

# Use case: To track and predict hazard to agricultural crops in Europe induced by climate change using crop growth models and DestinE data (agroclim)

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3rd Destination Earth User eXchange, Agriculture and Biodiversity session

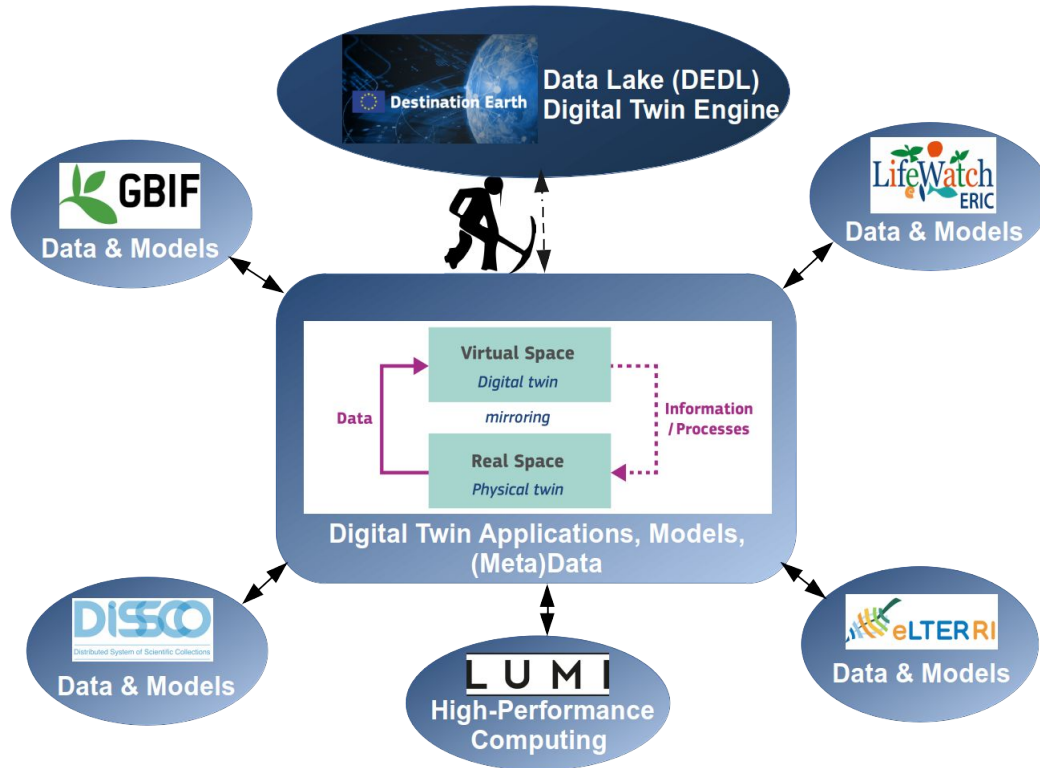
October 15-16, 2024. Darmstadt, Germany



UNIVERSITY  
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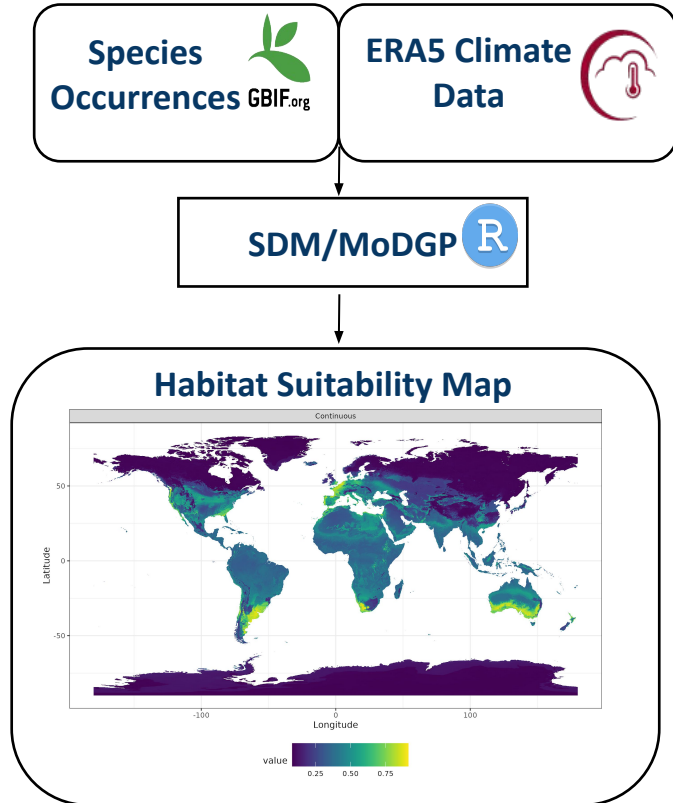


