→ MEASUREMENTS AND OBSERVATIONS IN THE 21st CENTURY CONFERENCE

River monitoring from the upcoming SWOT mission: altimetry measurements under different flow conditions

Alessio Domeneghetti*, Guy Schumann, Mike Durand , Rui Wei,
Tamlin Pavelsky, Attilio Castellarin, Armando Brath

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Surface Water & Ocean Topography (SWOT)

(NASA, French, Canadian and United Kingdom Space Agencies)

To be launched on 2021, SWOT will completely cover the world's oceans and freshwater bodies with repeated high-resolution elevation measurements.

Ka-band radar interferometer (SAR interferometer)

Altimetry observation for all rivers larger than 100 m (> 50 m)

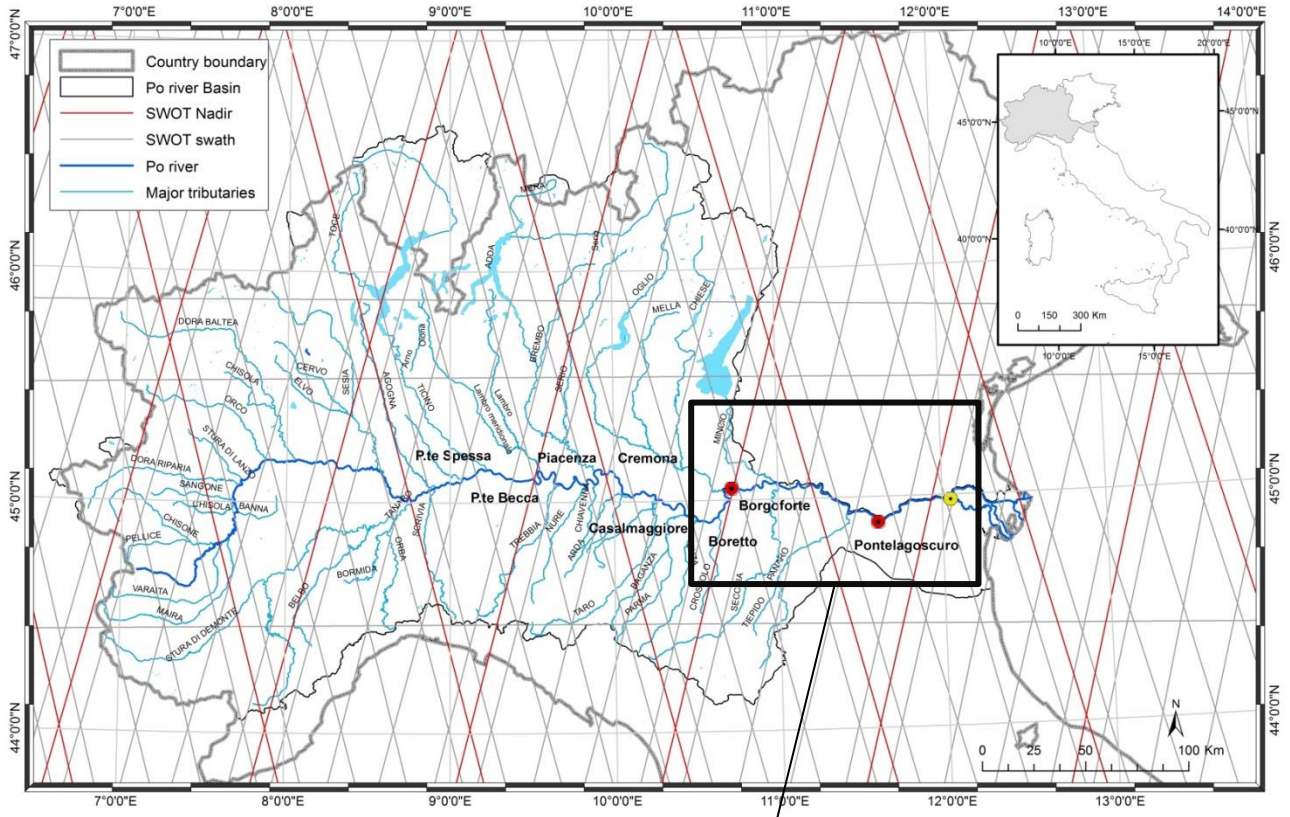
Altitude: 890.5 km

Repeat period: ~ 21 days

Height accuracy:

