UNIVERSITY OF CAMBRIDGE
INSTITUTE FOR SUSTAINABILITY LEADERSHIP

Disaster Risk Financing & Insurance Program
SUPPORTED BY WORLD BANK GROUP

CENTRE FOR GLOBAL DISASTER PROTECTION

GFDRR
Global Facility for Disaster Reduction and Recovery

UKaid
from the British people

Satellite Earth Observation (EO) and Disaster Risk Management (DRM)

Stephen Coulson, Philippe Bally

Directorate of Earth Observation Programmes (EOP)
European Space Agency (ESA)

17th July, 2018, Cambridge (UK)

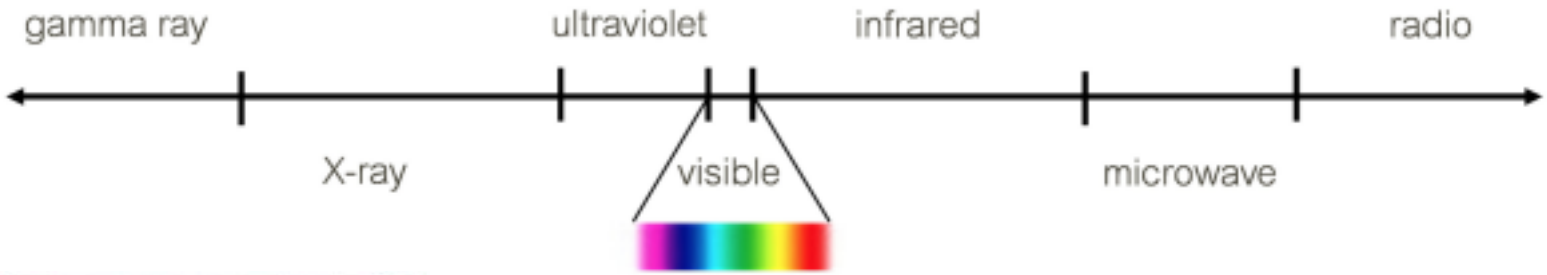
Take-home Messages

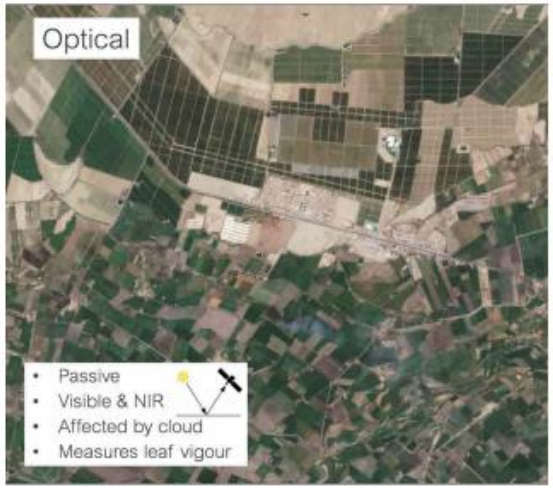
- Satellite Earth Observation (EO) can provide **key environmental information** in all phases of Disaster Risk Manangement (DRM) *: risk assessment, prevention, preparedness, response & recovery*

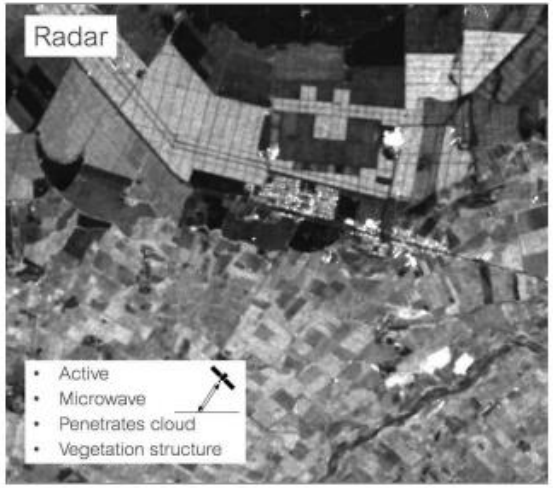
- This information is being delivered in the event of **natural disasters** under operational conditions to end-Users (Civil Protection) both inside **Europe and Globally**,

- ESA has **strategic collaborations** on-going with the main International Financing Institutions (eg. World Bank) to demonstrate the benefits if **EO for Sustainable Development**. DRM is one theme; opportunities exist for Users (You?) to be involved (2018-21).

