The NFDI4Earth journey: Diversity and common ground in Earth System Sciences

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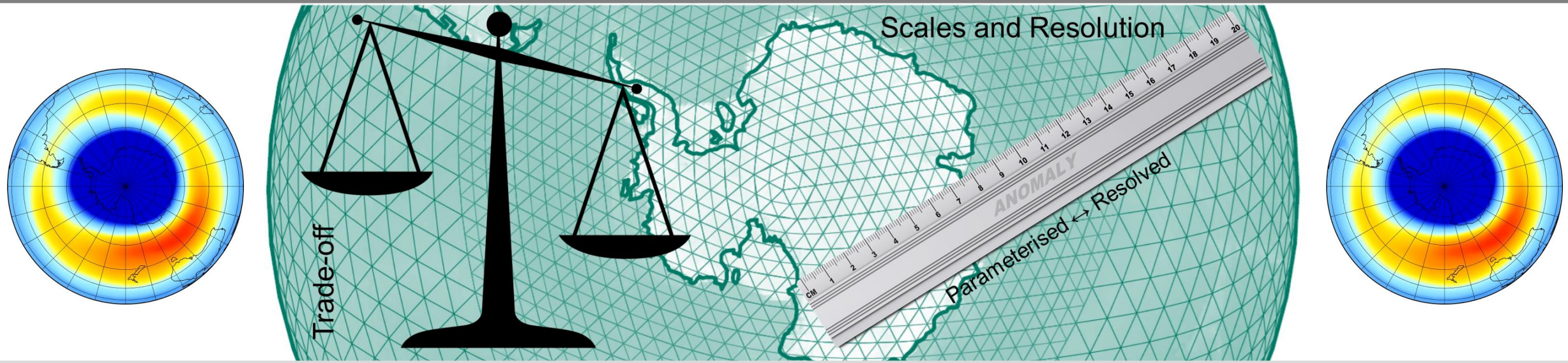
… with thanks to the NFDI4Earth colleagues …

IMK-ASF, Division IV, Helmholtz Program ATMO



Introduction

- Introducing myself (because it is a perspective)
- What is Earth (System) Science?
- NFDI4Earth
  - What is NFDI4Earth?
  - What is the current structure and status?
- Example: RDM and ozone research
- Outlook – NFDI4Earth as a comprehensive component of NFDI

Introducing myself

https://www.imk-asf.kit.edu/english/staff_1638.php

- Diploma in Meteorology (TU/FU Berlin)
- PhD in Meteorology (Research campaigns in Sweden)
- PostDoc in Cambridge/UK
- Senior Research Associate
- Professor in Karlsruhe (KIT)
  - Theoretical atmospheric physics
  - Section head modelling IMK-ASF
  - Scientific coordinator REKLIM: https://www.reklim.de/
  - ECRA Chair: http://www.ecra-climate.eu/
  - Co-Coordinator: Helmholtz RF E&E DataHub

https://www.helmholtz.de/en/research/earth_and_environment/initiatives/

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Ozone research

What is Earth (System) Science?

- Ask Wikipedia! (Highlighting by me …)

