ASSESSMENT OF REDUCED-DYNAMIC GRACE/GRACE-FO ORBITS CO-ESTIMATED WITH MONTHLY GRAVITY FIELDS

Martin Lasser, Ulrich Meyer, Daniel Arnold, Adrian Jäggi

Astronomical Institute, University of Bern, Switzerland

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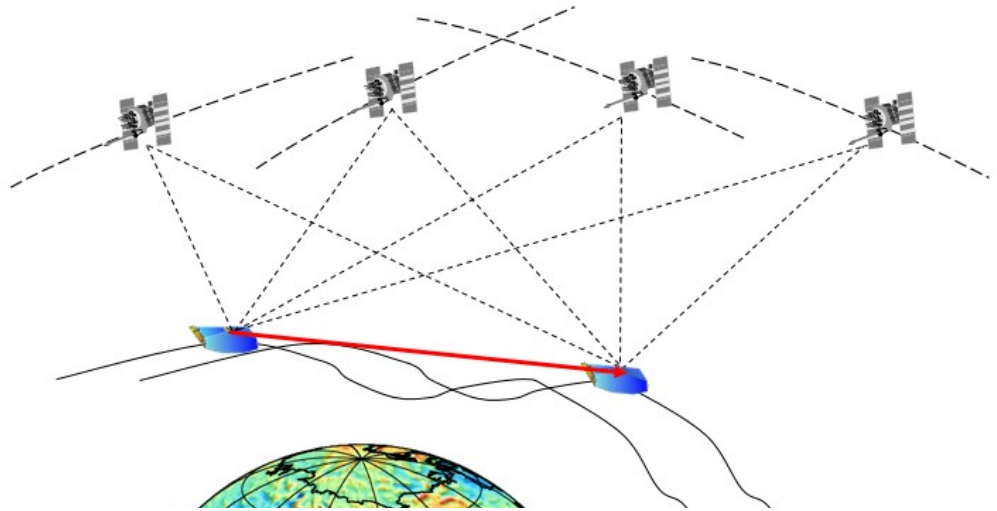
Background

Gravity field modelling: orbit is a sine qua non condition
→ co-estimation of reduced-dynamic orbits

GRACE/GRACE-FO: GPS & K-band



→ GPS needs to be downweighted to obtain best gravity field solution
→ not the «best possible» orbit

Modelling

Parametrisation

6 initial conditions (daily)

accelerometer bias and scaling (daily)

15 min piecewise constant accelerations (PCA) (daily)

} forms the reduced dynamic orbit

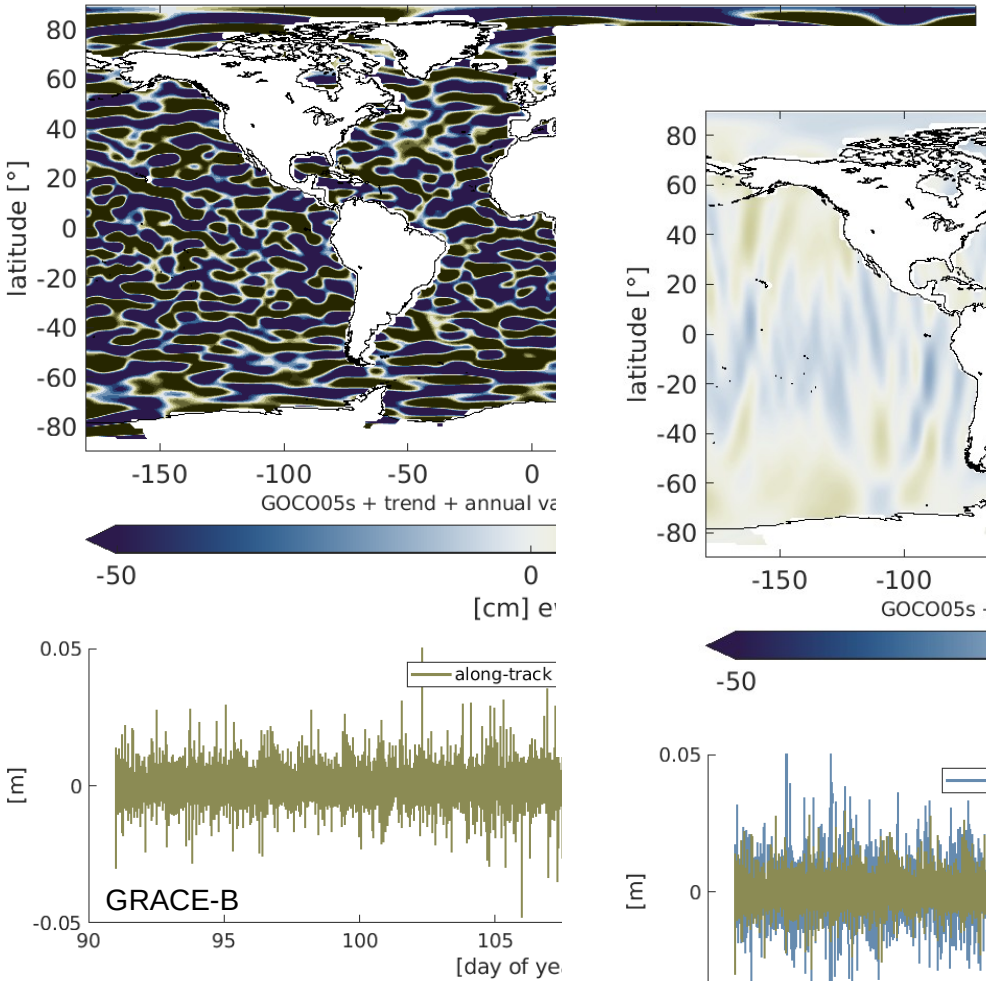
gravity field coefficients (monthly)

