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## Mission Satellitaire SWOT (Surface Water and Ocean Topography)

Pierre-Olivier Malaterre, Hind Oubanas, I.Y. Gejadze, Dylan Quittard,  
Isadora Rezende, Cécile Cazals

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Submitted on 6 Nov 2024

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# ➤ Mission Satellitaire SWOT (Surface Water and Ocean Topography)

Pierre-Olivier Malaterre<sup>(1)</sup>, Hind Oubanas<sup>(1)</sup>, Igor Gejadze<sup>(1)</sup>  
Dylan Quittard<sup>(1,2)</sup>, Isadora Rezende<sup>(2,3,1)</sup>, Cécile Cazals<sup>(4,2,1)</sup>

(1): UMR G-eau, Inrae/IRD/Cirad/BRGM/AgroParisTech/Institut  
Agro, Montpellier

(2): CNES, (3): CLS, (4): CS



# > Plan

Objectifs de la Mission

Historique

Caractéristiques Techniques

    Instruments KaRIn, Poseidon 3C

    Orbite calval

    Orbite scientifique

Exemple de Données

Accès aux Données

Applications

Calculs des Débits des Fleuves

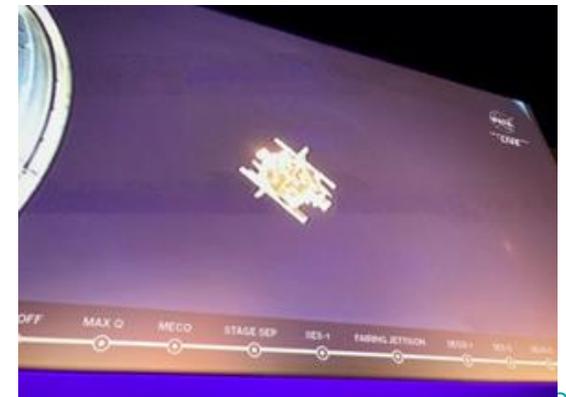
Perspectives et Suites

Conclusion



# ➤ Satellite SWOT

Mission Franco Américaine (CNES + NASA), 2.4T, 1 B\$, lancement 16/12/2022



Titre de la présentation

Date / information / nom de l'auteur

# ➤ Objectifs de la mission SWOT

Hydrologie et Océanographie

- Mesure (globale) des hauteurs d'eau, largeurs et pentes des rivières/fleuves ( $\geq 50\text{m}$ ), hauteurs et surfaces des lacs et réservoirs ( $\geq 1\text{Ha}$ ) et zones inondées
- Hauteurs des océans, zones hauturières et côtières (étude de la méso-échelle)
- Estimation (globale) des débits des fleuves et des volumes stockés dans les lacs et réservoirs
- => Instrument de rupture technologique, un radar interférométrique large fauchée dénommé KaRIn
- Mission Scientifique (initialement pour une durée de 3-4 ans : mi 2026, mais probablement prolongé ...)



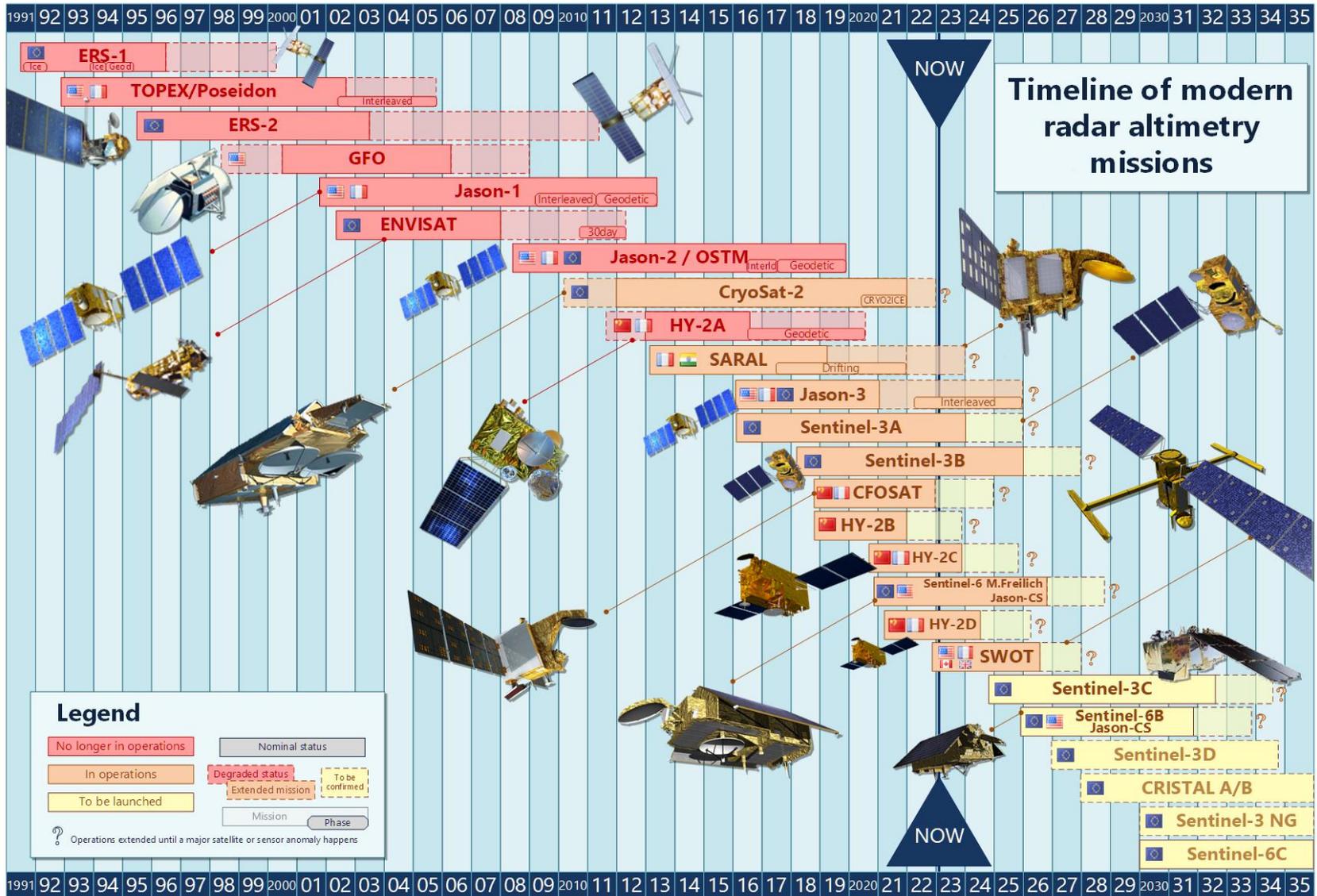
**INRAE**

Titre de la présentation

Date / information / nom de l'auteur

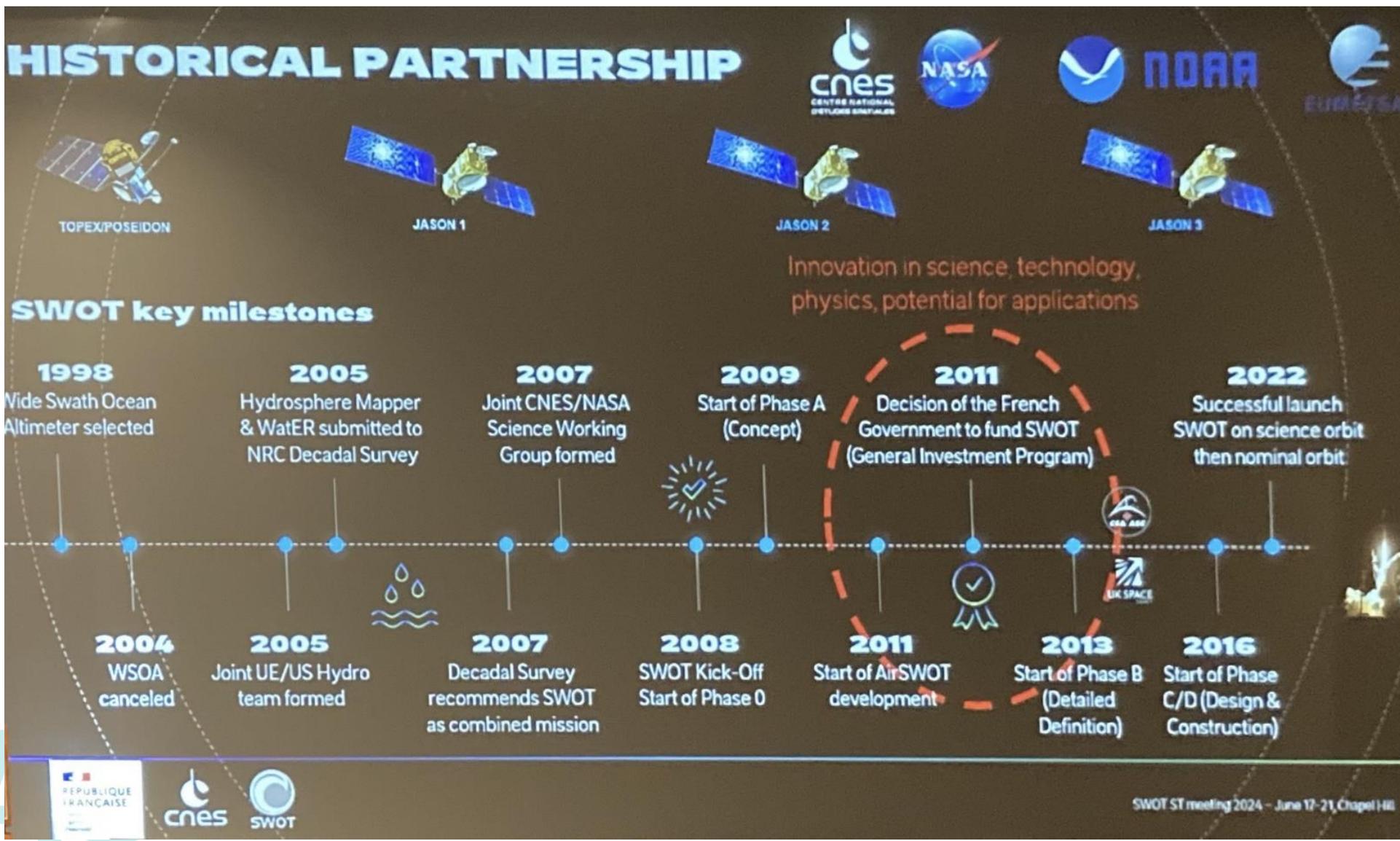
# Historique

## Missions altimétriques



# ➤ Historique

Dates clés pour SWOT



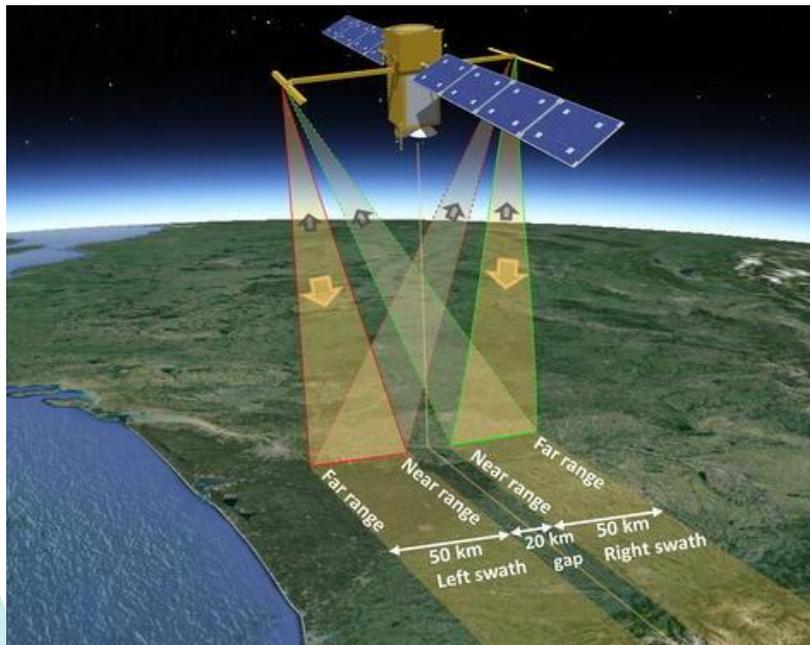
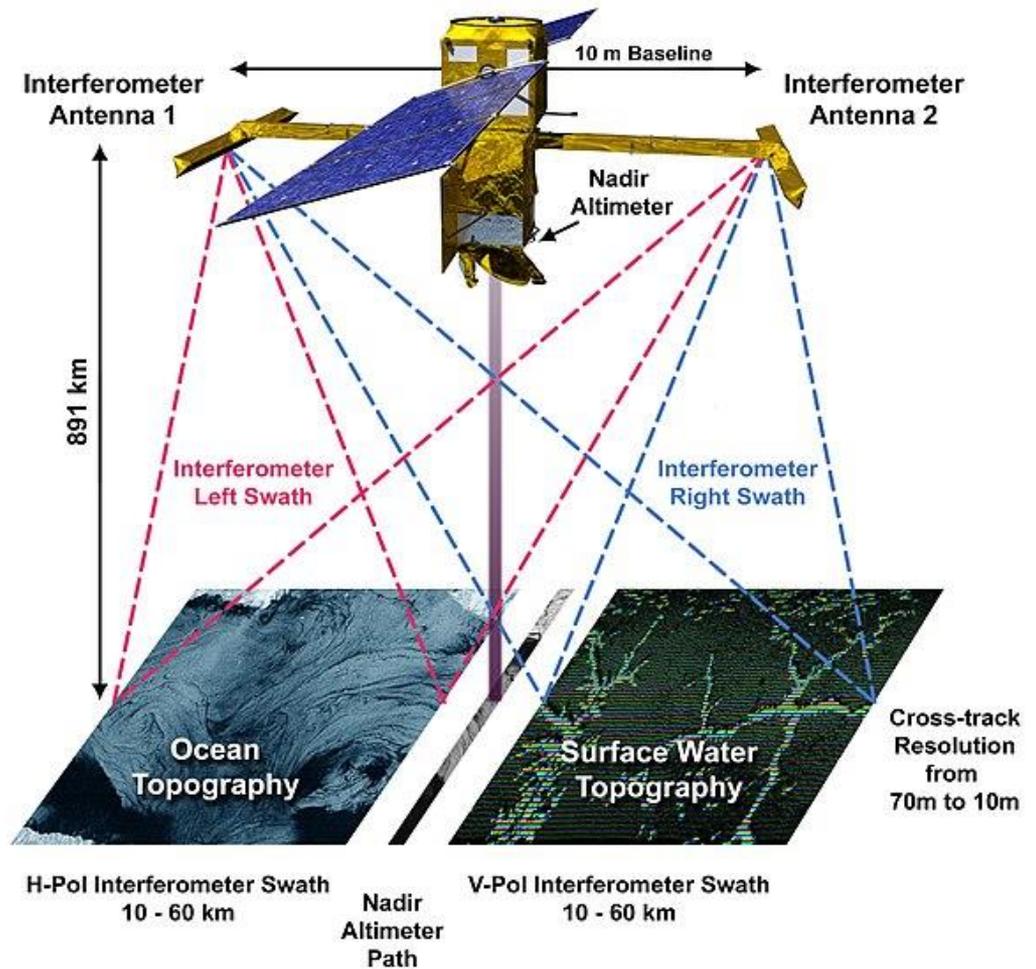
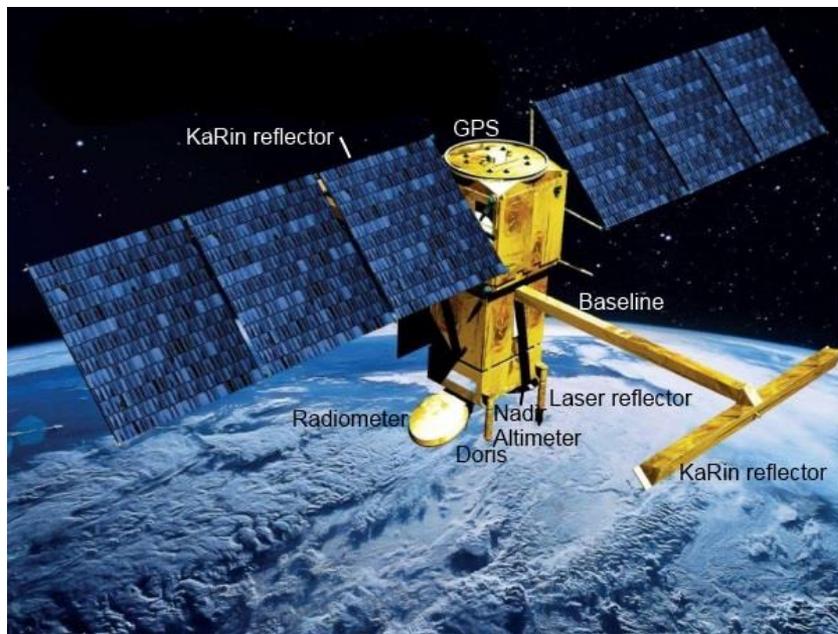
# ➤ Historique

