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European Gravity Service for Improved Emergency Management
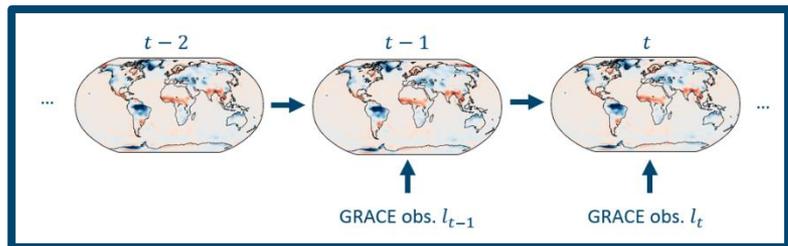
ITSG-Grace2016 – Daily Gravity Field Solutions from GRACE

Andreas Kvas, Beate Klinger, Saniya Behzadpour, Matthias Ellmer, Norbert Zehentner, Torsten Mayer-Gürr
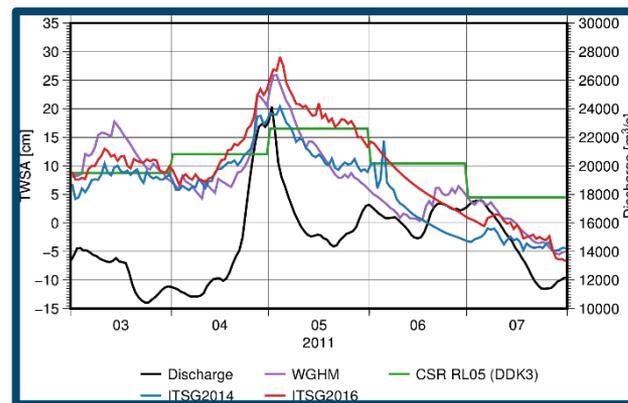
Graz University of Technology

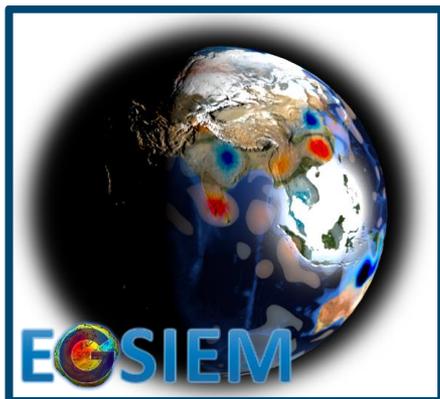Grace Science Team Meeting
Potsdam, 2016-10-05

Outline

ITSG-Grace2016 Processing Strategy
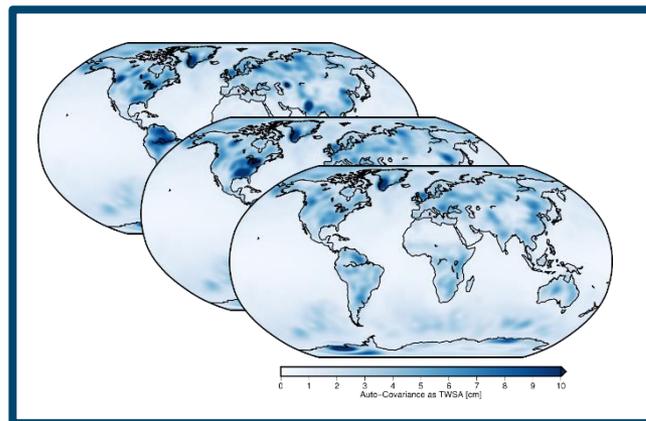

Comparison with In-Situ Data

Conclusions and Outlook

Impact of Process Dynamic

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Processing Strategy

Processing Strategy

High spatial sampling

Limited spatial sampling

GRACE daily data coverage

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Processing Strategy

High spatial sampling

Limited spatial sampling

GRACE contribution limited to regions next to ground track

contribution [%]

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Processing Strategy

High spatial sampling ↑

GRACE contribution limited to regions next to ground track

contribution [%]

TWSA [m]

