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Station network GR, GRF (Graefenberg Array) and GRSN (German Regional Seismic Network)

GRF

The GRF array operating continuously since 1976 (fully operational since 1980) has been upgraded recently with 24bit digitizers. Before it has been equipped with 16bit gain ranging digitizers which were in operation since the installation of the array. This technical change was necessary since the 16bit digitizer were not available any more. Additionally it contributed to a better data quality by eliminating the gain ranging steps. The new digitizer has been developed in cooperation with the RefTek company. It simply replaced the old 16bit digitizer board, all other recording hardware at the field stations could remain in place. Due to budget limitations it has been decided to go this way as an alternative to a completely new digitizer system. Since end of 2003 the new digitizer boards are in operation at all GRF stations.

Currently ongoing is a replacement of the computer hardware at the field stations of GRF. There PCs have been installed in 1998 when the data transfer was changed from analog to digital telephone lines (ISDN). In order to prevent increased data outages due to computer failures the PCs are replaced after 6 years of continuous operation. The PCs collect data and store it on a local disk and manage the communication to the data center using ISDN links.

In general the complete hardware system of the GRF array runs reliably stable. Due to improvements in data transmission, local data storage and lightning protection the overall downtimes of the 13 stations went down to about 2% within the last years. To keep it in such a healthy condition further investments are necessary in future. Due to the long operational time of the stations more outdated hardware will have to be replaced.

In this context there is currently a discussion about the sensors of GRF. The seismometers of the Graefenberg array are Streckeisen STS-1 instruments and have been bought and installed towards the end of the seventies, actually the GRF instruments have been the first STS-1 seismometers installed at permament stations. They are now in place for almost 30 years and show more and more noticable quality deficiencies due to ageing effects. Also

maintenance efforts are relatively high when compared to a modern broadband instrument like the STS-2. For this reason it is considered to replace the existings sensors by STS-2 instruments. The main problem, of course, is the allocation of budgets for the procurement of 15 broadband seismometers. A successful solution of this financial problem would secure the operation of the GRF stations for many more years and upgrade the acquisition system to a full 3-component array.

The data of the GRF array go into the archive as soon as they are available at the SZGRF. Currently this is done with a delay of up to 90min. It is planned to implement a seedlink plugin for a standardized access to near real time data also at GRF. The data of the reference station GRA1 are copied to the IRIS DMC every day.

GRSN

The 12 original GRSN stations from 1991 and 1993 defined a standard for the installation of broadband stations in Germany. A number of new stations was installed since that time from different authorities. Most of them tried to keep as close as possible to the GRSN standard even though budgeting and purpose of installation may have been very different from that of the first 12 stations. Of course, the progress in computer and communication technology has lead to changes in some details. For example the local backup archiving on CD recordables became less important with the availability of high-capacity data transmission in near real time. So currently the typical setup of a GRSN-like station is an STS-2 seismometer with a digitizer (Quanterra, EarthData or others) connected to a Linux-PC running Seiscomp software to store data locally in MiniSEED format. Where possible an online data connection via seedlink to data centers are implemented, the other stations transmit data once a day using ftp connections. About half of the stations still make a local backup of the data streams onto CD recordables. The data are available at the data center in Erlangen as soon as they arrive. The total number of stations contributing to the GRSN data archive is currently 19. The current list of stations of the GRSN is as follows:

name	lat	lon	data delay	comment
BFO	48.3301	8.3296	online (seedlink)	
BRG	50.8732	13.9428	1 day	
BSEG	53.9353	10.3169	15 min (seedlink)	
BUG	51.4406	7.2693	1 day	
CLL	51.3077	13.0026	1 day	
CLZ	51.8416	10.3724	1 day	
FUR	48.1629	11.2752	online (seedlink)	
GEC2	48.8451	13.7016	1 day	
GRFO	49.6909	11.2203	online (seedlink)	shared with IRIS/USGS (IU) network
HLG	54.1847	7.8839	15 min (seedlink)	shared with GEOFON (GE) network
IBBN	52.3072	7.7566	online (seedlink)	shared with GEOFON (GE) network
MOX	50.6447	11.6156	online (seedlink)	
NRDL	52.4943	10.1073	1 day	
RGN	54.5477	13.3214	15 min (seedlink)	shared with GEOFON (GE) network
RUE	52.4759	13.7800	15 min (seedlink)	shared with GEOFON (GE) network
STU	48.7708	9.1933	online (seedlink)	shared with GEOFON (GE) network
TNS	50.2225	8.4473	15 min (seedlink)	
UBBA	50.8188	10.0010	1 day	
WET	49.1440	12.8782	online (seedlink)	

The Data Archive

The archiving system at the Seismological Observatory in Erlangen has been upgraded recently by a new DVD-Jukebox with a capacity of about 5 TByte. The advantage of this storage medium (DVD-R recordables) is that it is not erasable like hard disks and still it is automatically accessable for data retrieval procedures. Disk raid systems are installed in addition to the jukebox to make access faster on data of the most recent years. The complete continuous data set of the GRF/GRSN stations are accessible via a WWW interface at 'http://www.szgrf.bgr.de' and via an e-mail based AutoDRM at address 'autodrm@szgrf.bgr.de'. In addition, the near real time data via seedlink (see table above) are exported on the IP node 193.174.161.30 port 18000.