

NFDI Consortium Earth System Sciences



Applicant Institution: TUD Dresden University of Technology

Co-Applicant Institutions: Alfred Wegener Institute – Helmholtz Centre for Polar and Marine Research (AWI), German Climate Computing Center (DKRZ), Helmholtz Centre Potsdam – GFZ German Research Centre for Geosciences, Bochum University of Applied Sciences, Karlsruhe Institute of Technology (KIT), Gottfried Wilhelm Leibniz Universität Hannover, Goethe-Universität Frankfurt, Leipzig University, Max-Planck-Institute for Biogeochemistry, Senckenberg Society for Nature Research

Participants: BGR, BKG, BSA, BSH, BTU, DAI, DAM, DBFZ, DLR, DSMZ, DWD, FUB, GEOMAR, HCUNIH, HEREON, HUB, IASS, IGB, IOER, JÜLICH, JUNIHB, LIAG, LMU, LRZ, MFN, PIK, RUB, RWTH, TIB, TROPOS, TUB, TUBAF, TUBS, TUDA, TUDO, TUM, UFZ, UNIBI, UNIBN, UNIERN, UNIFR, UNIGOE, UNIHB, UNIH, UNIH, UNIH, UNIJ, UNIK, UNIKI, UNIMS, UNIP, UNITUE, UNU-FLORES, WSA, ZALF

Web: <https://www.nfdi4earth.de/>

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B-1 Progress Report Part 1, for publication

1 General Information

1.1 Name of the consortium

NFDI Consortium Earth System Sciences (in German: NFDI Konsortium Erdsystemforschung)

1.2 Research domains and research methods addressed by the consortium

NFDI4Earth focuses digital needs of Earth System (ES) Sciences (ESS). The ES is composed of a set of highly intertwined subsystems, commonly divided into the solid Earth, the hydrosphere, the atmosphere, and the biosphere as well as the anthroposphere. ES scientists cooperate in international and interdisciplinary networks with the overarching aim to understand the functioning and interactions within the ES and address the multiple challenges of global change. ESS rely on data-rich observations and data-intensive simulations, analysis, and synthesis on different spatio-temporal scales to understand the complex ES-processes and interactions. NFDI4Earth addresses the domains¹: Atmospheric Science, Oceanography and Climate Research (3.41), Geology and Palaeontology (3.42), Geophysics and Geodesy (3.43), Mineralogy, Petrology and Geochemistry (3.44), Geography (3.45), Water Research (3.46), as well as Astrophysics and Astronomy (3.25), Agriculture, Forestry and Veterinary Medicine (2.31).

1.3 URL of the consortium website and repositories used for publishing output

Consortium website:	https://nfdi4earth.de/
Zenodo Community for reports, white papers, etc:	https://zenodo.org/communities/nfdi4earth
GitLab Repository:	https://git.rwth-aachen.de/nfdi4earth/
Knowledge Hub:	https://knowledgehub.nfdi4earth.de/
OneStop4All:	https://onestop4all.nfdi4earth.de/
EduTrain Portal:	https://edutrain.nfdi4earth.de/
LinkedIn Community:	https://de.linkedin.com/company/nfdi4earth
Mastadon Community:	https://nfdi.social/@nfdi4earth

¹ Domains are named and numbered according to the DFG classification of subject area and review boards.

2 Summary

Midway through its first funding phase **NFDI4Earth is firmly established as a single, unifying National Research Data Infrastructure (NFDI) consortium for the majority of relevant stakeholders in the Earth System Sciences (ESS)**. It provides the national **cooperation hub related to all relevant aspects of FAIR Research Data Management (RDM) in ESS**. This is reflected in the recent report of the National Academy of Sciences Leopoldina where NFDI4Earth is named as a key initiative to address the digital challenges in the ESS. Since 2021 NFDI4Earth recruited six additional partners (to a total of 65) as further multipliers to achieve wide-reaching FAIR RDM in the ESS community.

The **first half of the project (2021-2024) emphasized community engagement**, with great success. In the **second half (2024-2026), the focus will be on the continuous improvement and expansion of the released services** and the further development of operating models.

