User's Guide to Communicating the Risks of Storm Surge

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Forecasting to Communication to Action: Enabling Institutions to Manage Storm Surge Risks

1. Purpose and Scope of the Report

This is a guide to communicating the risks from storm surges attendant to tropical cyclones or hurricanes. To develop guidelines for communication, a set of focused studies were conducted, including a literature review, a survey testing alternative message texts, and an evaluation of communication around Typhoon Haiyan and other events. These studies are found in the attached Addenda, which provide research in support of the recommendations in this report.

In the latter part of the report are a series of templates for crafting messages (consisting of text and graphics) for use in various venues, including news bulletins at various levels of communication, a media packet for TV and radio, and sms texts. The templates are prepared according to guidelines and best practices identified through the research done for this report. The focus of this report is not on the modeling and prediction of storm surges but on how such knowledge is communicated, shared, and utilized.

The report is designed for the use of agencies and nonprofits engaged in preparing for extreme weather events, news media, and education providers engaged in fostering awareness of these events. To craft guidelines and a toolkit for communicating storm surge risks, the project team reviewed and condensed much emerging research and tried to bring the most recent findings in the literature to the task. The team also conducted a number of empirical investigations in the Philippines, including a survey of public responses to message design and an analysis of institutional issues encountered during Typhoon Haiyan, which struck the Philippines in 2013. The team also reviewed case study literature on other events, such as Hurricanes Katrina and Sandy in the U.S. While much of the empirical work discusses the Philippine situation, which is the main project site, this report is meant to apply to other country situations, especially those where frequent extreme weather events are coupled with deep vulnerabilities, especially among lower-income communities, to these events.

Before entering into the art and science of risk communication, it would be good to note some underlying principles that inform this work. First, the task of risk communication should not be seen only as imparting information. Rather, it is part of a broader agenda in strengthening capacities for analysis, decision-making, and adaptation on the part of relevant agencies and local communities. Towards the end of the report is a discussion of a broader agenda involving interventions aimed at increasing the 'coastal literacy' of communities and strengthening the network of disaster risk reduction professionals. Second, the risk communication process, especially in places with marginalized populations like the urban poor, is a 'messy' process, wherein residents may receive information about a forecast event through different media, many of these informal. For this reason, agency staff and media need to take advantage of the multiplicity of routes of communication and ensure that communication along each route conforms to best practices and contains necessary message components (discussed later in this report). Third, there is a strong contextuality to risk communication --i.e., messages have to be tailored to the audience. In some cases, messages need to be tested across a broad spectrum of publics (agencies as well as members of the public) and, in others, they should be individualized to suit the particular community being addressed. What are the special considerations of the urban poor? What measures and messages are needed to address the needs of the infirm and disabled?

We should be cognizant of who the decision-makers are. In most societies, these are ultimately individual members of the public and heads of households. This is why communicating to promote understanding and involvement is important. One cannot simply assume that an evacuation order automatically produces the
desired response on the part of residents. But communication of technical information does not mean that recipients need to be proficient in handling the technical --indeed, much of this work is premised on the idea that science can be expressed in everyday terms.

This brings up the need to integrate different knowledge systems --technical and everyday community knowledge. This question comes up, most often, when talking about the use of hazard maps prepared by the national government, and their consistency with locally formulated maps. Moreover, unlike some of the literature, which contrasts rational, expert agency approaches with participatory, community-based approaches, what should be clear by now is the need to integrate both into a coherent strategy (Berke and Stevens, 2016).

Lastly, as will be discussed herein and in the Addenda to this report, communication of hazards needs to be an open, interactive process that involves actors (even the public) beyond the weather agency in transmitting knowledge about a storm surge risk. Contrast this to the conventional system where only the expert agency has knowledge, and only it can relay information. This report (and, in particular, Addendum A) works out why the conventional approach can be improved upon.

2. Employing a Risk Communication Framework

Risk communication is a rich field of study that provides valuable insight for practitioners involved in preparing communities for extreme weather events. There is much more to sharing knowledge about incoming storm surges than focusing on its risks to health and property, but lessons from risk communication research can pertain to these other aspects (emergency preparedness, logistics, long-term resilience) as well.

