Review report on “Combining probability distributions of sea level variations and wave run-up to evaluate coastal flooding risks” by Ulpa Leijala et al.

Major points:

1. In page 9, it is written: “The exponential function was fitted to sea levels with a frequency of exceedance of 5 events/year or less.” Why? The frequency of exceedance of the observed data in Figure 4 is from 1/46 to about 8000 events/year. It is thought that only the data of low frequency of exceedance are used in the curve fitting because we are interested in the events of high sea level. The reason why the data of low frequency of exceedance are used should be explained.
2. In Figure 4, the maximum frequency of exceedance occurs at the sea level of -50 cm, indicating that negative storm surges frequently occur in the study area. The reason for this should be explained in the paper.
3. In page 10-11, it is written: “The wave run-up can be calculated for different percentages, e.g. as the water level exceeded 2% of the time. We set out to seek a conservative estimate for the level exceeded once during the one hour time period.” In the design of coastal defense structures, it is common to use the 2% run-up height to determine the crest freeboard. If the mean wave period is 8 s, the wave run-up exceeding 2% run-up height occurs 9 times during one hour, whereas the run-up height exceeded only once during one hour is exceeded 0.22% of the time. Therefore, taking the run-up height exceeded once during the one hour time period is too conservative from the engineering point of view.
4. In page 11, the relationship $H_{\max} = 2H_s$ is used. Longuet-Higgins (1952, J. Marine Res. 11, 246-266) presented the relationship $H_{\max} = 0.707\sqrt{\ln N}H_s$ for a storm with a relatively large number of waves N. Again, if the mean wave period is 8 s, the number of waves during one hour is 450, which gives $H_{\max} = 1.75H_s$. Therefore, the relationship $H_{\max} = 2H_s$ may be too conservative.
5. The assumption of complete wave reflection from a coastal structure (i.e. $H_{runup} = H_{\max}$) may also be a too conservative assumption. This assumption, however, could be justified if we take into account the effect of wave nonlinearity in shallow water (i.e. peaked crest and flat trough), which was not considered in this study.
6. Sorensen (2006, Basic Coastal Engineering, 3rd ed., Springer, p. 237) presented the relationship $R_p = R_s\sqrt{\ln(1/p)/2}$ where R_p is the wave run-up height of the exceedance probability p and R_s is the run-up height of the incident significant wave height as if it were a monochromatic wave. If we use $p = 0.02$ and $R_s = H_s$ (i.e. complete wave reflection), $H_{runup} = R_{2\%} = 1.4H_s$ which is 70% of the value used in this study. On the other hand, if we use $p = 0.0022$, which is the exceedance probability of the wave height exceeded only once during one hour (when the mean wave period is 8 s), $H_{runup} = R_{0.22\%} = 1.75H_s$. This changes to $H_{runup} = H_{\max}$ (using the relationship $H_{\max} = 0.707\sqrt{\ln N}H_s$), which is the same as the run-up height used in this study except that $H_{\max}$ is not calculated as $2H_s$ but as $1.75H_s$. In conclusion, to avoid too conservative estimate for wave run-up height, either $H_{runup} = 1.4H_s$ (general design standard) or $H_{runup} = 1.75H_s$ (run-up height exceeded once during one hour as taken in this study) should be used.

7. In addition to Table 1, it may be worthwhile to show the curves of F_{SL} for 2017, 2050, and 2100.
8. Two-parameter Weibull distributions are used for the sensitivity analysis. It may be better to add the fitted Weibull distributions (along with the shape and scale parameters) in Figure 5 to show that the Weibull distribution fits well the observation.

Minor points:

1. 1st line below Eq. (1): wave height >> wave run-up height