GFZ Helmholtz Centre for Geosciences

International Training Course on

Seismology, Seismic Data Analysis, Hazard Assessment and Risk Mitigation

5 - 18 October 2025
Antananarivo, Madagascar

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Organised and sponsored by

GFZ Helmholtz Centre for Geosciences, Potsdam, Germany

with the local support of

Institut et Observatoire de Géophysique d'Antananarivo(IOGA),
Université d'Antananarivo
Madagascar

1. OBJECTIVES AND PROGRAMME OF THE TRAINING COURSE

The disastrous consequences of destructive earthquakes place a heavy burden on many societies and their economies, particularly in developing countries. In order to avoid or at least to mitigate the negative effects of such events a thorough scientific knowledge of their geological and geophysical causes, their structural, kinematics and dynamic characteristics and destructive effects as well as a developed capability to monitor and to analyse them is indispensable. The vulnerability of human societies and related human and economic losses due to earthquakes are steadily growing as a consequence of rapid population growth and urbanization. Accordingly, improved risk assessment and effective disaster mitigation measures are prerequisites to ensure sustainable development in earthquake-prone countries.

The GFZ Helmholtz Centre for Geosciences is running an annual international training course in the field of seismology and seismic hazard assessment. The training course, has been part of the related programs of the United Nations (OCHA and UNESCO), aims at promoting training and know-how transfer, especially to nationals from developing countries. The courses are a contribution to the Sendai Framework for Disaster Risk Reduction 2015-2030.

In 2025, the GFZ organizes and runs the course in Antananarivo, Madagascar in the time period 4 October to 18 October 2025 **for the benefit of participants from earthquake-prone developing countries from Southern and Eastern Africa and neighboring countries** under the main topics:

"SEISMOLOGY, SEISMIC DATA ANALYSIS, HAZARD ASSESSMENT AND RISK MITIGATION".

The training course 2025 is entirely sponsored by GFZ. Until 2024, more than 1,200 participants from 125 countries, amongst them graduate students, university lecturers as well as senior staff and directors of reputed research institutes, have attended the seismology training courses organized and supported by the GFZ Helmholtz Centre for Geosciences. Since the foundation of the GFZ in 1992 these courses are held alternately in Potsdam and as regional courses in a hosting country of Africa, Asia or Latin America. In the latter case, the course topics are specifically tailored to the needs and potentials of the respective region and can integrate local lecturers into the international team of instructors.

More details on the training courses, including the circular, programme and application form for the course in 2025 can be found on the GFZ web-page under https://www.gfz.de/en/about-us/education-and-training/seismology-and-hazard-assessment.

In line with the steadily growing demand by participants in former courses for mainly practice-oriented training and workshop discussions related to case studies, the current course programme comprises, besides introductory and state-of-the-art review lectures on the various subjects of earthquake seismology and risk assessment, extensive practical exercises, demonstrations, workshop and discussions. Generally, the course programme aims at developing interdisciplinary problem understanding, acquaintance with the theoretical fundamentals and basic features of modern instrumentation, commonly used models and algorithms as well as developing practical skills in data evaluation and analysis.

The scientific-technical background and work duties of the course participants are usually rather different. None the less, there are generally two main groups of applicants:

- those responsible for the installation, maintenance, operation of and/or data analysis at seismic stations or network centres;
- those mainly working in the field of seismic hazard and risk assessment, earthquake zonation and microzonation and/or earthquake engineering and disaster management.

The detailed scientific programme of the course is annexed to this circular.

The training course is planned as a 2-week course. The training is dedicated to fundamental lessons and exercises on Seismology, Earthquake Source analysis, Site Effects, Strong Ground Motion, and Seismic Hazard Assessment and Risk Estimation. Additional topics are the use of InSAR and geodynamic modelling.

Some sessions of the training course are dedicated to scientific-technical presentations by the course participants, who will report about his/her work: such scientific-technical presentations are planned as talks to the other course participants and interested colleagues from the GFZ.

