

# Helix Nebula, the Science Cloud: Potential for Earth Science

Franco-British Workshop on Big Data in Science  
6-7 November 2012

Maryline Lengert, ESA

# Strategic Goal

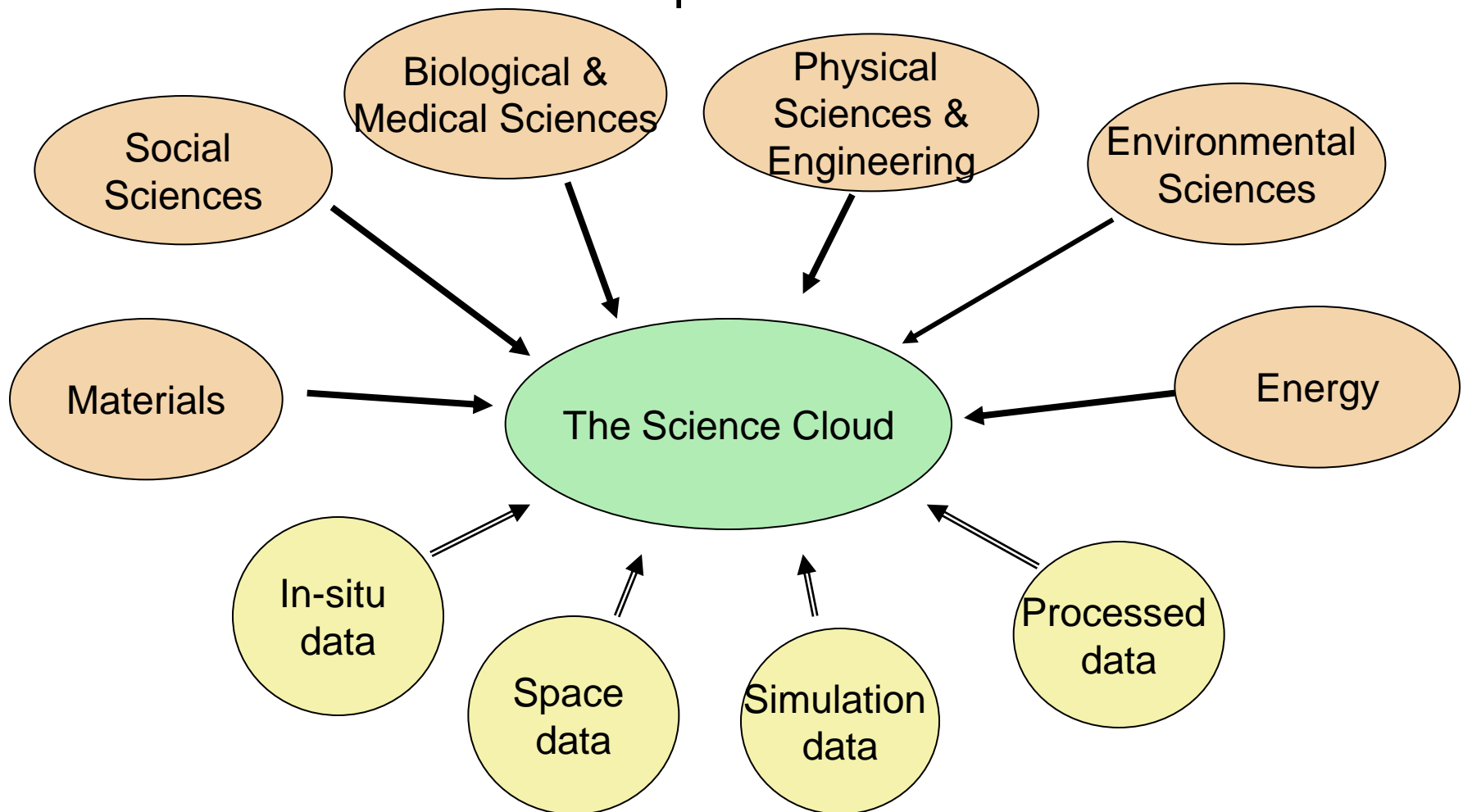


## Helix Nebula, the Science Cloud

is a partnership that has been created to support the **massive IT requirements** of European scientists and **create a Cloud computing market** for the public sector in **Europe**.

