Performance of Saral/AltiKa over inland water

Eva Boergens, Christian Schwatke, and Denise Dettmering
Deutsches Geodätisches Forschungsinstitut (DGFI), München
boergens@dgfi.badw.de

Abstract

The Saral is the first altimeter satellite that carries a Ka-band instrument (AltiKa). The use of Ka-band has the advantage, that it allows a closer approach to the shoreline due to less disturbed waveforms and decreased off-nadir effect. Together with a higher spatial resolution, the Saral/AltiKa data is useful for monitoring smaller inland water bodies. However, the Ka-band is stronger attenuated due to atmospheric water content. Not only rain, but in general higher water content in the troposphere caused by clouds or fog can distort the waveforms. This might be a problem, especially in the tropics where we have to expect rain and a high level of humidity every day. In this study, we investigate the ability of Saral/AltiKa for inland water level estimation. We compare the weather dependence of AltiKa Ka-band measurements with those of the Envisat Ku-band measurements.

Saral/AltiKa and Envisat

	Envisat	Saral/AltiKa
Mission	Mar 2002-Oct 2010 (till Apr 2012 EM)	Feb 2012 -
Orbit	35 days repeat cycle, inclination 98.5°	
Altimeter band (GHz)	13.575 (Ku)	35.75 (Ka)
Bandwidth (MHz)	320, 80 and 20	500
Antenna beamwidth (°)	1.29	0.61
Pulse repetition frequency (kHz)	1.795	3.8
Pulse duration (msec)	20	110

Lake Tana

Weather Influence

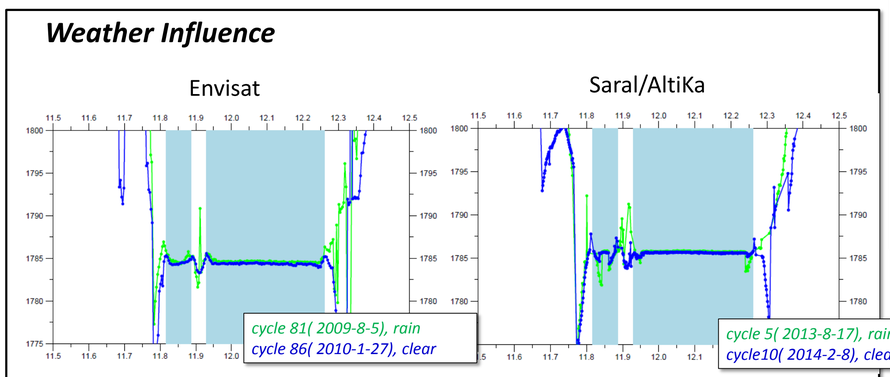
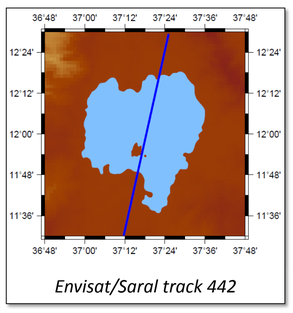


