SEMINAIRE ANNUEL

GEPASUD

GPS Subsidence Rate Of Tahiti Island Comparison With Coral Reef Stratigraphy

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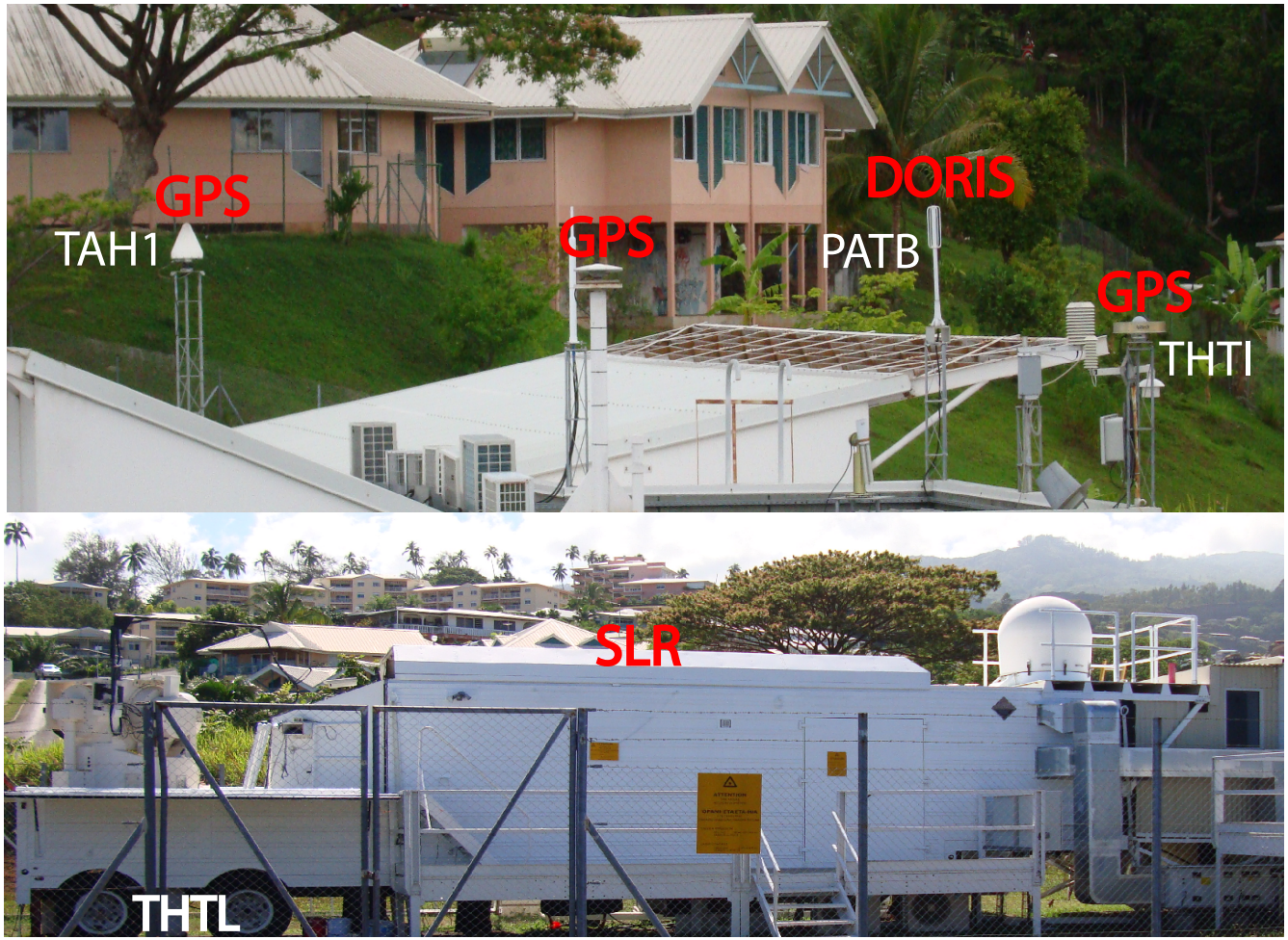
Coral reef stratigraphy data (Bard *et al.* 1996) and model (Koelling *et al.* 2009) showed that:
Tahiti is slowly subsiding at 0.25 mm/yr.
Is it time to detect sub-mm level vertical rate using GPS observations?



