

Measuring river water levels by Satellite radar altimetry : Characterization of measurement quality

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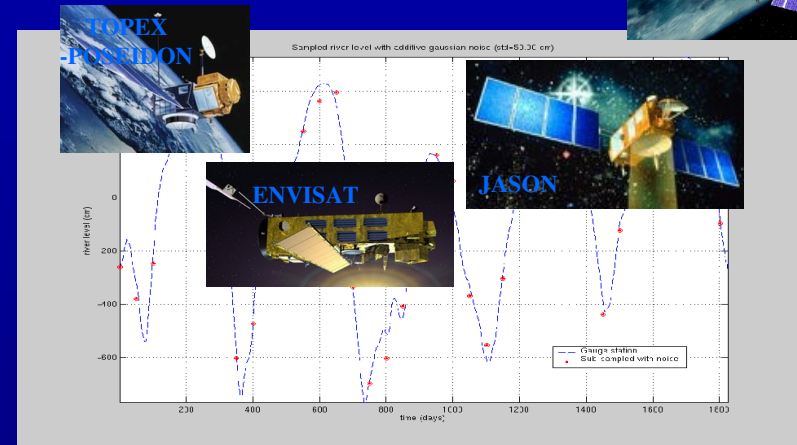
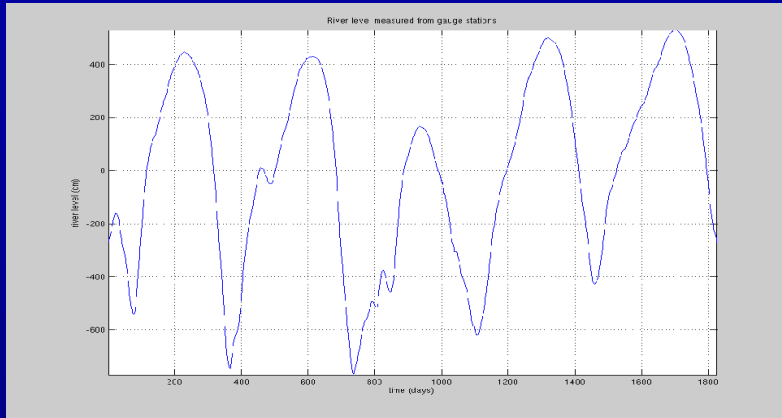
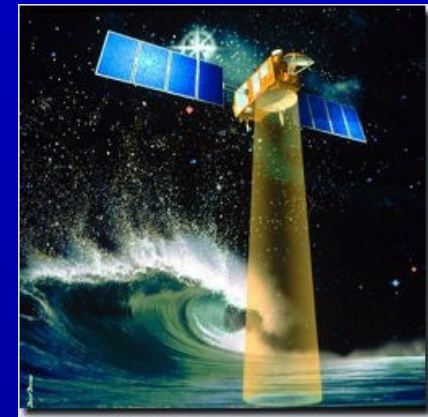
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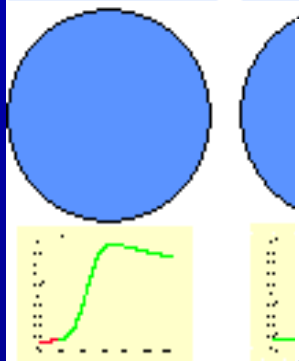
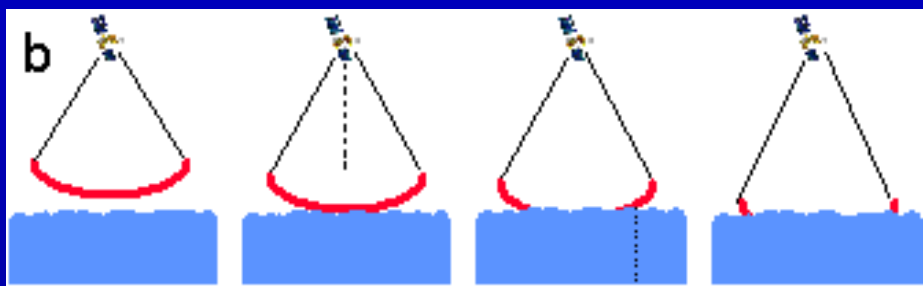
SNPH - Porto de Manaus											
NÍVEIS MÁXIMOS DO RIO NEGRO											
1970						1959					
1964	1971	1973	1980	1972						1955	1956
1969					1957						
1974	1975	1976	1977	1978	1979	1981	1982	1983	1984	1985	1986
1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010



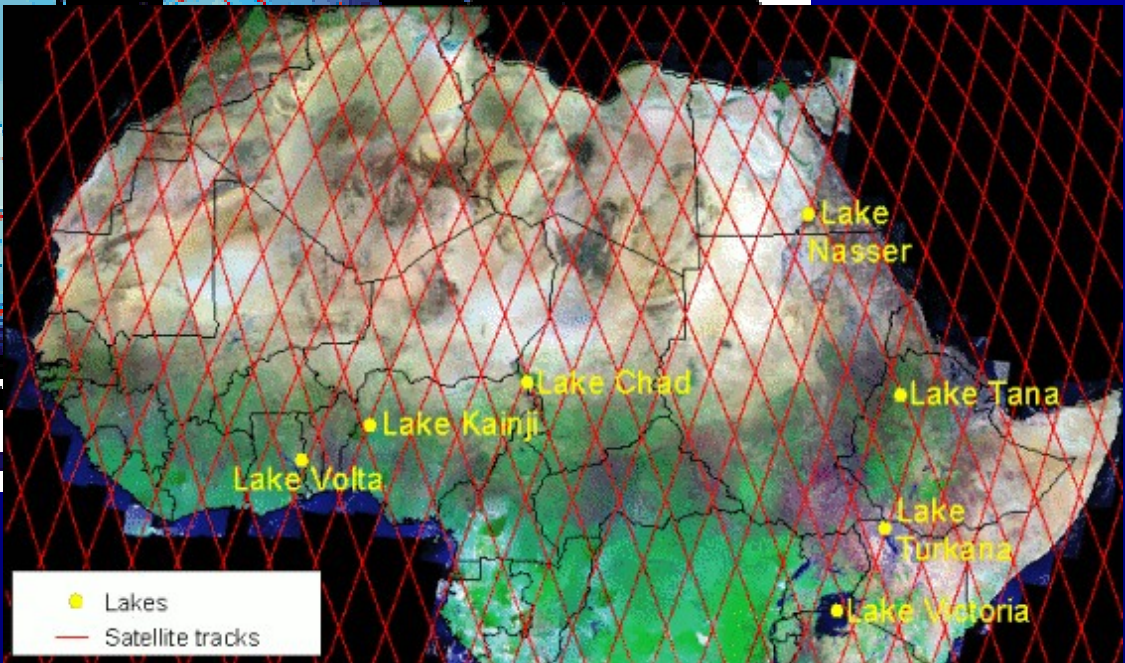
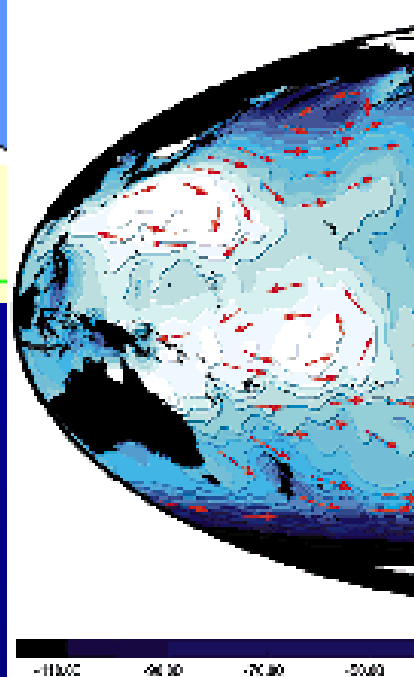


What is the "Quality" of water level time series provided by Satellite Radar Altimetry ?

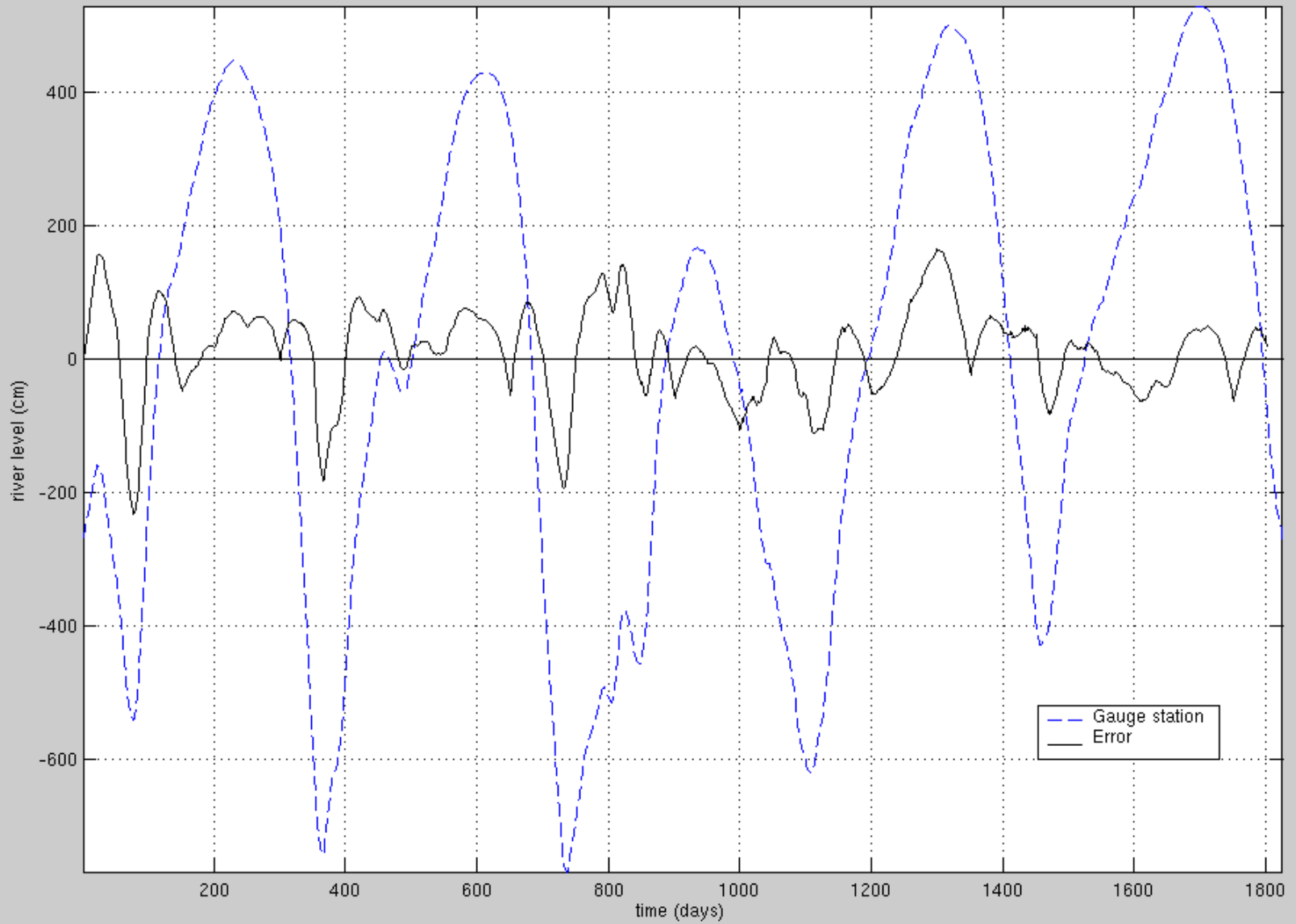
- ◆ How to characterize this quality ?
- ◆ Which factors affect the quality of satellite radar altimetry ?
- ◆ Which hydrological applications can use satellite radar altimetry water levels ?

