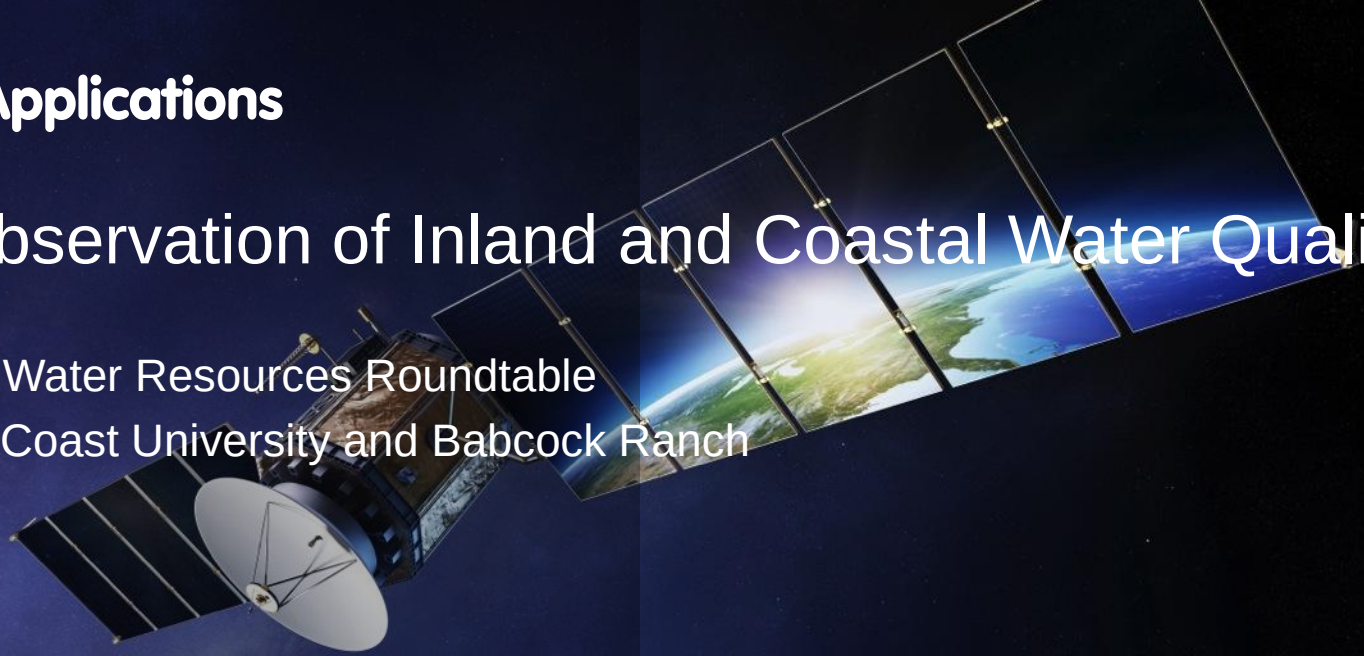
Satellite Applications

Earth Observation of Inland and Coastal Water Quality

Sustainable Water Resources Roundtable
Florida Gulf Coast University and Babcock Ranch



Cathy Johnson

22 December 2016

We work with Innovate UK

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Satellite Applications Catapult – part of Harwell Space Cluster

Satellite Applications: Three Waves of Innovation

First Space Age

Prestige → Science

1962
Kennedy Speech

Second Space Age

Institutional → Commercial

inmarsat

1979
Inmarsat

1978
Navstar 1

1964
Intelsat

INTELSAT

New Space Age

Disruption → Mass Market

2007
Economic downturn

2004
- X-Prize Flight
- Commercial Space Launch Amendments Act

So what can we use satellites for?

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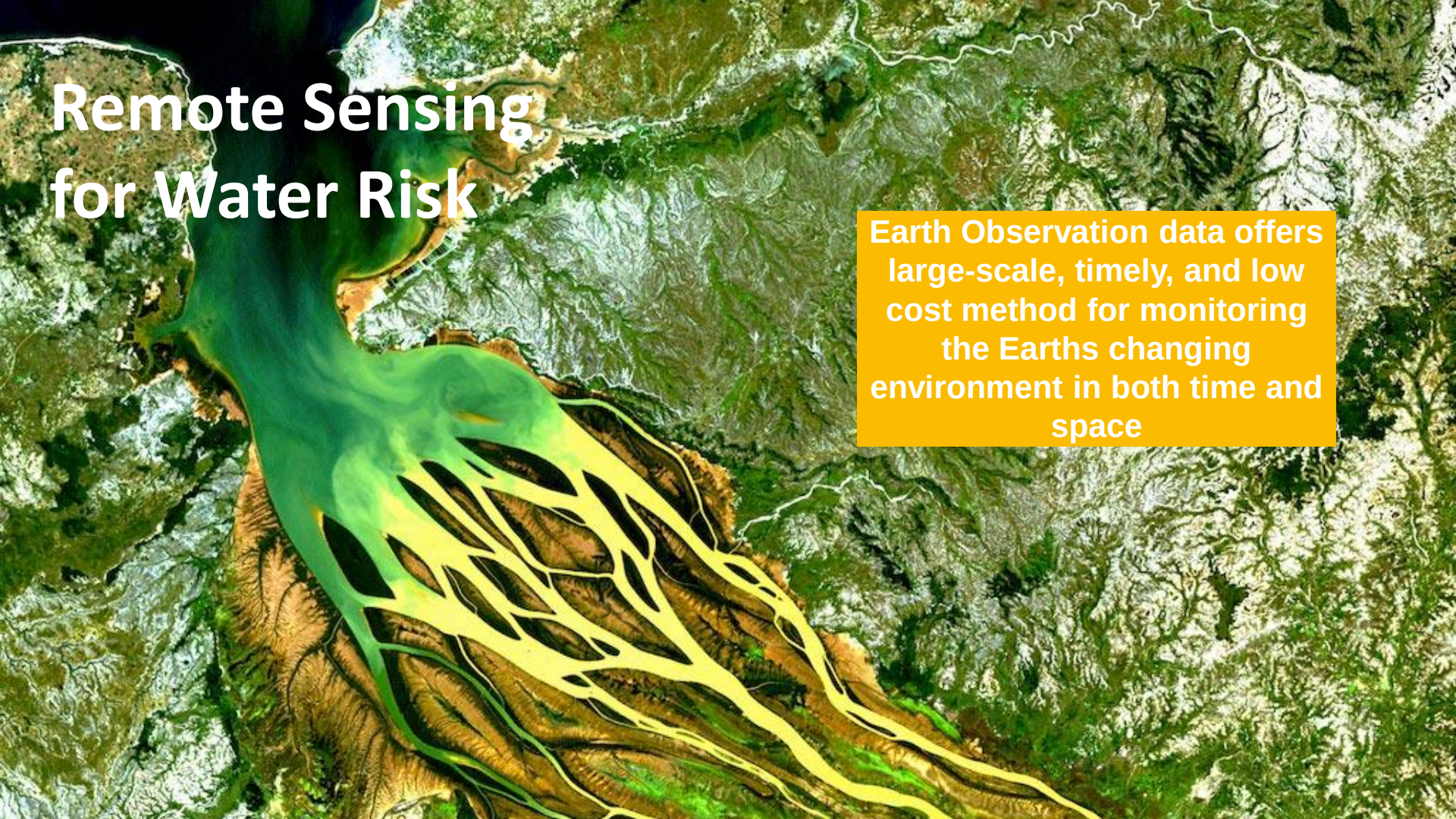
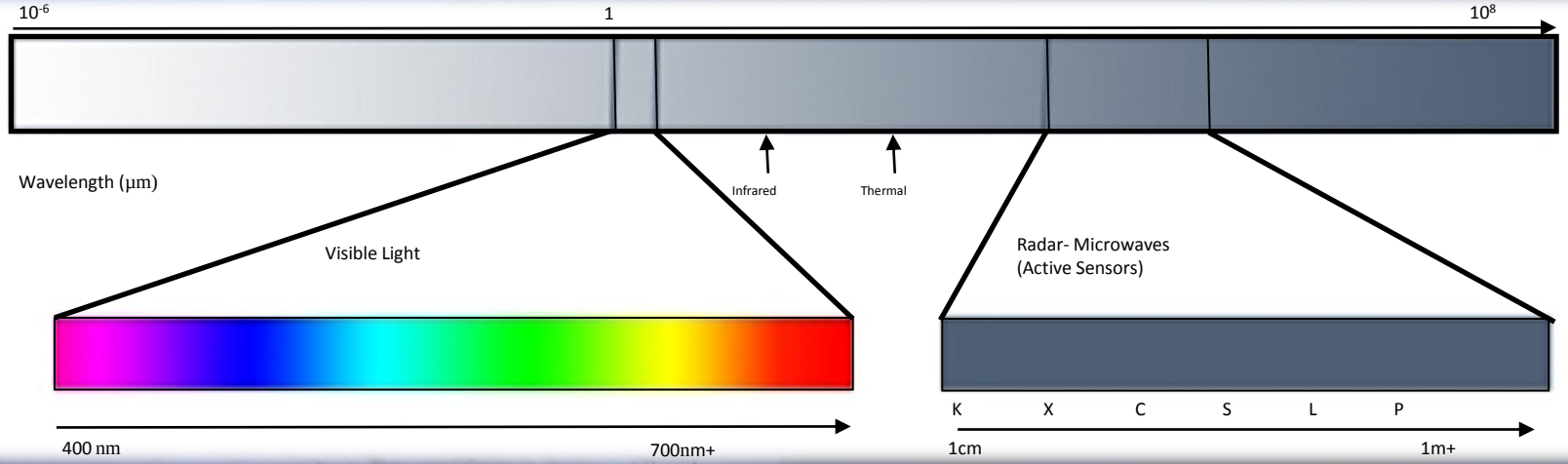
Remote Sensing for Water Risk



Earth Observation data offers large-scale, timely, and low cost method for monitoring the Earths changing environment in both time and space

How does a satellite see?



