European Gravity Service for Improved Emergency Management

Project Overview and First Results

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Introduction

The project

EGSIEM European Gravity Service for Improved Emergency Management

is a project of the Earth Observation Space Calls of the Horizon 2020 Framework Program for Research and Innovation of the European Commission.

LANTMÄTERIET

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
JOINT RESEARCH CENTRE
Directorate H - Institute for Environment and Sustainability
Climate Risk Management

TECHNISCHE UNIVERSITÄT MÜNCHEN

universitätbonn igg

DRESDEN concept
Exzellenz aus Wissenschaft und Kultur

EGSIEM project overview (1)

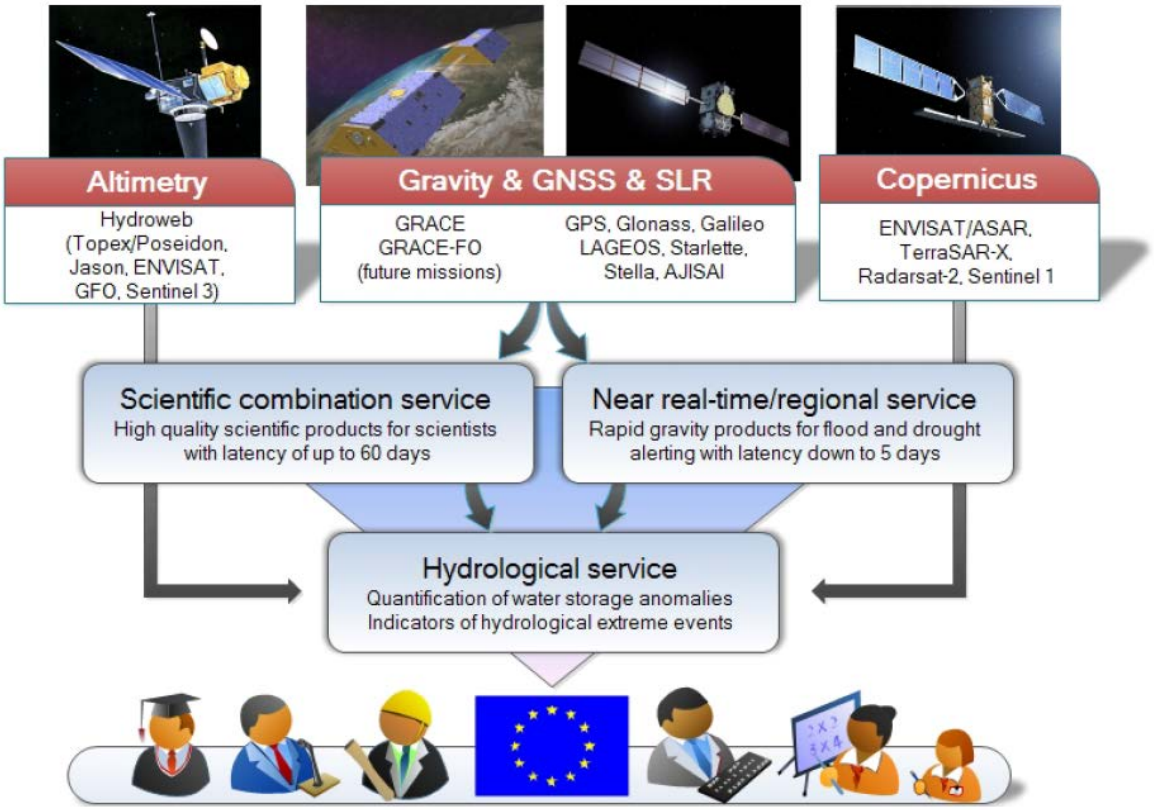
The EGSIEM project has officially started on January 1, 2015.

The three main objectives of EGSIEM are to

- **deliver the best gravity products for applications in Earth and environmental science research**
- **reduce the latency and increase the temporal resolution of the gravity and therefore mass redistribution products**
- **develop gravity-based indicators for extreme hydrological events and demonstrate their value for flood and drought forecasting and monitoring services**

EGSIEM project overview (2)

