COBECORE activities at the Botanic Garden Meise

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Gent, 6 maart 2017

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Belgian Science Policy Office
belspo

Aims

- "to provide specific leaf area, stomatal density parameters and leaf nitrogen and carbon content (traits) which are important parameters in ecosystem models and indicators of adaptation to climate change in their own right"

- "cross-link this data with … data collected during the COBIMFO,… Jungle Rhythms,… BIOSPHERETRAITS."

- "proper data integration into a database structure and dissemination through a web portal and outreach towards the scientific community, the public and the private sector."

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Functional traits

Functional traits are defined as morpho-physio-phenological traits which impact fitness indirectly via their effects on growth, reproduction and survival, the three components of individual performance (Diaz et al. 2013).

Functional traits are morphological, biochemical, physiological, structural, phenological, or behavioral characteristics that are expressed in phenotypes of individual organisms and are considered relevant to the response of such organisms to the environment and/or their effects on ecosystem properties (Violle et al. 2007).

e.g.

- wood density
- specific leaf area
- seed size
- stomatal density
- maximum height

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Plant functional trait data can provide insight in global climate change

New Phytol. (1995), **131**, 311–327

The influence of CO_2 concentration on stomatal density

By F. I. WOODWARD[1] and C. K. KELLY[2]

American Journal of Botany 96(10): 1779–1786. 2009.

Long-term relationships among atmospheric CO_2, stomata, and intrinsic water use efficiency in individual trees[1]

Abraham J. Miller-Rushing,[2] Richard B. Primack, Pamela H. Templer, Sarah Rathbone, and Sharda Mukunda

nature ecology & evolution

ARTICLES

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Functional trait diversity maximizes ecosystem multifunctionality

Nicolas Gross[1,2,3†*], Yoann Le Bagousse-Pinguet[1†*], Pierre Liancourt[4†*], Miguel Berdugo[1], Nicholas J. Gotelli[5] and Fernando T. Maestre[1]

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PNAS

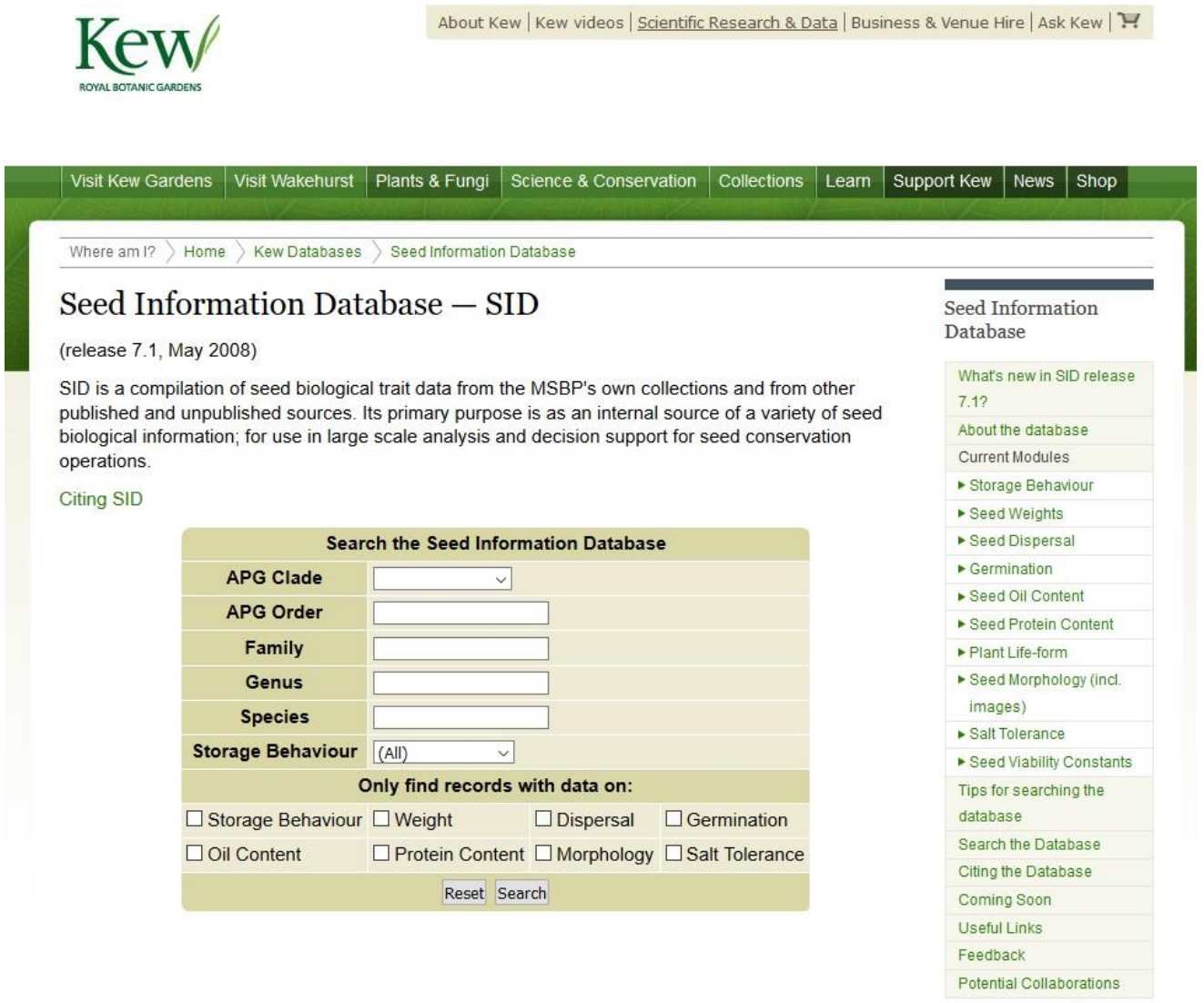
Functional traits predict relationship between plant abundance dynamic and long-term climate warming

