



Welcome to GHRSSST XVI from ESA

Noordwijk, 20 July 2015

Maurice Borgeaud

Head of the Department "Science, Applications, and
Future Technologies"

“To provide for and promote, for exclusively peaceful purposes, cooperation among European states in **space research** and **technology** and their **space applications.**”

Article 2 of ESA Convention



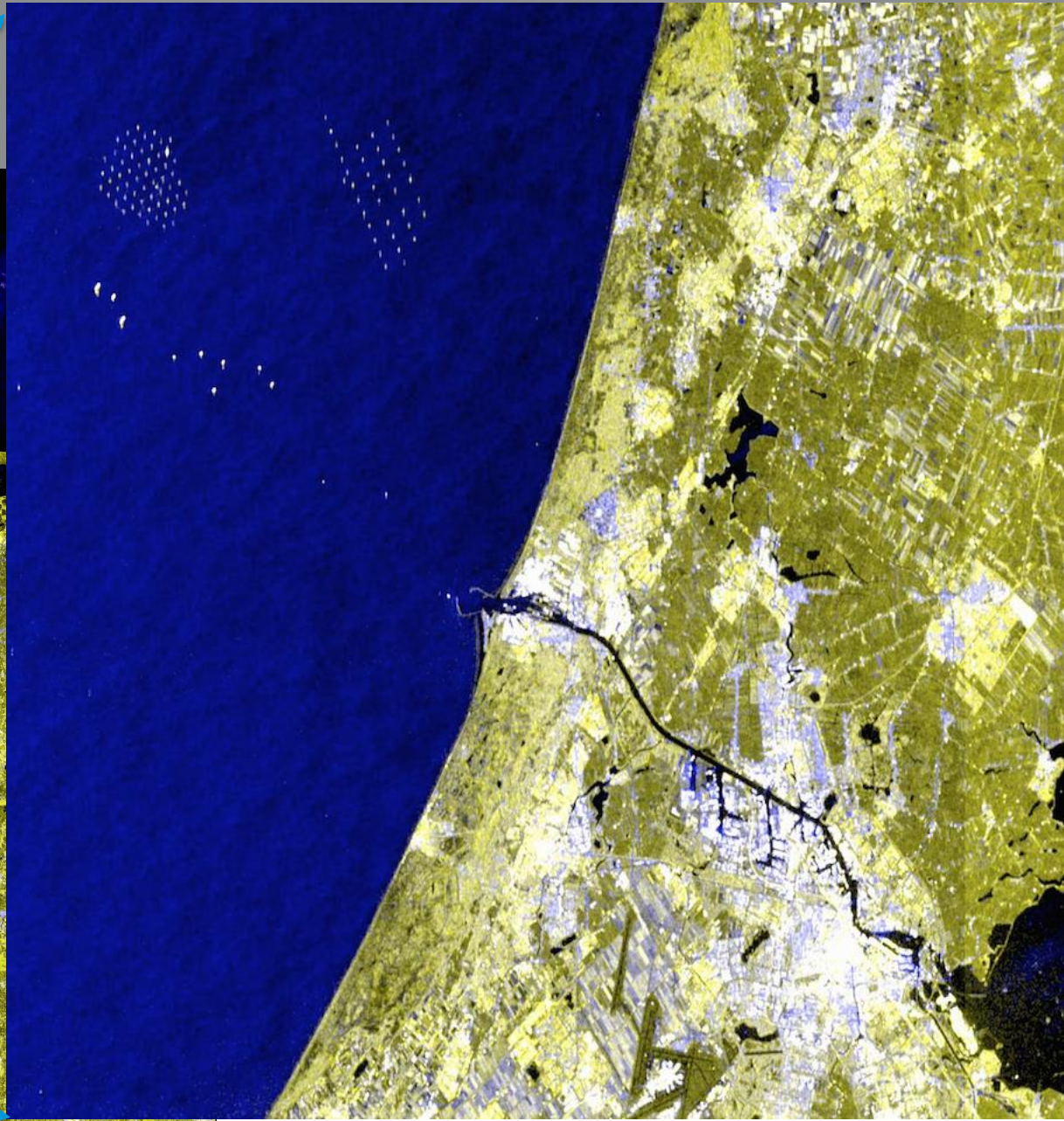
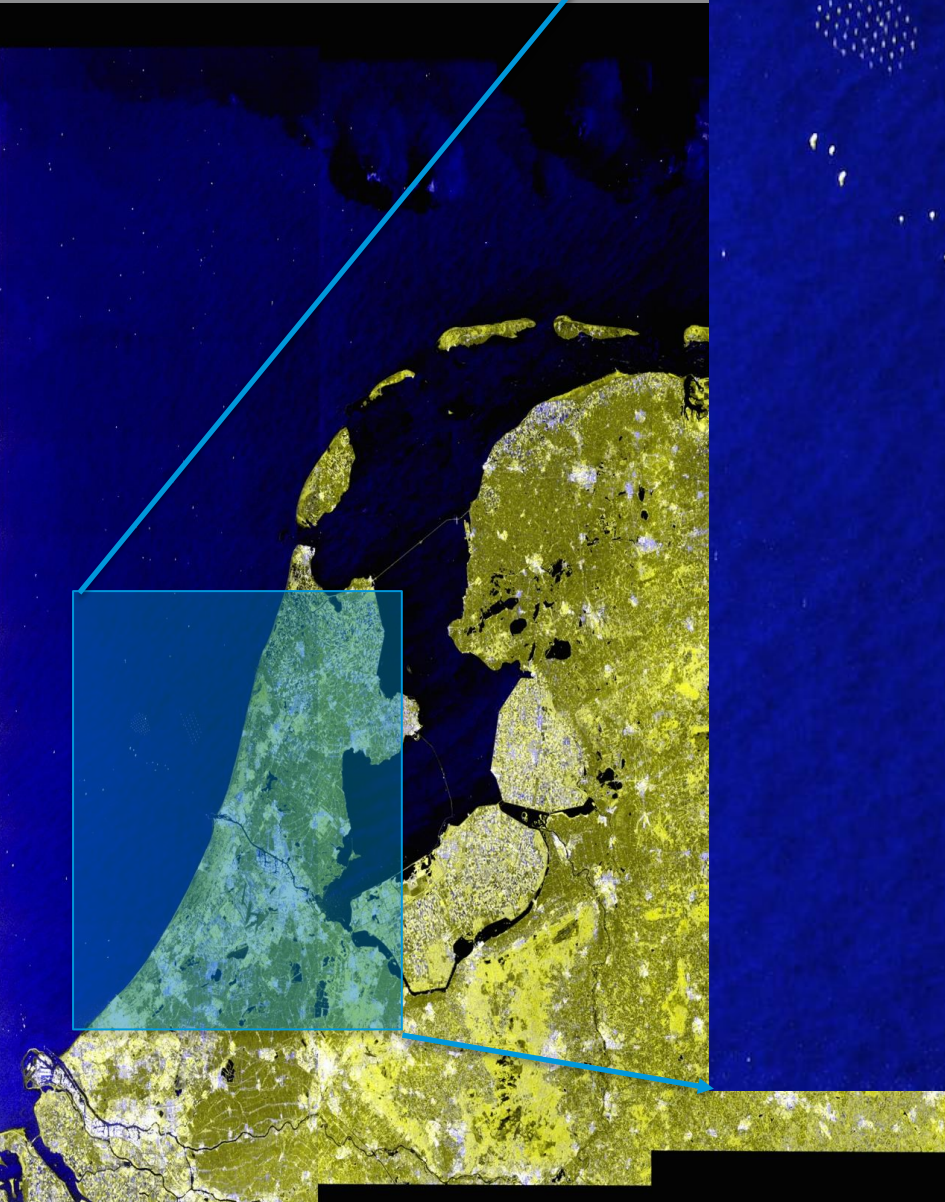
ESA: 22 Member States, growing Eastwards



