



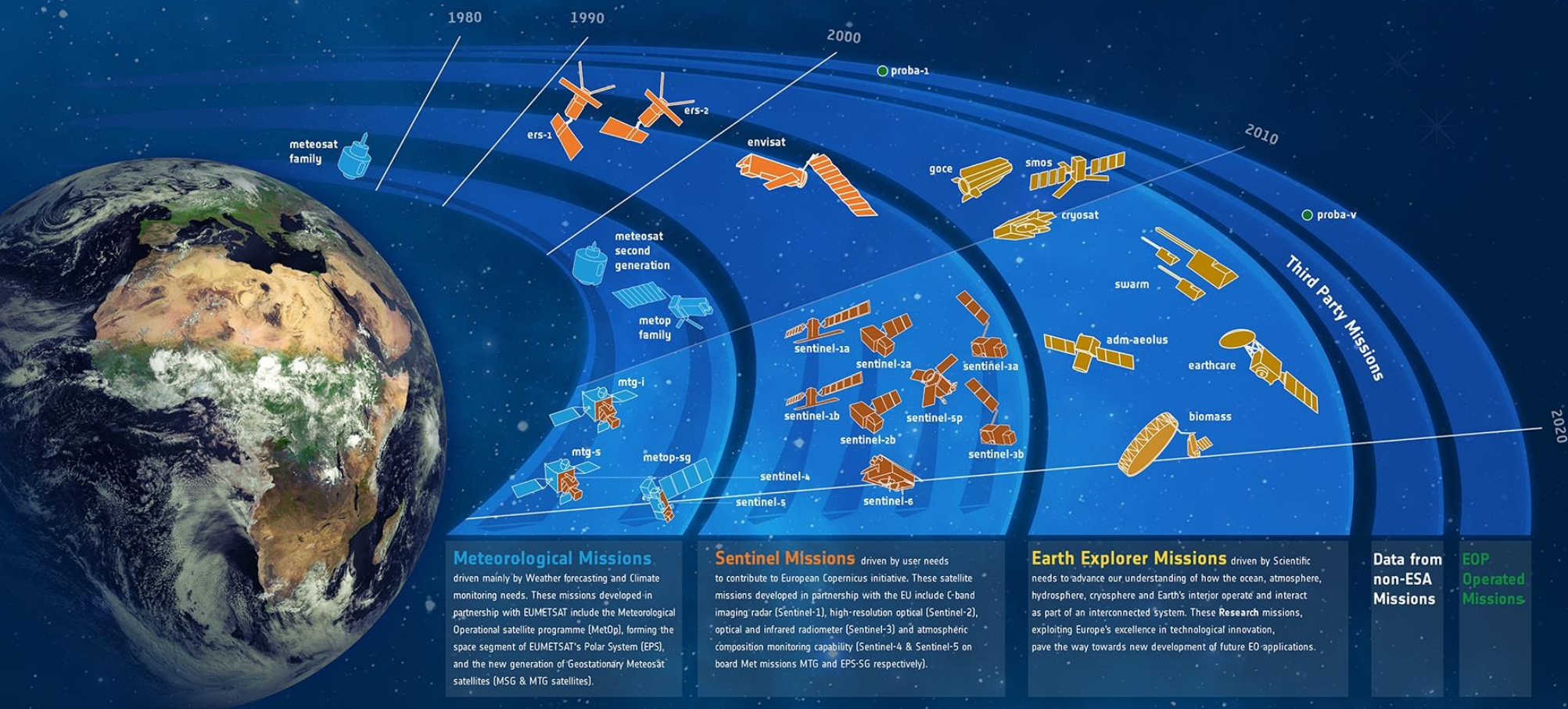
ESA Earth Observation Missions for Snow & Ice Services

Innsbruck, 4 December 2014

Josef Aschbacher, ESA

Head, Programme Planning & Coordination (EOP-C)
Earth Observation Programmes Directorate

ESA Earth Observation Programmes



Copernicus: A New Generation of Data Sources



Sent-1A/B



Sent-2A/B



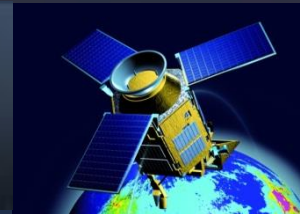
Sent-3A/B



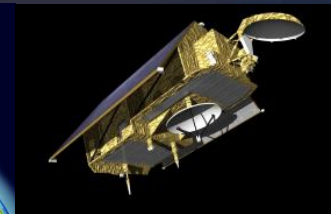
Sent-4A/B



Sent-5/5P



Sent-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
- Sentinel-1A launch: 3 April 2014

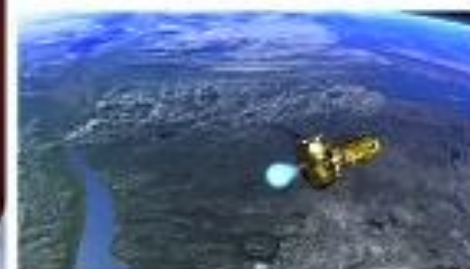
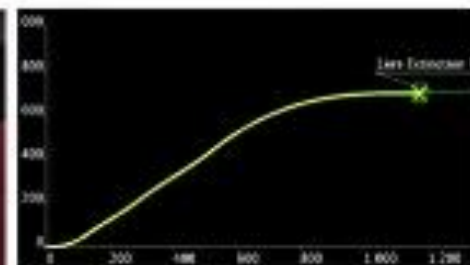


Moments of high tension ...



ESA Space HD
service & solutions

19:31



JOSEF ASCHBACHER

Head of Programme Planning & Coordination Service, ESA

Altitude : 695 Km

Distance : 5 313 Km

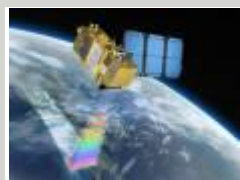
VS 07
Speed : 7,46 Km/s

Copernicus Dedicated Missions



Sentinel-1 (A/B/C/D) – SAR imaging

All weather, day/night applications, interferometry



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

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



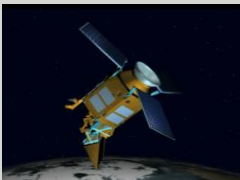
Sentinel-3 (A/B/C/D) – Ocean and global land monitoring

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



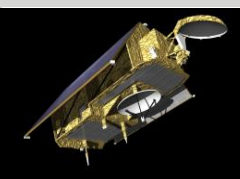
Sentinel-4 (A/B) – Geostationary atmospheric (on MTG)

Atmospheric composition monitoring, trans-boundary pollution



Sentinel-5 Precursor/ Sentinel-5 (A/B/C) – Low-orbit atmospheric (on MetOp-SG Series A)

