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Experience, reviews, discussions

Potential Benefits of the Comprehensive Nuclear-Test-Ban Treaty Organization to Ghana

Paulina Amponsah[1,2] and Shiloh Osae[1]
[1]*National Nuclear Research Institute, Ghana Atomic Energy Commission*
[2]*Graduate School of Nuclear and Allied Sciences, Ghana Atomic Energy Commission*

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The National Data Centers established around the globe with the support of the Comprehensive Nuclear Test Ban Treaty Organization are used to monitor and manage its data, to control and ultimately eliminate nuclear weapon test explosions. The National Data Center in Ghana was established in February, 2010 at the Ghana Atomic Energy Commission. The Center is mandated to collate seismic, radionuclide, infrasound and hydroacoustic data for monitoring nuclear test explosions for global peace. The data are obtained from our neighboring country Cote d'Ivoire and the International Data Center in Austria. The objectives of the Data Center include the following: receive and use data from the International Monitoring System (IMS) stations and products derived from the IMS from the International Data Center for verification and compliance of the Comprehensive Nuclear Test Ban Treaty and for earthquake hazard studies. From 2010 to date local seismic events from the Center are catalogued for earthquake hazard studies in the country. The data are also made available to our stakeholders for earthquake disaster risk reduction. The benefits of the National Data Center to Ghana are numerous. Apart from the data for seismic hazard studies, it can also provide data for research in fisheries, for the study of the crustal structure among others.

Keywords*: Ghana, National Data Center, achievements, Comprehensive Nuclear Test-Ban Treaty Organization, nuclear explosions*

1. Introduction

In 2009 the government of Ghana initiated a bilateral discussion with the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) in Austria and requested for the supply of equipment which could be used to access the International Monitoring System data and International Data Center (IDC) products to monitor compliance of the Comprehensive Nuclear Test-Ban Treaty (CTBT) and earthquake activity in the country. After some correspondence and deliberations with the then Ministry of Environment Science and Technology (MEST), the Ghana Atomic Energy Commission (GAEC) and the CTBTO, the dream came true. The data center was eventually given birth to on February

3, 2010 at the Ghana Atomic Energy Commission. The Center then started its operation immediately with a three (3) member staff, namely, a Manager, a scientific officer and an Information Technology officer. Today we can boast of eight (8) members of staff. National Service persons and students on industrial attachment programs are occasionally posted to the center for training.

The CTBTO is an international organization established to monitor the planet for signs of nuclear explosions. The organization is a main tool indeed to stop the testing of nuclear weapons worldwide (Calmy-Rey, 2011; Masood, 2010; Fihri, 2009). It was adopted by the United Nations General Assembly on September 10, 1996.The verification of the CTBTO consists of three hundred and thirty seven (337) facilities using four different technologies, namely, seismic, infrasound, hydroacoustic, and radionuclide for the monitoring.

The data collected by these facilities and the products derived from them by the IDC are transmitted to the National Data Center (NDC) of member states in near-real time. The NDCs analyze the data they have received and draw their own conclusions regarding the nature of the events that have been detected (Zerbo, 2013). The data are not only used in monitoring the compliance of the CTBT by member states, but they are also used for natural disaster mitigation studies (Zerbo, 2013; Madi 2013; Terzi,2013), as well as for nuclear emergency preparedness, as in the Fukushima nuclear power plant accident. The International Monitoring System stations measured and indicated the transport of the released radionuclide to the affected state in the shortest possible time(Bieringer et al., 2013).

Ghana has not been left out in this verification regime. The National Data Center of the country (Figure 1) is the national technical organization capable of advising the government on the verification of the Comprehensive Nuclear Test-Ban Treaty (CTBT). The Center has technical expertise in the monitoring and verification technologies of the CTBT. It is mandated to collate seismic, radionuclide, infrasound, and hydroacoustic data for monitoring nuclear test explosions for global peace. As part of its mandate the center accesses and receives both the seismic data from the International Monitoring System (IMS) station in Cote d'Ivoire and the products derived from the IMS stations from the International Data Center (IDC) for monitoring seismic activity of the country. Local seismic events are compiled and catalogued for earthquake hazard studies in the country since its establishment (2010 to date). The data are also made available to our stakeholder agencies for earthquake disaster risk mitigation. This would complement the seismic monitoring effort of the Geological Survey Department of Ghana (Opoku, 2013). Apart from this, we gather information about possible nuclear test explosions which is a primary goal of the CTBTO. The data are also used for other scientific researches such as in the study of the environment and disaster management. We also analyze seismic waveforms requested from the International Data Center and prepare monthly reports on seismic events that occurred either locally or in other parts of Africa. Periodically, we organize training programs (Figure 2) for stakeholders on the relevance of the CTBT, its civil and scientific applications as well as the use of the geotool analysis software.