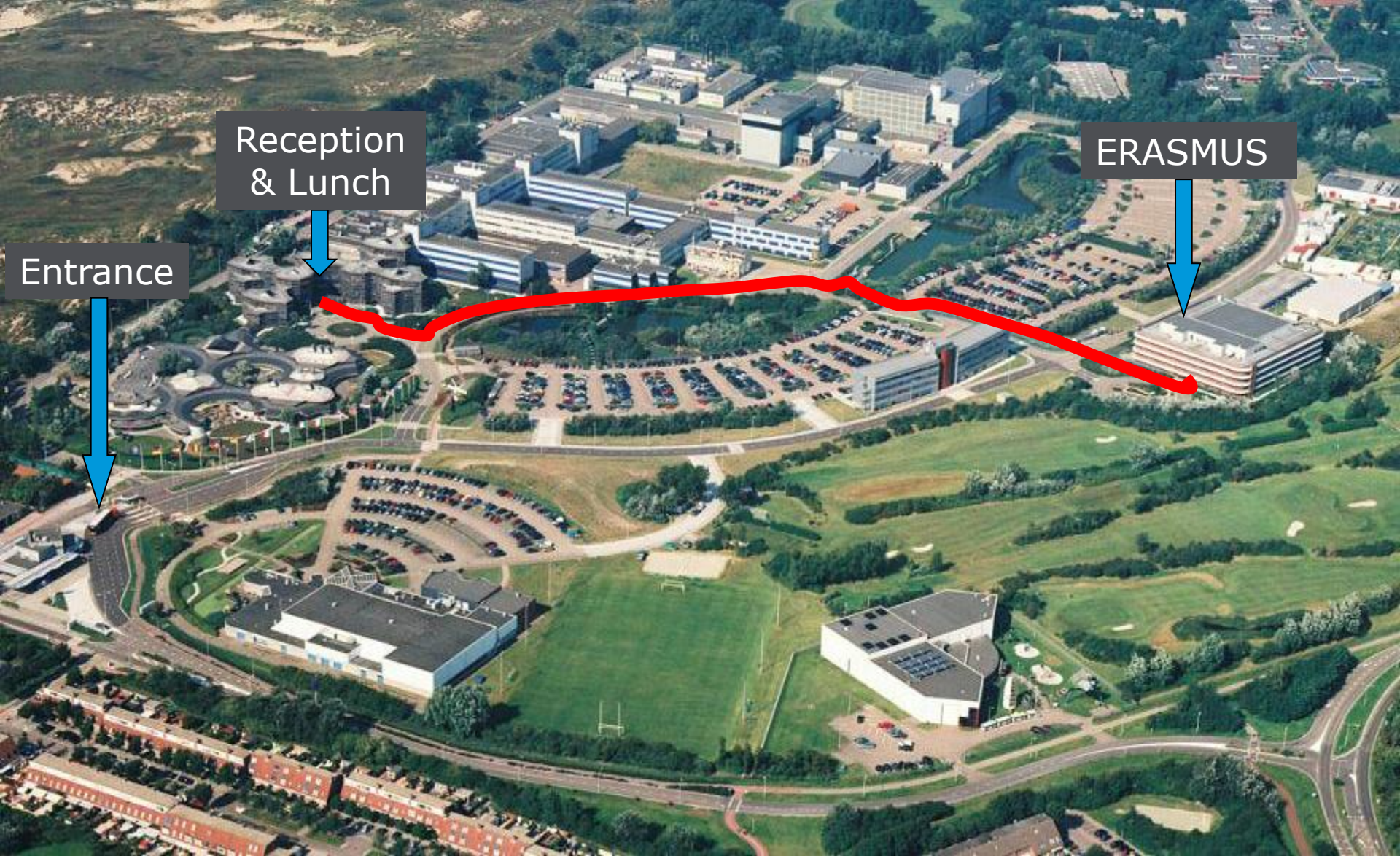
- ESA is an international organisation of Member States.
- **ESA has 22 Member States:** AT, BE, CZ, DK, ES, FI, FR, DE, GR, HU, IE, IT, LU, NL, NO, PO, PT, RO, SP, SE, CH, UK.
 - Bulgaria, Latvia, Slovakia and Slovenia are 'European cooperating States'
 - Canada takes part in some programmes under a Cooperation Agreement.
- **By coordinating the financial and intellectual resources of its members, ESA can undertake programmes and activities far beyond the scope of any single EU country**



S1a image over the



European Space Research and Technology Centre (ESTEC) – the technical heart of ESA



