

Kalman filtered daily GRACE gravity field solutions in near real-time – first steps

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ESA LPS2016 - 09.05.2016 - 13.05.2016

EGSIEM near real-time (NRT) service

- As part of EGSIEM (European Gravity Service for Improved Emergency Management) a tech demonstrator for near real-time gravity products will be established

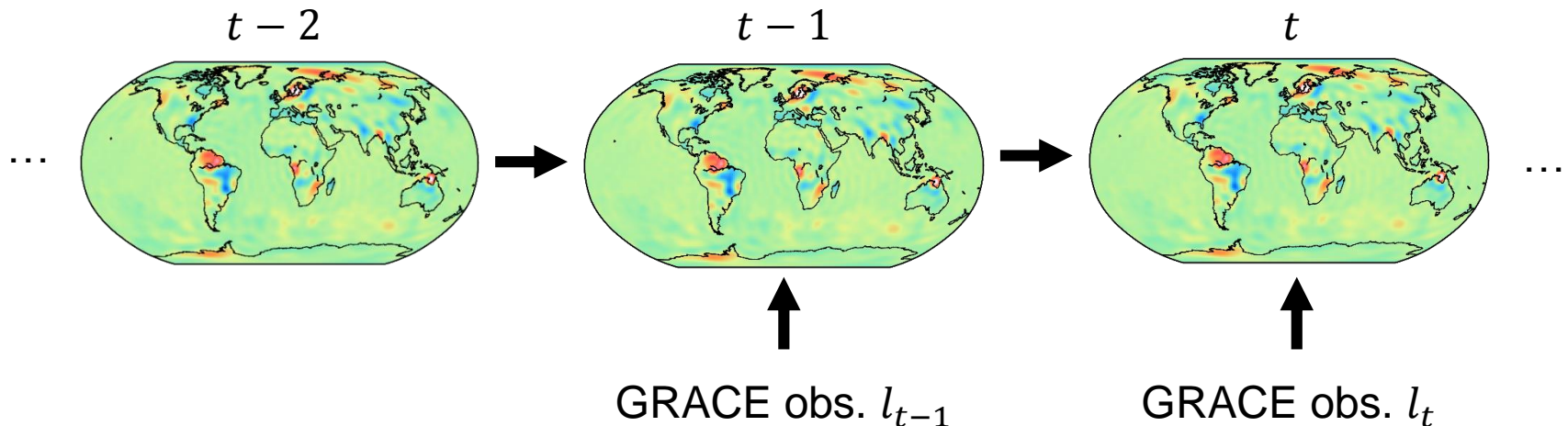


Horizon 2020

- Scope: daily gravity field solutions with five day delay
- Operations will be run at GFZ and Graz University of Technology
 - Regional and global solutions
 - Evaluation with GNSS loading at University of Luxembourg

Daily gravity field solutions from GRACE

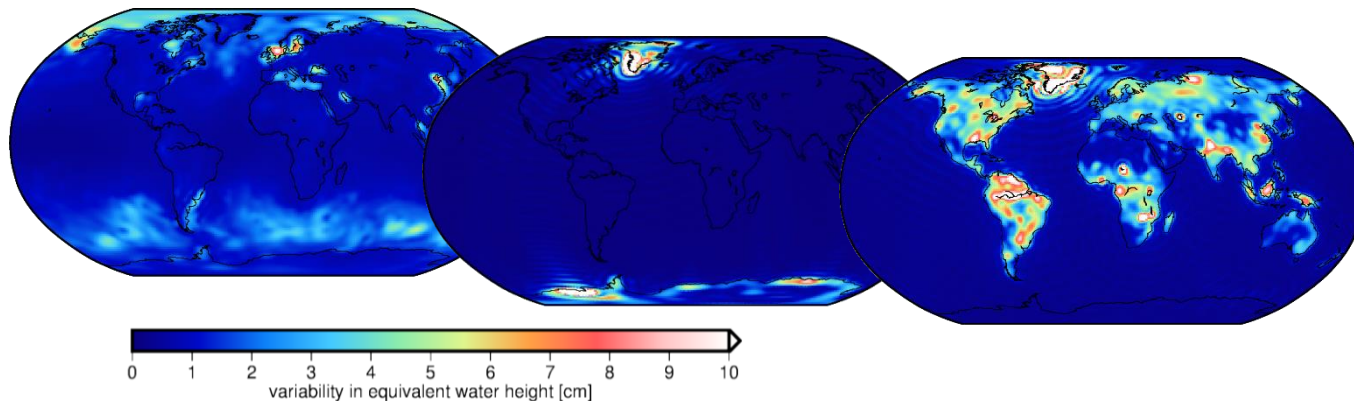
- Additional information is introduced in form of a **process model**
 - Prediction based on spatio-temporal correlations from geophysical models
 - Solution is weighted mean between GRACE observations and prediction



GRACE Kalman Filter
(Kurtenbach et al. 2012)

Post processing results – ITSG-Grace2016

- GRACE time series (2002 to 2016) processed and continually updated
 - 5053 daily solutions (4258 days with GRACE contribution)
- Process model derived from WGHM (hydrosphere) and ESA ESM (residual atmosphere/ocean)

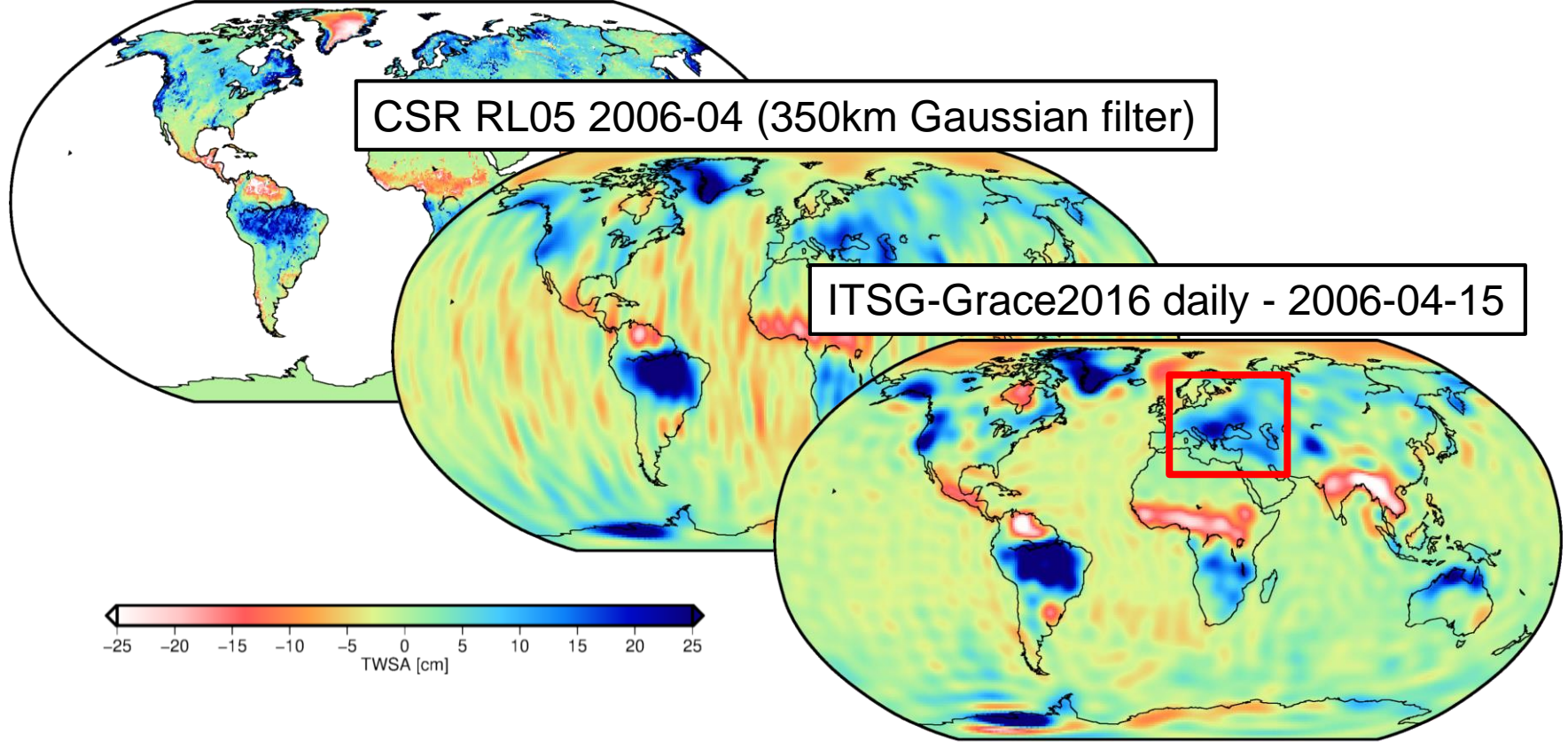
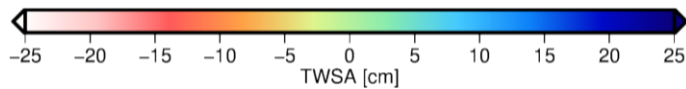


