

Recommended Revisions to Warning Product Prototypes of the NWS National Tsunami Warning Center

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Executive Summary

This report was prepared under contract between East Tennessee State University and the National Weather Service (NWS Award Number NA10NWS4670015) to support the project, *Incorporating Social Science into NOAA's Tsunami Program*. The purpose of this report is to describe results of an on-going review of tsunami messages of the National Tsunami Warning Center (NTWC) in Palmer, Alaska and make recommendations for improvement using evidence-based approaches from the social and behavioral sciences as they relate to human behavior in response to warnings.

In general, we believe the message prototypes are well organized. They are much improved over previous messages, in terms of both content and style. Nevertheless, we corrected internal inconsistencies in message content and style.

We also attempted to clarify differences in impacts that are considered to be either *possible* or *expected* in areas under a Tsunami Warning or a Tsunami Advisory. This latter issue (possible versus expected impacts) is particularly challenging to address given the constraints of the existing alert categories, which only allow for designation of Watch, Advisory or Warning areas. The difficulty is encountered when trying to provide information about possible impacts versus expected impacts when: a) a tsunami has not yet been confirmed and b) areas may be under a Warning or even an Advisory, but there are drastically differing levels of tsunami hazard (e.g., inundation, run-up, current velocities) expected for isolated areas within these areas.

The existing language for expected and possible impacts is largely is for a worst case scenario and while this is useful for the areas likely to experience worst case hazards, it is not necessarily useful for areas likely to experience much milder hazards. We think that this can be avoided with more specific language about possible and expected impacts unique to areas exposed to varying degrees of tsunami hazard (e.g., high or low hazards), but this language would increase the length of the message. An alternative is to provide tsunami inundation maps as graphics to accompany the text messages. These maps and additional language would have the benefit of allowing individuals to read and see graphically the variation in expected hazards such as inundation across a Warning area and to make protective action decisions according to their situation.

The format of this paper discusses changes we made (or recommend) to the prototypes within each section (e.g., Evaluation, Impacts, etc) of the three message prototypes reviewed. We introduce the rationale for the change as an *Issue* and the recommended change as a *Recommendation*. We see these changes as further refinements of the existing NTWC messages, which could readily be applied to messages of the Pacific Tsunami Warning Center.

Project Background

This report was prepared by East Tennessee State University under contract with the National Weather Service (NWS; Award Number NA10NWS4670015) to support the project, “*Incorporating Social Science into NOAA’s Tsunami Program.*” The purpose of this report is to describe results of an on-going review of tsunami messages of the National Tsunami Warning Center (NTWC) in Palmer, Alaska and make recommendations for improvement using evidence-based approaches from the social and behavioral sciences as they relate to human behavior in response to warning messages.

Previously in this project we developed a metric to help guide our evaluation of message prototypes. We then reviewed some 37 message prototypes of the NTWC (then the West Coast Alaska TWC) and the PTWC. These results, including presentation of the metric, were described in a report prepared by Gregg, Ritchie, Johnston, Sorensen, and Vogt Sorensen, dated August 31, 2012, for Mike Angove, Director, NWS Tsunami Program.

This report describes results of work we conducted on warning products since the August 31, 2012 report was issued. C. Gregg and J. Sorensen visited the NTWC (then the WCATWC) in June 2013 and Gregg again in October 2013. Each time we worked with Paul Whitmore of the NTWC to advance the quality of warning messages. Gregg and Sorensen also worked with Chip McCreery of the PTWC in November 2013 to discuss application of the work on NTWC message products to PTWC products. Since those meetings, our review has focused on three NTWC message prototypes shown in Table 1 below.

The NTWC prototypes are somewhat of a hybrid of older PTWC and WCATWC (NTWC) tsunami messages. The prototypes are derived from our work with focus groups (see the August 31, 2012 report) and parallel work performed by an NWS warning tiger team led by Troy Nicolini of the NWS. New message products of the NTWC went live in November 2012 and it is the format, content and style of these new messages that we refined in this current phase of work. We also worked with the NTWC on a new prototype message that contained new ways of presenting geographical identifiers for areas under alert.

We understood that our continued work on NTWC messages would be used to make a second round of revisions to NTWC messages and a first round of revisions to PTWC messages, once the revisions were reviewed within the NWS and among its stakeholders. Our latest work focuses strongly on fine tuning message content and style, including, but not limited to internal specificity, clarity, certainty and accuracy.

Table 1. Message prototypes reviewed for this report.

1. WEAK51 PAAQ 031705
TSUAK1
BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 1
NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
905 AM PST SUN FEB 3 2013
2. WEAK51 PAAQ 031800
TSUAK1
BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 3
NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
1000 AM PST SUN FEB 3 2013
3. WEAK51 PAAQ 031955

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TSUAK1
BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 6
NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
1155 AM PST SUN FEB 3 2013

The Warning Message Metric and Review of Message Prototypes

The Warning Message Metric

For convenience and ease of reference the metric is provided in Table 2. As explained in the 2012 report, the metric incorporates factors that predict response to warning information, which are divided into categories of Message Content, Style, Order and Formatting and Receiver Characteristics. Recall that it is important to note that the warning message metric does not predict the effectiveness of response to the warning message, only how well the message contains elements that are recognized by research as important in facilitating protective action decision-making processes, such as advising people to shelter or evacuate. An effective response requires both a good message and that other factors lying outside the control of the message are met. These may include a range of social, cognitive and cultural factors and they may be especially important for local tsunamis where the decision-making process is very short in duration compared to distant, far-field tsunamis. In local, near-field tsunamis, people may not receive an official warning message in the time frame required to be useful, in which case they would be forced to make decisions based on receipt of only natural warnings, environmental and social cues, and informal warnings.

Message prototypes were evaluated by cross-referencing the message prototype with the meaning of metric factors and assigning a score for each factor. A maximum score of 1 was assigned where a message fully incorporated the characteristics of a specific factor. In contrast, where the characteristics of a factor were not described at all, no points were assigned. For factors that were partially described, we assigned a fractional value. The results of evaluating a message against the metric were used to edit a message's Content and Style until the characteristics of the metric were met. A metric factor was also flagged for discussion when the message could not be edited any further to increase the score.

Note that during this latest phase of evaluations we made some minor changes to the metric. These include, for example, exclusion of the US Geological Survey as a message Source; renaming the message factor "Observations of Impacts" to "Observations of Tsunamis." This removes the need to describe actual tsunami impacts during an event, which are beyond the role of TWCs to monitor and report. It also clarifies the need to describe observations of the tsunami, including observed maximum tsunami heights.

Table 2. The tsunami warning message metric.

Factor	Factor or Sub-factor Description	Points (0-1.0)	Score
Message Content			
Warning Type	Tsunami Message	1.0	
Audience	The intended audience is/are stated (e.g., public, emergency managers, media)	1.0	
Message Source	Name all key response agencies: NWS PTWC or NTWC	1.0	
Time/Date	Time and date of the message— not a section header.	1.0	
Update	*If this is a 2 nd or later message, specify updated information, specifically higher risk information	1.0 or NA	
Location	1. Specify affected areas	0.5	
	2. Specify unaffected areas	0.5	
Guidance or Recommended Actions	Follow your local or State Emergency Management Agency’s recommendations for evacuation & shelter; remain out of evacuation zone until the all-clear is announced. Use common sense about the threat if no official evacuation order is given.	1.0	
Timing	1. Times given in Local Time(s), avoiding Zulu, and UTC	0.25	
	2. Estimated time before impact of first wave (use local times) and duration of time until next update	0.25	
	3. Estimated duration of dangerous event	0.25	
	4. Duration of time until next update message	0.25	
Hazard, Vulnerability and Risk	1. <i>Primary Hazard</i> (tsunami) and its characteristics— multiple strong currents and waves of varying height, each lasting 10-30 min’s, separated by several minutes to hours.	0.25	
	2. <i>Threat of Primary Hazard</i> (strong waves, currents and coastal flooding that drown or injure people and weaken or destroy buildings and bridges; floating debris that injures people or weakens buildings and bridges)	0.25	
	3. <i>Tsunami Origin</i> - timing (in local time) and root cause of the tsunami (water displaced over a wide area by an earthquake, landslide, etc). Provide earthquake magnitude, region, coordinates & depth.	0.25	
	4. <i>Forecasts</i> - provide forecast of max tsunami height above sea level, start time (tsunami arrival times) and duration of event.	0.25	
Observations of tsunami	1. If this is a 2 nd or later message (i.e., a tsunami has been measured), provide observed maximum tsunami heights.	0.5 or NA	
	2. Include a statement that measurements of the leading wave and subsequent waves (and impacts) could vary considerably there and elsewhere.	0.25 or NA	
	3. Run-ups reported in both English and metric units; time in local time(s).	0.25 or NA	

