



→ 25 YEARS OF PROGRESS
IN RADAR ALTIMETRY SYMPOSIUM

OSTST MEETING

24–29 September 2018
Ponta Delgada, São Miguel Island
Azores Archipelago, Portugal

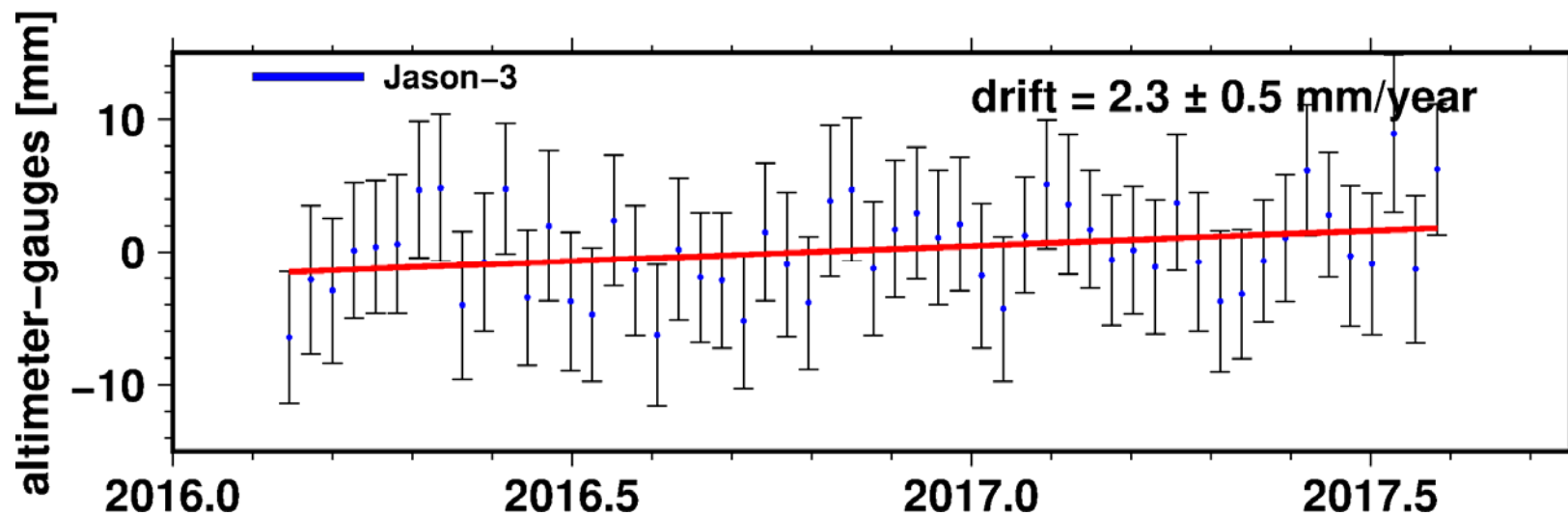
Comparisons of Jason-3,
Sentinel-3A, Sentinel-3B and
tide gauges

¹E. Leuliette and ^{1,2}A. Plagge

*¹NOAA,
²Global Science and Technology, Inc., USA*

Estimated Jason-3 – gauges drift time series

OSTST2017/Miami Jason-3 drift series



Was there a significant drift? (1-sigma uncertainty)

NOAA Altimeter/tide gauge comparison system



Modified version of Mitchum [1998; 2000] to account for phase lags between gauges and altimeter passes and covariance

Altimetry data from RADS

- TOPEX/Jason-1/Jason-2/Jason-3
- ERS-2/Envisat/Altika
- Sentinel-3A
- Sentinel-3A/B



