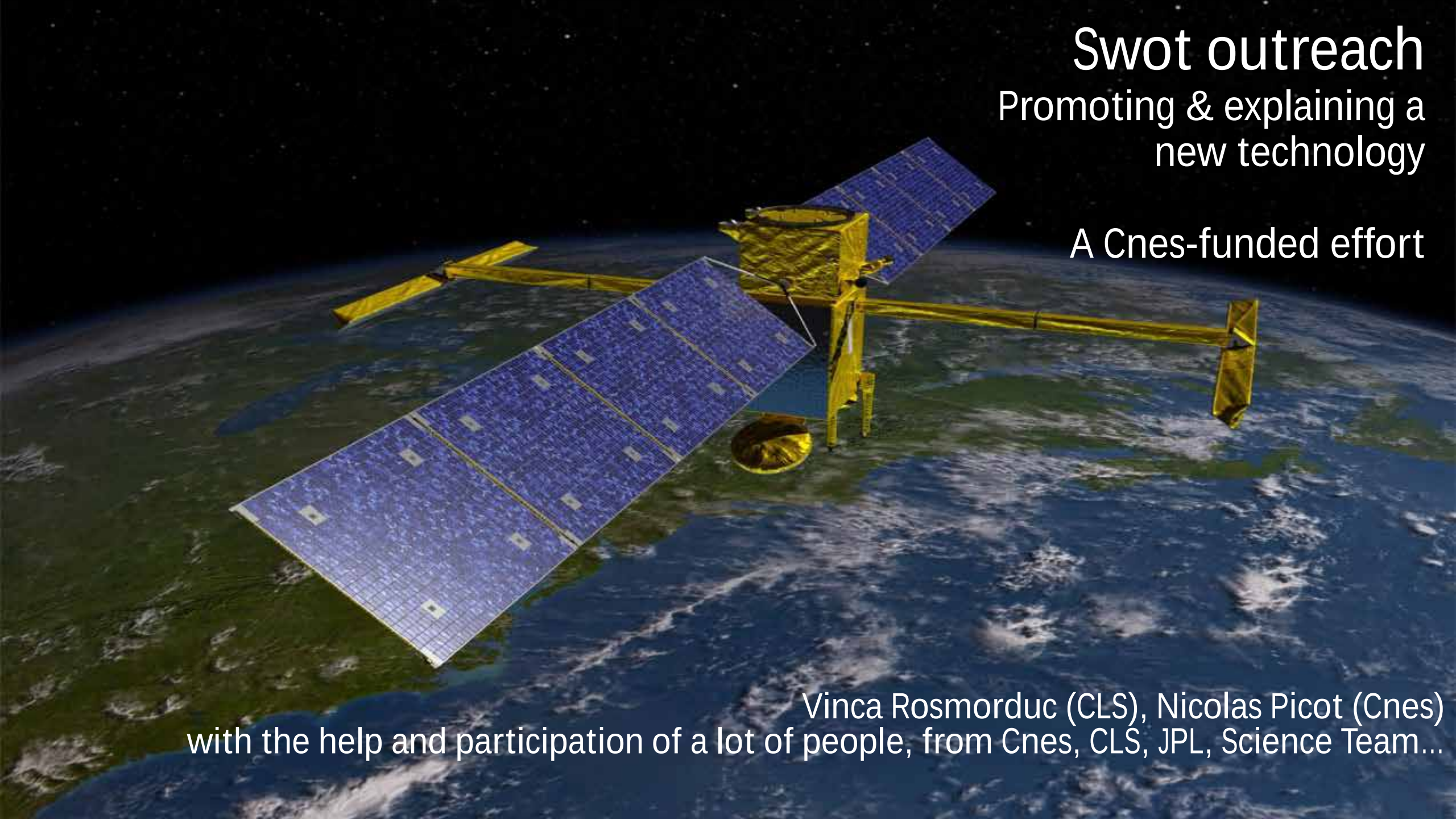
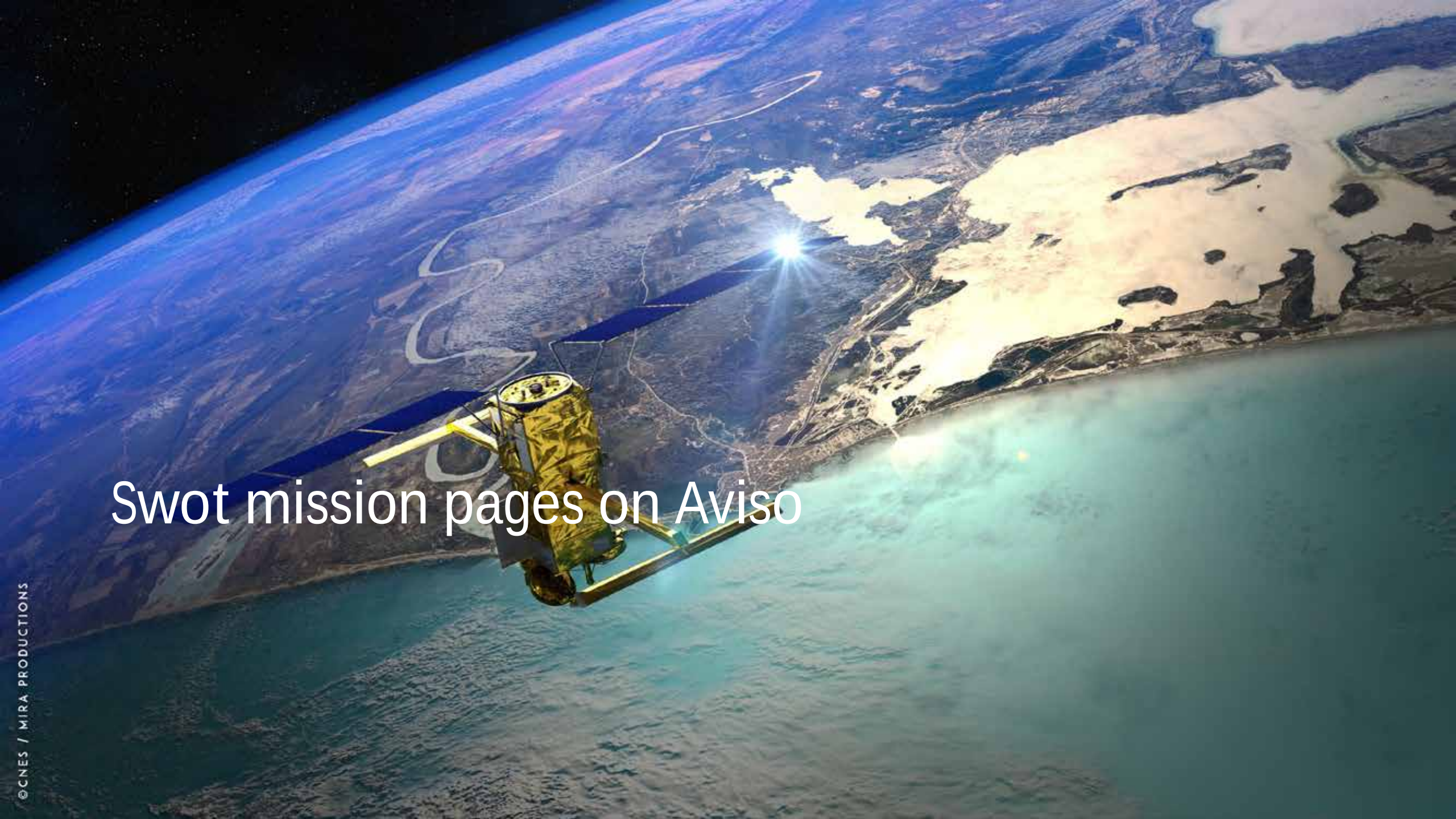