Three co-located space geodesy techniques at the Tahiti Geodesy Observatory (DORIS, GPS & SLR).

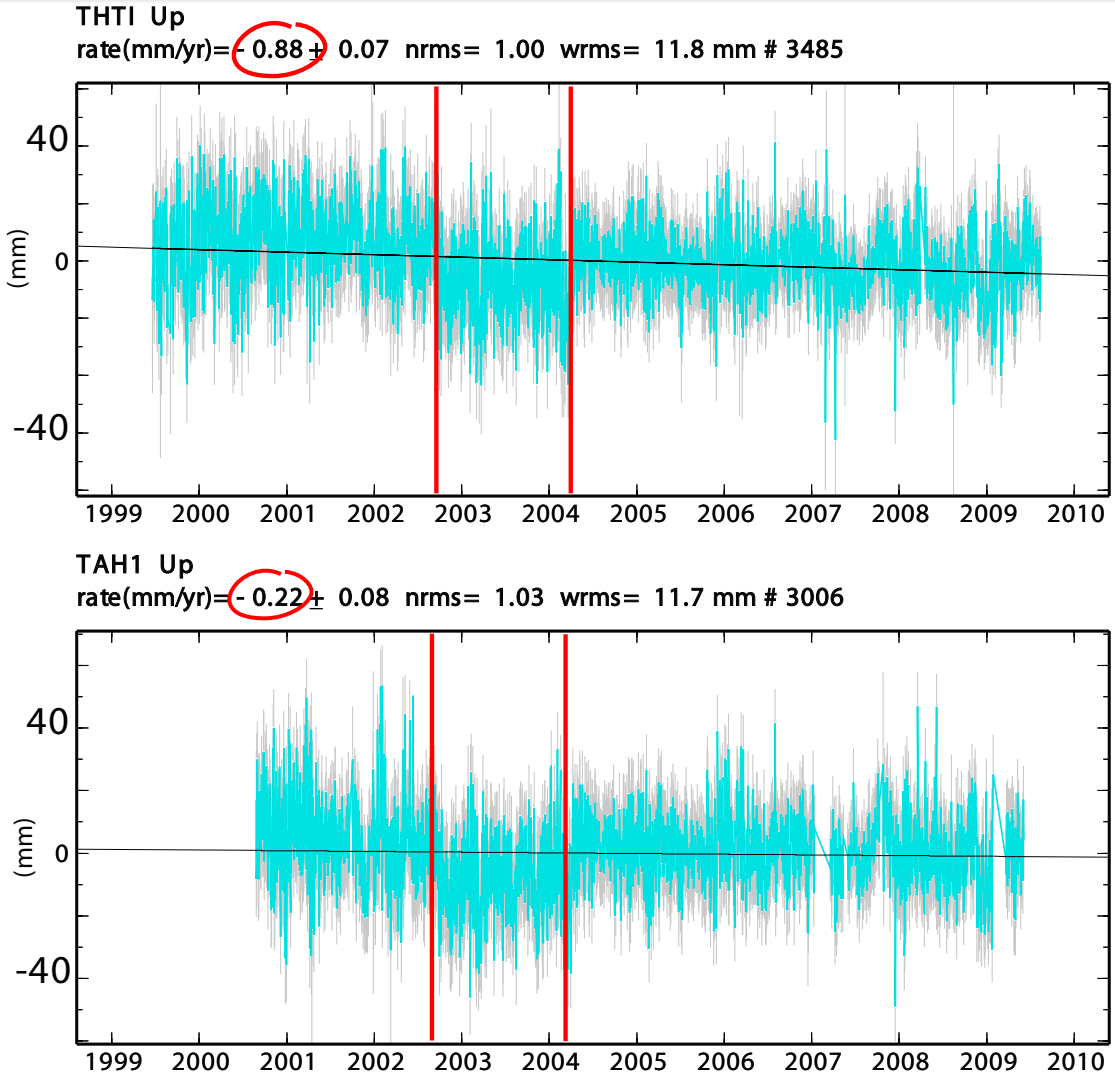
GPS DATA PROCESSING SCHEME

Softwares	**GIPSY-OASIS II (JPL)**[1]		**GAMIT-GLOBK (MIT)**[2]
Modes	**Precise Point Positioning (PPP)**		**Double - Differenced (DD)**
Parameters	**Orbits / Clocks IGS & JPL**	**Antenna Model IGS Antex**	**Reference Frame Scale / Scale Rate**
Stations	**Co-located IGS Stations**		
