German Centre for
Integrative Biodiversity Research (iDiv)
Halle-Jena-Leipzig

sPlot – the new global vegetation-plot database for addressing plant trait-environment relationships across the world's biomes

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Synthesis Centre (sDiv) of iDiv

iDiv is a research centre of the DFG Deutsche Forschungsgemeinschaft

idiv-biodiversity.de

sPlot

- **sDiv Working Group on “Global Plant Trait-Environment Relationships”**
- Hosted by the **Synthesis Centre (sDiv)** of the German Centre of Integrative Biodiversity Research Halle-Jena-Leipzig (iDiv).
- The **sPlot database** is a common vegetation-plot database for data from all continents
- It combines these with **mean species trait values from the TRY database** and tools to match data from different sources taxonomically

Aim: the analysis of

plant trait-environment relationships

across the world's biomes

on the basis of vegetation-plot data.

Motivation

Macroclimate is a major predictor for trait values, but the interaction of local and global drivers is still poorly known:

(i) To which extent are relationships between traits preserved across environmental gradients worldwide, irrespective of macroclimate?

(ii) To which degree is the effect of local abiotic drivers mediated by climate?

However: So far, there was

- no good global coverage of multiple traits (apart from leaf economic spectrum, LES)
- no global vegetation-plot database
- no availability of fine-scale environmental factors

Leaf economics spectrum

- Leaves with low long leaf life span (LL) and high leaf mass per area (LMA)

  versus

  Leaves with high photosynthetic capacity per leaf mass (Amax), high dark respiration rates (Rdark), high leaf nitrogen contents (N) and high phosphorus contents (P)

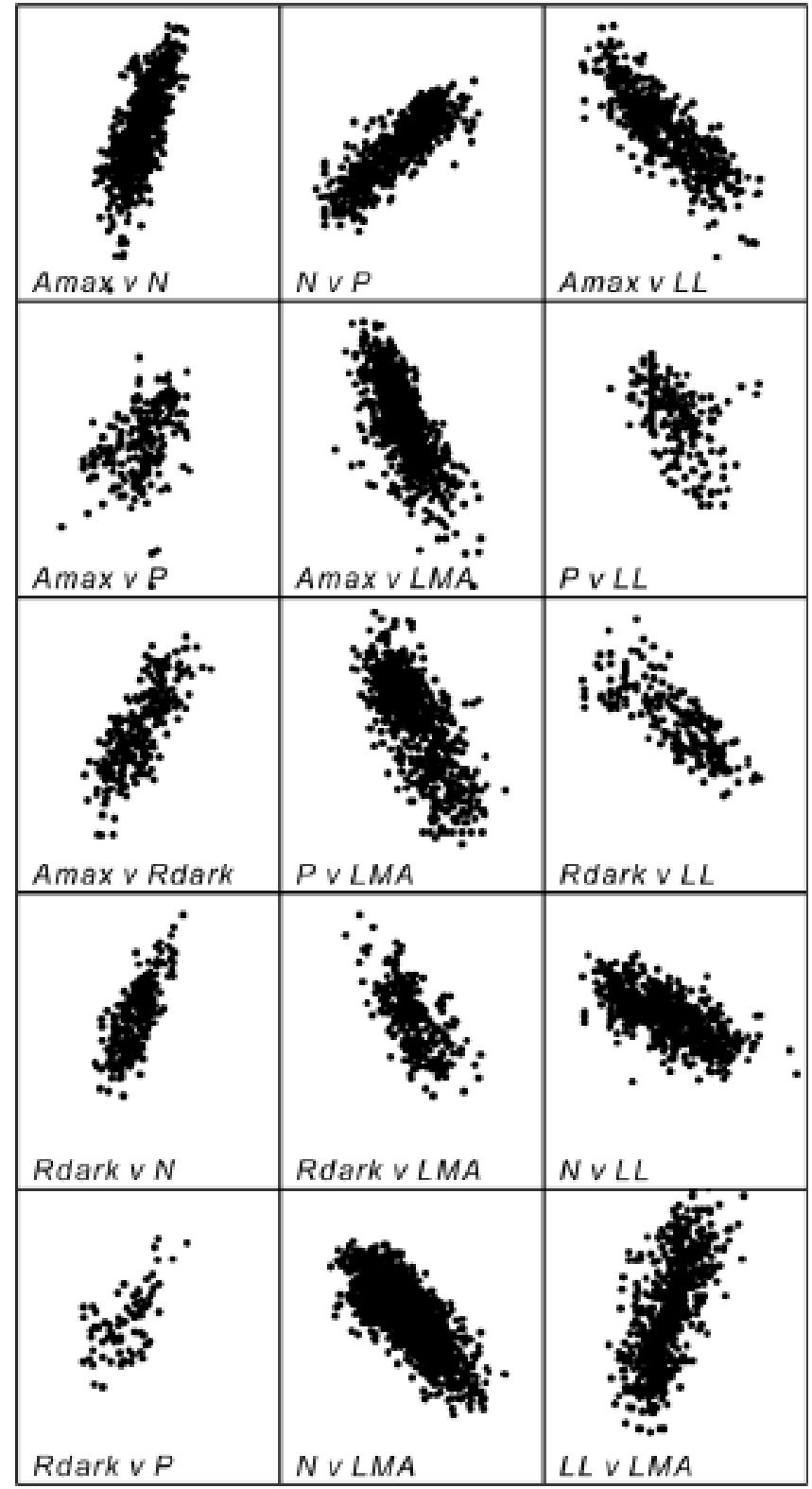


Fig. 1 from Osnas et al. 2013, *Science* 340: 741-744.

Trait values as a function of macroclimate

- Latitudinal gradient in SLA (log_{10} transformed)
- Based on species occurrence data on 1° grid cells.