Factor	Factor or Sub-factor Description	Points (0-1.0)	Score
Receiver Characteristics			
Env. cues & natural warnings	Information provided about <u>other sources of potential warning information</u> . This includes mention that shaking or rolling of the ground indicates an earthquake has occurred and a rapidly receding or receded shoreline or unusual wave forms and sounds and strong currents indicates a tsunami may occur.	1.0	
Social cues	For 2 nd and later messages. Unusual numbers of people congregating, packing or evacuating or doing so at unusual times indicates that something may be wrong. Seek information.	1.0 or NA	
Order	Factors should show an orderly progression of information with a BLUF– Bottom Line Up Front**	1.0	
Formatting	Text follows contemporary formatting methods to improve ease of reading (lower and upper case letters, punctuation, headings, bold, italics, etc)	1.0	
Message Style			
Specificity	1. Hazard agent and threat (waves/flood waters, ground motion, collapsed structures) and expected wave height (run-up) and distance traveled inland (inundation);	0.20	
	2. Risks of unprotected exposure (injury or death by drowning & blunt force trauma or collapsed structures);	0.20	
	3. Locations at risk and not at risk;	0.20	
	4. Guidance on recommended protective actions;	0.20	
	5. Time of impact; duration of time of a single wave, time between waves	0.20	
Consistency	1. Within messages issued by the PTWC & NTWC;	0.5	
	2. Across different messages from PTWC & NTWC	0.5	
Certainty	Message stated with certainty even if ambiguity in information exists	1.0	
Clarity	1. Message stated in simple sentences understandable to most people message;	0.5	
	2. Lacks unnecessary jargon or provides simple definitions	0.5	
Accuracy	Message is honest & includes all known scientific understanding and uncertainty, including margins of error	1.0	
Sufficiency	Appropriate level of information provided (succinct but sufficient detail)	1.0	
Channel	Where multiple channels are available, calculate score as: number of channels used / number of channels available (e.g., 3 used of 4 = 0.75).	1.0	
SCORE		*21 to 18	

*Where a message is the 2nd or later message, a statement should be made upfront concerning how the current message differs from the previous message. For example, new and important changes in alert

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levels or updates of forecasted and observed tsunami activity can be mentioned. The importance of this section will be underscored in ocean-wide events, when multiple messages are disseminated. ****Important information provided up front in a message is commonly referred to among persons with military backgrounds as a BLUF— bottom line upfront.**

Review of Message Prototypes

The following three sections describe the results of our evaluation of the three message prototypes—WEAK 51 Messages 1, 3 and 6. We use section headers of each message as a basis for guiding the discussion of changes. Principle changes are described as an *Issue* and corresponding *Recommendation* that is indented.

WEAK51 PAAQ 031705 TSUAK1 BULLETIN PUBLIC TSUNAMI MESSAGE NUMBER 1

Evaluation

Issue: For message 1 or any message issued before a tsunami is detected, the message should be specific about whether it is or is not known that a tsunami exists.

Recommendation: We added a statement, “WE DO NOT YET KNOW IF A TSUNAMI WAS GENERATED” in order to be certain about the uncertainty of a tsunami.

Issue: During the revision of messages over recent months, definitions of Tsunami Warning, Advisory and Watch areas were deleted. In their previous forms they were too technical and never really characterized these areas in terms of who the message applies to and what is to be expected or dangerous. We developed some simple language to do this succinctly.

Recommendation: Definitions were supplied that state to whom the message applies and what is expected. The language is different for definitions of Warning and Advisory. These definitions capture the real distinctions between Warning and Advisory areas, by specifying that: “A TSUNAMI WARNING APPLIES TO ALL PEOPLE AND STRUCTURES IN... ON OR NEAR THE WATER AND FURTHER INLAND” and “A TSUNAMI ADVISORY APPLIES TO ALL PEOPLE IN... ON OR NEAR THE WATER.”

The language concerning what is possible in terms of impacts in each of these alert areas is now unique. For example, for the Warning area we write: “DANGEROUS WIDESPREAD FLOODING AND DAMAGING WAVES AND CURRENTS ARE POSSIBLE.” For the Advisory area we write: “STRONG WAVES AND CURRENTS ARE POSSIBLE.” Note that this language in message 1, which is issued before a tsunami is known to have been generated, states that the impacts are possible. In subsequent messages issued after a tsunami is confirmed, the word possible is replaced by “expected.” This is discussed in more detail in the subsection **Impacts** further below.

In the subheadings TSUNAMI WARNING IN EFFECT FOR. . . and TSUNAMI ADVISORY IN EFFECT FOR. . .

Issue: There is inconsistency in the way in which geographical areas under a Warning are described within individual messages [the Issue persists between messages of the NTWC and PTWC]. For example, sometimes geological features are used, and other times place names or geographical boundaries are used.

Recommendation: There needs to be consistency in the use of location identifiers, using either state and coastal county names or very prominent locations that people in the area will understand. We recommend that you consider the edits we made to the location identifiers in some areas of Message 1 and work with the PTWC to decide on a standard practice for NTWC and PTWC message products.

Impacts

Issue: Given the great variation in what can be expected in terms of impacts within a broad geographic region under a warning or advisory, there needs to be a statement up front in this section that alerts readers to the fact that impacts can vary within Warning areas and within Advisory areas.

Recommendation: Adopt the language proposed: “IMPACTS WILL VARY AT DIFFERENT LOCATIONS IN THE WARNING AREAS AND IN THE ADVISORY AREAS.”

Issue: Some of the impacts for people and property in Warning and Advisory areas are identical.

Recommendation: In earlier revisions to the prototypes, we developed three subsections to describe the possible or expected impacts in these two areas (Warning and Advisory). The third subsection was created to merge some of the common impacts observed across both areas. This reduced repetition more than anything, but refinement of the information across all three categories makes the information contained in each subsection distinct from the other subsections. These areas were listed as the following but note that they were renamed as indicated in A, B and C below:

1. IMPACTS FOR TSUNAMI WARNING AREAS. . .
2. IMPACTS FOR TSUNAMI ADVISORY AREAS. . .
3. IMPACTS FOR TSUNAMI WARNING AND ADVISORY AREAS. . .

Issue: In order to make the subsection titles for Impacts and Recommended Actions identical, the three subsection headers need to be revised.

Recommendation: Revise subsection headers outlined in 1,2, 3 above to:

- A. IF YOU ARE IN A TSUNAMI WARNING AREA. . .
- B. IF YOU ARE IN A TSUNAMI ADVISORY AREA. . .
- C. IF YOU ARE IN TSUNAMI WARNING OR ADVISORY AREAS. . .

Issue: There is inconsistency in the certainty of impacts for warning and advisory areas. For example, some bullet items say impacts are “possible”, while others say impacts are “expected.” This Issue is two-fold. First, for Message 1 it is not known if a tsunami has been generated. Second, for subsequent messages issued once a tsunami has been confirmed, there will be a great disparity in impacts expected for different areas within a broad Warning zone.

Recommendation: The language in the IMPACTS section needs to be consistent with language in the previous EVALUATION section. However, there can be some variation because the EVALUATION section is a summary.