NFDI4Earth **gives an active role to the different communities of interest in ESS**, allowing them to collaborate within NFDI4Earth and to advance FAIRness in several ways. Through open calls for **NFDI4Earth Pilots, Incubators and EduPilots** the community was invited to formulate needs, innovative ideas for RDM and competence building in ESS. More than 40 projects were funded and led to a variety of data products, software solutions and educational resources, all openly available for reuse by researchers, covering a breadth of ESS subdisciplines, e.g., Climate Research, Geophysics, Landscape Ecology, Petrology, Remote Sensing, and Water Research. The **NFDI4Earth Academy** promoted competence building around data science and FAIR RDM in ESS. Two successful open calls, allowed to recruit more than 73 early career researchers from diverse ESS subdisciplines, universities and research institutes. **NFDI4Earth offered information, training, and outreach** to the ESS community in form of the annual NFDI4Earth plenaries (> 100 participants each), conference workshops, coffee lectures, summer schools, think tanks, newsletters and special journal issues. The consortium endorsed and supports 7 NFDI4Earth Interest Groups tackling topics such as High-Performance Computing, Machine Learning, Research Software, Metadata Standards for Geochemical Data, Long Term Archiving and FAIR Earth System Sciences Terminologies. Further, NFDI4Earth supported more than 20 research groups, in their applications for research funding. Three quarters of these supported applications have been successful and are being funded with an estimated total budget of 30 million euros.

NFDI4Earth closely **cooperates with other NFDI consortia**, delivered joint scientific articles and white papers and co-organized joint events, for instance the DataXplorers Hackathon. NFDI4Earth members **strongly engaged in the NFDI** and co-founded NFDI working groups on cross-cutting topics. TU Dresden as applicant of NFDI4Earth took a **leading role in Base4NFDI** and several NFDI4Earth partners participate in the **development of NFDI basic services**.

NFDI4Earth strengthened international ties: NFDI4Earth members participate in projects and initiatives such as OneGeochemistry, the OGC Persistent Demonstrator, AquaINFRA, FAIRCORE4EOSC (since 2023), FAIR-IMPACT, and the EOSC Data Commons. So far, NFDI4Earth signed two Memoranda of Understanding (MoU), one with the *United Nations University* and one with *re3data* (2024).

To further advance in implementing the FAIR principles NFDI4Earth started designing an overarching **NFDI4Earth Architecture** and developing the **NFDI4Earth Label** as a means of classifying ESS-related repositories. The NFDI4Earth Label intends to help researchers find the most suitable repositories for their needs regarding data access and publication, and provides repository operators with a self-assessment tool for documentation and evaluation. In parallel, the recent launch of the first version of the **NFDI4Earth FAIRness and Openness Commitment** invites individuals and organisations to declare their support to NFDI4Earth and their intent to promote the transition to FAIR RDM in the ESS.

To secure **sustained operation** and cooperation networks NFDI4Earth established close cooperation with important national public environmental data and geodata infrastructures as the GDI-DE *Geodateninfrastruktur Deutschland* (GDI-DE), *umwelt.info* and the National Monitoring Centre for Biodiversity. **Relevant research communities have pledged to closely link their data infrastructures and service developments into NFDI4Earth** and to streamline their offerings with NFDI4Earth: (1) Helmholtz represented by seven centres and prominently its *DataHub of the Research Field Earth and Environment*, the *Helmholtz Metadata Collaboration* and (in parts) the *Helmholtz Federated IT Services*, (2) Leibniz represented by ten institutes and their ESS data repositories and services, (3) the German Climate Computing Center and the Max-Planck Institute for Biogeochemistry. NFDI4Earth applicant TU Dresden establishes a new permanent professorship for Data Analytics in Earth System Sciences to support NFDI4Earth.

NFDI4Earth launched first versions of **five new services**: (1) the **Knowledge Hub** offers metadata over a broad range of resources including datasets, learning resources, repositories, people, organizations, standards for metadata provision and software source code; (2) the **Living Handbook** as collection of articles of various topics relevant to RDM and ESS, including documentation about successfully completed Pilots and Incubators; (3) the **OneStop4All** as portal to browse resources on the Knowledge Hub and offering spatio-temporal search functionalities when applicable; (4) the **EduTrain Portal** to provide access to a range of curated open educational resources related to RDM in the ESS; (5) the **User Support Network** offers first and second level ESS-RDM-support and operates as a federated system across RDM-support-desks of NFDI4Earth partner institutions. In the second term of this funding phase these services will get further enhanced, driven by the community feedback.

