RBR
rbr-global.com

Product Overview: RBR*solo* ³ T

Candace Smith

Technical Sales Manager

Loggers

OEM

Sensors

Systems

RBR


RBRcoda ODO
RBRcoda^3
RBRconcerto^3
RBRmaestro^3
RBRconcerto^3
RBRbrevio^3
RBRsolo^3

RBR

RBR*solo*^{3} T

Compact temperature logger (memory + battery)

2Hz sampling => 25 million readings on a single AA battery

2Hz sampling => ~5 months deployment

5s sampling => 6.6 years

±0.002°C accuracy

<0.00005°C resolution

RBR

Compact temperature logger versions

- RBR*solo*³ T – shallow (1 700m) with 1s time constant thermistor

- RBR*solo* ³ T|fast8 (16Hz or 32Hz) – shallow with 0.1s time constant thermistor

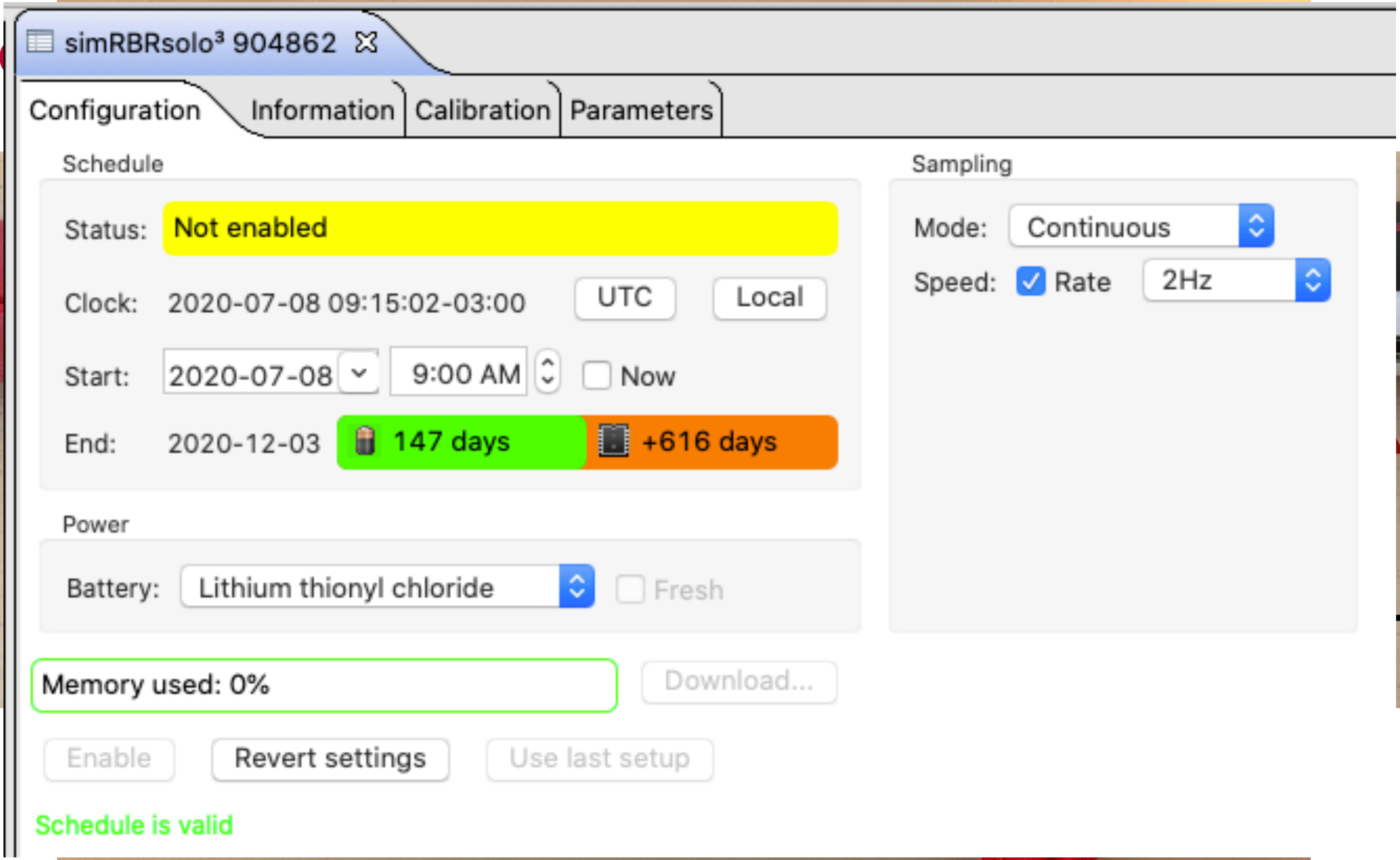
nstant thermistor

- RBR*solo* ³ T|fast8|deep (16Hz or 32Hz) - deep with 0.1s time constant thermistor

- RBRduet³ T.D – shallow, deep, fast (8Hz, 16Hz, 32Hz, wave, tide)

RBR

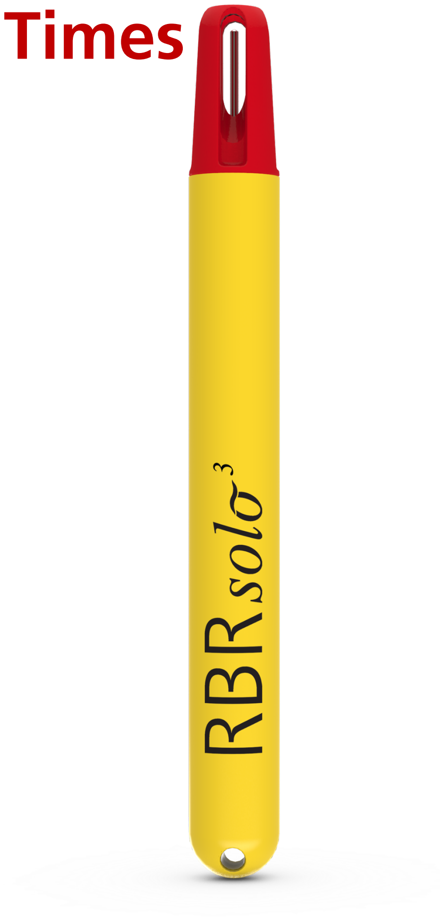
Insi


simRBRsolo³ 904862
Configuration
Information
Calibration
Parameters
Schedule
Status: Not enabled
Clock: 2020-07-08 09:15:02-03:00
UTC
Local
Start: 2020-07-08
9:00 AM
Now
End: 2020-12-03
147 days
+616 days
Power
Battery: Lithium thionyl chloride
Fresh
Sampling
Mode: Continuous
Speed: Rate 2Hz
Memory used: 0%
Download...
Enable
Revert settings
Use last setup
Schedule is valid

-C

Special Pricing RBR*solo*^{3} T and Lead Times

- **Quantity discount:**
  - 0.5% * Quantity (from 2) to max discount of 20%
    - 30 units is a 15% discount
- **Pre-paid calibration voucher:**
  - < $200 per unit
- **Lead times:**
  - Up to 50 units in 4 weeks



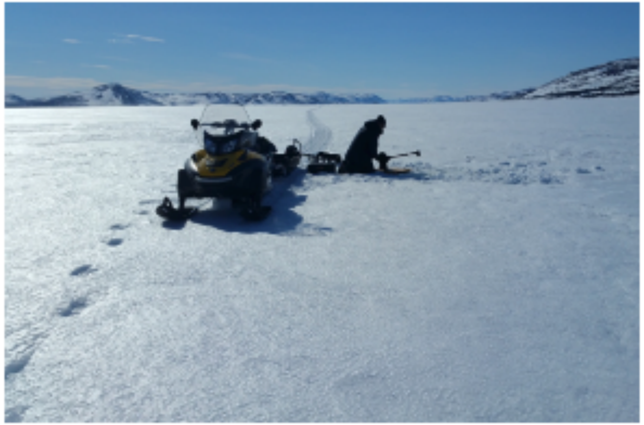
RBR

Upcoming Webinars

Future Webinars

Sensor Technologies for Measuring Arctic Methane: The ChemYak in Nunavut

Anna Michel (WHOI)
July 15, 2020 at 12PM EDT



Community-based observing of the coastal ocean in Nunatsiavut

Eric Oliver (Dalhousie University)
July 22, 2020 at 12PM EDT

RBR

Thank You

Contact Us

RBR
rbr-global.com
info@rbr-global.com
+1 613 599 8900

RBR

Using high-frequency observations of temperature and dissolved oxygen to reveal under-ice convection in a large lake

Bernard Yang[1], Joelle Young[2], Jz Li[1] & Laura Brown[3], Mathew Wells[1]

