# DEVELOPMENT OF TSUNAMI FORECAST MODEL FOR PORT SAN LUIS, CALIFORNIA

Burak Uslu, Robert Weiss and Nazila Merati

April 22, 2009

DRAFT

# Contents

Abstract ..... 5
1.0 Background and Objectives ..... 5
2.0 Forecast Methodology ..... 5
2.1 Study Area – context ..... 6
2.2 Grid Extents and Bathymetry used ..... 9
2.3 Historical tsunamis ..... 12
2.4 Water height/tide gauge records ..... 12
2.5 Model Setup ..... 12
3.0 Results ..... 13
3.1 Model Validation of the Port San Luis, CA SIM for historical tsunamis ..... 13
4.0 Summary and Conclusions ..... 30
5.0 References ..... 31
6.0 Appendix A ..... 32
6.1 RIM *.in file for Port San Luis, CA – updated for 2009 ..... 32
6.2 SIM *.in file for Port San Luis, CA – updated for 2009 ..... 33

DRAFT

# List of Tables

Table 1 Grid extents for SIM and RIMS for Port San Luis, CA ..... 10
Table 2 Summary of SIM and RIM parameters for Port San Luis, CA ..... 13
Table 3. Tsunami sources of 7 historical events used for model validation in this study. ..... 14
Table 4 Synthetic scenarios used to test stability of the Port San Luis RIM and SIM. 22

DRAFT

# List of Figures

Figure 1 Google Earth image of Port San Luis, CA and its relation to Avila Beach and other coastal communities. ..... 7
Figure 2 Industrial area in the vicinity of the Port San Luis C grid (source: http://www.portsanluis.com/) ..... 8
Figure 3 Google Earth image of the location of Port San Luis tide gauge noted by red triangle. ..... 9
Figure 4 Grid extents for Port San Luis, CA ..... 11
Figure 5 Extent of the Port San Luis C grid. ..... 11
Figure 6 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1952 Kamchatka tsunami. ..... 15
Figure 7 Comparison of water level of modeled (red) versus observed (blue) at the Avila Beach tide gauge for the 1952 Kamchatka tsunami. ..... 16
Figure 8 Time series of modeled water level records at Avila Beach tide gauge for the 1952 Kamchatka tsunami. ..... 16
Figure 9 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1960 Chile Kamchatka tsunami ..... 17
Figure 10 Water level heights at the warning point -- Avila tide gauge for the 1960 Chile Earthquake. ..... 18
Figure 11 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1964 Alaska tsunami. ..... 18
Figure 12 Comparison of water level of modeled (red) versus observed (blue) at the Avila Beach tide gauge for the 1964 Alaska tsunami. ..... 19
Figure 13 Water level heights at the warning point -- Avila tide gauge for the 1964 Alaska Earthquake for Port San Luis, CA. ..... 19
Figure 14 Time series comparison of tide gauge (blue) v. model (red) time series for the 2006 Tonga event. ..... 19
Figure 15 Time series comparison of tide gauge (blue) v. model (red) time series for the November 2006 Kuril event. ..... 20
Figure 16 Time series comparison of tide gauge (blue) v. model (red) time series for the January 2007 Kuril event. ..... 20
Figure 17 Comparison time series plots of the RIM and SIM for synthetic events. Please refer to Table 4 for region and sources tested. ..... 24
Figure 18 Comparison of maximum wave distributions for the Port San Luis, CA SIM and RIM. Please refer to Table 4 for region and sources tested. ..... 29

DRAFT

# Development of a Tsunami Forecast Model for Port San Luis, California

Burak Uslu, Robert Weiss and Nazila Merati

DRAFT

## Abstract

This report describes the development and testing of a tsunami forecast inundation model, named Stand-by Inundation Model (SIM), for Port San Luis, California, as a component of NOAA's tsunami forecast and warning system. The Port San Luis SIM was validated with four historical tsunamis and tested with a set of simulated megatsunamis based on subduction zone earthquakes in the Pacific. The SIM outputs were verified with numerical results from a reference inundation model (RIM) with higher resolution of 2/3 arc-second (20 m). The optimized SIM can provide a 4-hour local forecast of first wave arrival, amplitudes and reasonable inundation limit in minutes of receiving tsunami source information constrained by deep-ocean DART measurements. It shows robust results for all test cases.

## 1.0 Background and Objectives

A tsunami forecasting system known as Short-term Inundation Forecasting for Tsunamis (SIFT) is under development for the Tsunami Warning Centers (TWCs) by the NOAA Center for Tsunami Research (NCTR) at the Pacific Marine Environmental Laboratory (PMEL) (Titov et al., 2005). The primary goal of the system is to provide warning centers with operational tools which will enhance their early warning capability. These tools work in tandem with deep-ocean measurements from tsunameters which provide real time data quantifying and locating the tsunami source (Bernard et al., 2006). Additional integrated operational tools to the SIFT system are SIMs, which are a modeling tool aimed to produce efficient forecasts for tsunami arrival time, height and inundation for the target coastlines given a tsunami event quickly and efficiently. Several examples of real time application of the forecasting system under development are given in Titov (2009), i.e. November 17, 2003 Rat Islands, May 3, 2006 Tonga, November 15, 2006 Kuril Islands, August 15, 2007 Peru events. The accuracy, efficiency, and reliability of SIFT was tested with the real time forecasting that occurred during August 15, 2007 Peru event (Wei et al. 2008).

The report describes the development and testing of the Port San Luis, CA SIM including the data set up, validation with historical events, sensitivity testing. SIMs will be incorporated into the U.S. tsunami warning system for use at the Pacific and West Coast-Alaska Tsunami Warning Center. Synolakis et al. (2007) and Tang et al. (2008) describe of the technical aspects of SIM development, stability testing and robustness.

## 2.0 Forecast Methodology

The methodology for modeling these coastal areas is to develop a set of 3 nested grids (A, B, C) each of which is successively finer in resolution until the near shore details can be resolved to the point that tide gauge data from historical tsunami in the area match reasonably with the modeled results. The procedure is to start with large spatial extent grids at high resolution referred to as Reference inundation Model (RIM). These grids for the RIMs are noted as AR, BR and CR. Optimization of the grids and modeling effort is achieved by coarsening and shrinking the grid, until the model runs in under 10 minutes for the significant portion of the modeled tsunami waves. This equates to 4 to 10 hours of modeled tsunami time to pass through the model domain without too

DRAFT

much signal degradation. This final model is referred to as the "optimized" Standby Inundation Model or SIM. Its grids are referred to AO, BO and CO.

The 10-minute run time limit is based on the optimized SIM running on one of 4 Intel Xeon 3.6 GHz processors without competition under Red Hat Linux.

### 2.1 Study Area – context

Situated 160 miles northwest of Los Angeles, the Port San Luis serves as the shipping hub for the San Obispo, California and the surrounding areas. The actual port is not as well known as the as well known as the community that surrounds it - Avila Beach with a year round population of 797 (Census 2000). Avila Beach was established in the latter half of the 19th century and served as the main shipping port for San Luis Obispo. Although Avila Beach still has a working commercial fishing pier and the inland areas have extensive apple orchards, tourism is now the main industry.
Avila Beach is less than 0.5 miles (0.8 km) long and sheltered in San Luis Bay, which is formed by Point San Luis on the west and Fossil Point on the east. (http://en.wikipedia.org/wiki/Avila_Beach, last accessed April 22, 2009). Avila Beach faces south and is protected from the prevailing northwesterly winds by Point San Luis. Most of Avila Beach areas is undeveloped, except for a few blocks adjacent to the beach with homes, hotels, and small businesses. Additionally the Beach is home to three piers – one for recreational fishing, one used by commercial boats and one used for marine research. Adjacent communities to Avila Beach are Morro Bay and Pismo Beach. The Port San Luis area is also home to the Diablo Canyon Power Plant.

Figure 1 shows Port San Luis in the context of other communities located in Southern California. Figure 2 is a more detailed aerial photo of the physical port structure. The Google Earth image of Avila Beach shows the Port in relationship to the port facilities.