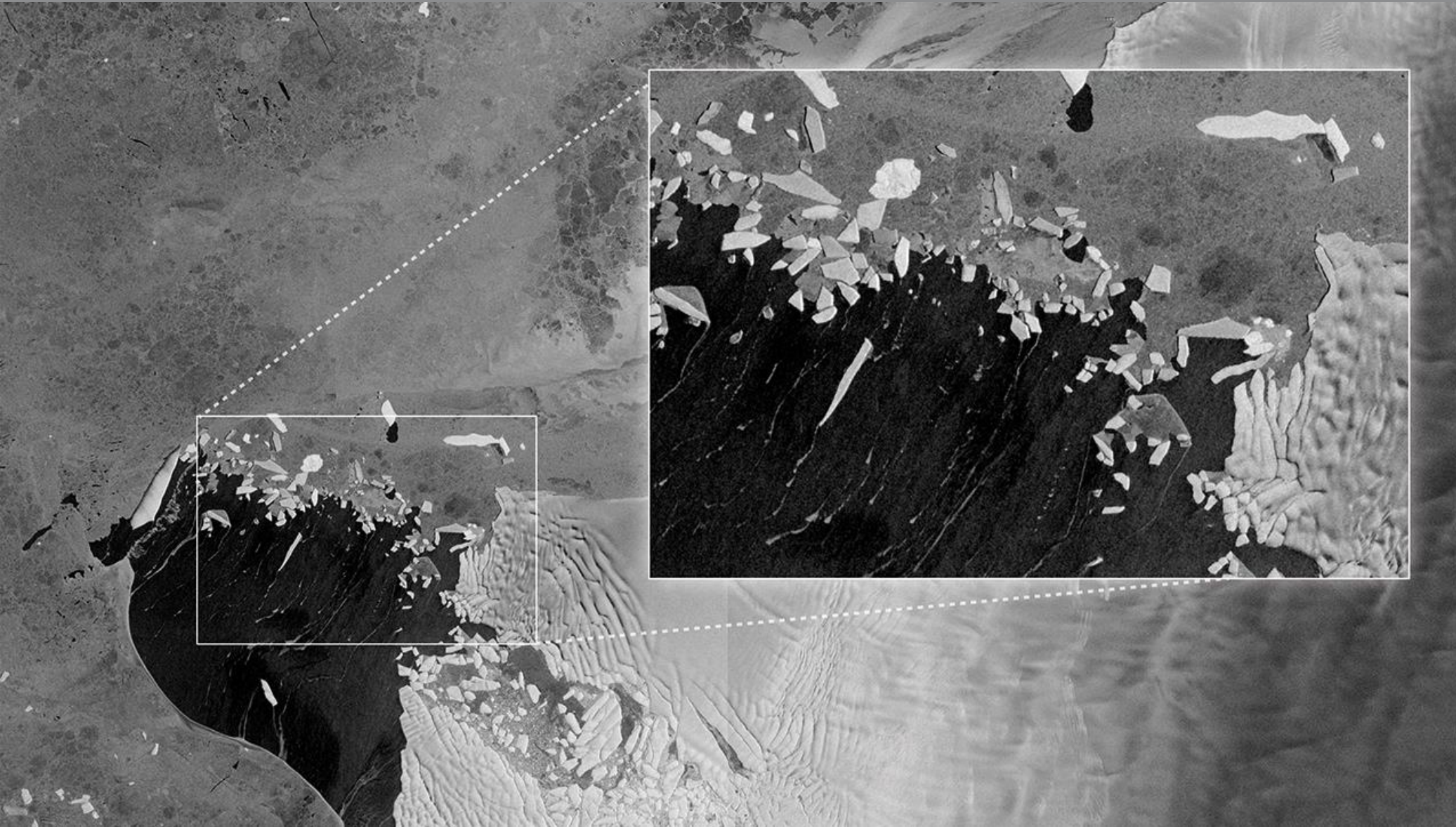
Atmospheric composition monitoring



Sentinel-6 [Jason-CS] (A/B) – Low inclination altimetry

Sea-level, wave height and marine wind speed

First Images of Sentinel-1A



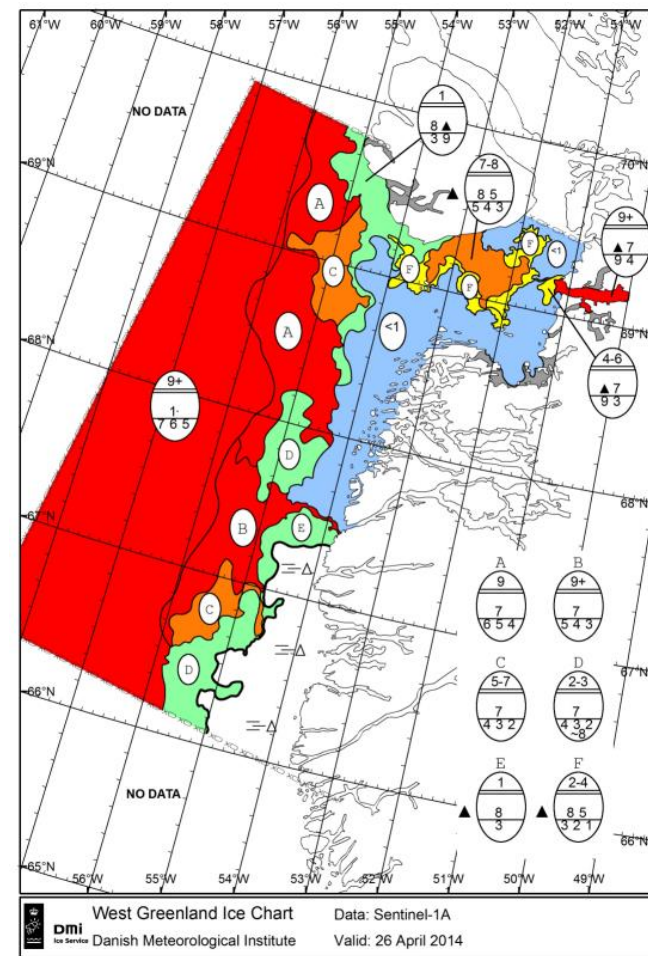
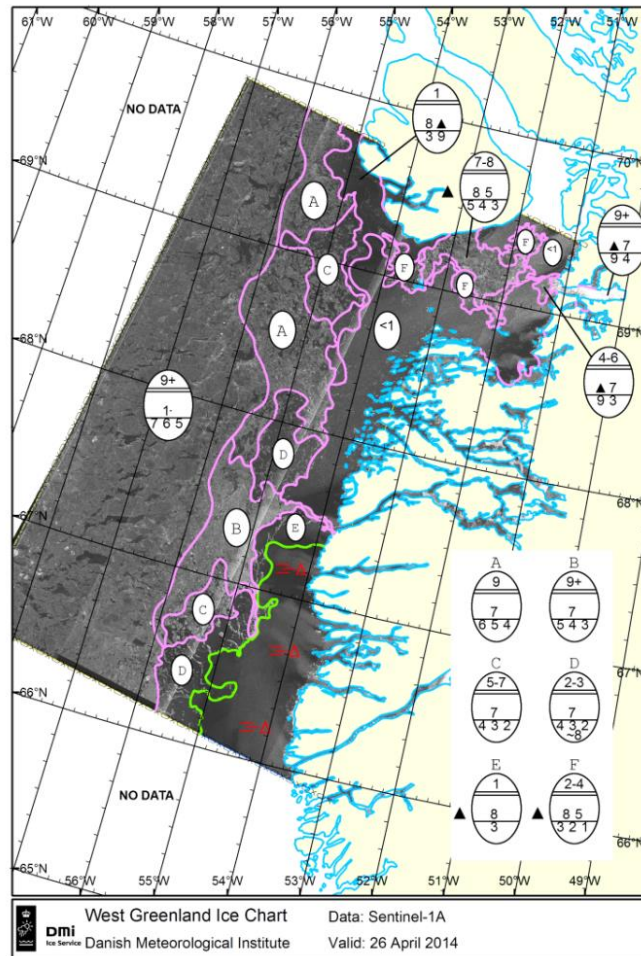
First Images of Sentinel-1A



Sentinel-1A: Sea Ice Applications

*The first
Sentinel-1
sea-ice chart*

*S1A image20140426
10:10 UTC,
EWS, HH*

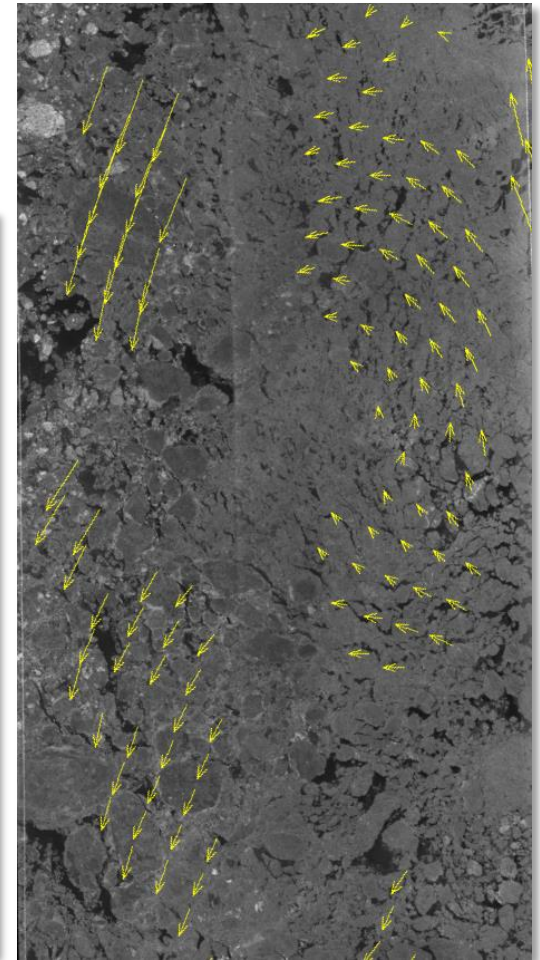
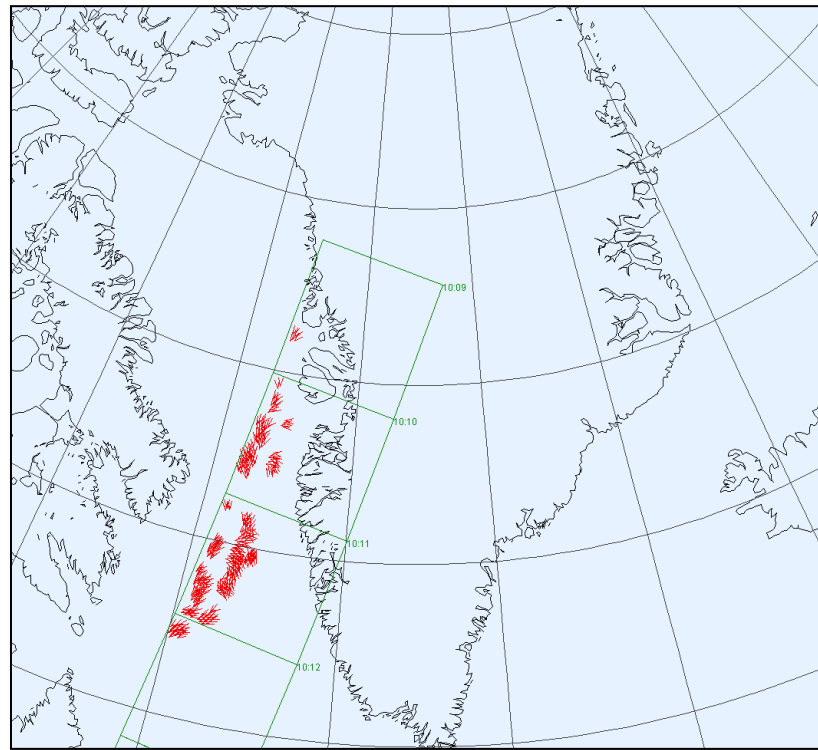


Sentinel-1A: Sea Ice Drift

*Arctic Sea Ice drift between April 26 and April 27,
observed by Sentinel-1 and Radarsat-2*

*4 Sentinel-1A HH
scenes on April 26
and*

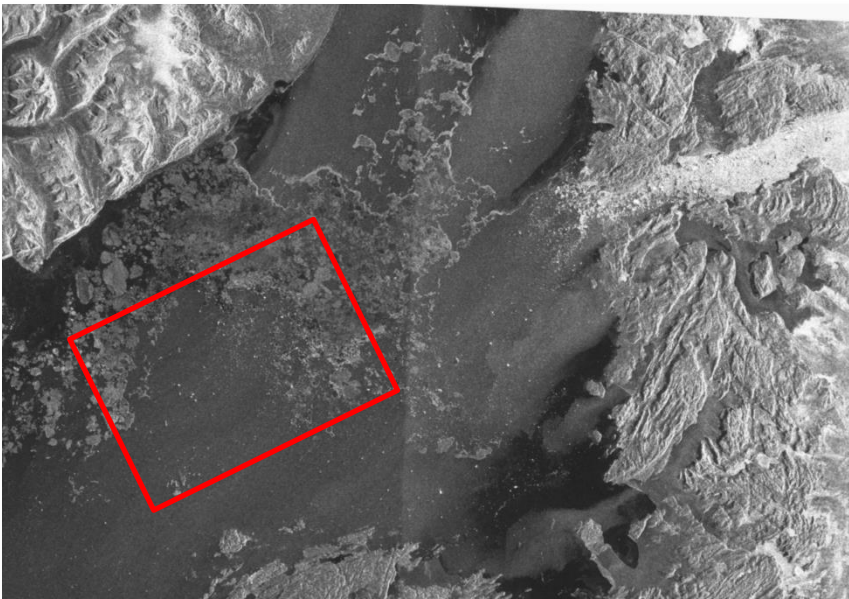
*3 partly overlapping
Radarsat-2 HH
scenes from April 27*