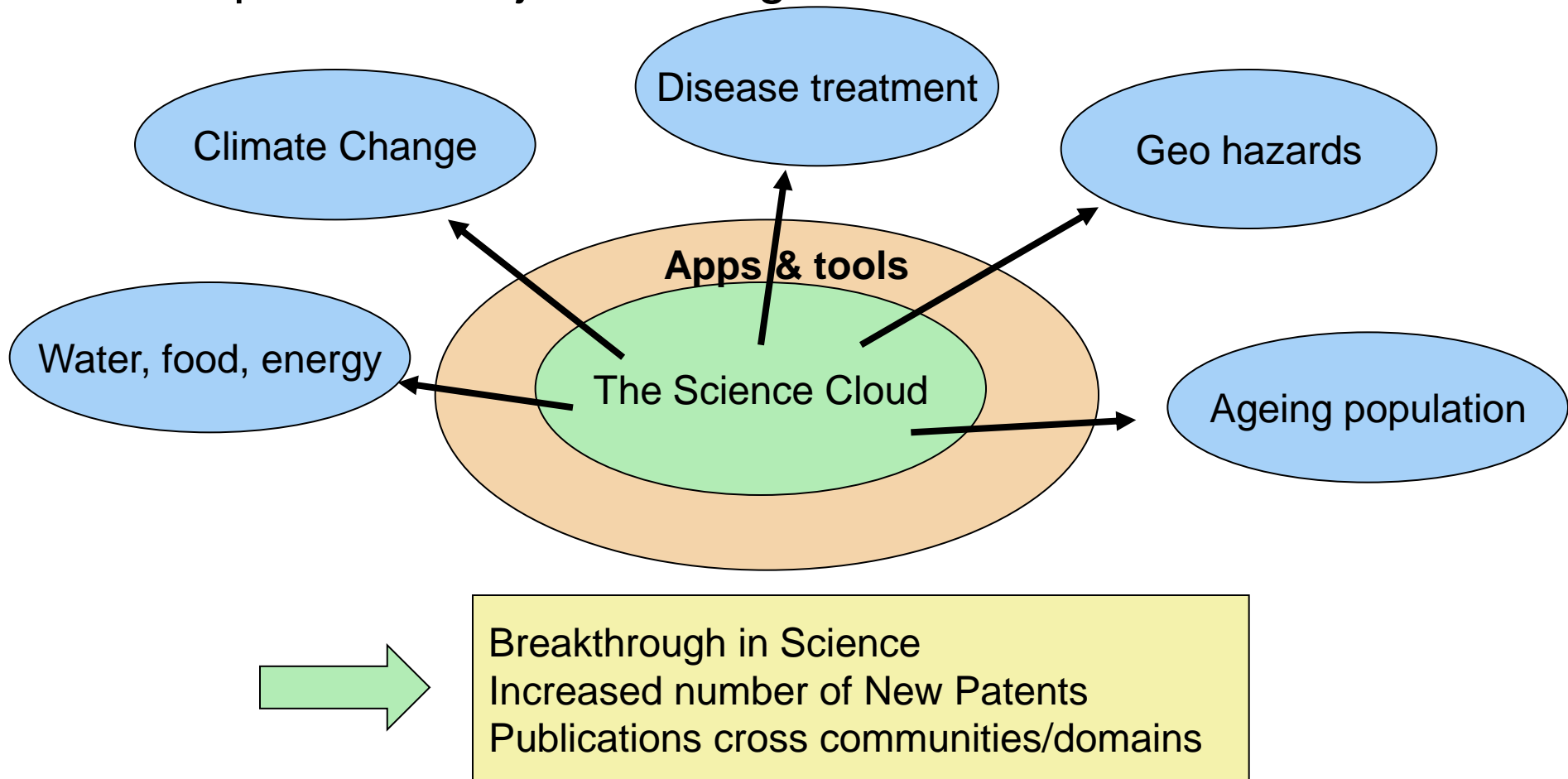
# The Science Cloud : INPUT

**The Science Cloud** : a unique mine of scientific data



# The Science Cloud: OUTPUT

**The Science Cloud** : a unique opportunity for Scientists to comprehend major challenges



# Strategic Plan for a Scientific Cloud Computing infrastructure for Europe



1.1

8<sup>th</sup> August 2011

- **Establish a sustainable multi-tenant cloud computing infrastructure in Europe**
- **Initially based on the needs for the European Research Area & space agencies**
- **Based on commercial services from multiple IT industry providers**
- **Adhere to internationally recognised policies and quality standards**
- **Governance structure involving all stakeholders**

Dr. Maryline Lengert  
ESA - European Space Agency  
Senior Advisor  
Maryline.Lengert@esa.int  
Tel +39 06 941 80430

Dr. Bob Jones  
CERN – European Organization for Nuclear Research  
IT department  
Bob.Jones@cern.ch  
Tel. +41 22 767 14 82

Copyright © 2011 by CERN and ESA. This work is made available under the terms of the Creative Commons Attribution-Non-Commercial-No Derivative Works 3.0 Unported license,  
<http://creativecommons.org/licenses/by-nc-nd/3.0/>

## 4 Goals outlined in the Strategic Plan



1. Set up a **cloud computing infrastructure** for European Research Area
2. Identify and adopt **policies** for trust, security and privacy on a European-level
3. Create a light-weight **governance** structure involving all stakeholders
4. Define a short and medium term **funding** scheme

# EC is strongly supporting Helix Nebula



**Europe's Information Society**  
Thematic Portal

European Commission >

[Policies](#) [Activities](#) [Culture & Society](#) [Economy & Work](#) [Education & Training](#) [Quality of Life](#) [IS Industry](#) [Regions / World](#) [Research & Innovation](#)

**Newsroom**  
[Calendar](#)  
[Funding Opportunities](#)  
[Calls for Proposals](#)  
[Calls for Tender](#)  
[Press Packs](#)  
[Press Releases](#)  
[Library](#)  
[Audiovisual](#)  
[Speeches](#)  
[Search Newsroom](#)  
[Register & Subscribe](#)  
[Login](#)  
[Services for the Press](#)

**News ::**

## Helix Nebula makes Europe become Cloud Active in Science

(25/06/2012) The European Commission just took another step towards a Cloud Active Europe with the signature of a grant agreement for Helix Nebula. The Commission is giving €1.8 million in funding to this initiative which will develop cloud services in the scientific domain by partnering main research infrastructures in Europe (CERN, EMBL and ESA) with main stakeholders in the industry (e.g. Atos, T-systems, etc). The Commission's grant will support moving flagship applications (Atlas HEP, Genomic Assembly in the Cloud and Supersites Exploitation Platform) to the cloud, while identifying business opportunities for cloud services for the scientific community.

The signature of this agreement is one step in the implementation of the Digital Agenda for Europe, which calls for the further development of e-Infrastructures and the establishment of an EU strategy for cloud computing for government and science.

Helix Nebula as a cloud partnership for science launched under the e-Infrastructures activity of FP7, is a forerunner of the forthcoming Integrated Cloud Computing Strategy for the European Union expected to be adopted by mid-July and in particular is complementary to the European Cloud Partnership to promote public sector take-up of cloud services that was **announced by Neelie Kroes in Davos**.

**More information**  
[Digital Agenda for Europe](#)  
[Digital Agenda Cloud Computing home page](#)



# A Collaboration Initiative

**European Commission  
& relevant projects**

**User organisations**  
*Demand-side*

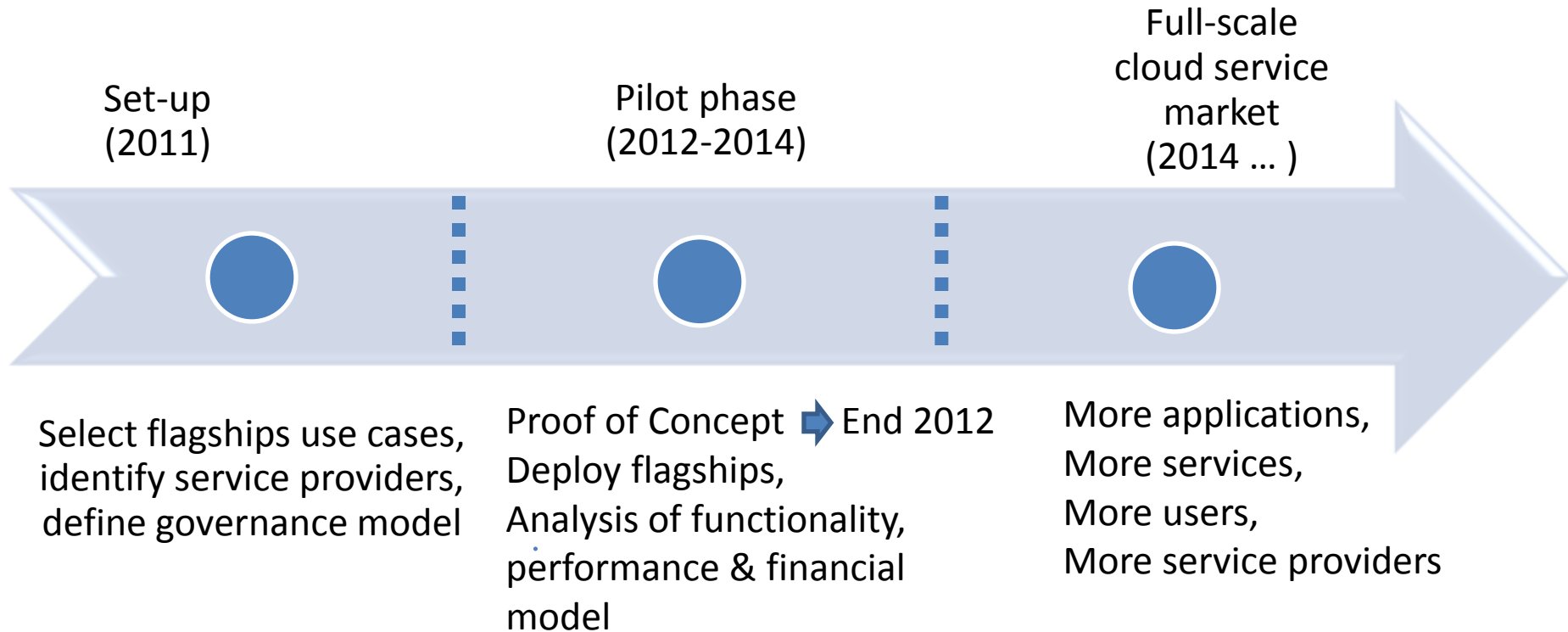
**European  
Cloud Computing  
Strategy**

