PRO-GRACE
PROMOTING A PLANT GENETIC RESOURCE COMMUNITY FOR EUROPE

Funded by the European Union

DiSSCo-RI and GRACE-RI: Collaborations and Synergies

2nd International Workshop on Plant Genetic Resources
Chania (Greece) Oct 9, 2025

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DiSSCo IT

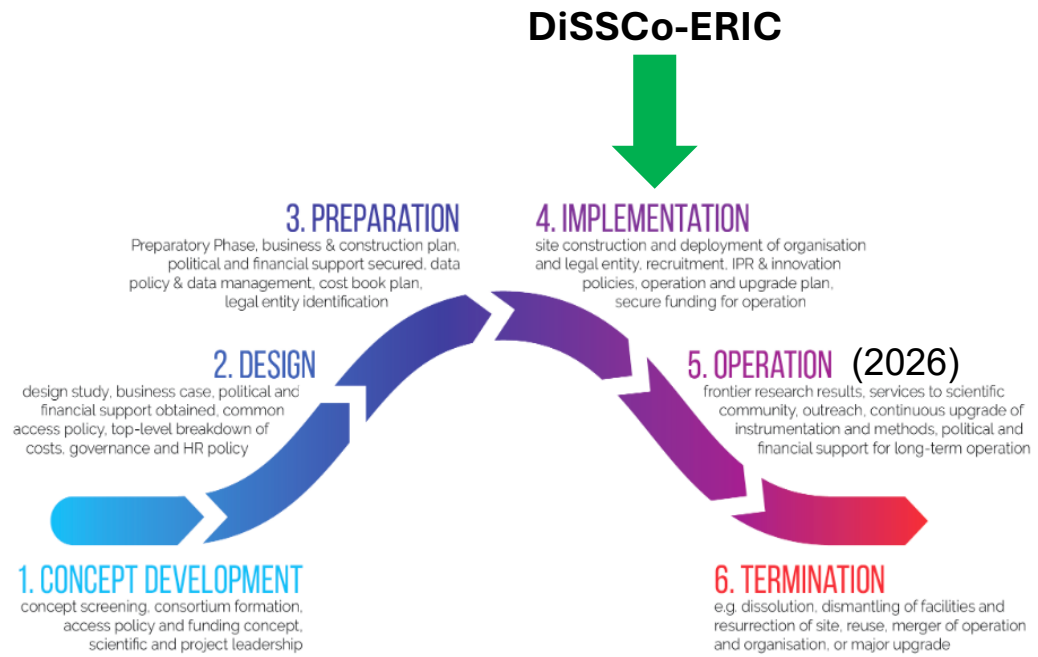
Brief introduction to the Distributed System of Scientific Collection (DiSSCo)

General Overview

DiSSCo is a new world-class Research Infrastructure (RI) dedicated to all kinds of Natural Science Collections (NSC), including **museum collections, botanical gardens, research collections**, etc.

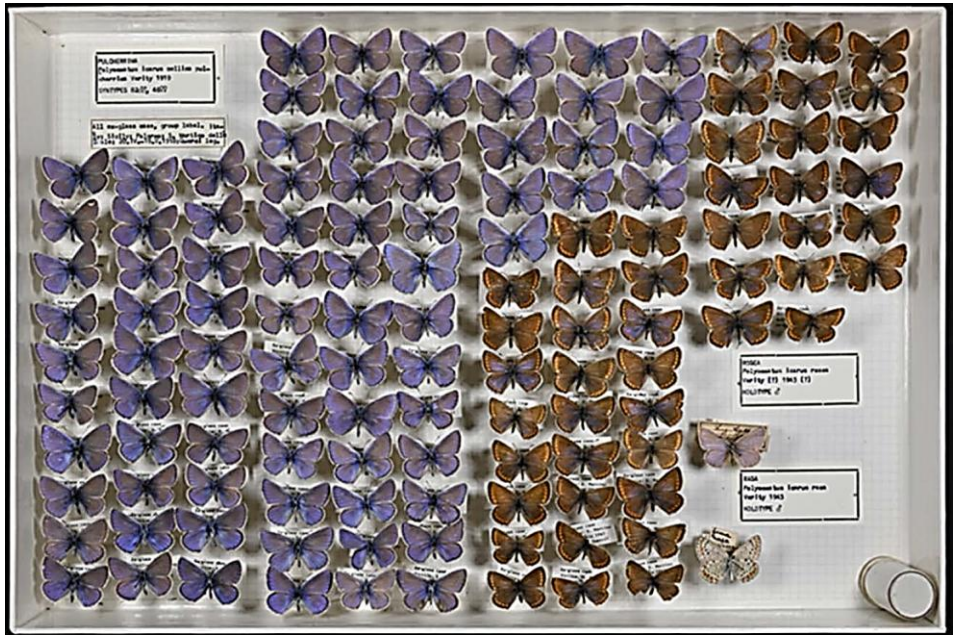
It aims to create a new business model for one European collection that digitally unifies all European natural science assets, sharing **common access, curation, policies, and practices across countries** while ensuring that all the data complies with the FAIR principles (Findable, Accessible, Interoperable and Reusable data).

DiSSCo will enter its **Operation Phase in 2026**, and will soon become an ERIC (European Research Infrastructure Consortium).



