General comments:

This paper investigates several topics related to important engineering applications, such as wave overtopping combined with the probability of a higher occurrence of spectrum bimodality. The research concentrates on one specific climatic event (Winter 2013/2014) and one specific place of failure (Dawlish). The use of simplistic formulations in coastal structure designs is a vital research topic, even though computational capacities have become more powerful in recent years. Aspects such as the increased complexity of the directional spectrum and how this complex wave behavior must be included in new engineering equations is of upmost importance. However, several important aspects must be included in the analysis to help understand the physical problems and the future inclusion of these aspects in new formulations.

Firstly, I agree with most of the comments mentioned by the reviewer that highlight the need to understand and include other marine dynamics such as storm surges, astronomical tides, beach configuration and even sea level rise (see Dawson et al, 2016). I also agree that it is important to perform the analysis including not only the wave bimodality but also other wave components in the directional spectrum (e.g. the significant swell component mentioned by the reviewer or even other complex systems). To investigate this clearly, it is necessary to perform an analysis for different extreme events that includes the conditions mentioned above combined with a more complex understanding of atmospheric (spatial wind patterns, synoptic charts through the storm track) and wave dynamics in the research area (spatial behavior of main wave parameters such as Significant wave height for sea and swell systems, peak periods, peak directions, directional spectrum, among others).

Bimodality of the spectrum has a strong connection with local and far from climate conditions (local sea and far from swell systems), strong influence in the evolution of the spectrum of the no linear wave-wave interactions was observed. Local wind direction and main peak directions and frequencies of the directional spectrum might be very important in the analysis of bimodality. But the research does not consider any kind of directional analysis of the ocean waves reaching the research area. Despite the well-known difficulties obtaining the directional spectrum, I consider that it is important to try to include this aspect. As we know directionality (even in a simple form – using angle of wave attack) is very important for most of the empirical formulations of wave overtopping. It is known that the wave pressure and overtopping for obliquely incident waves are smaller than those for normally incident waves.

All the comments mentioned above might be useful to find the **main characteristics** of wave bimodality (when compare with other wave conditions) in combination with

other marine dynamics that increase the probability of coastal flooding and will be a strong scientific contribution.

Some minor comments and some related to the topics mentioned above are shown below:

Specific comments through the manuscript:

1) **Line 24:** Please include other scientific references confirming this behavior. Include the paper called Computational Investigation of the Effects of Bimodal Seas on Wave Overtopping by Thompson et al. (2016).
2) Wave buoy data section. **Comment:** Please consider including a brief description of the study area, and please include a description of the general climate during the year. What about the Met Office's network of Marine Automatic Weather Stations (MAWS) consisting of 11 moored buoys?
3) Figure 1. Please include more details on this figure: coordinates, names, a map with a general location, etc. A map showing the continental shelf (including bathymetry) might be useful given the importance of this area on wave process. Please use a more detailed title that includes the research area. Please describe more details about the spectrum construction. Some instrumental buoys present several drawbacks related with these estimations. Please include the names of the buoys employed for the main analysis in Looe Bay (Section 1), Dawlish (Section 2) and Rustington (Section 3).
4) Partitioning method. Given the possible differences between the partitioning methods, please explain why you not did use other partitioning methods.
5) In the manuscript, the following asseveration is included: *The method does not classify multi-peak spectra (more than two peaks). If the algorithm is unable to choose a suitable separation frequency, the spectrum is flagged and the separation frequency chosen manually (by eye).* Given these drawbacks why were other methods not tested?
6) Figure 3. Please include the energy spectrum units (m^2/Hz)
7) Title **3 Winter 2013/2014.** Please consider having a more clear title for this section, e.g. Description of climatology during the 2013/2014 winter season.
8) In the next text: The purpose of providing Table 4 in this data analysis is to highlight the overall contribution coastal flooding played to the total damage caused by the winter storms. **Comment:** This is the main reason why the climate must be explained briefly in the study area section proposed.
9) In the text: Significant wave height and energy content. **Comment:** Please explain the concept employed for energy content. The connection between Psc and energy content is not clear. Please explain the exact definition of energy content.
10) In general: Please include in the Figures all the places mentioned throughout the paper.

11) Figure 4. Please improve the quality of this figure. Try to add the coordinates in latitude and longitude. Please try to edit the original Synoptic chart to increase the quality of the coastline using another color or line style. Please add the bottom boarder line of the figure. Is possible to add the evolution of the storm toward the research area for different dates? See the following link as an example. http://www.mwis.org.uk/synoptic-charts.

