

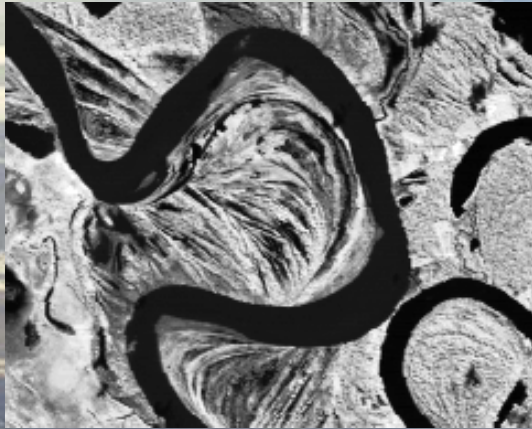
Discharge vs storage Rate:
Present and Future
Contribution
of radar Altimetry

Stéphane CALMANT

And many others....

Dynamics of river morphology

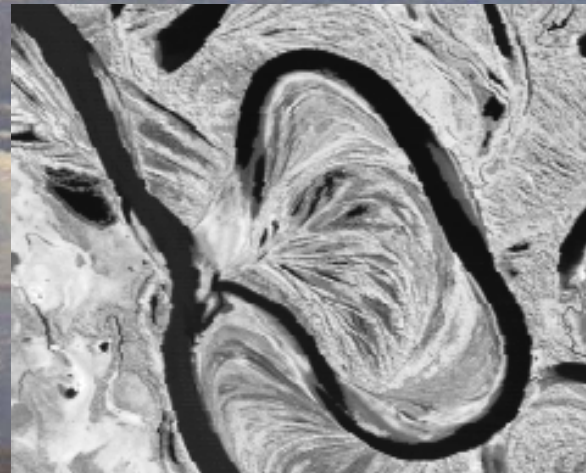
1984



1991



1993



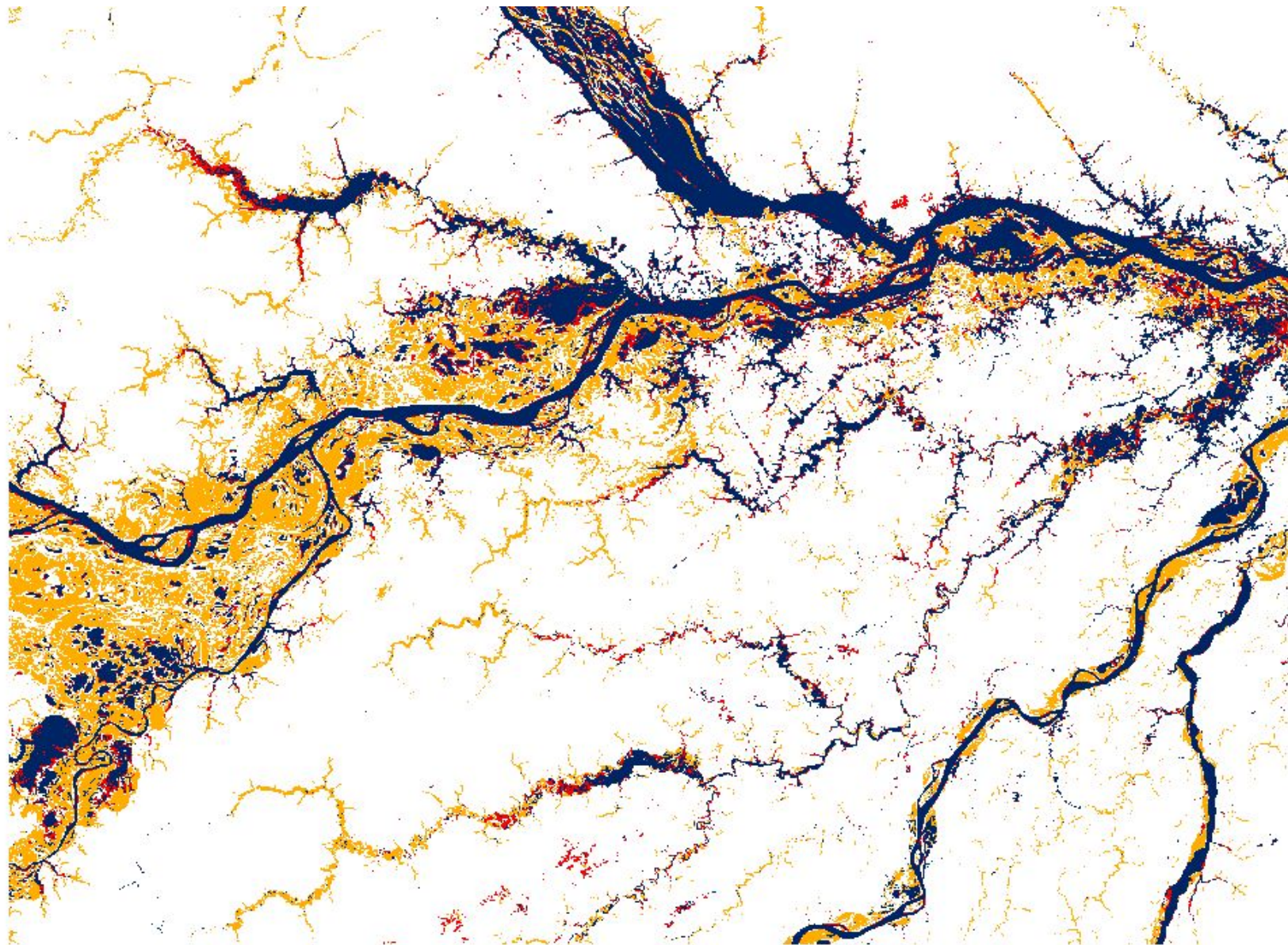
0

7 km

Courtesy F. Seyler

- What are we searching for ?
- Transport of water throughout the watersheds

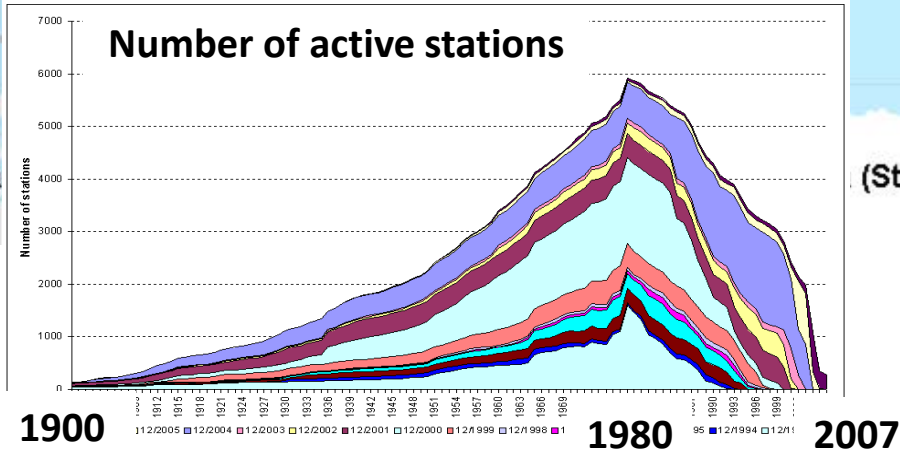
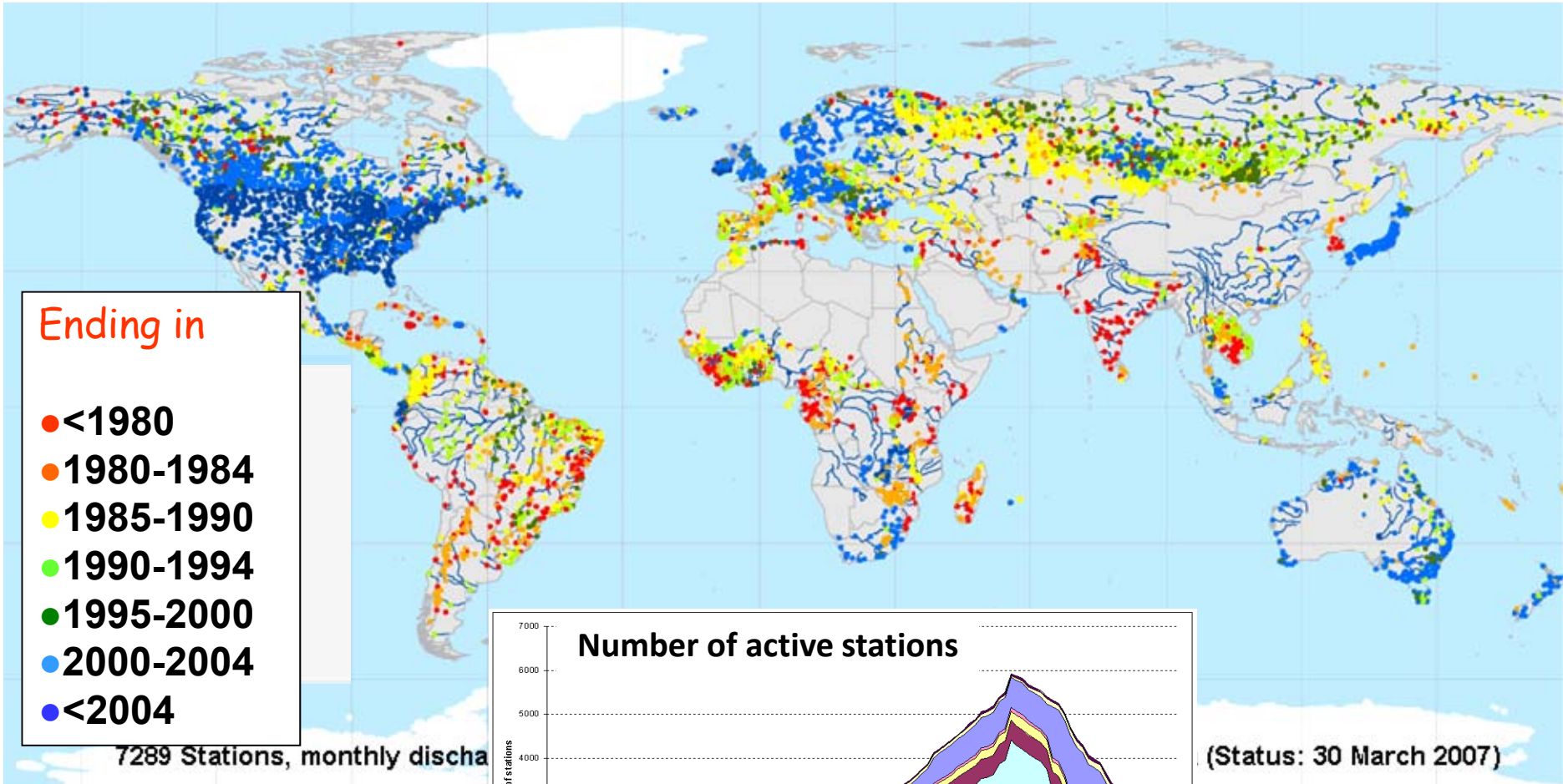
How is the problem stated in the major bassins ?



