Ghana's experience in the establishment of a national data center*

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Abstract The government of Ghana in a bilateral agreement with the Preparatory Commission for the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO) has established a National Data Center in Ghana with the aim of monitoring the testing of nuclear explosions. Seismic, hydroacoustic, radionuclide and infrasound methods are used for the monitoring. The data center was commissioned on 3 February, 2010 at the Ghana Atomic Energy Commission. At present Ghana does not have any operational, centralised data (seismic, hydroacoustic, radionuclide and infrasound) acquisition system with the capability of accessing data from other international stations. Hence, the need of setting up the National Data Center which would enable us constantly monitor, manage and coordinate both natural and man-made seismic activities in the country and around the globe, upload data to the International Data Center (IDC) as well as receive and use International Monitoring System (IMS) data and IDC products for treaty verification and compliance. Apart from these, the center also accesses and analyzes seismic waveforms relevant to its needs from the International Data Center; makes data available to its stakeholder institutions for earthquake disaster mitigation; reports on all aspects of disasters related to earthquake to the relevant government agencies that deal with disasters; makes recommendations to the government of Ghana on earthquake safety measures; provides information to assist government institutions to develop appropriate land and building policies. The center in collaboration with stakeholder agencies periodically organises public lectures on earthquake disaster risk mitigation.

Key words: Ghana; seismicity; treaty; nuclear explosion

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1 Introduction

At present Ghana does not have any operational, centralised data acquisition system with the capability of accessing seismic, hydroacoustic, radionuclide and infrasound data from other international stations. In February, 2010, a national data center was established to serve that purpose. The center was set up with the support of the Comprehensive Nuclear Test-Ban Treaty

Organisation (CTBTO) based in Austria (Figure 1).

The main objective of establishing the center is to monitor nuclear test explosions for global peace. Specific goals include non-proliferation of nuclear weapons, disarmament on the use of nuclear weapons and the peaceful use of nuclear technology. The CTBTO acknowledges the importance of reducing and ultimately eliminating nuclear weapon test worldwide in all environments (Masood, 2010; Calmy-Key, 2011; Musood, 2010; Fihri, 2009). The CTBTO has therefore established data centers around the globe to monitor and manage its data to control nuclear weapon test explosion.

The establishment of the data center is timely and strategic as it gives us the capability to access seismic

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Figure 1 Staff installing UPS and mainframe server at the National Data Center.

data from our neighbouring countries and other international organizations. The National Data Center (NDC) would complement the efforts of the Geological Survey Department of Ghana in monitoring seismic activities in the country with the data it receives from the International Data Center (IDC) (Opoku, 2010).

Earthquake monitoring in Ghana began in 1914 when the colonial government installed a Milnes single-boom seismograph in the country. It operated until 1933 when it ceased recording due to financial constraints. Instrumental recording of earthquakes began again in March, 1973. A seismograph observatory equipped with a Worldwide Standard Seismograph Network (WWSSN) system was established at Kukurantumi in the eastern region of Ghana (Amponsah, 2004). In 1979 and 1980 two vertical short period seismometers were installed at Ho in the Volta region and Saltpond in the central region of Ghana.

At present, there is a nine-station radio telemetric network with a central recording station at the Head Office of the Geological Survey Department in Accra, the capital city. It is an analog recording system. Heat pens (Hot-stylus) are used for the recording. The seismometers are located at Ho (HOGH), Winneba (WIGH), Shai Hills (SHGH), Weija (WEGH), Kukurantumi (KUK), Legon (LEGH), Tema (TEGH), Akosombo (AKGH) and Koforidua (KOGH) all in southern Ghana. All the seismometers are the S-13 model. Two Africa Array seismic stations were installed at Kukurantunmi and Shai Hills in July, 2009. The seismic network available in the country at the moment is not operational. Plans are far advanced to install a digital seismic network in the country (Opoku, 2010).

Earthquake-related damage to human life and

property is an important socio-economic issue which needs to be addressed at all cost by all nations, be it developed or developing as these disasters occur without limiting itself to any geographical boundary. We need a concerted effort to effectively mitigate earthquake disaster risk and other disasters globally.

