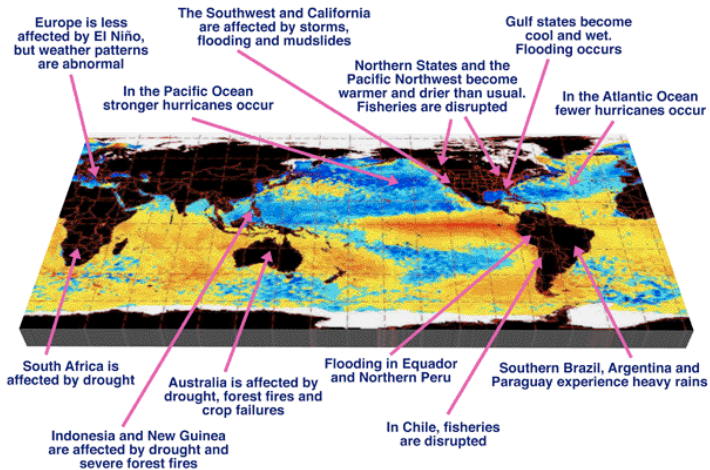


El Niño Ready Nations and Disaster Risk Reduction (DRR)

Executive Summary

The Global Impact of El Niño



Source: TOPEX/Posiden Project NASA

Michael H. Glantz, PI, Editor

January 2017



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www.usaid.gov

www.noaa.gov

www.ccb-boulder.org

www.elninoareadynations.com

www.laninareadynations.com

www.nws.noaa.gov/com/weatherreadynation

Tribute

Kelly Sponberg (1976-2015)

This report and the research for the 15 country studies on which it is based is dedicated to Kelly Sponberg, a constant supporter of efforts to improve societal understanding of the El Niño Southern Oscillation's (ENSO's) phenomenon, and climate in general for the purposes of disaster risk reduction and enhancing societal resilience through new technologies, techniques and approaches to early warning systems.

Kelly made sure that his work would make a lasting difference around the world. He focused his career on information and insight for the world's most vulnerable populations. Climate was an entry point only; he went wherever he had to go and pushed us all to have the courage to produce more, share more, explain more. He worked tirelessly with grace, dedication, and the world's most infectious laugh.

He will be remembered for his kindness toward friends and strangers, his commitment to making lives better at home and abroad and love for his family. It can honestly be said that CCB's work has continued for the past five years because of Kelly. This report is the latest of Kelly's contribution to disaster risk reduction around the globe.

-Michael H. Glantz and the CCB network

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**This report serves as an
Executive Summary of the
Portal study & the ENRNs 15-
country study.**



Source: andnowuknow.com

Introduction

The Lessons Learned Portal Project is a recommendation by participants of the February 2015 Expert Forum in Antalya, Turkey, a gathering of more than 90 participants that focused on “Lessons Learned about Lessons Learned about Hydro-meteorological Disaster Risk Reduction in a Changing Climate.” The initial objective of the Portal Project, which began in the Fall of 2015, was to assess the value of establishing an international, open-access, web-based platform -- a clearing house – for countries to share their hydro-meteorological disaster risk reduction (DRR) experiences and lessons identified as well as learned.

At the very beginning of the Portal Project, the onset of an El Niño of “Godzilla proportion” was forecast by various international meteorological centers to emerge by late 2015 and continue into 2016. The 2015-16 El Niño forecast came with strong statistical support, a probability hovering around the 90 percent level. It was shaping up to be an extraordinary event, popularized in the media as a “Godzilla El Niño” to rival the 1997-98 “El Niño of the Century.”

The “Godzilla” forecast had followed a previous forecast of a major El Niño that appeared to be developing but failed to become a full-blown event in mid-Spring 2014. Rather than announce that the expected 2014 El Niño failed, forecasters referred to it in retrospect as a “borderline weak El Niño.”

CCB took advantage of the opportunity to combine two research activities by making the 2015-16 El Niño review an integral part of the Portal Project.

A team of researchers came together to focus on the real-time responses to the forecasts and the impacts of El Niño in 15 countries in Asia, Latin America and Sub-Saharan Africa, countries affected to some degree during the 2015-16 event. The combined activity was renamed “Lessons Learned Portal Project for El Niño Ready Nations (ENRNs): A Stepping Stone toward ENSO-related DRR Lessons Learning.”

To an attentive public, the following story about El Niño is likely known. They’ve read about it, track its progress in news clips, videos, etc.

The following paragraphs and graphic images are taken from the IRI website. They present a succinct description of the El Niño Southern Oscillation (ENSO) cycle.

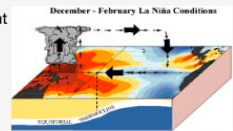
"ENSO" refers to the El Niño/Southern Oscillation, the interaction between the atmosphere and ocean in the tropical Pacific that results in a somewhat periodic variation between below-normal and above-normal sea surface temperatures and dry and wet conditions over the course of a few years. While the tropical ocean affects the atmosphere above it, so too does the atmosphere influence the ocean below it. One layer of the Pacific Ocean that is influenced by ENSO is the thermocline.

The thermocline marks the transition between the warm upper water and the cold deep water in the Pacific Ocean. The upward currents along the equator (or *upwelling*) are strongest across this transition zone. The depth of the thermocline has a direct relationship with water surface temperatures. When the thermocline is closer to the water surface, *upwelling* of cold, nutrient rich deep-water is transported up from the bottom layers, leading to cooler temperatures at the water surface. The interaction of the atmosphere and ocean is an essential part of El Niño and La Niña events (the term coupled system is often used to describe the mutual interaction between the ocean and atmosphere). During an El Niño, sea level pressure tends to be lower in the eastern Pacific and higher in the western Pacific while the opposite tends to occur during a La Niña. This see-saw in atmospheric pressure between the eastern and western tropical Pacific is called the Southern Oscillation, often abbreviated as simply the SO.

Since El Niño and the Southern Oscillation are related, the two terms are often combined into a single phrase, the El Niño-Southern Oscillation, or ENSO. Often the term ENSO Warm Phase is used to describe El Niño and ENSO Cold Phase to describe La Niña.

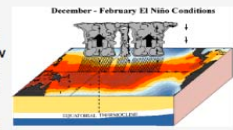
La Niña

During La Niña conditions, the east to west flow present during neutral conditions is intensified.



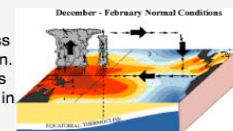
El Niño

During El Niño conditions, the usually present east to west winds weaken and an anomalous west to east flow develops. The west to east flow drives warm equatorial waters from the western Pacific towards the eastern Pacific and northern South America.



ENSO Neutral

During ENSO neutral conditions, surface trade winds blow westward across the equatorial Pacific Ocean. Blowing against the ocean's surface, these winds result in a westward current.



Source:

https://iridl.ldeo.columbia.edu/maproom/ENSO/ENSO_info.html

Meta-Observations

In the 400 or so pages in the full study document, CCB identified many factors meriting more discussion, eight of which are briefly described below. These factors influence one's perceptions and thoughts about hydro-meteorological forecast credibility and accuracy and can in turn adversely affect timely preparedness. They present obstacles to

effective disaster risk reduction. Each factor was encountered in the Project's country, region and city studies about the 2015-16 El Niño event.

1. El Niño Science Is Incomplete

The El Niño research community is still on a learning curve for understanding the science of the phenomenon: its characteristics, behaviors and impacts. As a basin-wide regional air-sea interaction in the tropical Pacific with global implications, El Niño is a relatively recent discovery.

Before the late 1960s, El Niño had traditionally been viewed as a local phenomenon off the western coast of South America. Since then, El Niño has become a scientific mystery under increasing scrutiny. Interest in it from different sectors has only heightened after each major event—1972-73 (the El Niño of scientists, when the failure of coastal upwelling was identified as an international economic concern); 1982-83 (the El Niño of Governments, after which funding for El Niño science and impacts research notably increased); and 1997-98 (the El Niño of the People, during which a sharp increase developed in public and media awareness and interest).

After each of these major events, the research community focused on ENSO suggested it *now* understood the El Niño process, only to be surprised when the next El Niño

onset forecast would fail. This type of response by the science community has continued until now. In addition, once forecasters announce that an El Niño had peaked and started to decay, public interest in it drops like a stone in water. Attention then shifts to other pressing socio-economic priorities even though the event's impacts can continue long after sea surface temperatures (SSTs) in the tropical Pacific have returned to normal.

2. The Characteristics of the El Niño Phenomenon Itself Are a Problem for Decision Makers as well as Forecasters

El Niño forecasters, researchers, decision makers and the media are frequently challenged with regard to the apparent lack of accuracy of forecasts. They are no less challenged as to the appropriateness of the socio-economic and political responses to the forecasts. Important to realize, however, is that the variability in the characteristics of the El Niño phenomenon are a large part of the problem of forecast accuracy in terms of the timeliness of early warnings as well as of optimal societal responses to El Niño's foreseeable—but never assured—adverse impacts. Some examples of this variability are as follows:

- El Niño's return period of between 2 to 7 years is irregular and uncertain

- Other atmospheric and oceanic quasi-periodic oscillations are at play and influence ENSO extremes in the tropical Pacific, making it difficult to forecast either El Niño's *onset* or its societal and environmental impacts
- An El Niño's intensity can range unpredictably from borderline weak, to weak, to moderate, to very strong
- Variations in climate, water and weather factors at the regional scale have a major influence on El Niño's likely consequences
- The attribution of a cause (El Niño) to an effect (a drought or a flood) remains challenging
- Which countries that fall into the set of global teleconnections for a given event remains uncertain
- Scientific uncertainty remains high about which natural factors specifically "kick-off" a major El Niño episode
- The relatively few observed El Niño events notwithstanding, some speculation suggests the possibility of a 15 or so year return interval of a strong El Niño. Such speculation can suggest to a government in power that DRR activities could (or even should) be put on hold

in order to fund other pressing social, political, or economic problems.

3. Strategic vs. Tactical Use of El Niño Information in Hydro-Meteorological-Related Disaster Risk Reduction (DRR)

Two basic approaches that a government can pursue to cope with potential disasters, aside from doing nothing, include (1) tactical and (2) strategic responses. Decision makers in government, tactically speaking, can choose to wait for a forecast of the *onset* of a developing El Niño before deciding when and how best to advise communities to prepare, given a short lead time, for the possible impacts of that specific event (in essence the earliest of early warnings of a potential hydromet hazard). For a variety of reasons, they can wait to respond to forecasts for each of an El Niño's *onset* without consideration of or concern about future such events.

In contrast, a strategic approach to preparedness in a country prone to recurring adverse impacts of El Niño events in the future requires a broader perspective by decision makers on how to prepare for El Niño's recurring consequences in the "out years" as well as in a current event. Strategic thinking can reduce a country's vulnerability to El Niño's hydro-meteorological impacts over the long term. A strategic approach, however,

requires an infusion of up-front funding and longer term planning, as El Niño-related DRR decisions must be evaluated with sustainable development in mind.

The following question merits serious consideration: Does every country need to prepare strategically for El Niño and its consequences, such as droughts and floods, that could foreseeably recur in the distant future as well as the not-so-distant future? A tactical approach may be costlier to a country in the long run, but it may *not* be costlier to a government that has a limited time in office. In other words, it may be politically wiser to deal with an El Niño episode, once it has been forecast.

Some governments do not have the luxury to choose between strategic or tactical response. Its response may have to be tactical to a specific forecast of El Niño's *onset*, because it does not have the means to sustain support for El Niño-related DRR, given that events do not occur every year. Also, the impacts of any specific El Niño could range from negligible (easily dealt with) to severe. A tactical approach avoids having to allocate funds without seeing immediate benefits—social or political.

Yet another factor at play against longer-term planning occurs when forecasters inform the media that El Niño's intensity has peaked after a few months and is on its decline. To

decision makers, such information may lead them to conclude the threat is over and, therefore, there is little need to continue worrying about it for a few years until the next event has been forecast.

A third option for decision makers (of which there are actual examples) is to say and do nothing. Let El Niño run its course and, if there are adverse consequences, only then undertake reactive steps of disaster response and recovery (e.g. drr) activities as well as seek international assistance.

While all governments have a right to be warned of a possible event, it becomes the responsibility of each government to generate in-country awareness-raising about El Niño and ways its citizens might cope with foreseeable consequences. Political leaders in power have to decide how best to deal with the phenomenon we've come to know as El Niño.

Thus, an argument can be made that not every country needs to prepare *strategically* for El Niño's possible consequences in the future.

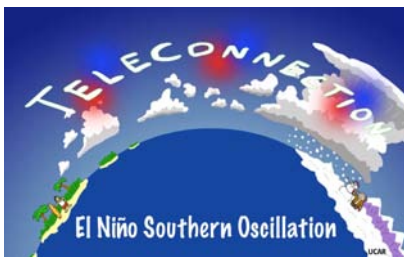
4. Coping with El Niño Impacts is not the same as Vulnerability Reduction, though actions on either can inform the other

Which is needed first, an improved El Niño forecast or reducing underlying political, socio-economic and even bureaucratic

vulnerabilities, which are often exposed during an El Niño? The former focuses on immediate hydromet threats; the latter, focuses on societal vulnerabilities and longer-term sustainable development efforts. In fact, both are necessary to enhance resilience in the face of a variable and changing climate.

To focus only on forecasts and impacts for each successive El Niño as it occurs would be analogous to responding to and coping with the symptoms of an illness but not the underlying causes of the illness that are producing those symptoms. Both must be addressed at the same time. Focusing on societal vulnerabilities requires identifying the root causes (natural, socio-economic, political) of those vulnerabilities. Addressing them would likely improve society's resilience in the face of hydro-meteorological hazards and extremes associated with a variable and changing climate as well as with a variable El Niño phenomenon.

5. Attributing climate and its related impacts to an El Niño event remains challenging



While some members of the scientific community contend that no two El Niño events are alike, others refer to “flavors” of El Niño, meaning types. Although the structure of climate anomaly impact maps compiled in the 1980s by Ropelewski and Halpert continue to provide a generalized glimpse of El Niño's possible impacts, they were meant only to be illustrative and not definitive. They have become outdated for direct use by today's decision makers. To non-experts, however, they continue to appear adequate if not definitive about foreseeable changes in precipitation and temperature.

What non-experts do not understand is that the Ropelewski and Halpert ENSO maps do not identify, for example, the different intensities or specific downscaled locations of impacts. Meanwhile, the NMHSs are under pressure to provide desired specific details to policy makers and the public for El Niño's possible impacts within their respective countries. More informative climate anomaly and socio-economic impact maps are needed to convey a realistic glimpse of El Niño's teleconnected impacts. In any case, impact maps should come with a “User Beware” warning.

“Mostly El Niño”

The phrase “mostly El Niño” is a useful one, given the advances in the science of ENSO. Although we have learned a lot in the past century, a

complete understanding of the El Niño phenomenon and its impacts still eludes researchers.

Types of El Niño events (so called “flavors” of El Niño) cannot yet be definitively identified, because some flavors may not as yet have been identified let alone witnessed. Researchers have not observed a large enough sample to encompass the combinations and permutations of El Niño’s varying physical characteristics and the impacts on them of its surrounding air-sea oscillations (Glantz, 2015).

Attempts to ascribe societal impacts to El Niño encounter similar problems as each so called flavor is itself influenced by other variations and oscillations in the global oceans and atmosphere that would produce variations in impacts on society and environment even in the absence of El Niño. The nonlinearities are difficult to track let alone measure. Despite these scientific uncertainties, however, one can assume that when an El Niño event occurs and runs its course over several months, expected “normal” seasonal climate, water and weather patterns are disrupted: a wet season becomes very dry and a growing season is plagued by drought; conversely, a dry season can become excessively wet and flood-prone.

Depending on the intensity of an El Niño and the strength of its teleconnections, one could argue that the set of impacts during El Niño

episodes, over decades, could help to identify what might be called, for lack of a better term, country-specific “El Niño climates.”

It is important to realize that for some extreme hydro-meteorological anomalies that occur during an El Niño (or a La Niña) year “teasing apart” what might have occurred independent of the influence of the El Niño on local and regional seasonal anomalies is at present not an easy task. Whatever local or regional anomalies that happen to occur during an El Niño episode have some linkage to the El Niño-modified global climate regime, either caused by El Niño or weakened or strengthened by it. What impacts that occur contrary to expectations for an El Niño does not alter the possibility that the societal impacts during an event are “mostly El Niño-related,” at least until scientific researchers tells us otherwise.

6. Climate change makes attribution of the severity of hydromet hazards, disasters and their socio-economic impacts to El Niño difficult

“Southern Africa cries for help as El Niño and climate change savage maize harvest”

-The Guardian headline 26/09/2016

Discussing El Niño and its societal consequences without having to

answer questions about the influence of global warming on the ENSO cycle (and its impacts) is becoming commonplace. Global warming is yet another of several factors that influence attribution of specific ENSO-related hydromet anomalies (in specific locations) to their teleconnected socio-economic impacts extremely challenging.

Global warming along with demographic change combine to hinder our ability to attribute an impact specifically to an El Niño. Programs focusing on attribution of impacts-to-causes require the use of multidisciplinary, multifaceted skills similar to those of forensic scientists, as suggested in the INDR/ICSU (2011) report titled “The FORIN Project: Forensic Investigations of Disasters.” Attributions, perceived as well as real, can drive responses by decision makers to undertake certain DRR policies and responses. If the attributions are highly uncertain or incorrect, their preparations for responses may be of little value.

7. El Niño and its influence on seasonality



El Niño: Haze in SE Asia

People, societies and economies are attuned to the normal (expected, but not necessarily actual) flow of the seasons. Seasons influence lives and livelihood in many ways. Not only are people attuned to the seasons, but they live according to them. For example, food production around the globe is for the most part highly influenced by the flow of the seasons: planting season, summer rains, heat-degree days, harvest time. Any hydromet changes can adversely disrupt crop yields and production. Societies have developed numerous ways and means to reduce as best as they can, the influence of extreme events on their climate, water and weather dependent activities. For example, irrigation systems and reservoirs supply water to crops in semiarid and arid lands as well as in drought situations.

The severity of a hazard’s impacts can vary from event to event, even for the same kind of hazard with a similar intensity in the same location. The reason for this is that societies are constantly undergoing demographic change. As a result of those changes, the level of vulnerability and of resilience at a given point in time can also vary over time.

ENSO’s warm and cold extremes influence seasonality in different ways. El Niño, for example, can be viewed as an *out-of-season anomaly*: one expects rain and a meteorological drought occurs, or

there are unexpected heavy rains in the normally dry season. In contrast, La Niña can be viewed as an *intra-seasonal anomaly*. What this means is that if in ENSO-neutral times there is normally adequate rainfall (in terms of the timing and volume) for crop production, during La Niña excessive rainfall can adversely affect croplands.

El Niño affects the natural flow of the seasons. During the 2015-16 El Niño, several of the countries in this study suffered from droughts, generating food insecurity and raising the importance of El Niño's influence on seasonality as an issue of concern to decision makers.

The WMO publishes graphic portrayals each year of weather and climate extremes around the globe, noting droughts, floods, fires, haze, tropical cyclones and major severe storms with their month of occurrence. The maps are illustrative and instructive about how many climate, water and weather anomalies occur in a given calendar year. When used with care, the seasonal and out-of-season distribution of the various types of hydro-meteorological hazards can be identified.

A composite of anomalous seasonal changes for specific locations during El Niño episodes can highlight patterns of change in seasonal characteristics (e.g. its seasonality). The composite could be viewed as

El Niño climate, or “seasonality changes in the time of El Niño.”

8. Constraints on developing of a Lessons Learned About Lessons Learned web-based international portal

Developing an online, international, open access, web-based portal (e.g. clearinghouse or repository) could, theoretically, be an important step toward sharing and learning DRR lessons drawn from many countries. In practice, establishing such a portal would require significant sustainable, long-term funding. It would also require considerable effort to identify the target audience(s) for such a portal's contents and how that content should be framed to be most useful to that audience.

A glimpse of other attempts at similar portals on the Internet suggests that they can have a short shelf life. Though likely created with great interest and enthusiasm, some disappear within a few years, either for lack of sustained interest or lack of funding. Others, however, have done well.

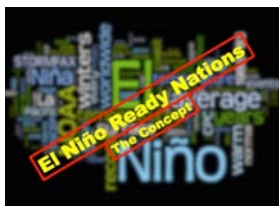
The idea to gather DRR-related lessons for sharing among countries is clearly a good one, but many questions need to be addressed. Lessons and recommendations drawn from hydromet hazards and disasters worldwide would be shared in many languages. What languages

would be preferred for a portal? Would lessons in other languages be translated? Which organization might host it? Who would serve as gatekeeper for cataloguing and posting the lessons and recommendations from dealing with hydro-meteorological hazards and disasters?

An alternative approach to the top-down setting up of such a portal might be for countries or regions to setup and maintain their own lessons learned portals as part on an international network composed of national portals. An important consideration centers on which government agency would be tasked with the responsibility to oversee the development, maintenance and the securing of long-term funding for such a lessons learned open-access portal.

What it Means to be El Niño Ready

Governments that take El Niño occurrences as serious quasi-periodic threats to their country and seek to enact policies to protect their citizens, their livelihoods and properties, public and private, can be considered to be among the El Niño-ready nations (ENRNs). This statement



applies as well to El Niño Ready Cities (ENRCs) and can also apply to El Niño Ready Hydromet Services (NMHSs).

Differing Perceptions of What It Means to be “El Niño Ready”

What readiness means for getting ready for an El Niño event is open to interpretation. In any discussion of readiness what discussants mean in their use of the term readiness has to be made clear at the outset. A government, for example, can prepare for droughts of the future, knowing that a drought of varying intensity and duration is likely to accompany an El Niño (e.g. an average return period of 4.5 years). A different government affected in different ways by an El Niño might consider itself ready when it chooses to respond to an El Niño once it has been forecast, with little regard for the recurring nature of the phenomenon. As suggested earlier, a government can be ready in a tactical or in a strategic sense. Degrees of readiness can be represented on a continuum.