## Recap: Biodiversity Digital Twin (BioDT)

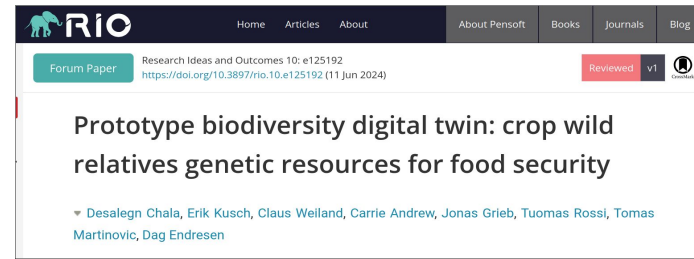


- [BioDT](#) Project: **Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities (HE)**
- Mobilize traceable data & models from environmental-related RIs like **DiSSCo**, **eLTER**, **LifeWatch ERIC** and **GBIF** for state-of-the-art modeling on HPC platforms (CSC's LUMI)
- Address biodiversity grand challenges such as biodiversity loss in the **anthropocene** due to climate change, land use, alien invasive species and zoonotic diseases by a set of DTs (cp. [Martinovič et al. 2024](#))

# A Biodiversity Digital Twin for Crop Wild Relatives (UiO's MoDGP)

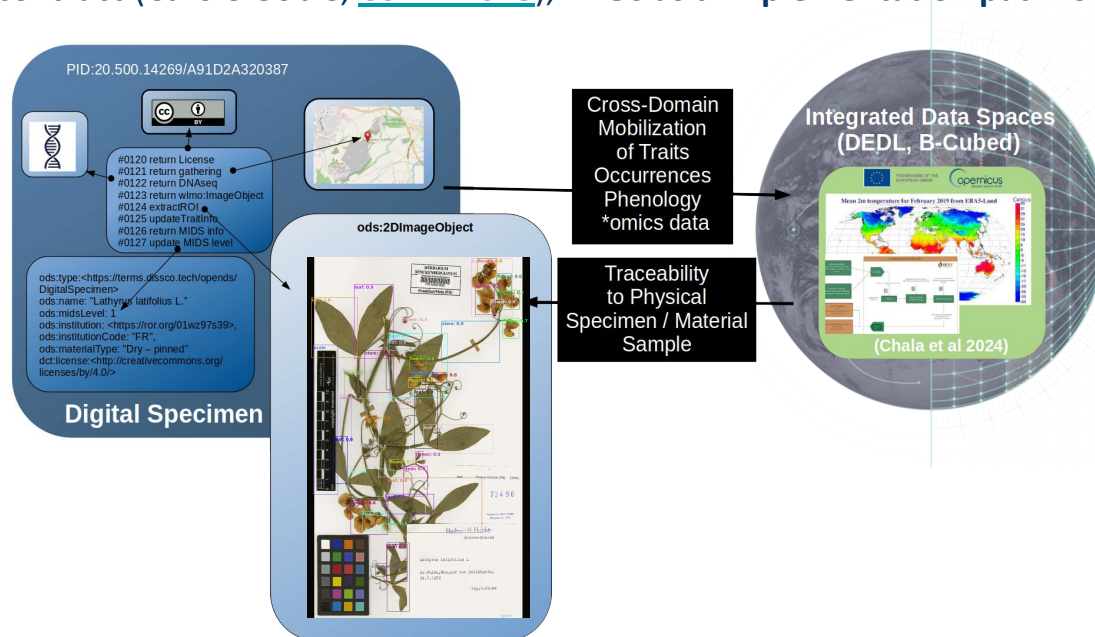


- MoDGP aims to identify novel genetic resources within crop wild relatives (CWR) that can **enhance the resilience of domesticated crops against current environmental changes and contribute to global food security in alignment with SDG 2 (“Zero Hunger Goal”)**
- Builds on **species distribution modelling (SDM, data source GBIF) involving climatic, topographic, and soil variables (ERA-5) to compute habitat suitability maps**
- **agroclim**: Blueprint study for the **integration of DT CWR into DEDL (UiO, SGN, EUMETSAT)**



