

# GEOSS and its Architecture



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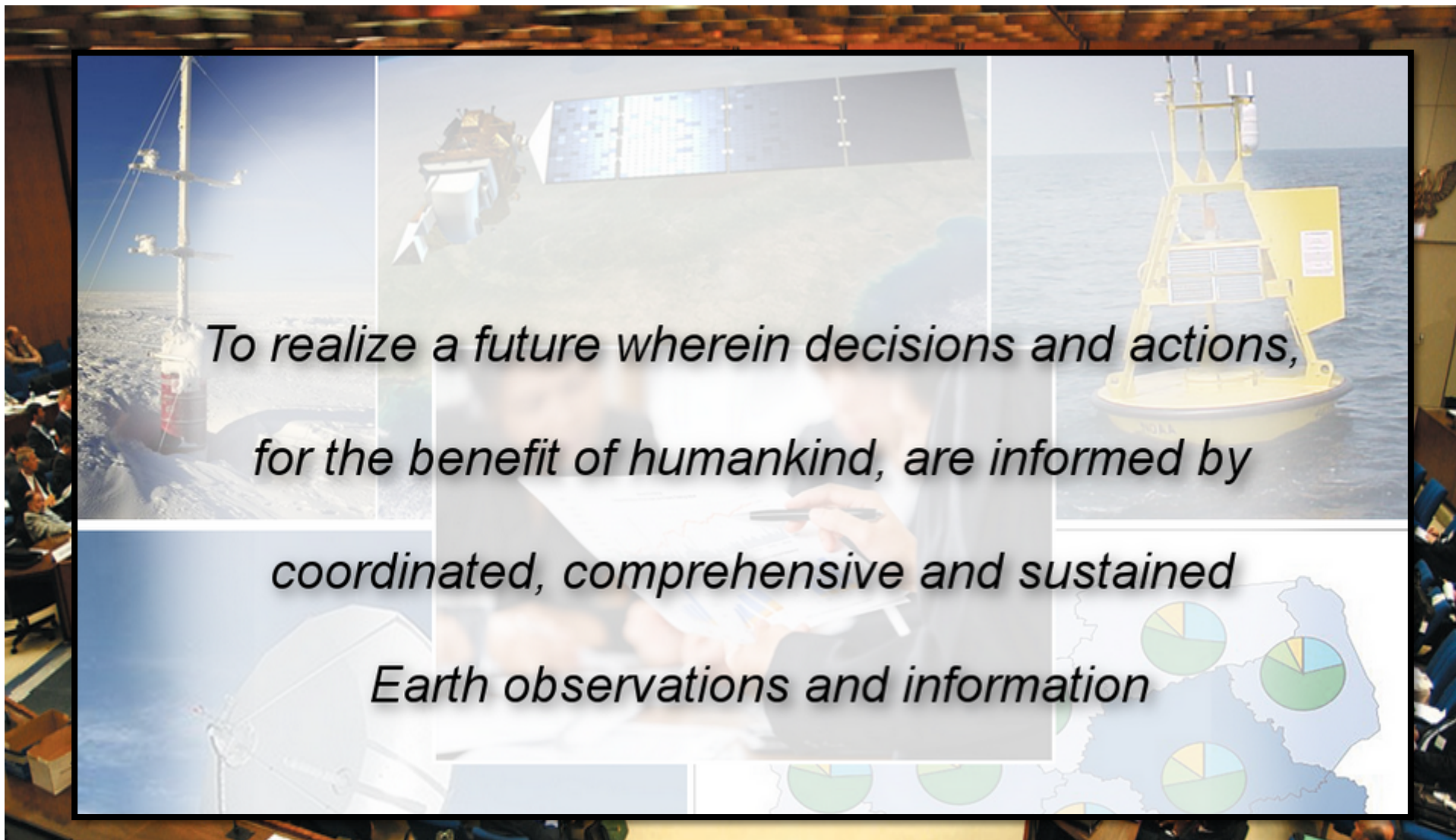




# GROUP ON EARTH OBSERVATIONS



*To realize a future wherein decisions and actions,  
for the benefit of humankind, are informed by  
coordinated, comprehensive and sustained  
Earth observations and information*

