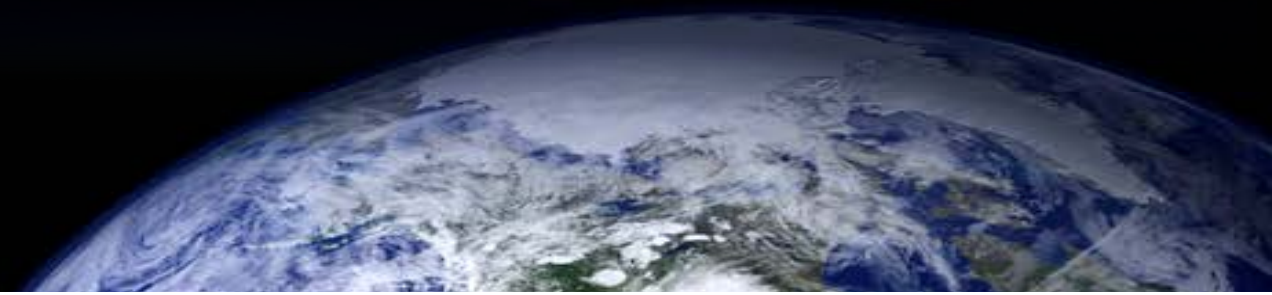
The data flood: Implications for data stewardship and the culture of discovery

Margaret Leinen
Vice Chancellor for Marine Science, UC San Diego
Director, Scripps Institution of Oceanography

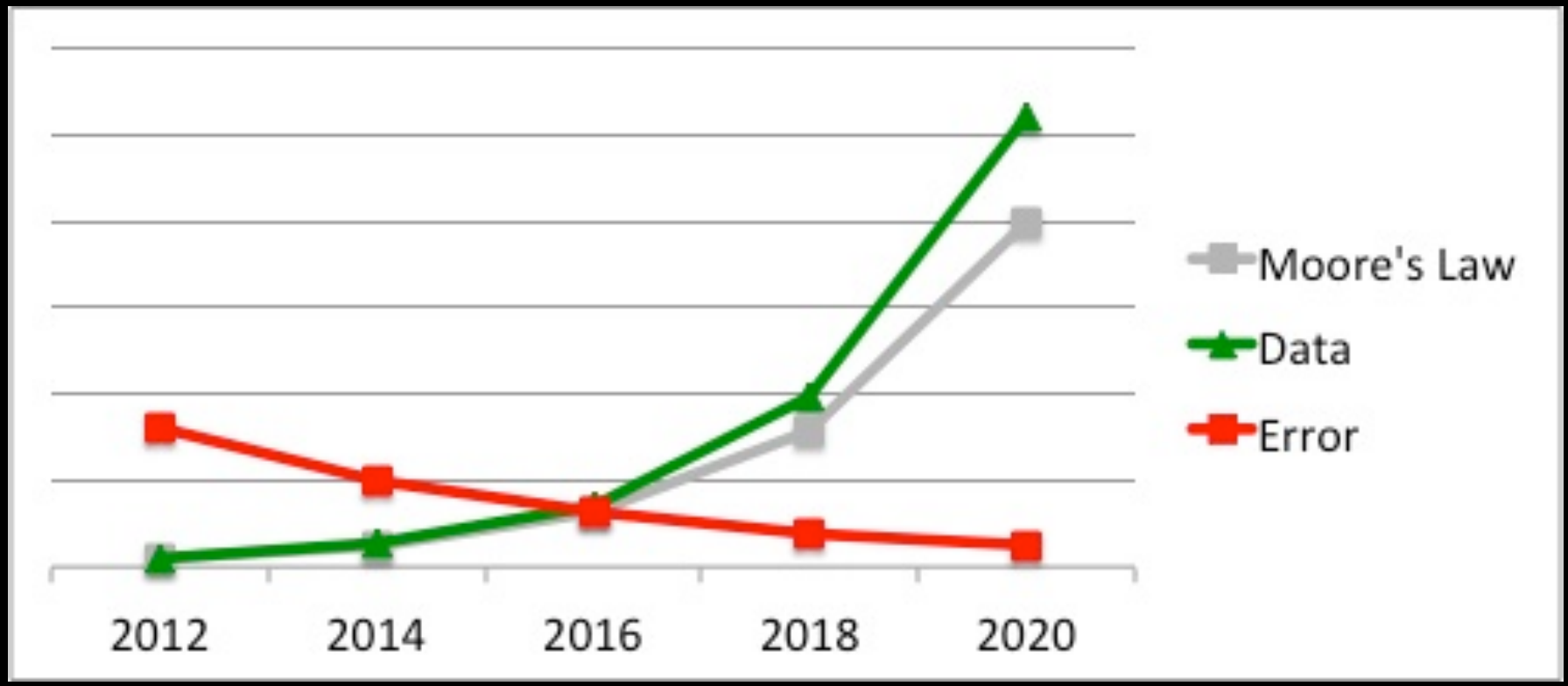


DataONE Webinar
September 8, 2015

observation (data) is the first step
toward understanding

Five exabytes of content were created between the birth of the world and 2003. In 2013, five exabytes of content were created each day.