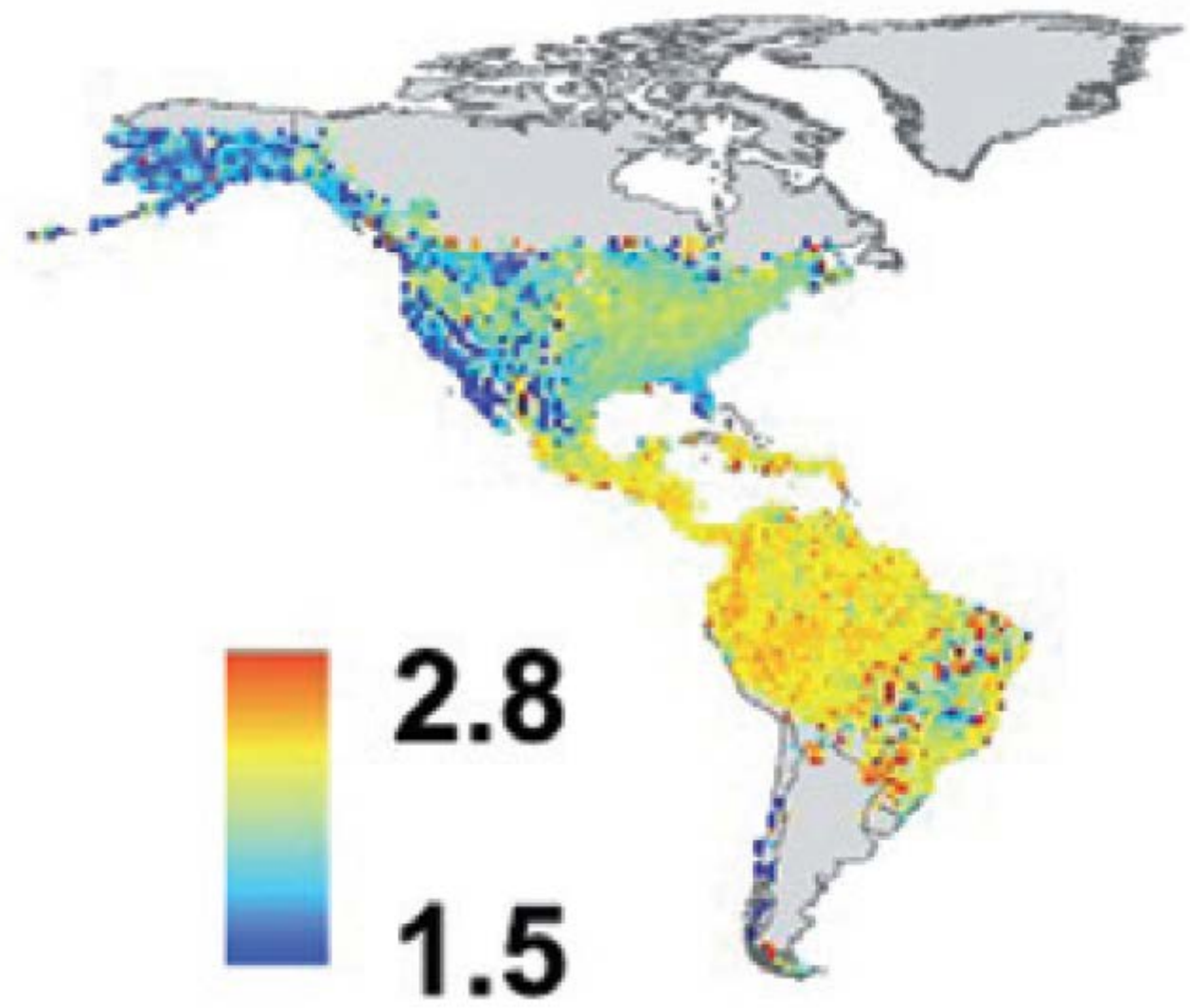


Fig. 1 from Swenson et al. 2012, *Global Ecol. Biogeogr.* 21: 798-808.

Trait-environment relationships at the scale of North America

- Strong trait-environment relationships across biomes

Trait	Lat	Alt	MAT	TS	TR	AP	PS
Maximum height	**0.25**	–0.05	**–0.10**	**0.15**	**0.16**	**0.16**	**–0.25**
Leaf %N	–0.01	**0.18**	**0.23**	–0.04	–0.05	**0.14**	**0.23**
Leaf %P	0.62	0.07	**–0.54**	**0.65**	**0.62**	**–0.42**	**0.30**
Seed mass	**–0.26**	**–0.20**	**0.47**	**–0.43**	**–0.44**	**0.50**	0.01
Specific leaf area	**–0.48**	**–0.19**	**0.33**	**–0.40**	**–0.36**	**0.44**	0.07
Wood density	**–0.61**	**–0.24**	**0.62**	**–0.54**	**–0.51**	**0.23**	**0.33**

Lat, absolute value of latitude; Alt, altitude; MAT, mean annual temperature; TS, temperature seasonality (standard deviation of 12 mean monthly temperatures); TR, annual temperature range (maximum – minimum annual temperatures); AP, total annual precipitation; PS, precipitation seasonality (coefficient of variation of 12 monthly rainfall totals). Bold values indicate significant correlations ($P < 0.05$).

Table 1 from Swenson et al. 2012, *Global Ecol. Biogeogr.* 21: 798-808.

