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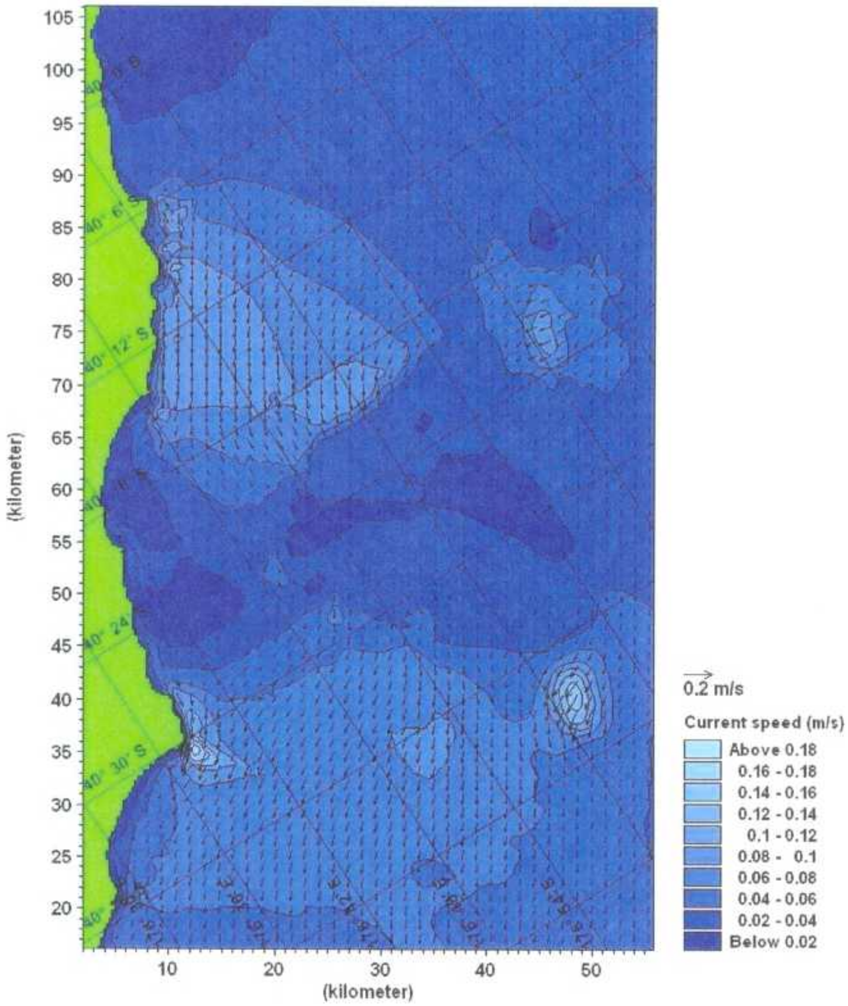

Figure 7b: Predicted peak south bound tidal currents.