- ACI Information Group



Ion Stoica, AmpLab Blog, 2013

Data growth is poised to exceed Moore's Law growth:
average growth = 64%, with many areas growing faster

CONSEQUENCES OF THE FLOOD

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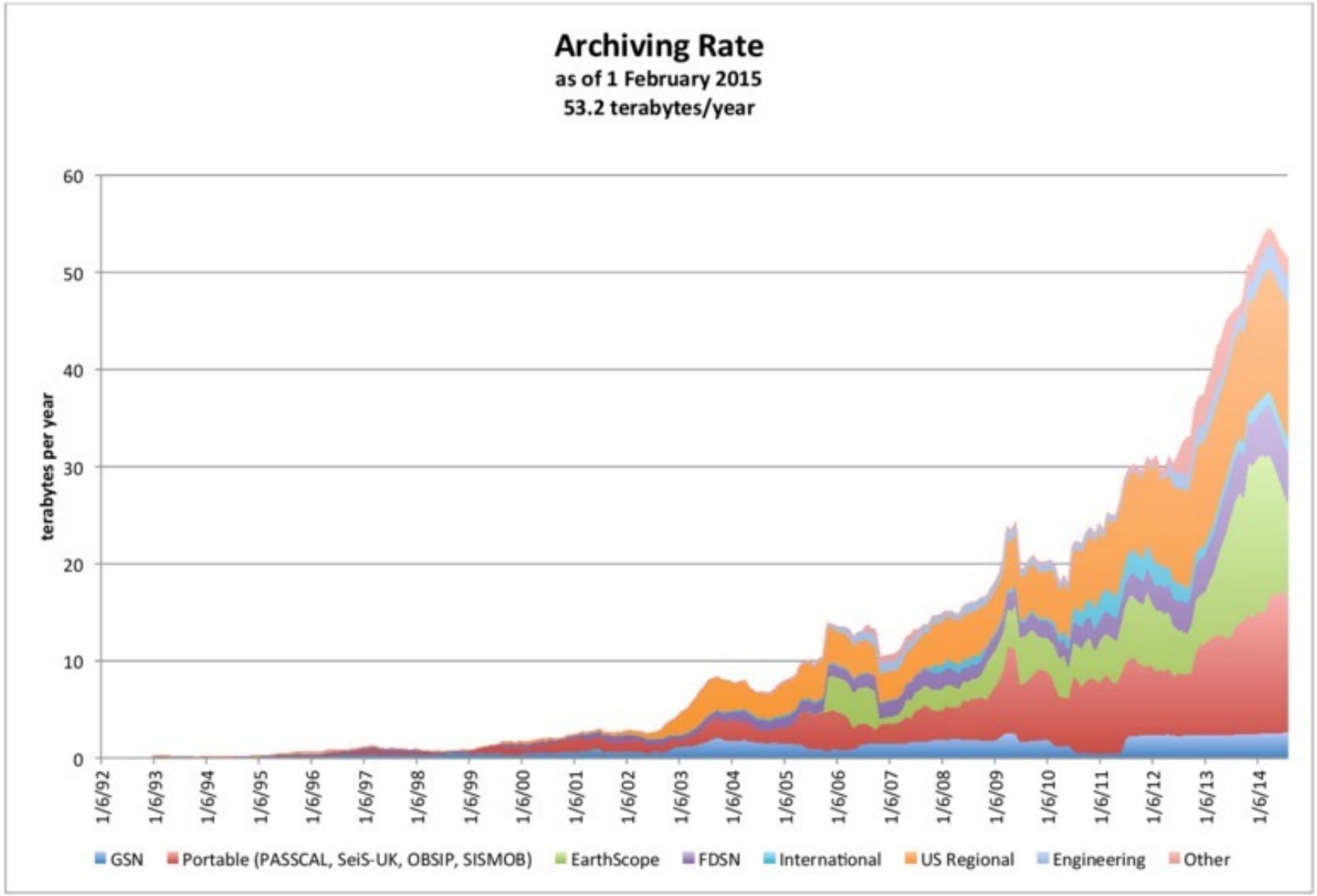
We've gotten used to not thinking about storage as a problem, but…


