Distribution of intraspecific diversity across species ranges: Insights from herptiles in six global regions

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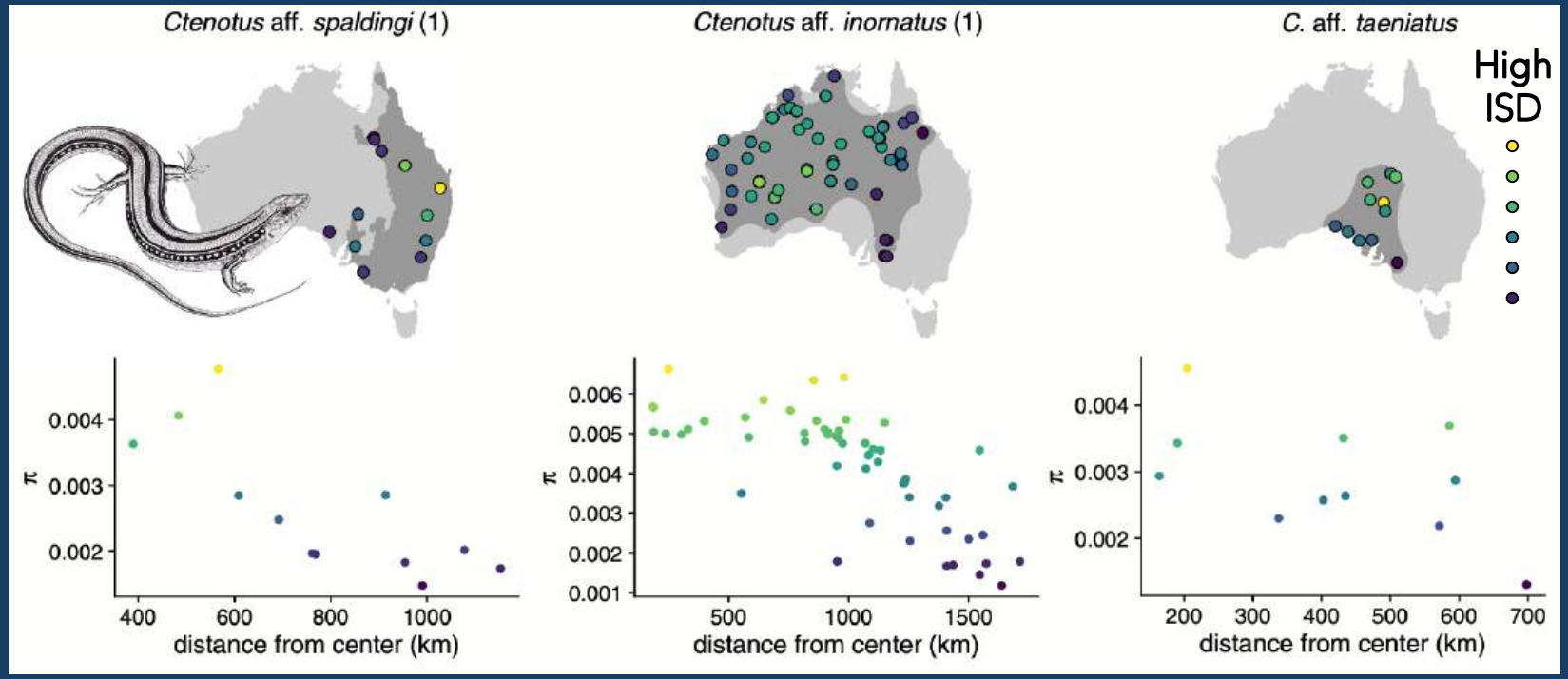
Why study intraspecific diversity?

- Intraspecific genetic diversity (ISD) is one of the three pillars of biodiversity
- Underlies species adaptation and survival, ecosystem resilience, and nature's contributions to people
- Neglected in conservation policy and spatial conservation planning

Why study intraspecific diversity?

Understanding the distribution of ISD across species' geographic ranges is fundamental

- Better conservation planning guidelines
- Effective protective areas in representing ISD