Shades of readiness can range from not-at-all ready to fully prepared for whatever impacts an El Niño event might have on a given country. There are qualitative descriptions of degrees of readiness: hardly ready, somewhat ready, almost ready, and so forth. An EU health program (TRaNSforMnursing, 2012) suggests that:

Readiness is conceptualized both as a state and as a process. In the process of becoming ready to create change ... a person or state

can choose to ‘opt-in’ or ‘opt-out’ of the process of becoming...

El Niño is associated with numerous adverse anomalous climate, water, and weather impacts around the globe, many of which can last from several months to years. El Niño’s most obvious negative impacts include drought, flooding, flash floods, fires and vector-borne disease outbreaks. Each of these has its own ripple effects (2nd or 3rd order) in societies and the ecosystems on which they depend. Direct impacts, while lasting only a matter of months, can and has set back a country’s economic development prospects for years.

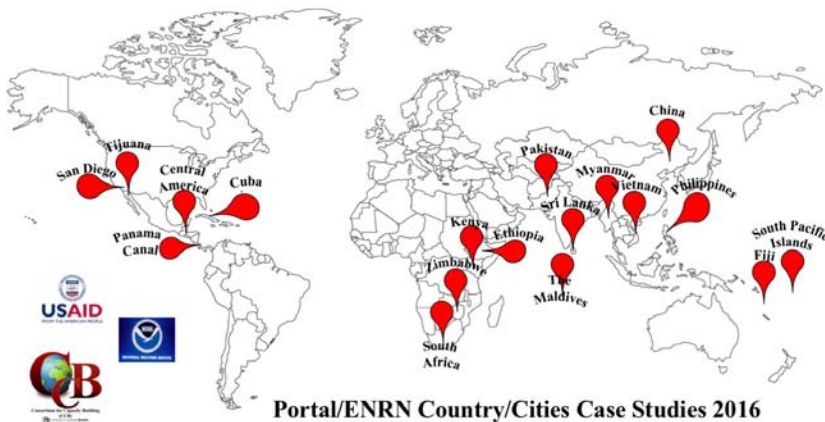
El Niño’s adverse impacts can recur in many, but not all, places on the globe and, therefore, can be anticipated, planned for, and mitigated, if not avoided altogether.

Disaster risk reduction, through informed approaches to prevention, avoidance and preparedness, merits much greater consideration in political as well as funding decision-making processes. Folk wisdom suggests that “an ounce of

prevention is worth a pound of cure.” This raises questions about who will pay for that prevention through preparedness and who gets to benefit from the “cure,” both in the short term and in the long term?

Case study overviews

In the broader context of lessons learning for hydromet DRR, the following case studies were undertaken to collect information in real time in order to identify lessons across 15 countries about how they responded to the recent El Niño forecasts and impacts. The cases include South Africa, Kenya, Zimbabwe, Ethiopia, the Philippines, Sri Lanka, the Maldives, Pakistan, the Pacific Island Region, Fiji, the Panama Canal, Central America, Tijuana (Mexico) and San Diego (USA), and a Tijuana-San Diego Cities comparison study. The concise overviews that follow are brief summaries based on detailed longer drafts of country reports.



El Niño Ready Nations (ENRNs)

African Region

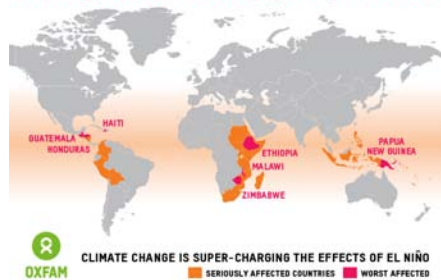
Ethiopia

Ethiopian climate is characterized by three seasons, locally known as Bega (October to January), Belg (February to May) and Kremt (main rains; June to September). Seasonal classification is based on rainfall. The key atmospheric system that affects the Kremt rainfall system in Ethiopia is the Inter-Tropical Convergence Zone (ITCZ).

The Ethiopian People's Revolutionary Democratic Front (EPRDF) came to power in May 1991, after defeating the Military government (Derg). It created institutions that strengthened disaster preparedness and risk management at all levels. The new government, whose policy was rural oriented, made disaster preparedness and prevention (including to El Niño) one of its key policies. It strengthened disaster risk management institutions and designed and updated strategies. Its capacity to respond to El Niño-related disasters and its political commitment was tested in the 1997-98 as well as the 2015-16 El Niño events, neither of which led to famine.

The introduction of disaster preparedness and prevention policies and the creation of institutions for early warning and response were important milestones. A national committee for disasters was created at the highest level of

DROUGHT. FLOODS. HUNGER.



Source: <https://blogs.oxfam.org>

government as the country made a deliberate shift in its disaster management approach from being reactive to crises to being more proactive.”

Many scientists believe there is a statistically reliable teleconnection between El Niño in the Tropical Pacific (thousands of miles away from Africa) and Ethiopia's subnational regional climate variability.

Droughts and floods have historically impacted Ethiopia. There has not been any *complete* understanding of the role of El Niño as a basic driving force of the country's seasonal rainfall variability. There is no single correlation between ENSO's warm extreme (El Niño) and the whole country's seasonal rainfall variability because some areas (stations) are more significantly correlated with El Niño than others.

Onset of an El Niño event that could affect Ethiopia in 2015-16 was officially announced in March 2015. NOAA and the Australian Bureau of Meteorology detected the El Niño. The national NMA

incorporated El Niño in its early warning and planning process for 2015 and 2016.

The impacts of El Niño on Ethiopia depend on the time of its arrival in relation to the main onset of the seasons. When the onset, distribution and cessation of rainfall mismatches with the seasonal agricultural calendar, it often leads to crop failures. Drought and floods, as well as frosts and hail, are the major climate-related hazards in Ethiopia. Climate sensitive health hazards such as malaria, meningitis and Rift Valley Fever (RVF) are also prevalent in the lowland areas. El Niño leads to climate variability, which creates favorable conditions for these health hazards.

El Niño events do not have the same impacts in all parts of the country, spatially or temporally. There is abnormal rainfall in some areas such as Southeastern Ethiopia, while there is drought in highland areas. The current 2015-16 El Niño arrived in Ethiopia when the country was in a different socioeconomic and political context than it had been in 1972-74 or in the first half of the 1980s, when drought ravaged parts of the country. The economy of the country has doubled and a functioning Productivity Safety Net Program (PSNP) that works during non-emergency situations has been institutionalized. The overall confidence of the country has improved. There is also trust on the part of Ethiopia's international partners that the government will implement any cooperative hydromet risk management agreements effectively.



Source: Adapted from UNICEF Fundraising Poster (March 2016)

Hurdles and Obstacles

Very few researchers in Ethiopia study the basic science of El Niño and its impacts on the country.

Constraints to action include but are not limited to the existence of different kinds of hazards and disasters before as well as after an El Niño event. For example, when El Niño was forecast in 2015, the Belg rains had failed because of other factors. The dependence of Ethiopian agriculture on millions of smallholders that solely depend on rainfall with no access to irrigation makes them vulnerable to slight as well as major climate changes, regardless of the causes.

Another constraint is the massive number of people that are affected by El Niño and the locally available resources to respond: if it was not for the effective preparedness of the Ethiopian government and its excellent relationship and coordination with donors, 2015-16 could have been characterized as a famine year. When less than 50% of the needed funds are raised from the government and the donors, however, lack of adequate funding also becomes a constraint to implementing preparedness

plans, as happened during the 2015-16 El Niño impact.

Another problem is that decision makers consider the forecast of the NMA not specific enough for their needs. People tend to expect forecasts to be deterministic, true or false, even though all forecasts are probabilistic with an inherent amount of uncertainty.

Another issue is that there is very little discussion in Ethiopia about the certainties and uncertainties of El Niño information, including forecasts.

There were also unsuccessful forecasts by global and regional climate research centers concerning the onset of El Niño in 2014.

Lessons

- In the last three decades Ethiopia has developed a very effective disaster risk management and food security system. It has strengthened the DRM institutions at all levels of society. This has led to a very effective early warning and response system to disasters.
- In Ethiopia, the PSNP has altered traditional responses of communities during droughts. The PSNP is not a free distribution of resources but funds public work programs such as soil conservation and reforestation programs at the community level. It helps people to stay in their villages and work on public works for environmental rehabilitation.
- Call on the Ethiopian diaspora's climate-related experts to provide human capacity (expertise) that is not available or affordable in country.
- People, including decision makers, expect forecasts to be deterministic, true or false, even though forecasts are probabilistic with an inherent amount of uncertainty. There is very little discussion in Ethiopia about the certainties and uncertainties of El Niño information, including forecasts.
- El Niño readiness in Ethiopia has become effective because DRM institutions have been very active in responding to climate-related disasters during non-El Niño years.
- Ethiopia has accumulated lessons from previous El Niño episodes. For example, the 1982 El Niño proved a governmental turning point for heightened awareness in disaster preparedness and response for the country.
- Communities have their own coping mechanisms during El Niño-related disasters. They activate social mechanisms and wealth transfers among themselves as well as with those who can transfer money from outside their villages.
- Communities with access to water and road infrastructure and a diversified income respond more easily to the impacts of El Niño-

related disasters than do others with no access to such infrastructures.

- Research and teaching institutions, such as the Ethiopian Institute for Climate and Society at Mekelle University, are expected to provide leadership on El Niño-related research and response in the future.

Kenya

Kenya is an agricultural country with a major cash crop economy based on coffee, tea and flowers grown primarily for export. There are few natural resources. The climate is variable and subject to drought and flood, although neither are generally severe or prolonged.

Strong El Niño events such as those in 1982, 1997 and 2002 can intensify the Seasonal Short Rainy Season in Kenya. To the extent to which an individual event might be deemed “extraordinary” cannot be anticipated with full confidence. While there is an emphasis on El Niño enhanced rainfall anomalies in Southern Kenya, attention must also be given to the likelihood of drought and its associated adverse effects in Kenya.

In line with decisions made after the 1997-98 El Niño, a National Plan to address ENSO has been developed and was ready for implementation in this widely-tracked 2015 “Mother of all El Niños,” as one National newspaper branded it. Indeed, the IGAD Climate Prediction and Applications Centre made impressive and timely outputs on the

development and progress of the 2015-16 El Niño in Eastern Africa.

On August 24, 2015 the Kenya Meteorological Department (KMD) issued an Advisory of Development of El Niño, estimating that “There is a greater than 90% chance that the evolving El Niño will continue through to the ‘Short Rains’ (Oct-Nov-Dec) season and around an 80% chance it will last into early 2016.” In October 2015, the KMD issued an El Niño warning for Kenya regarding the likely occurrence of El Niño Rains over the Short Rains season. The Short Rains of mid-October to mid-December were heavy, though not extremely so, and continued into the following dry season—a common feature of a strong El Niño.



Source: Coastweek.com, Rescuers attempt to salvage the remains of a bus swept by flood waters in Lake Gadudia, Northern Kenya

If by March 2016 Kenyans had thought the danger had passed as the El Niño event waned, then they were mistaken. The Long Rains of April and May 2016 were heavy with some periods of especially heavy rain that resulted in flash floods, traffic chaos and

infrastructure damage including collapsed buildings, built unwisely and illegally on wetlands, which resulted in considerable loss of life that matched or exceeded those attributed to the period during the El Niño event. Whether the intensity of the seasonal rains were influenced by El Niño or not is unclear.

Interest in El Niño is intense in Kenya. The reason for this is the familiarity with the adverse effects of the 1997-98 event. It was a devastating occurrence and few in Kenya at that time have good memories of the experience. The severity and longevity of the occurrence was unprecedented and the country was unprepared. Subsequent investigations of previous El Niño years (although, of course, they had not then been recognized as such) indicated nothing comparable to the 1997-98 event.

In fact, there are many positive lessons for Kenya to be taken from the 2015-16 event. The wetter than average conditions have led to prime conditions for agriculture. Vegetation cover increased to well above average across most of the country, leading to a recovery of previously drought-affected areas and very good prospects for pastoralists. In the wheat-growing areas of the country, there have been bumper harvests. "The crop has been very good this year. Much of it is attributed to the El Niño rains which were facilitative rather than destructive," Narok County chief officer in charge of agriculture Christopher Nkunkuu said (Daily Nation 24 July 2016).

Kenya Initial Rapid Assessments (KIRA) noted that in Garissa and Tana River counties, displaced populations lack safe water, shelter, sanitation, food and non-food items, exposing them to the risk of waterborne diseases such as acute watery diarrhea, malaria and Rift Valley Fever (RVF).

Theoretically, the government had been well-prepared for the anticipated El Niño. Large amounts of money, equipment and personnel had been dedicated to disaster preparedness and mitigation. The 2015/16 event appears to have been a much more modest occurrence than its 1997/98 predecessor, however, and no major response was needed despite warnings that the current El Niño was the strongest ever.

Hurdles and Obstacles

Knowledge of an ENSO warm event and its perceived impacts on East Africa is far from being complete. No two events appear to be the same. The location and intensity of both rainfall excess and drought vary from event to event, no matter how similar the wider climatic picture might be. Recent research on the Indian Ocean dipole (IOD), has shown its importance as a moderating or enhancing feature of the Inter-Tropical Convergence Zone and the monsoons that are the principal drivers of East African weather.

Lessons

- Forecasts are made and received well in advance and are satisfactory, although not perfect.
- Many urban drainage systems were improved in preparation for the recent event. But not all, and a combination of flooding and improper infrastructure led to several fatalities.
- Kenyans are universally aware of El Niño. Forecasts are probably as good as they can be given current knowledge.
- Settlement on flood-prone areas are to be discouraged rather than enforced.
- Although climate information is incorporated into most planning activities, risks are frequently ignored and safe practices are not implemented.
- Integrated watershed development to manage flooding is limited, though river, lake and dam development to harness water resources exist in Kenya, which is categorized as a water-deficient country.
- Priority is given to hydro and thermal power production, with flood control a secondary rather than a primary consideration.
- Food security is often mismanaged with reserves secretly disposed of

and replacements imported at a seriously high cost. This is a symptom of corruption and will not soon change. If corruption was addressed, then most of the identified “lessons” would be implemented.

- Early warning capacity building has improved and should be further developed.
- Disaster preparedness will improve but will depend on identified priorities and reduction in corruption. In developing countries, including Kenya, there are often insufficient resources to manage normal circumstances and little to spare for potentialities.

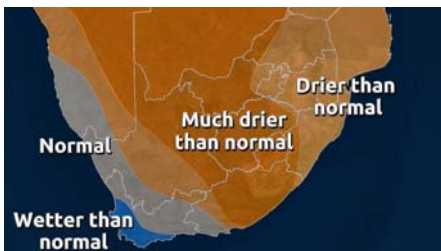
Other lessons learned involved the need for accurate long-term weather forecasts, public awareness campaigns, infrastructure development and maintenance sufficient to cope with extreme flooding as well as discouraging settlements and activities on river banks and flood prone areas.

South Africa

Drought is a recurrent feature of South Africa’s climate history. During the 2014-15 austral (SH) summer, Southern Africa as a whole suffered the strongest drought since 1995. It was not identified as an El Niño-related event, however, because the El Niño was considered ‘borderline weak’. During the 2015-16 El Niño event, the Pacific became even warmer and, despite a lack of correlation

between the strength of El Niño and the intensity and spatial extension of a drought, conditions led to one of the strongest droughts ever experienced in the country. Due to the worsening of the drought in the context of El Niño and a lack of preparedness measures, several provinces and municipalities declared a state of disaster.

ENSO is an important influence on rainfall variability and society in South Africa. El Niño is often associated with drier conditions (dry spells including drought) over the larger part of the SH summer rainfall region. Previous research shows that eight of the ten strongest droughts that affected the country since 1900 occurred during El Niño's mature phase. The correlation between El Niño and drought is statistically significant during December to March and thus, mid-summer climate (SH) anomalies affecting South African rainfall are best predicted during ENSO warm event years.



Source: eNCA.com

November 2016 projection for the growing season

Overall, there are many lessons that can be drawn from the current—as well as from past—El Niño events in South Africa. The strong 1982-83 El Niño episode and the moderate El Niño of 1991-92 caused extensive drought and

significant socio-economic impacts and ripple effects through various sectors, such as livestock, water resources and agricultural industries (Glantz et al., 1997). A key Ministry of Agriculture informant noted (Feb 26, 2016), “You can have lessons, but implementing them depends on the political landscape.”

Quite often, the scientific community refrains from releasing early information about the occurrence of an El Niño because of uncertainties surrounding its onset, as well as its teleconnection (correlation) with drought. They want to avoid generating panic in society. If decisionmaking cannot rely on the detection of an El Niño alone, it can certainly use such information to implement precautionary measures. Likewise, a misunderstanding of forecasts, a lack of trust in climate-related products, as well as competing cultural values and beliefs explain the limited effective response to warnings in climate-sensitive sectors.

Delayed warnings reduce time for preparedness and contribute to heightening negative impacts. Likewise, complex, bureaucratic institutional arrangements can impair drought management processes. Without adequate risk communication, including warning issuance and appropriate format of information, and without flexible proactive reduction systems, risk preparedness cannot be enhanced.

Hurdles and obstacles

Current challenges of coordinating multiple channels of inputs continue to promote what appears to be a reactive approach to drought management in South Africa.

Flexibility and diversity are critical characteristics of a risk management system, whereas rigid bureaucratic systems provide many barriers to risk preparedness, even for recurring and known hydromet hazards.

Without adequate support from local governments or other institutions, most farmers do not have the capacity to implement adequate strategies in response to forecasts, mainly due to their limited financial resources. A possible lack of trust in climate and agricultural advisories is another barrier to using forecasts for decision-making.

Finally, distinguishing between development challenges and problems arising as a direct result of a drought period (e.g. differentiating between aging infrastructure and poor asset management) remain a persistent problem, as noted in past droughts (e.g. the early 1990s) and more recently.

Lessons

- Uncertainties about El Niño and its impacts can lead to delays in warning issuance and related advisories sometimes at a point in time when preparedness is no longer possible.

- Improving detection and accelerating communication about El Niño to the government as well as to stakeholders in climate-sensitive sectors is critical to provide time to prepare, especially in a context where strong El Niño events could become more frequent.
- The timely release of relevant information is needed, but so is training about the meaning of such information, especially in that an El Niño event does not necessarily mean a disaster will occur. Also needed is better distribution of information about potential no-regret measures that could prove beneficial in any event.
- Raising awareness about El Niño events and their potential impacts on South Africa is critical. Developing public awareness campaigns is a way to inform different people about El Niño-related risk. It is also a way to engage them in a dialogue that could potentially contribute to building relationships of trust between forecasters, policy-makers, end users in climate-sensitive sectors as well as with the general public.

- ‘Science communicators’ are needed to fill in the gap between producers and users to ensure that products are accessible, useable and understandable so that they have maximum impact for disaster risk reduction. As such, an opportunity exists to enhance preparedness at the

local level through better communication of information and through opening dialogue.

- Without clear scientific understanding of El Niño-related risks in vulnerable societies, and without outreach from forecasters or policy-makers toward farmers and livestock owners, forecasts and advice as relevant decision-making tools might continue to be discounted or even disregarded.
- Moving beyond a traditional governmental (bureaucratic) structure is critical to implementing an accelerated process for risk management in order to enable on-the-ground implementation of proactive policies. Likewise, securing contingency funds that can be quickly released at the local level, once a risk is detected (without going through multiple channels of approval), is critical if potential long-term impacts of El Niño events are to be avoided (or at least mitigated).
- Combining science-based expertise with socio-economic and socio-cultural analysis is needed in order to better understand all potential impacts and to foster cooperation between sectors and governance structures
- Outreach should specifically focus on El Niño, and not only on droughts, to ensure a clearer

understanding among relevant stakeholders.

- Cooperation among all stakeholders involved in drought detection and management is critical to ensure development and implementation of adequate responses.
- Cooperative governance approaches to drought management are necessary if drought responses are not to remain focused on providing relief assistance at the cost of tackling the root causes of vulnerability.
- Current challenges of coordinating multiple channels of inputs continue to promote what are (or appear to be) reactive approaches to drought management in South Africa.
- The 2014-16 droughts have once again revealed that governments (and other relevant actors from private sector and civil society) need to be more proactive and responsive rather than reactive to impacts as they occur.
- Providing relief in time of crisis does not trigger behavioral changes, and can contribute to locking populations into unsustainable practices.

Zimbabwe

The Government of Zimbabwe has been under fire from the international community because of the lack of

relevant democratic institutions, a result of the Mugabe regime's attempt to hold on to power. Assistance for development or even sustainable DRR activities cannot be counted on. Given the state of Zimbabwe's economy, it was up to those adversely affected by hydromet hazards to more or less fend for themselves, hoping that humanitarian assistance would come from outside the region. A university professor gave the following advice: "catch the water, store it in reservoirs and then use it reliably" (Chara, 2014).

"Zimbabwe is considered a low-income, food-deficit country, ranked 156 out of 187 developing countries on the Global Hunger Index, which measures progress and failure in the global fight against hunger" (Mutenga, 2015).

There is a controversy as to whether there has been a decline in precipitation in Zimbabwe in recent decades. Regardless, changing land use, deforestation, droughts and dry spells, lack of irrigation water, land surface desiccation, and El Niño-related droughts have all adversely impacted the country's meteorological and hydrological processes to the detriment of food security. Global warming is expected to make this bad situation even worse (see, for example, Brazier 2016).

Farmers are on small plots of land, as the large productive European farms were divided into small subsistence plots that were given by President Mugabe to his

political supporters in the early 2000s. Since then, with the implementation of the measures of the Land Reform, Zimbabwe's farmers have become more vulnerable to hydromet disasters (Nangombe 2014). Land reform marked a turning point in Zimbabwe's food production, as the country went from producing a food-surplus and exporting crops in and before the 1990s to its present food deficit classification (Rogers 2013). Most poor farmers are on small plots.

According to a recent Zimbabwe Vulnerability Assessment Committee report, "Rural food insecurity has remained high in Zimbabwe over the past decade due to a combination of unfavorable weather conditions, low productivity, high poverty levels, vulnerable livelihoods, high food prices, among other factors" (Mutenga, 2015).