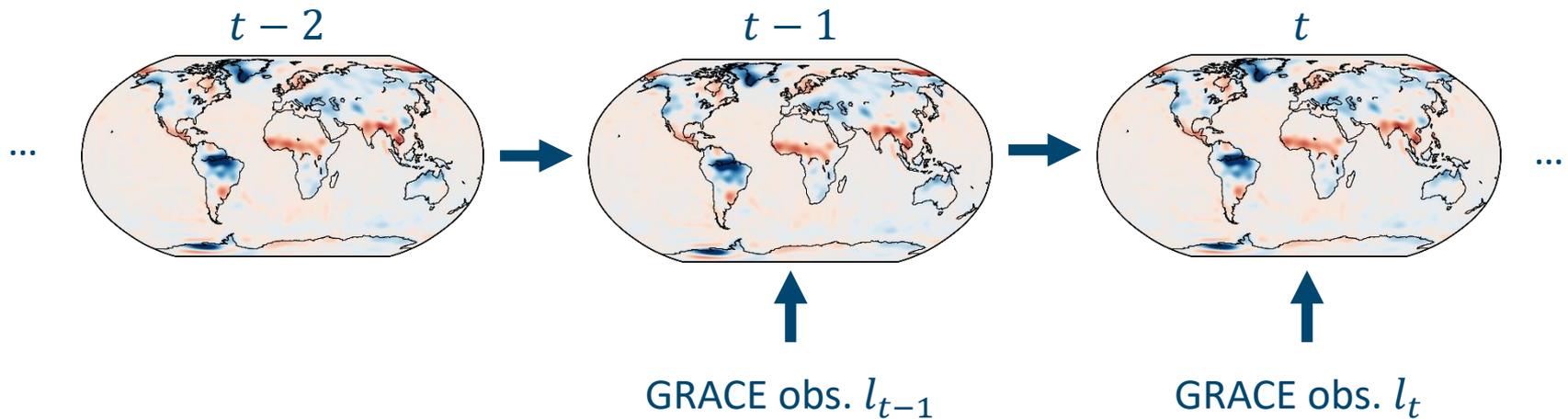→ GRACE alone cannot observe the full gravity field signal

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Processing Strategy

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

$t-2$ $t-1$ t

GRACE obs. l_{t-1} GRACE obs. l_t

GRACE Kalman Filter
(Kurtenbach et al. 2012)
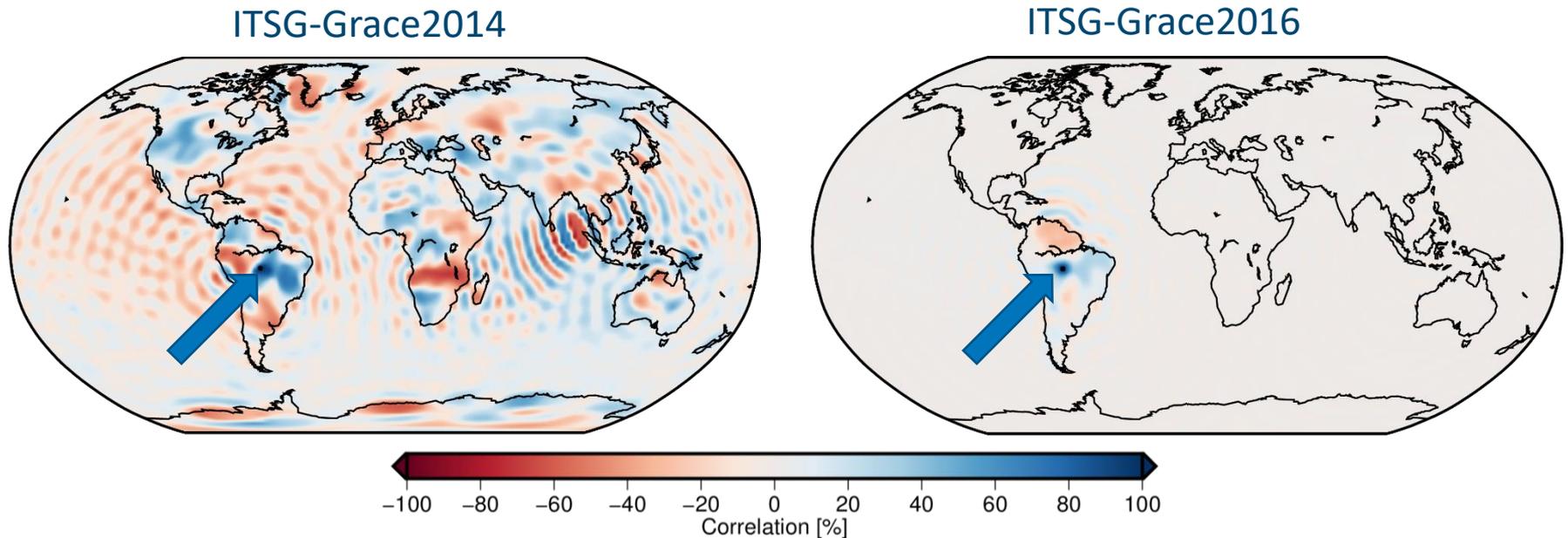
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ITSG-Grace2016 Gravity Field Solutions

