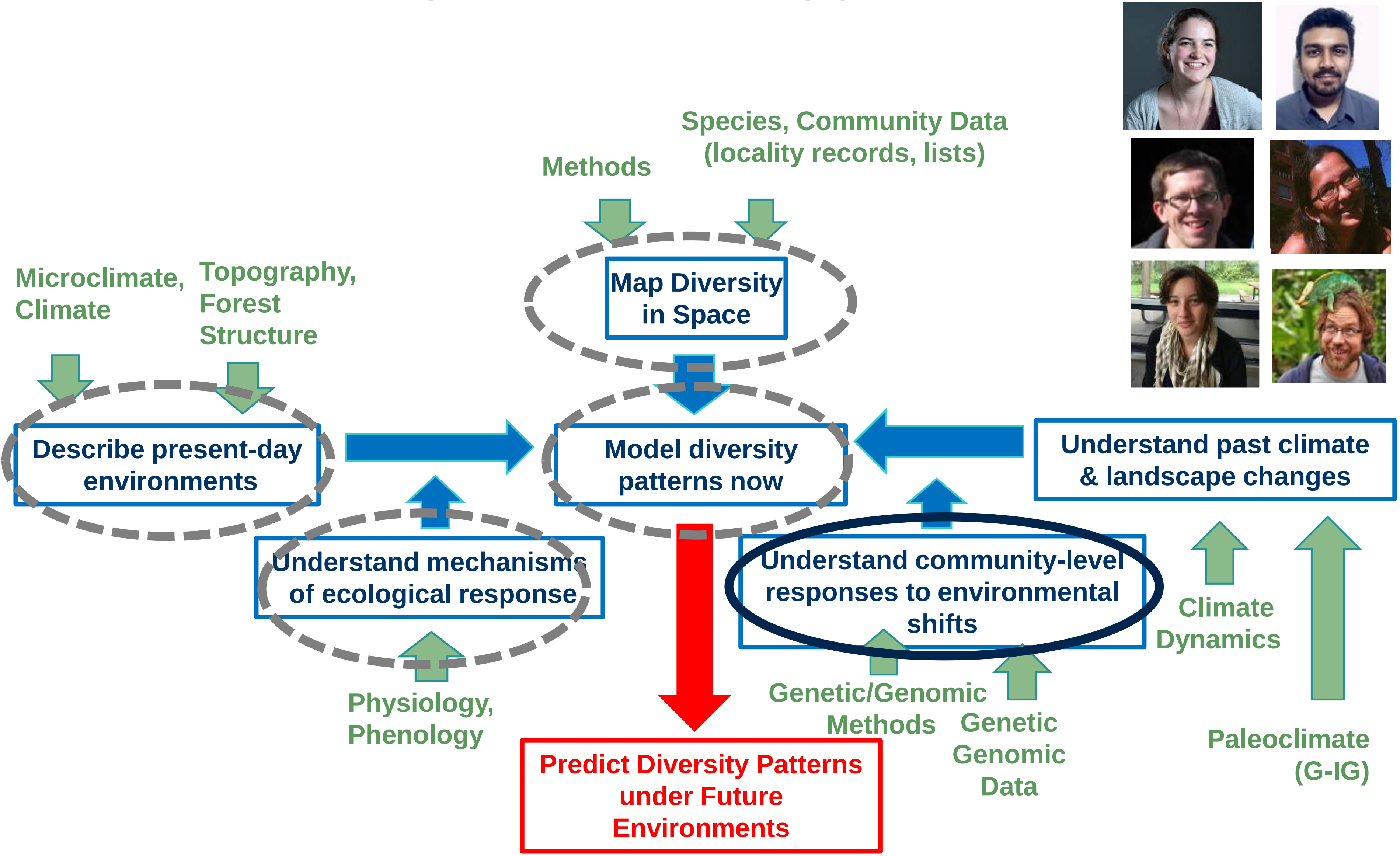
The Brazilian Atlantic Rainforest

- ~1,230,000 Km^2

Framework


Species, Community Data
(locality records, lists)
Methods
Map Diversity in Space
Microclimate, Climate
Topography, Forest Structure
Describe present-day environments
Model diversity patterns now
Understand past climate & landscape changes
Understand mechanisms of ecological response
Understand community-level responses to environmental shifts
Climate Dynamics
Physiology, Phenology
Genetic/Genomic Methods
Genetic Genomic Data
Paleoclimate (G-IG)
Predict Diversity Patterns under Future Environments

How can the incorporation of remote sensing components improve biodiversity prediction?