Recommendation: Until the NTWC and PTWC and states develop a tiered approach to different levels of Warning, which would apply to relatively small and large inundation and evacuation zones, there is no easy way to describe what is to be expected versus what is only possible. There will always be some uncertainty in expected impacts, but we are recommending two things to address the issue now. The first involves message number 1, where we suggest language be used indicating impacts are “possible” and in subsequent messages issued after a tsunami has been confirmed, replace “possible” with “expected.” However, in the second and later messages, the

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language adopted assumes a worst case scenario. Given that impacts will vary greatly within the Warning area and within the Advisory area, providing global statements about impacts will inevitably be accurate for the regions in a specific alert zone (e.g., Warning zone) experiencing high hazard but inaccurate for those areas in the same zone that experience lower degrees of hazard. The second thing that could be done to allow people to start to make informed decisions about how they will respond is for the TWCs to simultaneously issue graphic inundation maps with the text messages. This has the advantage of allowing people to see the expected variations in inundations for regions within a Warning zone.

Issue: There is some inconsistency in the order of sentences using the terms “marinas, harbors, bays and inlets.”

Recommendation: We corrected these by making them all the same order.

Issue: There is some inconsistency in use of adjectives that modify waves and currents for Warning and Advisory areas and it is still not obvious how areas under Warning differ from areas under Advisory.

Recommendation: We made the language in each of the Warning and Advisory areas unique to each area. Without unique language that describes what is possible or expected in each area people will think they are the same. This is, of course, undesirable. For example, for areas under a Warning we write:

“* STRONG AND UNUSUAL WAVES... CURRENTS AND INLAND FLOODING CAN DROWN OR INJURE PEOPLE AND WEAKEN OR DESTROY STRUCTURES ON LAND AND IN WATER.”

In contrast, for areas under an Advisory, we write:

“* WAVES AND CURRENTS CAN DROWN OR INJURE PEOPLE IN THE WATER.”

“* CURRENTS AND WAVES ON BEACHES AND IN HARBORS... MARINAS... BAYS... AND INLETS MAY BE ESPECIALLY DANGEROUS.”

Recommended Actions

Issue: There needs to be a statement indicating that the recommended actions are for a worst case scenario and why.

Recommendation: We added the language: “ACTIONS REQUIRED TO PROTECT HUMAN LIFE... SAFETY AND PROPERTY WILL VARY WITHIN TSUNAMI WARNING AREAS AND WITHIN TSUNAMI ADVISORY AREAS. THESE ACTIONS ASSUME A WORST CASE SCENARIO BECAUSE MOST AREAS ONLY HAVE ONE HAZARD ZONE AND HENCE EVACUATION ZONE.”

Issue: Just as with the section on IMPACTS, some of the RECOMMENDED ACTIONS for people in Warning and Advisory areas are identical.

Recommendation: As with earlier revisions of the prototypes, we list recommended actions in two subsections as follows. We renamed these to be consistent with the language used in the subsections for IMPACTS:

1. IF YOU ARE IN A WARNING AREA...
2. IF YOU ARE IN A WARNING OR ADVISORY AREA...

Note that these subsection headers previously were named:

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1. RECOMMENDED ACTIONS IN WARNING AREAS
2. RECOMMENDED ACTIONS IN WARNING OR ADVISORY AREAS

Subheading for IF YOU ARE IN A WARNING AREA...:

Issue: For warning areas the language concerning vertical evacuation is vague and perhaps not very useful. This is probably because there are few vertical evacuation structures for tsunamis in the USA and no such structures are designated with signage, like is done overseas in Japan, for example. Consequently, it is not easy to recommend to which building evacuees should seek shelter. Hawaii has had language in telephone books for many years that advise people to go to the third floor or higher in six or more story modern steel-reinforced buildings. However, knowing what is a modern building or whether it is steel-reinforced is not straight forward in non-crisis times, let alone during the a tsunami Warning.

Recommendation: We decided on very general but specific language: “EVACUATE INLAND OR TO HIGHER GROUND ABOVE AND BEYOND DESIGNATED TSUNAMI HAZARD ZONES OR MOVE TO THE THIRD FLOOR OR HIGHER OF A MULTI-STORY BUILDING DEPENDING ON YOUR SITUATION.”

Note that previous language only provided a quantitative value for the vertical evacuation, but not horizontal evacuation inland or to higher ground. Consequently, to make these two statements consistent, we added, “... ABOVE AND BEYOND DESIGNATED TSUNAMI HAZARD ZONES...” to provide more specific guidance concerning to where people should evacuate.

Notice that we added new language to the end of the statement above: “...DEPENDING ON YOUR SITUATION.” This was done to prompt people to think about evacuation options in their own context, which might differ from their peers.

We note that a recent dissertation by Stuart Frazer¹ of New Zealand proposes a framework for policy to develop vertical evacuation strategies. Frazer reports that further engineering, risk management, public policy and communications research should be focused on developing appropriate evidence-based advice for communities with respect to tsunami vertical evacuation options. His dissertation, only submitted in mid-April 2014, may provide some insights about possible language to include in these messages.

Subheading IF YOU ARE IN A WARNING OR ADVISORY AREA...:

Issue: there needs to be specific recommendations for people in general and for boaters.

Recommendation: The language for people in general is simply to: “MOVE OUT OF THE WATER... OFF THE BEACH AND AWAY FROM HARBORS... MARINAS... BAYS AND INLETS.”

Three recommended actions for boaters are:

1. “*...WHERE TIME AND CONDITIONS PERMIT MOVE YOUR BOAT OUT TO SEA TO A DEPTH OF AT LEAST 180 FEET.” Note that we changed the depth from 150 feet to 180 to align the depth with the 30 fathom depth currently under consideration in the

¹ Fraser, S. (2014). Informing the development of tsunami vertical evacuation strategies in New Zealand.. PhD dissertation, Massey University, New Zealand

State of California. We recommend that the NTWC use its best judgment in deciding on the recommended depth to which boaters should go, because the 30 fathom (180 feet) depth considered by the State of California conflicts with current NOAA recommendations of 100 fathoms (600 feet).

2. “*...IF AT SEA AVOID ENTERING SHALLOW WATER... HARBORS... MARINAS... BAYS... AND INLETS TO AVOID FLOATING AND SUBMERGED DEBRIS AND STRONG CURRENTS.” The language “avoiding shallow water” was chosen to reflect the increased tsunami hazards in shallow water.
3. “*...LISTEN TO US COAST GUARD MARINE ADVISORIES AND WARNINGS.” Reference to the Coast Guard is made because they handle warnings at sea.

Forecasts of Tsunami Activity

Issue: For message 1, it is uncertain if a tsunami has been generated. Forecasted arrival times are provided for specific areas in case a tsunami is generated. It is necessary to be certain about the uncertainty of a tsunami and explain why forecasts of arrival times are being provided even when there is no confirmation a tsunami has been generated.

Recommendation: We added the language below the section header: “WE DO NOT KNOW AT THIS TIME IF A TSUNAMI HAS BEEN GENERATED. IF THE TSUNAMI OCCURS IT IS FORECASTED TO ARRIVE AT THE FOLLOWING LOCATIONS AND SPECIFIED TIMES.”

Issue: Some focus group participants wanted to know about the accuracy and precision of forecast arrival times provided in the table.

Recommendation: If the accuracy is not of the order of a minute, consider providing arrival times as a range, rather than specific times or specific times with the error.

Issue: The sites listed in the table seem to lump into sites that must either: 1) take urgent and immediate response actions because the tsunami source area is very close or 2) take action over a longer time period (e.g., seek information) because the threat is not as immediate and the response perhaps not as urgent. There is a need to distinguish these too.

Recommendation: For areas needing to take immediate action, we wrote in below them in the table: “IF YOU ARE IN OR BETWEEN SANTA BARBARA AND SAN DIEGO TAKE ACTION IMMEDIATELY.” However, we are not satisfied with some of the language: “...OR BETWEEN THEM...” Perhaps the NTWC has a better idea.

For areas that are further away, we wrote in below them in the table: “IF YOU ARE ON THE CALIFORNIA COAST NORTH OF SANTA BARBARA LISTEN TO OFFICIAL INSTRUCTIONS.”

