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African Centres for Lightning and Electromagnetics Network (ACLENet)

Progress Report

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***Abstract*—ACLENet (https://ACLENet.org) is a pan-African network of centres dedicated to decreasing deaths, injuries and property damage from lightning.**

Lightning is more common in tropical and subtropical climates and 90% of sub-Saharan buildings are not 'lightning safe', leaving families at risk 24/7. Lightning damage to infrastructure such as utilities, aviation, mining, banking and small businesses hampers development of already economically challenged African countries.

ACLENet works at all levels of education to promote lightning safety and injury prevention, improved forecasting, and adoption of internationally recognized lightning protection codes (IEC62305-1,2,3,4) by governments. ACLENet actively promotes improved undergraduate, graduate and ongoing professional training of engineers with respect to lightning impacts, working in partnership with national universities, professional organizations and standards setting groups, as well as writing grants for training, research, and disaster management.

ACLENet welcomes volunteers, advisors, partners, and donors who want to be part of decreasing deaths, injuries, property damage from lightning (https://ACLENet.org/how-to-help/overview.html).

Keywords-Lightning injury, lightning injury prevention, lightning risk assessment, electromagnetic compatibility, lightning protection, property damage from lightning, education, lightning in Africa

I. INTRODUCTION

Most ILDC/ILMC attendees are from developed countries and have little familiarity with how life is lived in developing countries or the risk of lightning injury there. Lightning density is higher in tropical and subtropical climates [Holle et al., 2018]. About 90% of sub-Saharan buildings are not 'lightning safe', leaving families at risk 24/7, regardless of their activities (Fig. 1). Farmers, those walking to market or at church meetings, and school students are among those at risk [Blumenthal, 2005; Dlamini, 2009; Holle, 2016; Holle and Cooper, 2016; Kalindekafe et al., 2018; Mary et al., 2014; Nibigira and Gomes, 2014].

Fig 1. Typical African dwellings and work areas are mudbrick with generations-old thatch roofs or sheet metal held down by rocks. In some areas, chicken wire may be cast over the thatch to prevent monkeys and baboons from disrupting the roof. In others, car tires are on the roof because it is thought that their 'rubber' will protect the building from lightning.

II. THE FOUNDING OF ACLENET

At a 2011 NAM S&T conference in Kathmandu, Richard Tushemereirwe, Senior Science Adviser to the President of Uganda, was appalled to learn the number of his fellow Ugandans who had been killed by lightning during the past few months. He returned to Uganda determined to do something about it. With the help of those he had met in Nepal, he organized another NAM S&T lightning meeting in Uganda in 2013, which resolved that Africa needed a multi-faceted organization to address lightning injuries, deaths and property damage from lightning. The Principal of the Makerere University Business School, who was at the 2013 meeting, pledged to give an academic home to the organization when it

TABLE I. HISTORY OF ACLENET

Year	Event
2011	Kathmandu, Nepal, NAM S&T – Kathmandu Resolution.
2013	Kampala, Uganda, NAM S&T meeting - Resolution to Establish African Center for Lightning Information and Research (name changed to African Centres for Lightning and Electromagnetics). Makerere University offers to host ACLE headquarters.
2014	First Scientific Symposium, Entebbe, Uganda.
2015	First national centre, ACLE-Zambia, formed. ACLE changed to ACLENet as the international parent organization, reserving ACLE-country/region for national or regional organizations. Second ACLENet Scientific Symposium held in Lusaka, Zambia, August 2015.
2015	Award of United Nations Global Resilience Partnership grant for $1,000,000 in partnership with four other organizations to bring Severe Weather Early Warnings to those living around Lake Victoria.
2016	Incorporated in Uganda and in the United States with tax-exempt status granted.

was founded in 2014, the African Centres for Lightning and Electromagnetics Network (Table I).

III. MULTI-FACETED OBJECTIVES

ACLENet is envisioned as a pan-African Network of Centres dedicated to decreasing deaths, injuries, and property damage from lightning. There are hundreds of deaths and thousands of injuries every year from lightning in Africa. Lightning also causes property damage to utilities, aviation, mining, and other business infrastructure that threatens already economically challenged countries (Table II).

IV. PROGRAMS AND ACTIVITIES

A. Gathering Baseline Data - Availability and Sources

To influence change-makers such as governments, funding agencies, and donors to do something about lightning deaths, injuries and property damage requires that they must first be aware of the problem - and that takes data.

