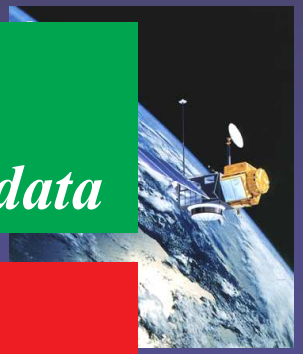
Accuracy of Satellite Radar Altimetry over rivers

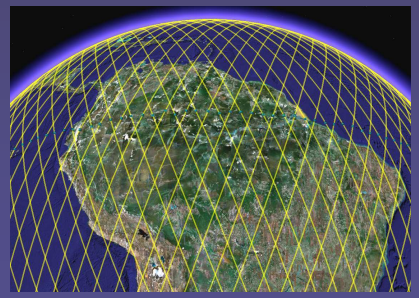
Statistical analysis and Comparison of retracking algorithms

Bercher, N. (1); Kosuth, P. (1); Mercier, F. (2); Frontera, V. (1)
(1) Cemagref; (2) CLS

In situ water level measurements

Satellite radar altimetry water level measurements



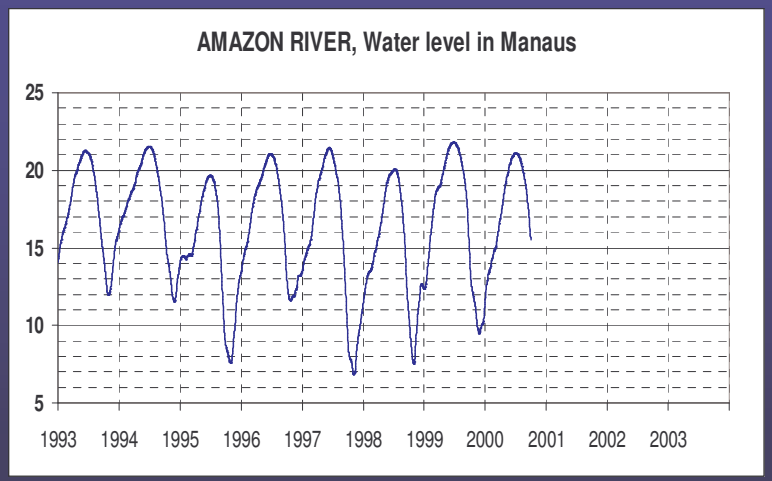


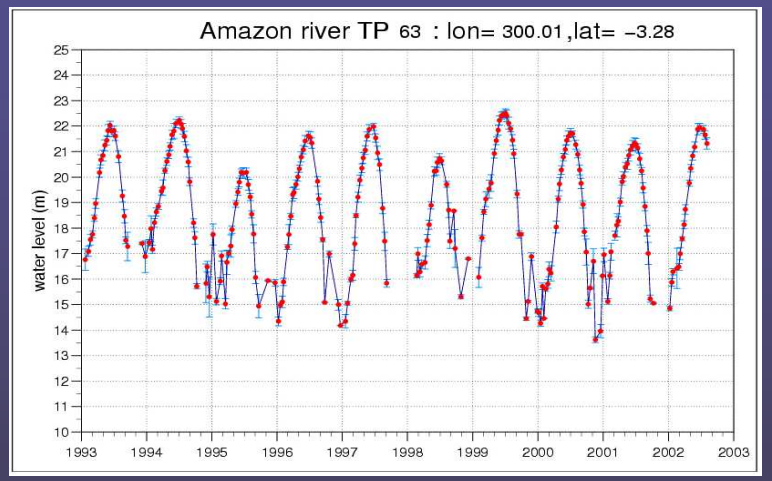
+ Global coverage

+ Near real time access to data

- Low sampling frequency

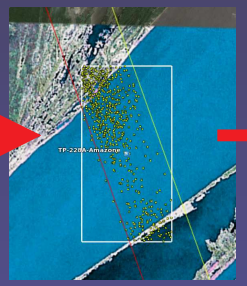
- Accuracy ??

