History of research institutions on the Potsdam Telegraph Hill (Telegrafenberg)

by Peter Bormann
Topics

1. Famous Potsdam Scientists
2. Buildings on the *Telegrafenberg*
3. History of Berlin-Potsdam Astronomy & Astrophysics
4. History of Berlin-Potsdam Geodesy
5. History of Berlin-Potsdam Meteorology and Geomagnetism
6. The role of the Potsdam Institutes in German Polar Research
7. Contributions of Potsdam to seismology since 1889 in its relations to Strasbourg, Jena and Freiberg
8. The Central Institute of Physics of the Earth (1969-91)
9. Developments on the Telegrafenberg since 1992
10. University Potsdam
1. Famous Potsdam Scientists:

• Wilhelm von HUMBOLDT (1767-1835)
  - Philologist
  - Pedagogue
  - Jurist
  - Statesman
  - Founder of the Berlin University
    (now named „Humboldt-University“)
• Alexander von HUMBOLDT (1769-1859)

- Royal Chamberlain to F.W. III
- Initiated many research institutes and programs, mainly in astronomy and geomagnetism
- Universal geoscientist and traveller
- Honorary freeman of Potsdam since 1849
- Wrote most of "Cosmos" (10 Volumes) in the Royal City Palace of Potsdam

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• Heinrich BERGHAUS (1797-1884)
  - Founder of „Geographical School of Art“ in Potsdam
  - Published the first Physical World Atlas

Isothermal Map of Europe from the BERGHAUS’s Physical World Atlas 1852
Hermann von HELMHOLTZ (1821-1894)

- Military physician at Garrison in Potsdam, freed from army service by A. v. Humboldt
- Invented „eye mirror“ and „Helmholtz coil“
- Discovered the energy conservation law (with Joule and Mayer) and the curl laws
- Developed the theories/concepts of thermo- & hydro-dynamics, three-color eyesight, music and acoustics, quantum nature of electricity, „Principle of the smallest effect“
- Major contributions to non-Euclidian geometry
- 1st president of the Physical-Technical Agency of the German Reich

Birth house → of H. v. Helmholtz; Wilhelm-Staab-Str. 8 in Potsdam

Garrison in Potsdam, Berliner Strasse, where v. Helmholtz worked as military physician
• Ernst HAECKEL (1834-1919)

- Professor of Zoology at the University of Jena (1862–1909)
- The strongest German supporter of Charles Darwin
- Pioneered the concept and term of „ECOLOGY“

In this house „Am Kanal 24a“ (now Yorkstrasse 7) E. Haeckel was born on 16. February 1834.
Haeckel’s drawings from his monographs about radiolarians (left) and medusas (right) from his related monographs on the comparative anatomy of species.
• Adolf SLABY (1849-1913)

- Prof. of Mathematics and Mechanics at Potsdam Technical School (1873-82) and of electrotechnique at TH Charlottenburg (1882-1913)

- In 1897, with Graf Arco (1869-1940), **first wireless broadcast** in Germany between the Sacrow church tower and the Glienicker Bridge
2. Buildings on the *Telegrafenberg* (93.5 m a.s.l.)

- The Telegraph Hill is the highest elevation next to Potsdam on the Pleistocene *Saarmund* push moräne ridge (max. 124.6 m a.s.l.)

1832/33 **Opto-mechanical telegraph** line Berlin-Magdeburg-Köln-Koblenz set up with 62 stations, at 7.5-15 km distance

- Station No. 4 on the Potsdam Telegraph Hill

- 6 levers in 3 levels allow for 4096 sign combinations!

- State telegrams from Berlin to Koblenz and vice versa in < 10 min

- 1848 replaced by electric telegraph

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Astrophysical Observatory Potsdam (built 1876/77)

Since 2001 used by the

Potsdam Institute for Climate Impact Research (PIK)

↑ Tower entrance from north

View from southeast →

XXIX ESC General Assembly, Sept. 12-17, 2004
Magnetic Observatory (built 1888/89)

Today used by the GFZ Working Group on Palaeomagnetism.
Geodetic Institute
(built 1889-91)

Today used by the GFZ Department 1 „Geodesy and Remote Sensing“

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Main Building of the Meteorologic-Magnetic Observatory (1890-93)

1949-1991 part of the Meteorological Service of the GDR
1992-2004 branch of the German Weather Service (DWD)
From 2007 onwards the building will be used by PIK

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Observatory for Angular Measurements (built 1892-93)

From angular measurements

Now named „Helmert Turm“

satellite tracking & ranging

with the CIPE-built SBG mounted on a ZEISS Jena satellite tracking telescope

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Observator and director houses (built in the 1880s and 90s)

A6: In the 1980s center of POT seismic net

A26: Civil servant house, later astro-library and from 1982 to 1991 used by the Seismology Department of CIPE

A33: Former AOP director house

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Die Königlich Preußischen Observatorien bei Potsdam auf dem Telegraphen-Berge (um 1892)

Geodätisches Institut mit Observatorium für Winkelmessungen

Astrophysikalisches Observatorium

Magnetisch-Meteorologisches Observatorium

Eingang zum Observatoriumsgelände

Wilhelm Ernst & Sohn, Berlin nach einem Entwurf von Spieler

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Great Refractor (built 1896-99)

In operation between 1899-1968.

d = 80 cm
f = 12 m
photographic

The Great Refractor in the 1950s

4th largest refractor world-wide

d = 50 cm
f = 12.5 m
visuell
Earthquake House (completed in 1902)

The 1905 WIECHERT 1200 kg-Pendulum

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Einsteinturm (built 1920-24)
A43 (built 1963-64)
(Inaugurated on the occasion of the 75th anniversary of the Geomagnetic Institute Potsdam)

- 1969-91 used by the Central Institute of Physics of the Earth (CIPE); in the 1980s also headquarters of the Research Branch Geo- and Cosmics Sciences of the Academy of Sciences of the GDR.

- Since 1992 used by the Potsdam branch of the Alfred-Wegener-Institute for Polar Research (AWI)
Potsdam Institute for Climate Impact Research (since 1992)

Temporary buildings used by PIK since 1993 (until 2007)

New PIK main building, used since 2001.

← To be used by PIK from 2007 onwards
Main buildings of the GeoForschungszentrum Potsdam (1995-98)
Built 1996-98

Canteen and main lecture room building for the institutions on the Telegrafenberg
Laboratory of the AWI-Potsdam (built 1998-99)
3. History of Berlin-Potsdam Astronomy & Astrophysics

1700  By recommendation of Gottfried Wilhelm LEIBNITZ (1646-1716) and Royal order foundation of the **Berlin Astronomic Observatory** and of the „**Brandenburgische Societät**“ (later Royal Prussian Academy of Sciences → Berlin Acad. of Sciences → German Acad. of Sciences → Acad. of Sc. of GDR)

- It had the Gregorian calendar patent/monopol and close scientific relations with the Academicians LEIBNITZ, EULER, LAMBERT, LAGRANGE, MAUPERTIUS et al.

First Berlin Astronomic Observatory (1711-1832)
1764  Johann BERNOULLI (1744-1807) head of the observatory

1773  Johann Elert BODE (1747-1807) director of the observatory; editor of → Astronomic Yearbook (published from 1776-1959), of 1st class star catalogues and famous star maps.

1825  Johann Franz ENCKE (1791-1865), student of C. F. Gauss (1777-1855) and member of the Academy, appointed director of the observatory; → comet Enke and derivation of the solar parallax
1832-35  Construction of the new Berlin Astronomic Observatory

- Architect: Royal architect C.-F. Schinkel (1781-1841)
- On recommendation by Alexander von Humboldt equipped with the (second after Tartu) world-wide largest and best Frauenhofer refractor.
- Used by ENCKE and GALLE also as geomagnetic observatory.
- Pendulum measurements at the observatory by Friedrich Wilhelm Bessel (1784-1846)
- Operated until 1913 when the observatory moved to Neubabelberg

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1846 Andreas W. G. GALLE (1858-1943) discovers with the 9-inch Fraunhofer refractor planet Neptun, guided by the Berlin star maps (produced on suggestion by F. W. Bessel) and the theoretical prediction of U. J. J. Leverrier (1811-77).

