



An interactive website for enhancing the Open-Loop Tracking Command (OLTC) of conventional altimeters for inland waters observations



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Jason-3 capability over inland waters

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A database of hydrology targets for the new DEM onboard Jason-3

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CNES, Sophie Le Gac

Satellite radar nadir altimeters have been widely used to measure river and lake surface water elevations for the last two decades.

However, since these instruments are primarily designed to observe ocean surface topography, they are not always able to observe inland waters. For rivers running in valleys not wider than a few kilometers and surrounded by slopes higher than 50 meters, altimeters tend to observe the top of the surrounding topography rather than the river itself.

This occurs for all river widths, but is more frequent for smaller rivers. The altimeter instrument on Jason-3, launched in January 2016, operates in "Diode/DEM" tracking mode or Open-Loop mode (OL) which is designed to overcome this issue. The altimeter uses an onboard Digital Elevation Model to set the echoes reception window. This tracking mode has proven efficient, however, it requires a *priori* knowledge of the target elevation with fairly good exactitude (typically a dozen or so meters). It is no minor task to collect data which meet this constraint on a global scale.

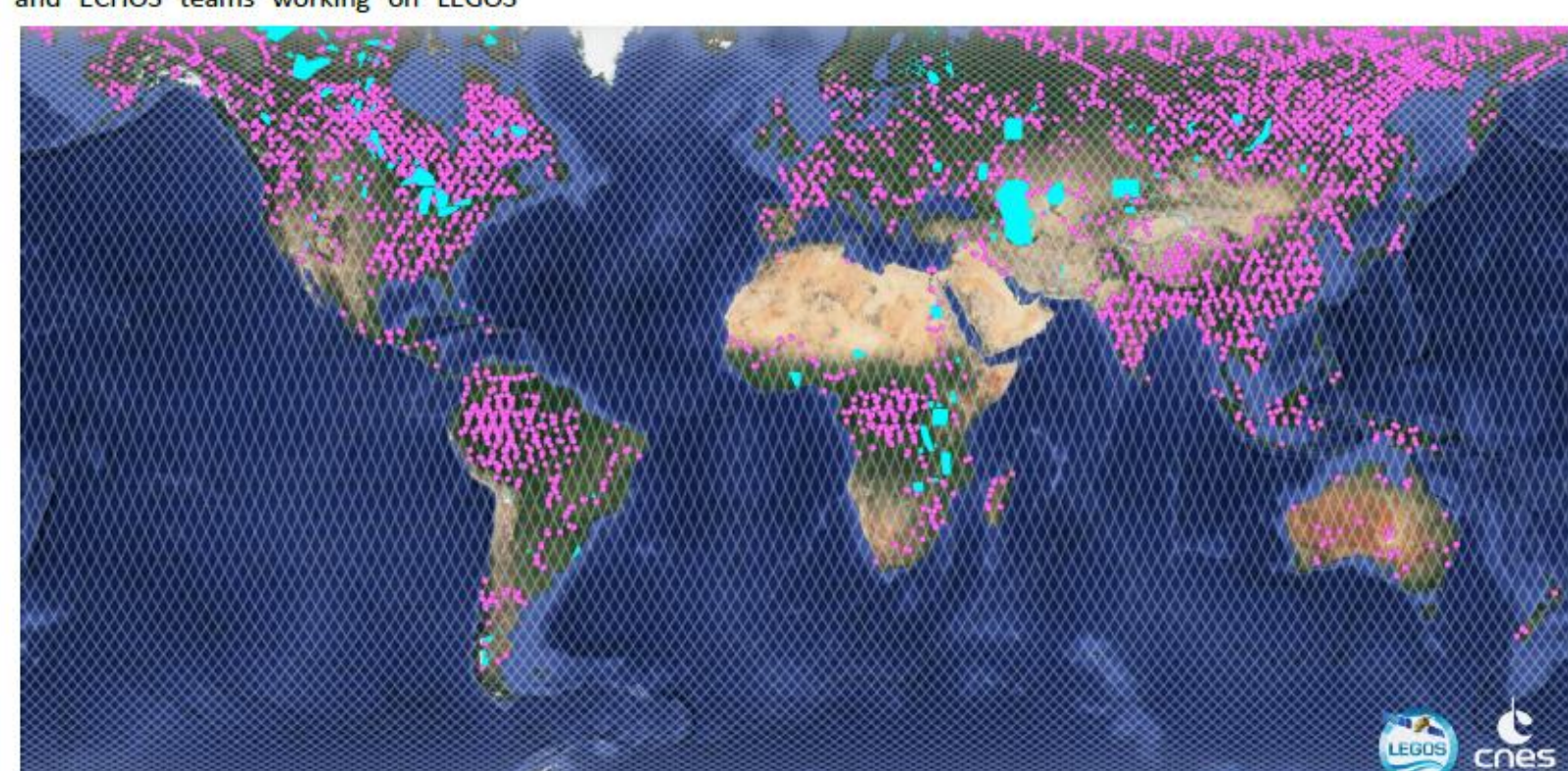
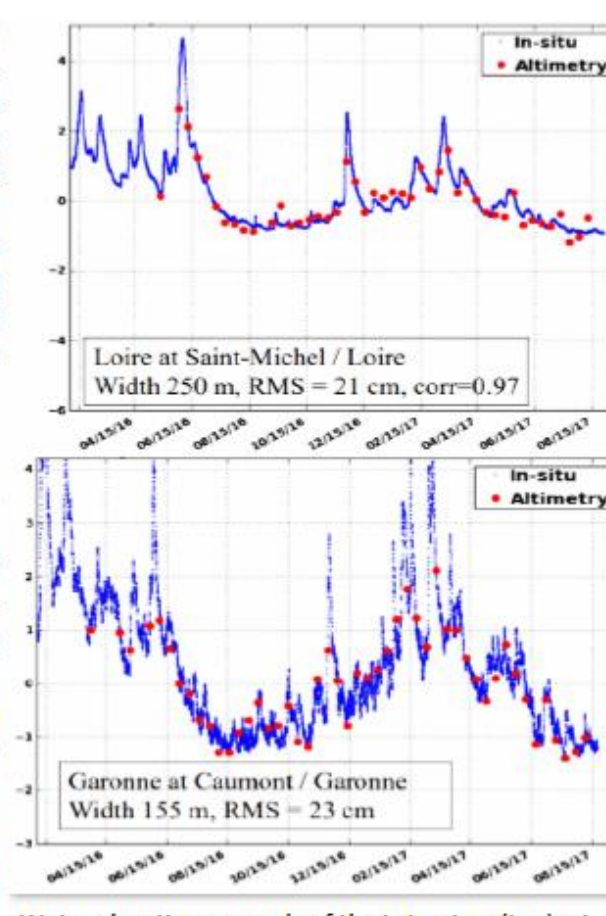
This is why, given the interest for the entire hydrology community, the CTOH and ECHOSS teams working on LEGOS