- < 10 cm; water area > 1 km^2
- < 25 cm; (250 m)^2 < water area < 1 km^2

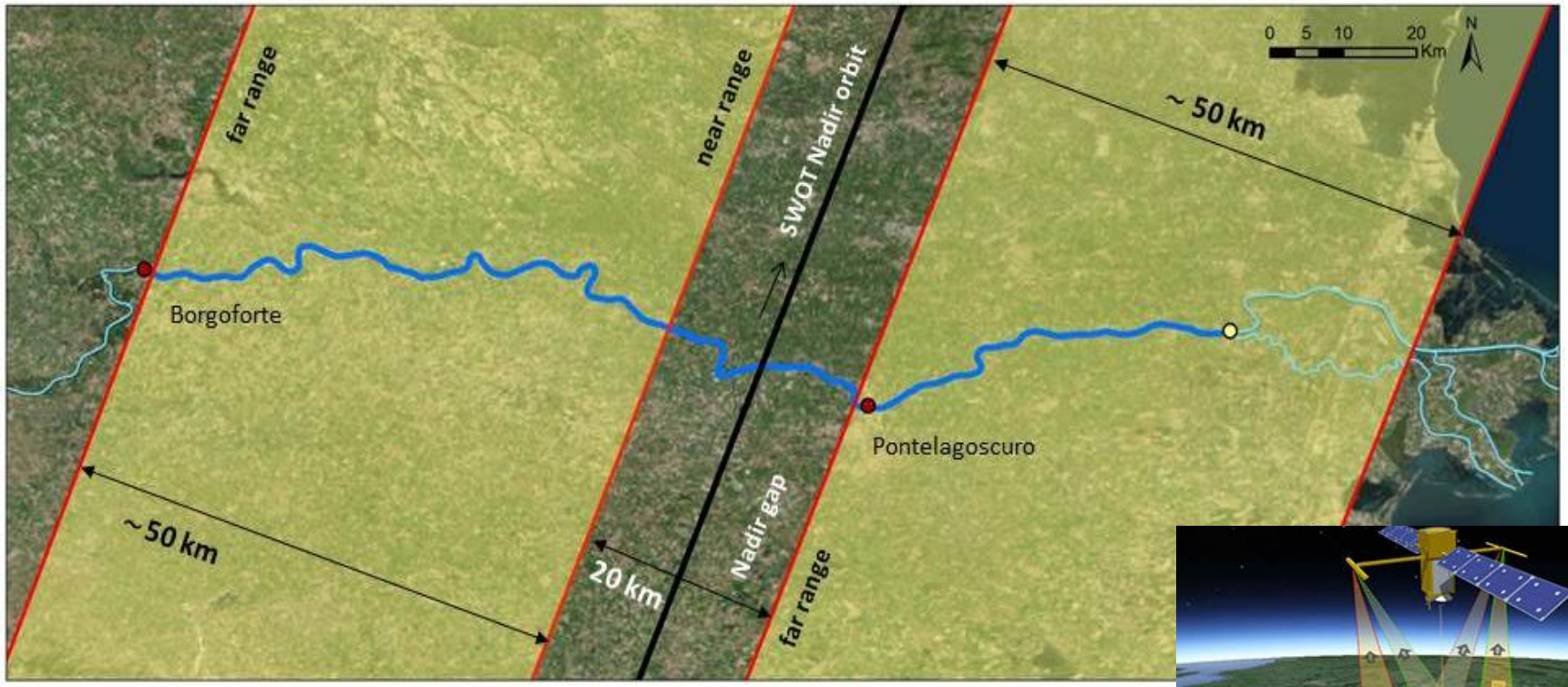
Slope accuracy: 1.7 cm/km
(averaging over water area > 1 km^2)

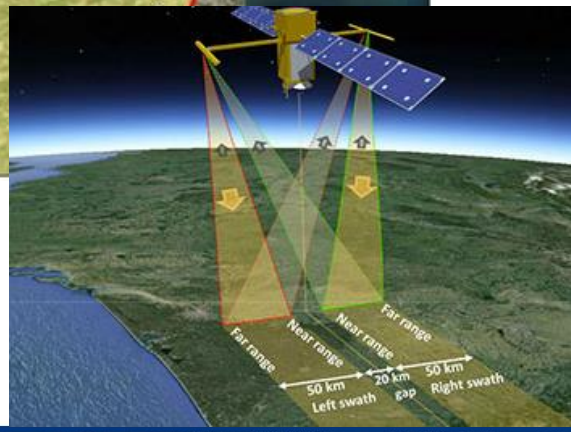


Po River
Total length ~360 km

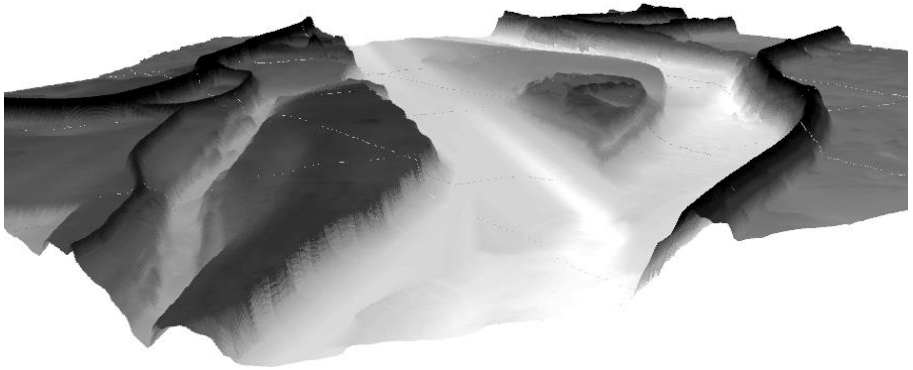
Study area

Study area
~140 km reach





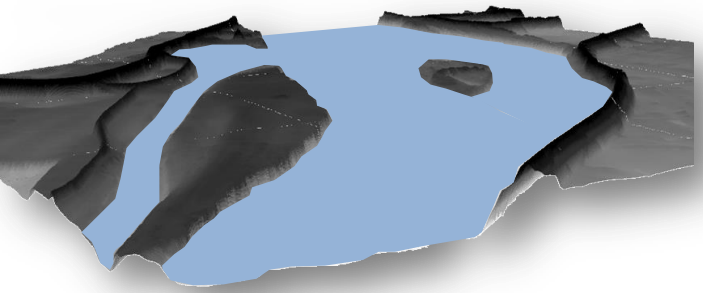
"Nadir gap" of 20 km over the SWOT orbit



