Ocean Surface Topography Science Team Meeting (OSTST)

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Chicago, Illinois

Altimetry satellites SLR residuals analysis

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SLR analyses, objectives

- a 'core network' (8 stations) is currently used for orbit performance verification

7090	Yarragadee
7105	Washington
7119	Halekala
7501	Hartebeesthoek
7810	Zimmerwald
7839	Graz
7840	Herstmonceux
7941	Matera

- SLR high elevation residuals (now below 1 cm) rms are sensitive to previously ignored station biases

- difficulties with stations showing significant biases (example 8834 Wettzell)

- very few high elevation measurements for one cycle arc

analysis of the complete Network
- measurement quality
- biases …

how to improve the SLR residuals processing for LEO orbits validation

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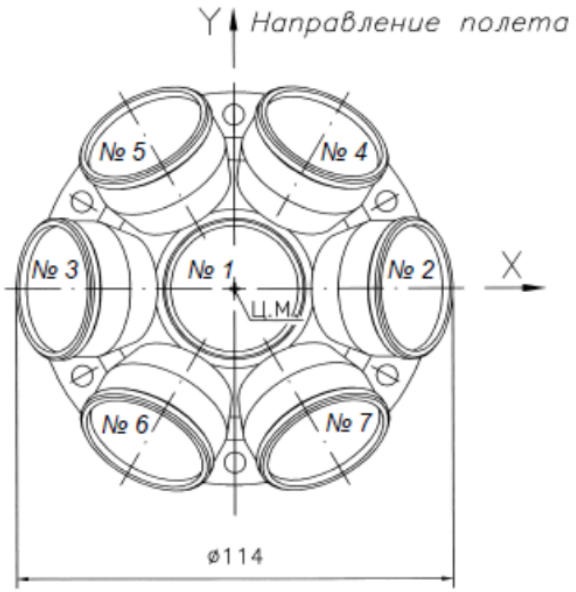
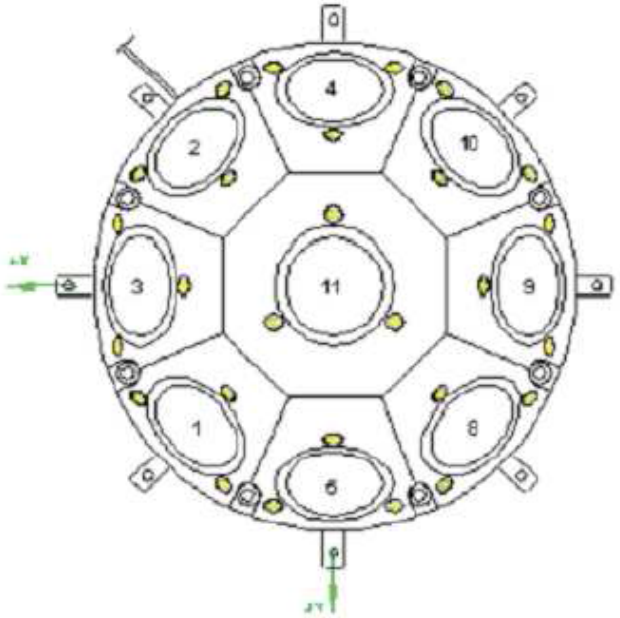
SLR analyses, retroreflector models

Satellites used : Cryosat 2, Jason 3, Sentinel 3A, Sentinel 3B

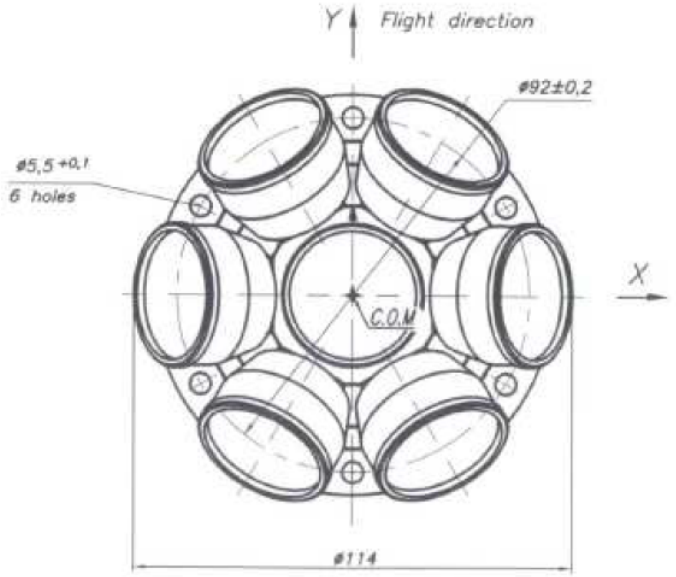
SLR array precise models (modelling of all corner cubes)
- geometrical descriptions from the ILRS documentation



Cryosat 2



Jason 3



Sentinel 3

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SLR analyses, preprocessing

Specific preprocessing for this study

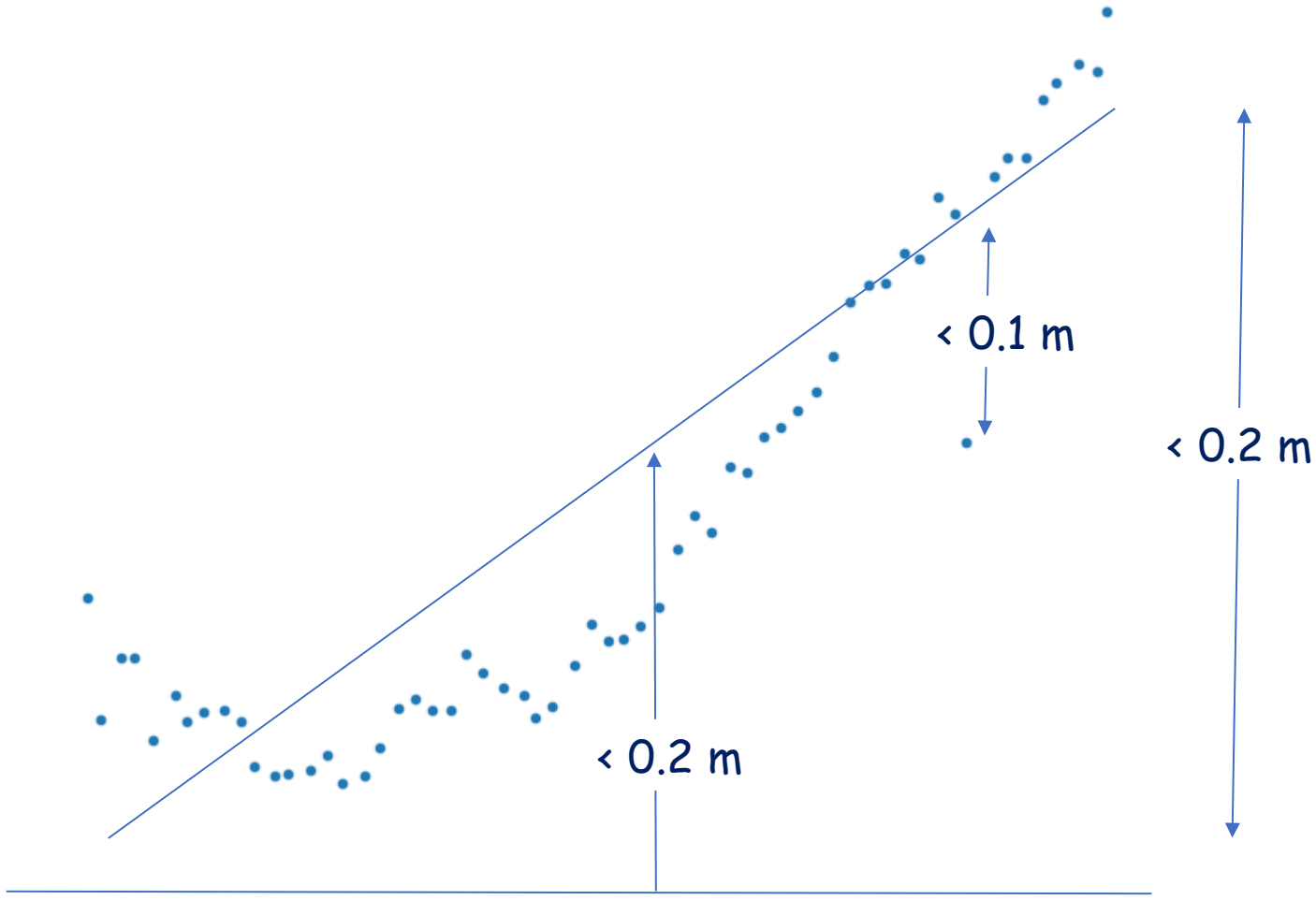
Validated pass :