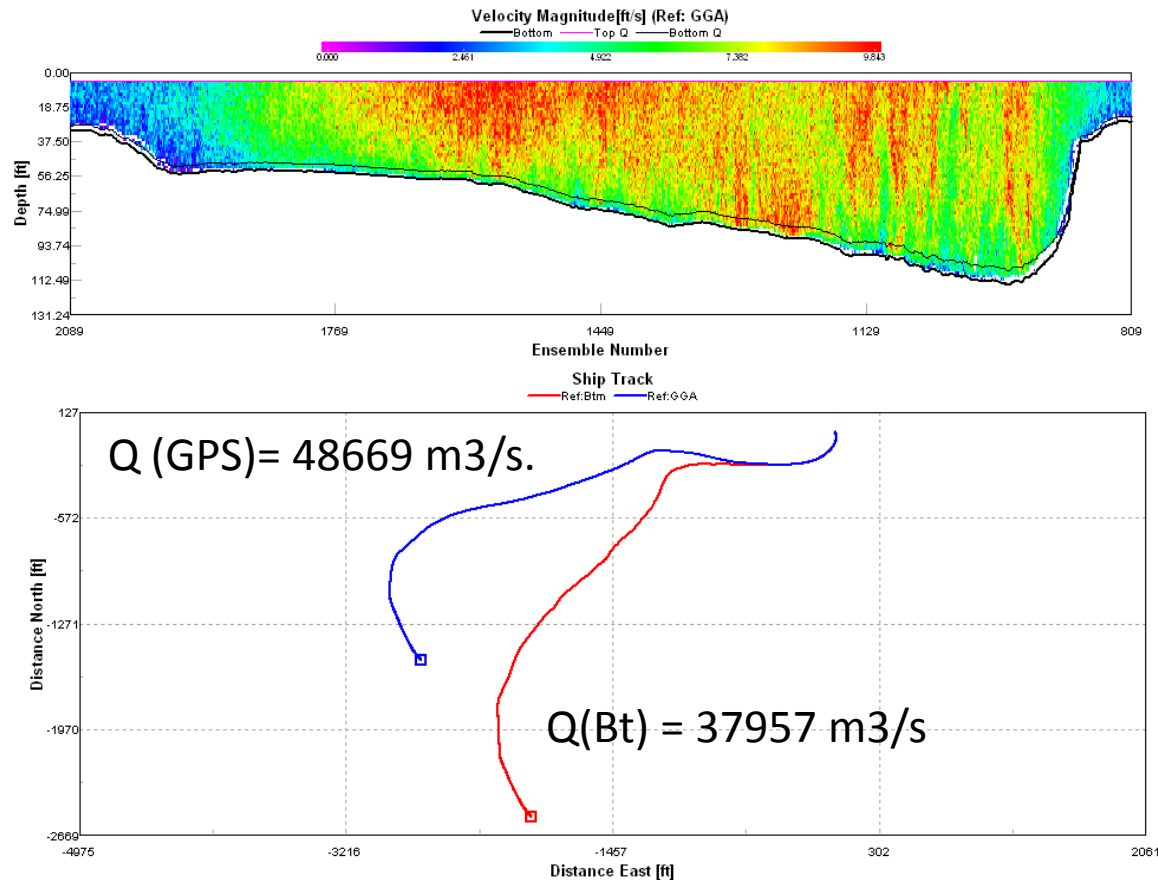
90 0 90 180 Kilometers

Courtesy F. Seyler

Geographical distribution of measurements



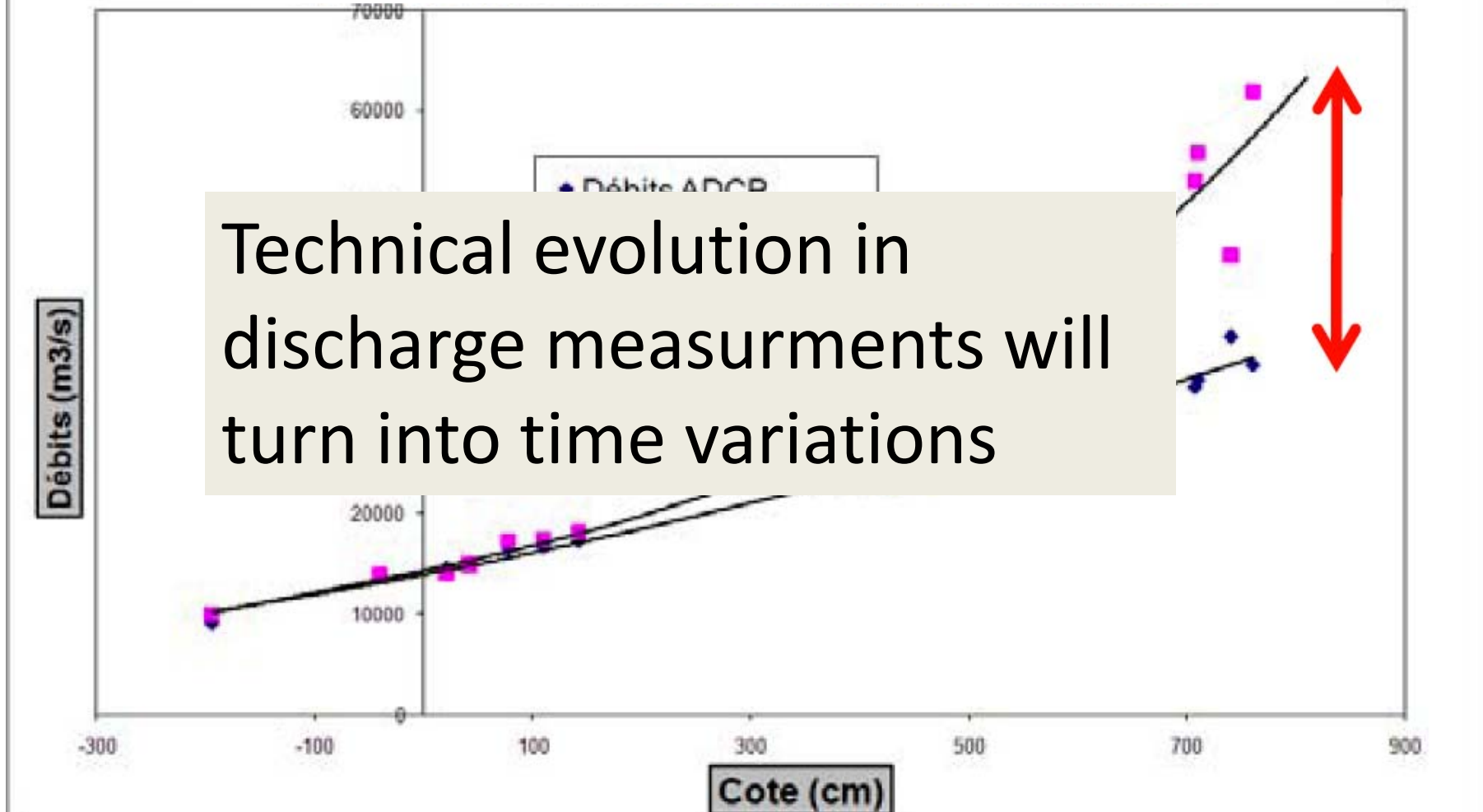
Discharge: The measurement precision



Boat trajectory across the river

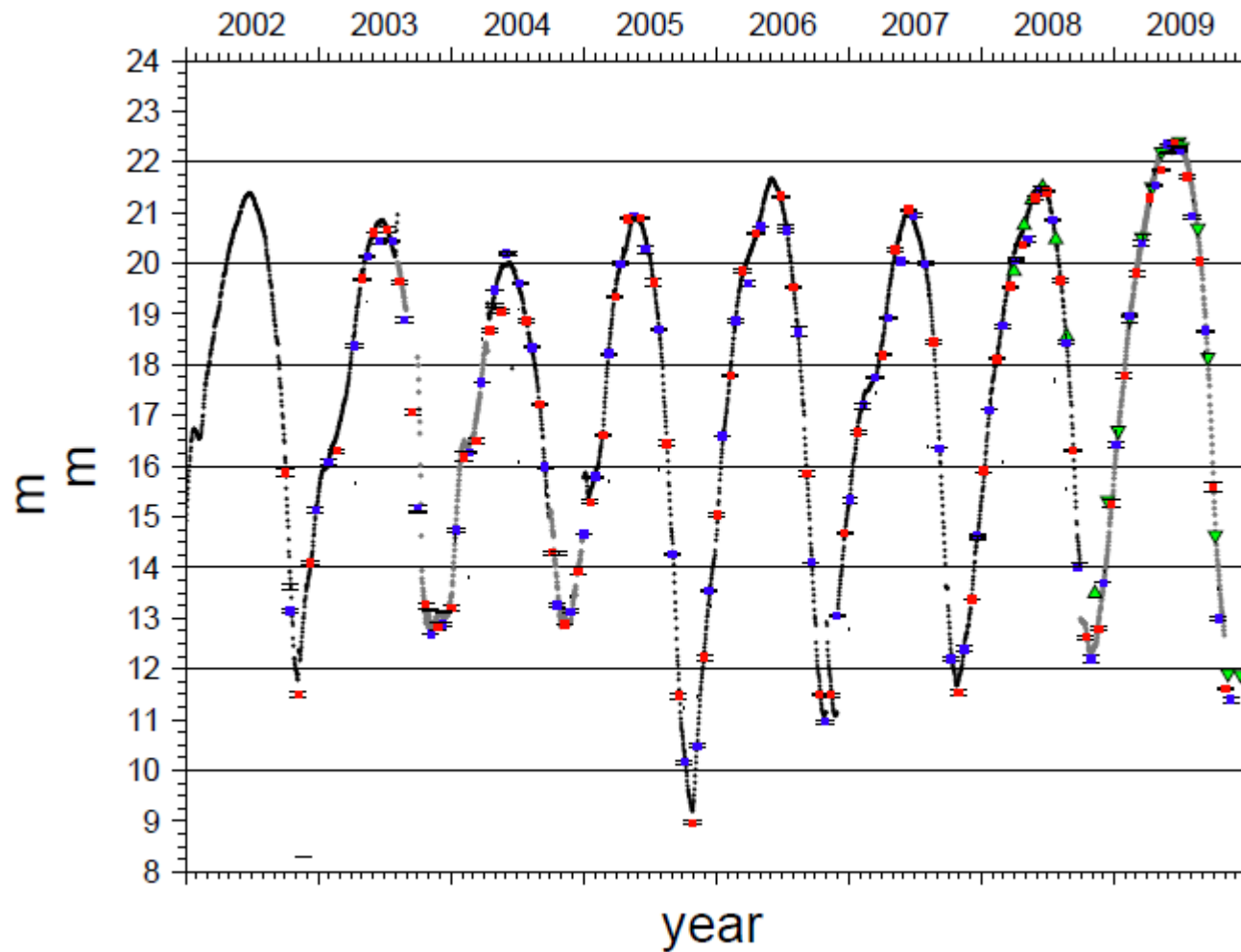
Courtesy P. Frazy (IRD/Peru)

