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Discussions

Interactive comment on “Spatial and temporal analysis of extreme sea level and skew surge events around the coastline of New Zealand” *by* Scott A. Stephens et al.

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Overview

The present paper addresses the spatial and temporal patterns of extreme sea levels and skew surges in New Zealand, which is interesting, not so much for providing local extreme values but rather for understanding the conditions in which such events occur. Accounting for MSLA in particular provides valuable information, and finding that the seasonal patterns of extreme sea levels follow the seasonal pattern of MSLA rather than that of astronomical tide is very interesting.

The paper is well written and structured, and the authors are well known in the field of research. Although it could be directly accepted, I have identified several ways of improving it.

Specific comments

First, the reader would probably welcome, after the introduction section, a short description of tides and surge climate in New Zealand. Is the tide semi-diurnal, with diurnal inequality, mixed…? What is the typical tidal range, let us say along both the east and west coast? What are the typical surge values? Is there a wide or a narrow continental shelf? Some of these information are provided here and there in the text, but having a good (though concise) overview before beginning the data / methodology section would help.

As regards the extrapolation technique, it looks like the sampling method is the R-largest method, not the POT one. So in this case there is no Poisson assumption, and this is generally a GEV distribution that is fitted. But maybe is it 5 values per year in average? However, I am more bothered by the choice of considering equally a direct and in indirect approach for extreme sea levels (even more when one of the co-authors has shown the differences between both approaches!). I do not really see what the results of the direct POT (or R-largest) extrapolations provide to the paper, apart from confusion.

I have seen at several occurrences the (widely spread) confusion between level, a vertical position that is always referenced to a datum such as LVD, CD or MSL, and height, a vertical distance, in m, independent of the datum (a height being a difference between two levels). In particular, comparisons between a surge (which is an extra height) and a sea or tidal level is, strictly speaking, physically meaningless. Therefore, figures and tables referring to “sea-level (m)” cannot be understood. For the purpose of this paper, it seems that the relevant physical quantities are the tidal amplitude, or semi-range (difference between tidal level and MSL), skew surge (unchanged), MSLA (unchanged) and what could be referred to as “sea-level height” (or, preferably, a better name), namely the difference between sea level and MSL. Therefore, “sea-level height” would be the sum of tidal amplitude and skew surge (which includes MSLA), and all quantities could be compared. This could be explained in the first sections, before the results.

Last, it is explained that “red-alert” forecasts are emitted to coastal and hazards managers, because extreme sea levels tend to occur in conjunction with high tides, as shown in this study. But considering the other findings of the study and the relationships with the weather types, the reader would think that it should be rather easy and straightforward to improve this warning system by combining the occurrence of high tides with the weather types prone to surges. This would be an immediate benefit of the study, and it seems strange that this possibility is not mentioned.

- l. 62: “. . . are well sampled by tide gauges”: if no seiching occurs, or, if it does occur, if the sampling rate is fine enough to characterize these LF waves

- l. 79/80: how many components for the harmonic analysis?

- l. 81: “annual and semi-annnual tides” -> “. . . components”?

- l. 82: “. . .most of the seasonal signal is actually driven by non-astronomical effects”: well, at least not directly, I believe this is a longstanding debate. . . But this is not very important.

- l. 93: this is not the best definition of return period, it would be better to speak of a 1/5 annual probability of exceedance, while highlighting the cumulative effect, year after year, and the probability of encounter in a given period of several years.

- l. 113-116: simple statistics exist for assessing the tide-surge dependence, see in particular Dixon and Tawn (1994)

- Figure 2, legend: if I understand, well, these are not the “85 extreme sea-level events” or “135 skew-surge events”, but rather the 85 (135) storms generating the extreme sea

levels (skew surges)

- l. 162/163: “ratio of maximum observed skew surge to maximum observed sea level”: only relevant if considering the elevation relative to MSL, see comment above

- Figure 3: the y-axis cannot be “sea level (m)”, but something like “surge / water height above MSL”, see comment above

- l. 169/170: same comment, is it a comparison of levels in m LVD, or of water height above MSL?

- l. 260: “despite the fact that the UK has larger tides”: yes, but laybe the ratio surge / tide is similar?

- l. 264/266: interesting information, but it is mentioned too late in the paper (see comment about a description of tide and surge climate in NZ)

- Section 4.3, §2 and 3: the logical link between the two paragraphs is not clear to me

- l. 325/326 (hourly surges), in relation with l. 336/338 (numerical models): indeed, if the total signal of surge can be accurately distinguished (sometimes very difficult with gauge measurements, hence the skew surge approach, but straightforward through numerical modelling), then much more information can be used for probabilistic extrapolation. Mazas et al. (2014) provide a POT-JPM model that works for the total signal of skew surge and hourly (or 10 min) residual as well.

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