Post processing results – ITSG-Grace2016

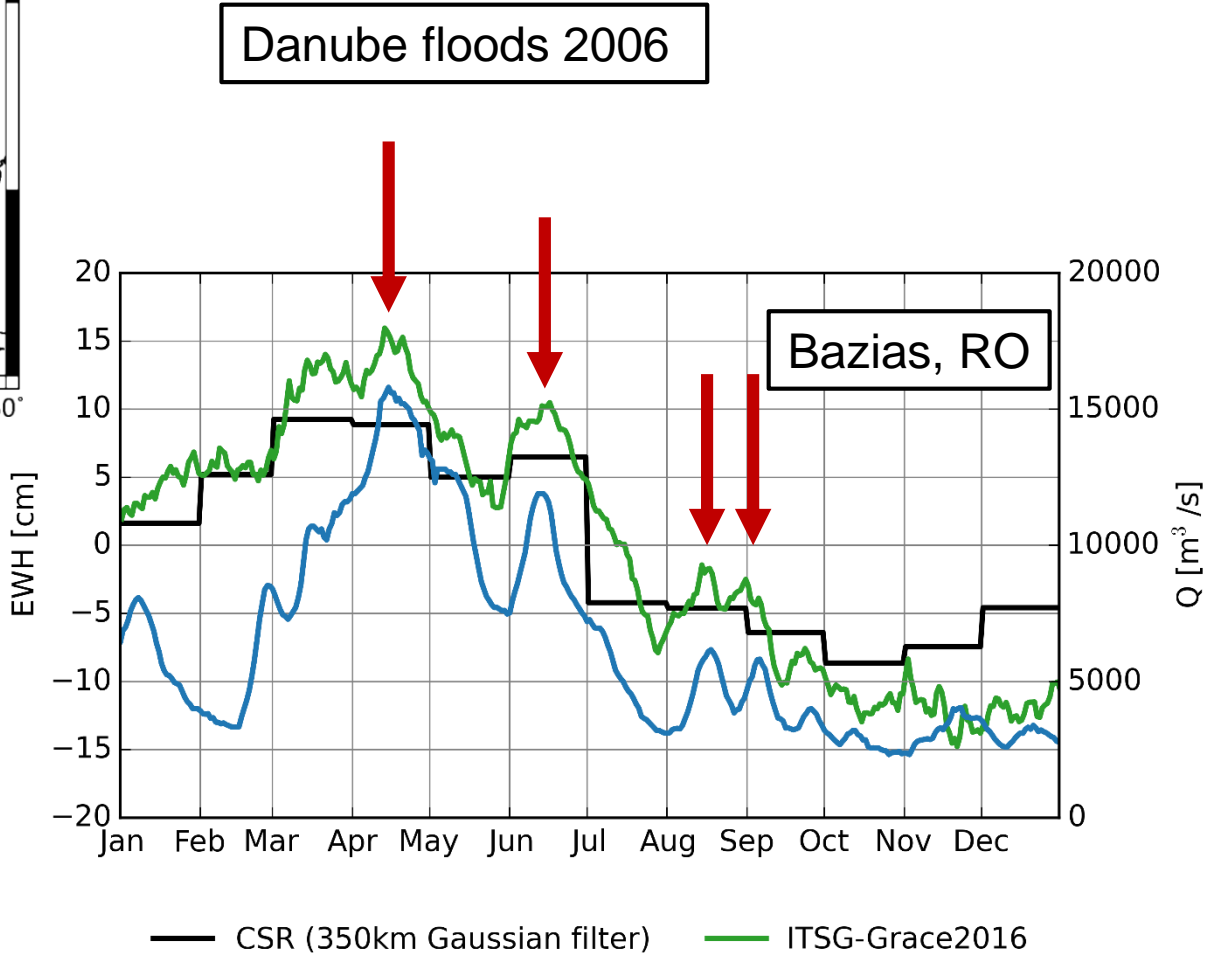
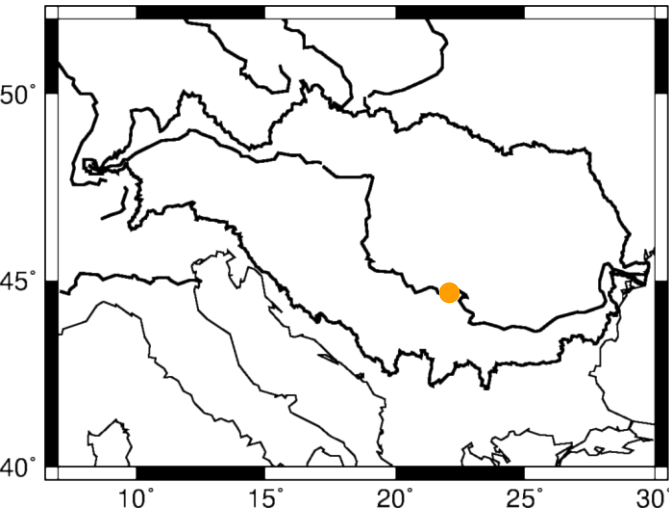
WGHM - 2006-04-15

CSR RL05 2006-04 (350km Gaussian filter)

ITSG-Grace2016 daily - 2006-04-15



Post processing results – ITSG-Grace2016

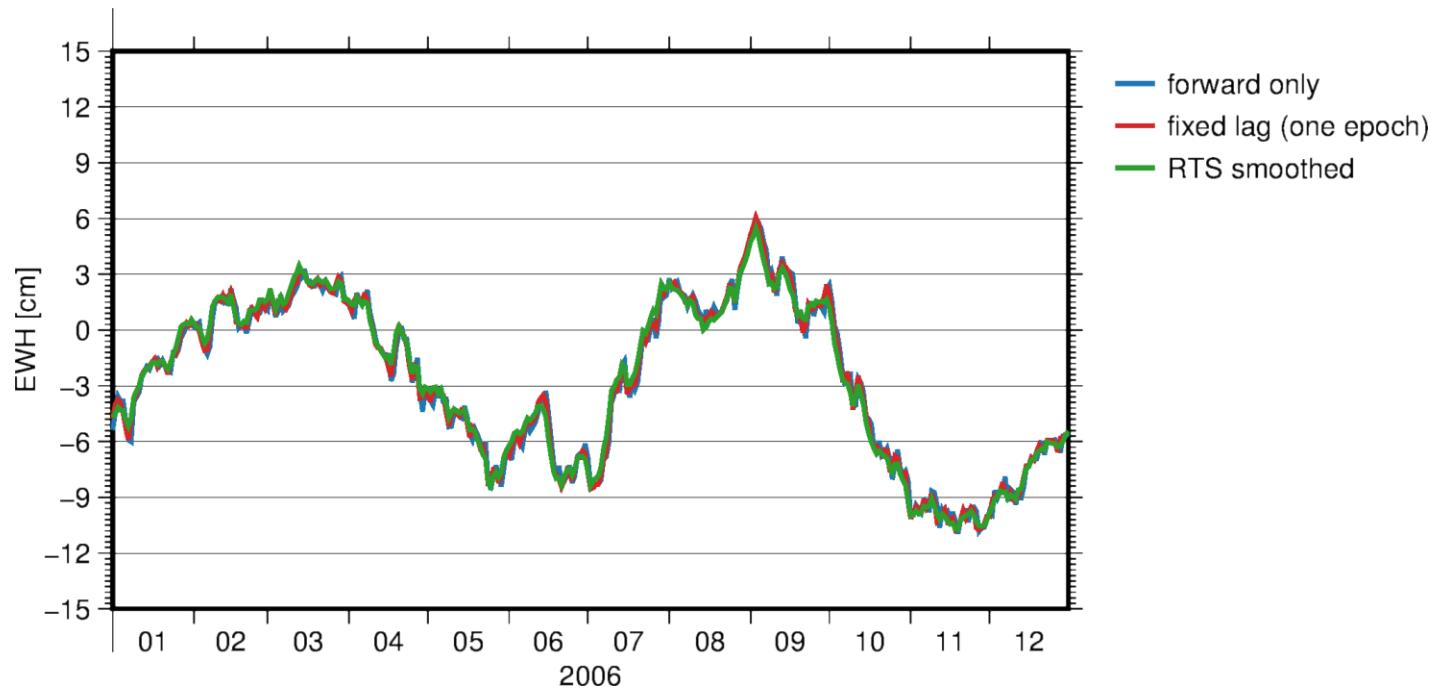


Smoothing algorithms

- Post-processing allows for fixed interval smoothing
 - Kalman filter runs in forward and backward direction
 - Minimum variance average of both time series
 - Implemented as RTS smoother (Rauch et al. 1965)
- Adapted daily gravity field processing scheme:
 - Rapid GNSS constellation and Earth orientation
 - forward only filtering → increased high frequency noise
- RTS smoother replaced by fixed-lag smoother
 - Nominal solution delay allows for 1-2 lag epochs

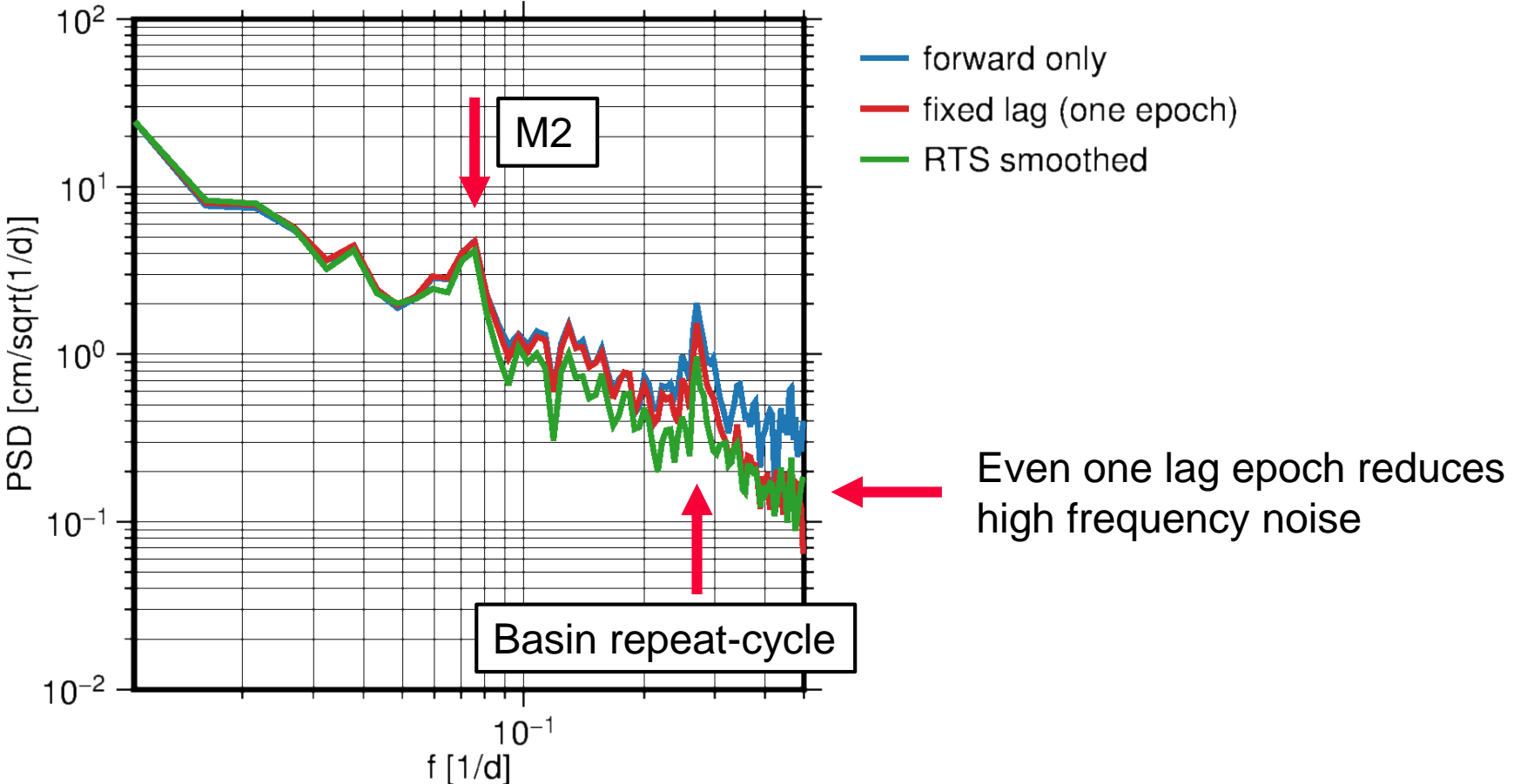
Smoothing algorithms

Danube basin area mean time series
(annual, trend removed)