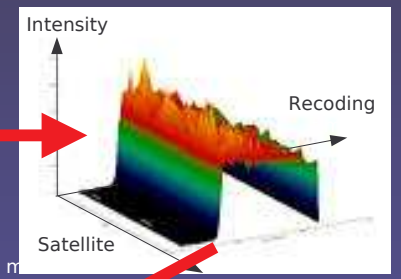


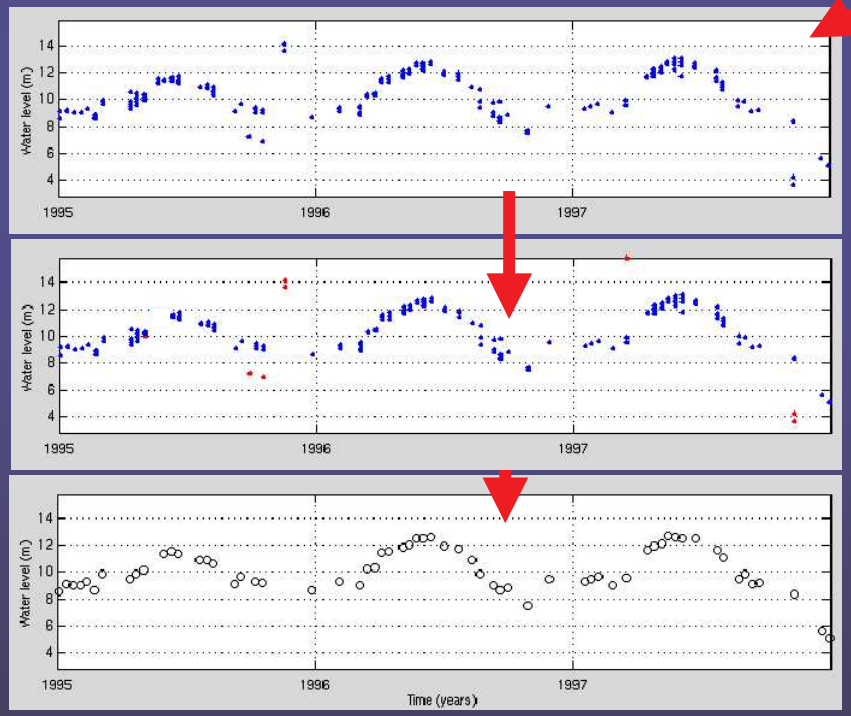


Radar altimetry water levels : a 7 step processing chain

1. Location of the Satellite Radar Altimetry station
2. Delineation of geographic extraction window
3. Waveform retracking
4. Tropospheric corrections
5. Translation to the geoid
6. Filtering of erroneous measures
7. Selection of one value per satellite overflight

