Non-dedicated satellite missions for time variable gravity field estimation

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Introduction

- High-low satellite-to-satellite tracking often proposed as possible gap filling technology
- Proof of concept in several recent studies
- Most of them based on data from CHAMP, GRACE or GOCE

- *BUT: non of them is available in case of a gap between GRACE and GRACE-FO*

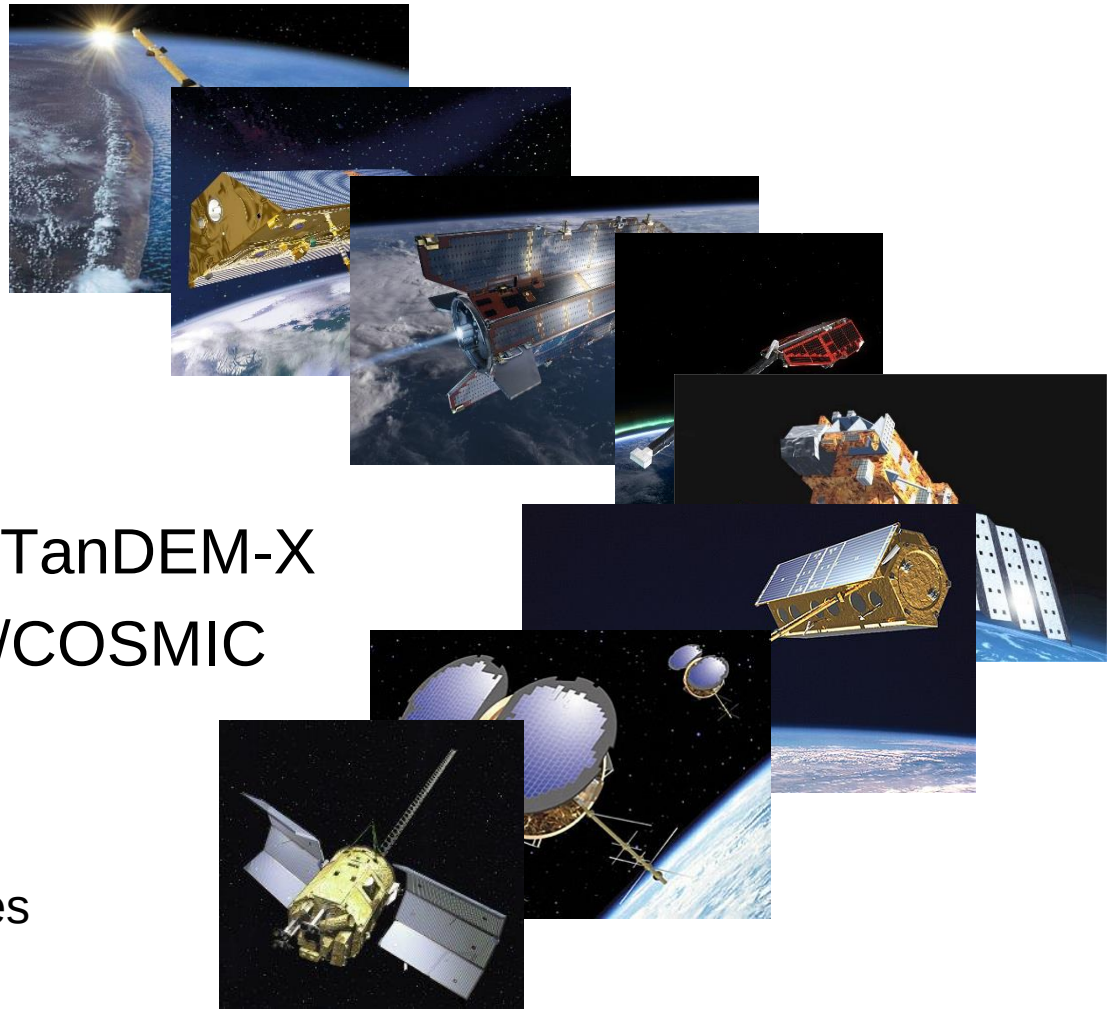
- *Question: Which other mission could provide this information?*

SST high-low

- Kinematic orbits
  - PPP approach
  - Raw code and phase observations
  - PCVs for rec./trans., higher order ionosphere, ionospheric bending, …
- Gravity field estimation
  - short arc integral approach ⇨ monthly solutions (max. D/O 60)
  - No K-Band data
  - No regularization
  - No Kalman filter
- Combination on the level of normal equations
- Missions?

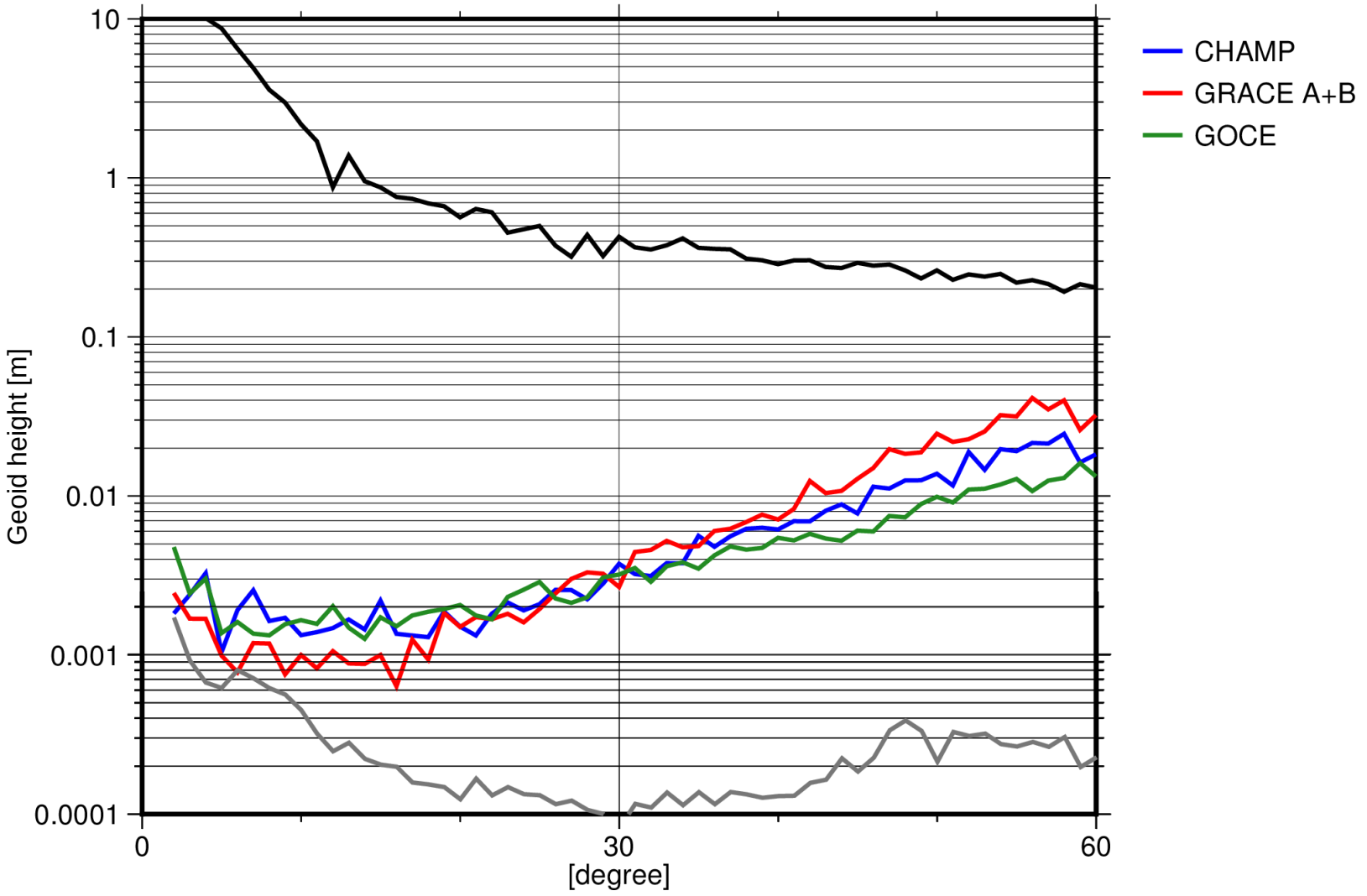
Missions

- CHAMP
- GRACE
- GOCE



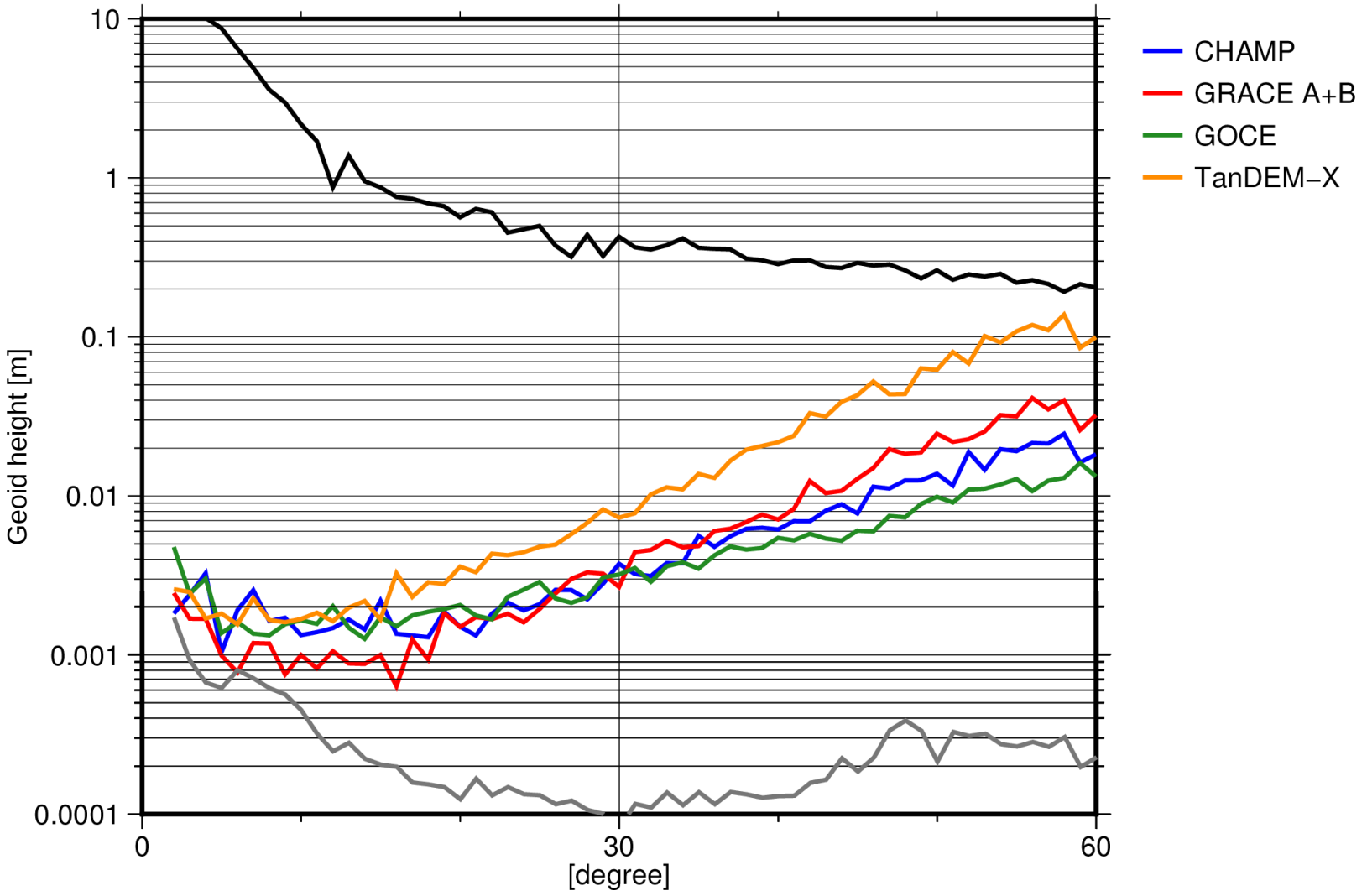
- Swarm
- MetOp A & B
- TerraSAR-X & TanDEM-X
- FORMOSAT-3/COSMIC
- SAC-C
  - Total 18 satellites

