From sensor to dissemination:

Stewardship of data in the marine sciences

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IDCC, 2013-01-15, Amsterdam
Modern Science is based on data – since Renaissance!

- 1606 - 1618: Kepler’s Laws
  - reduced Tycho Brahe’s quality data
- 1684 – 1687 Newton De Motu – Principia
  - explained (!) Kepler’s laws

\[ F = ma \]

\[ F \sim \frac{mM}{r^2} \]

<table>
<thead>
<tr>
<th>Planet</th>
<th>( T )</th>
<th>( d )</th>
<th>( T^2 )</th>
<th>( d^3 )</th>
<th>( T^2/d^3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merkur</td>
<td>0,241</td>
<td>0,387</td>
<td>0,058081</td>
<td>0,057960603</td>
<td>1,002077221</td>
</tr>
<tr>
<td>Venus</td>
<td>0,615</td>
<td>0,723</td>
<td>0,378225</td>
<td>0,377933067</td>
<td>1,000772446</td>
</tr>
<tr>
<td>Erde</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mars</td>
<td>1,881</td>
<td>1,524</td>
<td>3,538161</td>
<td>3,539605824</td>
<td>0,999591812</td>
</tr>
<tr>
<td>Jupiter</td>
<td>11,863</td>
<td>5,203</td>
<td>140,730769</td>
<td>140,8515004</td>
<td>0,999142846</td>
</tr>
<tr>
<td>Saturn</td>
<td>29,458</td>
<td>9,555</td>
<td>867,773764</td>
<td>872,3526289</td>
<td>0,994751131</td>
</tr>
</tbody>
</table>

\( T \) = siderische Umlaufzeit in trop. Jahren \( d \) = große Halbachse in astronomischen Einheiten (Abstand Erde–Sonne)
PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOUNT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD.

Vol I.
For Anno 1665, and 1666.

In the SAVOY,
Printed by T. N. for John Martyn at the Bell, a little without Temple-Bar, and James Allestry in Duck-Lane, Printers to the Royal Society.
Does computation threaten the scientific method?

FEATURE | MARCH 28, 2012 | BY LESLIE HATTON, ADRIAN GUARDANI

The scientific method has been the most successful contributor to systematic progress in the history of human endeavour. One of the key elements of the method is that if the result cannot be reproduced, it is discarded. Models are then
The biggest experiment in the world (not at CERN!)

3624 Floats
14-Jan-2013
An important, typical Experiment

- **EISENEX / EIFEX**: Two expeditions of “Polarstern”:
  With a few tons of iron fertilizer, south of Capetown ….

- **EIFEX (2004):**
  - 54 scientists and students from
  - 14 institutes and 3 companies from
  - 7 EU countries and South Africa
  - Oceanographers
  - Biologists
  - Chemists…..

- “Biogeochemistry”
- + Satellite observations!
Person \( \xrightarrow{\text{IsMemberOf}} \) Group \( \xrightarrow{\text{IsPartOf}} \) Project \( \xrightarrow{\text{IsPartOf}} \) Expedition / Experiment / Campaign

Project \( \xrightarrow{\text{IsMemberOf}} \) Group

Publication \( \xrightarrow{\text{IsAuthorOf}} \) Dataset

Dataset \( \xrightarrow{\text{IsDescribedBy}} \) Publication

Publication \( \xrightarrow{\text{IsBasedOn}} \) Dataset

Dataset \( \xrightarrow{\text{IsResultOf}} \)Publication

Person \( \xrightarrow{\text{IsMemberOf}} \) Group

Project \( \xrightarrow{\text{IsMemberOf}} \) Expedition / Experiment / Campaign

Project \( \xrightarrow{\text{IsMemberOf}} \) Group

Publication \( \xrightarrow{\text{IsAuthorOf}} \) Dataset
eXpedition (in production, since 2005)

Related Information: "Reports on Polar and Marine Research" (1982 to date)
- **Primary data** (all polarstern datasets in PANGAEA)
- Handbook and scientific device documentation (in deutsch)
- DShip (Polarstern Data Acquisition System)
- VirtualPS: Virtual Polarstern Tour

| Expedition   | Date || Port       | Region || Research            | Publications & Primary Data                                                                 |
|--------------|------|-------------|---------|-------------------------|-------------------------------------------------------------------------------------------|
| ANT-XXI/3    | 21.01.2004 - 25.03.2004 | Atlantic/Indian Ocean, Polar frontal zone, Biology | **ePIC: Publications**  
**ePIC: Reports on Polar and Marine Research**  
**ePIC: Weekly reports**  
**PANGAEA: Stations**  
**PANGAEA: Datasets**  
[Note: Publications and datasets for recent cruises may not yet be available]  
Meteorology |
| Coordinator: | Pörtner, H.  
Chief scientist: | Smetacek, V.  
Capetown - Capetown | [Map(png)] | **EIFEX** |

| ANT-XXI/4    | 27.03.2004 - 06.05.2004 | Lazarev Sea, Biology, Krill, GLOBEC | **ePIC: Publications**  
**ePIC: Reports on Polar and Marine Research**  
**ePIC: Weekly reports** |