Satellite Earth Observation (EO) : some basics





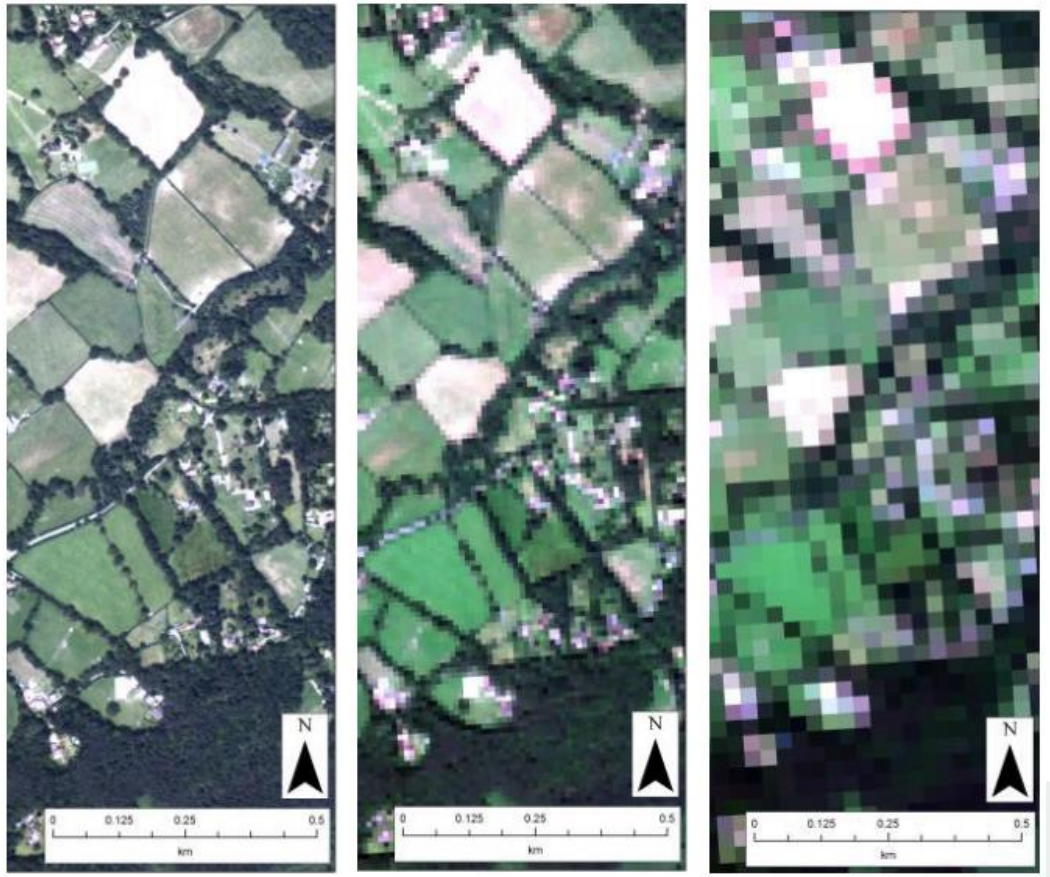


EM Spectrum

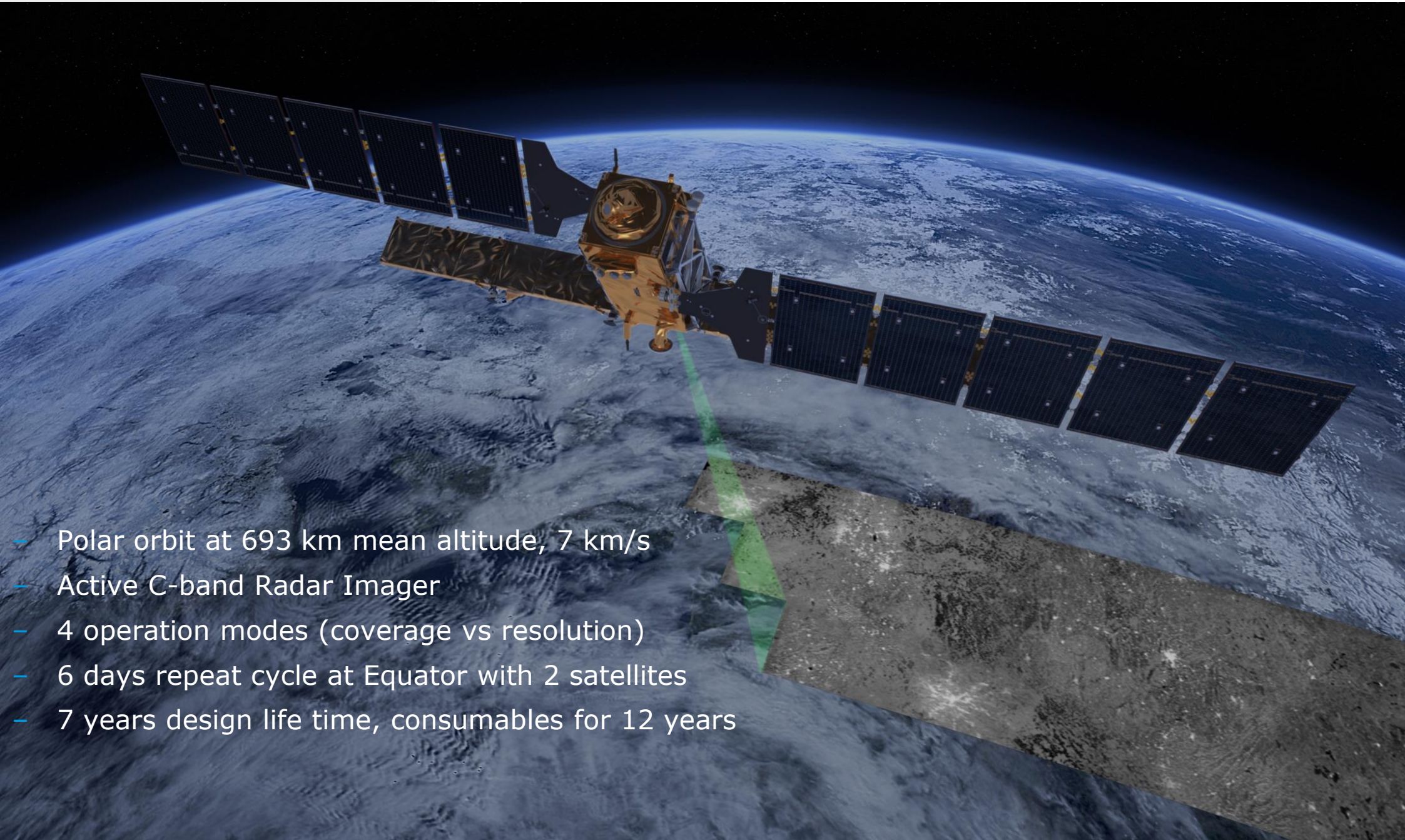
Optical Vs Radar

Resolution

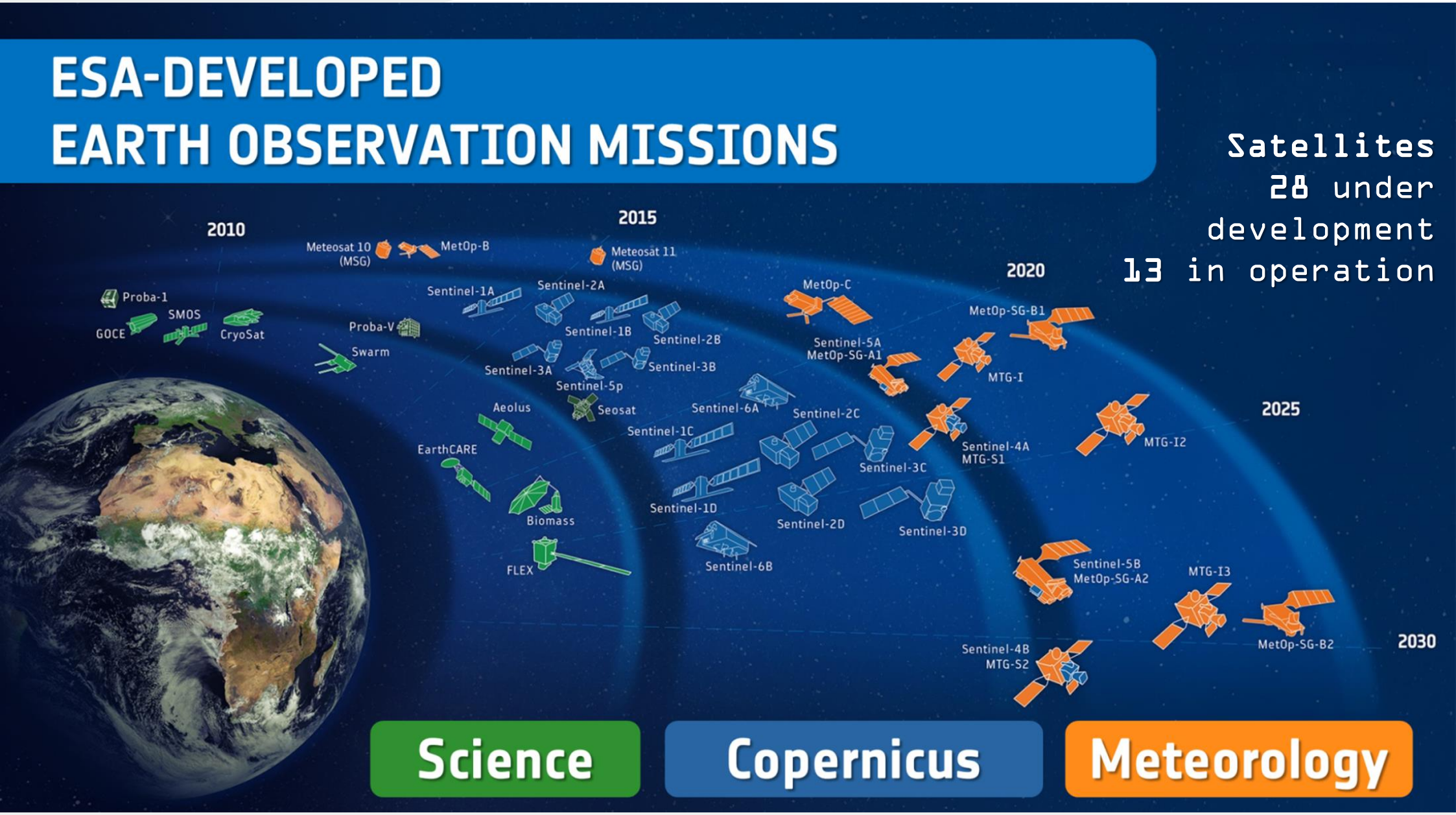
WorldView 2 (1.84m) **Sentinel 2 (10m)** **Landsat 8 (30m)**



