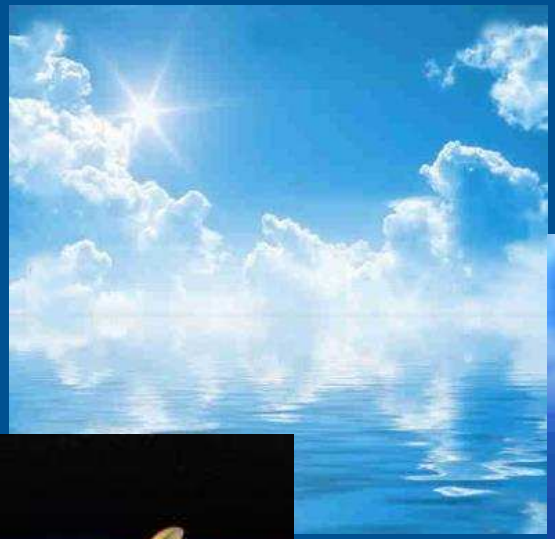
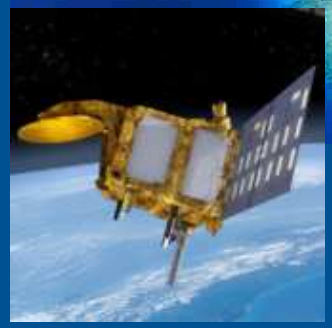
From COP 21 to COP 22, new challenges for space agencies on climate: greenhouse gasses and water resources measurements from space

CNES
Authors: P. Ultre-Guerard, C. Deniel, S. Cherchali
Presented by Dr. Paolo BAIOCCO





