

Using DORIS daily PPP results to investigate the effect of the South Atlantic Anomaly on Jason-2 oscillator

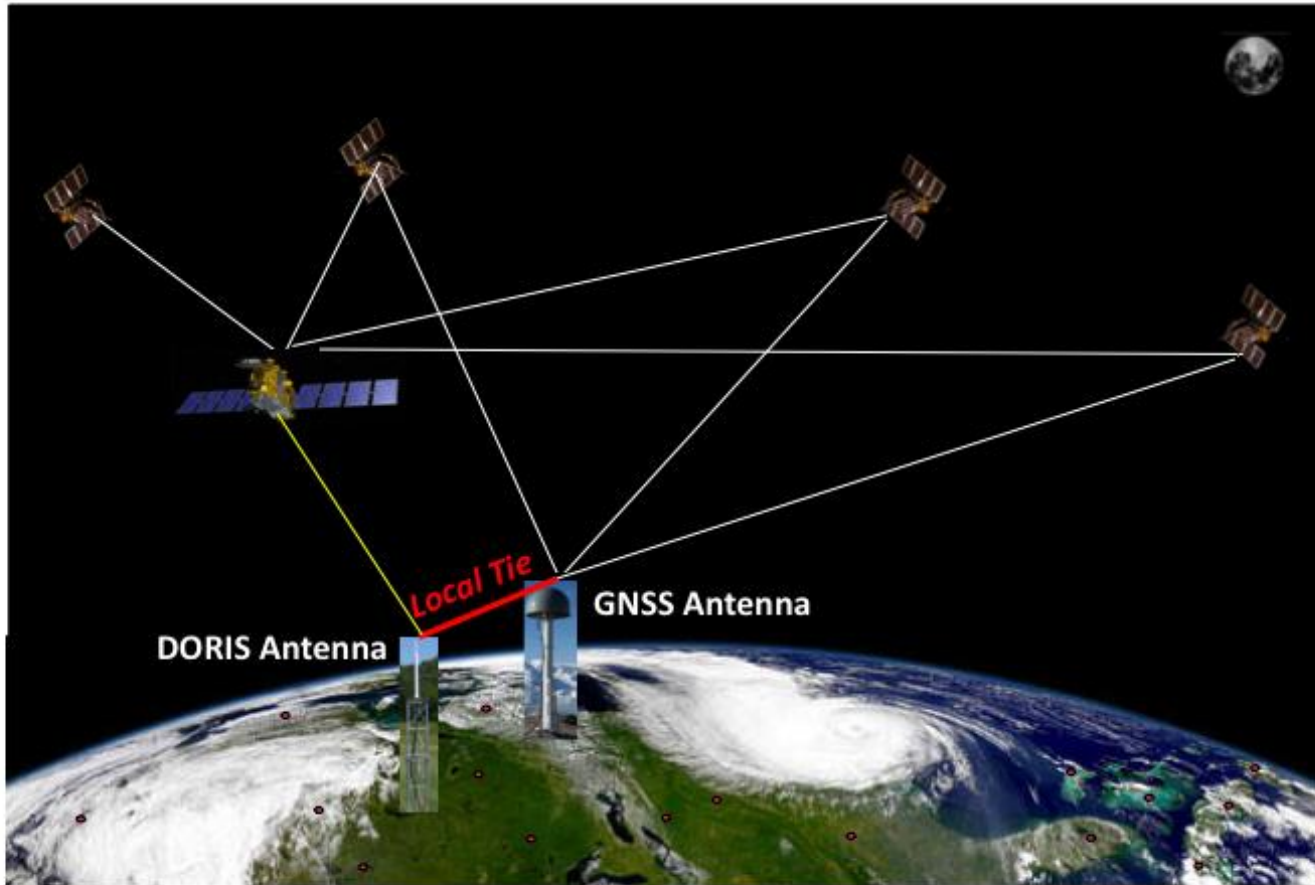
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NB: see also Willis et al., ASR, 58(12), 2016

OUTLINE

- Description of the method (DORIS PPP)
- Individual results (Greenbelt, Santiago and Cachoeira-Paulista stations)
- Global analysis (horizontal, vertical)
- Doppler residuals and effects for geodesy and Precise Orbit Determination
- Conclusions

DORIS daily PPP



Closure equations

$$D_{ti} = (DORIS_i0 + DORIS_i(t)) - (GPS_i0 + GPS_i(t)) - local_tie_i \quad (\text{Eq. 1})$$

$$\sigma^2 D_{ti} = \sigma^2 DORIS_{it} + \sigma^2 GPS_{it} + \sigma^2 local_tie_i \quad (\text{Eq. 2})$$

