EXTREMES OF WAVES MEASURED BY A WAVERIDER BUOY AND VERTICAL LASERS

Anne Karin Magnusson
Norwegian Meteorological Institute, Bergen, Norway

Mark A. Donelan
Rosenstiel School of Marine and Atmospheric Science, University of Miami, USA

Abstract for Rogue waves 2000 workshop, Brest, 29 - 30 November

Extreme wave crests have been of special interest for fixed platforms, since their designs are directly connected to the crest heights and the water velocities in such waves. Some activities on the platforms also depend on what crest heights can be expected in a given sea state while in operation. Extreme statistics are usually made from point measurements, but waves often appear in wave groups. Due to the dispersive nature of the waves, these groups can have different maximum crests at different positions along the direction of travel. In a paper by Magnusson, Donelan and Drennan, C.Eng. 1999, (*'On estimating extremes in an evolving wave field'*), time series from a waverider were evolved using linear propagation and assuming unidirectionality. The waverider data were also corrected for the buoy's quasi-Lagrangian behaviour. The effect on estimating extremes was demonstrated. On average, evolving 150 original records increased the maximum crest to trough value in each record by about 10%, and the maximum crest height by 17%. But maximum increases were seen to be up to 30 and 50% respectively. Wave forces, being proportional to the horizontal velocity squared, were found to increase by 50%. Correcting for the quasi-Lagrangian behaviour of the buoy decreased the mean water level by 8% of the standard deviation of surface elevation, showing that the uncorrected buoys report too low crest heights above mean water level.

In this work we look at simultaneous measurements taken from the waverider and vertical lasers at the same location. New storms are analysed. The effect of buoy correction is discussed and the propagation effect on statistics of highest crests and wave heights from all instruments is presented. Once the corrections are made skewness and steepness values from the buoy are seen to converge toward laser measurements.

An example is given in the figure hereunder. An original record from the waverider is in the middle panel, while the bottom panel shows this record after correction for the quasi-Lagrangian behaviour of the buoy. Forward crest steepness is .34 for the highest crest measured by a laser in this particular storm (top panel). The measurement with the waverider is .23, and becomes .32 after correction. Crest height is in this case hardly increased, and is far from the highest crest measured by the laser (11.5 compared to 14.4m).

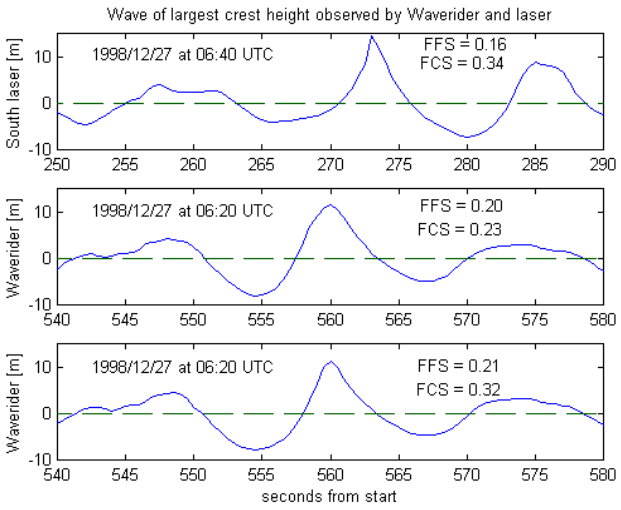

Figure 1. Wave with highest crest measured in a particular storm by a vertical laser (top panel) and a waverider (middle panel). Bottom panel shows the waverider crest after correction for the quasi-Lagrangian behaviour of the buoy. FFS and FCS are forward face steepness and forward crest steepness, defined in paper.