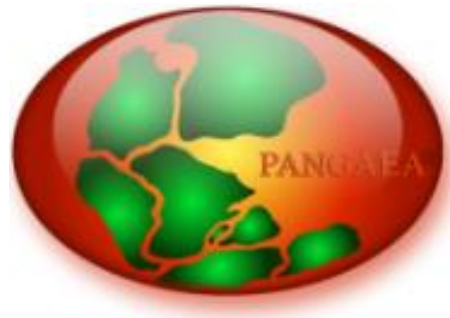


# PANGAEA

## Archiving and Publication of Scholarly Data for the Long Tail of Science



Michael Diepenbroek

# What is PANGAEA?



- Information system for long-term archiving and publication of data from earth & environmental sciences  
*(since 1993)*
- Accredited by the „World Meteorological Organisation“ (WMO) as „*World Radiation Monitoring Center*“ (WRMC)  
*(since 2007)*
- Accredited by the „International Council for Science“ (ICSU) as „*Publisher for Earth & Environmental Science*“ (PAGES)  
*(since 2001)*



**ICSU**  
**WORLD DATA SYSTEM**

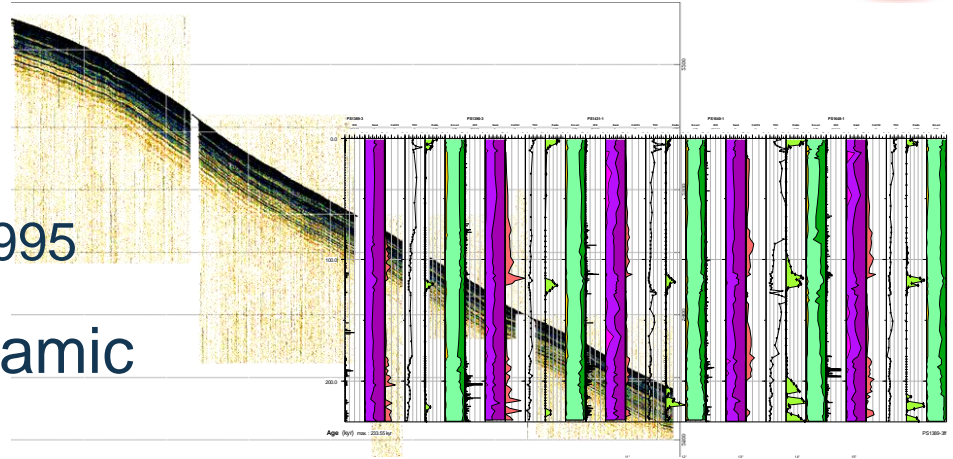


**World  
Meteorological  
Organization**  
Weather • Climate • Water

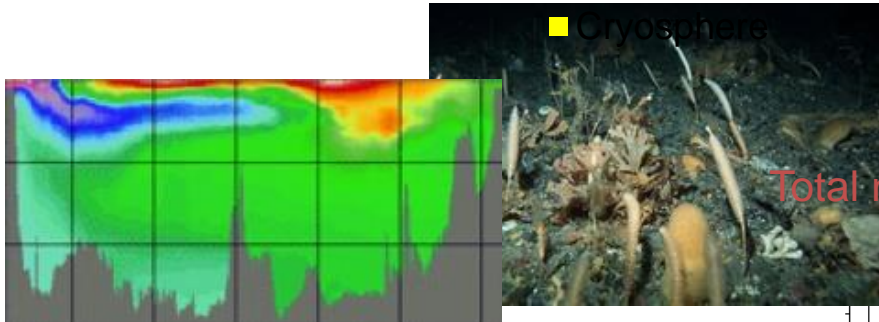
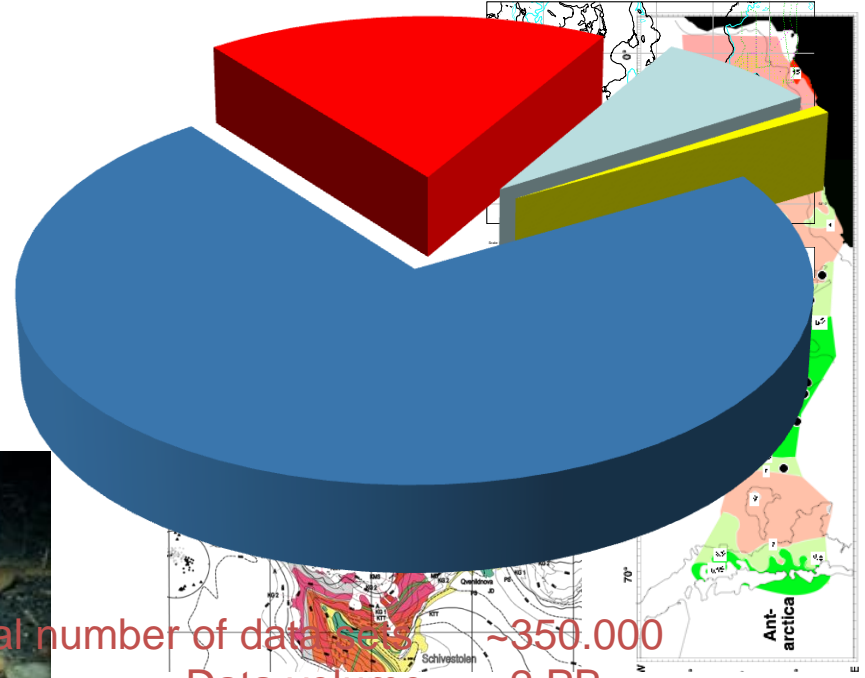
# PANGAEA - contents



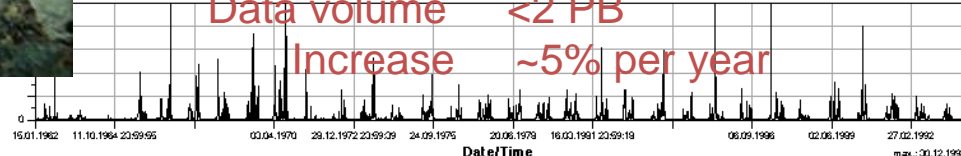
- Integral part of science
  - More than 160 European to international projects since 1995 ([www.pangaea.de/projects](http://www.pangaea.de/projects))
- highly heterogenous & dynamic
- multidisciplinary