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Passive System

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Active System

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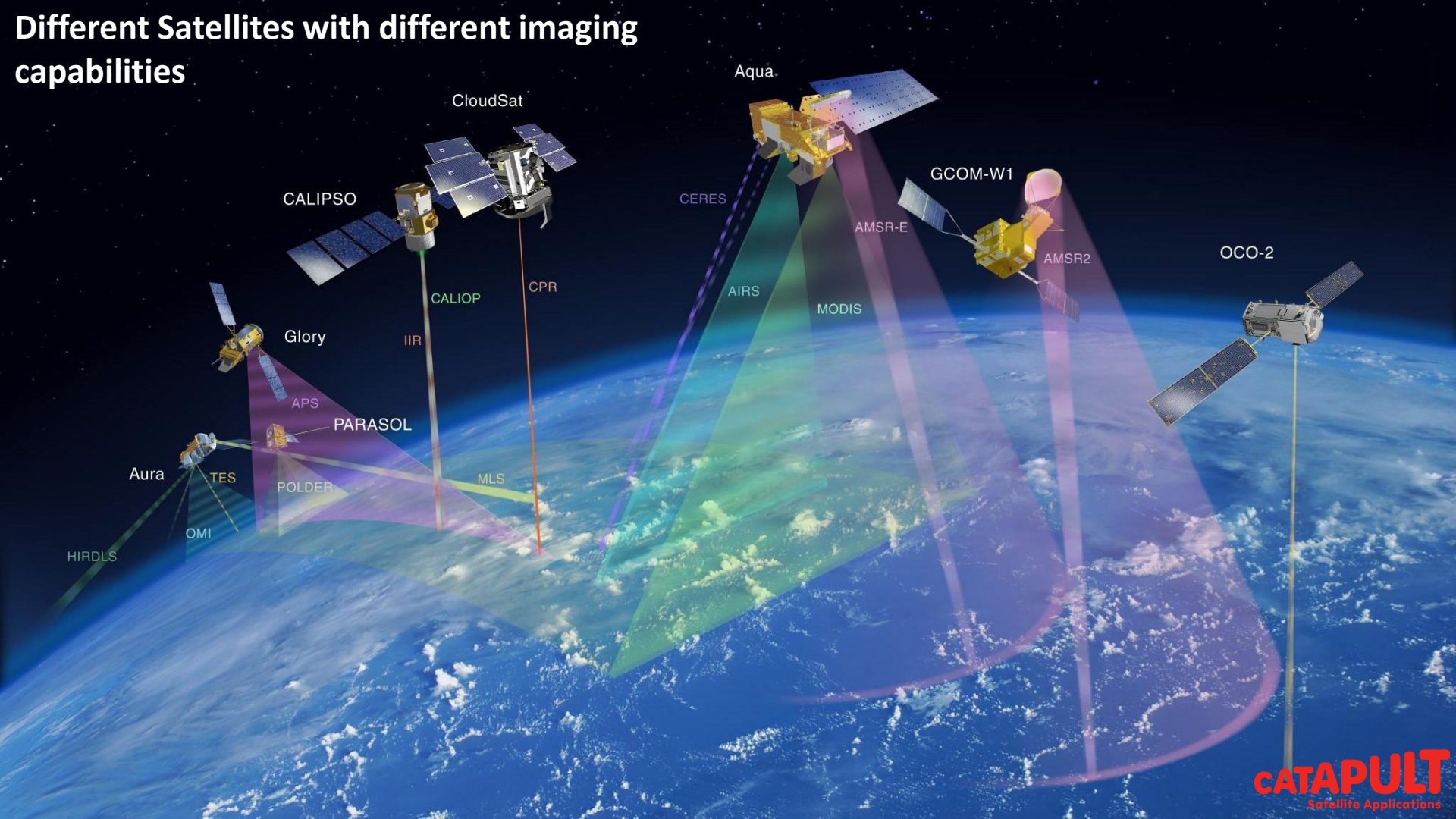
Different Satellites with different imaging capabilities



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Data © Digital Globe 2015
Image © Satellite Applications Catapult 2015
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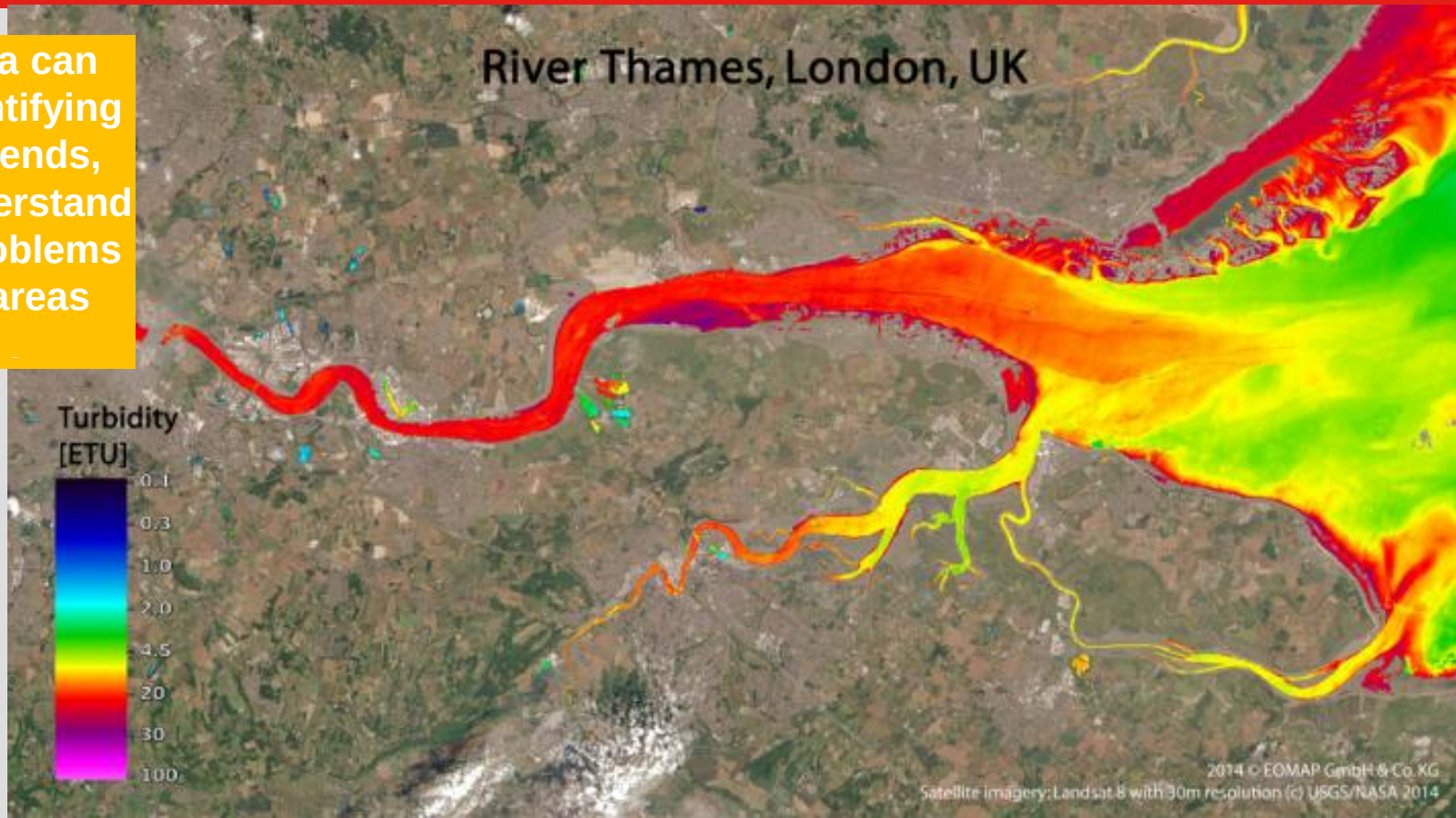
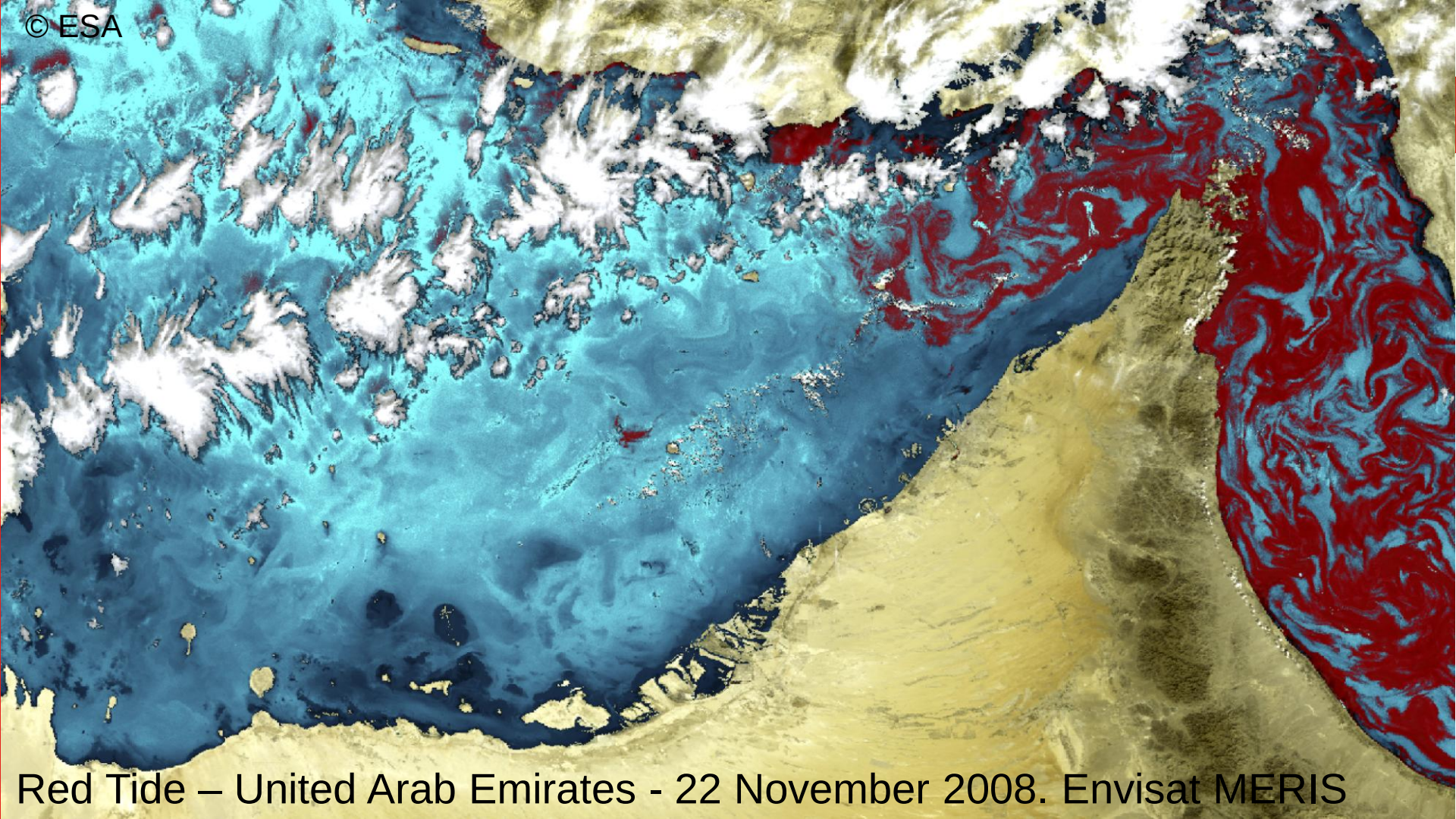
Water Quality – Algal Blooms in Lake Erie