Entrance

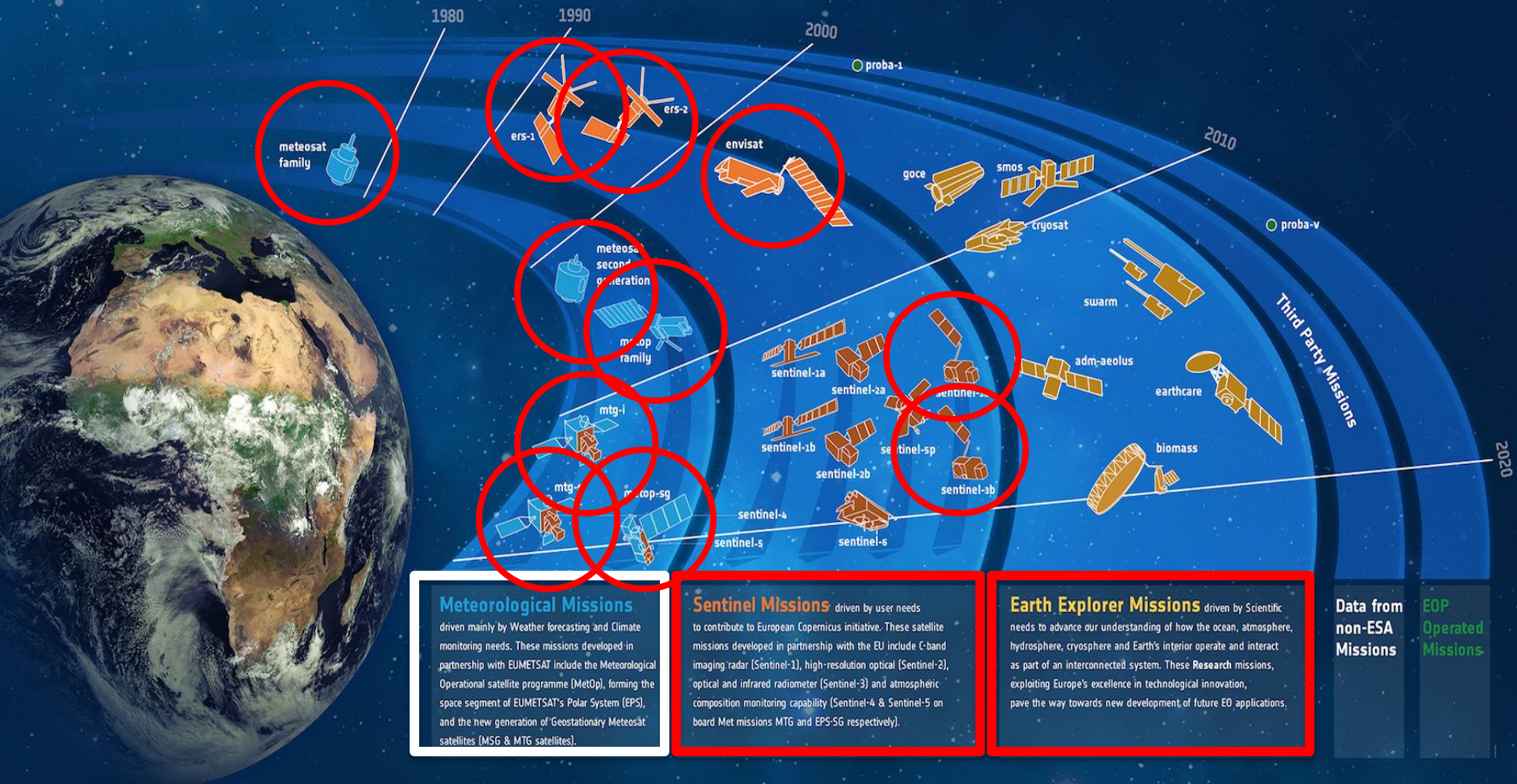
Reception & Lunch

ERASMUS

Why is GHRSSST important to ESA?
Because we build a lot of SST missions!



THE ESA EARTH OBSERVATION PROGRAMME



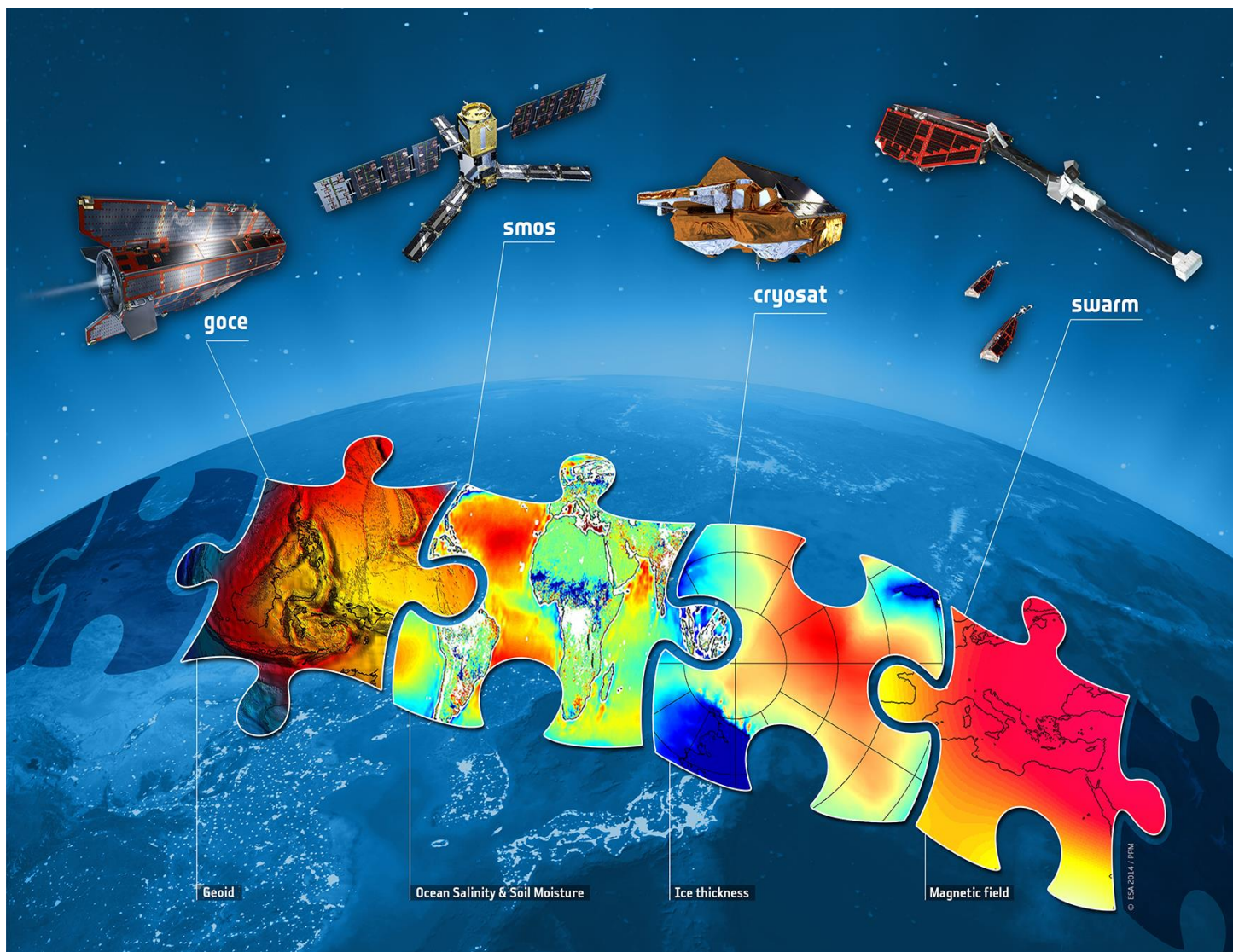
Meteorological Missions
driven mainly by Weather forecasting and Climate monitoring needs. These missions developed in partnership with EUMETSAT include the Meteorological Operational satellite programme (MetOp), forming the space segment of EUMETSAT's Polar System (EPS), and the new generation of Geostationary Meteosat satellites (MSG & MTG satellites).

Sentinel Missions driven by user needs to contribute to European Copernicus initiative. These satellite missions developed in partnership with the EU include C-band imaging radar (Sentinel-1), high-resolution optical (Sentinel-2), optical and infrared radiometer (Sentinel-3) and atmospheric composition monitoring capability (Sentinel-4 & Sentinel-5 on board Met missions MTG and EPS-SG respectively).

Earth Explorer Missions driven by Scientific needs to advance our understanding of how the ocean, atmosphere, hydrosphere, cryosphere and Earth's interior operate and interact as part of an interconnected system. These Research missions, exploiting Europe's excellence in technological innovation, pave the way towards new development of future EO applications.