and CNES teams have combined their technical and scientific expertise to implement the right strategy. The database was thus recently enlarged with about 4,700 targets (lakes and rivers) all over the world to build the new Jason-3 onboard DEM which was uploaded at the end of August 2017 and has been activated since Cycle 57, track 160.

Validation

This upload was very successful and the validation done over four cycles shows that the altimeter performance over inland waters has been significantly improved. For example, it has been shown that "small" rivers such as the Loire or the Garonne in France, which had never been observed in the past by the Jason satellites, are now observed for each overpass.

A much larger scale validation was performed in two steps. (1) Validation on a global scale using a high backscatter coefficient (sigma0) as a proxy to ensure that



Current Jason-3 onboard DEM targets operational since Cycle 57, pass 160 (August 31st, 2017), including 355 lakes from Hydroweb database (in blue) and 4,366 rivers and lakes (in pink). Credits CNES/LEGOS.

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the altimeter is indeed tracking water (not shown here, see details on the poster presentation, part 5). (2) Visual validation using human expertise for a sample of 100 stations randomly located around the globe (map below). The result of this validation is shown in the table below.

Access to the database

Users are strongly encouraged to "dive" into Jason-3 data over hydrological targets. The database of targets (lakes and rivers) is available upon request in shapefile or text format. Please send your request and any comment/



Map on the left: location of the 100 stations (yellow dots) superimposed to the Jason-3 ground tracks. Table on the right: Percentage of occurrence of water observation in the Open-Loop (OL) mode is 91% while it was only 34% in the classic autonomous or so called Closed-Loop (CL) mode. 124 stations already in OL mode during cycles 53 to 56.

References:

- Blumstein D., et al., A Database Of Hydrology Targets For The New DEM Onboard Jason3, OSTST 2017, Miami.
- Biancamaria S. et al., Validation of Jason-3 tracking modes over French rivers, RSE, in press.
- Le Gac S., Update and validation of the onboard Jason-3 DEM for enhanced acquisitions over inland water targets, OSTST 2017, Miami.

	Closed-Loop	Open Loop
Tracking water	41 (54%)	91 (91%)
Not tracking water	35 (46%)	9 (9%)
total	76 (1)	100

What are OLTC tables ?

The Diode/DEM tracking mode, also called « Open-Loop Tracking Command » (OLTC), is the nominal operating mode :

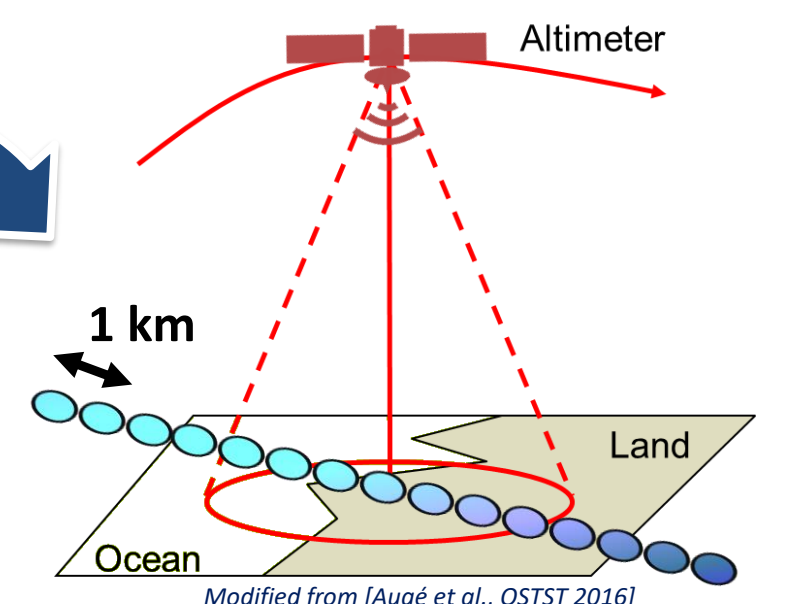
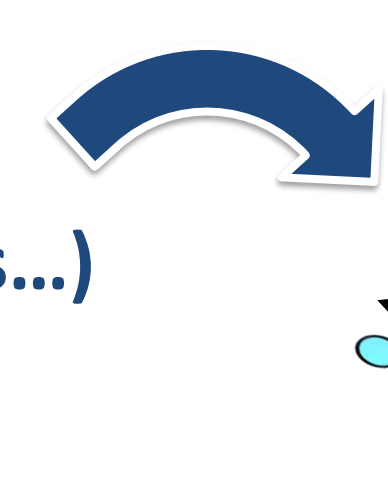
- For Jason-3/POSEIDON-3B, over all surfaces incl. oceans and inland waters. Jason-3 has the ability to switch automatically between Autonomous and Diode/DEM tracking modes
- On Sentinel-3 SRAL altimeters, a tracking mode mask is defined : areas of interest define where SRAL is operated in Open-Loop (OL) mode.

OLTC tables are generated on ground and uploaded onboard.



Users define targets (rivers, lakes, dams, glaciers...)

Location and elevation of water bodies are defined using surface masks and digital elevation models



Altimeter data analysis

Continuous, reliable timeseries of water surface height can be derived for water bodies defined in the OLTC tables.