An Example : Sentinel-1

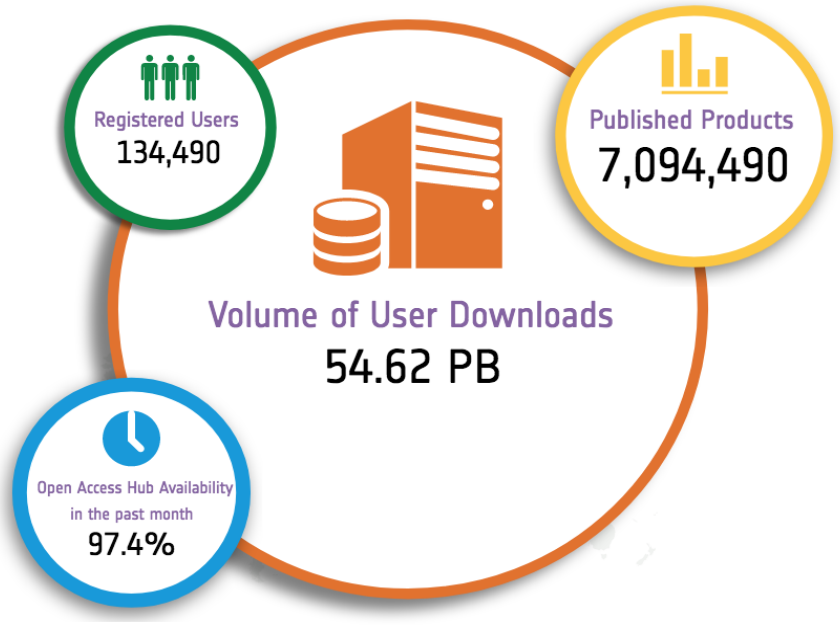


- Polar orbit at 693 km mean altitude, 7 km/s
- Active C-band Radar Imager
- 4 operation modes (coverage vs resolution)
- 6 days repeat cycle at Equator with 2 satellites
- 7 years design life time, consumables for 12 years


ESA-DEVELOPED
EARTH OBSERVATION MISSIONS
Satellites
28 under development
13 in operation
2010
2015
2020
2025
2030
Proba-1
SMOS
GOCE
CryoSat
Meteosat 10 (MSG)
MetOp-B
Proba-V
Swarm
Sentinel-1A
Sentinel-2A
Meteosat 11 (MSG)
Sentinel-1B
Sentinel-2B
Sentinel-3A
Sentinel-3B
Sentinel-5p
Seosat
Aeolus
EarthCARE
Biomass
FLEX
Sentinel-6A
Sentinel-1C
Sentinel-2C
Sentinel-3C
Sentinel-1D
Sentinel-2D
Sentinel-3D
Sentinel-6B
MetOp-C
Sentinel-5A
MetOp-SG-A1
MetOp-SG-B1
MTG-I
Sentinel-4A
MTG-S1
MTG-I2
Sentinel-5B
MetOp-SG-A2
MTG-I3
Sentinel-4B
MTG-S2
MetOp-SG-B2
Science
Copernicus
Meteorology

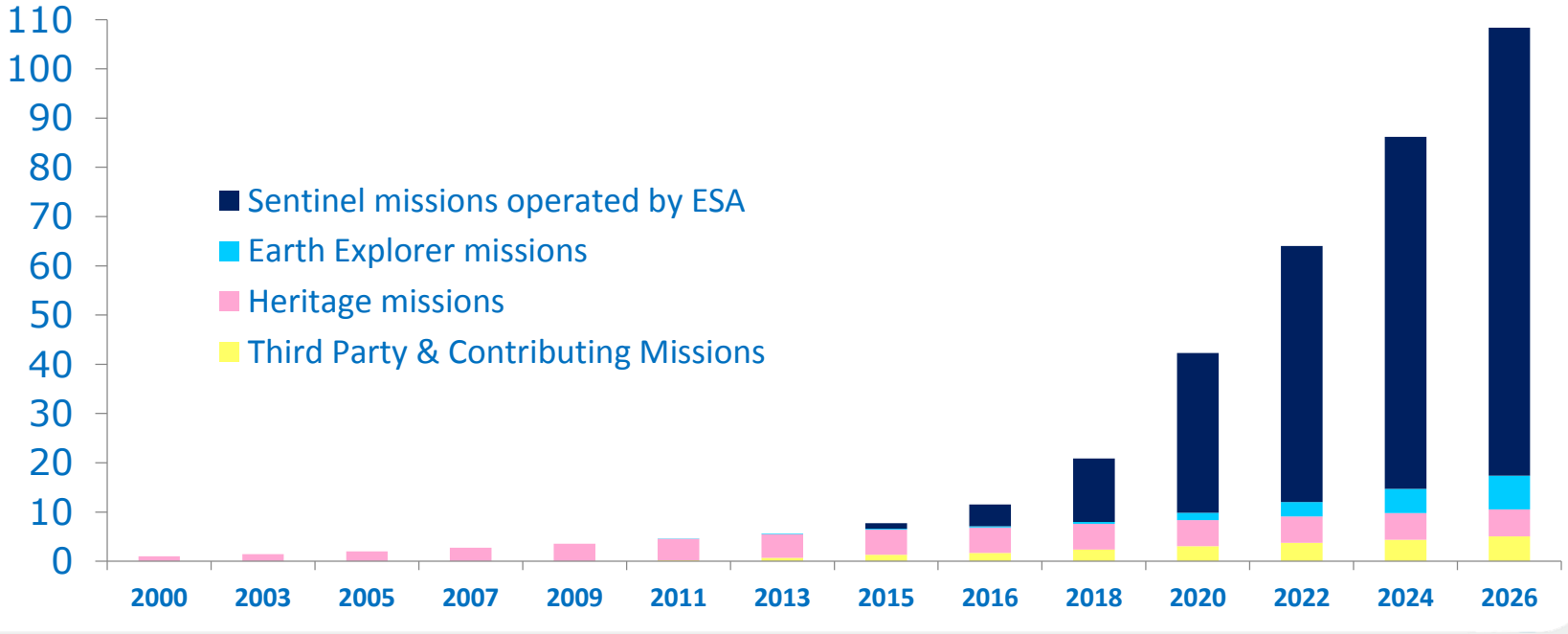
Copernicus : Big Data Revolution

Free, full & open data policy



ESA EO Data Archive

Petabyte



Statistics as of
06 April 2018

But, the EO Landscape is ***rapidly evolving***

*'**OldSpace**'…….Big/Govt/Traditional*

- 60 Space Agencies (156 Satellites),
- Government financing
- 3000 – 100 Kg class
- 100 - 500 M€
- Developing the Technology
- Few Units (1-4)

***Sentinel 2-B** AIT Clean Room, ESA/ESTEC (2017)*

CEOS Committee on Earth Observation Satellites

*'**NewSpace**'…….Small/Private/Innovative*

- 20-30 players, Private Sector, (Mainly USA)
- VC financing
- 10 – 5 Kg class
- 1 - 5 M€
- Spin-in Technology (Smartphone, Manufacturing, ….)
- 100's Units (constellations)

***Planet** team (2010) & first **Doves** (2013), Now 500 employees, 300 satellites (2017)*

How can EO support Disaster Risk Management ?