Nadejda A. Soudzilovskaia[a,1], Tatiana G. Elumeeva[b], Vladimir G. Onipchenko[b], Islam I. Shidakov[c], Fatima S. Salpagarova[d], Anzor B. Khubiev[d], Dzhamal K. Tekeev[c], and Johannes H. C. Cornelissen[a]

[a]Systems Ecology Department, Vrije Universiteit Amsterdam, 1081 HV, Amsterdam, The Netherlands; [b]Department of Geobotany, Moscow State University, Moscow 119991, Russia; [c]Teberda State Reserve, Teberda 369210, Russia; and [d]Department of Biology and Chemistry, Karachai-Cherkessian Aliev University, Karachaevsk 369200, Russia

Edited by Monica G. Turner, University of Wisconsin, Madison, WI, and approved September 12, 2013 (received for review June 6, 2013)

Functional trait databases



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Functional trait databases

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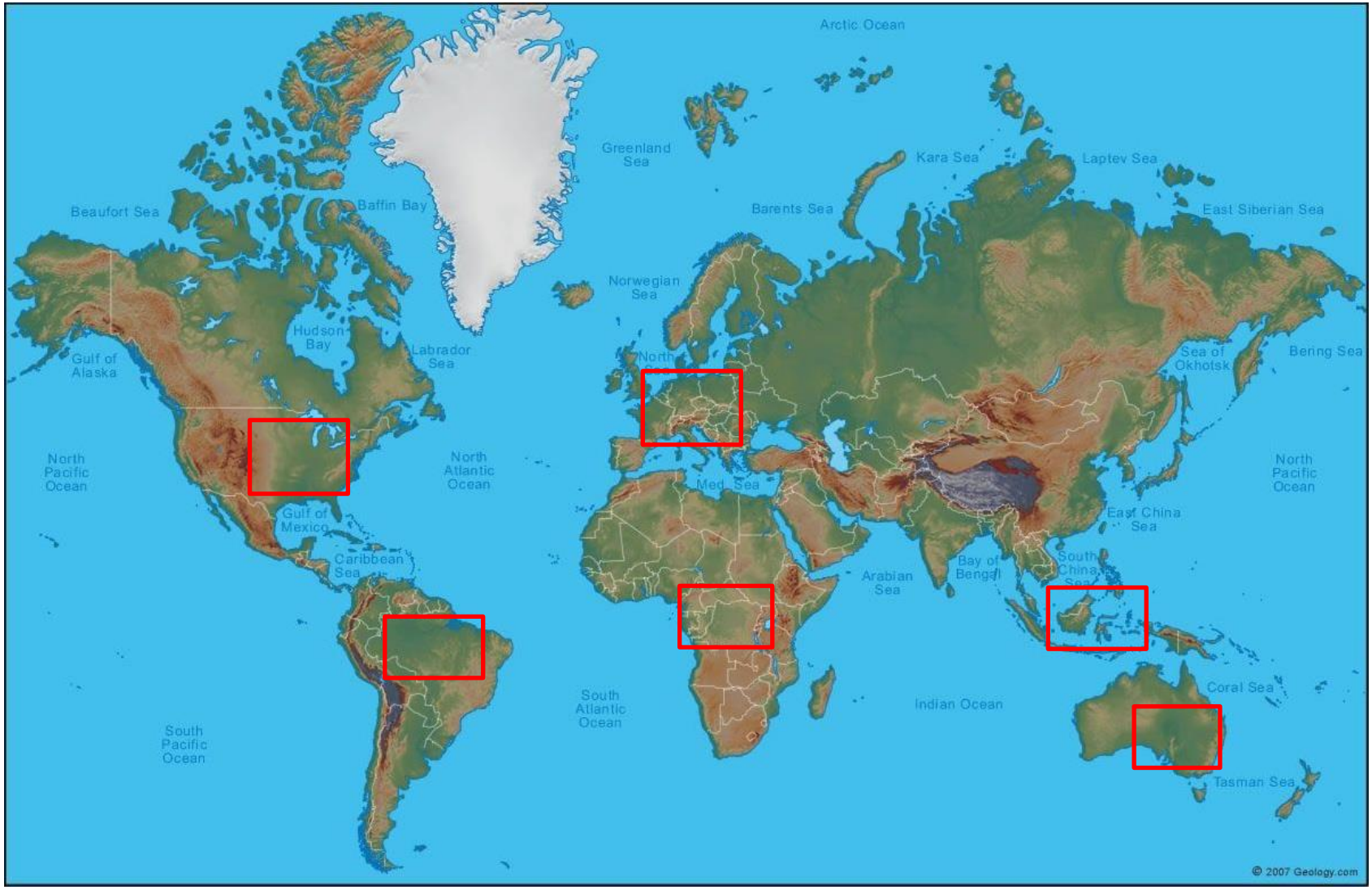
Plant functional trait data in different regions



