by Sandra Humenik

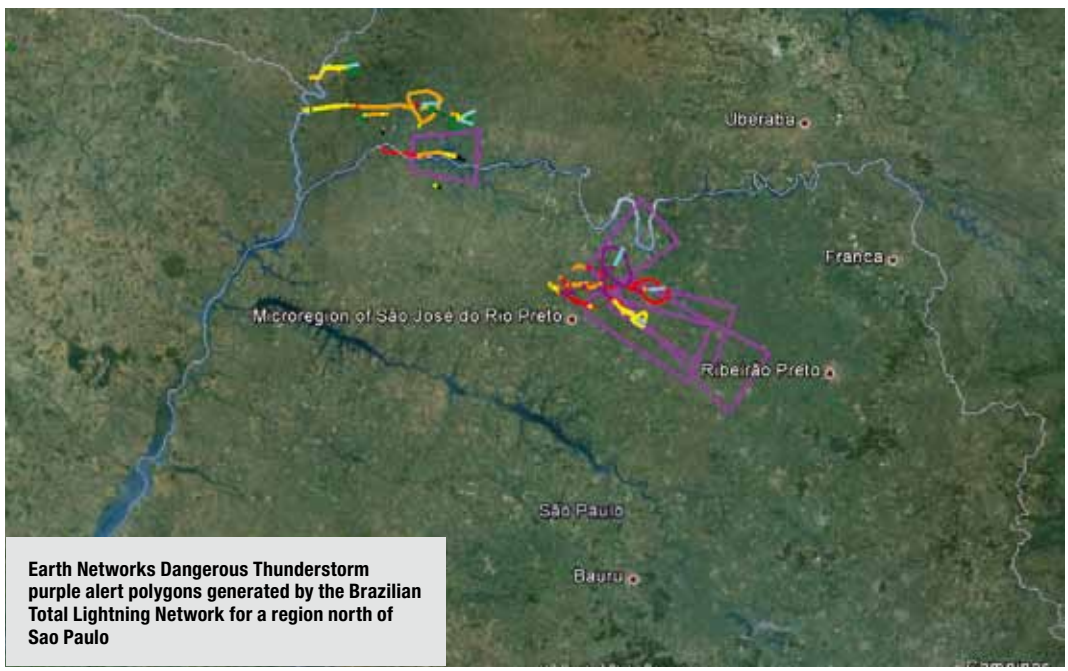
KNOW BEFORE

Early warning system offers forecasting and automated mobile alerts

Advanced technology has provided a breakthrough in severe weather warning and nowcasting capabilities for multi-hazard alert delivery

There is mounting evidence that climate change is causing an increase in the frequency and intensity of severe weather events. Evidence suggests that climate change has led to changes in extremes such as heatwaves, record high temperatures, and, in many regions, heavy precipitation over the past half century. During the period from 1970 to 2008, more than 95% of deaths from natural disasters occurred in developing countries. The need for a flexible and robust weather infrastructure that supports an early warning system (EWS) for multi-hazard events is an unmet challenge for many countries today. In fact, virtually every climate adaptation plan is either focused on, or includes a provision for, an EWS.

An integrated approach to early warning systems will ensure that timely, accurate information is used to generate advanced warnings and to disseminate these warnings with a proven delivery mechanism so that government, industry, and the general public 'know before' multi-hazard events take place.



Earth Networks Dangerous Thunderstorm purple alert polygons generated by the Brazilian Total Lightning Network for a region north of Sao Paulo

Figure 1: The UN/ISDR four key elements of effective early warning systems and Earth Networks' early warning system infrastructure show a cohesive structure alignment

The need to deliver early warnings

An EWS is an effective tool for decision-makers to monitor and respond to multi-hazard events from extreme real-time weather such as severe thunderstorms and flooding, to the longer-term impacts of drought and famine, as well as health emergencies such as an epidemic or even a pandemic outbreak.

Traditionally, an EWS has been interpreted narrowly as a technological instrument for detecting and forecasting impending hazard events and for issuing alerts. However, this interpretation does not clarify whether warning information is received by or helpful to the population

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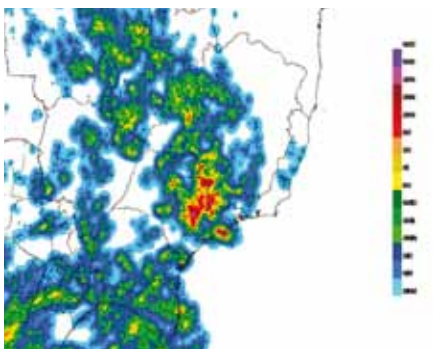