Discharge vc Stage relationship

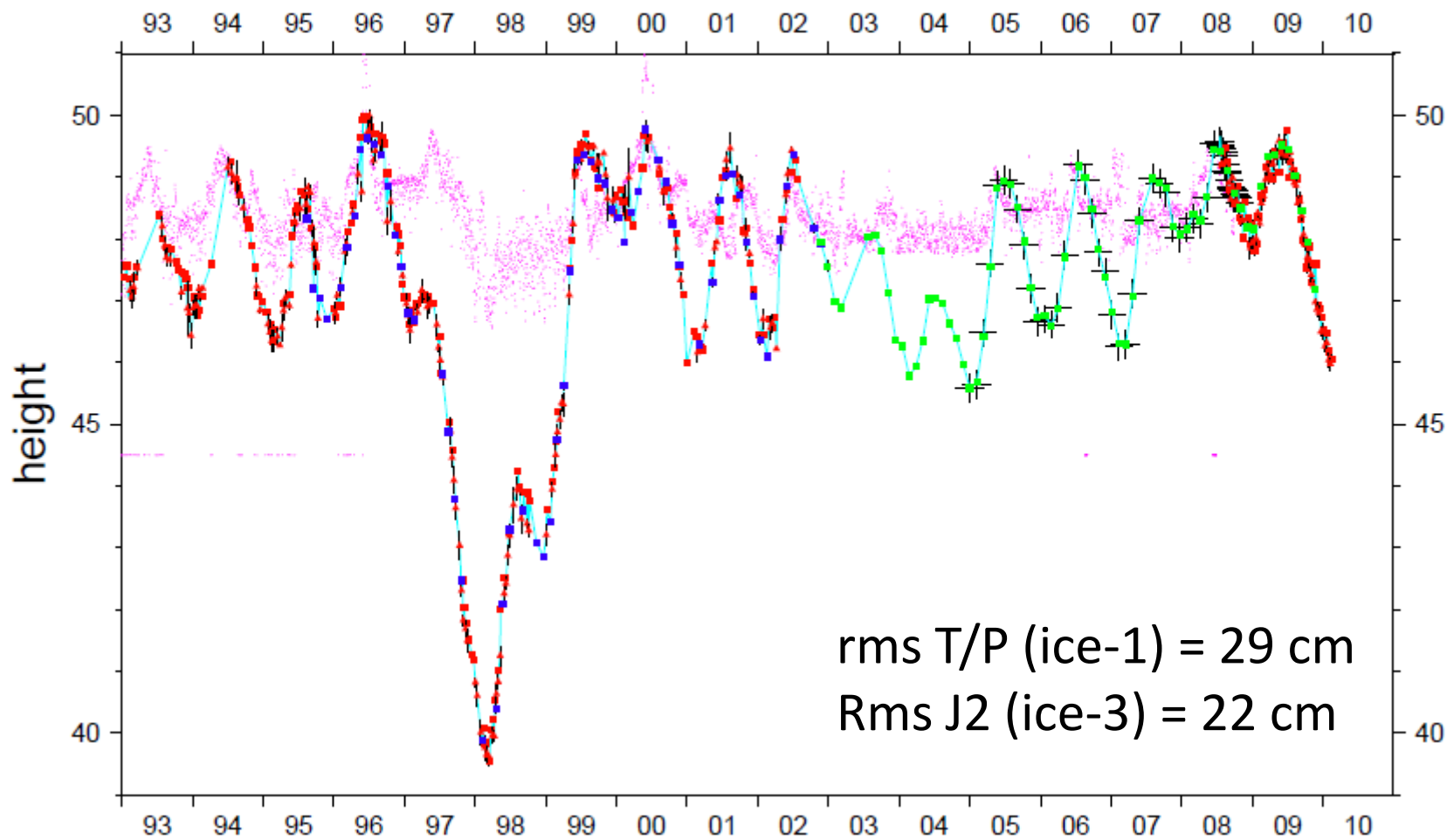


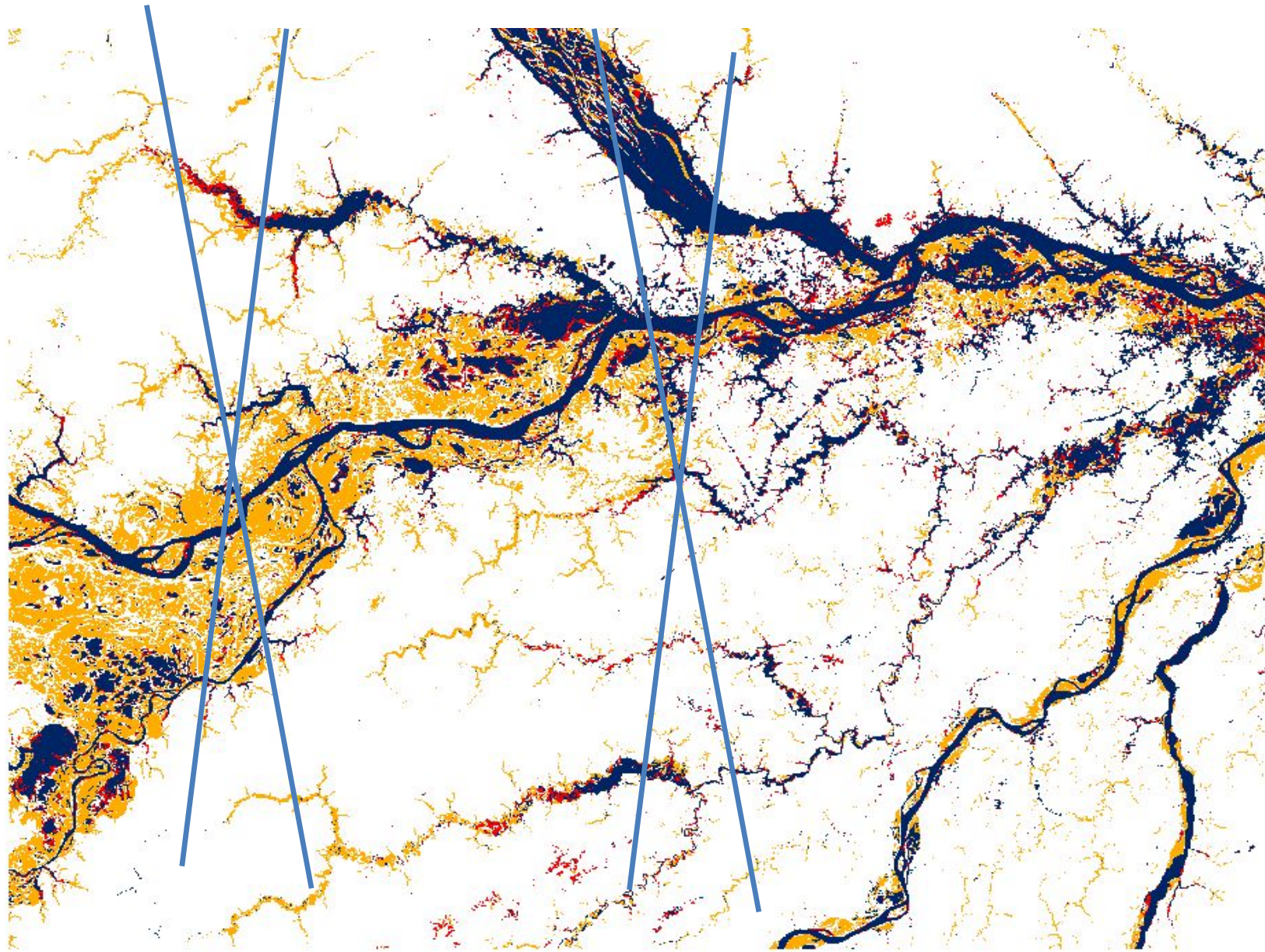
Technical evolution in discharge measurements will turn into time variations