A standard definition of the term, risk communication, is a “process of exchanging information among interested parties about the nature, magnitude, significance, or control of a risk” (Covello, 1992, p. 359). For the purposes of this report, we can take risk communication to pertain to the transmission and sharing of knowledge concerning storm surge hazards (in terms of threats to public safety or property) among affected organizations and individuals.

The simplest, most basic conceptual framework for risk communication is the classic "source–receiver" model of risk communication, as shown in Fig. 1 (Shannon and Weaver 1949; Witt 1973; Shoemaker 1987). In this classic model, the goal is simply to transmit, with as great a degree of fidelity as possible, a message from originator to recipient. The focus of this model is on the accuracy and completeness of the message, the success of physical transmission to the receiver, and the degree of understanding on the part of the recipient.

As useful as the source-receiver model is, it needs to be complemented by other depictions of the communication process that better describes aspects of the social and political environment. Figure 2 depicts the model known as the social amplification theory of risk (Kasperson et al. 1988; Renn et al. 1992). In this literature, risk communication is mediated by a host of social, cultural, and other processes, which affect how such communication is received (Pidgeon et al. 2003). The figure also reflects Everett Rogers' insight that communication is not simply a one-way, linear process (Rogers, 2010) and, instead, interactive feedback and conversation between the parties (Hadden, 1989).
And Figure 3 describes the complex institutional environment within which risk communication takes place. Instead of an exchange between two parties, knowledge courses through a network of organizations and individuals.

With these conceptual models in mind, it is good to acknowledge a number of essential features of the risk communication process today.

Reception: Messages must be received, understood, considered relevant by recipients to their situation, and acted upon. This is as suggested by the classic model of risk communication, as in Figure 1. The focus is on the design of the message and transmission process. As discussed below, there are key
essential elements that should appear in messages whenever possible.

Redundancy: An organization or individual, in reality, receives multiple messages from multiple sources, as suggested by the network model of Figure 3 (see, also, Sorensen, 2000). This brings up issues about redundancies in information, diversity of modes of communication, and possible issues with conflicting messages. The focus is on taking advantage of multiple communication pathways and consistency /richness of communication all throughout.

Competencies: Communicating risks of an anticipated event builds on a store of common knowledge and shared skills (at interpreting messages and hazard classifications, reading maps, using technical information, etc.) and previous experiences of individuals, organizations, and communities of related events.

Unprecedentedness: The previous point raises a particular feature of extreme weather events, which is that, too often, the event is something that the impacted population has never experienced before. This is particularly true of storm surges, as most people's experiences of floods are those of inland flooding due to rainfall and overflowing watercourses. Most importantly, for many (or most) communities that will be hit with a severe storm surge, this event will be the first of such magnitude that they will have ever experienced. Communication needs to help them visualize the oncoming event and motivate precautionary action.

Informality: Lastly, communication can occur informally. A community resident often hears about an event such as a local evacuation from friends and relatives, either face-to-face or through other means (social media, text messages, phone calls, email). Agencies tasked with initiating risk communication should take advantage of these informal routes, for reasons discussed below.

3. Key Ideas

The following are key ideas that underlie the approaches to risk communication of storm surge recommended in this report. A full discussion of each idea follows this section.

Message Elements: There are a list of message elements that should appear in each message, to the extent possible. This includes even very short messages, as in sms texts.

Duplication: The tendency is for organizations and agencies to simply pass on, routinely, messages from the national weather agency. This can have the effect of making messages appear to be simply routinary and pro-forma communications, not necessitating special consideration from the recipient.

Interpretation/Translation: In contrast to pure duplication, research supports the idea that messages need to be contextualized and personalized. In many cases, this entails elaborating or translating messages from the national weather agency to reflect local conditions and to speak directly to recipients, as the messages become distributed in more and more local contexts. Translation also means putting the message in language that recipients easily understand and can pass on.

Self-Relevance: A message can be ignored or treated perfunctorily by a recipient when it is not seen as directly relevant to the recipient's situation. Including key message elements, and increasing contextualization and personalization (with degree of locality), can foster this.

