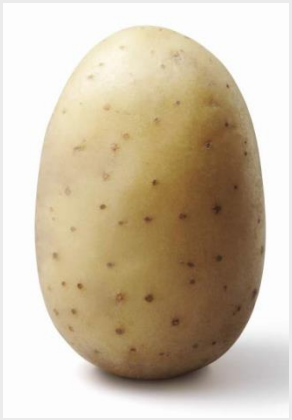
Join the Open EO Science (R)evolution ?

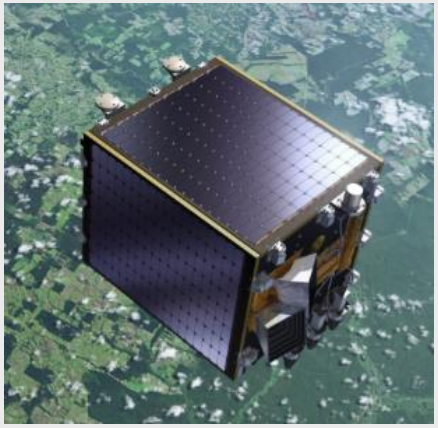
PP. Mathieu, J. Wagemann & many colleagues .. with many thanks to them!

ESA/ESRIN | pierre.philippe.mathieu@esa.int
BELSPO 50th Anniversary, Brussels, 17 September 2015 (v01)

Heat map showing the collaboration networks between researchers in different cities using the Scopus database (papers published between 2008 and 2012) Reference

The Last Three Decades … of MAGIC





Time

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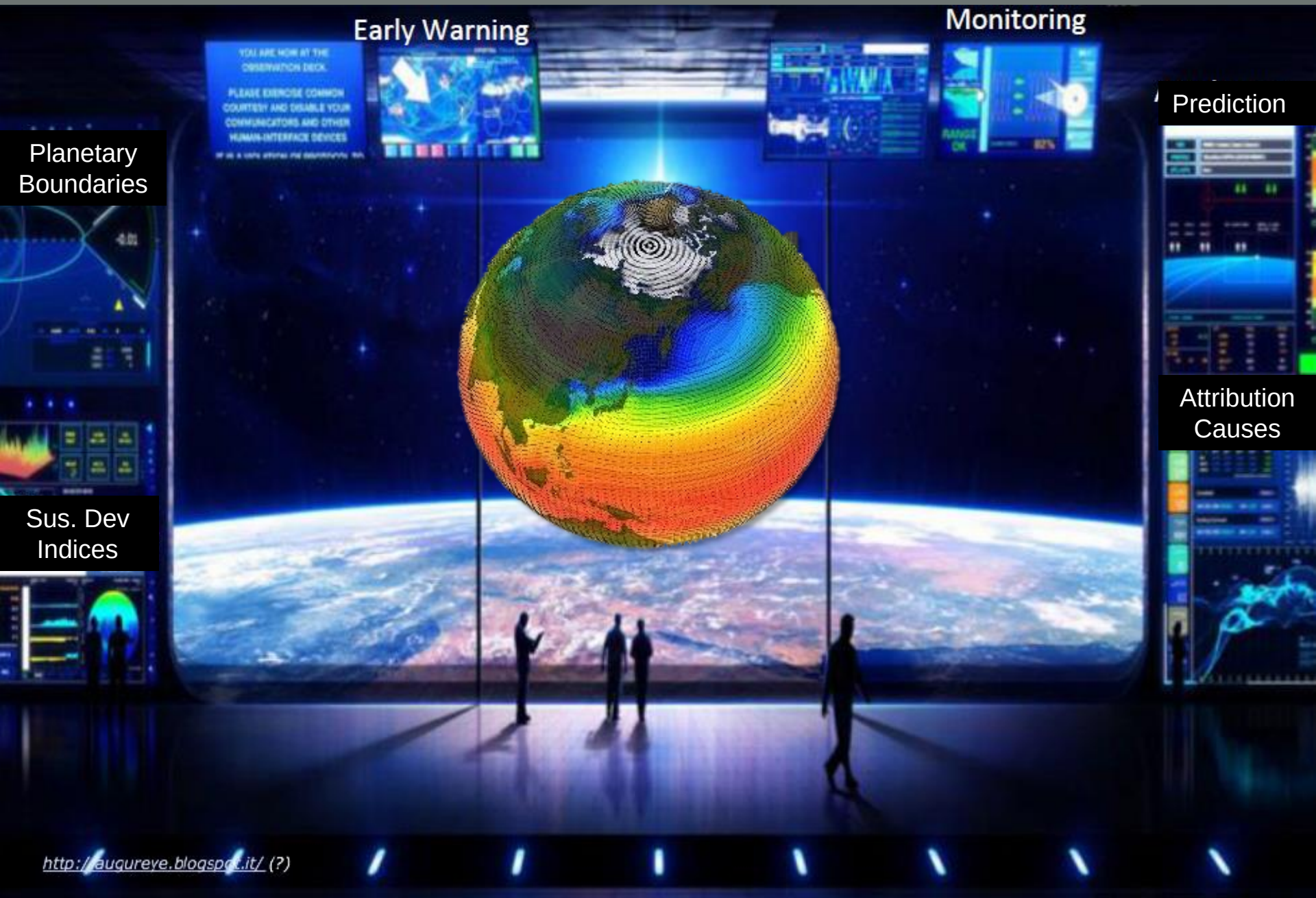
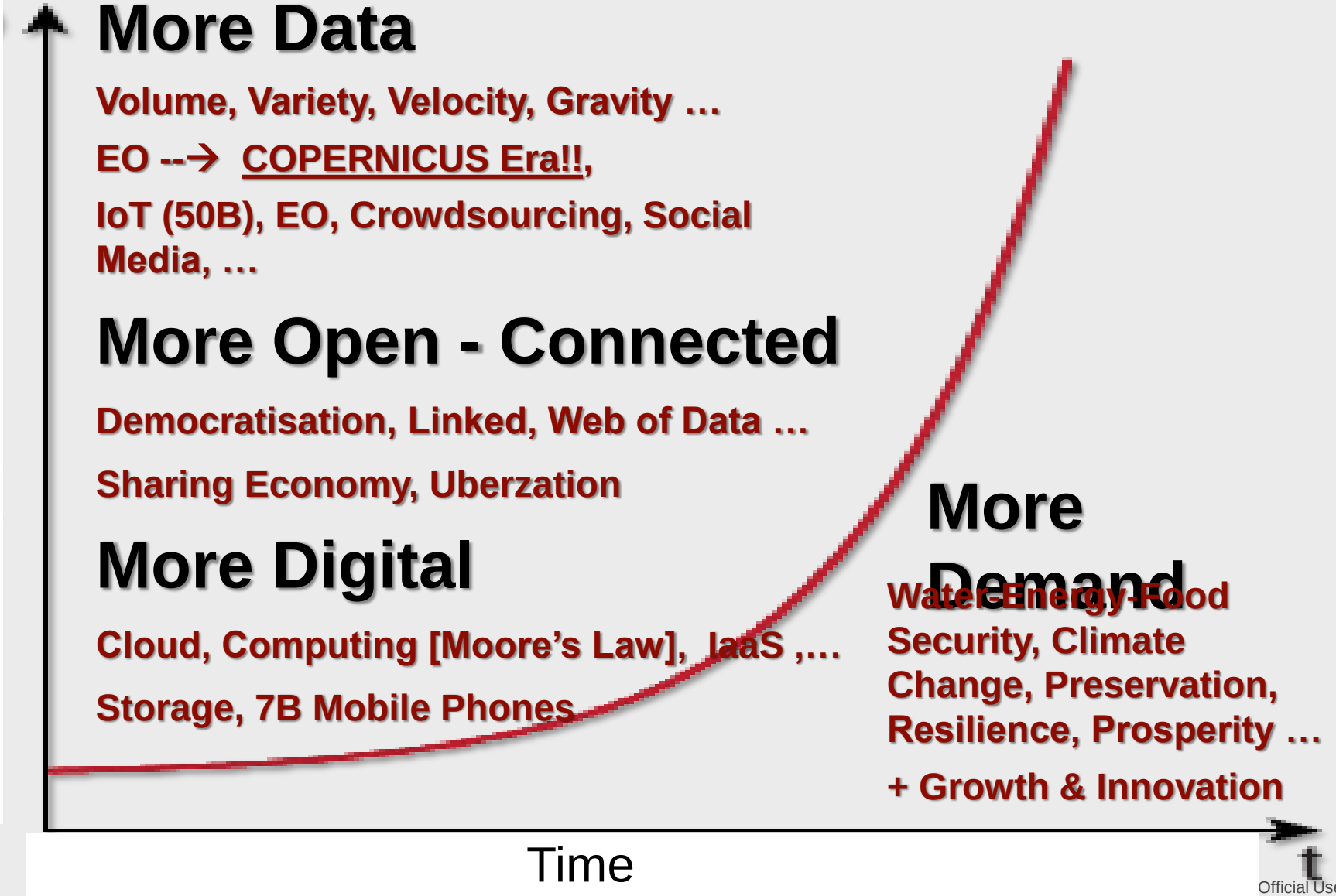
The next three decades ….

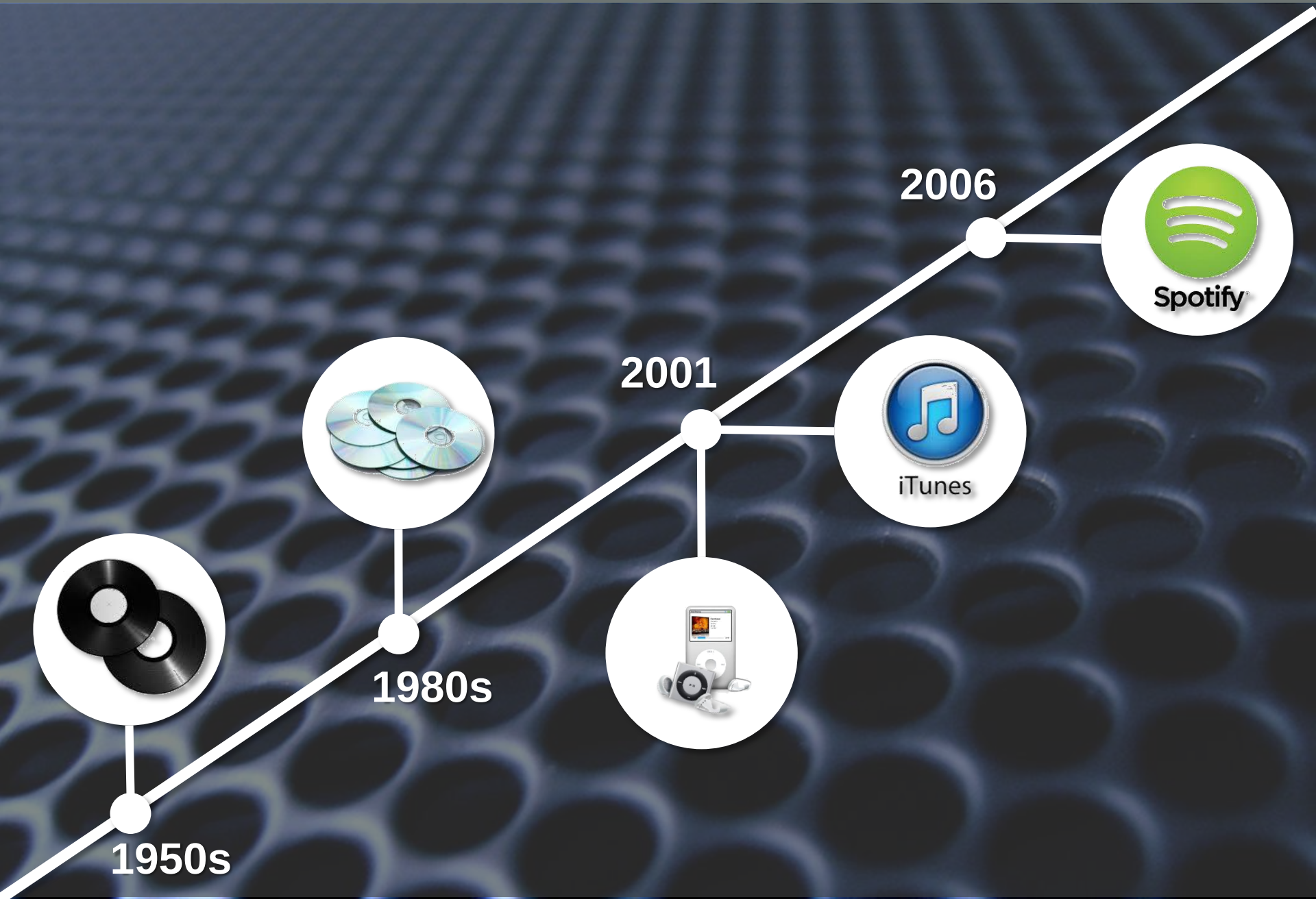


Triple Revolution = Great Acceleration + Convergence



Official Use

Disruption in the Music Industry



Global Partnership for Sustainable Development

Moving from Millenium Development Goals (MDGs) to Sustainable Development Goals (SD

A NEW GLOBAL PARTNERSHIP:
ERADICATE POVERTY AND TRANSFORM ECONOMIES THROUGH SUSTAINABLE DEVELOPMENT

The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda

May 2013

"We also call for a data revolution for sustainable development, with a new international initiative to improve the quality of statistics and information available to citizens. We should actively take advantage of new technology, crowd sourcing, and improved connectivity to empower people with information on the progress towards the targets. "

July 2014

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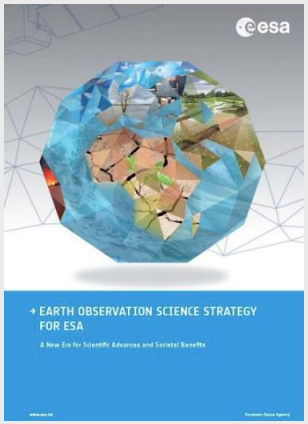
A new Era for EO Scientific Advances & Societal Benefits



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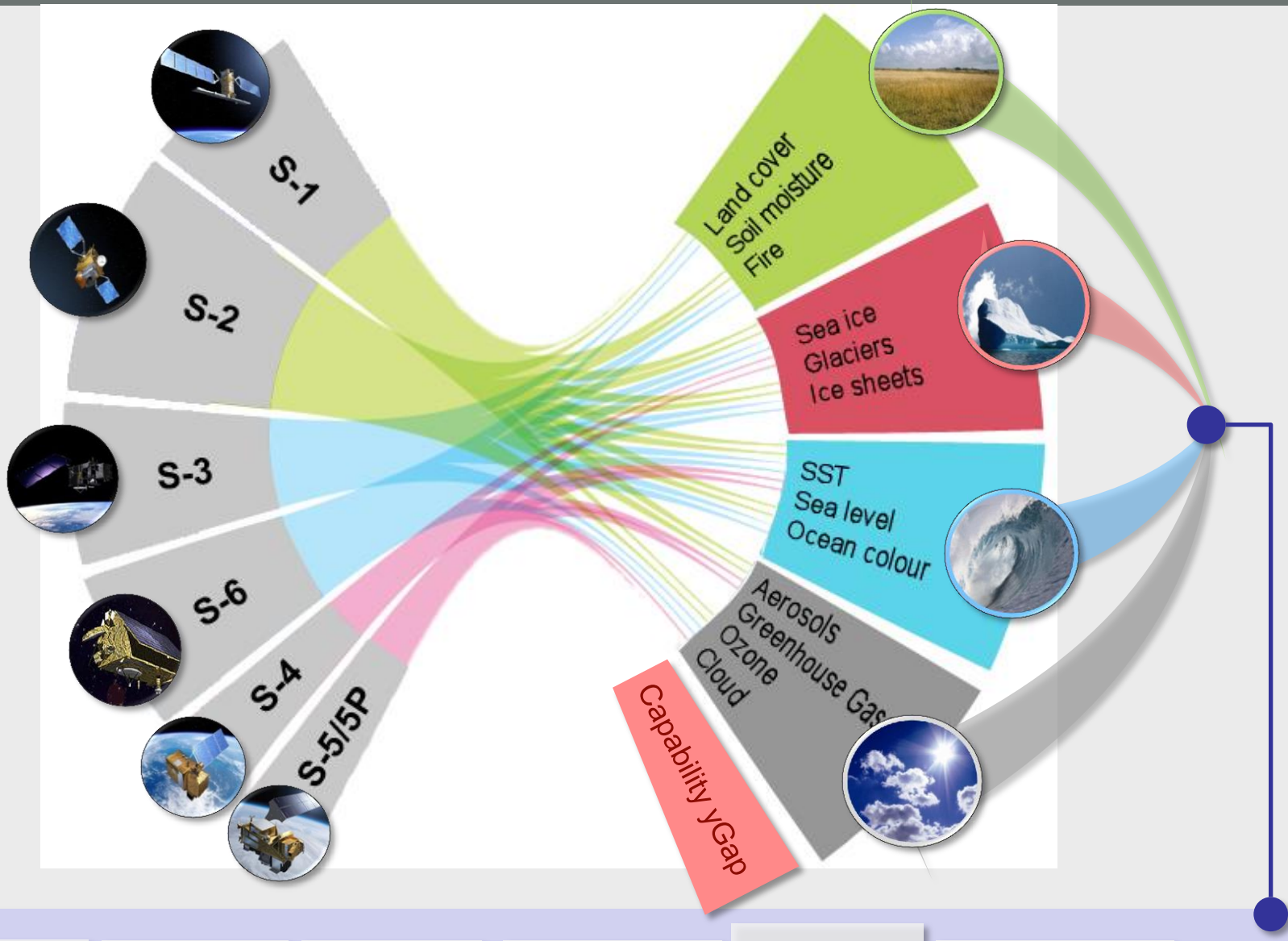
All Sentinels for Climate Services



Monitoring | Prediction | Projection | Re-analysis | Informing Decision | Understanding

S-2A first images – Pavia / Po Valley, Italy

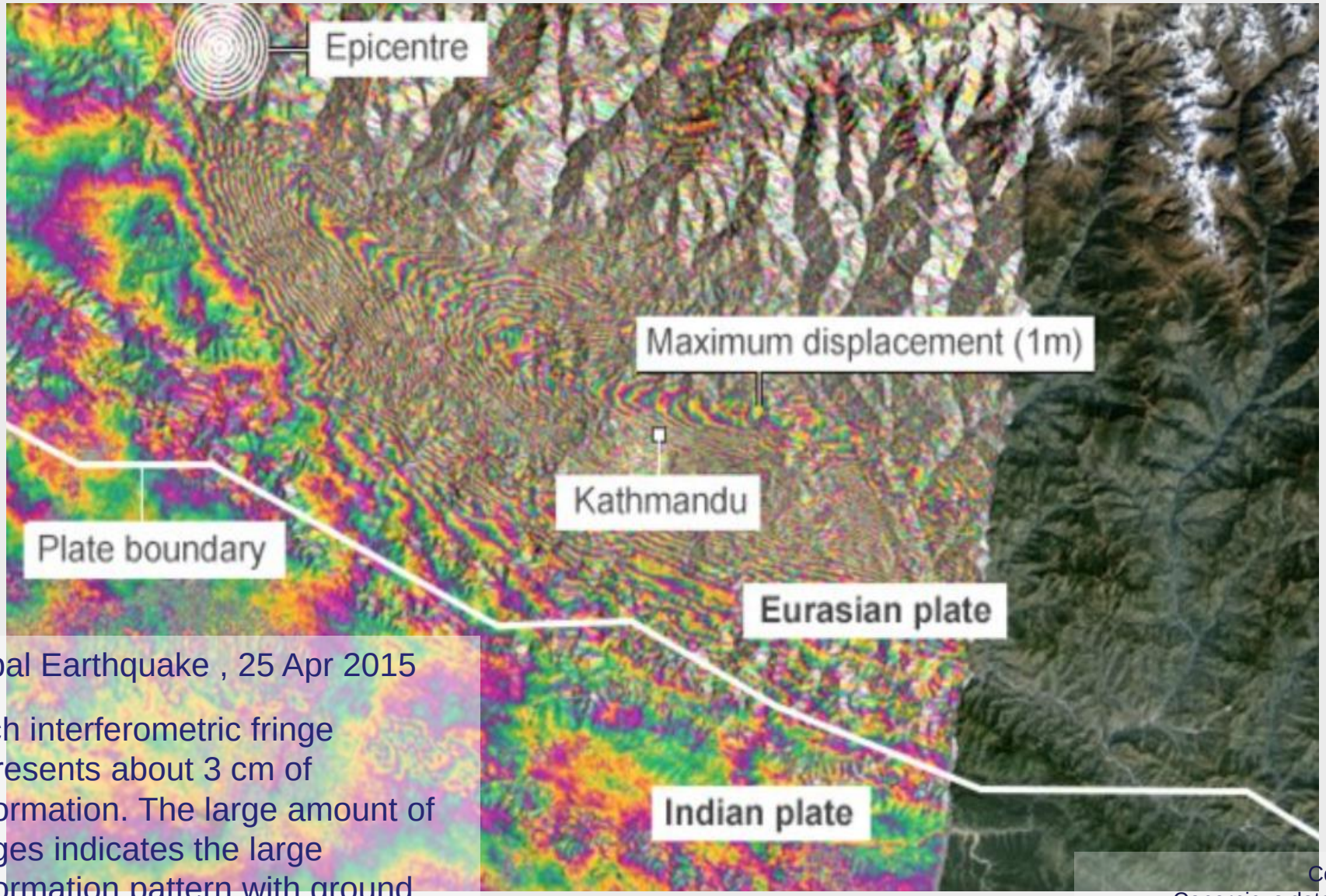
S2-A launched 23 June 2015,

- 13 Bands (VIR, NIR, SWIR, red edge),
- 290km swath,
- 10-20-60m resolution,
- 10d revisit.