**Commercial Service  
Providers**  
*Supply-side*

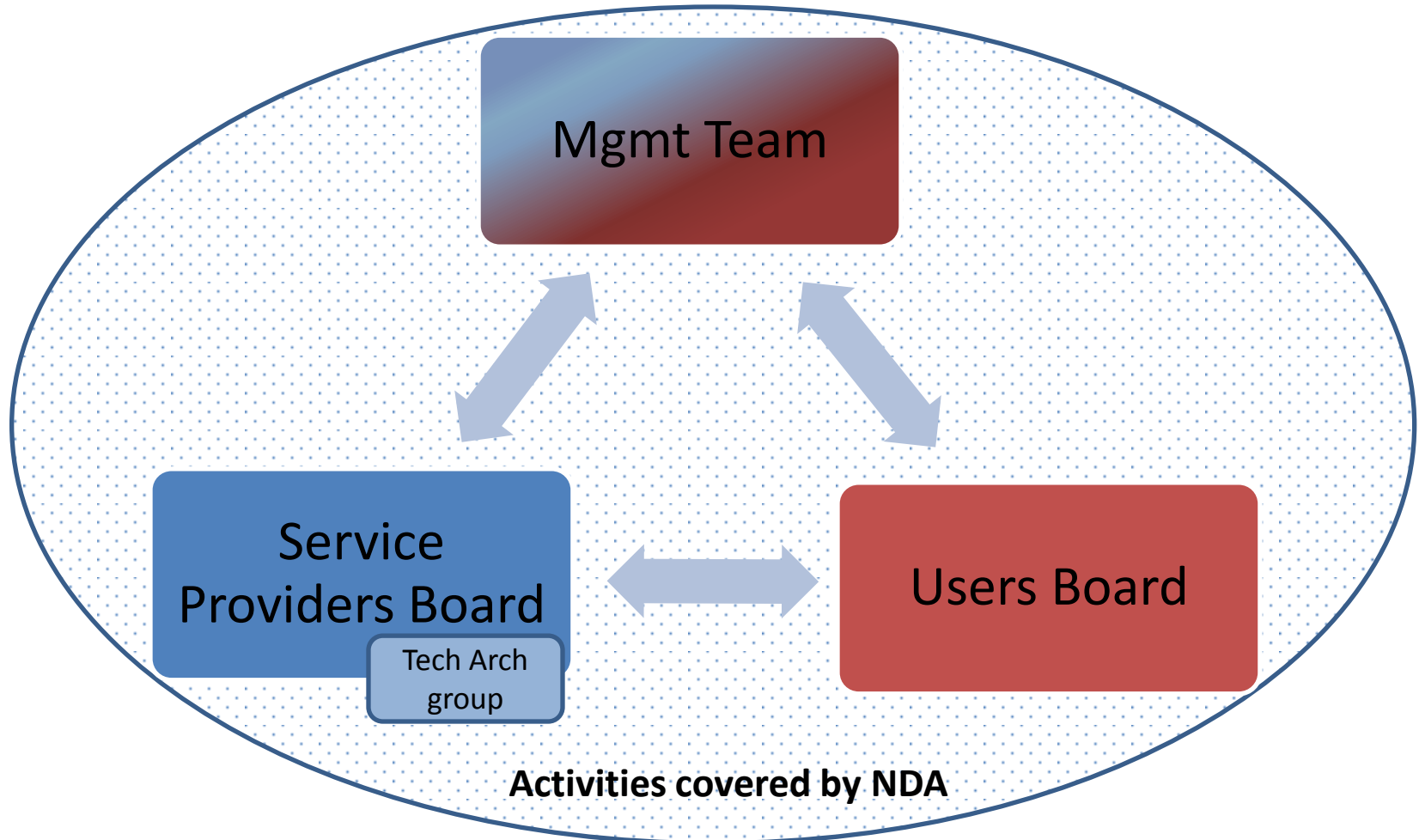
Bringing together all the stakeholders to establish a **public-private partnership**



# Timeline



# Governance Model during Proof of Concept in the Pilot Phase



# Consortium membership



- Consortium includes all participating supply-side and demand-side companies/organisations
  - Member status and adopter status
  - All sign a non-disclosure agreement
  - “interested parties” can also register
- Procedure to become a new member is on Helix-Nebula website <http://www.helix-nebula.eu/>

# Become a new member !

as:

Users



**Users:** An organisation that applies to become a user member should be a science or space organisation and commit to provide at least one flagship use case for cloud computing that can be verified and validated through a Proof of Concept with multiple service providers. Users will name a representative to participate in regular meetings of the Helix Nebula Users Board.

Service  
Providers



**Service Providers:** An organisation that applies to become a service provider member should commit to support a minimum set of cloud computing services and perform at least one Proof of Concept of a flagship use case with a user. Service Providers can apply to one or more of the following categories: Connectivity Provider, Infrastructure-as-a-Service Provider (IaaS), Platform-as-a-Service Provider (PaaS), Software-as-a-Service Provider (SaaS), Integrator, Consultant or Broker. Service Providers will name a representative to participate in regular meetings of the Helix Nebula Service Providers Board.

Adopters



**Adopters:** An organisation may apply to become an adopter, if they initially do not want to be directly involved in the flagship use cases but wish to make use of the Helix Nebula's products and services on a pay-per-use basis and be able to provide feedback. Adopters may be invited to Boards (either Service Providers or Users) meetings for information purposes. Adopters will name a representative to be informed or invited by the Helix Nebula Consortium on a regular basis.

Interested  
Parties



**Interested Parties:** An organisation may apply to become an Interested Party, if they initially do not want to be directly involved in the flagship use cases but wish to be kept informed of the work of or use information provided by the Consortium.

**For all types of members a formal acceptance procedure will apply** (specified hereafter), to be implemented by the Helix Nebula Management Team following the receipt of the membership request. **Membership application implies acceptance of the vision of Helix Nebula** as outlined in the strategic plan [Strategic Plan for a Scientific Cloud Computing infrastructure for Europe, CERN-OPEN-2011-036, August 2011](#), and **willingness to collaborate with the other partners** in order to achieve the vision. All decisions must be adopted by consensus of both the user organisations and service provider companies. In case of lack of consensus, decision will be taken by a qualified majority of all members of the two Boards, which must include the positive vote of the public user organisations.

**All users and service providers applying to become a member of the Helix Nebula Consortium (except as an Interested Party) agree to sign a multi-lateral NDA prior to becoming an active member.**

For more details and updates about how to join, write to us at [contact@helix-nebula.eu](mailto:contact@helix-nebula.eu)

## Become a new member



Over the next two years the Helix Nebula Consortium is expected to involve an increasing number of members.

The potential members are likely to be stemming from the categories below:

Become a new member

Contact us

Disclaimer

Privacy Policy

Cookie Disclosure

Site map

Become a new member

Events



**Helix Nebula @ DCI Workshop, 18 September 2012, Prague**  
Bob Jones (CERN) and Michael Symonds (Atos) will participate to the DCI Workshop "Distributed Computing Infrastructures for e-Science: Future Perspectives".