Trust: A message can be treated with less importance by recipients when they have no trust in the sender or the message. Trust is a factor of the authority of the messenger but, also, the degree to which the recipient is familiar with or recognizes the sender as someone that is trustworthy.

Relationality: The idealized communication situation is that of face-to-face exchange between
sender and recipient. In this ideal situation, self-relevance and trust can result. Another feature of direct exchange is the possibility of interaction, where the recipient does not simply receive a message but is able to dialogue, query, and confirm with the sender. The implication of this is that messages and modes of transmission can emulate the qualities of direct face-to-face communications. This has further implications for message design, since recipients should be able to pass on the message to others in their own ways of speaking.

Distinctiveness: There is a need to communicate coming events as distinct --i.e., they have to stand out and catch the reader's or listener's attention. This requires a number of practices on the part of the agencies, including ways of highlighting or foregrounding extreme weather forecasts. This is especially needed since, in the case of severe storm surges, such an event will be something never before experienced by the affected community.

Uncertainty: Lack of accuracy or precision of weather and storm surge forecasts can lead to hesitation, on the part of the sender, to communicate richer information. One way to address this is to incorporate expression of uncertainty into the message.

Mixed-Motives: People have multiple motivational reasons for evacuating or staying in place. These can include dismissal of the warnings, fear of theft while away from home, negative impressions of the evacuation sites, and others. The warnings should attempt to address these multiple factors.

Each of these key ideas are supported by the research done for this project. In the following pages, these ideas are developed, referencing the technical reports in the Addenda where relevant.

At the end of the report are the communication templates, each designed with these key ideas in mind. Following the templates is a language design aid, providing possible phrases that the user might choose from in crafting a message.

4. Discussion

4.1 Message Elements

The key idea is that the recipient, whether an agency or member of the public, understand what the event is, what the recommended action is, and why the message is directly relevant to the particular agency, individual, or community. The goal of any message is to have the recipient use the knowledge to decide on a pertinent course of action.

Risk communication research has identified five necessary message elements: Source (Lindell and Perry, 1987; Stephens et al., 2013), Hazard (Drabek, 1999; Neuwirth et al., 2000), Location (Drabek 1999; King and Cook, 2008), Guidance (Drabek, 1999; Mayhorn and McLaughlin, 2012), and Time (Sorensen et al., 2004). Recent work has confirmed the importance of having all these elements present in the message, though it is less clear if their order of placement makes a difference (USDHS, 2014).

As discussed in the following pages, messages are more effective when they are contextualized and personalized --i.e., when it is clear to the recipients that the message addresses their situation and location directly. For this reason, the project has identified a sixth element to add to the list, which we can refer to as the Recipient, or some phrase in the message that tells the recipients that the message is addressing them directly. This can take the form of identifying the affected population specifically. At a minimum, even simply writing the message in second-person format can achieve some degree of personalization (e.g., instead of "Those in the affected areas should evacuate immediately", say "If you are in the affected area, evacuate immediately").

The final list of message elements is shown below:
**Source**: Who is sending the message (whether agency or individual)?

**Recipient**: Who does the message concern, and is it directly addressed to them?

**Event/Description**: What is the forecast hazard?

**Location**: Where will the event occur, and what local areas are to be most affected?

**Guidance**: What is the suggested course of action?

**Timing**: When will the event occur, and by when does the action need to be taken?

It is important to note that each of these elements can be present as very long strings of text or very brief ones. The idea is that they would, ideally, be present in each communication, whether an extended technical memorandum (where these elements can be discussed at length) or short SMS texts (where these elements can be very brief). For example, Figure 4, shows how a brief text message ("RED ALERT: San Pablo coastal residents, storm surge 4 m danger high, evacuation begins Tues 2 pm, call 119:"") contains all of the elements in a short bit of text, as in the U.S. Federal Wireless Emergency Assistance (WEA) system, which has a 90 character limit.

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**Figure 4. Message Elements in a Sample WEA Text**

RED ALERT: San Pablo coastal residents, storm surge 4 m danger high, evac. begins Tues 2 pm, call 119.