Individual solutions



Polar gap of
18° excluded

Individual solutions



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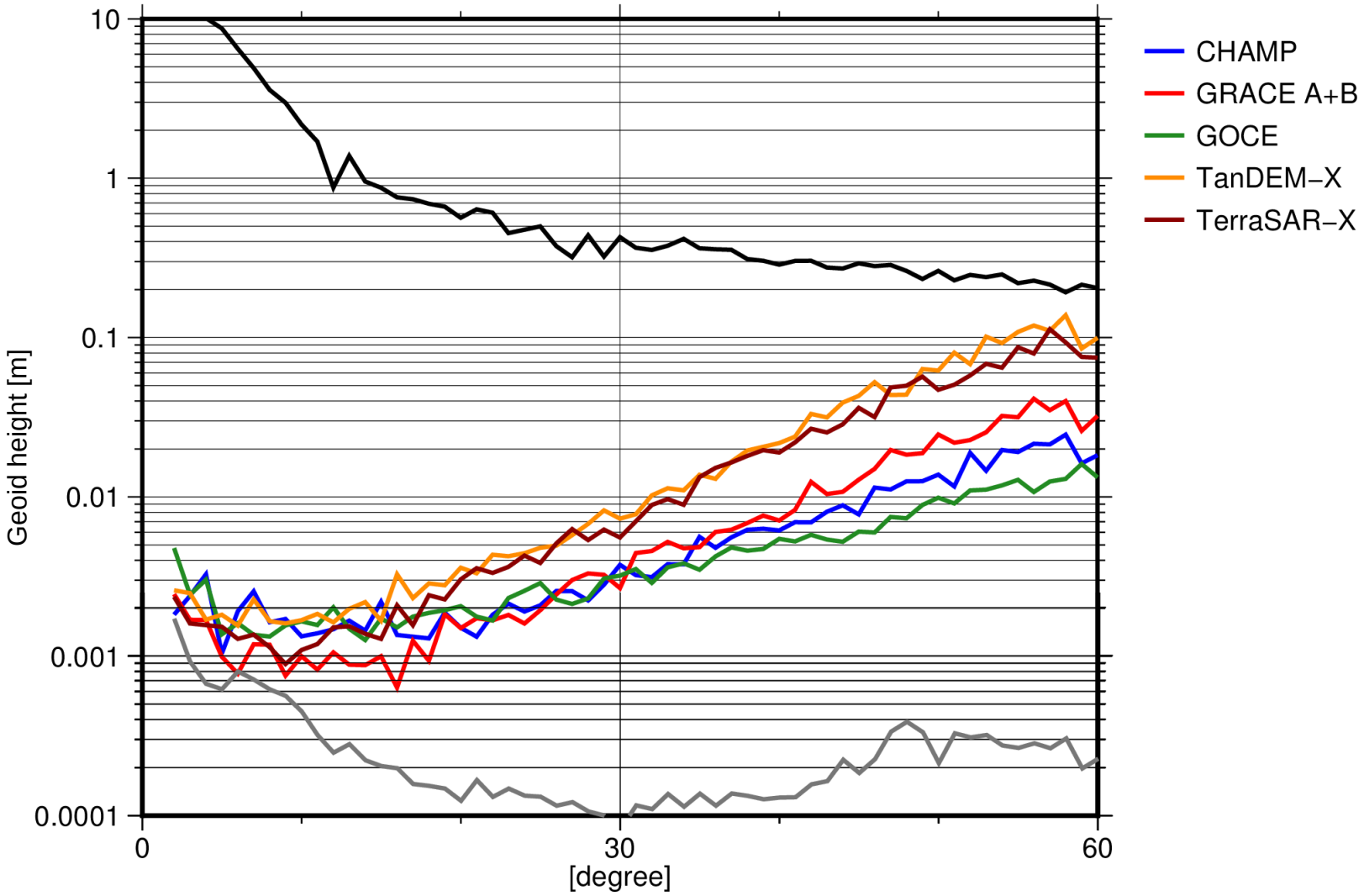

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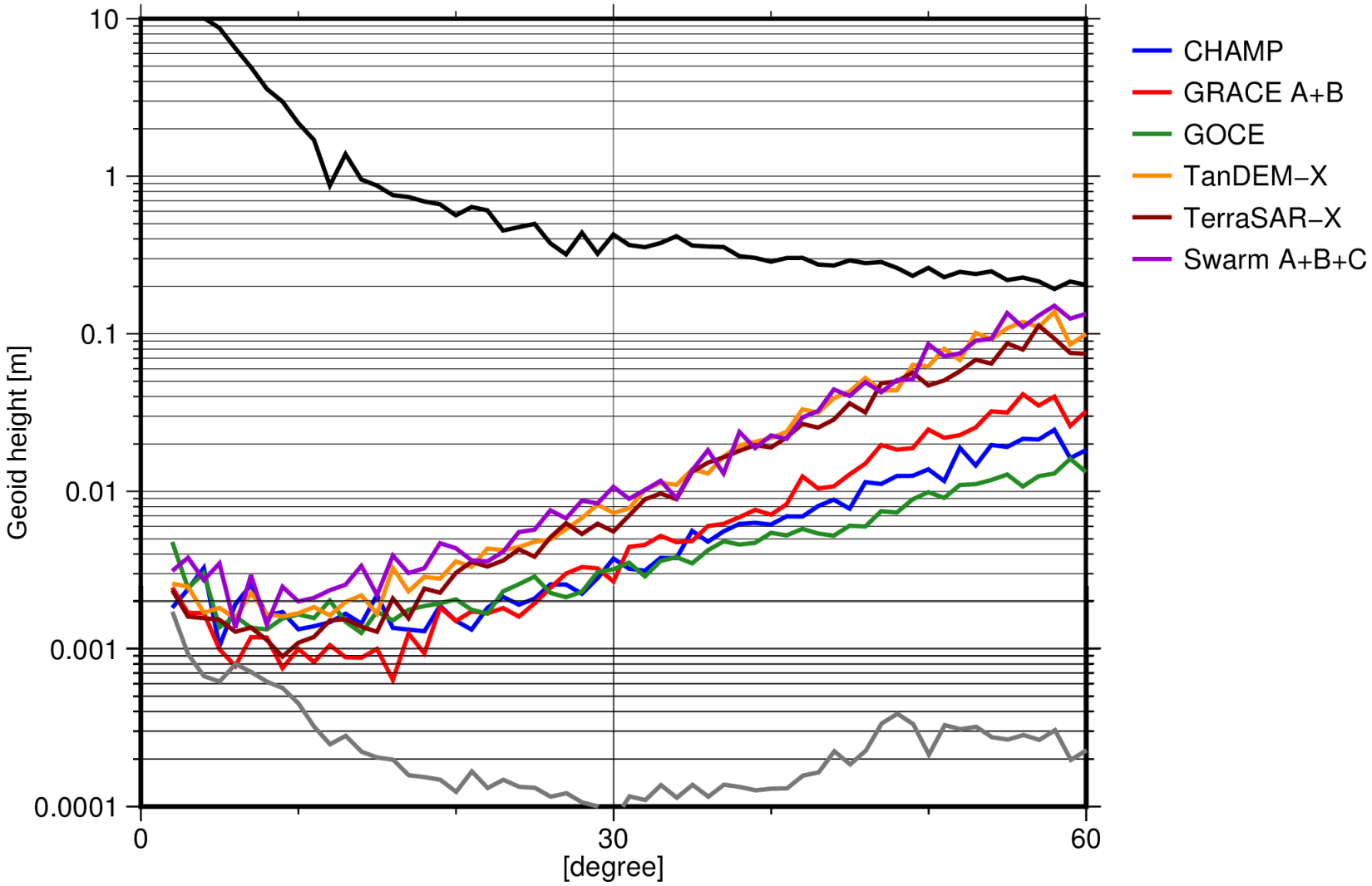

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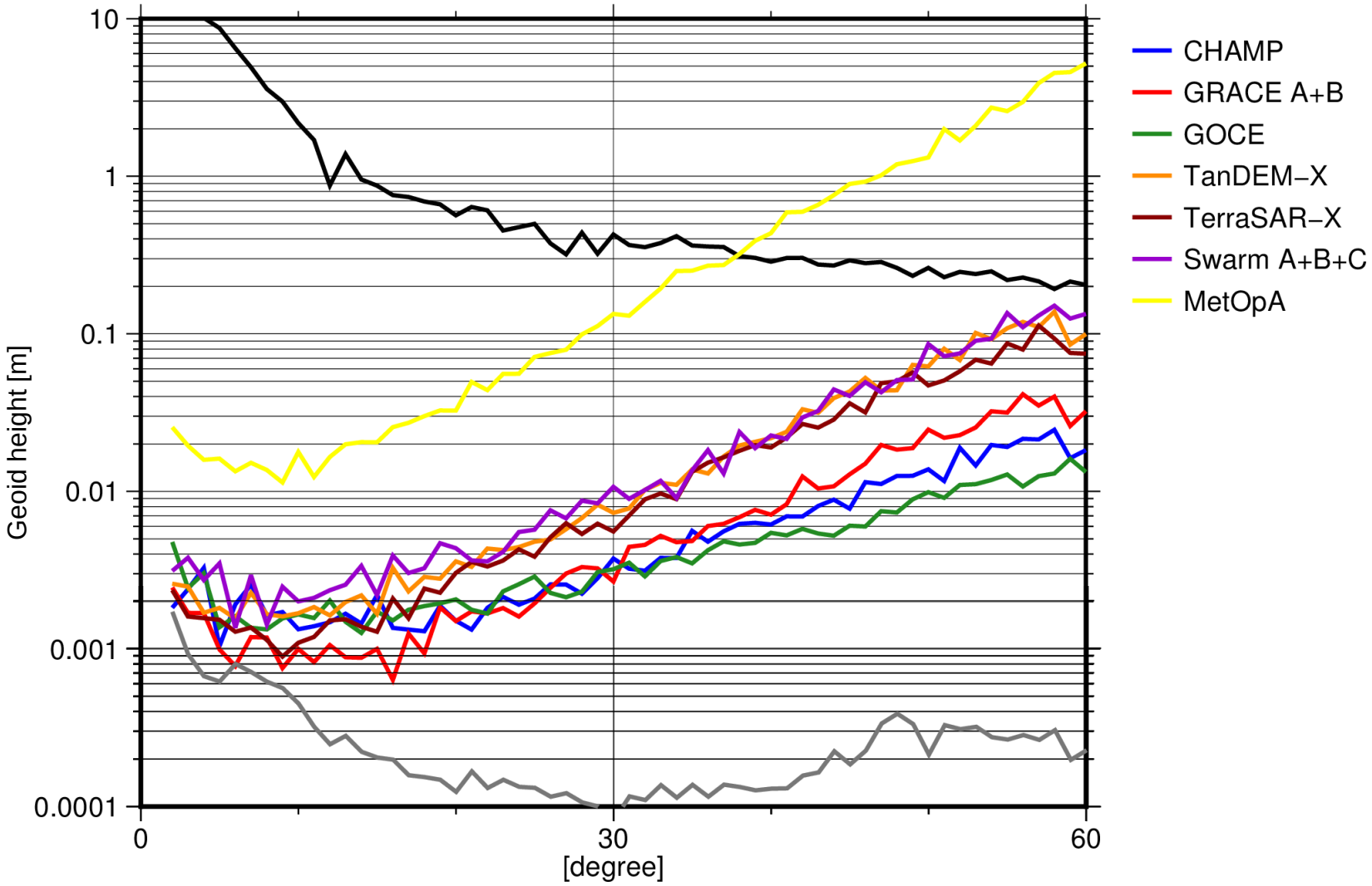
Individual solutions