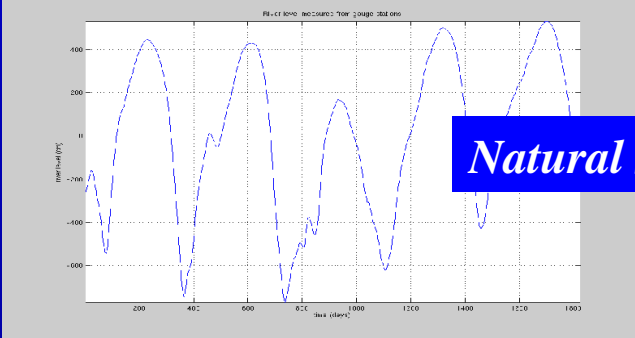


Sea surface dynamic topography as observed by Topex/Poseidon

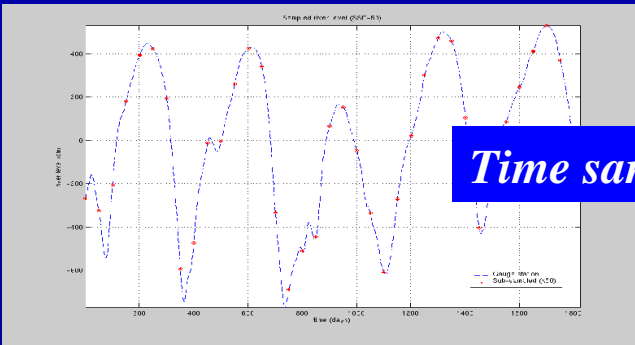


Reconstruction error: STD=67.10cm

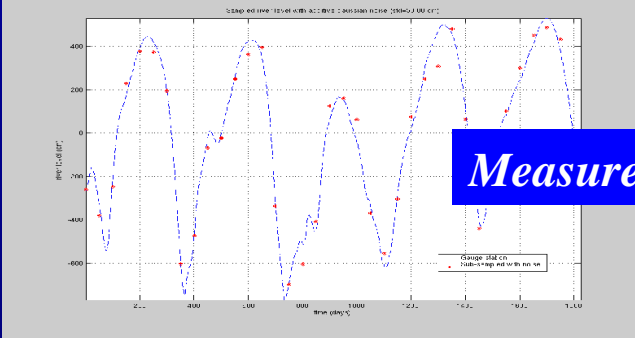




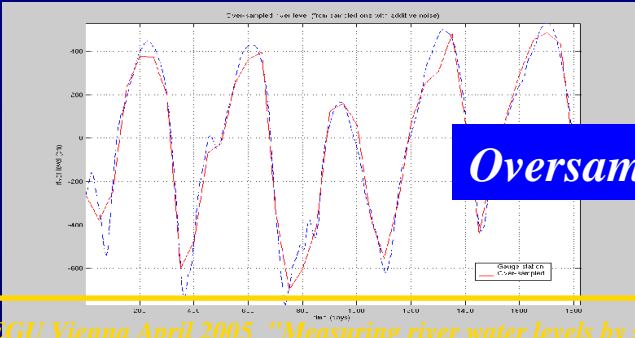
Natural signal



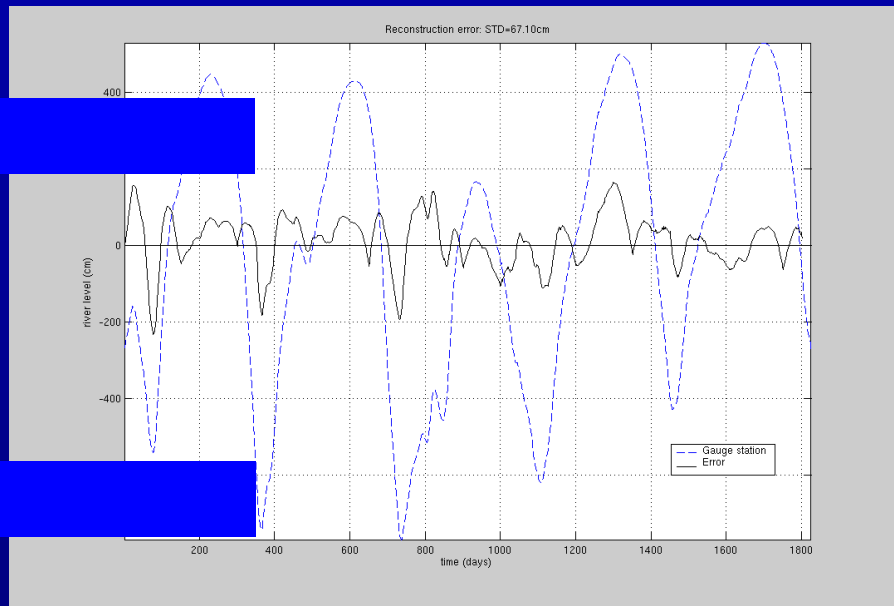
Time sampling period



Measurement Accuracy



Oversampling (interpolation) method



Quality of the river water level time series from Satellite radar altimetry depends on 4 elements

“Quality” of river levels time series from Satellite Radar Altimetry

A. Time sampling and effect of sampling period

B. Measurement accuracy

C. Cumulated effects of Time sampling and measurement accuracy : “Quality” of water level time series

A.1-Effect of time sampling and sampling period

Theoretical Sampling Period over a given station :

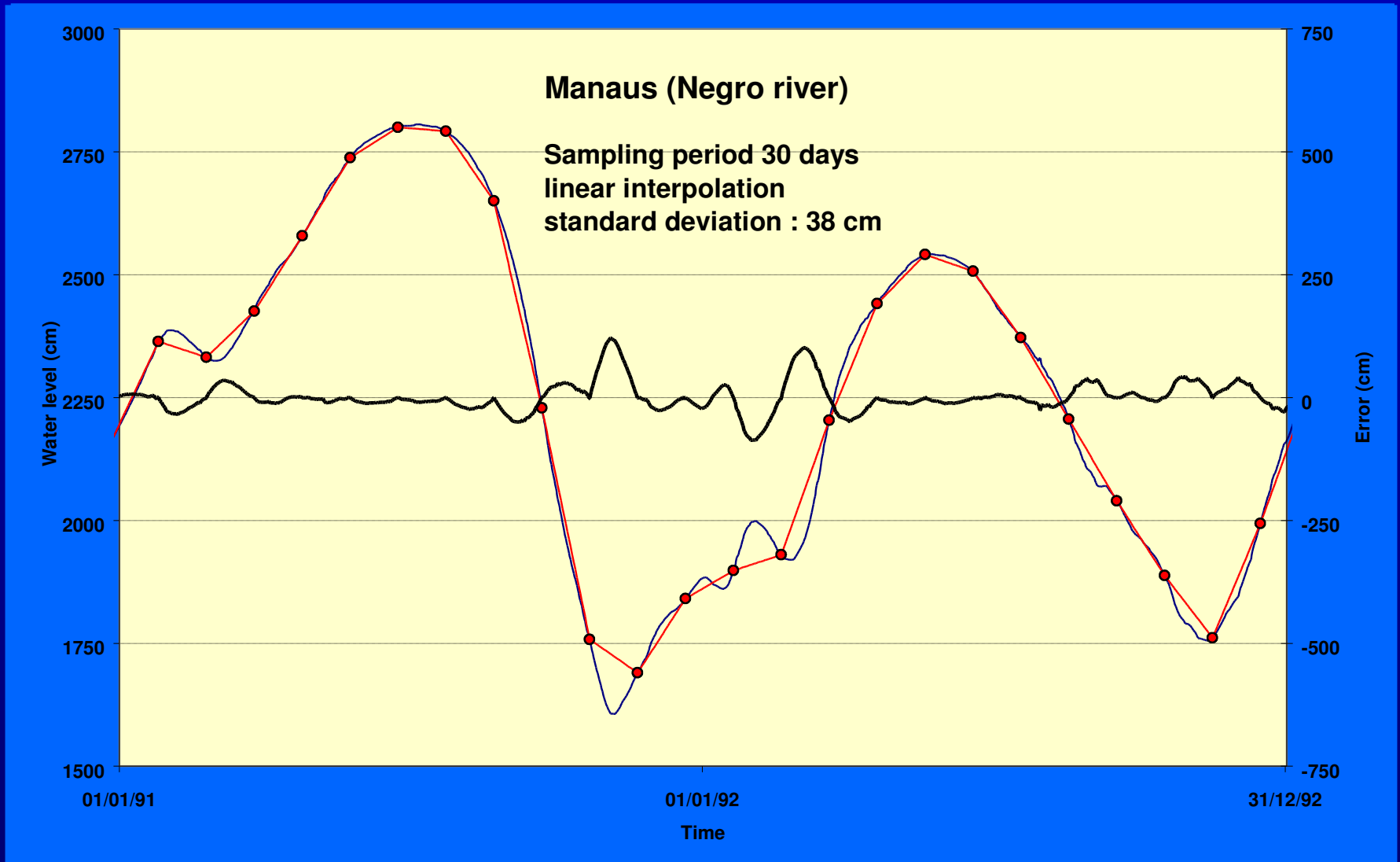
- *Topex/Poseidon, Jason:* 10 jours
- *ERS-1/ERS-2, Envisat:* 35 jours
- *SEASAT/GEOSAT:* 17 jours



