



Le programme Copernicus

The Copernicus program

Serge RIAZANOFF
Director of VisioTerra

What is Copernicus?

Copernicus is a European space flagship programme led by the European Union

Provides the necessary data for operational monitoring of the environment and for civil security

ESA coordinates the space component



Copernicus Space Component: Dedicated Missions



S1A/B: Radar Mission



S2A/B: High Resolution Optical Mission



S3A/B: Medium Resolution Imaging and Altimetry Mission



S4A/B: Geostationary Atmospheric Chemistry Mission



S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission



S5A/B/C: Low Earth Orbit Atmospheric Chemistry Mission

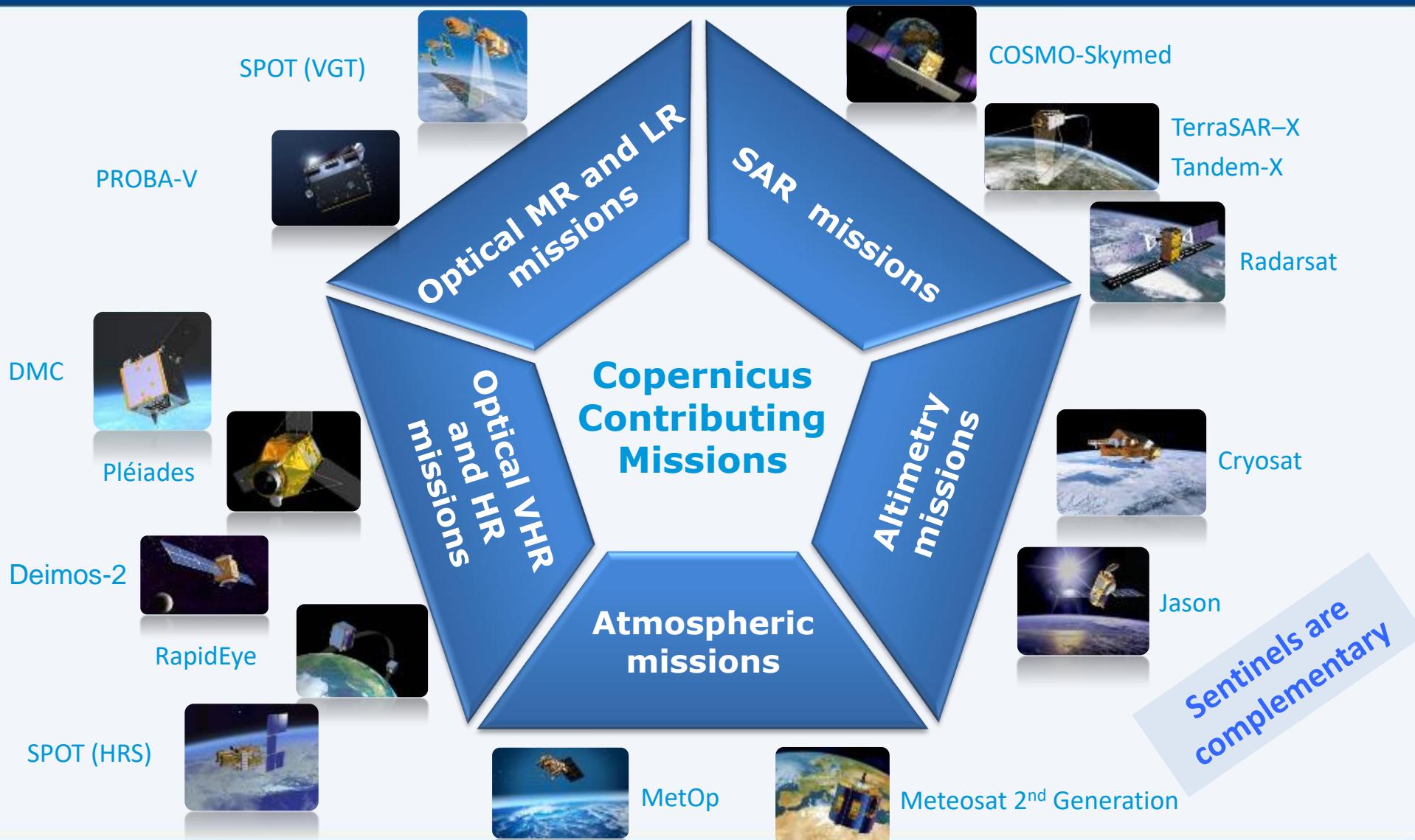


Jason-CS A/B: Altimetry Mission

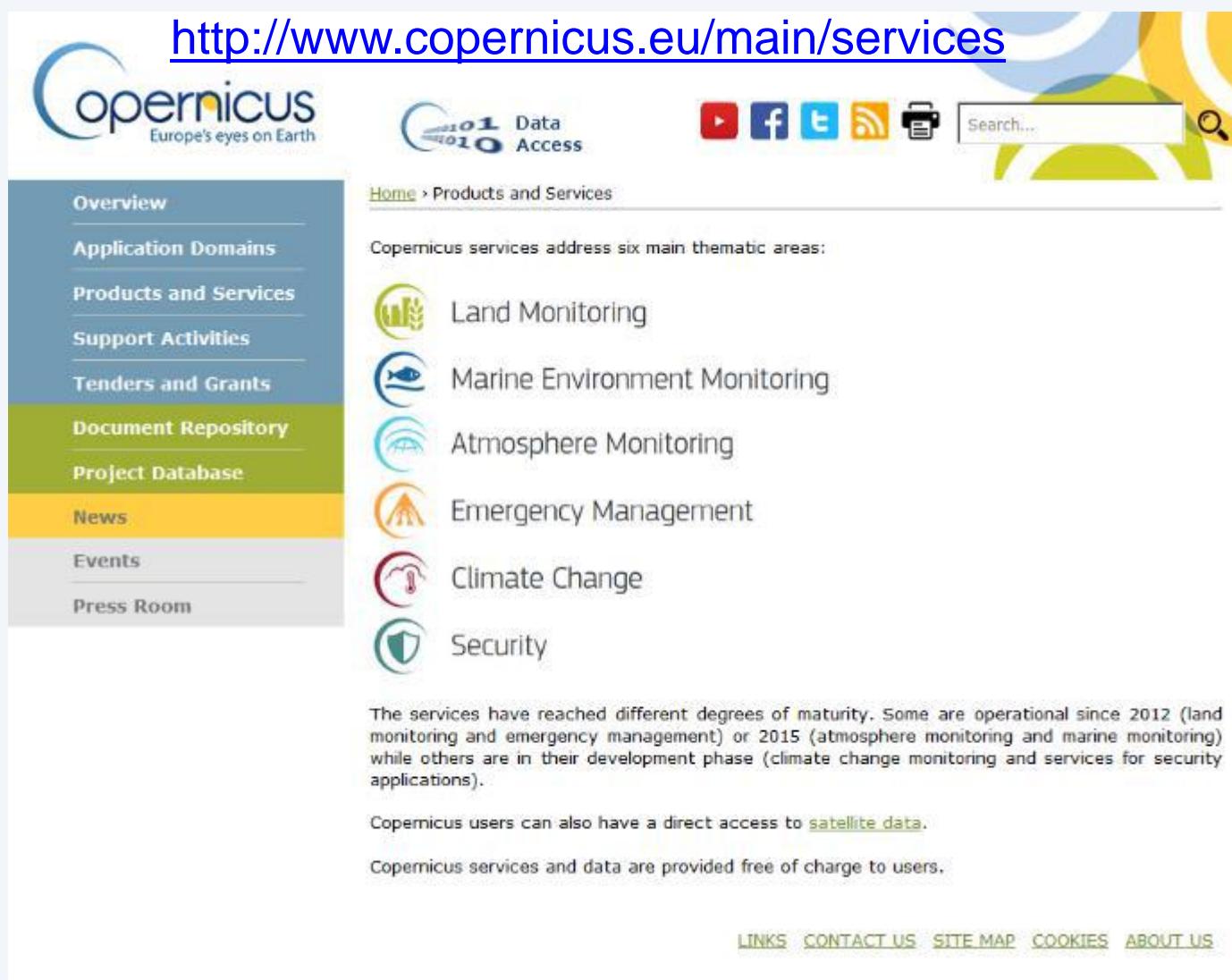


EDRS

Copernicus Contributing Missions



<http://www.copernicus.eu/main/services>



The screenshot shows the Copernicus website's main services page. On the left, a vertical navigation menu lists: Overview, Application Domains, Products and Services, Support Activities, Tenders and Grants, Document Repository (highlighted in green), Project Database, News (highlighted in yellow), Events, and Press Room. At the top right are links for Data Access, YouTube, Facebook, Twitter, RSS, Print, and a search bar. The main content area title is "Products and Services". It states that Copernicus services address six main thematic areas, each with an icon: Land Monitoring (green field), Marine Environment Monitoring (blue fish), Atmosphere Monitoring (teal wavy line), Emergency Management (orange flame), Climate Change (red thermometer), and Security (blue shield). Below this, a text box explains service maturity levels. A note at the bottom says users can access satellite data directly.

Overview

Application Domains

Products and Services

Support Activities

Tenders and Grants

Document Repository

Project Database

News

Events

Press Room

[Data Access](#)

[!\[\]\(92a9c66d52fa00484c508cd82aded8f9_img.jpg\) YouTube](#) [!\[\]\(9e8b1f24d41d14b4d8e581945144a20f_img.jpg\) Facebook](#) [!\[\]\(8baa3426035fce54f6ade6e931d94c3a_img.jpg\) Twitter](#) [!\[\]\(5a5d7bd8f4d79c0f8a11012b3ece3a87_img.jpg\) RSS](#) [!\[\]\(78a3c5f5df949fc14c0d9546153f5650_img.jpg\) Print](#) 

[Home](#) > Products and Services

Copernicus services address six main thematic areas:

-  Land Monitoring
-  Marine Environment Monitoring
-  Atmosphere Monitoring
-  Emergency Management
-  Climate Change
-  Security

The services have reached different degrees of maturity. Some are operational since 2012 (land monitoring and emergency management) or 2015 (atmosphere monitoring and marine monitoring) while others are in their development phase (climate change monitoring and services for security applications).

Copernicus users can also have a direct access to [satellite data](#).

Copernicus services and data are provided free of charge to users.

[LINKS](#) [CONTACT US](#) [SITE MAP](#) [COOKIES](#) [ABOUT US](#)



L'Education Training



Ingénierie et education en observation de la Terre EO engineering and education

January 1990

March 2004



GAEL Consultant

- 1. Software development
- 2. Quality control
- 3. Cartographic production

May 2004



VisioTerra

Science consulting for Earth observation

- 1. Software development – Virtual globes, access to EO data
- 2. Cartographic production – geometry, radiometry, statistics
- 3. Studies - EO expert support, technical studies, audit
- 4. Training – Remote sensing, Image processing, Geodesy...
- 5. Communication – Web, scientific document editing

March 1993



University Paris-Est Marne-la-Vallée – Gaspard Monge Institute



Professor

- 1. Image processing
- 2. Remote sensing
- 3. Trainees following

ENSG (IGN school)

