Wendy Pyper

Dr Mohand Amghar and Dr Simon Bell, water-quality modellers with the Queensland Environmental Protection Agency.

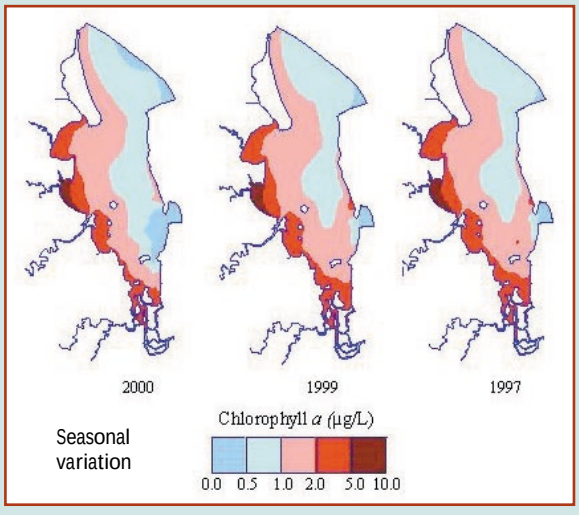
Master modellers

Models are important tools for understanding natural processes, and for predicting the outcome of scientific experiments or management actions. So it's no surprise that a model representing the complex ecosystem of Moreton Bay and its catchments should arise from the plethora of research and monitoring programs conducted as part of the Moreton Bay Study and the Regional Water Quality Management Strategy.

What is surprising is that the information underpinning the Receiving Water Quality Model – provided by more than 20 research, government and industry groups – has been collated by just two modellers: Dr Simon Bell and Dr Mohand Amghar of the Queensland Environmental Protection Agency.

The pair has produced a report, 'Modelling Scenarios for South-east Queensland Regional Water Quality Management Strategy', which showcases the model's potential in 57 management scenarios.

For example, one model scenario predicts the point at which the lowering of nitrogen and phosphorus concentrations by sewage treatment plants is both environmentally and economically worthwhile.



Changes in chlorophyll a concentrations are a useful indicator of ecosystem health and can be used to model the effects of different management actions on water quality in the bay and rivers.

This result, achieved in only three days of computing time, is based on five years of data crunching and calibration using real measures of ecosystem processes from various scientific tasks and the Moreton Bay Ecosystem Health Monitoring Program.

The water-quality model is based on a suite of models developed by Professor Ian King from the Water Research Laboratory. It was substantially upgraded during the Moreton Bay Study, and consists of four sub-models: a hydrodynamic model, a transport model, a sediment model and a water quality model.

The hydrodynamic model underpins the three other components, and models the movement of water in the bay and its rivers. The area to be modelled is represented by a grid or 'mesh' of more than 8000 points of information pertaining to bay bathymetry (depth).

'If you get the bathymetry wrong, the hydrodynamics will be wrong and all the other sub-models will be wrong as well,' Bell says.

Once the hydrodynamic model was verified against an independent data set, the transport model could be calibrated, allowing the dispersion and advection (horizontal movement) of pollutants through the waterways to be modelled.

Next came the sediment model, which looks at the re-suspension and deposition mechanisms for sediment in the water column and benthos (seabed). These mechanisms include the effects of wind, waves, tidal currents and ocean swell.

By combining the power of the hydrodynamic, transport and sediment models, and with outputs from a catchment runoff model (see story on page 23), Bell and Amghar have shown that large plumes of suspended sediments enter Moreton Bay primarily from the Brisbane River, but also from the Caboolture, Pine and Logan Rivers. These plumes are mostly evident after flooding.

According to Bell, most sediment from flood events ends up as a fine layer on the bay floor, where it is 're-worked by resuspension and deposition processes. This results in the collection of sediment in a dead zone known as the 'mud patch', as well as export of sediment from the bay.

'The modelling results suggest that turbidity in Moreton Bay is predominantly caused by re-suspension of sediment, rather than by loads from the rivers,' Bell says.

'The mud patch is a result of sediment loads from the catchment over a number of years, and to stop it getting any bigger we'll need good catchment management practices. But if re-suspension is the dominant cause of turbidity in the bay, it will take a long time to see any improvements in water clarity.'

The final component is the water-quality model, which can predict the effects of management actions on a range of chemical and biological constituents, including dissolved oxygen, organic nitrogen and phosphorus, phosphate, ammonia, chlorophyll *a* and salinity.

This sort of information will support management decisions made by stakeholders in the Regional Water Quality Management Strategy.