Wave field is often required because of its importance for a variety of applications in a sea state including coastal engineering (design, planification, exploitation and maintenance of a maritime structure, sediment transport, beach erosion), offshore industry, safety in the sea, navigation route, above all on Catalan coast, where sea state is so important.

Wave spectrum is one of the most usual forms to describe the irregular wave properties showing how energy waves is distributed over a range of frequencies and directions: energy distribution ($m^2 \cdot s$ ó m^2/Hz) over frequencies is represented by one-dimensional energy spectral density function $S(\omega)$, and energy distribution over directions is called angular spreading function $D(\omega, \theta)$.

Using measurements from Cabo Tortosa buoy, situated on the southern Catalan coast, wave spectra are characterized for some storms: two different meteorological phenomenons happened, first one, between 8th and 20th of November 2001 (with significant waves until 6 metres), and the second one, between 27th and 6th of April 2002. In these two periods, we could differentiate its peaks, which will be specially studied by one-dimensional and directional spectra, related to *sea* waves (wind driven conditions) or swell (free conditions).

This study has detected a parallel structure on these two storms because two different peak periods exist, and bimodal wave conditions are important (it means waves coming from different directions and different frequencies at the same time).

An exhaustive study has been carried out about approximation models fitting sea states. After *sea* or swell wave divisions, it is possible to realise errors because of using mean or non-directional approximations, so it is necessary to use multimodal and directional theory (more difficult to find) because this theory represents better real situations that could be hap on a coast. The introduction of free shape - directional spectrum will help to solve errors because unimodal non-directional distributions cannot describe, at a given frequency, waves components coming from different directions, and on this work has been shown bimodality importance on Mediterranean Sea on heavy storms.

As it has been observed, the main reasons that cause bad approximations of the studied models over real sea states are: bimodality and *sea*-swell interactions (swell refracts *sea* waves), difference on direction between *sea* waves and wind in contrast with hypothesis of models (wind and *sea* waves directions are the same) and bimodal directional spreading of *sea* waves at frequencies of approximately twice the peak frequency.

On the other hand, parameters like wave age and spectral width have been studied, the first one is related to wind energy and, the second one, is related to the energy distribution around energy density peak. These factors are important because they can improve numerical simulations used like engineering tools. It has been shown that observed width parameter values are different from theoretical values from the state of art, specially influenced by bimodality.

Finally, showing engineering side, this work has been related to different applications. The first one is related to the longshore sediment transport and the second one is related to the necessity of sea state knowledge for the responses of maritime structures to directional waves.