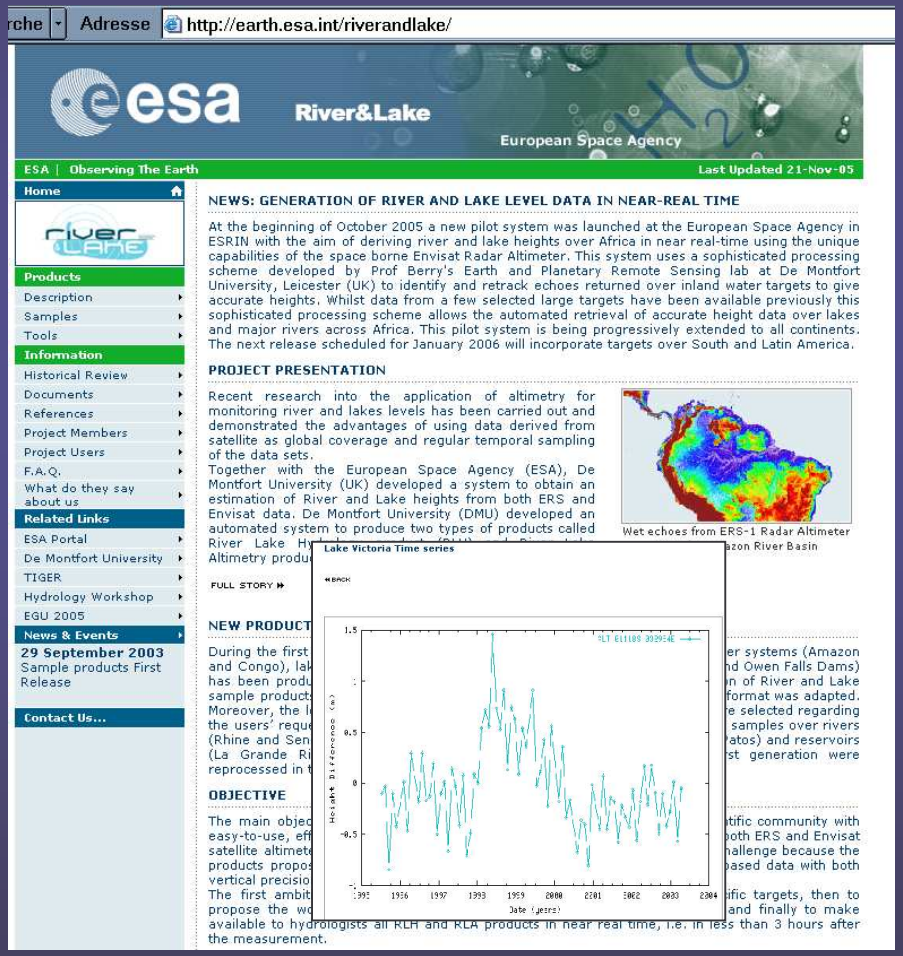




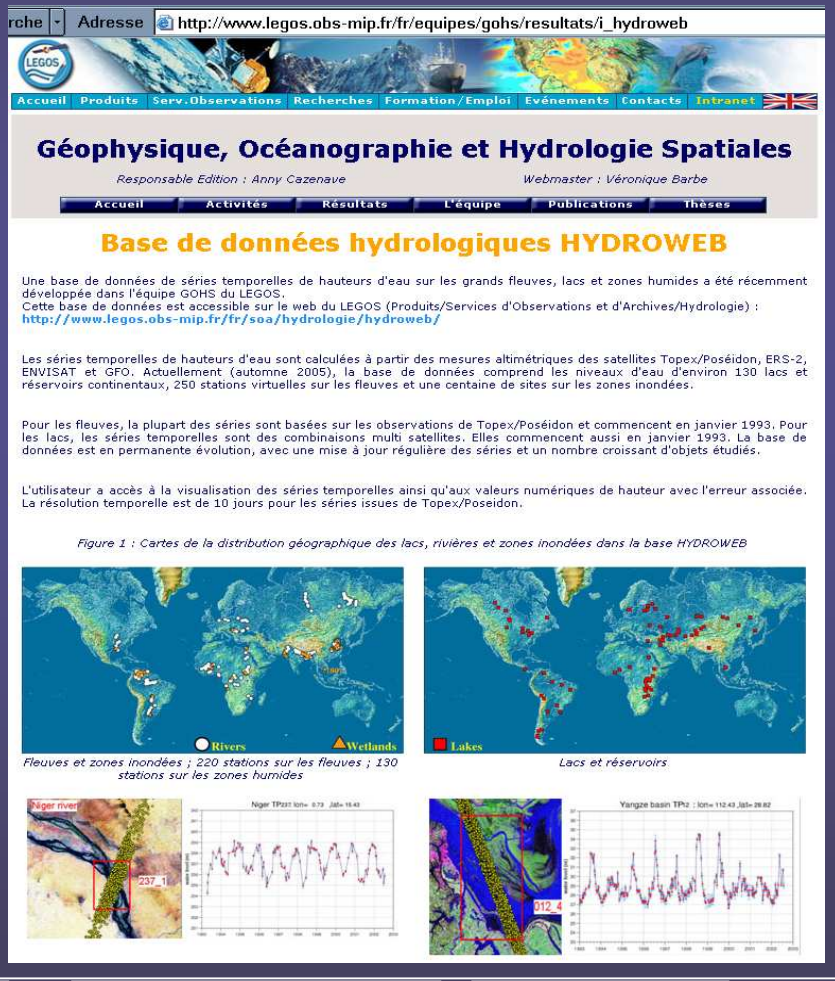


A few providers of Satellite radar altimetry continental water levels

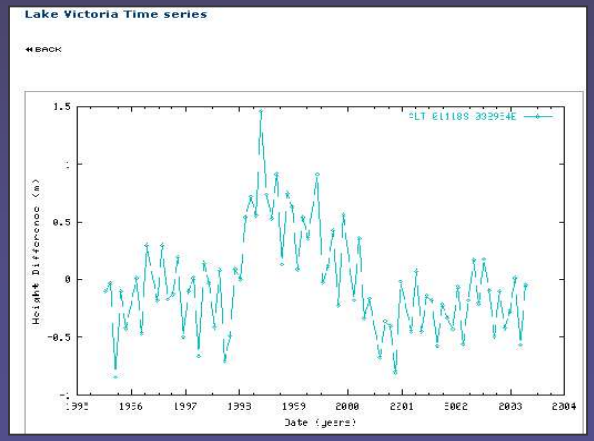
ESA « River and Lake » Project
(De Montfort Univ. UK)



LEGOS « Hydroweb »
(CNES, IRD, « CASH » Project Fr)



Radar altimetry over continental waters : pending issues

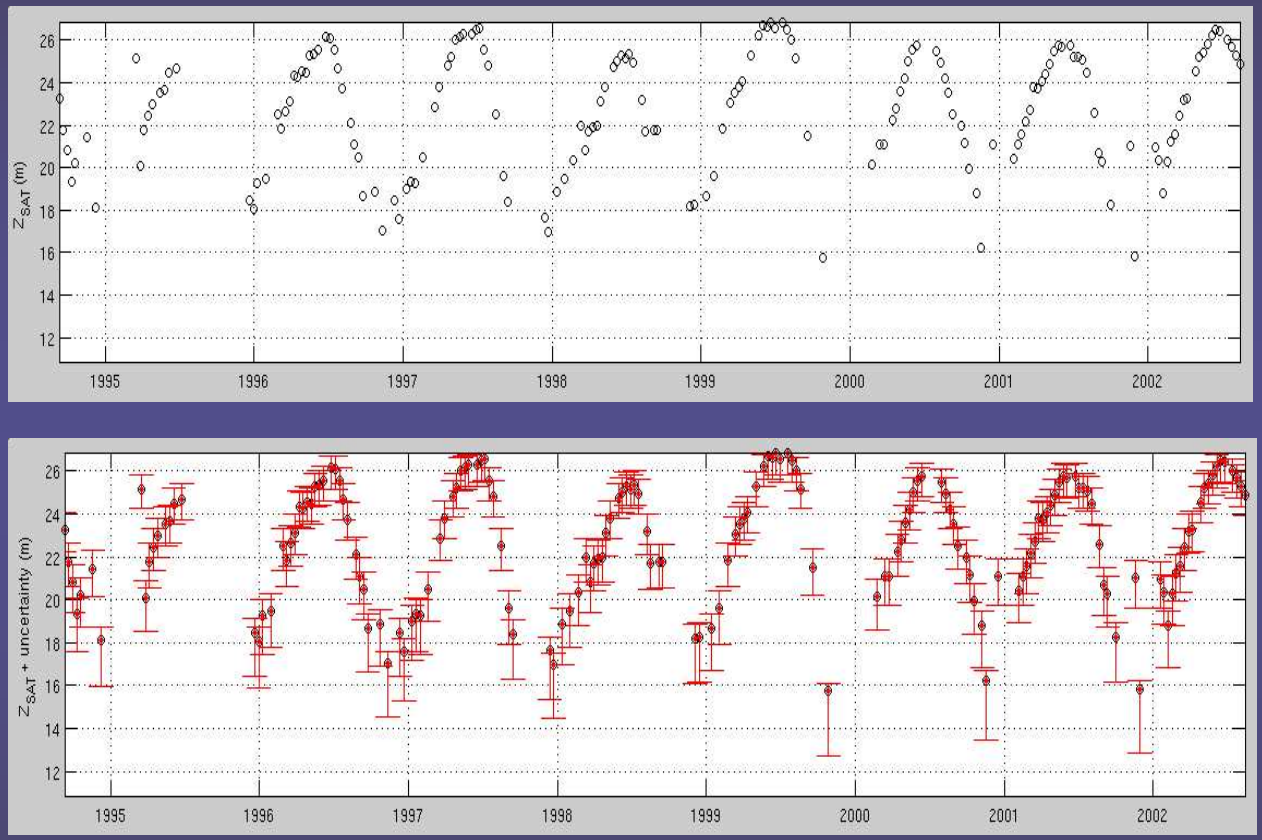


What is the accuracy (quality) of satellite radar altimetry data (products) ?