Effective Sampling Period is higher :

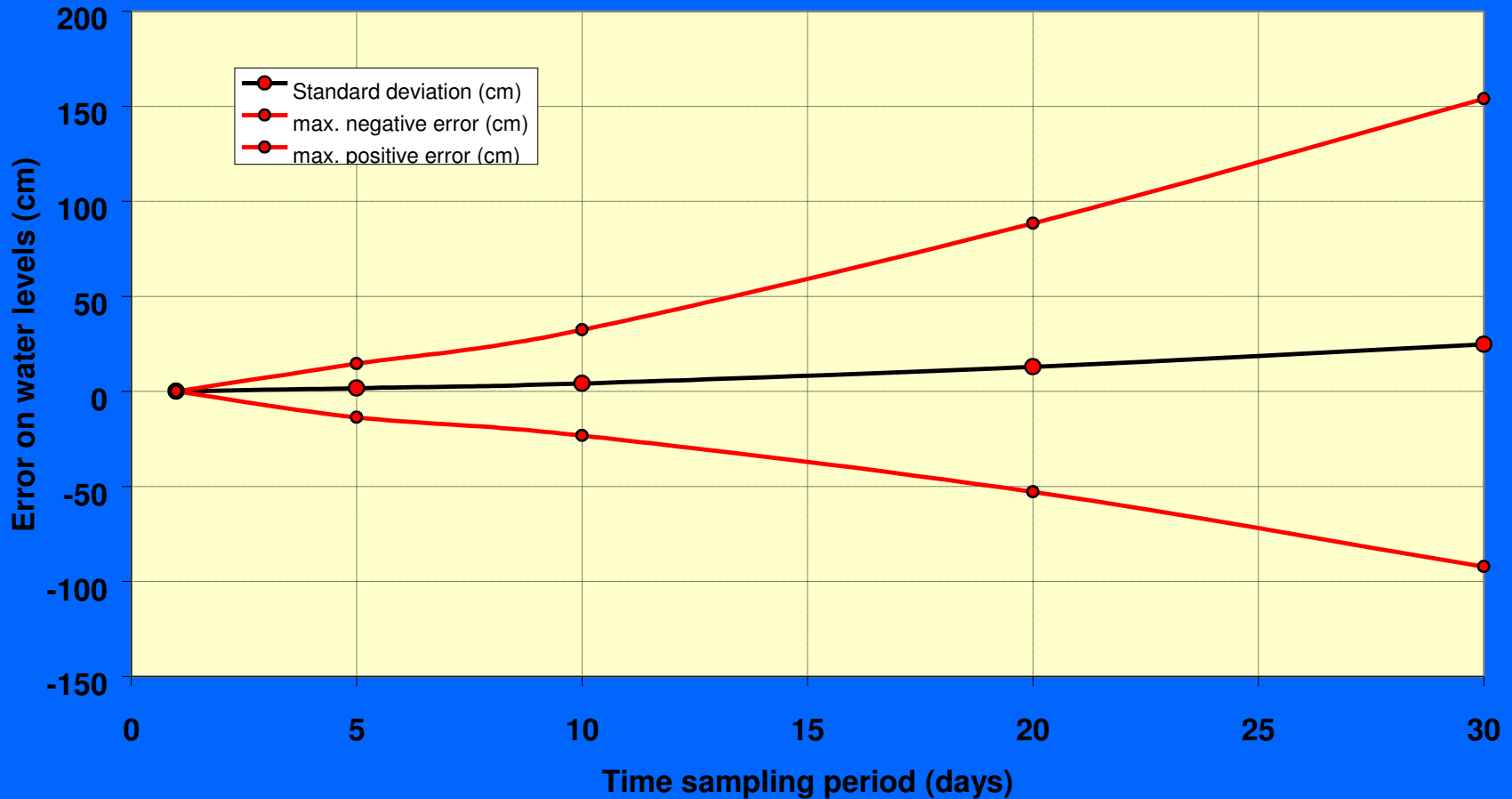
- *Waveform retracking algorithms do not succeed in processing all data*
- *Effective Sampling period is longer, particularly at low river stage*

A.1-Effect of time sampling and sampling period

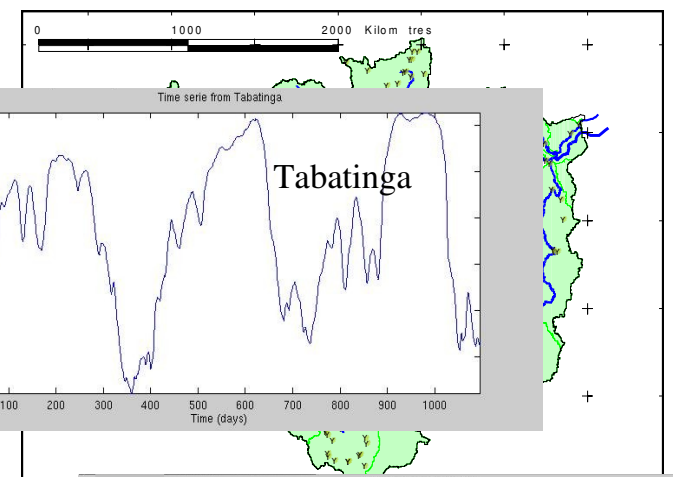
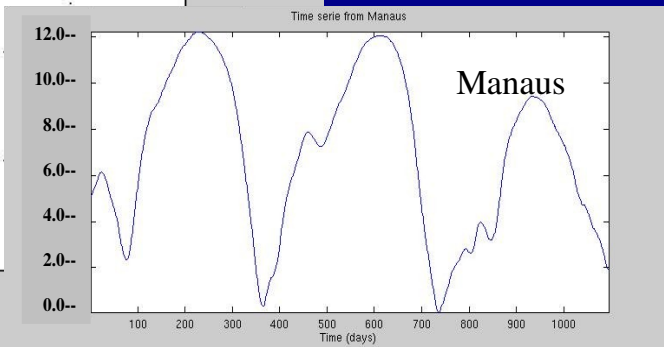
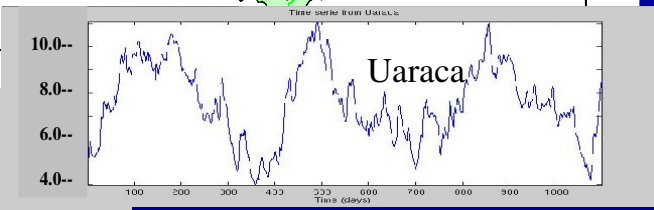
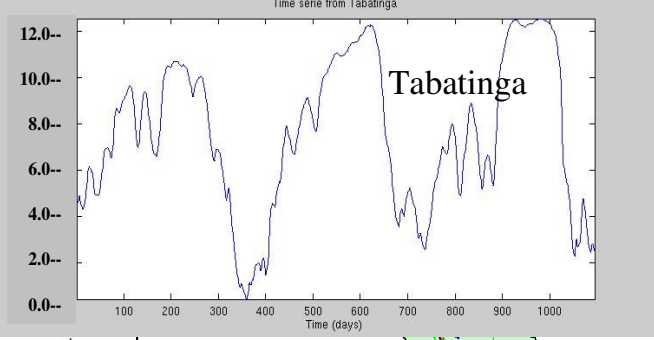
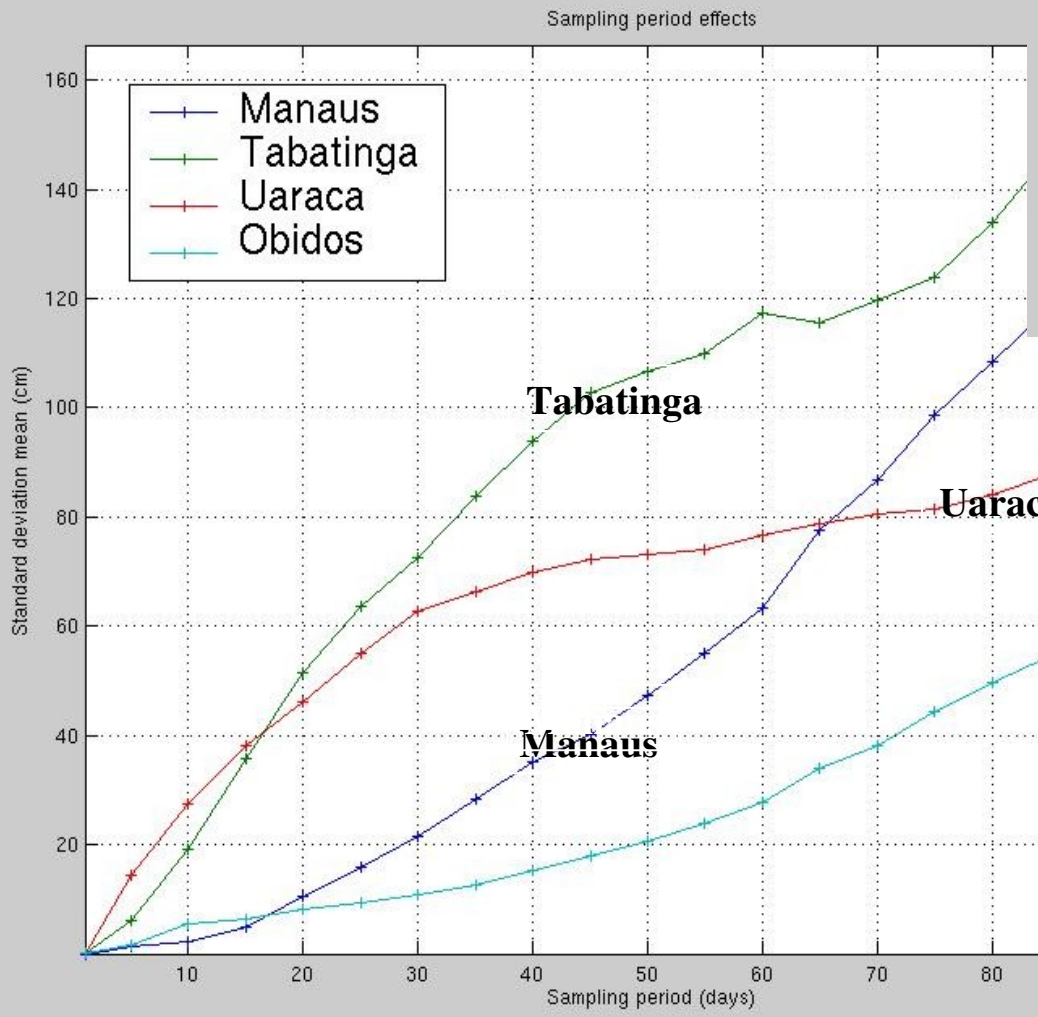