Source: Reuters Bulawayo Villagers collect their monthly food ration provided by the United Nations World Food Programme (WFP) in Masvingo, Zimbabwe, 25 January 2016

During El Niño events, there is a high probability of drought, food shortages and food insecurity in Zimbabwe. According to FEWSNET,

“Historically, El Niño conditions are associated with below-average and erratic rainfall in the southeastern parts of the region during this period. These conditions might result in a late start of season in the southern parts of Mozambique, Malawi, and Zimbabwe.” (Mutenga, 2015)

The 1991-92 El Niño caused major drought in Zimbabwe and adversely affected agriculture. The 1991-92 El Niño was often cited as a reference point for 2015-16, as in comparison to 1991-92 the 1997-98 event had only minor impacts in Zimbabwe. According to the agriculture ministry, Zimbabwe is experiencing its worst drought since 1992, which killed over one million cattle (Moyo, 2016).

Zimbabwe entered the 2015-16 El Niño already suffering from drought and food shortages. The 2013-14 farming season was poor. There was concern that 2014-15 would be an El Niño year and that would mean likely drought conditions during the rainy season (October to April). International forecasts predicted a major El Niño event with a high probability of being a record-setting event. It began to occur but eventually began to collapse as early as May 2014, a false alarm. Even though the highly advertised 2014 El Niño did not materialize, drought conditions nonetheless did occur, however. Also in 2014, a 1.67 million tonne regional (Southern Africa) deficit of Maize arose. Within a few months came the forecast of an extraordinary 2015-16 El Niño, again touted as a rival to the 1997-98 “El

Niño of the Century.” The entire country was adversely affected but more so in the arid-semiarid south of Zimbabwe (Matabeleland area) than in the north.

According to the FAO, “Southern Africa is currently in the grip of an intense drought driven by one of the strongest El Niño events recorded in the past 50 years. Across large swathes of Zimbabwe, this year’s rainfall season has so far been the driest in recent years. In typical years, families normally have enough food to eat after the main harvests begin in late March and April; that however is not the case this year” (FAO 2016).

The United Nations children's fund estimates that “At least 11 million children in eastern and southern Africa face hunger, disease, and water shortages as a result of the strongest El Niño weather phenomenon in decades” (Migiro, 2015).

Hurdles and Obstacles

The isolation of Zimbabwe by the international community has put considerable pressure on its people. Humanitarian organizations have been able to come to the rescue to some degree, but the question remains: how can the international community effectively and universally assist a population in dire need of food and water while in essence boycotting the Zimbabwean government?

In order for a country to prepare for hydromet hazards, its government must have the financial means to develop and

pursue foresight-driven, proactive policies for hydromet DRR. The economy of Zimbabwe is in chronic crisis and financial resources are hard to come by. Aside from the “way” to achieve DRR, there must also be a “will” to do so. Articles appear suggesting that the government of Zimbabwe does not have the resources at this time to pursue DRR. The government has apparently neglected support for infrastructure maintenance and repair and has invested very little in irrigation, forecasting, or drought tolerant cultivars.

Lessons

- Countries that are relatively isolated or experiencing crises in governance are less likely to invest strategically in enhancing forecasting and preparedness for El Niño events.
- Do not look at only one El Niño year to identify and respond to the impacts of an ENSO warm or cold event. Several El Niño years and their impacts must be looked at to get an idea of what is likely to happen and what might be necessary to prepare for. Doing so, however, seemingly goes against human nature.
- The tendency is to look only as far back as to the last major el Niño, which was the 1997-98 event, even though earlier events may serve better as analogue years.
- Climate, water and weather impacts one year before as well as one year after an El Niño event must be looked at. In Zimbabwe, the 2015-16 record-setting drought was preceded by a severe drought in the growing season of 2014-15. Impacts of drought in a year that precedes the onset of an El Niño worsen the impacts of the El Niño-related drought year that tends to follow.
- Enhanced support for NGOs that educate small stakeholders and farmers about water-harvesting best practices and about growing drought tolerant crops, as needed.
- An impact map depicting an El Niño’s teleconnections does not indicate the strength of the teleconnection or the magnitude of the event, and therefore is not sufficient for use in the planning and development of long-term goals.
- The value of real-time reviews of a country’s impacts and responses to El Niño need to be compared with historical accounts once the El Niño has ended. It can provide a glimpse of the feelings and emotions in real time that accompanied the 2015-16 El Niño and its impacts.
- It is important to note that the impacts of an El Niño event can linger for seasons as well as years after an El Niño event has ended.

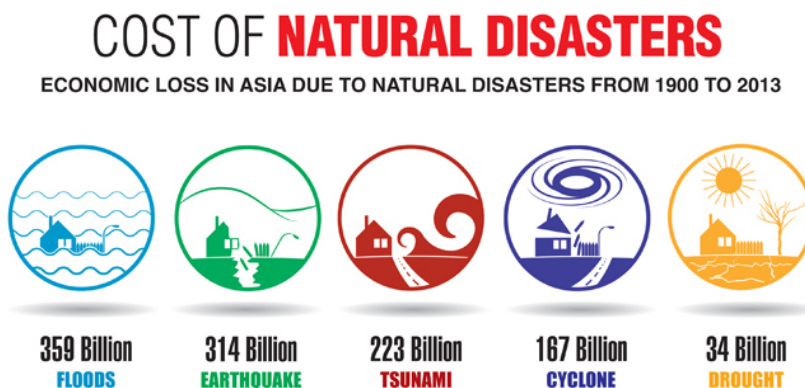
Asia Region

China

Because of its vast, complex geographical and climatic conditions, natural disasters occur frequently in China and exhibit significant regional characteristics, seasonality, and downstream (knock-on) effects (Shi, 2011). China is one of only a few countries in the world that suffers almost all types of natural disasters: floods, droughts, typhoons, snow & ice storms, landslides, mudslides, dust storms, forest fires and pests, etc.

developed early-warning information dissemination system, which includes cell phone, TV, radio station and disaster information service personnel to disseminate and update information about hydromet disasters in a timely manner. The government also uses the Internet, SMS messaging, Mobile News, IM software, blogs and other channels to provide early warning information to disaster-prone areas, and to people located in areas designated as high-risk zones.

The Institute of Atmospheric Physics (IAP) predicted in March 2015 that the intensity of the 2015-16 El Niño would



(FIGURES ARE IN US DOLLARS)

(SOURCE: CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS)

The China Meteorological Administration (CMA) issued forecasts about the onset and development of the 2015-16 El Niño event and warnings were sent to the central government as well as to various government agencies at different levels. The Chinese government then used its newly

be close to a 2.3 degrees C anomaly, which is quite close to what actually occurred. The National Climate Center (NCC) accepted the prediction results in Spring 2015. From March 2015 to January 2016, IAP's prediction results were quite consistent.

Due to the complexity of the weather and climate systems over China, El Niño is only one of the major factors affecting the anomalous behavior of those systems. Many researchers have shown that there are considerable heterogeneities in the responses of different parts of the country and of different socio-economic sectors to El Niño-related hydromet anomalies.

Generally speaking, the impacts of El Niño on China's weather and climate have four main characteristics: (1) the number of tropical storms (typhoons) in the Northwest Pacific and the number of landfalls on Chinese territory tend to be less than those in ENSO-neutral years that appear following an El Niño; (2) in southern China, including along the Yangtze River and in southern regions, low temperatures and flooding tend to occur in the second calendar year of an El Niño. For example, 100-year floods occurred in 1931, 1954 and 1998, each of which was in the second year of an El Niño event. El Niño was also one of the most important factors for the 1998 Great Floods; (3) El Niño events tend to result in high temperatures and drought in the summer in northern China. During El Niño years, China's summer monsoon is usually weak. The monsoon rain belt stays to the south in central China, or south of the Yangtze River. Northern China is prone to drought and high temperature in the summer of those years. For example, drought and high temperatures in northern China were quite severe in 1997, an El Niño onset year; (4) North China is prone to have a warm winter in El Niño years.

With the development of the 2015 El Niño, six southern Chinese provinces witnessed rainfall amounts equal to their historical records. In fact, the consequences of its development were witnessed all over the country, from the landslide in Zhejiang Province to severe flooding in Hunan Province. The El Niño event played a significant role in the weather and climate in the north of the country, which saw the highest temperatures in the past several hundred years in November and December of 2015.

Since the end of 2015, due to the El Niño effect, countries along the Lancang-Mekong River have sustained droughts of varying degrees, and their people's lives and work have been affected. Requests from Vietnam and Cambodia were sent to the government of China to release water to help alleviate severe droughts downriver. Initially set from March 15 to April 10, then extended until the end of the low-water period, China decided to discharge water in accordance with the situation in upstream areas and not to the actual demands of downstream countries.

Climate change is expected to alter patterns of precipitation, temperature and wind. In addition, extreme weather and climate events, such as heavy precipitation, heat waves, super-cyclones and El Niño and La Niña events will become more frequent, more intensified and longer lasting.

Hurdles and Obstacles

In general, the major obstacle for improving meteorological services in China is the tight control of meteorological information, including observations, forecasts and impact assessments, as bounded by the Law of Meteorology of China, which was first passed in 2000 and then amended in 2015.

The impacts of El Niño in different regions and different socio-economic sectors vary significantly.

The current administrative structure is clearly not suitable for effectively dealing with extreme events such as the Super El Niño of 2015-16, which lasted a long period of time and with unexpected intensity. In late 2015, CMA released an official statement to warn that the 2015-16 El Niño-related floods in the Yangtze River basin were more serious than the Great 1998 Floods, which affected the whole of central China. Although major hydrological infrastructures took immediate measures to prepare, many small to mid-size rivers still suffered greatly because of a lack of appropriate assessment and preparedness.

CMA can only use its own channels, such as China Weather TV, CMA's website, the Chinese Meteorological Newspaper, etc. to pass its messages to the public. This restraint negatively impacts response at local levels.

Impacts of El Niño in China are widely scattered. Because of large uncertainties

in predicting the timing and scale of the impacts of El Niño, the government and most business sectors have largely ignored the potential financial impacts of El Niño when accounting for their financial and fiscal liabilities.

Lessons

- Other, more available social media platforms would likely better educate the general public and involve more experts, government officials from other agencies and business managers in making El Niño events more transparent.
- More importantly, those experts all emphasized the uncertainties in the El Niño process and the weakness in understanding El Niño's mechanism and making forecasts (China Weather TV, "Facing the Weather," June 17, 2014).
- By recognizing that natural disaster-related contingent liabilities that are largely ignored by financial entities present systematic financial risks to the economy, insurance and re-insurance companies are now moving forward to work with the Chinese government to better use a disaster insurance mechanism as a relevant capital instrument for hedging massive contingent liabilities caused by disasters such as El Niño.

- The use of commercial insurance to close gaps in the coverage of risks could be one of the potential measures to deal with impacts of extreme events such as a Super El Niño. It is reported that insurance companies are now discussing with governments at different levels to use insurance mechanism as a potentially viable solution for the risks posed to public assets by natural disasters, including El Niño.

Fiji

The Republic of Fiji includes over 300 islands in the South Pacific. One hundred of these islands are inhabited by the Fijian population, which totals about 870,000 people (Secretariat of the Pacific Community, 2008, Fiji Bureau of Statistics, 2016). Fiji's top earning industries are tourism and sugar cane production, but the majority of the country's workforce is employed in agriculture (The Heritage Foundation, 2016), most of which is subsistence farming and is the foundation of livelihoods for around three quarters of Fiji's population. These three industries are climate dependent and are highly susceptible to the damages that can result from cyclonic activity (World Bank, 2015). The high risk of natural disasters, particularly during the cyclone season, makes this population highly vulnerable both in terms of income and food security (The Heritage Foundation, 2016).

More than 30 percent of the rural population lives below the poverty line and has a higher dependence on natural resources that are susceptible to natural hazards (Van Beukering et al., 2007). Isolation of rural and low island populations results in difficulties for developing and maintaining DRR systems, making these populations the most at risk due to their subsistence lifestyles (World Bank, 2015).

Prior to the last El Niño event (2015-16) the primary focus of ENSO effects in the region were largely connected to droughts (SOPAC, 2009). Tropical cyclone (TC) risk for Fiji, in general, was anticipated to be elevated and during El Niño events tropical cyclones can occur outside the official TC season. All communities were warned to remain alert and prepared throughout the 2015-16 TC season. During past El Niños, food security and agricultural production have been adversely affected, with cascading effects on livelihoods, health, water, sanitation, education and other sectors.

Hurdles and Obstacles

The 2015/16 El Niño event highlighted the gap between humanitarian funding requirements in countries to address El Niño-related emergencies and the capacity of the international community to respond. For example, as of April 2016, only 33% of humanitarian appeals for Fiji had been received.



Source: Reuters, Strong waves caused by Cyclone Evan wash a beach in Queen Elizabeth Drive in Suva.

The societal need for warning or forecast information that could be localized, timely and in easily understandable language meets end users' needs. But the major hurdles and obstacles include a lack of capacity to generate localized and reliable operational science-based information; advances in generating hazard risk information that have not yet been incorporated into operational forecast systems; operational forecasts have not yet been integrated into decision-making processes in order to reduce disaster risks; and experience in communicating probabilistic scientific information for practical use by end users.

Lessons

- The 2015-16 El Niño event exposed the gap between humanitarian funding requirements to address El Niño-related emergencies and the capacity of the international community to respond. There have been increasing demands for humanitarian assistance, given the apparent increase in extreme

hydromet events attributed to a warmer global climate.

- TC Winston also provided important lessons on the value of *public-private partnerships*.
- Sustained commitments and investments are needed to improve regional and national climate services and establish and/or strengthen multi-hazard early warning mechanisms and preparedness for effective response at all levels to reduce the effects of extreme weather and climate events, including those associated with El Niño.
- A proper understanding of ENSO and its forecasting and application is essential to improve the understanding of TC climatology and variability and therefore ultimately reduce the risks and damages associated with TC occurrences.
- Undertake an assessment/review of lessons learned on what was predicted, communicated, what the impacts were and what actions were taken in the context of the 2015-16 El Niño.

The societal need for warning or forecast information that could be localized, timely and in easily understandable language meets end users' needs. But the major hurdles and obstacles include a lack of capacity to generate localized and reliable operational science-based

information; advances in generating hazard risk information that have not yet been incorporated into operational forecast systems; operational forecasts have not yet been integrated into decision-making processes in order to reduce disaster risks; and experience in communicating probabilistic scientific information for practical use by end users.

Maldives

The Maldives is facing environmental risks which leave the population highly vulnerable due to the far flung geography of its 1192 small islands, which are almost wholly at elevations below 2 meters from mean sea level. The islands are scattered on 26 natural Atolls on a North-South axis from 0.5°S below the equator to 800 km to the North (Figure 1, p. 32). Population has risen from 0.1 million (1960) to 0.35 million (2016), leading to urbanization and land use change and threats to sustainable uses of resources such as water.



Source: BBC.com
President Mohamed Nasheed and his cabinet met underwater,

Maldives has undergone constitutional reform recently leading up to multi-party election in 2008. Since 2010, there has

been a transfer of power and elections which have not been harmonious, resulting in deep societal divisions. All of this points to instability in society and governance. At the same time, threats toward sustainability such as sea level rise have become increasingly dire.

El Niño has significant impacts on rainfall, sea surface and land temperature, wind, and associated climatic features of the Maldives. It produces discernible impacts on water resources, hazards (including drought and floods), fisheries, agriculture, health (e.g. dengue transmission) and coral reefs. The impact on the coral reefs is particularly critical given the coral reef based geology of the islands. A significant coral bleaching event in the Maldives in 1997 was associated with El Niño. This is happening again in 2016.

El Niño influences vary by region, by season, and from event to event. Indeed, the climatology of the northern and southern islands contrast, with the rainfall climate dominated by the boreal summer monsoon in the north and by the boreal winter monsoon in the south. The El Niño influences are an additional contrast between the Northern, central and southern islands (See Figure 2): on the northern islands, the high rainfall during the summer of June to September is diminished during an event. On the central islands, El Niño usually leads to more rainfall in May and from October to December and less in June to August and from January to April. On the southern islands, rainfall is usually lower from June to August and higher from October to November.

Communication of these seasonal and regional nuances regarding rainfall has been tricky. The communication of temperature influences in the seas and on land are much more straightforward, however. The temperature warms during El Niño throughout the Maldives, and there is some modulation of sea conditions due to Indian Ocean dynamics. This inter-annual warming in conjunction with the warming of the regional seas has resulted in the rise of temperatures that exceed the tolerance of coral reefs.

Communications is further complicated by other oceanic and atmospheric events. El Niño influences are considerably modulated by the Madden Julian Oscillation, the Indian Ocean Dipole and warming Indian Ocean conditions. Of late, there have been drought emergencies declared on many islands, particularly in the north, leading to the need for costly supplies of desalinated purified water from water treatment facilities in the capital of Male'.

National preparedness for El Niño is within the umbrella of the Ministries in charge of Environment and Energy, Defense, Aviation, Fisheries and Agriculture. The Maldives Meteorological Service and the Water and Energy authorities function under the Ministry of Environment. The Disaster Management Centre is under the Ministry of Defense. These departments undertake primary roles in responding to climate extremes. The Marine Research Centre and other organizations under the Ministry of Fisheries, have been

proactive in monitoring coral reef bleaching due to the 2016 El Niño event.

The Maldives Meteorological Service is the authoritative body for weather and climate prediction and communication. Recently, considerable advancements have been made with the installation of prediction systems. Sustained attention of Ministerial officials and officials at MMS along with collaborations with organizations such as the Foundation for Environment, Climate and Technology, WMO and RIMES have also been helpful.

No dedicated funds exist from national sources for El Niño preparedness. The Disaster Management Center has emergency funding to deal with drought. Several International projects have also been implemented by organizations such as UNDP, World Bank, USAID. Although meant to address climate resiliency, these projects have made only small dents in terms of the country's needs.

The Maldives Meteorological Service relies on the WMO and other forecast centers. One of its officers participated in the recent South Asia Climate Outlook Forum (SASCOF), the April 2014 consensus projections from which called for a slightly dry tendency over the central and northern islands and a slightly wet tendency over the June to September period for the southwest (summer) monsoon. The SASCOF in October 2015 predicted a slightly wet tendency for October to December uniformly across the Maldives. These

projections are not consistent with the historical record for the southern islands.

The rainfall climate from April 2015 to May 2016 followed that of historical norms in gross terms for the northern and central islands in aggregate. There was slightly reduced rainfall in the June to October 2015 period in the north but the impact of this deficit was mitigated by high rainfall in May 2015. On the central islands, rainfall from July to October was high even for an El Niño phase. In November and December, however, it was not as high as expected. On the southern islands, the rainfall was highly variable from month to month with significant extremes. There was no clear-cut relationship with El Niño records, however.

All the islands experienced clear warming, which was expected during the El Niño, though the magnitudes of warming were much greater than due to El Niño alone. In particular, the overall temperature peaked between March and May 2016. These high temperatures were followed by reports of coral bleaching across the Maldives as registered by the Marine Research Centre.

Hurdles and Obstacles

The Maldives Meteorological Service provides extended range weather forecasts. Its officers also collaborate with the Foundation for Environment, Climate and Technology (FECT) to provide monthly statements to experts in fisheries, water and disaster sectors. The

information is also provided via social media and to newspapers.

Both of these forecasts are limited, emerging efforts and in the future a more sustained and concerted campaign is needed. The only exception was the study of coral bleaching during this El Niño: there were several sponsored efforts to monitor bleaching particularly in collaboration with the Marine Research Centre. Other sectors such as Fisheries and Disasters were not as proactive. While El Niño is a clear concern, the nuances are complex and communication of these differences has confounded several agencies.

Occasional news coverage in the English press was available during the event, though such coverage tended to focus exclusively on coral bleaching. Taken as a whole, the average person could only rely on media reports as alerts; they were not adequate to provide the basis for informed response.

The identification, prediction and communication of El Niño impacts is particularly challenging in Maldives. The Maldives has had success in bringing together scientists to work on monitoring bleaching, but analysis of the historical evidence for El Niño impacts on key sectors such as fisheries and tourism is still to be carried out. Evidence shows that Dengue transmission, which is the primary disease of current concern, has a direct relationship with climate variability. The evolution of this El Niño has lessons for future preparedness and bears further study.

Lessons

- Going into this El Niño, there was quite a keen sense of awareness of coral bleaching hazard and a recent tendency for water shortages, particularly in the northern islands. There was great interest in the media in relation to causes of and sensitivity to climate anomalies.
- Provision of seasonal climate information for the Maldives in the last few years has been led by MMS working with WMO and RIMES. There has yet to be reliable evaluations of confidence in these seasonal climate forecasts, however. Predictions from Global Forecast Centers do not represent the dynamics in the Indian Ocean well
- El Niño influence is modulated by other factors such as cyclonic events, the Madden Julian Oscillation and Indian Ocean characteristics, all of which must be better understood, especially through historical validation.
- Impact studies need to be expanded and deepened, particularly on key sectors, like the economy in terms of fisheries and tourism and the social in terms of water resources, disaster management and agriculture. The dependence of sea level on El Niño events also needs to be better understood, as do the combined influences of El Niño and Indian

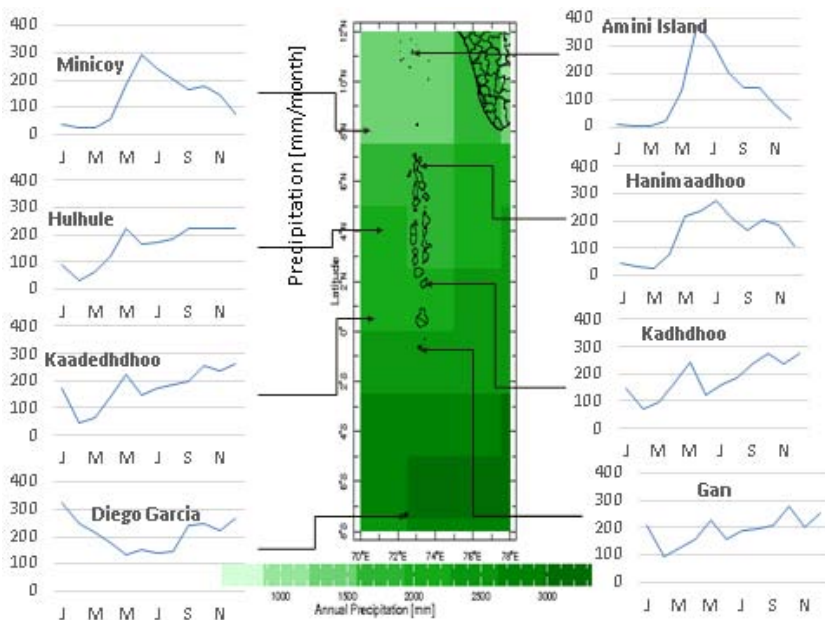


Figure 1: Rainfall Climatology on Lakshadweep-Maldives-Chagos Ridge spanning Indian, Maldivian and British claimed islands.