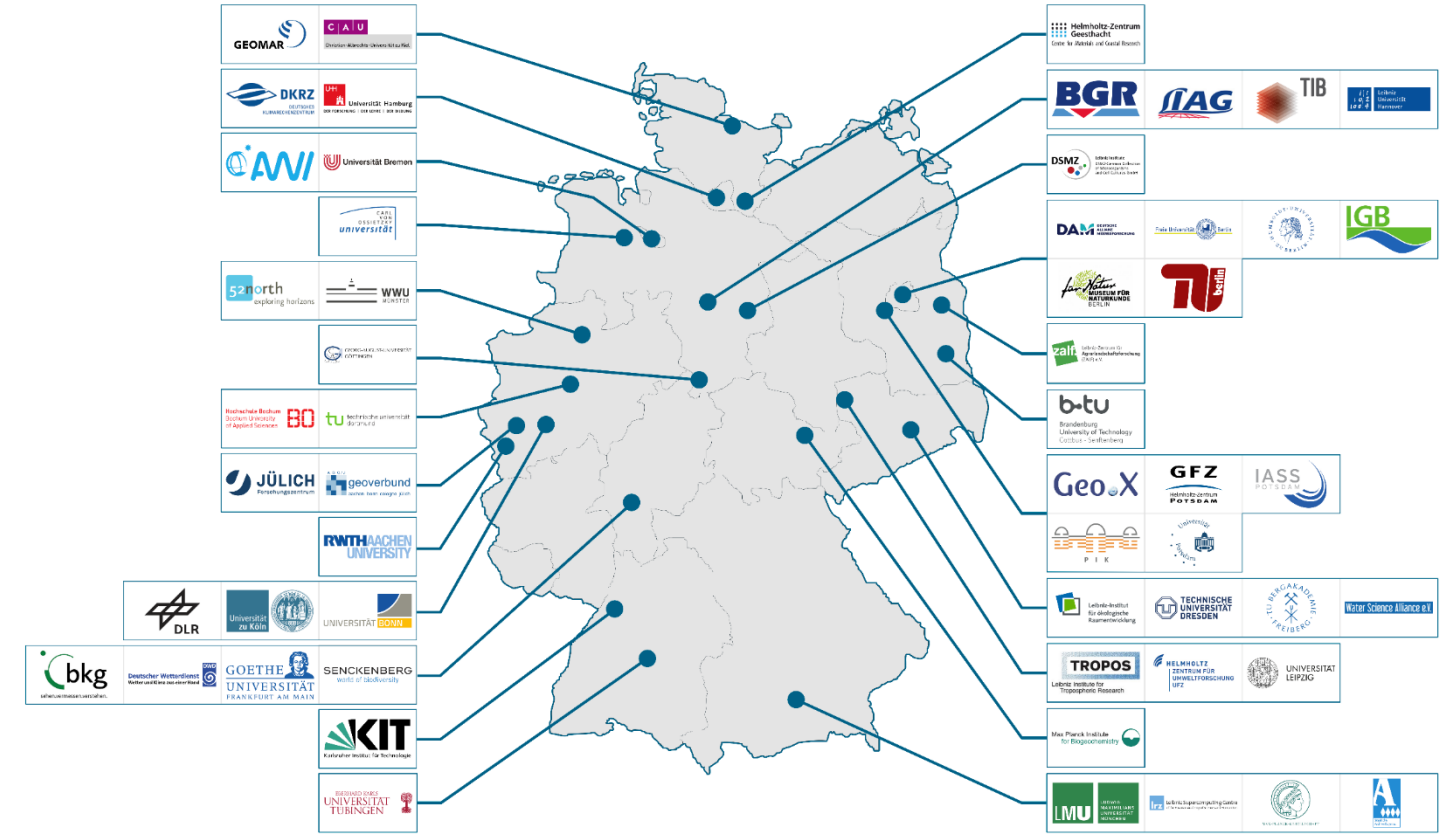
- Earth Science: https://en.wikipedia.org/wiki/Earth_science
  - This is a branch of science dealing with the physical and chemical constitution of the Earth and its atmosphere. Earth science can be considered to be a branch of planetary science …

- Earth System Science: https://en.wikipedia.org/wiki/Earth_system_science
  - In particular, it considers **interactions** and **'feedbacks'**, through material and energy fluxes, between the Earth's sub-systems' cycles, processes and "spheres“ – atmosphere, hydrosphere, cryosphere,[5] geosphere, pedosphere, lithosphere, biosphere,[6] and even the magnetosphere[7] – as well as the impact of human societies on these components.[8]

- Conclusion regarding data: Findable, accessible, interoperable and reusable (FAIR)!

What is NFDI4Earth?

- More than 50 German partners from:
  - Universities
  - Research Organisations
    Helmholtz, Leibniz, Max Planck Society
  - Infrastructure Providers
    Research Infrastructures, Repositories, High Performance Computing Centers, Libraries
  - Governmental Institutions
  - Scientific Associations



- Established 2018 as an **Open Consortium** and the **Earth System Science (ESS)** branch **in the German Research Data Infrastructure (NFDI)**

NFDI4Earth – Strategy and Building Blocks

2Participate

Earth System Data Science Pilots;
(see https://www.nfdi4earth.de/participate/get-involved-by-pilots)
Incubators; Education and Training; Academies

2Facilitate

Virtual Help Desk; N4E One Stop;
N4E Data Science Tools; Governmental Data;
Long Term Preservation

2Interoperate

N4EArchitecture; Gold Standards for FAIR ESS;
NFDI Commons; National & International Networks