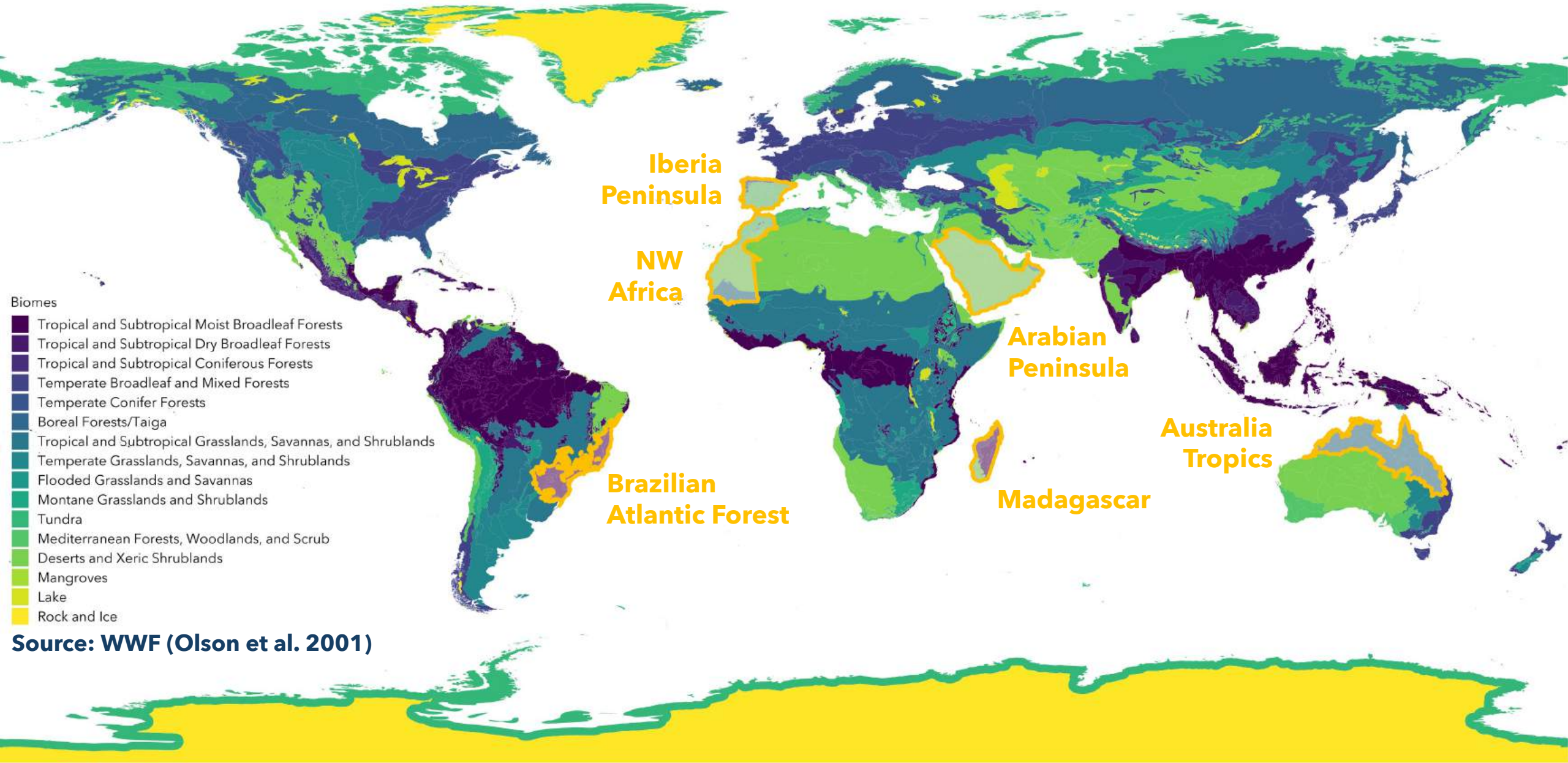
Singhal et al. (2022) *Molecular Ecology*

Explore spatial patterns of ISD within species

shortfalls of knowledge:

1. taxonomic coverage when identifying which populations contain the highest ISD
2. potential generalities among species and clades
3. underlying evolutionary and ecological mechanisms