$\sum_{d=1}^{31}$ accumulate normal equations to a monthly solution

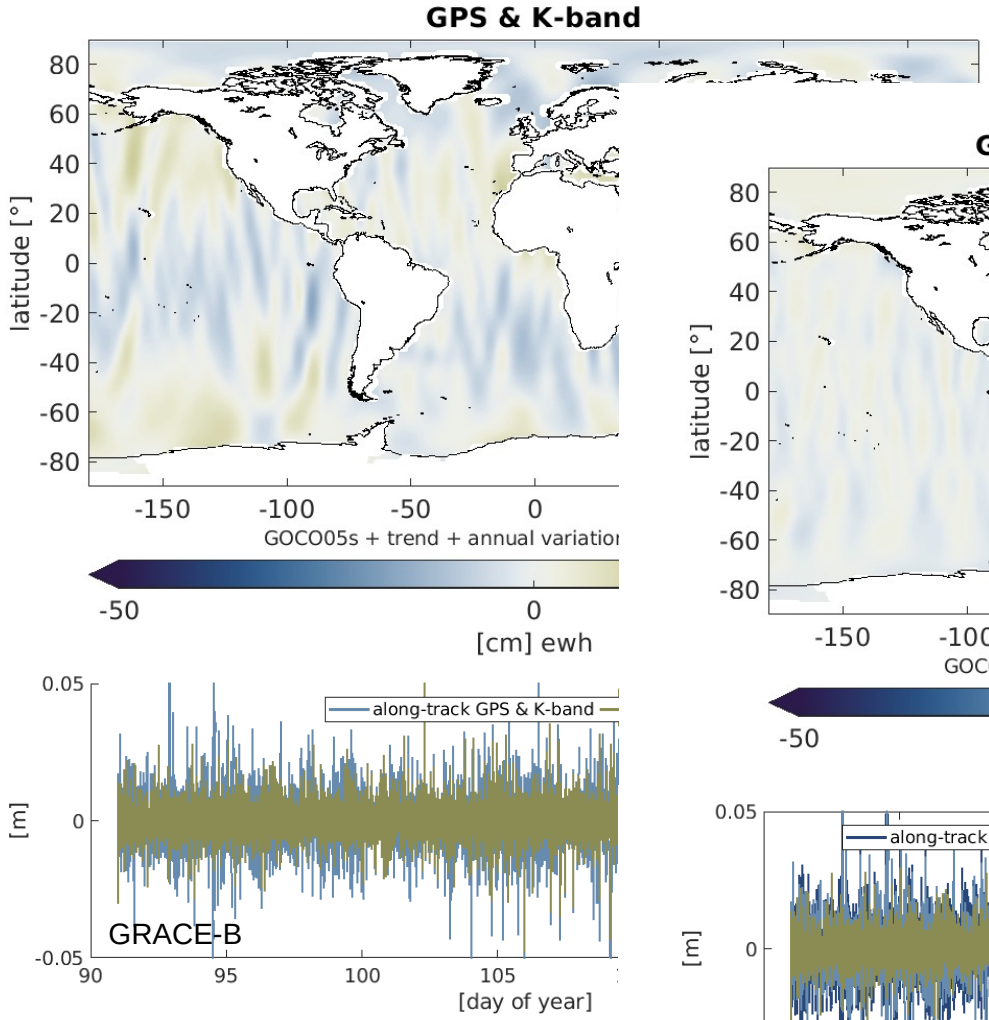
The problem illustrated

GPS-only

RMS = 4.17 cm

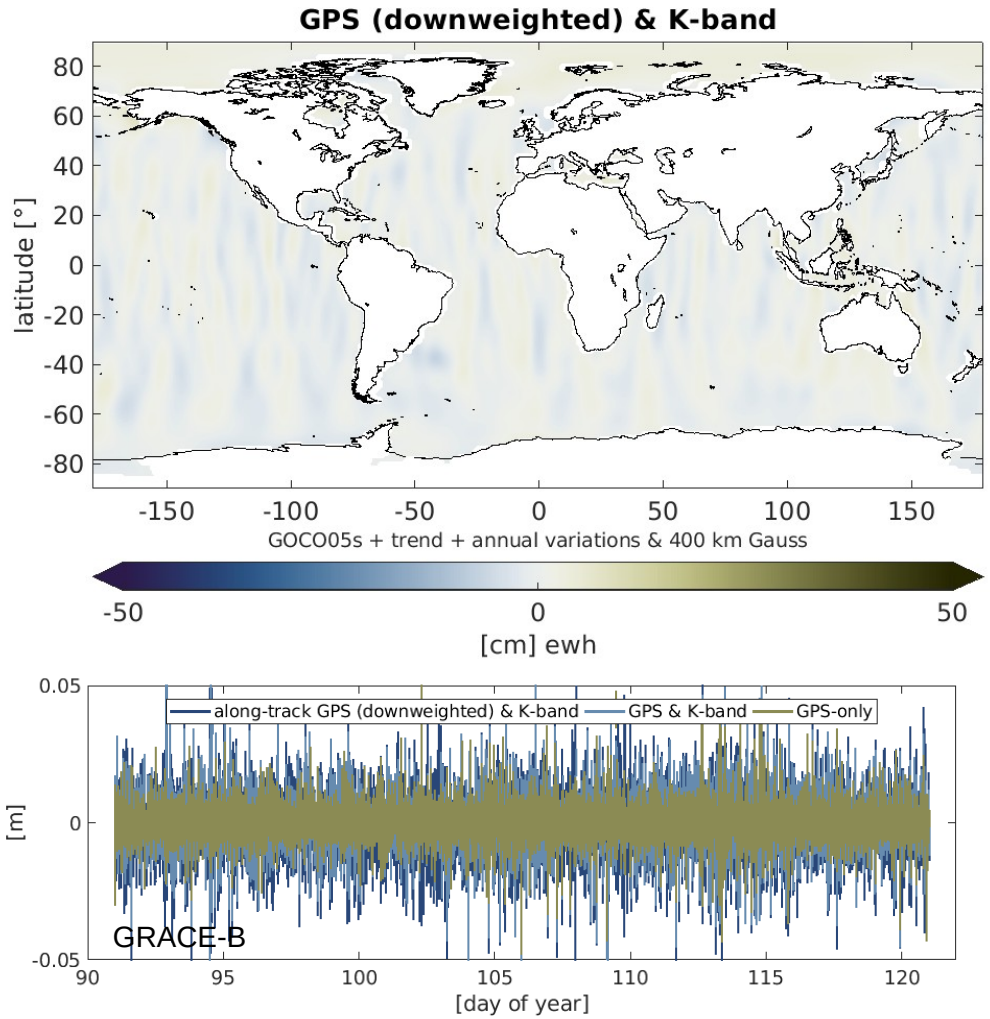


