

Estimation of phase center offset corrections for Sentinel satellites

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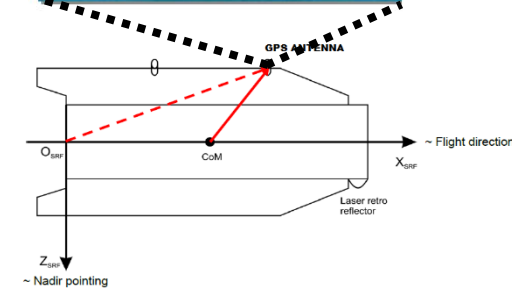
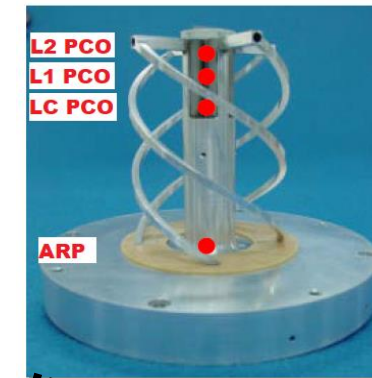
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Introduction

- At AIUB precise orbit solutions of Sentinel satellites are computed (Copernicus POD Service QWG)
- Dynamic LEO Precise Orbit Determination (POD) using the Bernese GNSS Software on centimeter precision level (Mao et al. 2021)
- Knowledge of exact signal receiving point is essential, whereby receiving point is composition of Antenna reference point (ARP) and Phase Center Offset (PCO)



LEO Precise Orbit Determination

- Dynamic orbit representation
 - Solar radiation pressure, Earth radiation pressure, airdrag
 - No scaling factors for non-gravitational forces estimated
 - Piecewise-constant accelerations in along- and cross-track every 30min, constrained to 0.5 nm/s^2
- Fixing integer ambiguities in the process of PCO correction estimation
- No phase center variations (PCV) applied

Processed LEOs

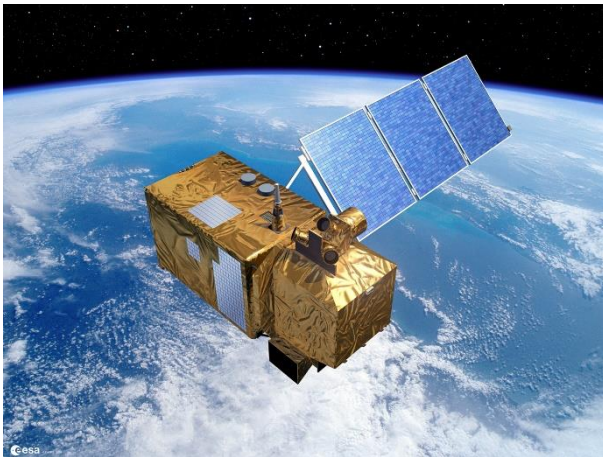
Sentinel-1A/B



Sentinel-3A/B



Sentinel-2A/B

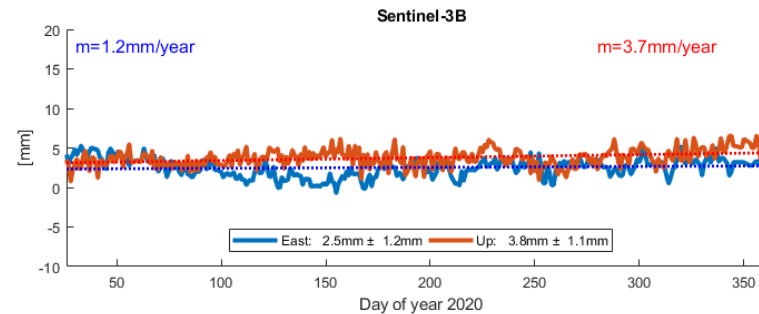
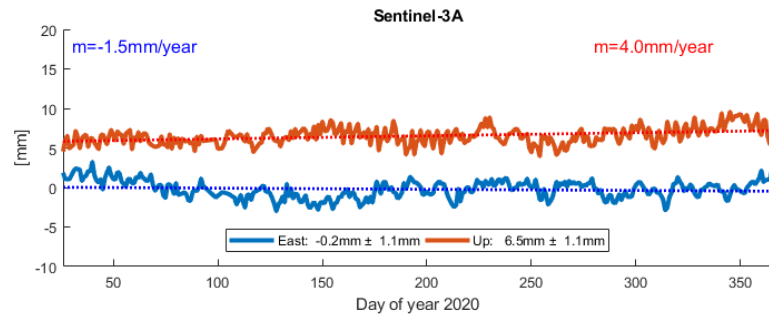
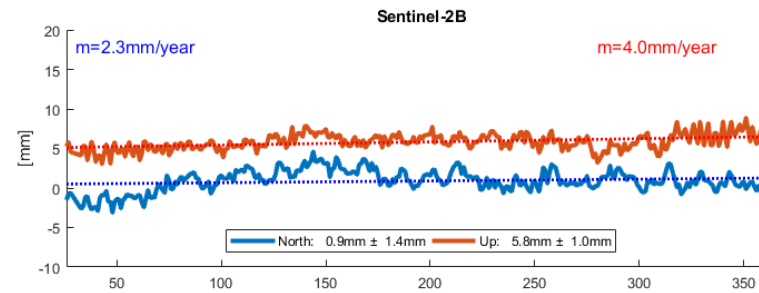
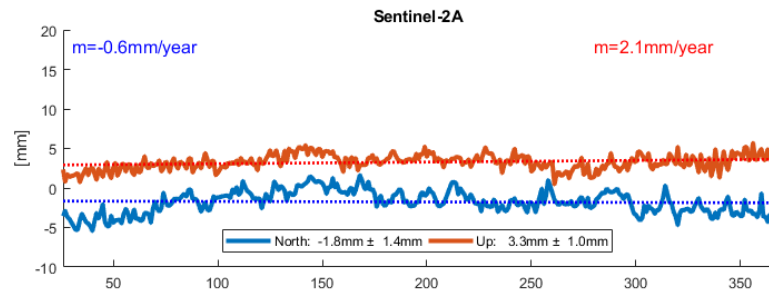
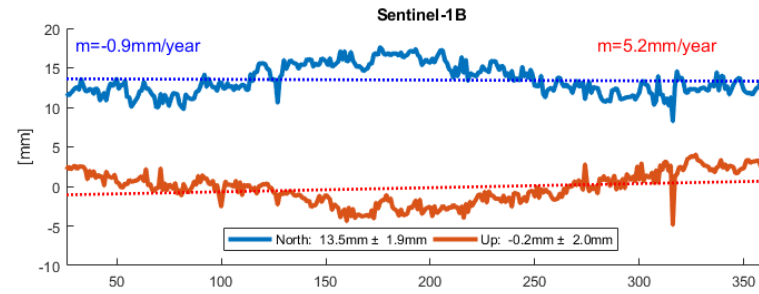
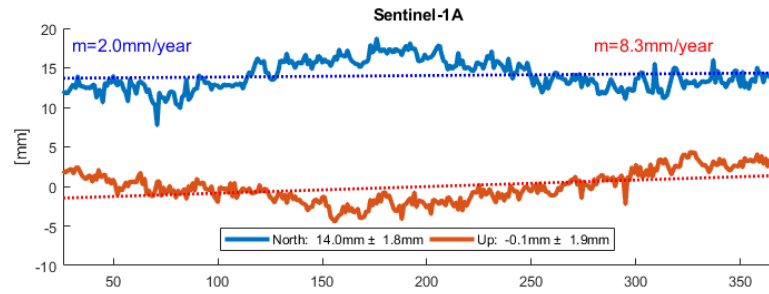