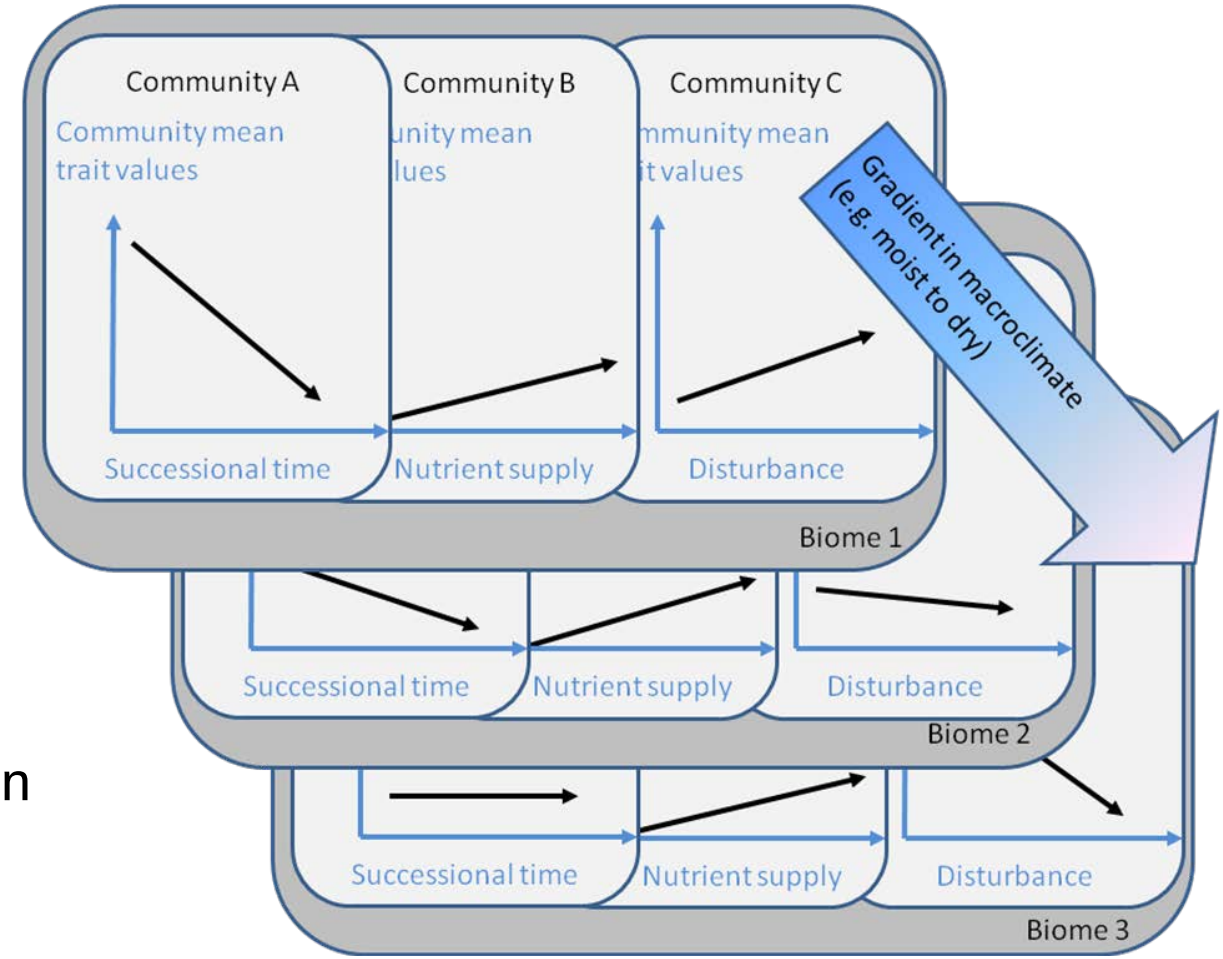
Why do we need community data?

- Traits are filtered by the environment,
  but environment does not exclusively determine the trait values
  at a certain site
- within-site variation of trait values is caused by:

➢ Limiting similarity within communities

➢ Different species composition in different local environments

➢ Trait relationships might vary differently with macroclimate in different communities

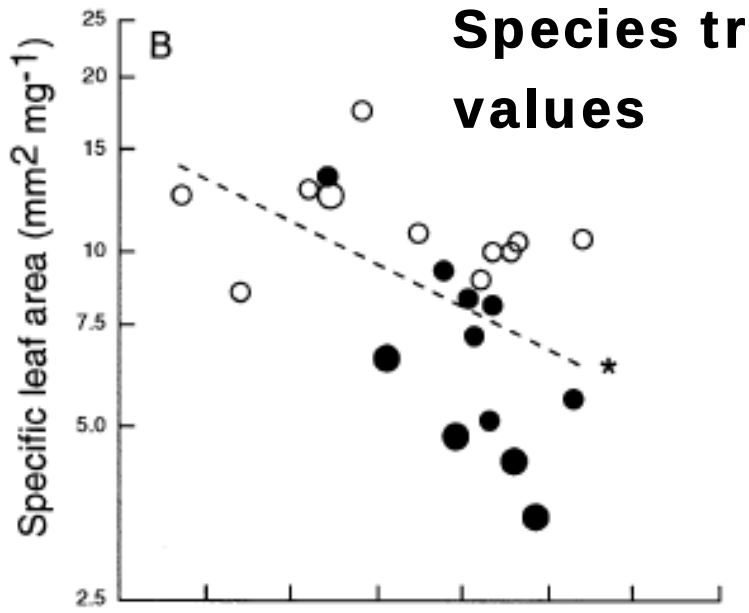


Species trait values versus community mean trait values

- Species traits value plotted against (unweighted) **mean** site variables

Or

- Community **mean** trait values plotted against (weighted or unweighted) site variables