GPS & K-band



RMS = 1.57 cm

GPS (downweighted) & K-band

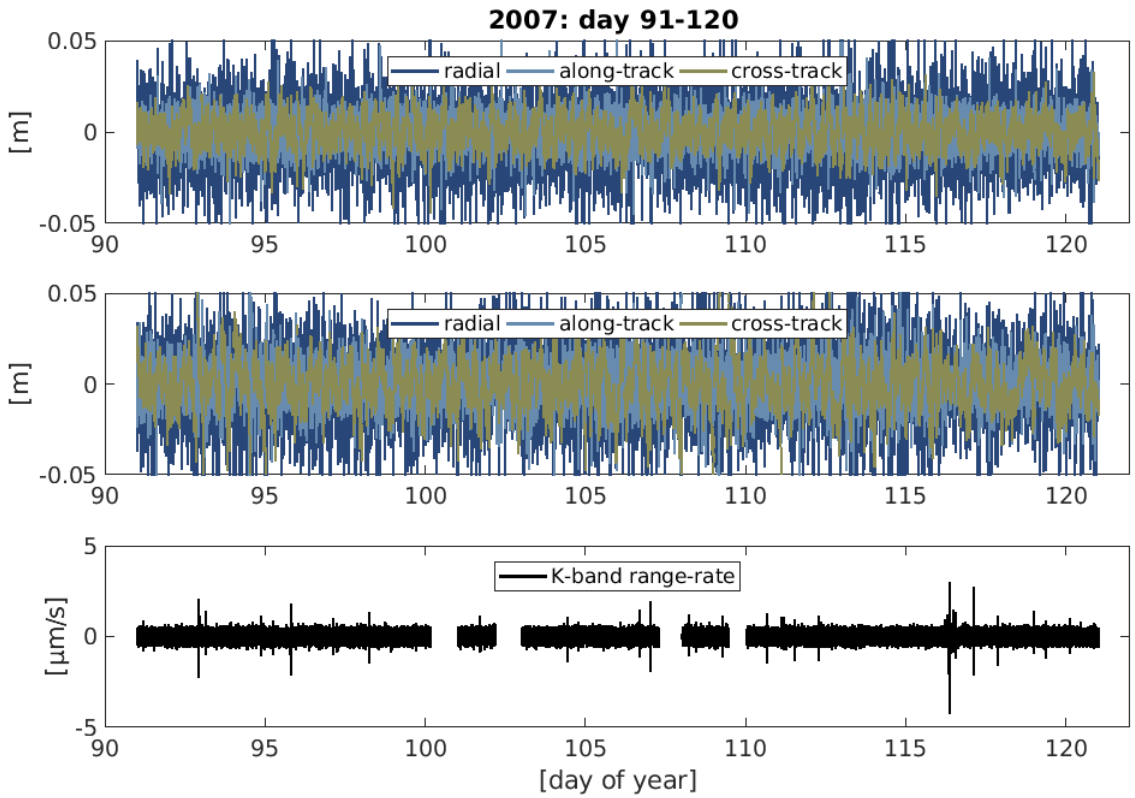


Post-fit residuals

1. Estimate orbit and gravity field

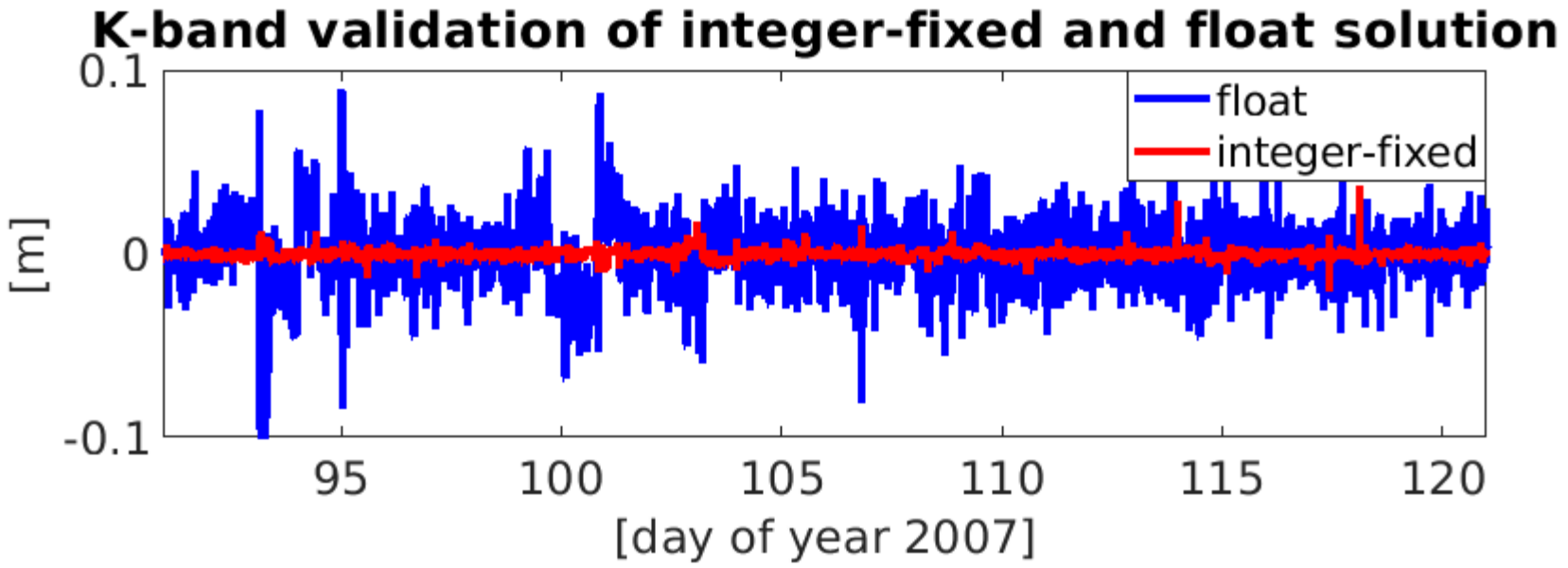