> nb meas. > 10
> bias < 0.2 m
> variation < 0.2 m
> all residuals < 0.1 m

No other elimination

Elimination of less than 1% of the passes

ITRF 2014 stations coordinates and POE-F geocentre motion model



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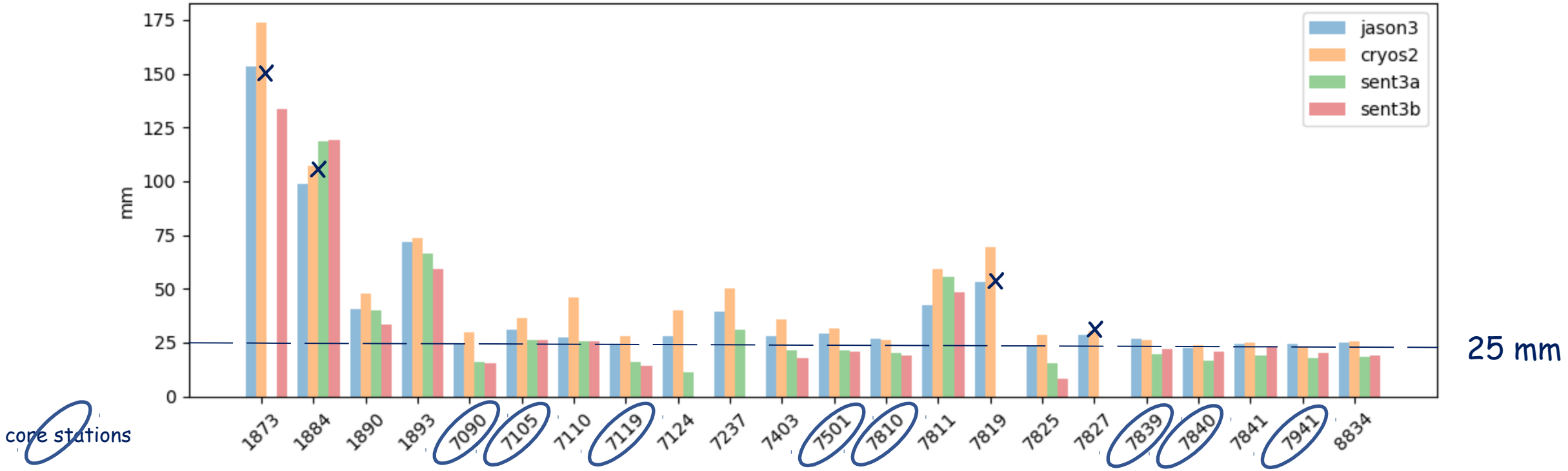
Global performance (dispersion of the measurements)

Stations selection : quantiles 0.1 – 0.9 (corresponds to ~+-1.25 sigma interval)



Stations with more than 5000 measurements on Jason 3, from 2016-01 to 2019-07

1873, 1884, 7819, 7827 removed from the analysis ---> 18 stations remaining

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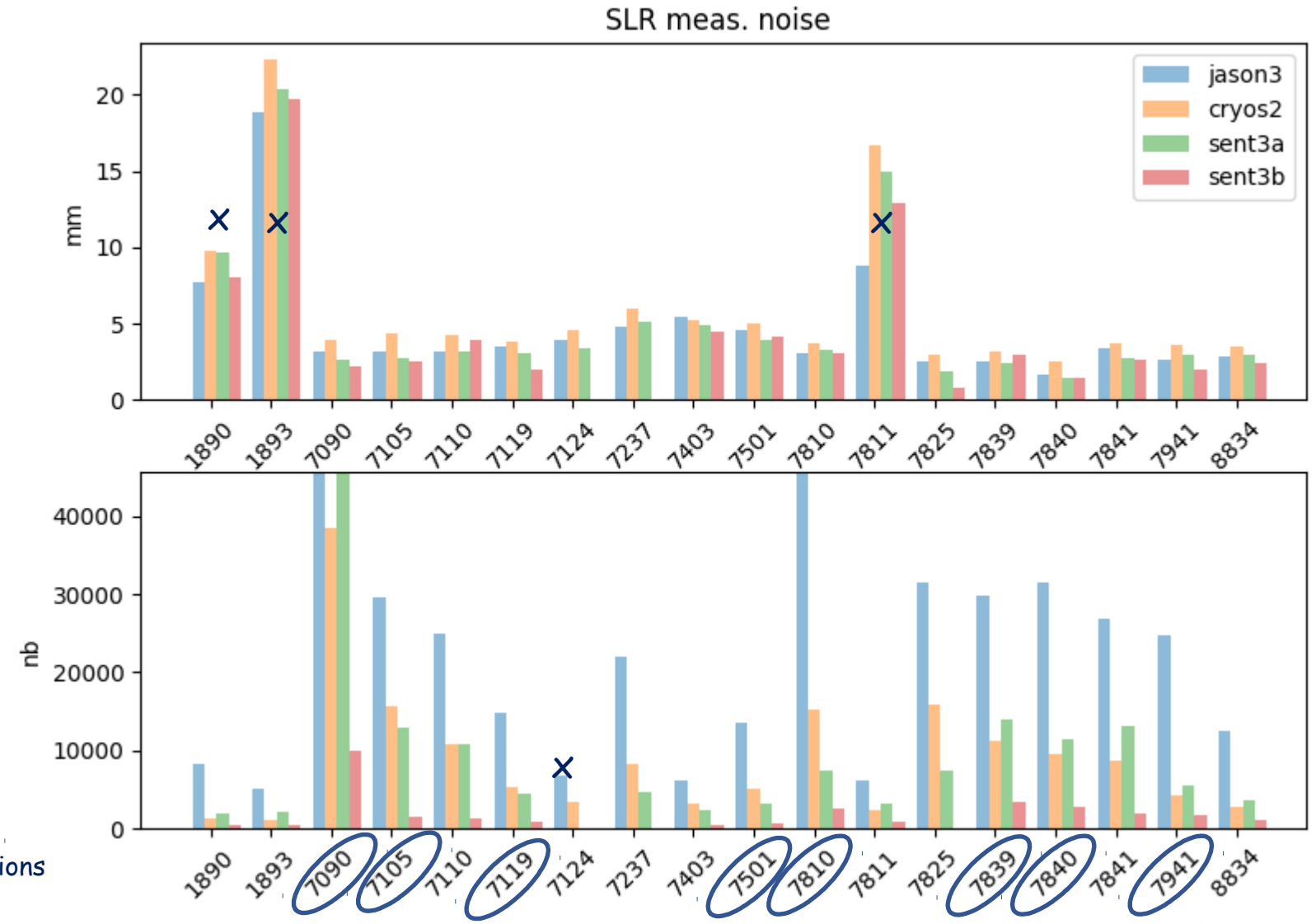
Stations performance (noise, nb. measurements)

Good stations : noise ~2.5 mm

1890,1893,7124,7811 removed
(important noise,
or few measurements)



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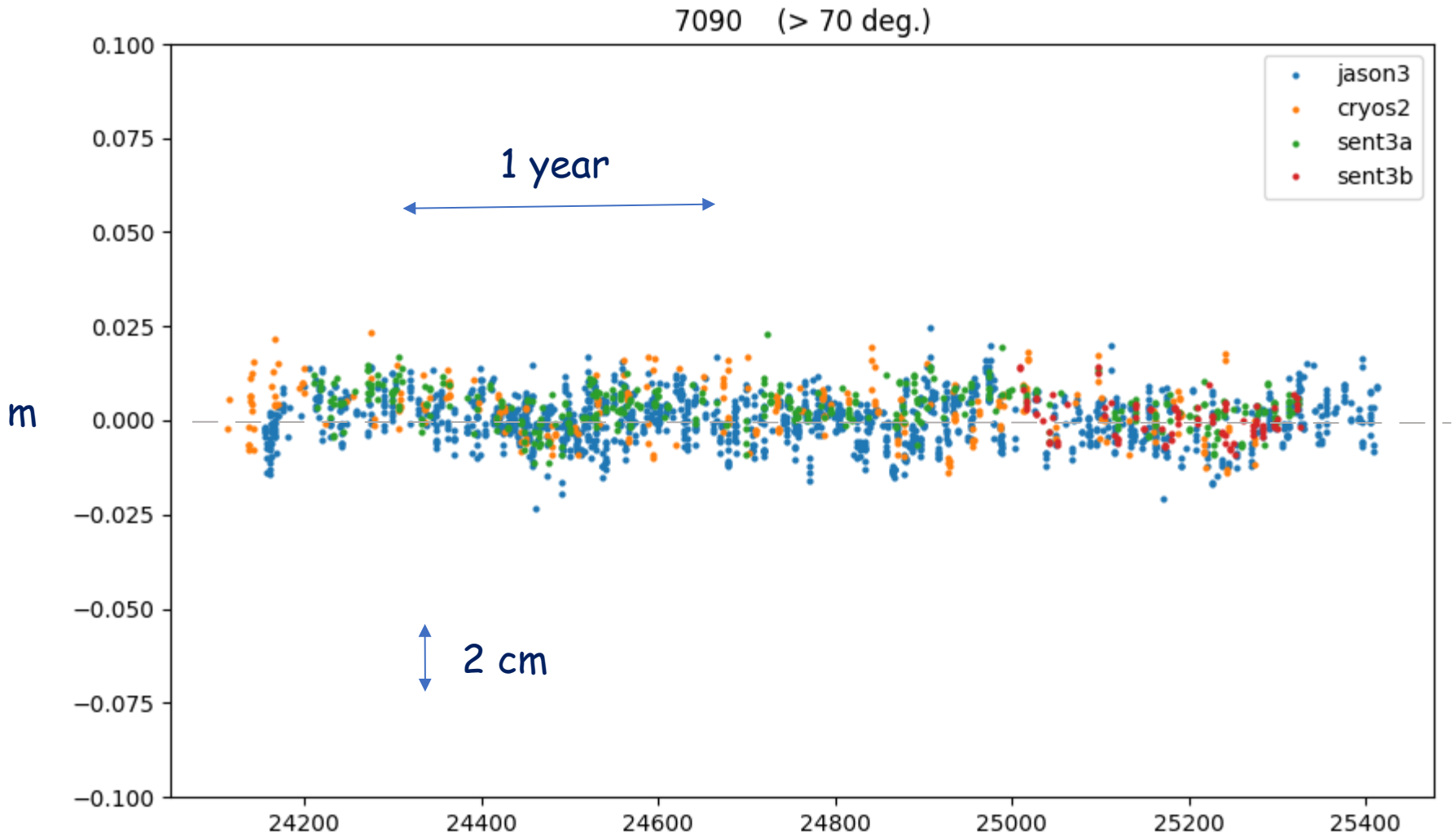
High elevation residuals, all satellites

7090 **Yarragadee**
(core station)

Effects common to
all satellites :

- annual variations ?