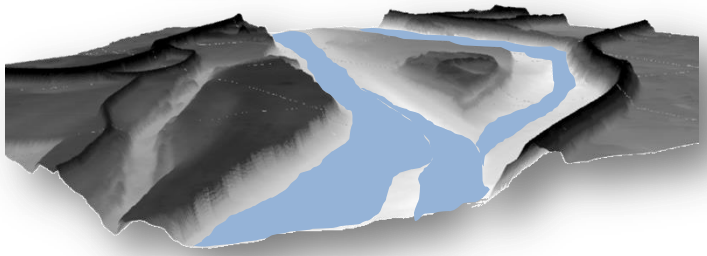
LiDAR 2m resolution of the Po river (river floodplains and bathymetry)

Quasi-2D numerical model of the study area for the simulation of different flow conditions
(the model is conditioned on traditionally observed data and calibrated referring to detailed flow watermarks)

Max flow

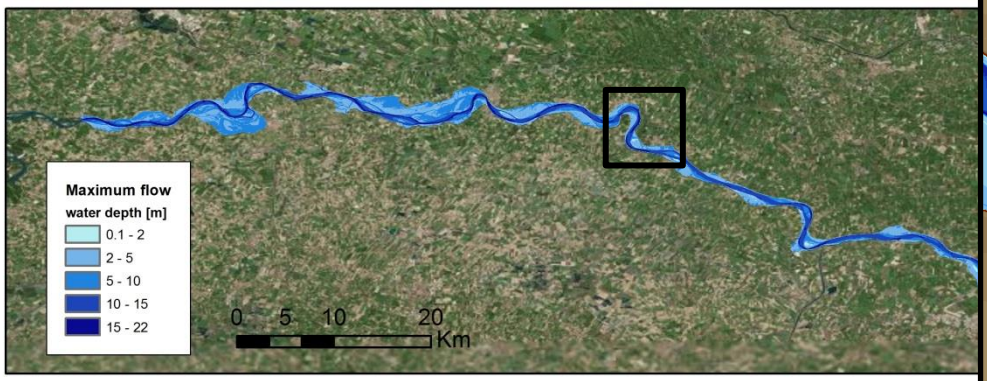


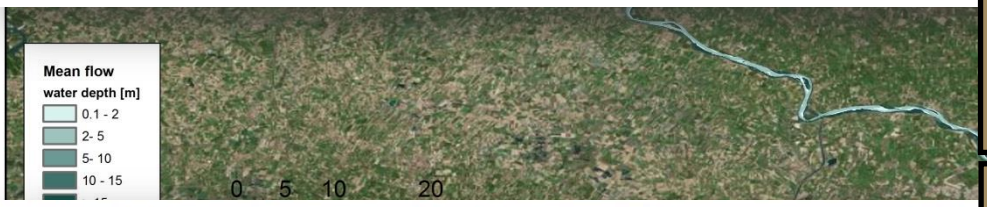
Min flow

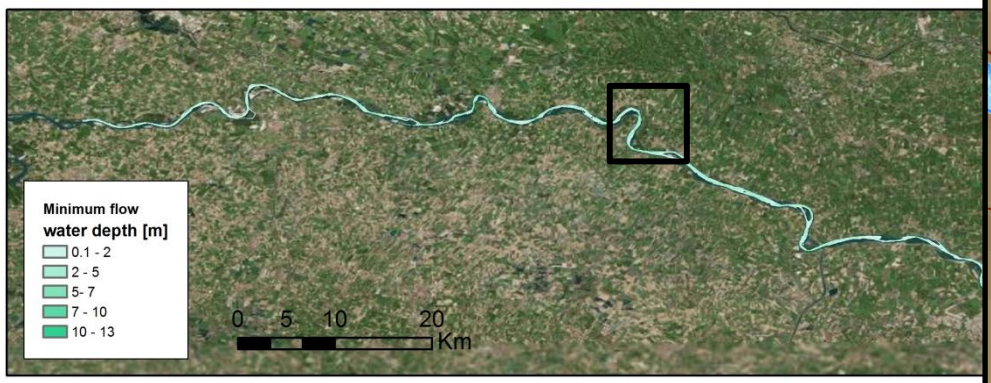


→3 flow scenarios:

Max flow : ~11260 m^3/s
Mean flow: 1500 m^3/s
Min flow: 170 m^3/s

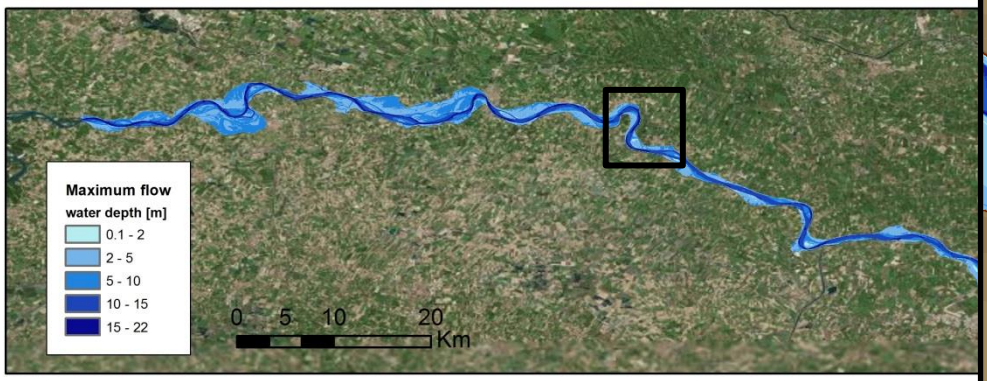

Maximum flow
water depth [m]
0.1 - 2
2 - 5
5 - 10
10 - 15
15 - 22
0 5 10 20
Km

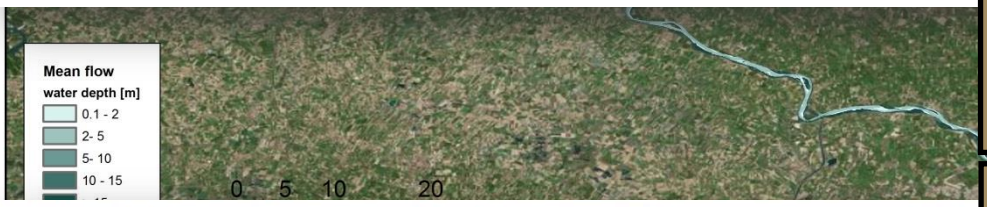

Mean flow
water depth [m]
0.1 - 2
2- 5
5- 10
10 - 15
0 5 10 20


Minimum flow
water depth [m]
0.1 - 2
2 - 5
5- 7