Swot outreach

Promoting & explaining a new technology

A Cnes-funded effort

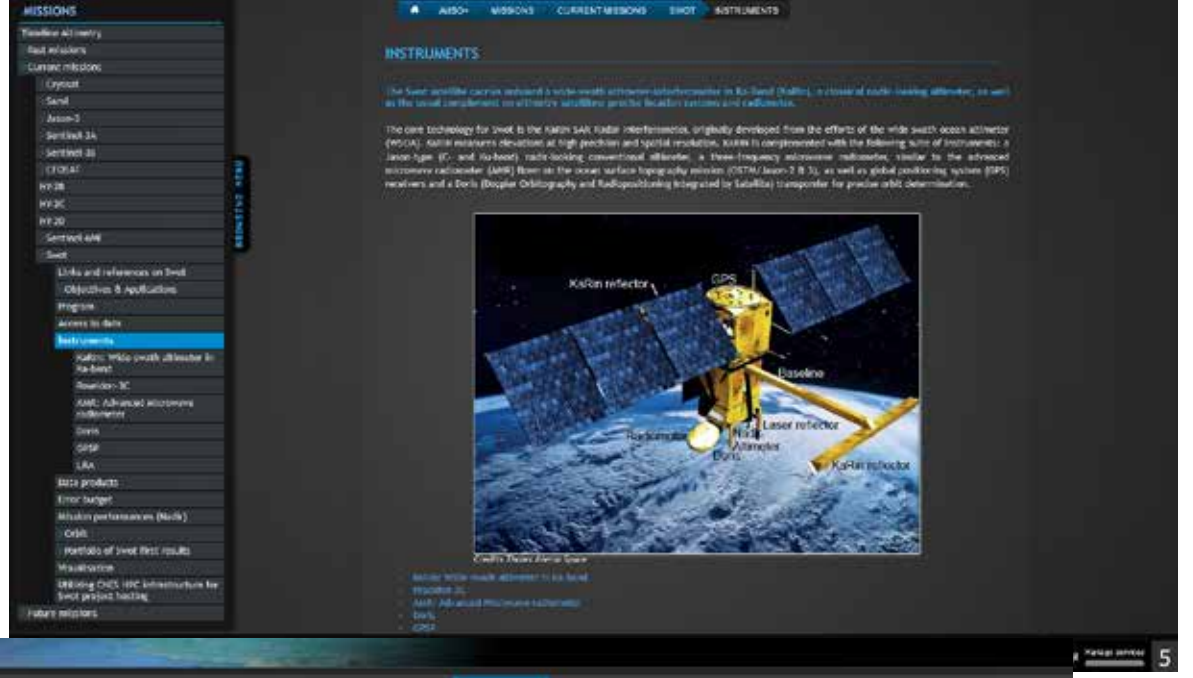
Vinca Rosmorduc (CLS), Nicolas Picot (Cnes)
with the help and participation of a lot of people, from Cnes, CLS, JPL, Science Team...

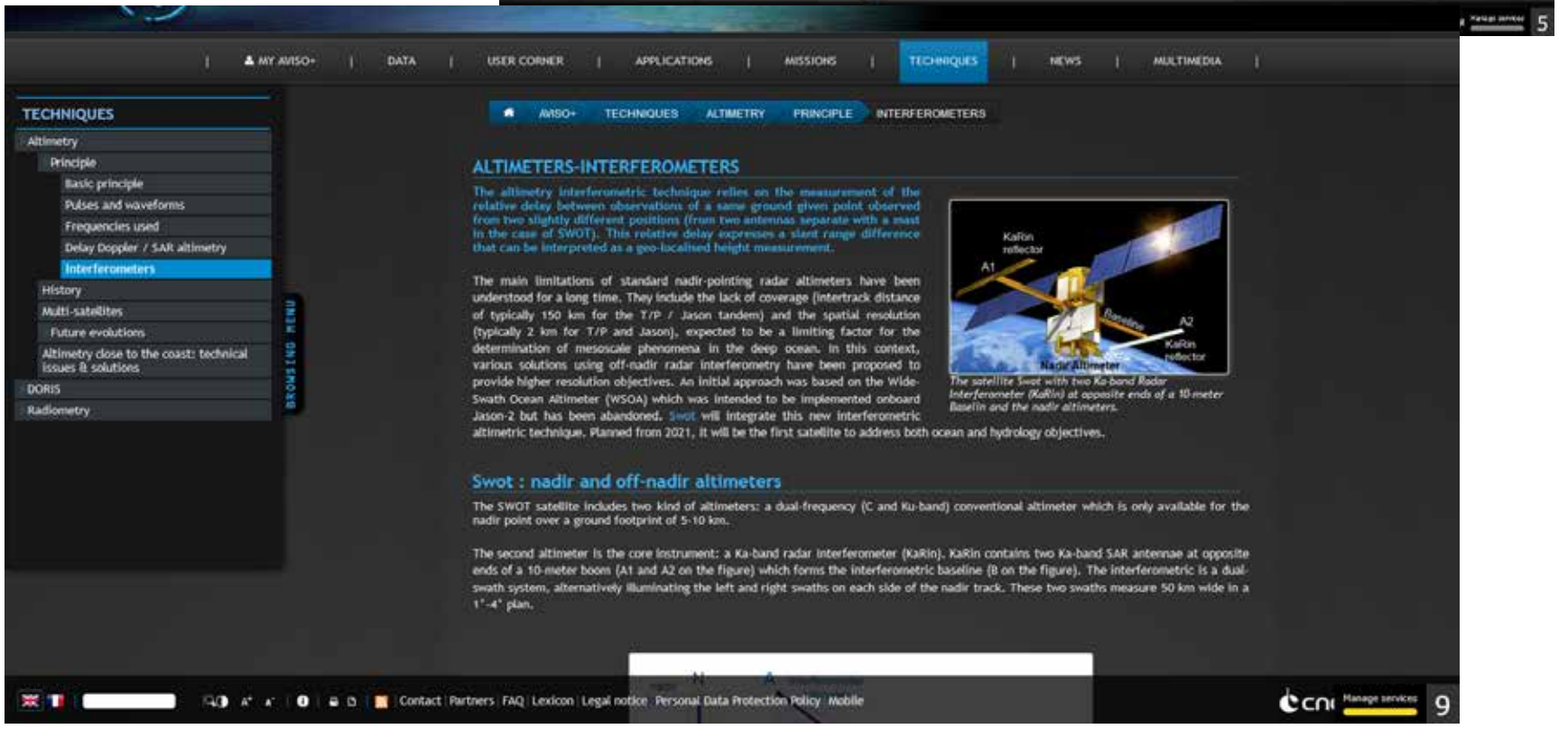


Swot mission pages on Aviso

Swot on Aviso web

- The usual Aviso “mission” section content, adapted to this specific mission, PLUS:
  - links & refs
  - Access to data (ocean only)
  - Portfolio of first results
  - Practical info on Cnes infra
- Data products (links)
- Other pages
  - Techniques
  - Applications
  - Gallery
  - Courses
- News