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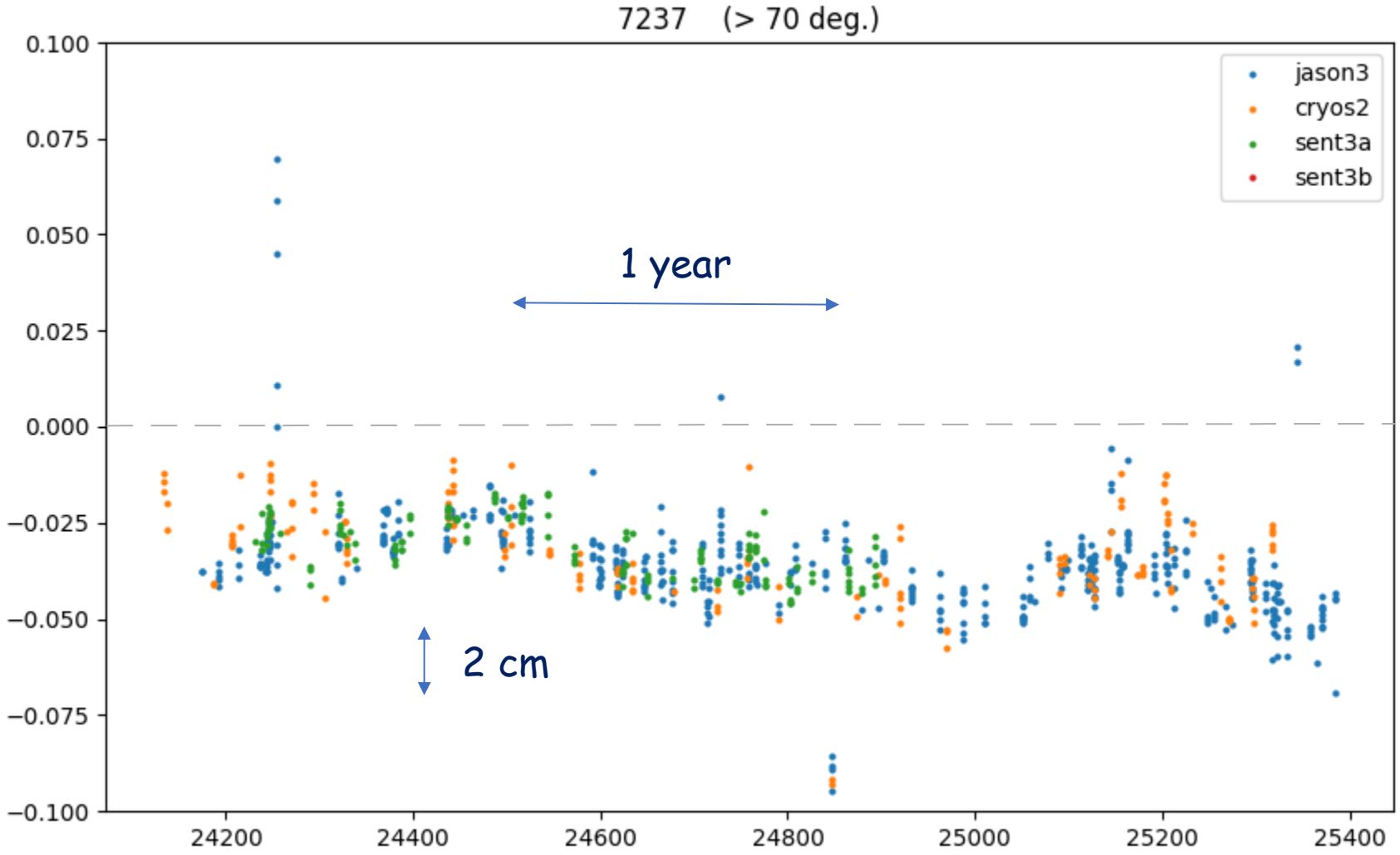
High elevation residuals, all satellites

7237 Changchun

Effects common to all satellites :

- important bias
- annual variations ?
- drift ?



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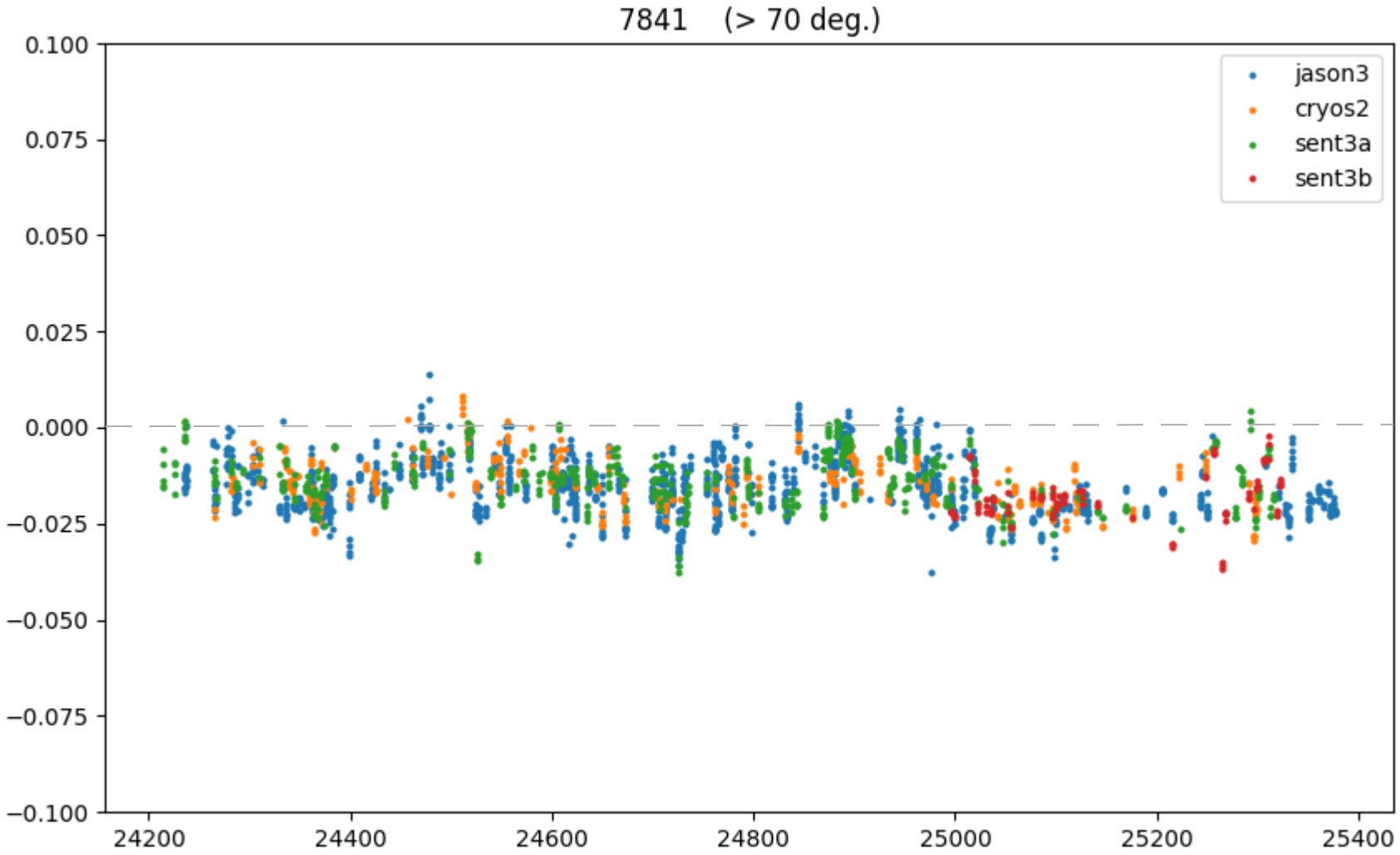
High elevation residuals, all satellites

7841 Potsdam

Effects common to all satellites :

- important bias
- annual variations ?



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Bias and sigma, high elevation residuals (>70 deg.)