Coordination Office

Governance; Communication; Community Support;
FAIR- & Openness Commitments

Innovation Perspective

User Perspective

Infrastructure Perspective

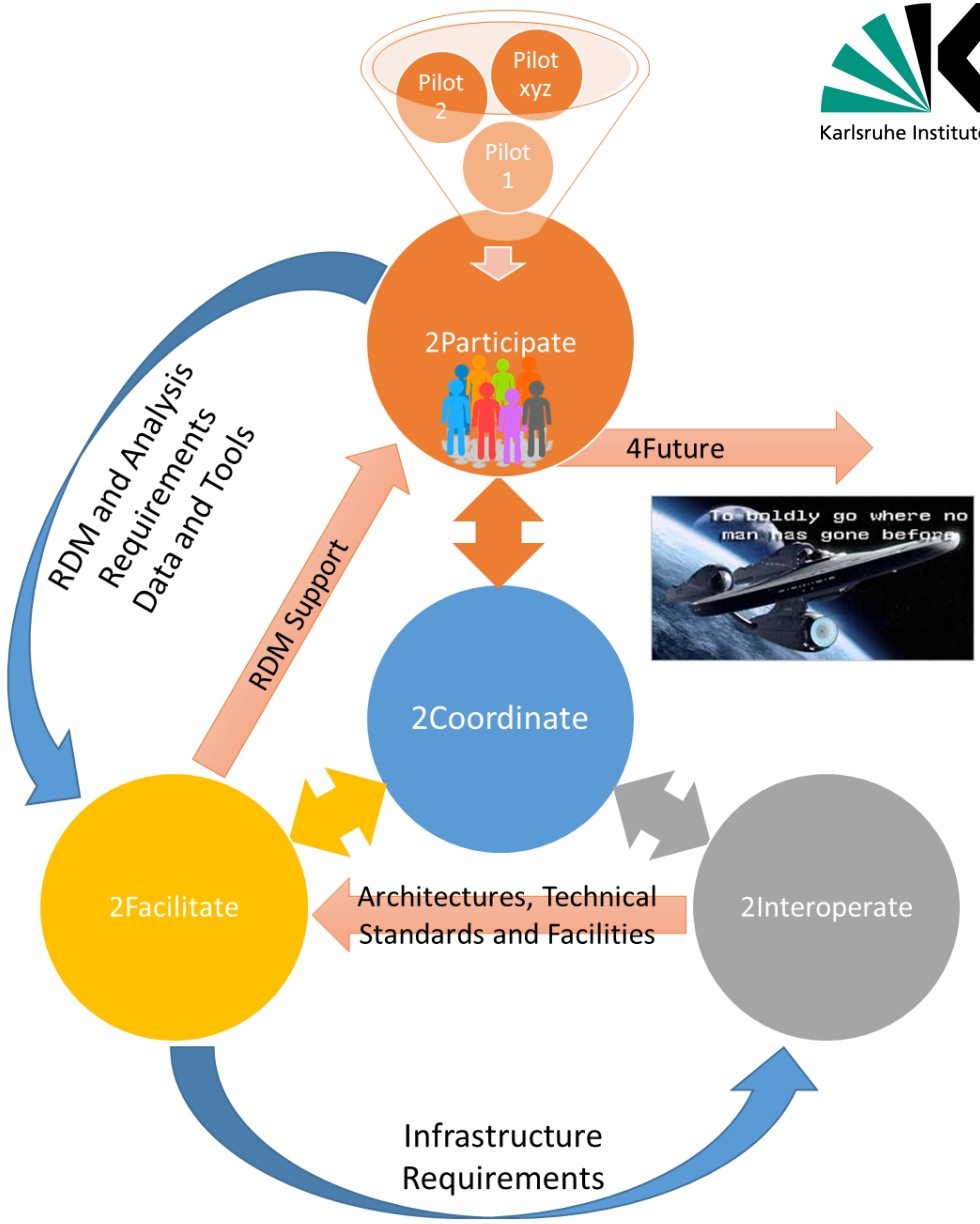
NFDI Integration

Community Perspective

NFDI4Earth – current status

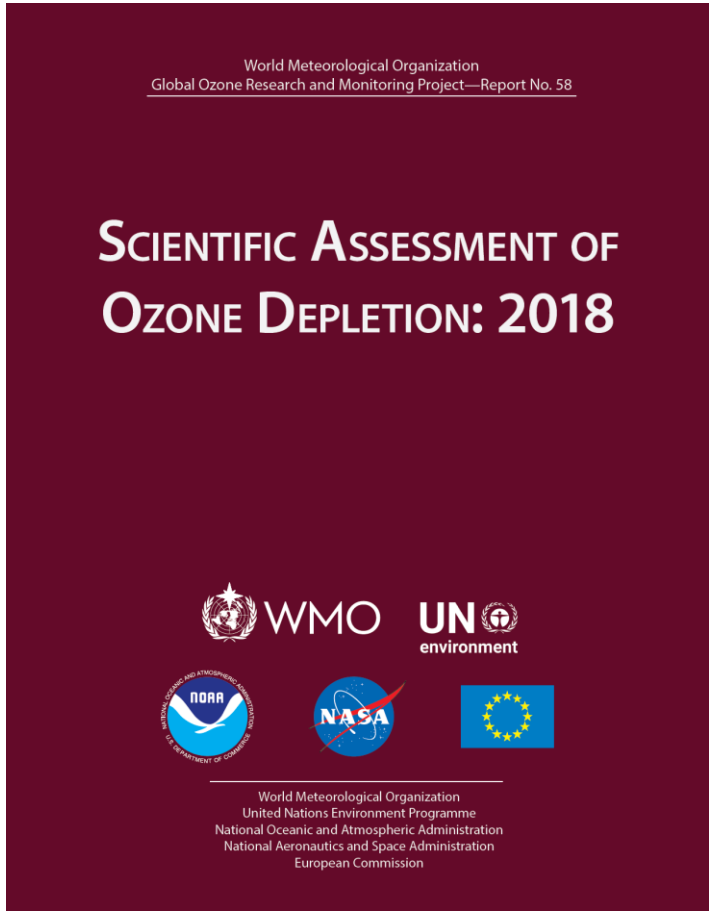