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Plant functional trait data from central Africa missing

Data in TRY database

	Measurements
Tropical South America	366629
Central Europe	254132
North America	83374
Tropical SE Asia	53632
Australia	29776
Tropical Africa	14675

	Species
Central Europe	2846
Tropical South America	2615
Tropical SE Asia	1535
North America	1264
Australia	796
Tropical Africa	616

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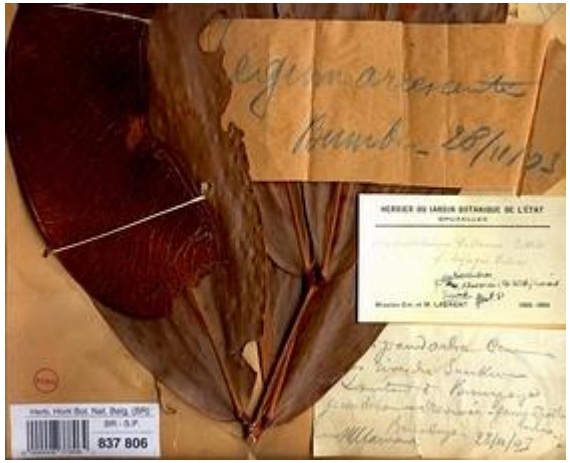
Herbarium Meise: A functional trait treasure

- The *Herbarium Belgii* contains 300,000 specimens from Belgium and Luxembourg
- The *Herbarium Africanum*: about 1 million specimens from Sub-Saharan Africa (cfr. National Herbarium Yangambi)
- About 1 million specimens from the rest of the world



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Herbarium Meise: A functional trait treasure unlocked

1,2 miljoen gedroogde planten worden zeer voorzichtig ingescand

Plantentuin digitaliseert onvervangbare collectie

01/06/2016 om 05:52 door JORIS HERPOL - Print - Corrigeer

Minister Philippe Muyters en bioloog Koen Es scanden de eerste stuks. (FOTO: JHP)

