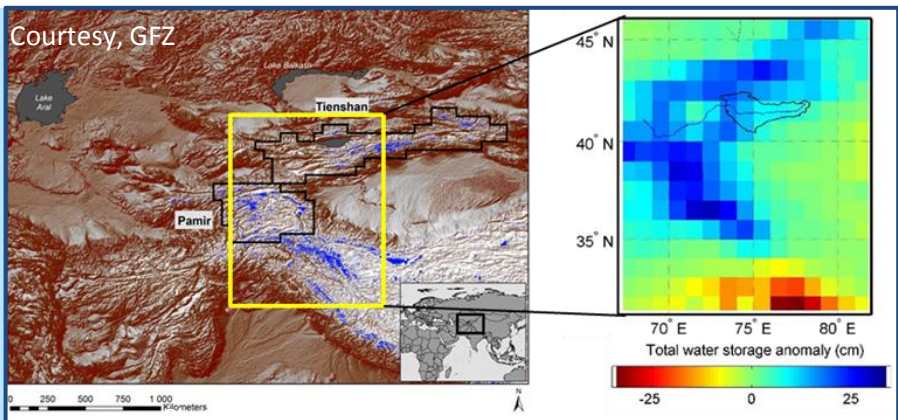
No. 6
Sep. 2016

Newsletter

EGSIEM

European Gravity Service for Improved Emergency Management

Inside this issue:



Naryn river basin, Tian Shan mountains in Kyrgyzstan.
River gauging station Uchterek (basin size of ~50000 km²), April 2010.

THE SCIENTFIC COMBINATION SERVICE BECOMES OPERATIONAL

By the end of June (half-time of the EGSIEM project) the design and concept phase for the scientific combination service of monthly GRACE gravity fields is over and our readiness for the pilot phase of the operational service has been reported to the project office of the European Union.

The main goals of the concept phase were:

- to define the data formats of the information exchanged between the different analysis centers (ACs) and the combination center at AIUB, i.e., gravity field solutions in spherical harmonic coefficients and normal equations, and the data formats of the final L2- and L3-products and the interfaces to the users of the combined products
- to derive and test adequate weighting schemes for the combination of monthly gravity field solutions
- to derive and test the tools and weighting schemes for the combination of normal equations.

Because the improved individual monthly gravity fields of the EGSIEM ACs will only be available after the data analysis phase, i.e., in July 2016, the combination on solution level was studied using the different gravity field releases available at the International Center for Global Earth Models (ICGEM: http://icgem.gfz-potsdam.de/ICGEM/). Combinations were achieved for the spherical harmonic degree/order 60 solutions and the degree/order 90 solutions. Prior to combination the individual gravity fields undergo a strict quality check to guarantee that they are suited for combination. Quality criteria are the signal content, evaluated by the amplitudes of annual storage variations in several of the Earth's major river basins, and the noise levels of the individual solutions, evaluated by their short time variability in regions where no short periodic signal is expected, i.e., in the oceans.

The main goal of the quality check is not to screen out gravity fields with increased noise (different noise levels can be taken care of by relative weighting of the different solutions) but to detect regularized solutions that often can be recognized by reduced signal content and a very low and homogeneous noise Level. Regularized solutions are excluded from the combination because they may introduce biases.

THE SCIENTFIC COMBINATION SERVICE BECOMES OPERATIONAL …

After screening, the individual gravity fields are combined using weights that are derived iteratively by Variance Component Estimation (VCE). The iterative procedure guarantees adequate weights, even in the case of extremely different noise levels. Three different weighting schemes were investigated:

- degree- and order-specific weights
- order-specific weights and
- one single weight per gravity field.

Because all three weighting schemes lead to very similar results, the scheme based on one single weight per gravity field is chosen for the final combination due to its ease of implementation and interpretation.

