ESA‘s New Earth Science Strategy – Recent achievements of ist Earth Explorer and Copernicus Sentinel Missions

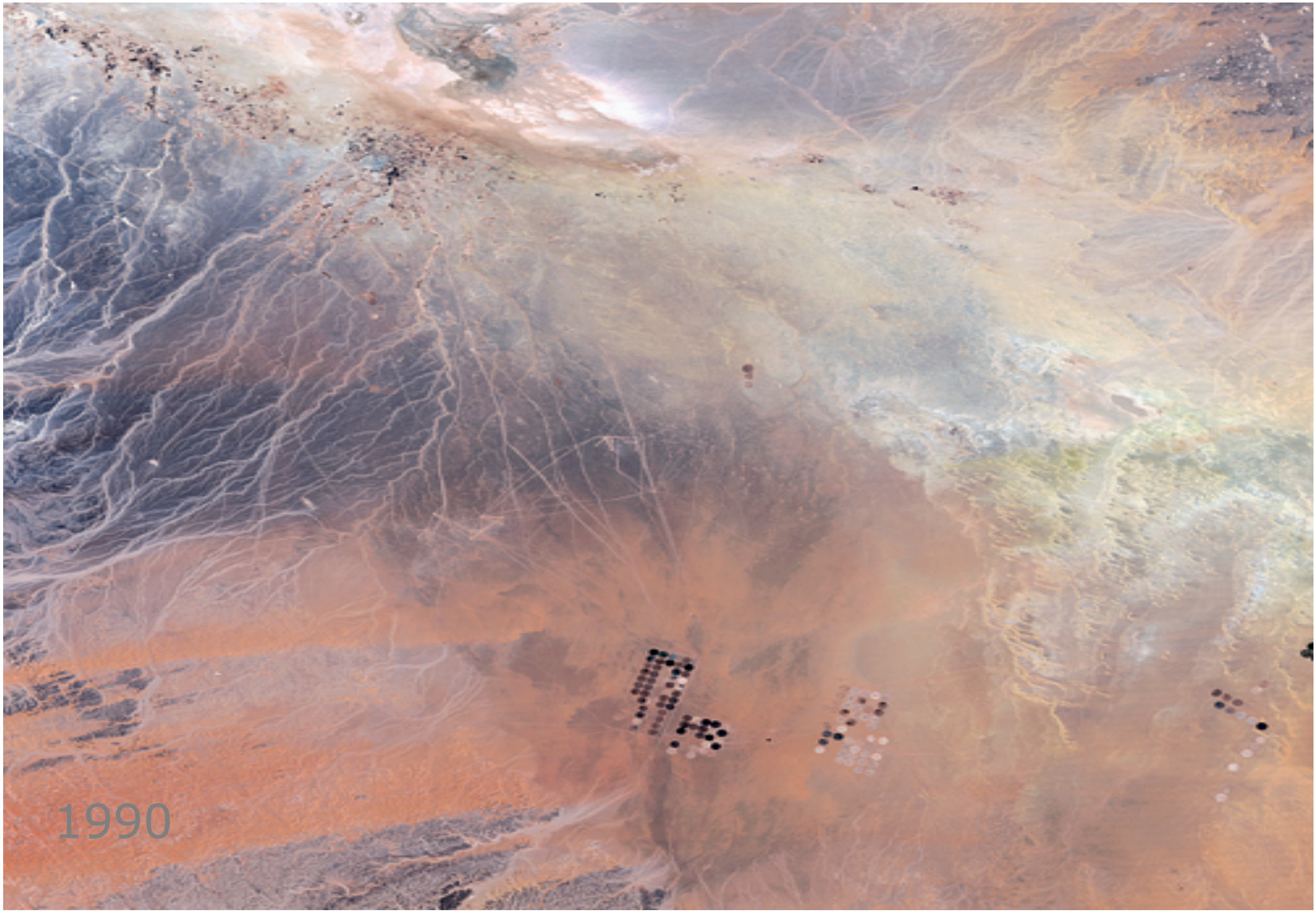
Third ICES Biennial, Geneva, 6 November 2015

Michael Rast, European Space Agency

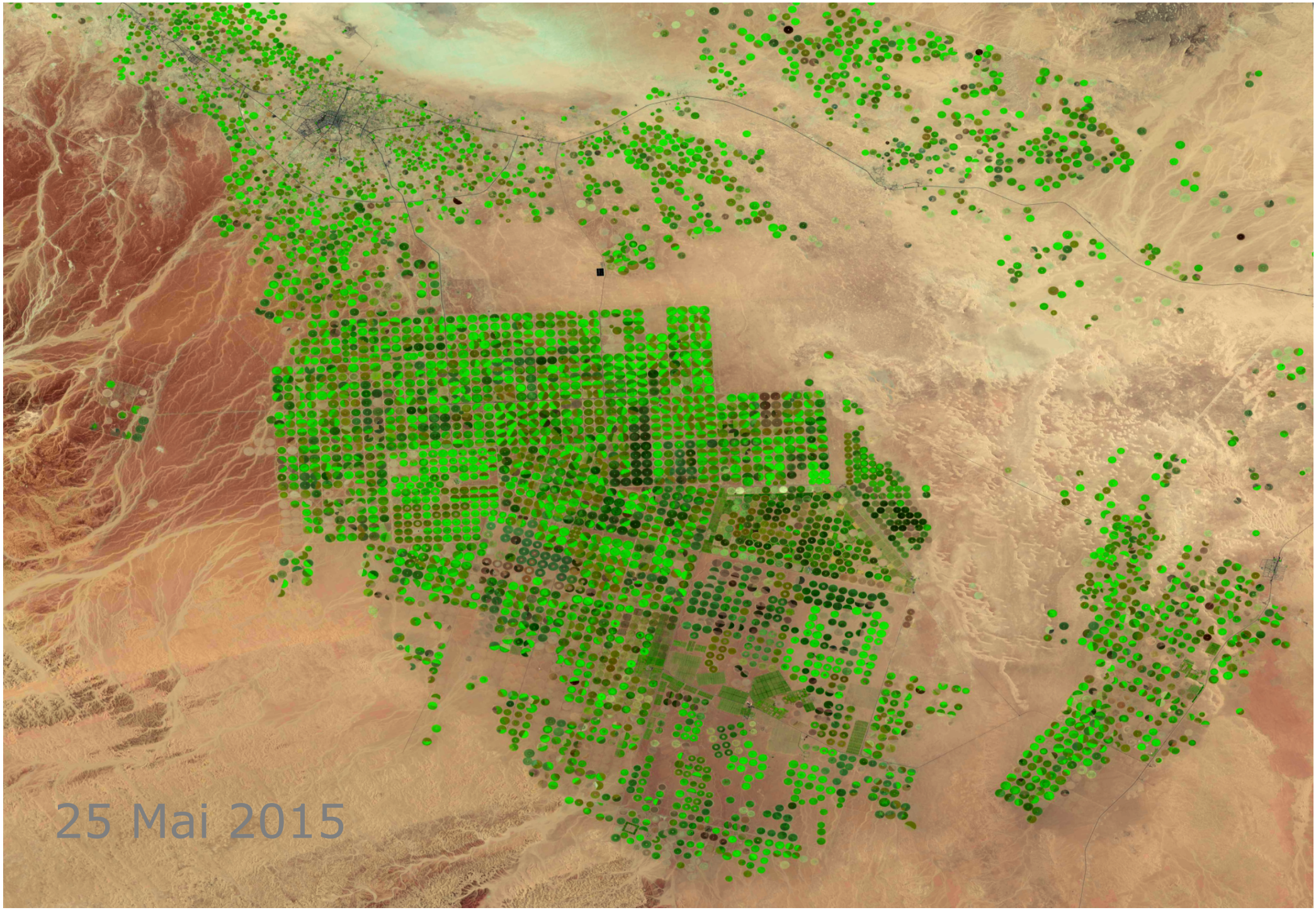
Head, Science Strategy, Coordination and Planning Office
Directorate of Earth Observation Programmes

www.esa.int

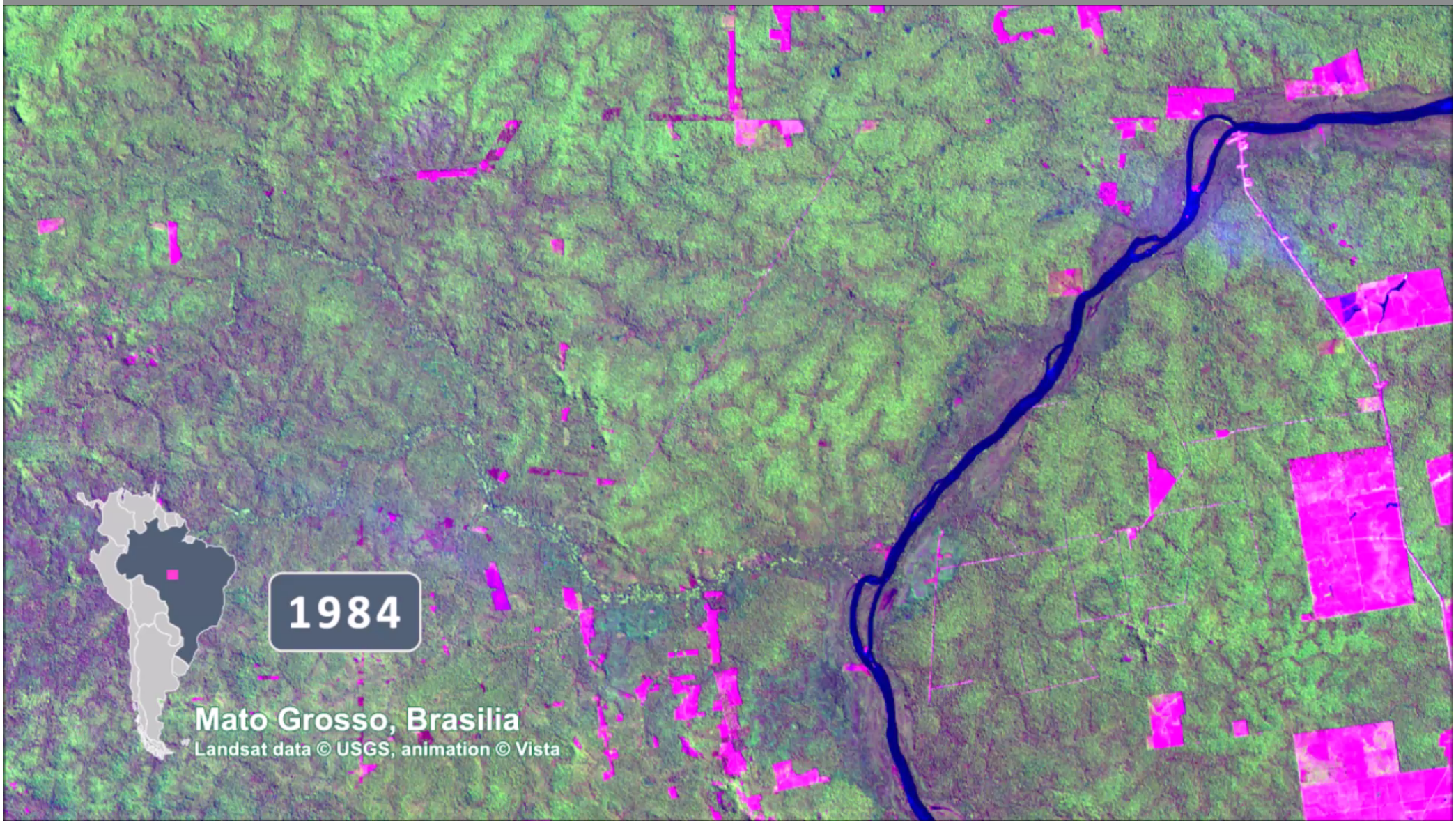

1980


1990

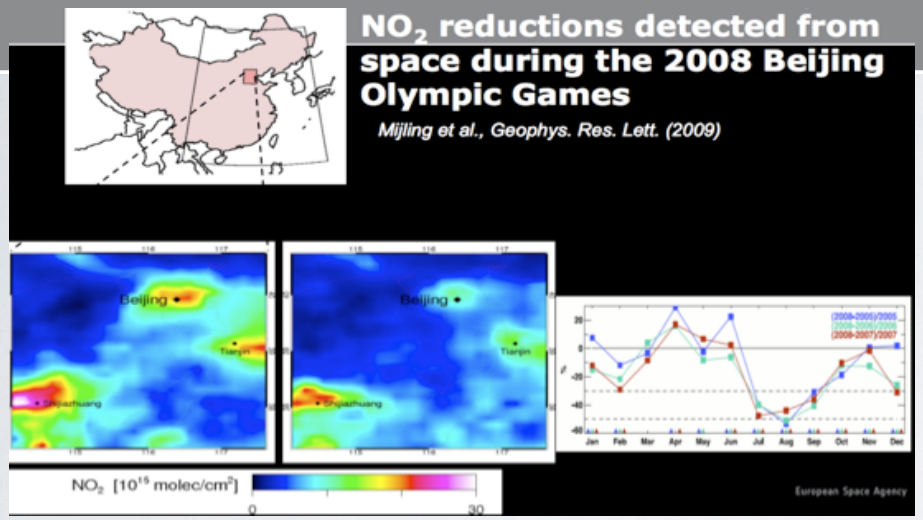

2000


25 Mai 2015

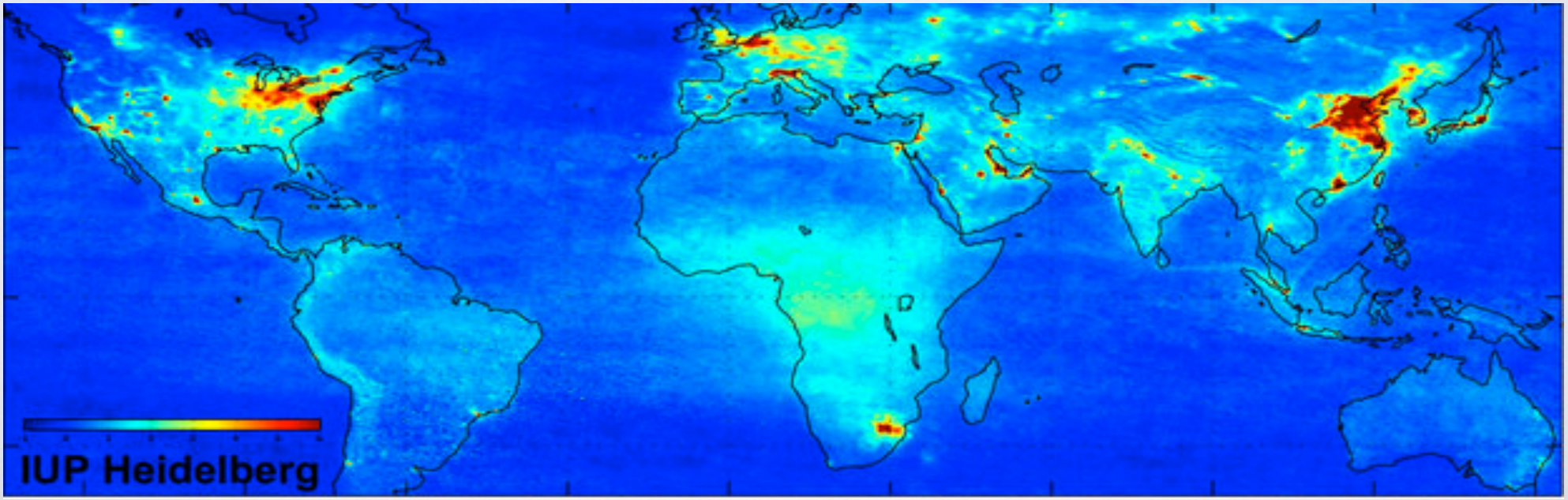
Deforestation



More Polluted



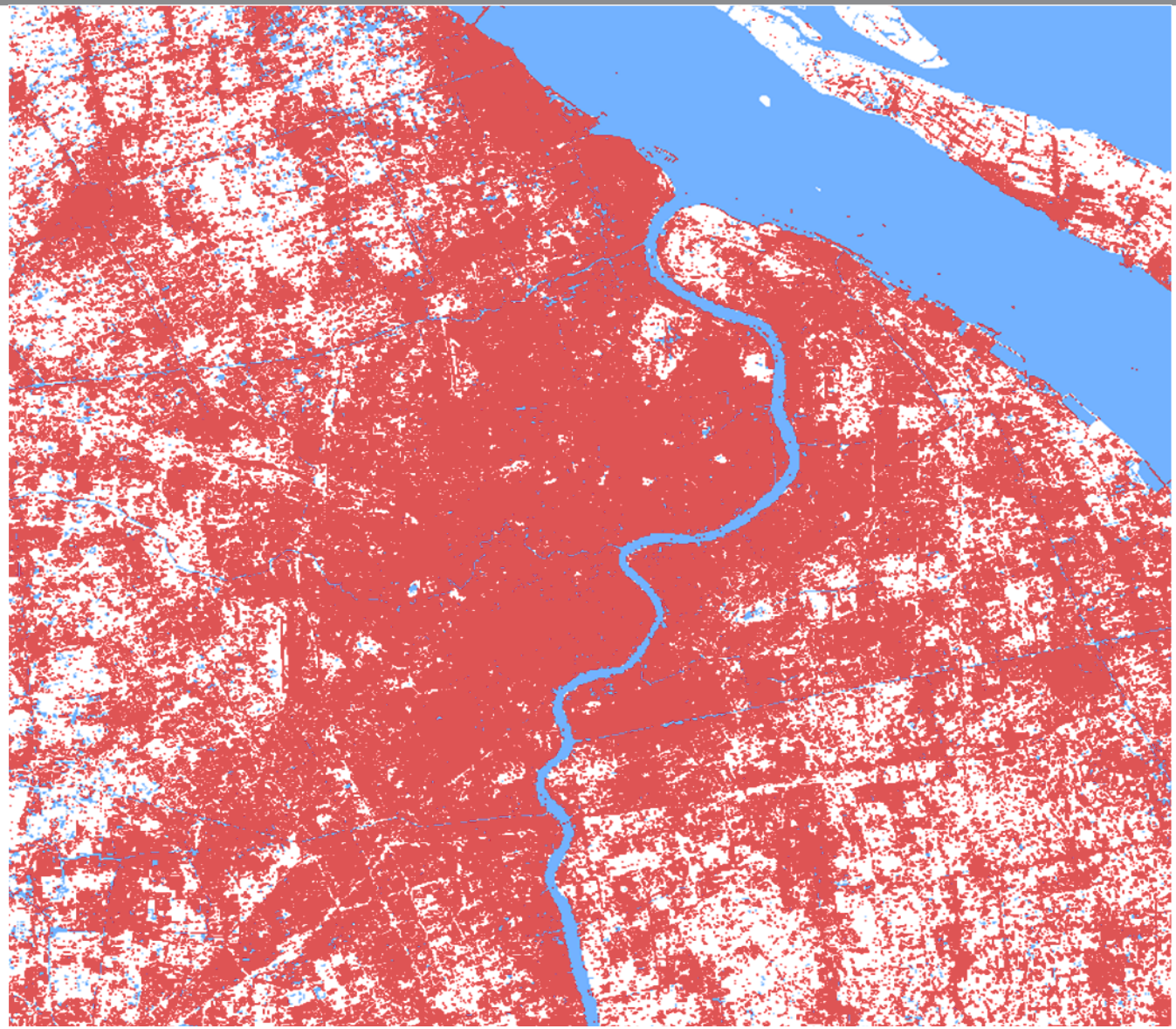
Air Quality,
Black Carbon
& Climate Change



