JERICHO PROJECT REPORT - POL contribution (June-September 1998)

Jericho Technical Report 03 J.Wolf (July 1998)

1. Introduction

The present phase has consisted of setting up some fine-scale coastal wave models on 3 grids, with bathymetric data supplied by Halcrow. The wave model is the SWAN model (Booij et al, 1998; Ris et al, 1998). The depth data has been supplied on a 200m grid for 3 coastal sites, with an extent of about 20km in the offshore direction and about 60km in the longshore direction. The three sites selected were Holderness, Lyme Bay and Carmarthern Bay as agreed at the last JERICHO meeting. Some idealised test cases have been run on the Holderness grid, in particular to test the optimum method for specification of the cross-shore boundary condition. The model has been run on a Unix Workstation and on a Pentium PC.

2. Activities

(b) The depths supplied by Halcrow were checked, some discrepancies in the digitisation for Carmarthen Bay were detected, this was then rectified by Halcrow. The depths now appear OK.

(c) The depths were reformatted to be read into the SWAN model.

(d) The Holderness grid with selected output locations at N1, N2 and N3 has been set up.

(e) The SWAN model has also been run with an idealised bathymetry, using waves of Hs=3.5m at the offshore boundary, with wind and all terms switched on in the model, to investigate the effects of cross-shore boundary conditions. The model depths were on a rectangle, of similar dimensions to the Holderness model, using a cross-shore depth profile equivalent to that along the line N1 to N3.

(f) Waverider data for the Holderness experiment from stations N1, N2 and N3 have been sent to David Cotton for inclusion in the inventory. Further information on water levels and currents are also available for this experiment if required.

3. Model grids

The contoured depths on the three grids are shown in Figures 1-3. Contours are at 10m intervals except for Lyme Bay which is 5m intervals.

