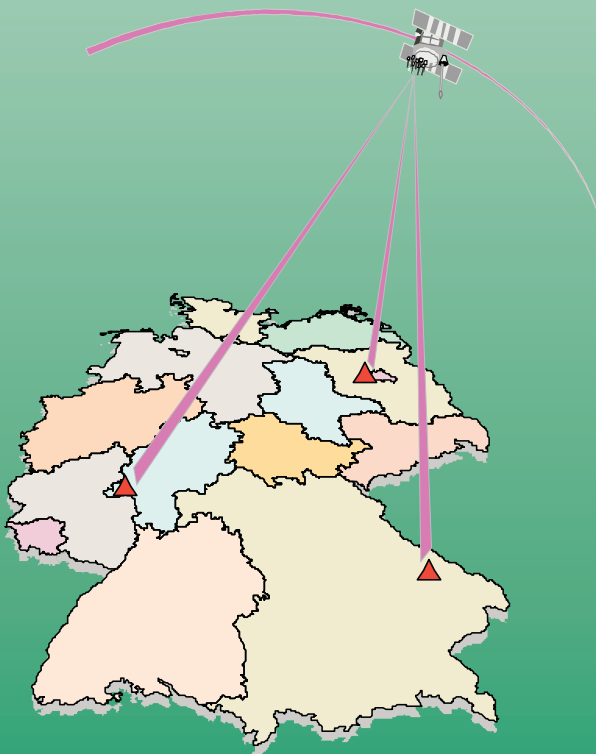




Bundesamt für
Kartographie und Geodäsie

GRAF

Integrated Geodetic
Reference Network of
Germany



Task

The Bundesamt für Kartographie und Geodäsie (BKG) (Federal Agency for Cartography and Geodesy) is responsible for the basic cartographic-geodetic provisions within the frame of the tasks to be performed in the interest of the Federal Administration, which include the maintenance of uniform geodetic reference systems for the total area of the Federal Republic of Germany. A network of observation stations is operated for this purpose, on which data of the Global Satellite Navigation Systems (GNSS), the US Global Positioning System (GPS) and the Russian Glonass System are received. Because of its combination with other measurement methods it is called integrated Geodetic GNSS Reference Network (GREF).

Through the observations carried out by the GREF stations are realised

- the provision of a uniform three-dimensional reference system,
 - the integration of this system into the European Terrestrial Reference System (ETRS) and the International Terrestrial Reference System (ITRS),
 - the support of the Differential GNSS Positioning Systems as well as
 - the linkage to the height and gravity reference,
- thus laying the foundations for the georeferencing of any objects.

Products

- GNSS observation files in RHINEX format
- weekly coordinate files
- troposphere parameters
- GNSS observations in real-time via internet

RINEX files of the GREF stations are distributed by the Landesvermessungsämter (state survey offices) or by BKG. Separated according to GPS weeks coordinate files can be accessed under the following internet address:

<http://igs.bkg.bund.de>

Information on the access to GNSS observations via internet in real-time are available under

http://igs.bkg.bund.de/index_ntrip.htm

Network

The network established under the name GREF in cooperation with the Bundesländer (states of the Federal Republic of Germany) comprises ca 30 stations operated by BKG, other Federal or Länder (states) institutions or jointly.

At the GREF stations several measurement methods are combined, which include observations to GNSS satellites. Their data are transferred to BKG either in real-time or at hourly intervals via internet connections.

Furthermore, absolute gravity measurements are carried out and meteorological parameters recorded. At some stations changes of the groundwater level are determined and measurements of temporal changes of the acceleration of gravity are performed by means of superconducting gravimeters. At the North and Baltic Seas the stations are located in close proximity to the sea level gauges. Some stations have been installed in geophysical observatories. The stations of the GREF network have been tied to the Deutsche Haupthöhennetz (DHHN) (German Primary Levelling Network). The different sensors are connected through local backup measurements.