DiSSCo-RI Goals

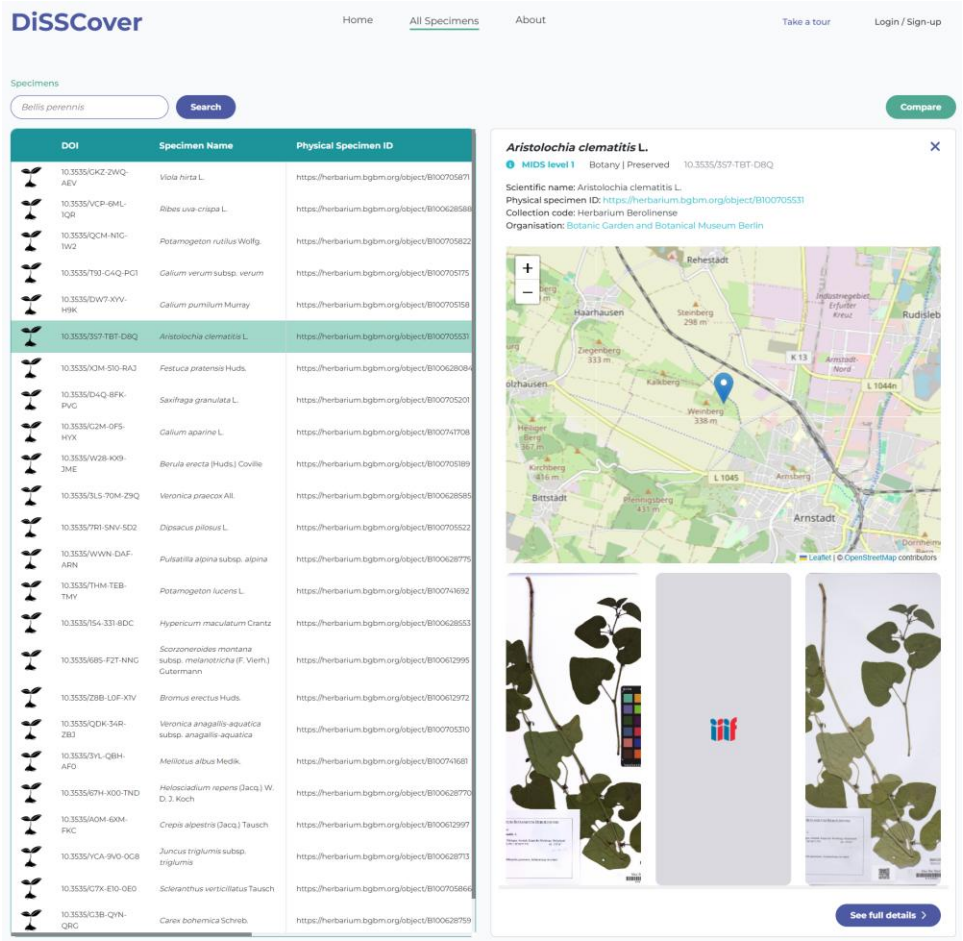
1. Create a **comprehensive e-science infrastructure** that provides discovery, access, interpretation, and **analysis of complex linked data**
2. Provide end-user services such as **digitisation on demand**, **research support**, and **training activities** to address current community limitations.
3. Optimise collection **access, curation, and management practices** in individual institutions, enabling strategies under a common research agenda (*GRACE Pillar I*).
4. **Accelerate digitization of collections**, scaling the current workflows to an industrial scale.
5. Permanently **link digital specimens to their attributes** across distributed digital resources, ensuring robust science (*GRACE Pillar III*).
6. **Reduce the global carbon footprint** with digital collections access that will reduce international trips and global shipments of specimens.
7. Enhance efficiency, leverage economies of scale, and address urgent needs in natural science research to **advance our understanding of biodiversity and its discovery**.



DiSSCo Support to Research

What type of research will DiSSCo support?

- **Taxonomic studies** through extended digitization of taxa collected worldwide.
- **Phylogenetic analyses** by analyzing material from related taxa through -omic technologies.
- Long-term **evolutionary studies** by providing reference specimens collected through time (last 200+ years).
- **Biodiversity assessment** through space and time and the impact of anthropogenic activity through time.
- **Museomics** - Museum genomics studies to uncover previously unexplored genetic information.
- Provision of **reference genomes** for barcoding/metabarcoding analyses.
- Disentangling Operational Taxonomic Units (**OTUs**) and Preliminary Species Hypotheses (**PSHs**) into distinct taxa, mainly in microorganisms.



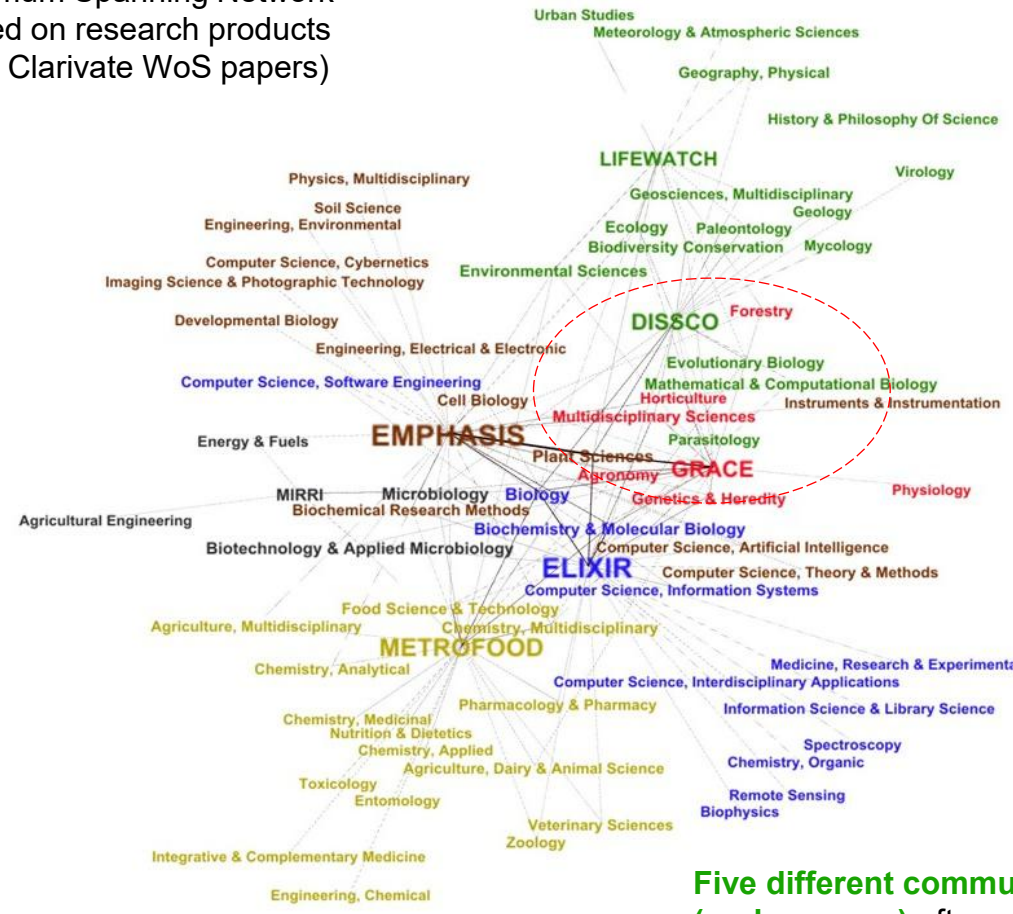
Selected references:

Card et al. (2021). Annu. Rev. Genet. 55: 633-659. – doi: 10.1146/annurev-genet-071719-020506
Raxworthy & Tilston Smith (2021). Trends in Ecology and Evolution 36 (11): 1049-1060. - doi: 10.1016/j.tree.2021.07.009
Veltjen et al. (2024). RIO 10: e135978 - doi: 10.3897/rio.10.e135978
Islam S (2025). Biodiversity Data Journal 13: e141562 - doi: 10.3897/BDJ.13.e141562
Lopez et al. (2020). Molecular Ecology Resources 20 (5): 1153-1160. – doi: 10.1111/1755-0998.13245
Greve et al. (2021). Biol. Lett. 17: 20210123 - doi: 10.1098/rsbl.2021.0123

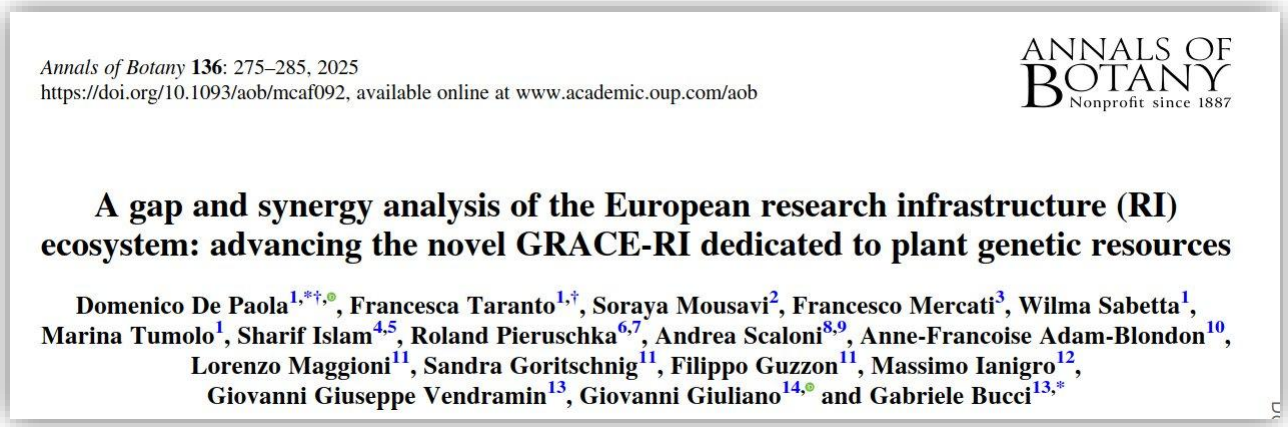
DiSSCo in the ESFRI Landscape

Non-parametric Network Analysis

Minimum Spanning Network
based on research products
(314 Clarivate WoS papers)



Five different communities (node groups) after multiscale modular test (Blondel et al. 2008)



Annals of Botany **136**: 275–285, 2025
https://doi.org/10.1093/aob/mcaf092, available online at www.academic.oup.com/aob

ANNALS OF BOTANY Nonprofit since 1887

A gap and synergy analysis of the European research infrastructure (RI) ecosystem: advancing the novel GRACE-RI dedicated to plant genetic resources

Domenico De Paola[1,*†,◎], Francesca Taranto[1,†], Soraya Mousavi[2], Francesco Mercati[3], Wilma Sabetta[1], Marina Tumolo[1], Sharif Islam[4,5], Roland Pieruschka[6,7], Andrea Scaloni[8,9], Anne-Francoise Adam-Blondon[10], Lorenzo Maggioni[11], Sandra Goritschnig[11], Filippo Guzzon[11], Massimo Ianigro[12], Giovanni Giuseppe Vendramin[13], Giovanni Giuliano[14,◎] and Gabriele Bucci[13,*]

Call identifier:
PRO-GRACE
Grant agreement no: 101094738

Promoting a plant genetic resource community for Europe

Deliverable No. D5.1

Gap analysis of the present European RI ecosystem, including an analysis of the possible synergies with existing RIs

Contractual delivery date:
Nov 2023

Actual delivery date:
Nov 2023

Responsible partner:
CNR
Contributing partners:
IPGRI, IPK, NORDGEN, INRAE, NASC

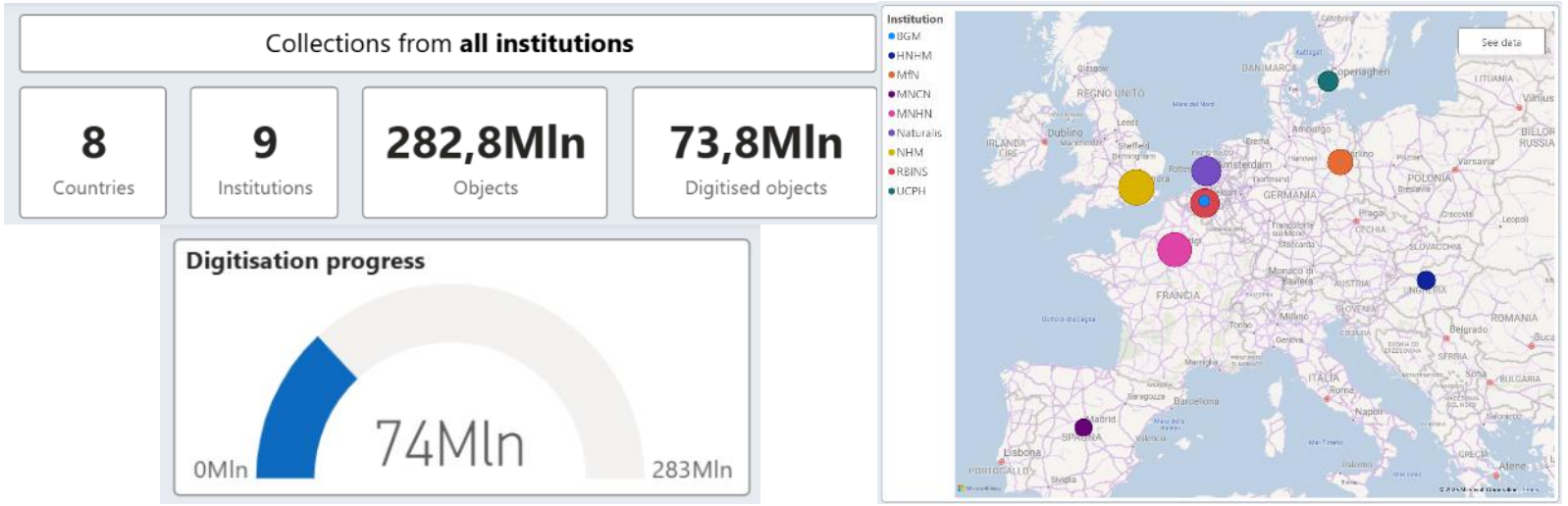
This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101094738.