2. Evaluate estimated orbit in the new force field

3. Difference to original
   - kinematic positions
   - K-band range-rate observations

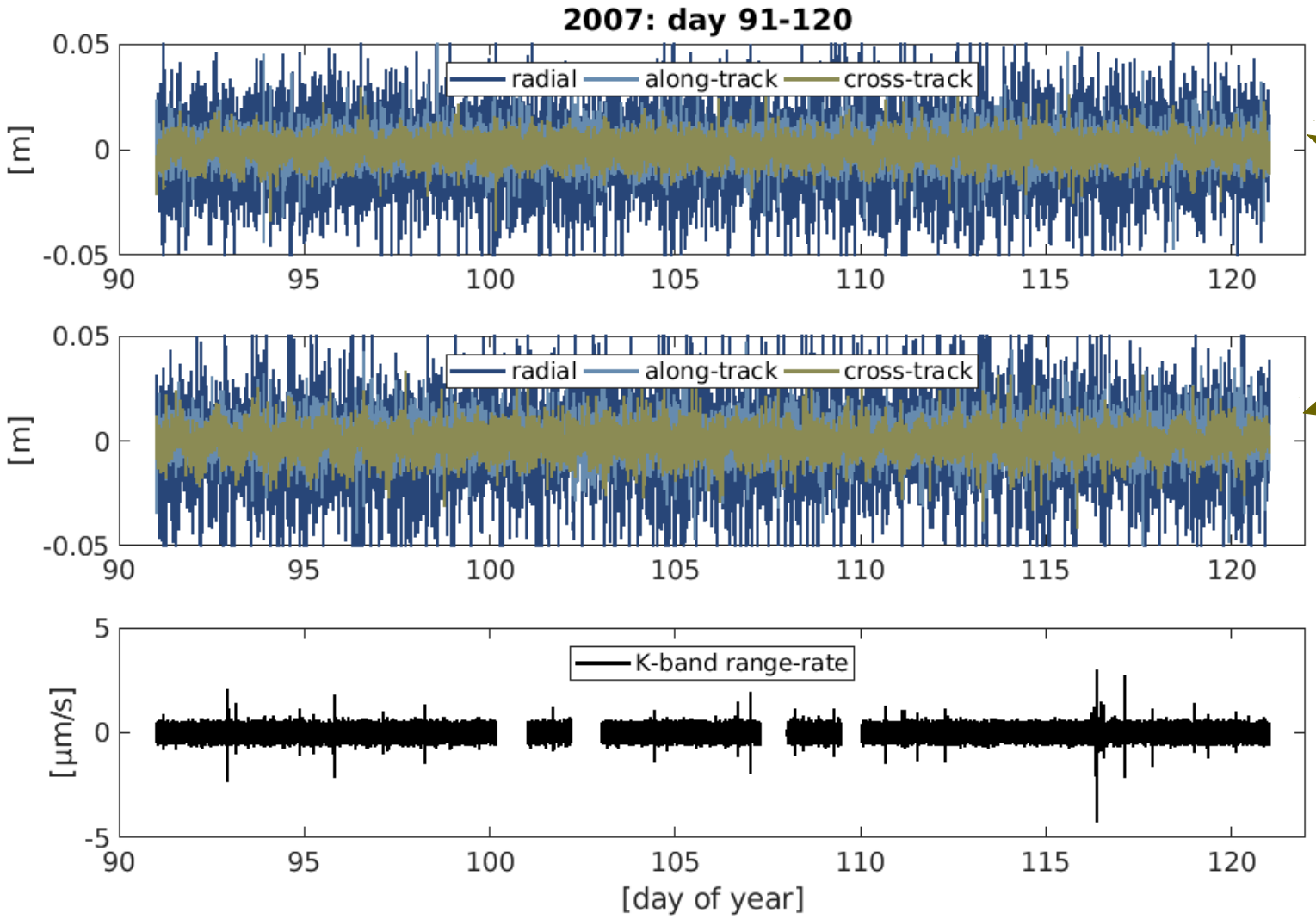


Towards a solution...