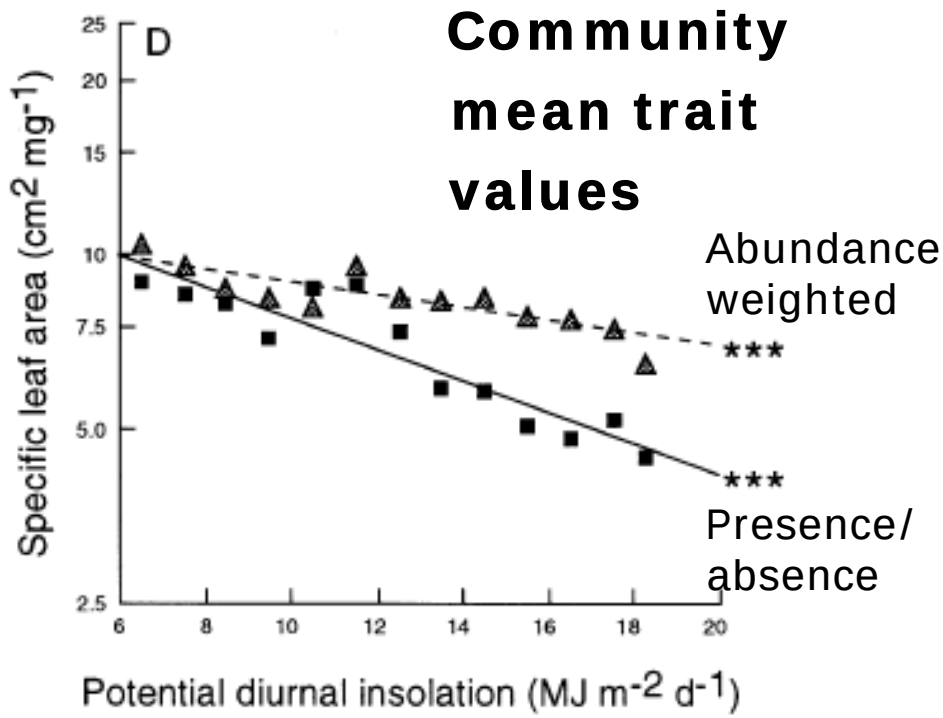
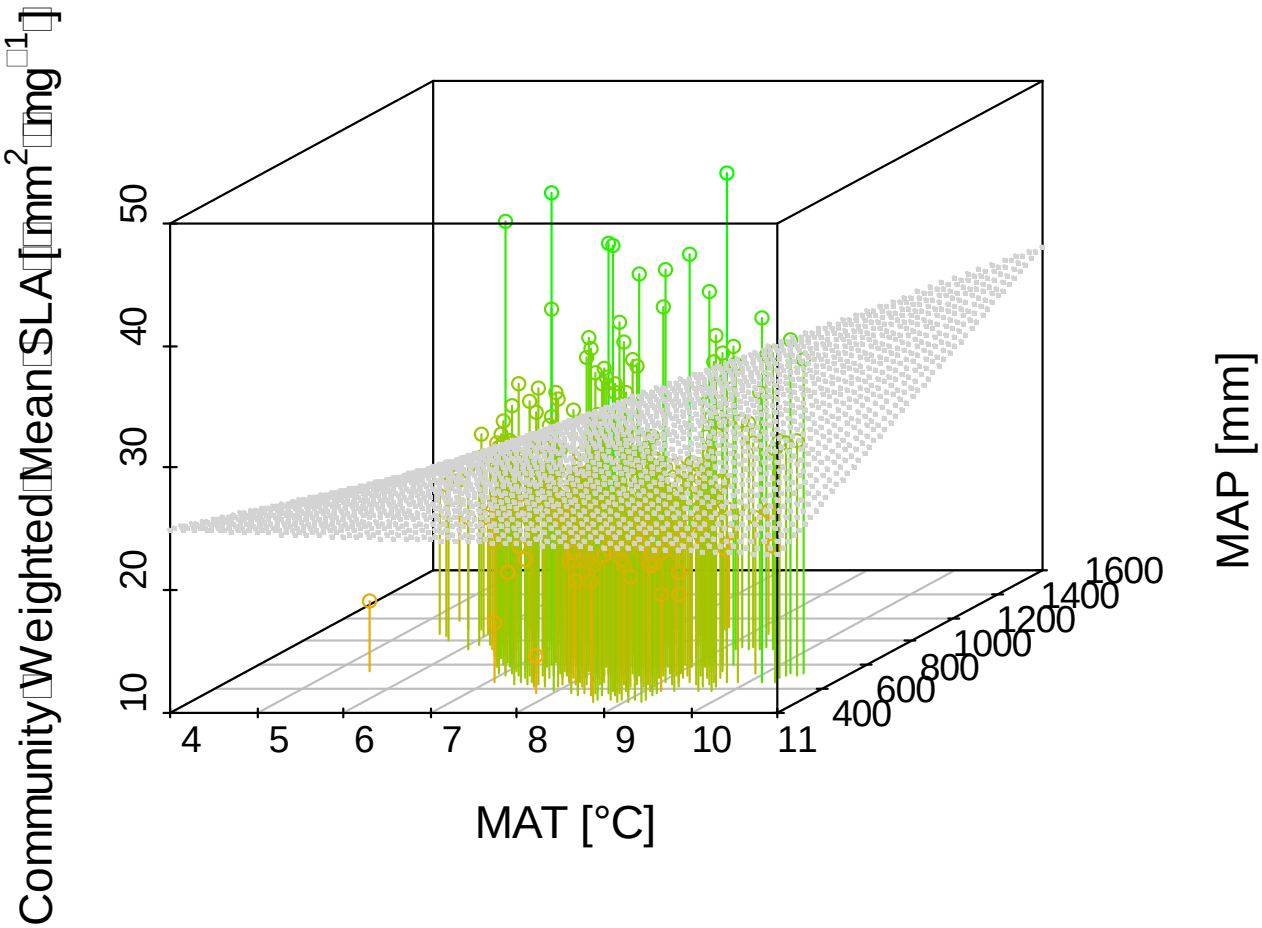


Fig. 4B, D from Ackerly et al. 2002, *Oecologia* 130: 449-457.