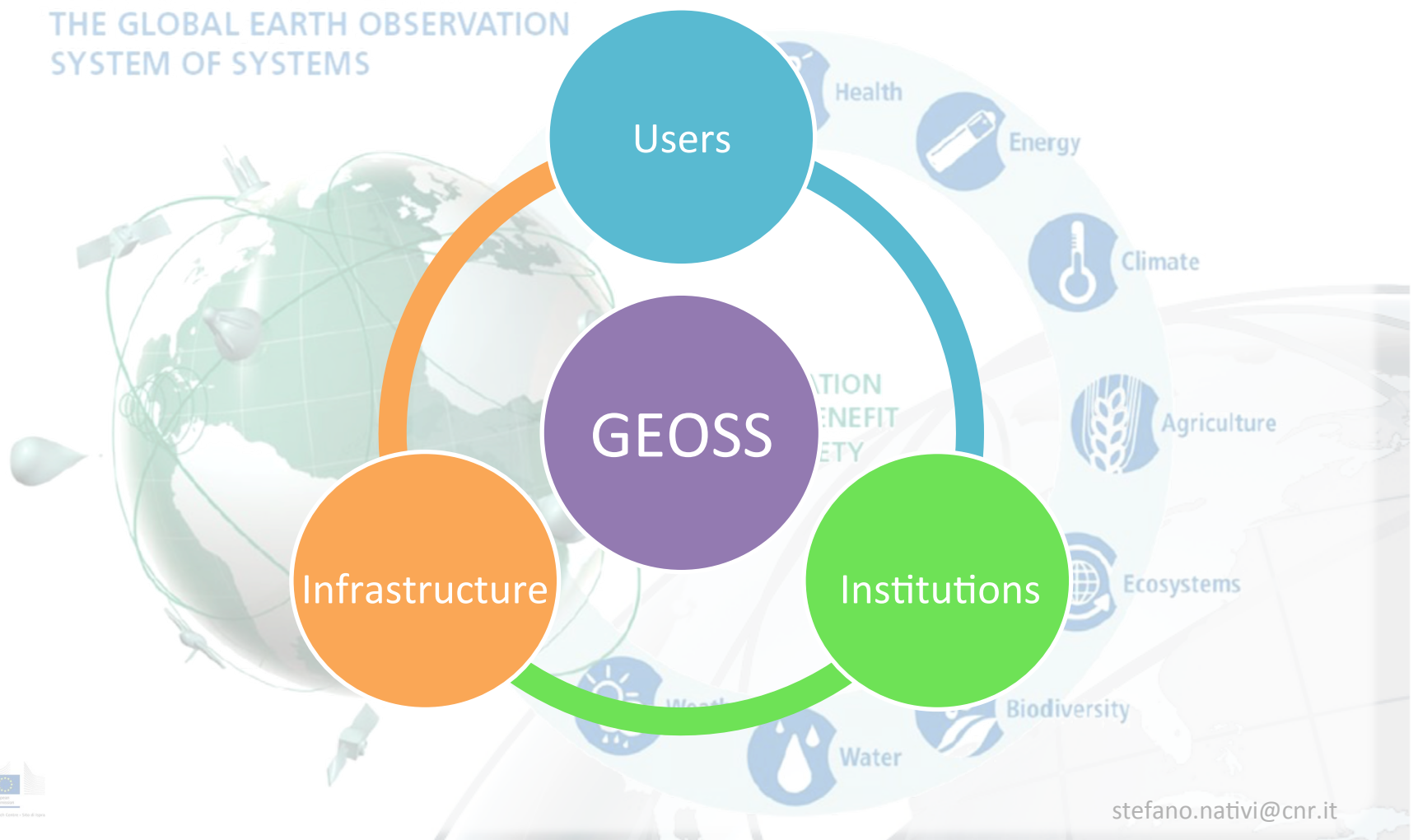




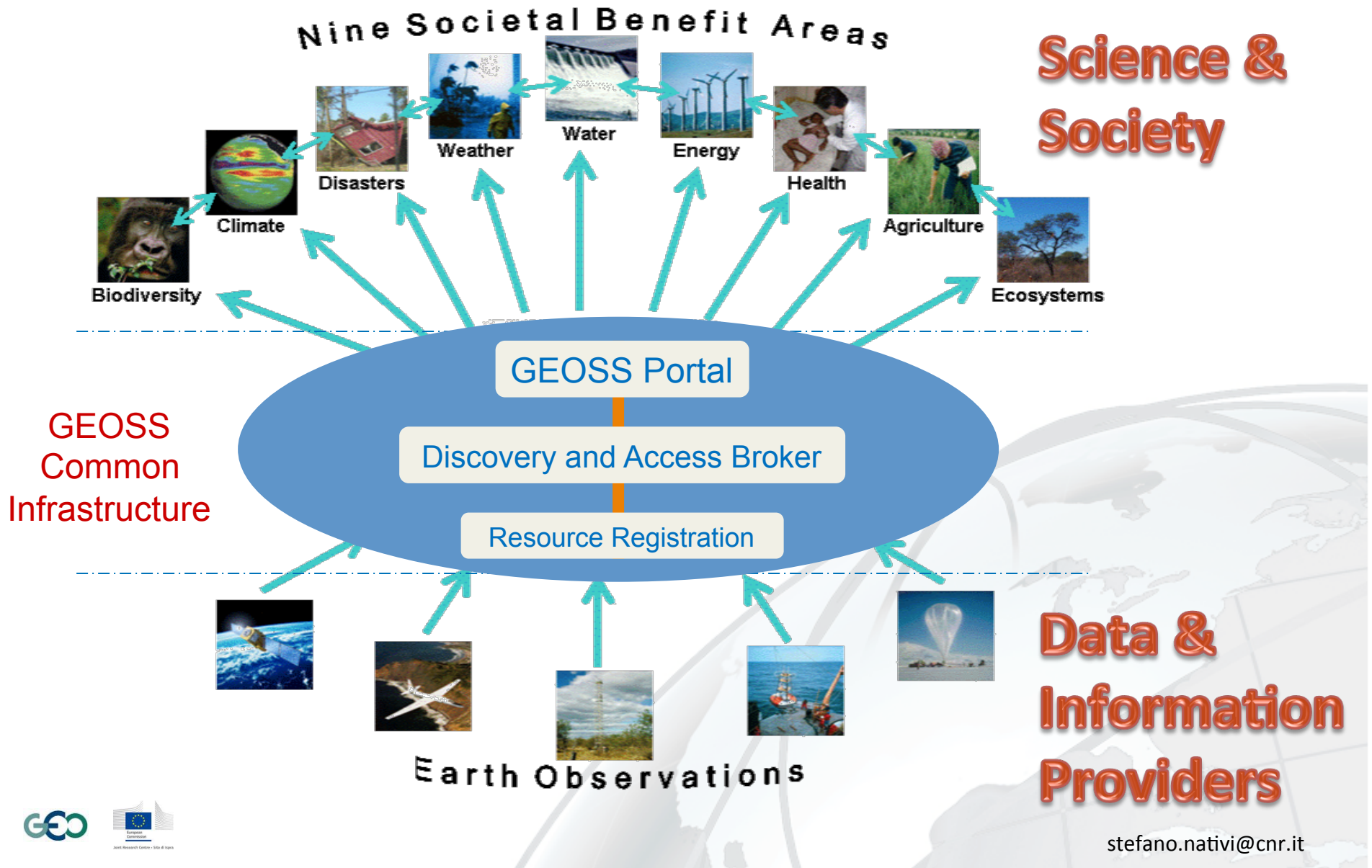


# Global Earth Observation System of Systems (GEOSS)

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS



# Rationale



# Service-Oriented Collaborative Architecture



CSLMS  
