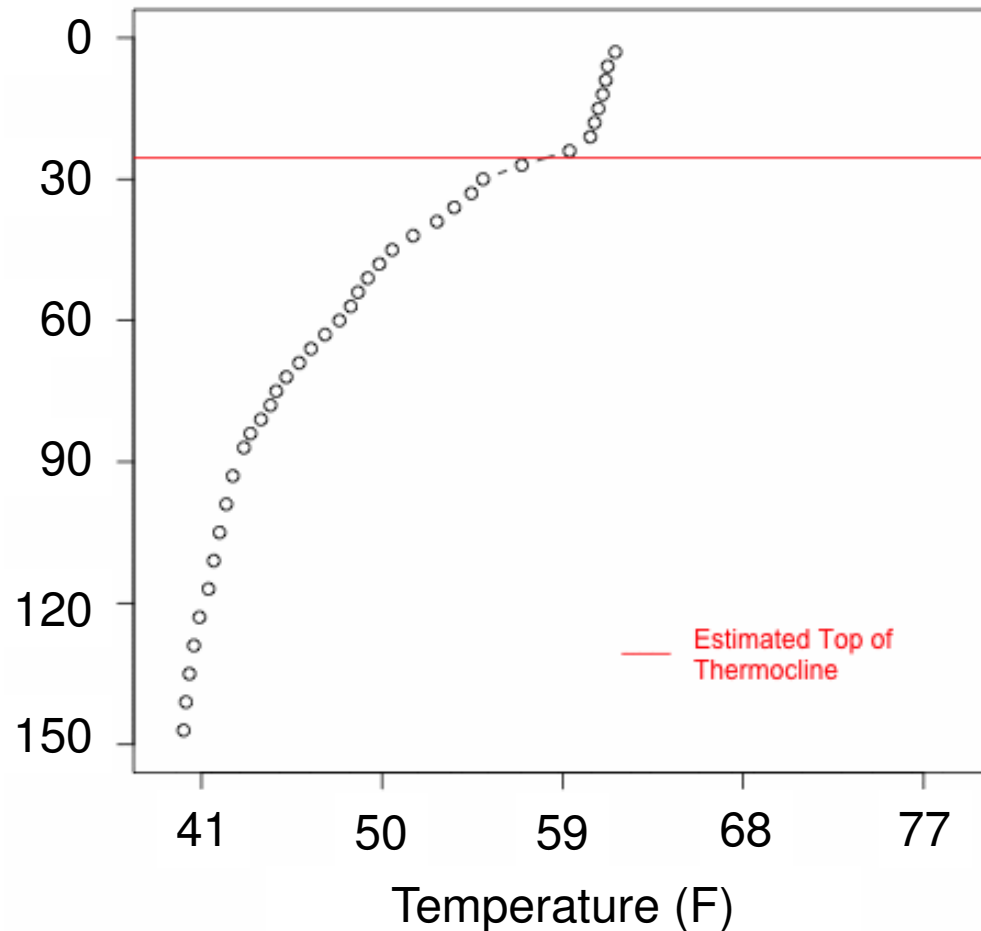
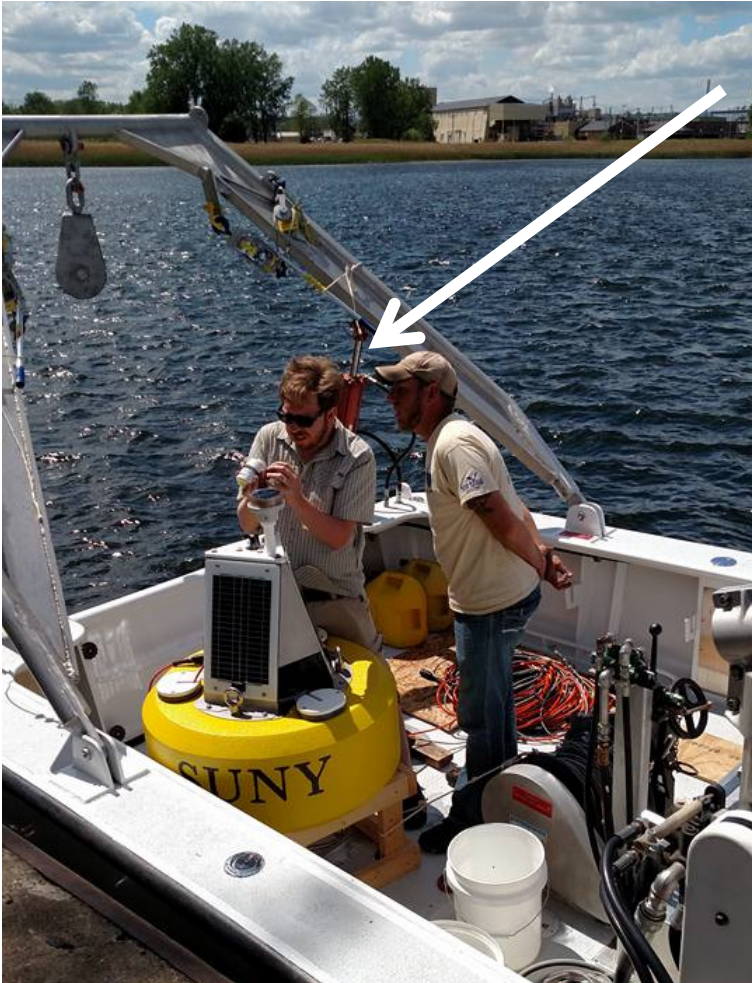


