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**Scientific Content**

**Title**

NETLAKE - NETworking LAKe observatories in Europe

**Abstract:**

Lakes are key ecosystems within Europe, but also provide drinking water, power, recreation and fisheries. Developments in sensor technology now allow in-depth monitoring of key parameters in lakes using instrumented platforms that provide real-time data to scientists, managers and local end-users via web-based technology. A great potential lies in integration of these data from platforms. The over-arching objective of NETLAKE is to establish a network of people and monitoring sites focused on the development and application of cutting-edge sensor technology for the protection of European lakes. Deliverables will include a meta-database of sites, case studies on management-relevant topics, a tool-box of standardised protocols for managers and scientists, and educational material for use by citizen science groups and educators. The action will also provide an on-line platform for collaboration between citizen science groups, managers and scientists, focused on lakes in Europe.

**Key Words:**

Lakes

Sensor technology

Instrumented platforms

Lake management

Data sharing

Citizen science

Lake metabolism

Algal blooms

Water Framework Directive

**Preferred COST Domain:**

Earth System Science and Environmental Management

**Text of proposal:**

## BACKGROUND, PROBLEMS

Recent developments in sensor technology make it possible to automatically monitor ecologically and management-relevant parameters in lakes using in-situ platforms, and to provide web-based access to these data. Many such platforms have been deployed across Europe, supported through local, national and EU funding, and managed at local level. At a subset of these sites, particularly those involved in early initiatives funded by EU programs (e.g. LIFE, and the REFLECT and CLIME projects), initial deployment occurred up to a decade ago and a wealth of experience has been gained. Now, reduced cost and the availability of 'off-the-shelf' packages have increased the number of such sites. Individually, each site provides a stream of data that can be used to assess pressures and impacts by managers, explore processes by scientists, and inform and engage local stakeholders. However, a greater potential lies in the integration of these sites and these individuals as a network.

Some of these sites are involved with the Global Lake Ecological Observatory Network (GLEON), an organisation, mainly US funded, which comprises approximately thirty-four lake observatories across the world (ten in Europe)([www.gleon.org](http://www.gleon.org)). This involvement has enabled European organisations to continue collaborations in an ad hoc fashion. However, in order to strengthen collaboration and exploit the potential of these systems in a European context, there is a need for a more concerted effort within Europe. The aim of the current COST action is to build a network that will support development and deployment of sensor-based systems in lakes across Europe, and use these to address water quality issues such as those highlighted by the EU Water Framework Directive. The latter specifically requires assessment on a spatially integrated basis, based on River Basin Districts. Other pressures which require coordinated assessment at wider scales include human-related climate change. Current barriers to the development of such a network include a lack of information on sites, a lack of standardisation in procedures and data processing, and the lack of any platform for the scientists, technologists, managers and stakeholders involved. The principle aim of this COST action, NETLAKE (NETworking LAKe observatories in Europe), is to integrate sites and individuals into a network of lake monitoring stations across Europe.

## BENEFITS

The primary benefit of NETLAKE will be to coordinate the sharing and use of sensor data from lakes, allowing scientists and stake-holders to assess and respond to impacts at regional and pan-European scales. Specifically, the action will harness current expertise in measurement, quality assurance and control (QA/QC), and data analysis, and ensure that this is made available, now and in the future. A particular benefit will be the opportunity to train early career scientists in this emerging technological area. The project will also provide an opportunity for citizen science projects to place local initiatives based on web-access to sensor data in a regional perspective. Increased availability of such data will also lead to improvements in our ability to detect any coherence between responses in lakes to environmental pressures at regional and supra-regional scales, and to contribute to global science.

## OBJECTIVES, DELIVERABLES AND EXPECTED SCIENTIFIC IMPACT

The over-arching objective of NETLAKE is to establish a cross-discipline and cross-regional network of scientists, managers and technologists, and local end-users committed to the development and application of cutting edge sensor technology for the protection of European water resources. Specific objectives include:

1. Establish a forum focused on use and development of instrumented platforms using sensor technology on

lakes in Europe.

2. Provide a comprehensive assessment of the current use of sensor technology on lakes.
3. Establish a standardised methodology for measurement and data analysis procedures for key parameters.
4. Provide an opportunity for scientists, managers and citizen science projects to place their initiatives in a European perspective.