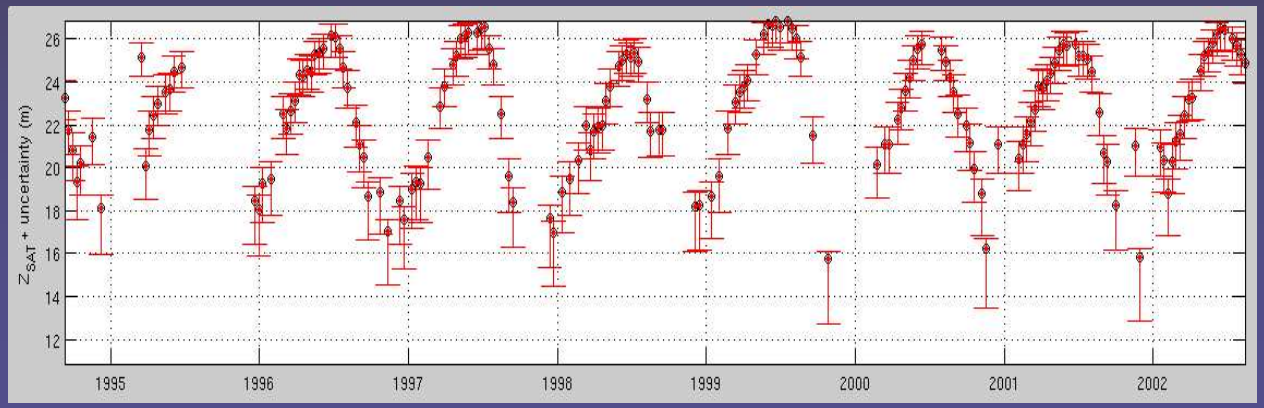
What kind of hydrological applications can be developped with these products ?

How can we improve the accuracy (quality) of radar altimetry products?

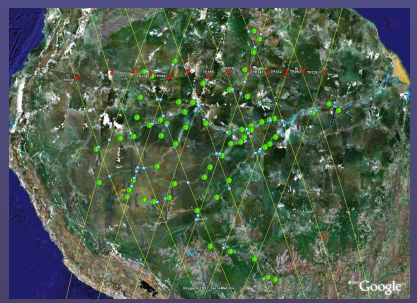
What is the accuracy / uncertainty of satellite radar altimetry data ?

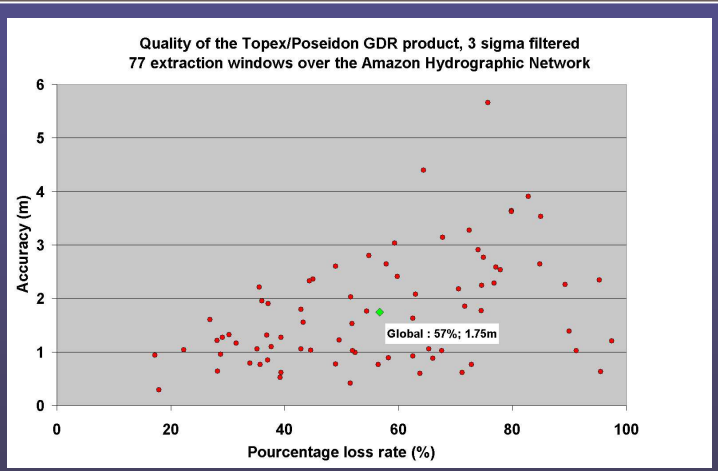


What is the accuracy / uncertainty of satellite radar altimetry data ?



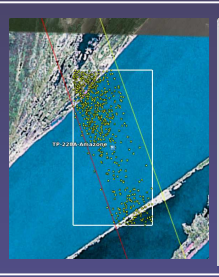
How to assess the overall quality of a Satellite Radar altimetry product ?

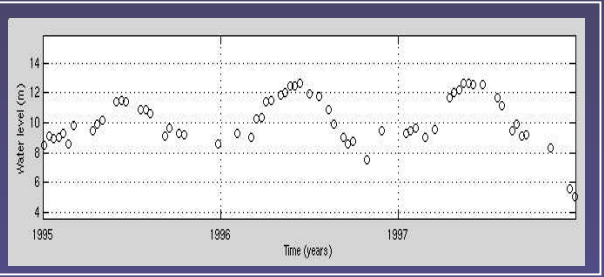




Quantifying the accuracy of satellite radar altimetry data (4 step approach)

