





# NFDI4Earth

Deliverable D4.3.4

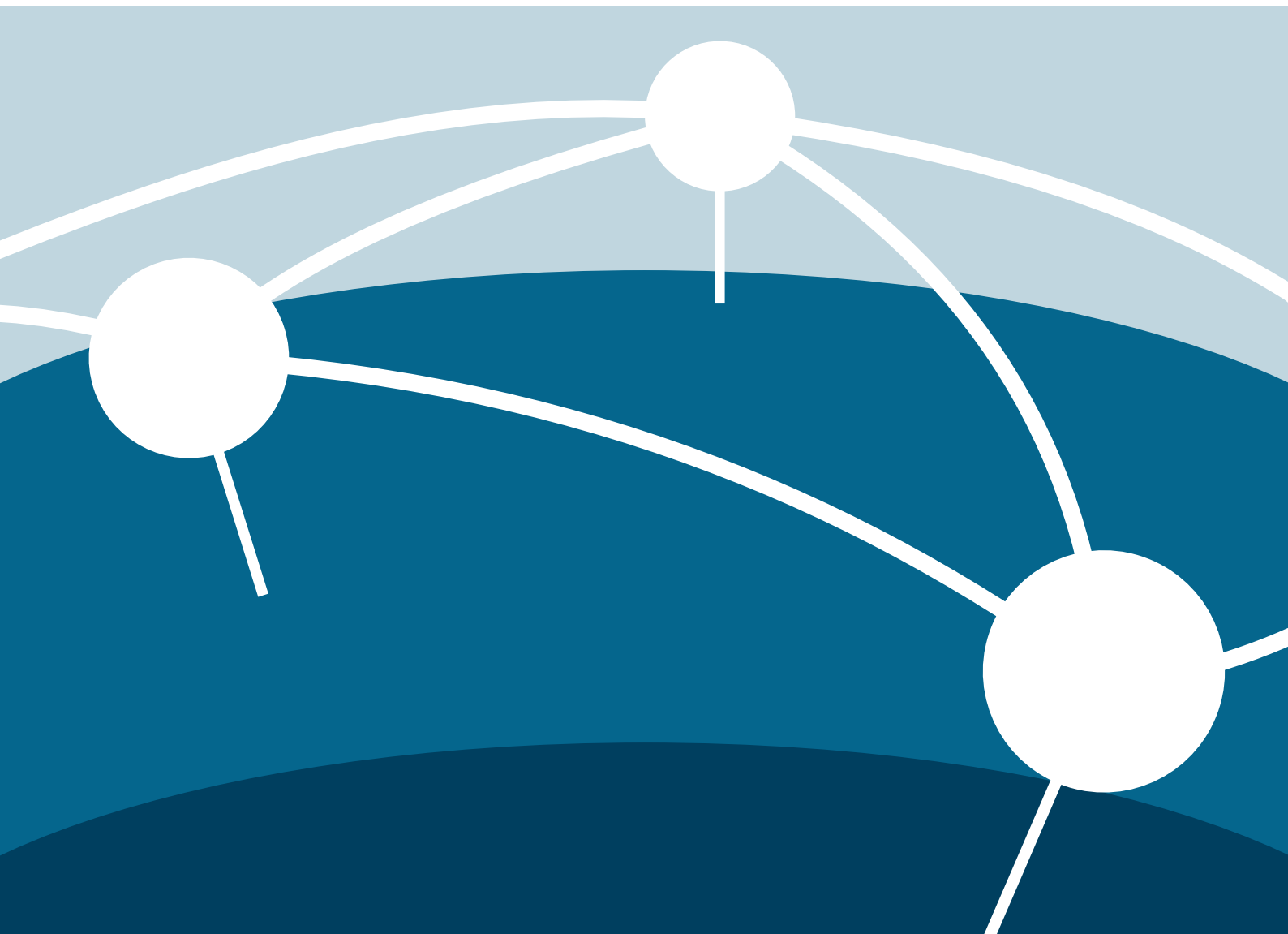
## OneStop4All - Implementation Strategy, Evaluation and Selection of Software