DRAFT

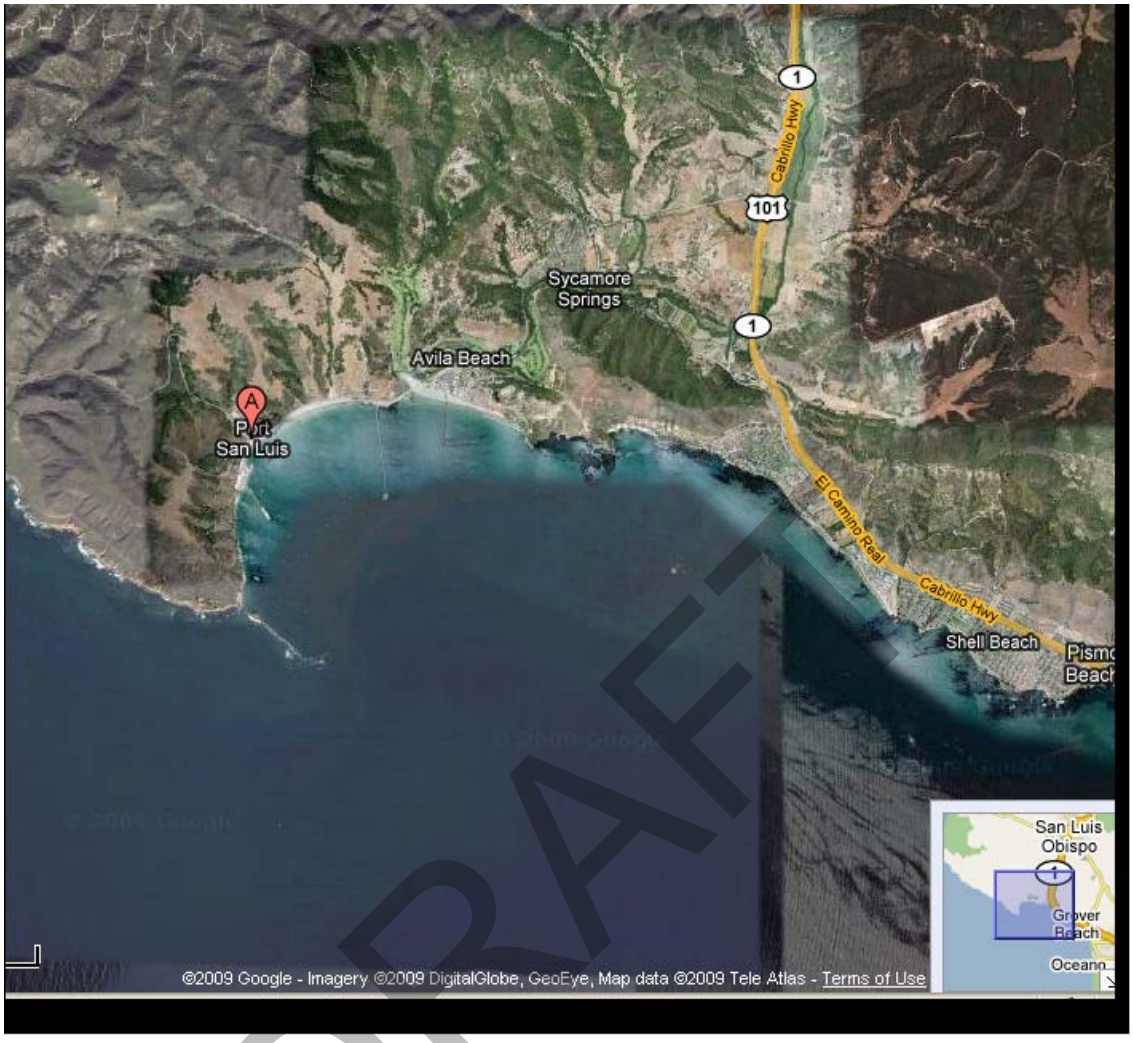



Figure 1 Google Earth image of Port San Luis, CA and its relation to Avila Beach and other coastal communities.

DRAFT

Figure 2 Industrial area in the vicinity of the Port San Luis C grid (source: http://www.portsanluis.com/)

Figure 3  Google Earth image of the location of Port San Luis tide gauge noted by red triangle.

DRAFT

### 2.2 Grid Extents and Bathymetry used

Accurate bathymetry and topography are crucial inputs to developing the reference and standby models, especially for the inundation of the near-shore environment. National Geophysical Data Center (NGDC) developed a 1/3 arc second merged bathy/topo digital elevation model for the Port San Luis area.  The grid coverage of the 1/3 arc second DEM is 120.45' -121.3 and 34.6-35.7 N.  Selected data of the highest resolution and quality were collected from Federal, State, and local agencies for use in each digital elevation model (DEM).

Additionally, a 30 arc second grid of the Pacific Ocean and a larger global grid were used to create the A and B grids for this study. The A grid extents covering the 60 arc-second and 6 arc-second grids were developed for wave transformation from the open ocean to the target coastal areas; and a high-resolution (1/3 arc-second) topography and bathymetry DEM was developed for modeling of wave runup and inundation onto dry land. Grids are made available in the ESRI ArcGIS raster format. All data were converted to the WGS 84 vertical datum.

DEMs were cropped to set up three-nested computational grid, reference grid, for the reference model runs as shown in Figure 4. Details of the grid structure are given in Table 1.

| Grid | Ref Res (sec) | Ref Extent<br>Lat. [°N]<br>Lon. [°W] | Opt Res (sec) | Opt Extent |
|---|---|---|---|---|
| **A** | 60 | 30.0167-40.00<br>117.0083-126.9917 | 120 sec | 30.0333 – 40.000<br>126.992-117.0251 |
| **B** | 10 | 35.5500-34.7111<br>121.2899-120.5511 | 20 | 35.5000-34.7555<br>121.2899-120.5566 |
| **C** | 1 | 35.2160-35.1001<br>120.8339-120.6001 | 2.5 | 35.2165-35.1004<br>120.8339-120.6006 |

Table 1 Grid extents for SIM and RIMS for Port San Luis, CA

DRAFT

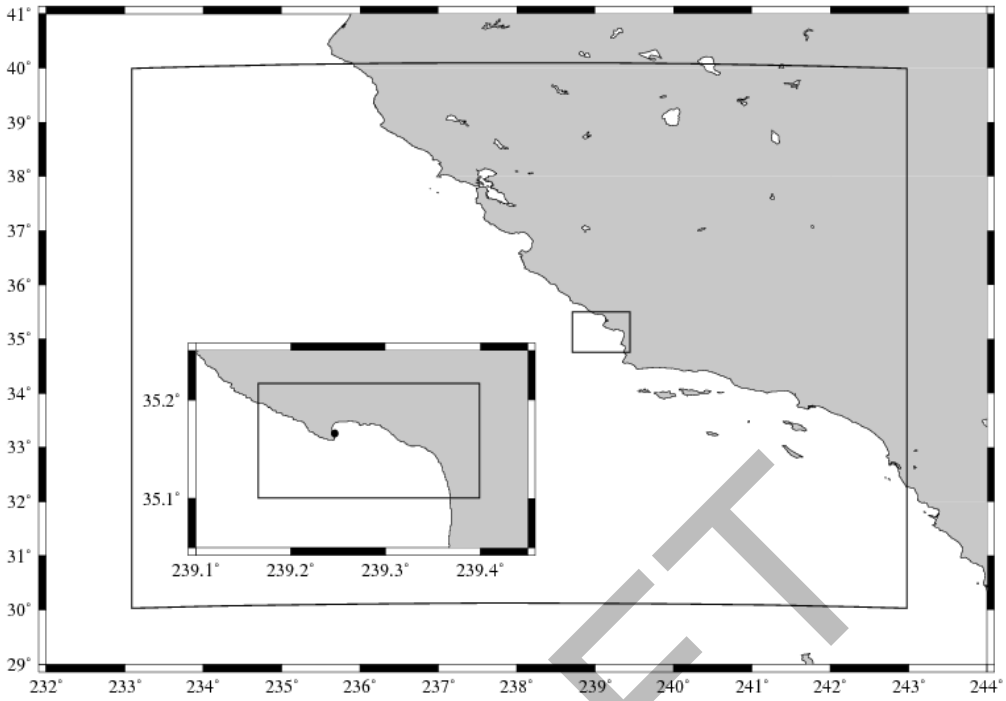



Figure 4 Grid extents for Port San Luis, CA

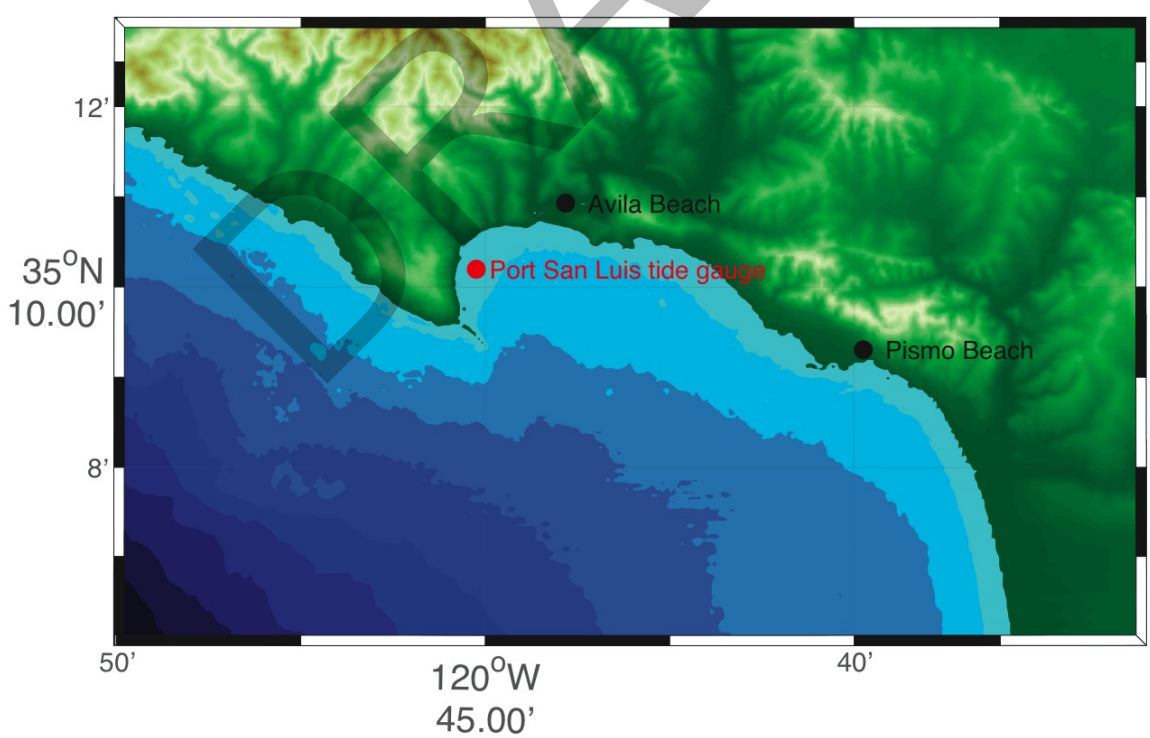



Figure 5 Extent of the Port San Luis C grid.

DRAFT

### 2.3 Historical tsunamis

NGDC run up records show that since 1800, there have been 18 incidents of tsunami run ups in Port San Luis, CA, and 11 records of tsunami run up recorded at Avila Beach. Run up heights have ranged for 1.4 m max height recorded for the 1946 Alaska tsunami at Port San Luis and minimal impact for more recent events. Records show that Avila Beach has experienced greater than one meter waves during the 1946, 1952 and 1964 events (NGDC tsunami run up web site *http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=167&d=, last accessed April 22, 2009*).

### 2.4 Water height / tide gauge records

The Avila Beach tide gauge was established in October 1933. Its present installation dates from October 1989. The location of the gauge is 35.168806 N and 120.754167 W. The station's mean range is 3.58 feet with a diurnal range of 5.32 feet. Mareograms and digital tide gauge records for most of the current events used for SIM testing. Table3 lists the events used for model validation.

