

# Long-term hind- and forecasting of water quality for lake Rotorua: Coupling catchment, lake and climate models

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Diffuse pollution in the form of prolonged unsustainable nitrogen loads from increasingly pastoral land use over recent decades has resulted in increased productivity and frequent cyanobacterial blooms in Lake Rotorua, New Zealand. Bottom sediments are also a significant source of nutrients to the lake, therefore, local government are investigating both in-lake interventions and catchment mitigation options with the aim of returning water quality to historic levels prior to land use intensification. The coupled hydrodynamic-ecological model DYRESM-CAEDYM was used to simulate the lake ecosystem over six 8-year periods within 1920–2100. Meteorological input included historic measurements and forecast simulations based on IPCC climate change predictions and downscaling with the model DARLAM. Catchment nitrogen inputs were obtained using the NIWA model Rotorua Taupo Nitrogen (ROTAN). Dynamic sediment nutrient releases were incorporated into the model in order to represent interactions between changes in external nutrient load and bottom sediments. Parameters for sediment nutrient release and oxygen demand within DYRESM-CAEDYM were modified using empirical relationships from historic monitoring data between external nitrogen load and both hypolimnetic oxygen demand and sediment nitrogen concentration. The coupled models adequately reproduced historic and contemporary lake trophic state, and showed that substantial catchment and in-lake restoration would be necessary to achieve the desired improvement in water quality.