DORIS formal error is predominant / 2-3cm

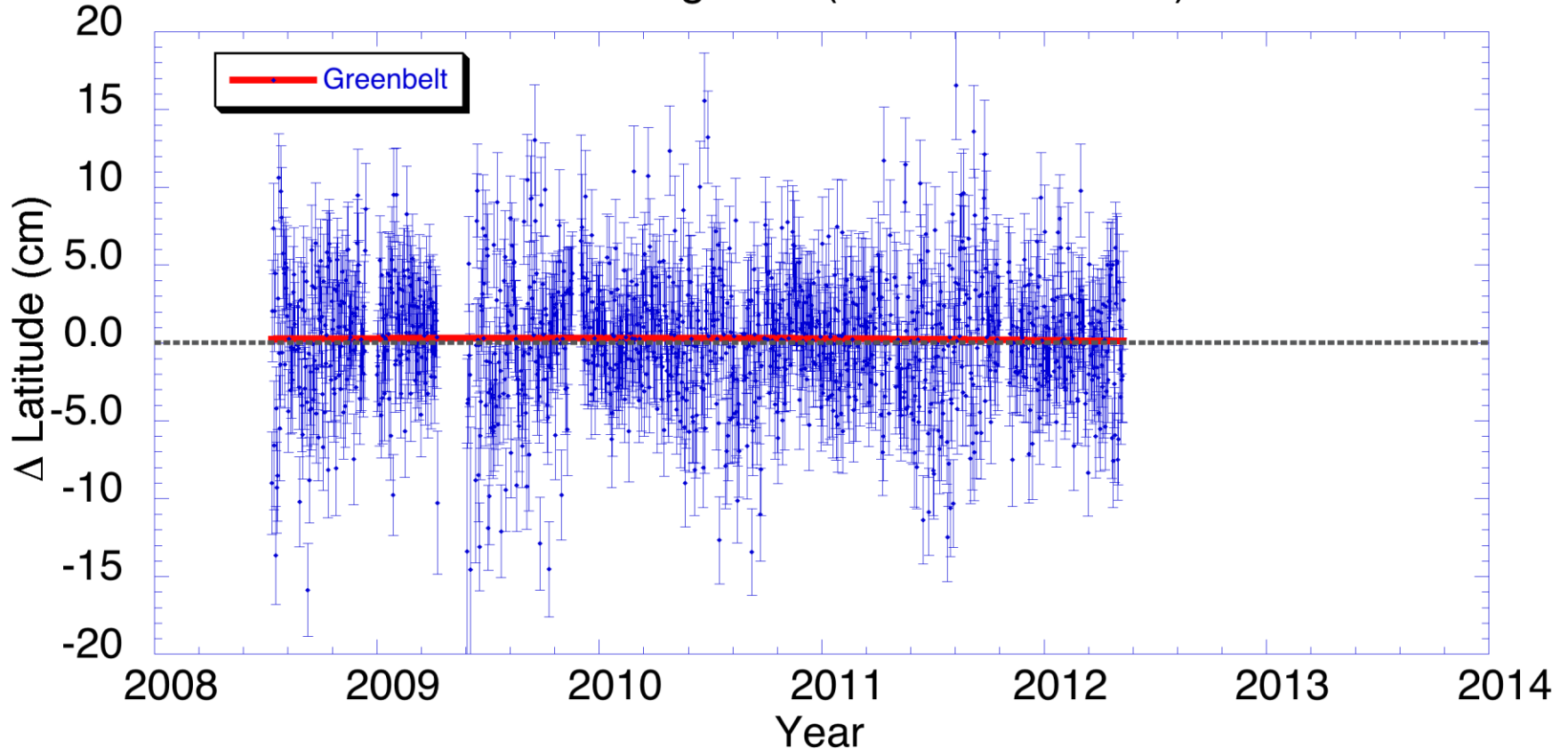
And not 5-7mm because:

1 day vs 7 day

1 satellite vs 4 satellites

Greenbelt (DORIS-GPS)