Observations of Tsunami Activity

Since there is no confirmation of a tsunami, this section only reads: “NO OBSERVATIONS OF TSUNAMIS ARE AVAILABLE TO REPORT YET.”

Preliminary Earthquake Parameters

Issue: Earthquake magnitudes are estimated rapidly in order to provide a rapid tsunami message and occasionally an initial tsunami message(s) is sometimes revised. The revised measurement is usually

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upward as the earthquake continues to rupture and new seismic data obtained. It is useful for people to know why earthquake magnitudes and hence tsunami magnitudes might vary from one message to the next and when they might anticipate one or the other to be upgraded in magnitude.

Recommendation: Provide information describing why earthquake magnitudes are both preliminary and subject to revision. To do this, we added the language: “THE FOLLOWING PARAMETERS ARE BASED ON A PRELIMINARY RAPID ASSESSMENT AND CHANGES CAN OCCUR... ESPECIALLY FOR LARGE EARTHQUAKES ABOVE 7.9 OR WHERE THERE ARE FEW INSTRUMENTS. NTWC and PTWC should make sure they are comfortable with this threshold and the scenarios where magnitudes are most likely to be upgraded.

Issue: There are some inconsistencies in the format of the Date. Some messages show the date as “FEB 03” and some show it with a dash: “FEB-03.”

Recommendation: We edited all dates to follow the format: “Month- Day” (e.g., FEB-03).

Additional Information and Next Update

Issue: Tsunami warning messages issued by the NTWC and PTWC are one of the primary sources of warning information. Other sources include informal warnings, natural warnings (also called environmental cues) and social cues. Informal warnings are informal messages about an event made by people who are not acting in an official capacity. Social cues are observations of other people and how they respond (e.g., running, packing, screaming, congregating in unusual places or at unusual times). Research demonstrates that many people delay taking protective actions because they want to *confirm* information pertaining to the information received initially. If they do not have access to multiple sources of risk or warning information the delay may be lengthened. Consequently, information should be provided

Recommendation: Given their importance in the warning or warning confirmation process, we added language that includes a description of social cues and informal warnings. “IF YOU FEEL A STRONG EARTHQUAKE TAKE IMMEDIATE PROTECTIVE ACTIONS. IF YOU DO NOT RECEIVE A WARNING ABOUT A TSUNAMI OR SEE OR HEAR OF OTHERS TAKING PROTECTIVE ACTIONS SEEK ADDITIONAL INFORMATION.”

Issue: Previous versions of the prototype did not discuss the importance of marine radios and Coast Guard broadcasts.

Recommendation: We added the language: “* LISTEN TO MARINE RADIOS FOR U.S. COAST GUARD BROADCASTS OF URGENT MARINE WARNINGS AND RELATED TSUNAMI INFORMATION.”

WEAK51 PAAQ 031800 TSUAK1 BULLETIN PUBLIC TSUNAMI MESSAGE 3

This message #3 is issued after a tsunami has been confirmed by instrumentation.

Updates

This is a section that is embedded in the NWS header identified by language such as: “. . . THE TSUNAMI WARNING REMAINS IN EFFECT...”

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Issue: The update section previously contained information indicating that a tsunami had been detected.

Recommendation: We added the following language to the initial statement about updates: “A TSUNAMI HAS BEEN CONFIRMED AND SOME IMPACTS ARE EXPECTED.” The language then states: “THIS MESSAGE REDUCES THE WARNING AND ADVISORY AREAS AND PROVIDES FORECAST HEIGHTS AND OBSERVATIONS.”

Evaluation

Issue: In the first statement below the section header “EVALUATION”, previous versions had no statement indicating that a tsunami had been confirmed.

Recommendation: We added the language: “... AND A TSUNAMI HAS BEEN CONFIRMED” at the end of the statement: “THE WARNING/ADVISORY AREAS ARE IDENTIFIED BECAUSE AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 7.7 OCCURRED NEAR THE SOUTHERN CALIFORNIA COAST AT 0903 PST ON FEBRUARY 03 2013.”

Impacts

Issue: The language in previous prototypes did not change the certainty of impacts from “possible impacts” to “expected impacts” once a tsunami was confirmed.

Recommendation: Review our language replacing terms such as “possible” found in Message 1 to “expected” in message 3 and the rationale for the change— because a tsunami has been detected. However, the limitation of the accuracy and real utility of this change in wording is limited for two reasons. One, even though a tsunami has been measured, it does not necessarily mean that specific impacts outlined in the message, which tend to be worst case impacts, are to be “expected” in all areas under the warning rather than just “possible.” Second, the warning area will inevitably include areas with high levels of inundation and run-up and very low levels of inundation and run-up. We envisage that this language can become more specific, certain and accurate as the TWCs develop new ways to communicate various levels of risk in the coming years, such as with the use of tiered warning levels or releasing inundation maps along with text messages.

While we could work with you to provide specific language for expected impacts in a range of tsunami scenarios, it is our belief that for the purposes of the prototypes we reviewed you were looking for basic information that could be applied to a range of scenarios. Providing more specific language that reflects the impacts expected for areas of varying tsunami inundation and run-up (and currents and velocities in ports, harbors, marinas, etc) would require crafting many more short but specific statements. This would increase both the complexity of selecting from a bank of prewritten statements for the Duty person at the TWC and the length of the message.

We want to draw your attention to one possible way to address the disparity in the accuracy of the existing statements about possible and expected impacts across a large Warning region. This involves stating the possible and expected impacts for two or at most three different regions. These include 1) areas of high tsunami hazard, 2) areas of moderate tsunami hazard and 3) areas of low tsunami hazard. We would recommend considering just two (high and low). While this would increase the length of the message, the value might be worth the cost of a longer message because people could begin to see real descriptions of how impacts are expected to vary from geographic place to place within the same Warning area. Sometimes they vary surprisingly over short distances due to bathymetry, shape of the shoreline, location with respect to the parent earthquake and tsunami source region, etc. Another limitation of this approach is that few areas have designated high and low hazard zones, such as those for distant and local tsunamis in Oregon.

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Forecasts of Tsunami Activity

Issue: Now that a tsunami has been confirmed in this message 3, it is necessary to indicate the basis for the forecasts.

Recommendation: We inserted the following language just after the section header, “A TSUNAMI HAS BEEN GENERATED. THE FIRST WAVES WERE PREDICTED TO ARRIVE AT THE FOLLOWING LOCATIONS AND SPECIFIED TIMES. THE DURATION OF THE DANGEROUS WAVES EXISTS FOR THE HOURS SPECIFIED.”

Issue: We noticed that it is possible for the expected arrival times of the first wave in the tsunami to be before the warning message was issued.

Recommendation: We inserted language P. Whitmore provided regarding why this is so: “ARRIVAL TIMES WILL ONLY BE ISSUED FOR ONE HOUR AFTER THE FIRST WAVE ARRIVES AT A SPECIFIC SITE.”

Issue: The meaning of FORECAST TSUNAMI DURATION is not clear.

Recommendation: We inserted the language provided by P. Whitmore: “FORECAST TSUNAMI DURATION IS THE APPROXIMATE LENGTH OF TIME WHICH THE TSUNAMI MAY PRODUCE DANGEROUS WAVES WHICH IS ESTIMATED TO BE 30 CM OR 1 FOOT.” The NTWC should consider whether or not it can provide a quantitative value for current velocities which would be useful for areas under a Tsunami Advisory.

Issue: The exact meaning of the term FORECAST MAX TSUNAMI HEIGHT is unclear.

Recommendation: We inserted the language provided by P. Whitmore: “FORECAST MAX TSUNAMI HEIGHT IS THE HIGHEST EXPECTED WATER LEVEL ABOVE THE TIDE TO OCCUR DURING THE ENTIRE TSUNAMI AT THE DESIGNATED SITE.”

Observations of Tsunami Activity

Issue: During our visit in Hawaii to work with the PTWC, we asked C. McCreery why measurements of tsunamis were included in messages. He explained because it confirms that a tsunami has been generated. Consequently, we developed language to introduce this section and similar sections, such as Preliminary Earthquake Parameters.