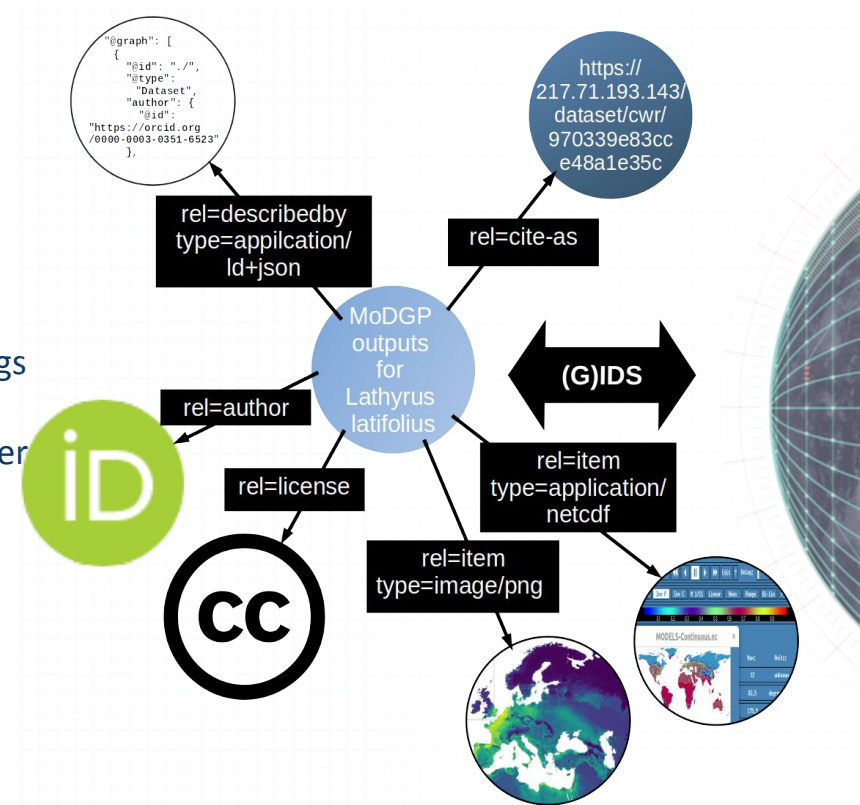
## Data model for DataSpace Integration: FAIR Digital Objects

- Aim: Mobilize (agro)biodiversity data for autonomous processing by machines (machine-actionability a core objective of FAIR) and cross-domain usage in integrated data spaces (B-Cubed/BMD, FC4EOSC, DEDL)
- Use a unified data model for machine-actionable knowledge units → FAIR Digital Objects ([FDOs](#))
- Consider *FAIR as a contract* (Carole Goble, [CoRDI 2023](#)), FDOs as a implementation path for fulfilling this contract



