





NFDI4Earth

Deliverable D4.3.3

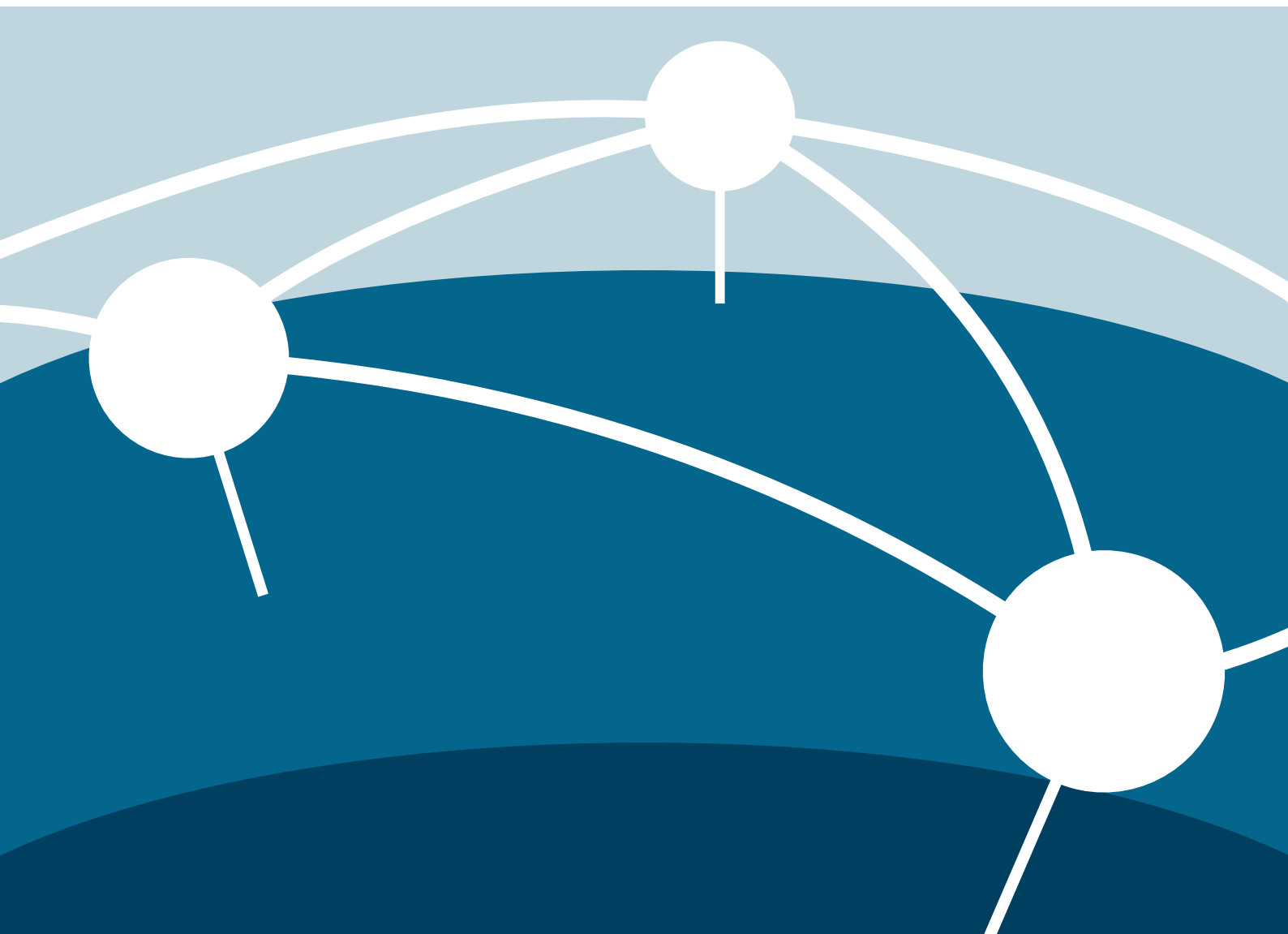
Cooperation strategy with existing GI Open-Source Software Frameworks and Platforms

Christin Henzen  (christin.henzen@tu-dresden.de), Daniel Nüst ,
Auriol Degbello , Felix Cremer 

2024-03

DOI: [10.5281/zenodo.13629353](https://doi.org/10.5281/zenodo.13629353)

nfdi4earth.de



Citation

Christin Henzen, Daniel Nüst, Auriol Degbelo, Felix Cremer. 2024. *Cooperation strategy with existing GI Open-Source Software Frameworks and Platforms (NFDI4Earth Deliverable D4.3.3)*. NFDI4Earth Community on Zenodo. <https://doi.org/10.5281/zenodo.13629353>

License

This work is licensed under a [Creative Commons "Attribution 4.0 International"](#) license.