Sentinel-1A: Icebergs

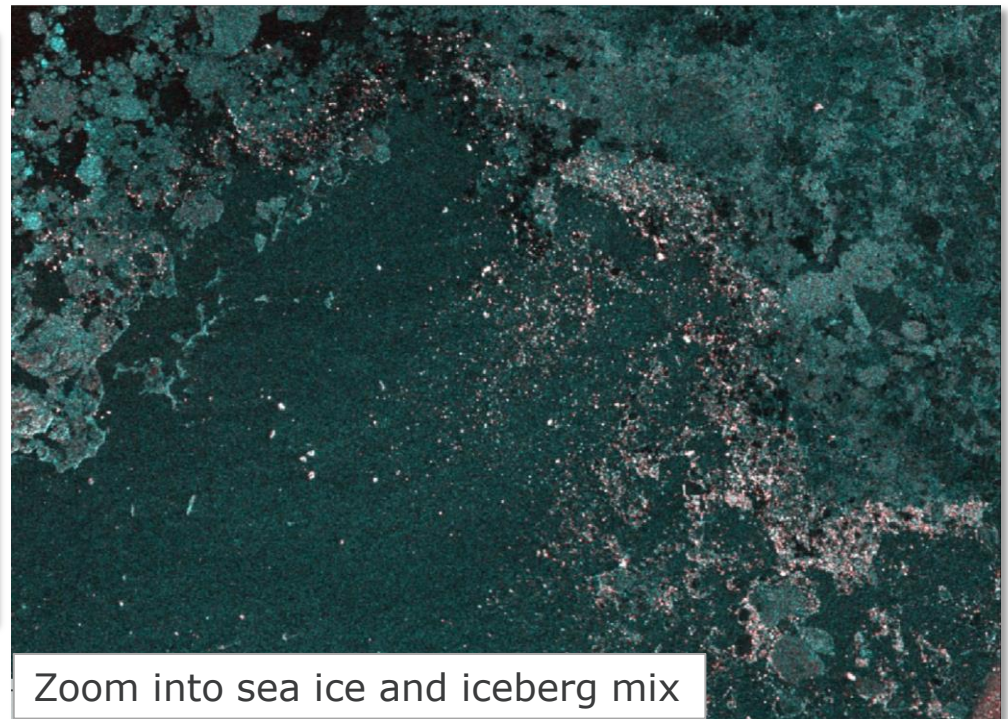
Icebergs in Disko Bay, Sentinel 1A, 20140426 10:10 UTC, EWS, HH+HV
Icebergs show up pink, sea-ice in bluish colors when using dual polarisation

Single pol HH

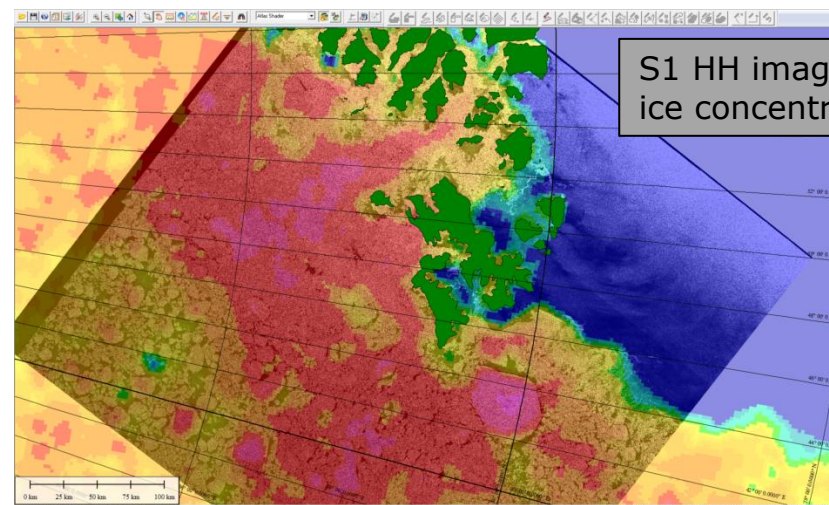
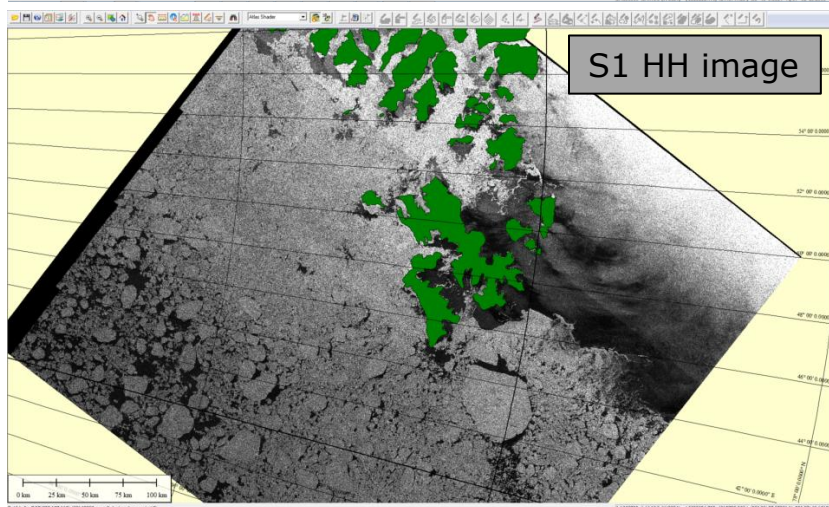
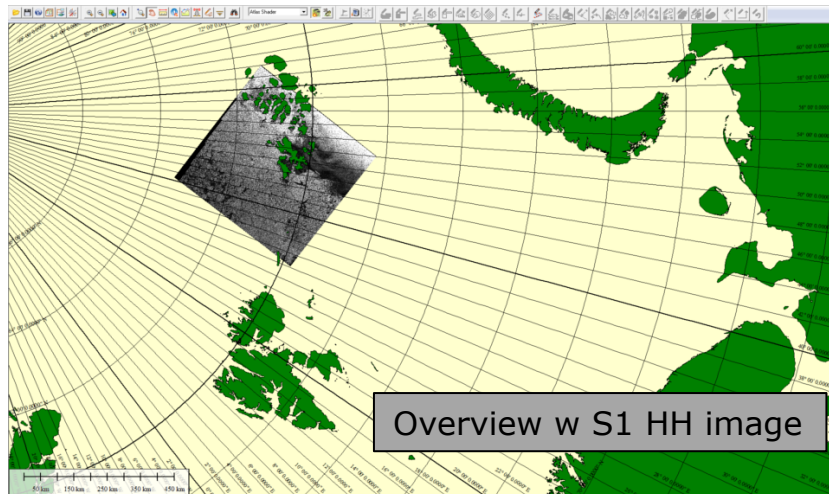


Jakobshavn glacier pouring
icebergs into Disko Bay

Dual pol HH+HV



Sentinel-1A: Ice Charting

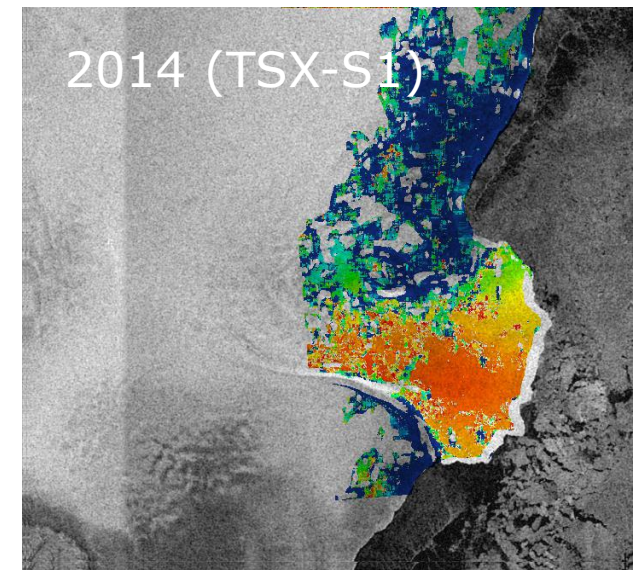
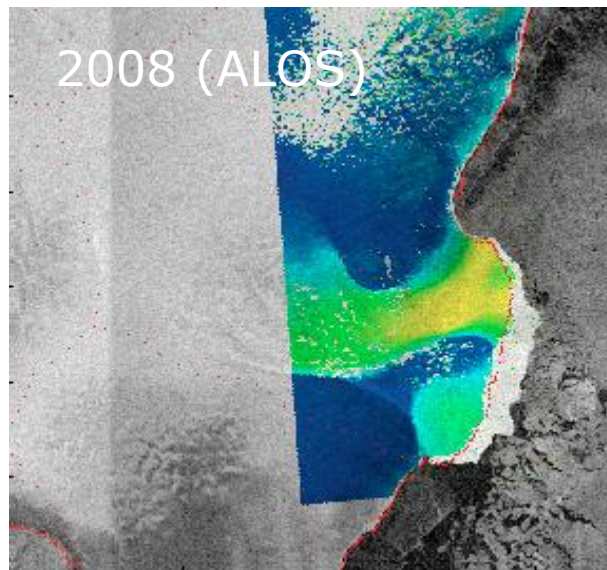
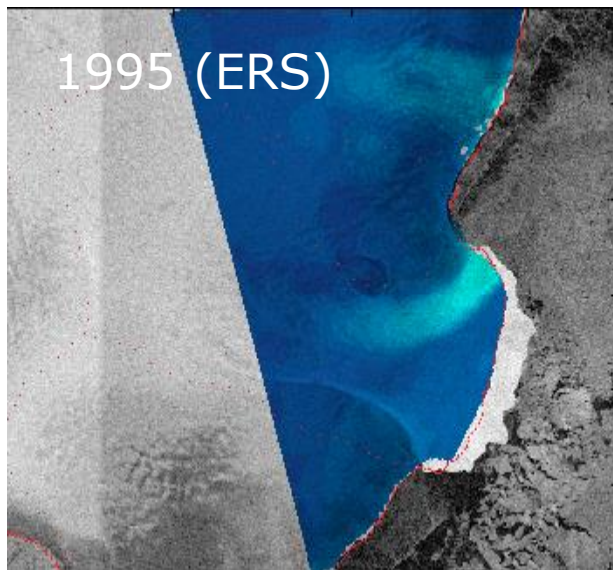