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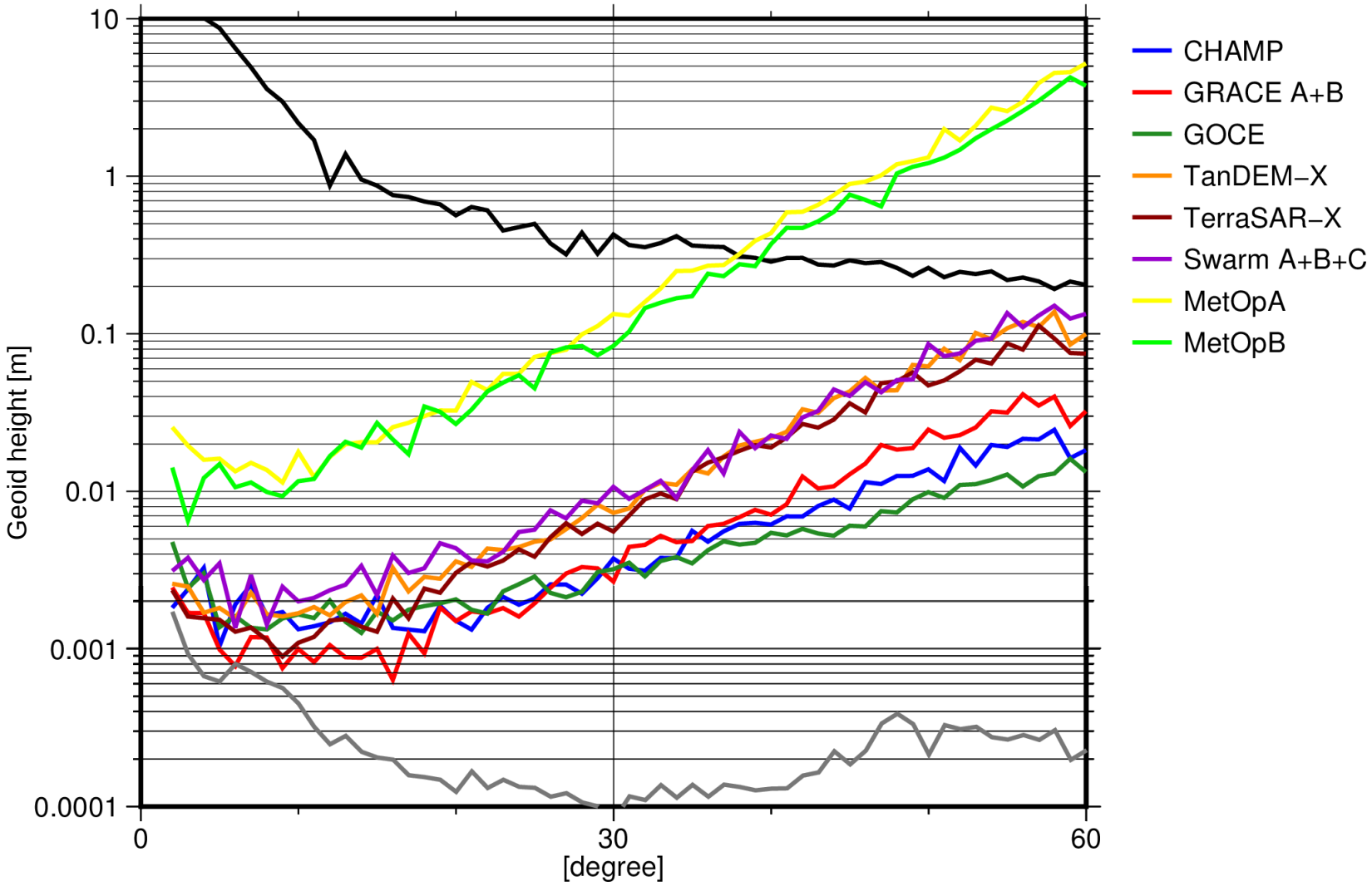

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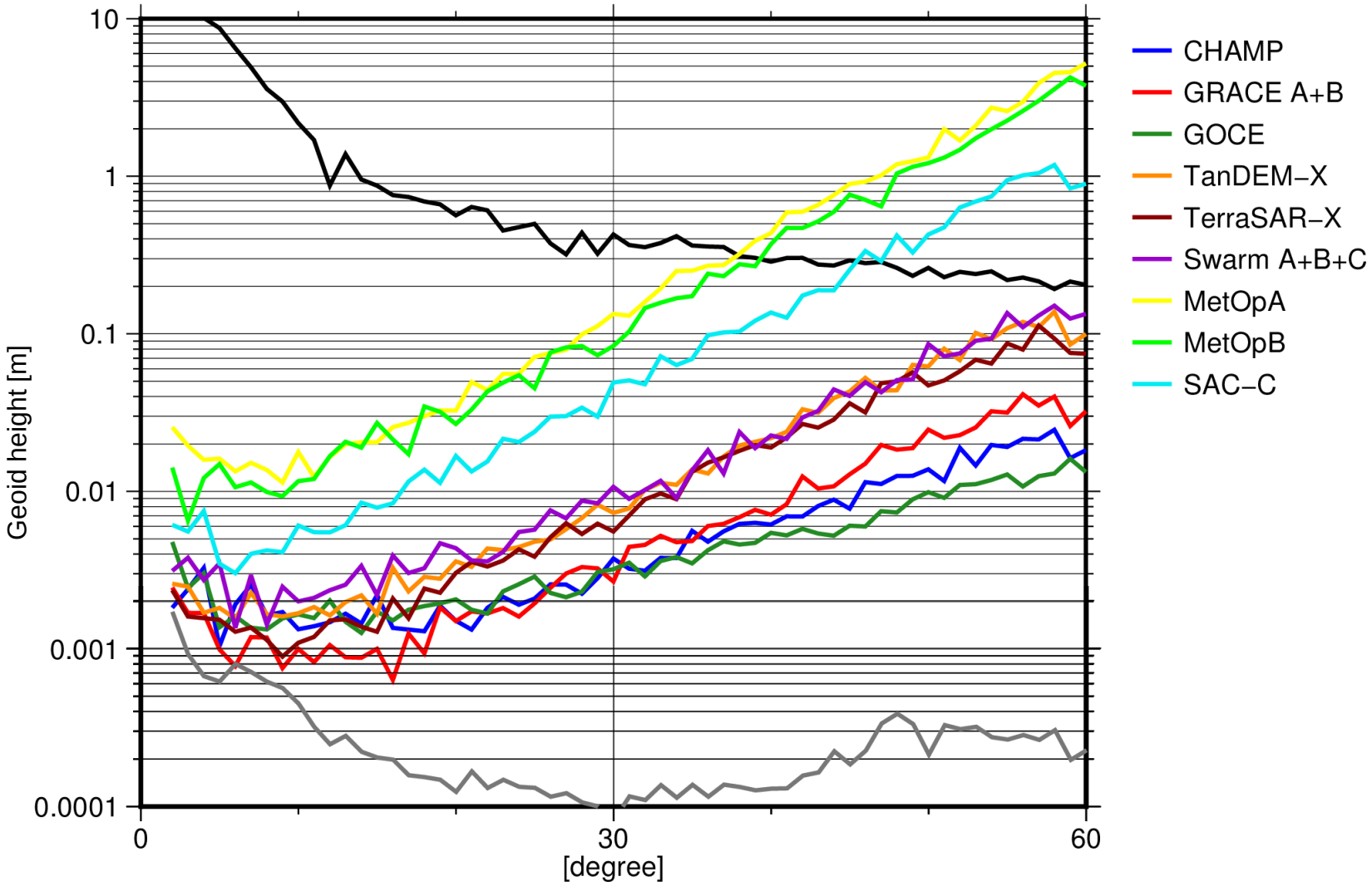

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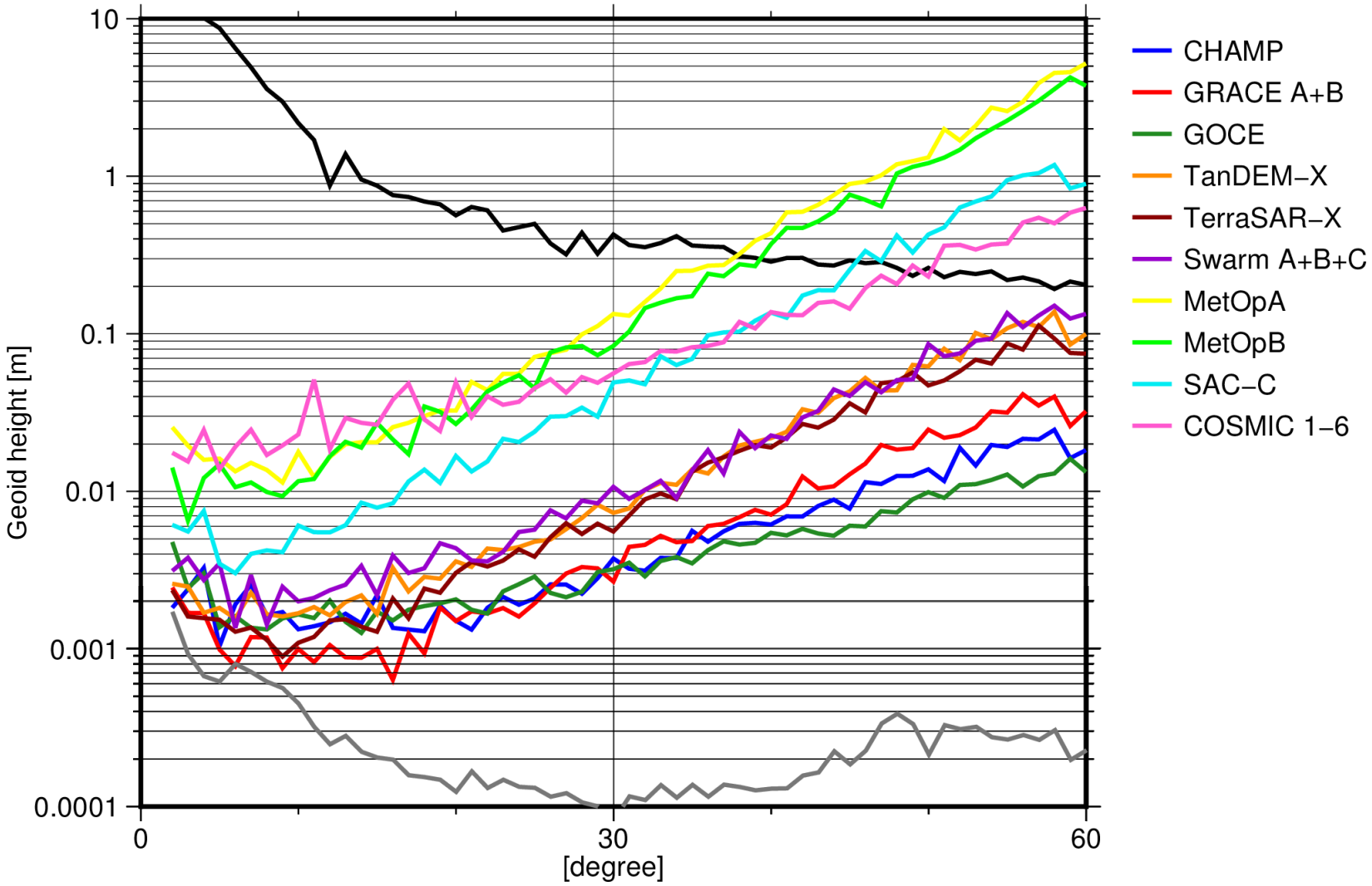


