

Tsunami Self-evacuation of a Group of Western Travelers and Resulting Requirements for Multi-Hazard Early Warning

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ABSTRACT

This paper describes the experiences of a West-European project group in Sri Lanka in March 2005, during a tsunami threat. They had previous disaster related knowledge and used both local guidance, global media and contacts back home, but could not get adequate information about how much time they had, how likely a tsunami was, or which countries had ordered evacuations. Their decision to evacuate was based on their own reasoning and influenced most by one trusted local resident. Their mobile phone communication with their relations in Europe created a de facto ad hoc mobile emergency announcement (MEA) system. Their decision to return relied heavily on the ad hoc MEA text messages, as local authorities had not yet issued an all-clear. The findings underline the importance of multiple early warning languages and delivery channels and suggest that when relevant, 'event onset time' should be explicit in early warning.

Keywords

Traveler safety, developing countries, early warning, pre-disaster mitigation, group evacuation, mobile emergency announcement, MEA, ad hoc MEA system, false alarm.

INTRODUCTION

In pre-disaster situations, well designed and timely early warning enables effective mitigation and can substantially limit loss and destruction.

Early warning studies and reports have mostly focused on people who live in developed societies, and receive early warning in their everyday environment. Some information is available about the early warning and other disaster information needs of residents of developing countries (e.g. Fakhruddin, 2004; Samarajiva, Anderson and Zainudeen 2005). However, in extensive literature searches during April 2006 – January 2007, information was found on neither the early warning needs nor the emergency behavior of foreign travelers in developing countries during the pre-disaster phase.

This study provides some answers. It describes how a group of 23 students and professionals of emergency management from Europe acted during a tsunami threat on Sri Lanka. The incident occurred during the night between the 28th and 29th of March 2005, following an 8.7 magnitude earthquake near Sumatra at 23:09 WIT (Sumatran time), 22:09 LKT (Sri Lankan time). Though no official tsunami warning reached the group, they chose to evacuate.

The goal of this study is to review current requirements for early warning from the recipient's point of view, based on the group's experiences. We also aim to understand if travelers in developing countries who come from (Western) developed countries differ from what is known about the global general public or travelers in (Western) developed countries, in regard to early warning needs or emergency behavior. Due to the make-up of the group, we will also consider if emergency management professionals behave differently from what is known about the global general public, when they find themselves under disaster threat.

Main issues of interest:

- Travelers' preparedness for disasters – knowledge and equipment
- Travelers' information needs and resources during the pre-disaster phase

- Travelers' information seeking behavior during the pre-disaster phase
- User requirements for early warning, which are especially important for travelers
- Facets of local and international disaster management, which are especially important for travelers

EARLY WARNING END USER REQUIREMENTS

Requirements for early warning are based on research about human behavior in disasters. The author's summary of relevant research is available on WWW (Addams-Moring, 2007). Below are summarized those early warning requirements that are most relevant from the end user's point of view. (Mileti and Sorensen, 1990, ch. 3.1.3 & 5; McGinley, Turk and Bennett, 2006; Samarajiva et al., 2005; Sillem and Wiersma, 2006; Sullivan and Häkkinen, 2006; Zhao, Addams-Moring and Kekkonen, 2005):

- Accessibility and population reachability – everyone should be able to receive early warning
- Targetability and timing – the right recipients should get the early warning at the right time
- Action-orientedness and specificity – early warning should be explicit about what people should do
- Non-ambiguity and understandability of the early warning
- Familiarity and trustworthiness of the early warning source
- Consistent confirmation by several early warning sources
- Familiarity and usability of the delivery channel and device
- Multiple channels for early warning delivery
- Multiple early warning languages

An international open standard, the Common Alerting Protocol (CAP) has been defined to ensure that all relevant information has a designated place in an early warning message's structure (Botterell, 2006). CAP is designed to support a multi-hazard or all-hazard warning system architecture, which in most cases is the most effective and efficient early warning design approach (Botterell and Addams-Moring, 2007; McGinley et al., 2006).