Data from non-ESA Missions and **EOP Operated Missions**

Science: The Earth Explorer Missions



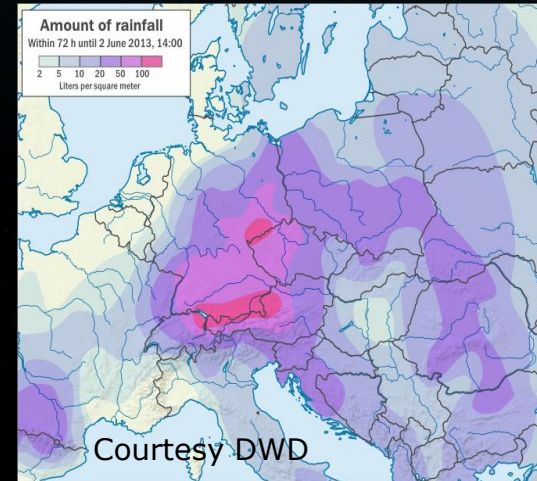
Earth Explorers launched so far

Synergy of data have brought tremendous results

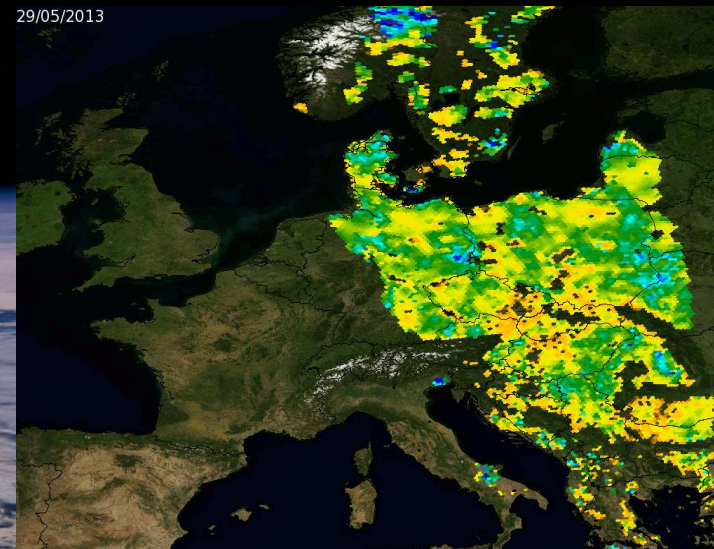
SMOS – Soil Moisture and Ocean Salinity



- Routine data delivery since February 2010
- Complete Earth coverage within three days
- Radio Frequency Interference (RFI) mitigation continues
- Outstanding international cooperation
- 2013 in-orbit review confirms mission health
- Array of new scientific applications in development, beyond primary mission objectives
- Mission extension until 2017



29/05/2013



SMOS soil moisture for 29 May to 2 June 2013; The blue areas indicate wetter soils and the yellow and orange colours indicate drier soils; ©CESBIO

- Candidate missions for 8th Earth Explorer:
 - **Flex** to provide global maps of vegetation fluorescence. Proposed to operate in tandem with S3
 - **CarbonSat** to determine the global distribution of carbon dioxide and methane
- **User Consultation Meeting**
15-16 Sep 2015, Krakow



Copernicus: A New Generation of Data Sources



Sent-1A/B



Sentinel-2A/B



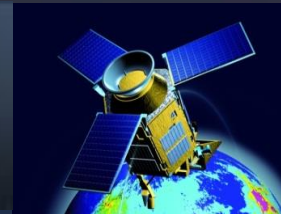
Sentinel-3A/B



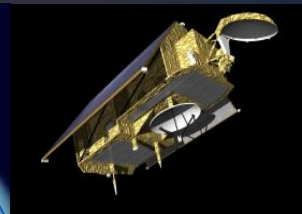
Sentinel-4A/B



Sentinel-5/5P



Sentinel-6A/B



- Copernicus is a European space flagship programme led by the European Union
- ESA coordinates the space component
- Copernicus provides the necessary data for operational monitoring of the environment and for civil security
- Free and open data policy



Copernicus Sentinel missions: Major value for science



- **Continuity** of global observations
- Fast **open data** access => accelerated scientific progress
- Analysis of massive **global data** sets
- Analysis of **dynamical processes** locally/regionally/globally
- Analysis of **global trends** and variability
- More complete analysis of **global cycles**: water, carbon
- Improved understanding of key **climate processes**
- **Synergy** with research missions
- Key inputs for **improving models**
- Fundamental data sets for **Earth System Science**

Copernicus dedicated missions



Sentinel-1 (A/B) – SAR imaging

All weather, day/night applications, interferometry

**1A LAUNCHED
3/4/2014**



Sentinel-2 (A/B) – Multi-spectral imaging

Land applications: urban, forest, agriculture, ...
Continuity of Landsat, SPOT

**2A LAUNCHED
23/6/2015**



Sentinel-3 (A/B) – Ocean and global land monitoring

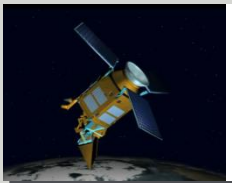
Wide-swath ocean color, vegetation, sea/land
surface temperature, altimetry

**3A LAUNCH DATE
31/10/2015**



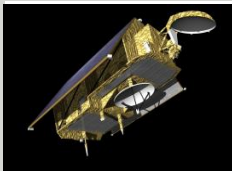
Sentinel-4 (A/B) – VIS and NIR spectrometer, Geostationary

Atmospheric composition monitoring, transboundary
pollution



Sentinel-5 precursor/ Sentinel-5 (A/B) – VIS, NIR and SWIR spectrometer, Low-orbit