- **Three dedicated services shall be established**

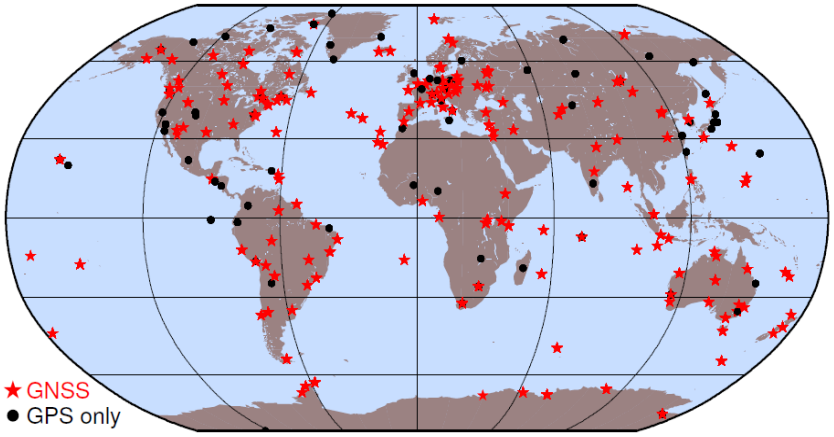


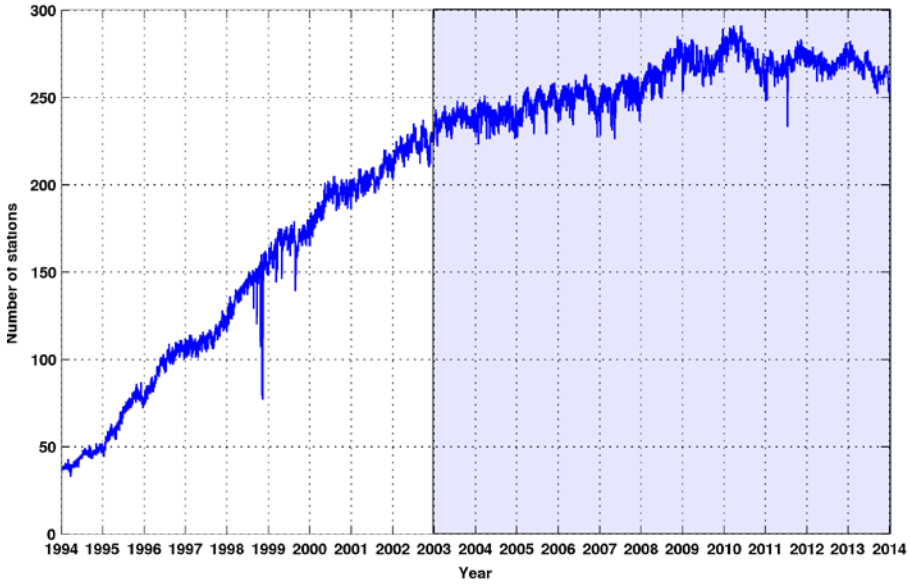
Services will be tailored to the needs of governments, scientists, decision makers, stakeholders and engineers. Special visualisation tools will be used to inform, update, and attract also the large public.

Integration of complementary data

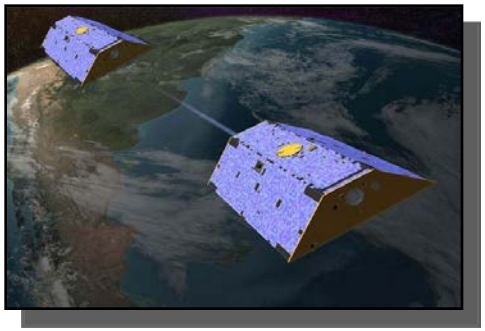
New GNSS Reprocessing:

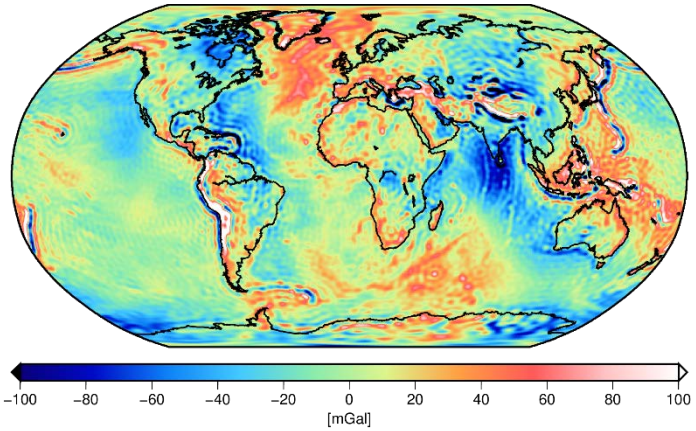
- more than 250 globally distributed tracking stations homogeneously reprocessed for 2003-14
- rigorous combined processing scheme of GPS and GLONASS measurements applied
- significant improvements due to the new empirical GNSS orbit model
- main products are GNSS satellite clock corrections (30-sec, 05-sec), GNSS satellite orbits, Earth rotation parameters, station coordinates
- will be used as a consistent input product for all EGSIEM groups for gravity field recovery





Gravity Field Analysis





Improved gravity field solutions by:

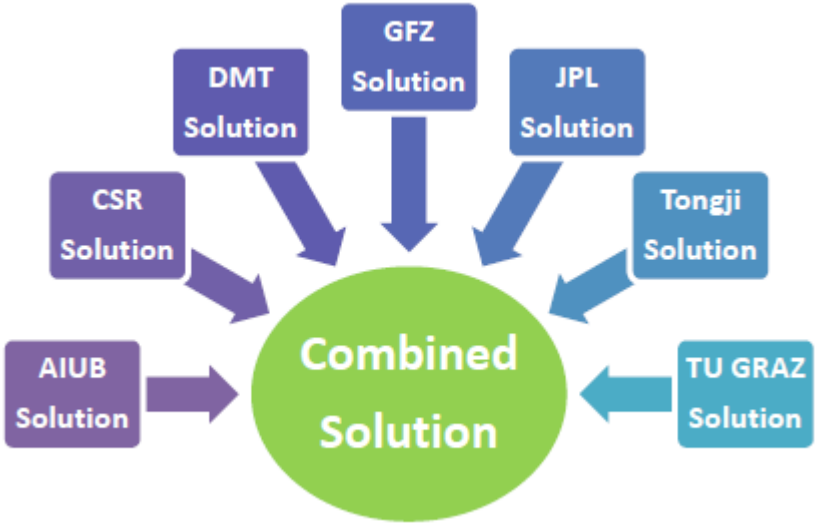
- Harmonization of processing standards
- Improvements of analysis methods
- Error analysis with End-to-End simulator

EGSIEM Analysis Centers (ACs):

- **GFZ** (Direct Approach)
- **CNES** (Direct Approach)
- **AIUB** (Celestial Mechanics Approach)
- **ITSG** (Short-Arc Approach)
- **University of Luxembourg** (Acc. Approach)
- **More in the future …**

