Global Signals in Plant traits

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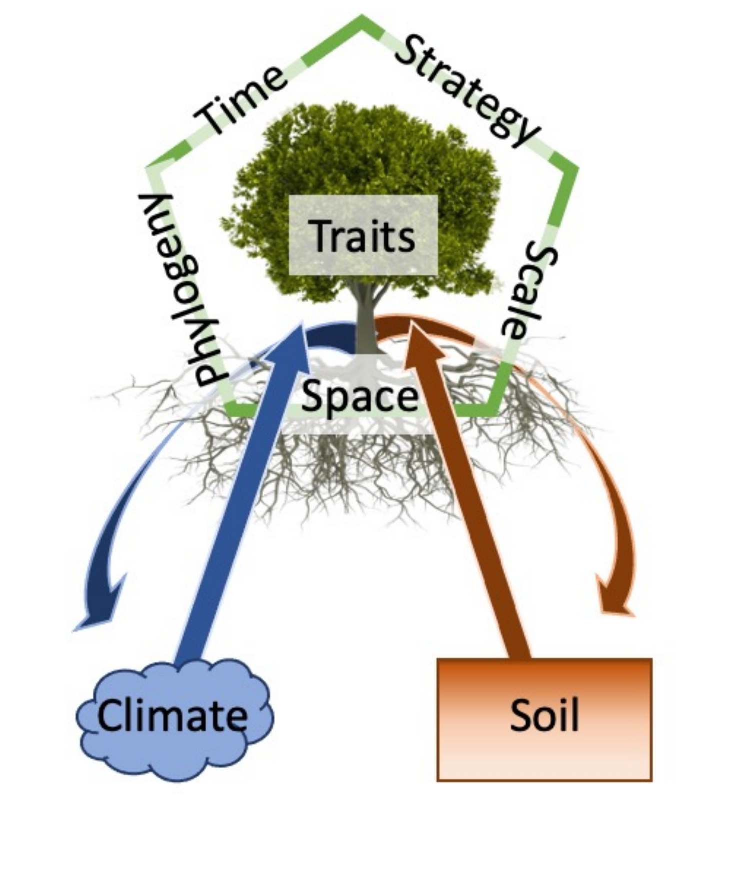
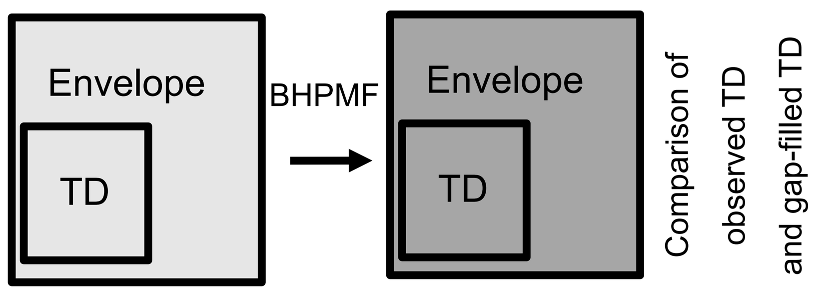
Motivation

The study of biological diversity in space holds the promise of making plant – environment feedback predictable [1]. Plant traits are considered to being the nexus between the environmental influence and ecosystem functioning that feeds back to the environment (conceptual figure below).



Plant trait data

Plant trait data of in situ measurements are costly and sparse even when assembled on data bases. This scarcity inhibits analyses on the trait-environment feedback. BHPMF, gap fills with machine learning, using taxonomy and trait-trait relationships [6,7].



TD: Completely observed test data set (TD) from TRY (try-db.org, 1236 individuals, 6 traits added 0-80% gaps, [5]), BHPMF gap-filled.
Envelope: Sparse observed data set enveloping the TD (241,653 individuals, 17 traits).