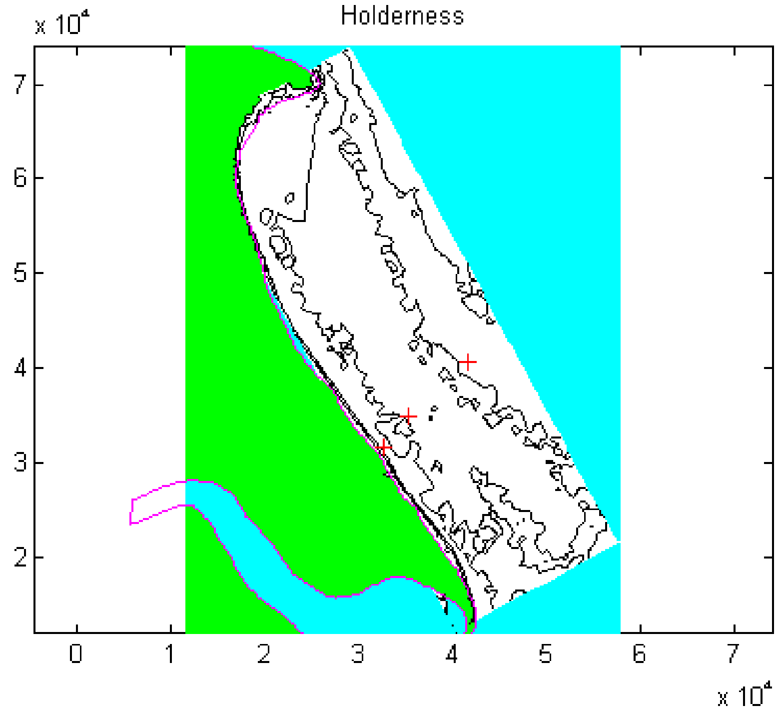


Figure 1: Holderness

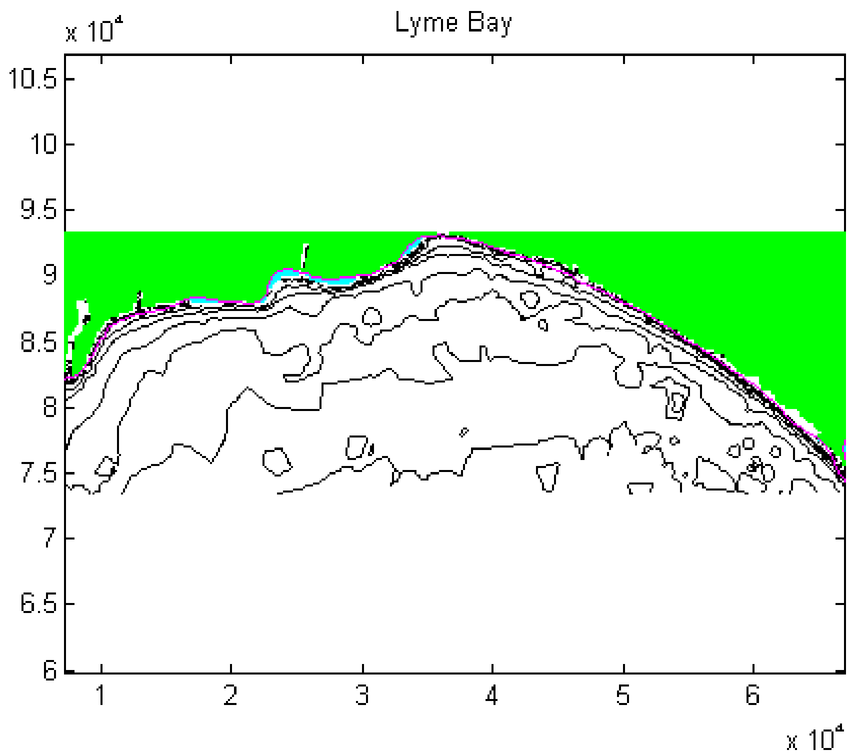


Figure 2: Lyme Bay

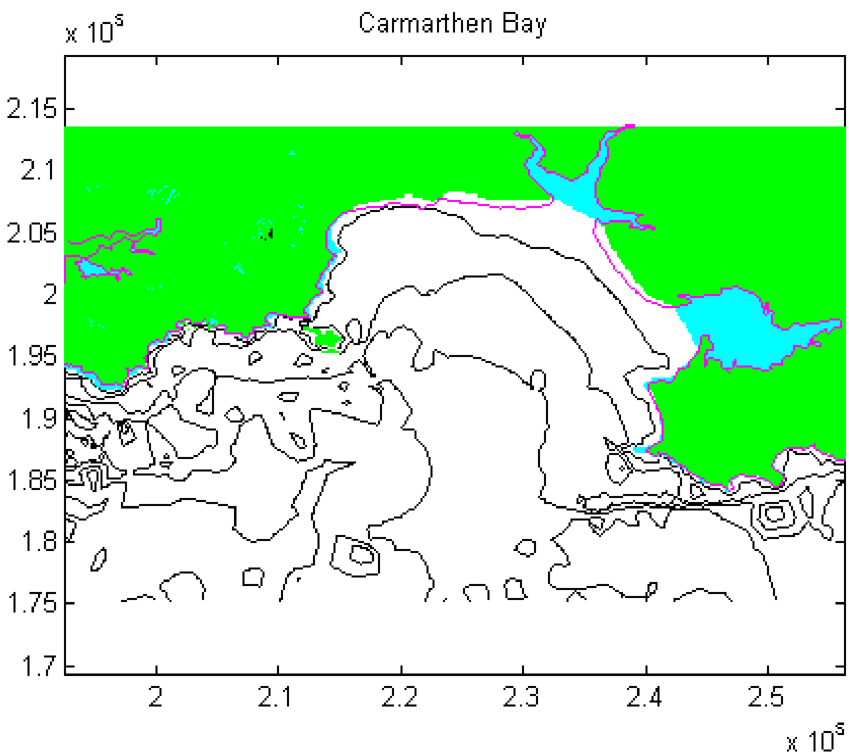
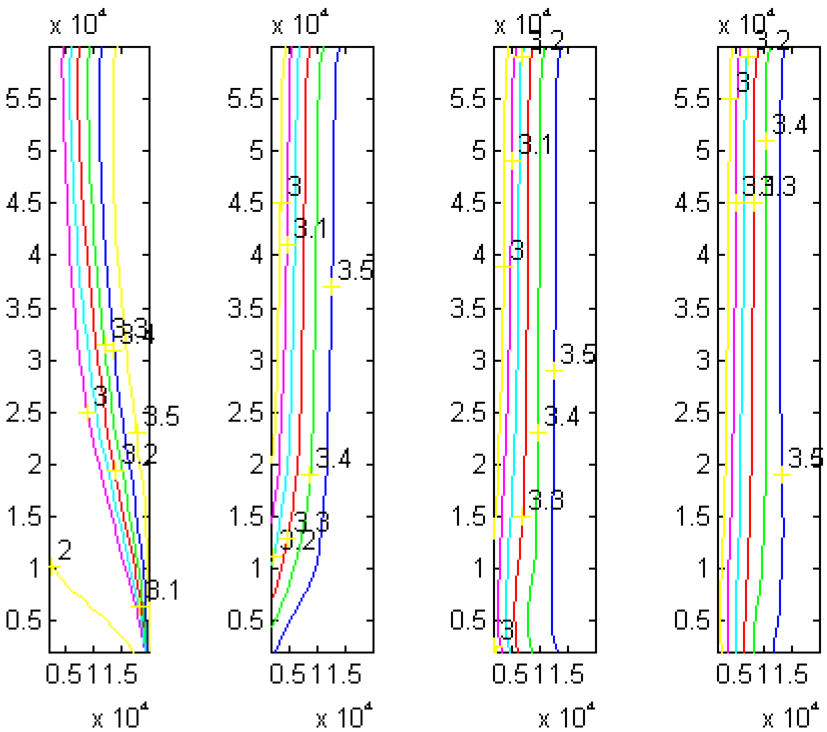


Figure 3: Carmarthen Bay

4. Cross-shelf boundary conditions

The incorrect specification of a cross-shelf boundary condition at the upwind boundary can lead to spurious results near that boundary. A simple method is being examined to scale the wave height from the offshore boundary to the coast using the cross-shore depth profile, based on Tucker (1994). This is described more fully in Wolf (in preparation). Four methods have been compared: (a) zero waves, (b) constant waves equal to the offshore wave height (c) the new method and (d) a 'periodic'-type condition whereby the waves at the downwind boundary are fed in at the upwind boundary. Contours of wave height from the idealised rectangular model, with dimensions similar to Holderness but no long-shore variation, are shown in Figure 4. The model was forced by 3.5m waves at the offshore boundary (x=20km). The periodic condition (d) gives the most accurate results but is only appropriate when there is no variation of depth profile in the longshore direction, not usual in real applications. Method (c) gives an improvement over the first two methods, assuming the correct solution to be wave height contours parallel to the shore.



(a) (b) (c) (d)

Figure 4: Idealised rectangular SWAN model with various cross-shelf boundary conditions at upwind boundary (y=0)

(a) Hs=0 (b) Hs=3.5m (c) Hs scaled according to Tucker (1994)   (d) 'periodic' boundary condition

5. Preliminary results from Holderness model

An idealised test case of the Holderness 200m model with realistic depths, 90*290 grid-points, 12 spectral wave directions and 25 frequencies is shown. This used a constant wave height boundary condition on the south and east boundaries of 3.5m, with a peak period of 8 seconds and a JONSWAP spectral shape, with the peak wave direction from the SE (120°) in conjunction with a 15m/s wind from the same direction. Various types of output may be examined, e.g. integrated parameters along a line through N1-N3, 2-D spectra at selected points (N1, N2 and N3) and a contour plot of wave parameters. Here some sample results are shown in Figures 5-7. Refraction and energy dissipation may be observed from station N3 to N1.