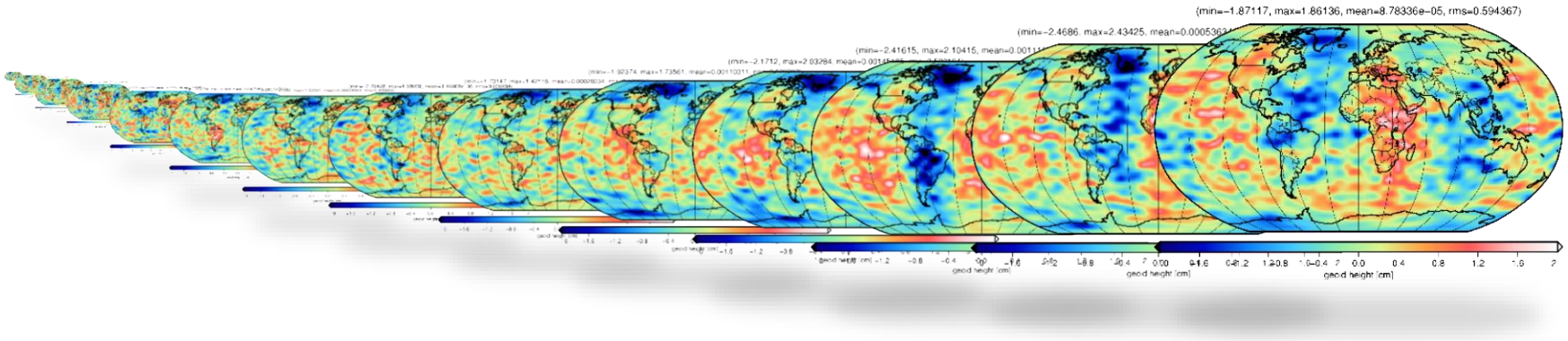
Polar gap of
18° excluded

Combined solutions

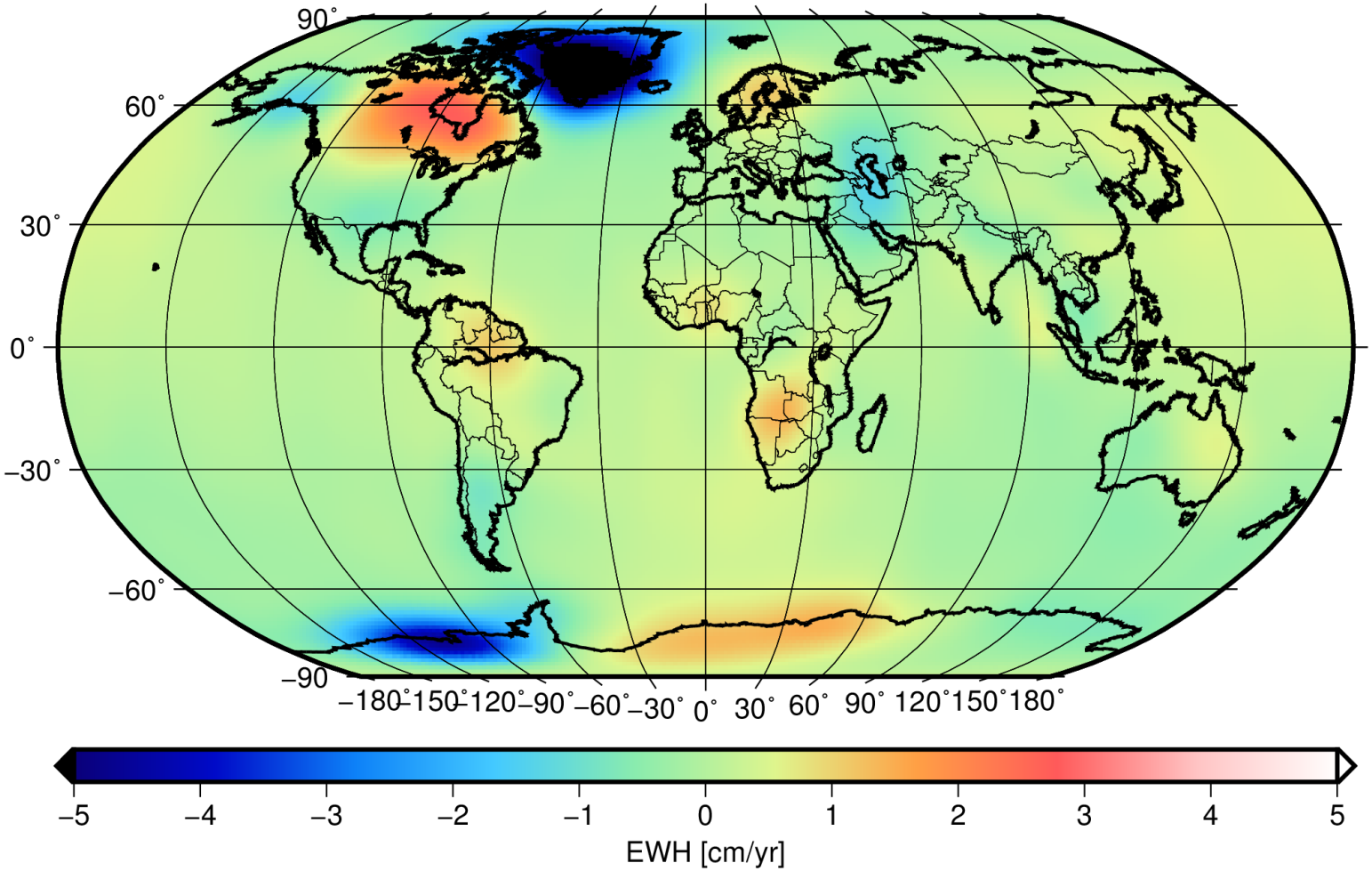
- Different combinations for time frame 2003-2014

