

Surface Water and Ocean Topography (SWOT) Mission

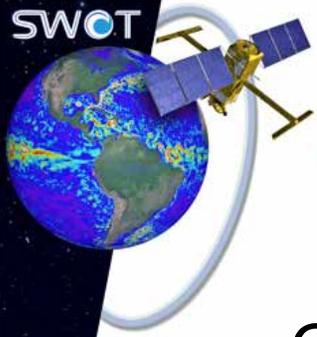


June 27, 2018



Current pre-launch and post-launch cal/val plans **led** by France

S. Calmant IRD - J.F. Crétaux LEGOS -
N. Picot CNES – A. Paris CLS – and many others

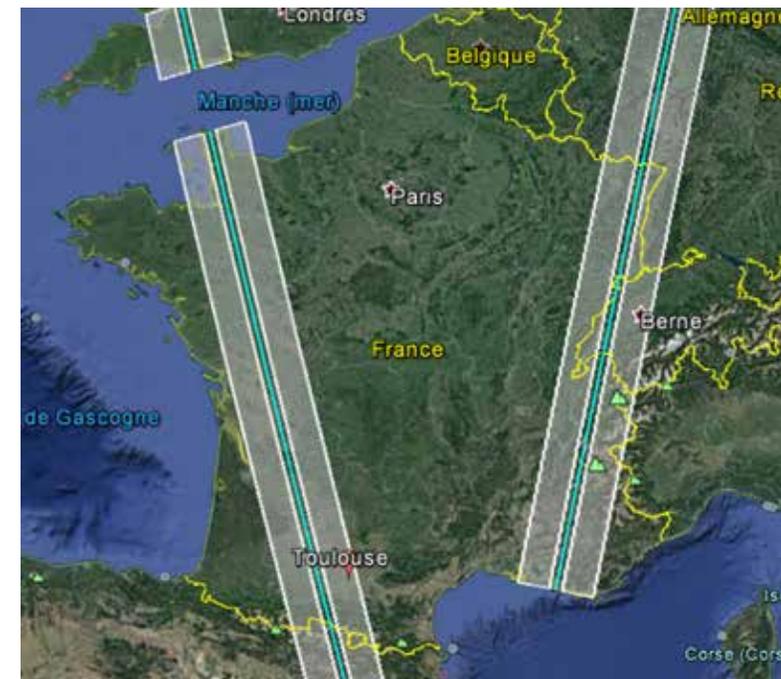
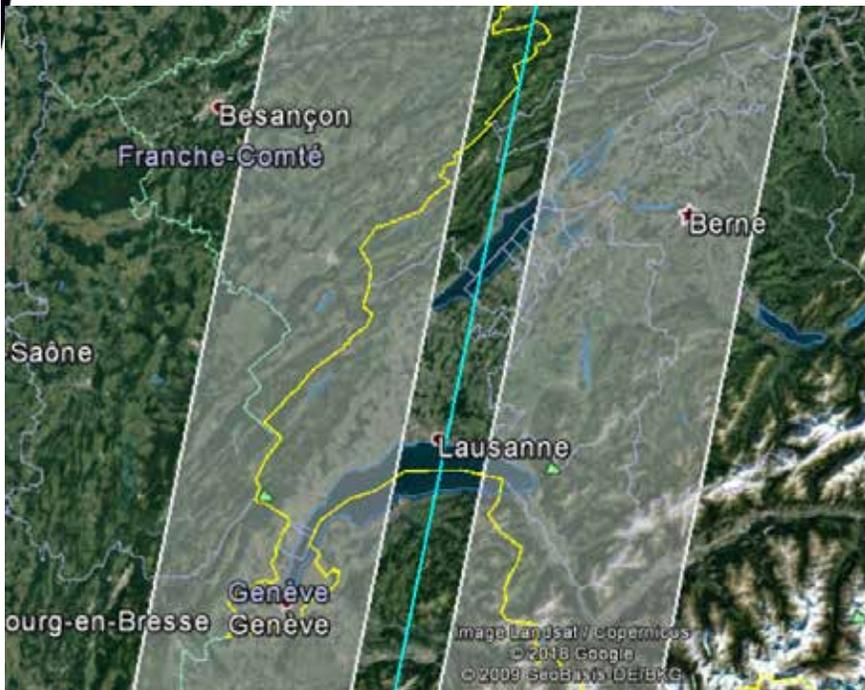


Outline

- Calibration activities in France during past 12 months :
 - Seine campaign
 - Garonne campaigns
 - Rhine workplan
- Some words on the means used :
 - Lidar
 - Drone
 - GPS carpet
- International Calibration activities as described past year
- Tentative workplan for 2018-2019

France 1 day orbit

- Two 1 days orbit over France, Garonne & Rhine rivers are well covered, but many lakes are also included in the swath