1865 Wilhelm Julius FOERSTER (1832-1921) director of the observatory. He has been instrumental in:

- introducing of the international metric system,
- creating the German and the international organizations for measures and weights,
- initiating in 1865 a „sun observatory“ at Potsdam which later became the world’s first Astrophysical Observatory in Potsdam (AOP),
- founding the Geodetic Institute Potsdam (GIP) Telegrafenberg and promoting/suggesting systematic astronomic-geodetic measurements at both Berlin and Potsdam,
- founding, together with Wilhelm MEYER and Wernher von SIEMENS, the URANIA Society → First public astron. Obs.
1876-78 Construction of the Astrophysical Observatory Potsdam

AOP design plan front view S to N

AOP in 1886
North-south cross-section through the AOP
1881 1st interferometer measurement by Albert A. MICHELSON (1852-1931) in the vault under the eastern cupola of the AOP →

- The experiment aimed at proving the relative motion of the Earth against the hypothetical „light ether“.

- The negative outcome of this experiment suggested that the velocity of light is independent of the velocity of the light source.

- This discovery encouraged Albert EINSTEIN (1879-1955) in his strong rejection of the „Ether Theory“ of light propagation and lead in its consequence to the development of the „Theory of Relativity“.
1882 Hermann Carl VOGEL (1841-1907) →

director of the AOP

• Founder of the spectral photometry

• First measurements of the Doppler velocity of stars → double stars and their eigen-motion

1886 **Discovery of channel waves** by Eugen GOLDSTEIN (1850-1930)

→ nuclear and plasma physics.

1888 • **Discovery of polar distance fluctuations**

by Karl Friedrich KüSTNER (1856-1936) with the zenite telescope by J. Wanschaff →

• First photographic determination of the radial velocity of stars

• First record of a spectrum of an extra-galactic object (Andromeda nebula)

1889 • **Discovery of spectroscopic double stars**

• Measurement of sun spot positions and determination of sun rotation
1889 April 1 to Sept. 24 continuous measurements of the time-variable deflections of the vertical with a modified ZÖLLNER horizontal pendulum by Ernst von REBEUR-PASCHWITZ (1861-95) in the vault underneath the eastern cupola of AOP
v. Rebeur-Paschwitz found in the records:

- influence of air pressure and temperature changes on the records → discusses causes and need for shielding/avoidance.
- increase of instrumental period with amplitude and sees the cause in elastic deformation of suspension and bearing components (theor. by Bessel).
- the dominant influence of ocean tides and related crustal deformations in near-coastal records (Wilhelmshafen, Teneriffa);
- the half-day period (lunar term) of Earth tides;
- the daily period of Earth tides;
- diurnal and seasonal variations of microseisms and their dependence on wind conditions;
In conclusion, he stresses the **need for long-term permanent recordings** in order to be able to investigate and separate these various complex influences:

> „Given such a complex composition of a phenomena one can not expect to achieve remarkable results by means of only isolated sporadic observations. Rather, ... as in other related fields of natural sciences ... the real progress is only achieved by organizing well-planned and uninterrupted observations.“
And most importantly:

von Rebeur-Paschwitz identifies more than 30 transient events of different duration and amplitude which superpose his long-period tidal records. He finds that they are often in close timely co-incidence in the synchronous records at POT and WHF.

→ earthquakes!
1899  Inauguration of the Great Double Refractor
Essential contributions achieved with the Great Refractor

• First proof of an absorption line and thus → **discovery** of the *interstellar gas* by Johannes Franz HARTMANN (1865-1936), who worked from 1896-1909 at the AOP.

• Contributions to an exact photographic brightness scale of weak stars.

• Temperature determination of fixed stars by visual spectral photometry.

• Discovery and investigation of many double stars.

1904 Karl Hermann STRUVE (1854-1920), grandson of Wilhelm STRUVE (1793-1864), the former director of the Russian Imperial Astronomical Observatory at Pulkovo, becomes **director of the Berlin and** from 1913-20 of the subsequent **Babelsberg Astronomical Observ.**
1909 Karl SCHWARZSCHILD (1873-1916) new director of the AOP.

• Founder of the modern photometric theory

• Co-founder of the modern theory of stellar and comet atmospheres (→ radiation and energy transport)

• Provided the first exact metric solution of Einstein’s gravitation equations

• In 1914 first (unsuccessful) measurements from the tower of A26 aimed at proving the relativistic red-shift of solar spectral lines.

His conclusion: Larger telescope and a spectroscope of much higher resolution are required → Einstein tower.
1911-14 Building of the **Astronomical Observatory Babelsberg**, at that time one of the most modern and best equipped research institutions worldwide.

1913 Introduction of photo cells for light-electric (photometric) measurements of star brightness by Paul **GUTHNICK** (1879-1947).

**Discovery** of subtle **brightness changes** of Beta Cephei by only 0.05 orders.

1915 Completion of the great Carl Zeiss refractor at the Babelsberg Observatory →

1920 Paul GUTHNICK director of the Babelsberg Observatory (until 1939).

1924 Installation of the 122cm mirror telescope, → at that time the most powerful in Germany. 1945 as war reparation to the Crimea observ.
1921-22 Construction of the „Einstein tower“ (ET)

Architect: Erich MENDELSOHN (1887-1953)

Albert Einstein at the tower in late 1921
1922-24 Installation of the **tower telescope** (first in Europe) and of the **spectroscope** in the Einstein tower.

Carl Zeiss Jena mirror system for the coelostate in the cupola of the Einstein tower.

FRAUENHOFER-Spectrum of the sun from 390-657 nm
Erwin F. FREUNDLICH (1885-1965)
First director of the ET
(until 1933).

His expedition in 1914 to Crimea to prove the relativistic light deflection during a total solar eclipse failed due to outbrake of WWI. He and his team were detained and the instruments confiscated. (The prove was only achieved in 1919 by a British expedition under Arthur S. Eddington)

1939 Walter GROTRIAN (1890-1954)
- discovers 2 „forbidden“ spectral lines
- transitions in highly ionized atoms
- calculation of T in sun corona (>1Mio°K)
- GROTRIAN term schemata

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Since 1940 at the Einstein tower investigation of magnetic fields in sun spots (via ZEEMAN-effect)

From H. KLÜBER (1948)
1954  AOP Department of Radioastronomy moves to Tremsdorf near Potsdam → Observatory for solar radio astronomy ↓

1958  Installation of a 36m radio-telescope at the Heinrich-Hertz-Institute in Berlin-Adlershof ↓

→ 1960-64 systematic radio survey of galaxes at 54 cm wavelength ↓

Director Otto HACHENBACH in 1961 separated from his institute by setting up of the Berlin Wall.
1969 Establishment of the **Central Institute for Astrophysics (ZIAP)** of the Academy of Sciences of the GDR

**Main fields of work:**

- Theory of gravity and its application to cosmology (H.-J. Treder; since 1979 director of the international EINSTEIN laboratory)
- Dynamo theory of planetary and stellar magnetic fields (M. Steenbeck, F. Krause and K.-H. Rädler)
- Theory of spectroscopy, solar physics, star atmospheres and variable stars
- History of astronomy and astrophysics
- Since **1980** a ZIAP-developed double spectrograph and magnetograph; → **3D-measurements** of the magnetic field in two arbitrary spectral lines radiated from different altitude in the solar atmosphere.
- Observation of oscillations in different layers of the solar atmosphere: → **excitation and propagation of magneto-acoustic gravity waves**
  → **Sounding of layers in the solar atmosphere and convection zone**
  → **Helio Seismology**
1993  Foundation of the Astrophysical Institute Potsdam (AIP)

Main fields of work:
- Cosmic magnetic fields, solar and stellar activities
- Extra-galactic astrophysics and cosmology

New and reconstructed buildings at the API in Babelsberg

- **Schwarzschild House**
- New API library in the rebuilt dome of the former 122cm mirror telescope (until 1945)
- Reconstruction of the old Meridianhouses into a Media and Communication Center

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4. History of Berlin-Potsdam Geodesy

1831-36 Friedrich Wilhelm BESSEL (1784-1846) → carries out the East Prussia arc measurement, assisted by Colonell J. J. Bayer.