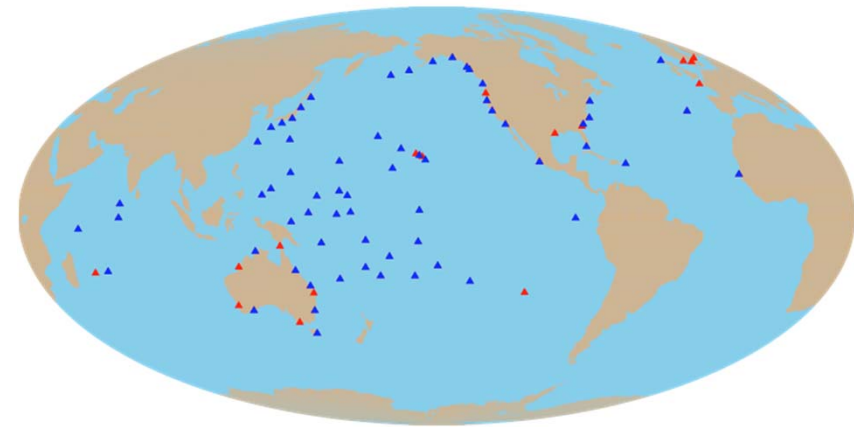
RADS defaults for sea level anomalies

- RADS Nov 2017 updates:
 - Cal-1 correction removed from TOPEX; new intermission offsets

Tide gauge network

Tide gauge (TG) data from the University of Hawaii Sea Level Center (UHSLC)

- Fast-delivery data
 - Some TG records extended with research quality data
 - Estimate datum level shift from overlap
-
- 60 of 64 gauges used by Leuliette, Nerem, Mitchum [2004], and Leuliette & Scharroo [2010], Beckley et al. [2010], Nerem et al 2018.
 - Additional gauges chosen primarily from those used in Watson et al 2015 after controlling for data availability



Mitchum 2000 criteria



Mitchum [2000] applied a quality control to the UHSLC time series and eliminated gauges based on these criteria:

- No reliable land motion estimates
No "internal" estimate from a long time series; no GNSS
- Overlap period with altimetry is too short
- Possible tide gauge level shift
- Apparent nonlinear land motion
- Poor ocean signal agreement

Mitchum gauges dropped from analysis

OSTST2017	OSTST2018
Suva	Suva
Kushiro	Kushiro
Johnston Island	Pago Pago
	Adak

Additions and truncations



Added to Mitchum (13)

Easter Island	Fremantle
Nawiliwili	Brisbane
Kahului	Booby Island
Port Louis	South Beach, Oregon
Portland, Aus.	Fort Pulaski, Georgia
Broome	Goteborgorsh
Brest	

