Is the Jason-2 oscillator also affected by the South Atlantic Anomaly?
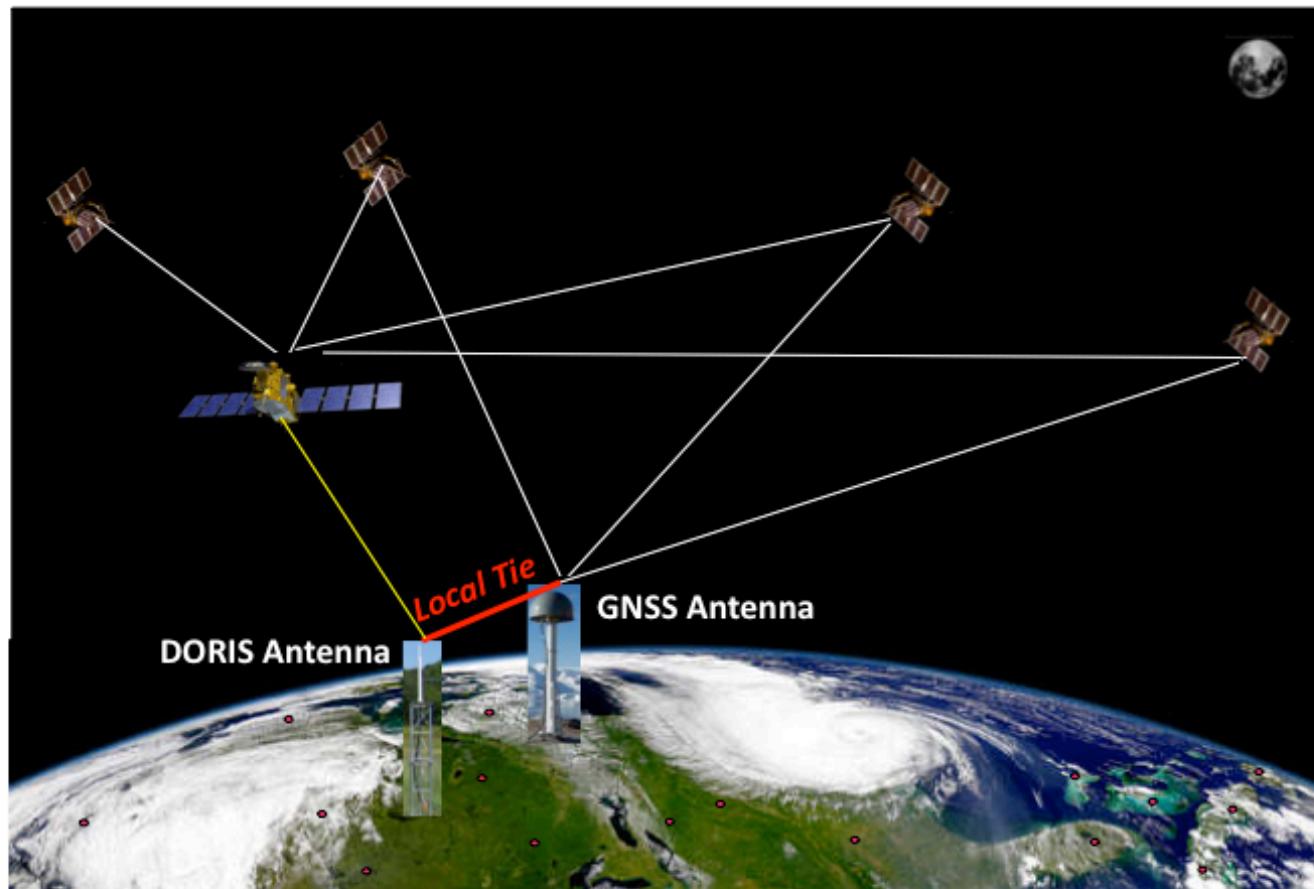
Pascal Willis, Mike Heflin, Bruce Haines, Yoaz Bar-Sever, Willy Bertiger, Mioara Mandea

NB: article with same title and authors was submitted to ASR, under revision

OUTLINE

- Description of the method (DORIS PPP)

- Individual results (Santiago and Greenbelt stations)

- Global analysis (horizontal, vertical)