Archiving Rate
as of 1 February 2015
53.2 terabytes/year
terabytes per year
60
50
40
30
20
10
0
1/6/92
1/6/93
1/6/94
1/6/95
1/6/96
1/6/97
1/6/98
1/6/99
1/6/00
1/6/01
1/6/02
1/6/03
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1/6/05
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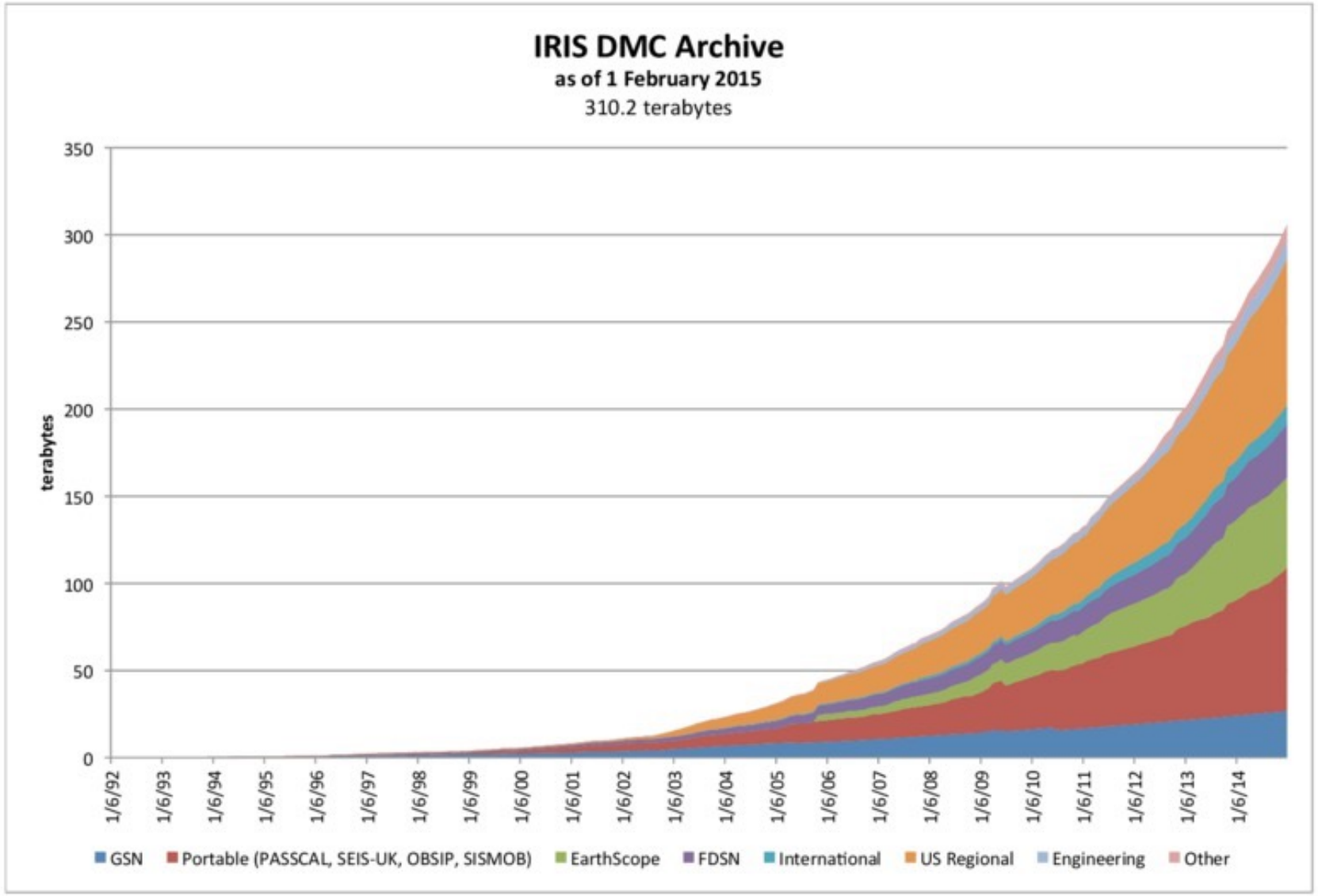
1/6/07
1/6/08
1/6/09
1/6/10
1/6/11
1/6/12
1/6/13
1/6/14
GSN
Portable (PASSCAL, SeiS-UK, OBSIP, SISMOB)
EarthScope
FDSN
International
US Regional
Engineering
Other