Fig. 1. Installation of mainframe server at the National Data Center

Fig. 2. Staff in a meeting with students on attachment at the National Data Center

2. Activities at the National Data Center (NDC)

Although the data received from the IMS stations and products derived from the IDC are used for monitoring nuclear explosions and treaty verification, we also employ the seismic data to compile an earthquake catalogue for Ghana (Table 1). Eighteen (18) earthquakes of magnitudes ranging from 1.7 to 4.4 have been recorded from August, 2010 to July, 2013.

The NDC monitors, manages and coordinates both natural and man-made seismic activities within the country and around the globe using the data from the IDC. The Center accesses and analyzes seismic waveforms received from the International Data Center. We also make data available to our stakeholder institutions for earthquake disaster mitigation as well as make recommendations to the government on earthquake safety measures and other related natural disasters. We provide information to assist appropriate government agencies to develop land and building policies for the nation.

The Center renders services to its stakeholder institutions such as the National Disaster Management Organization, the Meteorological Agency and Universities. It also carries out research and development activities related to seismic hazard studies.

In collaboration with our stakeholder agencies the Center periodically organizes public lectures on earthquake disaster mitigation. An example is a lecture organized in collaboration with the National Forum for Harnessing Research, Science and Technology at the Teachers Hall in Accra on March 3, 2010 which attracted the general public and the media (Amponsah and Serfo-Armah, 2013). The audience included teachers, students and the media. These public educational lectures, aimed at sensitizing the people of Ghana, are periodically organized to educate the citizenry on what to do in the event of an earthquake or earth tremor, as well as what to do before and after the event. Specific safety measures in the design and construction of buildings are also emphasized at these events . This is done to correct an entrenched misconception about earthquakes among the people.

We also educate students from junior, senior high schools, the universities, other tertiary institutions and organized bodies, who visit the commission, on the benefits of the CTBT to the nation, and on earthquake safety measures.

The Ghana Institution of Engineers periodically organizes seminars and workshops for engineers, architects and other stakeholders to deliberate on earthquake safety measures, such as earthquake resistant designs of buildings in the country. Resource persons from the Center are invited to give talks during these programs. Apart from this, resource persons from the Center are also invited to similar programs organized by the African Urban Research Analyses Network at the University of Ghana.

Table 1. Catalogue of earthquakes in Ghana, August, 2010 – July, 2013

Date	Origin Time			Location		Magnitude		Town/Region
	Hr	Min	Sec	Latitude	Longitude	M_b	M_L	
30-09-2010	05	53	31.45	7.33	-2.11	-	1.9	Nkinkanso,Brong Ahafo
26-11-2010	21	01	06.94	5.28	-2.37	3.8	-	Kwesikrom,Western
28-01-2011	08	19	30.55	6.65	-2.15	2.2	-	Akantanso,Ashanti
31-01-2011	15	33	07.21	4.91	-1.62	3.8	2.2	Anoe,Western
28-02-2011	18	39	14.13	5.92	-1.76	4.1	-	Buabenso,Central
29-03-2011	16	56	08.87	8.64	-2.30	4.3	1.7	Tinga,Northern
02-04-2011	06	46	19.72	6.97	-2.48	4.2	-	Mim,Brong Ahafo