	THTI		**TAH1**
	Jun 6^{th}, 1998 @13:54:30		**Jul 12^{th}, 2000 @20:07:30**
	Hardware Change		
	Receiver/Antenna Jan 13^{th}, 2004		**No Hardware Change**
	Baseline Components		
	North (meters)	**East (meters)**	**Height (meters)**
	3.6503	**27.6701**	**1.7948**

[1] (Webb & Zumberge 1995; Zumberge *et al.* 1997; Bar-Sever *et al.* 2003)

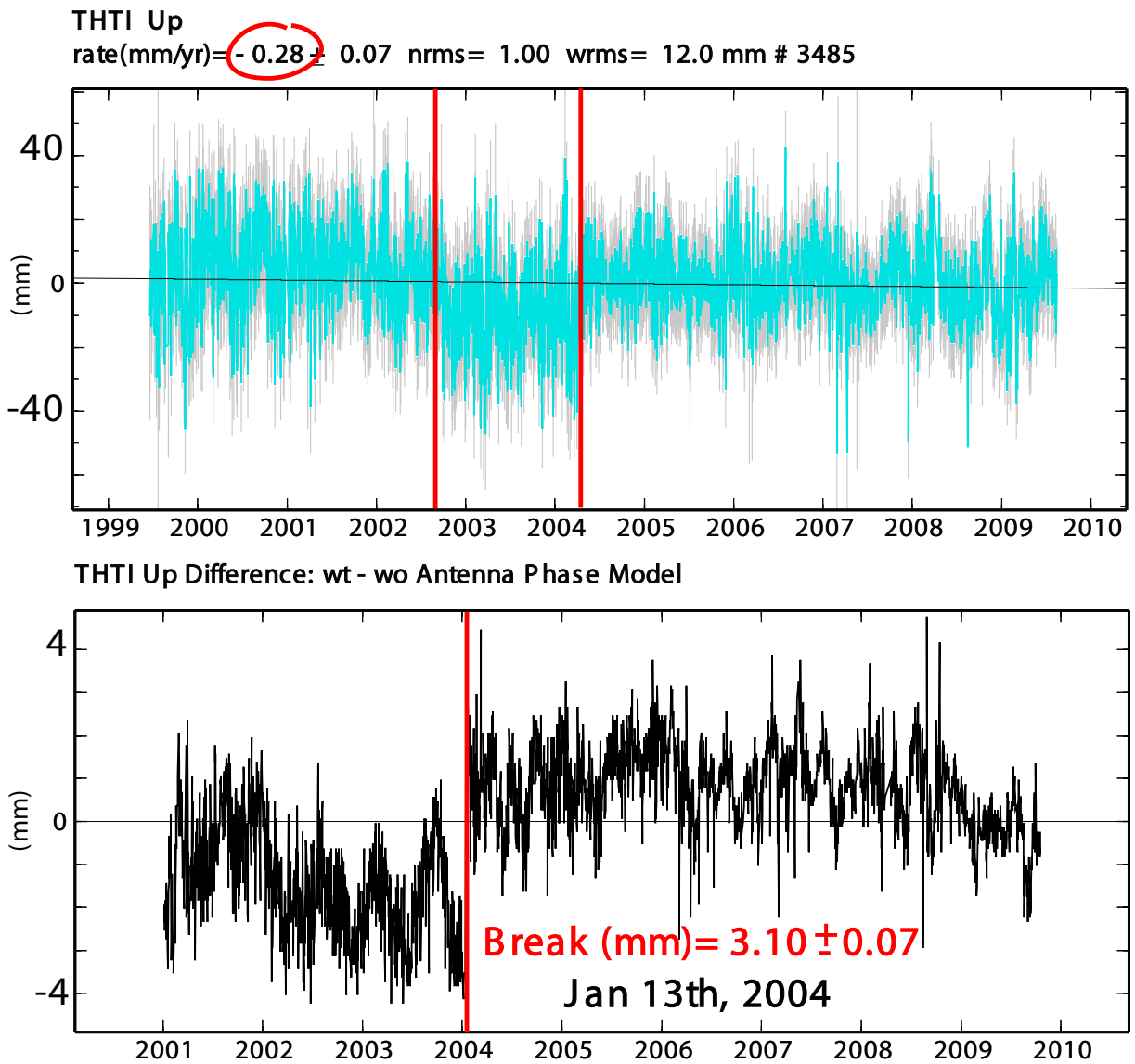
[2] (King & Bock 2004; Herring 2002)