- GRACE time series (2002 to 2016) processed and continually updated
  - 5175 daily solutions (4363 days with GRACE contribution)

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

- Model output only used up to 2002-03 → no overlap with GRACE time series

Variability in TWSA [cm]

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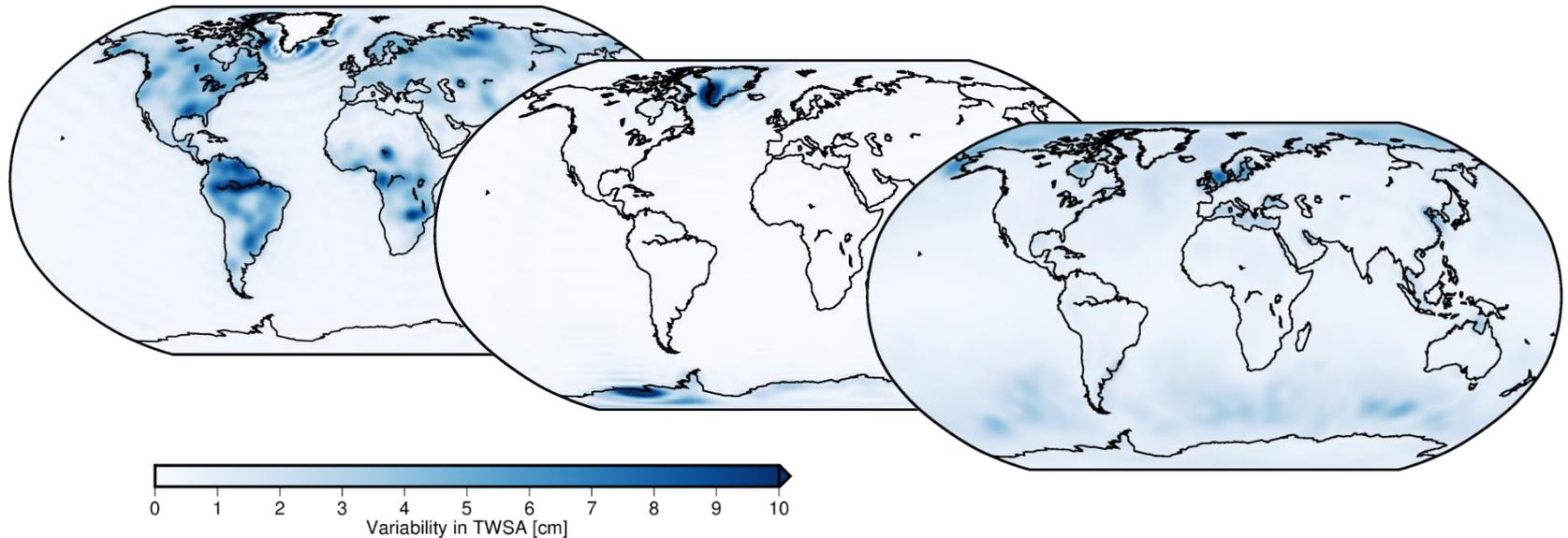
ITSG-Grace2016 Gravity Field Solutions

- Updates to previous release:
  - Improved GRACE processing scheme (see Talk Mayer-Gürr et al.: Insights into the ITSG-Grace2016 processing)

  - Introduction of regions of independent temporal behavior to reduce spurious correlations

ITSG-Grace2014   ITSG-Grace2016

Correlation [%]

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Comparison with In-Situ Data

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Comparison with In-Situ Data