Aquatic Optics used to characterise composition of dissolved materials

Water Quality – Water turbidity from Landsat 8

Historic data can assist in Identifying long-term trends, and help understand emerging problems over large areas

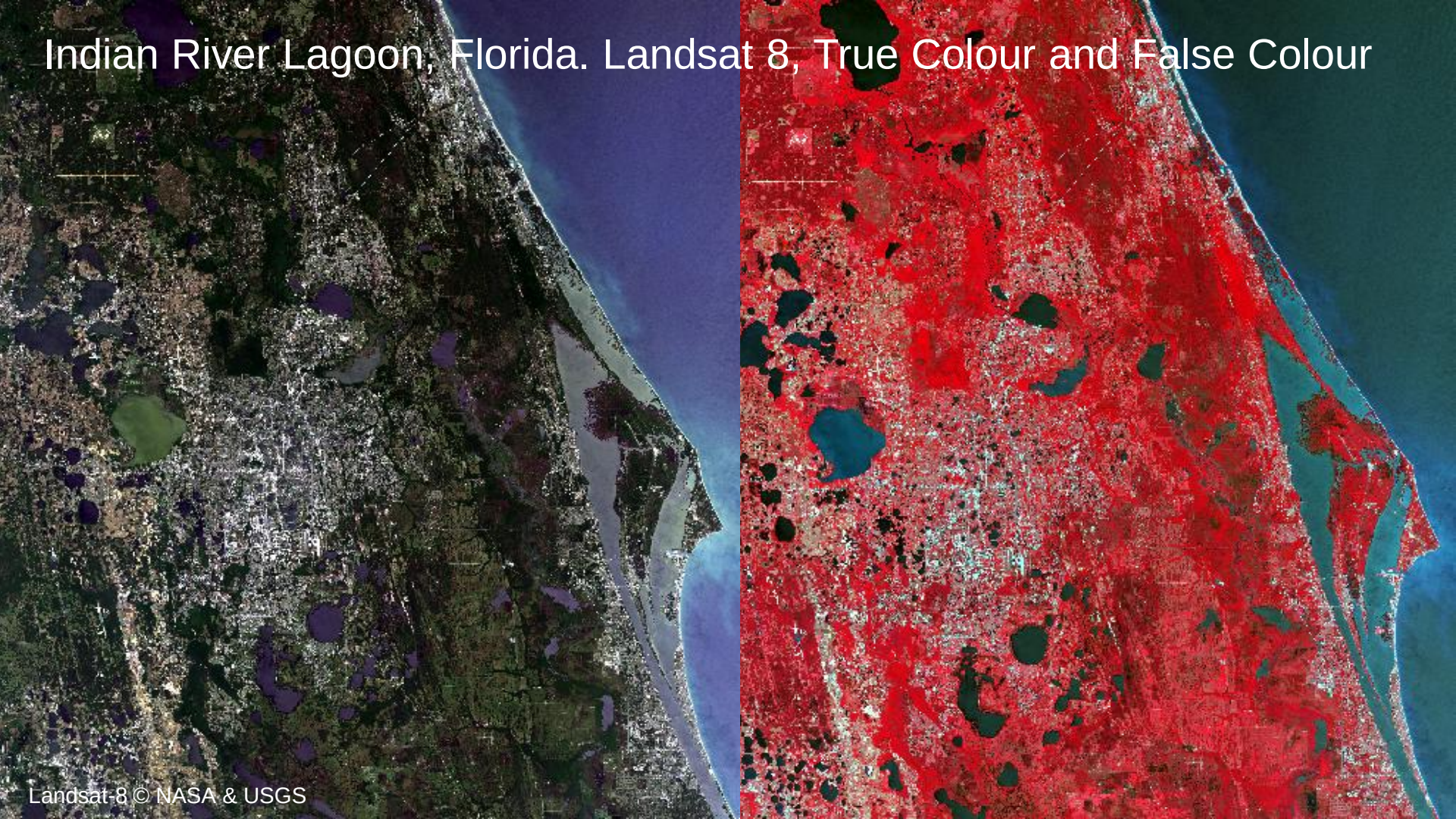




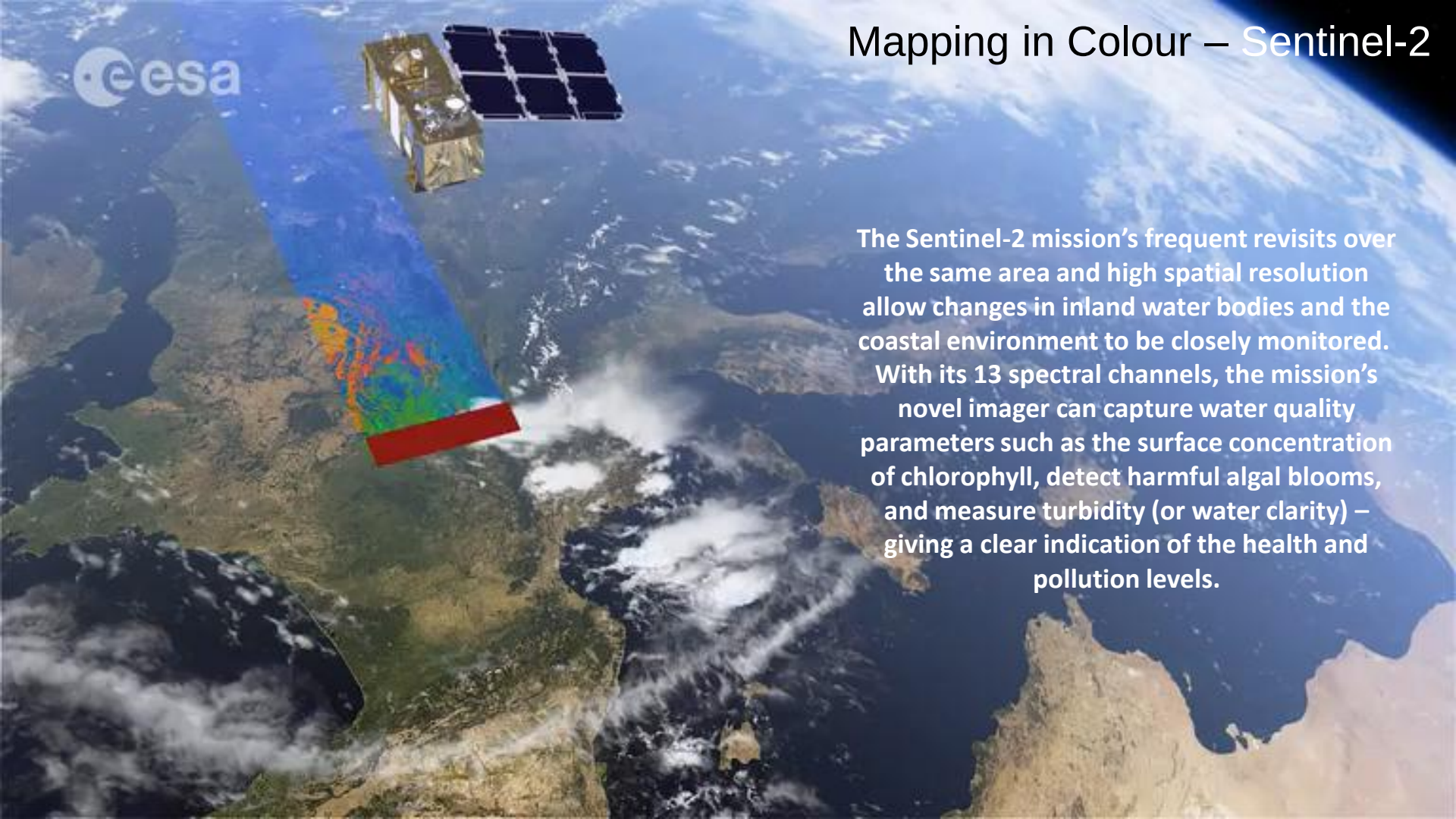
Red Tide – United Arab Emirates - 22 November 2008. Envisat MERIS