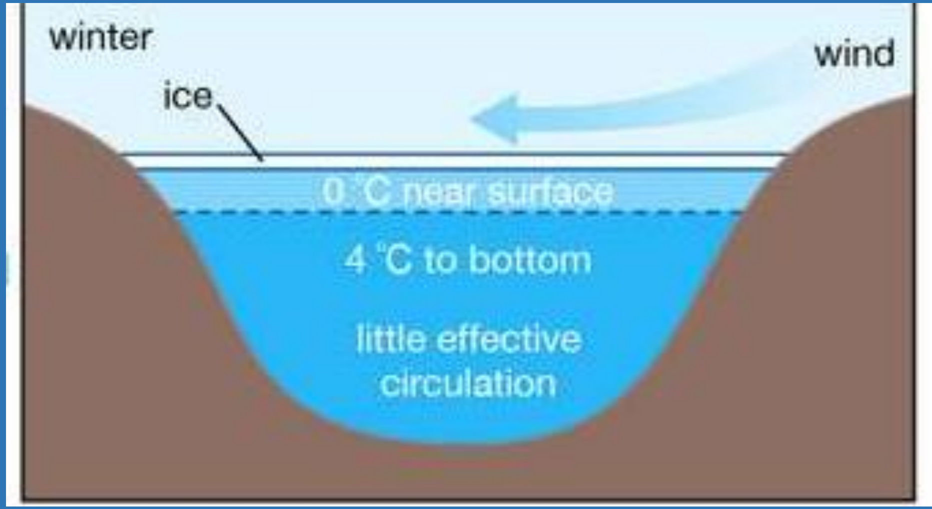
[1] University of Toronto Scarborough
[2] Ontario Ministry of Environment , Conservation, and Parks
[3] University of Toronto Mississauga

- Inter-annual variations in under-ice thermal stratification are explained by differences in ice cover

- We use high frequency and accurate temperature loggers to analyze the thermal structure in ice-covered lakes

- The most vigorous convection is associated with high solar radiation

Dimictic lakes in winter and spring



Winter stratification

Spring Overturn

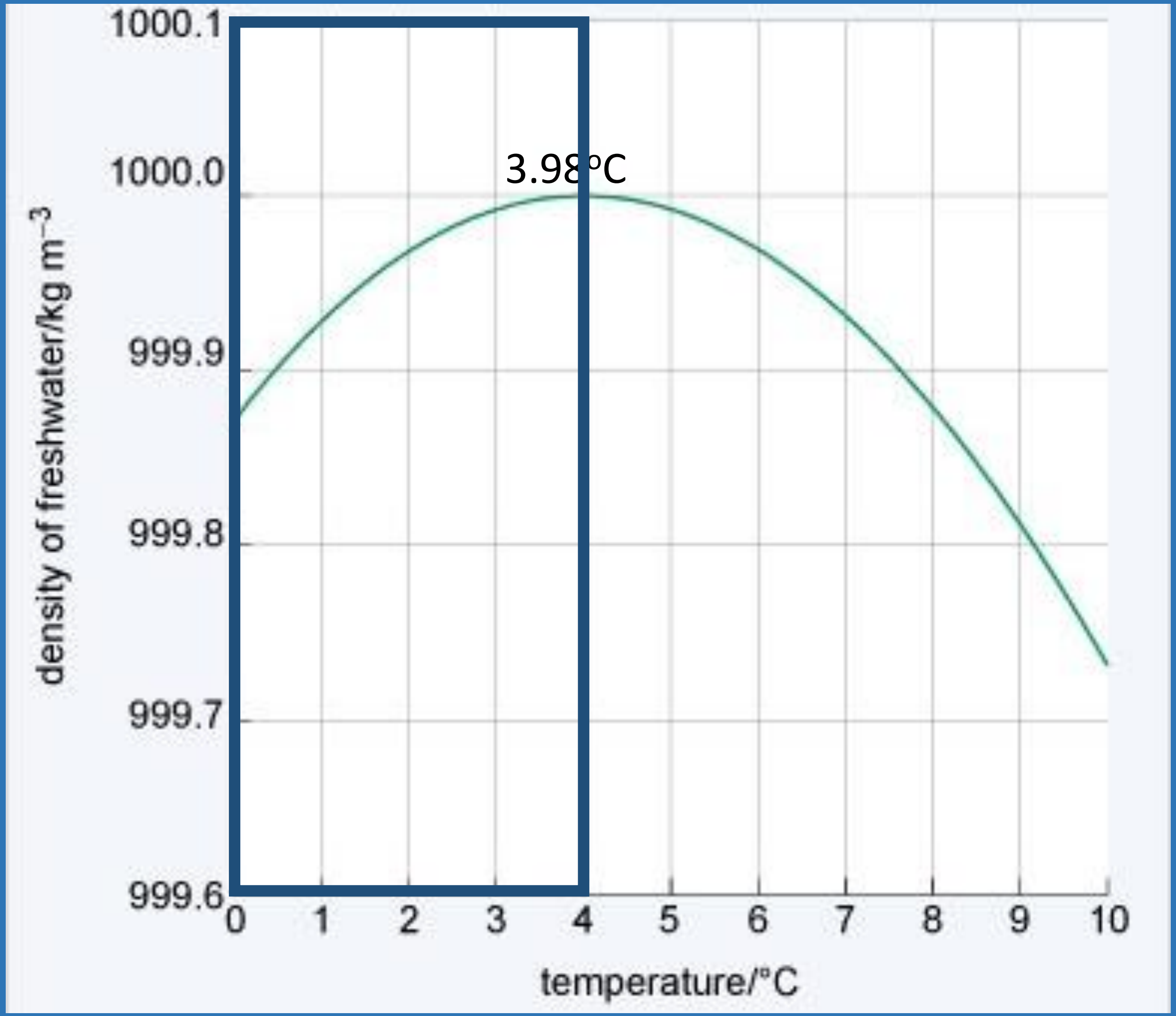
Picture from Encyclopedia Britannica

Dimictic lakes fully mixes twice per year in spring and fall

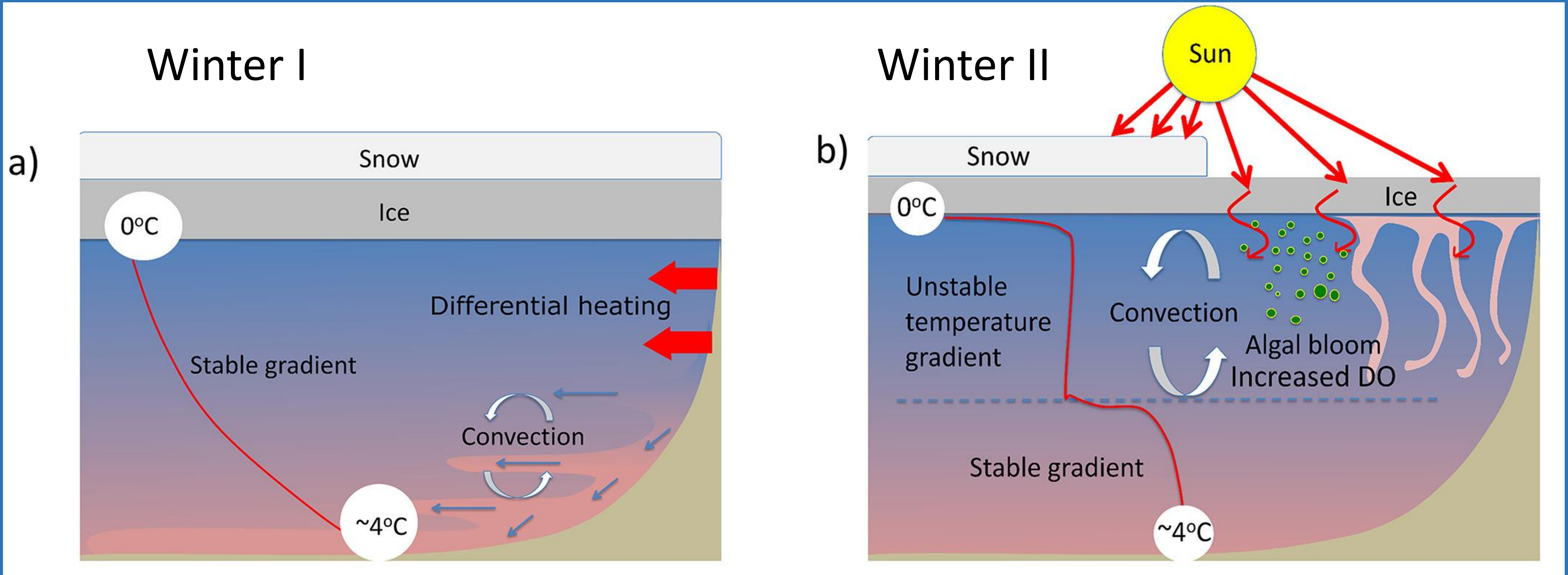
Many lakes are in northern countries, and seasonally ice-covered

What are the important physical processes in winter and spring

The density of water in kg/m^3 is plotted as a function of temperature. Below the temperature of maximum density, 4^{o}C, any heating leads to an increase in density, whereas above 4^{o}C heating leads to a decrease in density.

