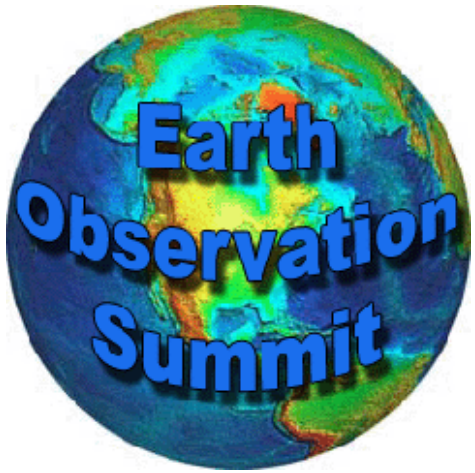
Mastering the Data Explosion in the Earth and Environmental Sciences, Shine Dome, Canberra, 19-21 April, 2006

Towards a Geoscience Information Commons: the Electronic Geophysical Year, 2007-2008 and the Global Earth Observing System of Systems



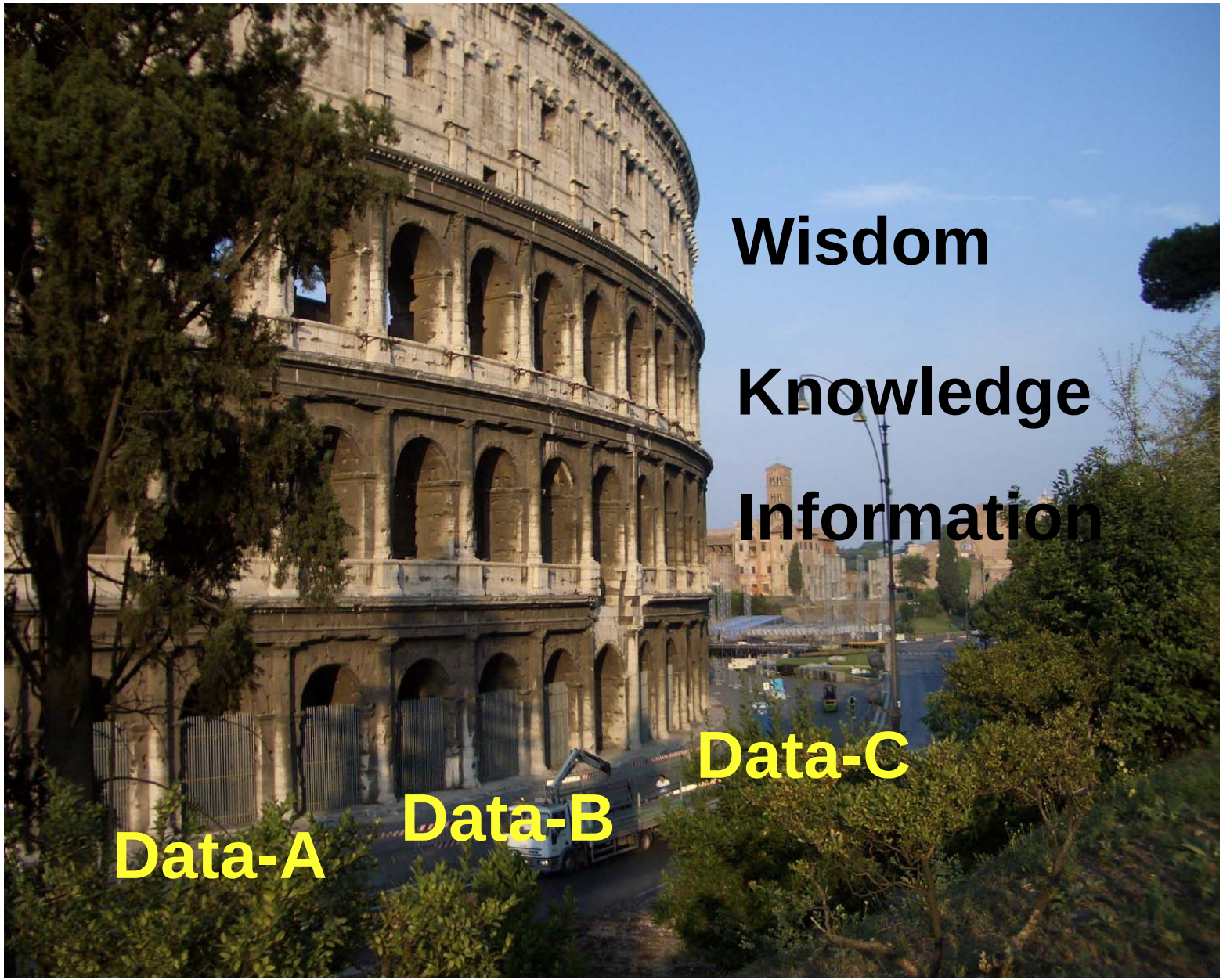
Charles.Barton@anu.edu.au

Alex.Held@csiro.gov

Where do we come from?

What are we?

Where are we going?


Wisdom
Knowledge
Information
Data-C
Data-B
Data-A

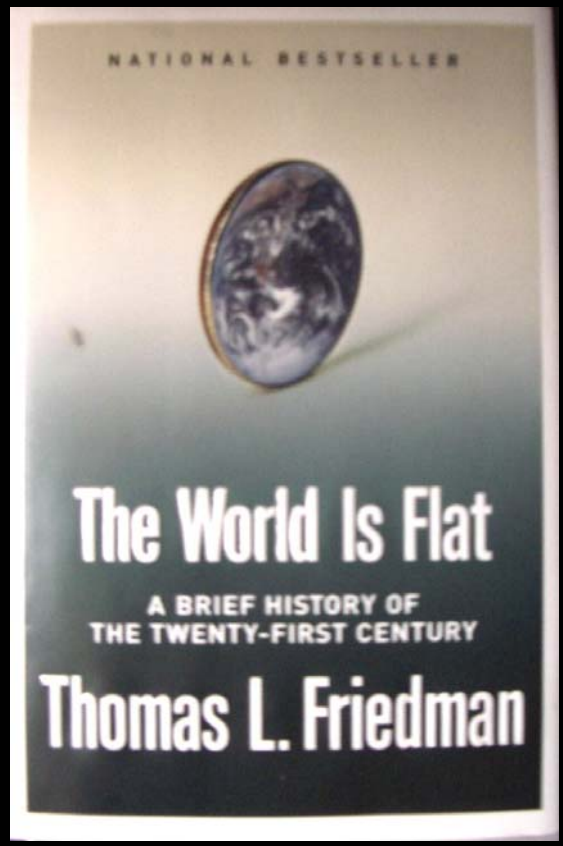
“Knowledge is the common wealth of humanity.”

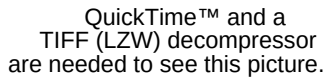
Adama Samassekou

Convener of the UN World Summit on the Information Society

Our capabilities are evolving rapidly

QuickTime™ and a
YUV420 codec decompressor
are needed to see this picture.


NATIONAL BESTSELLER
The World Is Flat
A BRIEF HISTORY OF
THE TWENTY-FIRST CENTURY
Thomas L. Friedman



Benjamin Disraeli (1844), Coningsby. “The mystery of mysteries is to view machines making machines, a spectacle that fills the mind wiith curious and even awful spectacle”