## Dates clés

- Idées antérieures (dès 1998 WSOA, choix techno entre 4 options en 2004, WATER ESA mission 2005 abandonnée)
- 19 septembre 2008 : Début du programme SWOT
- Septembre 2009 : Début de la phase A du développement
- Novembre 2013 : Début de la phase B du développement
- Mi-2016 : Début de la phase C/D du développement, début de la construction du satellite
- **Automne 2019 : Livraison des instruments Français : RFU, POSEIDON 3 et DORIS au JPL. Livraison du Centre de Contrôle SWOT au CNES**
- 2021/2022 : Assemblage et Intégration du satellite et Qualification Opérationnelle du système
- 16 décembre 2022 : Lancement du satellite SWOT par une Falcon 9 (Space X, Base de Vandenberg, Californie)



➤ **KaRIn**  
 SAR, bande Ka (35 GHz) pour  
 meilleure résolution et  
 précision (qq m, qq cm)

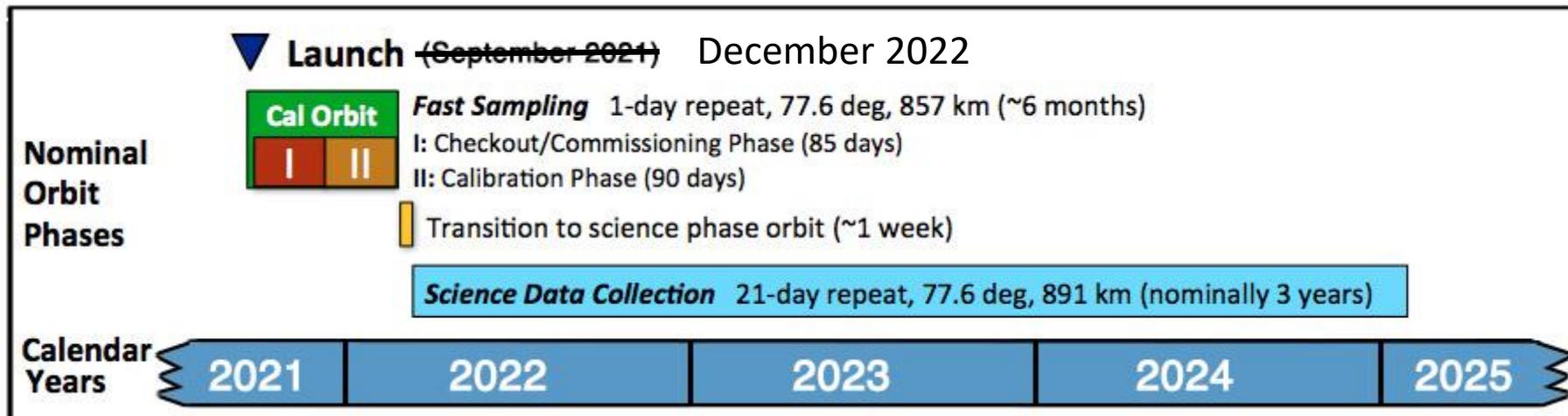


Titre de la présentation

Date / information / nom de l'auteur

# ➤ Caractéristiques techniques

2 Orbites différentes :

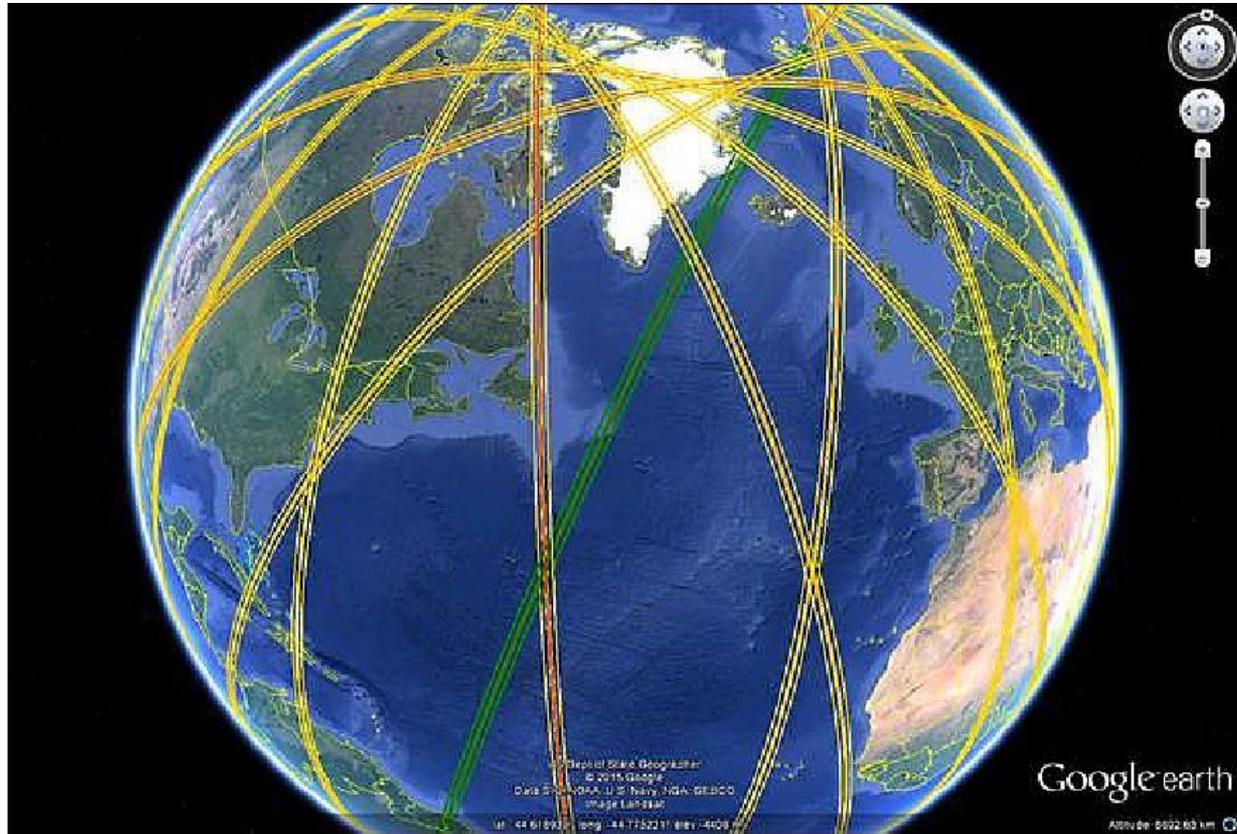


Orbite CalVal : 30 Mars 2023 -> 11 Juillet 2023

Orbite Scientifique : 21 Juillet 2023 -> Juillet 2026 ?

# ➤ Caractéristiques techniques

Orbite calval (DT=1 jour)



# ➤ Caractéristiques techniques

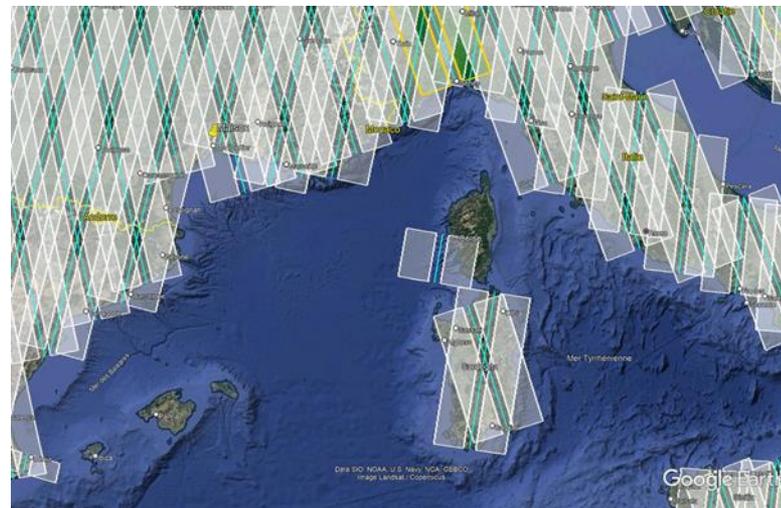
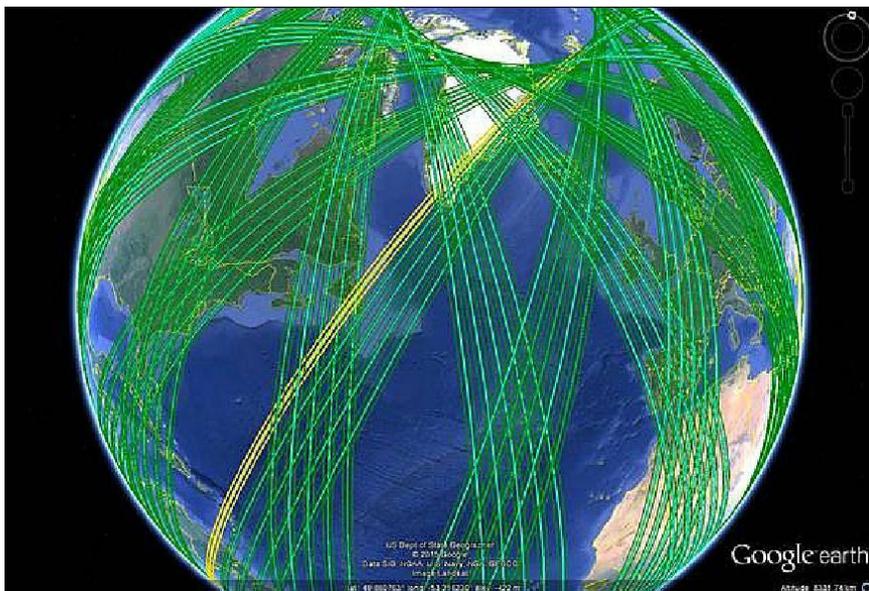
Sites calval (Calibration – Validation)

> 50 In-situ and Airborne Validation Sites in **2023** (ocean research campaigns, river, lake, delta, estuary validation, ... )



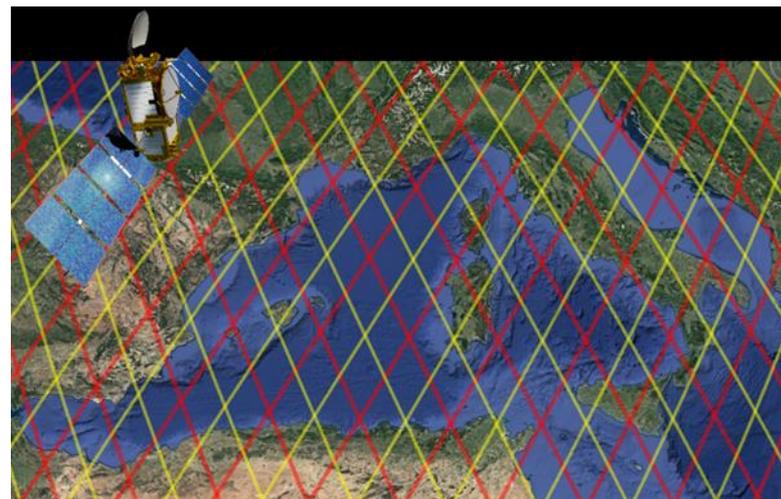
# ➤ Caractéristiques techniques

Orbite scientifique depuis le 21/07/2023



Fauchées SWOT

Jason 2 (jaune)  
Jason 3 (rouge)