[More](#)

Participants



# ESA's experience with Helix Nebula in Earth Science

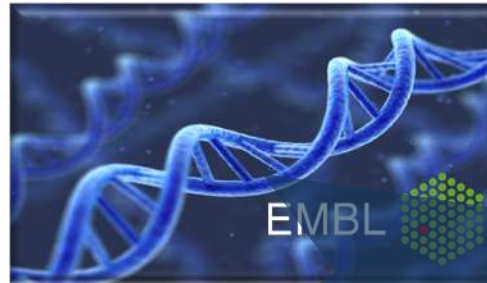
# Initial Flagship Use Cases

## ATLAS High Energy Physics Cloud Use



To support the computing capacity needs for the ATLAS experiment

## Genomic Assembly in the Cloud



A new service to simplify large scale genome analysis; for a deeper insight into evolution and biodiversity

## SuperSites Exploitation Platform



To create an Earth Observation platform, focusing on earthquake and volcano research

## Call for proposals

- Template agreed by demand and supply side
- Eligibility review and analysis with cloud service suppliers

# Why the Cloud?



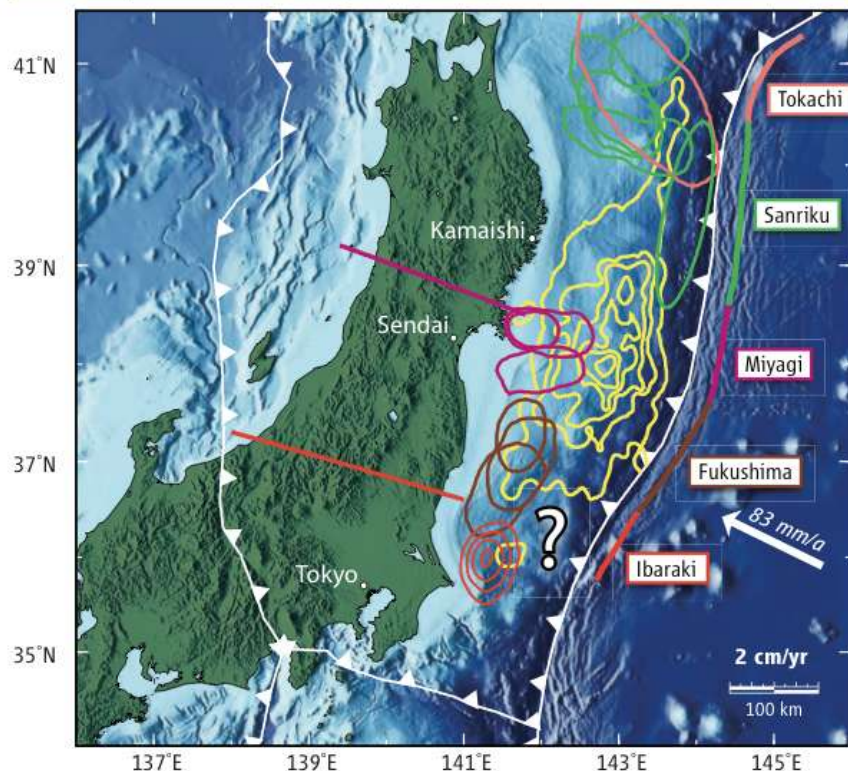
**Data deluge**

**Many users**



# Geo Hazard : Japan earthquake

## EARTHQUAKES OF THE JAPAN TRENCH



A game of ring toss. March's huge quake (yellow contours) and past smaller quakes (colored loops) have left a patch of threatening fault (question mark).

- Tohoku-oki: unprecedented >50 m slip in places (Simons et al., Science 2011, NASA-funded study).
- Will another magnitude 9 occur further south?
- It is unknown whether this fault segment has been accumulating slip.
- Need all InSAR, GPS, Seismic, Petrology, Geochemistry, ... !

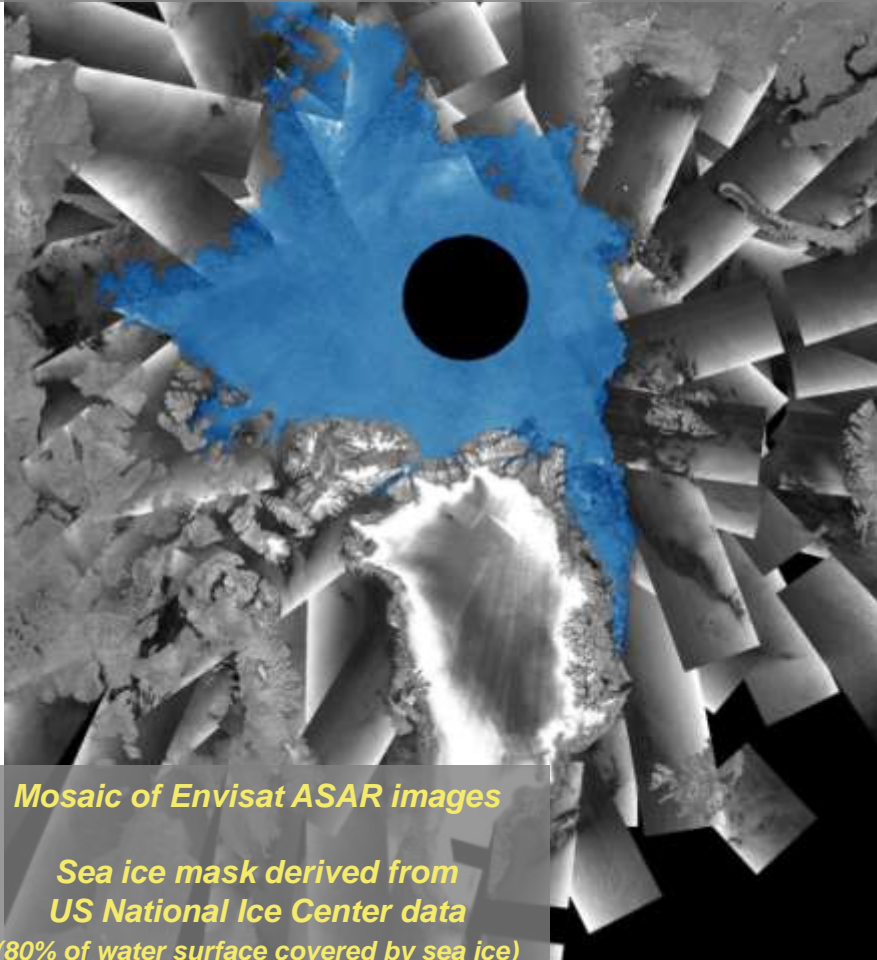
(-2004 magnitude 9.2 Sumatra earthquake was followed by magnitude 8.7 half-a-year later)

→ The Science Cloud with its “unlimited” resources on data, processing capacity and tools will allow cross-domain science and ease data sharing. The easy usage of this infrastructure will pull “intelligence” to apprehend the challenges.

