Scale in DORIS solutions

(downweighting and elevation cut off)

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DORIS Scale is affected by

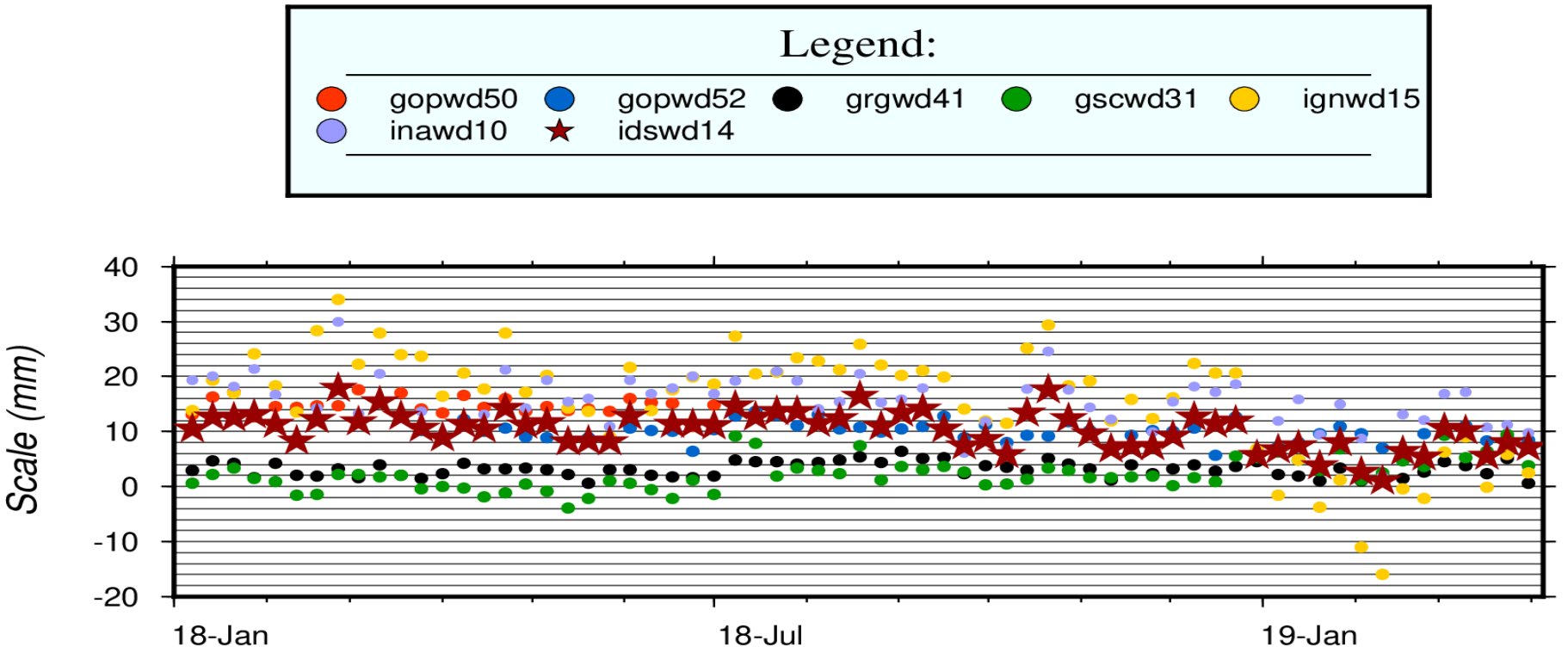
- **Troposphere and ionosphere modeling**
- **SAA compensation strategy**
- **Elevation cut off**
- **Data elevation-derived downweighting**
- **Antenna PCO**
- **Antenna PCV**
- **SAA mitigation strategy**
- **Satellite constellation (systematic errors)**

In the processing of Doppler data format also by application of

- CNES observations validation from the observation file
- Centre of mass corrections from the observation file

Agreement of individual AC scale in the recent operational series

- Only short time span
- Very good consistency and agreement of GRG and GSC (also with ITRF 2014)
- GOP about 10 mm higher (for the new series wd60 not dispalyed here 5-6 mm)
- IGN and INA more than 10 mm higher
- Scale discontinuity around January 2019 for IGN