Sentinel-6A



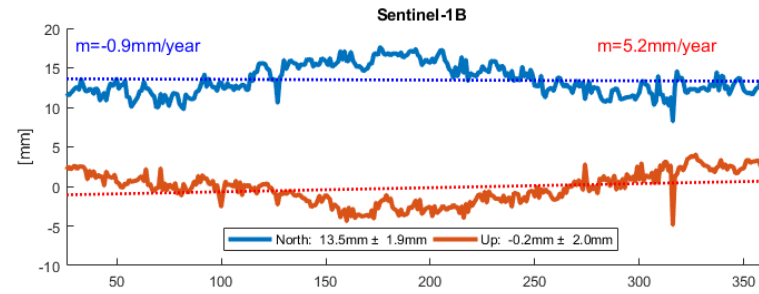
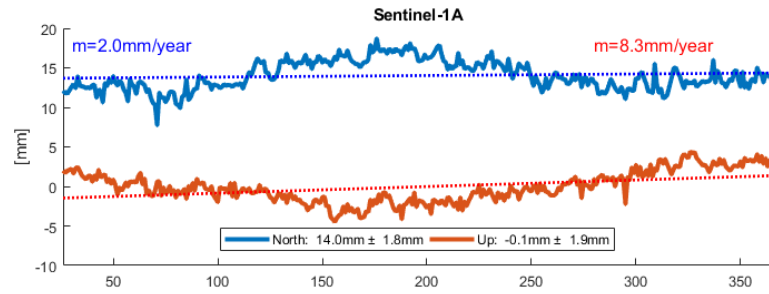
Image credit: ESA

Estimated PCO corrections (S1A/B, S2A/B, S3A/B)

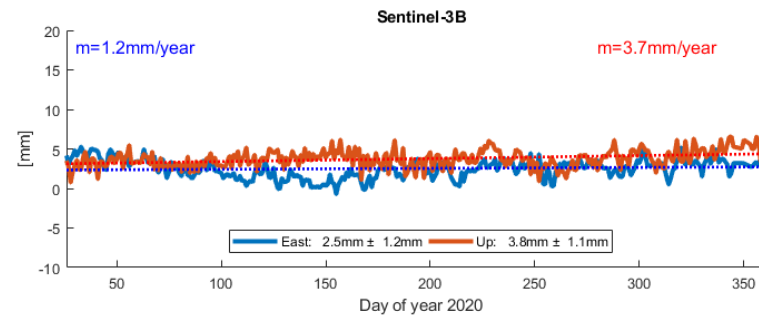
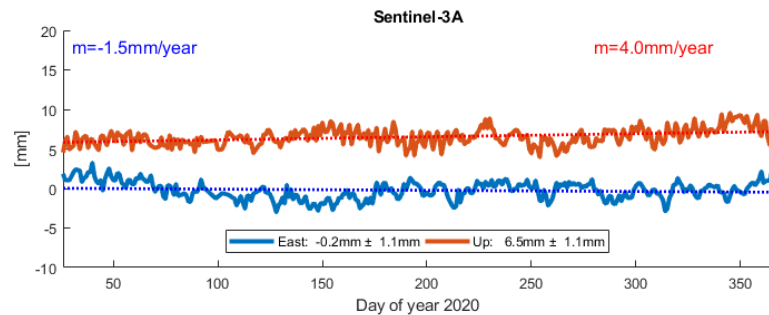
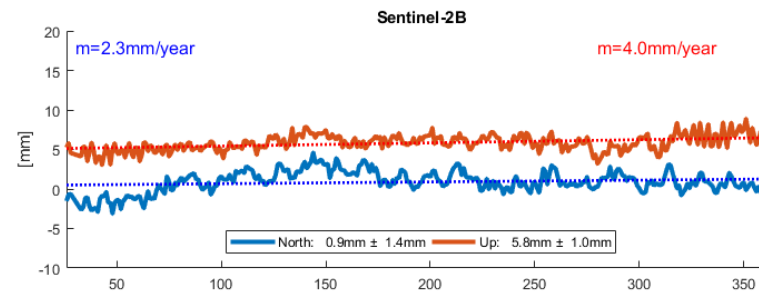
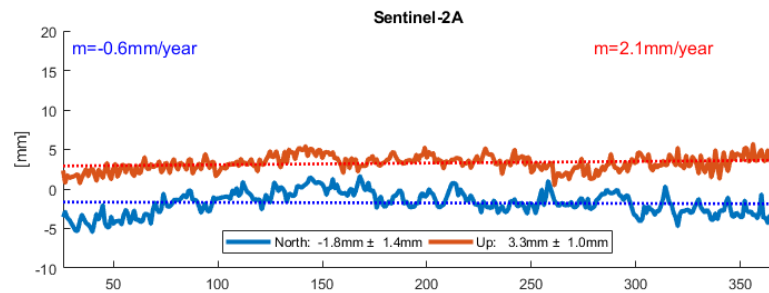


→ Results using default settings for Sentinel POD at AIUB

Estimated PCO corrections (S1A/B, S2A/B, S3A/B)



