Impact of climate changes on salmonidae habitats in northern Québec lakes

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NIVA Norsk institutt for vannforskning
GRIL Groupe de recherche interuniversitaire en limnologie et en environnement aquatique
CENTRE D'ÉTUDES NORDIQUES CEN Centre for Northern Studies
Fondsvert Québec
NSERC CRSNG
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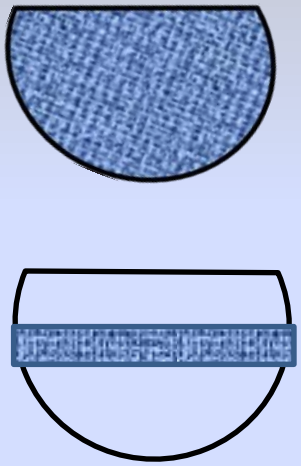
Contents

1. Introduction

Salmonidae habitats

Touladi
(*Salvelinus namaycush*)
Lake Trout

Habitat
$T < 12°$ et $[O_2] \geq 6$ mg l^{-1}



Complete habitat

Partial shelter

No habitat

2. Objectives

Objectives

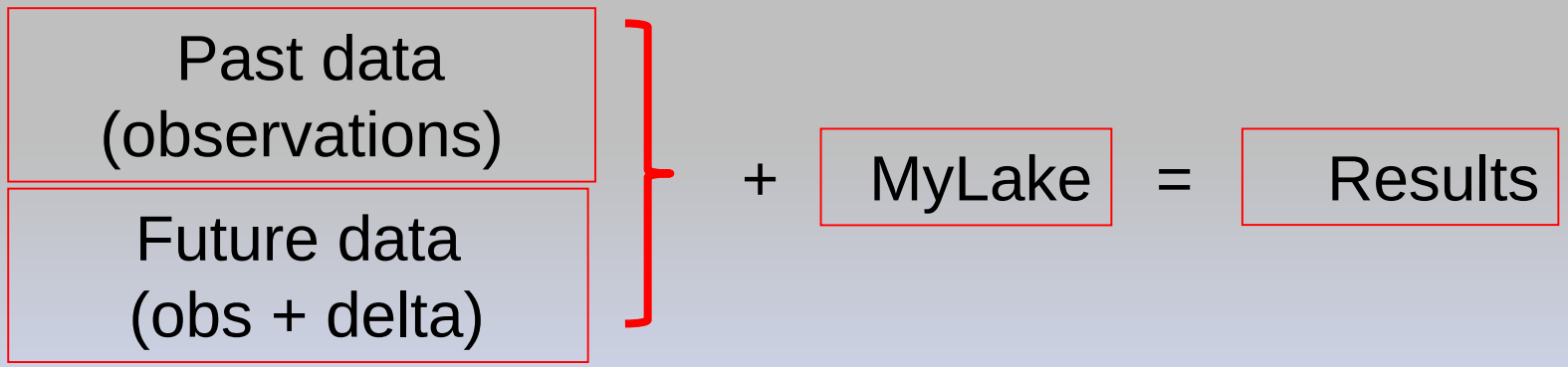
The objectives of this work are to estimate the temperature and dissolved oxygen concentrations in lakes in northern regions and to predict their impact on the future availability of habitats for Lake Trout and Arctic Char. The results will be used to manage the resource. The project was carried out in two steps.

1. Estimate the impacts of climate changes on thermal habitats for the 2041-2070 horizon. (June 2010 to April 2013)

2. Estimate the impacts of climate changes on thermal and oxic habitats for the 2041-2070 et 2071-2100 horizons. (November 2015 to August 2017)

3. Methods

Delta method : an overview



The climate, past and future, simulations are based on a 30 year period: 1981-2010.