- Doppler residuals and effects for geodesy and Precise Orbit Determination

- Conclusion and future work

DORIS daily PPP

Closure equations
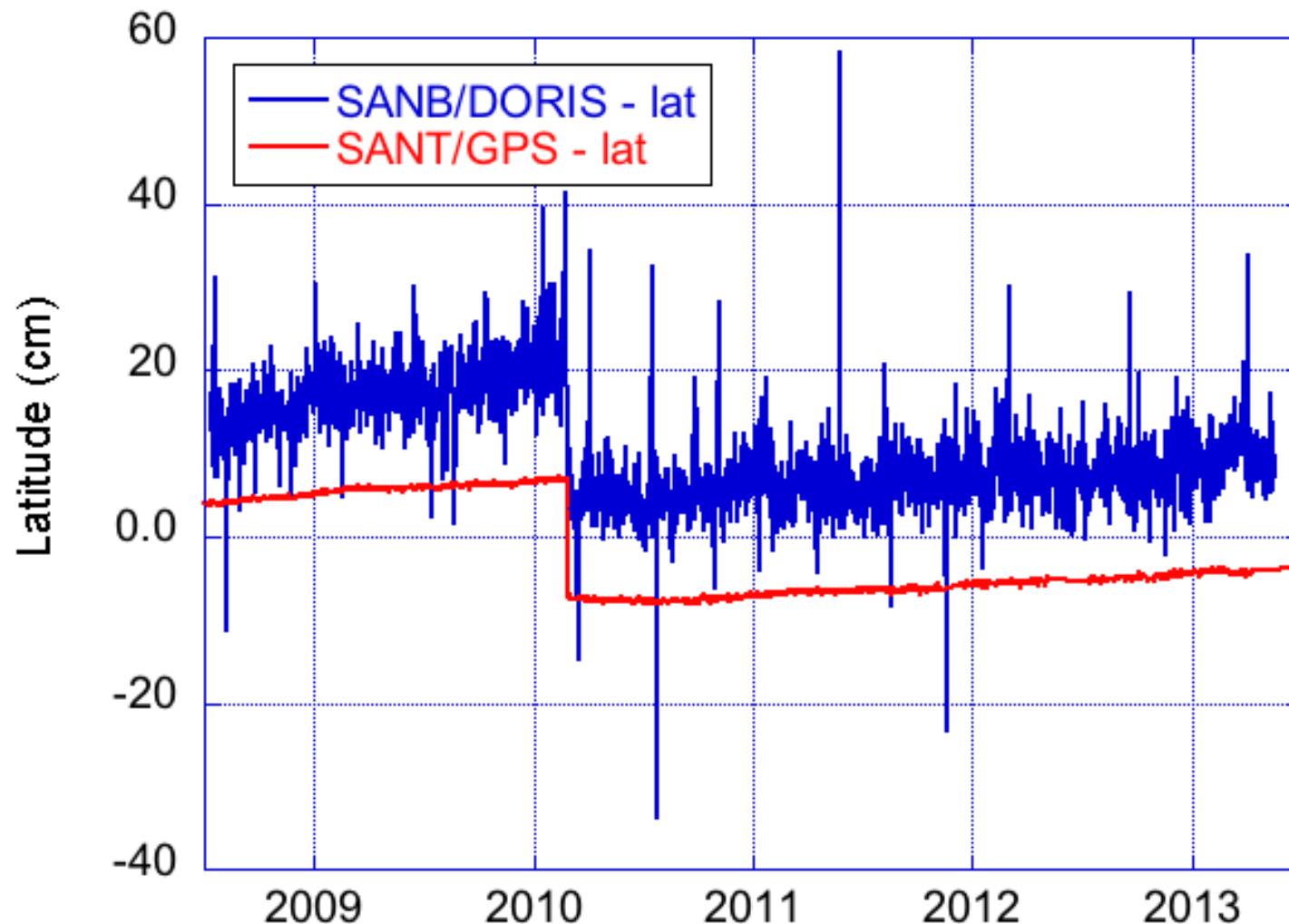