Changes from OSTST2017

Truncated at level shift

Ofunato
Burnett Heads, Bundaberg
Townsville
Kwajalein

Dropped

Galvaston

Sensitivity studies

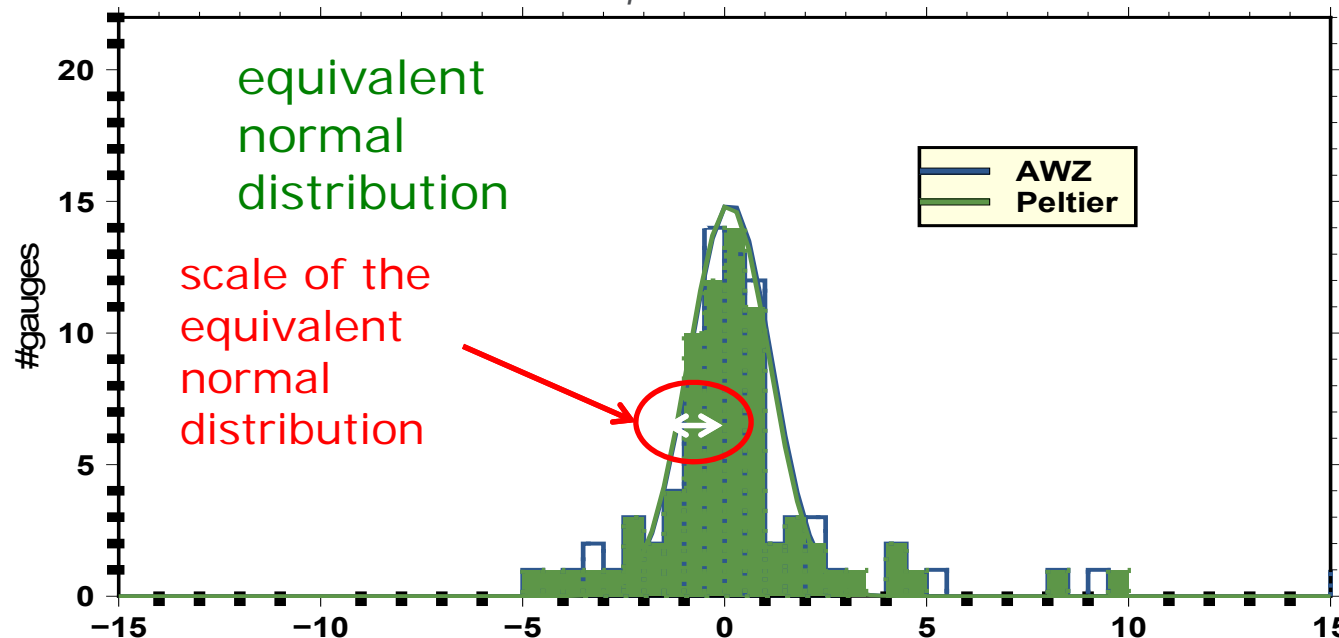


1. Apply different gauge selection criteria, gauge series truncations, and different vertical land motion (VLM) corrections
2. Examine the statistical distribution trends in the residual altimetry-gauge time series for each station for each processing method
3. Ideally, the narrower the width of the distribution, the better confidence that the processing strategy has limited errors from VLM.

Distribution of TJ-TG residuals (GIA-only)

Using only GIA model estimates of VLM produce TOPEX/Jason–TG the distribution of the residuals have scales of 0.84 and 0.82 mm/year

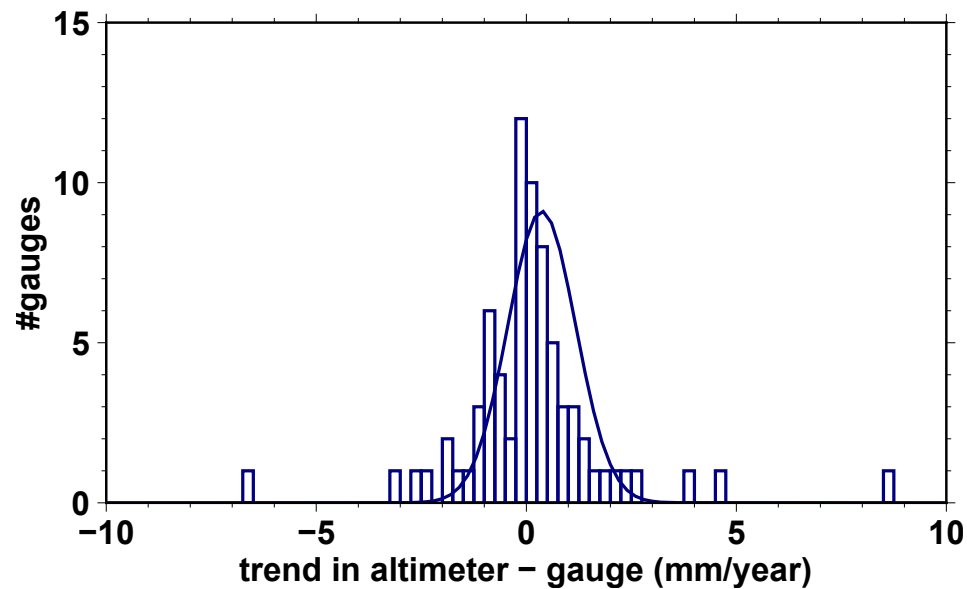
The results are similar results for A, Wahr and Peltier.