- Barents Sea Sept 3, 2014
- Sentinel-1 HH image from Sept 3, 2014
- AMSR-2 image from Sept 3, 2014
- Quality good, Geometry good
- s1a-ew-grd-hh-20140903t044329-20140903t044433-002223-002457-001.tiff

Sentinel-1A: Svalbard Ice Cap



- *Unique (first ever) combination of S1A stripmap and TerraSAR-X SAR data provides first map of Austfonna ice speed in 2014*
- *Data show that glacier at Cap Mohn has experienced a rapid acceleration*



Ice Speed (kilometres per year)



Credit: N. Gourmelen,
University of Edinburgh

Sentinel-2



- Wide swath high resolution super-spectral imaging mission
- Land and Security Services
- Data continuity Landsat and SPOT-type missions



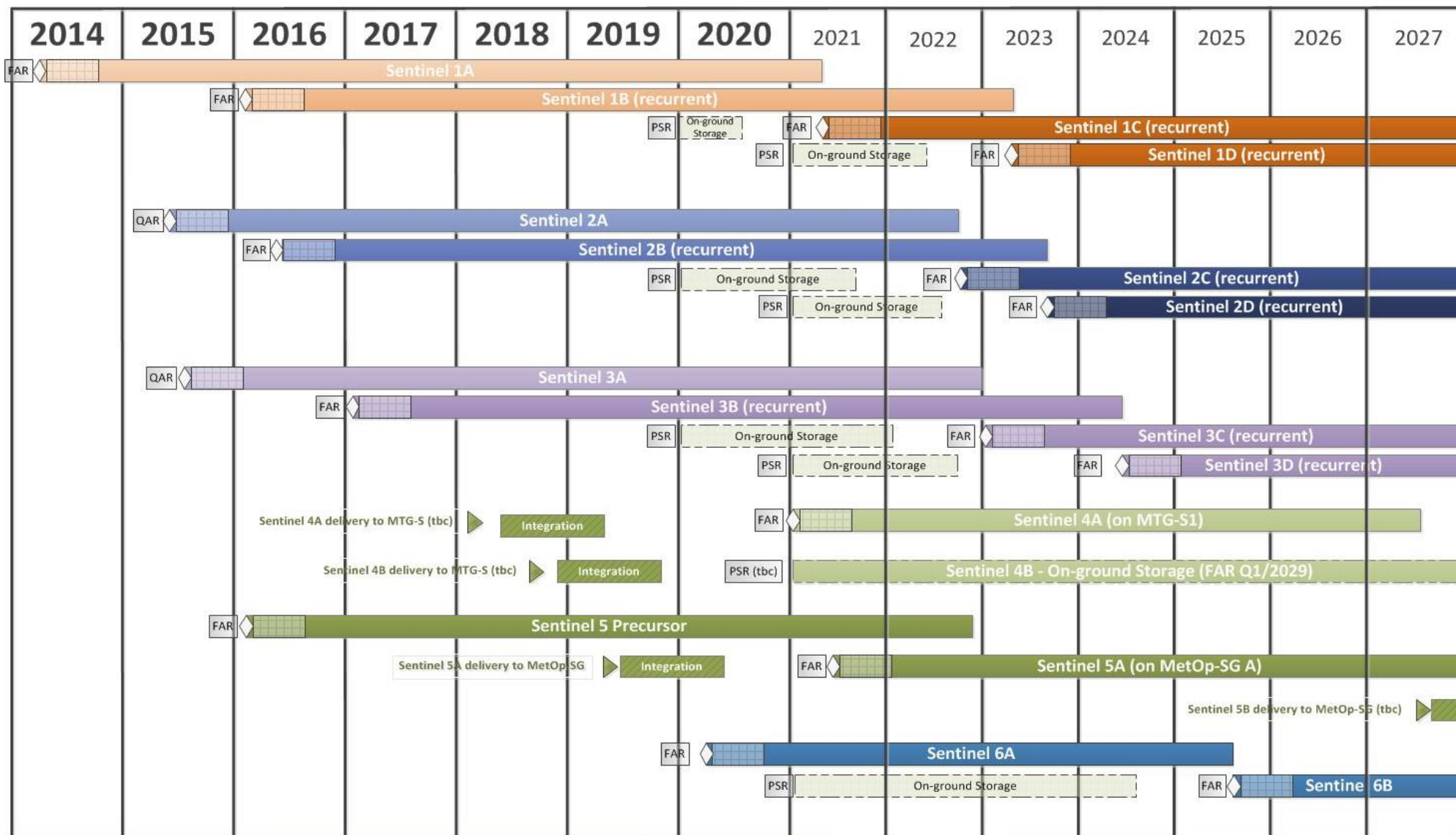
Sentinel-3



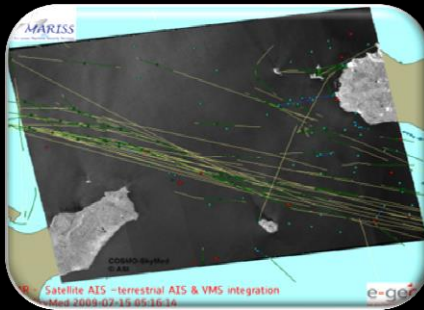
- Medium resolution imaging and altimetry mission
- Land and ocean applications