Hazard mapping:

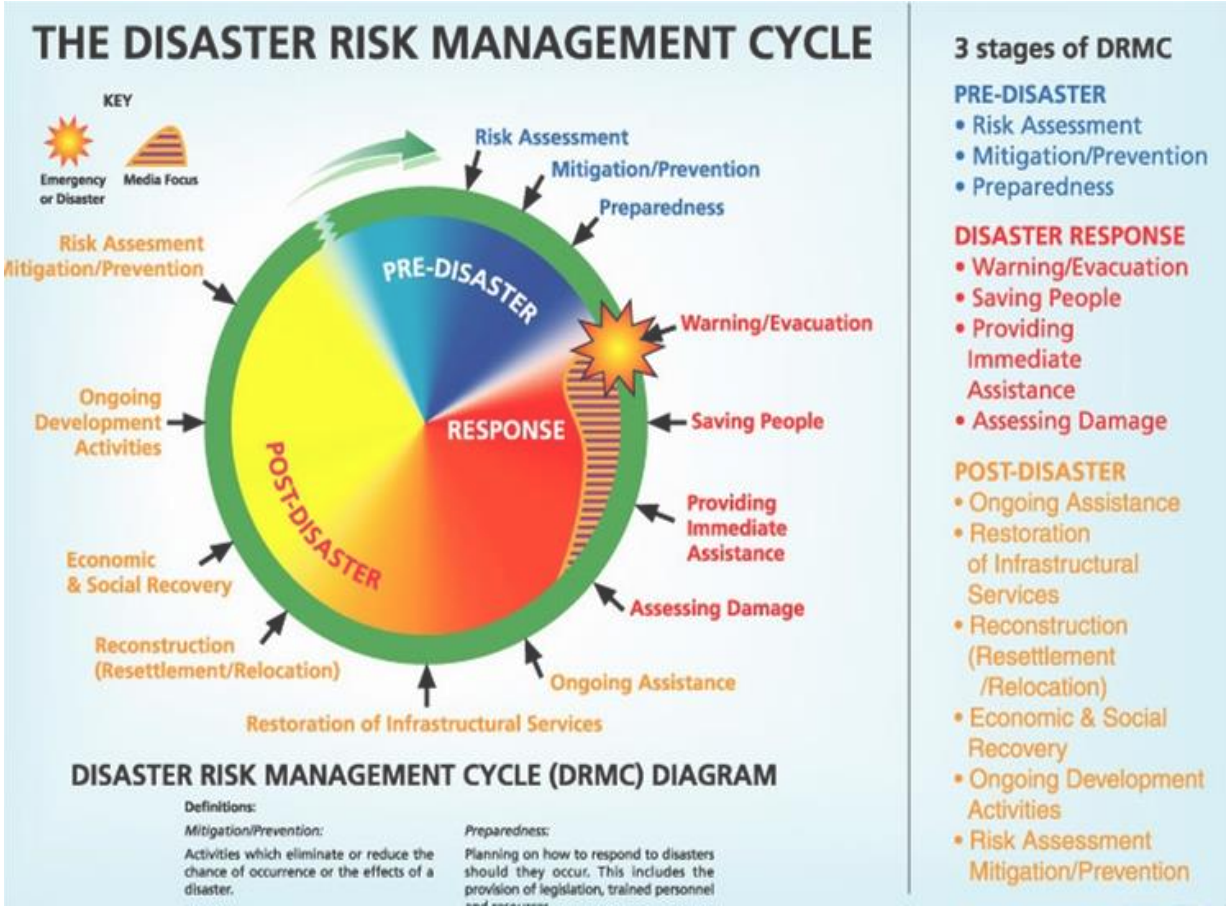
Hazard impact and zoning of damaged areas (basic information content, but rapid production) (*Response phase*)

Detailed information on Hazard/Risk (*Risk assessment in prevention/preparedness*)

Better characterization of Hazards (*Science & Operations*)

