# Cyanobacteria in Urban Lakes: Health risk Monitoring and Mathematical modelling

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## Objectives:

✓ Better understand the physical and ecological functioning of urban lakes
✓ Validate hydrodynamic and ecological model
✓ Predict cyanobacterial behavior in lakes

## Motivation:

Water bodies are essential recreational areas for the city residents and important spots of biodiversity in densely populated regions. Therefore, the determinants of their water quality and their ecological status must be better understood.

### European Directive

In response to the degradation of water resources and to avoid health risks the European Community created the Water Directive (2006/7/EC) concerning the management of bathing water quality.

This Directive presents indicator parameters for predicting microbiological health risk and to achieve a high level of protection of inland surface waters.

### Research Project and local Partnership

A research project, OSS-Cyano, funded by the French Research Agency ANR and conducted at LEESU (*Ecole des Ponts ParisTech*) is aimed at developing a new monitoring and warning system for cyanobacteria blooms in lakes. In the framework of this project, a partnership with a local authority (*Conseil départemental de Seine-Saint-Denis*) made it possible to implement an experimental setup in Lake Champs-sur-Marne.
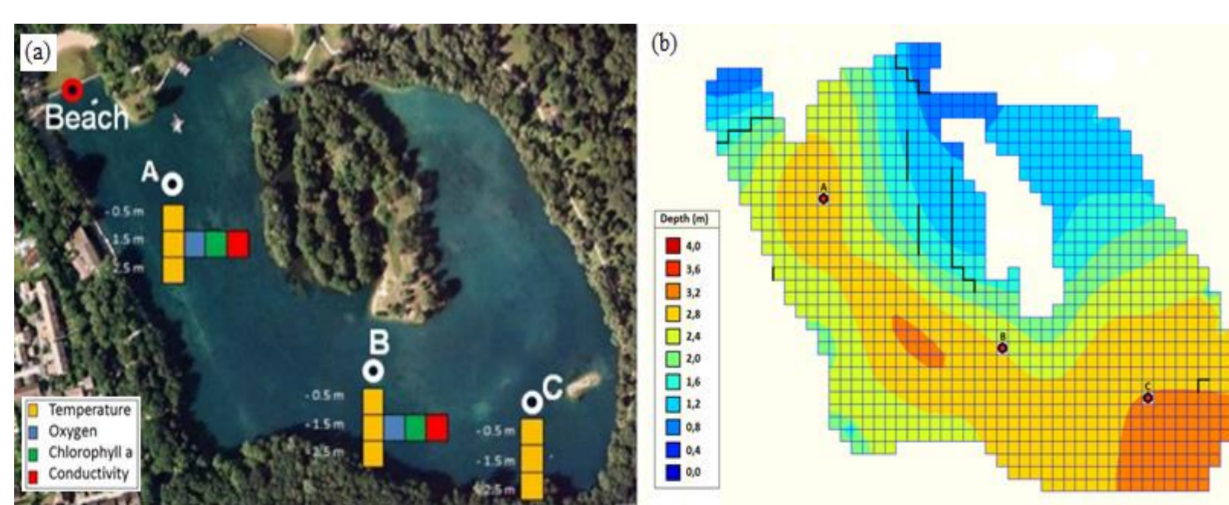
### Bathing Prohibited:

Bathing in Lake Champs-sur-Marne has been repeatedly prohibited in summer because of potentially toxic cyanobacteria blooms and health risks.



### Monitoring and modelling of Lake Champs-sur-Marne

Monitoring: High-frequency since 2015.
Modelling: Delft3D-FLOW for hydrodynamics and D-Water Quality for phytoplankton dynamics