Stages: the measurement precision



Balbina date





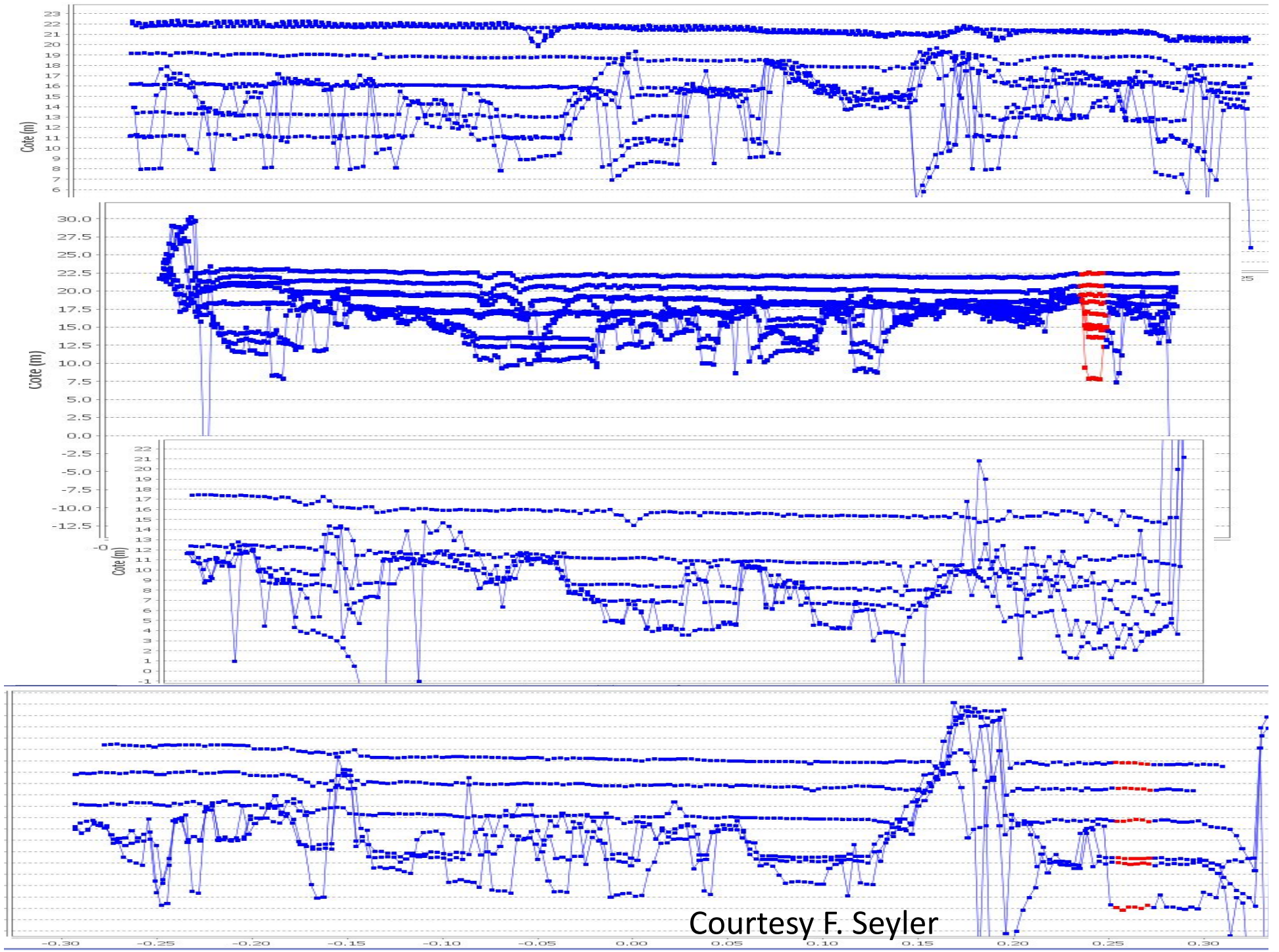
90

0

90

180 Kilometers

Courtesy F. Seyler

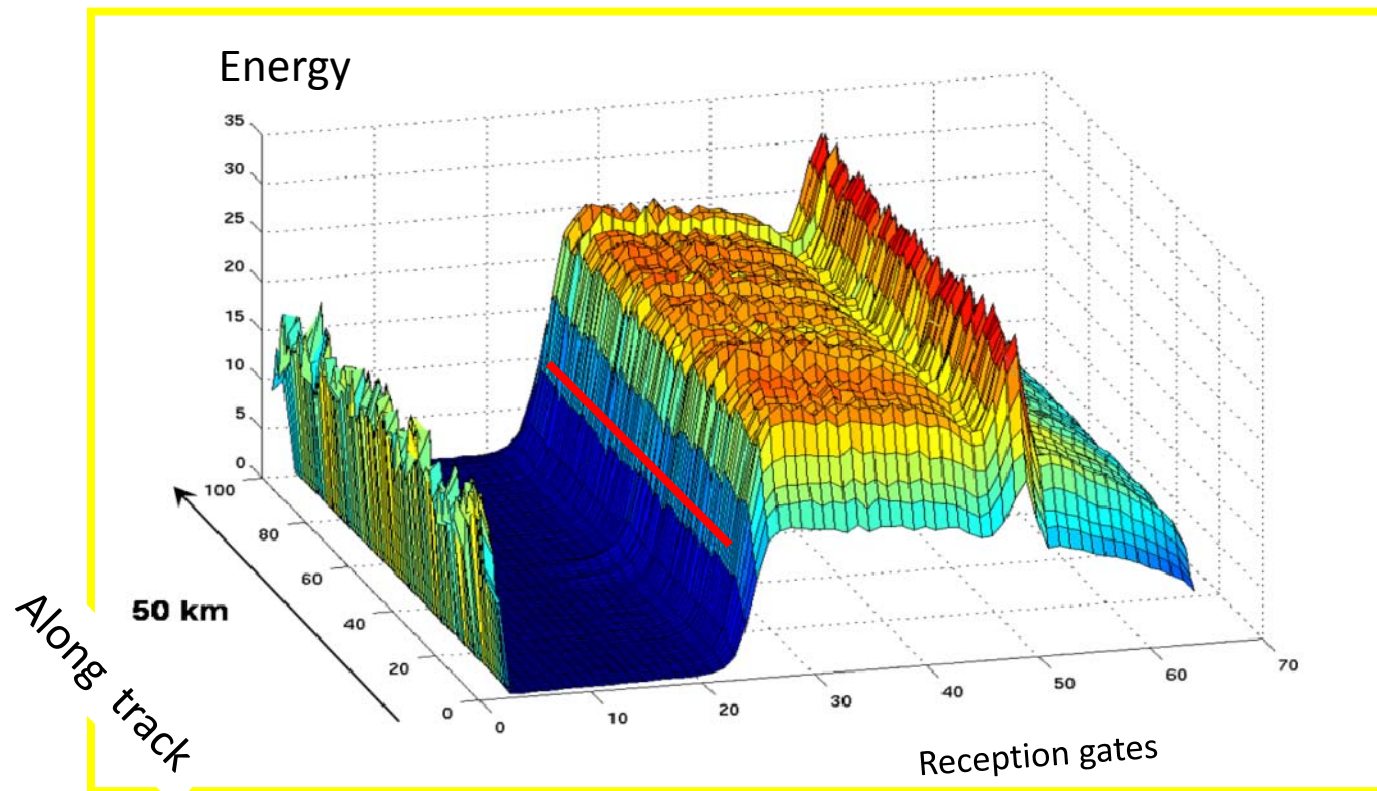


Courtesy F. Seyler

The altimetric measurement
Over river waters

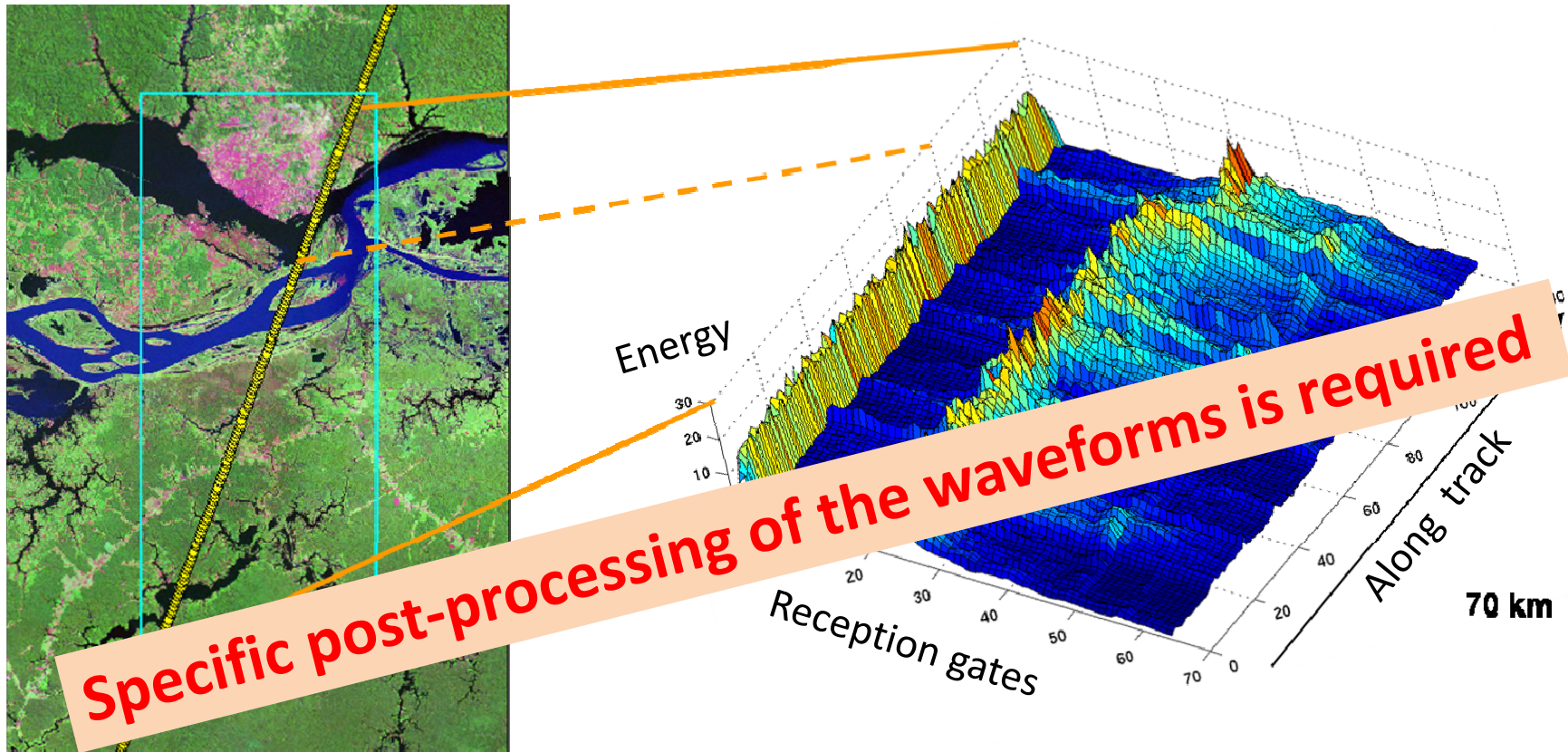
The waveform tracking problem:

Radar Echoes in the oceanic case



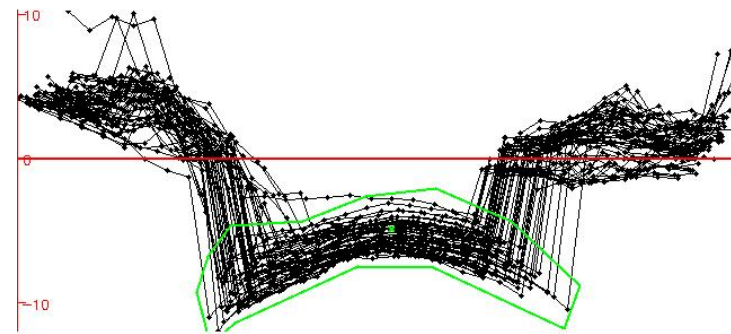
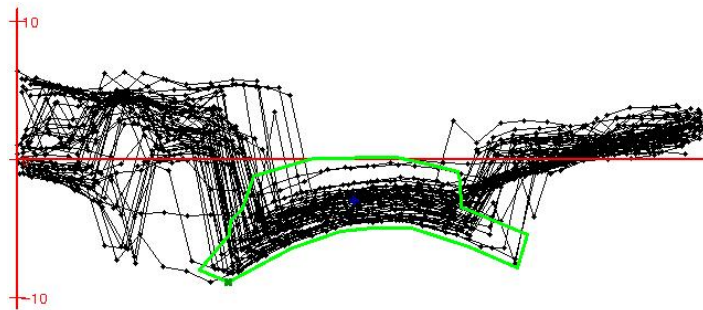
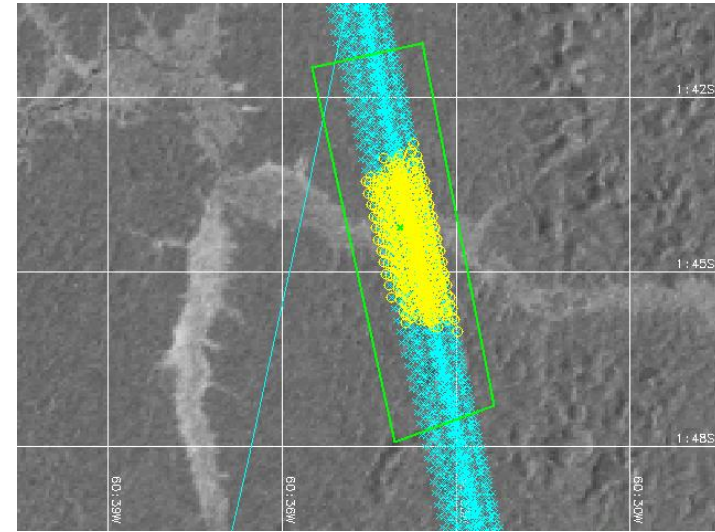
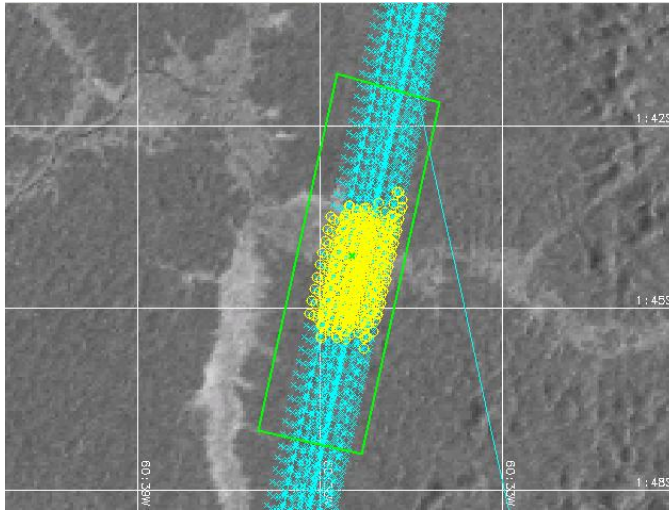
Courtesy F. Mercier, CLS