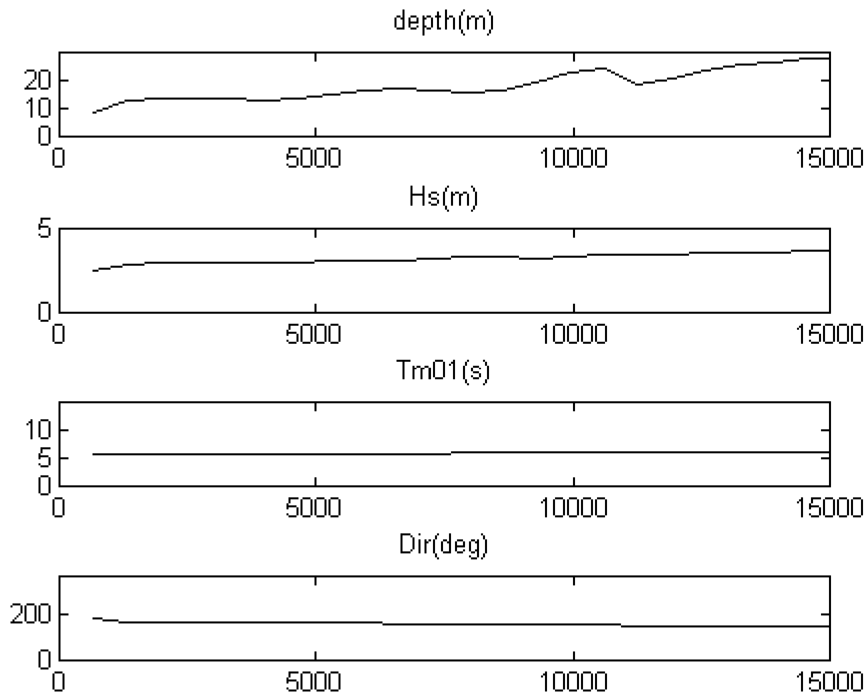
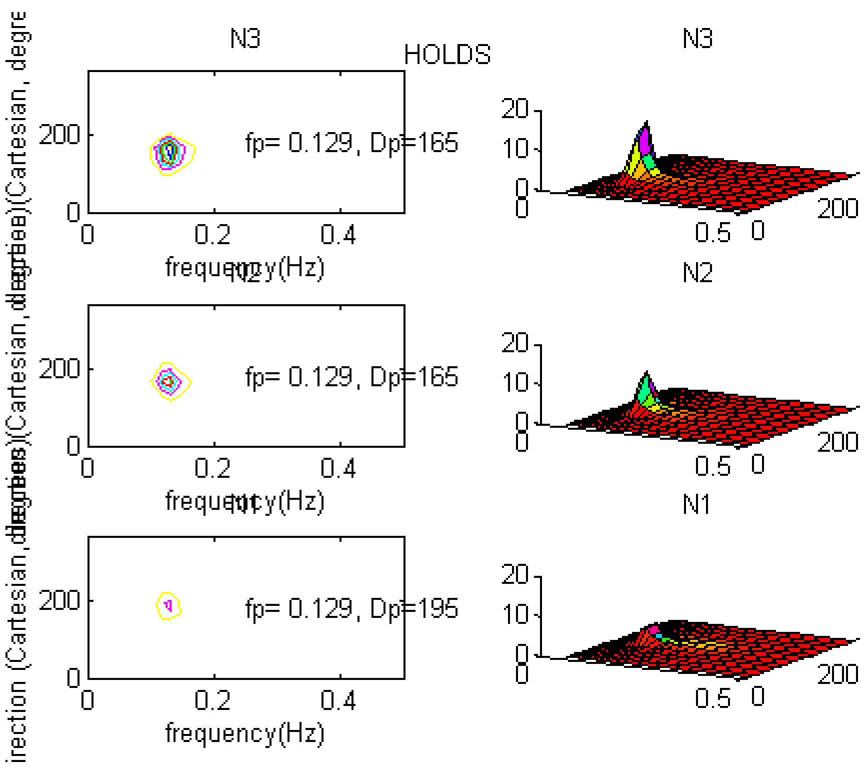