GIPSY-OASIS II (PPP) / FLINN_NF



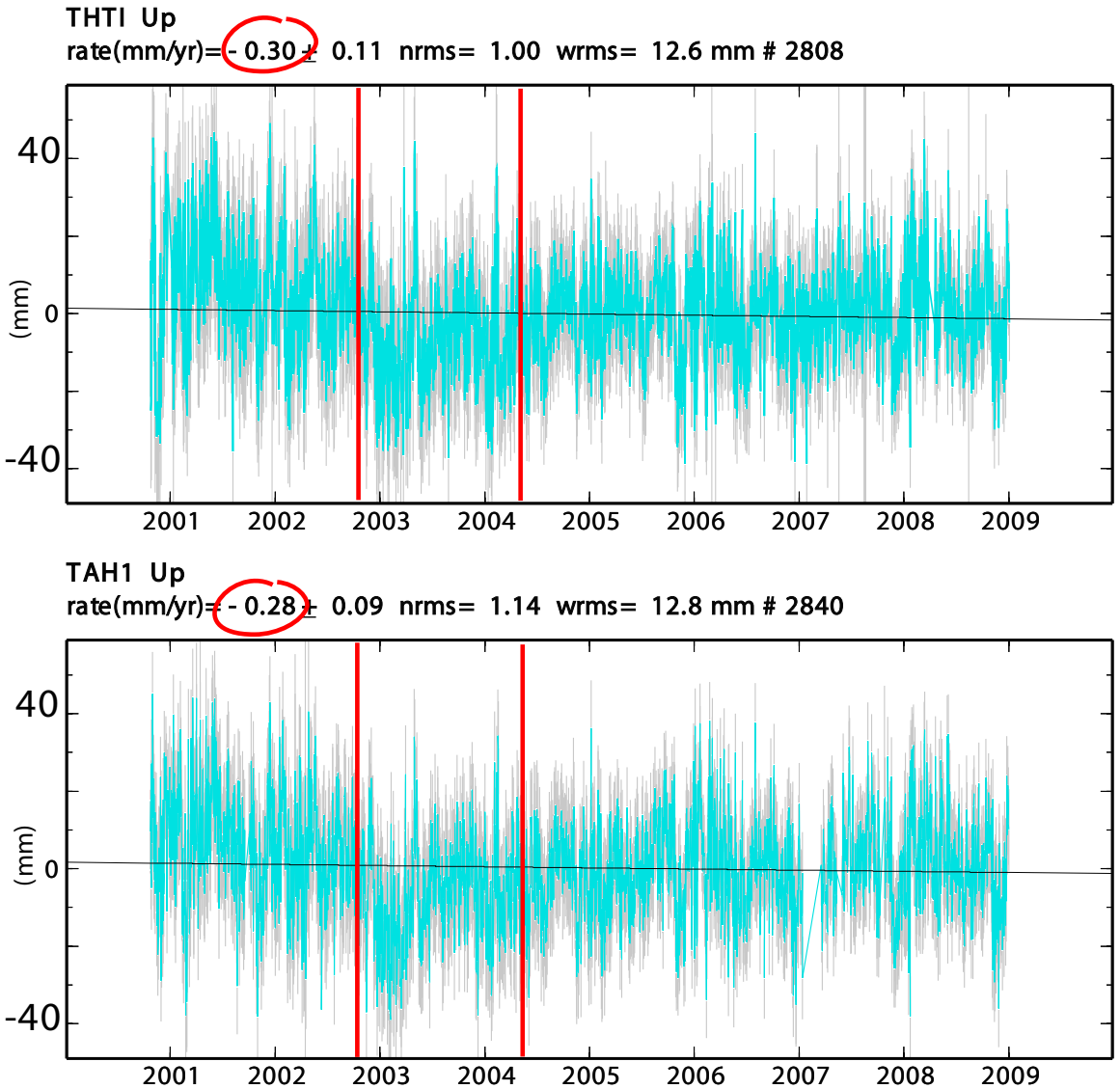
THTI and TAH1 height time series derived from Gipsy-Oasis II (PPP) without antenna calibration. JPL flinn_nf orbits and clocks were used. Daily solutions were aligned to ITRF2005 using JPL x-files. What caused the difference in the vertical rates and the two major jumps in the time series?