3 Composition of the consortium

3.1 Applicant institution

Applicant institution	Location	Duration
TUD: Dresden University of Technology	01062 Dresden	10/2021 - today

3.2 Spokesperson

Spokesperson	Institution, location	Duration
Prof Dr Lars Bernard [0000-0002-3085-7457]	TUD, Dresden	10/2021 - today

3.3 Co-applicant institutions

Co-applicant institutions	Location	Duration
AWI: Alfred Wegener Institute – Helmholtz Centre for Polar and Marine Research (AWI)	Am Handelshafen 12 27570 Bremerhaven	10/2021 - today
DKRZ: German Climate Computing Center (Deutsches Klimarechenzentrum GmbH)	Bundesstraße 45a 20146 Hamburg	10/2021 - today
GFZ: Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences	Telegrafenberg 14473 Potsdam	10/2021 - today
HSBO: Bochum University of Applied Sciences	Am Hochschulcampus 1 44801 Bochum	10/2021 - today
KIT: Karlsruhe Institute of Technology	Kaiserstraße 12 76131 Karlsruhe	10/2021 - today
LUH: Gottfried Wilhelm Leibniz University Hannover	Welfengarten 1 30167 Hannover	10/2021 - today
UNIF: Goethe-Universität Frankfurt am Main	Theodor-W.-Adorno-Pl. 1 60323 Frankfurt a. M.	10/2021 - today
UNIL: Universität Leipzig	Ritterstraße 26 04109 Leipzig	10/2021 - today
MPIBG: Max-Planck-Institute for Biogeochemistry	Hans-Knöll-Str. 10 07745 Jena	10/2021 - today
SGN: Senckenberg Society for Nature Research	Senckenberganlage 25 60325 Frankfurt a. M.	10/2021 - today

3.4 Co-spokespersons

Co-spokespersons	Institution, location	Task area	Duration
Prof Dr Miguel Mahecha [0000-0003-3031-613X]	UNIL, Leipzig	TA 1	10/2021 - today
Prof Dr Monika Sester [0000-0002-6656-8809]	LUH, Hannover	TA 1	10/2021 - today

Co-spokespersons	Institution, location	Task area	Duration
Prof Dr Carsten Keßler [0000-0002-9724-820X]	HSBO, Bochum	TA 1	10/2021 - today
Dr Hildegard Gödde [0009-0004-9939-4202]	GFZ, Potsdam	TA 1	10/2021 - today
Prof Dr Peter Braesicke [0000-0003-1423-0619]	KIT, Karlsruhe	TA 2	10/2021 - today
Hannes Thiemann [0000-0002-2329-8511]	DKRZ, Hamburg	TA 2	10/2021 - today
Prof Dr Markus Reichstein [0000-0001-5736-1112]	MPIBGC, Jena	TA 2	10/2021 - today
Prof Dr Stephan Frickenhaus [0000-0002-0356-9791]	AWI, Bremerhaven	TA 3	10/2021 - today
Dr Claus Weiland [0000-0003-2820-6564]	SGN, Frankfurt a. M.	TA 3	10/2021 - today
PD Dr Dominik Hezel [0000-0002-5059-2281]	UNIF, Frankfurt a. M.	TA 3	09/2022 - today
PD Dr Wolfgang zu Castell [0000-0003-2820-6564]	GFZ, Postdam	TA 3	10/2022 - today
Prof Dr Wolfgang E. Nagel	TUD, Dresden	TA 4	10/2021 - today

3.5 Participants

Participating institutions	Location	Duration
BGR: Federal Institute for Geosciences and Natural Resources	Hannover	10/2021 - today
BKG: Federal Agency for Cartography and Geodesy (Coordination Office GDI-DE)	Frankfurt am Main	10/2021 - today
BSA: Generaldirektion der Staatlichen Archive Bayerns	München	10/2021 - today
BSH: Bundesamt für Seeschifffahrt und Hydrographie	Hamburg	10/2021 - today
BTU: Brandenburg University of Technology Cottbus	Cottbus	10/2021 - today
DAI: German Archaeological Institute	Berlin	10/2021 - today
DAM: German Marine Research Alliance e.V.	Berlin	10/2021 - today
DBFZ: Deutsches Biomasseforschungszentrum	Leipzig	08/2024 - today
DLR: German Aerospace Center	Köln	10/2021 - today
DSMZ: Leibniz Institute – German Collection of Microorganisms and Cell Cultures GmbH	Braunschweig	10/2021 - today
DWD: Deutscher Wetterdienst	Offenbach	10/2021 - today
FUB: Freie Universität Berlin	Berlin	10/2021 - today
GEOMAR: GEOMAR Helmholtz Centre for Ocean Research Kiel	Kiel	10/2021 - today