All stations have similar sigma (except 7237)

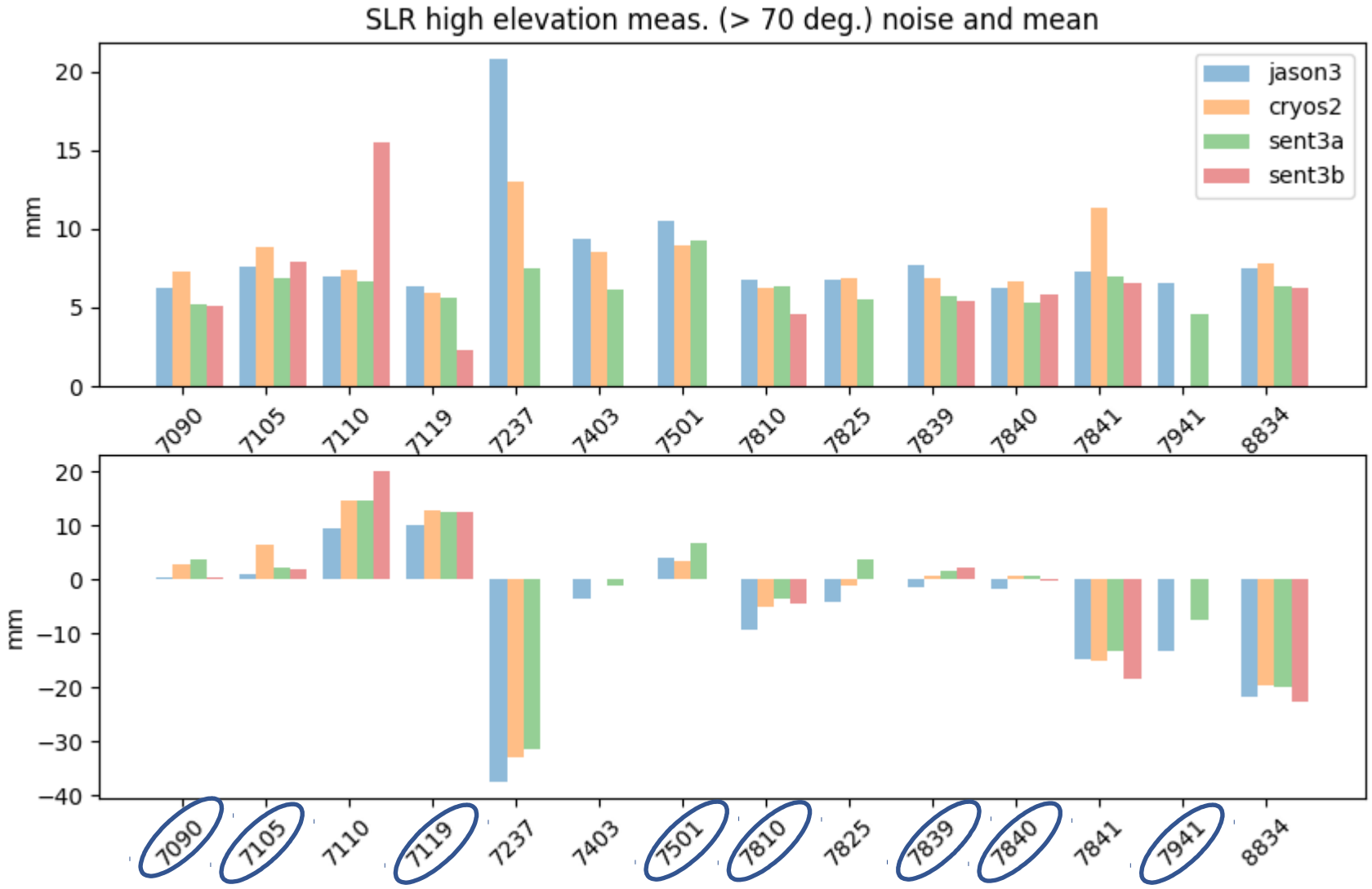
All satellites have similar biases on each station

Some core network stations have important biases (7119)

Origin ?

How to handle this situation ?

core stations



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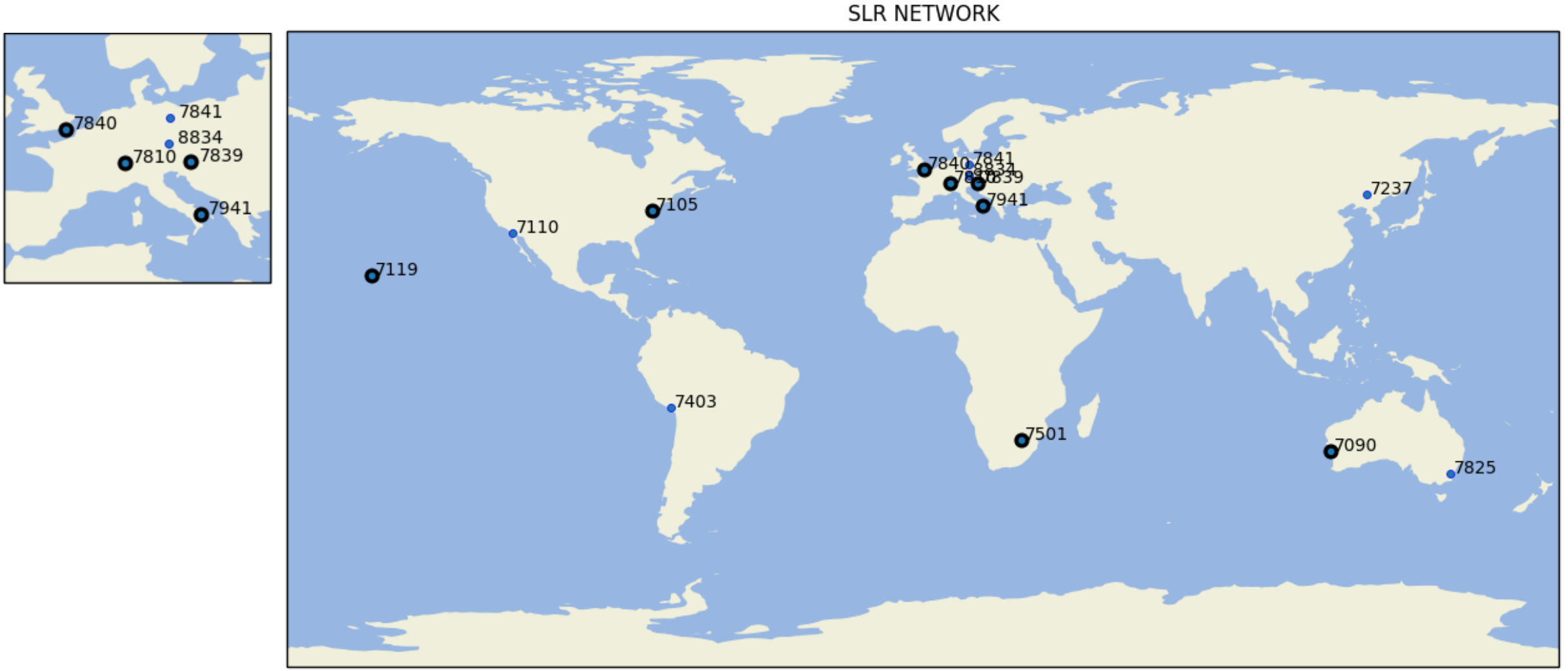
Network



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High elevation observed biases

The station biases are common to all satellites

may include : station height modelling errors

Values for the high elevation processing biases
(* : core network)
using Jason3, Cryosat2, Sentinel3A :

	bias (mm)	
L7090	2.0	*
L7105	3.0	*
L7110	13.0	
L7119	12.0	*
L7237	-34.0	
L7403	-2.0	
L7501	5.0	*
L7810	-6.0	*
L7825	-1.0	
L7839	0.0	*
L7840	0.0	*
L7841	-14.0	
L7941	-7.0	*
L8834	-20.0	

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Global results

Heigh elevation residuals (>70 degrees)

- 14 stations network, biases correction

Radial performance estimation (mm)

	14 stations biases corr.
jason3 (cnes)	8.5
jason3 (jpl)	7.9
cryos2	8.2
sent3a	6.5
sent3b	6.8