Seine Campaign

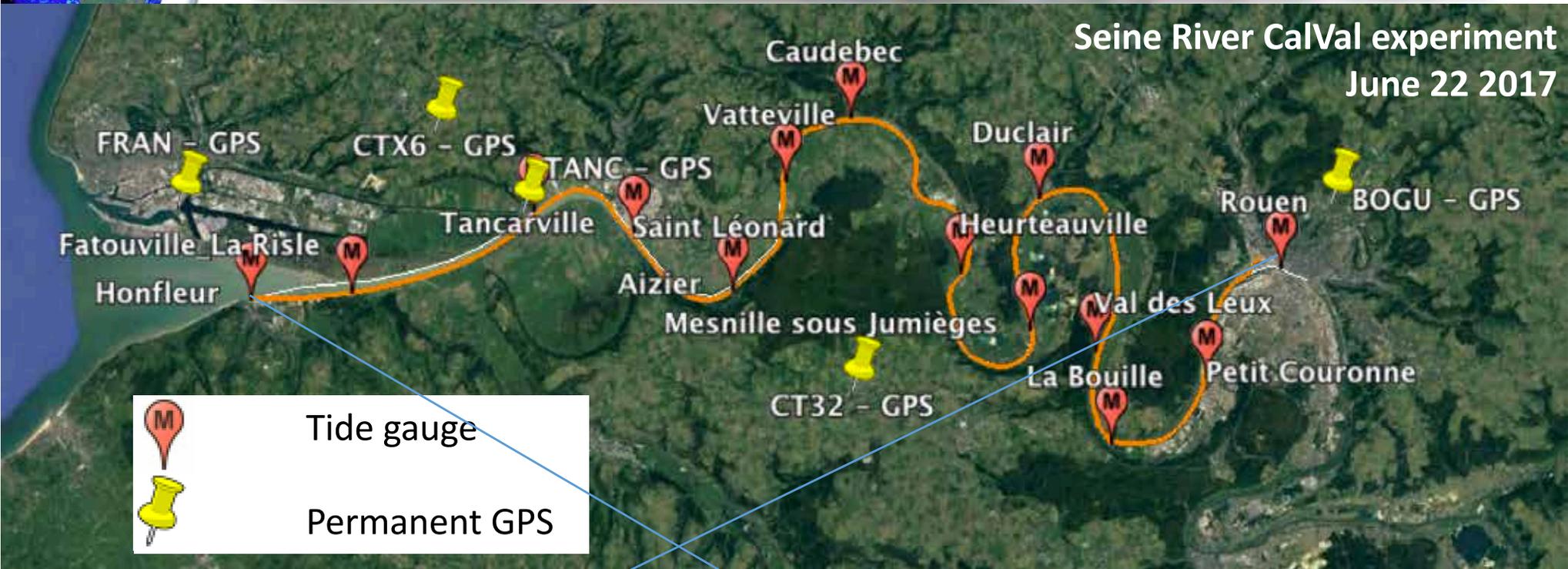
- Planned in June 2017, involving GPS carpet, drone, Lidar, ADCP
- But Due to several issues only the GPS carpet data were acquired and useful in June 17 -> refer to F. Lyard presentation during tide keynote talk.
- Lidar data were acquired later in October





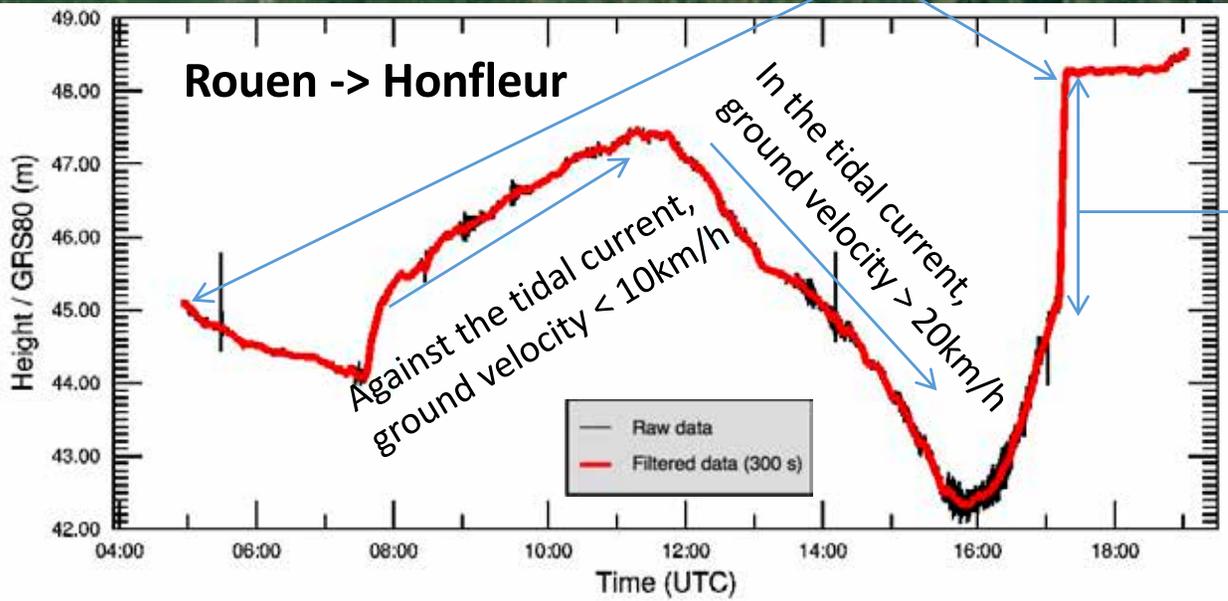
Seine Campaign Preliminary results (CaNaGeo)