1861 Johann Jacob BAEGYER (1794-1885), meanwhile General-lieutenant in the Prussian General Staff → submits to the Royal Prussian War Ministry the memorandum: „Draft for a Central European Arc Measurement“. Its main goals were:

- To homogenize and connect the triangulations of all participating countries;
- Narrow-mesh determination of deflections of the vertical for studying the shape of the geoid, including geodetic-astronomical measurements at 30 astronomical observatories in the area.
1862-67 Execution of the **Central European Arc Measurement**
→ *world-wide first intern. scientific cooperation between states!*

1866-85 Central Bureau of the CEAM and EAM in Berlin under BAEYER

1867-86 **European Arc Measurement**

1870 On the application of J. J. BAHEYER foundation of the **Royal Prussian Geodetic Institute at Berlin** with the obligations:

- to serve as the **Central Bureau** for the CEAM and the EAM
  (→ forerunner for todays IAG);
- to carry out - in this framework of international collaboration - the related works in Prussia;
- to continue and further develop - as a permanent task - the higher geodesy, astronomy and physical-technical sciences in Prussia.

1878 **Theory of the figure of the Earth** by Ernst Heinrich **BRUNS** (1848-1919), Prof. of Mathematics in Berlin (1878-82), later for Astronomy in Leipzig

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After the death of J. J. Baeyer in 1885:

1886-1917 **International Arc Measurement**

1885/6 Friedrich Robert HELMERT (1843-1917) elected President of the Central Bureau and appointed Director of the Geodetic Institute.

1887 Deflections of the vertical in Europe (Helmert)

F. R. HELMERT is the founder of the mathematical and physical theories of modern geodesy
1889-91 Building of the new Geodetic Institute on the Telegrafenberg
Ostwestlicher Durchschnitt des Hauptgebäudes.
The library houses now the world-largest stock of literature on Earth’s measurements.
The former large instrument room in the Geodetic Institute Potsdam
(now library reading room)
1888-90  First proof of the existance of the **CHANDLER wobble** with the zenite telescope of WANSCHAFF by Th. **ALBRECHT** (1843-1915).

1898-1904  First precision determination of the **absolute gravity value** \( g \) by KÜHNEN and FURTWÄNGLER

\[
\begin{align*}
g & = 9812740 \pm 30 \text{ μm/s } \text{exp}^2
\end{align*}
\]

It served from 1909-71 as the world gravity reference value → **Potsdam Gravity System**

1899  • Foundation of the International Latitude Service (ILS) with its Central Bureau in Potsdam until 1922 (then in Mizusawa, Japan)
1892/93 Construction of the Geodetic-astronomical Observatory for Angular Measurements (now named „Helmert Tower“) together with two meridian houses.
1891-1910  Oskar HECKER (1864-1938) works at the GIP and makes contributions to seismology:

- Since 1896 regular use of the horizontal pendulum for earthquake observations
- Improving the Rebeur-Paschwitz pendulum by introducing air attenuation.
- Uses it as a shock and vibration meter and for determination of average velocities in north-german sands
- Proposed design for the Potsdam earthquake house, completed in 1902
O. HECKER’s sea gravity meter

- Developed on the recommendation of F. R. HELMERT and financed by the International Earth Measurement

- Derives the gravity value from the difference between gravity dependent air-pressure values of mercury thermometers and gravity independent boiling point thermometers

- between 1901 and 1909 used for extended measurements on the Atlantic, Indic and Pacific Ocean with accuracy of ± 30 mGal.

**Confirmed:**

- **Airy & Pratt hypothesis of isostatic equilibrium**
- **Helmert’s normal gravity formula**
- **Strong gravity anomalies in the Indic Ocean and over deep sea trenches**

Now technical monument in the Munich German Museum
• Hecker proposed design for the Potsdam earthquake house, completed in 1902.
• Head of the Potsdam seismic station between 1902 and 1909 and responsible for the station bulletin.

• Equipping the station with his own improved 2-component horizontal pendulum with air attenuation →

HECKER-modified Rebeur-Paschwitz pendulum in use at POT station from 1902-14.

• and with the 1200 kg astatic 2-component horizontal WIECHERT-pendulum, operating at station POT from 1903-54
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1914-28 Only the astatic horizontal 1200 kg WIECHERT pendulum and occasionally also the 80 kg vertical WIECHERT pendulum are operated at station POT. WIECHERT response, N-comp. →

1929-54 Besides the 1200 kg WIECHERT also a vertical component GALITZYN-WILIP seismograph is operated at station POT →

No seismological research at station POT or the GIP until the foundation of CIPE in 1969.
1913/14 First gravimetric proof of the solid Earth tides $M_2$ by SCHWEYDAR with measurements in a Freiberg silver mine, 189 m below surface, as earlier arranged by O. HECKER.

1933/34 First German quartz clocks developed at the Physical-Technical Agency of the German Reich in Berlin and calibrated/drift-controlled by geodetic-astronomic measurements at the GIP and since regularly used by the GIP.

- **Discovery** of variations in the Earth’s rotation velocity
- **Potsdam time service** → steering GDR radio time signals until 1975
5. History of Berlin-Potsdam Meteorology and Geomagnetism

1823 Commencement of barometer observations in Potsdam by the director of the teacher’s seminar, Karl Friedrich von KLOEDEN

1836-65 Continuous measurements of D, I, and intensity F at the Berlin Astronomical Observatory.

1842-62 First regular meteorological observations in Potsdam by the Royal gardener in Sanssouci, Wilhelm LEGELER, as voluntary observer of the Royal Prussian Meteorological Institute at Berlin.


1885 Wilhelm von BEZOLD appointed first professor of meteorology at the Berlin Humboldt University.
1890-93 Construction of the Meteorologic-Magnetic Observatory on the Potsdam Telegrafenberg

↑ The Geomagnetic Observatory

← main building of the Meteorological Obs. on the Telegrafenberg. Foto: Around 1900
Meteorologisches Observatorium
auf dem Telegraphenberg bei Potsdam.
5.1 Meteorology

1890/91 Richard ASSMANN (1845-1918)

- initiates balloon soundings of the atmosphere,
- develops methods for accurate determination of air temperature and moisture,
- discovers the stratosphere at the same time as TEISSERENCE de BORT
- organizes regular daily ascents of kites and balloons for the investigation of the higher atmosphere layers.

1893 Adolf SPRUNG first director of the Meteorological Observatory (until 1909); start of regular meteorological observations. Secular station Potsdam → World Climate Program

The unique „Secular Station“ where soil temperatures are measured in 10 boreholes between 2 cm and 12 m depth.
Since 1893  Development of many standard meteorological instruments:

SPRUNG´s balance barograph, most widely used in Europe.

SPRUNG´s wind speed meter
SPRUNG’s wind speed recorder

SPRUNG’s stereoscopic cloud camera, developed in 1896 on the occasion of the 1st International Cloud Year and in use until 1922 → German Cloud Atlas.
Rain meter (left) and snow meter (right), system HELLMANN-FUESS

Theodolite for measuring the polarization of sun light.

plus

- MICHELSON-MARTEN actinometer for measurement of direct solar radiation intensity with SCHOTT filters, which are still in use today (determination of turbidity coefficient).
31 May 1901  R. SÜRING and A. BERSON  first balloon ascent of man into the stratosphere!

- First in-situ proof of the existence of the stratosphere.
- The reached altitude of >10,500 m is up to now world record in an open manned balloon!
1909  Reinhard Joachim SÜRING (1866-1950), director of the MMOP between 1909-32 and 1945-50

At the MMOP were carried out:

Since 1907  • Measurement of intensity of solar radiation

• Theoretical investigation of the radiation budget in the 20s and 30s.