OLTC tables computation

- Sampling along the orbit : 0.01° (~1 km)
- Elevation assigned to the nadir point
- Priorities between surfaces : Transponder > Ocean > Inland waters
- Coding and compression for onboard memory



Upload OLTC tables

OLTC tables can be **updated** (modification of existing elevations) or **upgraded** (addition of numerous virtual stations) pending operational constraints (telecommands needed).

Global map of the echo presence flag over 4366 virtual stations defined in Jason-3 onboard DEM v3.0 (green = success, 95.8%) for cycle 84 (May 2018).

https://www.altimetry-hydro.eu

A new website, developed by Noveltis and CNES for ESA, offers the possibility to display OLTC elevation tables onboard ESA Sentinel-3 SRAL altimeters.

An interactive map allows all visitors to view elevations defined onboard Sentinel-3 altimeters and navigate over inland water targets worldwide.

Several visualization tools have been added to enhance the OLTC website experience: choice of map layout, display of satellite ground tracks and areas of interest.

- ✓ Choice of mission (S3A/B/C/D)
- ✓ Choice of map layout (aerial / road)
- ✓ Display of satellite passes (at a sufficient zoom level)
- ✓ Display of OLTC areas of interest
- ✓ Basic toolbox for zoom, distance calculator, ...
- ✓ Contribution tools : for registered users only

Also available :

- ✓ Frequently Asked Questions (FAQ)
- ✓ Help page
- ✓ Contact form

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OLTC : Altimeter Open Loop Tracking Command for Hydrology Monitoring

VISITOR

- View on board elevations
- Basic toolbox
- Contribute to the database

ENTER

CONTRIBUTOR

- View on board elevations
- Basic toolbox
- Contribute to the database

Username

Password

Forgot password or username ?