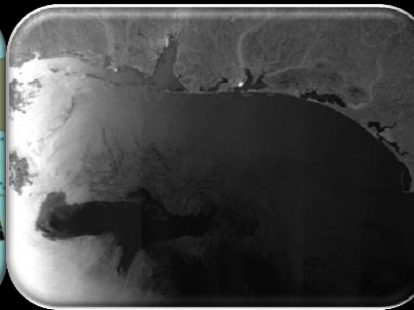
Tentative Sentinel Schedule



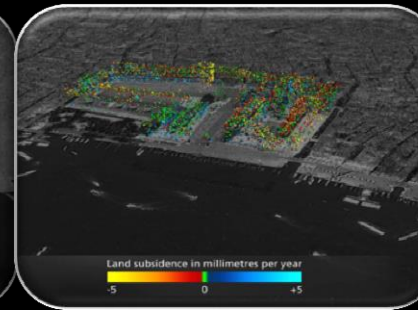
Some Sentinel Application Areas



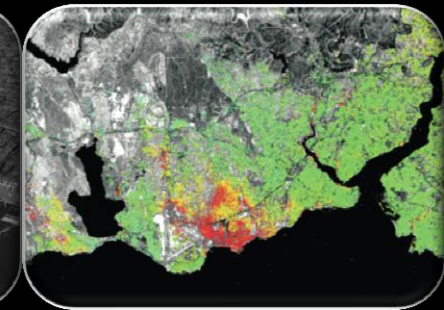
Maritime surveillance



Oil spills



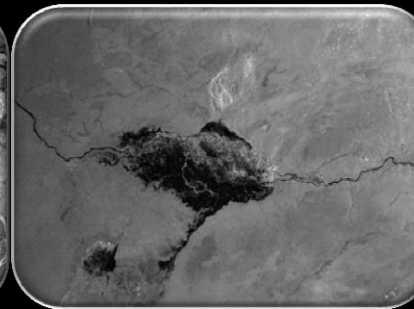
Land subsidence



Tectonics



Volcanoes



Floods



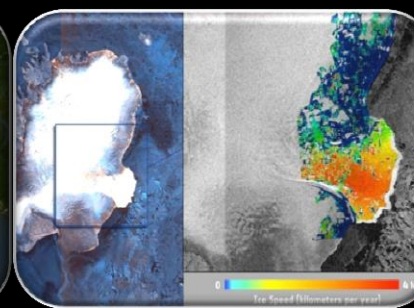
Deforestation



Vegetation



Sea ice extent



Ice speed

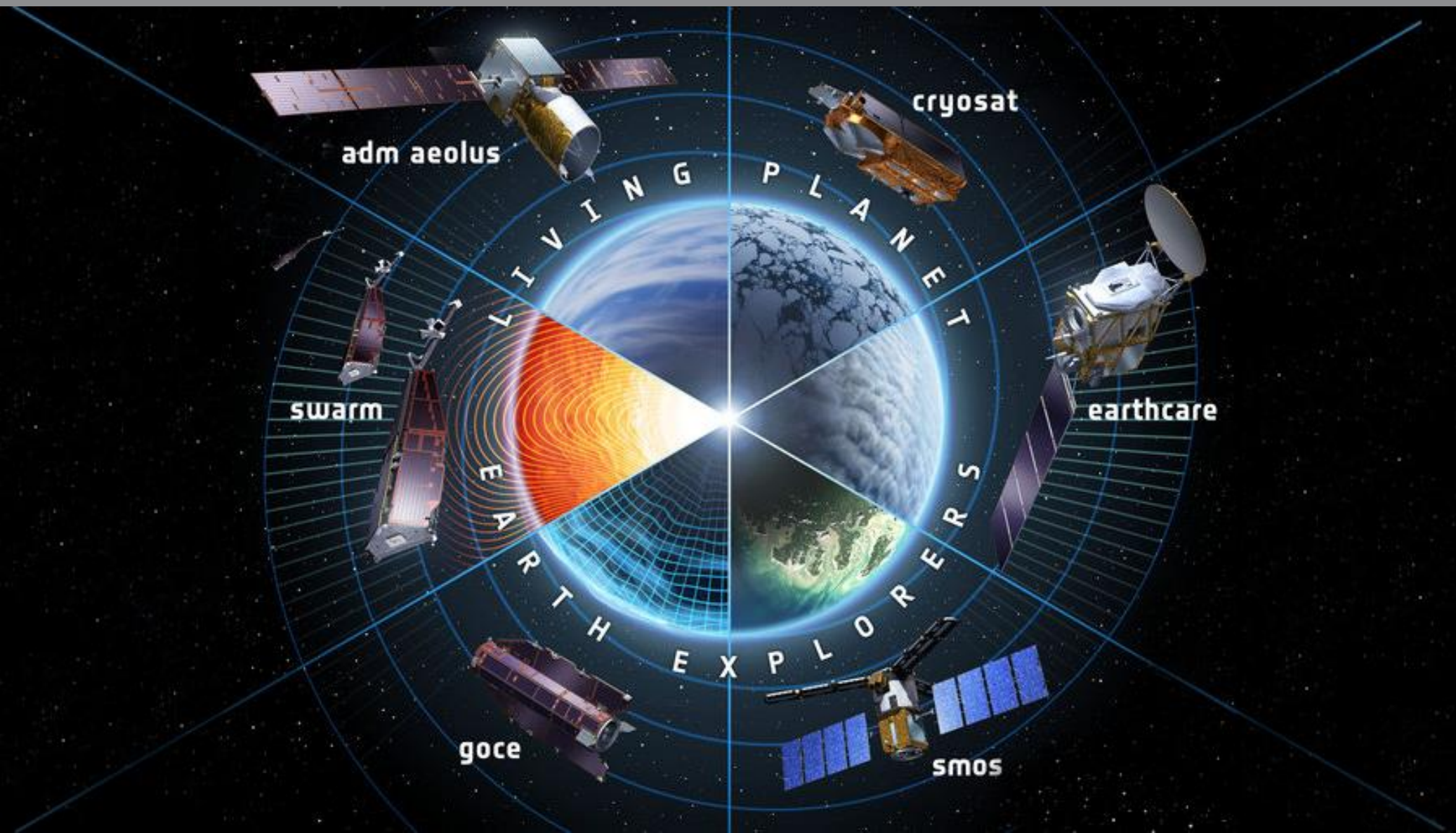


Atmosphere



Ocean colour

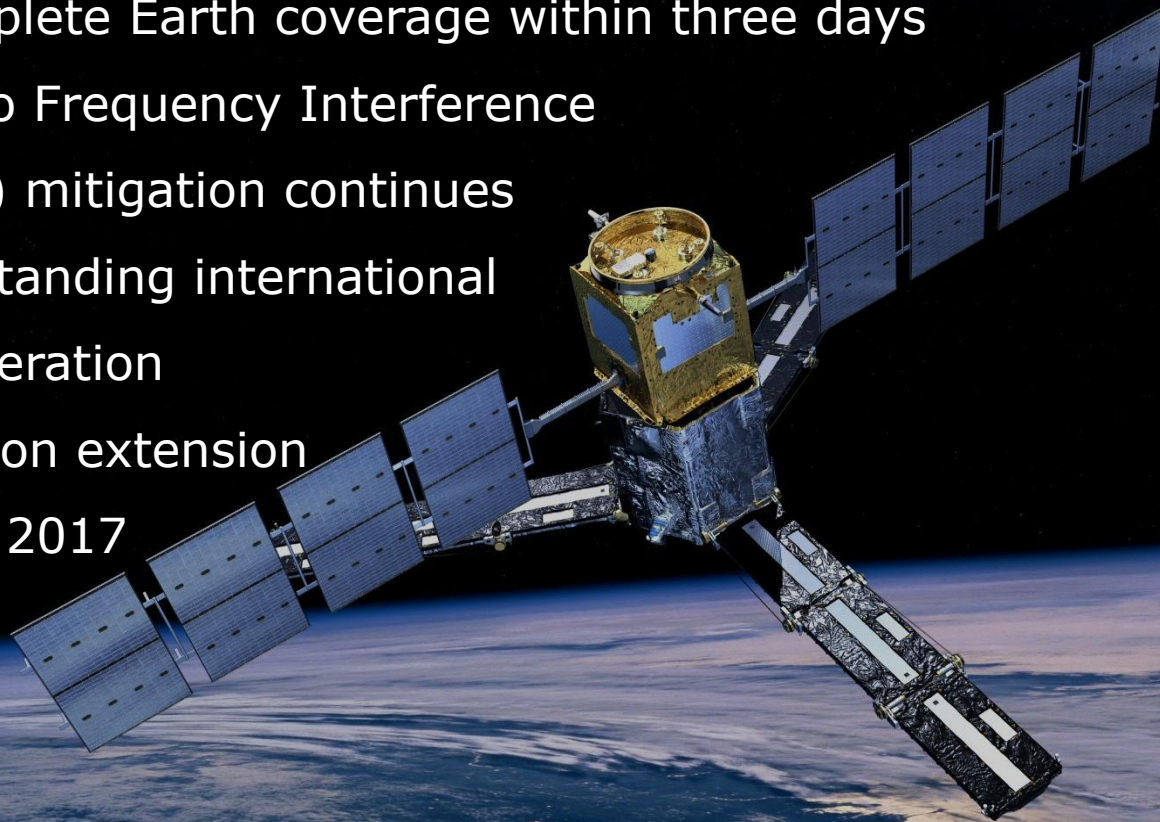
Science – the Earth Explorers



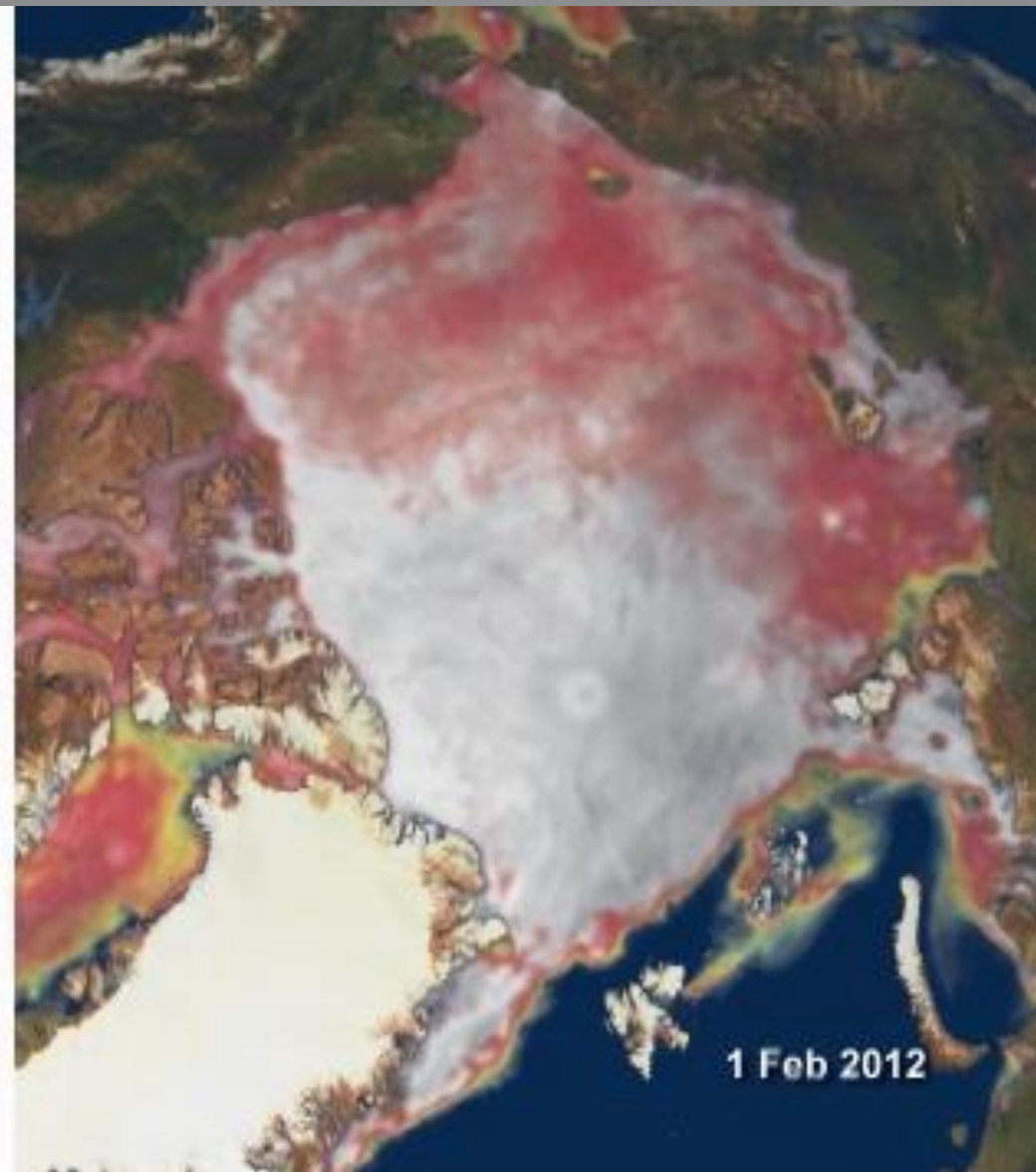
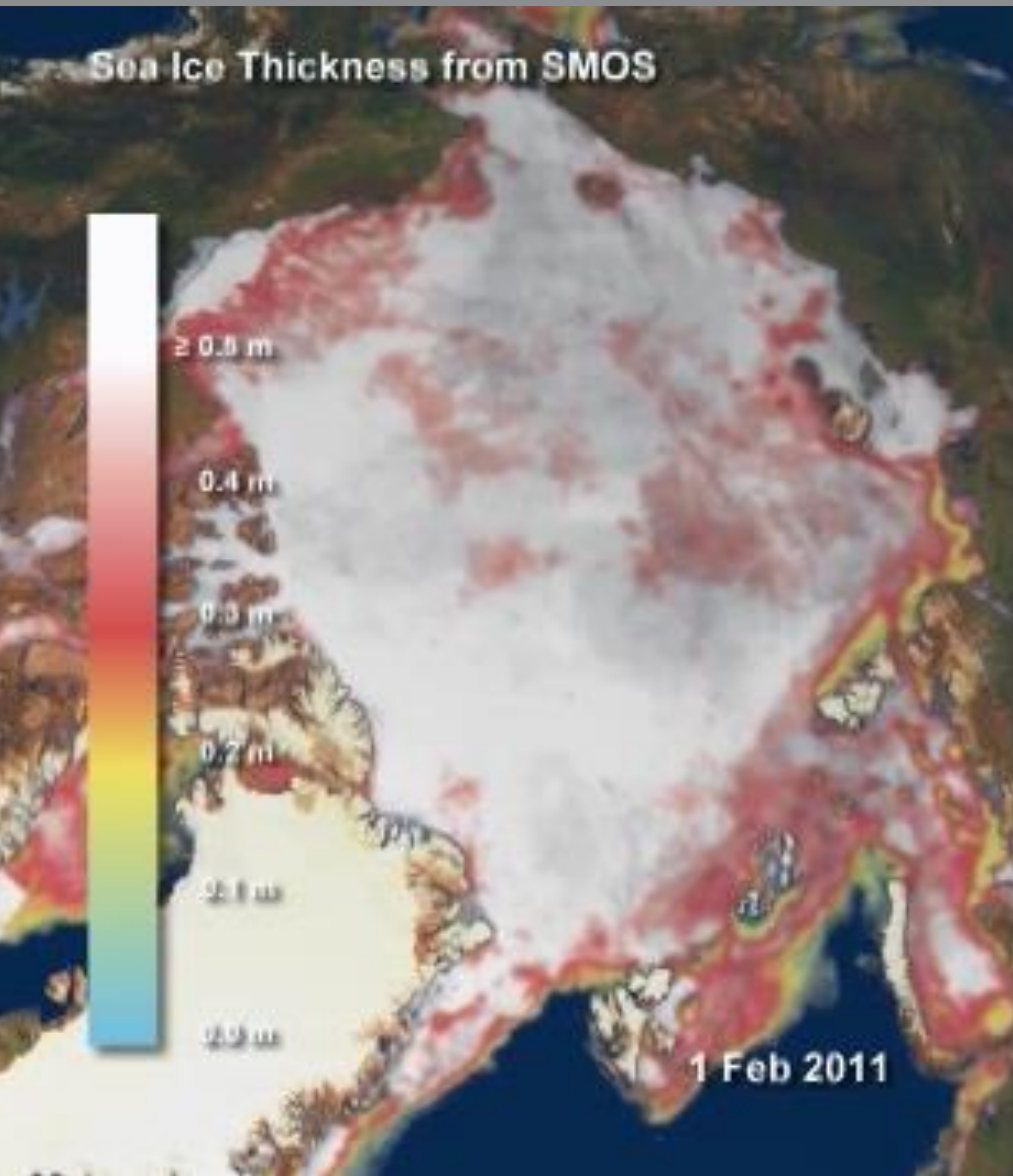
SMOS – Soil Moisture and Ocean Salinity