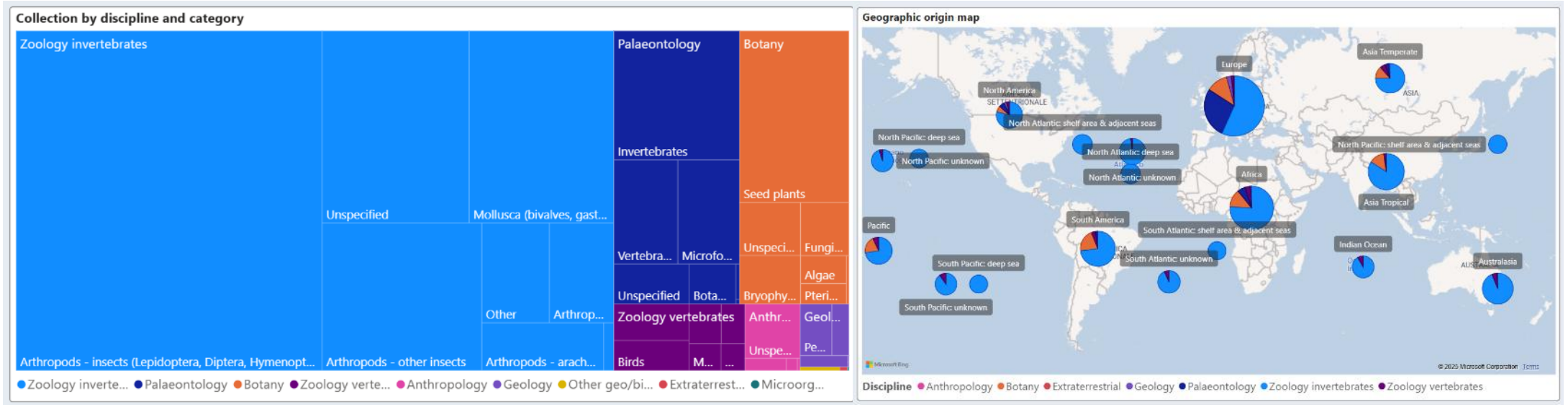
DiSSCo Digitization Objectives and Status (1)

DiSSCo Goals (estimate)

1.5 billion specimens
5,000 scientists
300+ institutions
23 countries

1 European collection





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DiSSCo Digitization Objectives and Status (2)

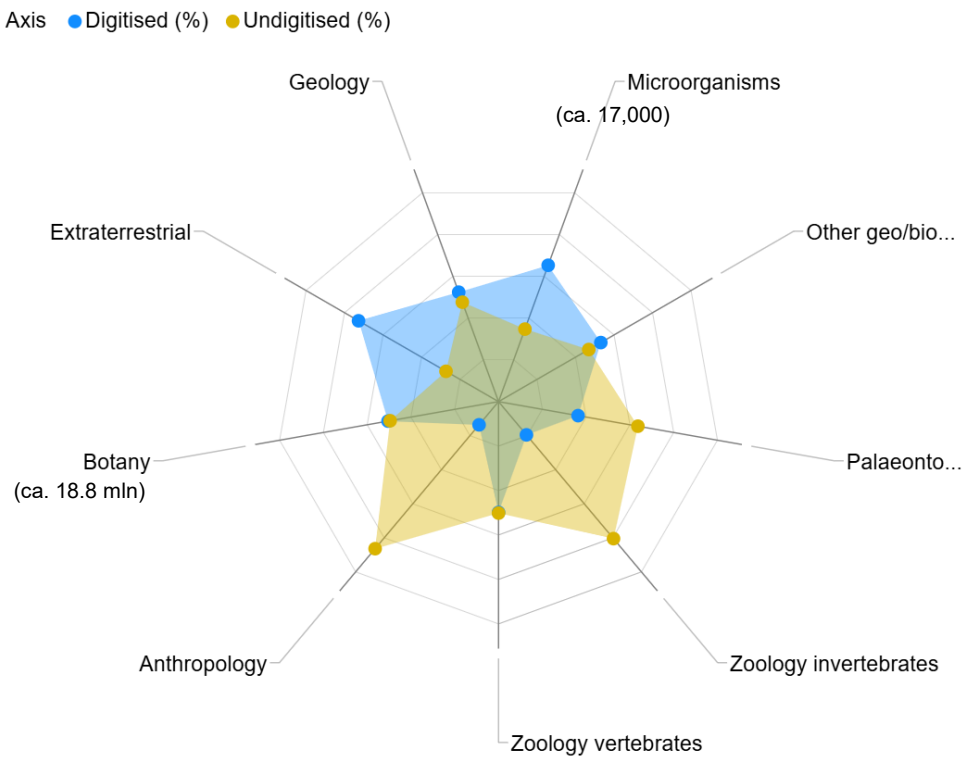
DiSSCo Goals (estimate)