LOGIN

SIGN UP

Mission Configuration

Satellite : s3a

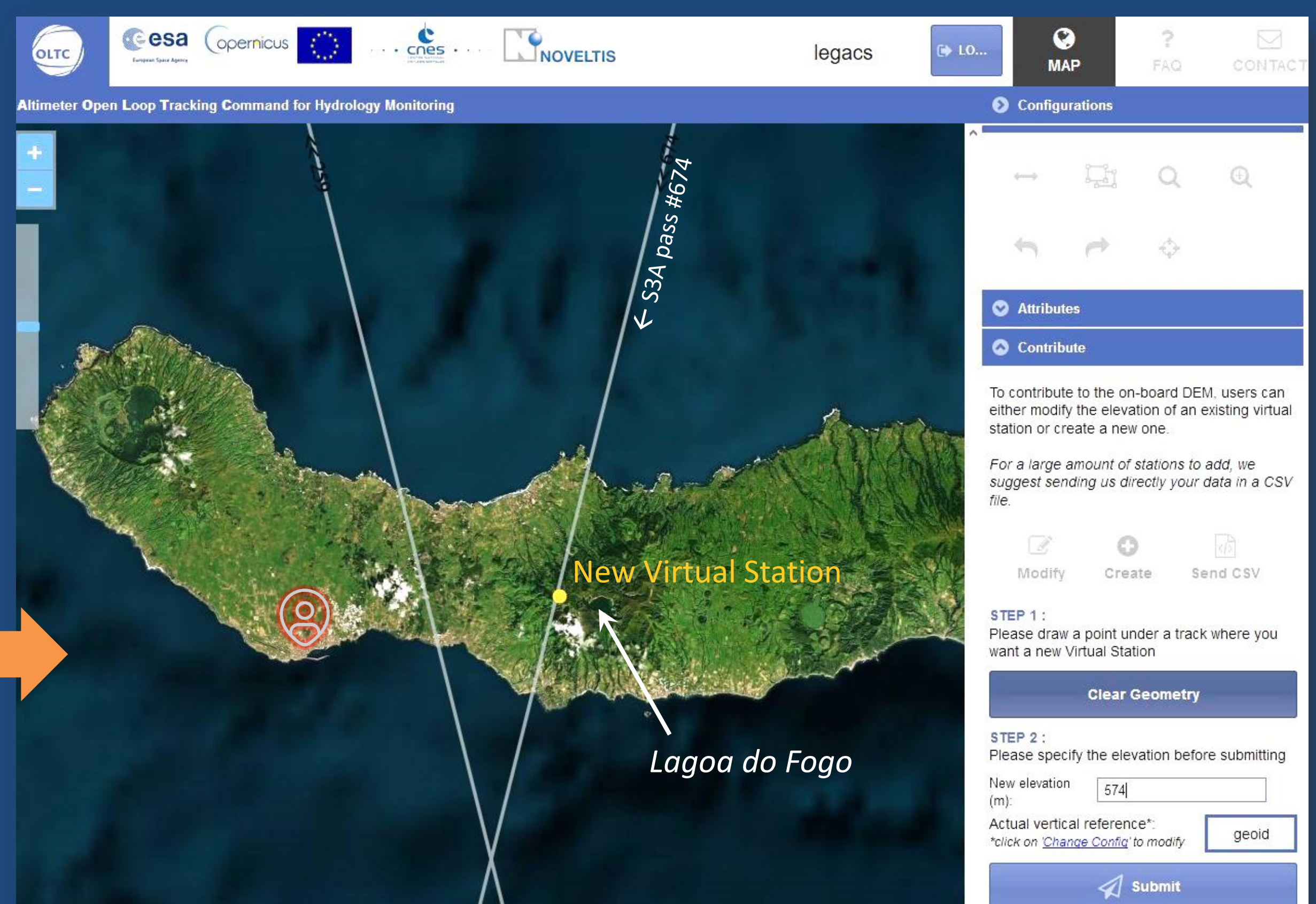
DEM : v4_2

DEM : v4_1
Date start : 2016-04-18
Date end : 2016-05-24

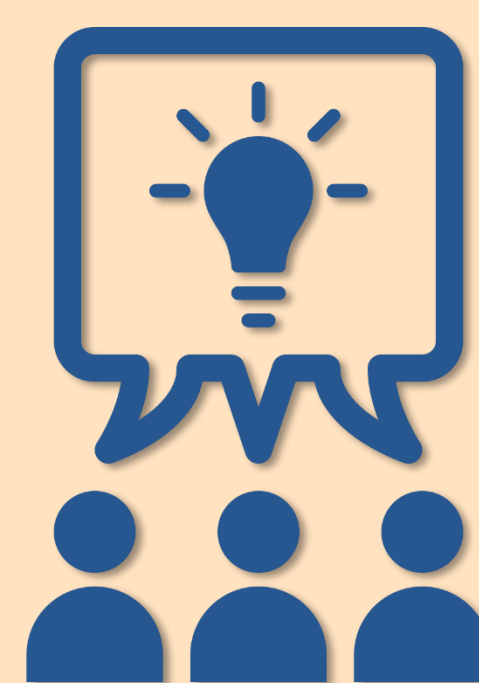
DEM : v4_2
Date start : 2016-05-24
Date end :

Reference : geoid

LOAD LAYERS



You can contribute to the database of targets !



1. Sign up (directly on the welcome page or through the "Contribute" tab)
2. Log in and you will have access to the "Contribute" tool
3. Browse the map to the desired area (inside Sentinel-3A or Sentinel-3B OLTC areas of interests)
4. Add virtual station(s) by clicking on the map (under the satellite ground track and the water body) and fill in the elevation!
Alternatively, you can send us a text file with a detailed list and description of targets.
5. Once reviewed and approved by the OLTC database Committee, your target(s) will be uploaded onboard !