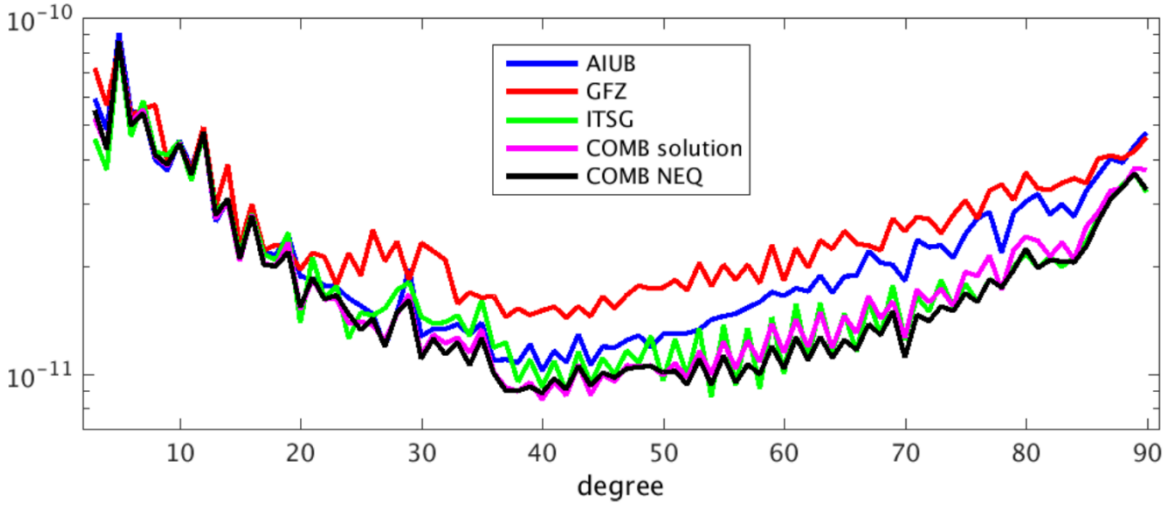


FIGURE 1: DIMENSIONLESS DEGREE VARIANCES OF ANOMALIES FOR THREE INDIVIDUAL GRAVITY FIELD SOLUTIONS (UP TO ORDER 29).

The weights derived by comparison of the individual solutions are subsequently reused for the combination of normal equations. Only normal equations contain the full information on correlations of the gravity field parameters with pre-eliminated orbit or instrument parameters. Moreover the normal equations of the EGSIEM ACs are based on common processing standards to ensure consistency. But due to the different noise models applied by the individual analysis centers the different normal equations cannot be combined just like that. First, empirical weights have to be derived to achieve equal contribution of each normal equation to the combination. Subsequently the weights derived by the comparison of solutions are multiplied to these empirical weights to account for the different noise levels. To implement and test the combination of normal equations, preliminary normal equations were provided by three of the five EGSIEM ACs.

Figure 1 shows degree variances of anomalies of the three individual solutions, the weighted combination on solution level (pink) and the weighted combination on normal equation level (black). The anomalies are derived by subtraction of a deterministic model of temporal variations containing bias, trend, annual and semi-annual periodic variations. They are a measure for the variability of the gravity field in excess of the main hydrological cycle and long term ice mass variation in polar regions. At medium to high degrees, the anomalies are dominated by noise and for these degrees the black line is the lowest and thus the superiority of the combination on normal equation level is obvious.

After the concept phase a pilot phase for operational combination service will start. The improved individual gravity fields of the different EGSIEM ACs will be combined on solution and normal equation level and the combinations made available to the users as L2-products (spherical harmonic coefficients) and L3-products (global grids). The L2-products will be provided by the service of ICGEM in the established ICGEM-format and via the EGSIEM-plotter (http://plot.egsiem.eu/). The L3-products will be made available via the EGSIEM-plotter.

