

Interactive comment on “The role of diffraction effects in extreme runup inundation at Okushiri Island due to 1993 tsunami” by K. O. Kim et al.

Anonymous Referee #2

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Overview

This paper presents numerical simulations, obtained using high-resolution non-hydrostatic inundation modeling, which attempts to better understand the occurrence of the extreme runup of about 32 m height near the village of Monai in Okushiri Island, Japan, due to the 1993 Hokkaido Nansei-Oki earthquake tsunami. Using a very realistic initial condition and several nested numerical grids, a 3D hydrostatic regional model is applied to simulate tsunami wave propagation through stepwise refinement of the spatial scale and one-way dynamic nesting. The results from the regional model are transferred in an offline manner to the high-resolution inundation model with a grid of at least 10 m resolution. The modelling methodology the authors use is not novel in the sense that the authors have already tested successfully this approach to repro-

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duce other known extreme runup values from two more recent tsunamis on Japanese coasts. Considering the presence or absence of the two islands near the Monai valley, the authors compare extensively the characteristics of the 1993 Hokkaido Nansei-Oki earthquake tsunami, such as the occurrence and the time of maximum runup in the flooded area, the inundation area, water depths and velocities in the inundated zones, among others. In each case, the wave runup near Monai valley was simulated using the 3D fully nonlinear Reynolds-Averaged Navier–Stokes equations (k - ϵ turbulence closure) and very detailed bathymetry and land topography data. The results obtained in the presence of islands show convincing evidences that local coastal effects are a very important issue for numerical modelling of extremes runup values and characteristic velocities during runup and rundown phases. Given that hydrostatic models usually underestimate the modeled runup near the village of Monai, this paper presents important results for the tsunami modeling community. In particular, these results emphasize the need for high-resolution non-hydrostatic inundation modeling over steep or rapidly varying topography, when high vertical acceleration occurs.

General comments

As a first general comment, the overall presentation of this paper is well structured, clear and easy to understand by a wide and general audience. In the light of the significance of this work for subsequent investigations of local effects on tsunami-induced inundation, especially around islands or over steep topographic features, and their influence on the accuracy of actual tsunami models, this study is necessary and useful.

Though the authors do generally well in describing the overall methodology, used data and the results of their simulations, I find (i) that there is lack of information on how the runup and more generally the inundation modeling is treated with the regional model; (ii) it is regrettable that the authors did not consider running the regional model on the finest grid to see whether the increase of resolution improves the comparison with observed runup values in the region of interest; and (iii) that the authors do not discuss the potential impact on their results, had they considered using other turbulence clo-

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sure for the local model. Despite these minor points, which I expect to be commented by the authors, it should be emphasized that their approach decouples the propagation modeling and the high-resolution inundation simulation, and further provides flexibility to use input from one propagation model for several inundation coastal sites. Thus, I recommend this manuscript for publication after minor revisions. Technical corrections and suggested revisions follow.

Technical corrections (or clarifications)

1. p.6910 l.5 I find this phrase very long and suggest to either rephrase it with correct punctuation or to split it.
2. p.6913 l.26 replace "grids" by "grid cells"
3. p.6915 l.19 repetition: suppress "based...Navier-Stokes"
4. p.6915 l.21 repetition: suppress "based...hydrostatic equations"
5. p.6916 l.5-23: Though the authors focus their investigation in the Monai valley region, I do not consider the results from Domain D3 to be "fairly comparable with observed values except for the observations near Monai Valley". Figure 5 shows there is a substantial disagreement (a factor 2) way up north Monai valley and down south near Aonae town. Hence I suggest to rephrase this sentence.
6. p.6916 l.24-28 this sentence is too long; suggest splitting.
7. p.6918 l.23 subject is missing in "...as goes..."
8. p.6919 l.16 suggest to rephrase "can be in more detail"
9. p.6920 l.13 suppress "the" in the group "...in the more focussing..."
10. Figures 3,6,7 - please specify units for the color bars.

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