Physical drivers of water quality in artificially destratified lakes and reservoirs

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Project description

Clean water is an important resource and a crucial worldwide societal challenge. Drinking water reservoirs in the UK and around the world become depleted in oxygen in the summer, when layers of different temperature form due to increased solar heating. Besides being lethal for fish and other aquatic organisms, low oxygen leads to the growth of nuisance algae, leading to blooms. Lack of oxygen also causes manganese in the bottom sediments to be released into the water.

To deal with this problem, water utilities employ reservoir destratification systems that mix the water so that oxygen can mix downwards from the surface. There are several methods of destratification; bubble plumes are most commonly used by water utilities in the UK. Recently, utilities have been making new capital investments in surface mixers, which act in reverse by pushing water from the surface down to the bottom, creating circulation in the reservoir.

Yet these destratification systems are imperfect, and utilities still suffer from water quality problems that must be dealt with through the water treatment process. Thus better understanding and optimization of destratification systems can lead to improved source water quality, lighter treatment load at drinking water plants, and a decrease in energy use by water utilities if less mixing is required.

The overarching goal of this project is to improve the management of water supply reservoirs that depend upon destratification for maintaining water quality. To this end, a field campaign is proposed that has two primary aims:

1. Assess the variability in mixing and water quality in two reservoirs with different destratification systems.

2. Determine the seasonal variation in mixing and how this impacts water quality.

These aims will be achieved through field measurements in two reservoirs. Blagdon Lake is destratified using three bubble plumes located near the location where water is drawn from the reservoir. In early 2015, Durleigh Reservoir's bubble destratification system was replaced with a surface destratification system. Through long-term measurements in Blagdon, the performance of the bubble system will be assessed throughout the summer. Concurrent measurements in the peak of summer in Durleigh will then allow comparison of the performance of the two system types. Through these aims, we will generate knowledge that can be used to better understand the hydrodynamics of destratification systems, with a future aim of improving management of our water resources.