A.1-Effect of time sampling and sampling period

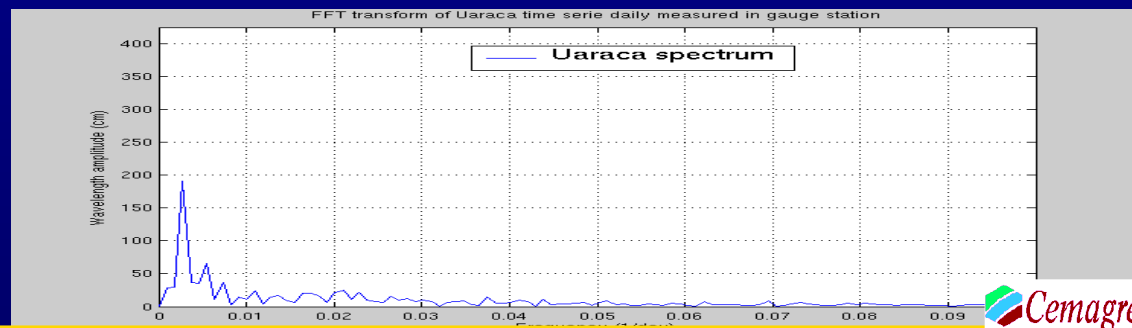
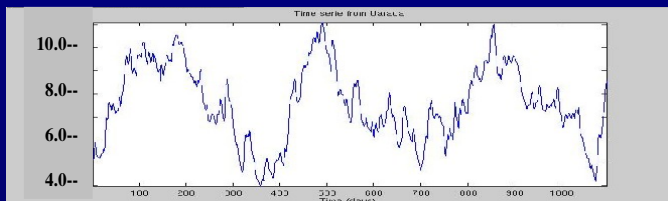
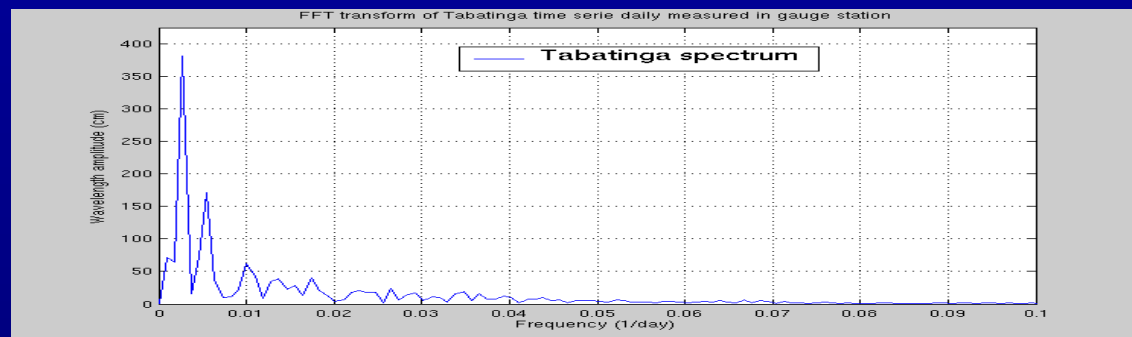
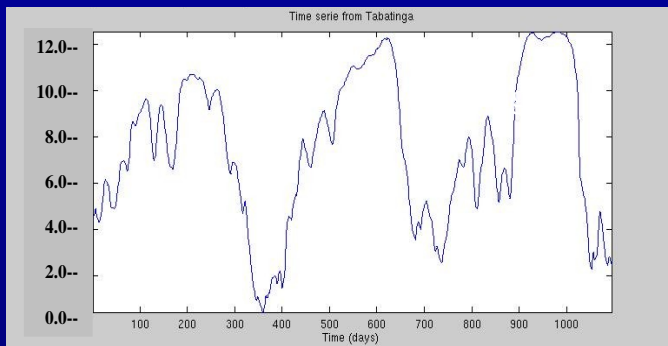
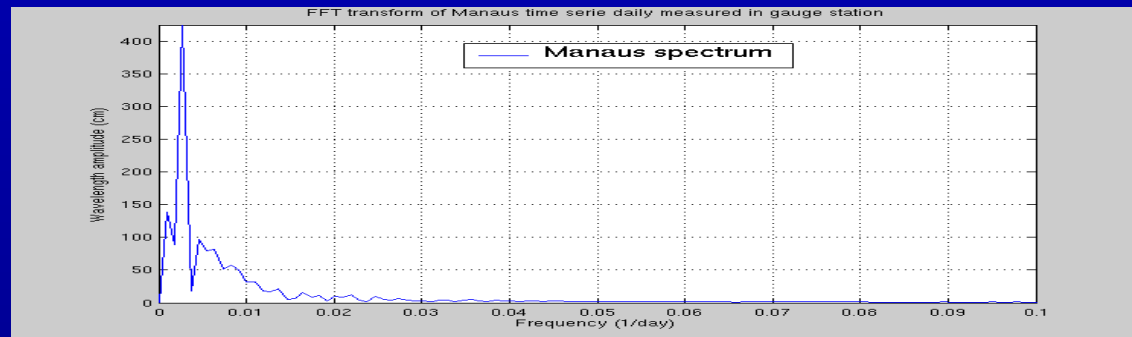
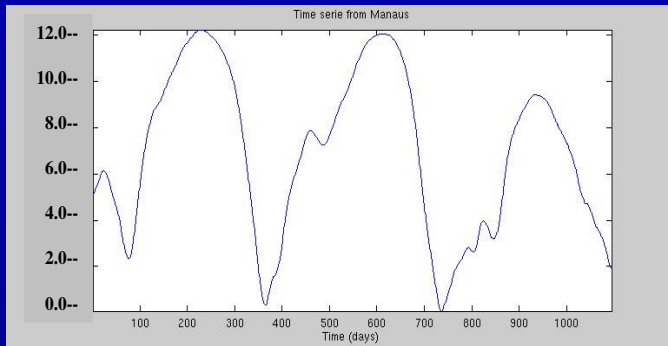
Effect of time sampling period on the error in water levels time series
Manaus gauging station