=> Provide different solutions for the generation of a combined product

Scientific Service



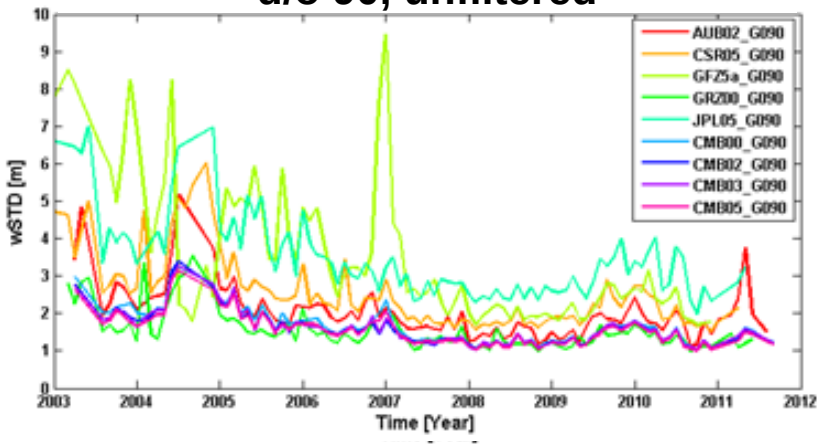
- Various solutions from different processing centers are available
- Systematic errors specific for individual processing centers shall be reducded
- Noise shall be reduced

- Combination of all AC solutions to generate combined solutions using several schemes, e.g.:
  - Calculate weighted averages based on empirical weights
  - Determine combined solutiond based on a combination of normal equations (NEQ) generated by the individual ACs

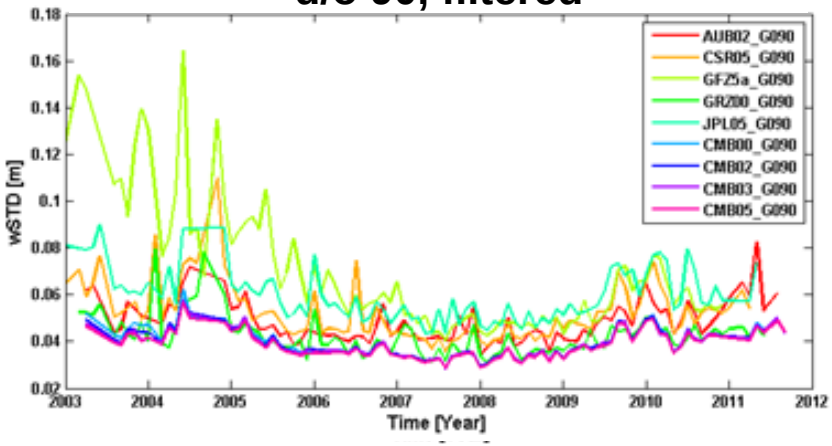
Validation of Combined Solutions (1)