- Data delivery since February 2010
- Complete Earth coverage within three days
- Radio Frequency Interference (RFI) mitigation continues
- Outstanding international cooperation
- Mission extension until 2017



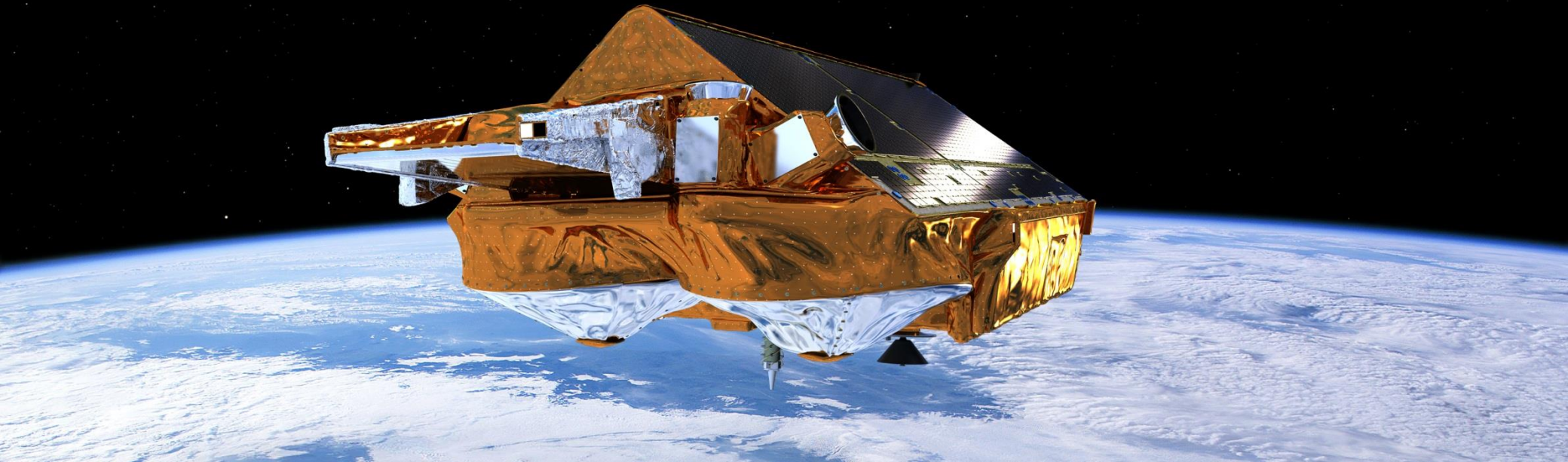
SMOS – Soil Moisture and Ocean Salinity



CryoSat: The Ice Mission

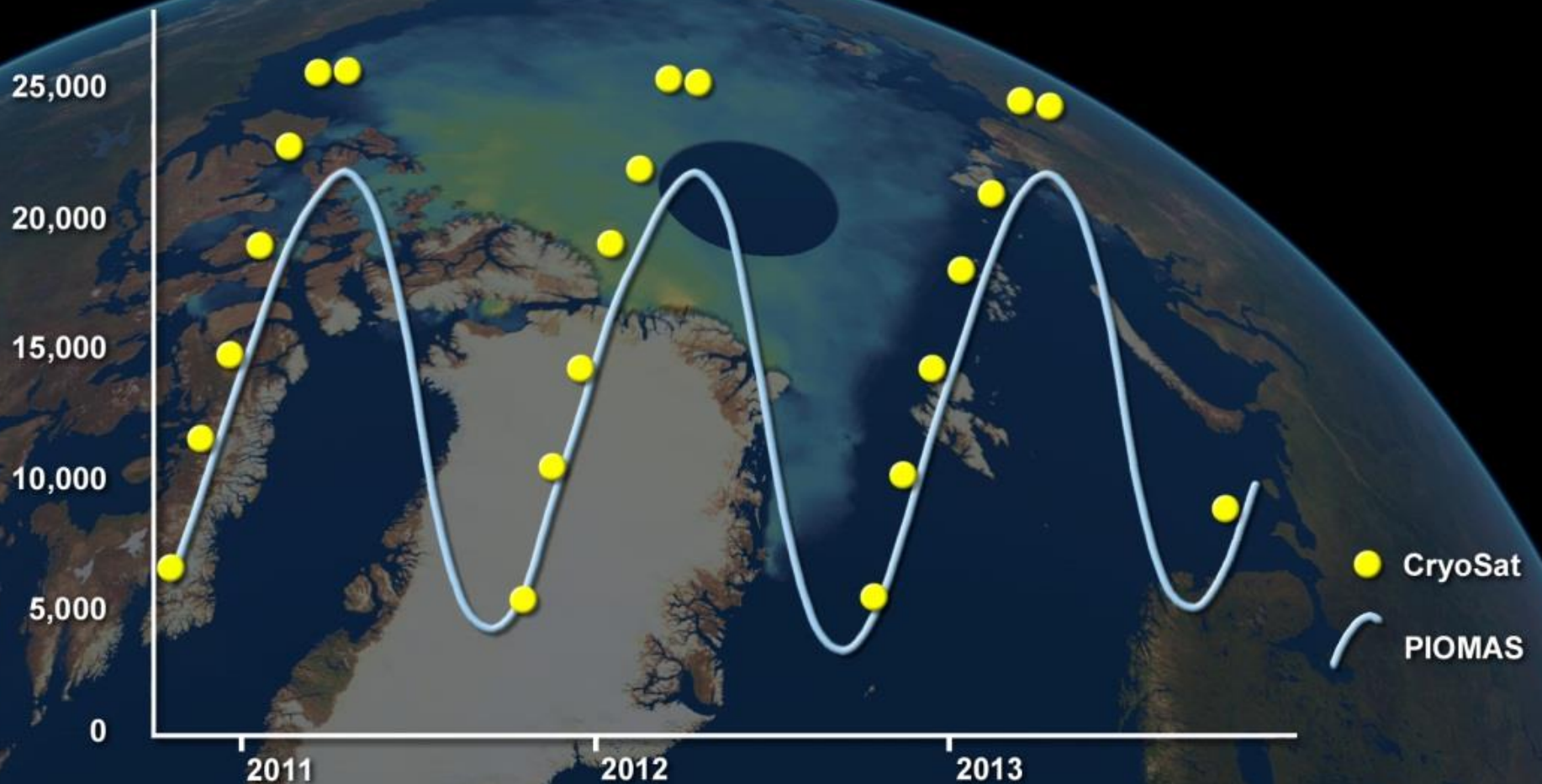


- First interferometric altimeter in space
- Global sea ice thickness measurements
- Data used for ice research, but increasingly also for oceanography
- Mission extension until 2017