Figure 2: PulseRad image of rainfall accumulation over Brazil November 30, 2011

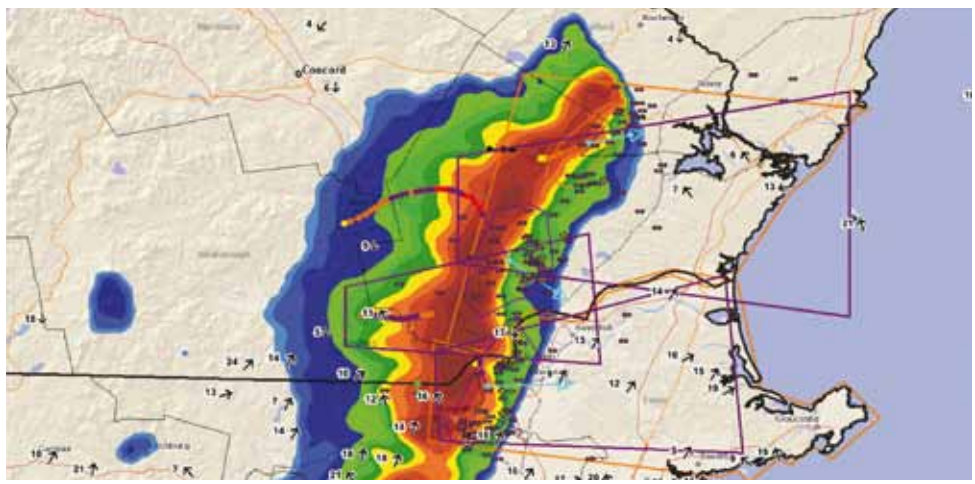

Figure 3: DTA alert, depicted by a purple polygon encompassing the alert area, provides lead times up to 30 minutes before ground-level weather develops

it serves, or is actually used to reduce risks. Many systems fall short based on the information used to generate actual warnings, as well as in the delivery mechanisms used to reach the general public.

Early warning system framework

An effective EWS is critical to disaster risk reduction. The primary objective of a warning system is to empower individuals and communities to respond in a timely manner and appropriately to the hazards in order to reduce risk of death, injury, property loss, and damage. Warnings need to get the message across and motivate those at risk to take action.

A complete and effective EWS comprises four elements spanning the knowledge of risks to preparedness to act on early warning (*UN/ISDR Platform for the Promotion of Early Warning*). These elements include: risk knowledge (data collection/risk assessment phase); monitoring and warning service (hazard monitoring/early warning services); dissemination and communication (risk communication/early warnings); and response capability (national and community response).

Earth Networks' EWS framework cohesively aligns with the UN/ISDR four elements of an effective EWS (Figure 1). Earth Networks operates the largest weather and lightning networks to observe, analyze, inform, and alert more than 40 million users and decision makers around the world with information that is used to 'decide and act'. This information is provided through data feeds, applications, and, more importantly, through alerts delivered via mobile SMS, text, email, desktop applications, social media, and other channels (*www.earthnetworks.com*). The organization has more than 20 years' experience in providing government, industry, and the general public with accurate and reliable real-time weather information, forecasts, and alerts for informed decision making.

Sophisticated radar technology

In the developed world and, increasingly, in countries-in-transition, sophisticated radar technology has been deployed to enable National Meteorological and Hydrological Services (NMHS) to deliver early warnings of severe weather events. Additionally, weather observation equipment is used to generate localized forecast information. Despite these advances, developed countries continue to struggle with inaccurate forecast information for alerting and are unable to disseminate timely warnings and alerts.

For developing countries, radar technology is prohibitive financially, and operationally complex for the NMHSs to maintain. Additionally, weather observation equipment is sparse at best and not connected. This lack of weather infrastructure hampers efforts to execute accurate forecasting and implement an EWS.

However, advances in technology have shown that radar-like capabilities and automated earlier warnings can be provided to NMHS by using more cost-effective and easy-to-maintain weather and total lightning detection solutions. Earth Networks has recently developed a new radar-like alternative that, in conjunction with automated weather sensors and mobile delivery technologies, forms the basis for the Earth Networks' Early Warning System.Recent research indicates a strong correlation between total lightning data (in-cloud and cloud-to-ground) and severe storm

