![NFDI4Earth logo]

Letter of Intent

for submission of renewal proposal in 2025

1   Binding letter of intent as advance notification of a full renewal proposal

x	Binding letter of intent (required as advance notification for renewal proposals in 2025)

2   Formal details

- **Name of the consortium**

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

- **Acronym of the consortium**

  NFDI4Earth

- **Applicant institution TUD**

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The NFDI4Earth Co-Applicant Institutions are listed alphabetically according to their acronyms.
New Co-Applicants and/or new new Co-Spokepersons are marked by *.

- **Co-Applicant institution AWI**

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- **Co-Applicant institution DKRZ**

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  Director Prof Dr Thomas Ludwig

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- Co-Spokesperson

  Prof Dr Wolfgang Graf zu Castell-Rüdenhausen

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  President Prof Dr Jan Hesthaven

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  President Prof Dr Volker Epping

- Co-Spokesperson

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  Institute of Cartography and Geoinformatics

- **Co-Applicant institution MPI BGC**

  Max-Planck-Institute for Biogeochemistry, Hans-Knöll-Str. 10, 07745 Jena

  here representing the Earth System and Solar Research Partnership in the Max Planck Society

  Director Prof Dr Markus Reichstein

- Co-Spokesperson

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  Department of Biogeochemical Integration

- **Co-Applicant institution SGN**

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- Co-Spokesperson

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- **Participant institution BFG***

  Bundesanstalt für Gewässerkunde (Federal Institute of Hydrology)

  Dr Ralf Busskamp, Geodatenzentrum

- **Participant institution BGR**

  Federal Institute for Geosciences and Natural Resources

  Tino Langos

- **Participant institution BKG**

  Federal Agency for Cartography and Geodesy

  Dr Marcus Brühl, Coordination Office GDI-DE

- **Participant institution BSA**

  Generaldirektion der Staatlichen Archive Bayerns

  Dr Lina Hörl, Abteilung 2: Überlieferungsbildung, Erschließung, Beratung, Archivrecht

- **Participant institution BSH**

  Bundesamt für Schifffahrt und Hydrographie

  Dr Susanne Tamm

- **Participant institution BTU**

  Brandenburg University of Technology Cottbus – Senftenberg

  Dr Claudia Börner, Information, Communication and Media Centre

- **Participant institution DAI**

  Deutsche Archäologisches Institut

  Dr Christin Keller, Research Data Management

- **Participant institution DAM**

  Deutsche Allianz Meeresforschung e. V.

  Dr Gauvain Wiemer, Core Area Data Management and Digitalisation

- **Participant institution DBFZ**

  DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH

  Dr Torsten Thalheim, Research Data Management

- **Participant institution DLR**

  Deutsches Zentrum für Luft- und Raumfahrt | German Aerospace Agency

  Dr Jonas Eberle, Earth Observation and Environmental Data Science

- **Participant institution DSMZ**

  Leibniz Institute DSMZ – German Collection of Microorganisms and Cell Cultures GmbH,

  Dr. Lorenz Reimer, Department of Scientific Databases

- **Participant institution FUB**

  Freie Universität Berlin

  Dr Andreas Hübner, University Library

- **Participant institution GESIS**

  GESIS – Leibniz Institute for the Social Sciences

  Dr Bernhard Miller, Office of the Executive Board

- **Participant institution HCUHH**

  HafenCity Universität Hamburg

  Prof. Dr. Annette Eicker, Geodesy and Adjustment Theory

- **Participant institution HEREON**

  Helmholtz-Zentrum hereon

  Dr Ulrike Kleeberg, Department Data Management Coastal Research

- **Participant institution HUB**

  Humboldt-Universität zu Berlin

  Prof Dr Patrick Hostert, Department of Geography

- **Participant institution IGB**

  Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB)

  Dr Sami Domisch, Department of Community and Ecosystem Ecology

- **Participant institution IOER**

  Leibniz Institute of Ecological Urban and Regional Development

  Dr Tobias Krüger, Research Data Centre

- **Participant institution IOW**

  Leibniz Institute for Baltic Sea Research Warnemünde

  Dr Manja Placke, Data Management Support

- **Participant institution JÜLICH**

  Forschungszentrum Jülich GmbH

  Dr. Konstantin Ntageretzis, Geoverbund ABC/J

- **Participant institution LIAG**

  Leibniz Institute for Applied Geophysics (LIAG)