INRAE

Titre de la présentation

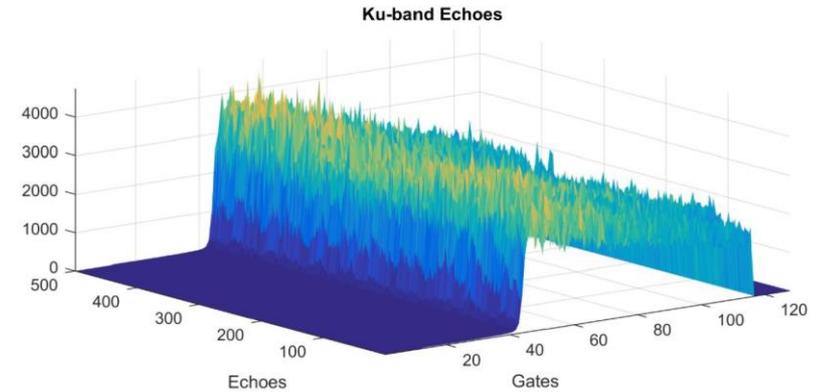
Date / information / nom de l'auteur

# ➤ Exemples de données

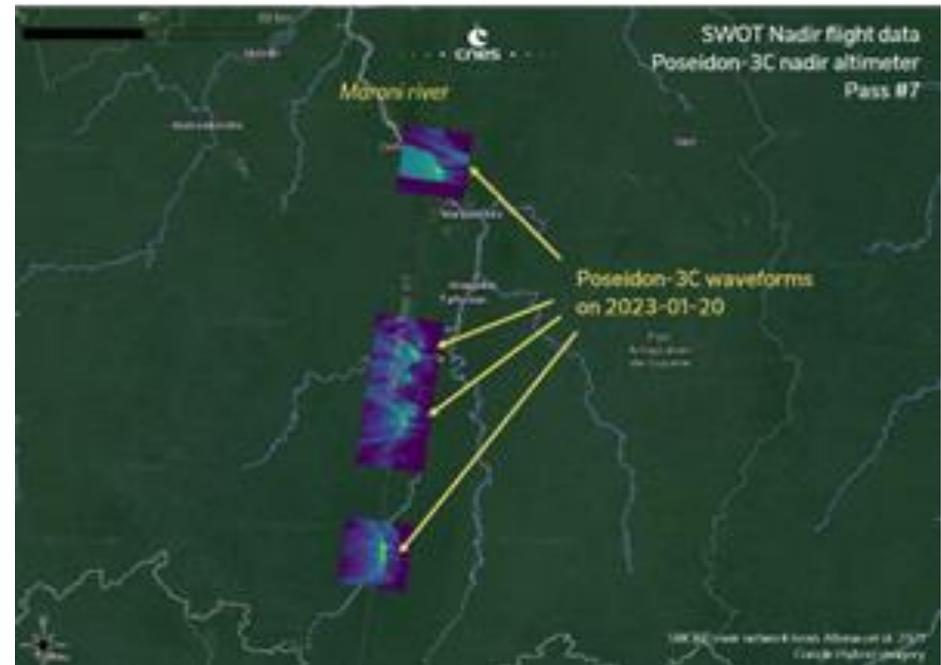
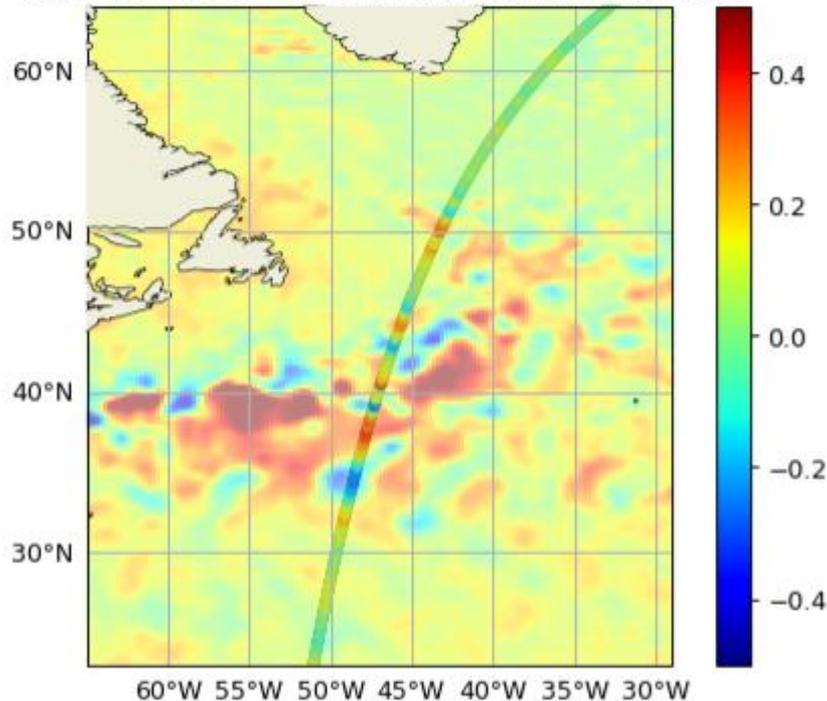
## Allumage POSEIDON-3C

Premiers échos océans  
Le 16/01/2023 10h56min59s

### Premières données Nadir (Poseidon 3C)

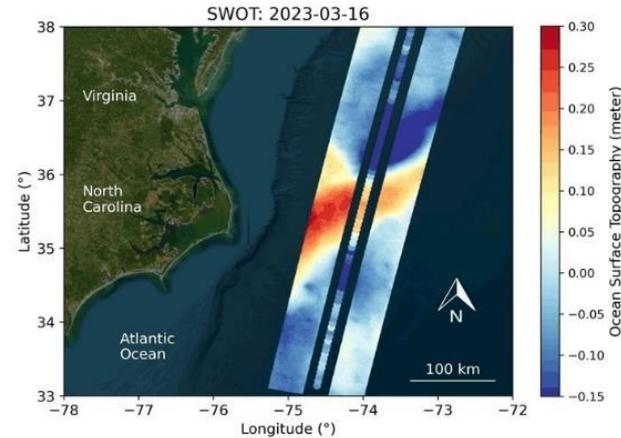
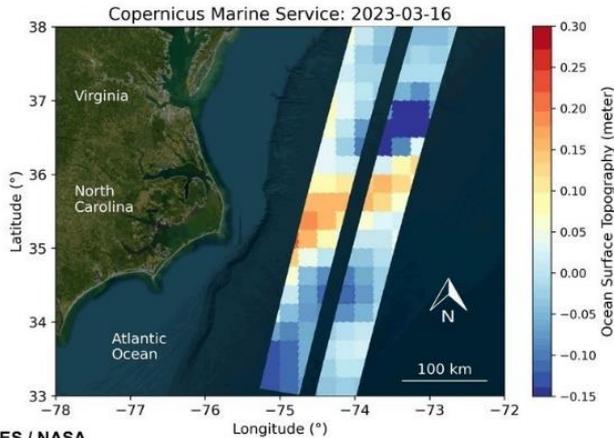


SWOT POS-3C & CMEMS L4 ssha(m) 19/01/2023



# ➤ Premières données (Fauchées, KaRIn)

## Le Gulf Stream vu par Copernicus et le satellite SWOT



© CNES / NASA

Résolution 10\* meilleure  
Cours d'eau de 10m de large sont vus (Canal du Midi)



INRAE

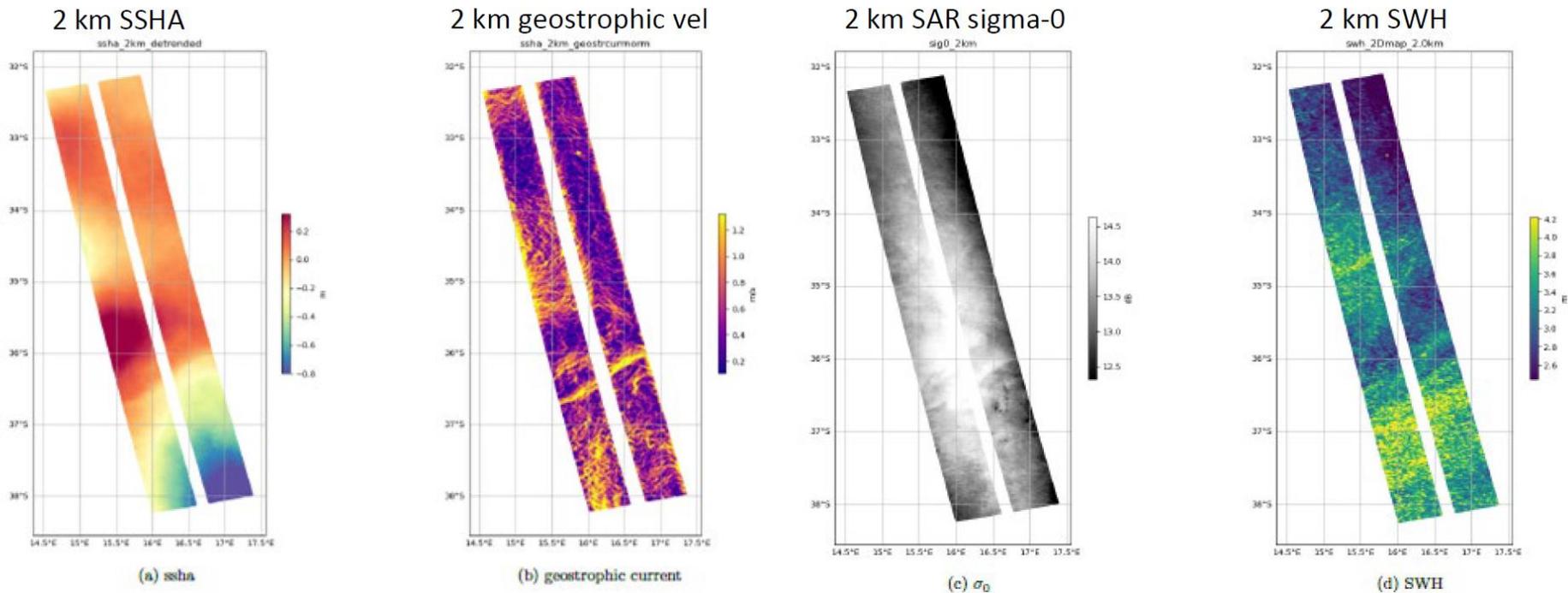
Titre de la présentation

Date / information / nom de l'auteur

# ➤ Exemples de données

## Océans

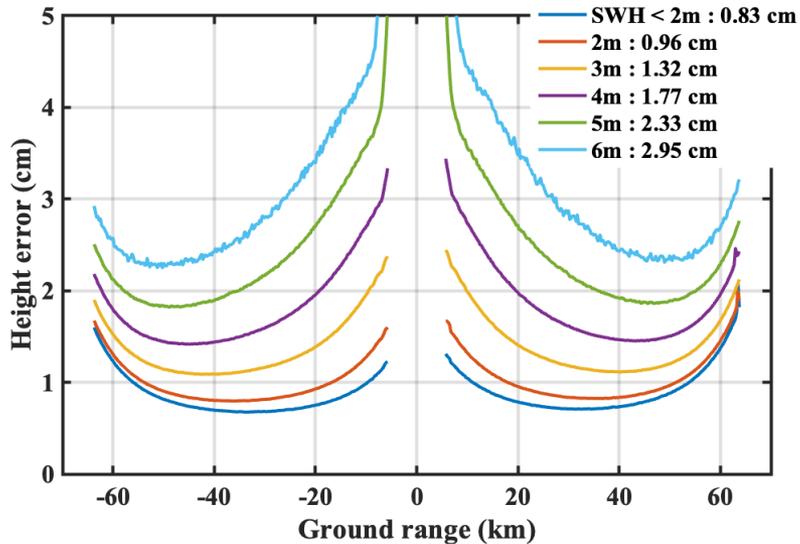
### SWOT : a new 2D vision of ocean currents – waves – winds at km scale



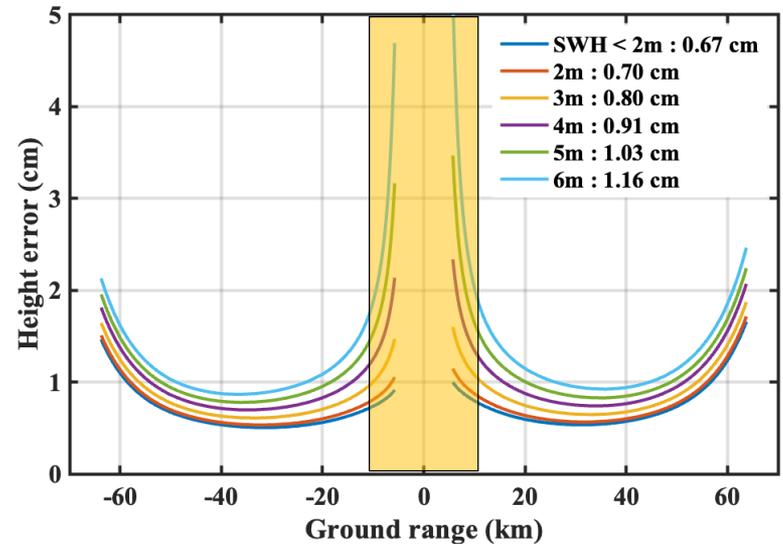
SWOT provides 2D simultaneous maps at km scale of **ocean surface topography** (-> geostrophic **courants**), de surface backscatter (dominated by the **wind**, & other physical signatures) & **waves** (significant wave height) :  
- air-sea interaction studies.