Figure 5: Wave parameters along cross-shore section through N1-N3.



(a) (b)

Figure 6: 2-D spectra at N1, N2 and N3, (a) and (b) are 2-D and 3-D plots of the same data

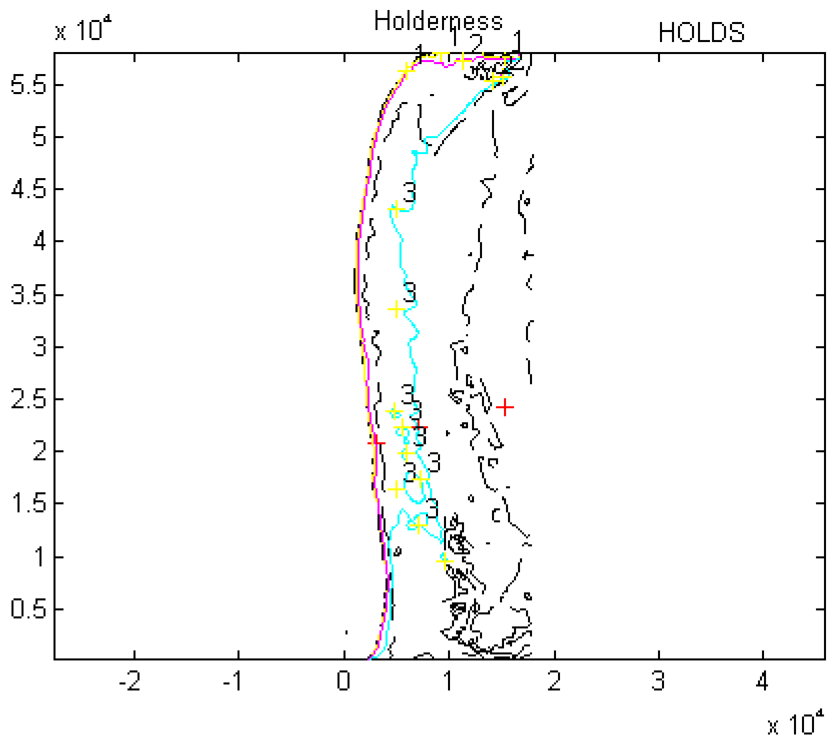


Figure 7: Contours of significant wave height for idealised test case at Holderness. Contours of Hs are in colour, black lines are depth contours at 10m intervals.

6. Summary

The model grids are now set up and look reasonable. We are ready to do the test cases required for investigation of the transformation of wave statistics from near-shore to the coastline. This will require a definition of the appropriate runs. Output will be compared with the equivalent results from the Halcrow 'STORMS' package.

References

Booij, N., L.H. Holthuijsen and R. Padilla-Hernandez, 1998, Numerical wave propagation on a curvi-linear grid. WAVES'97, pp. 286-294.

Ris, R.C., Holthuijsen, L.H., N. Booij, J.H. Andorka Gal and J.C.M. de Jong, 1998 The SWAN wave model verified along the southern North Sea coast, WAVES'97, pp. 49-63

Tucker, M.J. 1994 Nearshore waveheight during storms. Coastal Engineering, 24, 111-136.

Wolf, J. (in preparation) Specification of the Cross-Shore Boundary Condition for Coastal Wave Models.