May 26 -28th

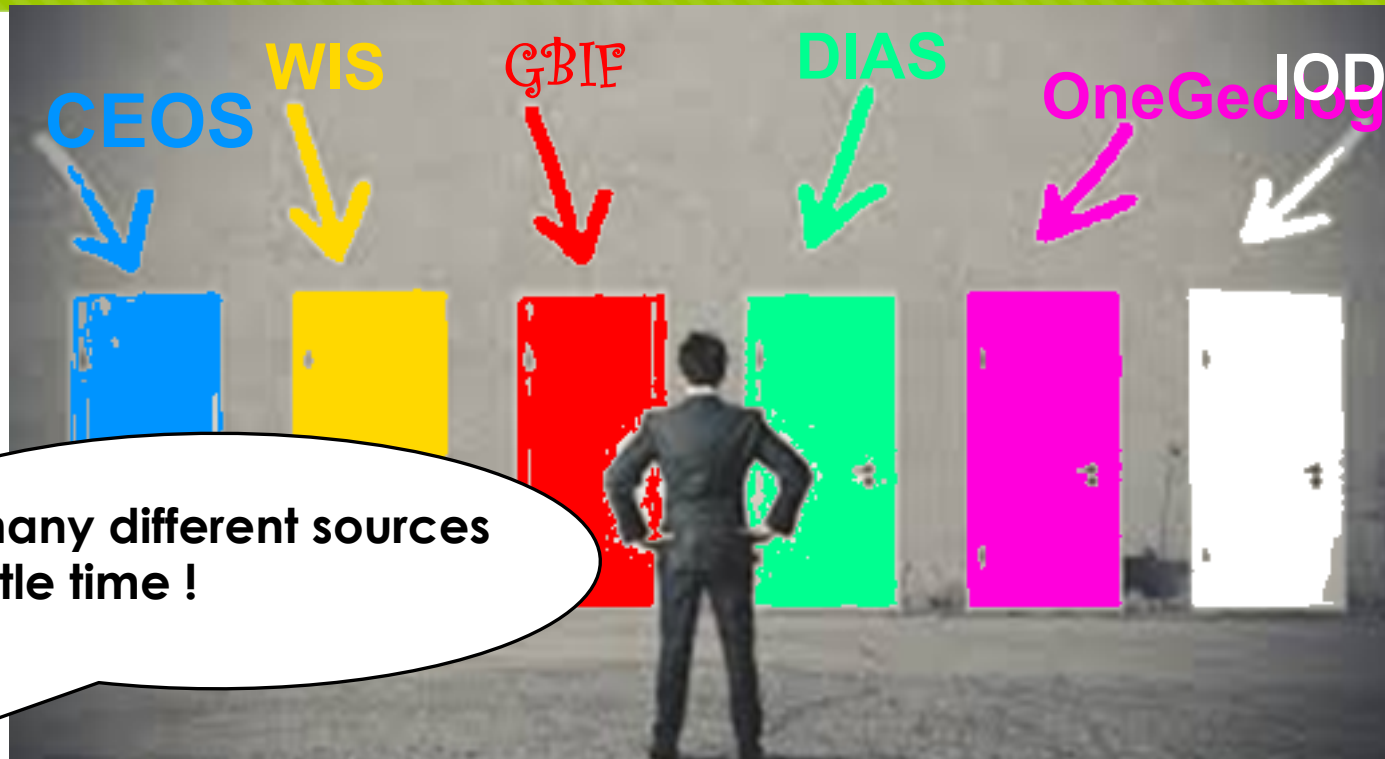
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# Recognized Barriers (especially for GEOSS)



So many different sources  
So little time !