WGHM - 2006-04-15

CSR RL05 2006-04 (DDK3)

ITSG-Grace2016 daily - 2006-04-15

TWSA [cm]

−25 −20 −15 −10 −5 0 5 10 15 20 25

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Comparison with In-Situ Data

- Danube Floods of 2006

- Peak TWSA: approximately 17th of April

ITSG−Grace2016 daily TWSA [cm]
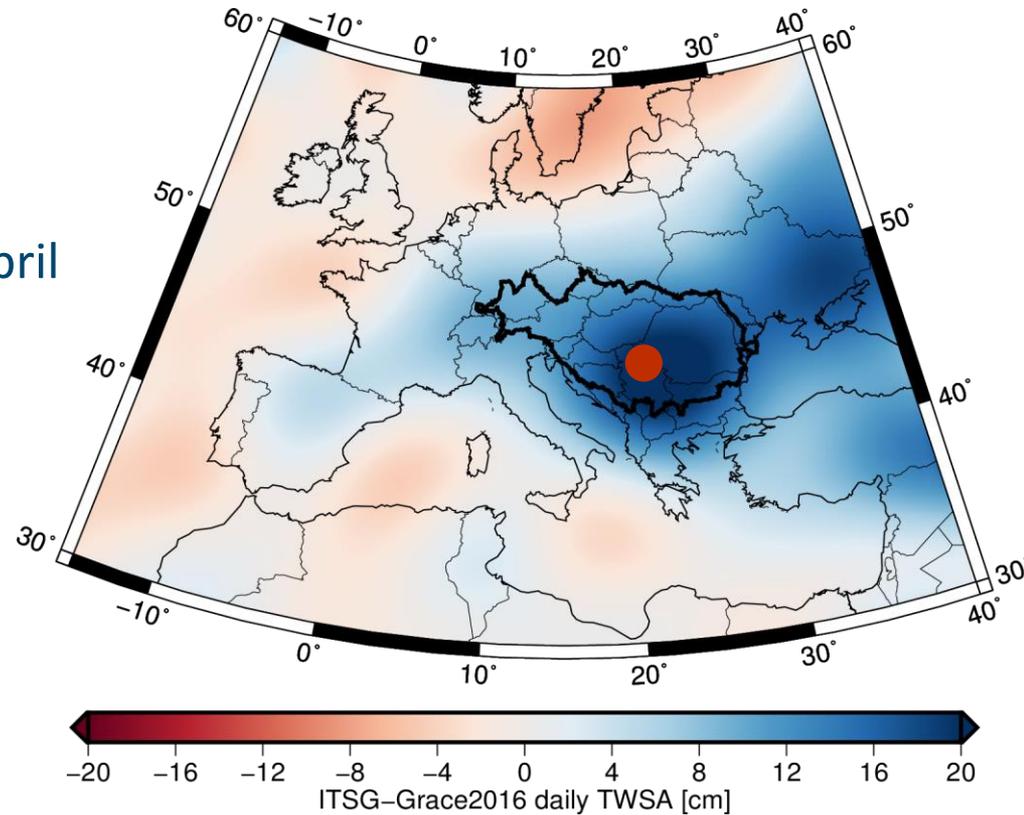
🔴 Bazias Discharge Station