Recommendation: We suggest that the NTWC adopt the language inserted below the section header: “WE KNOW A TSUNAMI HAS OCCURRED BASED ON THE FOLLOWING MEASUREMENTS OF TSUNAMI WAVE HEIGHTS.”

Issue: Sometimes the Forecast Max Tsunami Height differs from the Observed Max Tsunami Height. We want to be certain that the definition is accurate from the perspective of the NTWC and PTWC.

Recommendation: Review the following language and make sure this is the most meaningful way to inform people why Forecast and Observed Max Tsunami Heights may vary: We wrote: “OBSERVED MAX TSUNAMI HEIGHTS MAY BE DIFFERENT THAN FORECASTED MAX HEIGHTS BECAUSE THE HIGHEST WAVE MAY NOT HAVE ARRIVED OR THE HIGHEST PART OF A WAVE HAS NOT BEEN MEASURED.”

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WEAK51 PAAQ 031955 TSUAK1 BULLETIN PUBLIC TSUNAMI MESSAGE 6

This is the last message in the sequence of prototypes. It cancels the warning and advisory.

Impacts

Issue: Even though a warning and advisory may be cancelled, we want to ask the NTWC and PTWC if it is reasonable to expect some minor sea fluctuations or unusual currents for a day or so after cancellation of the alerts? If so, we recommend the following language be used:

Recommendation: Insert the language, "SOME AREAS MAY CONTINUE TO SEE SMALL SEA LEVEL CHANGES AND UNUSUAL CURRENTS." The duration of these events is subsumed under the next bulleted item in the statement, which is for a "few days." Alternatively, if the TWCs prefer, they could amend the statement above by adding, "...FOR A DAY OR TWO."

Issue: The warning message does not address actual impacts or damages. We believe this is beyond the scope of the message but suggest adding it in the section, ADDITIONAL INFORMATION AND NEXT UPDATE. We recommend the following language be added in that section (see below).

Additional Information and Next Message

Issue: There is no information concerning social cues.

Recommendation: We added the language: "FOLLOW INSTRUCTIONS FROM YOUR LOCAL EMERGENCY OFFICIALS BECAUSE THEY MAY HAVE MORE DETAILED OR SPECIFIC INFORMATION FOR YOUR LOCATION... INFORMATION ON DAMAGES. . . COMMUNITY IMPACTS. . . CONTINUING AND POTENTIAL HAZARDS AND AREAS SAFE TO RETURN."

-----End Message 6-----

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Appendices

Appendix A: WEA51 PAAQ 031705 (Message 1)

Appendix B: WEA51 PAAQ 031800 (Message 3)

Appendix C: WEA51 PAAQ 031955 (Message 6)

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Appendix A: WEA51 PAAQ 031705 (Message 1)

WEAK51 PAAQ 031705
TSUAK1

BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 1
NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
905 AM PST SUN FEB 3 2013

...A TSUNAMI WARNING IS NOW IN EFFECT...
...A TSUNAMI ADVISORY IS NOW IN EFFECT...

AUDIENCE

EMERGENCY MANAGERS... MEDIA... GENERAL PUBLIC

EVALUATION

THE FOLLOWING WARNING/ADVISORY AREAS ARE IDENTIFIED BECAUSE AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 7.7 OCCURRED NEAR THE SOUTHERN CALIFORNIA COAST AT 0903 PST ON FEBRUARY 03 2013 AND CONDITIONS FOR A TSUNAMI EVENT EXIST. WE DO NOT YET KNOW IF A TSUNAMI WAS GENERATED.

A TSUNAMI WARNING APPLIES TO ALL PEOPLE AND STRUCTURES IN... ON OR NEAR THE WATER AND FURTHER INLAND. DANGEROUS WIDESPREAD FLOODING AND DAMAGING WAVES AND CURRENTS ARE POSSIBLE.

A TSUNAMI ADVISORY APPLIES TO ALL PEOPLE IN... ON OR NEAR THE WATER. STRONG WAVES AND CURRENTS ARE POSSIBLE.

TSUNAMI WARNING IN EFFECT FOR...

- * ALEUTIAN ISLANDS - ATTU TO NIKOLSKI INCLUDING PRIBILOF ISLANDS.
- * BRITISH COLUMBIA - OUTER WEST COAST OF VANCOUVER ISLAND.
- * WASHINGTON - OUTER COAST FROM NEAY BAY TO THE OREGON/WASHINGTON BORDER.
- * OREGON - OREGON/WASHINGTON BORDER TO THE CALIFORNIA/OREGON BORDER.
- * CALIFORNIA - THE CALIFORNIA/OREGON BORDER TO SAN ONOFRE STATE BEACH/WHICH IS 60 MILES SE OF L.A./.

TSUNAMI ADVISORY IN EFFECT FOR...

- * ALEUTIAN ISLANDS - NIKOLSKI TO UNIMAK PASS /WHICH IS 80 MILES NE OF DUTCH HARBOR.
- * SOUTH ALASKA AND ALASKA PENINSULA - PACIFIC COASTS FROM UNIMAK PASS /WHICH IS 80 MILES NE OF DUTCH HARBOR/ TO CAPE SUCKLING /WHICH IS 75 MILES SE OF CORDOVA/ INCLUDING COOK INLET.
- * SOUTHEAST ALASKA - OUTER COASTS FROM CAPE SUCKLING /WHICH IS 75 MILES SE OF CORDOVA/ TO THE ALASKA/BRITISH COLUMBIA BORDER.

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- * BRITISH COLUMBIA - NORTH COAST AND HAIDA GWAII... CENTRAL COAST AND NORTHEAST VANCOUVER ISLAND COAST... AND JUAN DE FUCA STRAIT.
- * WASHINGTON - THE JUAN DE FUCA STRAIT AND COLUMBIA RIVER ESTUARY.
- * OREGON - COLUMBIA RIVER ESTUARY.
- * CALIFORNIA - SAN FRANCISCO BAY AND FROM SAN ONOFRE STATE BEACH/WHICH IS 60 MILES SE OF L.A./ TO THE MEXICO/CALIFORNIA BORDER.

FOR OTHER US AND CANADIAN PACIFIC COASTS IN NORTH AMERICA - THE LEVEL OF TSUNAMI DANGER IS BEING EVALUATED. ADDITIONAL INFORMATION WILL BE PROVIDED IN SUPPLEMENTARY MESSAGES.

IMPACTS

IMPACTS WILL VARY AT DIFFERENT LOCATIONS IN THE WARNING AREAS AND IN THE ADVISORY AREAS.

IF YOU ARE IN A TSUNAMI WARNING AREA...

- * A TSUNAMI WITH DAMAGING WAVES AND POWERFUL CURRENTS IS POSSIBLE.
- * REPEATED COASTAL FLOODING IS POSSIBLE AS WAVES ARRIVE ONSHORE... MOVE INLAND... AND DRAIN BACK INTO THE OCEAN.
- * STRONG AND UNUSUAL WAVES... CURRENTS AND INLAND FLOODING CAN DROWN OR INJURE PEOPLE AND WEAKEN OR DESTROY STRUCTURES ON LAND AND IN WATER.
- * WATER FILLED WITH FLOATING OR SUBMERGED DEBRIS THAT CAN INJURE OR KILL PEOPLE AND WEAKEN OR DESTROY BUILDINGS AND BRIDGES IS POSSIBLE.
- * STRONG AND UNUSUAL CURRENTS AND WAVES IN HARBORS... MARINAS... BAYS... AND INLETS MAY BE ESPECIALLY DESTRUCTIVE.

IF YOU ARE IN A TSUNAMI ADVISORY AREA...

- * A TSUNAMI WITH STRONG WAVES AND CURRENTS IS POSSIBLE.
- * WAVES AND CURRENTS CAN DROWN OR INJURE PEOPLE IN THE WATER.
- * CURRENTS AND WAVES ON BEACHES AND IN HARBORS... MARINAS... BAYS... AND INLETS MAY BE ESPECIALLY DANGEROUS.