In case a course participant wants to use own data (seismic data, instrumental microzonation, earthquake catalogue, etc.) during the time of the Training Course a copy of the data should be sent in advance to the GFZ for checking and quality control.

Throughout the course the completion of exercises by the participants as well as their contributions to workshop sessions and topical discussions are evaluated.

The successful participation in the course is acknowledged by a certificate at the end of the course.

2. APPLICATION AND ADMISSION

2.1 Conditions for application and admission

The course is arranged for the benefit of participants from earthquake-prone countries. To make the training effective, the number of participants is limited to 16. Preference is given to young candidates engaged in seismology, seismic monitoring and zonation, earthquake data analysis, hazard, vulnerability and/or risk assessment. Applicants should have active interest and obligations in these fields. Engineers with background and duties in earthquake engineering and disaster management who want to deepen their understanding of seismological phenomena, methods and data products are also considered, as are researchers or university lecturers in geosciences who may act as conveyers of the knowledge acquired in the course (training of trainers).

Applicants must have a scientific degree (B.Sc. or M.Sc., diploma or higher) in geosciences, physics or engineering from a recognized university, a focus will be on PhD-students. Preferably applicants should have several years of professional experience in subjects covered by the course. Applicants must also have a thorough knowledge of English which is the only working language of the course.

It is also **mandatory** for admission to the course that applicants are able and willing to present **own scientific work, through an oral presentation (15 minutes + 5 minutes discussion).**

Priority is given to applicants who are able to cover the cost for travel from domestic institutional or development-aid project funds for training. Only a limited number of **Travel grants** are available to selected participants from developing countries in need of support.

An application is considered only when:

- **the attached application form is duly filled-in and submitted in time**
- **the application form is accompanied by two letters of recommendation**
- **the applicants explicitly confirm to have appropriate command of the English language, if possible by adding copies of language certificates;**
- **the applicants give the title of their scientific presentation in the application form (with abstract)**
- **the application includes a sound motivation letter written by the applicant him/herself (½-1 page)**
- **the applicant confirm, that an international travel and health insurance will be concluded.**

Those who intend to present and discuss additionally in a special workshop session data, methods used or case studies from their country should indicate this separately in the registration form and submit an abstract giving details about the subject, method applied, kind of data available as well as of the open questions they want to thresh out.

Without such specifications and accompanying documents an application will not be considered!

All participants have to present, at social evening get-togethers (**cultural evening**), slide, power point or self-produced video shows or any other suitable kind of material or personal performances (dances, songs, instruments) which can convey to their fellow participants some impressions about geography, culture, customs, music and daily life in their respective home countries. Such presentations should be limited to max. 10 min.

In the selection of participants **preference is given to those applicants,** who (as confirmed in the application forms and accompanying letters):

- are most in need of training in the subjects covered by the course;
- are concerned with the operation of and data analysis at seismic stations or network centres;
- are working on seismicity analysis or earthquake source modeling;
- are working with seismic hazard assessment or microzonation;
- are involved in vulnerability and risk assessment, engineering seismology, and/or disaster management and mitigation projects;
- can serve as multipliers in spreading the knowledge and skills acquired;
- can make an active contribution to the workshop sessions and discussions;
- had applied already earlier for the course, been found eligible/qualified but could not be accepted due to the limited number of available fellowships;
- can pay their travel.

The application forms and accompanying candidates´ files will be carefully screened by the Academic Board and Selection Committee of the course. Members of the board are prominent geoscientists of the GFZ Helmholtz Centre for

Geosciences. Chairman is Prof. Dr. T. Dahm, head of section 2.1 “Physics of Earthquakes and Volcanoes” at the GFZ.