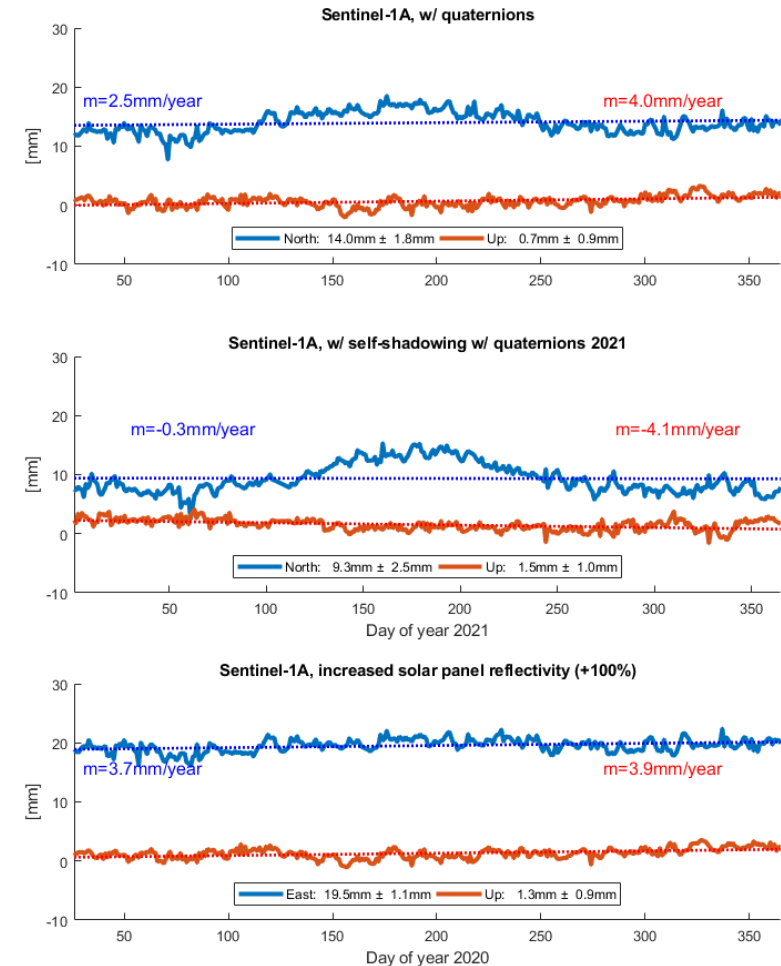
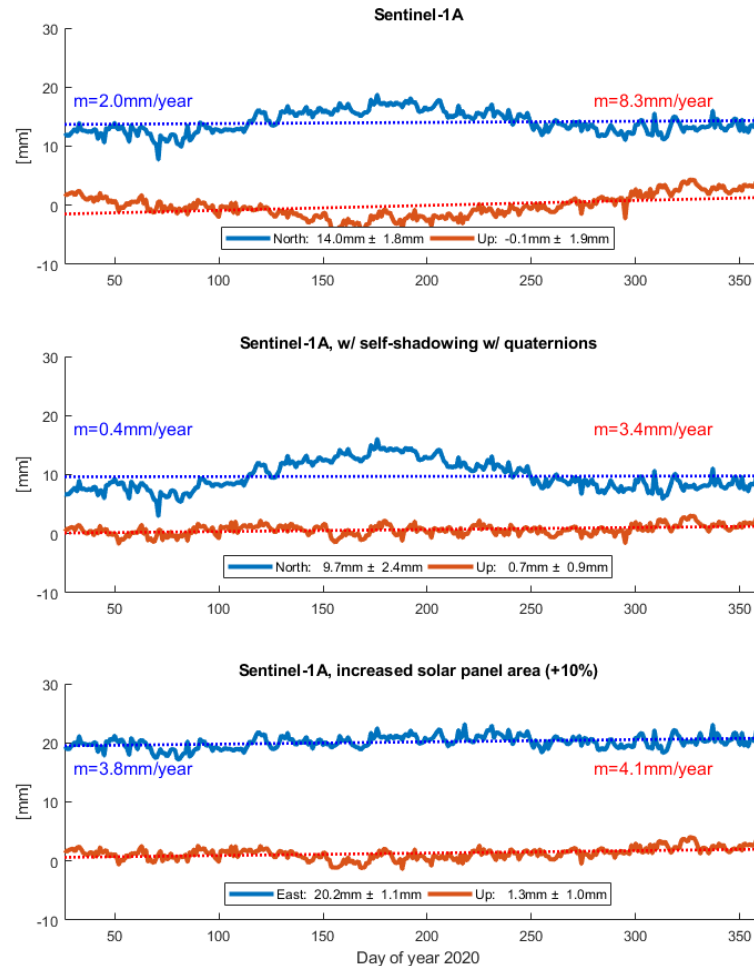
→ β -dependency