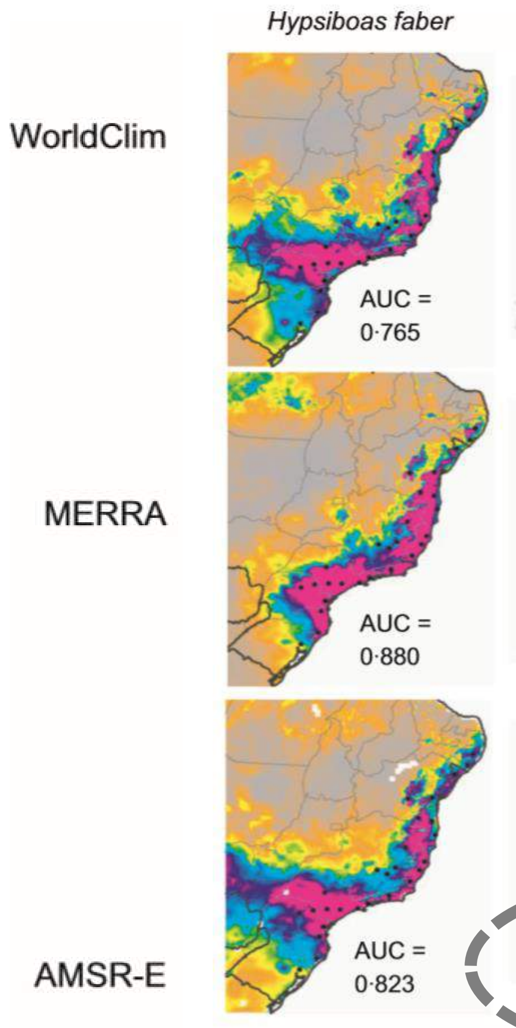


Microwave data enable characterization of present-day environments for biodiversity modeling

- Species Distribution Models derived from MERRA-derived bioclimatic layers performed better than models built with WorldClim data.

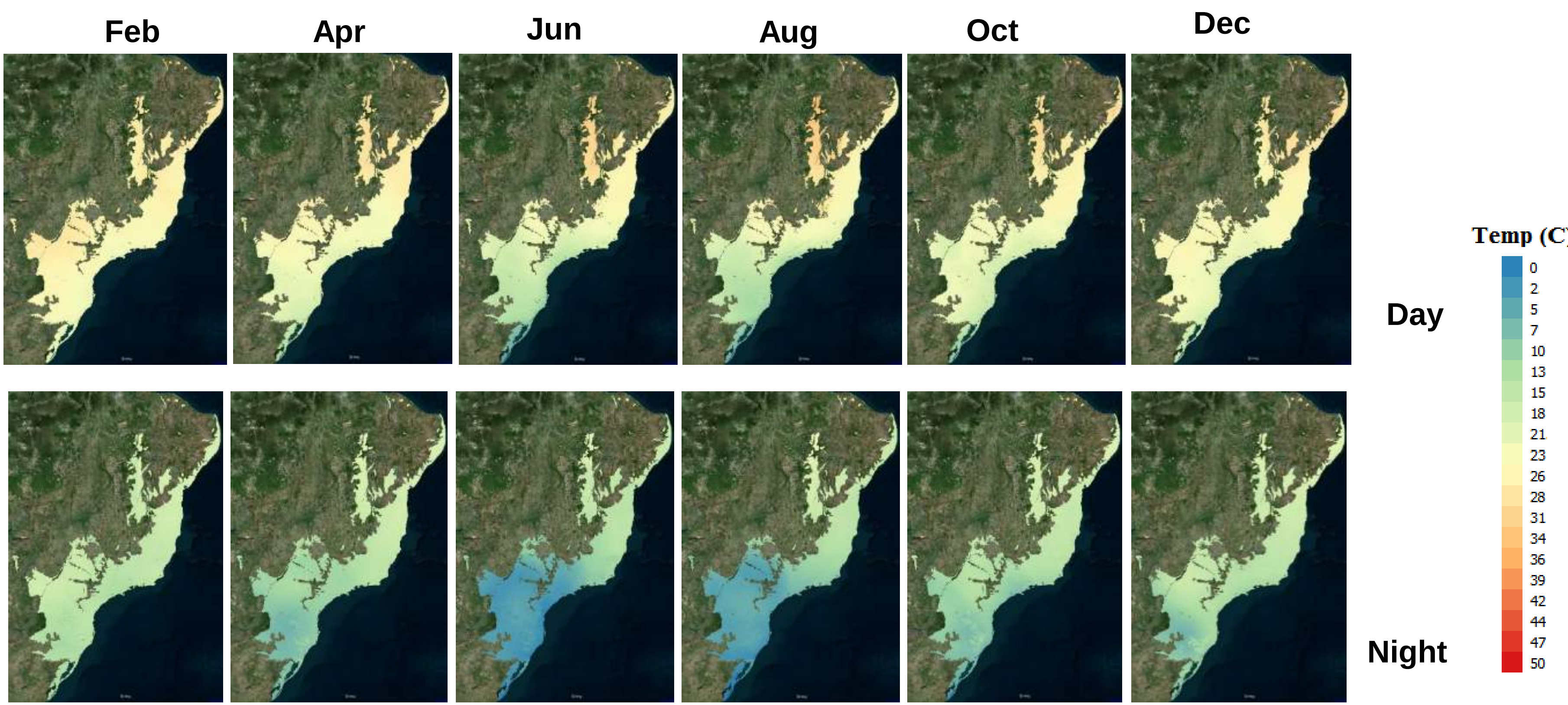
- Models constructed with AMSR-E-based layers had similar performance to models built with WorldClim.