- Hydrosphere
- Lithosphere
- Atmosphere
- Cryosphere

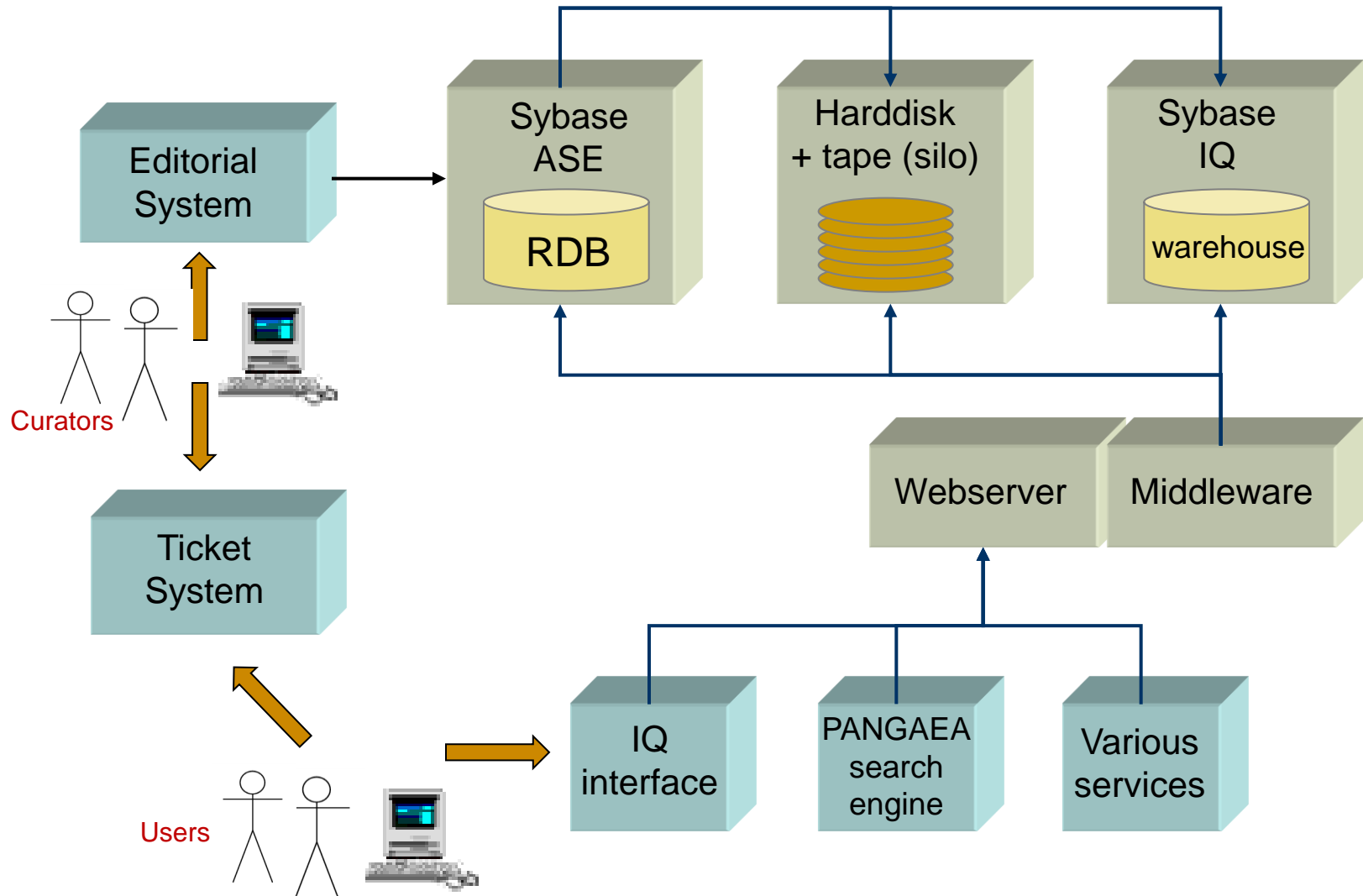


Total number of data ~350.000  
Data volume <2 PB  
Increase ~5% per year



# PANGAEA

## - technical architecture



# PANGAEA - interoperability



## Portals

- ✓ CARBOOCEAN
- ✓ EUR-OCEANS
- ✓ IODP - SEDIS
- ✓ ICSU WDS portal
- ✓ ESONET/EMSO



## Broker function

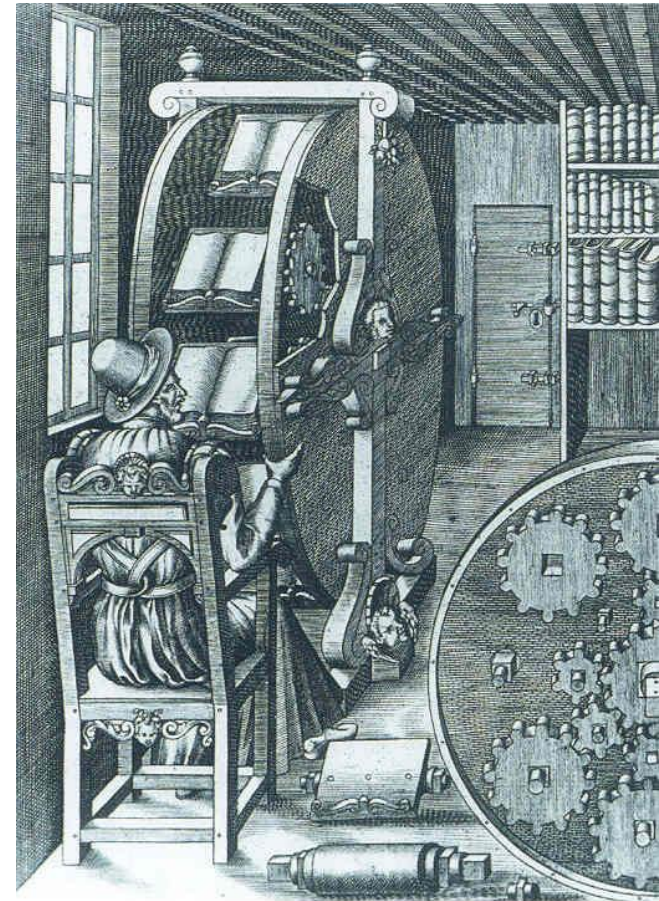
- ✓ GBIF, OBIS

## Sensor webs

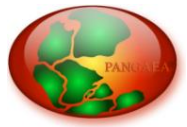
- ✓ ESONET/EMSO, Statoil

## Conform to global standards

- ✓ ISO19xxx, OGC, W3C, OAI



# PANGAEA – interoperability



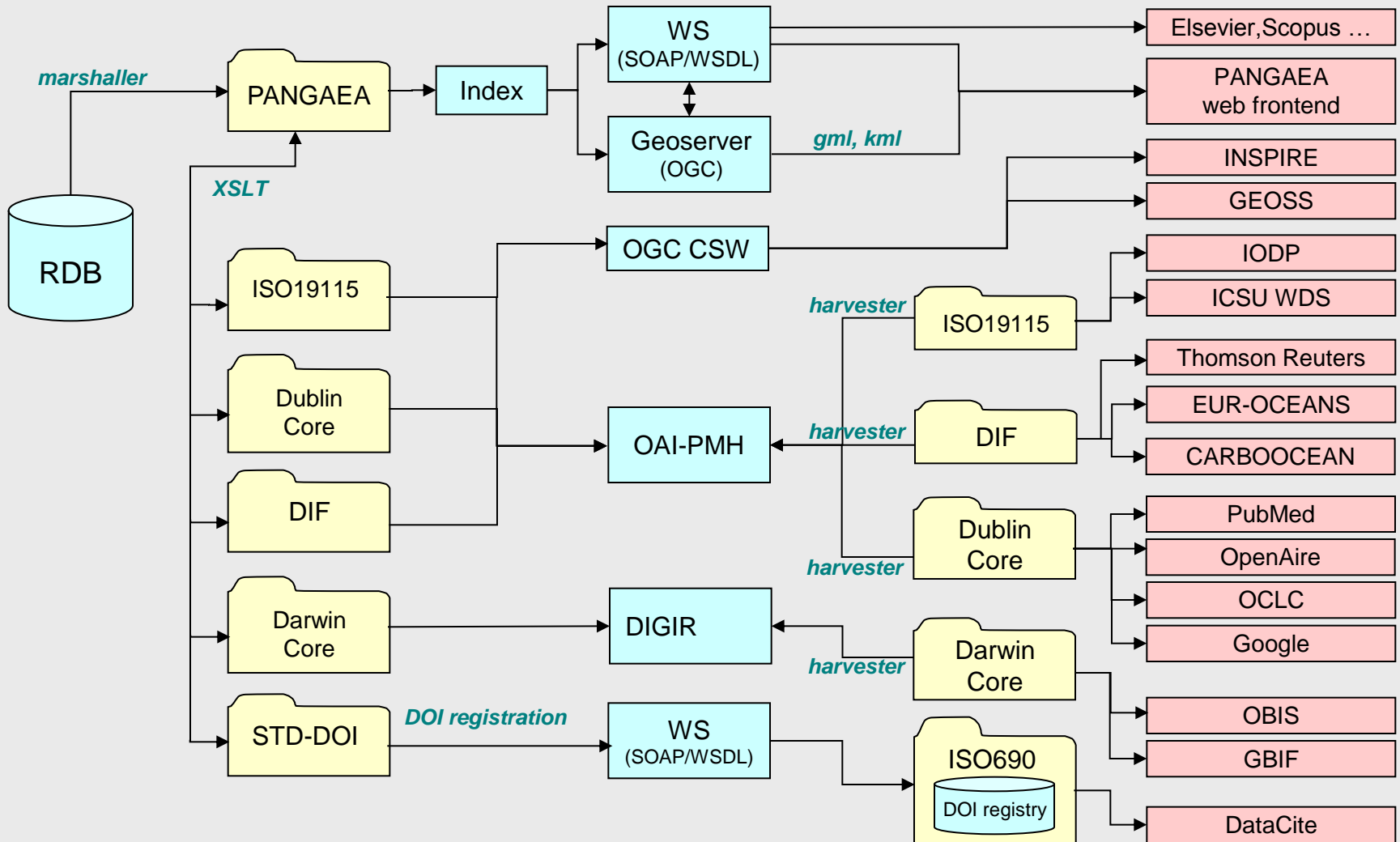
*data management & longterm archiving*

*catalogues*

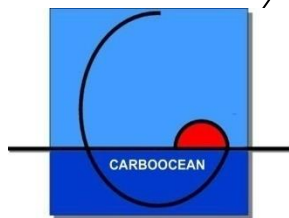
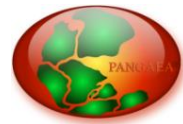
*protocols*