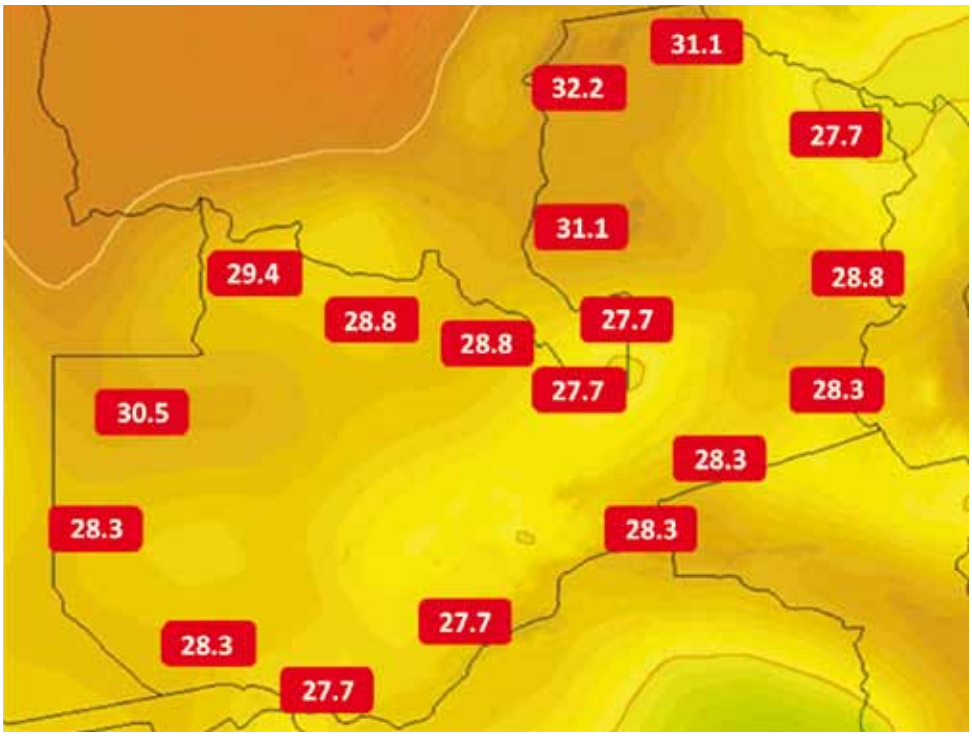

Figure 4: Next-day high-temperature forecast for Zambia

activity. This research has now enabled an accurate and cost-effective proxy radar alternative called PulseRad. PulseRad uses total lightning data from the Earth Networks' Total Lightning Network (ENTLN) and can be used for tracking severe weather events, for short-term tracking of precipitation rates over large areas in real time, and for long-term tracking of accumulated precipitation useful for drought assessment (Figure 2).

The system provides easy-to-interpret radar-like images of severe weather events for improved monitoring and forecasting of events such as thunder and lightning storms, heavy precipitation, flooding, tornadoes, cyclones, and others. PulseRad provides much of the value of a traditional radar system at a fraction of the cost.

Furthermore, the research also shows that in-cloud lightning flash rate increases, or 'jumps', provide an early indicator of severe thunderstorms capable of producing hail, high wind or tornadoes. Earth Networks monitors total lightning data from the ENTLN by tracking developing lightning cells in real time. By monitoring the total lightning flash rates in cells, it is possible to issue dangerous thunderstorm alerts (DTAs) with a lead time of up to 30 minutes before ground-level severe weather develops.

The system generates purple alert polygons (Figure 3), which define areas likely to be affected by severe conditions as the storm builds and intensifies. The cell tracking and DTAs can be used as an automated severe storm tracking tool, which can be used to augment radar, computer model data and observations to issue reliable severe weather warnings.

Accurate weather forecasting

The Earth Networks EWS also includes tailored weather forecasts using the latest available technology for numerical weather prediction. By combining the existing functional observational infrastructure with a denser array of new, robust real-time weather observations in one system (Figure 4), more accurate weather forecasts can be produced for a country or region. Science has shown that using more initialization data in weather models provides more accurate weather forecast output, and results in greater benefit to society. Earth Networks integrates real-time localized weather information from its automated weather stations and other weather stations within a country or region to provide better forecasts in addition to advanced alerts.

Figure 5: Severe weather SMS alert warning of heavy precipitation

Alert delivery

The last critical challenge within an EWS is the dissemination of information to emergency personnel and the community at large. In areas lacking landline communications, the basic mobile telephone is the most effective, and in most cases, the only means of communication. For this reason, mobile communications must be considered as the primary vehicle in the dissemination of early warnings of severe weather (as well as other early warnings). The Earth Networks early warning system enables automated distribution warnings via SMS mobile alerts, mobile applications, and email (Figure 5) in conjunction with the NMHSs. The flexible EWS mobile architecture may also be used for integrated and custom alert management and delivery.

For other areas, the EWS also provides audible alerting via sirens to warn communities of impending severe weather conditions. This dual-purpose alerting system uses a high-decibel siren to warn individuals, both indoors and outdoors, of changing and potentially dangerous severe conditions and to the presence of lightning.

At a time when climate change is threatening the most vulnerable, this EWS is essential in aiding NMHSs to 'Know Before' with accurate forecasts and early warnings of severe weather and other multi-hazard events. The robust EWS components enable NMHSs with proven, cost-effective and easy-to-use technology for monitoring and decision support during severe weather events, coupled with automated alerting for both mobile and audible alert communication delivery. The flexible communications architecture within the Earth Networks EWS also enables integration with other alerting systems for expanded communication reach for improved disaster risk management. ▮

Sandra Humenik is director of international and solutions marketing for Earth Networks Inc, headquartered in Maryland, USA (shumenik@earthnetworks.com; www.earthnetworks.com)

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