• Complementing the air-electric research by investigations on the propagation of electromagnetic waves, of thunderstorms, lightning, aerosols, dust and radioactivity.

1928-34  Investigation of the high altitude radiation by KOHLHÖRSTER, co-discoverer of the cosmic rays together with Victor HESS, the nobel-prize winner of 1936. The Nazi regime prevented adequate honoring of KOHLHÖRSTER.
1934 The Meteorological Observatory Potsdam becomes part of the Weather Service and of the Aviation Ministry of the German Reich.

1935 Meeting of the International Radiation Commission at Potsdam

1950 Foundation of the Meteorological Service of the GDR.

The Potsdam Main Meteorological Observatory becomes part of this service with emphasis on the traditional areas of research such as:

• air electricity
• radiation
• heat budget

1955-75 Günther SKEIB (* 1919 in Berlin) director of the MMOP:

→ renown expert in heat/radiation budget as well as turbulence research;

• 1959-61 leader of the first German research team in Antarctica after WWII; first measurements of total ozon content in Antarctica
The Potsdam Meteorological Observatory becomes the WMO European Regional Center for ozon measurements (until 1990).

Since 1965

• The MMOP is one of the very few institution world-wide which carries out direct turbulence measurements with a self-developed ultra-sound anenometer
  • Systematic investigations into atmospheric turbulence, heat budget and forecast models
  • Research into changes of the green house effect, climate variability and climate scenarios
  • Use of electromagnetic radiation from satellites for atmospheric studies
  • Measurements of total ozon content and vertical ozon sounding.

1974

The Potsdam Meteorological Observatory becomes the WMO European Regional Center for ozon measurements (until 1990).

1984

Radiation and ozon station on the Ravensberge; contributions to the Global Ozon Observation System (GOOS).
1985-92 Special international program of balloon-borne measurements of vertical ozone content and profile in Antarctica; Co-ordinator: Dr. Hartwig GERNANDT, MMOP/Lindenberg

GFZ

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Since 1992  The Potsdam Meteorological Observatory becomes part of the German Weather Service (DWD).

End of 2004  The MMOP building is handed over to the

Potsdam Institute for Climate Impact Research (PIK)

Main research topics:

• Global and regional climatic changes and its ecological, economic and social consequences

• Carrying capacity of the Earth’s system

• Integrated system analysis

• Strategies for sustainable development of men and nature
Comparison of paleoclimate data and recent measurements about temperature changes on the northern hemisphere (red curve) with the PIK Climate Model (orange curve) and IPCC upper and lower expert assessments for the climate change in the next decades.

Simplified PIK model of the thermohaline global ocean circulation. Red: near surface currents; blue: deep ocean currents.
5.2 Geomagnetic Studies at Freiberg, Berlin, Potsdam and Niemegk

1735  Beginning of first isolated magnetic measurements at Freiberg.

1800  Beginning of regular measurement of the declination $D$ at Freiberg on the recommendation of A. v. HUMBOLDT and C. F. GAUSS.


1890  Foundation of the Magnetic Dept. of the Meteorologic-Magnetic Observatory Potsdam.
1890  Max **ESCHENHAGEN** (1858-1901) → first director of the Magnetic Department of the MMOP on the Telegrafenberg.

- Develops field variometers, produced in Potsdam by O. Toepfer and later used also in SCOTT’s Antarctic Expedition

1894  Pioneering work of Adolf **SCHMIDT** on the global representation of the geomagnetic field
1902  Adolf SCHMIDT (1860-1944) director of the Geomagnetic Dept. of the MMOP (until 1928): →

- initiates geomagnetic survey of Germany,
- introduces the geomagnetic indices,
- investigates geomagnetic secular variations,
- develops many geomagnetic instruments ↓.

← SCHMIDT´s theodolite for absolute precision measurements of the declination D and horizontal intensity H (1927).

SCHMIDT´s „Field Balance“ → for mobile relative measurements in geomagnetic prospection and survey (Z or H) (1915).
1907  Partial re-deployment of instruments (for variation measurements) to Seddin because of electric tow-line traffic through the Teltow Canal at 12 km distance and introduction of electric trams in Potsdam.

1930  Total re-deployment of the Potsdam and Seddin magnetic observatories to Niemegk under the directorship of Alfred NIPPOLD (1874-36) because of strong disturbances by Berlin DC-electric S-Bahn.
Classical variometers at Niemegk in the 1930s

← For measuring D, H and I

For measuring N, E and Z →
Niemegk Observatory in the 1930s

House and room for measuring the absolute values of the magnetic field components.
1936-45 Julius BARTELS (1899-1964), Director of the Geophysical Institute Potsdam →

- Developed **statistical methods** for testing geophysical models and useful geophysical indices, amongst them the **planetary geomagnetic Kp index**

- Published in 1940 with S. Chapman the **standard textbook** „*Geomagnetism*“

- One of the key initiators of the **IGY 1957**

- First President of **IAGA**

- Vice President of **IUGG** (1960-63)

BARTEL’s famous representation of the **Kp indices** of global geomagnetic activity as „*musical scales*“ →
1945-57 Gerhard FANSELAU (1904-82) → Head of the Niemegk Observatory and

1957-69 Director of the Geomagnetic Institute Potsdam

• Develops widely used instruments such as:
  - „Fanselau coils“ for the generation of very homogeneous magnetid fields
  - electrodynamic theodolites for absolute determination of the components of the geomagnetic field vector
  - geomagnetic field ballance with thread suspension for Z and H measurements →
  - mobile recording units for studying local differences in geomagnetic variations

• Most dense and precise magn. country survey
• Essential contributions to mathematic-statistical methods of geomagnetic field representation
• Editor „Geomagnetism and Aeronomy“ (2 Vol.)
Proton magnetometer complex developed at the observatory Niemegk in operation at the GDR Antarctic station „Georg Forster“.

Synchronous recordings of a magnetic storm on January 9, 1983 at Niemegk and station „Georg Forster“ with saturable-core magnetometers developed at the observatory Niemegk.

1969-91 The Geomagnetic Institute Potsdam becomes part of CIPE

- Major contributions to GDR Antarctic research
6. Potsdam Institutes in German Polar Research (1872-1968)

6.1 The AOP

1872 Prof. Herman Carl VOGEL, director of the AOP from 1882-1907, publishes his results of the spectral investigations of aurora borealis.

6.2 The GIP

1887 Erich von DRYGALSKI (1865-1949), leader of the first German South Polar Expedition (1901-03) publishes his PhD thesis, which F. R. HELMERT had proposed.

1888-91 E. v. DRYGALSKI works at the GIP.

1894 E. v. DRYGALSKY carries out at the GIP reference measurements for his Grönland expedition (1891-93) gravity data (with STERNECK pendulums).
1899-1901  F. R. HELMERT member of the Scientific Preparatory Commission for the 1st German South Polar Expedition (1901-03).

- The **GIP** builds a special *pendulum apperatus* for gravity measurements during the 1st GSPE and trains the observer.

- Prof. Haasemann of the **GIP** analyses the gravity measurements of this expedition.
• Prof. Haasemann of the GIP takes care of the gravity measurements of SCOTT’s British Antarctic Expedition (1910-13) and leases a pendulum apparatus.

• Charles WRIGHT, physicist at the SCOTT expedition who had found the corpses of SCOTT and his comrades, carried out in 1910 and 1913 the gravity reference measurements at the GIP.
1928-47 Karl WEIKEN participates in WEGENER’s Grönland Expedition (1930-31), later President of the German Society for Polar Research, worked at the GIP.

- Besides astronomic position and trigonometric altitude determinations, WEIKEN used in Gröland a special GIP-built double pendulum for gravity measurements at West Station and along a profil to Ice Middle.

- Ernst KOHLSCHÜTTER (1870-1942), in these years GIP director and member of the Greenland Commission, had a shared responsibility for the Greenland expedition report.
1965 • Absolute gravity-link measurements by means of pendulums between Potsdam and station Mirny, Antarctica, by Claus Elstner, GIP. 
• Measurement of solid Earth tides in Antarctica by Hans Wirth, GIP.