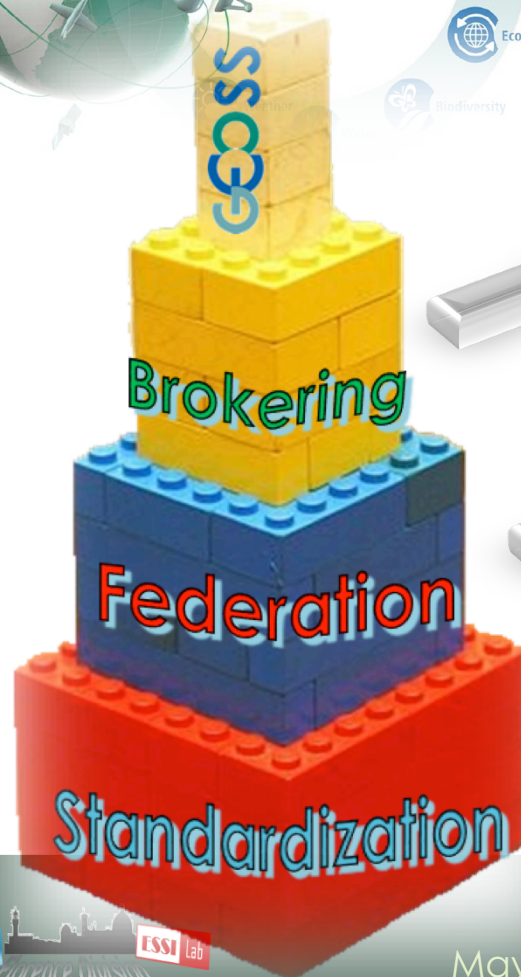


## Brokering pattern

# A Brokered Service-Oriented Collaborative Architecture



THE GLOBAL EARTH OBSERVATION  
SYSTEM OF SYSTEMS



# Interoperability Standards



Multi-domain SoS / NoN



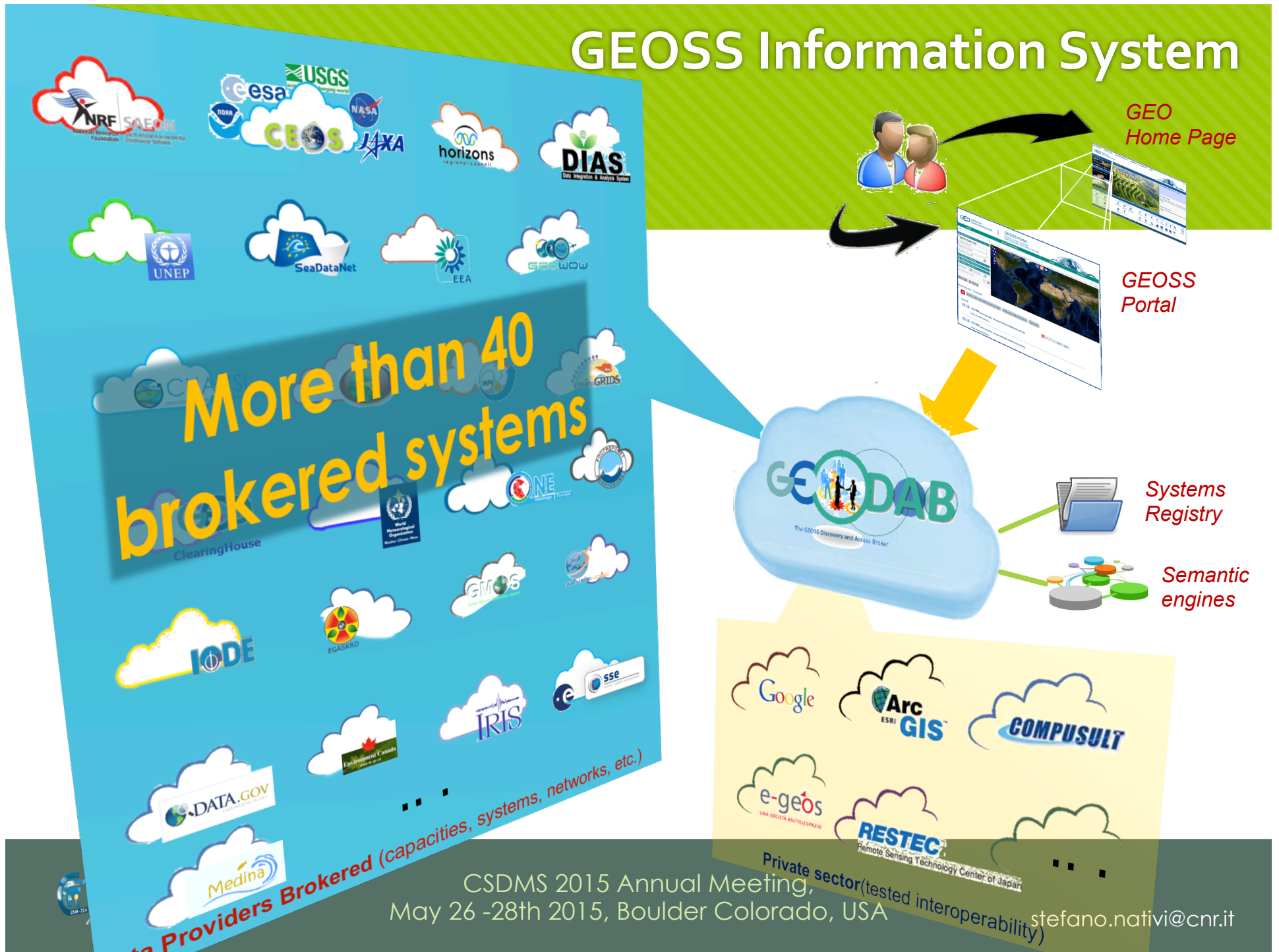
CoP Infrastructures



Domain-related Open Systems



# GEOSS Information System



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# GEOSS Assets (Apr 2015)



More than **40 brokered Data Providers** – capacities, systems, Communities

*Publish*



About **40 Million** (about **2 Million** GEOSS Data Core) Discoverable and potentially Accessible **first level resources**

(mix of data collections, datasets and individual images)

*Contain [source: data providers]*

**BIG  
DATA**

More than **170 Million** (more than **51 Million** **GEOSS Data Core**) Discoverable and potentially Accessible **individual resources**

(e.g. satellite scenes, rain gauge records)