Exposure & Asset mapping

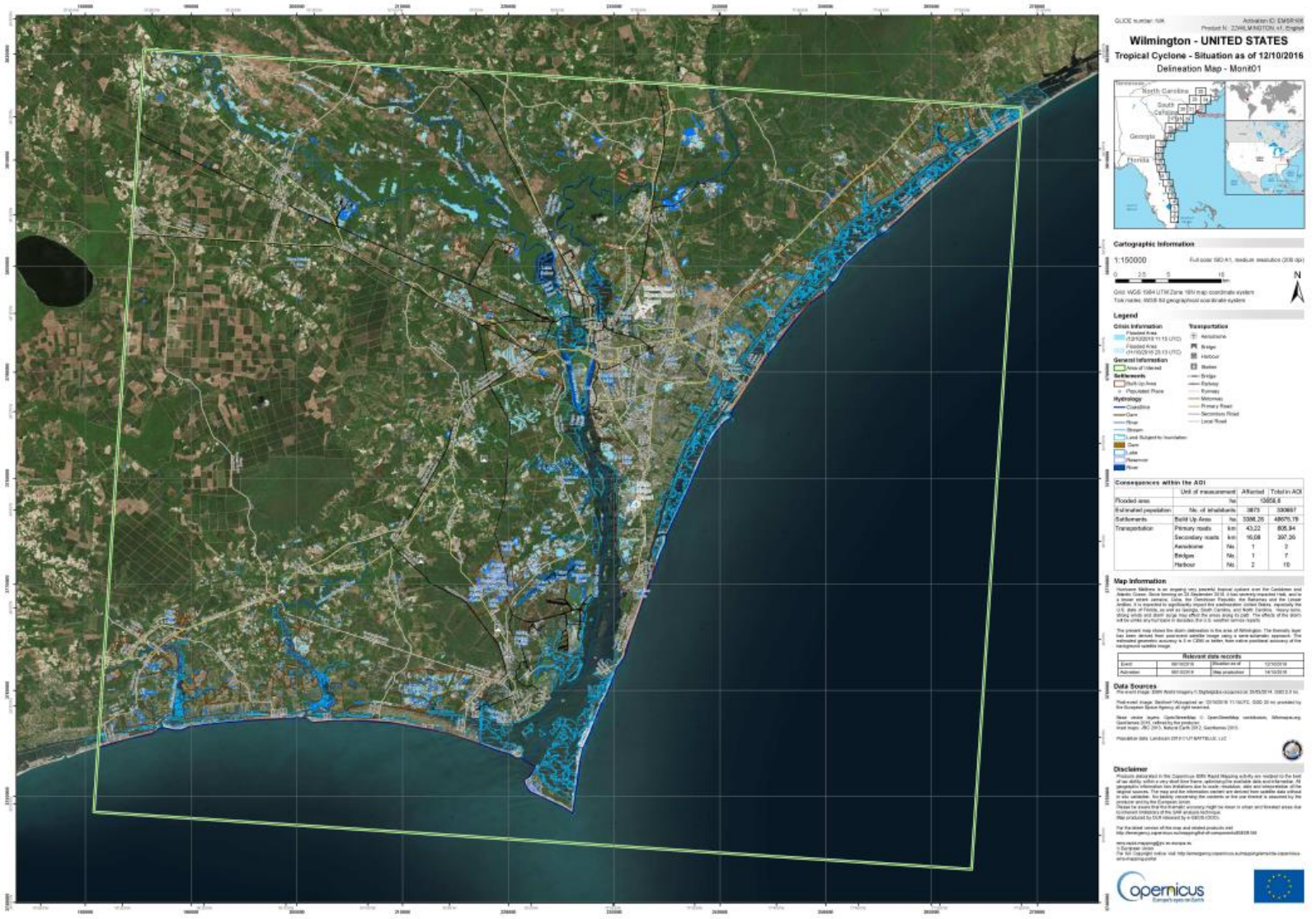
Wide range of information products



Floods : Extent & Evolution

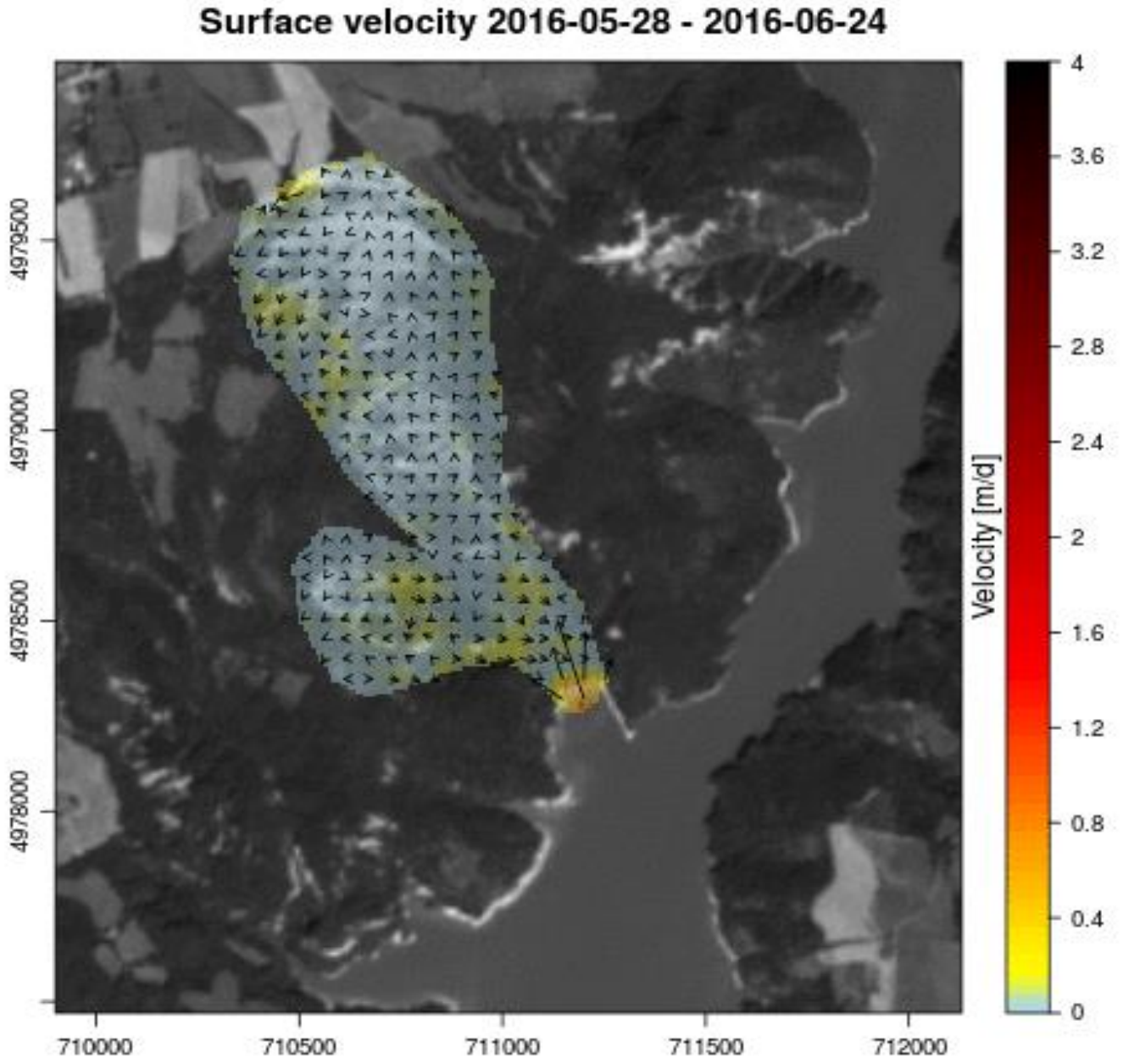
Hurricane Matthew in the USA, 2016

Situation map in Wilmington using Sentinel-1 data (12/10/2016)



Landslides : Delineation & Monitoring

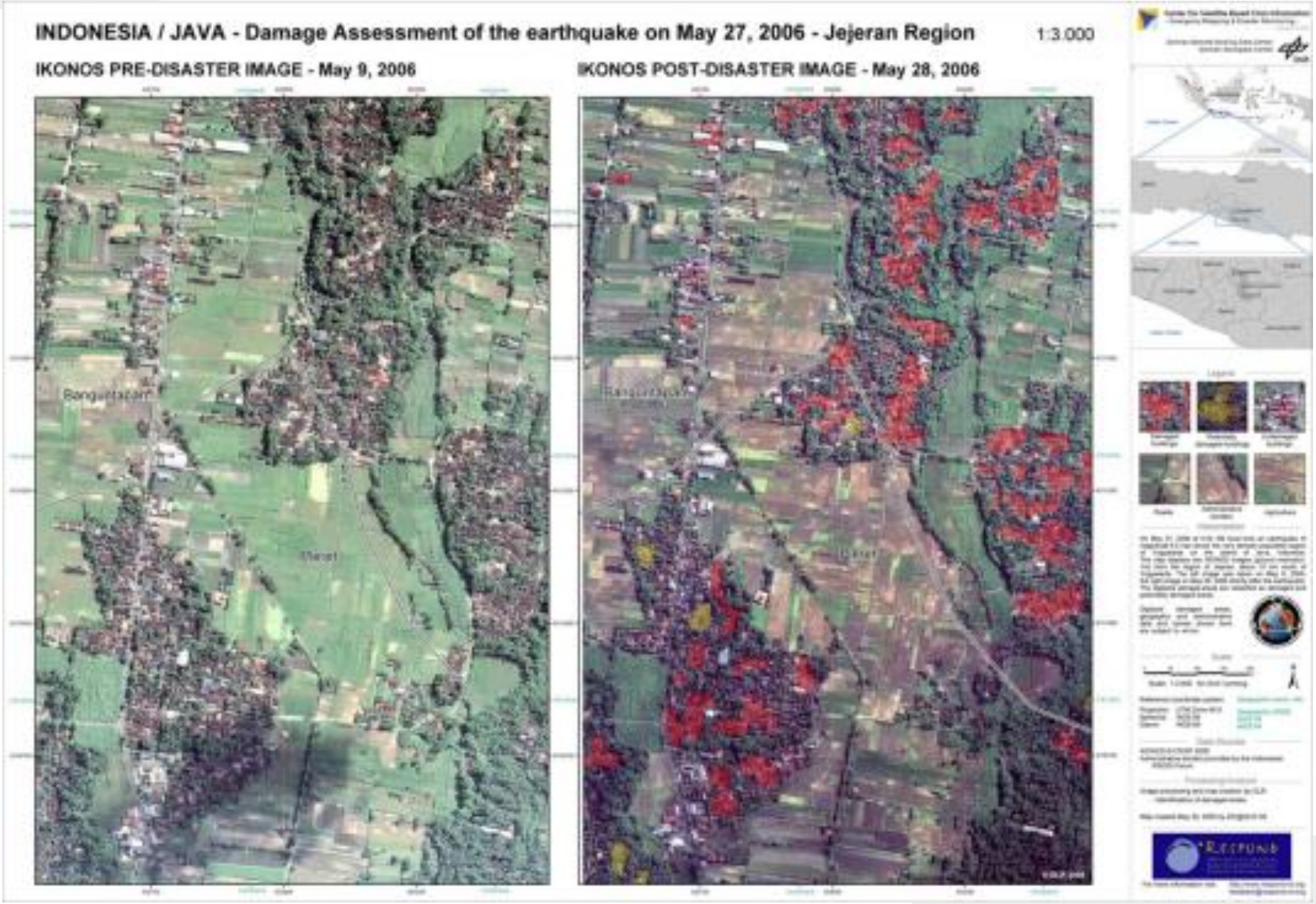
Hamalières landslide (France) using Sentinel-2 time-series, May-September 2016