Ocean warming. In the future impact predictions are needed.

- What is known about El Niño, including its nuances and its impacts, needs to be made more

accessible to the general public. Programs can be effectively targeted at students. The lessons learned here shall bear on the next El Niño or La Niña.

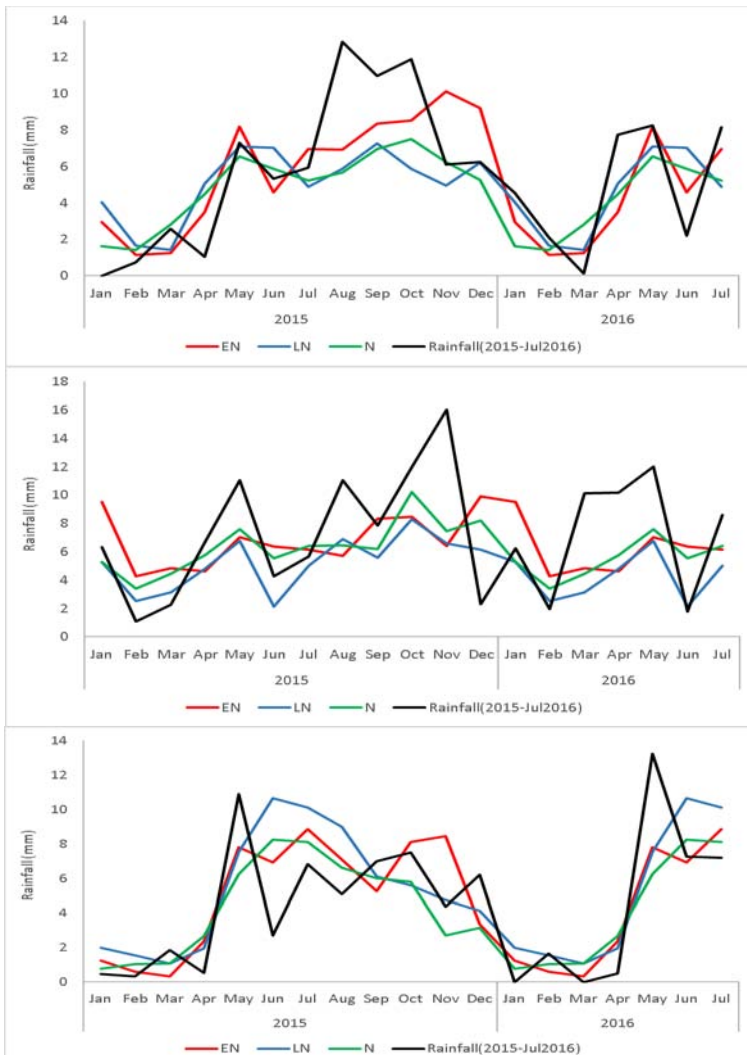


Figure 2: Rainfall climatology for northern (top panel), central (middle) and southern (bottom) Maldives during El Niño (red line), Neutral (green) and La Niña (blue) along with Rainfall for 2015 to June 2016 in the black line.

Pacific Island Region (Pacific Island Regional Preparedness for El Niño)

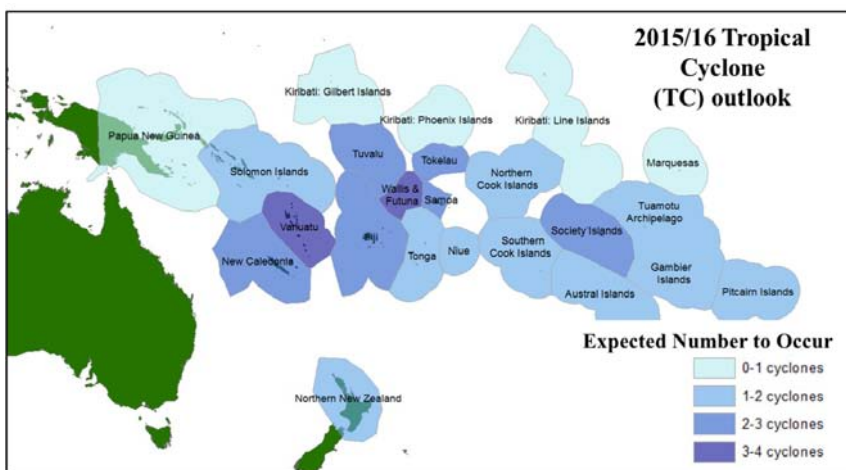
This case study focuses on the Pacific Islands as a region and not as separate countries each of which is concerned about El Niño impacts in its own way. In October of 2015 the First Pacific Islands Regional Climate Outlook was held and a Regional Statement was issued.

The report released on 16 October 2015 identified some potential impacts in the region, as noted in the following statement.

“Historically, El Niño has caused reduced rainfall in the southwest Pacific (from southern Papua New Guinea southeast to the southern Cook Islands) and enhanced rainfall in the central and eastern Pacific (e.g. Tuvalu, Kiribati,

Tokelau and Nauru). Also, El Niño usually affects the number of tropical cyclones and their preferred tracks. So, there is a risk of extreme rainfall events even where drier than normal conditions are forecast. El Niño events have also been associated with an increased risk of coral bleaching and changes in tuna catch. Note, impacts vary from event-to-event and across the region.”

Pacific island inhabitants experience El Niño primarily as seasonal-scale changes to their environment, including alterations to the ocean temperature, sea level, precipitation, and winds, in turn affecting plants and animals, including fisheries. The PIRCOF noted the following concerns for countries in the region: Tropical cyclone impacts in the region, lower than normal rainfall, higher temperatures, below normal sea level,



Source: niwa.co.nz Overall seasonal outlook for the number of named storms interacting with an island group based on the 2015-16 Island Climate Update tropical cyclone guidance.

coral bleaching, and reduced drinking water supplies. The impacts of El Niño, however, can last months, even years, after the El Niño event has passed.

When articles report specific events, such as a cyclone or drought, the information is highly localized—as it should be—without much perspective from a Pacific regional standpoint. El Niño is sometimes mentioned with respect to specific events and sometimes not. As an overview, the media representations of El Niño at a Pacific level are sparse and generally focused on expectations for the coming months. At the regional level, especially for El Niño-related activities, most of which are conducted through SPREP and SOPAC, little day-to-day difference emerges. Non-sovereign territories and sovereign states deal with each other effectively as equals.

Underlying vulnerabilities for the Pacific region emerge due to the islands' comparative isolation, frequent marginalization, small land area, small populations, and limited options for self-contained land-based livelihoods (e.g. Campbell 2009; Lewis 1999; Méheux et al. 2007). Consequences include limited internal resources and expertise for DRR, outside interests not always being fully aware of or interested in providing assistance, and significant expense for and barriers to mobility-related hazard responses such as evacuation. Despite these traits indicating vulnerability, they frequently yield resilience at the same time (e.g. Baldacchino 2005; Gaillard 2007; Scheyvensa and Momsen 2008).

As isolation has diminished in many places in recent times, new DRR and disaster response strategies have been adopted. These include remittances, development assistance, and humanitarian aid (Betram and Watters 1985).

Hurdles and Obstacles

El Niño in the Pacific region is said to be of high concern and garners a lot of attention from the media, scientists, and agencies. Much of the scientific attention is due to El Niño originating in the Pacific rather than due to specific impacts within the Pacific.

When examining detailed scientific evidence and actual responses to El Niño warnings, much at the Pacific regional level relates to expectations. Attributing specific impacts to El Niño in the region is difficult. Opposite impacts can occur within the large expanse of the Southern Pacific with regard to tropical cyclone threats, rainfall deficits or surpluses, etc.

The attention given to El Niño could shift blame from underlying causes of vulnerability to a hazard-centric viewpoint. As such, singular attention to El Niño must be understood as possibly degrading vulnerability reduction efforts.

El Niño is seen as a short-term concern to be dealt with when it occurs: it will fade in a matter of months and then the problems it causes will be solved—or so some believe. This construction comes partly from the media and partly from a natural hazard focus, which entails

addressing what is happening now rather than thinking about root causes and longer time frames.

Lessons

- Much discussion regarding El Niño and the Pacific problematizes El Niño, suggesting it is a threat to be addressed at tactical levels once an event is forecast. More strategic opportunities that might arise and be taken advantage of should be identified and acted on.
- No specific warnings or warning thresholds were evident for El Niño at the Pacific regional level (which might be different at the country level). Instead, information was available from multiple sources, which different regional players used in different ways to be informed about and to inform others about El Niño at different times.
- Some tactical responses said to be relevant to El Niño are presented by agencies and are discussed in the media. When examined closely, it is not evident that the responses are unique to El Niño, or are implemented solely because of El Niño. Instead, El Niño might have spurred specific tactical responses, but those actions were appropriate for longer-term disaster risk reduction anyway. Meanwhile, similar actions such as responses to reduced rainfall are implemented outside of El Niño periods. This work on disaster risk reduction should continue as part of El Niño preparedness and should be made more strategic.
- The media attributes observations of hydromet impacts to El Niño, even though these observations might not be related to El Niño. The media is, however, useful in raising awareness regarding wider topics such as the need for disaster risk reduction and longer-term capacity building. No evidence was found indicating that such awareness spurred new action. Further engagement with the media to focus regional preparedness messages (tactical and strategic) could be useful.
- At the Pacific regional level, there is no specific party or chain-of-command responsible for monitoring, identifying, and warning about El Niño. Discussion of El Niño at the Pacific regional level tends to be focused on an expected or ongoing El Niño, with limited comparison with previous years. Comparative analysis of impacts from and responses to past El Niño events could assist with current preparedness.
- Around the Pacific region, capacity building has been extensive and continues regarding NMHSs as well as wider DRR activities, including climate change adaptation. This work is strategic but is not identified as being specific to El Niño and is rarely explicitly linked to El Niño.

Overall, the Pacific Region cannot be said to be “El Niño Ready” yet, as parallel and wider work and initiatives that would contribute to El Niño readiness are all needed. A focus on El Niño specifically would need to be balanced between (i) El Niño used strategically as a catalyst to achieve wider development work and (ii) El Niño becoming a distraction from the fundamental concerns, which create and perpetuate vulnerability to El Niño among other hydromet hazard drivers.

Pakistan

Throughout Pakistan, El Niño tends to decrease precipitation drastically, resulting in scanty rainfall both in the summer and winter seasons, adversely affecting agricultural productivity. The 1997-98 El Niño induced shortfalls of precipitation, triggering Pakistan’s worst drought in terms of length and intensity. It lasted from fall of 1998 to spring 2003, well beyond the 1997-98 event itself (Naheed et al. 2013). Changes in the Indian Ocean dipole also play an important role in modulating the ENSO-related monsoon rainfall variability on multi-decadal timescales.

Pakistan faces multiple levels and types of challenges, some of which even threaten the future existence of the country within its current administrative boundaries. Major challenges include rising poverty, terrorism, regional insurgencies in El Niño induced drought prone areas, religious & ethnic extremism, poor governance, corruption, gender discrimination, a fragile

economy, deficient public institutions, ill-planned development processes, and political vulnerability to repeated military interventions. Prolonged conflicts on the eastern and western borders (India and Afghanistan, respectively) are another major challenge to the development and security of the country.

Natural disasters in Pakistan are primarily caused by hydromet phenomena, such as floods, storms, cyclones, landslides and droughts as well as geophysical hazards such as earthquakes. Climate change and variability, on top of existing socio-economic drivers of change such as population growth, rural to urban migration, globalization and haphazard economic development are major dynamic pressures that increase the vulnerabilities of Pakistani society to hydromet hazards.

Climate has been experiencing a rapidly changing trend embedded with the increased frequency and intensity of extreme events in Pakistan due to global warming. Increased frequency of torrential rains (e.g. 2010 Indus floods), prolonged heat waves, frequent tropical cyclones, recurring flooding and persistent drought are the phenomenal changes experienced in this deltaic region. Rapid deforestation and melting of glaciers in most of the north are contributing to floods downstream in the plains and to coastal flooding. The intrusion of saline sea-water in the lower Indus delta, with decreasing wetland and Mangrove land cover, has severely affected fertile agricultural land.

Pakistan has three levels of governance: national, provincial and district levels. At the provincial level, the Provincial Disaster Management Authorities (PDMAs) are the focal points of disaster management efforts. They are regulated at the national level by the National Disaster Management Authority (NDMA). The capacity of District Disaster Management Authorities (DDMAs), the frontlines to directly deal with disasters, has remained weak over the years and even their capacity building is poorly focused.

There is no mechanism as such in place to respond to El Niño forecasts or early warnings. Forecasts are mainly provided in a statement of potential drought conditions or excessive rains. There have been as such no El Niño readiness or preparedness activities undertaken so far in Pakistan.

Although in relation to the recent El Niño in 2015, improvements have been made in the warnings by the Pakistan Meteorological Department (PMD) & NDMA. Communication of general impacts have also improved. There were, however, no effective responses, preparedness activities, or mitigation actions taken up at the national or provincial levels. Another main reason behind such a lackluster government response is the lack of technical, financial, and human resource capacities at federal, provincial, and local levels.

The existing research work is limited in a sense in that it is mainly concentrated on El Niño impacts on summer monsoon rains. Developing region-specific

physical, social, and economic impacts of El Niño and its associated anomalous weather patterns have not been possible. Research interest to explore the socio-economic impacts of El Niño is growing in different parts of Pakistan. A lack of technical knowledge, skilled human resources, and high-tech computers for advanced model simulation, coordination, and financial resources have, however, restricted the government's El Niño preparedness activities.

Hurdles and Obstacles

In relation to the recent El Niño of 2015, improvements have been made in issuing early warnings by PMD/NDMA by using NOAA and/or WMO data and communicating its general impacts. There were, however, no effective responses, preparedness measures, or mitigation activities taken up at either national and provincial levels.

Even if the political will and more favorable conditions (e.g. the dissolution of insurgency) existed, the ability to generate accurate, spatially specific forecasts would be limited due to poor technical and financial capacity in relevant agencies. The current insurgency in Balochistan, the epicenter of El Niño induced drought, may, however, play a larger overall role in governmental inaction than the lack of availability of El Niño forecast.

Lessons

- Flood and drought forecast and mitigation capacity (as well as political will) are severely lacking in the current political and security environment.
- Generating awareness is an ongoing process even though El Niño is an irregularly recurring phenomenon. Societies have to consider the need to generate awareness continually at all levels of education as well within general society as via media, workshops, etc.
- PMD and concerned academic centers need capacity building to undertake scientific work on measuring the impacts of El Niño in various regions of the country.
- El Niño is presently not, but should be, included in Pakistan's national risk matrix.
- In view of the apparently increased frequencies of El Niño events over the last decades as well as its teleconnected impacts, filling the huge gaps and devising and implementing broad-based national level action plans on El Niño Preparedness and Readiness for Pakistan is imperative.
- Organizing El Niño impacts training and sensitizing programs for print and electronic media in Pakistan is needed.
- The probability of flooding increases in La Niña years, so a full ENSO readiness approach needs to be taken in the case of Pakistan.
- Utilization of El Niño forecast is not only a function of forecast availability but also of the political climate of the region (i.e. the presence or absence of insurgency), which plays a very important role in proactive governmental actions to mitigate the adverse impacts of El Niño induced drought.
- Further research to explore the socio-economic impacts of El Niño, particularly in those conflict prone districts of Baluchistan, is needed.
- A clear gap in knowledge and understanding of El Niño and related issues exists at all government, NGO, academic and community levels. Spectrum-wide awareness raising efforts are needed.
- El Niño preparedness coordination among concerned institutions at national and provincial level is also lacking. Such coordination could be established through existing mechanism among institutions like PMD, Ministry of Climate Change, NDMA, PDMAs, Planning and Finance Ministry. Ample opportunities exist for integrating El Niño preparedness in national level Disaster Risk Reduction (DRR) programs as well as for promoting social safety nets for vulnerable

communities living in El Niño impacted regions and districts

The Philippines



Source: PAGASA

One could effectively argue that the Philippines is ground zero for El Niño in the western Pacific. One of the most recognizable themes that was recurrent across all sectors was the warning of the upcoming El Niño. These came from scientists and meteorologists of PAGASA, the international scientific community, leaders of environmental NGOs, some legislators and local government and community leaders, as well as the federal government. This recurrence indicates a sense of urgency not just by the government but by all concerned sectors as to the need to address the impacts of El Niño.

First, it is important to note that the country is predominantly Catholic, and has a strong indigenous pre-colonial culture. The impact of this reality is such that El Niño, along with other weather and climate events, have a tendency to be treated not just scientifically but also in a mythical sense. For Typhoon Haiyan, for instance, much of the discourse (both online and in casual conversations among Filipinos) reflected the general

framing of the event, even among policymakers and some scientists, as an “Act of God.”

The Philippines is home to almost 170 distinct languages and 12 major ethnic groups, which does not even include smaller ethnic groups found at the peripheries of state society. Filipinos are said to have a very ‘regionalistic’ mindset, which is oftentimes perceived to be an obstacle to achieving national unity and a genuine collective identity.

- **Drought / dry spell.** The main concern of the Philippines, being an agricultural country with 41.7% of arable land devoted to agricultural production, is the impact of drought (or a “dry spell”), which is expected during an El Niño event. The occurrence of drought is highly important, affecting all the other secondary impacts mentioned in this section.
- **Decline in crop production.** Significant decline in crop production is common in El Niño years, prompting the government to institute mechanisms that would provide support to farmers in the event that farm output is adversely affected.
- **Crop damage.** The Department of Agriculture (DA) reports that the 2015-16 El Niño event resulted in almost P4.7 billion worth of losses in agricultural production, from the period of February 2015 to February 2016. The majority of these losses were in the areas of rice, corn and

other high-value crops.

- **Reduced economic growth.** Mainly due to crop damage and reduced levels of crop production, the Philippine government's main economic agencies have expressed a concern over a negative effect on the country's gross domestic product (GDP), effectively compromising expected gains in the last three years of the present administration. Unemployment was also foreseen as a possible economic impact of the event.
- **Food security/shortage.** Another result of damaged crops and low farm output is the shortage of food. As such, many affected communities experienced hunger brought about by a significant reduction of income, most of which came from farm production. Hunger (as a result of food shortage) is one of the more widely recognized impacts of El Niño in the Philippines.
- **El Niño-induced conflict.** A final unexpected impact of El Niño social. On 1 April 2016, a large group of farmers (mobilized by left-leaning activist groups and farmers' associations) took to the streets to demand of government much-needed assistance and humanitarian action as they—along with their families—were already suffering the harsh impacts of the 2015-16 El Niño event. The rally ended violently, as many farmers were caught in a clash with police forces

stationed to keep the peace. News agencies and blog-sites carried stories and commentaries of the situation, resulting in one of the most damaging incidents in the Aquino administration.

Government remains the main voice in shaping El Niño discourse. Journalists and news agencies rely heavily on information coming from relevant government institutions, which have been mandated to address the impacts of the event.

Hurdles and Obstacles

A PAGASA spokesperson noted that because of the commencement of the election season in the Philippines in February 2016, distribution of assistance to affected areas and communities had to be discontinued in accordance with Philippine election laws, which prohibits the execution of any form of government assistance as it may be used for unfair political leverage.

According to FAO's Claudius Gabinete, some international organizations admit to having a pro-farmer bias. This bias is due to the fact that farmers are oftentimes at the receiving end of El Niño's impact due to the chain reaction that comes with the event:

"When we talk about El Niño, it would mean less water, less rainfall. Less rainfall means less irrigation water. And if you have less irrigation water, you cannot plant. [Even] if you are able to plant, it will not grow that much.

Even if you harvest, you will harvest less—if at all. So for us [in FAO], El Niño is drought, dry spell, no water, no crops, low production. If you have low production, you have a problem of food insecurity. If you are food insecure, the government will try to provide some relief. That is why we always look at how best we can mitigate the impact of El Niño in agriculture.”

Apart from calling for effective governance and allocation of government funds on El Niño mitigation measures, NGOs and humanitarian organizations also express the need to address other “peripheral” issues such as hunger, nutrition, and deforestation (as contributory to weak irrigation systems), as well as the need for PAGASA to continuously improve weather services and information.

But what does this have to say about readiness? The data supports the idea that readiness in the Philippines context revolves around the physical reality that agriculture and agricultural production is and continues to be the top concern on all fronts.

Lessons

- One of the basic reasons for the poor response during the 1997-98 El Niño was the weakness of PAGASA to monitor and forecast the impact of El Niño at that time. The Climate Prediction service of PAGASA was not well organized

then, unlike today where there are trained people equipped with better tools and excellent access to data and information both here and abroad. The availability of the Internet is indeed crucial.

- Current climate services in the Philippines have shown the effectiveness of the climate prediction service. The conduct of regular climate forums helps to keep the public engaged with PAGASA and make them aware of ongoing climate events. Furthermore, PAGASA has provided customized information using GIS technology to help simplify expressions and make it easier to understand. As a result of these efforts, increases in the demand for climate information has been notable.
- The recent El Niño event showed remarkable improvements in information dissemination by engaging other agencies not in the sectors of Agriculture and Environment to participate in mitigation activities through Local Government Units (LGU), Non-Governmental organizations (NGOs), Department of Social Welfare and Development (DSWD), Armed Forces of the Philippines (AFP), Philippines National Police, and Department of Health (DOH). The Philippines has successfully institutionalized the practice of mobilizing all government institutions to support procedures such that line agencies

are required to formulate action plans whenever information is officially issued on a developing El Niño/La Niña event. These action plans are presented and harmonized by the National Economic Development Authority (NEDA).