2.2 Application formalities

Applications should include the following information:

(1) Filled-in application form;
(2) Two letters of recommendation or reference which give details on the applicant’s personality, duties and performance in seismic station operation, data analysis or other specified applied or research projects;
(3) Confirmation of appropriate command of English;
(4) Title and one-page abstract of the proposed topic or case study to be presented or discussed in a special workshop session;
(5) Title and kind of intended cultural presentation;
(6) Letter of motivation;
(7) List of scientific publications (if available)

The deadline for the submission of the application documents is July 2, 2025.

Candidates will be informed of the decision of the Academic Board by July 25, 2025 and, if accepted, will receive further instructions by the GFZ in a letter of acceptance. Any additional questions may be directed to the address above.

2.3 Services provided to selected participants

Fellowships granted to participants entitle them to the following services:

- Accommodation in single rooms (double rooms during the excursion), meals and tea-break refreshments within the facilities and arrangements provided by the organizers.
- Tuition, course material, scientific and cultural excursions;
- Collection of scientific material and software which participants can take home;
- Local transport in connection with the official programme, field excursions and pick-up arrangements for meeting participants arriving at and departing from the airport.

Travel grants to cover the cost of international air travel might be available for few participants only. Therefore, every applicant is urged to look into available possibilities to cover travel expenses on his/her own with the support of his/her nominating or sponsoring institution and to make, an explicit statement to this effect in the application form.

2.4 Costs borne by participants or nominating agencies

Participants or their nominating governments/agencies are required to bear the following:

- Cost of personal travel, accident, live and medical insurance;
- All expenses in the home country for travelling abroad, including passports, visa, medical examinations, inoculations, domestic travel, etc.;

- Salary and related allowance during the period of participation in the training course;
- Any expenses other than the travel grants for selected participants and the living and accommodation expenses at the seminar place (see 2.3) including subsistence and incidental expenses during travel, any expenses incurred during stop-over en route and any additional costs for travel by other route than the one originally provided with the ticket;
- Any costs for excess luggage.

Neither the GFZ nor any other co-organiser or co-sponsor of the course will assume responsibility for the following expenditures or services:

- Costs incurred by participants with respect to travel insurance, medical bills and hospitals fees in connection with their attendance at the training course;
- Loss of or damage to property while attending the training course;
- Compensation in the event of death or disability of participants in connection their attendance at the training course;
- Any claim towards expenses incurred by participants other than those mentioned in section 2.4 above (e.g. for accommodation in hotels, food and drink orders or private trips of the participants own choice, shopping, excess luggage, etc.);
- Re-routing tickets or making visa arrangements.

Participants may exchange their own freely convertible currency into the local currency to cover themselves the cost for any additional personal needs beyond what is provided under 2.3.

By attending the International Training Course on Seismology, you grant the GFZ Helmholtz Centre for Geosciences the right to use your name, photograph and biography in GFZ news, or promotional material, whether in print, electronic or other media, including the GFZ website.

By sending the application form all applicants and their nominating institutions accept these conditions irrevocably.

For more information, please contact:

GFZ Helmholtz Centre for Geosciences, Section 2.1 “Physics of Earthquakes and Volcanoes”
Dr. S. Cesca
Telegrafenberg, D-14473 Potsdam
GERMANY

E-mail: course-un@gfz.de

3. GENERAL INFORMATION

3.1 Location of the course

The training course will be held at the Hotel ibis Antananarivo, where also the course participants will be accommodated. (tbc)

3.2 Excursions

During the weekends, we plan to have an excursions, with field destinations to be defined. Participants are recommended to bring appropriate shoes and waterproof clothes.

3.3 Climate and recommended dressing

Madagascar has a tropical climate

Climate normal and extremes in Antananarivo during the October are:
- The average daily temperature: 20.2°C
- The average daily maximum is 26°C
- The average daily minimum is 14.3°C
- The average monthly precipitation 39 mm
- The average number of sunny hours 8 hours
- The average of rainy days 4 days
- The average humidity 67%

3.4 GFZ Helmholtz Centre for Geosciences

The future can only be secured by those who understand the System Earth and its interactions with Man: We develop a profound understanding of systems and processes of the solid Earth together with strategies and options for action to address global change and its regional impacts, to understand natural hazards and to minimize associated risks, as well as to assess the human impact on System Earth.