Seine River CalVal experiment
June 22 2017



Tide gauge

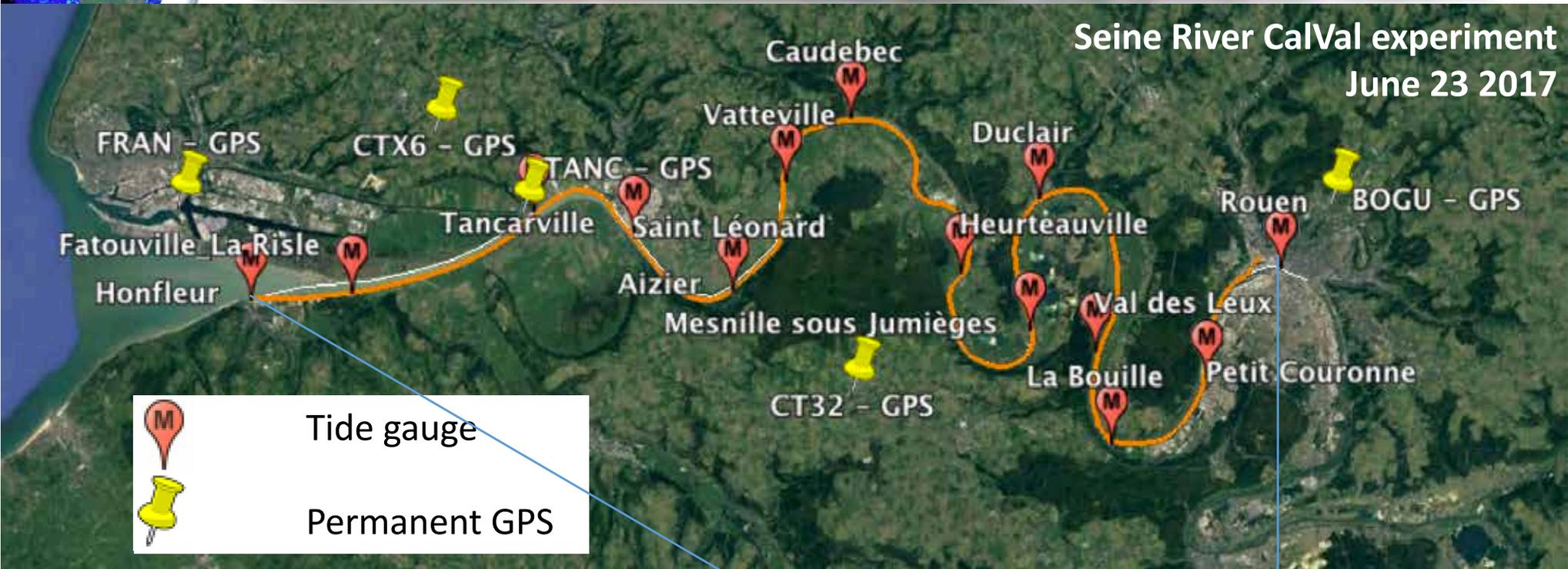
Permanent GPS



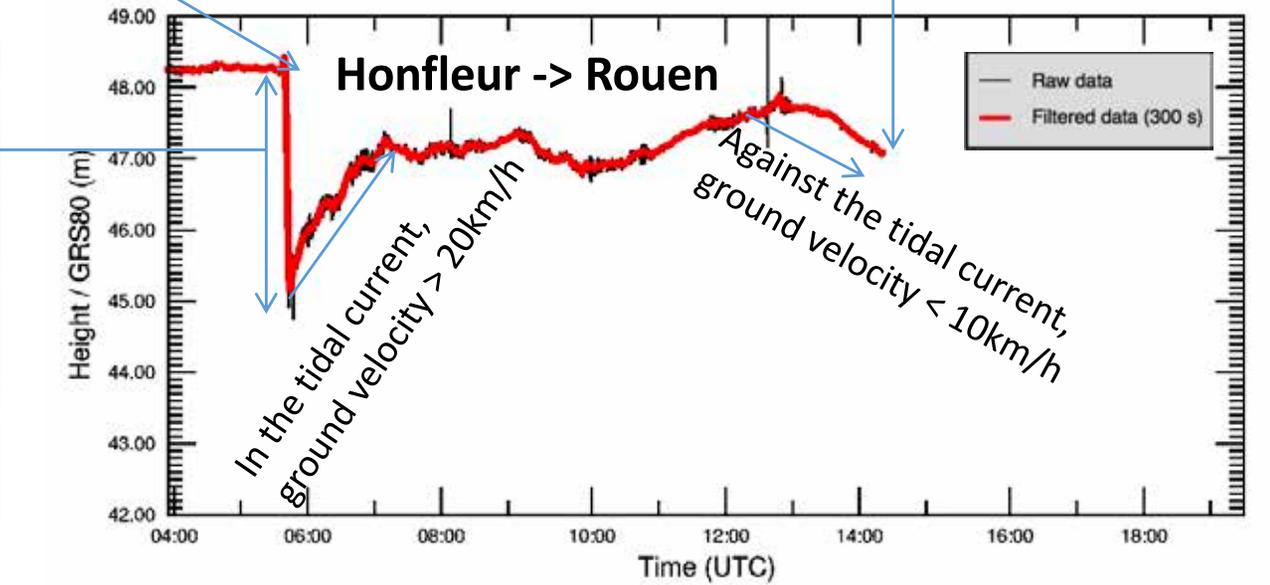


Seine Campaign Preliminary results (CaNaGeo)