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Optional Message Elements

The above constitute the necessary message elements, but other elements can be added as well. Among the extra, optional message elements are:

**Time Stamp**: the date and time of the message, so that readers can judge if it is current or not;

We have described the above messages as strings of text. Though it is not always possible, the inclusion of a map can increase message effectiveness. In some cases, the map is the message though, in general, a message should consist of both text and graphic. The USDHS study (2016) cautions, however, that message effectiveness seems to increase only with the inclusion of high-resolution maps, where readers can identify their positions on, and that low-resolution maps can reduce the recipient's interest in the message. Another issue is the need, on the part of the reader, for some degree of facility with reading and interpreting maps.

Lastly, many routes of communication cannot use maps (e.g., radio broadcasts, word of mouth, text-only SMS messages) and, so, we emphasize the need for messages to consist of text, not just graphics. Though both are important, the absolute need is greater for message texts rather than maps, which goes against the tendency of most technical agencies to concentrate on map production (e.g., storm surge hazard maps). This is not mutually exclusive, however, since maps can be translated, usually informally, into words by radio announcers, local government officials, and members of the public.
Uncertainty: acknowledgement, and maybe even estimates, of the inherent uncertainty behind storm surge predictions;

Regarding uncertainty, discussions with agency staff suggest a desire on their part to be able to impart, to the public and other agencies, the idea that all the weather and storm surge forecasts come with a considerable degree of uncertainty. The inherent goal of the scientist is to report the science as accurately as possible, and this means reporting the uncertainty associated with predictions. A secondary consideration is trepidation over false negatives (when the event turns out to be worse than predicted) and, to a lesser degree, false positives (when the event is not as severe as predicted). Related to this is a desire to avoid undue post-event criticism of the agency's forecasts.

The conventional way of expressing uncertainty, however, is a statistical approach (e.g., indicating 'error bars' or standard errors), which some experts fear would be overly complex and a type of information overload that many publics would not be able to handle. A thorough way of incorporating uncertainty is to incorporate it into a hazard map --e.g., the U.S. National Hurricane Center's Probabilistic Storm Surge Exceedance graphic maps probabilities that areas will experience a certain storm surge flood height (see http://www.nhc.noaa.gov/surge/psurge.php).

Uncertainty can be expressed in different ways, however. The simplest is a qualitative approach, where language is used that acknowledges uncertainty and the possibility that the forecasts are wrong. Perhaps a middle ground is to use a simple measure of uncertainty, without employing a suite of statistical measures. An example of this is to posit that the probability that the forecast event (e.g., storm surges along a specific coastal area) might not actually occur. Note the difference of such an estimate from that that pins the probability that the actual storm surge inundation heights would not match those which were predicted --the probability of such would be essentially 100 percent. But the probability of no occurrence at all, of storm surge, in a general area where some storm surge has been predicted, is a smaller probability and something that provides people with a reasonable sense of uncertainty.

4.2 Duplication

The research team conducted an evaluation of communication issues observed during Typhoon Haiyan (and, to a lesser degree, similar issues during other events like Hurricane Sandy). This report is found in Addendum A -- Evaluation of Communication Practices: Case Study and Recommendations.

The usual communication situation begins with a national weather agency generating a storm surge forecast or model output. This, or related, agency then transmits the information as hazard warning bulletins to other agencies and to the public. There is a tendency for a recipient organization to take the bulletin and simply retransmit the same unchanged (though, sometimes the organization will remove parts of the message and transmit an even shorter form of it). The evaluation exercise (Addendum A) suggested, however, that mere duplication of a message increases the likelihood that it will be seen by the recipients as a routine exercise requiring no responses out of the ordinary. For members of the public, the response is often to ignore the message completely. This was seen to be the case during Typhoon Haiyan in the Philippines in 2013 and, to some extent, in the case of Hurricane Sandy in New York and New Jersey states in 2012. In short, the routine copying and retransmission of messages (which often are sent to a national audience) can reduce the degree to which recipients find them as self-relevant and actionable.