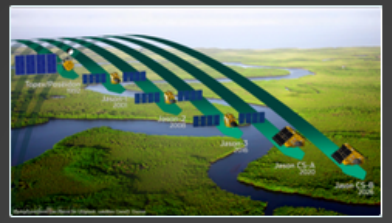
Collections of slides

Rationale

è Provide would-be users, teachers & trainers with a basis they can **re-use** as they need

- In English and in French
- Mostly meant for graduated- / engineering school- level audiences
- Several can be used at secondary school level (some at primary school), with explanations by someone knowledgeable
- Multimedia > Education > Altimetry Courses section

NADIR ALTIMETRY FOR HYDROLOGY



Find a series of pptx files presenting altimetry for hydrology applications. They are provided in English and in French (separate files), and with a lighter version if need be (no illustrative images, no video embedded, images compressed). They are splitted in three series of slides:

- "Water heights (altimetry): how does it work?" is on the technique (English -- English light -- French -- French light)
- "Water Heights (altimetry): the satellites / sensors" is on the different altimetry satellite missions and their instruments used for hydrology applications (English -- English light -- French -- French light)
- "Water heights (altimetry): How are they used?" is showing some examples of past and current use (English -- English light -- French -- French light)

Feel free to use them in your lectures, courses by picking the slides you need. Don't hesitate to send us your feedback.

HYDROLOGY FROM SPACE AND SWOT

Find a series of pptx files presenting hydrology from space and the Swot mission.
They are splitted in six series of slides (a seventh is being designed). They are provided in English and in French (separate files), and with a lighter version if need be (no illustrative images, no video embedded, images compressed).

- "Swot in a nutshell": the future Swot mission in 5 slides (English -- English light -- French -- French light)
- "Why study water on Earth?": facts and figures on freshwater on Earth (English -- English light -- French -- French light)
- "Hydrology from space": main reasons to observe freshwater from a satellite (English -- English light -- French -- French light)
- "Hydrology from space - what can be measured": the different observations which can be made from space in the broad field of hydrology (English -- English light -- French -- French light)
- "How Swot is working": the technique of Swot (English -- English light -- French -- French light)
- "Swot mission": the different aspects of the mission (applications, spacecraft, orbit, launch, ground segment) (English -- English light -- French -- French light)

Feel free to use them in your lectures and courses, whole or by picking the slides you need. Don't hesitate to send us your feedback.

HYDROLOGY FROM SPACE TO HELP PRESENT AT SCHOOLS

Find a series of pptx files presenting hydrology from space (upcoming: the Swot mission & altimetry applications), to be used when explaining such topics at schools. Note that the slides' level of understanding varies, so some may be complex to show to general public or primary school, or will need more oral explanations than others.
They are splitted in four series of slides (a fifth is being designed). They are provided in English and in French (separate files),

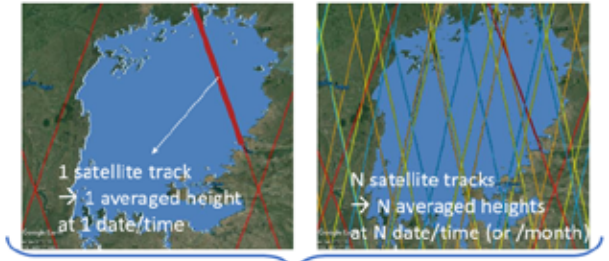
- "Why study water on Earth?": facts and figures on freshwater on Earth (English -- French)
- "Water cycle" (English -- French)
- "Hydrology from space": generalities on satellites, main reasons to observe freshwater from a satellite (English -- French)
- "Hydrology from space - what can be measured": the different observations which can be made from space in the broad field of hydrology (English -- French)

Feel free to use them in your lectures at primary, middle or high schools, whole or by picking the slides you need. Don't hesitate to send us your feedback.

Nadir altimetry for hydrology Collection

- "Water heights (altimetry): how does it work?" is on the technique
- "Water Heights (altimetry): the satellites / sensors" is on the different altimetry satellite missions and their instruments used for hydrology applications
- "Water heights (altimetry): How are they used?" is showing some examples of past and current use

Lakes: integrated surface height

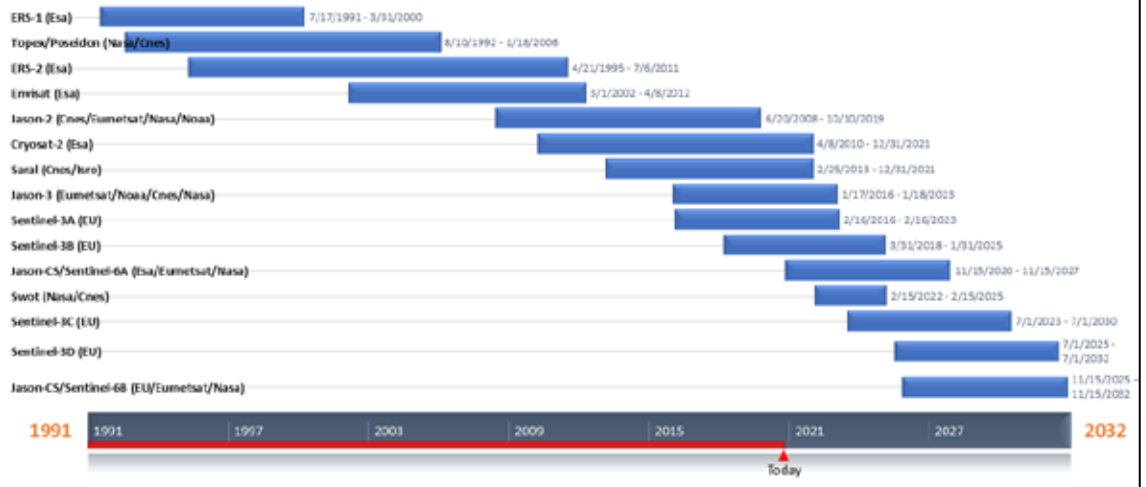


All measurements done over a lake by one given satellite along one of its ground track are averaged dated at a mean hour (before Nov. 2011: per month).

Several tracks and several satellites can be used to build a time series.

The water height is given with respect to a reference (geoid).

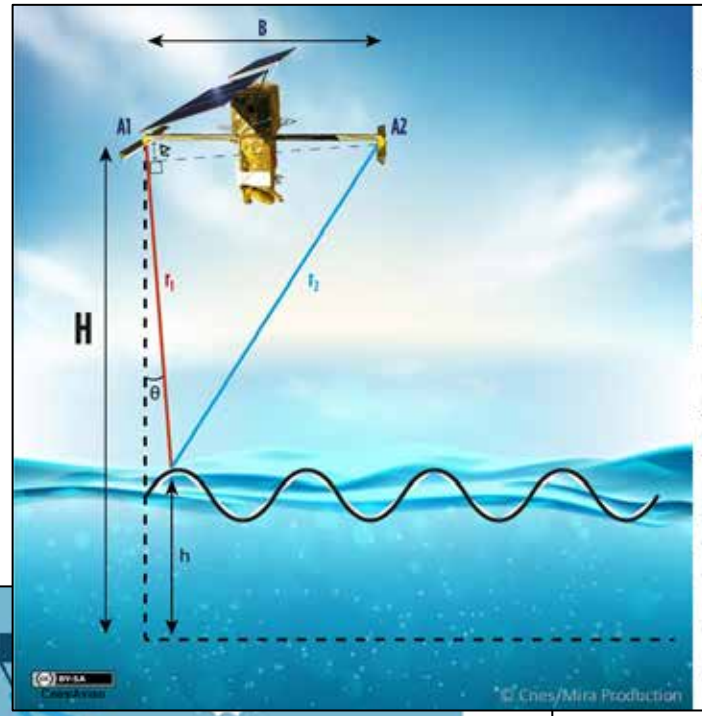
Altimetry missions used in hydrology



Hydrology from space and Swot Collection

- "Swot in a nutshell": the future Swot mission in 5 slides
- "Why study water on Earth?": facts and figures on freshwater on Earth
- "Hydrology from space": main reasons to observe freshwater from a satellite
- "Hydrology from space - what can be measured": the different observations which can be made from space in the broad field of hydrology
- "How Swot is working": the technique of Swot
- "Swot mission": the different aspects of the mission (applications, spacecraft, orbit, launch, ground segment)