Source: ESA Dragon, NASCC. Source urban Portal: GISAT

Urban Exploitation Platform

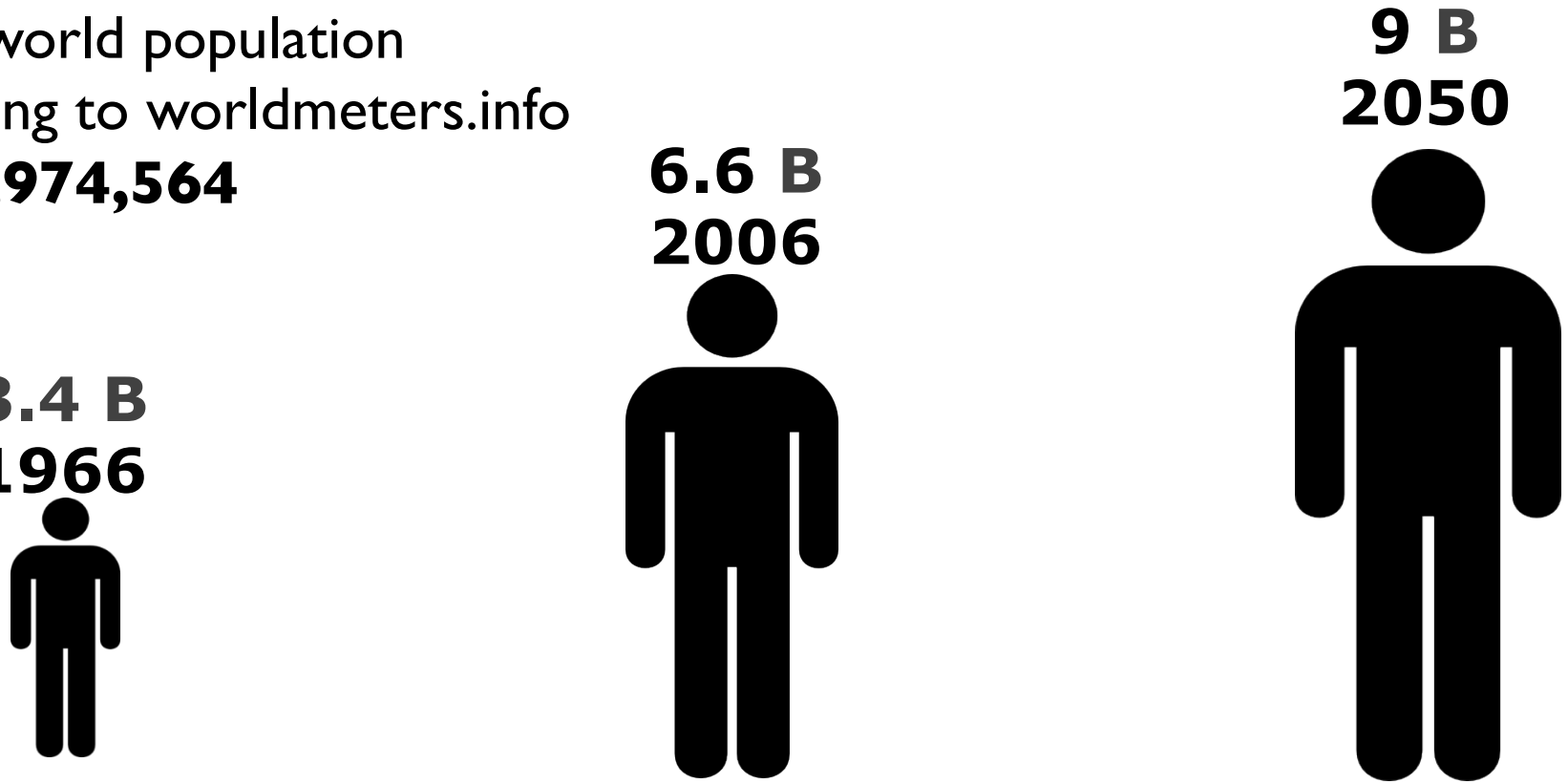
Shanghai



Urban Growth 1990 2010

Megatrends of our planet:
More Crowded … More Wealth .. More Inequalities

Today world population
according to worldmeters.info
7,378,974,564



Growing & Aging Population. Growing Wealth but Extreme Poverty. "Up to **3B** more **middle-class** consumers by **2030**, boosting demand at a time when obtaining new resources could become more difficult and costly." (McKinsey, Resource Revolution)

Source population: UNDESA, World Population Prospects: The 2012 Revision

More Urban

Rise of the Urban species:
50% population urban in 2010,
70% urban by 2050,

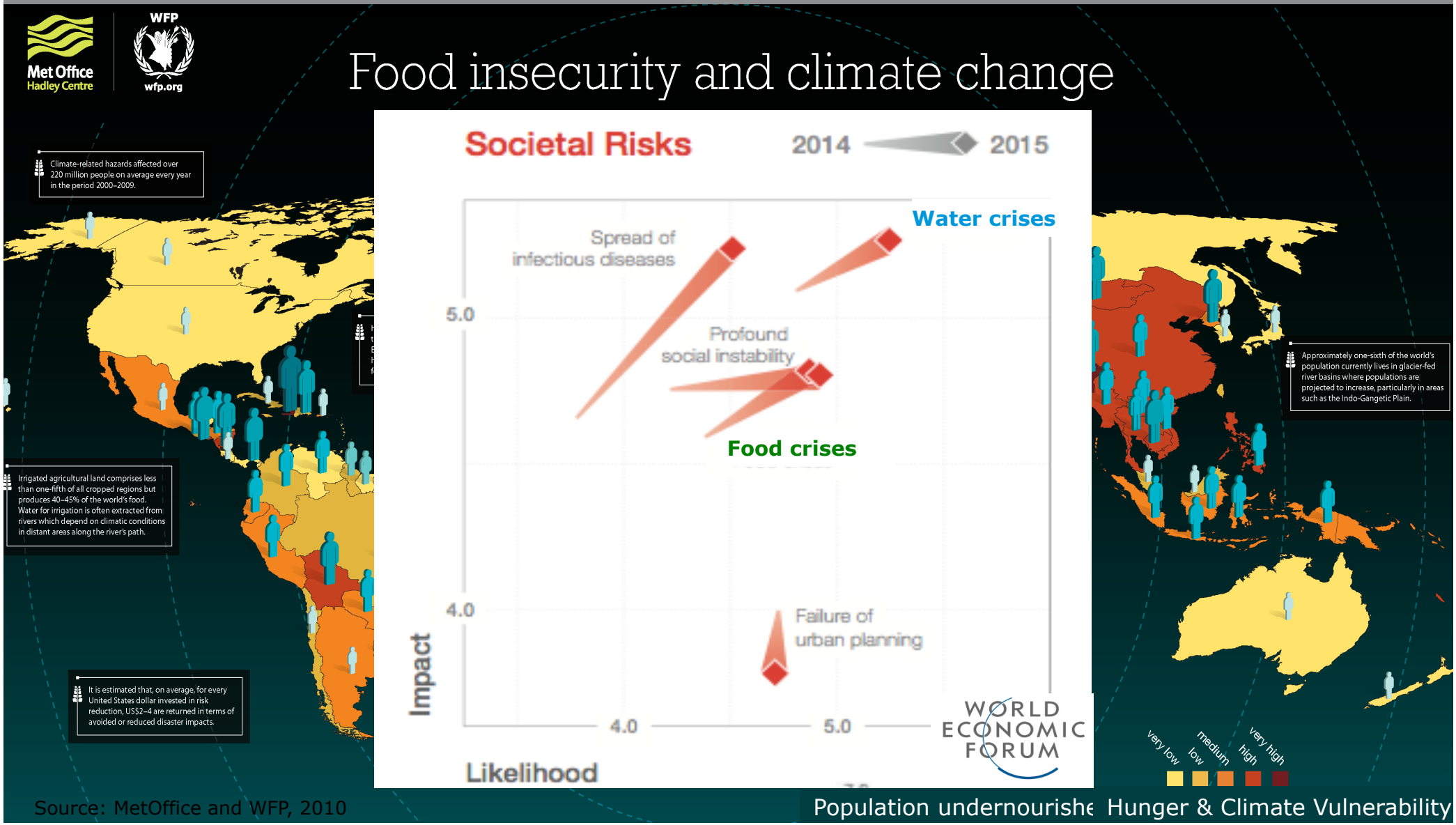
Migration:
3M moving to cities each week in developing world

Rise of **Mega-Cities** & **Mega-Slums**
4 (1975), 18 (2000), 27 (2012), 40 (2025)

More Environmental **Mega-Stress**

Dubai - Source: Joe McNally, National Geography, pict taken from Burj Khalifa
Source: UN Dep.t of Econ. and Soc. Affairs, 2012; OECD, 2012
Barbara Boyle Torrey (Population Reference Bureau, *Urbanization: An Environmental Force to Be Reckoned With*, 2004; EURAMET, *Megacities*, 2013

Main Challenges & Issues



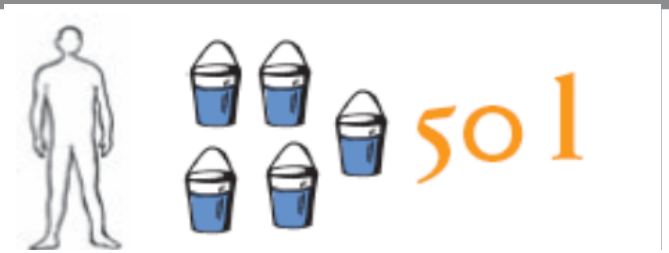
Source: MetOffice and WFP, 2010

Population undernourishe Hunger & Climate Vulnerability

Interconnected Food-Water security

Hunger often results from water scarcity

- We consume water for drinking and sanitation



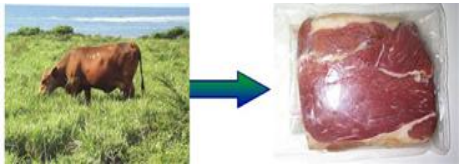
- But we need much more water for food!

1200 liter vegetarian

2300 liter meat

How much water is needed to produce 1 kg of ...?

maize: 900 l



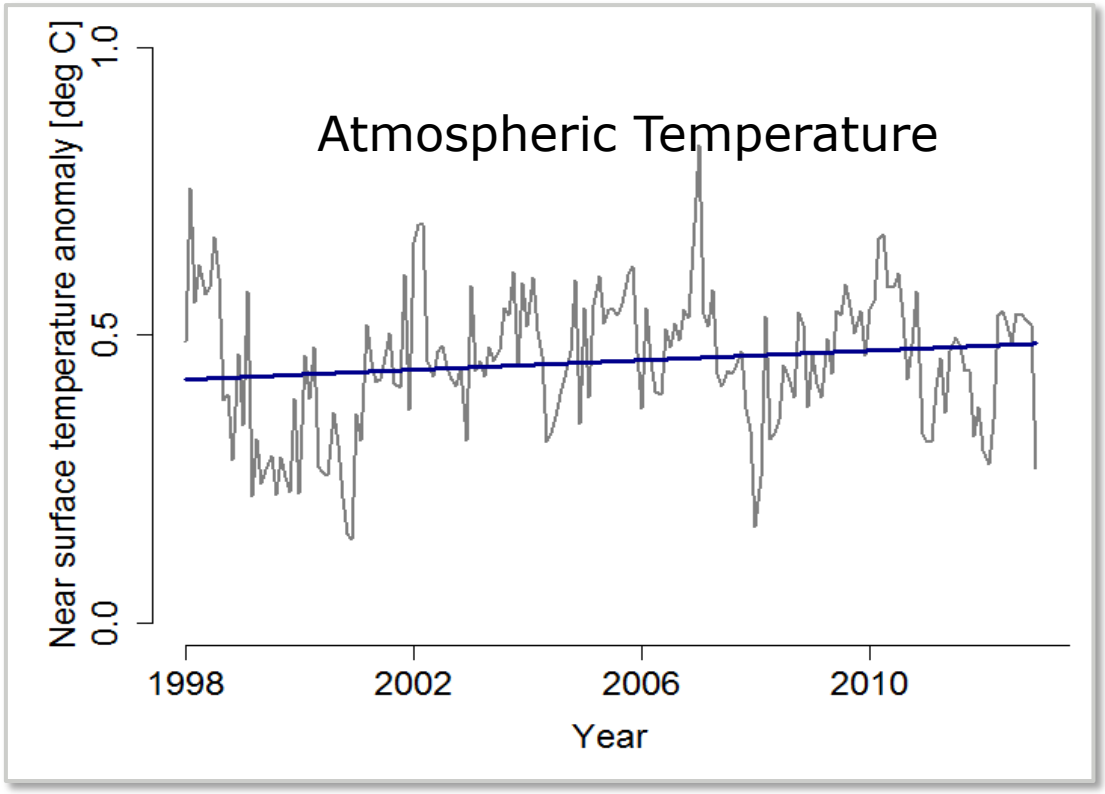
beef: 16 000 l

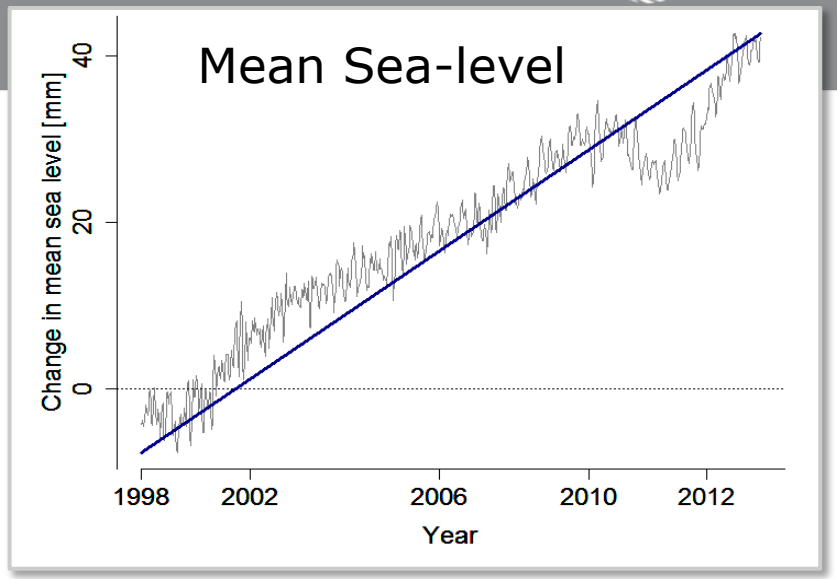
Source: EO4Food study

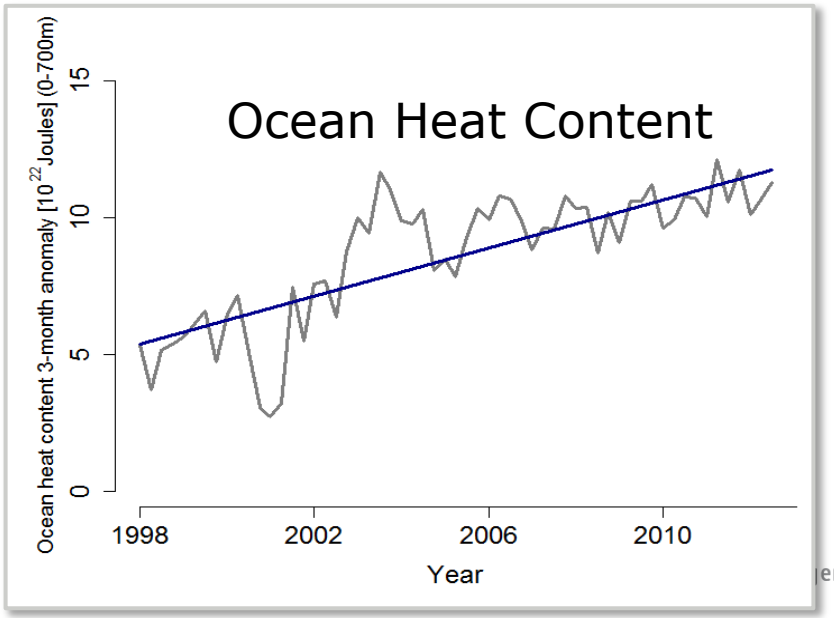
Climate change impact – floods in Bangladesh

Need for an integrated view

Heat accumulation into ocean although atmospheric temperature did not increase significantly over recent decades