→ Results using default settings for Sentinel POD at AIUB

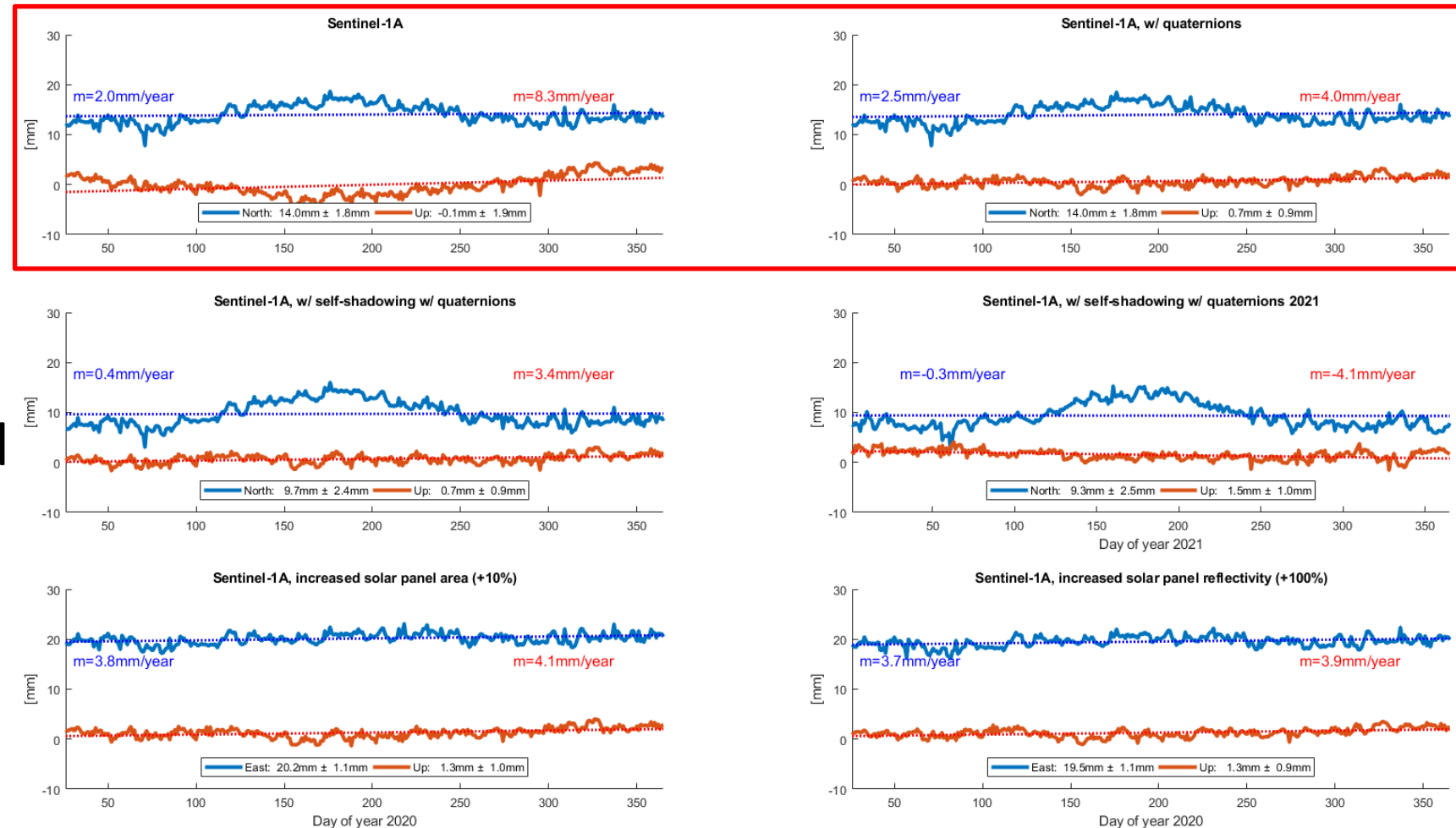
Sentinel-1A

- Attitude: Quaternions vs nominal model
- Self-shadowing
- Trend in estimated PCO corrections
- Macro model modifications