IF YOU ARE IN TSUNAMI WARNING OR ADVISORY AREAS...

- * SOME IMPACTS MAY CONTINUE FOR MANY HOURS TO DAYS AFTER ARRIVAL OF THE FIRST WAVE.
- * THE FIRST WAVE MAY NOT BE THE LARGEST SO LATER WAVES MAY BE LARGER.
- * EACH WAVE MAY LAST 5 TO 45 MINUTES AS A WAVE ENCROACHES AND RECEDES.

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- * COASTS FACING ALL DIRECTIONS ARE THREATENED BECAUSE THE WAVES CAN WRAP AROUND ISLANDS AND HEADLANDS AND INTO BAYS.

RECOMMENDED ACTIONS

ACTIONS REQUIRED TO PROTECT HUMAN LIFE... SAFETY AND PROPERTY WILL VARY WITHIN TSUNAMI WARNING AREAS AND WITHIN TSUNAMI ADVISORY AREAS. THESE ACTIONS ASSUME A WORSE CASE SCENARIO BECAUSE MOST AREAS ONLY HAVE ONE HAZARD ZONE AND HENCE EVACUATION ZONE.

IF YOU ARE IN A WARNING AREA...

- * EVACUATE INLAND OR TO HIGHER GROUND ABOVE AND BEYOND DESIGNATED TSUNAMI HAZARD ZONES OR MOVE TO THE THIRD FLOOR OR HIGHER OF A MULTI-STORY BUILDING DEPENDING ON YOUR SITUATION.

IF YOU ARE IN A WARNING OR ADVISORY AREA...

- * MOVE OUT OF THE WATER... OFF THE BEACH AND AWAY FROM HARBORS... MARINAS... BAYS AND INLETS.
- * BOAT OWNERS...
 - ...WHERE TIME AND CONDITIONS PERMIT MOVE YOUR BOAT OUT TO SEA TO A DEPTH OF AT LEAST 180 FEET.
 - ...IF AT SEA AVOID ENTERING SHALLOW WATER... HARBORS... MARINAS... BAYS... AND INLETS TO AVOID FLOATING AND SUBMERGED DEBRIS AND STRONG CURRENTS.
 - ...LISTEN TO US COAST GUARD MARINE ADVISORIES AND WARNINGS.
- * DO NOT GO TO THE SHORE TO OBSERVE THE TSUNAMI.
- * DO NOT RETURN TO THE COAST UNTIL LOCAL EMERGENCY OFFICIALS INDICATE IT IS SAFE TO DO SO.

FORECASTS OF TSUNAMI ACTIVITY

WE DO NOT KNOW AT THIS TIME IF A TSUNAMI HAS BEEN GENERATED. IF THE TSUNAMI OCCURS IT IS FORECASTED TO ARRIVE AT THE FOLLOWING LOCATIONS AND SPECIFIED TIMES.

LOCATION FORECAST ARRIVAL TIME OF TSUNAMI

* CALIFORNIA
SAN PEDRO 0912 PST FEB-3
LA JOLLA 0931 PST FEB-3
SANTA BARBARA 0951 PST FEB-3
IF YOU ARE IN OR BETWEEN SANTA BARBARA AND SAN DIEGO TAKE ACTION IMMEDIATELY.
SAN FRANCISCO 1119 PST FEB-3
CRESCENT CITY 1142 PST FEB-3

IF YOU ARE ON THE CALIFORNIA COAST NORTH OF SANTA BARBARA LISTEN TO OFFICIAL INSTRUCTIONS.

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OBSERVATIONS OF TSUNAMI ACTIVITY

NO OBSERVATIONS OF TSUNAMIS ARE AVAILABLE TO REPORT YET.

PRELIMINARY EARTHQUAKE PARAMETERS

THE FOLLOWING PARAMETERS ARE BASED ON A PRELIMINARY RAPID ASSESSMENT AND CHANGES CAN OCCUR... ESPECIALLY FOR LARGE EARTHQUAKES ABOVE 7.9 OR WHERE THERE ARE FEW INSTRUMENTS.

* MAGNITUDE 7.7
* ORIGIN TIME 0803 AKST FEB-03 2013
 0903 PST FEB-03 2013
 1703 UTC FEB-03 2013
* COORDINATES 33.6 NORTH 118.2 WEST
* DEPTH 2 MILES
* LOCATION 85 MILES NW OF SAN DIEGO CALIFORNIA
 30 MILES S OF LOS ANGELES CALIFORNIA

ADDITIONAL INFORMATION AND NEXT UPDATE

-
- * BE ALERT TO AND FOLLOW INSTRUCTIONS FROM YOUR LOCAL EMERGENCY OFFICIALS BECAUSE THEY MAY HAVE MORE DETAILED OR SPECIFIC INFORMATION FOR YOUR LOCATION.
 - * LISTEN TO MARINE RADIOS FOR U.S. COAST GUARD BROADCASTS OF URGENT MARINE WARNINGS AND RELATED TSUNAMI INFORMATION
 - * STRONG SHAKING OR ROLLING OF THE GROUND INDICATES AN EARTHQUAKE HAS OCCURRED AND A TSUNAMI MAY BE IMMINENT OR IS OCCURRING.
 - * IF YOU FEEL A STRONG EARTHQUAKE TAKE IMMEDIATE PROTECTIVE ACTIONS. IF YOU DO NOT RECEIVE A WARNING ABOUT A TSUNAMI OR YOU SEE OR HEAR OF OTHERS TAKING PROTECTIVE ACTIONS SEEK ADDITIONAL INFORMATION.
 - * A RAPIDLY RECEDING OR RECEDED SHORELINE OR UNUSUAL WAVES AND SOUNDS AND STRONG CURRENTS ARE SIGNS OF A TSUNAMI.
 - * THE TSUNAMI MAY APPEAR AS WATER MOVING RAPIDLY OUT TO SEA... A GENTLE AND RISING TIDE LIKE FLOOD WITH NO BREAKING WAVE... AS A SERIES OF BREAKING WAVES... OR A FROTHY WALL OF WATER.
 - * REFER TO THE INTERNET SITE NTWC.ARH.NOAA.GOV FOR MORE INFORMATION.
 - * PACIFIC COASTAL RESIDENTS OUTSIDE CALIFORNIA... OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD REFER TO THE PACIFIC TSUNAMI WARNING CENTER MESSAGES FOR INFORMATION ON THIS EVENT AT PTWC.WEATHER.GOV.
 - * THIS MESSAGE WILL BE UPDATED IN 30 MINUTES ... OR SOONER IF NEW INFORMATION BECOMES AVAILABLE..

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Appendix B: WEA51 PAAQ 031800 (Message 3)

WEAK51 PAAQ 031800
TSUAK1

BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 3

NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
1000 AM PST SUN FEB 3 2013

UPDATES

A TSUNAMI HAS BEEN CONFIRMED AND SOME IMPACTS ARE EXPECTED. THIS MESSAGE REDUCES THE WARNING AND ADVISORY AREAS AND PROVIDES FORECAST HEIGHTS AND OBSERVATIONS.

...THE TSUNAMI WARNING REMAINS IN EFFECT...

...THE TSUNAMI ADVISORY REMAINS IN EFFECT...

AUDIENCE

EMERGENCY MANAGERS... MEDIA... GENERAL PUBLIC

EVALUATION- UPDATED

THE WARNING/ADVISORY AREAS ARE IDENTIFIED BECAUSE AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 7.7 OCCURRED NEAR THE SOUTHERN CALIFORNIA COAST AT 0903 PST ON FEBRUARY 03 2013 AND A TSUNAMI HAS BEEN CONFIRMED.

A TSUNAMI WARNING APPLIES TO ALL PEOPLE AND STRUCTURES IN... ON OR NEAR THE WATER AND FURTHER INLAND. DANGEROUS WIDESPREAD FLOODING...AND DAMAGING WAVES AND CURRENTS ARE POSSIBLE.