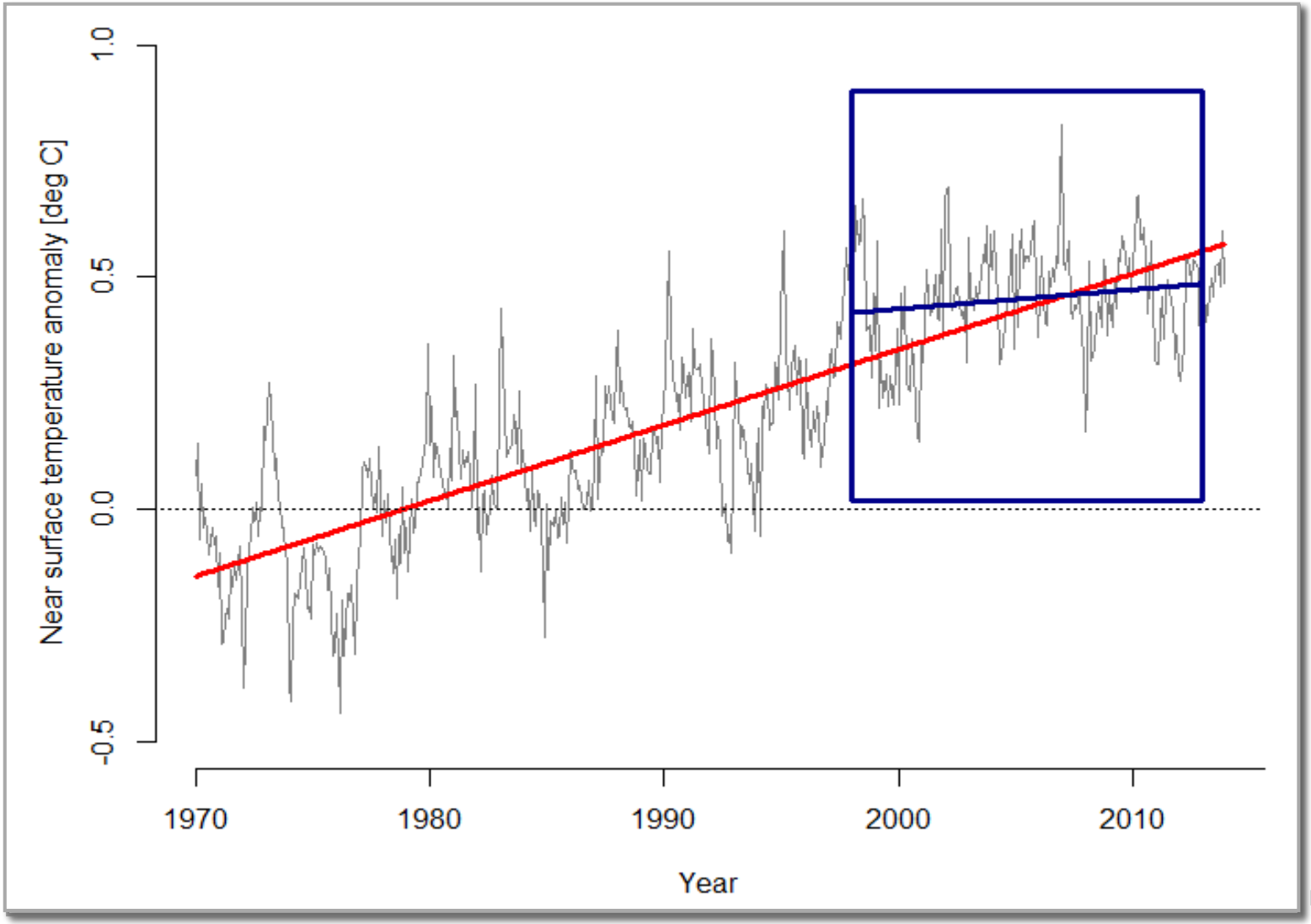






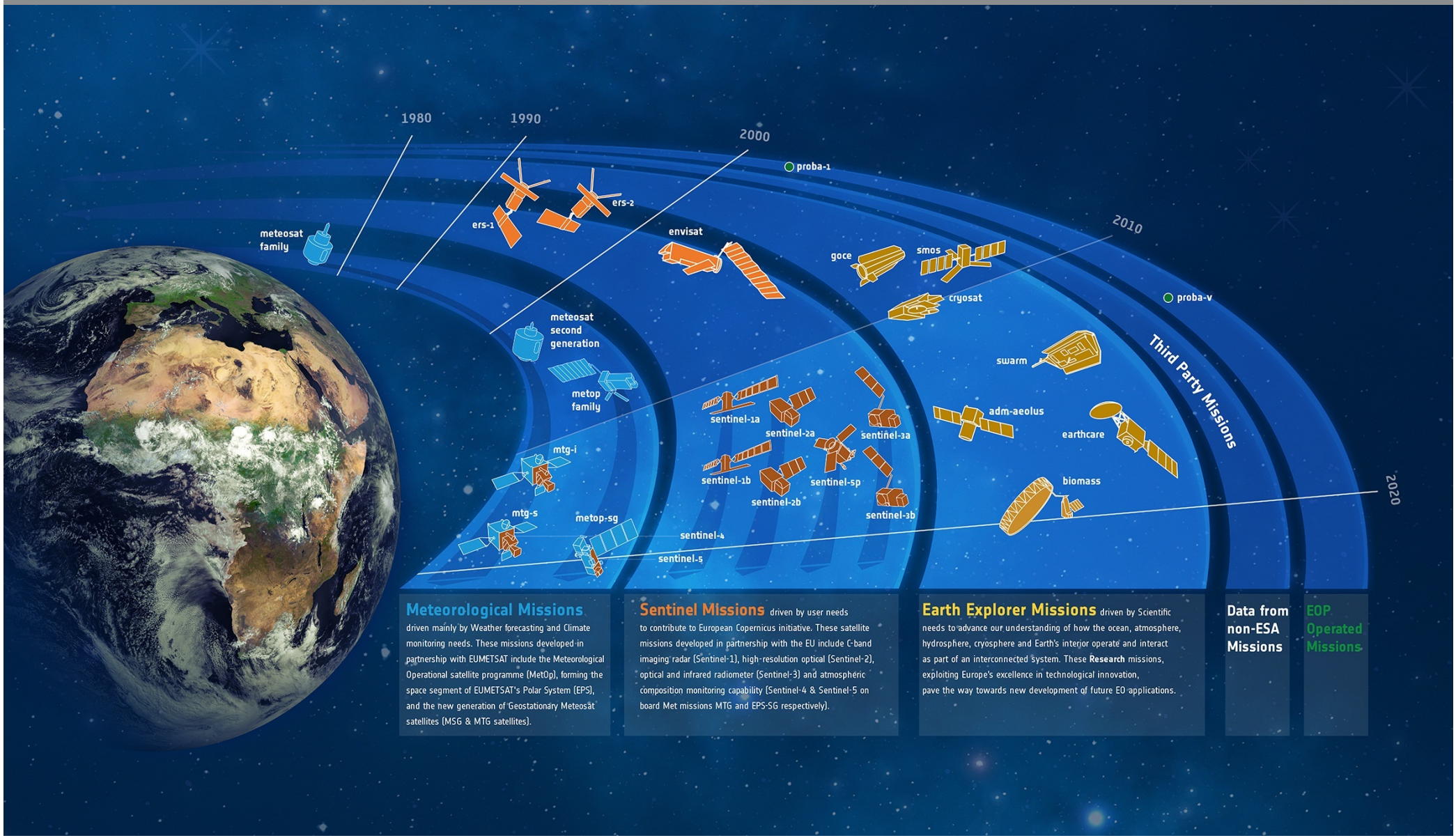
Data source: MetOffice (2014), NOAA (2014)

Need for a long-term view – quantify trends



Data source: HasCRUT4 MetOffice (2014) Plot produced by JW

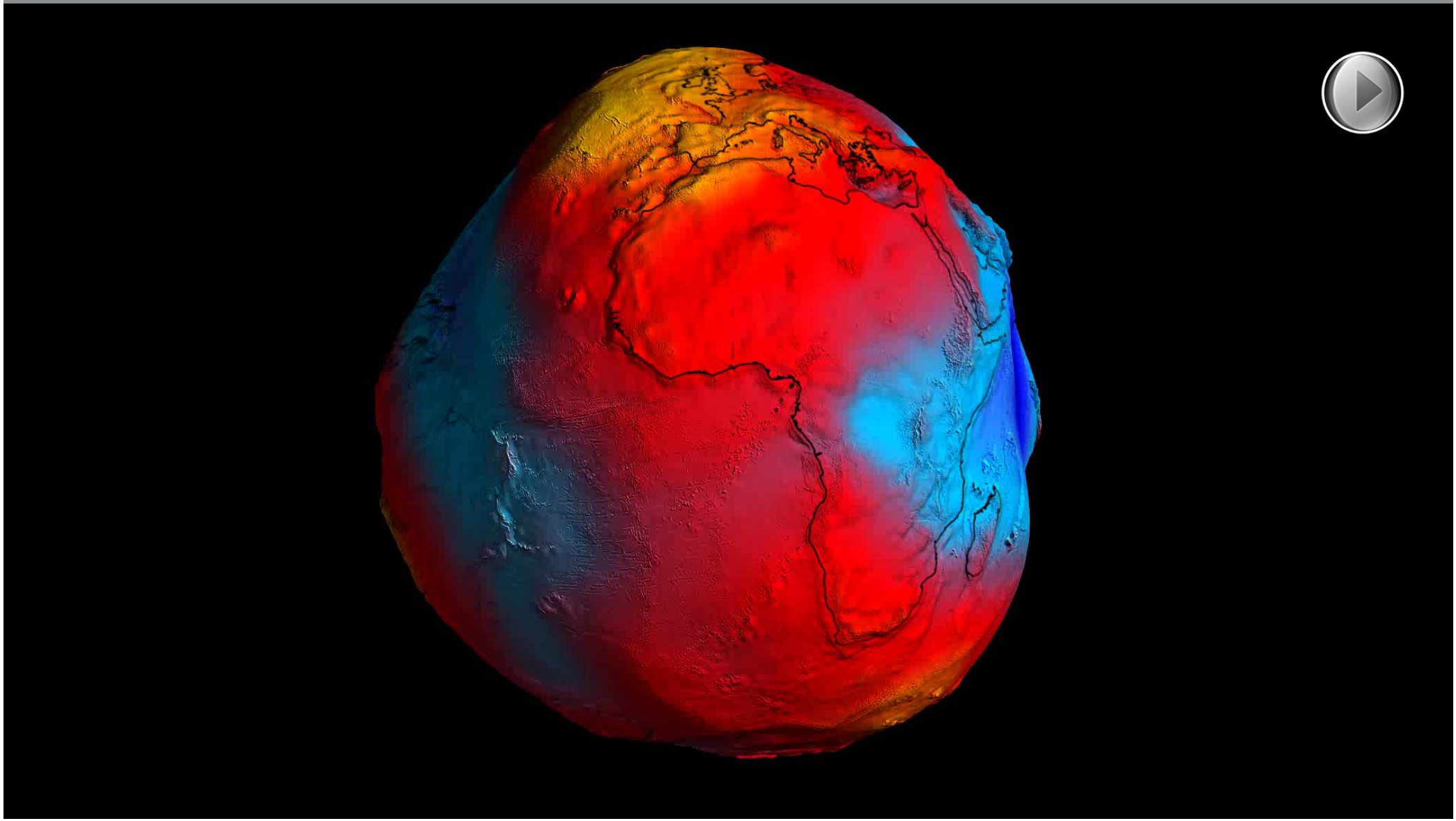
Assets in orbit



GOCE: Gravity and Ocean Circulation

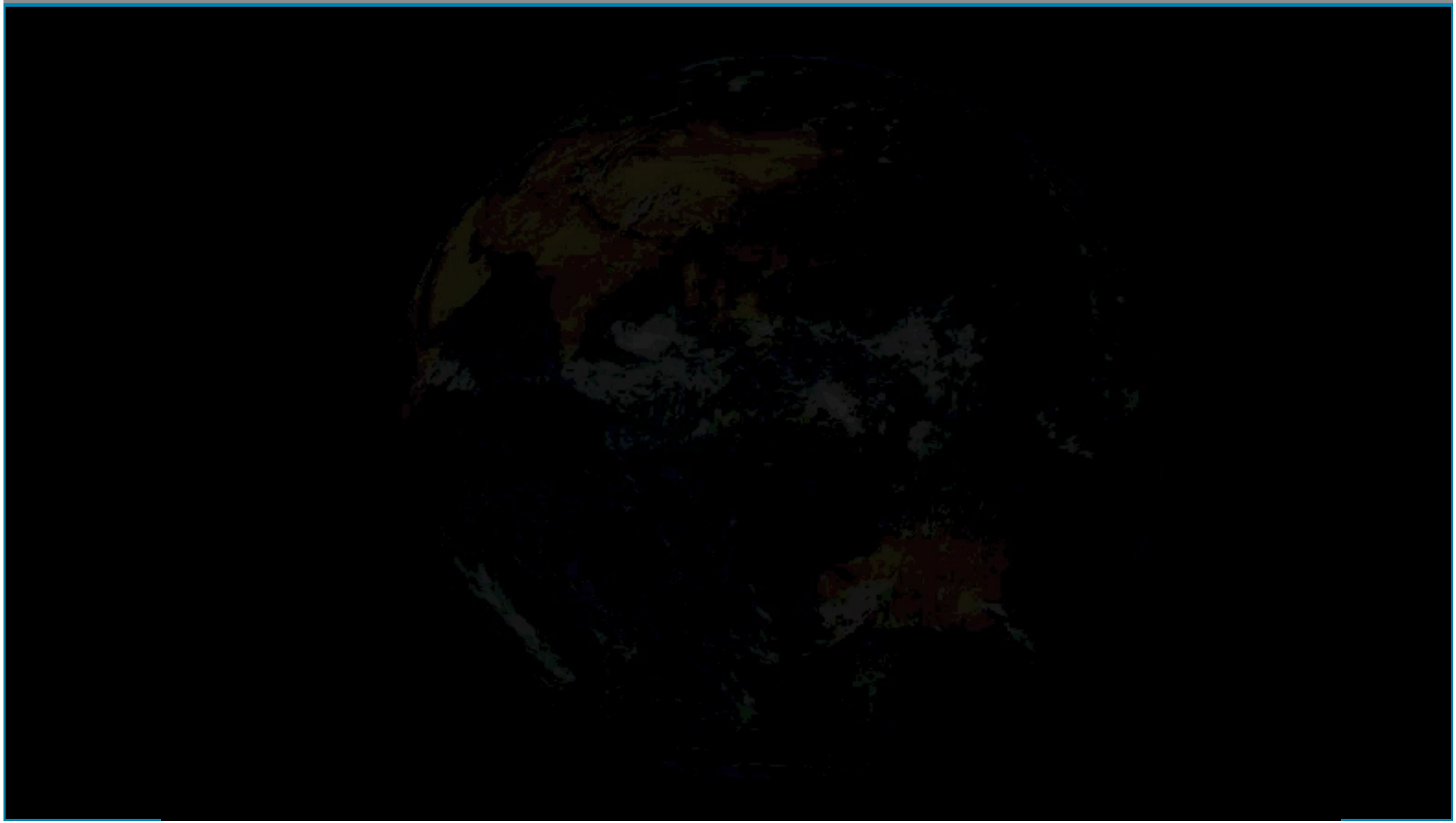
- First gradiometer in space
- Best geoid ever
- 5th version of geoid foreseen released in July 2014, including all GOCE measurements
- End of mission declared 21 October 2013 following depletion of Xenon fuel
- Re-entry 11 November 2013

GOCE – ESA's Gravity Mission



GOCE making the first Global Moho Atlas

Dr. Danielle Sampietro
POLIMI, IT



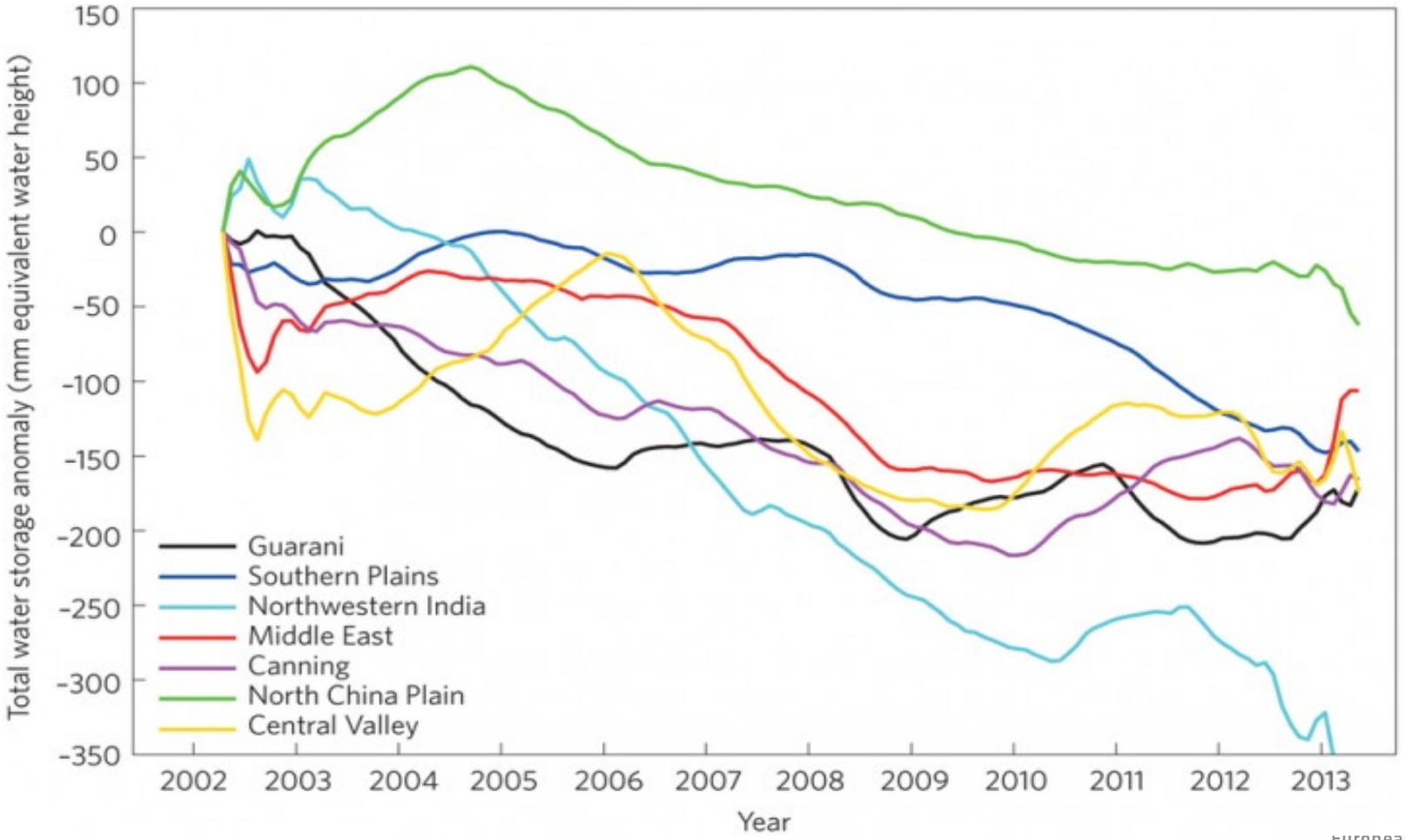
Space Perspective on aquifers depletion

Gravity measurements from GRACE highlighting that, **water tables** have fallen in various countries, including China, India, and the United States, which together produce nearly half of the world's grain.