Smoothing algorithms

PSD of Danube area mean time series



Conclusion and outlook

- GRACE can provide information for much shorter time spans than the standard monthly solutions
- Reduced latency will enable monitoring of floods and droughts as they occur
- EGSiEM near real-time operational test run starts in 2017
 - Global and regional daily GRACE gravity fields with 5 days latency
 - Check out **www.egsiem.eu** for updates
- ITSG-Grace2016 solutions available under **ifg.tugraz.at/ITSG-Grace2016**

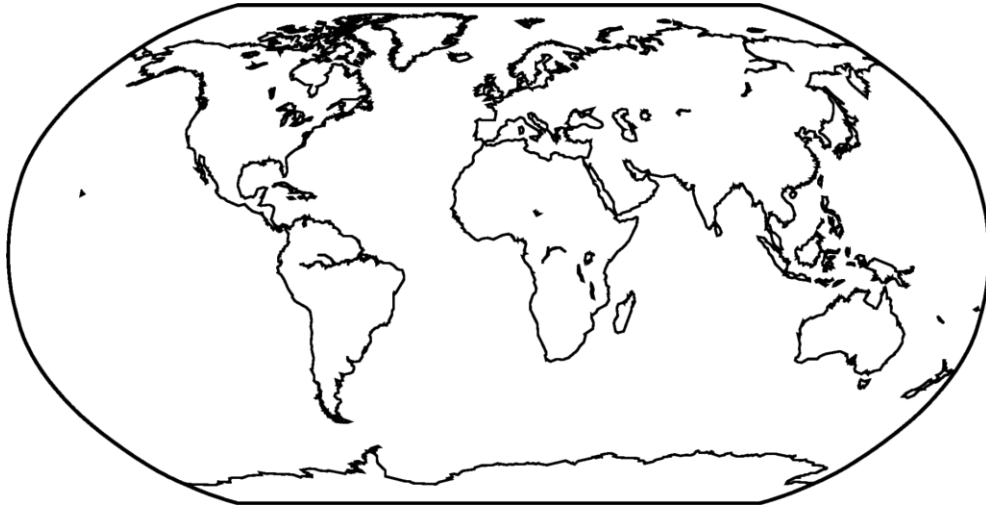
Acknowledgements



EGSIEM is funded by the Horizon 2020 Framework Programme of the European Union under grant agreement No 637010.

Discharge data provided by the Global Runoff Data Centre, 56068 Koblenz, Germany

Daily gravity field solutions from GRACE



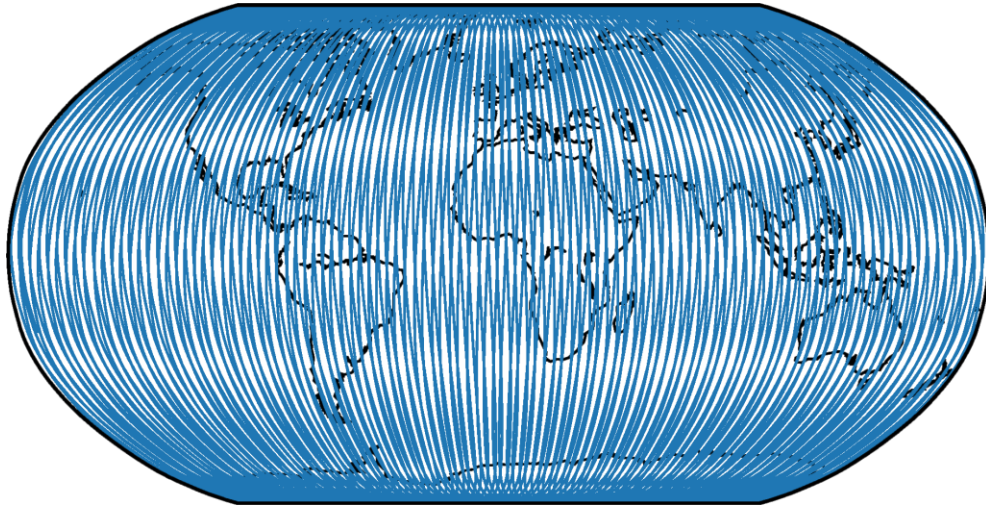
GRACE data coverage:

Daily gravity field solutions from GRACE



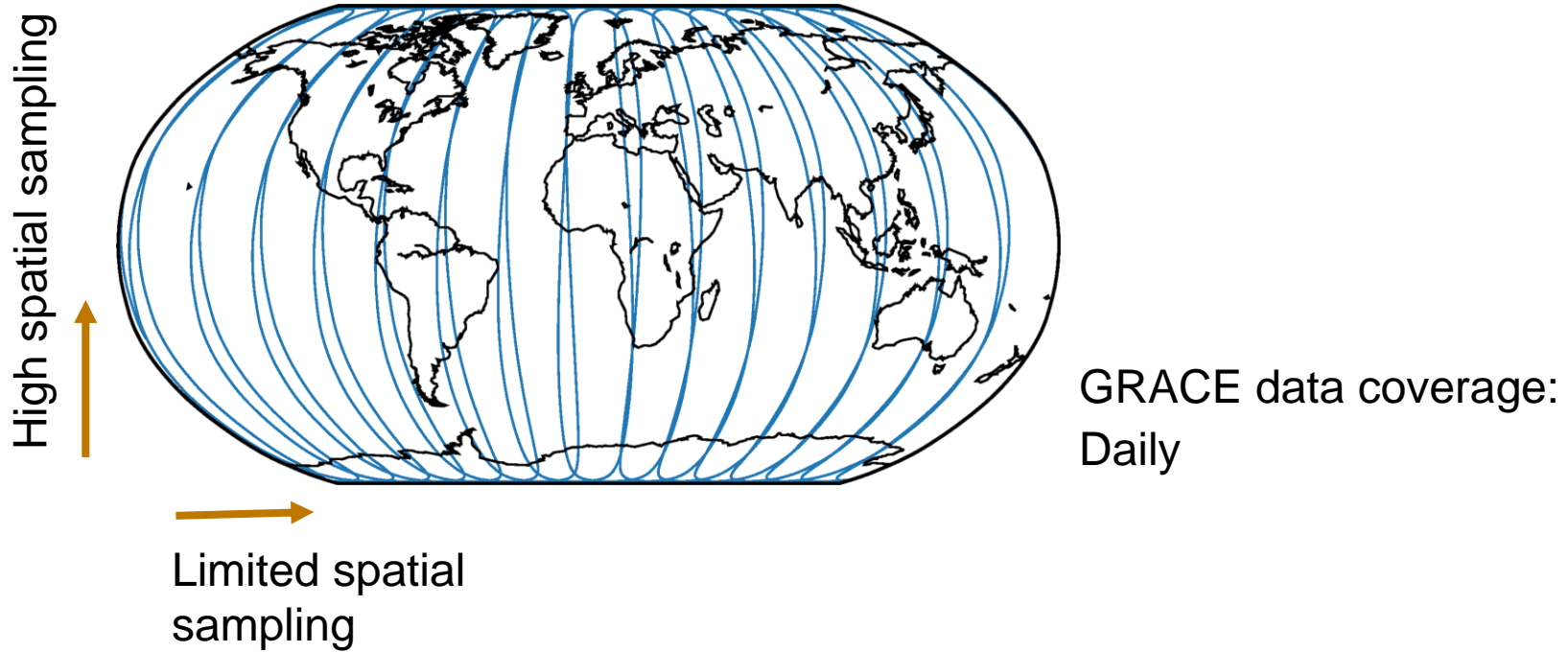
GRACE data coverage:
Monthly

Daily gravity field solutions from GRACE



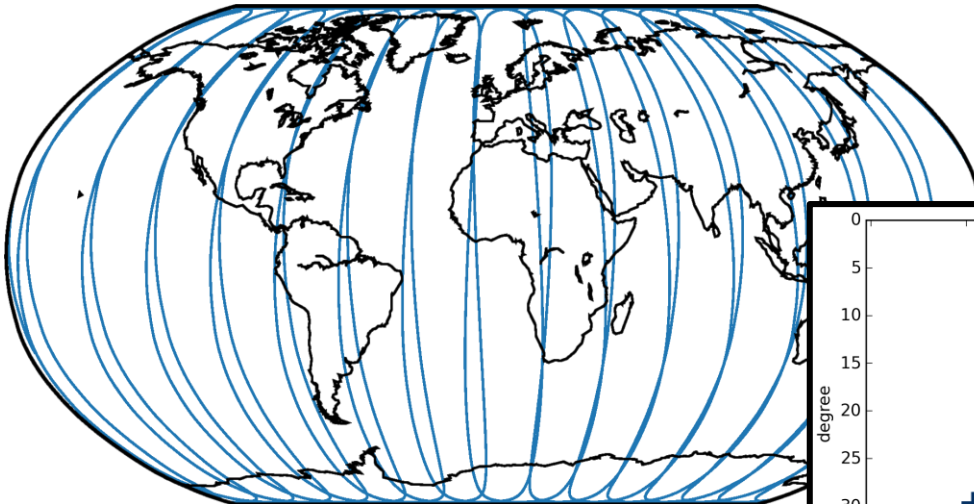
GRACE data coverage:
Weekly

Daily gravity field solutions from GRACE



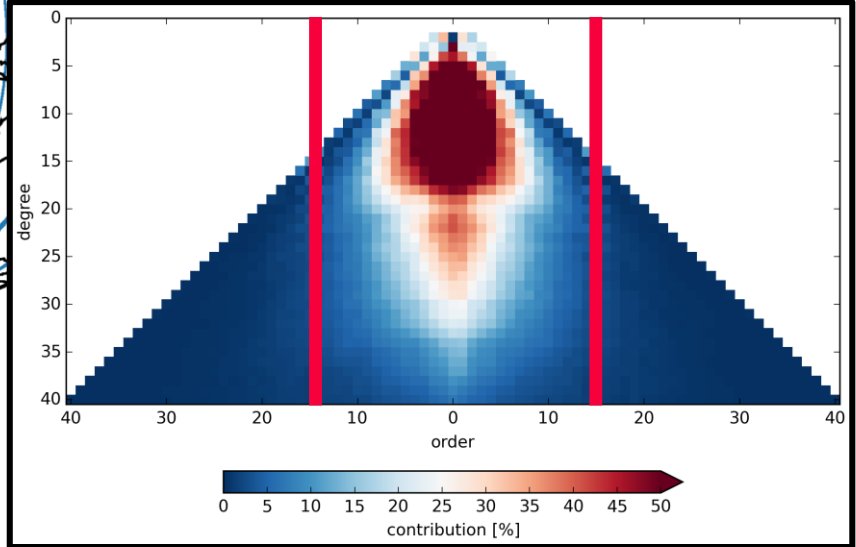
Daily gravity field solutions from GRACE