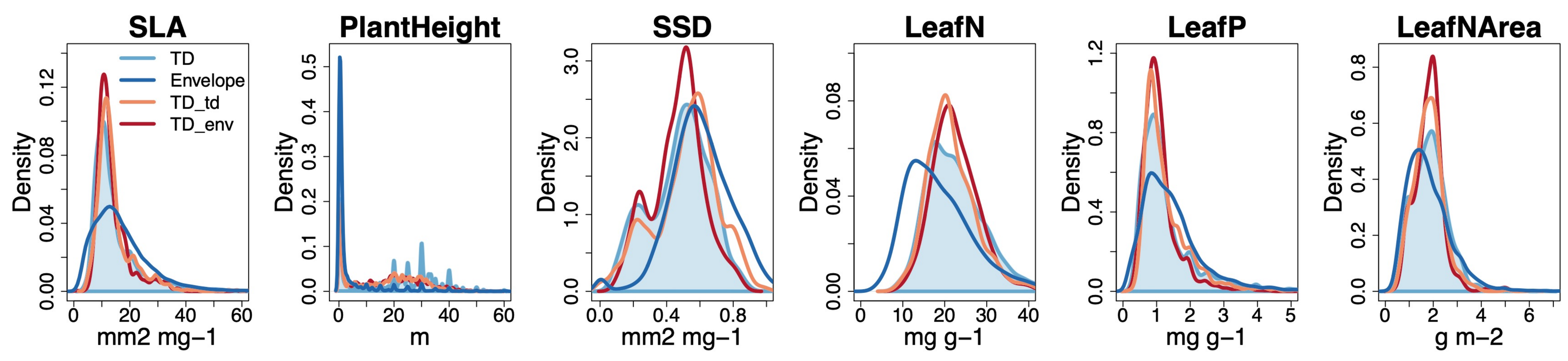


Figure 1: Good fit of trait distributions of observed and BHPMF gap-filled trait data (originally 80% missing) [8].

Outlook

Trait Data | trait sampling, different input: eg. Phylogeny or environmental data.
Trait-trait relationships | add further relevant traits: root, chemical, link to spectral data. Subgroups.
Environment-trait | Plant species assembly is also driven by other factors → smaller scales, animals, co-occurences of plants, land managemet.

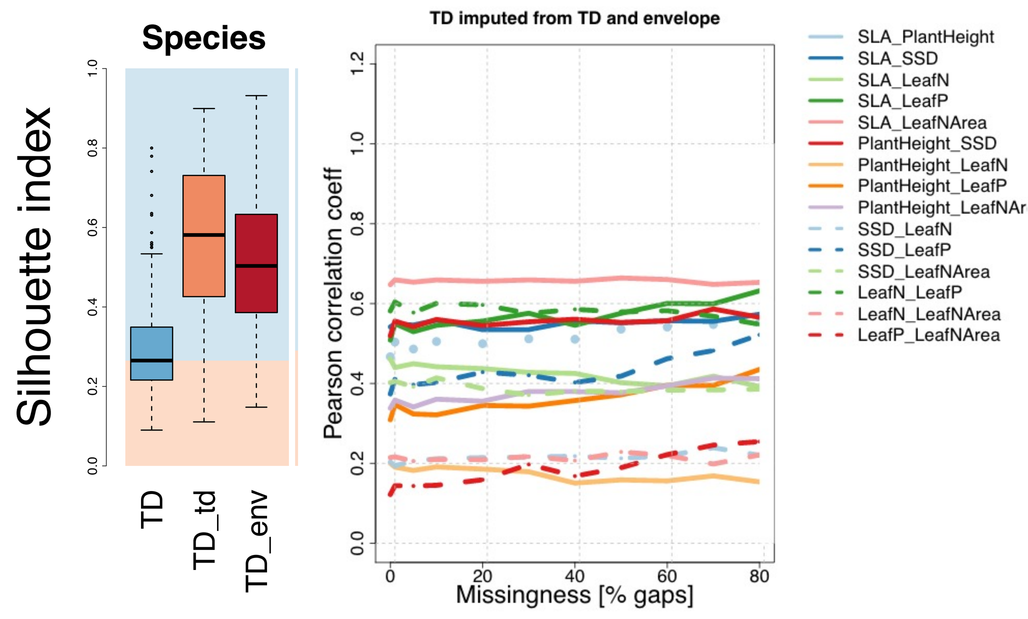


Figure 2: (Left) Clustering index (silhouette) is significantly altered by BHPMF [6,7] gap-filling [8]. (Right) Trait-trait correlations remain stable and (mainly) unchanged with added gaps after gap-filling [8].

