

GIPP: Geophysical Instrument Pool Potsdam

GFZ German Research Centre for Geosciences *

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Abstract: The Geophysical Instrument Pool Potsdam (GIPP) consists of field instruments, sensors and equipment for temporary seismological studies (both controlled source and earthquake seismology) as well as for magnetotelluric (electromagnetic) experiments. These instruments are mainly mobile digital recorders, broadband seismometers and short period sensors, and they are used to reveal the subsurface structure and to investigate earthquakes. Sensors for magnetotellurics include induction coil and fluxgate magnetometers and non-polarizing silver / silver-chloride electrodes. It is operated by the GFZ German Research Centre for Geosciences. The instrument facility is open to all academic applicants, both national and international. Instrument applications are evaluated and ranked by an external steering board. Currently, for seismological applications >850 geophysical recorders, >170 broadband seismometers and >1300 short period geophones are available (among others). Available for magnetotelluric experiments are > 50 real-time data-loggers, > 150 induction coils, and > 500 electrodes. User guidelines and data policy are in force and data archives are provided (standard exchange formats).

1 Introduction

Geophysical field measurements play an important role when investigating “System Earth” by providing new and important insight into the structure of our planet and ongoing processes. Due to the large size of the object under investigation (planet Earth) experiments have to be carried out in situ in the field and not in the lab. Most of these experiments are performed from the Earth’s surface, and they utilize for example elastic waves (seismology) or electromagnetic fields (magnetotellurics). The Geophysical Instrument Pool Potsdam (GIPP) is a large infrastructure facility providing the equipment for these experiments such as digital recorders, seismometers, magnetometers and electrodes (www.gfz-potsdam.de/gipp). Most of the instruments run autonomously in the field for days, weeks or

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months (up to 2 years). Data is either stored on local memory or transferred by different devices (modem etc.). The facility is part of the “Modular Earth Science Infrastructure” (MESI) of the Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences and it is situated in Potsdam and in Niemegk (Figure 1). Between 1993 and 2015 the GIPP supported almost 300 experiments, and almost 400 ISI publications based on data gathered with GIPP instruments have been published (see full list via www.gfz-potsdam.de/gipp).



Figure 1: Geophysical field instruments in the storage in Potsdam.

2 Services offered and Procedures

The facility is open for German and international users for academic research. The supply of instruments follows a transparent application process with applications being evaluated by an external steering board. Applications can be submitted twice a year (for general information, submission form and next submission date please visit our web site www.gfz-potsdam.de/gipp). A rental contract listing the instruments and the period of supply is signed by both parties. "Terms of Usage", which can be found on our web site, are part of the contract. For a period of 4 years after completion of a field project gathered data is reserved for internal use within a project. Afterwards, data will be made freely available to the public. Seismological data are archived at the "GEOFON" archive, data of controlled source and magnetotelluric experiments are stored in the "GIPP experiment and data archive". Data and the accompanying report are published as data publications (including digital object identifier). The GIPP also offers instrument training, guidance of field work, and software (e.g. for data conversion).

3 Typical Applications

3.1 Methods

- Temporary Seismological Networks (monitoring)
- Controlled Source Seismics (reflection seismics, refraction)
- Magnetotellurics
- Controlled Source Electromagnetics (receivers)

3.2 Geological structures

- Earth structure (convergent margins; passive margins; collisional orogens; lithospheric shear zones; basins; continents)
- Earthquakes (sources, locations)
- Exploration for geo-resources (ground water, geothermal, hydrocarbons, minerals)
- Reservoir exploration and monitoring
- Volcanoes
- Hazard estimation
- Engineering
- Soils
- Archaeological sites

4 Technical data – specifications

4.1 Geophysical recorders

Earth Data PR6-24 Digital Field Recorder (250 units)

- A/D converter: Sigma-Delta 24bit; sampling rates 1 – 3000sps; 140 dB @ 100 sps to 96 dB @ 3000 sps; 3 or 6 channels plus 4 auxiliary
- Clock: TCXO; accuracy $<1 \times 10^{-6}$; GPS synchronization; external antenna; continuous or cycled
- Data: MSEED format or ASCII; continuous or time window; stored on exchangeable mass storage 10 – 40GB
- Interfaces: USB, ethernet, RS232
- Power consumption: < 1.8 Watts (GPS cycled) to 2 Watts (GPS conti) @ 3×100 sps
- Rugged weather-sealed housing; weight 3.75– 4.3 kg; operating temp.: -20 to -65 °C

Earth Data EDR210 Digital Field Recorder (96 units)

- A/D converter: Sigma-Delta 24bit; sampling rates 1 – 3000sps; 142 dB @ 100 sps; 3 or 6 channels plus 4 auxiliary
- Clock: TCXO; accuracy $<1 \times 10^{-6}$; GPS synchronization (internal/external antenna), continuous or cycled
- Data: MSEED format or ASCII; continuous or time window; stored on exchangeable mass storage 10 – 40GB
- Interface: WiFi, USB, ethernet, RS232
- Power consumption: 800 mW @ 3×100 sps(GPS cycled)
- Rugged weather-sealed housing; 230x100x150mm; weight 1.6 kg; operating temperatures: -20 to -65 °C

Omnirecs DATA CUBE Field Recorder (217 (1ch) + 280 (3ch) units)