Community weighted means (CWM) in large vegetation-plot databases

- German Vegetation Reference Database (GVRD), **all plots with pH and geographic information (MAT and MAP)**
- Grasslands and forests
- *n* = 6632 plots, 1787 species
- SLA for 1277 species



	Estimate	Pr(>|t|)
Intercept	**32.3270**	**< 2e-16**
MAT	**-1.2659**	**1.69E-05**
MAP	**-0.0155**	**3.28E-09**
MAT x MAP	**0.0024**	**2.06E-13**

Bruelheide, H. & Jandt, U. (unpubl.)

Timeline

6-9 March ‘13	**1st sPlot Workshop** in Leipzig (with 42 participants)
since June ‘13	J. Dengler employed as coordinator (25% position)
June ’13	Cooperation agreement with EVA
July ‘13	***Governance and Data Property Rules*** approved
July ‘13	Invitiation of contributing databases started
Dec. ‘13	Decision to implement sPlot under TURBOVEG 3; collaboration with Stephan Hennekens
April ‘14	First extra-European databases joined with most of the EVA databases (= official **start of the sPlot database**)
August ’14	First **match of sPlot with TRY** to check overlap of species
2-5 Dec ‘14	**2nd sPlot Workshop** in Leipzig (invitations just sent out)

The sPlot Rules

4.a. Data can be contributed to sPlot only upon invitation by the Steering Committee. The owner of this database becomes a member of the sPlot Consortium.

4.d. Trait data will technically be handled through the TRY initiative. Persons who contribute trait data via TRY and agree on the sPlot Rules have the same rights as all other sPlot Consortium members.

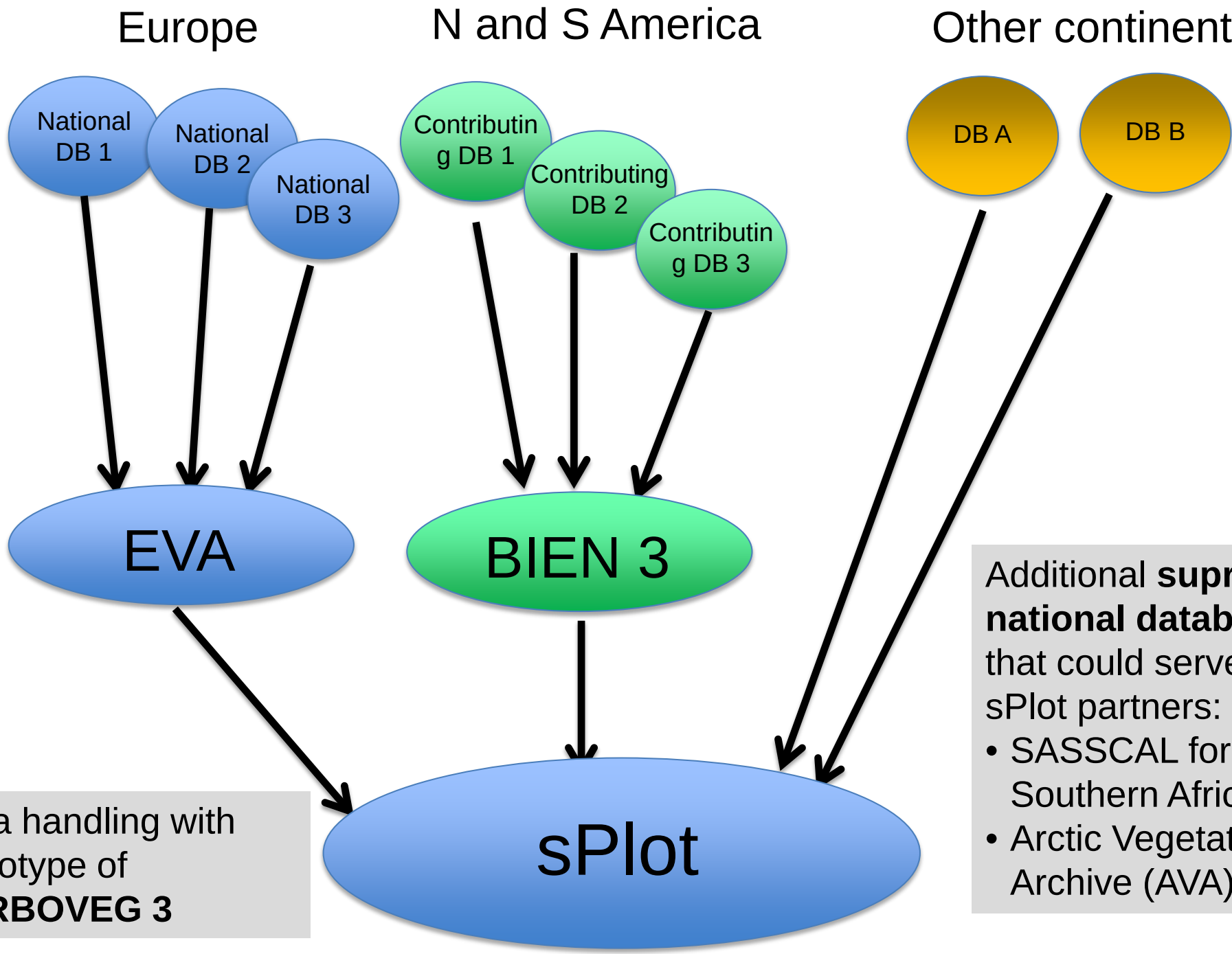
4.e. All data contributed to the sPlot database remain intellectual property of data contributors and may be withdrawn at any time.

5.a. The sPlot database can only be used by sPlot Consortium members for specific research projects focusing on global- or at least continental-scale analyses.

5.c. Each member of the sPlot Consortium has the right to propose analytical or other papers using sPlot data.

6.a The sPlot Steering Committee will send the approved paper proposal to all members of the sPlot Consortium and inform them which amount of data of which contributors is supposed to be used in the respective analyses. The members of the sPlot Consortium can then declare their willingness to join the paper project as active co-authors during a period of one month (opt-in papers).