A TSUNAMI ADVISORY APPLIES TO ALL PEOPLE IN.. ON OR NEAR THE WATER. STRONG WAVES AND CURRENTS ARE POSSIBLE

TSUNAMI WARNING IN EFFECT FOR...

- * ALEUTIAN ISLANDS - ATTU TO NIKOLSKI INCLUDING PRIBILOF ISLANDS.
- * BRITISH COLUMBIA - OUTER WEST COAST OF VANCOUVER ISLAND.
- * WASHINGTON - OUTER COAST FROM NEAY BAY TO THE OREGON/WASHINGTON BORDER.
- * OREGON - OREGON/WASHINGTON BORDER TO THE CALIFORNIA/OREGON BORDER.
- * CALIFORNIA - THE CALIFORNIA/OREGON BORDER TO SAN ONOFRE STATE BEACH/WHICH IS 60 MILES SE OF L.A./.

TSUNAMI ADVISORY IN EFFECT FOR...

- * ALEUTIAN ISLANDS - NIKOLSKI TO UNIMAK PASS /WHICH IS 80

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MILES NE OF DUTCH HARBOR.

- * SOUTH ALASKA AND ALASKA PENINSULA - PACIFIC COASTS FROM UNIMAK PASS /WHICH IS 80 MILES NE OF DUTCH HARBOR/ TO CAPE SUCKLING /WHICH IS 75 MILES SE OF CORDOVA/ INCLUDING COOK INLET.
- * SOUTHEAST ALASKA - OUTER COASTS FROM CAPE SUCKLING /WHICH IS 75 MILES SE OF CORDOVA/ TO THE ALASKA/BRITISH COLUMBIA BORDER.
- * BRITISH COLUMBIA - NORTH COAST AND HAIDA GWAII... CENTRAL COAST AND NORTHEAST VANCOUVER ISLAND COAST... AND JUAN DE FUCA STRAIT.
- * WASHINGTON - THE JUAN DE FUCA STRAIT AND COLUMBIA RIVER ESTUARY.
- * OREGON - COLUMBIA RIVER ESTUARY.
- * CALIFORNIA - SAN FRANCISCO BAY AND FROM SAN ONOFRE STATE BEACH/WHICH IS 60 MILES SE OF L.A./ TO THE MEXICO/CALIFORNIA BORDER.

THE FOLLOWING AREAS HAVE BEEN CANCELED BECAUSE ADDITIONAL INFORMATION AND ANALYSIS HAVE BETTER DEFINED THE THREAT.

THE TSUNAMI WARNING IS CANCELED FOR...

- *
- *
- *

THE TSUNAMI ADVISORY IS CANCELED FOR...

- *
- *
- *

FOR OTHER US AND CANADIAN PACIFIC COASTS IN NORTH AMERICA - THE LEVEL OF TSUNAMI DANGER IS BEING EVALUATED. FURTHER INFORMATION WILL BE PROVIDED IN SUPPLEMENTARY MESSAGES.

IMPACTS- UPDATED

IMPACTS WILL VARY AT DIFFERENT LOCATIONS WITHIN THE WARNING AREAS AND WITHIN THE ADVISORY AREAS.

IF YOU ARE IN A TSUNAMI WARNING AREA...

- * A TSUNAMI WITH DAMAGING WAVES AND POWERFUL CURRENTS IS EXPECTED.
- * REPEATED COASTAL FLOODING IS EXPECTED AS WAVES ARRIVE ONSHORE... MOVE INLAND... AND DRAIN BACK INTO THE OCEAN.
- * STRONG AND UNUSUAL WAVES AND CURRENTS AND INLAND FLOODING CAN DROWN OR INJURE PEOPLE AND WEAKEN OR DESTROY STRUCTURES ON LAND.

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- * WATER IS EXPECTED TO BE FILLED WITH FLOATING DEBRIS THAT CAN INJURE OR KILL PEOPLE AND WEAKEN OR DESTROY BUILDINGS OR BRIDGES.
- * STRONG AND UNUSUAL CURRENTS AND WAVES IN HARBORS... MARINAS... BAYS... AND INLETS ARE ESPECIALLY DESTRUCTIVE.

IF YOU ARE IN A TSUNAMI ADVISORY AREA...

- * A TSUNAMI WITH STRONG WAVES AND CURRENTS EXPECTED.
- * WAVES AND CURRENTS CAN DROWN OR INJURE PEOPLE IN THE WATER.
- * CURRENTS AND WAVES ON BEACHES AND IN HARBORS... MARINAS... BAYS... AND INLETS MAY BE ESPECIALLY DANGEROUS.

IF YOU ARE IN TSUNAMI WARNING OR ADVISORY AREAS...

- * SOME IMPACTS MAY CONTINUE FOR MANY HOURS TO DAYS AFTER ARRIVAL OF THE FIRST WAVE.
- * THE FIRST TSUNAMI WAVE MAY NOT BE THE LARGEST SO LATER WAVES MAY BE LARGER.
- * EACH WAVE MAY LAST 5 TO 45 MINUTES AS A WAVE ENCROACHES AND RECEDES.
- * COASTS FACING ALL DIRECTIONS ARE THREATENED BECAUSE THE WAVES CAN WRAP AROUND ISLANDS AND HEADLANDS AND INTO BAYS.

RECOMMENDED ACTIONS

IF YOU ARE IN A WARNING AREA...

- * EVACUATE INLAND OR TO HIGHER GROUND ABOVE AND BEYOND DESIGNATED TSUNAMI HAZARD ZONES OR MOVE TO THE THIRD FLOOR OR HIGHER OF A MULTI-STORY BUILDING DEPENDING ON YOUR SITUATION.

IF YOU ARE IN A WARNING OR ADVISORY AREA...

- * MOVE OUT OF THE WATER... OFF THE BEACH AND AWAY FROM HARBORS... MARINAS... BAYS AND INLETS.
- * BOAT OWNERS...
 - ...WHERE TIME AND CONDITIONS PERMIT MOVE YOUR BOAT OUT TO SEA TO A DEPTH OF AT LEAST 150 FEET.
 - ...IF AT SEA AVOID ENTERING SHALLOW WATER... HARBORS... MARINAS... BAYS AND INLETS TO AVOID FLOATING AND SUBMERGED DEBRIS AND STRONG CURRENTS.
 - ...LISTEN TO US COAST GUARD MARINE ADVISORIES AND WARNINGS
- * DO NOT GO TO THE SHORE TO OBSERVE THE TSUNAMI.
- * DO NOT RETURN TO THE COAST UNTIL LOCAL EMERGENCY OFFICIALS INDICATE IT IS SAFE TO DO SO.

FORECASTS OF TSUNAMI ACTIVITY- UPDATED

April 29, 2014

A TSUNAMI HAS BEEN GENERATED. THE FIRST WAVES WERE PREDICTED TO ARRIVE AT THE FOLLOWING LOCATIONS AND SPECIFIED TIMES. THE DURATION OF THE DANGEROUS WAVES EXISTS FOR THE HOURS SPECIFIED.

LOCATION	FORECAST ARRIVAL OF OF TSUNAMI	FORECAST TSUNAMI DURATION	FORECAST MAX TSUNAMI HEIGHT
* CALIFORNIA SAN PEDRO	0912 PST FEB-03	12 HRS	1.8-3.4FT
LA JOLLA	0931 PST FEB-03	9 HRS	1.5-2.6FT
SANTA BARBARA	0951 PST FEB-03	6 HRS	1.0-1.8FT

IF YOU ARE IN OR BETWEEN SANTA BARBARA AND SAN DIEGO TAKE ACTION IMMEDIATELY.

ARRIVAL TIMES WILL ONLY BE ISSUED FOR ONE HOUR AFTER THE FIRST WAVE ARRIVES AT A SPECIFIC SITE.

FORECAST ARRIVAL OF TSUNAMI IS THE TIME WHICH TSUNAMI IMPACT IS EXPECTED TO START AT THE LISTED LOCATION.