Source: GRACE mission, NASA, DLR, UCI, USGS, R.Vijgen, P.Weil, Heads Up! 2012.

=> Depletion of Aquifer-fed irrigation systems

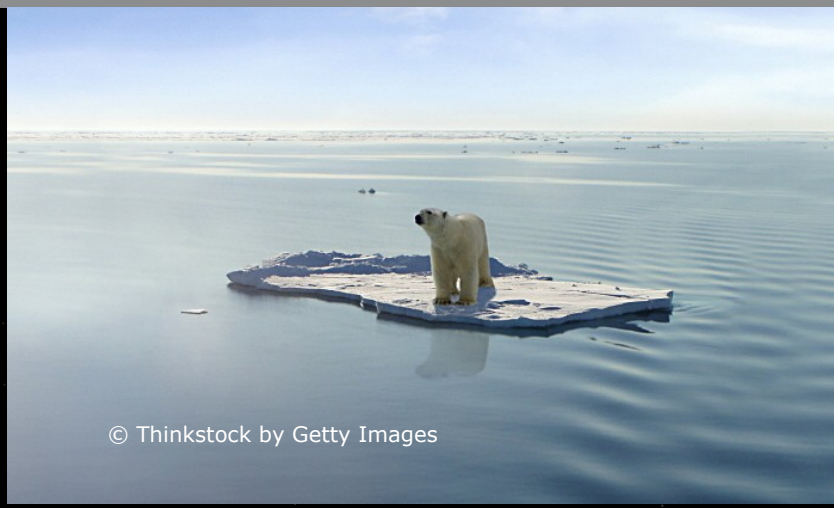
Depletion of major Acquifers (GRACE Gravity mission)



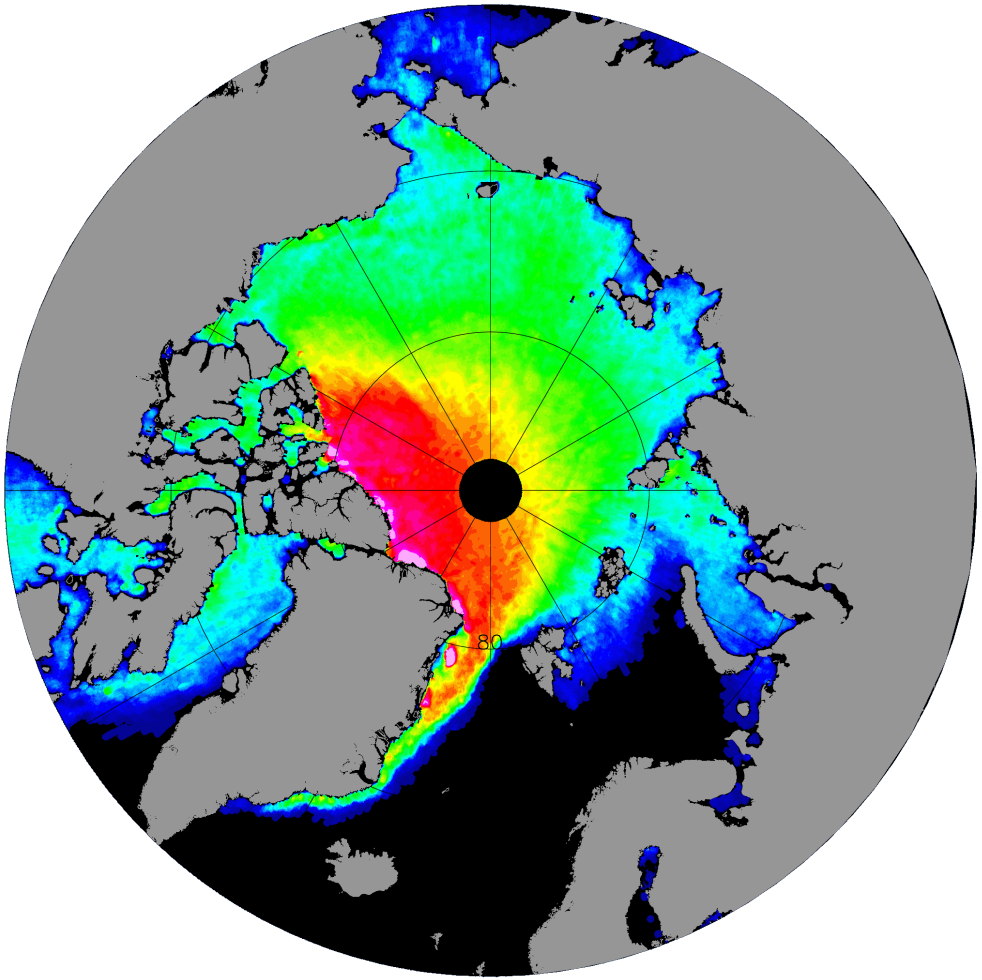
Source: JT Reager NASA JPL

CryoSat: The Ice Mission

- First interferometric altimeter in space
- Global sea ice thickness measurements
- Data used for ice research, but increasingly also for oceanography



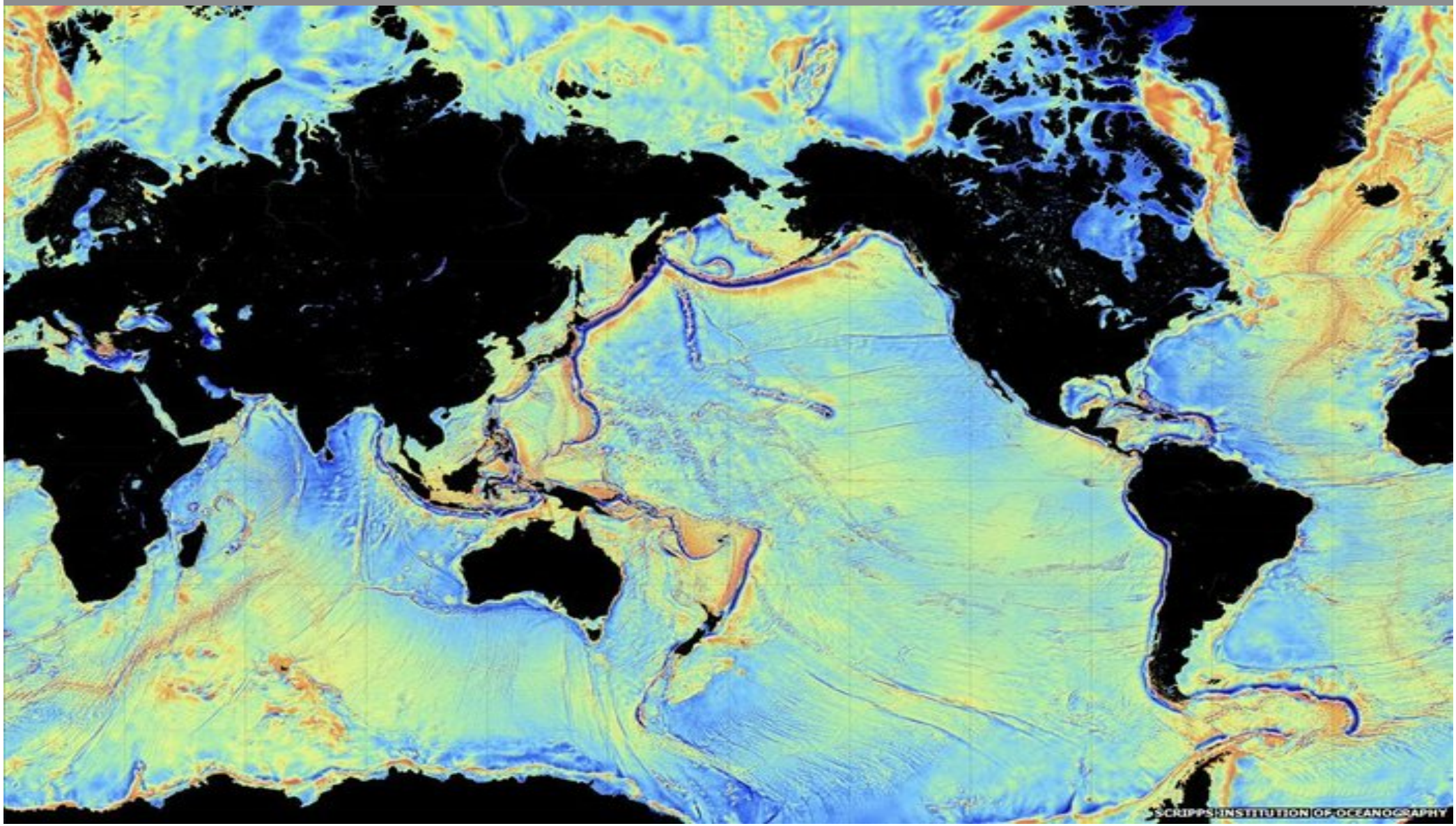
Sea Ice thickness from Cryosat



0 3 m

European Space Agency

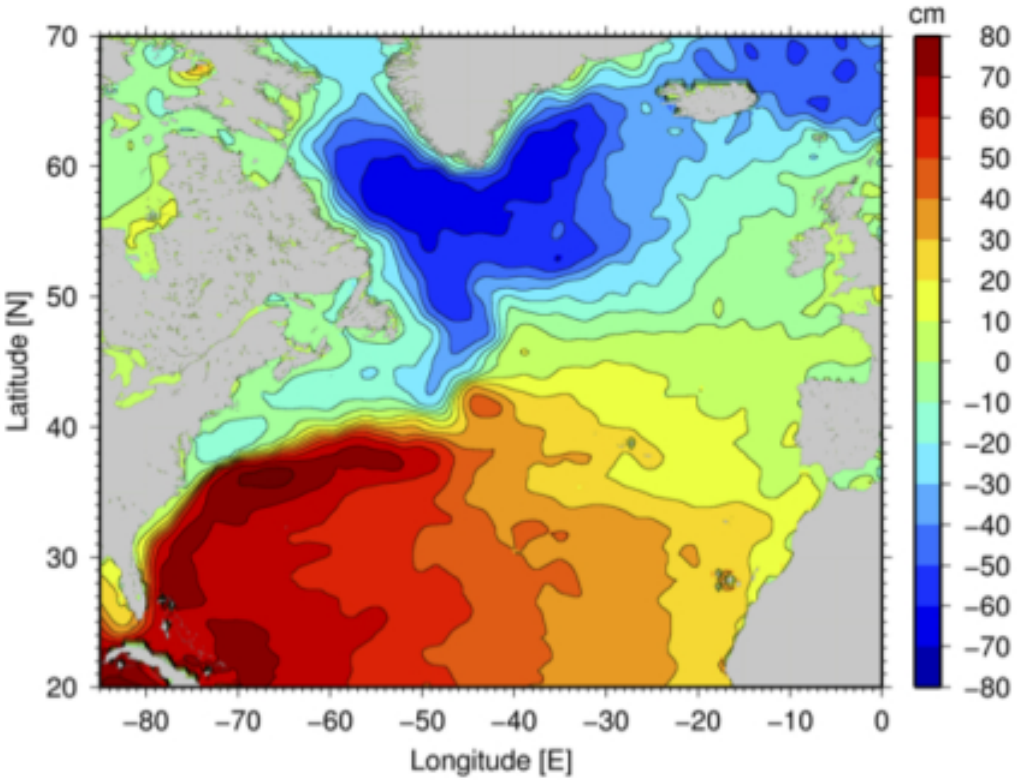
CryoSat: Gravity reveals sea floor



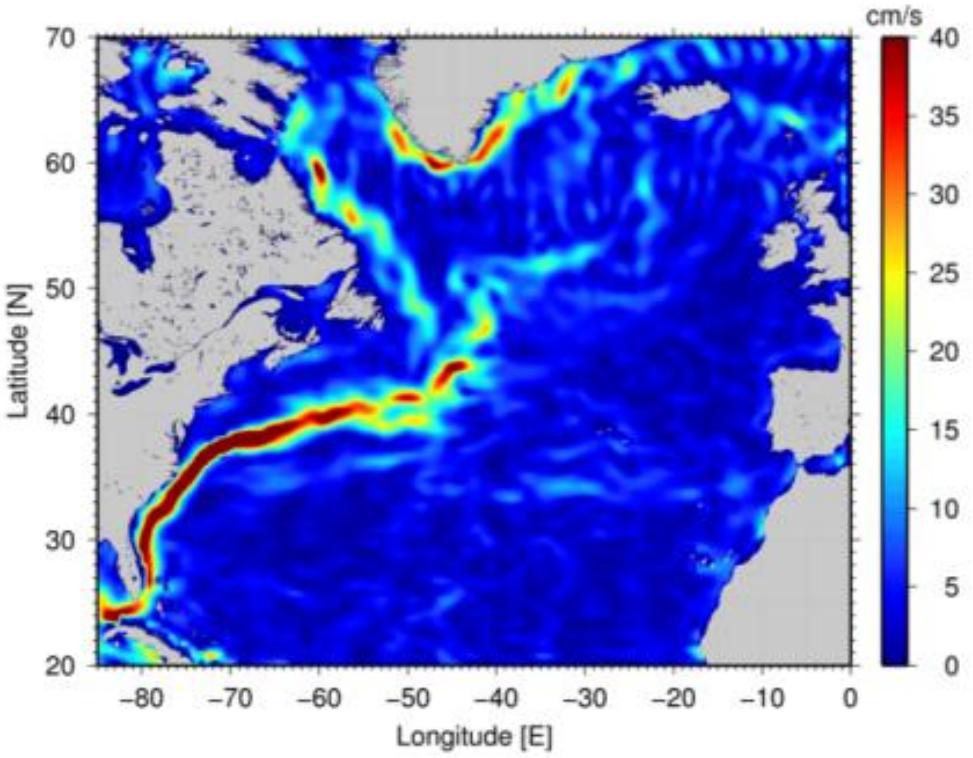
GOCE: accurate ocean currents map

- With GOCE geoid, for the first time, global currents can be extracted directly from satellite altimetry data.

Ocean Dynamic Topography



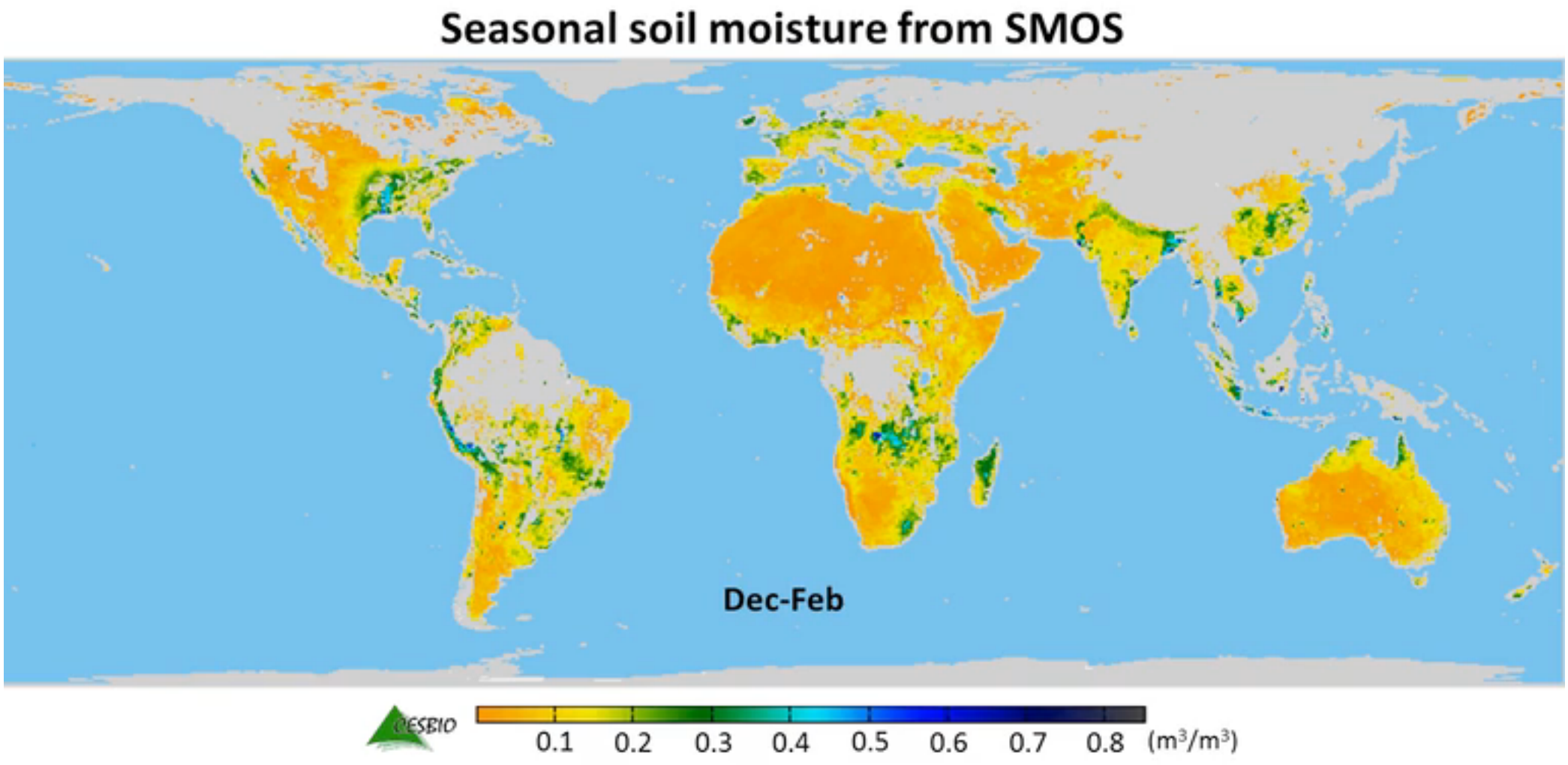
Water Surface Velocity



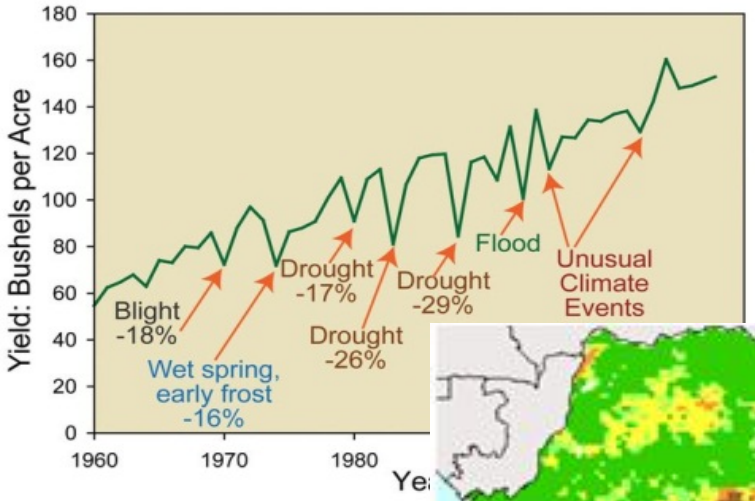
SMOS – Soil Moisture and Ocean Salinity

- Data delivery since February 2010
- Complete Earth coverage within three days
- Outstanding international cooperation