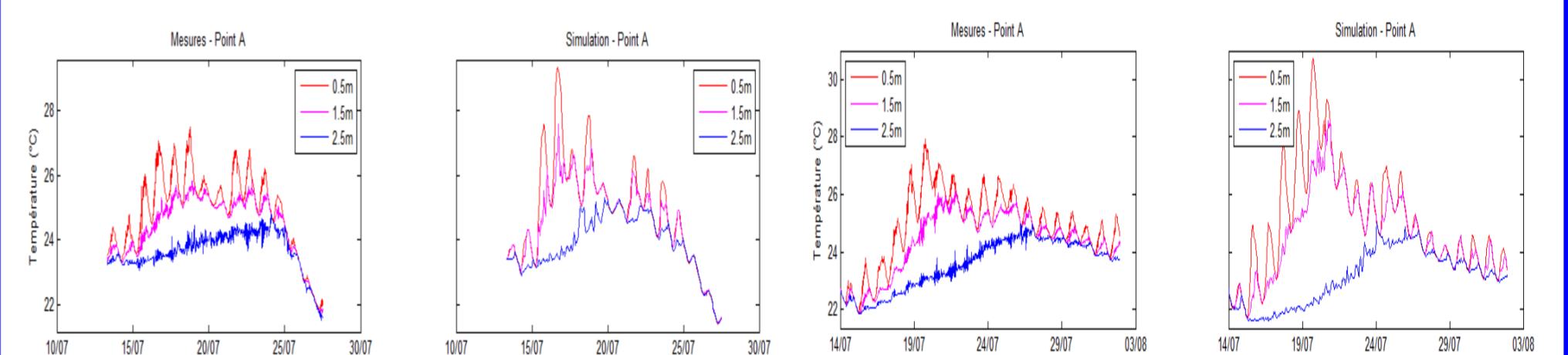### Calibration and Validation periods

Selected according to the following criteria:
(i) at least 10 µg/L of Chl-a (low threshold value for warning);
(ii) presence of cyanobacteria;
(iii) profile measurement during the period;
(iv) start with a mixed condition;
(v) thermal stratification during most of the period.
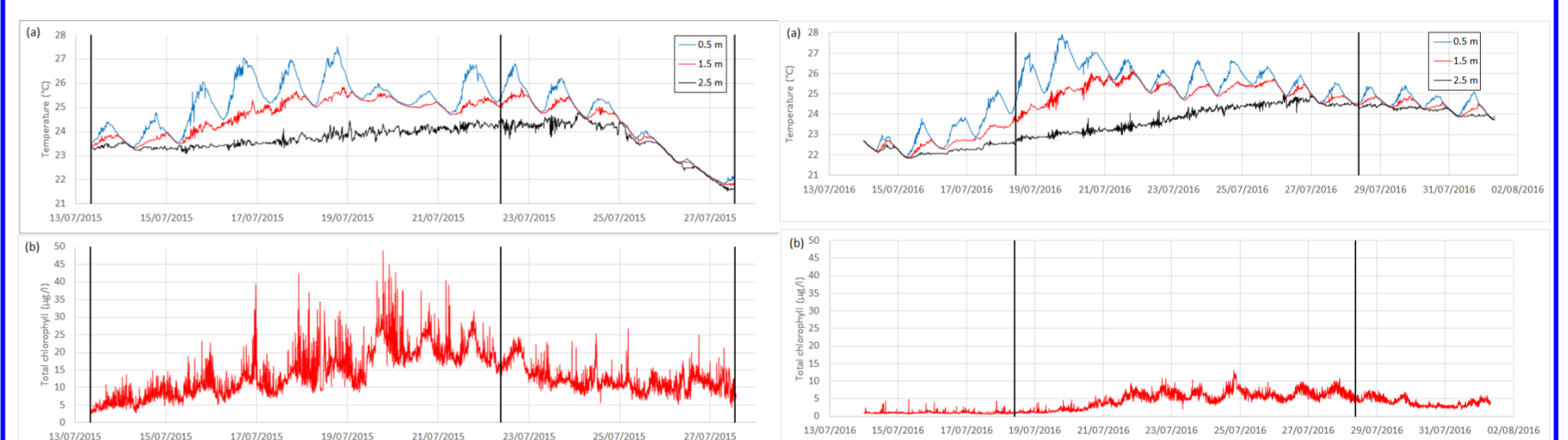


### Calibration and Validation Hydrodynamics Results

The measured water temperature was compared to the model outputs for the calibration period
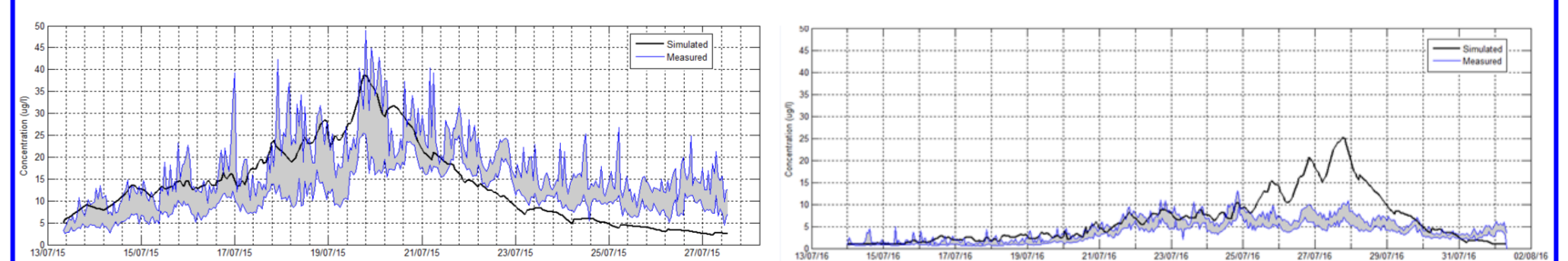


Performance indicators:
Calibration Period: MAE between 0,30 and 0,62 °C, $R^2$ between 0,63 and 0,84
Validation Period: MAE between 0,48 and 0,77 °C, $R^2$ between 0,71 and 0,89

### Calibration and Validation Ecological Results



Performance indicators:
Calibration Period: MAE=5,8 µg/L, $R^2$=0,46, RE=0,42 (n=342)
Validation Period: MAE=2,95 µg/L, $R^2$=0,59, RE=0,77 (n=441)

## Applications

Monitoring and forecasting the phytoplankton biomass concentrations in space and time are crucial aspects in aquatic ecosystem management.
Models can also provides information to lake managers on the important ecological processes in the lake, helping to find the way in which management problems arise and the options available for conservation and rehabilitation of the lake quality.

After further validation on other independent data sets, we expect that this model will provide a reliable tool for predicting the cyanobacteria biomass in Lake Champs-sur-Marne as well as other similar small lakes and it will be integrated into a cyanobacteria bloom warning system.