Atmospheric composition monitoring

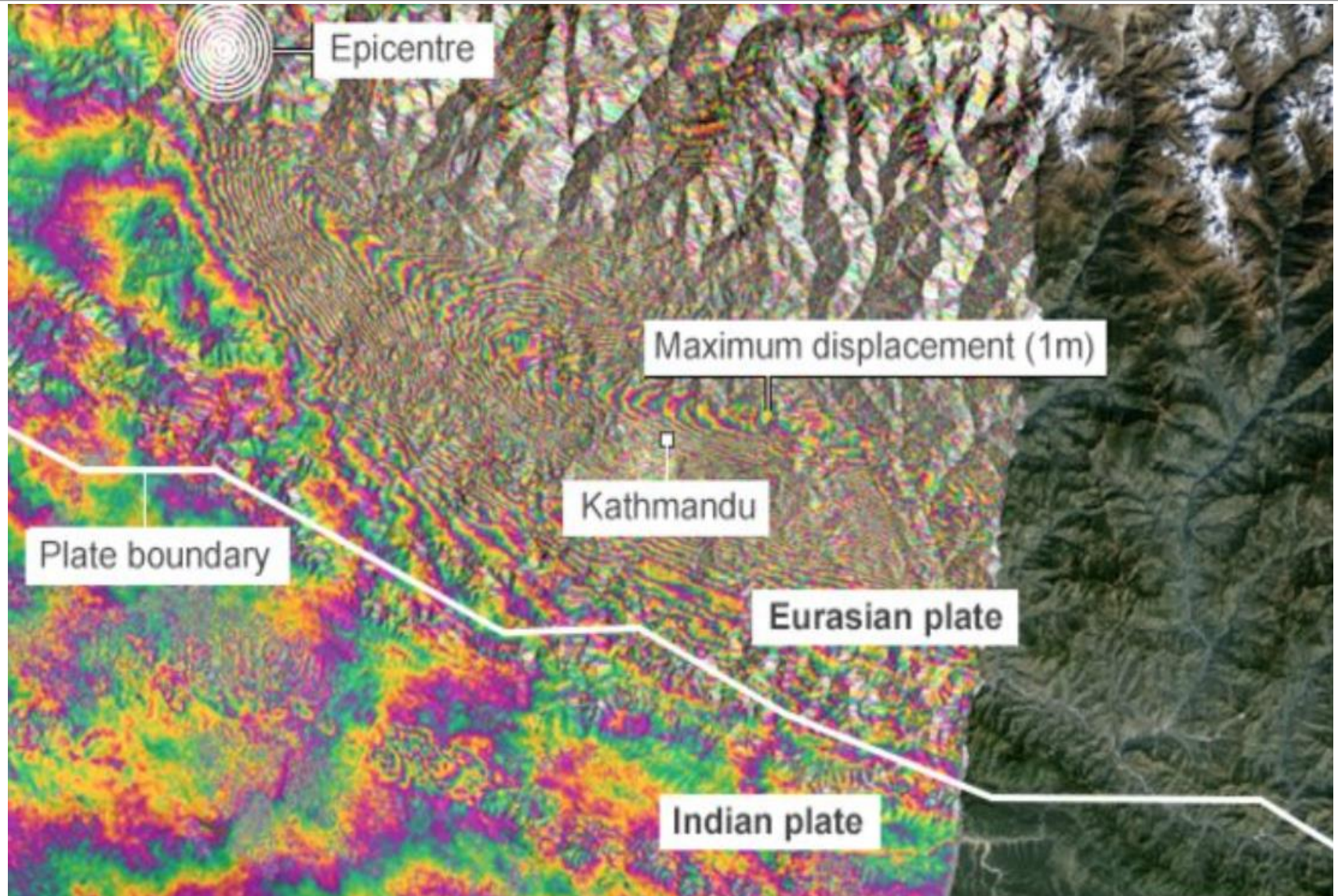


Jason-CS (A/B) – Low inclination Altimetry

Sea-level, wave height and marine wind speed



Katmandu, Nepal – Interferogram with S1



Sentinel-2A launch



- 22 June 2015
- Kourou
- Vega VV05

Sentinel-2A: First images



**Northwest Italy
and Southern**



French Riviera

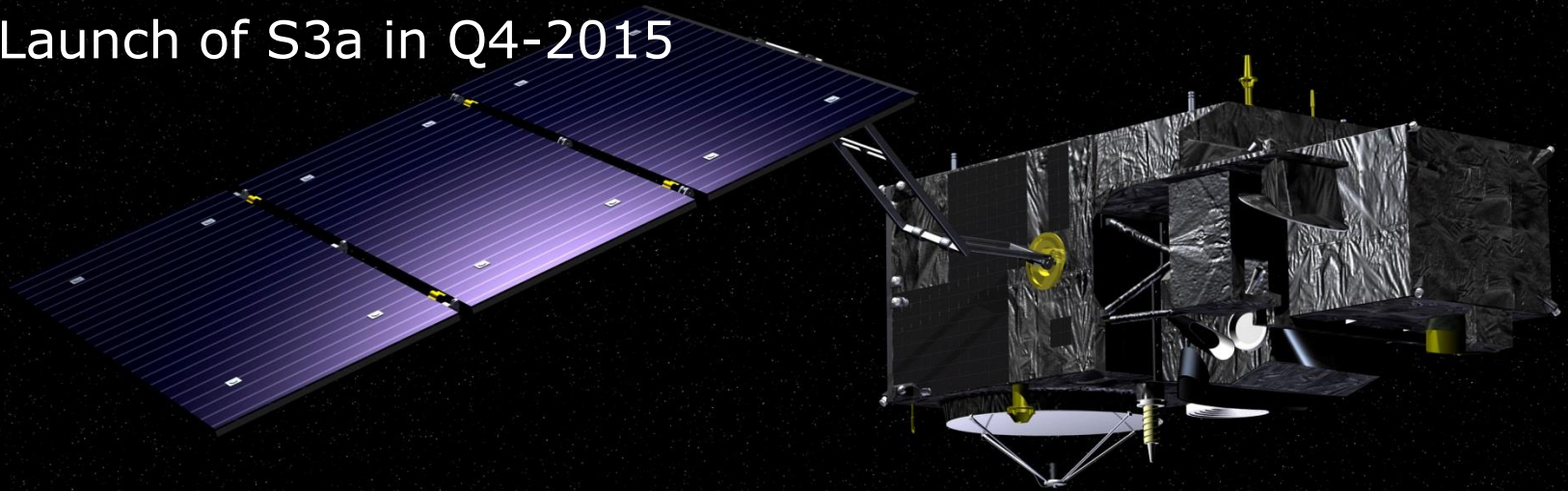


Po Valley

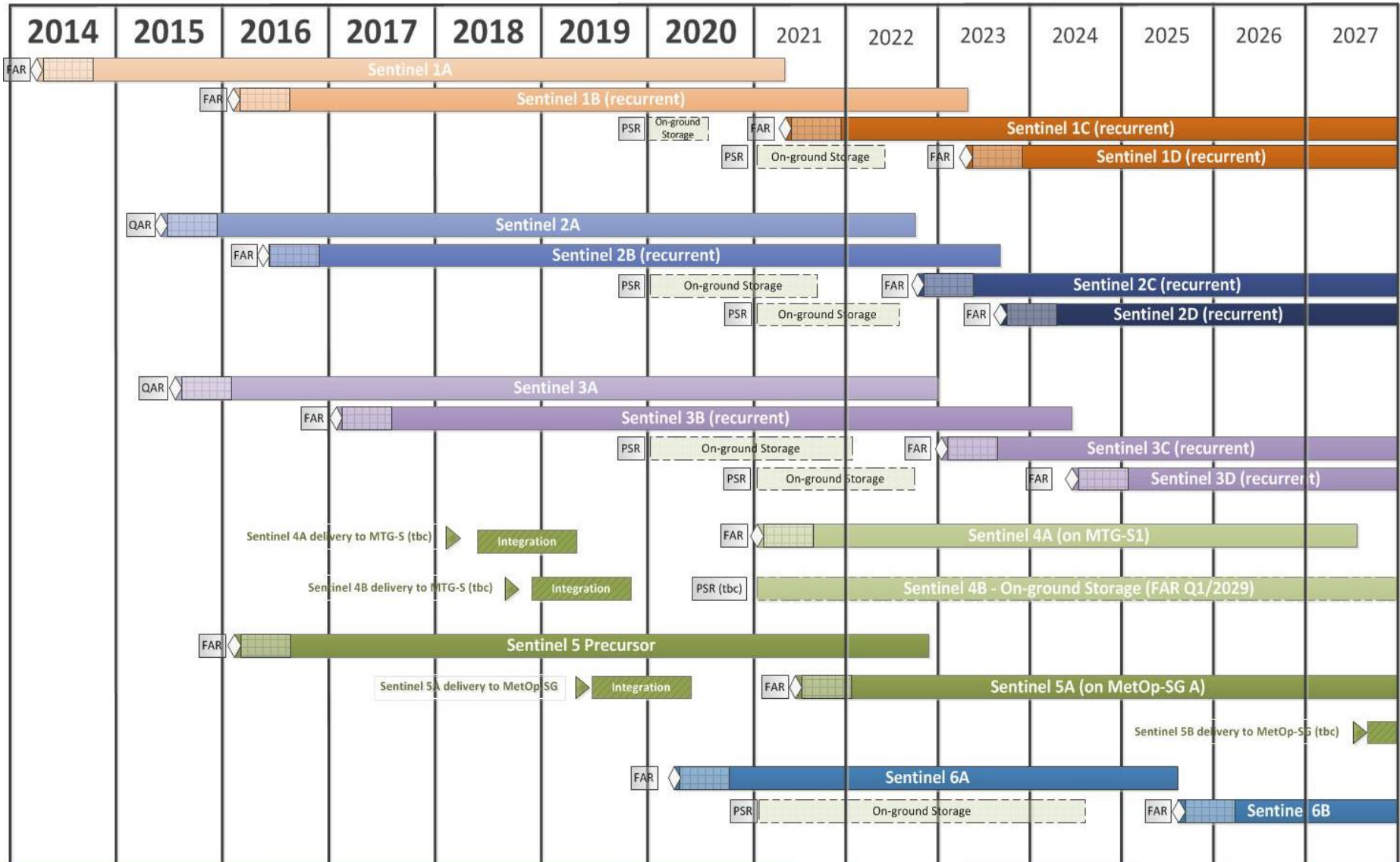
Sentinel-3



- Medium resolution imaging and altimetry mission
- Land and ocean applications
- Launch of S3a in Q4-2015



Tentative Sentinel Schedule



Copernicus Services Component...



...and how Sentinels contribute



ESA support to GHRSSST



Infrastructure

www.esa.int (Satellite and archives)

www.esa.int/du_e (Application Programme)

du_e.esrin.esa.int/stse/ (Science Programme)

www.esa-cci.org (Climate Change Programme)

www.ceos.org (CEOS SST-Virtual Constellation)

...

Projects

www.ghrss.org (GPO)

www.medspiration.org (SST project)

www.microwat.org (New Microwave mission concept)

www.globcurrent.info (Ocean surface currents)

www.storm-surge.info (Storm Surges)

www.oceanflux-ghg.org/ (Ocean Carbon Flux)

New Studies and new programmes

...



- 2003-2008: UK Met Office: Director Dr Craig Donlon
- 2010-2012: University of Reading: Direktor Dr. Andrea K. Kaiser-Weiss

- 2012-2016: University of Leicester: Director G Corlett
- Discussions are now taking place to ensure continuity of funding for the GHRSSST project Office post 2016.

- ESA funding must be reconsidered at the end of 2016 (end of EOEP-4)
- How can multiple Space Agencies participating in GHRSSST contribute to the long-term funding of the GPO?

Interoperable User Access via OPeNDAP, TDS, WCS, FTP...



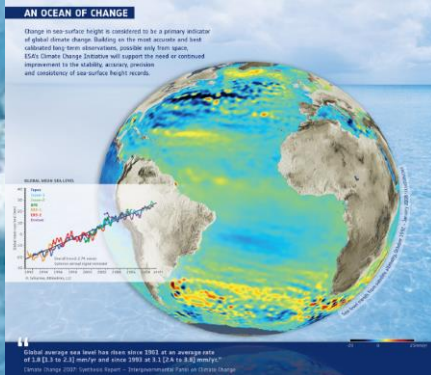
...etc...



→ UNDERSTANDING CLIMATE CHANGE FROM SPACE

AN OCEAN OF CHANGE

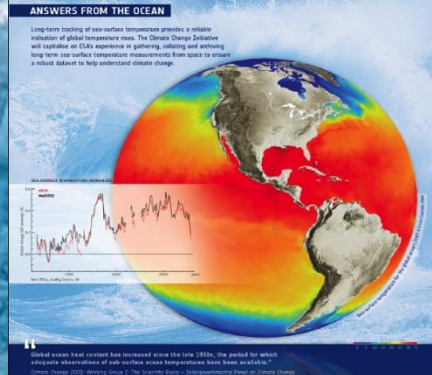