THE EGSIEM CHALLENGE

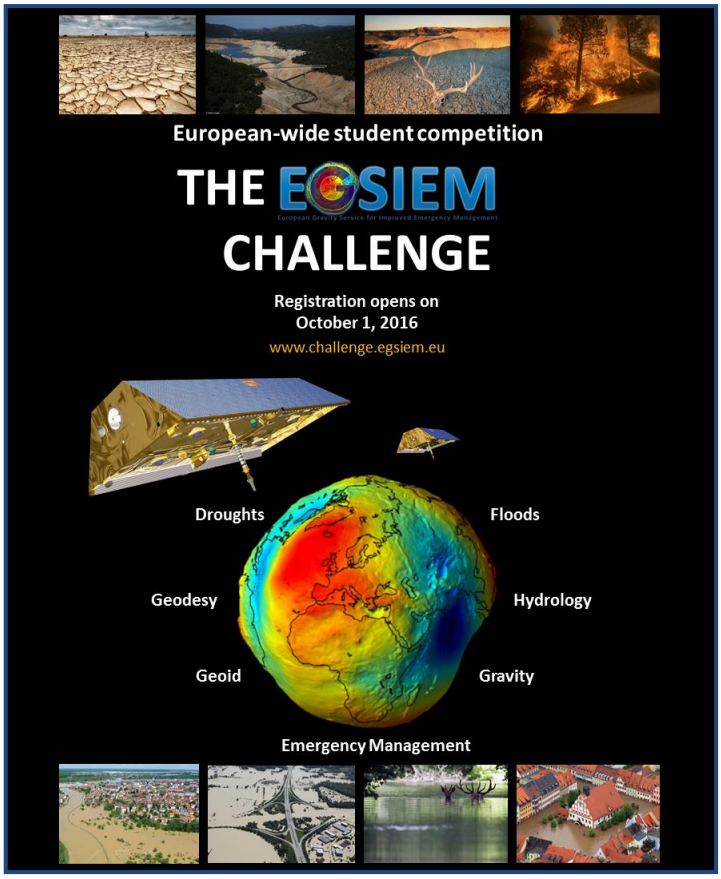
As we rapidly approach the opening of the EGSIEM challenge for students (in October 2016), we would like to give our audience an overview of the process. As a central part of the EGSIEM project has been to encourage the next generation of hydrologists and geodesists, the competition has been continuously discussed during various team and project meetings since the very beginning of the project (January 2015). We hope that those entering will find it obviously a 'challenge' but also a fruitful exercise for students.

Once students have completed their registration at www.challenge.egsiem.eu (open from October onwards) the first of two selection stages will involve 20 multiple-choice questions. This may sound a lot but the answers to these questions should be readily available online to students from a variety of different backgrounds. Once the students have completed the online test, and after the month-long first stage has taken place, those who have passed will be invited to take part in the second-stage.

This will involve more in-depth knowledge of:

- Earth's gravity field
- Hydro-gravimetry with the twin GRACE satellites
- Flood & Drought monitoring.

Students will be expected to provide written answers to another 20 questions. This will again involve some online study, but will also incorporate textbooks which should already be familiar to students in the above fields.



Once all of the entries have been judged, the best two will receive a prize of an internship at one of the EGSIEM partners suited to their interests., another two will receive free entry to the EGSIEM summer school. We hope everyone enjoys applying!

EGSIEM in the News

In the June 2016 issue of the quarterly UniPress magazine of the University of Bern, the theme was on researching in networks. EGSIEM is an excellent example of such research, as our network brings together researchers from different backgrounds such as geodesy, hydrology, emergency management etc.

In the article, the project leader Prof. Adrian Jäggi describes the background of the work being undertaken on EGSIEM, giving a broad overview of the information available to scientists from satellite earth observation, and introduces the aims of the project, all in simplified language.

The last section of the article on EGSIEM is an interview with Dr. Ulrich Meyer who gives an insight into his hobby of cave exploration, quite a contrast to satellite-based geodesy – it is well worth taking a look – so long as you can read German!

EGSIEM CONSORTIUM INTRODUCES ITSELF

Dr. Sandro Martinis

1 – Even being one of the few non-specialists in Geodesy within the EGSIEM project I was quickly fascinated by the possibilities of using gravity measurements for detecting terrestrial water storage anomalies and its potential applicability in disaster management.

2 – Together with my colleague Hendrik Zwenzner I am working in EGSIEM on the validation of GRACE-based flood indices using flood volumes derived from medium to high resolution optical and radar satellites and on the integration of an early warning component based on GRACE-derived indicators for flood forecasting and drought monitoring into the operational rapid mapping service of the Centre for Satellite-based Crisis Information (ZKI) of DLR.