Radar Echoes over rivers



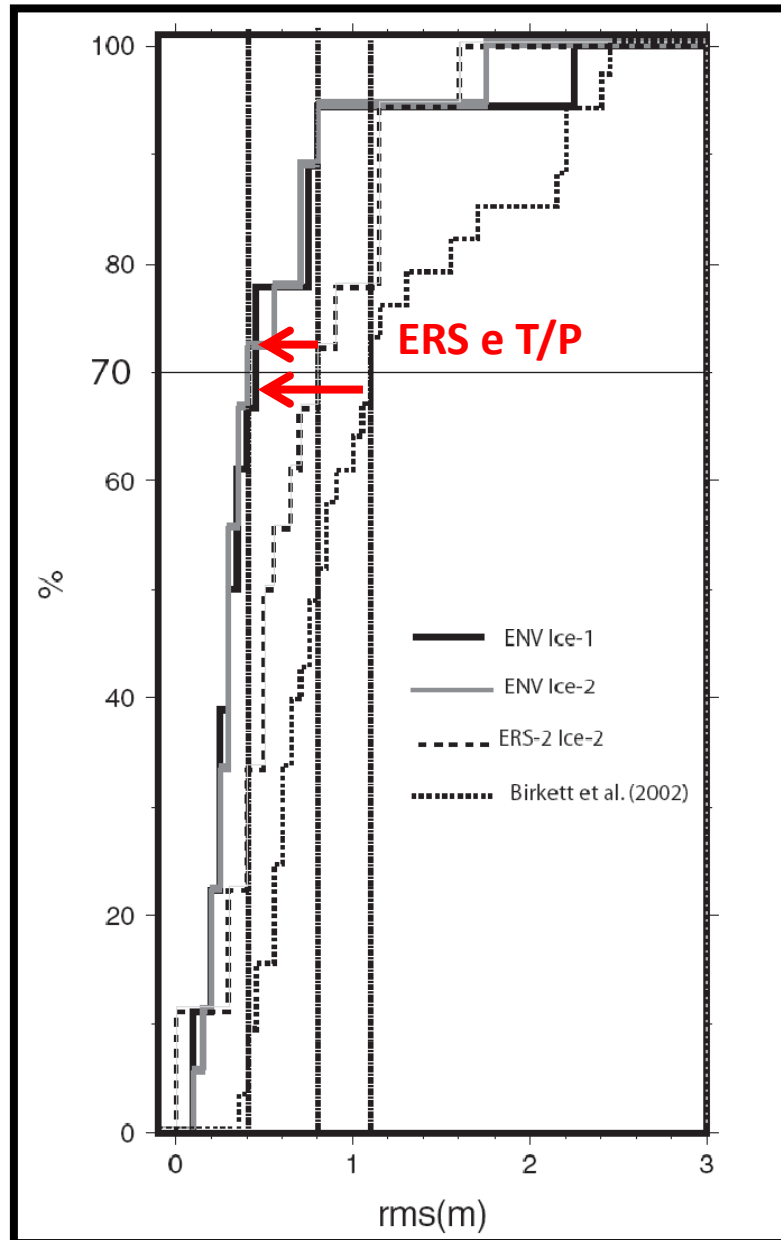
Courtesy F. Mercier, CLS

The slant measurements (1)



Courtesy J. Silva

Evolution of the performance



Birkett *et al.* (2002)

