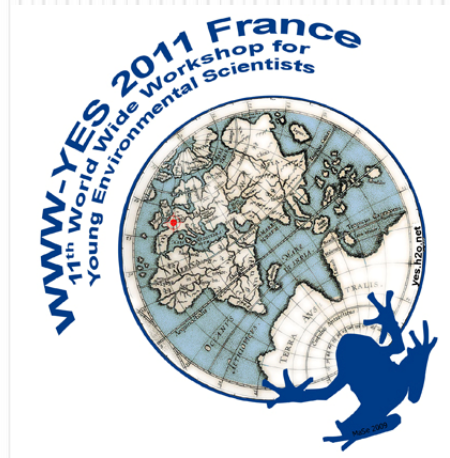


A coupled hydrodynamic biological model for cyanobacteria dynamics in reservoirs

Ali Fadel, Bruno J. Lemaire,
Brigitte Vinçon-Leite



Outline

- Introduction
- Materials and methods
 - Study sites
 - Measurement methods
 - DYRESM-CAEDYM model
- Results and discussion
 - Field observation
 - Simulation
 - Results interpretation
- Conclusion and perspectives

Introduction

- Reservoirs usages
 - Flood control
 - Power generation
 - Drinking, Irrigation, etc.

- Toxic cyanobacteria (*Microcystis aeruginosa*)
- Need for a simple tool for early warning of phytoplankton proliferations



Microcystis aeruginosa

- Cyanobacteria (blue-green algae)
 - Phycocyanin and chlorophyll a
 - Mid to late summer
 - Warm, fresh, nutrient enriched water
-
- Problems caused:
 - Hypoxia
 - Odor and taste
 - Health problems (microcystin)



MATERIAL & METHODS

Study sites

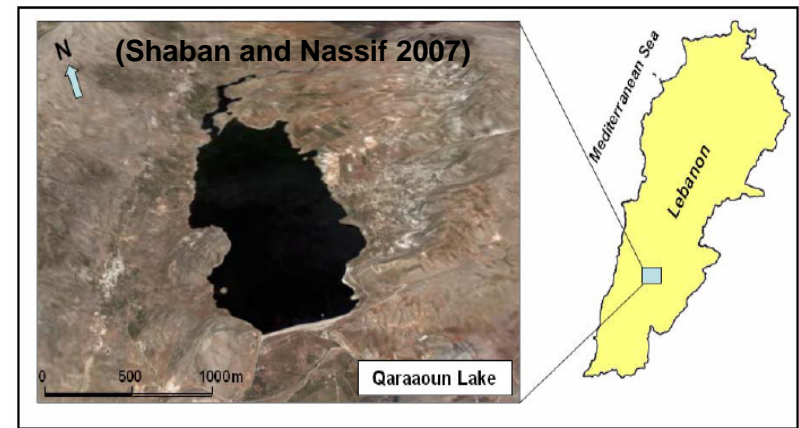
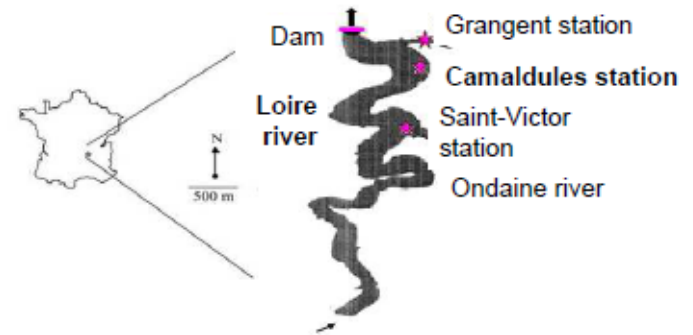
- Energy production, drinking and irrigation, nautical activities, etc....