High spatial sampling



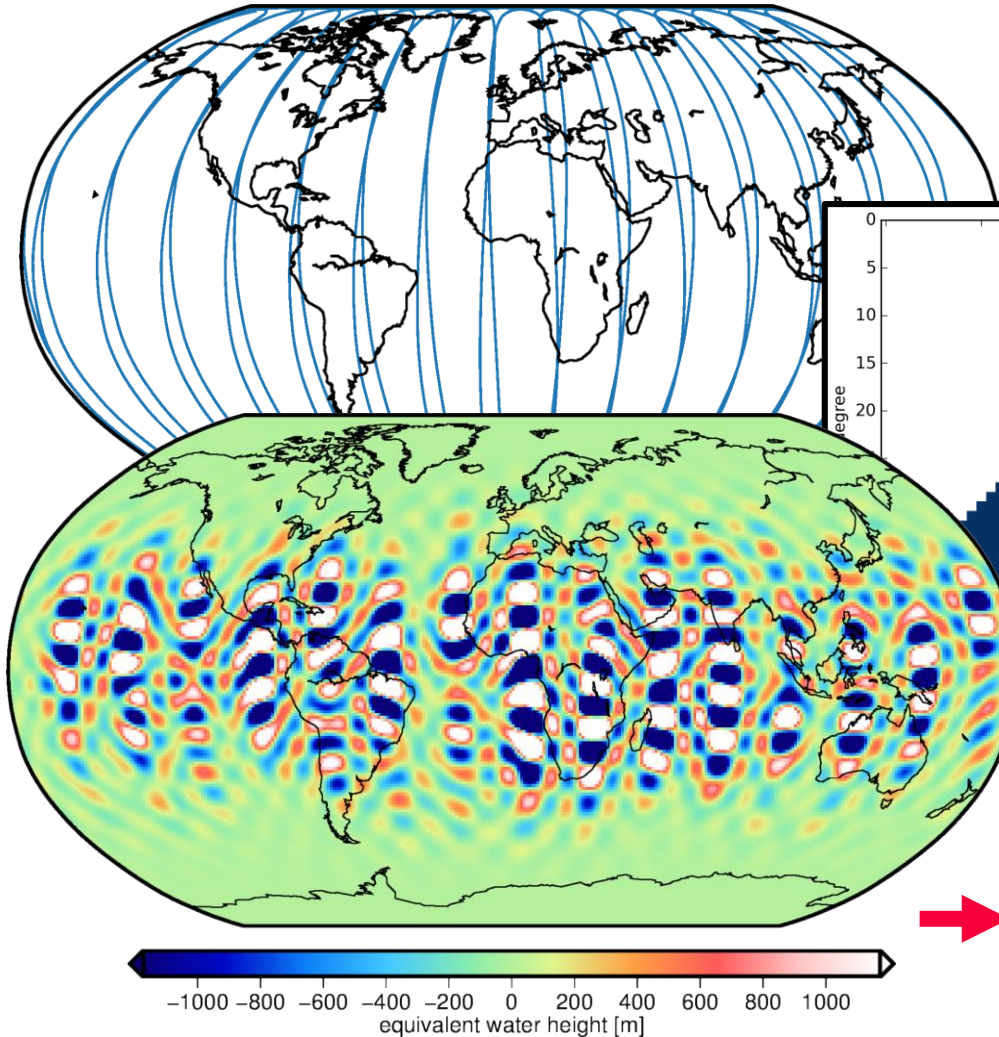
Limited spatial sampling

GRACE contribution limited to order ~15

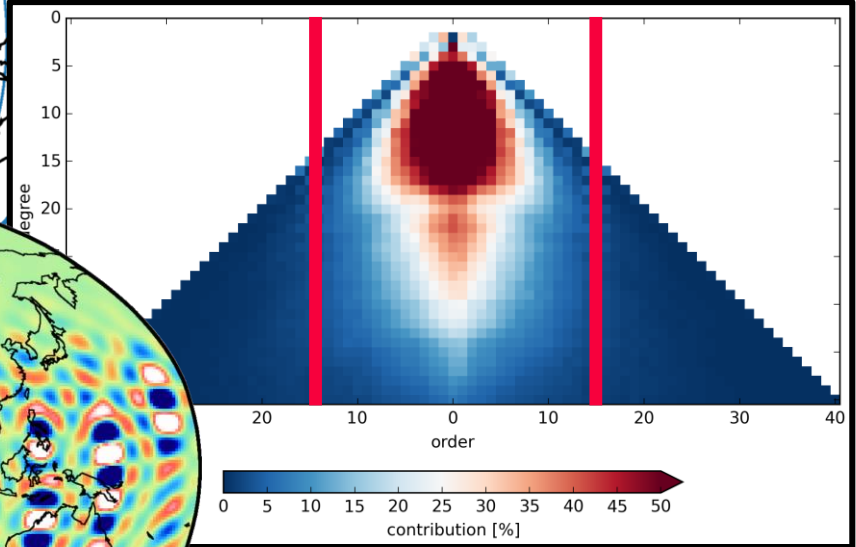


Daily gravity field solutions from GRACE

High spatial sampling



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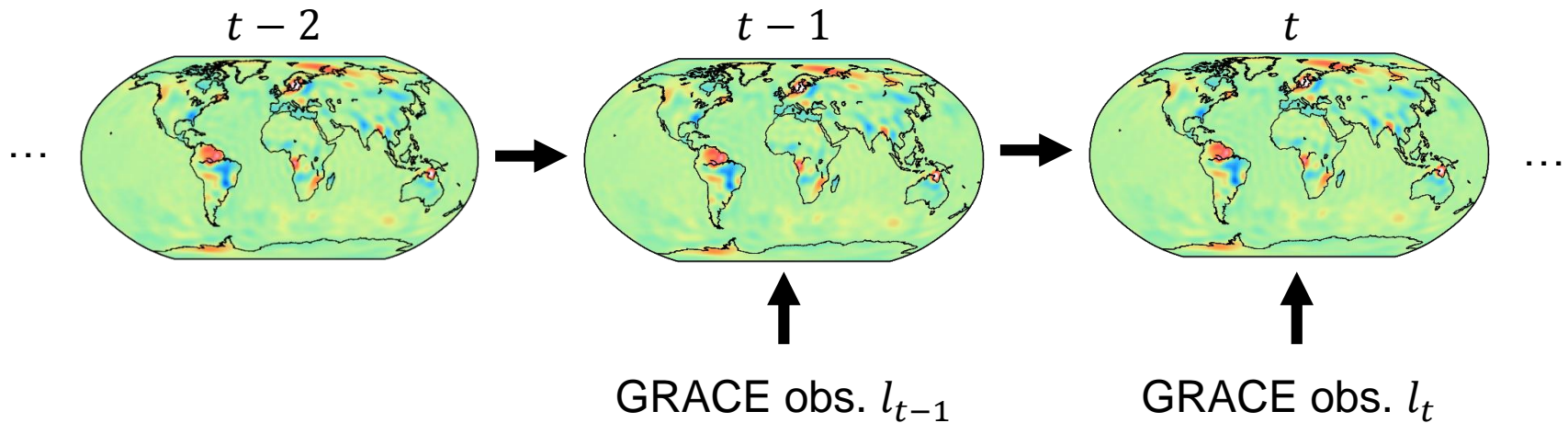


GRACE alone cannot observe the full gravity field signal

Daily gravity field solutions from GRACE

Additional information is introduced in form of a **process model**

- Prediction based on spatio-temporal correlations from geophysical models
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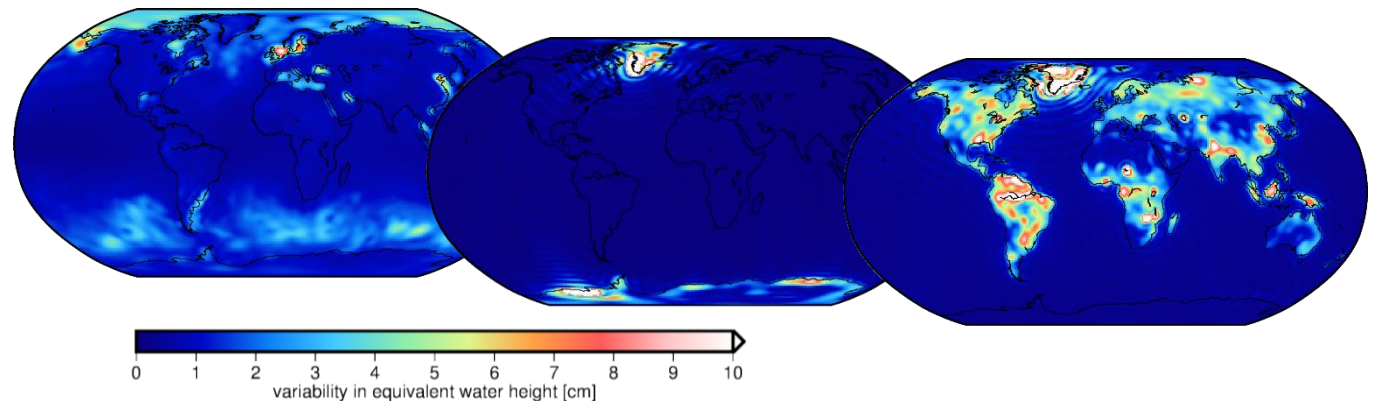


→ GRACE Kalman Filter
(Kurtenbach et al. 2012)