- Resources tend to flow for disaster preparedness and response, once the president becomes informed of the looming impact of an El Niño/La Niña event. The Interagency Task Force usually takes the lead in activities that will determine and address the extent of damage and scope of assistance to be provided to vulnerable sectors. Its subsequent actions enable the government to look for resources to be pulled-out, to realign regular funds and to help augment the President's emergency funds.
- Line agencies cannot disburse funds to help people ahead of an impending disaster because of government rules to release and utilize public funds only during times of calamity upon the approval of proper authorities. This measure is intended to safeguard public money against possible abuse of the word "prevention" in disbursing public funds. When PAGASA provides information ahead to warn people of climate extremes about to happen, line agencies wait for the inter-agency Task Force to

formulate mechanism of gathering resources to address the creeping impacts of El Niño/La Niña.

- Current mitigation practices in the Philippines have demonstrated the effectiveness of information dissemination. Technical agencies like PAGASA share scientific products through the Interagency Committee, which collects, synthesizes and translates technical information into expressions most understandable to common end-users like farmers, fisher folk, aquaculturists, water conservationists among others.
- The recent El Niño occurrence has once again showed the importance of cooperation among different sectorial groups that contribute substantially in most aspects of public assistance particularly in information dissemination efforts.
- Scientific-based institutions such as PAGASA can help significantly in implementing strategies that provide earliest warning for communities.

Sri Lanka

Sri Lanka is emerging from a sustained period of civil war. The conflict affected resources allocated to infrastructure, community trust in government (in some regions), levels of scientific advancement, and unregulated private construction, all of which had influenced societal and environmental vulnerability.

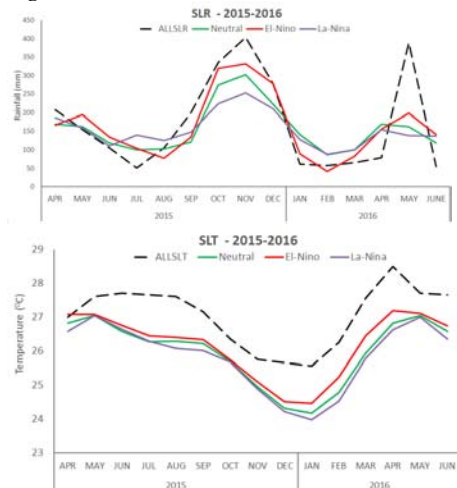
Population rise from 10 million (1960) to 20 million (2014) has also pushed more and more people into vulnerable locations which are prone to flooding, landslides and coastal inundation.

El Niño has significant impacts on rainfall, temperature, wind and associated climatic features in Sri Lanka. There are also discernible and documented impacts on Sri Lanka's water resources, hazards including drought, landslides and floods, agriculture, health (e.g. malaria transmission) and coral reefs. Floods, droughts, landslides, cyclones, storm surges and coastal inundation have become more common (Zubair et al., 2007). Water borne diseases and those that are affected by water availability for transmission such as malaria and dengue are also concerns.

There are, however, several reasons why El Niño influences are not as clear-cut in Sri Lanka as in other regions. El Niño influences varies somewhat from event to event, by region within Sri Lanka, by decade and most consequentially by season. In particular, El Niño influences on rainfall changes by season with more rainfall in May and from October to December and less from June to August and from January to April. The temperature remains warmer during all seasons during an El Niño event.

The following figure shows rainfall climatology for average Rainfall (top panel) and average Sri Lanka Temperature (bottom) during El Niño (red line), Neutral (green) and La Niña (blue) along with Rainfall/Temperature for 2015 to June 2016 in the black line.

Figure.1



El Niño influences are considerably modulated by the Madden Julian Oscillation, the Indian Ocean Dipole and warming Indian Ocean conditions. It is important to note that there have been recent major droughts and floods in Sri Lanka that did not coincide with El Niño.

National preparedness for El Niño is under the umbrella of the Ministries in charge of Disaster Management, Water Resources, Science and Technology and Agriculture. These Ministries do not coordinate action. The Department of Meteorology is in charge of prediction and communication of authoritative information, but progress has been slow in adopting prediction methods (Zubair, 2002 - IESL) until recently. Motivated individuals in other departments also pay attention to El Niño events and to climate variability in general.

There are no dedicated funds for El Niño preparedness from national resources.

The Disaster Management Agency, the Department of Agriculture and the Department of Meteorology have ongoing funding to deal with climate variability.

Severe droughts not due to El Niño are common. The chance of severe droughts and floods increases due to El Niño, depending very much on the rainfall in May. Rainfall in May is highly variable: enough can ameliorate prevailing dry conditions but too little can result in a total of nine months of dry weather that will only end after summer in August.

The Department of Meteorology relies on the WMO, IRI and other forecast centers. Its officers participate in the South Asia Climate Outlook Forum (SASCOF). The SASCOF of April 2014 predicted a dry tendency for the Southwest (summer) monsoon over Sri Lanka. In April 2015, The SASCOF of 2015 predicted a drier tendency for most of Sri Lanka, except in the northern region, which had a near-normal tendency. The SASCOF held in October of 2015 predicted wetter conditions for October and November and normal conditions thereafter.

The rainfall climate followed that of historical norms with increased rainfall in May and from October to December and decreases in other months. Temperature were higher in all months. There was flooding in 2014, but rice cultivation was not affected in the Yala season (April to September 2016) because of the high rainfall in May 2015.

Hurdles and Obstacles

The Department of Meteorology does month ahead predictions but it does not communicate these predictions. The Foundation for Environment, Climate and Technology (FECT) provides seasonal statements to water managers and via social media. Both of these efforts are limited and there are no concerted campaigns. In general, apart from newspaper reports, no preparatory actions have been reported since the communication failures for the 1997-98 El Niño (see Lessons). Global prediction centers are not that skilled in predicting the climate in the Indian Ocean rim particularly in regions that have both wet and dry seasons. While doing so is clearly desired, the nuances are complex and adequate communication has eluded several agencies.

There are no dedicated national funds for El Niño preparedness.

News coverage did not take advantage of the understanding of El Niño impacts on climate and economic activities even though these are readily understandable. Overall, the average person examining these reports would find them confusing and of no help for preparedness or mitigation.

The identification, prediction and communication of El Niño impacts is particularly challenging in Sri Lanka. There are several lessons here. Given the reticence amongst scientists to communicate the complex nature of El Niño evolution and its impacts, inexpert

others have taken it upon themselves to fill in the gaps, which has resulted in confusion. The outcomes of this El Niño do not give confidence for future preparedness. Remedial action is needed.

Lessons

- At the onset of this El Niño, quite a keen sense of awareness of drought hazards was clear, so the media took great interest in explanations of causes and reports of sensitivity to climate anomalies. The threat of drought, as much as the El Niño event itself, led to an interest in climate-related articles from news outlets.
- Due to past failures in predicting and communicating impacts in Sri Lanka, concerns over levels of uncertainty restrained robust communication and action based on El Niño predictions.
- For example, during the 1997-98 El Niño, drought was predicted and communicated in Sri Lanka without any nuance about seasons. This resulted in the wrong mitigation action taken, such as growing chilies and not harvesting tea, in the ensuing wetter than normal conditions. Massive losses in agriculture were due to poor communication.
- Predictions from Global Forecast Centers do not represent the dynamics of the Indian Ocean well,

which is particularly consequential for Sri Lanka.

What is known about the El Niño and its impacts needs to be made more accessible to the general public. The lessons learned here shall bear on the next El Niño or La Niña.

Vietnam



Source: Viettimes.vn

El Niño 2015-16 has had significant impacts in Vietnam, especially in agriculture, hydro-electricity production, health, water security and food security. In the first three months of 2016, the agriculture sector showed a decrease in production due to the effects of El Niño. Many hydropower plants stopped producing electricity because of the lack of water. Many citizens are also threatened by harvest lost and shortages of fresh water. In addition, El Niño 2015-16 has also raised tensions of over-managing trans-boundary rivers such as the Mekong.

The National Meteorological and Hydrological Services (NMHSs) provide information on hydromet hazards to

DRR/ DRM agencies and early warning system (EWS) stakeholders.

The first official early warning of El Niño 2015-16 in Vietnam was issued on August 27, 2015; most Vietnamese people believed the pronouncements of the NMHS.

Vietnam has developed systems of climate change adaptation (CCA) and disaster risk management (DRM)/disaster risk reduction (DRR) through a top-down approach. The country suffers from weather- and climate-related disasters such as storms, floods, droughts, typhoons, heat waves and salt water intrusion, much of which is due to its geographical setting. El Niño can be considered as an important factor in DRM in Vietnam.

The Vietnamese believe that their government must take the main role in responding to the phenomenon and its impacts.

The effects of El Niño on weather and, more generally, hydromet disaster risks in Vietnam has been a concern; the frequency and intensity of El Niño and La Niña events have witnessed an upward trend; however, related research in the country is still rather limited. Studies on ENSO-related hazards such as tropical cyclones, floods and droughts are being conducted by various agencies in Vietnam, but the overall knowledge of the quasi-periodic ENSO cycle has mainly been acquired and extrapolated from international sources.

Similar to other El Niño occurrences, the media headlines are likely to draw immediate attention to El Niño events, but soon after attention tends to focus more on its related impacts such as drought and salt-water intrusion.

At present, the public's awareness of El Niño and the ENSO phenomenon as well as of climate change related hydromet hazards is still limited and response tends to be reactive. Many stakeholders do not know about its frequency or socio-economic and environmental impacts. They also do not know how or when to address it (either tactically or strategically). Their comments show their perceived powerlessness in the face of hydromet hazards. Vietnamese people are usually not prepared to deal with those hazards.

Vietnam's emphasis has been mainly on the construction of sea dikes for disaster risk reduction and irrigation systems (Nguyen Huu Phuc, 2011).

Hurdles and Obstacles

Vietnam lacks high levels of expertise, technology and funding. Experts from the Water Resources University (Hanoi) indicated the troubles in policy and in coordination between stakeholders and ministries. Because the policy is quite new, many stakeholders do not know how to follow them.

According to experts in the Water Resources Directorate, it could be because of a top-down approach and an absence of a development strategy for

specific sectors that up to March 2016 only one billion VND out of the total of 700 billion VND had been allocated. Weak coordination was also seen between related ministries in attempts to secure underground water supplies for domestic water consumption in mountainous and other areas of Vietnam where water shortages are common.

Lessons

Convincing the government of the importance of El Niño research remains an issue, especially in terms of teleconnections that affect Vietnamese environment and society.

- The Vietnam Government is likely to remain passive when dealing with El Niño in terms of strategy. Lessons experienced from previous events are not likely to be considered in DRR.
- The authorities should more proactively guide people to deal with El Niño events.
- Better mechanisms are needed to raise awareness so that the public can better respond in terms of both DRR (Disaster Risk Reduction) and drr (disaster response and recovery).
- Broadcasting early warnings and knowledge of El Niño should use more diverse media. Instead of only publishing information in newspapers, short videos about events should be made available in broadcasts throughout the days in

addition to daily weather forecast programs.

- The Ministry of Agriculture and Rural Development (MARD) plays a crucial role in overseeing El Niño-related preparedness in Vietnam. For better preparedness, however, El Niño deserves involvement by all agencies, ministries and people.
- An El Niño early warning was announced in August 2015, but local governments continued to pursue routine agriculture productions (focusing on rice production) in order to meet MARD targets. Electric power companies sought to meet the targets of MOIT. Both agriculture and energy sectors are disrupted by El Niño in Vietnam, so planning must be adjusted when forecasts are announced.

The NHMS cooperates with international partners of the World Meteorological Organization (WMO) to establish climate forecasts and outlooks for three-month periods based on ENSO information on the possibility of temperature extremes and drought events.

Latin American Region

Central America

Central America is well known for the occurrence of major hydro-meteorological disasters such as Hurricane Mitch (1998) during which over 11,000 people were killed and

damages of more than five billion USD were calculated. While extreme events with excessive amounts of rain are more likely to gain media attention, the lack of rain (meteorological drought) can cause great damage across longer time scales. Both phases of ENSO produce effects in Central American countries. During El Niño there is a tendency towards drought and during La Niña towards increased rainfall. Understanding underlying social vulnerability is essential in order to reduce the risks in one of the poorest regions of Latin America.



Source: Based on the Central American Atlas for Sustainable Territorial Management.

Central America (Purple represents "the dry corridor")

Although all countries of the Central American dry corridor are exposed to drought risk, Guatemala, Honduras, El Salvador and Nicaragua have witnessed the most significant impacts. Drought affects maize and beans crop production thereby increasing the risk of food insecurity, as maize and beans are staple foods in the region.

While the seven countries in the region share cultural characteristics like the common use of Spanish (except Belize, a former British colony), they also show

structural differences. Costa Rica has an image of prosperity based on tourism, while El Salvador and Nicaragua are still healing the wounds of armed conflicts dating back to the 1980s. There are big economic and political disparities between Central American countries.

The climate system of the region is characterized by a great variability influenced by various oscillations, such as the Pacific Decadal Oscillation, the Multi-Decadal Atlantic Oscillation and the quasi-periodic El Niño Southern Oscillation (ENSO). The ENSO warm extreme is related to a reduction in rainfall during half of the rainy season (July-August) in the period known in Spanish as "canicula" or "veranillo," which affects Central America's dry corridor that runs from southern Mexico to Panama. Droughts in the region are a risk factor for increased food insecurity, with subsistence farmers being the most vulnerable. The United Nations Food and Agriculture Organization (FAO) estimates that during the 2015-16 El Niño "More than 1 million families dependent on subsistence agriculture live in the Dry Corridor."

One of the biggest challenges for preparedness is the timing and legitimacy of the declaration of the onset of El Niño. In previous years, NMSs used to declare alerts mainly by using external sources of information, especially from NOAA. In recent years, sharing expertise and data in regional Climate Forum has been a way for NMSs to produce knowledge about El Niño and generate their own capacity to detect it and alert their governments, sometimes even before

NOAA. Governments have, however, hesitated to take the risk of unblocking prevention funds without NOAA's validation of an El Niño's presence. This symbolizes a conflict for decision-making as governments seem to mistrust their own NMSs.

During the 2015-16 El Niño alerts came mainly as forecasts distributed by each NMS. These seasonal outlooks had been previously discussed in climate forums. The flow of information about El Niño is clearly related to the risk of drought, but the NMSs are not the only institutions to disseminate information.

Intergovernmental organizations such as the FAO, the World Health Organization (WHO), and the Inter-American Institute for Cooperation on Agriculture (IICA) are also linked to El Niño preparedness. NGOs, particularly those focused on food security such as OXFAM, Action Against Hunger and the Famine Early Warning Systems Network (FEWS NET-USAID), also play active roles in the region.

Although the hydro-meteorological service in each country has its own institutions, there are also regional cooperation mechanisms such as the Central American Integration System (SICA) that have agreed to discuss and produce regional knowledge despite the differences in local capacities in all seven countries in the region.

Hurdles and Obstacles

NMSs need to acquire more credibility with their own governments. The seasonal outlooks and forecasts are

considered as indicators and alerts, but their use in decision-making is still vague.

Central America requires further development of local capacities with the training of new staff. The lack of scholarships and work incentives make staff rotation a common issue, making it urgent to hire new professionals who remain permanently in the different positions required by the NMS. This would increase their ability to produce information, forecasts and prevention tools.

Integration and knowledge sharing platforms remain limited since the disparities in Central America are quite pronounced.

Lessons

- Central America has previous experience with El Niño impacts.
- The NMSs have learned to interpret the signs of El Niño and to generate their own information. They are the first to identify changes in El Niño indicators.
- Some of the biggest challenges for an NMS is to be credible in the eyes of its own government. This lack of confidence increases uncertainty and puts into question the reliability of cooperation mechanisms such as the Climate Forum.
- Although there are important differences in terms of the

capabilities of each NMS, the regional approach can produce seasonal forecasts that can help complement knowledge from those countries like Guatemala and Honduras that have less modernized NMSs.

The El Niño 2015-16 was detected in time to take action; however, preparedness capacities of each country remain very uneven. Preparation for El Niño's impacts tends to focus on responses to the humanitarian and food security crises in Guatemala, Honduras, El Salvador and Nicaragua.

Cuba

Cuba comprises the island of Cuba as well as Isla de la Juventud and several minor archipelagos. It is a developing country with a one-party system and top-down planned economy that is dominated by tourism and the exports of sugar, tobacco, coffee and skilled labor.



Cuba's government controls the media, organizations and agencies, so civil society/individuals are usually not able to make or coordinate actions on their own. The safety mechanisms in Cuba drive the

national government and the civil defense. In order to strengthen the capacities of the country and the territories to face high intensity earthquakes, tidal waves, hurricanes, droughts, and health disasters, the METEORO exercise is carried out annually, simulating preparations for and ways of coping with the occurrence of such hazards.

The El Niño that began in 2015 in Cuba caused millions of dollars in losses in agriculture, affecting crops such as sugarcane, tobacco, rice, coffee and vegetables. Nearly 90,000 tonnes of rice were lost in 2015 due to water shortages. Droughts added further losses in vegetable and grain crops, but due to winter rainfall sugar and tobacco harvests were also affected. Crops of tuberous vegetables such as potatoes were also poor.

Cuban climate associated with El Niño tended to be very rainy and sometimes stormier between the months of January and April in 1997-98. After the dry month of October, the months of November, December, and January were rainy in the west and center of the country. Strong winds and high temperatures in December led to losses in potato and tomato fields, among other crops.

A weak El Niño does not cause, in general, significant changes in the rainfall and temperature patterns in Cuba. If they are moderate or strong, they can lead to severe storms, persistent rains and coastal flooding by sea penetration (intrusion) into low-lying areas of the northern coast in the western region, mainly in the Malecón in the heart of Havana.

El Niño information and forecasts come from the Climate Outlooks issued by the Climate Center of the Institute of Meteorology from Cuban specialists based on NOAA information. This information is used to develop a Cuban forecast for the next hurricane season. The information serves as a basis for extended range forecasting, because El Niño's impacts in Cuba are delayed by about 6 months after El Niño's onset.

The Institute of Meteorology's Climate Center is responsible for providing predictions about everything related to the weather over three months periods, and in its forecast El Niño is noted. The analogues of potential impacts are used and are dependent on the intensity of the El Niño event. If they are weak, they do not cause, in general, large changes in the circulation and, therefore, large changes in rainfall and temperature patterns are not observed. If they are moderate or strong, the analogues of 1982-83 and 1997-98 are analyzed, which correspond to strong El Niño events that led to severe storms, persistent rains and coastal flooding by sea penetration into low-lying areas of the northern coast in the western region, mainly in the Malecón in Havana where

the water penetration inland reached up to 500m.



Source: Anon. Waves hitting the Malecon.

According to the newspaper Granma (July 25, 2015), "The main impact of ENSO on Cuban weather usually occurs between January and April of the year after its appearance, generally when rainfall totals exceed the normal values for that season. Also, it sometimes increases the episodes of heavy rainfall, severe local storms and coastal flooding. Likewise, in certain moments, there has been a marked decline in rainfall in the period from August to October, as in 1972, 1982 and 1997 (the year of El Niño's onset)."

There is cooperation among agencies including many institutions related to science and the environment. They join their efforts to strengthen inputs that could be useful in developing the forecast of severe events associated with El Niño at short and middle time scales.

The media in Cuba is fully controlled by the government. In an El Niño event, the media is responsible for reporting to the population the measures taken by

provincial governments, the events predicted by specialists of the Institute of Meteorology, and other news items about El Niño impacts from other countries. The media is an effective link between the Forecast Centre and the community, having a strong influence on the content of as well as the way information is received by the people.

Hurdles and Obstacles

- Risk perception by society concerning El Niño is all but non-existent. El Niño is not like a fast developing cyclone, tropical wave, or cold front. Neither is it a relatively short episode or a phenomenon visible through a satellite image. It does not occur in the nearby Atlantic Ocean or Caribbean Sea, but in the tropical Pacific. In the past 50 years, the most severe El Niño-events appeared in a time interval from 14 to 17 years, which is too long to be remembered by most people.
- The national government grants funding for research aimed at the understanding and prevention of hazards and disasters associated with severe weather events such as tropical cyclones, strong cold fronts, coastal flooding, and severe storms lines. The latter hazards are more related to El Niño effects, however, demanding an infrastructure of rapid response to those events and immediacy in the forecast in the very short term because those events are of very rapid evolution. The RSS

channel was opened on the website INSMET.com, but it is still insufficient to reach the majority of the population, especially those not living in the major cities.

Lessons

- Presently, there is no real risk perception by society about El Niño as a hazard because it is not like a fast developing cyclone, tropical wave, or cold front.
- To increase the risk perception about El Niño, there should be an increasing and long-lasting effort in building capacity and increasing awareness in society.
- Various agricultural associations need to plan strategies at the local level using El Niño forecasts. Although NGOs might not have direct investments, they can influence the population to increase awareness.
- The negative effects of the 2015-16 El Niño were very significant in the damage of infrastructure in large cities (mainly Havana), due to population growth and poor maintenance capacity. Consequently, vulnerability increases, and disastrous effects become more noticeable.

The Panama Canal

The Panama Canal (Spanish: *Canal de Panamá*) is a man-made 48-mile (77 km)

waterway in Panama that connects the Atlantic Ocean with the Pacific Ocean. The canal cuts across the Isthmus of Panama and is a key conduit for international maritime trade.



Source: panamaextrema.com

The Watershed of the Panama Canal (CHCP), which is used for different purposes, is the most important hydrological resource of the Isthmus. The contributions of the Chagres River water are used mainly for human consumption in the cities of Panama and Colon, for operation of the Panama Canal, and for generation of hydroelectric power.

The Panama Canal Watershed has shown vulnerability to climate change phenomena at various times, two of which came from extreme events that occurred in 1997-98 and in December 2010. The effects of these events, drought in the first place and excess rain in the second, affected the whole country with losses of and damage to human lives, infrastructure, health and food security, and economy. A diminished supply of drinking water production for Panama and Colon Provinces was also

seen. In both cases, canal operations had to be stopped.