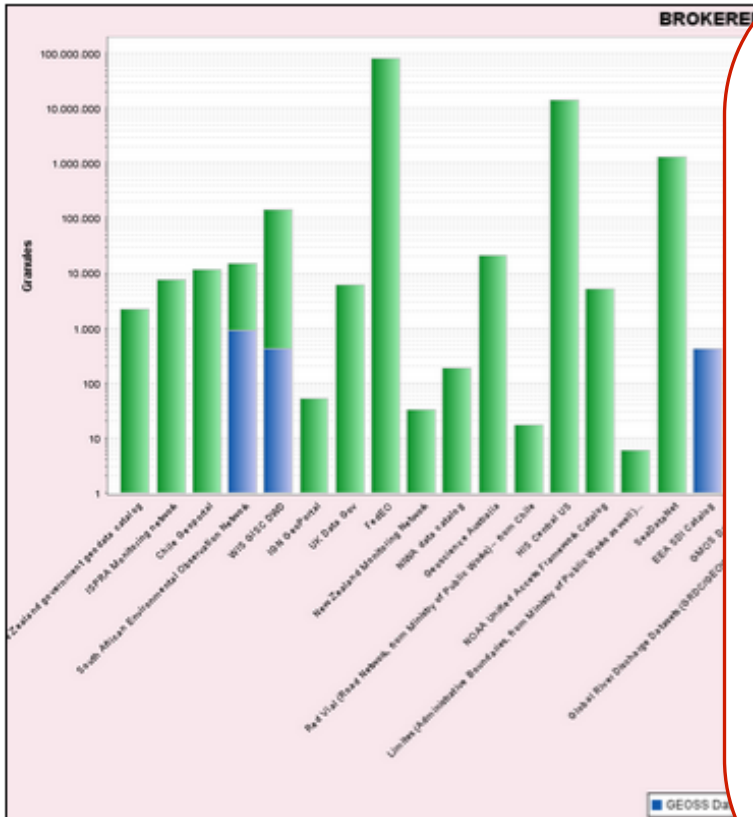
**Resources**



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Date 2015-04-13



## Ongoing Brokering tests:

- IGN
- DigitalGlobe
- GBIF
- Geoscience Australia
- FP7 GeoCarbon DBs
- UK.gov
- FAO
- RapidEye
- EO MAP
- . . . . .

	Records	GEOS Data Core records	Granules	GEOS Core granules	Capacities Under
New Zealand government geodata catalog	2.175	0	2.175	0	Number of records and granules harvested by GEODAB
ISPR Monitoring Network	7.680	0	7.680	0	Number of records and granules harvested by GEODAB
PANGAEA	335.877	335.877	335.877	335.877	Number of records and granules harvested by GEODAB
US Data Gov	85.229	467	85.229	467	Number of records and granules harvested by GEODAB
One Geology	438	438	438	438	Number of records and granules harvested by GEODAB
<b>Total</b>	<b>40.642.337</b>	<b>1.219.917</b>	<b>174.292.868</b>	<b>51.218.096</b>	

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# Big Data challenges for GEOSS



