Accuracy of Satellite radar altimetry over inland waters : still over one meter for large rivers

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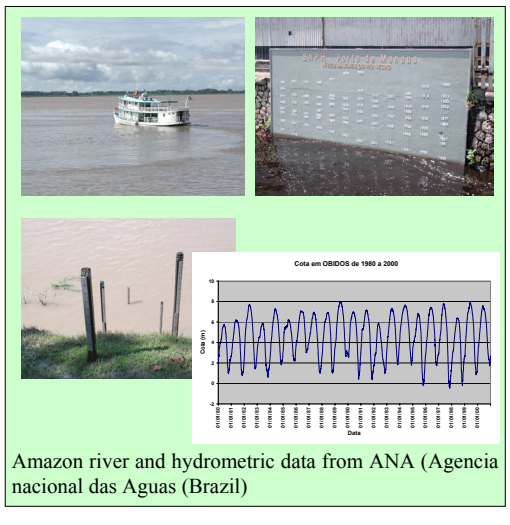


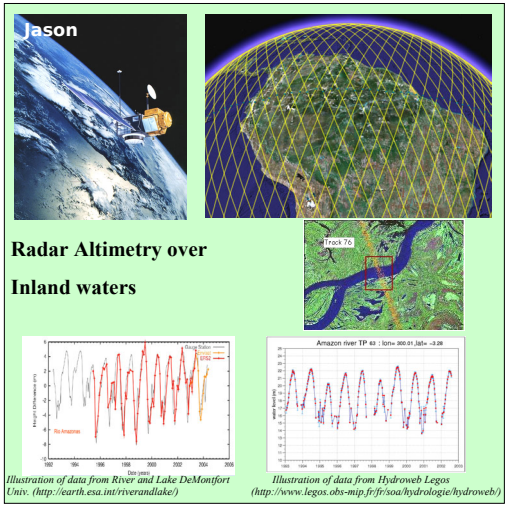
Amazon river and hydrometric data from ANA (Agencia nacional das Aguas (Brazil)

Using radar altimetry water levels for hydrological purposes, requires a reasonable knowledge of their accuracy and sampling period ("Quality of Radar Altimetry").

Although numerous works deal with radar altimetry for continental hydrology, some groups currently providing water level products *(River and Lake, CASH,...)*, the issue of quality characterization still has not been addressed properly. Published accuracy values often focus on few "selected samples" and, in some cases, data are filtered based on in situ information prior to error analysis.

We present a statistical approach, based on a standardized methodology, to quantify accuracy and effective sampling period of radar altimetry products. It can be applied to any processing chain. It allows inter-comparison and quantification of gains by new retracking and filtering algorithms.

Current uncertainties appear to range between 1 and 2 m. Announces of "0.25m accuracy" on rivers and lakes appear to be over-optimistic.



Radar Altimetry over Inland waters

Illustration of data from River and Lake DeMontfort Univ. (http://earth.esa.int/riverandlake/)

Illustration of data from Hydroweb Legos (http://www.legos.obs-mip.fr/fr/soa/hydrologie/hydroweb/)

(1) Radar Altimetry processing chain for inland waters

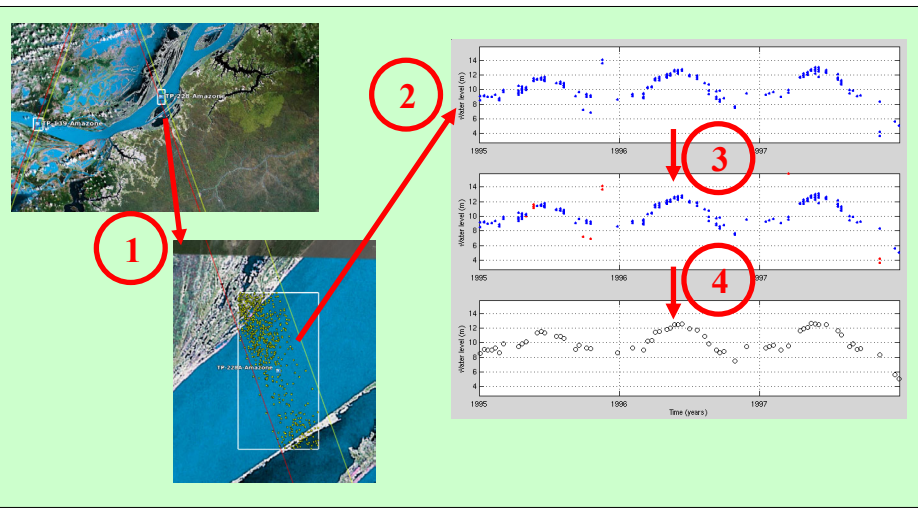
Processing chain to generate radar altimetry products (water level time series on inland waters) is a multiple step chain :