GIPSY-OASIS II (PPP) / FLINN_NF & ANTENNA CALIBRATION



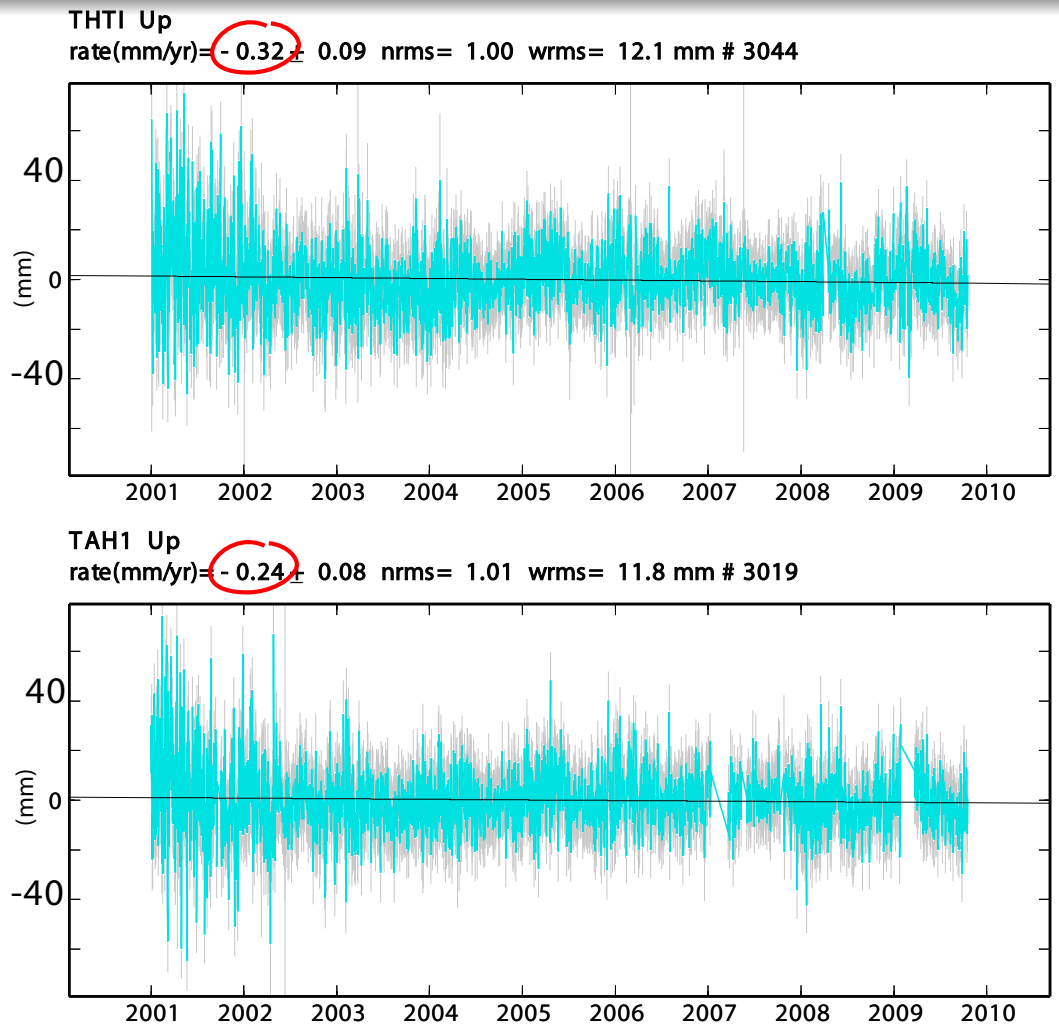
THTI height time serie derived from Gipsy-Oasis II (PPP) with antenna calibration (top). A clear jump affected the time-serie on Jan 13th, 2004 (bottom).