https://www.nfdi4earth.de/home

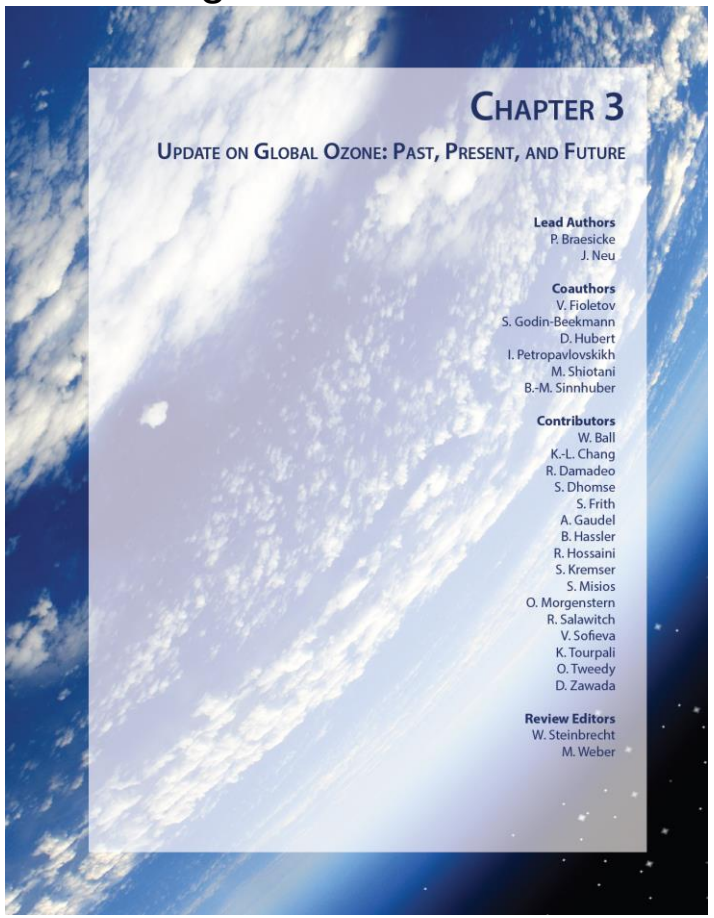
- 2Participate (4Future)
- 2Facilitate
- 2Interoperate
- 2Coordinate

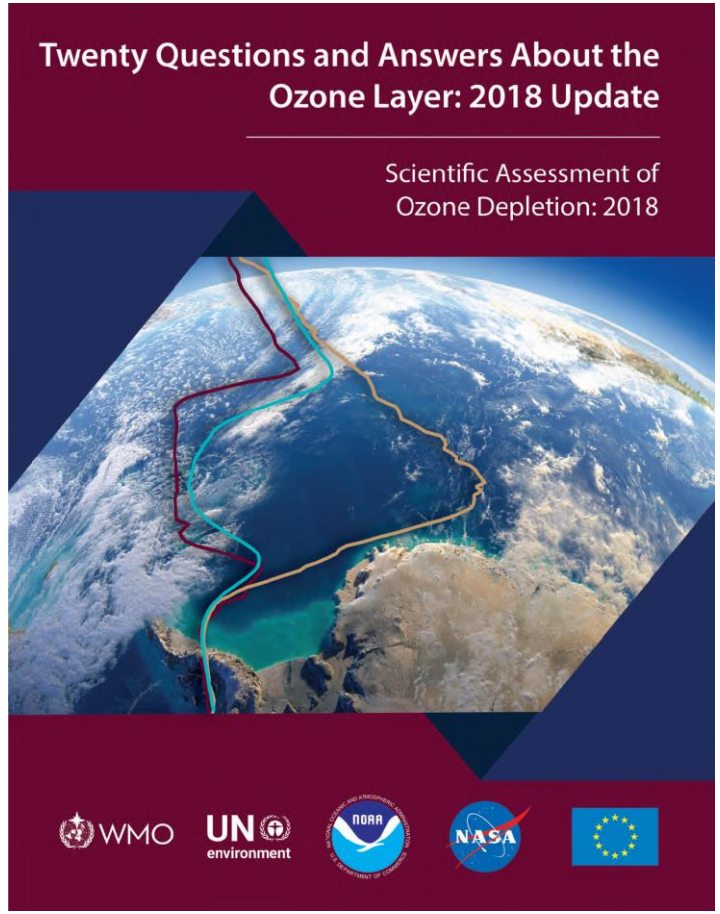


RDM and ozone research

https://www.esrl.noaa.gov/csd/assessments/ozone/2018/downloads/twentyquestions.pdf