Damage Assessment (Buildings)

Damage mapping after the 27/5/2006 Earthquake hitting Jejeran, Indonesia;

Credits: Airbus S&D, ESA



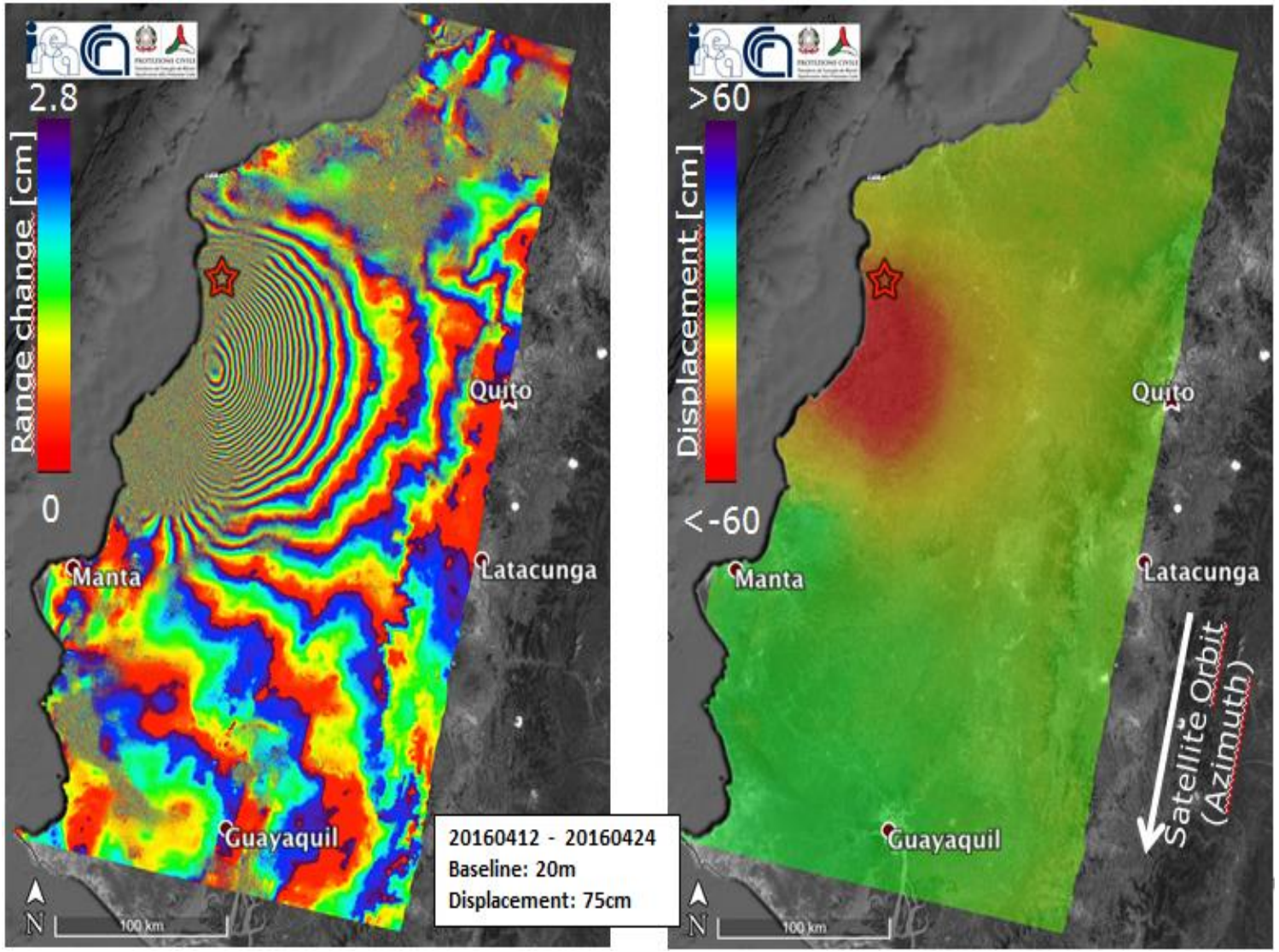
Earthquakes : Co-Seismic Displacement

Earthquake in Ecuador (Mw 6.0 in Muisne) on 16 April 2016

Land surface precision displacement map generated from two Copernicus Sentinel-1 acquisitions of 12 and 24 April 2016 (before & after)

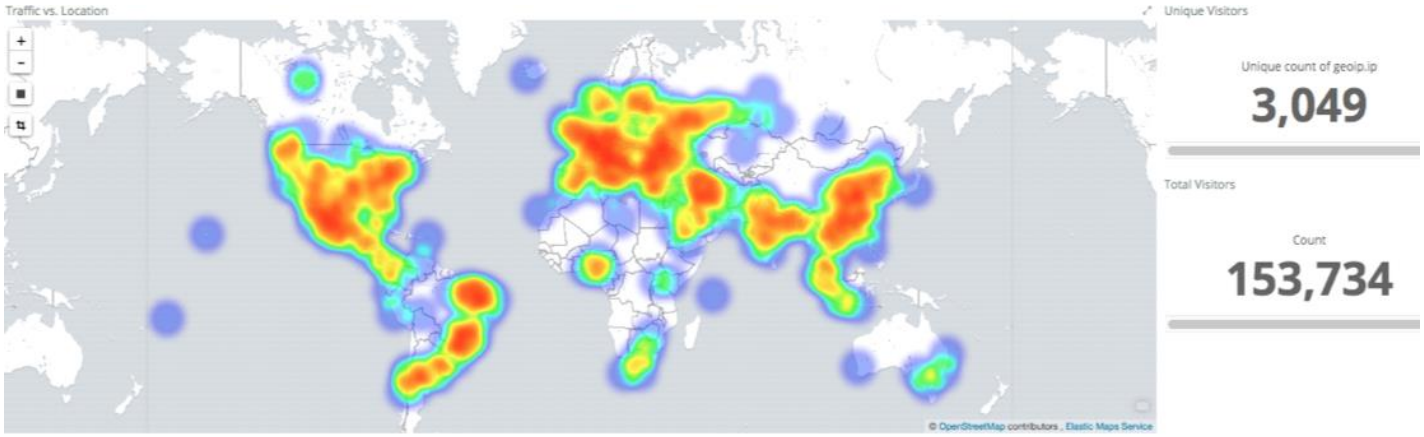
Understand the extent of area effected

Better model the seismogenic fault to undertand the causes.