Change in sea surface height is considered to be a primary indicator of global climate change. Tracking on the most accurate and best calibrated long-term observations, available only from space, ESA's Climate Change Initiative will support the need for continued improvement to the stability, accuracy, precision and consistency of sea surface height records.



Global average sea level has risen since 1993 at an average rate of 3.8 (± 0.3) mm per year and since 1993 at 3.1 (± 0.8) mm/yr.
Source: Cheng 2017, Swenson Report - Intergovernmental Panel on Climate Change

ANSWERS FROM THE OCEAN

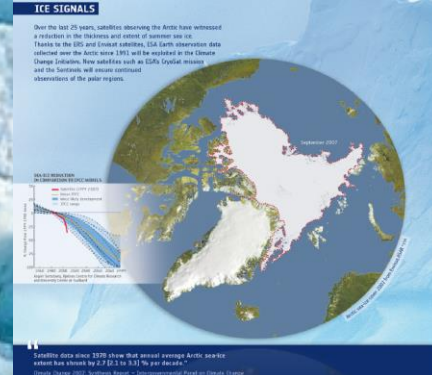
Long-term tracking of sea-surface temperature provides a reliable indicator of global temperature rise. The Climate Change Initiative will continue an ESA experience in gathering, collating and archiving long-term sea surface temperature measurements from space to ensure a robust dataset to help understand climate change.



Global ocean heat content has increased since the late 1950s, the period for which adequate observations of sea surface temperatures have been available.
Source: Cheng 2017, Swenson Report - Intergovernmental Panel on Climate Change

ICE SIGNALS

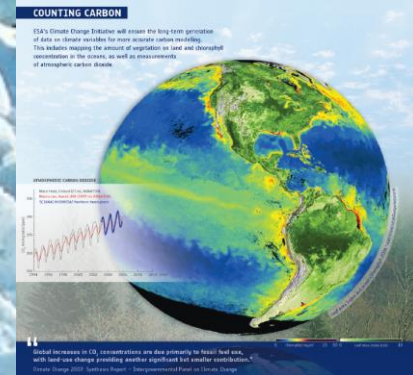
Over the last 25 years, satellites observing the Arctic have witnessed a reduction in the thickness and extent of summer sea ice. Thanks to the Cryo and Icecap satellites, ESA Earth observation data collected over the Arctic since 1993 will be vital to the Climate Change Initiative. New satellites such as ESA's Copernicus mission and the Sentinel will ensure continued observations of the polar region.



Satellite data since 1979 shows that average Arctic sea ice extent has shrunk by 0.7 (± 0.1) m per decade.
Source: Cheng 2017, Swenson Report - Intergovernmental Panel on Climate Change

COUNTING CARBON

ESA's Climate Change Initiative will assess the long-term generation of data on climate variables for more accurate carbon modelling. This includes measuring the amount of vegetation on land and dissolved organics in the ocean, as well as measurements of atmospheric carbon dioxide.