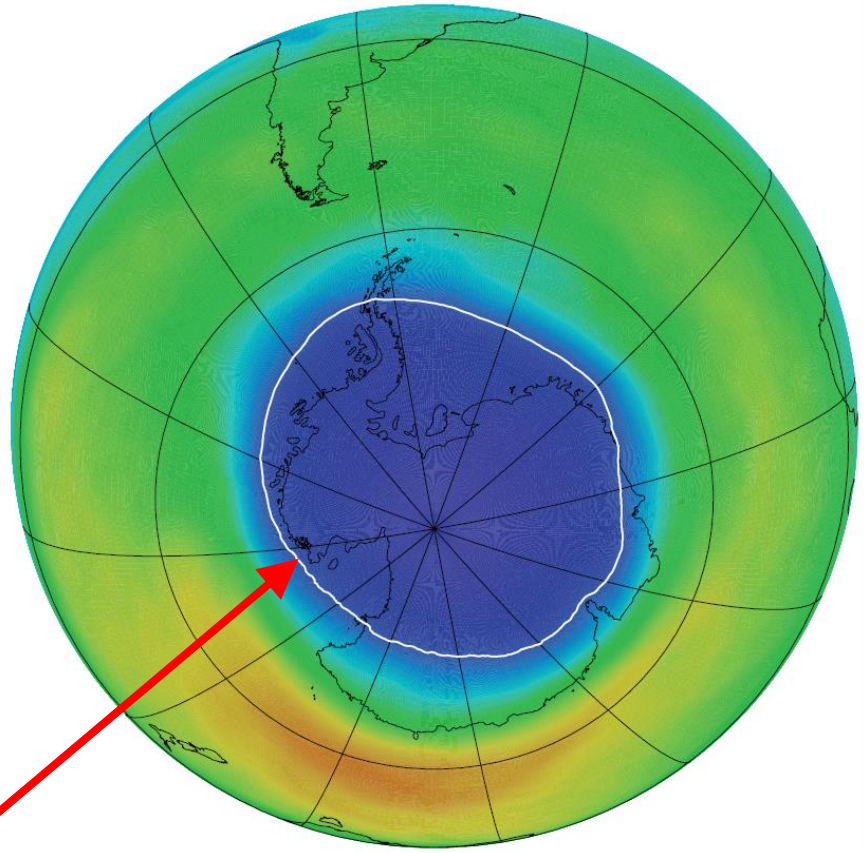






https://www.esrl.noaa.gov/csd/assessments/ozone/2018/downloads/2018OzoneAssessment.pdf

Why is ozone important?

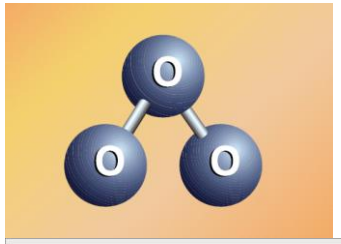


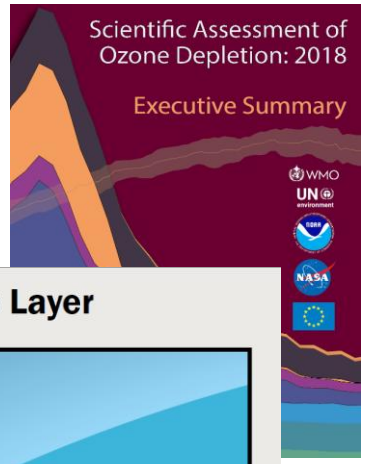
21– 30 September 2017

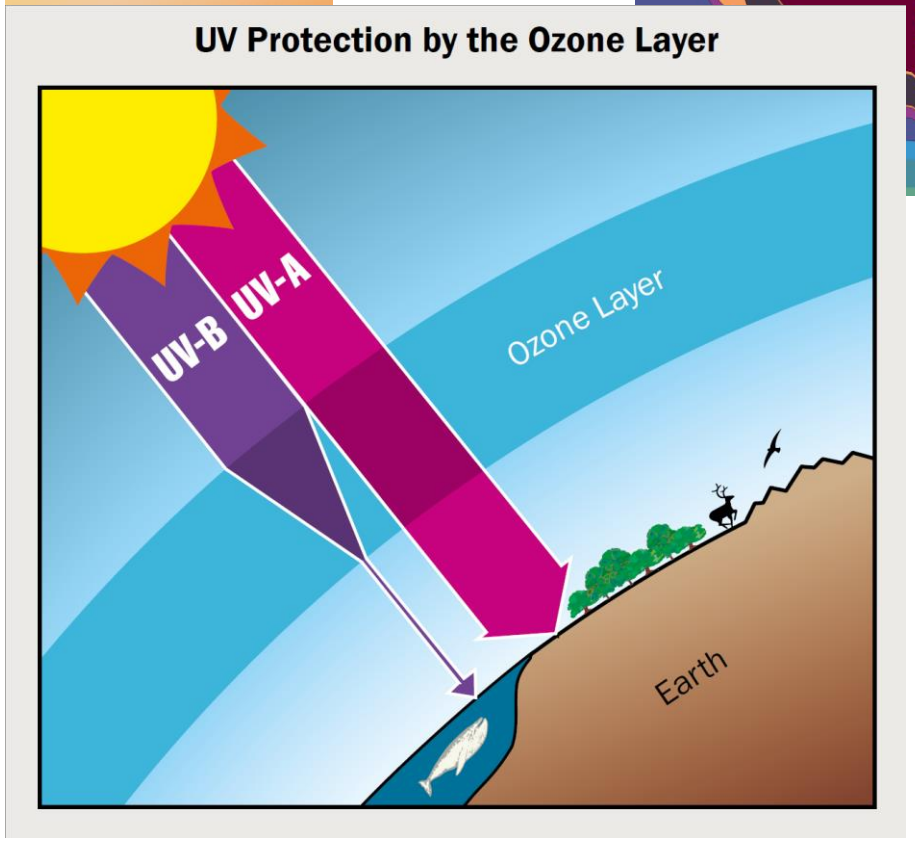
100 200 300 400 500 600

Total Ozone (Dobson units)

You might have heard about the „ozone hole“?