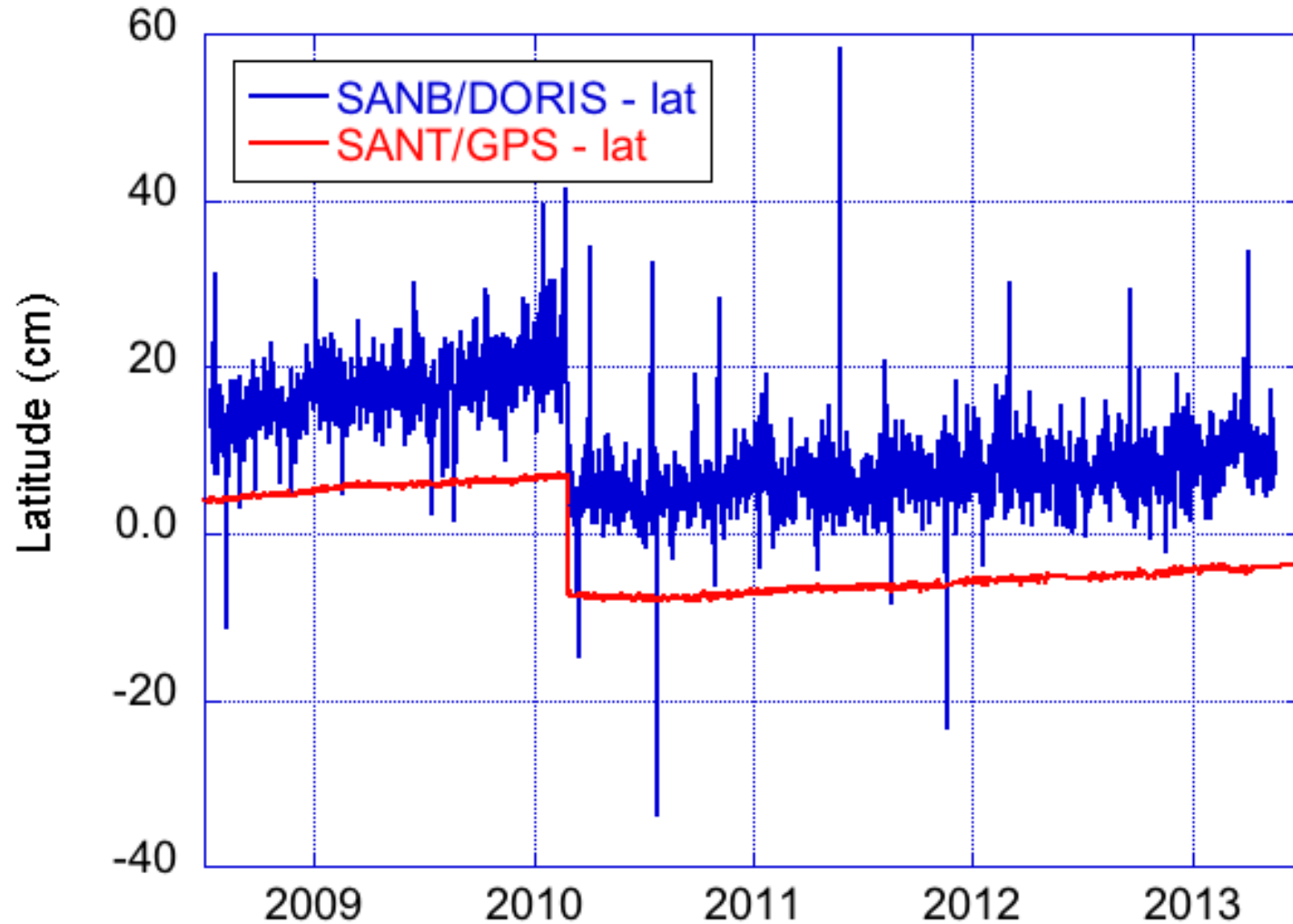
Greenbelt Differential Longitude (DORIS vs. GPS)



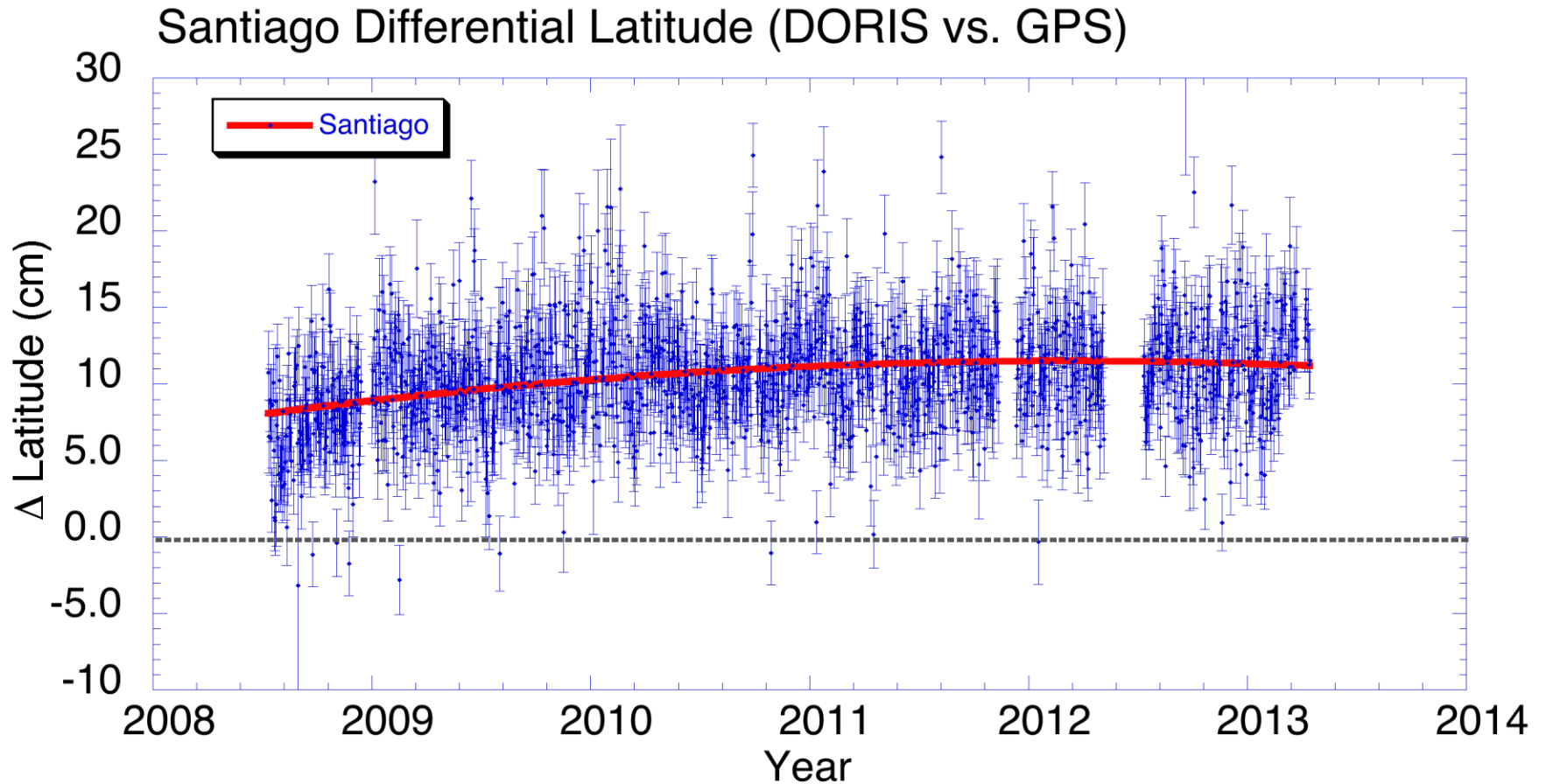
NB: no bias detected. Consistency between space geodesy and local ties