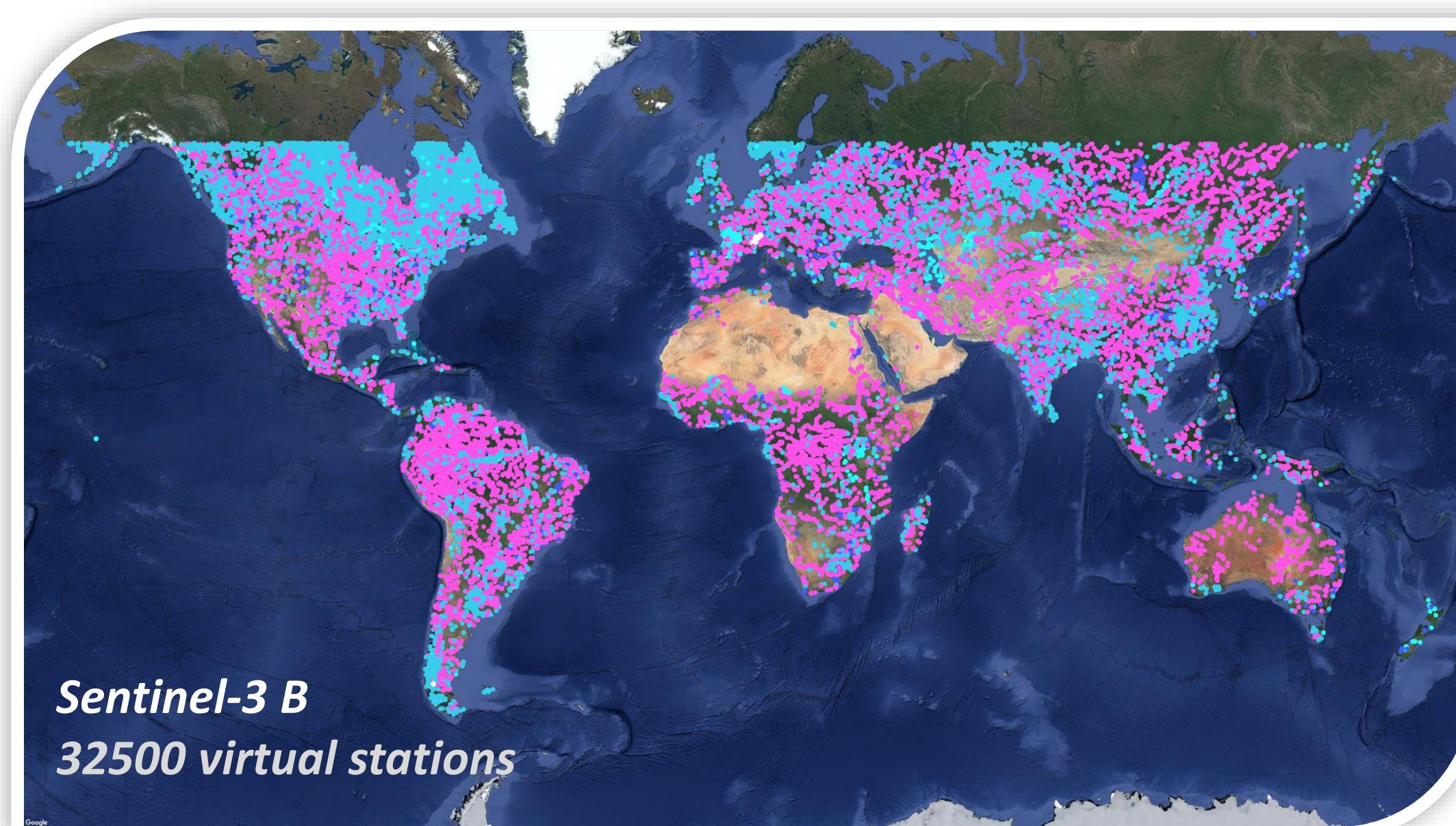
NEW !! 2018 Upgrade

A major upgrade will be performed on Sentinel-3B and Sentinel-3A OLTC tables in 2018.