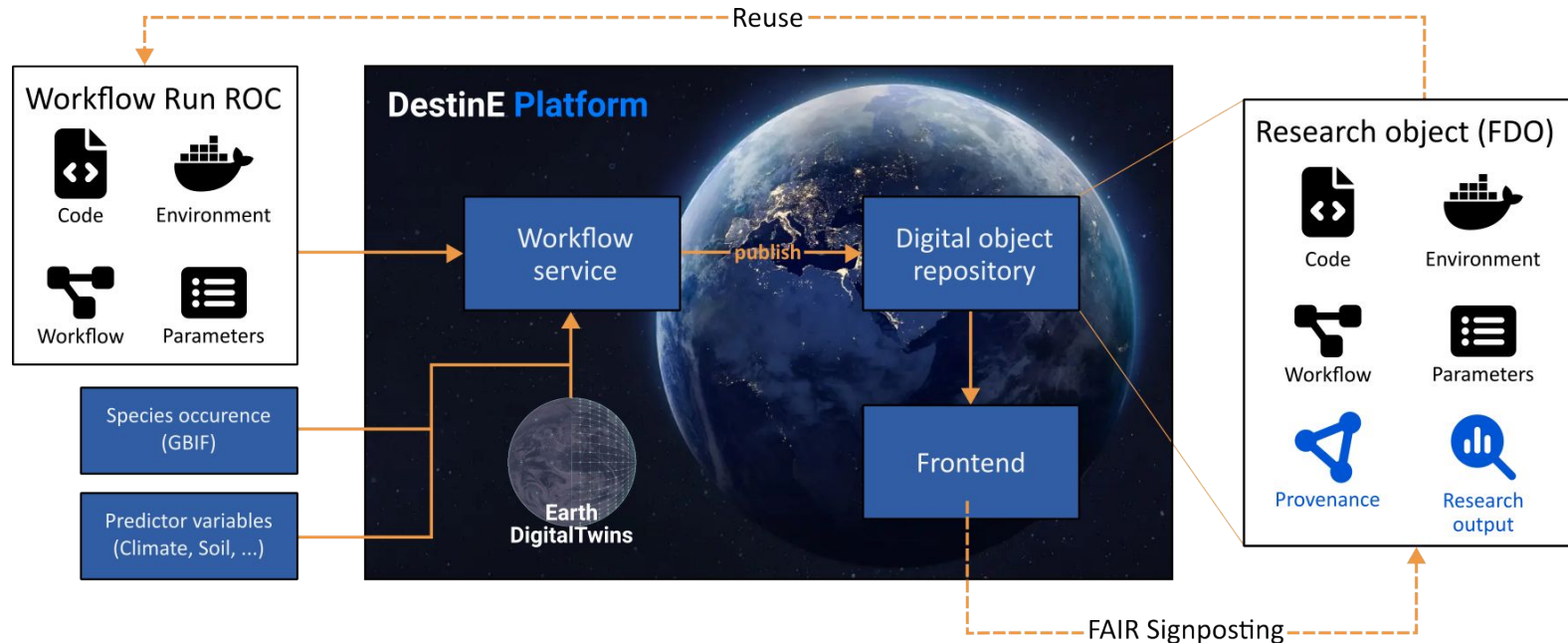
## “Webby” FDOs with FAIR Signposting

- We use **RO-Crate + FAIR Signposting** to set up an implementation path leveraging on common web technologies → **webby FDO**
- **RO-Crate**: Provides a lightweight container for the FAIR-compliant representation of research data with metadata, workflow descriptions (CWL) and schema mappings to make the data cross-domain re-usable (e.g. mapping the SpatioTemporal Asset Catalogues (STAC) format to the broader concepts in Bioschemas).
- **FAIR Signposting**: Add **machine-interpretable links to human-readable digital objects** using link relation types ([RFC8288](https://www.rfcs.org/rfcs/0288)) such as `item`, `cite-as`, `describedBy` to present the web topology of a resource