# Climate Change : Arctic Sea Ice Extent

## Record Minimum in September 2012

*Sea ice extent as observed by Envisat imaging radar sensor*



Sea ice extent fell to 3.41 million square kilometers, now the lowest summer minimum extent in the satellite record

**An entire intricate ecosystem of wildlife and plant life will be profoundly affected by a prolonged warming trend in the Arctic**

► **Risk of “trophic cascade”**  
Need biological, oceanographic, atmospheric data as well as computer modelling to apprehend GLOBAL change

# SuperSites Exploitation Platform (SSEP) - Approach



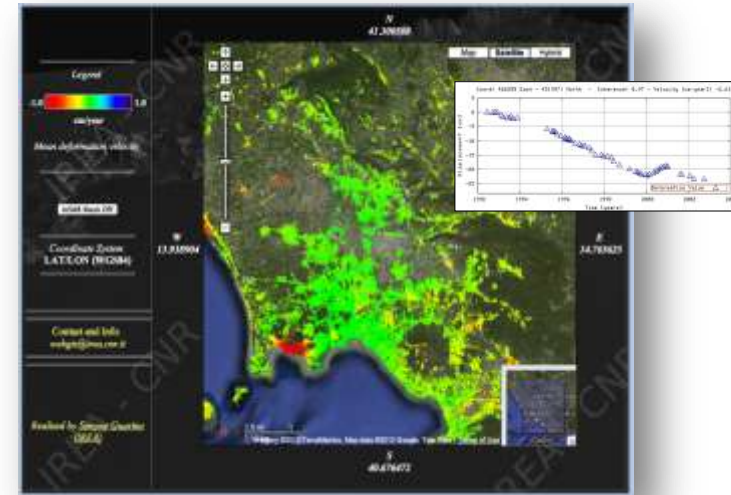
1. SSEP is vested as an Helix Nebula “flagship”; along sites other flagship at CERN and EMBL.
2. CNES, DLR and CNR agreed to participate to Helix Nebula. The CNR/IREA (Italian Research Council) as a none-space agency contributes with their Radar processor adapted for the cloud.
3. Helix Nebula Prove of Concept – Suppliers participants:
  1. ATOS
  2. CloudSigma
  3. Interoute
  4. T-Systems

# SSEP Expected Results

1. Science: better scientific understanding of geohazards with the aim of providing sound information about the risks and the potential mitigation measures
2. Data sharing: information extracted from different sources (satellite & in-situ) will open a wide range of new approaches: Cross-domain research
3. Building Communities : In return to SSEP access, scientists will be asked either:
  - to provide results into the information repository on the Science Cloud,
  - to provide their data processing open source code,
  - to provide application tools (“Apps”)

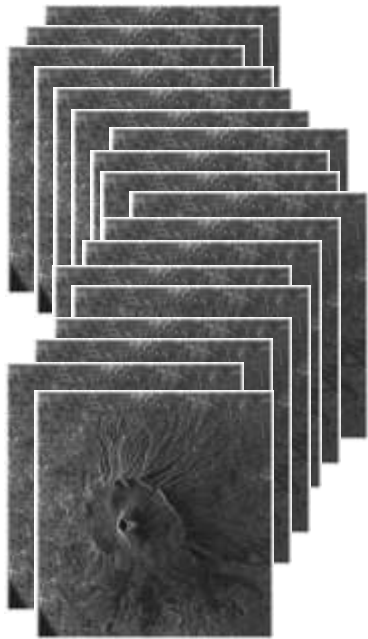
# Earth Observation Application Platform exploiting 20 years of satellite data

- EO Application Platform
  - OpenNebula
  - Data Catalogue and Access
  - Map-Reduce computing model
  - Software repository
  - Utilities for sw development and testing
- Cloudification of application
  - CNR / IREA (Italian Research Council in Naples) developed an application (SBAS) measuring the vertical movement of ground in sub cm from space.
  - **SBAS** targets
    - Time series over **20 years** with ESA archive
    - Points of Interest are at **world scale**
    - **TBytes** of data to process