Concept of data integration in sPlot



Data handling with prototype of **TURBOVEG 3**

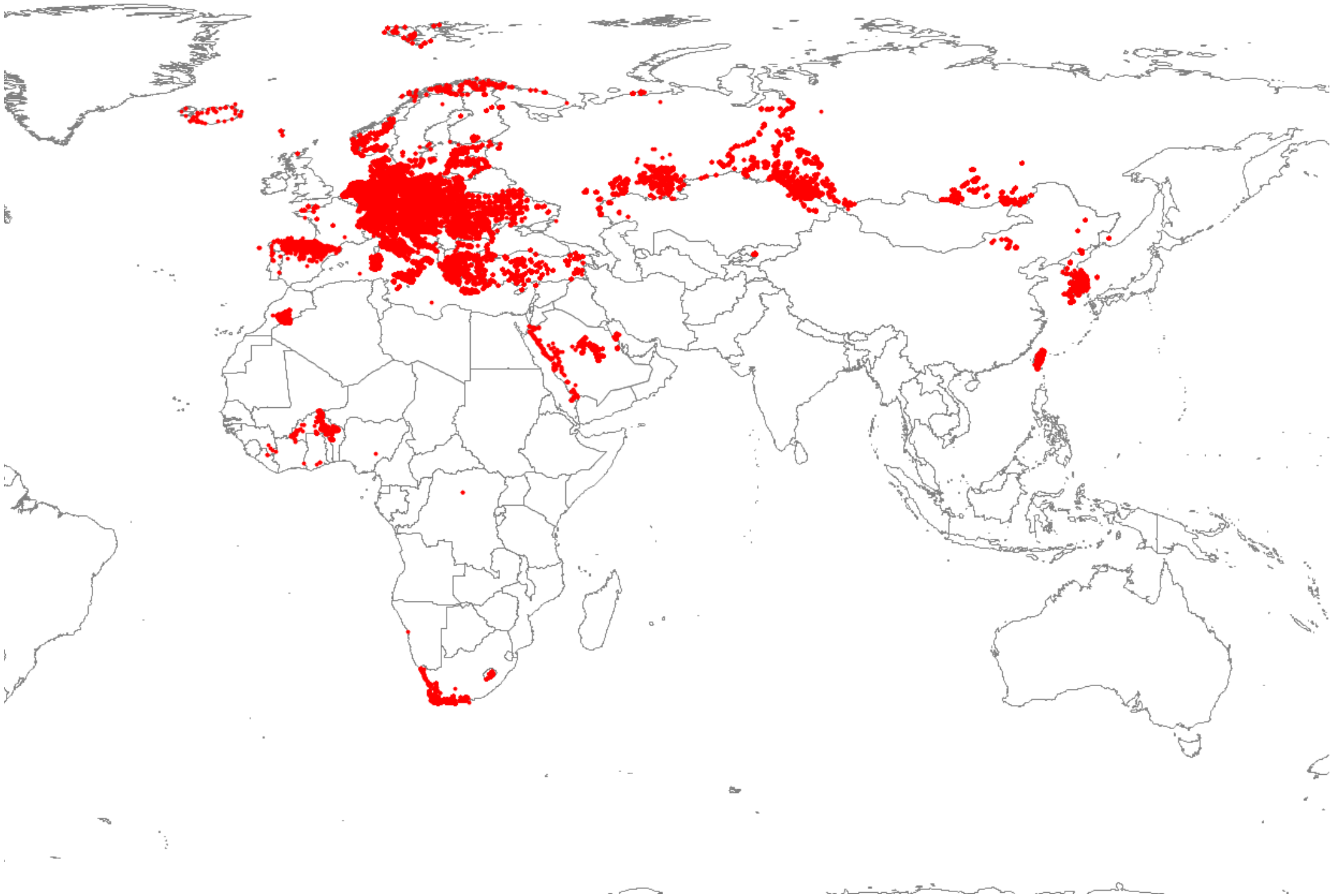
Additional **supra-national databases** that could serve as sPlot partners:

- SASSCAL for Southern Africa
- Arctic Vegetation Archive (AVA)