### 2.5 Model Setup

The Method of Splitting Tsunami (MOST) model is used for tsunami propagation and inundation. MOST is a numerical model developed to solve the nonlinear shallow-water wave equations using the splitting of the nonlinear shallow-water wave equations into a two-1D problem. MOST is tested substantially comparing with analytical, experimental and field data in many peer-review publications (Titov and González, 1997, Titov and Synolakis, 1998) through validation and verification steps identified in Synolakis et al. (2007 and 2008). For a more detailed discussion of the development, verification and validation of MOST refer to the above publications.

The MOST model is setup such a way that it may use a series of nested grids from low to high resolution to compute tsunami generation, propagation, and inundation. Low- to medium-resolution Digital Elevation Models (DEMs) of bathymetric depth values are used to calculate tsunami generation and propagation. A high-resolution DEM of bathymetric depths and topographic elevations is necessary to compute inundation onto land in the region of interest (Venturato 2005). Final model set up is seen in Table 3.

DRAFT

# 3.0 Results

### 3.1 Model Validation of the Port San Luis, CA SIM for historical tsunamis

Several events were used to test the Port San Luis, CA RIM and SIM development. Tide gauge data was available for model verification for the following events including the 1964 Alaska, 1960 Chile, May 2006 Tonga, January 2007 Kuril and the November 2007 Kuril events. Table 2 gives the parameters for the final SIM and RIM testing. All the events used for model validation are detailed in Table 3 and Figures 5-23.

| Grid | Region | Reference Inundation Model (RIM) | | | | Stand-by Inundation Model (SIM) | | |
|---|---|---|---|---|---|---|---|---|
| | | Coverage | Cell | Time | | Coverage | Cell | Time |
| | | Lat. [°N] | Size | Step | | Lat. [°N] | Size | Step |
| | | Lon. [°W] | ["] | [sec] | | Lon. [°W] | ["] | [sec] |
| A | Central California Coast | 30.0167-40.00<br>117.0083-126.9917 | 60 | 0.6 | | 30.0333 – 40.000<br>126.992-117.0251 | 120 | 6.4 |
| | | | (599x599) | | | | (299x299) | |
| | | | | | | | | |
| B | Central California Coast | 35.5500-34.7111<br>121.2899-120.5511 | 10 | 0.2 | | 35.5000-34.7555<br>121.2899-120.5566 | 20 | 4.8 |
| | | | (265x302) | | | | (131x134) | |
| | | | | | | | | |
| C | Port San Luis | 35.2160-35.1001<br>120.8339-120.6001 | 1 | 0.2 | | 35.2165-35.1004<br>120.8339-120.6006 | 3 (x)<br>2 (y) | 1.6 |
| | | | (841x416) | | | | (280x208) | |
| Minimum offshore depth [m] | | | 1 | | | 1 | | |
| Water depth for dry land [m] | | | 0.1 | | | 0.1 | | |
| Manning coefficient | | | 0.0009 | | | 0.0009 | | |
| CPU time for a 4-hour simulation (min) | | | 20 | | | 5.5 | | |

Table 2 Summary of SIM and RIM parameters for Port San Luis, CA

DRAFT

| Event | Time (UTC) | Zone | $M_w$ | Lat | Lon | Source |
|---|---|---|---|---|---|---|
| Solomon | 2007.04.01 20:40:40.7 | NBSV | 8.2 | 7.96S | 156.4E | 12.0×b10 |
| Kuril | 2007.01.13 04:23:48.2 | KISZ | 7.9 | 46.18N | 154.80E | -3.82×b13 |
| Kuril | 2006.11.15 11:14:16 | KISZ | 8.1 | 46.75N | 154.32E | 4.0×a12+0.5×b12 +2.0×a13+1.5×b13 |
| Tonga | 2006.05.03 15:26:39 | NZKT | 8.1 | 20.13N | 174.164W | 8.44×b29 |
| Alaska | 1964.03.28 03:36:14 | AASZ | 9.0 | 61.04N | 147.73W | Tang et al. |
| Chile | 1960.05.22 19:11:14 | SASZ | 9.5 | 45.88S | 76.29W | Kanamori and Cipar (1974) |
| Kamchatka | 1952.11.04 16:58:26 | KISZ | 8.7 | 52.75N | 159.5E | Under investigation |

Table 3. Tsunami sources of 7 historical events used for model validation in this study.

DRAFT

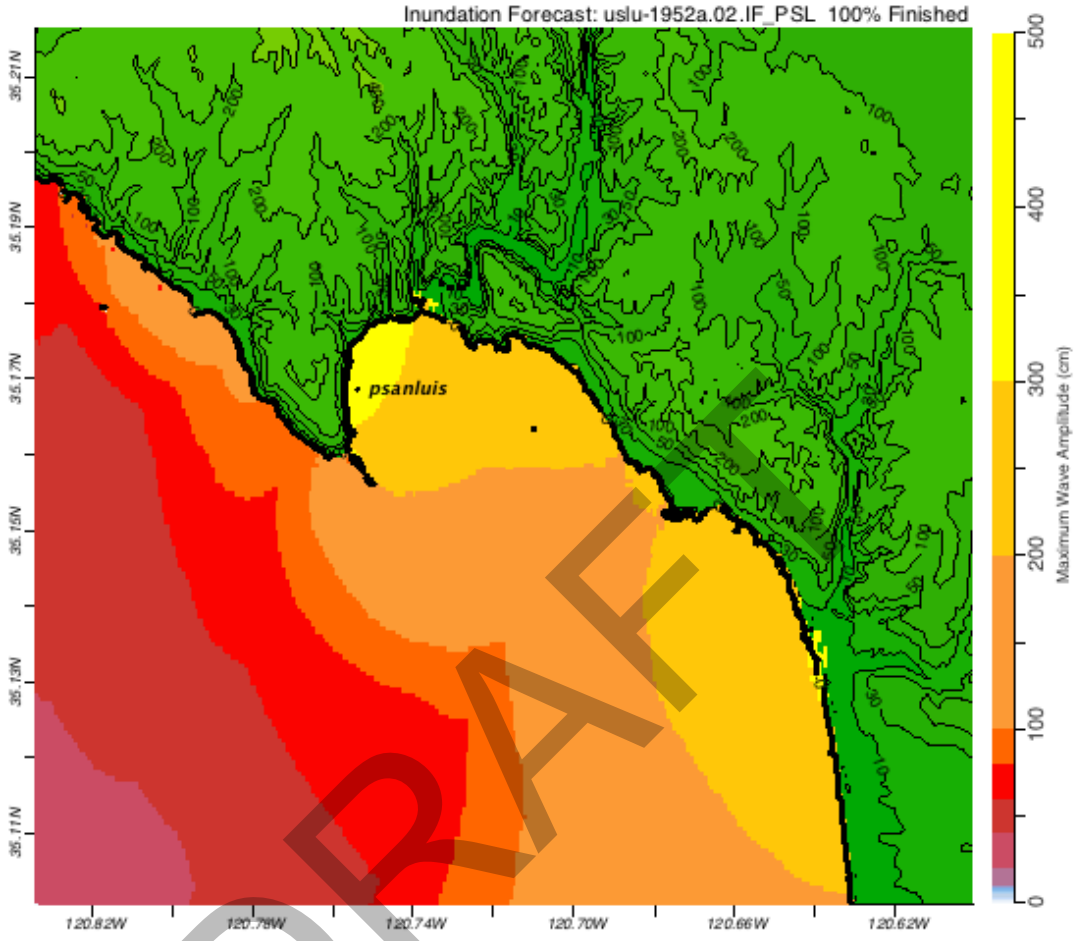



Figure 6 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1952 Kamchatka tsunami.

DRAFT

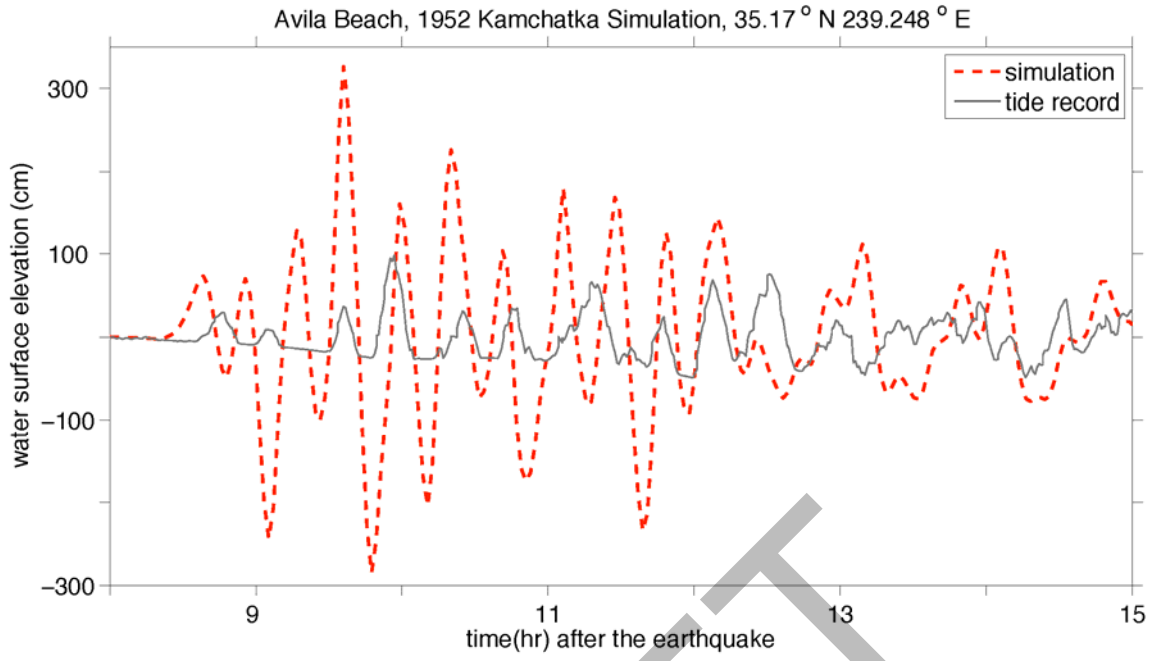



Figure 7 Comparison of water level of modeled (red) versus observed (blue) at the Avila Beach tide gauge for the 1952 Kamchatka tsunami.