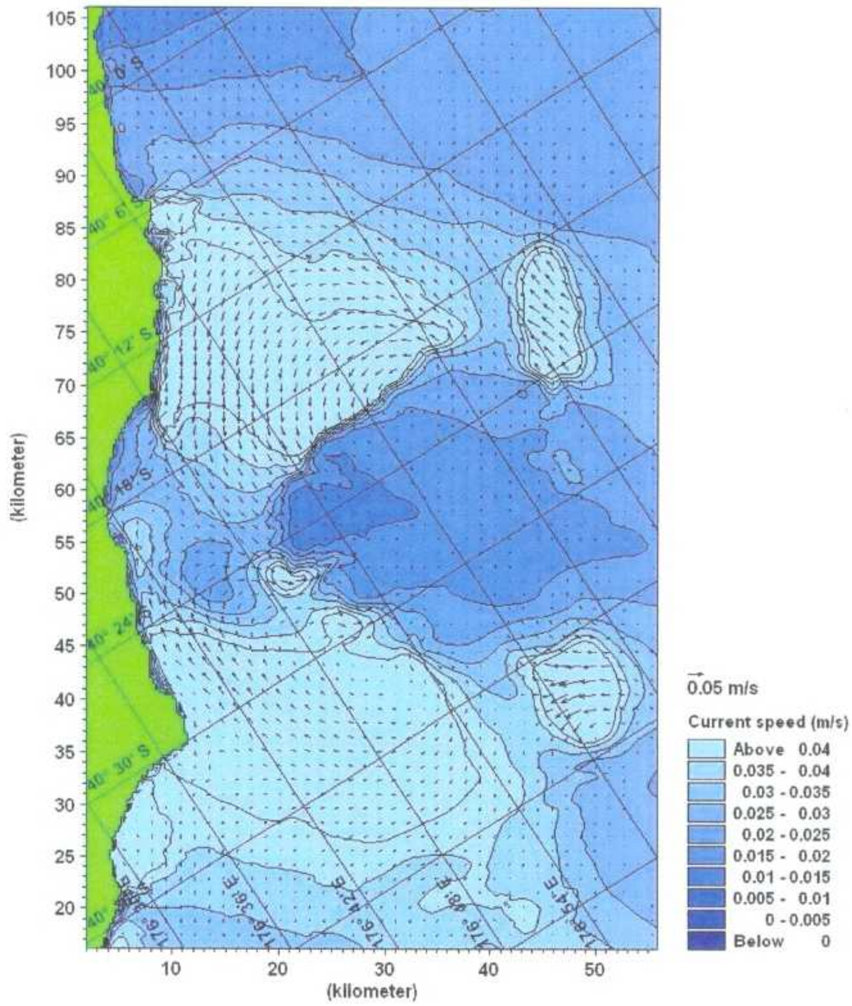

Figure 8: Mean tidal currents over a 12.5 hour tidal cycle.

2.4.2 Ocean forcing

A NIWA regional ocean model (Rickard et al. 2005) has been used to produce climatological estimates of the flows along the wider Wairarapa coastline. The outer solutions at a resolution of some 14 km have been downscaled via one-way nesting to give simulations at around 2 km resolution along the Wairarapa coast. These fully three-dimensional, open ocean simulations attempt to capture the important large scale circulation and variability (as detailed by Chiswell 2005) associated with the Wairarapa Eddy (WE) situated in the deep water off the Wairarapa coast.

The nesting to improve the model resolution is necessary to try to capture the inshore Wairarapa Coastal Current (WCC) that is observed to flow along the shelf adjacent to the Wairarapa coast (Chiswell 2000). Month-long current meter records at two sites located on the 250 m isobath showed along-shore currents to be nearly always northwards, with means of around 20 cm s^{-1}.

The model shows the strength of the WCC is strongly influenced by the WE. An intensification of the WE tends to push warmer water onto the shelf, and dampen (or even cut off) the northward flowing WCC. This effect is strongest at the northern end of the WCC, and weakens going southwards along the coast. The timescale for such events to occur can be months. To represent such potential variability and associated impacts on larval dispersal, three mean states representing a weak, average, and strong model WCC have been derived in order to produce mean current boundary conditions. Note that "weak, average, and strong" here are model-dependent definitions; if the month-long current meter records do indeed represent long term means, then the "strong" model condition may well be an underestimate of actual mean WCC flow speeds.

These three different scenarios of ocean forcing (weak, average and strong) were incorporated into the hydrodynamic model. Figure 9a - c show the predictions from the ocean model under the three scenarios. The boundary fluxes for the hydrodynamic model were ramped up from zero to those calculated from the ocean forcing over a period of 6 hours. This avoids the problem of introducing instabilities to the model which would occur if a rapid change in flux at the boundary was applied. After the initial start-up period of 6 hours the model was then run for 4 tidal cycles (50 hours) to reach an equilibrium condition. Comparisons between the predicted ocean model flow patterns (Figure 9) and those predicted by MIKE21 show good agreement in the offshore regions of the model. Differences in the nearshore zone result from the different resolution of bathymetry used by the two models

