

High resolution integrated lake monitoring: from physics to fish

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Structure of presentation

- 'Traditional' lake monitoring
- Recent technological developments
- Hydroacoustic mapping of habitat and biology
- Automatic monitoring of physics, chemistry and biology
- Summary





'Traditional' lake monitoring





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- Many lakes have been monitored manually for many decades
- Typically restricted spatially (single location over deepest point) and temporally (to intervals of 1, 2 or even 4 weeks)
- Gives long-term and seasonal trends for limnetic and profundal zones







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- Typically restricted spatially (single location over deepest point) and temporally (to intervals of 1, 2 or even 4 weeks)
- Gives long-term and seasonal trends for limnetic and profundal zones
- Fails to provide spatial coverage
- Fails to provide the temporal resolution required for better understanding and modelling of processes











- GPS
- Hydroacoustics
- Sensor technology
- Telemetry
- Cloud computing







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- BioBase (www.cibiobase.com)
 combines consumer hardware and
 cloud computing
- Simple field operation logs data to SD card
- Data subsequently uploaded to the Cloud for processing by automated system with QC
- Produces automated reports and 'raw' data for bathymetry, macrophytes and bottom typing
- Example here of application to macrophytes











- A typical application in Orchard Lake, USA
- 'Traditional' point samples of macrophytes
- Hydroacoustic transects for BioBase









Freq Occurrence 85%



2012





2013

Biovolume 40%



Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL



Biovolume 53%



Freq Occurrence 81%



2014



Biovolume 37%



- Future incorporation of higher frequency sound data for higher resolution macrophyte 'images'
- Future incorporation of existing fish detection algorithms for quantitative analysis
- Future utilisation of co-collected data on water surface temperature





- Lowrance's free Insight Genesis is already producing 'social maps' of lake bathymetries
- Opportunities for citizen science on macrophytes, bottom typing, fish and water surface temperature















- Systems deployed at 11 lakes in UK
- Physics: e.g. meteorology, water temperature
- Chemistry: e.g. pH, dissolved oxygen
- Biology: e.g. chlorophyll a, phycocyanin
- Data telemetered at 4 min intervals to central database
- ~4 million data points system ⁻¹ year ⁻¹
- Includes automated winch to produce full water column profiles













• Captures highly heterogenous and highly dynamic features







 Combination of high resolution, real-time data with PROTECH to forecast algal populations



Day of year





Summary

- Advances in hardware and software are helping to release the study and management of lakes from its long-standing constraints in space and time
- Cloud computing is facilitating the collection, analysis and dissemination of data and results in near real-time
- Advances are also opening up new opportunities for citizen science, potentially improving the resolution of lake monitoring in both space and time
- These advances are taking us much closer to being able to monitor lakes on a national scale and to forecast major biological events to the benefit of lake managers and users





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