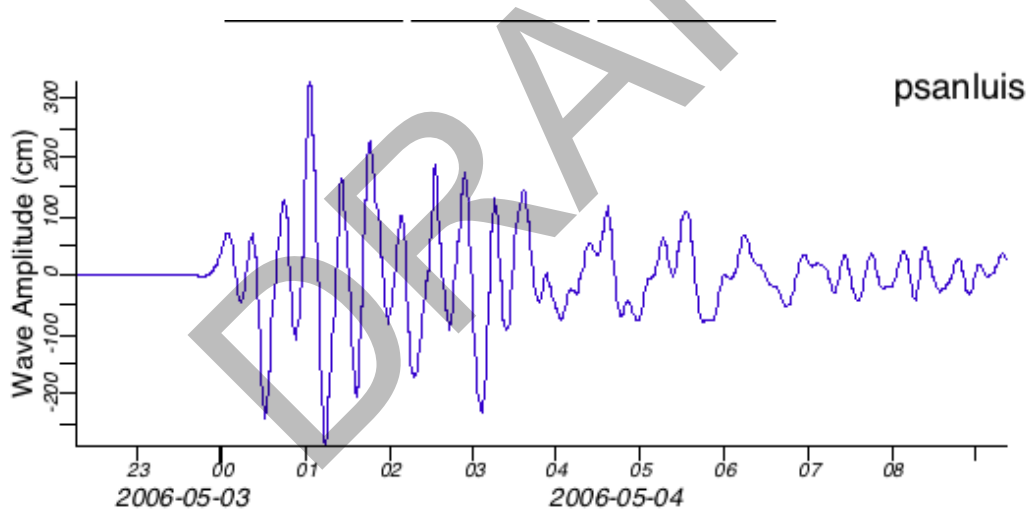



Figure 8 Time series of modeled water level records at Avila Beach tide gauge for the 1952 Kamchatka tsunami.

DRAFT

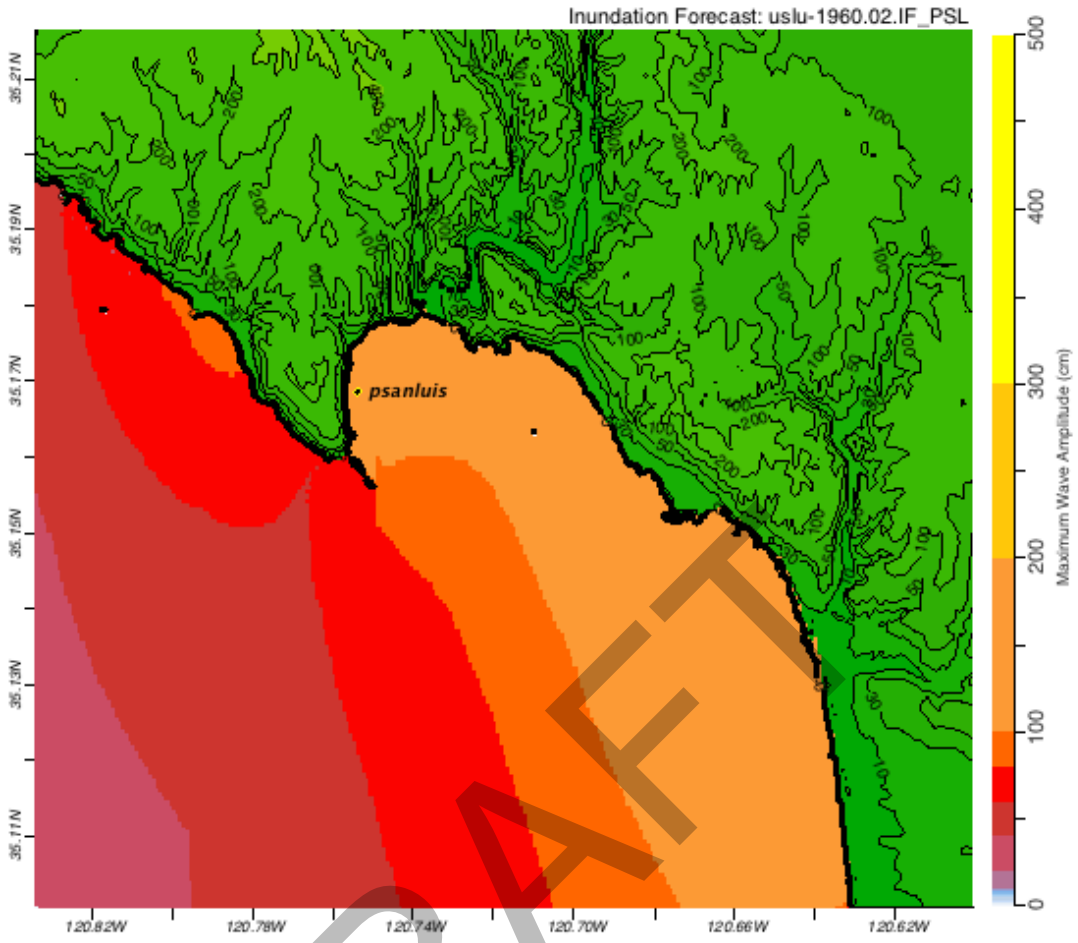



Figure 9 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1960 Chile Kamchatka tsunami

DRAFT

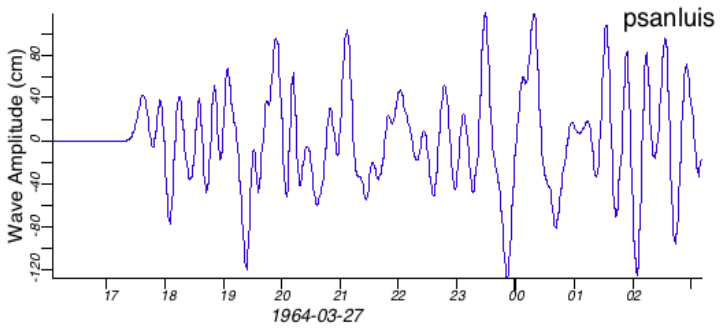



Figure 10 Water level heights at the warning point -- Avila tide gauge for the 1960 Chile Earthquake.

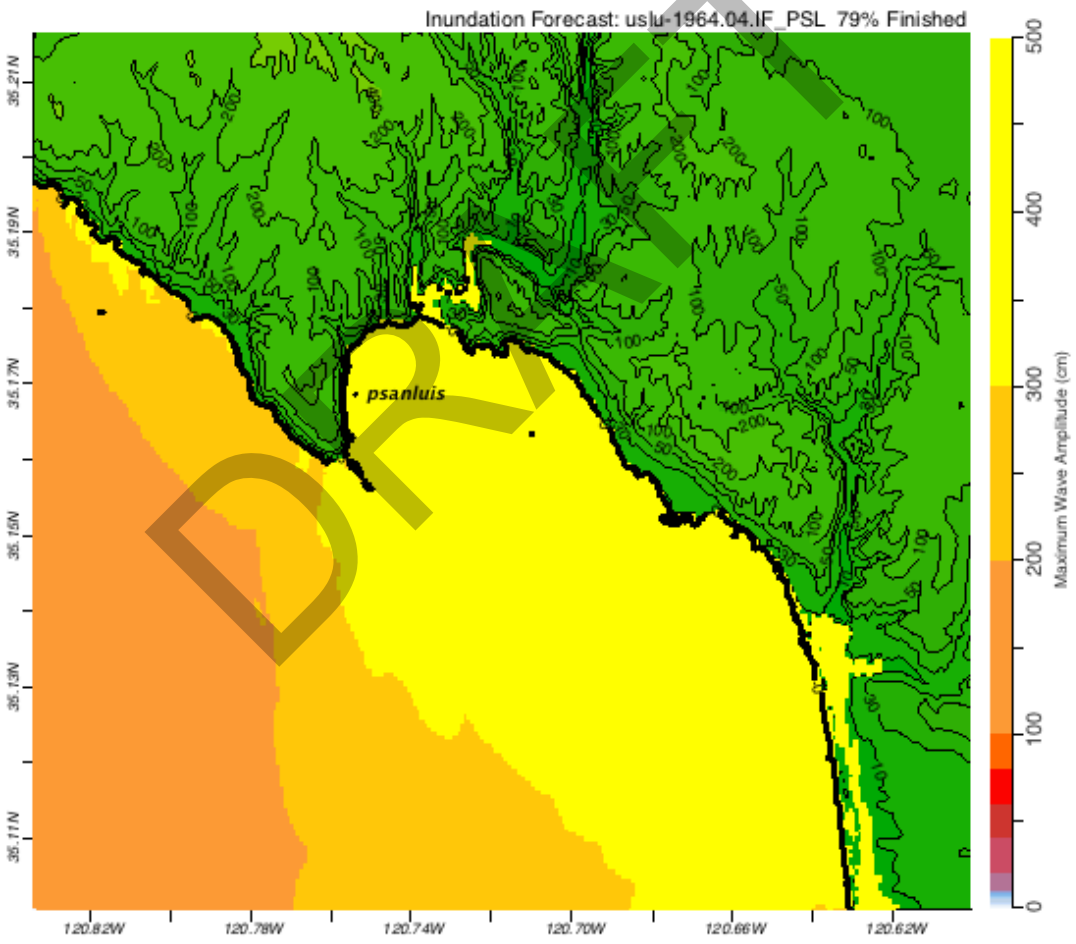



Figure 11 Inundation Forecast for Port San Luis, CA SIM C Grid for the 1964 Alaska tsunami.