Hydrology from space and Swot Collection



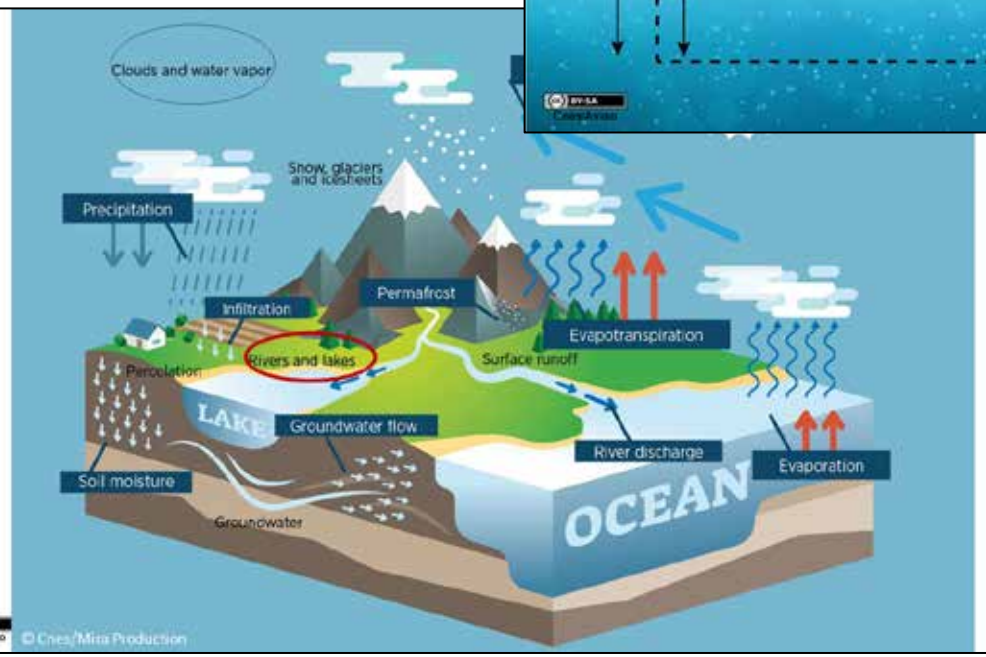
Swot measurement

r1: determined using the round-trip time between the satellite and the surface

r2 (or **Δr**): deduced from the interferences between the two returned signals:
the interferometric phase difference **Δϕ = -(2π/λ)(r2-r1)**
but **Δϕ** is known modulo 2π rad. So several values of (r2-r1) can provide with the same Δϕ.
The ambiguity is raised using a DEM as reference, including surface heights over waters. This is possible if the height equivalent to a full 2π-phase shift is higher than the expected h (+/- 3 m near the nadir, but up to +/-30 m at the farthest in the swath).

θ is a

The w



“Hydrology from space to help present at schools” Collection

- "Why study water on Earth?": facts and figures on freshwater on Earth
- "Water cycle"
- "Hydrology from space": generalities on satellites, main reasons to observe freshwater from a satellite
- "Hydrology from space - what can be measured": the different observations which can be made from space in the broad field of hydrology

(part of the latter was adapted for the ArgoHydro Argonautica web tutorial – in French only, & only on the techniques used by this project)

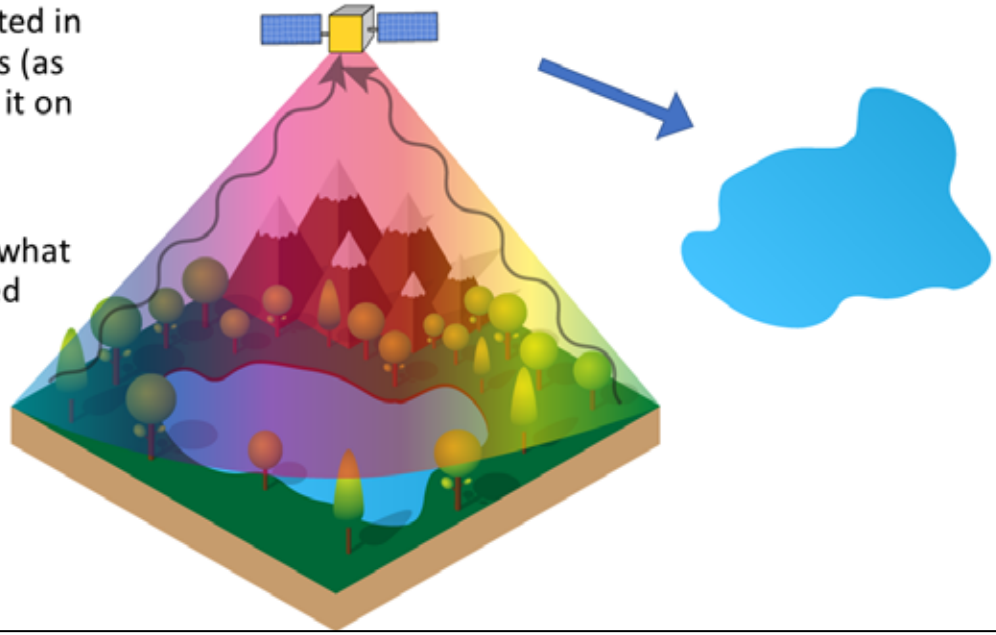
“Hydrology from space to help present at schools” Collection

We need water to

grow plants (including those we are eating, or animals are eating)

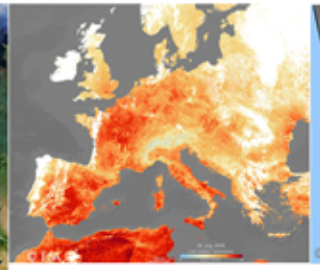
How?