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Comparison with In-Situ Data
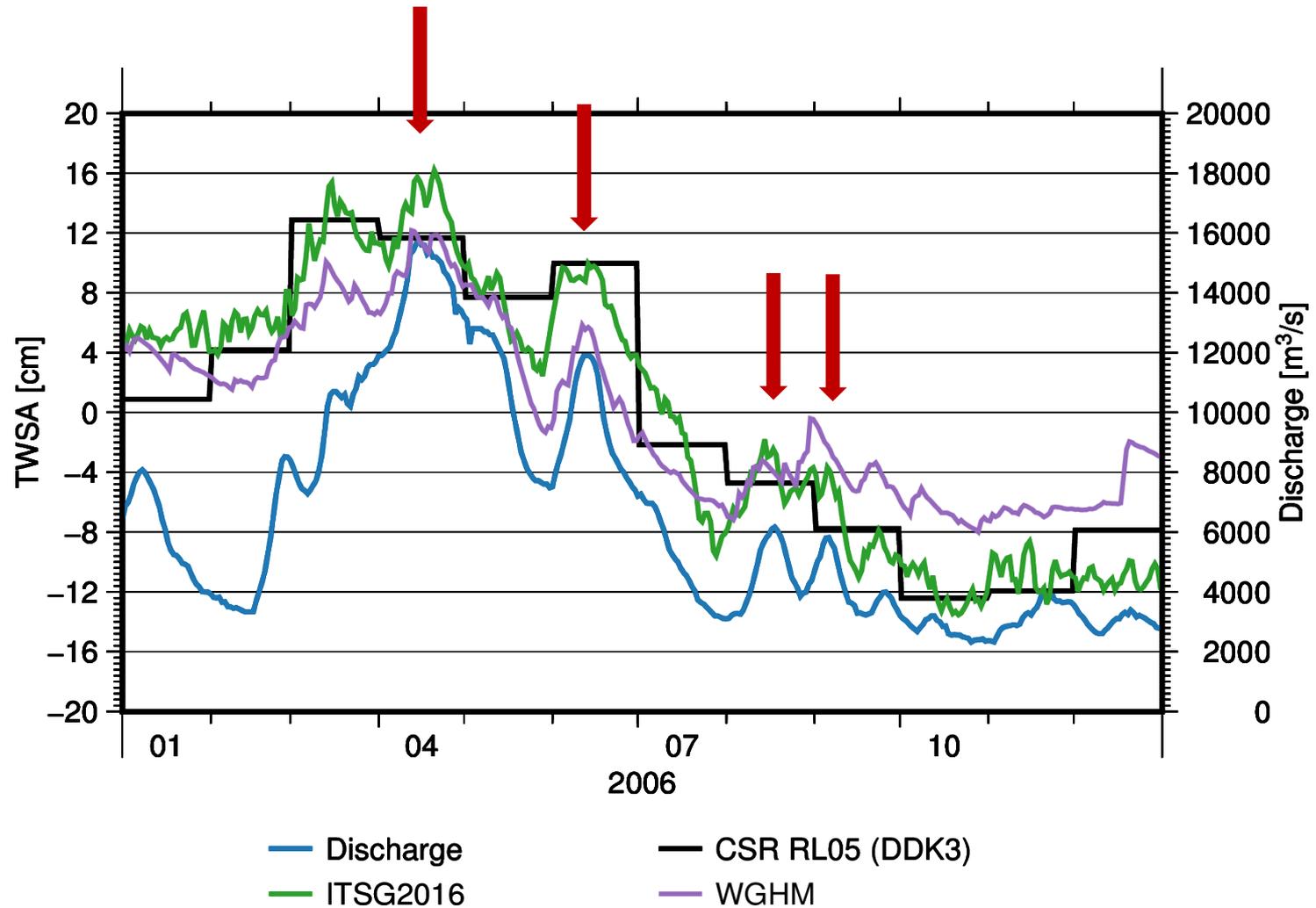
Comparison with In-Situ Data