As discussed below, the remedy requires interpretation and modification of the message by the recipient. The idea is to produce messages that are tailored for more specific recipients and that
increase the degree of contextualization and personalization. This brings up the question of how the recipient can increase message specificity or richness when the original message contained none of it. This issue will be discussed below.

4.3 Interpretation

Consider a bulletin from a national weather agency that is received by a local mayor's office or community organization, which then passes on a message to field agents or the local population. Ideally, the local agency would modify the message to call out locally relevant details and address the local community directly --otherwise, recipients may regard the communication as the same as standard bulletin information from the national weather agency, leading to a business-as-usual response. This even pertains to transmission of local emergency response orders --when they appear identical to previous, then there is no indication as to what different responses are required in the present situation. But responses have to be tailored to the specific situation --whether on the part of the local government or members of the public. For example, which areas to evacuate depend on the specifics of the oncoming event.

The literature has reinforced the idea that different message recipients need to be active in interpreting warning messages. That is, one cannot assume that members of the public would evacuate en masse if told they should without explanation. In the end, individual households decide to evacuate or not, regardless of what the national or local agencies tell them (even under a mandatory evacuation order). Local agencies and organizations have to assess the degree of urgency or severity of the situation to calibrate their actions, as well. There is a natural tendency of bureaucracies to assume that pre-established routines are sufficient to organize the right response, but routines do not determine the extent of actions on the ground. There is always a degree of discretion on the part of the local agency official or member of the public. Moreover, routines can fail to respond adequately to extreme weather events that have never been experienced by the local population.

The basic idea is that, as messages are routed through more and more local networks, the messages themselves need to become more contextualized and personalized. That is, the messages have to speak to the recipients specifically and directly. This is discussed at length in Addendum C and is depicted in Figure 5, below.

The need for interpretation on the part of recipients before retransmitting the message is echoed in the discussion below, on self-relevance and trust. We emphasize that these same principles pertain whether the recipient is a government agency, an organization, or members of the public.

![Figure 5. Tailoring Messages to Scale](image)

Table: Tailoring Messages to Scale

<table>
<thead>
<tr>
<th>National</th>
<th>Regional</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>increasing contextualization/personalization</td>
<td>increasing scale</td>
<td></td>
</tr>
</tbody>
</table>
4.4 Self-Relevance and Trust

Ultimately, the success of a disaster prevention or evacuation effort depends on the decisions of thousands of individuals and households. Evacuation orders can be ignored, or they can be treated with urgency. For this reason, messages need to be understood by these people as immediately and directly relevant to them, and the sources have to be those that they regard with trust.

Now, this pertains even when the message recipient is a local government agency. The field agent needs to personally assess the severity of the threat is, as well as the urgency of action. An evacuation order can be treated as a routine event or an extraordinary one necessitating unprecedented action.

The literature on message self-relevance and trust is discussed in Addendum C. Self-relevance increases when the message speaks to the situation of the recipient in specific terms. Another aspect of self-relevance is when the message is somehow addressed directly to the recipient.

Similarly, trust involves multiple dimensions, one of them being the credibility and authoritativeness of the message source. There is more to trust, however, than simply knowing the sender is an authoritative one. Another aspect of trust is referred to as affective or identification-based trust, which refers to the aspect of the recipient's knowing, being familiar with, or identifying with the sender. This brings us to the next key idea.

4.5 Relationality

As discussed in Appendices B and C, the idealized communication situation, which maximizes self-relevance and trust is the direct face-to-face exchange between two persons (the sender being a person considered by the recipient as trustworthy), as depicted in Figure 6.

Figure 6. Idealized Face-to-Face Communication
Weather and disaster risk reduction agencies and local governments are not able to communicate directly with individuals, of course (of course, there are exceptions to this, such as when the agency maintains a hotline). But messages can be contextualized and personalized to closely approach the ideal of direct communication. As described in Addendum B, the research team tested the effect of two alternative messages, shown below: Message A, an enhanced message that features a greater degree of contextualization and personalization, and Message B, a default storm surge warning bulletin.