# ➤ Résumé des performances de l'instrument KaRIn (sur les océans)

**Total height error in 1km<sup>2</sup> pixels**  
Requirement: 2.5cm @ SWH 2m



**Random height error in 1km<sup>2</sup> pixels from decorrelation**



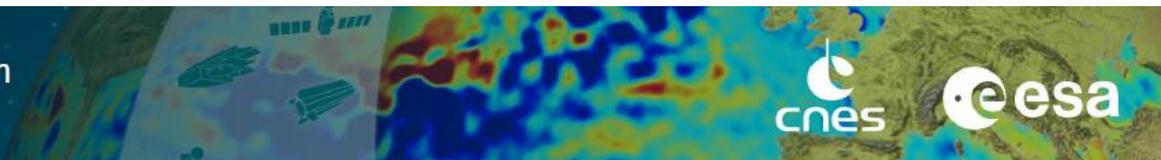
***KaRIn's performance remains nominal with high SNR margin and excellent random performance***



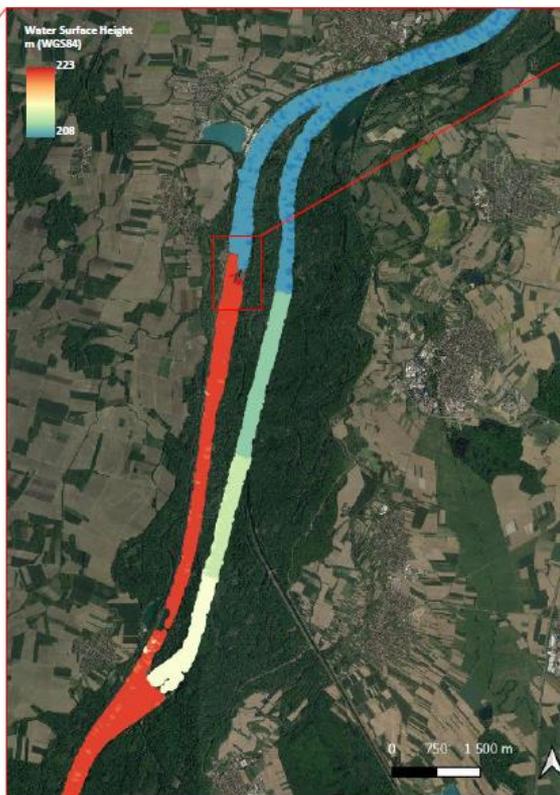
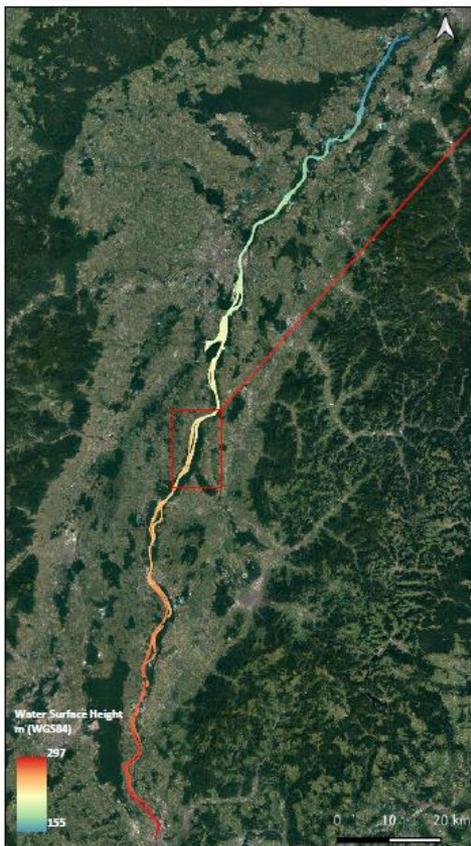
# ➤ Divers types de données (rivières & lacs)

Pixel Cloud

30 Years of Progress in Radar Altimetry Symposium  
2-7 September 2024 | Montpellier, France



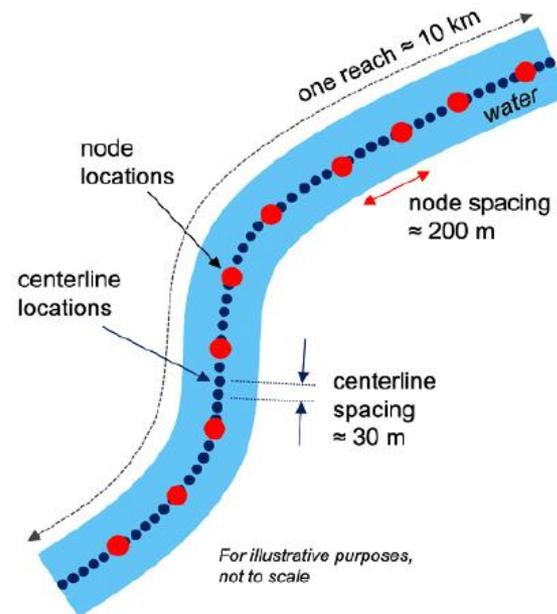
## SWOT PIXC L2 HR PGC0 - Class 4 - Cycle 540



- Global slope of the Rhine well illustrated
- Identification of the weirs, locks and dams

# ➤ Divers types de données (rivières)

## Noëuds et Biefs (Nodes & Reaches)



Logiciel RiverObs fait le passage du Pixel-Cloud aux Noëuds et Biefs :  
<https://github.com/SWOTAlgorithms/RiverObs>

# Exemples de données

Rivières - Fleuves



51 River kilometers

Elevation: 36.06 m

Elevation: 16.21 m



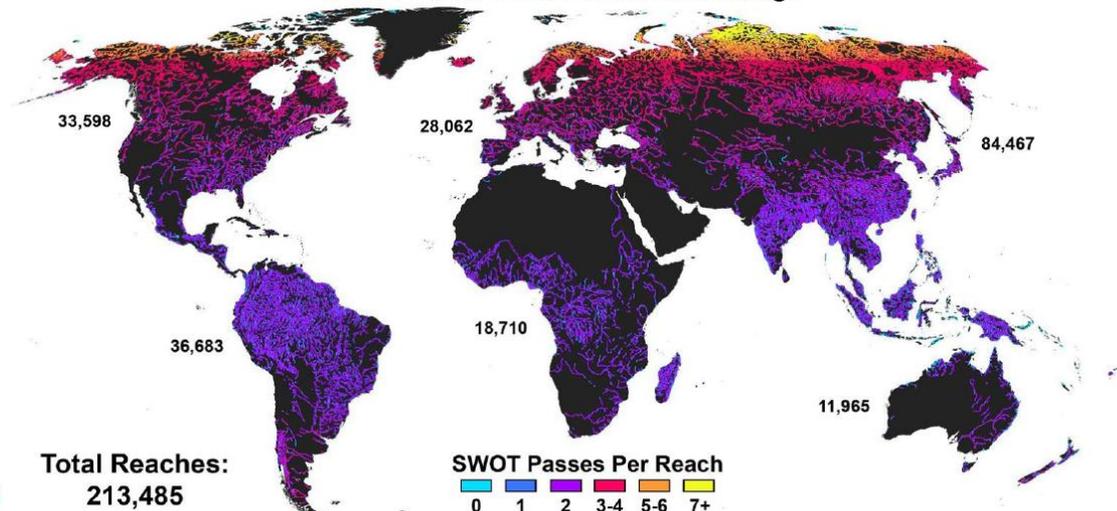
15 40 m  
Sacramento River, California

## SWOT Measurement Capabilities for Rivers

Conventional nadir altimeters measure water surface elevation in rivers at virtual stations.

SWOT measures water surface elevation continuously along rivers, along with inundation extent. Slope can also be extracted.

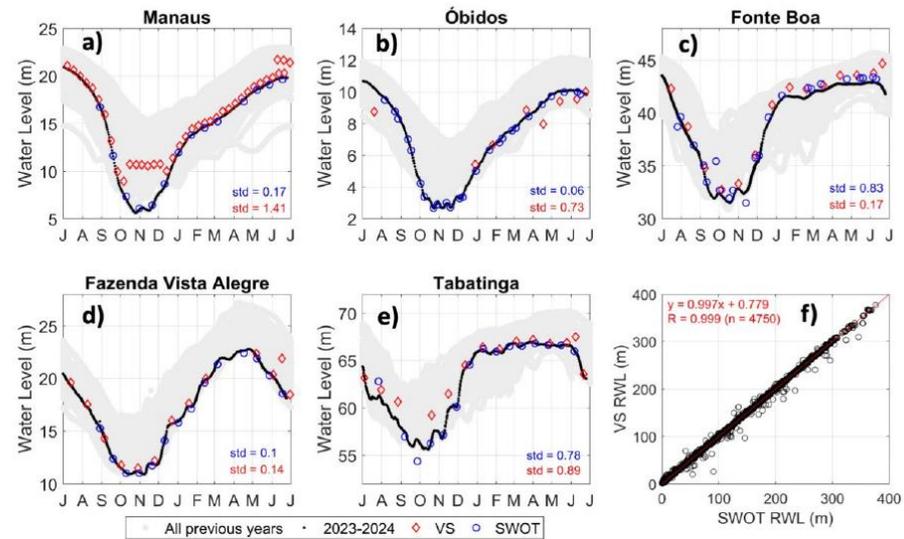
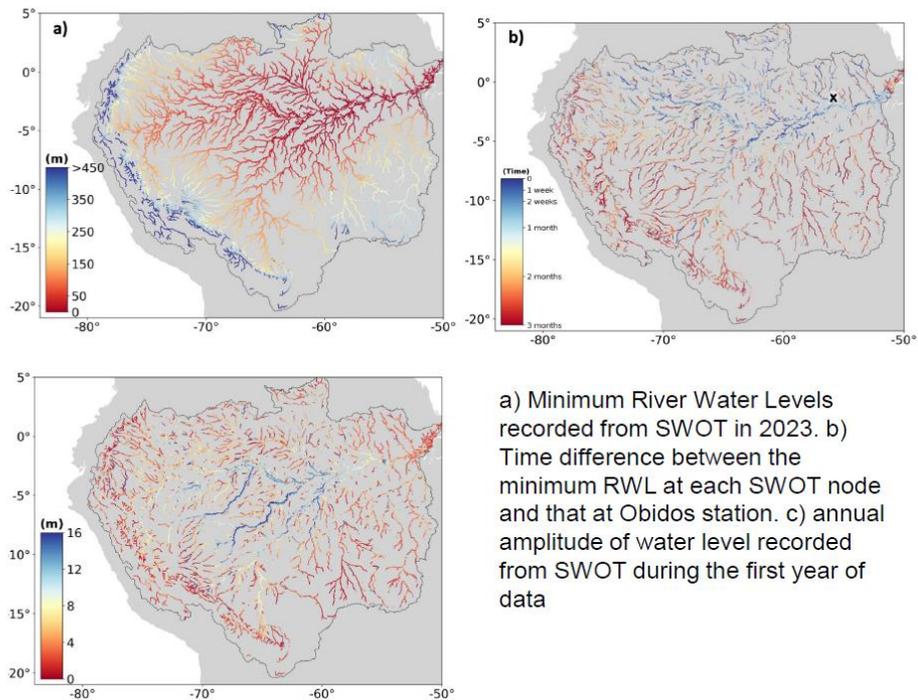
SWOT River Data Product Coverage



# Exemples de données

## Rivières - Fleuves

Widespread and Exceptional Reduction in River Water Levels Across the Amazon Basin during the 2023 Extreme Drought Revealed by Satellite Altimetry and SWOT

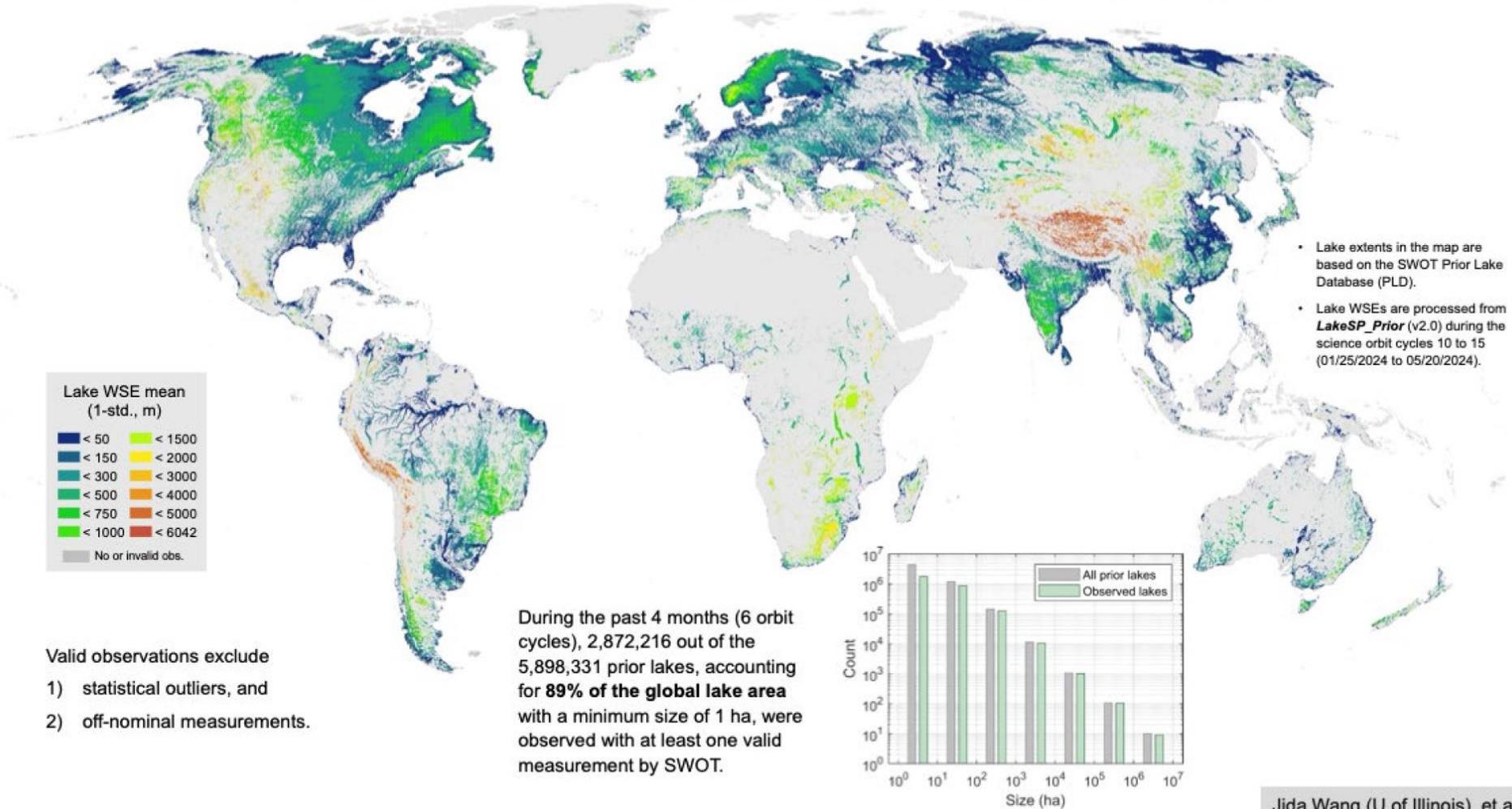


a-e) July to June annual variations (light grey lines) of daily River Water Levels at 276 five gauging stations from 1970 to 2022. The dotted black line is for July 2023 to June 2024, along with River Water Level estimates from nadir altimetry at Virtual stations (red diamond) and from SWOT (blue circle). f) Scatterplot between River Water Level estimates from Virtual Stations and SWOT during the drought period (October and November 2023, 4,750 manuscript submitted to Geophysical Research Letters)