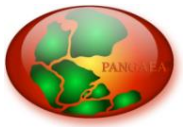
*catalogues*

*Frontends / portals*

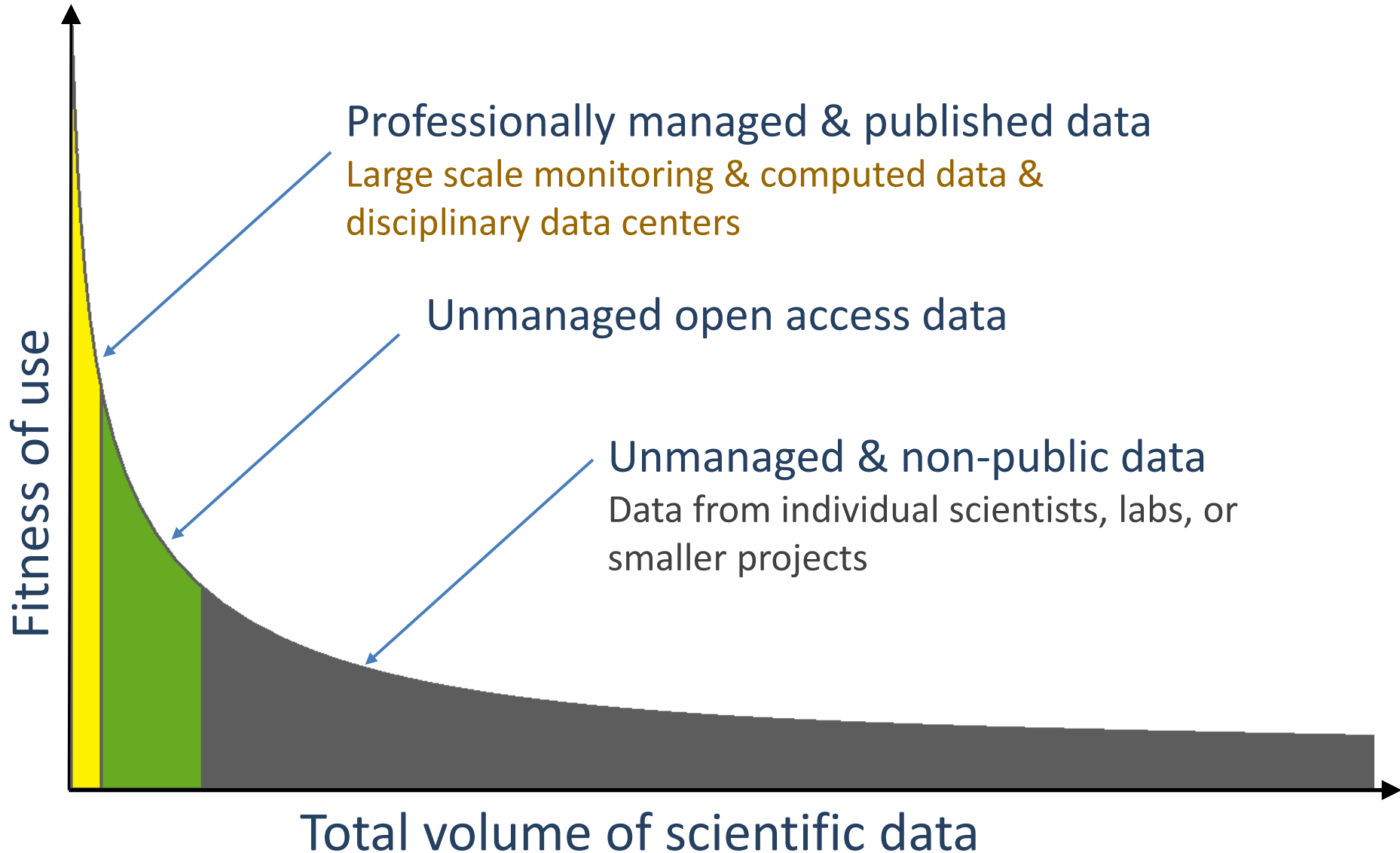


# PANGAEA – Dissemination of Data & Metadata





# The Long Tail of Data

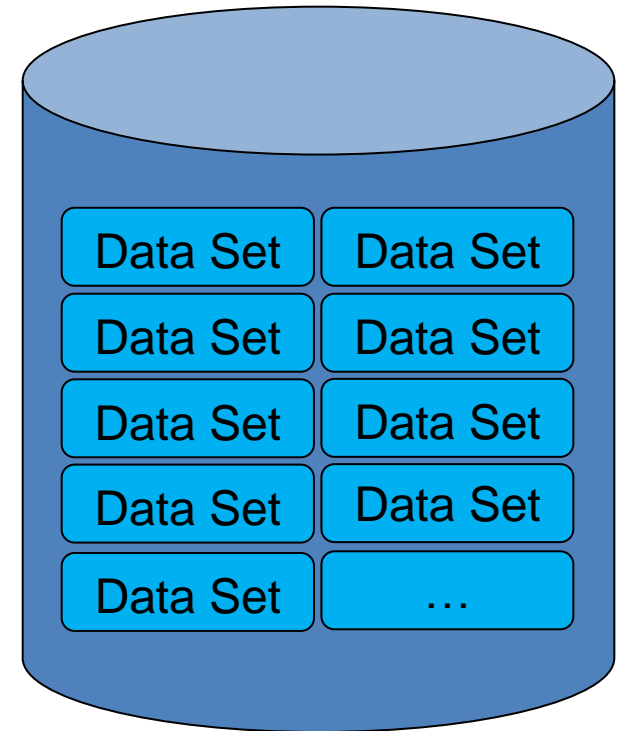




# Publishing data with PANGAEA

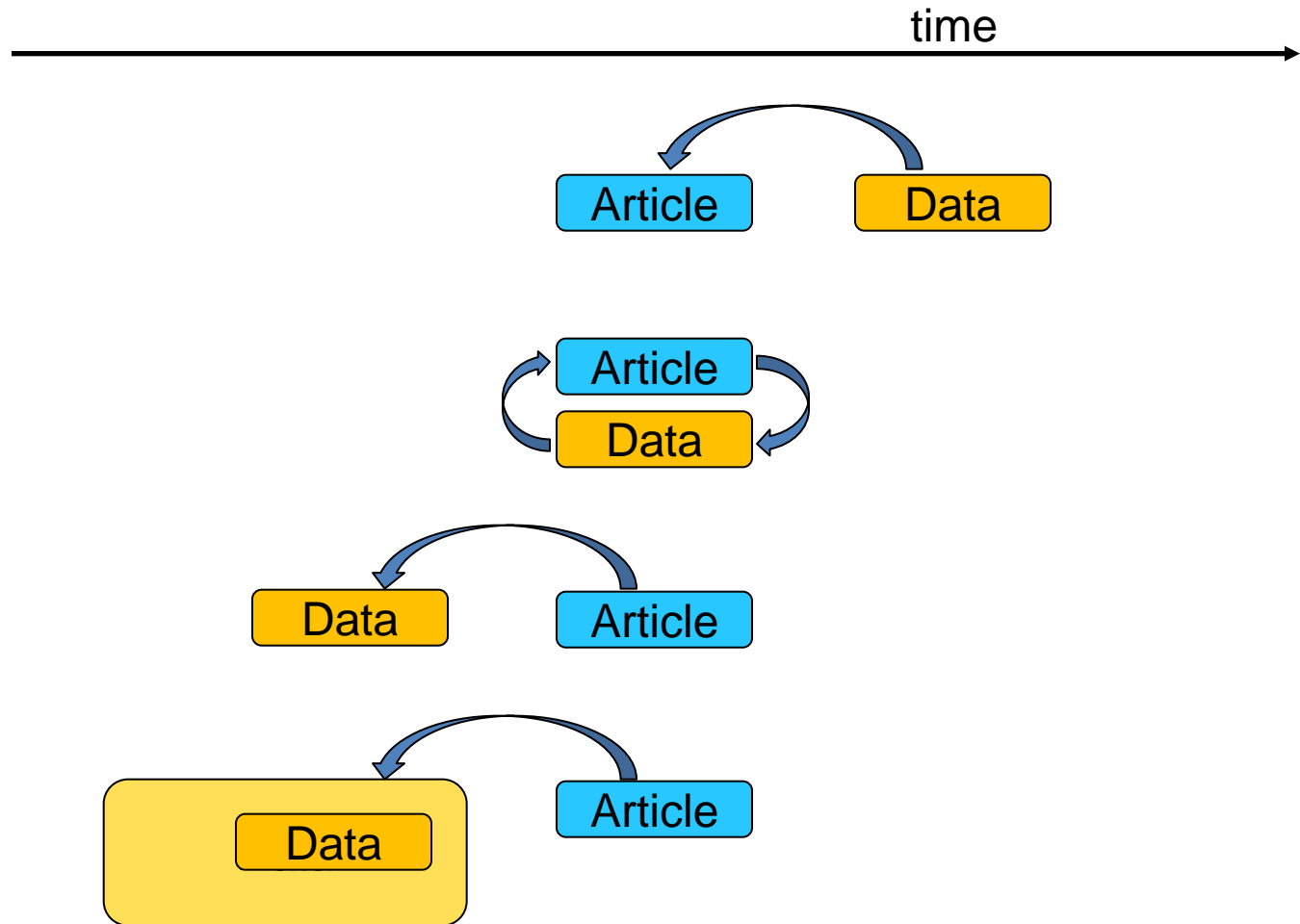