IRIS DMC Archive
as of 1 February 2015
310.2 terabytes
terabytes
350
300
250
200
150
100
50
0
1/6/92
1/6/93
1/6/94
1/6/95
1/6/96
1/6/97
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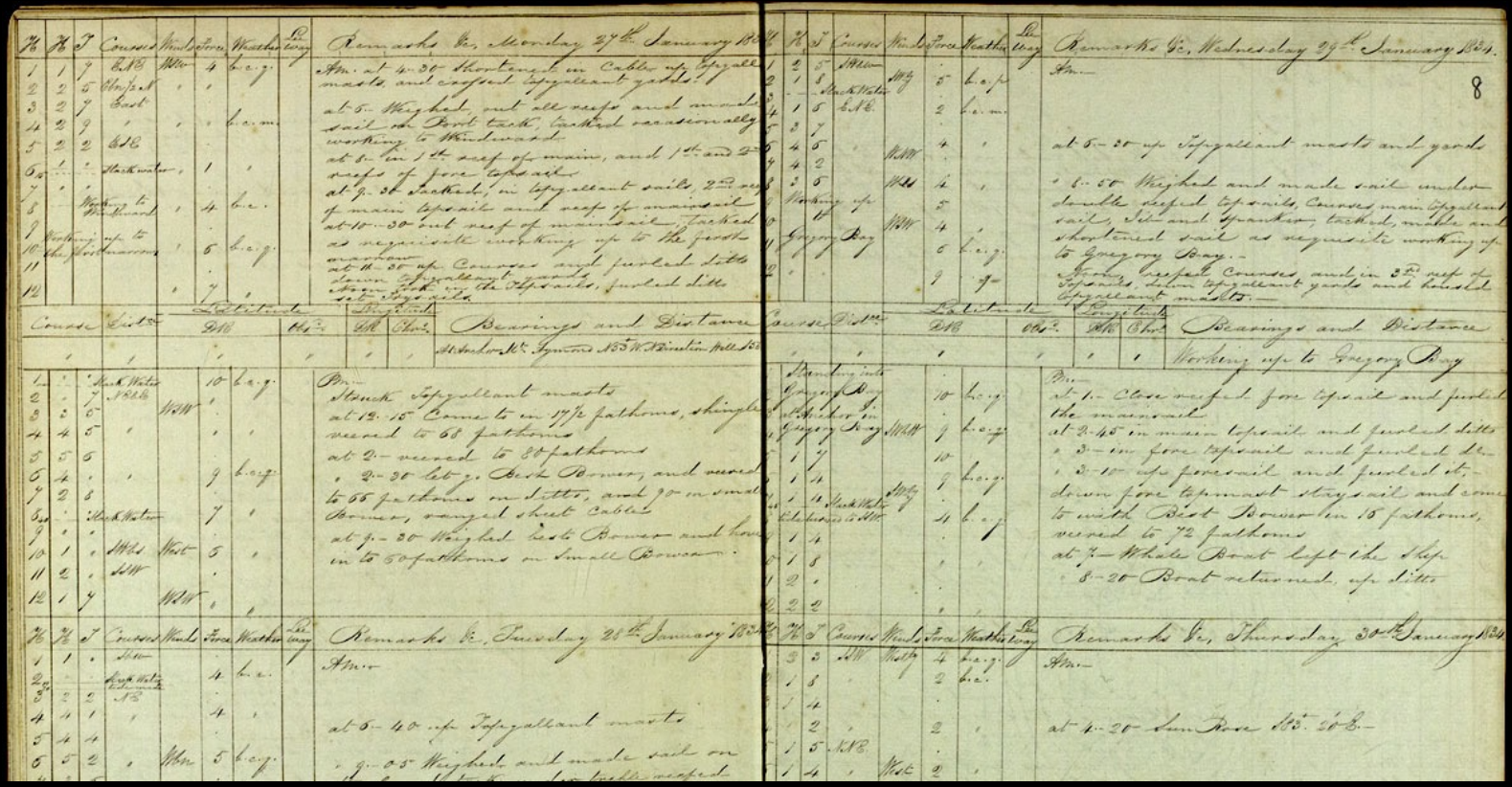
1/6/14
GSN
Portable (PASSCAL, SEIS-UK, OBSIP, SISMOB)
EarthScope
FDSN
International
US Regional
Engineering
Other

We've also gotten in the habit of thinking of data as the flood of automatically collected digital data, but…

What do we need to preserve and for how long?



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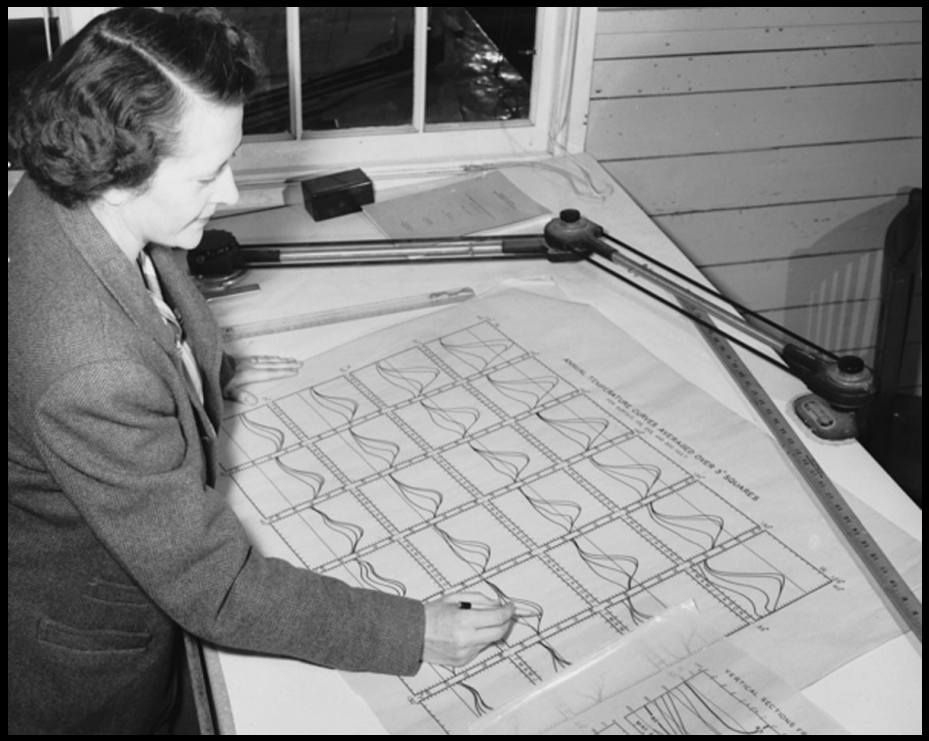
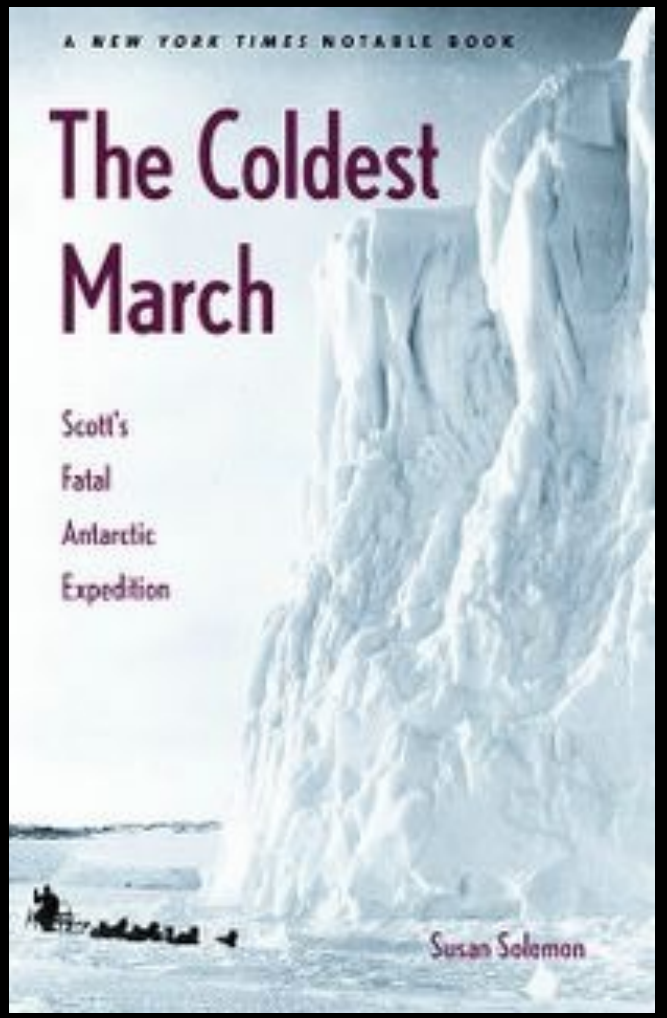