Image of Pavia acquired on 27 June 2015 at 10:25 UTC,

Copyright: Copernicus data (2015) / ESA

Nepal Earthquake



Nepal Earthquake , 25 Apr 2015

Each interferometric fringe represents about 3 cm of deformation. The large amount of fringes indicates the large deformation pattern with ground motions of more than 1m.

Copyright:
Copernicus data (2015)/
ESA/Norut/PPO.labs/COMET-
ESA SEOM INSARAP study

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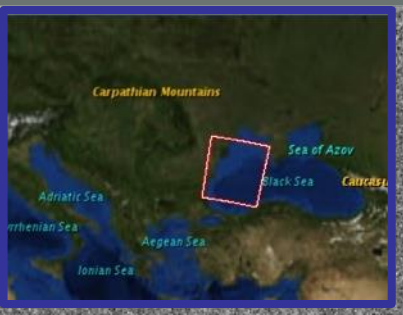
S-1 Oil Spill and Ship detection

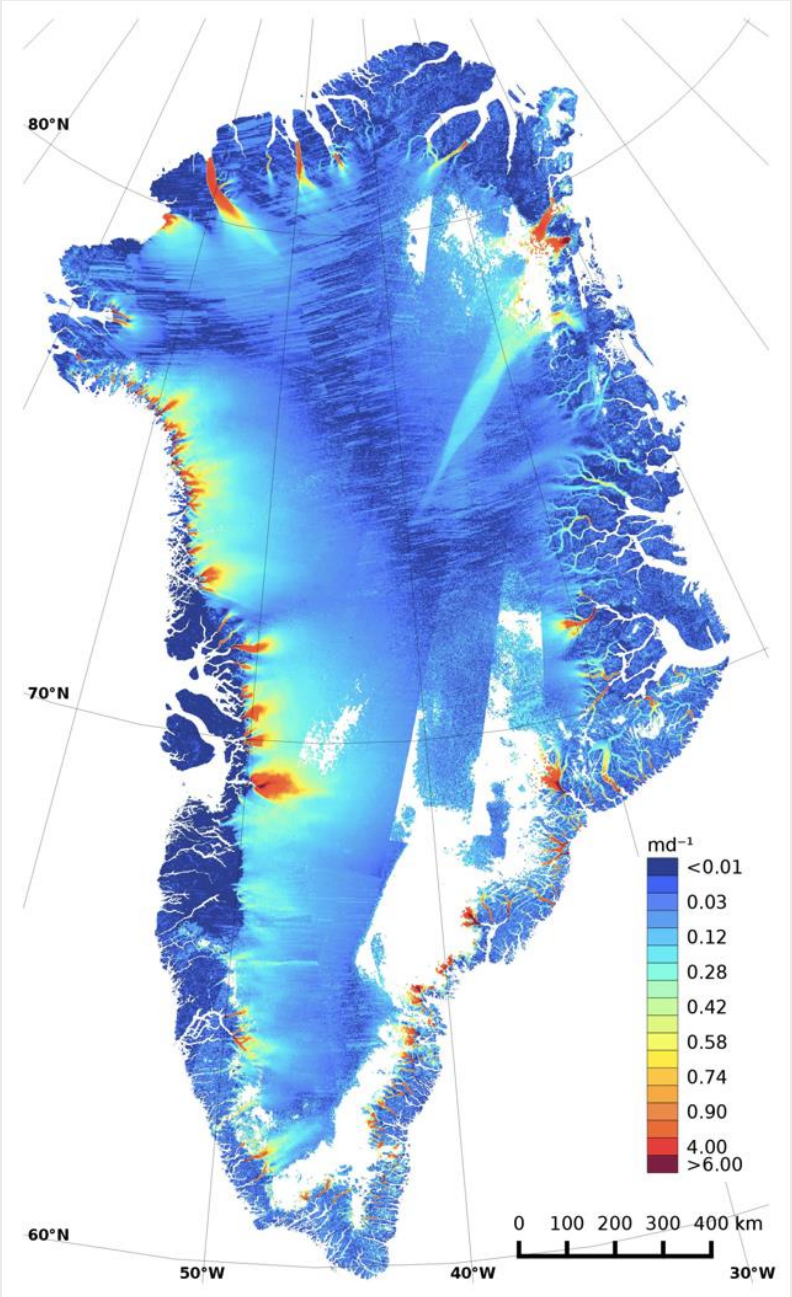


Sentinel-1A TOPS EW HH/HV
acquired on 25 April 2014

CleanSeaNet: the European satellite oil pollution and vessel detection monitoring system, operated by the European Maritime and Safety Agency (EMSA) of the European Commission

Sentinel-1A TOPS EW VV/VH
acquired on 19 April 2014

S-1 Greenland Ice Sheet Velocity



Based on SLC products from S-1 IWS mode

Period: Jan-Mar 2015 (some scenes from Oct-Dec 2014)

~ 800 scenes
~ 25 000 bursts
~ 2.7 TB of SLC data

Courtesy ENVEO IT Gmbh / ESA CCI Ice Sheets Project

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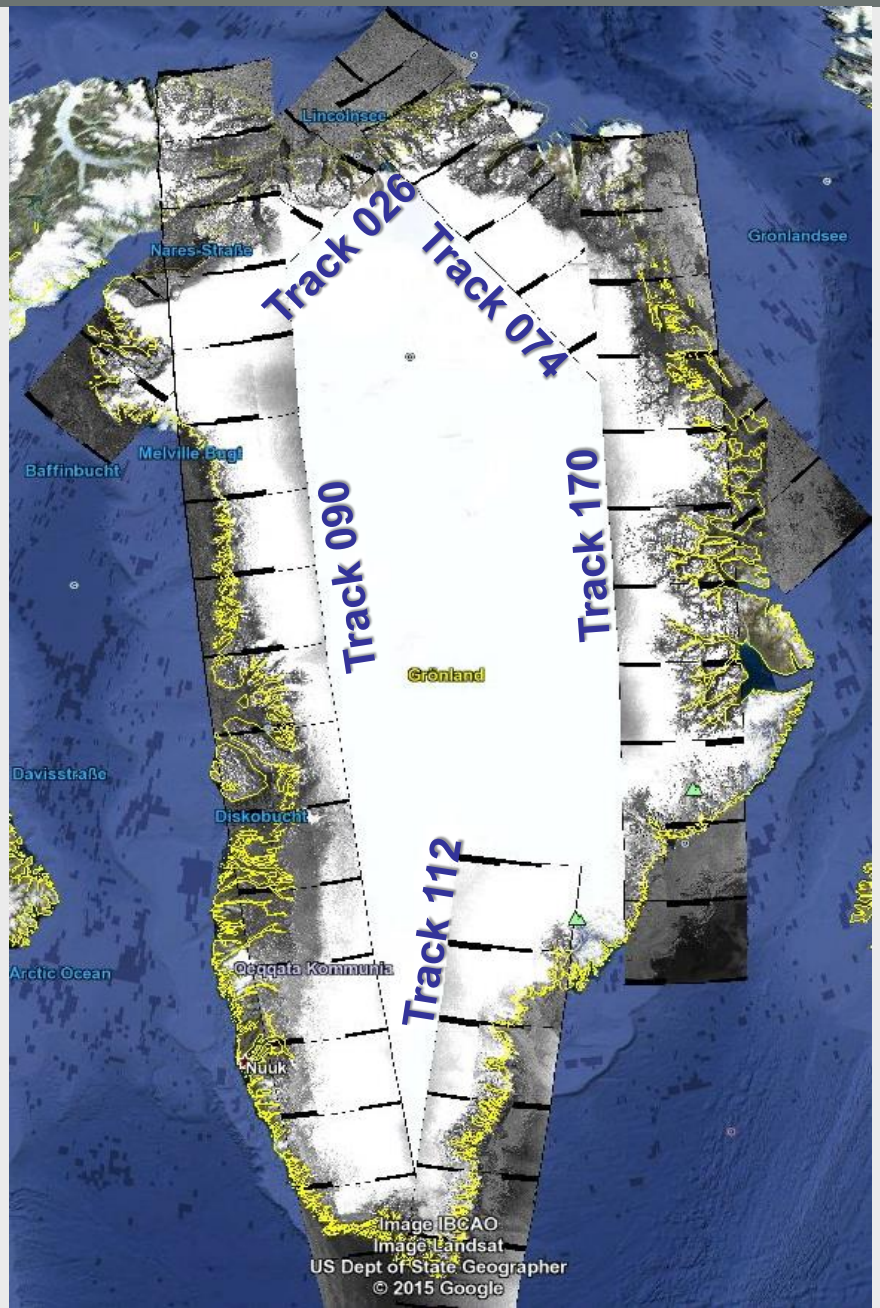
S-1 Ice Sheet Systematic Monitoring



Continuous Monitoring of Greenland margins

every Cycle → Overall ca 50 slices

+ Campaigns

→ Allows to monitor outlet glaciers with high observation frequency of 12 days

Courtesy ENVEO IT Gmbh / ESA CCI Ice Sheets Project

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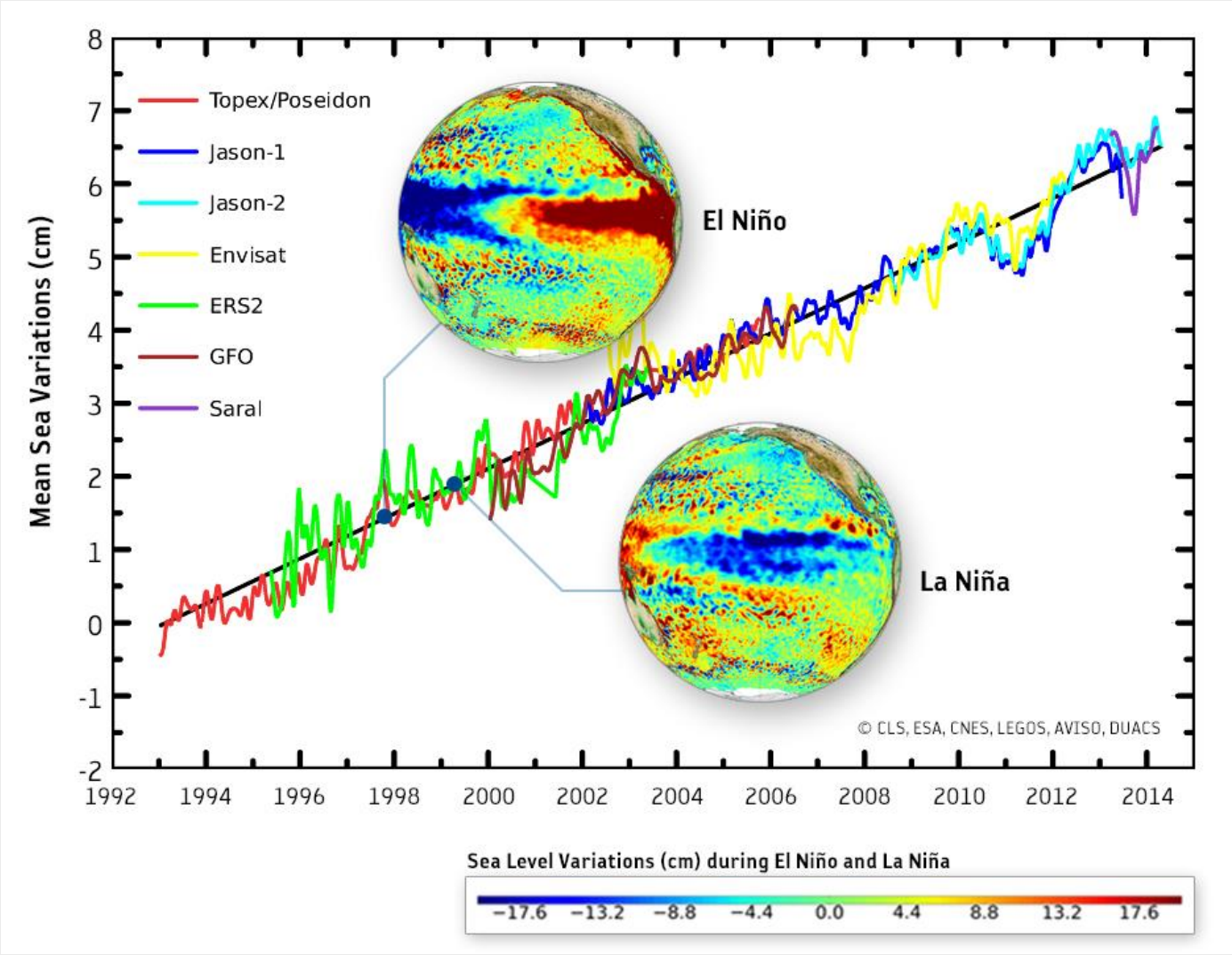
S-3 like Sea Level Rise



S-3 RA
S-6 Jason

Flood damage in the world's major coastal cities may top **$1 trillion** a year by **2050** due to rising seas and subsiding land, according to a World Bank study in Nature Climate Change. Hallegatte, S. et al: Future flood losses in major coastal cities. Nature Climate Change, 2013. doi:10.1038/nclimate1979

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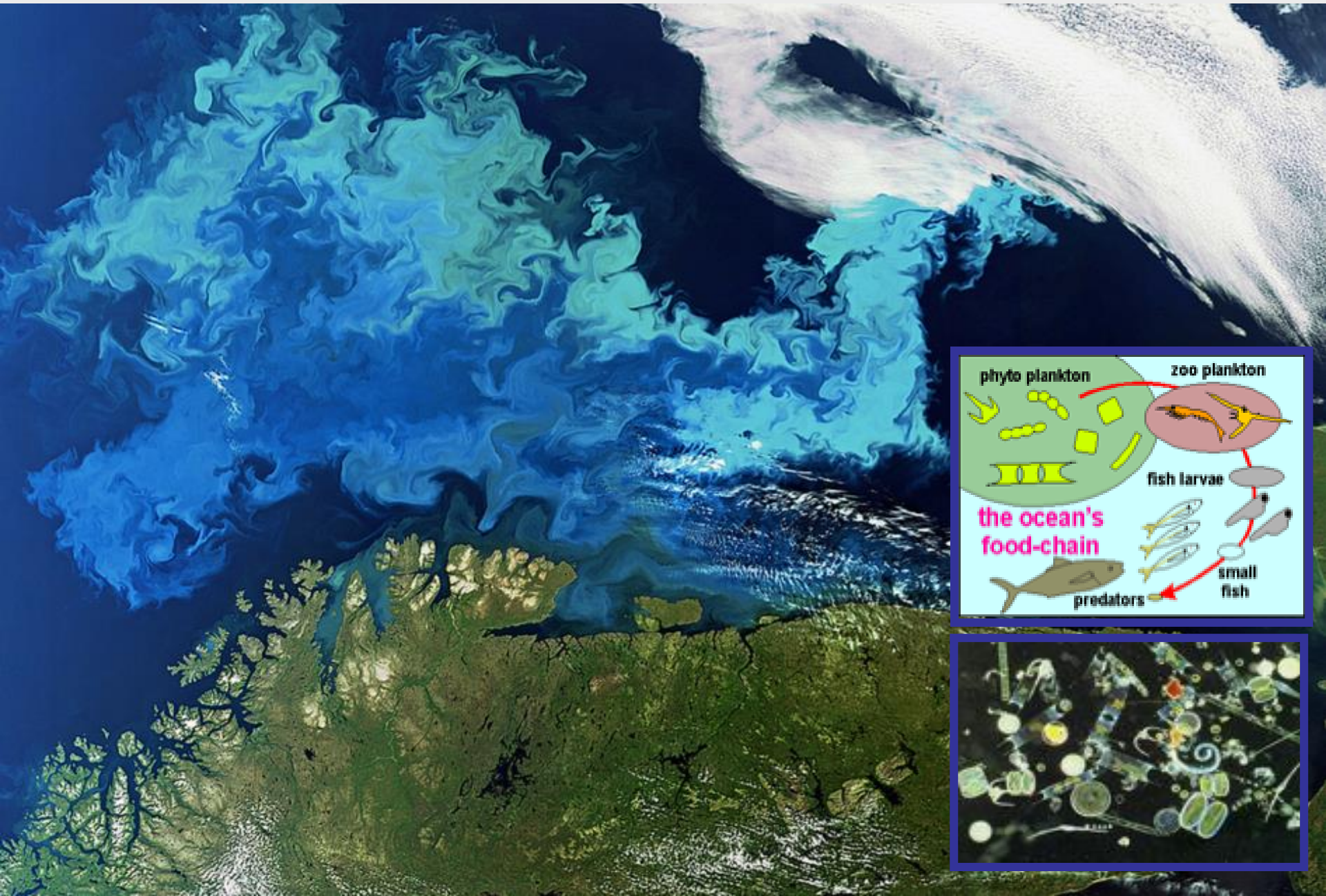
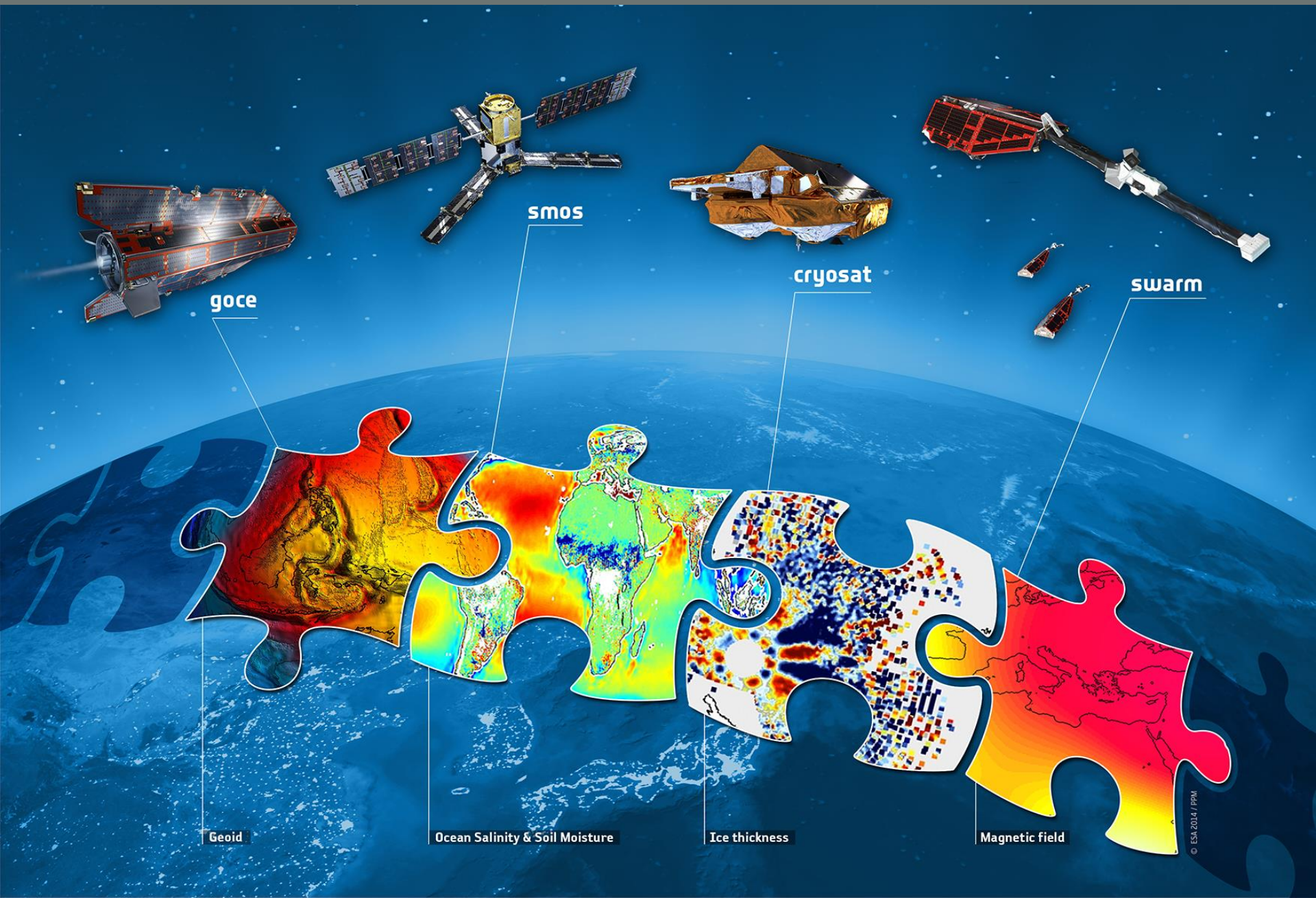
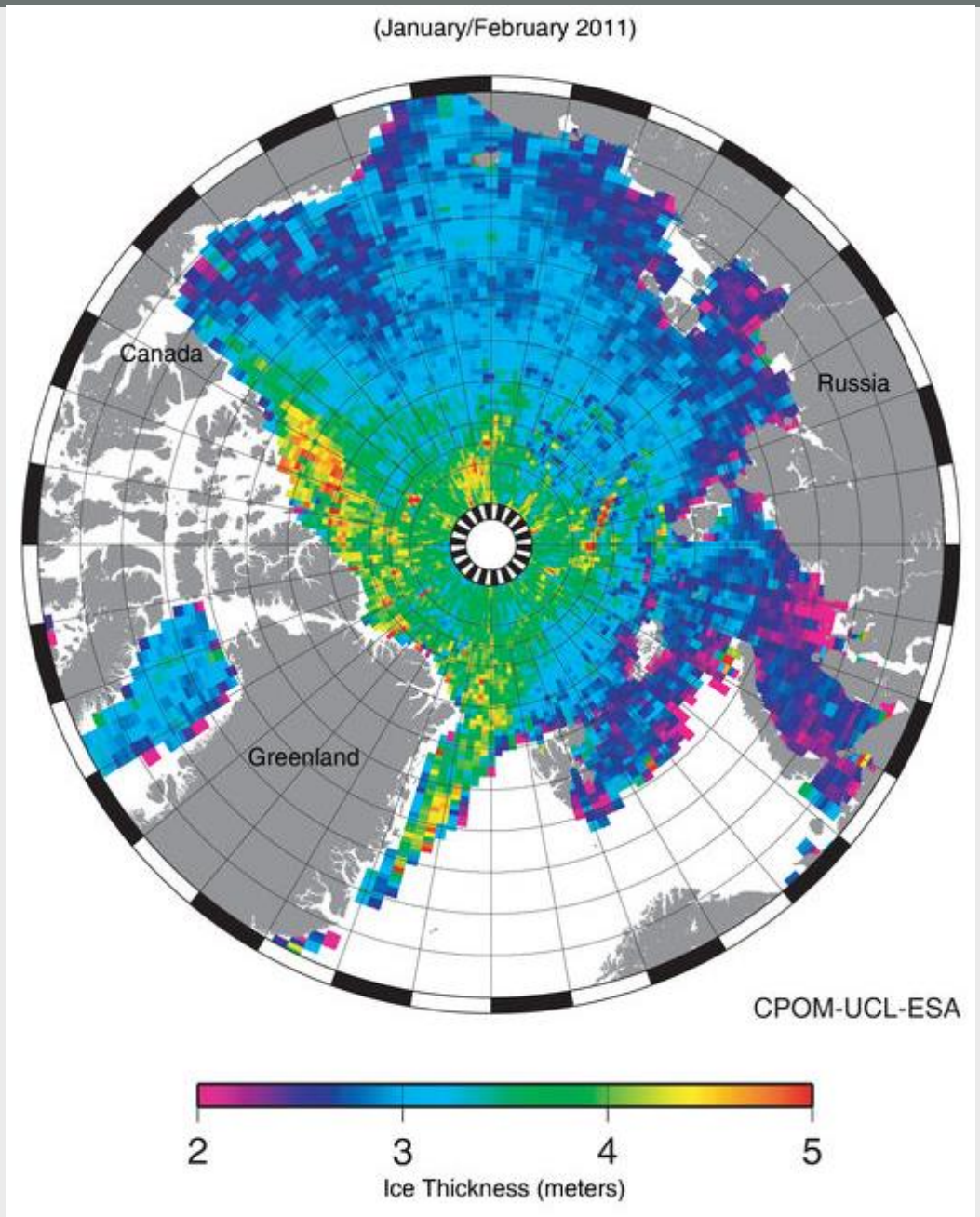
Carbon Biological Pump