#### Deliverables

1. A network of individuals and sites to support the application, improvement, and development of sensor technology for monitoring lakes.
2. A meta-database that will provide, for the first time, coordinated and up-to-date information on the availability of such data in Europe.
3. A set of recommended standard measurement and QA/QC protocols for key parameters.
4. A tool-box of data methods for analysis of high frequency datasets.
5. Benchmark datasets that can be used in cross-European analysis and modelling assessments.
6. A series of training workshops aimed at local stakeholders and focused on cross-European citizen science initiatives.
7. Collaborative peer-reviewed scientific papers using sensor-based data.
8. A web-based portal to provide access to these deliverables.

The scientific impact of NETLAKE includes an integrated and accessible network of scientists and organisations with the expertise, technology and data required to inform policy and management decisions about lakes. In addition, instrumented platforms can be used to involve communities in citizen science initiatives, particularly when data is made available through a public website. The tool-box of methods will collate and disseminate both new and existing methodology from and for the scientific and management communities.

#### SCIENTIFIC PROGRAMME AND INNOVATION

This will include four working groups (WGs) which will be charged as follows:

WG 1: compilation of a meta-database on existing sites and data, and development of recommended measurement and QA/QC protocols for key variables, for example, dissolved oxygen and chlorophyll fluorescence. This WG will also identify sites with core datasets for modelling of lake pressures and biological responses. The participants in this WG will make site visits to facilitate compilation of protocols, and act as a task-force on these protocols for members.

WG 2: development and collation of data processing and modelling tools, and analysis of selected core data sets using these tools. These could include automated statistical analyses, similar to Lake Analyzer (<http://lakeanalyzer.gleon.org>), a tool set for analysing physical data which was developed within GLEON (1). Expertise within the current group includes methods for calculating lake metabolism using dissolved oxygen data (2) that could potentially be developed into a user-friendly web-based tool. Methods have also been developed for interpreting data from in-situ scanning flow-cytometers, an exciting development in sensor technology (<http://www.cytobuoy.com>) (<http://www.ae.ethz.ch/research/aquaprob>) (3). This WG will also organise training schools that will focus on case studies on policy-relevant issues suggested by WG3, e.g., the occurrence of toxic blooms.

WG 3: focus on the establishment of a European-wide citizen science initiative on instrumented lake sites.

Some sites already have active local groups: these will be invited to be part of the COST action, forming a core of individuals committed to the protection of lakes. This WG will organise ‘training the trainers’ workshops for local representatives, contributing to expansion of the network, and will explore educational initiatives, similar to material developed in association with the Irish Federation of Group Water Schemes (<http://www.worldofwater.ie>). The latter included development of a water-based curriculum, teaching materials, and workshops for local groups, and is a program that could be adapted for other countries.

WG 4: charged with development of the web-based portal. This is a critical deliverable and will be used to provide access to the meta-database, real-time and historical water quality data, case studies on management-relevant topics, the tool-box for water managers and scientists, and educational material. The portal will also provide a forum for interaction between the group, exchange of ideas, and web-based meetings.

The major innovation in this project lies in the establishment of a network of European citizens, scientists, technologists and managers focused on protection of ecosystem function in lakes across Europe, and in the use of cutting-edge sensor and web-based technology to link this network together. The network will also be well equipped to move beyond the current established protocols and procedures for in situ sensing technology via rapid dissemination of validation results as novel sensors are deployed locally within the network.

## ORGANISATION

NETLAKE will be led by a management committee, with representation from diverse regions and key sectors and led by a chairperson and vice-chairperson. Each of the WGs will have a co-ordinator, who will sit on this committee. WGs may also have task coordinators depending on their charge. Management meetings will be held bi-annually. Collaboration between meetings will be facilitated through web-enabled networking, thus enhancing the effectiveness of the group. Many of the core group collaborate on smaller-scale projects, or have local funding for post-graduate and post-doctoral researchers. Local groups generally operate on a voluntary basis. COST therefore represents an ideal vehicle to enhance networking and science between these individuals and to reach out to others with an interest in protecting lakes in Europe using cutting edge technology.

## References

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2. Stæhr et al. 2010 Limnology & Oceanography: Methods 8, 2010, 628–644.
3. Pomati et al. in press Environmental Science & Technology.

## **Participants interested in network:**

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