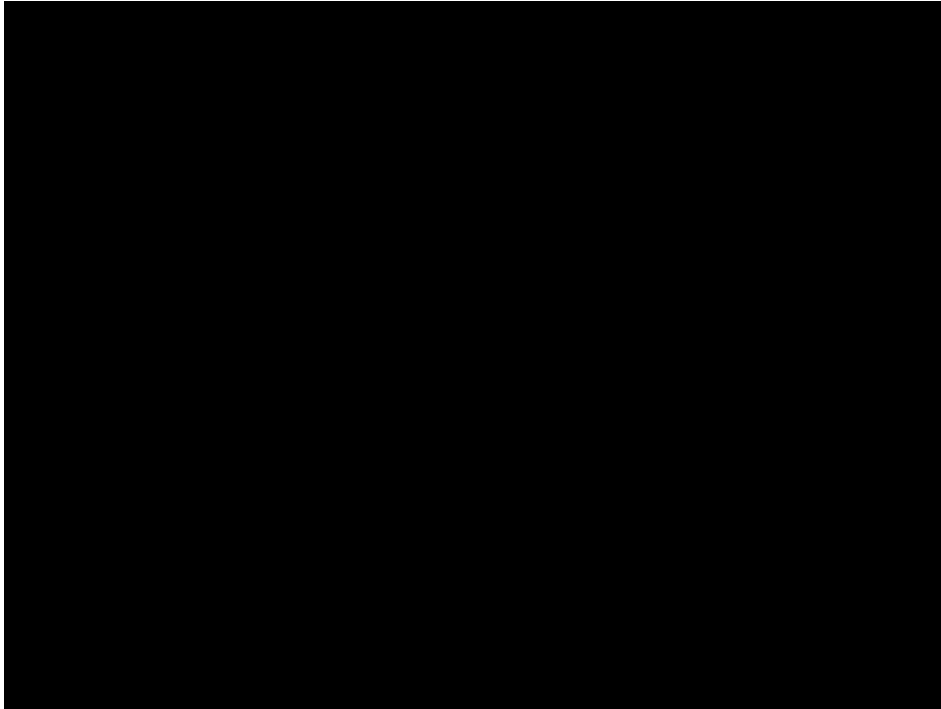


## Implementation Concept for DEDL integration (Daniel Bauer)

- Build prototype service with lightweight frontend for workflow deployment in DEDL
  - Backend: Leveraging on [CNRI's Cordra](#) middleware for managing digital objects at scale.
  - Frontend: Support FAIR Signposting plus interoperable workflow provenance ([Khan et al. 2019](#))



## agroclim workflow demo



<https://bit.ly/agroclimmov>

# Many Thanks!



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# Backup



# Achievements

A workflow platform for  
crop wild relatives

The screenshot shows a web browser window with a dark green header. The browser address bar shows a URL starting with 'https://217.71.193.143/da...'. The page title is 'Crop wild relatives'. In the top right corner of the header, there are links for 'Datasets', 'Workflows', 'Submit workflow', and 'Login'. The main content area is titled 'Species distribution models for Lathyrus'. Below this title is a 'Details' section containing a table of metadata. Underneath the details are three buttons: 'View Digital Object', 'View RO-Crate', and 'Download RO-Crate (zip)'. Below the buttons is a 'Provenance' section with a table of workflow information. At the bottom is a 'Visualization' section showing a partial graph with nodes labeled '@type: Dataset' and 'author'.

**Crop wild relatives** Datasets Workflows Submit workflow Login

### Species distribution models for Lathyrus

#### Details

PID:	cwr/ba3f7488a84a9060405a
Description:	Species distribution model for Lathyrus
Keywords:	Lathyrus, ModGP, SDM, Crop wild relatives
Published:	2024-08-14T02:22:00.280Z
Author(s):	Daniel Bauer ( <a href="https://orcid.org/0000-0001-9447-460X">https://orcid.org/0000-0001-9447-460X</a> )
License:	<a href="https://spdx.org/licenses/CC-BY-NC-SA-4.0">https://spdx.org/licenses/CC-BY-NC-SA-4.0</a>
Created at:	23 Aug. 2024 11:08 UTC
Last modified:	14 Aug. 2024 02:08 UTC

View Digital Object View RO-Crate or Download RO-Crate (zip)

#### Provenance

Agent:	Daniel Bauer ( <a href="https://orcid.org/0000-0001-9447-460X">https://orcid.org/0000-0001-9447-460X</a> )
Instrument:	<a href="#">workflow.yaml</a> (Argo workflow definition) <a href="#">Resubmit workflow</a>
Start Time:	13 Aug. 2024 09:08 UTC
End Time:	14 Aug. 2024 01:08 UTC
Parameters:	<b>species:</b> Lathyrus <b>numberOfCores:</b> 9 <b>modgpSource:</b> <a href="https://github.com/BioDT/uc-CWR.git">https://github.com/BioDT/uc-CWR.git</a> <b>modgpRevision:</b> main

#### Visualization

@type: Dataset  
author

# Machine-Actionability through RO-Crates and FAIR Signposting

Signposting.org metadata: this page is of the type described at <https://schema.org/ItemPage>

Signposting.org metadata: this page is of the type described at <https://schema.org/Dataset>

Signposting.org metadata: this page is authored by <https://orcid.org/0000-0001-9447-460X>

Signposting.org metadata: this page is licensed according to <https://spdx.org/licenses/CC-BY-SA-4.0>

Signposting.org metadata: this page should be cited as <https://doi.org/10.26434/chemrxiv-2024-08-26t13>

Signposting.org metadata: this page is described by <https://217.71.193.143/dataset/cwr/059ec70eae551253061?format=ROCrates&download=true> (application/json)

Signposting.org metadata: this page is described by <https://217.71.193.143/dataset/cwr/059ec70eae551253061?format=ROCrates&download=true> (application/zip)