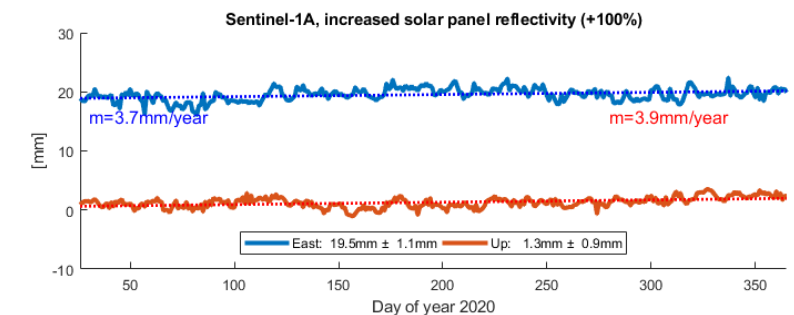
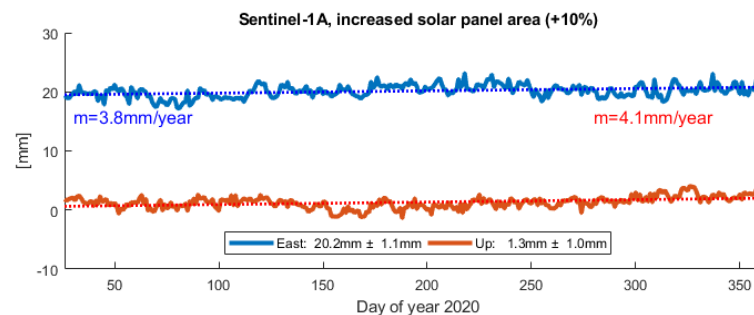
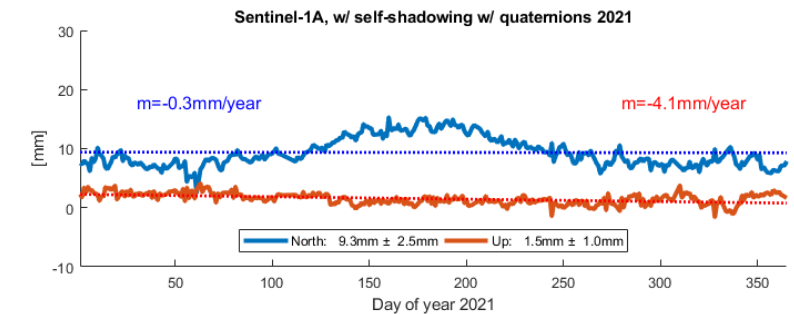
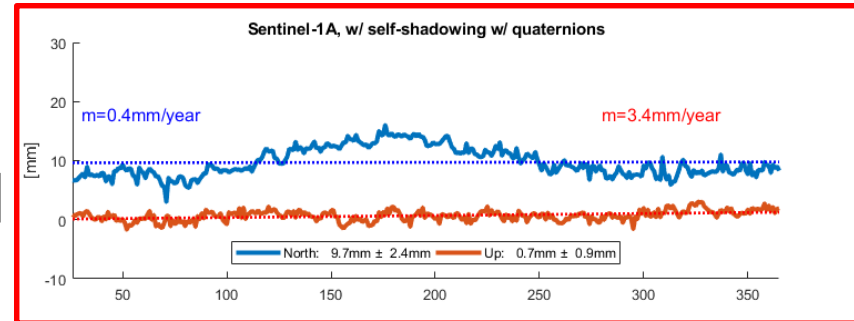
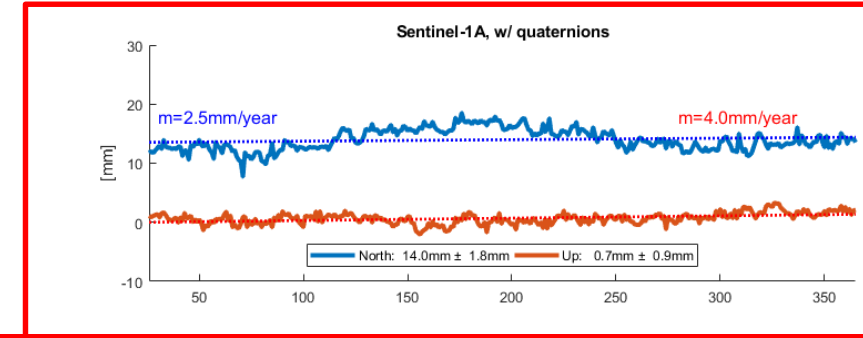
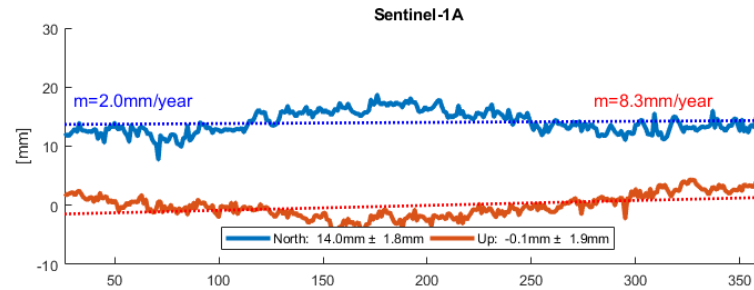
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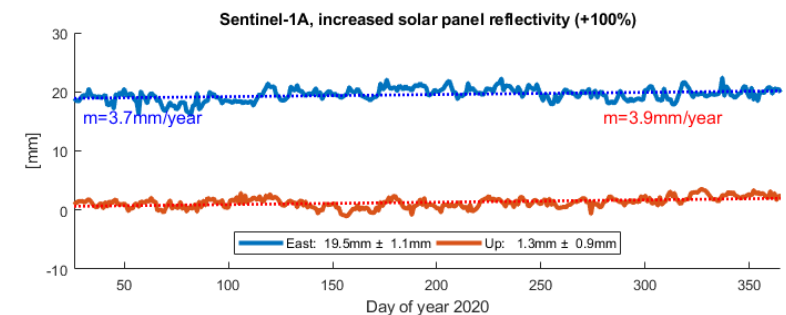
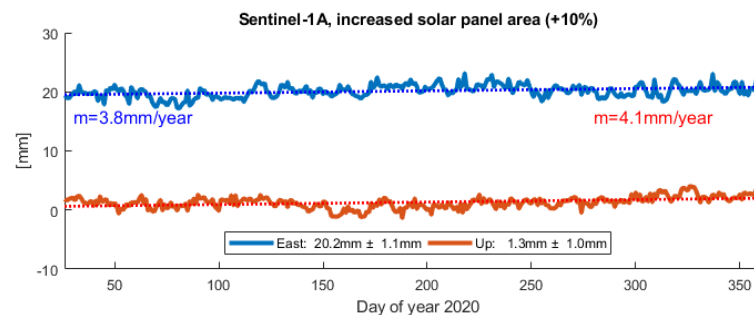
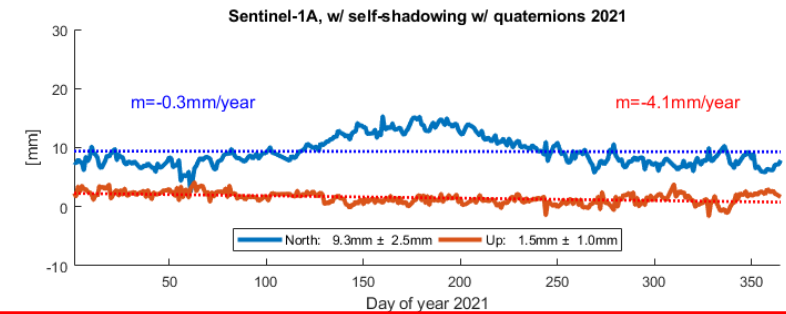
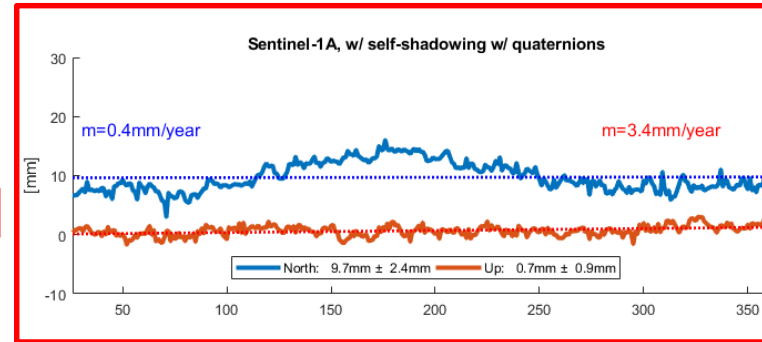
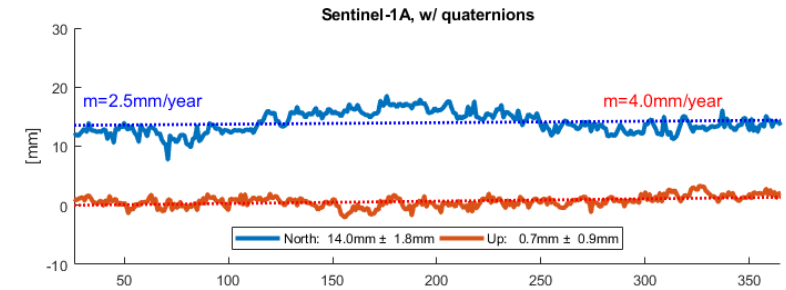