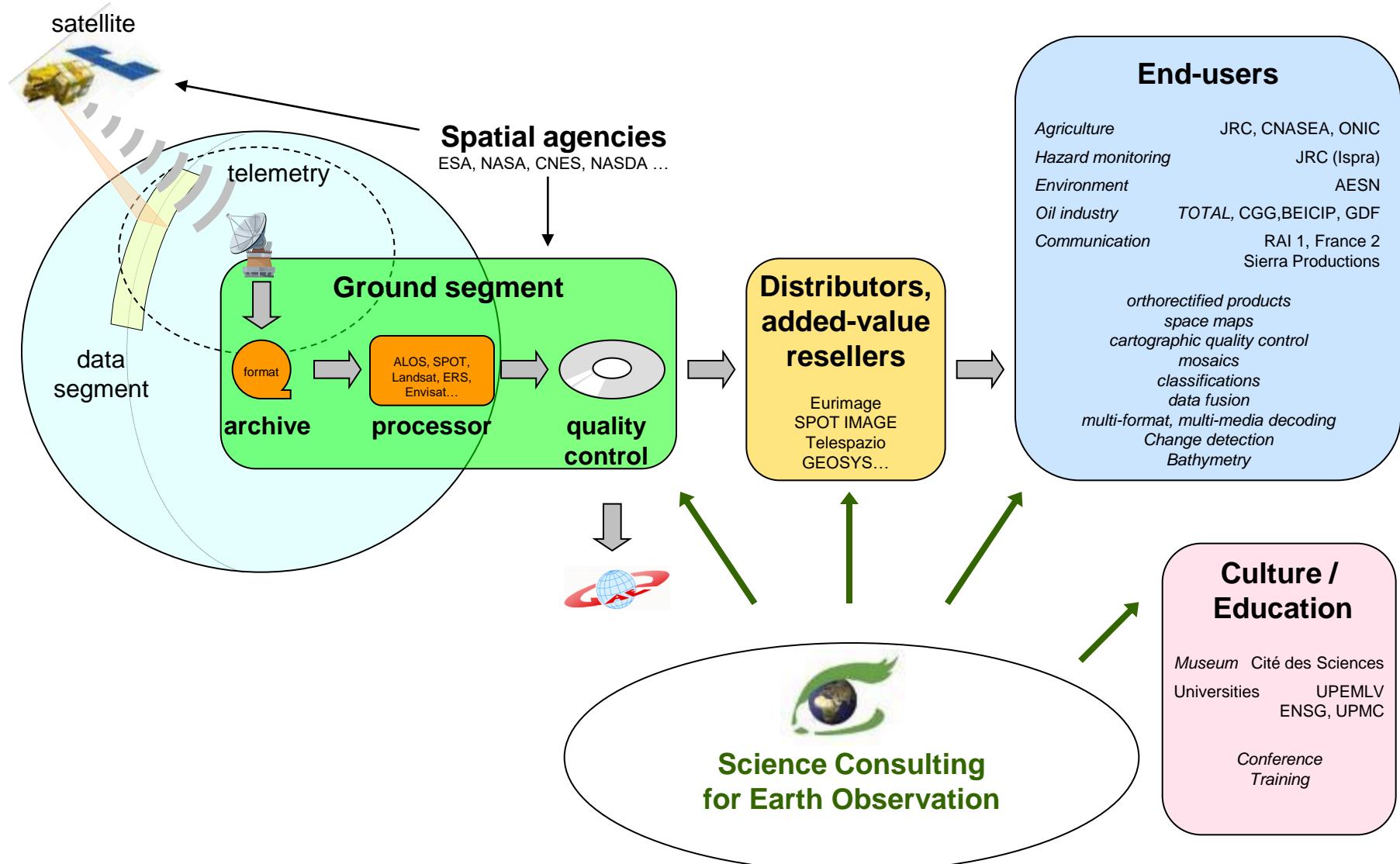
University Paris 7

World univ. (Algeria, Morocco, Palestine, Douala, Kinshasa...)



