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UPDATED TSUNAMI INUNDATION MAPS FOR SELDOVIA, ALASKA

E.N. Suleimani, D.J. Nicolsky, and J.B. Salisbury

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UPDATED TSUNAMI INUNDATION MAPS FOR SELDOVIA, ALASKA

E.N. Suleimani[1], D.J. Nicolsky[1], and J.B. Salisbury[2]

Abstract

This release updates the previous tsunami hazard assessment for Seldovia, Alaska, by Suleimani and others (2019). We numerically remodel the extent of potential inundation from tsunami waves using a new, more accurate digital elevation model (DEM) that allows for better resolution of terrain in wooded areas. Results presented here are intended to provide guidance to local emergency management agencies for tsunami inundation assessment, evacuation planning, and public education to mitigate impacts of future tsunami events.

INTRODUCTION

In 2020, the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (NCEI) used lidar to develop a seamless 8/15 arc-second resolution bathymetric–topographic DEM to support tsunami hazard mitigation efforts in Seldovia (Carignan and others, 2020). We use this updated, more accurate DEM to calculate new potential inundation zones in Seldovia as the previous study (Suleimani and others, 2019) was based on a lower resolution IfSAR-derived digital terrain model (DTM).

METHODOLOGY AND TSUNAMI SOURCES

In this update we use the same hypothetical tectonic tsunami sources and tsunami modeling techniques as the previous study (see table 3, "Numerical Model of Tsunami Propagation and Runup" in Suleimani and others, 2019). Similarly, we use a series of nested grids, ranging from level 0—the North Pacific grid, to level 4—high-resolution grid focused on Seldovia, to model tsunami dynamics and runup (table 2, Suleimani and others, 2019). In this update, the level 4 high-resolution DEM is now based on the lidar-derived DEM developed by Carignan and others (2020), allowing for more accurate tsunami runup modeling.

MODELING RESULTS

New results suggest that potential tsunami wave heights in Kachemak and Seldovia bays are the same as shown in Suleimani and others (2019), but the extent of modeled inundation in Seldovia is more severe. Notable differences occur in the wooded areas and along narrow gullies in Seldovia (fig. 1, map sheets 2–8). Graphical plots of modeled tsunami wave height dynamics and water velocities are shown in appendix A for selected locations.

SUMMARY

We have updated our tsunami hazard assessment for Seldovia, Alaska, by numerically modeling hypothetical tectonic tsunami waves on a new, high-resolution DEM. We considered several geologically plausible earthquake-generated tsunami scenarios and provide an estimate of maximum credible tsunami inundation associated with each. A megathrust earthquake in the KI-KP region with maximum slip at a depth of 15–35 km (9.3–21.7mi) results in the largest inundation in Seldovia (scenario 6, Suleimani and others, 2019).

The maps in this report have been completed using the best information available and are believed to be accurate; however, their preparation required many assumptions. Actual condi-

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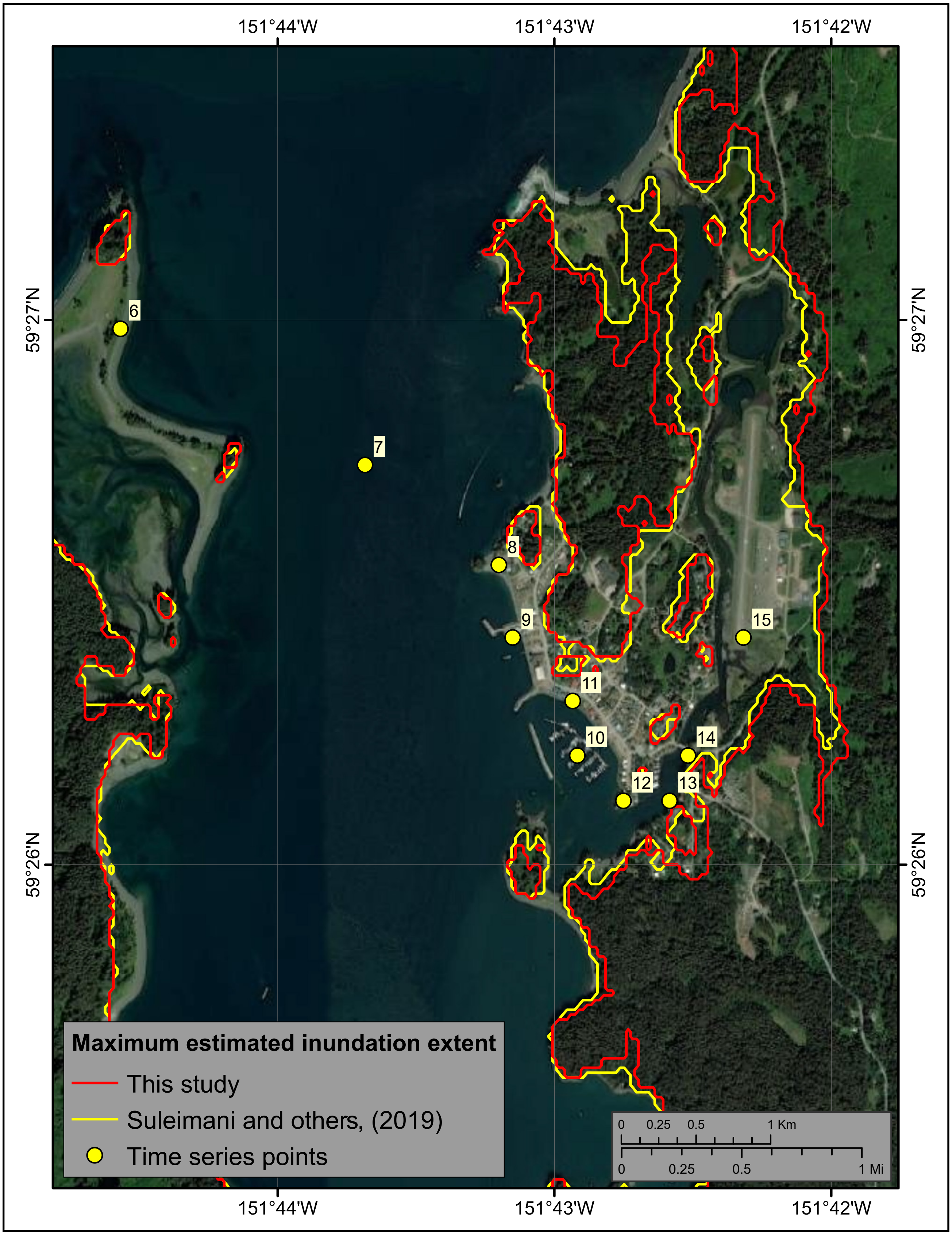

Figure 1. Comparison of the potential inundation according to this study and Suleimani and others (2019). Locations of time series points are shown by yellow circles.

tions during a tsunami event may vary from those considered, so the report's accuracy cannot be guaranteed. The limits of inundation shown should only be used as a guideline for emergency planning and response action. Actual inundated areas will depend on specifics of earth deformations, on-land construction, and tide level, and may differ from areas shown on the map. The information on this map is intended to assist state and local agencies in planning for emergency evacuation and tsunami response actions in the event of a major tsunamigenic earthquake. These results are not intended for land-use regulation or building-code development.