# Exemples de données

## Lacs et réservoir

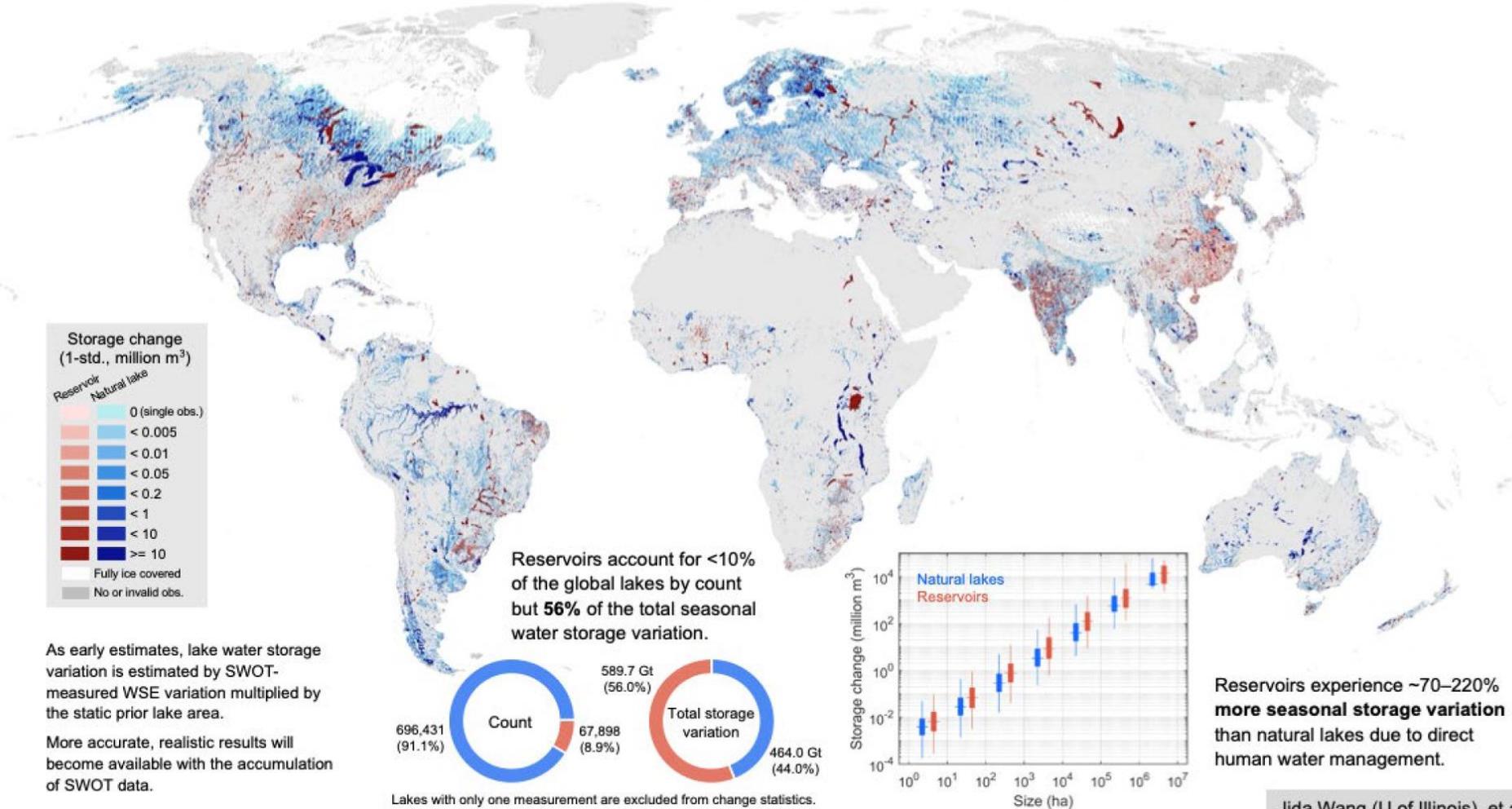
SWOT-measured **mean water surface elevation** on global lakes during January to May 2024



# Exemples de données

## Lacs

A first look at global lake storage changes from SWOT (January to May 2024)



Jida Wang (U of Illinois), et al.

# ➤ Qualité des données HR (continents)

Aux pixel cloud, nœuds, biefs



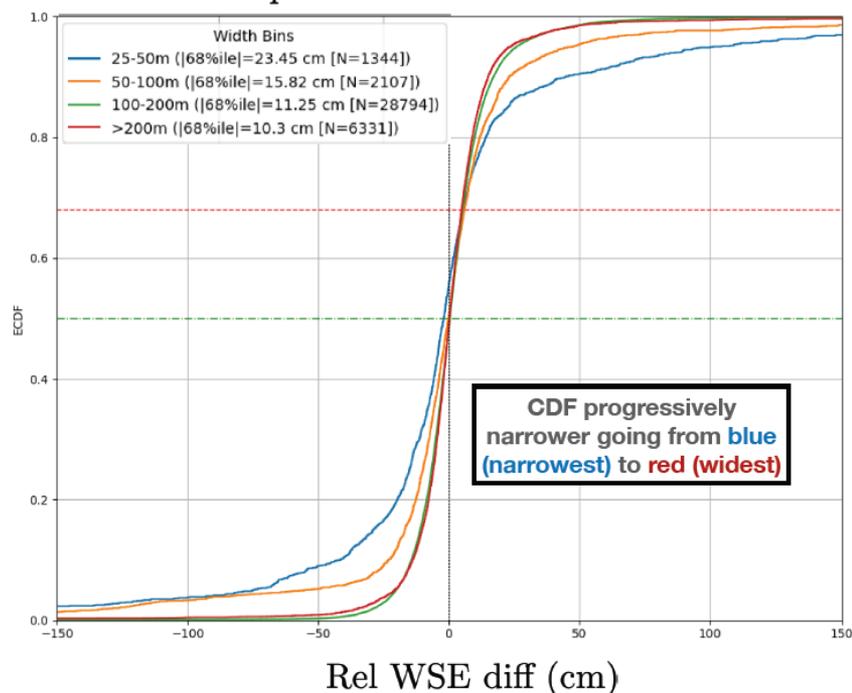
## 7c: Relationships with prior river width Node-level data; CNES/Tier 3/Tier 1 combined

This CDF combines all relative WSE node data from all measurement approaches, for a total of N=38 576 WSE comparisons.

We observe that node-level performance degrades below 100 m.

River Width	[68%ile] Node WSE performance
25-50 m	23.5 cm
50-80 m	15.8 cm
100-200 m	11.3 cm
> 200 m	10.3 cm

Rel WSE performance with Prior Width



## ➤ Accès aux données

7 TB / j -> 5 antennes -> (CNES : 3000 cœurs 18h / j) -> 20 TB / jour  
Near Real Time (qq heures à qq jours)

- CNES : DUACS/Aviso+ (LR ie Océans) & Hydroweb.next (HR ie Continents)
- NASA : PO.DAAC, Hydrocron API (<https://podaac.jpl.nasa.gov>)
  - individual river reaches and nodes found in the [SWOT L2 HR RiverSP 2.0](#) collection (Sword)
  - individual prior lakes found in the [SWOT L2 HR LakesSP 2.0](#) collection (PLD)



# ➤ Accès aux données

NASA, PO.DAAC

## Quelques Produits :

- LR interferogram
- LR Sea Surface Height
- HR River single pass
- HR River cycle average
- Lake single pass
- Lake cycle average
- Water mask pixel cloud
- Water mask raster

Surface Water and Ocean Topography (SWOT)

SWOT MISSION OCEAN TERRESTRIAL HYDROSPHERE COAST

ABOUT MISSION DATA NEWS & ANNOUNCEMENTS RESOURCES

DATA

The SWOT mission launched successfully on December 16, 2022. The table below details SWOT-relevant datasets currently at PO.DAAC. Please refer to "Mission Events" for relevant information about spacecraft events that impact data quality and availability. This page includes links to the downlink masks for the KaRIn high-rate data.

Found 56 matching dataset(s)

TABLE | LIST

Search Text

Dataset Name	Processing Level	Start/Stop	Format
SWOT Level 2 KaRIn Low Rate Sea Surface Height Data Product, Version C	2	2022-Dec-16 to Present	netCDF-4
SWOT Level 1B Low-Rate Interferogram Data Product, Version C	1B	2022-Dec-16 to Present	netCDF-4
SWOT Level 2 River Single-Pass Vector Data Product, Version C	2	2022-Dec-16 to Present	Shapefile
SWOT Level 2 River Cycle-Averaged Data Product, Version C	2	2022-Dec-16 to Present	Shapefile
SWOT Level 2 Lake Single-Pass Vector Data Product, Version C	2	2022-Dec-16 to Present	Shapefile
SWOT Level 2 Lake Cycle-Averaged Data Product, Version 2.0	2	2022-Dec-16 to Present	Shapefile
SWOT Level 2 Water Mask Raster Image Data Product, Version C	2	2022-Dec-16 to Present	netCDF-4
SWOT Level 2 Water Mask Pixel Cloud Data Product, Version C	2	2022-Dec-16 to Present	netCDF-4
SWOT Level 2 Water Mask Pixel Cloud Auxiliary Data Product, Version C	2	2022-Dec-16 to Present	netCDF-4
SWOT Level 1B High-Rate Single-look Complex Data Product, Version C	1B	2022-Dec-16 to Present	netCDF-4
SWOT Level 1B Low-Rate Interferogram Data Product, Version 1.0	1B	2022-Dec-16 to 2023-	netCDF-4

NEWS AND ANNOUNCEMENTS

RESOURCES

INRAE

Titre de la présentation

Date / information / nom de l'auteur

# ➤ Accès aux données

## CNES Aviso+ (Océans)

Fichier Édition Affichage Historique Marque-pages Outils Aide

Hydrocron Time Series API for S X Surface Water and Ocean Topog X Des données SWOT qui dépasse X SWOT L3 Ocean products X +

https://www.aviso.altimetry.fr/en/index.php?id=5483

Rechercher

Mobile version

MY AVISO+ DATA USER CORNER APPLICATIONS MISSIONS TECHNIQUES NEWS MULTIMEDIA

AVISO+ DATA PRODUCTS SEA SURFACE HEIGHT PRODUCTS GLOBAL SWOT L3 OCEAN PRODUCTS

### SWOT LEVEL 3 OCEAN PRODUCTS

Type of dataset: SWOT Sea Surface Height Data Products (SWOT\_L3\_LR\_SSH)

Digital Object Identifiers (DOIs):

- SWOT\_L3\_LR\_SSH\_Basic: 10.24400/527896/A01-2023.017 - more metadata
- SWOT\_L3\_LR\_SSH\_Expert: 10.24400/527896/A01-2023.018 - more metadata
- SWOT\_L3\_LR\_SSH\_Unsmoothed: 10.24400/527896/A01-2024.003 - more metadata

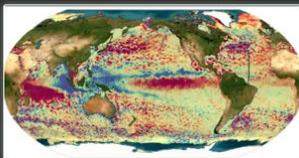
Condition of access: SWOT\_L3\_LR\_SSH is distributed by AVISO under standard AVISO+ license agreement.

Contents: The SWOT\_L3\_LR\_SSH product provides ocean topography measurements obtained from the SWOT KaRIn and Nadir altimeter instruments, merged into a single variable. The dataset includes measurements from KaRIn swaths on both sides of the image, while the measurements from the Nadir altimeter are located in the central columns. In the areas between the Nadir track and the two KaRIn swaths, as well as on the outer edges of each swath (restricted to cross-track distances ranging from 10 to 60 km), default values are expected.

Use: SWOT\_L3\_LR\_SSH is a cross-calibrated product from multiple missions that contains only the ocean topography content necessary for thematic research (e.g., oceanography, geodesy) and related applications. This product is designed to be simple and ready-to-use, and can be combined with other altimetry missions. The SWOT\_L3\_LR\_SSH product is a research-orientated extension of the L2\_LR\_SSH product, distributed by the SWOT project (NASA/JPL and CNES). SWOT\_L3\_LR\_SSH is managed by the SWOT Science Team project [DESMOS](#).

Description: The SWOT\_L3\_LR\_SSH product is organized in 3 subproducts:

- Basic L3\_LR\_SSH (or lightweight), which includes only SSHA (Sea Surface Height Anomaly) and mean dynamic topography.
- Expert L3\_LR\_SSH (or extended), which includes the backscatter coefficient ( $\sigma_0$ ), the mean sea surface (MSS) and geostrophic currents (absolute and anomalies) in addition to SSHA and mean dynamic topography (MDT). It also integrates a quality flag, corrections and external models as separate layers.
- Unsmoothed L3\_LR\_SSH: which includes the MSS, MDT and geostrophic currents (absolute and anomalies) in addition to the SSHA and MDT on the 250 m KaRIn native grid. Like the Expert subproduct, it also integrates a quality flag, corrections and external models as separate layers.



Example of Level-3 SSHA composite (unit: cm) for January 2024 (ascending passes). Credits CNES,CLS.

Products guide

Products

Sea surface height products

Global

**SWOT L3 Ocean products**

SWOT KaRIn Low Rate Ocean products

ALTimetry Innovative Coastal Approach Product (ALICAP)

Simulated SWOT products

SSALTO/DUACS Experimental products

Experimental Multimission Gridded L4 sea level heights and velocities with SWOT

SSALTO/DUACS Experimental products including CFOSat for wave-current interactions studies

Gridded sea level heights and derived variables - Multiscale Interpolation

Gridded sea level heights and derived variables - Multiscale Interpolation combining altimetry and drifters

Gridded velocities - altimetry and SST

Gridded Mean and Climatology

SSHA

Along-track Sea Level Anomalies (L2P)

GDR, IGDR and OGDR

Experimental Sentinel-6 products

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Geographic coverage: global

Discover AVISO+

Customizable home, reading tools, products search guide, etc.. Discover step by step the features of the new site AVISO+.