Des satellites jusqu'aux utilisateurs finaux

From satellite to end users



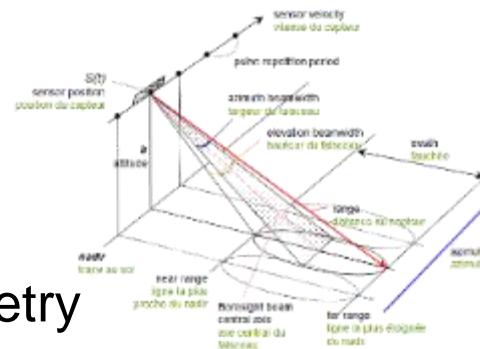


Propagation d'orbites et géométrie d'acquisition

Orbit propagation and acquisition geometry

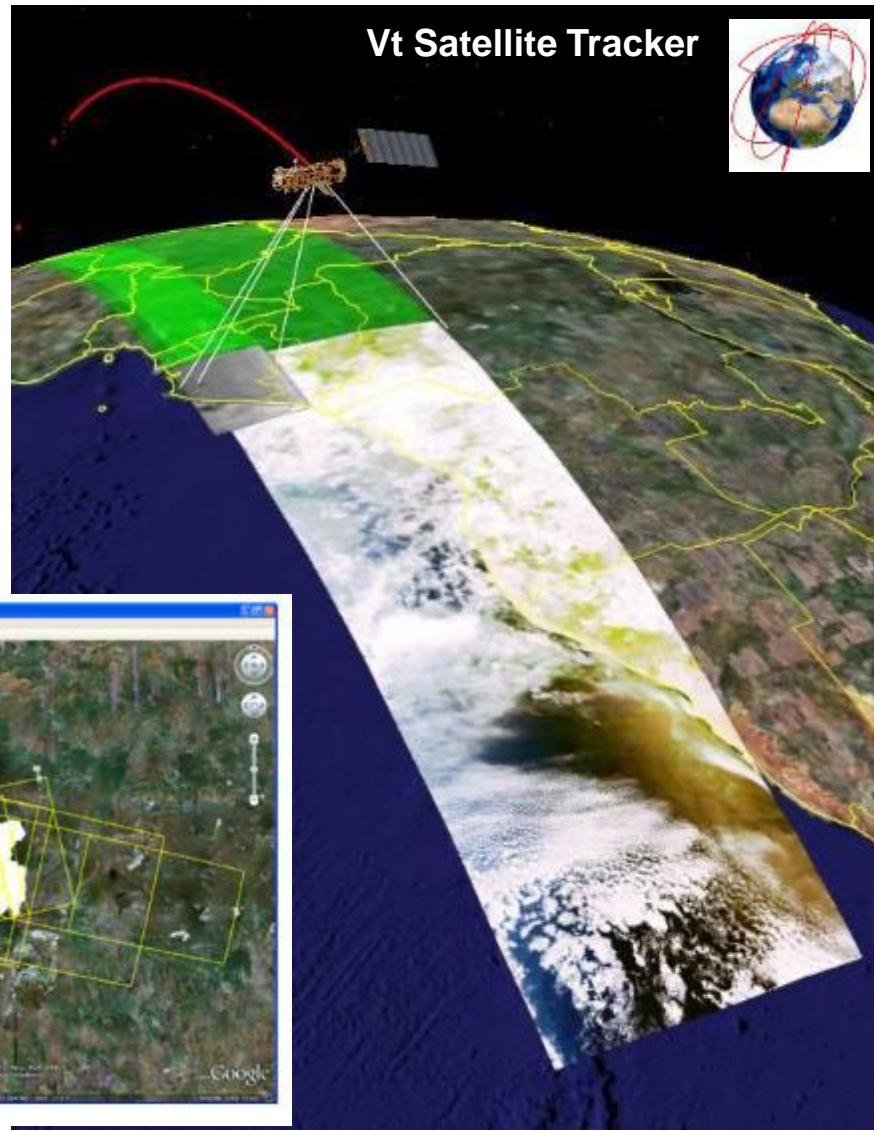
➤ Orbit propagators

- SGP4
- Nominal

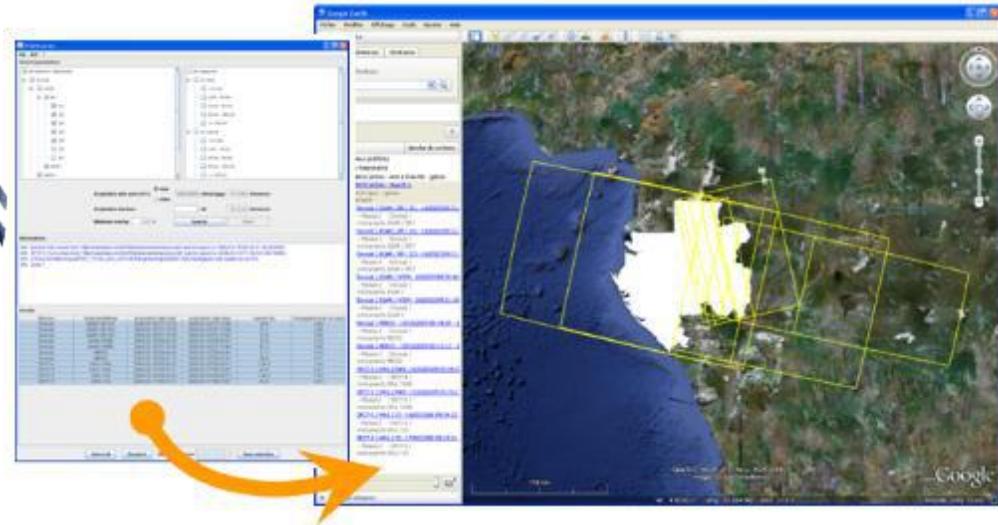


➤ Acquisition geometry

- Optical / Radar
- Mission / Instrument / Mode



Vt Aoi Catcher





Traitement interactif des données

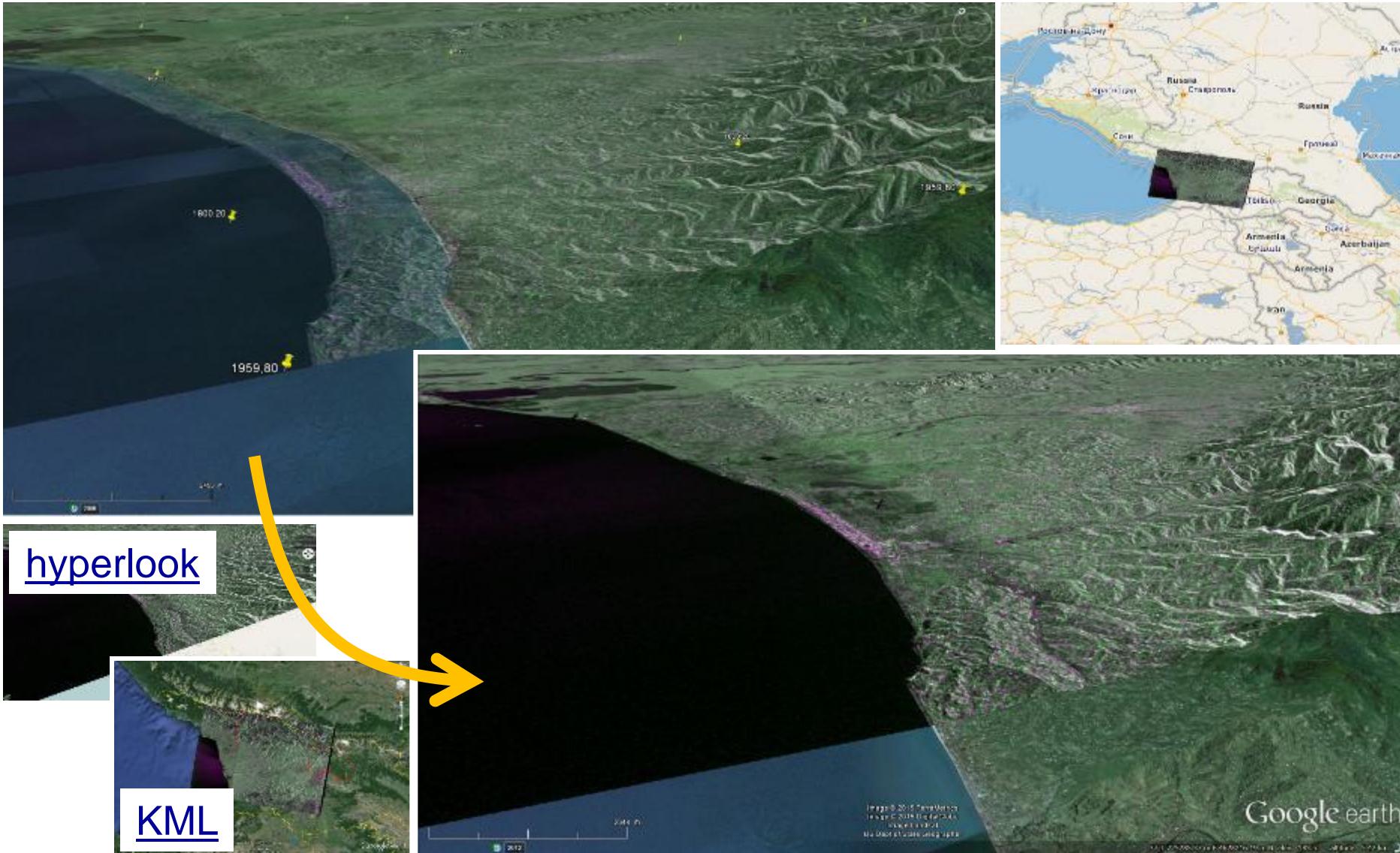




Modification de la grille des points de contrôle de Sentinel-1

Modification of the Sentinel-1 tie-points grid

S1A_IW_GRDH_1SDV_20141009T031601_20141009T031626_002747_003156_9DF0





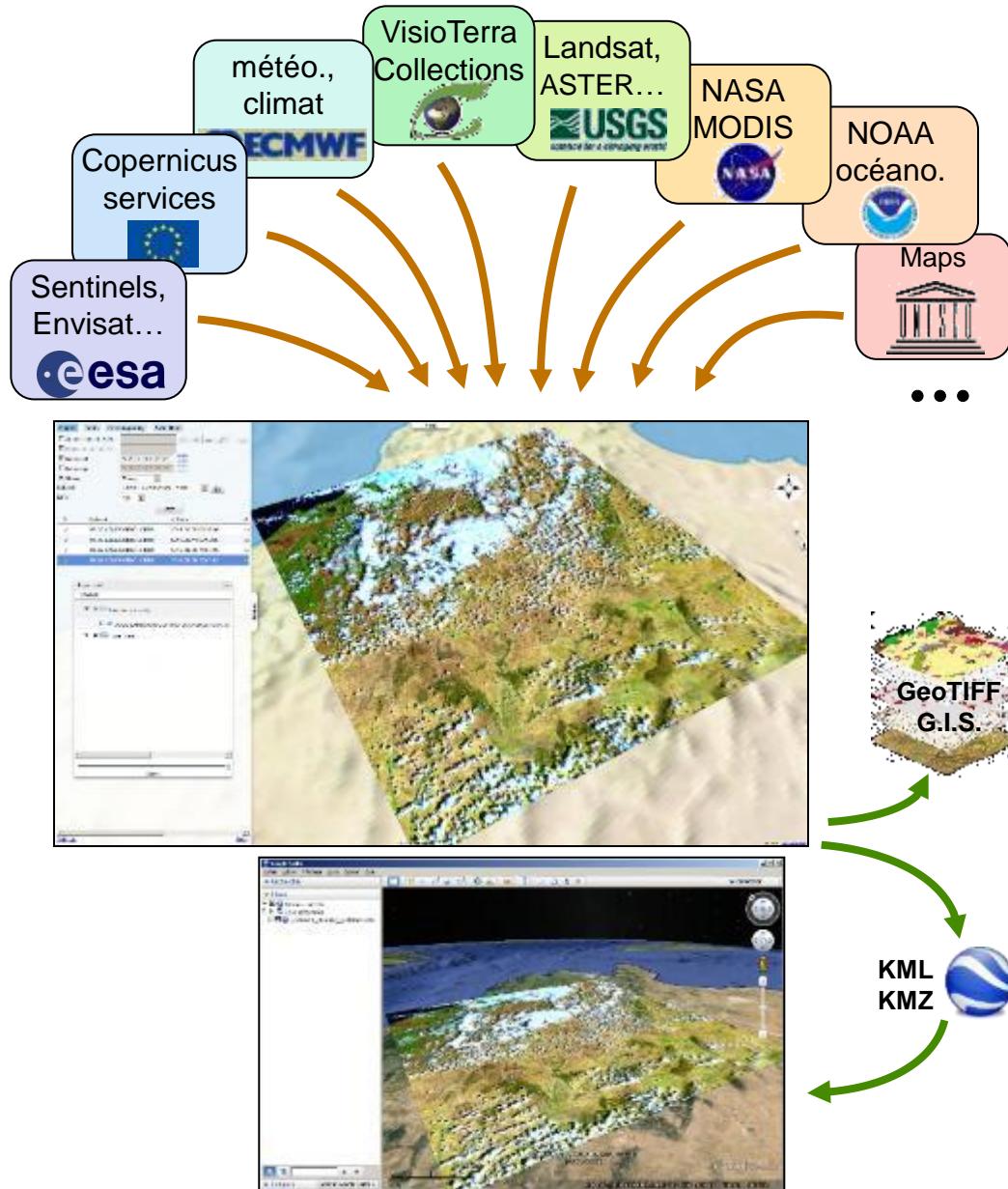
VtWeb – From high-level requirements up to design

High-level requirements	Design concepts	VtWeb features
Better exploit EO data	<p>Hide the complexity of data access, representation, processing levels, projection...</p> <p>Enable user to only check</p>	<p>Dataset modules</p> <p>Near real-time access</p> <p>Immediate access</p>
Bring users to data	<p>Enable users to focus on his/her core business / skill</p> <p>Provide a wide range of data types and time-series</p>	<p>Worldwide free data</p> <p>2D / 3D display in their classical Web navigators without any installation</p>
Extract information from big data	<p>Enable users to interactively browse / transform / merge data</p> <p>Cross / aggregate products</p>	<p>Processing on-the-fly (POF)</p> <p>Get associated data</p> <p>Change tracker</p> <p>Layer stack of mixed data</p>
Share this information	<p>Enable users to download the processed AOI only:</p> <ul style="list-style-type: none">- for a view- for their GIS	<p>Smart dissemination:</p> <ul style="list-style-type: none">- "hyperlook"- KML script- GeoTIFF



VtWeb principles

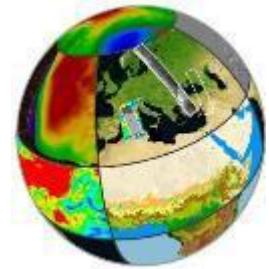
- global / free data
- data retrieval / data mining
- satellites / meteo / ECV / altimetry models / maps...
- Near Real-Time access
- automated processing
 - for citizen
 - default style
 - predefined styles
 - for scientists
 - parameter tuning
 - toward a P.O.F. toolbox
- collaborative infrastructure(s)
project management
- webmapping / 3D virtual globe
- on your area of interest
- archives to analyse changes
- value-added services, recurring monitoring, alarms...





Sentinel-1 – Last of the day

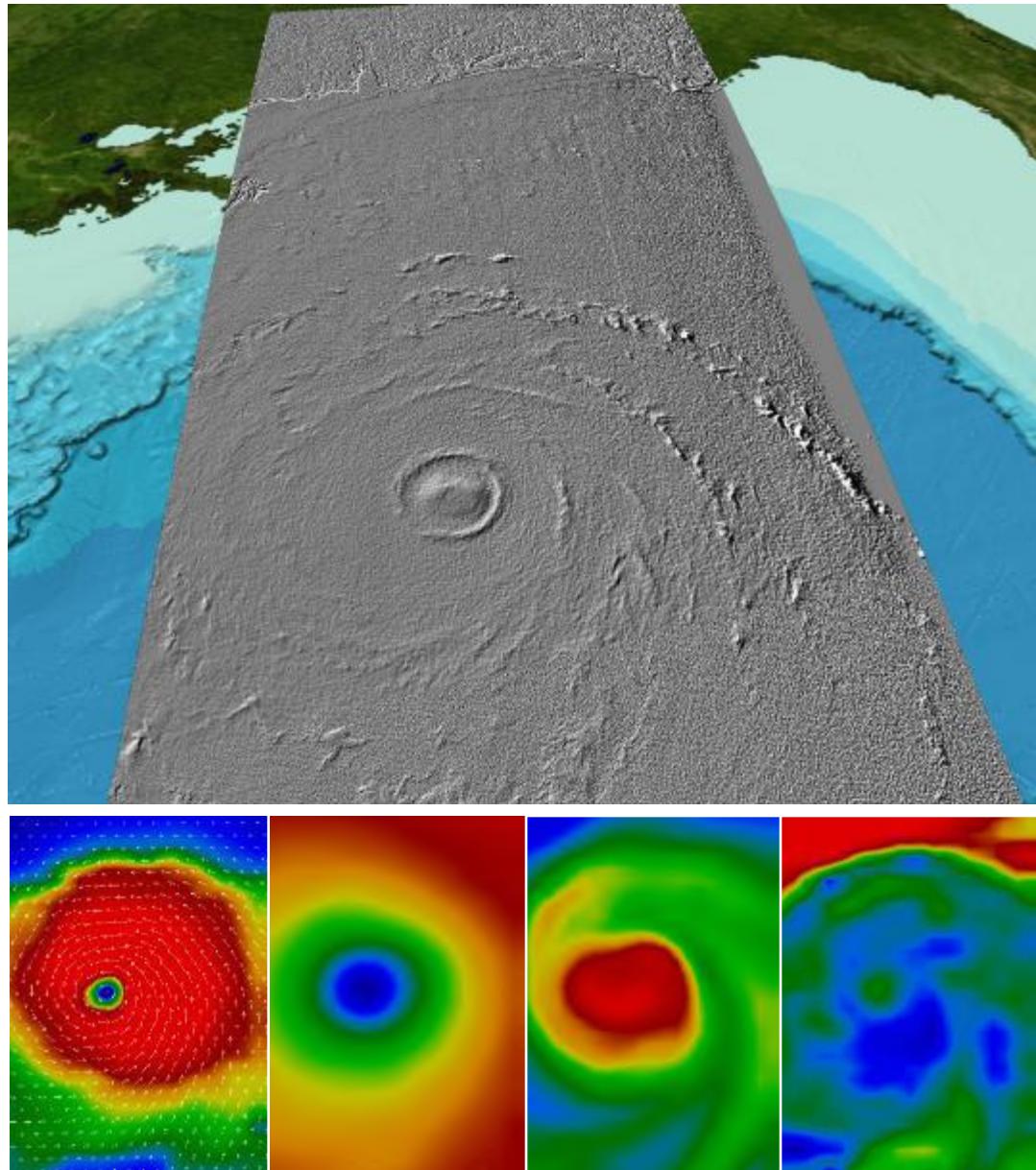
[VtWeb](#)





Katrina (28.08.2005) – Early warning

- Envisat [ASAR](#) 28.08.2005
Envisat MERIS 15:50:08
- Meteorology
 - winds <10m: [2D view](#)
 - pressure (msl) [2D view](#)
 - water column [2D view](#)
 - temperature <2m [2D view](#)





Katrina (28.08.2005) – Assessing damages

- L5 TM 22.08.2005
- L5 TM 07.09.2005

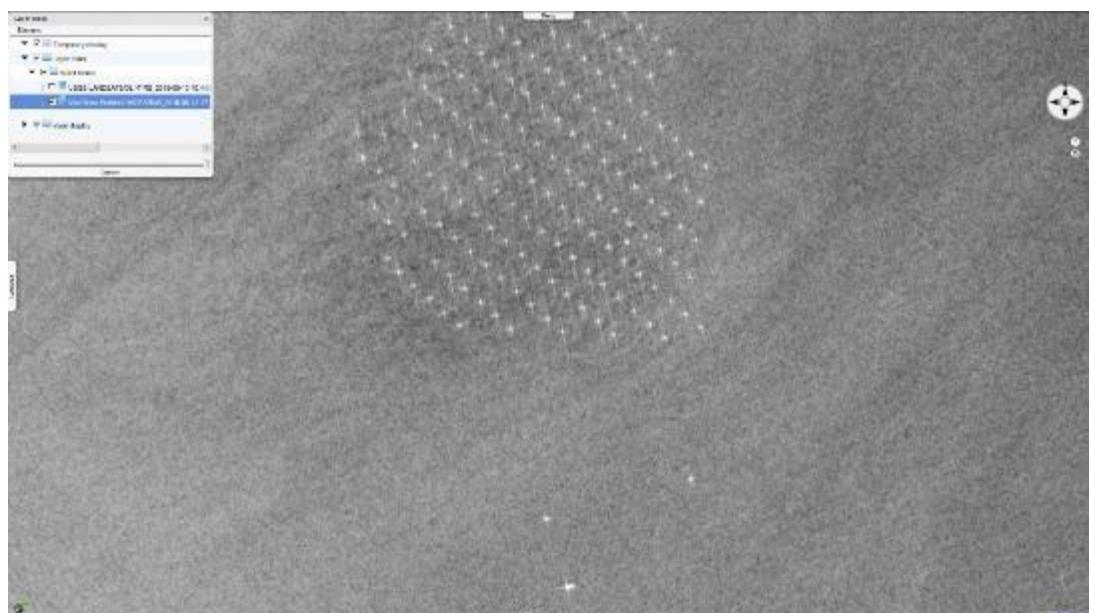
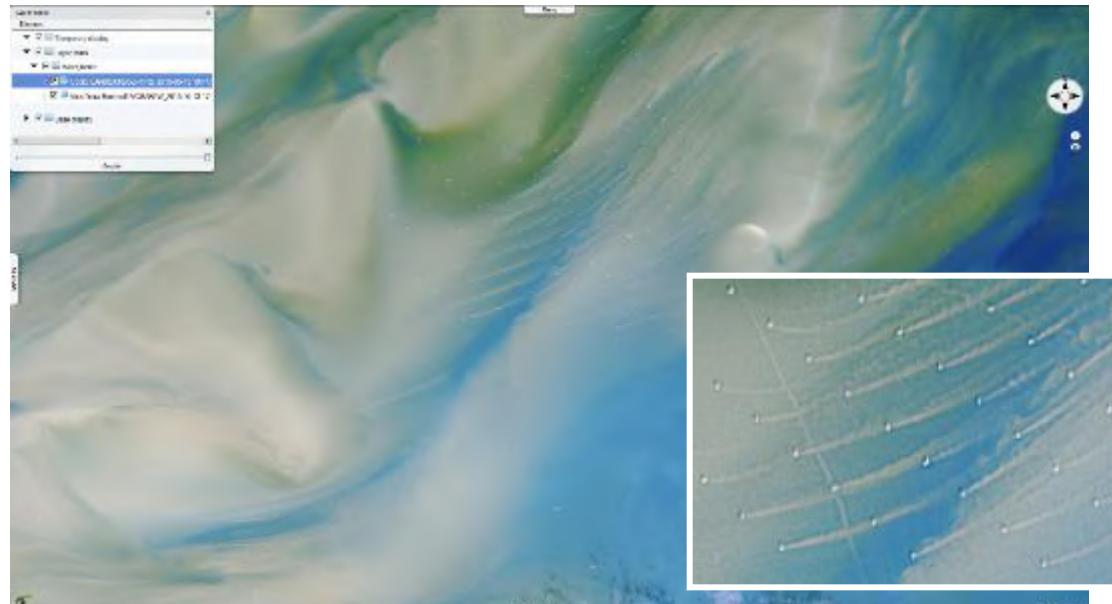
- Hyperlook: [2D animation](#)
 [3D animation](#)