Lake Champlain Temperature Profile - 2016-06-01



**Temperatures in L. Champlain:
Can climate research be of use to anglers?
Eric M. Leibensperger (SUNY Plattsburgh)
Mark Malchoff (L. Champlain Sea Grant)**

Eric M. Leibensperger
(eleib003@plattsburgh.edu)



Mark Malchoff
(malchom@plattsburgh.edu)



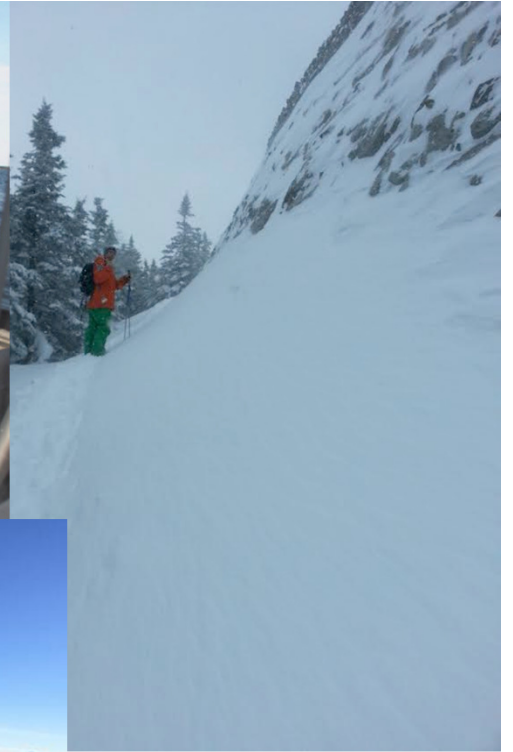
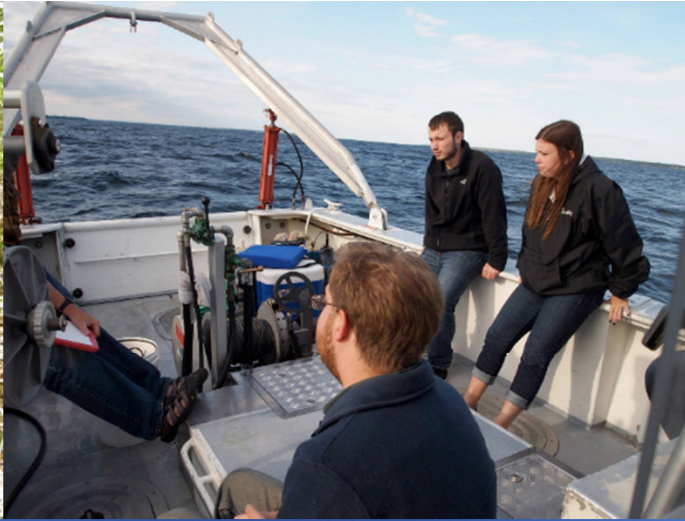