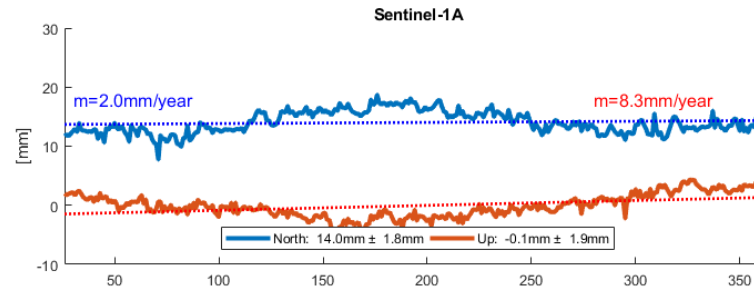
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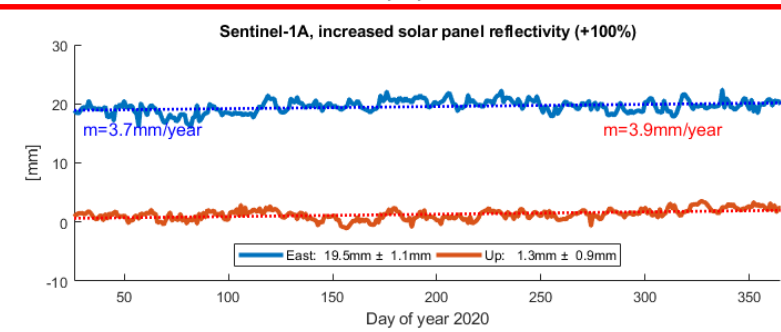
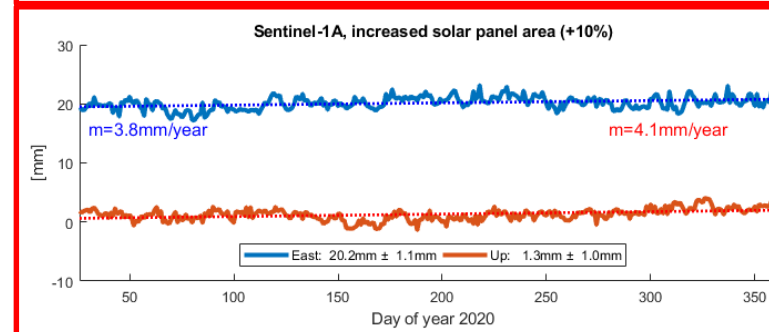
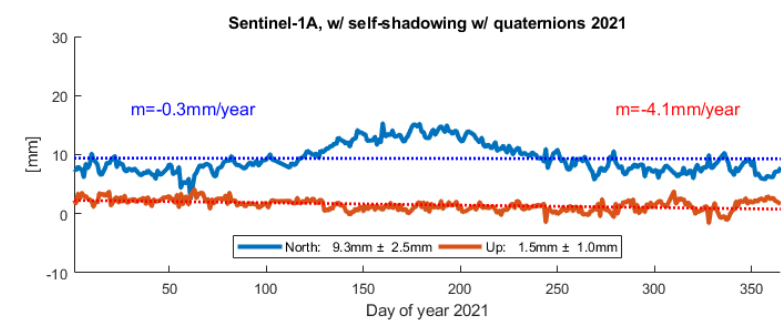
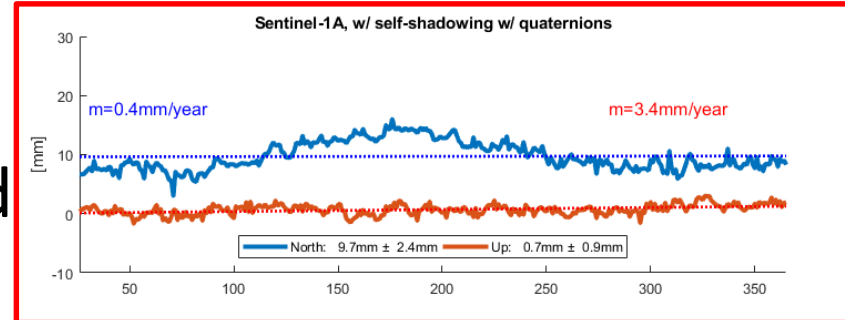
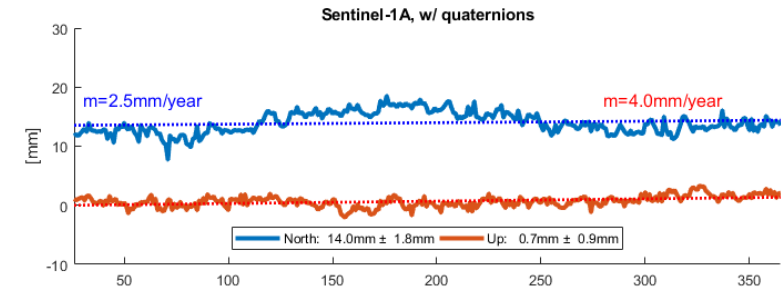
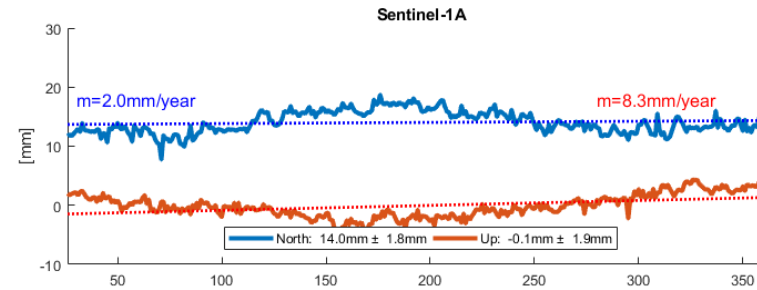
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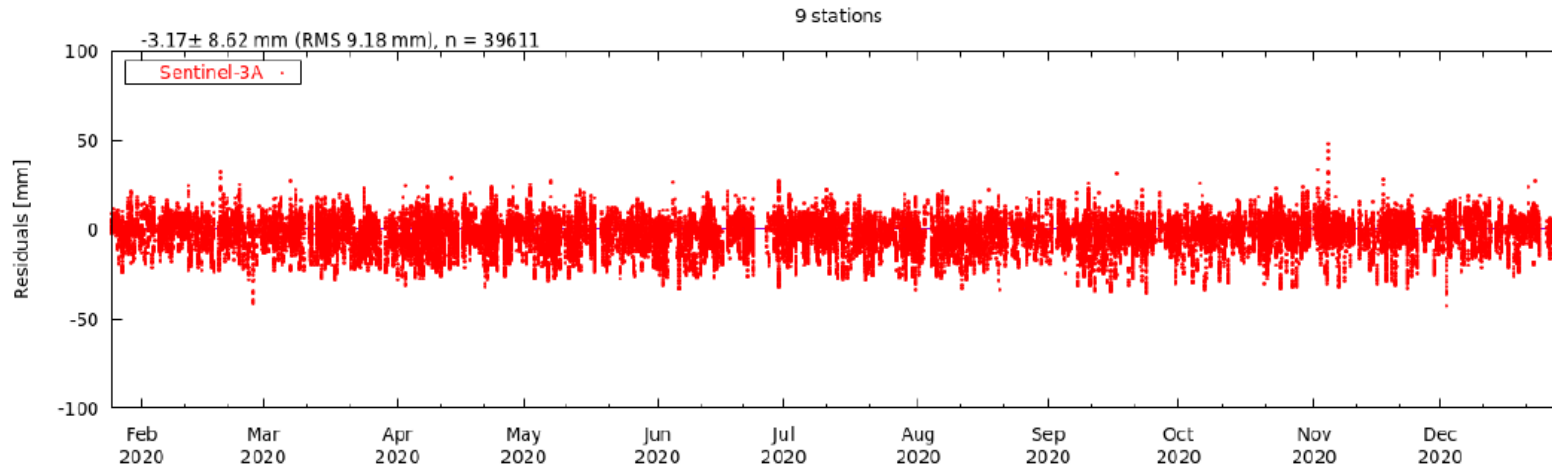
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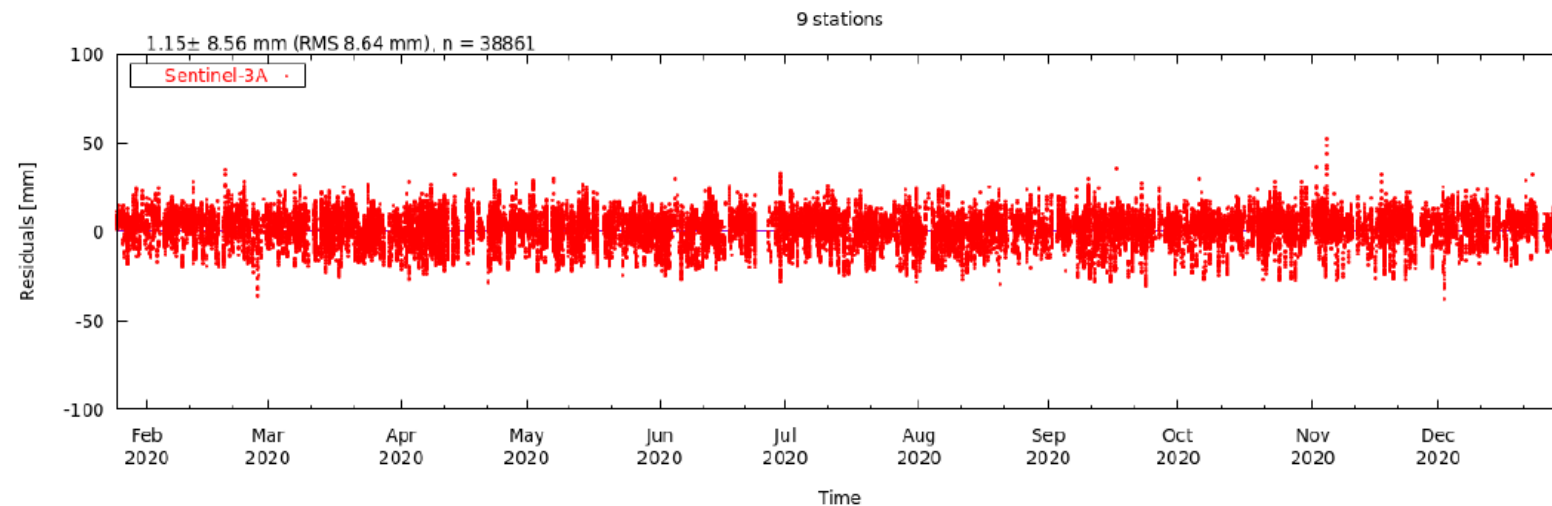