GIPSY-OASIS II (PPP) / IGS FINAL PRODUCTS



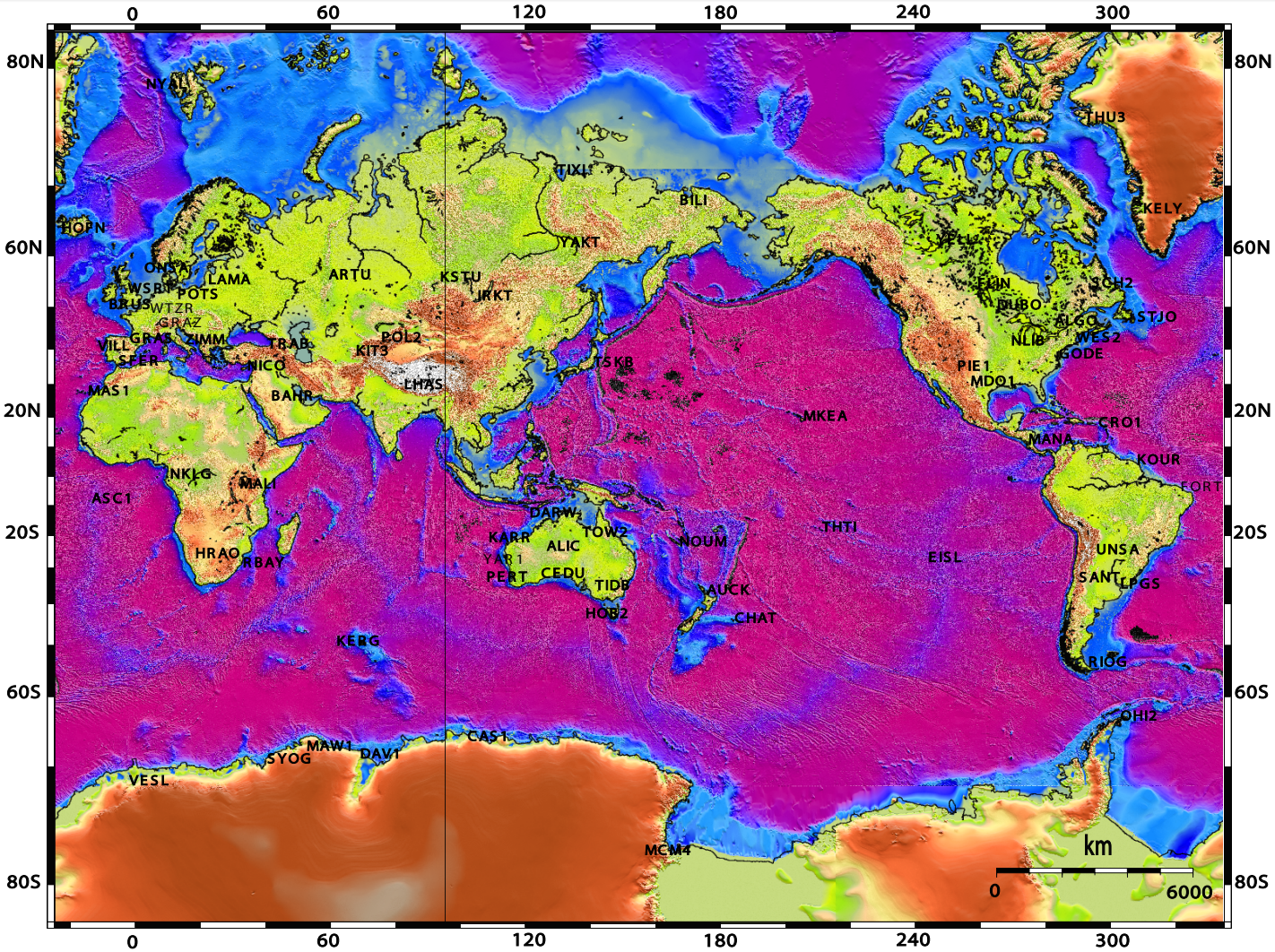
Jumps affected THTI and TAH1 height time series, derived from Gipsy-Oasis II (PPP) using IGS final orbits, clocks and antenna phase center maps.