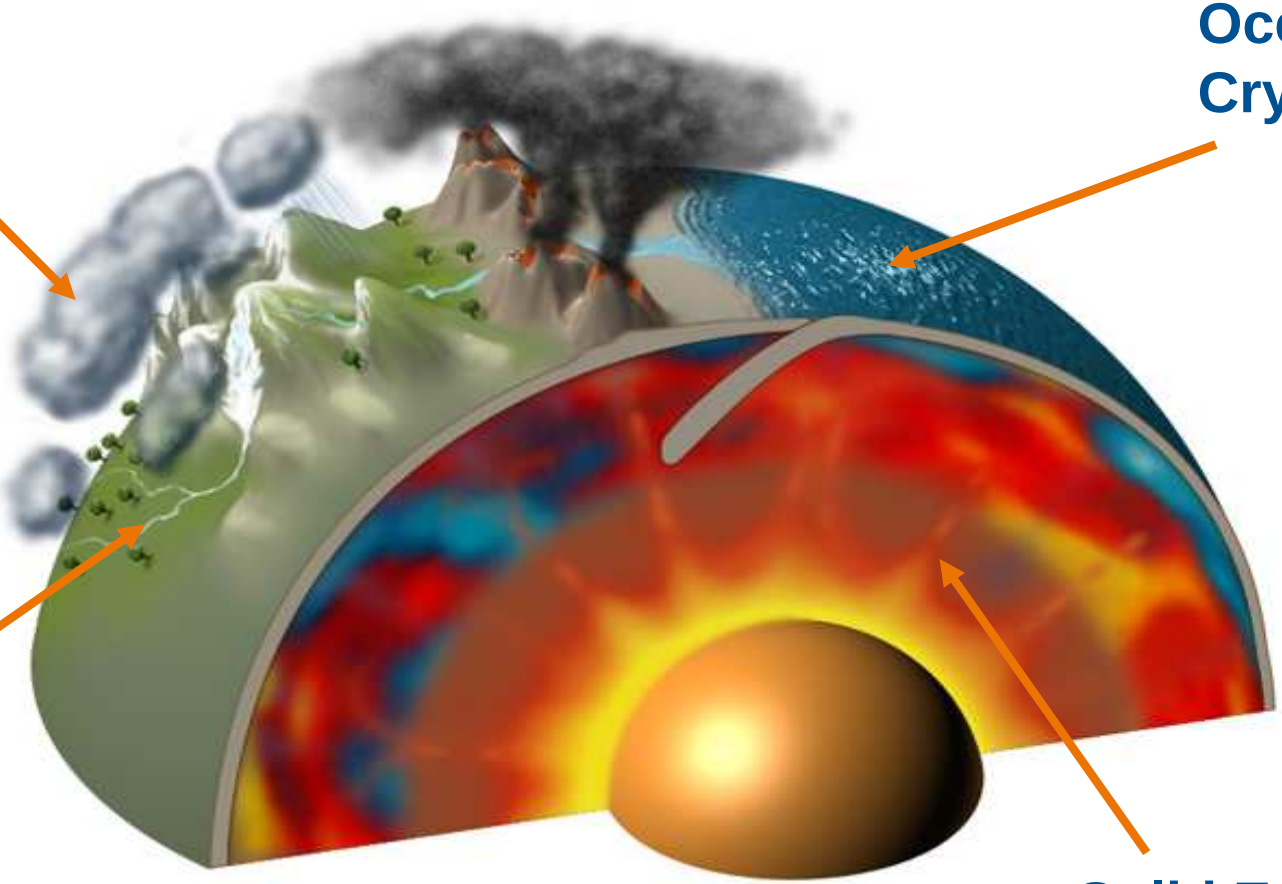




Objectives of EO : Advanced Earth Sciences

Atmosphere and Climate Monitoring

Oceanography Cryosphere

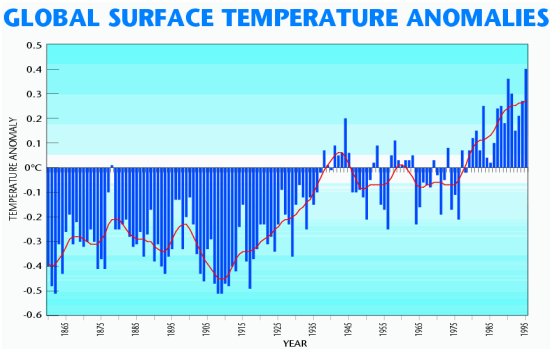


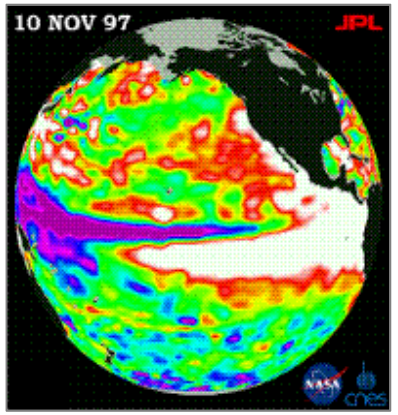
Land areas

Solid Earth Geomagnetism

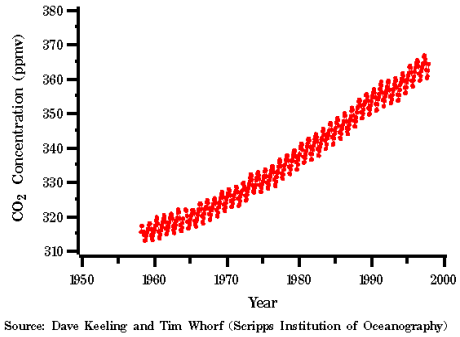
+ Interfaces, Carbon cycles, Water cycles…

Objectives of EO: Inform decision (societal benefit)

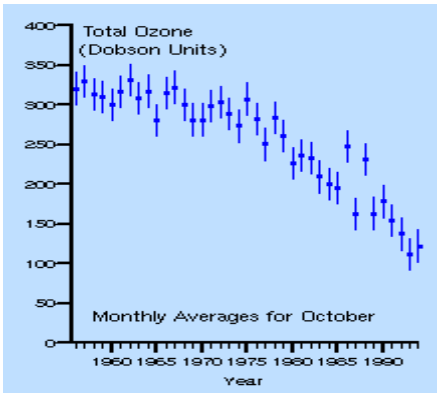




Mauna Loa, Hawaii



Source: Dave Keeling and Tim Whorf (Scripps Institution of Oceanography)