- Grangent reservoir (France)

- 57.4 million m³
- maximum depth 50 m
- 415 m elevation

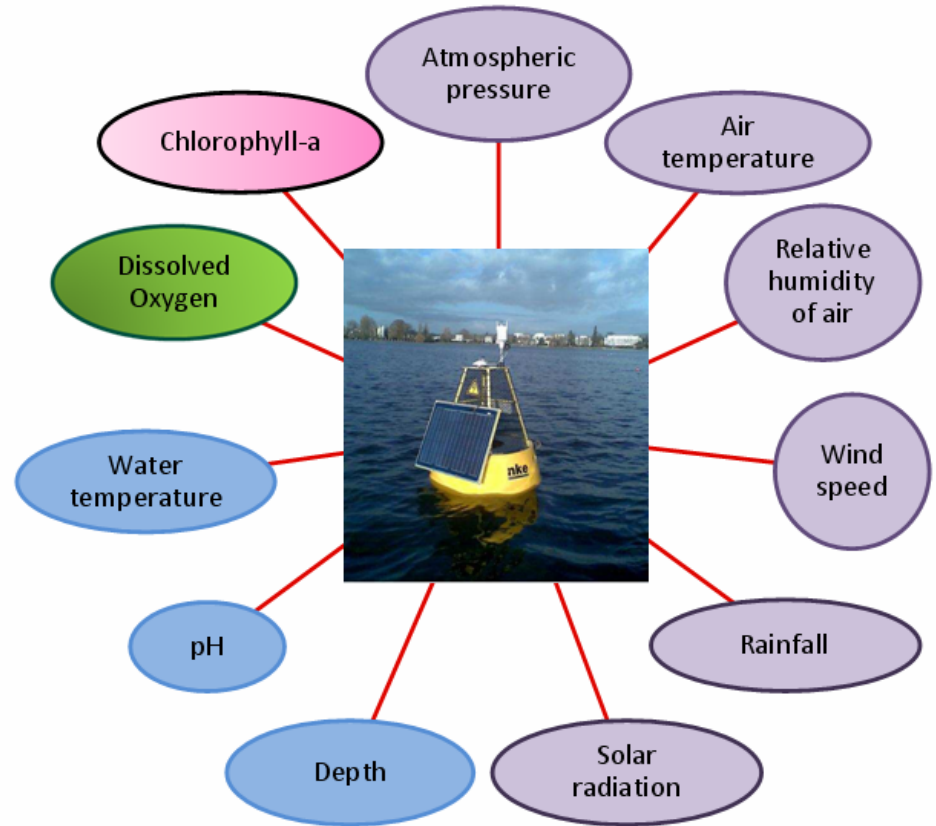
- Karaoun reservoir (Lebanon)

- 220 million m³
- maximum depth 45 m
- 860 m elevation



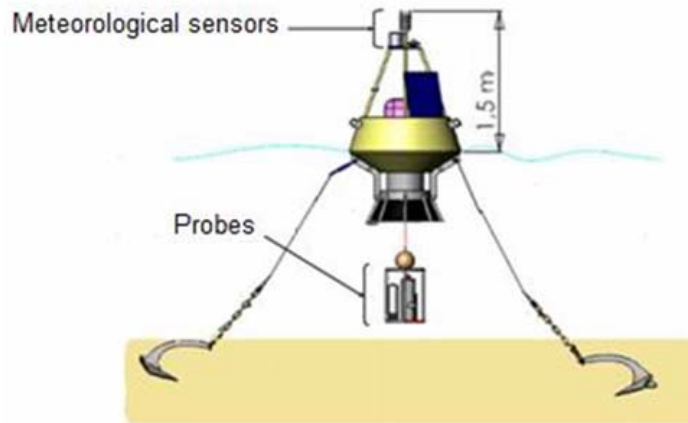
PROLIPHYC PROJECT

- A measurement buoy
 - Continuous measurements
 - Remote and high-frequency data (30 min)
- Warning system:
 - Based on the weather forecast
 - Short-term predictive modelling