Panama's climate presents two distinct seasons, a rainy season (mid-April to mid-December), and a dry season (mid-December to mid-April). El Niño has ample repercussions in Panama. It is characterized mainly by the alterations that it causes to regional precipitation patterns.

Panama is typically affected by winter drought during El Niño years. Large-scale subsidence and orographic effects are mechanisms by which El Niño affects the central eastern and western Caribbean. The intense anomalous convection in the eastern Pacific generates greater circulations down on the Caribbean Sea, which inhibit deep convection and normal winter rains.

A significant element to consider in summers during El Niño is the intensification of trade winds over the Caribbean. Intensification results in more rain on the Caribbean coast of Panama, while also producing a deficit of precipitation in central areas and along the Pacific coast. The intensity and duration of the deficit of rain in the country is highly correlated with the intensity of the El Niño event.

El Niño is responsible for causing major problems to the economy of the region, and consequently to the economy of Panama. The appearance of these events affects not only the economy of the country, but also the life of its inhabitants. El Niño affects several socio-economic sectors in the Republic

of Panama. These sectors include but are not limited to the following (Cathalac, 1995): water resources and energy, natural resources, agriculture, fisheries, and health.

Comparing the impacts of the 2015-16 El Niño event on the Panama Canal with the 1997-98 El Niño as a baseline, taking consideration that the social conditions of the country have changed with rapid migration of the population into the city is necessary. In addition, the Panama Canal Authority apparently learned to take action after coping with past events in 1982-83 and 1997-98. In term of rainfall amounts, the 2015-16 event was similar to the 1997-98, but the impacts were different.

SINAPROC is responsible for coordinating DRM in Panama as the highest-ranking authority in the event of a natural catastrophe or man-made emergency. SINAPROC is also charged with executing the actions, regulations and directives towards the removal or reduction of the negative effects of disasters on human lives, goods and society.

In the summer 2015, the Panama Canal Authority issued early warning about possible draft restriction for passing vessels due to potentially negative effects from El Niño and the drop in rainfall. El Niño event may also cause serious reductions in rainfall and drops in water levels in the Gatun and Madden reservoirs. This can seriously affect canal operations and can create greater need to institute draft limitations on vessels.

In March 2015, NOAA's Climate Prediction Center (CPC) confirmed the arrival of weak El Niño conditions. In July, El Niño conditions were forecast to intensify into strong conditions by fall and winter of 2015. The CPC expected a greater than 90% chance that El Niño would continue through the 2015-16 winter and a more than 80% chance that it would last into the spring of 2016. In addition to the warmer than normal waters generated by the El Niño conditions, in August 2015 the CPC reported that this El Niño would be one of the strongest on record. The canal had already suffered the driest June in 84 years.

Not all El Niño events have the same impacts on the country. Impacts are highly dependent on the intensity of the event. Weak and moderate events may have little or no noticeable effects in Panama. In the last 90 years, according to research by the Smithsonian Tropical Research Institute, there have been El Niño events that had little or no significant effect on annual rainfall over the canal area, which at least partially explains the low priority given to El Niño forecasts in the past. Priority changed after the strong 1997-98 event. The 2015 El Niño onset coincided with previous drought conditions in 2013 and 2014, when rainfall was below historical averages. The El Niño of 2015 reinforced the deficit and resulting water crises had major impacts on Panama's economy.

Panama is a country where news media in both the television and the press tend to be sensationalist and reactive. They keep attention on disastrous climate

events when they are occurring. They also tend to seek explanations or faults. No disaster prevention/education actions are provided in the media.

Hurdles and Obstacles

In general, the 2015 El Niño event was considered as or even more intense than the 1997-98 event. The ACP achieved better water resources management and was able to take timely actions that enabled continuation of its economic and social activities. Unfortunately, this view was not the same in other economic sectors of Panama, where the refusal to take actions to address the event and the lack of serious scientific research were followed by poor dissemination of information about it in the media.

Lessons

- Based on lessons learned from the 1997-98 El Niño impacts, the ACP developed operational actions for the conservation of water resources in the canal watershed. Since late 2015, the Gatun hydroelectric power plant was taken offline and hydraulic assistance in the operations of the locks was eliminated.
- Other measures have been designed to save water in canal operations, including the transit of more than one ship in a lock. The canal has an active plan for the protection of forests and reforestation. Projects to deepen the navigation channel of the canal have also helped to improve reserves of water.

- Mitigating impacts has been crucial. New strategies to this end have been established for the use of water, to develop crisis plans to respond to possible damage to the canal and its watershed, and to work on new contingencies to address risks.

El Niño Ready Cities (ENRCs)

San Diego, California (City)

The City of San Diego has a strong, democratically elected mayor and council form of government. It is the eighth largest city in the United States and the second-largest city in California. For southern California and the City of San Diego, El Niño typically means warmer summers with more moisture in the winters and above normal precipitation and frequent storms between December and March. This can contribute to coastal erosion and flooding, which can be accelerated during storm events. Previous El Niño years associated with heavy precipitation and flooding in southern California include 1982-83 and 1997-98. In San Diego, the 1982-83 and 1997-98 events both brought heavy precipitation and flooding, particularly along the San Diego River and its tributaries.

Understanding the processes that drive El Niño-Southern Oscillation (ENSO) extremes is an important component of forecasting warnings, which provides critical information to coastal communities and policymakers (Allan and Komar, 2006). Most of the research

and climate predictions concerning El Niño in San Diego are available from the San Diego National Weather Service (SDNWS) and the University of California, San Diego (UCSD) Scripps Institute of Oceanography (SIO). These centers for climate predictions provide guidance to San Diego policymakers for decisions related to El Niño preparation and management. The SDNWS maintains the current status of El Niño and includes monthly updates on El Niño conditions.

In addition to the SDNWS web page, the SDNWS and SIO provide secondary sources such as social media that primarily targets the public. Popular social media outlets such as Facebook and Twitter, are both updated daily. The NWS YouTube Channel and Weather-Ready Nation provides public education for weather preparation.

Visible impacts produced by 2015-16 El Niño-generated storms included flooding and coastal damage. Flooding in San Diego occurred in anticipated flood zones such as Mission Valley, Sorrento Valley, and coastal regions as well as in higher mesa areas such as Kearny Mesa. Coastal damage included erosion and sinkholes in La Jolla and Del Mar. Flooding also occurred across roads that were built directly over the San Diego River. An example is the Avenida del Rio in Mission Valley where water and sediment flooded over the road, causing road closures that lasted until the river stage declined. Urban channels such as Alvarado Creek flooded during an El Niño driven storm. Alvarado Creek is a

typical urban channel tributary to the San Diego River that frequently floods during winter storms due to invasive species and decreased channel capacity.

As of June 2016, the overall cost of the 2015-16 El Niño for the City of San Diego Department of Transportation and Storm Water for their Storm Water Division was approximately \$1.2 million USD. The cost included personnel expenses and infrastructure expenses (e.g. pump station maintenance/repair, structure inspection and cleaning). Other departments' overall costs for 2015-16 El Niño damages were not reported.

Preparation for El Niño related storms is financially supported by the City of San Diego and additional funding for specific mitigation activities is allocated accordingly. For example, the City of San Diego declared a state of emergency in November 2015, which allowed the city faster access to state and federal funding (Alvarez, 2015). Those involved with El Niño preparation within the city range from government departments to residents. To prepare for El Niño storms and impacts, San Diego agencies pre-developed plans in the event of an emergency. Local agencies were also involved in ensuring that the city and its residents were prepared, providing resources and education as well as outreach services.

El Niño warnings are widely disseminated to the public through media outlets such as the television news, radio, city websites, social media (e.g., Facebook, Twitter, and YouTube), and mobile alert messages for smartphones.

Although challenges to El Niño preparation were identified, San Diego's civic agencies were prepared and able to take action with their own pre-developed plans. These agencies also noted that storm preparation is an ongoing process, not limited to just El Niño.



Hurdles and Obstacles

Some barriers and challenges to preparing for the 2015-16 El Niño were noted.

- Red-tape involving environmental permitting in order to clean out storm channels impeded prompt action for El Niño preparedness. Under normal circumstances, permitting can take about one to two years to complete (City News Service, 2015). After the onset of an El Niño forecast, however, and again when its accompanying storms occur, the city may declare a state of emergency, allowing it to obtain fast-tracked permits in order to clean clogged storm channels. In addition, the state of emergency allows the city to procure other funding for storm-channel maintenance.
- Another challenge was the weather forecasts for this El Niño 2015-16 season (Hoell et. al, 2016). Predicting El Niño storm events currently remains a challenge and the amount of precipitation that the San Diego region expected was

overestimated (Robbins, 2016). The total amount of precipitation anticipated in Southern California was displaced to Northern California because the El Niño-strengthened jet stream ending up traversing primarily across Northern California and the Pacific Northwest rather than Southern California (Swain, 2016).

Lessons

In previous El Niño years, challenges arose from inter-agency communication and coordination, resulting in slower response times and less efficient mitigation actions. In the 2015-16 El Niño season, agencies emphasized the importance of collaboration between agencies and took specific efforts toward establishing lines of communication throughout the season.

- Interviews with representatives from key agencies indicated that there was less interagency communication and collaboration during previous El Niño events than during the 2015-16 event. In general, more communication and pre-planning for emergencies has resulted in quicker response times to emergency events.
- Collaboration and communication among different agencies is vital for San Diego to be El Niño ready, which means improving efficiency and response times to emergency situations.

- Pre-planning and practice for flooding events is important, providing preparation and coordination of agencies emergency situations.
- Having the most recent and up-to-date information and data are needed to keep agencies informed and to provide adequate lead-time for preparatory actions.
- Forecasts of El Niño events are not always correct (e.g. the 2014 El Niño forecast). This uncertainty complicates precautionary mitigation strategies and procedures (Chen et al., 2004; Chen and Cane, 2008; Glantz, 2015b).

Tijuana, Mexico (City)

The concept of El Niño Ready Cities (ENRCs) is one where institutions and citizens recognize El Niño and take actions to prevent potential damages and to take advantage of positive impacts. Prevention means, ideally, to prevent disasters, not only to be ready to face emergency situations. This includes reducing vulnerability and risk, which is a process that requires the integration of tools, knowledge of risks, and coordination between institutions and general populations.

Tijuana is located in the state of Baja California Norte and is the largest city in western Mexico. San Diego, just across the border, and Los Angeles, 132 miles away, are fundamental parts of the

economy of the city. Although San Diego and Tijuana have been separated by a border wall since 2007, they are part of the same economic region: everyday over 300,000 people legally cross the border to go to school and to work in the United States, making San Ysidro the most crossed border in the world.

In Tijuana official land regulations have been overtaken by the realities of uncontrolled urban growth, which is partly explained by the city's location as a meeting point for a migrant population and industrial development. This is especially the case since Mexico signed the North American Free Trade Agreement (NAFTA) with the United States and Canada.



Source: info7 News

The impacts of El Niño are geographically located in the Tijuana River basin, which crosses the border and includes San Diego, California. Although very different in terms of their risk profiles, both cities are linked by weather systems, the river and regional economic dynamics by which they share much more than just the international border.

In terms of DRR, there is a lack of local capacity for producing concrete data to

enable decision makers to implement long-term preventive actions and, moreover, to take advantage of the positive effects of El Niño. The primary source of information consulted by regional decision makers and municipal government officials is mainly NOAA and the US National Weather Service; preventative actions are designed to deal with possible emergencies and disasters, especially landslides and floods.

The NMS and the regional Ensenada Center for Scientific Research and Higher Education (CICESE) also provide permanent Internet platforms for El Niño alerts and seasonal forecasts, though there is no Early Warning System (EWS). During the 2015-16 event, both institutions alerted the public about El Niño, which was quickly integrated into the municipal agenda. Expectations of the "El Niño Godzilla" were also increased by mass media and social networks. Officers were mobilized to implement a series of preparedness measures through various municipal and state institutions, most of which were focused on cleaning of drains and canals.

Generally speaking, the people in Tijuana know what El Niño is and they link it with extraordinary winter rains. The effects of El Niño are different in each region of the country. In southern Mexico its effects are correlated with a decrease in the amount of rain and negative impacts on agriculture, especially in the state of Chiapas, which is part of the Central America dry corridor. In the Northwest where Tijuana is located, winter rains tend to intensify during an El Niño. Colder winters tend to

be experienced across the country during an event (Magaña, 1999).

Hurdles and Obstacles

- Two of the most important issues facing Tijuana are infrastructure that is insufficient to handle large amounts of rainfall and the need for more efficient mechanisms for regulating urban development; only 10% of the city has rainwater-harvesting coverage. Lack of an efficient waste collection service is another important problem because the trash clogs the channels and streams in most marginal neighborhoods when heavy rains occur.
- Seasonal forecasts enable El Niño to be included on Tijuana's local agenda. The information is broad, however, so integrating it into the planning decisions of productive sectors and government can be difficult. Forecast also rarely reach the general population, among which information tends to remain limited to warnings about the probability of the presence of the phenomenon as well as its expected intensity.
- In Tijuana there is no weather radar capacity, though the proximity to San Diego's radar enables officials to access a level of detailed information that would otherwise be unavailable.
- At the organizational level there are other kinds of limitations. For

example, the government system in Mexico's municipalities is such that governments change every three years without eligibility for re-election. This produces problematic issues of discontinuity for officials. The result is a turnover that discourages long-term professionalization and planning. Some officials are trained, but once they have learned how to govern, they have to prepare to leave office. Likewise, salaries are not adequate to encourage staff retention among employees otherwise unaffected by the three-year turnover mandate.

- Some of the existing instruments of decision making such as municipal risk cartography were access restricted for online public consultation during some periods of 2015-16. Others had outdated databases.

Lessons

The 2015-16 El Niño produced less damage than expected and no reports of casualties. Nonetheless, it presented an opportunity for institutions to test their prevention mechanisms. In general terms it can be seen that there were no surprises; preventive measures directly related to El Niño effects were taken.

- The 1997-98 El Niño remains in the memories of people and institutions today.
- Relevant scientific material was produced immediately after the

1997-98 even, but little production occurred after this period.

- The various institutions considered El Niño as a hazard and put it forward as part of the 2015-16 preparedness agenda.
- Collaboration exists between the cities of Tijuana and San Diego. Both Mayors have met to develop agreements for facing El Niño, particularly by monitoring the levels of the Tijuana River and the Abelardo Rodriguez Dam.
- A challenge for Tijuana will be to develop readiness capacities that span long-term periods, even when an El Niño signal is weak or not present.
- The primary source of information consulted by decision makers and municipal government officials is NOAA and the US National Weather Service.
- There is no early warning system.
- The vulnerable population receives warnings by traditional media (e.g. radio, television).

El Niño Ready Cities: A Trans border comparison in San Diego (California, USA) and Tijuana (Baja California, Mexico)

El Niño 2015-16 was anticipated to be one of the most intense in recent history.

The cities of San Diego (California, United States) and Tijuana (Baja California, Mexico) are united by a shared economy and urban area, but separated by an international border. Both cities developed their own respective strategies to face the impacts of El Niño in their dissimilar sociopolitical contexts. By using the notion of El Niño Ready Cities as a frame of reference and based on case studies, both cities have been compared to identify similarities and differences that show El Niño's preparedness and collaborative possibilities for shared readiness.

Cities are anthropogenic environments, a combination of natural landscapes and social development. According to UN-HABITAT World Cities Report 2016, 54% of world population live in urban areas, and by 2030 it is estimated that the urban population of developing countries will double, while the area covered by cities will triple. In terms of risk, increased development will typically occur in areas that are naturally prone to hazards like flooding and landslides. Damages in cities can be very expensive and jeopardize development at regional or national levels, though cities can also develop opportunities, which are often economical, political and cultural engines independent of their countries.

The concept of El Niño-Ready Cities (ENRCs) is one by which institutions and citizens can recognize the threat of El Niño and take actions to prevent potential damages and take advantage of any positive impacts. Prevention ideally minimizes or avoids the onset of

disasters by providing readiness for emergency situations. This includes reducing vulnerability and risk, which is a process that requires the integration of tools, knowledge of risks and coordination between institutions and the population. To be an El Niño Ready City, institutions should have access to El Niño-related data, disseminate the information to the public, have feasible action plans and have the capacity to implement action plans prior to and during an El Niño event.

San Diego is located north of the United States-Mexico border; it is the eighth largest city in the United States and the second largest city in California. On the southern side of the border, Tijuana is the largest city in western Mexico and the largest on the Baja California peninsula. Although San Diego and Tijuana have been separated by an international border since the 19th century, and from 2007 by a wall, they are part of the same economic region: with over 300,000 people legally travelling between Mexico and the United States for school and work on a daily basis, the San Ysidro border is the most crossed in the world.

Both cities share common weather patterns and geographical features. San Diego and Tijuana are semi-arid and characterized by a Mediterranean climate with warm, dry summers and mild winters. Most of the annual precipitation falls between December and March (average rainfall 250 mm (10 in.)) and the average temperature is 17°C (63°F). For southern California (USA) and northern Baja California (Mexico), El

Niño typically means warmer summers with more moisture in the winters and above normal precipitation and frequent storms between December and March. In San Diego this can contribute to coastal erosion and flooding, which can be accelerated during storm events.



Figure 1: San Diego, California (United States) and Tijuana, Baja California (Mexico).

The most notable El Niño events in San Diego occurred in 1982-83 and 1997-98. Both periods brought heavy precipitation and flooding, particularly along the San Diego River and its tributaries. Coastal areas of Oceanside, Encinitas, Cardiff, Solana Beach, Del Mar, Pacific Beach and Mission Beach were impacted by high sea level events and an additional 23 El Niño-related emergency permits were granted to San Diego (Hansch et al., 1998).

In Tijuana, El Niño has become a major issue in disaster risk reduction since 1982-83, but the worst damages occurred during the 1997-98 El Niño, when intense rains in February 1998 caused 13 deaths and more than 7.3 billion US dollars in damages (Magaña, 1999).

Most research and climate predictions concerning El Niño in San Diego are available from the San Diego National Weather Service (SDNWS) and the University of California, San Diego (UCSD) Scripps Institute of Oceanography (SIO). These centers for climate prediction provide guidance to San Diego policymakers for decisions related to El Niño preparation and management. The SDNWS maintains the current status of El Niño and includes monthly updates on El Niño conditions.

In Tijuana, permanent Internet platforms about El Niño play an important role by providing alerts and seasonal outlooks, particularly through the Center for Scientific Research and Higher Education (CICESE) in Ensenada and the National Meteorological System of Mexico (SMN), which is administered by the National Water Commission (CONAGUA). Regional decision makers and municipal government officials primarily consult information from the United States National Oceanic and Atmospheric Administration (NOAA) and US-National Weather Service (NWS), however.

For El Niño 2015-16, high expectations were related to the impact of forecasts, social networks and mass media. An article published in August 2015 on the BBC World News portal gave rise to the appellation *El Niño Godzilla*, which became a worldwide media phenomenon and reminded people of the catastrophic potential of El Niño events. It also helped to give El Niño visibility and develop monitoring and preparedness initiatives

at various local levels in both San Diego and Tijuana.

In San Diego, preparation for El Niño-related storms is financially supported by the city of San Diego and additional funding for specific mitigation activities is allocated according to need. For example, the city of San Diego declared a state of emergency in November 2015, which allowed the city faster access to state and federal funding (Alvarez, 2015). Those involved with El Niño preparation within San Diego range from city government departments to city residents. To prepare for El Niño storms and impacts, San Diego agencies pre-developed plans in the event of an emergency. Local agencies are also involved in ensuring the city and its residents are prepared with resources and education and outreach services. El Niño warnings are widely disseminated to the public through media outlets such as the television news, radio, city websites, social media (e.g., Facebook, Twitter, and YouTube), and mobile alert messages for smartphones.

The municipality of Tijuana identified the 2015-16 El Niño as a potential disaster risk, and preventative actions were designed to deal with emergencies and disasters. Nonetheless there was a lack of local capacity for producing data to enable decision makers to implement long-term preventive actions or to take advantage of any positive effects of El Niño. Decision-making for releasing warnings and preparing for potential damages is based on weather information available mainly from external sources such as NOAA but not available locally.

There is no Early Warning System (EWS) in Tijuana. Vulnerable populations in Tijuana receive warnings from traditional mass media (radio and television); the upper social classes, who have access to the Internet, benefit from additional social media resources such as Facebook updates from the Local Civil Protection Office.

In San Diego, visible impacts produced by 2015-16 El Niño storms included flooding and coastal damage. Flooding in San Diego occurred in anticipated flood zones such as Mission Valley, Sorrento Valley, coastal regions, and higher mesa areas such as Kearny Mesa. Coastal damage included erosion and sinkholes in La Jolla and Del Mar. Flooding also occurred across roads that were built directly over the San Diego River. An example is the Avenida del Rio in Mission Valley where water and sediment flooded the road, causing road closures that lasted until the river stage declined. Urban channels such as Alvarado Creek, a typical urban channel tributary to the San Diego River, flooded during a 2015-16 El Niño-driven storm due to invasive species and decreased channel capacity. As of June 2016, the overall cost of the 2015-16 El Niño for the city of San Diego Department of Transportation and Storm Water was approximately \$1.2 million USD. The costs included personnel expenses and infrastructure expenses (e.g. pump station maintenance/repair, structure inspection and cleaning). Other Departments' overall cost for 2015-16 El Niño damages were not reported.

In Tijuana, damages for storms are clearly related to social vulnerability; the lack of rainfall runoff infrastructure in the city is one of the most critical issues, as well as the need for more efficient regulation mechanisms for urban development. The lack of an efficient waste collection service is also a central problem because uncollected trash clogs channels and streams in marginal neighborhoods during heavy rains. El Niño 2015-16 produced less damage than expected, with no reports of casualties.

The bi-national collaboration between Mexico and the United States has federal protocols on both sides of the border that make it difficult to implement interventions in the event of a disaster. There is, however, collaboration between the cities of Tijuana and San Diego—both mayors have met to develop agreements for facing El Niño, particularly by monitoring the levels of the Tijuana River and the Abelardo Rodriguez Dam. More improvements in urban areas, on either side of the border, may minimize regional consequences despite persistent issues like resource availability and language and cultural difference. Institutions from both cities are open to sharing knowledge regarding preparedness strategies that may be developed in the future.