$Dti=(DORISi0+DORISi(t))-(GPSi0+GPSi(t))-local\_tiei$ (Eq. 1)

$\sigma2Dti=\sigma2DORISit+\sigma2GPSit+\sigma2local\_tiei$ (Eq. 2)
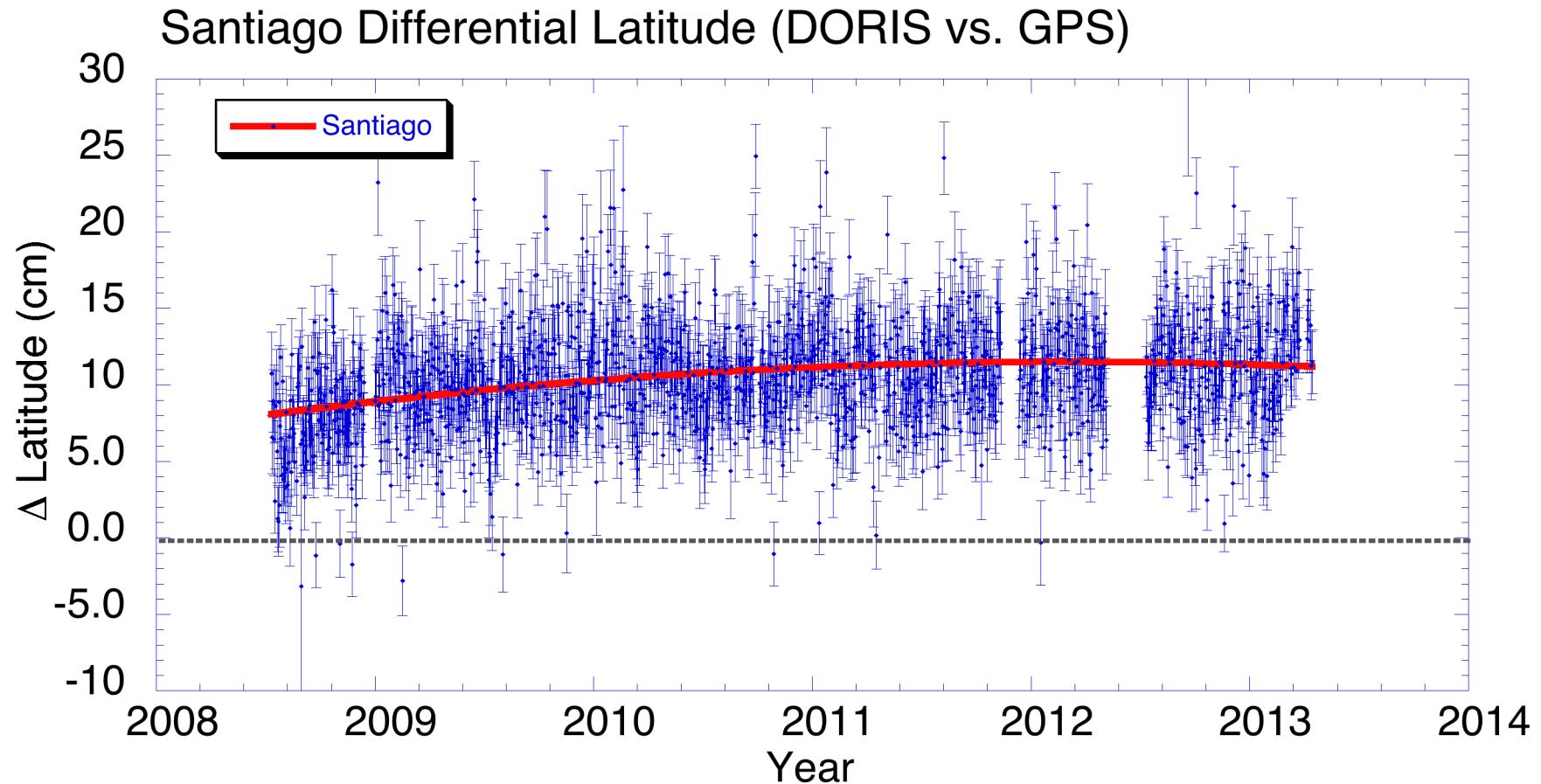
DORIS formal error is predominent / 4cm