ACKNOWLEDGMENTS

This report was funded by the Department of Commerce/National Oceanic at Atmospheric Administration through the National Tsunami Hazard Mitigation Program (NTHMP), Award #NA21NWS4670003 to the Alaska Division of Homeland Security & Emergency Management. This does not constitute an endorsement by NOAA. Numerical calculations for this work were supported by High Performance Computing resources at the Research Computing Systems unit at the Geophysical Institute, University of Alaska Fairbanks.

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Suleimani, E.N., Nicolsky, D.J., and Salisbury, J.B., 2019, Updated tsunami inundation maps for Homer and Seldovia, Alaska: Alaska Division of Geological & Geophysical Surveys Report of Investigation 2018-5 v. 2, 97 p., 11 sheets. https://doi.org/10.14509/30095

Table A1. Maximum water levels and water velocities for tectonic scenarios at time series points near Seldovia. The maximum water depth above ground is provided for onshore (S) locations, whereas the maximum water level above the pre-earthquake mean high high water (MHHW) is provided for offshore (O) locations. The minimum elevation above the post-earthquake MHHW datum is provided for onshore locations, while the minimum post-earthquake depth is provided for offshore locations. The horizontal datum used is World Geodetic System of 1984.

#	Label	S / O	Longitude (°W)	Latitude (°N)	Minimum elevation/ depth (m)	Maximum Water Depth Above Ground/Sea Level (m) Tectonic scenarios									Maximum Water Velocity (m/sec) Tectonic scenarios								
						1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1	Kachemak Bay	O	-151.642222	59.526111	110.7	2.6	2.9	3.6	4.3	6.4	10	7.8	1.1	0.6	0.6	0.7	0.9	0.8	1.2	1.1	0.7	0.2	0.2
2	Tutka Bay	O	-151.494444	59.474444	10.7	3.3	3.7	4.3	5.9	7.9	11.2	8.6	1.3	0.8	0.7	1.5	1.7	1.8	1.4	0.7	0.6	0.2	0.3
3	Kasitsna Bay	O	-151.555833	59.475000	29.0	3.1	3.3	4.3	5.7	7.4	10.8	8.5	1.2	0.8	0.3	0.5	0.5	0.4	0.5	0.3	0.3	0.1	0.1
4	Jakolof Bay pier	O	-151.537222	59.465556	1.2	3.1	3.4	4.2	5.6	7.7	11	8.7	1.3	0.7	0.3	0.9	0.7	0.5	0.5	0.4	0.5	0.2	0.3
5	MacDonald Spit	S	-151.560556	59.481389	-6.8	2.1	2.4	3.2	4.6	6.4	9.8	7.6	0	0	0.6	0.9	1.8	1.6	1.4	1.2	1.9	0	0
6	Point Naskowhak	S	-151.742778	59.449722	-2.8	0	0	0	0.8	1.8	5.7	4.5	0	0	0	0	0	1.5	2.5	3.0	3.2	0	0
7	Seldovia Bay	O	-151.728056	59.445556	9.4	2.7	3.1	3.2	4.4	5.5	10	8.7	1.2	0.7	1.7	3.2	3.6	3.3	3.0	2.4	3.2	0.8	0.8
8	Watch Point	O	-151.720000	59.442500	0.6	2.7	2.6	3.0	4.5	5.5	10.1	8.9	1.2	0.7	0.1	0.1	0.2	0.2	0.8	1.6	1.9	0	0
9	Dock Street	O	-151.719167	59.440278	0.9	2.7	2.7	3.0	4.5	5.6	10.1	8.9	1.2	0.7	0.7	2.1	2.3	0.9	0.9	1.4	1.6	0.4	0.3
10	Boat Harbor	O	-151.715278	59.436667	9.9	2.7	2.7	3.1	4.6	5.8	10.3	9.1	1.2	0.7	0.2	0.6	0.7	0.7	0.6	0.5	0.6	0.1	0.1
11	Tide Pool Cafe	S	-151.715556	59.438333	-4.2	0	0	0.4	1.9	3.0	7.5	6.4	0	0	0	0	0.2	0.8	0.8	0.7	1.0	0	0
12	Dancing Eagles Rental	O	-151.712500	59.435278	0.8	2.7	2.8	3.2	4.7	5.7	10.3	9.2	1.3	0.8	1.1	2.2	2.0	1.8	1.8	1.3	1.5	0.4	0.5
13	Seldovia Slough	O	-151.709722	59.435278	4.4	2.8	2.8	3.3	4.9	5.8	10.3	9.2	1.3	0.8	0.6	1.4	1.3	1.0	1.0	0.8	0.9	0.3	0.3
14	Bridge	S	-151.708611	59.436667	-3.8	0	0	0.2	1.7	2.6	7.2	6.1	0	0	0	0	0	0	1.5	2.0	2.2	0	0
15	Seldovia Airport	S	-151.705278	59.440278	-4.2	0	0	0	1.0	2.7	7.6	6.6	0	0	0	0	0	1.4	1.2	1.4	1.3	0	0

Figure A1. Time series of water level (left column) and velocity (right column) for tectonic scenarios 1–3 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