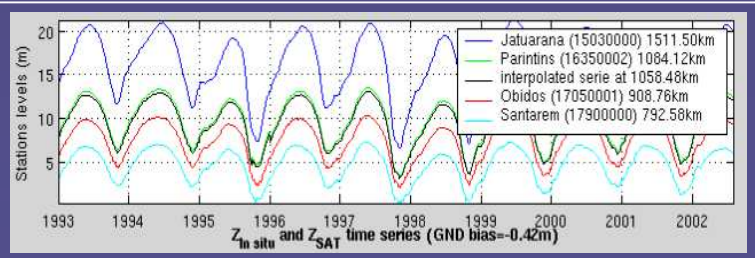
(1) Radar Altimetry data

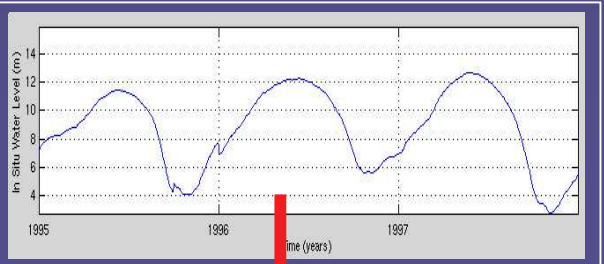




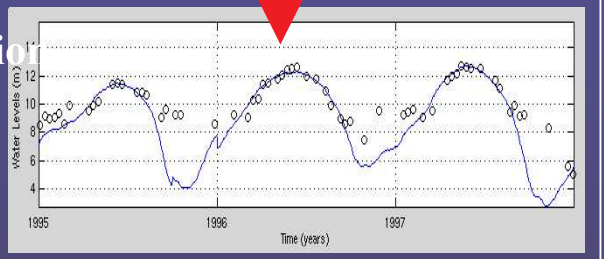
(2) In situ data

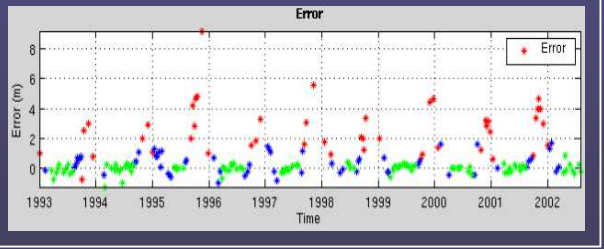
Interpolated or modelled



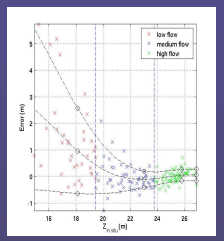


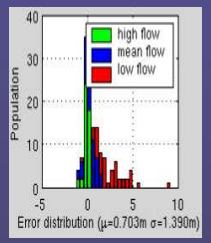
(3) Quantification of error

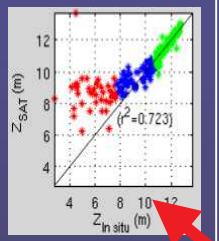




(4) Analysis of error





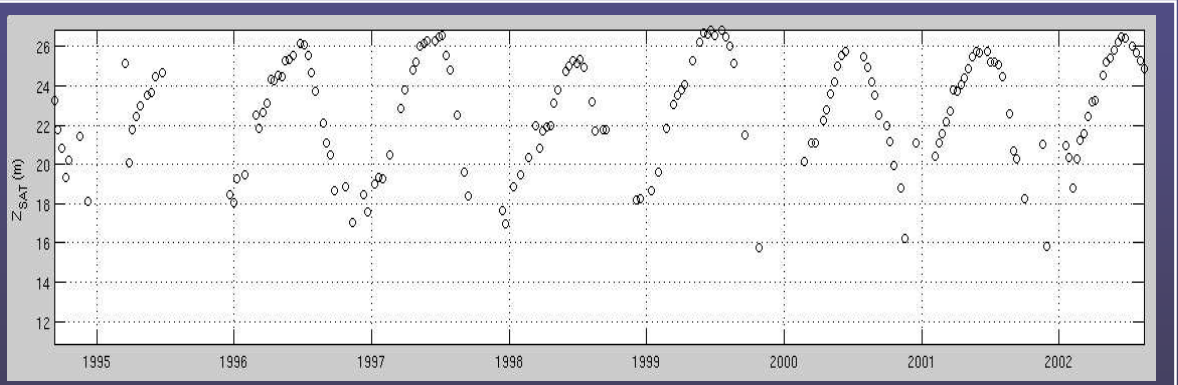


Error and measurement loss rate

		RMS (m)	Loss rate (%)
Global		1.56	43%
High stage	10.8m < Z	0.29	38%
Medium stage	7.7m < Z < 10.8m	0.75	46%
low stage	Z < 7.7m	3.09	57%

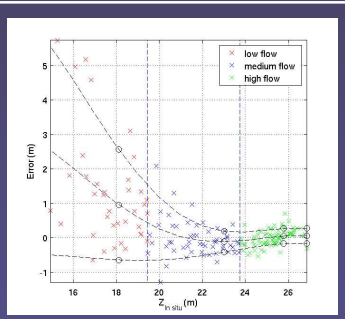
Quantifying the uncertainty of radar altimetry data (through error modelling)

Quantifying the uncertainty of radar altimetry water level



Quantifying the uncertainty of radar altimetry data (through error modelling)

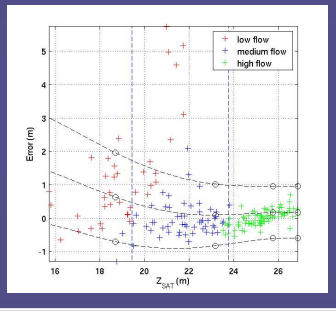
Accuracy : Modelling error from in situ water level



	$Z_{in\ situ}$ (m)	RMSE (m)	Mean (m)	STD (m)	Teff (days)
Global	$10,9<Z_{in\ situ}<26,8$	1,10	0,30	1,06	15,90
High	$23,8<Z_{in\ situ}<26,8$	0,24	0,00	0,24	12,10
Medium	$19,5<Z_{in\ situ}<23,8$	0,52	-0,04	0,52	14,27
Low	$10,9<Z_{in\ situ}<19,5$	2,21	1,41	1,73	26,00