MATERIAL AND METHOD

Group members were twenty higher education students from the Netherlands and three 'group guardians' from Belgium: a teacher-researcher who was the group leader, a teacher and a researcher. Their native language was Dutch and all were fluent in English. Only one - the teacher - was a woman.

The purpose of the trip was community rebuilding after the Boxing Day 2004 tsunami catastrophe. The trip had been prepared for several months and the students were divided into four teams of 4-6 students each, each team having their own subproject for a Sri Lankan customer.

The group members' familiarity with each other varied: most knew most other group members at least by name and face before the trip. All students knew their own team members well. The group leader, the researcher and the teacher also knew each other fairly well. However, the whole group had not been together before the trip started.

Over 90% of the group members were students or professionals connected to emergency preparedness and disaster response. During the trip's preparations all group members had gotten additional information about tsunami effects, disaster response, and post-disaster rebuilding.

From Incidental to Planned Data Collection

All data was collected some three weeks after the incident. The data collection began when the group leader and the author met by chance in Europe. The extempore individual interview that followed was unstructured, with questions such as "Then what happened?", "Why did you think that?", "What did the others say?", and "What reasons did you have for doing that?" The interview notes were made in longhand writing, as no other recording technology was available.

After the first interview the goal became to interview two students and one more group guardian. As atypical group

members as possible were sought for an *extreme case* sample (Robson, 2002, p. 266). Because almost half of the students were in the area, also a group questionnaire and a group interview could be made. Thus the material of this study became the memories of nine group members (hereafter “interviewees”):

- ☒ Four in-depth, unstructured individual interviews, each lasting 30 min - 2 h and producing 5-12 pages of longhand notes by the author. These interviewees were (chronologically):
 1. The group leader
 2. Student A, who was pointed out by many group members (including himself) as the student who was the least motivated to evacuate
 3. Student B, who was pointed out by many group members (including himself) as the student who was the most motivated to evacuate
 4. The teacher - the only woman
- ☒ One group questionnaire, answered by the leader, student B and five other students. They wrote their answers to the author’s spoken questions individually (2-3 pages each).
- ☒ One group interview with the same group, which lasted some 30 minutes and produced two pages of longhand notes by the author.

At the time of the incident, the group was divided into two subgroups. The bigger subgroup was on the West Coast of Sri Lanka and the smaller on the East Coast. Only one group interviewee came from the East Coast group.

The criteria for including and excluding group members are summarized in table 1 below.

Group member	Subgroup during the incident	Individual in-depth interview: inclusion or exclusion criteria	Group questionnaire and group interview: inclusion or exclusion criteria
Leader	West Coast	Incl: chance (first interview)	Incl: helped with arrangements for the group questionnaire+interview
Teacher	West Coast	Incl: only woman	Excl: could not come
Researcher	East Coast	Excl: not enough time	Excl: could not come
Student A	West Coast	Incl: student who did not believe the danger to be real	Excl: could not come
Student B	West Coast	Incl: student who strongly believed the danger to be real	Incl: volunteered
Student C	West Coast	Excl: not in the area	Excl: not in the area
Students D-H	West Coast	Excl: not enough time	Incl: volunteered
Students I-T	either	Excl: not enough time	Excl: not in the area or could not come

Table 1. Study inclusion and exclusion criteria for the group members

For all data collection situations except the teacher’s individual interview, two co-interviewers whose native language was Dutch were present.

Method: Systematic Qualitative Content Analysis

The analysis was qualitative and based on all the interviews and questionnaire answers, which were systematically organized to produce as detailed and transparent a description of the group's experiences as possible. This methodological solution is borrowed from media research, where it can be applied to case studies in a new field, in which research has not yet established formal results (Weibull, 1997).

RESULTS

We will hereafter consider mostly the West Coast group. However, the one East Coast group interviewee's answers are included in the numbers, unless stated otherwise. All times are LKT.

The progress of events was not linear: many of the happenings and activities occurred simultaneously or in overlapping stages, as can be seen in figure 1 below.

