DATE: 02/24/2014

REPORT TITLE : **A Tsunami Forecast Model for Elfin Cove, Alaska**

Comment Review Response Form

General Comments	Action Accepted /Rejected	Brief Responder Comments
1. The developed forecast model shows a good agreement with the reference model. Based on the provided results, the forecast model is very likely to be suited for the real-time assessment of the tsunami hazard in Elfin Cove.	N/A	
2. The report is very complete and contains much more than the required minimum information.	N/A	
3. The report is well-written and has a lot of details, but references are often missing.	Accept	Responses are made for each of the relevant specific comments below.
4. The report states that "However there is a tendency for the largest peaks and troughs to appear in the reference model solution." It might be beneficial to have a quantitative assessment of this discrepancy. It looks like the peaks in the reference model are 10% (on the safe side) higher than in the reference model.	Accept	This is a very useful suggestion. The model output files were consulted and a table comparing the reference (RM) and forecast model (FM) results for eight sources (4 historic, 4 "mega") was added. For the first wave peak the agreement is quite gratifying, with the RM consistently exceeding the FM but only by minor amounts (0.91% to 3.81%). First wave arrival times are identical or in close agreement (worst case: 2.5 minutes of 172 minutes in a Cascadia scenario). The discrepancies noted by the reviewer do consistently associate larger amplitudes with the RM. The difference is quite small when the maximum occurs early in the tsunami wave train but can be quite large (15%, 20%, and even 62% for the "mega" source near New Guinea) when the maximum is in the later waves. Considering the consistent

		amplitude underestimation by the forecast model, a suggestion is added that a safety factor of the order of 10% be applied in operational use of forecast model projections.
5. Non-standard historical events can be added as an appendix to the report, but should be separated from the rest of the historical cases and the cursory source used for them, should not appear in the Table 6 of the report, but perhaps on a separate table similar to Table 7.	Reject	We have a difference of opinion here. I think all historical events that severely impacted the model region should be addressed in the report. However I agree that source mechanisms that have limited support from DART observations or the literature should be identified as such and have used the term "ad hoc" to qualify these events in the table.
6. A list of Figures and List of Tables are included in the Table of Contents, but they appear as a separate document.	Accept	Duplication resolved.
7. Personal communications: Please provide this type of references (Name, Organization, Year, Oral/Written communications)	Accept	This has been done.
8. Some typos in the manuscript were corrected and provided to the author in a reviewer-modified manuscript file.	Accept	Typos were corrected and wording changes suggested by the reviewer were adopted.
9. Some imprecisions were pointed out to the author in the modified file.	Accept	Text clarified as appropriate.
10. Some additional figure suggestions and necessary explanations were suggested to the author in the modified file.	Accept	Figures were revised per suggestions
11. Some typesetting errors were brought up to the attention of the author in the modified file.	Accept	Corrected
12. Need to make reported values to run time consistent throughout.	Accept	Run time is a movable target, changing as the model is recompiled, features added, etc. To simplify matters I have imposed consistency by using throughout the value reported in Appendix C (12.92 min/4 hrs).

13. Mark reference point in figures illustrating model results.		This was done (only) in Figure 15a, the first of many figures with the same layout. The caption was amended to reference Figure 4b where the tide gauge location is best seen.

Specific Comments	Action Accepted /Rejected	Brief Responder Comments
1. "Alaska Earthquake Information Center" is now renamed to "Alaska Earthquake Center"	Accept	The AEIC apparently still has a web presence but the reviewer's suggestion has been adopted.
2. Acronym BPR not defined.	Accept	A valid criticism. "BPR" appears in two places, neither of which really needed a discussion of how tsunamis are measured. Instead of defining BPR, I removed both instances and instead referred to "tsunami data."
3. Abstract. Too much like the Intro. Need to add results.	Accept	Agreed, particularly in the 4th paragraph. This has been modified to reduce the repetition and provide the run time metric (12.92 min) and a justification for exceeding the 10 min target.
4. Section 1.1 "Tide gauges are in place that can serve to validate these models, permitting their use to provide real-time warning …" This is a confusing sentence. Please re-phrase.	Accept	A valid criticism. The following replacement text has been inserted: "For most of these communities tide gauge records, or in some cases verbal reports of observed historical events, provide ground truth with which to