Signposting.org metadata: this page has an item at [https://217.71.193.143/api/objects/cwr/fea87af8a5f4796442b9?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/src/Exports/ModGP/Lycopodium\\_SDMData.RData](https://217.71.193.143/api/objects/cwr/fea87af8a5f4796442b9?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/src/Exports/ModGP/Lycopodium_SDMData.RData) (application/octet-stream)

Signposting.org metadata: this page has an item at [https://217.71.193.143/api/objects/cwr/d30b104e85dc95c0bb6?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/main\\_log](https://217.71.193.143/api/objects/cwr/d30b104e85dc95c0bb6?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/main_log) (application/vnd.hp-hpgl)

Signposting.org metadata: this page has an item at [https://217.71.193.143/api/objects/cwr/93fac4504e40a387b7a19a?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-4267039332/main\\_log](https://217.71.193.143/api/objects/cwr/93fac4504e40a387b7a19a?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-4267039332/main_log) (inode/x-empty)

Signposting.org metadata: this page has an item at <https://217.71.193.143/dataset/cwr/daDce9dc4e7efce93bcf&format=ROCrates> (application/json)

Signposting.org metadata: this page has an item at <https://217.71.193.143/dataset/cwr/a556b00d40f16db3e4018&format=ROCrates> (application/json)

Signposting.org metadata: this page has an item at <https://217.71.193.143/api/objects/cwr/93c1623a4ca5d1eb64bd?payload=workflow.vaml> (text/vaml)

[View Digital Object](#) [View RO-Crate](#) or [Download RO-Crate \(zip\)](#)

### Provenance

Agent:	Daniel Bauer ( <a href="https://orcid.org/0000-0001-9447-460X">https://orcid.org/0000-0001-9447-460X</a> )
Instrument:	<a href="#">workflow.vaml</a> (Argo workflow definition)
Start Time:	26 Aug. 2024 12:08 UTC
End Time:	26 Aug. 2024 13:08 UTC
Parameters:	species: Lycopodium numberOfCores: 9 modgpSources: <a href="https://github.com/BioDTuc-CWR-git">https://github.com/BioDTuc-CWR-git</a> modgpRevision: main

### Visualization

⊙ type: Dataset



## Workflow Run RO-Crate

```
1 // 20240826176130
2 // https://217.71.193.143/dataset/cwr/059ec70eae551253061?format=ROCrates&download=true
3
4 {
5   "@context": [
6     "https://w3id.org/ro-crate/1.0",
7     "https://w3id.org/ro-crate/1.0/ro-crate",
8   ],
9   "@graph": [
10    {
11      "@id": "-/",
12      "@type": "Data",
13      "author": {
14        "@id": "https://orcid.org/0000-0001-9447-460X",
15        "name": "Daniel Bauer",
16        "conformsTo": [
17          "https://w3id.org/ro-crate/1.0/ro-crate",
18          "https://w3id.org/ro-crate/1.0/ro-crate",
19        ],
20      },
21      "hasPart": [
22        {
23          "@id": "https://217.71.193.143/dataset/cwr/daDce9dc4e7efce93bcf&format=ROCrates",
24          "@type": "Data",
25          "description": "Crop Wild Relatives distribution modeling workflow using ModGP for Lycopodium. Lycopodium is not not actually a crop species, but serves as a good test genus due to the limited amount of species in this genus (and thus the short workflow execution runtime). Lycopodium is a genus of clubmosses within the family Lycopodiaceae. These perennial, evergreen plants are characterized by their small, needle-like or scale-like leaves arranged in spirals or whorls along the stems. Lycopodium species reproduce via spores rather than seeds and often form dense mats in forests, particularly in moist, shaded environments.",
26          "hasPart": [
27            {
28              "@id": "https://217.71.193.143/api/objects/cwr/fea87af8a5f4796442b9?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/src/Exports/ModGP/Lycopodium_SDMData.RData",
29              "@type": "Data",
30            },
31            {
32              "@id": "https://217.71.193.143/api/objects/cwr/d30b104e85dc95c0bb6?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-2702153151/main_log",
33              "@type": "Text",
34            },
35            {
36              "@id": "https://217.71.193.143/api/objects/cwr/93fac4504e40a387b7a19a?payload=7c48b530-6b51-43ff-9112-cd4abc1fde98-4267039332/main_log",
37              "@type": "Text",
38            }
39          ]
40        }
41      ]
42    }
43  ]
44 }
```

[Linked Open Data](#) [Executable](#) [Discoverable](#) [Reproducible](#)