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Some questions

- bias changes (station configuration, drifts ?)
  ILRS logs information

- bias variations as function of elevation
  to be investigated

- special characteristics of Sentinel3 and Cryosat SLR retroreflectors

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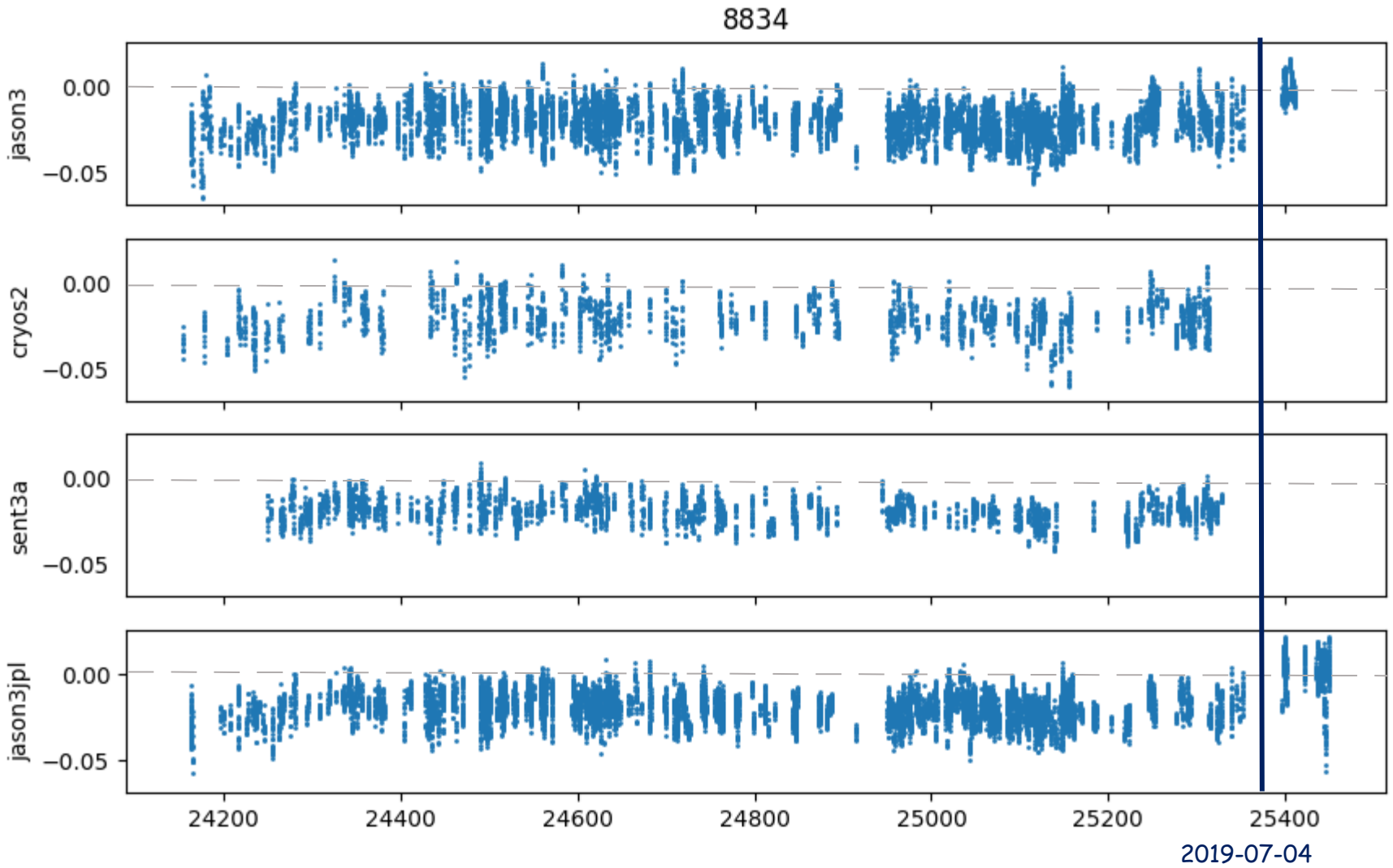
Bias change example : Wettzell

20 mm on the period

from station log ILRS

laser change on
2019-07-04
(day 25386)



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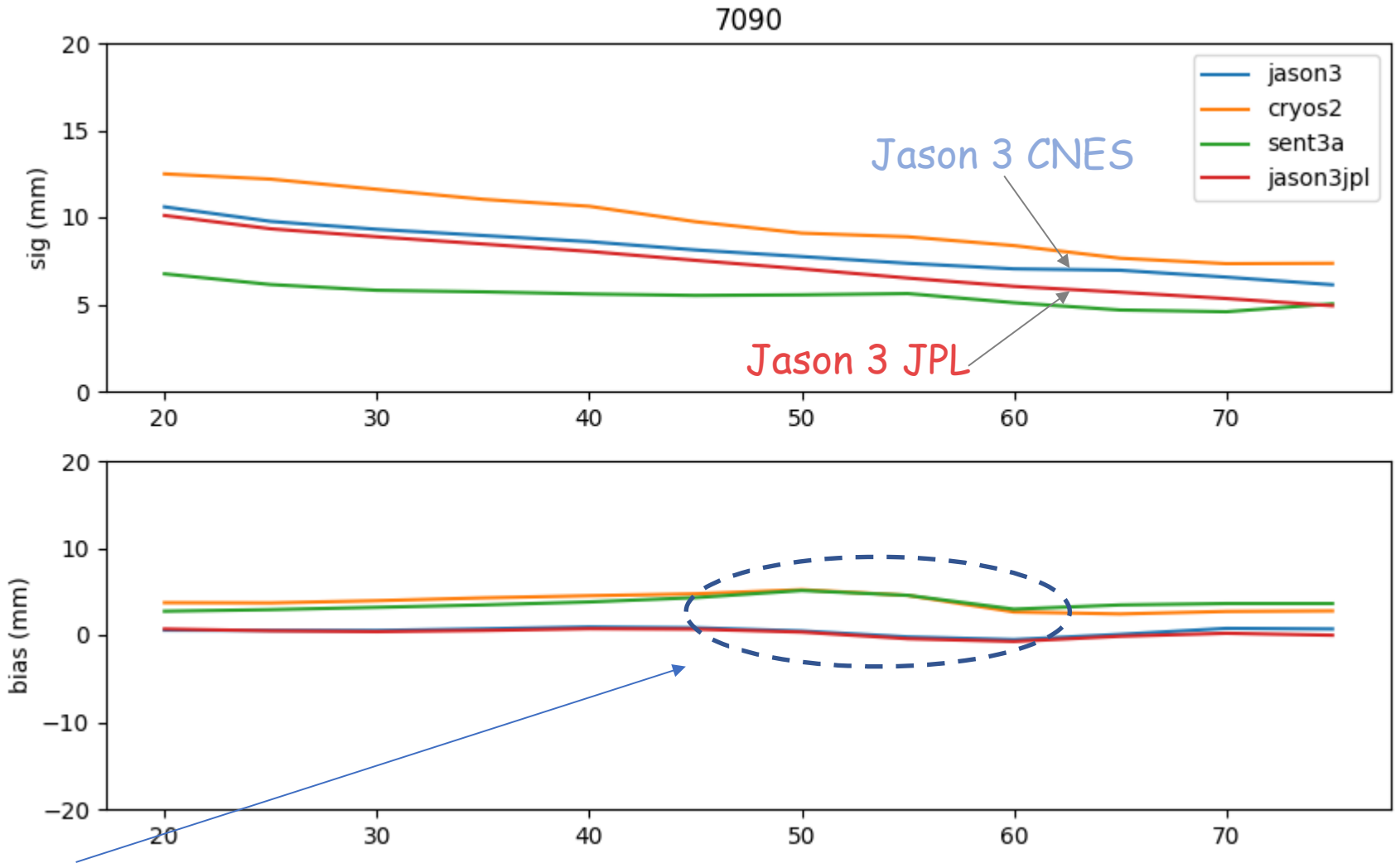
Elevation dependency, Yarragadee

mean and sigma for 10 deg. elevation intervals

Jason3 : CNES and JPL orbits



bias signatures around 55-60 deg (Cryosat and Sentinel)