Date	Origin Time			Location		Magnitude		Town/Region
	Hr	Min	Sec	Latitude	Longitude	M_b	M_L	
03-04-2011	14	29	32.08	9.95	0.03	4.2	-	Nagale,Northern
03-04-2011	22	44	43.95	6.51	0.67	3.8	2.3	Agotime,Volta
23-06-2011	13	09	10.53	7.49	-2.23	2.4	-	Sunyani,Brong Ahafo
03-07-2011	03	53	33.64	5.60	-2.78	4.4	-	Omanpe,Ghana/Cote d'Ivoire border
06-08-2011	12	41	55.52	5.39	-1.85	3.9	-	KwakuAdzeikrom,Western
11-10-2011	21	51	48.76	6.19	-2.33	3.9	-	Sefwi Bekwai,Western
14-11-2011	06	13	15.63	6.68	-2.30	4.4	-	Asuako,Ashanti
22-08-2012	08	09	32.32	10.56	-1.90	-	2.0	Bechembeli,Upper West
26-09-2012	19	25	45.78	6.29	-0.54	4.2	2.3	Kwabeng,Eastern
13-10-2012	03	08	08.48	6.26	-2.22	-	2.7	Awaso,Western
28-03-2013	08	50	57.55	9.07	-1.45	1.9	-	Busunu,Northern

Where: M_b *– body wave magnitude;*
M_L *– local magnitude.*

3. Achievements and benefits of the National Data Center

The staff of the Center has been active participants and beneficiaries of training courses, workshops and meetings organized by the CTBTO. The Center has also hosted some training courses.

3.1 Achievements

The Center hosted the following activities:

- Regional Training Course on National Data Center Capacity Building: Access and Analysis of IMS Waveform Data and IDC Products held at the School of Nuclear and Allied Sciences Conference Room, Ghana Atomic Energy Commission, from November 21 – December 2, 2011.
- Capacity Building Advance Training Course which was held at the Nuclear Chemistry and Environmental Research Center conference room, Ghana Atomic Energy Commission from July 26 – 31, 2010.

The Center participated in the following activities:

- Comprehensive Nuclear -Test-ban Treaty: Science and Technology 2013, Vienna, Austria.
- Fortieth session of the working group B meeting held in Vienna, Austria, from March 17 to April 5, 2013.
- Online Intensive Policy Course, Multilateral Verification, Collective Security: "Contribution of the CTBT" held in Vienna, Austria by Capacity Development Initiative (CDI) of the CTBTO in 2013.
- National Data Center capacity building: Access and Analysis of IMS waveform Data and IDC products, and improvement in Regional seismic travel times (RSTT) through ground truth events May 7-22, 2012.
- Online Advance Science Course titled "Around the Globe and Around the Clock: The Science and Technology of the CTBT" organized by the CDI / CTBTO from November 12 - 23, 2012 Vienna, Austria.
- Online conference organized by Technology Foresight – CTBTO which aims to identify and map technology developments relevant to the organization's ongoing and future verification approaches from October 16 - 18, 2012.
- 2011 National Data Centers (NDC) Evaluation Workshop, Bucharest – Romania, October 3 – 7, 2011.
- Infrasound Technology Workshop 2011 (ITW 2011), Dead Sea – Jordan, October 30 – November 4, 2011.
- National Data Center (NDC) Workshop on the operation of newly established NDCs under the Capacity Building Project in Africa, from November 8 – 10, 2011, Vienna, Austria.
- Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) workshop for African States, held in Rabat, Morocco. October 28- 29, 2010.
- 18th On-site Inspection Introductory Course, in Vienna, Austria, April 13-16, 2010.
- Advanced Training/Capacity Building Course for National Data Center Technical Staff in Northern and Western Africa, Rabat, Morocco November 2-13, 2009.

3.2 Benefits

- Ghana as a member state has access to the certified data from the IDC, as well as the state-of-the-art science and technology and global communication system.
- Our research institutions can use the IMS data for research in earthquake disaster management; can study the earth's structure and use it as a teaching material. The School of Nuclear and Allied Sciences and the Department of Earth

Science both in the University of Ghana are beneficiaries of this.
- The National Disaster Management Organization (NADMO) can use the data for disaster risk mitigation.
- There are also training opportunities for man-power development and software for analyzing seismic data.
- The earthquake data received from the IDC would complement local seismic monitoring efforts by the Geological Survey Department of Ghana.
- Currently, we are using the data to compile a catalogue of earthquakes in Ghana and some parts of Africa with the ultimate aim of producing a seismic hazard map of Ghana.