Susan Solomon's 'The Coldest March'

- Combined
  - meteorological data
  - Logbooks and journals of Scott's expedition
  - Current modeling and understanding
- Insights about the climatic forces influencing history

- We need to keep making this possible



THE IMPACT ON CULTURE OF SCIENCE

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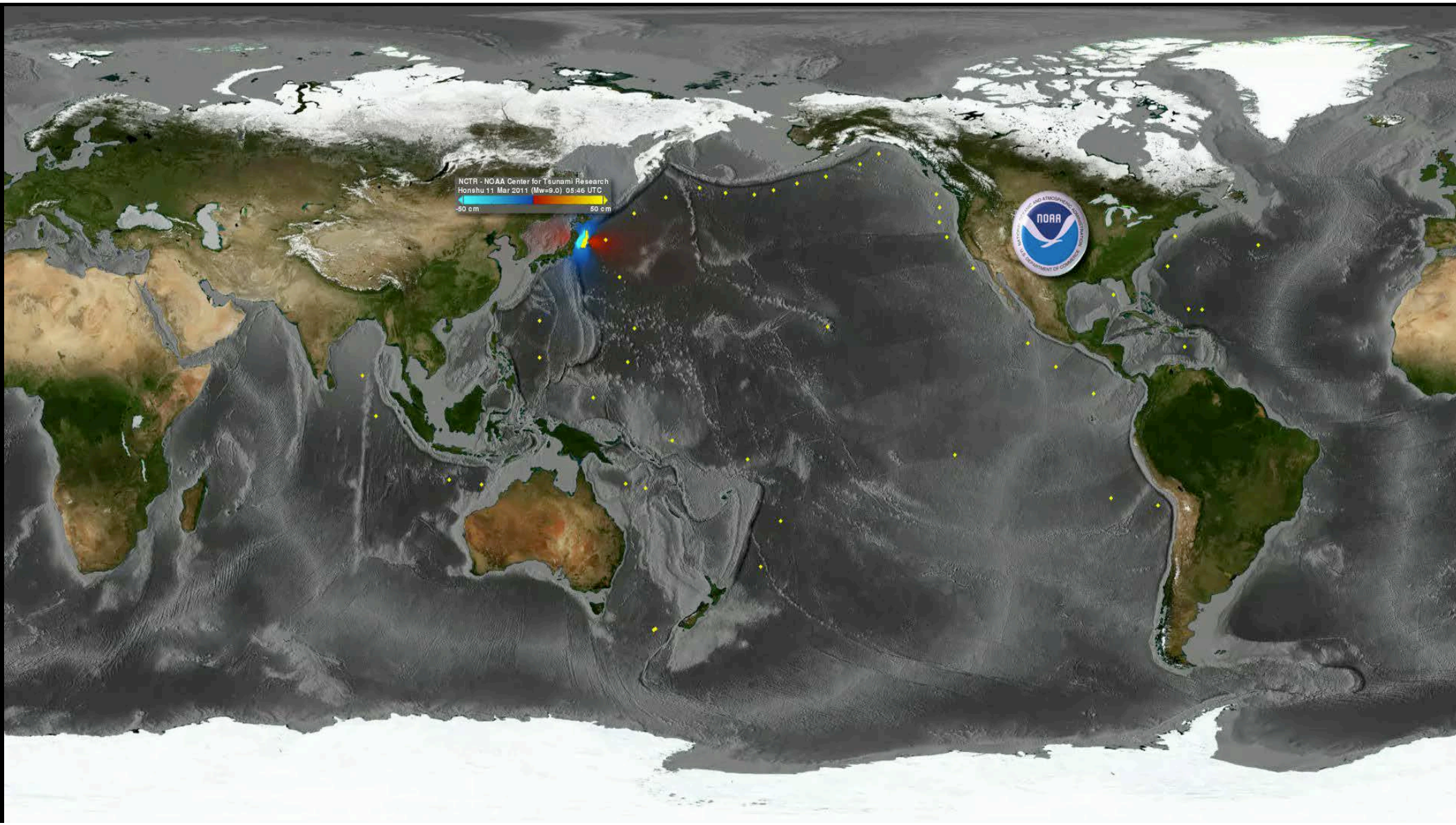
"The ultimate measure of success is the replicability of science"