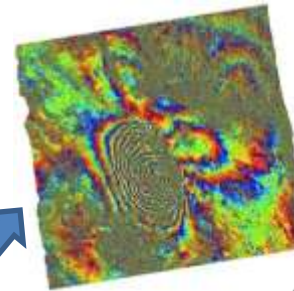


# CNR SBAS Processing

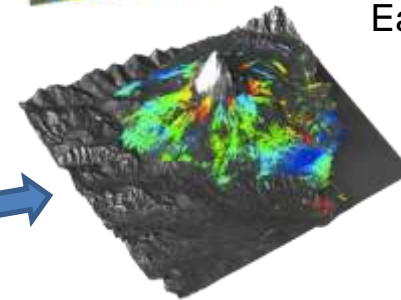


~150 Satellite  
images:  
**1.5TB**

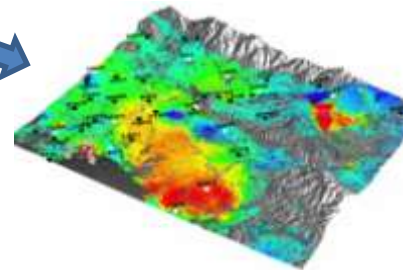
Time  
Processing:  
**150h**



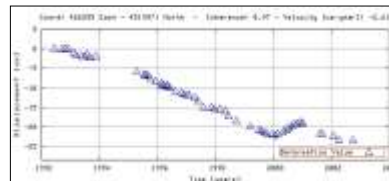
Earthquakes



Volcanoes



Oil & Gas

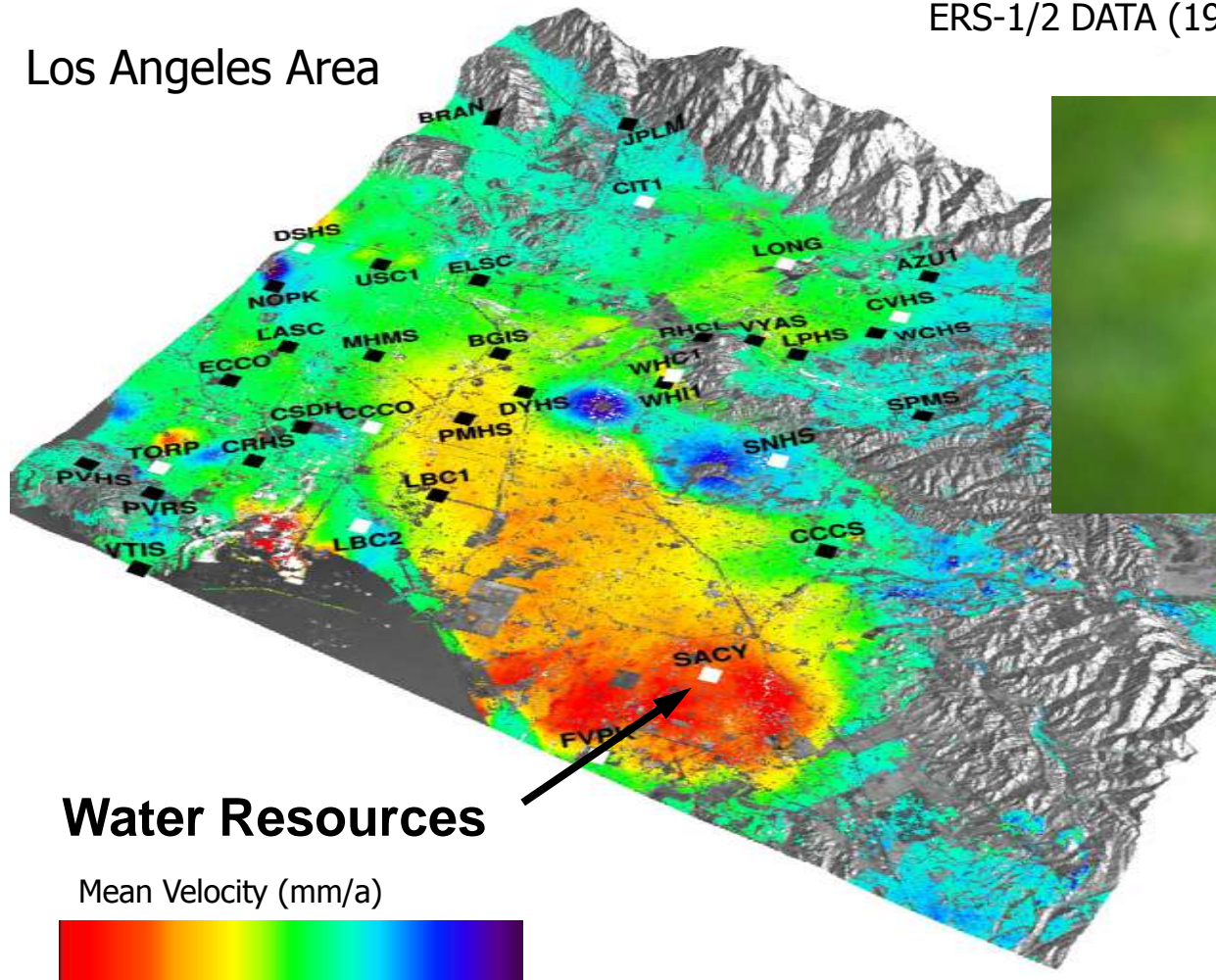


Water  
Resources

# Opportunity: Natural Resources

ERS-1/2 DATA (1995-2002)

Los Angeles Area



**Water Resources**

Mean Velocity (mm/a)



< -10      0      > 10

Maryline Lengert, ESA



**Agriculture**

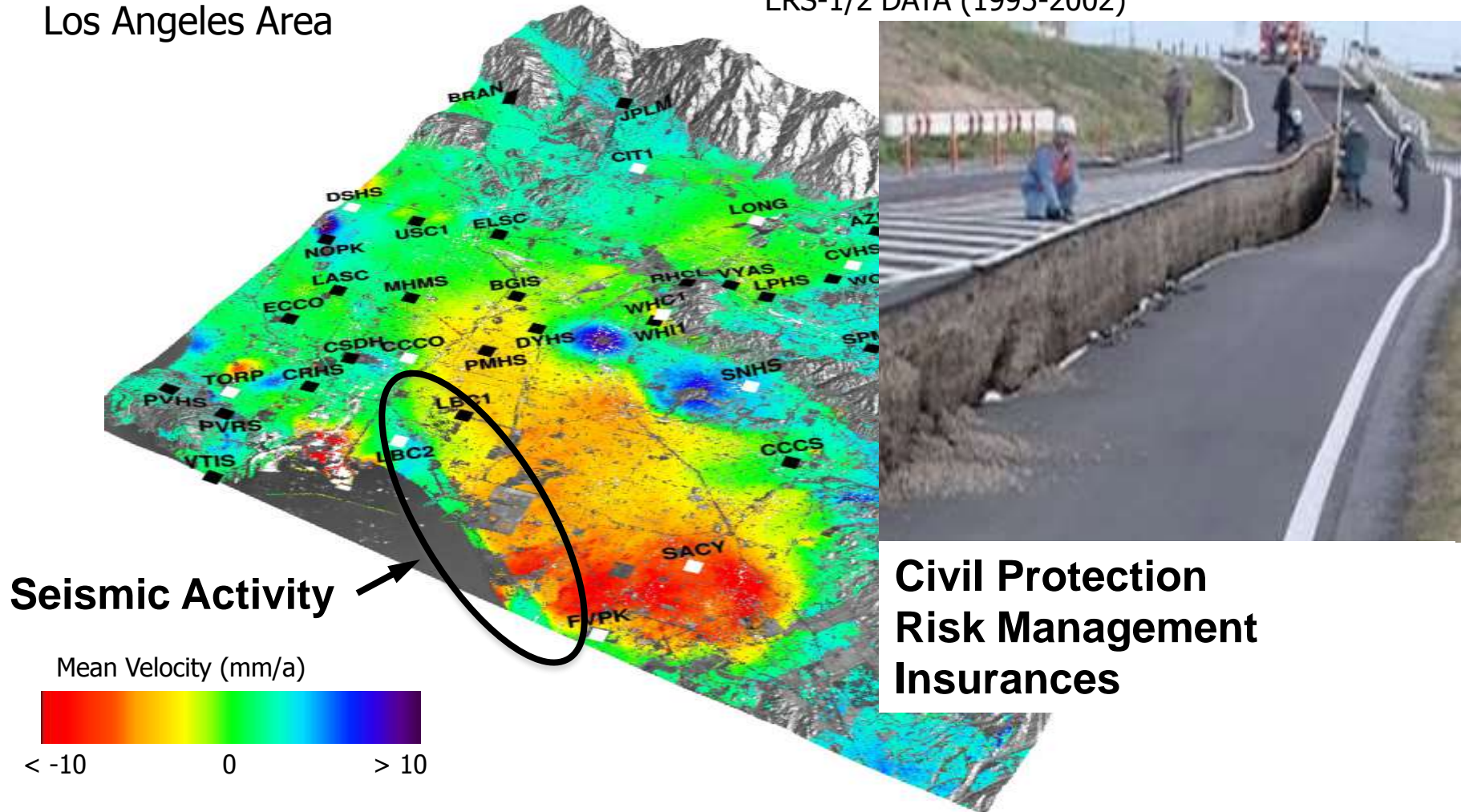
**Sustainable and  
social development**



# Opportunity: Natural Hazards

ERS-1/2 DATA (1995-2002)