Six global regions



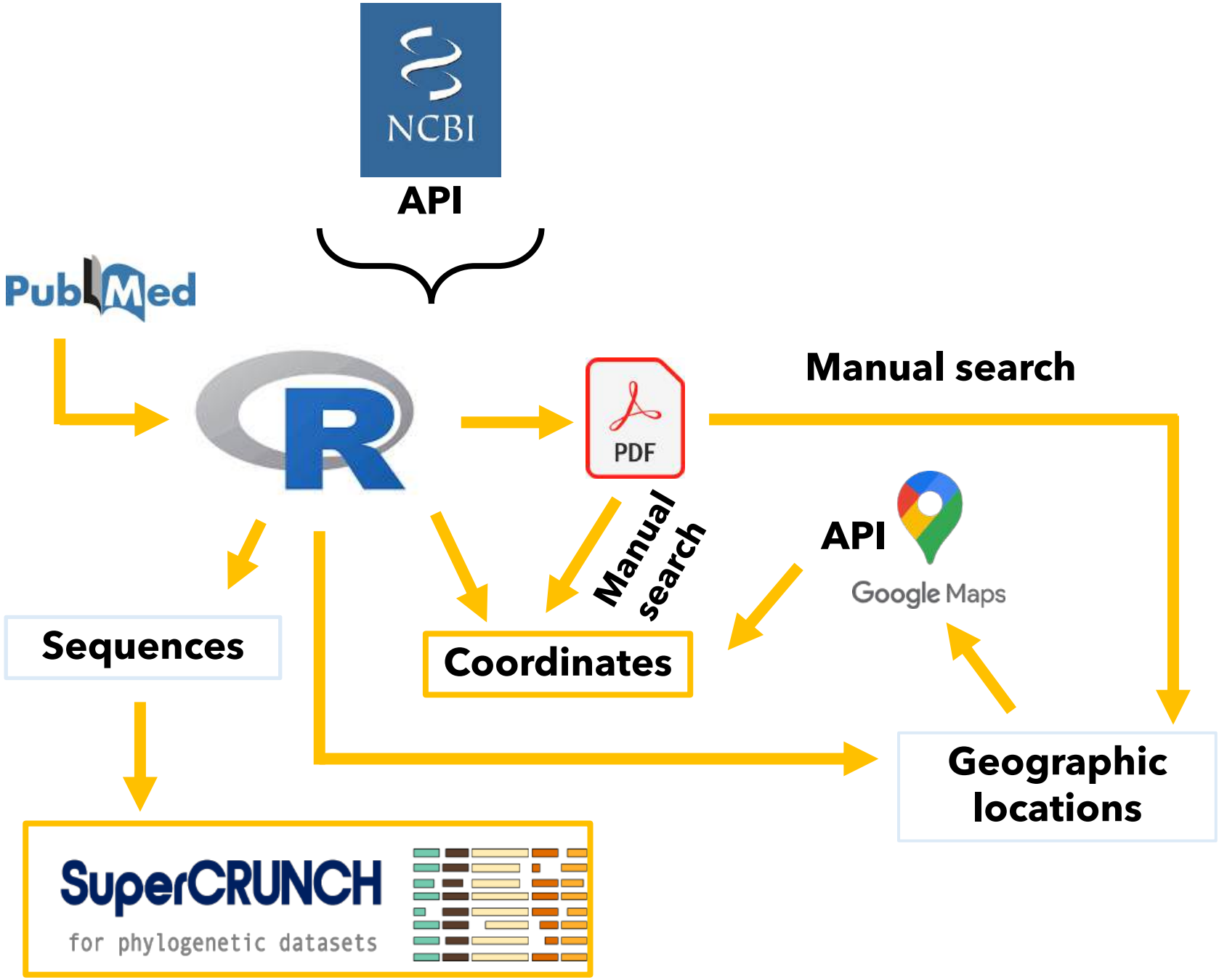
Source: WWF (Olson et al. 2001)

Data Compilation



Extensive dataset sourced from open-access repositories

- georeferenced mtDNA sequence data
- coordinate data
- reptile and amphibian species worldwide