FORECAST TSUNAMI DURATION IS THE APPROXIMATE LENGTH OF TIME WHICH THE TSUNAMI MAY PRODUCE DANGEROUS CURRENTS AND WAVES WHICH FOR WAVES IS ESTIMATED TO BE 30 CM OR 1 FOOT.

FORECAST MAX TSUNAMI HEIGHT IS THE HIGHEST EXPECTED WATER LEVEL ABOVE THE TIDE TO OCCUR DURING THE ENTIRE TSUNAMI AT THE DESIGNATED SITE.

OBSERVATIONS OF TSUNAMI ACTIVITY- UPDATED

WE KNOW A TSUNAMI HAS OCCURRED BASED ON THE FOLLOWING MEASUREMENTS OF TSUNAMI WAVE HEIGHTS.

LOCATION	TIME OF MEASUREMENT	OBSERVED MAX TSUNAMI HEIGHT
LOS ANGELES CA	0925 PST FEB-03	02.6FT
SANTA MONICA CA	0933 PST FEB-03	01.3FT
LA JOLLA CA	0945 PST FEB-03	01.0FT

OBSERVED MAX TSUNAMI HEIGHT IS THE HIGHEST RECORDED WATER LEVEL ABOVE THE TIDE LEVEL UP TO THIS TIME.

OBSERVED MAX TSUNAMI HEIGHTS MAY BE DIFFERENT THAN FORECASTED MAX TSUNAMI HEIGHTS BECAUSE THE HIGHEST WAVE MAY NOT HAVE ARRIVED OR THE HIGHEST PART OF A WAVE HAS NOT BEEN MEASURED.

PRELIMINARY EARTHQUAKE PARAMETERS

THE FOLLOWING PARAMETERS ARE BASED ON A PRELIMINARY RAPID ASSESSMENT AND CHANGES CAN OCCUR... ESPECIALLY FOR LARGE EARTHQUAKES ABOVE 7.9 OR WHERE THERE ARE FEW INSTRUMENTS.

* MAGNITUDE 7.7
* ORIGIN TIME 0803 AKST FEB-03 2013
0903 PST FEB-03 2013
1703 UTC FEB-03 2013

April 29, 2014

* COORDINATES 33.6 NORTH 118.2 WEST
* DEPTH 2 MILES
* LOCATION 85 MILES NW OF SAN DIEGO CALIFORNIA
30 MILES S OF LOS ANGELES CALIFORNIA

ADDITIONAL INFORMATION AND NEXT UPDATE

-
- * BE ALERT TO AND FOLLOW INSTRUCTIONS FROM YOUR LOCAL EMERGENCY OFFICIALS BECAUSE THEY MAY HAVE MORE DETAILED OR SPECIFIC INFORMATION FOR YOUR LOCATION.
 - * LISTEN TO MARINE RADIOS FOR U.S. COAST GUARD BROADCASTS OF URGENT MARINE WARNINGS AND RELATED TSUNAMI INFORMATION
 - * STRONG SHAKING OR ROLLING OF THE GROUND INDICATES AN EARTHQUAKE HAS OCCURRED AND A TSUNAMI MAY BE IMMINENT OR IS OCCURRING.
 - * IF YOU FEEL A STRONG EARTHQUAKE TAKE IMMEDIATE PROTECTIVE ACTIONS. IF YOU DO NOT RECEIVE A WARNING ABOUT A TSUNAMI OR YOU SEE OR HEAR OF OTHERS TAKING PROTECTIVE ACTIONS SEEK ADDITIONAL INFORMATION.
 - * A RAPIDLY RECEDING OR RECEDED SHORELINE OR UNUSUAL WAVES AND SOUNDS AND STRONG CURRENTS ARE SIGNS OF A TSUNAMI.
 - * THE TSUNAMI MAY APPEAR AS WATER MOVING RAPIDLY OUT TO SEA... A GENTLE AND RISING TIDE LIKE FLOOD WITH NO BREAKING WAVE... AS A SERIES OF BREAKING WAVES OR A FROTHY WALL OF WATER.
 - * REFER TO THE INTERNET SITE NTWC.ARH.NOAA.GOV FOR MORE INFORMATION.
 - * PACIFIC COASTAL RESIDENTS OUTSIDE CALIFORNIA... OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD REFER TO THE PACIFIC TSUNAMI WARNING CENTER MESSAGES FOR INFORMATION ON THIS EVENT AT PTWC.WEATHER.GOV.
 - * THIS MESSAGE WILL BE UPDATED IN 30 MINUTES ... OR SOONER IF NEW INFORMATION BECOMES AVAILABLE..

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Appendix C: WEA51 PAAQ 031955 (Message 6)

WEAK51 PAAQ 031955
TSUAK1

BULLETIN
PUBLIC TSUNAMI MESSAGE NUMBER 6
NWS NATIONAL TSUNAMI WARNING CENTER PALMER AK
1155 AM PST SUN FEB 3 2013

UPDATE

...THE TSUNAMI WARNING AND ADVISORY ARE CANCELLED...

AUDIENCE

EMERGENCY MANAGERS... MEDIA... GENERAL PUBLIC

EVALUATION- UPDATED

THE TSUNAMI WARNING AND ADVISORY IS CANCELED... FOR ALL AREAS OF THE US AND CANADIAN PACIFIC COASTS IN NORTH AMERICA.

THESE WARNINGS AND ADVISORIES HAVE BEEN CANCELED BECAUSE ADDITIONAL INFORMATION AND ANALYSIS INDICATE THE TSUNAMI IS NO LONGER EXPECTED TO POSE A THREAT.

IMPACTS - UPDATED

- * A TSUNAMI WAS GENERATED DURING THIS EVENT BUT NO LONGER POSES A THREAT.
- * SOME AREAS MAY CONTINUE TO SEE SMALL SEA LEVEL CHANGES AND UNUSUAL CURRENTS.
- * SOME AREAS OF THE WATER MAY APPEAR DIFFERENT FOR A FEW DAYS AND MAY CONTAIN FLOATING AND SUBMERGED DEBRIS.

RECOMMENDED ACTIONS - UPDATED

- * DO NOT RE-OCCUPY HAZARD ZONES UNTIL LOCAL EMERGENCY OFFICIALS INDICATE IT IS SAFE TO DO SO.

OBSERVATIONS OF TSUNAMI ACTIVITY - UPDATED

LOCATION	TIME OF MEASUREMENT	OBSERVED MAX TSUNAMI HEIGHT
LOS ANGELES CA	1725 PST FEB-03	02.6FT
SANTA MONICA CA	1821 PST FEB-03	03.0FT
LA JOLLA CA	1804 PST FEB-03	02.0FT

OBSERVED MAX TSUNAMI HEIGHTS MAY BE DIFFERENT THAN FORECASTED MAX TSUNAMI HEIGHTS IN PREVIOUS MESSAGES BECAUSE THE HIGHEST WAVE MAY NOT HAVE ARRIVED OR THE HIGHEST PART OF A WAVE HAS NOT BEEN MEASURED.

ADDITIONAL INFORMATION AND NEXT UPDATE- UPDATED

April 29, 2014

- * FOLLOW INSTRUCTIONS FROM YOUR LOCAL EMERGENCY OFFICIALS BECAUSE THEY MAY HAVE MORE DETAILED OR SPECIFIC INFORMATION FOR YOUR LOCATION... INFORMATION ON DAMAGES... COMMUNITY IMPACTS... CONTINUING REAL AND POTENTIAL HAZARDS... AND AREAS SAFE TO RETURN.
- * REFER TO THE INTERNET SITE NTWC.ARH.NOAA.GOV FOR MORE INFORMATION.
- * PACIFIC COASTAL REGIONS OUTSIDE CALIFORNIA... OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD REFER TO THE PACIFIC TSUNAMI WARNING CENTER MESSAGES FOR INFORMATION AT PTWC.WEATHER.GOV.
- * THIS WILL BE THE LAST NATIONAL TSUNAMI WARNING CENTER BULLETIN ISSUED FOR THIS EVENT UNLESS NEW INFORMATION BECOMES AVAILABLE..

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