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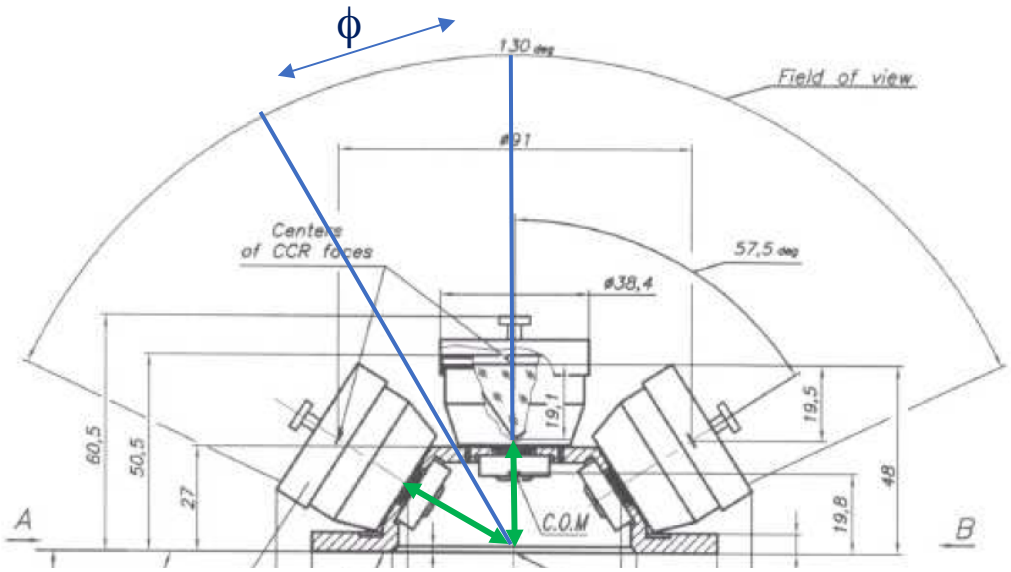
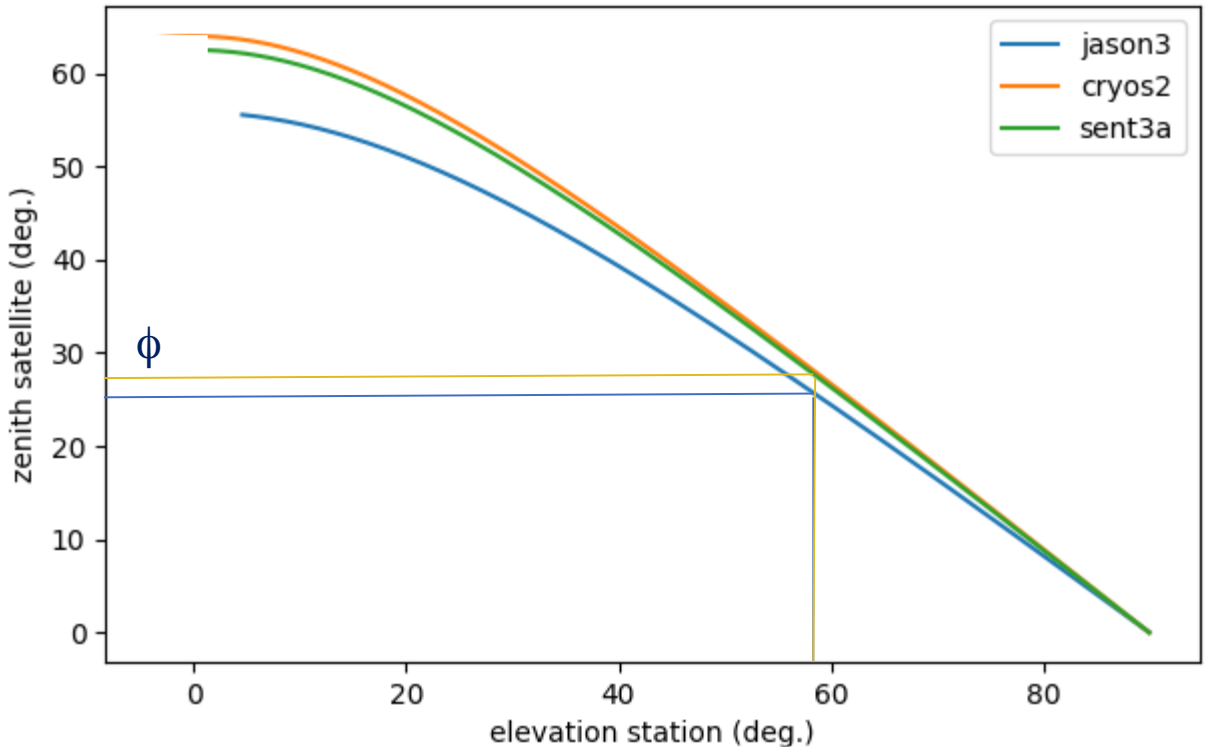
SLR array characteristics around 60 deg. elevation





Apex distances from optical centre

	jason3	cryosat2	
angle	50.0	57.5	(deg.)
central	82.5	48.6	(mm)
other	82.6	54.0	(mm)

side cubes

central cube

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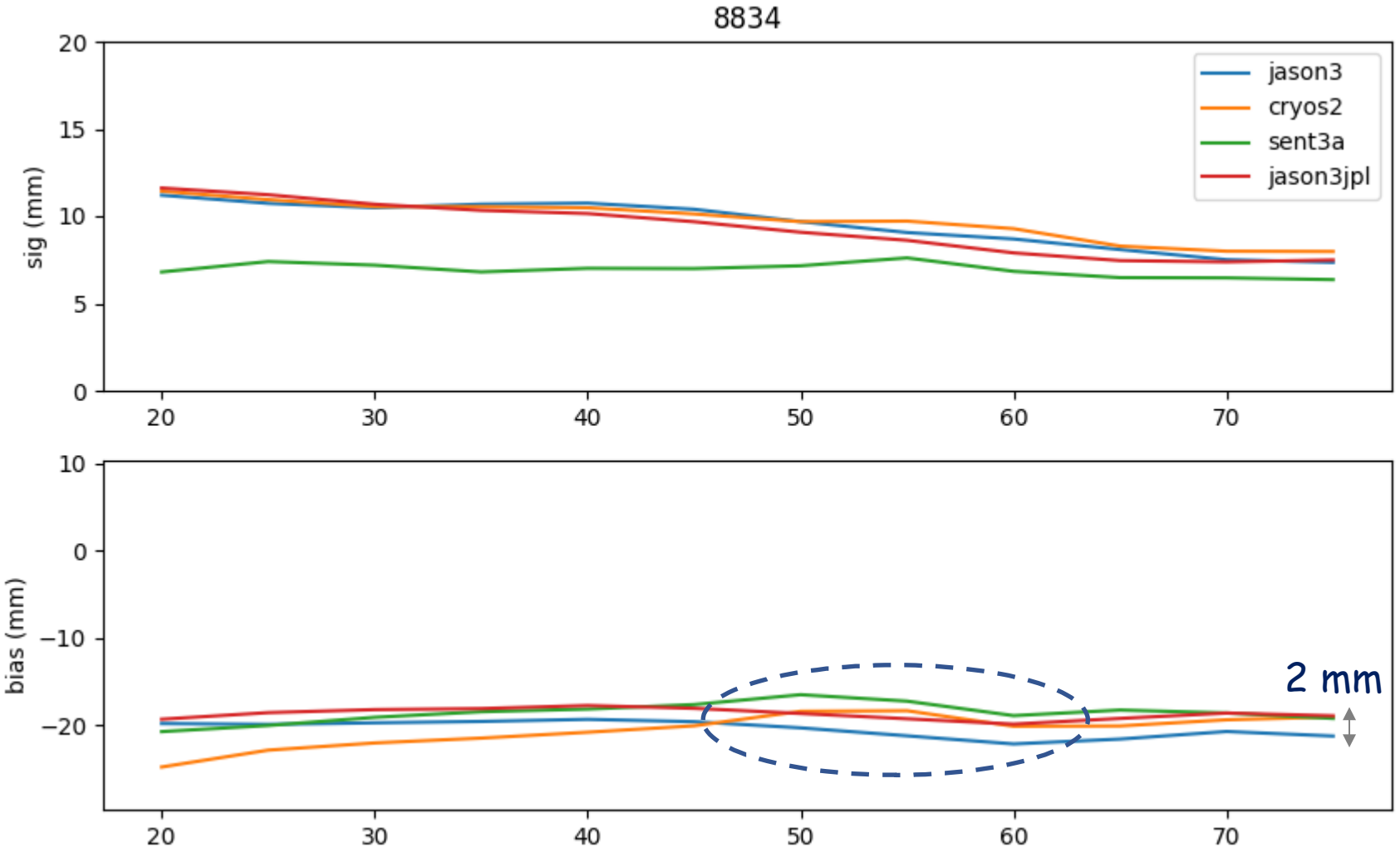
Elevation dependency, Wettzell

Similar results as Yarragadee

- stable bias, -20 mm
- signatures around 55-60 deg.

- small bias between
  CNES and JPL solutions



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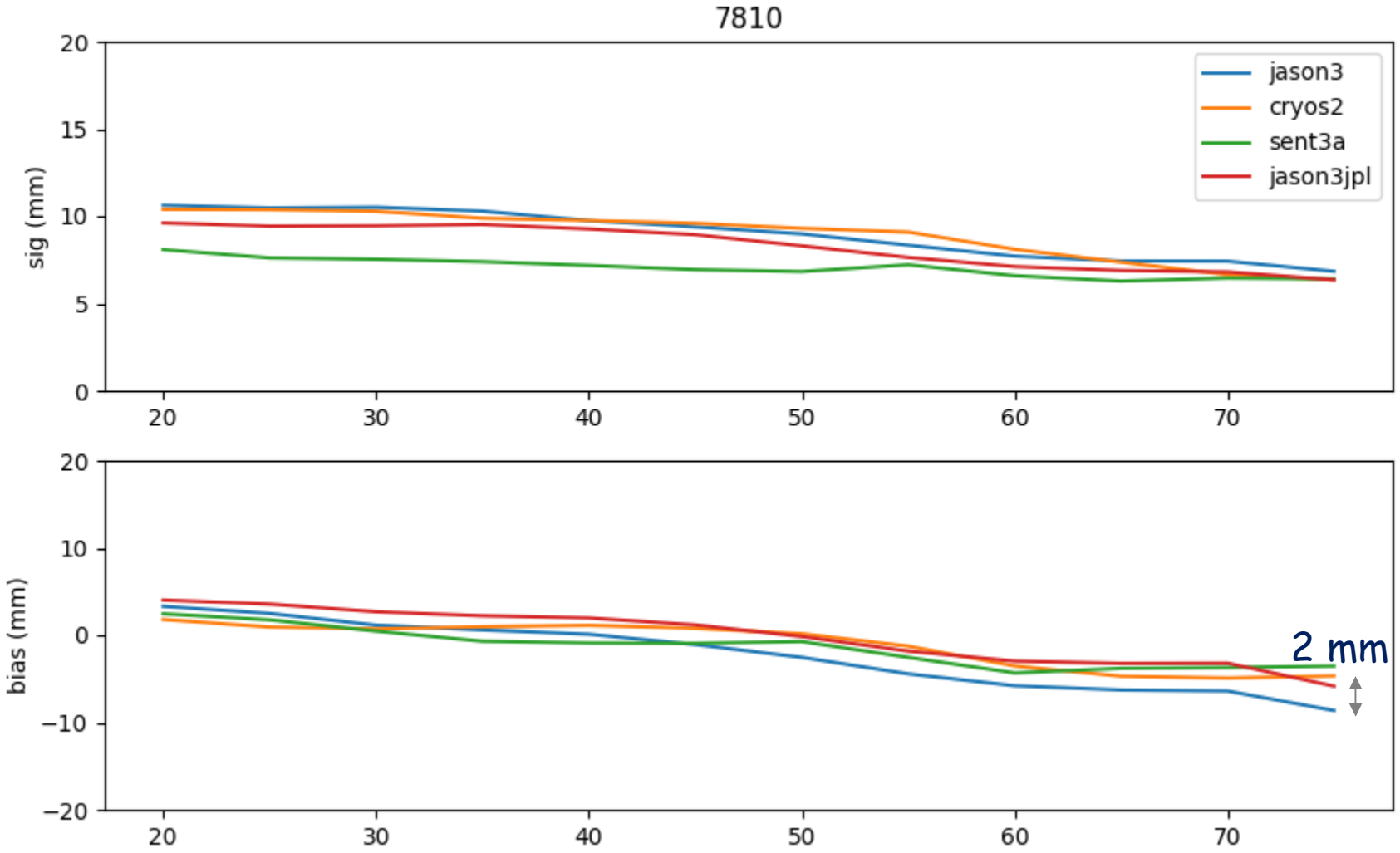
Elevation dependency, Zimmerwald

