The Significance of GLEON to Limnology and Global Water Resources

Lakes globally are under pressure from water extraction, modified catchments, eutrophication, fishing pressure and invasive species. These pressures are unlikely to diminish as human populations grow, demand for water resources increases and climate change modifies the drivers of lake ecosystems.

The Global Lake Ecological Observatory Network (GLEON) combines an array of lake sensors deployed around the globe to address local issues for individual lake ecosystems but also to document changes in lake ecosystems that occur in response to different landuse, latitude and climate. Because many of the modifications to the landscape and climate will be expressed firstly in lake ecosystems, these systems offer a unique opportunity to monitor, analyse and predict future landscape and climate change. By understanding the implications of these changes at a global level the expected ecosystem change can be predicted and planned for. Planning for future lake management and adaptation to meet community needs and expectations will be compromised without knowledge of how lakes respond to natural and anthropogenic forcing.

Planning for the future relies on prediction of the outcome of landscape modification, rain and mixing events, and climate change. Simulation of these events enables this prediction, but it is necessary to inform the development and calibration of models in a range of climatic zones to ensure predictions are broadly valid. GLEON offers an unequalled opportunity to develop and test lake models in a range of climates. The inventory of lakes in GLEON spans broad gradients in limnological characteristics, landscape and climate settings. As GLEON grows, this wealth of lake data will increase and provide opportunity for interpretation at broader space and time scales. Comparison of lakes across latitude will provide significant insight into how lake ecosystems are likely to be shaped by climate change. Lessons learnt on one lake can be applied globally to ensure sustainable lake ecosystems into the future.

“Lakes are the canaries in the landscape.” Lake Ecosystems are sensitive indicators of catchment modification and climatic conditions. Because lakes integrate across landscape, hydrology and climate, ecosystem change in aquatic systems is often observed more quickly than adjacent terrestrial ecosystems. Therefore changes to catchment or climate may be expressed in lake ecosystems before they are evident in other ecosystems. Early warning of significant ecosystem change and knowledge of the likely consequences enables communities to respond and adapt to the change. However, to detect changes in lake ecosystems it is necessary to monitor sensitive indicators at appropriate timescales. Events that drive lake ecosystem processes occur at a range of timescales from short-term such as rain event inflows to seasonal changes and longer term features such as El Niño and climate change.

Real-time, high frequency measurement of local climate, water temperature, dissolved oxygen and phytoplankton chlorophyll fluorescence by stations deployed on lakes captures many of the important ecosystem drivers and responses at timescales necessary to resolve the features of interest. These measurements can then be used to inform risk assessment of pathogen fate and transport, cyanobacterial growth and the impact of catchment or lake derived carbon on lake metabolism and ecosystem health.