Situation and Resources Before the Incident

Before the incident, the group had been in Sri Lanka a few days, traveling fairly widely, and on 28th March they moved to new locations: the group leader and the teacher with 15 students to the West Coast and the researcher with five students to the East Coast. The West Coast group had seen something of their new environment before nightfall. Among other things, there was an irrigation channel in the eastward village fields, running parallel to the shoreline. Behind it the terrain rose towards some hills.

Each group member had at least one mobile phone, there was a television showing CNN in a public room in both the East Coast and the West Coast hotel, and there was an Internet café near the West Coast hotel. The West Coast hotel was on the beach, and some interviewees had noticed water marks on their hotel's walls and heard that the water from the Boxing Day tsunami had reached into its ground floor. That night was partly cloudy, with an almost full moon.

Around eleven PM the leader and the teacher went for a walk on the beach. The rest of the West Coast group was dispersed in and near their hotel. They were all tired, but nobody was asleep.

First Information

When asked "When and from where (or whom) did you get the first news that something was wrong?" the interviewees reported varying times: one stated "around 23:00", four "23:30", three "23:45" and one "00:15." All nine interviewees got information first from a person. This first information was, roughly: "There was an earthquake near Sumatra, which causes a tsunami warning – we must evacuate."

Three primary sources for first information were identified: the hotel manager alerted one student (student C, not among the interviewees) and he immediately warned all group members he could find. The exact content of the hotel manager's message could not be established. Two students (one of whom, student D, was among the interviewees) were at the near-by Internet café, where one of the owners told them about the earthquake. Student D then checked www.cnn.com for "place of epicentre, time, advice..." before running back to warn the others, "But they knew about it already."

First Reactions – Faulty Situational Awareness

When asked "What were your first thoughts and feelings about the news?" many interviewees reported reacting with disbelief: four reported reactions such as "Is this a joke?" or "This can not be true!" Two reported being "shocked", two feeling a "need to act quickly" and becoming "very focused", and one thought that "As others are not worried, I don't need to worry, either." Several interviewees reported initially doubting student C – he was known to often joke and do pranks – but they became convinced, when they noticed that "he really was scared" and "he really meant it."

Seven interviewees' first motivation was to contact, find or warn other group members. Two reported wanting to "discuss or plan with [the] others", three to "get back to" or "find" group members and three to "warn others."

All nine interviewees (with the possible exception of student D) first misunderstood the situation believing that the earthquake near Sumatra had happened recently, though most of them got their first information some 1.5 hours after the earthquake. The group mistakenly assumed that they had at least one hour before they needed to act.

Evaluating Additional, Conflicting Information

When asked "What were your first actions after hearing the news?" several more interviewees reported looking for additional information and confirmation. One interviewee asked how his informer knew about the tsunami warning. The leader and the teacher first watched CNN and then talked with the hotel manager. Several group members talked to other travelers. Additionally, the leader got a phone call from a local guide, who had helped with travel arrangements. The East Coast group decided to watch television for more information. The first mobile phone text

messages were exchanged between the East and West subgroups at this time, too.

The West Coast hotel manager recommended that the group stay at the hotel’s top floor. However, the teacher was suspicious of his motives - she reported thinking “you are a businessman ... panic was the worst for him.” Moreover, some students did not want to stay inside an already tsunami-affected building, especially after having seen many other buildings that had collapsed in the Boxing Day tsunami. The leader became convinced of the situation’s seriousness by the local guide, who explained, calmly and clearly, that the group should evacuate and gave a couple of alternatives where to go.

