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Discussions

Interactive comment on "Developments in large-scale coastal flood hazard mapping" *by* M. I. Vousdoukas et al.

Anonymous Referee #2

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The paper describes the development of a coastal flooding methodology that is then applied at a European Scale. Undertaking a European-wide coastal flood mapping exercise is a complex and challenging task, that is not to be underestimated. There are well known data gathering and computational challenges that arise when undertaking studies at this scale. The authors are to be congratulated for their efforts and achievement.

As with all studies of this type it is inevitable there are significant uncertainties associated with the methodology and results. Presumably the main objective of the analysis, and perhaps this could be made clearer, is to enable the relative comparison of coastal flood risk for different regions in Europe? Hence, care should be taken when interpreting the results, particularly at local scales. Given the necessary methodological limitations it is perhaps worth expanding on those limitations within the text, as dis-

cussed further here.

The approach to extreme value modelling that has been adopted involves the application of what Bruun and Tawn (1998) termed the Structure Variable Method (SVM). The SVM involves the reduction of the multivariate sea condition to a univariate distribution, of set-up in this context, thus enabling univariate extreme value methods to be applied. There are a number of known limitations associated with this approach, Bruun and Tawn (1998).

In areas where the tidal regime is significant, the coastal flood response is sensitive to the timing of peak wave conditions. Peak wave conditions occurring at low tide versus high tide can mean the difference between severe or no flooding. The SVM implicitly assumes the distribution of the timing of peak wave conditions, in relation to the astronomical tide, is explicitly defined within the historical observations. Or, in other words, the SVM does not explicitly consider the likelihood that severe storms that, by chance, peaked (in terms of wave height) at low tide, could occur at high tide. This can lead to an underestimation in the extremes. The other main limitation of the SVM is extrapolation in the region where the variable itself (set-up in this case) maybe highly non-linear. The process of extrapolation will not capture these non-linearities and hence joint probability methods are often employed instead, Bruun and Tawn (1998), Hawkes et al (2002), Wahl et al (2012) and Gouldby et al (2014), for example.

The use of wave-setup as the variable for defining the peak sea condition level is also of interest. Coastal flooding can occur through processes of wave runup and associated wave overtopping. i.e. when the dynamic water level far exceeds the still water level (including setup). So whilst the wave effects have been included in this analysis, this is only a partial inclusion that does not include the dynamic wave proceeses. It would have been possible to utilise a wave runup formula, that includes the important variable of wave period but not necessarily beach slope (for which it is understood there are data restrictions) , Stockdon et al (2006), for example, to capture the dynamic wave effects. It would be interesting to understand the rationale for the alternative that was adopted and perhaps extend the text to include this discussion.

Data limitations at this scale are well-known and the authors have overcome limitations relating to defence crest level data using a standard of protection (SOP) based approach that has been widely applied on previous studies. The choice of the 5-year SOP for areas where no defence information is available warrants further discussion. Where defences have been constructed these will often have been designed to have a standard of protection greater than 100 years. Would the methodology not therefore significantly overestimate flooding in these areas?

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