Seine River CalVal experiment
June 23 2017



Tide gauge
 Permanent GPS





Calval LiDAR

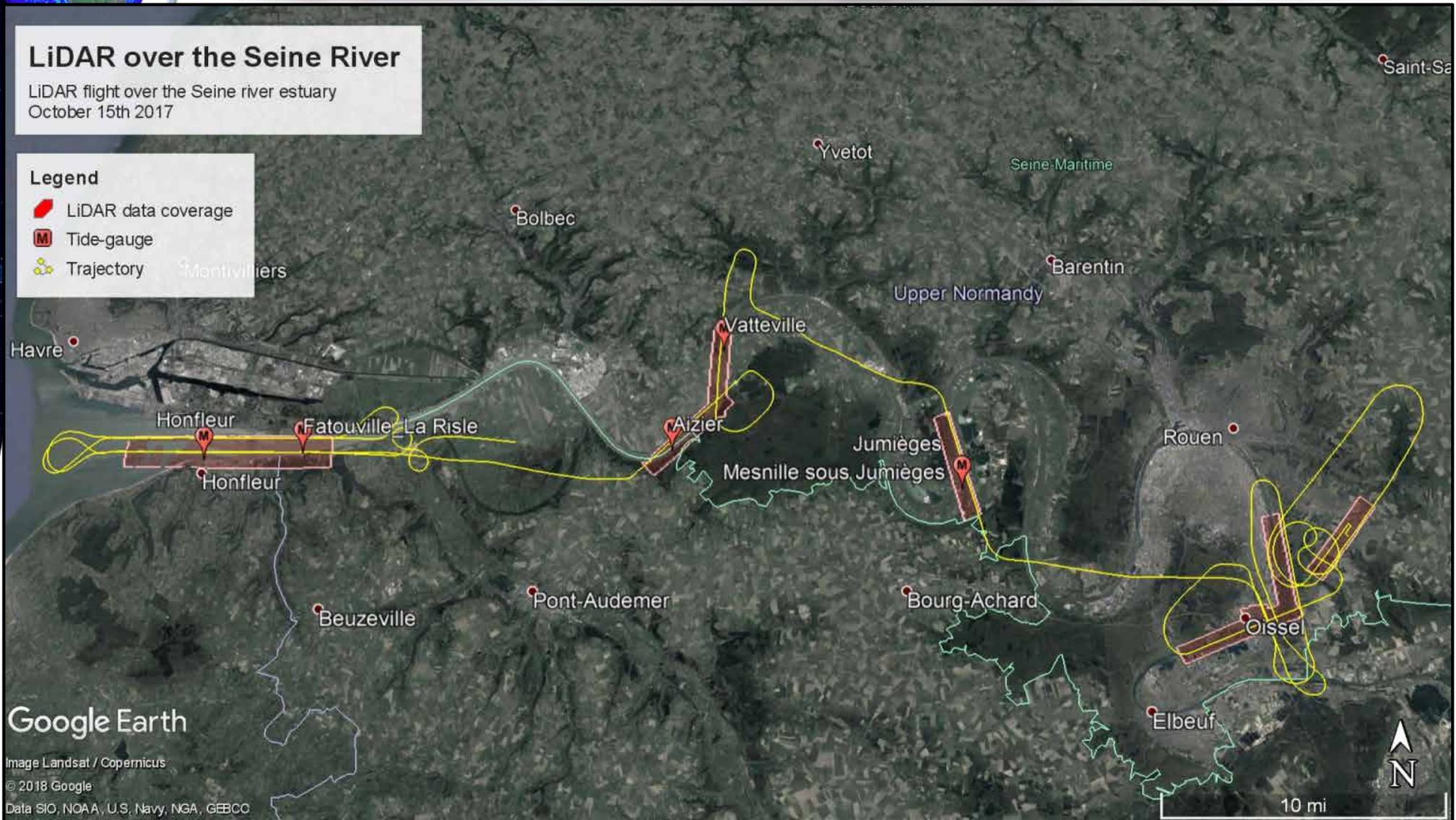
Project: SWOT COTEST - PI: B. Laignel

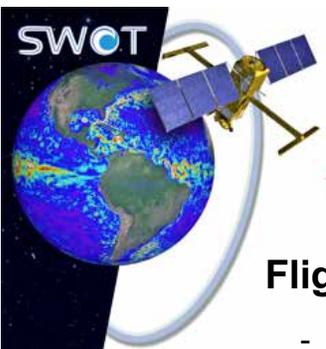
LiDAR over the Seine River

LiDAR flight over the Seine river estuary
October 15th 2017

Legend

- LiDAR data coverage
- Tide-gauge
- Trajectory





Calval LiDAR

Project: SWOT COTEST - PI: B. Laignel

Flight

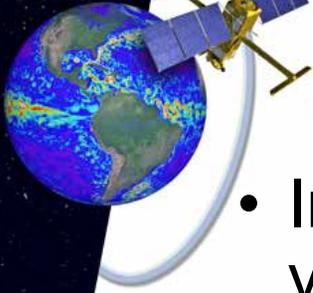
- Initially planned in June 2017 to acquire synchronous data with the GPS carpet boat campaign
 - => postponed at the last minute due to change in weather conditions
- Flown in October 15, 2017 without the boat.
- Flight plan
 - Low altitude of 800 m to ensure accuracy of the sensor
 - Nadir centered on water to ensure maximum returns



Top view of the tidal gauge pier in Honfleur (in red)

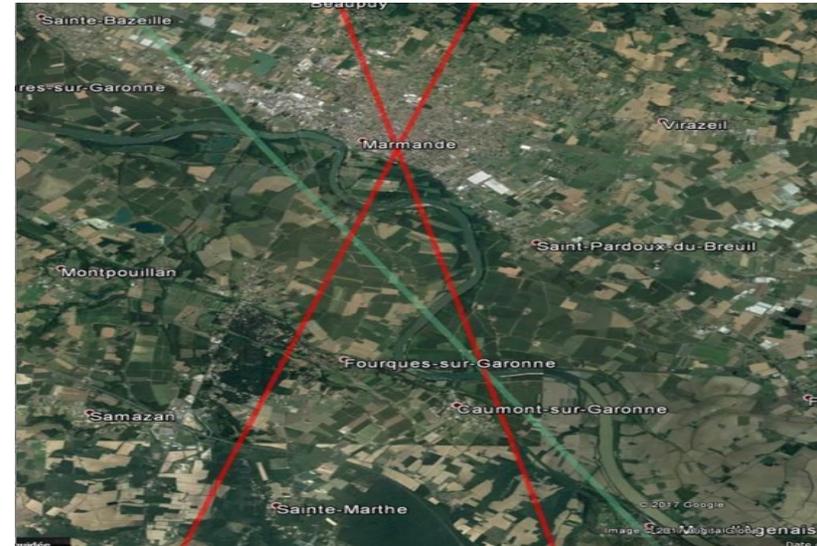
Processing

- 150 million measured points / 30 million on water
 - Trajectory computed based on DGPS receivers deployed on the field for the campaign
 - DGPS points were taken on the ground at 4 different locations
 - absolute georeferencing error of 5.3 cm in RMS
- The comparison with tidal gauges is in progress
 - Future work will be to compare the LIDAR measurements and the SWOT data of the simulator