Individual warning recipients

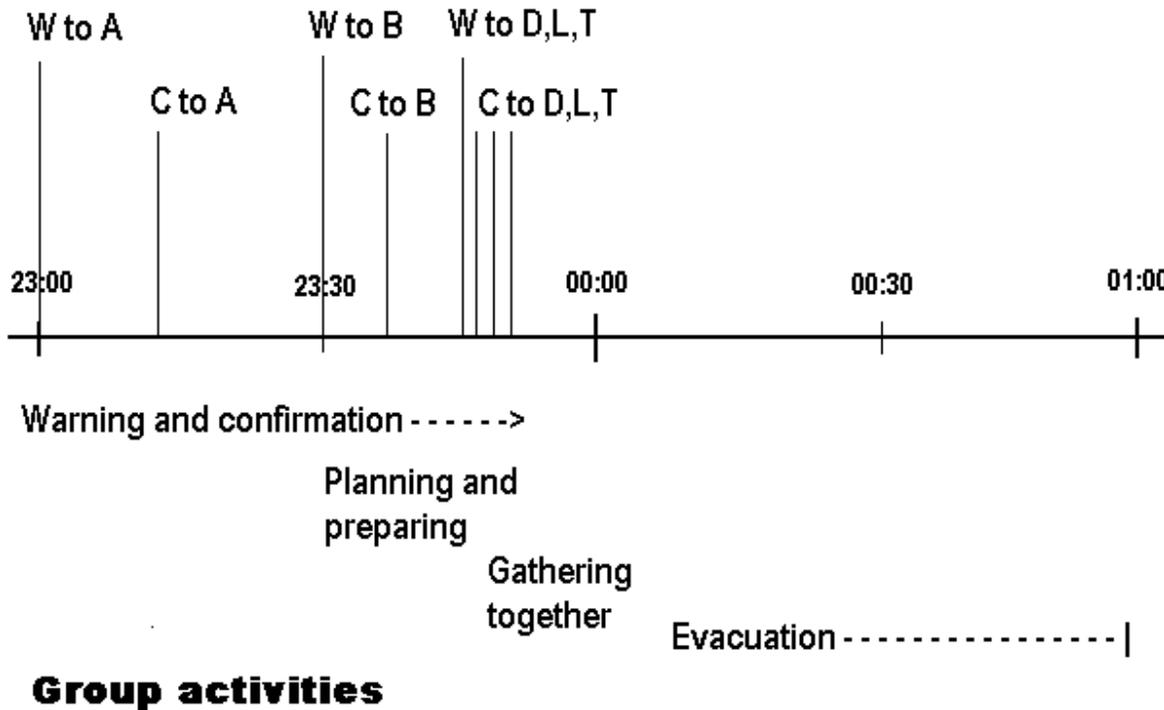


Figure 1. Approximate timeline: main events until completed evacuation (arrival at the church)
 W = first warning, C = confirmation ; A,B,D = students, L = leader, T = teacher

The group members evaluated the information in small dynamic groups. Four interviewees reported that most group members considered that the magnitude of the earthquake was smaller than that of the Boxing Day event – some group members also discussed that “the Richter scale ... is exponential.” Others thought that because Sumatra lies east from Sri Lanka, Sri Lankan West Coast was relatively safe. The leader and the teacher had noticed that the water had not receded from the beach.

The information from CNN (television) was evaluated negatively by all interviewees. They did not find out how much time had elapsed since the earthquake, nor estimates of the likelihood of a dangerous tsunami nor reports of tsunami observations (or lack thereof), nor which countries had ordered a coastline evacuation. The style of news delivery was described as making “a big deal of everything” and sounding “like they have a lot to say when they actually have nothing”. One interviewee commented “It is not the way I am used to getting the news [in my home country].” Use of old video footage from the Boxing Day tsunami without a clear archive material label was

severely criticized, as it created a false first impression that a big tsunami wave was on the move this time, too.

Evacuation Preparations until Time “Vanished”

When asked “What did you do next?” the interviewees’ stories began to diversify. Most were packing their passports, tickets and money to take along, moving luggage upstairs or finding group members. The teacher stayed at the hotel main entrance – her task was to get a transport. The leader and some students went to the beach to warn local fishermen, who believed them (even though the water had not receded) and wanted help with securing their boats. Meanwhile, a minibus took off with other people in it.

Four interviewees spontaneously expressed acceptance of losing the minibus: “those people were handicapped”, “it could be better used for elderly, children, etc.” and “the young can walk.” Others either did not express any opinion or showed that they had not been too enthusiastic about walking, despite the helping moonlight.