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2023-12

DOI: [10.5281/zenodo.13629130](https://doi.org/10.5281/zenodo.13629130)

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## Citation

Christin Henzen, Auriol Degbelo, Markus Konkol, Jan Schulte, Arne Vogt, Christoph Wagner, Ralf Klammer, Simon Jirka. 2024. *OneStop4All - Implementation Strategy, Evaluation and Selection of Software (NFDI4Earth Deliverable D4.3.4)*. NFDI4Earth Community on Zenodo. <https://doi.org/10.5281/zenodo.13629130>

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## Acknowledgement

This work has been funded by the German Research Foundation (DFG) through the project NFDI4Earth (DFG project no. 460036893, <https://www.nfdi4earth.de/>) within the German National Research Data Infrastructure (NFDI, <https://www.nfdi.de/>).

## Executive summary

The OneStop4All is the primary visual and user-friendly access point to the NFDI4Earth virtual research environment and provides a harmonised view on relevant RDM resources for the Earth System Sciences (ESS) community. In this deliverable, we build on the requirement and concept design as described in [Deliverable D4.3.1](#). We present the implementation strategy, software decisions and software implementation results of the first series of sprints.

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## 1 Introduction

The OneStop4All is the primary visual and user-friendly access point to the NFDI4Earth virtual research environment and provides a harmonised view on relevant RDM resources for the Earth System Sciences (ESS) community. The implementation of the OneStop4All should therefore be flexible enough to align with the extensions and updates of the NFDI4Earth core services and to meet the demands of the growing and culturally changing ESS community and open-source community.

The OneStop4All is designed and implemented iteratively. This Deliverable builds on the results of the Deliverable D4.3.1 (Henzen *et al.*, 2023), which includes a detailed description on the requirements engineering and design process. Here, we present the implementation strategy with its main pillars, targeted results within software development phases as well as selected rationale for the choice of software solutions.

## 2 Implementation Strategy

The implementation of the OneStop4All is driven by the needs of the ESS community. These needs can be viewed as having a “domain-independent” component and “domain-dependent” component. The domain-independent component refers to tasks that are still challenging for researchers to execute, irrespective of their fields of specialisation within the ESS. The domain-dependent component takes into account the peculiarities of each subdiscipline (e.g., various degrees of awareness of and maturity levels in the implementation of the FAIR principles) in the offer of solutions. We briefly discuss these two aspects under the headings *RDM services* and *application domains* below.

*RDM services:* NFDI4Earth targets four major types of services (called “general use cases” in D4.3.1) through the OneStop4All: discovery (i.e. find resources relevant to the researchers’ current tasks), publishing (i.e. find appropriate metadata standards and repositories to publish their research information products), RDM support (i.e. obtain help when they have issues on tasks related to research data management), and tools to create new information products (e.g. visualisations, analysis results) based on existing ones (e.g. datasets).

*Application domains (a.k.a. subdisciplines):* The boundaries of the ESS are challenging to precisely define, but the following areas mentioned in previous deliverables can be given as an illustration.

- D1.3.1 by Sadeghi *et al.* (2023), based on the DFG subject area classification: Atmospheric Science, Cartography, Climate Research, Geochemistry, Geodesy, Geoinformatics, Geography, Geology, Geophysics, Hydrology, Hydrogeology, Human Geography,

Integrated Water Resources Management, Limnology, Mineralogy, Oceanography, Paleontology, Petrology, Photogrammetry, Physical Geography, Remote Sensing, Urban Water Management, Water Chemistry, Water Research.

- D4.3.2 by Degbelo *et al.* (2023): Astrophysics, Astronomy, Atmospheric Sciences (e.g., Climatology, Meteorology), Geochemistry, Geodesy, Cartography, Geography, Geoinformatics, Geology, Paleontology, Geophysics, Hydrology, Ecology, Mineralogy, Crystallography, Oceanography, Planetology, Remote Sensing, Photogrammetry, and Soil Sciences.