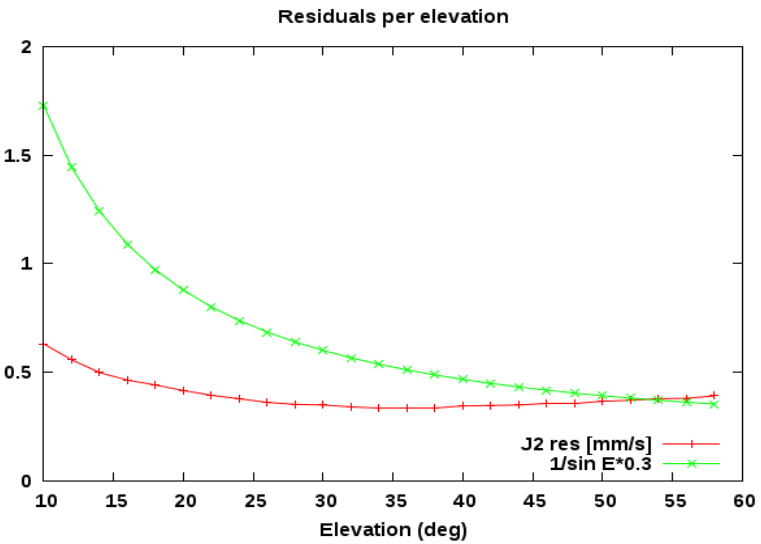
Elevation cut off and data downweighting

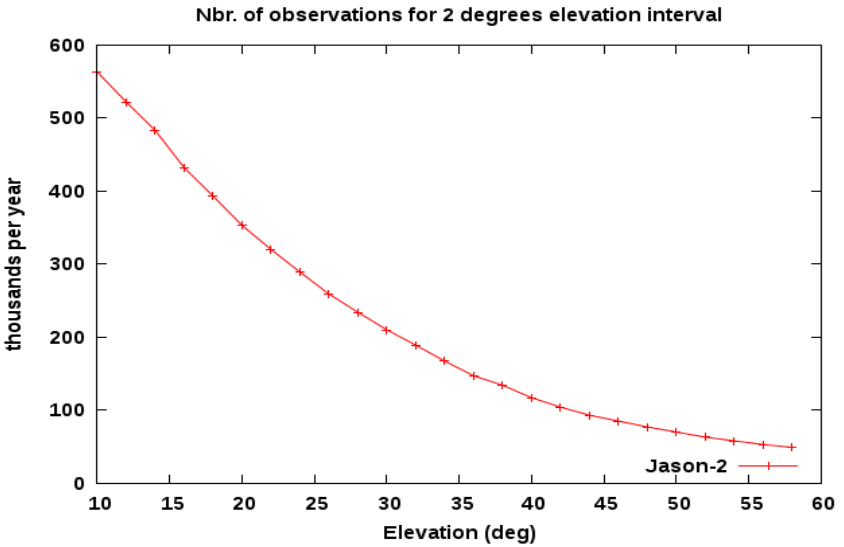
- Effect of Elevation cut off and data downweigting demonstrated e.g. By Štěpánek and Filler, SGG, 2018; Capdeville et al., IDS AWG, 2016.
  - ➢ Confirmed by at least 2 ACs
- Asscociated with systematic elevation-dependent effect
  - ➢ Troposphere delay modeling ?
  - ➢ Onboard Antenna patern ?
  - ➢ Multipath ?
- Effect can be observed/studied by residual analysis
  - Impact on ascending/descending Doppler observations with different sign
  - Onboard Antenna PCV ?
  - Multipath ?

Why downweighting ?

- Downweighting functions typically used are usually not corresponding to the residual RMS for elevation
- Number of the observation increases in low elevation (strong effect)

  results in „weak“ contribution of higher elevation observations
- Possible systematic errors specific for low elevation
  - r*educed by downweighting*





Testing campaign (1.)