seasonal/secular variations reduced

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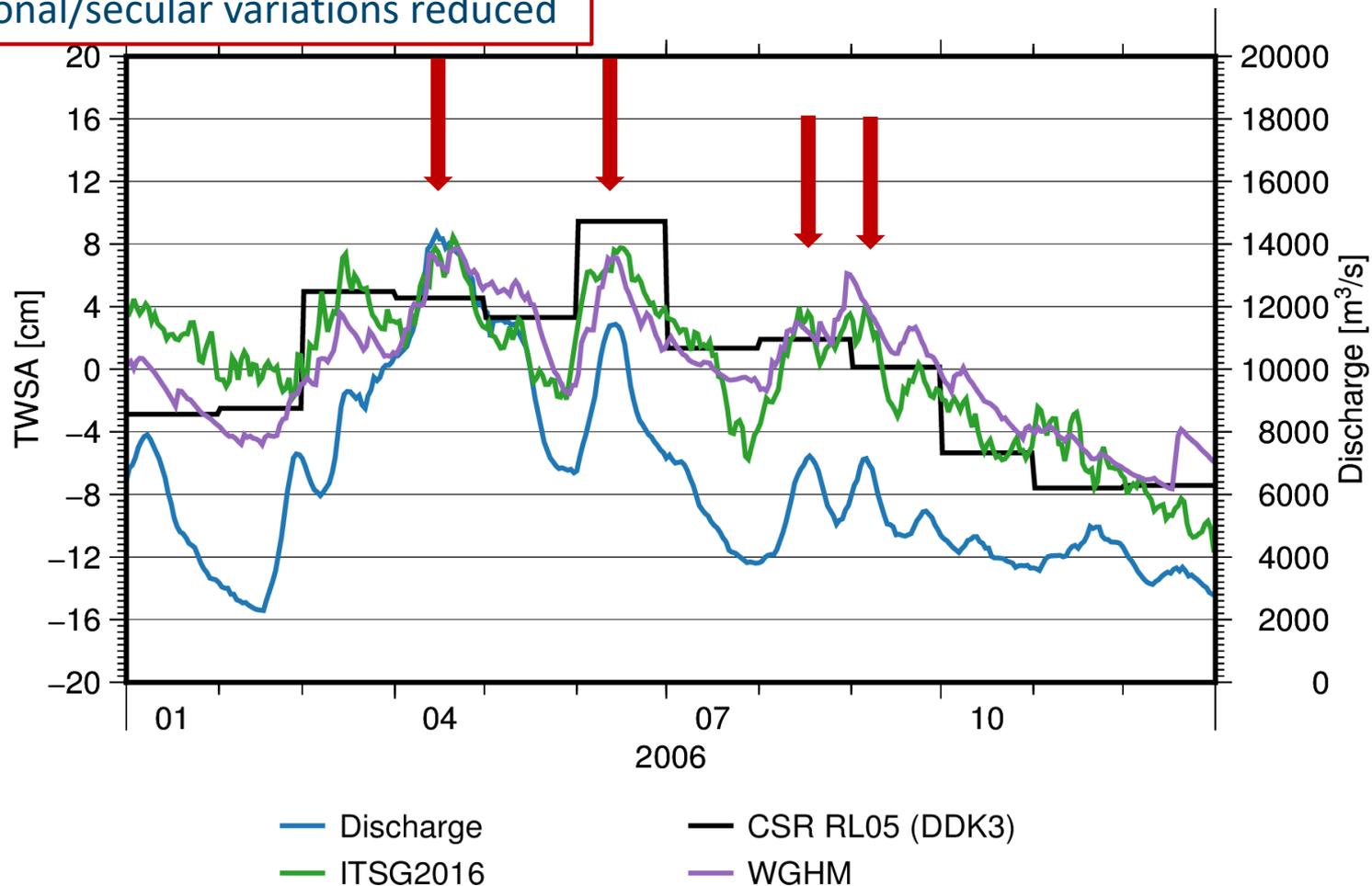
Impact of the Process Dynamic