Santiago daily results
Maule earthquake, 27-FEB-2010, Mw=8.8

Santiago (DORIS-GPS)
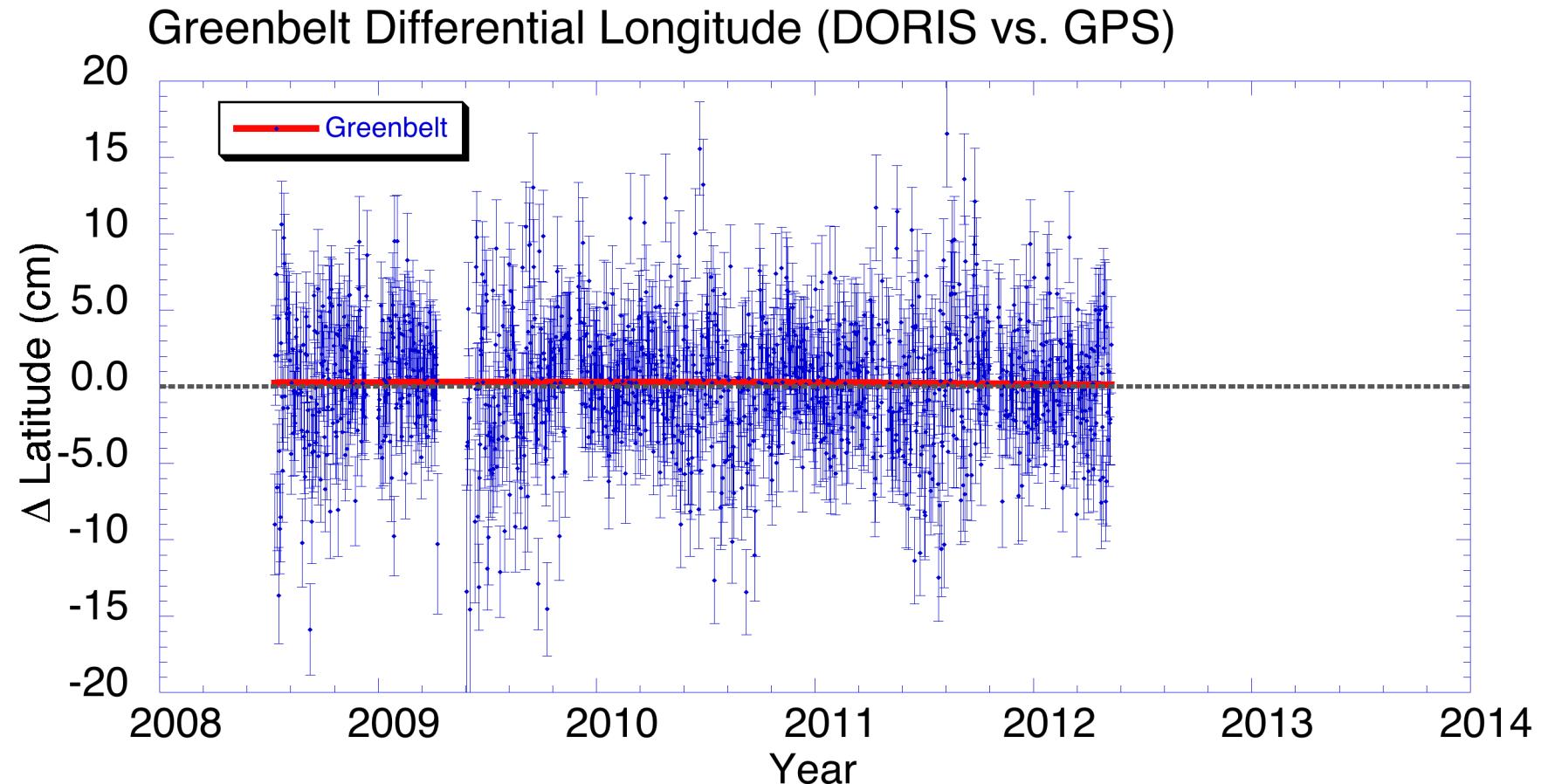
Santiago Differential Latitude (DORIS vs. GPS)
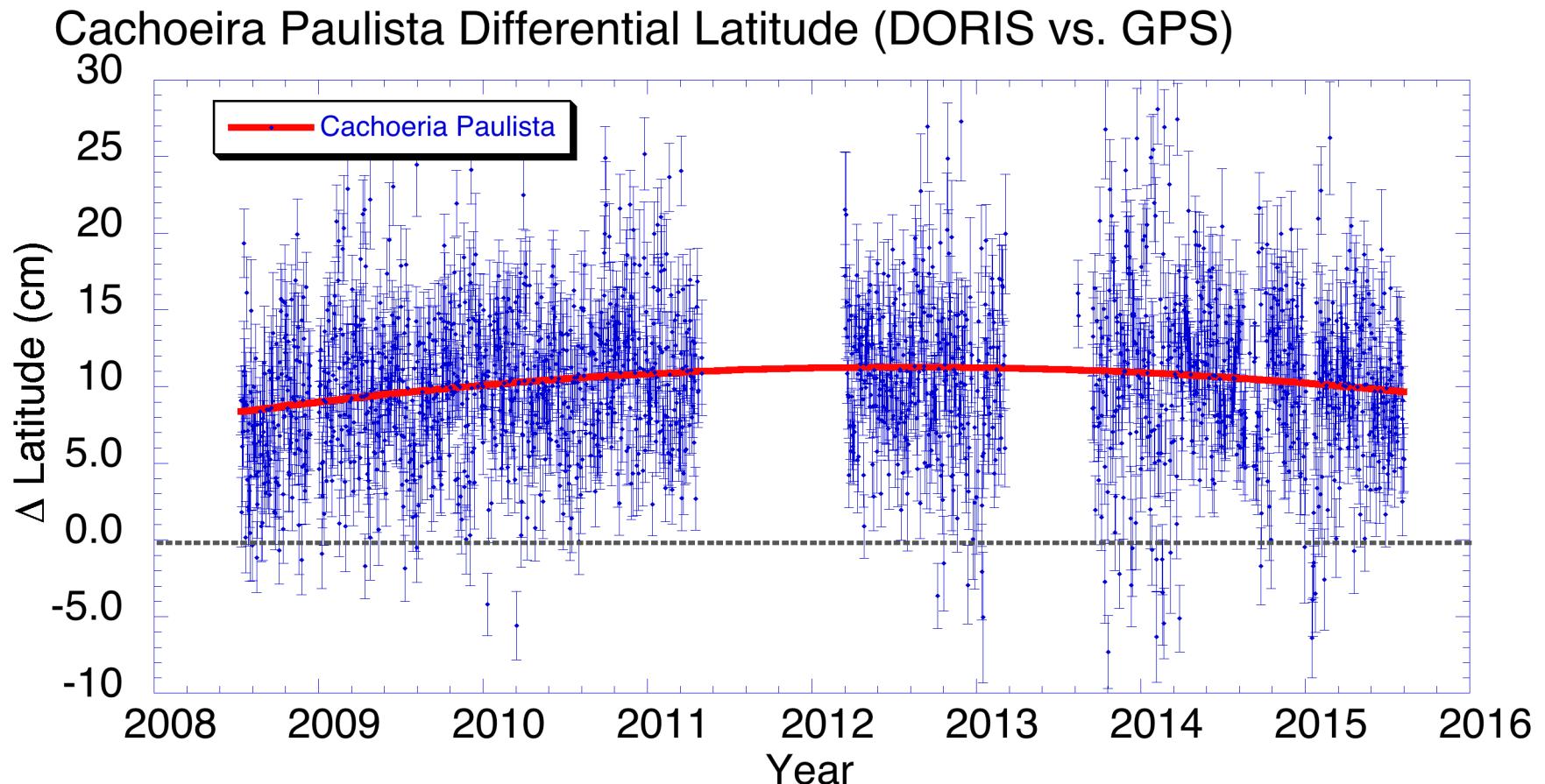
**NB**: Maule earthquake is not visible in plot

Greenbelt (DORIS-GPS)