Fig. 1: Water level heights [m] over Lake Tana



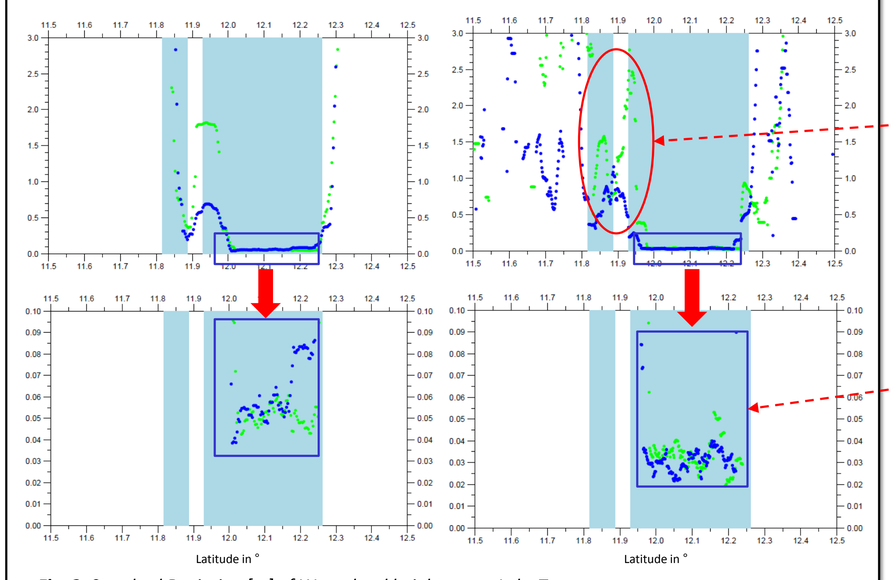


Fig. 2: Standard Deviation [m] of Water level heights over Lake Tana

Disturbance of atmospheric water content more prominent near land

Over open water no difference between wet and dry weather

Land Influence

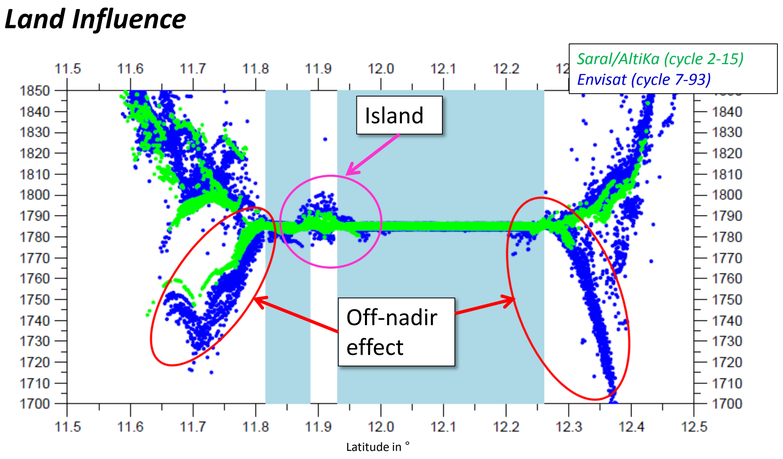


Fig. 3: Overlay of the heights in [m] of all Saral/Altika and Envisat cycles processed with the ocean retracker

Saral/Altika is less influenced by land than Envisat

Time Series

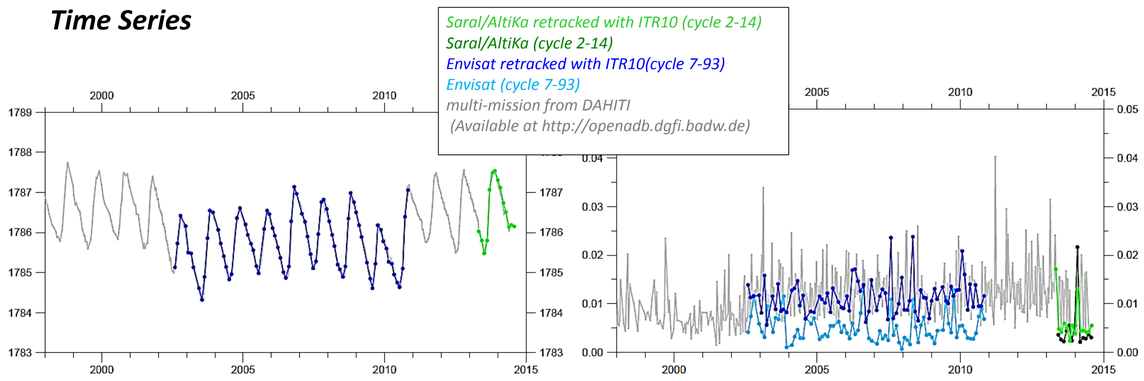


Fig. 4: Time series of Envisat and Saral in [m] (left) and the standard deviations of the time series of data retracked with ocean retracker and ITR10 (Improved Threshold Retracker 10%) (right)

See OSTST Poster 134 "Schwatke et al.: Database for Hydrological time series of inland waters (DAHITI)" on Thursday for detailed information on the multi-mission approach

Rio Negro

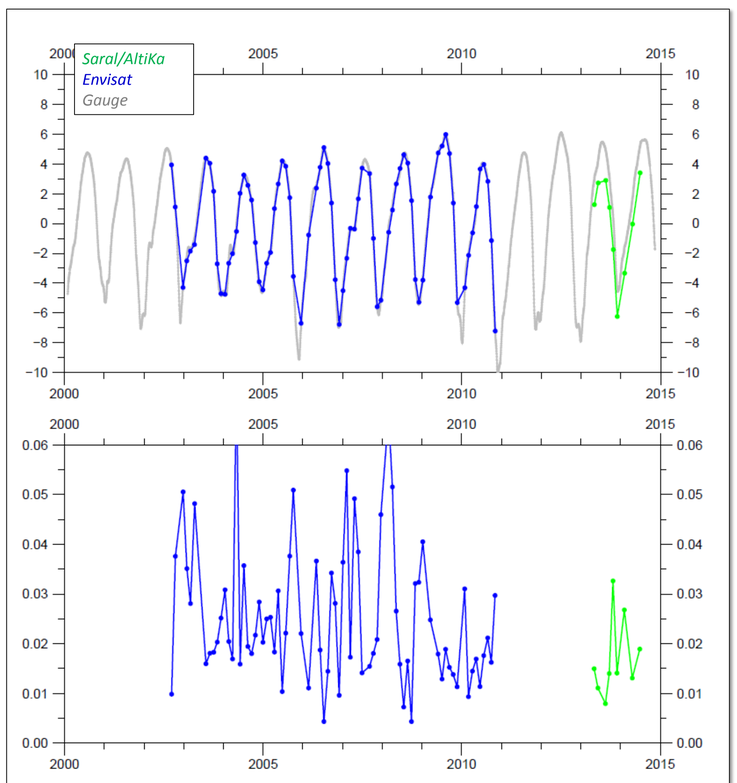
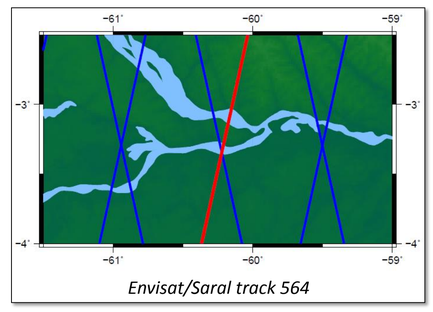