7 - 10
10 - 13
0 5 10 20
Km


Maximum

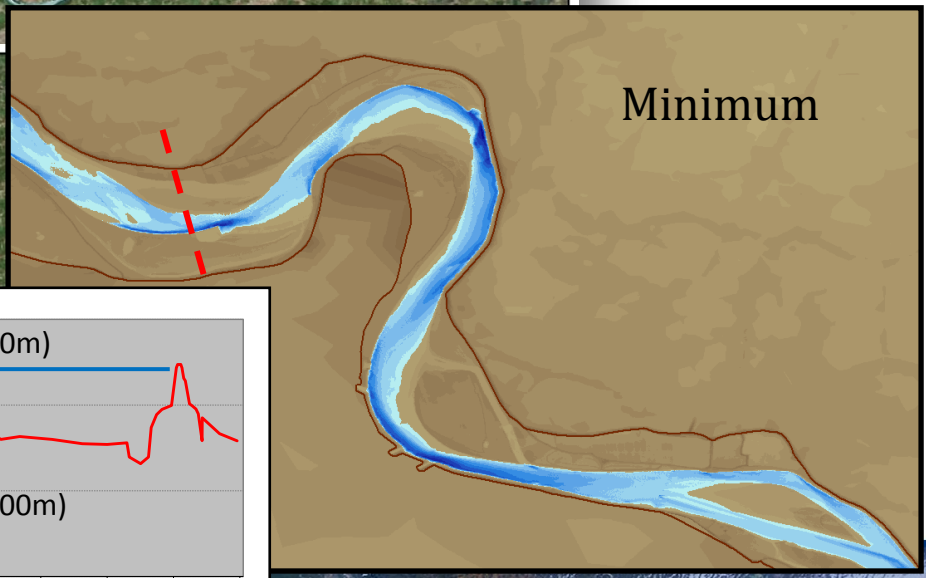

Minimum

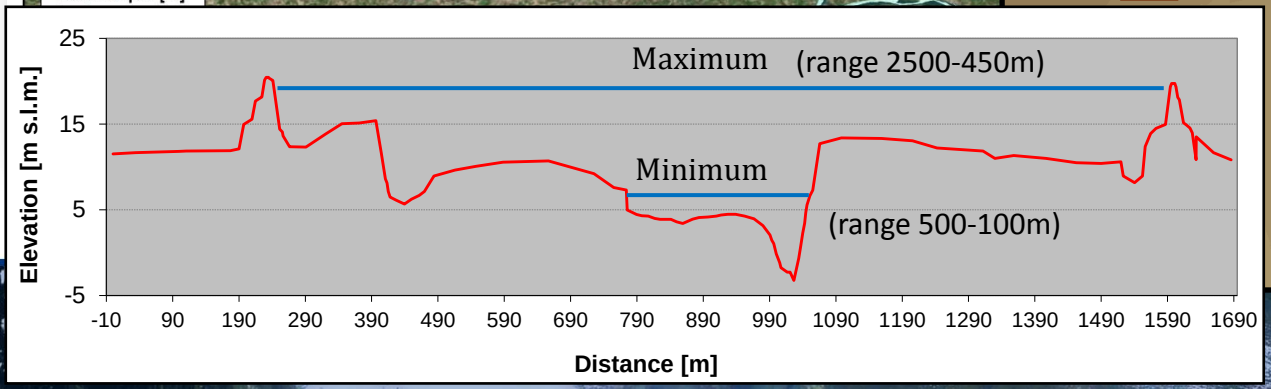

Maximum flow
water depth [m]
0.1 - 2
2 - 5
5 - 10
10 - 15
15 - 22
0 5 10 20
Km

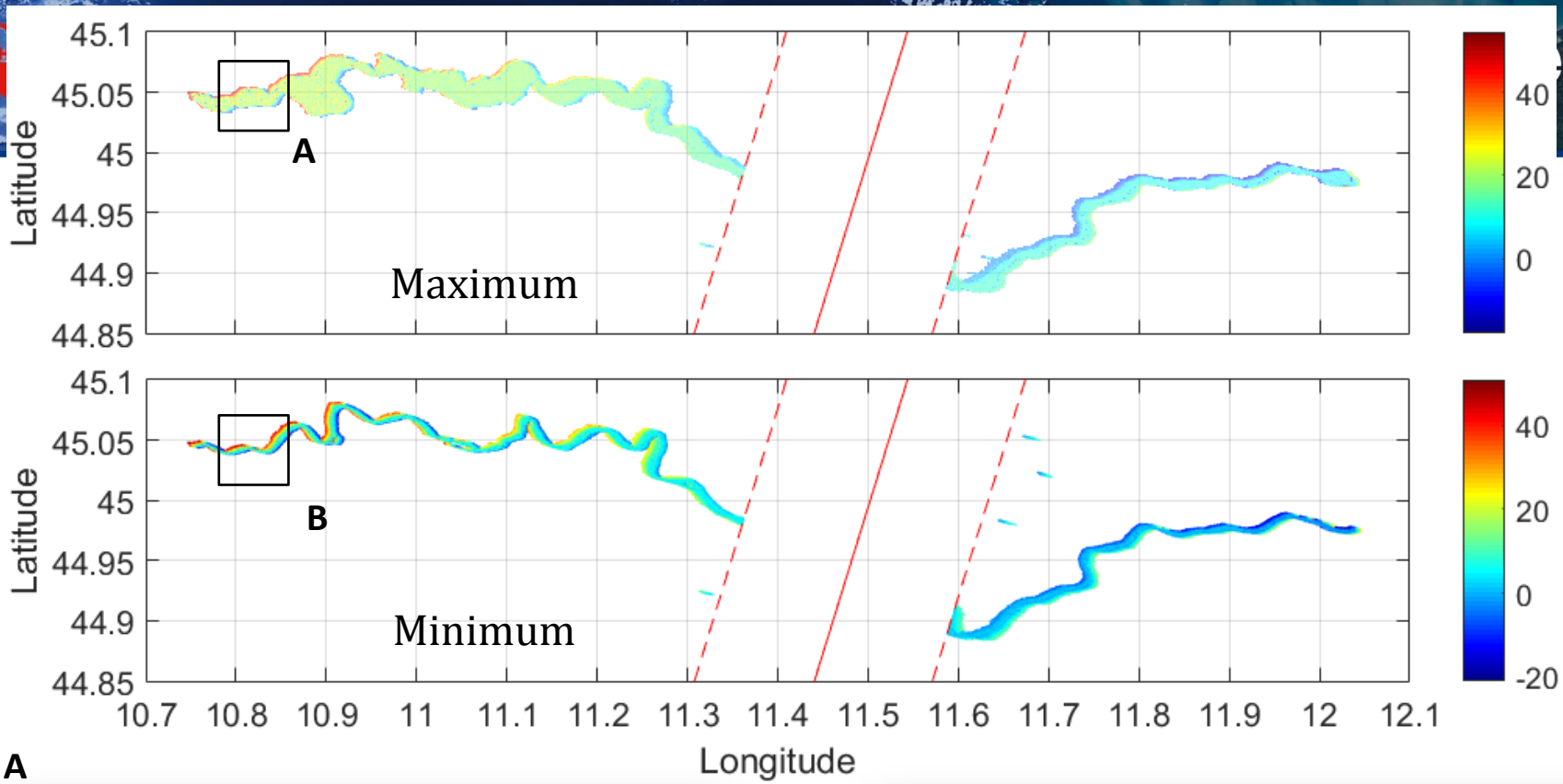

Mean flow
water depth [m]
0.1 - 2
2- 5
5- 10
10 - 15
0 5 10 20


Minimum flow
water depth [m]

