CSG13 Question: If sediment is controlled and Waikato River water gets clearer, will phytoplankton growth increase in response to higher light, resulting in little improvement in water clarity?

TLG Response:

(We consulted with experts Dr Rob Davies-Colley and Dr Piet Verburg)

Reductions in suspended sediment concentrations are not expected to result in significant increases in phytoplankton growth in response to an improved light climate. The reasons for this view are:

- the short residence time in the Waipa (that lacks any significant dams) is expected to limit the development of phytoplankton in the Waipa system;
- downstream of the Waipa confluence the Waikato River is relatively shallow and sufficiently turbulent such that phytoplankton are likely to be exposed to sufficient light such that growth is unlikely to be light limited;
- in the hydro-lakes, suspended sediment is (most of the time) low and light limitation to phytoplankton growth is not considered to be significant. Verberg (2015) found that ratios of chlorophyll *a*:nutrients in the Waikato hydro-lakes were typical of that found for lakes in general, providing some support for the contention that current levels of suspended sediment do not inhibit phytoplankton growth.

Reference

Verburg P 2015. Nutrient relationships relevant to limitation of phytoplankton growth in the Waikato River. NIWA Client Report HAM2015-092, 236 p. – Currently under peer review.

CSG13 Question: If inputs of P from land use and discharges are reduced, will the release of P from hydro lake sediments maintain P levels and so maintain phytoplankton growth?

TLG Response:

(We consulted with Dr Chris Hickey and Dr Max Gibbs)

P can be released from the bed of lakes when lakes stratify and the bottom water become anoxic (depleted of oxygen). The information on stratification and deoxygenation within the Waikato hydro-lakes is rather patchy, with no regular monitoring of vertical profiles of DO in place. Nevertheless, the only hydro-lake known to have strong deoxygenation related to summer stratification is the deep Lake Ohakuri, where studies in the mid-1990's (Hickey and Martin 1996) found periods of bottom water deoxygenation and associated release of P during January and February in the Whirinaki Arm below 22 m depth. Hickey and Martin (1996) concluded that the interflow of cool oxygenated water from the operation of Aratiatia Dam reduces the impact of lake stratification on oxygen depletion in Lake Ohakuri. Bottom water deoxygenation was worse in the 1980's than currently due to higher inputs of organic pollutants from the Reporoa Dairy Factory and poorly treated dairy shed wastewater discharges (pers. comm. Dr Chris Hickey NIWA). Reduction of P inputs to the river is likely to reduce the sediment P release from Ohakuri by reducing phytoplankton growth and hence

the amount of carbon to be respired (consuming oxygen) in the bottom waters and lake bed sediments.

The other hydro-lakes are shallower than Ohakuri and have greater through-flow than the Whirinaki side arm, and so are less prone to bottom water deoxygenation than Lake Ohakuri. For example, during a recent study of phytoplankton growth, Gibbs et al. (2014) found that no evidence for sediment release from the bottom water of lake Karapiro during the summer when stratification developed at a depth of about 8 m.

In conclusion, we do not expect that hydro-lake sediment sources of P will be significant enough to prevent the Waikato River phytoplankton responding to reductions in P inputs from land use and point source discharges.

Reference

Gibbs M, Safi K, Albert A, Duggan I, Bowman E, Burger D. 2014: Factors influencing chlorophyll a concentrations in the Waikato River. Retention time and thermal stratification in the hydro lakes prepared for DairyNZ, NIWA Client Report No. HAM2014-059. – About to be released.

Hickey CW, Martin ML 1996. Lake Ohakuri monitoring: 1994/96. NIWA Technical Report EVW60204 Prepared for Environment Waikato 54 p.

CSG13 Question: Ed Brown's presentation discussed IPO trend of dryer weather, and how does this compare against climate change predictions?

Answer (from Ed Brown):

Climate change is a long-term trend in climate overlaid by oscillations driven by shorter term 5 to 30 year cyclic climate fluctuations. The weather at times between the two may not be too dissimilar. Long-term climate change projections is for warmer temperatures and more sporadic rainfall – longer/more droughts. This can also occur for spells in the shorter term driven by natural climate fluctuations. e.g. El Nino southern Oscillation. El Nino phases can result in drier conditions (3-5 year period) in the east of the North Island and also the IPO can result in (15-30 year) periods influenced by drier conditions.

Reference

https://www.wmo.int/pages/themes/climate/significant_natural_climate_fluctuations.php#f

https://www.niwa.co.nz/publications/wa/vol13-no4-december-2005/climate-variability-climate-change-and-energy

http://www.mfe.govt.nz/climate-change/overview-climate-change/about-climate-change

http://www.mfe.govt.nz/publications/climate-change/chapter-3-relationship-current-climate-variability-and-change

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