BIG DATA



**VOLUME**  
DATA SIZE



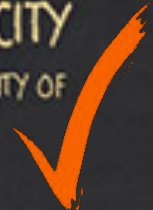
**VELOCITY**  
SPEED OF CHANGE



**VARIETY**  
DIFFERENT FORMS  
OF DATA SOURCES



**VERACITY**  
UNCERTAINTY OF  
DATA





# Daily Count of Discovery Queries

Last Two Weeks

17k

2014: more than 410 thousand



1. Keyword
2. GEOS Data-CORE
3. BBOX
4. ...

\* Only



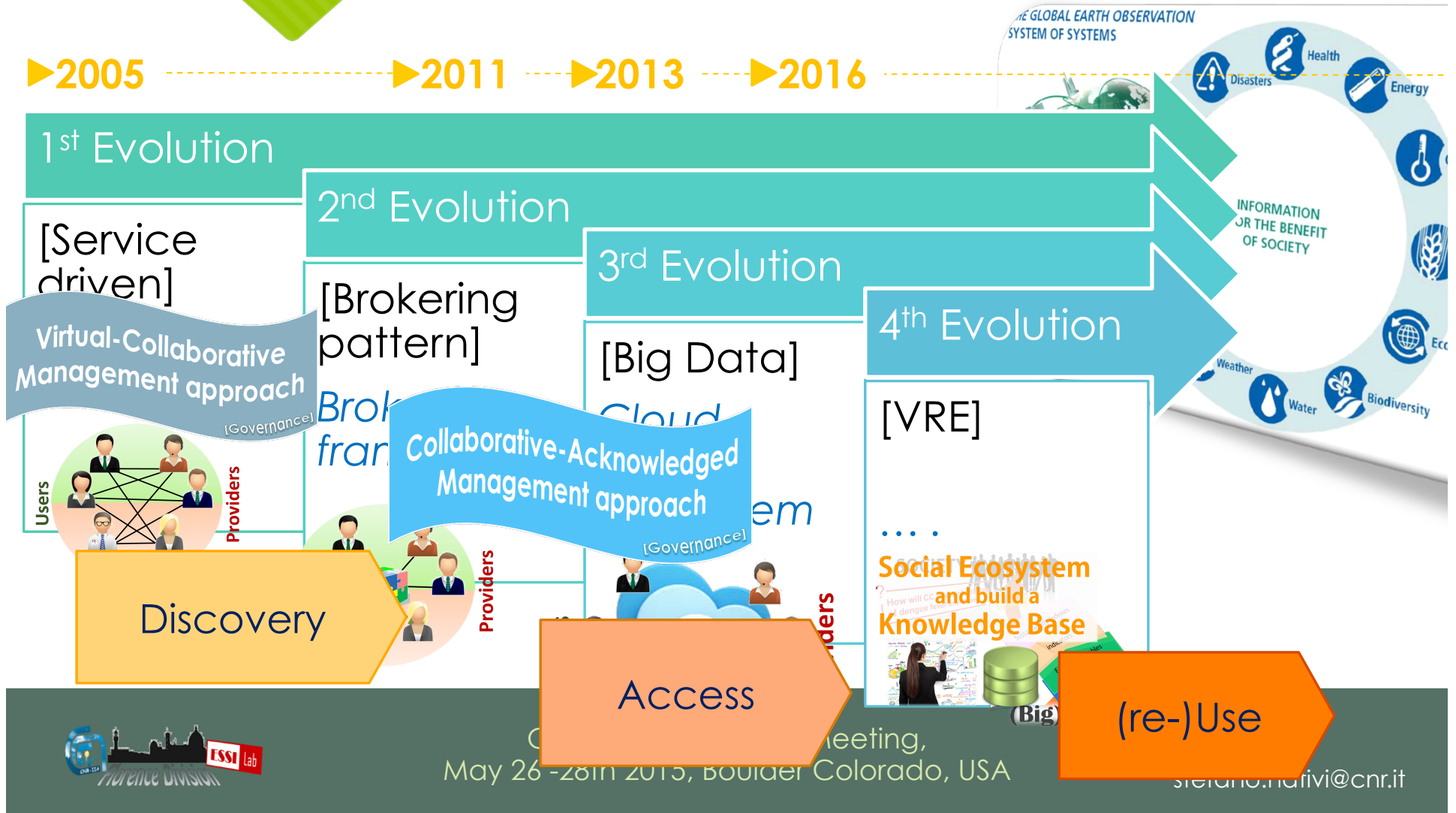
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# The Architectural Evolutions

▶ 2005      ▶ 2011      ▶ 2013      ▶ 2016



CROWDSOURCING



PICO SATELLITES



SMART CITIES

CLOUD COMP.



ANALYTICS



CONSUMERIZATION

CITIZEN OBSERVATORIES



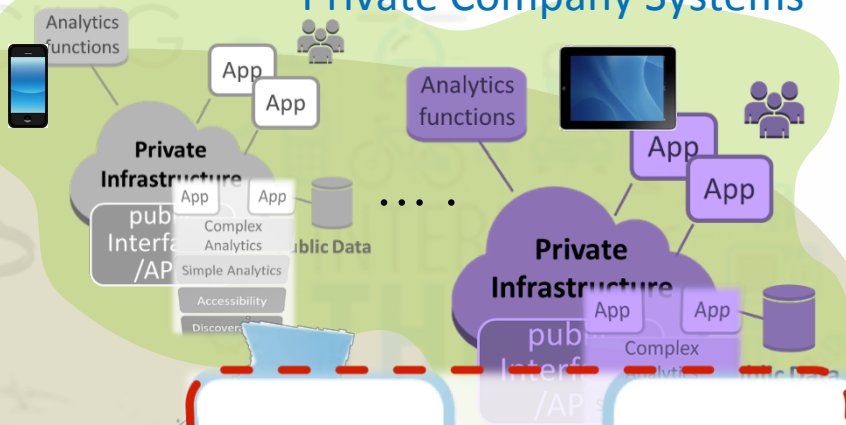


**GEOS Portal**

**Community Portals**



**Private Company Systems**

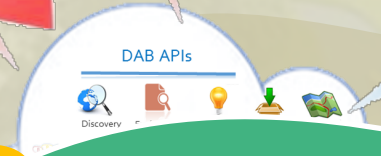


**GEOS Knowledge Base**

**GEOS**



**Simplified GEOS Registration**



# Software Ecosystem (Cloud based)



**Feedback**

**GEOS interdisciplinary Collaboration & Social services**

**(GCI 3.0)**

**Discoverability**

- Accessibility
- Discoverability

**NGO systems**

- Simple Analytics
- Accessibility
- Discoverability





# Models

**GEOSS**

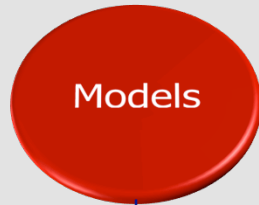
## Earth System Models

- Oceans
- Cryosphere
- Land
- Atmosphere
- Solid Earth

**Predictions and Analysis**  
High Performance Computing



**Decision Support**  
• Assessment  
• Decision Support Systems



?