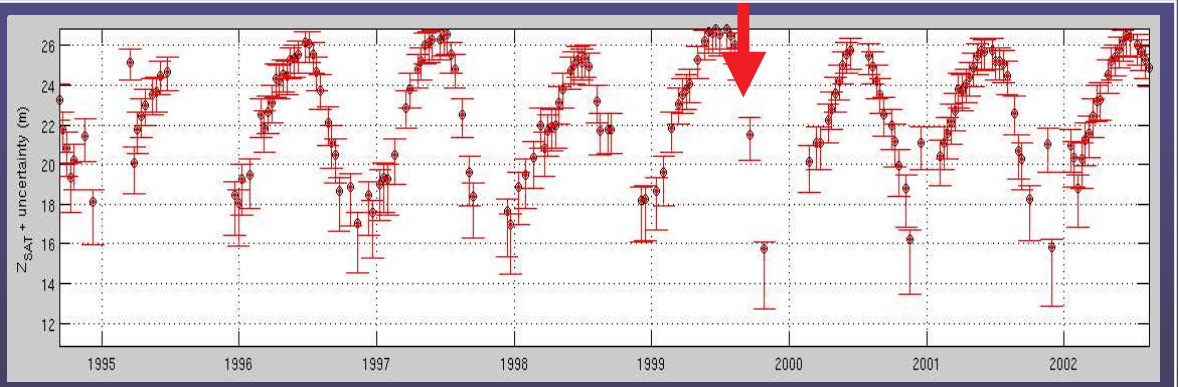
Systematic bias

Uncertainty : Modelling error from satellite water level



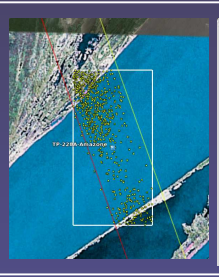
	Z_{SAT} (m)	RMSE (m)	Mean (m)	STD (m)
Global	$15,7<Z_{SAT}<26,9$	1,10	0,30	1,06
High	$24,7<Z_{SAT}<26,9$	0,79	0,18	0,78
Medium	$21,7<Z_{SAT}<24,7$	0,92	0,09	0,92
Low	$15,7<Z_{SAT}<21,7$	1,46	0,63	1,33

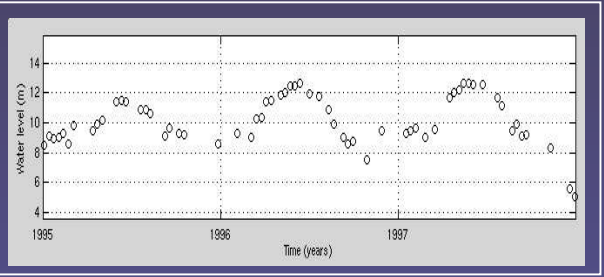
Quantifying the uncertainty of radar altimetry water level



Assessing the quality of radar altimetry products

(1) Radar Altimetry data





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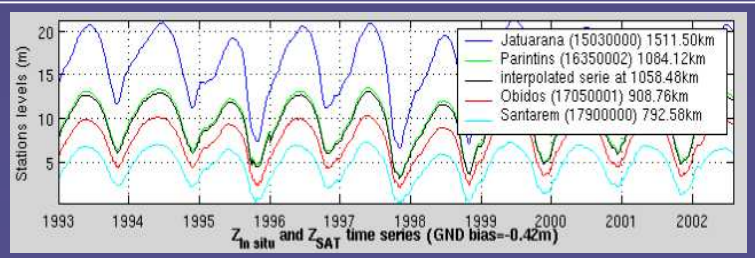
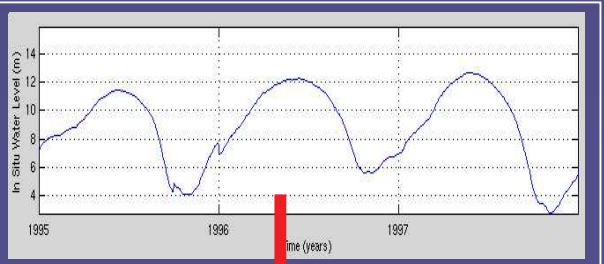
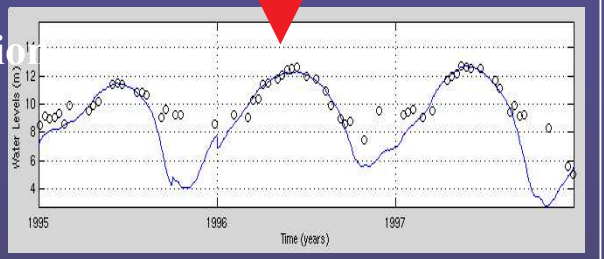
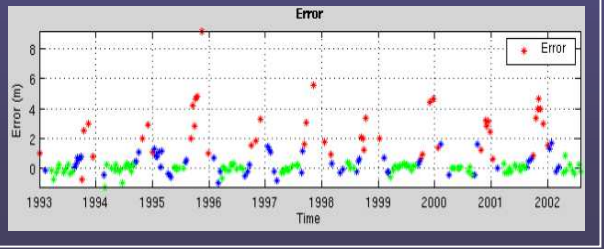