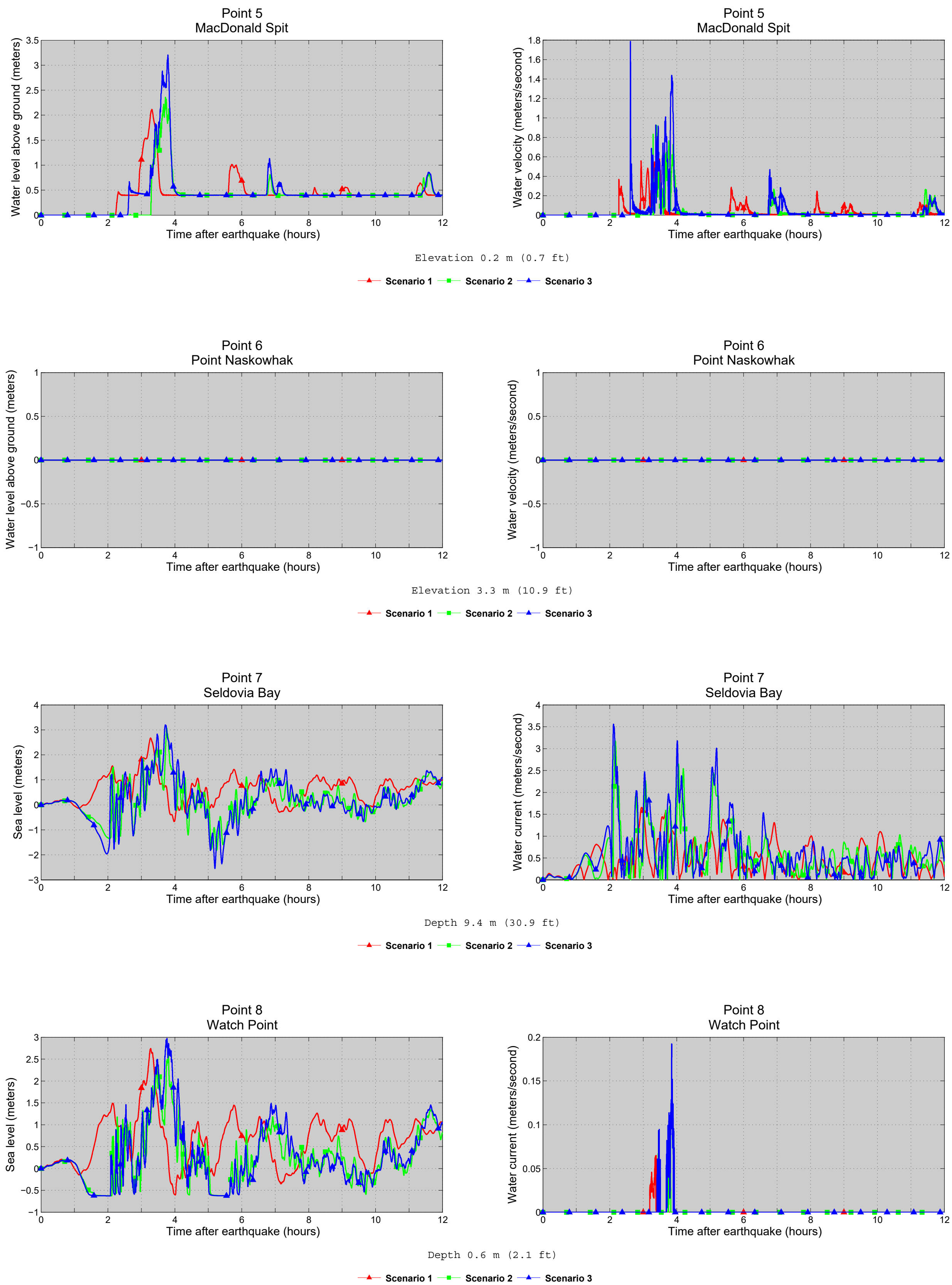

Figure A1, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 1–3 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