SMOS – Seasonal Soil Moisture



Measuring soil moisture to predict drought

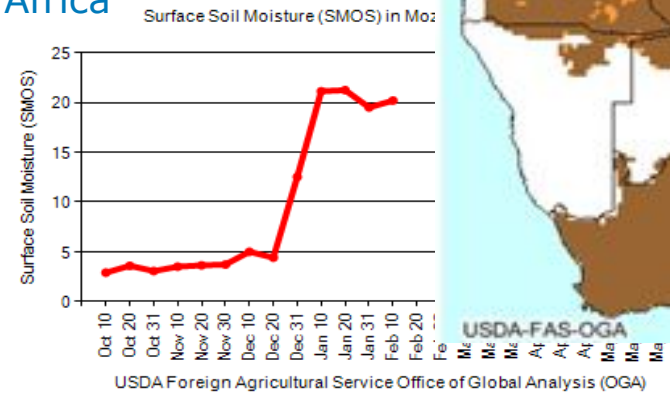


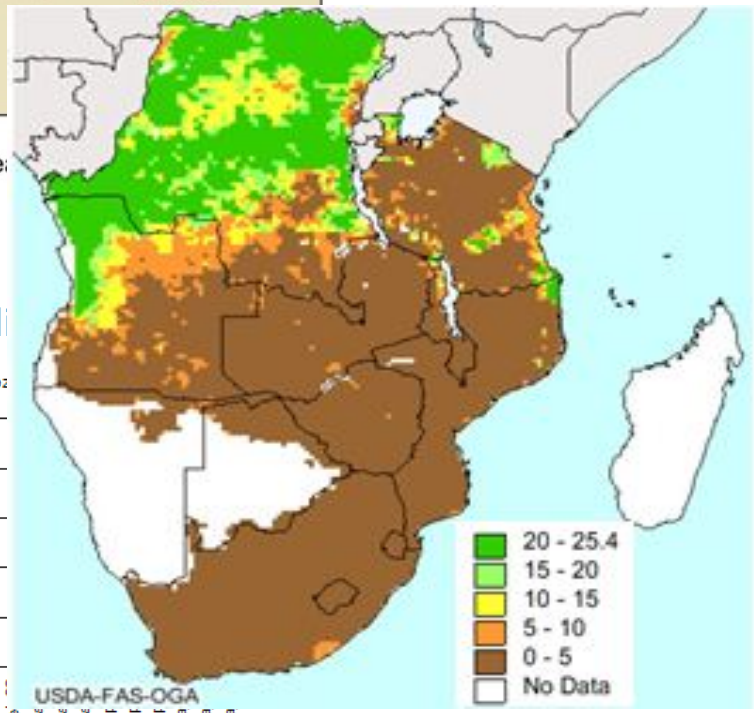
Credit: USDA FAS

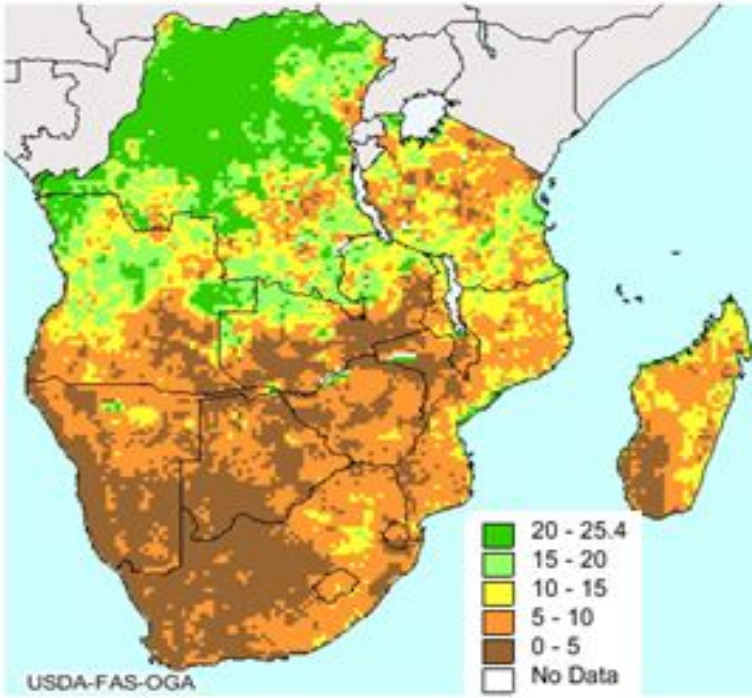
SMOS data used to predict drought and improve crop yield by US Department of Agriculture (USDA)

Crop Explorer website: http://www.pecad.fas.usda.gov/cropexplorer/

Current Zambezi Flood
Africa



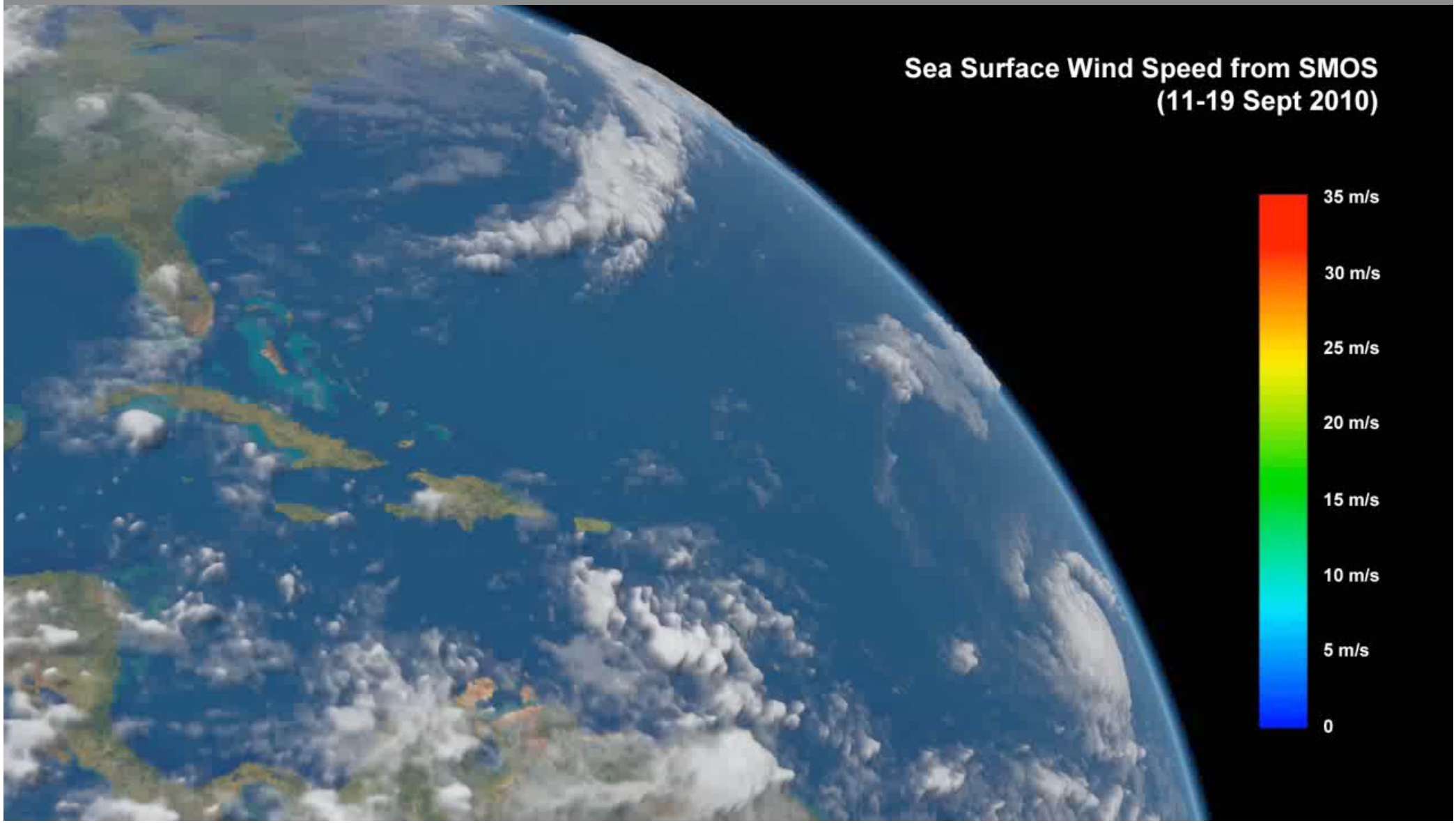




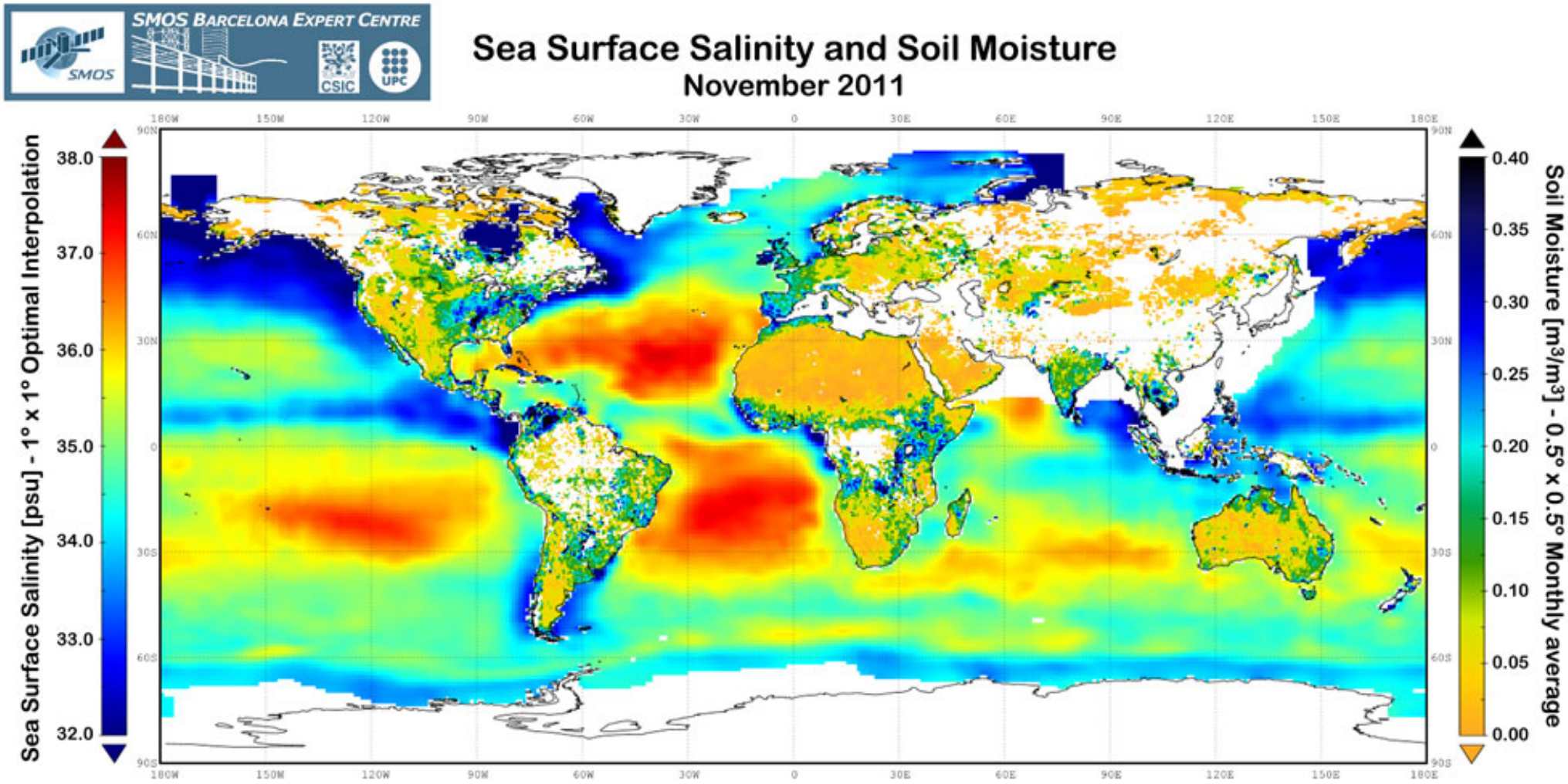
European Space Agency

Credit: USDA FAS, Soil moisture in southern Africa in mid-April 2014.

SMOS - Hurricane Igor

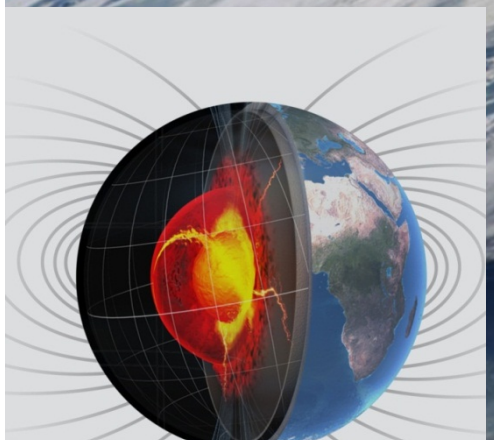


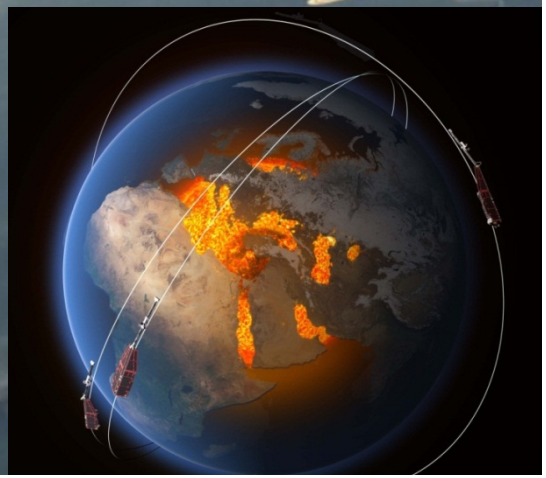
Soil Moisture and Sea Surface Salinity



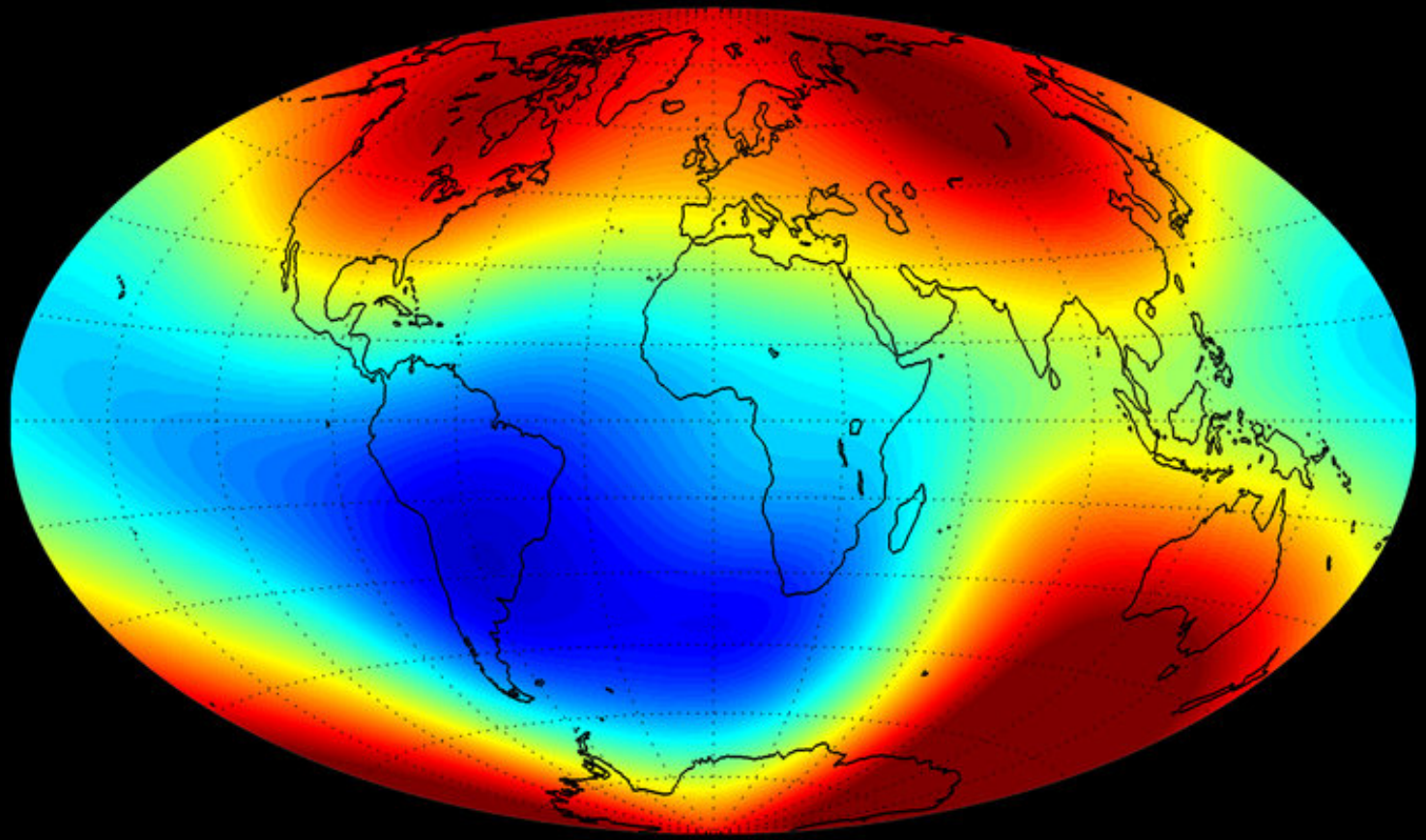
Swarm

- Three-satellite-constellation, providing the best-ever survey of the geomagnetic field and its variation in time
- Gaining new insights into the Earth's interior and climate
- Launched November 2013