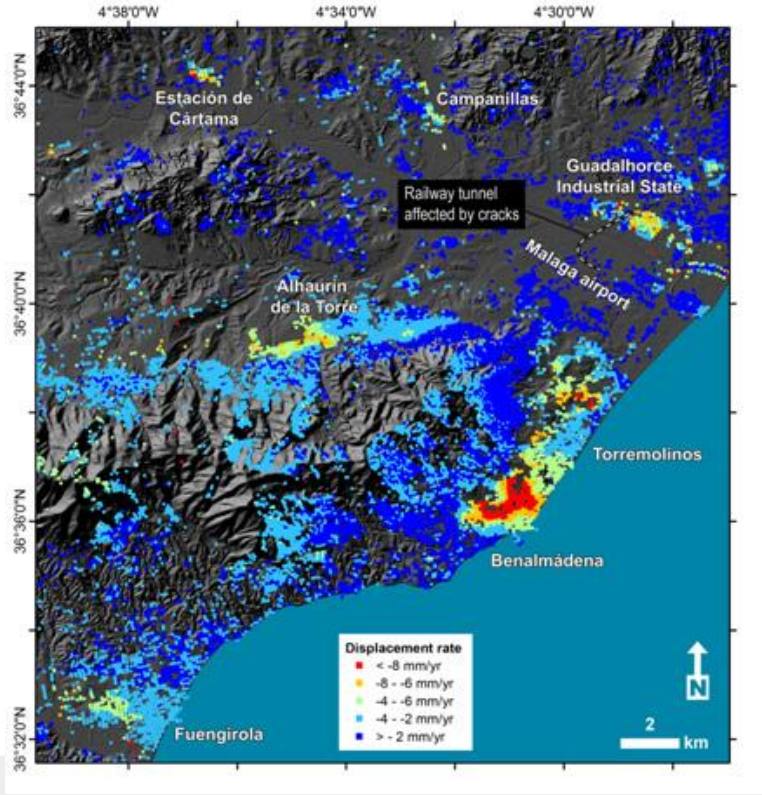
GeoHazards Lab : Exploitation Platform

Distribution of Users



Aims to address priorities of the **Sendai Framework for Disaster Risk Reduction** 2015-2030 using satellite EO (focus: better understanding hazards & risks)

Surface velocity map (West Malaga, Spain)

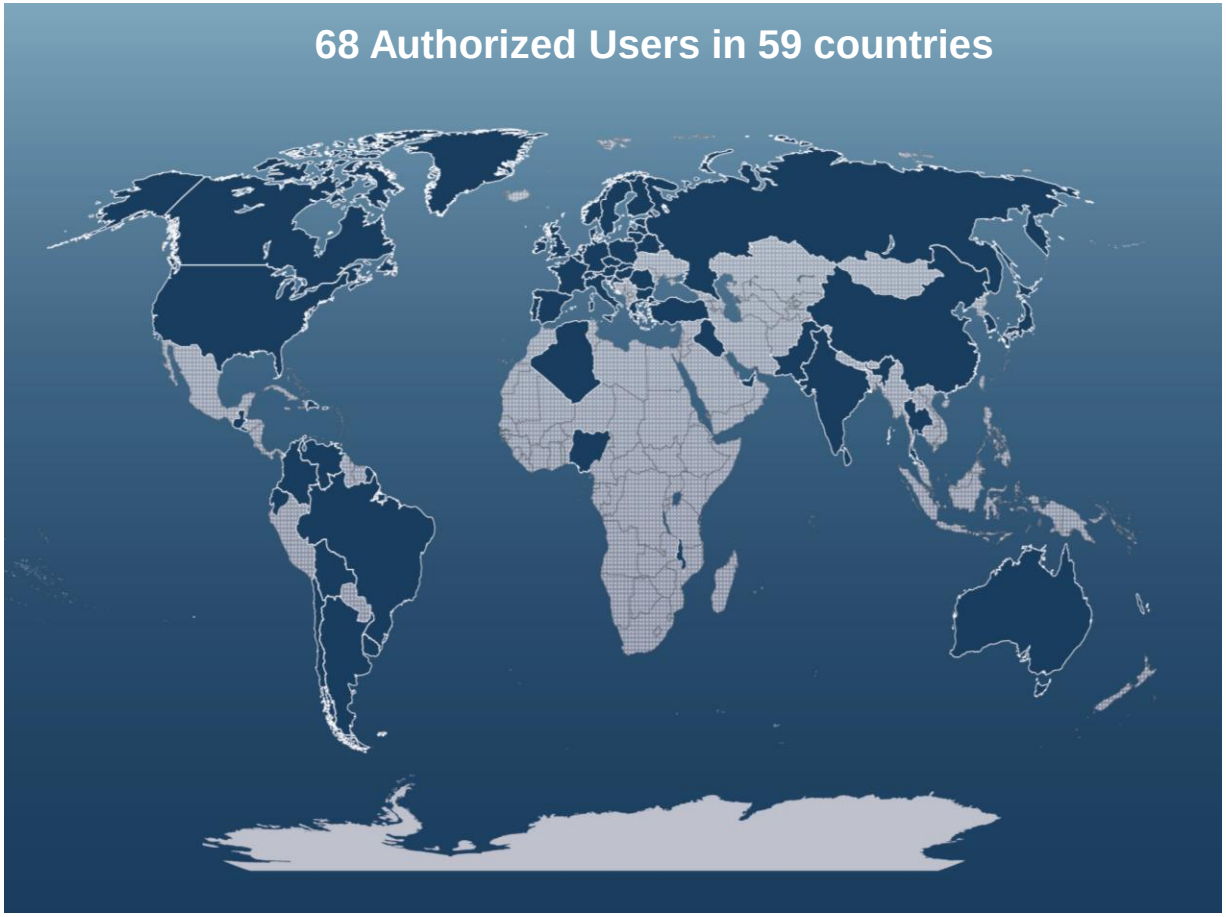


- ➔ **Systematic** processing services to address needs for “common information layers”
- ➔ **On-demand** processing services to address AOI-specific analysis
- ➔ **Massive Cloud** Compute power, managing multi-tenant resources
- ➔ Access to 70+ TB of **EO data archives**, including Copernicus Sentinels-1/2/3 repositories.