Greenbelt Differential Longitude (DORIS vs. GPS)
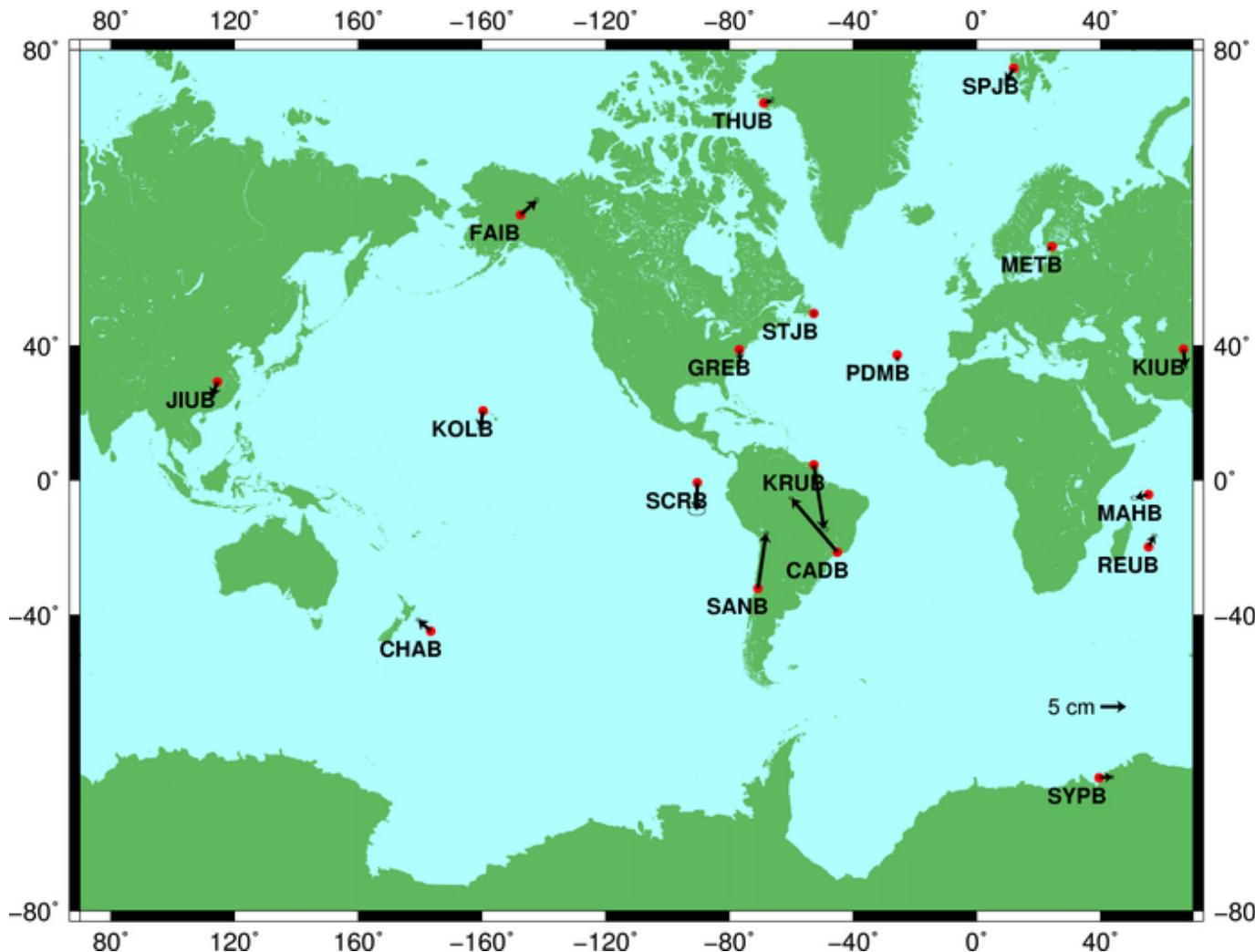
NB: no bias detected. Consistency between space geodesy and local ties
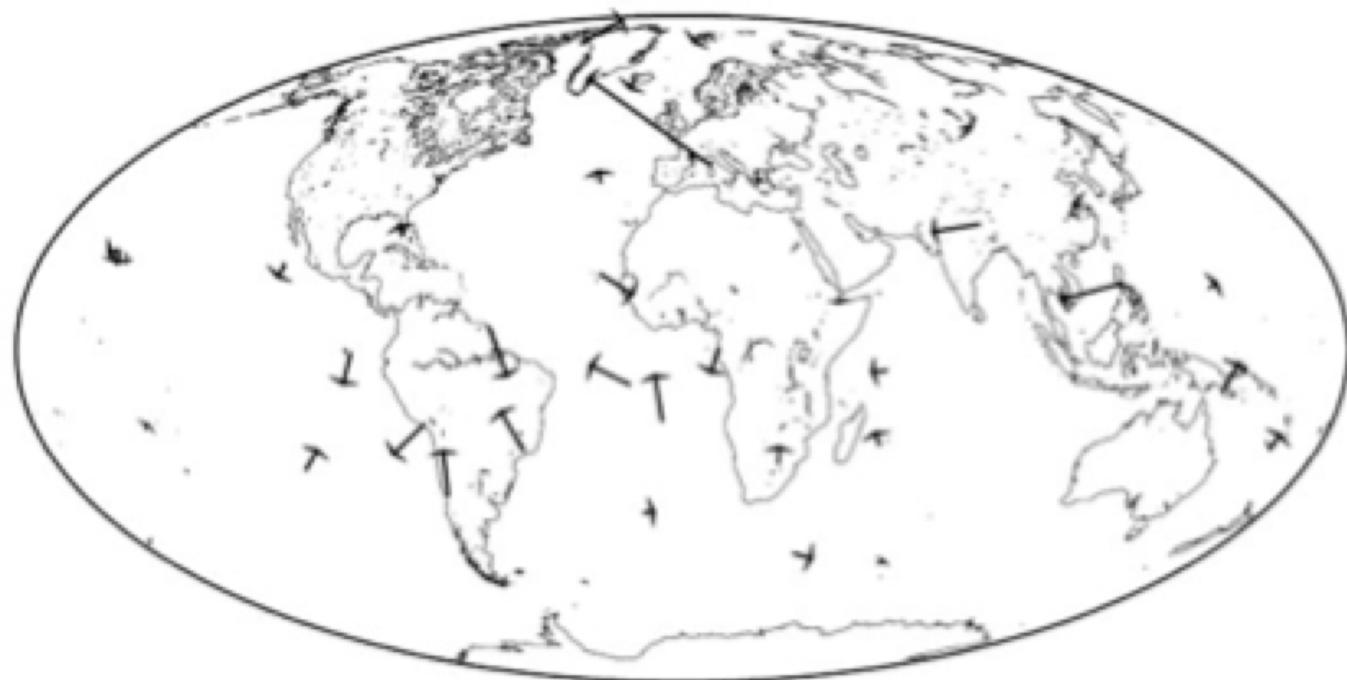
Cachoeira-Paulista (DORIS-GPS)