Data Compilation

Extensive dataset sourced from open-access repositories

Genetic Alignments & Spatial Modelling

Nucleotide diversity maps

- SuperCRUNCH per locus
- spatial interpolation

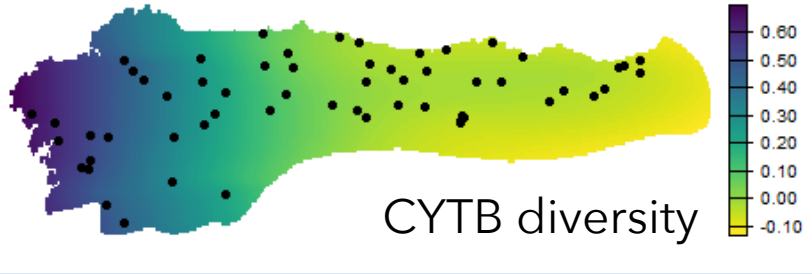
Geographic centroid

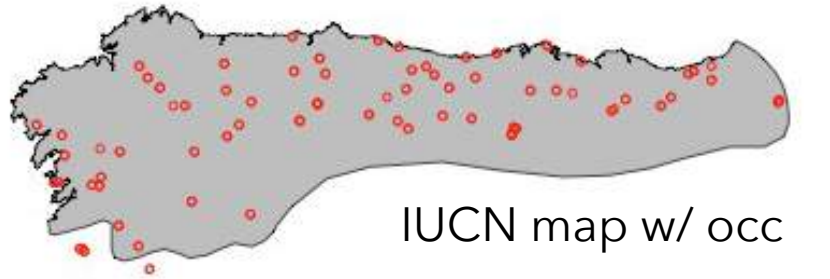
- IUCN range maps

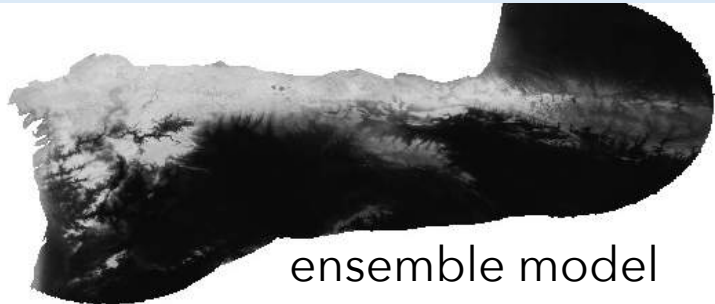
Climatic centroid

- SDMs ensemble of distinct algorithms









Data Compilation



Extensive dataset sourced from open-access repositories

Genetic Alignments & Spatial Modelling