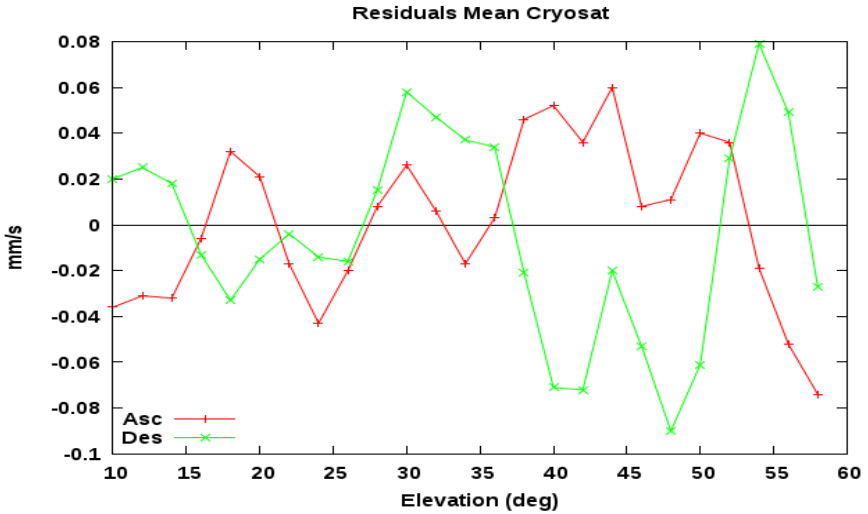
- GOP AC
- Data January – December 2018
- 10 deg elevation cut off
- Weight = Sin^2 E Weight(definition) = $1/\sigma^2$
- 6 satellites
- SAA strategy for Jason-2, Jason-3
- New mean (secular) pole and gravity field model EIGEN RL04
- Analysis for ascending/descending residuals

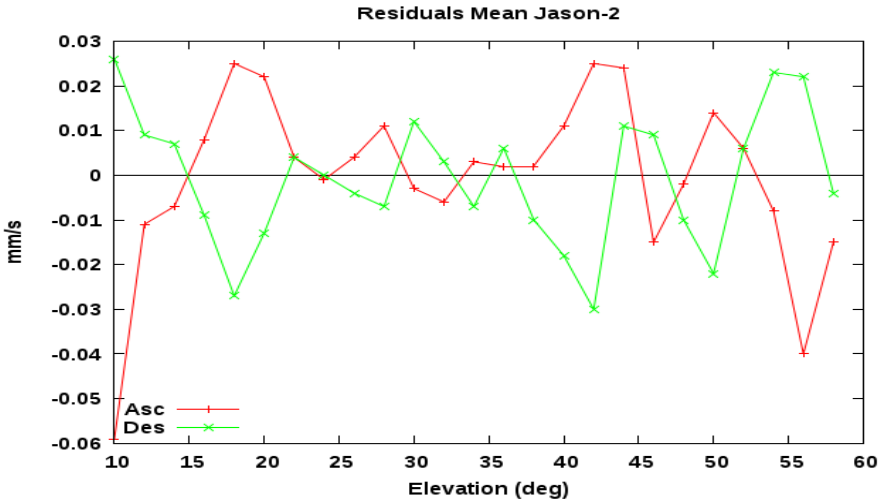
Residuals per elevation (step 2 degrees)