GRACE time series (2002 to 2016) processed and continually updated

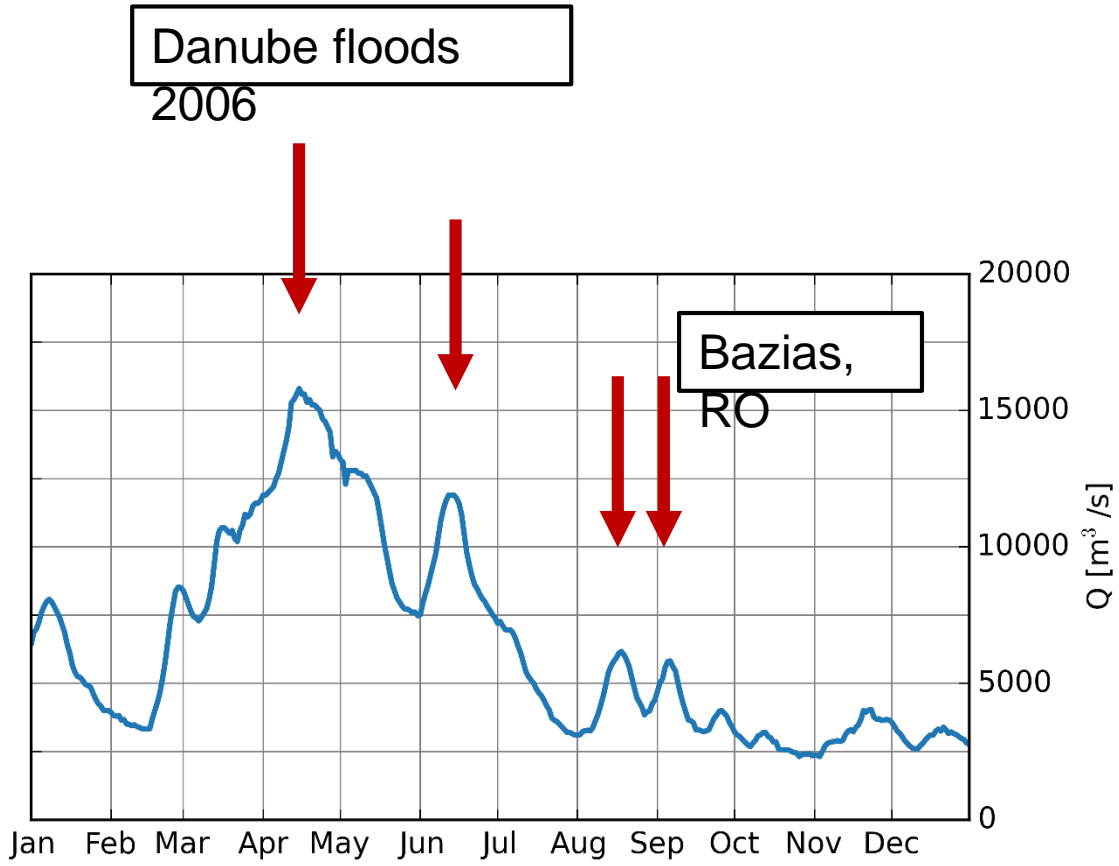
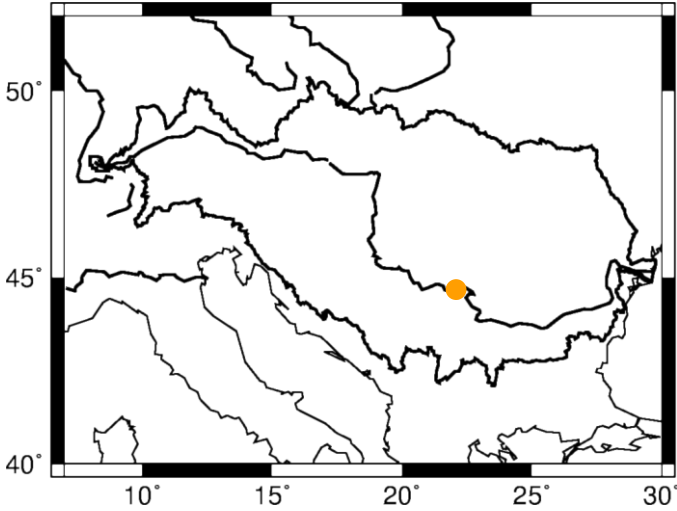
Post processing results (ITSG-Grace2016 with GRACE contribution)

Process model derived from WGHM (hydrosphere) and ESA ESM (residual atmosphere/ocean)

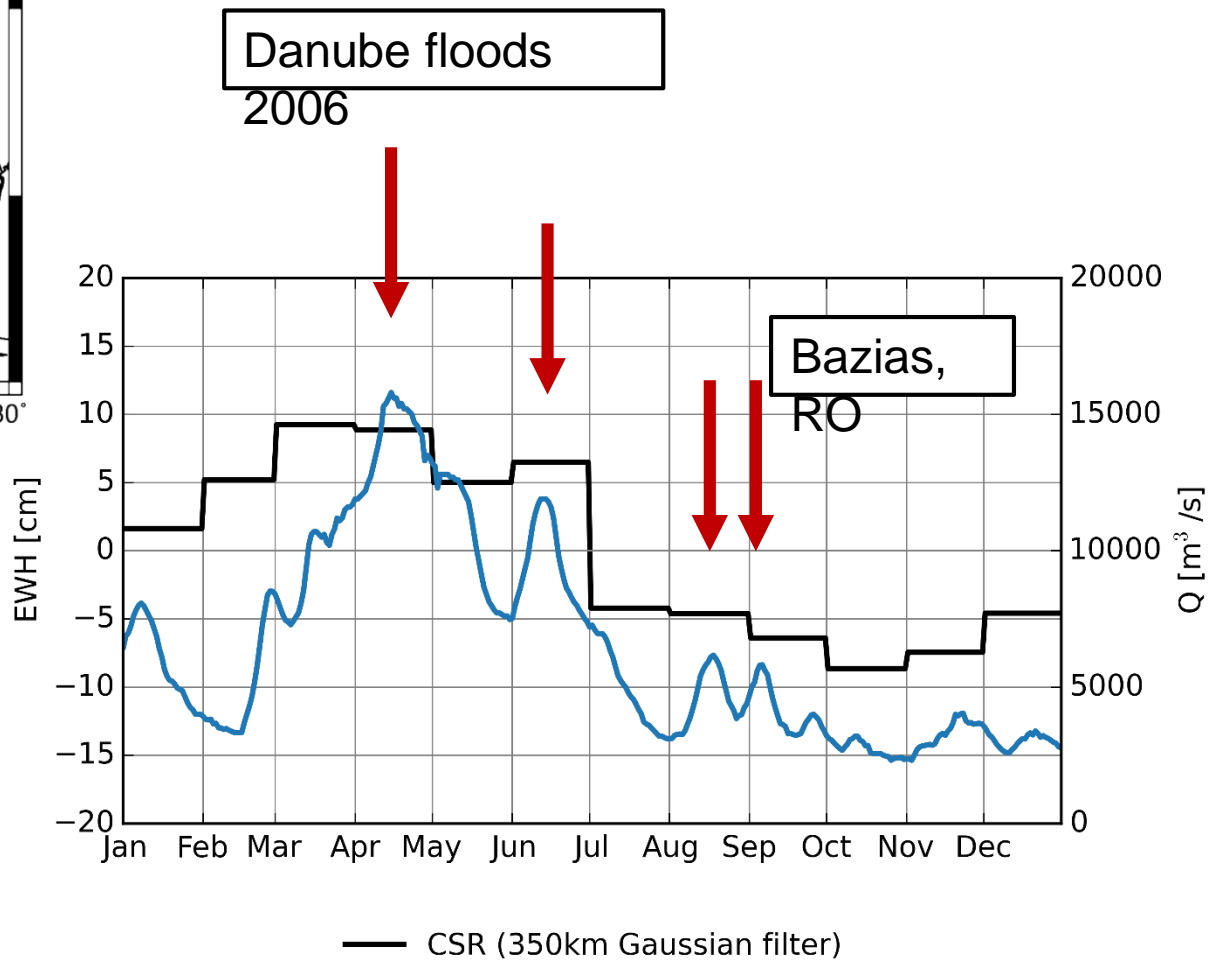
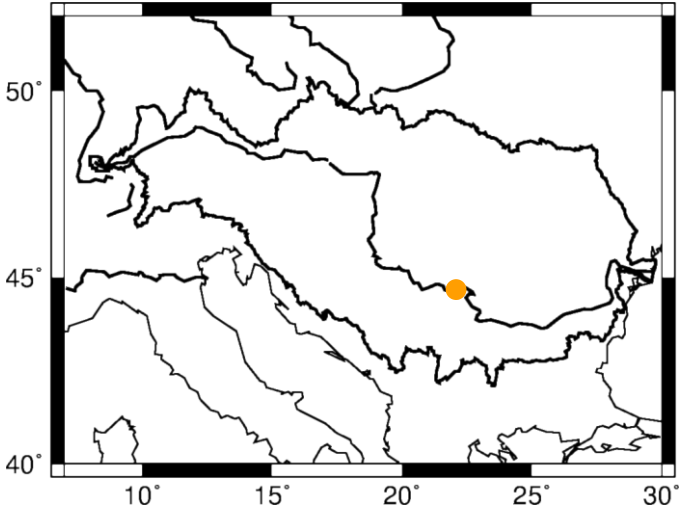


GRACE processing details: Klinger et al. - Towards a new ITSG-Grace release: improvements within the processing chain, Session G4.2 - Wednesday, 9am