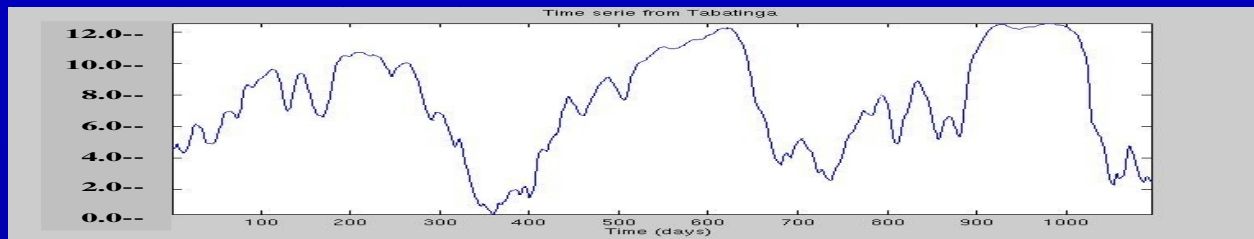


A.1-Effect of time sampling and

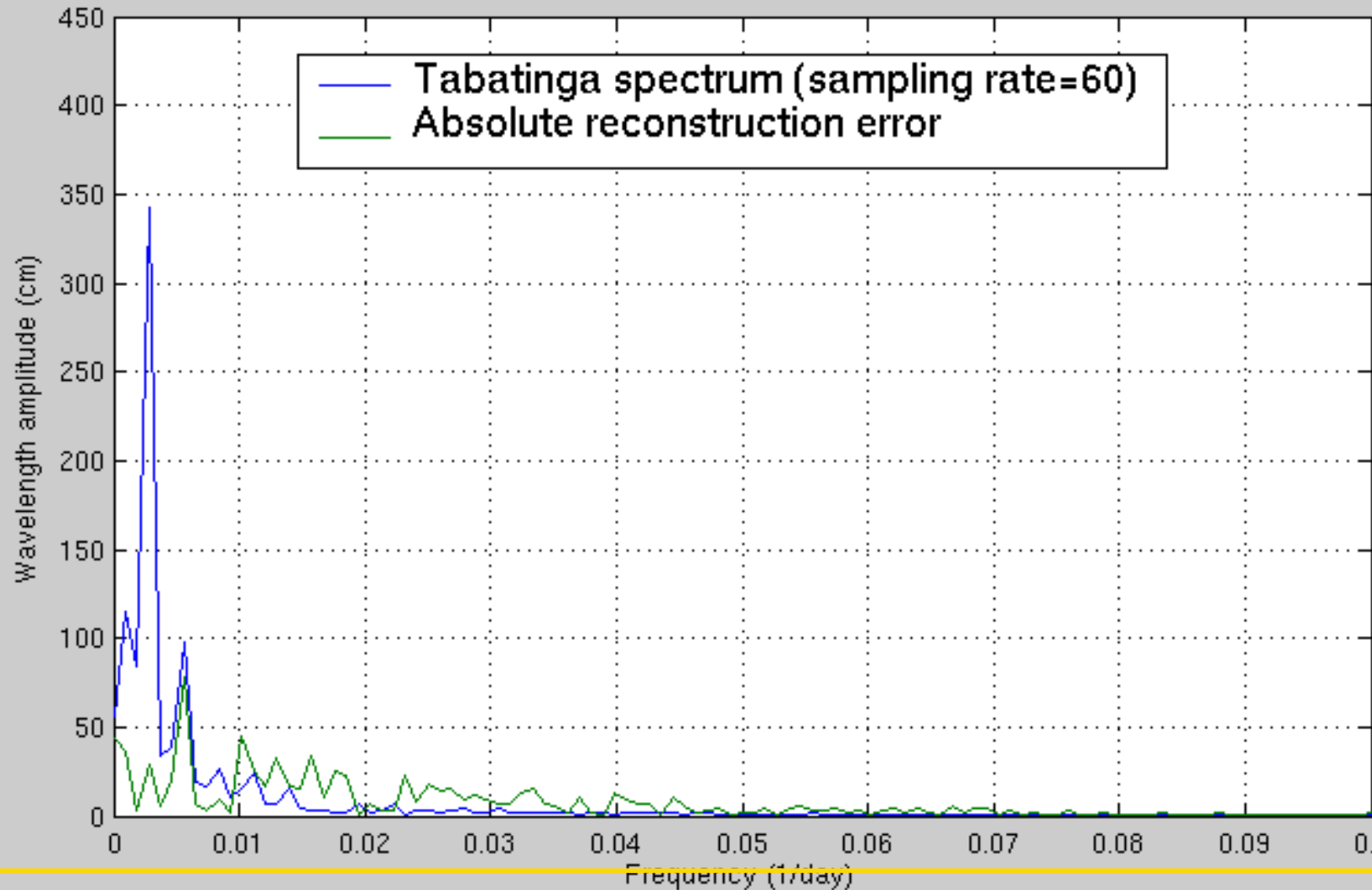


Spectral analysis of river water level time series

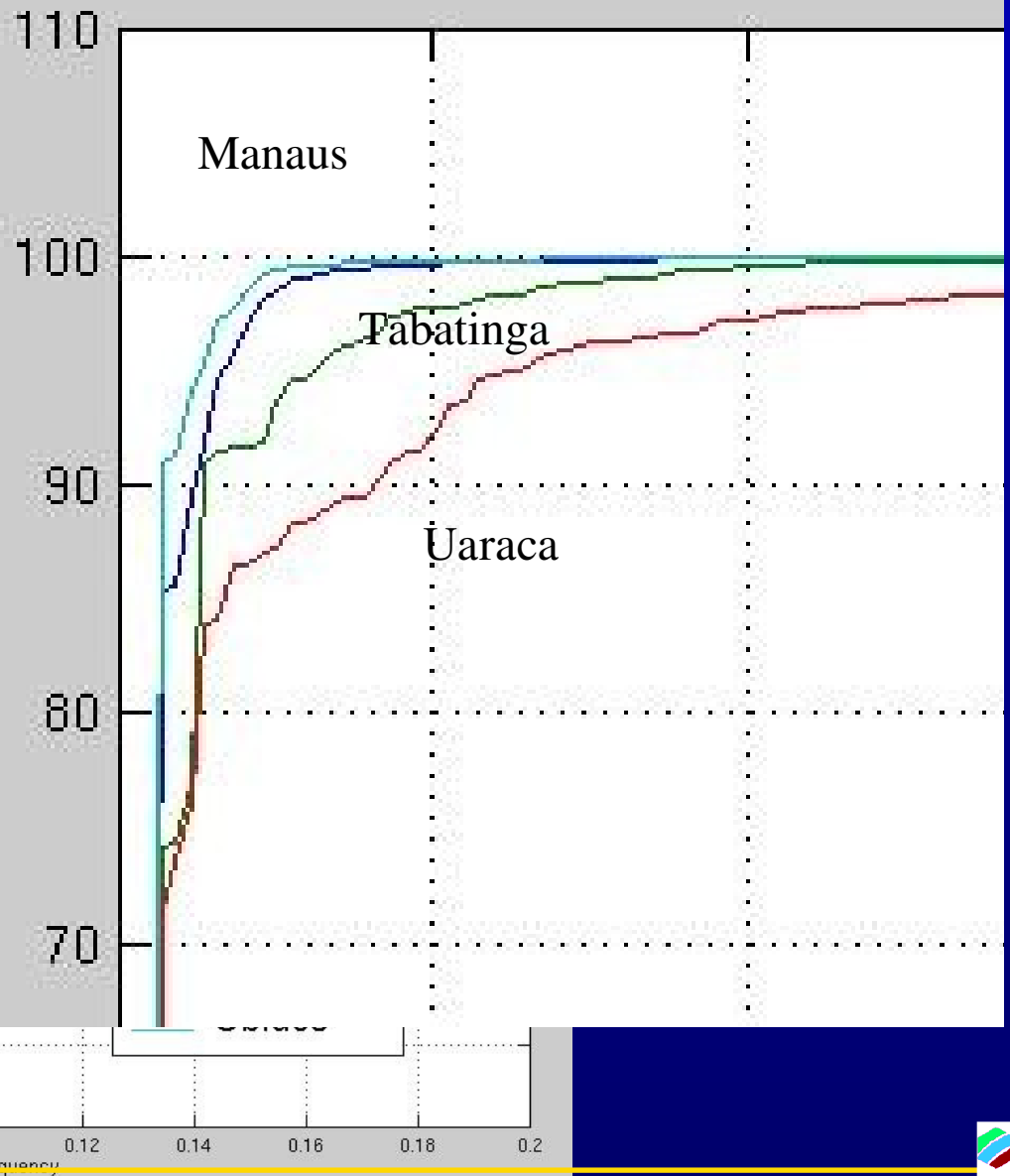
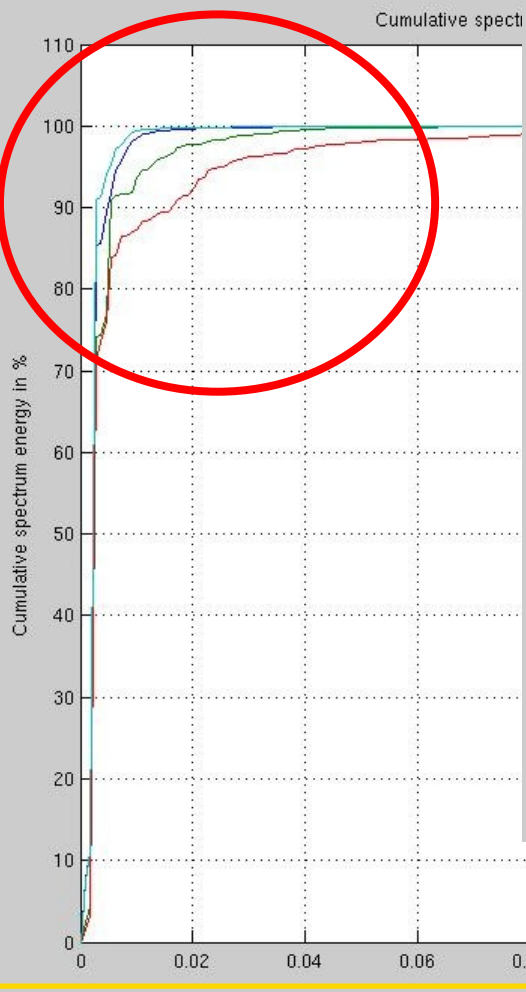




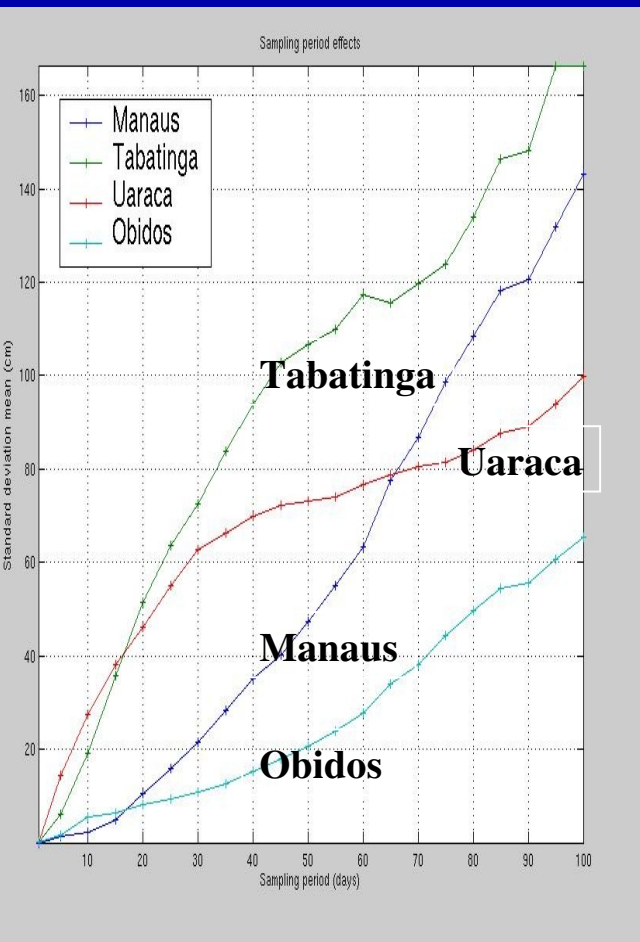
FFT transform of Tabatinga time serie daily measured in gauge station (sampling rate=60)