Cachoeira Paulista Differential Latitude (DORIS vs. GPS)

Mislosure errors (position)
# Jason-2 DORIS PPP
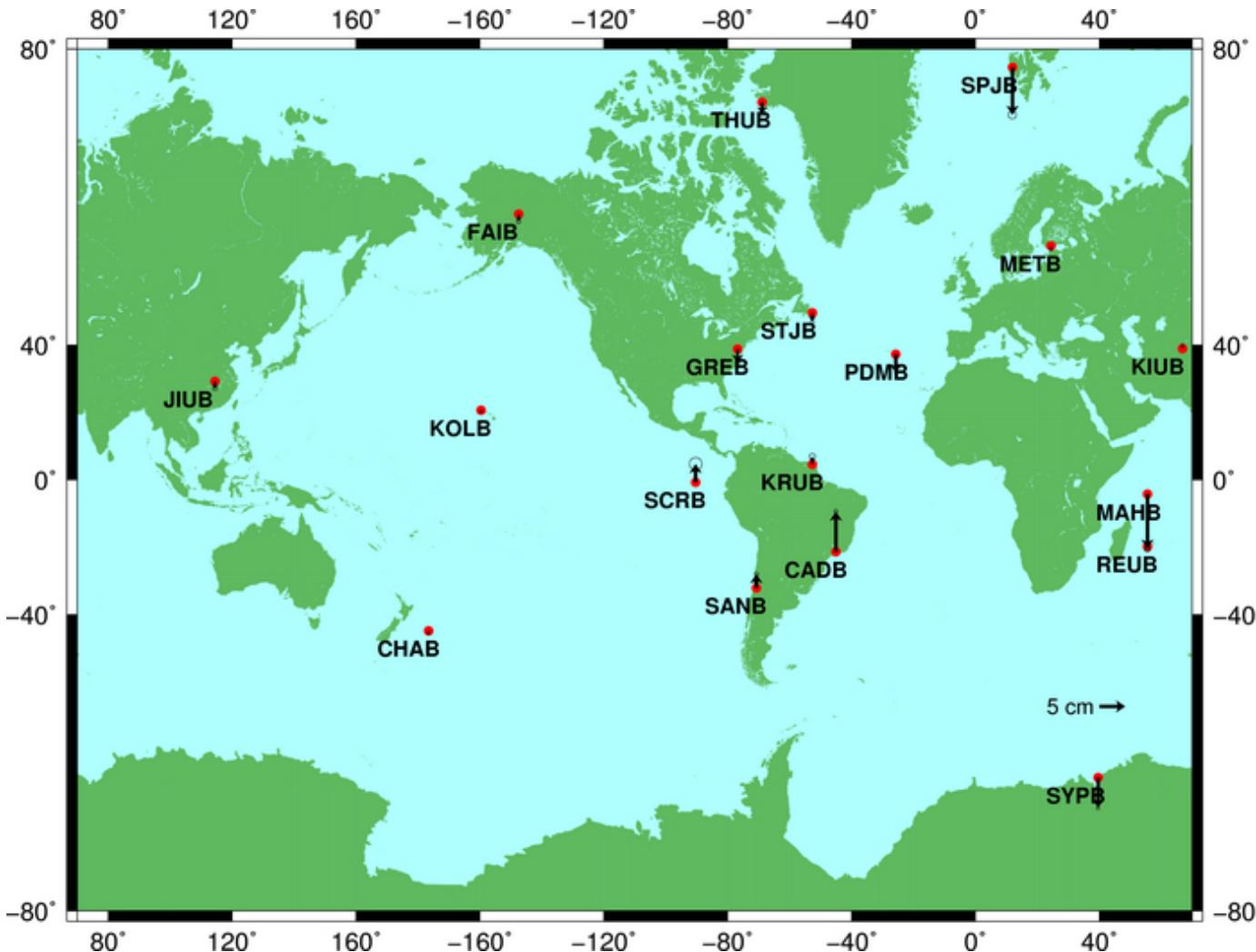
Velocity errors (Jason-1) (old results)
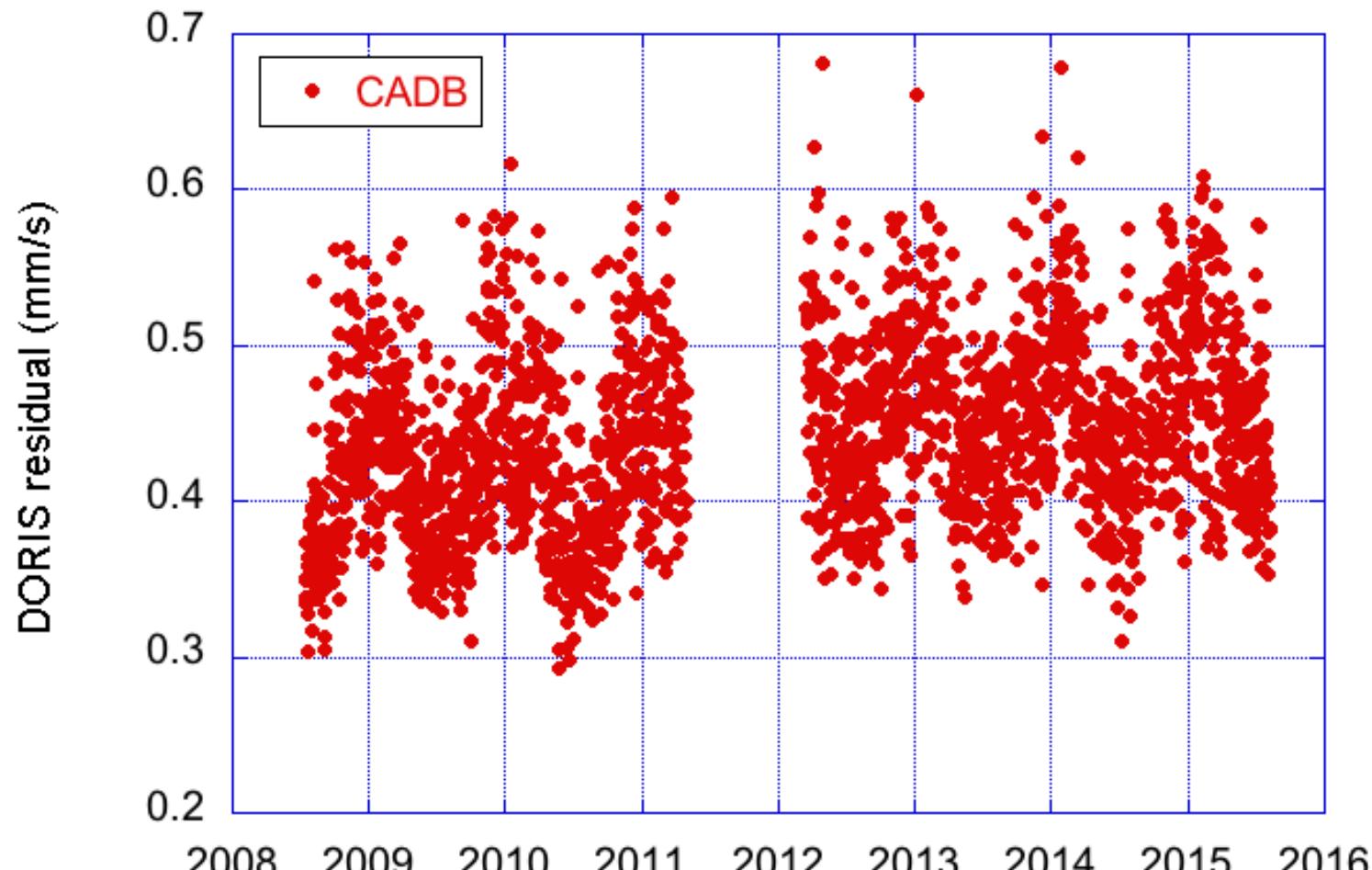
Willis et al., CR Geosci., 2004