- Noise assessment: wSTD over oceans

d/o 90, unfiltered



d/o 90, filtered

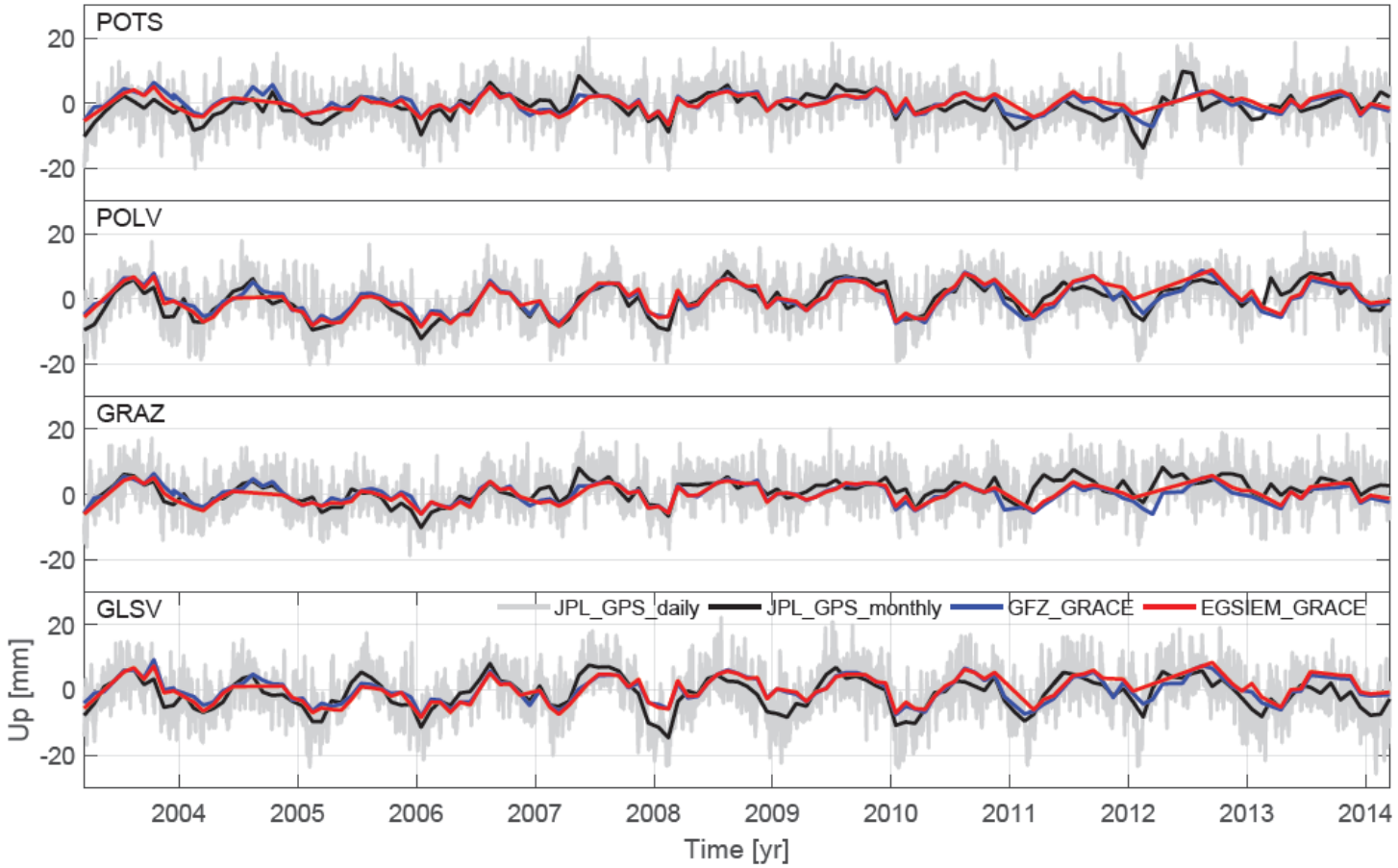


Involved Individual Solutions
d/o 60: AIUB, CSR, TU Graz, Tongji U
d/o 90: AIUB, CSR, GFZ, TU Graz, JPL

Label	Type of Combined Solution
CMB00	Simple Arithmetic Mean
CMB02	Coefficient-wise Weighted Mean
CMB03	Order-wise Weighted Mean
CMB05	Month-wise Weighted Mean

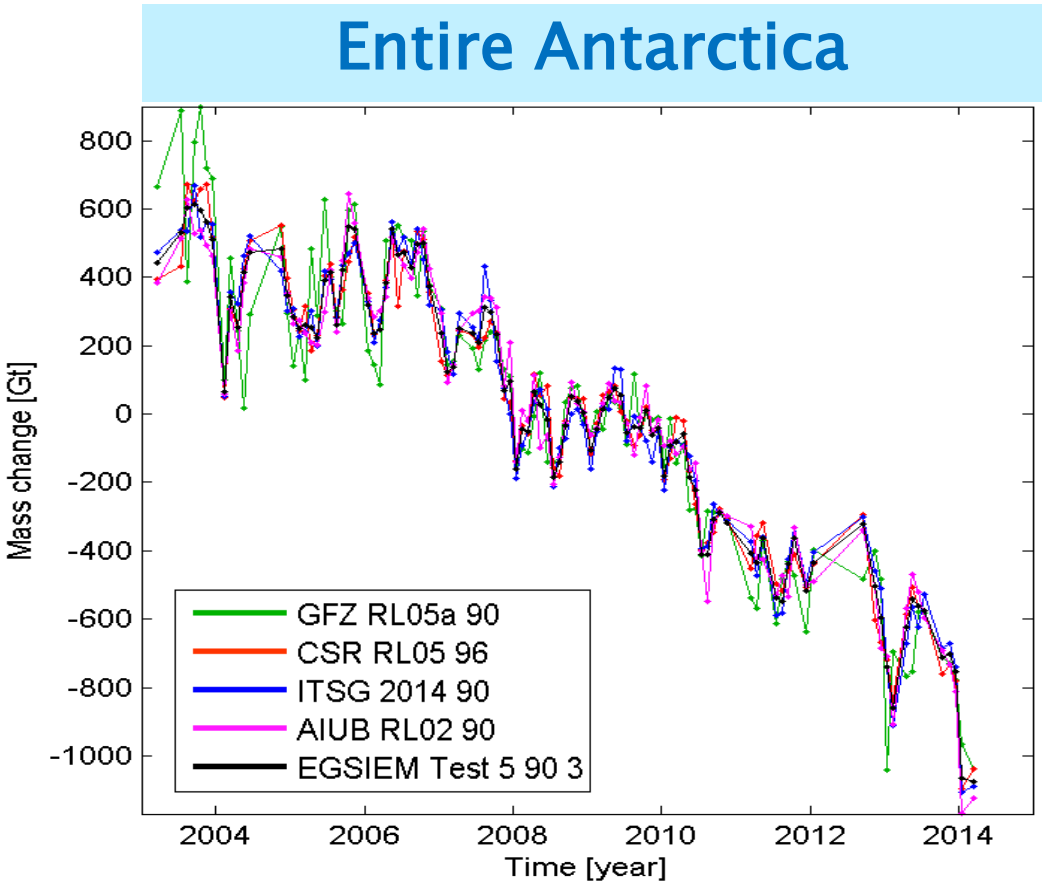
Validation of Combined Solutions (2)

- Comparison with GPS loading (GPS from JPL processing):