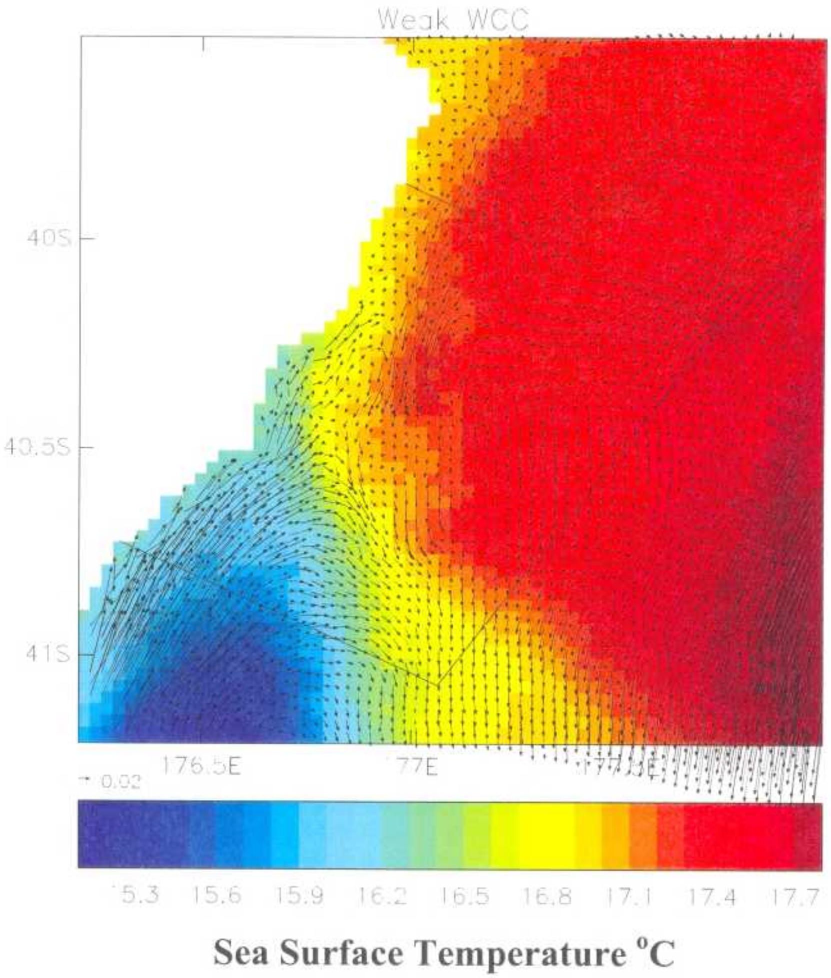

Figure 9a: Predicted ocean currents for weak formation of the Wairarapa Coastal Current. Underlying colour plot shows sea surface temperature, and vectors show the predicted depth-averaged velocity. Box shows the approximate limits of the 270 m hydrodynamic model.