Integrated Observing System



Sea-ice Thickness in the Arctic ocean



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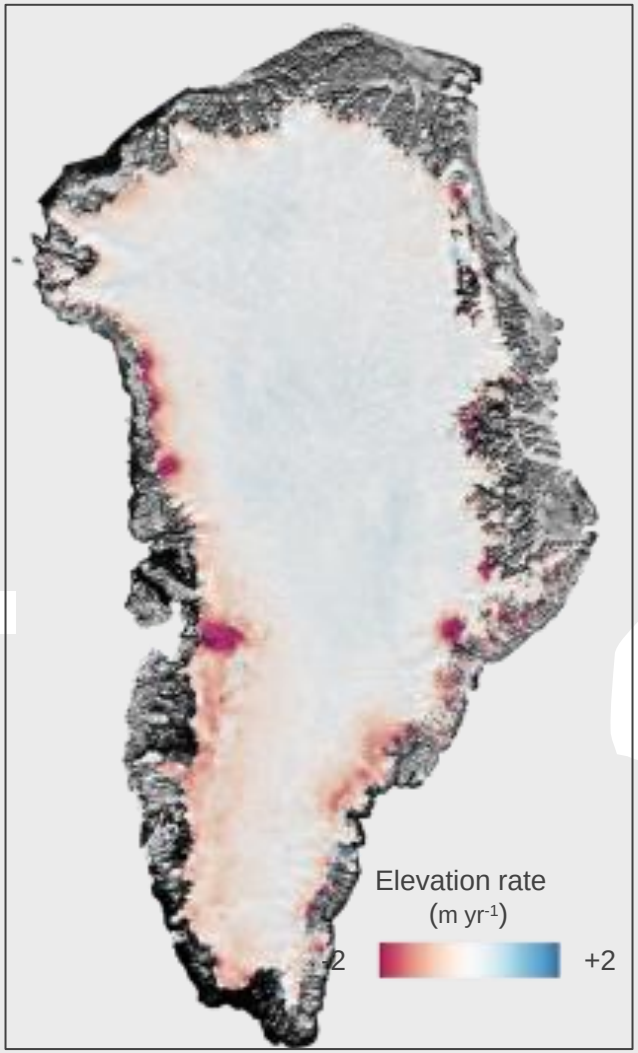
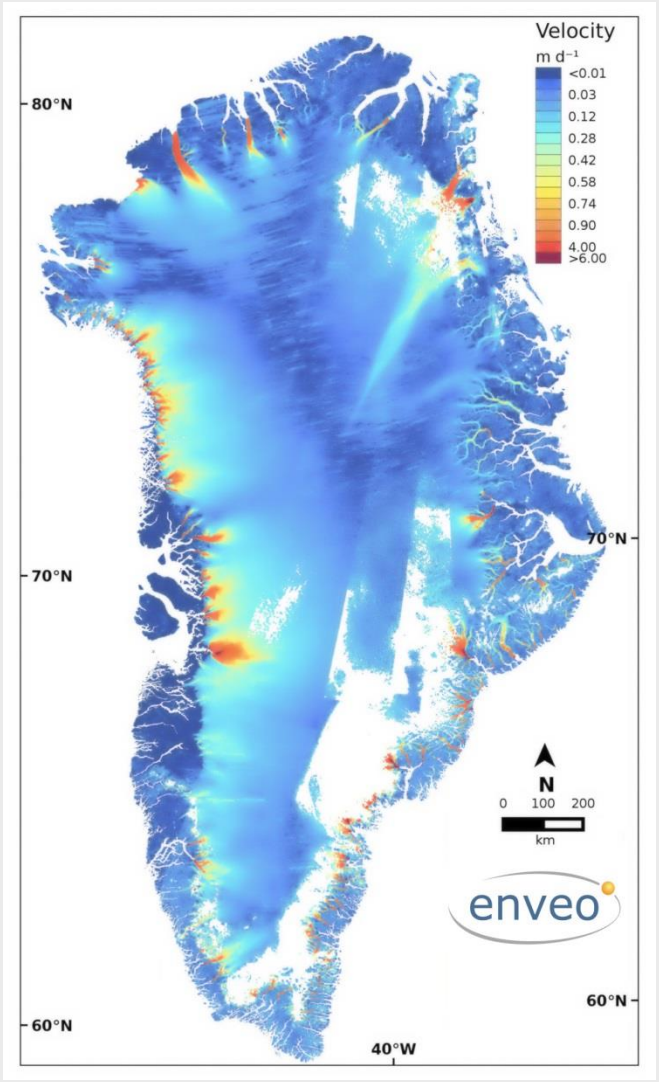
Synergy for Ice Sheet Balance



CryoSat-2



Sentinel-1

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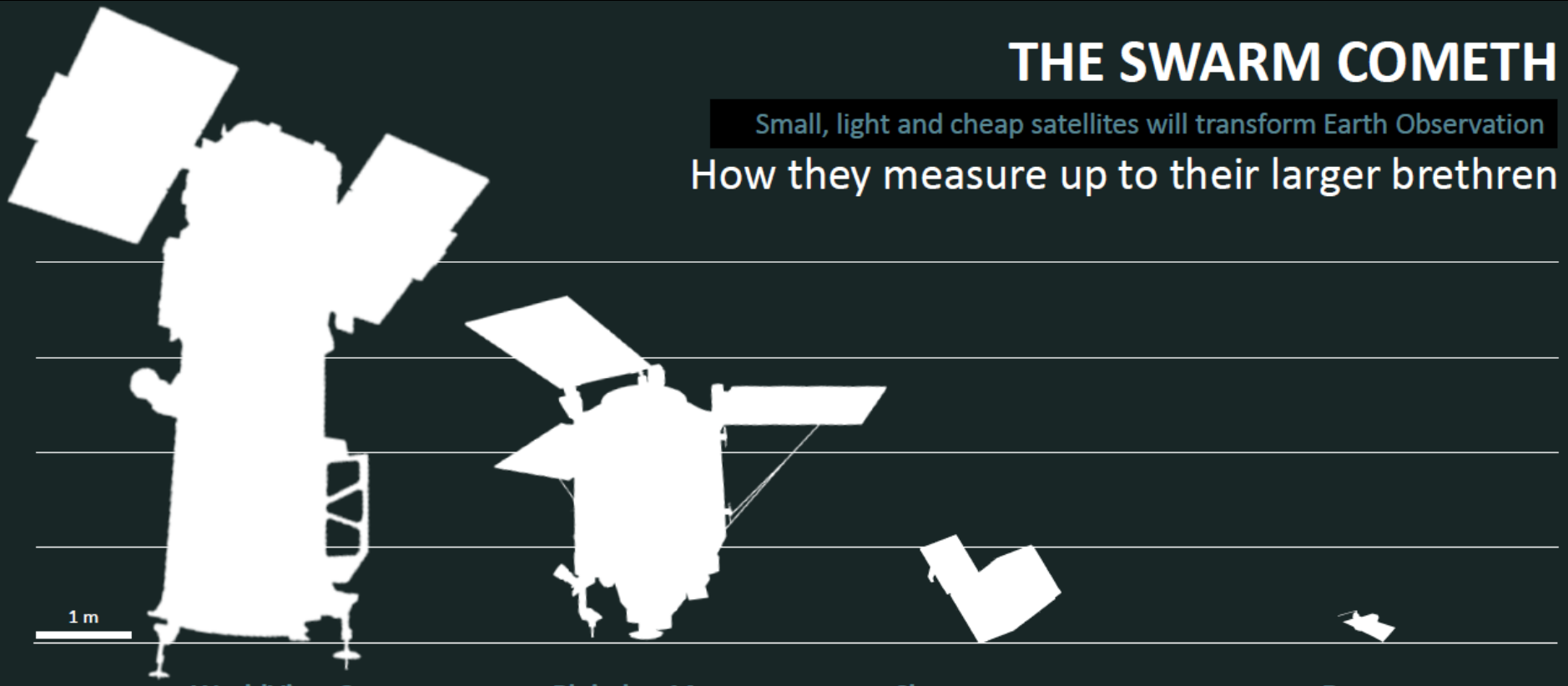
SMALL is the new BIG…



	WorldView-3	Pleiades-1A	Skysat	Dove
Operator:	DigitalGlobe	CNES/Airbus D&S	Skybox Imaging	Planet Labs
Constellation:	N/A	2	24[¤]	100[¤]
Weight:	2,800 Kg	940 Kg	120 Kg	5 Kg
Instruments:	Multiple spectral bands	Multiple spectral bands	Optical and near infrared spectral bands	Optical and near infrared spectral bands
Spatial resolution:	0.3-3m[¥]	0.5-2 m[¥]	~1 m (+1080p HD Video)	3-5 m

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[¥] Depending on spectral mode

[¤] When fully operational

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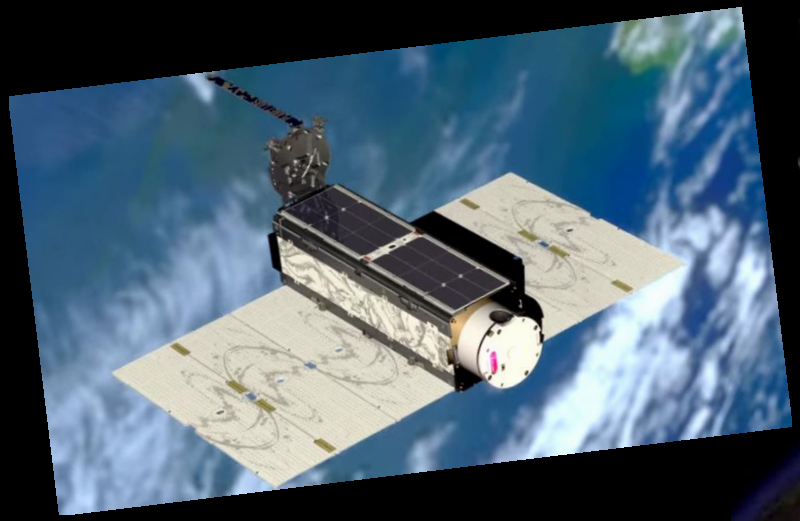
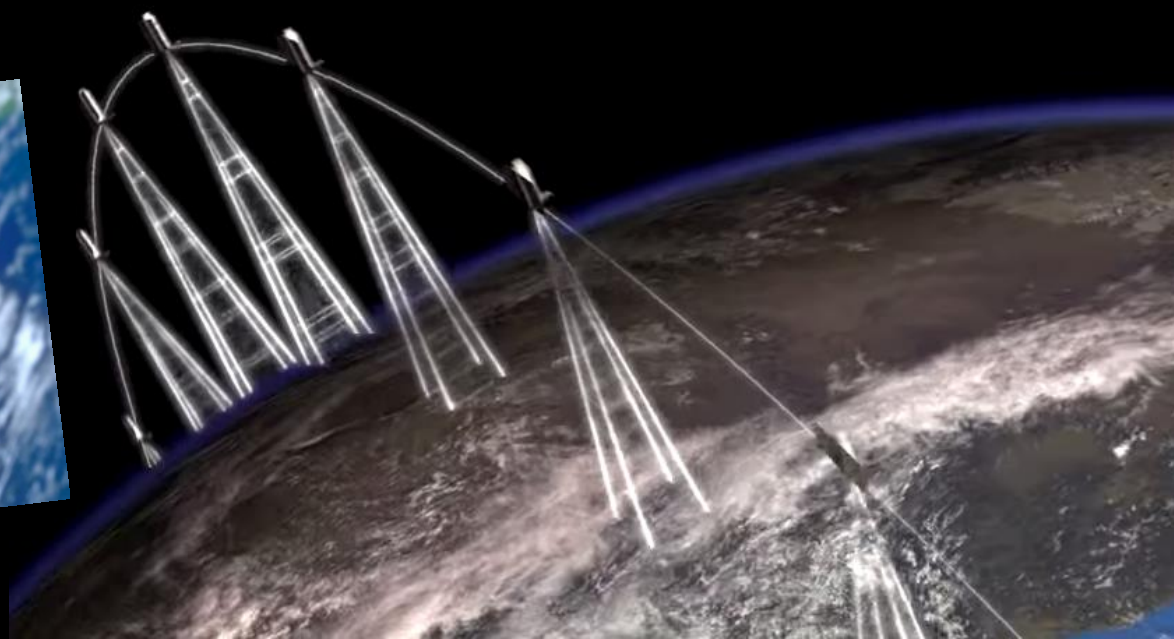
Market for Cubesats Constellations

PLANET LABS

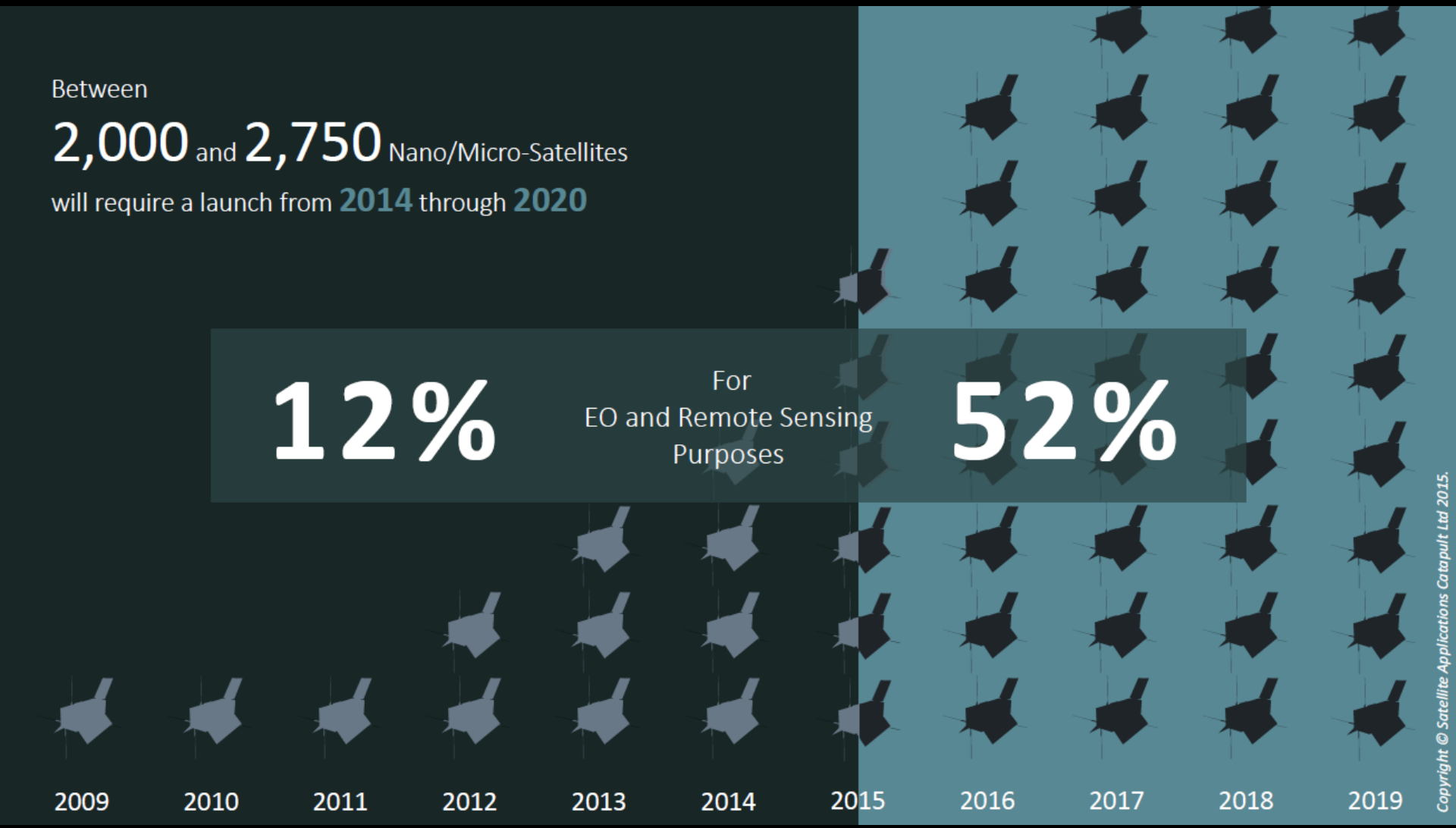
BlackBridge
Delivering the World





The Small-sat Era

Between
2,000 and **2,750** Nano/Micro-Satellites
will require a launch from **2014** through **2020**



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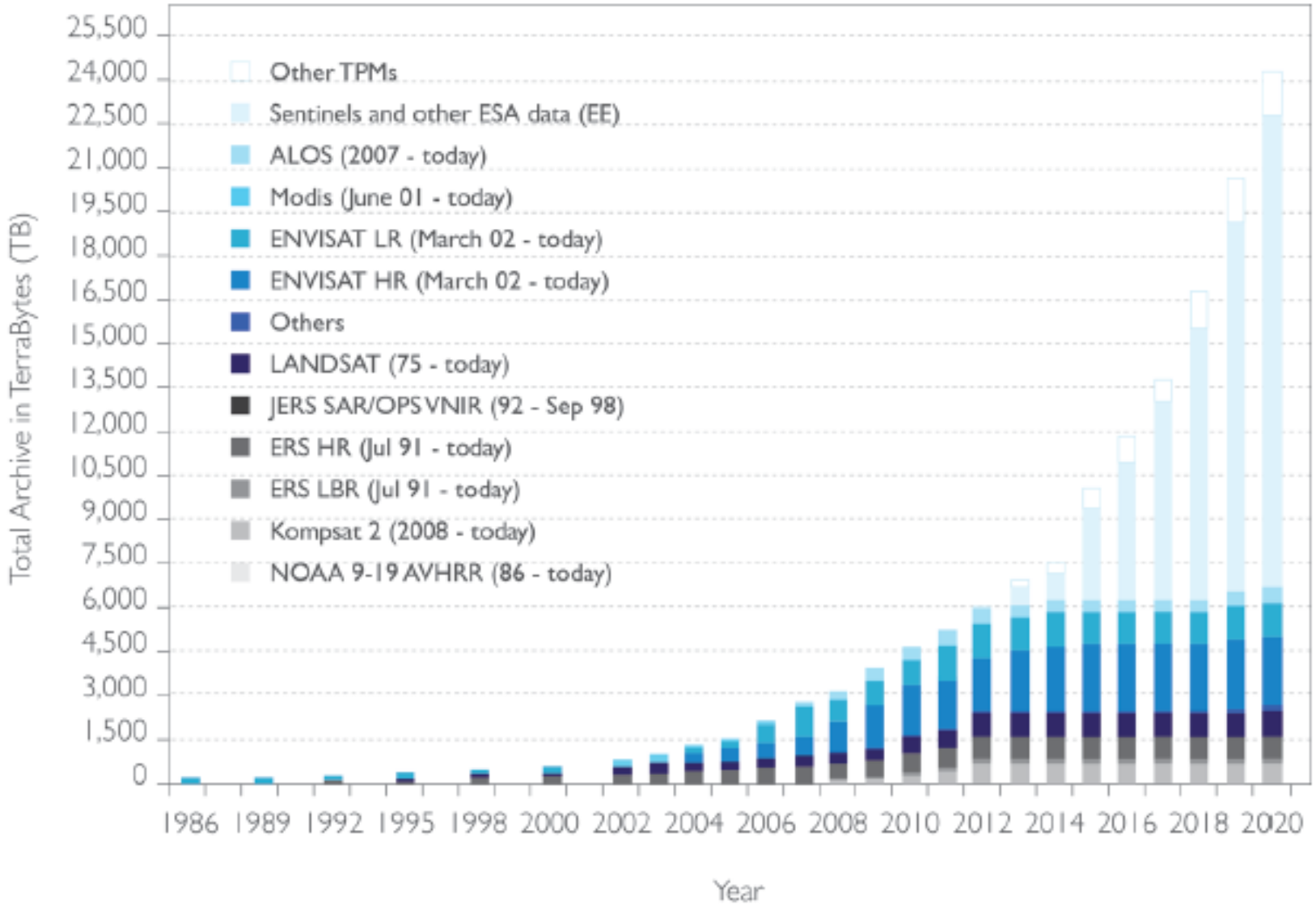
HD Real-time Videos from Space

urthecast

Deimos Imaging is now a subsidiary of UrtheCast Corp. (Canada)
UrtheCast Corp. is a Vancouver-based technology company
that is developing the world's first.
Ultra HD video feed of Earth, streamed from space in full color.