T/P Ocean

70% RMS < 110 cm

ERS Ice-2

70% RMS < 80 cm

ENVISAT Ice-1 e Ice-2

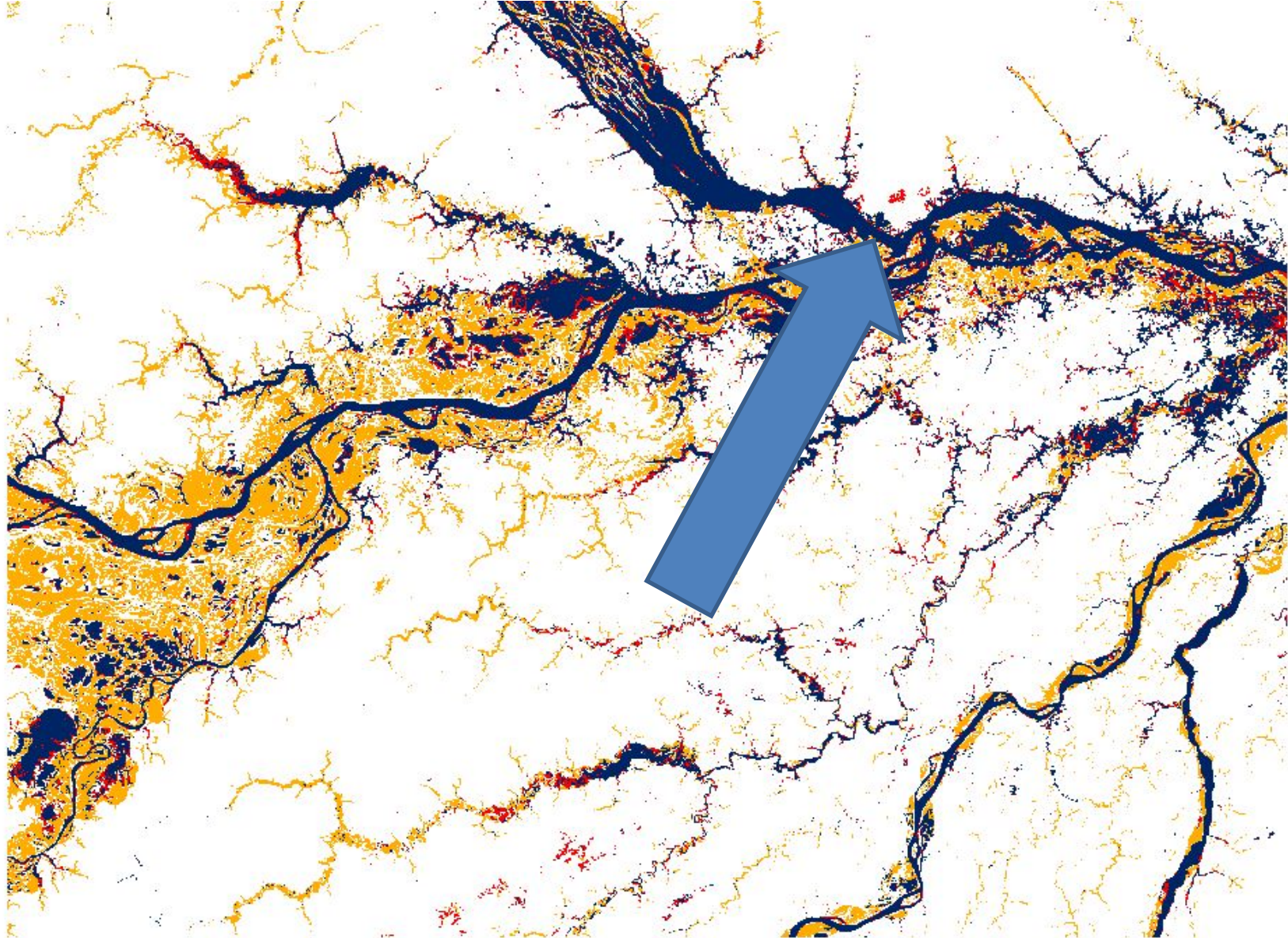
70% RMS < 40 cm

JASON-2 Ice-3

10 < RMS < 30 cm

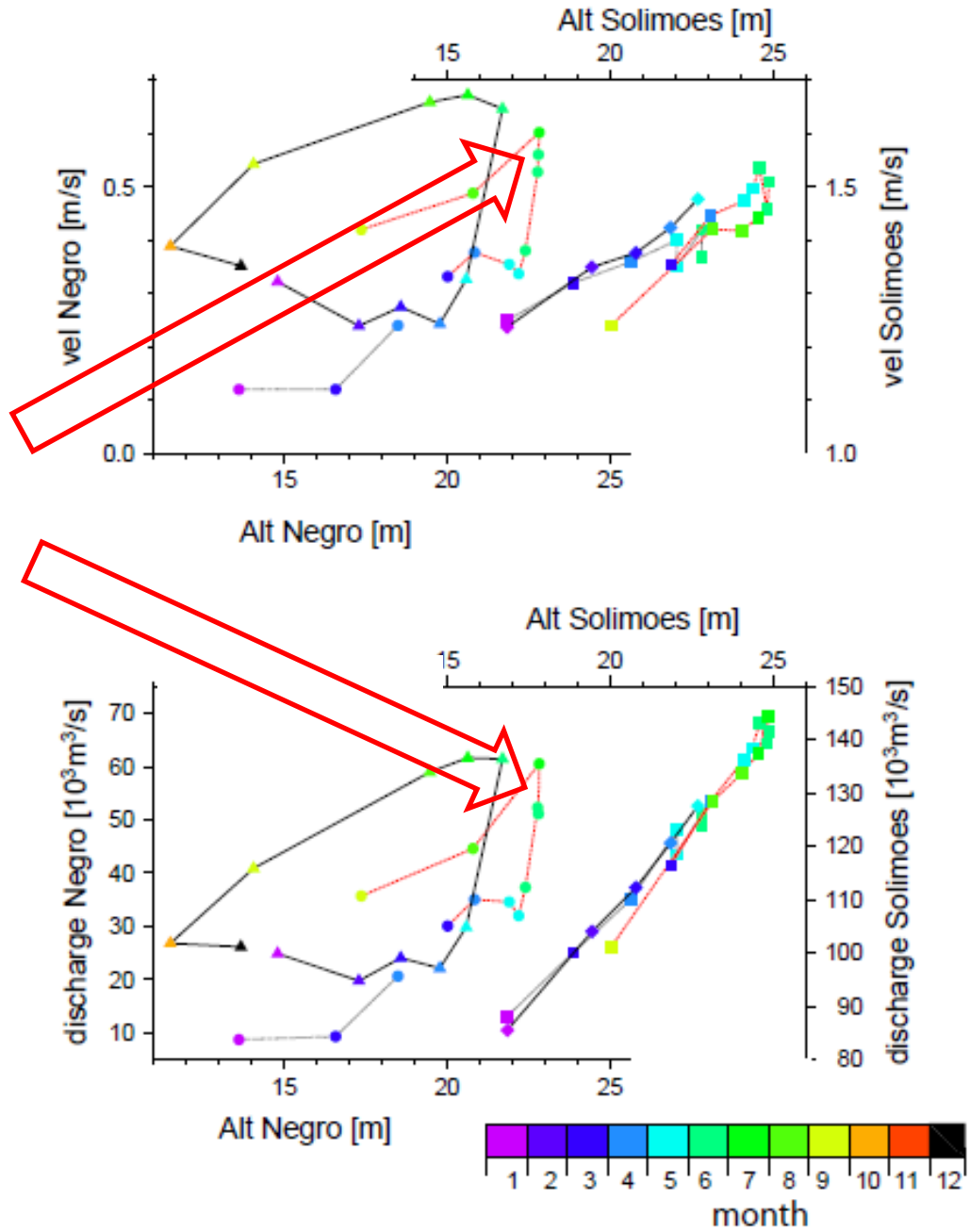
Courtesy J. Silva

The question of the desired
location of the discharge value

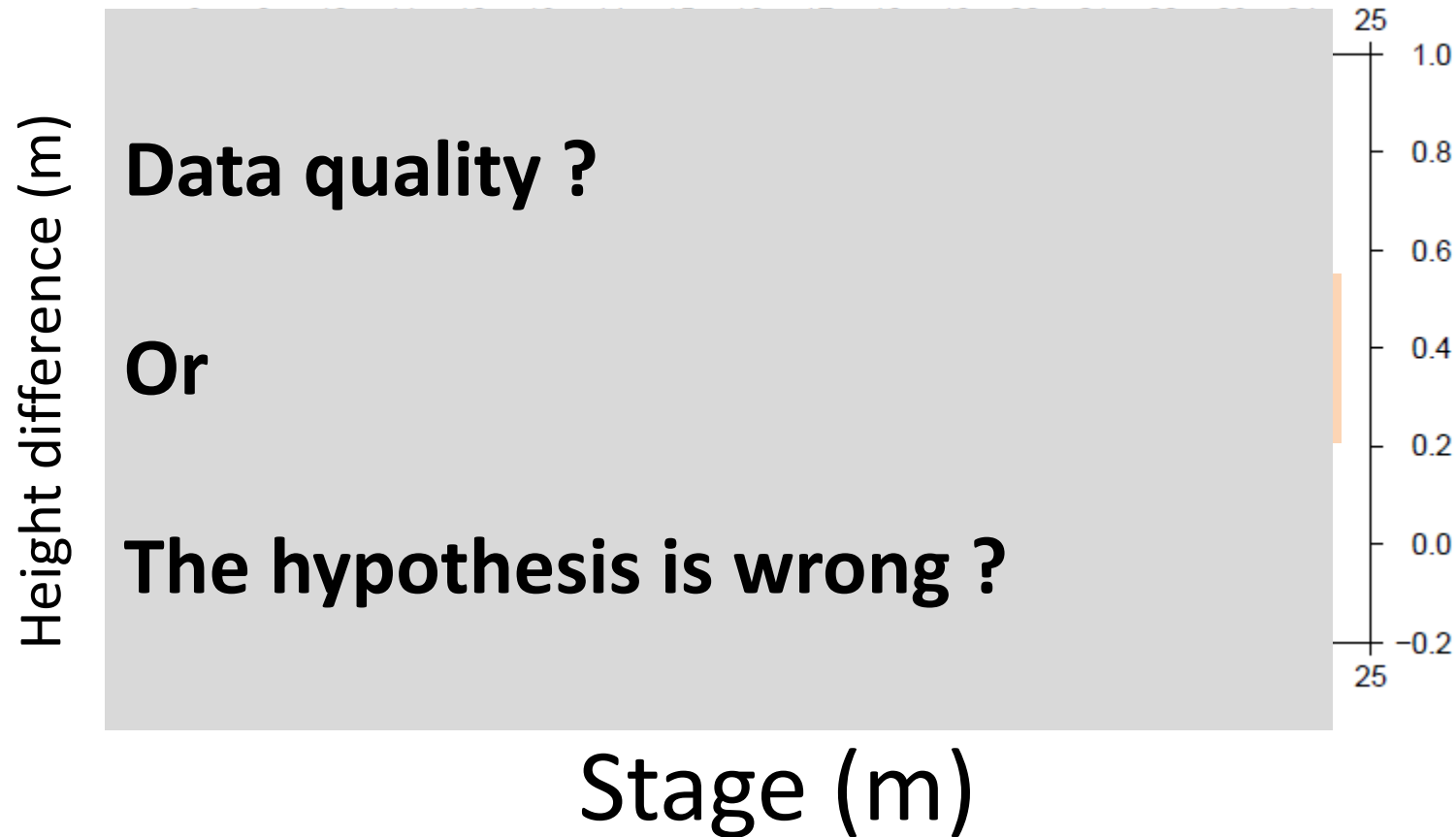


90 0 90 180 Kilometers

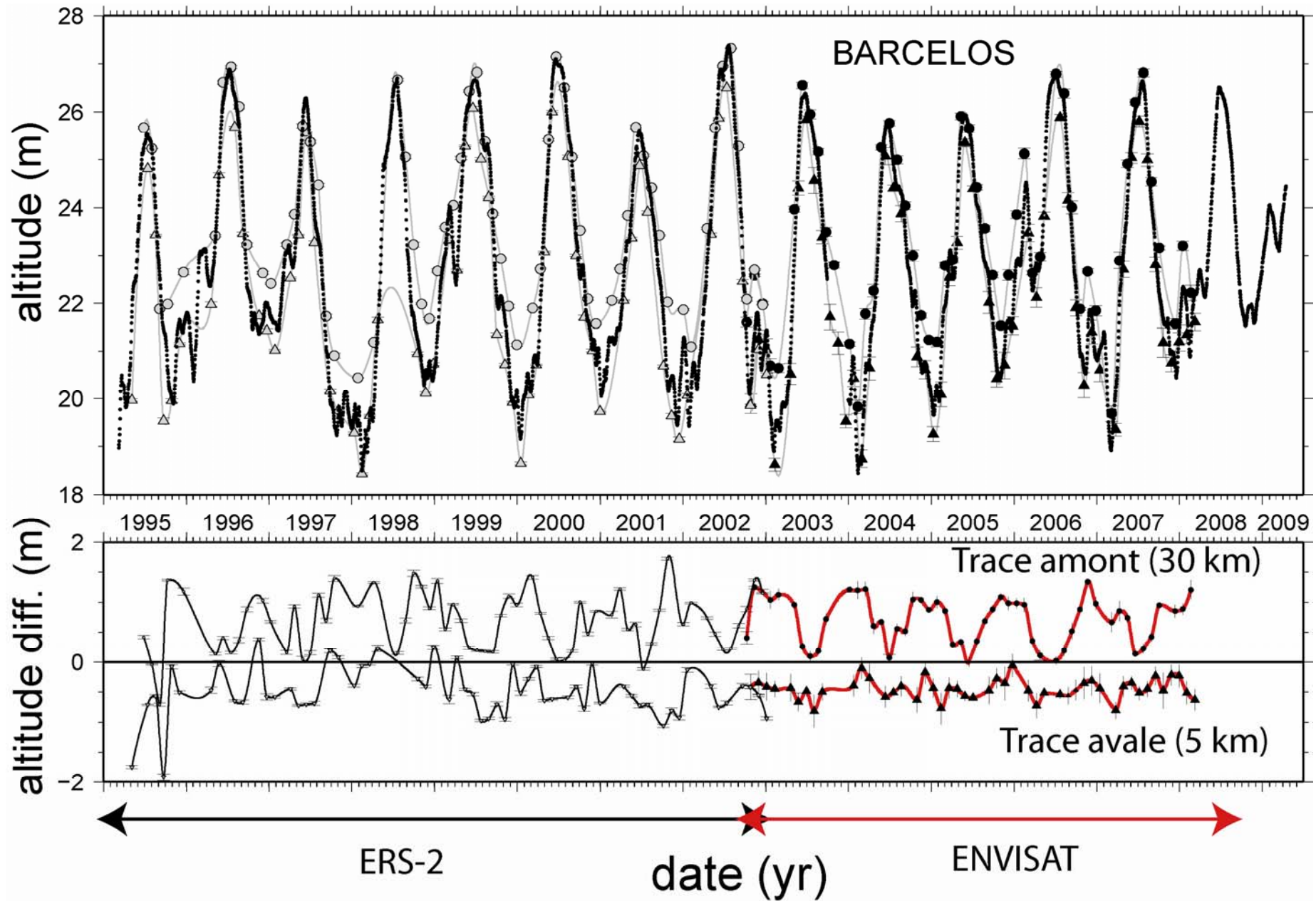
2009 FLOOD