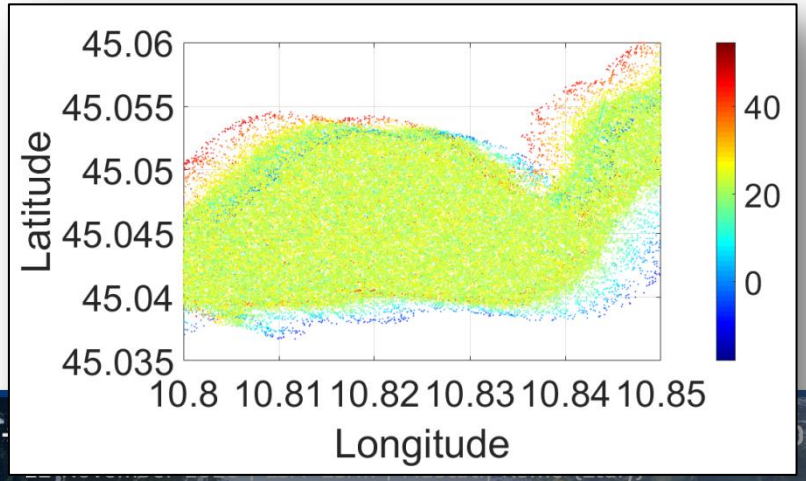

Maximum


Minimum

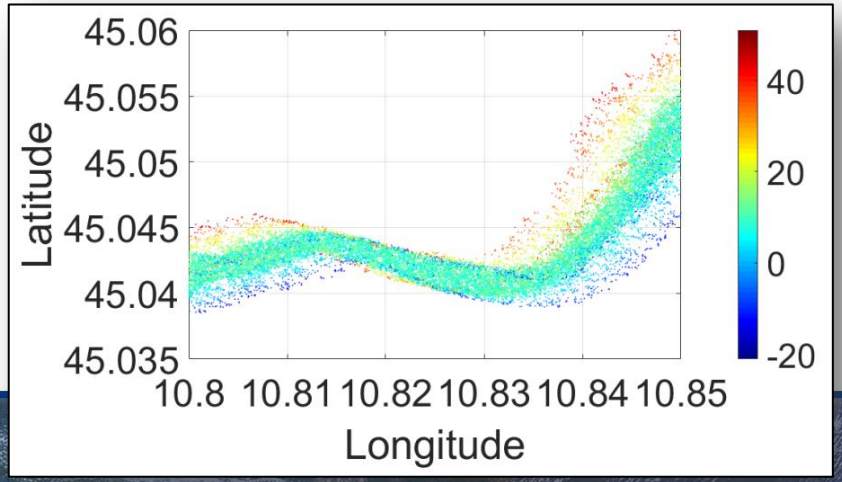

Maximum (range 2500-450m)
Minimum
(range 500-100m)
Elevation [m s.l.m.]
25
15
5
-5
-10 90 190 290 390 490 590 690 790 890 990 1090 1190 1290 1390 1490 1590 1690
Distance [m]

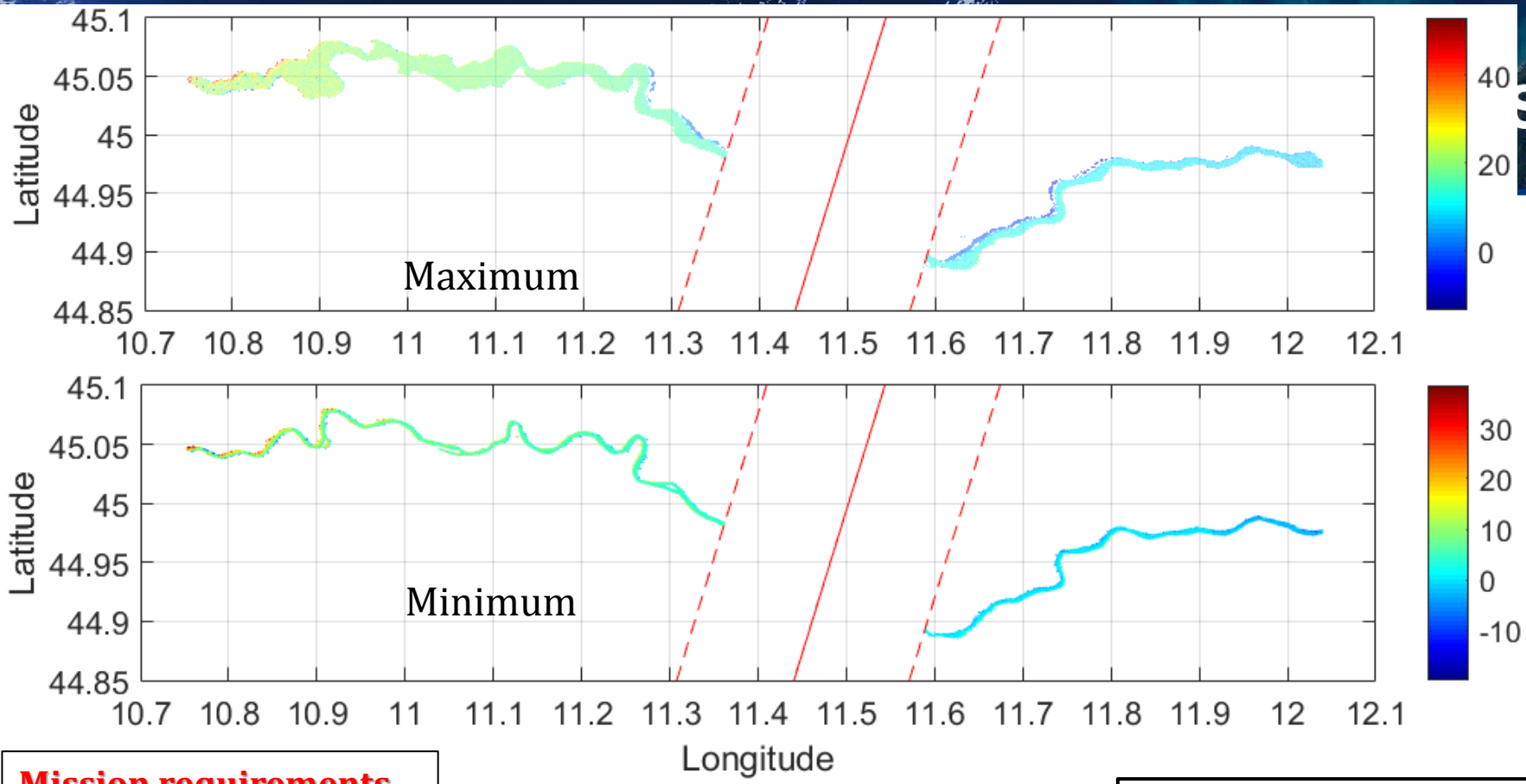

Maximum
Minimum
A
B
Latitude
Longitude
45.1
45.05
45
44.95
44.9
44.85
10.7
10.8
10.9
11
11.1
11.2
11.3
11.4
11.5
11.6
11.7
11.8
11.9
12
12.1
40
20
0
-20