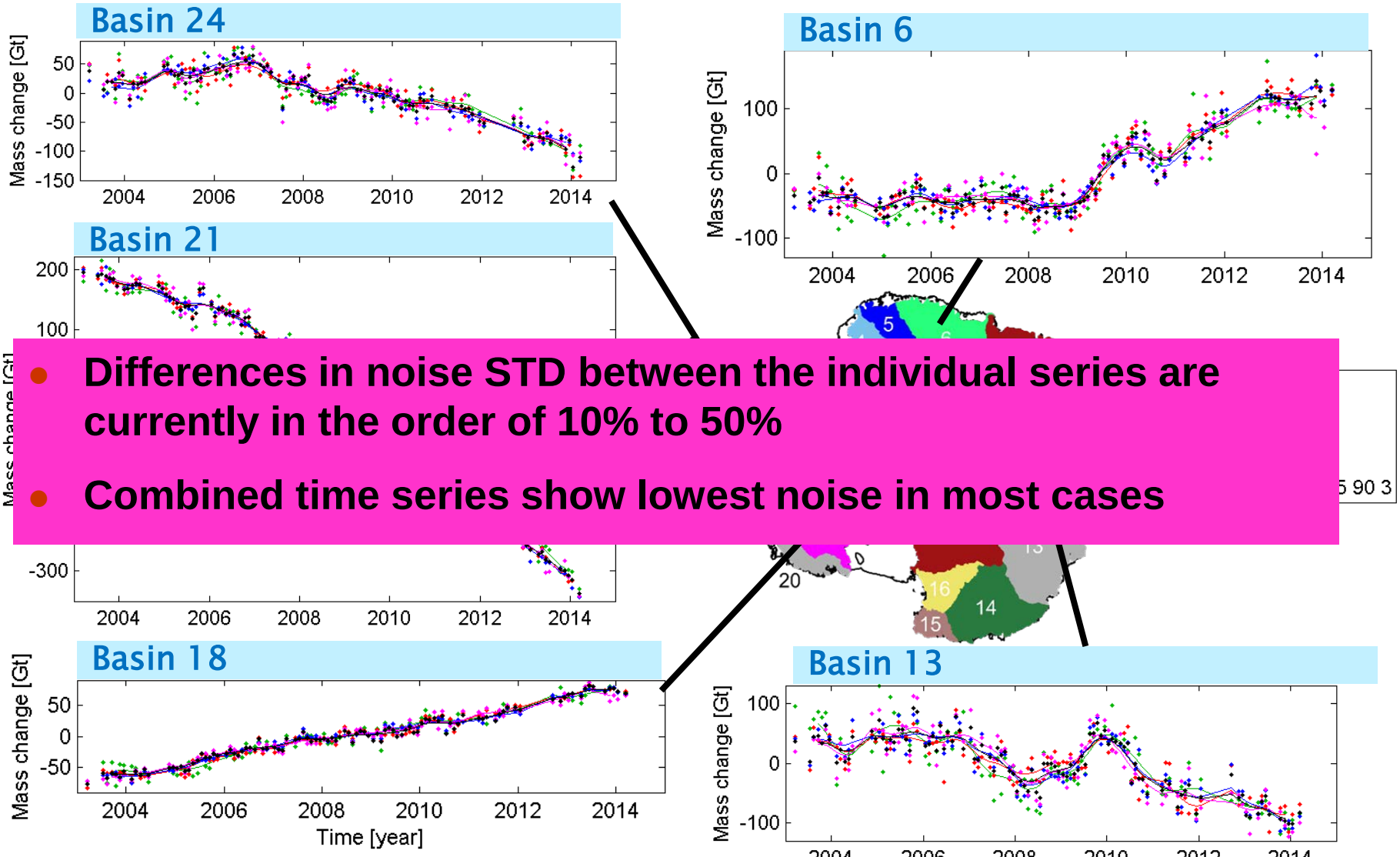
Validation of Combined Solutions (3)

- Regional mass changes over antarctica and antarctic drainage basins



- same kernel used for all series
- No difference in apparent signal content
- Different levels of apparent noise.
- Examples shown on next slide were low-pass filtered to show their inter-annual and long-term comparability.

Validation of Combined Solutions (4)