Santiago daily results

Maule earthquake, 27-FEB-2010, Mw=8.8



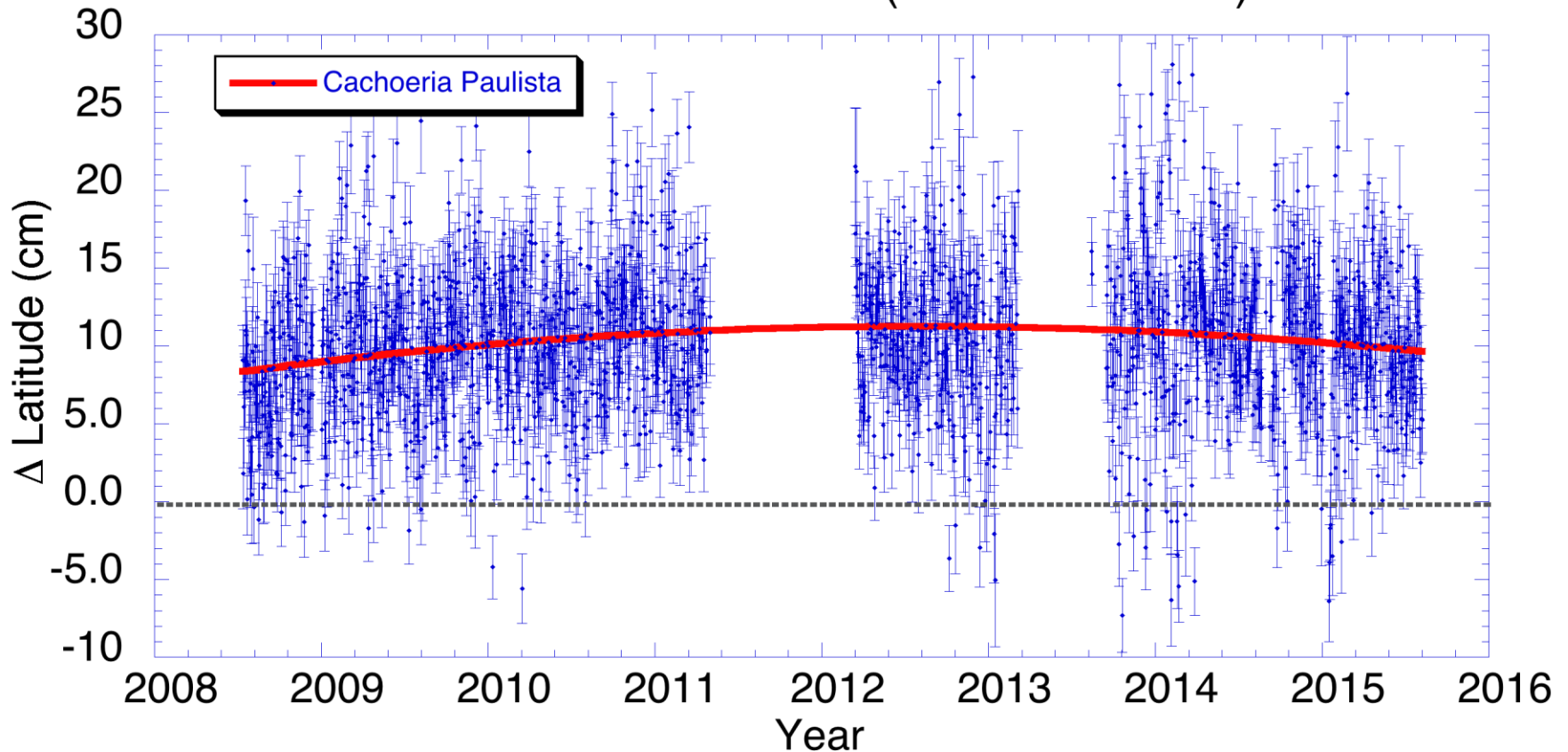
Santiago (DORIS-GPS)