- Citable & persistent (DOI)
- CC-BY License
- Quality data
  - ✓ QA/QC -> review procedures
- Efficient usage
  - ✓ (Meta)data & interoperability standards (machine readable)
- **FITNESS OF USE!**

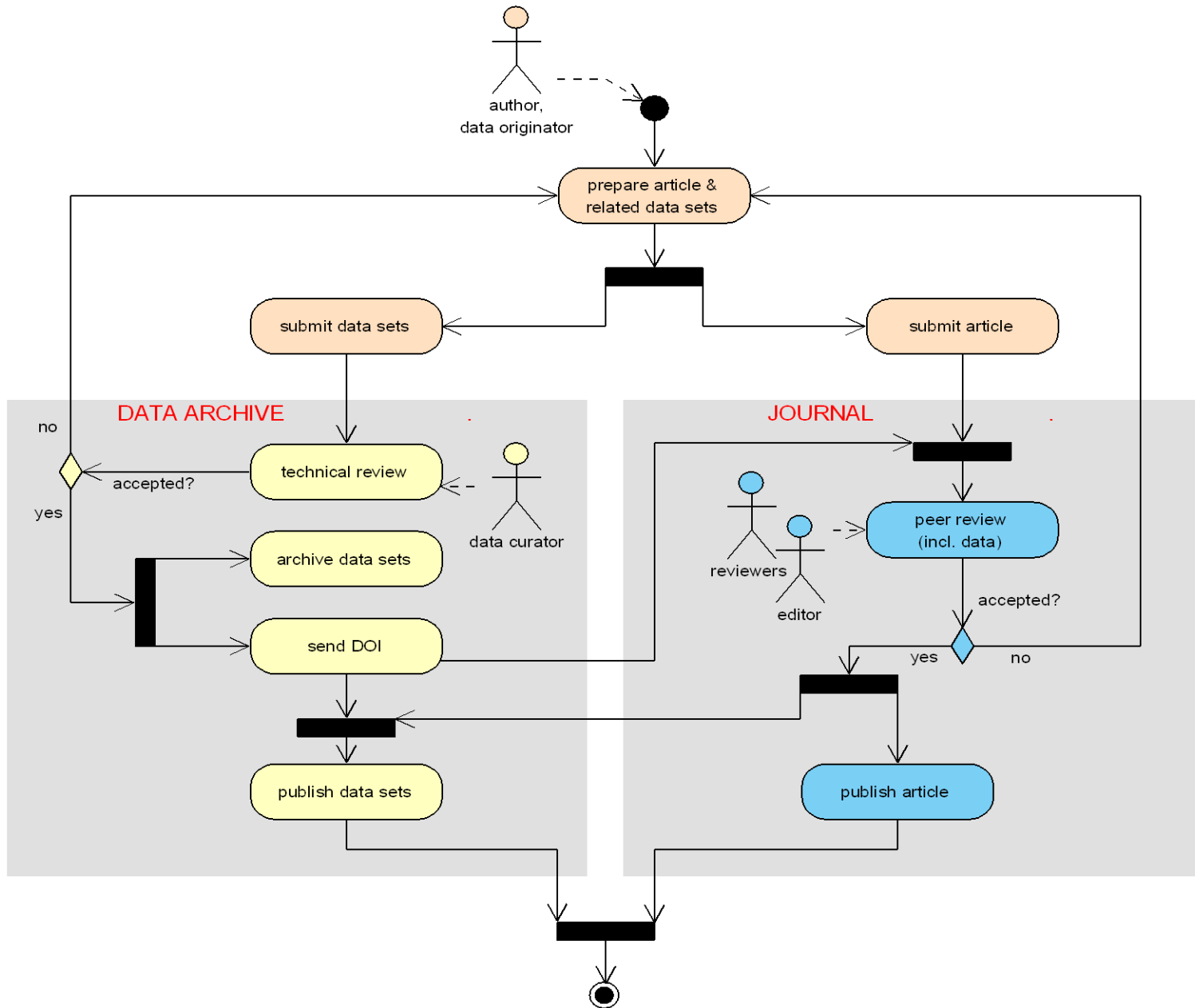


OECD principles and guidelines for access to research data (2007)