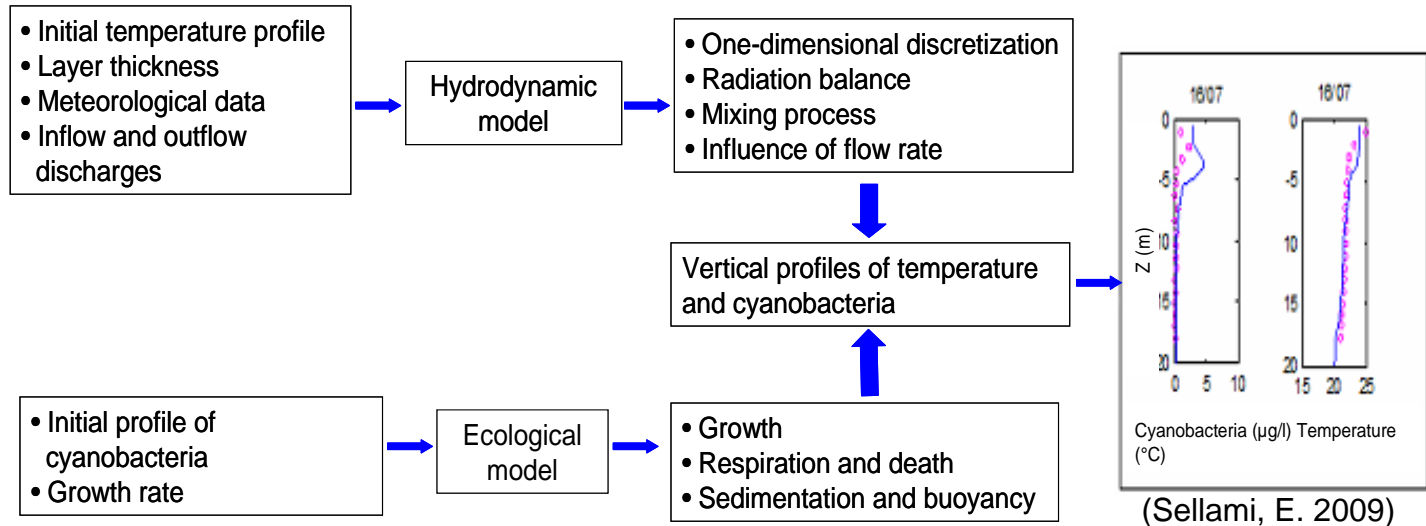
Measurement methods for Grangent

- **PROLIPHYC**, monitoring and warning system
 - Autonomous
 - Profiler with underwater sensors
 - Meteorological measurements
 - Teletransmission to data base and model
 - Automatic antibiofouling treatment
 - Cyanobacterial concentrations



DYRESM-CAEDYM model

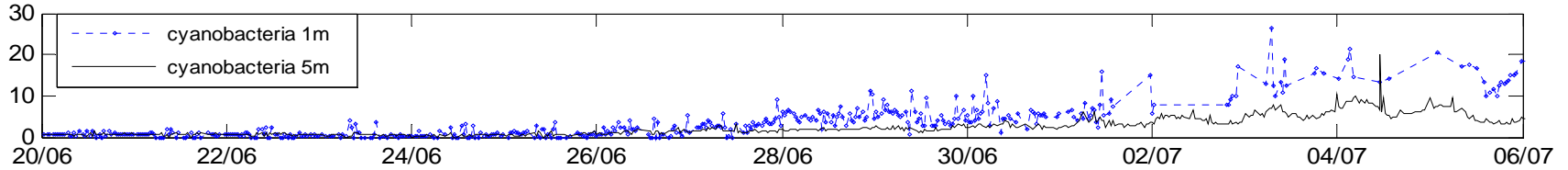
- Centre for Water Research (CWR), Australia
- DYRESM, Dynamic Reservoir Simulation Model
 - simulates temperature, salinity and density
 - one dimensionality, no role for horizontal variation
- CAEDYM, Computational Aquatic Ecosystem DYNamics Model
 - Aquatic ecological model
 - linked to a hydrodynamic model
 - Simulate phytoplankton dynamics.