Strong Chlorophyll response indicating algal bloom.
SeaWiFS, 1999 © NASA

Indian River Lagoon, Florida. Landsat 8, True Colour and False Colour

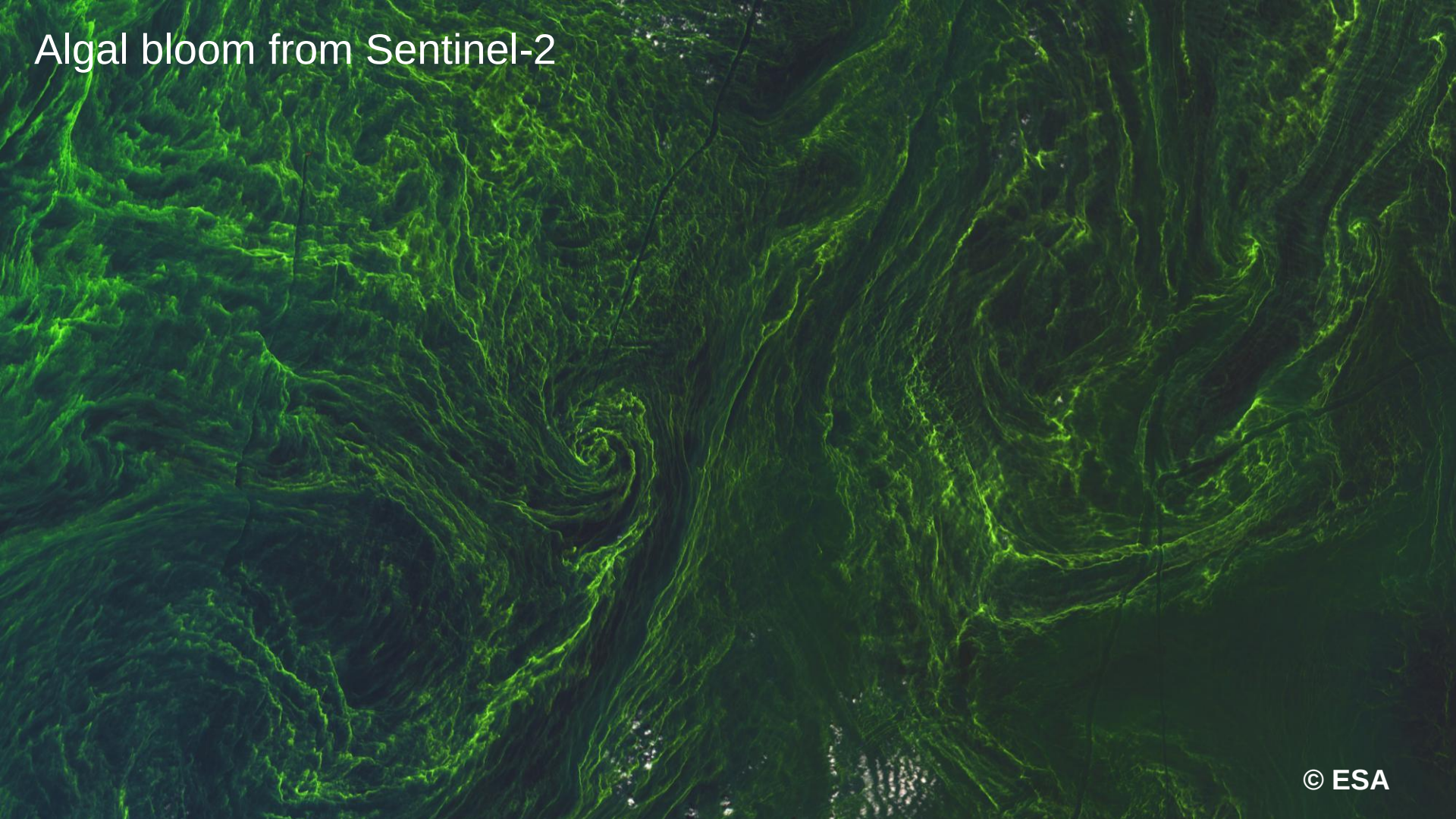


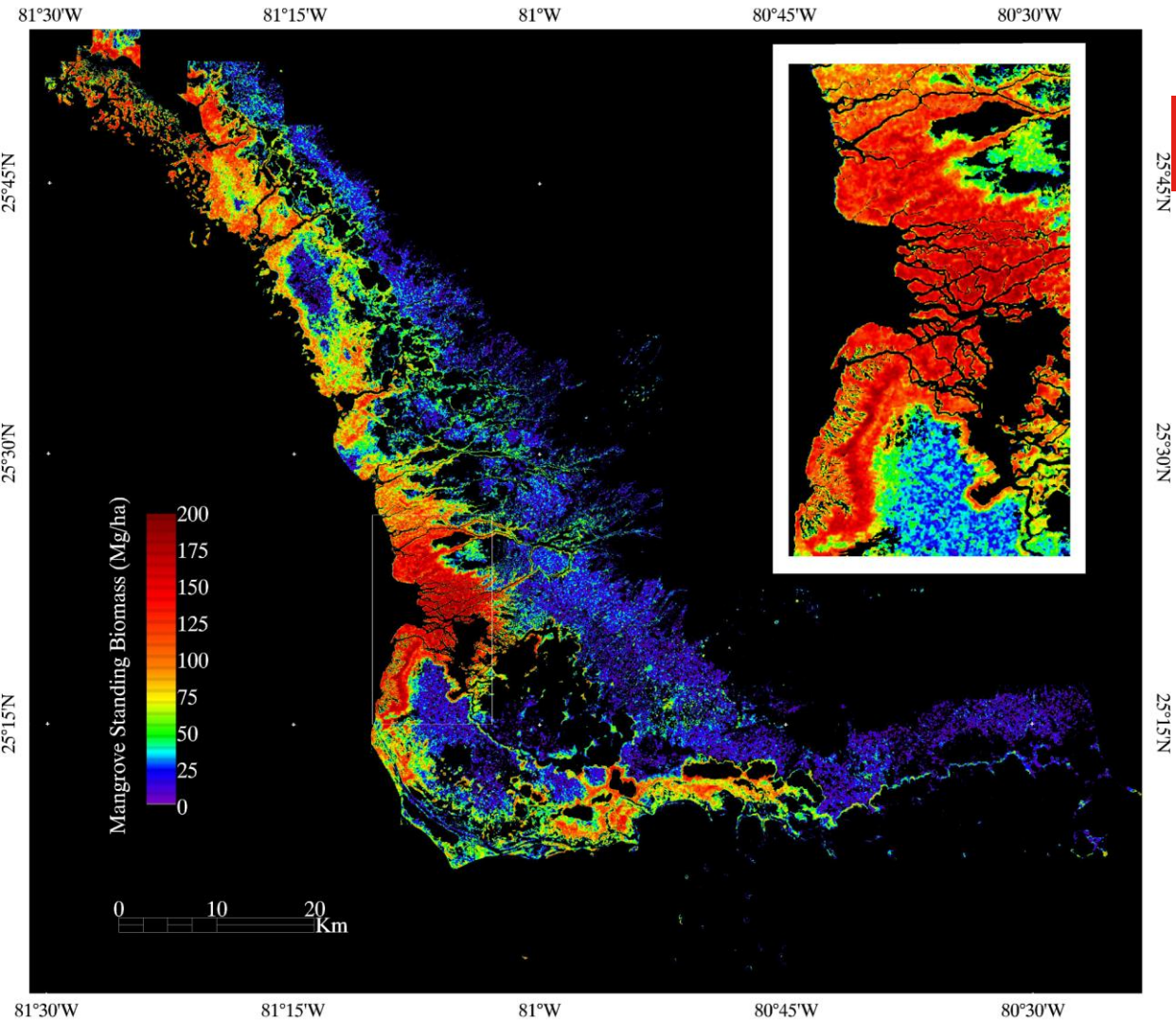
Mapping in Colour – Sentinel-2



The Sentinel-2 mission's frequent revisits over the same area and high spatial resolution allow changes in inland water bodies and the coastal environment to be closely monitored. With its 13 spectral channels, the mission's novel imager can capture water quality parameters such as the surface concentration of chlorophyll, detect harmful algal blooms, and measure turbidity (or water clarity) – giving a clear indication of the health and pollution levels.

Algal bloom from Sentinel-2





Maps of Mangrove Forest Biomass in Everglades National Park created using SRTM

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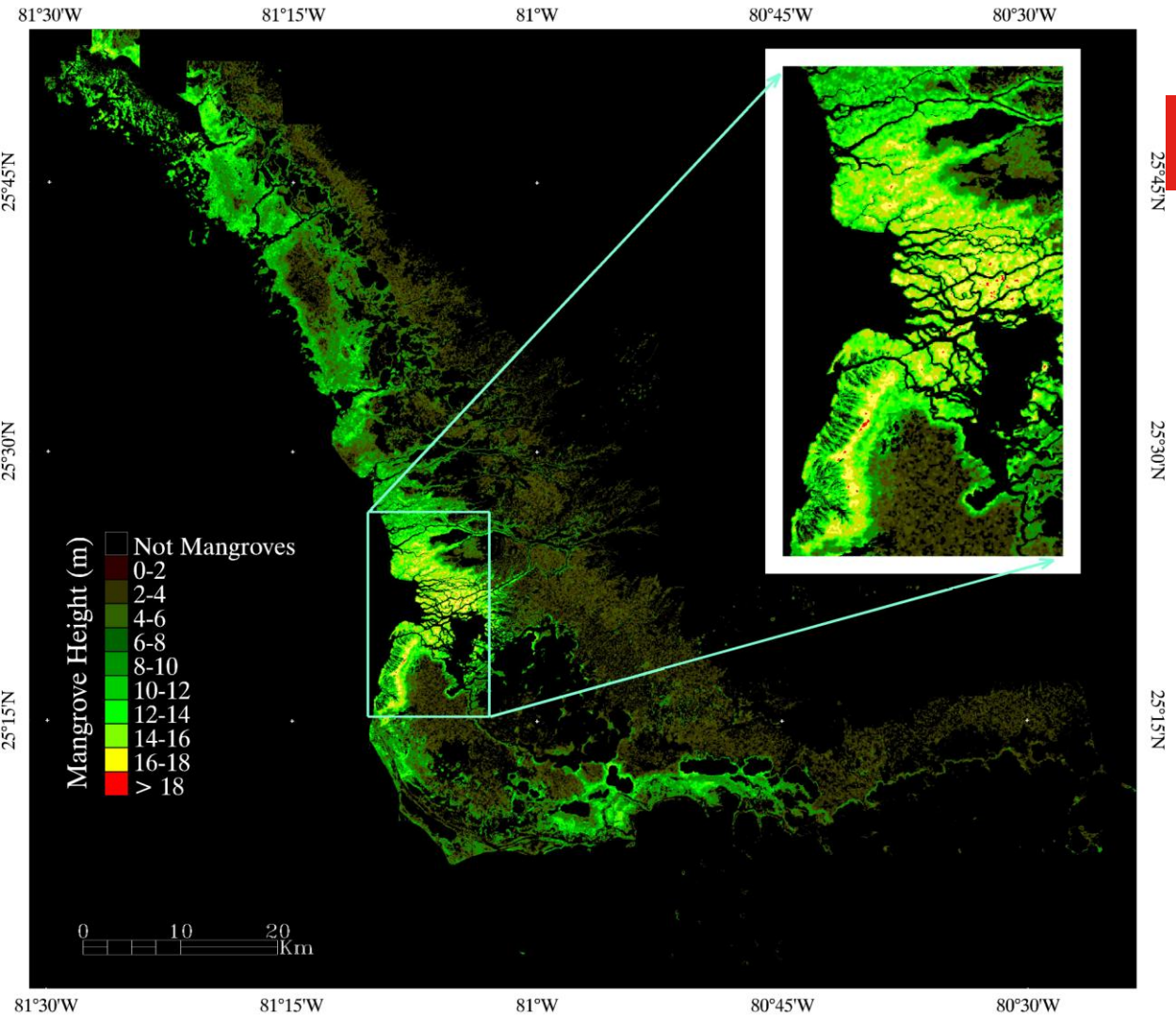

Maps of Mangrove Forest Height in Everglades National Park created using SRTM

Simard, Marc; Keqi Zhang, Victor H. Rivera-Monroy, Michael S. Ross, Pablo S. Ruiz, Edward Castaneda-Moya, Robert R. Twilley, and Ernesto Rodriguez, 2006. "Mapping Height and Biomass of Mangrove Forests in Everglades National Park with SRTM Elevation Data" Photogrammetric Engineering & Remote Sensing. Vol.72, No.3, pp299-311.