  Dr Thorsten Agemar, Department of Geothermics and Information Systems

- **Participant institution LMU**

  Ludwig-Maximillians-Universität München

  Prof Dr Heiner Igel, Department of Earth and Environmental Sciences

- **Participant institution LRZ**

  Bavarian Academy of Sciences and Humanities (Leibniz Supercomputing Centre)

  Dr Stephan Hachinger, Research Department

- **Participant institution MFN**

  Museum für Naturkunde – Leibniz Institute for Evolution and Biodiversity Science

  Falko Glöckler, Department of Science Data Management

- **Participant institution PIK**

  Potsdam Institute for Climate Impact Research (PIK),

  Dr Jan-Philipp Dietrich, Department of Transformation Pathways

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- **Participant institution RWTH**

  RWTH Aachen University

  Prof Dr Florian M. Wagner, Division of Earth Sciences and Geography

- **Participant institution THÜNEN***

  Johann Heinrich von Thünen Institute (Federal Research Institute for Rural Areas, Forestry and Fisheries) Dr Christian Brümmer, ICOS National Network Germany

- **Participant institution TIB**

  Leibniz Information Centre for Science and Technology University Library

  Dr Markus Stocker, Knowledge Infrastructure Lab

- **Participant institution TROPOS**

  Leibniz Institute for Tropospheric Research (TROPOS)

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- **Participant institution TUB**

  Technische Universität Berlin

  Dr Marco Otto, Institute of Ecology, Computational Climatology

- **Participant institution TUBAF**

  Technische Universität Bergakademie Freiberg

  JProf Dr Conrad Jackisch, Institute of Drilling Technology and Fluid Mining

- **Participant institution TUBS**

  Technische Universität Braunschweig

  Dr Hannes Müller-Thomy, Division Hydrology and River Basin Management

- **Participant institution TUDA**

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  Prof Dr Peter Pelz, Institute of Fluid Systems

- **Participant institution TUDO**

  Technische Universität Dortmund

  Prof Dr Nguyen Xuan Thinh, Department of Spatial Management and Modelling

- **Participant institution TUM**

  Technical University of Munich

  Prof Dr Martin Werner, School of Engineering & Design, Big Geospatial Data Management

- **Participant institution UBA***

  Umweltbundesamt (German Environment Agency)

  Dr Anja Reineke, Nationales Zentrum für Umwelt- und Naturschutzinformationen

- **Participant institution UFZ**

  Helmholtz Centre for Environmental Research GmbH - UFZ

  Dr Jan Bumberger, Research Data Management

- **Participant institution UNIBI**

  Universität Bielefeld

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- **Participant institution UNIBN**

  Rheinische Friedrich-Wilhelms-Universität Bonn

  Prof Dr Jan-Henrik Haunert, Institute of Geodesy and Geoinformation

- **Participant institution UNIERN**

  Friedrich-Alexander Universität Erlangen-Nürnberg

  Prof Dr Johannes Barth, Chair of Applied and Environmental Geology

- **Participant institution UNIFR**

  Universität Freiburg

  Prof Dr Teja Kattenborn, Faculty of Environment and Natural Resources

- **Participant institution UNIGOE**

  Georg-August-Universität Göttingen & Göttingen State and University Library

  Prof Dr Belá Gipp, Scientific Information Analytics

- **Participant institution UNIHB**

  Universität Bremen

  Prof Dr Frank Oliver Glöckner, Earth System Data Science & Research Group PANGAEA

- **Participant institution UNIHH**

  Universität Hamburg

  Prof Dr Felix Ament, Centre for Earth System Research and Sustainability (CEN)