Radar + Optical - Landsat-8 OLI + Sentinel-1 C-SAR IW

- L8 13.05.2015 10:44
- S1 13.05.2015 13:17
- Hyperlook: [2D stack](#)
[3D stack](#)
- Animation: [2D_anim](#)
[3D_anim](#)

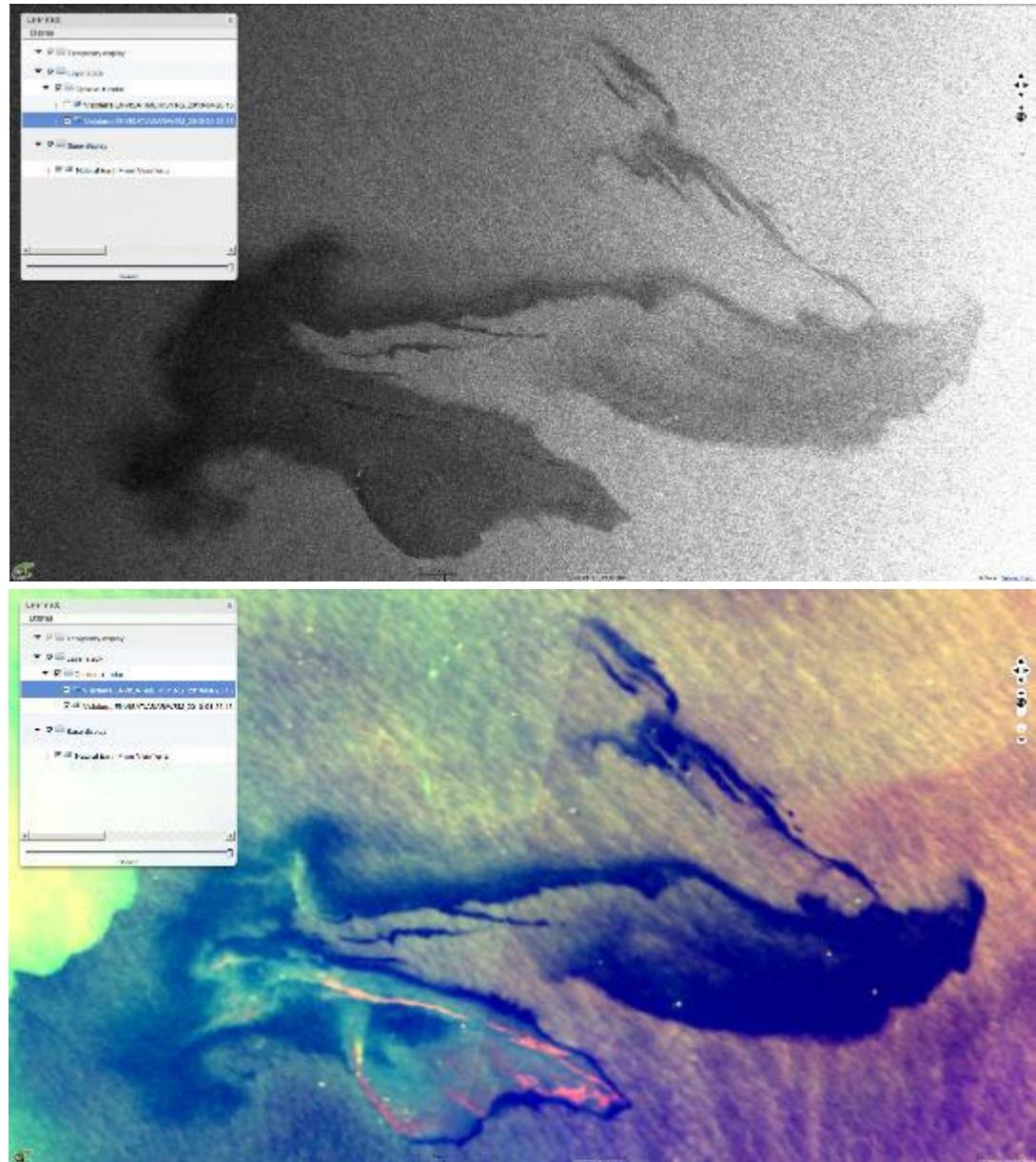




Radar + Optical - Envisat ASAR and MERIS

- Envisat ASAR + MERIS
26.04.2010 15:56 GMT

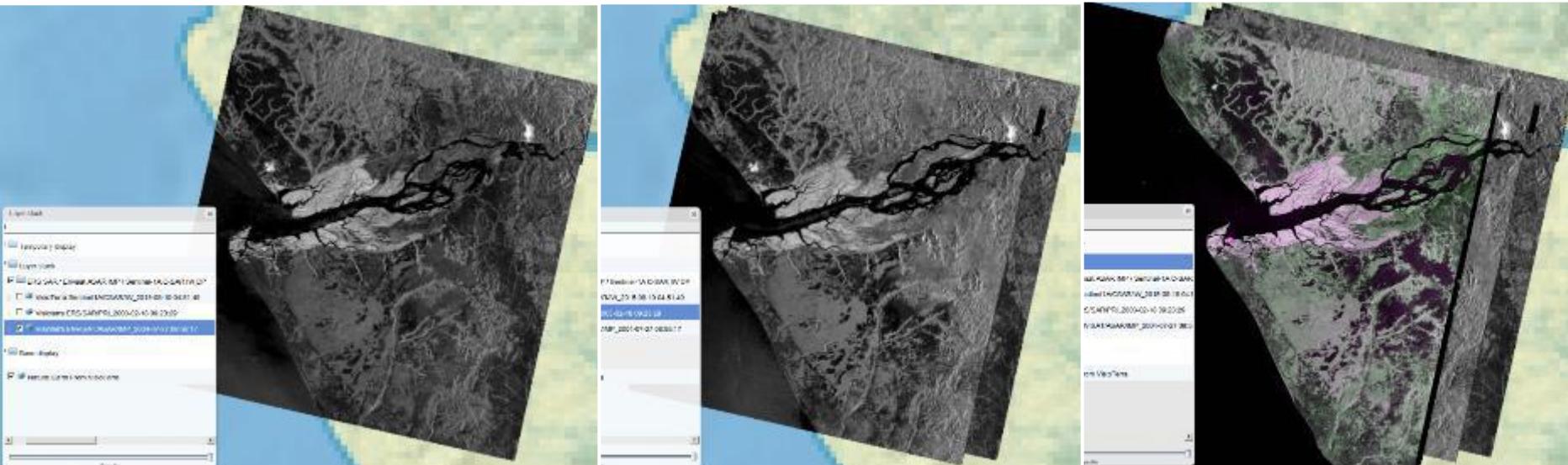
- Hyperlook: [2D stack](#)
- Animation: [2D_anim](#)





Heritage: ERS SAR → Envisat ASAR → Sentinel-1 C-SAR

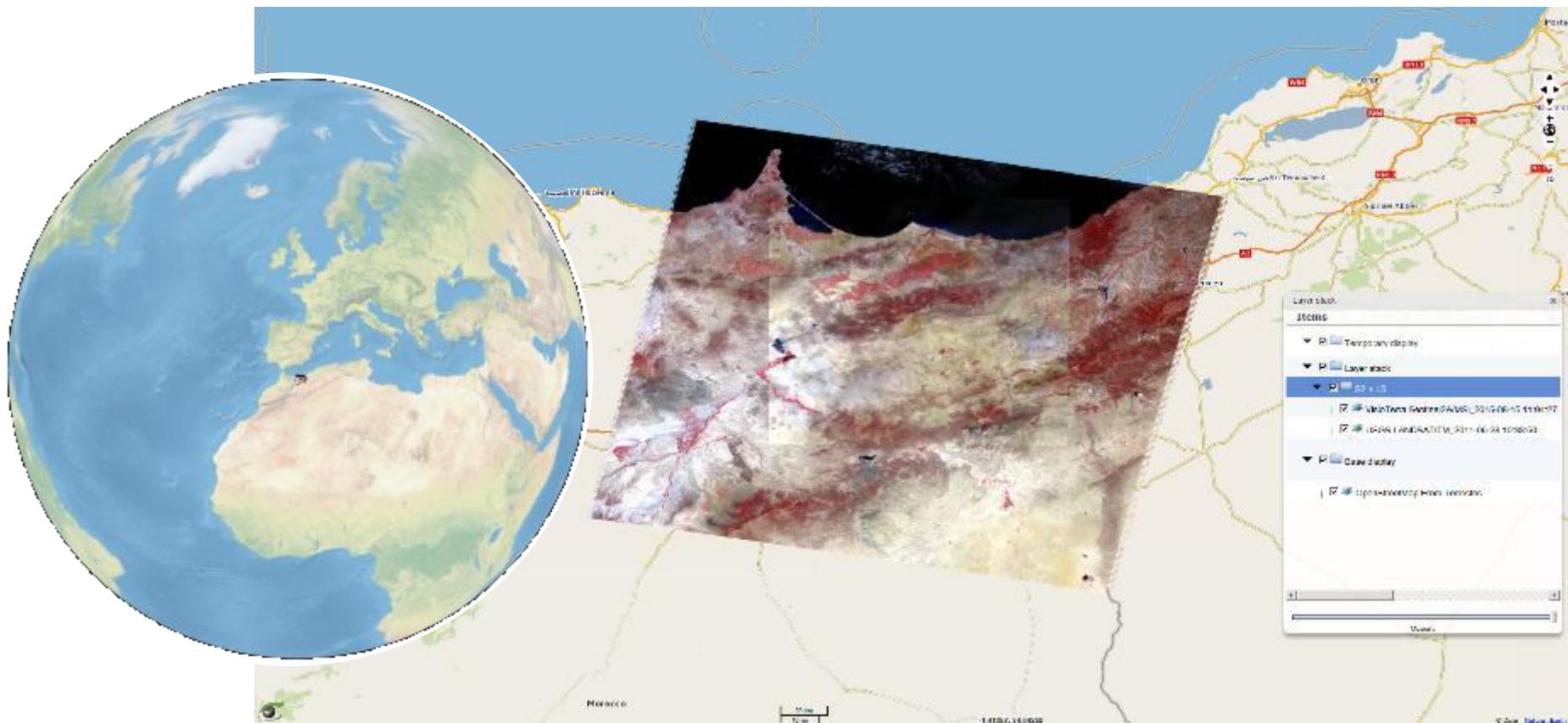
- ERS SAR PRI 27.07.2004 08:55
- Envisat ASAR IMP 18.02.2003 09:23
- Sentinel-1 C-SAR IW 19.08.2015 04:51
- Hyperlook:
 - Land processing animation [2D stack](#)
 [2D anim](#)
 - Sea processing animation [2D stack](#)
 [2D anim](#)