Many lives have been lost and properties worth millions of dollars have been destroyed when earthquakes occurred in countries such as Japan (2011, 1995), New Zealand (2011, 2010), Haiti (2010), Italy (2009), China (2008), Indonesia (2004, 2005), Iran (2003, 1990), Los-Angeles (1994), Armenia (1988), Algeria (1980) and Ghana (1939) just to mention a few.

These events occur unexpectedly and are so sudden and the magnitude quite big that many lives and properties are lost as a result of their occurrence.

Although Ghana is far from the major earthquake zones of the world available records show that damaging earthquakes have occurred in the past with magnitude ranging from 1.0–6.5 on the Richter scale (Amponsah, 2002, 2004; Akoto and Anum, 1992; Ambraseys and Adams, 1986; Quaah, 1982; Junner, 1941).

Major events occurred in 1615, 1636, 1862, 1906 and 1939 (Junner, 1941, Quaah, 1982, Ambraseys and Adams, 1986).

Fifteen years ago the country experienced a series of Earth tremors, magnitude ranging from 3.8 to 4.8 on the Richter magnitude scale. Seismic events presently in the country are accessed from the international monitoring system stations including Dimbokro (DBIC) station in Cote d'Ivoire. The data received from the International Data Center is playing a major role in the seismic hazard assessment of the country.

2 The verification technology of the Comprehensive Nuclear Test Ban Treaty Organisation

The CTBTO is an international organization established to monitor the planet for signs of nuclear explosions. The verification consists of three hundreds and twenty one facilities using four different technologies (seismic, infrasound, hydroacoustic and radionuclide) to monitor the globe for nuclear explosions and is supported by a network of sixteen radionuclide laboratories. The network registers shock waves emanating from nuclear explosions underground, in the sea and in the air and detects radioactive debris released into the atmosphere.

The National Data Center is the national technical organisation capable of advising her government on the verification of the Comprehensive Nuclear Test-Ban Treaty. The center has technical expertise in the monitoring and verification technologies of the CTBTO.

As part of its mandate, the center accesses and receives seismic, hydroacoustic, infrasound and radionu-

clide data from the international monitoring system and products from the International Data Center for monitoring nuclear test explosions. The data and products are used for monitoring the test of nuclear explosions, treaty verification and compliance, natural disaster management and many other civil and scientific applications.

Apart from these, we gather information about possible nuclear tests and earthquakes, analyze seismic waveforms requested from the International Data Center, produce bulletins on earthquakes, prepare monthly and quarterly reports on seismic events that occurred locally and in other parts of Africa, make data available to our stakeholder agencies for earthquake disaster risk mitigation, provide information on potential earthquake hazards to assist appropriate government agencies to develop land and building policies for the nation as well as embark on public awareness education on earthquake safety measures. Our facility is made available to students from the first and second cycle and tertiary institutions and guests who visit the Ghana Atomic Energy Commission where the data center is located (Figure 2).

Figure 2 Students pay visit to the National Data Center.

The center in collaboration with its stakeholder agencies periodically organises public lectures on earthquake disaster mitigation. An example of such a public lecture was one organised in collaboration with the National Forum for Harnessing Research, Science and Technology in Accra on 3 March, 2010 which attracted the general public including teachers and students of the second cycle institutions and the media. Other activities carried out at the center include organization of semi-

nars, workshops and training programmes for staff and our stakeholders from the University of Ghana, Ghana Meteorological Agency and the Geological Survey Department (Figures 3 and 4).

Besides, we endeavour to establish strategic partnership with the relevant local, national and international bodies to enhance growth and development in the global monitoring system.

Figure 3 NDC resource person making contribution at the KNUST-GhIE-ICE workshop (Ampadu, 2010).

Figure 4 Training session with an expert from the International Data Center.