NB: Maule earthquake is not visible in plot

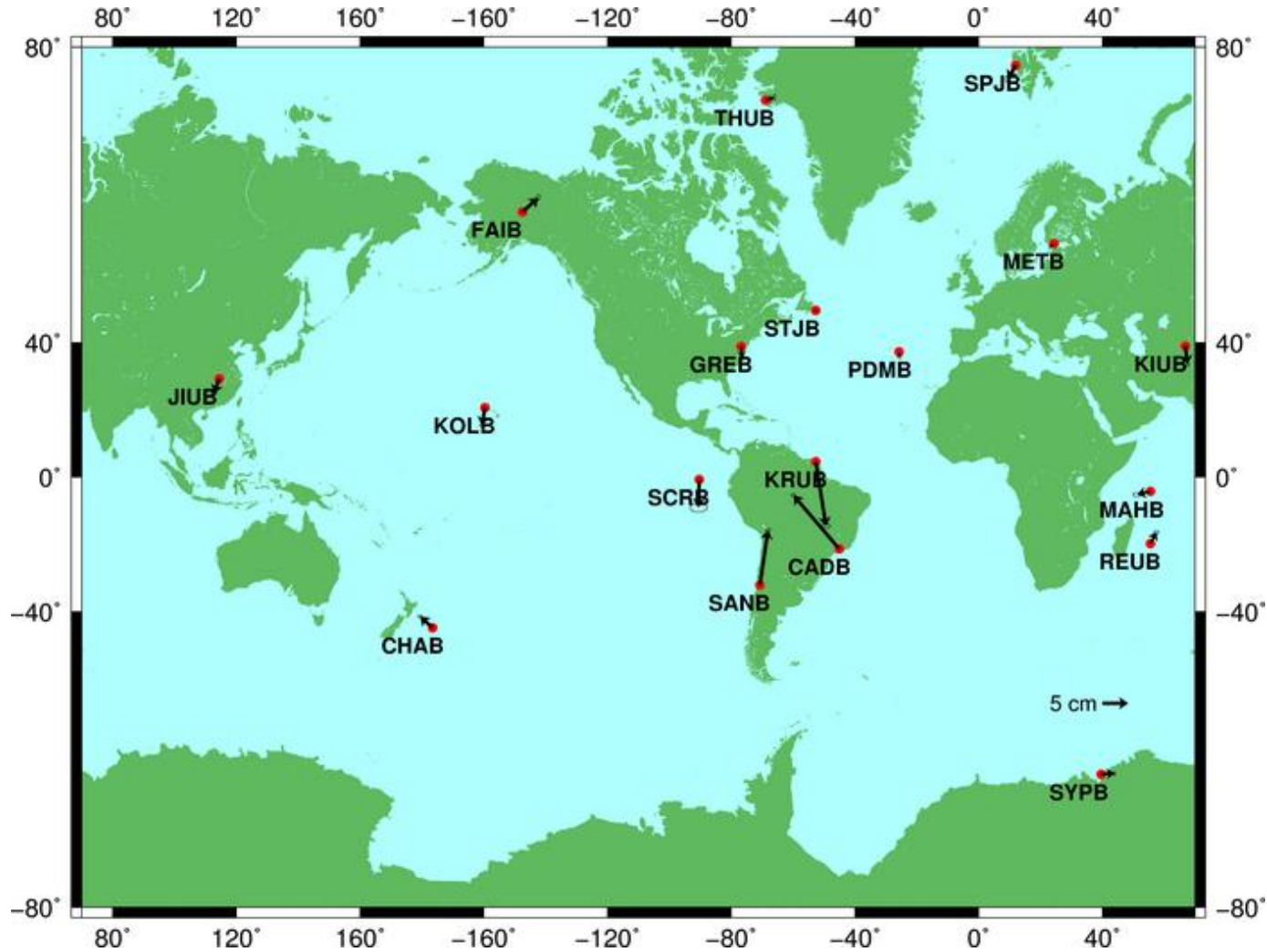
Cachoeira-Paulista (DORIS-GPS)

Cachoeira Paulista Differential Latitude (DORIS vs. GPS)