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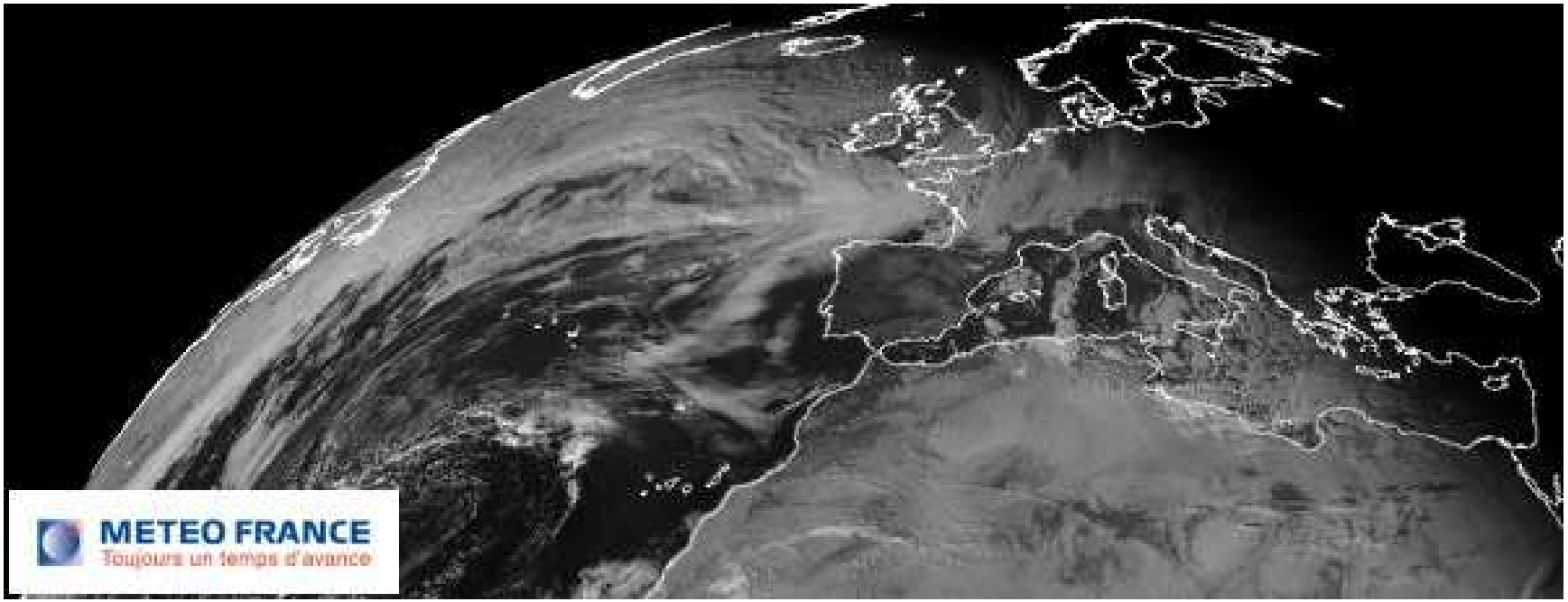
Success stories

Some examples…

Numerical weather prediction



Observation

Atmosphere/Weather

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IASI and IASI-NG

(Infrared Atmospheric Sounding Interferometer)
Breakthroughs for meteorology and determining the composition of the atmosphere