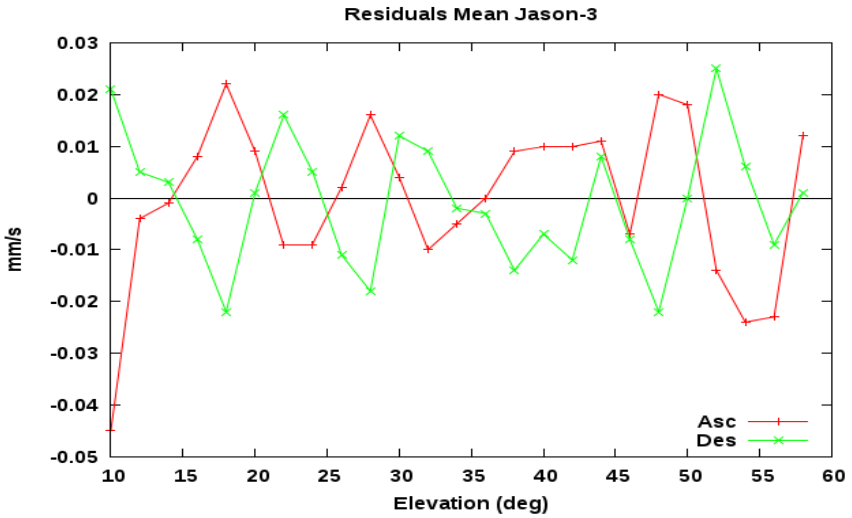
Up and Down behavior

Similar behavior at least below Elev. = 18 deg

Asc/Des. difference is higher for Jasons in the lowest elevations



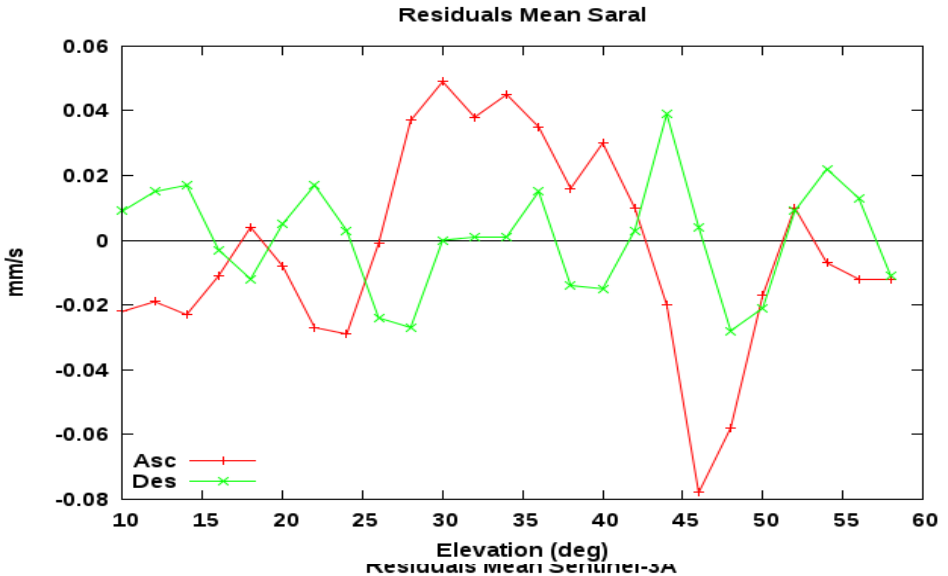


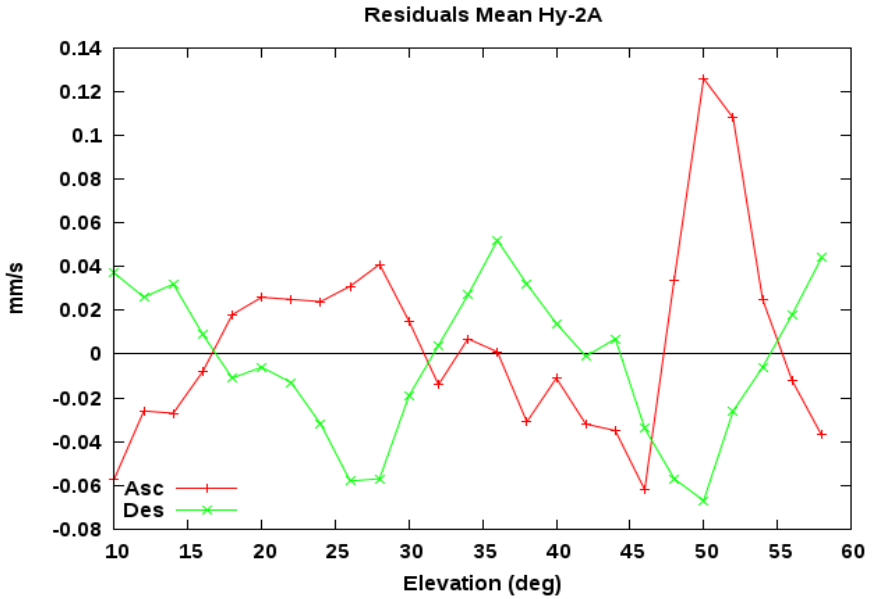