During pre-evacuation most group members attempted a mobile phone call to at least one person in Europe, to let family and friends know about their situation. At this time, most calls got through.

Before all group members had gathered, it became clear for several group members, including the leader, that their original time estimate was wrong: they had almost no time left before a tsunami might hit. Of the four interviewees who reported on this two expressed feeling more stressed, hurrying up or focusing even more keenly on their tasks. One reported becoming convinced that there would be no tsunami: “If it hasn’t come already, it won’t come at all.” One expressed feeling uncertain, yet deciding that leaving (fast) was still the safest option.

Evacuation: Wayfinding in Foreign Darkness

Eight of nine interviewees spontaneously emphasized the importance of their subgroup keeping together.

It was past midnight when the West Coast group members had convened. As they no more had a transport and as time probably was scarce but the water had not receded, they decided to walk briskly inland (east), aiming to first cross the nearby irrigation channel, as it would probably dampen a tsunami’s effect.

Three of four in-depth interviewees described having a poor sense of direction or being unsure of the group’s route choice. First the group mistakenly took a southbound road, parallel to the shoreline, until a student remembered that he had a mobile-phone compass. As soon as the compass was in use, the group turned east, inland. It took some time to reach a bridge over the channel. A schematic presentation of the evacuation route is in figure 2 below.

The group observed the traffic: vehicles were going eastwards full and coming back empty. Many local people were still in the coastal area, though, and some were watching CNN. Several interviewees tried to warn local residents who were not moving away from the coastline, and felt confused when these locals seemingly did not take the threat seriously, even though they clearly spoke and understood English. Some locals responded by telling that people were already gone, and many locals laughed as a first response to the warning. These reactions felt incomprehensible to the interviewees and dampened their communication efforts.

After the evacuation started, mobile phones were the group’s only information channels. Due to network congestion, making voice calls was mostly impossible. Also receiving calls became rare. However, even after sending text messages mostly failed, group members kept receiving text messages, which gave them updates based on global media: disaster information websites, BBC, and CNN. The phone numbers in the mobile phones’ memories proved precious: the leader in particular had several direct numbers to emergency management professionals, who could provide them with as relevant and correct information as could be found in the global media.

At approximately 1 AM the group arrived at a church, which was uphill and some 3 kilometers inland. Numerous local people had gathered outside the church, and the group reached consensus that this was a good enough place to stop. While they waited there, some local residents observed their mobile phone use and asked for information. Several interviewees reported that also now communication with the locals felt hampered and stated that the problems did not feel as language problems: “they did speak English”, more like “something cultural”. Some interviewees said that they did not understand the reasons for or the nature of the communication problems and therefore gave up.