Fixing carrier phase ambiguities to integer values
→ higher consistency between two GRACE satellites (i.e. K-band)



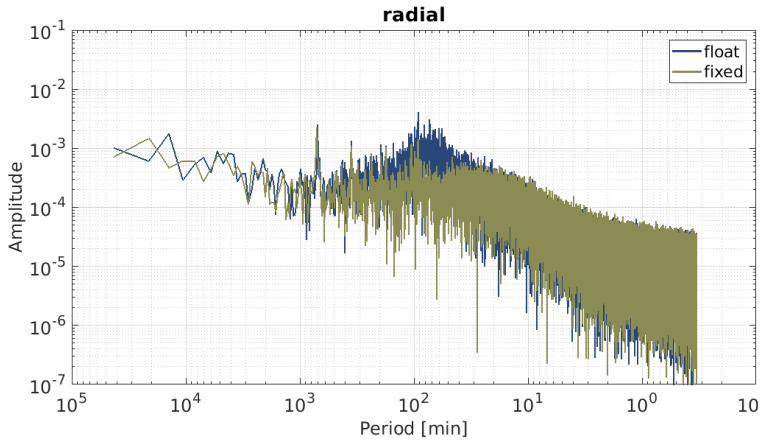
In terms of post-fit residuals

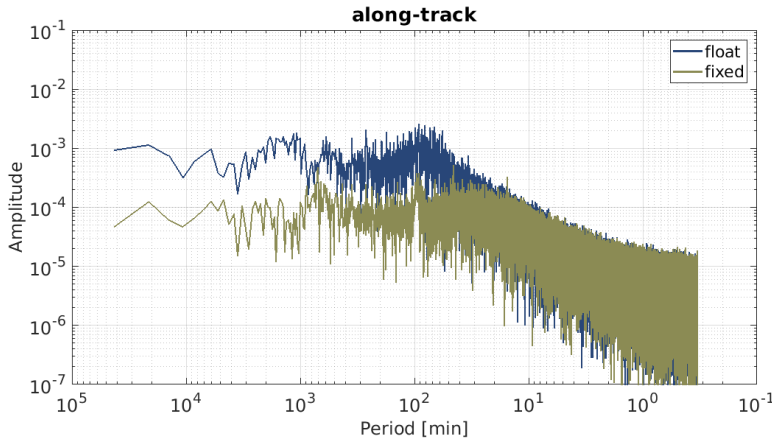


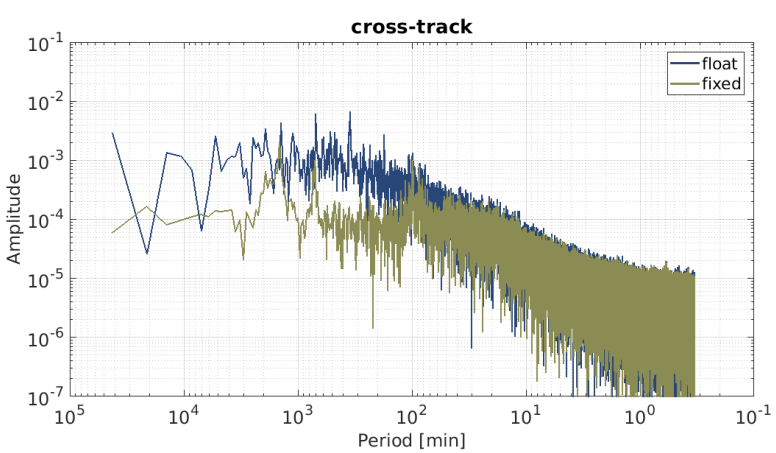
less noise in the co-estimated orbit residuals