Heritage: Landsat-4,5/7/8 TM / ETM+ / OLI → Sentinel-2 MSI

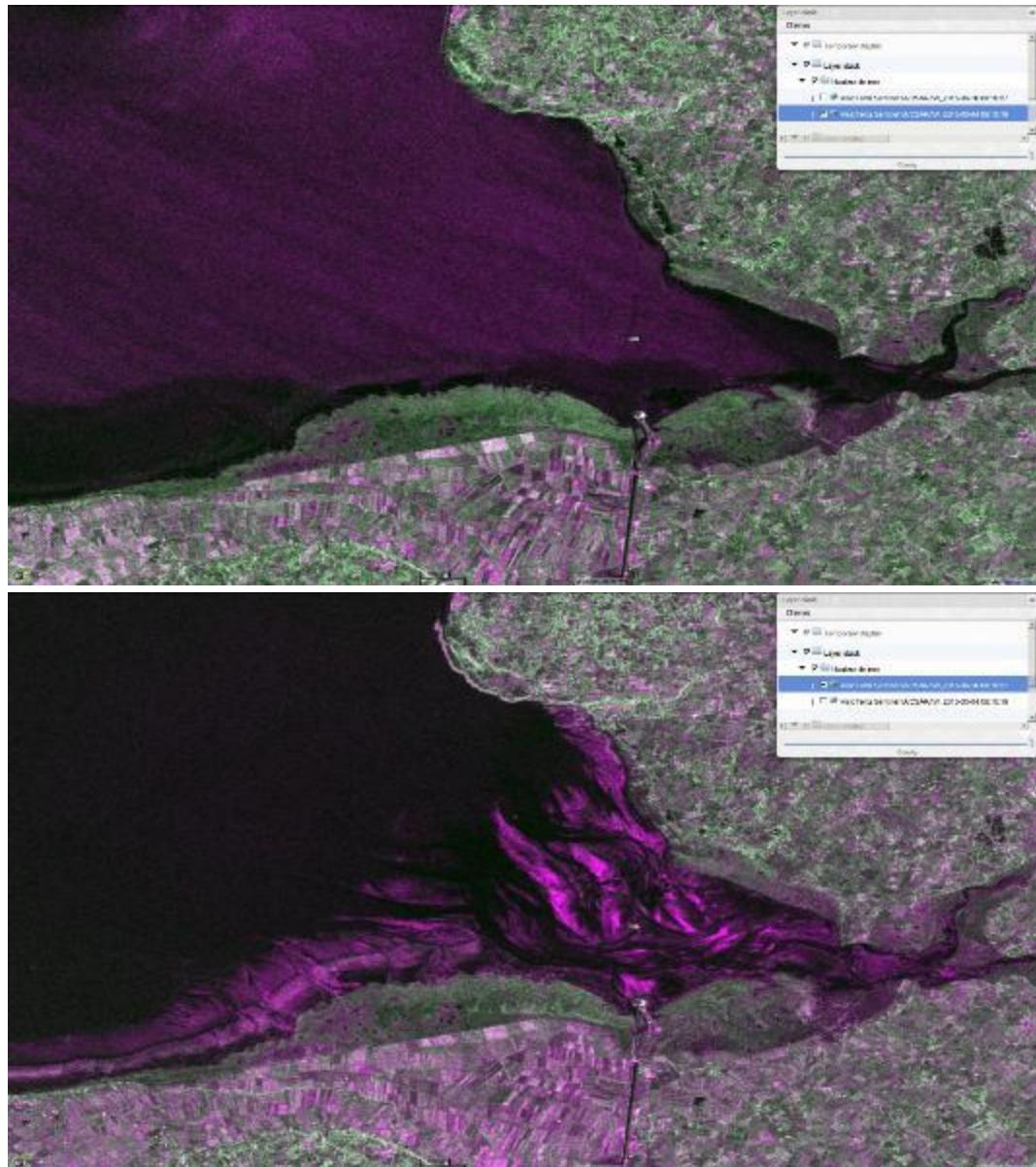
- Landsat-5 TM 28.06.2011 10:33
Sentinel-2 MSI 15.08.2015 11:04
- Hyperlook
Video [2D view](#) [2D anim](#)
<https://www.youtube.com/watch?v=nzQiD-vTgzs>





Sentinel-1 time series - An example of tides monitoring

- Sentinel-1 C-SAR IW
 - 04.03.2015 06:15
 - 16.03.2015 06:15
- Hyperlook: [2D stack](#)
Animation: [2D_anim](#)



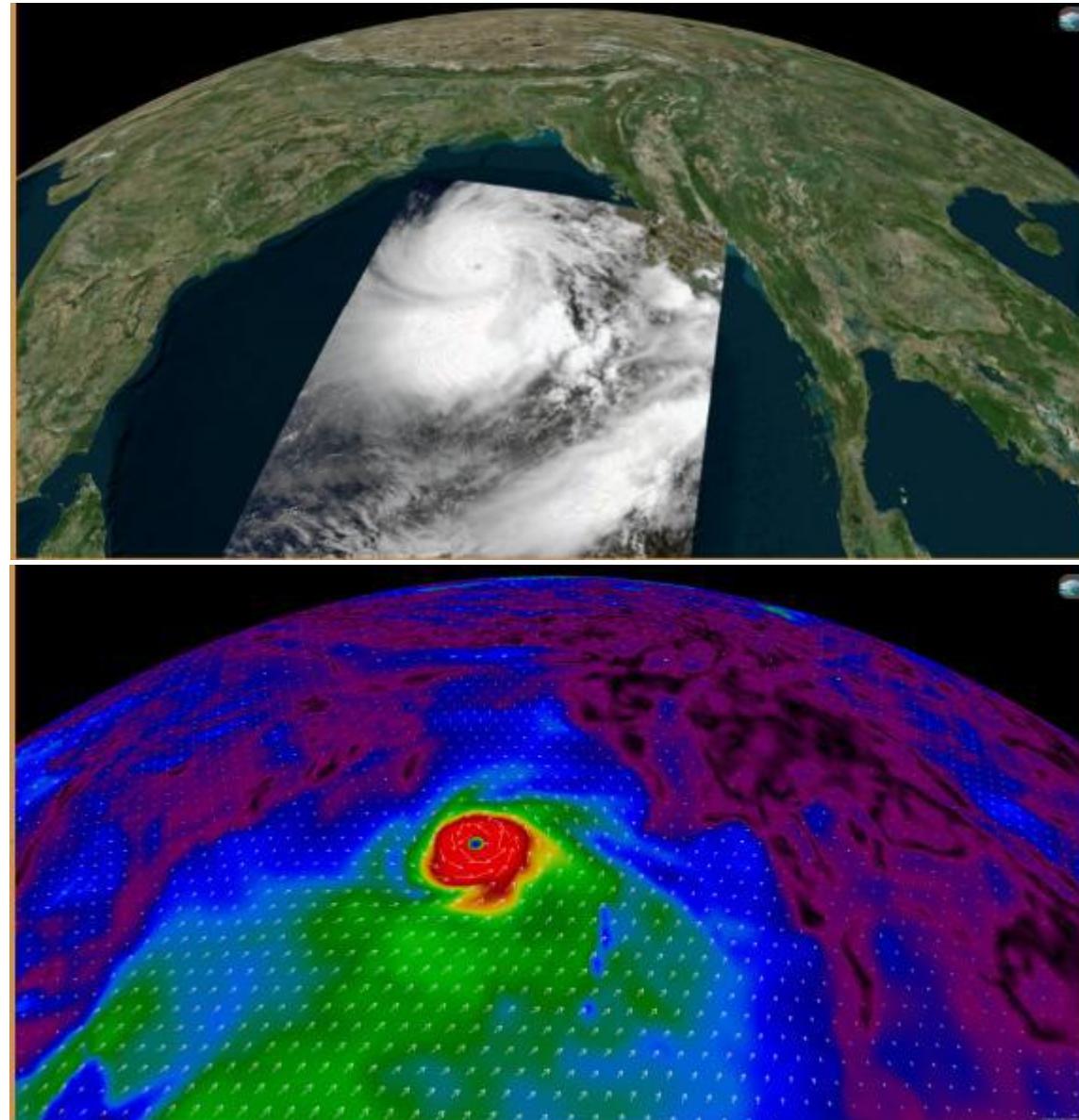


Coupling EO and meteo data

➤ Nargis cyclone

[2D_stack](#) [3D_stack](#)