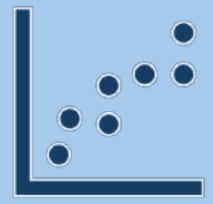


Nucleotide diversity map

Geographic centroid

Climatic centroid

Correlation Analysis & Visualization



Pearson's *r*

- genetic diversity ~
  - climatic centroid
  - geographic centroid

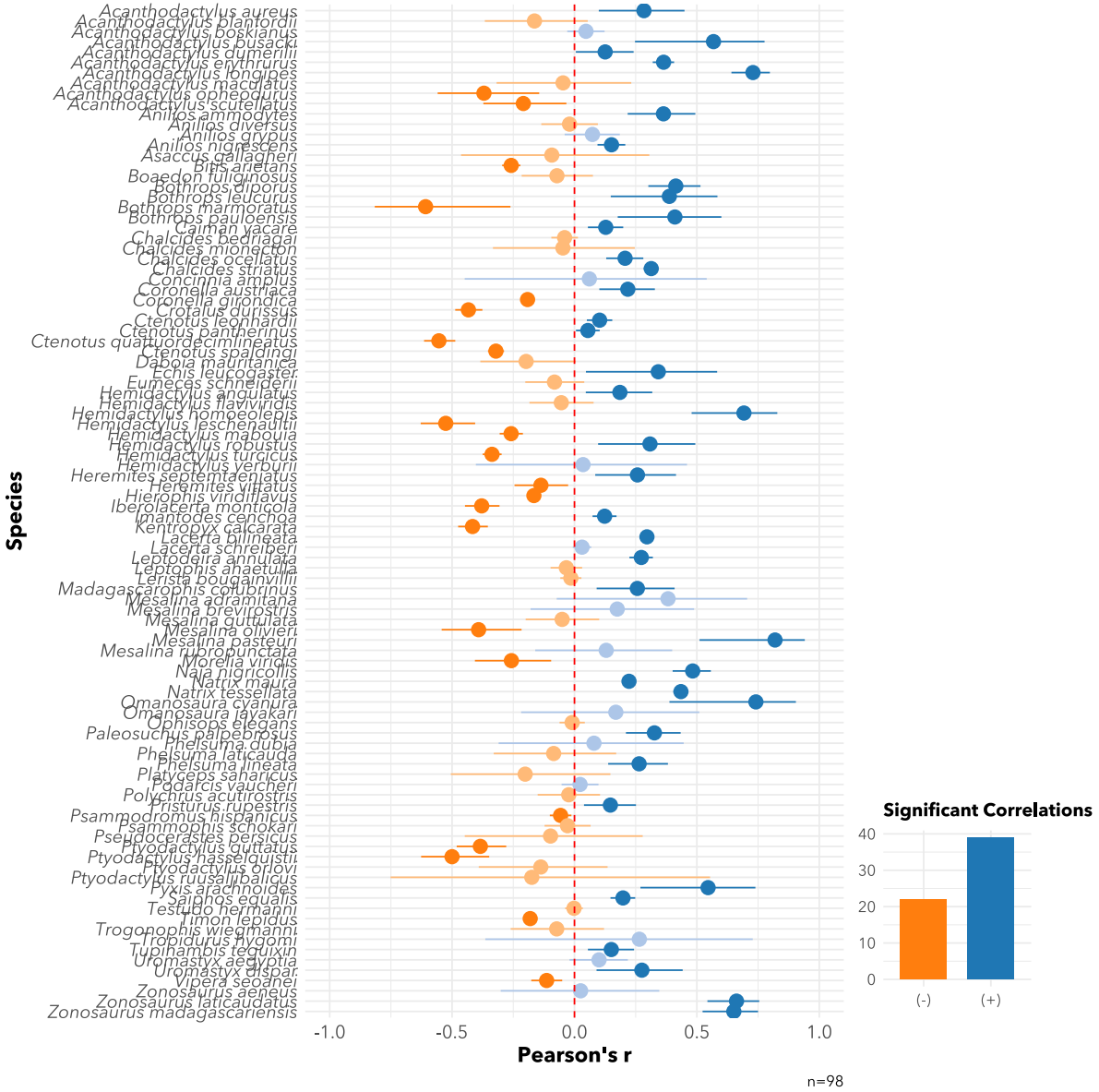
Forest plots

- significant vs non-significant
- positive vs negative

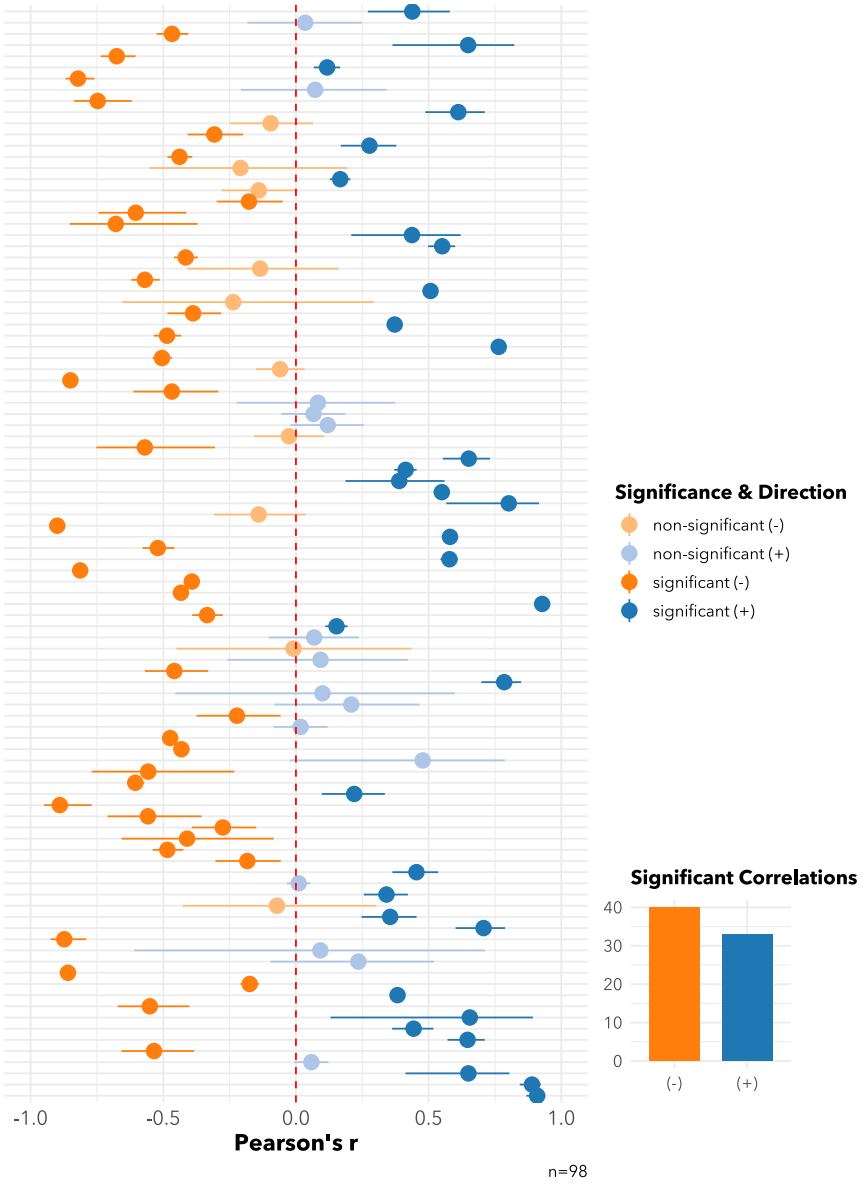
preliminary

CYTB

ISD ~ climatic centroid

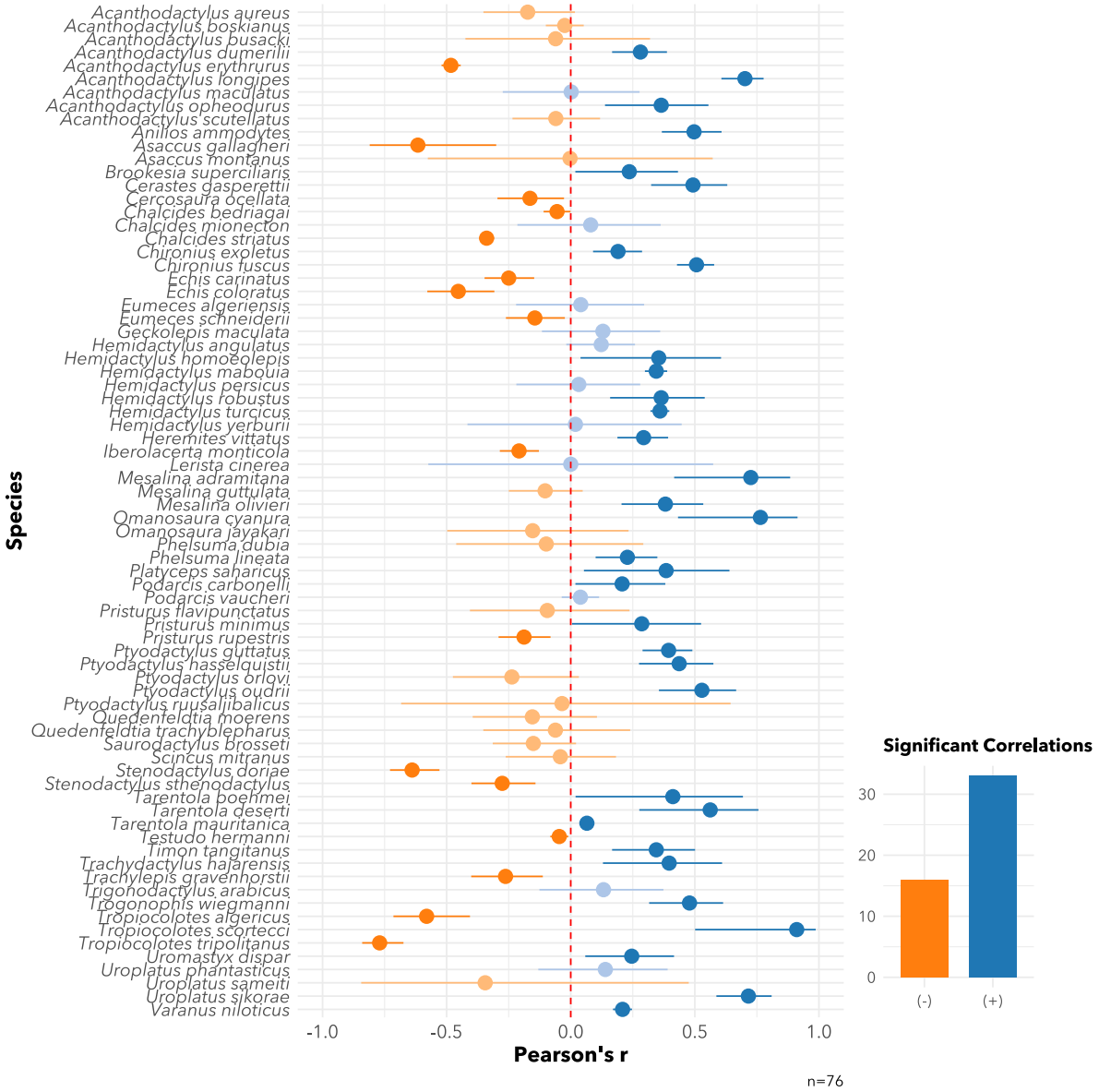


ISD ~ geographic centroid

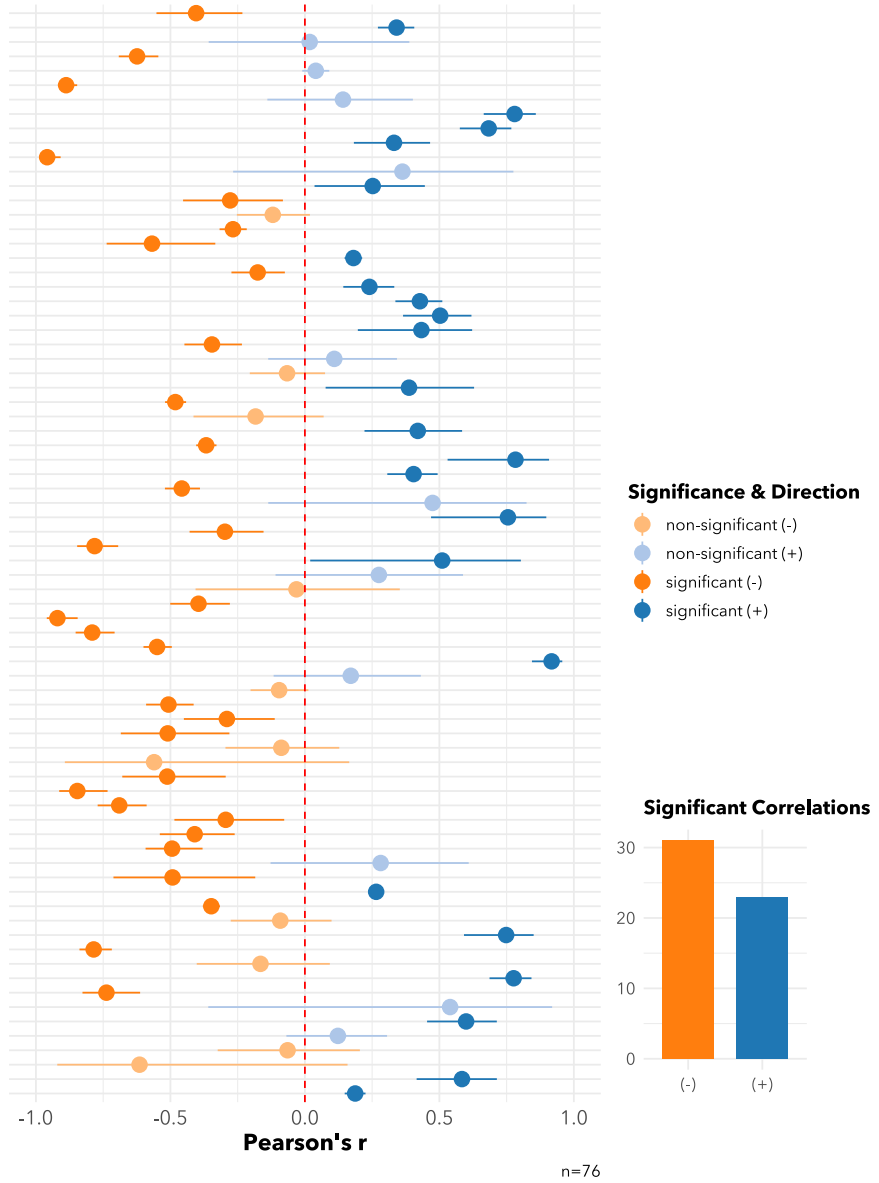


12S