More EO Data…



Credit: ESA (2013)

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Big Data Mining and Machine Learning

Credit: www.mashable.com | Sven Sachsalber

The Digital Transformation

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2005

2013

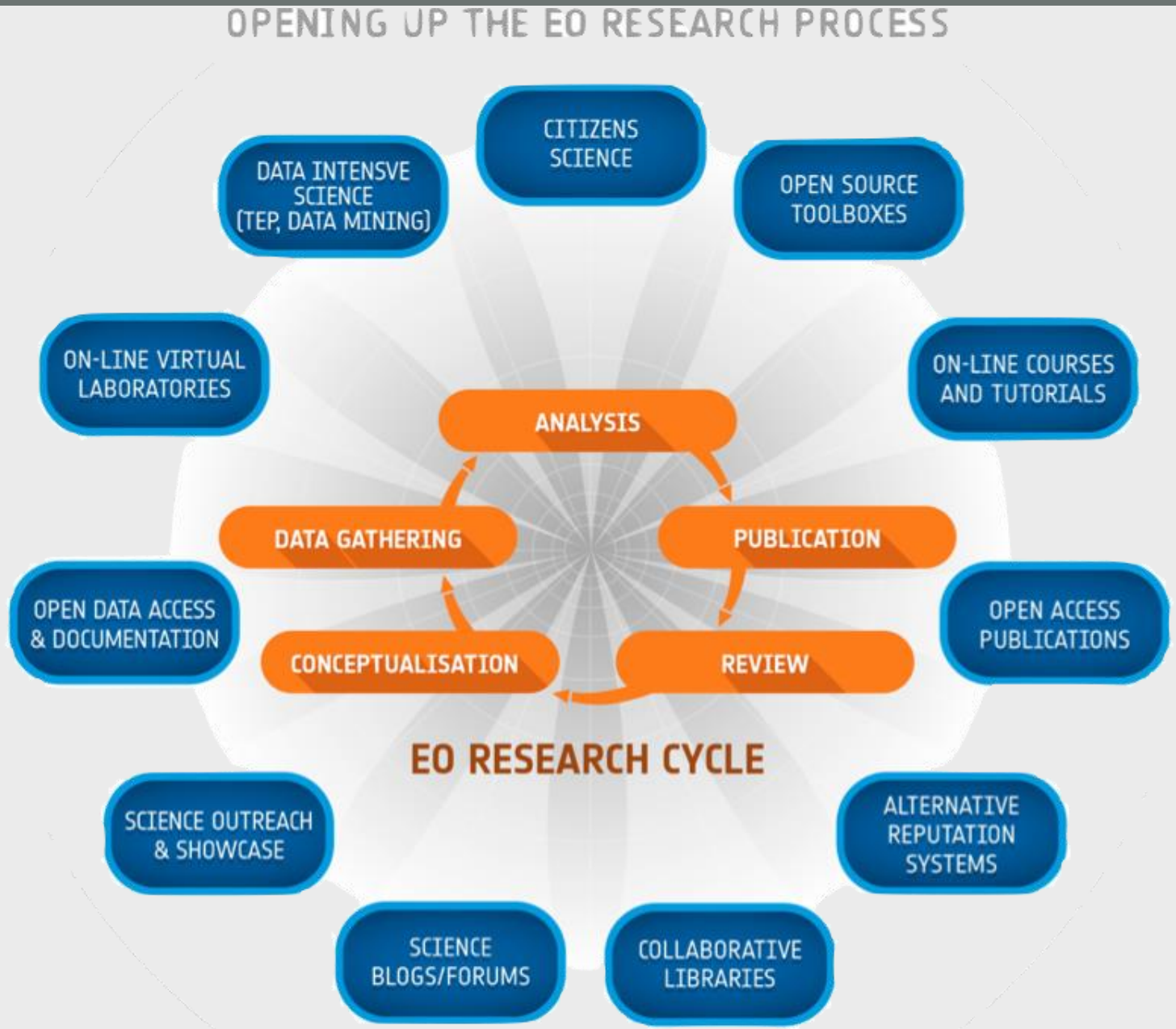
CATAPULT
Satellite Applications

EO21

esa

eo21.org

Digital Revolution Opening up the EO Research Process



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Open-Skate Community – Greater than the sum …

Rodney Mullen Pop an ollie and innovate! (TED Talk)

Pillars of The Community

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ESA Science Strategy

A new era for scientific advances and for societal benefits

Source: ESA PPM

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Virtual Research Laboratories

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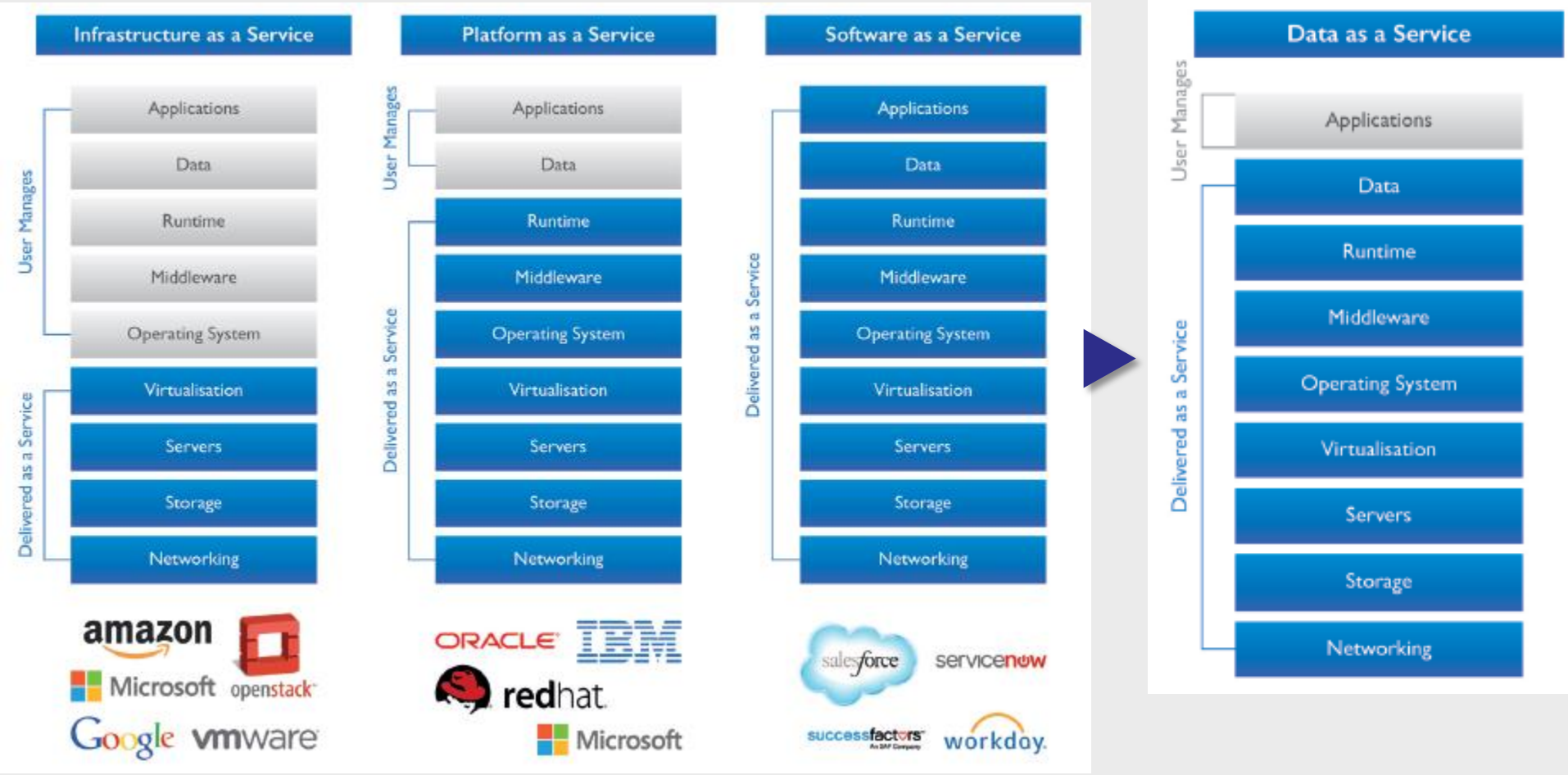
IaaS, SaaS, DaaS, ….

EO Data as a Service: represents the enablement of regular, non-expert users to effectively take control of often highly complex and traditionally inaccessible IT tools.



Credit: Woodside Capital Partners (2014)

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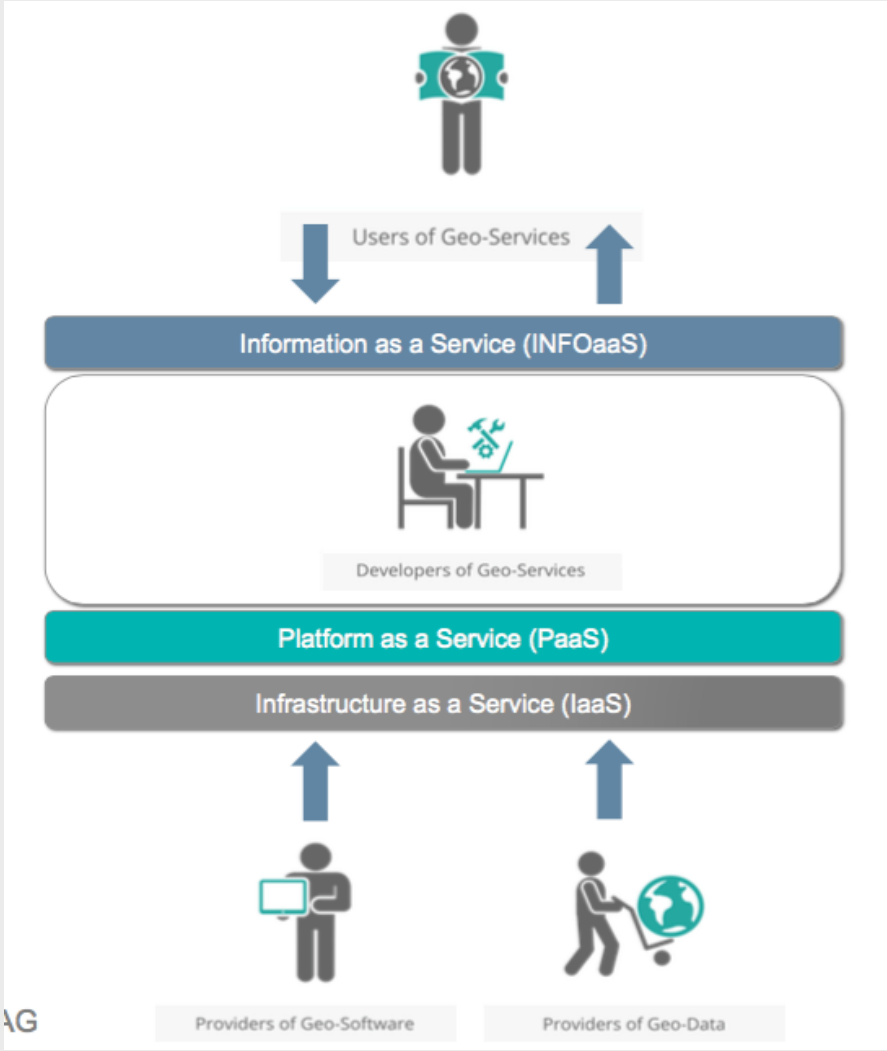
From IaaS, SaaS, … to Data & Information as a Service



Credit: Woodside Capital Partners (2014)

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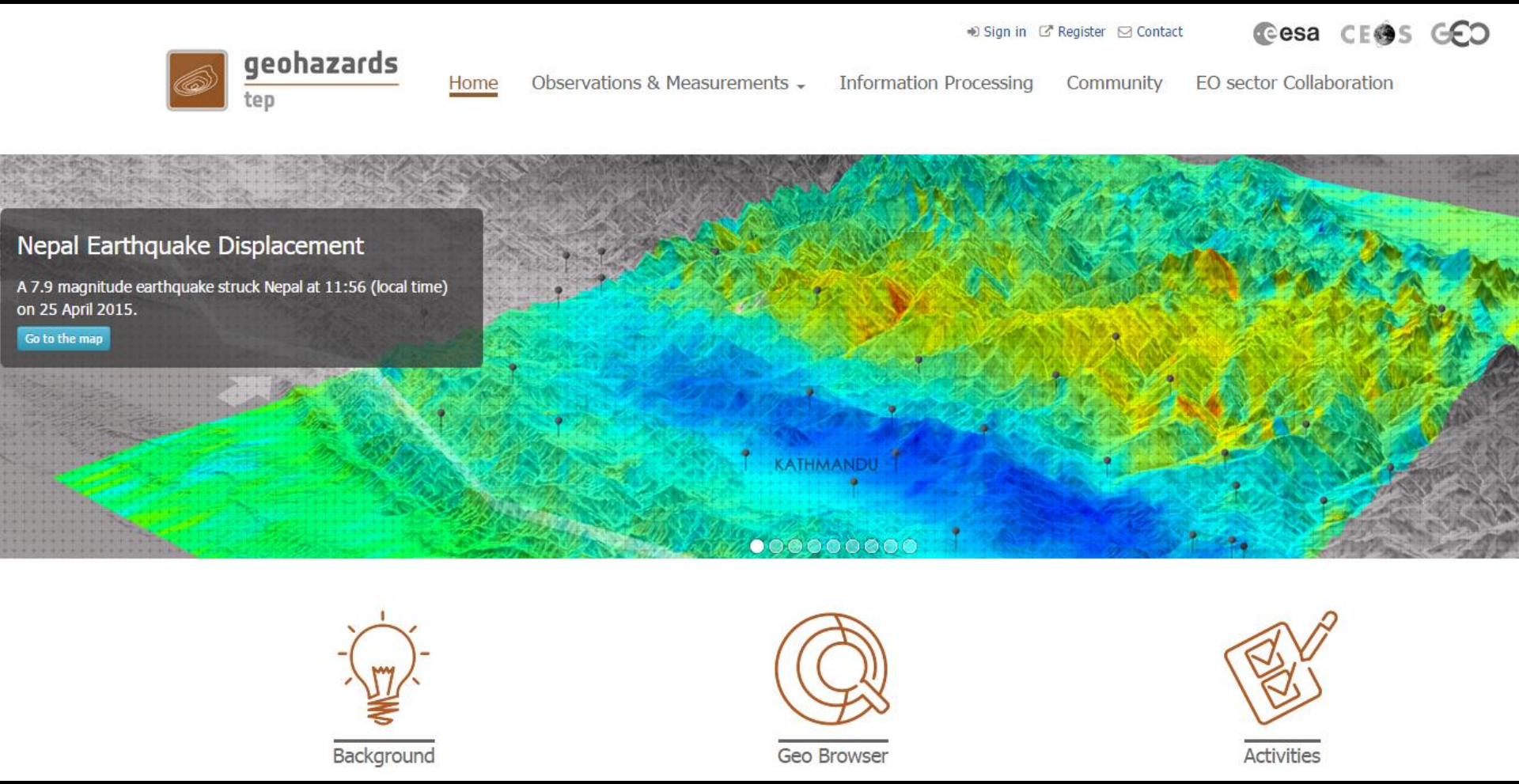
Ecosystem of Thematic Exploitation Platforms



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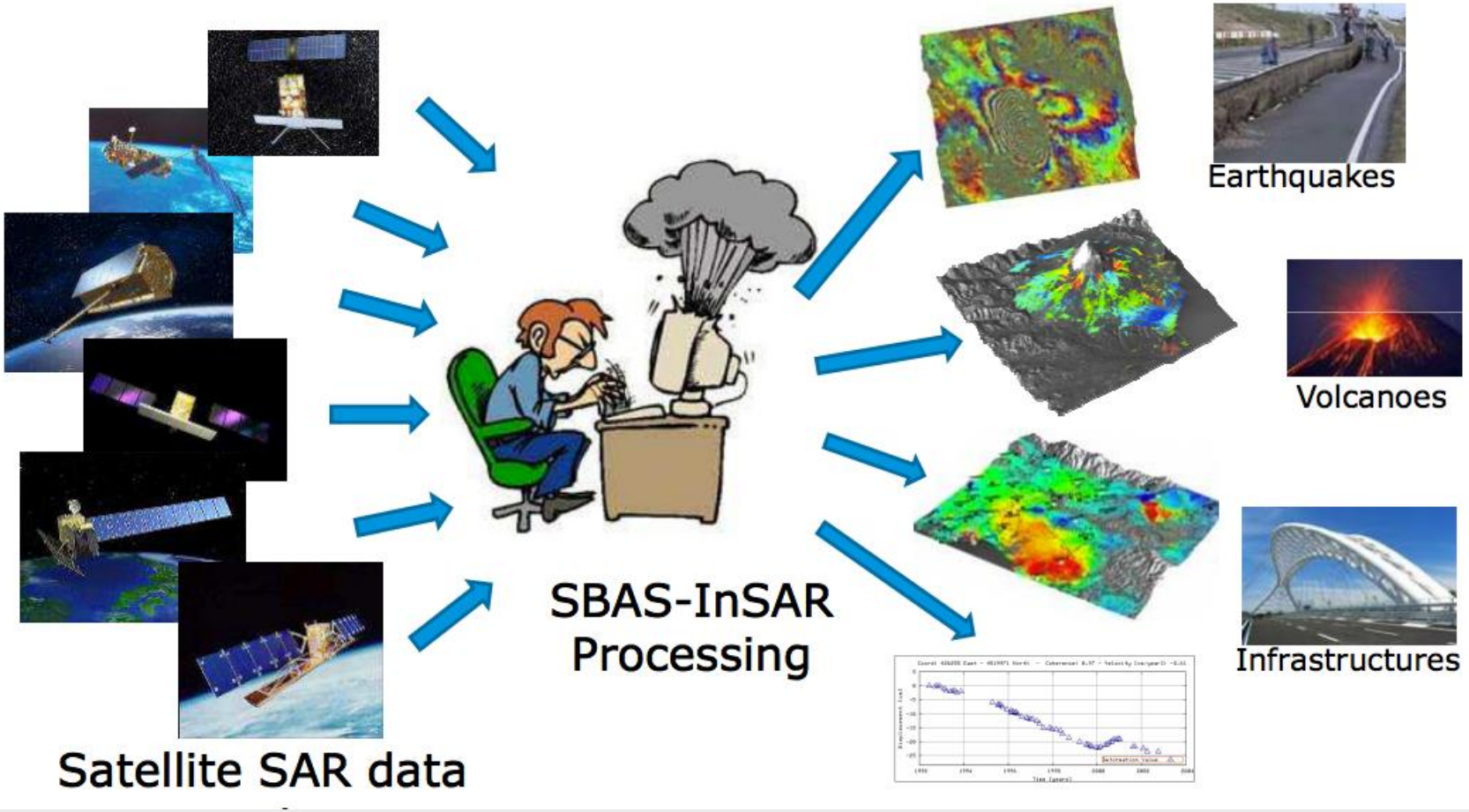
Ground displacement monitoring: the SBAS-InSAR technique



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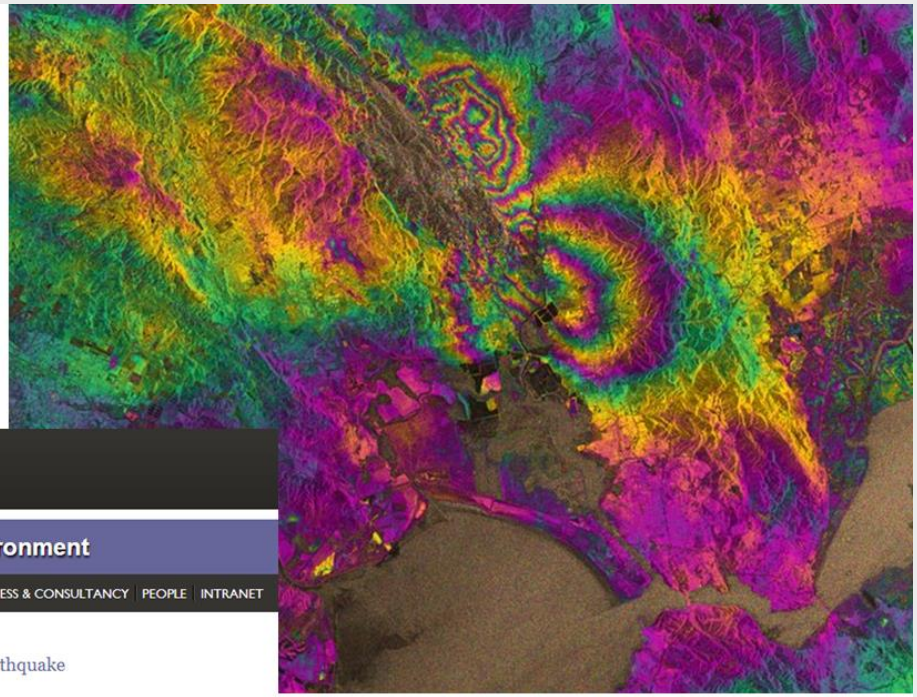
CEOS Pilot of Global Seismic Risk

Sentinel-1A data acquired on 7 August and 31 August 2014 (2 cycles).
Still during the Commissioning Phase.



