The Centre for Water Research (CWR)

@ The University of Western Australia

Realtime Management for Optimising Lake, Estuary and Coastal Seas, Ecosystem Services and Health

THE UNIVERSITY OF WESTERN AUSTRALIA

Achieve International Excellence

CENTRE FOR WATER RESEARCH

Introduction

Over the last 30 years the Centre for Water Research, at The University of Western Australia, has made major contributions to the understanding of the transport and mixing processes in stratified lakes, estuaries and coastal seas.

This fundamental understanding was made possible through the development of new instruments: fine-scale profilers, portable flux profiler and most recently a combined sensor chain and meteorological station, called the Lake Diagnostic System (LDS). A smaller version of the LDS has also been configured as a river gauging logger.

This new process understanding provided the basis for the development of three major models, the 3D Estuarine, Lake, Coastal Ocean Model (ELCOM), a hydrodynamic driver, the Computational Aquatic Ecosystem Dynamics Mode (CAEDYM) and the Adaptive Realtime Management System model (ARMS). The fundamental process understanding, together with the software and hardware tools have laid the foundations for adaptive realtime management.

What we offer

Our ecosystem services offers solutions for stratified lakes, estuaries and coastal seas, suffering from: manganese, iron or oxygen depletion problems in the hypolimnion; increasing deep water meromixis due to increasing nutrient loadings and increasing water column stability due to climate warming; eutrophication of the surface waters; excessive evaporation; downstream river temperature anomalies; and inadequate retention times of inflowing waters causing pathogen contamination in offtakes.

The solutions generally lie in modifying the seasonal stratification regimes. This can be achieved with bubblers, oxygenators, impellers, curtains and or offtake strategies.

Using ARMS it is now possible to automatically control these devices to obtain an optimum water body service (bulk water, hydropower, flood control, fish production, carbon sequestration) at optimum health (biodiversity).

Hardware Components

1 *Lake Diagnostic System (LDS):* A CWR designed 20 bit thermistor sensor chain, a full meteorological station and a logger with 10 additional 16 bit a/d analogue input channels for other chain or atmospheric sensors.

2 *River Logger (RL):* A smaller, self-contained version of the LDS with standard configuration using CWR thermistor nodes, commercial depth and conductivity sensors. The Logger has provision for 10 extra analogue sensors and 10 digital sensors.

3 *Shore Station (SS):* A laptop computer of choice configured with the Portable Data Acquisition (PDQA) software.

4 *Server (S):* A standard desktop server, with adequate memory.

5 *Multi Scale Profiler (MSP):* A new CWR designed free falling profiler combining: a standard CWR Fine Scale Profiler; a temperature microstructure device; a Turner C6 Multi Probe Configuration; a four component forward scatter laser Doppler current meter; an acoustic altimeter and buoyancy control mechanism for easy retrieval.

In addition to the acquisition of fine scale profiles of all variables, data streams may be used to capture turbulent fluxes.

Software Components

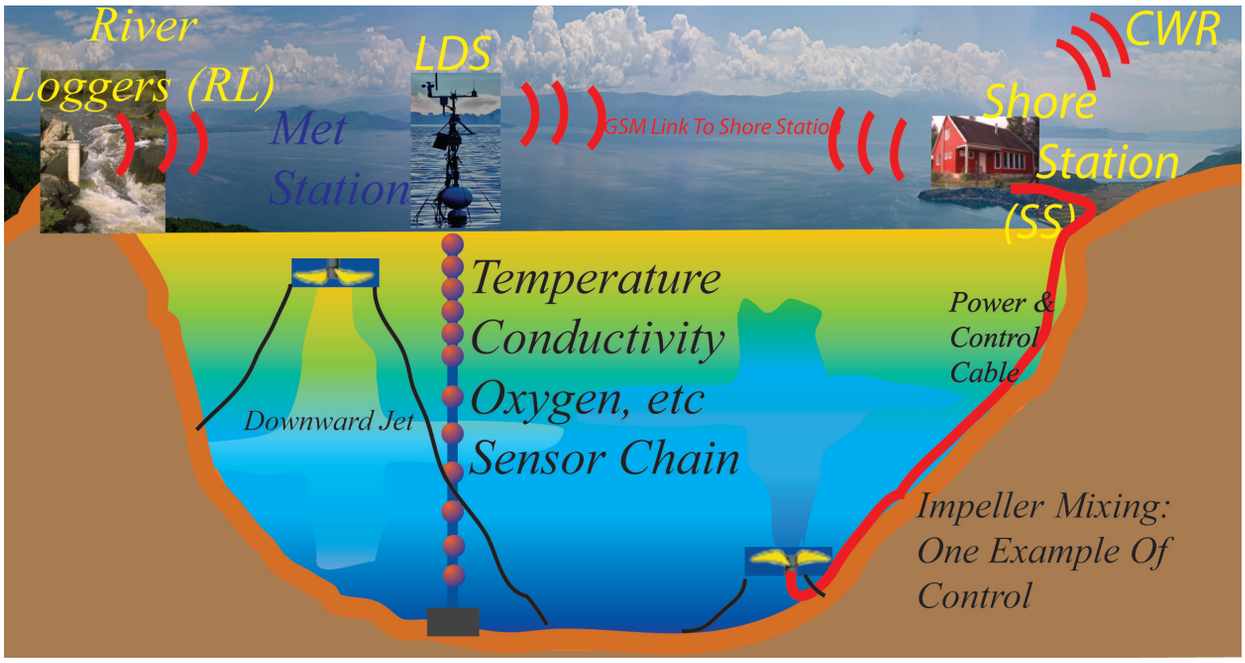
1 *Index Of Sustainable Functionality (ISF):* A spreadsheet programme, incorporated into ARMS that allows easy set up and computation of the ISF.