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

NFDI4Earth deals with several software solutions for a variety of data types in the Earth System Sciences, ranging from customised solutions to well-known and well-maintained standard software products. To coordinate the organisational, methodological and technical aspects of software developments in NFDI4Earth, we developed the following cooperation strategy.

Contents

- 1 Introduction** **1**
- 2 Cooperation strategy** **2**
 - 2.1 Action plan 2
 - 2.2 Snapshot of Cooperation and Contribution Activities to OSS in ESS 4

1 Introduction

NFDI4Earth deals with numerous software solutions for a variety of data types in Earth System Sciences (ESS), ranging from customised solutions to well-known and well-maintained standard software products. As described in the proposal¹, the NFDI4Earth consortium contributes to established software projects, supports the development of needed solutions with funding, and develops central support services for the Earth System Science community, e.g., for (meta)data discovery. The NFDI4Earth consortium has thus agreed on the principles of sharing its open-source code as an extension of the FAIR principles.

Within NFDI4Earth, Measure 4.3 (Central Support Services) manages and supports the federated implementation of the NFDI4Earth-developed services and accompanies the development of quality-assured open-source software solutions, e.g., with support infrastructure or coordination of distributed developer teams. Moreover, Measure 2.5 (Advancing Tools) provides guidance and best practices for open-source software developments on research data management and data analysis, taking data cubes as examples, and enhances existing solutions when needed. Measure 3.3 also gathers best practices on software through providing and editing the NFDI4Earth Living Handbook.

NFDI4Earth meets two broad areas of open-source software projects. On the one hand, NFDI4Earth uses and extends general purpose software in the context of the NFDI4Earth services, in particular the NFDI4Earth-developed central support services, e.g., open-source databases or generic infrastructure tools to provide metadata as linked open data, tools for hosting and provisioning, or libraries used to build user interfaces. On the other hand, NFDI4Earth supports discipline-specific tools for use within the ESS. NFDI4Earth thus supports feature developments and innovative approaches for data science applications in ESS in the context of NFDI4Earth pilots and incubators. In the future, we expect these areas to connect more closely, e.g., in the form of a community platform for pilots, by expanding discipline-specific tools to connect with the NFDI4Earth services, or by contributing extensions needed for handling ESS use cases back to general purpose software.

To coordinate organisational, methodological and technical aspects of software developments in NFDI4Earth, we developed the following cooperation strategy. This strategy concerns both areas of development and the interaction with the respective development communities of software projects.

¹ <https://doi.org/10.5281/zenodo.5718944>

2 Cooperation strategy

When NFDI4Earth-developed services and software become part of ESS researchers' daily routines and basis for further developments, managing the software and aligning the developments with those of neighbouring services and software needs a strategy.

Our vision is to openly share and re-use software facilitating the progress towards digital RDM approaches for the Earth System Sciences by collaborating with and contributing to national and international communities on both conceptual and technical aspects. We thus identified the following key objectives for the NFDI4Earth consortium:

- facilitate the cultural change towards more **FAIRness and Openness** in ESS software development, including the recognition of software as a research output
- facilitate **harmonisation** efforts in the ESS standards
- foster **sustainability** in terms of infrastructure
- support **innovative** RDM developments according to the community needs
- foster and contribute to **community-driven** developments
- ensure **free use** of the NFDI4Earth-developed and -maintained services for all members of the international ESS community

2.1 Action plan

The key objectives are implemented with the following actions:

A1 Inventory of open-source software developed by NFDI4Earth members and used frameworks and platforms

In close cooperation with M2.5 und M3.3, we provide an overview of existing NFDI4Earth open-source software, that is software developed and used by NFDI4Earth members, and we continuously identify relevant frameworks and platforms. The inventory is realised as a collection of software products and projects as first level resources alongside data and articles in the NFDI4Earth Knowledge Hub (KH). The KH harvests and draws software metadata from multiple sources, e.g., software development repositories and software catalogues.