Extension of the plant trait spectrum

Díaz and colleagues [2] display the viable trait strategies in a plane two main axes show: **size**: whole plants and plant organs and **leaf economics spectrum** (LES,[3]) balancing leaf persistence against plant growth potential. Does this hold for added individuals and traits?

Three resulting groups are:

1. size-related traits (blue)
2. economics traits (red)
3. uncorrelated group (yellow)

→ The traits still covary in two dimensions remain.

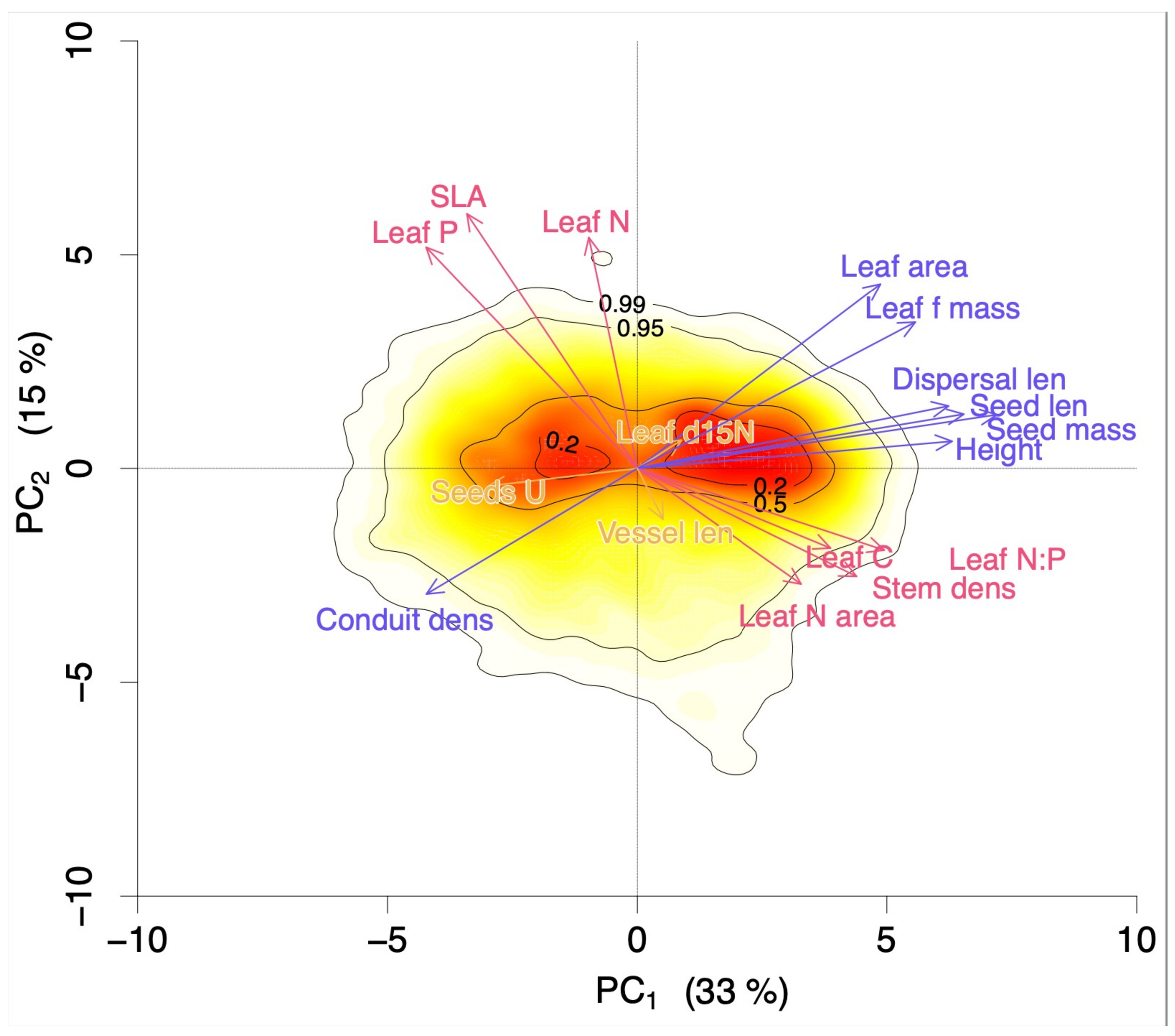


Figure 3: Previously identified global axes of variation in size and economics traits hold for an extended trait set. Arrow tips refer to the loading of the traits [4]. Gap-filled data of trait observations from TRY (36,197 Species and 17 traits, [5]).