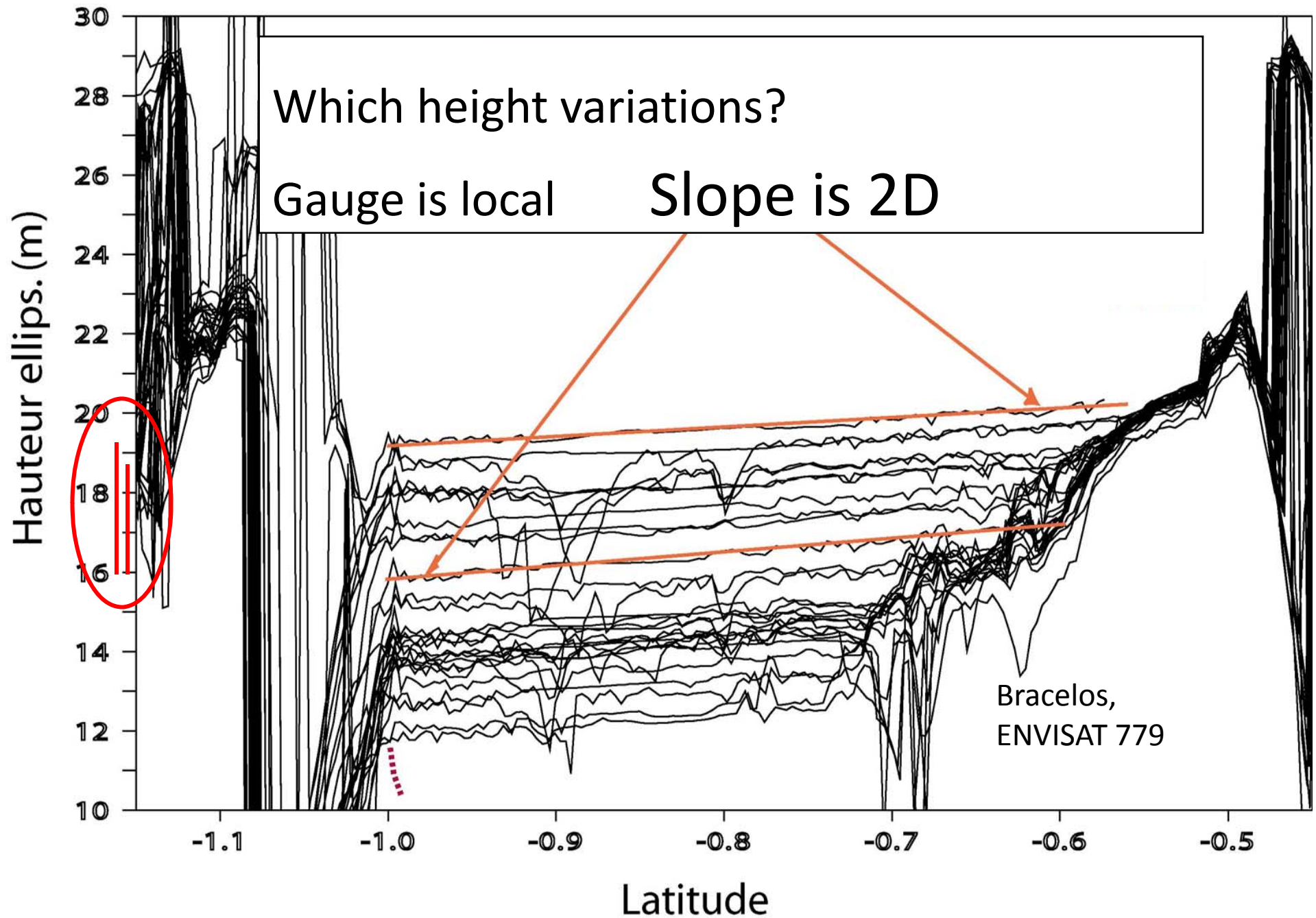


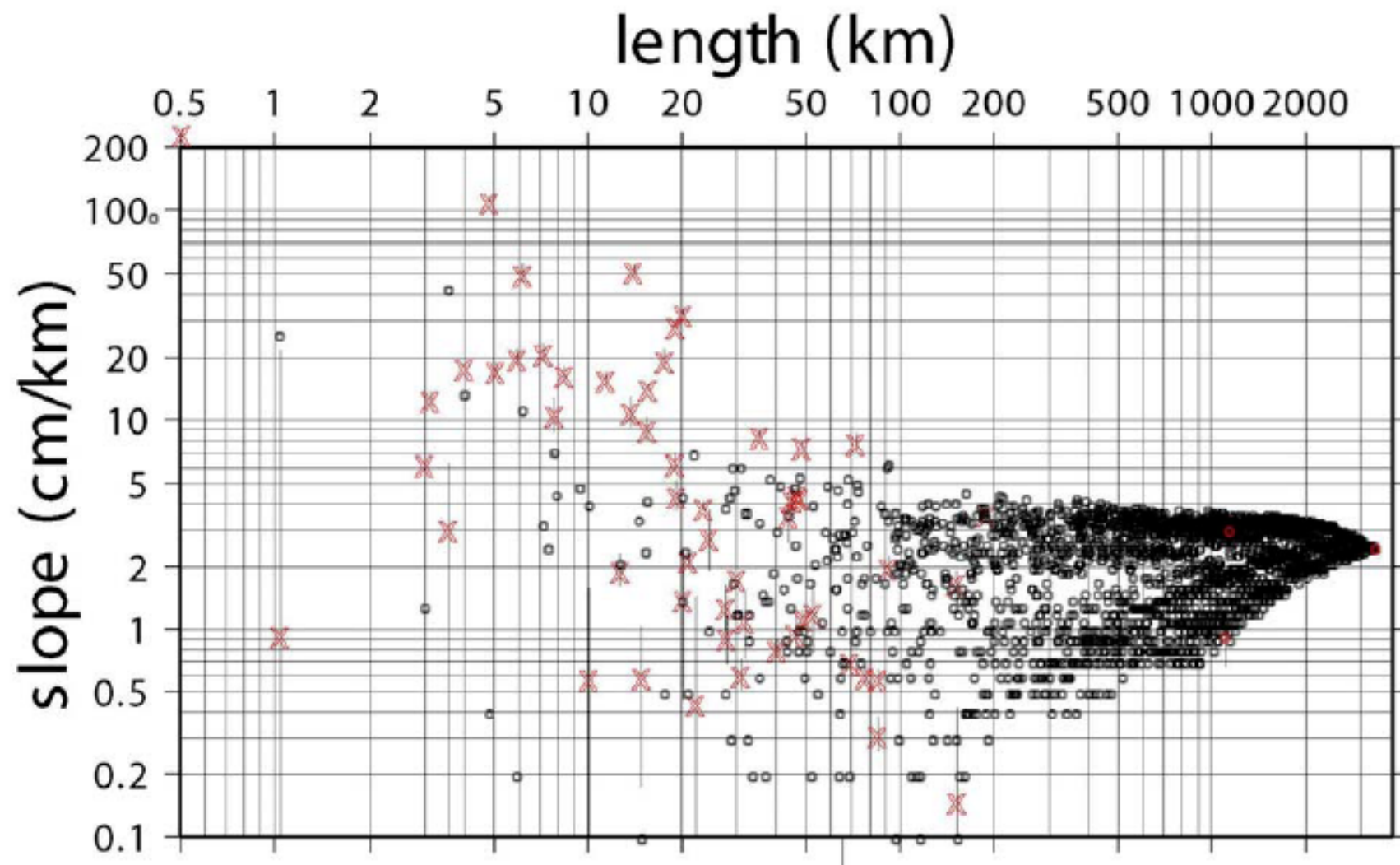
Slope variation at the mouth of the Negro River

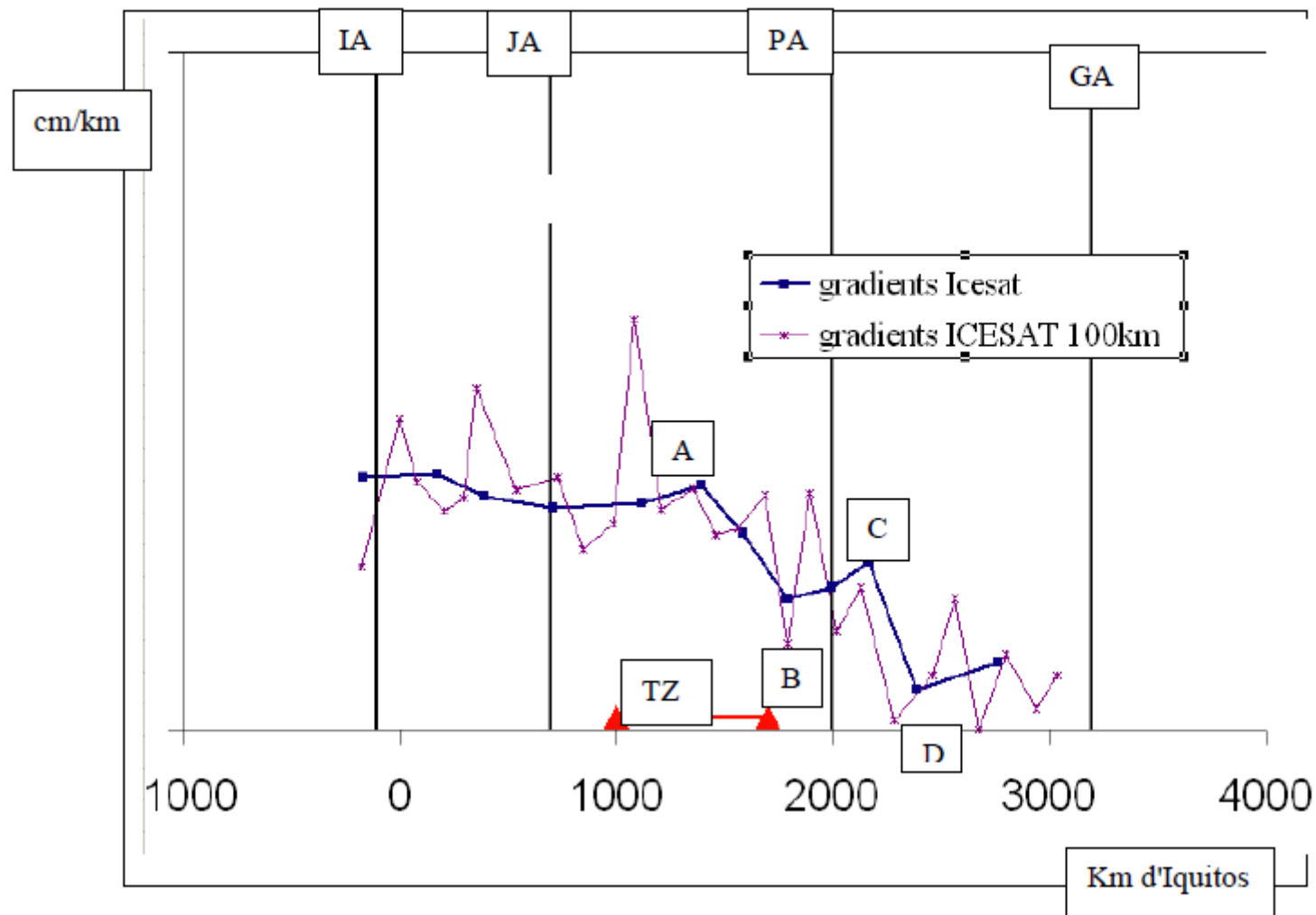


It looks to work not so bad upstream





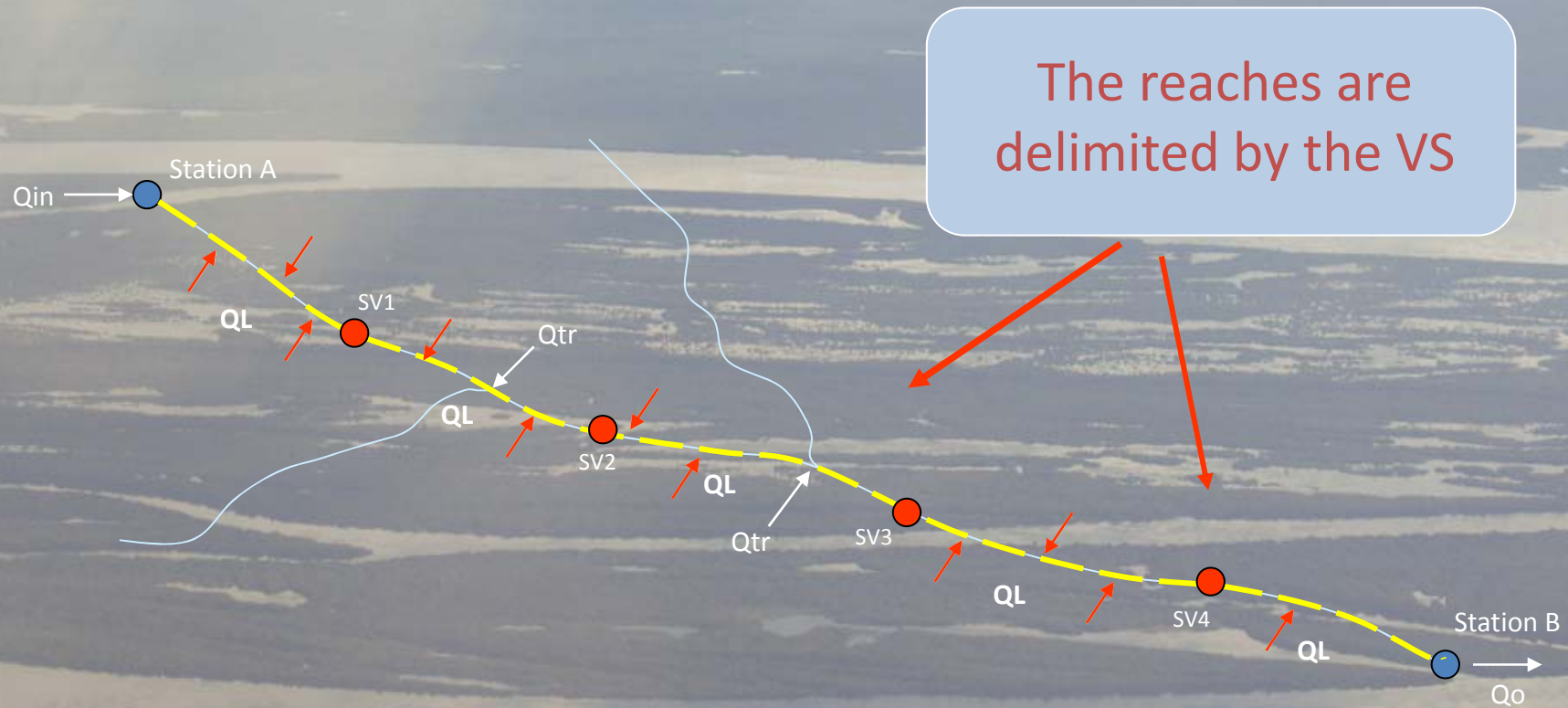




**High resolution altimetry will help to determine
 What is the « good » reach length to compute a
 slope that is related to discharge**