DRAFT

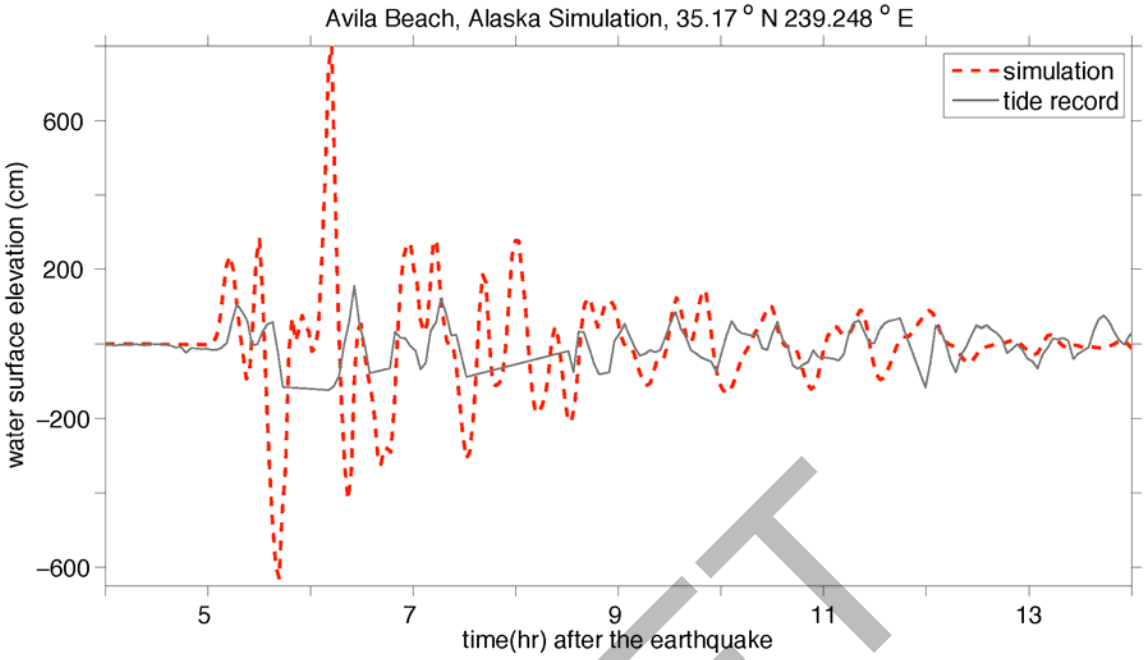



Figure 12 Comparison of water level of modeled (red) versus observed (blue) at the Avila Beach tide gauge for the 1964 Alaska tsunami.

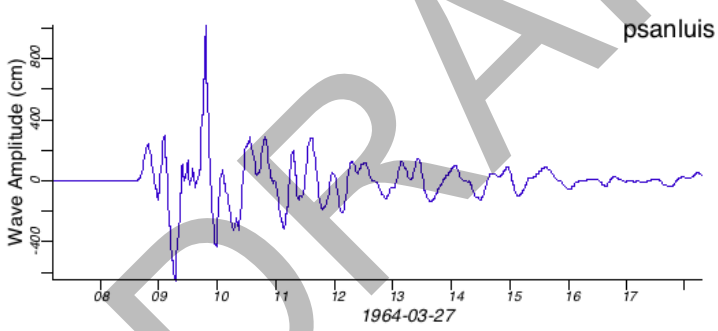



Figure 13 Water level heights at the warning point -- Avila tide gauge for the 1964 Alaska Earthquake for Port San Luis, CA.

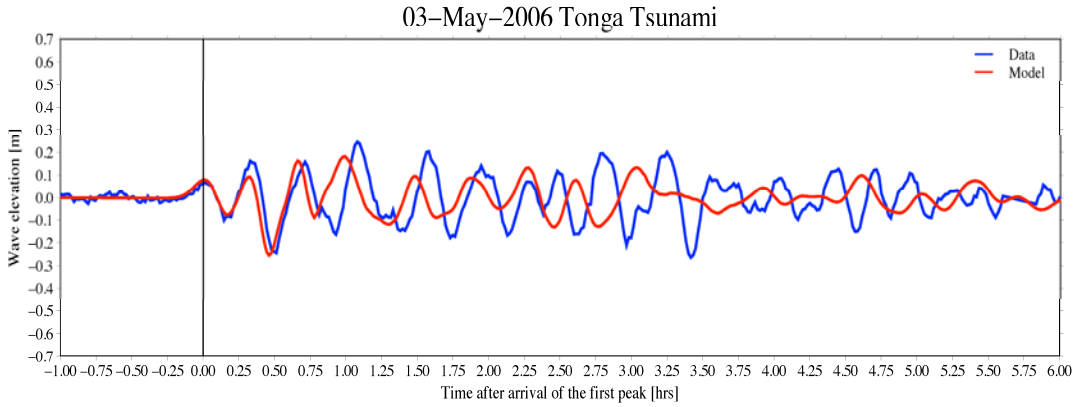



Figure 14 Time series comparison of tide gauge (blue) v. model (red) time series for the 2006 Tonga event.

DRAFT

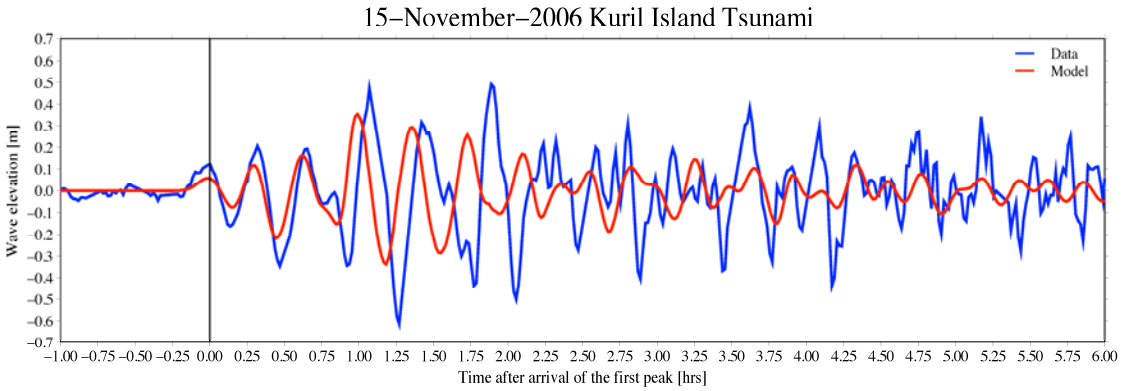



Figure 15 Time series comparison of tide gauge (blue) v. model (red) time series for the November 2006 Kuril event.

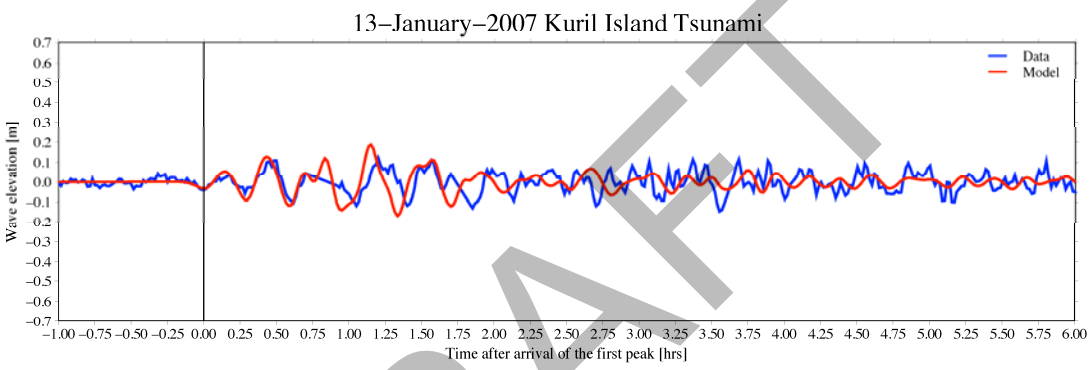



Figure 16 Time series comparison of tide gauge (blue) v. model (red) time series for the January 2007 Kuril event.

DRAFT

### 3.2 Model stability and reliability

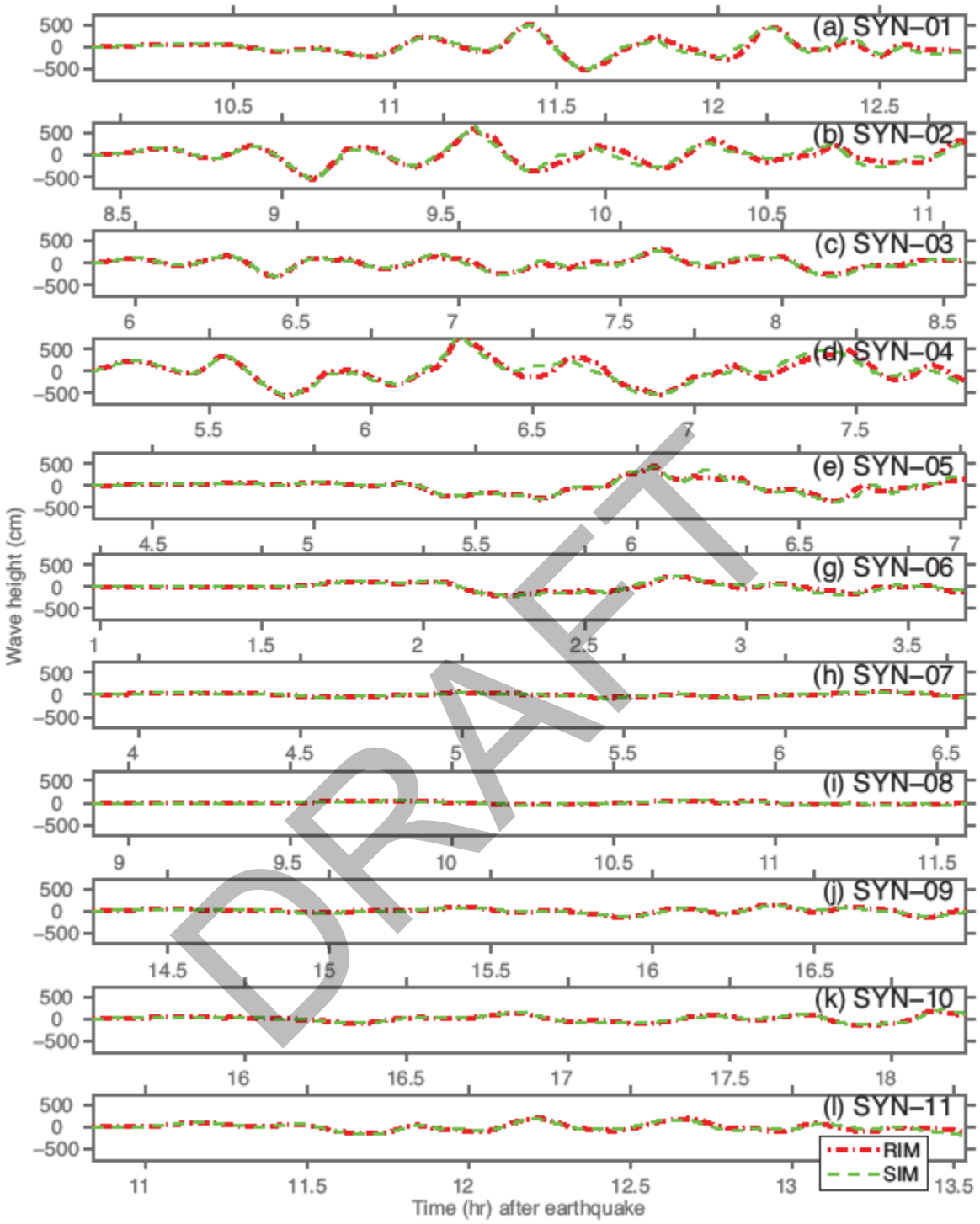
The SIM was also tested for several scenario events to ensure the optimized models developed will perform as expected for the possible extreme events. Again it is not intended here to discuss the likelihood of events, rather test the developed SIMs performance during such event. The source sensitivity study of Titov et al. (1999) has established that a few source parameters are critical for the far-field tsunami characteristics namely the location and the magnitude. It is proposed here that location of the source might affect the inundation detail and wave behavior at SIM location. However, the SIM should perform well for these extreme magnitude events. Therefore, several representative large magnitude events were chosen to test the performance of the SIM for the subduction zones around the Pacific (Table 4). The following time series comparisons of the SIM and RIM for the 18 synthetic events modeled. The SIM shows good agreement with the RIM. The earliest significant waves to arrive at the warning point are from the Kuril Kamchatka sources, while the largest waves originate from Manus and New Zealand and Tonga (Scenarios 12 and 14). Maximum amplitude plots comparing RIM and SIM inundation validate the time series results and demonstrate that the south west sources will have the greatest impact on the site. The lack of instabilities in the grid and good agreement with the RIM demonstrate that the Port San Luis SIM performs well for these extreme events.