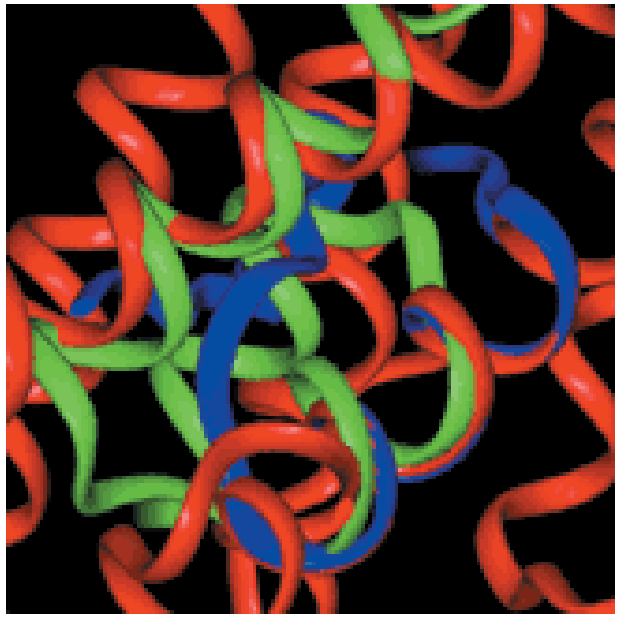
21st Century Science Drivers

Earth (Complex) System science

Higher space/time resolution

Rapid response

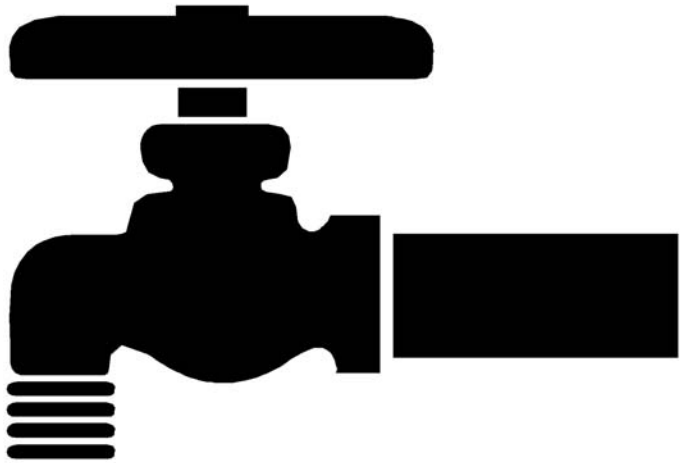
Data assimilation into models



Challenges:

- large and/or distributed data sets
- complex cross-disciplinary data
- data discovery, preservation, and rescue
- open access and sharing.

Courtesy: Mark Parsons



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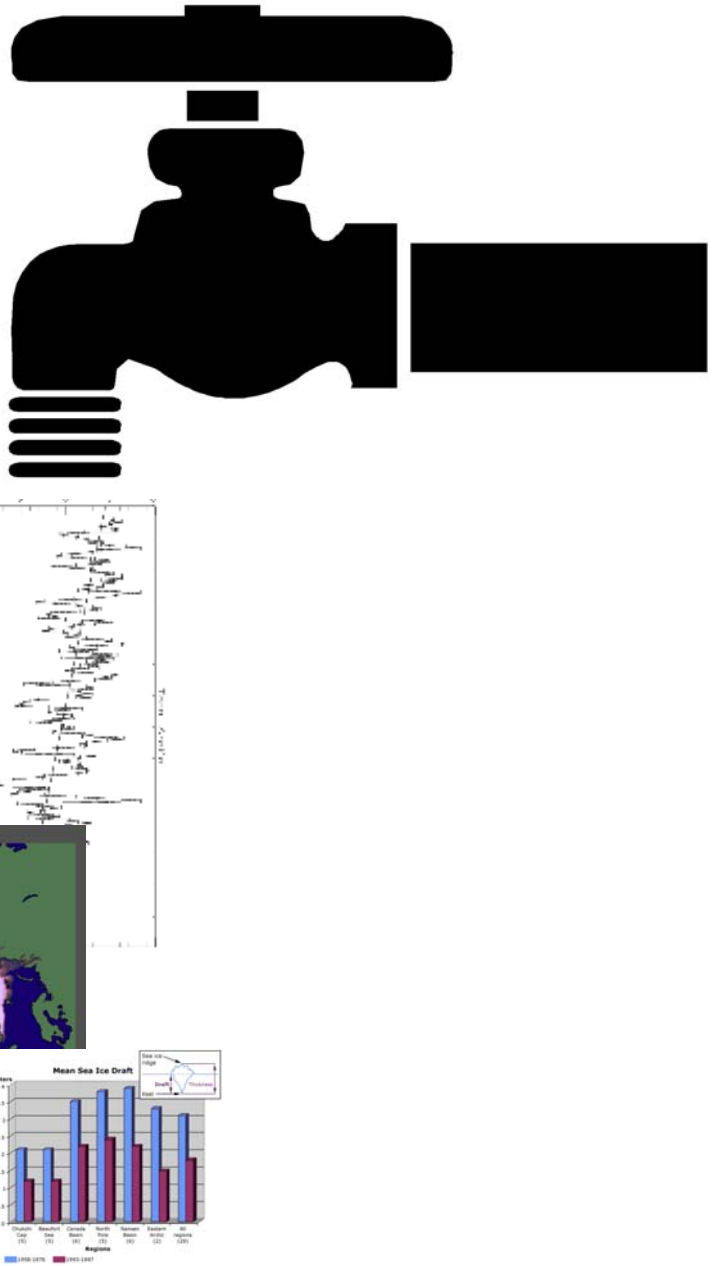
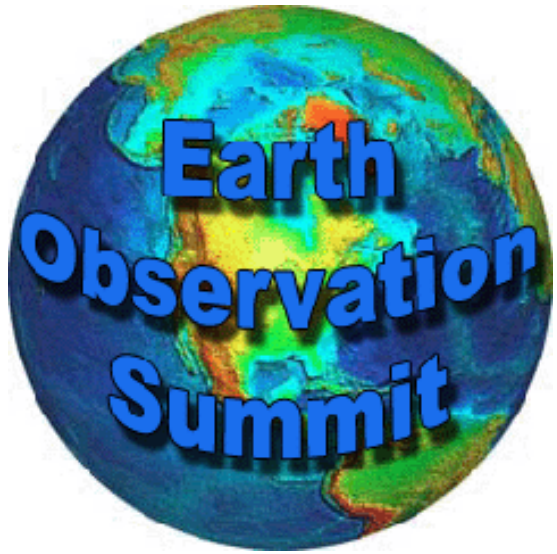
Courtesy: Mark Parsons



Courtesy: Mark Parsons

EARTH OBSERVATION SUMMIT III

- Formally established GEO
- Endorsed a GEOSS 10-year Implementation Plan
- Endorsed the creation of a 2005/2006 workplan and a team to draft it.



http://earthobservations.org/

- GEO is an intergovernmental organization, with membership open to all member States of the UN and to the European Commission
- GEO Participating Organizations may be intergovernmental, international, or regional organizations with a mandate in Earth observation or related activities, subject to approval by Members
- GEO will coordinate with relevant UN Specialised Agencies and Programmes; may invite others to participate in GEO activities as observers

GROUP ON EARTH OBSERVATIONS

Australian Delegates to GEO

John Zillman

Bureau of Meteorology

Alex Held

CSIRO - COSSA

Ian Carothers

Australian Greenhouse Office

GEO = Many People

- 58 Nations
- European Commission
- 43 Participating Organizations

GEOSS = One Vision

- A globally coordinated, comprehensive system of earth observing systems

GROUP ON EARTH OBSERVATIONS

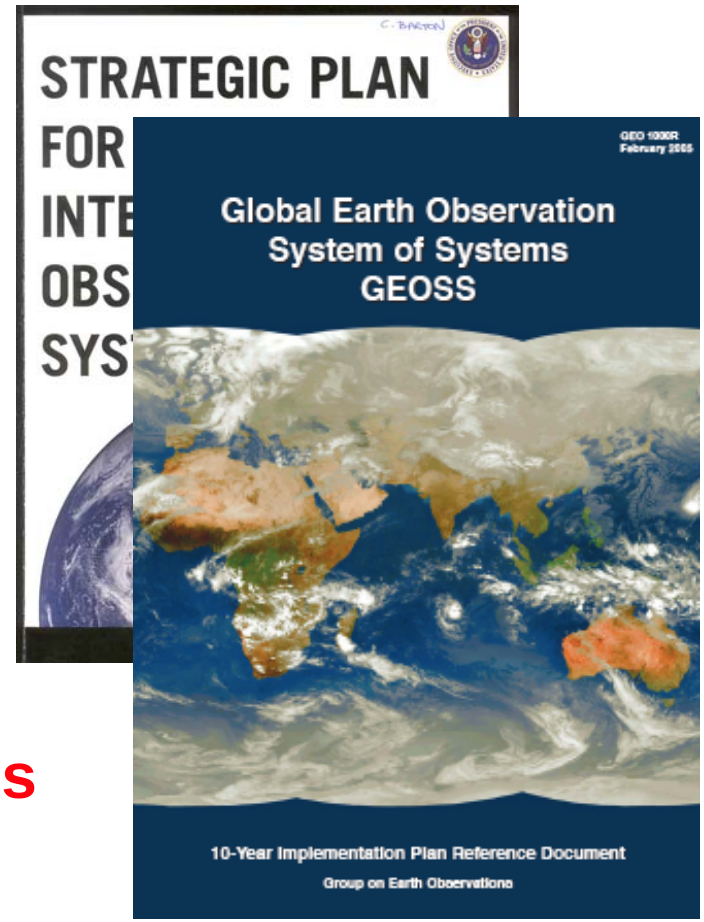
"The **vision** for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth observations and information."