Waltari et al. 2014. Meth Ecol Evol



Map Diversity in Space

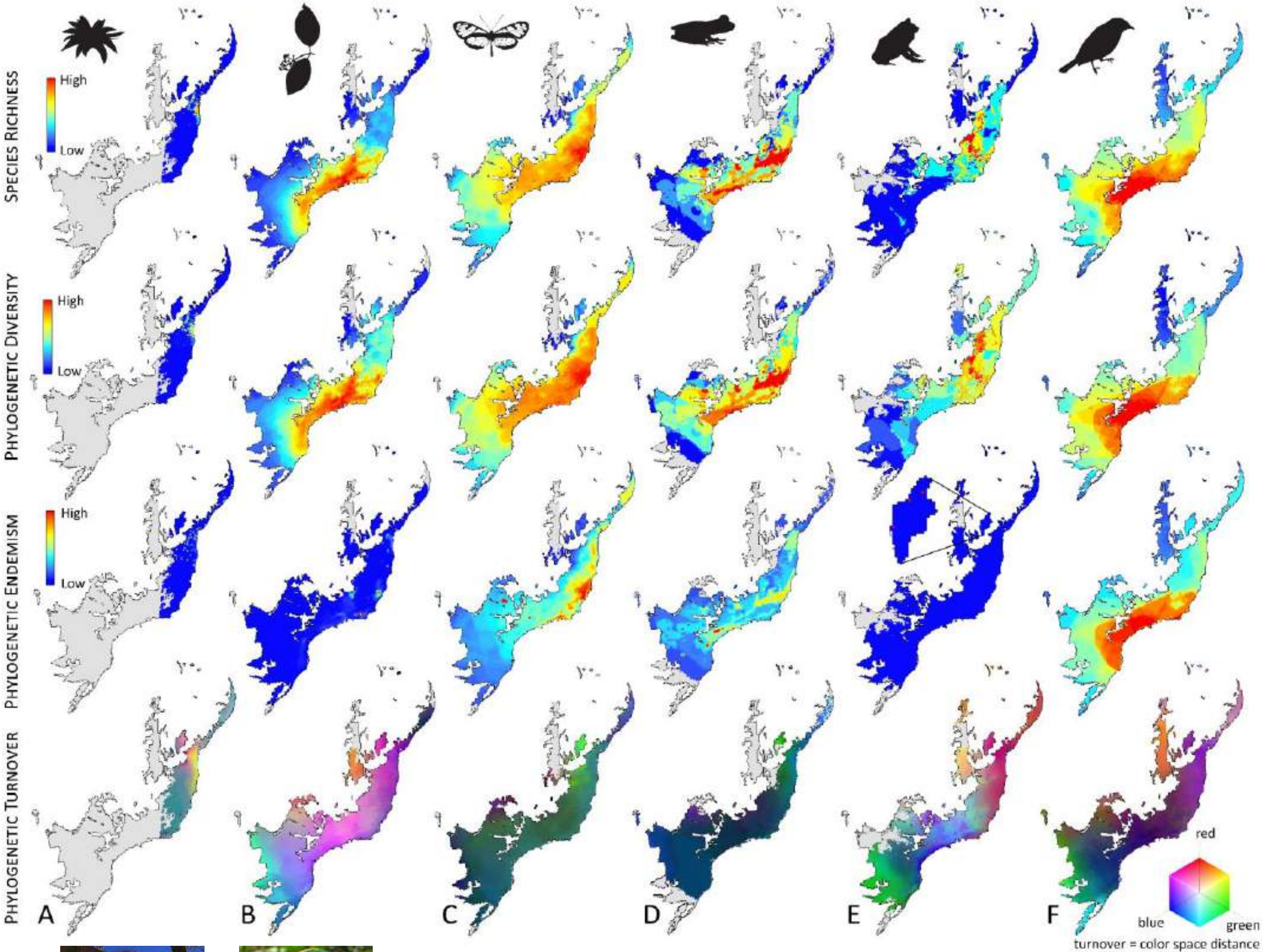
AMSR-E Climatology enables description of day/night temperature shifts (here, LST Min; 2003-2011)



Khan et al. in prep.

Describe present-day environments

Remote sensing products predict diversity patterns at larger ecological and geographical scales



Brown, Paz et al. in review.
Paz et al. in prep.

Model diversity patterns now

Remote sensing products predict diversity patterns at larger ecological and geographical scales

	R^2 Phylogenetic Diversity	R^2 Phylogenetic Endemism
	0.92	0.77
	0.95	0.51
	0.94	0.46
	0.78	0.27
	0.89	0.05
	0.86	0.05

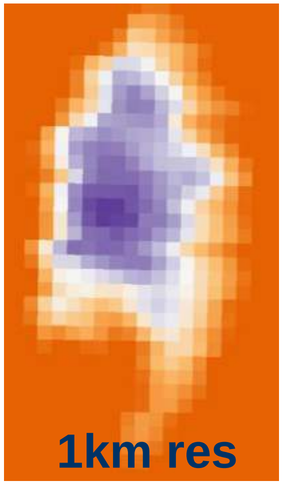
PRELIMINARY ANALYSES BASED ON MODIS AND CHIRPS DATA

Conditional Autoregressive Models used to address spatial autocorrelation; probability of values at any given location is conditional on neighboring values.

Paz et al. in prep.