- A/D converter: Sigma-Delta 24bit; sampling rates 50 - 800sps; 21bit @ 100 sps; 1 or 3 channels; 4.1 Vpp input signal
- Time: GPS build in; <10 ms over 20 days without processing; <0.01 ms with processing (resampling)
- Data: continuous recording; proprietary format; stored on internal SDHC card 16GB
- Interface: USB (for setup and data download)
- Power consumption: Typically 150mW (low power); internal batteries 2x D-cell or external
- Rugged, compact waterproof housing (10 x 10 x 8,3 cm); weight 1 kg with batteries; operating temperatures: -40 - 60°C

Geometrics Geode Recording System (each 24 ch; 11 units; modular)

- A/D converter: Sigma-Delta 24bit; 110 dB @ 2 ms; sampling interval 0.02 – 16ms; 24 channels/unit
- Clock: Accuracy: 0.5 ppm; synchronization by GPS optional



- Data: SEG-Y, SEG-D, SEG-2 formats; triggered recording or continuous; data transmitted to PC through interface cable
- Power consumption: 0.2W (stand-by); 0.65W (acquisition)
- Rugged, weatherproof housing; weight 4 kg (one unit); operating temperatures: -30 - 70°C
- Accessories: Geophones (4.5Hz 1comp.); geophone cables; interface cables; trigger switches etc.

S.P.A.M. Mk. IV: real-time systems (each 6 ch, 50 systems)

- A/D converter: Sigma-Delta 24bit; sampling rates 50 kHz – 1 Hz
- Clock: TCXO; accuracy 150ns; GPS synchronization; external antenna; continuous.
- Data: continuous recording; scheduled modes, concurrent frequency bands, EMERALD data format; stored on internal hard disk
- Interfaces: USB, Ethernet
- Power consumption: Typically 7W (without sensors)
- Rugged, compact waterproof casing (37.5x29.5x14.5 cm), 5 kg; operating temperatures: 0 – 50°C.
- Accessories: Sensor-boxes, interface cables

4.2 Seismic sensors

Nanometrics Trillium 120 PA broadband sensor (20 units)

- Flat instrument response (ground velocity) between 120 s and 145Hz
- 3 symmetric triaxial sensors; force balance; max. output: +-20V
- Generator constant 1200 Vs/m
- Interfaces: USB, Ethernet
- Power consumption: 620mW @ 15V
- Waterproof housing; weight 7.5 kg; operation temperature: -20 - 50°C

Nanometrics Trilium Compact broadband sensor (72 units)

- Flat instrument response (ground velocity) between 120 s and 100Hz
- 3 symmetric triaxial sensors; force balance; max. output +-20V
- Power consumption: 160mW @ 12V
- Compact waterproof housing; weight 1.2 kg; operation temperature: -40 - 60°C

Güralp CMG-3ESP Compact broadband sensor (60 units)

- Ground velocity from 60s to 50Hz
- 3 orthogonal sensors; max output +-20V
- Generator constant 2x1000 Vs/m
- Power consumption: 0.75W @ 12V
- Waterproof housing; weight 8.3 kg; operation temperature: -10 - 65°C

Güralp CMG-3ESP broadband sensor (10 units)

- Ground velocity from 120s to 50Hz
- 3 orthogonal sensors; max output +-20V
- Generator constant 2x1000 Vs/m
- Power consumption: 0.9W @ 12V
- Waterproof housing; weight 11 kg; operation temperature: -20 - 65°C

Streckeisen STS-2 broadband sensor (5 units)

- Ground velocity from 120 sec to >50 Hz
- 3 inertial pendula in a cube-corner geometry; force balance, max. output: ±20 V
- Generator constant 2 * 750 Vs/m
- Power consumption: 1.56W @ 24V
- Weight 13 kg (incl. host box)

Mark L-4C-3D shortperiod geophone (200 units)

- Ground velocity from 1Hz to >100Hz
- 3 orthogonal geophones; output 180 Vs/m
- Generator constant: 270Vs/m

- waterproof, robust housing; weight 13kg, operation temperature: -20 - 60°C

SENSOR Netherlands PE-6/B 3C geophones (235 units)

- Ground velocity from 4.5Hz - >150Hz
- 3-component geophone
- generator constant: 28.8Vs/m
- waterproof; very robust; weight 1kg; operation temp. -40 - 100°C

SENSOR Netherland SM-6 1C geophone chains (300 units)

- as above, except 6 x 1 vertical component; weight 3kg

SENSOR Netherland SM-6 1C geophones (300 units)

- as above, except only 1 vertical component; weight 0.5kg

4.3 Magnetotelluric sensors

Metronix MFS05 induction coils

- broad band magnetotelluric recordings.
- frequency range 1 kHz-1000 s.
- number available: 30

Metronix MFS06 induction coils

- broad band magnetotelluric recordings.
- frequency range 8 kHz-1000 s
- number available: 80

Metronix MFS07 induction coils

- High-frequency magnetotelluric recordings.
- frequency range 50 kHz-100 s.
- number available: 30

Metronix MFS10 induction coils

- broad band magnetotelluric recordings, vertical field recordings.
- frequency range 1 kHz-1000 s.
- number available: 10

Geomagnet fluxgate magnetometer

- Low frequency magnetotelluric recordings, 3 components
- frequency range 1 Hz - DC
- number available: 30

Pulz / Magson Fluxgate magnetometer

- Low frequency magnetotelluric recordings, 3 components
- frequency range 1 Hz - DC.
- number available: 10

Silver / silver-chloride electrodes

- non-polarisable electrodes for electric field recordings
- no band limitations
- number available: 500

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