"The **purpose** of GEOSS is to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behaviour of the Earth system."

GROUP ON EARTH OBSERVATIONS

Defining Documents

- 10-year Implementation Plan
- Accompanying reference document
- Work Plan 2005-2006



http://earthobservations.org/docs

GEOSS is here to

- promote data accessibility and interoperability for earth observations
- promote interagency, intergovernmental, and interdisciplinary collaboration
- encourage shared infrastructure
- inform the decision makers what needs to be done to realize the vision, and to build the political will to make it happen.

Architecture & Data Committee
Co-chairs

Ivan DeLoatch, USGS ideloatch@usgs.gov,

Don Hinzman, WMO DHinsman@wmo.int,

Toshio Koike, Univ. Tokyo tkoike@hydra.t.u-tokyo.ac.jp,

CHU Ishida, JAXA ishida.chu@jaxa.jp,

Jay Pearlman Boeing/IEEE jay.pearlman@boeing.com

Where do we come from?

What is *e*GY?

Where is *e*GY going?

Vision

We can achieve a major step forward in geoscience capability, knowledge, and usage throughout the world for the benefit of humanity by accelerating the adoption of modern and visionary practices for managing and sharing data and information.

The Electronic Geophysical Year
2007-2008

IUGG initiative

Led by IAGA

Sponsored by IUGG, IAGA, NASA

In-kind support from LASP, NOAA, NCAR, NSIDC, USGS, …

IGY+50

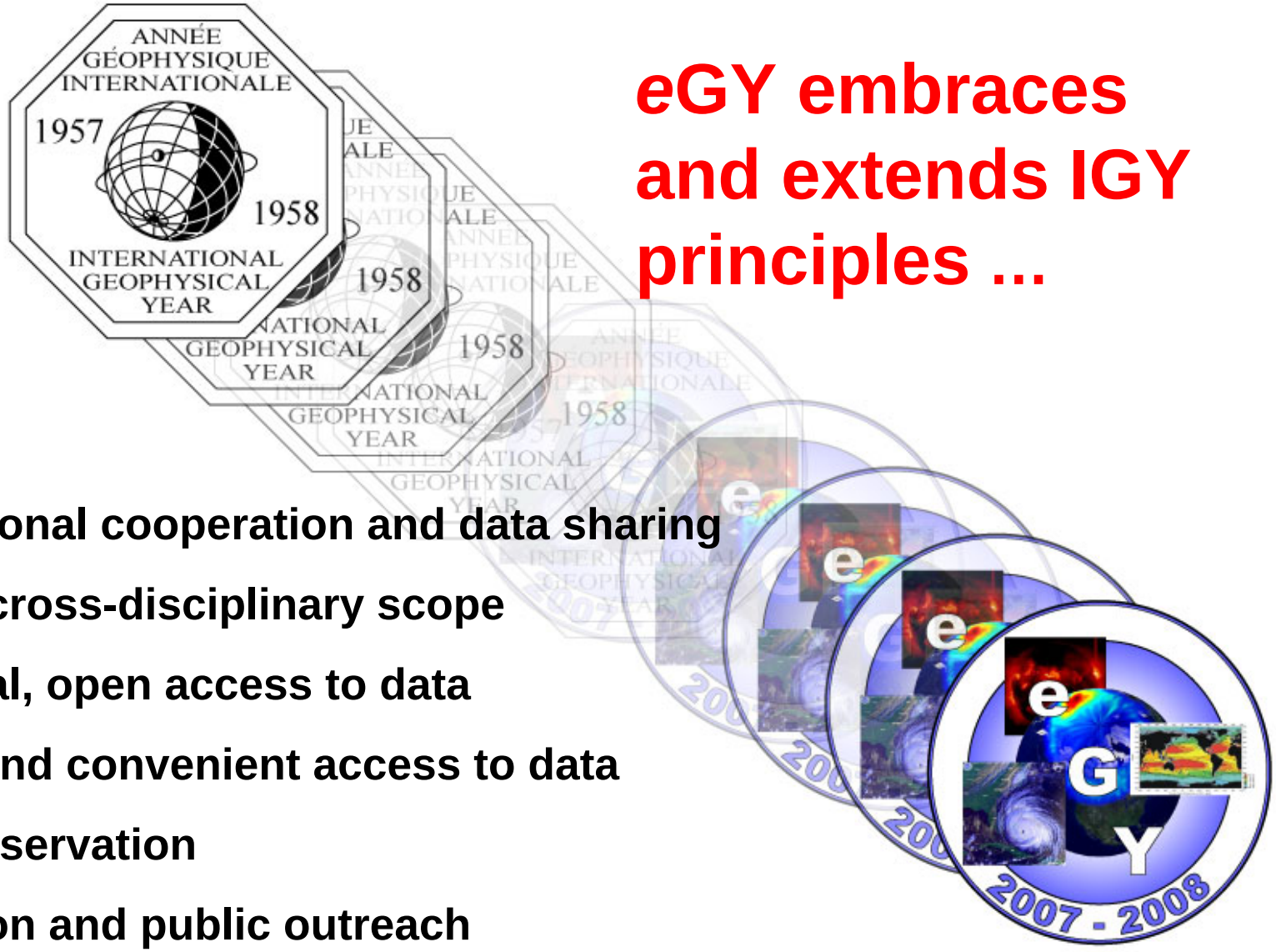
Four International Science Year programs are linked to the 50-year anniversary of IGY

International Polar Year

planetearth®
Earth Sciences for Society
2005 - 2007

International Heliophysical Year

Electronic Geophysical Year, 2007-2008



*e*GY embraces and extends IGY principles ...