Message A

To residents of Barangay Pablo,

According to PAGASA, our barangay may experience a storm surge of 1 ft (up to your knees) tomorrow. You and your family may be in danger. Even if low, you may be swept by the water and carried away. You or your family can be hurt or even drown as the fast-moving water carries you. Please evacuate immediately. Call me should you need assistance.

Your tanod and PAGASA liaison,
Mariano Loreto.

Message B

PAGASA forecast: 1 ft storm surge by tomorrow.
Risk: Possible danger as this level of surge can sweep people away.
Hazard: Possible injuries from trauma or drowning from flood.
Recommendation: evacuation of residents in affected area.

Survey responses indicate a statistically higher positive response (in terms of willingness to evacuate) from Group A compared to Group B. Moreover, Message A registered higher in vividness and self-relevance, but no statistically significant differences in trust and smaller difference in authority. So, the message can emulate characteristics of direct face-to-face communication, where the sender is a person known to the receiver, and the message directly addresses the receiver's situation. This effect is enhanced by the wording of the message, which is written in second-person (i.e., addressed to "you”).

An even more obvious strategy is to take advantage of direct communication. At the local level, this is achieved formally through door-to-door campaigns or, less directly, a roving announcer speaking through a loudspeaker, using a siren, or other similar method. One step removed from this is broadcasting messages through television and radio, especially through local stations.

One survey inquired into which routes of communication were most effective in spurring action. The highest ranked item was communication through family and friends, followed by tv, door-to-door visits, sirens, radio, internet posts, and SMS/text bulletins, in that order (USDHS, 2016). Social media and posters were not found to be least effective in inducing action. These findings are consistent with the relational model, where trust and self-relevance are seen to be maximized through direct face-to-face communication. For example, one reason tv
may be more effective than radio is that seeing the sender approximates receiving the message face-to-face.

There are yet more implications of the relational model. Extending the communication process to others, what we have is as depicted in Figure 7, which shows the message as being passed on from person to person. What is required for this to happen, however, is that the message be something that people can translate into their own ways of speaking, which requires understanding the meaning of the forecast event and recommended actions. And this has implications for agency staff, the media, and others, that messages need to be put into language that is not too technical, so that recipients cannot pass it on and retell the story in their own terms. This is further discussed in Addendum A, which evaluates how rigid organizational boundaries can constrain message reception and response.

One more thing to note, and that is the time needed for information to course through the network depicted in Figure 7. This means that organizational routines, which can delay alerting the public to a storm surge until either model results are more exact or until a cyclone enters a country's or agency's jurisdiction, can leave too little time for communities to learn about, communicate, and prepare for the event.

### 4.6 Distinctiveness

In many countries, cyclones are a fairly periodic occurrence. This means that populations are used to these storms and even expect them to occur each year. This can actually pose a problem, as far as coping with the risk of storm surge. Most of people's experience will be of strong winds and inland flooding. Extreme storm surges are not a common experience and, so, people's prior experiences will not guide them as far as dealing with storm surge risks, and this goes for both the public as well as local agencies.

This means that messages might contain some indication that the forecast storm surge is something beyond the range of experience of the local population (both residents and officials).
We can predict, with a fair amount of certainty, that catastrophic storm surges will occur in some part of the world. The issue is that, for that community that is hit by the surge, it will invariably be the first time the local population would have experienced such an event. This was the case during Hurricane Katrina, as well as Typhoon Haiyan. This poses a dilemma, since people's risk avoidance behavior is strongly influenced by memory of extreme weather events in the past (Hall and Endfield, 2016). Complicating this further is the possibility, as some recent scientific investigations suggest, that climate change may lead to increasing frequencies of these severe weather events (Emanuel, 2013).

4.7 Mixed-Motivations

The survey, described in Addendum B, recruited Tacloban City residents who chose not to evacuate during Typhoon Haiyan. They were asked to rate possible reasons for not evacuating on a scale of 1 to 4 (least applicable to most applicable). The responses are summarized below.

The responses reveal a wide range of reasons behind not evacuating, many of which had a mean rating of around 3 on a scale of 1 to 4. This suggests that many motivating factors were behind people's decision not to evacuate. The highest ranked responses include: perception of safety of the home, underestimating the strength of the event, negative impressions of the evacuation center, fear of theft, and lack of clarity regarding what a storm surge was.