ISD ~ climatic centroid

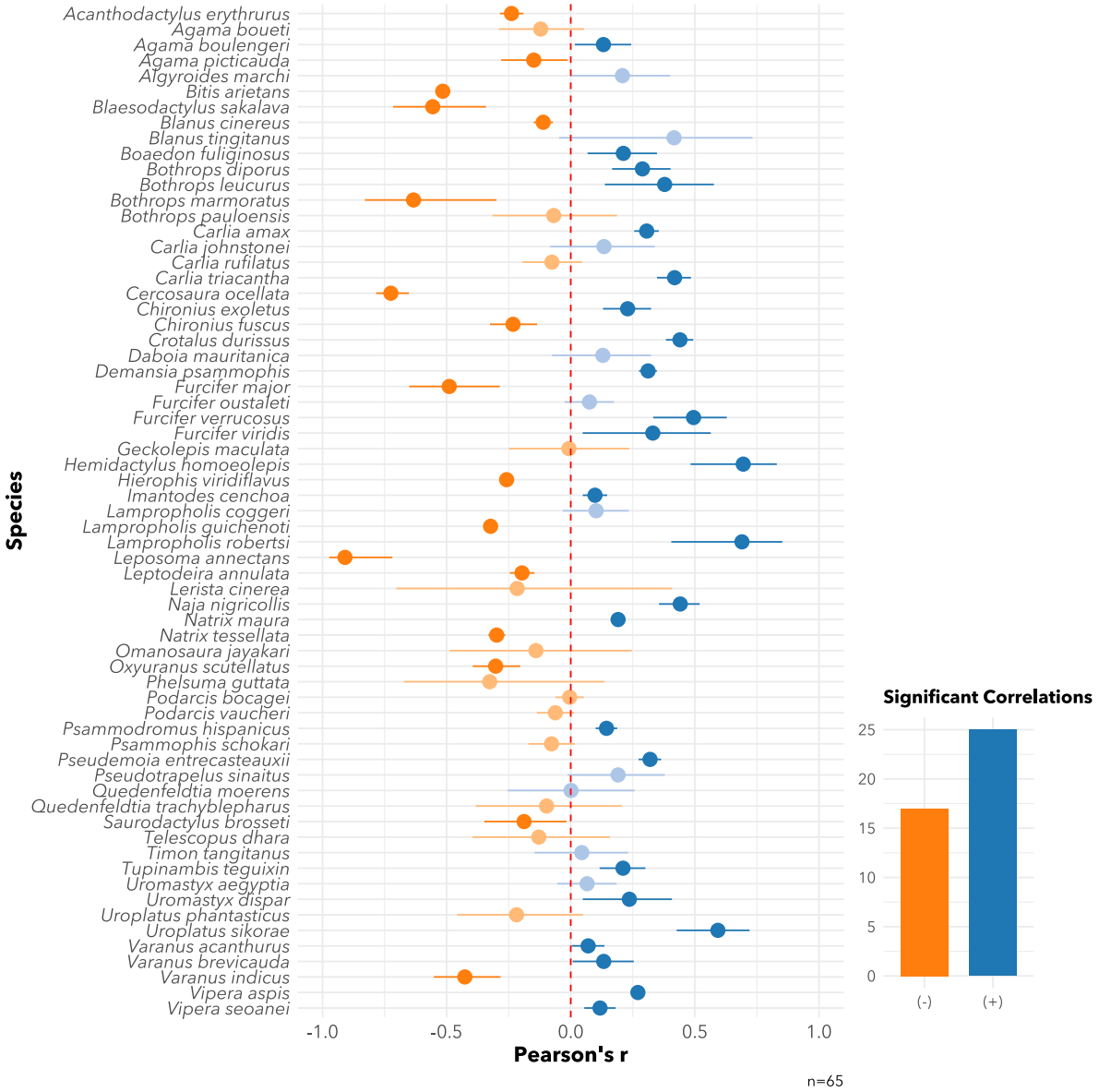


ISD ~ geographic centroid

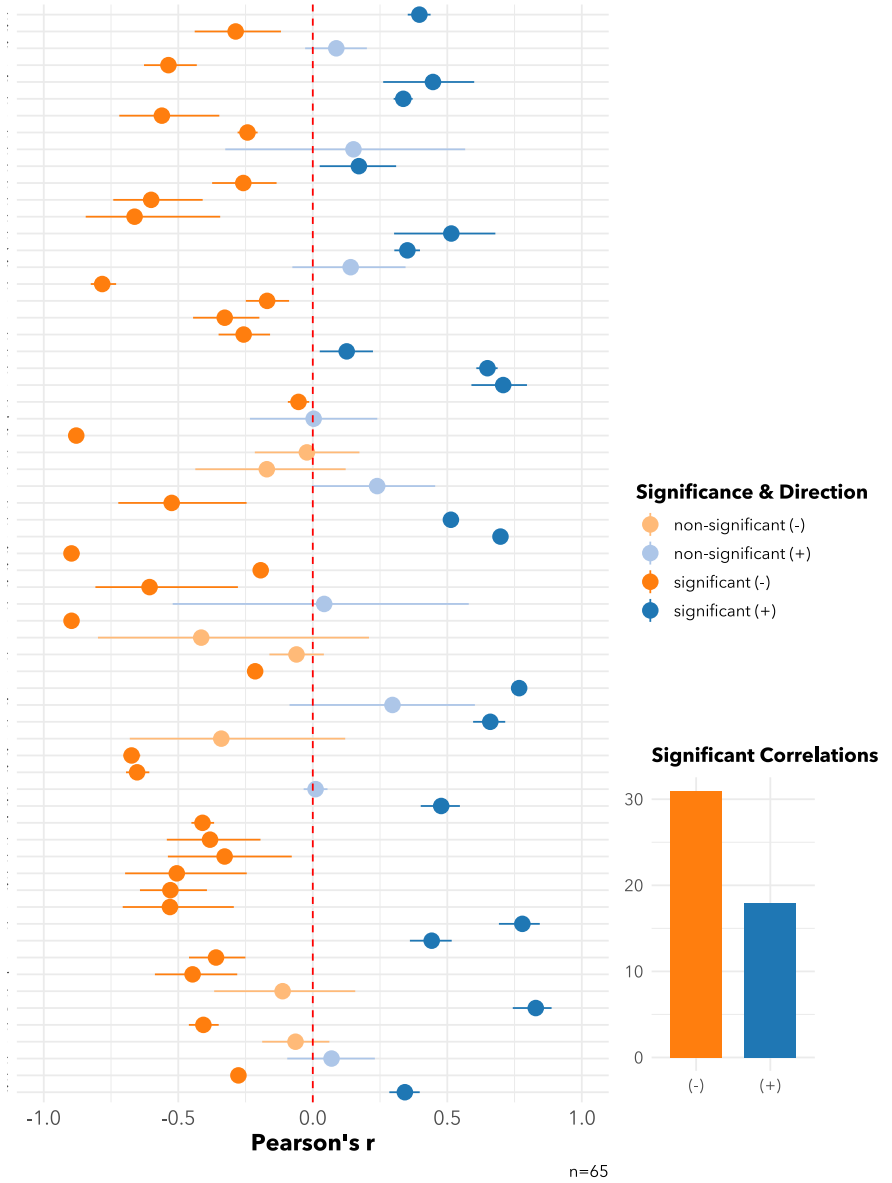


ND4

ISD ~ climatic centroid



ISD ~ geographic centroid



Key Takeaways

Geographic Centroid: ISD **decreases** with distance from the geographic centroid, aligning with the **central-marginal hypothesis**—central populations are larger, more stable, and experience higher gene flow

Climatic Centroid: ISD **increases** with distance from the climatic centroid, suggesting **adaptive divergence** in marginal climates, or **historical refugia**.