A2 Provision of services to manage NFDI4Earth open-source software projects

NFDI4Earth manages and provides services to facilitate development of open-source software and support the cooperation with relevant partners. This includes the NFDI4Earth GitLab

hosted at the RWTH Aachen (<https://git.rwth-aachen.de/nfdi4earth/>) and human support.

A3 Open-source software stack for NFDI4Earth core components

NFDI4Earth considers open-source software for the NFDI4Earth core components whenever possible. Moreover, NFDI4Earth publishes own developments as open source, including both extensions of existing solutions and new own projects. Software developments under NFDI4Earth leadership and control aim to be interoperable, use open technical specifications, provide open documentation, be open to external collaboration. Furthermore, a project life cycle, including, e.g., discontinuation of stale projects, is targeted.

A4 Promotion of and contribution to ESS standards

In ESS, software development can build on established standards, in particular for metadata, data and services. The NFDI4Earth software developers are encouraged to use existing standards, e.g., ISO19xxx series², Open Geospatial Consortium (OGC)³ standards, GeoDCAT, and to collaborate and contribute to (community) standard developments.

A5 Community building and event platform

The ESS software developer community is broad, covering different Earth System Sciences compartment aspects, e.g., geostatistics or data cubes, and providing solutions in diverse programming languages. NFDI4Earth faces the heterogeneity of ESS implementation knowledge and aims to provide a platform for community building and supports events, such as the workshop on "Spatial Data Science across Languages⁴". With these activities NFDI4Earth also aims to build bridges between developers and users of geospatial software.

A6 Support for NFDI4Earth software developers in legal aspects

NFDI4Earth supports software developers in the selection, application, and maintenance of a proper software license and in questions regarding copyright. As an example, NFDI4Earth provides a common license statement on using the Apache License 2.0 for the NFDI4Earth-developed services, i.e., OneStop4All, Living Handbook and Knowledge Hub. While no

² <https://www.iso.org/home.html>

³ <https://www.ogc.org/>

⁴ <https://r-spatial.org/sdsl/>

overarching legally binding advice can be given, established practices are documented for the development teams and centrally coordinated via Measure 4.3.

A7 Guidelines and best practices

NFDI4Earth develops guidelines and provide good practices on developing open-source software for the Earth System Sciences. The seed of these guidelines are the publicly developed and shared Developer Guidelines for projects developed by NFDI4Earth members for NFDI4Earth. An important source for demands on guidance in the context of open-source software are related inquiries of the NFDI4Earth User Support Network (USN)⁵.

A8 Transparency and communication

NFDI4Earth demonstrates an active role in using and developing open-source software. Moreover, NFDI4Earth supports the developers within NFDI4Earth, for instance with proper communication channels and with well-documented source code.

2.2 Snapshot of Cooperation and Contribution Activities to OSS in ESS

To identify relevant projects, we performed an initial landscape analysis of national and international initiatives on the development of Geoinformatics open-source software frameworks and platforms, like the Open Source Geospatial Foundation (OSGeo⁶) and the FOSSGIS e.V.⁷. Moreover, a cultural change in academia, the better understanding of business models around open-source, and shifts in political and funder policy⁸ lead to the publication of GI open-source projects by companies⁹, and research projects alike, e.g., via institutional GitHub/GitLab repositories¹⁰. As the landscape for existing OSS is diverse, here, we provide an overview of selected projects and networks NFDI4Earth is contributing to.

⁵ Lorenz, S., Mehrstens, H., Getzlaff, K., Munke, J., & Müller-Pfefferkorn, R. (2023). Concept for the organisation of a distributed user support network (USN) in NFDI4Earth (NFDI4Earth Deliverable D2.2.1b). Zenodo. <https://doi.org/10.5281/zenodo.7912702>

⁶ OSGeo (<https://www.osgeo.org/>) serves as umbrella for several high-quality GI software products and libraries, e.g., GeoNode, GeoNetwork, GeoServer, GDAL, and OpenLayers.

⁷ FOSSGIS (<https://www.fossgis.de/>) acts as local OSGeo chapter for German speaking countries.

⁸ For instance, as driven by the FSFE's Public Money Public Code campaign, see <https://publiccode.eu/>.