δ = average of future forecasts (2041-2070 et 2071-2100)
– average of past simulations (1981-2010)

Future series = past observations + δ (monthly δ)

We used only one greenhouse gaz warming scénario: the most pessimistic one (RCP 8.5)

4. Impacts of climate changes on thermal and oxic habitats

Four real lakes
and eight
"theoretical" lakes

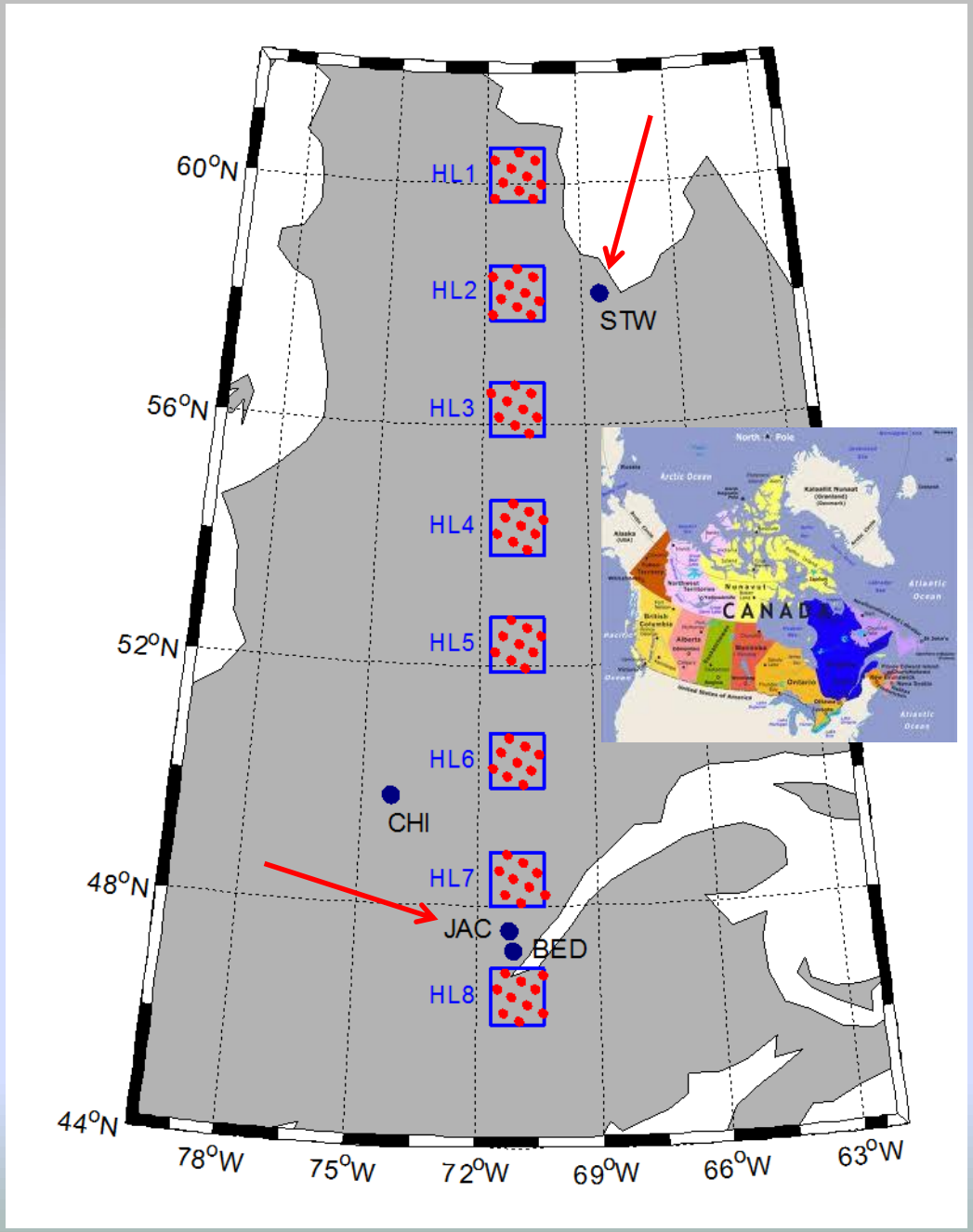
Stewart (STW)
8.5 km² - 15 m

Chibougamau (CHI)
213.1 km² - 59 m