1

# ➤ Accès aux données

Hydroweb Next (Rivières : Sword & Lacs : PLD = Prior Lake Database)

<https://hydroweb.next.theia-land.fr/>

The screenshot displays the Hydroweb Next web application interface. At the top, there is a navigation bar with tabs for 'Project', 'Timeline', and 'Download'. A search bar is located in the center, and a 'Rechercher' button is on the right. Below the navigation bar, a map of the region around Toulouse, France, is shown with a blue river network. To the right of the map is a 'Where' panel with options to 'Pick results by area', including 'Anywhere' and 'In map view'. Further right is a 'Map selection' panel with a list of data series:

- SWOT Level-2 HR River Single Pass - Reach.3
  - 23214200931
    - Water Surface Elevation: 163.084m
    - Selection period on timeline
    - Drawing
  - 23214201024
    - Water Surface Elevation: 171.883m
    - Selection period on timeline
    - Drawing
  - 23214201031
    - Water Surface Elevation: 173.378m
    - Selection period on timeline
    - Drawing

At the bottom, a 'Timeline' panel shows a horizontal axis for the years 2022, 2023, and 2024, divided into trimesters. Three data series are plotted as horizontal bars with selection windows:

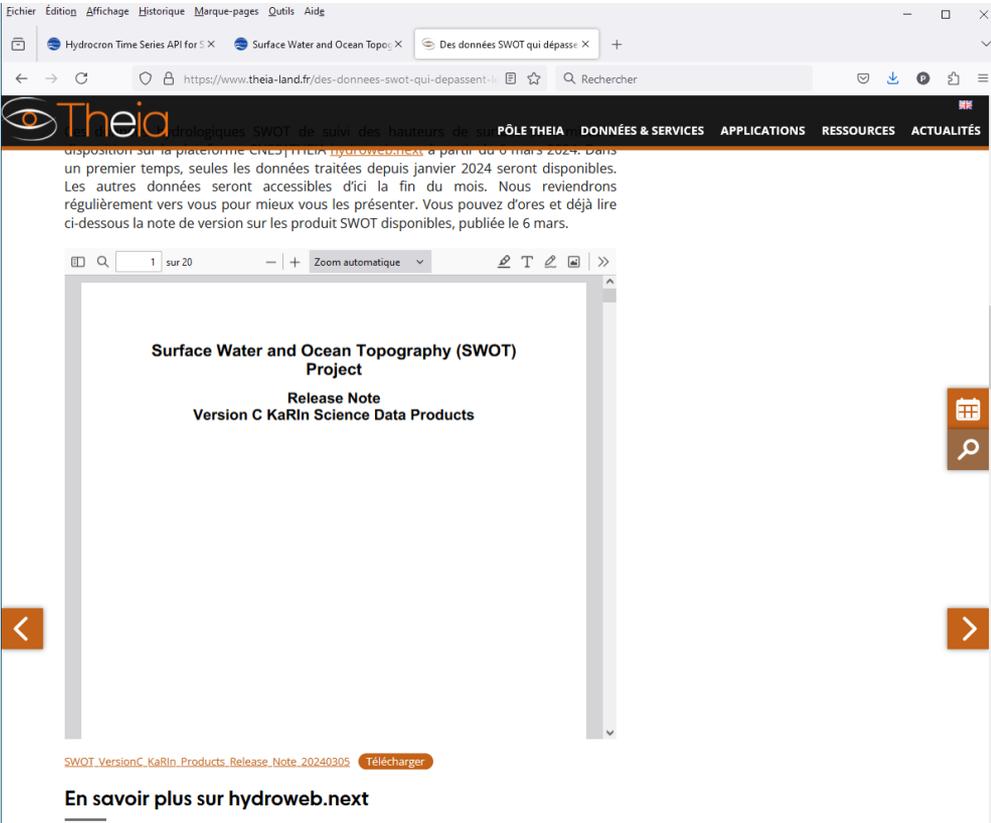
- SWOT Level-2 HR River Single Pass - Reach.3 (orange bar, selection window in Jun 2024)
- SWOT Prior Lake Database (teal bar, selection window in Nov 2022)
- SWOT Level-2 HR River Single Pass - Reach.2 (orange bar, selection window in Mar 2024)

The footer contains copyright information: '© Leaflet · OpenStreetMap contributors, tiles style by Humanitarian OpenStreetMap Team, hosted by OpenStreetMap France' and location/timezone data: 'Europe/Paris (UTC+1h/2h) 44.984 8.215'.

## ➤ Accès aux données

Document de référence sur les données (6 Mars 2024, version C)

- [https://www.theia-land.fr/wp-content/uploads/2024/03/SWOT\\_VersionC\\_KaRIn\\_Products\\_Release\\_Note\\_20240305.pdf](https://www.theia-land.fr/wp-content/uploads/2024/03/SWOT_VersionC_KaRIn_Products_Release_Note_20240305.pdf)



The screenshot shows a web browser window displaying a document from the website [www.theia-land.fr](https://www.theia-land.fr). The document is titled "Surface Water and Ocean Topography (SWOT) Project Release Note Version C KaRIn Science Data Products". The page content includes a paragraph about the availability of data on the CNEOS platform starting from March 6, 2024, and a "Télécharger" button for the PDF document.

Surface Water and Ocean Topography (SWOT) Project  
Release Note  
Version C KaRIn Science Data Products

SWOT\_VersionC\_KaRIn\_Products\_Release\_Note\_20240305 Télécharger

En savoir plus sur [hydroweb.next](https://hydroweb.next)

INRAE

Titre de la présentation

Date / information / nom de l'auteur

# ➤ Accès aux données

Base statique SWORD (Rivers). V16, bientôt v17 (Novembre 2024 ?)

Fichier Édition Affichage Historique Marque-pages Outils Aide

hydroweb.next x SWOT River Database (SWORD) x +

https://www.swordexplorer.com

Rechercher

SWOT River Database (SWORD)  
Interactive Dashboard

About Download

Africa Asia Europe & Middle North America Oceania South America

SWOT Version 16 Basin 23

**\*\*PLEASE NOTE: Reach geometries have been simplified for map efficiency, however, some large basins (i.e. Amazon, Ganges-Barmaputra) may still take a few moments to load.\*\***

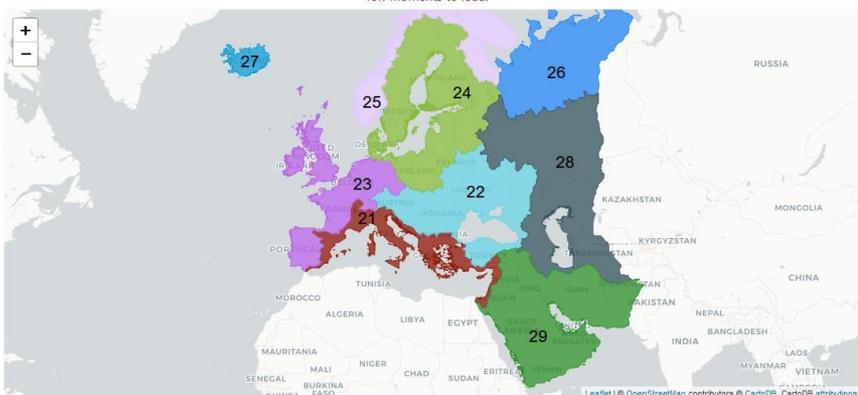
cartodbpositron  
Esri Satellite  
 Reach ID  
 Water Surface Elevation (m)  
 Width (m)  
 Flow Accumulation (sq.km)  
 Distance From Outlet (m)  
 Slope (m/km)  
 SWOT Observations

La Rochelle\* Limoges\* BORDEAUX\* Toulouse\* Montpellier\* Nîmes\* Marseilles\* Toulon\* GENEVA\* ALPES D'A\* OCCITANIE NOUVELLE-AQUITAINE CANTABRIA BASQUE

<https://www.swordexplorer.com>

# ➤ Fleuves couverts en France

<https://www.swordexplorer.com/>



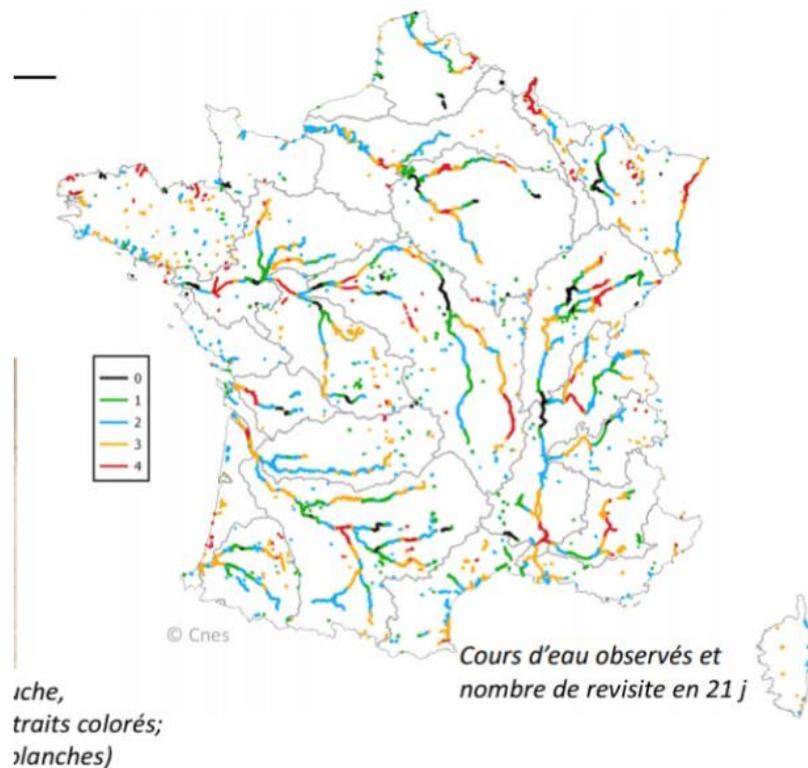
Type a Reach ID and click ENTER or "Plot Reach" to see node level attributes:  
(click "Report Reach" to file a problem with a reach)

81247100041

Plot Reach

Report Reach

Reach 81247100041: Node Level Attributes



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# ➤ SWORD database

## Datasets

Dataset	Attribute Contribution
<b>Global River Widths from Landsat (GRWL)</b> <i>(Allen and Pavelsky, 2018)</i>	Provides river centerline locations at 30 m resolution and associated width, water body type, and number of channels attributes.
<b>MERIT Hydro</b> <i>(Yamazaki et al., 2019)</i>	Provides river surface elevation and flow accumulation at 3 arc-second resolution.
<b>HydroBASINS</b> <i>(Lehner and Grill, 2013)</i>	Provides Pfafstetter basin codes.
<b>Global Reservoir and Dam Database (GRanD)</b> <i>(Lehner et al., 2011)</i>	Provides global locations for large dams.
<b>Global River Obstruction Database (GROD)</b> <i>(under development, UNC)</i>	Provides global locations of all river obstructions along the GRWL river network.
<b>Global Delta Maps</b> <i>(Tessler et al., 2015)</i>	Provides the spatial extent of 48 of the world's largest deltas.

# ➤ Accès aux données

SWOT DATA VIEWER: <https://swotvis.cuahsi.io>

The image displays two screenshots of the SWOT DATA VIEWER web application. The left screenshot shows the 'MAP' view, featuring a map of France with a blue river network. The right screenshot shows the 'PLOTS' view, displaying a time series plot for 'La Garonne | 23214400091 - Water Surface Elevation'.

**Variables**

- WSE
- SLOPE
- WIDTH
- AREA\_TOTAL

**Plot Options**

- Data Quality

Date	Water Surface Elevation (m)
Feb 2024	137.0
Feb 2024	138.0
Feb 2024	144.5
Feb 2024	152.5
Mar 2024	137.5
Mar 2024	138.5
Mar 2024	142.5
Mar 2024	143.5
Mar 2024	144.0
Apr 2024	136.5
Apr 2024	137.0
Apr 2024	137.5
Apr 2024	138.5
May 2024	139.0
May 2024	152.0
Jun 2024	137.0
Jun 2024	146.0
Jun 2024	145.5
Jul 2024	136.5
Jul 2024	137.0
Jul 2024	137.5
Jul 2024	138.0
Jul 2024	139.0
Jul 2024	144.0
Aug 2024	135.5
Aug 2024	137.5
Aug 2024	138.0
Aug 2024	144.0
Sep 2024	137.5
Sep 2024	144.5
Sep 2024	146.5
Oct 2024	136.5
Oct 2024	137.5
Oct 2024	144.5
Oct 2024	146.5
Oct 2024	137.0

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# ➤ Applications

Sur le Rhin (Ledauphin, Yésou et al)

30 Years of Progress in Radar Altimetry Symposium  
2-7 September 2024 | Montpellier, France

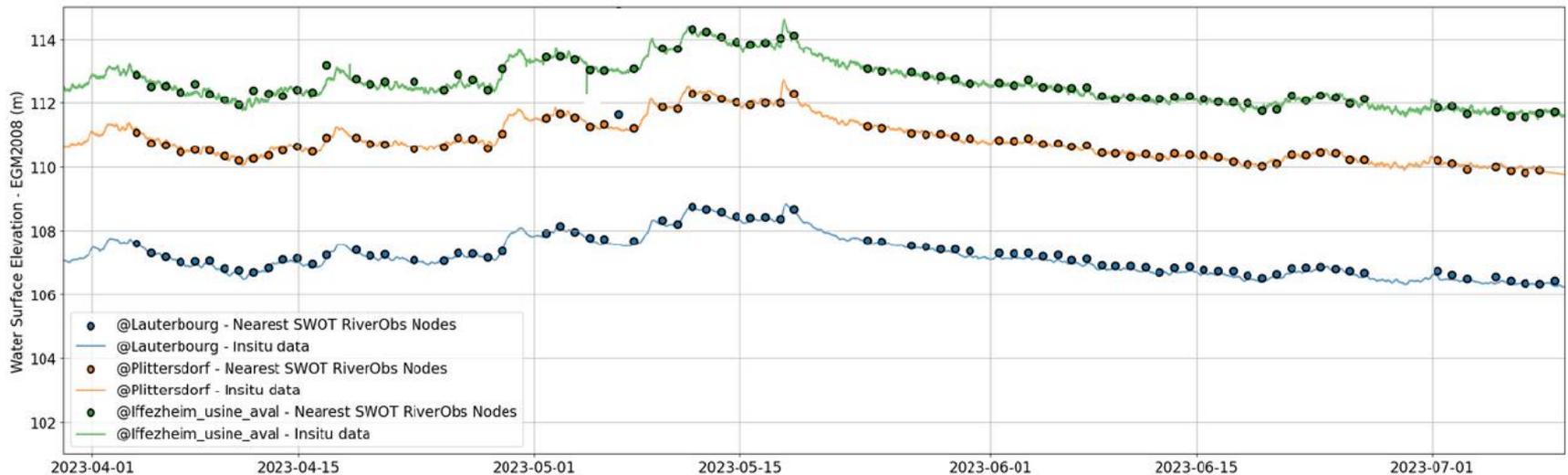


## At station scale : comparison insitu data vs nearest node



Example of the stations located on the reach between Iffezheim and Lauterbourg (last reach)