- **Participant institution UNIHOH**

  University of Hohenheim

  Prof Dr Volker Wulfmeyer, Institute of Physics and Meteorology

- **Participant institution UNIJ**

  Friedrich-Schiller-Universität Jena

  Prof Dr Christiane Schmullius, Geography and Earth Observation

- **Participant institution UNIK**

  Universität zu Köln

  Prof Dr Peter Dannenberg, Universität zu Köln, Department of Geosciences

- **Participant institution UNIKI**

  Christian-Albrechts-Universität zu Kiel

  Thilo Paul-Stüve, University Computing Centre

- **Participant institution UNIMS**

  Universität Münster

  Prof Dr Edzer Pebesma, Institute for Geoinformatics

- **Participant institution UNIOL***

  Carl von Ossietzky Universität Oldenburg

  Christina Beckers, Information Infrastructures

- **Participant institution UNIP**

  University of Potsdam,

  Prof Dr Bodo Bookhagen, Geological Remote Sensing

- **Participant institution UNITUE**

  Eberhard Karls Universität Tübingen

  Prof Dr Olaf Cirpka, Geo- und Umweltforschungszentrum

- **Participating institution UNIWUE***

  Julius-Maximilians-Universität Würzburg

  Prof Dr Samuel Kounev, Department of Computer Science

- **Participant institution UNU-FLORES**

  United Nations University Institute for Integrated Management of Material Fluxes and of Resources (FLORES), Dr Serena Coetzee, Education and Capacity Development

- **Participant institution WSA**

  Water Science Alliance e. V.

  Prof Dr Martina Flörke, Ruhr University Bochum, Faculty of Civil Engineering

- **Participant institution ZALF**

  Leibniz Centre for Agricultural Landscape Research (ZALF)

  Dr Nikolai Svoboda, Research Data Management

3 Objectives, work programme and research environment in the second funding period

3.1 Research area of the proposed consortium

NFDI4Earth focuses on the digital needs of researchers in Earth System (ES) Sciences. 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. Earth System Sciences rely on data-rich observations and data-intensive simulations, analysis, and synthesis on different spatio-temporal scales to understand complex ES-processes and interactions.

NFDI4Earth addresses the following research areas of the DFG Review Boards: 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 the DFG Subject Areas: Soil Sciences (2.31-01); Ecology of Land Use (2.31-04); Forestry (2.31-06); Urbanism, Spatial Planning, Transportation and Infrastructure Planning, Landscape Planning (4.51-02); Geotechnics, Hydraulic Engineering (4.51-06).

3.2 Concise summary of the consortium's main objectives and task areas

Building on its successful establishment as the national cooperation hub for FAIR Research Data Management (RDM) in Earth System Sciences (ESS), NFDI4Earth aims to expand from community building to comprehensive integration of its service portfolio into Earth System Research and Education. The consortium will focus on expanding the adoption of its services, implementing lighthouse use cases demonstrating FAIR data practices, enhancing educational offerings through open educational resources, credentials and specialized curricula, maturing core services, and strengthening international collaboration. Key priorities include supporting innovation in ES Data Science through AI integration, establishing cross-disciplinary research workflows, and ensuring long-term sustainability of the infrastructure.

Task Area 1: 2LINKIN – Community Collaboration and Use Cases

The 2LINKIN task area will implement a series of strategic Lighthouse Use Cases demonstrating NFDI4Earth's capability to support FAIR data practices in interdisciplinary research. Three initial use cases, selected for their potential to showcase end-to-end workflows and cross-disciplinary applications, will be implemented over 3 years, with flexibility for three additional cases starting in 2027/28. These will be complemented by agile 6-12 months ESS RDM Pilots focusing on specific aspects such as data curation and quality assurance. Finally, a co-design process will derive structured concepts for ESS Key Information Products first as a means to continuously map the

community's information needs and second to organise and channel the outcomes of Lighthouse Use Cases, Pilots and other ESS research projects into further scientific applications and broad community benefit.

Task Area 2: 2TRAIN – Education and Capacity Building

Led by universities 2TRAIN will significantly expand NFDI4Earth's training and educational impact. The EduTrain courses will be enhanced with well-curated, comprehensive, adaptive and AI supported learning paths and materials, focussing on RDM and topical Data Science for university curricula with related study credentials. In support, the EduHub Network will be strengthened and include NFDI4Earth partner universities to ensure sustainable development and delivery of training. The Academy continues in providing RDM and Data Science training and networking events for Earth System Data Scientists at different career levels, and will be complemented by a PhD Graduate School, preparing the next generation of researchers with advanced data management and analysis skills.

Task Area 3: 2PROVIDE4ALL – Service Portfolio and Support Network

2PROVIDE4ALL will focus on maturing and expanding NFDI4Earth's service ecosystem. The Service Portfolio Management will coordinate integration with key infrastructure partners including the Helmholtz Research Field Earth and Environment DataHub as well as the HPC and AI facilities of the NFDI4Earth partners, while defining architecture standards and key performance indicators. The OneStop4All and the Knowledge Hub will be enhanced – also with AI capabilities – to improve functionality. The User Support Network will be strengthened to provide comprehensive assistance, while newly established Service Stewards will ensure effective integration of NFDI4Earth services into active research projects. This coordinated approach will create a robust, user-centric service infrastructure.