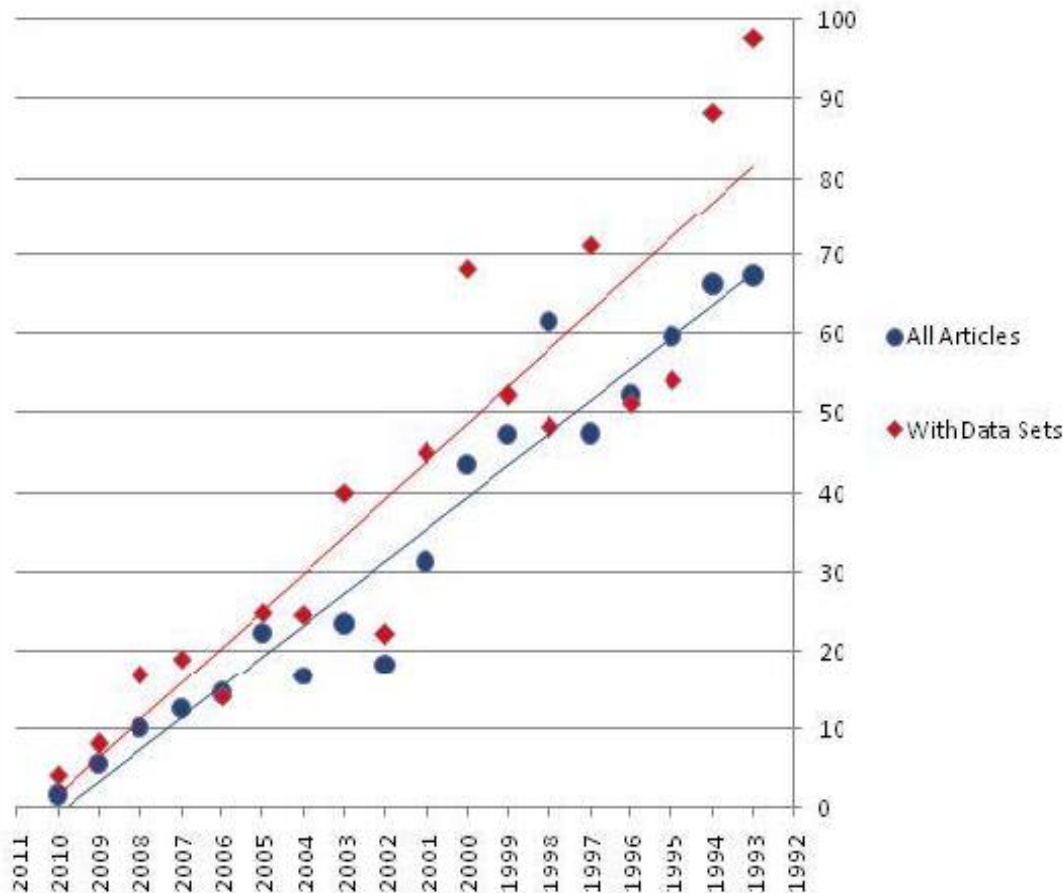
# Data publication - citability



# Publishing workflow - synchronized

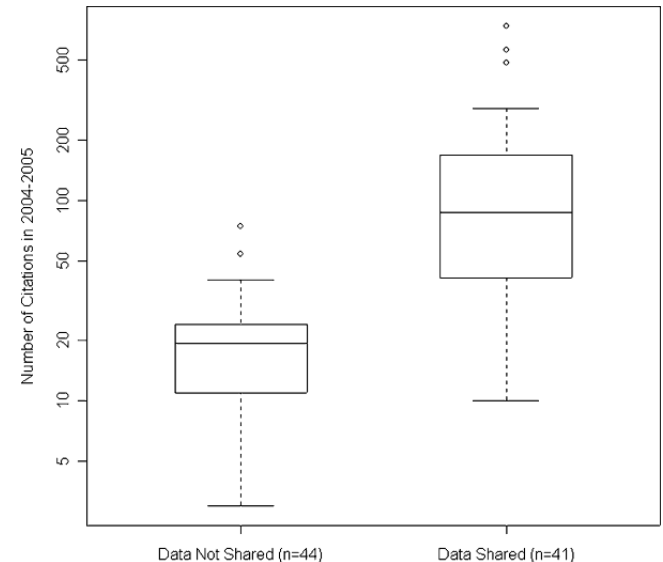


# Impact on citation rates



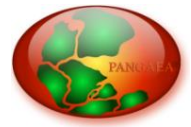
courtesy of Jon Sears (AGU)

**35% to 69%  
more citations!**

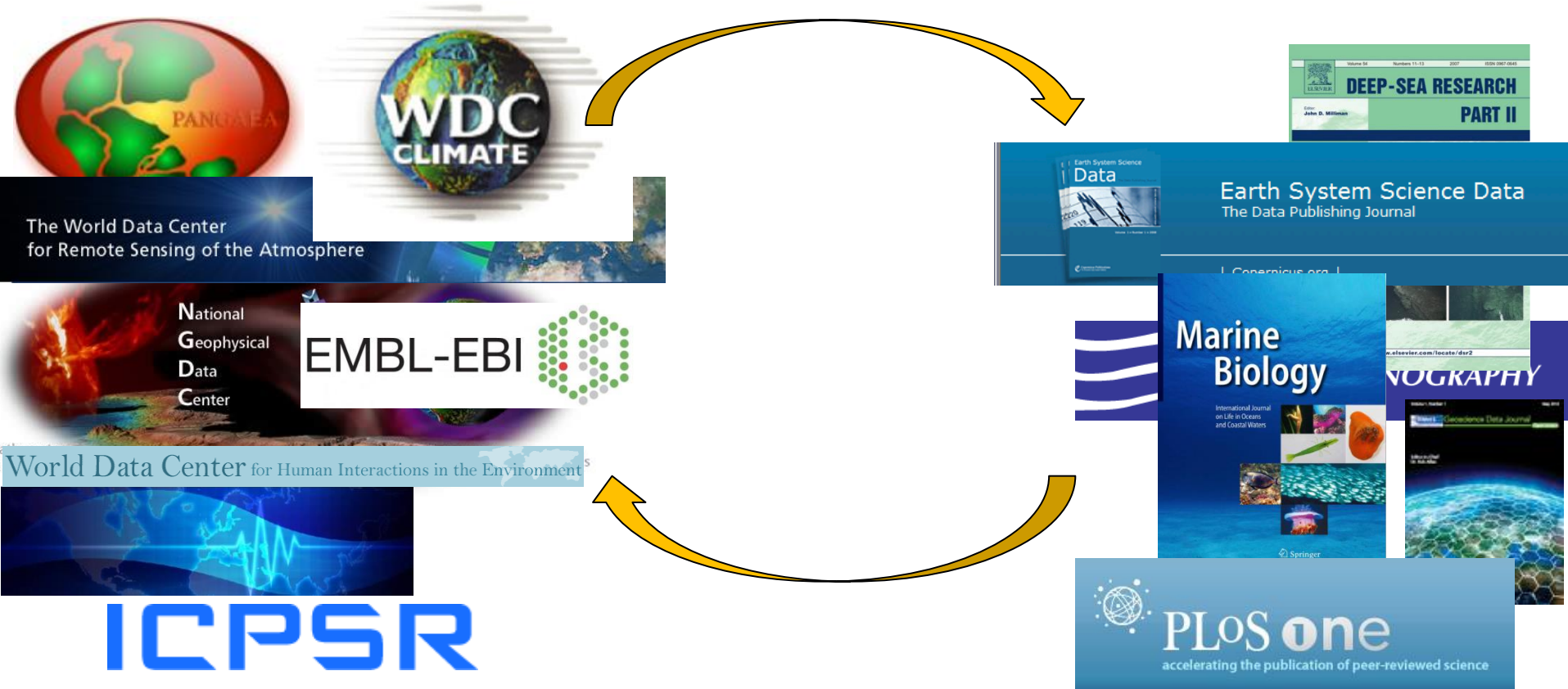


Piwowar HA, Day RS, Fridsma DB (2007) Sharing Detailed Research Data Is Associated with Increased Citation Rate. PLoS ONE 2(3): e308. doi:10.1371/journal.pone.0000308

# Collaboration between data centers & science journals



- ✓ linking editorial workflows
- ✓ linking services



# Data Publishing – Cross-referencing



ScienceDirect - Marine Microbiology  
Mohtadi, M et al. (2010): Surface sediment samples from several fore-arc basins west and southwest of the Indonesian Archipelago, analyzed by planktonic foraminifera, stable oxygen and carbon isotopic signals and opal and CaCO<sub>3</sub> contents in bulk sediment.  
doi.pangaea.de/10.1594/PANGAEA.733340



**PANGAEA®**  
Data Publisher for Earth & Environmental Science

Logged in as uschindler (log out, profile)

Always quote citation when using data!

