



## DISCUSSION

### Discussion of: Skyum *et al.*, 1996. Hyperbolic Distributed Wind, Sea Level and Wave Data, *Journal of Coastal Research*, 12(4), 883-889.

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#### INTRODUCTION

We found this paper to be fascinating stuff and very thought-provoking, and in our experience very original. We have read the paper over and over again, but still we find their data and conclusions somewhat puzzling, at least in some respects. For example, we were surprised that the authors' that: "it is well known that wave induced forces . . . arise from pressure, velocities and accelerations, all of which are proportional to wave height and depend on the wave period." As we understand it, wave force, or power, is proportional to  $H^2 \times T^2$  and not  $H$  and  $T$  alone, and wave pressure is proportional to  $V^2$ , and not just  $V$ . However, this we think, is really an irrelevant detail and only a casual statement as compared with the authors' more serious interest in the predictive problems of addressing joint distributions, for example of wave height and period, but also addressing other coastal parameters such as coastal wind speed and water levels.

#### THE HYPERBOLIC DISTRIBUTION

The most absorbing feature of the authors' paper is their use of the hyperbolic probability distribution for analyzing coastal processes instead of the usual coastal engineering sequence of the Gaussian, log-normal, Weibull, Gumbel and log-Gumbel distributions. But the authors make a very convincing case in the support of their selected distribution, and a case that might lead to a great deal of re-thinking about coastal process probabilities, as currently considered. In particular, the authors' data-point plots of their Figures 4, 5, 6, 7 and 10 demonstrate a remarkably good close fit to their deduced hyperbolic distributions, particularly over the peak "hump" of all the plots.

#### THE IMPACT OF TAILS

On the other hand, our puzzlement, when reading the paper, lies with the fact that all the good data-point fits are all nearly entirely within the peak hump zones, apart from Figure 7, which has perhaps two data points near the

right-hand tail, there are no tail data points anywhere, and indeed by definition, the hyperbolic distribution, as shown in Figure 2, does not have any tails anyway. It does not taper out to an asymptote to the base of the plot on either side of the curves as do traditional parabolic and skew parabolic distributions, as enumerated above. Yet it remains that these traditional parabolic distributions, from Gaussian to Log-Gumbel, have a long record of successful application for describing the variability of natural processes. Perhaps we might explain our confusion, by taking a single example. In Figure 5, the authors plot their data points to a suite of sea-level readings and show that the points fit their parabolic distribution, but then demonstrate that the data points do not fit the Gaussian distribution by plotting the Gaussian distribution apparently as a hyperbola instead of a standard "bell-shape" with tails.

#### THE HYPERBOLIC CUT-OFF

The final feature, that from our reading of the paper, again causes us confusion is not so much that the hyperbolic distribution does not have any asymptotic tails (see Figure 2) but that in the absence of tails, the distributions demonstrate very specific maximum and minimum parameter values, there is just no end uncertainty at all, see for example Figures 5, 7, and 10. The authors' hyperbolic data fits are still extremely convincing, but they rather go against the grain of all our past experience with natural process probabilities. To help us, perhaps the authors could explain why their natural data were encapsulated between precise maxima and minima and what were the physical explanations of this.

#### THE BIVARIATE PLOT

As a postscript we note that we do not really understand what message to the authors' Figure 8 is designed to expound. Down here on the Gold Coast of Queensland, Australia, we have always found that any plot of wave height against period, produces a wide "mess" nearly all over the plot, and often worse looking than their Figure 8. Thus, to

avoid this random “mess,” we have simply abandoned this class of plot from all our work, and instead we analyze our field and design data based only upon wave energy, *i.e.*  $H^2 \times T^2$ , instead. We might suggest that the authors may find, as

we have, that they can, in fact, describe their coastal actions and responses in terms of energy directly and never have to work with wave H and T individual interactions, or make bivariate plots of them at all.