International cooperation and data sharing

Global, cross-disciplinary scope

Universal, open access to data

Timely and convenient access to data

Data preservation

Education and public outreach

Capacity building, especially in developing countries

Themes

Data access

Data discovery

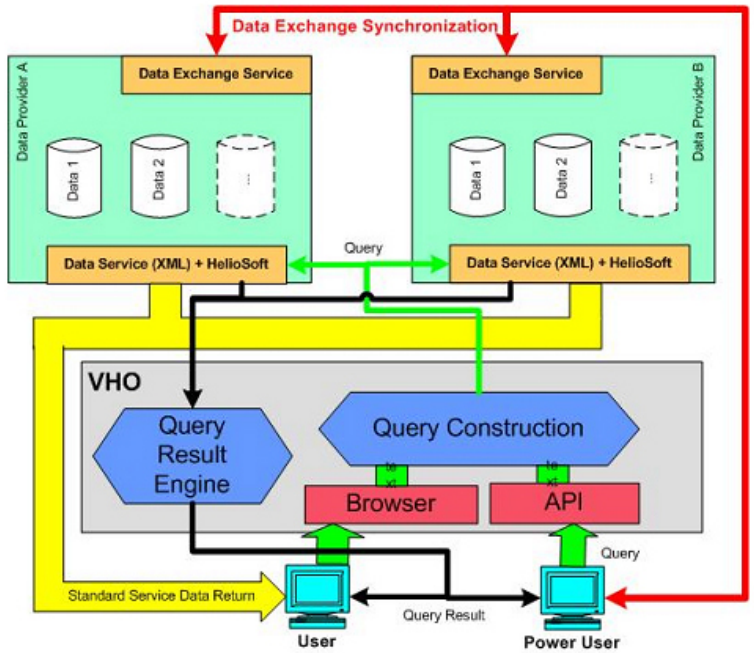
Data release

Data preservation

Data rescue

Outreach & Education

Capacity building



VHO architecture

WG: Virtual Observatories

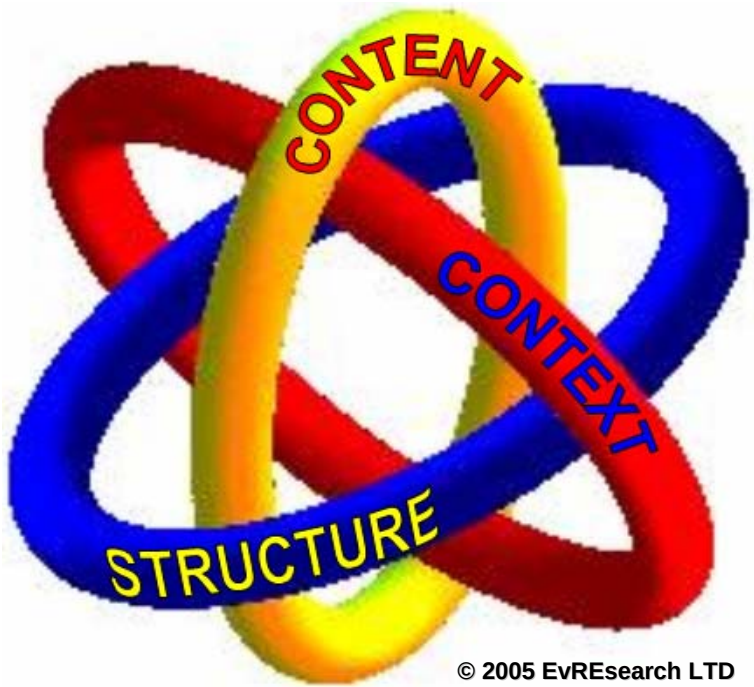
WG: Best Practice

WG: Data Rescue

WG: Education and Public Outreach

WG: Data Integration and Knowledge Discovery

WG: Data Integration & Knowledge Discovery

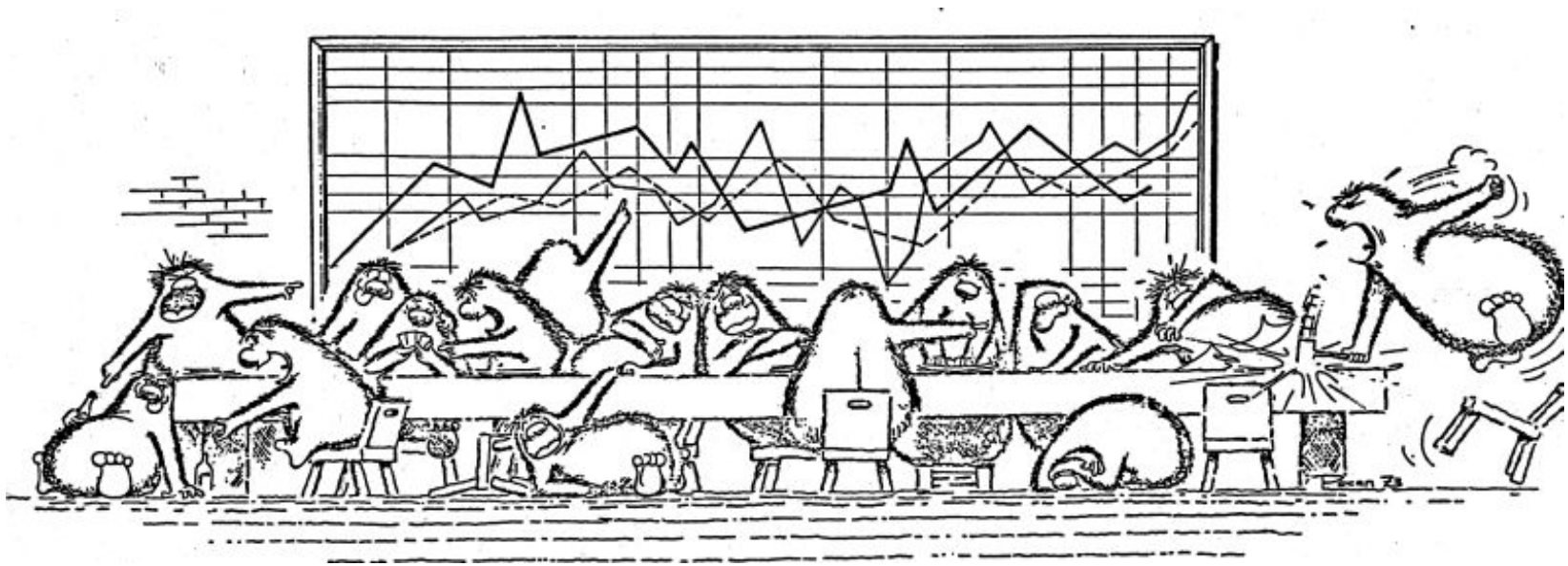


The ingredients of information

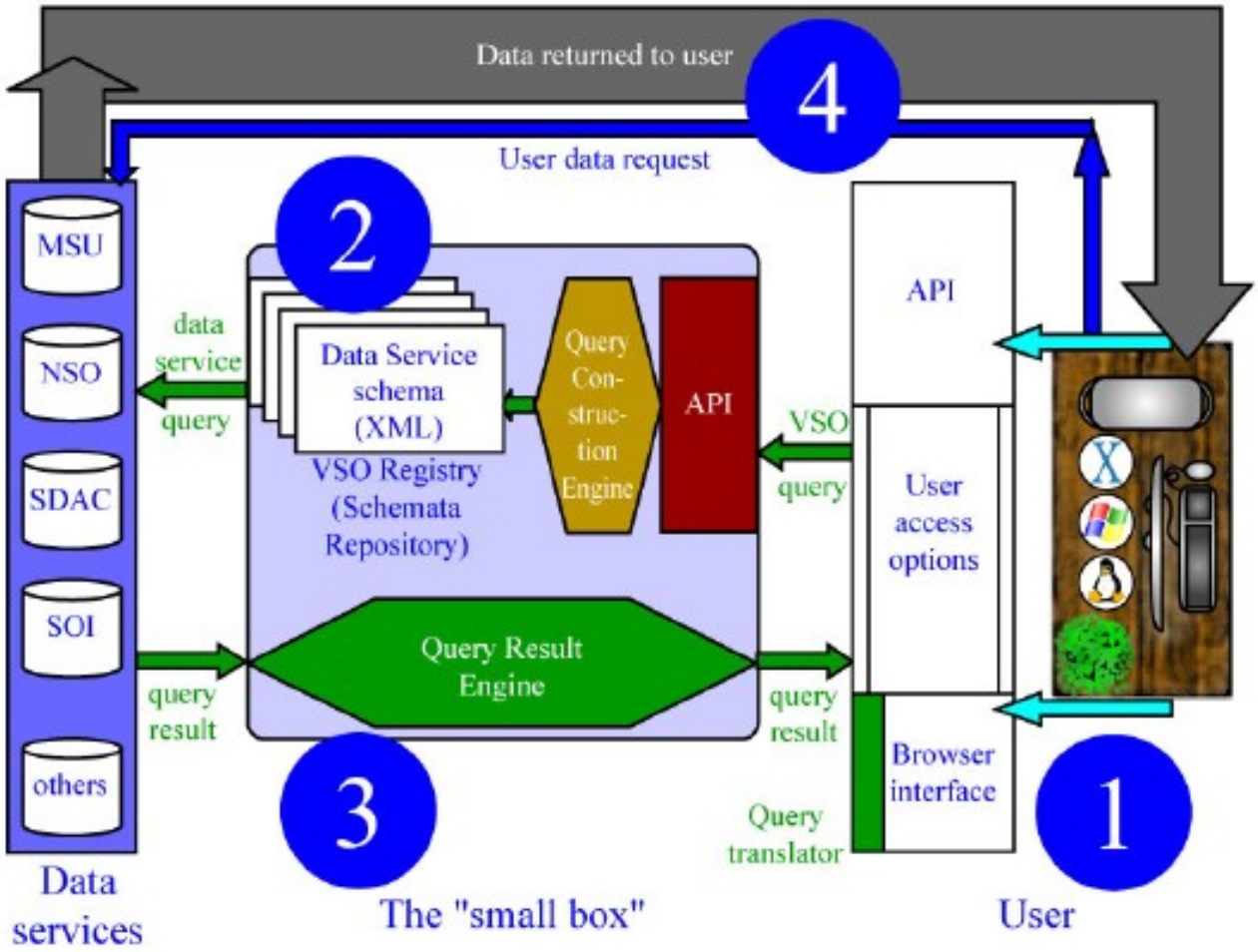
BORROMEAN RINGS - a symbol of unity

Three interlinked rings that represent inseparable parts of the whole. Remove any one ring and the other two fall apart.