1. Grace (SST-hl)
2. All satellites
3. Non-dedicated (including Champ)

- Evaluation in terms of trend and seasonal signal
  - Reference: ITSG-Grace2014

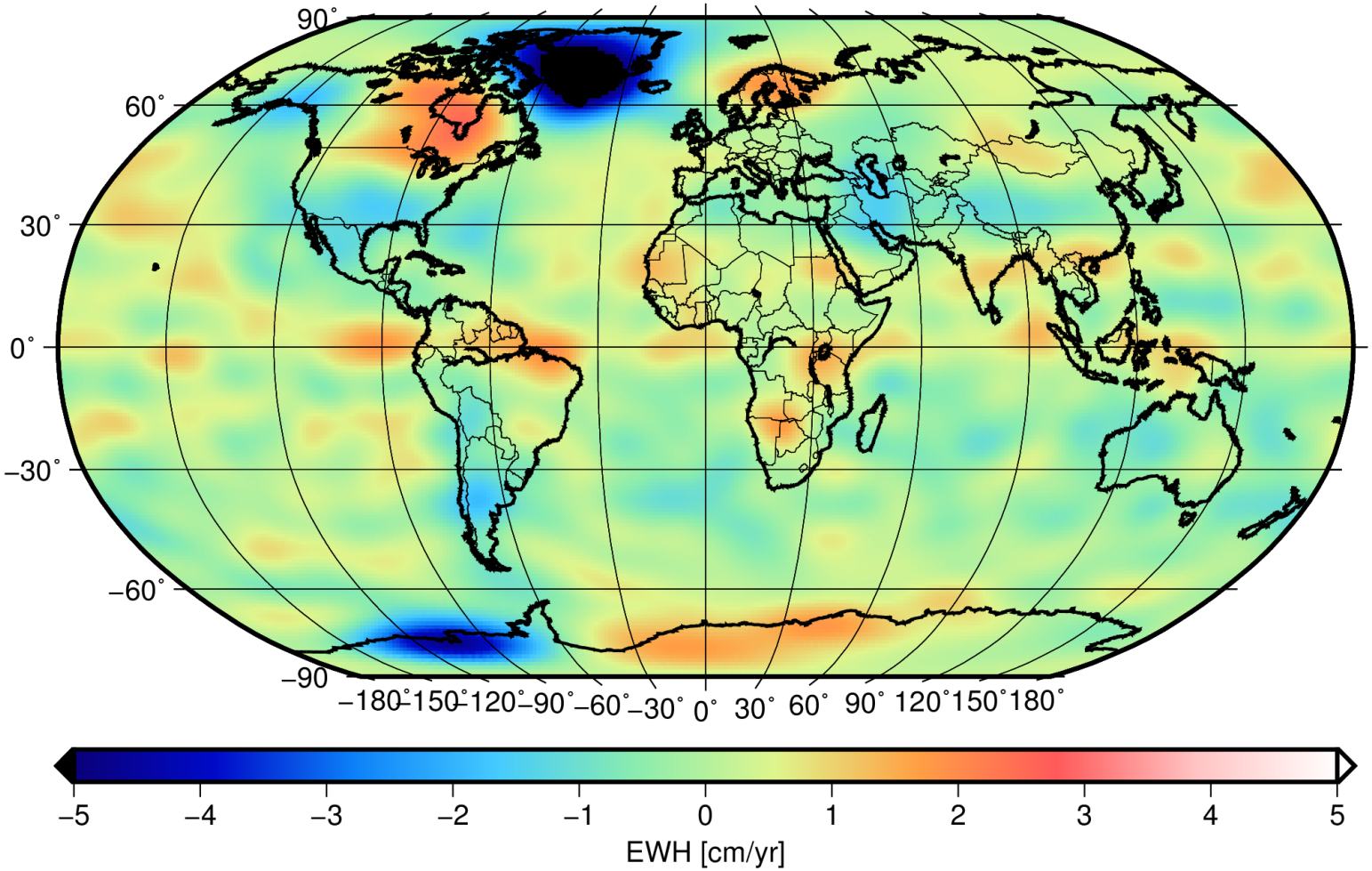


Trend: ITSG-Grace2014



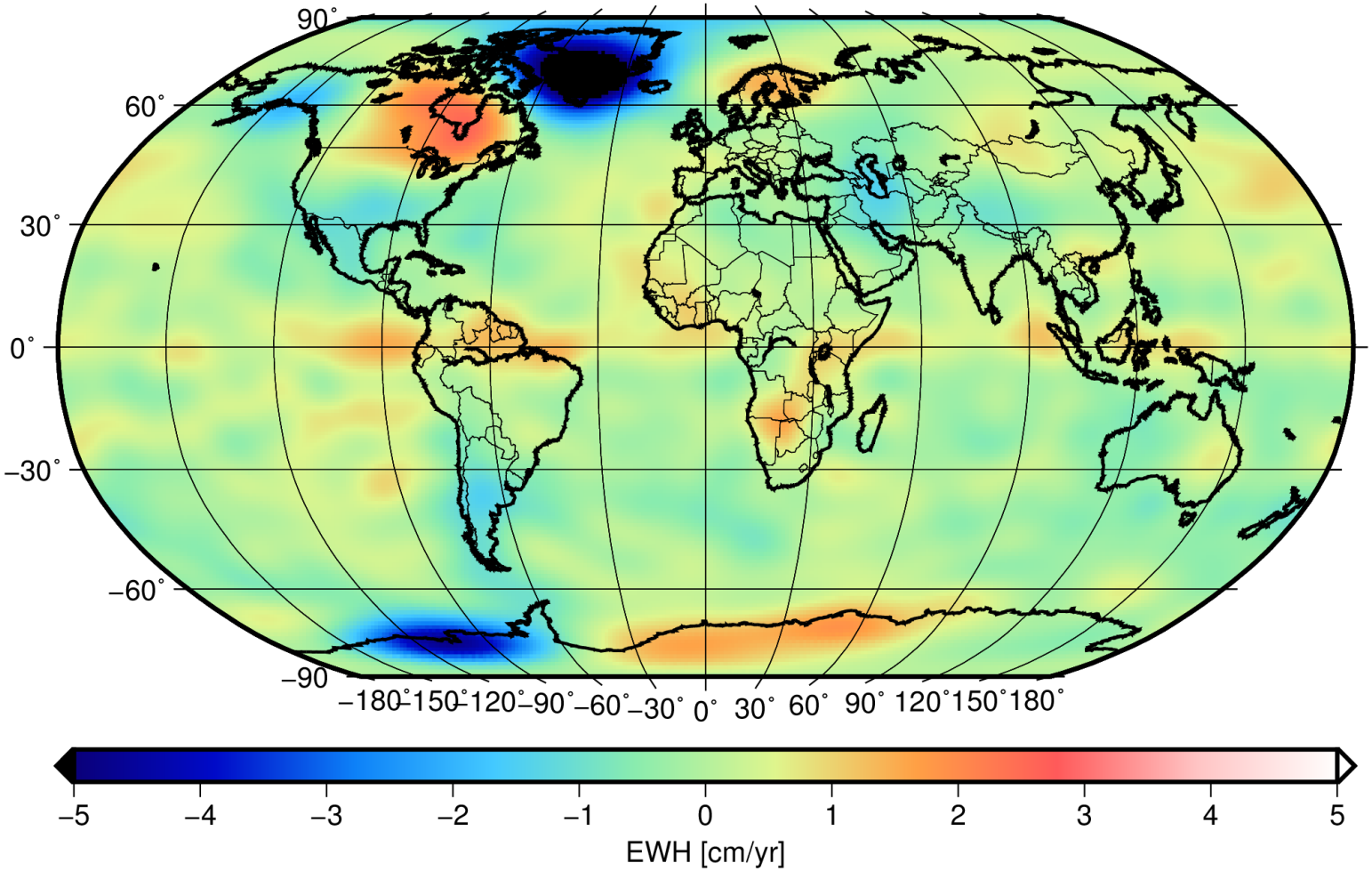
Gaussian filter 750 km

1. Grace (SST-hl)



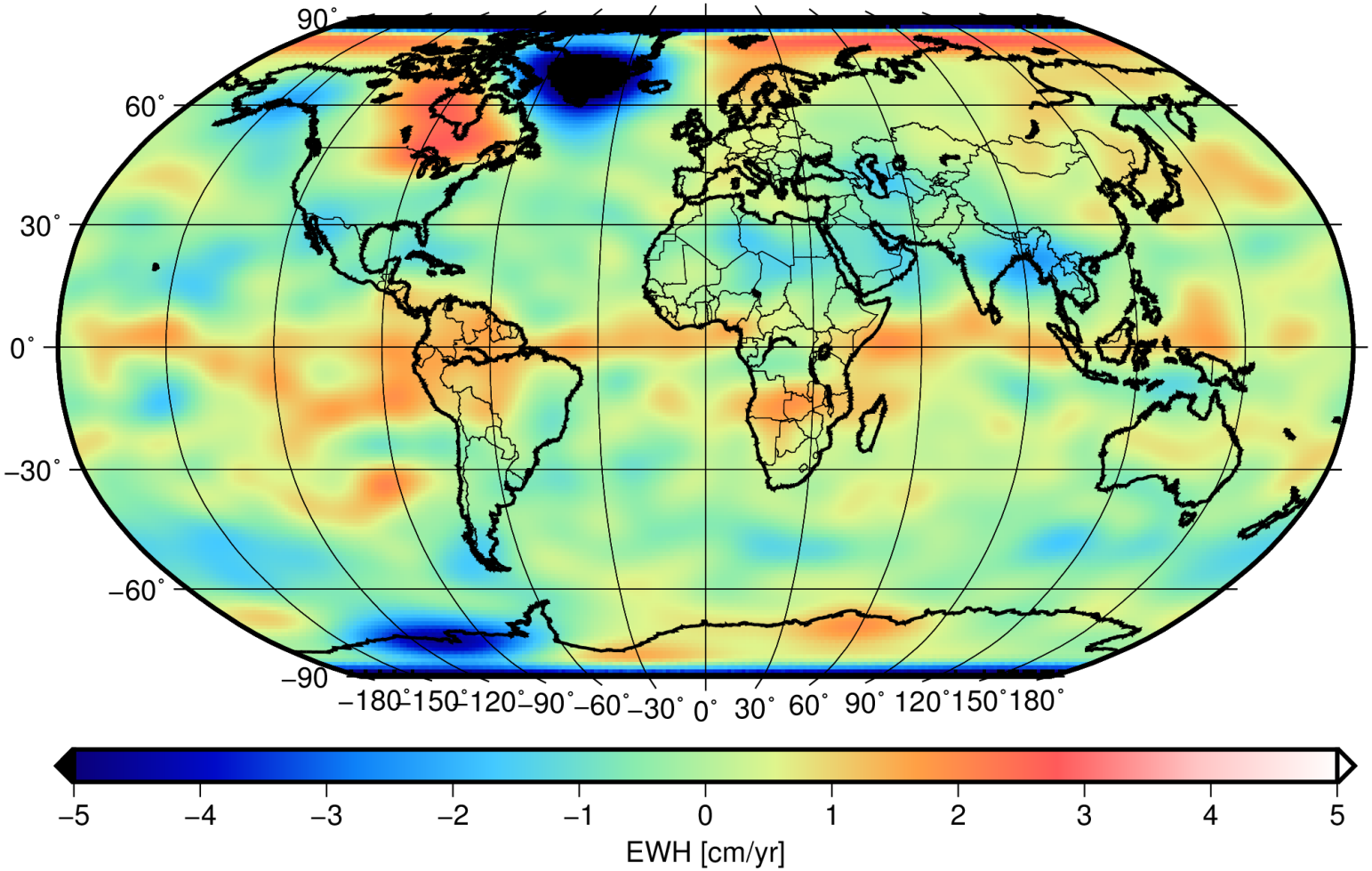