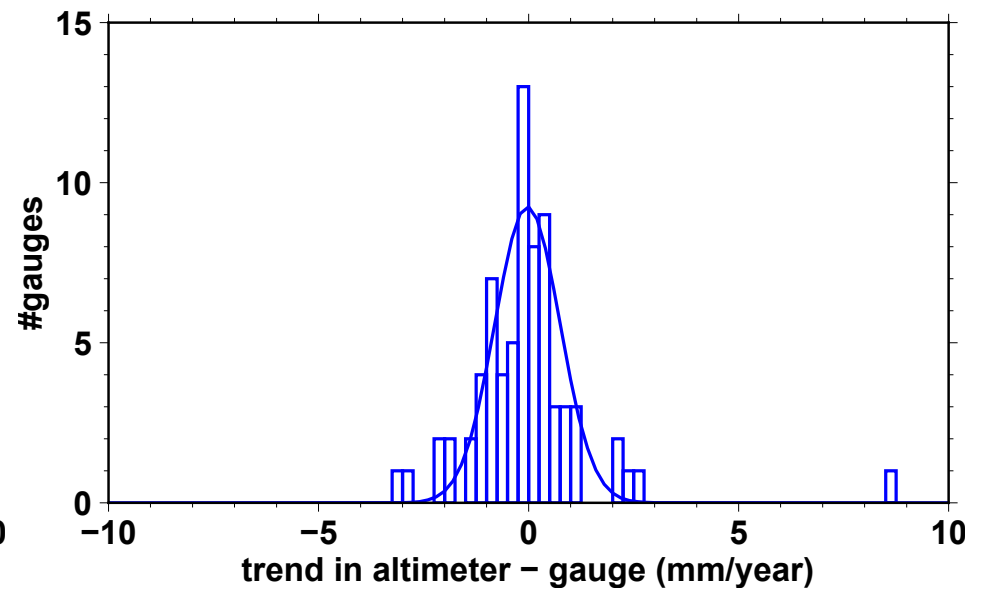
Sensitivity studies: results

- VLM based on Nevada Geodetic Laboratory rates + GIA model yields the best distribution
- Least median-of-squares of trends in altimetry–gauge residuals: 0.78 mm/year (versus 0.81 mm/year last year, equivalent to 1-sigma estimate of the distribution)
- The distribution of the trends is better centered around zero with new editing.