⁹ For instance, con terra's map.apps: <https://docs.conterra.de/de/mapapps/latest/index.html>

¹⁰ For instance, <https://git.geomar.de/>, <https://git.rwth-aachen.de/>, or <https://github.com/GeoinformationSystems>

Table 1: Selected Research Projects, Networks, and Initiatives with open-source developments (alphabetic order)

Name	Description and Relevance
BITS - BluePrints for the Integration of Terminology Services in Earth System Sciences	<p>The BITS project¹¹ aims at developing a terminology service for subfields of climate science and geoscientific collections (involving curated objects from mineralogy, petrology, and palaeontology).</p> <p>NFDI4Earth supports the development of the concept and provides infrastructure. Due to the high relevance of the service and envisioned data quality, the NFDI4Earth Architecture Team decided to support the implementation by providing an NFDI4Earth subdomain. Moreover, the NFDI4Earth solution on how to integrate the terminology service can act as a blueprint for further usage.</p>
European Open Science Cloud (EOSC) project AqualNFRA	<p>The EOSC project AqualNFRA¹² develops EOSC-compliant discovery and access services for Pan-European and national catalogues and infrastructures that provide marine, freshwater, and relevant ESS data.</p> <p>The functional and non-functional requirements for the AqualNFRA Interactive Platform (AIP) have a strong overlap with the requirements for the NFDI4Earth OneStop4All, in particular the discovery of different resources. The NFDI4Earth OneStop4All is implemented as a custom solution based on the React- and Type-Script-based framework Open Pioneer Trails¹³. This offers a simple architecture and supports extension and integration. The source code is licensed under Apache License 2.0 and published in the NFDI4Earth GitLab¹⁴. The NFDI4Earth Architecture Team thus decided to support the implementation of the AqualNFRA Interaction Platform (AIP) with the OneStop4All source code and by confirming that a collaborative joint development is welcome, e.g., to accommodate needs specific to the AIP without harm to the OneStop4All. More concretely, this support includes detailed documentation and consultation options. In return, the AIP source code and live instance will provide references to the source.</p> <p>The NFDI4Earth-AqualNFRA collaboration helps to improve the NFDI4Earth communication strategy with strong software development partners.</p>

¹¹ <https://aquainfra.eu/>

¹² <https://github.com/open-pioneer/>

¹³ <https://git.rwth-aachen.de/nfdi4earth/onestop4all>

¹⁴ <https://www.nfdi4biodiversity.org/>

Name	Description and Relevance
Helmholtz Metadata Collaboration (HMC)	<p>Within HMC¹⁵ several Helmholtz Centres develop methods and tools document research data with rich metadata. Within Data Hub Earth and Environment¹⁶, for instance, several Helmholtz Centres develop specific discovery and data management tools for Earth and environmental data. Moreover, the unHIDE¹⁷ project facilitates the multi-disciplinary discovery of linked research data with knowledge graph technologies.</p> <p>NFDI4Earth and Helmholtz Metadata Collaboration closely collaborate on an organizational and conceptual level, e.g., providing comprehensive metadata recommendations for Earth System Sciences. NFDI4Earth therefore contributes to events, e.g., an unHIDE workshop, and provides feedback on HMC solutions and requirements from the NFDI4Earth perspective.</p> <p>Moreover, future collaborations on software developments will be aligned with the implementation strategies of the related NFDI4Earth services.</p>
NFDI4Biodiversity	<p>NFDI4Biodiversity¹⁸ is an NFDI consortium that develops a national research data infrastructure for biodiversity and environmental data by using a research data commons approach.</p> <p>NFDI4Earth and NFDI4Biodiversity collaborate on diverse implementation topics. For instance, NFDI4Earth pilots and NFDI4Biodiversity use cases provide OSS solutions across consortium borders. Furthermore, a workshop on research data commons and on service management initiated the collaboration on cross-cutting concepts and developments. This collaboration is partly in preparation for a tighter integration of services in future iterations of the NFDI.</p>
openEO	<p>openEO¹⁹ is a project that develops an API to connect to Earth observation cloud backends. It uses and develops open-source technologies.</p> <p>NFDI4Earth collaborates with openEO, in particular on aspects of advancing tools.</p>

¹⁵ <https://helmholtz-metadaten.de>

¹⁶ <https://datahub.erde-und-umwelt.de/de>

¹⁷ <https://search.unhide.helmholtz-metadaten.de/>

¹⁸ Glöckner, F. O., Diepenbroek, M., Felden, J., Güntsch, A., Stoye, J., Overmann, J., Wimmers, K., Kostadinov, I., Yahyapour, R., Müller, W., Scholz, U., Triebel, D., Frenzel, M., Gemeinholzer, B., Goesmann, A., König-Ries, B., Bonn, A., & Seeger, B. (2020). NFDI4BioDiversity - A Consortium for the National Research Data Infrastructure (NFDI). Zenodo. <https://doi.org/10.5281/zenodo.3943645>