DRAFT

| | Region | Code | Mw | Alpha (m) | Unit Source combination |
|---|---|---|---|---|---|
| **1** | Kuril-Kamchatka/Japan | KISZ | 9.3 | 29 | KISZ 22-31AB |
| **2** | Kuril-Kamchatka/Japan | KISZ | 9.3 | 29 | KISZ 1-10AB |
| **3** | Alaska/Aleutians | ACSZ | 9.3 | 29 | 12-21AB |
| **4** | Alaska/Aleutians | ACSZ | 9.3 | 29 | 22-31AB |
| **5** | Alaska/Aleutians | ACSZ | 9.3 | 29 | 38-47AB |
| **6** | Alaska/Aleutians | ACSZ | 9.3 | 29 | 56-65AB |
| **7** | Central and South American | CASZ | 9.3 | 29 | 1-10AB |
| **8** | Central and South American | CASZ | 9.3 | 29 | 37-46AB |
| **9** | Central and South American | CASZ | 9.3 | 29 | 94-103AB |
| **10** | Central and South American | CASZ | 9.3 | 29 | 106-115AB |
| **11** | New Zealand-Kermadec-Tonga | NTSZ | 9.3 | 29 | 20-29AB |
| **12** | New Zealand-Kermadec-Tonga | NTSZ | 9.3 | 29 | 30-39AB |
| **13** | New Britain-Solomons-Vanuatu | NVSZ | 9.3 | 29 | 28-37AB |
| **14** | Manus OCB | MOSZ | 9.3 | 29 | 1-10AB |
| **15** | North New Guinea | NGSZ | 9.3 | 29 | 3-12AB |
| **16** | East Philippines | EPSZ | 9.3 | 29 | 6-15AB |
| **17** | Ryukus-Kyushu-Nankai | RNSZ | 9.3 | 29 | 12-21AB |
| **18** | Kuril-Kamchatka/Japan | KISZ | 9.3 | 29 | 32-41AB |
| | | | | | |

Table 4 Synthetic scenarios used to test stability of the Port San Luis RIM and SIM.

DRAFT


(a) SYN−01
(b) SYN−02
(c) SYN−03
(d) SYN−04
(e) SYN−05
(g) SYN−06
(h) SYN−07
(i) SYN−08
(j) SYN−09
(k) SYN−10
(l) SYN−11
Wave height (cm)
Time (hr) after earthquake
RIM
SIM