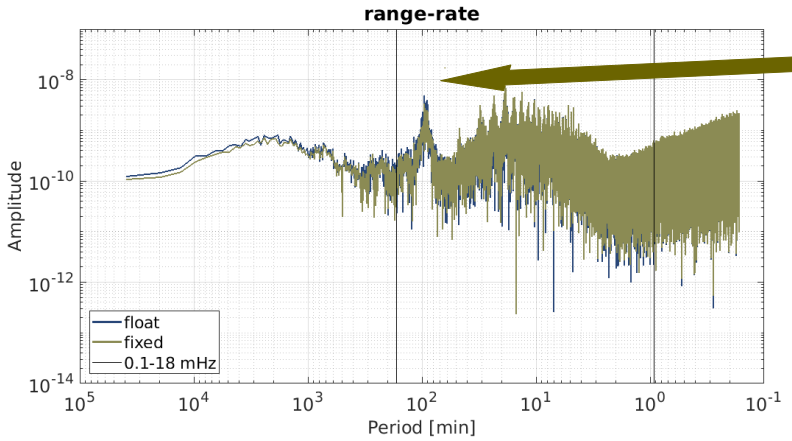
almost no difference in range-rate

Spectral analysis



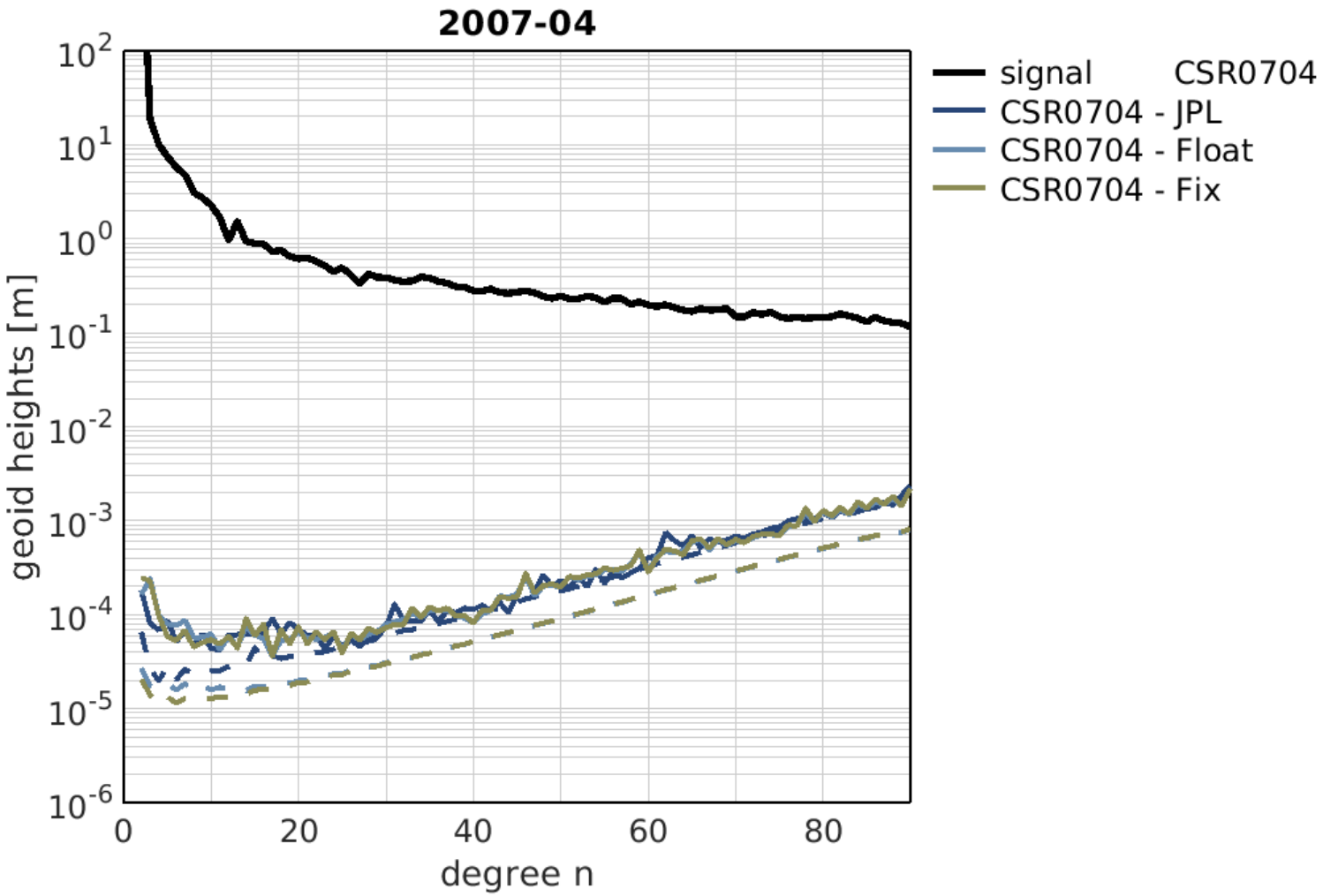




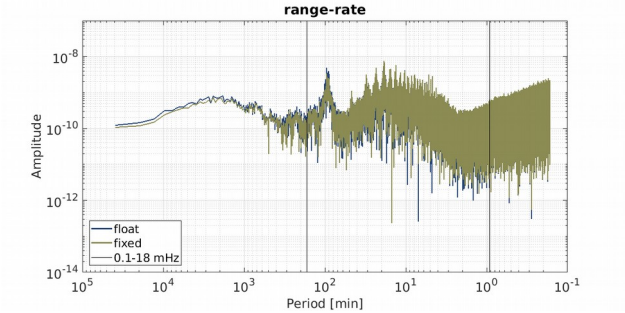


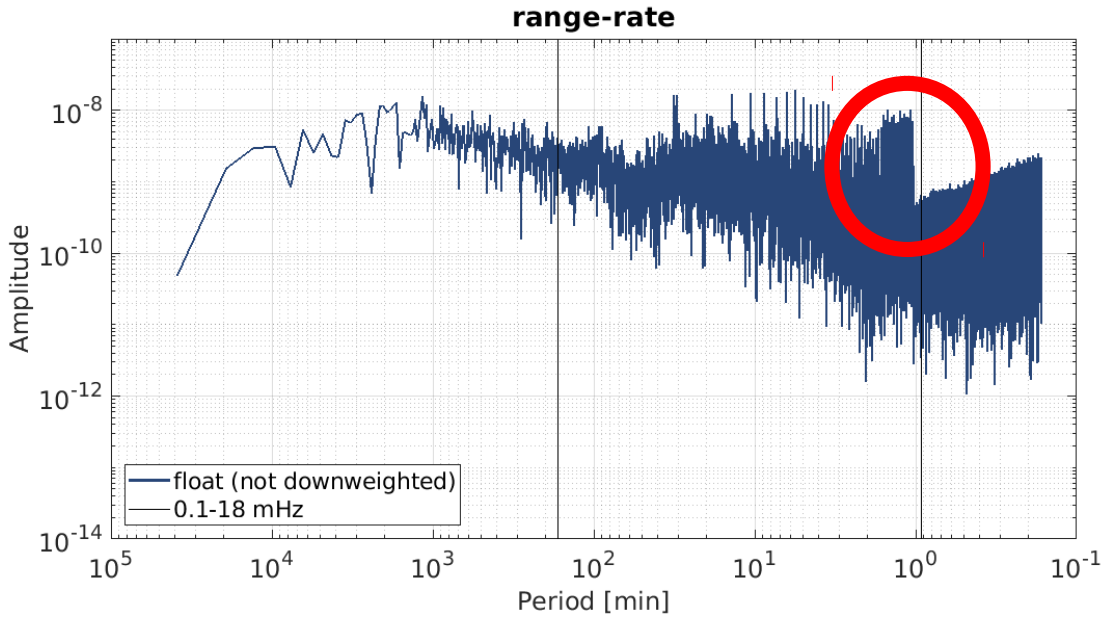
peaks at multiples per revolution

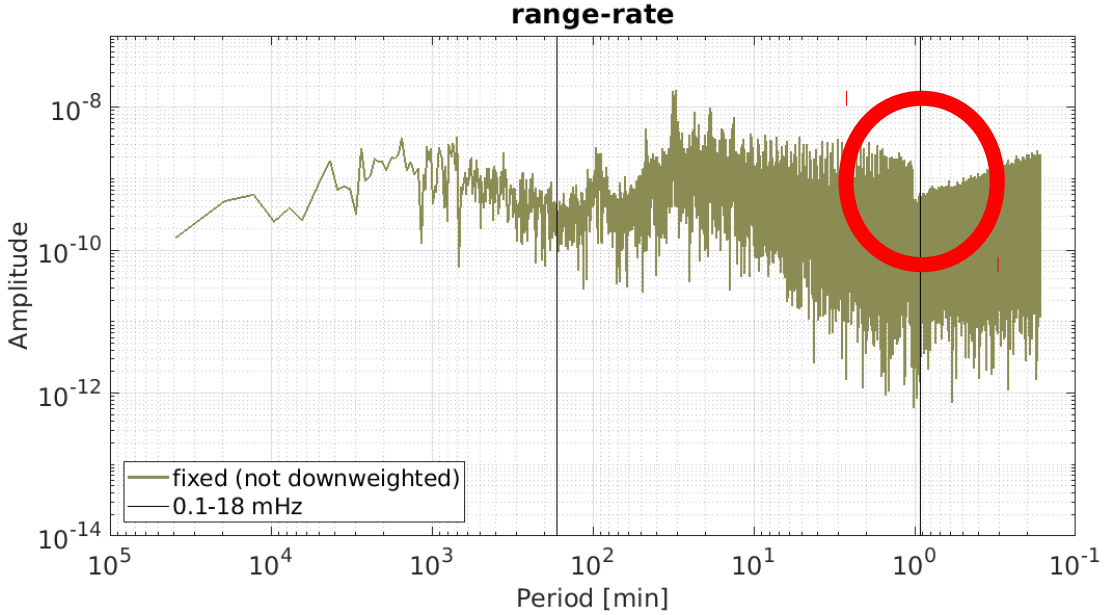