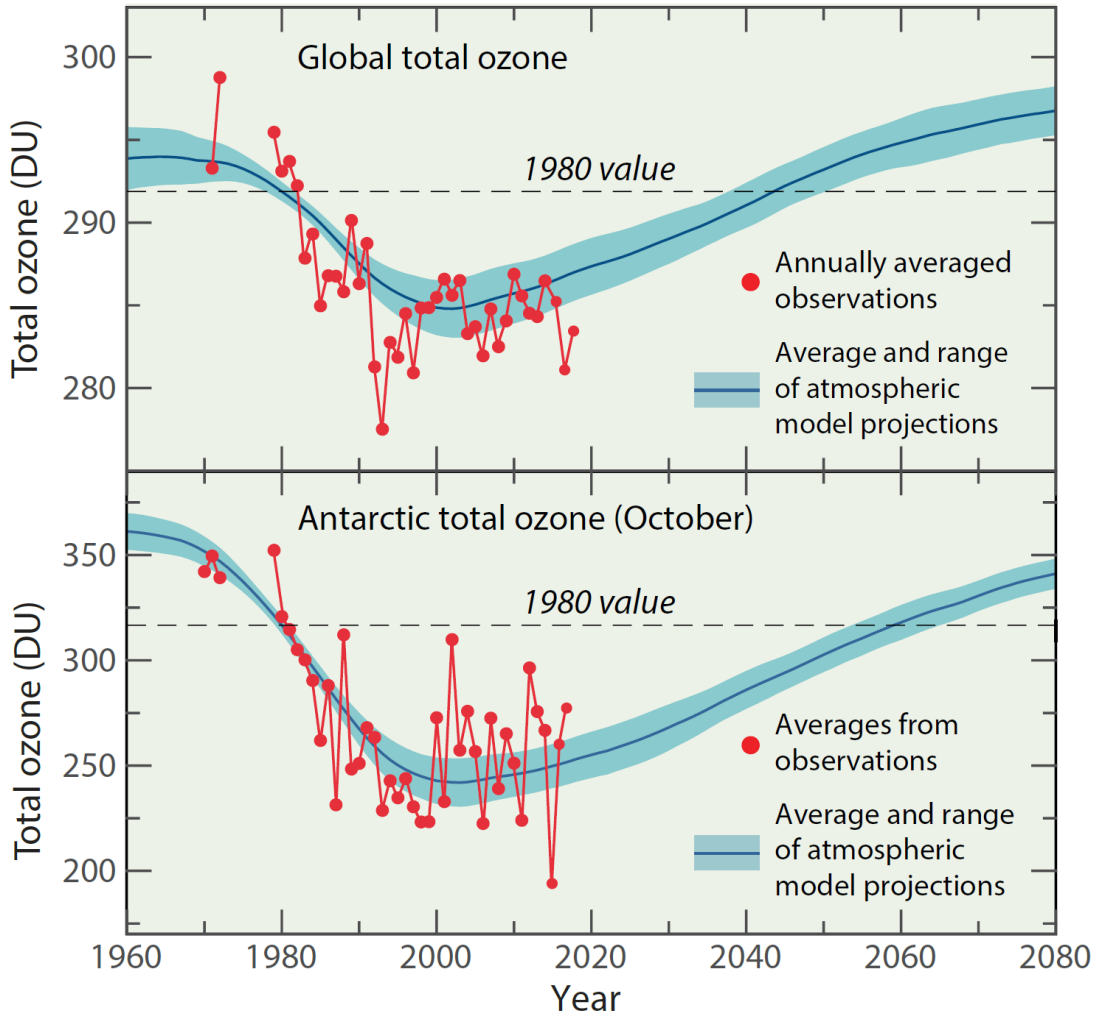




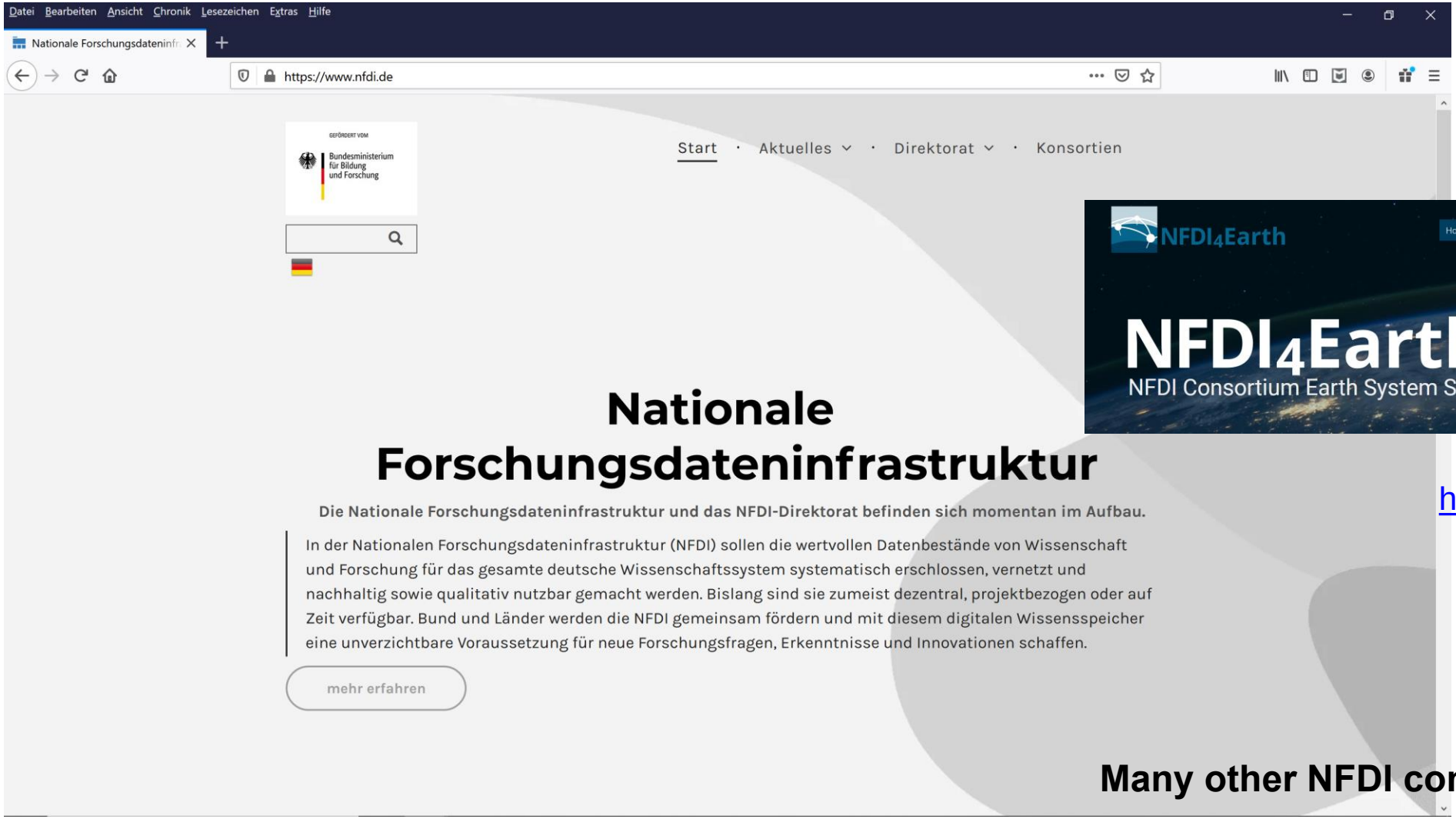


A simple plot – and always a challenge …

- A simple illustration of how stratospheric ozone is changing with time (highly processed ← common methodological ground)
- All model data (blue) is compiled from many models and realisations
- For the **past**: Observations are included (red)
- For the **future**: Model projections are based on boundary assumptions
- Will be brought into **EOSC** (EOSC-Synergy)