The GFZ is Germany's national research center for the solid Earth Sciences. Our mission is to deepen the knowledge of the dynamics of the solid Earth, and to develop solutions for grand challenges facing society. These challenges include anticipating the hazards arising from the Earth's dynamic systems and mitigating the associated risks to society; securing our habitat under the pressure of global change; and supplying energy and mineral resources for a rapidly growing population in a sustainable manner and without harming the environment.

These challenges are inextricably linked with the dynamics of planet Earth, not just the solid Earth and the surface on which we live, but also the hydrosphere, atmosphere, and biosphere, and the chemical, physical, and biological processes that connect them. Hence, we view our planet as a system with interacting components. We investigate the structure and history of the Earth, its properties, and the dynamics of its interior and surface, and we use our fundamental understanding to develop solutions needed to maintain planet Earth as a safe and supportive habitat.

In pursuit of our mission, we have developed a comprehensive spectrum of expertise in geodesy, geophysics, geology, mineralogy, geochemistry, physics, geomorphology, geo-biosciences, mathematics, and engineering. This is complemented by our deep methodological and technological knowhow and innovation. We are responsible for the long-term operation of expansive instrument networks, arrays and observatories, as well as data and analytical infrastructures. To accomplish our large-scale tasks, we have established MESI, the worldwide unique Modular Earth Science Infrastructure.

Our research is organized in a matrix structure, with disciplinary competences grouped in five scientific departments. The departments guarantee the development and continuity of disciplinary skills, methods, and infrastructures. This is an indispensable foundation for our ability to engage with evolving scientific insights, new technologies, and unexpected, pressing challenges of societal relevance.

Complementary to this, we at the GFZ are working on five topics in the joint programme of the seven Helmholtz Centres in the Research Field "Earth and Environment". Within the framework of this programme, "Changing Earth – Sustaining our Future", we will be researching the natural foundations of life –extending from the Earth's surface and the oceans to the remotest polar regions and from the deep interior of planet Earth to the atmosphere – in a systemic approach from the years 2021 to 2027.

The training course on "Seismology and Seismic Hazard Assessment" is part of the activities of the Geophysics Department. Disaster related topics of the Department are research on earthquakes and volcanic eruptions, multidisciplinary task force missions to be dispatched into areas which are struck by devastating, geological events with the aim to collect first-hand data about damages, vulnerability, aftershocks or other post events activity, local underground effects, seismo-tectonic conditions.

The GFZ is situated on the Telegrafenberg (Telegraph Hill) in Potsdam, where world famous scientific institutes for astrophysics, geodesy, geomagnetism and meteorology were founded already between 1876 and 1892. Seismology has a long tradition in Potsdam, too. On 17 April 1889, E. von Rebeur-Paschwitz, with a tilt-meter installed at the Telegrafenberg, obtained the world's first record of a teleseismic event, an earthquake near Japan. In 1902 the Potsdam seismic station began to operate and in 1906 the famous San Francisco earthquake was recorded there with a Wiechert seismograph. In 1969, the Geodetic and the Geomagnetic Institutes in Potsdam were united with the Geodynamic Institute in Jena and the Tectonic Institute in Berlin to form the Central Institute for Physics of the Earth (ZIPE) of the Academy of Sciences of the German Democratic Republic.

This institute initiated in 1979 the international UNESCO-sponsored training course on "Seismology and Seismic Hazard Assessment". After the unification of Germany, ZIPE was dissolved in December 1991. Part of its former facilities are now incorporated in the GFZ under a new scientific concept with a wider scope of national and international research activities and international co-operation.

More information is available from the GFZ homepage http://www.gfz.de/.