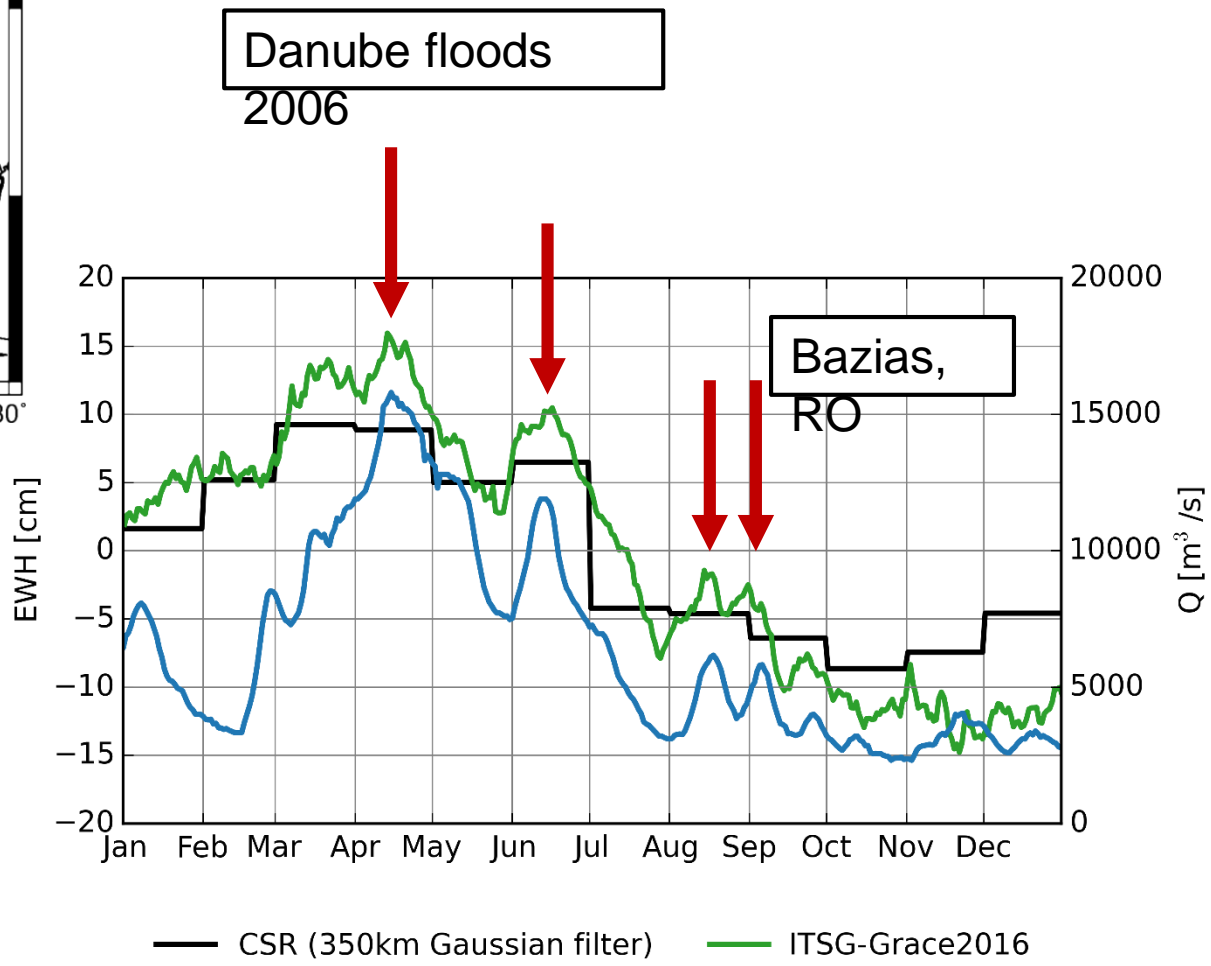
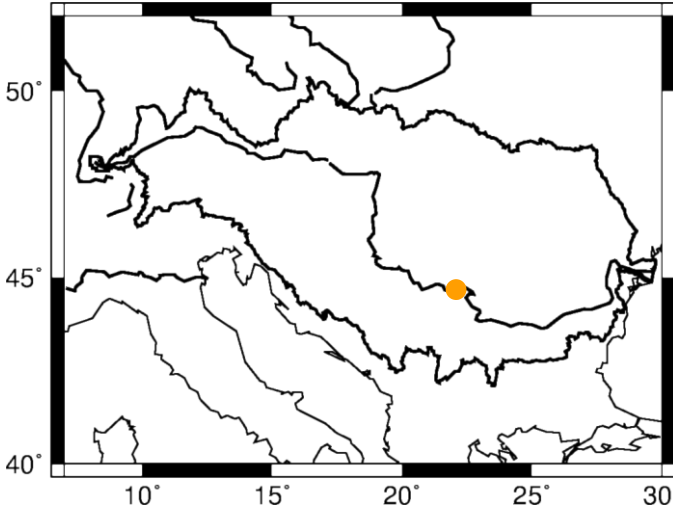
Post processing results – ITSG-Grace2016



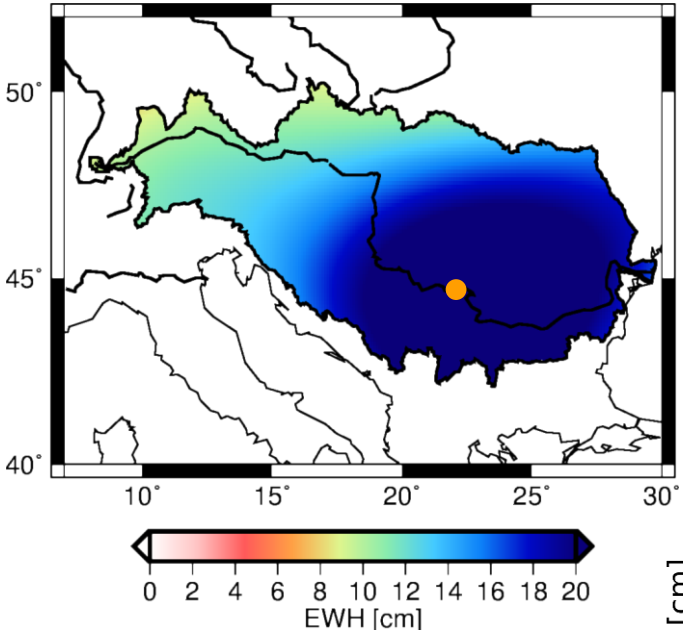
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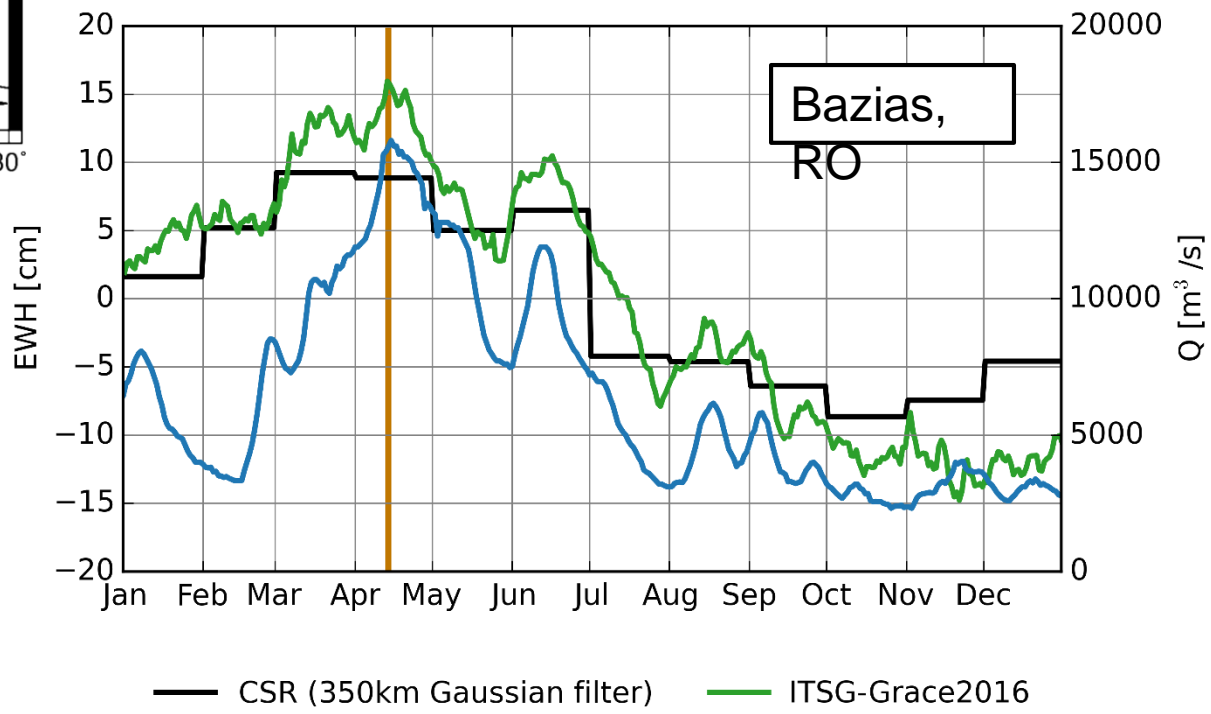
Post processing results – ITSG-Grace2016