12) In the text: In Section 1, Hm0 increases slightly with the arrival of the storm. **Comment:** Please clarify this analysis. The exact date of this analysis is not clear. A joint analysis of storm track information and wave parameters must be performed clearly.

13) In the text: unrealistically large wave heights are detected from the 5th February in Section 1. **Comment:** Please discuss the reason why this behavior (Unrealistically large wave heights) is not observed in the Perranporth location. I suggest including information about the track of the storm and some directional information about the ocean waves. The direction of the swell pattern traveling toward the research area can be very important for wave evolution through time. The evolution of storm direction can help to explain this behavior.

14) In the text: Porthleven experienced the greatest increase in energy content during the first day of the storm, 3rd February. The buoy at Perranporth detected the largest increase in energy content on the second day, 4th February. **Comment:** with a low value when compared to Porthleven. Try to discuss the relationship with the buoy location.

15) In the text: Perranporth wave buoy is the only buoy located on the northern tip of the south-west. The location explains the observed differences in conditions and is the only location that detected a continued increase in wave height and period on the second day of the storm. The results for Section 1 suggest locations along the northern tip of the south-west coast are more exposed to severe and prolonged wave conditions generated by storms with a track similar to the one in this period. **Comment:** This is one of the most important topics. For that reason, the quality of the discussion could be increased if a pattern of the spatial wave and storm evolution could be included in the paper. This would help to understand wave transformation toward the research area (other physical processes can be explained better).

16) In the text: Extensive damage occurred in Section 2 at Dawlish during this storm period, where key railway protection infrastructure along the beach collapsed on the evening of 3 rd and night of 4th February. **Comment:** Is it possible to include some damage photographs? During this event strong winds were observed, so please consider including some wind patterns (scatterometers could be a good option).

17) In the text: In the days leading up to the collapse, high peak wave periods (9 s - 20 s) and swell components (35%-25 45%) are observed. Comment: Please consider putting “were”.

18) In the text: Sibley et al., (2015) suggested that it was the south-southeast wind generated waves in the English Channel. **Comment:** Please consider putting the name of the channel in Figure 1.

19) In the text: A reason for the decrease in Psc could be associated with the arrival of the storm and strong local winds creating locally generated wind waves with high energy. **Comment:** If the local wind waves are very important, please consider including some information about local wind (magnitude, direction, spatial maps, among others).

20) Figures 5, 6 and 7: Please increase the quality of these Figures. As the y axis is too narrow, it is difficult to read the values. Some values look incomplete (cut off at the top of the figure). Discuss the evolution using exact values.

21) Have you considered showing the evolution of the unidirectional spectrum by showing the evolution of the sea and swell simultaneously through time?.

22) Historical comparison: Explain why these months were selected for the analysis. This topic supports the importance of a study area section when the main climatological aspects in the research area must be discussed. A discussion of the annual cycle or stormy season during the year can be helpful. The estimation of the Psc during the month is not clear, please explain better.

23) In the text: Bimodality during the winter period of 2013/2014 was frequent for both Dawlish and Rustington. Comment: Looe bay has similar behavior; please consider including it in the analysis.

24) In the text: Rustington, located in Section 3 and in the south-east UK could be considered to be less likely to be subjected to swell as its location further east in the English Channel provides greater opportunity for swell waves to be refracted and diffracted towards the shore before penetrating further up the Channel. **Comment:** This confirms the importance of using an ocean wave model like SWAN or WWIII to model the spatial behavior of the wind waves during these dates.

25) In the text: Bimodality during the winter period of 2013/2014 was frequent for both Dawlish and Rustington: **Comment:** Please try to connect the fact that for Dawlish the highest percentage of bimodality was observed during February 2013/2014 when compared with the other years and the fact that the sea wall collapsed during this month. A technical discussion could be very useful. Why does bimodality increase the failure probability? Looe bay has similar behavior; please consider including it in the analysis. The connection between bimodality and failure probability is not clear. Is there other evidence of bimodality and the failure of other structures?

26) In the text: As seen in Fig. 9, the mean Psc and the probability of bimodal occurrence is higher at Looe Bay than Dawlish in Section 2 and Rustington in Section 3. The highest mean Psc is observed during the 2013 - 2014 winter storms with high values of Psc throughout December to March (27% -37%) and the highest mean value of Psc over all the years being in February 2014.

Comment: This conclusion is not totally clear when comparing Looe Bay and Rustington; please verify.

References:

Dawson, D., Shaw, J and Gehrels, W., 2016. Sea level rise impacts on transport infrastructure: The notorious case of the coastal railway line at Dawlish, England. Journal of Transport Geography 51 (2016) 97–109.