- Coalition for Publishing Data in the Earth and Space Sciences (COPDESS)

But we deal with irreproducible events and observations


NCTR - NOAA Center for Tsunami Research
Honshu 11 Mar 2011 (Mw=9.0) 05:46 UTC
-50 cm
50 cm
NOAA

What does reproduceability mean in the geosciences with respect to data?

COPDESS Statement of Commitment

- Online community directory of appropriate community repositories
- Promulgate metadata information and domain standards
- Promote education of researchers in data management
- A working committee to update and curate this directory
- Reference data sets using the Joint Declaration of Data Citation Principles
- Include in research papers concise statements indicating where data reside
- Promote and implement links to data sets in publications and corresponding links to journals in data facilities
- Promote use of other relevant community permanent identifiers for samples (IGSN), researchers (ORCID), and funders and grants (FundRef).
- Develop workflows within the repositories that support the peer review process

Signatories

- American Astronomical Society
- American Geophysical Union
- American Meteorological Society
- Woods Hole Oceanographic Institution (BCO-DMO)
- Center for Open Science
- CLIVAR and Carbon Hydrographic Data Office)
- COOPEUS
- Community Inventory of EarthCube Resources
- CUAHSI
- Continental Scientific Drilling Coordination Office
- Council of Data Facilities
- Dryad
- Elsevier
- European Geophysical Union
- Scripps Institution of Oceanography
- Springer
- ICSU World Data System
- Geological Society of London
- Geochemical Society
- Geological Society of America
- Incorporated Research Institutions for Seismology
- Integrated Earth Data Applications (IEDA)
- John Wiley and Sons
- LacCore: National Lacustrine Core Facility
- Magnetics Information Consortium (MagIC)
- Mineralogical Society of America
- Neotoma Paleoecology Database
- National Snow and Ice Data Center
- Nature Publishing Group
- OpenTopography
- Paleonotological Society
- Proceedings of the National Academy of Sciences
- Rolling Deck to Repository (R2R) Program
- Science
- UNAVCO

- UNAVCO

Reproduceability in the field sciences

A May 2015 workshop sponsored by the Laura and John Arnold Foundation, AAAS/Science, American Geophysical Union, Ecological Society of America

Annotation and data

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- Not interoperable
- Not open source
- Not standards based

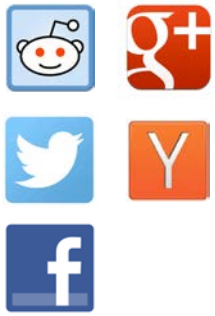
- Not able to be used everywhere
- Not federated