<https://www.researchobject.org/> community  
WRROC: <https://doi.org/10.48550/arXiv.2312.07852>

Crop wild relatives Datasets Workflows Submit workflow Logout

Submit workflow as RO-Crate

**1. Upload Workflow RO-Crate**

*Note: Upload must be a zip file following the [Workflow RO-Crate](#) specification. The workflow must be in yaml format and be a valid [Argo Workflow](#).*

No file chosen

**2. Edit Workflow**

**Metadata**

**Title:**  
Species distribution models for Lathyrus

**License:**  
Creative Commons Attribution Non Commercial Share Alike 4.0 International

**Description:**  
Species distribution models for Lathyrus

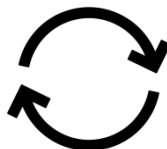
Submit workflows

Crop wild relatives Datasets Workflows Submit workflow Logout

**Workflows**

Name/Internal name	Submitter	Started	Finished	Duration	Status
Species distribution models for Lathyrus <a href="#">aaab97a-c567-4875-b395-8320e9358b40</a>	Daniel Bauer <a href="#">0009-0001-9447-690X</a>	26 Aug. 2024 13:08:32 UTC		1 hour, 17 minutes	Running
Species distribution models for Lycopodium <a href="#">7c49b530-5061-438f-9112-c448c116e88</a>	Daniel Bauer <a href="#">0009-0001-9447-690X</a>	26 Aug. 2024 12:08:20 UTC	26 Aug. 2024 13:08:08 UTC	50 minutes	Succeeded
Species distribution models for Lathyrus <a href="#">5232a25a-9477-4ceb-a384-561a47dad95c</a>	Claus Weiland <a href="#">0009-0003-0251-6523</a>	22 Aug. 2024 13:08:47 UTC	22 Aug. 2024 14:08:27 UTC	48 minutes	Succeeded
Test Dataset Resubmitted <a href="#">9229378c-3c41-4c08-ac4d-79c59c8ab43</a>	Daniel Bauer <a href="#">0009-0001-9447-690X</a>	21 Aug. 2024 14:08:18 UTC	21 Aug. 2024 14:08:49 UTC	0 minutes	Succeeded
Species distribution models for Lathyrus <a href="#">506a97b-5987-4a1b-b20c-4f438e92a92</a>	Daniel Bauer <a href="#">0009-0001-9447-690X</a>	13 Aug. 2024 09:08:46 UTC	14 Aug. 2024 01:08:04 UTC	16 hours, 16 minutes	Succeeded
Test Dataset <a href="#">1c711389-175c-48a0-388a-e141d19f3804</a>	Daniel Bauer <a href="#">0009-0009-0564-5112</a>	13 Aug. 2024 08:08:46 UTC	13 Aug. 2024 09:08:16 UTC	0 minutes	Succeeded

Monitor progress



Crop wild relatives Datasets Workflows Submit workflow Logout

**Species distribution models for Lathyrus**

**Details**

**PID:** cwr/iba3f7488a84a9060405a

**Description:** Species distribution model for Lathyrus

**Keywords:** Lathyrus, ModGR, SDM, Crop wild relatives

**Published:** 2024-08-14T02:22:00 ZB0Z

**Author(s):** Daniel Bauer (<https://orcid.org/0000-0001-9447-690X>)

**License:** <https://spdx.org/licenses/CC-BY-NC-SA-4.0>

**Created at:** 23 Aug. 2024 11:08 UTC

**Last modified:** 14 Aug. 2024 02:08 UTC

or

**Provenance**

Author: Daniel Bauer (<https://orcid.org/0000-0001-9447-690X>)

Reuse workflows

Crop wild relatives Datasets Workflows Submit workflow Logout

**Datasets**

Datasets found: 10

**Lycopodium deuterodensum**  
cwr/da556b00d40f16db3c401

**Description:**

**Files:** 12

**License:** <https://spdx.org/licenses/CC-BY-SA-4.0>

**Has workflow?** No

**Has Provenance?** No

Created: 26 Aug. 2024 13:08 UTC, Last modified: 26 Aug. 2024 13:08 UTC

**Lycopodium densum**  
cwr/da0ce9dc4e7efce93bcf

**Description:**

**Files:** 12

**License:** <https://spdx.org/licenses/CC-BY-SA-4.0>

**Has workflow?** No

View results