Gaussian filter 750 km

2. All satellites



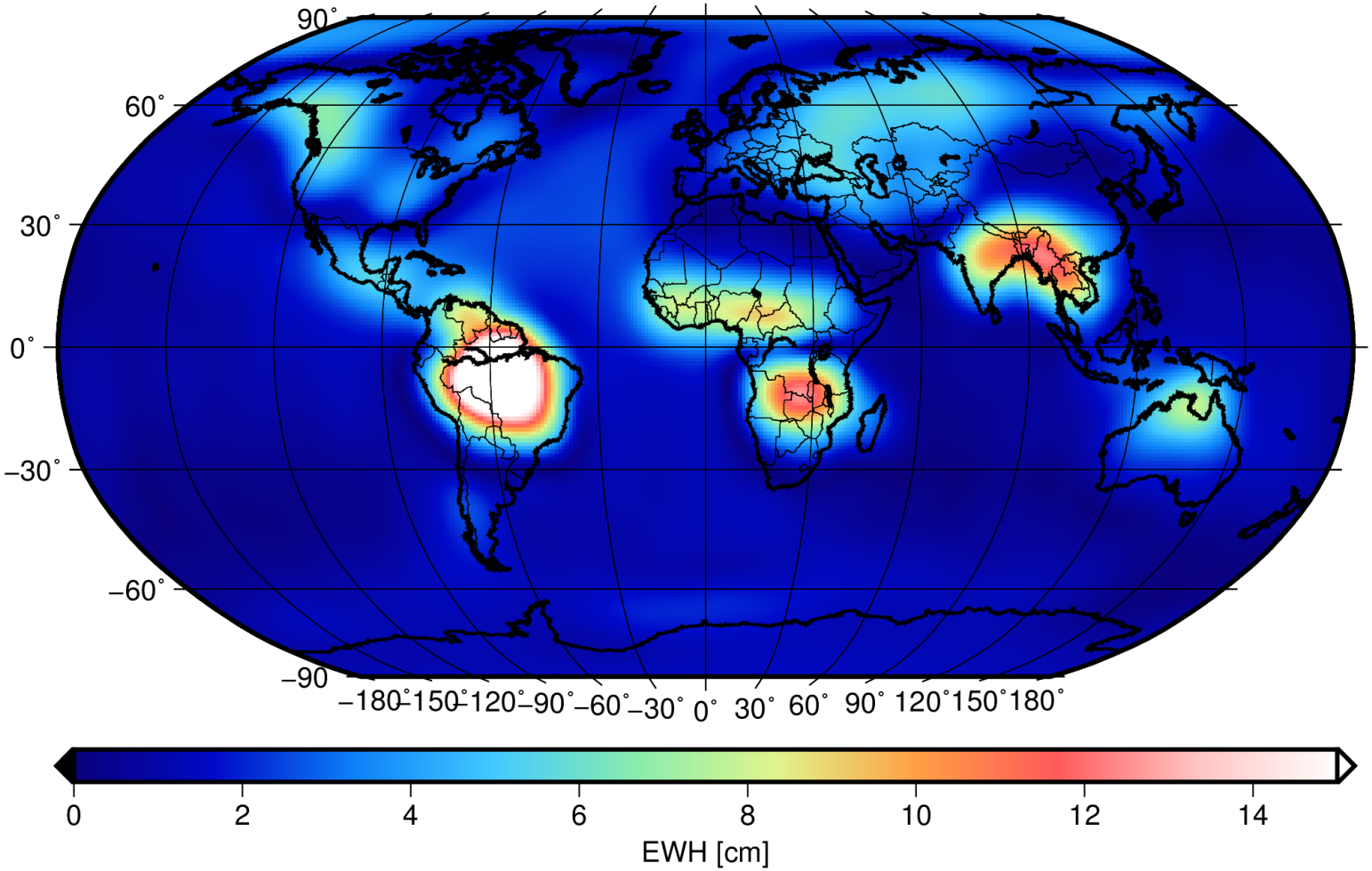
Gaussian filter 750 km

3. Non-dedicated



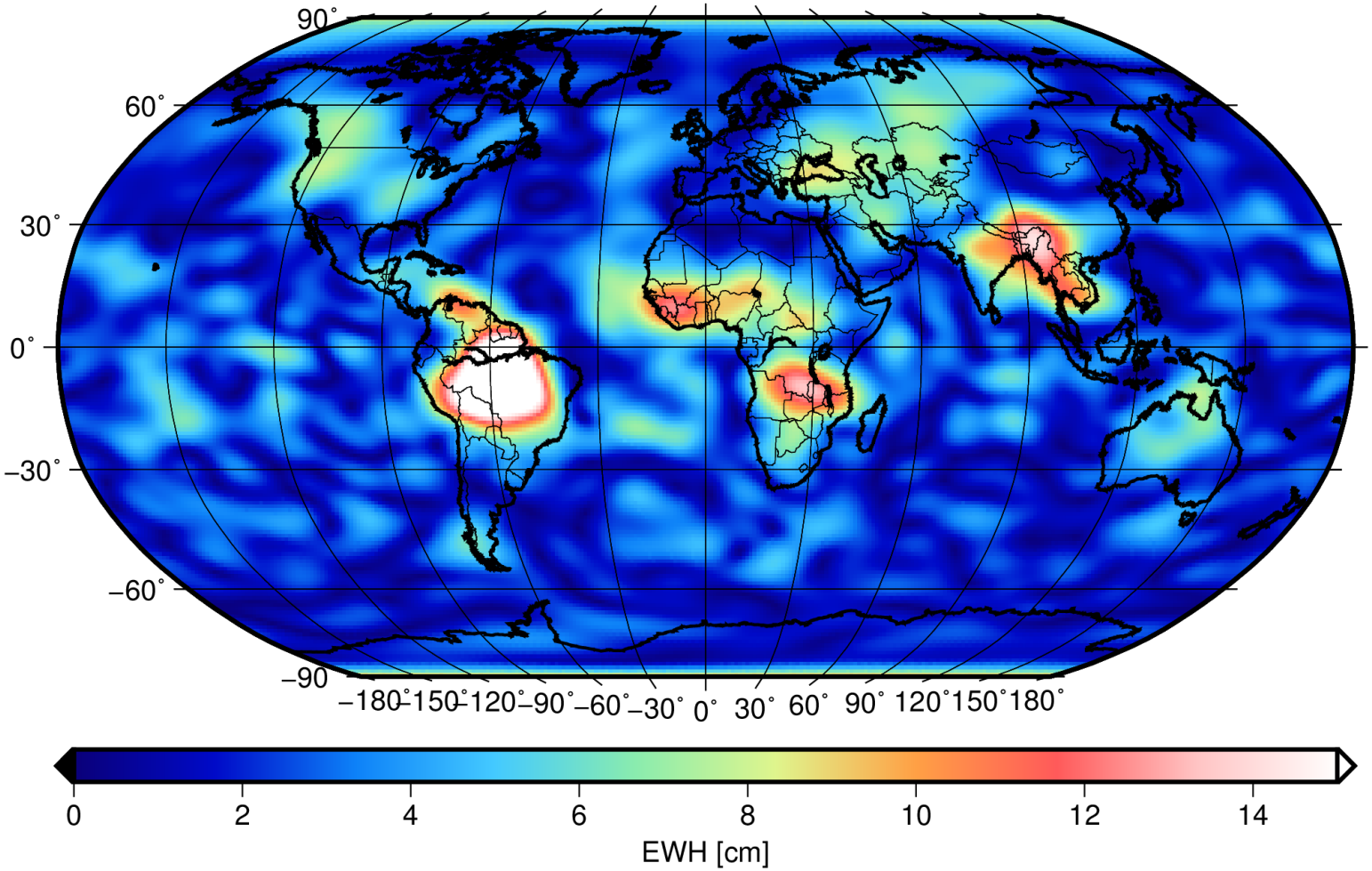
Gaussian filter 750 km

Amplitude: ITSG-Grace2014



Gaussian filter 750 km

1. Grace (SST-hl)



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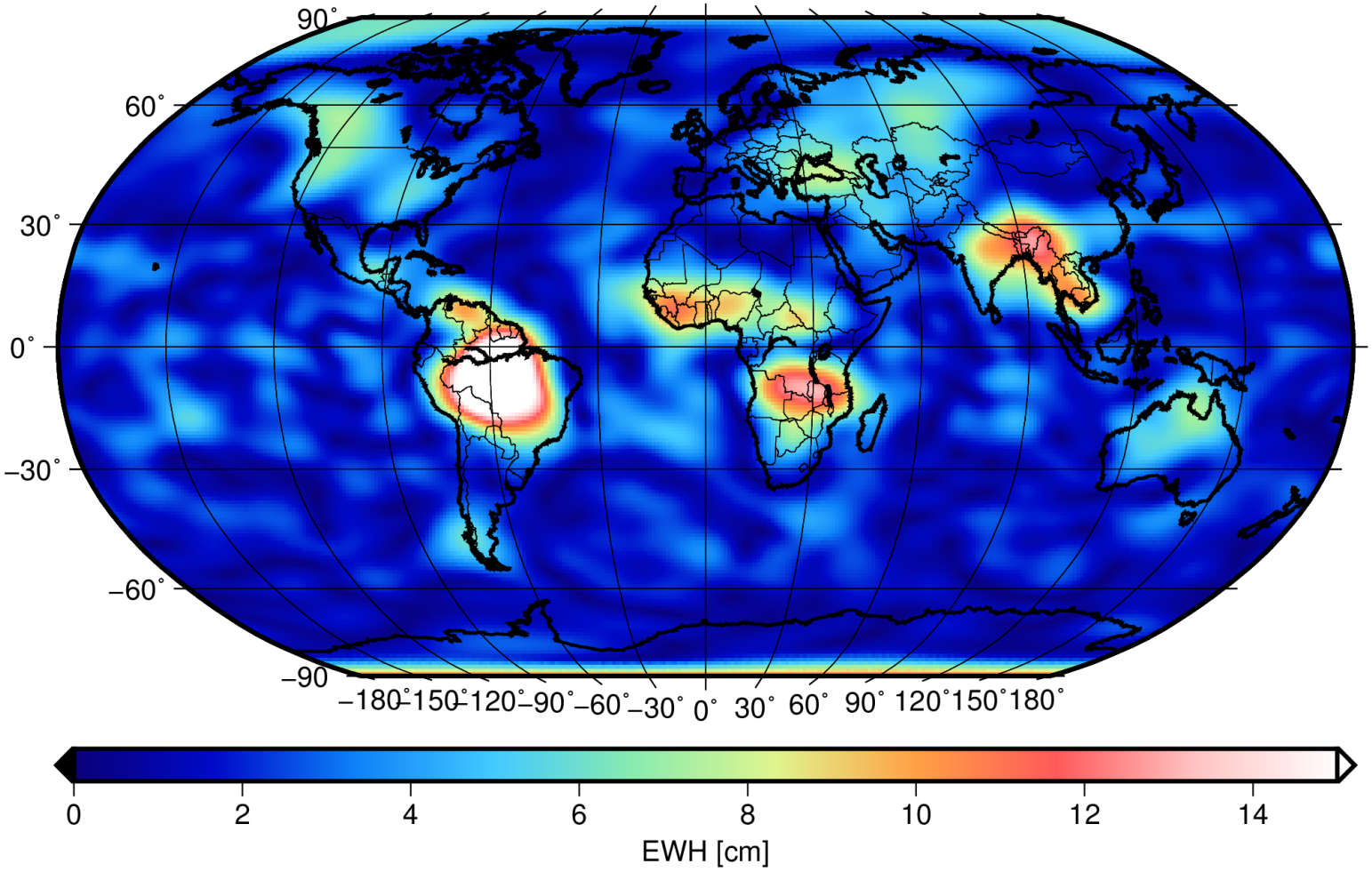