Gravity field solution



No downweighting of GPS

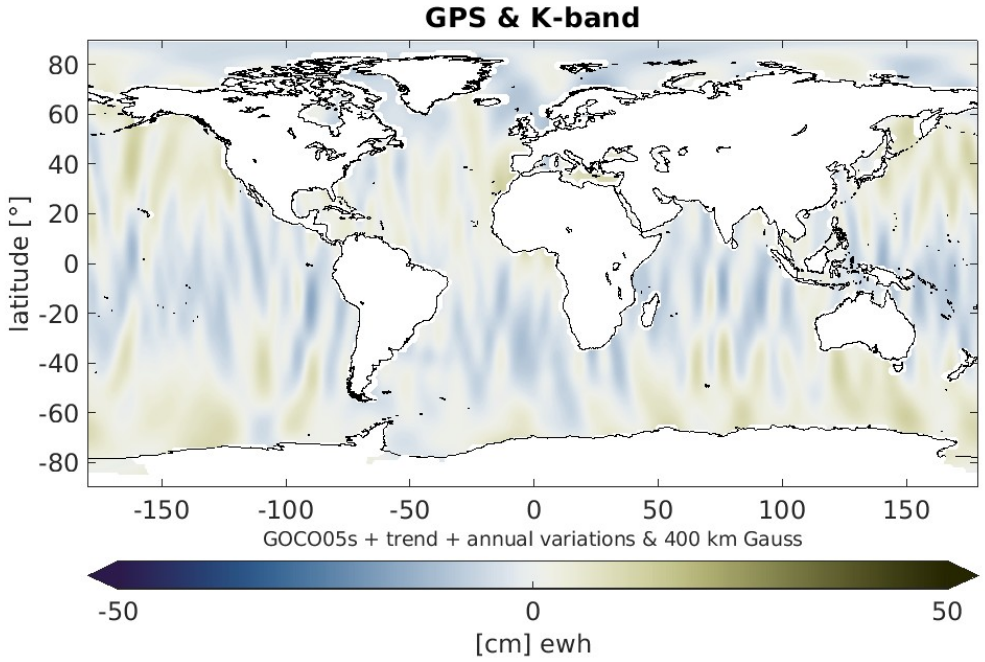


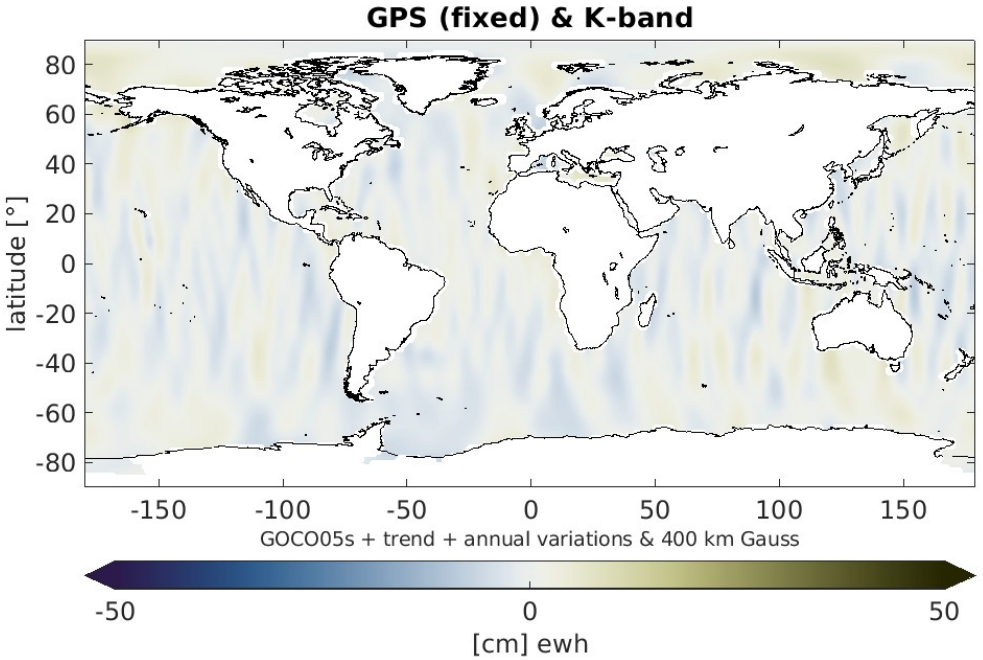




No downweighting of GPS – gravity field

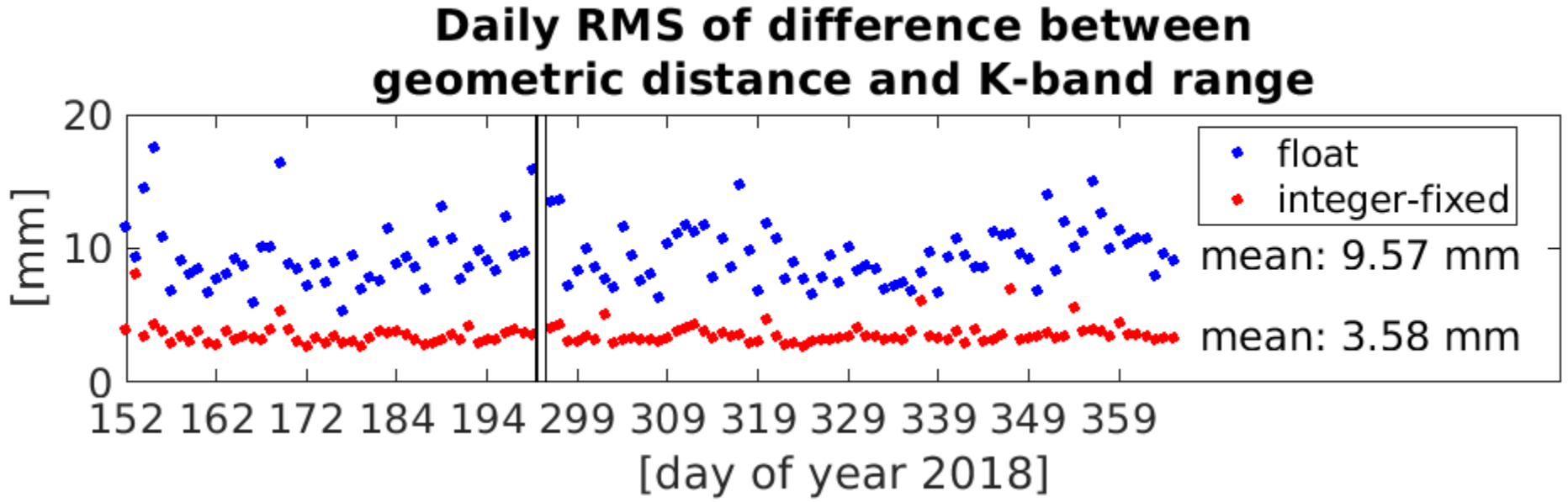
RMS = 4.17 cm





RMS = 2.16 cm

Outlook to GRACE Follow-On



Less (long-periodic) noise in the kinematic positions

→ orbits of the two satellites are more consistent

→ K-band observations become more apparent and easier to handle

→ downweighting of GPS could be reduced

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