DRAFT

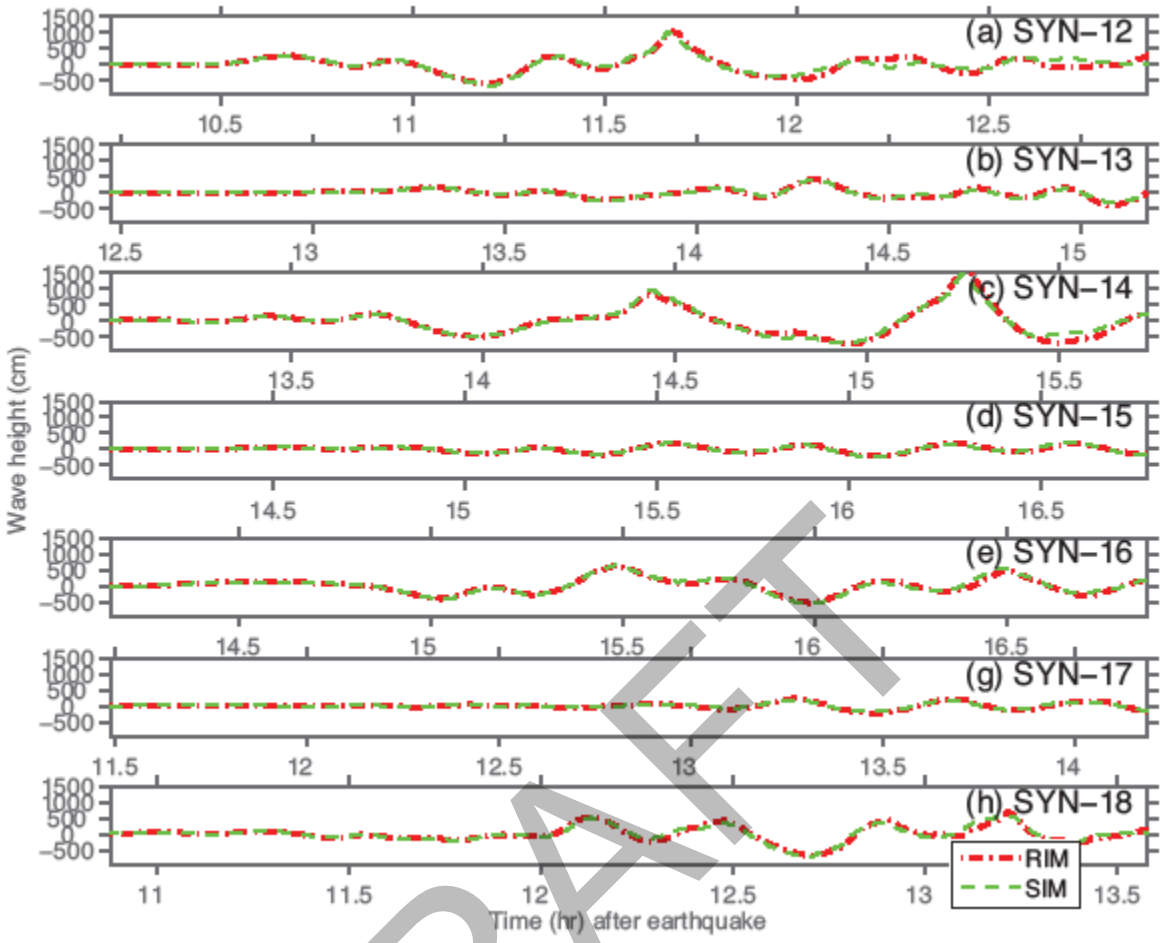
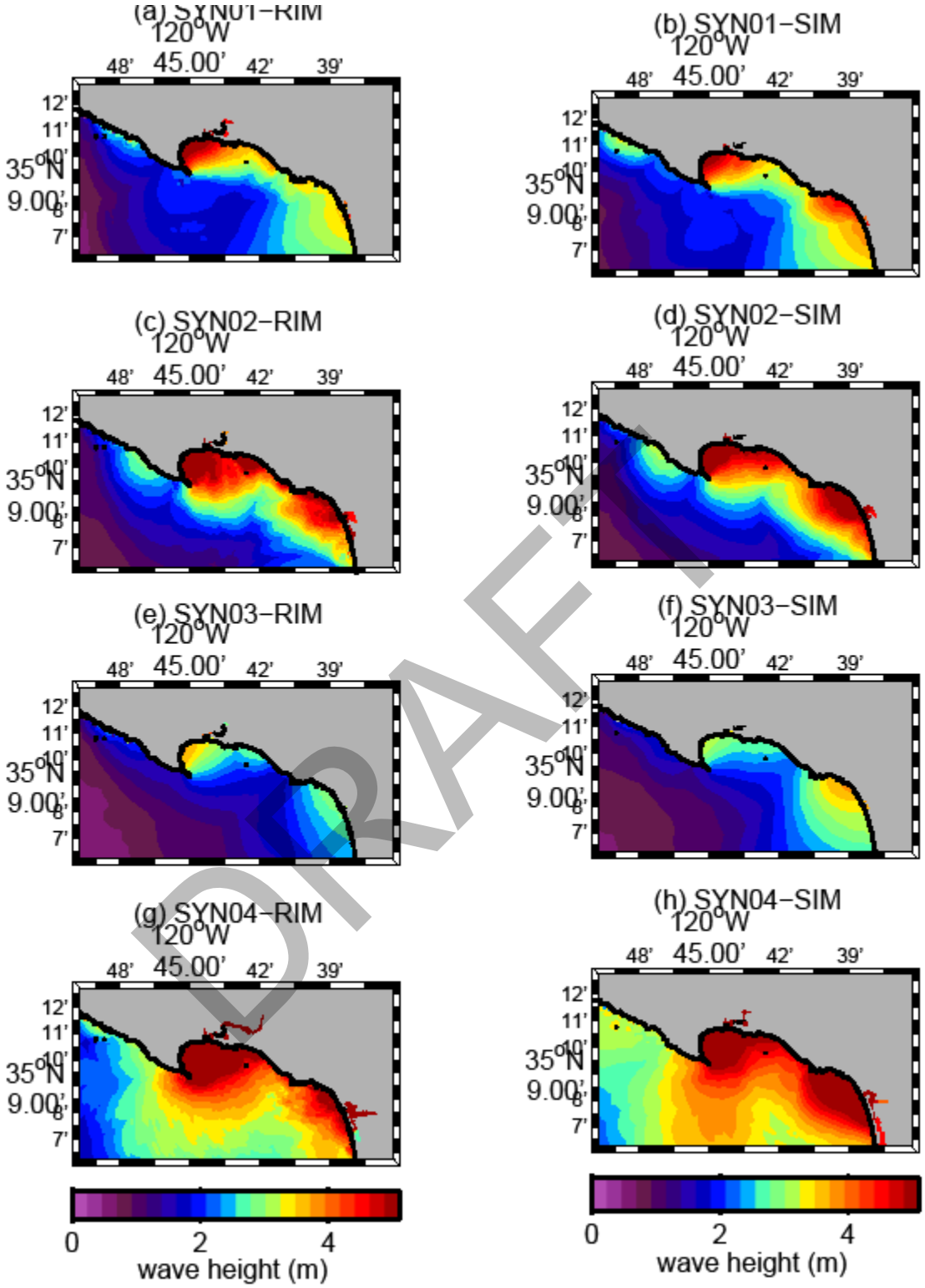
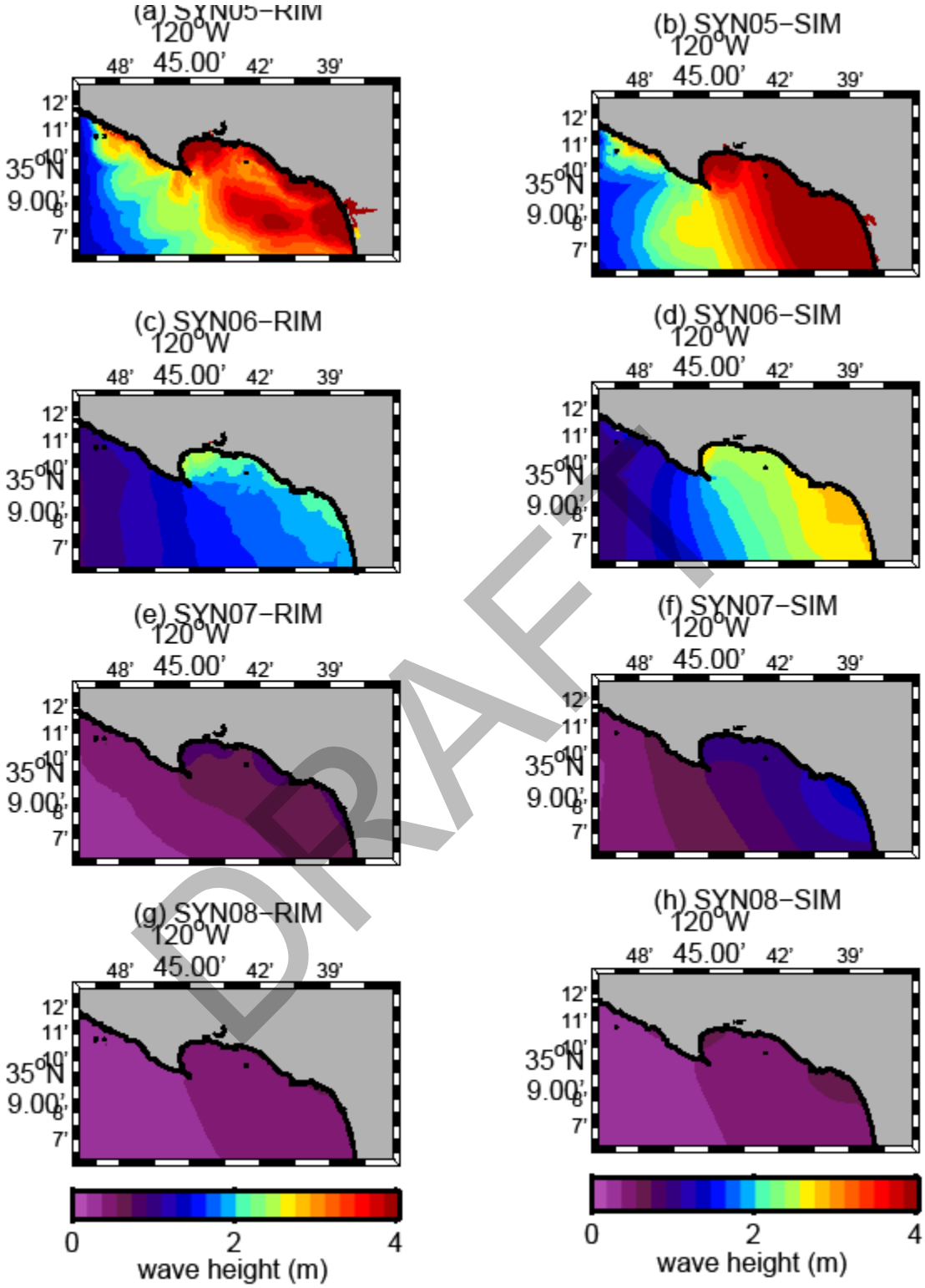



Figure 17 Comparison time series plots of the RIM and SIM for synthetic events. Please refer to Table 4 for region and sources tested.

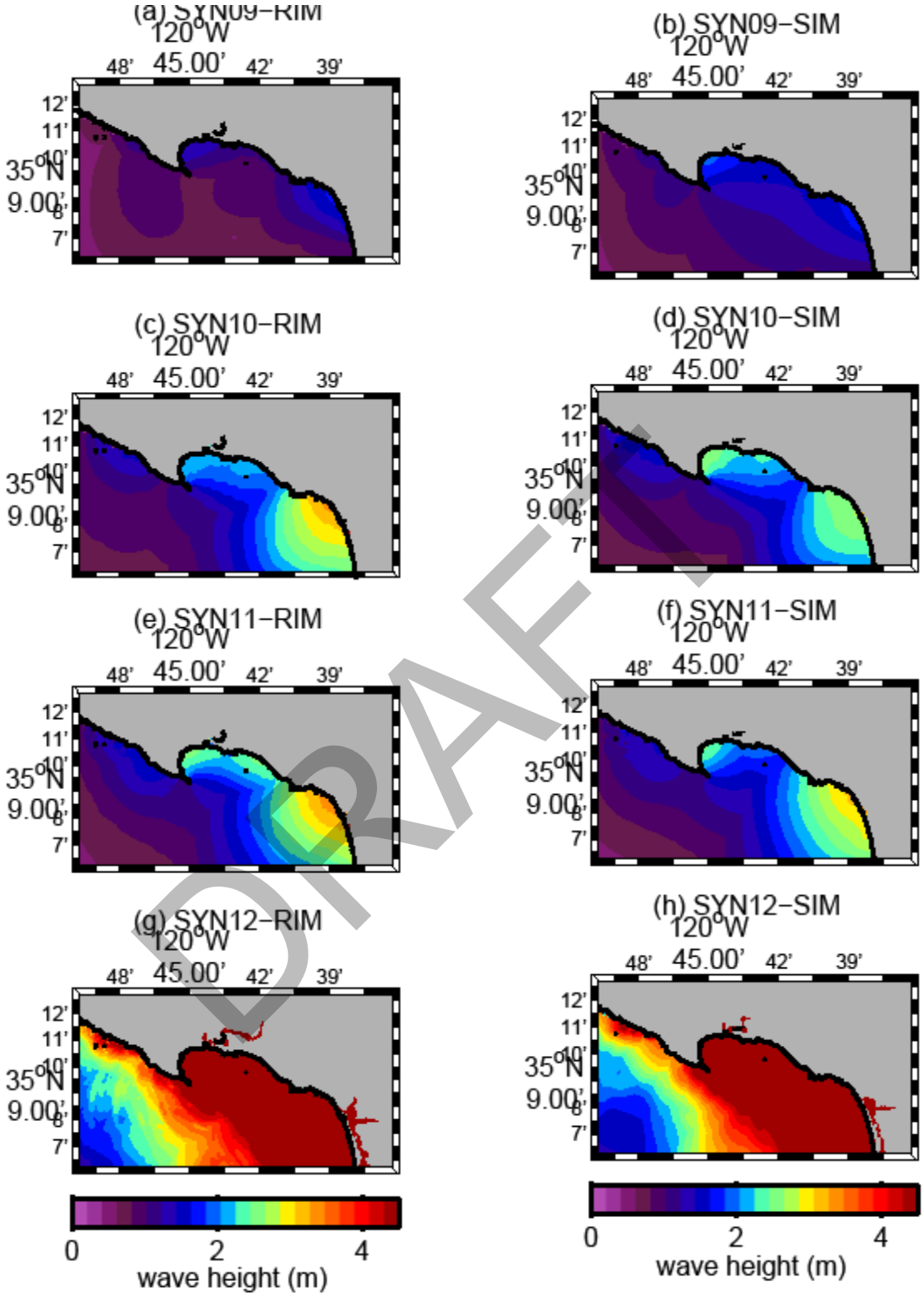
DRAFT


(a) SYN01−RIM
(b) SYN01−SIM
(c) SYN02−RIM
(d) SYN02−SIM
(e) SYN03−RIM
(f) SYN03−SIM
(g) SYN04−RIM
(h) SYN04−SIM
120°W
45.00'
48'
42'
39'
12'
11'
10'
35°N
9.00'
8'
7'
0
2
4
wave height (m)