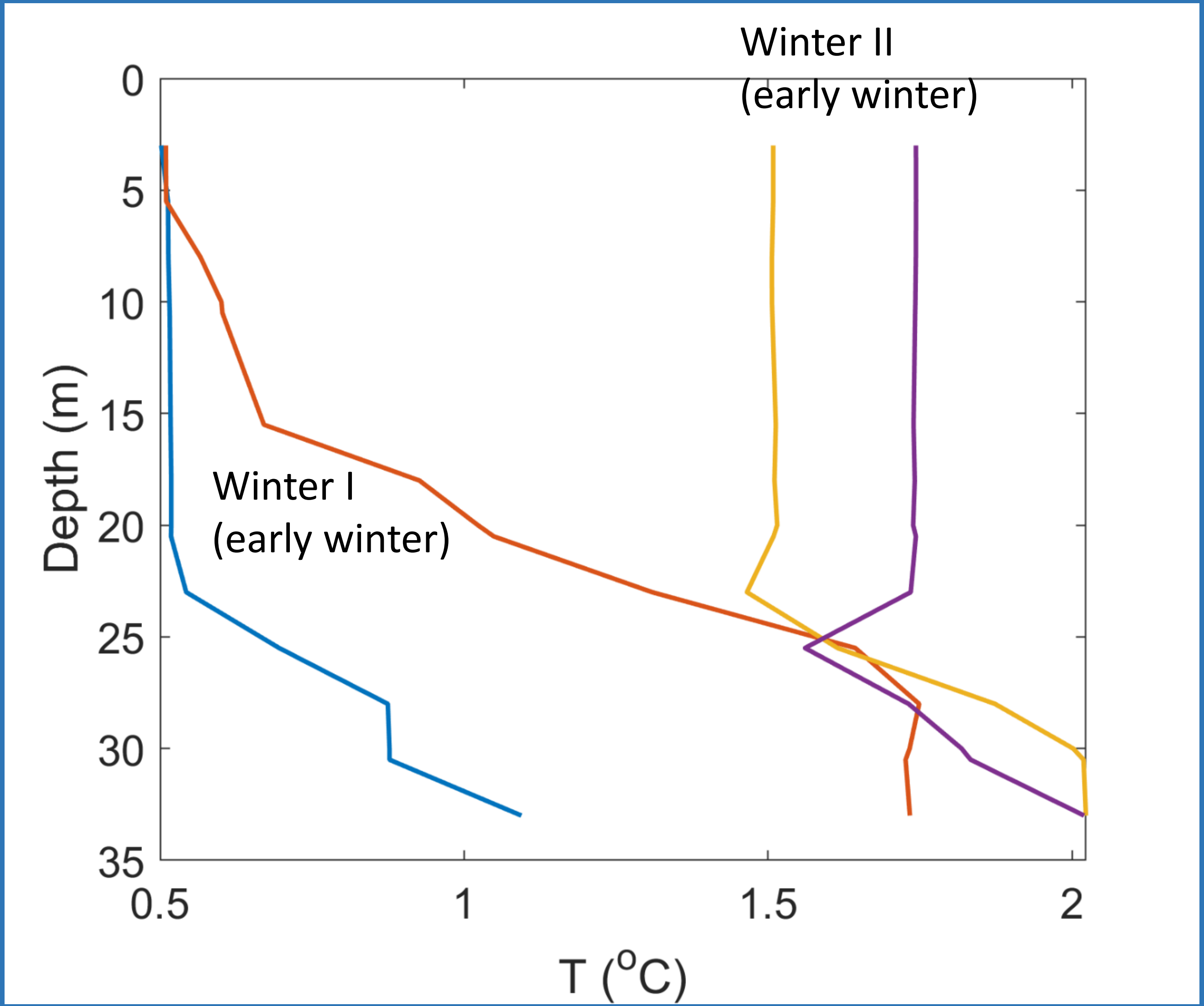


Freshwater equation of state



a) Dynamics during Winter I when differential heating from sediment drives warming of lower layers.
b) Dynamics during Winter II when solar radiation drives convection from upper layer, and possible algal blooms lead to increases in dissolved oxygen (figure after Kirillin *et al.* 2012).

Weak vertical temperature gradients in ice-covered lakes



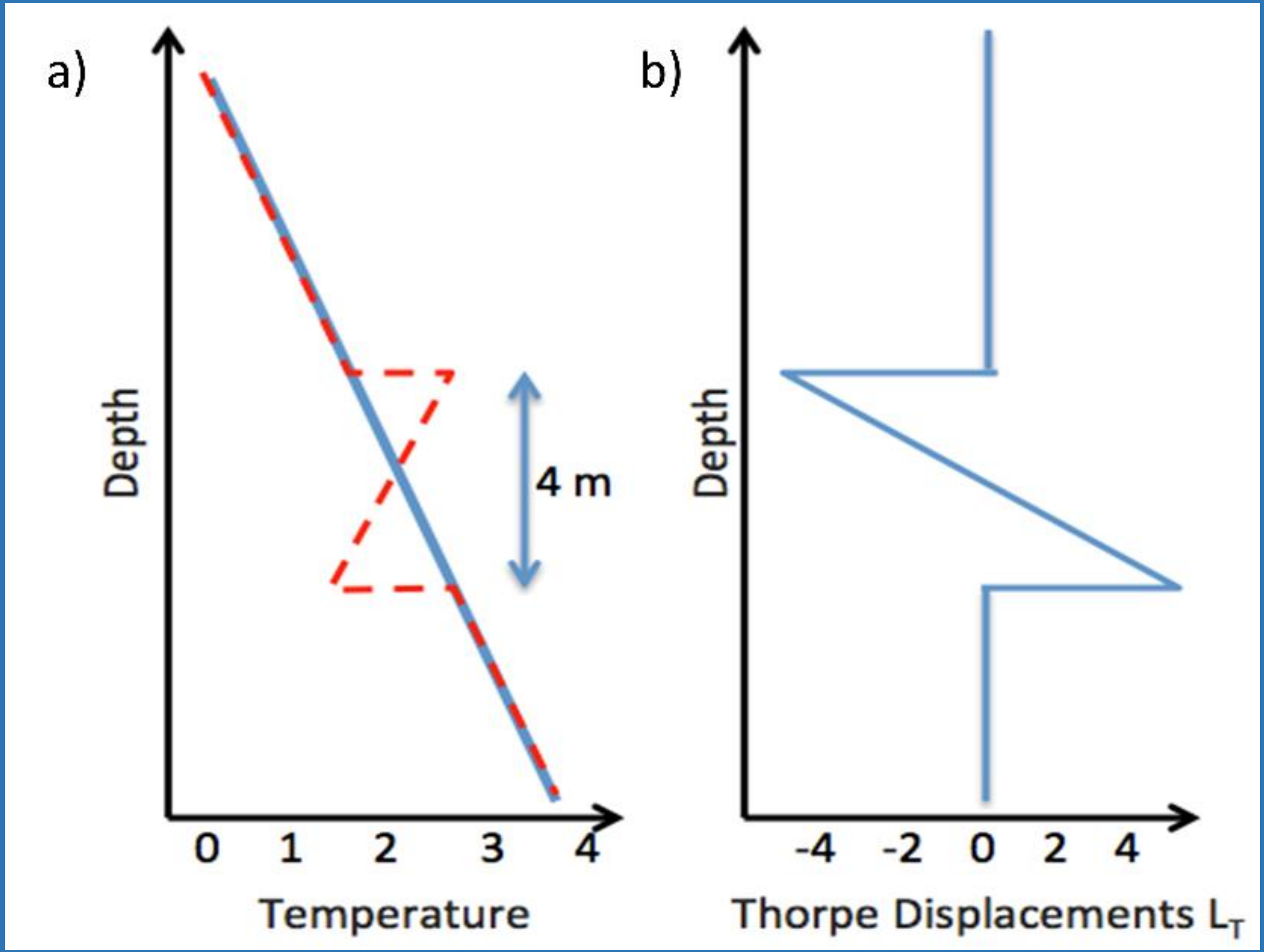
Sample vertical temperature profiles from Lake Simcoe in the winter of 2015

The range of temperatures is narrow

Temperature difference between loggers can be < 0.1^{o}C, in the surface mixing layer, variability is < 0.01^{o}C