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School of Earth and Environment

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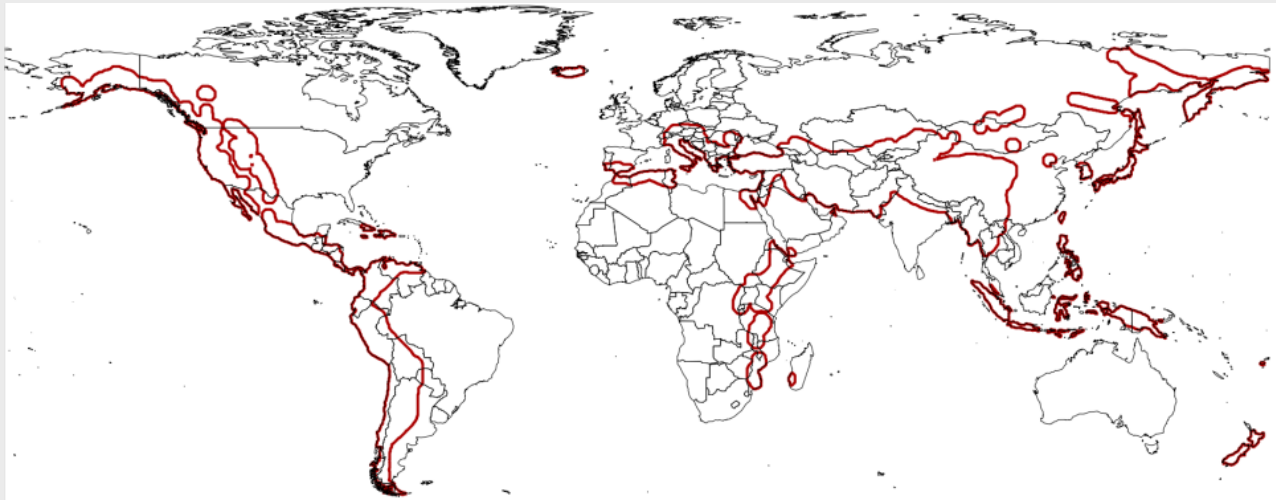
You are here: Earth and Environment > News > News Inner

New satellite maps out Napa Valley earthquake

02.09.2014 - 12:37

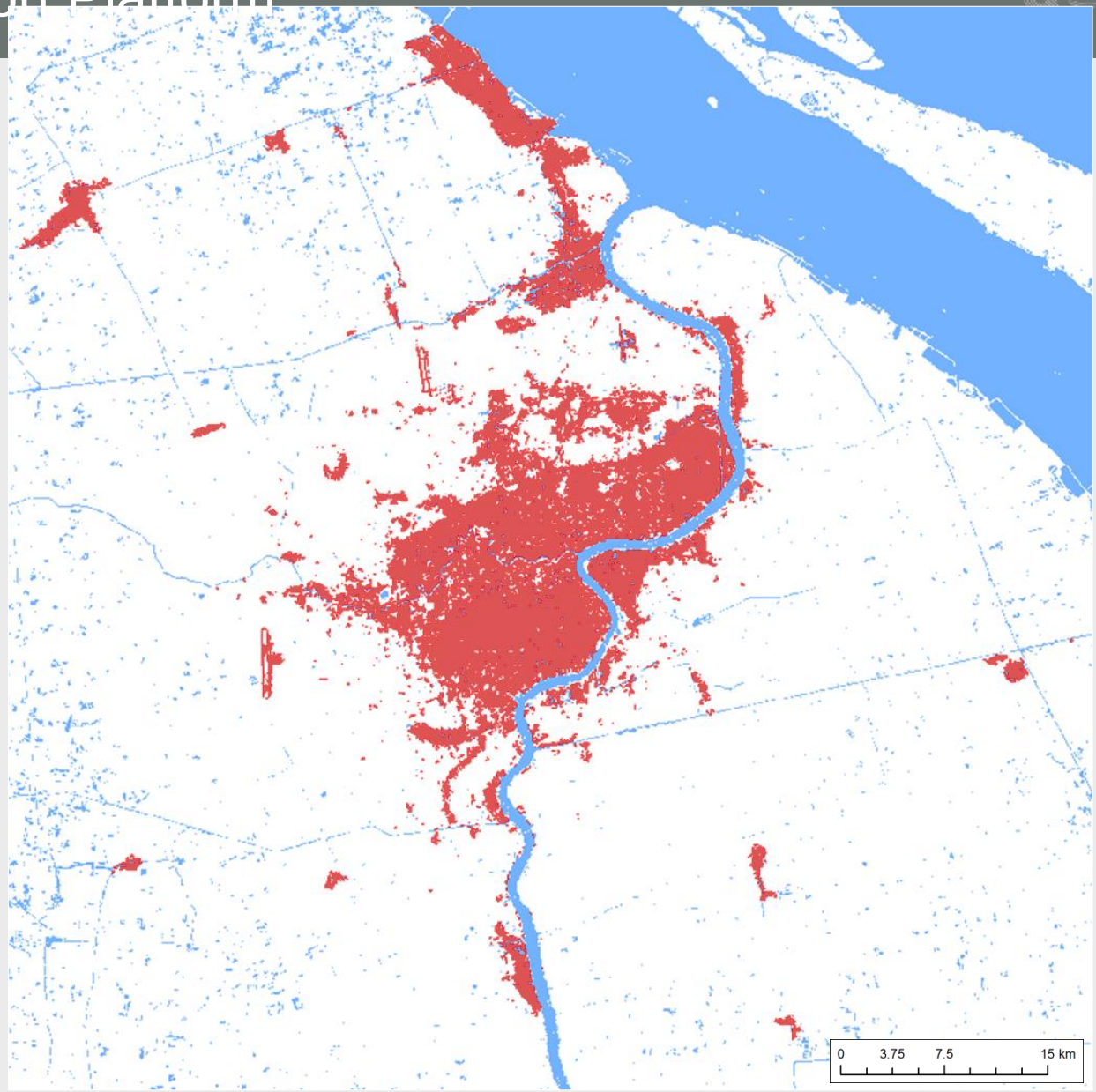
Credit: Copernicus data (2014)/ESA/PPO.labs-Norut–COMET-SEOM Insarap study.