Model diversity patterns now

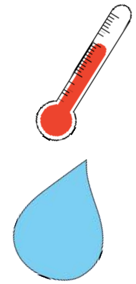
Remote sensing improves description of microclimates, which are needed to understand physiological responses to climate

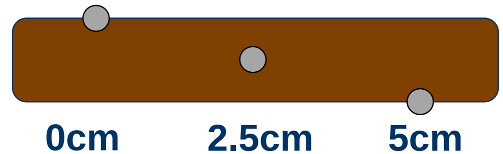


macro-climate: temp, precip, wind speed, solar radiation

elevation, veg, soil (DEM2; NDVI, soilgrids.org)

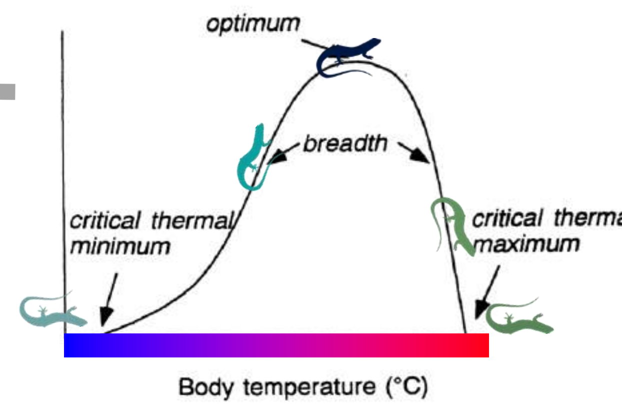
NicheMapR microclimate model

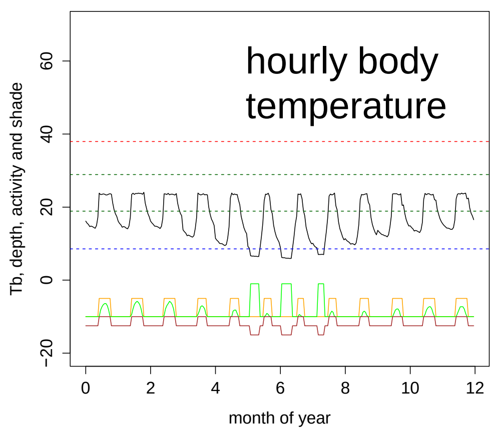




Temperature and relative humidity at multiple substrate depth

+



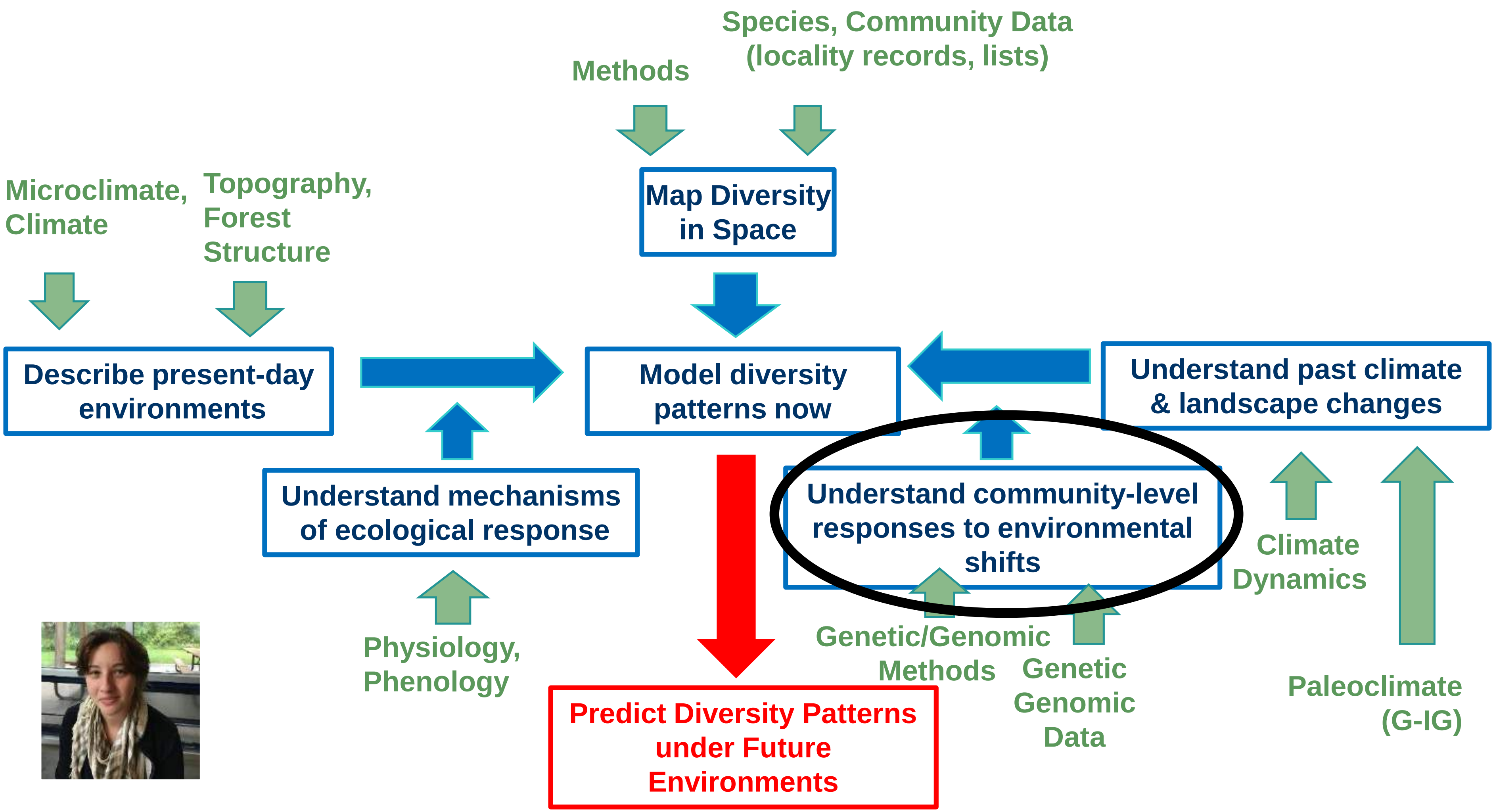


Understand mechanisms of ecological response

Strangas et al. 2018 Ecography

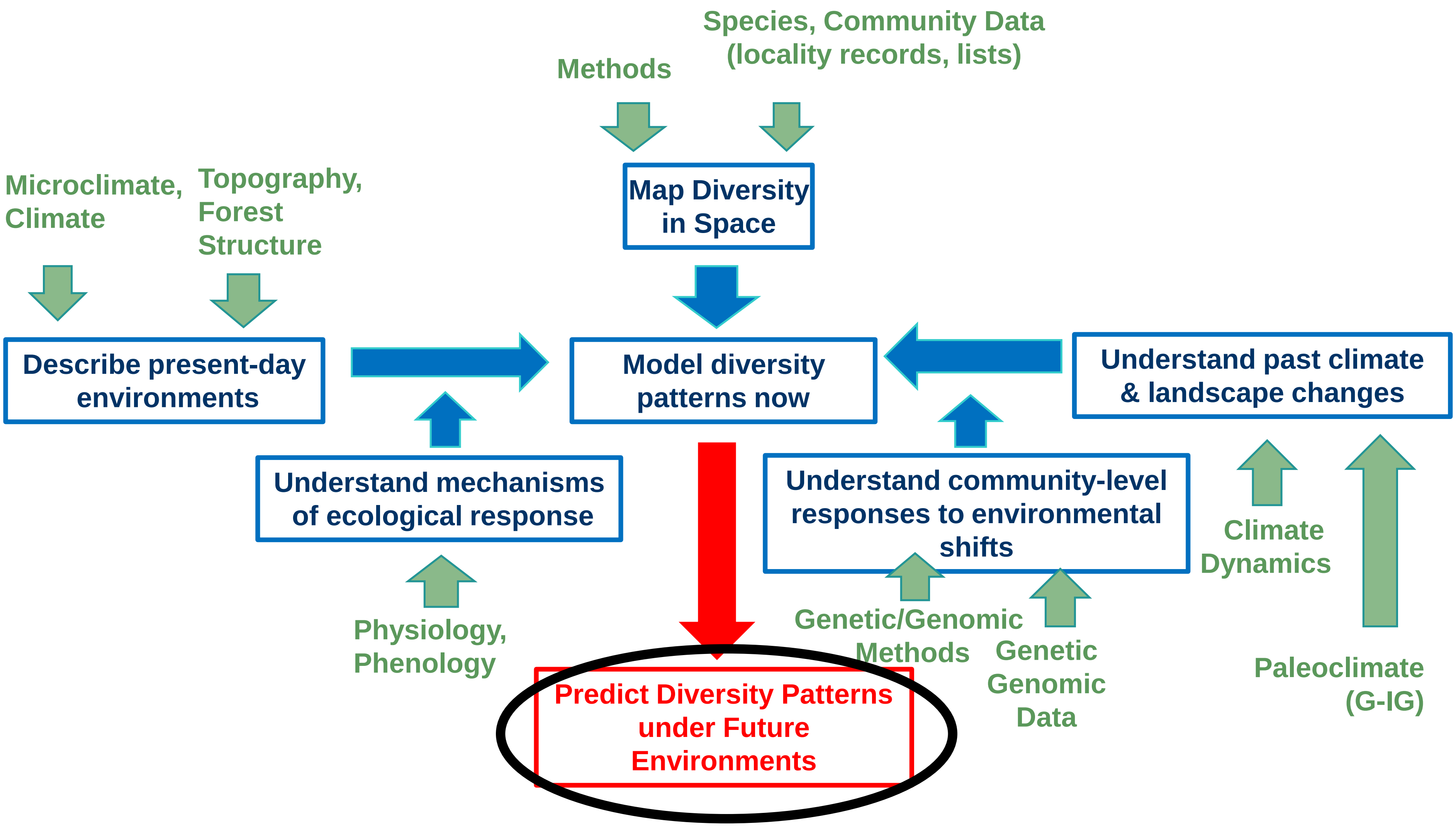
Stranas et al. in prep.