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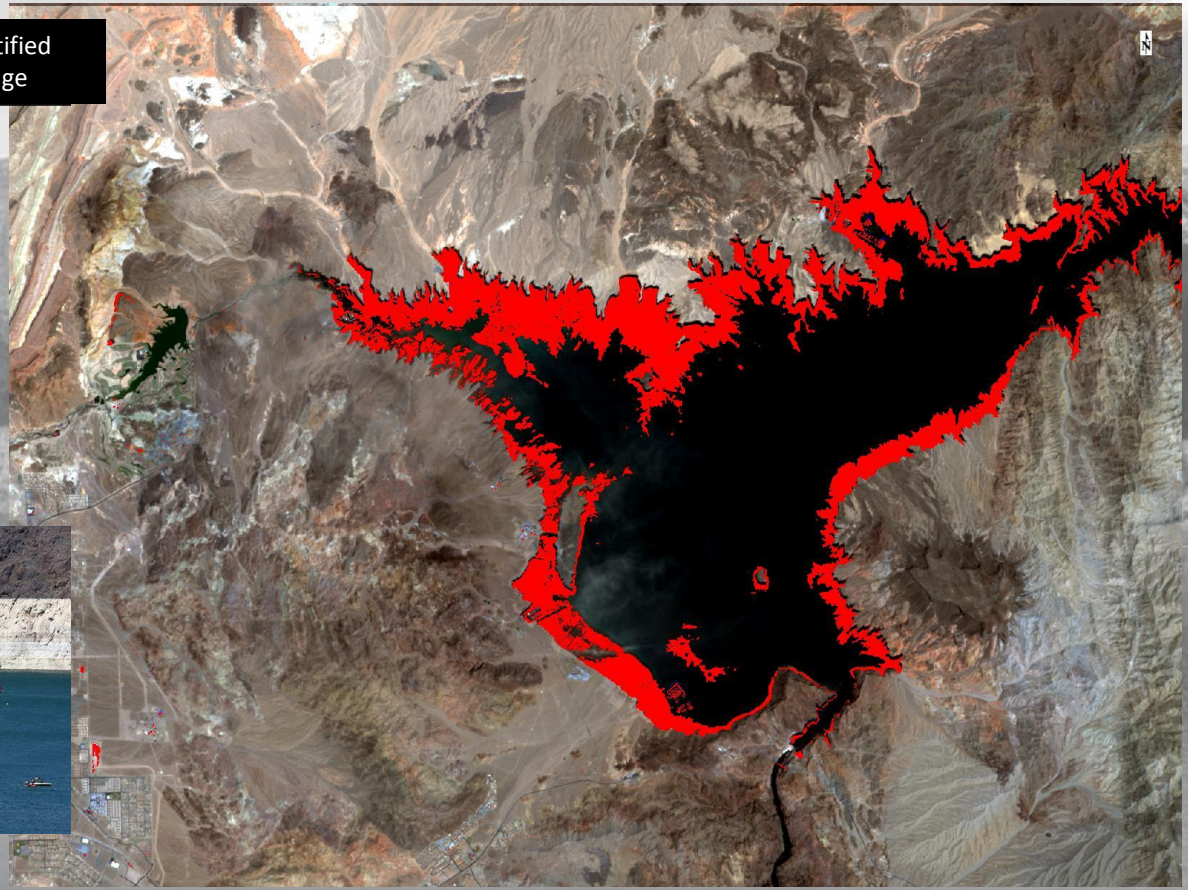
Environmental Monitoring – Change Detection

Lake Mead:
2000 to 2015



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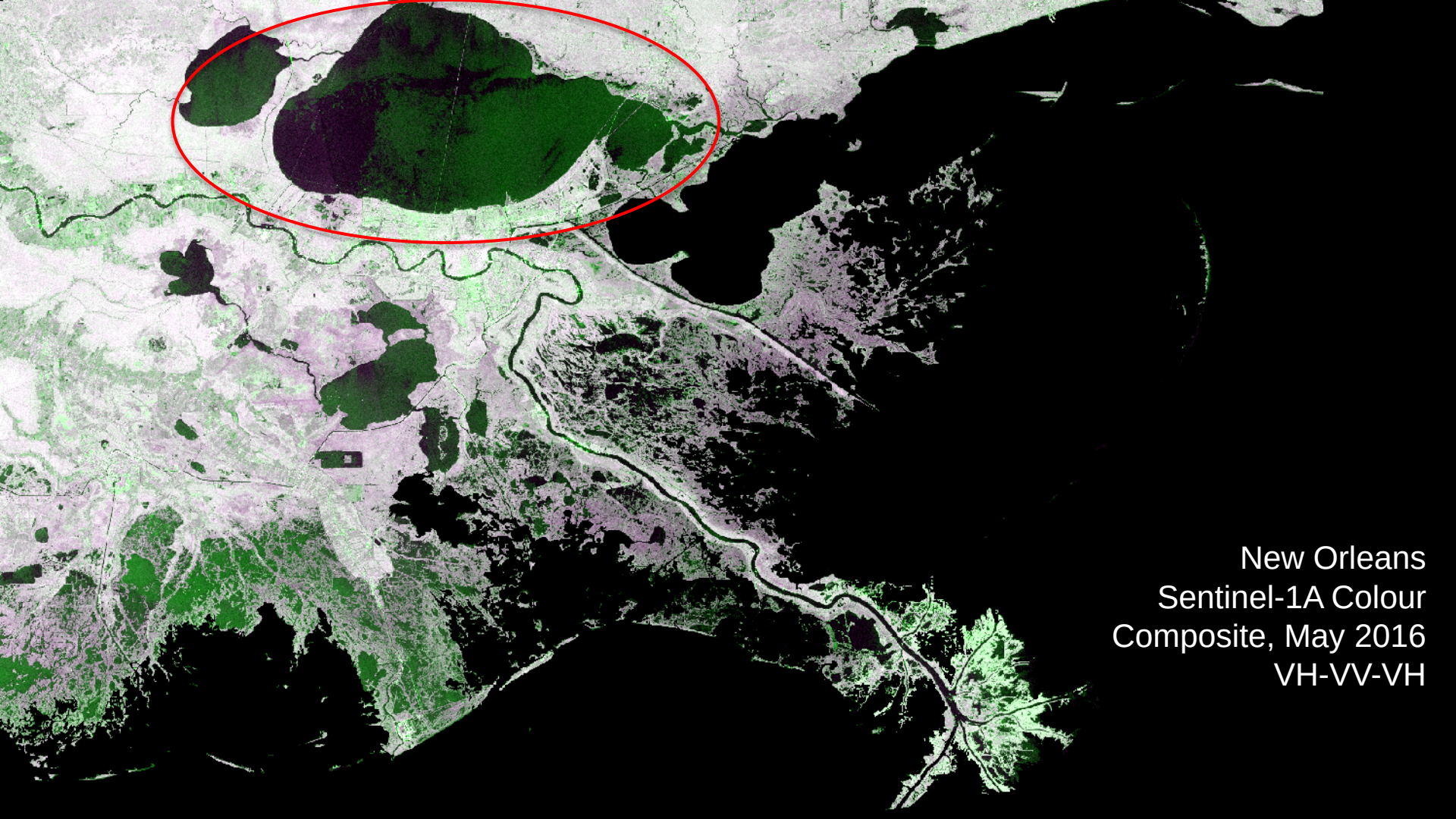

New Orleans
Sentinel-1A Colour
Composite, May 2016
VH-VV-VH

Environmental Change – Urban flooding in New Orleans

Free Sentinel 2 imagery produce tangible environmental outputs

10m resolution imagery **every 12 days** and every 6 days in 2016

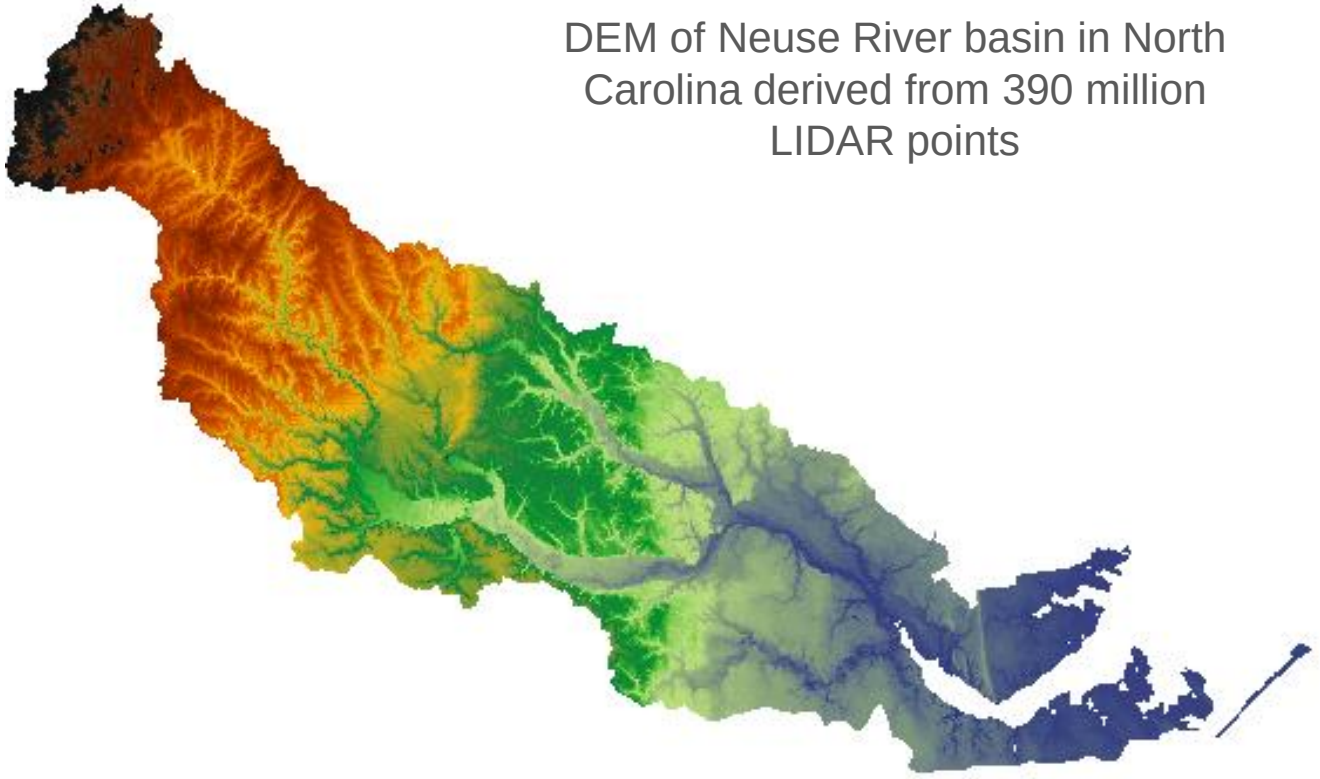
7 Spectral bands facilitating detailed imagery analysis

Catchment monitoring and modelling – Digital Elevation Models

Accurate DEMs are vital for river catchment modelling. DEMs can be derived from a variety of remotely sensed data:

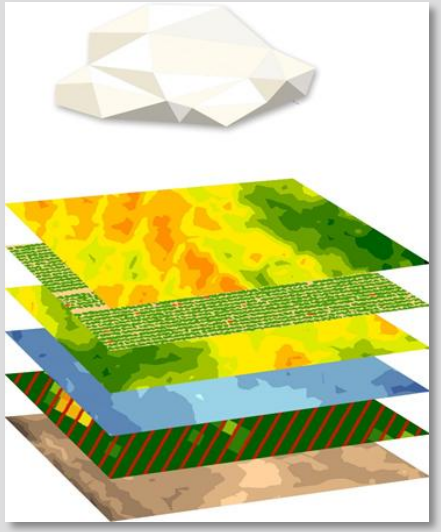
- Lidar
- Dual- and Tri-Stereo-photogrammetry
- SAR e.g. SRTM

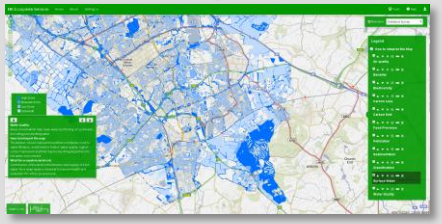
Accuracies from cm to metres depending on resolution of source data

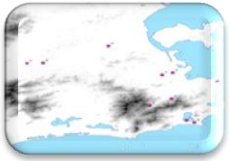


DEM of Neuse River basin in North Carolina derived from 390 million LIDAR points

Integrated data approach

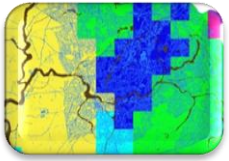






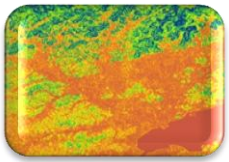
Gauges

Topography

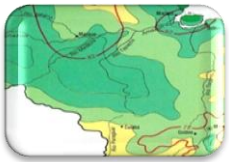


Land Use

Hydrology



Slope

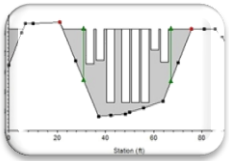


Rainfall

Soil Types

Urban

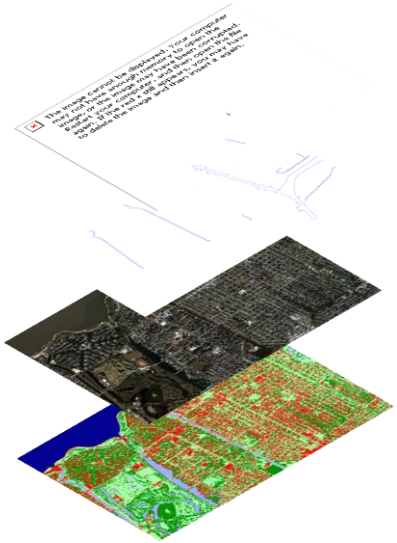
Defences



Structures

Imagery

Mapping



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A new era for Earth observation

CARBON MONITORING

NATURAL DISASTER RESPONSE

MARITIME MONITORING

AGRICULTURE HEALTH MONITORING

FINANCIAL TRADING INTELLIGENCE

UNPRECEDENTED

ACCESS TO SPACE

ENGABLING BUSINESS TO PROVIDE

LOW-COST

ON-DEMAND

COMMERCIAL SOLUTIONS TO ADDRESS REAL CUSTOMER NEEDS

MINING OPERATIONS MONITORING

INSURANCE MODELING

OIL STORAGE MONITORING

HUMANITARIAN AID

OIL & GAS INFRASTRUCTURE MONITORING

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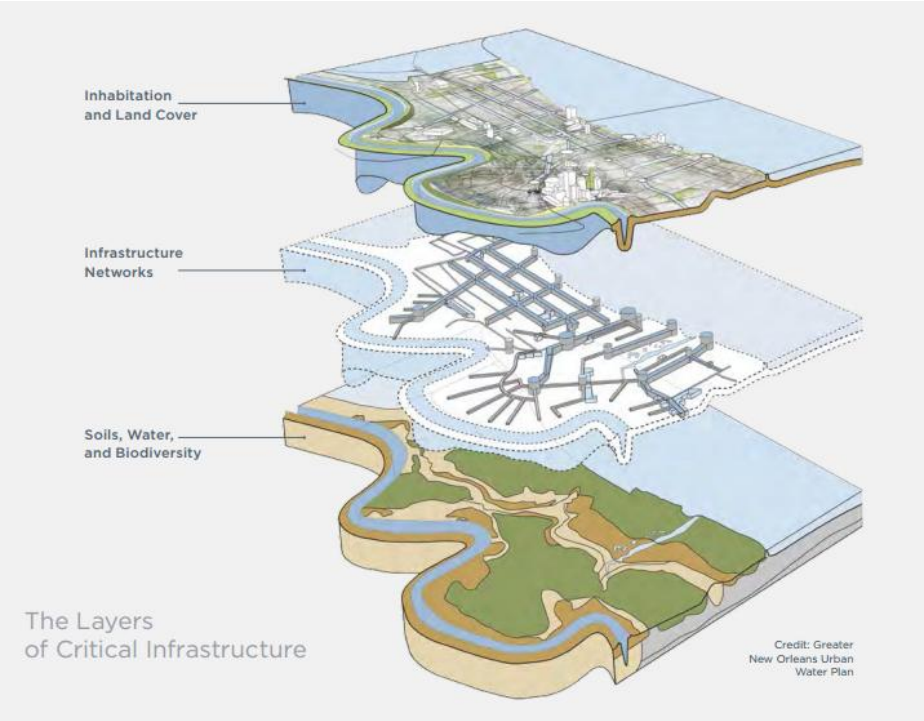
Resilient New Orleans

“Critical infrastructure in New Orleans is more than just levees, bridges, and canals. It is a complex series of interdependent built and natural systems that keep our coastal city safe, productive, and healthy.
Part of a resilient approach to infrastructure is an accurate understanding of the full geographic and functional breadth of these systems and the connection between our built urban environment and the managed landscapes that surround us.“
City of New Orleans



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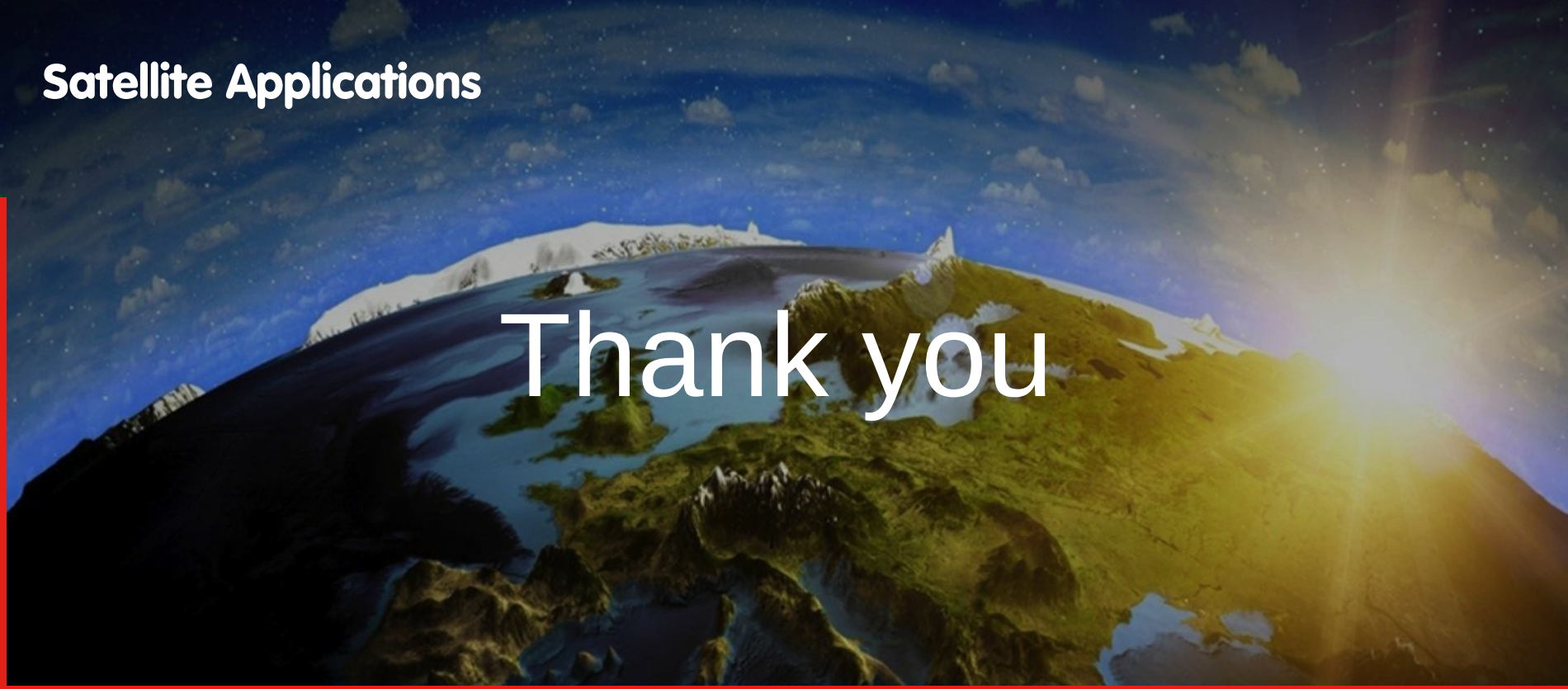

Thank you

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Black Tide, Florida, 2002. SeaWiFS