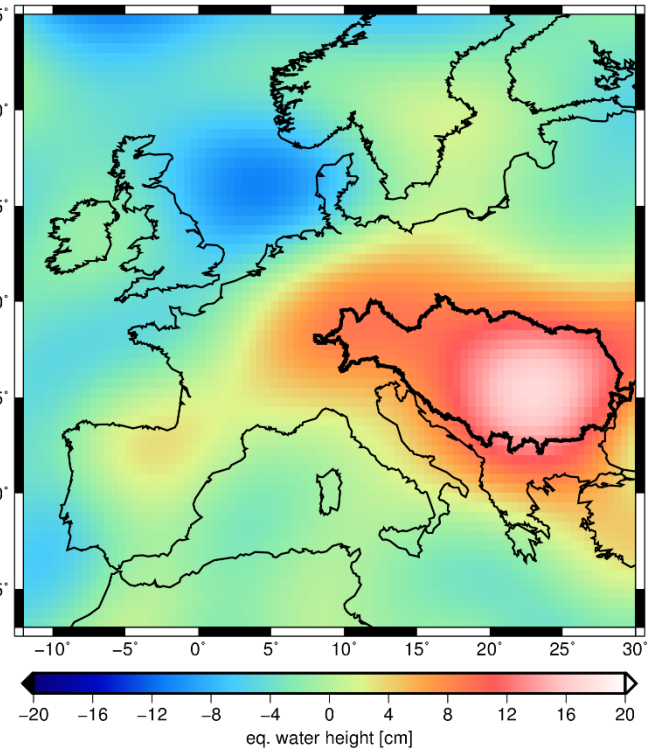


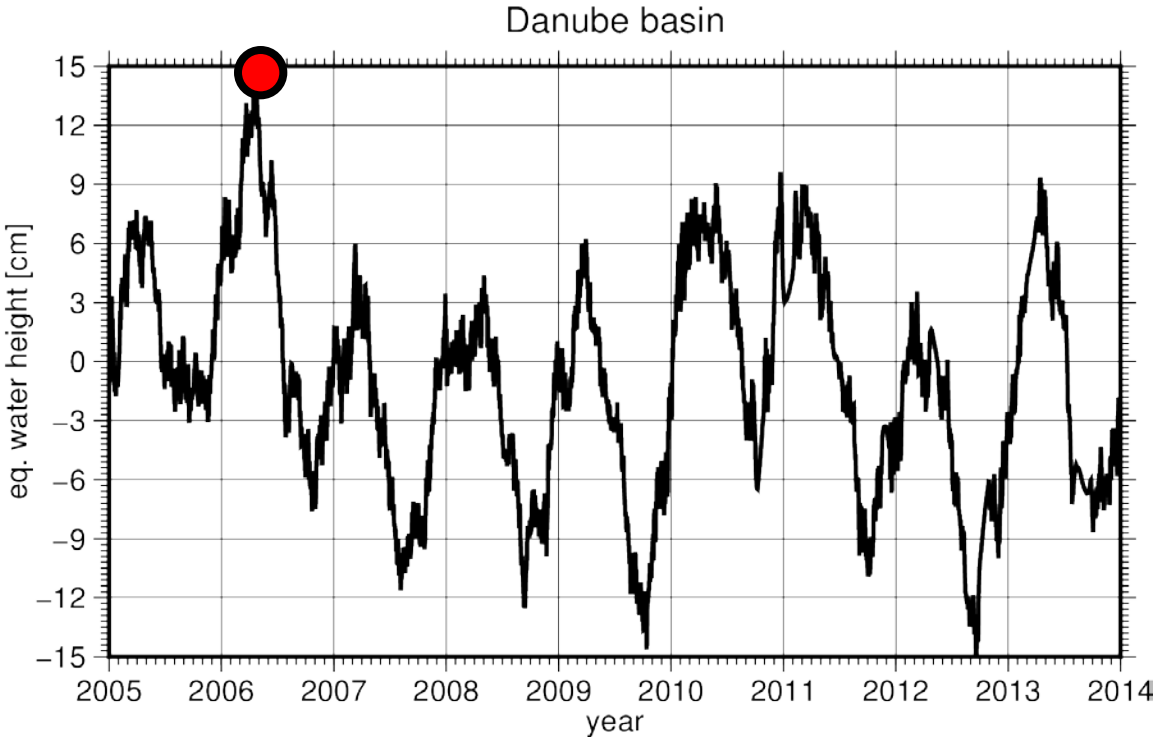
- **Differences in noise STD between the individual series are currently in the order of 10% to 50%**
- **Combined time series show lowest noise in most cases**

Near real-time and regional service

Daily updated solution (Near real-time with max. 5 days delay)

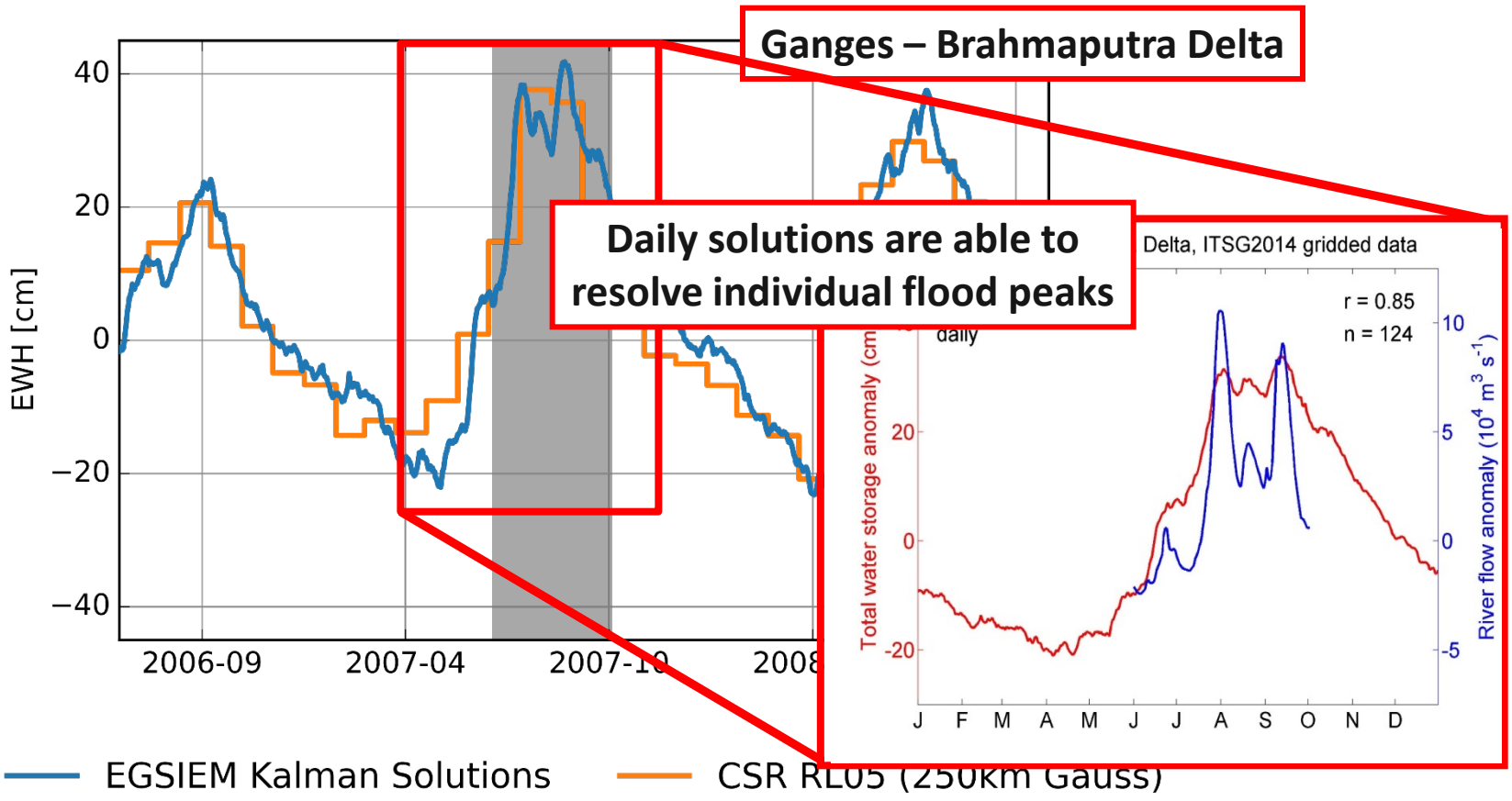
- ITSG: Kalman filtered solutions
- GFZ: Alternative representations (e.g., radial basis functions)