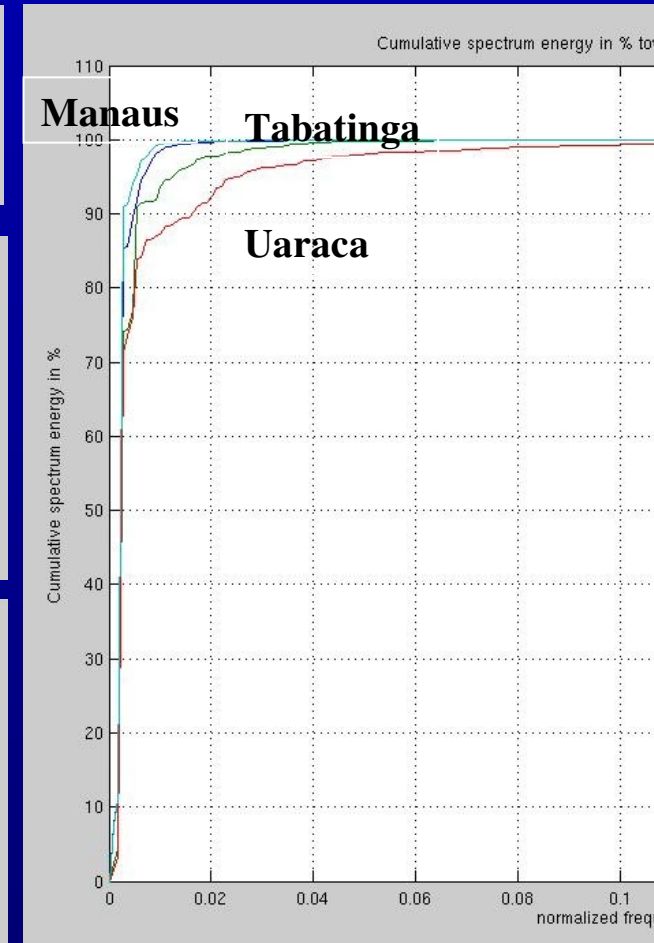
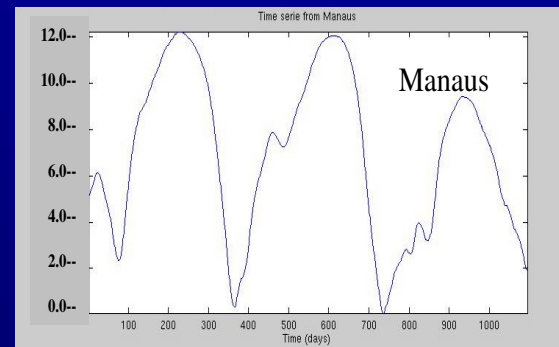
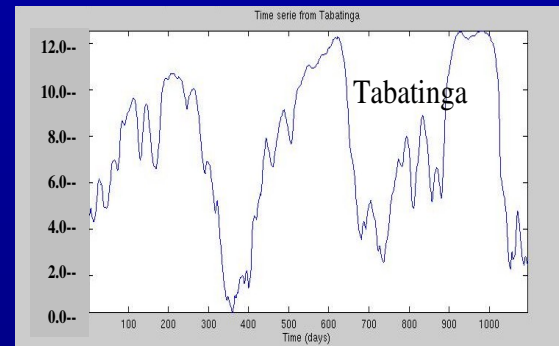
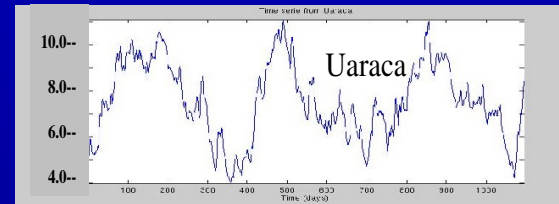
Signal reconstruction data :



Challenge : establish a direct relation between temporal analysis and frequency analysis and parametrize the effect of time sampling on time series error



Temporal analysis



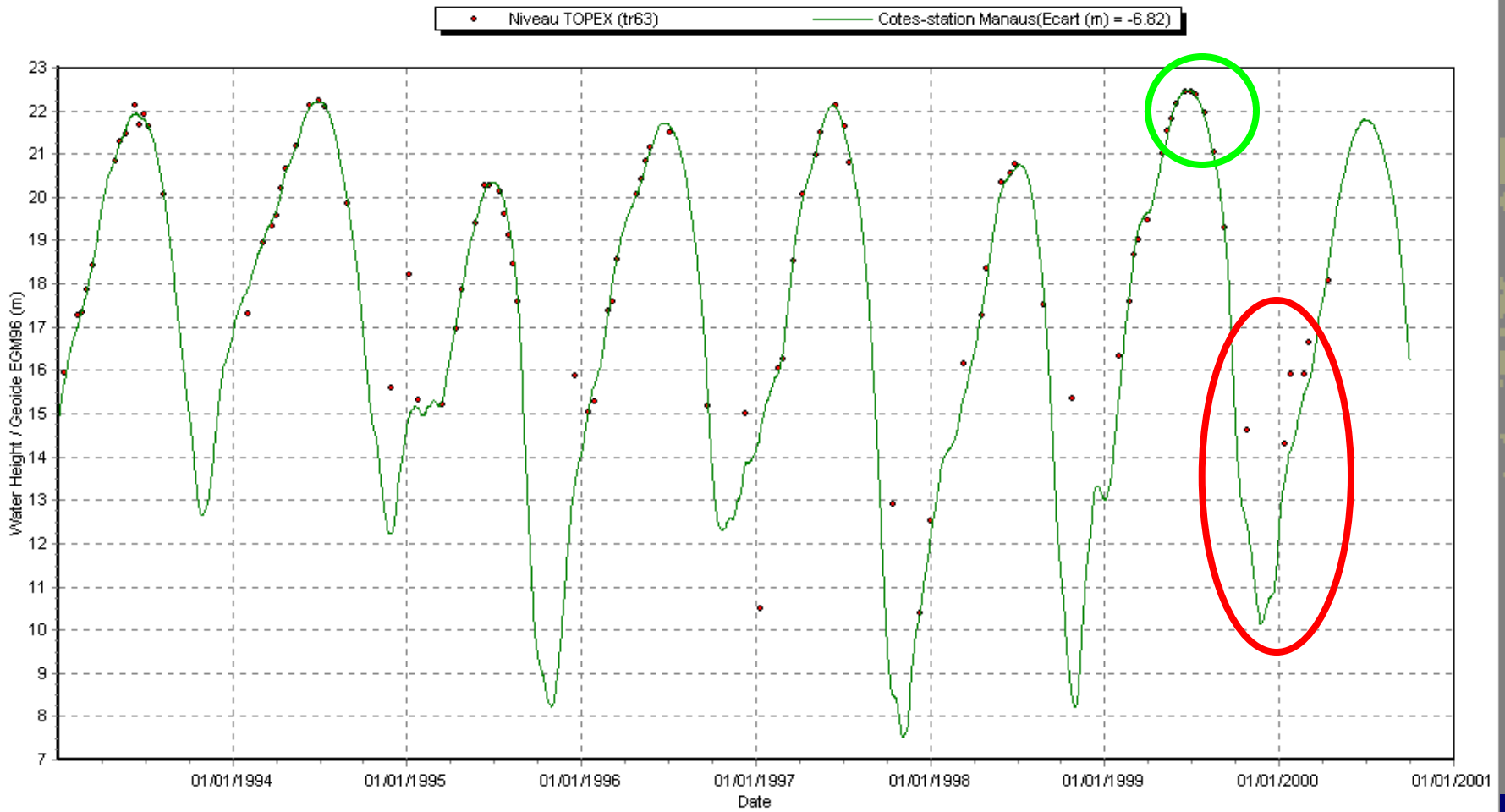
Frequency analysis

“Quality” of river levels time series from Satellite Radar Altimetry

A. Time sampling and effect of sampling period

B. Measurement accuracy

C. Cumulated effects of Time sampling and measurement accuracy : “Quality” of water level time series



“Quality” of river levels time series from Satellite Radar Altimetry

A. Time sampling and effect of sampling period

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C. Cumulated effects of Time sampling and measurement accuracy : “Quality” of water level time series

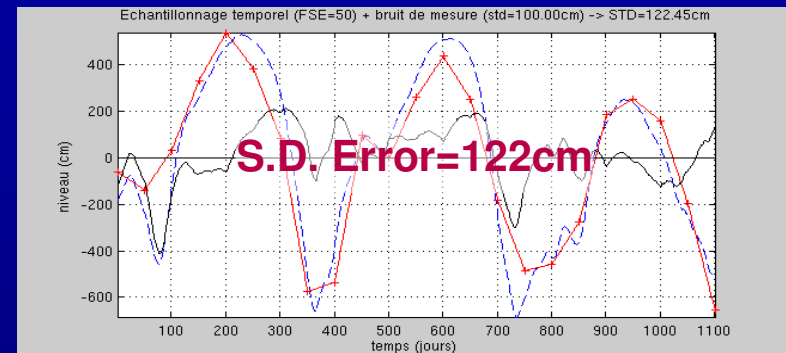
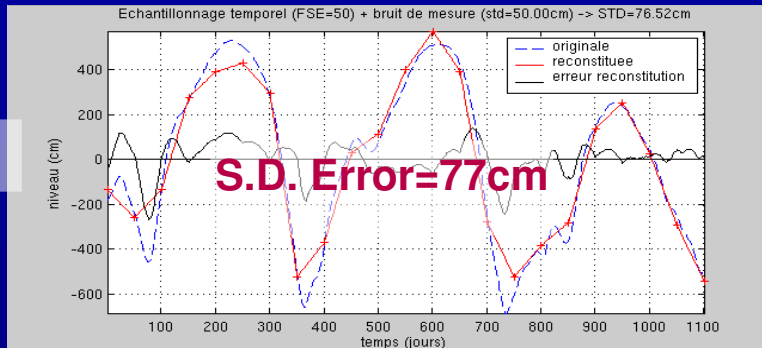
C. Cumulated effect of time sampling and measurement error

