Characterization of storm generating zones for wave climate assessment

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The wave climate (at specific locations) is in general specified by integral wave parameters as wave height, wave period, and mean direction, or more completely with statistics over the whole spectrum. The main purpose of this work is to extend this information to include parameters of individual wave systems (partitions) and also estimates of the generating meteorological events. The later consist mainly of wind speed and direction at the origin location, and path trajectories. This extra information is important in many aspects a) for model evaluation for instance, the analysis of the wave evolution from the generation location up to the analysis point allows for a much more robust comparison. b) Complementary, the collocation of model and satellite data is more consistent if origin/propagation information is available. c) The study of wave features that depend on the trajectory (e.g., swell dissipation) is facilitated. d) Geographical aspects for wave modelling such as the geographical domain and generation zones can be better understood and assessed. d) Background errors for data assimilation systems can be computed in a more precise (ad-hoc) manner, etc.

It is well known that information about the generating storms can be derived to some extent from time series of wave spectral data, by exploiting the dispersive behavior of swells [1,2,3]. At certain location, longer waves arrive first followed by shorter waves, and this information is carried by the peak frequency. A challenging aspect is the fact that storms are moving atmospheric events. Therefore, a single storm can *send* waves, to a specific location, from different positions at different times. In order to tackle this aspect, in this study, the storm-search procedure is further elaborated 1) by introducing a partitioning analysis. The advantage is that wave systems that overlap in time can be discerned better in the partitioned spectrum than, either in the whole spectrum (fig. 1), or in the 1D spectrum series (fig. 2), providing thus more precise information about arrival times. 2) Further, the statistical characteristics of the (peak frequency) time series contain also extra information. In this case, the confidence intervals of the regression slopes suggest the geographical and temporal ranges where the storm took place. 3) Finally, the location parameters are refined using a triangulation approach, for this, we use spectra from three different points of the same arrival area.
As byproduct, the clustering of peak frequency points, according to their dispersion patterns, happens to be an excellent and simple criterion to associate partitions (in time) with particular wave systems (fig. 3). It is worth noting that this has been an issue already prompted by Gerling, [4].

References

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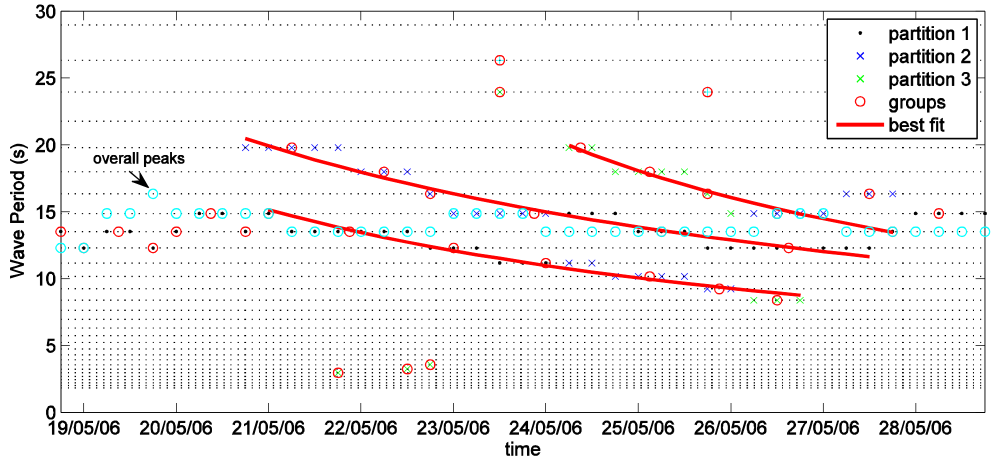

Figure 1. Peak frequency of partitions

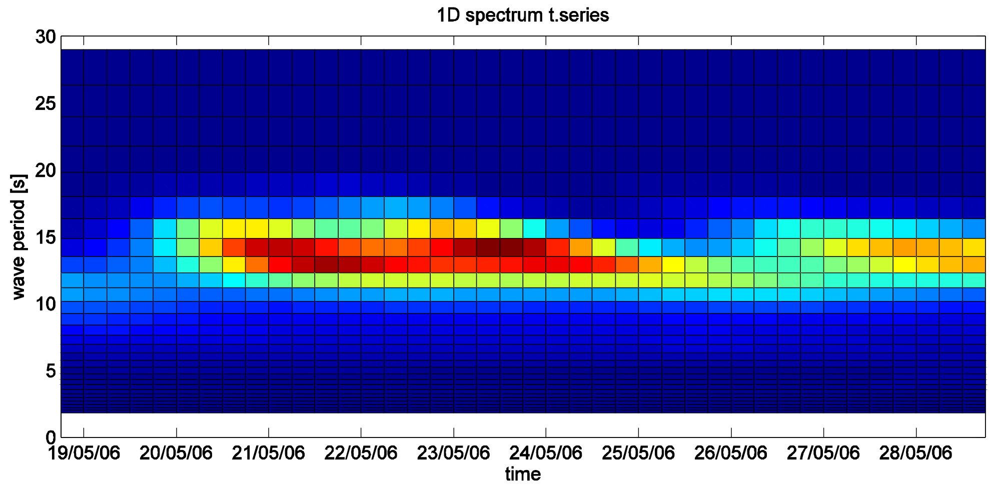

Figure 2. 1D spectrum time series

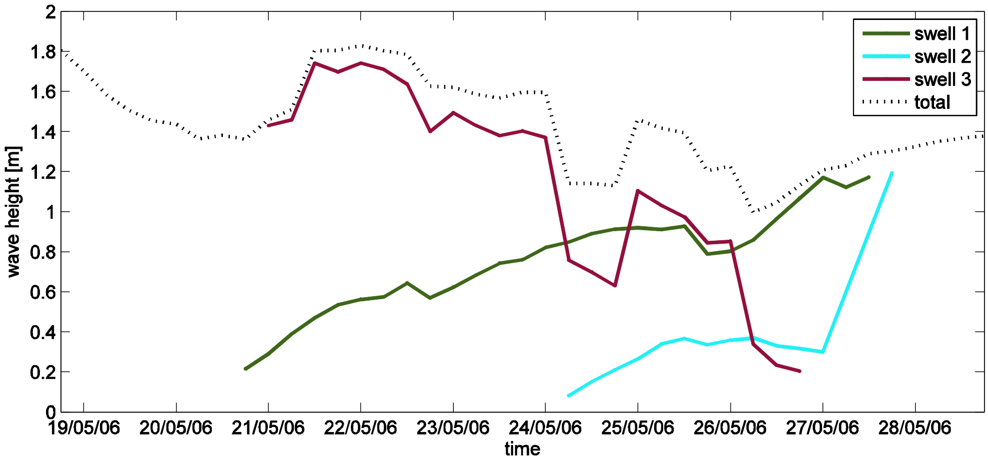

Figure 3. Wave height time series