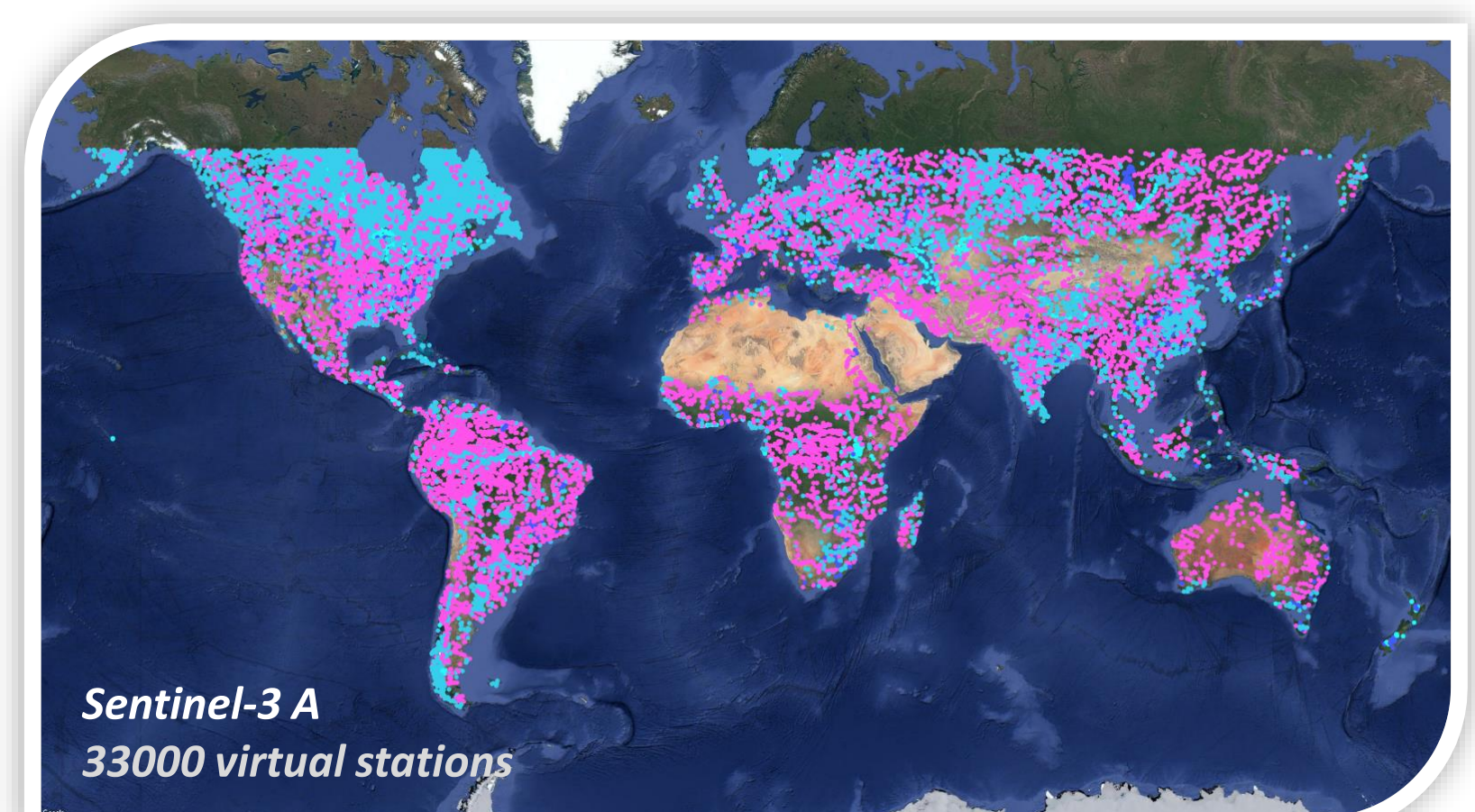
LEGOS and CNES have provided more than 65 000 virtual stations worldwide to enhance the performance of SRAL altimeters over inland waters.

Virtual stations include rivers (52%), lakes (44%), reservoirs (4%) and glaciers (<1%).

Virtual stations are defined by a position on the satellite ground track, width (along-track size of the water body) and elevation wrt to geoid, among other parameters.



Sentinel-3 B
32500 virtual stations



Sentinel-3 A
33000 virtual stations

For more information on the methods used to define these virtual stations, please refer to D. Blumstein poster #111 (25YPRA).