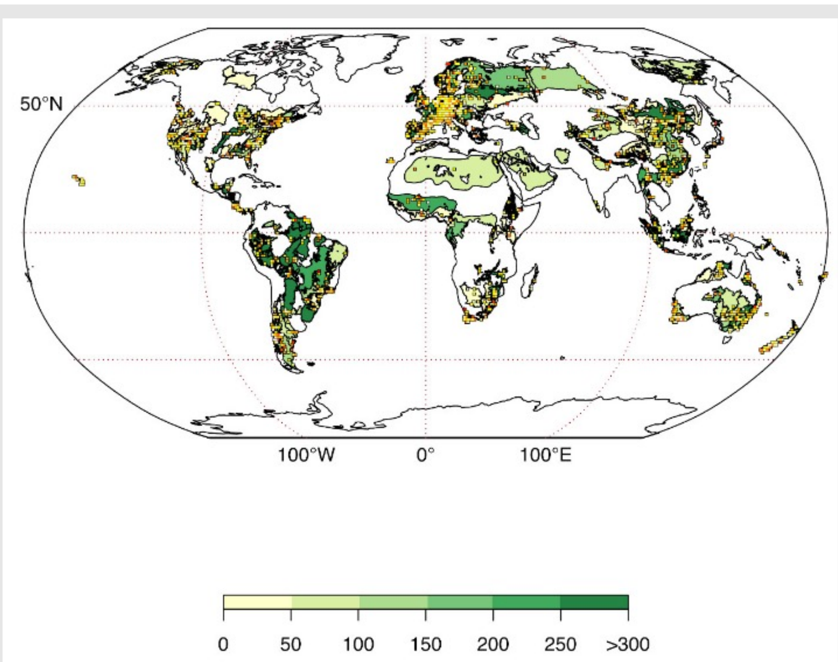


Figure 5: Map of ecoregions [9] included in this study (n=220). The number of species per ecoregion is colour-coded. Added are WorldClim and SoilGrid data (1km^2 resolution and 7 soil depths). Selection criterion: Species richness (Kier [10]) [4].

Environment explains plant traits

The environmental drivers of the two dimensions of plant form and function (see Figure 3) are yet to be defined.

Global variation of size traits (PC1, see figure 3) across latitude (representing some climate variables; Figure 4), but not economics traits (PC2, Figure 4).