Sentinel-3A

- SLR Validation of Reduced-dynamic orbit solutions, original/corrected PCO used in POD



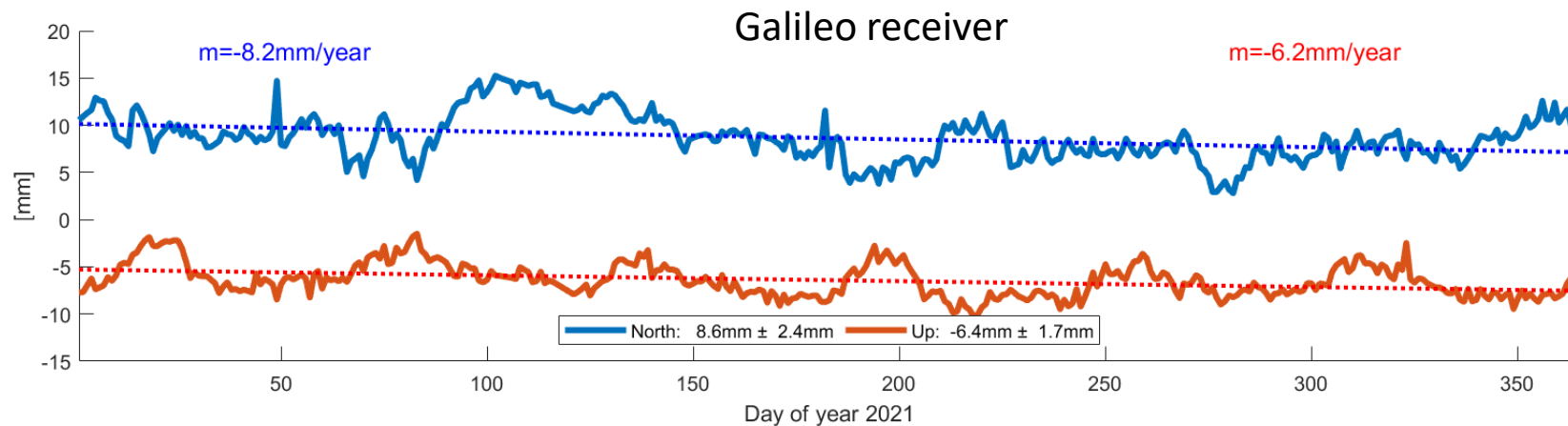
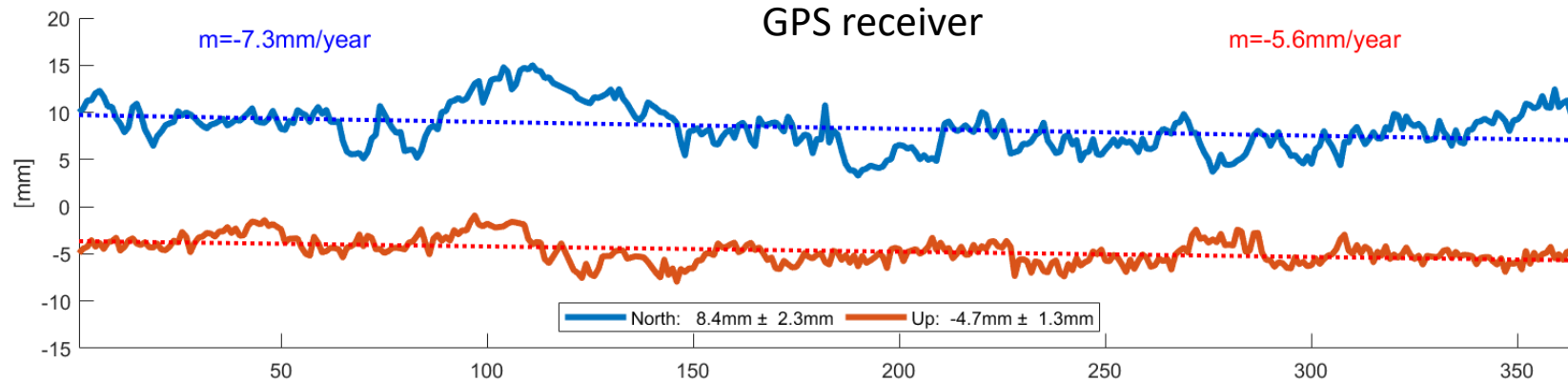
Original PCO
 $-3.17\text{mm} \pm 8.62\text{mm}$