Jacques-Cartier (JAC)
12.6 km² - 68 m

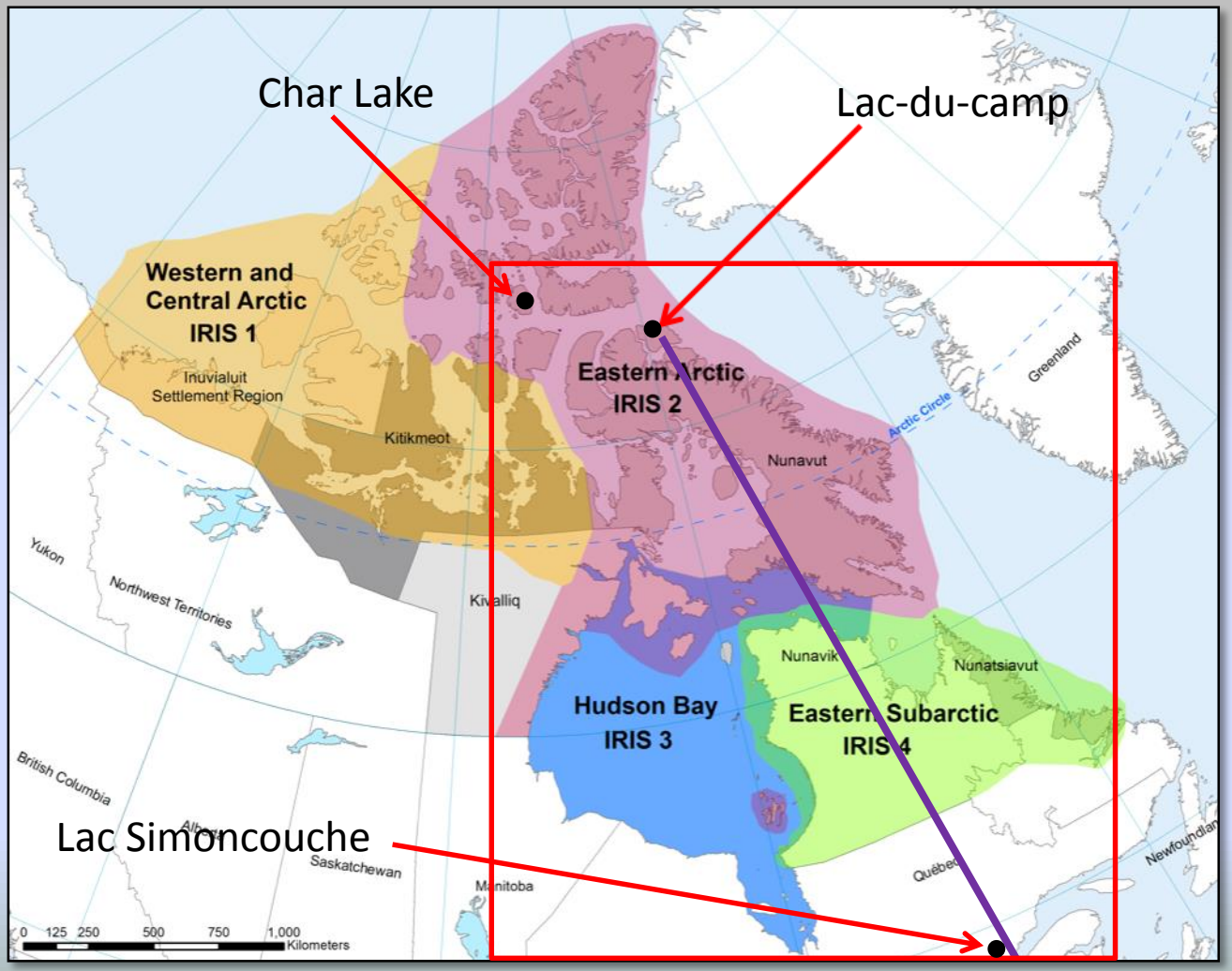
Bédard (BED)
0.06 km² - 11 m

Eight positions
along 71° W



North-South Section : O_2 et T

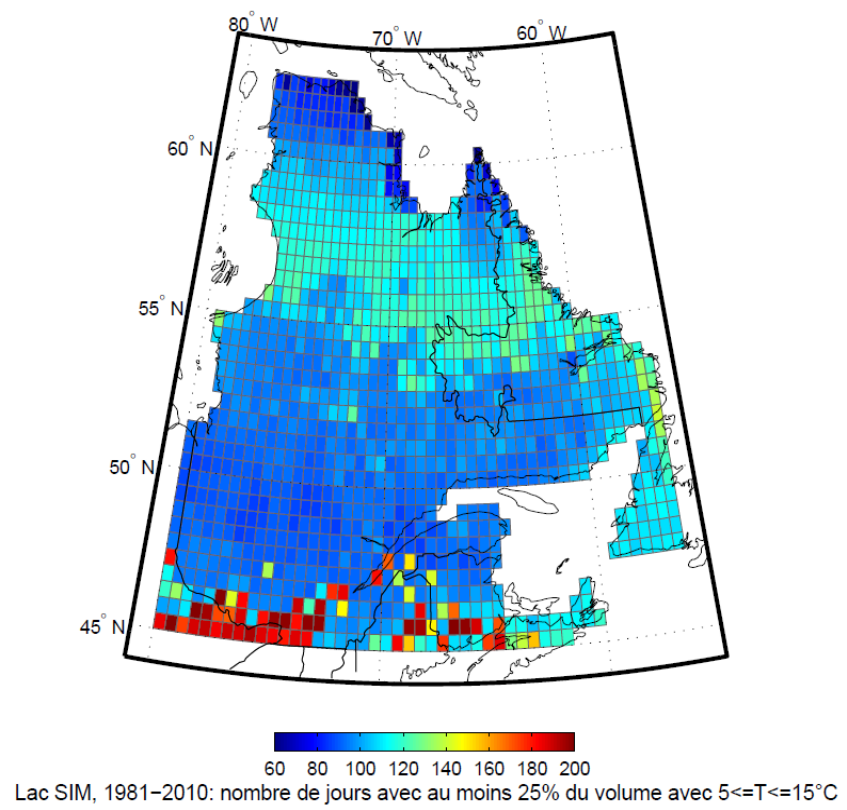
(approximative)



