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European Gravity Service for Improved Emergency Management

WP5: status & plans

Deliverable 5.1: NRT service concept

EGSIEM Meeting, University of Bern

June 11 – June 12, 2015

HORIZON 2020

Project Plan

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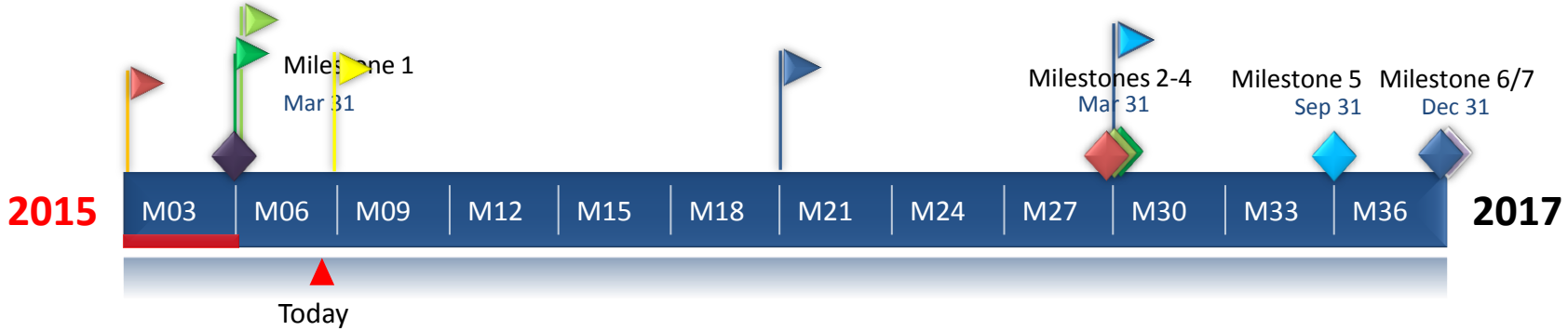

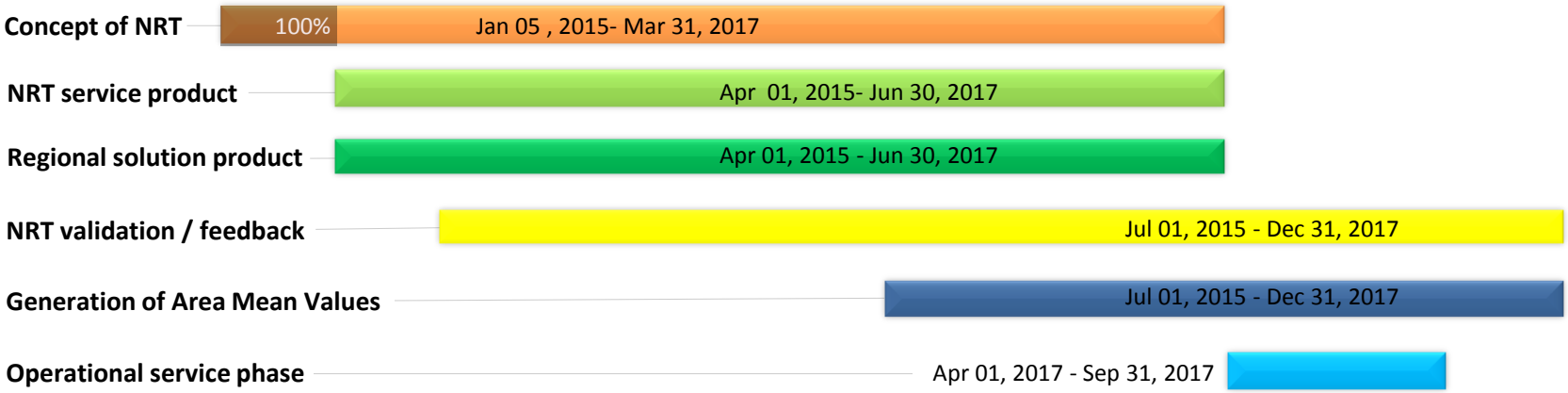

Input data for gravity recovery and latencies

Product	Source	Current Latency (IP)	Required Latency (OP)
EOP	IERS/UBERN	IERS: 1-3 days, UBERN: 14 days	IERS: 1-3days, UBERN: 17 hours
GPS Orbits/Clocks	UBERN (T3.4)	14 days	17 hours
GRACE L1B Data	JPL, Backup: GFZ	11 days	1 day
Dealiasing Product (AOD1B) **Specific hydrological basin (upon request)**	GFZ WP3/6	7 days Not available	3-4 days 1 day

hardware

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processing time for a single day: 2-3min

Infrastructure at GFZ

Product	Hardware	Software
Serversystem	Supermicro X10DRW-i	Matlab/shell scripts
	Dual socket R3 (LGA 2011) supports Intel® Xeon®	Fortran90 source
Processor	E5-2690 v3, 2.60 GHz, 12-Core Socket 2011-3, 30MB Cache	
Memory	256GB (16x 16GB) DDR4 / PC2133 Reg. ECC	
Storage	4x 3TB SATA3 Server-RAID-Festplatte HGST Ultrastar 7K4000 3.5IN 7200RPM, 24*7-certified	

Infrastructure at TUG

Product	Hardware	Software
Server System	Supermicro 2042G-TRF	C++/Python Source
	4x SG34 MB H8QGi-F	
Processor	CPU AMD OPTERON 6176 2.3GHZ 12Core SG34 18MB Cache	
Memory	32 x 8GB DDR3-RAM 1333MHZ	
Storage	SEAGATE HARDDISK 1000GB S-ATA2 7200RPM 32MB ST31000524NS	

Production-flow

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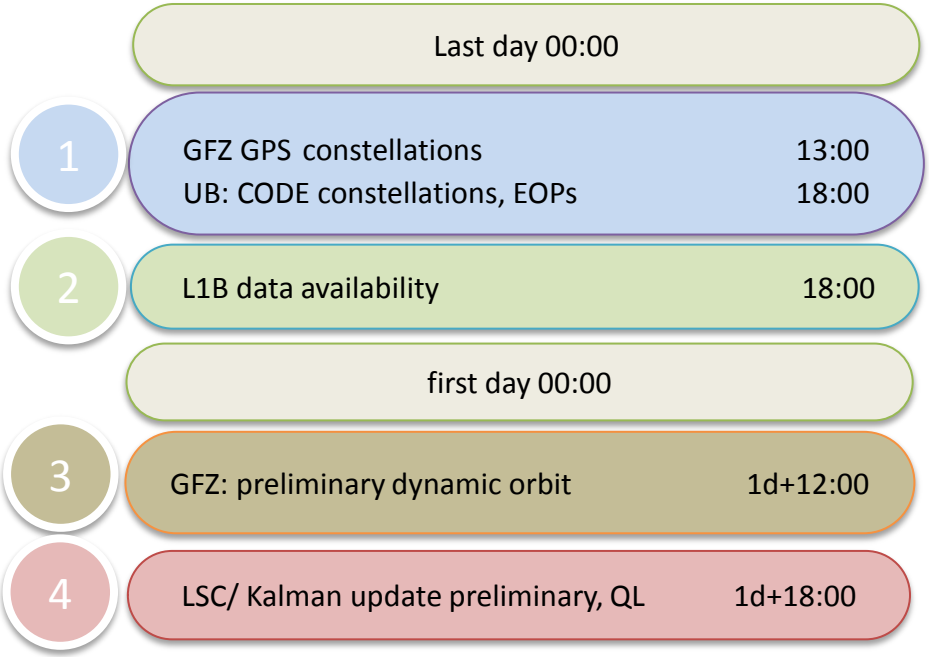
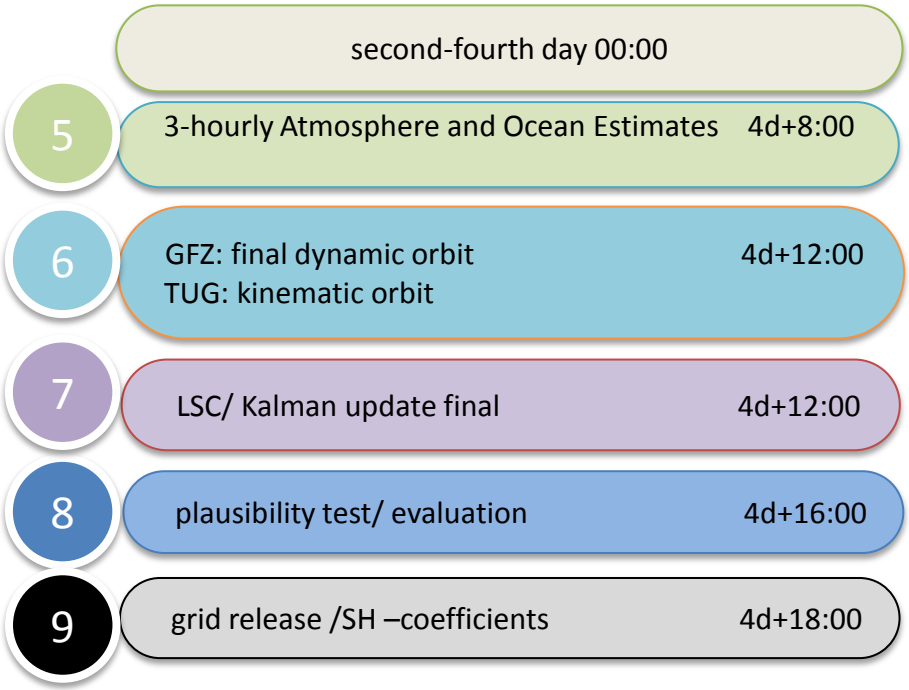


Production flow (cont.)



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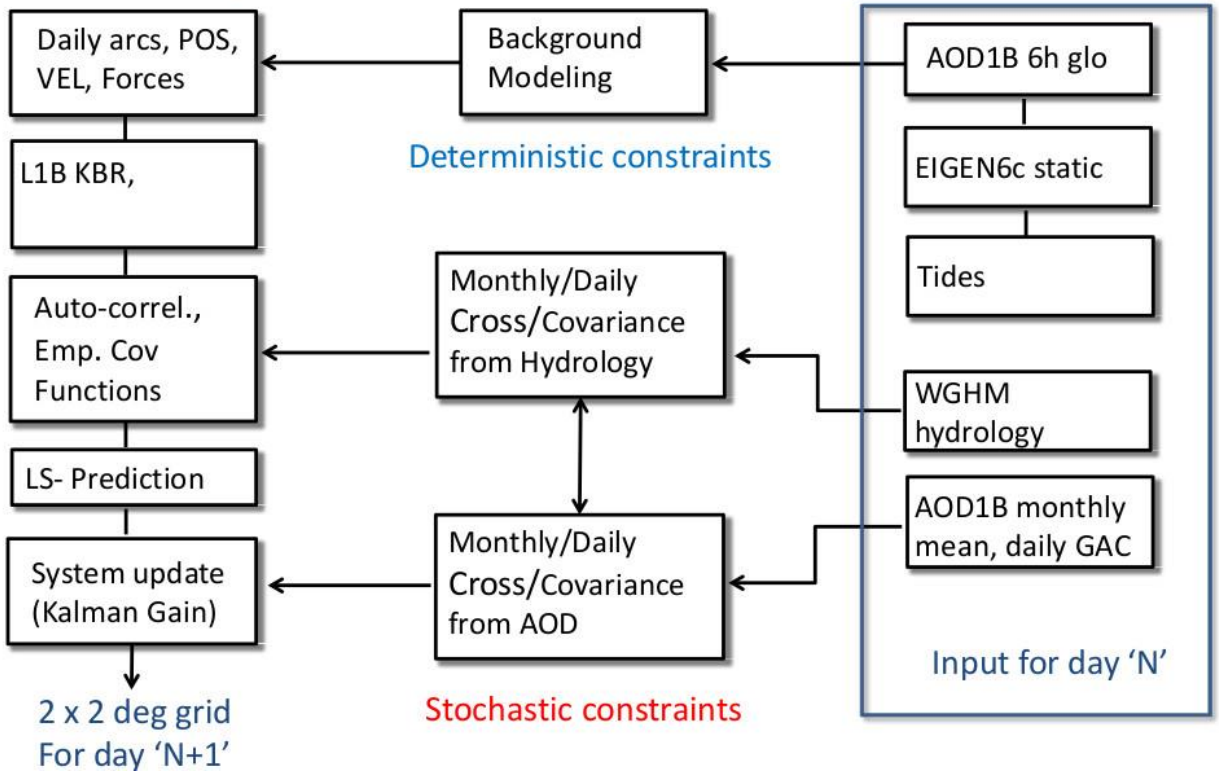
Processing Scheme Kalman Filter



Covariance functions

- Danish method: subtract everything known and later add it back. We do this for trends and (semi) annual signals.
- General covariance method:
  - directional dependence,
  - changing variance and correlation length

Error Covariances

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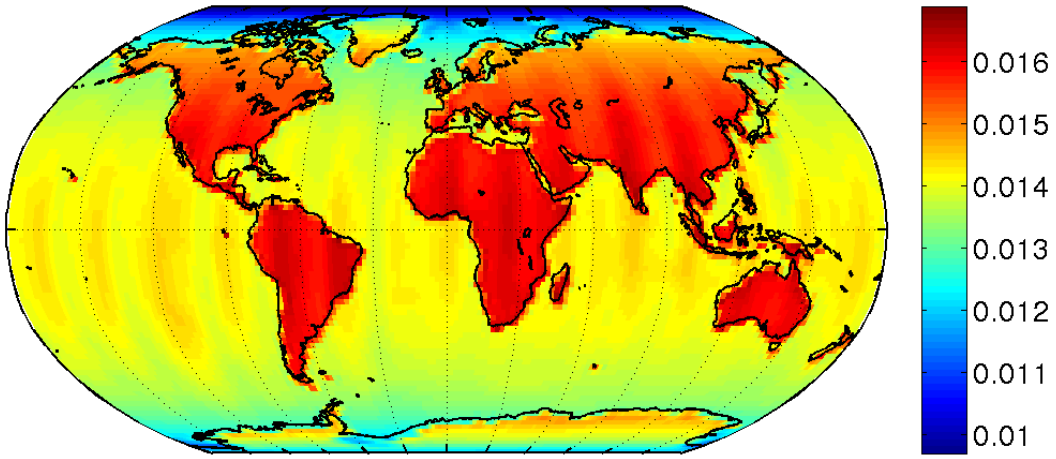
Error propagation (LS prediction) → Process noise addition → Kalman Error/Cov update



Error Variances after the Measurement update, EWH [m]

Process noise derivation

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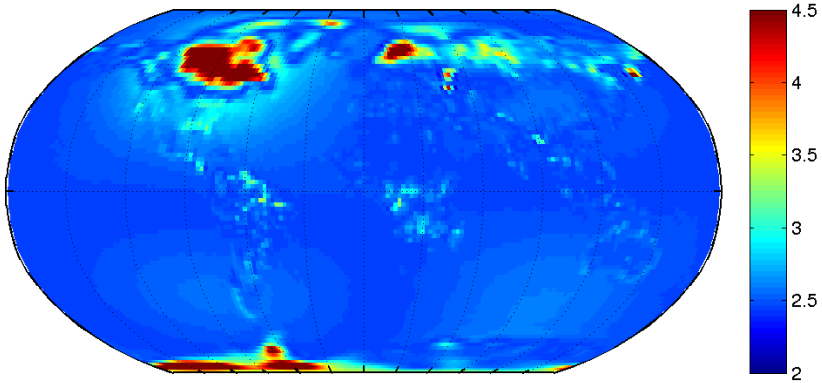
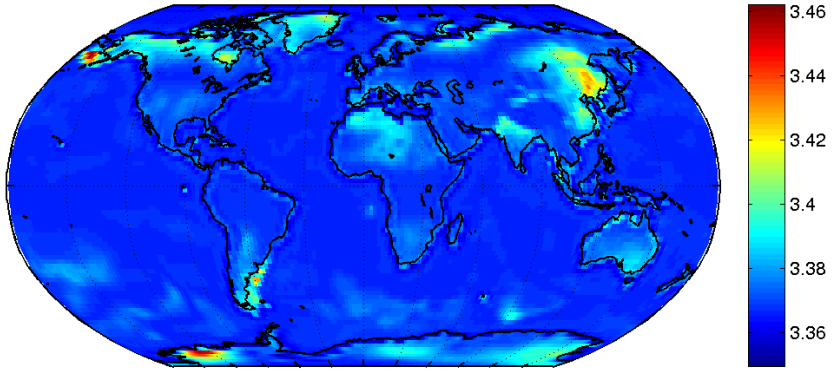


EWH Hydrology+ GIA variances [mm]



EWH Atmosphere+ Ocean variances [mm]

Process Noise

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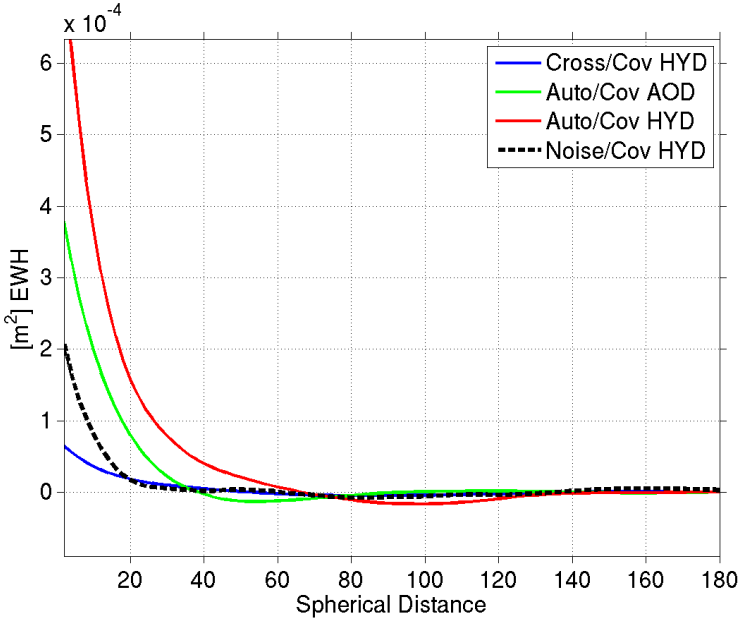
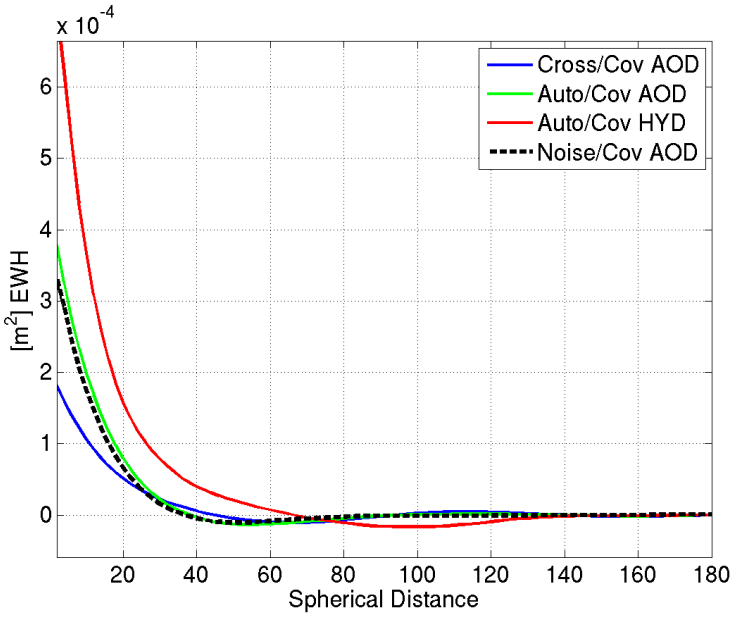


EWH Hydrology+ GIA



EWH Atmosphere+ Ocean

Land/Ocean separation

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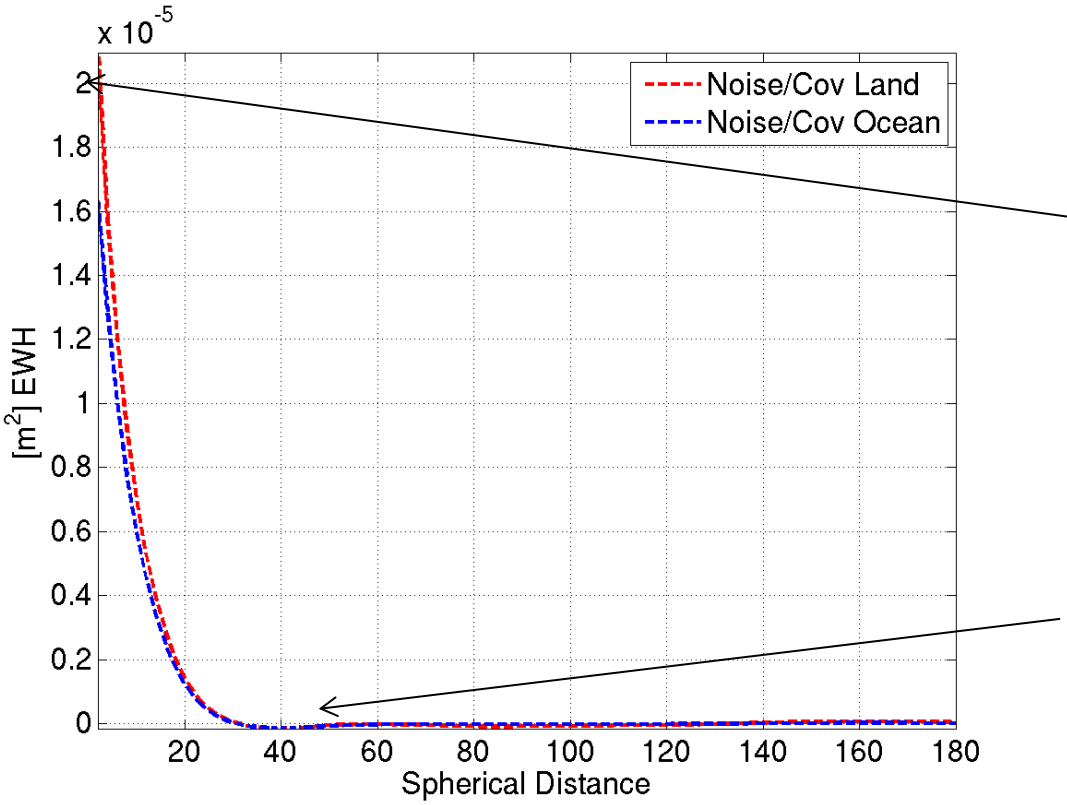

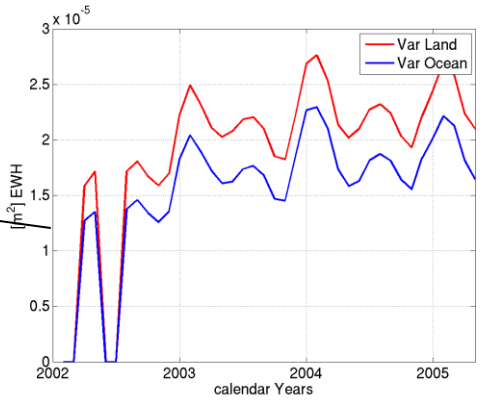

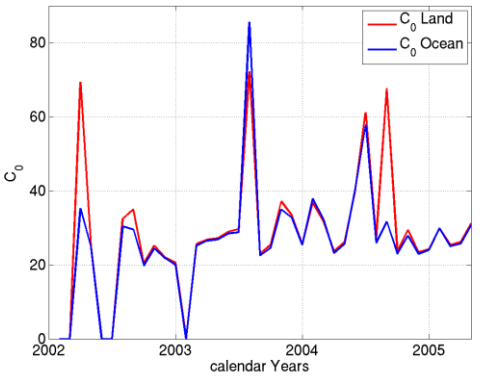

Issues/plans

- Construction of anisotropic cov. functions
- Subtraction of the reference model (monthly updated). Do we need the introduction of reference stochastics for a better process noise estimation?
- Dynamic orbits (thorough iteration towards K-band)
- Further convergence of the regularized solutions with the monthly (SDS) fields (w/o regularization)
- Start work on purely regional solutions

Mediterreanean coast, Spain

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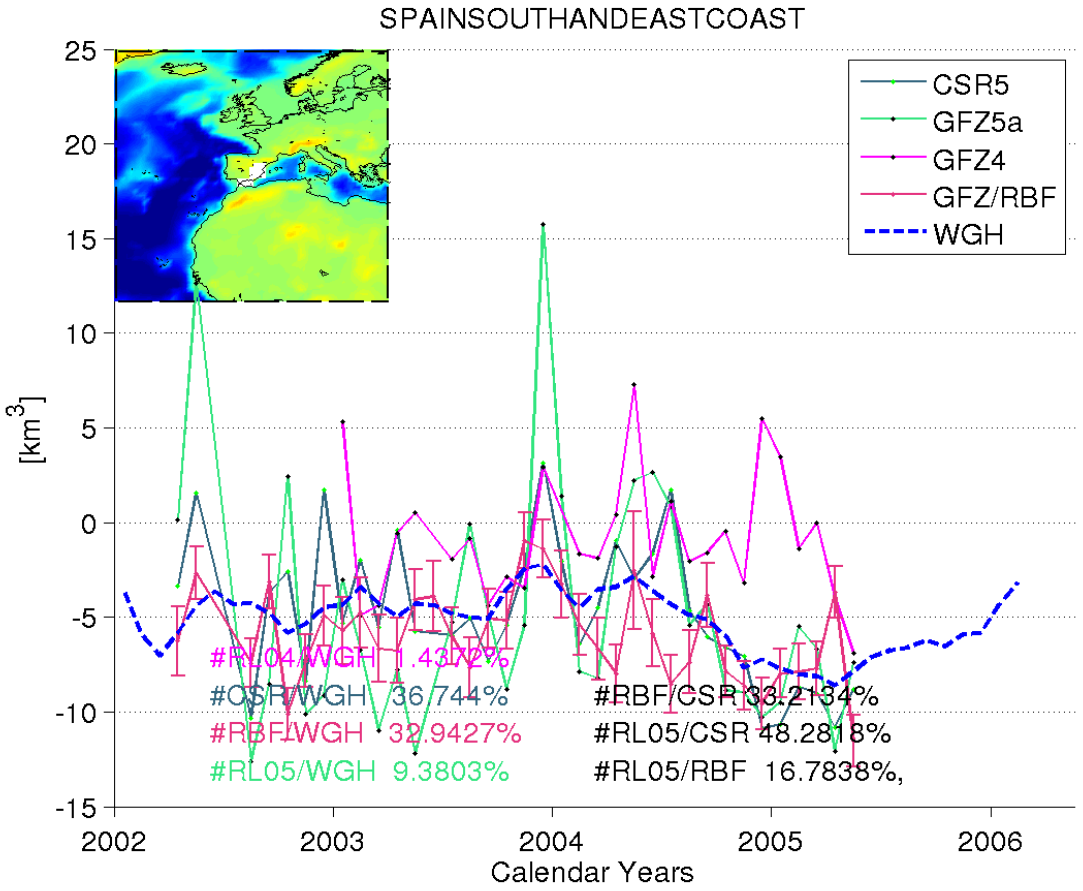

Mediterranean coast, Guadiana

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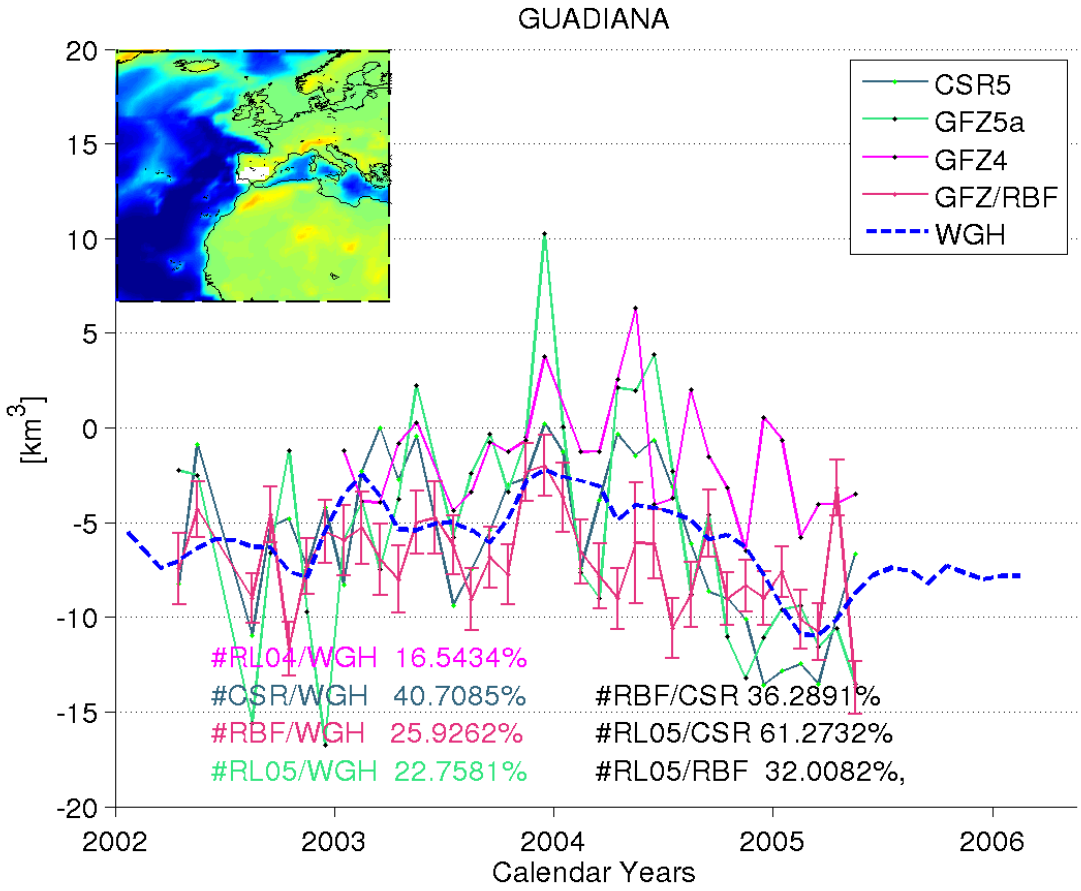

Narva

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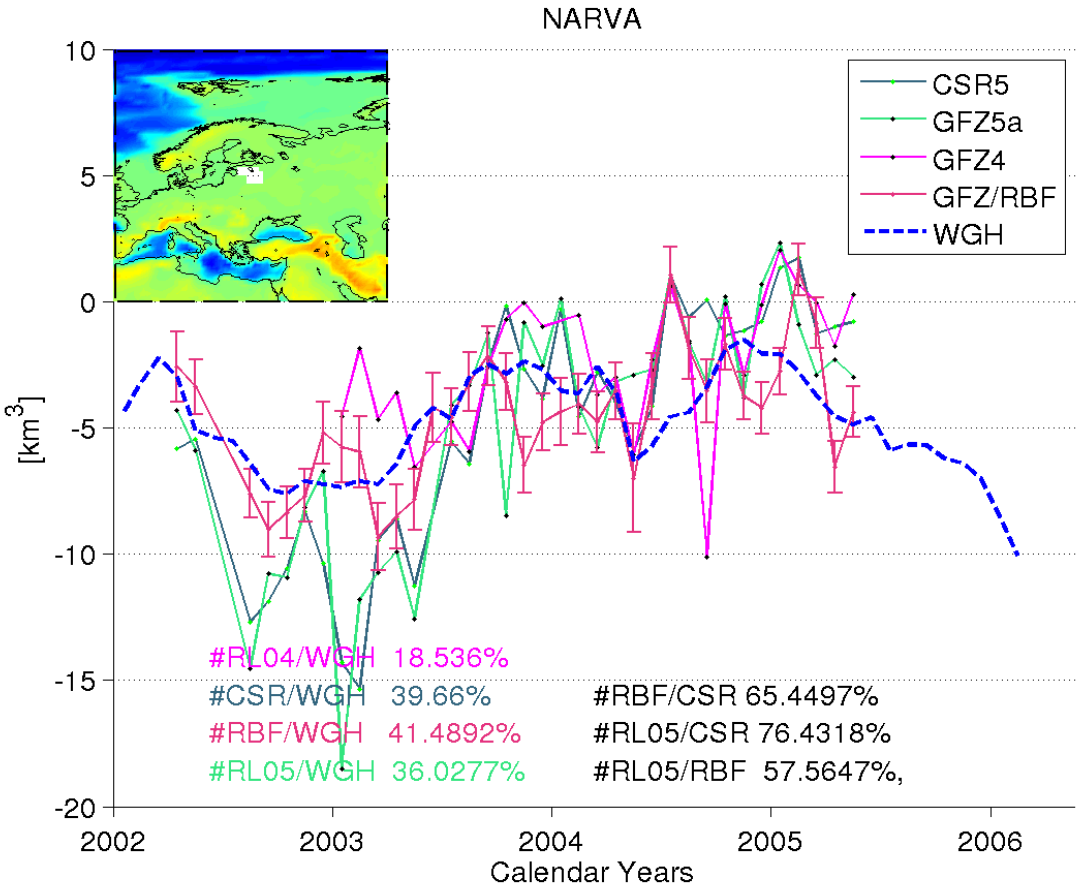

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Title: **WP5: NRT at TUG – Status and Plans**

Presenter: AK

Affiliation: TUG

EGSIEM Meeting, University of Bern

June 11. – June 12. 2015

Status of NRT implementation

- NRT is implemented according to D5.1 using L1B data and final GPS products

- GRACE time series starting from 2006 is currently being processed

- Primary focus:
  - Impact on solutions of NRT strategy compared to post processing
  - Finding software bugs and generally improve robustness

- Adaption of kinematic orbit processing to rapid products

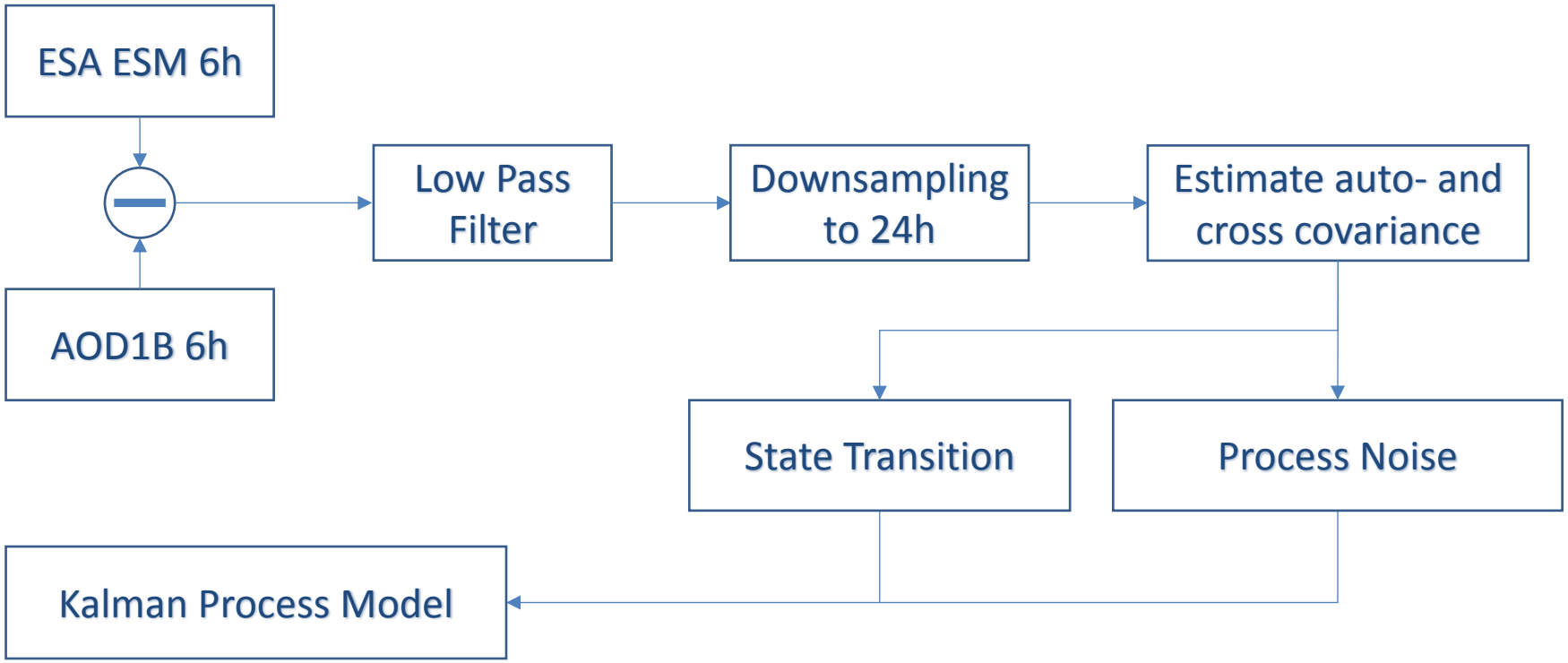
Kalman Solutions: Basic Concept at TUG

- State transition is based on least squares prediction

$$\mathbf{x}_t = \mathbf{B}\mathbf{x}_{t-1} + \mathbf{w} \qquad \mathbf{B} = \Sigma_\Delta \Sigma^{-1}$$

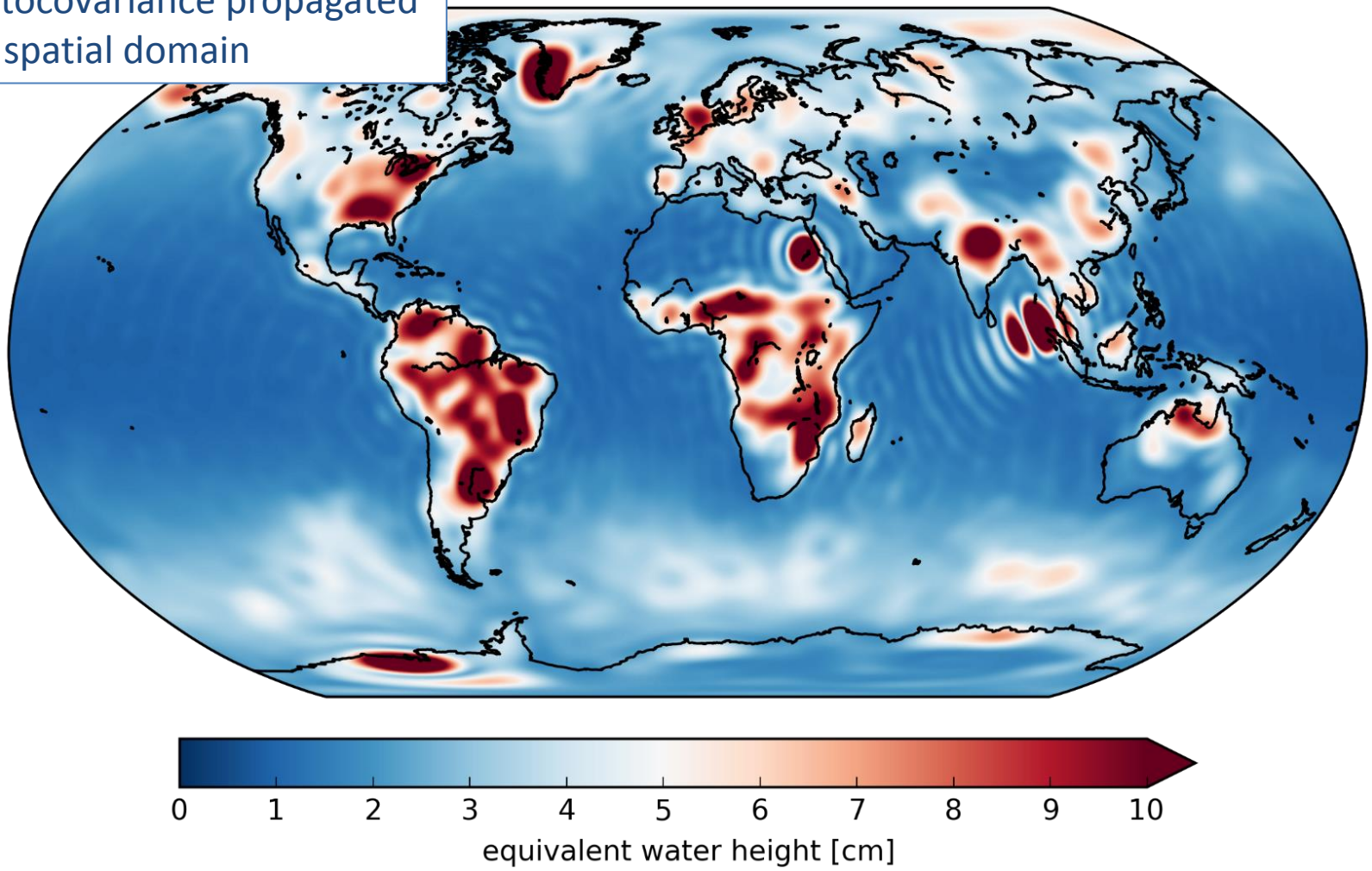
- Auto- and cross covariance can be derived in multiple ways:
  - assume the errors will be proportional to the amplitude of the signal
  - Use ensemble run differences
  - …?
- Currently, the model differences of ESA ESM and AOD are being investigated

Process Model Derivation (1)



Process Model Derivation (2)

autocovariance propagated to spatial domain

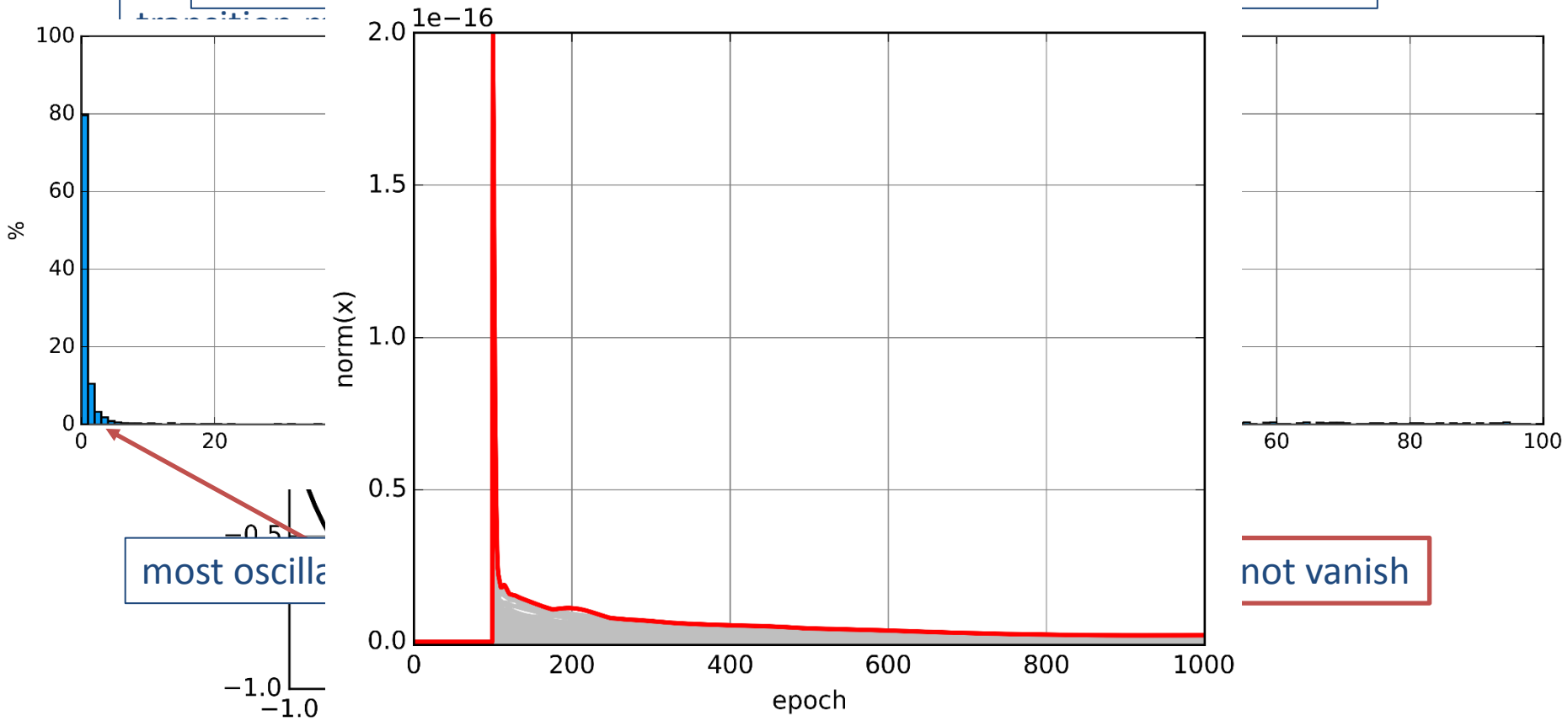


Process Model Properties (1)

unit impulse response

Eig half life of oscillations

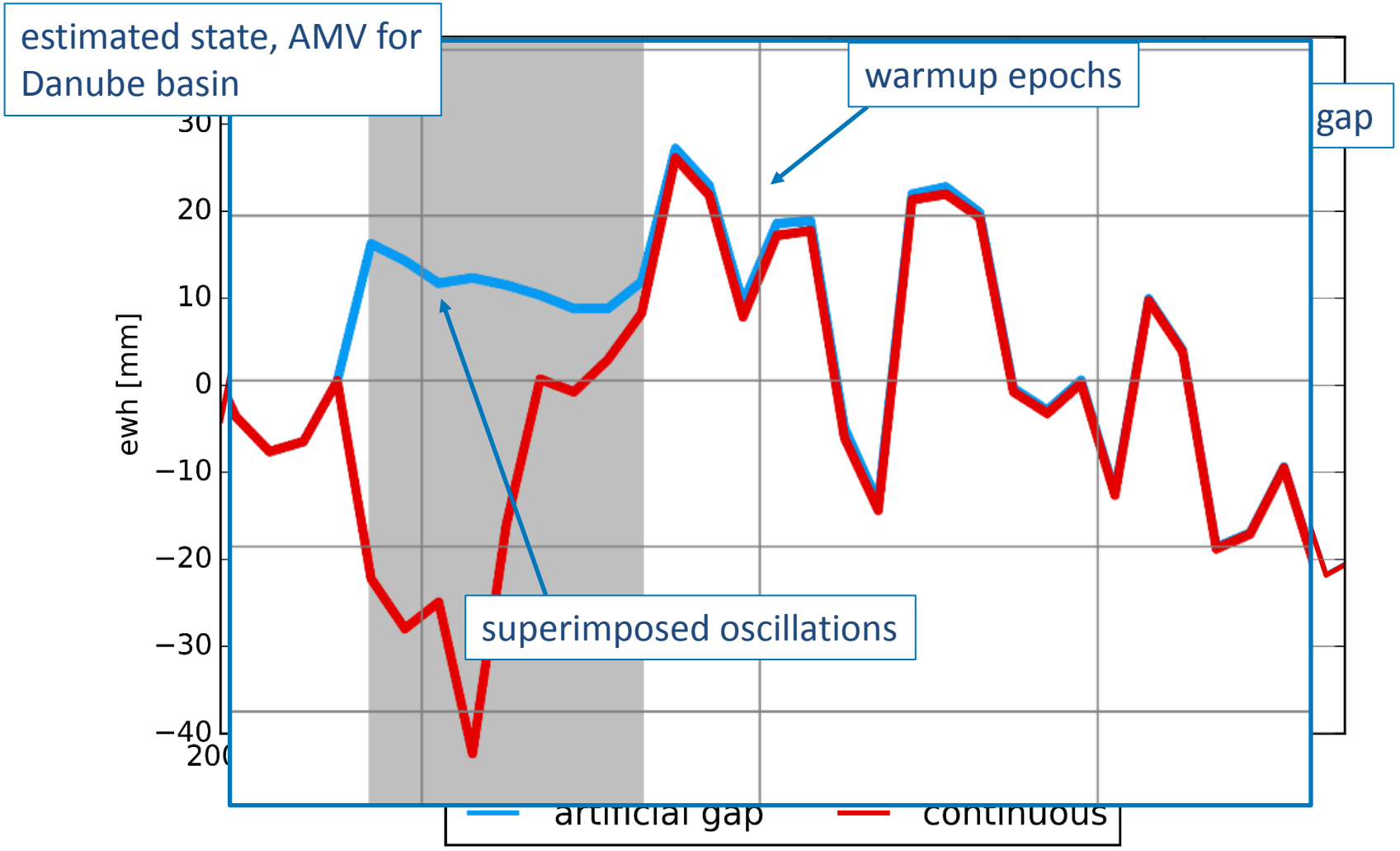
periods of oscillations



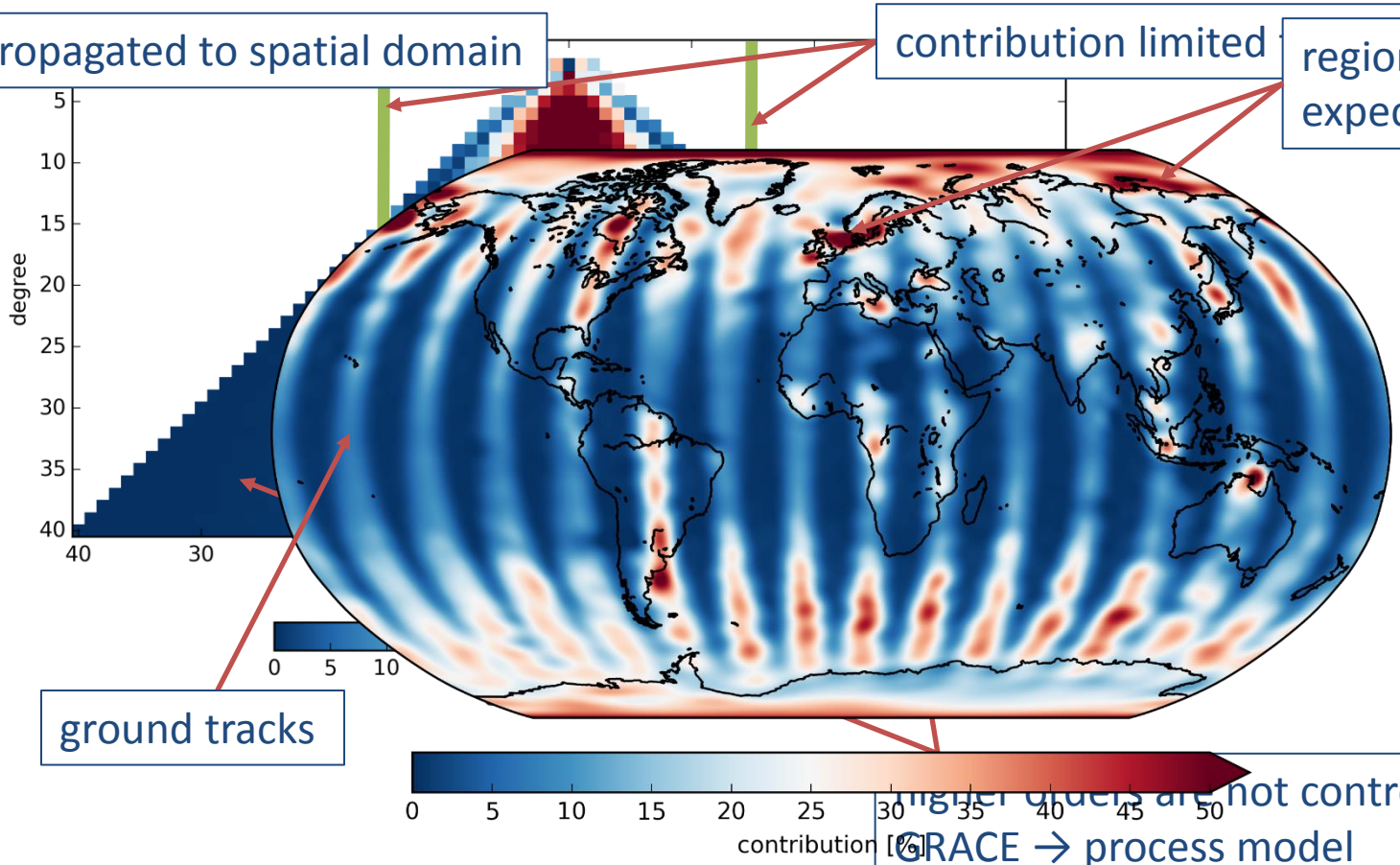
most oscilla

not vanish

Process Model Properties (2)



Contribution of GRACE to Updated State



higher orders are not controlled by GRACE → process model

Plans and Outlook

- Finalizing software framework
- Process model tuning
  - Handling of long term correlations in data gaps
  - Introducing new WGHM daily time series (maybe?)

- M7- : Reprocessing of time series using rapid GPS products
  - Improvement of kinematic orbit processing
  - T5.2: data basis for hydrological service (T6.1 & T6.2)

- M7- : Working towards (provisional) service operations resulting in D5.2

Items of Discussion

- During the development of the NRT Draft Concept (D5.1) some interesting points came up:
  - Dependence of the daily solutions of the models used to derive state transition and process noise matrix
  - Impact of constraint on the daily solutions