Urban Exploitation Platform

Shanghai

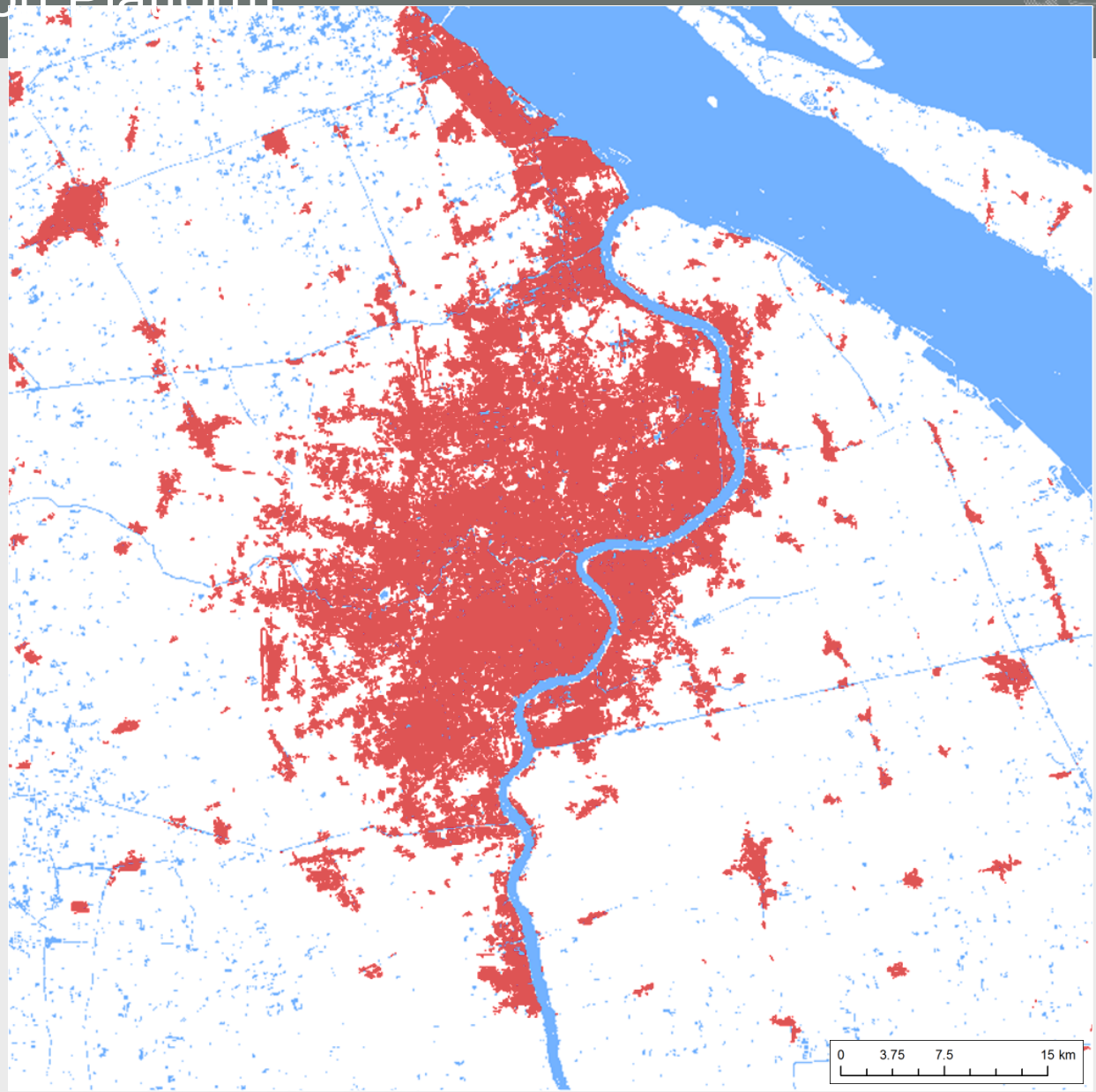
Urban Growth 1975



Urban Exploitation Platform

Shanghai

Urban Growth 1990

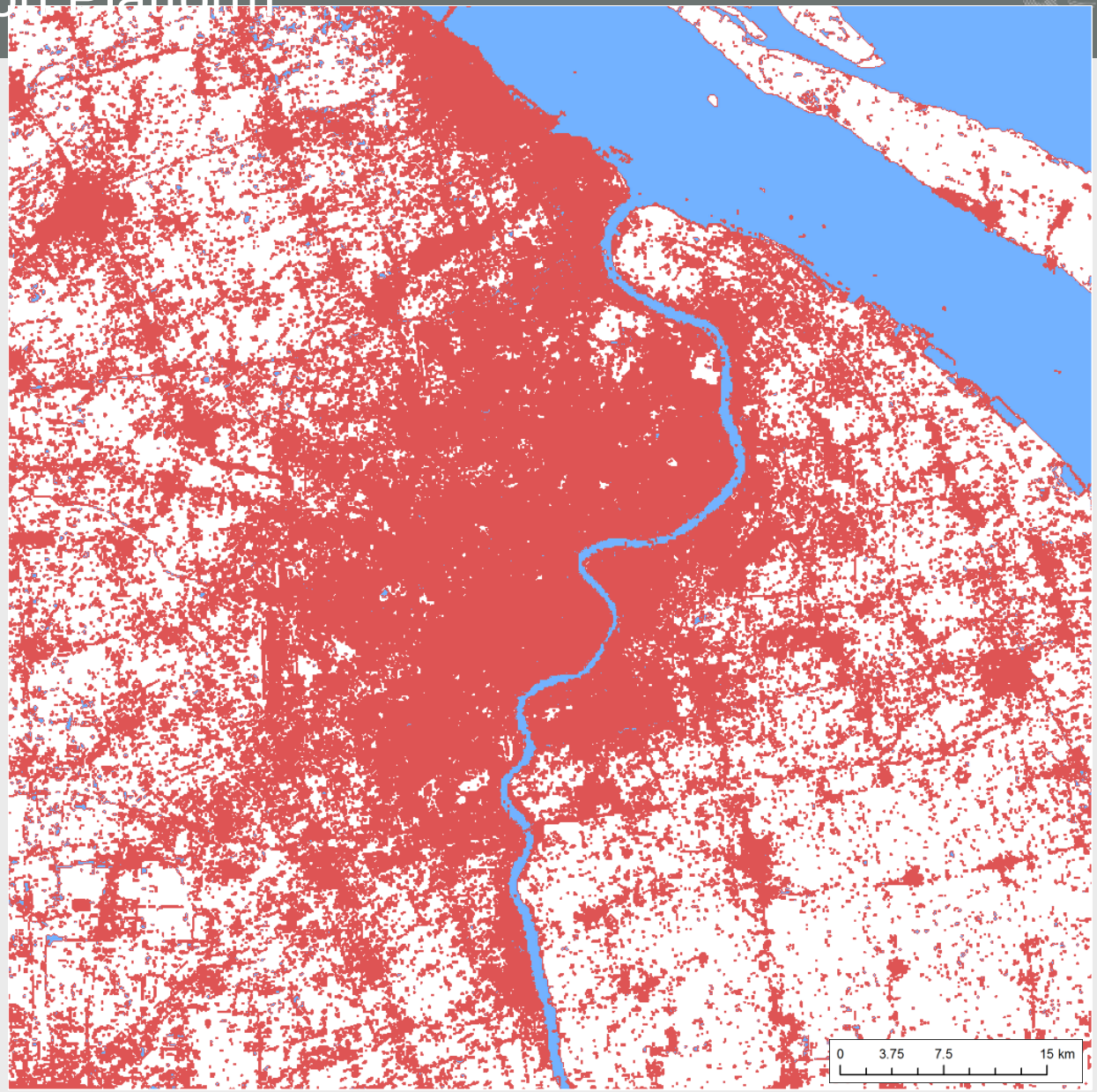


DLR

Urban Exploitation Platform

Shanghai

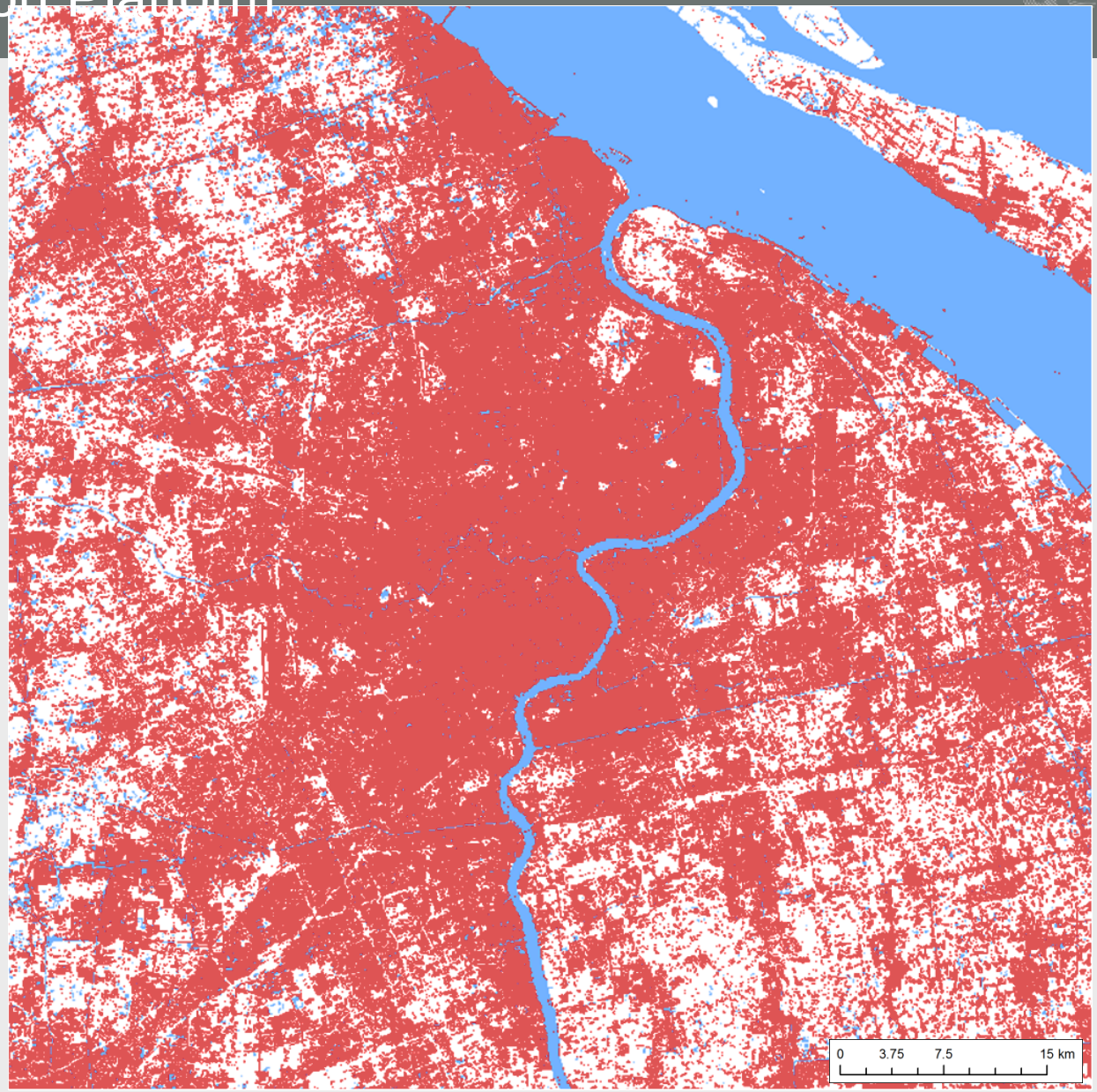
Urban Growth 2000



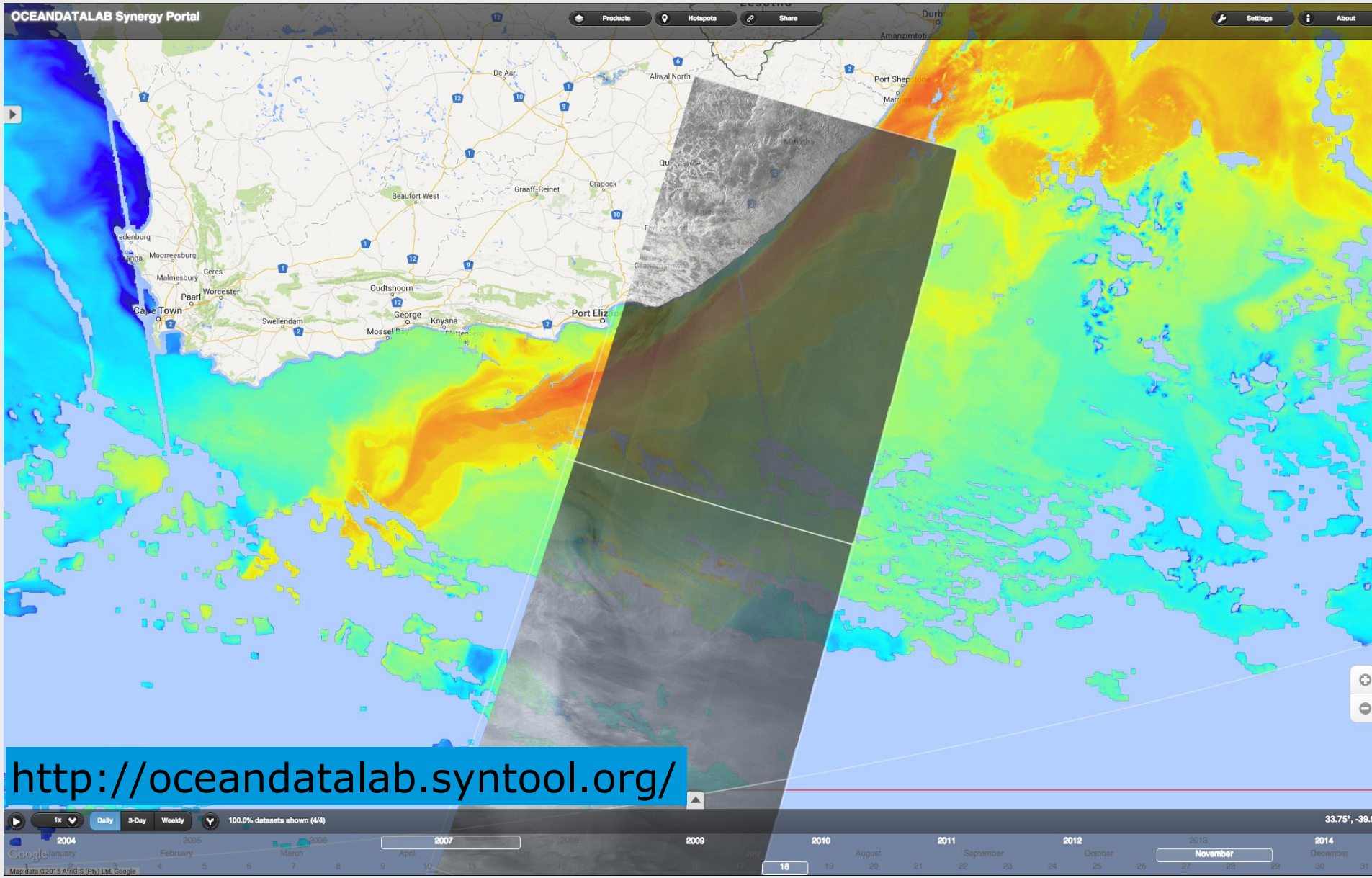
Urban Exploitation Platform

Shanghai

Urban Growth 2010



Ocean Data Lab



http://oceandatalab.syntool.org/

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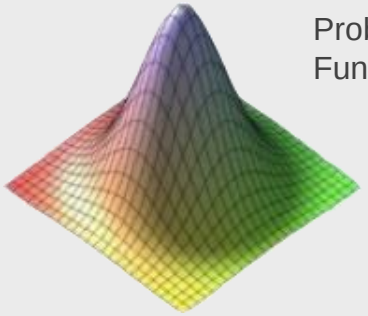
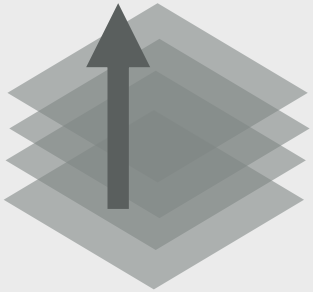
The Flux Engine

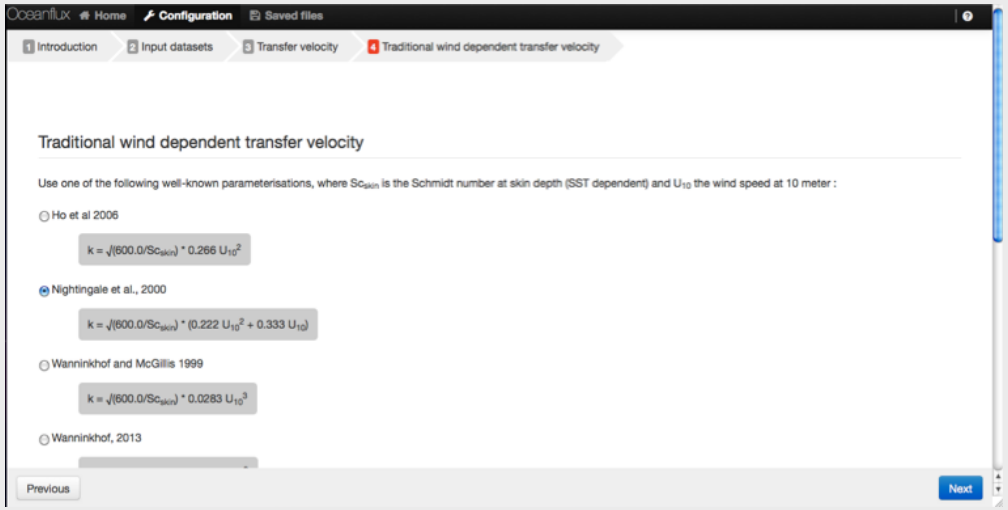


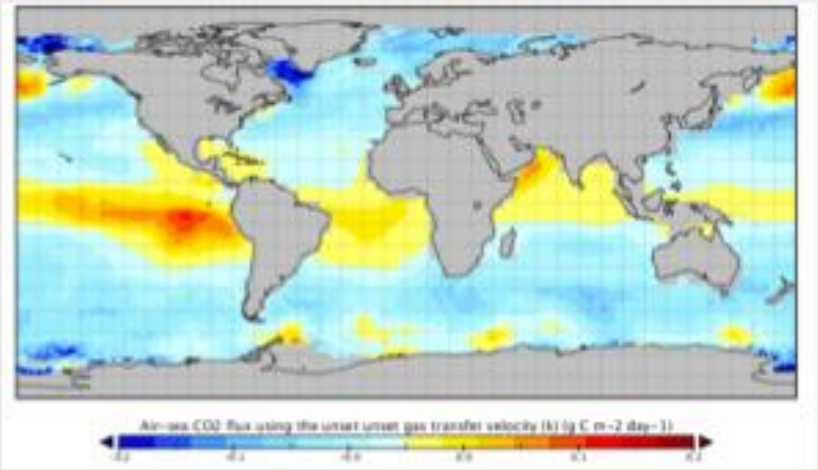
Probability Density Function

Input Data

Input Parameters







http://www.ifremer.fr/cersat1/exp/oceanflux

oceanflux ghg
support to science element

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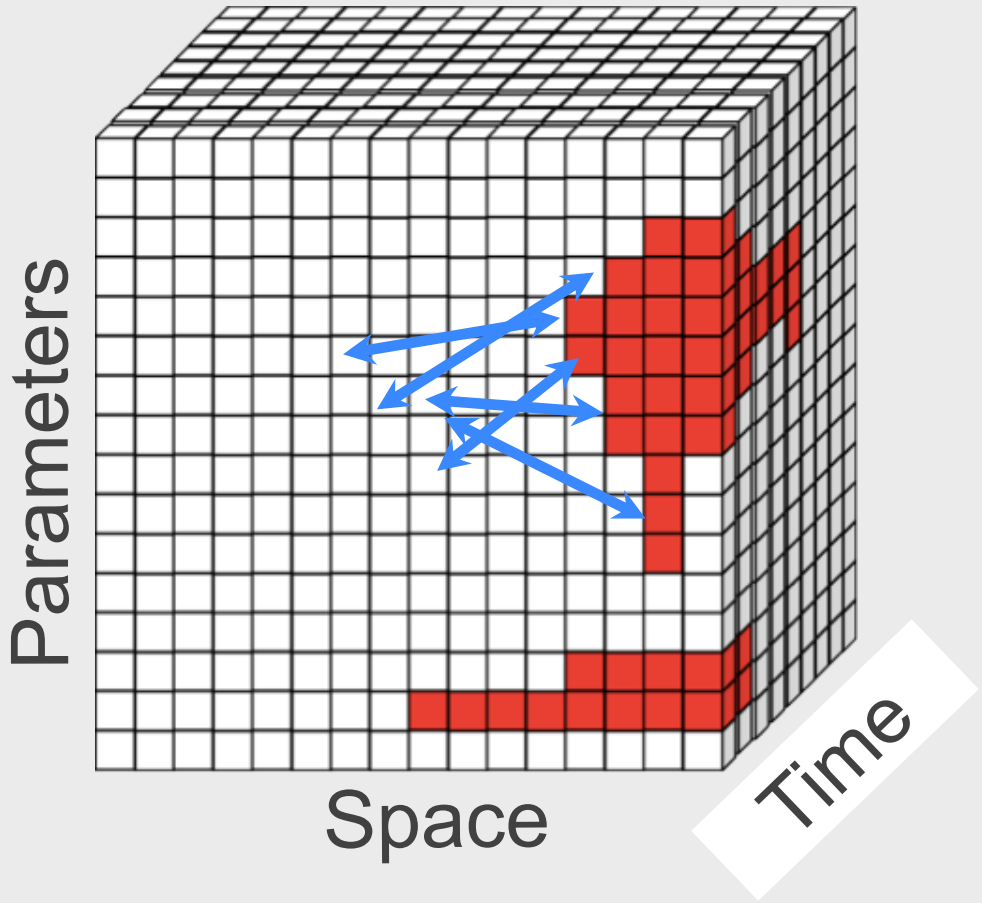
Earth System Data Cube



http://earthsystemdatacube.org

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Linked Data

ESGF
Climate Data

GODAE
Ocean State

BIOLOGY
Ocean Species

Products
Ocean Indicators
Coral Reef Stressor Index

User,
Assessment
(UNESCO,
IOC, Policy)

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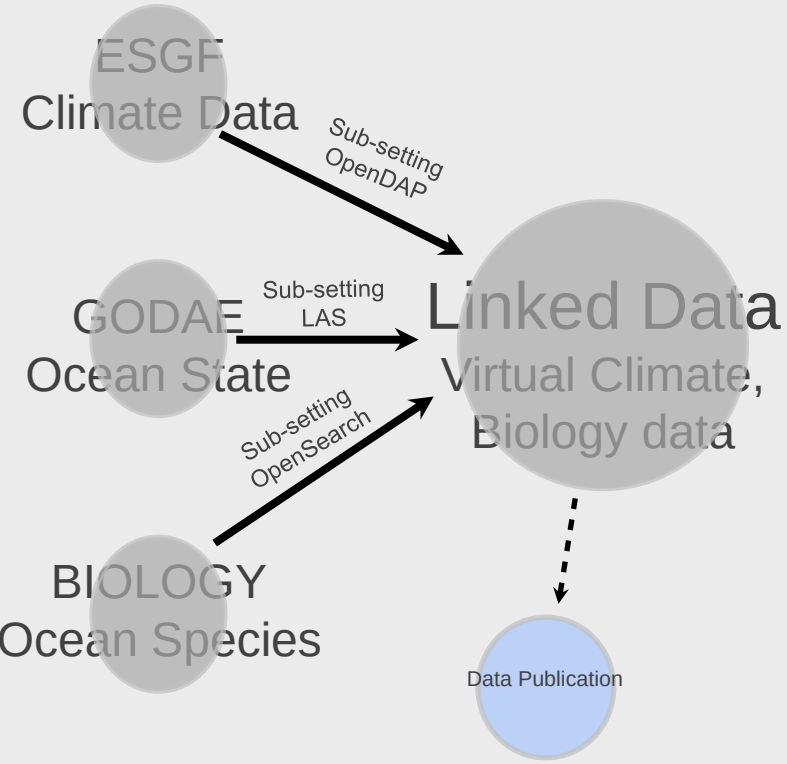
Linked Data



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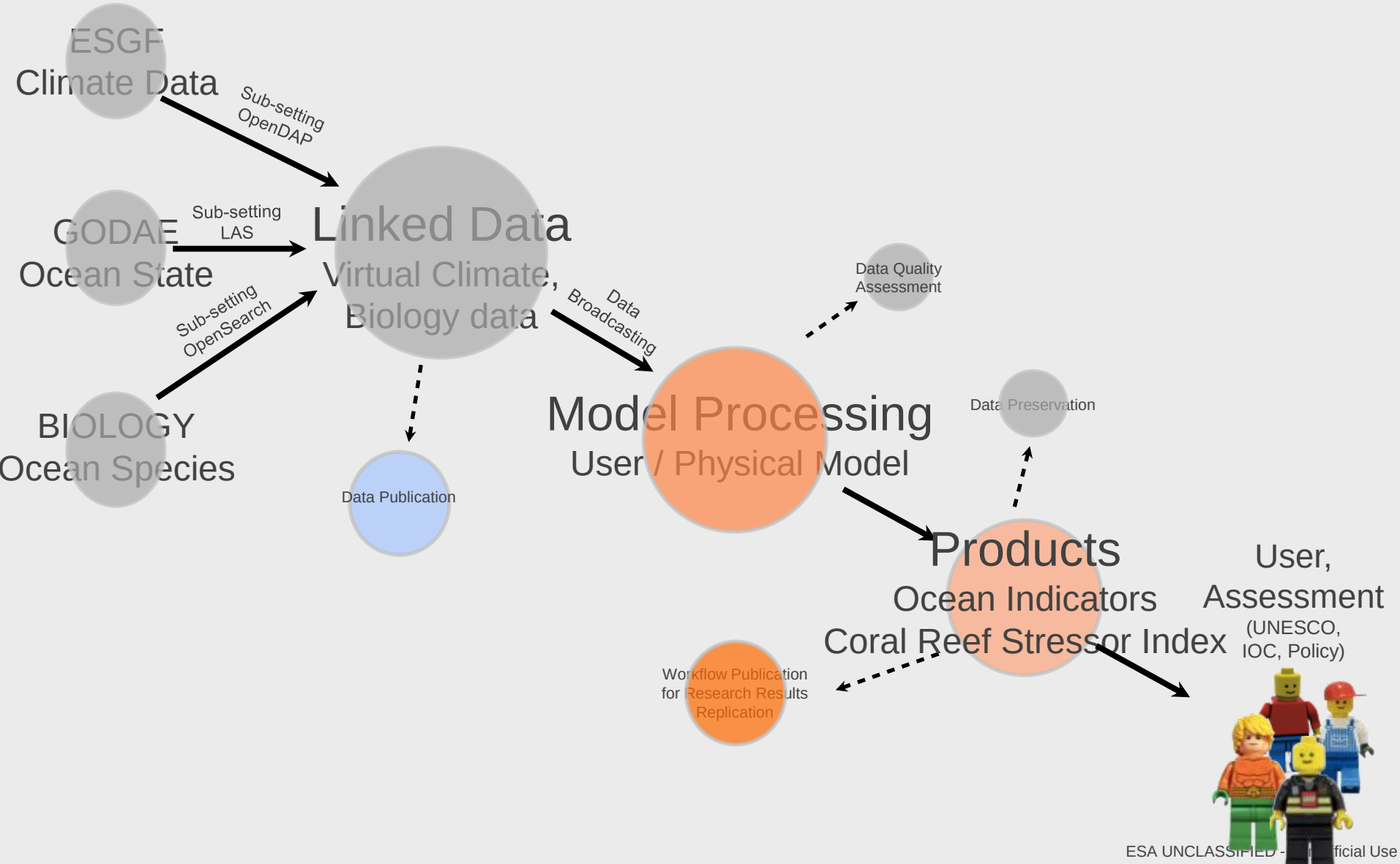
Linked Data



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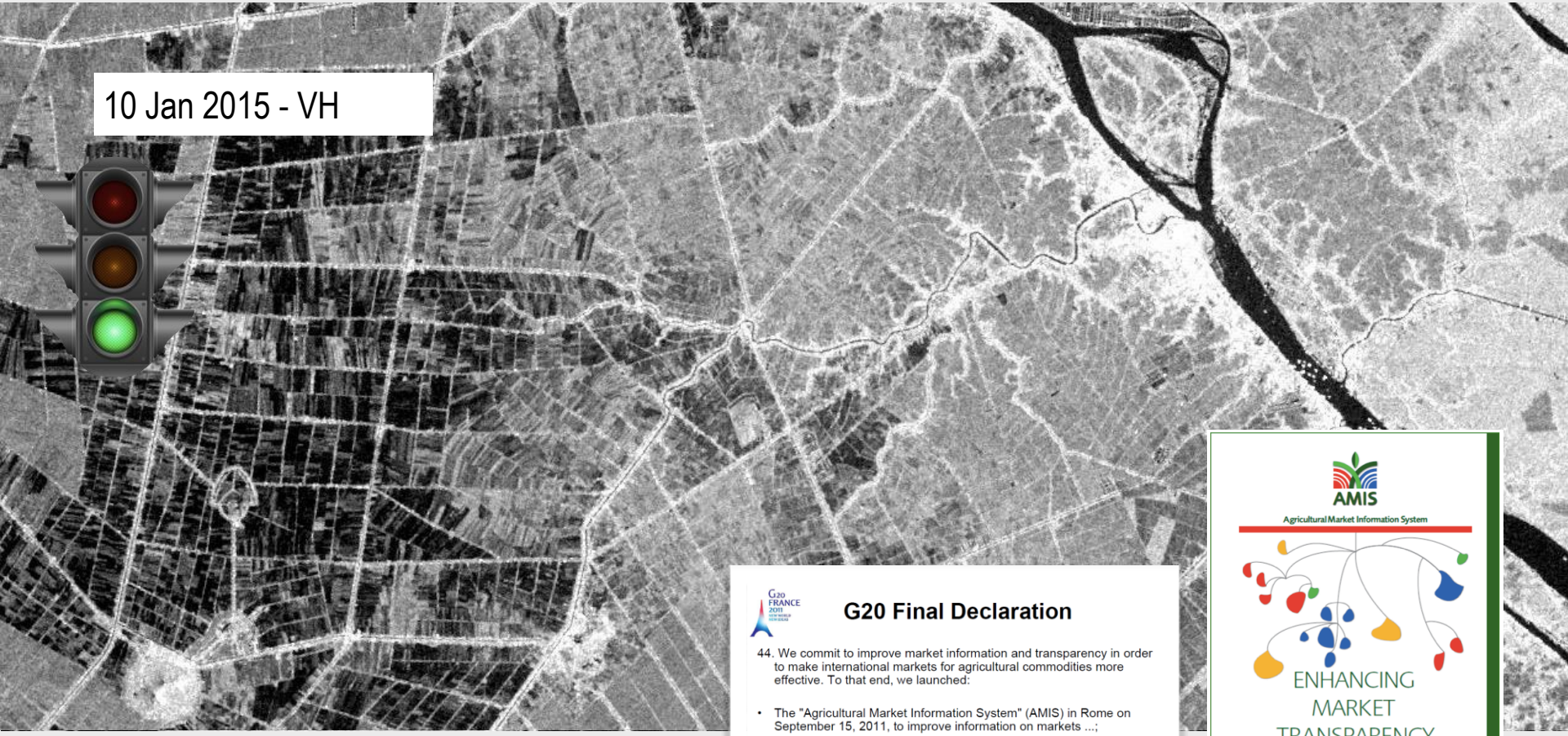
Monitoring Rice With S-1

Sentinel-1 time series (Oct.2014-Jan.2015)
GEOGLAM Asia-RICE Site: An Giang (Mekong River Delta, Vietnam)



G20 Final Declaration

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, we launched:

- The "Agricultural Market Information System" (AMIS) in Rome on September 15, 2011, to improve information on markets ...;
- The **"Global Agricultural Geo-monitoring Initiative" (GEO-GLAM)** in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data.