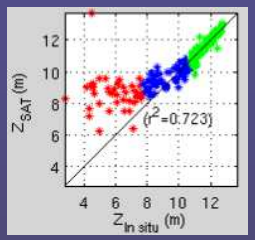


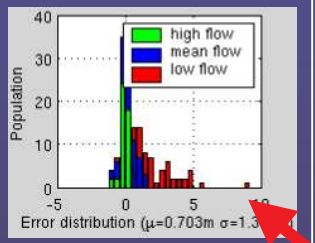
(3) Quantification of error





(4) Analysis of error





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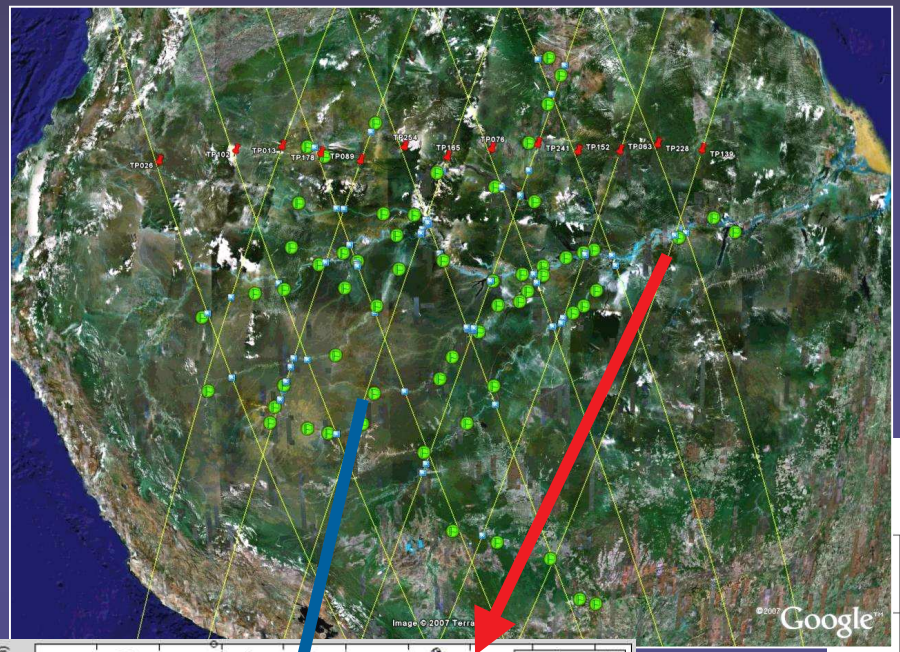
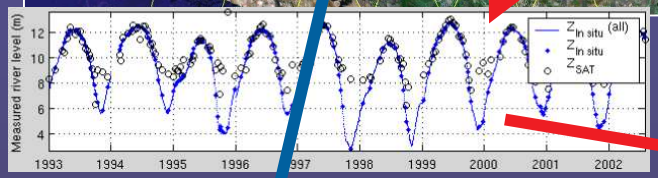
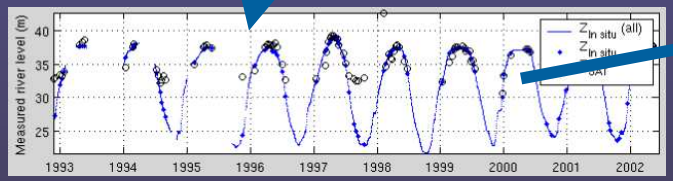
Statistical assessment of the quality of Radar Altimetry Products