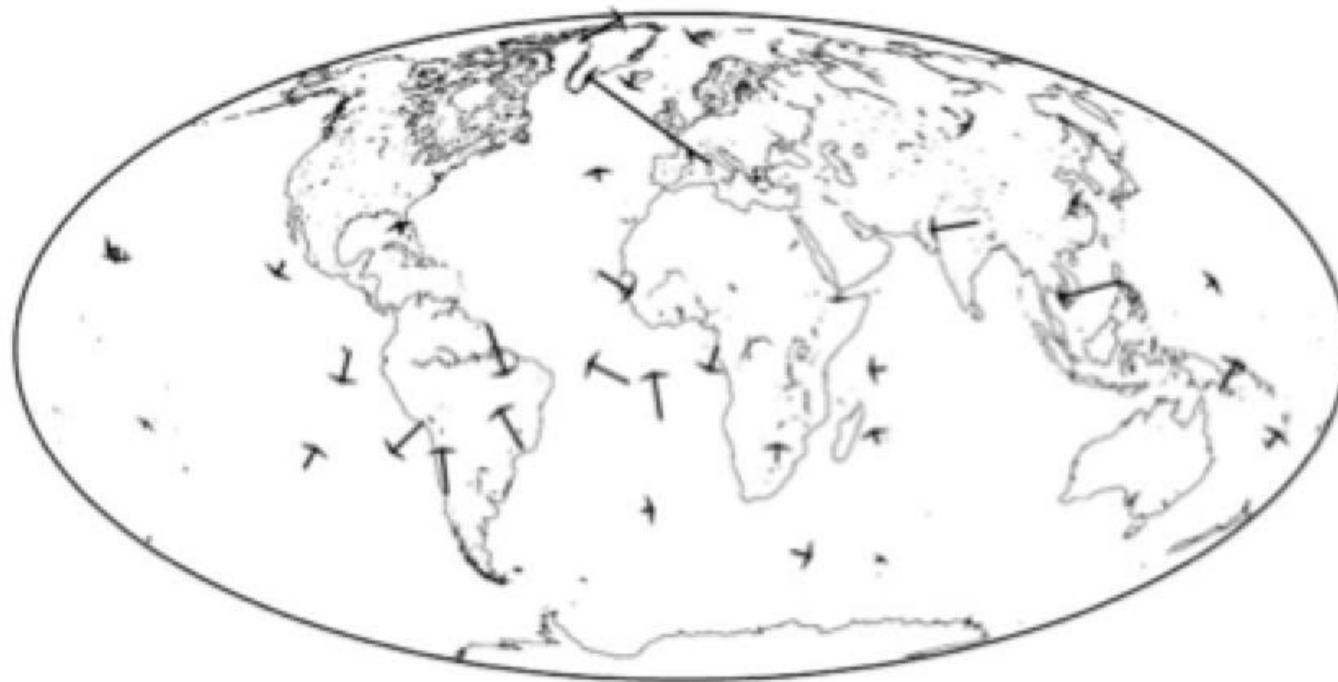


Misclosure errors (horizontal position)