3 Benefits of CTBTO to Ghana

All member states have access to certified data as well as transfer of technology in terms of state-of-the-art science and technology and global communication system. Our research institutes such as the universities have data for research in areas like earthquake disaster risk management, study of the structure of the Earth and teaching materials. The National Disaster Management Organization (NADMO) can as well use the data for disaster risk mitigation. There are also training opportunities for man-power development and software for analyzing data.

Other benefits also include disaster mitigation in the following areas:

1) Seismic data can be used in monitoring earthquake activities in the country and seismic hazard stud-

ies, for instance seismic hazard assessment and zoning of areas which are vulnerable to earthquakes. Structural and civil engineers can use the seismic parameters in their design of seismic resistant structures/buildings. Presently the data is being used to compile earthquake catalogue for Ghana and its neighbouring countries.

2) Hydroacoustic data can be used to study ocean processes, for instance study on population of fishes, whales etc. The Fisheries Department can use the data to study the behaviour of fishes. The navy as well can make use of the data. It can also be used for tsunami warning by providing timely information

3) Infrasound data can be used for studying disastrous chemical explosion near the Earth's surface and in the study of volcanic eruptions.

4) Radionuclide data can be used in mapping dispersion of radioactive materials from accidental nuclear

release as well as study of radiation levels.

4 Conclusions

Ghana is pleased to be part of this very important global agenda, monitoring the testing of nuclear explosions to ensure global security and peace. The data center will help the country contribute to the global effort in monitoring the testing of nuclear weapons around the world for disaster risk mitigation. The universities can make use of the data for their research work and as teaching material. The data can as well be used to assess the seismic hazard of the country. The Ghana National Data Center though very young is making a lot of progress in the area of public education on earthquake disaster mitigation. It does this in collaboration with its stakeholder agencies such as the universities and the National Disaster Management Organization.

References

- Akoto M A and Anum S A (1992). Monitoring recent microseismic activity in Ghana. *Tectonophysics* **209**(1-4): 43–46.
- Ambraseys N N and Adams R D (1986). Seismicity of West Africa. *Annales Geophysicae* **6**(4B): 679–702.
- Ampadu S I K (2010). Report from a Member Society: The Ghana Geotechnical Society. *International Society for Soil Mechanics and Geotechnical Engineering Bulletin* **4**(4): 10–11.
- Amponsah P E (2002). Seismic activity in relation to fault systems in southern Ghana. *Journal of African Earth Sciences* **35**: 227–234.
- Amponsah P E (2004). Seismic activity in Ghana: Past, present and future. *Annals of Geophysics* **47**(2/3): 239–543.
- Calmy-Rey M (2011). Moving forward on nuclear non-proliferation and disarmament. CTBTO spectrum. CTBTO Magazine Issue 16, pp 5–7.
- Masood T (2010). Moving towards a nuclear-weapon-free world. CTBTO spectrum. CTBTO Magazine Issue 15, pp 7–10.
- Fihri T F (2009). The CTBT: Its crucial and overdue entry into force. CTBTO spectrum. CTBTO Magazine Issue 13, pp 12–13.
- Junner N R (1941). The Accra earthquake of 22nd June, 1939. *Bulletin of Gold Coast Geological Survey* **13**: 3–41.
- Opoku N (2010). The recently acquired broad band and strong motion sensors in Ghana and the access to CTBTOs data and products: The way forward for the update of Ghanas national seismic hazard assessment for a sustainable infrastructure development. Book of Abstracts Comprehensive Nuclear C Test-Ban Treaty: Science and Technology 2011, pp118–119.
- Quaah A O (1982). A study of past major earthquakes in Southern Ghana using Intensity data. *Tectonophysics* **88**: 175–188.
- Pearce R G, Becker A, Coyne J, Gaya-Pique L, Given J, Grenard P, Mialle P, Nikkinen M, Prah M and Prior M (2009). Possible Projects for the CTBTO arising from the 2009 International Scientific Studies Conference. The Provisional Technical Secretariat of the Preparatory Commission for the Comprehensive Nuclear -Test-Ban Treaty Organization(CTBTO), Vienna, Austria, pp 7–9.