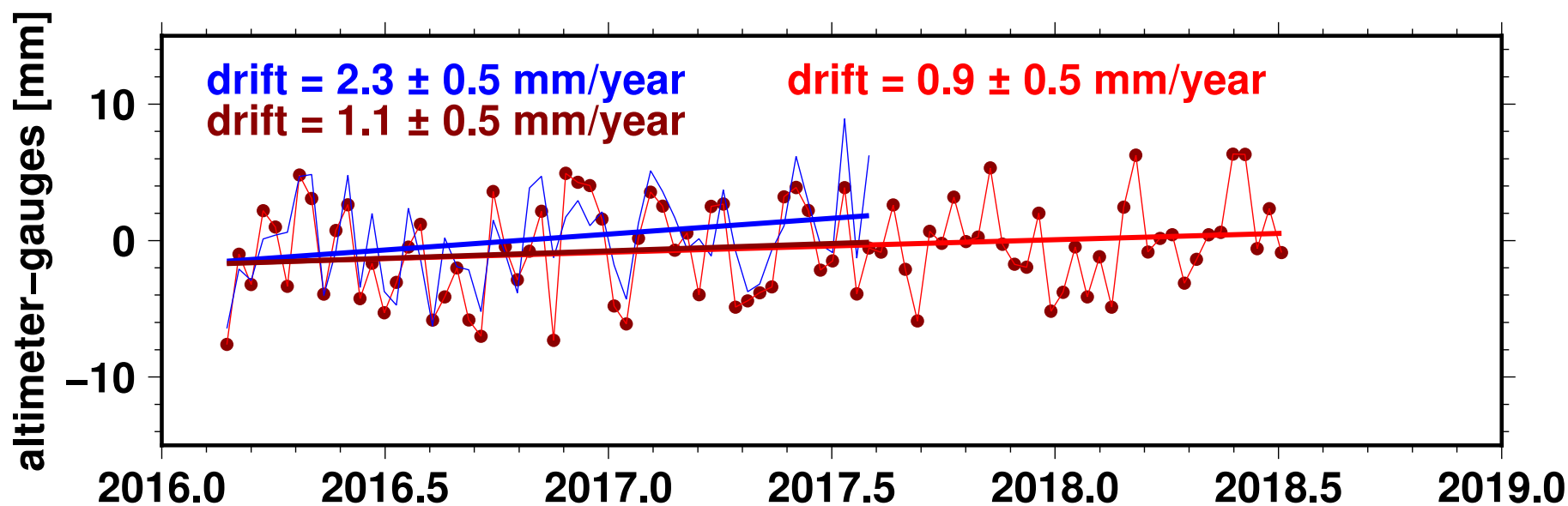
OSTST2017



OSTST2018



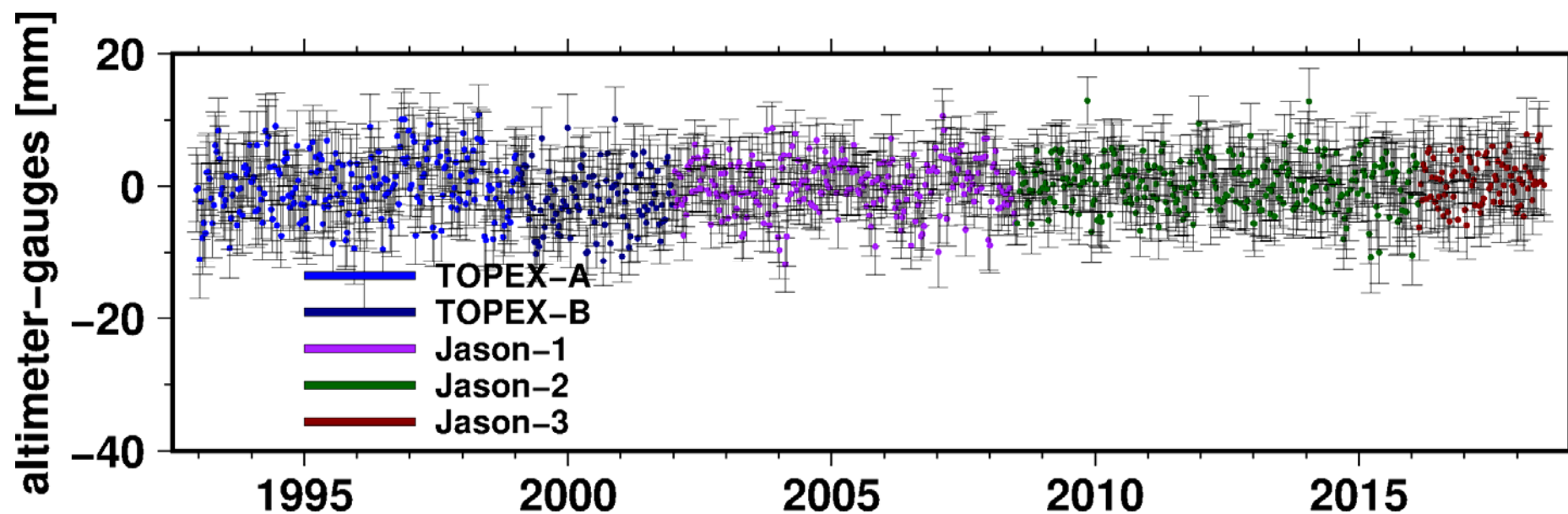
Jason-3 drift series



TOPEX/Jason drift series



TOPEX/Jason drift: -0.13 mm/year



Sentinel-3 versus tide gauges

Modifications for Sentinel-3