Source: nieuwsblad.be

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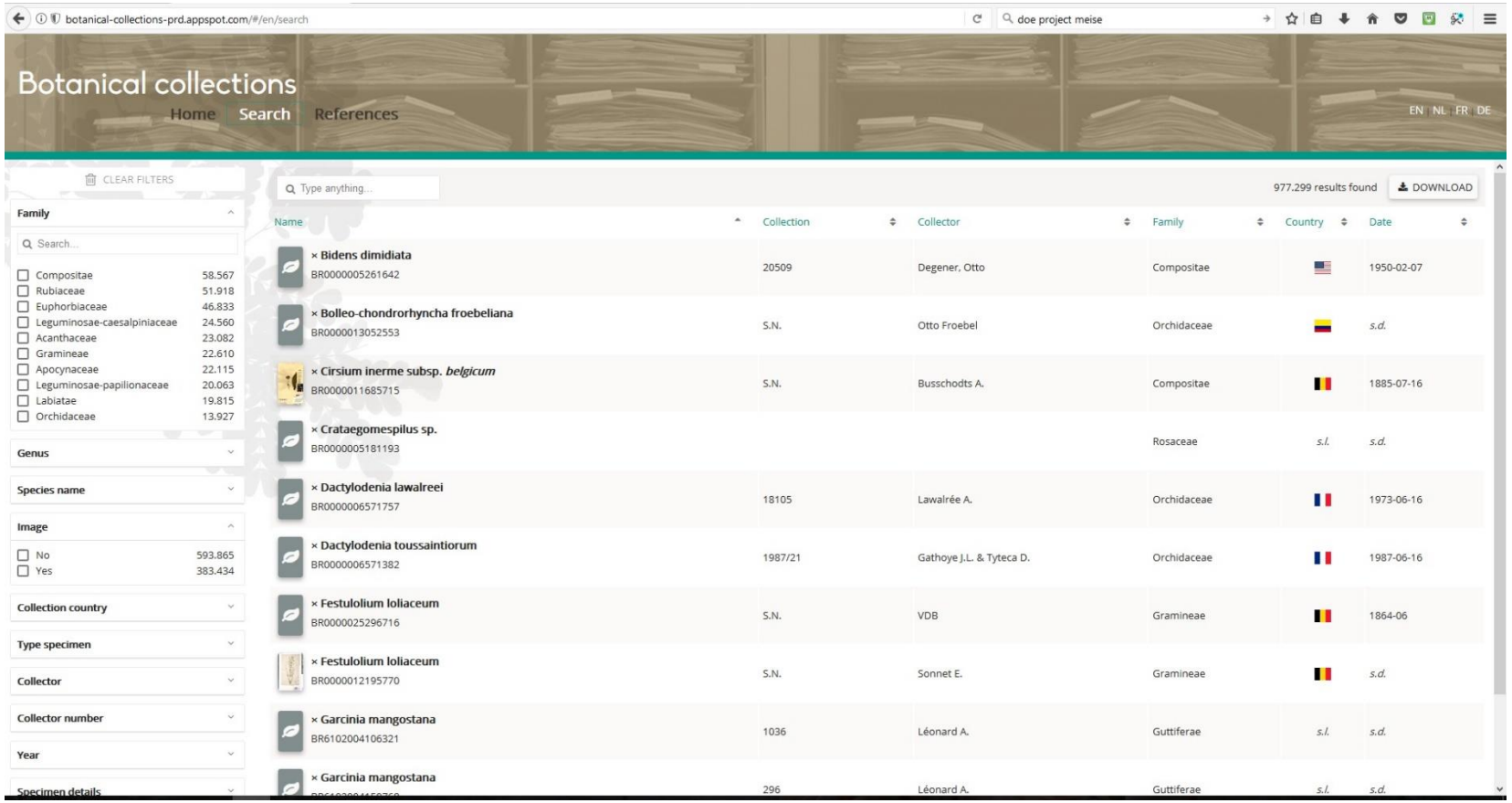
Herbarium Meise: A functional trait treasure unlocked



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What kind of (trait) data can be extracted?

- Extract plant functional trait data from herbarium specimens
  - Stomatal density
  - Specific leaf area
  - Leaf size
  - Leaf morphology
  - N content
  - Isotopes composition

- Databasing information on herbarium labels
  - Geo-referencing
  - Sample date
  - Additional information

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Research driven sampling strategy

- Temporal variation in leaf traits (BIOSPHERETRAITS)
- Spatial variation in leaf traits (HERBAXYLAREDD)
  - Species level
  - Population level
- Evolution and distribution of plant functional traits in tropical taxa (HERBAXYLAREDD)
- Community structure (COBIMFO)

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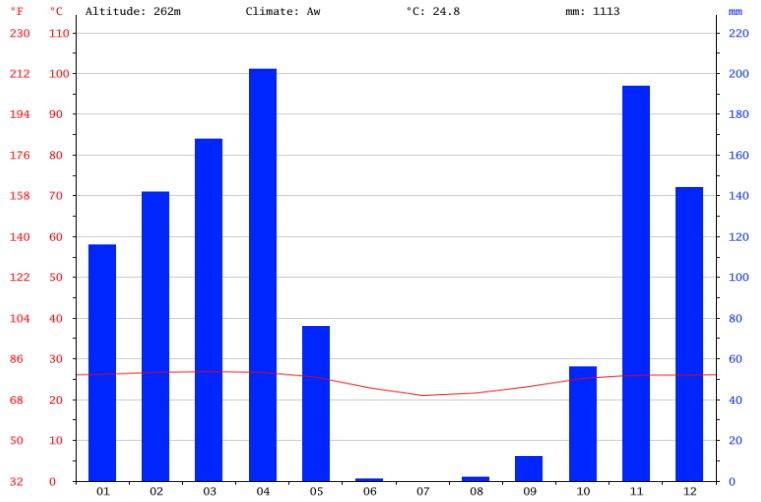
Spatial variation in leaf traits on the species level