		assess and validate model predictions."
5. Section 1.3 "The system has had considerable success in accurately forecasting …" Please provide a reference.	Accept	The Tang et al. (2012) reference, used elsewhere in the report, was inserted here and additional references: Titov (2009), Bernard, Wei, Tang, Titov (2014). "Impact of Near-Field, Deep-Ocean Tsunami Observations on Forecasting the 7 December 2012 Japanese Tsunami." Were added. The first two illustrate the utility of the forecast system for far-field impacts during several events; the latter reference is a case study, in hind cast mode, illustrating the potential for accurate forecast of near-field impacts based on early detection at suitably located DART detectors.
6. Section 2.1 I am not sure what is meant by "The validity of the MOST model applied in this manner …"	Accept	The "utility" or "credibility" is probably what was intended (rather than "validity") and the text has been modified accordingly.
7. Section 2.1 "Successful hindcasting of observed historic events" Please provide a reference.	Accept	See the response to Specific Comment 2 above; the same references have been inserted here.
8. Section 3.1 State uncertainties in the horizontal and vertical accuracy of the bathymetry and topography. This is very important since tiny Alaskan communities do not typically have a good data coverage. Table 1 could have an additional line with the uncertainties of DEMs.	Accept	These details are provided in the NGDC DEM Report (Love et al., 2012) cited in the report. Table 1 has been extended, as suggested,

		with the reported uncertainties and some minor additions to the text of Section 3.1 provide some context.
9. Section 3.1 "As noted earlier, the scope of the outer Elfin Cove grid was chosen to permit estimates of tsunami signals at Skagway and Juneau, but, with the relatively coarse spacing needed to attain acceptable operational run times, the estimates are of lower quality than would be possible in dedicated models for these communities." This is a confusing sentence. Please re-phrase …	Accept	The original sentence did, perhaps, have too many clauses. It has been divided into separate sentences. The point being made is that the model grids, needed to cover potential access to Elfin Cove via Chatham Strait, do provide an opportunity for estimates of impacts to Skagway, Juneau and other communities in the vicinity. However, the resolution used in these grids, constrained by the operational run-time limitation, are likely to restrict the accuracy of such estimates compared to what dedicated models might provide.
10. Section 3.1 Is the reference to "nctr.pmel.noaa.gov/forecast_reports" in the last paragraph appropriate as the source for revised/updated model reports?	N/A	As of now I have no information to the contrary. The "Elfin Cove" link at the above URL goes to a draft report currently (which may not at present have public access) but I'm assuming that this will be the repository of the finalized PDF reports. This paragraph is "boilerplate" for all reports and should likely be fixed uniformly before publication if necessary.
11. Section 3.3 "A similar analysis to that shown in Figure 7 was performed for the month of February 2010 when the Chile-2010	Accept	The lack of an explicit

tsunami occurred" Please refer to Figure 9 in this sentence, it might help a reader.		reference to Figure 9 in this sentence was a clear error and has been remedied.
12. Section 3.3 Apparent typo "1-second"	Reject	Originally I thought this might be a typo but, on re-reading the material to refresh my memory, the "1-second" is correct. Part of the six-minute data product from CO-OPS is a measure of the standard deviation of the 6-min values computed from the raw 1-sec data that go into its computation. This standard deviation is a useful representation of the ambient noise.
13. Section 3.4 "is normally used to represent" The reference is missing.	Accept	The 4 arc sec resolution is typically employed in the "propagation" phase of tsunami simulation by the MOST model in generating a database of basin-wide or global scenarios. The reviewer is correct that a reference should be inserted here. Suitable references are Gica et al. (2008) and Titov and Gonzalez (1997), employed elsewhere in the report but now inserted in this section.
14. Section 3.5 Reference to Figure. 10 should be Figure 11.	Accept	Thanks for catching that! In LaTeX I had a typo that pointed to the wrong figure –- an easy fix.
15. Section 3.6 "a "wall" is placed at": consider a substitution for "a reflective boundary condition is set at"	Accept	Agreed! This suggestion has been adopted.
16. Section 3.6 "are treated as land": consider a substitution "are assumed to be dry" "These files can be very large!" What is their size?	Accept	The "land/dry" substitution has been made in the text. The size

		of the various files seems of lesser concern but a succinct way of incorporating that information has been introduced, based on the following: 8 hours of 30-second output for an Elfin Cove forecast model run requires three files of 126MB each for the A-grid, three more of 499MB each for the B-grid, and three of 125MB each for the C-grid. By contrast, the "SIFT" file, with summary statistics for all three grids and time series for 14 salient locations, requires only 2.7MB.
17. Chapter 4: "micro-tsunamis" and "mega-tsunamis": I have never heard of these terms before. I heard of people use the term "Great Earthquakes". Please be more specific, provide the magnitudes.	Accept	It is perhaps not surprising that these terms are unfamiliar in the "real world" as they relate more to synthetic "sources" employed during model development to ensure stability. For operational use the forecast model should be capable of running under the most severe real-time events. The brief history of tsunami observation does not provide case studies of all potential future events. Hence a set of synthetic "mega-tsunamis", each representing a Mw 9.3 earthquake occurring in a 1000km long by 100km wide section of the