## Data Description

Show Map Google Earth RIS BibTeX

**Citation:** Mohtadi, M et al. (2010): Surface sediment samples from several fore-arc basins west and southwest of the Indonesian Archipelago, analyzed by planktonic foraminifera, stable oxygen and carbon isotopic signals and opal and CaCO<sub>3</sub> contents in bulk sediment. doi:10.1594/PANGAEA.733340, Supplement to: Mohtadi, Mahyar; Max, Lars; Hebbeln, Dierk; Baumgart, Anne; Krück, Nils; Jennerjahn, Tim C (2007): Modern environmental conditions recorded in surface sediment samples off W and SW Indonesia: Planktonic foraminifera and biogenic compounds analyses. *Marine Micropaleontology*, 65(1-2), 96-112, doi:10.1016/j.marmicro.2007.06.004

**Abstract:** A total of 69 surface sediment samples from several fore-arc basins located west and southwest of the Indonesian Archipelago was analyzed with respect to the faunal composition of planktonic foraminifera, the stable oxygen and carbon isotopic signal of a surface-dwelling (*Globigerinoides ruber*) and a thermocline-dwelling (*Neogloboquadrina dutertrei*) species, and the opal and CaCO<sub>3</sub> contents in bulk sediment. Our results show that the distribution pattern of opal in surface sediments corresponds well to the upwelling-induced chlorophyll concentration in the upper water column and thus, represents a reliable proxy for marine productivity in the coastal upwelling area off S and SW Indonesia. Present-day oceanography and marine productivity are also reflected in the tropical to subtropical and upwelling assemblages of planktonic foraminifera in the surface sediments, which in part differ from previous studies in this region probably due to different coring methods and dissolution effects. The average stable oxygen isotopic values (δ<sup>18</sup>O) of *G. ruber* in surface sediments vary between 2.9 per mill and 3.2 per mill from basin to basin and correspond to the oceanographic settings during the SE monsoon (July-October) off west Sumatra, whereas off southern Indonesia, they reflect the NW monsoon (December-March) or annual average conditions. The δ<sup>18</sup>O values of *N. dutertrei* show a stronger interbasinal variation between 1.6 per mill and 2.2 per mill and correspond to the upper thermocline hydrology in July-October. In addition, the difference between the shell carbon isotopic values (δ<sup>13</sup>C) of *G. ruber* and *N. dutertrei* (Δδ<sup>13</sup>C) appears to be an appropriate productivity recorder only in the non-upwelling areas off west Sumatra. Consequently, joint interpretation of the isotopic values of these species is distinctive for different fore-arc basins W and SW of Indonesia and should be considered in paleoceanographic studies.



**Project(s):** Center for Marine Environmental Sciences (MARUM)

**Coverage:** Median Latitude: -2.448691 \* Median Longitude: 102.924024 \* South-bound Latitude: -9.012150 \* West-bound Longitude: 95.331100 \* North-bound Latitude: 3.874500 \* East-bound Longitude: 121.002536

**Event(s):** GeoB10008-4 \* Latitude: -0.015914 \* Longitude: 98.004331 \* Date/Time: 2005-08-06T04:29:00 \* Elevation: -934.0 m \* Campaign: SO184/1 (PABESIA) \* Basis: Sonne \* Device: MultiCorer \* Comment: 6/6 4/4

GeoB10010-1 \* Latitude: -1.002969 \* Longitude: 97.016358 \* Date/Time: 2005-08-06T11:14:00 \* Elevation: -2937.0 m \* Campaign: SO184/1 (PABESIA) \* Basis: Sonne \* Device: MultiCorer \* Comment: 6/6 4/4

GeoB10014-1 \* Latitude: 1.011308 \* Longitude: 96.016350 \* Date/Time: 2005-08-08T01:30:00 \* Elevation: -1158.0 m \* Campaign: SO184/1 (PABESIA) \* Basis: Sonne \* Device: MultiCorer \* Comment: 6/6 4/4

# Data Publishing – Cross-referencing



Modern environmental con x

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Abstract

Keywords

1. Introduction

2. Regional setting

3. Materials and methods

Table 1.

Table 2.

4. Results

Table 3.

5. Discussion

5.1. Effect of dissolution

**Marine Micropaleontology**

Volume 65, Issues 1–2, 29 October 2007, Pages 96–112

**Modern environmental conditions recorded in surface sediment samples off W and SW Indonesia: Planktonic foraminifera and biogenic compounds analyses**

Mahyar Mohtadi<sup>a, b</sup>, Lars Max<sup>b</sup>, Dierk Hebbeln<sup>a, b</sup>, Anne Baumgart<sup>c</sup>, Nils Krüick<sup>c</sup>, Tim Jennerjahn<sup>c</sup>

<sup>a</sup> Center for Marine Environmental Sciences (MARUM), University of Bremen, 28359 Bremen, Germany

<sup>b</sup> Geosciences Department, University of Bremen, 28359 Bremen, Germany

<sup>c</sup> Center for Tropical Marine Ecology (ZMT), Fahrenheitstr. 6, 28359 Bremen, Germany

Received 23 April 2007. Revised 19 June 2007. Accepted 20 June 2007. Available online 6 July 2007.

<http://dx.doi.org/10.1016/j.marmicro.2007.06.004>, How to Cite or Link Using DOI

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**Abstract**

A total of 69 surface sediment samples from several fore-arc basins located west and southwest of the Indonesian Archipelago was analyzed with respect to the faunal composition of planktonic foraminifera, the stable oxygen and carbon isotopic signal of a surface-dwelling (*Globigerinoides ruber*) and a thermocline-dwelling (*Neogloboquadrina dutertrei*) species, and the opal and CaCO<sub>3</sub> contents in bulk sediment. Our results show that the distribution pattern of opal in surface sediments corresponds well to the upwelling-induced chlorophyll concentration in the upper water column and thus, represents a reliable proxy for marine productivity in the coastal upwelling area off S and SW Indonesia. Present-day oceanography and marine productivity are also reflected in the tropical to subtropical and upwelling assemblages of planktonic

**PANGAEA® – Related Data**

Surface sediment samples from several fore-arc basins located west and southwest of the Indonesian Archipelago were analyzed for CaCO<sub>3</sub> contents in bulk sediment.

Thailand Vietnam Philippines

Andaman Sea Gulf of Thailand Malaysia Indonesia Java Sea Banda Sea

Hybrid

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**Related articles**

- Direct evidence for nitrogen isotope discrimination in planktonic foraminifera from the North Atlantic Ocean. *Organic Geochemistry*
- Stable isotopes of planktonic foraminifera from the North Atlantic Ocean. *Marine Micropaleontology*
- Comparison of the Compositional, Microbiological and Geochemical Characteristics of Planktonic Foraminifera from the North Atlantic Ocean. *Journal of Dairy Science*
- A quadra-directional decomposition heuristic for the analysis of planktonic foraminifera. *Computers & Operations Research*
- Development of a <sup>1</sup>H NMR structural-reporter gene for the analysis of planktonic foraminifera. *Carbohydrate Research*

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**High-resolution record of Northern Hemisphere interglacial period**

[No author name available]

**Abstract**  
 Two deep ice cores from central Greenland, drilled in the Northern Hemisphere, but the oldest sections of the cores were present an undisturbed climate record from a North Greenland within the last interglacial period. The oxygen isotopes with temperatures 5 °C warmer than today. We find ice from northern Greenland and the undisturbed sections of the Northern Hemisphere modulated the latitudinal temperature temperatures that marked the initiation of the last glacial by an abrupt climate warming about 115,000 years ago appear to have an immediate Antarctic counterpart, suggesting that the climate see-saw between the hemispheres (which dominated the last glacial period) was not operating at this time.

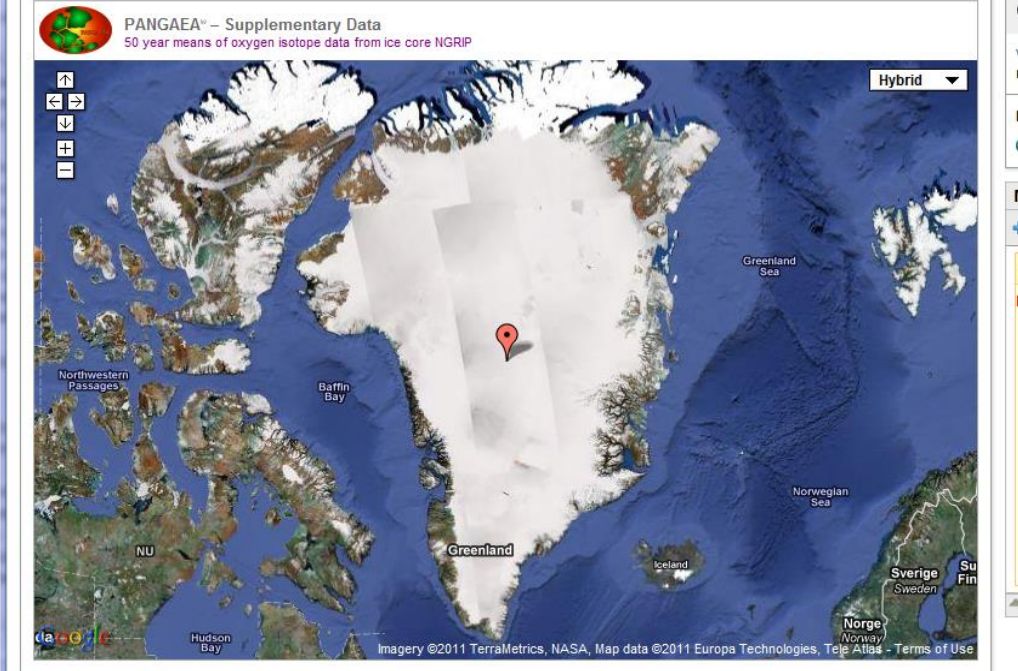
**Language of original document**  
 English