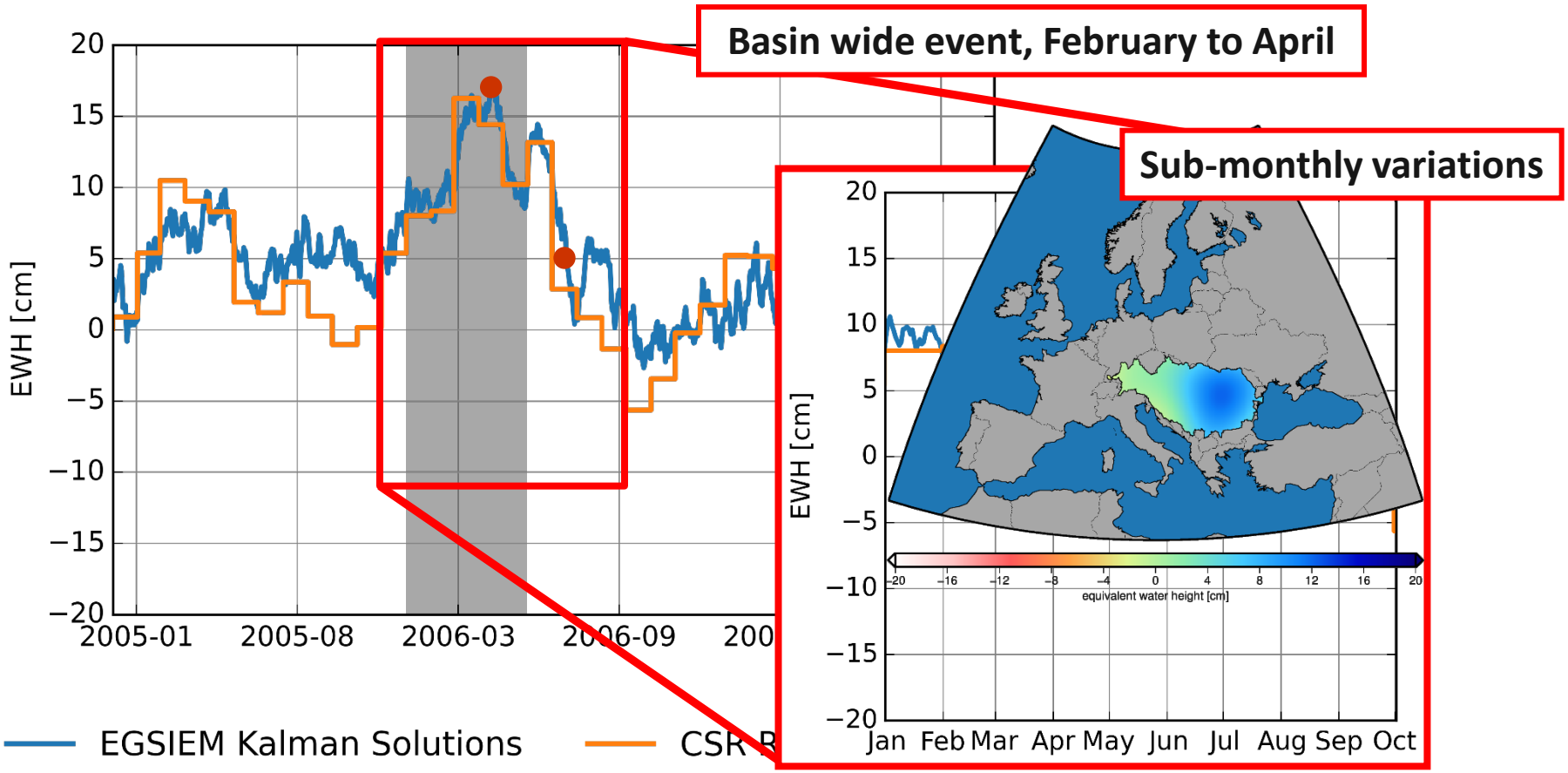
Validation of daily solutions (1)