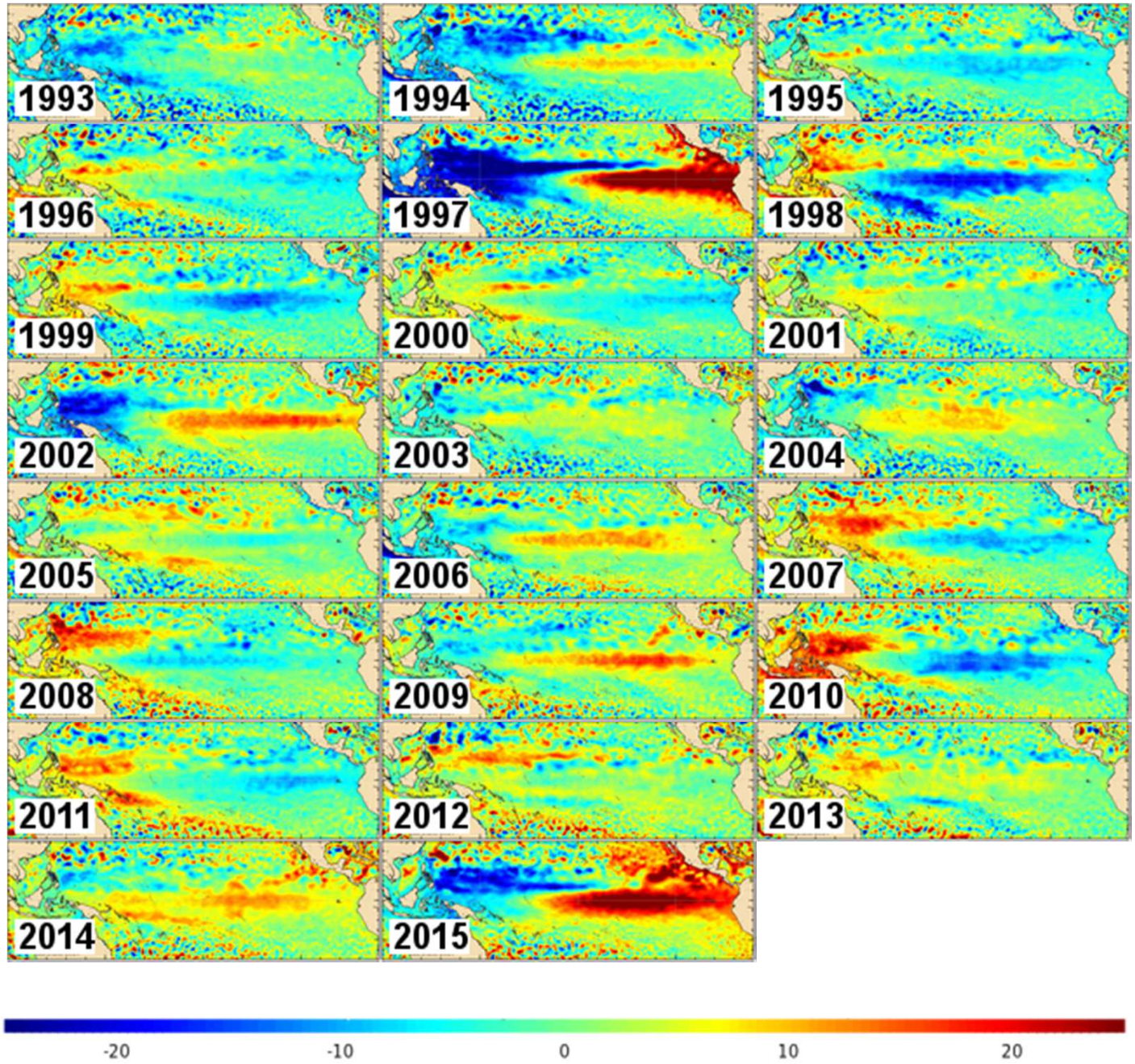
A CNES/EUMETSAT programme

- An essential instrument in the payload of the 3 European polar-orbiting meteorological satellites, MetOp (A & B) and MetOp-SG, due to its Fourier transform interferometer.
- Has resulted in improved 6-day weather forecasts. Provides air-pollution alerts 1 or 2 days in advance.
- First flight model launched in October 2006 on MetOp-A. Second model launched on MetOp-B in September 2012.
- The three IASI-NG models are under development.

Launch of the third IASI model in 2018 and of the first IASI-NG model in 2021

Seasonal variations El Niño/La Niña using altimetry data

Monthly averages maps (in cm) on Novembers each year since 1993, over the Equatorial Pacific from the El Niño Bulletin. The time series of the standardized Sea Level Anomalies is also displayed and updated on the Indicator page. Credits CLS/CNES