**Index Keywords**  
**Engineering controlled terms:** Geochronology; Glacial geology; Ice; Isotopes; Oxygen; Rocks  
**Engineering uncontrolled terms:** Bedrock; Greenland; Northern hemisphere  
**Engineering main heading:** Climate change  
**GEOBASE Subject Index:** ice core; Last Interglacial; Northern Hemisphere; paleoclimate; Quaternary  
**EMTREE medical terms:** Antarctica; article; chronology; climate change; cold climate; document examination; geographic elevation; glacial mass balance; information retrieval; last glacial maximum; latitude; low temperature; priority journal

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**Language of original document**  
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**Index Keywords**  
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**Engineering uncontrolled terms:** Bedrock; Greenland; Northern hemisphere  
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**EMTREE medical terms:** Antarctica; article; chronology; climate change; cold climate; document examination; geographic elevation; glacial mass balance; information retrieval; last glacial maximum; latitude; low temperature; priority journal



**References (50)** View in table layout

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1  Johnsen, S.J., Clausen, H.B., Dansgaard, W., Fuhrer, K., Gundestrup, N., Hammer, C.U., Iversen, P., (...), Steffensen, J.P.  
**Irregular glacial interstadial recorded in a new Greenland ice core**  
 (1992) Nature, 359 (6202), pp. 241-243. Cited 684 times

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Landais, A., Waelbroeck, C., Masson-Delmotte, V.  
**On the limits of Antarctic and marine climate records synchronization: Lag estimates during marine isotopic stages 5d and 5c**  
 (2006) *Paleoceanography*

Lhomme, N., Clarke, G.K.C., Marshall, S.J.  
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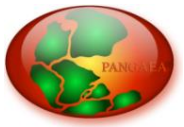
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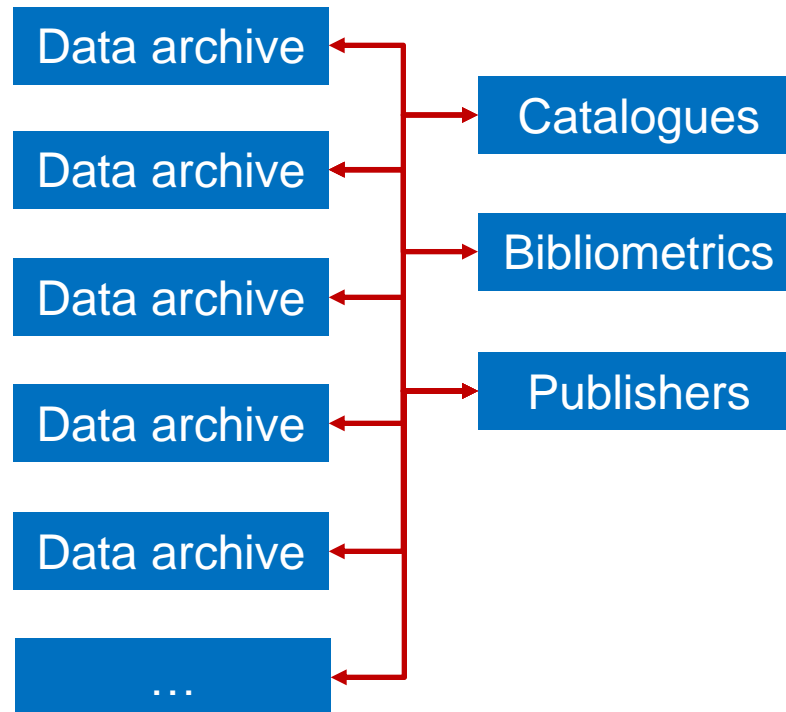
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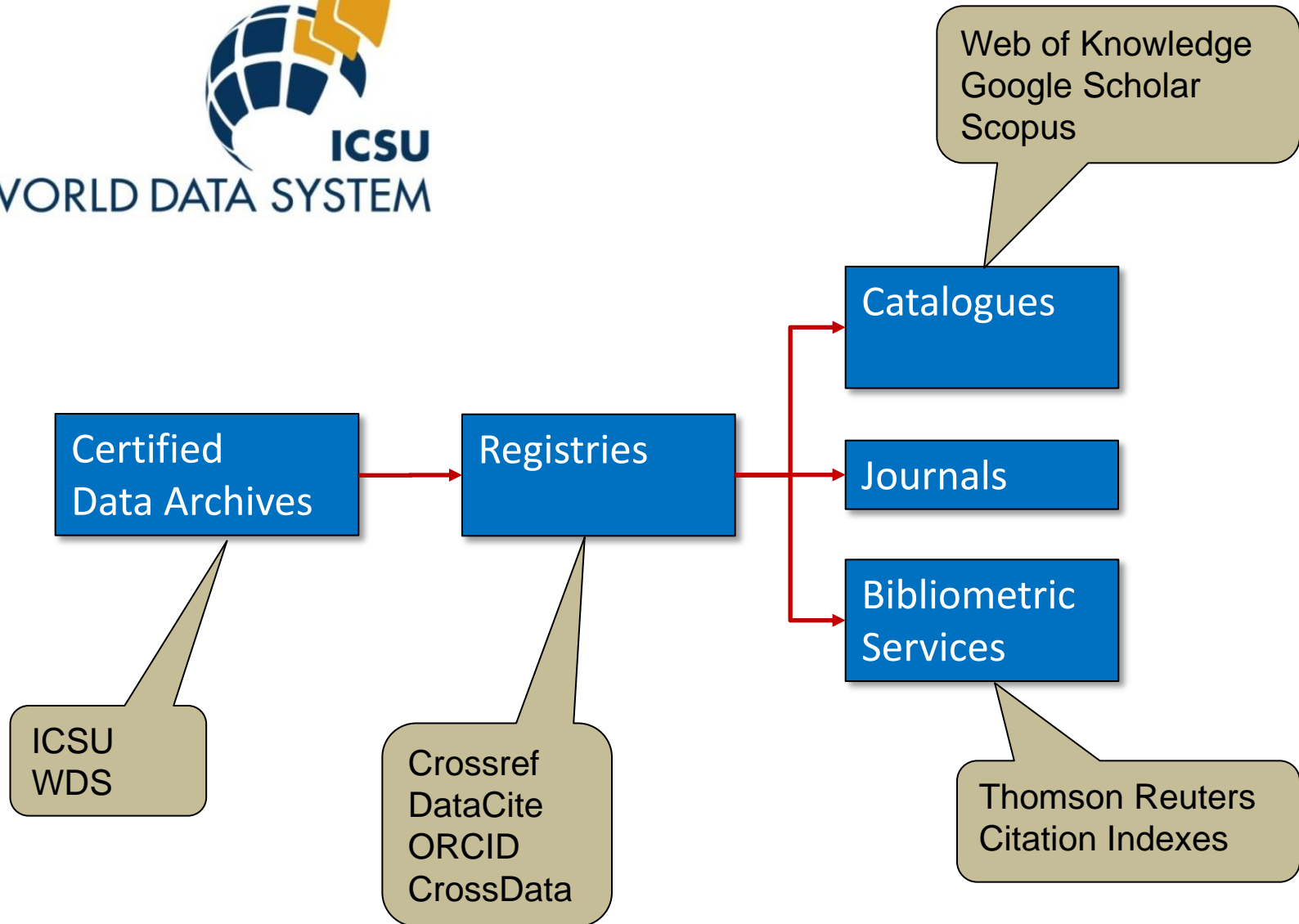