6.3 The MMOP

• The MMOP plays an important role in the preparations for the GSPE 1901-03 by co-ordinating the synchronous magnetic observations at 5 antarctic and one arctic expedition. Training of the participating German geomagnetists and meteorologists.

• Meeting of expedition heads in 1901 at the MMOP to agree about data formats and observation dates: William S. Bruce (Scotland), Otto Nordenskjöld (Sweden), Horacio Ballvé (Argentina), Robert F. Scott, Ernest Shackleton and Louis C. Bernacchi (Britain)

• Bernacchi used at Mc. Murdo Sound MMOP ESCHENBACH field variometers and recording units produced by the Potsdam firm of O. Toepfer.

• The same instruments were used by Alfred WEGENER during the Danmark Expedition 1906-08 in Northeast Grönland.
1902 • K. BIRKELAND prepares at the MMOP his observations of magnetic variations and of polar lights in the Arctic during his Norwegian Aurora Polaris Expedition 1902-03. This allowed a first direct comparison of the geomagnetic variation on both polar regions of the earth.

• Roald AMUNDSEN visits the MMOP for the preparation of his polar sea voyage with the ship „Gjöa“ in 1903-07 through the Northwestern Passage.

1911 Erich PRZYBYLLOK, MMOP, responsible for earth magnetic measurements during the 2nd German South Polar Expedition (1911-13) under FILCHNER, is introduced into the magnetic observation techniques by Adolf SCHMIDT, and uses his instrument for the determination of Z intensity. The second Potsdam scientist during the 2nd GSPE, has been Erich BARKOW, responsible for the weather observations during the ship voyage.

1925 Correspondence of Fridtjof NANSEN with Adolf SCHMIDT on air navigation in polar areas.

1928 On the recommendation of Adolf SCHMIDT, NOBILE uses during his polar flight with the „ITALIA“ the Potsdam double compass of the 2nd GSPE.
1932-33 The Potsdam meteorologist Joachim SCHOLZ, MMOP, carries out air-electric measurements on Franz-Joseph-Land, during the Soviet Arctic Expedition under Iwan PAPANIN.

1959-61 Günther SKEIB, director of MMOP, is leader of the first group of German scientists after WWII in Antarctica (within the 5th Soviet Antarctic Expedition (SAE) at station Mirny and on Drygalski Island).
1959-69  23 GDR scientists, most of them from Potsdam institutes, working in meteorology, glaciology, ionospheric studies, geodesy and gravimetry participate in SAEs at the Antarctic stations Mirny, Molodezhnaya and Wostok. There results have published in 33 papers.

1969-91  GDR research activities in Antarctica are co-ordinated by CIPE Potsdam (see → CIPE).
7. Contributions of Potsdam to seismology since 1889 in its relations to Strasbourg, Jena and Freiberg

• Ernst von Rebeur-Paschwitz’s 1889 earthquake records and the inferences and recommendations drawn therefrom were the first and main „seismological event“ at Potsdam with world-wide impact.

• With the exception of O. HECKER’s instrumental improvements, initiatives for setting up the Potsdam seismological station in 1902 and organizing a seismic service (1902-54) there has been no important seismological research and publications after v. REBEUR-PASCHWITZ until the foundation of CIPE in 1969.

• The establishment of a strong seismology group on the Potsdam Telegrafenberg in 1972 profited essentially from knowhow acquired and personalities who had worked at Strasbourg, Jena and Freiberg. Therefore, this tradition line, beginning with v. REBEUR-PASCHWITZ, is scetched below.
• On July 25, 1889, von REBEUR-PASCHWITZ published an article in NATURE. He refers to an earlier report in NATURE (June 13, 1889, p. 162) about an unusual earthquake recorded at the Seismological Observatory of the Imperial University at Tokyo on April 17, 1889, with rather large but gently slow motions.

• He provides convincing evidence that this EQ has indeed been recorded by his horizontal pendulums operated both at POT and WHF.

• He presents data for 10 other transient events of similar character in his records of the months April and May 1889.
In his first major publication in 1892 about his horizontal pendulum measurements in 1889 he:

- reiterates his interpretation of the earthquake in Japan on 17 April 1889;
- relates two other synchronous records at POT and WHF definitely to major earthquakes which had occurred in Central Asia on 11 July and in Greece on 25 August 1889, respectively;
- states that the large amplitude motions propagate dominantly not through the inner part of the Earth but rather close the surface;
- reasons that those motions may come to us along paths which supplement each other to a great circle $\rightarrow$ R1, R2, ...!!!
In the year of his death there appear two major publications by E. v. REBEUR-PASCHWITZ in GERLAND’s Beiträge zur Geophysik:

In volume 2, pages 211-536, he states:

- There are **surface and body waves** which propagate through the Earth;

- The propagation **velocity is significantly larger at greater depth** than near to the Earth surface;

- Accordingly, **the apparent horizontal velocity is a function of distance**!
“EQ observations provide us ... with a means to determine the elasticity modulus of the Earth interior at different depth.“

“We will thus be in a position, particularly with strong earthquakes, to track the wave propagation through the whole Earth’s body and thus to develop the fundamentals for a new theory which will guide us, in an indirect way, gradually to the knowledge of the composition of the Earth’s Interior.“

In conclusion he publishes in 1995 („Beiträge zur Geophysik, 2, p. 773-782)

Proposals for the establishment of an international system of earthquake stations (in total 35)

and drafts a related resolution for the 6th International Geographic Convention held in London in 1895:
• “We wish to propose in the first line the foundation of an international net of earthquake stations with the task to observe, in a systematic way, the propagation of motions on the Earth’s surface and through the Earth body that emanate from large earthquake centers.”

• “It is desirable and for the success of this undertaking important that all stations select the same kind of instruments and that these are brought up to the same degree of sensitivity.”

• “All signatories consider a Central Bureau for the collection and publication of the earthquake reports from all over the world a necessary supplement to the proposed monitoring system.”

This resolution is submitted to the conference by Georg C. K. GERLAND (1833-1919) Professor of Geography at Strasbourg University.

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Peter Bormann 
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7.1 Developments in Strasburg (until 1919)

Reinhold EHLERT (1871-1899), → assistant with Georg GERLAND.

He modifies in 1896 the single-component horizontal pendulum of v. REBEUR-PASCHWITZ to a 3-component horizontal pendulum ↓

Recommended by G. GERLAND as standard pendulum for the proposed global network
1897 Georg GERLAND proposes during the German Geographer Day in Jena the establishment of a seismological station in Jena.

1899 • Foundation of the „Imperial Central Station for Earthquake Research“ (ICSER) in Strasburg by Georg GERLAND (director until 1910).

• G. GERLAND proposes at the 7th International Geographic conference in Berlin the creation of an International Seismological Society

• At this Berlin conference an International Permanent Commission for Earthquake Research with 54 members was already created

Peter Bormann  XXIX ESC General Assembly, Sept. 12-17, 2004
This conference proposed an **International Association for Seismology** with a **Permanent Commission**, a **General Assembly** and a **Central Bureau**
1903 2nd International Seismological Conference at Strasbourg defines the statutes of IAS

1904 Foundation of the **International Seismological Association (ISA)** with its Central Bureau in Strasbourg. → First Chairman: G. GERLAND

- August SIEBERG (1875-1945) → employed at ICSER.
  → Works in the field of macroseismic data
  → Publishes „*Handbuch der Erdbebenkunde*“

1910 Oskar HECKER from the GI Potsdam new director of ICSER.

1912 MERCALLI-CANCANI-SIEBERG

**12-degree macroseismic intensity scale**

1919 After Germany lost Elsaß-Lothringen to France in WWI, HECKER and SIEBERG moved to Jena.
7.2 Developments in Jena from 1900 to 1969

In response to the recommendations made by G. GERLAND at the German Geographer Day 1897 in Jena and his publication on the establishment of an earthquake monitoring system sent in 1898 to the curator of the Jena University:

1900 Rudolph STRAUBEL (1864-1964) installs at the Physical Institute of the University of Jena
- a REBEUR-EHLERT pendulum and
- his own Z-component seismograph

1904 Opening of JENA Seismol. Main Station at the Astronomical Observatory in Jena.
The observatory is equipped with:
- STRAUBEL Z-comp. seismograph (T = 6.6 s, V = 2030), improved by Otto EPPENSTEIN.
- WIECHERT 1200 kg (N, E) astatic pendulum (T ≈ 10 ± 2 s; V ≈ 200 ± 30
1905 Since April regular monthly reports and later also annual bulletins of JEN

1908 Recording at station JEN of the famous Tunguska/Siberian meteorite fall with the improved STRAUBEL-seismograph.

(nach Martin, 1966)
1912 PhD thesis by Walter Pechau
„Propagation velocity and absorption of earthquake waves“
→ R1, R2, R3 etc.!