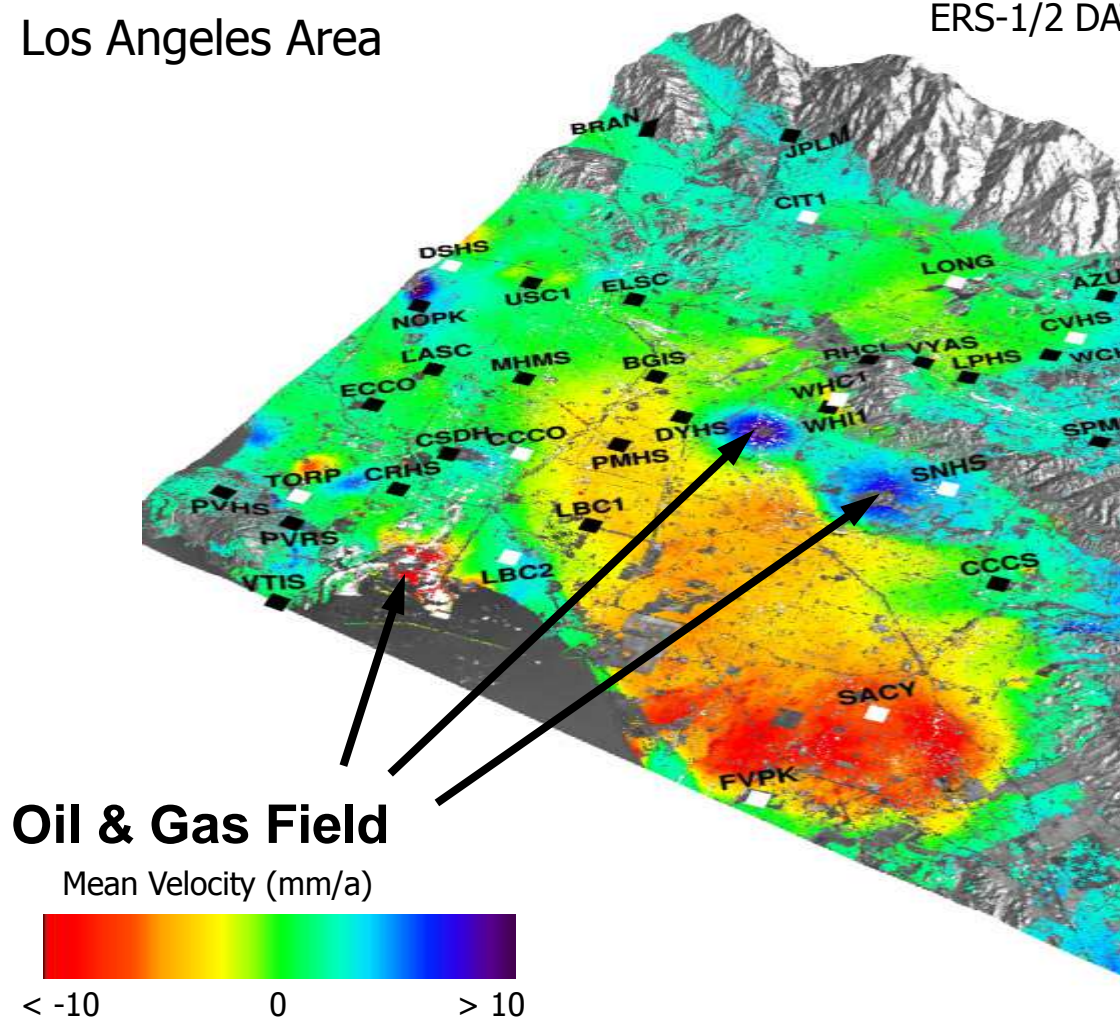
Los Angeles Area



# Opportunity: Energy Resources

Los Angeles Area

ERS-1/2 DATA (1995-2002)



Maryline Lengert, ESA



Franco-British Workshop on Big Data in Science  
6-7 Nov 2012

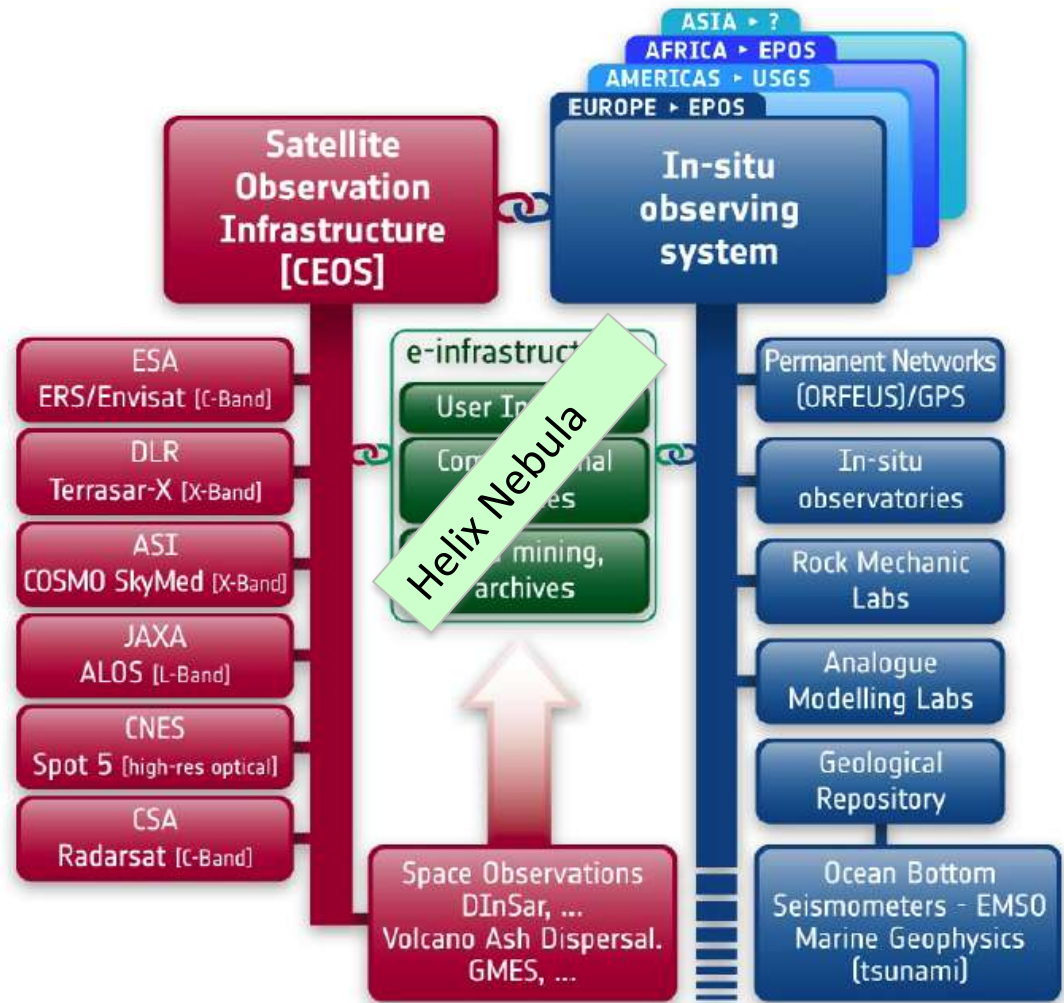


# Super Site Exploitation Platform

different actors, different environment helping to understand the Geophysics of Earthquakes and Volcanoes



The Geohazard Supersites partnership pool and coordinate the existing space-based and ground-based observation resources of GEO members to mitigate and to improve the preparedness for geologic disasters



# Supersite Exploitation Platform: potential actors benefits

## EO data provider benefits:

- Enlarge EO data exploitation (space agencies)
- Increase EO data sales (commercial distributors), in particular EO data archives

