Models to inform design of water quality monitoring systems: A novel approach for water supply reservoirs

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Design of a water quality monitoring system

- Where?
- How many?
- How often?
- What?
### Benchmark model

A 3D hydrodynamic and biogeochemical ELCOM – CAEDYM model
Field monitoring

Data for setup and calibration

Benchmark model

- Inflow and outflow
- Meteorological data
- Water temperature
- Water quality
- Flow direction and velocity
Field monitoring

Data for setup and calibration

Benchmark model

Forced with a complex, artificially generated meteorological data field and initial condition profiles systematically varied via simulation
Benchmark model
Field monitoring

Data for setup and calibration

Benchmark model

Forced with a complex, artificially generated meteorological data field and initial condition profiles systematically varied via simulation

Sampled from the BM

Engineering models

Forced with 1 - 3 meteorological forcing stations and initial condition profiles
Engineering model
Procedure

**Time line**

- **Summer**
  - 2008
  - 1 Jan 2008
- **Winter**
  - 2009
  - 1 Jul 2009
- **Summer**
  - 2010
  - 1 Jul 2010
- **Winter**
  - 2011
- **Summer**
  - 2012
  - 28 Feb 2012

**Pre-simulation**

1. **BM**

2. **Warm-up**

3. **Outcome for analysis**

4. **Similarity assessment and Determination of additional “monitoring location”**

* Extraction of initial condition profile and meteorological forcing data

**Engineering model**
Locations of monitoring stations – **BM-EM method**
Water temperature

![Graph showing RMSE vs Number of monitoring stations. The graph has a y-axis labeled RMSE ranging from 0.4 to 0.7 and an x-axis labeled Number of monitoring stations ranging from 0 to 3. The points on the graph are labeled BM-EM.]
Locations of monitoring stations - Random

3 x 1 station
3 x 2 stations
3 x 3 stations
Water temperature

![Graph showing RMSE vs. number of monitoring stations for different methods: BM-EM, Random 1, Random 2, and Random 3.]
• Simulation performance depends on the number and spatial distribution of monitoring stations included.

• The decrease in RMSE is exponential, meaning the addition of a monitoring station is most beneficial for the simulation performance in the beginning and decreases as the number increases.

• The BM-EM approach shows potential to aid in the determination of the number and spatial distribution of monitoring stations within water reservoirs so simulation performance improves.

• Further research is required.
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Questions?

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