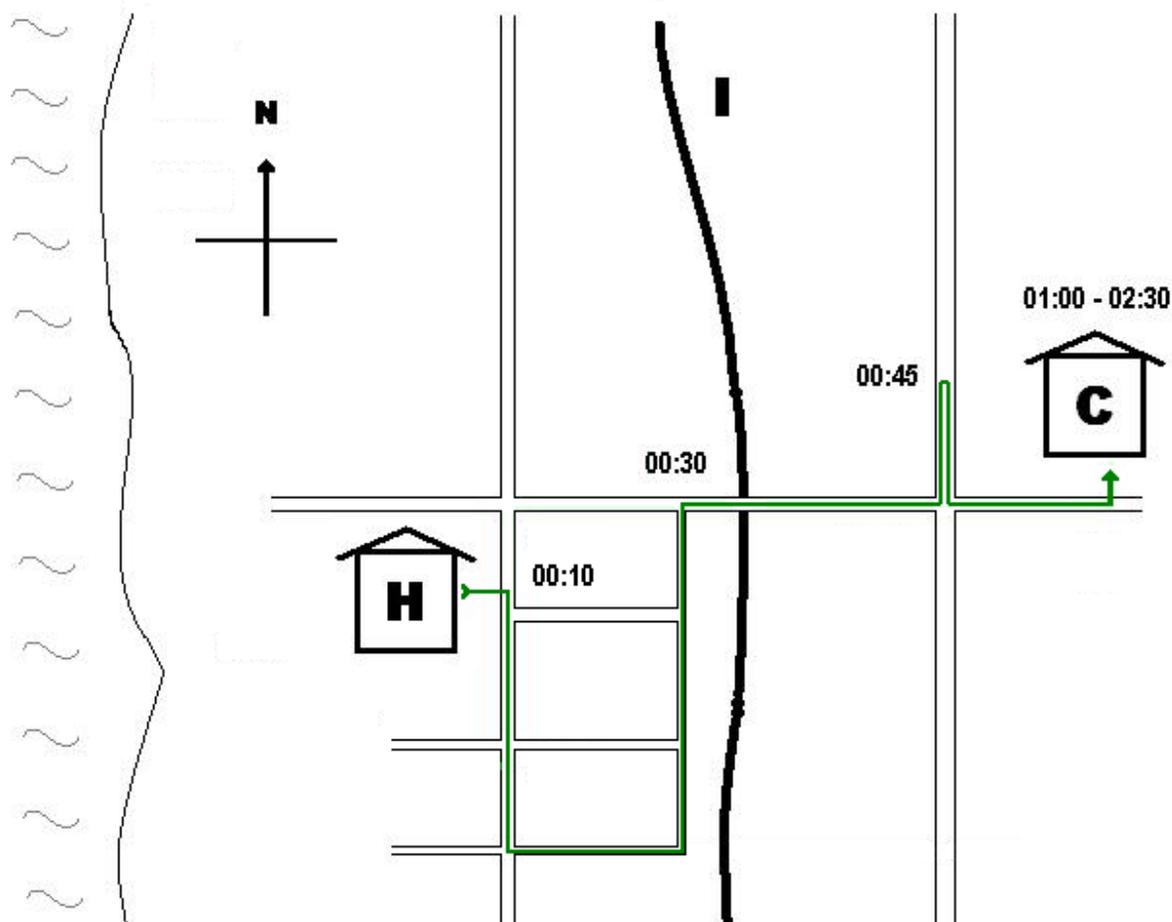


Figure 2. Evacuation route and times (both approximate)
 H = hotel, I = irrigation channel, C = church

After Return Maybe Official Notification

Around 1:20 AM at least two text messages arrived from Europe, stating that CNN or “some international agency” announced that the danger was over. Simultaneously the leader received a phone call stating “Don’t go back yet”, because Sri Lanka and Malaysia had not issued an all-clear. The group decided to stay for one more hour.

Around 2:30 AM the group was satisfied that the danger definitely was over, even though no all-clear had arrived. The group caught three transports, and was back at the hotel in “minutes.”

Around 4:00-4:30 AM, several group members received a text message that seemed to come from Sri Lankan authorities. This may have been an all-clear. Unfortunately, not one of these text messages was saved.

DISCUSSION

Results that confirm earlier findings

Most of the group’s experiences and behaviors were similar to those reported in literature about both the global general public and travelers in developed countries: nobody acted on the first warning, the group used multiple sources of information for confirmation, the information was evaluated in a comprehensive cognitive context and by group members together, everyone could act purposefully, the group stayed together, most group members called home and many spread the warning, altruistically helping each other and also outsiders.

At least one interviewee mistrusted the hotel manager’s advice, although due to his role he should have been one of

the more knowledgeable information sources. The personally more familiar local guide's advice was preferred.

Not surprisingly, the group got lost in the beginning of the night-time evacuation.

Results that conflict with or add to earlier findings and requirements

Compared with the findings of Dahlhamer and Nigg (1994) and the book by Drabek and Gee (2000) – both are based on data from before the global mobile phone era – the group members communicated actively and got a considerable part of their information via contacts back home. This may partly be due to their unusually strong background in emergency management and disaster response.

