

Linking eutrophication and ocean acidification to land use: 16 years of ocean observation in the Hauraki Gulf

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The ecosystem services of the Hauraki Gulf, New Zealand, include wild and farmed fisheries, natural amenity and recreation, and assimilation of coastal runoff. These services are concentrated in the Gulf's coastal areas – especially the Firth of Thames – where phytoplankton and zooplankton are most productive, snapper spawn most intensively, and most marine farms are located. The high productivity of the Firth is promoted by nutrient loading driven mainly by riverine input, with about 60-70% of its load entering from the intensively farmed Hauraki Plains. High productivity is then sustained by efficient nutrient recycling *in situ*.

NIWA has operated an ocean observation programme which has monitored conditions in the Hauraki Gulf and Firth since 1998, using time-series and process studies supported by mooring and ship-based surveys. This programme is revealing that while the enriched water quality of the Firth promotes benefits through high productivity, it also introduces stressors (low oxygen interacting with low pH) derived from the highly intensified land-use in its catchments. The carbonate system varies inter-annually, in response to varying primary biomass levels, and is very seasonally variable, in response to cycles of net-ecosystem metabolism.

Our current work aims to assess and understand these stressors and we intend to model their trajectories under future land-use scenarios, using dynamic and inverse modelling approaches.