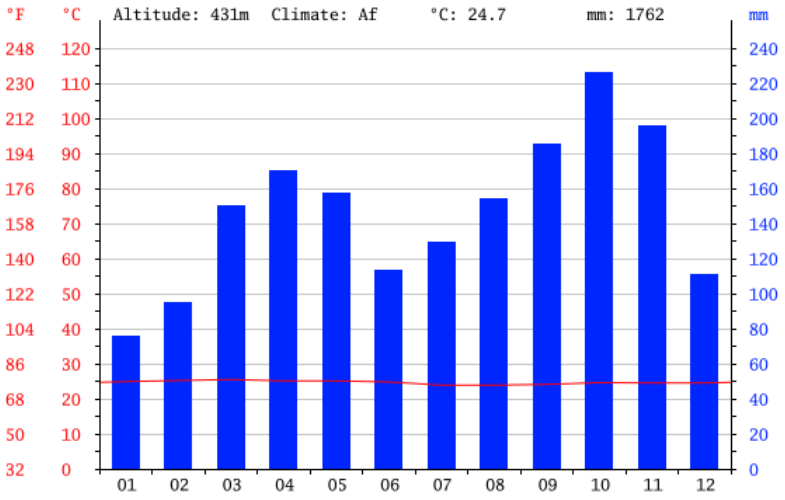
- Focus on two sites

Adaptation to drought in evergreen species:
- Small leaf size
- Lower Specific Leaf Area
- Lower stomatal density
- Small vessels
- High stem density

Luki



Yangambi



https://en.climate-data.org

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Spatial variation in leaf traits on the species level

Goal:

Pairwise comparison of leaf functional traits from 68 dominant tree species occurring at both sites

Methodology

- Five specimens per species and region of origin to be selected
- For each specimen five leaves to be weighed, scanned and surface area determined
- Stomatal density will be measured on three sites per leaf

Prioria oxyphylla

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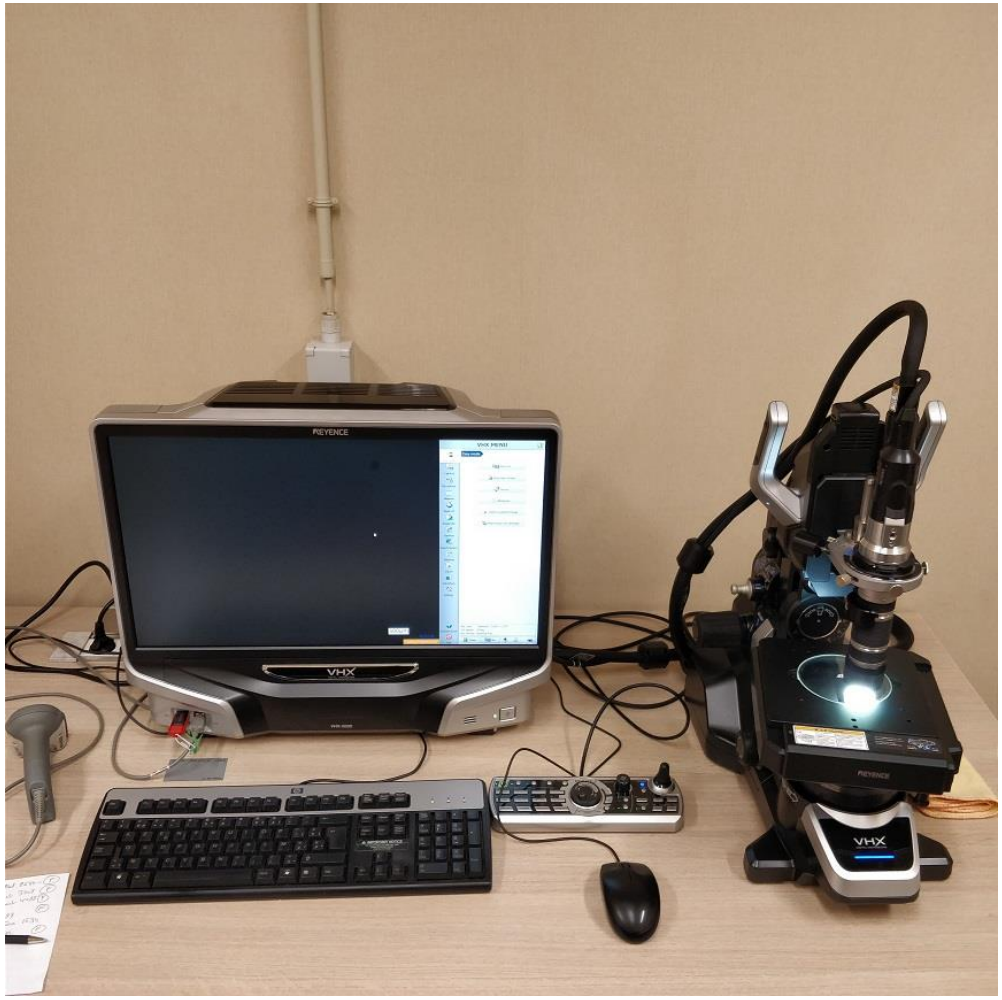
Keyence VHX Digital microscope: imaging stomata



