

### OTHER HYBRID COMBINATIONS

Other forms of hybrid model are beginning to emerge. In particular these involve other system linkages, such as the link between the morphology, water quality and biology. A number of these were explored in the UK estuaries research project and reported in the [EMPHASYS Report](#). Paper 8 by Wood, presents an intertidal transect model (BIOTIDE), where the sediment transport is moderated by the biota. The model is aligned cross-shore and includes movement of water and suspended sediment. The erosion due to tidal currents is modified by the degree of bioturbation, using the concentration of chlorophyll as an indicator of the microphytobenthos to alter the erosion threshold. This area of research is beginning to enable the role of biostabilisers and bioturbators to be explored and establish the significance of climatic variables, such as temperature, in the seasonal variability of the intertidal morphology (Black *et al.* 1998; Widdows *et al.* 2000).

A more general discussion of the links between the biology, geology and morphology is presented in Paper 23 and with the water quality and ecology in Paper 24. The approaches presented lead to the concept of using the physical processes to predict the distribution of macro benthic assemblages within the estuary, which was presented in Paper 22 and has been more extensively explored for the Humber estuary (Frost *et al.* 2004; Stillman *et al.* 2004). This type of model has also been used in conjunction with a saltmarsh model to predict the up-shore and down-shore species distribution of saltmarsh plants and with various shorebird models, which predict abundance and factors such as over-winter mortality rates (see section on [Ecological Modelling](#)).

### References

Black KS, Paterson DM, Cramp A (Eds), 1998, Sedimentary processes in the intertidal zone, Geological Society, London.

Frost NJ, Freeman SM, Hull SC, 2004, The use of ecological models in the sustainable management of estuaries, In: Proceedings of Coastal Environments 2004.

Stillman RA, West DA, Goss-Custard JD, McGroty S, Frost NJ, Morrissey NJ, Kenny AJ, 2004, Predicting site quality for shorebird communities: a case study on the Humber estuary, UK, *Journal of Applied Ecology*, Submitted.

Widdows J, Brown S, Brinsley MD, Salkeld PN, Elliott M, 2000, Temporal change in intertidal sediment erodability: influence of biological and climatic factors, *Continental Shelf Research*, 20, 1275-1289.