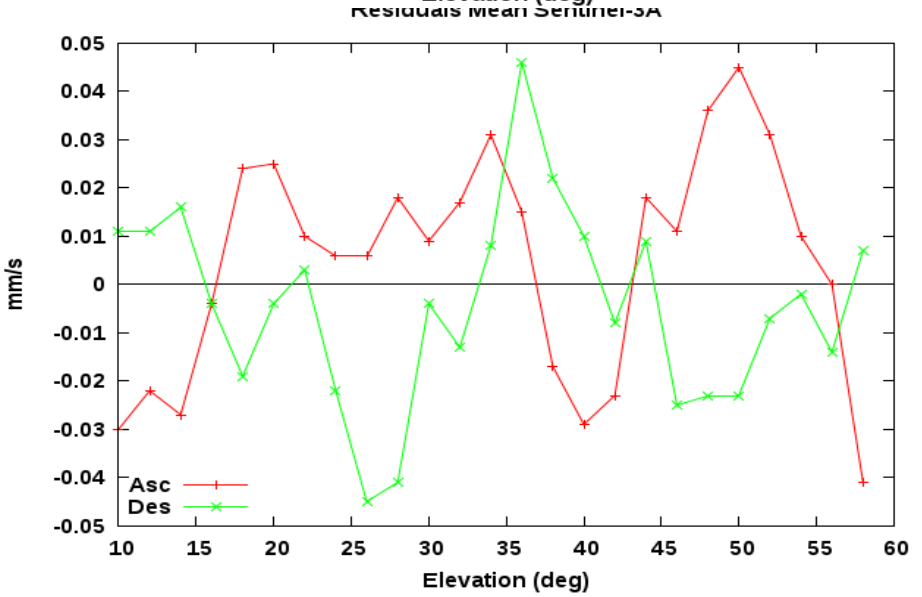
Residuals per elevation (step 2 degrees)

Similar behavior at least below Elev. = 18 deg

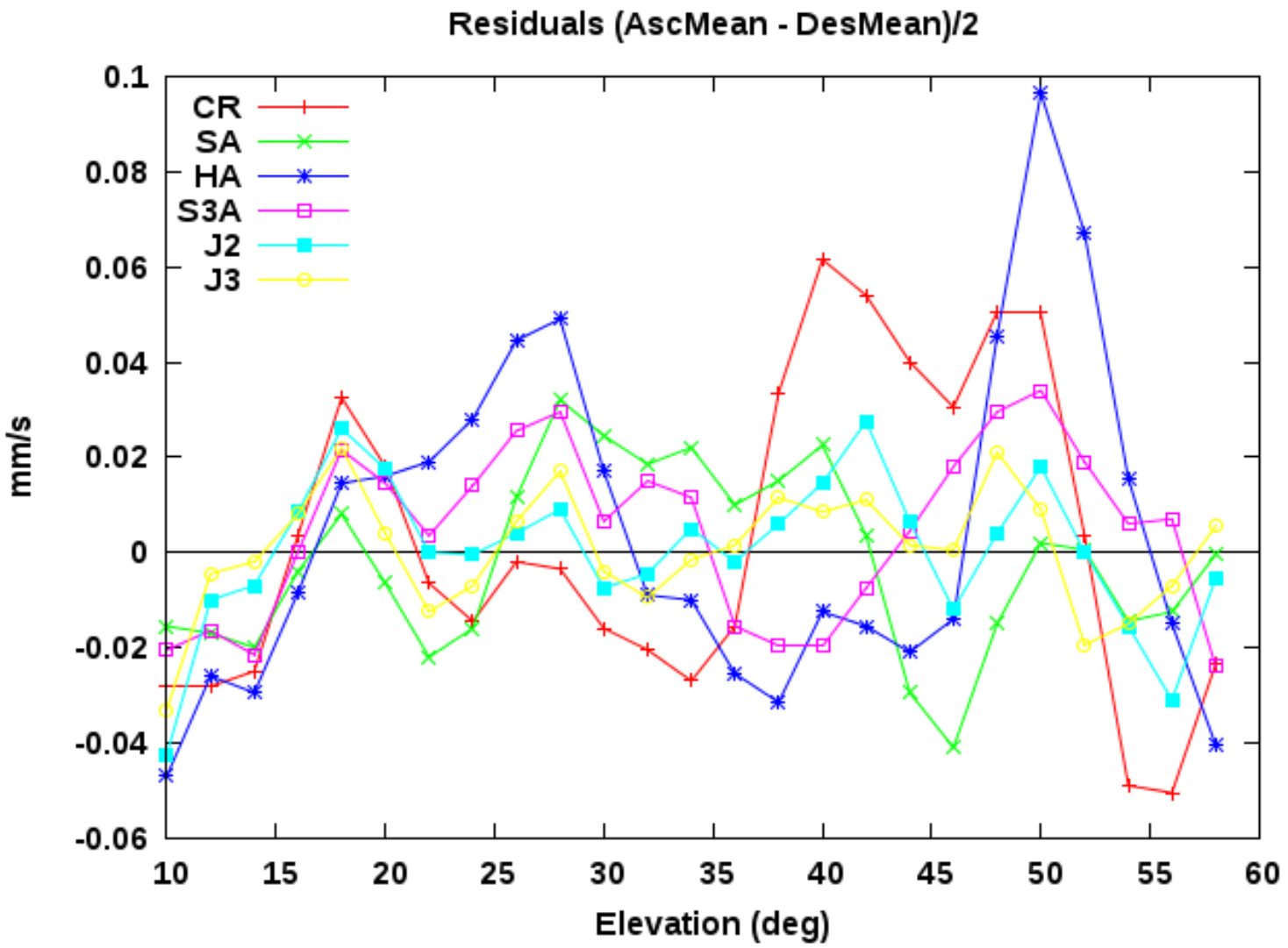
Asc/Des. difference is higher for Hy-2A in the lowest elevations