- MERIS 01.05.2008 04:03
- Wind 01.05.2008 00:00
- Wind 01.05.2008 06:00



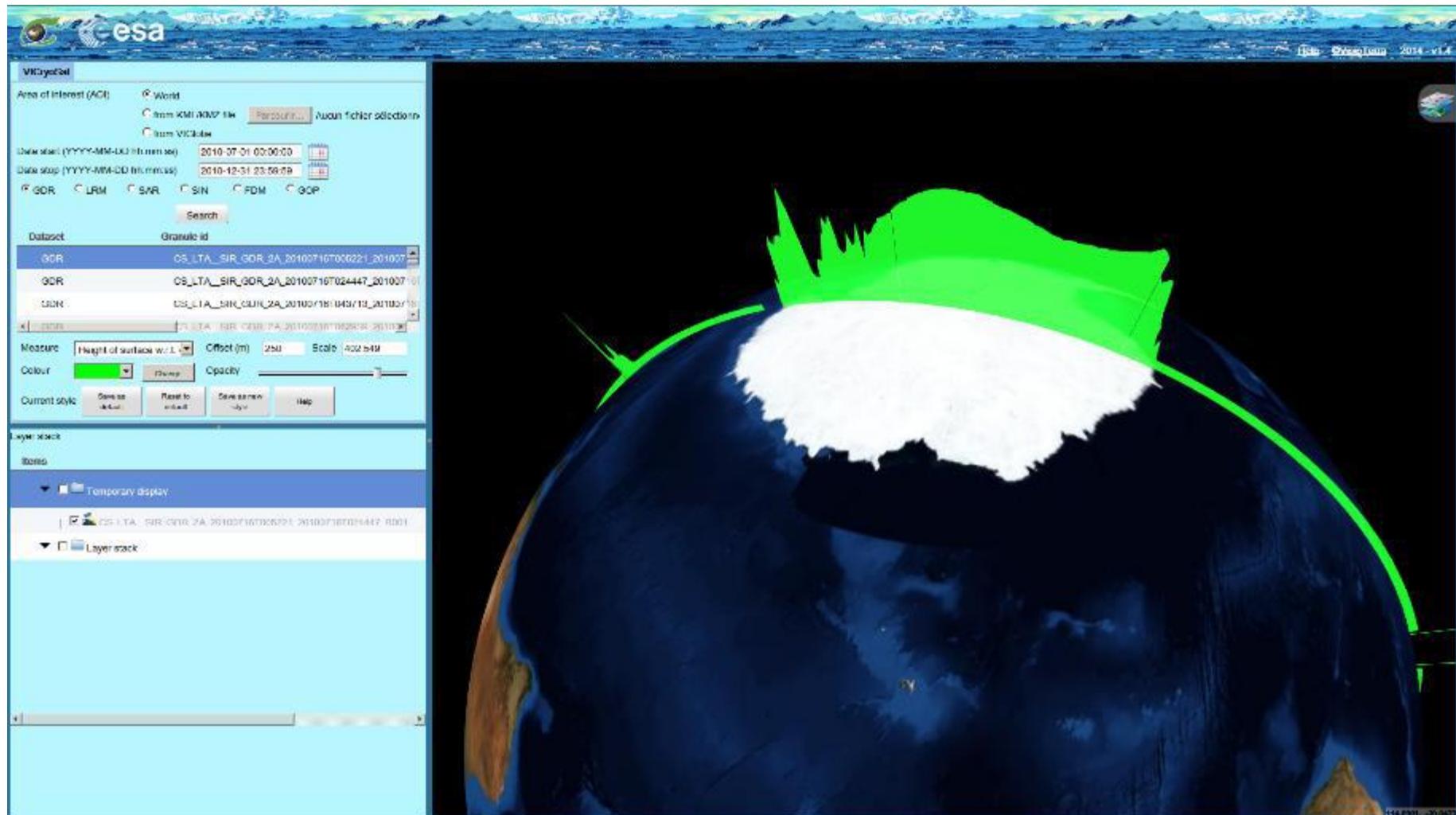


VtCryoSat - SIRAL altimeter products

VtCryoSat



- Requiring a high-tech spatial engine, radial representations



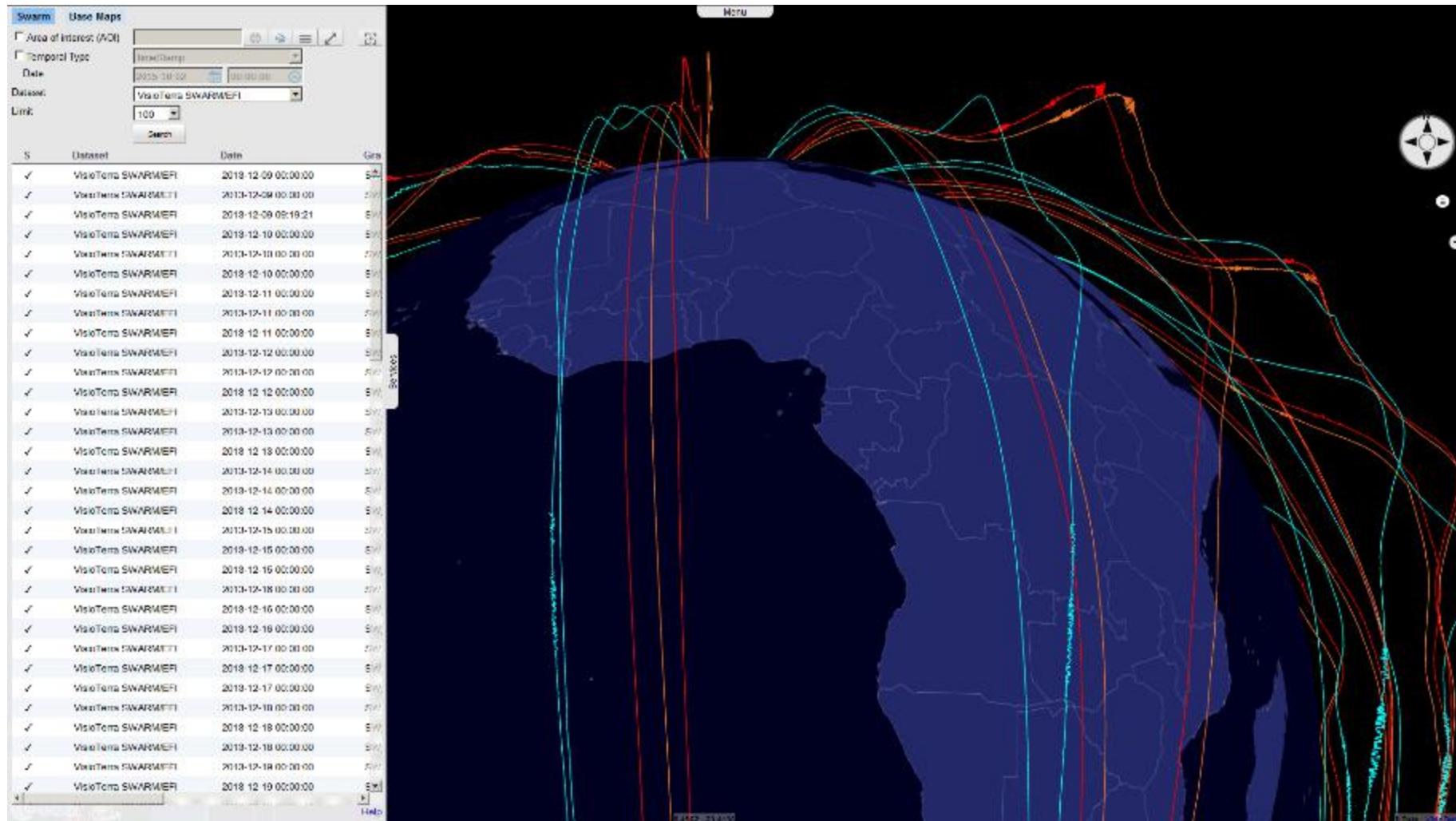


VtGsep - GOCE and Swarm Exploration platform

VtGsep



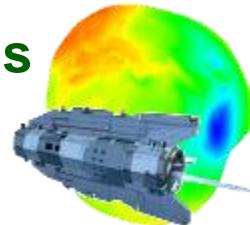
- Let scientists and citizen discover new correlations / applications



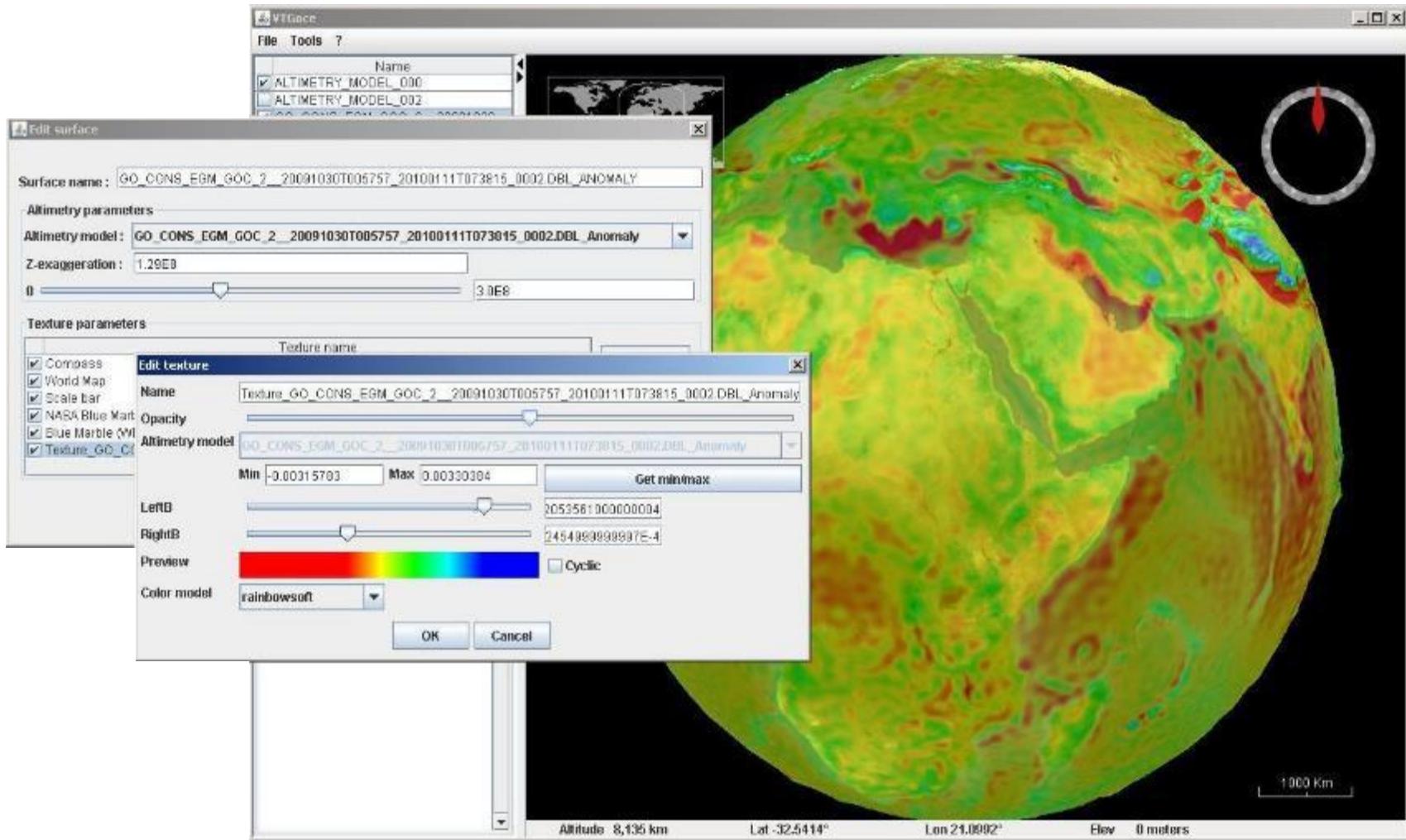


VtGoce - GOCE application to compute / display geoids

VtGoce



- 3D display of altimetry models, surface difference, serial profiles

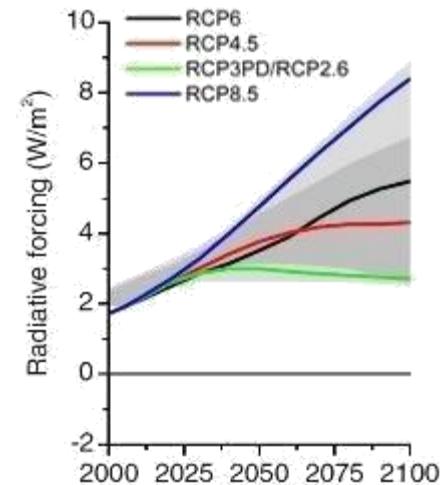




Towards a “climate service”

➤ Handling CMIP5 data (Coupled Model Intercomparison Project 5)

- IPCC (Intergovernmental Panel on Climate Change)
<http://www.ipcc-data.org/>
- Subset of precipitations, minimum and maximum temperature (air surface) from NASA site <https://nex.nasa.gov/nex/projects/1356/>
- RCP (Representative Concentration Pathways)
RCP 4.5 and RCP 8.5 retained
- GCM (General Community Model)
 - ACCESS1-0,
 - BCC-CSM1-1,
 - BNU-ESM,
 - CanESM2,
 - CCSM4,
 - CESM1-BGC,
 - CNRM-CM5,
 - CSIRO-MK3-6-0,
 - GFDL-CM3,
 - GFDL-ESM2G,
 - GFDL-ESM2M,
 - INMCM4,
 - IPSL-CM5A-LR,
 - IPSL-CM5A-MR,
 - MIROC-ESM,
 - MIROC-ESM-CHEM,
 - MIROC5,
 - MPI-ESM-LR,
 - MPI-ESM-MR,
 - MRI-CGCM3,
 - NorESM1-M



Fruitful advises from Gavin SCHMIDT (NASA), Marco GIORGETTA (Max Planck Institute for Meteorology), Laurent FRANCHISTEGUY (CNRM)



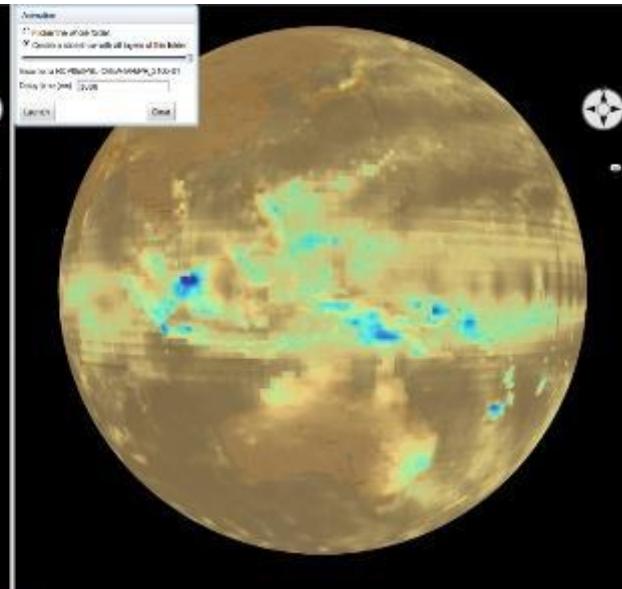
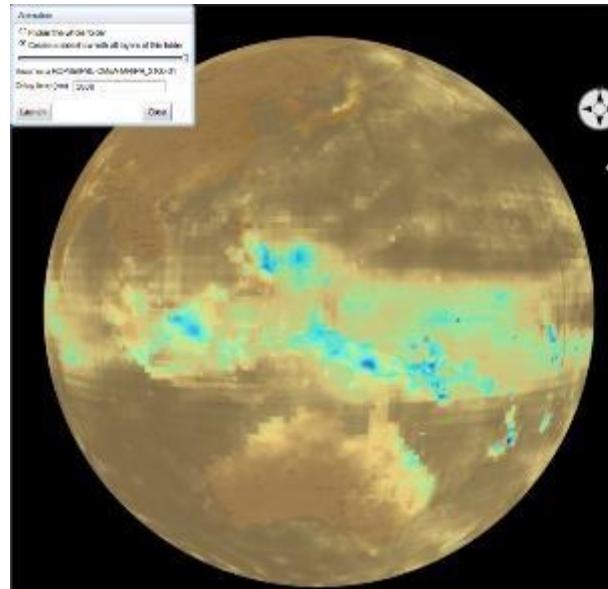
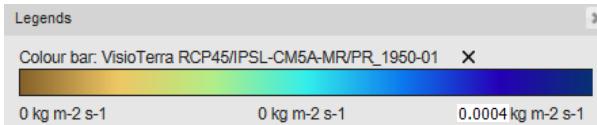
Comparison RCP 4.5 vs. RCP 8.5 - Precipitations