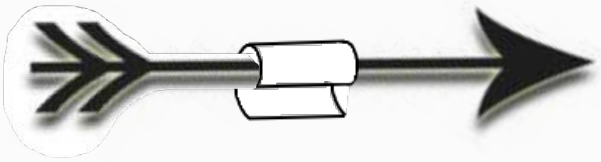
bookmarking

tagging

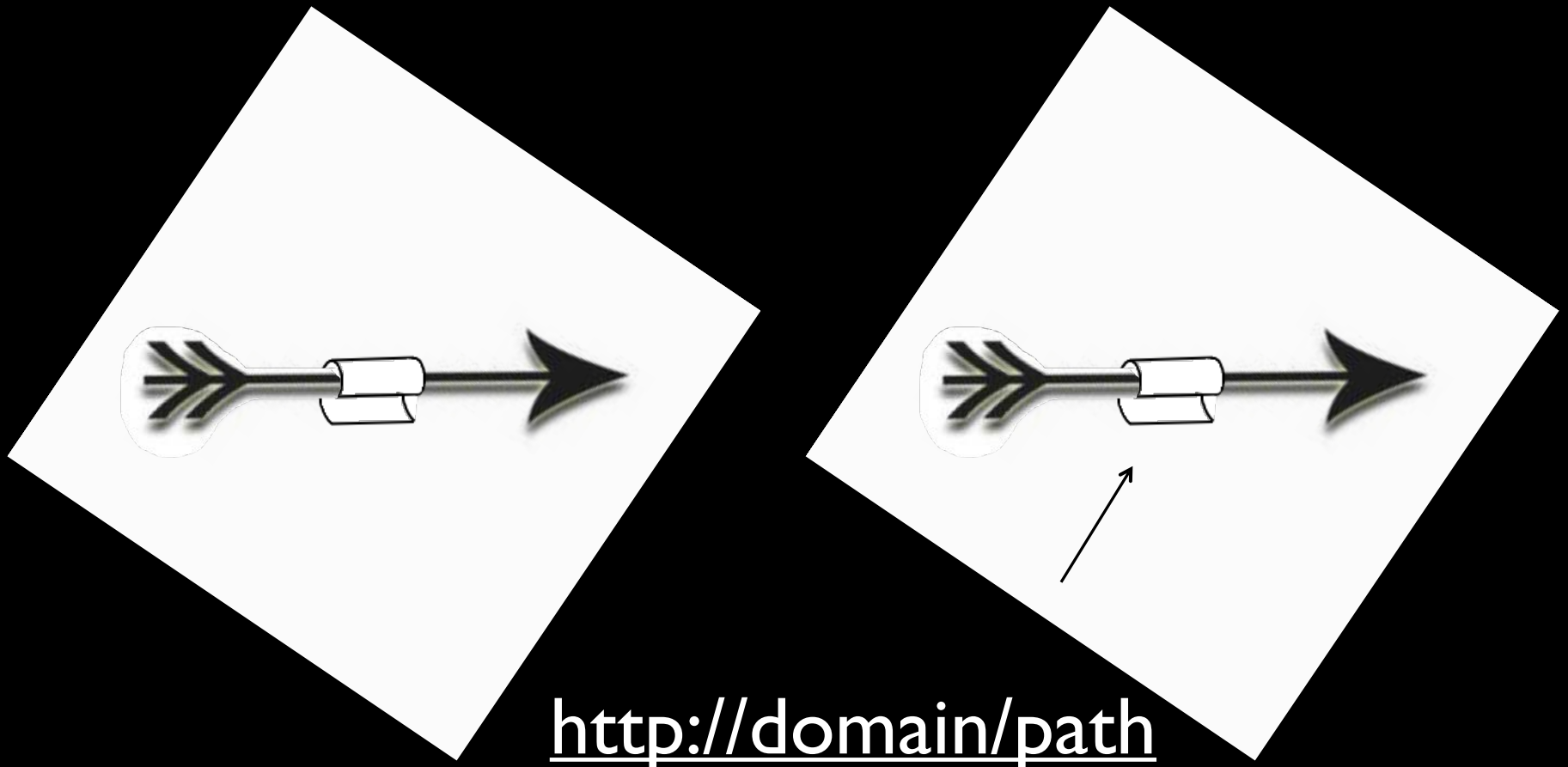
note taking

discussion





address message target



http://domain/path

Annotations are like the web

Interoperable
Decentralized
Characterized by open source implementations

Other kinds of data

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New trends merging ideas about data with those about samples

Challenges for universities and others who have sample collections

USA: ALASKA, St. Matthew Isl.
14m el. 60.57341° -172.99431°
±104m tundra
yellow bowls, 3-4A
Sikes, C.E. Bickford
UAM100341860
UAM100341801
UAM100341852
UAM100341853
UAM100341854
UAM100341855
UAM100341806
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MV22-0402
JPC 14 SEC VIII
WORK 171-192
cm
MV22 0402
14 JPC Sec IV
Archive
659-780 cm

Whose responsibility is it to maintain archives?

Challenges for universities and others who have data archives and sample collections

Does the responsibility last forever?

Many universities are losing the ability to steward these collections/archives appropriately

Whose responsibility is it to maintain archives?

Government data archives

Already seeing cracks in the ability of government archives to morph to new technology, accommodate innovation in systems and structures

Data and scholarship

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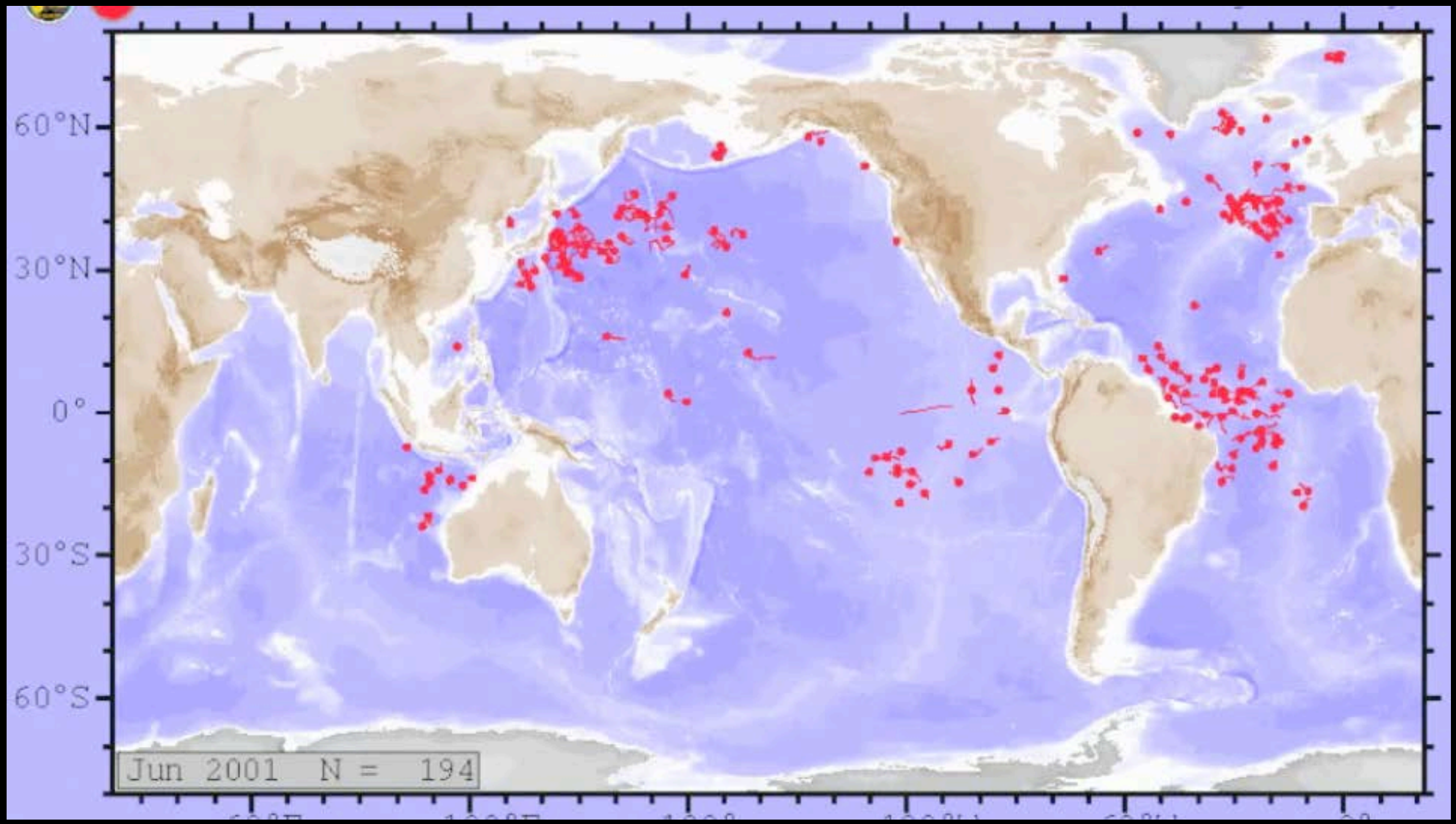
The emergence of doi's making data sets referenceable