What this implies is that warning messages and evacuation orders need to take these multiple factors in mind and attempt to address them, to at least some extent.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>I did not hear about or know about the coming flood/or storm surge.</td>
<td>2.278</td>
</tr>
<tr>
<td>I heard about the flood/storm surge but did not think the risk was great.</td>
<td>3.011</td>
</tr>
<tr>
<td>I felt my home was the safest place to be.</td>
<td>3.478</td>
</tr>
<tr>
<td>I did not like to stay at the evacuation center.</td>
<td>2.966</td>
</tr>
<tr>
<td>Storm warnings in the past, before Yolanda, are usually exaggerated, nothing usually happens.</td>
<td>2.889</td>
</tr>
<tr>
<td>I heard about the storm surge but the information was unclear about what a storm surge is.</td>
<td>2.922</td>
</tr>
<tr>
<td>I did not think that the information about the storm surge applies to me or my local area.</td>
<td>2.822</td>
</tr>
<tr>
<td>I was afraid to leave my home because someone may break in and rob us.</td>
<td>3.044</td>
</tr>
<tr>
<td>I was waiting for some official or person I know to inform us [about the storm surge?] in person.</td>
<td>2.191</td>
</tr>
</tbody>
</table>
5. Use of Maps

Maps can be a crucial part of the message. Most storm surge modeling will have a mapping component, where the model results will be depicted on a map. A storm surge model, however, might predict surge heights offshore (on the water) and not water heights onshore (on the land). A mapping of offshore surge heights can already be quite useful, as it identifies coastal areas that are most vulnerable.

The most detailed type of map, however, is one that shows inundation levels onshore. This type of map shows, directly, the areas most vulnerable to storm surge and, it follows, most urgently needing to be evacuated. For local government, this is most useful for evacuation planning. For the local resident, this increases the degree that a storm surge and evacuation warning is recognized as self-relevant and necessitating action. As discussed earlier, vividness of the message is important in spurring action.

If a map is used, the ideal type would be one that shows the underlying street grid in enough detail such that readers can identify their locations, evacuation routes can be planned, and exact locations of evacuation centers determined. One study concluded that such a level of detail is not just ideal, but that maps with low levels of detail can have no or a negative effect in terms of motivating action (USDHS, 2016). If the map lacks street detail, it can still include locations of local landmarks that will help readers orient themselves.

Morrow et al. (2015) conducted research that suggests some possible best practices. One is to express inundation in terms of water "heights" not "depths" and to express inundation levels on land in terms of heights above ground level instead of above sea level. Their research also suggests that different users (both meteorologists as well as members of the public) prefer multi-colored maps that depicted two or more zones of inundation with different colors (e.g., red indicating the most inundated area). A sample of their maps is shown in Figure 8. Color maps are most suited for dissemination by internet or on television but, with regard to print media, situations may require maps that can be shown in grayscale or even black and white. Map developers need to test whether a color map, printed in grayscale on a black-and-white printer is still sufficiently legible such that readers can identify zones of inundation (and evacuation).

![Figure 8. Sample Storm Surge Hazard Map](http://www.nhc.noaa.gov/surge/inundation/)
6. **Diagnostics**

The above guidelines can translate into an easy diagnostic that can be employed to evaluate messages and identify any improvements that can be made. The diagnostic amounts to asking a short list of questions, shown on the following table.

1. Are all the necessary message elements found? If not, can the missing elements be added?

2. Do the messages gain in contextualization and personalization as they get more local?

3. Does the message tell the reader about the unprecedented, unusual nature of the coming event?

4. Does the text or the map include some expression of uncertainty over the predicted event?

5. Does the message address some of the factors behind non-evacuation?

6. Does the message use simple, non-technical language or a combination of technical and everyday terms?
7. Communities of Practice

The literature often uses the term, Community of Practice, to characterize a participatory form of knowledge sharing (Lave and Wenger, 1991). The term simply represents a group of people in the process of learning together. The important thing, for the purpose of this report, is to conceive of such a community as a network of different persons: agency staff, local government officials, schoolteachers and principals, residents, NGOs, and others.