SeaWiFS 2002 © NASA

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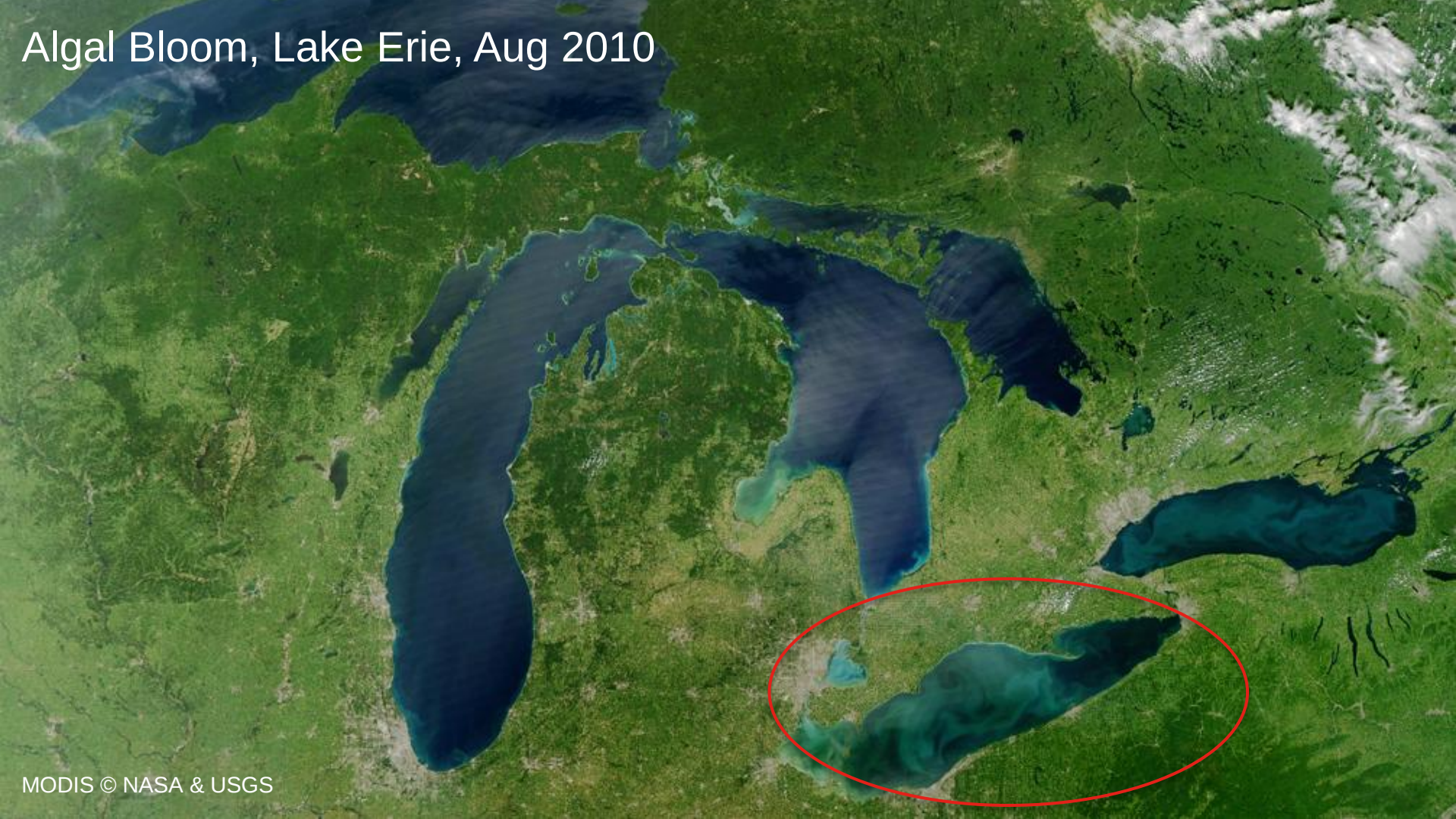
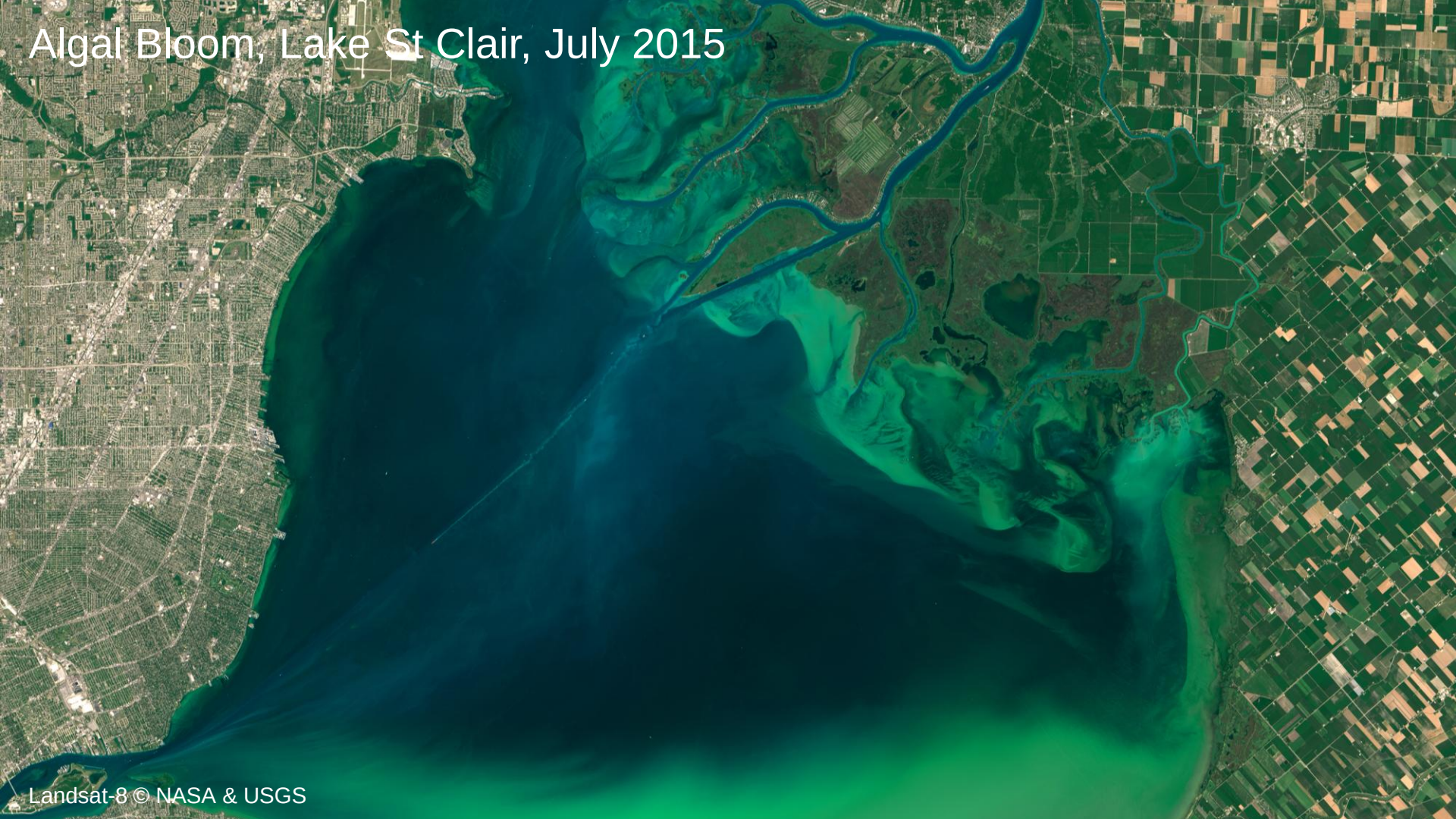
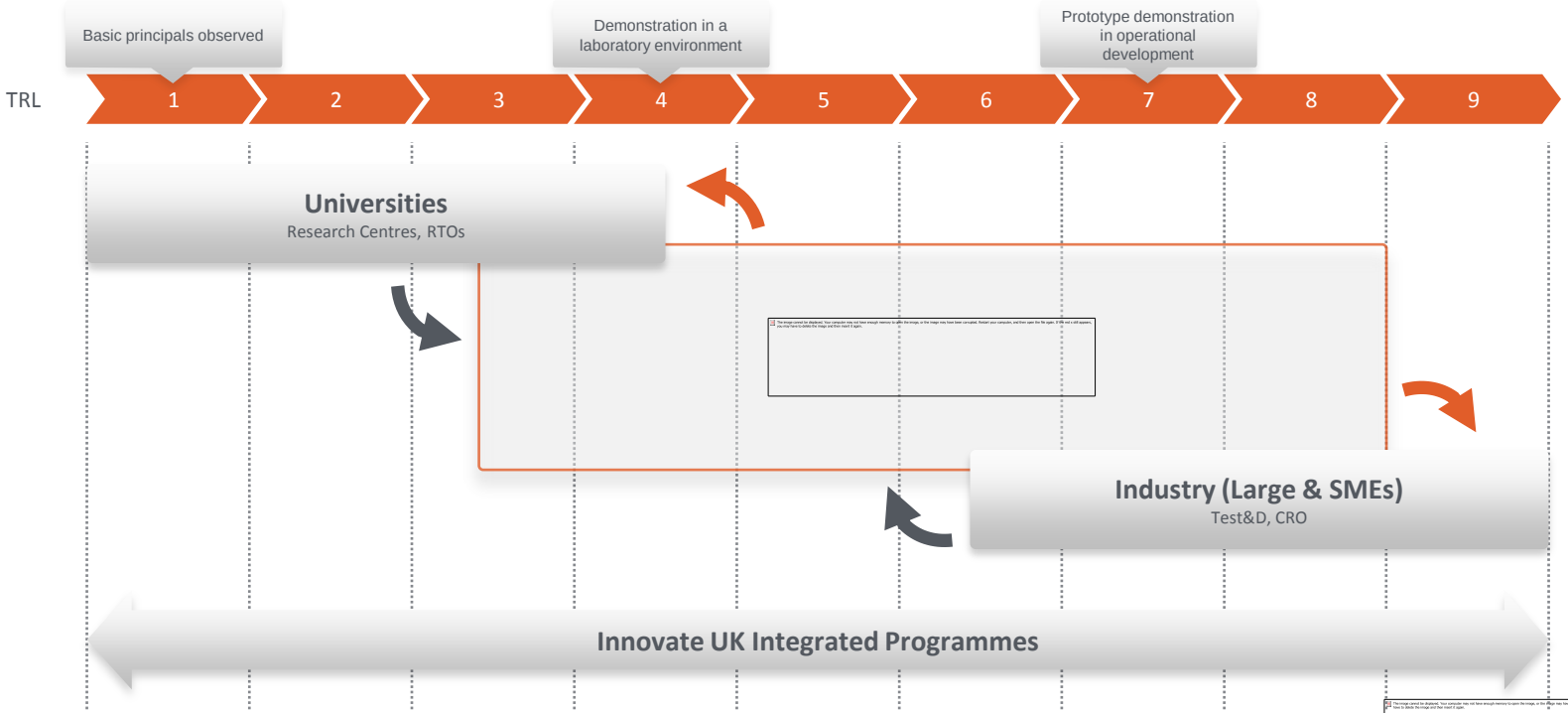