**How will CC affect infection rate of dengue fever in Vietnam?**

?

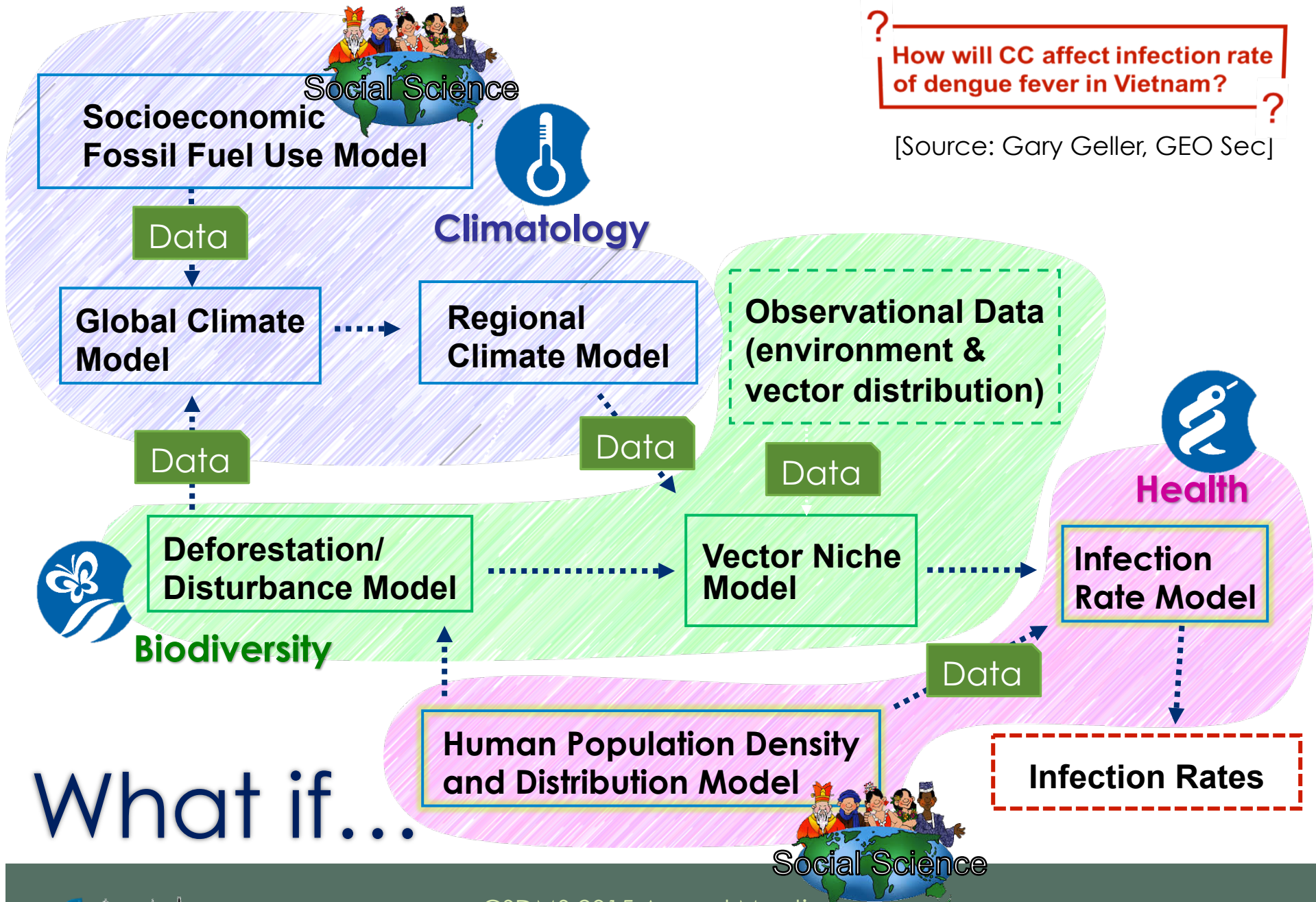
- *In situ*
- Airborne
- Space-based

**ECONOMIC Data**

Ongoing feedback to optimize value, reduce gaps, and account for human activity

Earth Observation Data

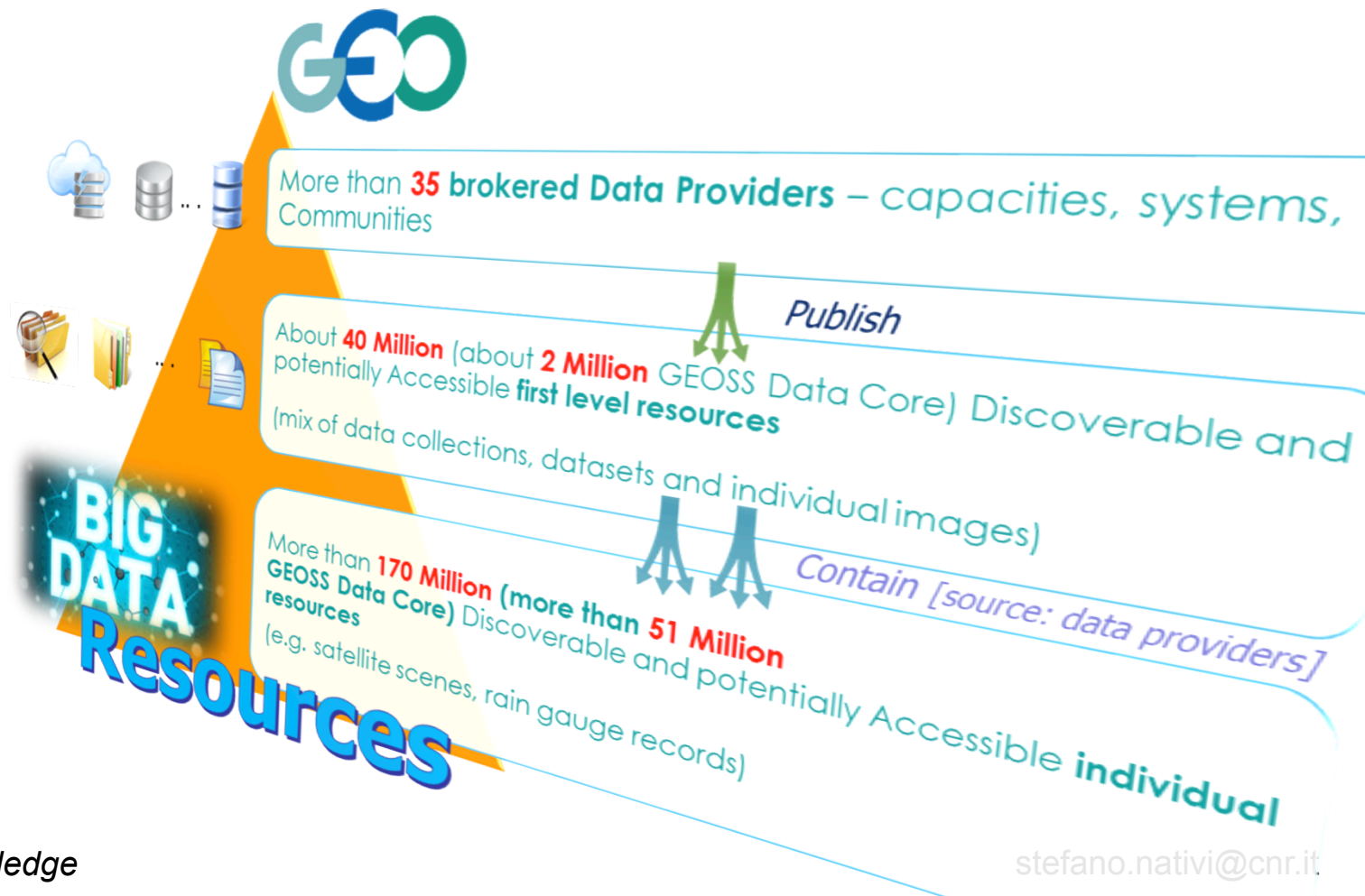
# 2005 GEOSS Implementation Plan Reference Document



? **How will CC affect infection rate of dengue fever in Vietnam?** ?

# Resources...

Data





# Resources...

Data

Model

? **How will CC affect infection rate of dengue fever in Vietnam?** ?



Object Modelling System  
**CSDMS** Tarsier  
SEAMLESS-IF  
OpenMI **ESMF** MaaS  
OpenModeller ICMS  
Invisible Modelling Environment  
ModCom  
SME  
nanoFORCE/nanoHub

How will CC affect infection rate of dengue fever in Vietnam?

# Resources...

**Data**

**BIG DATA Resources**

- More than **35 brokered Data Providers** – capacities, systems, Communities
- About **40 Million** (about **2 Million** GEOS Data Core) Discoverable and potentially Accessible **first level resources** (mix of data collections, datasets and individual images)
- More than **170 Million** (more than **51 Million** GEOS Data Core) Discoverable and potentially Accessible **individual resources** (e.g. satellite scenes, rain gauge records)



**Model**

Object Modelling System

ModCom **CSDMS** Tarsier **SME** nanoFORGE/nanoHub

SEAMLESS-IF **MaaS**

**OpenMI** **ESMF**

**OpenModeller** ICMS

Invisible Modelling Environment



Link (Integration)



Knowledge Bases (ontologies)