Observation

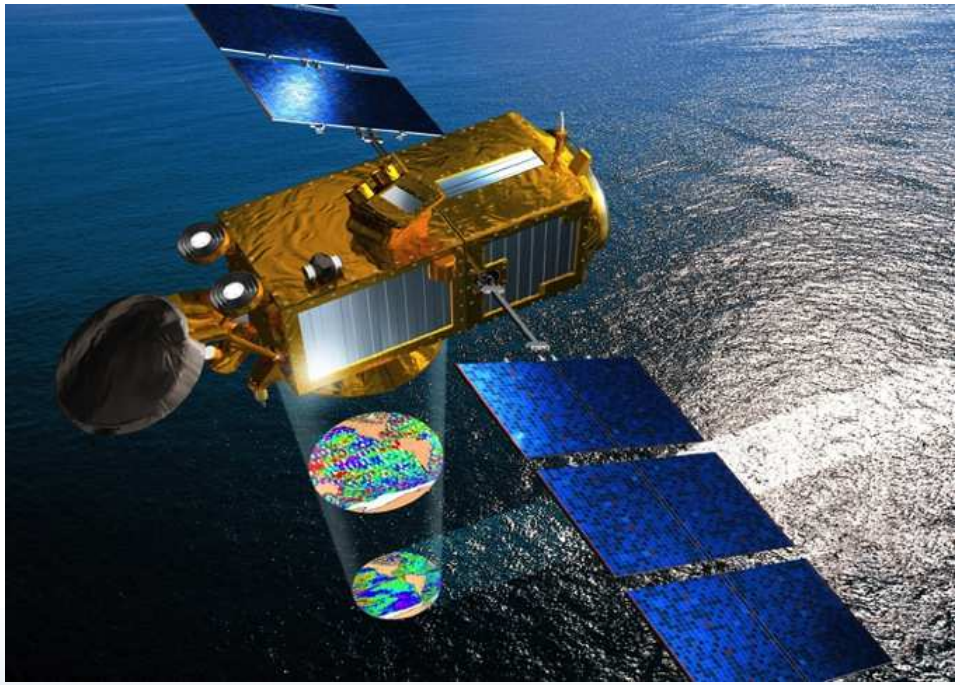
Oceanography

The Jason series

Towards operational oceanography

A CNES/NASA project (expanded to include NOAA and EUMETSAT).

- Following on from operational meteorology, Jason 2 was able to demonstrate operational oceanography.
- The programme is being continued with Jason 3, which shares many of Jason 2's characteristics.
- The follow-up to Jason 3 is already planned. This will be Jason CS (for "Continuity of Service"), the sixth Sentinel satellite of the Copernicus programme.



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Jason 3 was launched on 17 January 2016

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New challenges : climate

UN Sustainable Development Goals

CENTRE NATIONAL D'ÉTUDES SPATIALES

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

1) Greenhouse Gases observation from Space

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	**Surface:** Air temperature, **Wind speed and direction**, Water vapour, Pressure, Precipitation, Surface radiation budget **Upper-air: Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance)** **Composition: Carbon dioxide, Methane, and other long-lived greenhouse gases, Ozone and Aerosol, supported by their precursors**
Oceanic	**Surface: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice,** Surface current, Ocean colour, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers
Terrestrial	River discharge, Water use, Groundwater, **Lakes, Snow cover, Glaciers and ice caps, Ice sheets**, Permafrost, **Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass,** Soil carbon, **Fire disturbance, Soil moisture**

The ECVs – satellite observations make a major contribution to the ECVs shown in bold

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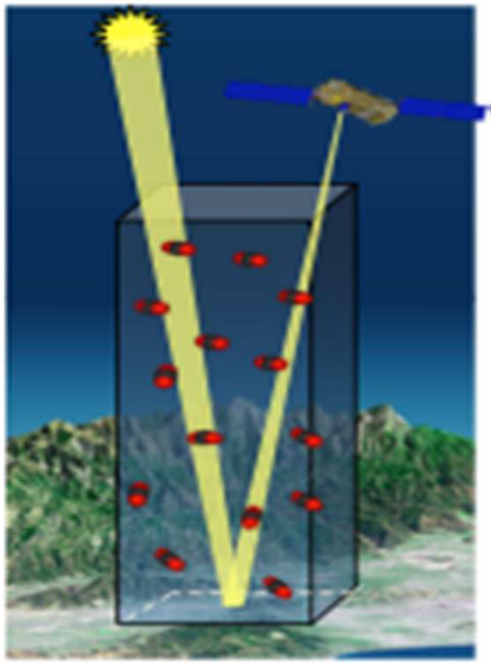
MICROCARB & MERLIN