Algal Bloom, Lake Erie, Aug 2010
MODIS © NASA & USGS


Algal Bloom, Lake St Clair, July 2015
Landsat-8 © NASA & USGS

Catapults - Force for Innovation & Growth



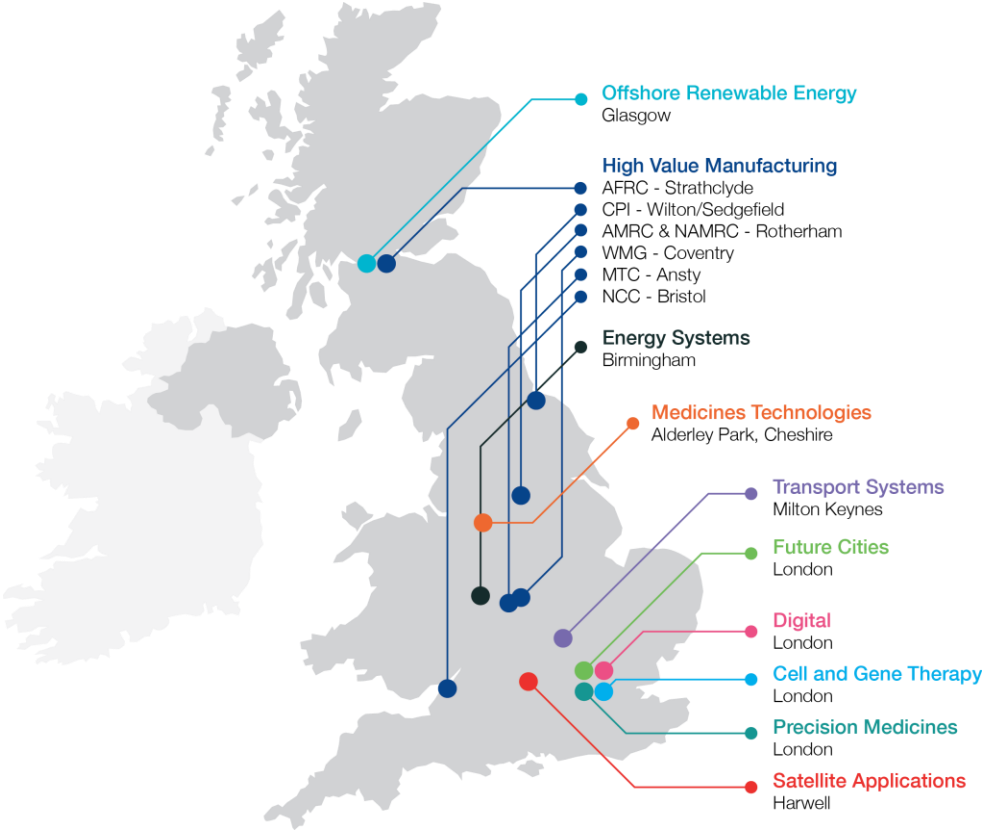
Catapults – The Network

10
Catapults

11th to be Compound Semi – Conductor Applications Catapult

£1bn

Private & Public Sector Investment



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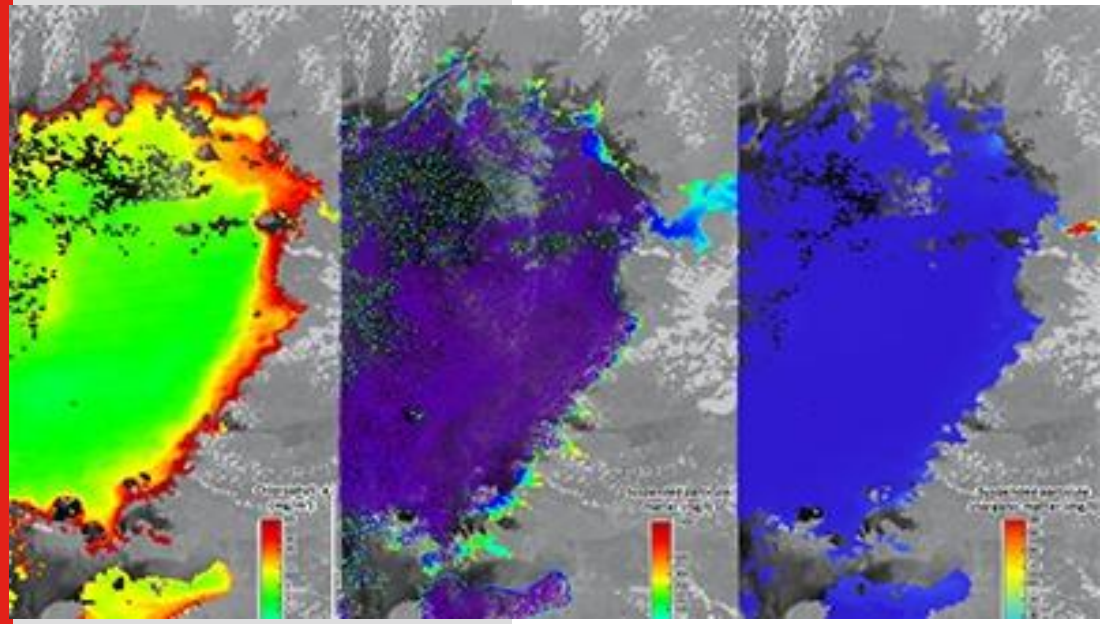
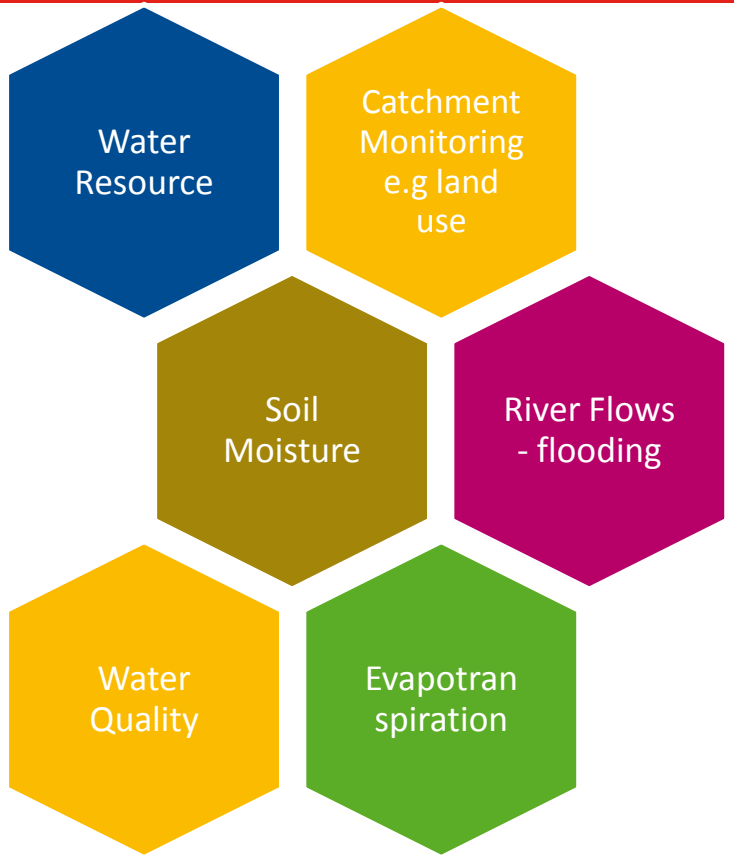
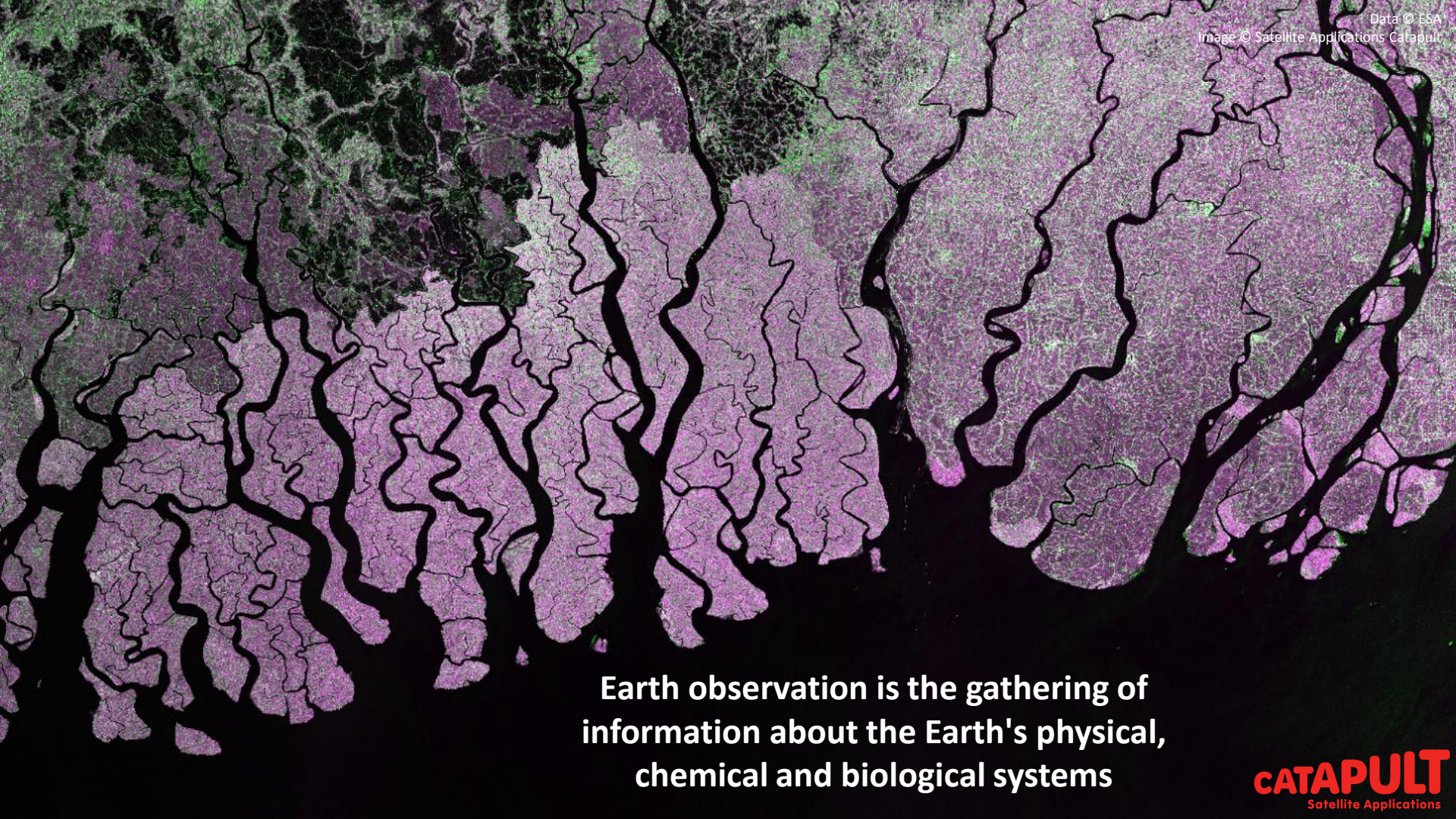
Remote Sensing of Water



Satellite monitoring reveals increasing pressure on the ecosystem of Lake Victoria, East Africa.





Earth observation is the gathering of information about the Earth's physical, chemical and biological systems

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Black Tide, Florida, 2002. SeaWiFS

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SeaWiFS 2002 © NASA