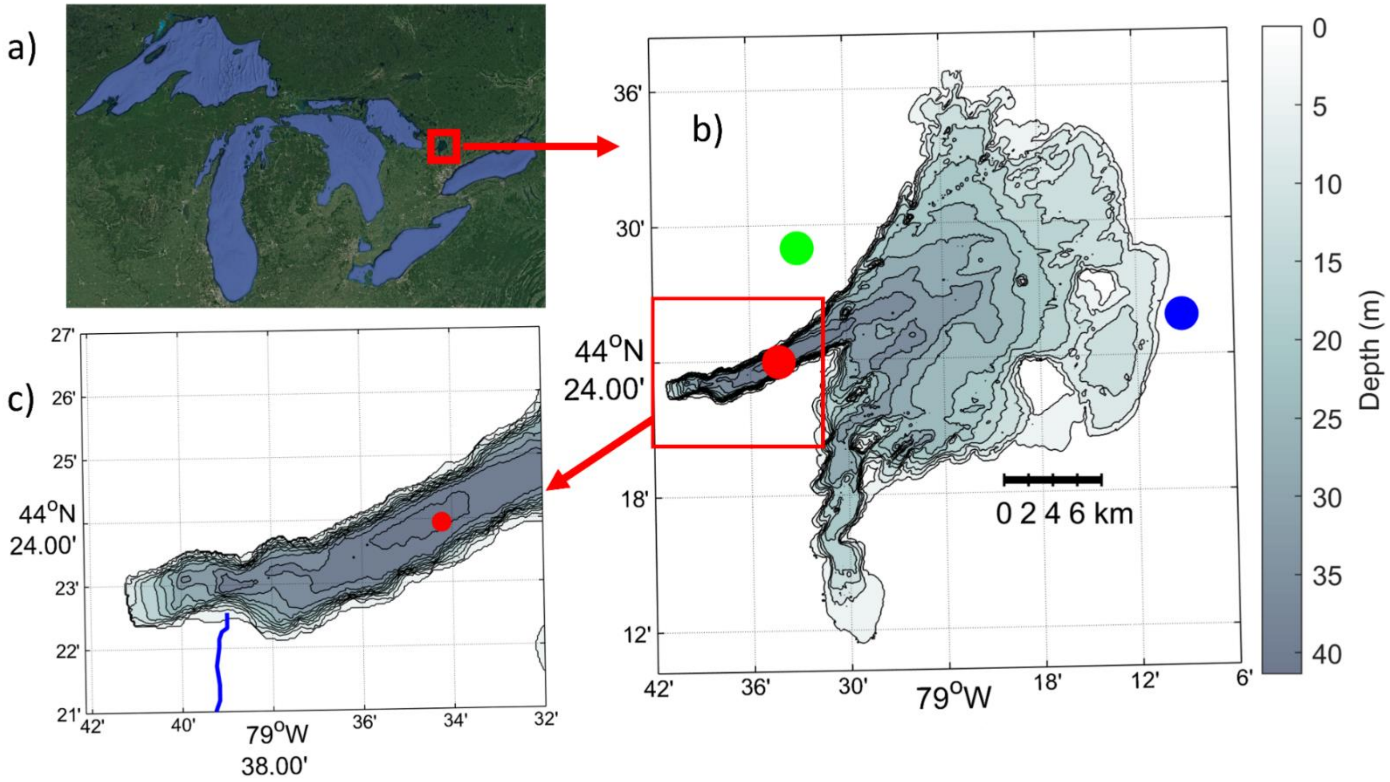
Because magnitude of variability is small, we need high accuracy measurements to distinguish the weak temperature gradients, particularly in the mixing layer

Thorpe-scale method quantifies size of overturns

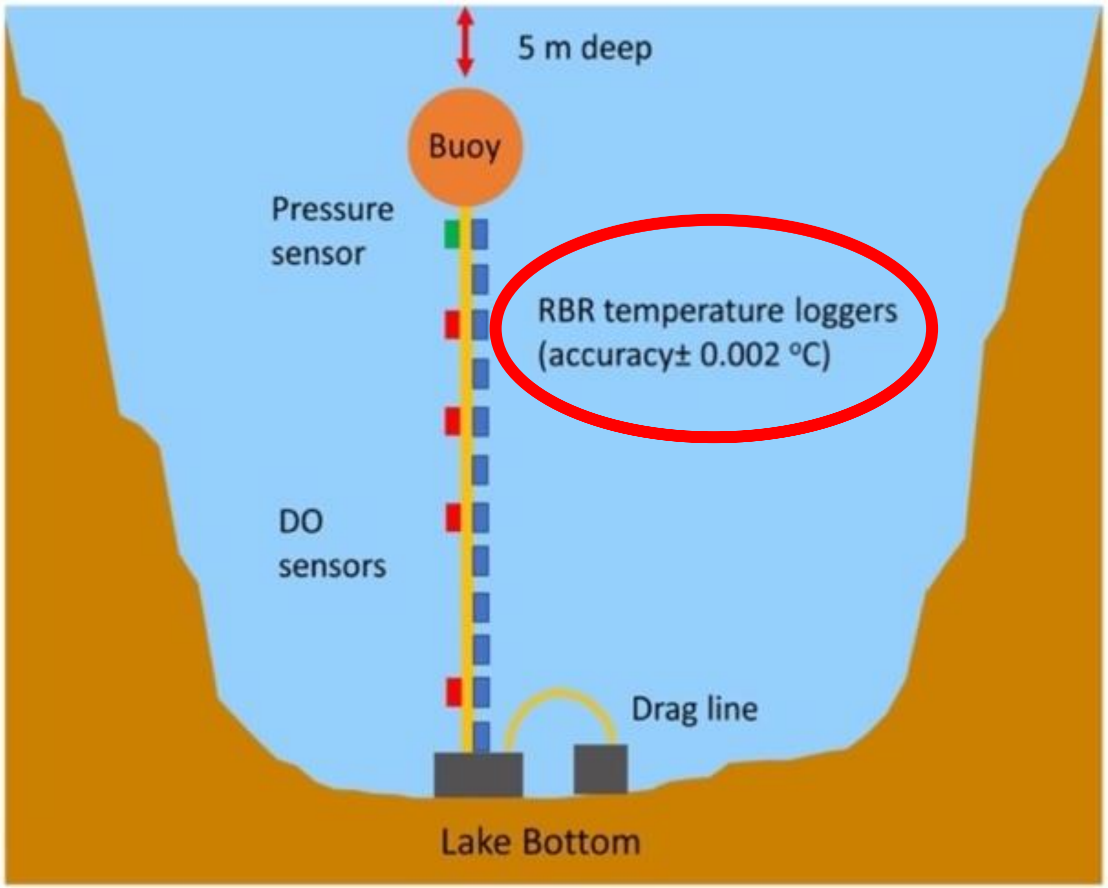


Thorpe scale calculation; temperature profile (a) with a 4 m inversion, and calculated Thorpe scale L_T (b), the root-mean-square of all displacements in the water-column.

Typical vertical velocity ~ 1 mm/s during periods of “vigorous” overturns at the end of winter, hard to measure



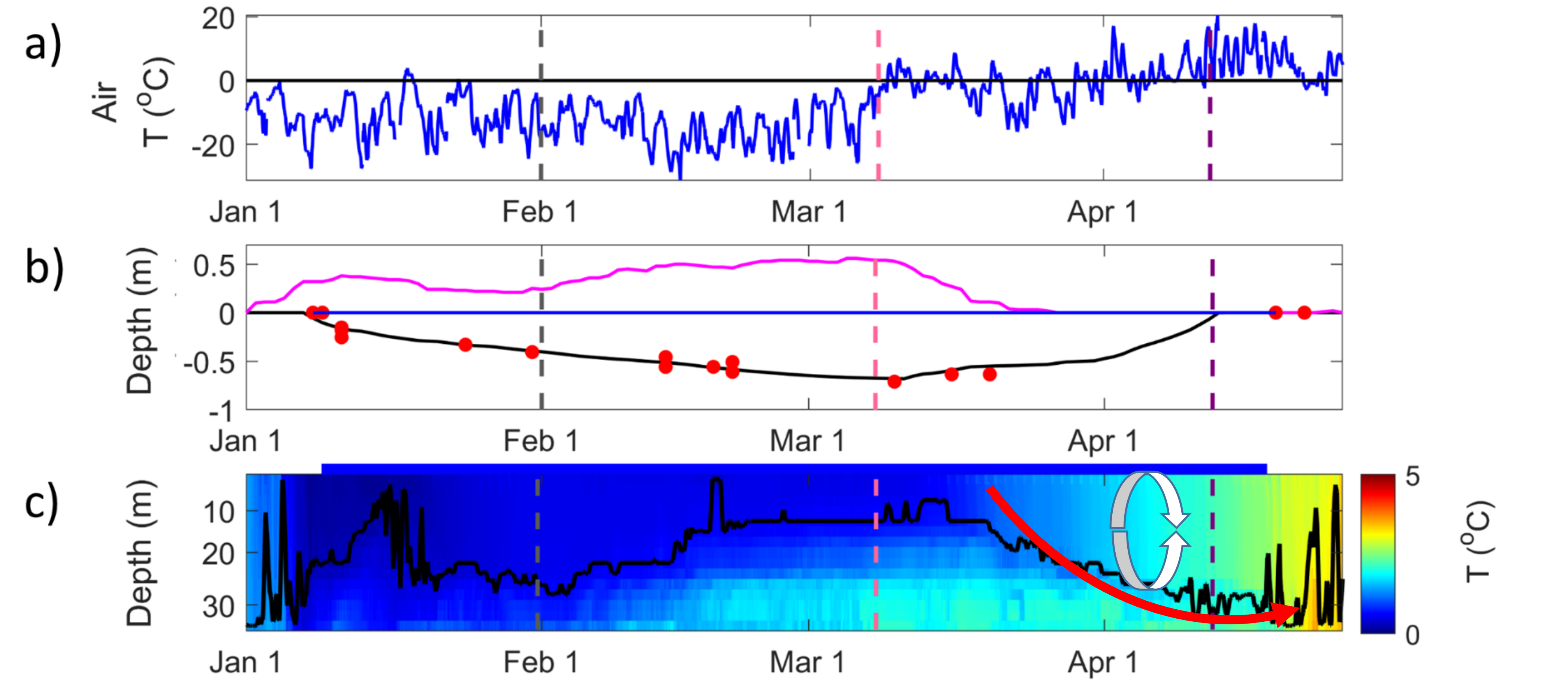
Location of K42 within Kempenfelt bay of Lake Simcoe (Max depth 42 m).



A schematic of mooring used in 2015. A similar mooring structure with sub-surface buoy was used in 2016 and 2017.