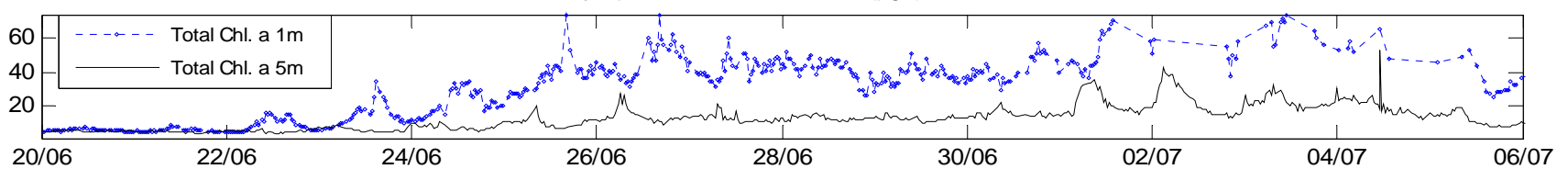
RESULTS AND DISCUSSION

Field observations

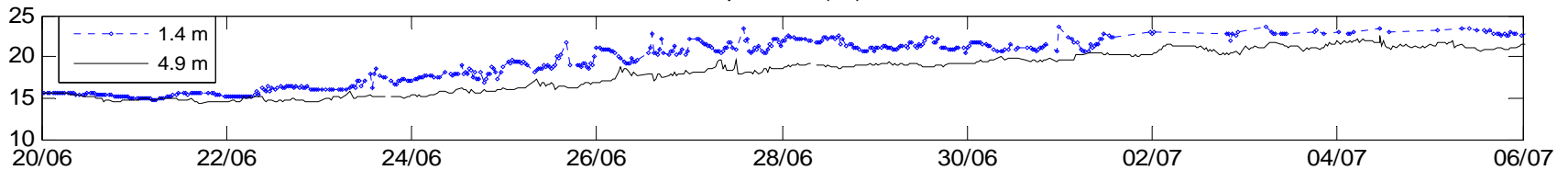
Cyanobacteria concentration ($\mu\text{g/l}$) in 2010



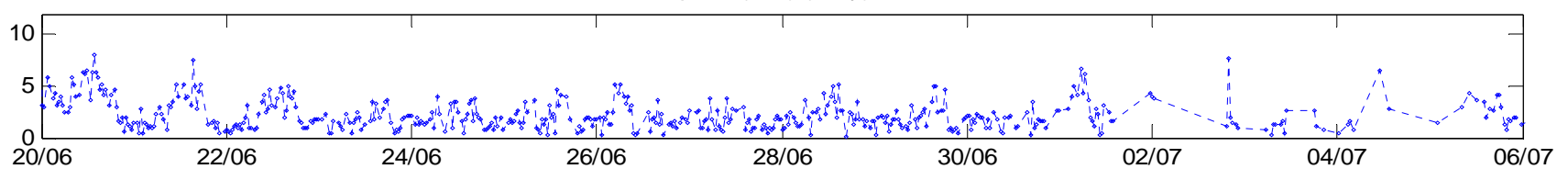
Phytoplankton concentration ($\mu\text{g/l}$) in 2010



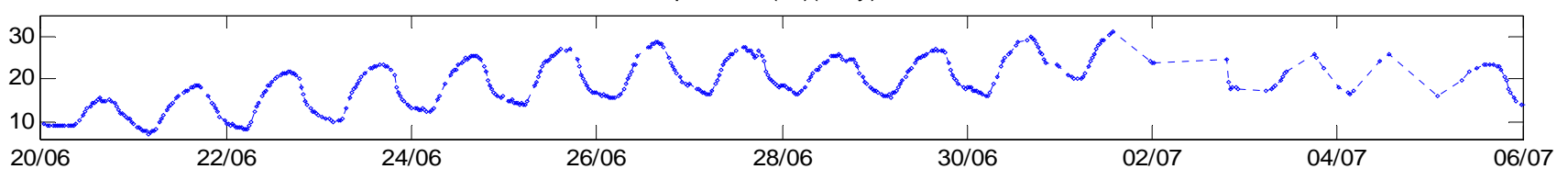
Water temperature ($^{\circ}\text{C}$) in 2010



