Referee review of the research article submitted to NHESS, titled: ”**Statistical properties of coastal long waves analysed through sea-level time-gradient functions: Exemplary analysis of the Siracusa, Italy, tide-gauge data”** by L. Bressan and S. Tinti, MS No.: nhess-2015-220

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General Comments

The article submitted by the authors presents a new method of analysis of the low frequency characteristics of extended duration sea level data gathered at relatively high frequency. The approach uses both spectral and statistical distribution functions matching to characterize the predominant and prevailing wave frequencies in the infragravity band. Four new sea level parameters for the infragravity range are defined by the authors. Using them, power density spectra are derived and averaged over monthly, yearly and total analyzed measurement period at a rate of 5 seconds sampling interval (more than 2 years). The proposed methodology requires carrying a “calibration study” for each study site, in order to choose the “constants values” for the four sea level functions.

In author’s opinion, the presented new method is somewhat cumbersome, relative to using methods of normal FFT power spectral analysis of the sea level data used in each burst and their spectral separation in a number of frequency ranges covering the infragravity range of the measured data, e.g. such as done by Rosen and Raskin (1996a,b;1997; 1999; 2003) for the characterization of the long waves in Haifa port, Israel, used for the design and modelling of the port expansion. There, the frequency domain was divided there in 4 specific ranges, covering the gravity range (2 sec to 20 sec), and 3 infragravity waves ranges (1/3’ – 1’; 1’-4’; 4’-8’). A 5th range from 8’ to 30’ was not considered at the time necessary for the port design, as the terms of reference were specified in late 1993, before the awareness on tsunami hazard in the region was achieved by the port authorities only during the last part of the 1st decade of this century. The energy in each frequency range was used to define quasi-“significant” wave heights representing the wave energy in each range. Then the data gathered in each 2 hours over 2048 samples at 2 sec sampling interval were used to build up a database of heights vs peak period in each range and perform statistical joint and marginal distributions on monthly, seasonal and yearly bases.

The methodology proposed and implemented by the authors of the submitted article and implemented for a case site (port Targia, close to Siracusa, Italy), provides an alternative means to characterize the infragravity waves range for any site, based on the sea level measured as described in the article. However, it does not provide any insight as to the sources of the various low frequency waves detected by the analysis. This consists a drawback in author’s opinion, as not only tsunami or meteo-tsunami waves may occur in the infragravity range, but also edge waves, seiche and surf beat induced wave groups with increased energy due to non-linear transfer, during the shoaling and breaking process of wind waves (both sea and swell) from the high frequency to the infragravity range can be encountered. This would then make difficult, if not impossible, to relate a certain long period event to the arrival of a tsunami wave (unless seismic information of an earthquake can be linked to it in near real time), or if such analysis would be accompanied by monitoring of additional physical parameters at low latency and their real time analysis, such as atmospheric pressure, currents, wind, as well as the gravity range of the sea level spectrum, such the way proposed by Rosen (2007) and Rosen and Raz (2011).

Specific Comments

P. 5248, L. 24: I suggest to add to the references that of Wiegel (1964). His book was to my knowledge the first to cover all tsunami, surge and harbor oscillations (called also Helmholtz resonance) and is yet one of the best oceanographic engineering handbooks available. He also differentiates between seiche, which is attributed to natural phenomena in bays and harbor oscillations, due to resonance of certain frequency period(s) as well as the presence of higher frequency modes.

P.5249,L.4: Again Wiegel (1964) covered earlier than Miles (1974) the subject and quite extensively. I also do not agree with the sentence that: “the main goal of coastal engineers is to design harbor structures tha are prone to free modes excitation”. It is not the main goal as far as I know. The main goal in harbor and port design is to design breakwaters and wharves and quays that are able to withstand the meteo-marine induced wave and current conditions and design the berths and quays such that the moored vessel movements of various types would enable sufficient yearly operability of the vessels at berth during loading or unloading operation (by proper dimensioning and structuring of the port facilities and improved mooring and fendering systems).

P.5255, L.3: The JONSWAP was derived for the North Sea and was adopted also for other places but not for shallow water, where transfer of wind induced waves energy moves due to shoaling and friction from the gravity range to the infragravity range. A rephrasing would be appropriate.

P. 5256, L.23 and further after: The authors searched for some statistical distributions which would fit the 4 sea level functions defined for the long infragravity range. The relationship with the gravity range of these functions is completely disregarded, though there must be a clear relationship for any specific site and sea state. The fitting becomes pure statistical curve fitting although successful exercises, but perhaps other distributions could be found to better describe the data, such as log-hyperbolic one. As indicated by the reviewer, he believes that a simpler, more direct and cleared description for the characterization of the long waves characteristics would be using joint and marginal statistics of the spectral energy and spectral peaks in a number of frequency ranges (2”-20”; 20”-1’; 1’- 4’; 4’-8’, 8’-30’) and relation of the spectral energy in each range to the total energy over the whole ranges.

P. 5265, L.1 and below: The authors refer to the TEDA method devised by them. It would be appropriate to mention that there have been additional methods proposed and even implemented for fast detection of tsunami from sea level records, e.g. Wei (2003), Rosen (2007), Di Risio and Beltrami (2014), Perez Gomez (2014).

Technical Comments and remarks

P.5250, L.15: and below: Suggest to add a schematic figure showing the 4 sea level functions defined.

P.5251, L.1: the definition of “generic sea level height” is in my view not properly defined. Such a definition is not a standard definition term and should be better explained in my opinion.

P.5252, L.13 and below: The de-tiding method is in fact removing the DC signal, but in case of the presence of wave groups might remove also some of their infragravity energy, particularly during stormy states of long swells arriving to the shore. Thus, it is not clear why de-tiding is not performed by removing from the measured sea level a tide forecast derived via harmonic analysis in advance.

P.5254, L.1 and below: The spectral analysis performed is not detailed sufficiently in my view. It is described that it was done in a way as indicated by Welch (1967) but there is missing clear information regarding the sample size (was it data sampled each 5 sec over 1 hour, i.e. 720 data, or a 12 hours window covering the prior 11 hours and the last 1 hour data, i.e. 14400 data samples per burst) and the smoothing method, i.e. the number of degrees of freedom used, etc.

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