WG: Best Practice

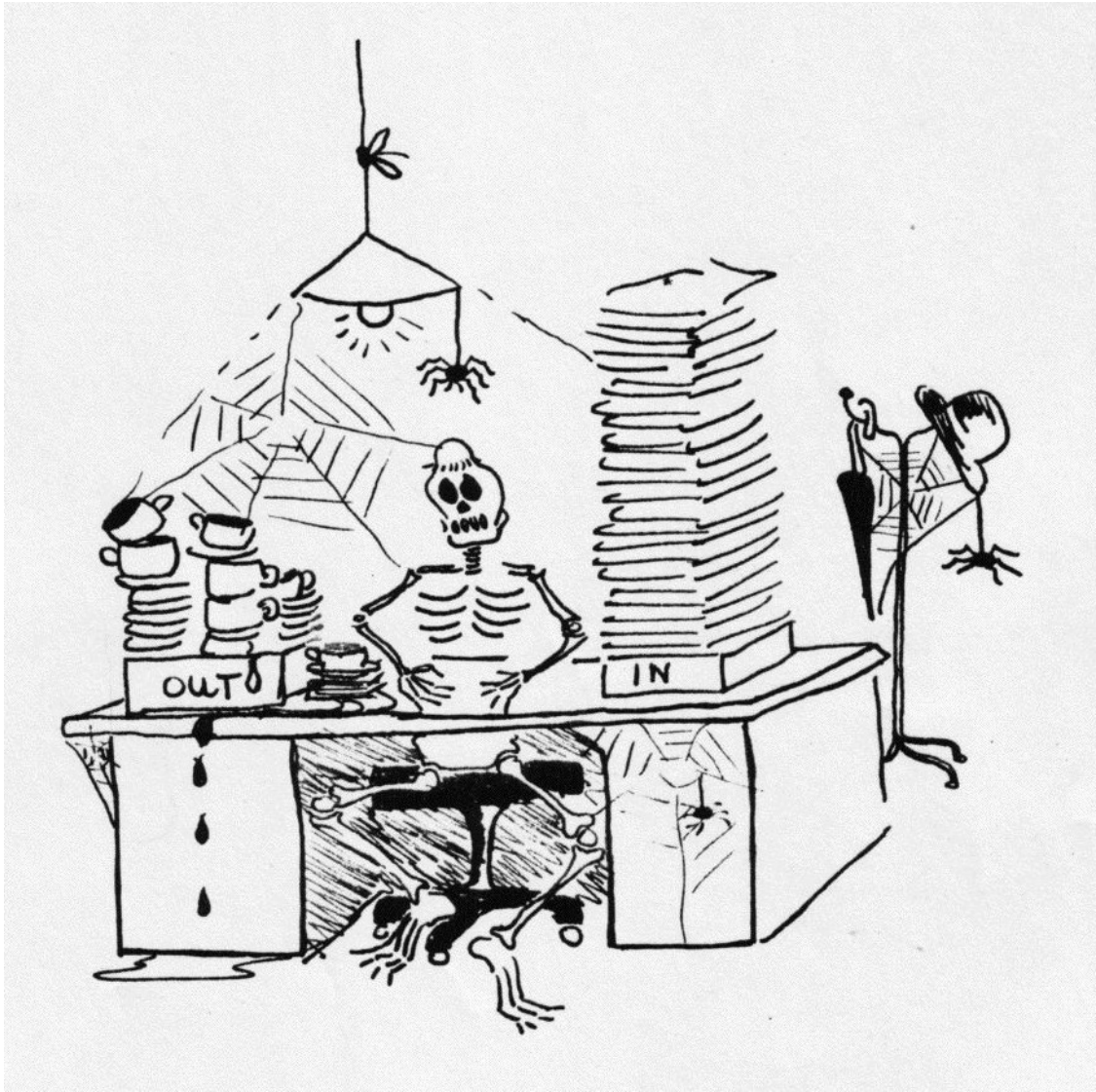


WG: Virtual Observatories

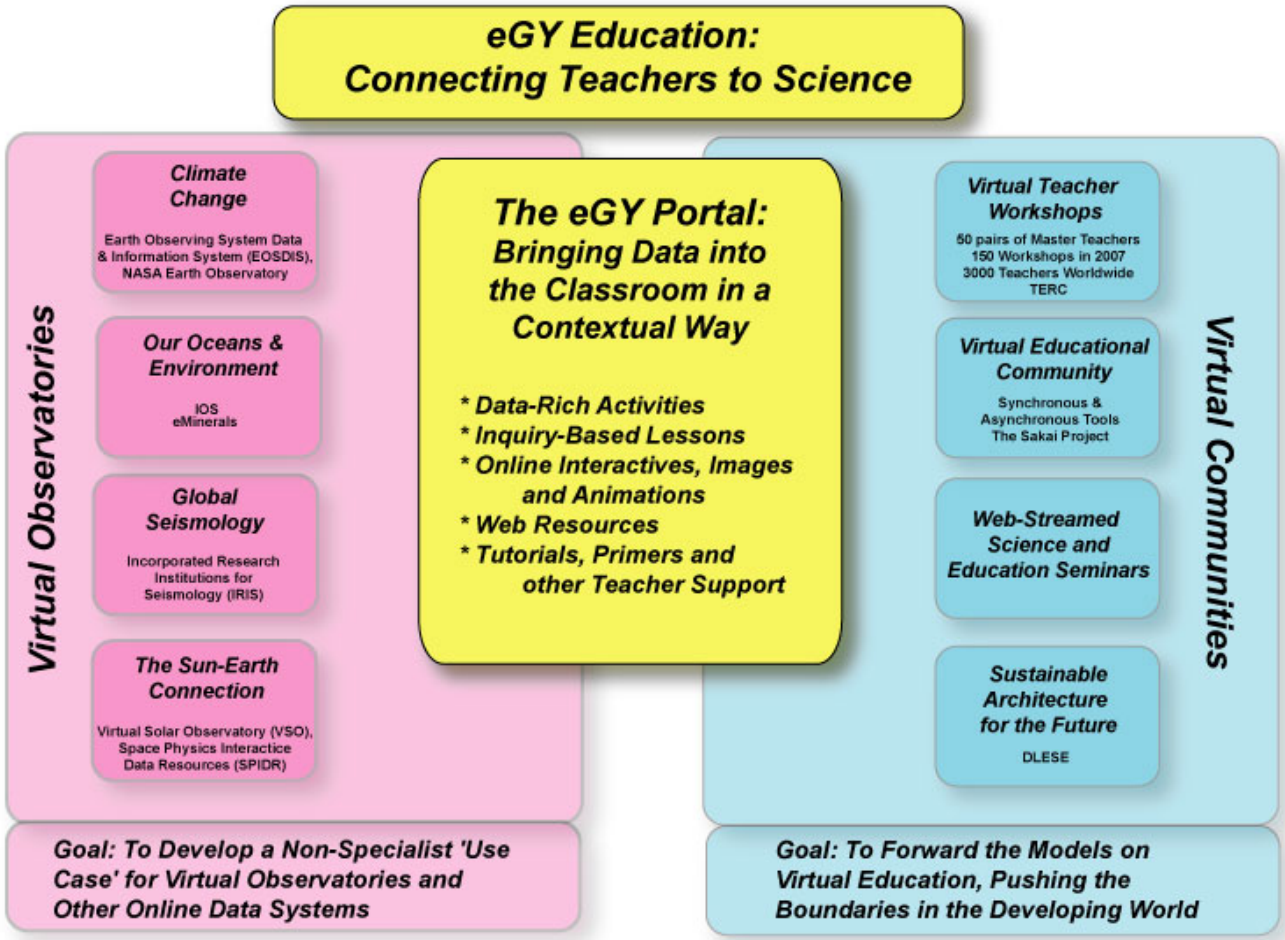


Virtual Solar Observatory architecture

WG: Data Rescue & Preservation



WG: Education & Public Outreach



Role

Provide an international, cooperative environment to

- **inspire**
- **facilitate**
- **encourage**
- **promote**
- **inform**

Virtual Observatories

AVO – Astrophysical Virtual Observatory

NVO – US National Virtual Observatory

VCO – Virtual Carbon Observatory

VGMO – Virtual Geomagnetic Observatory

VHO – Virtual Heliophysical Observatory

ViRBO – Virtual Radiation Belt Observatory

VMO – Virtual Magnetospheric Observatories

VOO - Virtual Ocean Observatory

VSN – Virtual Seismic Network

VSO – Virtual Solar Observatory

.....

e-Science initiatives

AstroGrid - Astronomy
BIOS – Biological Innovation for Open Society
CHRONOS
CIG – Computational Infrastructure in Geodynamics
DAKS - SDSC Data and Knowledge Systems program
Earthscope
eDiaMoND - Breast Cancer
eMinerals - Molecular simulations of environmental issues
FUSION – Fuel cell Understanding through Semantic Inferencing, Ontologies and Nanotechnology
G-Civil - Civil Engineering
Geoinformatics
MyGRID - Bioinfomatics
UK e-Science Core Program
US ITR Program

