GLEON13 General Research Poster Abstracts

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A scientific workflow used as a computational tool to assess the response of the Californian San Joaquin River to flow restoration efforts

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The objective of this work is to develop and test a near-real time scientific workflow to facilitate the observation of the spatio-temporal distribution of whole-stream metabolism estimates using available monitoring station flow and water quality data. The scientific objective is to identify correlations between whole-stream metabolism estimates and the seasonally variable flow and flow disturbances (e.g., flood-control releases), which are the primary driver of stream ecosystems. Our initial test case is the San Joaquin River which has been undergoing restoration since September 2009. Workflow development here faces technical challenges in terms of data collection and analysis because (1) the information required for this multi-site, long-term study, originates from different sources with different associated properties (data integrity, sampling intervals, units), and (2) stream flow variability is significant and presents the need for adaptive model selection within framework of the metabolism calculations. These challenges are addressed by using a scientific workflow in which semantic metadata is generated as the data retrieved and then subsequently used to select and configure the most data-appropriate models. Data preparation involves the extraction, cleaning, normalization and integration of the data coming from sensors and third-party data sources. In this process, the metadata captured includes sensor specifications, data types, data properties, and process documentation, and is passed along with the data within the workflow system, automating whole-stream metabolism estimates by the optimal modeling approach. This presentation will describe the architecture of the whole-stream metabolism workflow and present typical results.

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Combining new technologies for more effective spatial and temporal monitoring of water quality

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Good monitoring data is vital for tracking changes in water quality due to changing climate, point-source and diffuse pollution, as well as for evaluating efficacy of restoration measures in lakes and catchments. We have developed and deployed a network of solar-powered water quality monitoring stations at central locations in lakes of the North Island of New Zealand. The buoys measure temperature, chlorophyll and phycocyanin fluorescence, dissolved oxygen and turbidity, as well as meteorological variables. They telemeter measurements to a database and web-based interface every 15 minutes. On several lakes, water quality surveys are regularly undertaken (approximately monthly) using a towed probe with a similar suite of water quality sensors to the buoys, providing complementary spatial coverage. These cross-validated data streams can be used for calibrating and validating relationships between water quality indices and spectral/thermal images from satellites. We have used this method to derive surface water temperature, chlorophyll concentrations and turbidity from remote sensing images for a range of New Zealand lakes. Atmospheric correction and ground-truth data can increase the accuracy of satellite measurements. For example, Landsat 7 ETM+ thermal data were used to derive water temperature for 14 images between 2007 and 2009 on Lake Rotorua. These temperature predictions were validated with Lake Rotorua monitoring buoy data for validation, and atmospheric correction using the radiative transfer model MODTRAN v.3.7, yielding a root-mean-square-error of 0.36 °C. Satellite imaging has important potential as a monitoring tool to resolve heterogeneity within lakes at single instances, and through time. Integration with real-time monitoring stations and spatial data collection programmes enables instantaneous assessments of lake water quality across catchment, regional, national and international scales.

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Inferring processes from patterns in night-time respiration rates across GLEON lakes: Preliminary results.

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The respiration of organic matter to CO_2 by autotrophic and heterotrophic organisms in aquatic systems is a critical ecosystem process that structures food web dynamics, is linked to ecosystem trophic state, and has implications for global biogeochemical cycles. Although diel variability in rates of ecosystem respiration (ER) has long been recognized, only a handful of studies have examined intra-diel patters, and none have compared patterns among multiple lakes spanning gradients in biological and physical characteristics that may affect rates. We capitalized on the Global Lakes Ecological Observatory Network (GLEON) of autonomous, high-frequency sensor data from 25 globally distributed lakes to investigate patters in nighttime respiration rates. Using a comprehensive ecosystem metabolism model we tested the fit of four different functions in describing overnight patterns in ER (constant, linear decrease, exponential decrease, and sigmoidal change). In most lakes we found constant ER to be the most parsimonious model; however, both linear declines and sigmoidal change in ER were common. Complex dynamics in ER were related to physical drivers such as photosynthetically active radiation and water temperature. These drivers likely affect rates by influencing physiological variability in the metabolism of phytoplankton and by affecting the dissolved organic matter pool available to heterotrophic bacterioplankton. A greater mechanistic understanding of ER over a wide diversity of ecosystem types will better allow us to predict the ecosystem effects of anthropogenic changes such as eutrophication and climate change to aquatic ecosystems.