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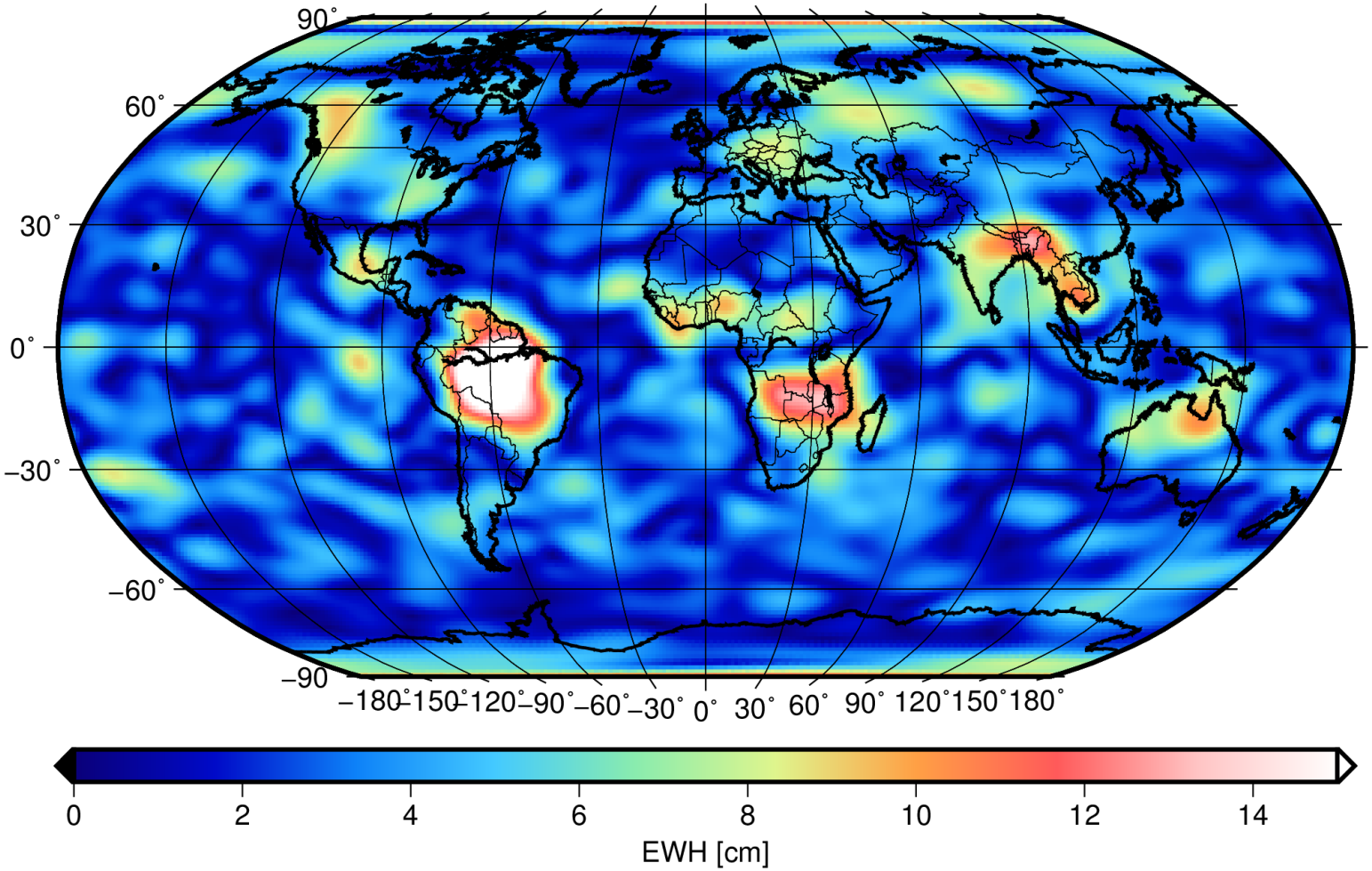
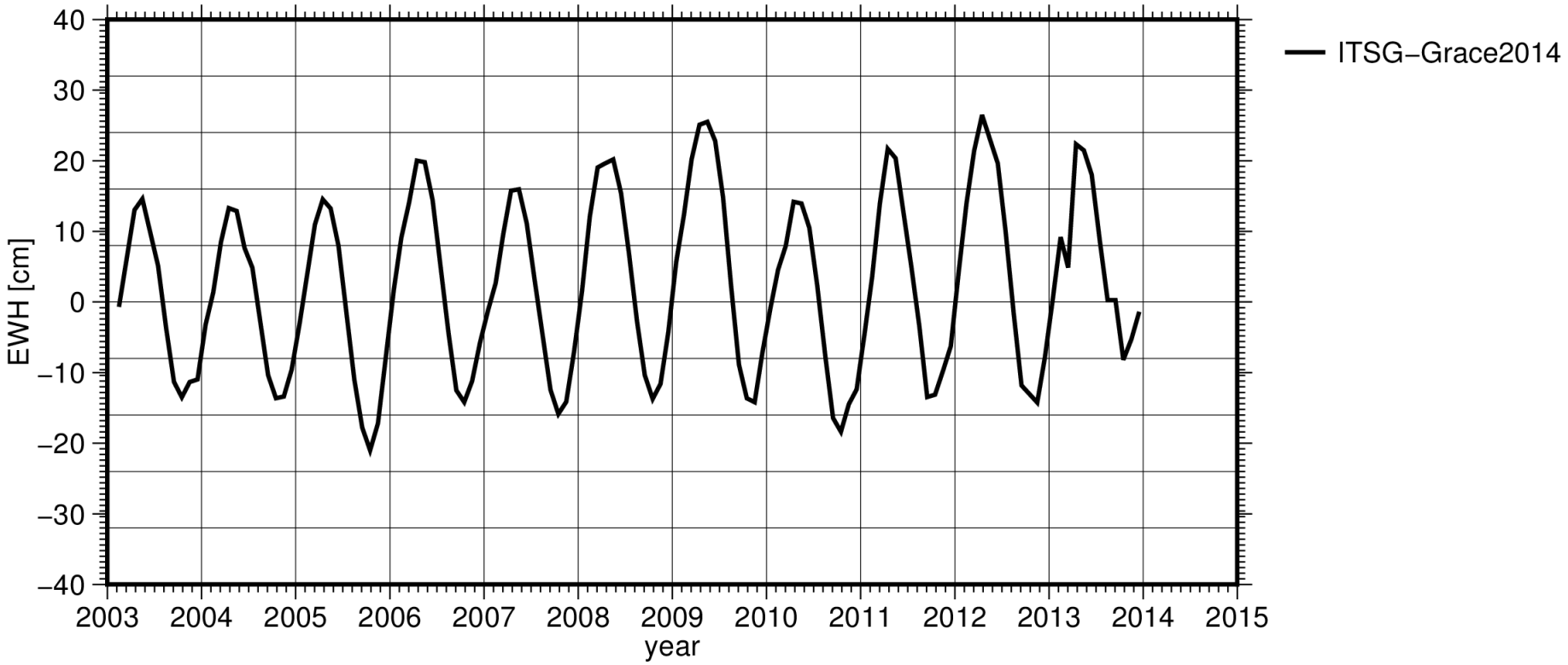


Gaussian filter 750 km

Amazon River basin

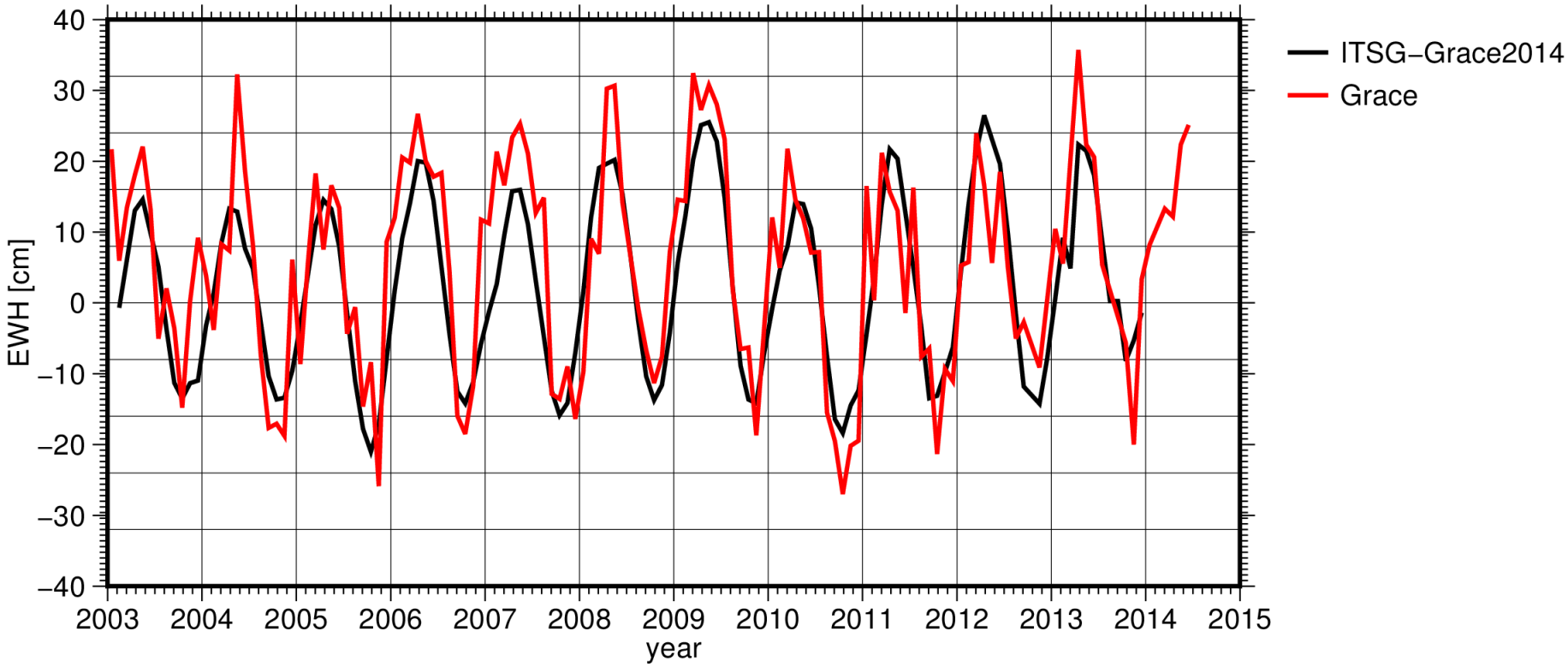
EWH mean value for the whole region for each month



Gaussian filter 500 km applied

Amazon River basin

EWH mean value for the whole region for each month



Gaussian filter 500 km applied

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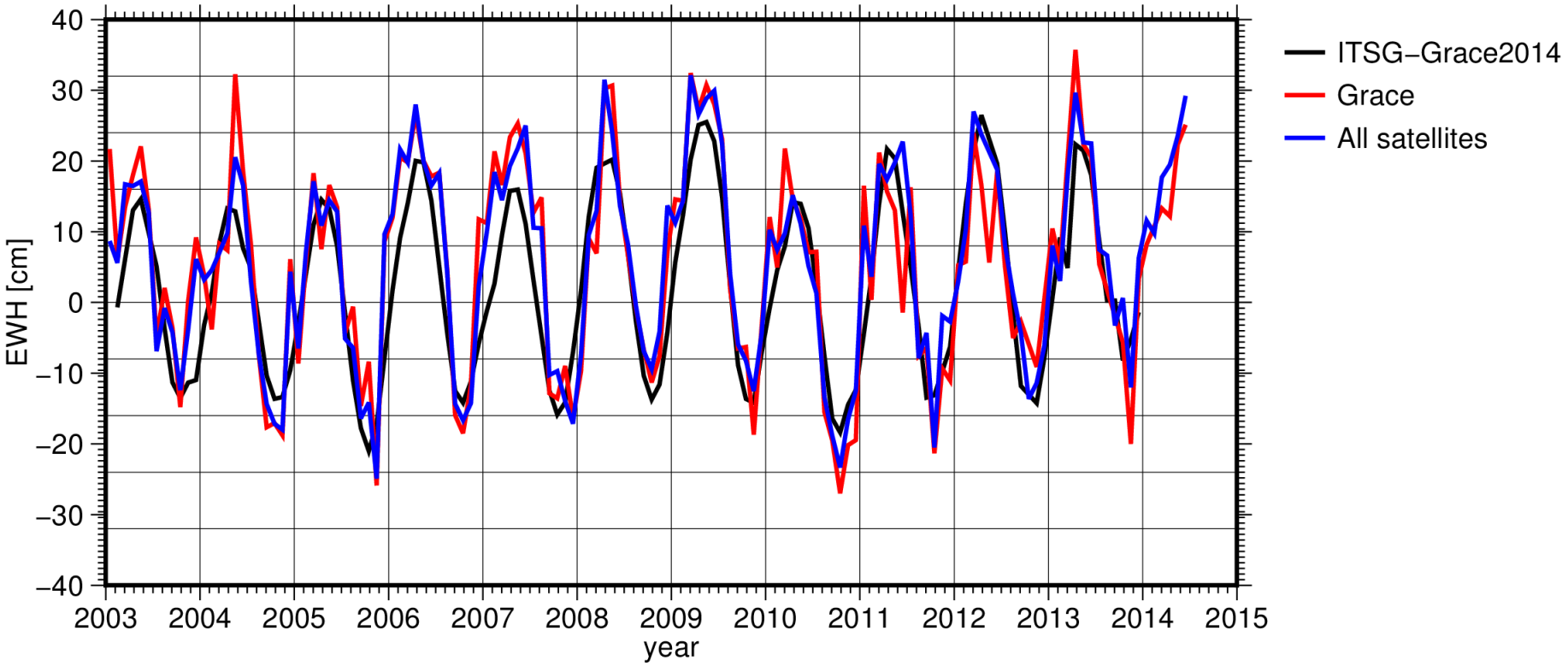