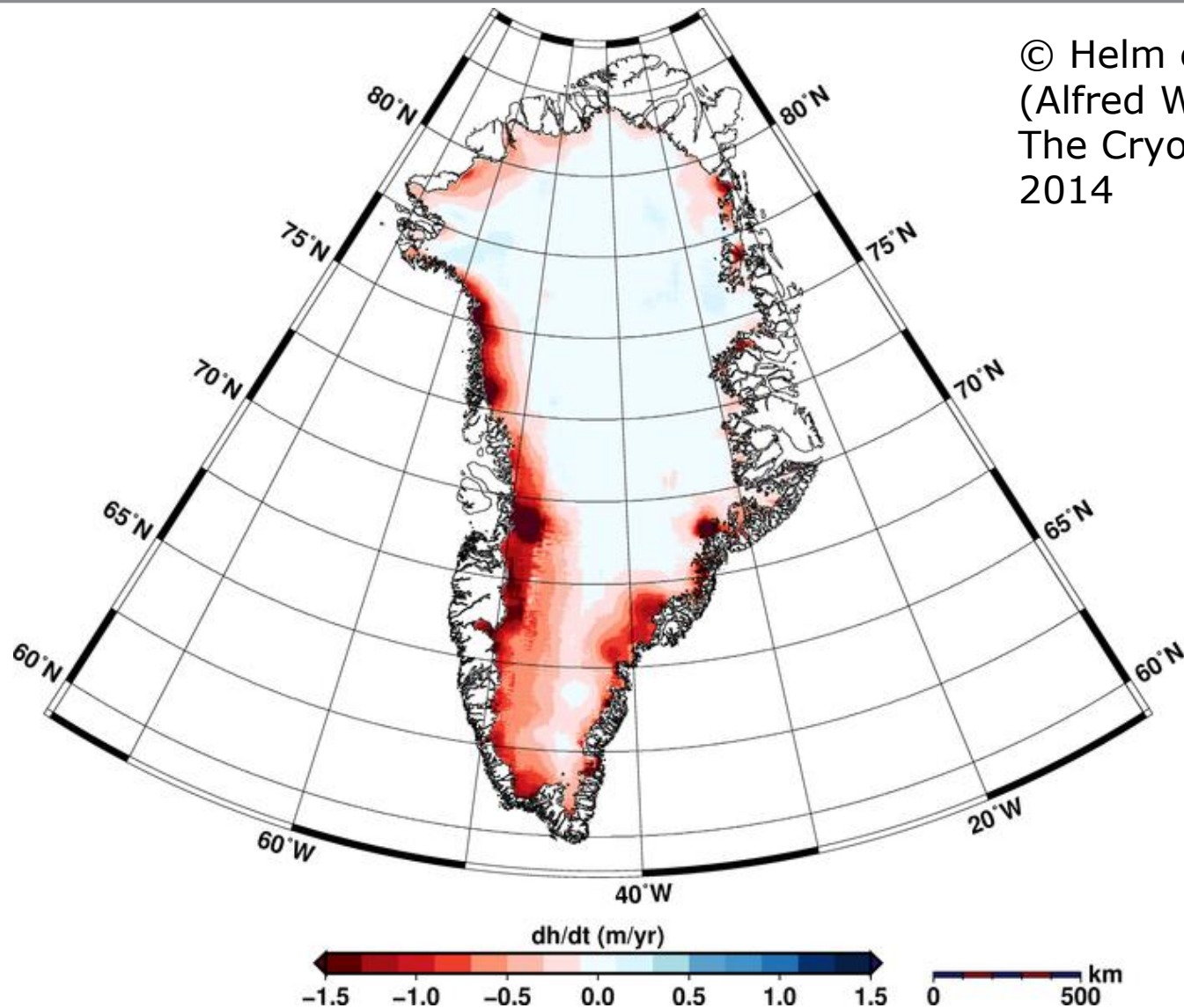


CryoSat: The Ice Mission

Arctic Sea Ice Volume
(cubic km)