Station	WSE Error Sigma0 (m)
Iffezheim usine aval	0.09
Plittersdorf	0.09
Lauterbourg	0.11

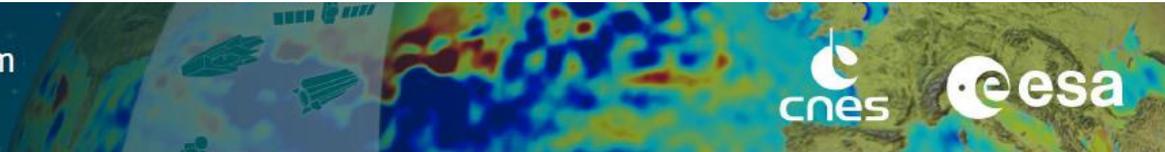


# ➤ Applications

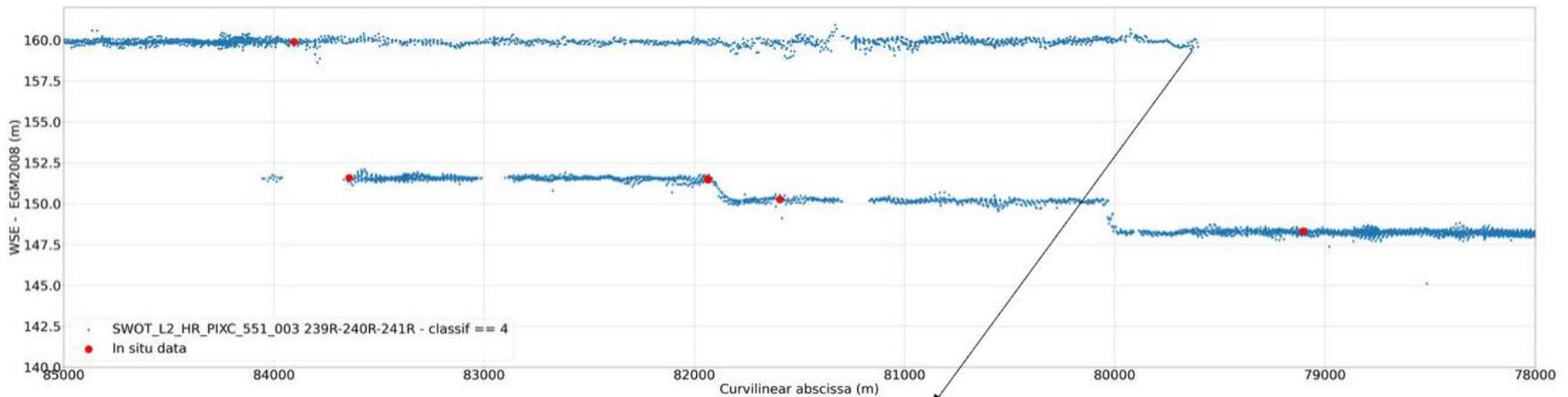
Sur le Rhin (Ledauphin, Yésou et al)

Utilisation du Pixel cloud pour contourner des problèmes de Sword v14

30 Years of Progress in Radar Altimetry Symposium  
2-7 September 2024 | Montpellier, France



## Gerstheim Dam (GCA)



- ~12 meter dam
- In line with EDF dam's description

# ➤ Calcul des débits ?

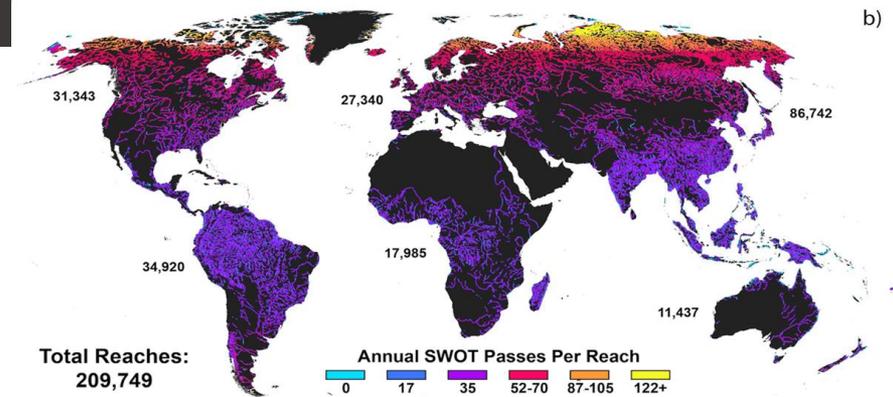
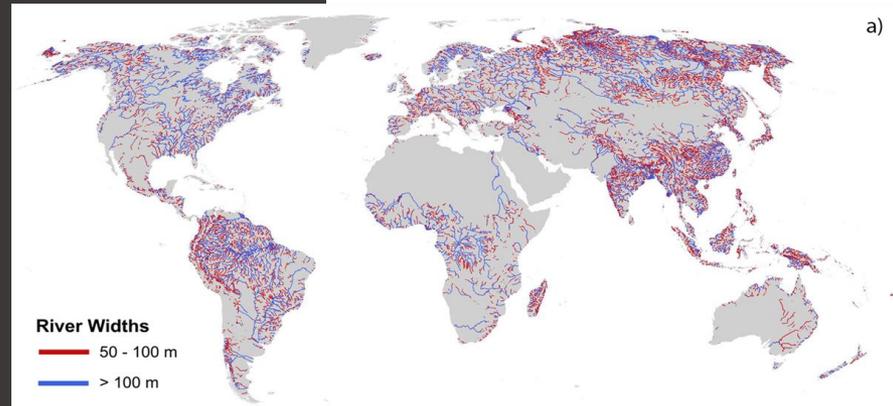
"Official" Discharge Product :



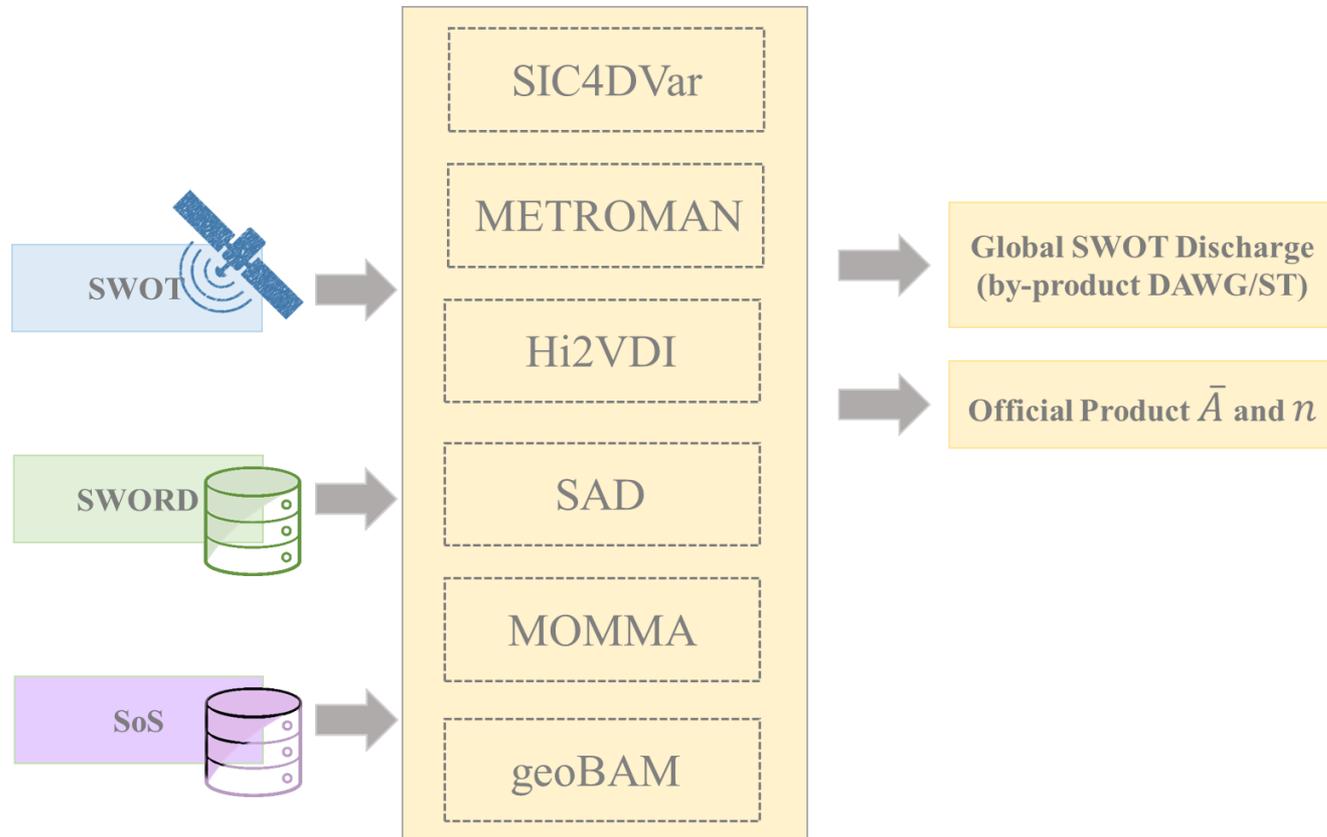
$$Q_i = \frac{1}{n} (\bar{A} + A'_t)^{\frac{5}{3}} W_i^{-\frac{2}{3}} S_i^{\frac{1}{2}}$$