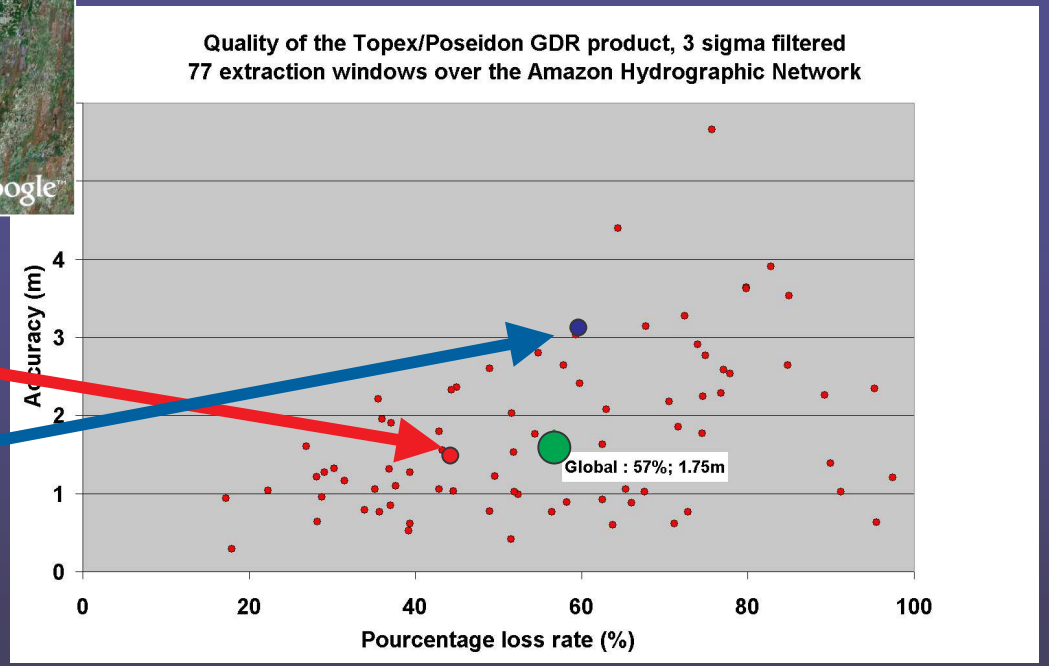




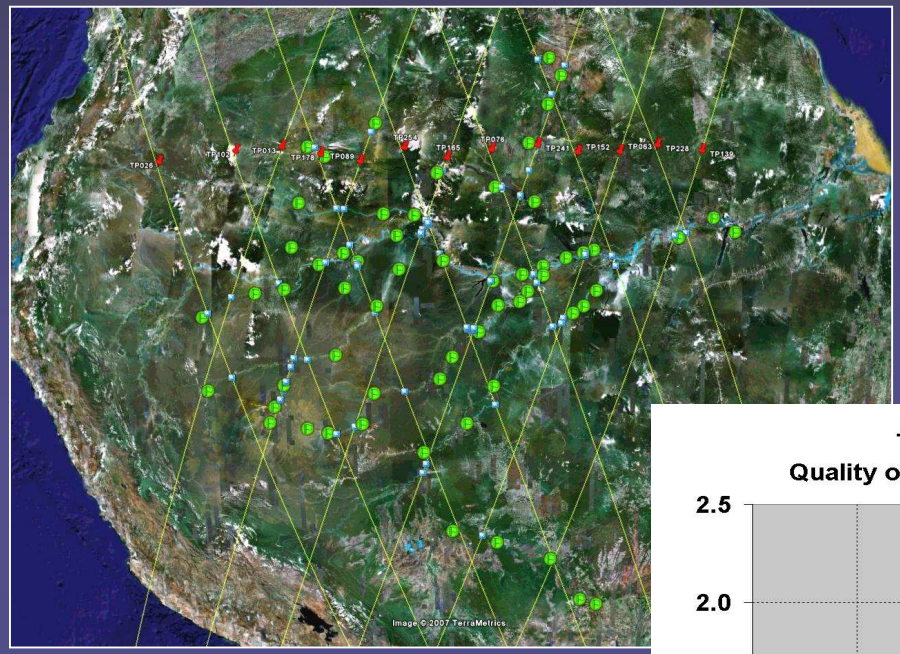
- **Amazon basin**

A large number of satellite track / river intersections (~100)

River width ranging from 100m to more than 3000m

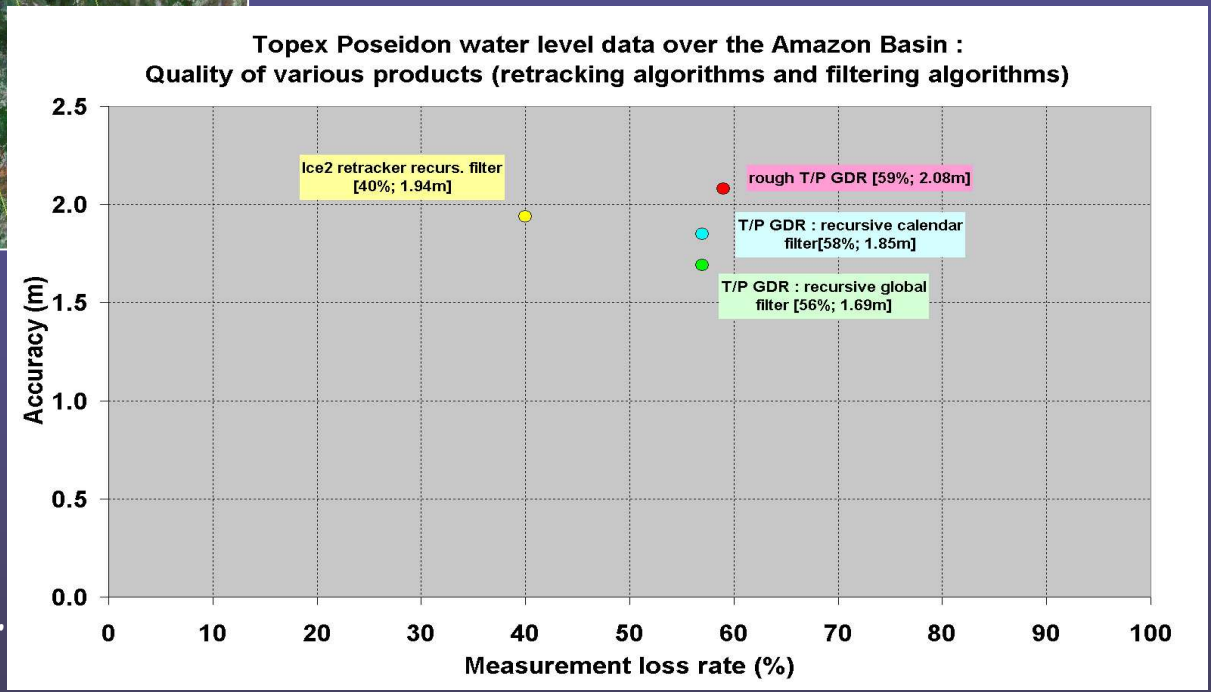


Comparing the quality of various Radar Altimetry Products



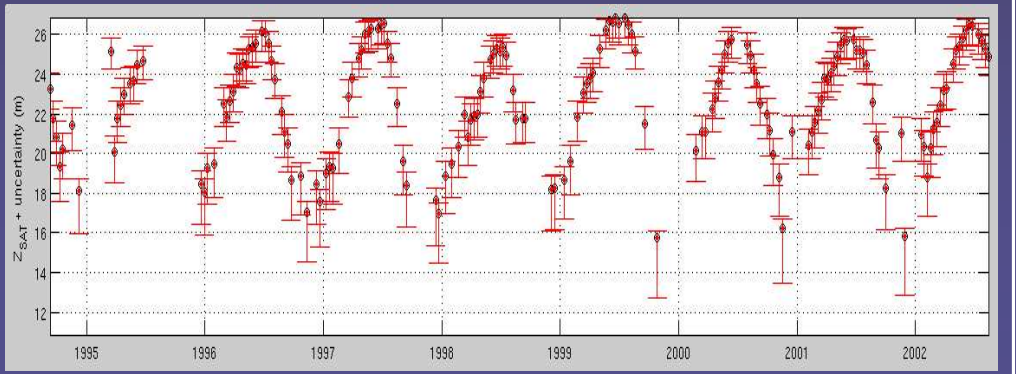
Topex Poseidon waveforms :
- *GDR Aviso – on board Ocean Tracker*
- *Retracked : Ocean (Envisat algo)*
- *Retracked : Ice 1 (Envisat algo)*
- *Retrackeg : Ice 2 (Envisat algo)*
- *Retracked : Sea-Ice (Envisat algo)*

Using Various filters
- *No filter*
- *Global 3sigma filter*
- *Recursive Global 3sigma filter*
- *Calendar 3sigma filter*
- *Recursive Calendar 3 sigma filter*



Conclusion

Providing the uncertainty of radar altimetry data



Assessing and comparing the performances of Satellite Radar altimetry products