While the long-term goal is to have operational, fully-functional services for all user groups in these communities, the path towards this goal is incremental progress. Hence, the key pillars of the OneStop4All implementation strategy include:

- 1) Incremental implementation of RDM services: the four types of services mentioned above are envisioned long-term NFDI4Earth services accessible through the OneStop4All. As mentioned in D4.3.1, the focus of the first development cycle for the OneStop4All is on discovery services.
- 2) Incremental coverage of ESS subdisciplines: a means of addressing needs of the subdisciplines within NFDI4Earth is through the NFDI4Earth pilots. As described in D1.1.5 (Grupp, 2023), the first round of the NFDI4Earth pilots covered domains such as Paleontology, Climate and Earth System Modelling, Freshwater Research, Geophysics, Marine geophysics, Landscape Ecology, and Remote Sensing. The integration of the results of the first pilots and the results from the following pilots into the OneStop4All is ongoing work, and a measure towards gradually covering the subdiscipline-specific ESS needs.
- 3) Reuse of open-source solutions, wherever appropriate, to achieve 1 and 2.

From the software development point of view, the development is iterative, taking into account all usual stages of software development. An overview of these phases and related results is presented in Tab. 1. The implementation is done according to the principles of the AGILE manifesto (<https://agilemanifesto.org/>), and we borrow the idea of sprints from the SCRUM guide (Sutherland and Schwaber, 2020).

**Table 1:** OneStop4All implementation phases and results

Phase	Targeted and achieved results
Requirement analysis	The results are described in Deliverable D4.3.1 and include high-level requirements and scenarios.
Evaluation of software	<p>We systematically evaluated solutions of other NFDI consortia as well as open-source solutions, e.g., catalogue software.</p> <p>As the other solutions did not fulfil the requirements, we   proposed to develop a custom open-source solution, which was decided by the NFDI4Earth architecture team.</p>
Design of the software	Results of this phase are detailed mockups implemented in Figma, which were ready to use for implementations. A preliminary mockup version is described in Deliverable D4.3.1.
Implementation	<p>The developments are organised along sprints. Sprints were used to implement</p> <ul style="list-style-type: none"> <li>• the backend, e.g., to set up the search index based on the NFDI4earth Knowledge Hub.</li> <li>• the logic for the user interface based on the mockups.</li> <li>• for combining backend &amp; frontend search</li> </ul>
Testing	The tests are organised along the sprints. We set up a specific test instance as well as productive system.
Deployment	There will be annual releases. The first release is planned step-wise as soft release with internal feedback and followed by a hard release.
Share source code with the community	We will provide NFDI4earth OneStop4All features implemented in Open Pioneer to the community and envision to support and benefit from the community for later stages as described in the Deliverable D4.3.4

## 3 Evaluation and Selection of Software

### 3.1 Requirements

The following two tables from D4.3.1 summarises the user experience requirements and technical requirements for the OneStop4All, as of this writing. These requirements have guided the selection process of the solutions to build the OneStop4All.

**Table 2:** High-level user experience requirements for the OneStop4All.

Category	Main requirements
General usability and user experience	<p>Follow general usability and user experience guidelines for Web applications with particular respect to discovery and exploration. That includes for instance:</p> <ul style="list-style-type: none"> <li>• Shneiderman's mantra: Overview first, zoom and filter, then details-on-demand</li> <li>• Nielsen's: 10 Usability Heuristics for User Interface Design</li> </ul>
Resource discovery	<p>Enable user-friendly, easy discovery and access of relevant ESS resources</p> <ul style="list-style-type: none"> <li>• Provide useful search and filter functionality for the given metadata and data so that users can select resources that best fit their requirements</li> <li>• Offer a problem-oriented navigation concept to guide the users</li> <li>• Provide a coherent and structured overview on metadata for a resource and information on linked resources</li> <li>• Provide action items to easily access related resources or the data source</li> <li>• Allow easy identification of NFDI4Earth labelled services</li> </ul>
Resource access	<p>Enable user-friendly, easy access to relevant ESS resources</p> <ul style="list-style-type: none"> <li>• Offer easy access to data and services, e.g., via harmonised metadata</li> <li>• Allow easy and user-friendly access to Living Handbook articles and navigation through the article</li> <li>• Provide access to a helpdesk</li> </ul>