Peer reviewed publications emphasizing data sets

Challenges for scholarly advancement

Little consensus on when data sets constitute scholarship


60°N
30°N
0°
30°S
60°S
Jun 2001 N = 194

Argo GDAC monthly snapshots DOIs

2015

- Snapshot of 2015 month 02
  http://dx.doi.org/10.12770/98ccefdc-39e4-4553-a0ed-6d16c2f1cbd1
- Snapshot of 2015 month 01
  http://dx.doi.org/10.12770/57ffbceb-bcb1-4295-a344-5e6c65151583

2014

- Snapshot of 2014 month 12
  http://dx.doi.org/10.12770/7693bfc1-a695-484d-a55c-7453d54719ec
- Snapshot of 2014 month 11
  http://dx.doi.org/10.12770/99e07802-e8cb-48c8-a1f9-f2b6265c8870
- Snapshot of 2014 month 10
  http://dx.doi.org/10.12770/503f0ebf-2c58-41c7-81f5-a5993b4af9a3
- Snapshot of 2014 month 09
  http://dx.doi.org/10.12770/bc3de4fa-6668-4e0e-bae3-102c6d9c8ddd
- Snapshot of 2014 month 08
  http://dx.doi.org/10.12770/57b95b6a-ef27-47db-b14f-f8cb7c729793

NOAA Atlas NESDIS 72

WORLD OCEAN DATABASE 2013

Timothy P. Boyer, John I. Antonov, Olga K. Baranova,
Carla Coleman, Hernan E. Garcia, Alexandra Grodsky,
Daphne R. Johnson, Ricardo A. Locarnini,
Alexey V. Mishonov, Todd D. O'Brien, Christopher R. Paver,
James R. Reagan, Dan Seidov, Igor V. Smolyar, Melissa M. Zweng

Editor: Sydney Levitus
Technical Editor: Alexey Mishonov

National Oceanographic Data Center
Ocean Climate Laboratory

Silver Spring, MD
September 2013

U.S. DEPARTMENT OF COMMERCE
Penny S. Pritzker, Secretary

National Oceanic and Atmospheric Administration
Kathryn D. Sullivan,
Acting Under Secretary of Commerce for Oceans and Atmosphere

National Environmental Satellite, Data, and Information Service
Mary E. Kicza, Assistant Administrator

THINKING OF THE FUTURE

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Brooks Hanson (AGU Director of Publications):

The publication of the future:

"I think the next big step, which the community is really trying to work on with some good initial steps but a long way to go is to really change what a publication is—to make data, code, etc. interoperable and seamlessly part of a publication so that a reader can move back and forth, rerun code; manipulate presentations of data sets."

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DIGITAL EDUCATION

>> Tech topics and trends in K-12

Education Week reporter Ben Herold explores how technology is shaping teaching and learning and the management of schools. Join the discussion as he analyzes the latest developments.

Benjamin Herold

« Houston District Leaders' Interoperability Push Sparks Big Reaction | Main | Ten Cities Seek to Bring Personalized Learning to Scale »

'Big Data' Skills Not Being Taught in K-12, Experts Say

By Benjamin Herold on December 17, 2014 8:08 AM

104

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The ability to turn large amounts of raw data into useful information is increasingly important in both the workplace and in society, but K-12 schools aren't teaching the required skills and knowledge adequately.

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