GIPSY-OASIS II (PPP) / FLINNR_NF



THTI and TAH1 height time series derived from Gipsy-Oasis II (PPP) using JPL flinnR_nf orbits, clocks and x-files. Antenna phase center table was applied to THTI. Mostly, breaks or jumps are due to: Earthquakes (not the case here), change in the hardware (antenna particularly which is not the case here at least for TAH1, and even for THTI the first jump was before Jan 13^{th}, 2004 date at which THTI receiver and antenna have been upgraded). In the present case, flinn_nf x-files were the main suspect.

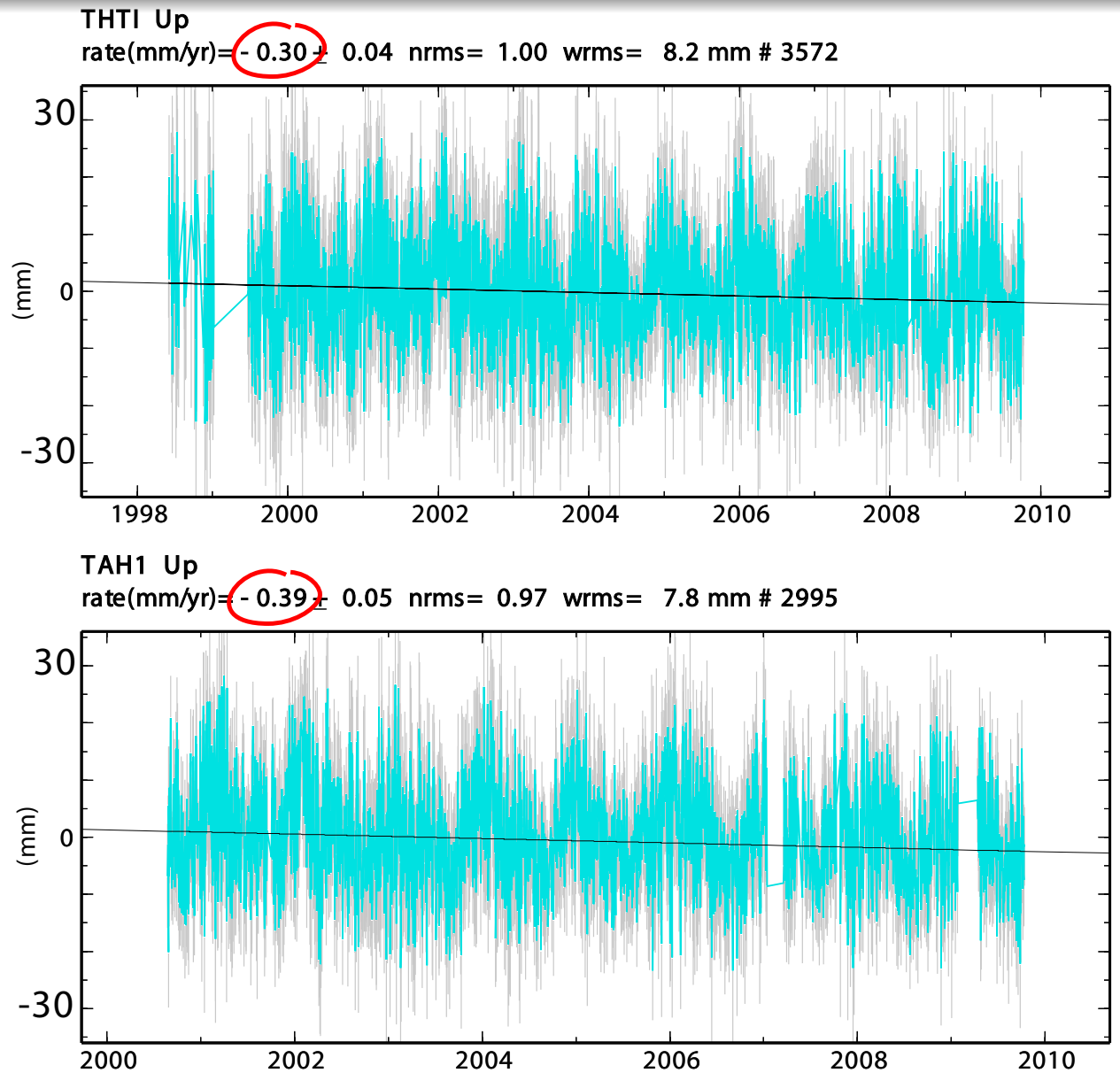
MIT QUASI-OBSERVATIONS



The GPS daily, weekly and global solutions were realized in a global reference frame by estimating Helmert parameters transformation (Translation, Rotation, Scale) between the loosely constrained GPS analysis[3] and the known ITRF2005 positions and velocities of 70 IGS stations shown in the map above.

[3] MIT daily quasi-observations archive: ftp://everest.mit.edu/pub/MIT_GLL

HEIGHT LINEAR FIT



THTI and TAH1 height time series derived from GAMIT-GLOBK daily solutions.

HEIGHT RATE

Software	GIPSY-OASIS II			
	Height Rate (mm/yr)			
	Products Type			
	IGSF	FLINN_NF	FLINNR_NF	
Station			Scale ON	Scale OFF
THTI	-0.30 $\pm$ 0.11	-0.28 $\pm$ 0.07	-0.32 $\pm$ 0.09	-0.83 $\pm$ 0.12
TAH1	-0.28 $\pm$ 0.09	-0.22 $\pm$ 0.08	-0.24 $\pm$ 0.09	-0.74 $\pm$ 0.12

Software	GAMIT-GLOBK			
	Height Rate (mm/yr)			
	Daily Linear Fit		Global Combined Solution	
	Scale ON	Scale OFF	Scale ON	Scale OFF
Station			Scale Rate ON	Scale Rate OFF