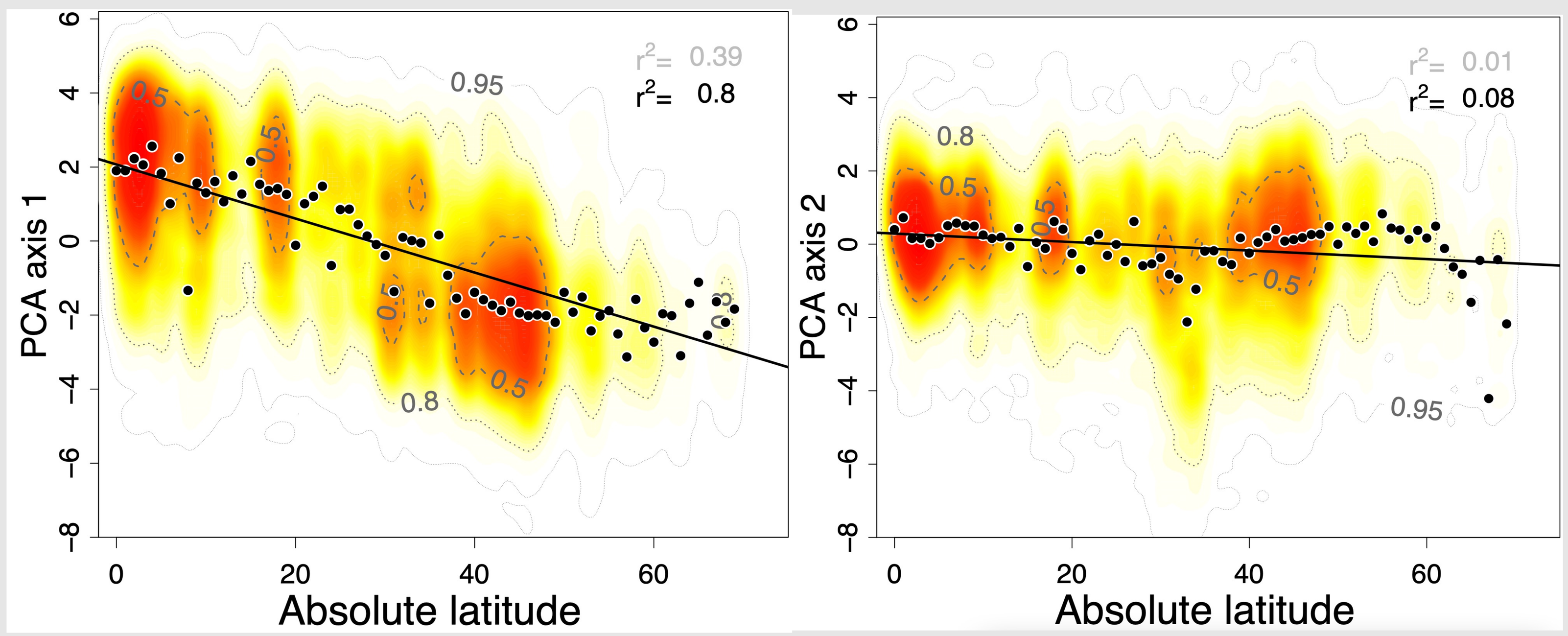


Figure 4: Size traits (PC1) vary along latitude (and climate), but economics traits (PC2) do not. This points to size traits being differently explained than economics traits. Aggregation of species (n= 36,197) to latitudinal bins increases the signal [4].