Center for
**EARTH &
ENVIRONMENTAL
SCIENCE**

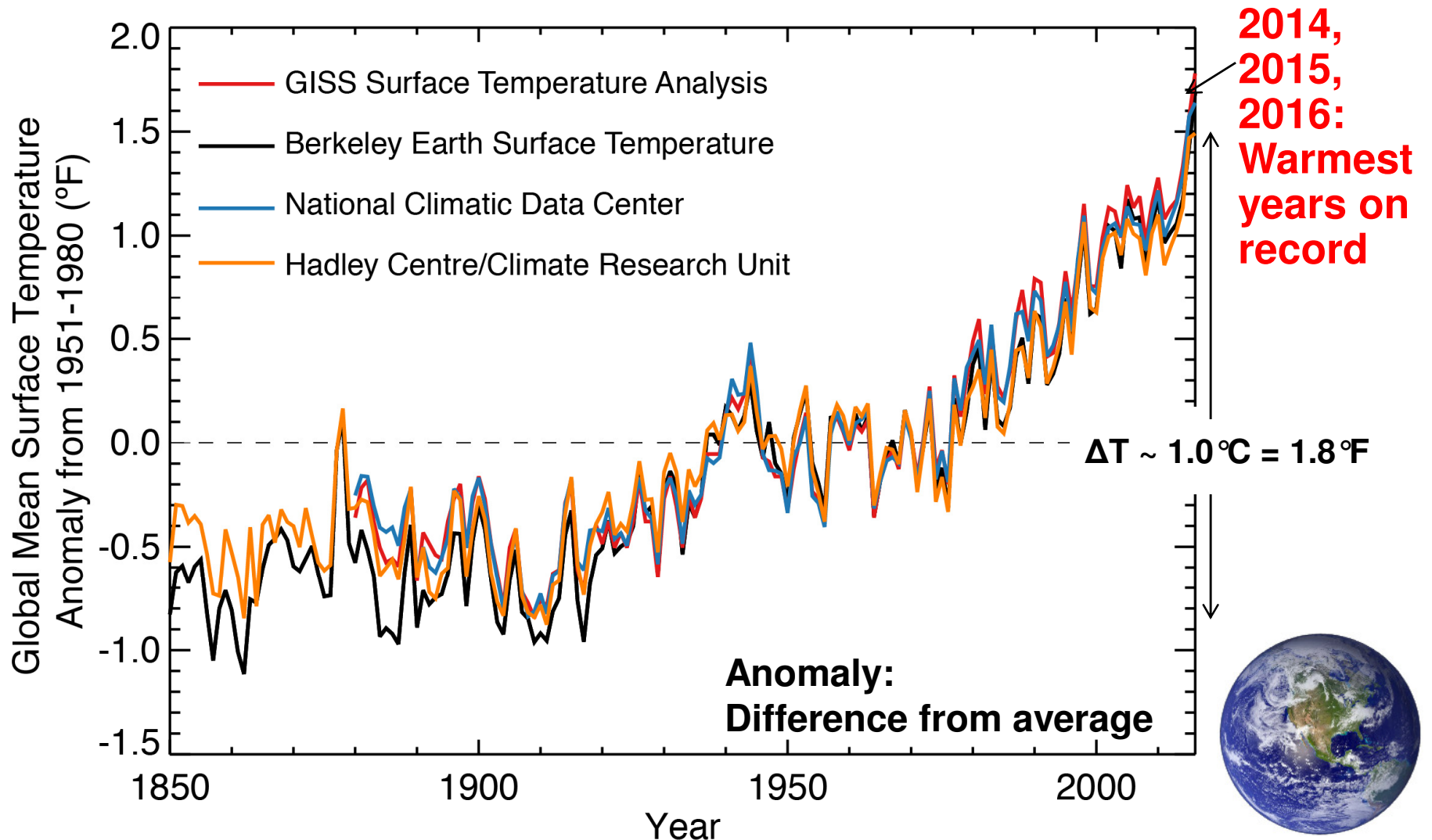
SUNY Plattsburgh



William Pierce and Vasu Govani (SUNY Platts.)
Technical Assistance: Tim Mihuc, Luke Myers (LCRI)
Advice from Tom Manley (Middlebury College)

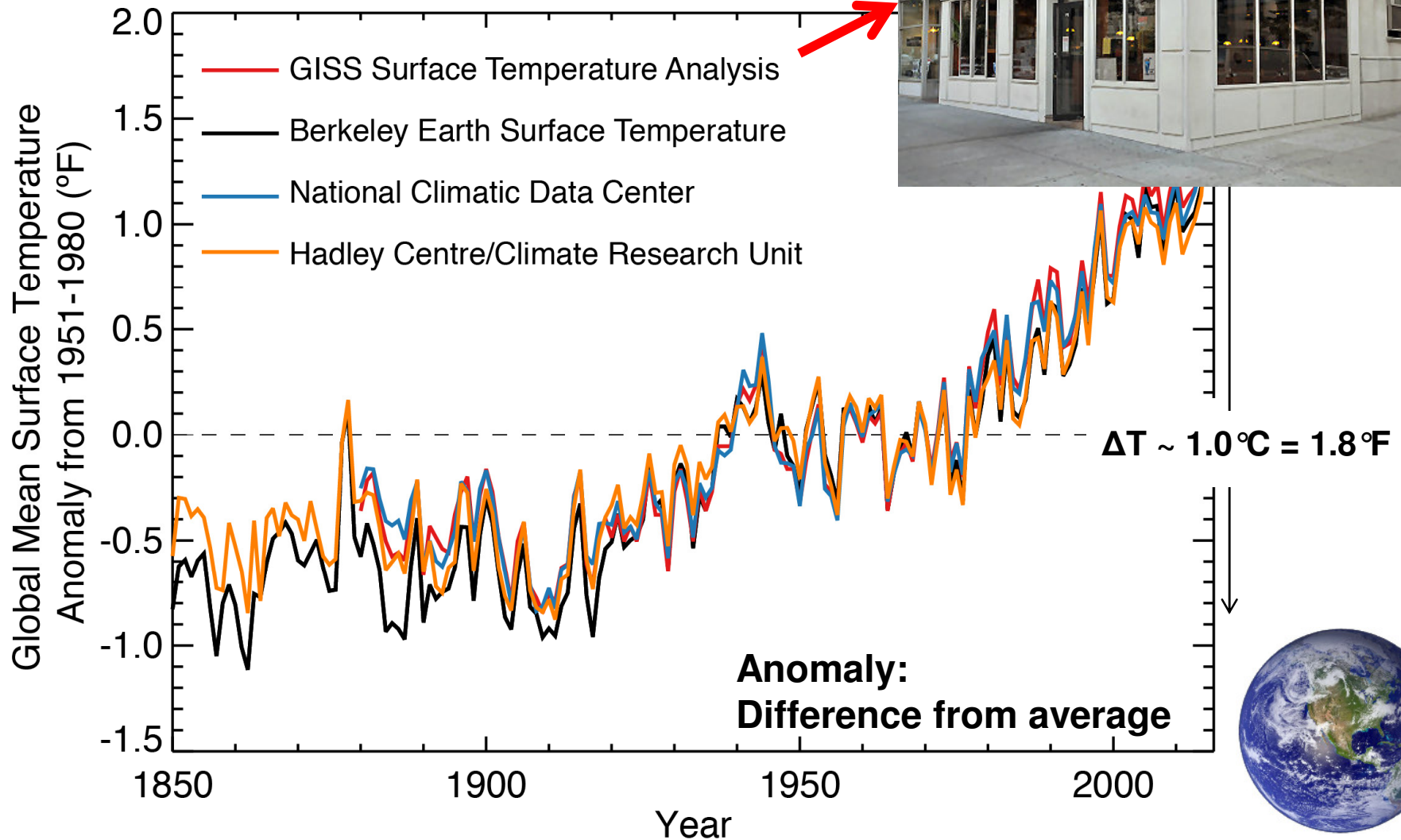


Warming is Unequivocal



*Independent analyses of observations agree: **Earth is warming***
→ Global Warming