Semantic services



Brokers

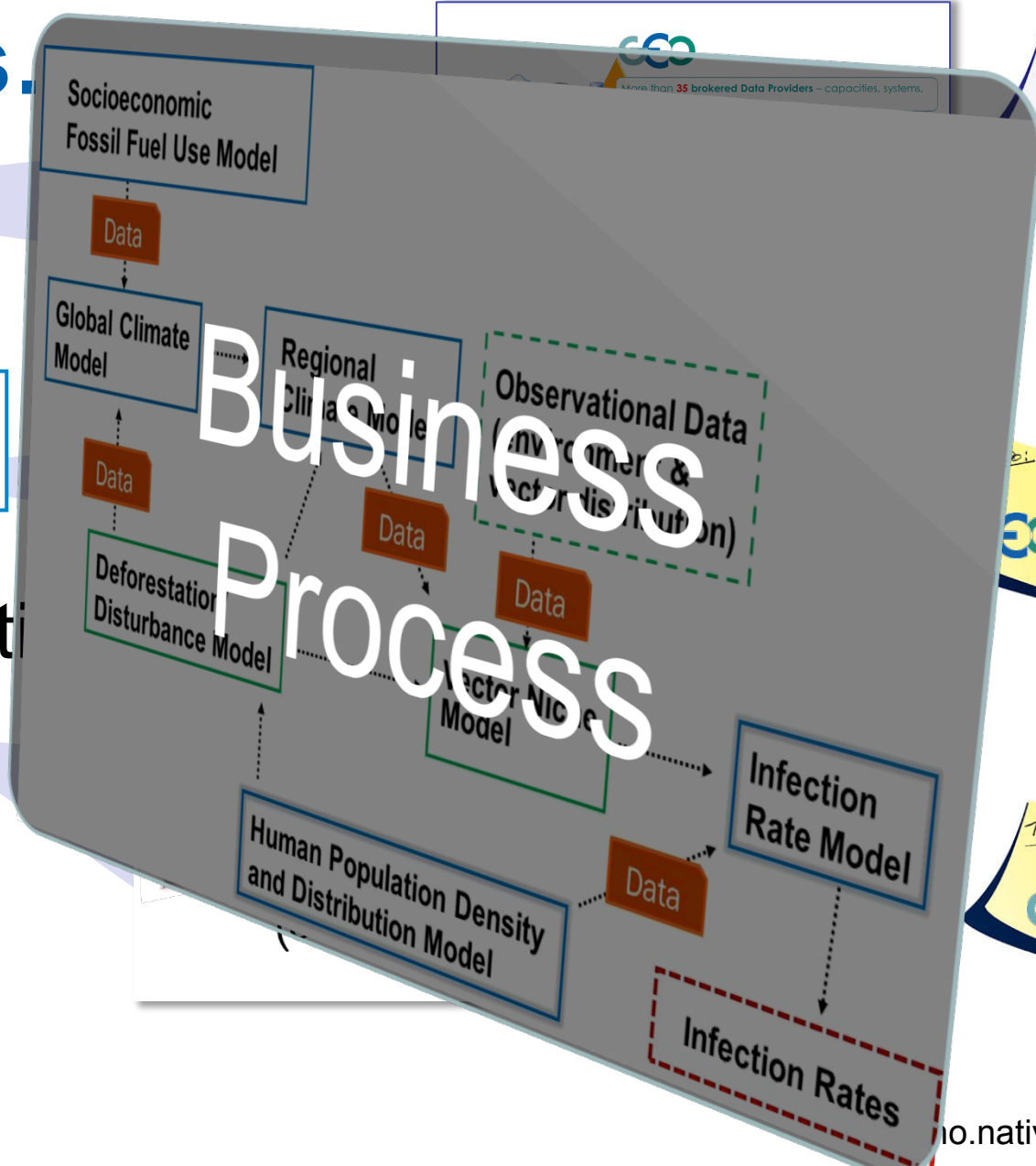
# Resources

? **How will CC affect infection rate of dengue fever in Vietnam?** ?

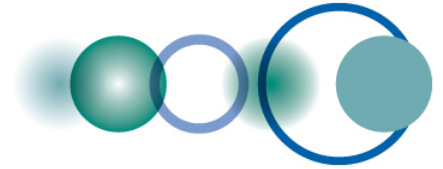
**Data**

**Model**

Link (Integrati  
.....▶



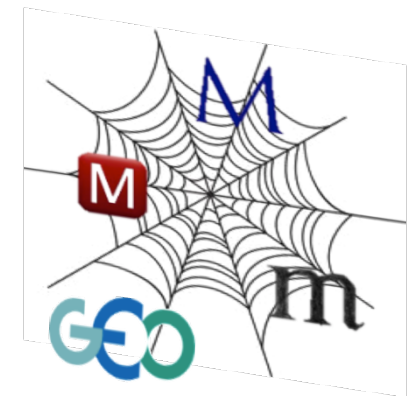




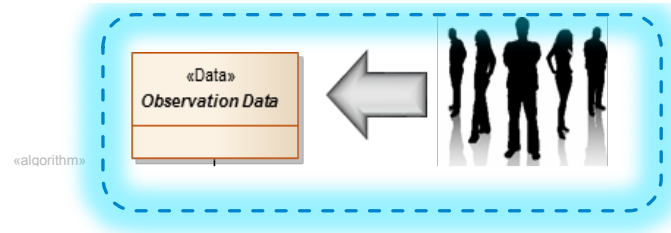
# GEO Model Web

*A dynamic **web of models**, integrated with databases and websites, to form a **consultative infrastructure** where researchers, managers, policy makers, and the general public can go to gain insight into **“what if”** questions*

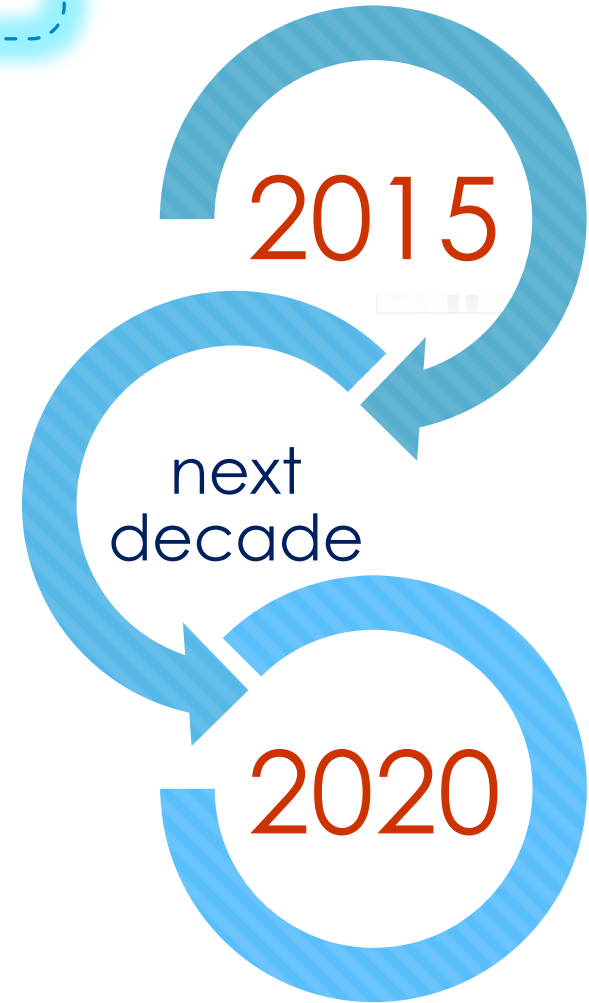
[Coordinators: Stefano Nativi (CNR) and Gary Geller (GEO sec)]



# From Data to Knowledge



## Social Ecosystem



# Potential Users



Data Volume



Users



EO Data Experts  
(IT experts)



Environmental  
Experts  
(Practitioners)



Global Change  
Experts  
(Educators)



Policy Makers  
(Citizens)

Re-use

Access

Discover

Today

Tomorrow

Interoperability Level

Observations

Essential Variables

Indicators

(Sustainability) Indexes

From Data to Knowledge

# GCI 2.0 Achievements

- (From a “Catalog of Catalogs” to) a **multi-disciplinary Brokering Platform**
- (From discoverability to) **accessibility and harmonization**
- (From an infrastructure to) **cloud-based software ecosystem**
- (From a virtual governance to) **collaborative-acknowledged governance**



# Future Work

*From Observation to **Knowledge management***

- Add **socio-economic data**
- Add scientific **models**
- Establish **a Social ecosystem (a VRE)** to capture expert knowledge

*From accessibility to **re-usability and re-producibility***



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# Thank you !

# Questions?



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# Generally Recognized Barriers (especially for GEOSS)

○ **Problem:** service users need to know the nature and location of service providers,

- making it **difficult to bind** and **dynamically change the bindings** between users and providers

○ **Solution:** The **broker pattern** separates users of services (**clients**) from providers of services (**servers**) by inserting an intermediary, called a broker.

- When a client needs a service, it queries a broker via a service interface. The broker then forwards the client's service request to a server, which processes the request