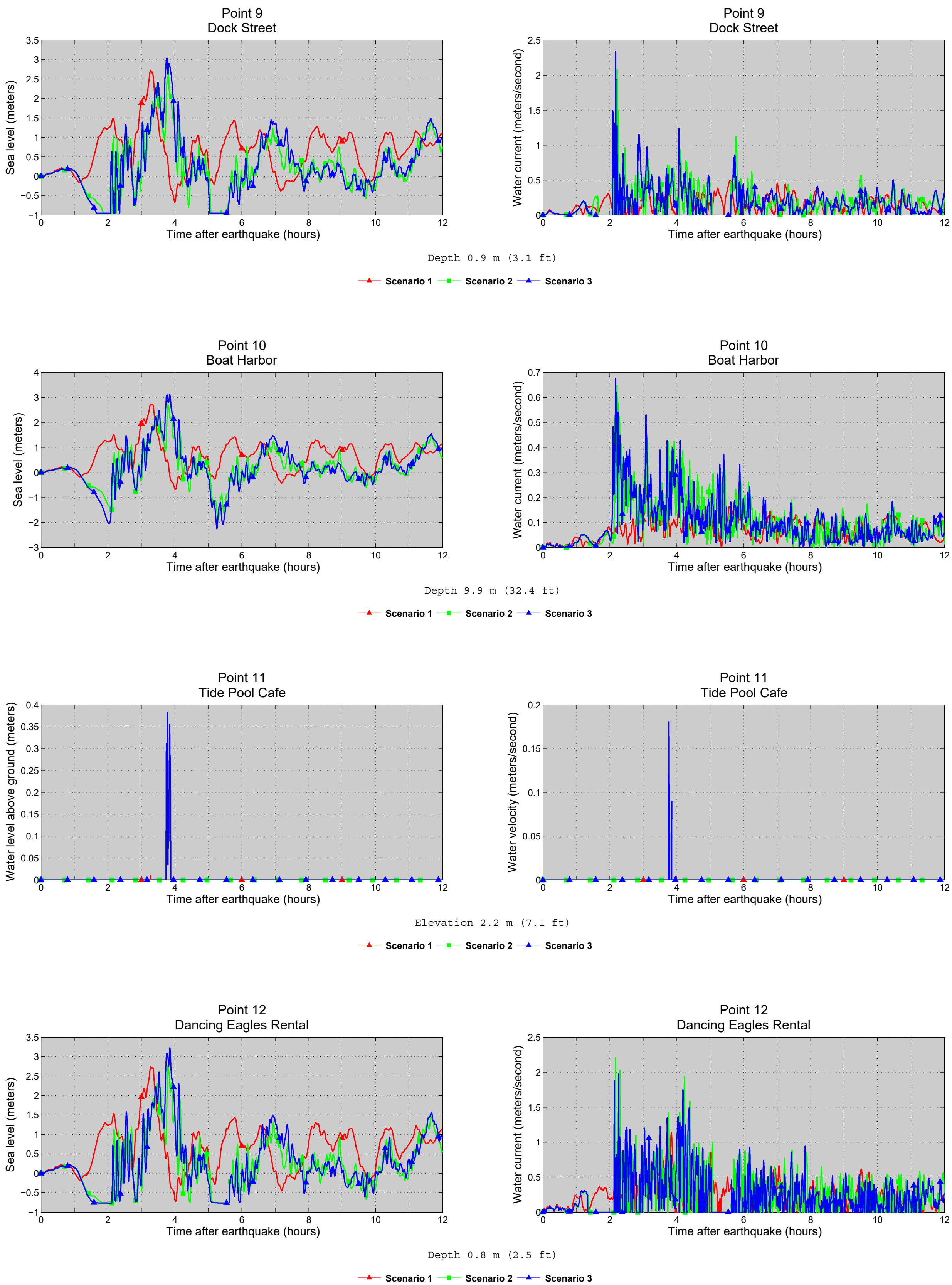

Figure A1, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 1–3 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

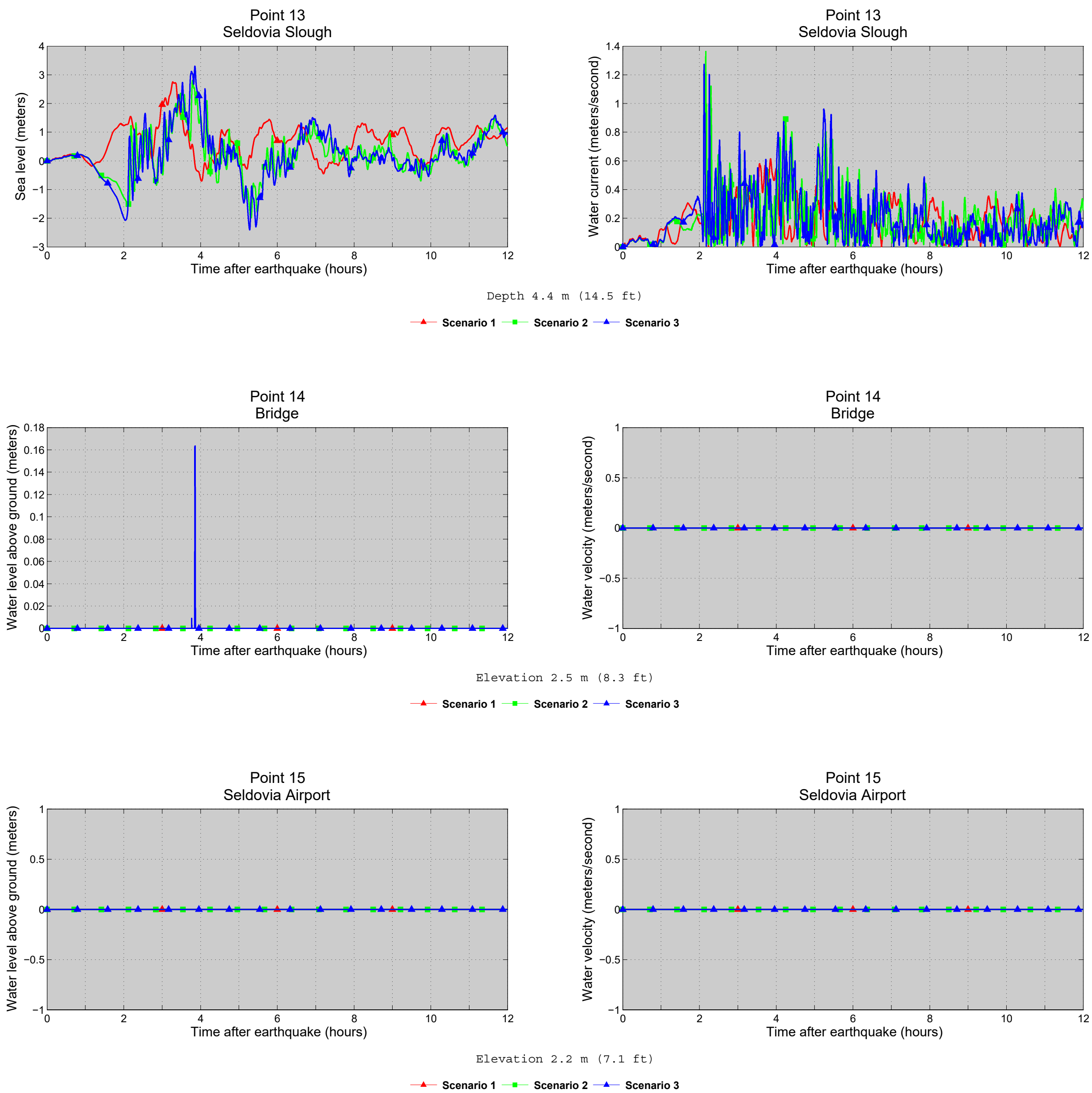

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Figure A2. Time series of water level (left column) and velocity (right column) for tectonic scenarios 4–7 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