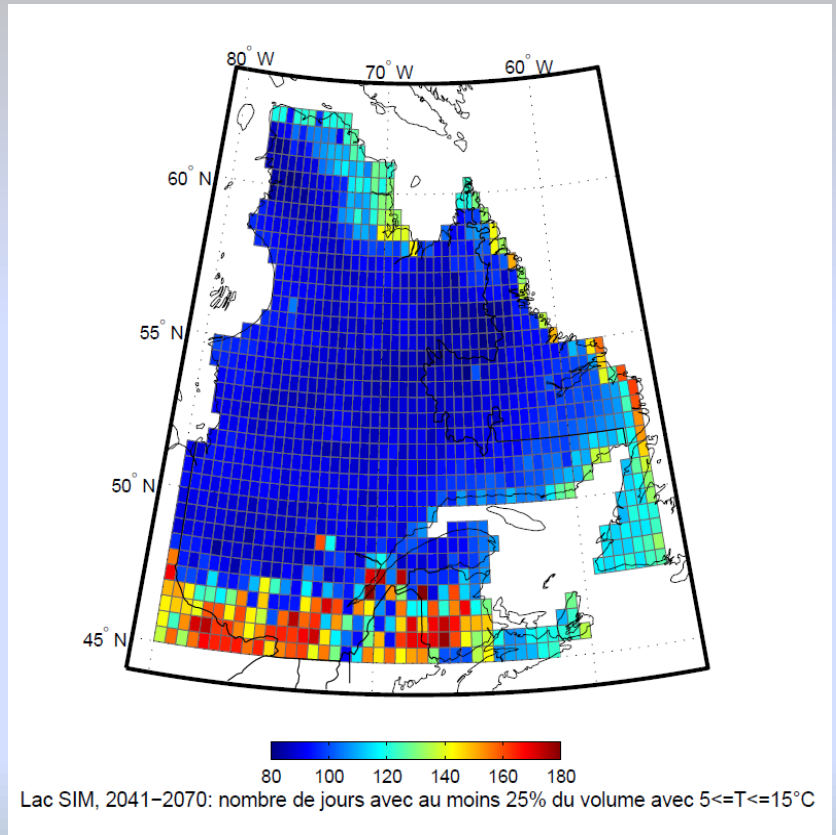
Thermal habitats

Number of days with at least 25% of the volume between 5° and 15°C

1981-2010

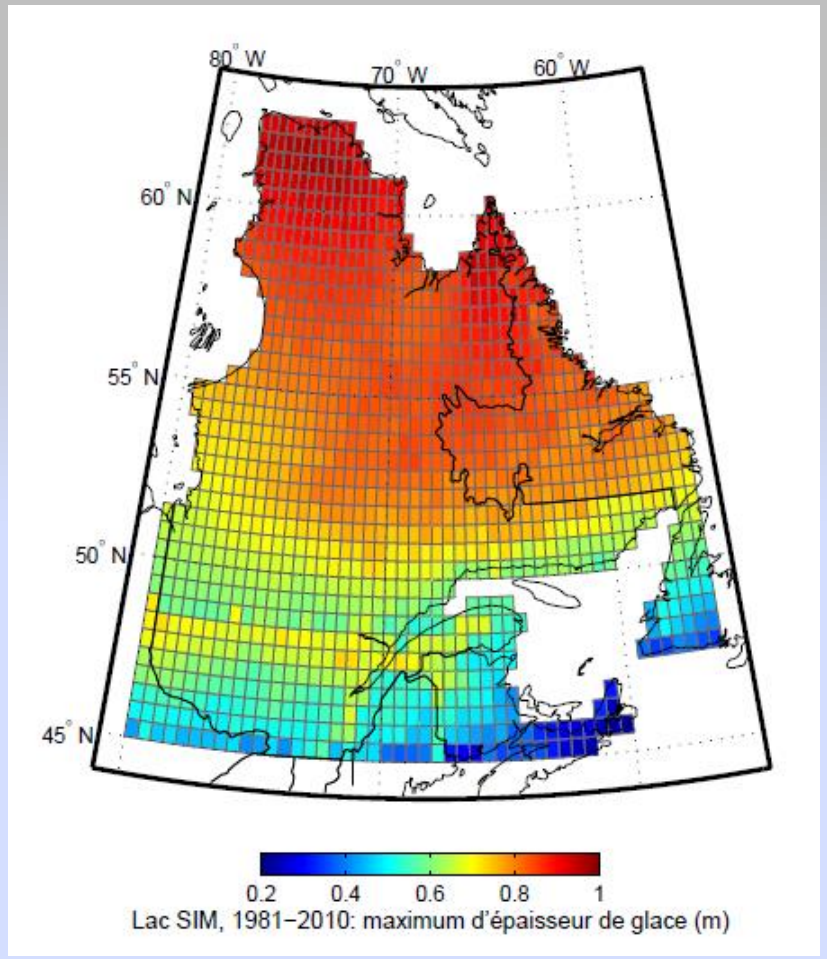


