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Interactive Comment

Interactive comment on "Numerical simulations of tsunami generated by underwater volcanic explosions at Karymskoye lake (Kamchatka, Russia) and Kolumbo volcano (Aegean Sea, Greece)" *by* M. Ulvrová et al.

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We thank Prof. Pelinovsky, Prof. Papanikolaou, Dr. Konstrantinou and an ananonymous referee for constructive reviews, comments and suggestions. Here, we address one by one each Referee Comment with detailed answers and relevant Short Comments. Original referee text, if cited, is indicated in italic type. A new version of the manuscript that includes all necessary corrections is attached. For convenience of the editor, text suggested to be deleted is highlighted by red color, text to be added is

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marked in blue.

Review by Prof. Pelinovsky

There is only one minor comment in the review concerning the date of cited publication (paper by Basov et al. was published in 1981, not in 1954). This is corrected in the manuscript, cf. Page 12 Line 366.

Review by Anonymous Referee #2

Major issues

- *In section 3, authors stated that the Manning coefficient n is set to be 0.025. However, it seems that this value was not used in the following applications. In application to Karymskoye lake, n = 0.02 and 0 were used. In application to Kolumbo volcano, the Manning coefficient is not mentioned at all, although only one friction condition (no bottom friction) is shown in the caption of Fig. 7. Was n = 0.025 examined in application to Kolumbo volcano? How was the effect of the Manning coefficient in this case? The values of Manning coefficient and its effect should be described.*

  In section 3 (page 6, line 168) we state that the Manning coefficient n is around $0.025\,\mathrm{m}^{-1/3}\mathrm{s}$ (not set to be $0.025\,\mathrm{m}^{-1/3}\mathrm{s}$), also discussing its origins, pointing out some uncertainties in adapting this value. Different authors use slightly different values and $n = 0.02\,\mathrm{m}^{-1/3}\mathrm{s}$ was e.g. adapted by Wang and Liu (2007). Although the value $n = 0.02\,\mathrm{m}^{-1/3}\mathrm{s}$ is according to us well justified, for the sake of clarity,

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we recomputed simulations with the Manning coefficient $0.025\,\mathrm{m}^{-1/3}\mathrm{s}$, cf. Figure 4. This does not change our conclusions.

In Section 5.1 (page 8, lines 239-244) we conclude that the effect of bottom friction (i.e. imposing Manning coefficient larger than 0) is negligible and the importance of bottom friction is of the order of magnitude smaller than other uncertainties entering the system related e.g. to the source mechanisms. Thus, we decide to neglect the bottom friction for the Kolumbo case.

- *In application to Karymskoye lake, authors concluded that the numerical results without bottom friction explained observations better than the results with n = 0.02. However, RMS errors in Fig. 4 show that the results using n = 0.02 explain better than no friction for initial wave height $>$ 50 m.*

  In page 8 lines 239-240 we state that we observe a better global match for experiments with dissipative processes included (i.e. where we included bottom friction with non-zero Manning coefficient) compared with no friction experiments (that is indeed apparent in Figure 4 on Page 19). This is in agreement with referee conclusion.

- *In section 5.1 and Fig. 5, there are some locations that have large discrepancies between observation and simulation results. Why did these mismatches occur? I suggest that locations where runup was measured should be indicated in Fig. 5, because it is difficult to find which locations (in Fig. 1 and 3) had mismatches.*

  Indeed, we corrected Figure 5 to include location names, cf. Page 20.

  A discussion concerning some discrepancies between observation and simulation results has been added, cf. Page 8, Lines 226-235.

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Minor issues

- *6408-L16: I recommend that released energy from larger volcanic explosions should be compared as described in Sato and Taniguchi (1997) rather than the Tohoku earthquake.*

  We agree. This is corrected in the manuscript, cf. Page 7 Lines 196-199.

- *6409-L19-21: It seems that the model with n = 0.02 explains observation better than the model with no bottom friction.*

  Indeed, we agree and this is stated in the manuscript in Page 8 Lines 239-240.

- *6410-L13-16: Was the water rim height calculated using Eq. 3? This should be stated clearly here.*

  We agree. Cf. Page 8 Line 257 for corrected version.

- *6411-L23: Figs. 9 and 10 might be Figs. 9 and 11.*

  Indeed, figure numbering is mismatched here. Figures illustrating the amplitude reduction of tsunami waves on the southern coast and the wave heigh increase due to interference are Figs. 8, 9 and 10. Cf. Page 9 Line 287.

Review by Prof. Papanikolaou

- *There might be a problem regarding the degree of validity of the Lake model used for the Kolumbo volcano in open sea conditions. This would be related to the multiple reflections within the lake system in conjuction with the absence of sea waves due to wind conditions in contrast to the open sea in Kolumbo where a few meters high sea waves may occur depending on the weather conditions at specific periods of the year.*

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Indeed, in the lake scenario multiple reflections due to closed environment occur. However, these happen at timescales larger than the first and second wave arrivals. These first two waves have the largest amplitudes and field measurements record their size. Field data are insensitive to trailing waves that might be a result of multiple reflections within the lake and so we believe our model is also suitable for open sea conditions.

- *The maps given at Fig.9 do not really show the width of the flooded coastal zone because of the scale. It might be possible to change the figure and give partial maps with some zooming in the key areas.*

  We agree. Zooming is added to improve the quality of the image, cf. Figure 9 on page 24.

- *Regarding the comment by Konstantinou I think there is no possibility to assume a different location of the future Kolumbo eruption because the pre-1650 eruption occured at the same location as this is observed along the slopes of the Kolumbo crater at about 450 m depth at its northeast side (Nautilus cruise 2010) and additionally there are 4-5 previous eruptions below the present Kolumbo crater as this has been detected in the multi-channel air gun profiles by the University of Hamburg.*

  Question of location of the future Kolumbo eruption is addressed below.

Short comment by Dr. Konstantinou

- *The authors should also talk in the manuscript about the possibility of a flank eruption for the sake of completeness, even if they do not perform additional numerical simulations.*

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I do not agree with the absolute certainty of D. Papanikolaou that a flank eruption is not possible because some previous eruptions occurred very near the Columbo crater. The 1650 eruption is classified by the Smithsonian Global Volcanism database as a flank eruption and the fact that its effects were felt by the population of Thera (based on historical sources) points to the possibility that its origin was much shallower than 400-500 m. Mastin and Witter (2000) have done a global survey of submarine eruptions and found that most of these eruptions that have breached the sea surface occurred in shallow depth (meters to tens of meters). Even if we accept that the "usual" eruptive behavior of Columbo is to erupt through its central vent, I fo not think that on volcanological grounds a flank eruption can or should be excluded as a possibility.

We agree and we discuss a flank eruption in Page 8, Lines 249-255.

After discussions with Dr. Konstantinou, Prof. Papanikolaou (cf. above) and Prof. Druitt, we conclude that scenario near Santorini coast is not very well justified since there are no evidences of volcanic edifices and vent activity in this area.

References

Wang, X. and Liu, P. L.-F.: Numerical simulations of the 2004 Indian Ocean tsunamis: coastal effects, Journal of Earthquake and Tsunami, 1, 273–297, 2007.

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