A


Latitude
Longitude
45.06
45.055
45.05
45.045
45.04
45.035
10.8
10.81
10.82
10.83
10.84
10.85
40
20
0

B


Latitude
Longitude
45.06
45.055
45.05
45.045
45.04
45.035
10.8
10.81
10.82
10.83
10.84
10.85
40
20
0
-20



Mission requirements

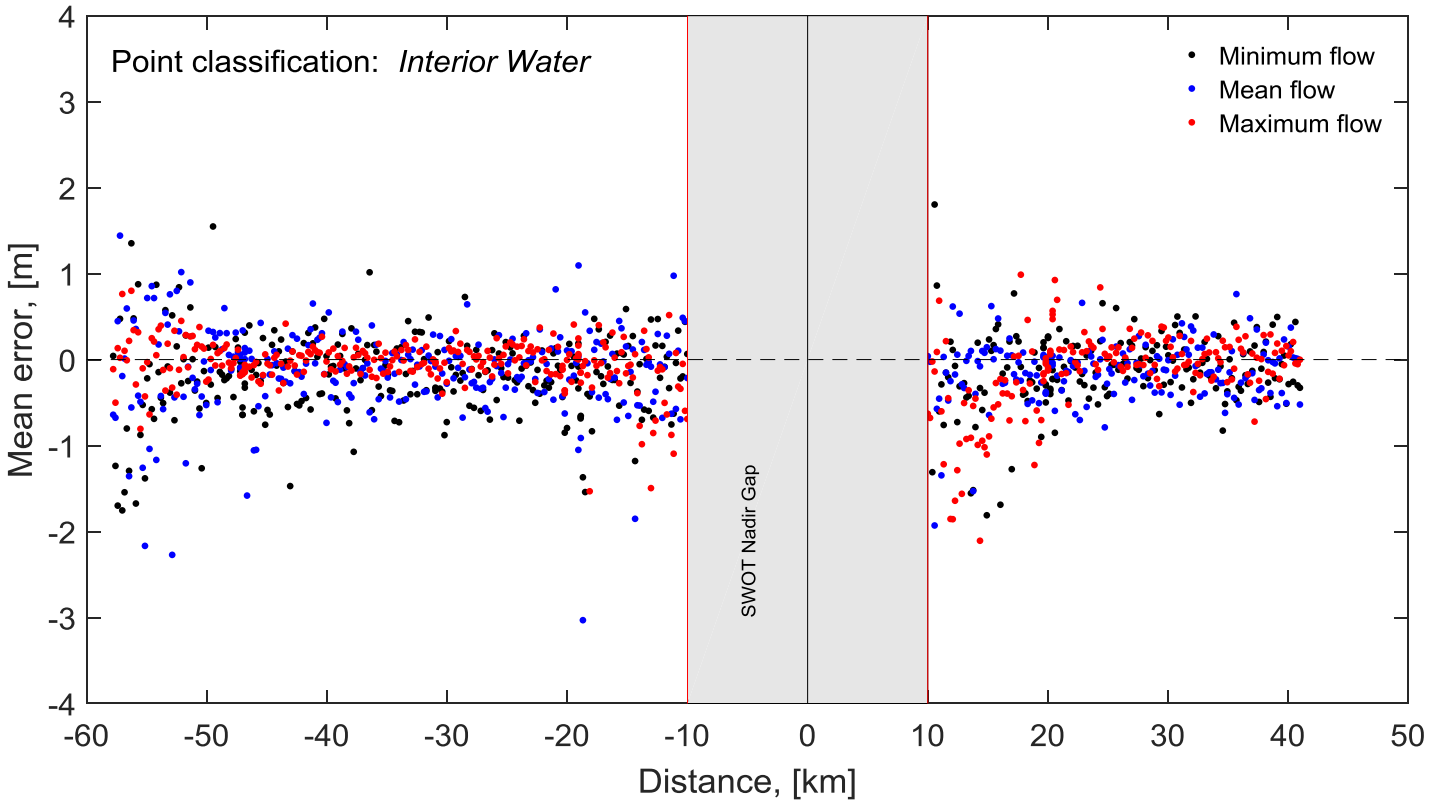
Height accuracy:

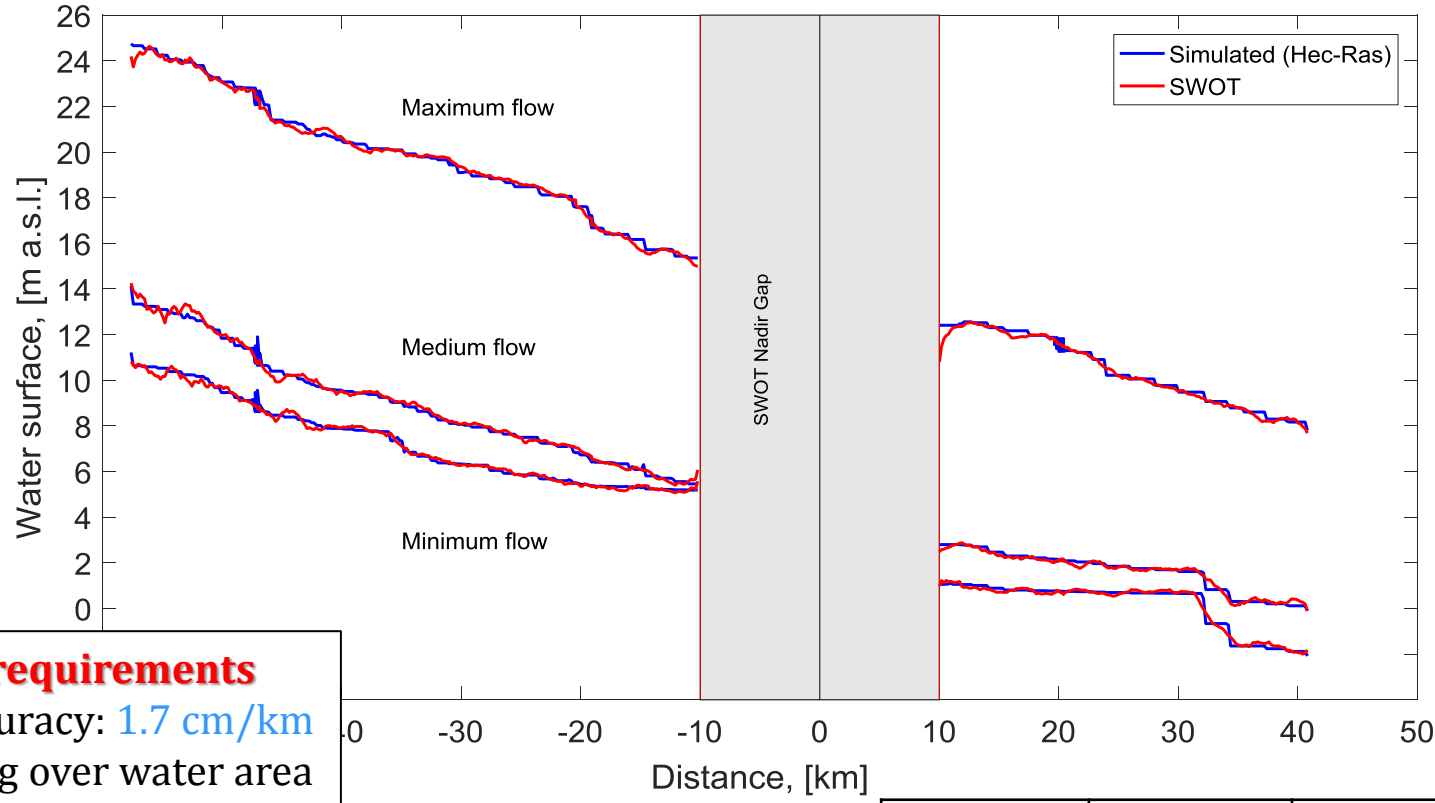
< 10 cm; area > 1 km^2

< 25 cm; (250 m)^2 < water area < 1 km^2

Error = SWOT – Hec-Ras

	Mean Error [m]			
	Interior water	Water near land edge	Land near water edge	Land
Max flow	-0.0016 m	0.378 m	0.773 m	0.059 m
Mean flow	-0.157 m	-1.249 m	-1.489 m	-0.197 m
Min flow	-0.218 m	-1.365 m	-1.588 m	-0.47 m


Point classification: Interior Water
Minimum flow
Mean flow
Maximum flow
SWOT Nadir Gap
Mean error, [m]
Distance, [km]
4
3
2
1
0
-1
-2
-3
-4
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50



Mission requirements

Slope accuracy: 1.7 cm/km (averaging over water area > 1 km^2)

~1 km moving average from the SWOT simulator output

	HR-slope (m/km)	SWOT-slope (m/km)	Δ slope SWOT-HR (cm/km)
Max flow	0.172	0.175	0.2573
Mean flow	0.0954	0.0855	0.9942
Min flow	0.0948	0.0608	3.394

Concluding remarks

- River flow conditions, land and embankments layover affect the SWOT measurements.

- Wet areas are observed with high accuracies, which satisfy the mission requirements. Accuracy is strongly influenced by the interaction with the surrounding topography and depends on the water surface level
  → possible problems on the identification of the water surface width.

- Altimetry measurements of dry areas (and also water near land edge) are affected by larger error (SWOT seems of not being able to provide reliable altimetry measurements of the river topography)

- The central portion of the river is surveyed with very high accuracy in every conditions
  → high performances on the extraction of the water surface profile.

Thanks for your attention

alessio.domeneghetti@unibo.it
http://people.unibo.it/it/alessio.domeneghetti

DICAM, School of Engineering, University of Bologna , Italy

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA