EGSIEM

European Gravity Service for Improved Emergency Management

L3 Product from EGSIEM Combined Solutions

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Horizon2020

Outline

- Definition of L3 Products
- Implementation and Technical Aspects
- Summary And Outlook

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Definition of L3 Products

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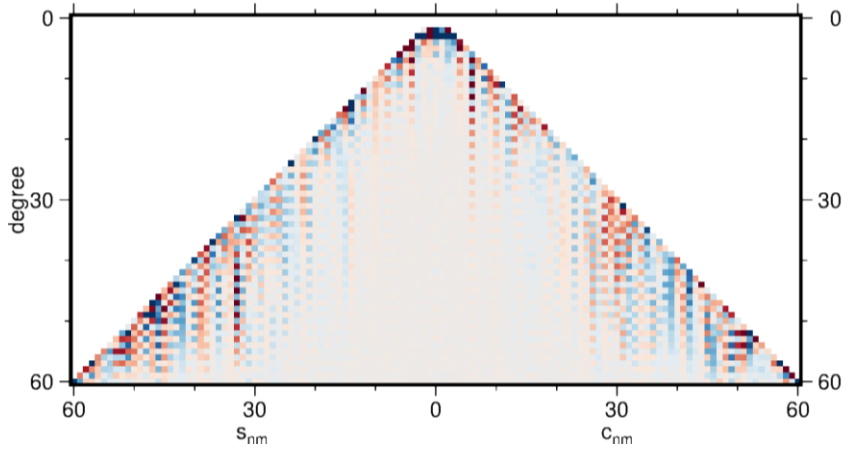
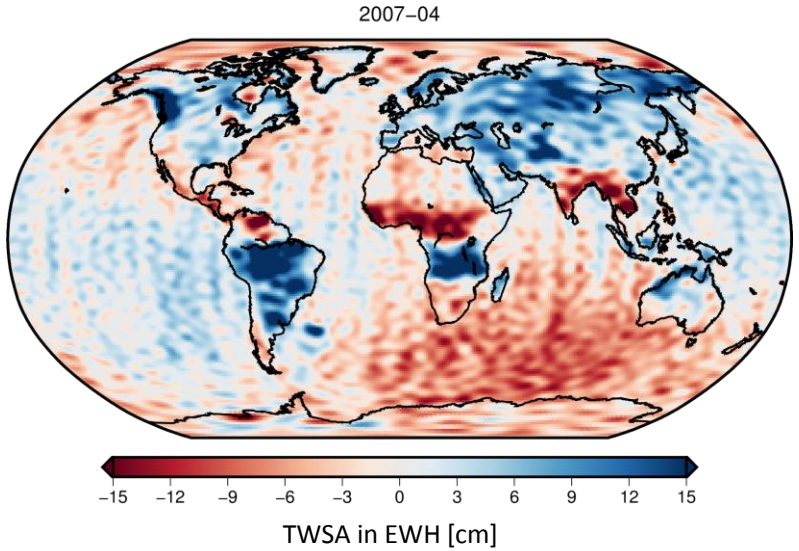
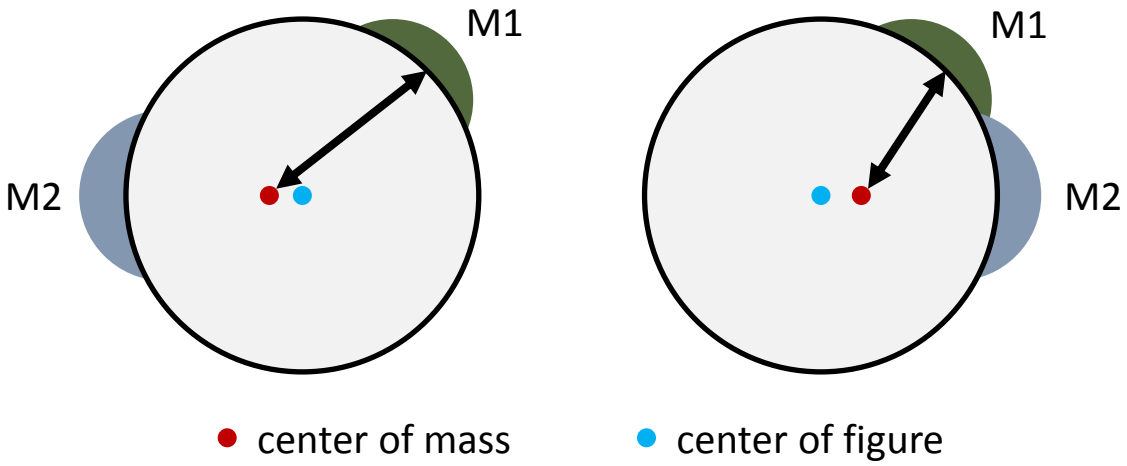
- The GRACE Science Data System (SDS) defines four levels of
  - L0: raw telemetry of the spacecraft
  - L1A/B: L0 data converted into engineering units (A) and pre-processed (B)
  - L2: spherical harmonics based on monthly batches of L1B data
  - L3: broadly usable, gridded data sets based on L2 data

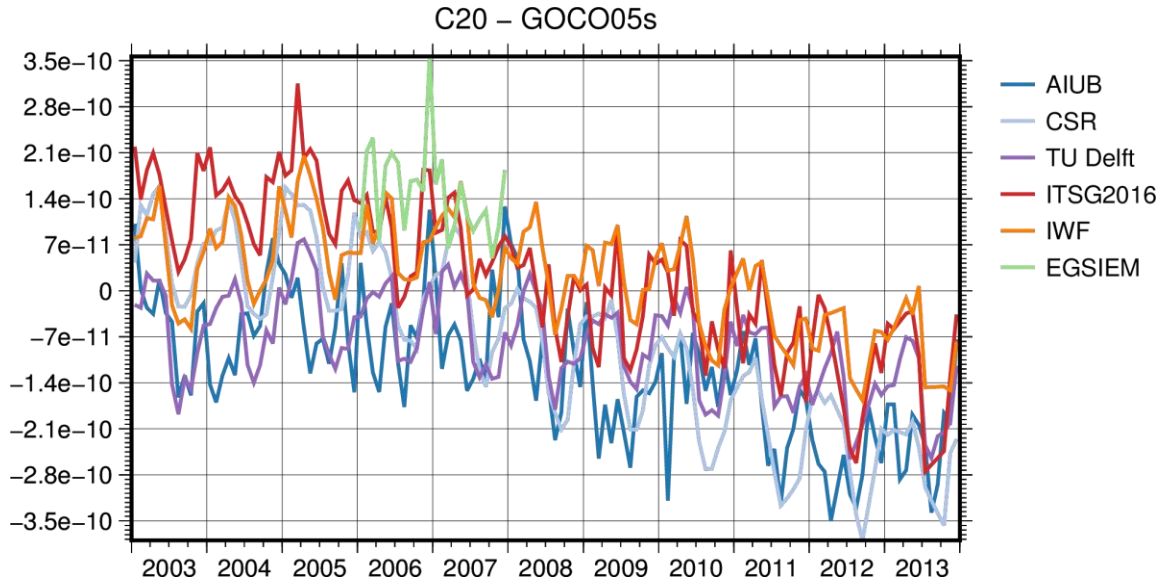




Definition of L3 Products

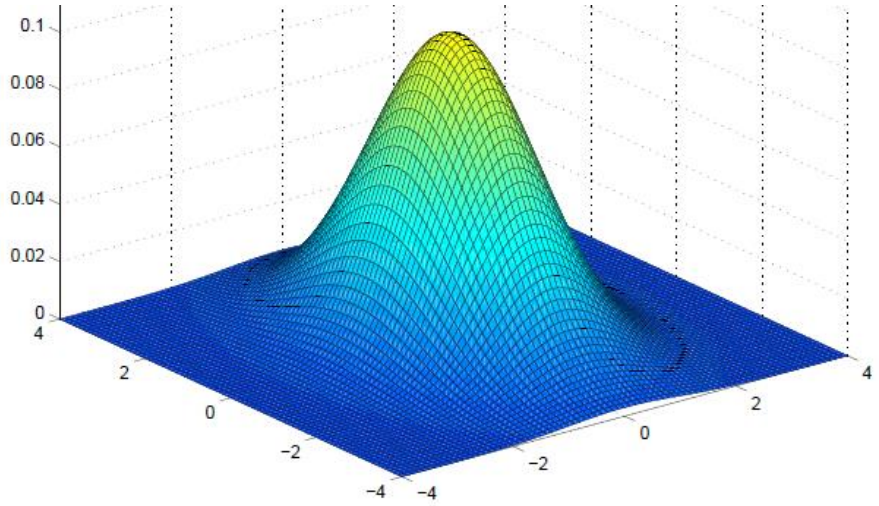
- To arrive at usable grids, some post-processing steps are necessary
  - Correction of geocenter motion
  - Substitution of Earth's oblateness by a more reliable estimate (e.g. SLR)

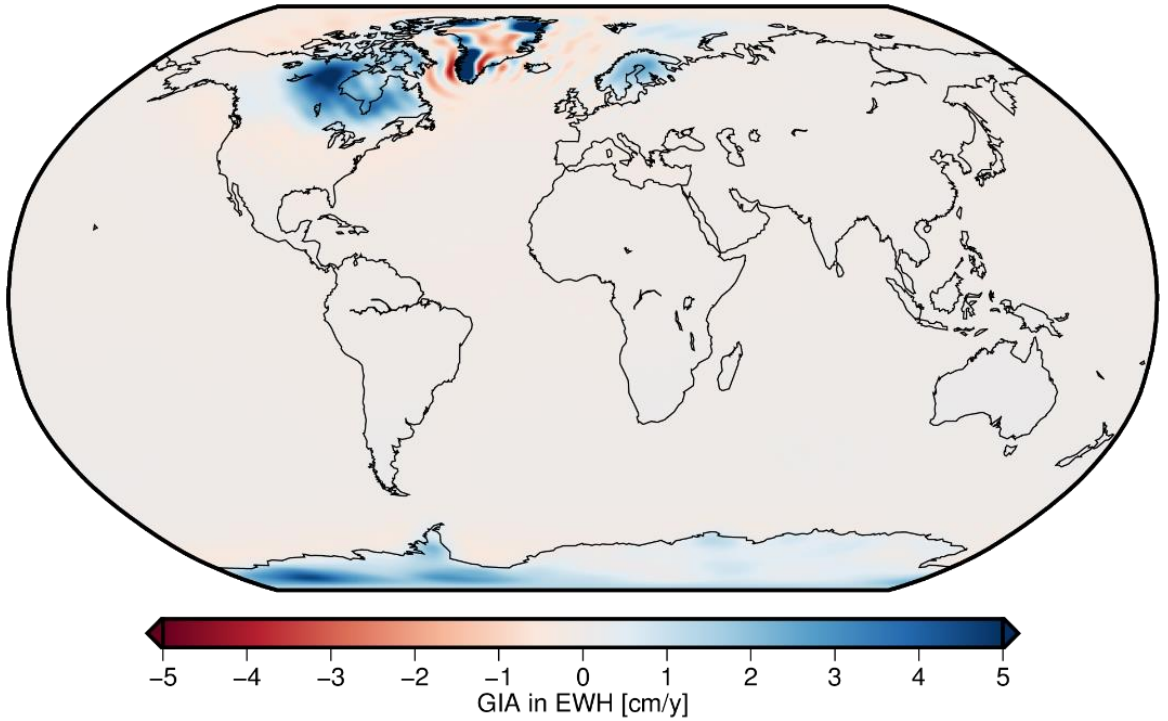




Definition of L3 Products

- To arrive at usable grids, some post-processing steps are necessary
  - Correction of geocenter motion
  - Substitution of Earth's oblateness by a more reliable estimate (e.g. SLR)
  - Reduction of high frequency noise by filtering
  - Removal of unwanted geophysical signals





Definition of L3 Products

- In practice, L3 products are produced for specific domains or geophysical systems, e.g.:
  - Hydrological sciences - terrestrial water storage
  - Oceanography – ocean bottom pressure variations
  - Atmospheric sciences – mass variations in the atmosphere

- For each subsystem/domain a tailored post-processing chain is required
  - Different filters are applied and/or different geophysical models are removed

- For EGSIEM we focused on land and ocean grids as they address the largest user base
  - Grids are available through the **egsiem.eu** website

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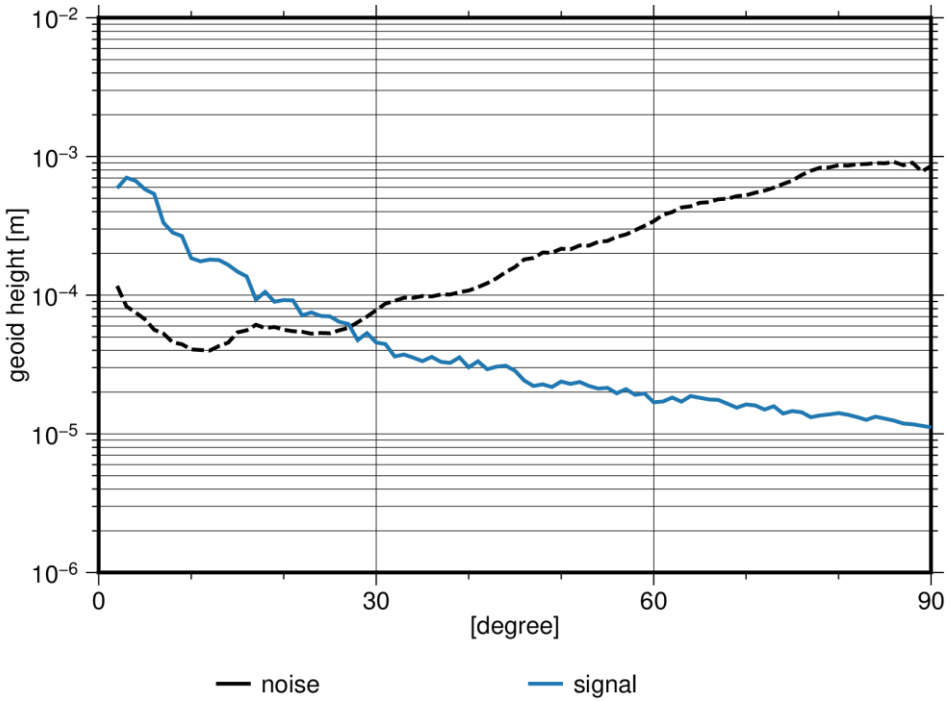
Implementation and Technical Aspects

Implementation and Technical Aspects

- For the EGSIEM grids, an extension to the popular DDK filter by Kusche et al. 2009 was implemented

- The DDK filter is based on the signal-to-noise ratio of a (theoretical) GRACE monthly solution
  - Analytical noise model for GRACE
  - Isotropic signal model – no spatial prior information

- A natural extension to this principle is to use actual GRACE uncertainty information
  - This takes the temporal changes in uncertainty into account: orbital decay, repeat cycles, large data gaps, …
  - Similar idea: VADER filter from TUM



Implementation and Technical Aspects

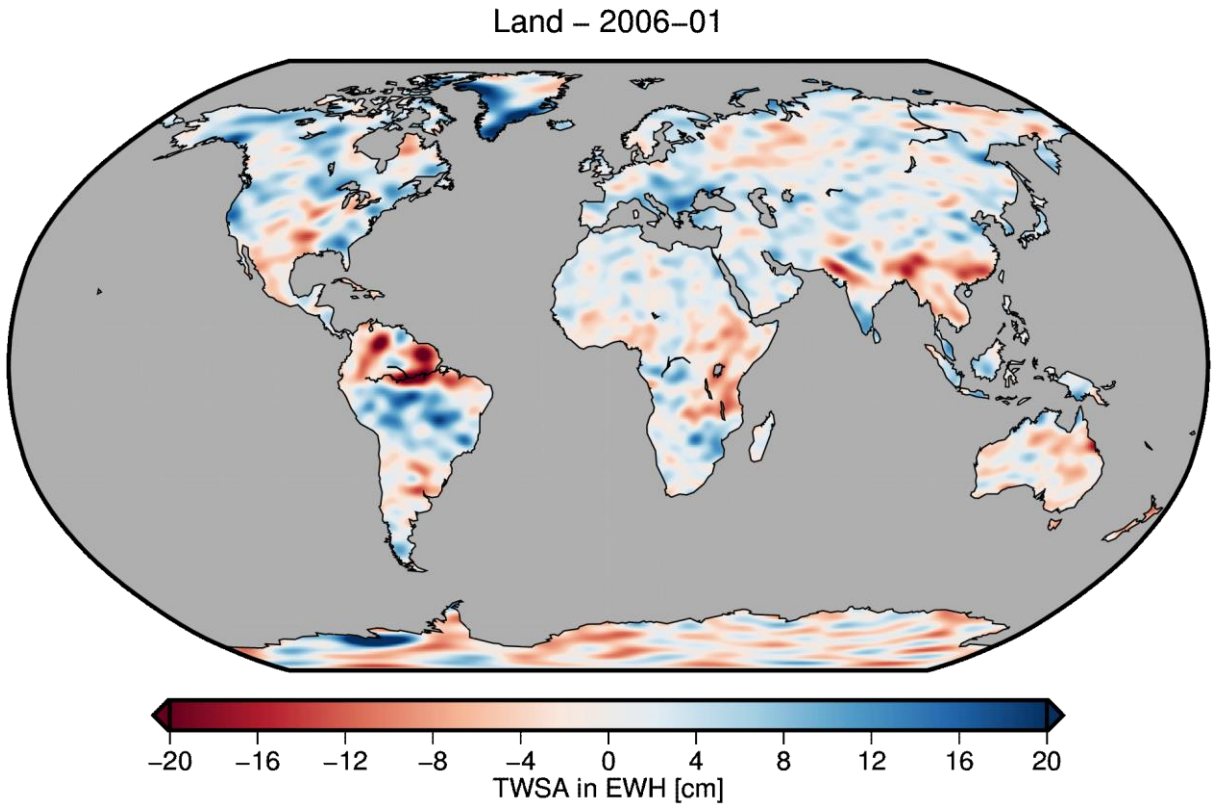
- The signal model for the EGSIEM filter is based on Kaula-type functions fitted to a hydrological and ocean model respectively
  - This represents the average expected water store anomaly and ocean bottom pressure variations

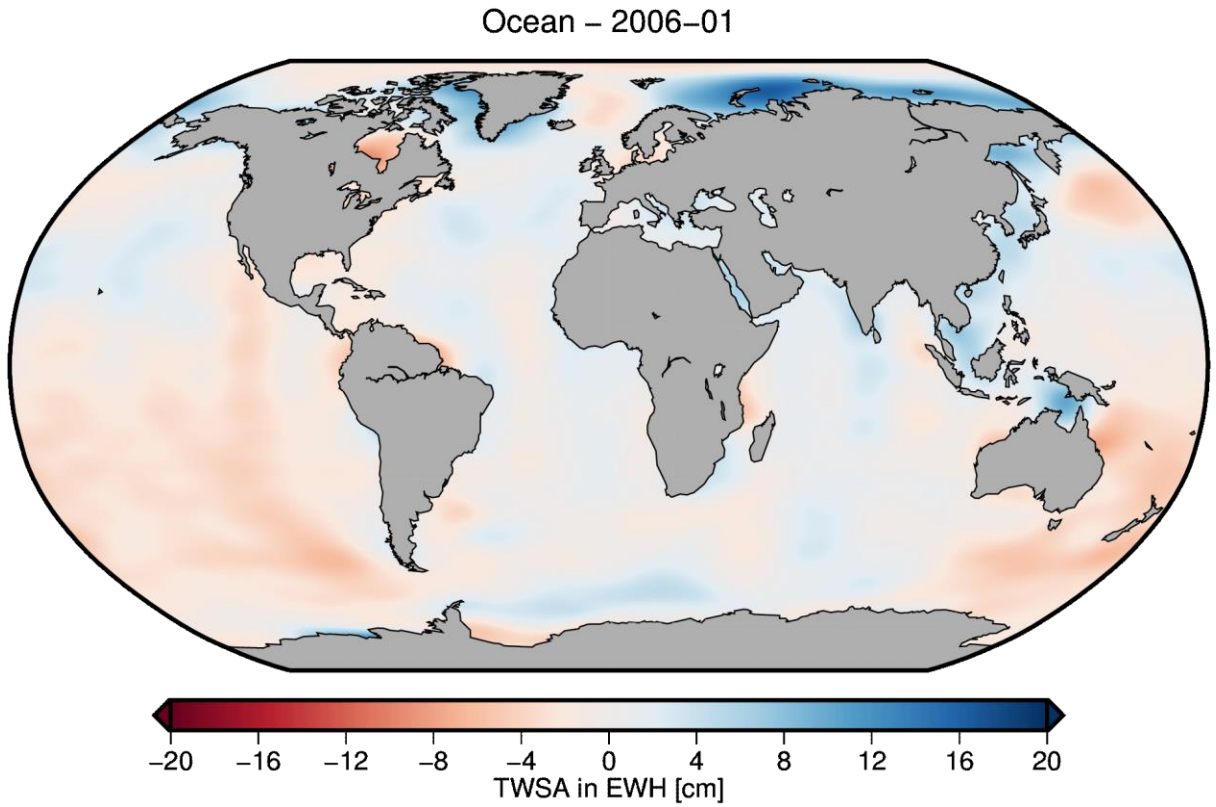
- The empirical noise model is based on ITSG-Grace2016 formal errors

- In contrast to the DDK filter, the filter matrix is time variable and dense
  - Each month has a unique filter – high storage requirements
  - Filter matrices are planned to be released to ensure reproducibility

- In order to retain as much of the amplitude of the filtered gravity field as possible, filtering starts at degree 15
  - Formal errors seem to be too pessimistic in the low degrees
  - A similar finding w.r.t. destriping filters was found by Chambers and Bonin (2012)

Implementation and Technical Aspects





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Summary and Outlook

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- EGSIEM L3 Products are based on the combined monthly solution
  - All input data sets are produced within the consortium

- The anisotropic filter of Kusche et al. 2009 was extended by using time variable GRACE noise model
  - This leads to a more consistent time series, as “bad” months are filtered more aggressively

- A longer time series is scheduled to be released before the EGU General Assembly 2018
  - This release will cover 2004 – 2010 and will extend the usability of the product