Fig. 5: Time series of Envisat and Saral in [m] (top) and the standard deviations of the time series of data retracked with ocean retracker (bottom)



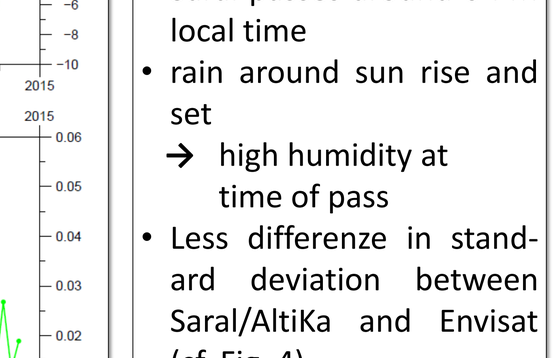
- Saral passes around 6 PM local time
- rain around sun rise and set
  → high humidity at time of pass
- Less differenze in standard deviation between Saral/AltiKa and Envisat (cf. Fig. 4)

Validation with in-situ data

	RMS [m]
Envisat	14.5
Saral	7.5

Amazon

Comparision of nine virtual stations with four gauging stations in the Amazon region



River	Gauging Station	Pass	Distance [km]	River width [km]	RMS Envisat [cm]	RMS SARAL [cm]	RMS Diff.
Rio Solimões	Tabatinga	0622 (-)	~22	~2.3	27.1	17.2	**37 %**
		0751 (+)	~24	~5.0	35.9	28.5	**21 %**
Rio Negro	Moura	0192 (+)	~33	~11.2	39.4	22.6	**43 %**
		0650 (-)	~68	~4.8	83.9	29.4	**65 %**
Amazon River	Itacoatiara	0063 (+)	~44	~4.6	32.5	15.4	**53 %**
		0478 (+)	~45	~4.6	36.6	16.8	**54 %**
		0521 (-)	~53	~4.2	53.3	18.9	**65 %**
Rio Tapajos	Santarem	0807 (-)	~6	~4.8	14.8	12.9	**13 %**
		0764 (+)	~27	~17.5	46.5	19.1	**59 %**
				Std =	**Ø 41.1 19.4**	**Ø 20.1 15.7**	**Ø 51 %**

From Schwatke et al. (2014): Potential of SARAL/AltiKa for inland water applications

In comparision to Envisat, Saral/AltiKa …

- has more reliable measurements close to the shore
- shows higher sensibility for atmospheric water content especially near the shore
- yields improved accuracies compared, but the improvement is depending on the amount of atmospheric water content

References:

- C. Schwatke et al. (2014). **Potential of SARAL/AltiKa for inland water applications**. *Marine Geodesy* (in review)
- *Schwatke C., Bosch W., Dettmering D.:* **A new Database of Water Level Time Series for Lakes, Rivers, and Wetlands from Multi-Mission Satellite Altimetry**. ESA Living Planet Symposium, Edinburgh, United Kingdom, 2013-09-09/13 (Poster)
- *Schwatke C., Bosch W.:* **Kalman filter Approach for geophysical lake level Time Series using multi-mission Altimetry**. FGS Workshop 2013, Bad Kötzting, Germany, 2013-04-25 (Poster)
- *Schwatke C., Dettmering D., Bosch W.:* **Using Multi-Mission Satellite Altimetry for Estimating Water Level Time Series of Inland Waters - The new Database for Hydrological Time Series of Inland Waters (DAHITI)**. Ocean Surface Topography Science Team (OSTST) Meeting 2013, Boulder, USA, 2013-10-10