		subduction zone, are employed in "stress-testing" the model as part of the development protocol. Modifications to the report text will, it is hoped, clarify the case for "mega-tsunamis" and the related use of "micro-tsunamis". The latter are synthetic sources that for Elfin Cove are scenarios representing remote Mw 6.17 events.
18. Chapter 4: "there is a parameter in the input file that truncates the run if a prescribed threshold is exceeded." Please be more specific about this parameter.	Accept	This is a valid criticism and the text has been modified accordingly. The parameter is a maximum tolerable elevation in the model predictions. If this is exceeded at any time step, in any of the three nested grids, the model run is terminated with a report on the grid, the value and where it occurred. During model development such reports help identify problem areas where grid modifications are needed. In operational use, the parameter should be set to a sufficiently large value so that premature termination of a model run is unlikely. A value of 900m is employed for Elfin Cove which lies atop potential seismic sources.
19. Section 4.4 In discussion of modeling results at top of page 18, reword to eliminate "disappointing at best." The reality may be that poor agreement is owing to noise and low quality of model specification.	Accept	That phrase has been removed thereby placing more emphasis on the key points: a) that Elfin Cove is less impacted by

		some of the standard test cases of use at other locations, and b) that the background noise level at Elfin Cove can, at times, limit its utility for monitoring mild tsunamis.
20. No reference to the following items were found in the main text: • Kanamori, H. and J.J Ciper (1974): Focal process of the great Chilean earthquake, May 22, 1960*. Phys Earth Planet. In., 9,128-136.* • López, A.M., and E.A. Okal (2006): A seismological reassessment of the source of the 1946 Aleutian "tsunami" earthquake. *Geophys. J. Int., 165(3), 835–849*, doi: 10.1111/j.1365-246x.2006.02899.x. • Tang, L., C. Chamberlin, E. Tolkova, M. Spillane, V.V. Titov, E.N. Bernard, and H.O. Mofjeld (2006): Assessment of potential tsunami impact for Pearl Harbor, Hawaii. NOAA Tech. Memo. OAR PMEL-131, NTIS: PB2007-100617, 36 pp.	Reject	The references that appear to be missing are located in Table 6.
21. Missing Vol. and pp in reference: Spillane, M.C. (2011): Development of a Tsunami Forecast Model for Point Reyes, California. NOAA OAR Special Report, PMEL Tsunami Forecast Series: Vol. , pp.	Accept	Corrected by the PMEL editor.
22. Table 1. Add description of Southeast Alaska DEM to table and in text.	Accept	This has been fixed by adding to Table 1 and by providing a reference to Caldwell et al. (2012) where the Southeast Alaska DEM is described. In the text a statement that the MHHW vertical datum of the Southeast Alaska DEM to the MHW needed for the Elfin Cove grids was added.
23. In Table 8 it should be indicated whether by Response we indicate max wave elevation value.	Accept	Modified table caption
24. Fig. 1 Make the DEM labels more distinct (from other labels)	Accept	The annotations for the Elfin Cove and SE Alaska DEMs have been made red and enlarged to discriminate them from

		other labels.
25. Fig 4. Chart has some symbols not standard to NOAA chart.	Accept	The figure was extracted from the NOAA chart as viewed with the navigation utility "PolarView" in order to avoid the insets of Elfin Cove (enlarged in Fig 5) and Inian Cove in the original NOAA chart. The offending symbols mark other information provided by "PolarView". The worst offender (at Pelican) was edited out; that at Elfin Cove was retained and additional annotation to highlight the location of Elfin Cove inserted.
26. Fig 10. Lacks text identifying "tsunami signal" and "noise burst" panels employed in companion figures 7 and 9.	Accept	Fixed Fig. 10 graphic and added text to the Fig. 7 caption to more clearly state what the lower (spectral plot) panels demonstrate.
27. Figure 11 is a bit confusing. First, I could not understand that the green rectangles mark the extents of the forecast DEMs. Please add labels to the rectangles similar to the labels in Figure 12.	Accept	The caption to Figure 11 and a visual comparison for Figures 11 and 12 I had thought made the point of the reduced spatial extents of the Forecast Model grids. However, both captions have been modified, and the green rectangles in Figure 11 annotated, to stress the point.
28. Fig 11. Magenta rectangles (to indicate the size of forecast model grids) in the reference grid graphic) do not show up well	Accept	This has been addressed by using thick green rectangles to delineate FM grids (and add one that was missing).
29. I do not think Figures 23 and 32 are referred to in the text.	Accept	Corrected.
30. Figure 25 Check that colors for Juneau panel are as intended.	Accept	The figure is as intended

		but the text has been modified to emphasize that the forecast model location chosen to represent Juneau is, of necessity, well outside the Gastineau Channel.
31. Figure 28. Modify caption to spell out what the annotation "x 0.2" means.	Accept	This has been done and a remark added to associate the poor agreement in amplitude with low accuracy in the source representation. The good match in arrival time is noted.