RBR soloT loggers can provide a high accuracy (0.002°C)

Thermal structure of Lake Simcoe over the colder winter of 2015



Air Temperature

Ice cover

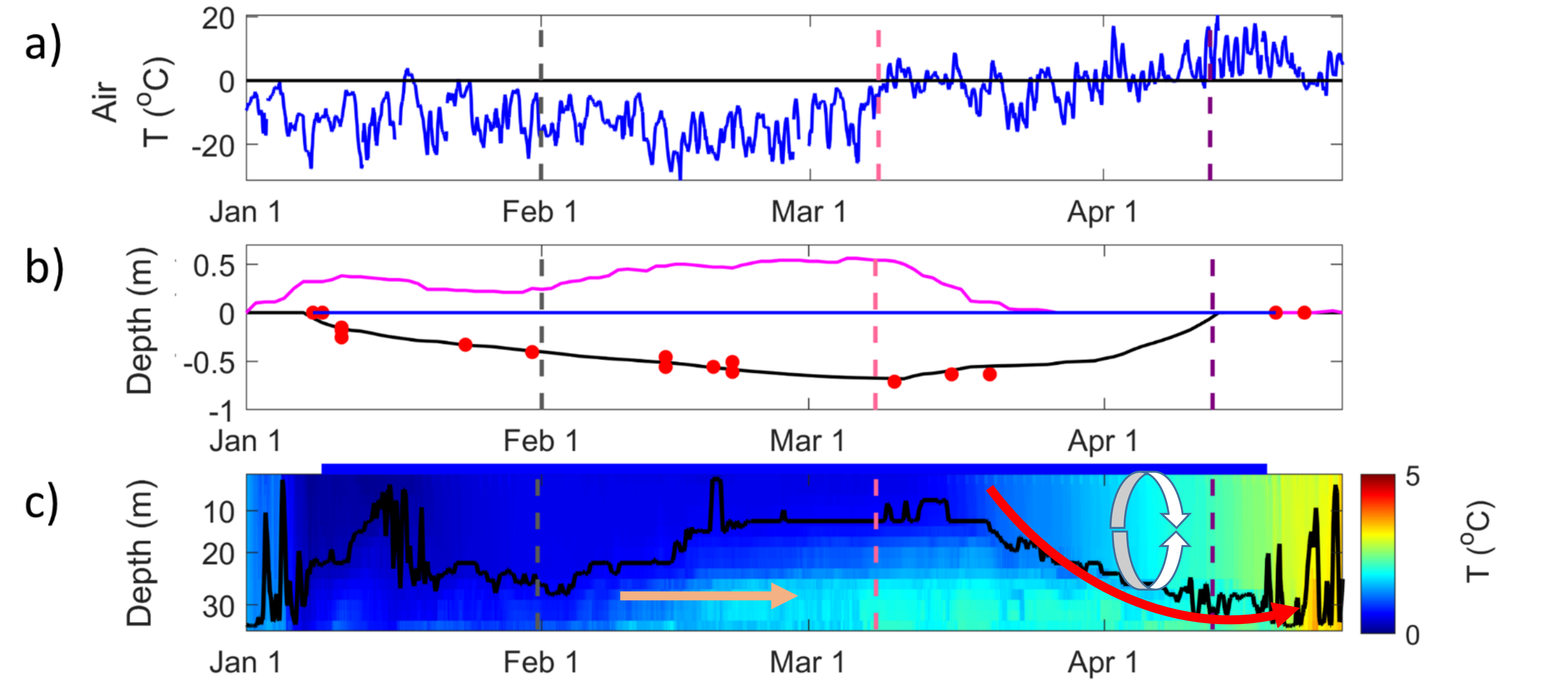
Water Temperature

Winter I start

Winter II start

Spring overturn start

Thermal structure of Lake Simcoe over the winter of 2015



Air Temperature

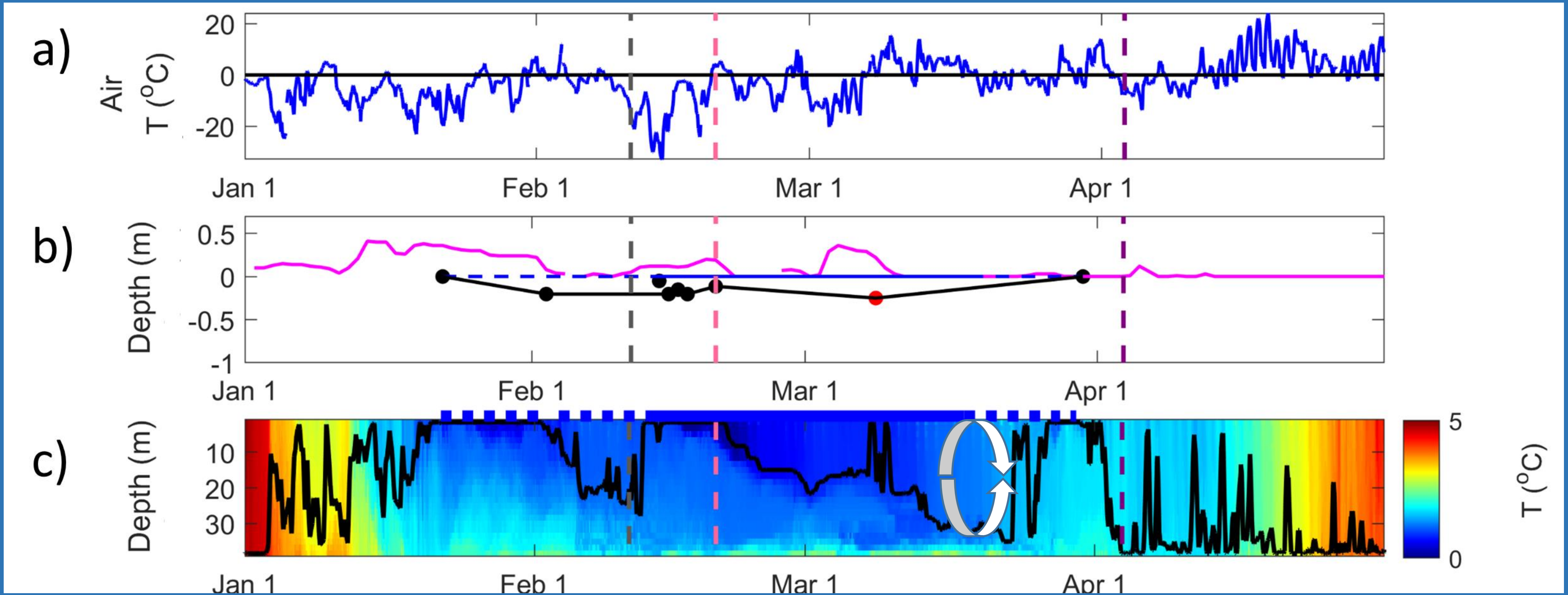
Ice cover

Water Temperature

Heat accumulating at the bottom in early winter

Vigorous surface convection near the end of winter when ice is thin

Thermal structure of Lake Simcoe over the warmer winter of 2016



Air Temperature

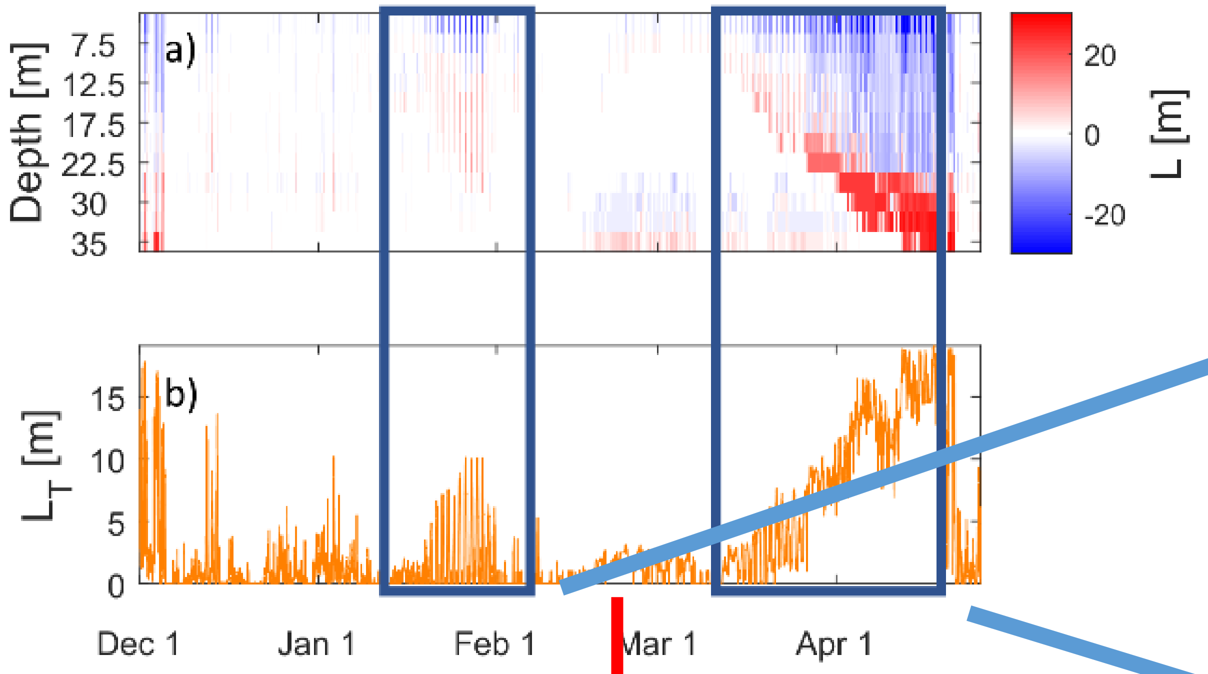
Ice cover

Water Temperature

- Less heat accumulating at the bottom in early winter in 2016, short Winter I
- Thin and patchy ice compared to 2015
- Duration of Winter II convection also shorter