1913 Main station JEN operates additionally
• 2-comp. REBEUR-EHLERT pendulum
• 80 kg-WIECHERT Z-pendulum
• 200 kg MAINKA pendulum (N, E)

MAINKA pendulum, T ≈ 26 s, V ≈ 28 →
1919
- O. HECKER becomes director of the main station Jena
- A. SIEBERG becomes head of the WG Macroseismic

1923 Foundation of the „Reichszentrale für Erdbebenforschung“ (RfEF) (Director: O. HECKER until 1932) with 3 Departments:

- Microseismic (Head: G. Krumbach)
- Macroseismic (Head: A. Sieberg)
- Appl. Geophysics (Head: O. Meisser)

- Opening of the new station JEN → (with support of CARL-ZEISS Foundation)
The new station JEN operates until 1964. It is equipped with:

- **MAINKA 200 kg Kegelpendel**
- **WIECHERT 1200 kg (N, E; MP)**
- **WIECHERT 1300 kg (Z; MP)**
- **WIECHERT 15,000 kg (N, E; SP)**

Astatic WIECHERT pendulum (N, E),
\[ T \approx 8.5 \text{ s}, \ V \approx 200 \]
View into the seismometer room of station JENA

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Complemented in:

1935 by a Jena-built vertical component
GALITZYN seismograph

And in the 1950s and early 1960s, respectively, by

- short-period KRUMBAKH seismographs (N, E, Z: T = 2.5 s, Vmax = 2000)
- TEUPSER HSJ-1 seismograph (N, E; broadband from T = 0.1-20s, V = 1000)
1924-40 Otto MEISSER (1899-1966) at the Jena RfEF

- land and air seismics
  (Handbook WIENS-HARMS)

→ Later director of the Inst. of Applied Geophysics at the Mining Academy Freiberg (BAF; 1940-64)

→ again director of the Jena Institute of Geodynamics (1964-66)

1924-55 Gerhard KRUMBACH (1895-1955), student of E. WIECHERT, employed at the Jena institute

- responsible for station JEN and the microseismic research

- 1946-55 director of the institute and initiator of the new building
1925-61 Hans Martin (1899-1990) at the Jena institute

- working in Dept. of Appl. Geophysics
- from 1934-40, together with O. Meisser, in the Commission for the Geophysical Survey of the German Reich
- 1956-61 director of the institute

1930 A. Sieberg: "Erdbeben" (175 pp.) and "Erdbebengeographie" (317 pp.) in Gutenberg's "Handbuch der Geophysik", Vol. 4

1932 A. Sieberg appointed comm. head of institute

1934-70 Wilhelm Sponheuer (1905-1981) working at the Jena institute with A. Sieberg in Dept. Macroseismic on

- complementing the German earthquake catalogue
- improving the macroseismic intensity scale

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1936  August SIEBERG appointed director of the Jena institute

1940  „Beiträge zum Erdbebenkatalog Deutschlands und angrenzender Gebiete für die Jahre 58 bis 1799“
1954-56 Construction of the new institute building in Jena

1960-63 Construction of the new seismological observatory MOXA, 35 km from Jena.
1962 ESC General Assembly in Jena

Prof. Savarensky ↓ Prof. Belousov ↓ Prof. S. Mueller ↓

Prof. W. Sponheuer ↑ Dr. Ch. Teupser ↑ ↑ Prof. O. Meisser
7.3 Contributions/decisions by Jena scientists with relevance for development of seismology in Potsdam during the 1970s/1980s

Wilhelm SPONHEUER

1952 „Erdbebenkatalog Deutschlands und der angrenzenden Gebiete für die Jahre 1800-1899“ (later continued for GDR until 1975; inc.)

1960 „Methoden zur Herdtiefenbestimmung in der Makroseismik“

used by G. Grünthal in the EK 1988 for depth determ., e.g. of Vogtland swarm earthquake → rheologically interpreted by Bankwitz, Bormann et al. (1984/85)
1964 • MEDVEJEV-SPONEUER-KARNIK intensity scale MSK-64

→ Further developed at Potsdam by G. GRÜNTHAL et al. to the EMS-98

• Full operation of station MOX, which later became the main seismological observatory within the Central Potsdam seismic network
Christian TEUPSER (1928-91)

Developed (in collaboration with the Jena theoreticians R. Maaz, P. Malischewski and W. Ullmann as well as with E. Unterreitmeier) all modern seismographs later used in the:

- GDR main observatories MOX, CLL and BGR;

- Potsdam Seismic Network

- Vogtland seismic monitoring net

- Special GDR network for investigation of the Earth crust and upper mantle by means of surface waves (H. NEUNHÖFER)

- Seismological stations BUDAPEST, TIRANA, SANTIAGO DE CUBA

- rock-burst monitoring systems in mines
HSJ-I
Ts = 15-30s

VSJ-I
Ts = 15-30s

HSJ-II
Ts ≈ 1s

HSJ-II
Ts ≈ 1s
The TEUPSER 30m quartz strainmeter in the MOX tunnel.

The Jena mechanical workshop.

Assembling TSJ-1 \( \uparrow \) and DRJ-1 \( \downarrow \) components.

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Horst NEUNHÖFER

• Complements and manages after the 1961 Vogtland earthquake swarm the local **Vogtland seismic network**

• Uses this network for detailed microseismic investigations into the spatial, temporal and energetic **peculiarities of swarm earthquakes**

• Installs several **seismic networks in mines** and studies rock bursts

• Installs and operates from 1966-82 a special long-period seismic network with VSJ-I for crustal/UM studies by means of surface-waves

• This included the first installations of the long-period TEUPSER VSJ-I seismographs at BGR, CLL (1966) and **POT (1967-74)**.
Otto Meisser

From **1964-66** director of the Jena Institute. He renamed it ,,Institut für Geodynamik“ and ordered to:

- review the state of seismological practice →
- produce a much more elaborated seismic bulletin in keeping with modern instrumentation and concepts (e.g., importance of secondary phases ↓, core phases, multiple rupture process etc.)
Type B

KIRNOS
SK-D BB

MPV1(B) = 6.4
MPV4(B) = 7.9

→ mB

Type A
(WWSSN-SP)

MPV(A) →

mb1 = 5.8
mb4 = 7.0

(\text{F4} - \text{P1}) = 40\text{s}!
mb within first 5 half-cycles (2–5 seconds?)

→ 1974: Recommendations for standardization and optimization of seismograph responses
Heinz STILLER

1966-68 Director of the Jena Institute of Geodynamics
1969 Founding director of CIPE Potsdam
1982-86 President of the ESC

suggested P. BORMANN to:

• work as scientist on duty at station MOX (1966-68) →
• study the possibility of single-station location and discrimination of seismic events

ΔAz SP
ΔAz LP
ΔD t(S-P)
ΔD t(secondary phases)

Central Asia
Western USA

• Wolfgang ULLMANN to deal with the equations of state of Earth’s matter.