- Water is detected in satellite images (as you would see it on a photograph)
- Variations are what is mostly looked upon

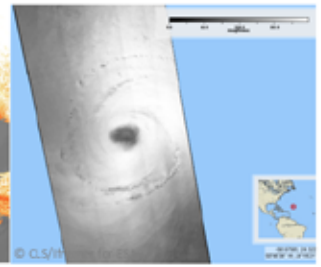


All satellites are not doing the same things

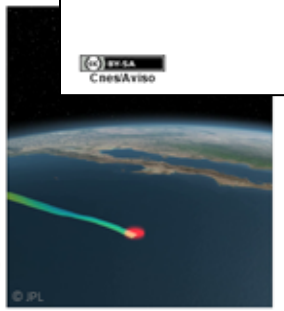
Some are taking images looking like photos
« optical imagers »



Others are taking images but that our eyes would not see
« infrared or microwave imagers »



Others again are taking images but after the satellite sent a signal towards the surface
« imaging radars »



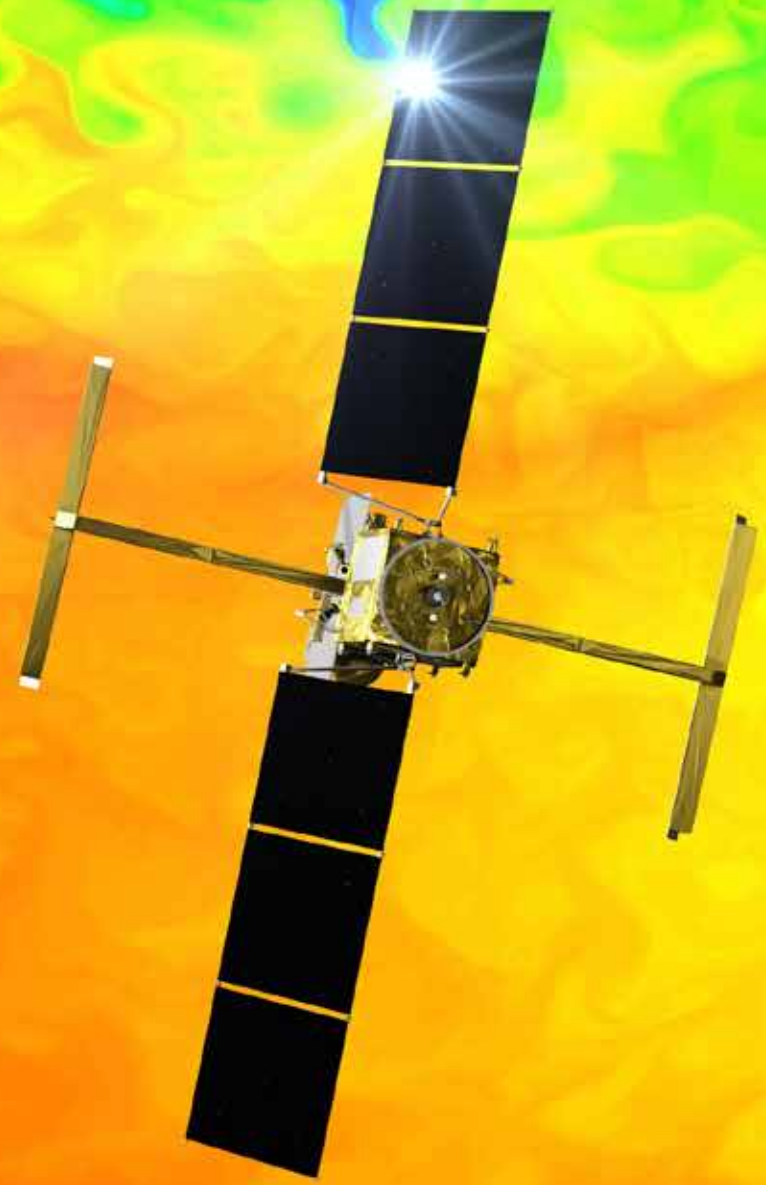
Other are taking measurements just beneath themselves (and not images)
« altimeters »

Passive instruments (collect what is emitted/reflected by the surface)

Active instruments (send a signal towards surface and collect what is reflected to them

Earth observation (civilian)

Portfolio of first outputs



Swot “portfolio” of first results

- showing promises fulfilled – and also unexpected results
- 8-9 posts on Cnes web site during Summer 2024 (in French only) & also on Aviso for ocean results (both English and French, more technical)

Publié le 26 juillet 2024

SWOT étudie l'étendue des inondations

Système Terre Eau Climat

Grâce à la détection des masses d'eau à la surface des continents, la mission franco-américaine SWOT récolte des données essentielles sur les phénomènes climatiques tels que les inondations.

© Getty Images, shoxin

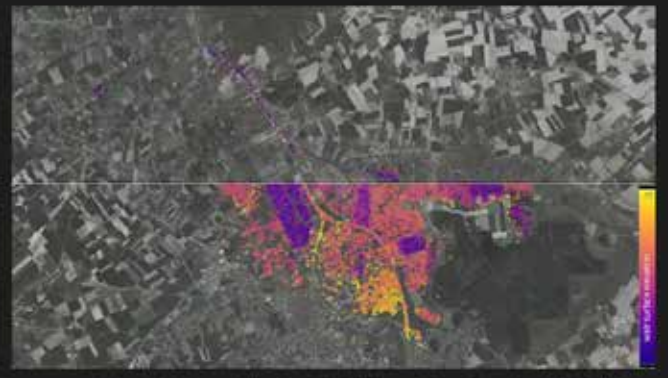


Image recomposée à partir de deux acquisitions du satellite SWOT à un an d'intervalle au-dessus de la ville de Saint-Omer © CNES 2024

L'image ci-dessus est une image recomposée à partir de deux acquisitions du satellite SWOT à un an d'intervalle au-dessus de la ville de Saint-Omer. La partie supérieure délimitée par une ligne blanche montre l'écoulement normal de la rivière, l'Aa, le 3 décembre 2023. Les données du satellite, en violet, nous indiquent alors que sa largeur est de 50 mètres et sa hauteur d'eau d'environ 1,50 mètres.

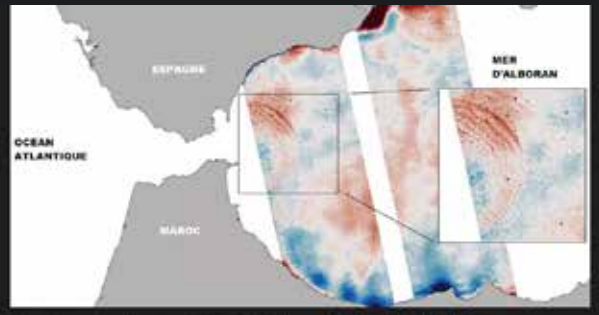
Publié le 02 août 2024

SWOT sur les ondes du détroit de Gibraltar

Système Terre Eau Climat

Grâce à un instrument innovant, la mission SWOT témoigne avec précision des ondes internes générées par les mouvements d'eau dans le détroit de Gibraltar.

Vue du détroit de Gibraltar depuis l'ISS © NASA, 2017



Ondes internes observées au niveau du détroit de Gibraltar par le satellite SWOT © M. Archer / JPL

Sur l'image ci-dessus, la mission SWOT livre une observation détaillée du phénomène d'ondes internes au niveau du détroit de Gibraltar. La configuration de la côte et le relief sous-marin provoquent des ondes dans le sillage du détroit. Les données acquises par le satellite en nuances de bleu et de rouge représentent les hauteurs de mers par rapport à un niveau moyen "0" en blanc et laissent apparaître les ondes qui se dirigent vers l'intérieur de la Mer Méditerranée.

De telles ondes ont pu être observées par le passé par des satellites radars ou optiques comme Sentinel-1 et Sentinel-2. Elles restaient cependant difficiles à détecter dans les mesures des missions altimétriques classiques qui ne mesurent que le long d'une ligne. L'instrument KaRIn à bord de la mission SWOT du CNES et de la NASA, développée avec des contributions des agences spatiales du Canada et du Royaume-Uni, permet non seulement de détecter ces ondes en deux dimensions, mais

Portfolio cont'd on Aviso web site (on ocean)

Videos & images

HYDROLOGY OF THE MARONI BASIN

Space Hydrology

The Maroni is the longest river in French Guiana and France's longest tropical river. With an average discharge of 1,700 m^3 per second, it winds ...