MERLIN : CH4 Active measurement

Accuracy< 27 ppb Bias < 3,7 ppb

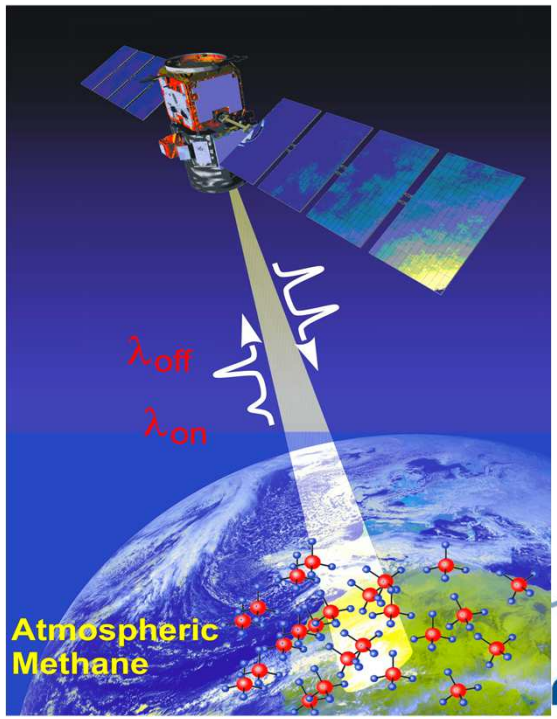
- DIAL Lidar at 1,67 µm
- Horizontal sampling accumulation: 50 km
- To be launched in 2021

DLR

MICROCARB : CO2 Passive measurement

Accuracy< 1 ppm Bias < 0,1 ppm

- XCO2 spatial gradients are small (< 10 ppm)
- Error on measurement (regional bias) implies wrong flux computation
- To be launched in 2020



Growing interest in CO_2 and CH_4 Observations from space

Japan:

- GOSAT (JAXA/NIES/MoE), launched in 2009.
- GOSAT-2 (JAXA/NIES/MoE), planned for 2018.

USA:

- OCO-2 (NASA), launched in 2014.
- OCO-3 (NASA), planned in or after 2018.
- GEOCARB (NASA), planned for ?
- ASCENDS (NASA), under study (2023+).

China:

- TanSat (CAS, MOST, CMA) launched in 2016.

Europe:

- COPERNICUS/Sentinel 5P (ESA) & 5 (UE) , planned for 2017 & 2021.
- MERLIN (CNES-DLR), planned for 2021.
- MICROCARB (CNES), planned for 2020.
- Sentinel 7 (ESA/UE), TBC, for 2025

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MARRAKECH
COP22|2016|CMP12

2) Water cycle and fresh water resources from Space

GCOS
GLOBAL CLIMATE OBSERVING SYSTEM

Domain	Essential Climate Variables
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The ECVs – satellite observations make a major contribution to the ECVs shown in bold

cnes

Observation

Oceanography/Hydrology

SWOT (Surface Water Ocean Topography Mission)

Monitoring the level of oceans and inland waters

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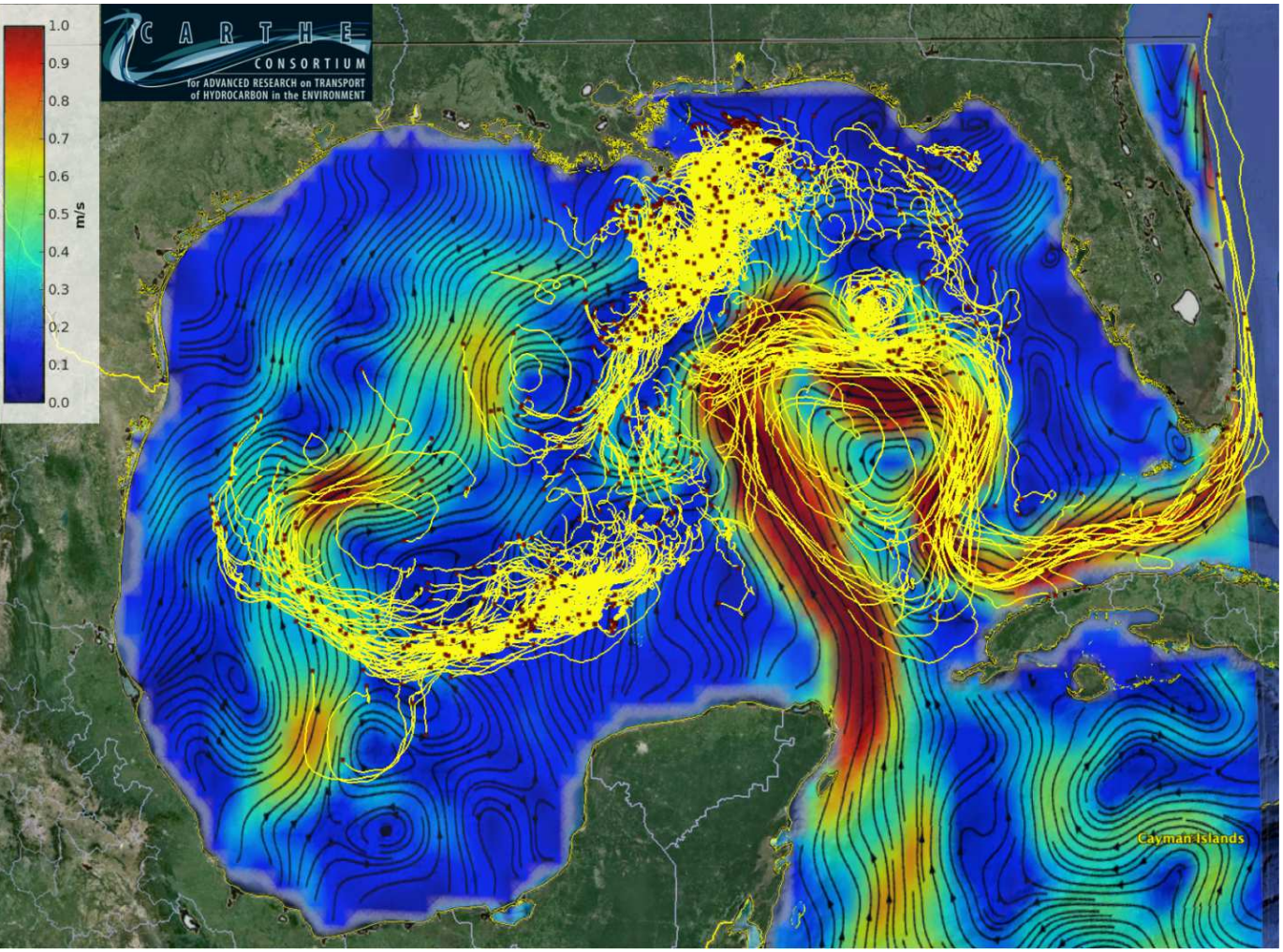
Launch scheduled for 2021