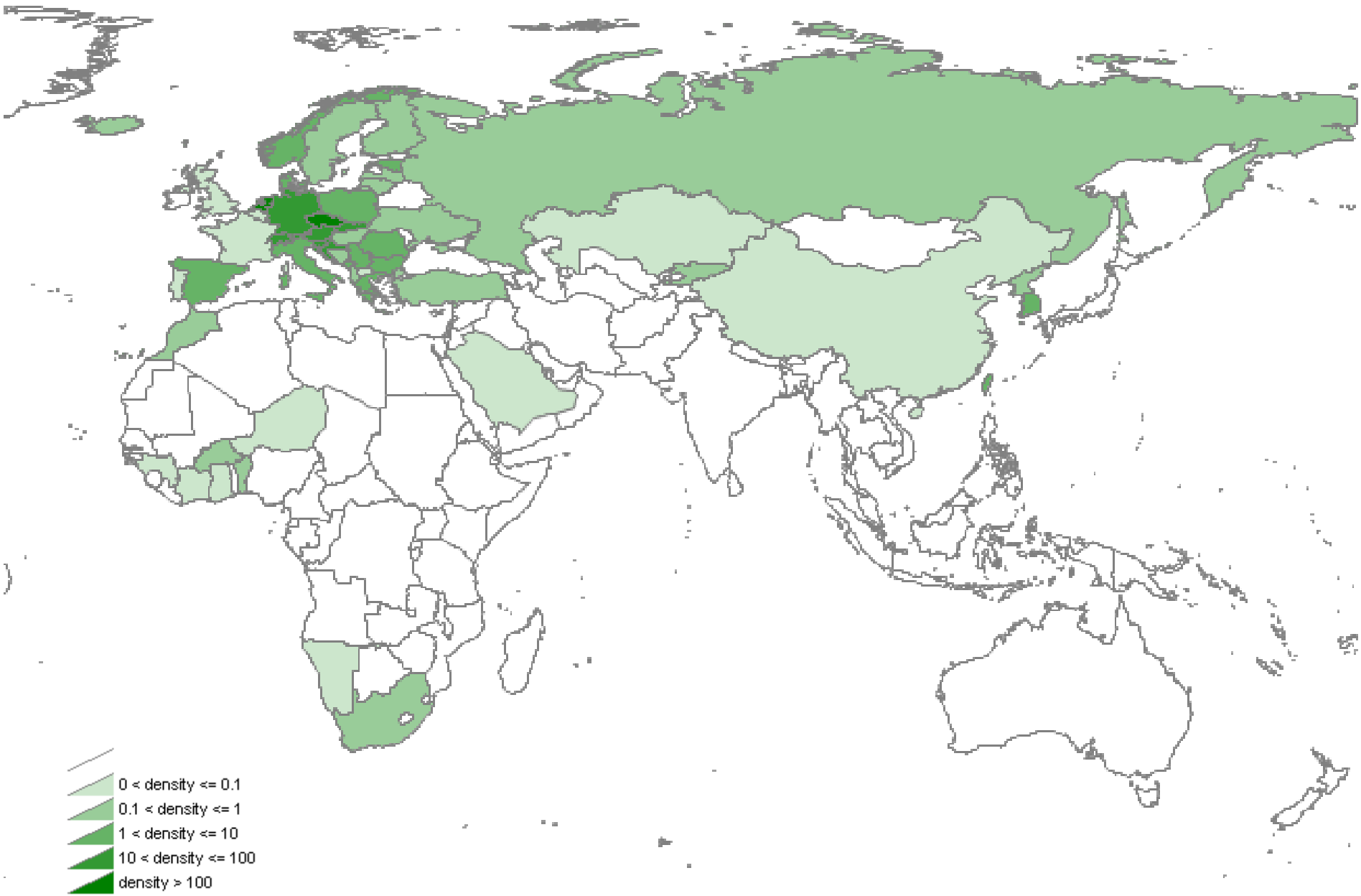
Content of sPlot on 31 August 2014

- Presently concentrating on **Old World (Eastern Hemisphere)**
- **Europe (including Turkey):** 48 DBs, 541,000 relevés
- **Extra-European:** 8 DBs, 24,000 relevés
- **Total:** 56 DBs and 565,000 relevés from 52 countries
- Many more under way…