# Misclosure error (position)
Jason-2 DORIS PPP
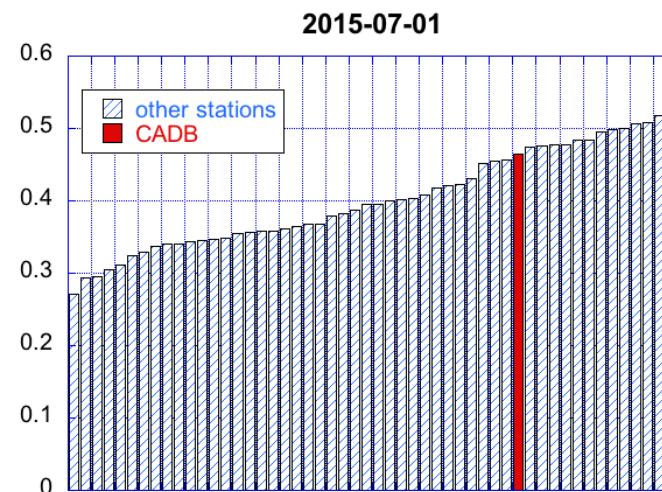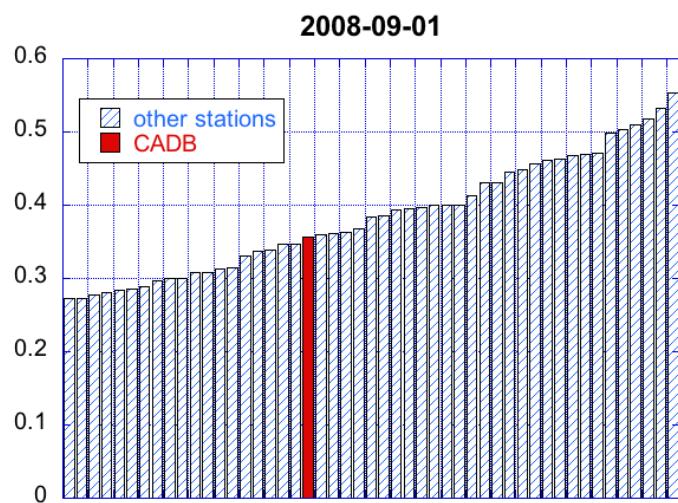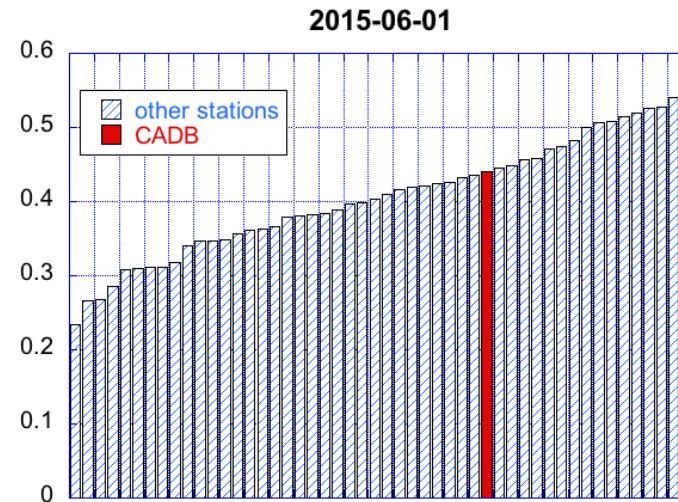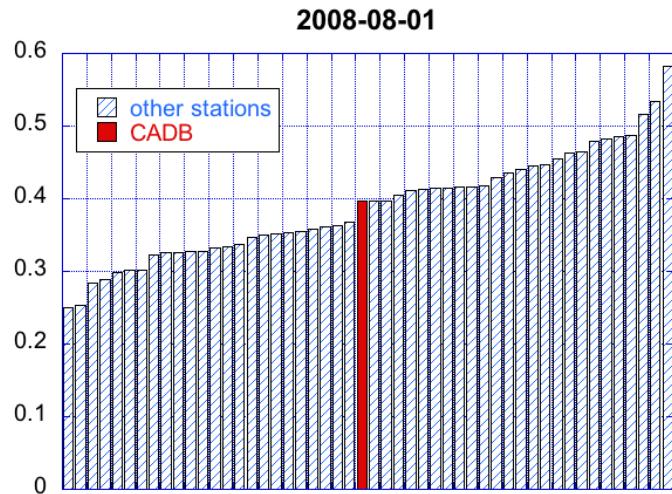
DORIS Doppler residuals using GPS orbit