Participating institutions	Location	Duration
HCUNIH : HafenCity Universität Hamburg	Hamburg	10/2021 - today
HUB : Humboldt-Universität zu Berlin	Berlin	10/2021 - today
HEREON : Helmholtz-Zentrum Hereon	Geesthacht	10/2021 - today
IASS : Research Institute for Sustainability - Helmholtz Centre Potsdam as a part of GFZ from 01/2023 (former Institute for Advanced Sustainability Studies e.V.)	Potsdam	10/2021 – 12/2022
IGB : Leibniz-Institute of Freshwater Ecology and Inland Fisheries	Berlin	10/2021 - today
IOER : Leibniz Institute of Ecological Urban and Regional Development	Dresden	10/2021 - today
JÜLICH : Geoverbund ABC/J c/o Forschungszentrum Jülich GmbH	Jülich	10/2021 - today
JUNIHB : Constructor University (Former Jacobs University Bremen gGmbH)	Bremen	10/2021 - today
LIAG : Leibniz Institute for Applied Geophysics	Hannover	10/2021 - today
LMU : Ludwig-Maximilians-Universität München	München	10/2021 - today
LRZ : Leibniz Supercomputing Centre of the Bavarian Academy of Sciences & Humanities	München	10/2021 - today
MFN : Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science	Berlin	10/2021 - today
PIK : Potsdam Institute for Climate Impact Research	Potsdam	10/2021 - today
RUB : Ruhr-Universität Bochum	Bochum	12/2022 - today
RWTH : RWTH Aachen University	Aachen	10/2021 - today
TIB : Leibniz Information Centre for Science and Technology University Library	Hannover	10/2021 - today
TROPOS : Leibniz Institute for Tropospheric Research	Leipzig	10/2021 - today
TUB : Technische Universität Berlin	Berlin	10/2021 - today
TUBAF : Technische Universität Bergakademie Freiberg	Freiberg	10/2021 - today
TUBS : Technische Universität Braunschweig	Braunschweig	11/2023 - today
TUDA : Technische Universität Darmstadt	Darmstadt	10/2021 - today
TUDO : Technische Universität Dortmund	Dortmund	10/2021 - today
TUM : Technische Universität München	München	10/2021 - today
UFZ : Helmholtz Centre for Environmental Research	Leipzig	10/2021 - today
UNIBI : Universität Bielefeld	Bielefeld	08/2023 - today
UNIBN : Rheinische Friedrich-Wilhelms-Universität Bonn	Bonn	10/2021 - today
UNIERN : Friedrich-Alexander Universität Erlangen-Nürnberg	Erlangen	10/2021 - today
UNIFR : University of Freiburg	Freiburg	08/2024 - today

Participating institutions	Location	Duration
UNIGOE: Georg-August-Universität Göttingen, Göttingen State and University Library	Göttingen	10/2021 - today
UNIHB: University of Bremen	Bremen	10/2021 - today
UNIHH: Universität Hamburg	Hamburg	10/2021 - today
UNIHOH: Universität Hohenheim	Hohenheim	11/2023 - today
UNIJ: Friedrich Schiller University Jena	Jena	10/2021 - today
UNIK: University of Cologne	Köln	10/2021 - today
UNIKI: Kiel University	Kiel	10/2021 - today
UNIMS: University of Münster	Münster	10/2021 - today
UNIP: University of Potsdam	Potsdam	10/2021 - today
UNITUE: Eberhard-Karls-Universität Tübingen	Tübingen	10/2021 - today
UNU-FLORES: United Nations University Institute for Integrated Management of Material Fluxes	Dresden	10/2021 - today
WSA: Water Science Alliance e. V. c/o ZWU at Universität Duisburg-Essen	Leipzig	10/2021 - today
ZALF: Leibniz Centre of Agricultural Landscape Research (ZALF)	Müncheberg	10/2021 - today

There are no participating individuals in NFDI4Earth.