2015 winter Thorpe Scales

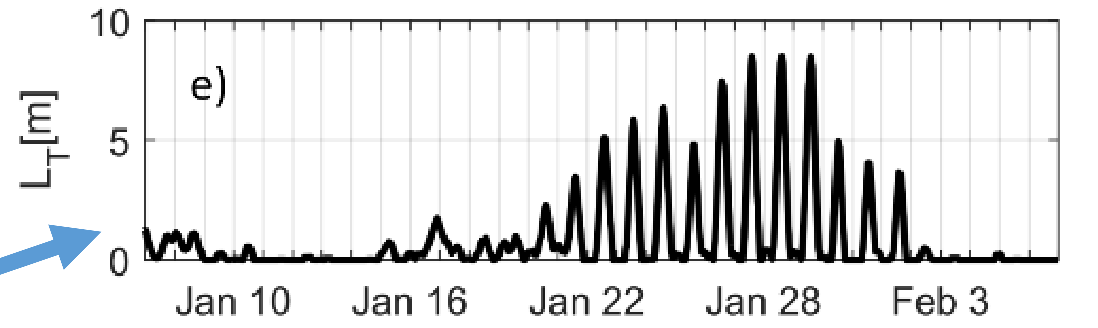
Thorpe displacements



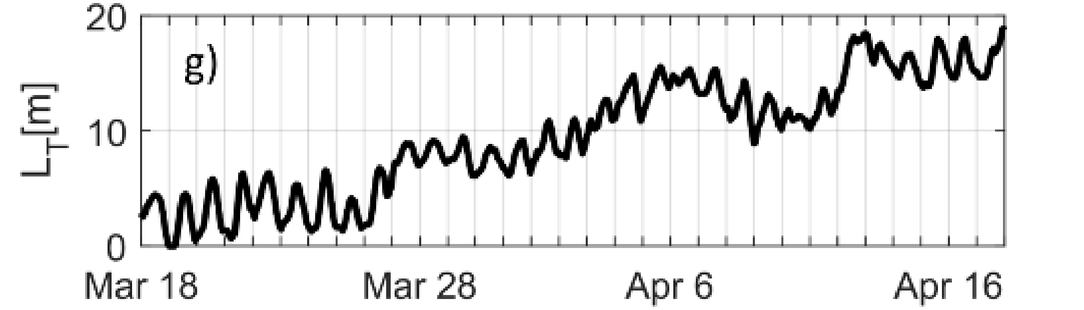
Thorpe Scales

Diurnal variation of Thorpe scales

Increased Thorpe scales when ice just formed and thin

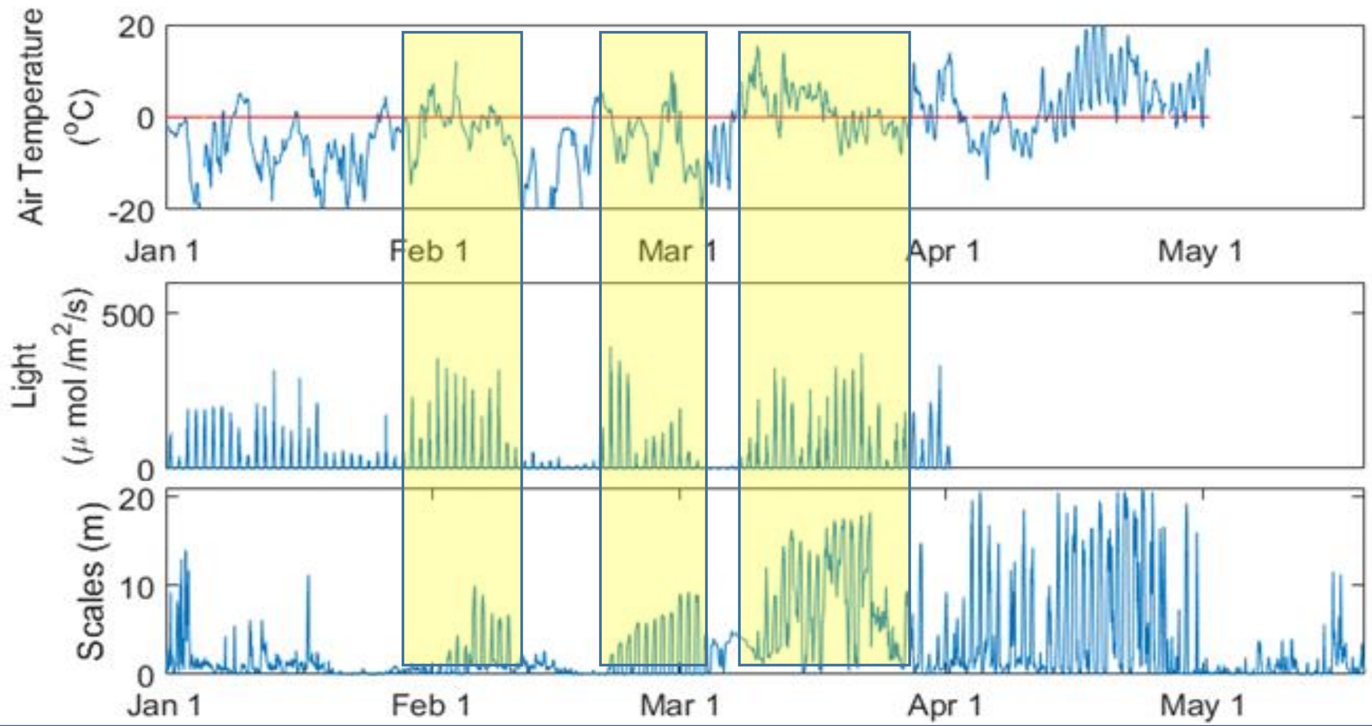


Increased Thorpe scales when ice is melting



Low Thorpe Scales and displacements when there is thick ice in the middle of the winter