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8. The Central Institute of Physics of the Earth (1969-91)

1969  Reform of the Academy of Sciences of the GDR
→ merging several disciplinary-oriented individual institutes into
large **interdisciplinary central research institutes**

- Astronomical Observatory Babelsberg → Institute for Relativistic and
  Extragalactic Research + AOP star physics + Astron. Obs. Sonneberg +
  Karl-Schwarzschild-Obs. ⇒ **Central Institute for Astrophysik (ZIAP)**

- Solar Obs. Einsteinturm + Obs. Tremsdorf for solar radio astronomy +
  ⇒ **Central Institute for Solar-terrestrial Physics (ZISTP)**

  Geodynamics Jena ⇒ **Central Institute for Physics of the Earth (ZIPE)**
8.1 Departments at CIPE

1. Department of Seismology

2. Department of Geodesy and Gravimetry

3. Department of Geology and Tectonics (including geochemistry, lithology and minerogeny)

4. Department of Remote Sensing and Geoinformatics

5. Geophysical Solid State and High Pressure research

8.2 Major R&D results at CIPE (with emphasis on seismology)

8.2.1 Seismology

Hardware and Infrastructure Development
The Jena group of CIPE Dept. 1 (Teupser, Unterreitmeier, Brunner, Wenk)

The triaxial electronic seismograph ← EDS1/TSJ-1e

and its overall and filtered response characteristics ↓

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Further developments by Ch. Teupser:

- 4-comp. electr. Quattro
- Vertikal component
  1Hz sensor KSJ-1

Computer center at Jena for on-line digital data from MOX
Modernization of MOX observatory

Units for data reception and control at station MOX, also for the local Vogtland network and for data transmission to JEN and POT

Observatory MOX in the 1980s
Completion of BRG into a full-fledged manned seismological main station

Realized in collaboration between the Jena and Potsdam seismology groups of CIPE

Since 1992

Peter Bormann

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Strainmeter developments at CIPE and completion of the deep observatory TIE

Invar wire strainmeters (by H. Harwardt)

Installation at TIE of VSJ-II SP and VSJ-I LP seismographs

Portable 1m universal strain meter
1976-1988 Development of the centralized POTSDAM seismic network

by
M. BAUMBACH
J. BRIBACH
H. GROSSER
J. NEUMEYER
W. STRAUCH
K. WYLEGALLA
et. al.

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VSJ-2 SP records of BRG, CLL and MOX at Potsdam center

TSJ-1 broadband records at MOX and Potsdam
Local (left) and teleseismic earthquake recordings (right) at the Potsdam net.
Records of underground nuclear explosions at the Potsdam seismic net.

Peter Bormann  XXIX ESC General Assembly, Sept. 12-17, 2004
Methodological and software developments for the Potsdam seismic net

Improvement of event location for Vogtland earthquakes
(W. STRAUCH)
Improvement of POT net event location for teleseismic earthquakes (W. STRAUCH)

With K. WYLEGALLA's regional slowness corrections
SEIS89 Software for the Potsdam seismic net (by M. BAUMBACH)
Polarization analysis

Spectral source parameter

Peter Bormann

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Controlled sources seismology - DSS

• Development of a digital field data logger

• Refraction seismic measurements along 1600 kilometer profiles over the main tectonic regions of the GDR by

E. APITZ/LÜCK, J. BRIBACH, A. SCHULZE, J. WOLTER et al.

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Complex seismological, geophysical and geological interpretation of the DDS profiles by an inter-institutional GDR-wide WG (chaired by E. Hurtig, later by P. Bormann):
Members: E. APITZ, P. BANKWITZ, A. SCHULZE (CIPE); F. JACOBS, MEYER (Uni Leipzig); Ch. OELSNER, G. PORSTENDORFER (BA Freiberg); W. CONRAD (VEBGeophysik Leipzig) & experts from Gommern, Greifswald.
Investigations into seismic spectra and source processes of local earthquakes and mining events
by M. BAUMBACH, St. GRÄSSL, H. GROSSER, W. KUHNT

\[ Mo = 2 \times \exp{13} \]
\[ R_o = 65 \text{ m} \]
\[ \Delta\sigma = 33 \text{ MPa} \]
\[ D_o = 4.5 \text{ cm} \]

Spectral source parameter of Vogtland swarm EQs

+ extensive comparison of insitu source parameters observed in mines with source parameters derived from seismic spectra (W. KUHNT).

Peter Bormann
XXIX ESC General Assembly, Sept. 12-17, 2004
Fault plane solutions of Vogtland swarm earthquakes

Fault-plane solutions from FM polarities with range of 90% probability solutions for the pressure and tension poles.

Range of admissible solutions for strike, dip and rake based in P/S moment ratios as derived from data of stations MOX and PLN.
Earthquake magnitudes (P. BORMANN, G. KOWALLE, K. WYLEGALLA)

1974
Bormann, Khalturin & Wylegalla

And calibration functions for PKP phases by Kowalle in the 1980s

XXIX ESC General Assembly, Sept. 12-17, 2004
Earthquake catalog, macroseismic studies and hazard assessment
by G. GRÜNTHAL

Probabilistic seismic hazard for the town Klingenthal (non-exceedence of intensity Is) during the time span D.
1979  Seismological expedition of CIPE into the source area of the April 15, 1979 Montenegro earthquake (Ms = 7.0, mb = 6.7, Io IX-X)
(E. HURTIG (Potsdam), H. NEUNHÖFER (Jena) et al.)
Since 1980 International Training Courses on Seismology and Seismic Hazard Assessment (Chairman: Peter BORMANN)

Between 1980 – 1991 246 participants from 51 countries attended these courses.

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Peter Bormann
Textbooks, monographs and PhD theses

• 20 monograph publications of CIPE and about 30 PhD and habilitation theses on seismometry, seismology and physics of the Earth’s interior

Peter Bormann
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8.2.2 Geodesy

CIPE built satellite lasers of the 1st and 2nd generation mounted on a CARL ZEISS Jena satellite tracking telescope on top of the HELMERT tower.

1st generation; accuracy: 1-2 m
1974-81

2nd generation; accuracy: 10-30 cm
1981-93
Polar motion 1981-90 as derived from CIPE satellite laser observations

• SCHÜLER et al (1969-70): Most precise absolute gravity determination with pendulum
  \[ g = 9812601.0 \pm 3 \, \mu \text{m/s}^2 \]

• 1990 discovery of the 11.5 y period of \( g \) changes

Variation of length of the day and y-component of earth rotation pole: 1 - IERS
2 - CIPE LAGEOS solution
3 - VLBI (NGS Washington)
8.2.3 Geology, tectonics, rock mechanics and remote sensing

Modelling of the development of sedimentary basins in space and time
Investigation of deformation processes in the lithosphere →

Rock mechanics ← investigations in the laboratory
Satellite remote sensing applied to geology
AKADEMIE DER WISSENSCAPHTEN DER DDR
Forschungsbereich Geo- und Kosmoswissenschaften
ZENTRALINSTITUT FÜR PHYSIK DER ERDE

Veröffentlichungen des Zentralinstituts für Physik der Erde
Nr. 65

ERDFERNERKUNDUNG

von
Peter Bormann

Herausgeber: Der Direktor des Zentralinstituts für Physik der Erde Potsdam
Als Manuskript gedruckt Potsdam 1980

Geofernerkundung

3. LEHRHEFT

Methoden und Geräte
zur Gewinnung von Fernerkundungsdaten

02 1012 03 0

Peter Bormann  XXIX ESC General Assembly, Sept. 12-17, 2004
Atlas zur Interpretation von kosmischen Scanneraufnahmen
Multispektralsystem „Fragment“: Methodik und Ergebnisse

124 case studies

Peter Bormann
XXIX ESC General Assembly, Sept. 12-17, 2004
3-weeks United Nations Training Courses on Remote Sensing Applications to Geological Sciences:

- October 05-24, 1987 at Dresden
- October 05-23, 1989 at Potsdam
- October 07-25, 1991 at Potsdam and Berlin
- Sept. 28-Oct. 16, 1992 at Potsdam and Berlin
8.2.4 Geothermal research

By HURTIG, CERMAK, HAENEL et al.