➤ precipitations

- 1950 → 2100 / 10

January

- [RCP 4.5](#)
- [RCP 8.5](#)

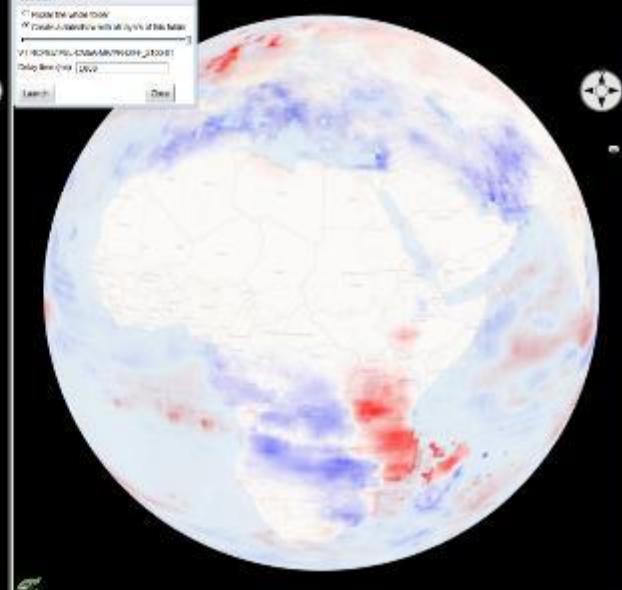
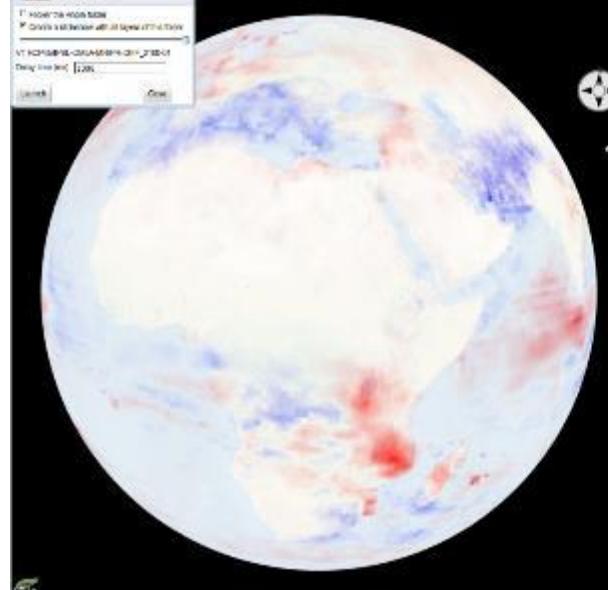
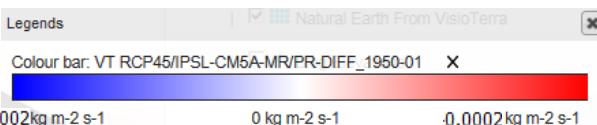


- Difference with 2006

1950 → 2100 / 50

January

- [RCP 4.5](#)
- [RCP 8.5](#)

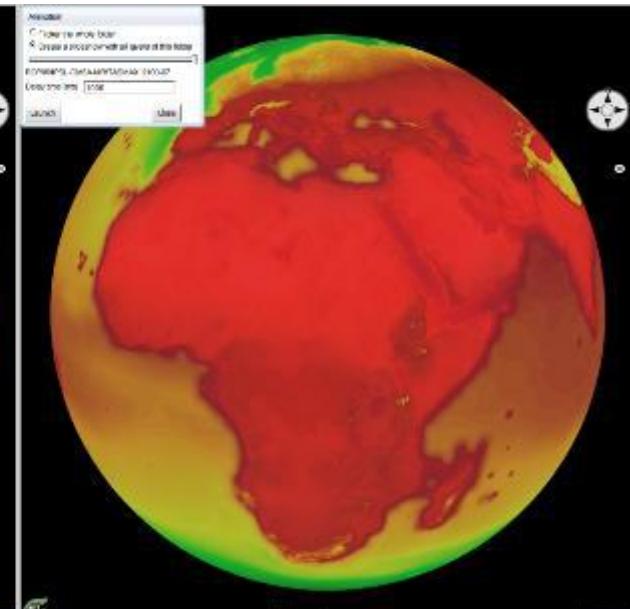
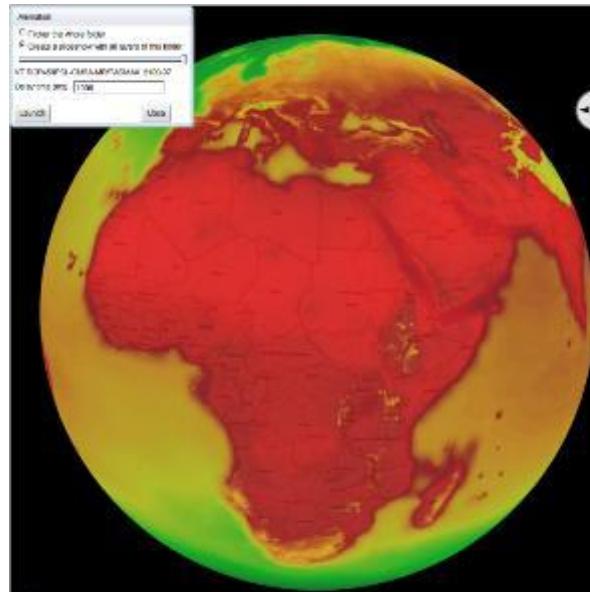
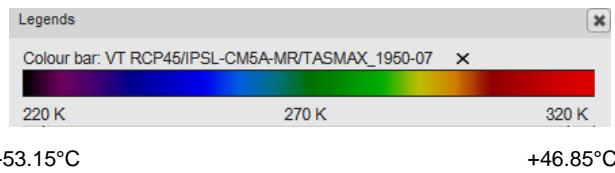




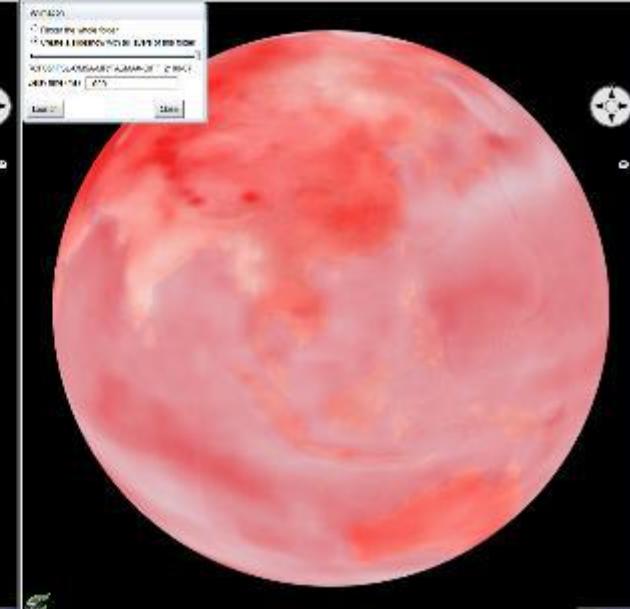
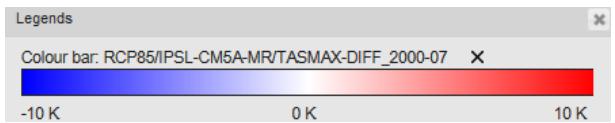
Comparison RCP 4.5 vs. RCP 8.5 – Temperature air surface max

➤ temperature air / surface maximum

- 1950 → 2100 / 10 July
 - [RCP 4.5](#)
 - [RCP 8.5](#)



- Difference with 2006
1950 → 2100 / 50 July
 - [RCP 4.5](#)
 - [RCP 8.5](#)





VtClimate – System of meteorological data aggregation, computation and dissemination of climate trends

à partir de votre propre ROI
from your own AOI



pour estimer
to assess

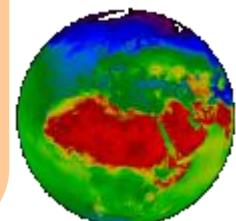
de
of

variable climatique essentielle
essential climate variable (GCOS)

les restituer comme
output results as

valeur unique
unique value
tableau 1D de valeurs
1D value array
image de valeurs échantill.
image of sampled values

3.5°C



moyenne *mean*
écart-type *standard deviation*
minimum *minimum*
maximum *maximum*
médiane *median*
classe majoritaire *majority class*

température de surface *surface temperature*
pression de surface *surface pressure*
précipitation de surface *surface precipitation*
humidité de surface *surface water vapour*

...
vitesse et direction
des vents *wind speed and direction*

...
ozone *ozone*
dioxyde de carbone *carbon dioxide*
aérosols *aerosols*

...
température des océans *ocean temperature*
courants océaniques *ocean currents*
salinité des océans *ocean salinity*

...
occupation du sol *land cover*

KML wind field 2° 1° 0.5°



Sea-level rising - Interactive flooding simulation

- **Sea-level rising:** [2 metres](#) [10 metres](#) [30 metres](#) [70 metres](#)





ESA vs. VisioTerra collaborations

➤ Collaborations with ESA

- GAEL Consultant - Since 1994
- Quality control of ESA products
- Envisat / MERIS / ASAR
- VTGoce / VtCryosat / VtSwarm
- DHuS Sentinel-1 / Sentinel-2

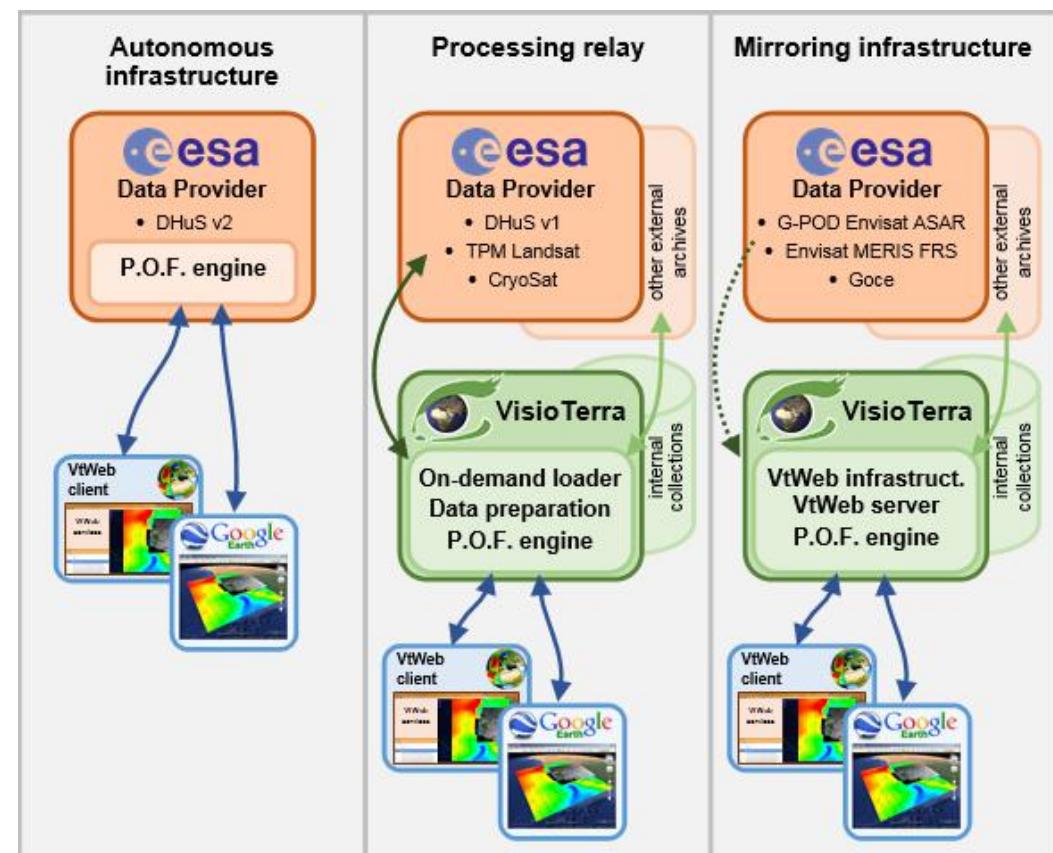


➤ VtWeb infrastructure

- 300 TB available
 - 50 TB ASAR and ERS
 - 150 TB MERIS
 - 100 TB/year S1A
- 1 Gbps symmetric fibre