Example of errors induced by combined measurement error and time sampling:

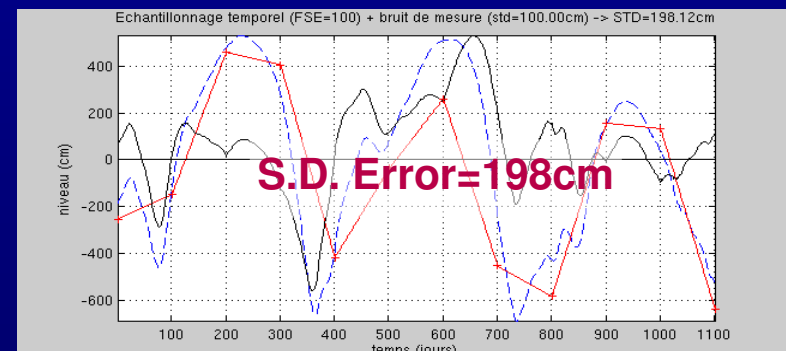
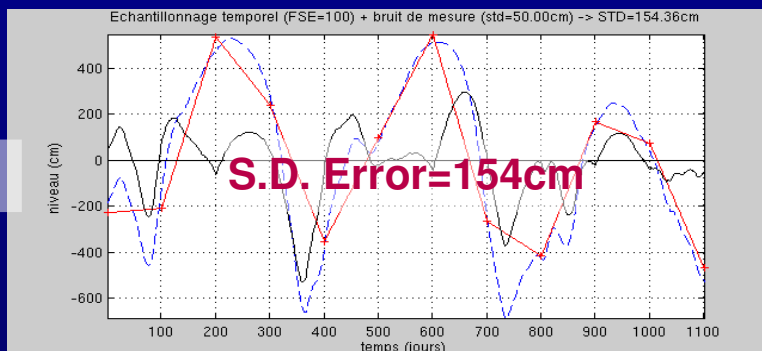
Measurement noise =50cm

Measurement noise=100cm

Te=50 jours

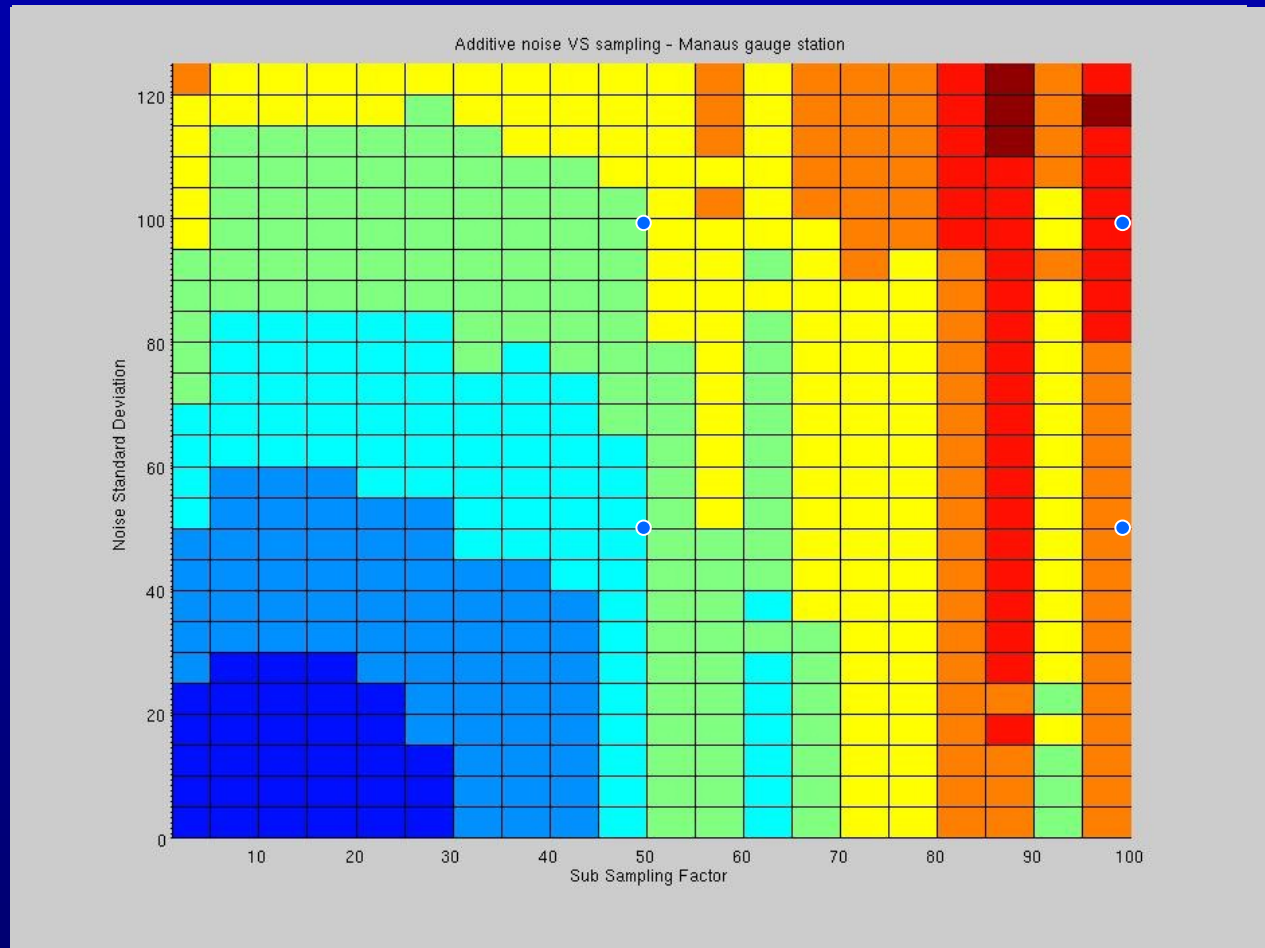
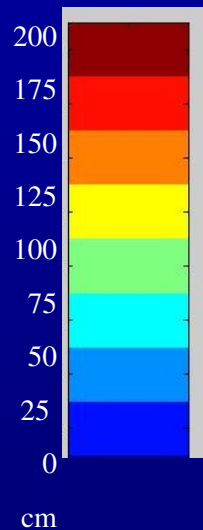


Te=100 jours

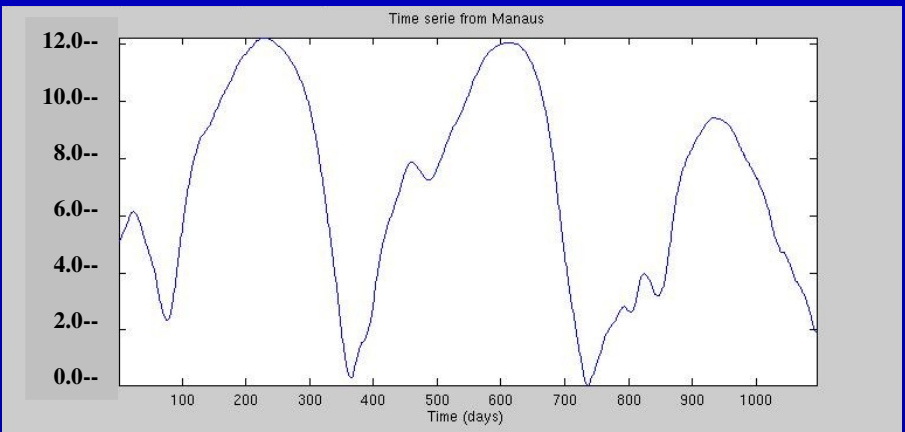


C. Cumulated effect of time sampling and measurement error

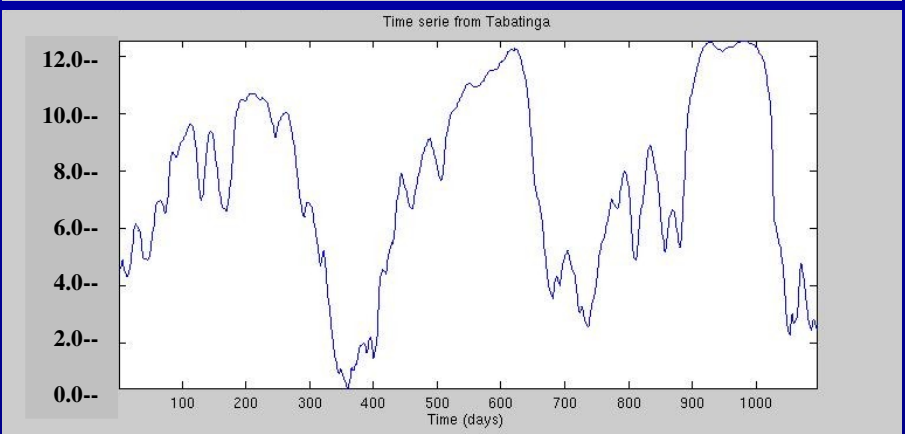
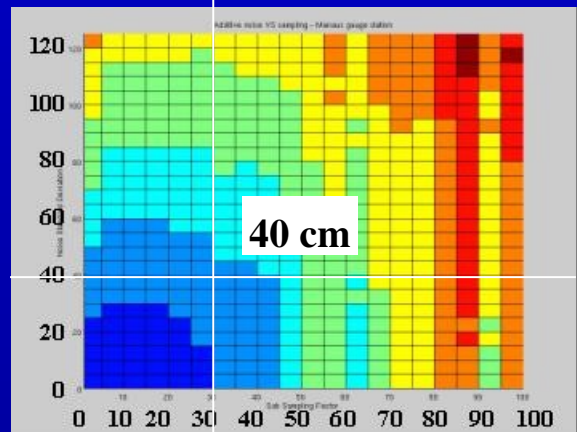
Manaus