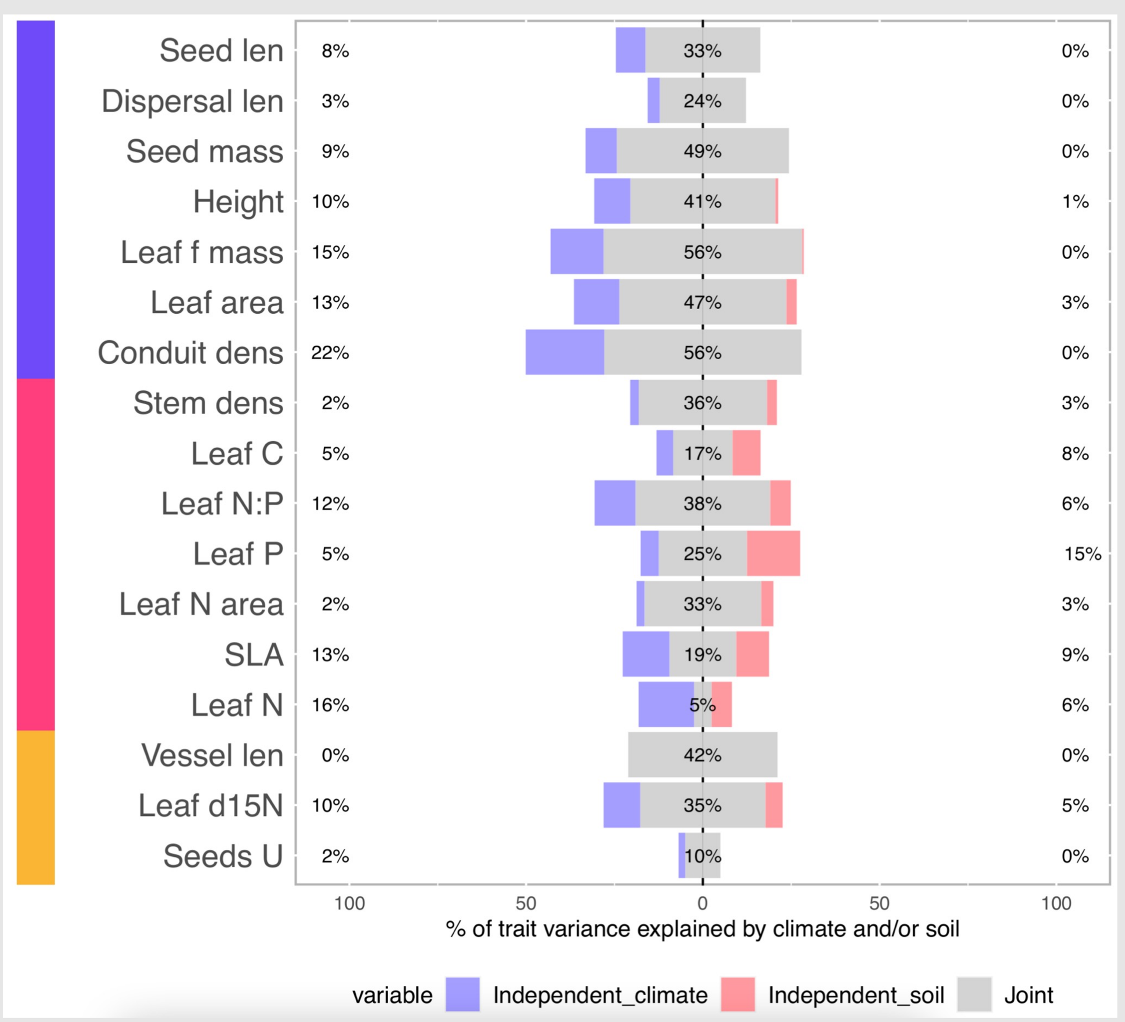


Figure 6: Climate and soil explaining 17 plant traits (ecoregion aggregation, see figure 5). Joint effect is largest, climate eplains almost all traits, while economics traits are explained by soil and climate alike [4].

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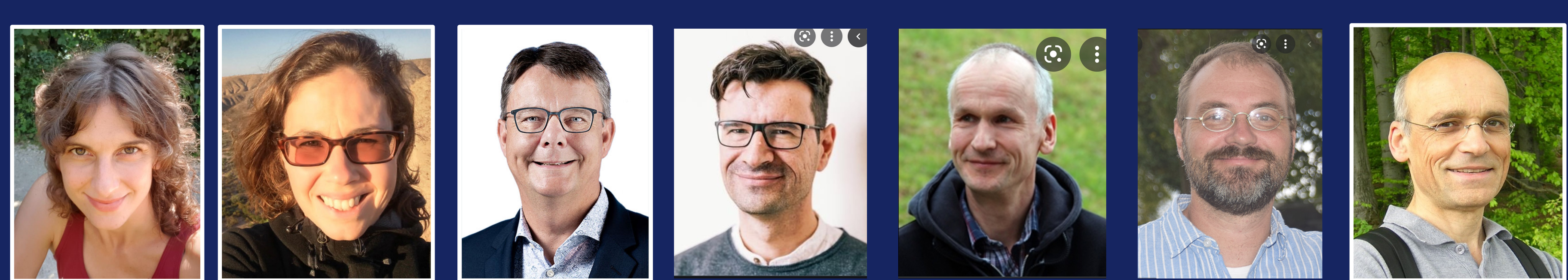

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