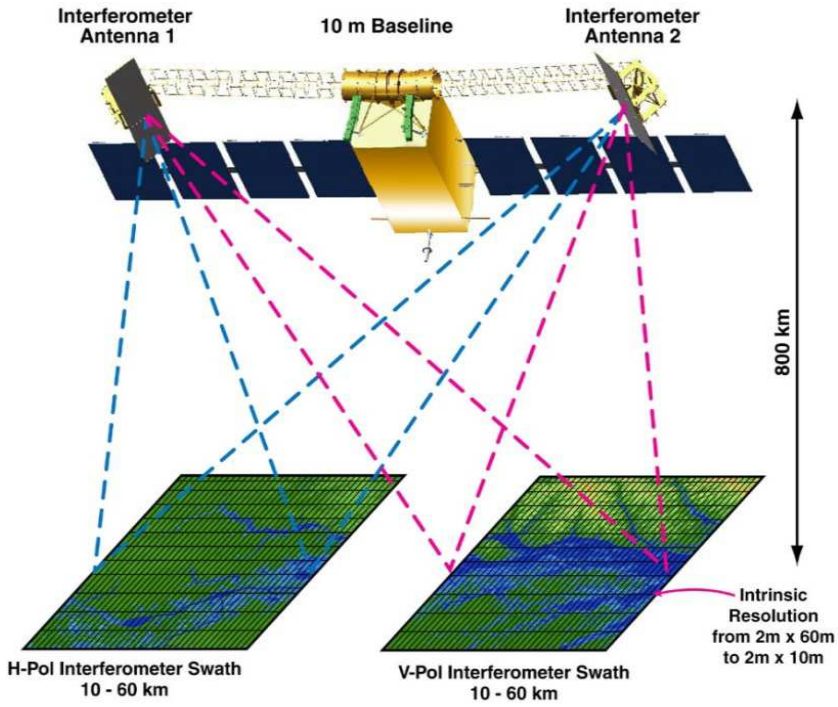
- A joint CNES/NASA/UKSA/CSA/ project to map variations in the levels of inland and ocean waters.
- CNES is providing the platform and co-operating with NASA on the instruments, in particular the highly-innovative KaRIn wide-swath altimeter.
- CNES is also in charge of the satellite's ground control segment and is developing (jointly with NASA) a mission ground segment for data processing.
  The French contribution is partly financed by the French future investments programme (PIA).