These kinds of communities can now be formed, which include people from remote parts of a country, using a combination of strategies ranging from traveling workshops, online workshops, email and social media, and other means.

The idea is that of a continuous risk communication network. Information about storm surge risks and forecasts should not simply be seen as a parcel of information passed from the central agency down to recipients, but a story that is retold by recipients to others. Addendum A makes the case that communication needs to be more open and inclusive. For knowledge to be passed on, this requires that, first, the message must be translated (or translatable) into everyday language that nonscientists can pass on and tell others about. Secondly, it requires some competencies in understanding and interpreting weather forecast information, especially that concerning storm surge. It is for this second reason that a community of practice approach can be valuable.

The community of practice is a network that includes experts from the weather and disaster risk reduction agencies, local officials, residents, and all the other players that are involved in decision-making during an extreme weather event. With regard to storm surge, it is possible to identify municipalities (and areas within those municipalities) most vulnerable to storm surges, and to tailor a learning process for these areas. The idea is to develop and share a kind of "coastal literacy" where agency officials and representatives of the local community understand the risks and opportunities of living along the coastline. This requires understanding occurrences such as storm surge, but also being able to read technical bulletins, maps, and other sources of information regarding these events. Requisite skills involve using such information in planning for emergency response (planning evacuation strategies and mobilizing red alert teams) and in pre-event planning and adaptation. For example, locals should learn skills in mapping out areas vulnerable to storm surge and discerning differences from areas vulnerable to inland flooding. They should gain skills in siting evacuation centers and planning evacuation routes. This may require being able to modify government-supplied hazard maps and tailoring them to suit local needs and to add local knowledge.

Coastal literacy means not just reading maps and bulletins but, more generally, "reading" the coastal environment. This means recognizing what features of the coast make an area more vulnerable or resilient (why, for example, coastal marsh and mangrove can reduce the severity of a storm surge). It also means being able to convey messages about coastal risks to others. Such competencies mean being able to receive a bulletin from a national weather agency and, then, conveying the message to another verbally. If risk communication is understood as a story to be told, then coastal literacy means everyone should be able to participate as a storyteller.

There is a need to go beyond officials in fostering a community of practice. The main reason is because multiple actors are involved in decisions to evacuate and other actions to protect community members. For example, it is important to involve both women and men from the affected communities. This is especially true in highly stratified and male-dominated communities. There is some research that suggests that positive responses to evacuation advisories are maximized when female heads of households make the decision (Bateman and Edwards, 2002). In general, the community of practice needs active involvement of female and male residents --as discussed in Addendum B, the
survey of survivors of Typhoon Haiyan suggests both female and male heads of households decide whether or not to evacuate.

The community of practice needs to seek out residents from the most vulnerable communities, which means the urban poor living along the coast. In many areas of the world, this means informal settlements built on vacant or marginal areas along waterways. For these kinds of precarious settlements, shelter-in-place may not be an option, and evacuation measures need to be completely effective. And, yet, the decision to evacuate or not still remains to the heads of households of even the lowest-income communities, which means building the same capacities for ‘coastal literacy’ among the urban poor.

There is one additional element of a community of practice that needs serious reflection, and this is the dimension of interaction. Messages do not just travel in a one-way direction. For this reason, there should be ways that community members, NGOs, and local governments dialogue with, query, or reason with technical experts (even if they are found in national agencies far removed from these vulnerable communities). This holds true during emergency situations, as well as during ongoing disaster risk prevention activities. But this requires, in many cases, departing from the idea of a chain of command with rigid organizational boundaries and formalized communication.

This report, along with the attached addenda, should be used as a handbook for those involved in risk communication, even indirectly. It is hoped that, by providing a reasonable set of guidelines for designing communication, the report may play a role in the broader mission of keeping communities safe.
SEE ACCOMPANYING DOCUMENTS:

Attachment: Toolkit for Storm Surge Risk Communication

Attachment: Template
References.