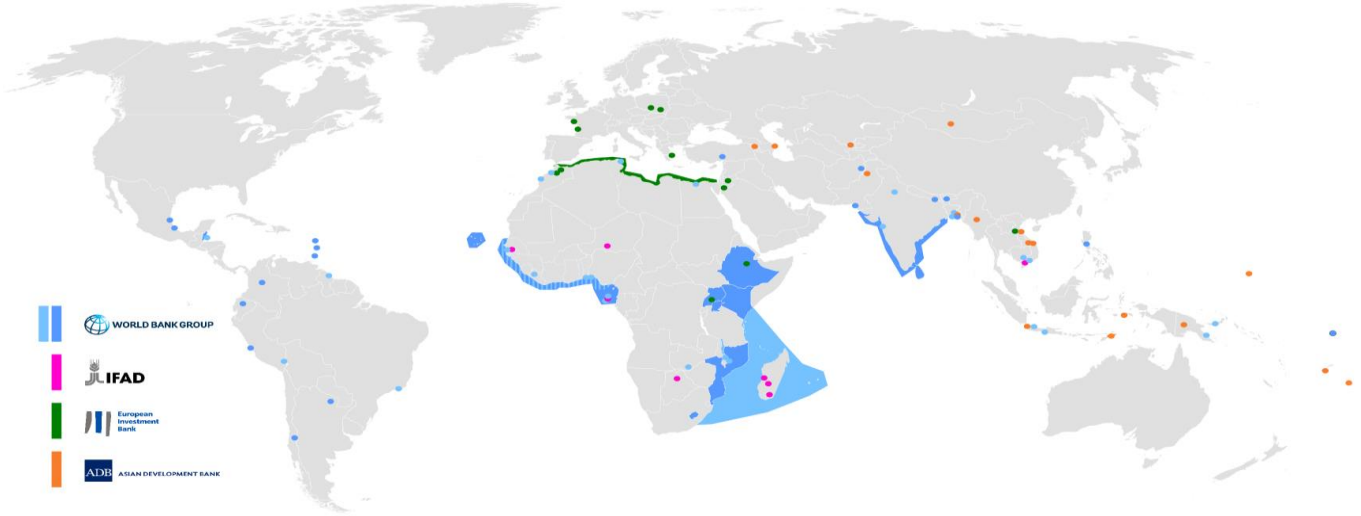
geohazards tep

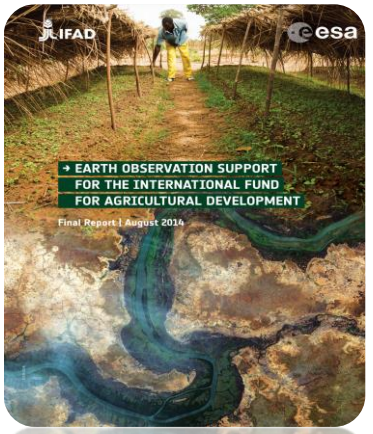
The International Charter Space & Major Disasters:

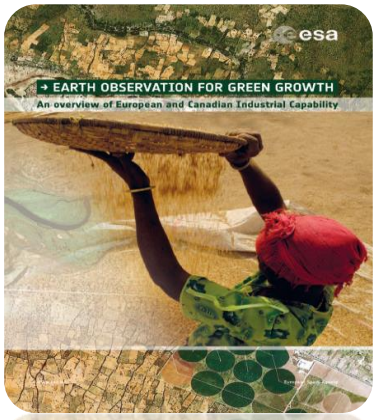
- An **International agreement among 17 Space Agencies** to support relief efforts in the event of emergencies caused by major disasters
- **Unified system of EO data acquisition / delivery** (at no cost, best effort basis)
- **Authorised Users :** Civil protection agencies, emergency & rescue services,
- **Operational** : 24/7 on-duty-operator
- **560+ activations in 123 countries** since 2000.



EO for Sustainable Development



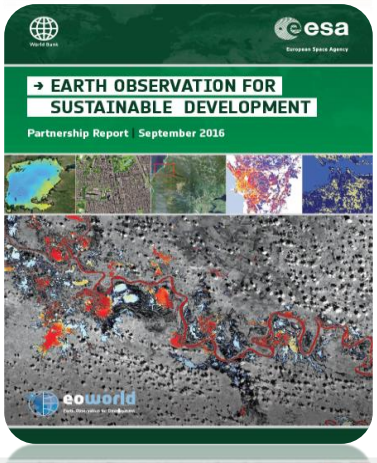




65+ small-scale demonstrations of EO-based environmental information in the implementation of International Financing Institutions (IFIs) projects 2010-15.

***World Bank**, Dec 2015*

***Asian Development Bank**, Nov 2016*



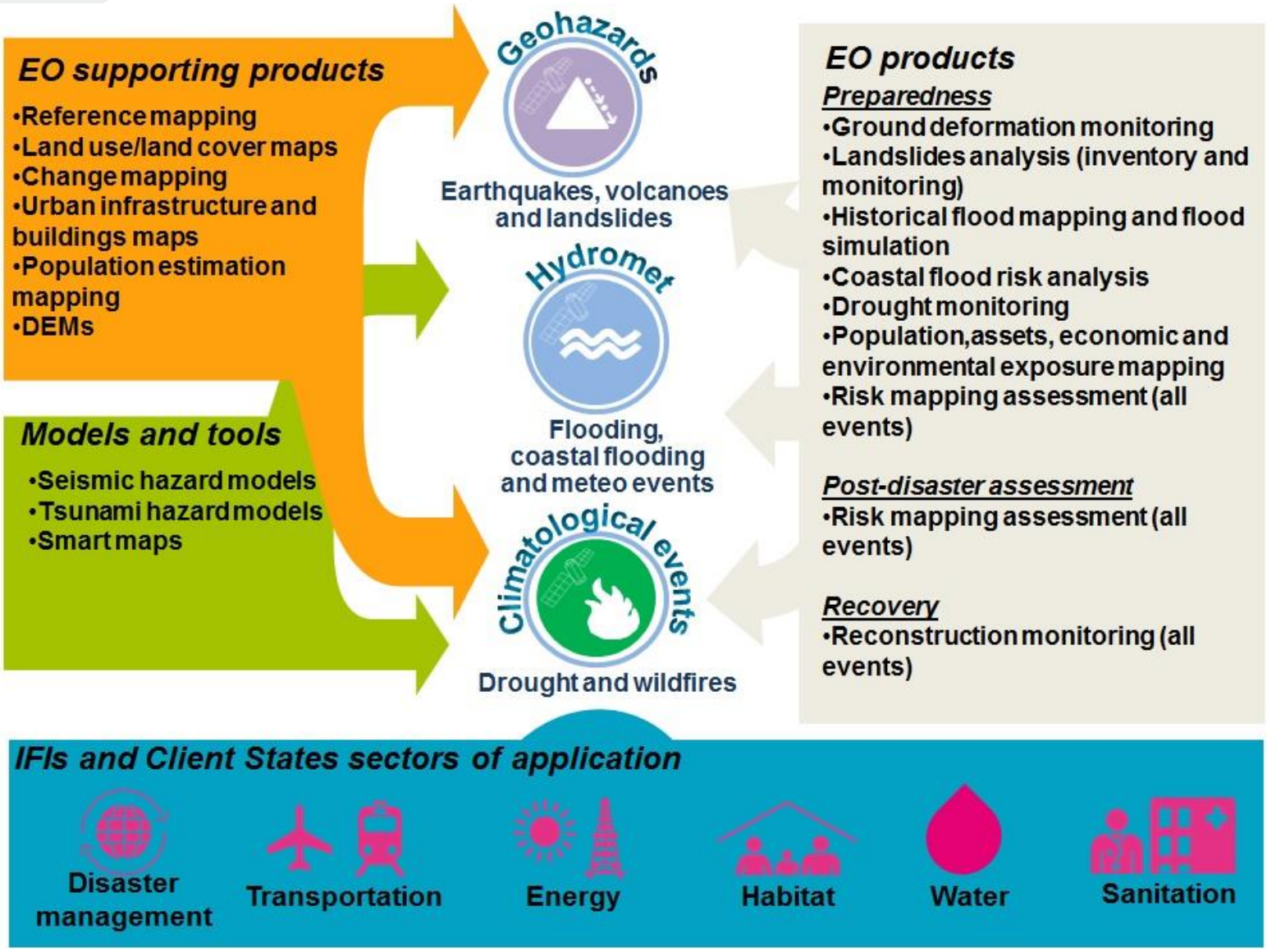
EO4SD DRM

Large-scale regional demonstrations

Consolidate Requirements,

Engage stakeholders (IFIs & Client States)

2018-21



eo4sd.esa.int

How to get further involved

- Through ESA activities happening now (or near future):
  - Disaster Risk Management (philippe.bally@esa.int)
  - EO for Sustainable Development (stephen.coulson@esa.int)

- More Information on Satellite EO Missions:
  - Committee of Earth Observing Satellites (ceos.org)

- More Information on Satellite EO Benefits to Society:
  - Group on Earth Observations (www.earthobservations.org)

Thank You for participation !