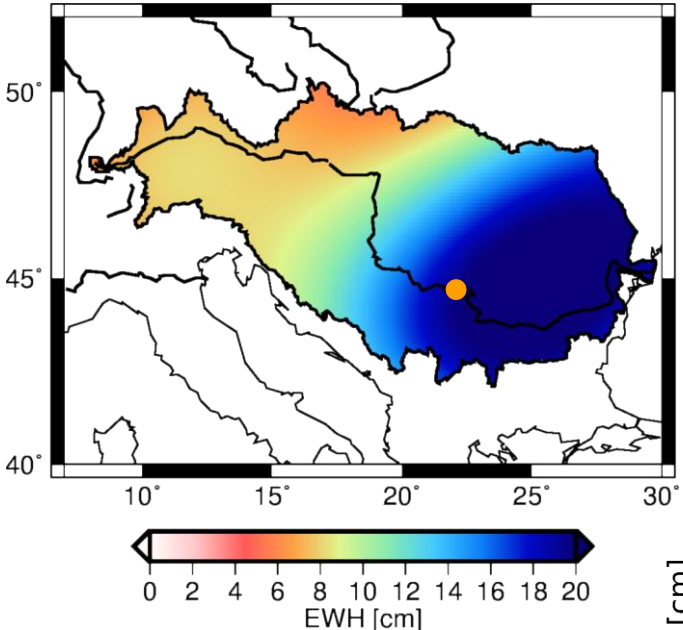
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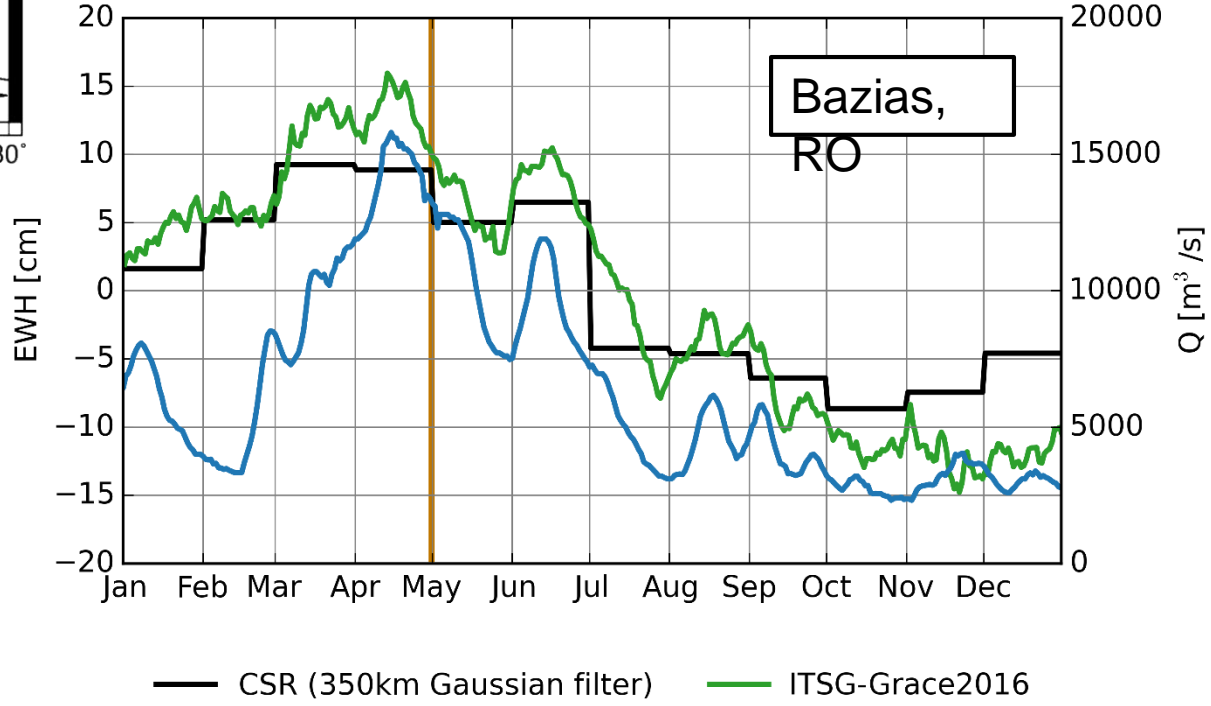
Danube floods
2006



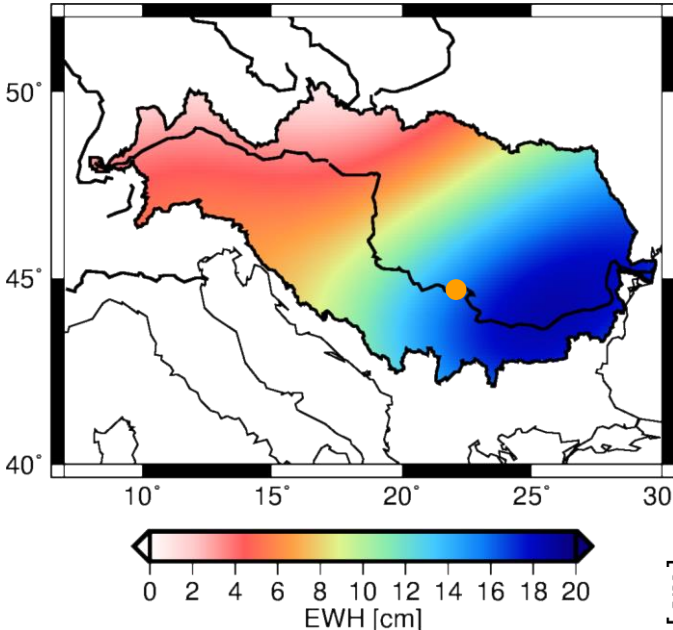
Post processing results – ITSG-Grace2016



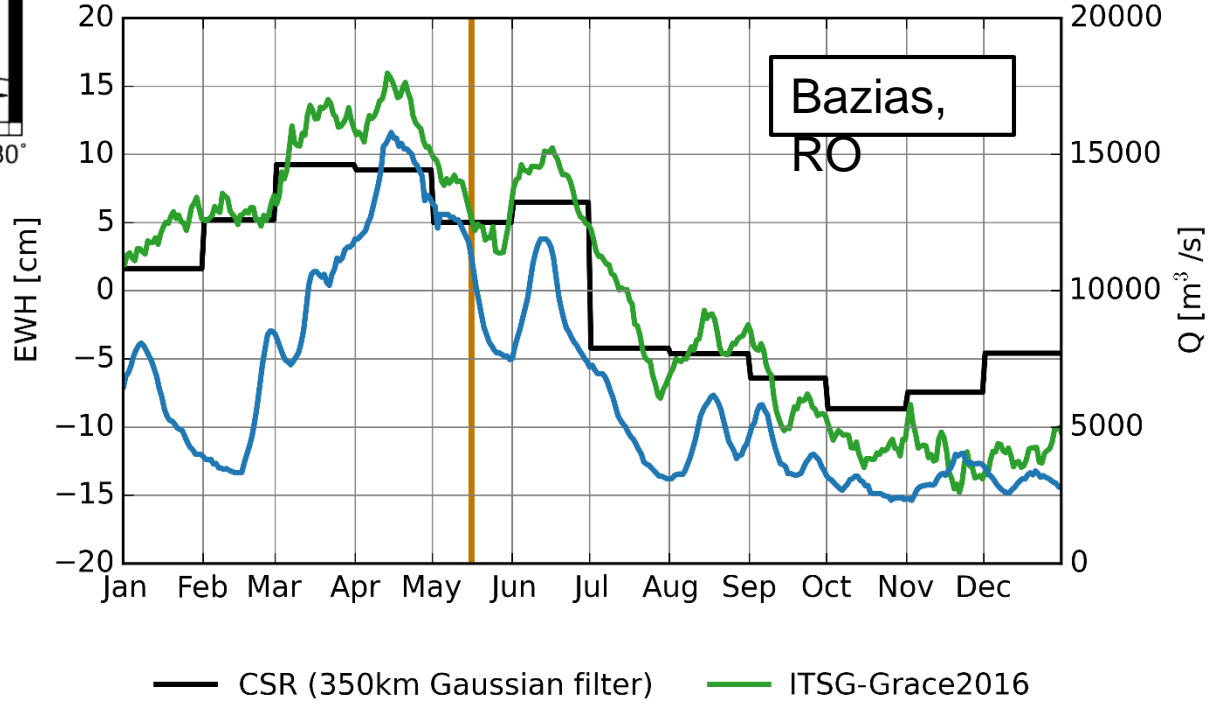
Danube floods
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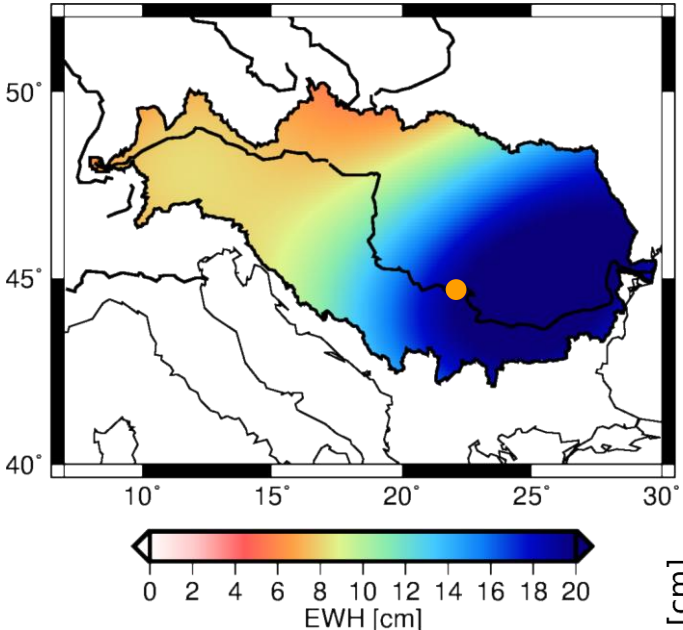
Post processing results – ITSG-Grace2016