4. Challenges

Having a huge success story we are still beset with some inherent challenges in our bid to achieve our goal. Continuous power and the Internet accessibility is a major problem. This is not an isolated case but a major challenge for most NDCs in Africa, e.g. in Zimbabwe (Marimira, 2013). In fact, without continuous power and the Internet access it is impossible to access the data from the IDC.

5. Conclusions

The National Data Center is immensely contributing towards the global efforts of monitoring the compliance of the CTBT for a safer and nuclear test free world. An earthquake catalogue from August, 2010 to date is being compiled for Ghana and its neighboring countries. The earthquake catalogue compiled at the Center can help us identify the areas in the country which are at high risk of seismic activities. The data can provide baseline information to assist researchers in their study of disaster management. The complete set of data can be helpful in assessment of the seismic hazard of the country. The universities can make use of the data for their research work and as a teaching material. The data Center in Ghana is contributing to the global efforts in monitoring the testing of nuclear weapons around the globe for world peace.

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Dr. Paulina Amponsah – Manager, National Data Centre/Senior Research Scientist. National Nuclear Research Institute, Ghana Atomic Energy Commission. Seismology, Seismic hazard assessment and earthquake microzonation for urban planning

Address: P.O.Box LG 80, Legon-Accra, Ghana
Tel.: +233208186666
Fax: +233302400807
E-mail: *pekua2@yahoo.com*

Prof. Shiloh Osae – Director of National Nuclear Research Institute. National Nuclear Research Institute, Ghana Atomic Energy Commission

Address: P.O.Box LG 80, Legon-Accra, Ghana
Tel.: +233243472164
E-mail: *dedehosae@fastmail.fm*

Patirtis, apžvalgos, diskusijos

Visuotinės branduolinių bandymų draudimo sutarties organizacijos teikiami pranašumai Ganos valstybei

Paulina Amponsah[1,2] ir Shiloh Osae[1]
[1]*Valstybinis branduolinės energetikos tyrimų institutas, Ganos atominės energijos komisija*
[2]*Aukštoji branduolinės energetikos ir gimininingų mokslų mokykla, Ganos atominės energijos komisija*

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Nacionaliniai duomenų centrų, įsteigtų visame pasaulyje ir remiamų Visuotinio branduolinių bandymų draudimo sutarties organizacijos, tikslas – stebėti ir valdyti duomenis, kontroliuoti ir galiausiai pašalinti branduolinių ginklų bandymų keliamus sprogimus. 2010 m. vasario mėn. Ganos atominės energijos komisija įsteigė nacionalinį duomenų centrą Ganoje. Centro tikslas – rinkti ir sisteminti seisminius, radionuklidų, infragarso ir hidroakustikos duomenis branduolinių bandymų sprogimų stebėsenai atlikti. Duomenys tyrimui atlikti yra gauti iš kaimyninės šalies – Dramblio Kaulo Kranto ir Tarptautinio duomenų centro Austrijoje. Šio duomenų centro tikslai yra šie: gauti ir naudoti duomenis iš Tarptautinių monitoringo sistemų (TMS) stočių, taip pat gauti ir naudoti patikrintus ir atitiktį gavusius pagal Visuotinio branduolinių bandymų draudimo sutartį produktus, įgytus iš TMS, Tarptautinio duomenų centro, taip pat naudoti duomenis žemės drebėjimo rizikos tyrimams atlikti. Nuo 2010 m. iki pat šių dienų vietiniai seisminiai įvykiai yra fiksuojami Centre tam, kad būtų galima atlikti šalyje įvykstančių žemės drebėjimų rizikos studijas. Šie duomenys taip pat yra prieinami ir kitoms suinteresuotosioms šalims tam, kad būtų galima sumažinti žemės drebėjimų keliamos riziką. Nacionalinis duomenų centras Ganoje teikia ypač didelę naudą. Be seisminio pavojingumo tyrimų duomenų, jo teikiami duomenys taip pat gali būti naudingi moksliniams tyrimams žuvininkystės srityje, taip pat žemės plutos struktūros tyrimams atlikti.