1.5 billion digitized specimens
5,000 scientists
300+ institutions
23 countries

DiSSCo Status

73.8 mln digitized specimens
? scientists
9 institutions
8 countries

Collections by digitization status and percentage



Collections by storage type

- Artefacts
- Cores
- Cryopreserved DNA/RNA
- Cryopreserved/ frozen
- Cut/polished gemstones
- Dried specimen
- Dried, assembled
- Dried, not assembled
- Fluid preserved
- Fluids
- Fossils preserved in natural resins (amber)
- Macro-objects
- Macrofossils (dry preserved)
- Mesofossils
- Microfossils
- Microscopic slides
- Other
- Oversized fossils
- Oversized objects
- Pressed and dried
- Unspecified

DiSSCo Indexing : “Digital Specimen Enrollment” Campaign

DiSSCover (https://disscover.dissco.eu)

Annotate digital specimens and contribute to science

Total specimens indexed: 3,728,499

Biology Microbiology 0	Biology Anthropology 0	Biology Botany 903,468
Biology Zoology 1,986,427	Biology/Geology Palaeontology 724,518	Biology/Geology Other Bio / Geodiversity 0
Biology Ecology 0	Geology Earth Geology 64,149	Geology Astrogeology 2,468
Natural Origin 3,681,030	Human made (Archive material) 0	Unclassified 47,469

Goal:
20 Mln of DOI assigned in 2025

Each specimen will be assigned a DOI (no costs for data providers)

Digital Specimen Data Enrollment

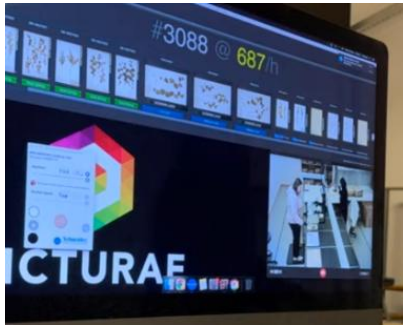
Online datasets can be pre-registered (deadline: Oct 31, 2025) by organisations that host natural science collections (museums, herbaria, universities, **other research infrastructures**). As a European Research Infrastructure, DiSSCo will prioritize datasets from organisations in Europe.

DiSSCo RI: Facilities

DiSSCo Facilities:

- Advanced equipment for digitizing museum specimens: photography facilities, optical stereomicroscopes, video cameras, 2D and 3D scanners, **high-throughput HR image acquisition systems (on-site digitization).**
- **Electric vehicles** for transporting the equipment and/or, in some cases, the collections.
- **High-speed, high-capacity servers** for image storage, database creation, and machine-to-machine interaction.
- Advanced equipment for characterizing living organisms (thermal cameras, NIR spectrophotometers, GEO-Slam TLS, field GPS, Cyflow Ploidy Analyzer, etc.)

Conveyor Belt Technology (Picturae, NL)



Museum für Naturkunde, Berlin

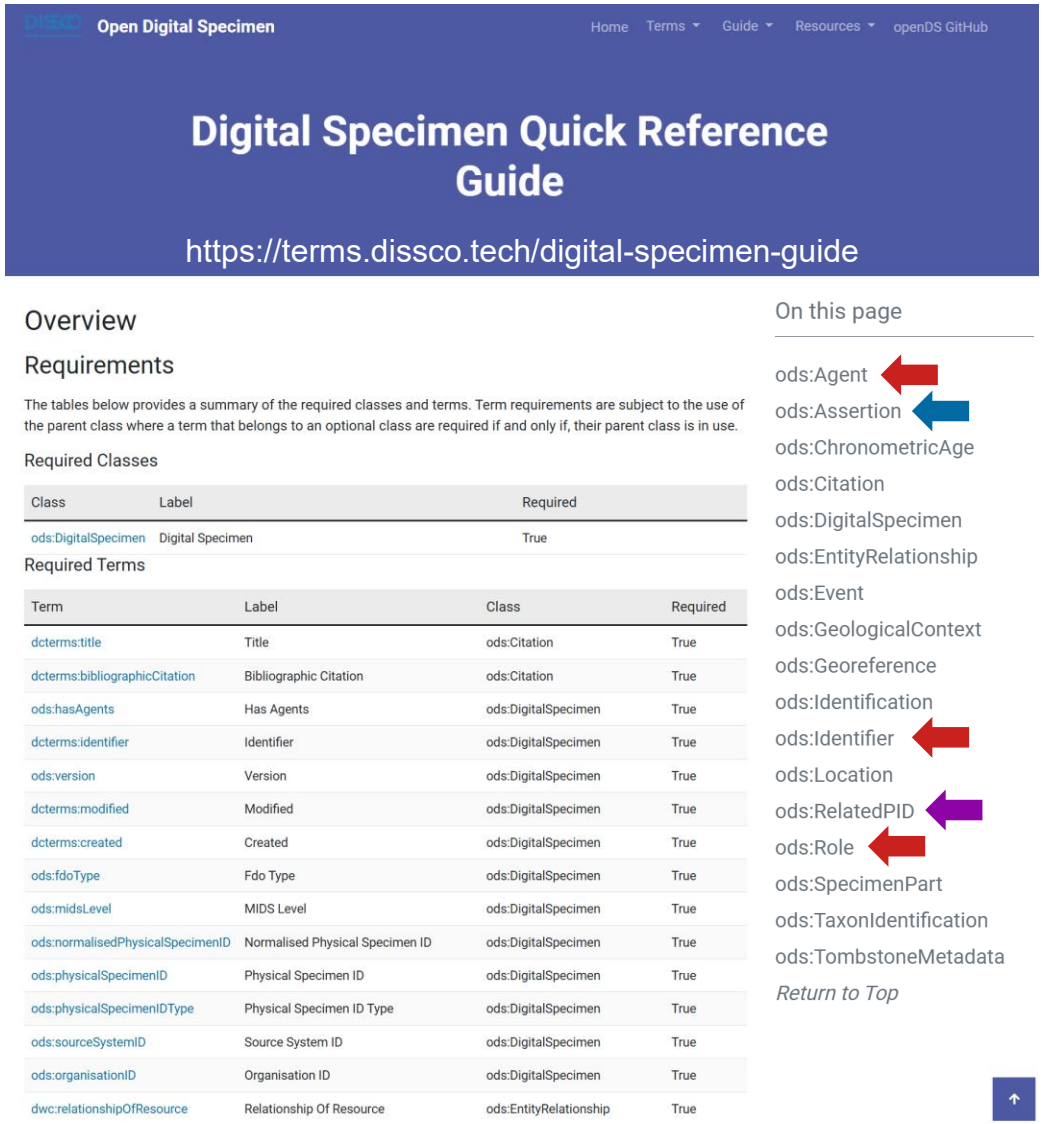
DiSSCo Data Model (openDS)

DiSSCo will manage **any data associated with specimens**, including PUIDs (DOI), taxonomic and geographic information, ecological relationships, genomic/biochemical/morphological data, literature data, images, and more.