Garonne campaign

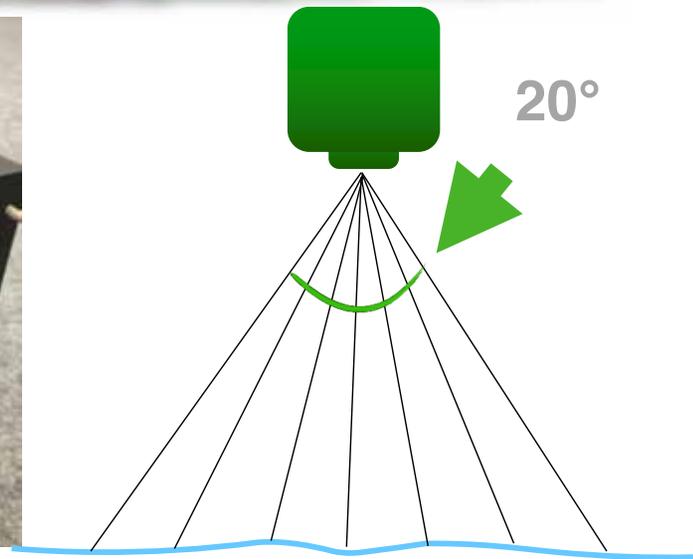
- In October 2017, mostly to validate the Drone Lidar performances along a Jason-3 & Sentinel-3A river over pass → noise level was higher than expected due to GPS interferences on the Drone.
- In April & May 2018 on several lakes around Toulouse to validate the new equipment
- In June & July 2018 around Toulouse to acquire fields measurements along Sentinel-3A&B satellites in 'SAR' mode



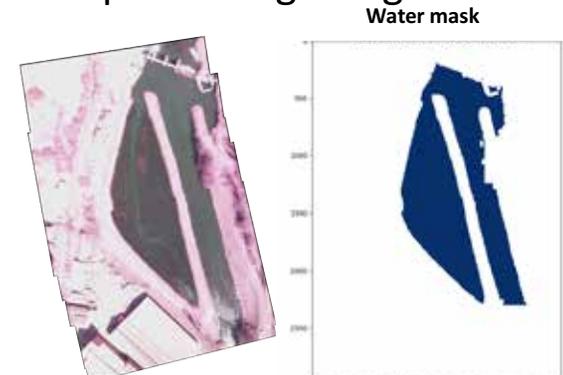
Date de survol	Commune	Cible hydrologique	Mode S3A	Mode S3B
25 Mai	Marmande	Garonne	SAR OL	LRM
21 Juin	Marmande	Garonne	SAR OL	LRM
24 ou 25 Juin	Bourg Saint Bernard / Giroussens / L'Isle sur Tarn	Lac de Bourg Saint Bernard / Agoût / Tarn	SAR OL	LRM
29 Juin	Boadella	Lac Panta de Boadella	SAR OL	LRM
18 Juillet	Marmande	Garonne	SAR OL	SAR OL
20 Juillet	Bourg Saint Bernard	Lac de Bourg Saint Bernard	SAR OL	SAR OL
21 Juillet	Calmont / Giroussens / L'Isle sur Tarn	Ariège / Agoût / Tarn	SAR OL	SAR OL



Drone acquisition close to marmande

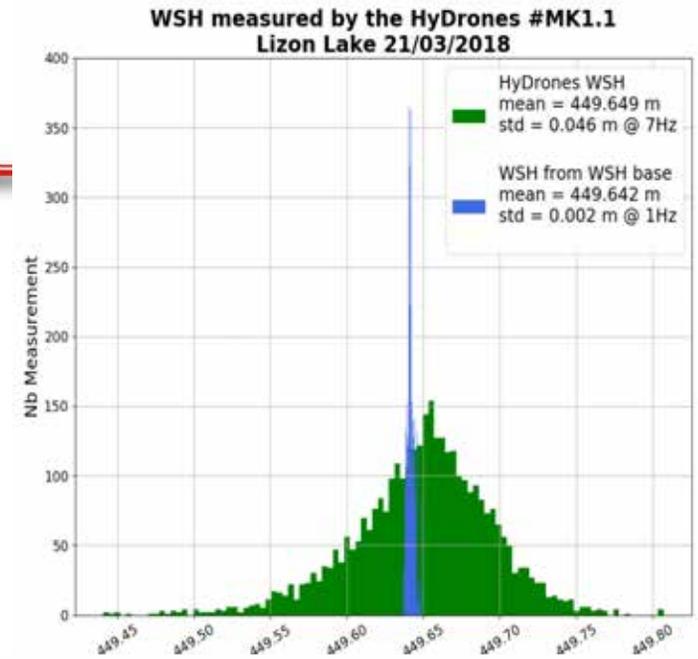


- LiDAR (905 nm) 8 scans covering 20°, gyro stabilized cell
- GPS RTK 10Hz, additional geodetic GPS on ground
- Optical camera 8 MegaPixels (Computation of water surface mask and on-going development of surface velocity algorithms)
- Real time data transmission and processing using phone network