Similar results as Yarragadee

- orbit performance
- signatures around 55-60 deg.

Elevation dependent bias
(from +3 mm to -6 mm)
- vertical coordinate error ?



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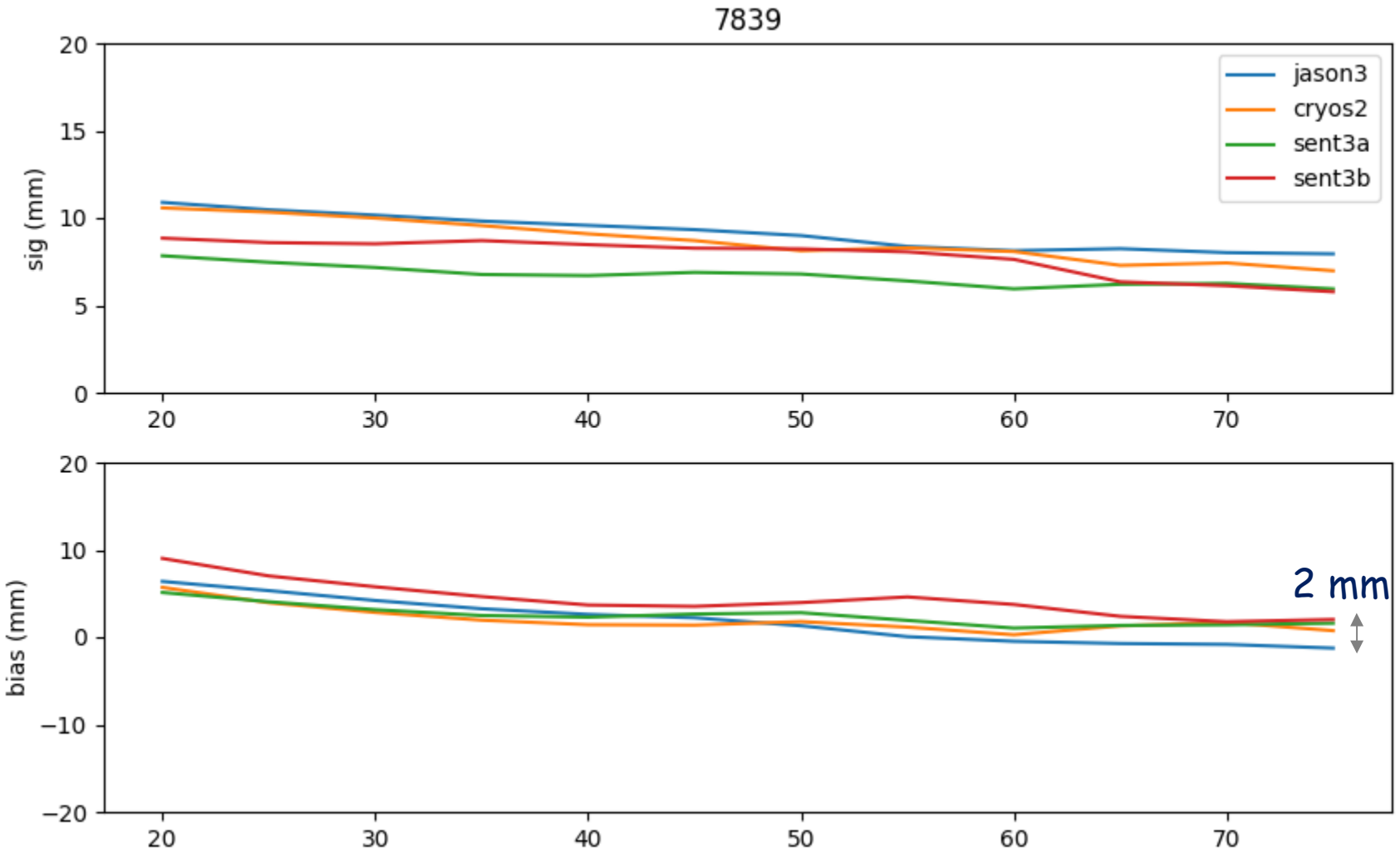
Elevation dependency, Graz

Similar results as Yarragadee

- orbit performance
- signatures around 55-60 deg.

Elevation dependent bias
(see Zimmerwald)



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Conclusion

Extension of the current 8 stations core network : 14 stations

The high elevation biaises are not negligible compared to the current orbit performances

Cryosat2 and Sentinel3 SLR array characteristics/modelling ?
(signatures at 55-60 deg.)

Some mean residuals function of elevation, annual variations

- origin to be investigated
- effect on the SLR residuals rms (at all elevations) ?

Efficient radial performance estimation using these biaises (7.9 mm rms on Jason JPL orbits)

	> 70 deg		elev. var.
7090	2.0	*	
7105	3.0	*	+5
7110	13.0		
7119	12.0	*	
7237	-34.0		-25
7403	-2.0		-10
7501	5.0	*	
7810	-6.0	*	-10
7825	-1.0		-5
7839	0.0	*	-5
7840	0.0	*	
7841	-14.0		-10
7941	-10.0	*	
8834	-20.0		

(before 2019-07-04)

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Thank you

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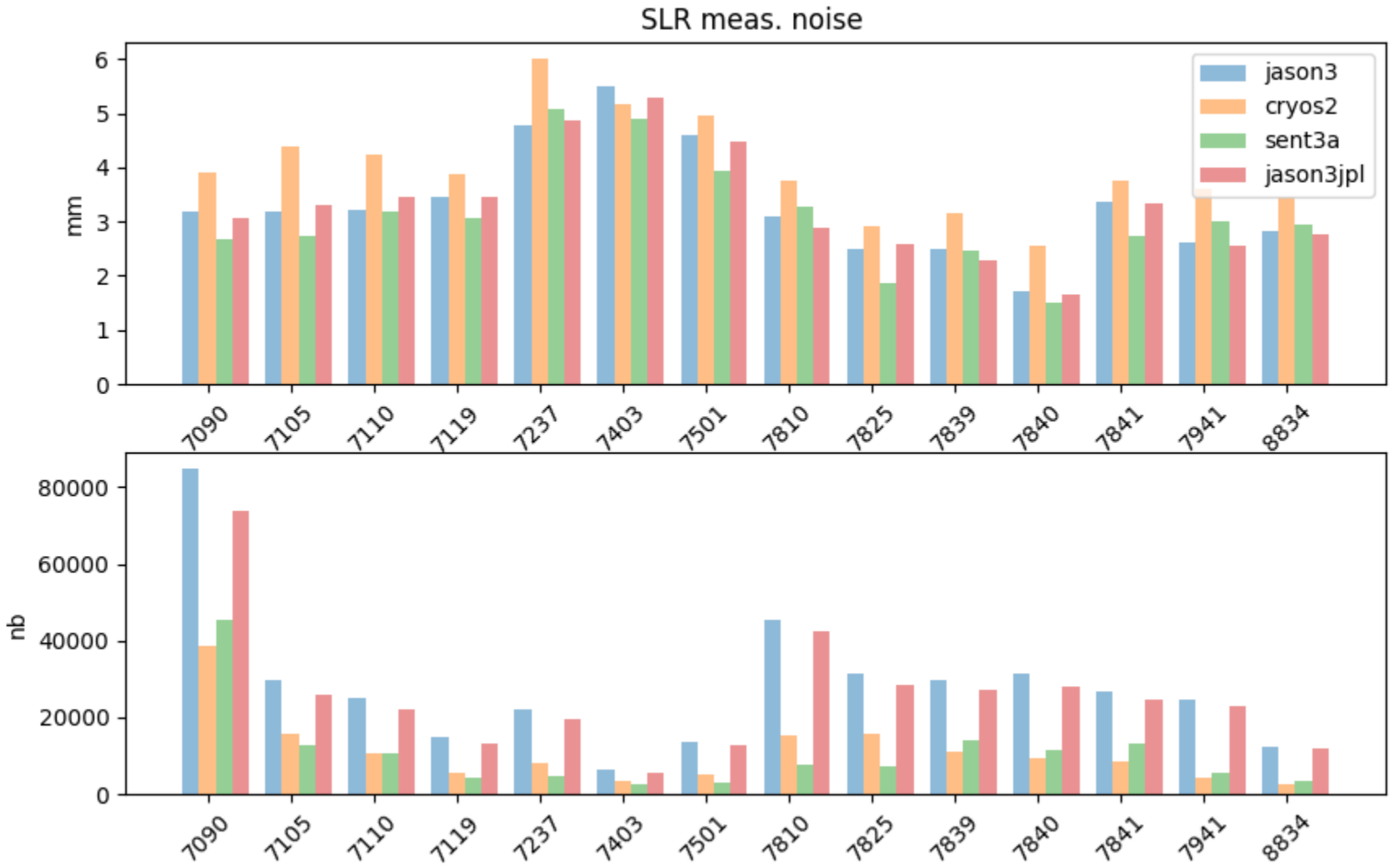
Statistics with JPL orbit