¹⁹ <https://openeo.org/>

Table 2: International networks (alphabetic order)

Name	Relevance for ESS OSS
52°North Spatial Information Research GmbH	<p>52°North²⁰ develops and provides APIs, contributes to the development of metadata standards and profiles for services, implements OGC standards, and provides good practice examples.</p> <p>NFDI4Earth members contributed to the development of the 52°North Open Source Software solutions, e.g., the Open Pioneer Trails. Moreover, NFDI4Earth supports young researchers events, like the 52°North Student Innovation Challenge.</p>
Earth Science Information Partners (ESIP)	<p>ESIP²¹ brings together Earth science data professionals and provides a platform for discussions on relevant data-related topics.</p> <p>Several NFDI4Earth members collaborate in the ESIP, for instance, the AWI as one active partner of the Helmholtz Metadata Collaboration.</p>
International Organization for Standardization (ISO)	<p>The ISO²² manages standards development, e.g., metadata standards for geospatial data and services, see ISO19xxx series; general software aspects, like usability ISO9241-210:2019; general data management aspects, e.g., quality management ISO9000:2015.</p> <p>NFDI4Earth encourages the use of relevant standards. We thus contribute to the ISO19157-3 Data quality measures register²³ as an OGC Liaison Expert.</p> <p>Future developments will support the implementation of mapping and harvesting solutions for ISO metadata and if needed, support the adoption of the existing standards with respect to the ESS community needs.</p>

²⁰ <https://52north.org/software/contribute>

²¹ <https://www.esipfed.org>

²² <https://www.iso.org/>

²³ <https://committee.iso.org/sites/tc211/home/projects/projects---complete-list/iso-19157-3.html>

Name	Relevance for ESS OSS
Open Geospatial Consortium (OGC)	<p>The OGC²⁴ organizes standards and API development, testbeds as well as pilot series. It facilitates community building by organising events and providing platforms and infrastructure.</p> <p>Several NFDI4Earth members are active in OGC working groups and initiatives, e.g., members of an NFDI4Earth interest group and members of the Measure 4.3 successfully submitted a proposal to the first (of three) OGC Call for Open Science Persistent Demonstrator²⁵. TU Dresden will represent NFDI4Earth and liaise with NFDI4Earth members as needed to participate in the OSPD and possibly prepare more substantial contributions in future calls. Moreover, Measure 4.3 members are active in the Data Quality Domain Working Group and the GeoDCAT Standards Working Group, Measure 2.5 members are active in the GeoZarr Standards Working Group.</p>
OSGeo	<p>OSGeo serves as an umbrella for several high-quality open-source projects. National hubs support collaborative developments with organisational efforts, e.g., OSS conferences.</p> <p>For now, OSGeo Tools are used in the NFDI4Earth Knowledge Hub.</p>
PANGEO	<p>PANGEO²⁶ provides OSS software and a platform for the software developer community.</p> <p>NFDI4Earth Measure 2.5 members contribute to the related activities, e.g., with good practice implementations on handling large geodata with Julia²⁷.</p>
Research Data Alliance (RDA)	<p>RDA²⁸ aims at facilitating open sharing and re-use of data. The alliance provides a network and platform to draft community standards, and develops guidelines and best practices for data-related aspects.</p> <p>NFDI4Earth members are active in IT-related groups, for instance, Research Data Architectures in Research Institutions IG.</p>
R-spatial	<p>R-spatial²⁹ provides a blog and acts as a community that develops tools in R to analyse spatial or spatio-temporal data.</p> <p>NFDI4Earth Measure 2.5 members lead and contribute to the related activities.</p>

²⁴ <https://www.ogc.org/>

²⁵ <https://www.ogc.org/initiatives/open-science/>

²⁶ <https://pangeo.io/>

²⁷ <https://github.com/JuliaDataCubes/ESDLTutorials>, <https://discourse.pangeo.io/t/september-1-2022-handling-large-geo-data-with-julia/2656>, and <https://r-spatial.org/>

²⁸ <https://rd-alliance.org>

²⁹ <https://github.com/JuliaDataCubes/ESDLTutorials> and <https://discourse.pangeo.io/t/september-1-2022-handling-large-geo-data-with-julia/2656>