SWOT  
Discharge  
Algorithm



# ➤ Calculs des Débits des Fleuves

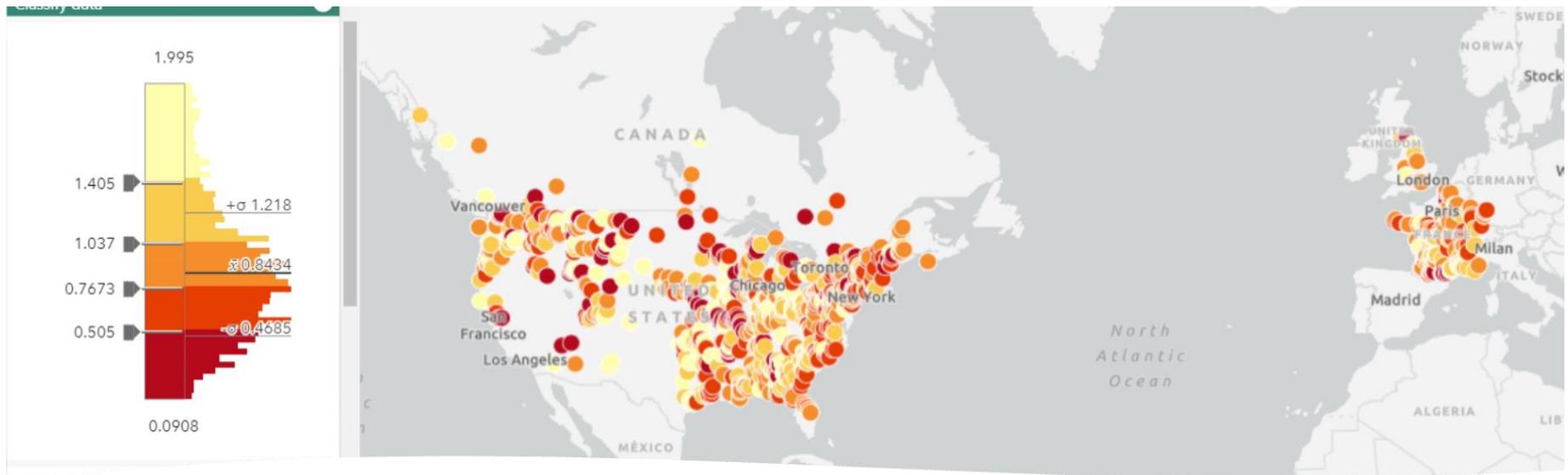


# ➤ DAWG (Discharge Algorithm Working Group)

## SWOT Discharge ALGORITHMS

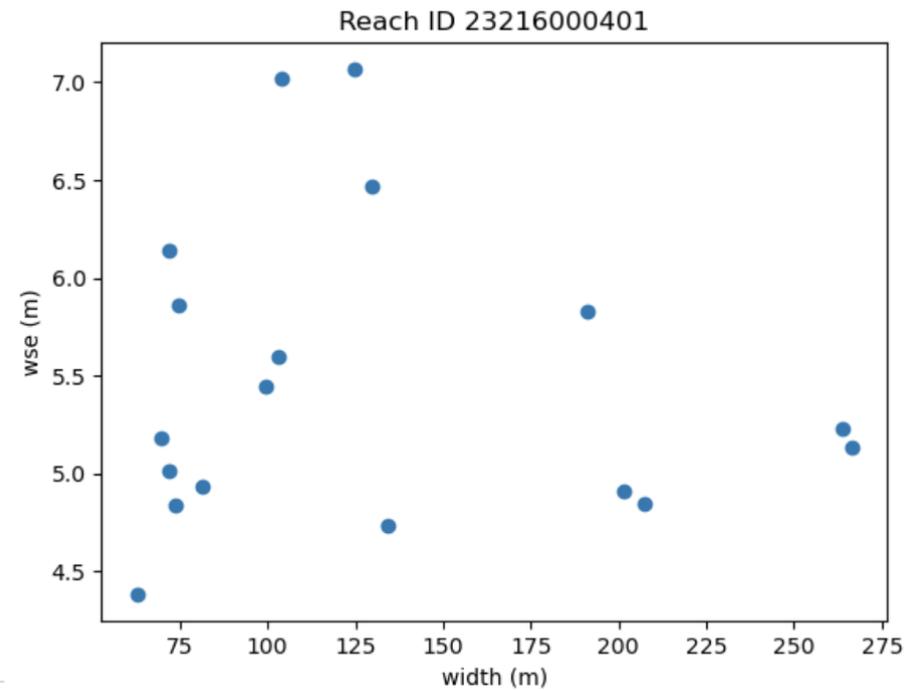
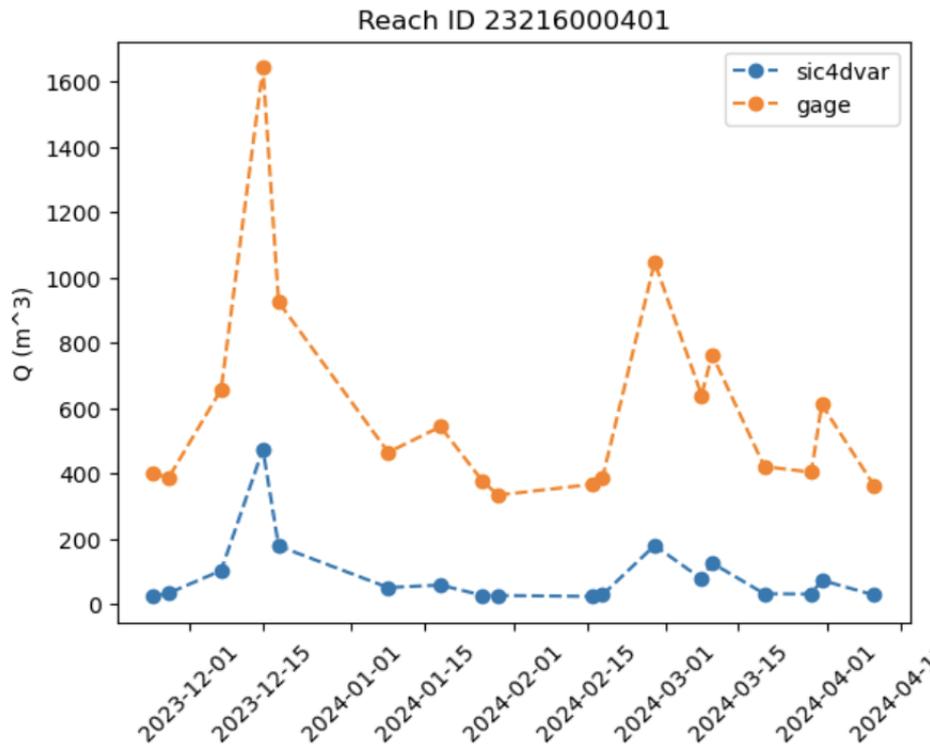
Algorithm	Theoretical basis	SWOT data	Method
<b>geoBAM</b>	Hydraulic geometry + Manning's eq.	Water surface width (W), slope (S), cross-sectional area anomaly ( $\delta A$ )	Bayes
<b>MetroMan</b>	Manning's eq. w/o Q	Water surface height (H), W, S, $\delta A$	Bayes
<b>Hi2VDI</b>	1D Saint-Venant + Manning's eq.	H, W, S, $\delta A$	Assimilation Machine Learning
<b>SAD</b>	Gradually varied flow + Manning's eq. + hydraulic geometry	H, W, S	Assimilation
<b>SIC4DVAR</b>	1D Saint-Venant	H, W, S	Assimilation
<b>MOMMA</b>	Empirical form of Manning's eq.	H, W, S	Calibration

## ➤ Premières comparaisons des Q(t)

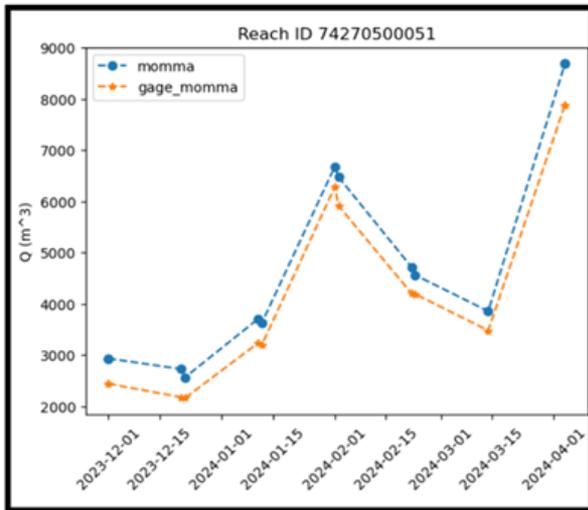


La chaîne opérationnelle (Confluence) fonctionne  
La base SoS est disponible (NASA & CNES)  
Comparaisons par rapport à des centaines de stations in-situ  
Variabilité des Q(t) à comprendre et améliorer  
Problème important dû aux largeurs pas toujours très fiables  
Gros travail en cours et à venir ...

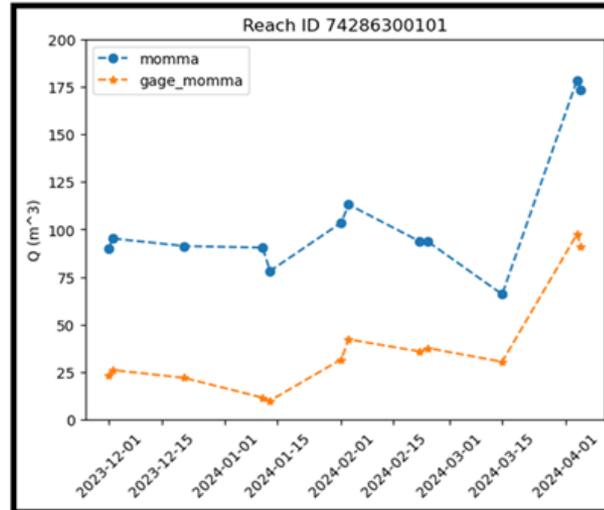
# ➤ Illustration de difficultés pour $Q(t)$



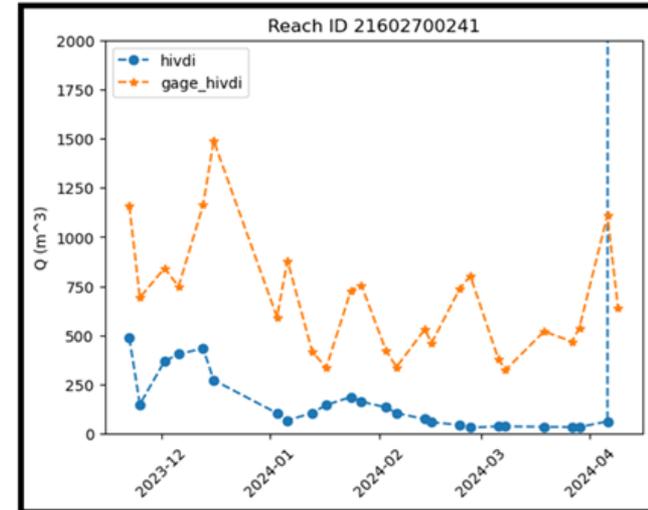
# ➤ Q(t) : Good, Bad & Ugly



Good



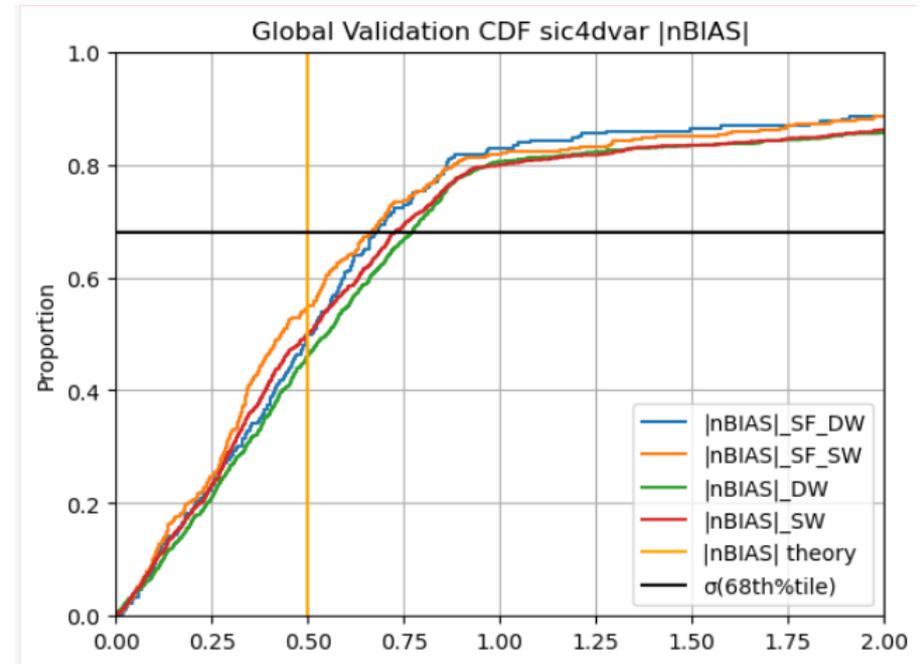
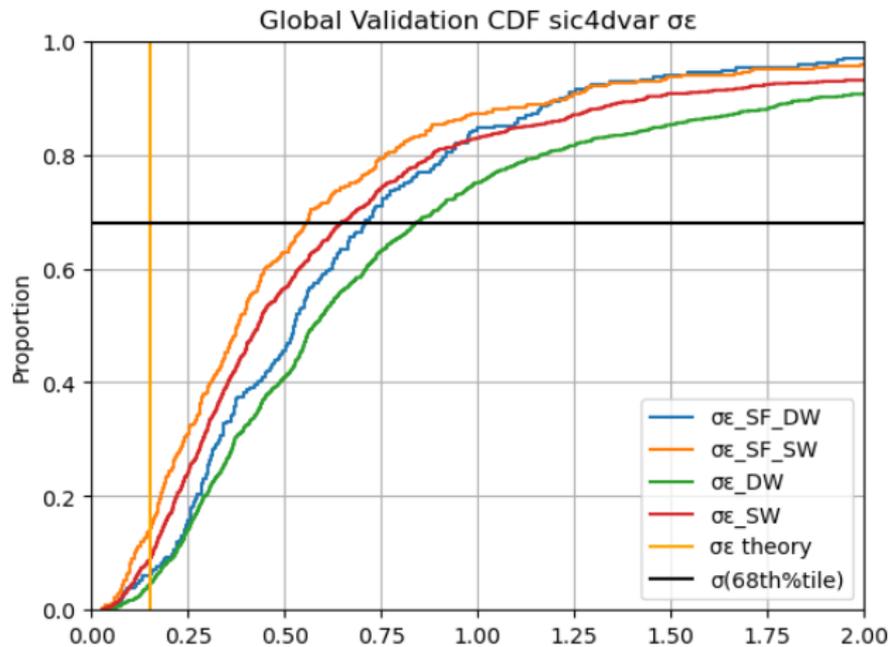
Bad (bias)



Ugly (bias & dynamics)



## ➤ Illustration de difficultés pour $Q(t)$



SF\_DW n= 151  
SF\_SW n= 437  
DW n= 644  
SW n= 968

## ➤ Perspectives et Suites

30 ans de travail en perspective ...

- Q(t) sur 10% des biefs en Novembre 2024 sur Sword v16. Produit global en 2025 sur Sword v17
- Séminaire DAWG à Montpellier les 11-14 Février 2025
- Produit débit opérationnel en 2025 (Confluence USA avec 6 algorithmes + le consensus + calculs sur AWS & CNES)
- Centre d'Expertise Hydrologie Multi-Mission (CNES), sur sites spécifiques (Maroni, Garonne, Ohio), puis France, puis ...
- Durée de vie initiale prévue de 3 ans (2026 ?), ou plus si tvb ... (et réentrée contrôlée)



## ➤ Perspectives et Suites

Futures missions sur les rails ...

- Sentinel 3 NG-TOPO : 2 altimètres à large fauchée et lancé après 2030, prolongera les avancées initiées par SWOT (ESA Copernicus)
- Smash : 10 petits satellites embarquant un altimètre (bande Ka) optimisé pour le suivi des eaux continentales. Avec des acquisitions journalières : Priorité P0 (ou « majeure » ) (info du 10 Oct 2024). Financement avec partenaire privé (BWI – Hemeria Group ?), BPI France 2030 ?
- SWOT-LAND OCEANIC AQUATIC CONTINUUM (LOAC) ?



## ➤ Perspectives et Suites

Science participative ...

- [LOCSS Area App on Google Play](#)
- Lake Observations by Citizen Scientists and Satellites (LOCSS)
- Contribuer à aider à comprendre la capacité de SWOT à distinguer l'eau de la terre
- pour collecter des données sur les emplacements des limites eau/terre et les envoyer et les comparer à SWOT
- Android app

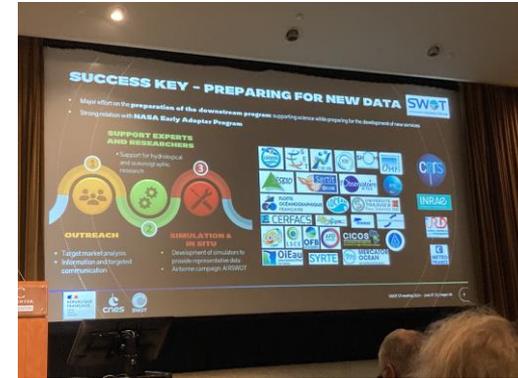


## ➤ Conclusions

- Première mission satellitaire dédiée majoritairement à l'hydrologie continentale
- Grand succès, supérieur aux attentes en altimétrie, en détection des objets divers (océans, icebergs, côtier, lacs, rivières, zones humides, glace, dune, vents de surface, vitesse et direction, etc)
- Y compris avec neige ou glace. Y compris sous végétation (angle d'incidence 0.6-3.9°)
- Difficultés à résoudre sur les masques en eau (largeur des rivières, surfaces les lacs) : en cours d'amélioration. Mais très bon pour voir les humidités de surface (cf. Sentinel 1)
- Les traitements HR sont bien plus complexes que LR, et nouveaux ... fort potentiel d'amélioration pour SWOT et les missions suivantes (FP DEM, Geoid, X-cal, etc.)



## ➤ Conclusions



- Travaux sur l'amélioration des traitements des données
- Favoriser la recherche en hydrologie et océanographie
- Favoriser les applications aval  
(gestion des fleuves transfrontaliers, inondations, gestion de l'eau, navigation, épidémies, pêche, biodiversité, etc)
- Intégration en cours dans les chaines opérationnelles  
(Copernicus Marine Service, etc)
- Intégrations dans des Systèmes d'Informations Hydrologiques
- Evolutions futures de Sword et PLD ? (ex: objets plus petits)



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# ➤ Merci. Questions et Remarques ?

Science Team SWOT, Septembre 2023, Toulouse



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Date / information / nom de l'auteur

Toute la matière de cette présentation vient de  
cette communauté