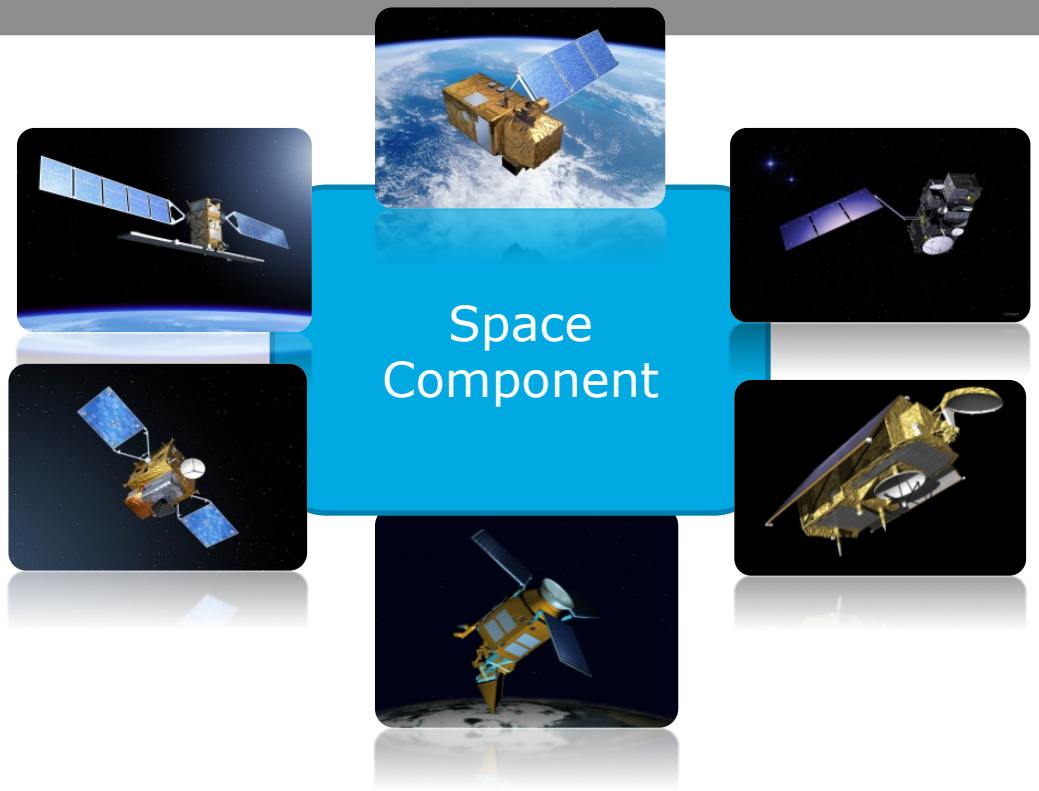


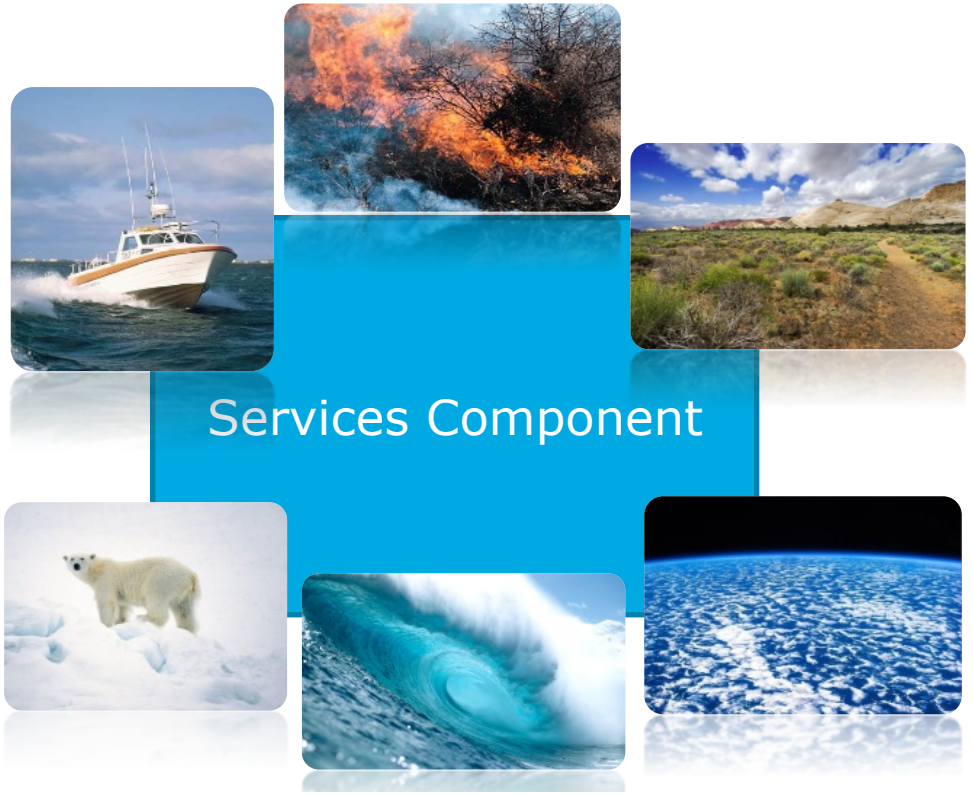


Earth’s Magnetic Field from Swarm Data

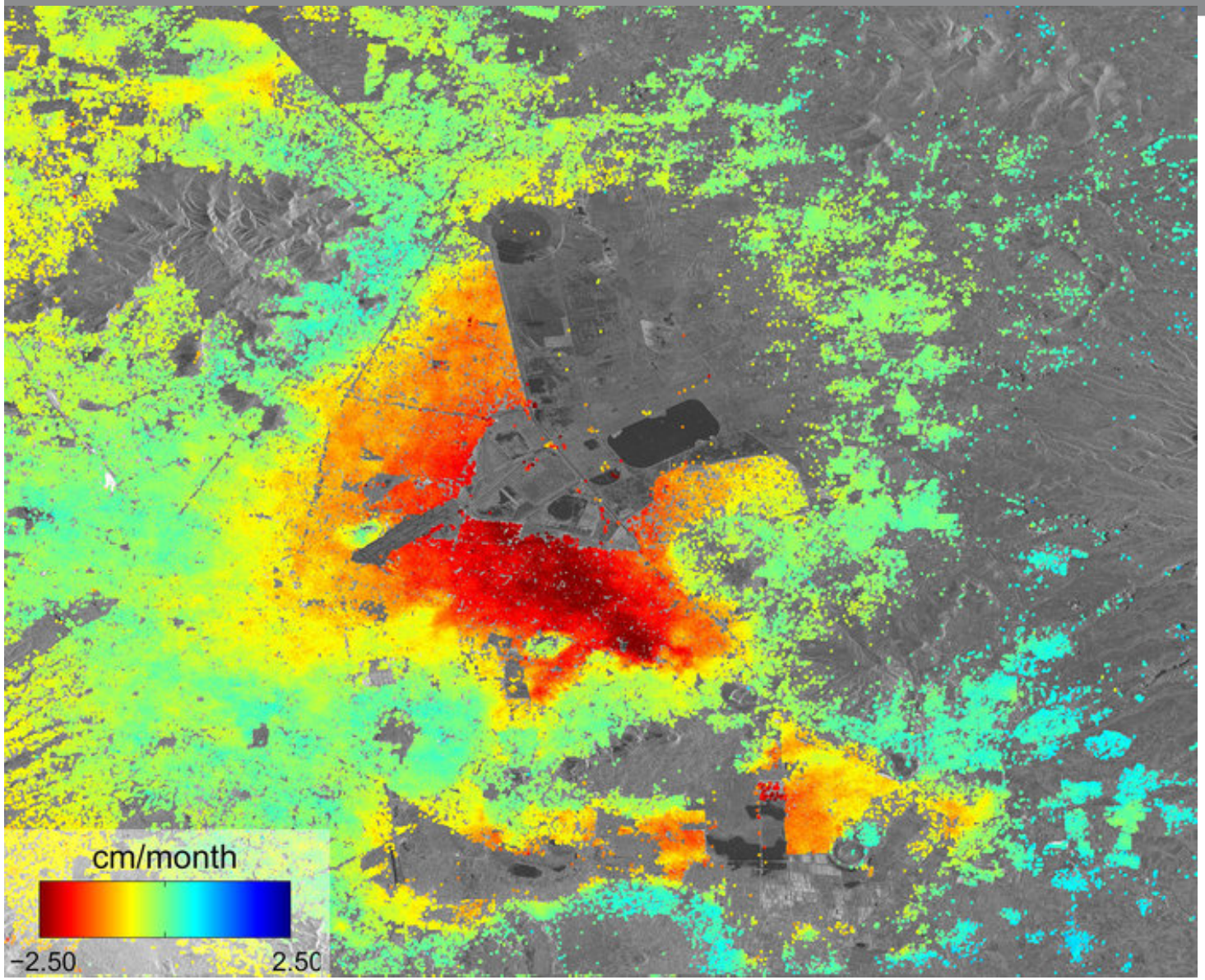


European Space Agency


Space
Component


Services Component

Impacts of ground water extraction



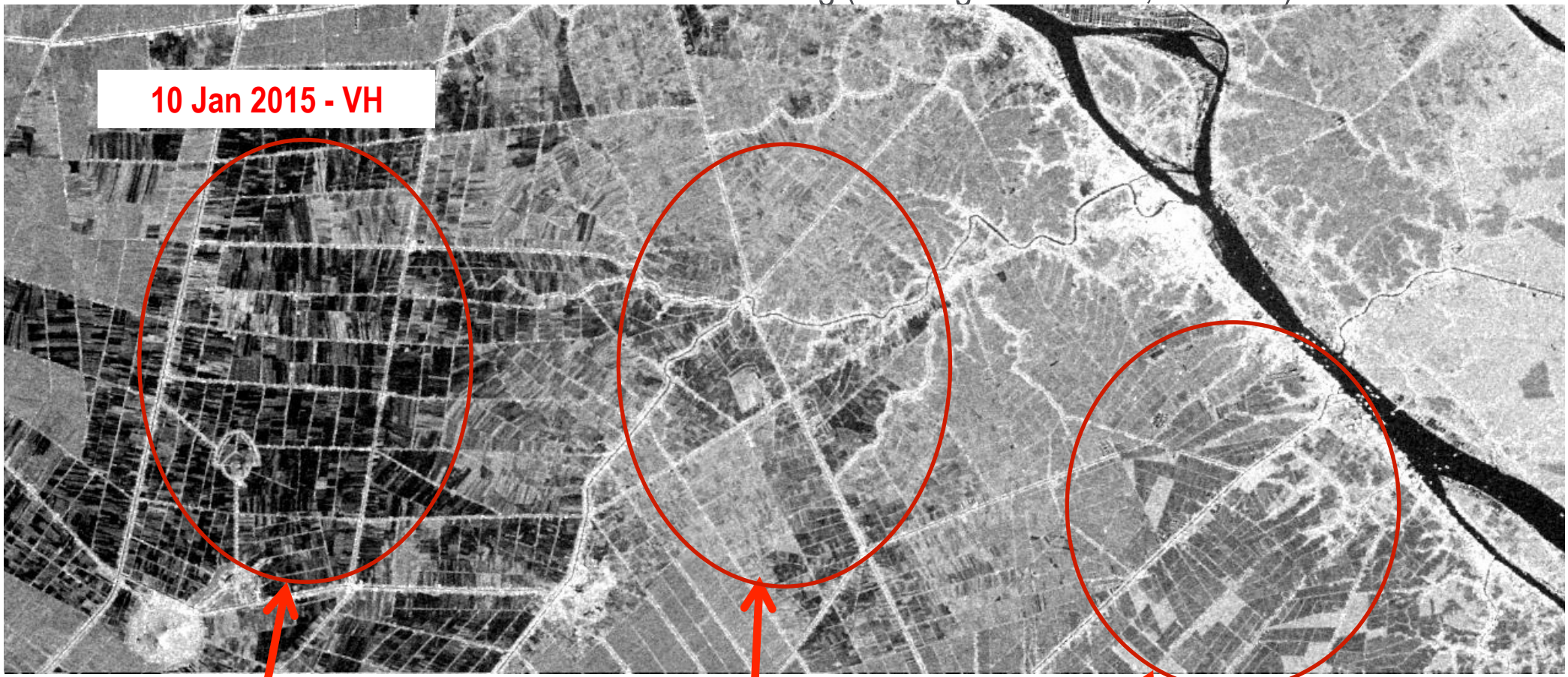
Measuring **Ground Deformation in Mexico City** from an instrument 800 km out in space

Combining five Sentinel-1 radar scans between 3 October and 2 December 2014

Monitoring Rice crops from Space

Sentinel-1 time series (Oct.2014-Jan.2015)

GEOGLAM Asia-RICE Site: An Giang (Mekong River Delta, Vietnam)



Bouvet & Le Toan

Establishing a Rice Crop Calendar

An Giang province (80x80 km)

Crop calendar

Crop season	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Winter-Spring crop														
Summer-Autumn crop														
Autumn-Winter crop														

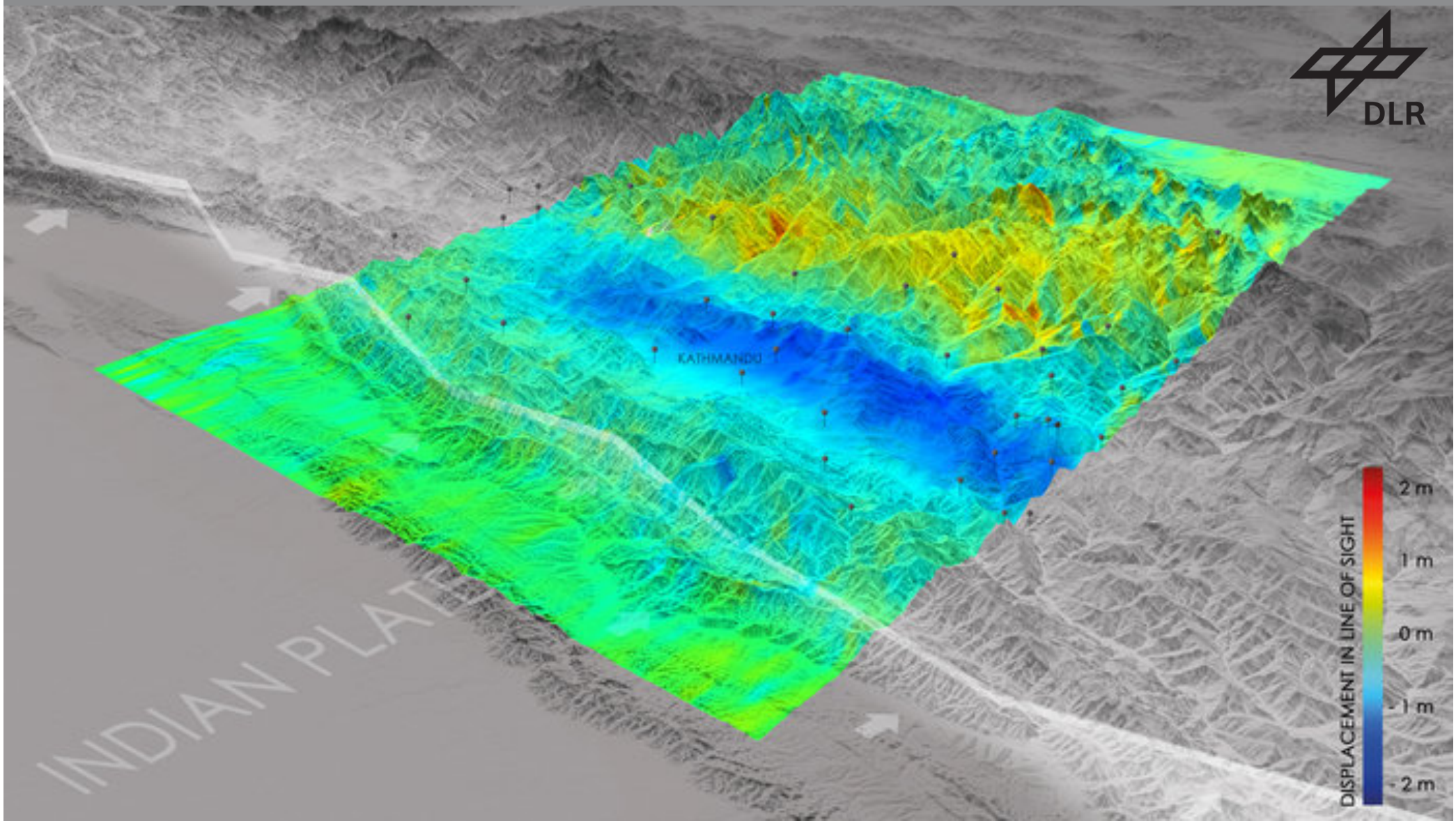
November-December: end of Autumn-Winter crop and beginning of Winter-Spring crop