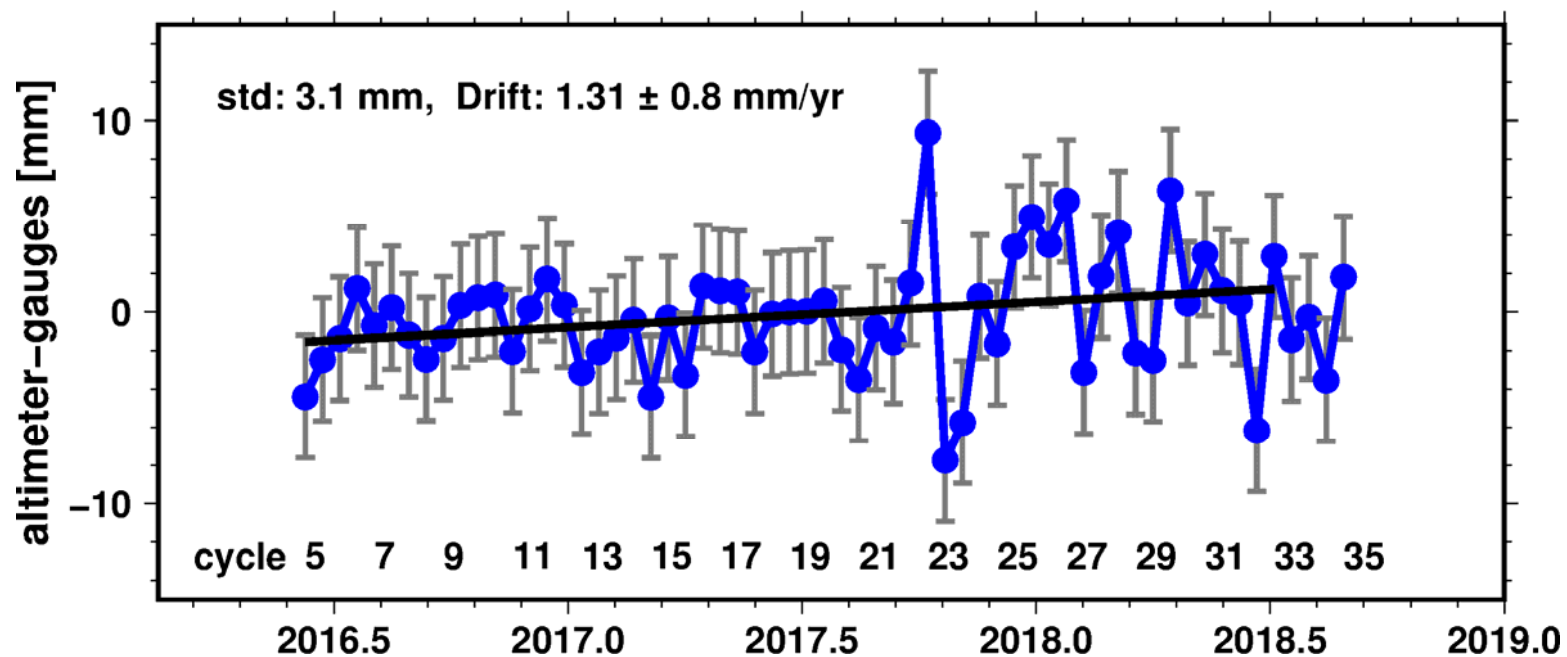
- Time step: half cycle (13.5 days)
 - Alternate time steps use different passes
- Remove variability at tidal aliases from altimeter–gauge residuals, if time series $> 2x$ alias period and periods are separable
- 66 gauges available