Searching for genomic signatures of adaptation to environmental gradients

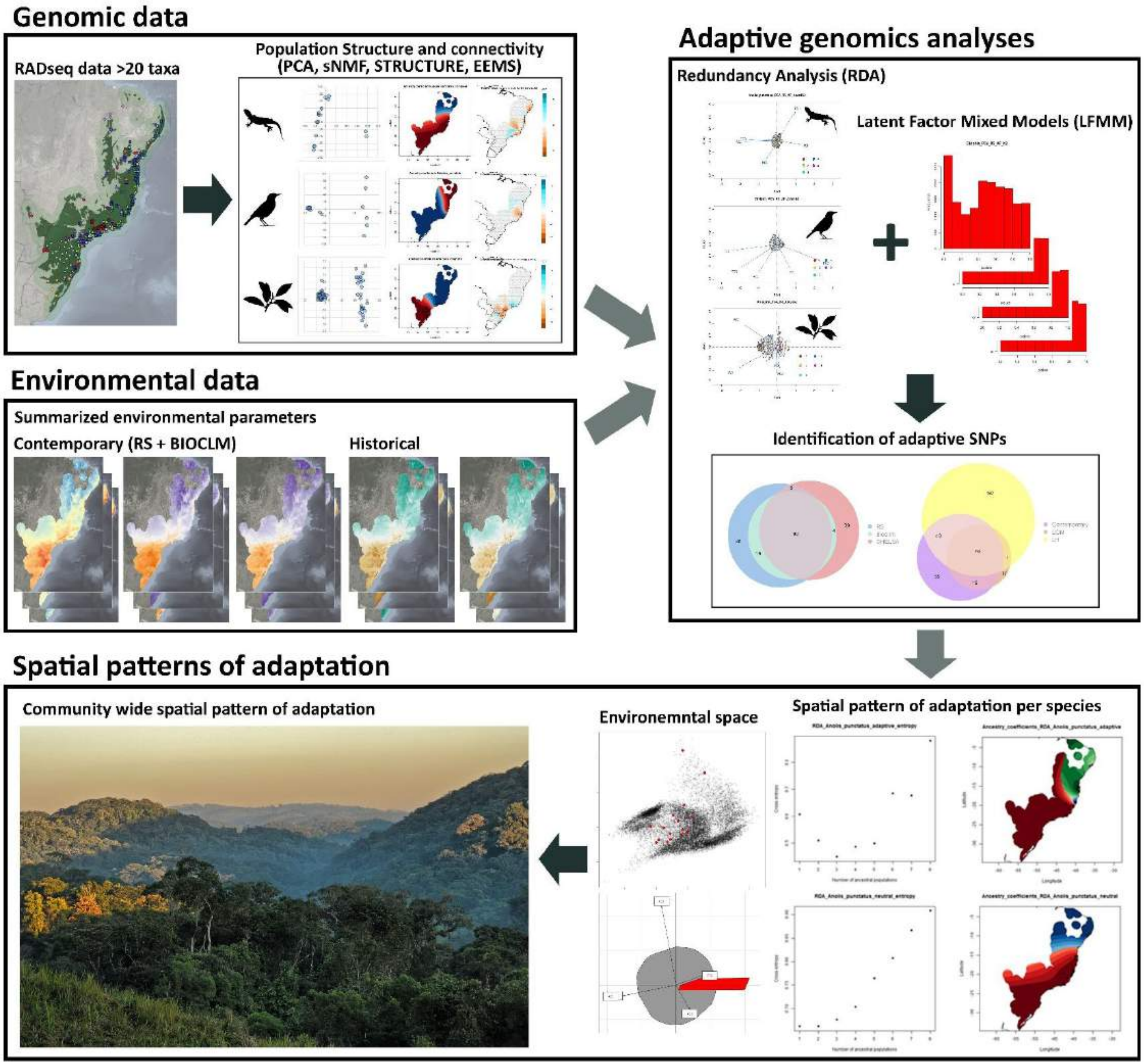


Bertola et al. in prep.

Stay tuned for next year's meeting



Searching for genomic signatures of adaptation to environmental gradients



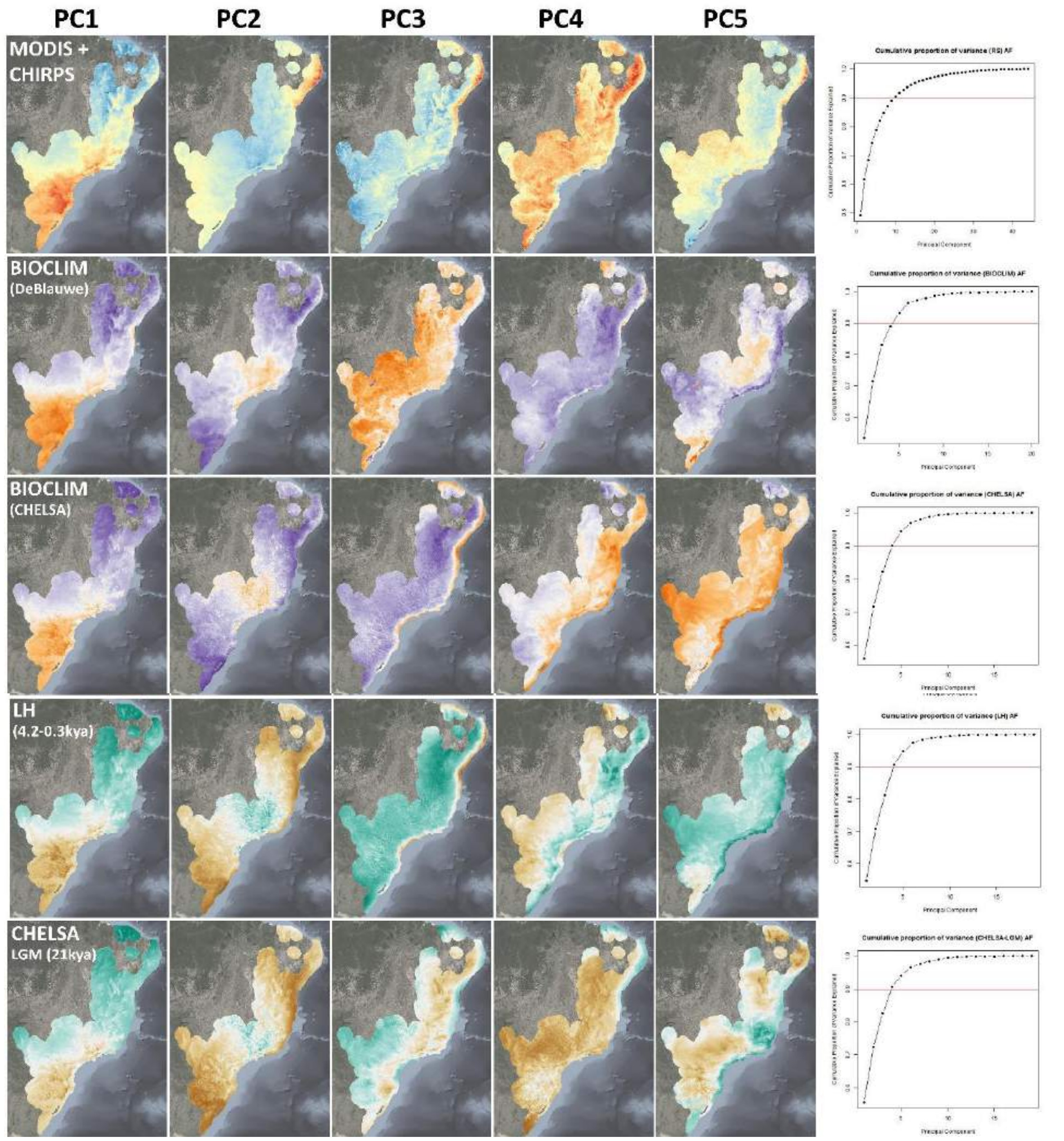
Environmental data:

Contemporay:

- Remote sensing
- BIOCLIM (DeBlauwe)
- BIOCLIM (CHELSA)

Historical:

- BIOCLIM LH
- BIOCLIM LGM

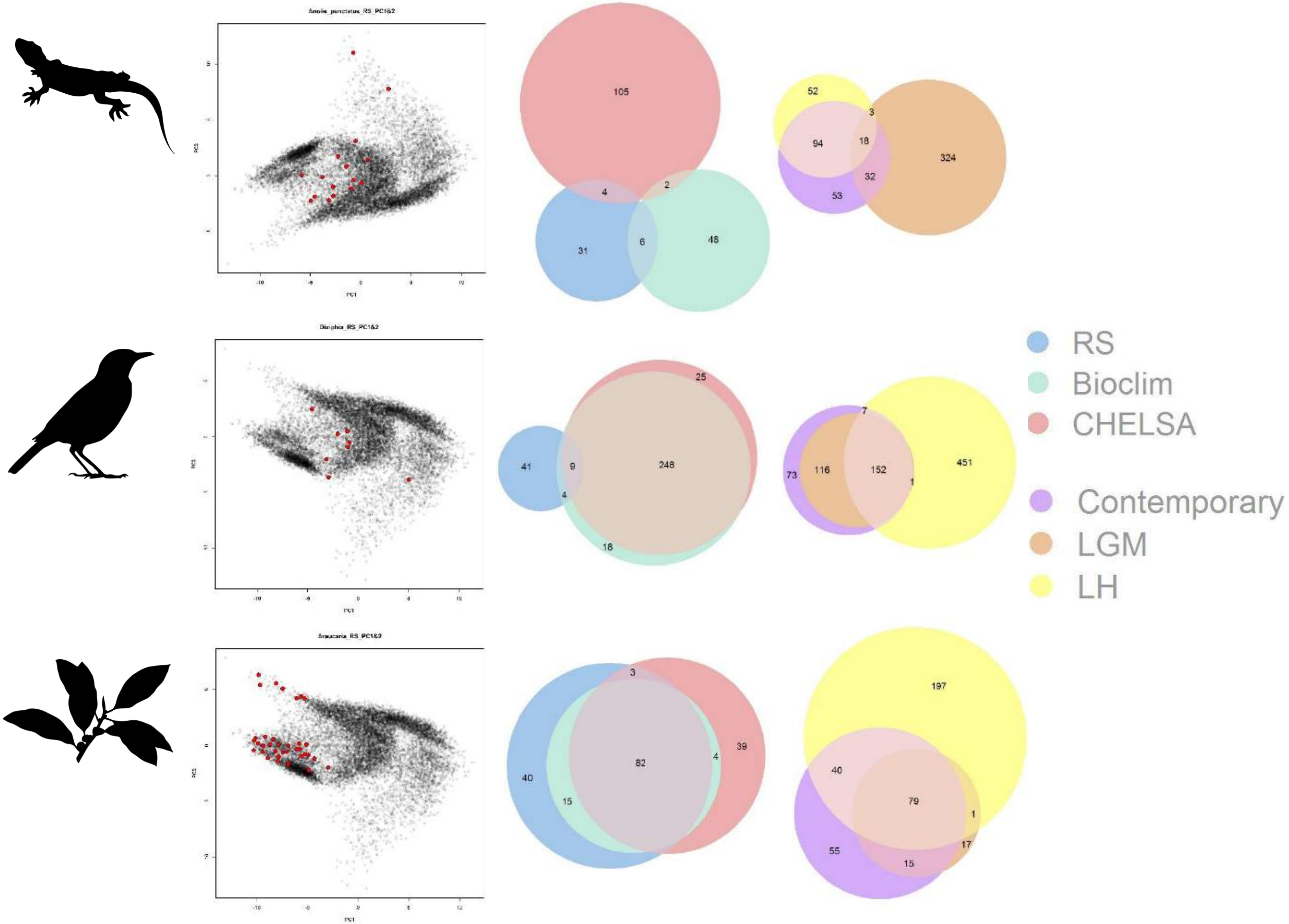


Genomic data:

- RADseq data
- >20 taxa
- Different ranges/ environmental space

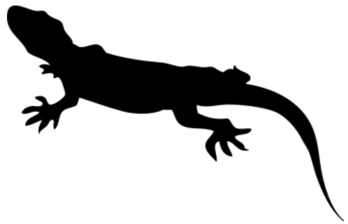


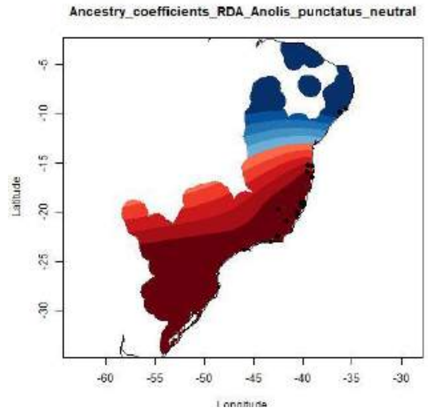


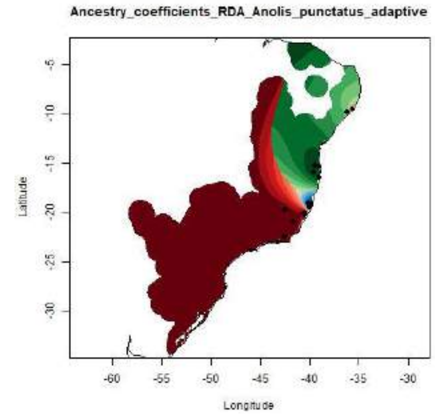


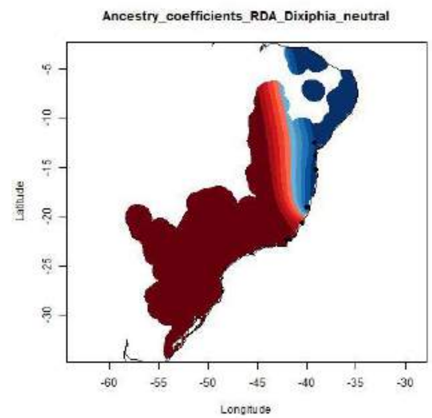
Anolis_punctatus_RS_PC1&2
PC1
PC2
105
4
2
31
6
48
52
3
94
18
324
32
53
Diniphia_RS_PC1&2
25
41
9
248
4
18
7
73
116
152
451
1
Araucaria_RS_PC1&2
3
40
82
4
39
15
197
40
79
1
55
15
17
RS
Bioclim
CHELSA
Contemporary
LGM
LH

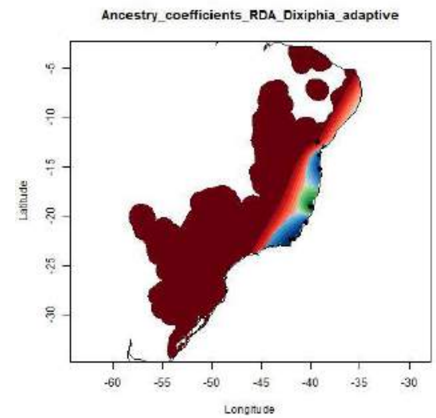
Neutral SNPs Adaptive SNPs

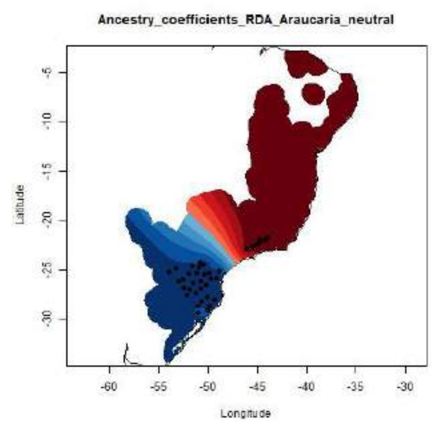


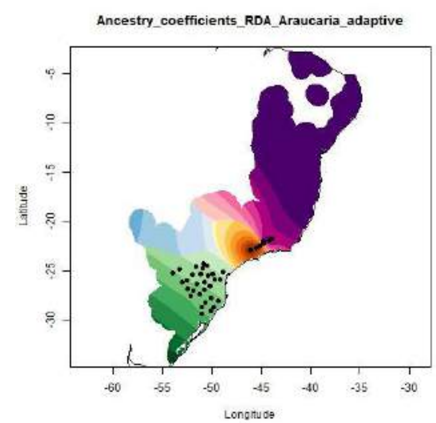












Acknowledgements

Cristina Miyaki
The Carnaval, McDonald, Hickerson, and Michelangeli Labs
Mauro Teixeira
Renato Recoder
Agus Camacho
José Cassimiro
Roberta Damasceno
Renata Amaro
Mariana Lyra
Francisco Dal Vechio
Miguel Rodrigues
Celio Haddad
Thiago Silva

NASA
NSF
DEB 1120487
DEB 1035184
DEA 0091511