- Sensitivity of Daily Solutions – 2007 South Asian floods



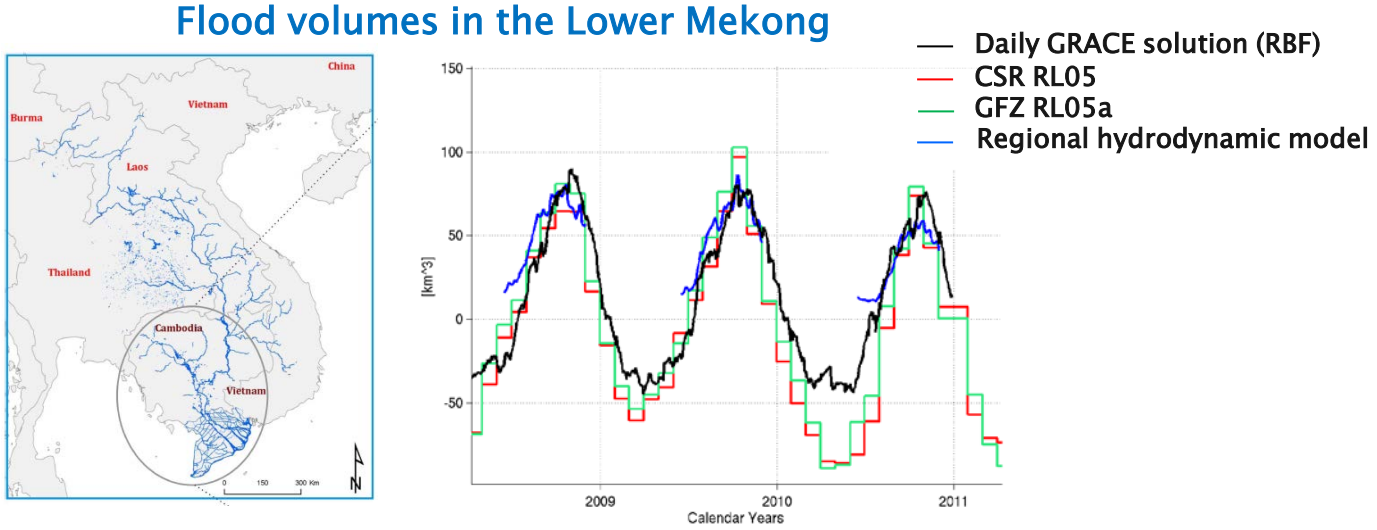
Validation of daily solutions (2)

- Sensitivity of Daily Solutions – 2006 Danube Flood



Hydrological Service (1)

- Gravity-based flood and drought indicators as descriptors of the integral wetness status of river basins
  → early warning for hydrological extreme events



- Testing the added value of gravity-based indicators at different lead times (several months to near real time)

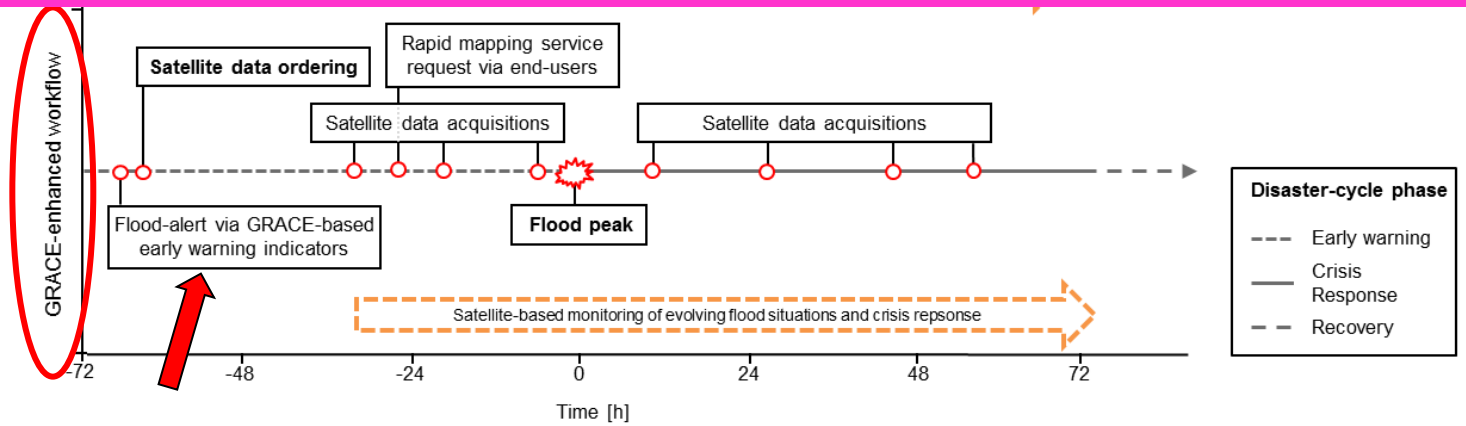
  - via assimilation into flood forecasting models

  - in statistical forecasting approaches

Hydrological Service (2)

- Improved rapid mapping by on-demand programming of satellite acquisitions
- Integration into automatic flood emergency management services

- **The performance of the NRT service will be tested using historical hydrological extreme events.**
- **An operational test run of half a year is foreseen in the frame of DLR's Center for Satellite Based Crisis Information.**



Summary and Outlook

- EGSIEM will run for three years (2015–2017)
- Three different services shall be established:
  - a scientific combination service
  - a near real-time (NRT) / regional service
  - a hydrological/early warning service
- Future integration into the services of the International Association of Geodesy (IAG), e.g., under the umbrella of the International Gravity Field Service (IGFS), and into the Copernicus emergency service is envisaged
- EGSIEM will have an open data policy and is open for collaborations with further partners.

Keep in touch

News and updates will be regularly published on various media, e.g., by the quarterly EGSIEM Newsletter.

Issues can be accessed at

www.egsiem.eu

EGSIEM is also present on social media:

https://twitter.com/EGSIEM

www.facebook.com/egsiem

https://egsiem.wordpress.com