Data & Info Networks

AEON – Australian Earth & Ocean Network

CANRI – Community Access to Natural Resource Information

CDMP – Climate Database Modernisation Program

DLESE – Digital Library for Earth System Education

EDNES – Earth Data Network for Education and Scientific Exchange

GEON – Global Earth Observing Network

ION – International Ocean Network

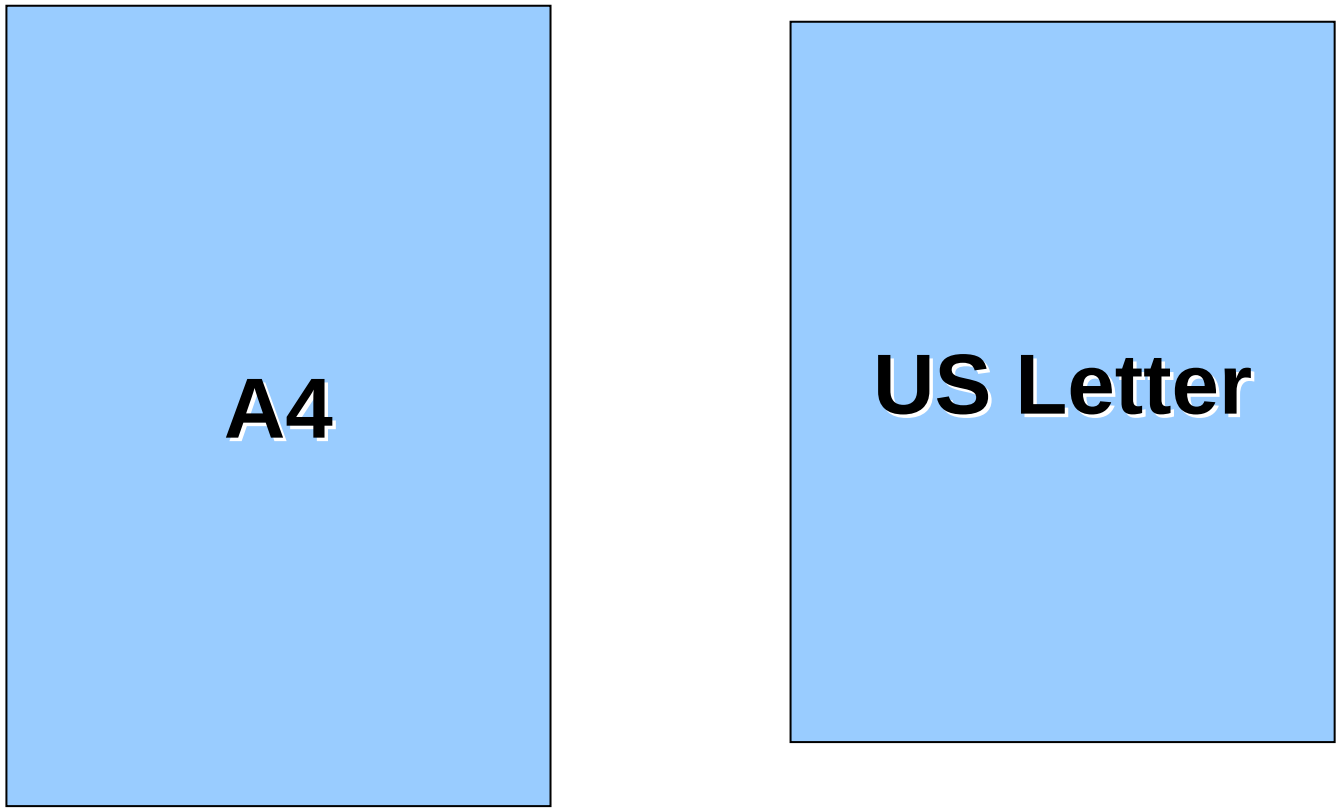
ITR – Information Technology Research program

SPIDR – Space Physics Interctive Data Resource

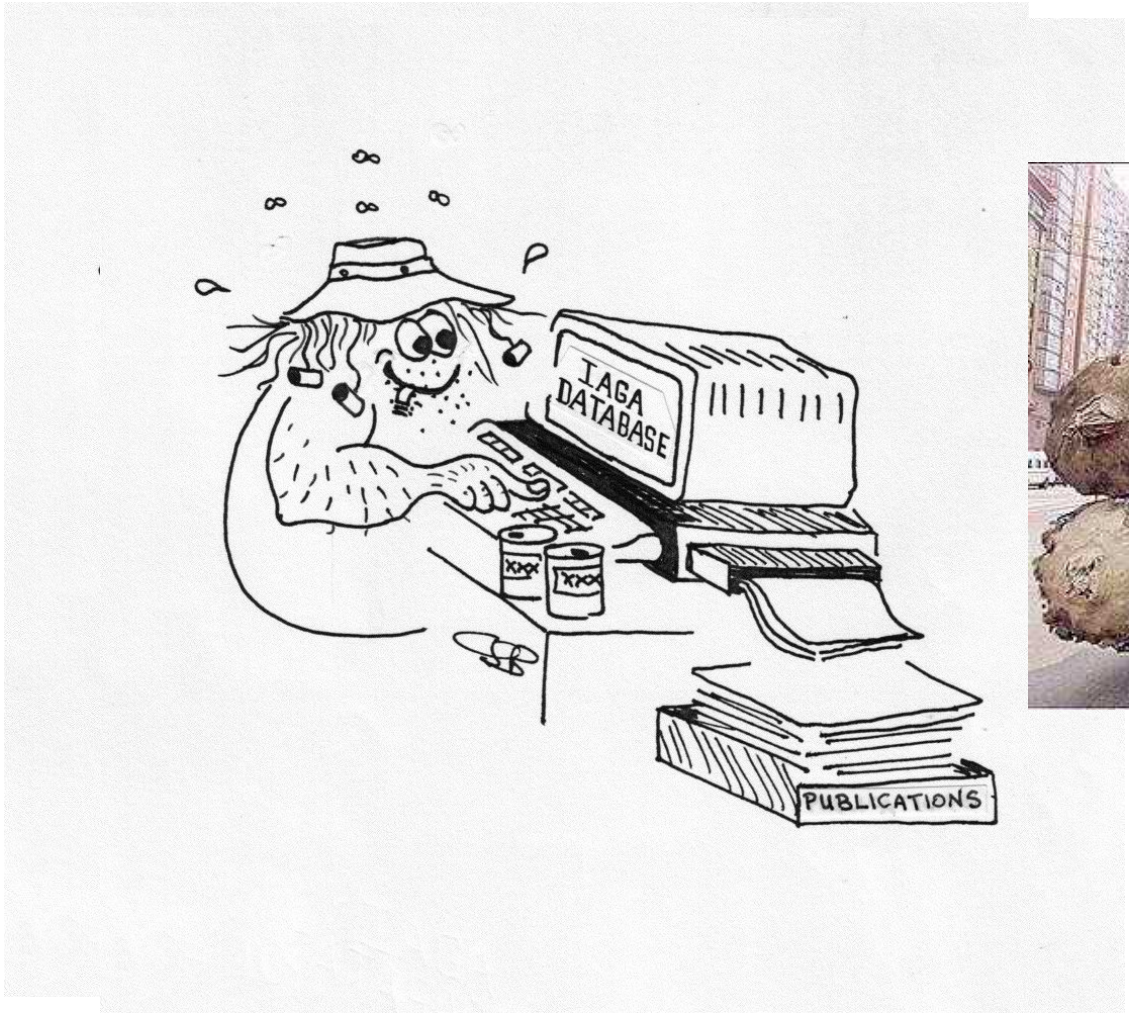
Earth Observation Systems & Partnerships

GEO - Group on Earth Observations
GEOSS - Global Earth Observation System of Systems
GEM – Global Environment Modelling project
GMES – Global Monitoring for Environment and Security
IWGEO – Interagency Working Group on Earth Observation
IGOS – International Global Observing Strategy
IGOS-P - International Global Observing Systems Partners
IGOSS – International Global Observing System of Systems
IGGOS – Integrated Global Geodetic Observing System
GOS - Global Observing Systems
GCOS - Global Climate Observing System
GOOS - Global Ocean Observing System
GTOS - Global Terrestrial Observing System
GOSIC - The Global Observing Systems Information Center
GOS/GAW - Global Observing System/ Global Atmosphere Watch (WMO)
ESONET – European Sea Floor Observatory Network
EOSDIS – Earth Observing System Data and Information System