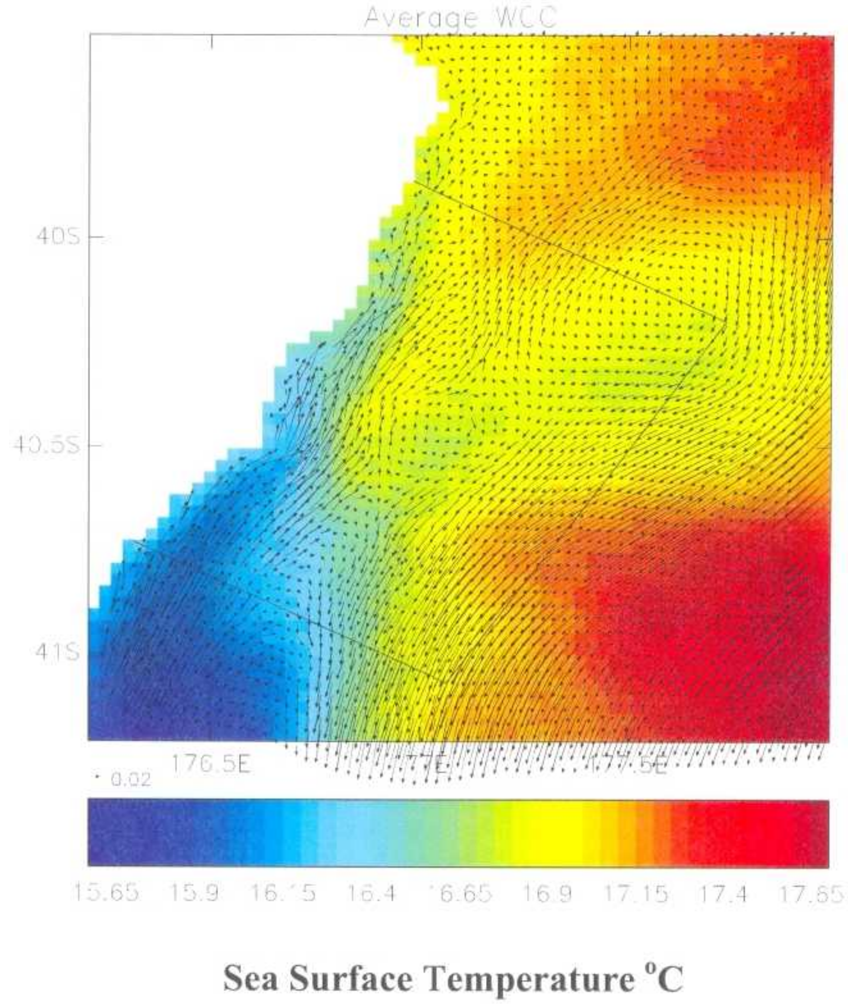

Figure 9b: Predicted ocean currents for average formation of the Wairarapa Coastal Current. Underlying colour plot shows the sea surface temperature and vectors show the predicted depth-averaged velocity. Box shows the approximate limits of the 270 m hydrodynamic model.

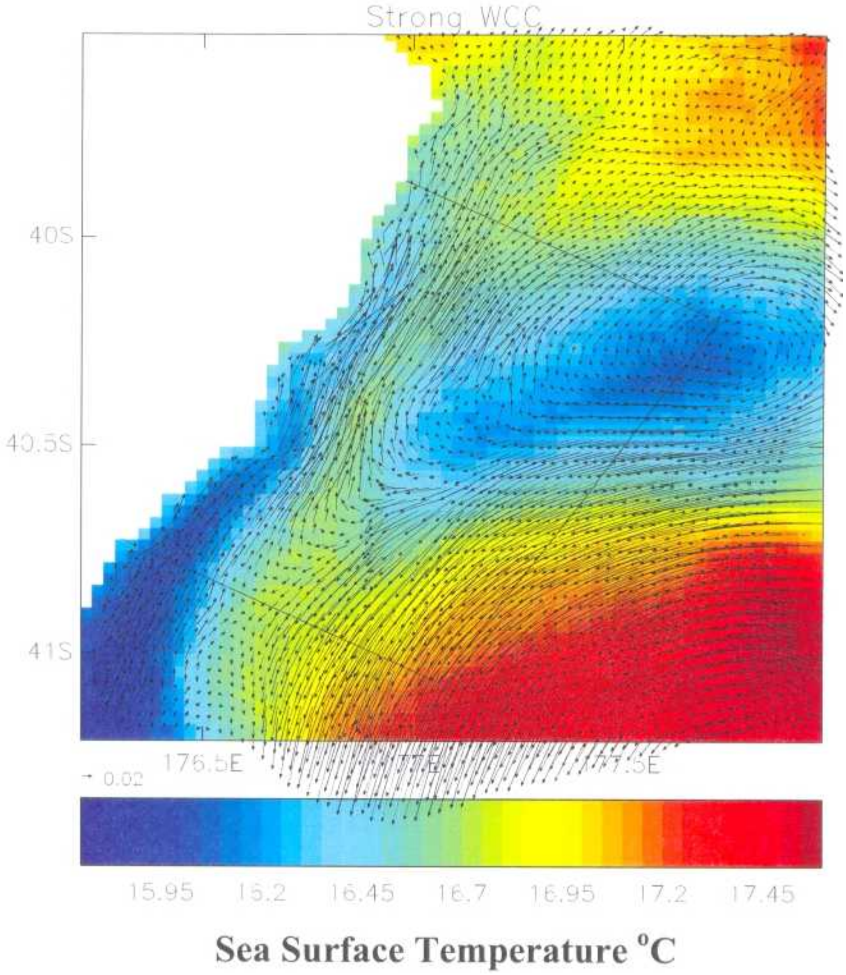

Figure 9e: Predicted ocean currents for strong formation of the Wairarapa Coastal Current. Underlying colour plot shows the sea surface temperature and vectors show the predicted depth-averaged velocity. Box shows the approximate limits of the 270 m hydrodynamic model.

To obtain the combined effect of the ocean forcing, tidal forcing and wave radiation stress all three boundary conditions were superimposed. Average conditions for the WCC were combined with the average wave conditions, weak WCC conditions were combined with the easterly storm wave condition and strong WCC conditions were combined with the southerly storm wave conditions. Combining the ocean forcing with the tidal forcing and waves results in the a net current field as predicted with ocean forcing with an oscillating tidal component (increasing in strength nearer the coast) plus strong near shore circulation compartments set up by wave radiation stress.

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