Crop calendar using the first Sentinel-1 data

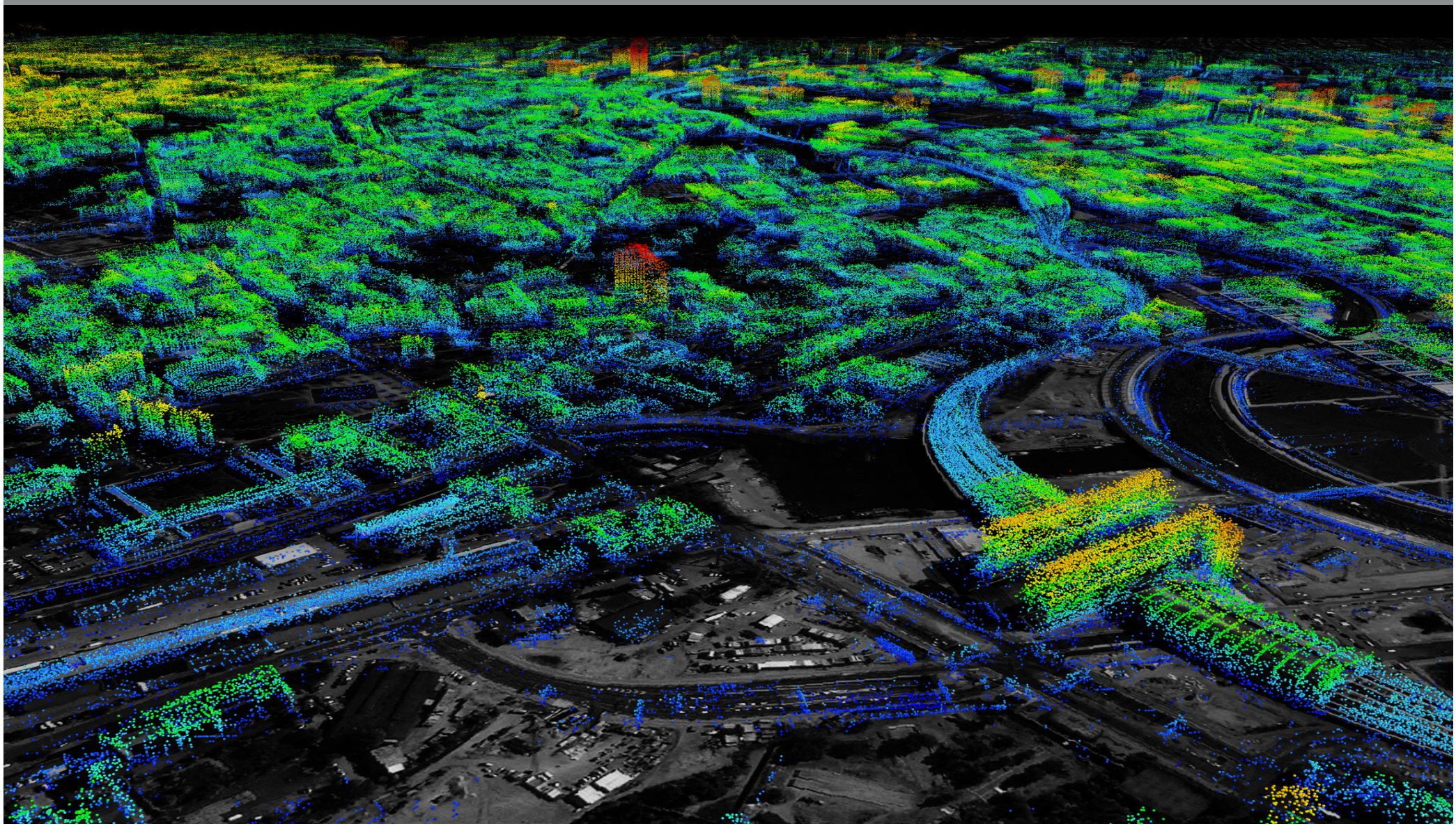
- Planted around 11-12- 2014
- Planted between 11-11 and 23-11
- Planted on 23 -11
- Harvested between 23-11 and 5 -12, and planted again around 5-12
- Harvested between 23-11 and 5-12, and planted again between 5 and 17 -12
- Harvested between 17 -12 and 10 -01-2015

Bouvet & Le Toan

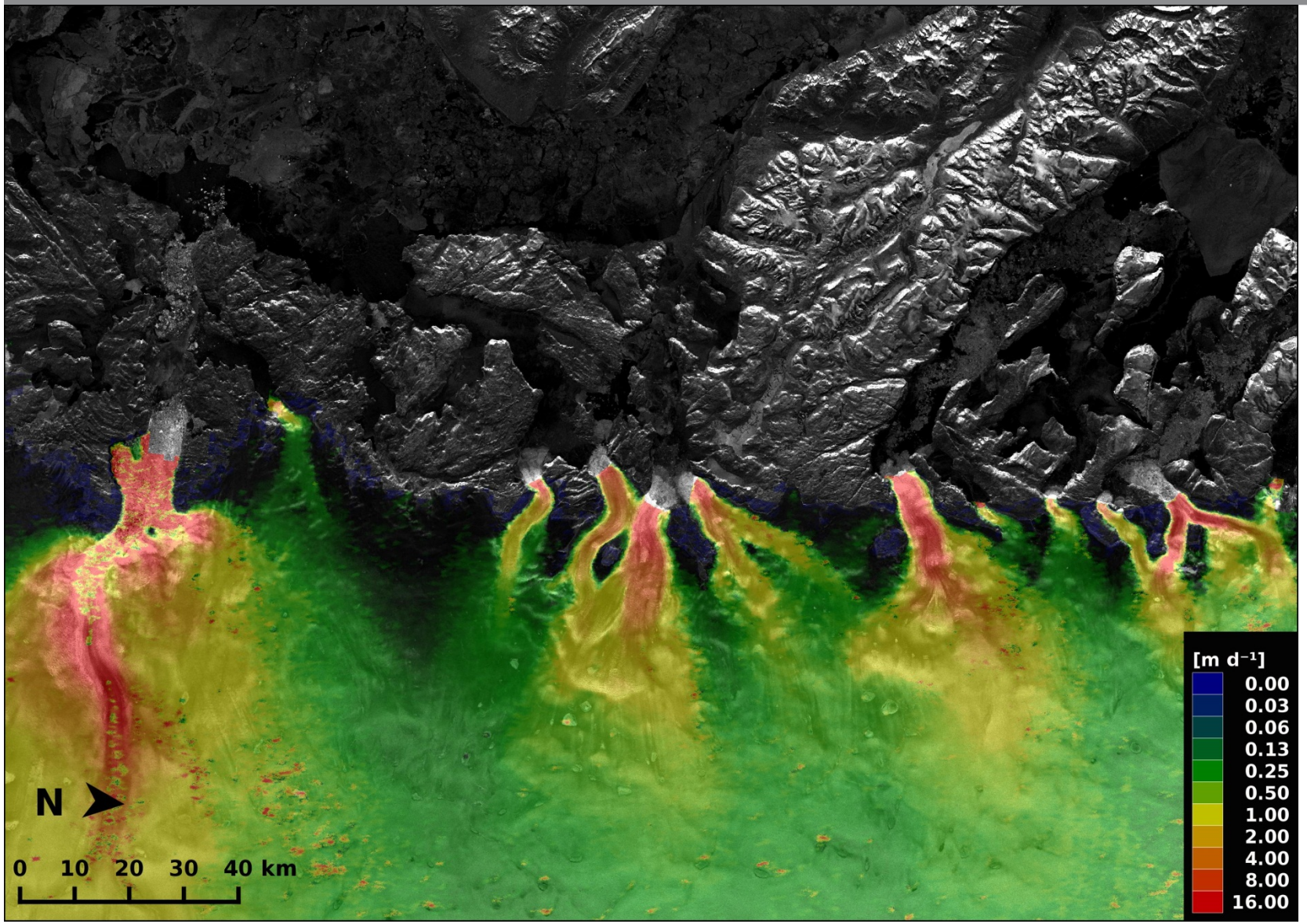
Sentinel-1A: Nepal Earthquake



Subsidence Berlin



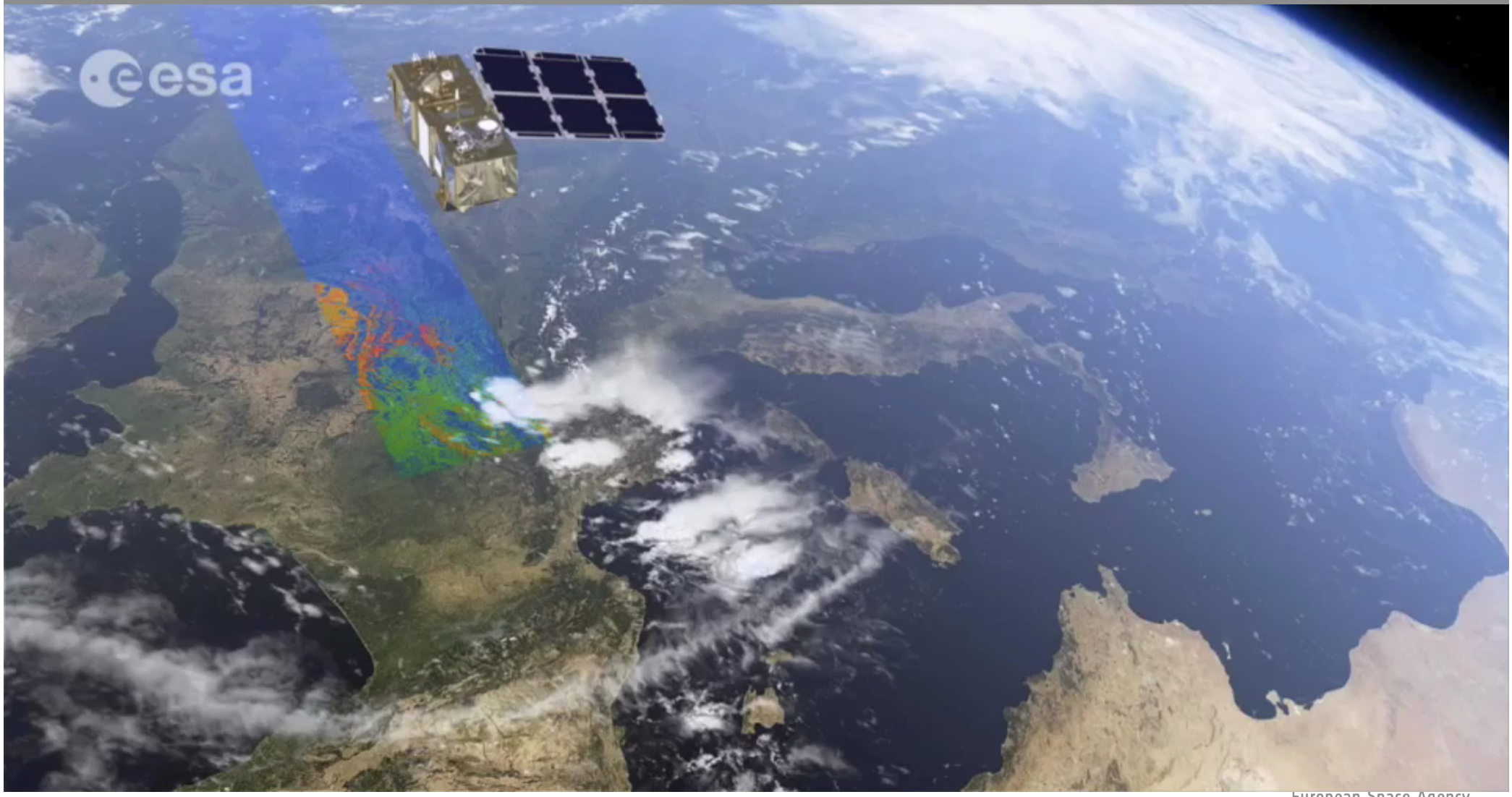
Ice Streams seen by Sentinel-1A



Greenland,
West Coast

January 2015

Sentinel-2

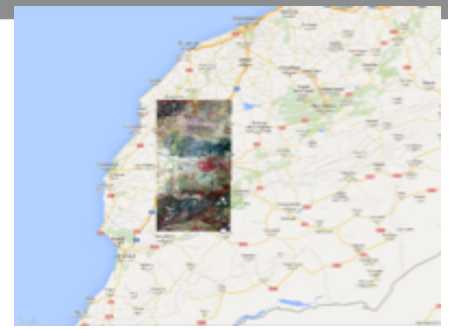


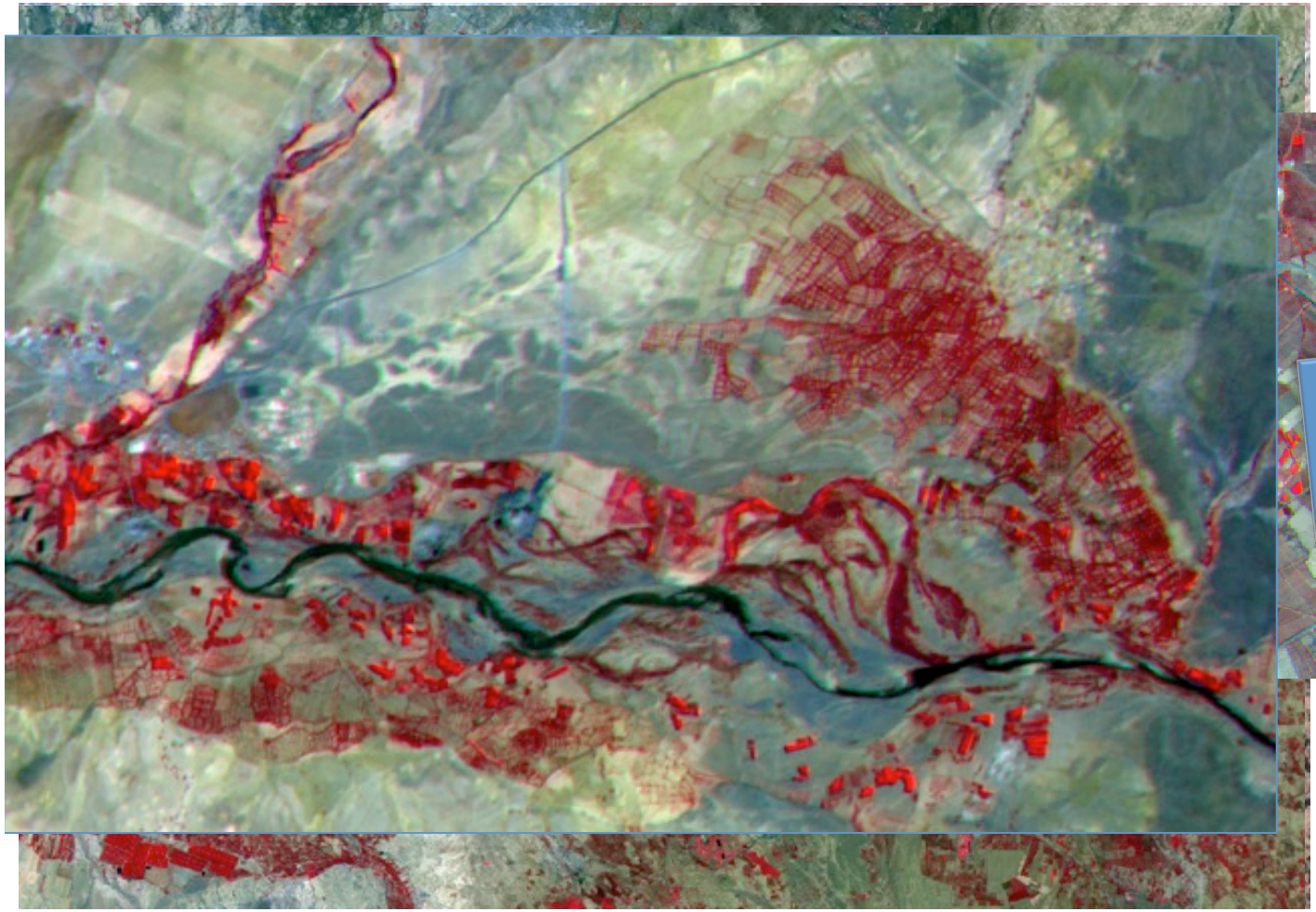
Agriculture: Irrigation monitoring at field scale

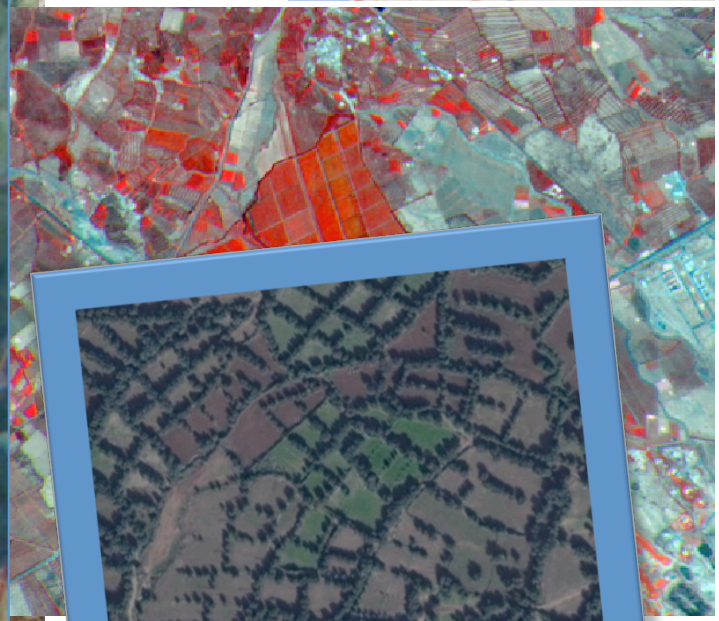
Marrakesh (Morocco) - Sentinel-2 - 12 July 2015