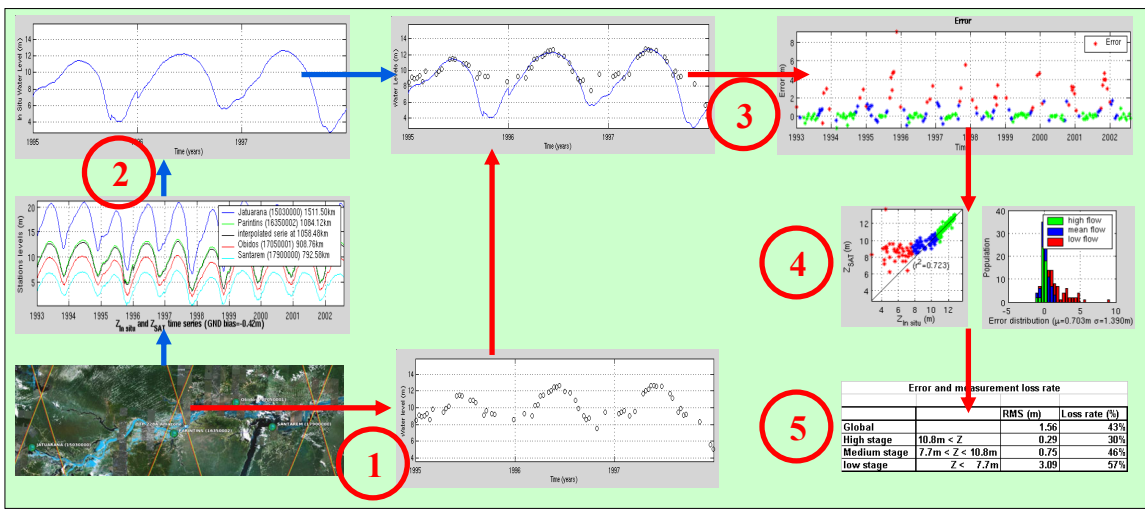
(1) Definition of a geographic extraction window over river-track intersection

(2) Extraction of satellite measurements over this window using a retracking algorithm (or expert system) and translation to a geoidal reference, using a geoid model

(3) Filtering of data

(4) Selection of a unique value for each satellite overflight





(2) Method for quantification of data accuracy

Radar altimetry time series (1) is compared with in situ water level time series below the satellite track, derived from available in situ gauging stations, through interpolation or propagation model (2).

Resulting error time series (3) is not gaussian. It is structured depending on in situ water level : accuracy is higher at river high stage, lower at low stage (4).

This allows quantification of accuracy (root mean square error) and measurement loss rate (measurement gaps) (5).

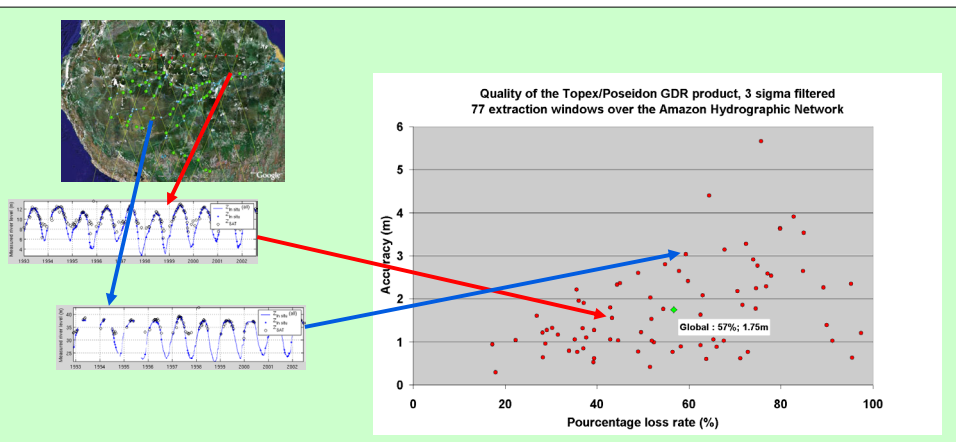
(3) Statistical characterization of product quality

For each extraction window the product (radar altimetry water level time series) presents a given accuracy and measurement loss rate.

The product is tested over 77 extraction windows over the Amazon hydrographic network with river width ranging from 80m to 17 000m.

The resulting figure illustrates the statistical characterization of the product quality for Topex Poseidon GDR product, filtered with a 3sigma filter : to each extraction window corresponds a dot in the accuracy / measurement loss rate plan.

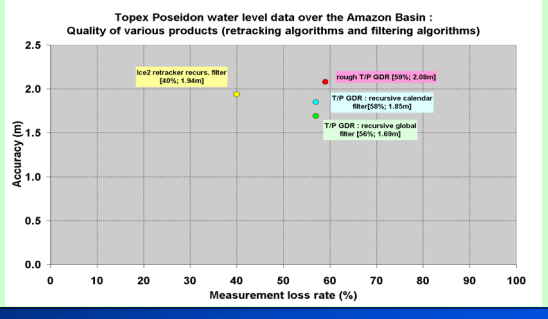
Average Quality of this product is 1.75m accuracy and 57% loss rate



(4) Comparison of product (processing chain) quality

Performances of various products can be analysed and compared on a statistical basis. Figure on the right illustrates various retracking algorithms (Ocean; Ice2) and filtering algorithms on the Topex Poseidon data :

* Rough GDR data present a 2.1m mean accuracy and 59% loss rate;
* Filtering GDR data allows a gain of 0.4m in accuracy without loss.
* EnviSat Ice 2 retracker improves quality by 0.2m and 20%.



Conclusion : Inland water radar Altimetry accuracy is in the range of 1 to 2m, lower than current optimistic examples (0.25m).

This method allows to characterize quality of radar altimetry products and to assess gains from new algorithms and methods.

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