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Impact of Process Dynamic
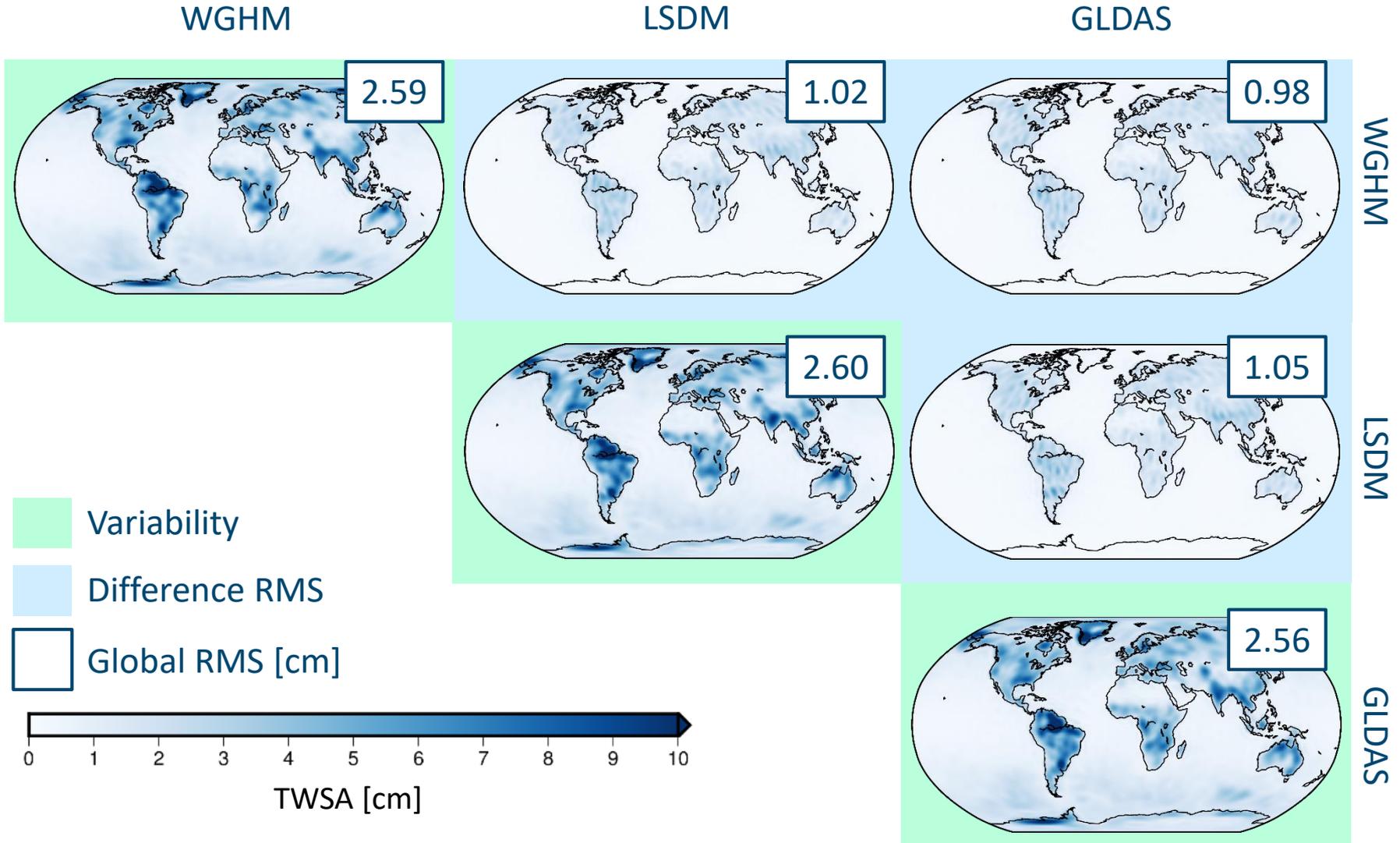
- How much prior information is contained in the Kalman solutions?

- Process dynamic derived from three different hydrological/land surface models
  - WGHM
  - LSDM (ESA ESM H component)
  - GLDAS

- Identical GRACE input: ITSG-Grace2016 daily normal equations

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Cross-Comparison of Model Output

WGHM   LSDM   GLDAS

WGHM: 1.90 / 2.59 / 1.62
LSDM: 2.69 / 2.53
GLDAS: 1.53

Variability

Difference RMS

Global RMS [cm]

TWSA [cm]