3.5 Institut et Observatoire de Géophysique d'Antananarivo (IOGA)

Through its scientific achievements and the rigorous standards passed down through generations, the IOGA has consistently played a leading role in geoscience research in Madagascar. Our focus is on preventing the devastating and harmful effects of natural hazards on the lives, health, and environment of the population.

Built in November 1889, on the hill of Ambohidempona, near the University of Antananarivo in Ambohitsaina, the Observatory was the first scientific research center in Madagascar. It is currently known as the IOGA following Rectoral Decree No. 99/143-RECT/PERS of October 1, 1999, which renamed and restructured the Observatory Service. The IOGA is dedicated to teaching (Masters and PhD levels) and conducting research in Earth Sciences. It also undertakes national and international observatory responsibilities, including observations in seismology, terrestrial magnetism, meteorology, and astronomy.

Between 1889 and 1967, the Observatory, established in 1889, was directed by French Jesuit priests, including Reverends Édouard Colin (1889-1923), Charles Poisson (1924-1965), and Louis de Laitre (1965-1967). Their primary focus was on meteorology, astronomy, geodesy, and magnetic fields. Additionally, they provided timekeeping services and named the center "Observatoire Royal de Madagascar.". Additionally, they provided timekeeping services and named the center "Observatoire Royal de Madagascar." On January 1, 1967, the Jesuits sold the Observatory to the Malagasy government for a symbolic price of 1 franc. Since then, the Observatory has been part of the University of Madagascar's Faculty of Sciences, the only existing university by then.

In 1969, the Faculty of Sciences was restructured, and the Observatory became part of the Physics department. From 1973 to 1988, it was led by Prof. Rakotondrainibe, the first Malagasy seismologist, who implemented significant modernization and renovation efforts at the Observatory. In 1994, the Observatory was renamed the Institut et Observatoire de Géophysique d'Antananarivo (IOGA), although the official paperwork reflecting this change was not signed until October 1, 1999. Since 2003, IOGA has operated under the University of Antananarivo and is directly linked administratively to the university's rectorate.

In addition to its national observatory tasks, IOGA supports global efforts to promote a nuclear-weapon-free world using geophysical techniques. On September 16, 2005, Madagascar deposited its instrument of ratification of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) with the United Nations Secretary-General. This allowed Madagascar to host two International Monitoring System (IMS) facilities: an auxiliary seismic station and an infrasound station. In 2019, Madagascar signed a tsunami warning agreement with the CTBTO. Since then, IOGA has become the 16th country to obtain tsunami warning agreements with the CTBTO and receives continuous data from the CTBTO's International Monitoring System (IMS) stations.

The IOGA is composed of five research laboratories.

The Laboratory of Geophysics of the Environment and Remote Sensing conducts research on various applications of spatial imagery and geographic information, focusing on areas such as the environment, regional planning, public health, and medical imaging.

The Laboratory of Applied Geophysics is dedicated to the studying the subsurface structure of the Earth and evaluating underground resources. Key areas of focus include: Groundwater exploration, Mining prospecting, and Geotechnical study

The Laboratory of Geophysical Instrumentation and Maintenance is responsible for the maintenance and troubleshooting of equipment at the seismic, infrasound, and magnetism stations. It also designs and produces geophysical equipment, including hardware and software, using microcontrollers such as Raspberry Pi, ChipKit, PIC, and Arduino.

The Laboratory of Geomagnetism and Electromagnetism aims to study the Earth's magnetic field and develop research related to this topic and its associated physical phenomena.

Laboratory of Seismology and Infrasound focuses on continuously improving earthquake monitoring in Madagascar, establishing local seismicity maps and crustal structures to enhance understanding of the underlying physical phenomena and studying local earthquakes and their associated hazards. Since 2001, this laboratory has also expanded its research to include the study of infrasonic waves from both natural and artificial sources.

More information is available from the IOGA homepage http://ioga.univ-antananarivo.mg/