Idiosyncratic Patterns: Correlation **strengths** and **directions** vary across species, likely due to species-specific traits.

Future Directions

Broaden Taxonomic Scope: Expand the analysis to **amphibians**.

Analyse Multiple Loci: Incorporate additional loci (**16S, CO1, ND2**), and make comparisons to uncover locus-specific patterns.

Understand Marginal Diversity: Investigate whether high diversity in marginal climates results from **adaptive pressures** or **historical climate change**.

Incorporate Species Traits: Test if traits like **dispersal ability**, **niche specialization**, or **climate tolerance** explain species-specific differences.

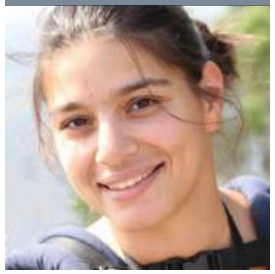
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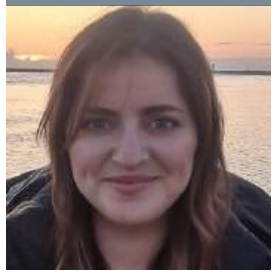
Thank you...

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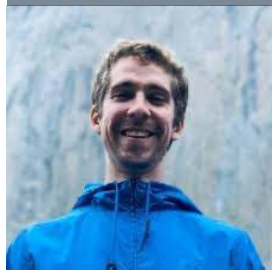
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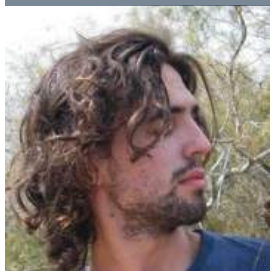

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