➤ VisioTerra promoting ESA

- ESA data in VisioTerra trainings
- Enhancement of ESA products
- Communication, papers
- Towards distributed DHuS





A new “change tracking” service



➤ Objectives

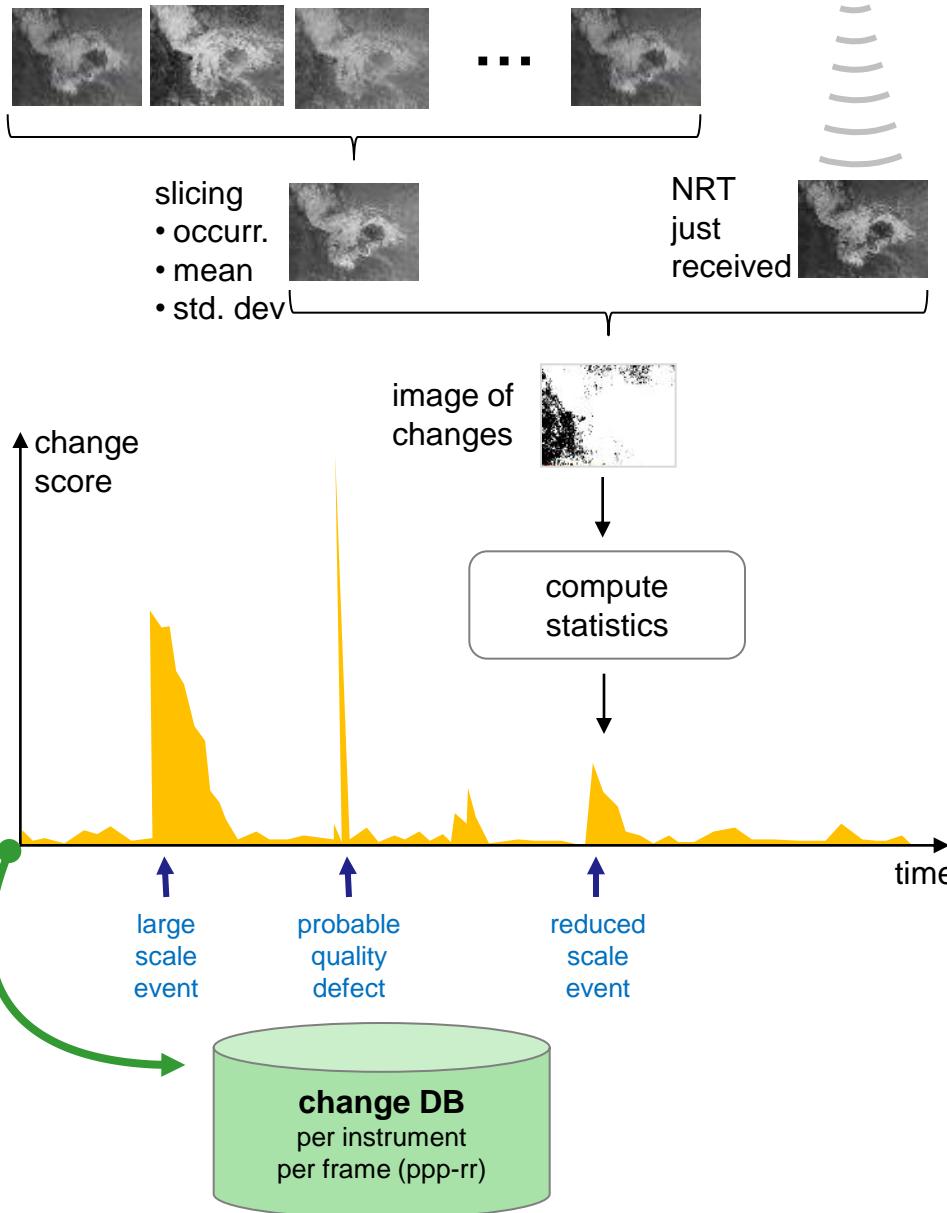
- To face the large amount of data
- To help users monitoring their AOI
- To initiate a collaborative assessment
- To detect quality defects

➤ Principles

- “Slicing statistics” (N, \bar{m}, σ)
- Systematic computation of change
→ change coefficient

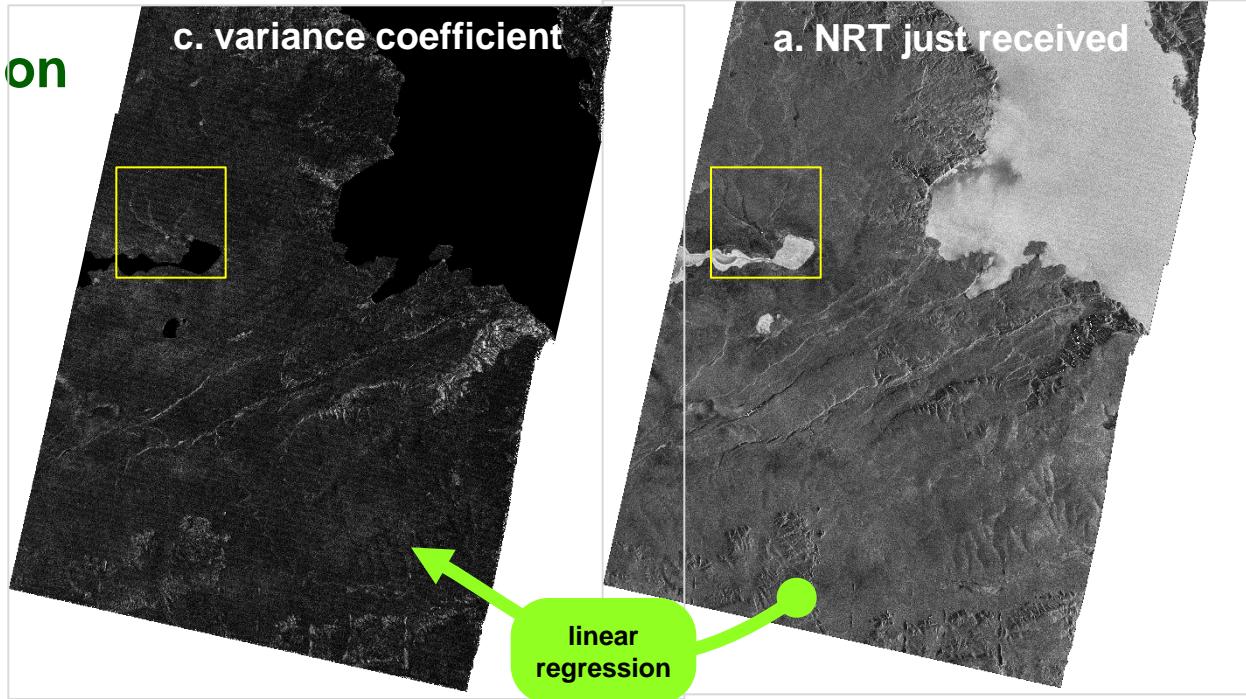
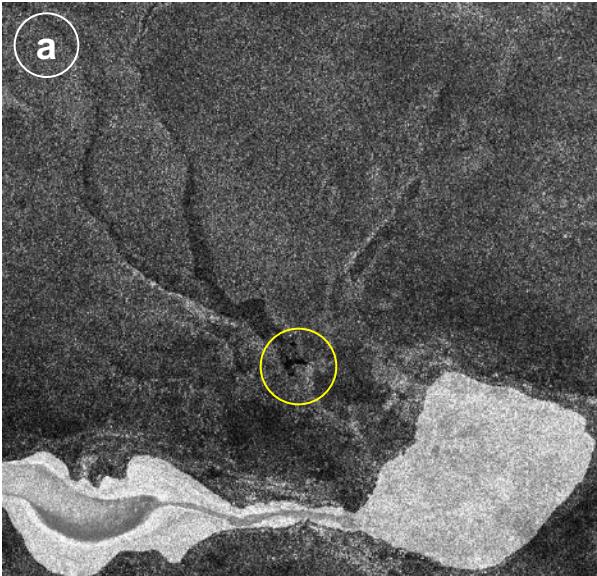
➤ Actions

- Check change statistics of the day
- Warn quality team for probable defect
- Warn communities via “hyperlooks”
 - civil protection, local bodies,
 - press, NGOs,
 - social networks
 - science / education communities
 - ...





Change detection

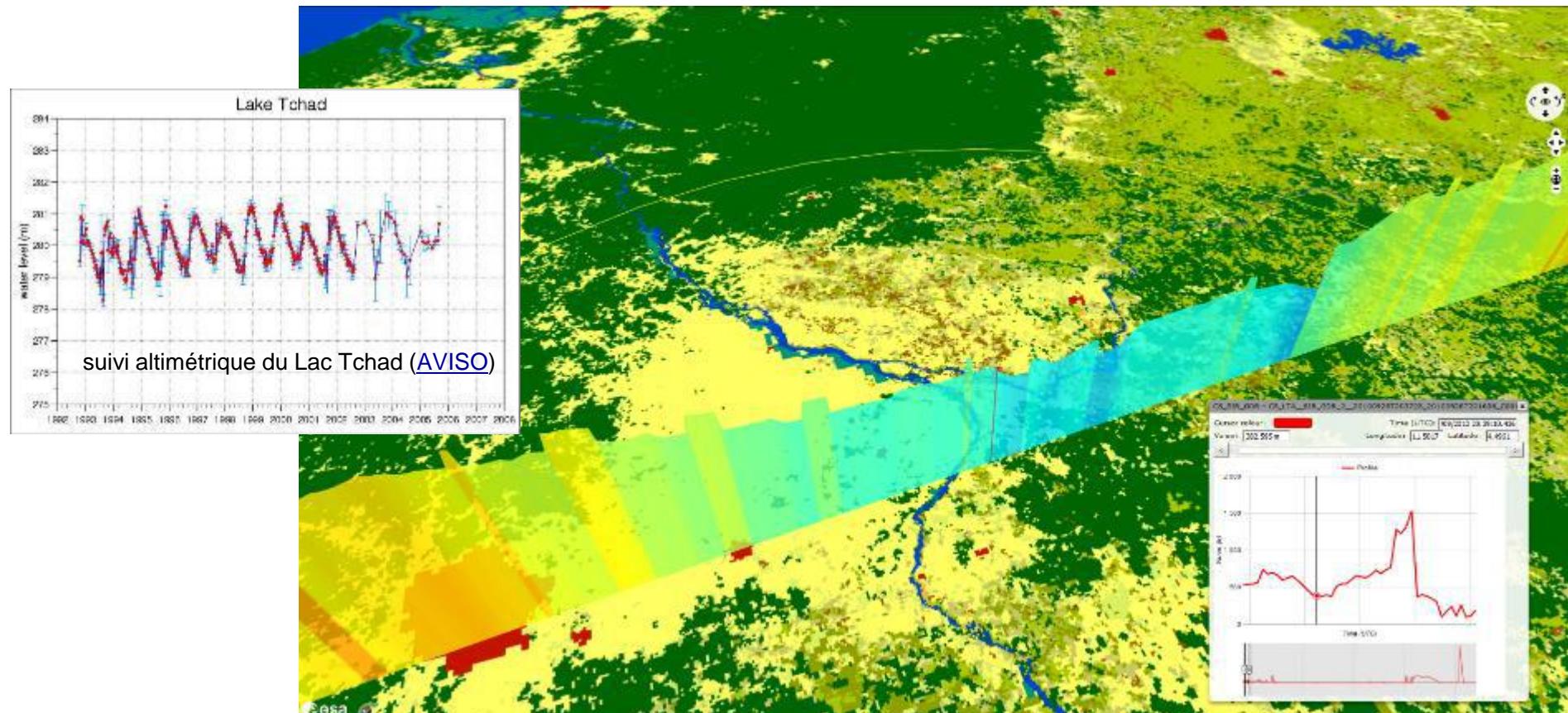




Opportunités dans le domaine de l' Altimétrie

➤ Altimétrie

- Résolution temporelle - Nombreux altimètres: CryoSat / SIRAL, Sentinel-3A/3B / SRAL, Sentinel-6A/6B (2020,2026), Jason-2, Saral / AltiKa, Jason-3, SWOT / KaRIn (2020)
- Résolutions spatiales – toujours plus élevée avec la "*swath altimetry*" de SWOT





Merci de votre attention.
Thank you for your attention.

Questions ?



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Director

serge.riazanoff@visioterra.fr

www.visioterra.fr