Category	Main requirements
Resource publication	<p>Support users in finding repositories and metadata standards to easily complete publication</p> <ul style="list-style-type: none"> <li>• Offer means of identifying the most relevant portal in the ESS to publish a given resource</li> <li>• Suggest metadata standards relevant to the publication of a given resource, based on its description</li> </ul>

**Table 3:** High-level technical requirements for the OneStop4All.

Category	Main requirements
General software development	<ul style="list-style-type: none"> <li>• Follow the NFDI4Earth software architecture constraints, e.g., uses an established programming language and is provided as Free and Open Source (FOSS)</li> </ul>
Linking to NFDI4Earth-developed services	<ul style="list-style-type: none"> <li>• Use the NFDI4Earth Knowledge Hub as central metadata and data source via API</li> <li>• Provide a comprehensive user interface for the Living Handbook</li> <li>• Link to the EduTrain learning management system and shows information on training materials based on their metadata stored in the Knowledge Hub</li> </ul>
Future extensions	<ul style="list-style-type: none"> <li>• Integrate a form to contact the User Support Network</li> <li>• Allow for the integration of future and existing services, e.g., visualisation services</li> <li>• Allow for the presentation of new/updated resource types from the NFDI4Earth Knowledge Hub</li> <li>• Allow for the integration of NFDI base services whenever possible, e.g., IAM service</li> </ul>

Some of the requirements mentioned above imply hard constraints, for instance:

- The NFDI4Earth Knowledge Hub can be accessed through a SPARQL endpoint. Hence, the solution should enable fast search over RDF data.
- Articles of the Living Handbook are available as Markdown documents. Hence, the solution should support seamless rendering (and editing) of various types of Markdown documents.

## 3.2 Selection of Software

CKAN (<https://github.com/ckan/ckan>), the popular open-source data portal platform, was considered at an early stage of the project, but it lacks the necessary flexibility w.r.t. custom rendering of markdown documents and rights management for the metadata. Hence, a customised solution was found more appropriate. As for the choice of the web-based development framework, Open Pioneer Trails was chosen as it provides a flexible and powerful Geo IT solution for web clients.

The chosen solution Open Pioneer Trails:

- Fulfils the functional and non-functional requirements
- Is licensed under Apache License 2.0
- Is implemented in JavaScript (React, TypeScript) and follows structures and concepts of a reusable and sustainable software project (<https://github.com/open-pioneer/>)
- Offers a simple architecture
- Supports extension and integration. For instance, Open Pioneer builds upon React (<https://react.dev/>), one of the leading frontend libraries that allows to use OpenLayers (<https://openlayers.org/>) for map visualisations and D3 (<https://d3js.org/>) for charts and figures.

The current version of the OneStop4All is available at: <https://onestop4all.nfdi4earth.de/>. Examples of useful functionalities, tailored to the needs of the projects, that were developed through Open Pioneer include:

- Search index for the entities in the triple store: The OneStop4All Harvester (<https://git.rwth-aachen.de/nfdi4earth/onestop4all/onestop4all-harvester>) is built on top of the Knowledge Hub triplestore and allows a faster search. We choose the Apache Solr search platform (<https://solr.apache.org/>) to create the search index.
- Rendering of Living Handbook articles using React-Markdown.
- Table of contents for Living Handbook articles.
- Custom facets for the exploration of entities from the Knowledge Hub.

The source code is published on GitLab under the Apache 2.0 License: <https://git.rwth-aachen.de/nfdi4earth/onestop4all>. The GitLab projects are also used to organise and document the sprints. Finally, the code is shipped as Docker containers to ensure smooth deployment and testing.

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