3 – The main aspect of EGSIEM that interests me is to investigate within a multidisciplinary consortium the potential of using gravity data for an improved forecasting of hydrological extreme events, i.e. floods and droughts. This would be of main importance to improve the value of Earth Observation data in hydrology and in disaster management applications and thereby increasing the benefit for the society.

German Aerospace Center (DLR)
German Remote Sensing Data Center (DFD)
http://www.dlr.de http://www.dlr.de/eoc

http://www.zki.dlr.de

The Center for Satellite Based Crisis Information (ZKI) presents a service of the German Remotes Sensing Data Center (DFD) at DLR. It provides a 24/7 service for the rapid provision, processing and analysis of satellite imagery during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide. The resulting satellite based information products are provided to relief organizations and public authorities. According to the requirements of the user, the information products are delivered in the form of maps, GIS-ready geo-data or dossiers which are then used to support disaster management operations, humanitarian relief activities or civil security issues.
For more information, please refer to the above websites.

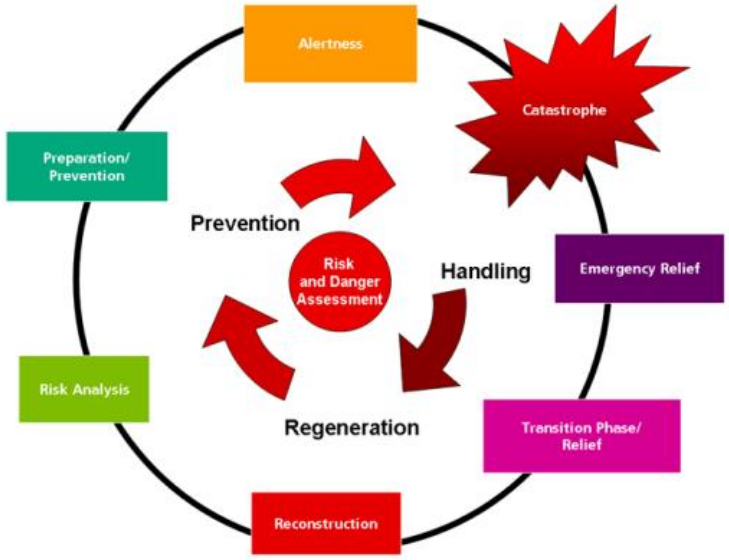
Interview questions:
1 - What interests you about Geodesy?
2 - Describe your role in EGSIEM?
3 - What is the one aspect of EGSIEM you are most interested in?

Dipl. Geogr. Hendrik Zwenzner

1 – To be honest, being a Geographer and Remote Sensing Expert, I am not an expert in Geodesy. What interests me most is the application of innovative satellite remote sensing techniques, which provide information about the earths surface variability. GRACE is a good example, because it provides valuable information about the variability of the terrestrial water storage.

2 – My main task is the retrospective analyses of satellite archive data from past large flood events., i.e. the estimation of flood volumes based on the combination of flood masks, elevation data and other data sources. The aim is to detect spatial-temporal correlation between the occurrence of large flood events and changes in the gravity field of the earth. Such findings will then be utilized in the Centre for Satellite-based Crisis Information (ZKI) in order to establish an early warning component, which can then be used for early satellite programming in case of emerging large scale flood events.

3 – For me the most fascinating aspect of EGSIEM is the multidisciplinary approach of the group of scientists including the GRACE community which are working hard to improve the possibilities of the GRACE system in terms of data reliability and temporal resolution. This in turn offers a unique and fascinating remote sensing opportunity for hydrological applications such as flood and drought forecasting.



MEET EGSIEM

Gravity, Geoid and Height Systems (GGHS)
Thessaloniki, Greece
Sep. 19th- Sep. 23th, 2016

GRACE Science Team Meeting (GSTM)
Potsdam, Germany
Oct. 5th- Oct. 7th, 2016

KEEP IN TOUCH

www.egsiem.eu
https://twitter.com/EGSIEM
www.facebook.com/egsiem
https://egsiem.wordpress.com/

Contact:
EGSIEM, Astronomical Institute
University of Bern
Sidlerstrasse 5
3012 Bern
Switzerland
info@egsiem.eu