*GREF Integrated
Geodetic
Reference
Network*



Results

With the inclusion of selected stations of the European GNSS permanent stations network (EPN) and stations of the International GNSS Service (IGS), the data obtained by the GREF network are evaluated daily at BKG, whereby station coordinates with a planimetric accuracy better than ± 5 mm and an altimetric accuracy better than ± 10 mm are computed.

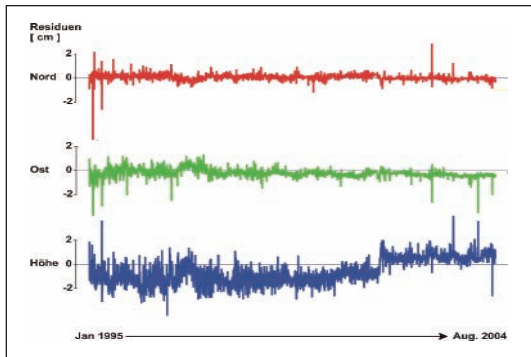
Moreover, the regular common evaluation of the data of the GREF network together with those of the SAPOS[®] Satellite Positioning Service, a joint project by the Arbeitsgemeinschaft der Vermessungsverwaltungen der Länder der Bundesrepublik Deutschland (AdV) (Union of Public Surveying Authorities in the States of the Federal Republic of Germany), serves the realisation of a uniform high-precision reference system at the federal level.

Standard deviations of the coordinates of selected GNS reference stations of the EPN network, daily solution, BKG's contribution to the European overall solution

— 1 cm



Time series of the coordinate residuals from daily solutions of the permanent GNSS observations of the Geodetic Observatory Wettzell

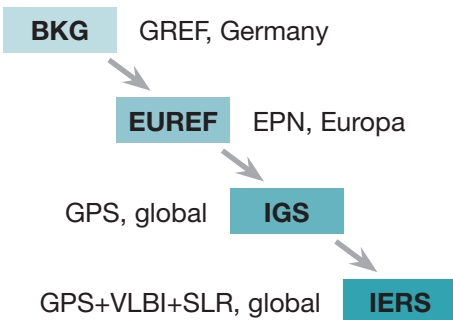


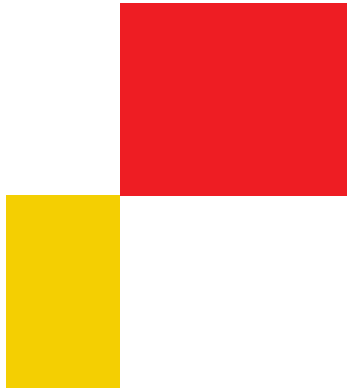
International cooperation

Some of the GREF stations constitute at the same time part of the European and international reference station networks (EPN and IGS). Within the frame of the EUREF (European Reference Frames) Subcommittee of the International Association of Geodesy (IAG), different institutions from 16 European states are conducting a joint evaluation of the GNSS observations performed by the European reference stations network (EPN). In each case overlapping partial networks are evaluated by the analysis centres, from which an overall solution for Europe is subsequently established.

The parameters for the acquisition of the tropospheric signal delay are combined in a similar manner, which are routinely co-estimated by the EUREF analysis centres and transferred to the BKG datacenter on a daily basis.

EUREF delivers the combination solution to IGS, where continental networks are integrated into a global GNSS network. The result obtained is passed on to the International Earth Rotation and Reference System Service (IERS), where it is combined with the results from satellite laser ranging (SLR) and very long baseline interferometry (VLBI) to quasars.





**For questions and inquiries please
contact:**

Bundesamt für Kartographie und Geodäsie
Abteilung Geodäsie
Richard-Strauss-Allee 11
60598 Frankfurt am Main
Germany

Phone: +49 (0)69 6333-391
+49 (0)341 5634-429

Fax: +49 (0)69 6333-425

E-mail: gref@bkg.bund.de

Internet: www.bkg.bund.de