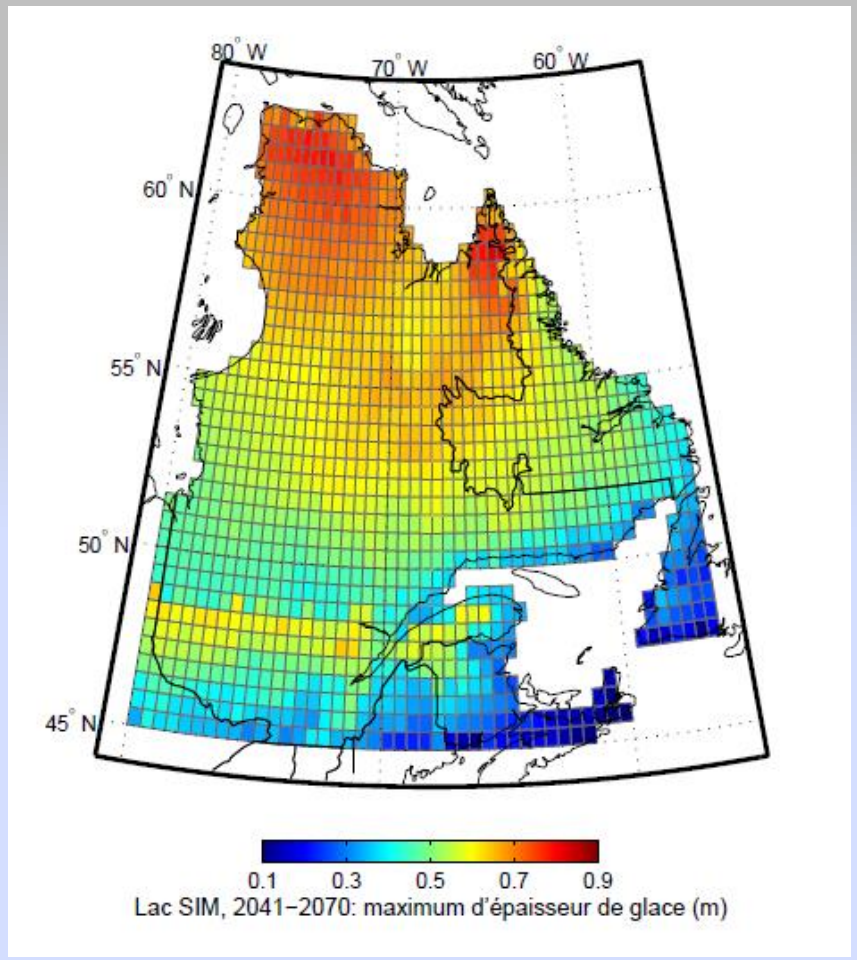
2041-2070



Simoncouche Lake

Maximum ice thickness





1981-2010

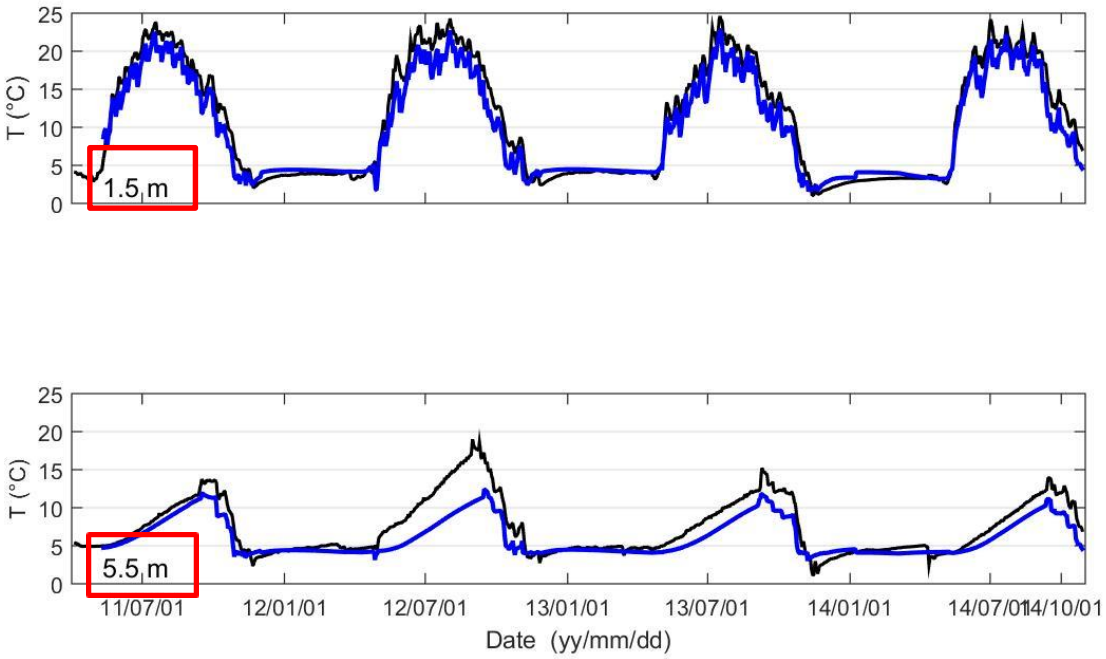
2041-2070

Simoncouche Lake

(z_{max} = 8.4 m; 0.83 km²)