Jason-2 DORIS PPP

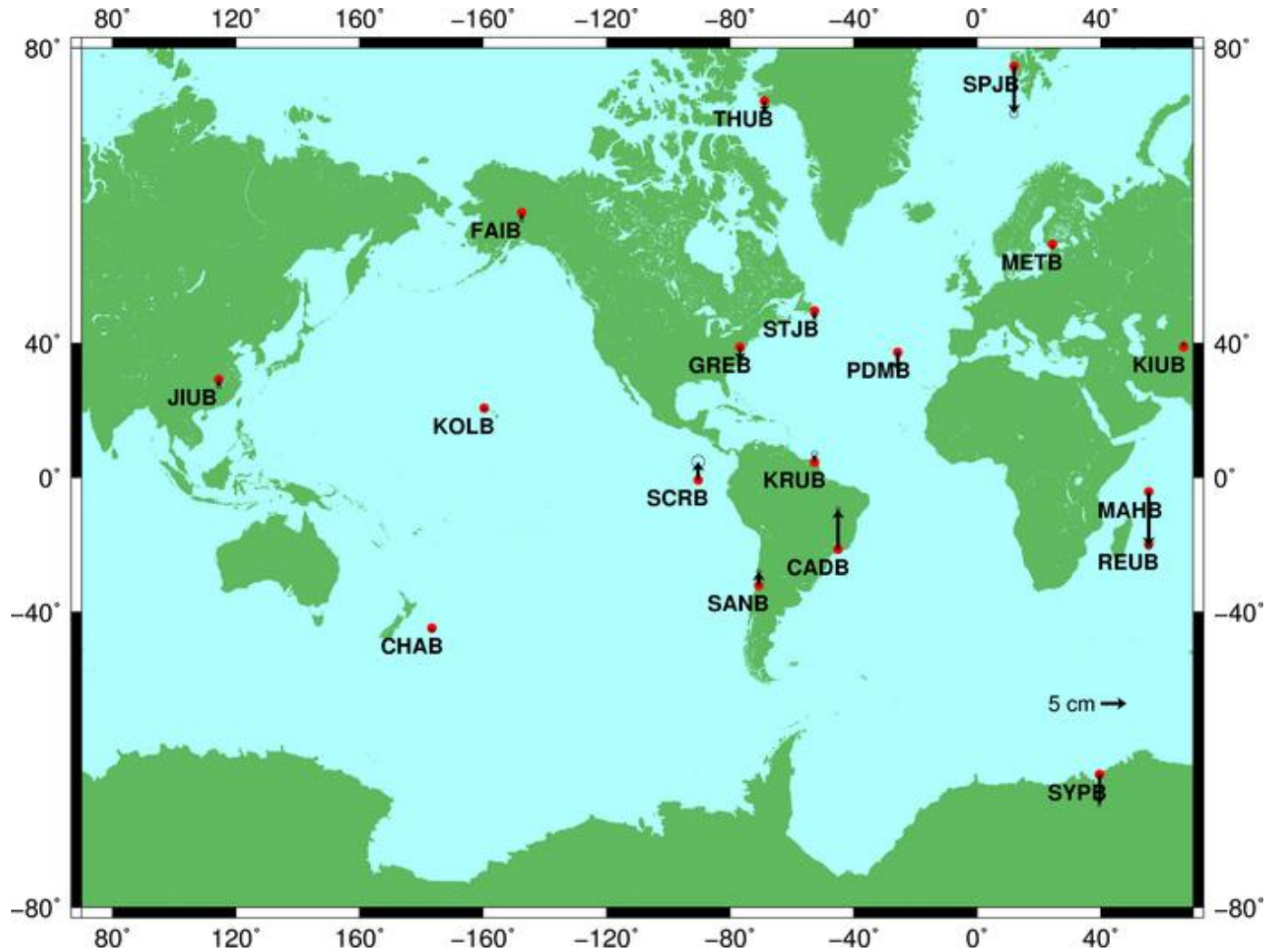


Velocity errors (Jason-1) (old results)