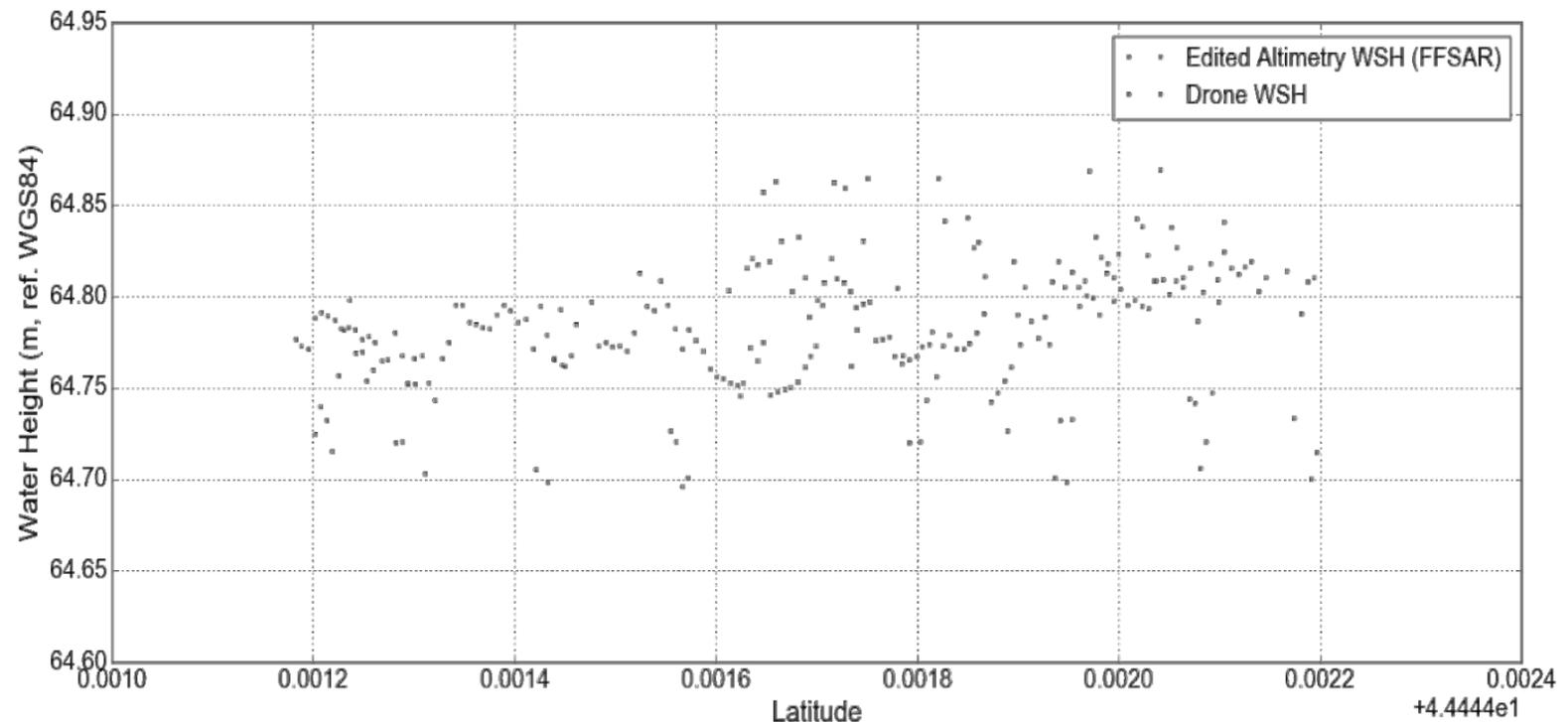


Drone performances

- Over a lake, compare to a ground GPS value: Biases of about 7 mm, stdev (7Hz data!) of 4.6 cms, quite windy conditions (40km/s)
- Over Marmande along S3A/B overpass
 - The time series displays the slope of the Garonne river, about 26 cm/km
 - Very good agreement with altimeter data in SAR mode (FFSAR processing)