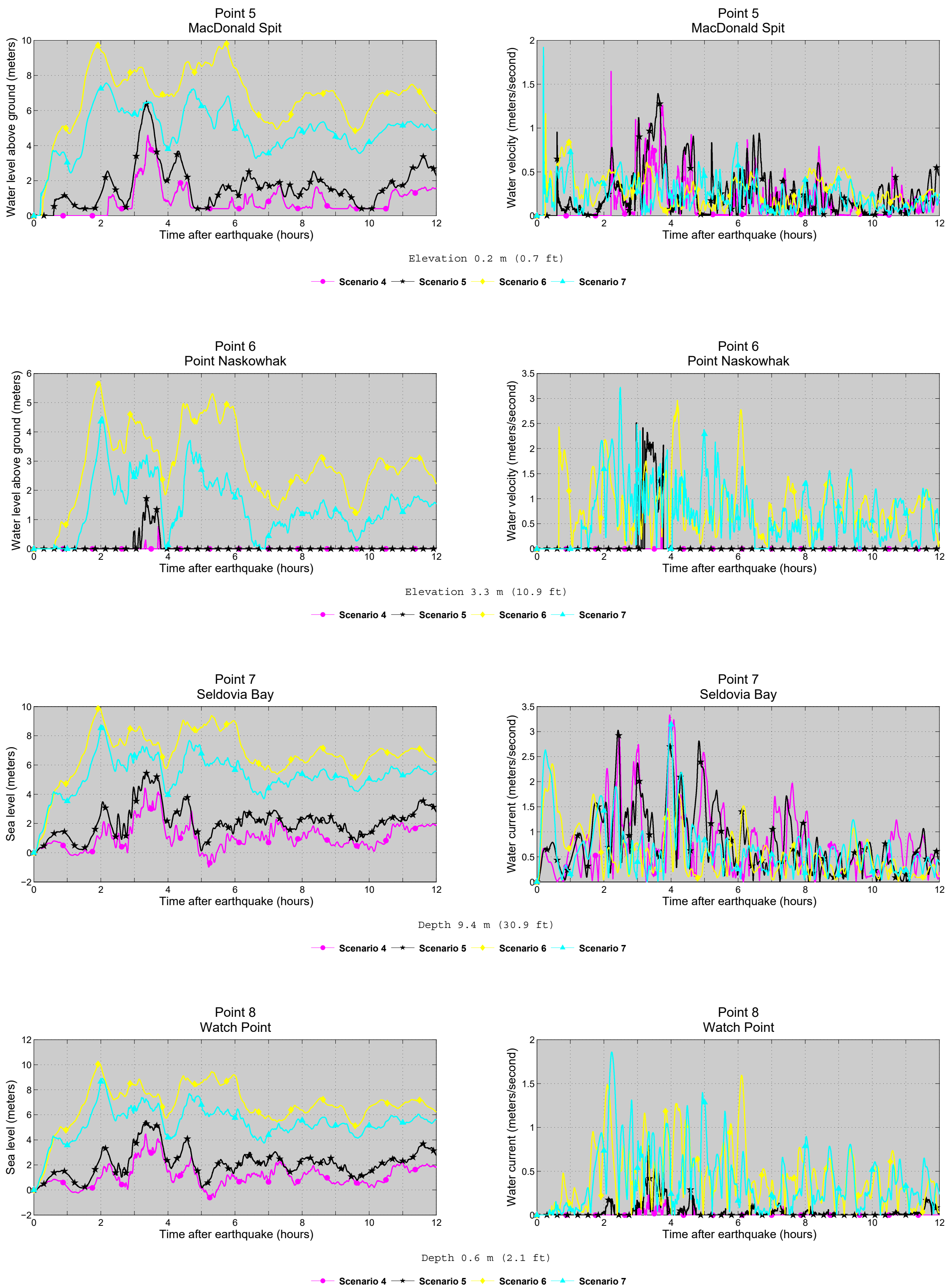


Figure A2, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 4–7 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

Figure A2, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 4–7 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

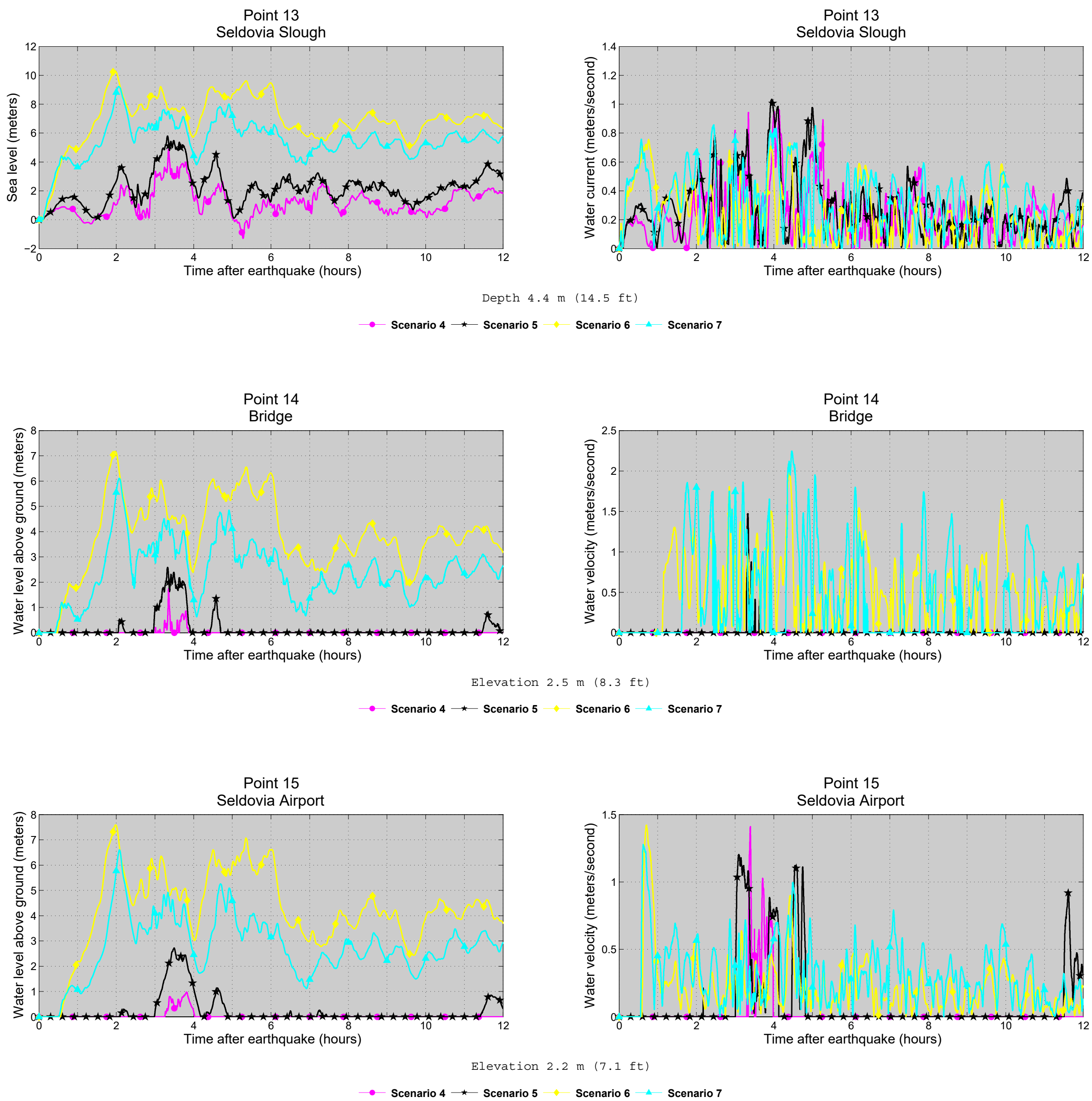


Figure A2, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 4–7 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