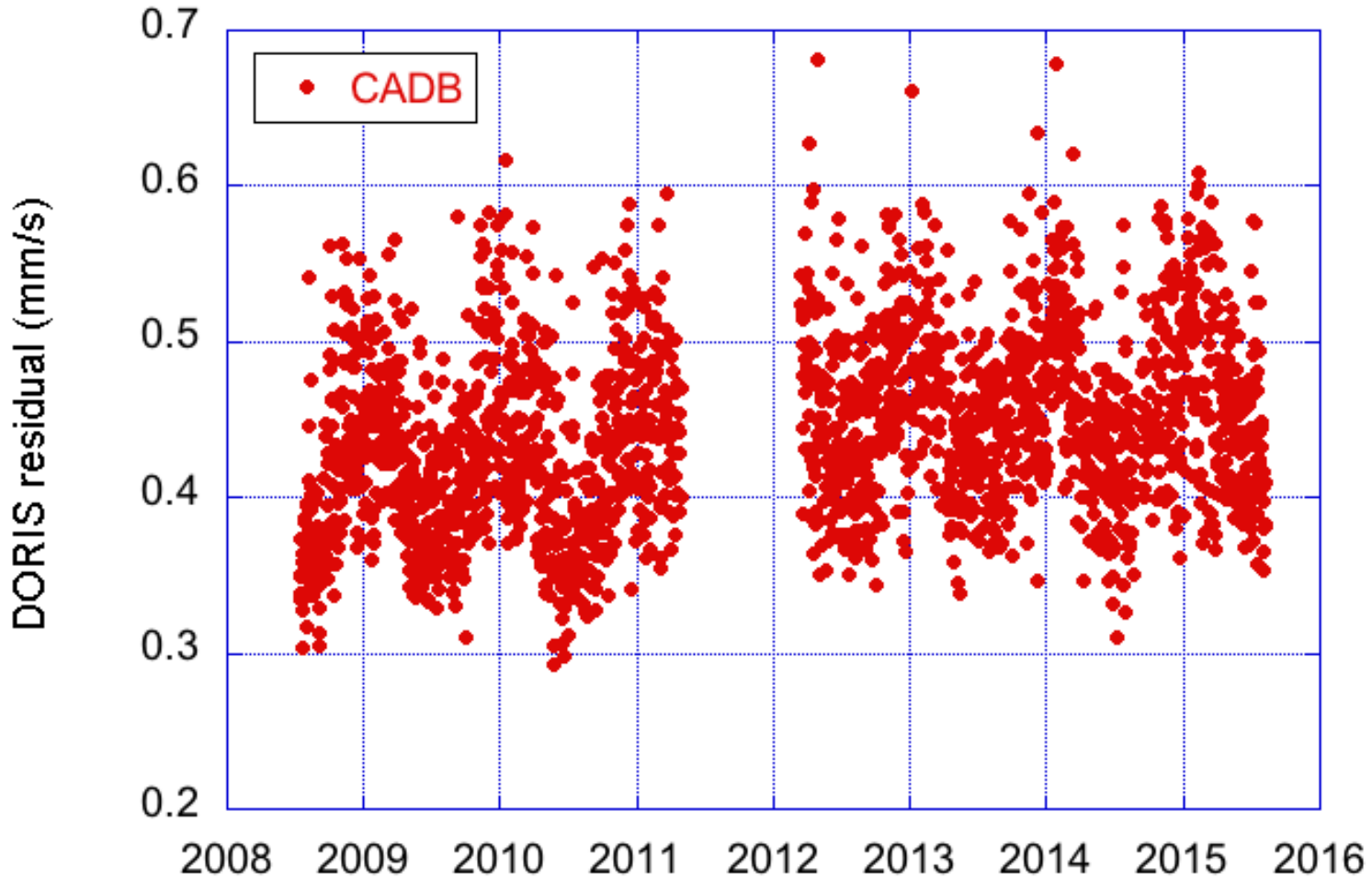


Willis et al., CR Geosci., 2004

Misclosure error (vertical position) Jason-2 DORIS PPP



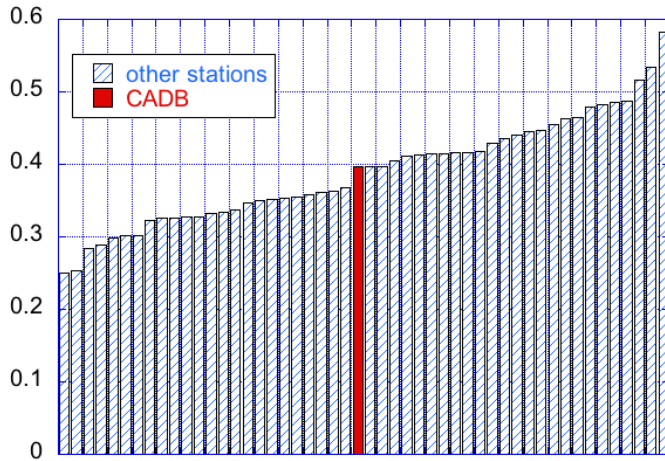
DORIS Doppler residuals using GPS orbit



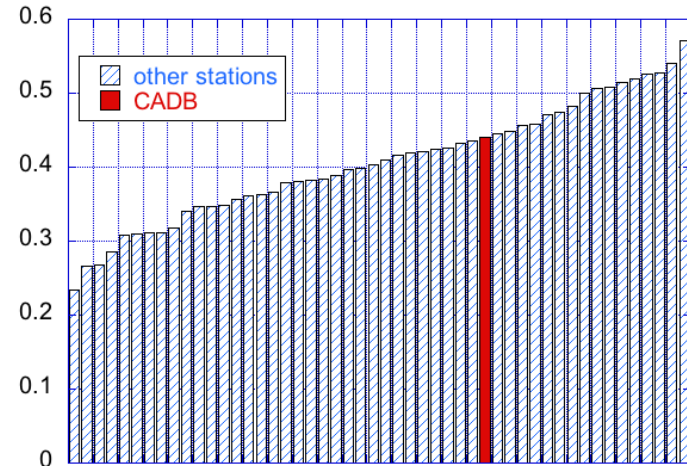
NB: Jason2 orbit is not estimated

Effect on Doppler residuals

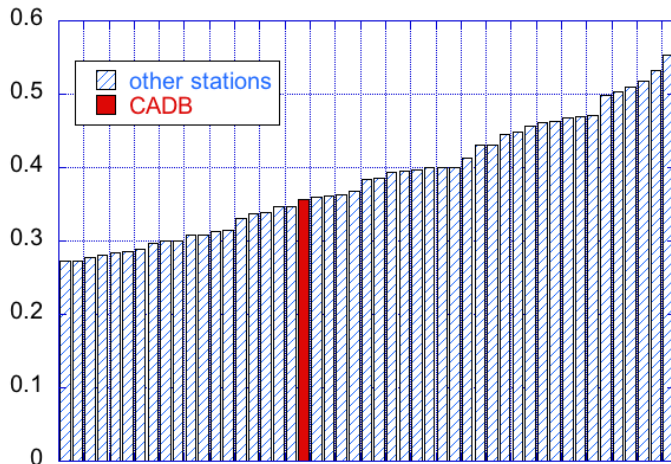
2008-08-01



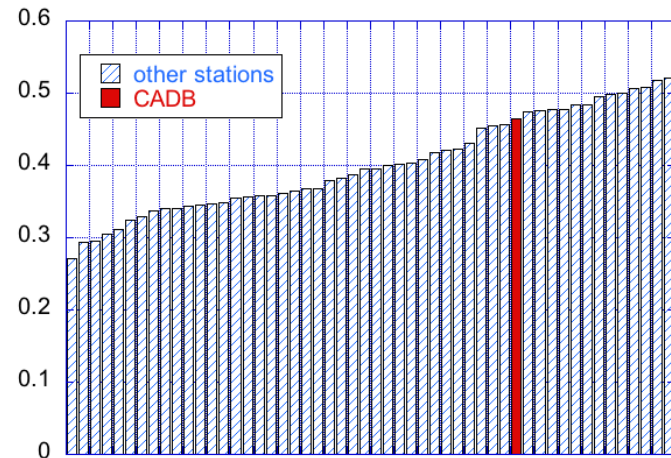
2015-06-01



2008-09-01



2015-07-01



Conclusions and future work

- There is SAA effect on DORIS/Jason2 station position as before for Jason-1 (also confirmed by independent studies)
- Unlike for Jason-1, effect does not degrade with time after about 6 months (thanks to oscillator radiation-hardening)
- Effect on geodesy is less than 10 cm and only for a few stations (2cm for a standard multi-satellite DORIS solutions with smooth evolution)
- Effect on POD is very limited while effect is large on geodetic results (if not corrected)
- Work in progress:
 - HY2A PPP using GPS orbit (GPS orbit or data availability?)
 - Jason-3 and Sentinel-3A PPP (on-going action implementing DORIS/RINEX data processing)