Hurdles and Obstacles

- Environmental permitting to clean out storm channels impeded prompt action for El Niño preparedness in San Diego. Under normal circumstances, the permitting

process in San Diego can take about one to two years to complete (City News Service, 2015). After the forecast of an El Niño onset, however, and again when its accompanying storms occur, the city may declare a state of emergency, enabling it to obtain the necessary permits to clear clogged storm channels. In addition, declaration of a state of emergency enables the city to procure additional funding for storm-channel maintenance.

- In Tijuana, critical infrastructure is missing to accommodate large amounts of rainfall. In addition, inefficient waste collection services contribute to the trash that clogs channels and streams in the most marginal neighborhoods when heavy rains occur.
- Predicting El Niño storm events remains a challenge. For example, the amount of precipitation that the San Diego region expected was overestimated (Robbins, 2016) and the total amount of precipitation anticipated in Southern California was displaced northward because the El Niño-strengthened jet stream traversed primarily across Northern California and the Pacific Northwest (Swain, 2016). On the other hand, El Niño-related information in Tijuana remains limited to warnings about the probability of the presence of the phenomenon and its intensity.

Lessons

- Although the 2015-16 El Niño produced less damage than expected, it was an opportunity for institutions to test prevention mechanisms. In San Diego in previous El Niño years, challenges arose from problems with interagency communication and coordination, resulting in slower response times and less efficient mitigation actions. In Tijuana, the impacts of the 1997-98 El Niño remain in the memories of people and institutions; despite limited resources, agencies such as Civil Protection took El Niño warnings seriously and included it in its preparedness agenda.
- The most current up-to-date information and data are needed to keep agencies informed and provide adequate lead-time for preparation actions. Tijuana's proximity to San Diego's radar provides officials more detailed information than their national weather services are able to provide.

To recognize San Diego and Tijuana as part of a shared urban area despite belonging to different countries may help to improve disaster risk reduction and water management systems of river basins across borderlines. Agencies and officials of both cities expressed interest in developing stronger cooperation.

Portal Review

Introduction

In February of 2015 The Consortium for Capacity Building, in collaboration with USAID/OFDA and the Turkish State Meteorological Service convened a group of more than 90 disciplinary and multi-disciplinary experts in various aspects of disaster risk reduction (DRR). The objective of this “Expert Forum on Lessons Learned about Lessons Learned about Disaster Risk Reduction in a Changing Climate,” held in Antalya, Turkey, was to discuss obstacles to acting on lessons identified during decades of DRR interventions. Previous studies, including *Working with a Changing Climate Not Against It* (Glantz and Baudoin, 2014), demonstrated that many lessons and recommendations continue to reappear repeatedly in DRR project reports, indicating that these lessons are merely identified. They are not learned and often not considered in the development of future programs. Each hydromet disaster, regardless of the country it occurs in, generates reports filled with lessons identified and recommendations drawn from societal responses to the adverse impacts of hazard events. But how can we ensure that these lessons are tested and, if successful, actually integrated into subsequent planning?

Six *Calls to Action* came out of the Expert Forum on DRR (see Box above), each addressing a different aspect of the DRR landscape and how DRR efforts in the future might be enhanced. Further dialogue with participants after the

Expert Forum revealed that the first *Call to Action* should be a “lessons identified portal” for DRR. The idea for such a portal generated the greatest interest among participants, who assessed the pros and cons of developing and sustaining such an international open access DRR lessons platform.

This particular call to action is intended to address a perceived need to better identify and share lessons drawn from hydromet events around the world in order to improve DRR lessons learning, and hence preparedness, in the face of climate, water and weather extremes. In theory an online DRR lessons learning

▫

Six Calls-to-Action

1. “Lessons Learning” Process: The Need for a “Lessons Identified” Portal

A user-friendly, innovative DRR knowledge portal should be established to focus specifically on collecting, verifying, cataloguing, archiving, transferring and sharing both positive and negative DRR-related lessons identified during previous DRR-related interventions.

2. Incentives for DRR Learning for Capacity Building (and Pilot Projects)

3. Blend and Integrate DRR & CCA (Climate Change Adaptation): Fund “Orange”

4. Role for the Next Generation (Youth & Young Professionals)

5. Hydro-meteorological Warning Systems

6. Governments, Banks, and Donors need to Improve Coordination

(Antalya Statement, 2015)

portal could serve as a collection point for lessons drawn from recent and current worldwide experiences preparing for and mitigating the impacts of extreme meteorological and hydrological events. Again in theory by providing a common platform, it could help individuals, organizations, and decision makers at various levels to share lessons identified and learned.

In response to participants’ interest in such a portal, this review evaluates the possibility of developing and providing a sustainable open access web-based knowledge portal for lessons learned in hydromet disaster risk reduction. It summarizes the existing literature on knowledge portals for a variety of applications and examines existing efforts to manage and share knowledge related to DRR, climate change, and development, applying lessons from others’ experiences and issues with portals to explore possibilities of a potential portal for DRR lessons. It organizes the findings into a DRR-specific SWOC* assessment that assesses potential strengths, weaknesses, opportunities & constraints.

Why a Knowledge Portal?

Repeated mistakes, the need to re-learn old lessons, high turn-over and concomitant loss of knowledge, and the desire or need to improve performance are among the reasons for considering a knowledge management platform (Barnes and Milton, 2015). These are among the primary challenges associated with lessons learning in the fields of

DRR and Climate Change Adaptation (CCA) (Glantz and Baudoin, 2014).

A DRR Lessons Portal would provide a platform for exposing and sharing information, whether anecdotal stories and experiences or concrete data, on issues related to DRR for hydromet hazards around the world. It would provide access to DRR-related lessons, as well as "lessons learned about lessons learned" (Glantz et al., 2014). As some writers have suggested, lessons identified—which are often inappropriately labeled lessons learned—but not shared are in fact "lessons not learned" (Milton, 2010). By more widely disseminating DRR lessons, there is a possibility that more would be used, and hence actually "learned."

What is a knowledge portal?

A knowledge portal is defined as "data organized for a particular purpose" (Drucker, 1988 in Deltor, 2004: 1) and with a particular audience in mind. According to Jansen et al. (n.d.), the four functions of a portal are (1) process support, (2) teamwork, (3) document management, and (4) personalization. A knowledge portal is therefore a specific strategy for knowledge management and sharing.

SWOC Analysis for DRR Portal

See Portal SWOC, Chart 1, Appendix

Analyses of strengths, weaknesses, opportunities, and constraints (SWOC) are useful tools for identifying the pros, cons, and key considerations of potential

policies and programs. The SWOC discussed below is a synthesis of the literature review on knowledge portals for a range of purposes adapted to the DRR context.

Strengths: What Could Go Right

Portals have the potential to facilitate the sharing of knowledge and experience within and across organizations. Providing a single, searchable, clearly organized portal can serve as a central access point for lessons learned from DRR-related operations across the globe.

They also have the...

- Potential to improve performance by allowing people to capture and share their knowledge in order to make better decisions because actors will not have to "reinvent the wheel" (Smith & Farquhar, 2000; Barnes & Milton, 2015: 30)
- Provide to practitioners baseline data or a sense of how locations have evolved over time or cross-country comparisons of hazards through earlier studies or with information about past lessons or interventions from areas in which they work
- Potential to connect actors working on similar problems or in similar contexts to one another (Hejazi, 2005)

Weaknesses & Constraints: What Could Go Wrong

The potential users of a portal (those contributing lessons) is vast, which may lead to a lack of focus and information overload, as well as to problems with communication across languages, cultures, disciplines, etc.



For example, lessons may be captured in languages other than English. A portal limited to English lessons would therefore exclude important lessons from non-English reports, whereas a portal in several languages could significantly complicate organization, management, and maintenance of the portal.

Establishing a portal also does not guarantee that practitioners will actually contribute information or consult information that has been contributed. Some organizations might fear publicizing their "failures," for example,

worrying about funding and reputational repercussions (Smith 2000).

Research suggests that in order to be successful, knowledge strategies need to be tied to incentives or behavioral changes (Barnes & Milton, 2015; Deltor, 2004). When use of a knowledge portal is not sufficiently "embedded within organizational processes and activities" (Milton p. 20), therefore, lessons are often not actually learned and performance is seldom actually improved.

Some experts estimate that 80% of knowledge management strategies fail (Barnes & Milton, 2015). Many of these failures occur because portal developers fail to engage relevant stakeholders, leaving knowledge management practices only partially realized.

If embedding knowledge management platforms is a challenge even within a single organization, one can only imagine the challenges of developing a decentralized strategy for sharing information across DRR organizations and actors who have diverse needs and likely conflicting internal policies. In the case of the lessons learned portal, knowledge management is not a goal in and of itself, however; it is conversely a means to lessons learned. Consequently, linking it to incentives (performance, financial, etc.) would be important to ensuring success.

Evidence has shown that DRR actors may discount the past—believing that circumstances have changed or lessons have already been incorporated into

planning—or believe that lessons from case studies do not apply to their particular location or project (Glantz et al., 2014). This begs the question, what will drive people to the portal? Who will access the site? Why? A successful strategy will need to consider who will access the site (identify the target users) and how to push them toward it or attract them to it. In addition to donor or proposal requirements, the developer of the portal will need to consider how to increase visibility via search engines and links to existing websites relevant to the intended audience (Micklos et al., 2011).

A DRR portal can only contain DRR knowledge that is captured and written down. Many of the potential solutions (as well as lessons, best practices, and experiences) to common DRR problems are likely to be stored in practitioners' heads but never explicitly written or shared on paper. This underscores the importance of fostering dialogue among practitioners in order to ensure that tacit knowledge relevant to learning from lessons is transmitted in addition to the details that make it into formal reports.

Opportunities: What Ought to Be

Each opportunity, and some of the strengths, listed in the table below represents something that may be realized, depending upon the design and execution of the portal and participation of the broader community.

Among the most important opportunities are the potential to improve access to quality lessons and improve transparency in DRR programs.

A portal has the potential to connect people to the right information quickly and easily, to catalyze and support the emergence of a new community of practice centered on DRR lessons learned by providing a virtual discussion platform for practitioners and other potential users of DRR lessons, and to provide a gateway to other online resources.

A DRR portal may add value to the DRR community by linking people to other portal members and to practitioners with relevant expertise instead of to information and case studies alone. Such networking could facilitate communication among practitioners as well as the sharing of ideas that could perhaps lead to better project design and implementation.

Unless a major funder is willing to act as a sustained champion of a portal by incentivizing the use of lessons by countries for a long time, however, many benefits of a DRR portal will likely go unrealized.

A Key Opportunity: Engage Users to Understand and Meet Their Needs & Overcome Their Constraints

The design phase of the portal presents an essential opportunity to ensure that the DRR portal realizes its potential strengths and opportunities. Extensive review of portals designed for business purposes confirms that designers need to understand information needs in order to ensure that the platform is useful (Deltor,

2004). A participatory design process in which intended users are engaged in developing the platform can help to ensure that the final product meets the needs of the target audience (Jansen et al., n.d). User engagement might be done through a survey of potential users, workshops, focus groups, interviews, or other forms of consultation. A collaborative or consultative process will increase the likelihood of stakeholders using the portal and of reaching the ultimate goal of more lessons learned.

Examples of What Is: Existing DRR knowledge portals

A number of DRR portals already exist, but they do not seem to have had a desired or a significant impact on the enhancement of learning DRR-related lessons. Existing DRR portals and platforms and their missions are presented in a chart in a report (see full report on the website ccb-boulder.org): “Existing DRR Knowledge Portals or Sharing Platforms.”

The existence of so many knowledge portals related to DRR and development raises many questions. If such portals exist already, is developing yet another (possibly competing) one alongside it prudent? How would developing a lessons-learned portal for DRR add value? If access to information is a primary obstacle to learning DRR lessons, why do lessons often remain unlearned given that such networking and knowledge sharing opportunities already exist? How could existing portals be improved to promote the

dissemination and learning of lessons? Given the existence of other DRR portals, might looking for ways to collaborate with or improve upon existing platforms rather than “reinventing the wheel” by developing a new platform from the beginning make sense? At the very least, the potential benefits of developing a new platform should be weighed against potential long-term costs and commitments versus the option of enhancing existing platforms.

Concluding Portal Thoughts

As illustrated above, there are many potential pros and cons to developing a DRR Lessons Portal. First and foremost among the considerations are funding commitments and ensuring that practitioners contribute to, and incentivize use of, portal lessons for the design and implementation of future projects, plan and interventions.

The portal is likely to be costly to maintain and would require sustained funding to ensure that the platform remains organized and relevant and that information remains up-to-date. Despite the costs, the literature on knowledge portals and evidence from existing DRR portals at different scales demonstrate that providing a forum for information does not guarantee that the information will transform decision making or contribute to improved learning of lessons, which would be the primary goal of developing and funding such a platform. Without well-conceived incentives for fostering contributions to

the portal and use of the lessons provided, a DRR knowledge portal risks becoming an expensive repository of information to which few practitioners turn to plan projects and implement interventions.

Because the potential DRR audience is diffuse, we recommend not investing in such a portal unless a number of organizations are committed to developing policies and a DRR information culture that encourages people to use the information a portal would provide, such as requirements to use lessons to inform project proposals and to contribute lessons at a project's end.

Introducing “ENSO Ready Nations”: El Niño, La Niña and Neutral

Although our project was at first focused on making nations ready to cope with El Niño, it was planned to then focus afterward on La Niña Ready Nations. Both of these events plus a Neutral phase are part of the broader ENSO (El Niño Southern Oscillation) cycle. Knowledge about ENSO's warm and cold extremes add value to forecasts related to climate, water and weather anomalies. A focus on El Niño is an interesting starting point for assessing disaster risk reduction activities and needs. It also provides a pathway to assessing the needs of modernizing a country's national meteorological and hydrological services (NMHSs).

The ENSO “cycle” has two other equally important phases: a cold extreme, La Niña, where warm surface waters stay piled in the western equatorial Pacific region due to persistently strong westward flowing surface winds, while the rest of the equatorial Pacific is, generally, cooler. ENSO neutral (sometime referred to as normal) is the third phase of the ENSO cycle. During the neutral phase, sea surface temperatures across the equatorial Pacific stay within a statistically average range (e.g. not falling into the sea surface temperature range of either El Niño or La Niña).

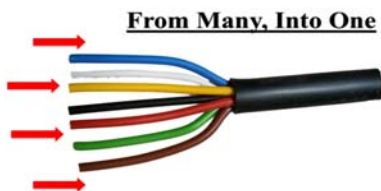
Like neutral conditions, under La Niña conditions rainfall in the eastern equatorial Pacific is subdued, while in the western Pacific rainfall tends to be above average, frequently resulting in flooding. La Niña impacts can be viewed as an extreme case of neutral: therefore, it can be viewed as an in-season anomaly.

El Niño and La Niña periods, despite their existing scientific uncertainties, both present a usable degree of predictability with regard to climate, water and weather anomalies.

Crosscutting Themes

(Based on the Portal/ENRNs Project's 15-country, city and region case studies)

Each of the 15 country studies exposed issues of concern raised by the research teams. CCB clustered several but not all of those key concerns into six general categories, each of which



Source: Aupratex: Hella Fahrzeugleitung

highlights challenges to decision makers in policymaking as well as in forecasting El Niño and for generating El Niño Readiness at national to local levels:

1) El Niño's Characteristics; 2) Forecasts; 3) Governance; 4) NMHSs (National Meteorological and Hydrological Services) 5) Awareness; and 6) Media and Social Media.

Though the categories are general in nature, they encompass basic needs of societies and foreseeable opportunities for country-appropriate responses to El Niño forecasts and potential impacts on either a strategic or a tactical basis.

The crosscutting themes includes recommendations, facts, and questions.

1. El Niño's Characteristics

The characteristics of the El Niño phenomenon itself are problematic for decision makers and scientists as well as forecasters. When civil society hears about El Niño, it is usually from electronic and print media headlines about an impending El Niño episode or about the devastation of its impacts somewhere on the globe. Once a forecast of an El Niño's *onset* and subsequent

forecasts are in play, they receive scrutiny from the media: Are the El Niño forecasts accurate? Are the projections about intensity or location on target? Are the impacts playing out as scientists suggested?

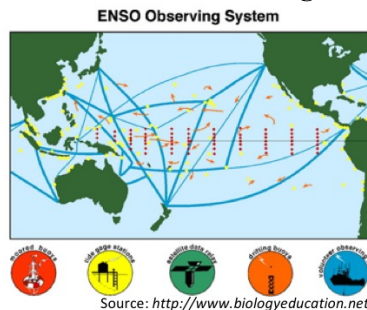
Forecasting El Niño is still partly science and partly art. Mysteries remain in understanding the phenomenon. A close look at El Niño reveals various uncertainties about its characteristics in terms of air-sea interactions in the equatorial Pacific. Uncertainties are also introduced from the influences on El Niño of other surrounding air-sea oscillations. These uncertainties working together determine the societal and environmental impacts during a specific El Niño episode.

El Niño characteristics can affect decision makers' perceptions about when or even whether to prepare for a specific El Niño (tactical) or to prepare for all events in the long term (strategic). They include but are not limited to the following:

- El Niño's uncertain return period of two to seven years (for example, a government can expect but one El Niño during its time in office)
- Other atmospheric and oceanic oscillations; Indian Ocean Dipole (IOD), Pacific Decadal Oscillation (PDO) that make accurately forecasting El Niño's *onset* and impacts difficult

- Local and regional social, economic, environmental and political factors in progress during an El Niño event do influence impacts
- El Niño can come in different strengths from weak, moderate, strong, extraordinary; researchers have difficulty forecasting intensity, except for the very strong events
- The strong, very strong and even extraordinary El Niño events capture media attention worldwide. Minor ones receive considerably less media attention and, therefore, generate less public or government concern. Some countries can be seriously affected even by weak-to-moderate events
- Physical scientists refer to “flavors of El Niño.” It is **now** time to identify and categorize flavors of El Niño’s impacts.
- Difficulty remains in attributing cause (El Niño) and effect (e.g. a teleconnected drought or flood)
- Research challenges also remain in forecasting the strength of teleconnections for a specific emerging El Niño
- Scientific uncertainty exists about what kicks off a basin-wide El Niño episode; there have been notable El Niño *onset* forecast failures as in 2014
- Few very strong or extraordinary El Niño events have as yet been directly observed
- Seemingly, there has been a media and scientific community over-focus on strong and extraordinary El Niño episodes and an under-focus on events of lesser intensity
- Although an event ends as determined by its physical characteristics, its impact can continue months to years afterward. Is there any value distinguishing between El Niño as a discrete event and as an episode (e.g. as a process)?

More Characteristics Thoughts



- A suggested circa 15-year return period of a strong-to-extraordinary El Niño could suggest to governments that they really need to get ready only for the big events, as smaller ones may be less worrisome. This is likely based on researchers and media highlighting only the recent major events: “The El Niño(s) of the Century” (a title given to both 1982-83, 1997-98 events); and, most

recently, “The Godzilla of El Niños” (2015-16)

- Preparations for a specific El Niño will depend on its expected intensity and its anticipated impacts. Which specific countries will suffer, however, depends on a country’s history with previous events and its projected intensity, timing and a realization that the forecast of El Niño is no longer a probability but a reality once it has entered into its “locked in” phase
- El Niño-affected countries appear to become mostly concerned about the strongest events, as they are newsworthy, highlighted and often hyped by attention-seeking media
- El Niño science is not yet perfect (and may never be), given that the global climate is warming. In any event forecasts El Niño can be erroneous, more so for *onset* and impacts than for its behavior during a “locked-in” phase
- Researchers and forecasters must be more forthcoming about the state of the scientific “knowns, unknowns and surprises” about the El Niño Southern Oscillation process and the forecasts of its extremes
- El Niño has downstream impacts that merit serious attention (e.g. 2nd and 3rd order impact, in essence a ripple effect). In the case of El Niño, “out of sight ***should not be*** out of mind.”

- Because the strength of known teleconnections varies from event to event, to rely only on the last or biggest previous El Niño as a guide to what impacts to expect and prepare for would be highly risky. It is necessary to consider a few events to identify a range of possible impacts.
- Individuals, socio-economic sectors, and NGOs live and in many cases operate with the expected flow of the seasons in mind, making the forecast of timing of the *onset* of an El Niño episode extremely important

In sum, the natural characteristics of the El Niño phenomenon are part of the problem with regard to timely accurate forecasts, early warnings, optimal DRR efforts and appropriate societal responses to El Niño’s foreseeable but not as yet certain impacts.

2. Forecasts



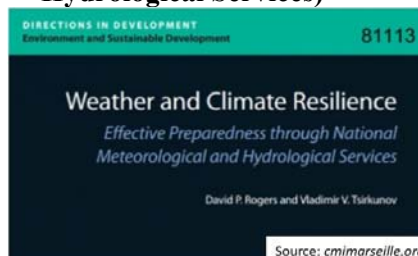
El Niño information typically reaches the general public by way of media reports about forecasts of an El Niño’s *onset*. People respond to them in different ways: to act or not to act becomes the question for decision makers to answer.

Forecasts, however, are based on probabilities as a quantitative expression of the likelihood of occurrence. Forecasts implicitly come with a “buyer beware” notice.

- It is imperative for the scientific community to make explicit the distinction between forecasting El Niño’s *onset*, forecasting its post-*onset* (so-called “locked in”) phase, e.g. forecasting its behavior during its life cycle.
- When a forecast has been released to the public, many people make decisions in response to it and to the cascade of impacts forecasts that follow in anticipation of the ripple effect of impacts that could affect routine activities and livelihoods. For example, reduced fishing means fewer boats needed, which means higher unemployment (fewer fishermen and less equipment needed) but higher food prices, etc.
- Forecasters and governments should continually re-evaluate their so called best practices for disseminating El Niño forecasts to the public. For some governments, this will require changes in governmental regulations that control agencies that officially issue “early warnings for hydromet hazards” as well as when they are allowed to alert the public and media
- There is no “canonical” (e.g. typical) El Niño in terms of its exact timing of *onset*

- Scientists should continue to improve techniques to identify attributions of teleconnected local and regional hydromet anomalies to El Niño events of different intensities
- Governments should invest in developing effective ways of tracking and measuring their respective country’s attributable El Niño-related socio-economic impacts
- Governments should support societal research to identify the relationship between El Niño as a catalyst that worsens chronic underlying socio-economic problems. The underlying chronic societal problems can negate otherwise effective responses to El Niño forecasts and impacts
- El Niño readiness addresses hidden and neglected underlying problems or societal weaknesses that might worsen with global warming

3. NMHSs (National Meteorological and Hydrological Services)



Source: cmimarseille.org

NMHSs are central players worldwide when it comes to monitoring ENSO’s

warm extremes and teleconnected hydromet impacts. While various NMHSs may have the necessary technological tools and personnel to directly monitor the SSTs in the tropical Pacific, many do not. Even though an NMHS has not yet become modernized to its desired level, it should at least have the personnel, training and equipment needed to track and follow up on an El Niño from timely forecasts and reports issued by any of the reliable regional and international centers.