Corrected PCO
 $1.15\text{mm} \pm 8.56\text{mm}$

Sentinel-6A

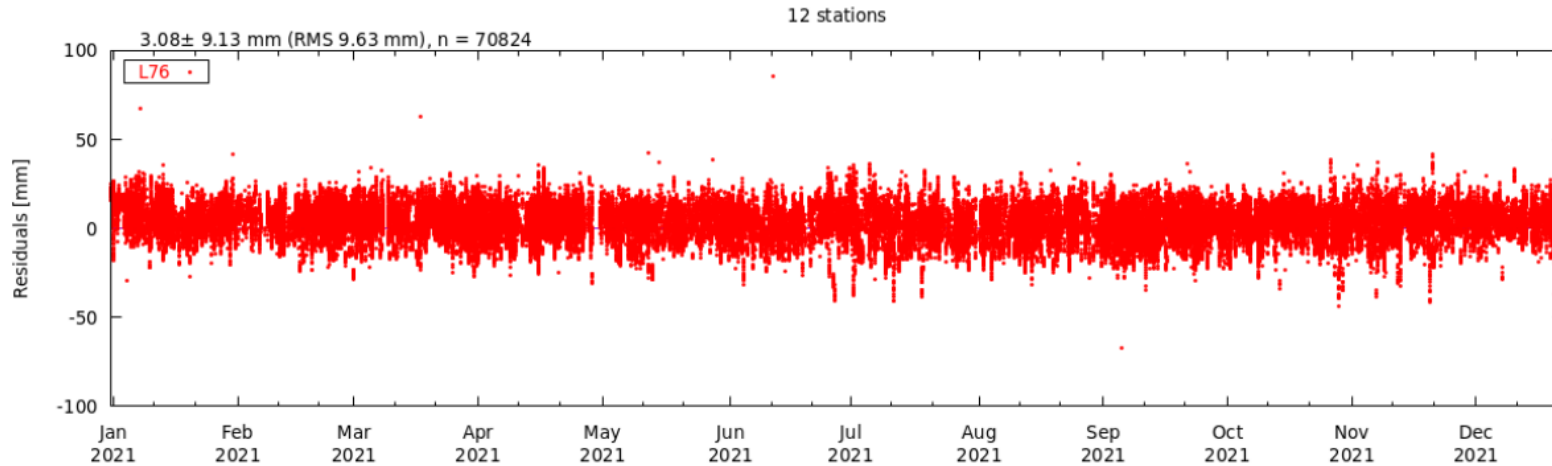
- PCO correction estimation for GPS and Galileo receiver



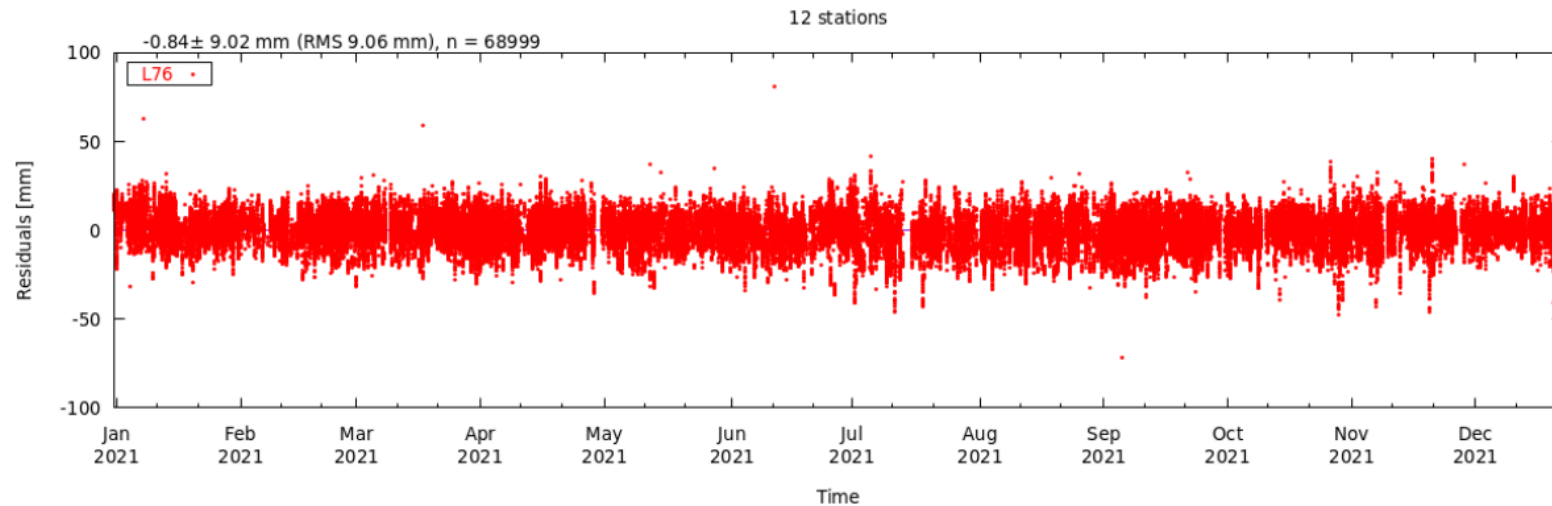
- GPS/Galileo only solutions
- For both receivers an offset in north direction of $\sim 8.5\text{mm}$ is estimated
- For both receivers a significant correction in up direction is estimated

Sentinel-6A

- SLR Validation of Reduced-dynamic orbit solutions, original/corrected PCO used in POD



Original PCO
 $3.08\text{mm} \pm 9.63\text{mm}$



Corrected PCO
 $-0.84\text{mm} \pm 9.02\text{mm}$

Summary

- PCO correction estimation with Bernese GNSS Software gives reliable results
- PCO correction estimation can serve as reference to detect modelling deficiencies
- According to SLR validation applying estimated PCO offset corrections lead to reduced-dynamic orbit solutions of improved quality, since mean and standard deviation are smaller when using a corrected PCO in the POD process

THANK YOU FOR YOUR ATTENTION!