Global increases in CO₂ concentrations are also primarily to blame for sea, with land-use change providing another significant but smaller contribution.
Source: Cheng 2017, Swenson Report - Intergovernmental Panel on Climate Change

SST_cci: Integrating SST data



1990 — 2000 — 2010 — 2020 — 2030

ATSR-1 (1991-2000)

ATSR-2 (1995-2008)

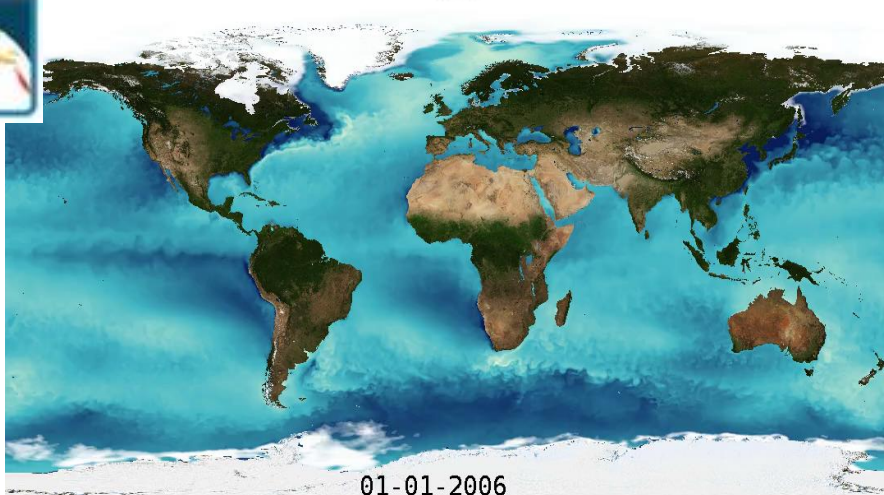
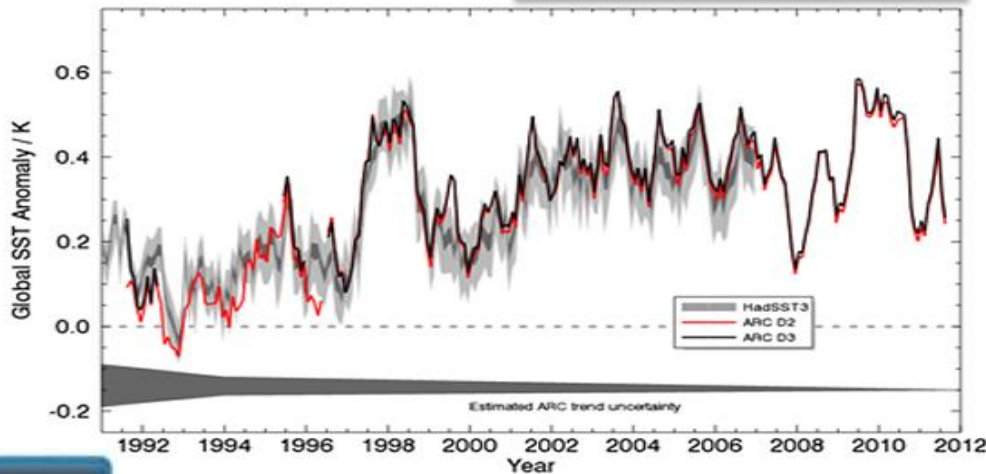
AATSR (2002-2012)

SLSTR-A
(2015-2023)

SLSTR-B
(2017-2024)

SLSTR-C
(2023-2030)

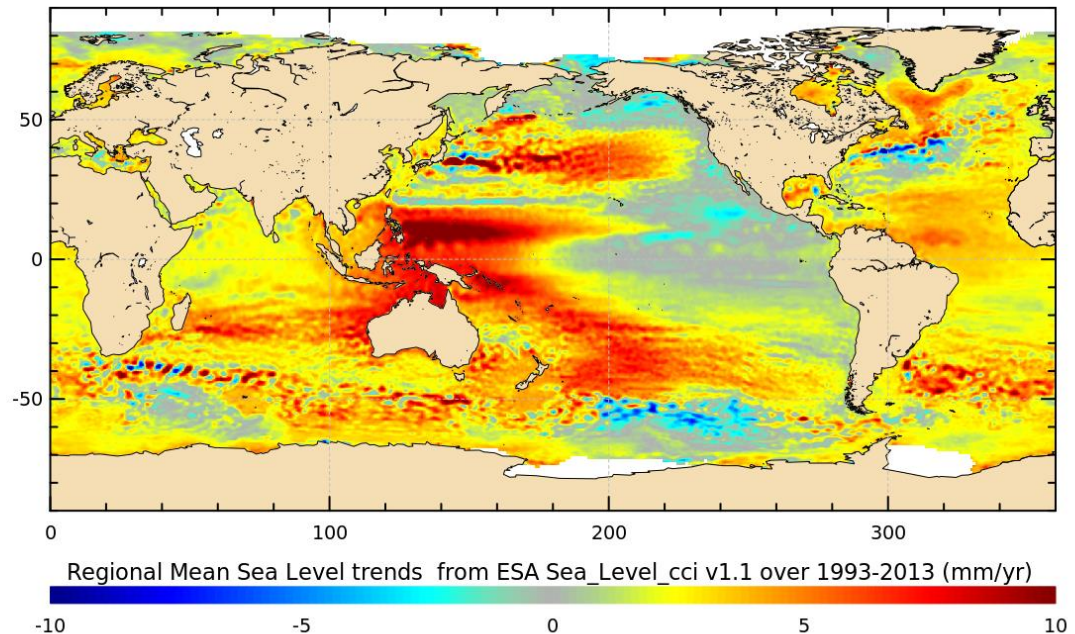
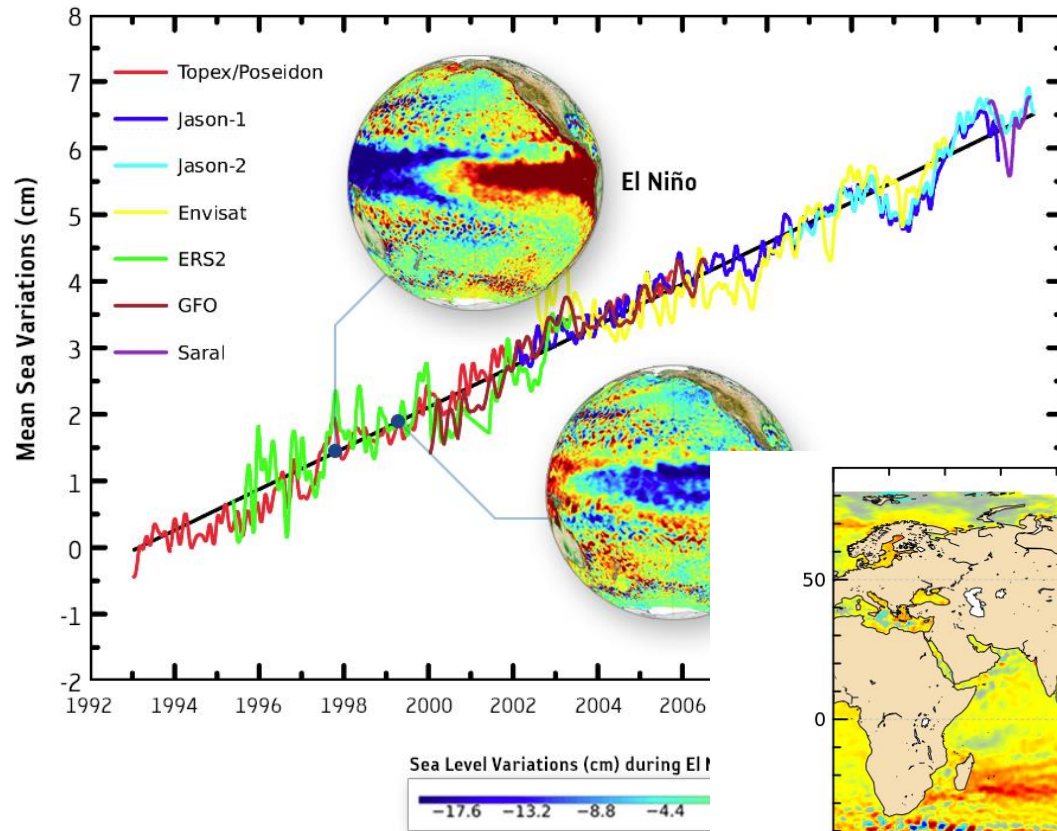
SLSTR-D
(2025-2032)