To this end, DiSSCo has developed a specific ontology (**openDS or Open Digital Specimen**), in collaboration with TDWG. It incorporates many terms from **Darwin Core** and **ABCD(GEF)**, ensuring full compliance with these standards.

Minimum requirements for datasets (DSE campaign)

- **A Darwin Core or ABCD dataset**
  - containing records about specimens,
  - published online**,**
  - containing a UUID for each physical specimen object
- **Associated digital media**, if provided, need to have a publicly accessible URL
- **Data needs to have a CC-0 or CC-BY license**
- A dataset must be accompanied by **ROR** (or Wikidata ID) for the collection hosting institution (Latimer core).



DiSSCo RI: Semantic Interoperability with GRACE

DwC and its extensions include **900+ descriptors** covering most characteristics of biological specimens (*including trait measurement and trials*).

The **DwC Germplasm Extension** provides a set of descriptors for describing genebank accessions, maintained by the thematic community of **PGRFA**. Most are imported from **MCPD**, which is maintained by Bioversity International and the FAO. Other terms were developed by **ECPGR**.

Matching MCPD terms with the Darwin Core data model is straightforward, thus favoring data exchange between GRACE and DiSSCo *via* machine-to-machine interactions.

DwC Class	DwC descriptor	MCPD v.2.1
Record-level	ownerInstitutionCode	INSTCODE
	references	ACCEURL
Occurrence	occurrenceID	PUID
	catalogNumber	ACCENUMB
	recordNumber	COLLNUMB
	institutionCode	COLLCODE
	otherCatalogNumber	OTHERNUMB
	recordedBy	-
	recordedByID	-
Taxon	genus	GENUS
	specificEpithet	SPECIES
	scientificNameAuthorship	SPAUTHOR
	infraspecificEpithet	SUBTAXA
	nameAccordingTo	SUBTAUTHOR
	vernacularName	CROPNAME
Event	eventDate	COLLDATE
	habitat	COLLSRC
Location	country	ORIGIN
	countryCode	ORIGCTY
	locality	COLLSITE
	decimalLatitude	DECLATITUDE
	decimalLongitude	DECLONGITUDE
	verbatimLatitude	LATITUDE
	verbatimLongitude	LONGITUDE
	geodeticDatum	COORDDATUM
	coordinateUncertaintyInMeters	COORDUNCERT
	maximumElevationInMeters	ELEVATION
	georeferenceSources	GEOREFMETH

DwC Class	DwC descriptor	MCPD v.2.1
Germplasm	germplasmID	-
	biologicalStatus	SAMPSTAT
	storageConditions	STORAGE
	collectingInstituteID	COLLCODE
	donorsIdentifier	DONORNUMB
	donorInstituteID	DONORCODE
	donorInstitute	DONORNAME
	acquisitionDate	ACQDATE
	breedingInstituteID	BREDCODE
	breedingInstitute	BREDNAME
	ancestralData	ANCEST
	safetyDuplicationID	-
	safetyDuplicationDate	-
	safetyDuplicationInstituteID	DUPLSITE
	safetyDuplicationInstitute	DUPLINSTNAME
	treayOrRegulationName	AEGISSTAT
	mlsStatus	MLSSTAT
	AcquisitionRemarks	REMARKS
Preservation	preservationType	-
	preservationTemperature	-
	preservationDateBegin	-
Preparation	preparationType	-
	preparationProcess	-
	preparationMaterials	-
	preparedBy	-
	preparationDate	-
Identification	identifiedBy	-
	identifiedByID	-

DiSSCo RI: e-Services

European Loans and Visits System (ELViS): One-stop shop for access to NSCs

- A unified way to request **visits, loans, and virtual access**.
- Management of **TNA calls**.
- Digitisation on demand.
- Support for collaboration on ideas and proposal submission.

Digital Specimen Repository (DSR) (machine-to-machine FDO-JSON retrieval)

- **APIs developed to grant access to the Digital Specimen Repository** (DSR) and other DiSSCo-related FAIR Digital Objects (FDOs) – Endpoints are available for developers (Swagger).

DiSSCo Knowledge Base (https://know.dissco.eu/)

- A centralized interface for all documentation related to DiSSCo, including research outputs from projects linked to DiSSCo as well as **training materials, FAQs, best practices, guidelines, technical documentation**, and documented decisions.

DiSSCover (Unified Curation and Annotation System)

- The **main catalog** of DiSSCo digital objects.
- Event-based **curation and annotation** functions on DS for experts in the community and for machines.
- Enhanced interpretation and use of specimen data by novel, **machine-actionable mechanisms** and **artificial intelligence** (AI) algorithms.

DiSSCo Labs (https://dissco.tech/labs/)

- A preview of experimental e-services and demonstrators created by the DiSSCo community (Authentication and Authorization Infrastructure for Institutional access; Dashboards for Collection Digitization, Policy, Research Infrastructures, DiSSCo Form Application, etc.)

DiSSCo GitHub (https://github.com/DiSSCo)

- Code hosting for DiSSCo software, version control, and collaborations (open source)

GRACE – DiSSCo RI: Collaborations and Synergies (1)

DiSSCo currently relies on the taxonomic backbone of the **Catalogue of Life** (CoL), which is mainly **biodiversity-oriented** but **limited for infraspecific taxa** of crop species.