NB: Jason2 orbit is not estimated

Effect on Doppler residuals

Conclusions and future work

- There is SAA effect on station position
- 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 should be very limited

- Recent work
  - Daily PPP → 10 day (cycle) PPP (results are not significantly improved = systematic errors vs. Random errors)
- 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

BACK-UP

Table 1: Observed biases between geodetic local ties values and vector derived from estimated DORIS and GPS position using PPP technique.

DORIS	GPS	Station (country)	Dist. (m)	tie error (mm)		Offsets (cm)
CADB	CHPI	Cachoeira-Paulista (Brazil)	1856	2	Lat Lon Rad	10.52±0.14 -8.82±0.18 8.46±0.13
CHAB	CHAT	Chatham Island (New Zealand)	61	2	Lat Lon Rad	2.14±0.10 -2.48±0.12 -0.47±0.10
FAIB	FAIR	Fairbanks (USA)	1074	2	Lat Lon Rad	2.62±0.13 3.08±0.10 -1.58±0.10
GREB	GODE	Greenbelt (USA)	206	2	Lat Lon Rad	-2.24±0.11 0.26±0.13 -2.82±0.08
JIUB	WUHN	Jiufeng (China)	12973	13	Lat Lon Rad	-2.82±0.15 -1.08±0.16 -1.70±0.13
KIUB	KIT3	Kitab (Uzbekistan)	6	1	Lat Lon Rad	-3.71±0.09 0.48±0.11 0.48±0.09
KOLB	KOKB	Kauai (USA)	359	3	Lat Lon Rad	-3.46±0.08 -0.53±0.11 -0.78±0.10

KRUB	KOUR	Kourou (French Guiana)	25056	50	Lat Lon Rad	-12.96±0.24 1.79±041 2.00±0.30
MAHB	SEY1	Mahe (Seychelles)	5767	20	Lat Lon Rad	-0.60±0.18 1.56±0.33 -9.76±0.26
METB	METS	Metsahovi (Finland)	2797	5	Lat Lon Rad	-0.28±0.09 -0.58±0.07 -0.74±0.06
PDMB	PDEL	Ponta Delgada (Azores)	6	1	Lat Lon Rad	-0.99±0.10 0.11±0.11 -3.74±0.09
REUB	REUN	La Reunion (France, Mascarene Island)	16	3	Lat Lon Rad	2.33±0.11 1.07±0.16 -0.85±0.13
SALB	TGCV	Sal (Cape Verde)	5677	10	Lat Lon Rad	-9.17±0.32 2.73±0.50 0.89±0.42
SANB	SANT	Santiago (Chile)	72	1	Lat Lon Rad	10.82±0.09 1.51±0.12 2.32±0.12
SCRB	GPLS	Santa Cruz (Ecuador)	104	1	Lat Lon Rad	-5.70±0.32 0.08±0.57 3.51±041
SPJB	NYA1	Ny Alesund (Norway)	1581	2	Lat Lon Rad	-2.77±0.15 -1.56±0.09 -9.37±0.19
THUB	THU3	Thule (Denmark, Greenland)	61	1	Lat Lon Rad	0.62±0.12 1.71±0.07 -2.29±0.13

Sunspot numbers

ISES Solar Cycle Sunspot number progression
(Observed data through Dec 2015)