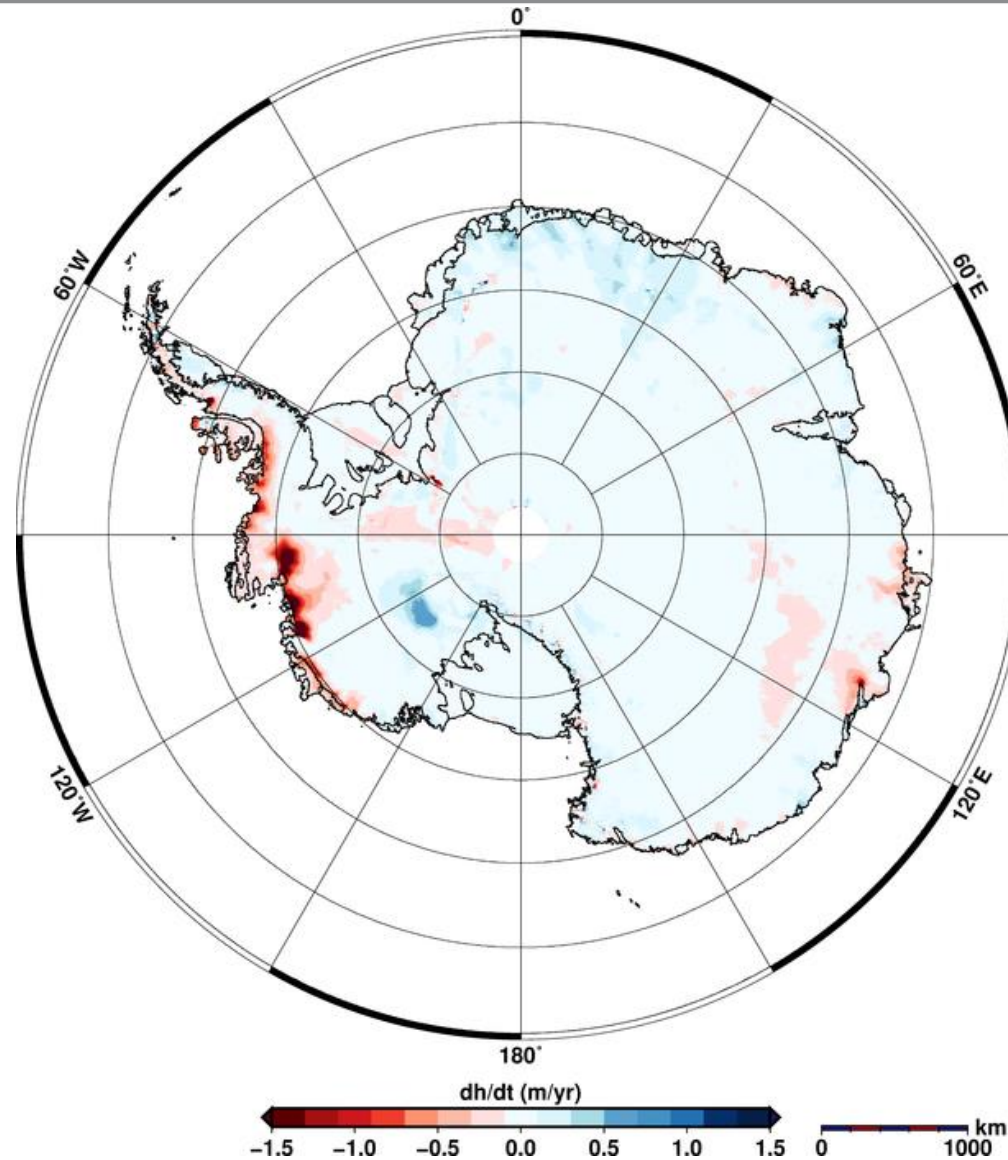


CryoSat: Greenland Ice Sheet Change



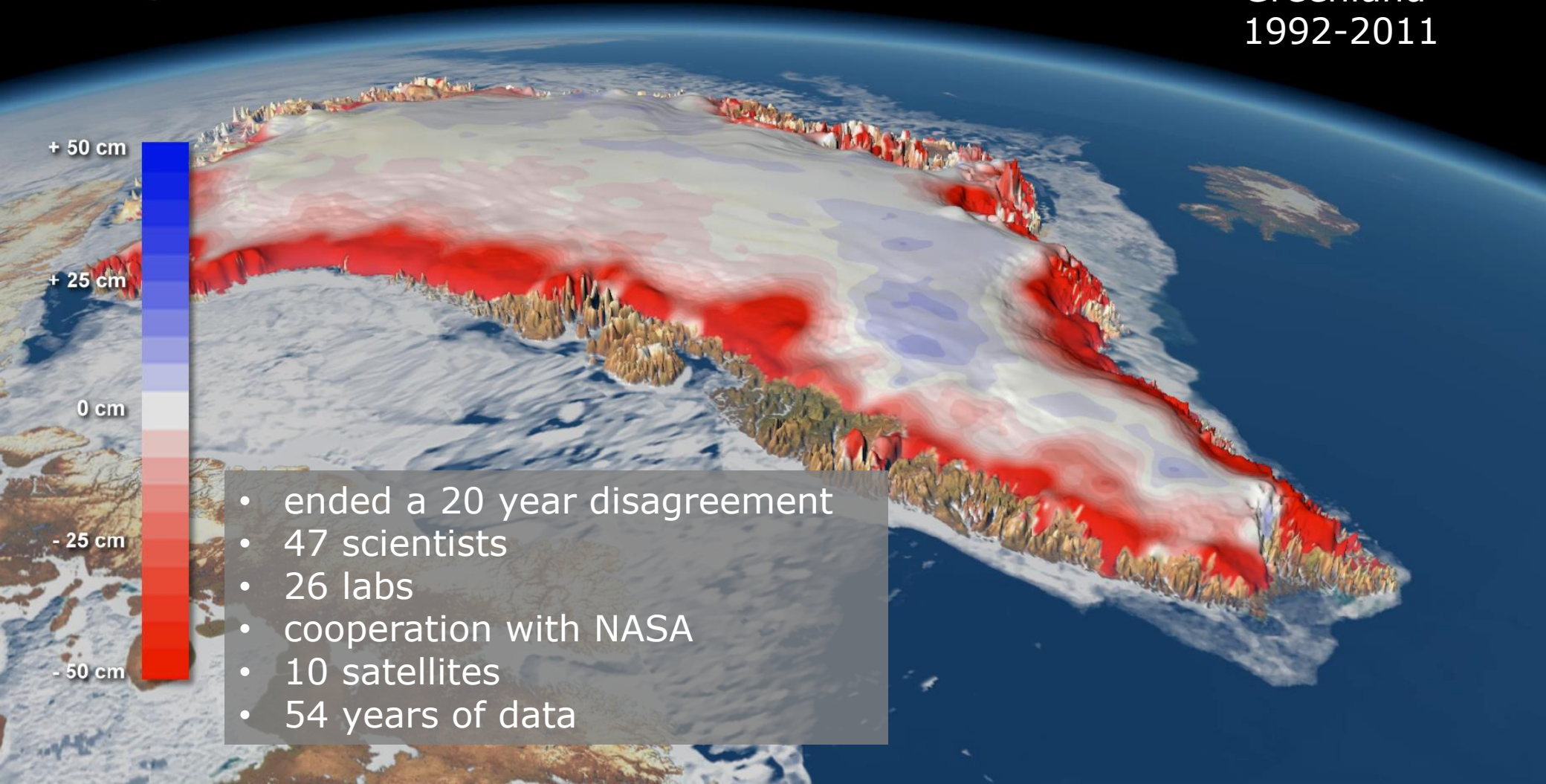
© Helm et al.
(Alfred Wegener Institut)
The Cryosphere,
2014

CryoSat: Antarctic Ice Sheet Change

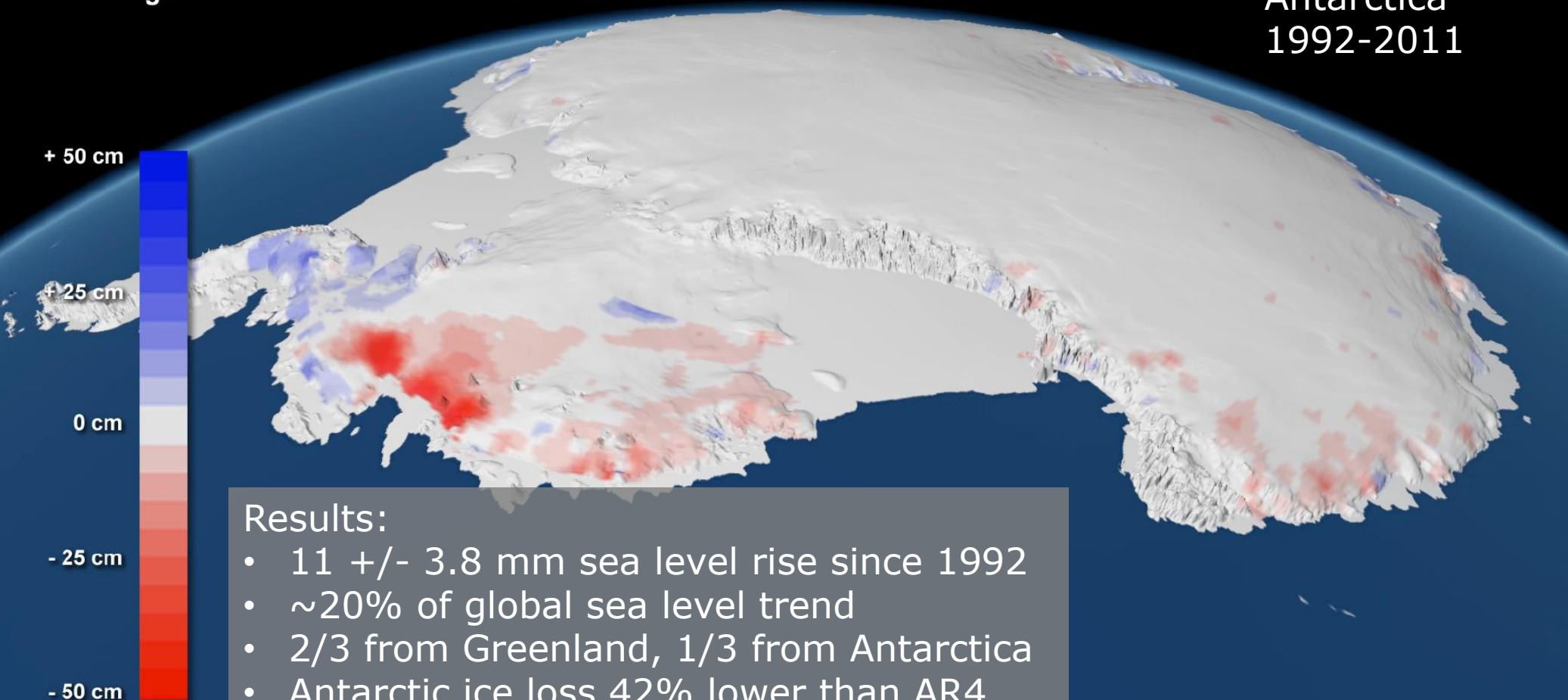


Change in Ice Sheet Thickness Per Year

Greenland
1992-2011



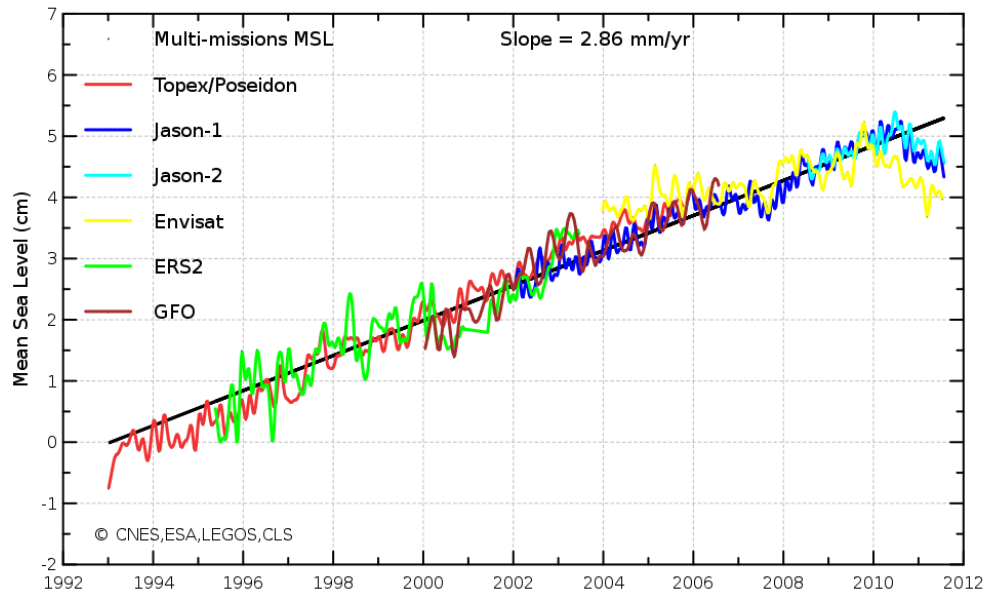
Change in Ice Sheet Thickness Per Year

Antarctica
1992-2011

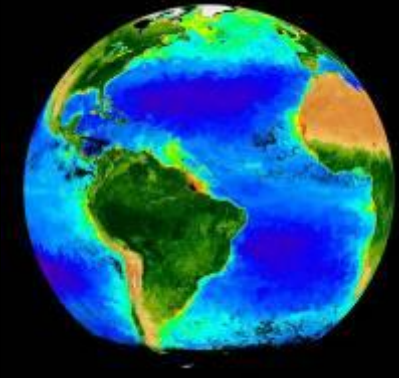
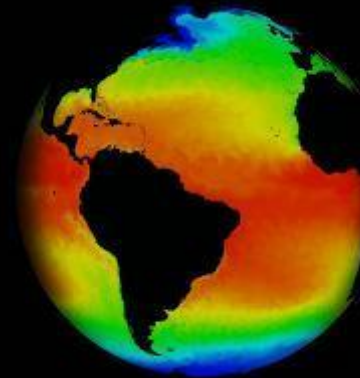
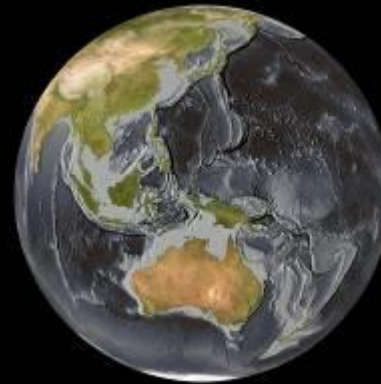
Results:

- 11 +/- 3.8 mm sea level rise since 1992
- ~20% of global sea level trend
- 2/3 from Greenland, 1/3 from Antarctica
- Antarctic ice loss 42% lower than AR4
- Loss 3 times higher than in the 90s

The ESA Climate Change Initiative (CCI)



- Cloud Properties
- Carbon Dioxide, Methane & other GHGs
- Ozone
- Aerosol properties
- Sea Surface Temperature
- Sea Level; Sea Ice
- Ocean Colour
- Glaciers and ice caps
- Land cover
- Fire disturbance
- Soil moisture



Sentinels/Copernicus:

- free and open access

<http://sentinel.esa.int>

Earth Explorers:

- datasets are free of charge
- downloadable from ESA data repositories

<https://earth.esa.int/web/guest/pi-community/apply-for-data>

- project proposal needed for service beyond download

Thank you for your attention