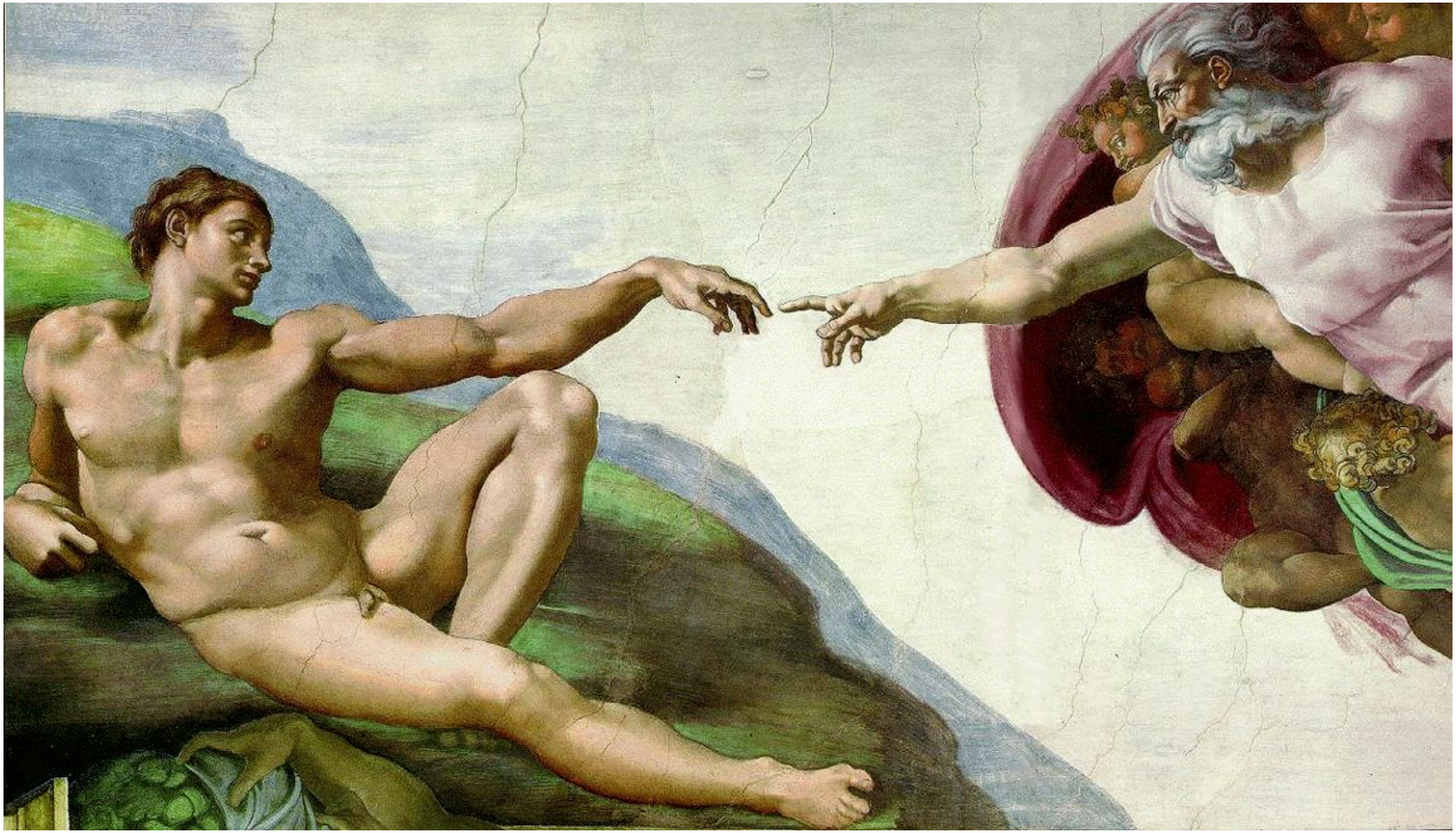

Worth1000.com


A4
US Letter

Burden shifts from the user to the provider



The heroic science funding paradigm



Declaration for a Geoscience Information Commons

"Knowledge is the common wealth of humanity"

Adama Samassekou, Convener of the UN
World Summit on the Information Society

The underlying principles on which *e*GY is based have been articulated by ICSU, the World Summit on the Information Society, CODATA, and other bodies. The principles are encapsulated in the eGY *Declaration for a Geoscience Information Commons* - a statement of aspirations and principles of data stewardship.

Declaration for a Geoscience Information Commons

PREAMBLE

Article 1: Data access

Earth system data and information should be made available electronically with interoperable approaches that facilitate open access.

Article 2: Data release

Owners, custodians, and creators of Earth system data should work together to share their digital information with the world community, though in a manner that respects propriety requirements and security constraints.

Article 3: Data description

Providers and users of Earth system data and information should share descriptions of structure, content, and contexts to facilitate interoperability and the discovery of relationships within and between information resources.

Article 4: Data persistence

Data and information about the Earth system should be preserved and sustained in forms that are both software and hardware independent so as to be openly accessible today and in the future.

Article 5: Data rescue

Effort should be made to identify and rescue critical Earth system data and ensure persistent access to them.

Article 6: Common standards and cooperation

Standards for interoperability should be identified, created, and implemented through international collaboration.

Article 7: Capability building

Communities with advanced information technology and communications capabilities should contribute to developing such capabilities elsewhere to reduce the digital divide.

Article 8: Education and public outreach

Students, scientists, decision-makers, and the public should be informed about and be enabled to contribute to our understanding and management of the Earth system phenomena that influence human survival.

is an opportunity to

- **Find out who is doing what?**
- **Share experience and expertise**
- **Coordinate activities**
- **Reduce replication of effort**
- **Promote common practices (standards)**
- **Widen participation**
- **Reduce the digital divide**
- **Raise awareness of the need for modern, professional data stewardship**
- **Educate; influence decision makers**
- **Inspire public interest.**

Deliverables

Messaging

- Publications, presentations
- Showcase demonstrations
- Meetings, workshops, and symposia (see calendar)

Facilitation

- A mandate/framework for action
  - the Declaration for a Geoscience Information Commons
  - framework for coordination
- Connectivity to experts and peers
- Network of National Committees

Services

- E/PO program
- Capacity building activities in developing countries

Website: www.egy.org *e*GY News

Events

May 2006	AGU, Baltimore
July 2006	AOGS, Singapore
July 2006	COSPAR, Beijing
Oct 2006	CODATA Conference, Beijing
Dec 2006	Fall AGU, San Francisco
Mar 2007	*e*GY General Meeting, Boulder
April 2007	EGU, Vienna
Ist July 07	Launch of eGY (and I*Y event)
July 2007	IUGG General Assembly, Perugia
Aug 2008	IGC-33 Oslo, Norway
Oct 2008	CODATA Conference
Dec 2008	Close of *e*GY

Interested in getting involved?

www.egy.org

***e*GY News**

Email lists

Sign the 'Declaration for a Geoscience Information Commons'

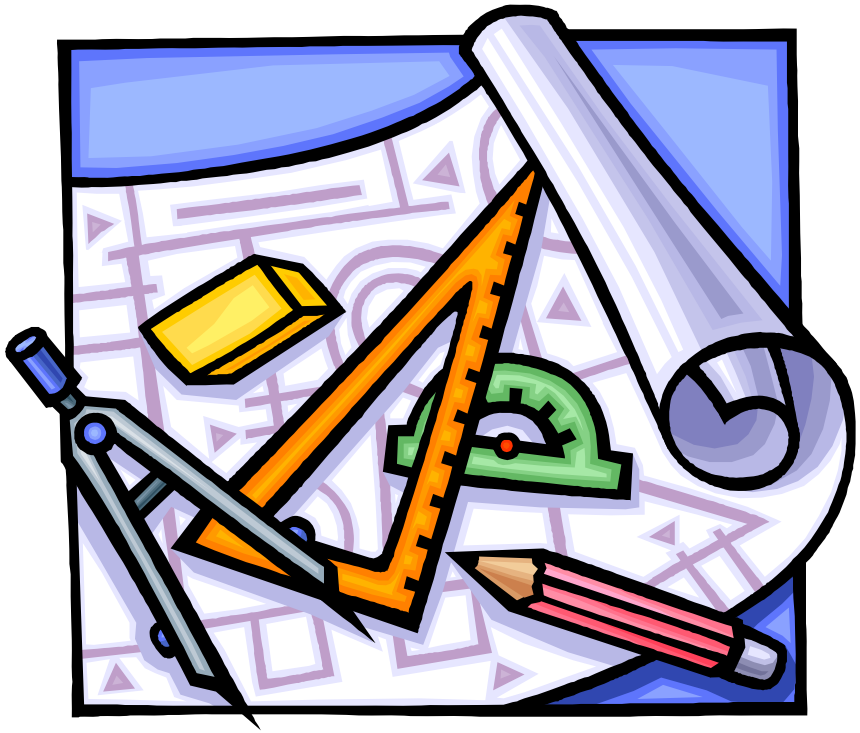
Bill.Peterson@lasp.colorado.edu

Interoperability!