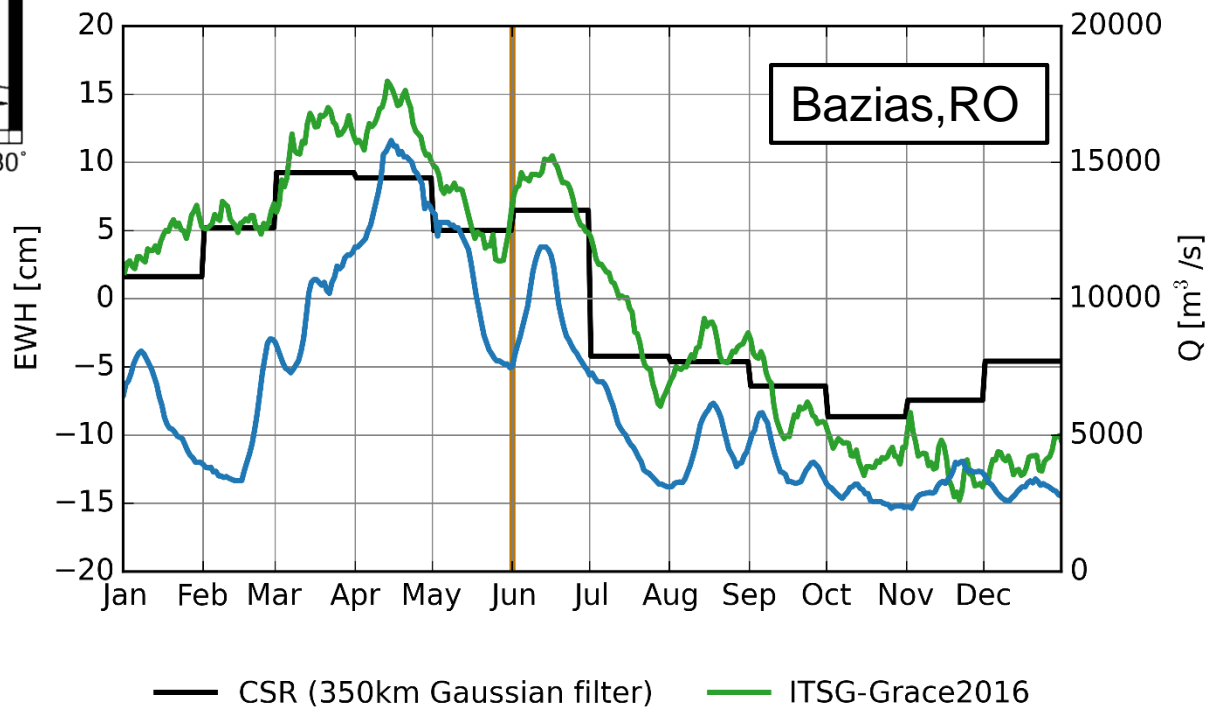
Danube floods
2006



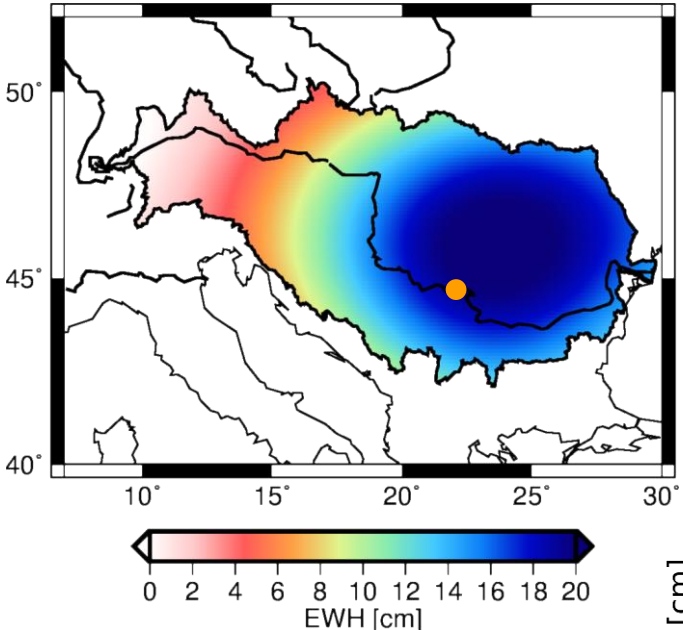
Post processing results – ITSG-Grace2016



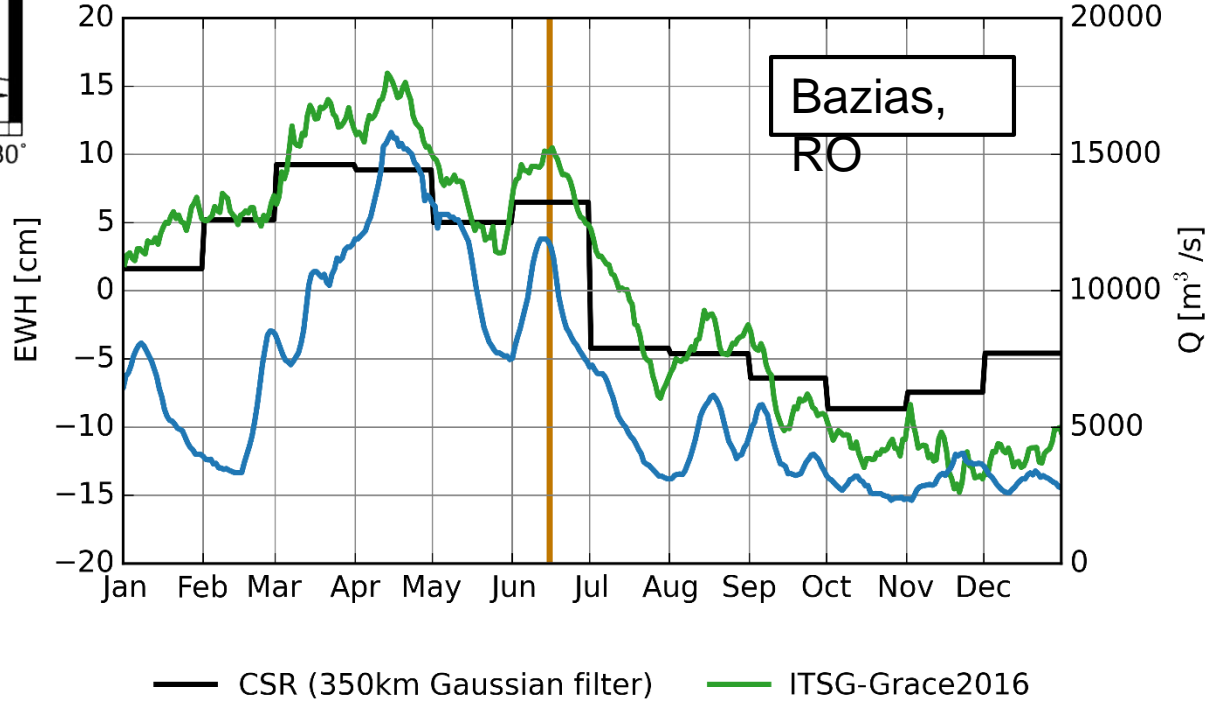
Danube floods 2006



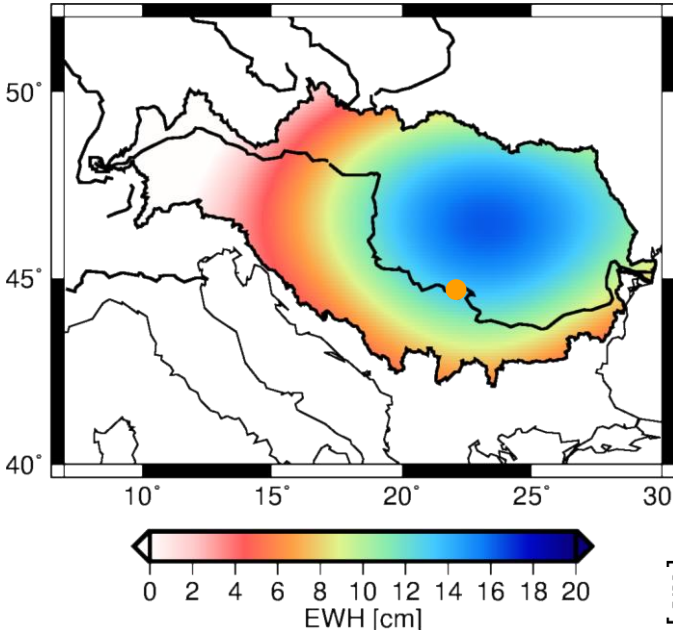
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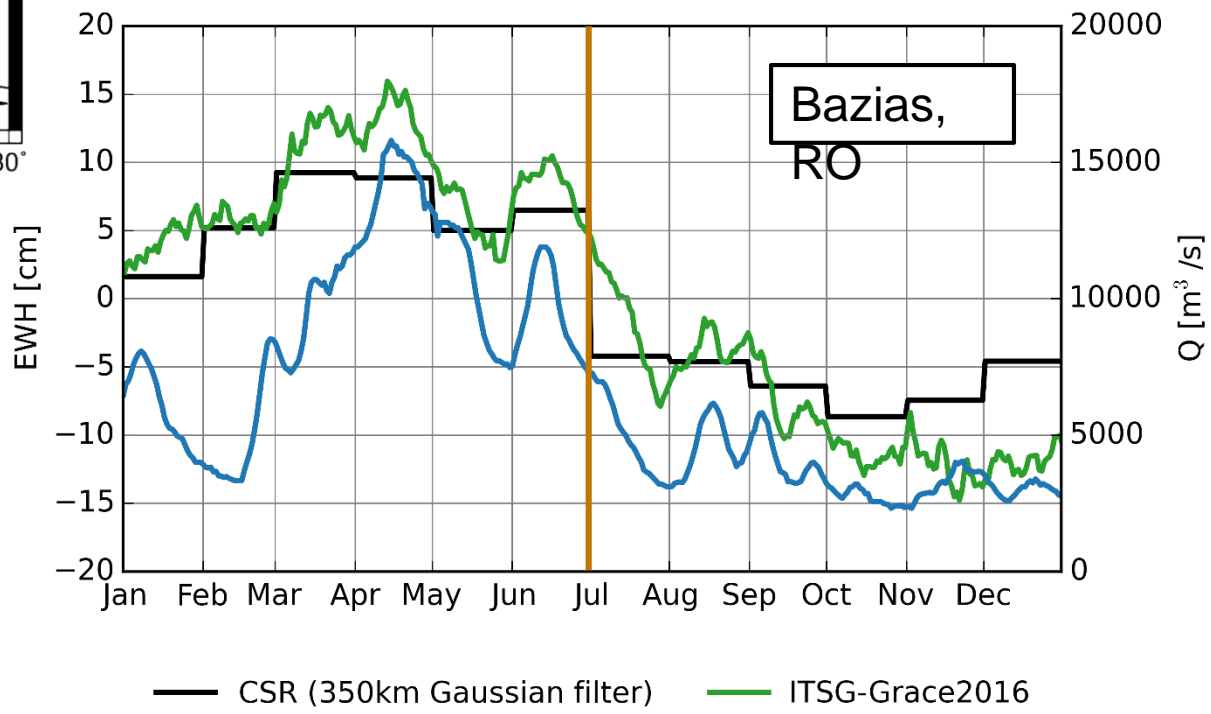
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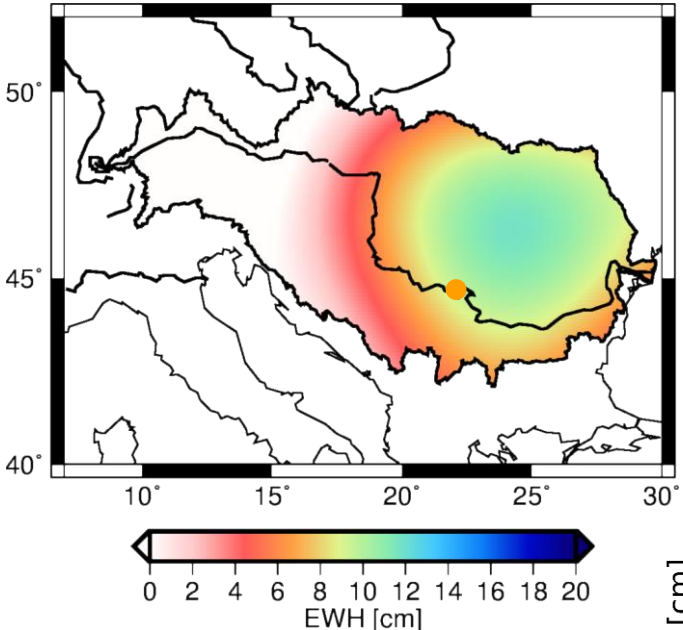
Post processing results – ITSG-Grace2016



Danube floods
2006



Post processing results – ITSG-Grace2016



Danube floods 2006