## End-user benefits:

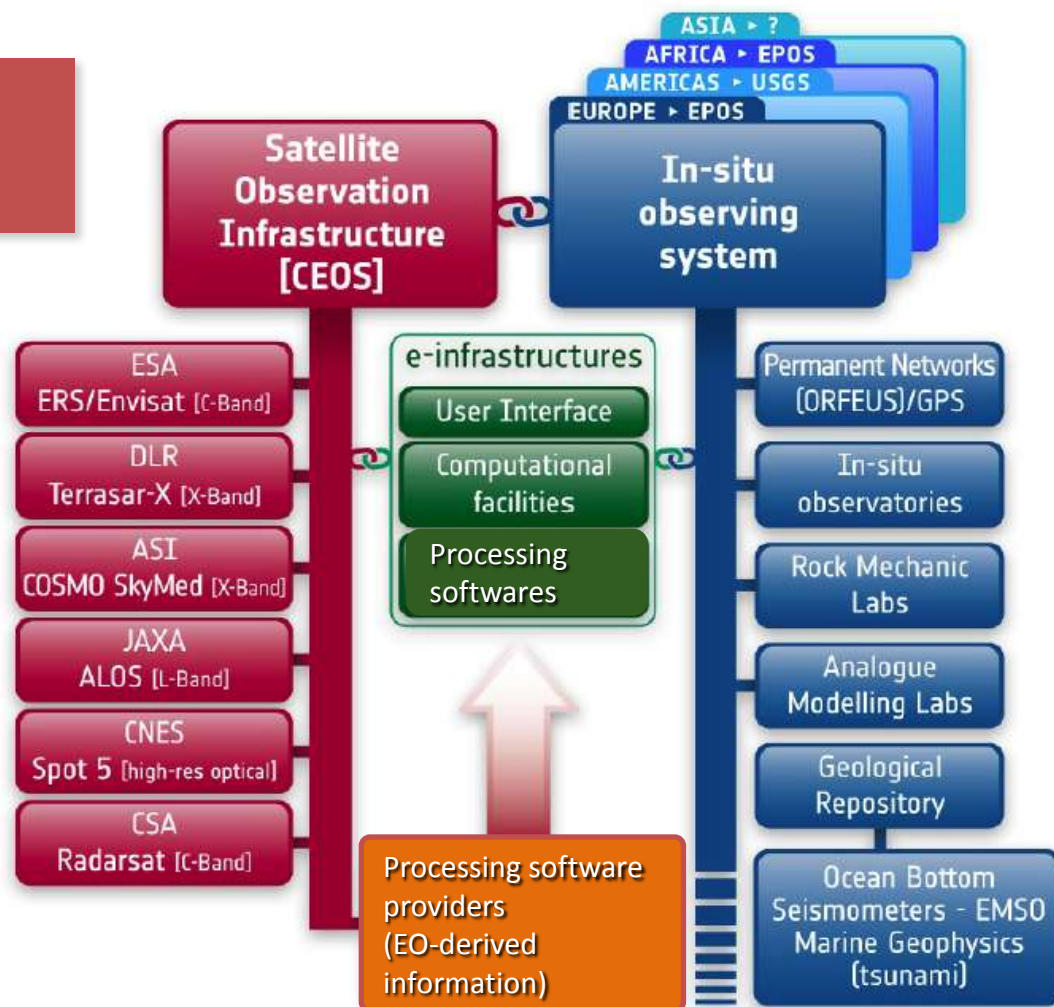
- More data, either free or at low cost
- Processing capabilities free or at low cost
- Processing softwares free or at low cost
- Forum for discussing/exchanging results  
→ More science

## Processing software provider benefits:

- Low investment
- Increase sales
- Increase software visibility

## IT companies (computational facilities) benefits:

- New business
- Access to a global user community
- Contribution to science



# Example of R&D feedbacks between ESA and EO services industry

- Jun 2003 : **Renewable Energy Industry** (33 companies).
- Oct 2007 : **EO services Industry** (100 companies)
- Sep 2009 : **Insurance** (15 companies).
- May 2008 + 2010 : **World Bank Group**.
- Oct 2009 : **SwissRe** (Flood Risk)
- Jul 2010 : **1<sup>st</sup> Global Business Biodiversity symposium**.
- Sep 2010 : **Oil & Gas** (104 participants).



# Flagship deployments

## First overall results - 1

- Proof of Concept stage within the Pilot Phase started January 2012
- Each flagship has been deployed with a series of providers independently :

CERN, EMBL and ESA succeeded in deploying scientific applications each involving tens of thousands of jobs running at data centres operated by Atos, CloudSigma and T-Systems

# Flagship deployments

## First overall results - 2



- **CERN** was able to run simulations previously executed on the Worldwide LHC Computing Grid by quickly deploying ATLAS experiment flagship application on the Cloud.
- **EMBL** successfully deployed and tested their novel software pipeline for large-scale genomic analysis using real world large genomic data sets.
- **ESA** successfully tested large-scale data processing and dissemination for its radar satellites using different cloud provider infrastructure.



# Flagship deployments

## First overall results - 3

- The PoC extensively evaluated **scalability**, **performance** and **on-demand provisioning of resources** for high performance computing and **fast data storage** in the cloud computing resources provided by **Atos**, **CloudSigma** and **T-Systems**
- In addition to the infrastructure providers, SME's such as **SixSq**, **Terradue** and **The Server Labs** were vital to get the flagship applications up and running.

## What's up now ?

The Helix Nebula consortium is now focussing on identifying a **common set of interfaces** for suppliers and users before the next wave of deployments, building on the lessons learned from the PoC.

## What's next ?

- Process for new Suppliers / new Users to join is starting:
  - New comers can either submit flagships that propose some **innovation** in terms of functionality, performance, scope, business opportunities or impact of the European Cloud Computing infrastructure, or use the HN platform as is.
  - The flagship use cases must be **sponsored by user organisations** and **Service Providers**. Will be selected so as to be complementary and maximise coverage of the objectives outlined in the Strategic Plan



**Templates will be provided**

# A European Cloud Computing Partnership big science teams up with big business



**Helix Nebula THE SCIENCE CLOUD**

**Strategic Plan**

- ▶ Establish multi-tenant, multi-provider cloud infrastructure
- ▶ Identify and adopt policies for trust, security and privacy
- ▶ Create governance structure
- ▶ Define funding schemes

**CERN**  
To support the computing capacity needs for the ATLAS experiment

**EMBL**  
Setting up a new service to simplify analysis of large genomes, for a deeper insight into evolution and biodiversity

**esa**  
To create an Earth Observation platform, focusing on earthquake and volcano research

**Partners:** Atos, Capgemini, CloudSigma, CSA cloud security alliance, egi, interoute, logica, OpenNebula.org, orange Business Services, SAP, the SERVER LABS, sixsq, Telefonica, terradue 20, THALES, Trust IT, T-Systems.

Email: [contact@helix-nebula.eu](mailto:contact@helix-nebula.eu) Twitter: [HelixNebulaSC](https://twitter.com/HelixNebulaSC) Website: <http://www.helix-nebula.eu/>

Big science teams up with big business

Enter Search 



Newsletter [Click here to subscribe to the Helix Nebula Newsletter](#)

Social    

## Highlights

### Helix Nebula on ISGTW

**isgtw** international science grid this week

ISC Cloud'12 Keynote Session to Investigate Helix Nebula, Europe's Science Cloud - Article by Anna Schachoff, ISGTW, August 17th 2012

[More](#)

### Helix Nebula on HPC Wire

**HPC** wire

Helix Nebula Cloud Targets European Scientific Research - Article by Robert Gelber, HPC Wire, July 10th 2012

[More](#)

[Become a new member](#)

## Events

**Helix Nebula @ DCI Workshop, 18 September 2012, Prague**  
Bob Jones (CERN) and Michael Symonds (Atos) will participate to the DCI Workshop "Distributed Computing Infrastructures for e-Science: Future Perspectives".

[More](#)

## Cloud Computing & The 'New' DG CONNECT



## Helix Nebula HelixNebulaSC

HelixNebulaSC CERN, EMBL and ESA will present HelixNebula, the Science Cloud at ISC Cloud'12 in Mannheim, Germany on September... [fb.me/1hxpWqkSp](https://www.facebook.com/1hxpWqkSp)  
2 days ago · reply · retweet · favorite

HelixNebulaSC Big data analysis in the cloud: Storage, network and server challenges... [fb.me/1qrYGLOO](https://www.facebook.com/1qrYGLOO)  
41 days ago · reply · retweet · favorite

HelixNebulaSC [ibm.com/developerworks](http://ibm.com/developerworks).... [fb.me/1DetHp99X](https://www.facebook.com/1DetHp99X)  
54 days ago · reply · retweet · favorite

HelixNebulaSC Helix Nebula Cloud Targets European Scientific Research Robert Gelber July 10, 2012 The scientific community is... [fb.me/1WuKkGBNz](https://www.facebook.com/1WuKkGBNz)  
56 days ago · reply · retweet · favorite

[Join the conversation](#)

## Participants

**Atos**

Stay tuned on :

<http://www.helix-nebula.eu/>