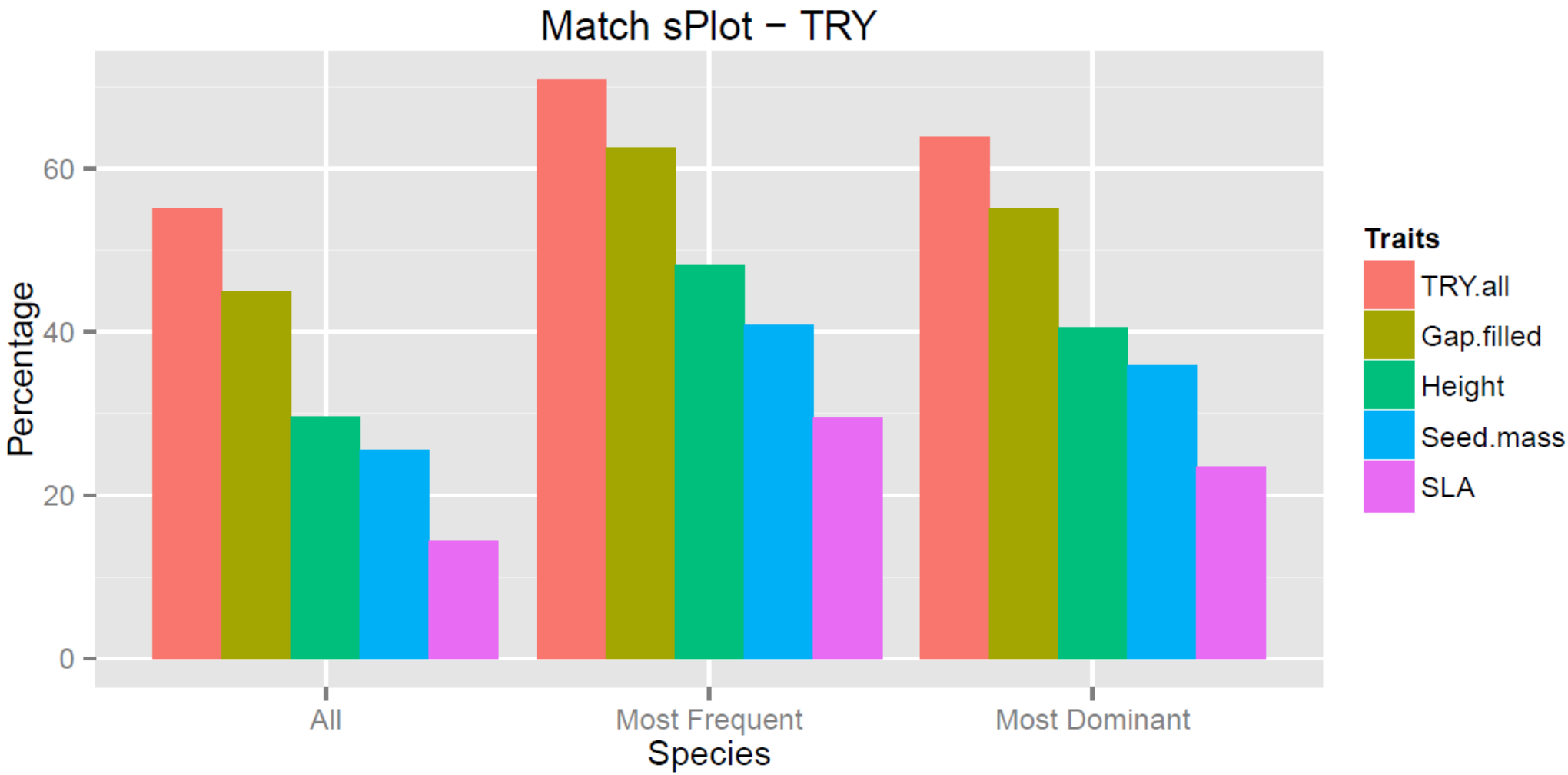
Content of sPlot on 31 August 2014



Content of sPlot on 31 August 2014

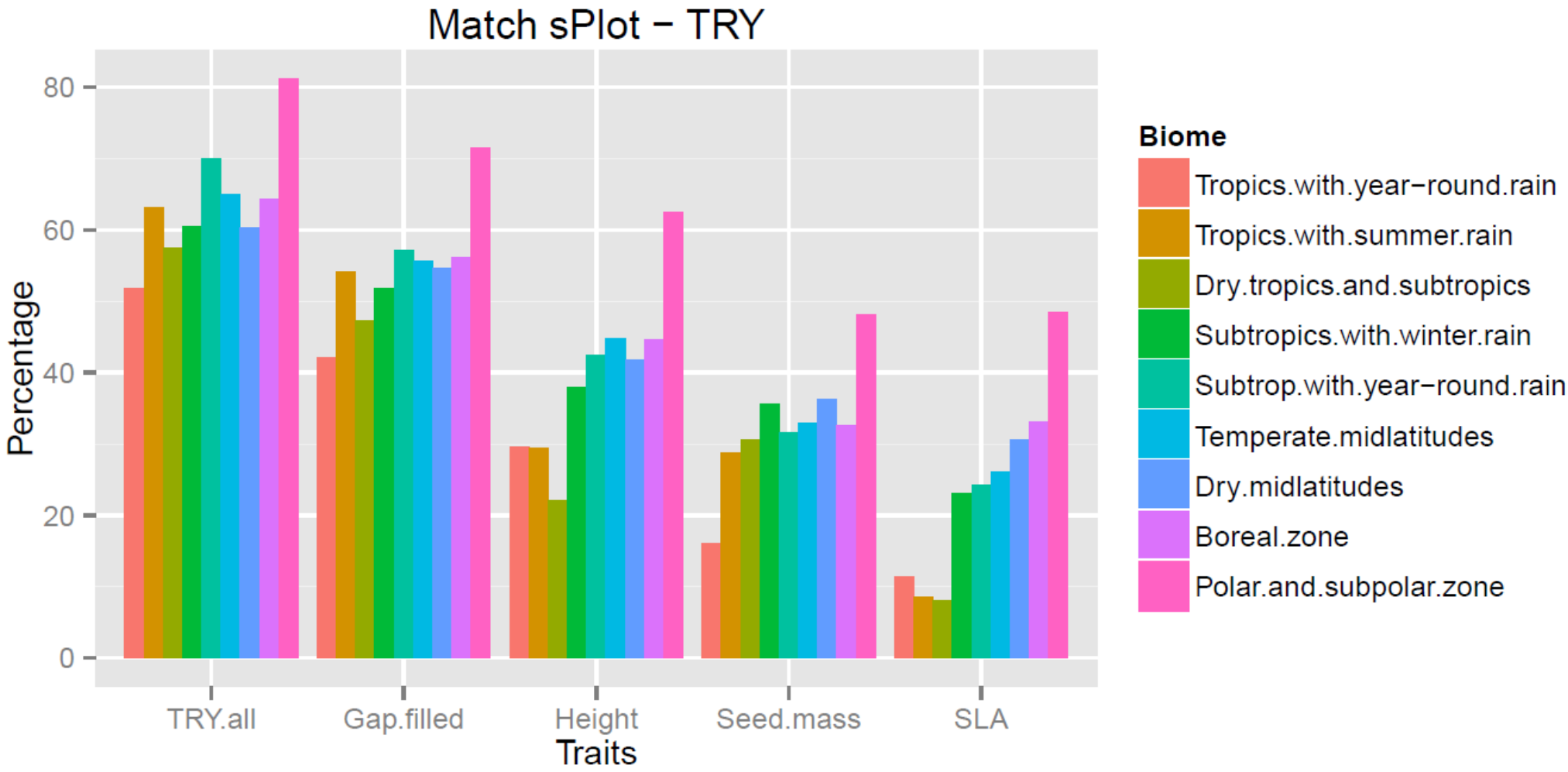


Matching of sPlot with TRY: all



Kattge, J. et al. 2011. TRY – a global database of plant traits. *Global Change Biol.* 17: 2905-2935.

Matching of sPlot with TRY: biome-wise



Schultz, J. 2002. *The ecozones of the world. The ecological division of the geosphere*. 2nd ed.

Outlook

- **sPlot continues to integrate supranational, national and major regional vegetation-plot databases**
- **Particularly welcome are databases from the tropics and subtropics** (with full species list including the herb layer) **and from underrepresented regions (Australasia, S Asia, Latin America, Africa)**
- **Preparation of a "database paper" and a first analytical paper during workshop in December**
- sPlot aims at being a **permanent database infrastructure at iDiv**
- sPlot offers maningfold **options to address fundamental questions** of community assembly, trait composition and biodiversity patterns on the basis of an unprecedented data source

▸ **more information** from J. Dengler, M. Chytrý or Válerio De Patta Pillar or at http://www.idiv-biodiversity.de/sdiv/workshops/workshops-2013/splot

sPlot

We thank those thousands of vegetation scientists who recorded relevés or measured plant traits and made these data available in common databases!

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