Task Area 4: 2SUSTAIN – Infrastructure Sustainability

The 2SUSTAIN task area will focus on ensuring NFDI4Earth's long-term viability through several key initiatives. The NFDI4Earth Label will be enhanced and complemented with additional automated processes to facilitate wider adoption among ESS repositories and service providers. The FAIRness and Openness Commitment will be strengthened with a defined operational model to encourage broader community participation and ownership of NFDI4Earth services. Standards development and coordination with the broader NFDI initiative will continue to be a key priority, alongside the development of a comprehensive long-term operating model. These efforts will establish sustainable frameworks and a firm and synergetic embedding in the NFDI.

Task Area 5: 2COORDINATE – Strategic Management

The 2COORDINATE task area will ensure effective management of NFDI4Earth's expanding scope through the Coordination Office. The office will continue to oversee synergy measures and maintain financial and scientific control of the funding mechanisms. International networking will

be strengthened, particularly through connections with the European Open Science Cloud (EOSC) and the European Research Infrastructure Consortia (ERIC), while communication strategies will be enhanced to build stronger community engagement. This coordinated approach will further strengthen NFDI4Earth's position as a leading force in ESS research data management while fostering national, European and global collaboration and innovation.

3.3 Brief description of the proposed use of existing infrastructures, tools and services that are essential in order to fulfil the planned consortium's objectives

NFDI4Earth builds on nearly 90 research data repositories and additionally on the compute and storage infrastructures operated and provided by the consortium members. The OneStop4All[1], implemented in the current NFDI4Earth funding phase enables comprehensive, structured searches for these resources.

Relevant research communities and institutions in the ESS context have demonstrated their commitment to closely link their data infrastructures and service developments into the respective NFDI4Earth activities and to streamline their offerings with NFDI4Earth services: (1) Helmholtz (represented by seven centres), prominently with its Helmholtz Research Field Earth and Environment DataHub[2], the Helmholtz Metadata Collaboration[3] and (in parts) the Helmholtz Federated IT Services[4], (2) Leibniz (represented by ten institutes) with their ESS data repositories and services, (3) further world-wide leading institutes in ESS, as the German Climate Computing Center (DKRZ), and the Max-Planck Institute for Biogeochemistry.

In addition, the NFDI4Earth-Applicant TUD provides the infrastructure for the central services developed for NFDI4Earth (Knowledge Hub, EduTrain Portal, OneStop4All). Virtual Machines are provided for development, continuous integration and development pipelines, as well as the production environment. NFDI4Earth Pilots and Incubators were provided with quick and easy access to TUD's HPC and AI resources, enabling rapid development and easy prototyping, and the federated User Support Network builds on a ticket service operated at TUD.

Frequent requests from researchers within NFDI4Earth reflect the lack of digital collaboration environments, in particular to provide cross-institutional and interdisciplinary research projects with a common, reliable and sovereign storage and compute environment to jointly develop methods and models, analyse data, etc. We partly tackled this issue by offering compute and storage facilities. Clearly our current in-kind contributions to NFDI4Earth cannot sufficiently serve all requests within ESS and related disciplines. On the other hand, neither current NFDI funding schemes nor the settings of the National High Performance Computing Alliance (NHR) allow

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[1] https://onestop4all.nfdi4earth.de/
[2] https://helmholtz.software/projects/datahub and https://earth-data.de/about
[3] https://helmholtz-metadaten.de/de
[4] https://www.hifis.net/

provision of such services to German researchers. We will therefore continue to strongly engage in designing adequate operation and funding models of cloud-based collaboration environments to secure digital sovereignty of research collaborations.

3.4   Interfaces to other NFDI consortia: brief description of existing agreements for collaboration and/or plans for future collaboration

Within NFDI4Earth, we have established intensive cooperation with related NFDI consortia (in particular NFDI4Biodiversity, FAIRagro, KonsortSWD, NFDI4Objects, NFDI4Ing, NFDI4Microbiota, NFDI4BioImage) to (1) set-up a common network for user support; (2) address related communities in plenaries, workshops and meetings; (3) work on common standards, data models and ontologies; (4) design and implement interdisciplinary use cases, pilot projects and hackathons; (5) jointly develop basic services; and (6) prepare a sustainable and synergetic operation of RDM support structures.