# Linking infrastructure



# ICSU WDS perspective

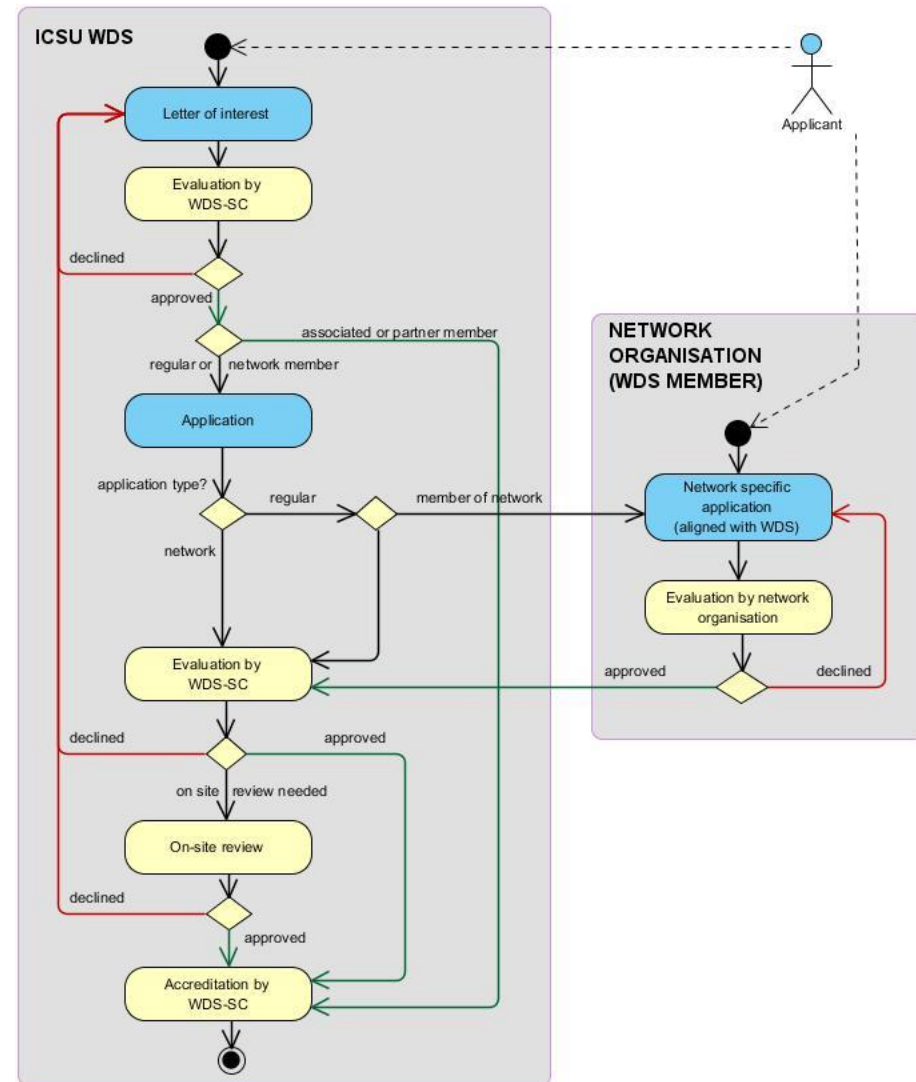


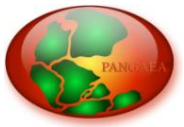
# WDS Certification & accreditation



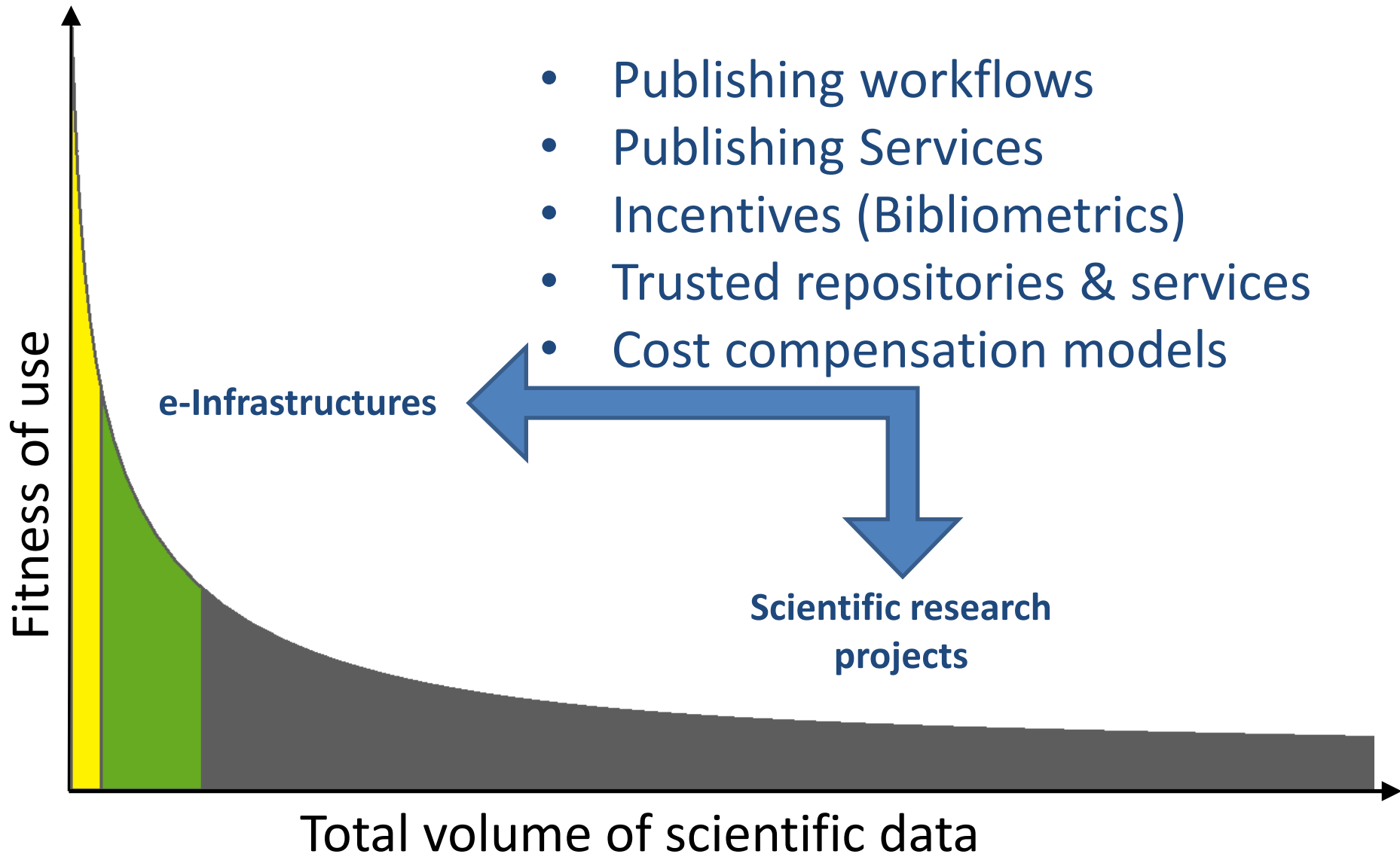
- **Trustworthiness** of WDS data holders and service providers
- **Evaluation criteria:** based on a compilation of international standards and best practices
- **Certification authority:** WDS Scientific Committee

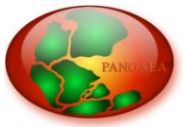
**2014/03: 75 members**





# WDS/RDA WGs and IGs





# Some conclusions

- Publishing data gives benefit to providers and has significant impact on data quality.
- „Fitness of use“ is an important aspect of data quality and a prerequisite for integrating data from different sources.
- Certification is key for the evaluation of the quality of services and data.
- Scalable services are needed to embed data publications into the current scholarly publishing system