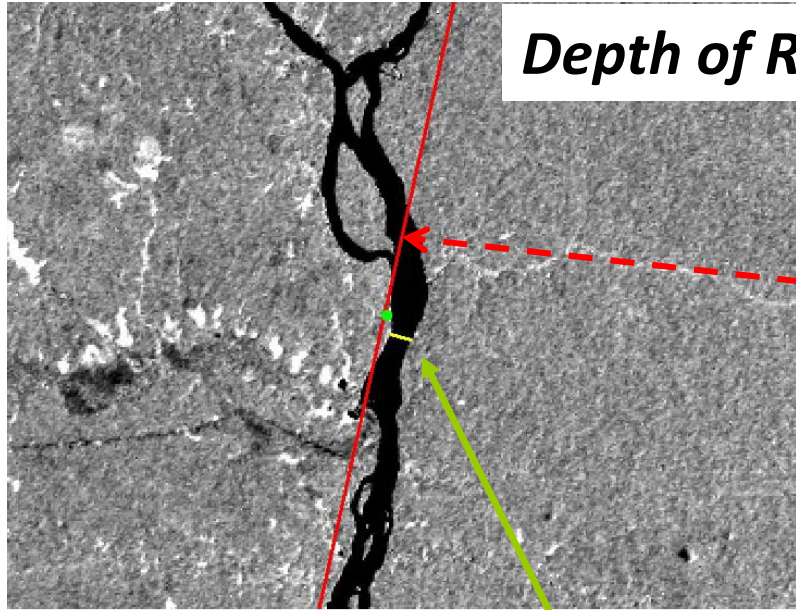
The river depth problem

Propagating discharge along strike the river



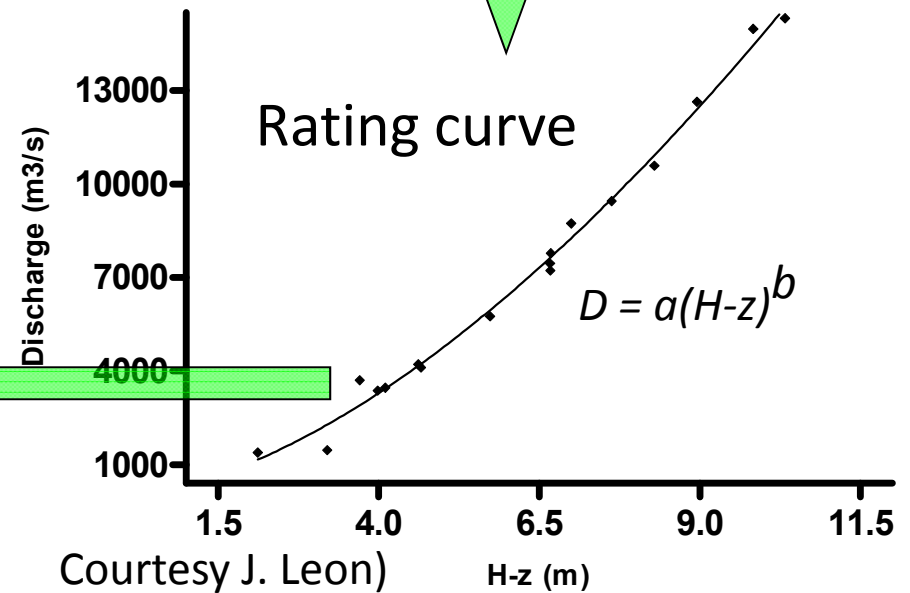
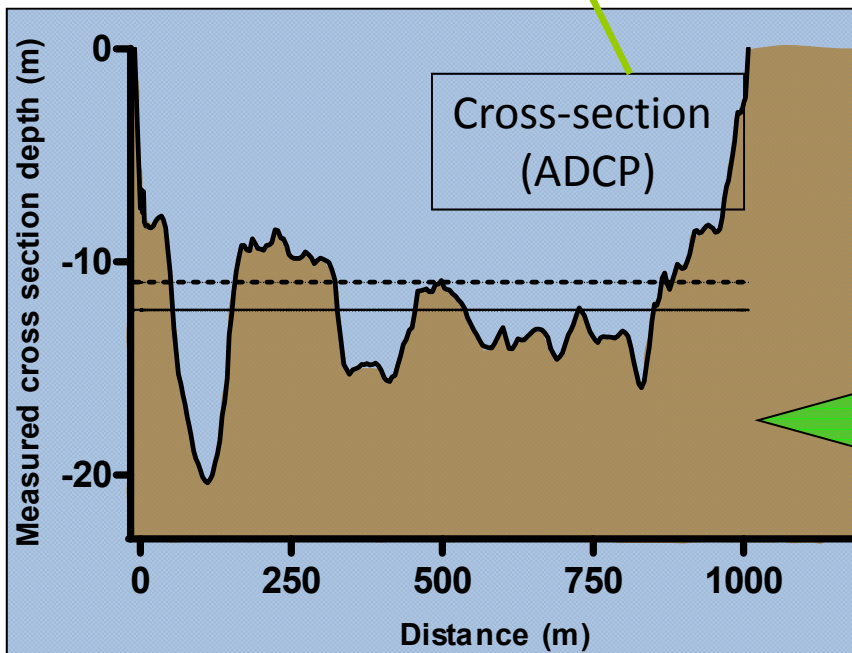
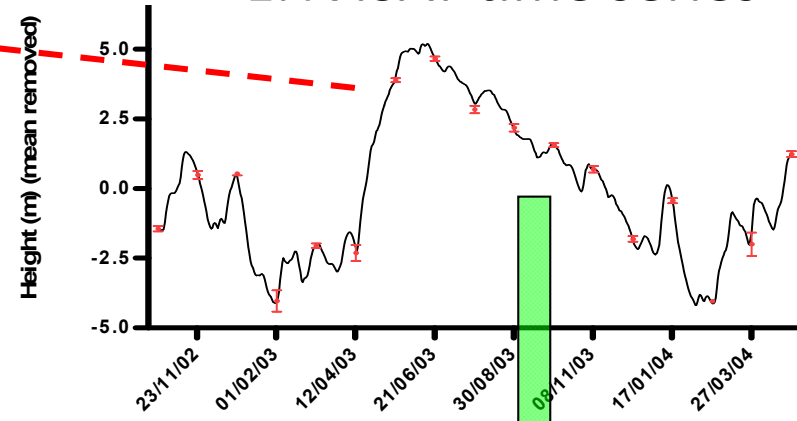
Courtesy J. Leon)

Depth of Rio Negro at Sao Felipe



0 10 20 Kilometers

ENVISAT time series



Courtesy J. Leon)

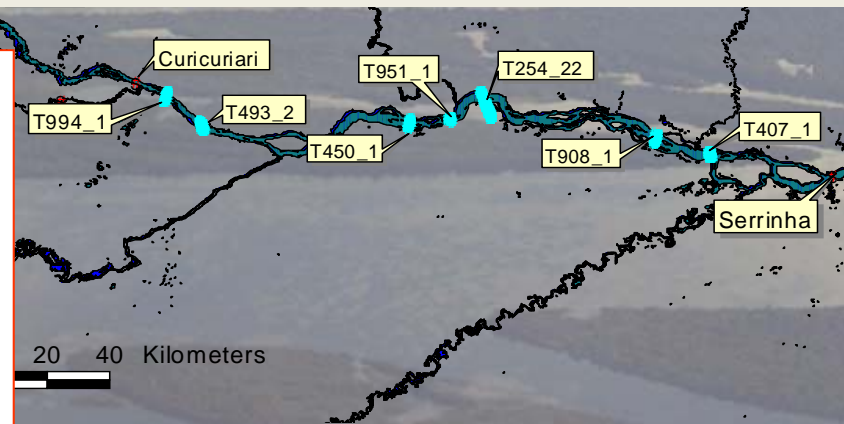
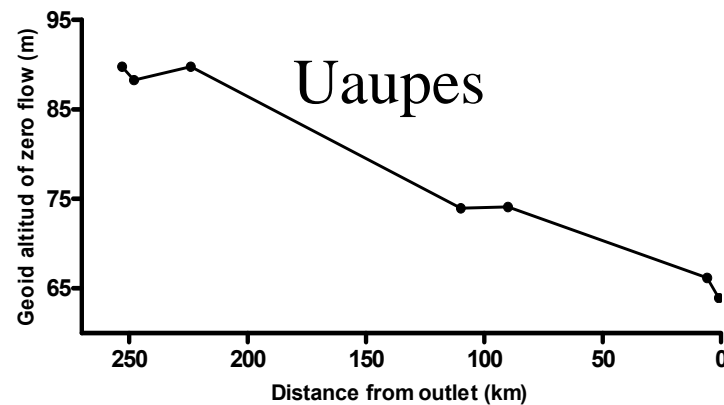
Profiles of river bed

Still under-sampled...

High resolution should enable « continuous »

River bed profiles

(see poster by Mike Durand)



Conclusion:

Present-day altimetry already permitted :

- to compute thousands of time series
(over the rivers but also over related wetlands)
- To validate the in-situ series of stage
- get stages BEFORE in-situ readings

Altimetry permitted to access to some parameters required by models such as the river depth
And provide punctual constraints for flow routing schemes

More studies are necessary to say if present-day altimetry is of sufficient quality to compute short scale surface slopes (ok for large scale)

High resolution altimetry might enable:

Better data

A full 3D view of the inundation areas (-> volumes)

Computation of rating curves at the desired place

Computation of river bed profiles all along the stems

Solve the question relative to the slope for discharge estimates