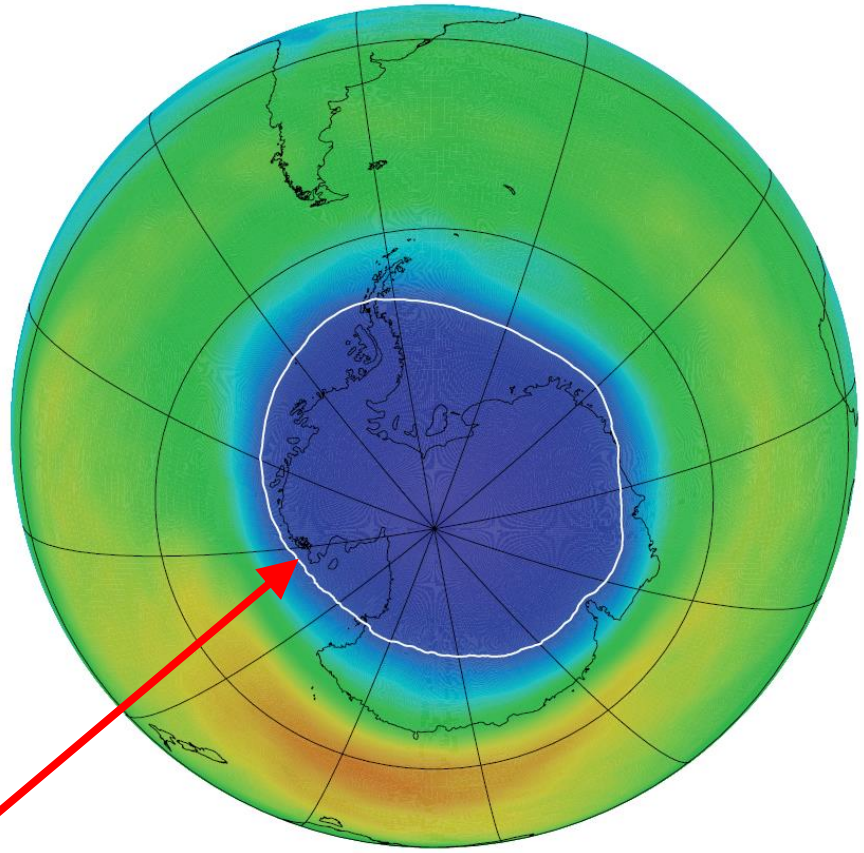
NFDI4Earth as part of NFDI



info@nfdi4earth.de
https://www.nfdi4earth.de

Many other NFDI consortia …

Thank you for your attention!



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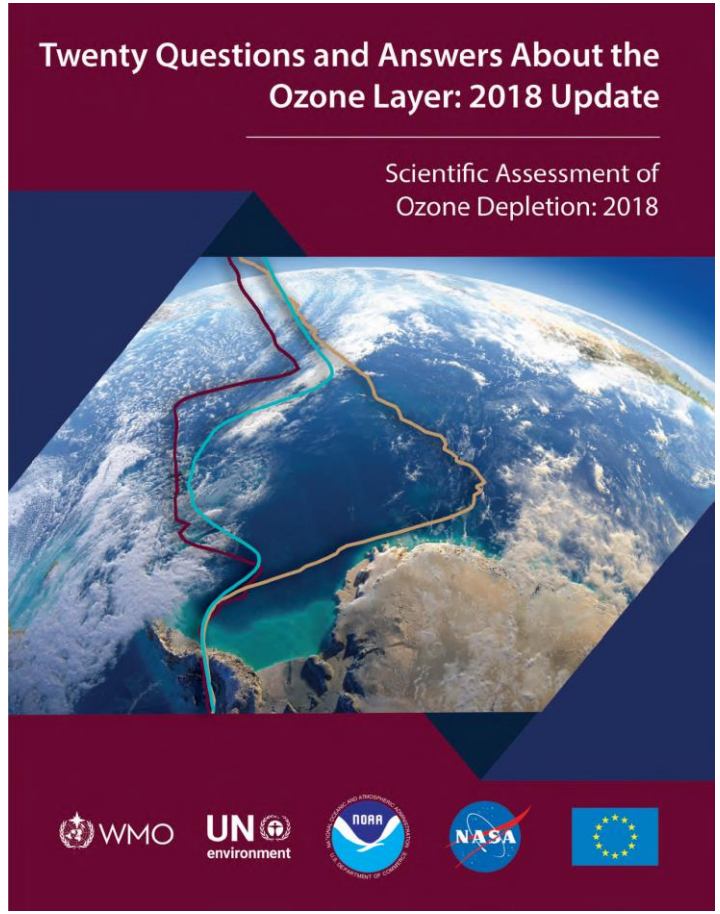

Abstract

Earth System Science (ESS) is a wonderfully diverse field, covering different compartments of the Earth System (ES) and their complex interactions. Diverse observational systems, laboratory studies and a wide range of models are creating rapidly increasing amounts of data to enhance our perception and understanding of the ES, which we urgently require to sustainably manage our environment.

In this context, Research Data Management (RDM) following FAIR principles is an important key to more efficient knowledge extraction from new and existing data. NFDI4Earth (https://www.nfdi4earth.de/), as a bottom-up RDM initiative, fosters FAIR RDM in the diverse ESS community as a methodological cross-cutting activity that integrates this diverse community closer together and enhances the potential for new interdisciplinary collaborations. The journey towards NFDI4Earth (also hopefully as a funded project in the future) has already produced new perspectives for many participants.

My personal perspective (presented here) is shaped by my background as a meteorologist, climate scientist and modeller with an interest in (mainly atmospheric) chemistry-climate interactions, where models are continuously confronted with observational evidence (a recent outreach talk regarding ozone and regional climate change can be found here: https://www.youtube.com/watch?v=d3HUGRwwt20). In my context, RDM is an important component in making results easily comparable, traceable and to enable the provision of information to policy makers – with provenance across borders being important as well. NFDI4Earth – as a national initiative – is thus also an integral building part of international collaborations in ESS.

Here, I will briefly review the journey towards today's NFDI4Earth and the opportunities and challenges we are facing in going beyond today's state-of-the-art in interdisciplinary FAIR RDM. Building such a collaboration is obviously a team effort and the diversity in ESS is a tremendous opportunity to look at problems from different angles and finding common ground in methodological cross-cutting activities that will strengthen us as a research community for years to come. Thus, NFDI4Earth will be an indispensable component of the overall NFDI.