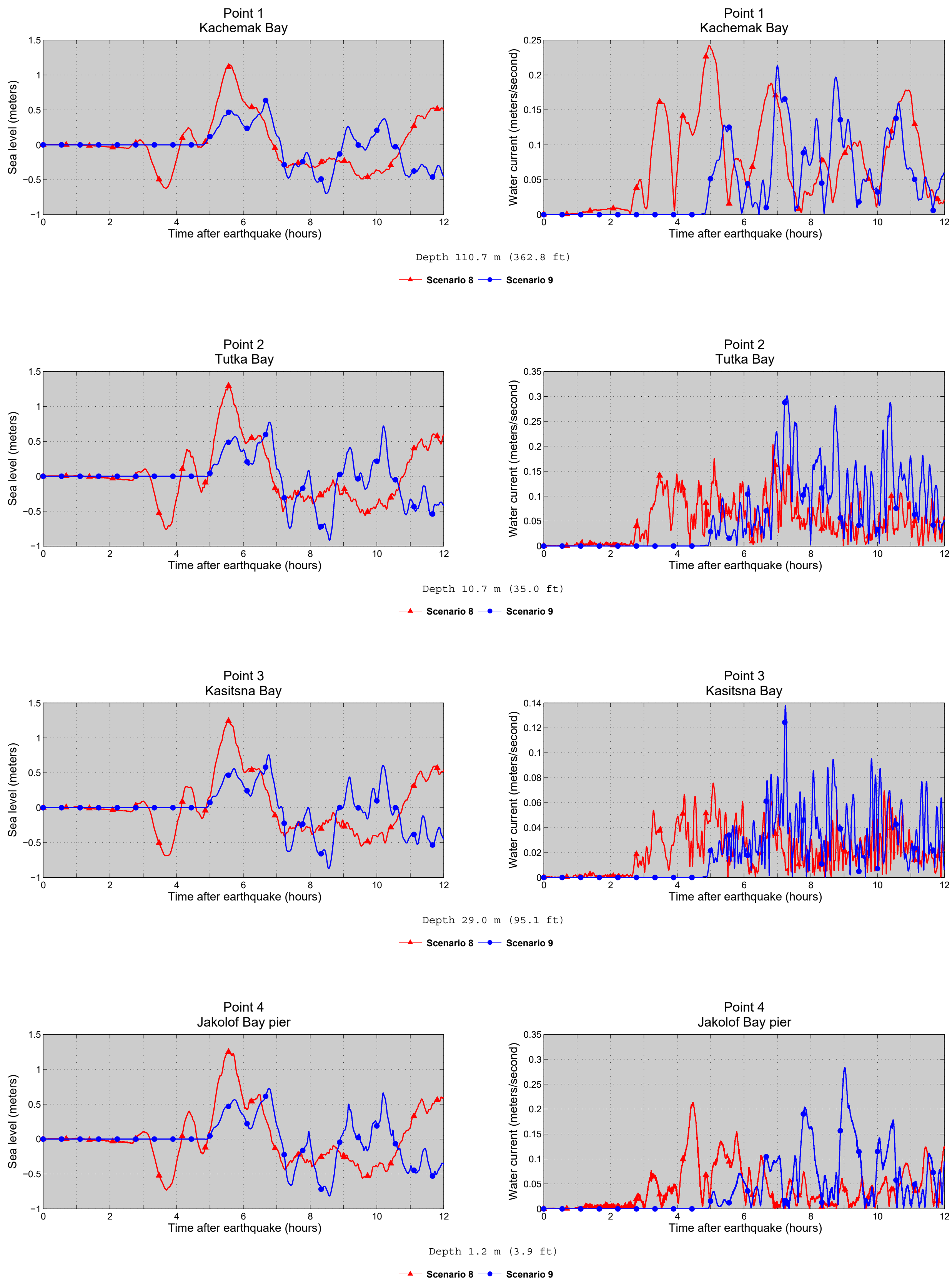


Figure A3. Time series of water level (left column) and velocity (right column) for tectonic scenarios 8 and 9 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