H. Pfeiffenberger, IDCC, 2013-01-15, Amsterdam
Organic matter rain rates, oxygen availability, and vital effects from benthic foraminiferal $\delta^{13}$C in the historic Skagerrak, North Sea

Sylvia Brückner and Andreas Mackensen

Alfred Wegener Institute for Polar and Marine Research, Columbusstr., D-27568 Bremerhaven, Germany

Received 27 March 2007; revised 21 September 2007; accepted 24 September 2007. Available online 4 October 2007.

Abstract

The sediment cores 225514 and 225510 were recovered from 420 and 285 m water depth, respectively. They were investigated for their benthic foraminiferal $\delta^{13}$C during the last 500 years.

Related Articles

- The tropical rainbell and productivity changes off north...
  Marine Micropaleontology
- Temporal variability in living deep-sea benthic foramin...
  Earth-Science Reviews
- Early Maastrichtian benthic foraminiferal assemblages f...
  Marine Micropaleontology
50,000 Participants

63 Nations, ca. 1 G€

Mission: To take a data snapshot of the polar caps, for reuse in decades to come
Disciplinary domains:
- Climatology
- Oceanography
- Veterinary medicine
- Ecology
- Sociology
- Geography
- and more??

Interdisciplinary, global research:
- different cultures
- different languages
- different standards

Need for cooperation and interoperability on an unprecedented scale
The global carbon budget 1959–2011


¹Tyndall Centre for Climate Change Research, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ, UK
²Carbon Dioxide Information Analysis Center (CDIAC), Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA
³National Oceanic & Atmosphere Administration, Earth System Research Laboratory (NOAA/ESRL), Boulder, Colorado 80305, USA
⁴Woods Hole Research Centre (WHRC), Falmouth, Massachusetts 02540, USA
⁵Cabot Institute, Dept of Geography, University of Bristol, UK
MaNIDA – Enabling Data-Intensive Marine Science

Global Change
• Assessing, understanding, and predicting environmental changes
• Human environmental impact

Hazards
• Risk analysis and support for disaster management
• Understanding environmental factors affecting human health

Resources
• Sustainable ecosystem management
• Energy from the ocean
Status of Marine Science Data in Germany

Extremely wide range of data sources
- Ship-based instruments
- Instruments in water column and at seafloor
- Air- and space-borne instruments
- Sensor networks (increasingly in the deep ocean)

- “snapshots“ (individual projects) and long-term monitoring
- stored in different data centers
  (e.g. AWI/PANGAEA, BSH/DOD, HZG/COSYNA)

Requirement: Data-intensive research through coherent data portal with common access strategy
Data Flow from Research Vessels

- FS Polarstern
- FS Meteor
- FS Maria S. Merian
- FS Sonne
- FS Heincke
- FS Alkor
- FS Poseidon
- FS Elisabeth Mann-Borgese

- BSH
- GEOMAR
- AWI
Harmonization of Data Acquisition Practices / Flow of Raw and Metadata

Underway - Daten

- gesamter Rohdatensatz
- Teilrohdatensatz z.B. Wassertiefe

Metadaten

Stationsnummer

DSHIP

Dateien

- Full data sets
- Stationbook

Datenbanken

ADCP
Manida – Publications and Data network

Late Quaternary climatic cycles as recorded in sediments from the Antarctic continental margin
Conclusions

- „Earth Science“ is a „Big Data“ problem
  - finding and exploiting patterns in metadata and data
  - but heterogeneous and distributed (in contrast to Amazon…)

- Needs publications linked to data
  - For quality assurance
  - The best „metadata“ one can have
  - Provide the linking hubs in the digital assets ecosystem

- Portal project, based on real world (scientists) requirements
  - Forces / enables us to find common language
  - Quality consideration leads to improved workflows from ship to dissemination
Thank you!

www.awi.de

www.manida.org

oa.helmholtz.de