AMIS
Agricultural Market Information System
ENHANCING MARKET TRANSPARENCY

Bouvet & Le Toan

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Citizen Science Crowdsourcing

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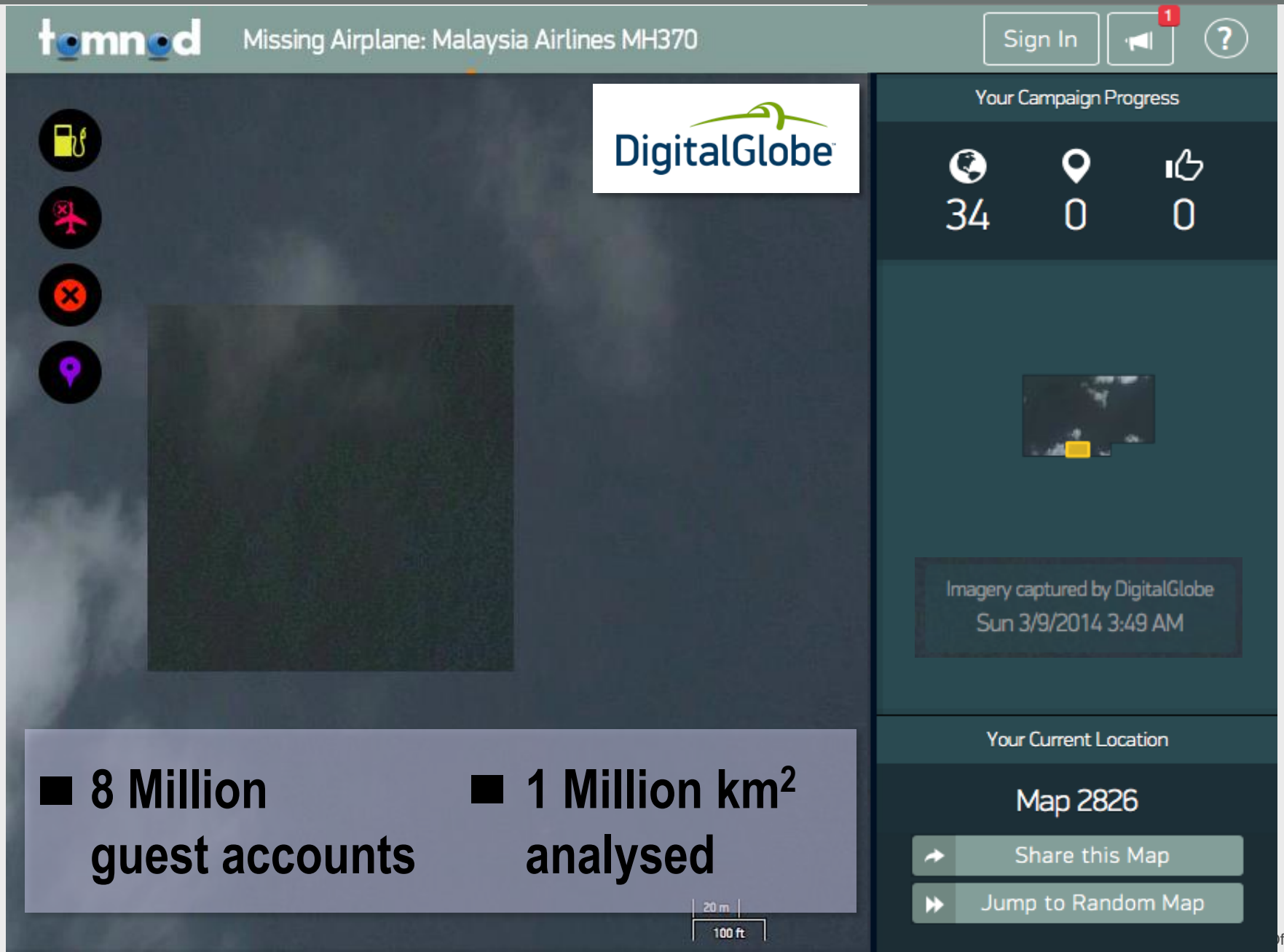
Citizen as Observatories | Flight 370 - Malaysia



Credit: PatrickMeier

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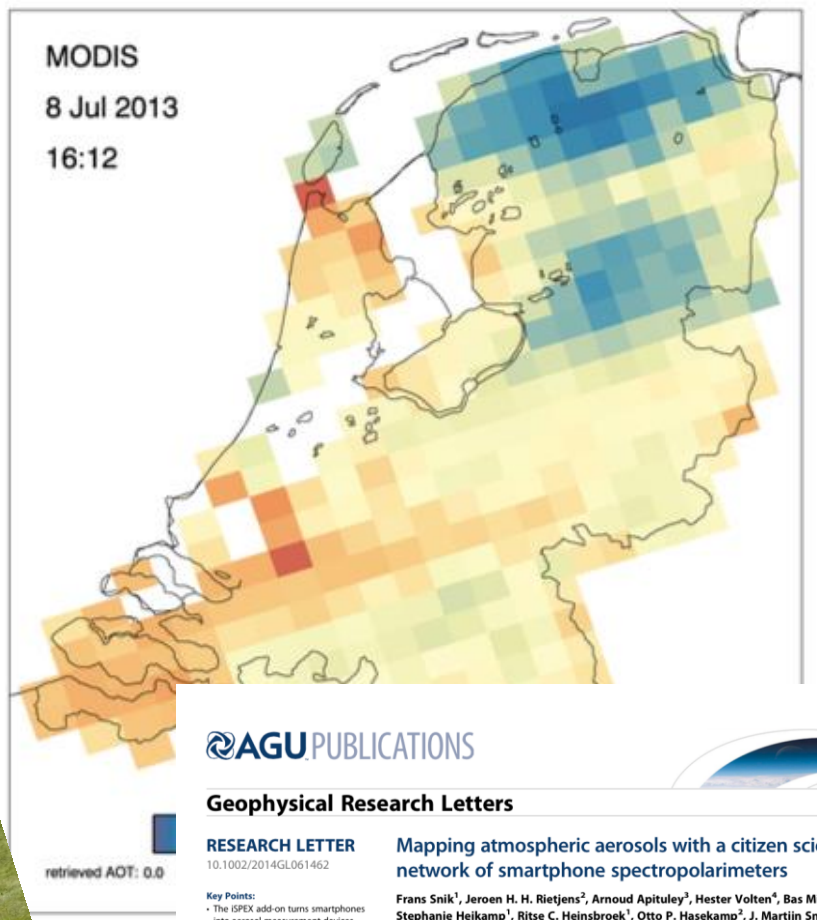
Citizen as Observatories | Air Quality



AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2014GL061462

Key Points:
- The iSPEX add-on turns smartphones into aerosol measurement devices
- Thousands of iSPEX measurements across the Netherlands form AOT maps
- The iSPEX AOT data match MODIS and AERONET data and have 2 km resolution

Supporting Information:
- Readme
- Supporting Text and Figures S1–S6

Correspondence to:
F. Snik,
snik@strw.leidenuniv.nl

Citation:
Snik, F., et al. (2014), Mapping atmospheric aerosols with a citizen science network of smartphone spectropolarimeters, *Geophys. Res. Lett.*, *41*, doi:10.1002/2014GL061462.

Received 7 AUG 2014
Accepted 8 OCT 2014

Mapping atmospheric aerosols with a citizen science network of smartphone spectropolarimeters

Frans Snik[1], Jeroen H. H. Rietjens[2], Arnoud Apituley[3], Hester Volten[4], Bas Mijling[3], Antonio Di Noia[2], Stephanie Heikamp[1], Ritse C. Heinsbroek[1], Otto P. Hasekamp[2], J. Martijn Smit[2], Jan Vonk[4], Daphne M. Stam[5], Gerard van Harten[1], Jozua de Boer[1], Christoph U. Keller[1], and 3187 iSPEX citizen scientists[6]

[1]Leiden Observatory, Leiden University, Leiden, Netherlands, [2]SRON Netherlands Institute for Space Research, Utrecht, Netherlands, [3]KNMI Royal Netherlands Meteorological Institute, De Bilt, Netherlands, [4]National Institute for Public Health and the Environment, Bilthoven, Netherlands, [5]Faculty of Aerospace Engineering, Delft University of Technology, Delft, Netherlands, [6]www.ispex.nl/participants

Abstract To assess the impact of atmospheric aerosols on health, climate, and air traffic, aerosol properties must be measured with fine spatial and temporal sampling. This can be achieved by actively involving citizens and the technology they own to form an atmospheric measurement network. We establish this new measurement strategy by developing and deploying iSPEX, a low-cost, mass-producible optical add-on for smartphones with a corresponding app. The aerosol optical thickness (AOT) maps derived from iSPEX spectropolarimetric measurements of the daytime cloud-free sky by thousands of citizen scientists throughout the Netherlands are in good agreement with the spatial AOT structure derived from satellite imagery and temporal AOT variations derived from ground-based precision photometry. These maps show structures at scales of kilometers that are typical for urban air pollution, indicating the potential of iSPEX to provide information about aerosol properties at locations and at times that are not covered by current monitoring efforts.

Citizen as Observatories | Validation Picture Pile

Copernicus Data (2015)

Outreach & Education

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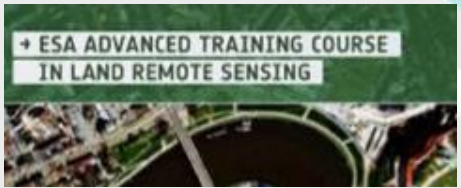
New Generation Scientists



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Monitoring Climate Change from Space

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Duration: 5 weeks

3 hours pw

ABOUT THE COURSE

We are now at a time on planet Earth where significant and rapid changes to the climate are taking place. It is becoming increasingly essential for us to study the climate and observe

EDUCATORS

Ravi Kapur

A guide to use Earth Observation Data in Climate & Development decision-making

1.17

Remote sensing techniques

Intro Q1 Q2

Q2

What is passive remote sensing

- Passive sensing is used during the day when the sun is illuminating the earth.
- Passive sensing detects energy reflected or emitted radiation from the earth.
- Passive sensing detects infrared radiation.
- Passive sensing detects energy which is scattered by the atmosphere.

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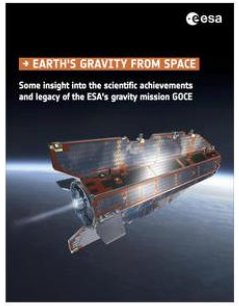

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Published 15 Nov, 2014

ENHANCED

This book includes video.

REQUIREMENTS

To view this book, you must have an iPad with iBooks 3 or later and iOS 5.1 or later, or a Mac with iBooks 1.0 or later and OS X 10.9 or later.

Earth's gravity from space

Some insight into the scientific achievements and legacy of the ESA's gravity mission GOCE

European Space Agency >

Details Ratings and Reviews Related

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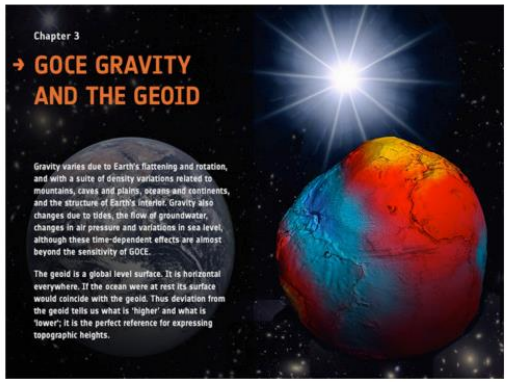
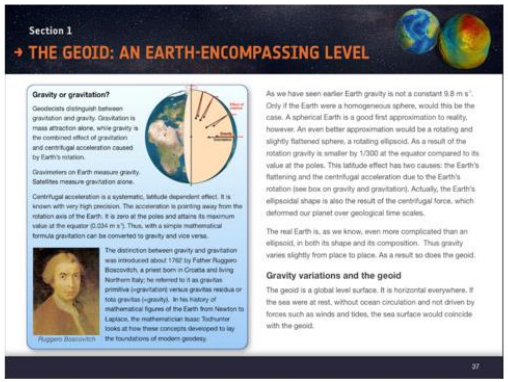
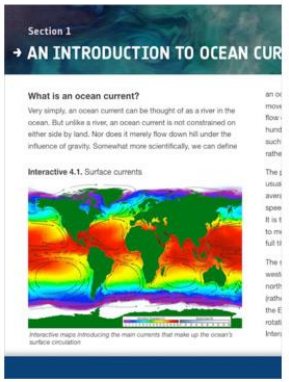
Book Description

This e-book invites you to explore some of the fascinating aspects of measuring the Gravity field from space. It describes key techniques to measure Gravity and describes some of the many scientific achievements and legacy of the ESA's Gravity mission GOCE. This e-book is intended as a living document, which will continue to capture new scientific research that uses satellite gravimetry, in particular data from GOCE, to deliver new insights across multiple Earth Science disciplines.

Screenshots







Information

Language	English	Published	15 Nov, 2014
Genre	Earth Sciences	Pages	125
Publisher	European Space Agency	Size	269 MB

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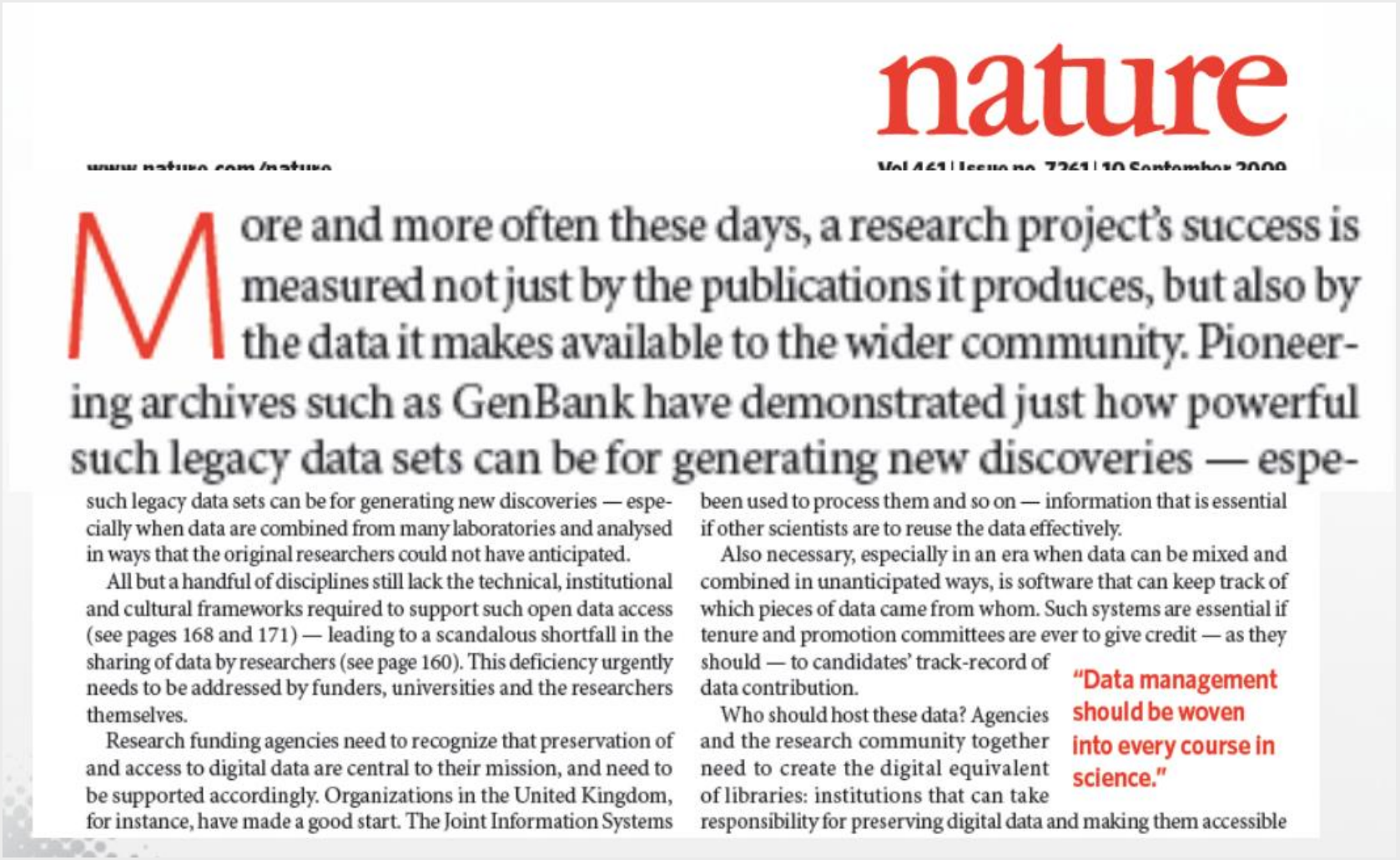
Alternative Reputation System



nature

www.nature.com/nature Vol 461 | Issue no. 7261 | 10 September 2009

More and more often these days, a research project's success is measured not just by the publications it produces, but also by the data it makes available to the wider community. Pioneering archives such as GenBank have demonstrated just how powerful such legacy data sets can be for generating new discoveries — espe-

such legacy data sets can be for generating new discoveries — especially when data are combined from many laboratories and analysed in ways that the original researchers could not have anticipated.

All but a handful of disciplines still lack the technical, institutional and cultural frameworks required to support such open data access (see pages 168 and 171) — leading to a scandalous shortfall in the sharing of data by researchers (see page 160). This deficiency urgently needs to be addressed by funders, universities and the researchers themselves.

Research funding agencies need to recognize that preservation of and access to digital data are central to their mission, and need to be supported accordingly. Organizations in the United Kingdom, for instance, have made a good start. The Joint Information Systems

been used to process them and so on — information that is essential if other scientists are to reuse the data effectively.

Also necessary, especially in an era when data can be mixed and combined in unanticipated ways, is software that can keep track of which pieces of data came from whom. Such systems are essential if tenure and promotion committees are ever to give credit — as they should — to candidates' track-record of data contribution.

"Data management should be woven into every course in science."

Who should host these data? Agencies and the research community together need to create the digital equivalent of libraries: institutions that can take responsibility for preserving digital data and making them accessible

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iPython Notebook

nature International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | For Authors

News & Comment › IPython interactive demo

IPython interactive demo

This demonstration is hosted by Rackspace Developer+.
Click here to make the notebook full screen.

IP[y]: Notebook

Python

Menu

- File
  - New
  - Open...
  - Make a Copy...
  - Rename...
  - Save and Checkpoint
  - Revert to Checkpoint

HTML interface to code, documentation and outputs, Pre set-up with tutorials, Supports tra

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Digital Market Places

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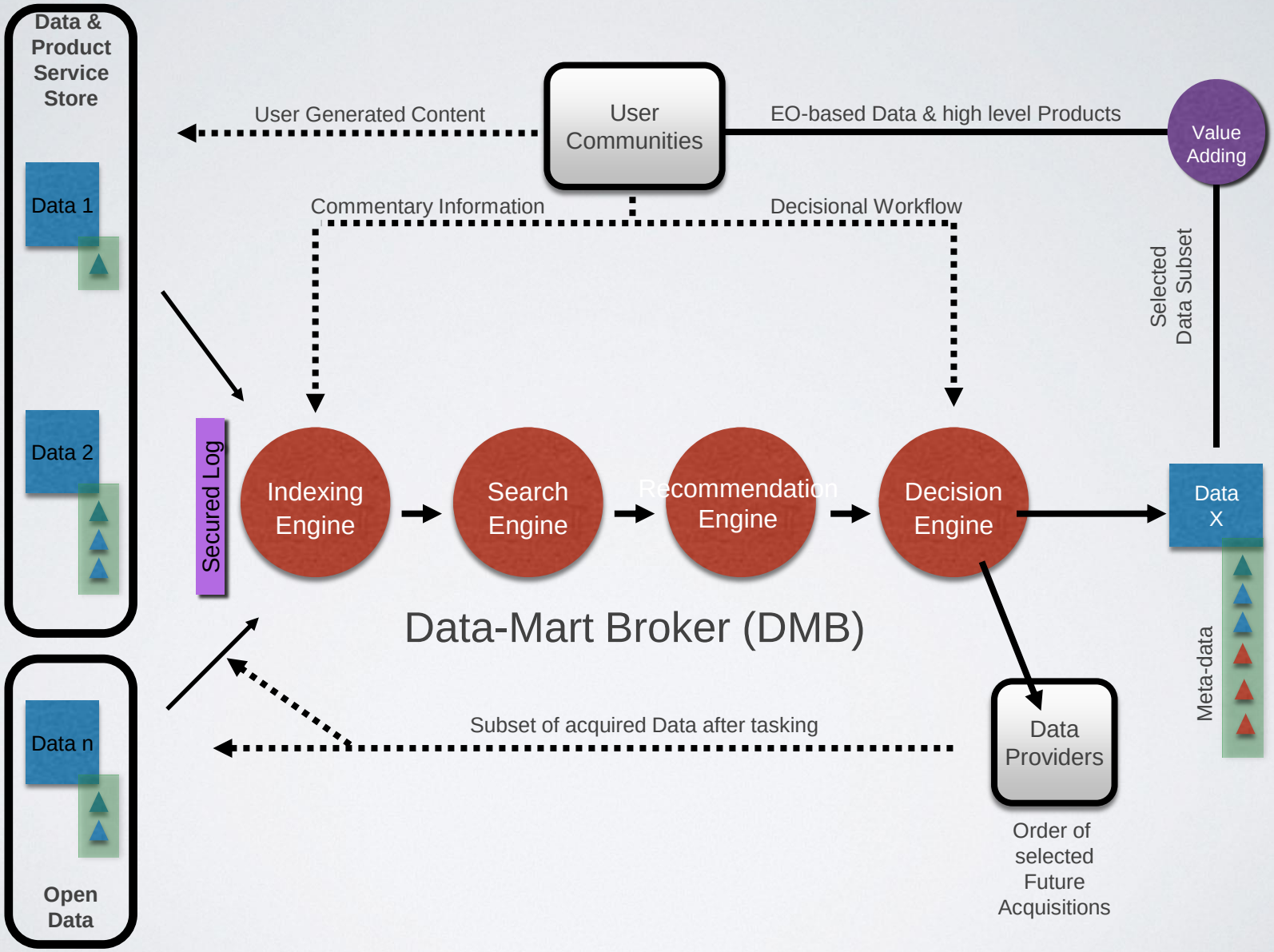
EO Oil & Gas Portal Marketplace