The group truly needed to know how much time they had before a tsunami might hit. The requirement for 'event onset time' as a part of early warning was implied but not underlined by Samarajiva et al. (2005) and Zhao et al. (2005). In Common Alerting Protocol 1.1 the data element for event onset is optional (Jones and Botterell, 2005), but this should not be interpreted as a recommendation to leave it unused in early warning.

New findings

Access to an international television news channel only confused the group members and delayed them from taking action. All interviewees said that they did not get any useful information from television.

Information dispersion from the group to the local residents was often inefficient. The problems occurred despite that there was a fluent enough common language, the group members really wanted to warn the locals and several locals actively asked for information.

The text messages through which the group's European contacts sent them updates could be called a do-it-yourself ad hoc mobile emergency announcement (MEA) system. MEA systems initiated and operated by private persons were not anticipated by Addams-Moring, Kekkonen and Zhao in 2005, but they have recently been implied, though not directly studied by Palen, Hiltz and Liu (2007).

CONCLUSIONS

In a pre-disaster situation in a developing country, the local residents have the strongest knowledge of local safety norms and traditions, and travelers from developed countries are likely to have many information and communication technology (ICT) resources. Yet according to this study, even with a shared language it is uncertain if they can overcome cultural and social group boundaries fast enough to effectively help each other.

Round-the-clock global news media and (almost) ubiquitous mobile ICT have lead to that anyone in a social network can be the first to know about a disaster threat against some group member(s). Today, early warning to travelers can come first from family or friends, who are far away and may never have visited the area in question. How accurate such a warning would be or how wise an action plan it would lead to is a reason for concern. For example, if travelers do not know that they are in a storm surge area, they might attempt to protect themselves from a typhoon by going underground. This type of risk may be compounded by that at least in this study travelers clearly preferred familiar, mostly far away information sources in comparison with less familiar local ones.

Mobile phones have changed sensemaking during evacuation. When satellite navigation capability is a standard feature in many enough mobile phones, we can expect even greater changes. Usability of this potentially life-saving feature is paramount.

Implications for Early Warning in Areas with Many Travelers

In general, the assumption has been that early warning comes from authorities. This assumption has never really reflected reality (Palen et al., 2007), but global ICT networks have extended the reach of neighborhood warning to the other side of Earth. This reality needs to be addressed, especially in areas with many travelers.

Early warning systems must be designed and built to utilize multiple early warning delivery channels and to deliver early warning in multiple languages to ensure that all social groupings in an affected area have access to accurate information.

The local authorities responsible for the threatened area(s) should as soon as possible ask for global media cooperation, so that early warning sent to the threatened area(s) would also be broadcasted globally with minimal delay. Thus, if travelers get information from their home countries (which is increasingly likely), that information

has a chance of being consistent with the early warning.

Especially in unfamiliar surroundings, the need to know how much time one has for evacuating or sheltering is strong. Early warning must be able to give an estimate for the time of onset of an event and to indicate how certain that estimate is.

Implications for Disaster Preparedness in Areas with Many Travelers

It is especially important for travelers that there are pre-planned evacuation routes also outdoors and that these are marked out clearly. Guiding signs would likely have stopped the group from getting lost.

Implications for Global News Media

It is unfortunate for the reputation of global news media if access to international news leads to that people in a disaster threatened area become confused, indecisive and delayed in taking action. In a real disaster situation, delayed action may aggravate the destruction and lead to additional deaths and injuries.

All global media should make a commitment to the serious side of their role as the “global information home” of many travelers and deliver disaster news in the same manner as responsible local or regional media: repeating the official warnings often and limiting background analysis until such time when the acute crisis is over.

Implications for Future Research

For effective early warning and other disaster information (e.g. marking evacuation routes), international research cooperation and end user participation would be needed to define symbols – pictograms, audio icons and tactile signals – that could be used as parts of early warning content and for other disaster related informing. Requirements for such symbols include that they should be internationally intuitive and unambiguous, easy to distinguish from each other, easy to reproduce in various media, such as in print, with sirens, on road signs, on WWW pages, with mobile phones, and on radio and television, and based on existing, standardized or otherwise well known warning symbols and established warning routines, when possible.

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