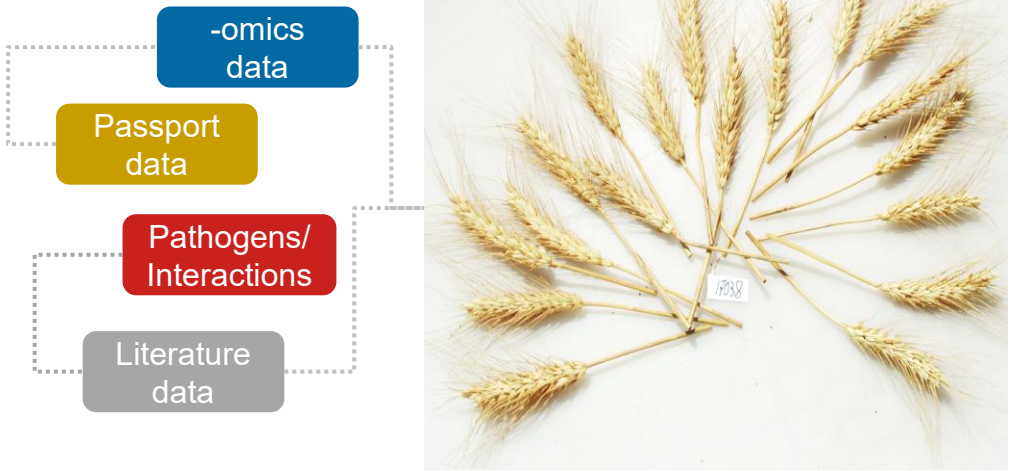
Creation of **digital herbaria** for the main infraspecific taxa of crop species (subspecies, varieties, cultivars, forms, clades, etc.)

Establish taxonomic references (to be considered as "**genomic holotypes/paratypes**") for infraspecific taxa of crop species, and their inclusion in current taxonomic backbones.

Establish **taxonomic validation services** to verify the taxonomic identity of genebank accessions.

Harmonizing the **taxonomic identity** of Crop Wild Relatives (CWR) and Wild Food Plants (WFP).