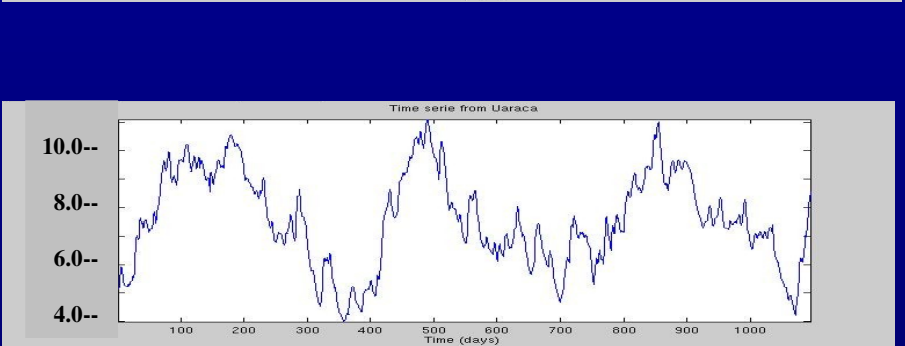
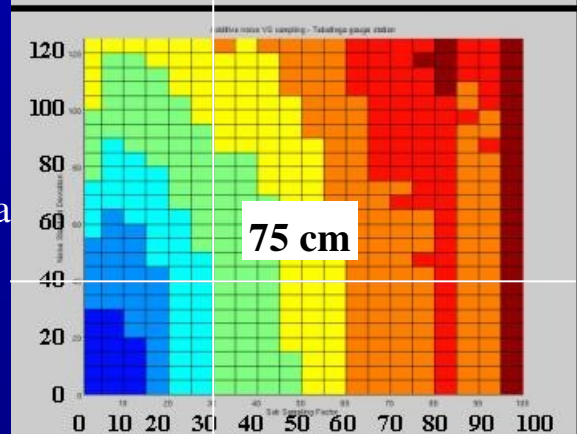
Standard deviation between in situ time series and reconstructed time series : *Relation with sampling period and measurement accuracy*



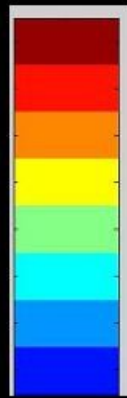
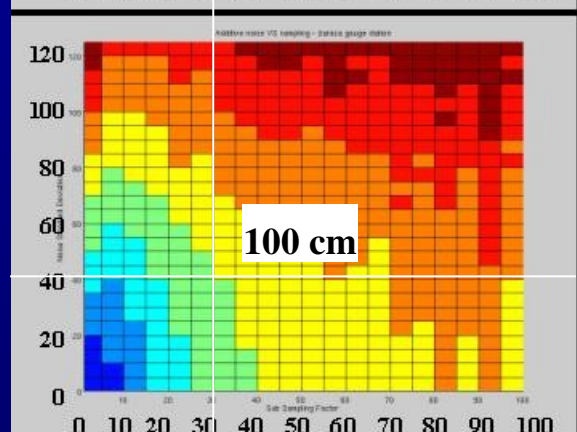
Manaus



Tabatinga

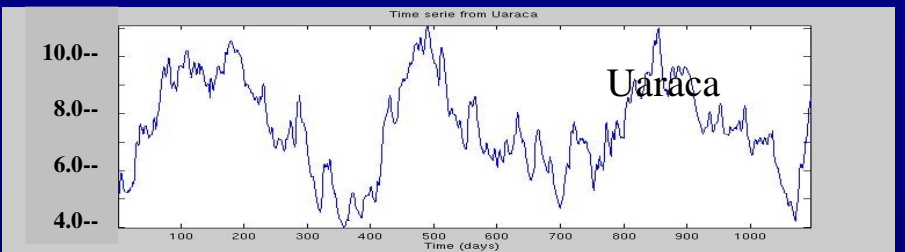
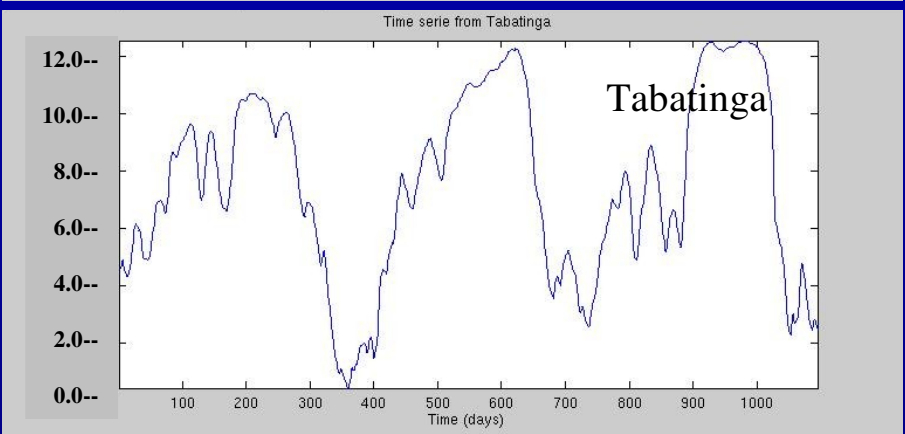
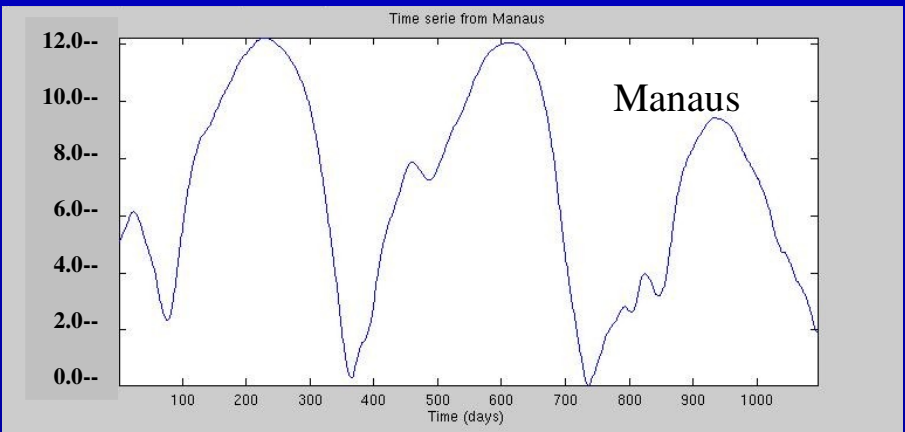


Uaraca



Standard deviation between in situ time series and reconstructed time





	20cm	40cm	80cm	
10j	15	35	70	Manaus
	25	35	70	Tabatinga
	35	50	100	Uaraca
30j	30	40	75	Manaus
	75	75	90	Tabatinga
	90	100	125	Uaraca

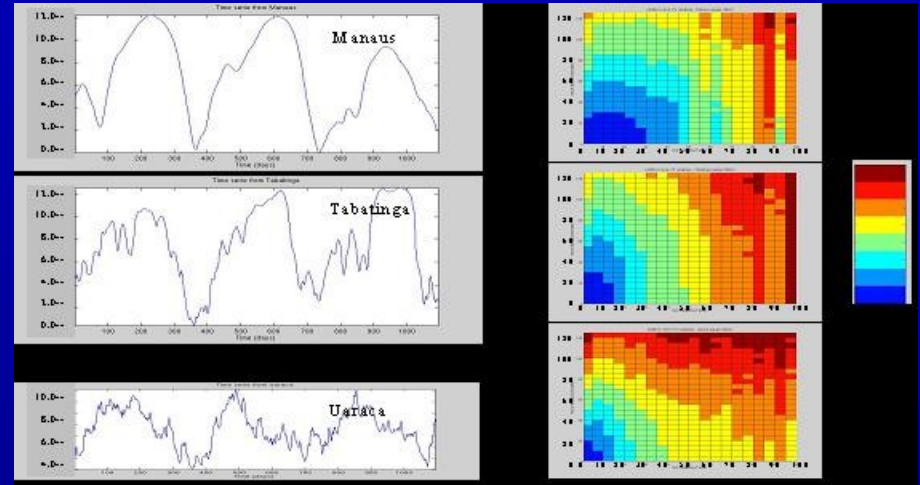
Standard deviation on a given station and for given satellite performances

Conclusion

The quality of satellite radar altimetry data

for river levels depends on :

3. River hydrology
4. River morphology
5. Satellite measurement accuracy
6. Sampling period

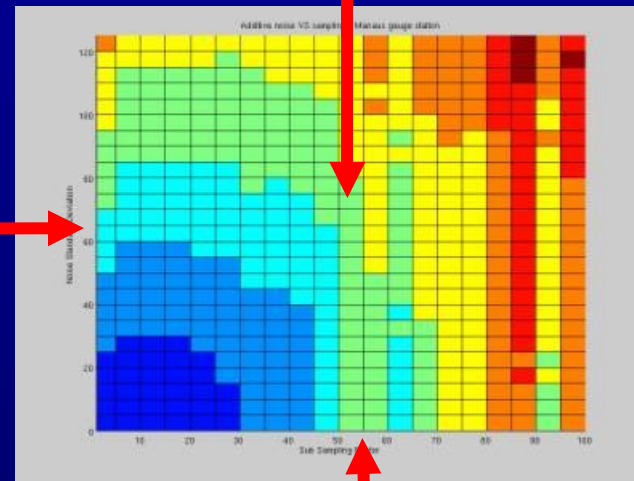


River Hydrology $h(t)$

River Morphology $L(h)$

Satellite measur. Accuracy $\sigma(L)$

Satellite effective sampling period T_e



Perspectives

1. Associate an **information on « quality »** to any Satellite Radar Altimetry time series of river water levels
2. Improve the accuracy of satellite measurement through satellite/**algorithm comparison and development**
3. Improve **interpolation methods** between sample measures
4. Develop the use of Satellite Radar Altimetry data for **hydrological applications** analysing error propagation