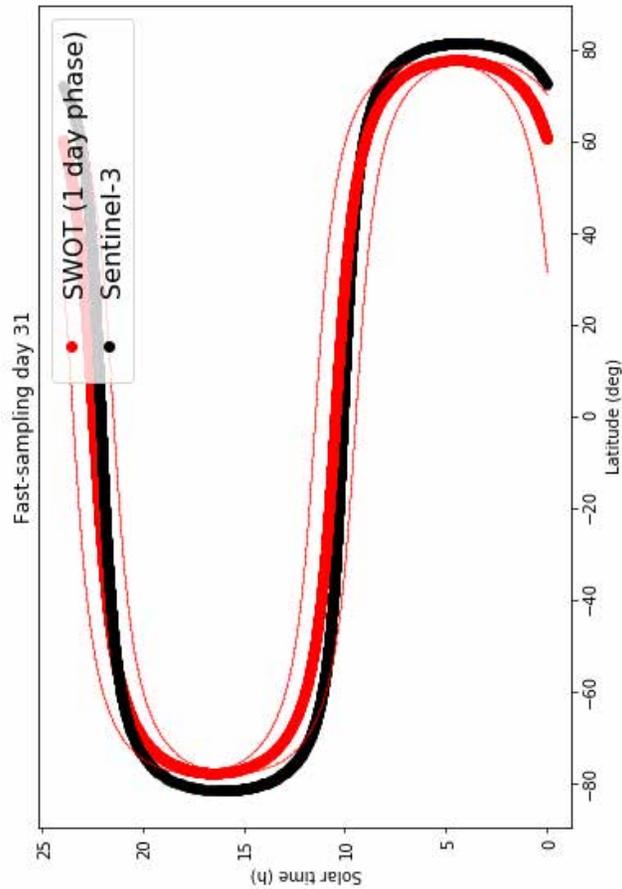
HyDrones WSH on the Garonne river



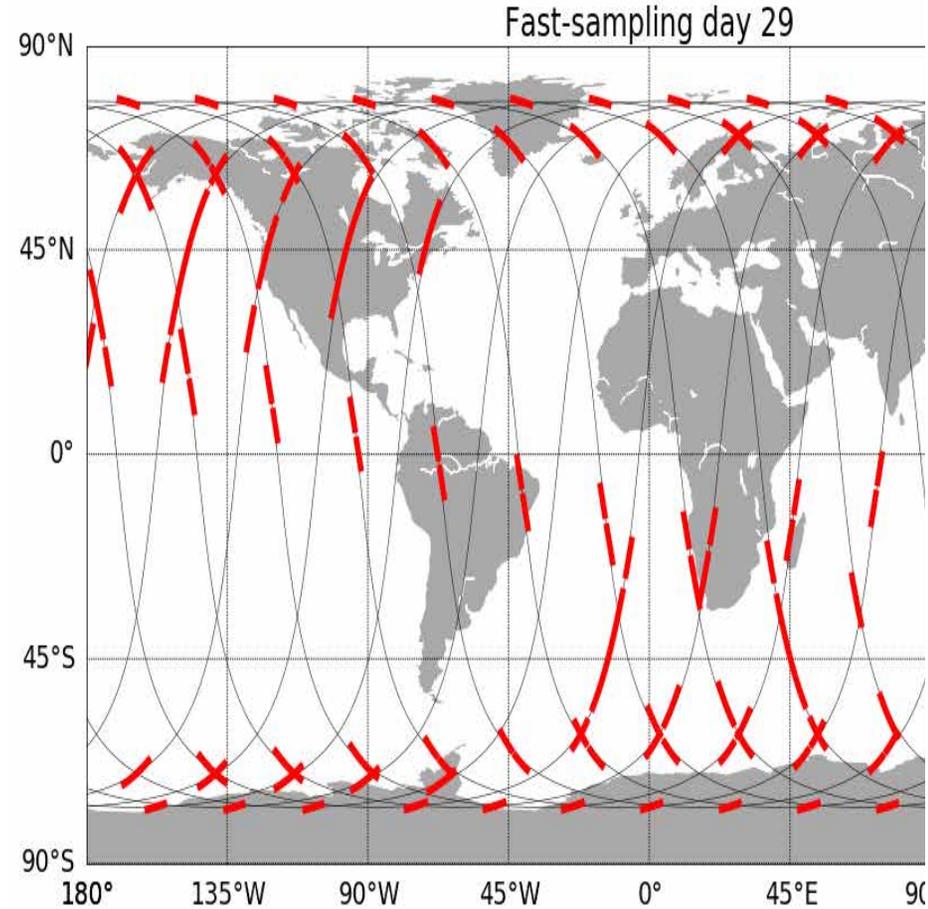


Case 1: good alignment of solar times

- Where there is a XOVER, the time difference is always less than 1h
- Valid segments at all latitudes + some extremely long segments



Longest XOVER found

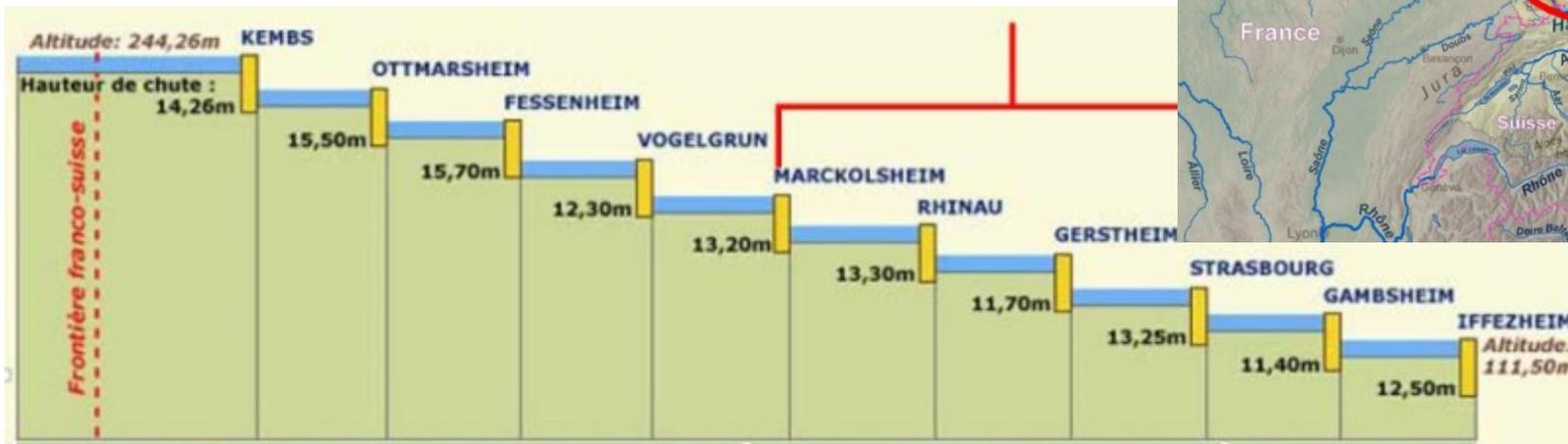


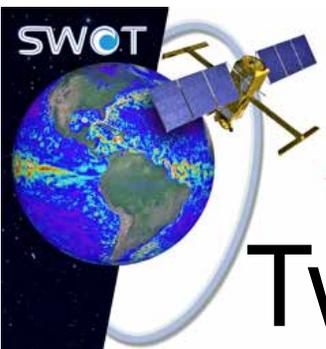
One random day's worth of S3A XOVERs when solar times are aligned (S3B: same quantity, different regions)



Rhine river

- In the 1 day orbit swath
- Very complex hydrologic situation with lots of dams, locks, flooded vegetation, dark water occurrences likely, ...
- Rhine canal and Rhine rivers very close but with 10m altitudes differences



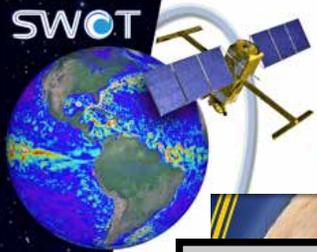


CalVal international plan (Adopt a Virtual Station)

Two distinct objectives :

- Acquire data fields during the Fast Sampling Phase (field work)
- Access to *in-situ* data during both the FSP and the Sc Phase with a *reasonable* delay

- Set up in place frame contract in the frame of international AO (World Bank, AFD, UNESCO, European ...)



In Africa

Database of :

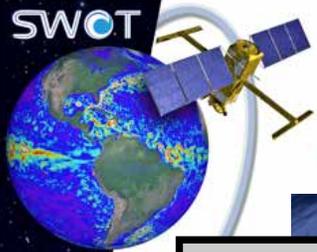
- (levelled?) water levels at gauges
- Discharge and cross sections at some gauges
- water levels, discharge and RC at VS
- Referenced River profiles (~1 km resolution)

NRT to be negotiated for a subset of gauges

Congo/CICOS: Funding obtained with AFD,

Tchad Lake/CBLT: on going project with UNESCO,
additional project under discussion with AFD

Niger/ABN: on going proposal to World Bank, additional
project under discussion with AFD



South America

Database of :

- (levelled?) water levels at gauges

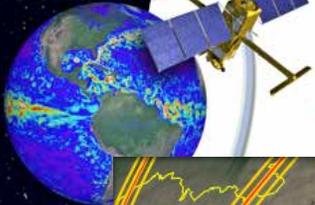
- Discharge and cross sections at some gauges