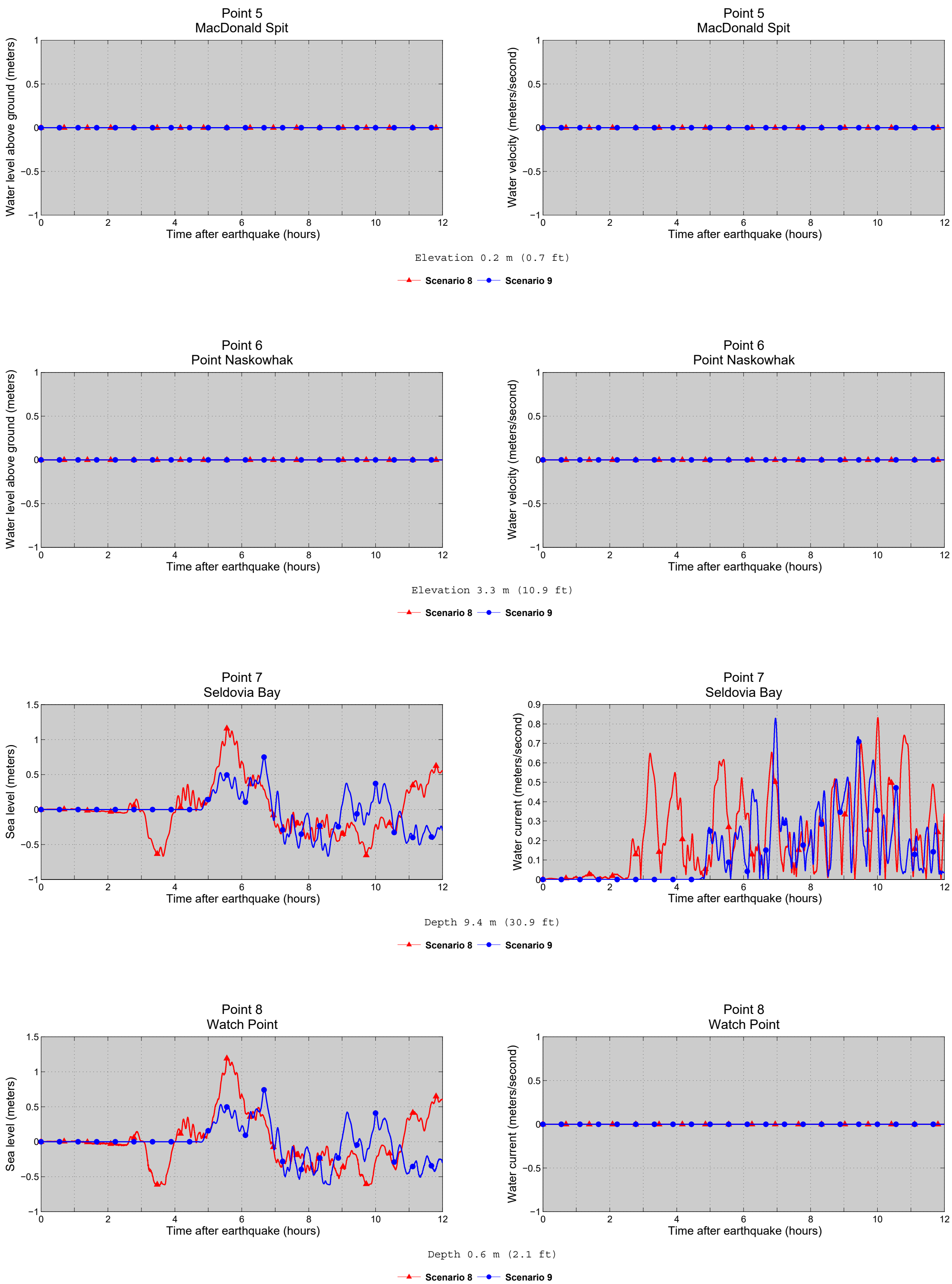
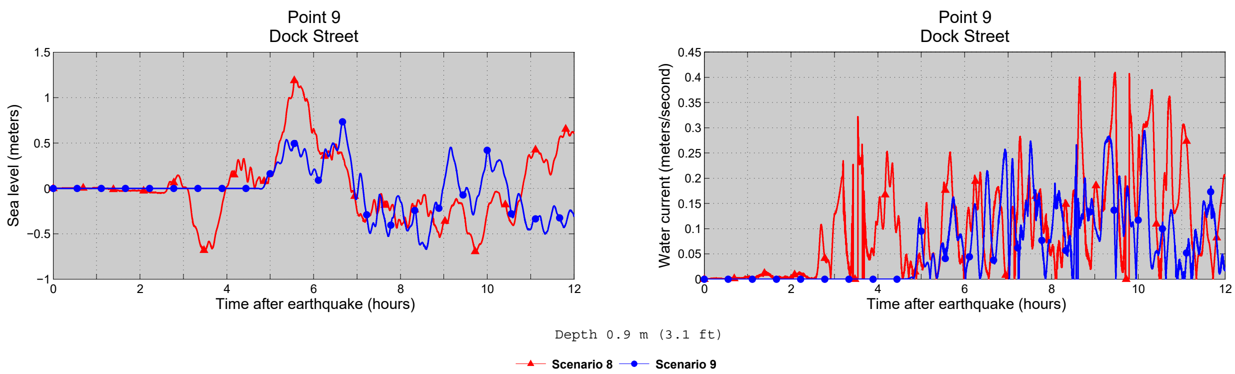
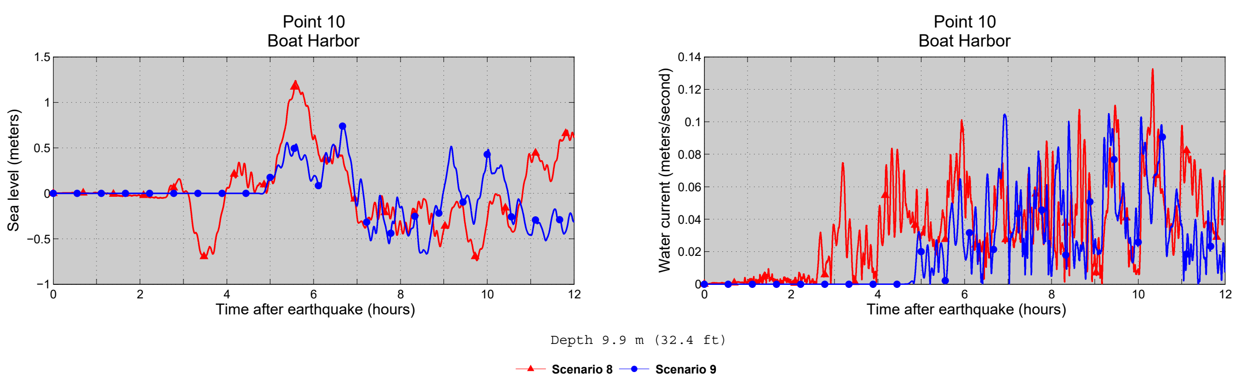
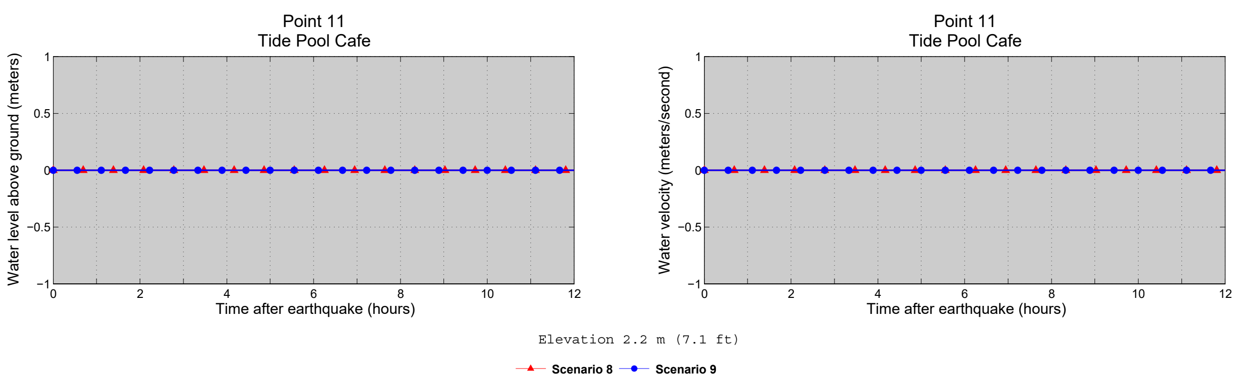


Figure A3, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 8 and 9 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.