NFDI4Earth members engage in a variety of ways in the NFDI sections and the individual Working Groups and Task Forces (*WG Terminology Services*, *WG Ontology Matching and Harmonization*, *WG Knowledge Graphs*, *WG Cookbooks, Guidance, and Best Practices*, *WG Search and Harvesting*, *WG Data Management Planning*, and *WG Long Term Archival and Access*). In addition, NFDI4Earth contributes regularly to several NFDI white papers and reports.

As NFDI4Earth consortium, we are one of the driving forces behind the idea of a joint NFDI Basic Service Initiative and the successful application for a Base4NFDI project. In 2023 Base4NFDI started delivering a framework for agile and quality-assured basic service development and establishing an NFDI-wide basic service portfolio. The firm anchoring of the NFDI4Earth consortium in the circle of national providers of compute and IT-infrastructures has been acknowledged within the NFDI and is reflected in the leading role of NFDI4Earth within Base4NFDI: The NFDI4Earth Applicant (TUD) serves as coordinating institution for Base4NFDI and the NFDI4Earth spokesperson (Lars Bernard) has been appointed as the Base4NFDI spokesperson. Several NFDI4Earth consortium partners are involved in developing and incubating basic services.

For the second phase of NFDI4Earth funding, we plan to continue running cross-consortia use cases and pilots to showcase NFDI benefits and advancements. We will strengthen our cross-consortia cooperation to jointly implement basic services: As follow-up of an MoU for a *Geo-Chem-Life Science Helpdesk Cluster*[5] we participate in the proposal of a *Basic Service Support Desk* to organise a sustainable federation of the help desks within the NFDI Consortia and to

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[5] Bernard et al. (2025): MoU of NFDI Consortia Earth-, Chemical and Life Sciences to support a network called the Geo-Chem-Life Science Helpdesk Cluster, Zenodo. https://doi.org/10.5281/zenodo.15065070

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pave the way towards an NFDI one stop for help and support. The concepts of the *NFDI4Earth FAIRness and Openness Commitment* and the *NFDI4Earth Label* are currently considered by other NFDI Consortia for adoption. We plan to extend this adoption and broaden the idea towards an NFDI wide FAIRness and Openness Commitment and Label to implement and assess interoperability and trustworthiness. We will also continue to strengthen the link between our RDM and Data Science activities and NFDI-wide initiatives.

4   International and national networking

NFDI4Earth members are active in several international ESS and RDM Initiatives (e.g., AGILE, CODATA, EGU, EPOS, OGC, RDA, re3data) and in the European Open Science Cloud (EOSC). NFDI4Earth Partners do actively engage within a number of EOSC projects (FAIRCORE4EOSC, Geo-INQUIRE, AquaINFRA, FAIR-IMPACT, EOSC Data Commons project) and thereby bridge between NFDI4Earth services and EOSC developments. We have also supported the NFDI Directorate's application to serve as a national EOSC Node and will help with its implementation. We will continue our involvement in the standardisation work of the OGC and in RDA working groups. NFDI4Earth will continue its contribution in OneGeochemistry.

Two Memoranda of Understanding (MoU) have been signed: A first MoU with the United Nations University related the UNU Sustainability Nexus Analytics, Informatics, and Data Programme, and a second MoU with re3data with regard to a close technical cooperation and joint metadata activities. In addition, we have started exchanges with related European Research Infrastructure Consortia (the ERICs EPOS and eLTER) and national data infrastructure initiatives as Data Terra (France) and Geoportti (Finland) to explore linkages, joint research, developments and agree upon future synergies.

NFDI4Earth considers its continued engagement in the *European Geosciences Union* (EGU) as a prime opportunity to strengthen international networks and to promote co-operation in the broad field of Earth System Sciences. We will continue to organise international NFDI4Earth Plenary and invite international partners (as we already do with ACM: Association for Computing Machinery; AGILE: Association of Geographic Information Science in Europe; OGC: Open Geospatial Consortium, RDA: Research Data Alliance, EPOS: the European Plate Observing System, etc.) to discuss the progress of NFDI4Earth and develop joint cooperation strategies.