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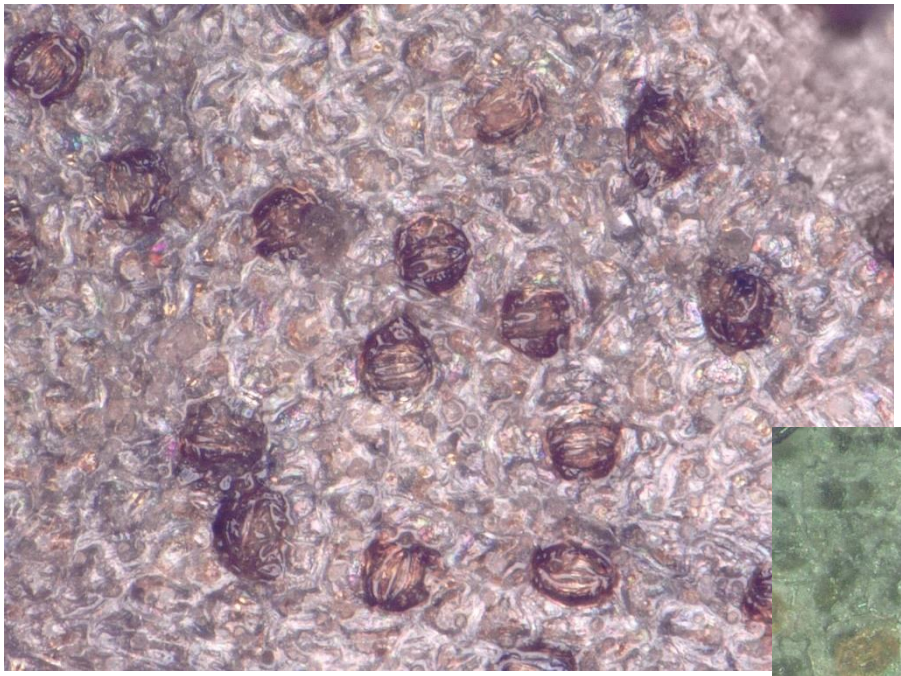
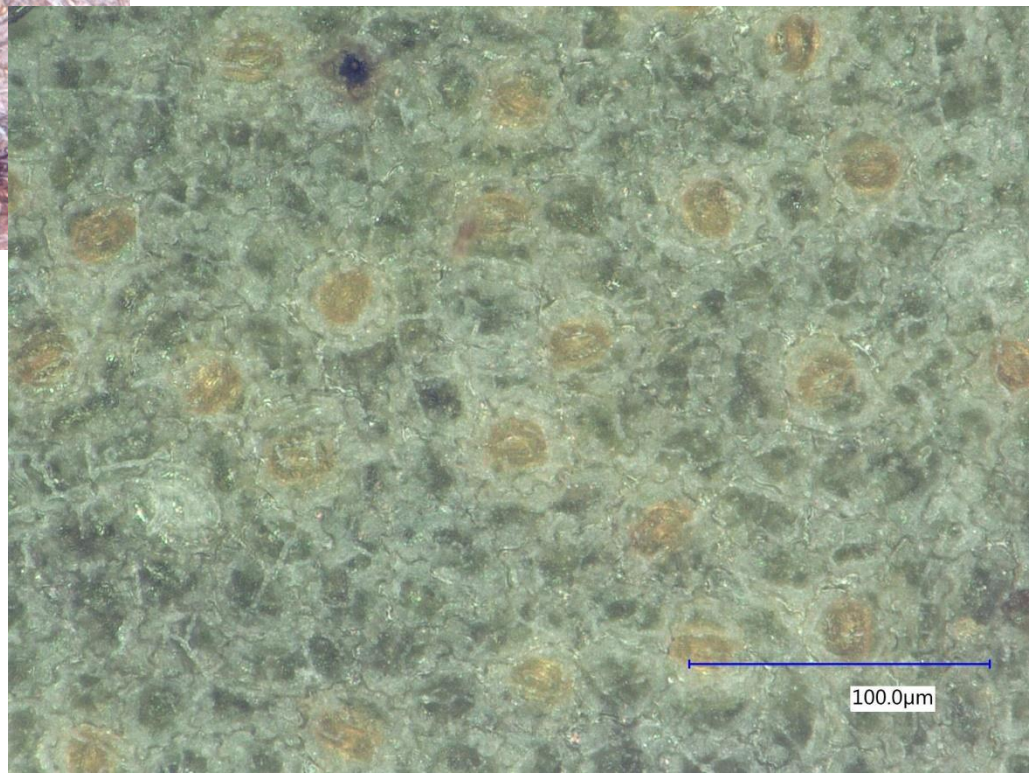