2 *Portable Data Acquisition (PDAQ):* Software that provides for easy acquisition of multiple data streams via GSM, CDMA or satellite. Also allows preliminary automatic data integrity checks.

3 *ARMS:* An extensive Java software package that allows coordination and archiving of all data streams, data correction, collation into standard data files, scheduling of model runs, preparation and presentation of all data and model outputs to web portal.

4 *ELCOM:* A 3D finite volume hydrodynamics model optimised for speed.

5 *CAEDYM:* A biogeochemical model that is easily coupled to various hydrodynamic drivers. Nutrients, plankton, zooplankton, fish, metals, pathogens, bacteria, organic and inorganic carbon are all represented.



CWR recommends the following ten steps to achieve desired optimization of ecosystems:

1 Articulate optimum operating space using some formal sustainability logic (e.g. the Index of Sustainable Functionality or ISF).

2 Assess existing data streams and ascertain realtime availability of data via web or ftp. Decide additional variables needed for modelling.

3 Install necessary river loggers (RL) to monitor inflows, outflows, point water levels and other properties.

4 Install necessary Lake Diagnostic Systems (LDS) in order to capture representative meteorological fluxes (from a meteorological station above water) and chain model validation data.

5 Set up Shore Station (SS) using data acquisition software (PDAQ) to capture all data streams and ftp to Server (S)

6 Install the Adaptive Realtime Managements System (ARMS) on Server (S) and setup data acquisition protocols.

7 Install ELCOM-CAEDYM and setup to run under ARMS.

8 Configure ARMS to provide the web portal realtime output embedded in Google Earth or similar GIS.

9 Run the system for one year during which time LDS data streams will be compared with model output. Confirm relevant process description with two field investigations, one in each extreme season, using the Multi Scale Profiler (MSP)

10 Assess process knowledge and implement, if adequate, to design intervention strategies

For more information contact

(i) For Fundamental Scientific Questions: Centre for Water Research

CWR undertakes fundamental and applied research in three areas – water, carbon, and sustainability. Our mission is to create tools and systems to quantify sustainability in aquatic ecosystems based on the building blocks of water and carbon and to use these tools to optimise water quality, carbon sequestration, aesthetic value and human satisfaction while delivering maximum water, power, flood control and protein depending on the system. We publish high impact papers by carrying out research funded from a range of sources, primarily external to the traditional University system. We establish, maintain and strengthen links with industry by incorporating research results into tools and systems for managing water, carbon and sustainability. We deliver a strong post-graduate programme in natural systems engineering.

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(ii) For Software and Services: Hydronumerics Pty Ltd

Hydronumerics Pty Ltd was formed out of the CWR Services Group to offer services related to the quantitative assessment of receiving water ecosystems, including lakes, reservoirs, estuaries and coastal seas. These services are based on development, customisation and application of CWR information management and numerical modelling software described above. The mission of Hydronumerics is to bring innovative, start-of-the-art and solution-based services to clients within the Australian and global water industry. These services include: data management; data analysis; numerical modelling; ARMS integrated decision support systems; technology transfer and training. Hydronumerics works in partnership with CWR to further develop and apply existing technologies with the goal of continually improving the service and function offered to our clients.

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(iii) For Hardware: Routers Australia trading as Global Water Monitoring

Routers Australia trading as Global Water Monitoring (GWM) designs and manufactures all types of scientific equipment for industry, aerospace, analytical laboratories and research institutions around the globe. GWM has a joint venture with CWR to manufacture, install and maintain Lake Diagnostic Systems and river loggers throughout the world. This working relationship keeps GWM in the forefront of technology. GWM's extensive experience in research and development, allows GWM to provide products and services to their customers of the highest standard.

Design
3 Dimensional modelling of products using CAD / CAM The computer aided design is then transferred into Data used to manufacture the product.

Electronics
Can be designed and built by GWM. Testing / calibration and production.

Examples
Data loggers. High resolution temperature sensor alongside data loggers.

Hardware
Designed /manufactured in house on CNC (computer numerical control)machines also built by GWM.

Installations
(Worldwide) example: Lake diagnostic systems for the Centre of Water Research based at UWA.

Supply
High tech instrumentation from well known companies and all assorted software.

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