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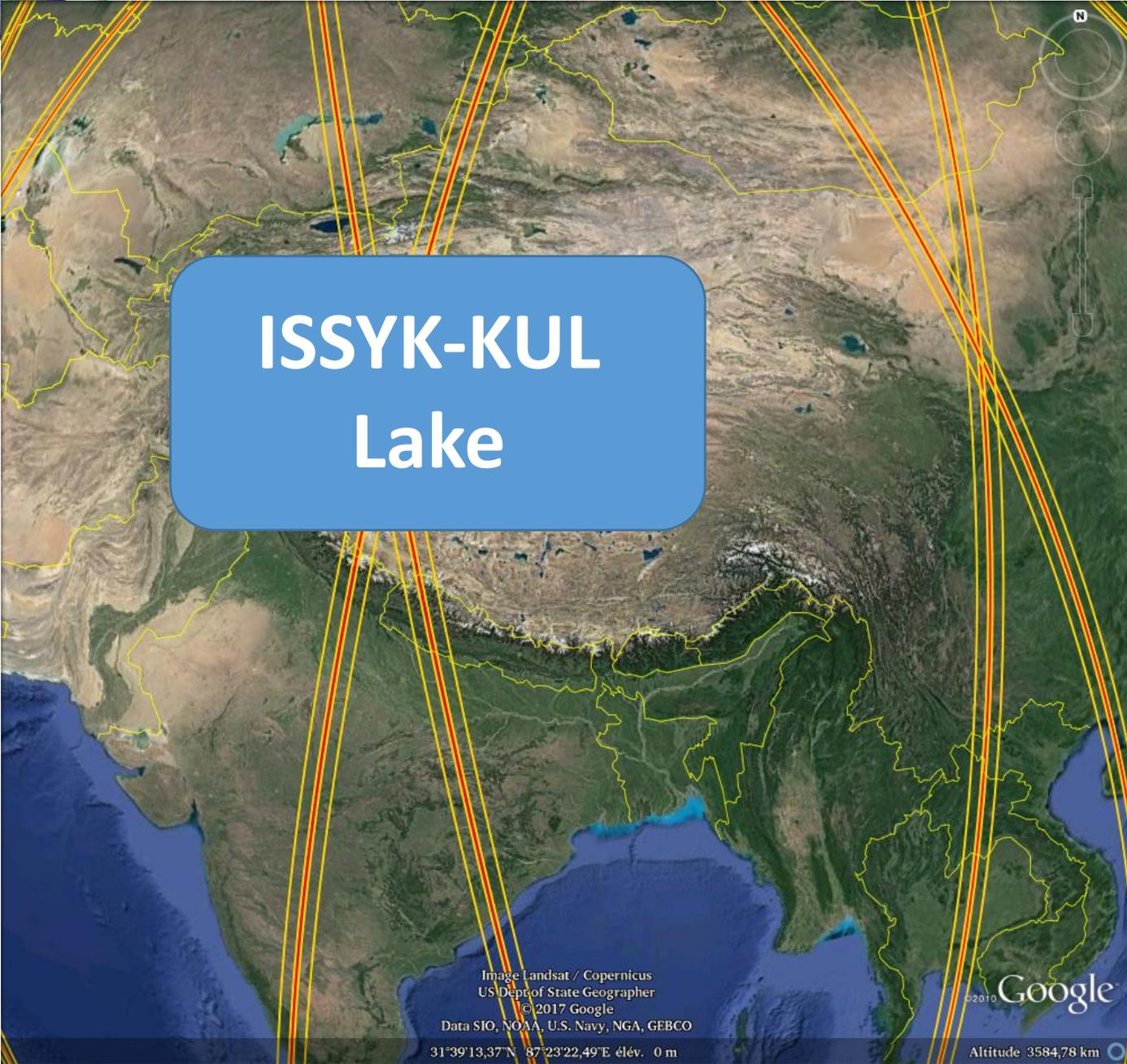
- Referenced River profiles (~1 km resolution)

NRT easy to get for a subset of Brazilian gauges

Brasil/CPRM: National funding and some contribution from CNES, HydroSim project will develop a new mean for water quality



Asia ...

A satellite map of Asia and surrounding regions, overlaid with multiple parallel tracks in orange and yellow, representing the SWOT satellite's scanning path. A blue rounded rectangle is centered over the Issyk-Kul Lake region. The map shows topographic details, including mountain ranges and the Indian Ocean to the south. A scale bar and navigation controls are visible in the top right corner.

**ISSYK-KUL
Lake**

Image Landsat / Copernicus
US Dept of State Geographer
© 2017 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
31°39'13,37" N 87°23'22,49" E élév. 0 m

©2010 Google

Altitude 3584,78 km



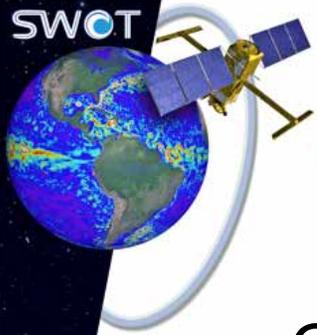
Partnership with International Institutions

- World Meteorological Organization

- GRDC
- HYDROLARE
- GTN-H

In the frame of Hydrolare,
in-situ data of lake levels
bathymetry of a set of lakes (-> volumes)

Ongoing discussion for NRT delivery of in-situ data during the Cal/Val phase of SWOT (for Lakes and Rivers) and/or the Sc phase



Tentative workplan for 2018-2019

- Continue Drone field campaigns acquisition over Garonne rivers and lakes
- Define and agree the work plan on the Rhine river
- Define and realize the campaign in the Gironde estuary
- Continue working with Africa, South America & Asia to set up in place international funding to secure fields campaign acquisitions
- Continue the iterations with WMO
- Continue improving the nadir altimeter satellite processing (FFSAR)