About 10 specimens and 150 pictures day^{-1}

Stomata counts: crowdsourcing



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Data already extracted in the framework of COBECORE

- Surface area and leaf weight for a total of 240 specimens of 48 tropical tree species
- Pictures for stomata counts were taken for 41 specimens (over 600 pictures)
- Surface area and leaf weight and pictures of stomata for over 100 specimens each of *Prioria sp.* and *Staudtia* sp.

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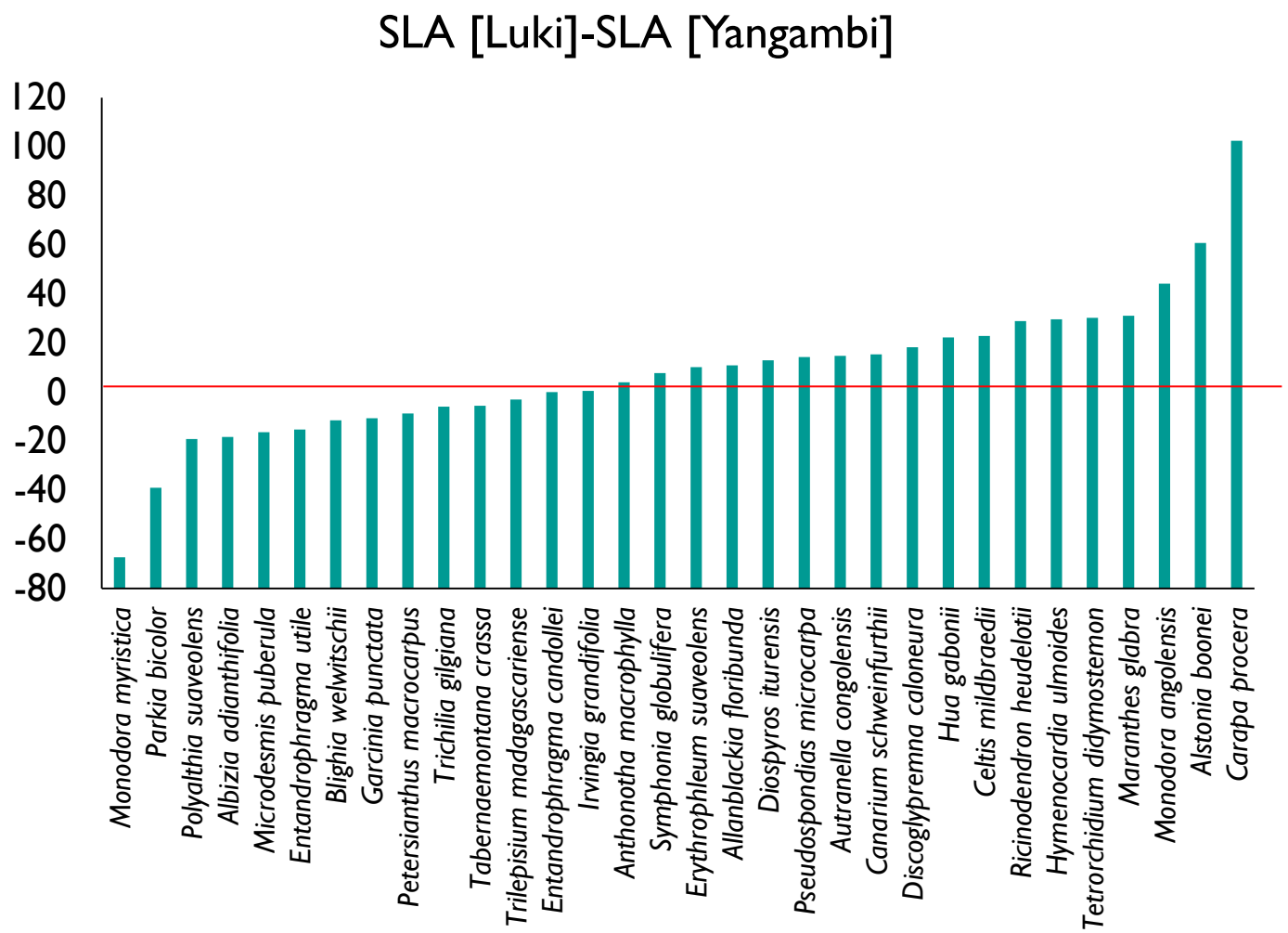
Preliminary results