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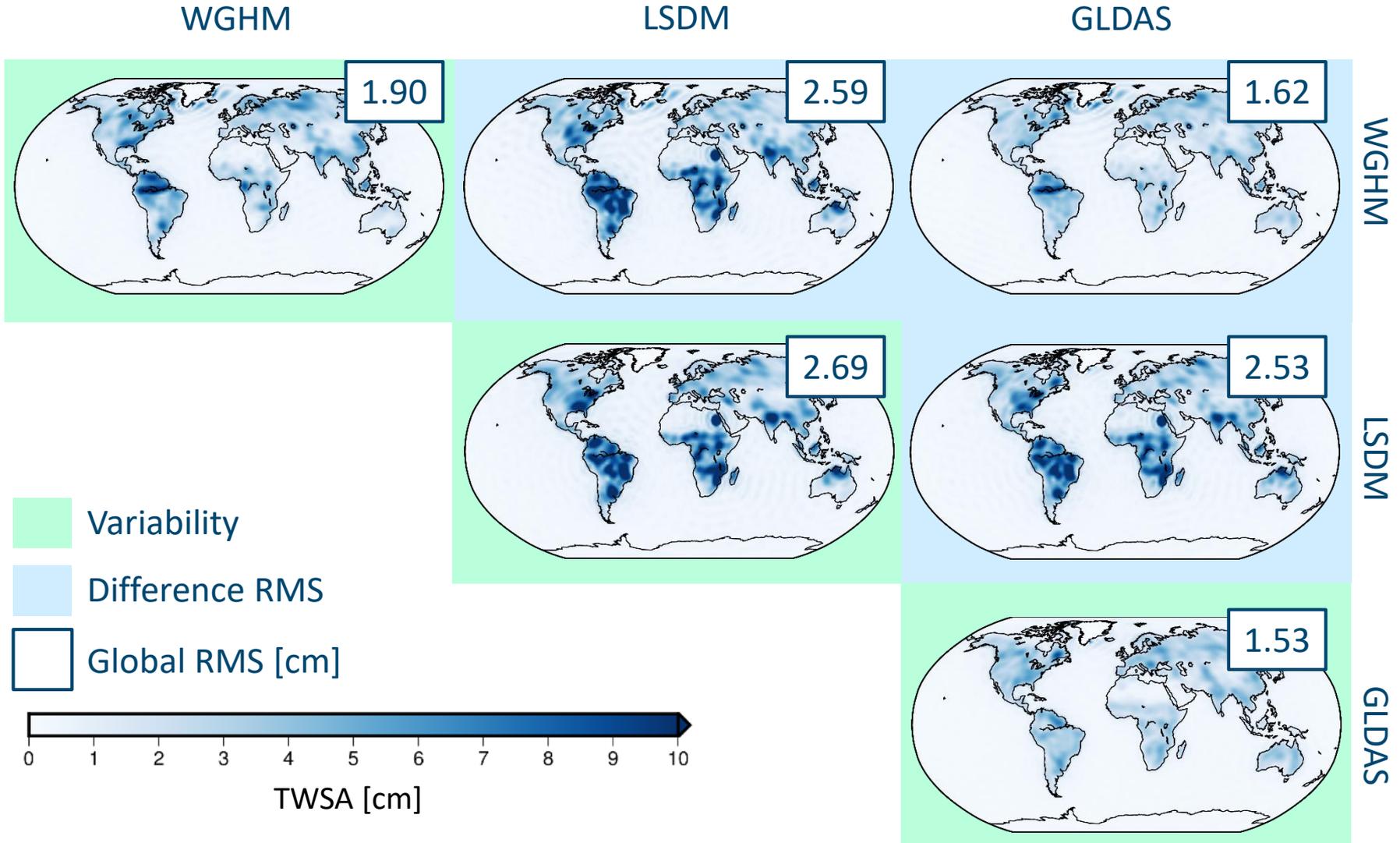
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Cross-Comparison of GRACE Solutions

WGHM · LSDM · GLDAS

WGHM: 2.59 · 1.02 · 0.98
LSDM: 2.60 · 1.05
GLDAS: 2.56

Variability
Difference RMS
Global RMS [cm]

TWSA [cm]

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Conclusions and Outlook

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EGSIEM near real-time (NRT) service

- As part of the EGSIEM project a tech demonstrator for near real-time gravity products will be established

- Operations will be run at GFZ and Graz University of Technology
  - Evaluation with GNSS loading at University of Luxembourg

- Scope: daily GRACE gravity field solutions with five day delay

- Two independently computed solutions
  - Global: spherical harmonic representation
  - Regional: radial basis functions
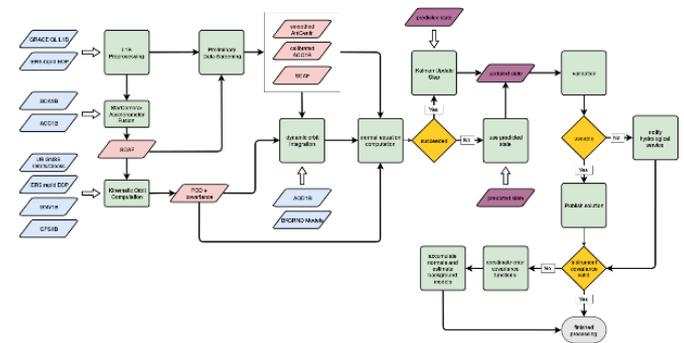
Conclusion and Outlook

- GRACE can provide information for much shorter time spans than the standard monthly solutions

- ITSG-Grace2016 solutions are available under **ifg.tugraz.at/ITSG-Grace2016**

- 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

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