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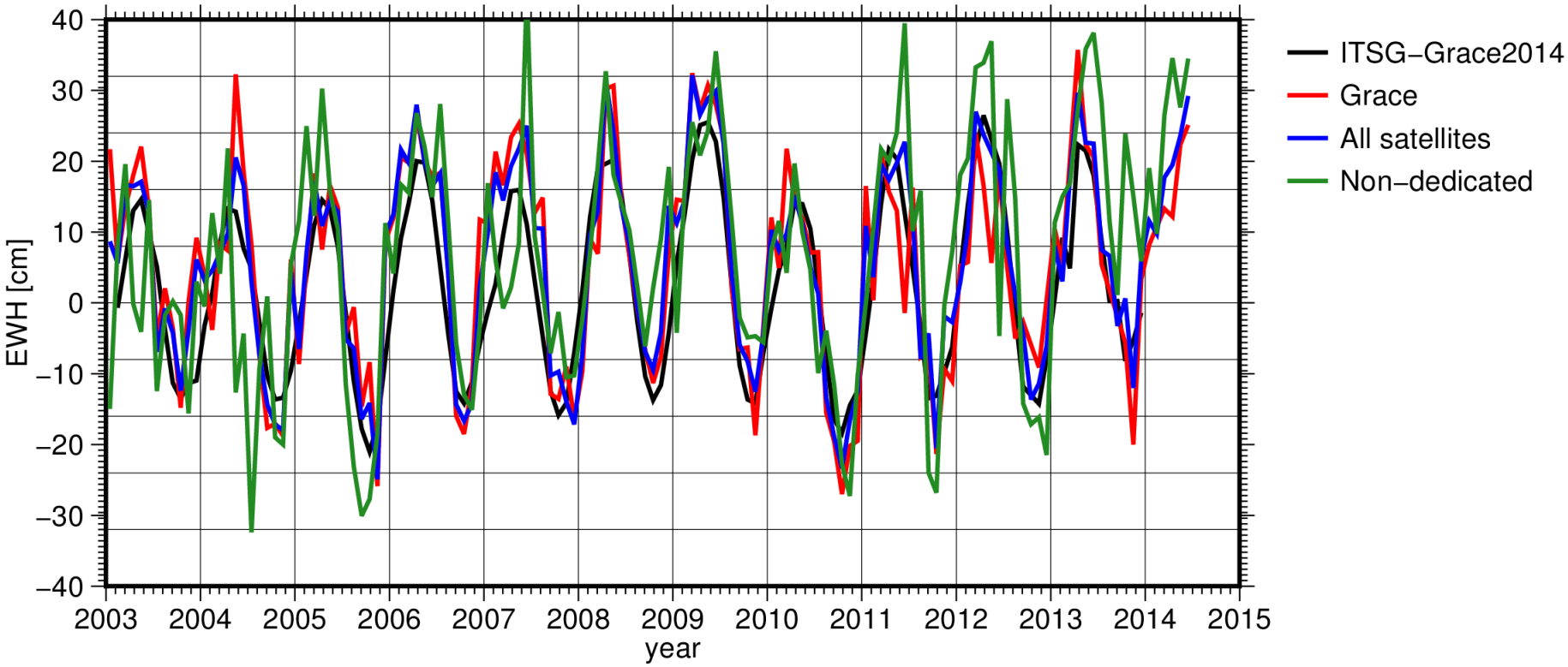
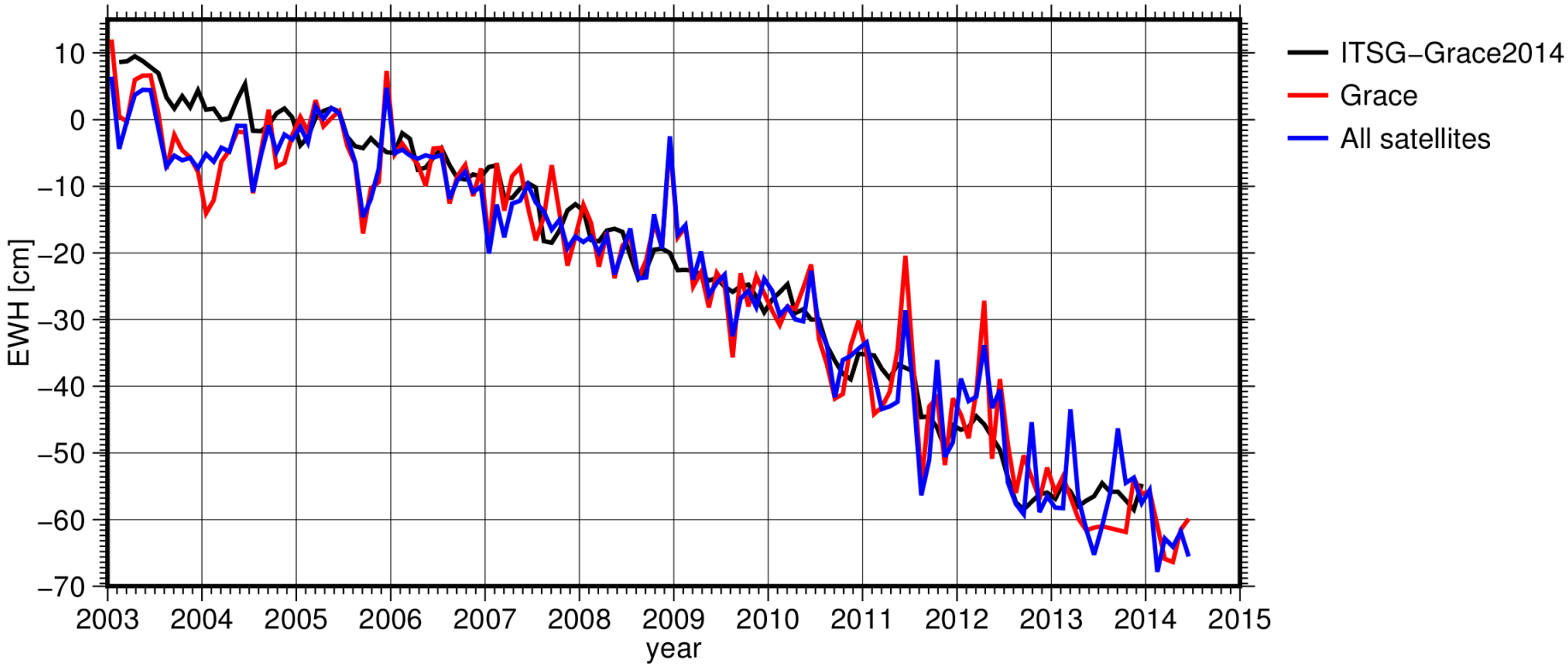


Gaussian filter 500 km applied

Greenland

EWH mean value for the whole region for each month



Gaussian filter 500 km applied

Greenland

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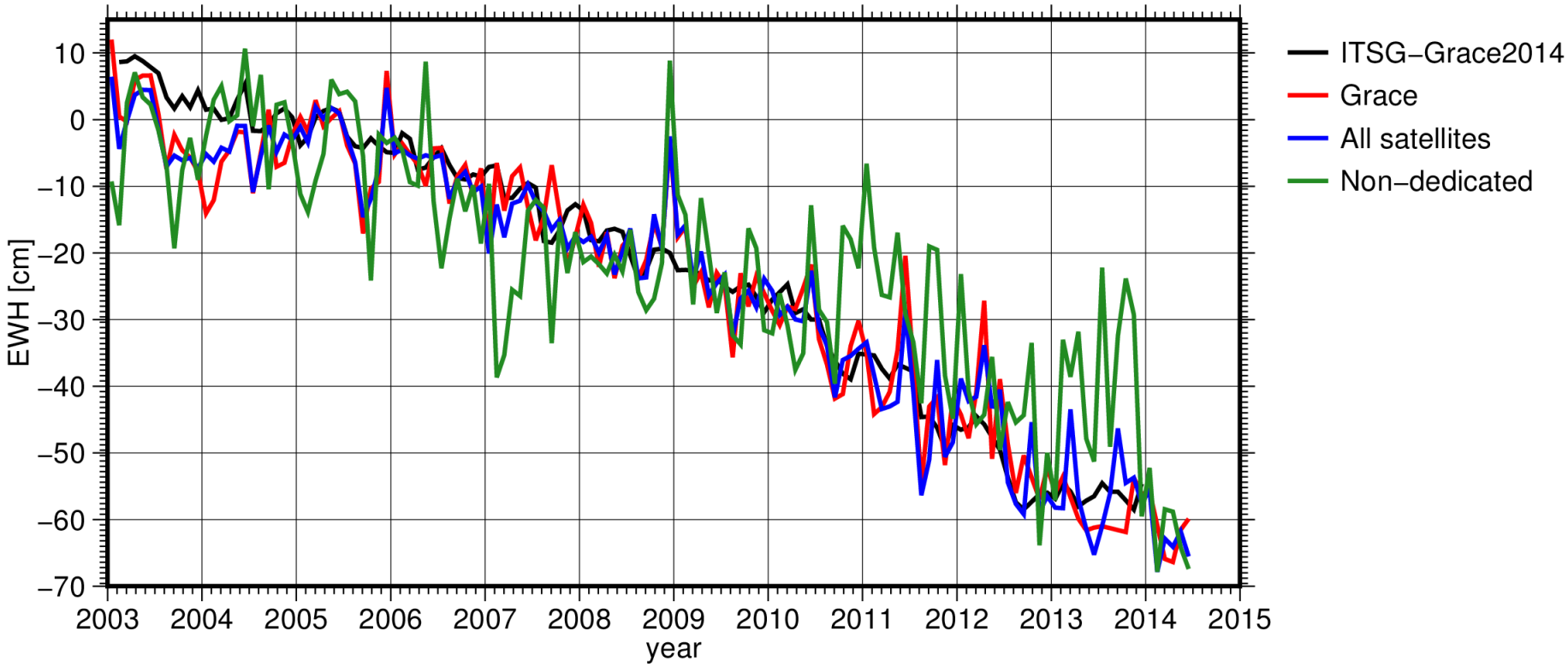

Gaussian filter 500 km applied

Summary

- Every satellite needs special attention
- Diverse problems:
  - Poor observation quality (MetOp, COSMIC, SAC-C)
  - Bad or no attitude data (COSMIC, MetOp, SAC-C)
  - Magnetic equator issue (GOCE, Swarm)
  - High altitude (MetOp ~800km)
  - Polar gap (COSMIC, MetOp, GOCE, TanDEM-X, TerraSAR-X, SAC-C)
  - …

Conclusions

- **Large scale mass variations are estimable – *also with non-dedicated missions***
- GRACE also in terms of SST-hl unequaled
  - Currently no mission with comparable data quality
- Kinematic orbits available at www.itsg.tugraz.at

Thank you

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