- NMHSs are increasingly expected, if not tasked, to engage in scientific research and applications *and* to undertake services that require interacting directly with society
- Communications between NMHSs and stakeholders at large and with government agencies should be improved, because climate, water, and weather disruptions can be a security issue
- Governments should provide funding to their NMHSs for training their personnel to be able to be science communicators, facilitators to act as intermediaries between technical people and the public, and users in weather sensitive activities
- The importance of NOAA's El Niño forecasts cannot be overstated. They are a service of the US to its citizens and to the rest of the world. Many foreign governments and their hydromet services rely on NOAA forecasts in their decision-making

processes, once a forecast for an El Niño *onset* has been issued

- NMHSs and the media, working with local NGOs, should explore innovative ways to reach at-risk populations with warnings and other DRR efforts
- If “an ounce of prevention is really worth a pound of cure,” who is expected to pay for that ounce that would help to modernize an NMHS, for example; and who is expected to benefit?

4. Governance



Source: Adopted from UNESCAP, 1999

Governance issues are central to effective disaster risk reduction (DRR) activities in the same way they are central to sustainable development planning.

“Governance” is a term first used in the fourteenth century and defined generally as “the act or manner of governing.” The 15-country case studies identified various aspects of governance that can affect, favorably or adversely, decision making related to El Niño.

DRR activities build societal resilience to hydromet hazards through the sharing of experiences, funding and political support for developing timely hydromet forecasts, early warnings, forecast dissemination, strengthening of hydromet capabilities, tactical or strategic readiness, and so forth.

Governments determine when to plan, to act, whether to react or pro-act, how to react or pro-act, and whether to allocate funds. They can make funding available for strategic El Niño preparedness in advance or for after-the-fact response to and recovery from impacts attributed to an event's climate, water and weather anomalies.

The bullets that follow are suggested for improving the governance of DRR-related issues.

- Consider framing El Niño-related governance decisions in terms of strategic and tactical responses
- Identify and evaluate government regulations that directly or indirectly impede effective responses to or preparations for the foreseeable impacts of an El Niño episode
- Foster collaboration among in-country agencies and neighboring countries that share the same weather systems to compare their regional responses and lessons
- A government might consider setting up at the national level an “ENSO Czar” to oversee

government agencies to assure that they collaborate, not just for El Niño, but also for the La Niña and Neutral phases of the ENSO cycle

- Some countries should consider a national level “Standing Working Group on El Niño” or, more broadly, “on ENSO”
- Agencies’ collaboration in advance of El Niño impacts can prove very effective for mitigating, if not avoiding, societal disruptions that are likely to occur
- Implementing lessons learned from past El Niño events is dependent on the political landscape, because political change affects continuity of government interests and awareness as well as policy responses for El Niño-related issues
- Does the possibility of El Niño impacts that might recur at some time between 2 and 7 years rank high among national crises? Governments face many crises in a given year (i.e. poverty, conflict, economic, demographic shifts, weather, climate and water hazards). Is an El Niño on a government’s list of threats at all?
- Should governments develop a national action plan for responding to El Niño forecasts and possible impacts? As an example, many countries already have national drought plans. Why not consider

such national plans for ENSO's phases?

- Assess not only obvious El Niño impacts but also identify its known and hidden downstream 2nd-order consequences

5. Awareness



Generating societal awareness about El Niño should be an on-going process that requires constant reinforcement and re-visits as new scientific information becomes available. However, awareness-raising often turns out to be little more than a one-time education or training workshop in different locations. Such efforts, while admirable, are not enough to develop let alone sustain a higher level of awareness.

Awareness of and obstacles to accessing knowledge about El Niño is a necessity, because El Niño is a potential life and livelihood threatening hydromet hazards-spawner. However, as a quasi-periodic event, it is not a constant annual concern to governments or civil society. At the least government agency and community decision makers along with the “attentive

public” merit special, priority attention in the awareness-raising process.

- The 2-7-year time between recurring El Niño events should be used to create better understanding as well as awareness of the phenomenon and to remind society about the possible impacts of and responses to previous El Niño events
- Consider whether an explicit distinction between “DRR” (Disaster Risk Reduction) and “drr” (disaster response and recovery) is useful for awareness-raising, education and training as well as pre-and post-disaster coordination purposes
- Targeting audience(s) for awareness raising is imperative, but doing so will vary from country to country
- Consider whether everyone in a given society needs to be made aware of the scientific details behind the El Niño phenomenon
- Researchers must demonstrate clearly and repeatedly the value of El Niño and ENSO information to governments and societies on a continual basis.
- Practice exercises (e.g. dry runs or fire drills) should be undertaken to reinforce awareness, concern and preparedness for El Niño and the havoc it could foreseeably wreak on a society and its plans for sustainable development

6. Media including Social Networking

(See Social Networking SWOC, Chart 2, Appendix)



People seem to have a tendency to focus on the last big climate, water or weather disaster (a drought, flood, hurricane, or severe storm). The same holds true for the media. However, looking back to the last big disaster of the same type may not provide the best insight about likely impacts for an upcoming event.

Science reporters, like the public and policy makers, must, however, look at more than just the last El Niño in order to provide its readers or listeners with a glimpse of possible impacts that could accompany El Niño.

- Media have a special role to play in informing the public through its daily newscasts
- Develop strategies and tactics for a sustained awareness-raising role for the media about more effectively disseminating El Niño information to reach at risk countries and people
- The media has an early warning role to play as well as to inform the

public about El Niño as part of the overarching ENSO cycle

- Funding agencies should help develop “media awareness and education needs” workshops to discuss how best to report on El Niño as part of the broader ENSO cycle
- “Social media” are increasingly important conduits for educating young people about how they can participate in early warnings for hydromet anomalies. Youth are more attuned to the various uses of social media, which is an advantage over older generations
- Explore the ways that social media can be used for El Niño awareness-raising (e.g. education and training) and for informing government agencies and media about local consequences of El Niño



- Encourage professionals to use social media to educate, train, create awareness and discuss El Niño as a disruptor, for good or ill, of weather patterns and more generally seasonality
- If media coverage is taken as a whole, the average person could only rely on its reports for an alert. Such reports have not been adequate

for undertaking informed responses.
Can social media help?

- Media must meet the differing needs of various distinct target audiences; some articles are for awareness-raising, while others could provide guidance about actions that need to be taken in different regions and socio-economic sectors.
- Positive guidance articles in the media is likely to be more useful to the public than focusing mostly on sensational headlines- about adverse disastrous impacts

Summary of the Executive Summary

This project merged two related activities, one planned and the other an unforeseen opportunity. The 1st activity was the lessons learned portal project which involved a desktop review of the literature on web-based platforms involving the various stages of developing a portal: soliciting, collecting, cataloging, archiving and the open-access sharing of recommendations and lessons related to hydro-meteorological hazards and disasters.

In theory, a portal would enable lessons from countries around the globe to be made available in an open-access, web-based platform to all countries in an effort to promote lessons learning from societal and governmental examples or preparations for and responses to past and ongoing hazards. This portal project was based on the premise that “lessons learned” have really for the most part

been “lessons identified,” since many of those lessons go untested or unused. Successive similar disasters seem to produce similar lessons, raising serious questions about the process of so called “lessons learning.”

A “lessons learned portal” for sharing experiences and concerns is a great idea. In practice, however, it is not such a straightforward and assured benefits-producing endeavor. Starting such a portal requires a commitment to support it well into the future. Many portals are started for different types of activities and for good reasons, but have short lifespans due to waning interest, lack of a sustained funding stream or lack of use.

The 2nd activity was focused on El Niño Ready Nations (ENRN). The idea behind the notion of *El Niño Readiness* for nations, cities, NMHSs and islands is to identify ways that lessons identified for coping with ENSO’s warm or cold extremes are collected, archived, evaluated, field tested, and applied in ENSO-related DRR efforts at national to local levels. When it comes to El Niño or La Niña, impacts for the most part are of national concern. Thus, there is likely a nation-bias about responding to the consequences of ENSO’s extremes.

Human nature is a factor that must also be considered. People tend to first recollect the most recent hydromet hazard as being the most important for lessons learning. National bias and discounting the past (that is, putting less value on the use of historical information) often lead to the view that a portal should be developed at the

national level primarily for the in-country sharing of lessons and, secondarily, for the sharing with other countries that might have to cope with similar hydromet hazards.

The 15 country case studies in this Portal/ENRNs project encompass different political systems, cultures, socio-economic and political settings from around the world. Each country study has its own set of lessons identified and learned, influenced by its own unique set of national and regional factors influencing its hydromet DRR- and drr-related policies in general. As these country cases have shown, however, when compared side by side, common interests and concerns emerge. Some of the common aspects were noted in the previous crosscutting themes section as to the range of national best practices related to DRR from which numerous countries could learn what other countries considered to be best practices to improve their own readiness by preparing for and coping with hydromet hazards and disasters.

Fostering awareness activities with regard to learning lessons in general and about lessons learning for specific disasters is the responsibility of a country's political leaders. It can also be seen as a responsibility of donor organizations that fund El Niño-related DRR projects. Governments should take up the responsibility to develop and maintain a web-based platform (perhaps with the help of the donor community), a platform that involves the soliciting, collecting, cataloging, archiving and sharing of lessons and recommendations

related to hydro-meteorological hazards and disasters. Each government should openly share its lessons and should have access to other governments' national lessons portals.

The value and importance of national meteorological and hydrological services have grown sharply in the last couple of decades, as climates' influence on human activities have expanded beyond what were once considered their normal boundaries. National approaches to lessons learning can be yet another activity of an NMHS. With commensurate funding to undertake this mission and working with universities, an NMHS can gather and truly apply lessons related to El Niño and La Niña as well.

As a final comment, the list of crosscutting themes in the previous section may viewed too general and even obvious for specific action-taking. However, these are areas that *must* be addressed, if progress is to be made on generating interest in making one's nation El Niño ready.

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Appendices

Chart 1. Portal SWOC

Strengths	Weaknesses
Possibility to sort and find information from a variety of sources	Resource intensive to build and maintain; is the benefit achieved worth the cost of maintenance?
Knowledge sharing; bring together people and information from many places and organizations	Potentially inefficient
Single/consolidated access point for lessons and best practices	"Big brother-ish:" Will people share information?
Stimulate knowledge creation, integration & applications	Doesn't address incentives to seek information
Provide functionalities to identify & connect users	The benefits are hard to quantify
Geographical and hazard specific content	Difficult to generalize from one place to another.
Awareness raising for portal users	People discount the value of past information.
May provide access to baseline DRR information enabling better monitoring of progress	Language barriers given the wide range of languages relevant to DRR projects around the world
Case studies provide information for cross-country comparisons	

Opportunities	Constraints
Improve action/decision-making	Knowing the audience? The more diverse the needs of users of a KP, the less successful the KP will be in providing knowledge integration.
Quality control of lessons/information; improve transparency, quality of info on lessons	How to balance quality control of lessons/information and resources required to maintain the portal?
Catalyze and support the emergence of a new community of practice centered on DRR lessons learned	Expertise and resources needed to maintain the portal website etc.
Opportunity for virtual meeting place for practitioners and end users	Knowledge Portals are geared at collecting explicit knowledge rather than gathering tacit knowledge and making explicit
Forum for exchanging views on hot topics and lessons learned	
Conduit for e-learning	
Gateway to other online resources	
Connect people to the right information quickly and easily	

Chart 2. Social Networks SWOC

Strengths	Weaknesses	Opportunities	Constraints	Comments
• Ability to reach millions of people • Ongoing updates • Not easily spammed (Why?) • Not? Google just had to remove malicious code inserted into YouTube. See hacking comments under “Constraints”) • More frequent contact with others • Ageless (W Some Limits), Genderless (unlikely), Borderless, etc. • Can stratify by types, location or needs of stakeholders • If web is down or overwhelmed in an emergency, FB or Twitter can continue to operate (How can Twitter or FB operate without the internet? See also the weakness that states “How to be somehow connected to the internet” repeated under “Constraints”)	• Legal concerns about age limit • Facebook can legally and indefinitely retain any information posted on its website (this might be a strength, to assist in post-hoc analysis to develop monitoring and metrics for improvement, and for legal recourse [which is good and bad] in case of problems) • Need a computer to access information • Need an internet connection • Need computer and internet skills • Social impact of distancing ourselves through the internet – lack of empathy effect, counter-productive in disaster relief situations • Gawking (virtual disaster tourism, virtual convergence) • Messages are open to misinterpretation, deliberate or inadvertent	• Social networks can be used for hazard warning systems • Networking • Business – selling a product • Information collection about people’s profiles- E-CENSUS • Profile research – for job interview, etc. • Effective reach across country, cultural and linguistic lines • Introduce idea of Late Warnings • Warning App? • Can educate public on EWS (e.g. Outreach and awareness raising) especially before it needs to be used • Can provide rewards for being connected to social networks....	• Legal concerns about age limits; other exclusions • Facebook can legally and indefinitely retain any information posted on its website • Need a computer to access information • Need an internet connection • Social impact of distancing ourselves through the internet – lack of empathy effect, counter-productive in disaster relief situations • People do not understand well probabilities (for perhaps probabilities are not communicated well; cf. weather forecast. Perhaps grade school math should be improved) • Attention span of recipient • Device must be on	• Social networks being used: Web 2.0, Facebook, Twitter, YouTube, Myspace, Flickr, Digg, Blogs, Tags, RSS, Del-icio-us • Use of social networks depends on purpose: education, awareness, alerts, recovery (where shelters are). This is referred to as “Crowd Sourcing” using the efforts of the unpaid public for warning • Who to target for EW? Who are the usual victims? Elderly? (How to reach them?) • Cell phones are useful. Can do reverse 911 or reverse 311, but cell phone has to be turned on

- Can supplement other forms of Early Warning, but not replace them - Can provide additional information - Often free of charge; once the social and technical infrastructure are in place, it is cheap to use - Most people in USA have wireless links, some are free most are not, (but do most Americans have the hardware and computer skills needed?) - Social networks are ubiquitous and require no programming skills to use. (But they require computer skills.) - One network can contact multiple networks - alerts can be targeted to specific geographical and functional communities - Can broadcast alerts (or messages) to highly mobile populations	- Messages are short (which can be good) and provide little detail - Recipient must “do” something (settings, leave phone on, sign up to receive messages or warnings) - Need for cross-cultural language/coding, including different languages, dialects, communication methods and disabilities - Battery life of cell phones is short in emergencies (may be no chance to recharge. [N.B. When emergency occurs; cell might not be at full charge]) - Possibility of competing warnings? Which is official one? - People are untrained in disaster communications - Prono to hearsay, rumors - Might inadvertently create “Haves” and “have nots” of Facebook (second class citizens)	- EWS lessons on smart phone via social network but the problem is not so much finding smart technology as avoiding dumb users - Can prioritize warnings for a variety of hazards in a given area - Community building can be achieved by using EWS alerts to communities who share dissemination responses - Delivery specificity (can target specific audiences) - Message effectiveness - Development of the concept of the “late warnings”, that is 11th hour alerts - Potential to reach people who might otherwise miss the alert - Redundancy in warnings can amplify urgency or make people complacent	- One warning statement is not enough – it might have to be adjusted to meet needs of different cultures, levels of education or recipients - Lack of understanding of an EWS system - Natural and legal age limits for social networking websites - Higher risk of panic response to EW - Requires continual support for staffing and resources - Language barriers between public and warning providers - Difficult to control for rumors - How to control social network information when no one is in charge - Control of length of messages, (e.g. Twitter)	- One can check who previous hazard victims were for different hazards and ask how they might have been served by social networks. Would they have been in any of them? - Does effective use of social networks involve online proficiency by organizations or individual users? - Need to distinguish between hype and real hope for use of networks (e.g. are the social networks a digital frontier for early warnings?) Can the Networks be used in all phases of the disaster cycle? - Who owns information on Facebook and in other media? Make sure the use of Facebook fits with the use you need
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Appendix 3

Selection of presentations from 2014 IDER Conference on Social Media and Disasters

Impact of Social Media on Disaster Management

Session Chairman: Professor David Alexander, Professor of Risk and Disaster Reduction, University College London

Social media (blogs, messaging, sites, etc.) are used in seven different ways: listening to public debate, monitoring situations, extending emergency response and management, crowd-sourcing and collaborative development, creating social cohesion, furthering causes (including charitable donation) and enhancing research. The positive side of social media is balanced by their potential for harm, for example by disseminating rumors, undermining authority or promoting terrorist acts. Despite some evident risks, such as violation of privacy, attempts to subvert social media have been successfully countered by the public consensus on ethics. Indeed, social media can be good at exposing corruption and malpractice. The widespread adoption and use of social media by members of the public throughout the world heralds a new age in which emergency managers must adapt their working practices and help ensure that social media are not misused in crises and emergencies. This session will review the use of social media in crisis situations, with examples from the recent past, and consider the potential of the 'new media' to improve emergency response and disaster risk reduction in the future.

Citizen participation in disaster management: A challenge beyond communication through social media

Paloma Díaz, Computer Science Department. Carlos III University of Madrid

In recent years we have seen how social media have empowered citizens to communicate quicker and more broadly than ever before in many situations, including disasters and emergencies. The Web 2.0 has enabled crowdsourcing power in real disasters, whether in the form of citizen journalism or as grassroots web sites for self-organizing citizens and volunteers. Agencies and corps in charge of emergency and

disaster management are aware of the power of social media but also know the limitations and problems their adoption could bring to the table, such as virally spread hoaxes, need of resources to manage huge amounts of information, lack of accuracy in the data provided by citizens, and loss of control and efficacy. In any case, citizen participation goes beyond communication, which is the lowest rung in Sherry Arnstein's participation ladder. In this talk we will explore challenges and opportunities to move upwards in the ladder and consider citizens as partners in the disaster management processes as a basic requirement to build resilient communities.

Social media in disaster management: doing more with less(?)

Serena Tagliacozzo, Institute for Risk and Disaster Reduction, University College London

Social media have brought important changes in the way in which disastrous events are handled as well as relevant concerns and challenges. In this presentation, I'll go through some of the benefits of these new interactive technologies for the disaster management field, enlightening at the same time the downsides that researchers are trying to address. The overall goal of the presentation is to answer to the following question: "Do social media allow to do more with less in the disaster management discipline?". Recent literature on applications of social media in disasters gets split between those who praise the usefulness of these technologies throughout the stages of the disaster cycle and those that focus on the unavoidable challenges. This presentation aims to briefly account for both these different positions.

Disasters and social media: are we ready?

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The Web 2.0, or of social media in the broader sense, is not merely a technical innovation, but it has a strong impact on our cultural models, and on our information and communication production processes, access and content. In the disaster field, the widespread of Social Media, highlights

the gap between institutionalized communication models and the “voice of the crowd”. The need of a clear and correct information is increasing and people, through new media, try to fill this gap, running the risk of information redundancy, inconsistency and rumors. However, the widespread of social media use calls institutions, media representatives, and scientific community to cope with this cultural change, in the whole disaster cycle. Some questions to be discussed: To what extent web innovation has been included in the agenda of emergency bodies as tool to build a better disaster preparedness? To what extent emergency bodies, scientific community consider citizen's engagement as threats or an opportunity? To what extent official communication models are resilient in face of the new media revolution?

Social media are presently an unreliable tool within the development of a social science strategy for early warning systems

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The 'social media' within early warning, whilst an obvious tool, has many flaws as has been witnessed numerous times in recent years, primarily due the 'media' and 'social media' systems reliance upon power source followed by their incapability of a coping mechanism for capacity excess use. Japan, Indonesia and Thailand have all experienced major failures, which have either cost lives or put lives at risk if the events were to materialize to the levels originally expected. The 'social science' of receiving, understanding prioritizing the dissemination of early warning and forecast information is a specific science, whilst reliant upon, it is actually a non-technical discipline, but remains highly complex, differing across many countries and within various cultures, incorporating indigenous local knowledge and precisely calculated messaging. This presentation reviews the complexities and 'social awareness' and preparedness components necessary for DMA's and Emergency Authorities to implement early warning and forecast messaging systems.

(Source: <http://www.iderweb.org/ider%202014%20programme.html>)

A government that takes El Niño occurrences as serious quasi-periodic threats and seek to enact policies to protect their citizens and their livelihoods and properties, public and private, can be considered an El Niño-ready nation.

El Niño is a recurring phenomenon in the tropical Pacific Ocean, appearing on average at least once in a decade but often returning at 2-to-7 year intervals, and generally lasting from 9 to 12 months or longer. It results from anomalous air-sea interactions that enable a warm pool of water in the western Pacific to shift eastward toward the central and eastern Pacific. As a result of such a shift, El Niño is associated with many adverse anomalous climate, water, and weather impacts around the globe also often lasting several months to years.

The most obvious impacts appear in the form of drought, flood, flash floods and fires each of which has ripple effects in society and ecosystems. These adverse impacts tend to recur in many (but not all) places and can, therefore be anticipated, planned for, and mitigated, if not avoided altogether. Disaster risk reduction (DRR) through informed prevention and preparedness merits greater visibility in political decision-making processes, given the adage that “an ounce of prevention is worth a pound of cure.” As a known spawner of hydro-meteorological hazards, focusing on the El Niño phenomenon is a good place to start for early warning for risk reduction.

This report summarizes a review of 15 countries affected by the 2015-16 El Niño.