THTI	-0.30 $\pm$ 0.04	-0.87 $\pm$ 0.04	-0.28 $\pm$ 0.40	0.02 $\pm$ 0.56
TAH1	-0.39 $\pm$ 0.05	-1.00 $\pm$ 0.05	-0.22 $\pm$ 0.68	0.04 $\pm$ 0.78

REFERENCES

BAR-SEVER, Y. E., S. BYUN, & G. GENDT.
2003.
The Tropospheric Products of the International GPS Service.
AGUFall Meeting,. Dec. 8-12,2003, San Francisco, CA, USA. .

BARD, E., B. HAMELIN, L. MONTAGGIONI, G. CABIOCH, G. FAURE, & F. ROUGERIE.
1996.
Deglacial sea-level record from Tahiti corals and the timing of global meltwater discharge.
Nature **382. 241–244.**

HERRING, T. A.
2002.
GLOBK: Global Kalman filter VLBI and GPS analysis program, Version 10.0.
Massachusetts Institute Of Technology, Cambridge .

KING, R. W., & Y. BOCK.
2004.
Documentation for GAMIT analysis software, release 10.2.
Massachusetts Institute Of Technology, Cambridge .

KOELLING, M., J.M. WEBSTER, G. CAMOIN, Y. IRYU, E. BARD, & C. SEARD.
2009.
SEALEX - Internal reef chronology and virtual drill logs from a spreadsheet-based reef growth model.
Global and Planetary Change **66. 149–159 doi: 10.1016/j.gloplacha.2008.07.011.**

WEBB, F. H., & J. F. ZUMBERGE.
1995.
An introductin to GIPSY-OASIS-II precision software fro the analysis of data from the Global Positioning System.
Rep. JPL D-11088, Pasadena, Calif .

ZUMBERGE, J. F., M. B. HEFLIN, D. C. JEFFERSON, M. M. WATKINS, & F. H. WEBB.
1997.
Precise Point Positioning for the efficient and robust analysis of GPS data from large networks.
J. Geophys. Res. **102. 5005–5017.**

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Thank you

Merci

Chokrane