Wind speed (m/s) (bouy) in 2010

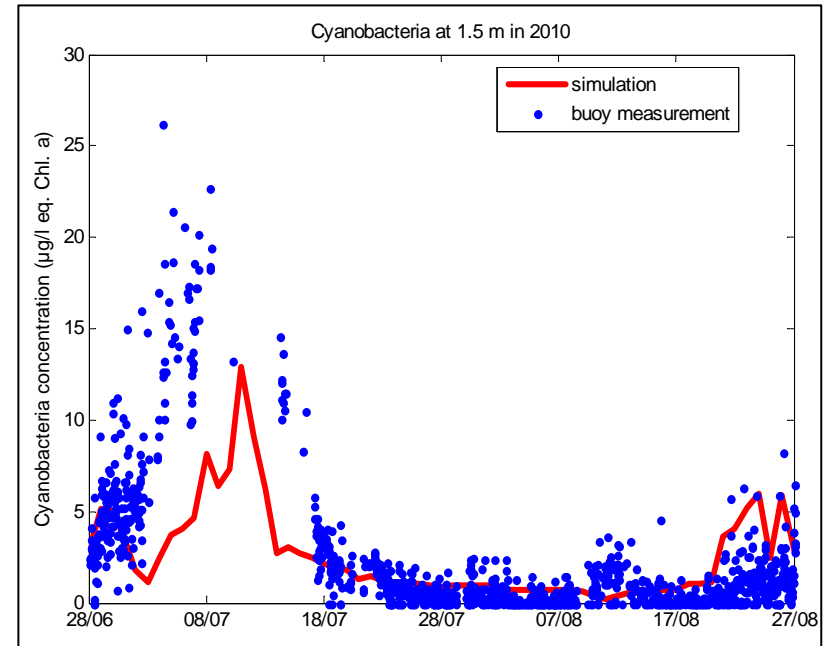
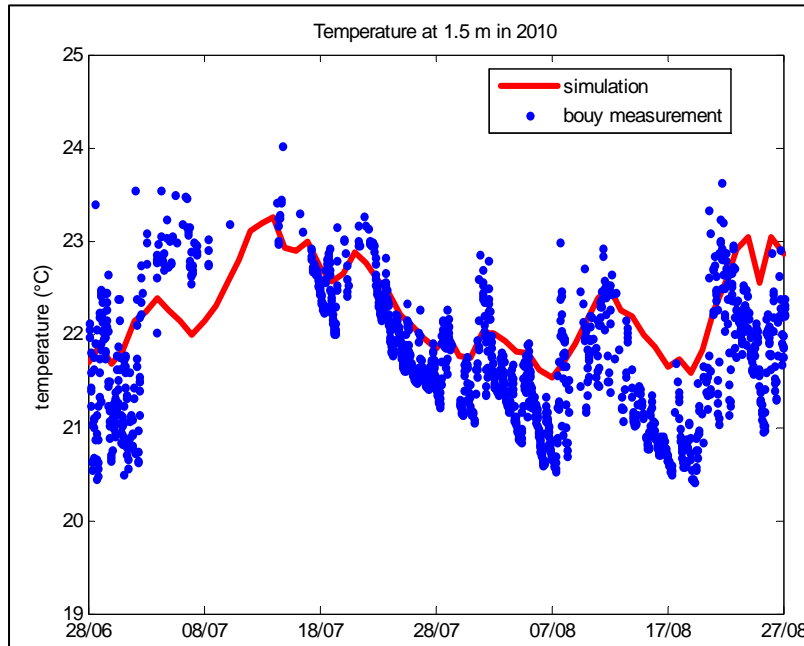


Air temperature ($^{\circ}\text{C}$)(bouy) in 2010



Simulation results

- 2 months (from 28th of June till 28th of August) 2010
- Inflow and outflow were neglected (not available)
- Ability to follow the trend
- Low average mean squared error



Conclusions and perspectives

- Grangent
 - Capability to simulate cyanobacteria dynamics
 - Increase the number of simulated groups
 - More precise simulation (short duration)
- Karaoun
 - Build a reliable database
 - Verify the ability of DYCD to simulate cyanobacteria dynamics
 - Influence of different weather and hydrological conditions, withdrawal, etc.....
 - Propose and analyze management scenarios

*Thanks for your
attention*