Before the development of the internet, lightning injury data in the United States (Storm Data) and other developed countries depended largely on newspaper clipping services, with 20-70%

TABLE II. ACLENET'S MULTI-FACETED GOALS

To assess the impact of lightning on each nation's citizens and economy.
To work with governments to assure that code-compliant lightning protection systems are designed for new schools and other important buildings.
To improve the availability of accurate and timely lightning data, weather forecasting, and warnings.
To educate teachers, parents, pupils and the general public on lightning safety.
To improve engineering training and professional qualifications in lightning protection.
To advise on code-compliant lightning protection of utilities and other economically important industries.
To work with universities to train Africa's own lightning experts for the future.

of injuries and deaths being unreported [Holle et al., 2005; López et al., 1993; Lushine, 1996;]. With the development and constant growth of the internet along with the nearly universal use of mobile communication devices, lightning incidents involving deaths or multiple injuries have become available on-line within hours of their occurrence and it unusual for any to escape media awareness, at least in the United States [Roeder and Jensenius, 2012]. While it is easy to set up daily internet searches to collect these reports, 95% of the citations are about sports teams, commercial products, and other non-casualty uses of the word 'lightning' so that the daily lists must be visually scanned, culled and individually opened to see where they occurred [Holle and Cooper, 2018].

However, in developing countries, news reports may be written days after an incident, often by journalists who have no first-hand knowledge of the incidents. Reports involving multiple casualty incidents, children or curiosities like animal deaths are probably more likely to be reported than a single death and injury. Despite these problems, internet news reports of lightning injury remain one of the best sources of data for developing countries, certainly across Africa where ACLENet works. These reports can be useful in raising awareness with governments, granting agencies, donors and in newsletters (https://aclenet.org/news-publications/country-news/uganda-injuries/).

ACLENet hopes to develop a mobile app so that citizens can report incidents, as well as potentially check forecasts or find other useful information (https://aclenet.org/how-to-help/report-an-incident.html). Reports such as these will allow ACLENet staff to investigate incidents when time, funds, and travel conditions allow (https://aclenet.org/how-to-help/lightning-srike-at-kifumura-primary-school-in-hoima.html).

B. National Centre Development

There is now an active national center in Zambia, where the coordinator, Mrs. Foster Chileshe Lubasi, is a trained electronics engineer with lightning hardening experience. She is working with her leadership team to bring about graduate training in lightning and electromagnetics at the University of Zambia (UnZa) as well as consultations on lightning protection (LP) with key stakeholders.

ACLE-Malawi, at the Malawi University of Science and Technology has committed to organizing and hosting ACLENet's Third Scientific Symposium in October 2018. Research is underway on lightning casualty studies within Malawi [Kalindekafe et al., 2018].

Other countries have expressed interest in forming national centres, including Kenya, South Africa and French West Africa. The differing talents, challenges. resources, opportunities, and priorities in each country add to the depth and diversity of the network.

C. School Protection Program

When lightning hit a school in Zimbabwe on January 25, 2018, two students were killed and 85 others injured. The next day, no students came to school [https://www.herald.co.zw/lightning-kills-2-pupils-injures-85/]. Frightened children, who have seen their friends die, and wary parents often avoid an impacted school for days, weeks, or even permanently abandon it after a lightning incident.

Schools in Africa are usually a collection of five to 20 individual small buildings of two to four classrooms arranged in a row, eating halls, an administration building, and sometimes dormitories. This arrangement adds to the complexity of planning LP and to the cost of materials and installation. Protecting only a few buildings which all students could reach for an evacuation would cut down on cost, but would also put the children at risk during the transfer across open areas between the buildings, frighten them and interrupt their studies for perhaps hours. No one learns well when they are frightened or anxious. ACLENet's goal with LP is to give the children a feeling of safety and relieve them and their parents of worry about this common tragedy by allowing children to stay where they are when a thunderstorm comes into their area (Fig. 2).

Due to the high incidence of deaths and injuries at schools, ACLENet challenged the international lightning community to protect school children at ICLP-2014 in Shanghai [Holle and Cooper, 2016]. The German-based lightning protection company DEHN, along with DEHN-Africa, stepped forward, providing the designs and materials to protect four schools plus giving training programs in LP and material use for installations. LP has been installed at several schools in Uganda where there have been lightning deaths and injuries in the past few years, sometimes more than once in a decade, and more than a dozen schools have been measured for LP design as donors are recruited. In March 2017, LP training was done for engineers and technicians from the Special Forces Command of the Uganda People's Defense Force to assist ACLENet with LP installation.