The Interoperability Era

QuickTime™ and a
None decompressor
are needed to see this picture.

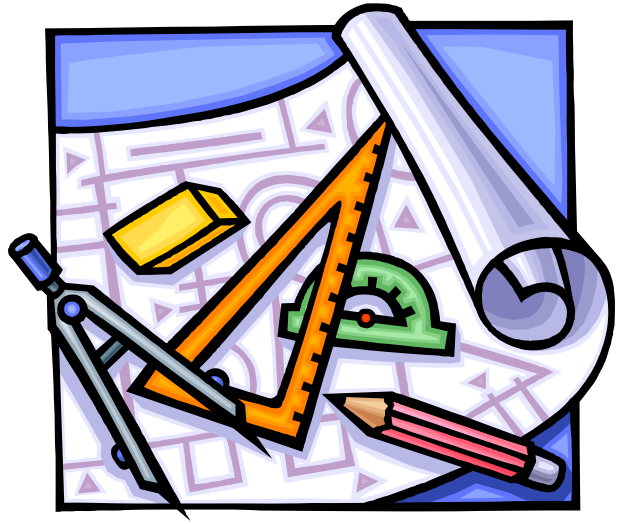
Interoperability Principles in GEOSS



Presented 13 March 2006 at eGY in Boulder, CO

by: Eliot Christian, USGS and WMO Space Programme

Interoperability Defined



Interoperability: w*hen the differences among systems are not a barrier to a task that spans those systems*

"What few things must be the same so that everything else can be different"

Interoperability Principles

Requirements on GEOSS contributed Systems are documented in:

- GEOSS 10-Year Implementation Plan, 5.3 Architecture and Interoperability
- Implementation Plan Reference Document, Sec 5, "Architecture of a System of Systems"

Requirement on Contributed Systems

"The success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata and products.

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

Standards

1. Emphasize non-proprietary standards
2. Focus on interfaces to the shared architecture
3. Promote interoperable recording and storage formats, with metadata and quality indications
4. Adopt a services-oriented architecture
5. Describe service interfaces of component systems

Standards

6. Avoid non-standard data syntaxes
7. Register the semantics of shared data elements
8. Implement the standard search service
9. Draw on existing Spatial Data Infrastructures
10. Contribute to the publicly accessible, network-distributed clearinghouse

1. Emphasize non-proprietary standards

"GEOSS interoperability will be based on non-proprietary standards, with preference given to formal international standards."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

1. Emphasize non-proprietary standards (cont.)

"In common with Spatial Data Infrastructures and services-oriented information architectures, GEOSS system components are to be interfaced with each other through interoperability specifications based on open, international standards."

from GEOSS Implementation Plan Reference Document, Section 5, Architecture of a System of Systems

2. Focus on interfaces

"Interoperability will be focused on interfaces, defining only how system components interface with each other and thereby minimizing any impact on affected systems other than where such affected systems have interfaces to the shared architecture."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

2. Focus on interfaces (cont.)

"For the most commonly used open-standard interfaces, the GEOSS process will advocate some implementations having no restrictions on being modified freely, commonly known as 'open-source' software."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

3. Promote interoperable formats, with metadata and quality

"For those observations and products contributed and shared, GEOSS implementation will facilitate their recording and storage in clearly defined formats, with metadata and quality indications to enable search, retrieval, and archiving as accessible data sets."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

3. Promote interoperable formats, with metadata and quality (cont)

"A key consideration is that GEOSS catalogues data and services with sufficient metadata information so that users can find what they need and gain access as appropriate."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

4. Adopt a Services Oriented Architecture

"GEOSS interoperability arrangements are to be based on the view of complex systems as assemblies of components that interoperate primarily by passing structured messages over network communication services. By expressing interface interoperability specifications as standard service definitions, GEOSS system interfaces assure verifiable and scaleable interoperability, whether among components within a complex system or among discrete systems."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

5. Describe service interfaces of component systems

"GEOSS service definitions are to specify precisely the syntax and semantics of all data elements exchanged at the service interface, and fully describe how systems interact at the interface. [...] use any one of four open standard ways to describe service interfaces: CORBA, Common Object Request Broker Architecture; WSDL, Web Services Definition Language; ebXML, electronic business Extensible Markup Language, or UML, Unified Modeling Language."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

6. Avoid non-standard data syntaxes

"Systems interoperating in GEOSS agree to avoid non-standard data syntaxes in favor of well-known and precisely defined syntaxes for data traversing system interfaces. The international standard ASN.1 (Abstract Syntax Notation) and the industry standard XML (Extensible Markup Language) are examples of robust and generalized data syntaxes, and these are themselves inter-convertible."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

7. Register the semantics of shared data elements

"It is also important to register the semantics of shared data elements so that any system designer can determine in a precise way the exact meaning of data occurring at service interfaces between components. The standard ISO/IEC 11179, Information Technology--Metadata Registries, provides guidance on representing data semantics in a common registry."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

8. Implement the standard Search Service

ISO 23950 Protocol for Information Search and Retrieval

"[...] is interoperable with the broadest range of information resources and services, including libraries and information services worldwide as well as the Clearinghouse catalogues supported across the Global Spatial Data Infrastructure [...] also has demonstrated interoperability with services registries."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

9. Draw on existing Spatial Data Infrastructures

"To enable implementation of the GEOSS architecture, GEOSS will draw on existing Spatial Data Infrastructure (SDI) components as institutional and technical precedents in areas such as geodetic reference frames, common geographic data, and standard protocols."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

9. Draw on existing Spatial Data Infrastructures (cont.)

"Data and information resources and services in GEOSS typically include references to specific places on the Earth. Interfaces to discover and use these geospatial data and services are agreed upon through the various Spatial Data Infrastructure initiatives. These include the ISO 23950 search service interface standard, as well as a range of ISO standards covering documentation and representation, and place codes."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

9. Draw on existing Spatial Data Infrastructures (cont.)

"The standard for geospatial metadata is ISO 19115: Geographic Information--Metadata. This standard facilitates the exchange and integration of data and information by giving a standard description of the identification, extent, quality, spatial and temporal scheme, spatial reference and distribution specifics of geospatial data."

from GEOSS Implementation Plan Reference Document, Section 5, Architecture of a System of Systems

10. Contribute to the public, network-distributed clearinghouse

"GEO Members and Participating Organizations and their contributions will be catalogued in a publicly accessible, network-distributed clearinghouse maintained collectively under GEOSS. The catalogue will itself be subject to GEOSS interoperability specifications, including the standard search service and geospatial services."

from GEOSS Implementation Plan, 5.3 Architecture and Interoperability

10. Contribute to the public, network-distributed clearinghouse (cont.)

"Users searching GEOSS catalogues will find descriptions of GEO Members and Participating Organizations and the components they support, leading directly to whatever information is needed to access the specific data or service in a harmonized way, independent of the specific provider."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

10. Contribute to the public, network-distributed clearing house (cont.)

"the interoperable GEOSS catalogues form the foundation of a more general ‘clearinghouse’. GEOSS data resources can be fully described in context, and data access can be facilitated through descriptions of other useful analysis tools, user guides, data policies, and services. Many examples of such clearing house facilities already exist in the realm of Earth Observation and networked information systems generally, and many of these already employ interoperable interfaces."

from GEOSS Implementation Plan Reference Document,
Section 5, Architecture of a System of Systems

On the Web:
GEOSS 10-Year Implementation Plan Reference Document

http://earthobservations.org/docs/
10-Year Plan Reference Document (GEO 1000R).pdf