2016 winter

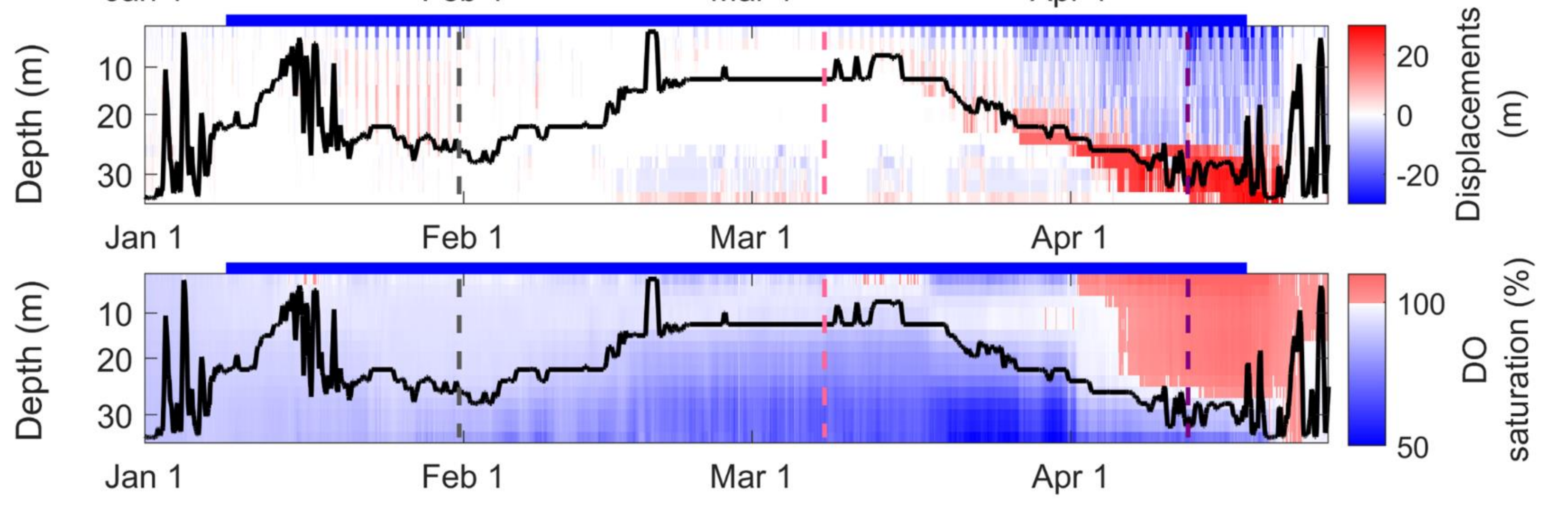


Warmer air temperatures

Higher under-ice light

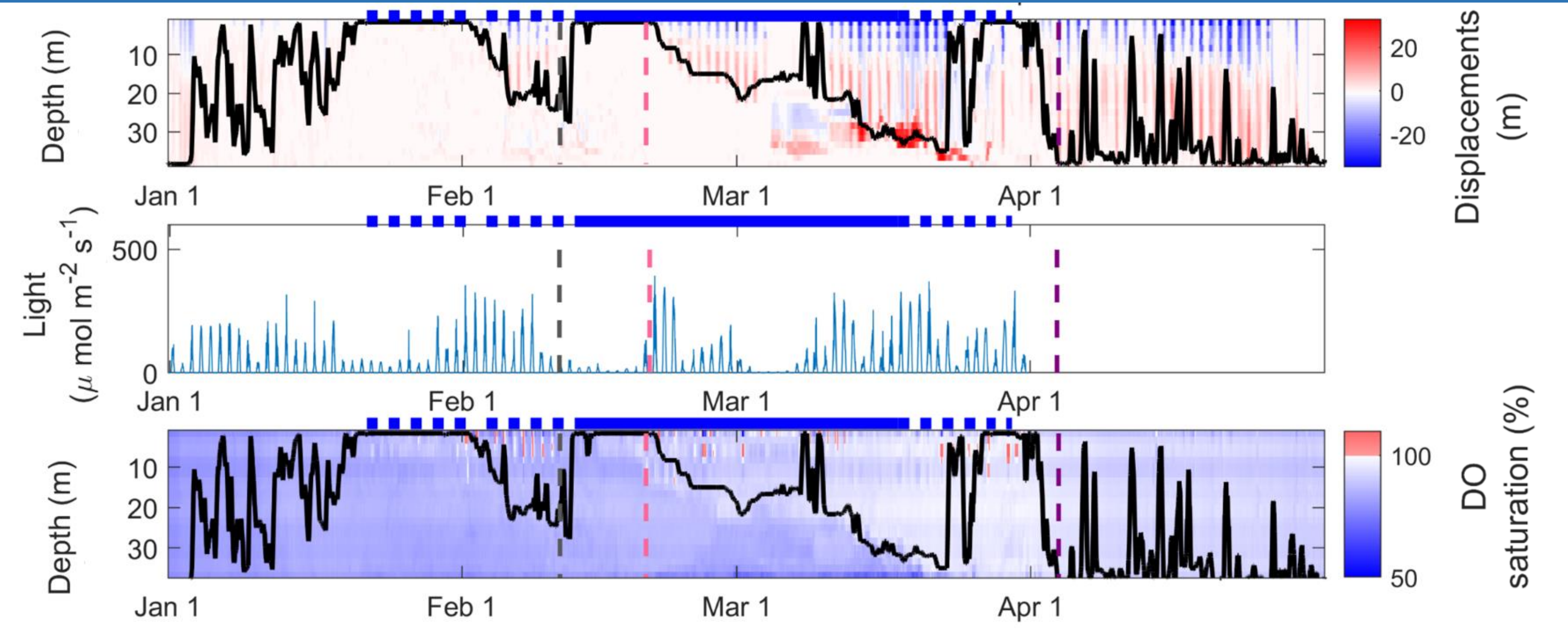
These correlate with larger Thorpe scales

Intermittency in 2016 ice cover and light permit intermittent convection driven by solar radiation