Temperatures

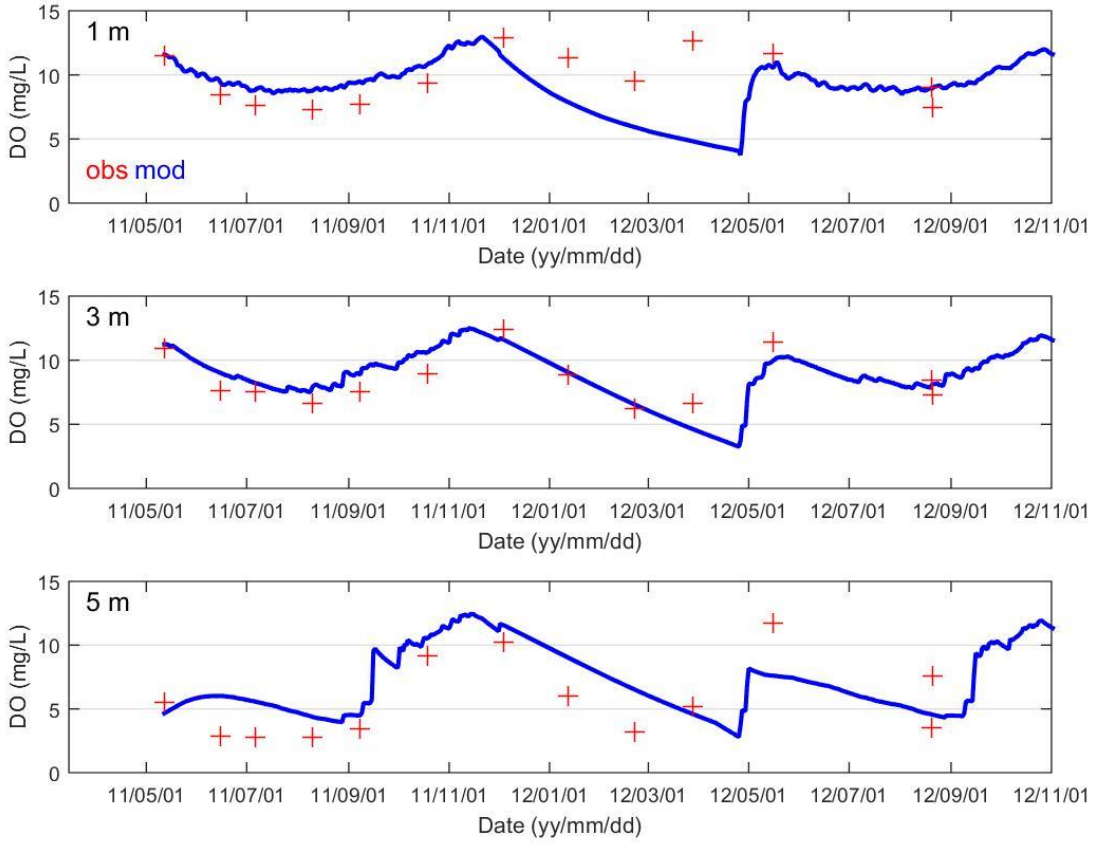
Observations (in black) and model (in blue)