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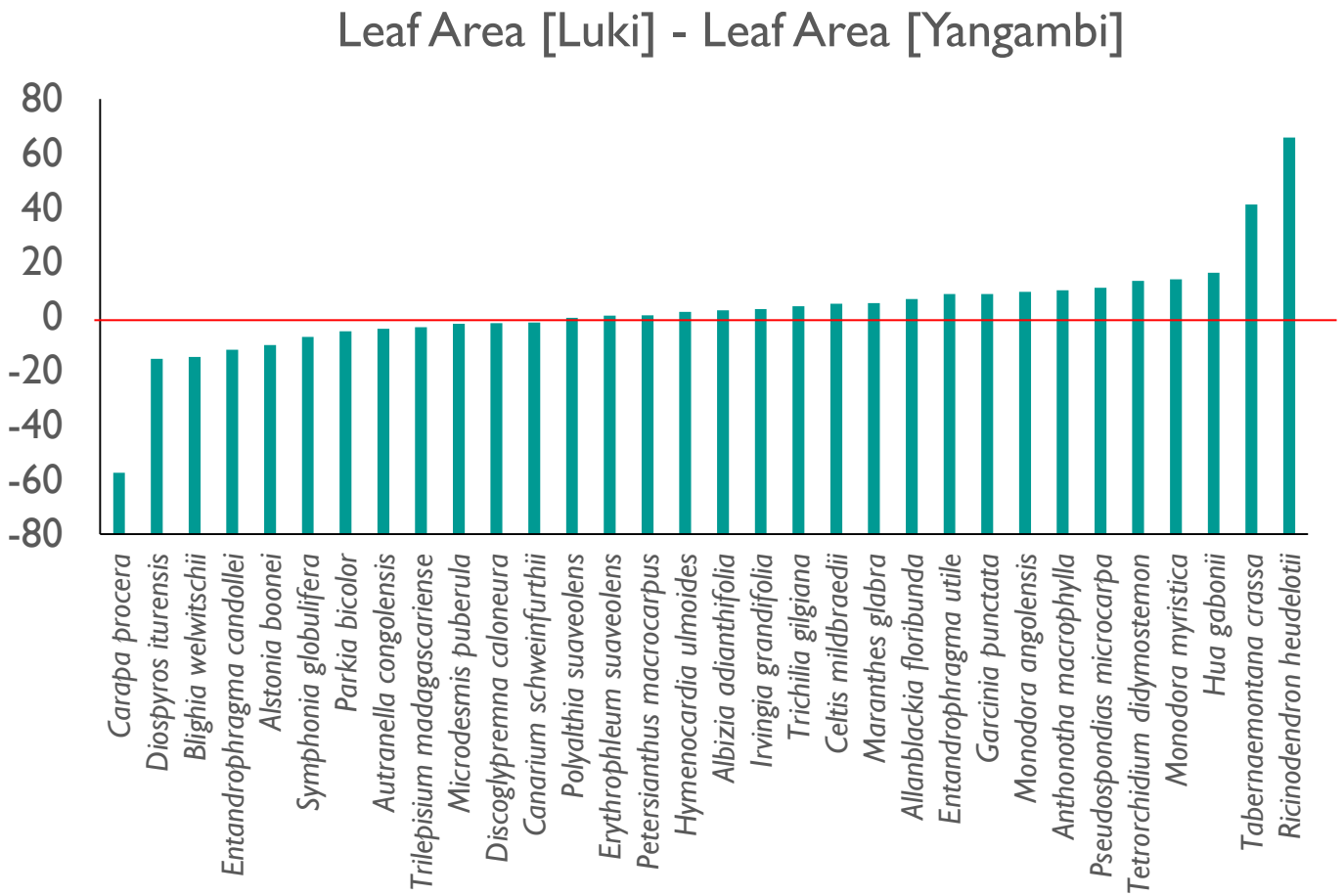
Preliminary results



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Prospects

- Increased trait sampling efforts: New group member Dr. Sofie Meeus and volunteers
- Set-up a crowd sourcing platform
- Explore possibilities to measure other leaf traits
- Analyses and writing-up of results

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