WATCH NOW

ANTARCTIC OCEAN – OCEAN CIRCULATION

Space Oceanography, Glaciology

The oceans absorb most of the heat and a big proportion of the carbon dioxide generated by humans. This process is most efficient in the ...

WATCH NOW

ANTARCTIC OCEAN – SEA ICE

Space Oceanography, Glaciology

As for the Arctic, the LEGOS research laboratory has processed 30 years of data from the European ERS-1, ERS-2, Envisat and CryoSat-2 radar satellites to ...

WATCH NOW

ARCTIC OCEAN – SEA ICE

Space Oceanography, Glaciology

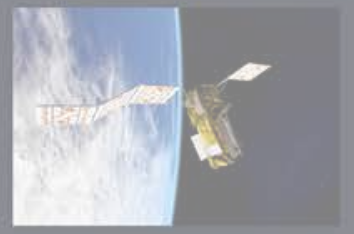
Since the late 70s, satellite data have shown how sea ice is receding as a result of global warming. However, sea ice dynamics are driven ...

WATCH NOW

MERCATOR - COPERNICUS

Animations

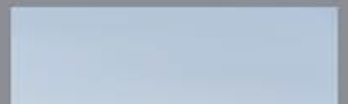
WATCH NOW



SWOT - 3D

Animations

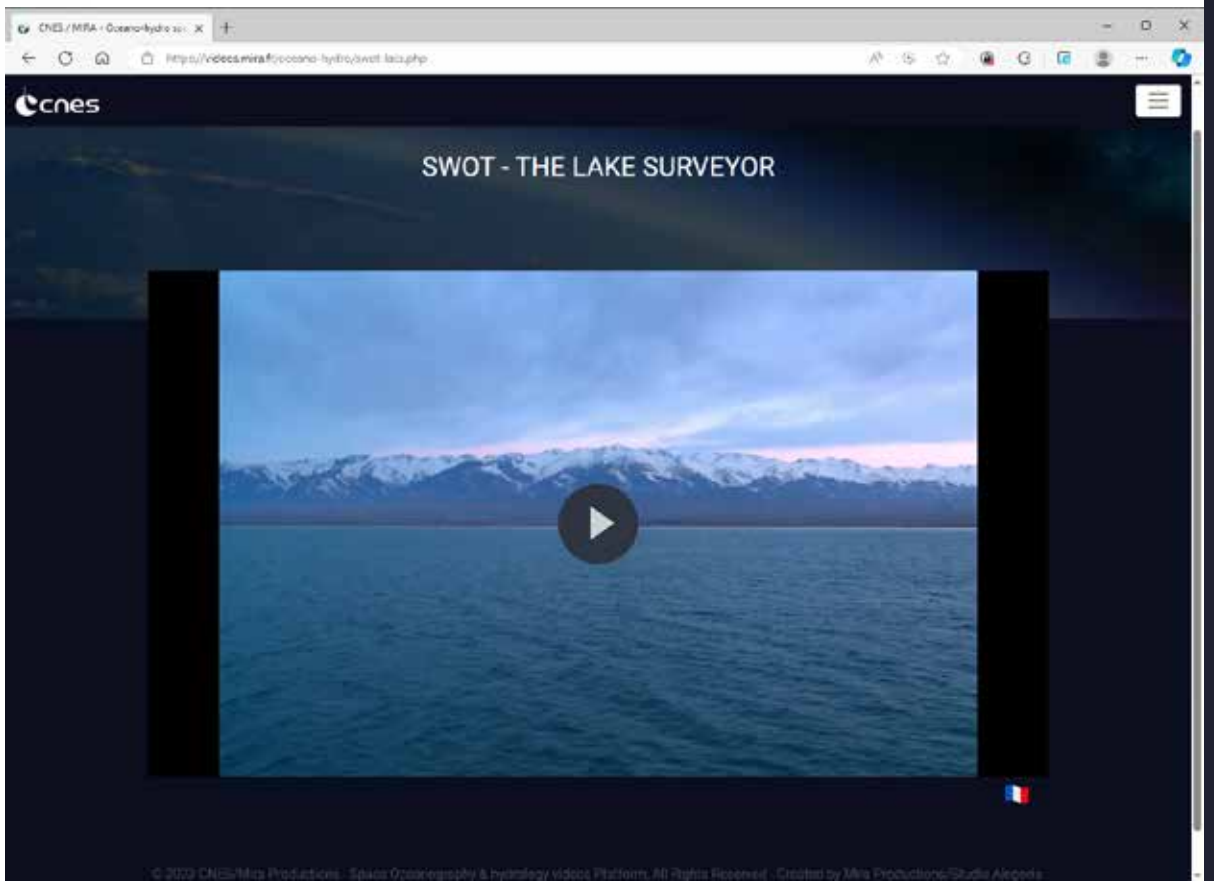
WATCH NOW

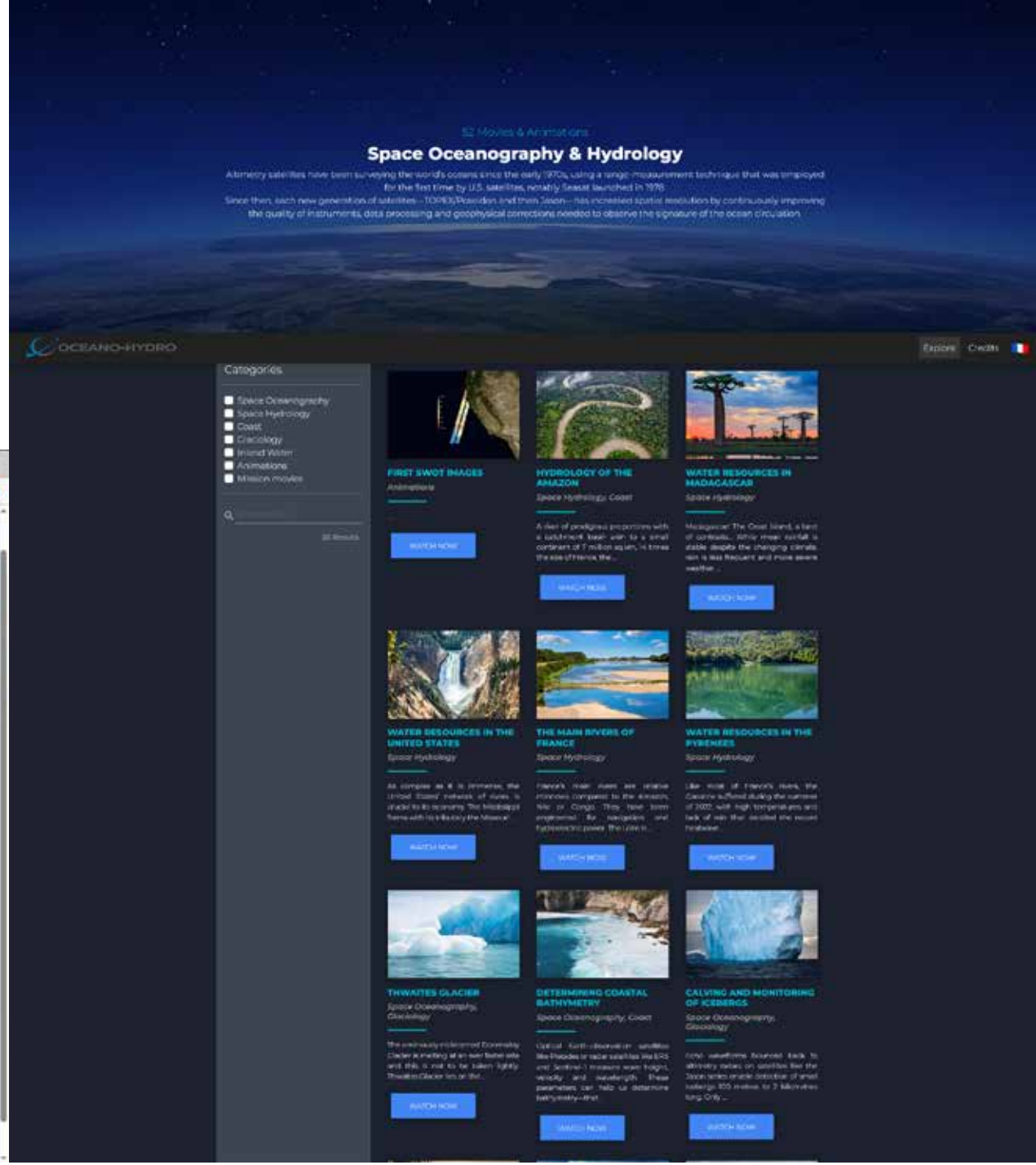


Video gallery

- https://oceano-hydro-spatiale.mira.fr/

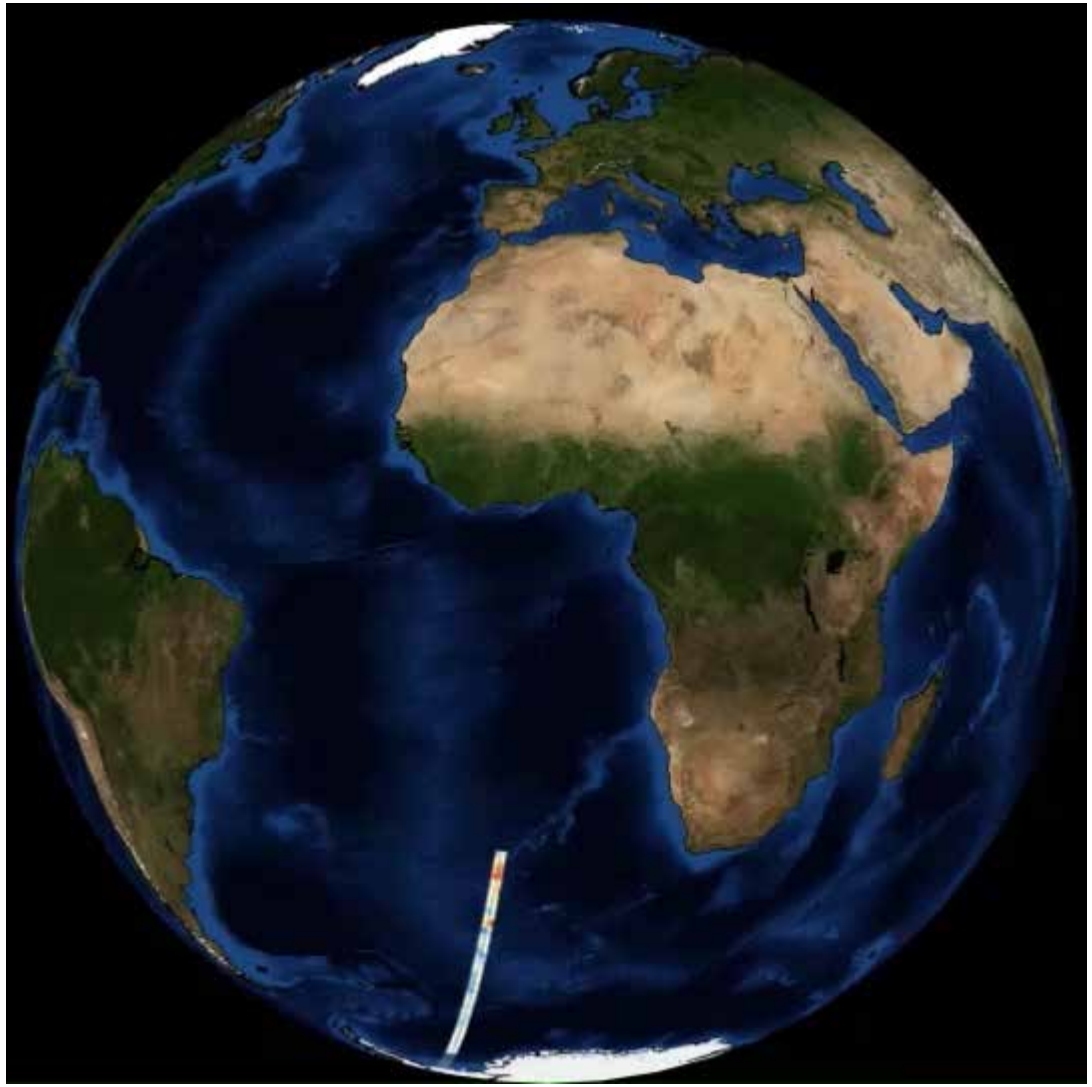
+ permalink video by video





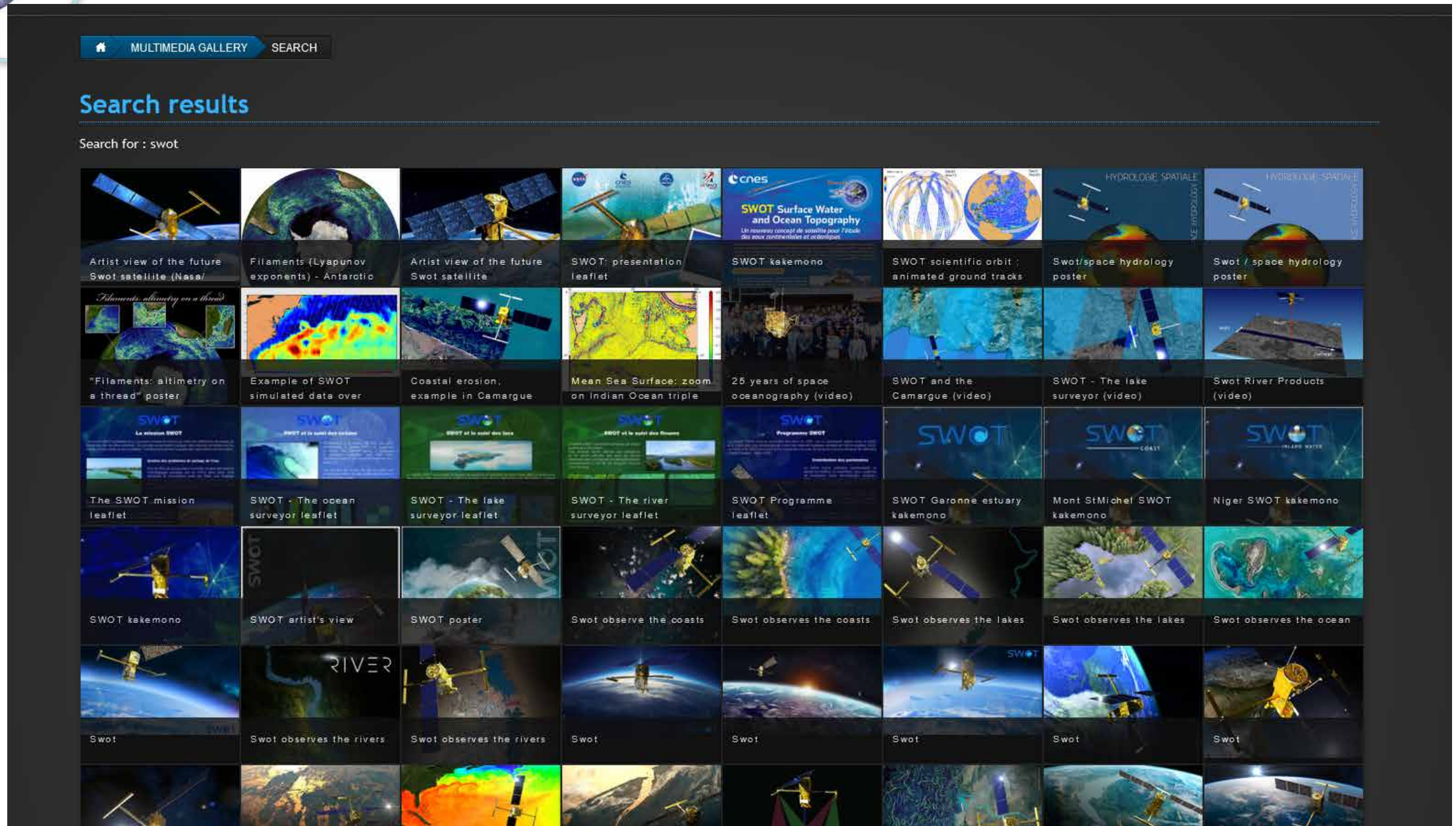
Swot along one cycle animation

- Ocean



- Hydrology

https://www.aviso.altimetry.fr/gallery/, search for “Swot”

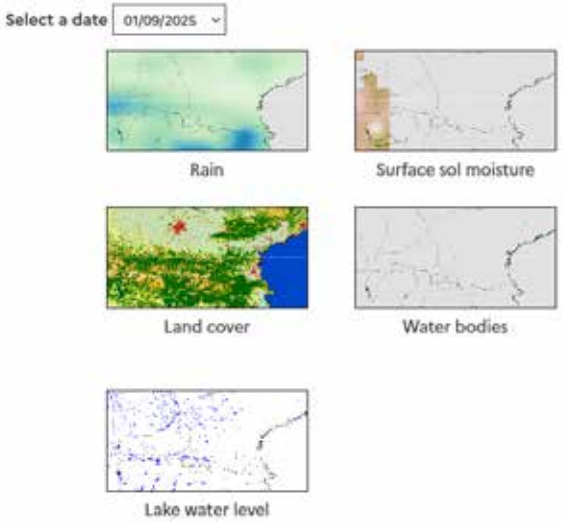


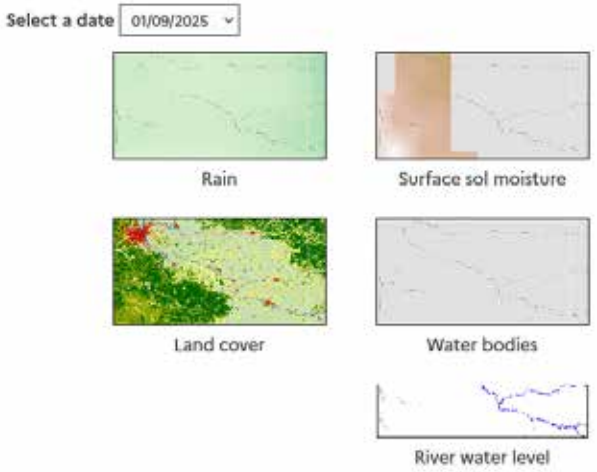
ArgoHydro: Cnes educational project

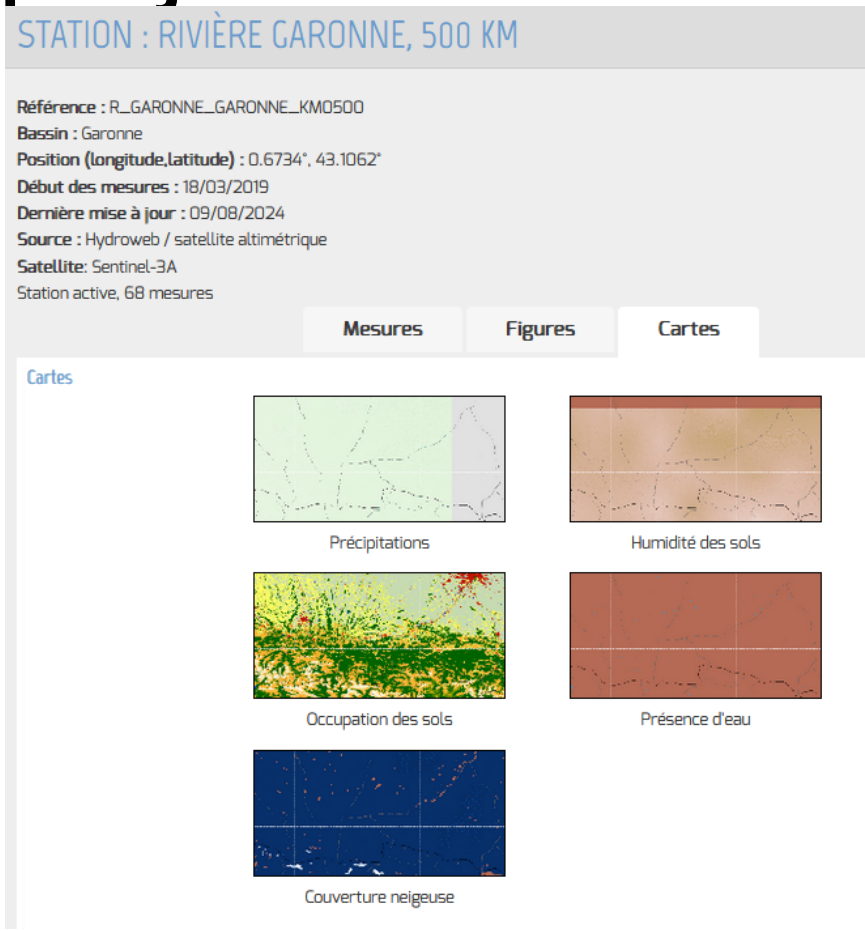
- **Hydro data available on Argonautica ArgoHydro platform**

  => https://argonautica.jason.oceanobs.com/ (Fr/En)

  => rainfall, soil moisture, land cover, water presence, snow cover
- Swot rivers & lakes added these days (work in progress)
- Your ideas are most welcomed to improve this for teachers to adopt this new part of the project







Summary

- Web pages https://www.aviso.altimetry.fr/swot/

- Portfolio (Missions > Swot > Portfolio)
  https://www.aviso.altimetry.fr/?id=5492

- Collections of slides (Multimedia > Education > Altimetry Courses)
  https://www.aviso.altimetry.fr/?id=292

What have you used (if any)?

What is missing?

What would you prefer another way?