Sentinel-3 SLSTR will:

- **Extend** the (A)ATSR **reference SST mission** for other SST sensors
- **Include critical heritage concepts** from (A)ATSR
- With much **better coverage**
- Includes new **spectral channels**
- **Sustained** until beyond 2030
- Dual-view gap **bridged and filled** by MetOp IASI/AVHRR

Sea level from altimetry: SST must be consistent => Sentinel-3 (SRAL) & Sentinel-6



ESA Support to the CEOS SST-VC



CEOS Committee on Earth Observation Satellites



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To foster the best quality sea surface temperature data for applications in short, medium, and climate time scales in the most cost effective and efficient manner through international collaboration, scientific innovation, and rigor

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Constellations

- [ACC-Atmos Composition](#)
- [LSI-Land Surface Imaging](#)
- [OST-Ocean Surf Topography](#)
- [PC-Precipitation](#)
- [OCR-Ocean Color Radiometry](#)
- [OSVW-Ocean Surf Vect Wind](#)
- [SST - Sea Surface Temp](#)

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The Committee on Earth Observatio Satellites (CEOS)

Like 295

Sea Surface Temperature Virtual Constellation

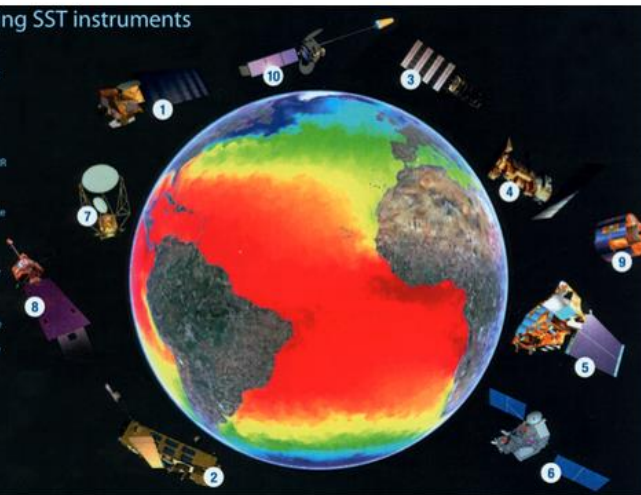
Satellites carrying SST instruments

Low Orbiting Satellites, their SST Sensors and Space Agencies:

- 1) AQUA MODIS NASA& AMSR-E JAXA, image credit: NASA
- 2) ENVISAT AATSR ESA, image credit: ESA
- 3) METOP-A AVHRR and IASI EUMETSAT, image credit: ESA-ROES Medialab
- 4) NOAA-18 and NOAA-19 AVHRR NOAA, image credit: NOAA
- 5) Terra MODIS NASA, image credit: NASA
- 6) TRMM TMI & VIRS NASA, image credit: NASA
- 7) Coriolis WindSat NRL, image credit: US Navy

Geostationary Satellites, their SST Sensors and Space Agencies:

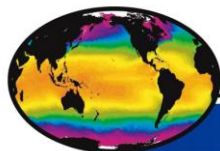
- 8) GOES-E and GOES-W GOES NOAA, image credit: NOAA
- 9) MSG SEVIRI EUMETSAT, image credit: ESA-DUCROS
- 10) MTSAT-2 MTSAT JMA, image credit: JMA



The SST-VC serves as the formal link between the Group for High Resolution Sea Surface Temperature (GHRSSST) and the broader CEOS community. At the highest level, the SST-VC provides a means for CEOS to present to GHRSSST its needs and requirements, and for GHRSSST to present its needs directly to global community of space agencies. In addition, there are several thematic connections between GHRSSST and CEOS that take place at the working group level (for example, between the GHRSSST Climate Data Record TAG and the CEOS Working Group on Climate).

GHRSSST has

ice 2005 and



GHRSSST

Group for High Resolution Sea Surface Temperature



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[Atmospheric Composition \(AC\)](#)

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CEOS SST-VC ToR, 2012

ESA's EO Science Strategy at a glance



Ground-breaking exploratory missions integrated into flexible observing systems for Earth system science

Sustained observations to understand and attribute trends beyond the expected variability

International co-operation to provide an integrated, optimised Earth observing system, which can grow in capability in a cost-effective manner

Translational science to synthesize and adapt the data streams from individual instruments and satellites into knowledge

Wider Communication and dialogue with people beyond the scientific sector to help explain the value, opportunities and inspiration provided by EO from space



GHRSSST XVI meeting Aim and Objectives



- The **aim** of GHRSSST is *to provide the best quality sea surface temperature data for applications in short, medium and decadal/climate time scales in the most cost effective and efficient manner through international collaboration and scientific innovation.*
- **During this meeting**, the GHRSSST Science Team must:
 - **Critically review where the GHRSSST activity shall focus** its effort for the future benefit of the stakeholders that have invested in the project to date
 - **Devise mechanisms that allow multi-agencies to fund core GHRSSST activities** such as the Project Office
 - **Prepare for the next generation of SST missions** including Copernicus and other Space Agency missions
 - **Take steps to ensure the highest quality of science and research** delivers the best operational output from missions to applications
 - **Scientific and operational application of SST must remain the core driver for GHRSSST activities**
 - Please **improve user interactions** and sharing of user interactions across the GHRSSST system.
 - **ESA appreciates the community effort to “make SST work” through the activities of GHRSSST**
 - **Have a great meeting!**

PRAGUE 9-13 MAY 2016



living planet symposium

PRAGUE
09-13 May
2016



Main Objective:
Presentation of Exploitation Results
based on ESA Earth Observation
Measurements



Important Dates:

Deadline for abstract submission
Notification of Acceptances
Issue of Preliminary Programme
Opening of Registration
Release of the Final Programme
Submission of Full Papers

16 October 2015
End January 2016
February 2016
February 2016
at the symposium
at the symposium

Themes:

Atmosphere, Oceanography, Cryosphere,
Land, Hazards, Climate and Meteorology,
Solid Earth/Geodesy, Near-Earth
Environment, Methodologies and Products,
Open Science 2.0

<http://lps16.esa.int>