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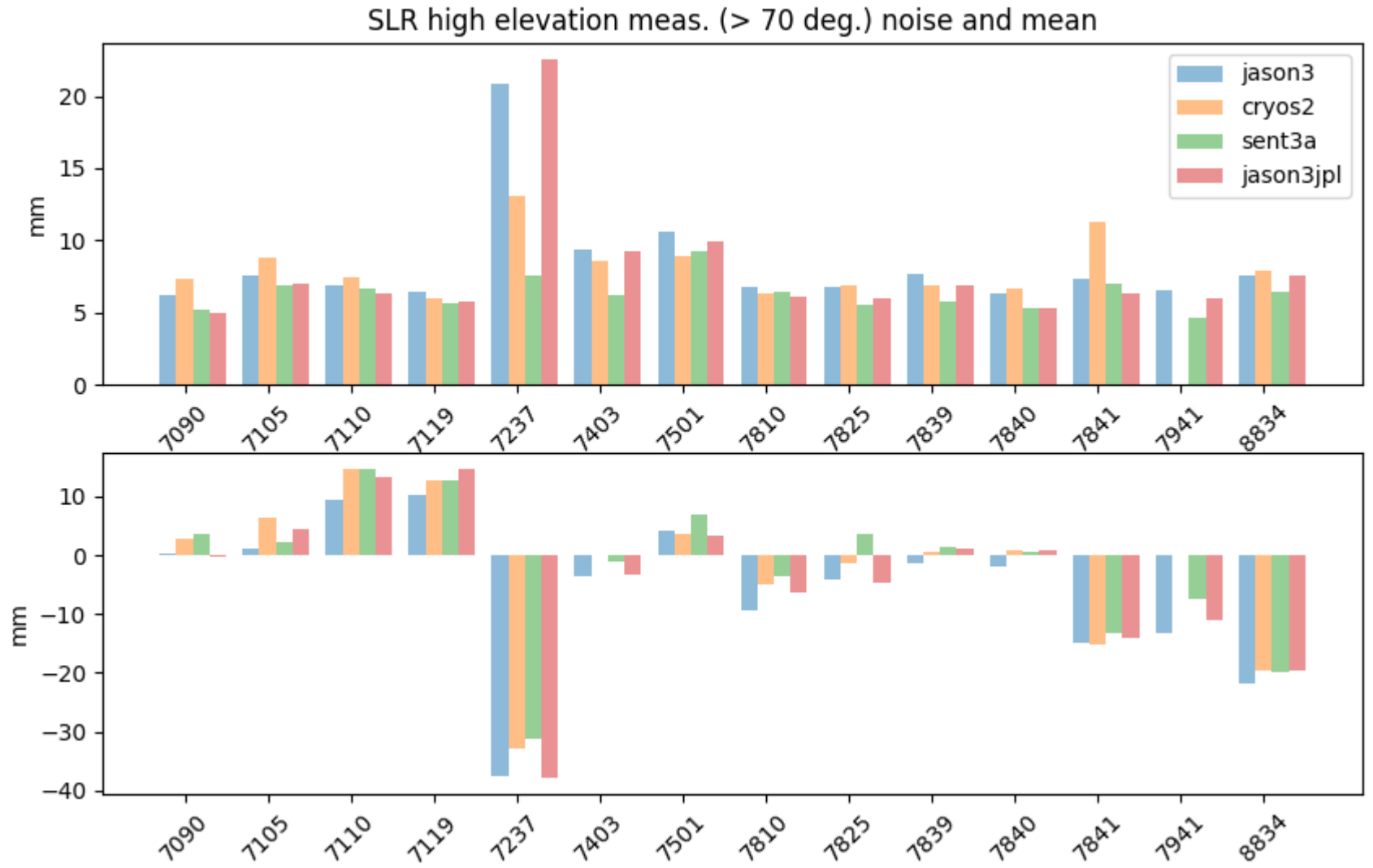
Statistics with JPL orbit



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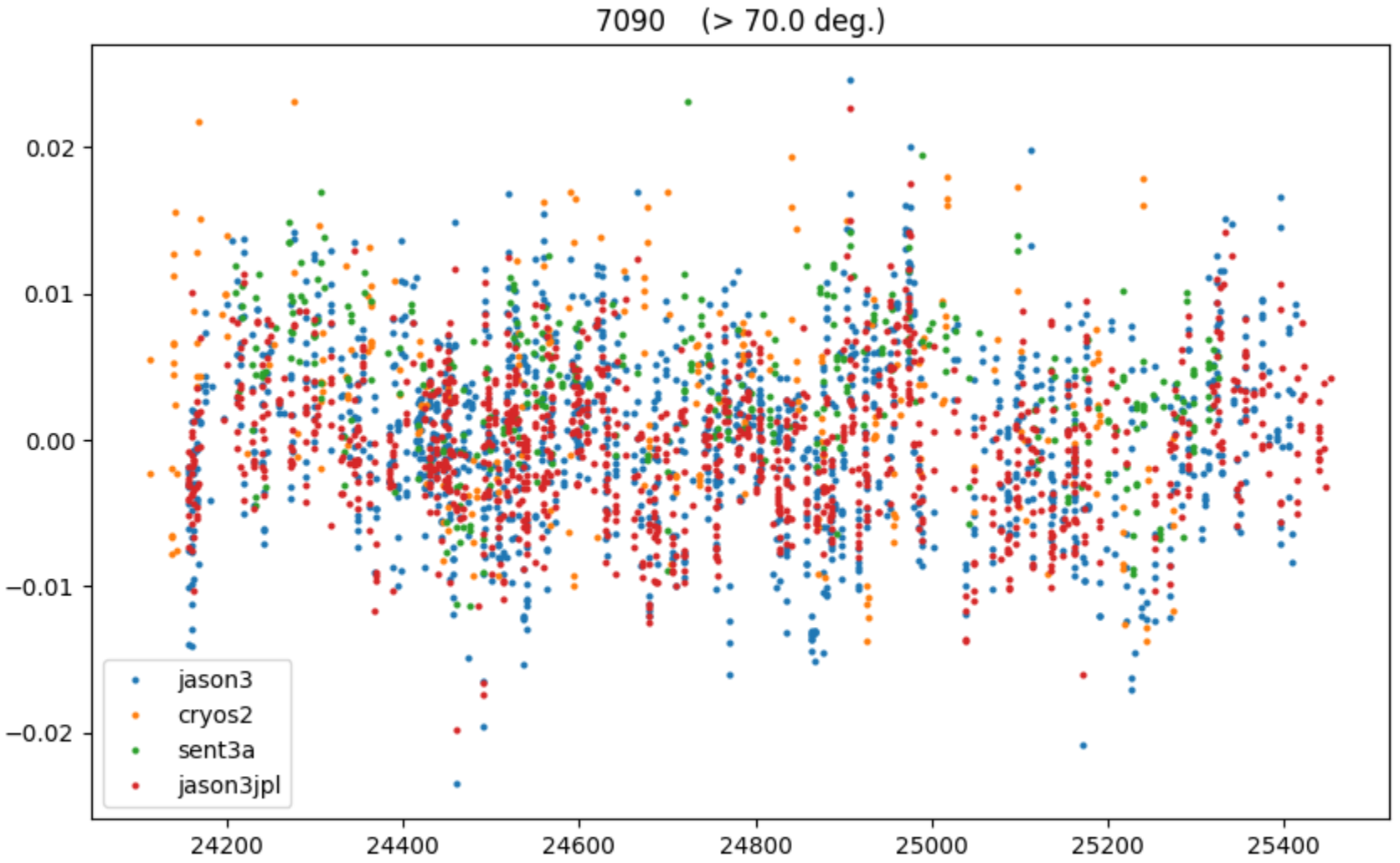
Yarragadee, jpl orbits



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