Fig. 2. Thank-you picture from one of the schools protected by ACLENet and DEHN-Africa.

Because of this work, ACLENet has become recognized as a school LP advocate throughout Uganda. The Ugandan Ministry of Education and Sports (MoES) requested training for their engineers and installers and for consultation on LP designs for 184 new schools that they plan to build this year with funding from the World Bank. Several NGO's have contacted ACLENet for advice and assistance on lightning protection for the schools they support.

D. Focused Public Education

Each time a school is protected, an educational program is given to parents, teachers, school officials and other local leaders. In addition, more general seminars on lightning and injury prevention are planned. On November 27, 2017, 50 parents, teachers, district education officers, farmers and other opinion leaders were invited to a pilot program on lightning at Shone School in Hoima District, Uganda. Lectures included how lightning forms, mechanisms of injury, discussion of some non-threatening myths and Q&A session [report available at https://aclenet.org/programs/education/countering-myths.html]. The questions asked also helped the speakers to learn the greatest concerns of the attendees and give them a chance to respectfully address long held myths.

Other lessons were learned from this pilot program that will be incorporated into a second, larger conference planned for Runyanya School, the site of the 2011 tragedy where 18 children were killed and 38 others hospitalized from one strike (https://aclenet.org/news-publications/country-news/uganda-injuries/uganda-2011.html and http://www.telegraph.co.uk/news/weather/8606238/Lightning-strike-kills-18-children-in-Uganda.html). Not only will local people and officials be invited, but also central Uganda officials from MoES, the Uganda National Council on Science and

Technology (UNCST), Uganda National Meteorological Authority (UNMA), and other appropriate ministries and organizations. In addition to the lightning lectures, a seminar on the basics of lightning protection and a walk-around are planned to point out IEC62305-compliant LP versus the locally available 'lightning arrestor' that had been installed (Fig. 3).

Runyanya School was the first school to have LP installed by ACLENet-DEHN. One of buildings at Runyanya had been abandoned as a 'death trap' as it was the second time in less than a decade that lightning injuries had taken place there. District officials have agreed to give the building to ACLENet to be rehabilitated and established as a science, lightning and severe weather educational center.

Fig. 3. Upper photo: Classroom building at Runyanya School. Lower photo: Closeup showing IEC compliant rod and old multipronged rod commonly found on many Uganda schools that ACLENet staff have visited and measured.

Fig. 4. Rondavel where people died, perhaps from the lightning strike but complicated by the fire caused when the thatch caught fire and fell on them.

E. Research

Because the lightning injury risk is so different in Africa from what most people experience in developed nations, many basic questions are raised that are amenable to research. Since the vast majority of people have NO 'lightning safe' areas when thunderstorms are present for evacuation, ACLENet is searching for what to tell people so that they can take actions to avoid injury. 'When Thunder Roars, Go Indoors,' the well-known lightning safety motto in developed countries, is the wrong advice to give when people live in flammable homes with no metal materials in the walls to channel lightning to ground more safely (Figs. 3 and 4). ACLENet is currently working with its international team of Research Advisers, consultants, and lightning injury prevention specialists to determine what methods can be used to decrease injuries and deaths, based on scientific data.

F. Diversification of Funding Sources

Soon after it was founded, ACLENet, along with four partner organizations, received a large grant from the first round of Global Resilience Partnership grants, a program sponsored by Rockefeller, USAID and CIDA. The partners are currently waiting on GRP's decision on whether the grant will be extended to scale up and move to other countries, which would be a great help in ACLE-National Centre formation.

There is no question that this grant allowed ACLENet to survive and prosper in its early years. Some organizations, however, find that restricted grants can also result in mission drift and more attention to bookkeeping than other goals such as training, research and public education. Just as wise individuals diversify their investments, ACLENet is working to diversify its funding sources to include donors, contracts, collaboration with government agencies on common goals, networking with organizations to address common goals, and other creative sources of funding.

V. Conclusions

There is much to be done in Africa to save lives, prevent property damage from lightning and to help raise the economic and educational level of its citizens. Many across the world have stepped forward to help. ACLENet welcomes volunteers, advisors, partners, and donors who want to be part of decreasing deaths, injuries, property damage from lightning (https://ACLENet.org/how-to-help/overview.html).

Acknowledgment

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