Tidal freq	S3A alias period (days)
Sa/K1/P1	365.2
Ssa	182.6
M2/Msf	157.5
O1	277.0
N2	141.0
Q1	229.6
Mf	1147.0
Mm	1341.6

Estimated S3A-gauge drift time series



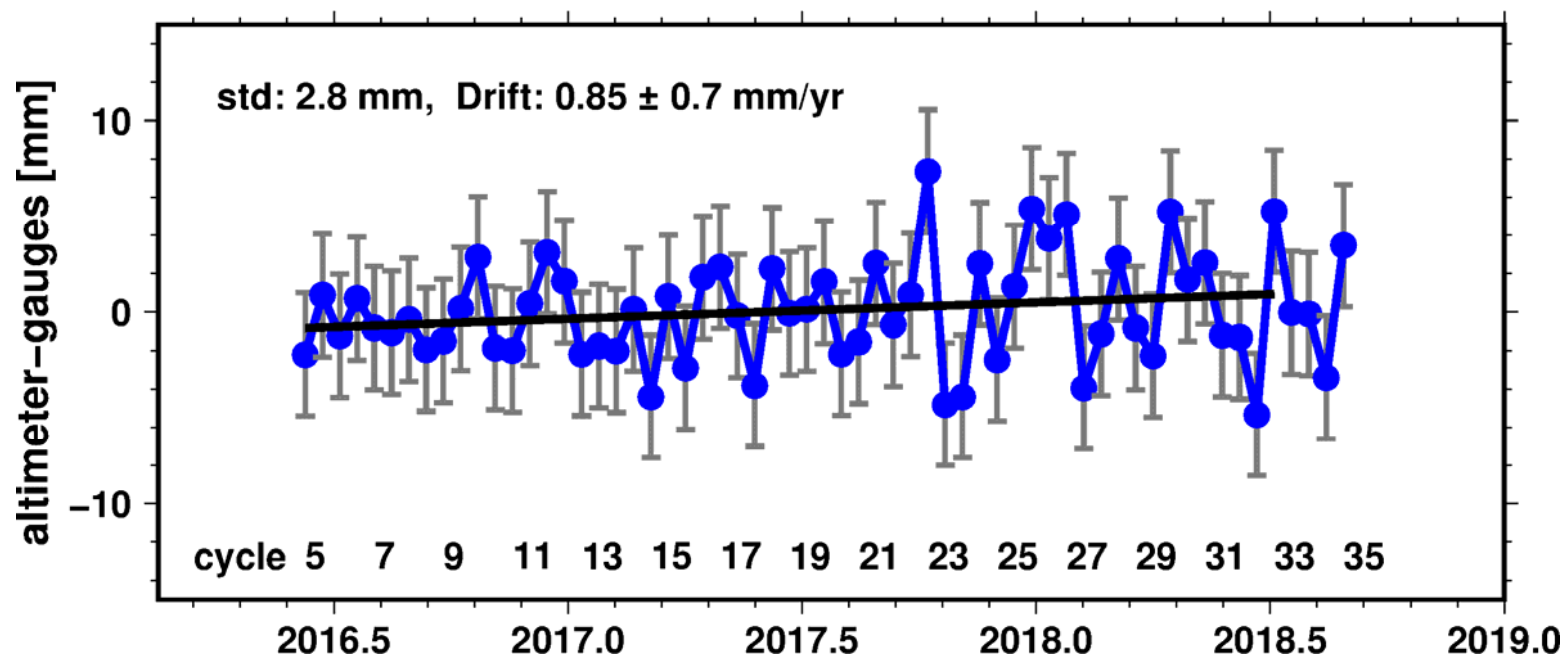
Sentinel-3A SARM



Estimated S3A-gauge drift time series



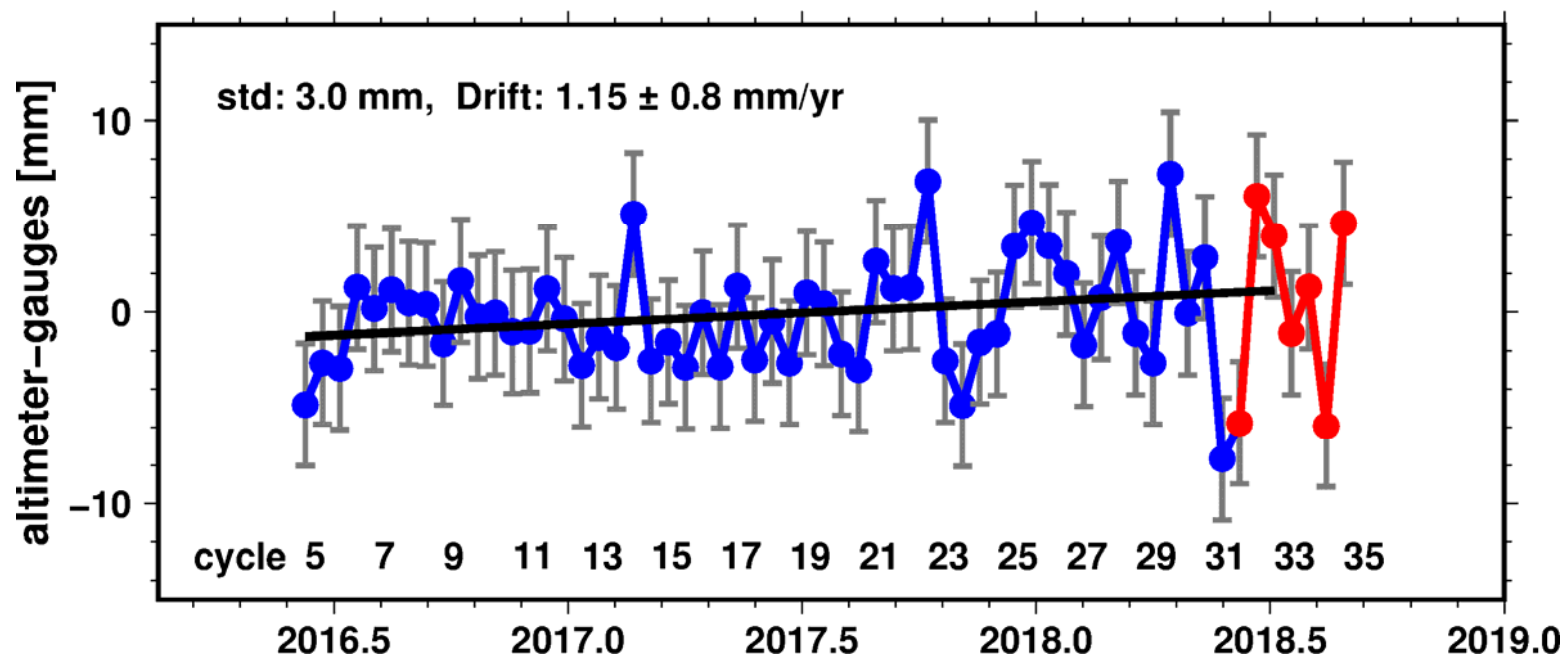
Sentinel-3A PLRM



Estimated S3A-gauge drift time series



Sentinel-3A (SARM) + Sentinel-3B (cycles 9 to 13)



Conclusions



- Continued work needed to refine gauge selection criteria
- Need eliminate level shifts from TGs to ensure consistency during the Jason-3/Sentinel-3 era and the earlier missions
- Continue the effort for GNSS collocation at GLOSS TG stations
 - French Frigate Shoals, HI
 - Galveston, TX
 - San Francisco, CA
 - Fort Pulaski, GA
 - Virginia Keys, FL