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The Sharing Economy

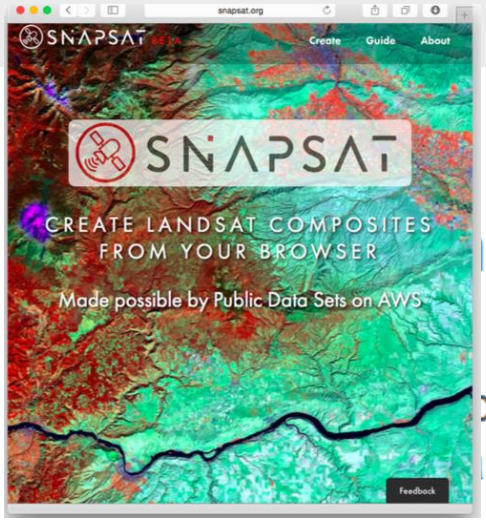
- Additional revenue from unused resources
- Save costs with “pay for use” model
- User has no costs of ownership and maintenance effort
- “Green” – sharing saves resources

Car Sharing: ↗ US$6.2 billion in 2020*

© 2015 CloudEO AG

*According to Navigant Consulting

Amazon Web Services



AWS

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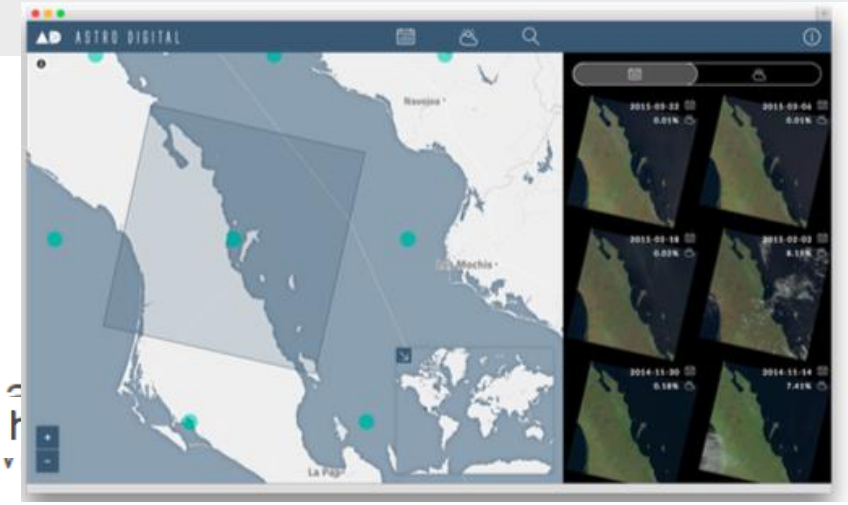


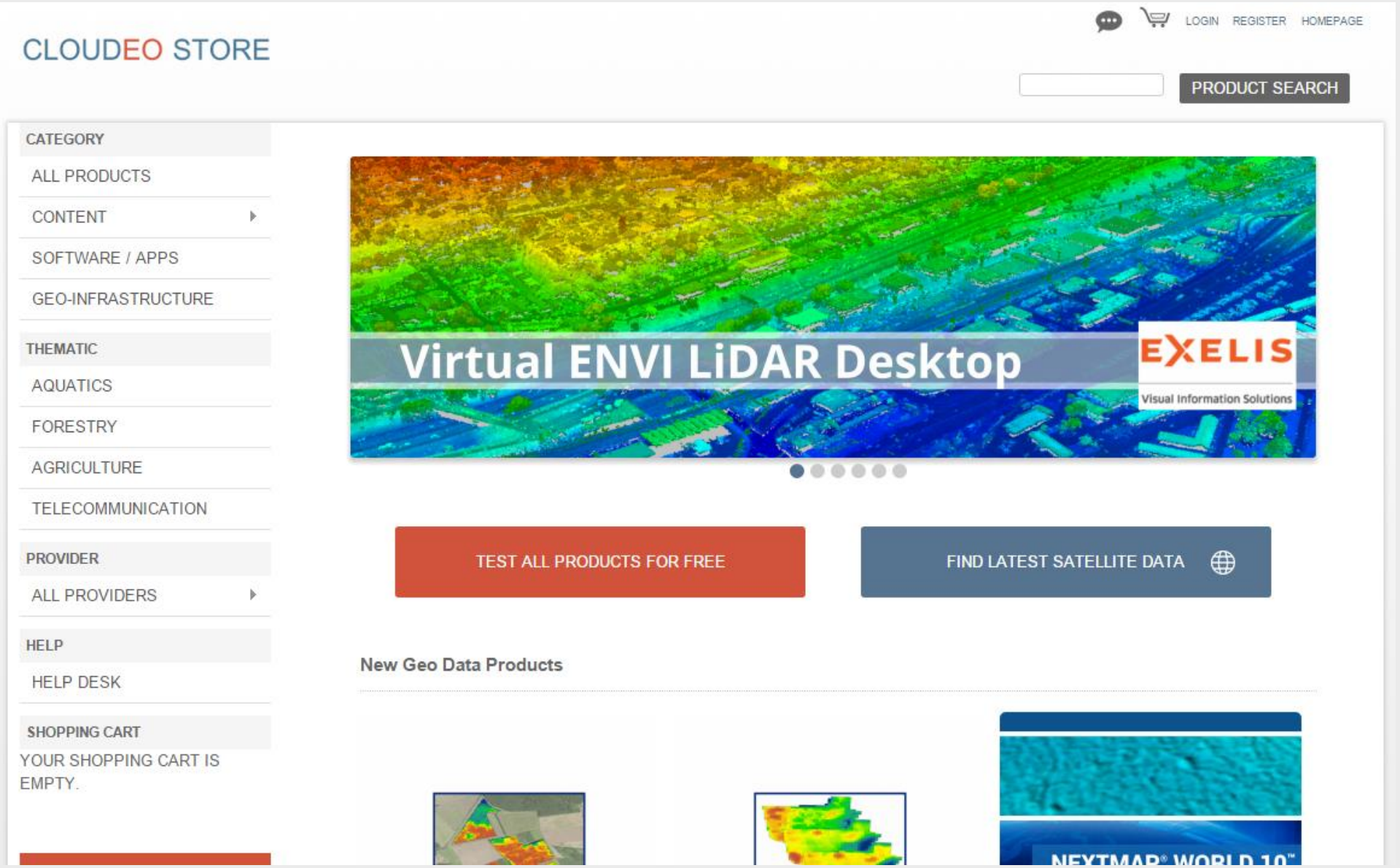
Amazon S3 lets you store and retrieve any amount of data, at any time, from anywhere on the web.

Amazon Elastic MapReduce (Amazon EMR) provides the Apache Hadoop analytics framework as an easy-to-use managed service.

Amazon DynamoDB is a fully-managed NoSQL database service that makes it cost-effective to store and retrieve any amount of data.

amazon web services

CloudEO Marketplace



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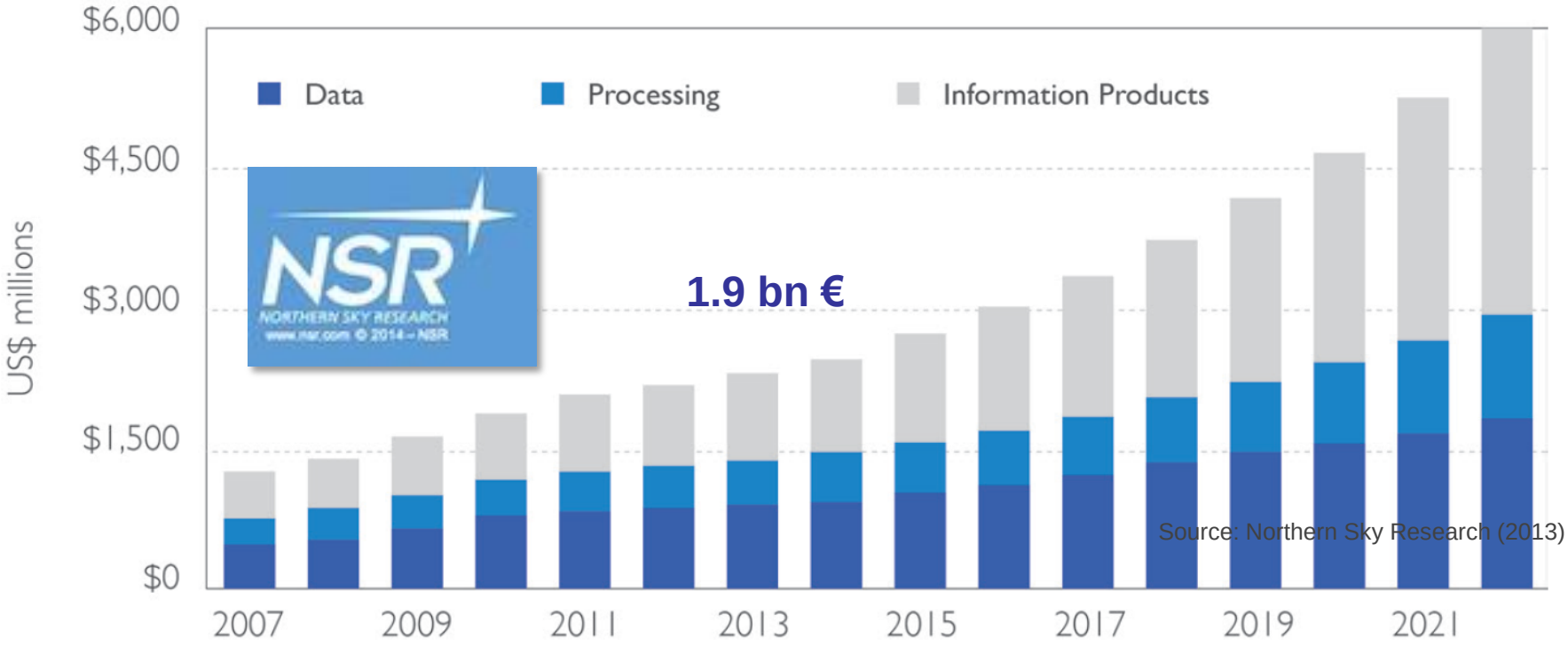
The Changing EO Market



Source: Northern Sky Research (2013)

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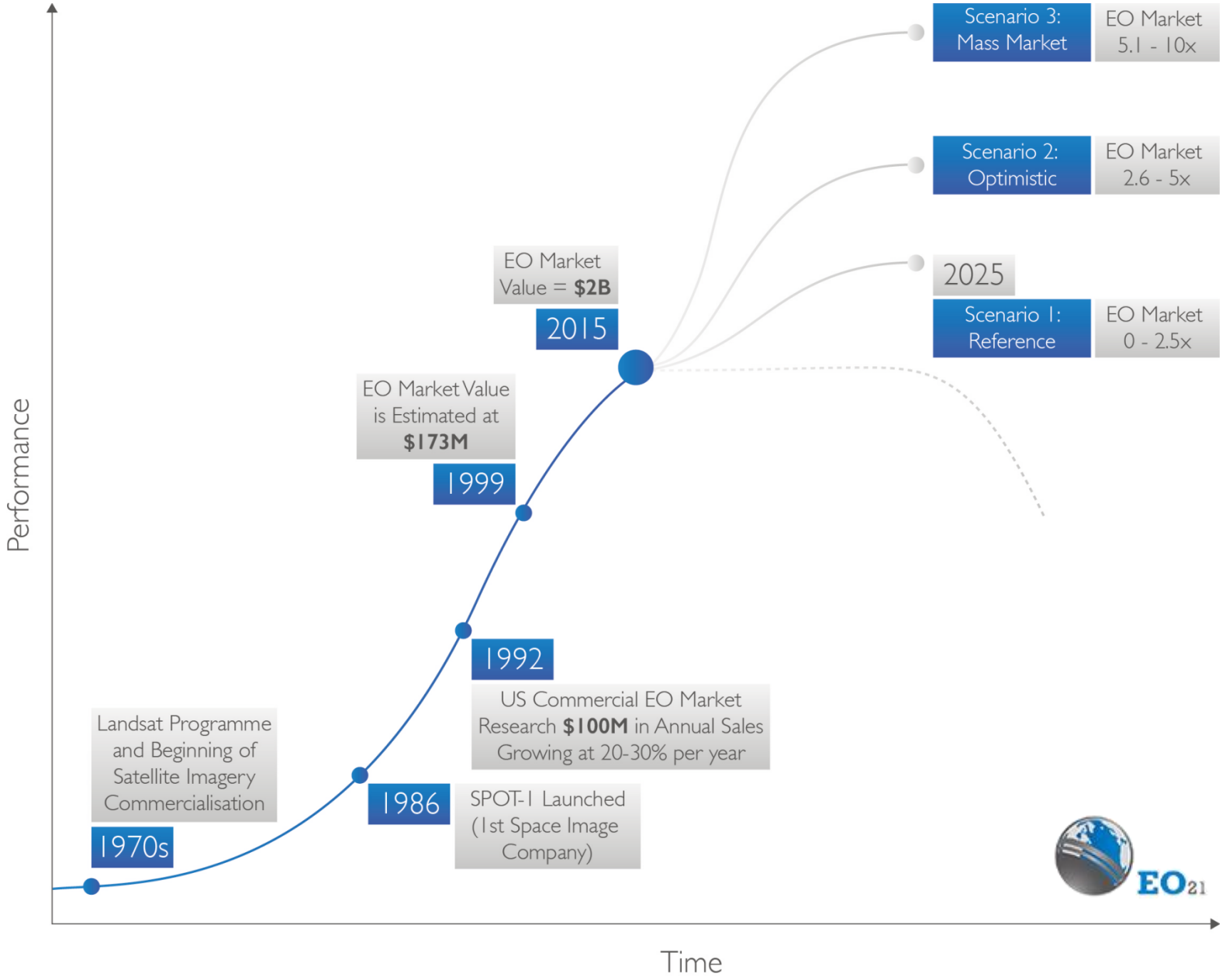
Possible future developments of EO industry



New role for EO Open Science funding bodies?

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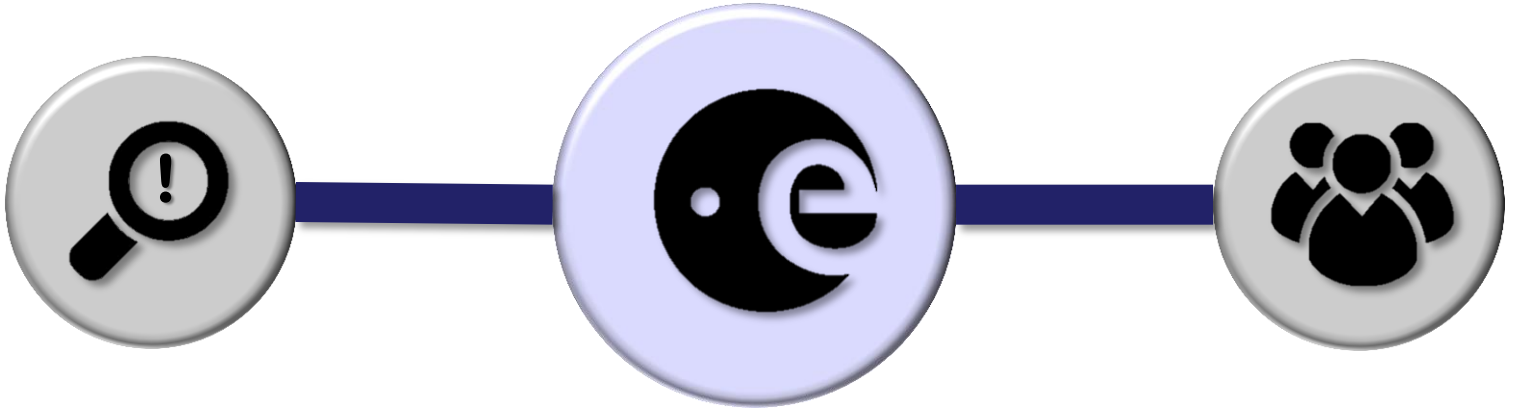
ESA as a Data Captain



Stewardship

- Creating standards and tools for better EO data access
- Marketing the accessibility of EO data
- Engage non-EO communities

Data Captain

- Identify long-term scientific goals
- Curation of long-term archives
- Partner up with cloud providers
- Data validation for new data types

Communication

- To non-EO actors about
  - Regulations
  - Policy
  - Key relationship management

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Open Innovation & Young Entrepreneurs

SPACE APP CAMP 2015

INITIATED BY esa

→ SPACE APP CAMP

14 – 21 SEP 2015, FRASCATI, ITALY

There are thousands of ways to enrich apps with data from space – what's yours? Enter the challenge!

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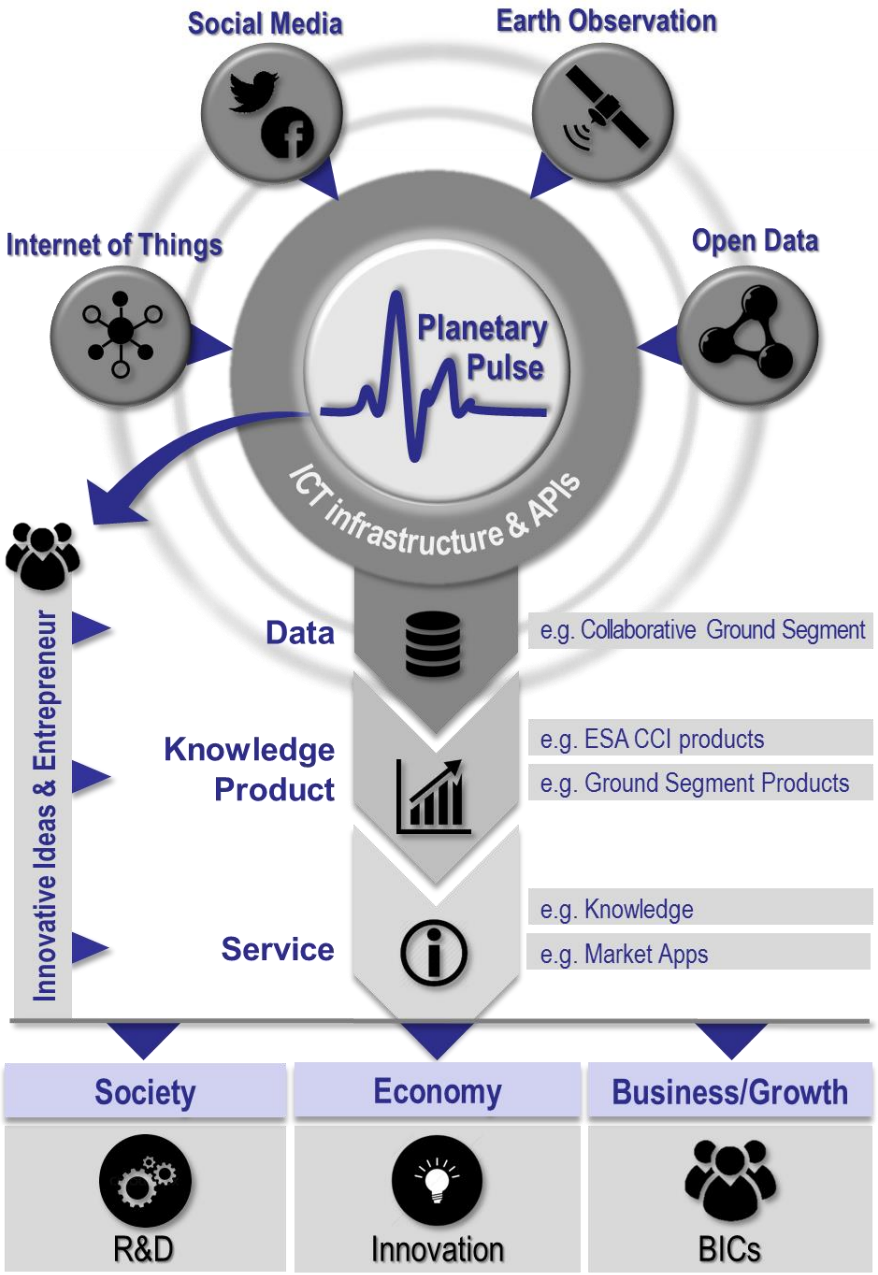
Open Data Innovation Ecosystem – Planetary Labs Initiative



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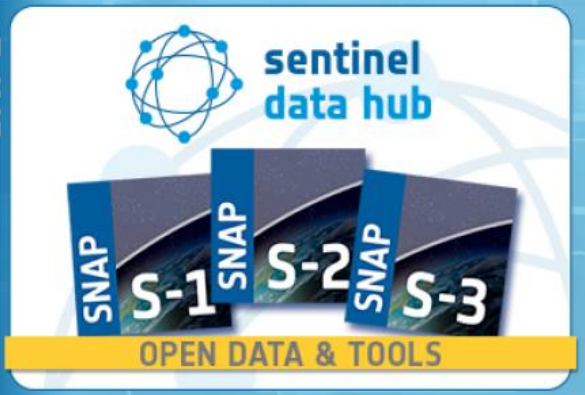
EO Open Science conference – 12-14 Oct

www.eoscience20.org

TOPICS FOR ABSTRACT AND EXHIBITIONS

DAY 1



DAY 2

DAY 3

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Many thanks for your attention ..

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