Going from large scale to smaller scale monitoring
New generation of altimetry measurements for oceanography

Example: Ocean dynamics in the Gulf of Mexico

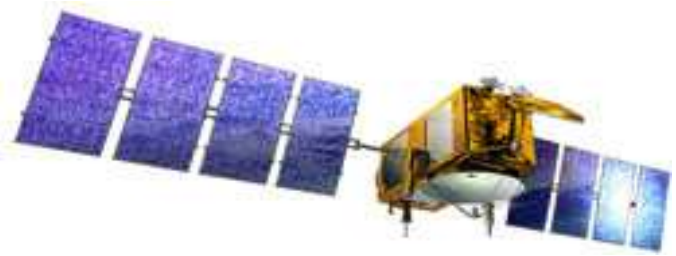
- The colored map depicts the ocean circulation as it is monitored by current satellite altimetry
- Yellow lines shows the actual trajectory or surface drifters



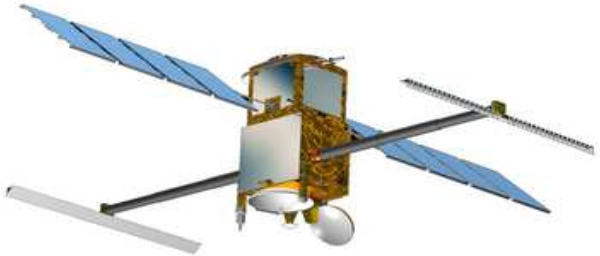


From nadir to wide swath altimetry

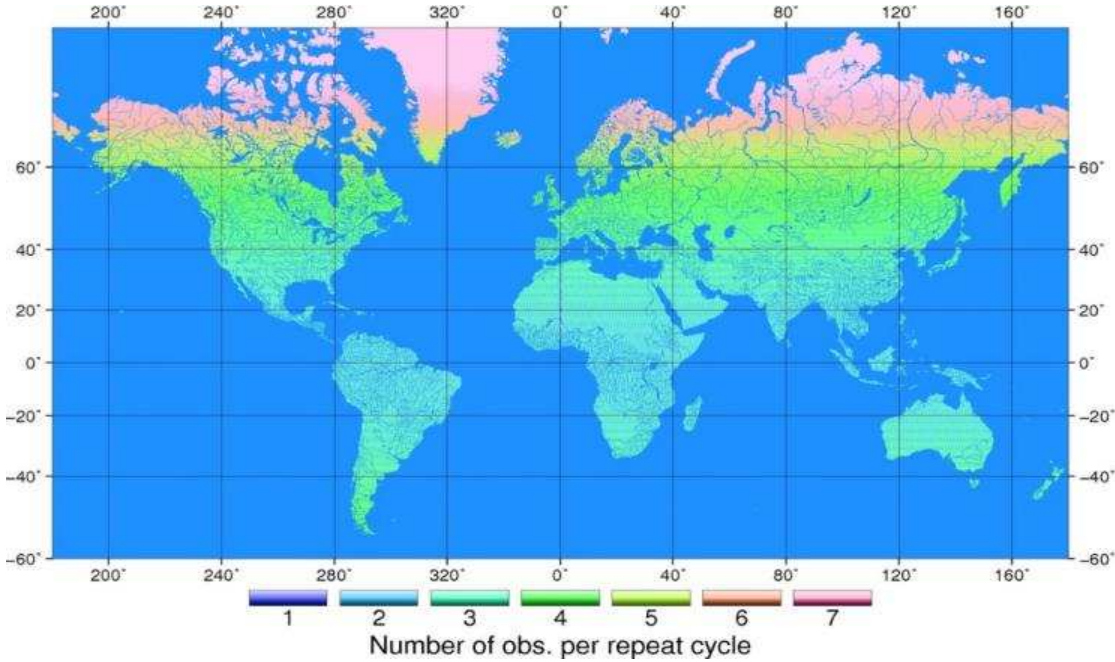
SWOT Coverage Leap - *from local altimetry to topography*



Conventional Nadir Altimeter



SWATH Altimeter : SWOT



SWOT mission will address challenges and shortcomings of conventional altimetry (e.g., spatial coverage and resolution) in both oceanographic and hydrologic applications and will enable a wide range of research opportunities in oceanography and land hydrology.

International cooperation

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

From COP 21 to COP 22

MARRAKECH
COP22|2016|CMP12

Marrakech Declaration – Water cycle and fresh water resources


Thank you for your attention!