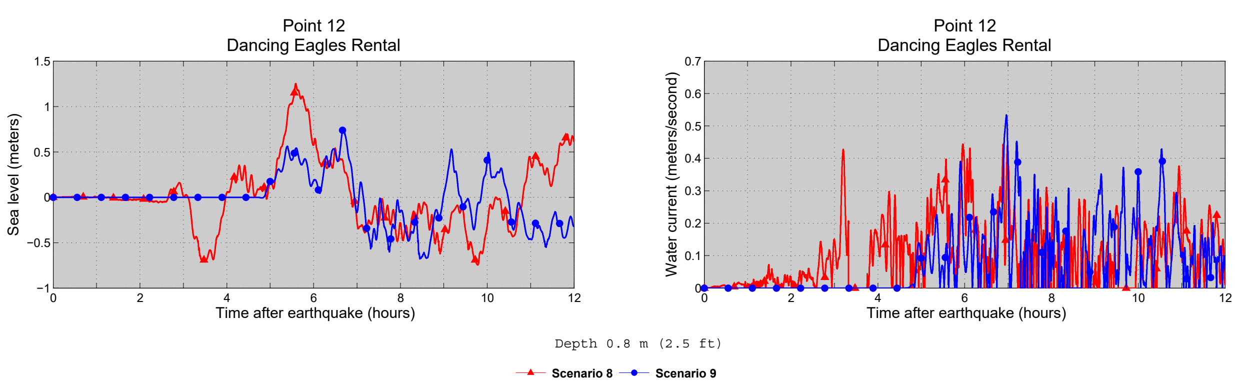


Figure A3, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 8 and 9 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.

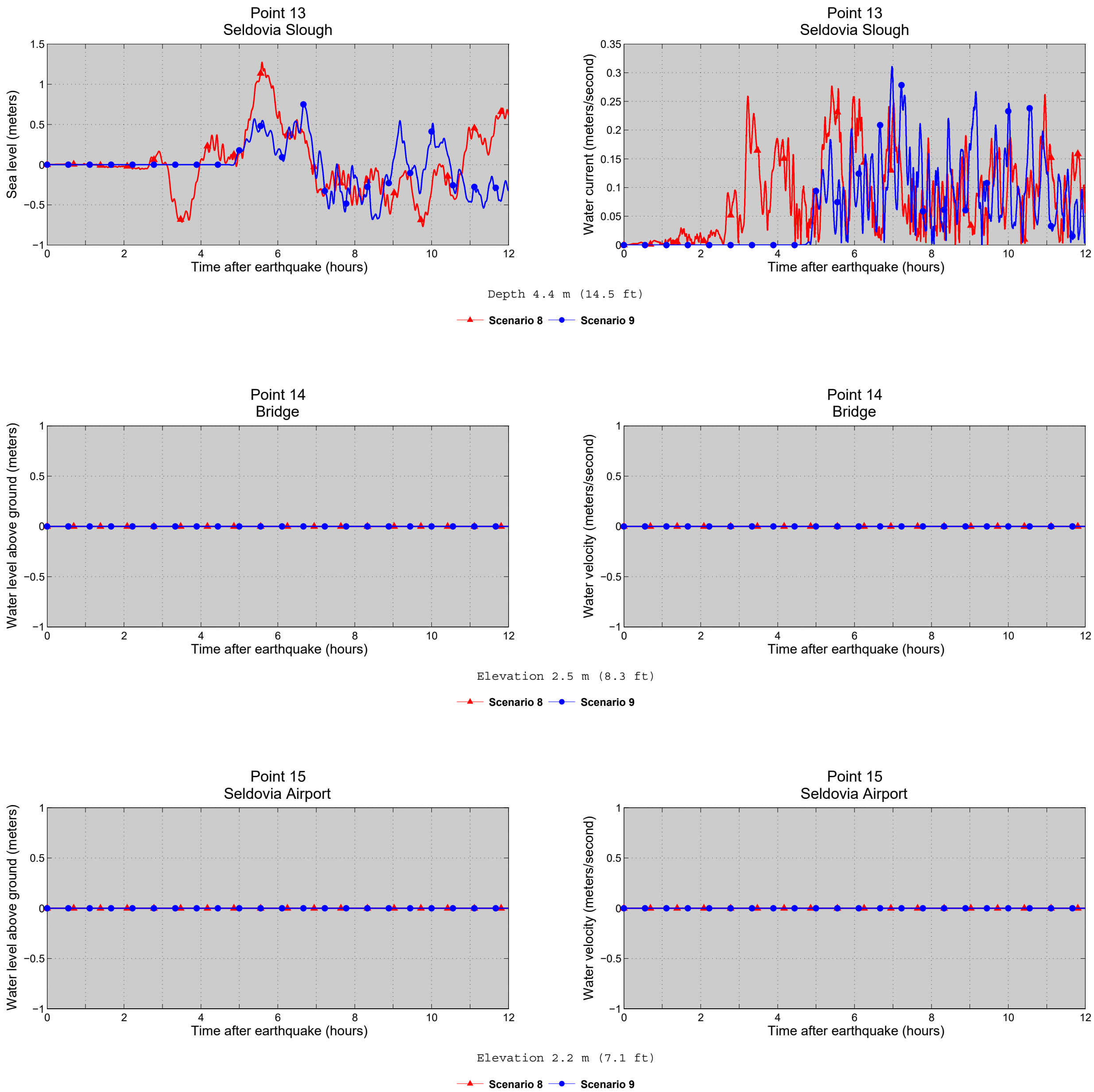


Figure A3, continued. Time series of water level (left column) and velocity (right column) for tectonic scenarios 8 and 9 at selected locations shown in figure 1 and in Suleimani and others (2018, figure B1). Elevations of onshore locations and ocean depth at offshore locations are given based on the pre-earthquake MHHW datum.