2015 Thorpe Displacements

2015 oxygen saturation

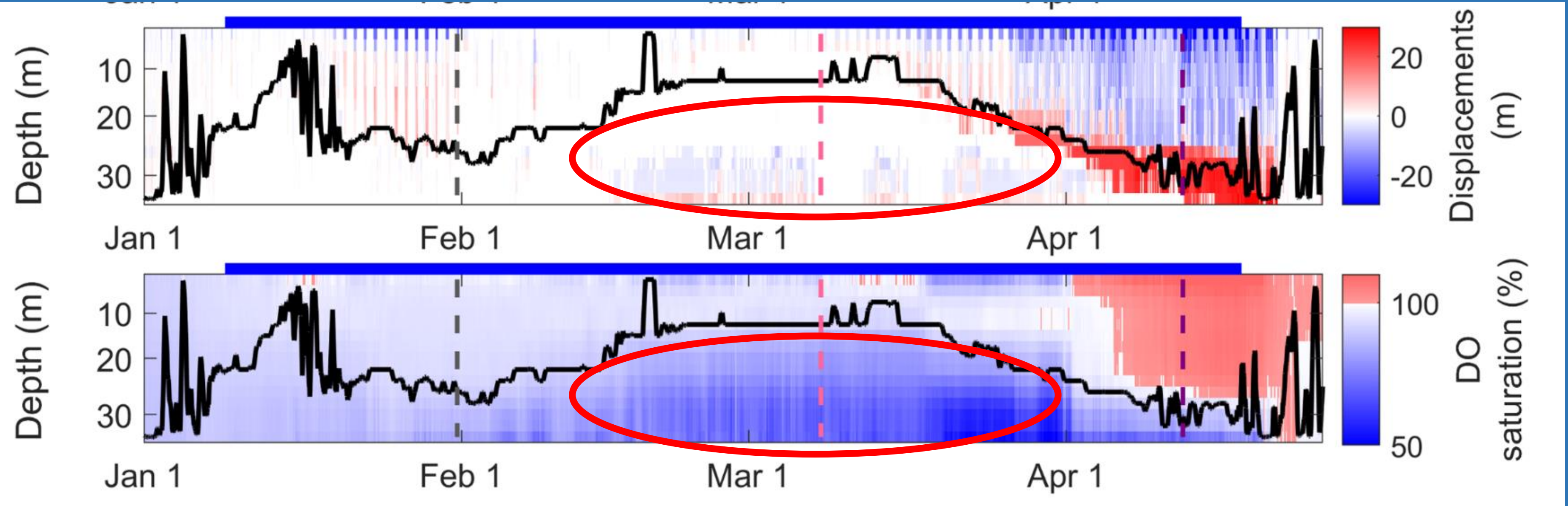


2016 Thorpe Displacements

2016 under-ice light

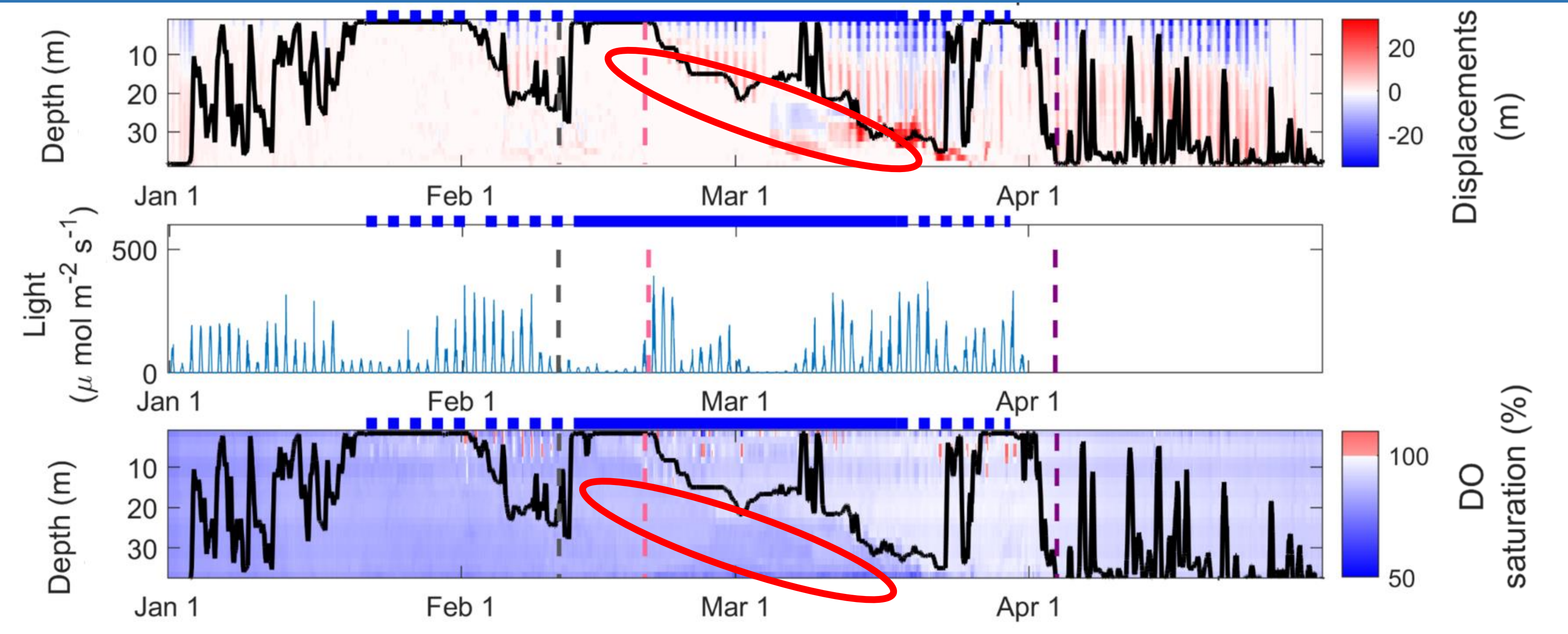
2016 oxygen saturation

2015

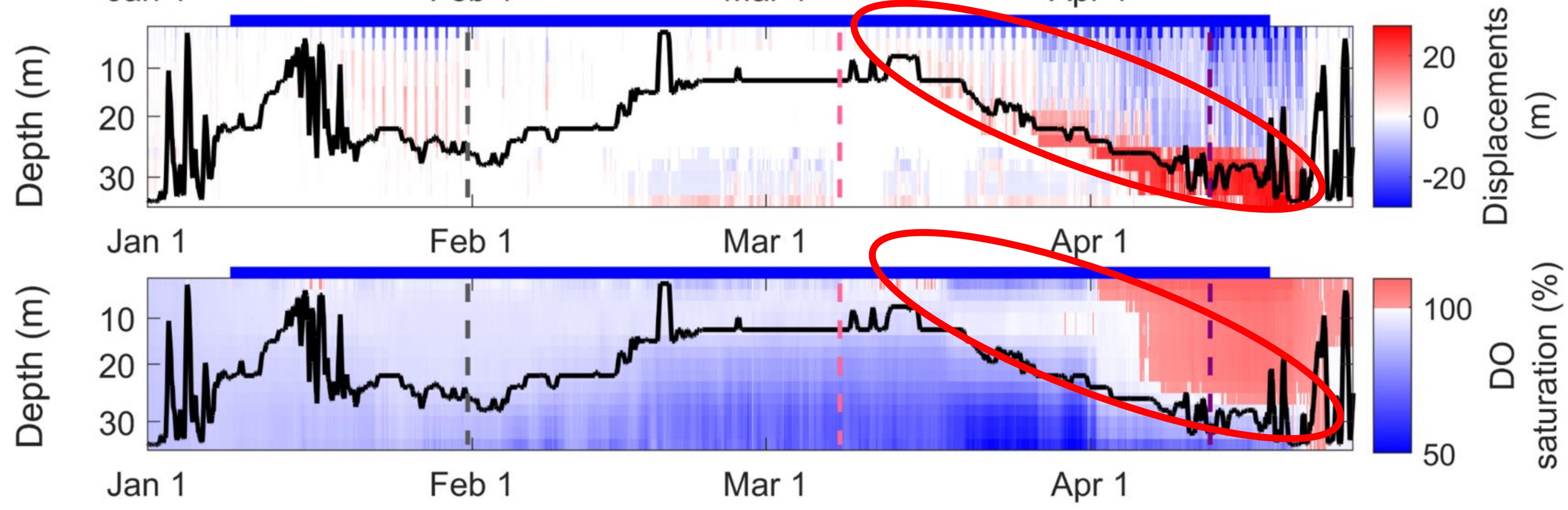


Beneath the surface mixing layer, oxygen decreased due to low light conditions and little vertical mixing

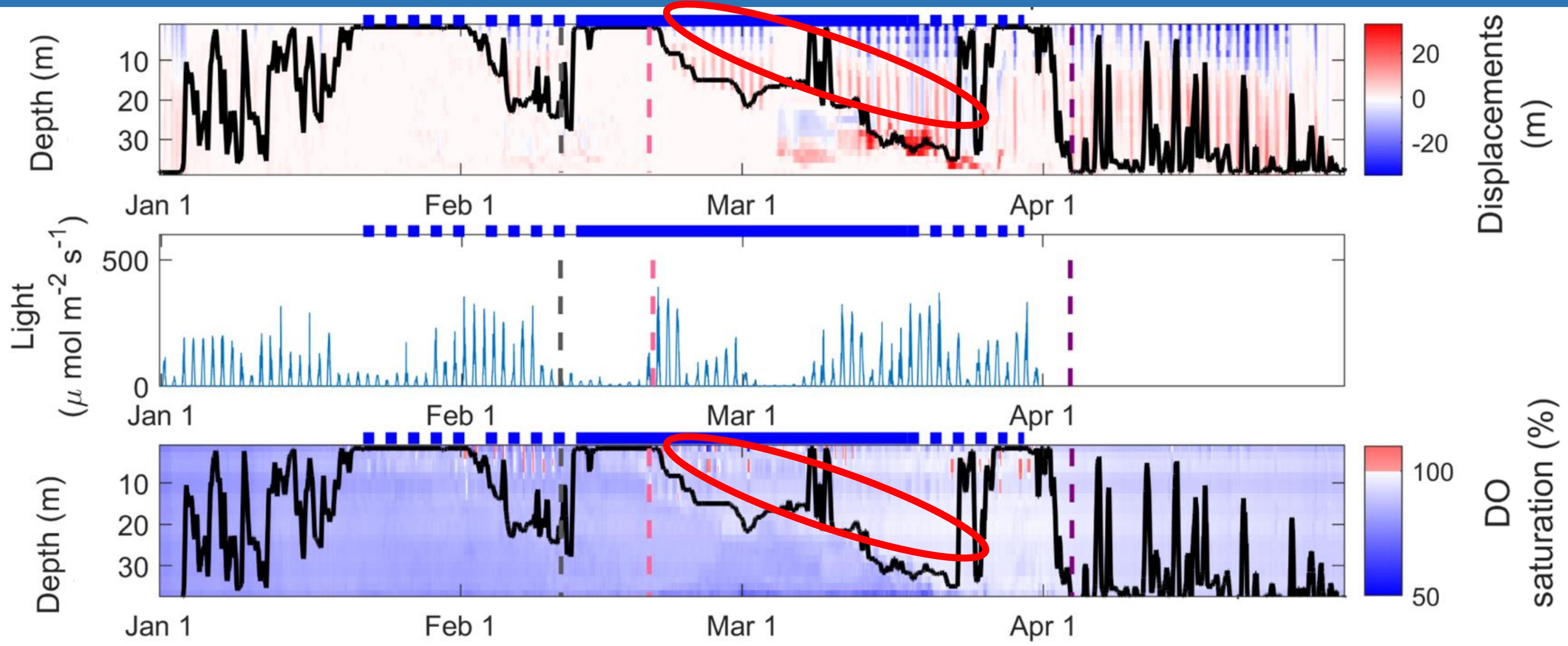
Thorpe displacements are close to 0 below the surface mixing layer



2016

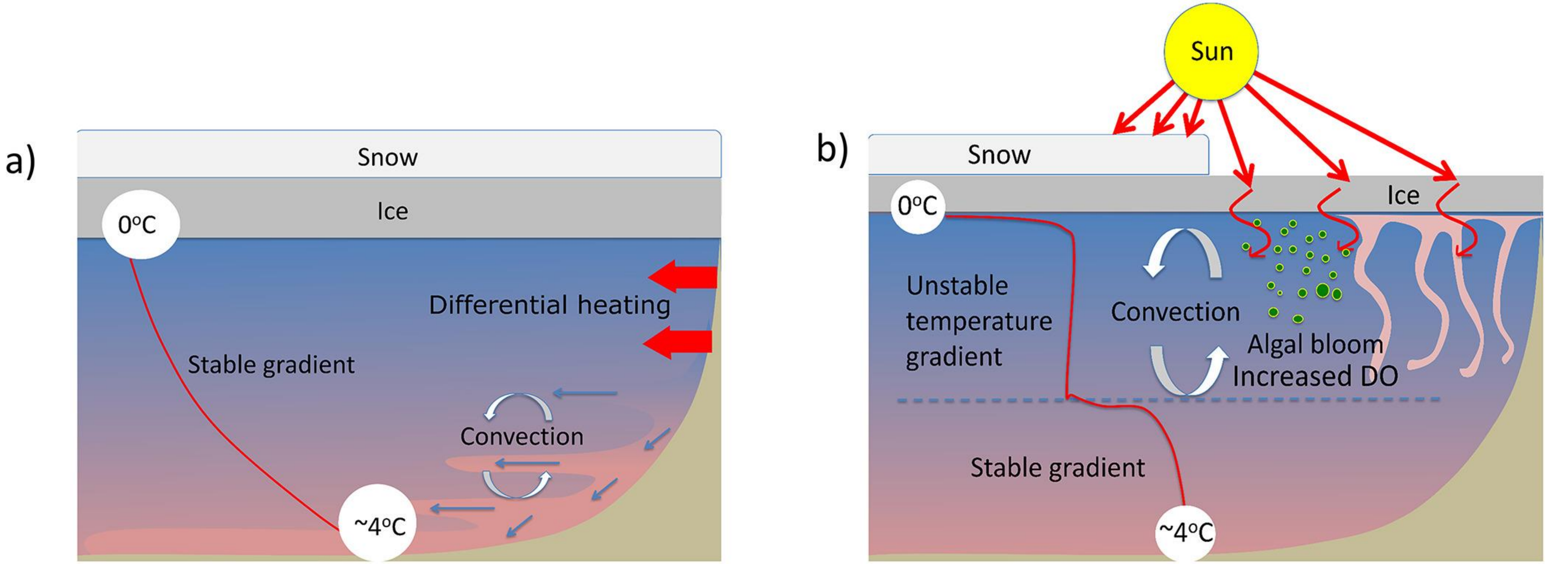


In contrast, within the surface mixing layer, oxygen levels are generally close to saturation



Near the end of winter when there was vigorous convection, oxygen increased in the mixing layer

Oxygen was super saturated in 2015, but not in 2016



- Yang, B., Young, J., Brown, L., & Wells, M. (2017). High-frequency observations of temperature and dissolved oxygen reveal under-ice convection in a large lake. *Geophysical Research Letters*.
- Yang, B., Wells, M., Li, J.Z., & Young, J. (2020). Mixing, stratification and plankton under lake-ice during winter in a large lake: implications for spring dissolved oxygen levels. *Limnology & Oceanography*.