Heat flow map of the Thyrrhenian Sea

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8.3 Coordination of GDR Antarctic Research

- Between 1969 and 1991 CIPE has been the leading institution for GDR Antarctic research, being responsible both for the scientific programs and providing the needed logistic support.

- The scientific co-ordination of the research projects of many participating institutions was in the hands of an inter-institutional WG „Antarctic Research“ chaired by the deputy director of CIPE (between 1981-89 by P. BORMANN).

- The WG was sub-ordinated to the Program Council „Geo- and Cosmic Sciences of the Academy of Sciences of the GDR.

- In total, 154 GDR scientists and 64 technicians worked in Antarctica between 1959 and 1990. Their results were published in more than 570 papers and monographs.

- Main research areas and topics between 1969 and 1991 were:
1969-75 • Ionosphere research and weather satellite imagery at Mirny
  • Gravimetry at Mirny and Vostok (inclusive connection)
  • Meteorology, geodesy and environmental isotopes at Molodezhnaya
  • Geology at Prince Charles Mts.
  • Glaciology at Hays glacier (repeated in 1976 and 1978)
GFZ

Peter Bormann  XXIX ESC General Assembly, Sept. 12-17, 2004
1975  Foundation of the Station „Georg Forster“ in the Schirmacher Oasis
1975-91 Systematic investigation of the Schirmacher Oasis and its surroundings by means of:

- geomagnetic observatory and field measurements; geodesy & gravimetry
- geologic-tectonic, petrographic, petrochemical and RS surveys
- comprehensive geomorphological, hydrological and glaciological studies
- weather and climate research complemented by long-term satellite sea ice monitoring over the Atlantic sector of the Southern Ocean
- comprehensive plant & animal census
- ionospheric & atmospheric ozon studies

All documented in a 450 pp. monograph plus annex volume
Annual variation of **average vertical ozon distribution** during 1985-92 over the „Schirmacher Oasis“ in Antarctica
Biological program at Bellingshausen and surrounding Islands

Documented in →

Peter Bormann  XXIX ESC General Assembly, Sept. 12-17, 2004
Geological field investigations in other Antarctic regions

- **Wohlthat Massif/Untersee**
- **Prince Charles Mts.**
- **Pensacola Mts.**
- **Shackleton Range**
- **Lassiter Coast**
- **Queen-Maud-Land**

(Wohlthat Massif, Petermann Range, Gruber Mts., Mühlig-Hofmann Mts.)

- **Neptun Range/Pensacola Mts.**

- **Herbert Mts./Shackleton Range**
9. Developments on the Telegrafenberg since 1992

• Foundation of the Potsdam Institute for Climatic Impact Research (PIK)

• Foundation of the Astrophysical Institute Potsdam (AIP)

• The Main Meteorological Observatory becomes part of the German Weather Service (DDG)

• The Antarctic research group of CIPE is complemented by more researchers and new research topics in both (N & S) polar areas and becomes a regional branch of the Alfred-Wegener Institute for Polar Research (AWI) with emphasis on paleoclimate and ozon studies

• Foundation of the GeoForschungsZentrum Potsdam (GFZ)
9.1 Geodesy and Remote Sensing

- Continuation of classical monitoring tasks with most modern techniques and greatly improved accuracy/resolution

GFZ Polar Motions

With GPS

Accuracy < 3 mmm

With supra-conductivity gravity meter T018

Peter Bormann
XXIX ESC General Assembly, Sept. 12-17, 2004
GFZ absolute gravity measurements →

(now continued in South Africa)
Pre-CHAMP/GRACE GFZ Geoid 1996

with SLR, GPS and terrestrial data

(c) wolfk@gfz-potsdam.de  
view: 104° 60°

XXIX ESC General Assembly, Sept. 12-17, 2004
EIGEN-GRACE
1 cm, 0.02 mgal @ $\lambda/2 = 270$ km
(GRACE 3 months)

EIGEN-CHAMP
1 cm, 0.02 mgal @ $\lambda/2 = 1000$ km
(CHAMP 3 years)

Geoid Model from 40 days of CHAMP data has already been as good as from previous 20 years of data from some 15 satellites
Earth’s magnetic field

Main field

Crustal field

Decrease of main field

Differenz MagSat-CHAMP Modell (10 Jahre)
Measurements for continuous atmospheric temperature and humidity profiling →

compared with the discrete measurements from air-borne balloon soundings (ECMWF and NCEP/USA)
Satellite laser ranging and plate motion studies


New GFZ Satellite Laser Ranging station with improved telescope, receiving equipment and range; prepared for 4th generation SLR with mm resolution

XXIX ESC General Assembly, Sept. 12-17, 2004
Remote sensing of ground deformation with satellite radar interferometry (INSAR)

Izmit earthquake, Turkey, 17 August 1999, Ms = 7.3
max. observed surface displacement 4.90 m

Bam EQ, Iran, 26 December 2003, Ms= 6.5
max. observed surface displacement 25 cm
9.2 Seismology

- **Continuation** of all seismological main fields such as
  - deep Earth structure (passive methods)
  - deep seismic sounding/controlled source seismology
  - source location and source processes
  - hazard assessment
  - training, etc.,
  however at a significantly deepened and world-wide co-operative scale

- **Discontinuation** of seismometer development and routine observatory practice/bulletin work

- **Discontinuation** of the Potsdam seismic network, however, world-wide deployment of broadband GEOFON stations for research purposes and global data exchange networking
The permanent GEOFON network is complemented by temporary seismometer deployments for lithosphere and mantle studies.
Examples are:

- Eiffel plume
- Hawai plume
- Bohemian Massif
- Trans-Alp project
- Trans-European Suture Zone

- Andes (Chile)
- Israel-Jordan (Dead Sea Project)
- Greenland
- Indonesian Arc
- Tibet

Receiver function data from Tibet and their geologic-tectonic interpretation
DESERET PROJECT crossing the Dead Sea Transform

P-wave tomography from near vertical reflection data

Magnetotelluric resistivity data superposed with seismic P-wave isotaches
MALLIK/Canada: Gas hydrates under permafrost

JNOC/ GSC/ GFZ- Project

with participation of > 100 scientists from 30 countries under the ICDP

GFZ interpretation of the MALLIK cross-hole seismic surveys

Peter Bormann

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This scale with vulnerability and damage grade classification & examples → is now European standard and widely used world-wide
NEW FIELD: Mikrozonation – local amplification of ground motions

Peter Bormann

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German Task Force Earthquakes

Chaired by the GFZ, 13 German institutions co-operate in the Task Force Earthquakes

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Izmit (Mw 7.4) and Düzce (Mw 7.2) earthquakes in Turkey (17/08 & 12/11/1999)
Cariaco/Venezuela EQ
July 9, 1977; Ms = 6.8

P-wave velocity tomography and relocation of aftershock hypocenters

a) Original aftershock epicenters on the basis of a 1-D layered velocity model

b) Relocated aftershock epicenters based on the tomographic 3-D velocity model
International Training Courses on Seismology, Hazard Assessment and Risk Mitigation

• Since 1992 alternately held in Germany and in developing regions
• Involving lecturers from 18 nations
In total:

- **1500 applicants**
- **609 participants from 97 nations**

XXIX ESC General Assembly, Sept. 12-17, 2004
A major spin-off of the training course materials, further elaborated and complemented by an IASPEI WG, is the NMSOP.
9.3 Other main GFZ research field

- Dynamics of the lithosphere
- Deformation and rheology (laboratory investigations)
- Dynamics of climate and sediments
- Paleomagnetic and geologic time scales and stratigraphy
- Anorganic and organic geochemistry
- Geomechanics
- Geothermy
- Engineering hydrology
- Operational support for the International Continental Drilling Program (ICDP)
10. University Potsdam
You are invited to visit the Telegrafenberg. The bus 606 dep. at 12:27
Astronomical Observatory Babelsberg (built 1911-13)
You are invited to visit the Telegrafenberg. The bus 606 dep. at 12:27