Revision/updating of the nomenclature of taxa in genebanks



APIs

Endpoints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    "citationProvidedBySource": true
  },
[…]
}
```


FDO (JSON, VRE ready)

GRACE – DiSSCo RI: Collaborations and Synergies (2)

DiSSCo collaborates with the **Barcode of Life** (iBoL) and the **UNITE community** through Naturalis (NL) and the Biodiversity Genomics Europe (BGE) consortium for the application of genomics to biodiversity research

UNITE Community (https://unite.ut.ee/)

Database and sequence management environment focusing on the eukaryotic (mainly fungi) nuclear ribosomal ITS region.

→ Simplified process for the identification/monitoring of pathogens (OTUs, PSHs) for **phytosanitary purposes** (*GRACE Pillar V*).

BOLD - Barcode of Life Data System (https://boldsystems.org/)

Database containing 1.3+ Mln BINs (Barcode Index Number), 101K plant species, and 27K fungi, representing the **reference database** for accurate species identification through barcoding/metabarcoding.

→ Collaborations can be established for **barcoding/ fingerprinting infraspecific taxa** of crop species, particularly regarding CWR, WFP, LR, and FGR (*GRACE Pillars II and IV*).

UNITE Portal

Accession number	UNITE taxon name	INSD taxon name	Sequence source	Interacting taxa	Sampling area	← Alignment →
MT522544	Archaeorhizomyces borealis	Archaeorhizomyces borealis (Archaeo...			China	----------
GQ205364	Archaeorhizomyces borealis	Fungi (uncultured fungus)	Ectomycorrhiza | sample	Pinus pinaster	Portugal	----------
FJ816777	Archaeorhizomyces borealis	Fungi (uncultured ectomycorrhizal f...	Ectomycorrhiza | sample	Pinus pinaster	Spain	----------
FJ013071	Archaeorhizomyces borealis	Fungi (uncultured ectomycorrhizal f...	Ectomycorrhiza | sample	Pinus pinaster	Spain	CAAGTGATCTTGGTCAATT
EU046087	Archaeorhizomyces borealis	Ascomycota (uncultured Ascomycota)	Ectomycorrhiza | sample	Pinus sylvestris	Austria	----------
DQ068979	Archaeorhizomyces borealis	Archaeorhizomyces borealis (Archaeo...	Ectomycorrhiza | sample	Pinus sylvestris	Lithuania	----------
LC096916	Archaeorhizomyces borealis	Fungi (uncultured fungus)		Castanopsis cuspidata	Japan	----------
LC096889	Archaeorhizomyces borealis	Fungi (uncultured fungus)		Pinus densiflora	Japan	----------
LT746035	Archaeorhizomyces borealis	Archaeorhizomyces borealis (Archaeo...		Cistus salviifolius	Portugal	C---CGNTTCTTGGTCATT
LT746022	Archaeorhizomyces borealis	Archaeorhizomyces borealis (Archaeo...		Pinus pinaster	Portugal	C---CGATTCTTGGTCCAT

DiSSCo-IT Accessory e-Services: ClimateDT

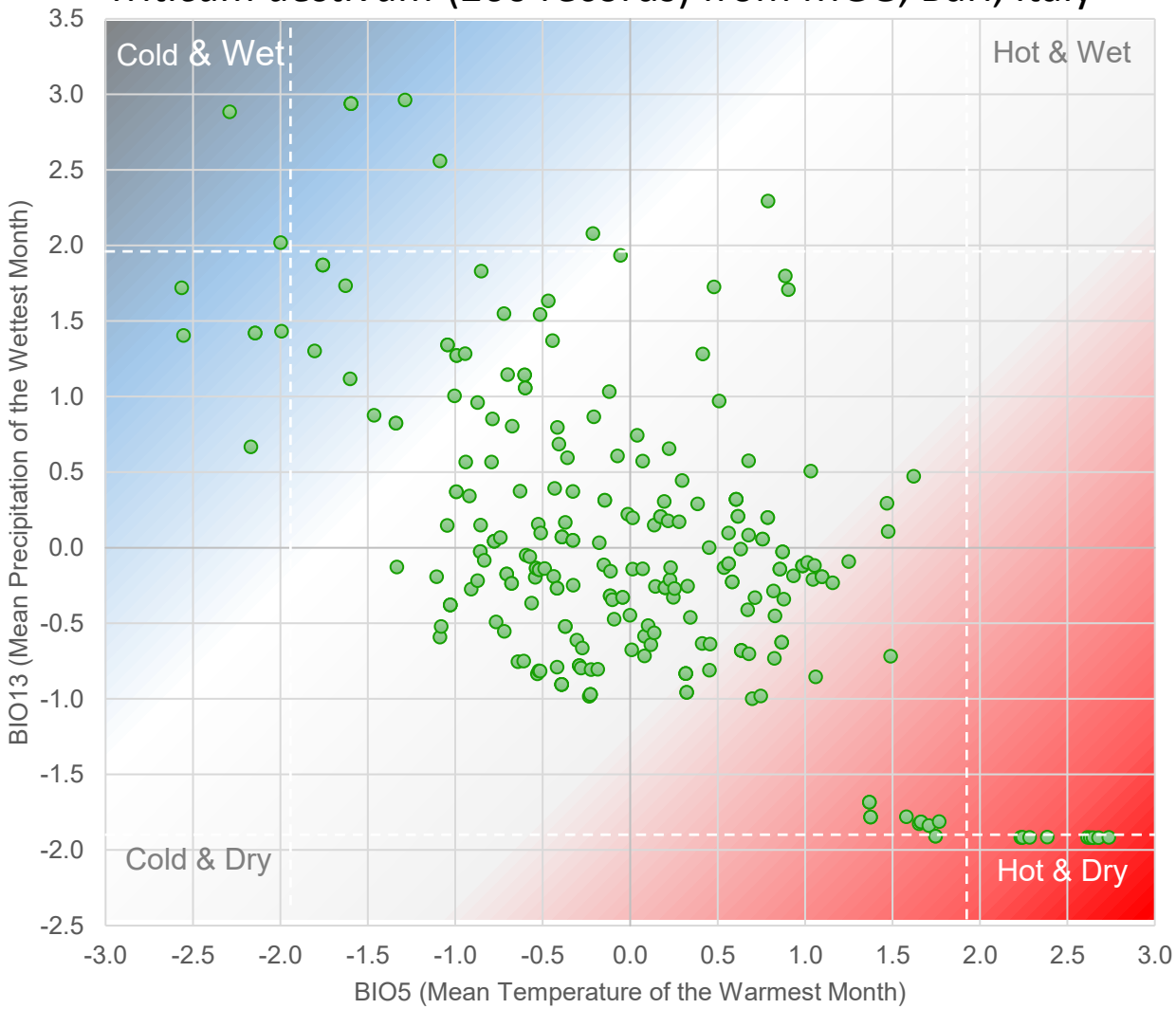
ClimateDT – Climate Downscaling Tool (https://climatedt.org)

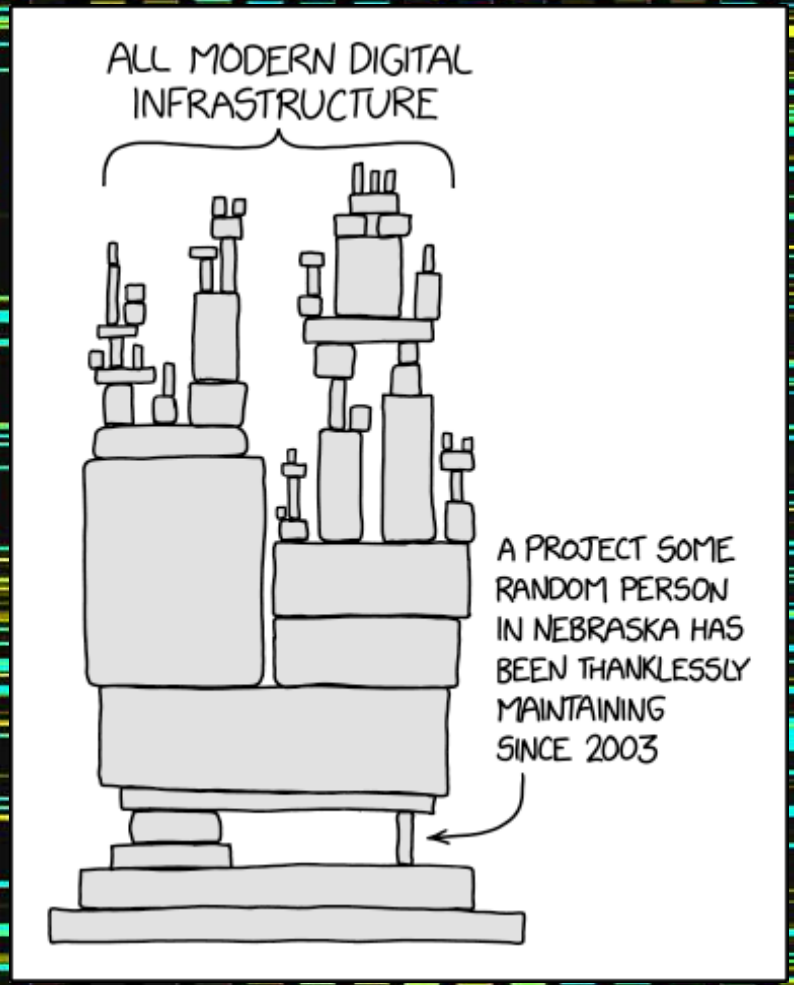
- Geo-web service for **downscaling 46 climatic variables and indices** from both past climatic series and future simulations by 5 General Circulation Models (GCM).
- Correction of climatic parameters based on **site elevation**.
- Past climate series from CRU-TS layers (1901-now), current climatic series from CHELSA 1.2, future climate scenarios from UKCP-18 projections (up to 2100).
- Tested against observational data from 12,000 meteo stations worldwide (Temp MAE: 0.80 °C; Rainfall MAE: 19mm).
- Useful in **modeling** the ecological/spatial distribution of taxa under climate change (e.g., SDM, ENM, etc.)
- Mapping of suitable areas for taxa across Europe under future climate scenarios (*GRACE Pillar III, no. 6*).

Marchi M, Bucci G, Iovieno P, Ray D (2024). ClimateDT: A Global Scale-Free Dynamic Downscaling Portal for Historic and Future Climate Data. *Environments* 11 (4): 82. - https://doi.org/10.3390/environments11040082

ClimateDT will soon be included among the services provided by DiSSCo-IT.

Triticum aestivum (260 records) from MGG, Bari, Italy





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