Residuals per elevation, (Asc-Desc)/2



Testing campaign (2.)

- GOP AC
- Data January – March 2018
- 7, 10 deg elevation cut off
- Weight = Sin^4 E, Sin^2 E, „CNES“, No
- In total 8 different solutions
- 6 satellites
- SAA strategy for Jason-2, Jason-3
- New mean (secular) pole and gravity field model EIGEN RL04

Scale

- Multi-satellite solution
- Impact of the Cut off
- Impact of the downweighting

(results in mm)

Weight	Cut off 10 deg	Cut off 7 deg
No	11.3	25.4
„CNES“ *	7.5	12.0
Sin^2 E	6.9	9.3
Sin^4 E	8.3	8.3

* Moyard et al., IDS AWG, 2016

Scale – single satellite

- Multi-satellite solution
- Impact of the Cut off (All)
- Impact of the downweighting (except for Cryosat and Saral cut off 10 deg)

(results in mm)

	Cut off 10 deg.		Cut off 7 deg.	
	Sin^2 E	No weights	Sin^2 E	No weights
Jason-2	**7.7**	**17.9**	**11.0**	**39.6**
Jason-3	**10.0**	**16.2**	**15.6**	**33.4**
Cryosat	**9.8**	**8.7**	**11.9**	**23.0**
Hy-2A	**7.6**	**18.7**	**9.4**	**30.4**
Saral	**7.4**	**7.9**	**9.8**	**20.6**
Sentinel-3A	**2.4**	**6.8**	**4.8**	**20.2**

Planned/possible extension of the experiments

- Go to 5 degrees cut off
- Longer series for 5, 7, 10 (12?) elevation cut off
- Other AC (at least residual analysis)
- Weight = Sin^4 E, Sin^2 E, „CNES“, No
- PCV model for onboard antenna (relative to PCO) ? See Aït-Lakbir et al., IDS AWG 2019

Discussion

- Dependence on elevation cut off /downweighting function
  - To be verified by other AC ?
- Consistent series ? - to be verified by longer campaign
- Scale without satellite antenna calibration ?
  - How precisely we know the antenna PCO ?
  - Are used PCO values independent from SLR ?
  - IGS scale dependent on other technique (ITRF2014) or based on calibrated antennas (ITRF 2020)
- Definition of the scale for IDS solution contributing to ITRF2020
  - The same as for ITRF 2014 ?
- Recommendations for ACs
  - Downweighting, elevation cut off ?
  - Possibilities: the same for all, no recommendations, „soft“ recommendations