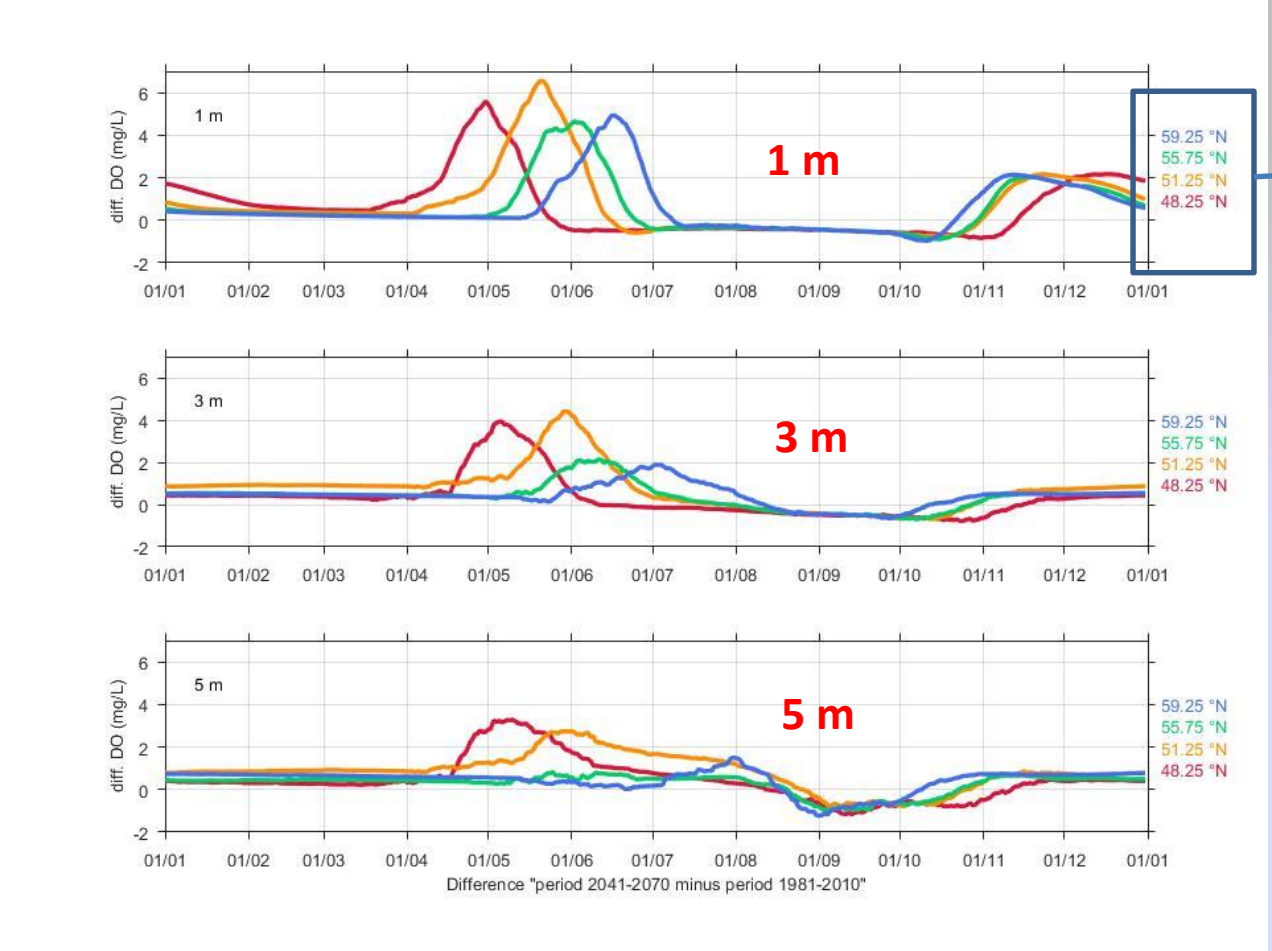
Oxic Habitats

Simoncouche Lake

(z_{max} = 8.4 m; 0.83 km^2)



Differences between 2041-2070 and 1981-2010



59.25°
55.75°
52.25°
48.25°

Less ice => more oxygen earlier in the season

5. Summary and Conclusions

Main results

Surprisingly good results for a 1-D model

- The model is very stable
- Temperature are exceptionnally well reproduced
- The dissolved oxygen demand (DOD) works very well

but there are still some small

- Problems with near surface DO exchanges in winter
- Problems with near bottom DO exchanges at first