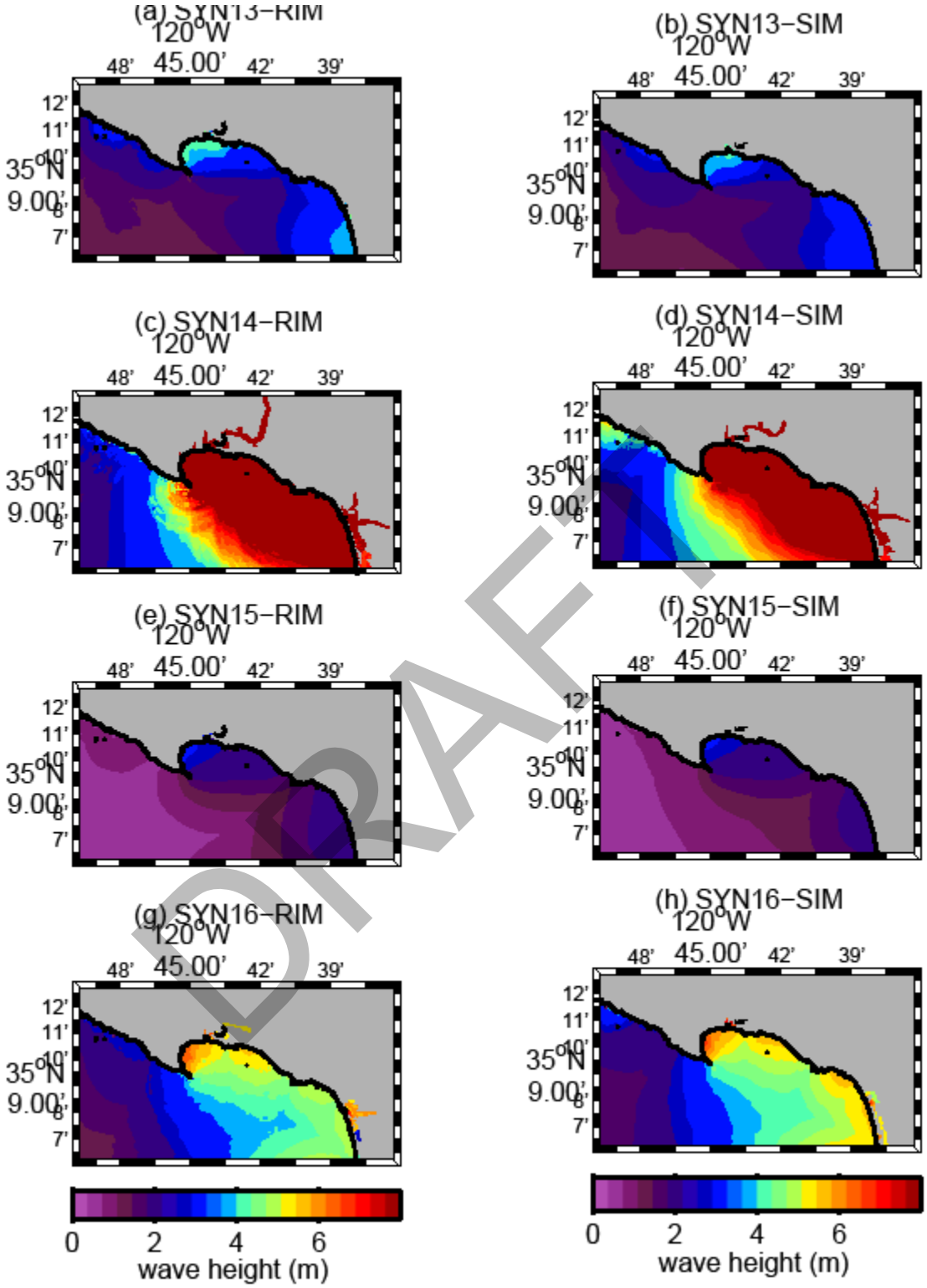
DRAFT


(a) SYN05−RIM
(b) SYN05−SIM
(c) SYN06−RIM
(d) SYN06−SIM
(e) SYN07−RIM
(f) SYN07−SIM
(g) SYN08−RIM
(h) SYN08−SIM
120°W
45.00'
48'
42'
39'
12'
11'
10'
35°N
9.00'
8'
7'
0
2
4
wave height (m)

DRAFT


(a) SYN09−RIM
(b) SYN09−SIM
(c) SYN10−RIM
(d) SYN10−SIM
(e) SYN11−RIM
(f) SYN11−SIM
(g) SYN12−RIM
(h) SYN12−SIM
120°W
45.00'
48'
42'
39'
12'
11'
10'
35°N
9.00'
8'
7'
0
2
4
wave height (m)

DRAFT


(a) SYN13−RIM
(b) SYN13−SIM
(c) SYN14−RIM
(d) SYN14−SIM
(e) SYN15−RIM
(f) SYN15−SIM
(g) SYN16−RIM
(h) SYN16−SIM
120°W
45.00'
48'
42'
39'
12'
11'
10'
35°N
9.00'
8'
7'
0
2
4
6
wave height (m)

DRAFT

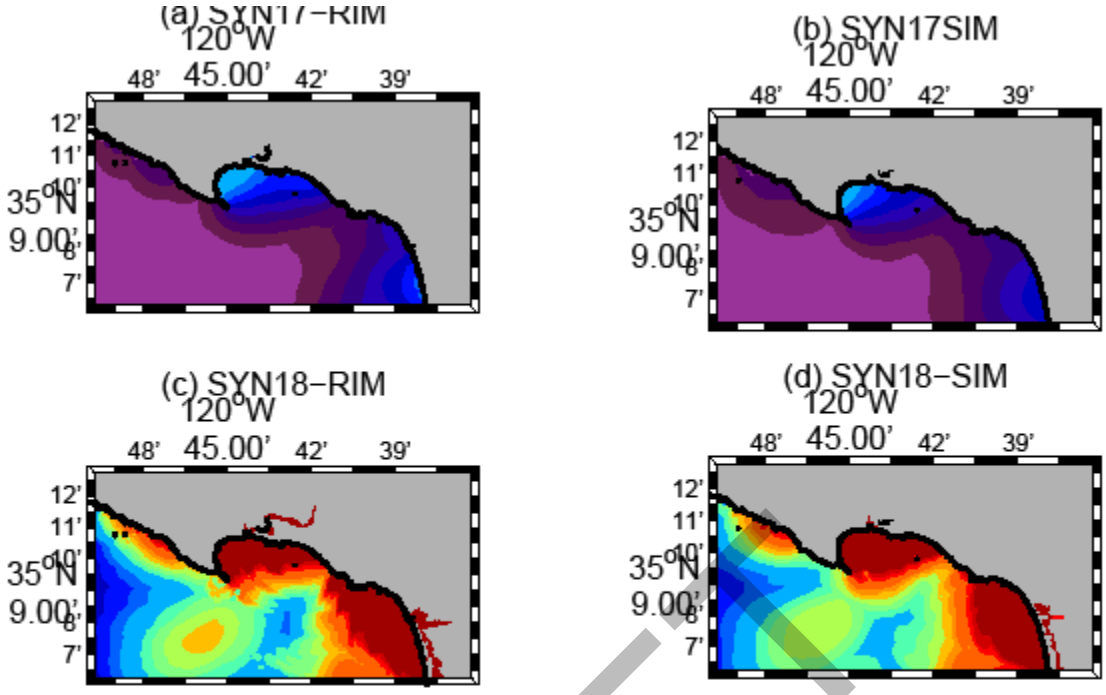



Figure 18 Comparison of maximum wave distributions for the Port San Luis, CA SIM and RIM. Please refer to Table 4 for region and sources tested.

DRAFT

## 4.0 Summary and Conclusions

A SIM was developed for the community of Port San Luis, CA. The model was tested using a variety of historical events and showed good agreement between the modeled results and the water level data at the tide gauge. Additionally, the model remained stable when tested with a likely 9.0 Mw event originated in the Alaska/Cascadia subduction zone.

DRAFT

## 5.0 References

Synolakis, C.E., E.N. Bernard, V.V. Titov, U. Kânoğlu, and F.I. González (2007), Standards, criteria, and procedures for NOAA evaluation of tsunami numerical models. *NOAA Tech. Memo. ERL PMEL-135*, 55 pp.

Tang, L., C. Chamberlin and V.V. Titov, (2008), Developing tsunami forecast inundation models for Hawaii: procedures and testing, *NOAA Tech. Memo., OAR PMEL -141*, 46 pp.

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.

Titov, V.V., and F.I. González (1997), Implementation and testing of the Method of Splitting Tsunami (MOST) model, *NOAA Tech. Memo. ERL PMEL-112*, 11 pp.

Uslu, B. (2008). Deterministic and Probabilistic tsunami studies in California from near and far field sources. PhD thesis, University of Southern California, Los Angeles, California.

DRAFT

## 6.0 Appendix A

Since the initial development of the Port San Luis, CA SIM, the parameters for the input file for running the SIM and RIM in MOST have been changed to reflect changes to the MOST model code. The following appendix lists the new input files for Port San Luis, CA.

### 6.1 RIM *.in file for Port San Luis, CA – updated for 2009

```
0.001    Minimum amplitude of input offshore wave (m):
10    Input minimum depth for offshore (m)
0.1    Input "dry land" depth for inundation (m)
0.0009    Input friction coefficient (n**2)
1    let a and b runup
100.0    max eta before blowup (m)
0.2    Input time step (sec)
120000    Input amount of steps
3    Compute "A" arrays every n-th time step, n=
1    Compute "B" arrays every n-th time step, n=
360    Input number of steps between snapshots
0    ...Starting from
1    ...Saving grid every n-th node, n=
```

DRAFT

### 6.2 SIM *.in file for Port San Luis, CA – updated for 2009

```
0.0001 Minimum amplitude of input offshore wave (m):
10     Input minimum depth for offshore (m)
0.1    Input "dry land" depth for inundation (m)
0.0009 Input friction coefficient (n**2)
1      let a and b runup
30.0   max eta before blowup (m)
1.6    Input time step (sec)
25000  Input amount of steps
4      Compute "A" arrays every n-th time step, n=
3      Compute "B" arrays every n-th time step, n=
36     Input number of steps between snapshots
0      ...Starting from
1      ...Saving grid every n-th node, n=
```

DRAFT