Water consumption for irrigation of summer vegetation (in red),

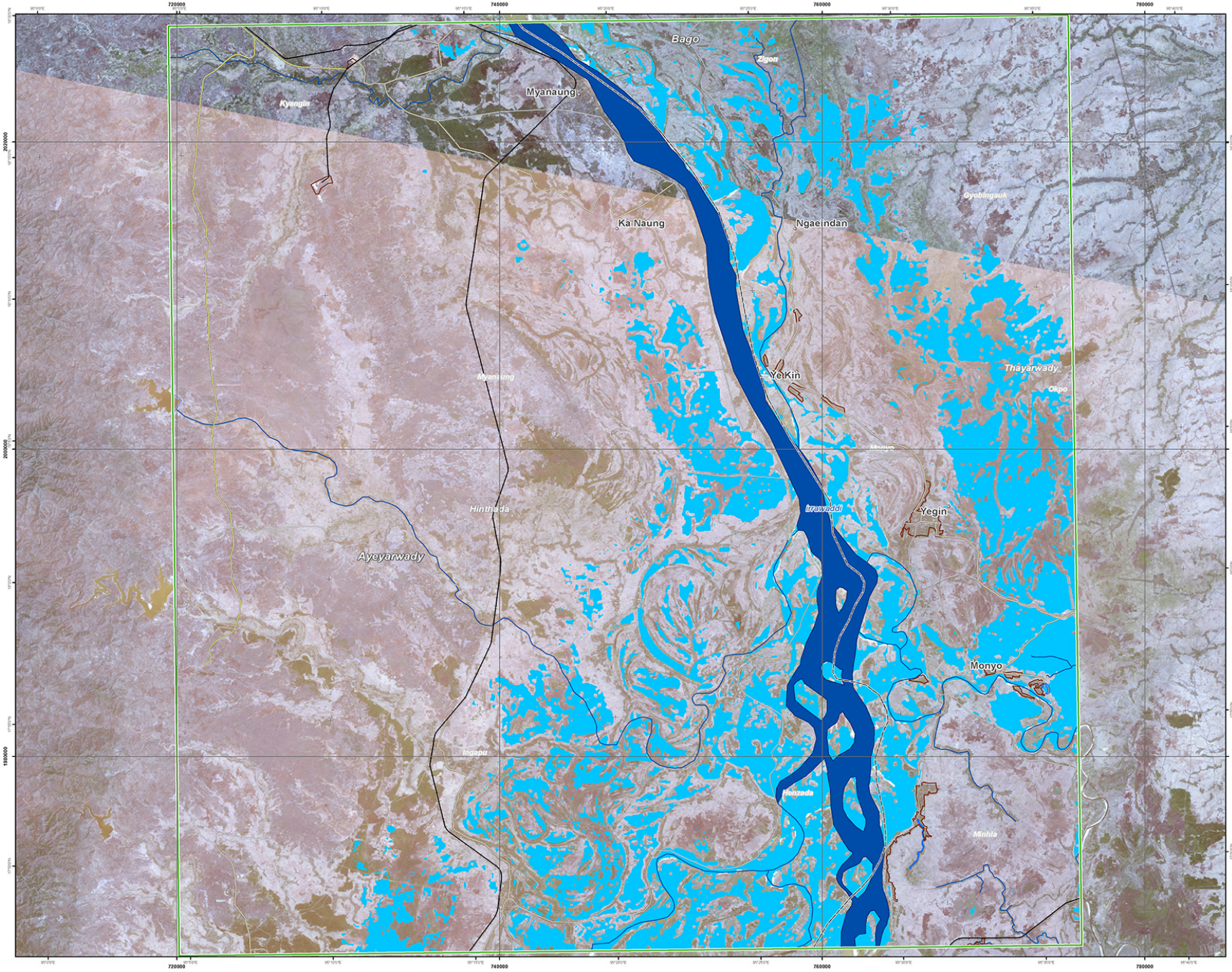
Hedges around fields/parcel delineation







Courtesy: S2AGri, UCL, Cesbio, ESA



GLIDE number: N/A

Activation ID: EMSR130
Product N.: 09MONYO, v1, English

Monyo - MYANMAR
Flood - 01/08/2015
Delineation Map

Cartographic Information

1:110000 — Full color ISO A1, medium resolution (200 dpi)

0 2.5 5 10 km

N

Grid: WGS 1984 UTM Zone 46N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

Crisis Information
- Flooded Area (11-08-2015 11:46 UTC)

General Information
- Area of Interest

Administrative boundaries
- Region

Settlements
- Populated Place
- Built-Up Area

Hydrology
- River
- Lake
- Reservoir
- River

Transportation
- Railway
- Primary Road
- Secondary Road
- Local Road

Consequences within the AOI on 11/08/2015			Affected	Total in AOI
Flooded area		ha	50634	
Estimated population		inhabitants	278018	828745
Settlements	Built-up area	ha	0	1021
Transportation	Primary roads	km	0	52.7
	Secondary roads	km	5	112.2
	Local roads	km	18.2	212.8
	Railways	km	0	105.5

Map Information

Unusual heavy monsoon rains have been affecting Myanmar since 16 July causing river overflows and floods. In the past few days, torrential rains damaged farmland, roads, rail tracks, bridges and houses.
The core users of the map is Emergency Response Coordination Centre (ERCC).

Relevant date and time records (UTC)			
Event	01/08/2015 00:00	Last crisis status	11/08/2015 11:46
Activation	07/08/2015 10:00	Map production	12/08/2015

Data Sources

Sentinel-1A, (acquired on 11/08/2015, 11:46 UTC, GSD 10 m) provided by the European Space Agency.
Landsat-8 © U.S. Geological Survey (acquired on 05/03/2015, GSD 15 m, approx. 0.88% cloud coverage)
Base vector layers based on OpenStreetMap © OpenStreetMap contributors, Wikimapia.org, GeoNames (approx. 1:10000, extracted on 01/01/2001), refined by e-GEOS. Source information is included in vector data.
Elevation data: SRTM (90 m posting). Height in meters above mean sea level.
Population data: Landscan 2010 © UT BATTELLE, LLC.
All Data sources are complete and with no gaps.
Inset maps based on: Administrative boundaries (JRC 2013), Hydrology, Transportation (Natural Earth, 2012), Settlements (Geonames, 2013).

Dissemination/Publication

Delivery formats are GeoTIFF, GeoPDF, GeoJPEG and vectors (shapefile and KML formats).
Map products available in the Copernicus EMS Portal at the following URL: http://emergency.copernicus.eu/mapping/list-of-components/EMSR130
All products are © of the European Union.

Disclaimer

The products elaborated in the framework of current mapping in rush mode activation are realized to the best of our ability, within a very short time frame during a crisis, optimising the available data and information. All geographic information has limitations due to scale, resolution, date and interpretation of the original data sources. The products are compliant with Copernicus EMS Rapid Mapping Product Portfolio specifications.

Map Production

The present map shows the flood delineation in the area of Monyo (MYANMAR). The basic topographic features are derived from public datasets, refined by means of visual interpretation of pre-event image Landsat-8.
Thematic layers, assessing the delineation of the event have been derived from post-event image Sentinel-1A.
All satellite images have been radiometrically enhanced, orthocorrected with RPC approach (using SRTM elevation data).
The estimated geometric accuracy of this product is 10 m CE90 or better, from native positional accuracy of the background satellite image.
The estimated thematic accuracy of this product is 85 % or better, based on previous experience in using high-resolution SAR for flood extent delineation. Please be aware that the thematic accuracy might be lower in urban and forested areas due to known limitations of the analysis technique.
Only the area enclosed by the Area of Interest has been analyzed.

Contact

Map produced by e-GEOS under contract 259736 with the European Union.
Name of the release inspector (quality control): e-GEOS(ODO).
E-mail: rapidmapping@ems-copernicus.eu

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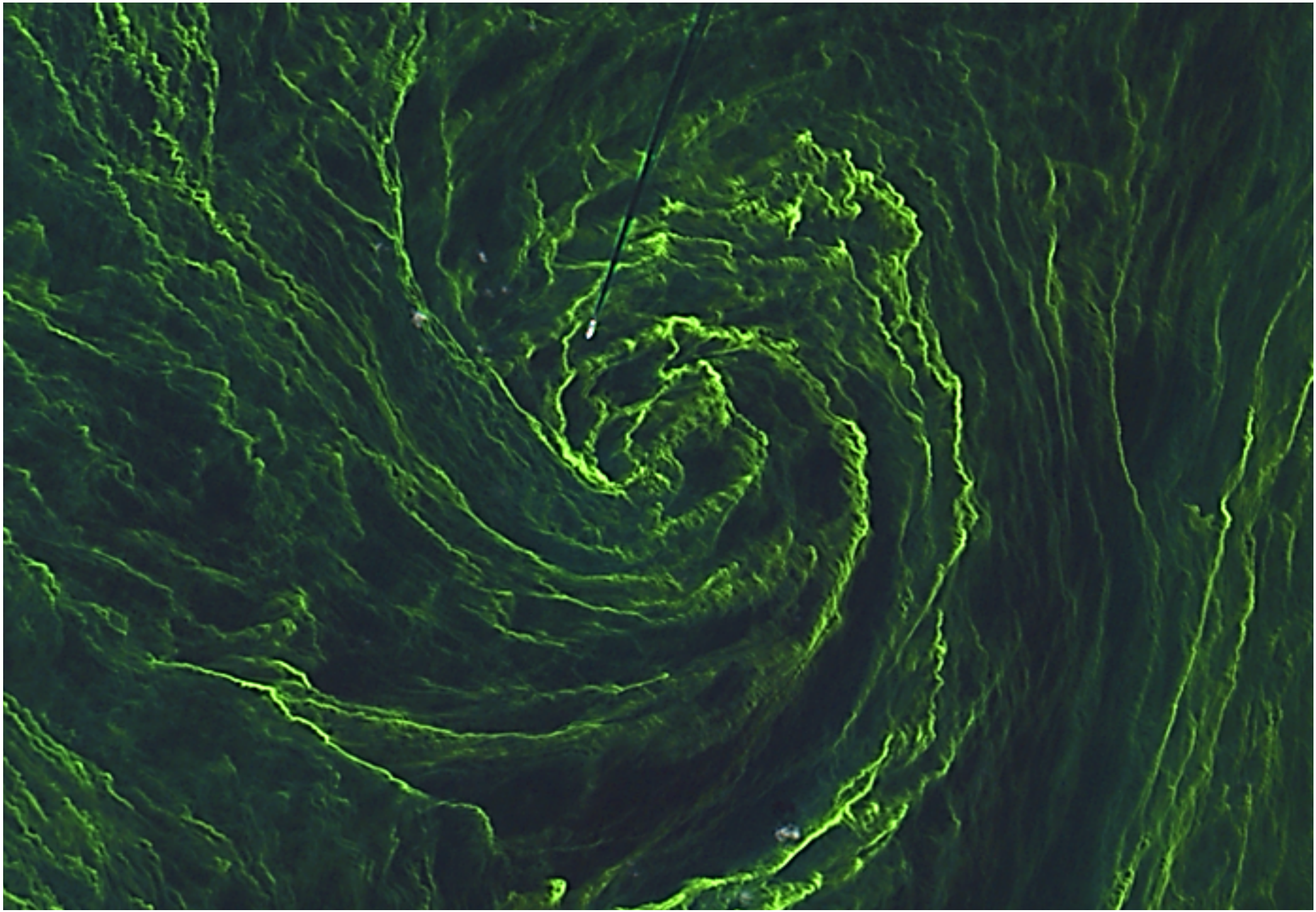
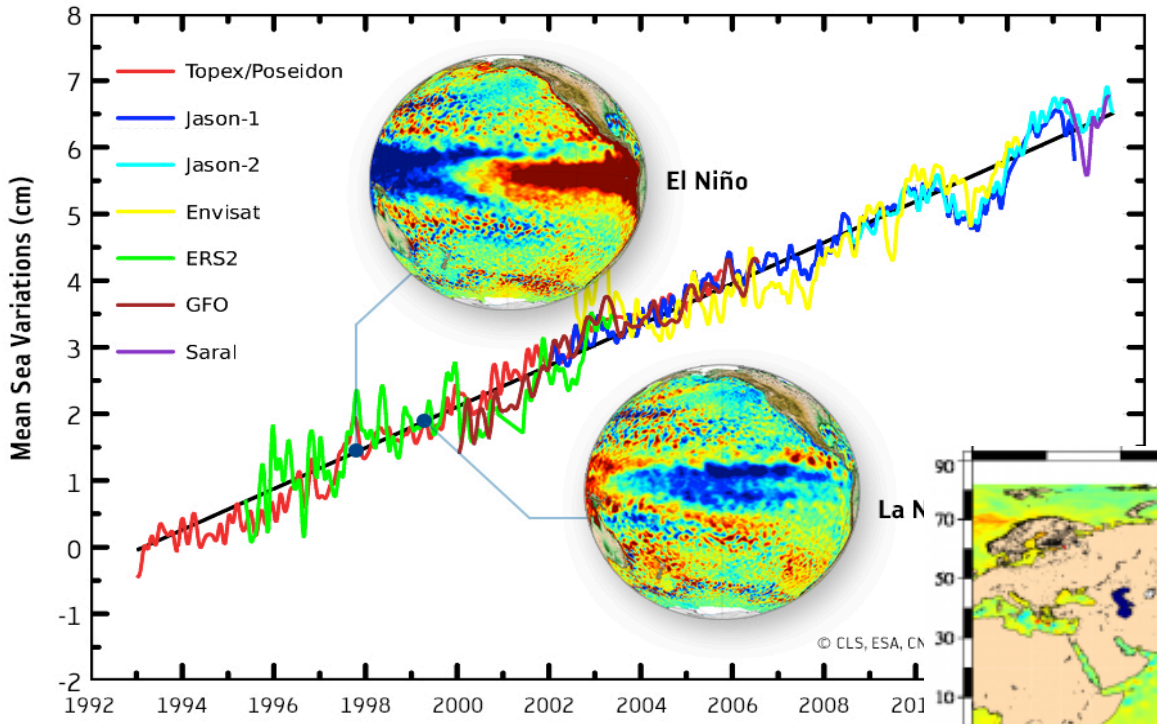
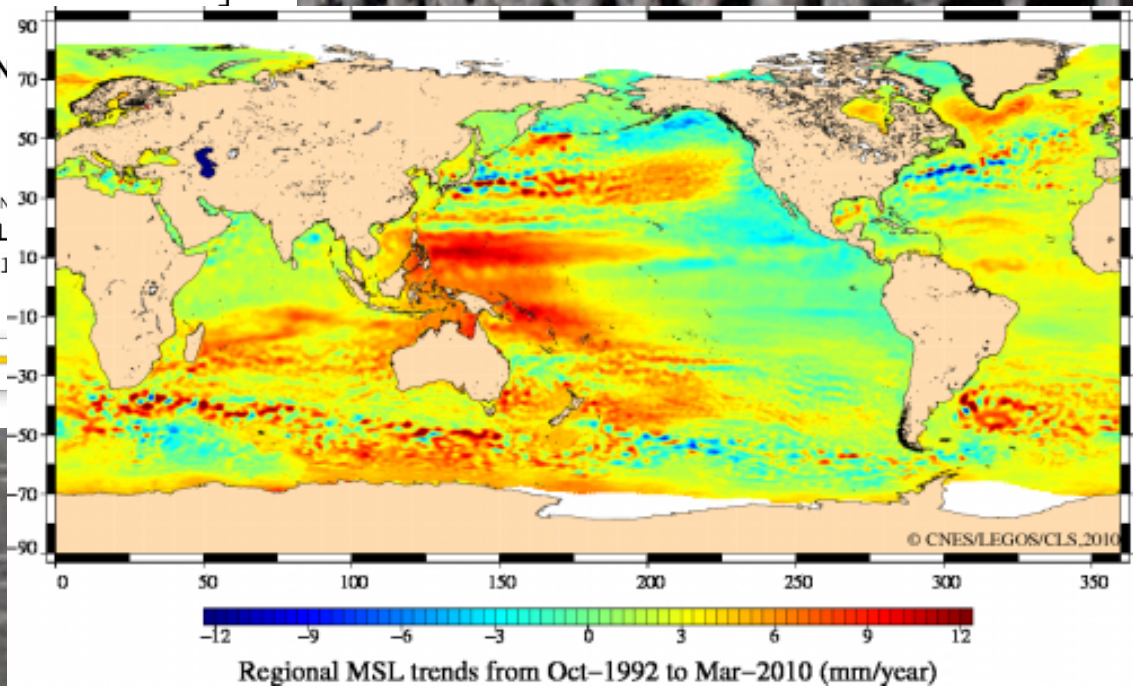


The ESA Climate Change Initiative (CCI)





ESA Climate Change Initiative & relevant Essential Climate Variables (ECVs)

PNAS

Climate change in the Fertile Crescent and implications of the recent Syrian drought

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Edited by Brian John Hoskins, Imperial College London, London, United Kingdom, and approved January 30, 2015 (received for review November 16, 2014)

Before the Syrian uprising that began in 2011, the greater Fertile Crescent experienced the most severe drought in the instrumental record. For Syria, a country marked by poor governance and unsustainable agricultural and environmental policies, the drought had a catalytic effect, contributing to political unrest. We show

Syria's water security by exploiting limited land and water resources without regard for sustainability (10).

One critical consequence of these unsustainable policies is the decline of groundwater. Nearly all rainfall in the FC occurs during the 6-month winter season, November through April, and this

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http://augureye.blogspot.it/ (?)


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