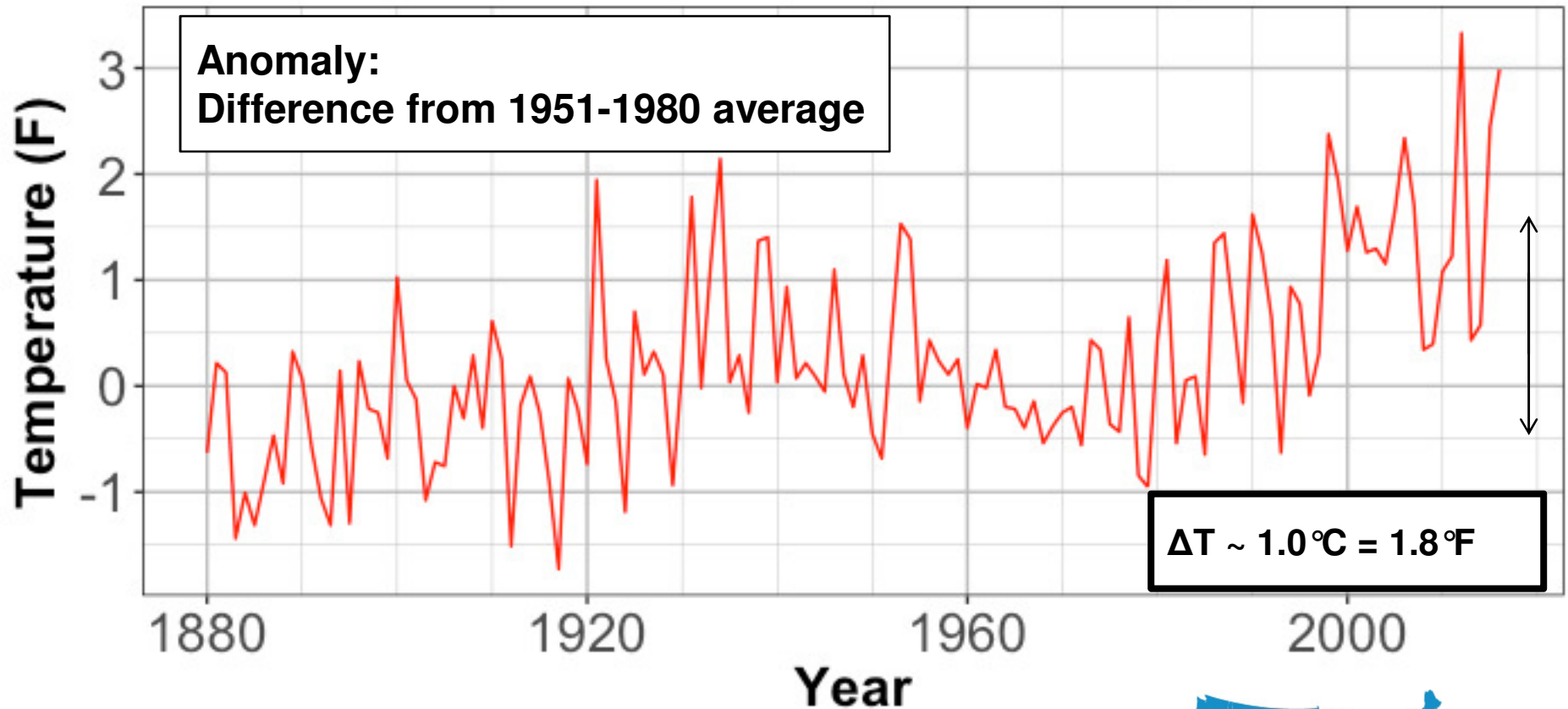
Warming is Unequivocal



*Independent analyses of observations agree: **Earth is warming***
→ Global Warming

Warming within the U.S.

Annual Mean United States Temperature



Warming evident in U.S.,
but with larger fluctuations

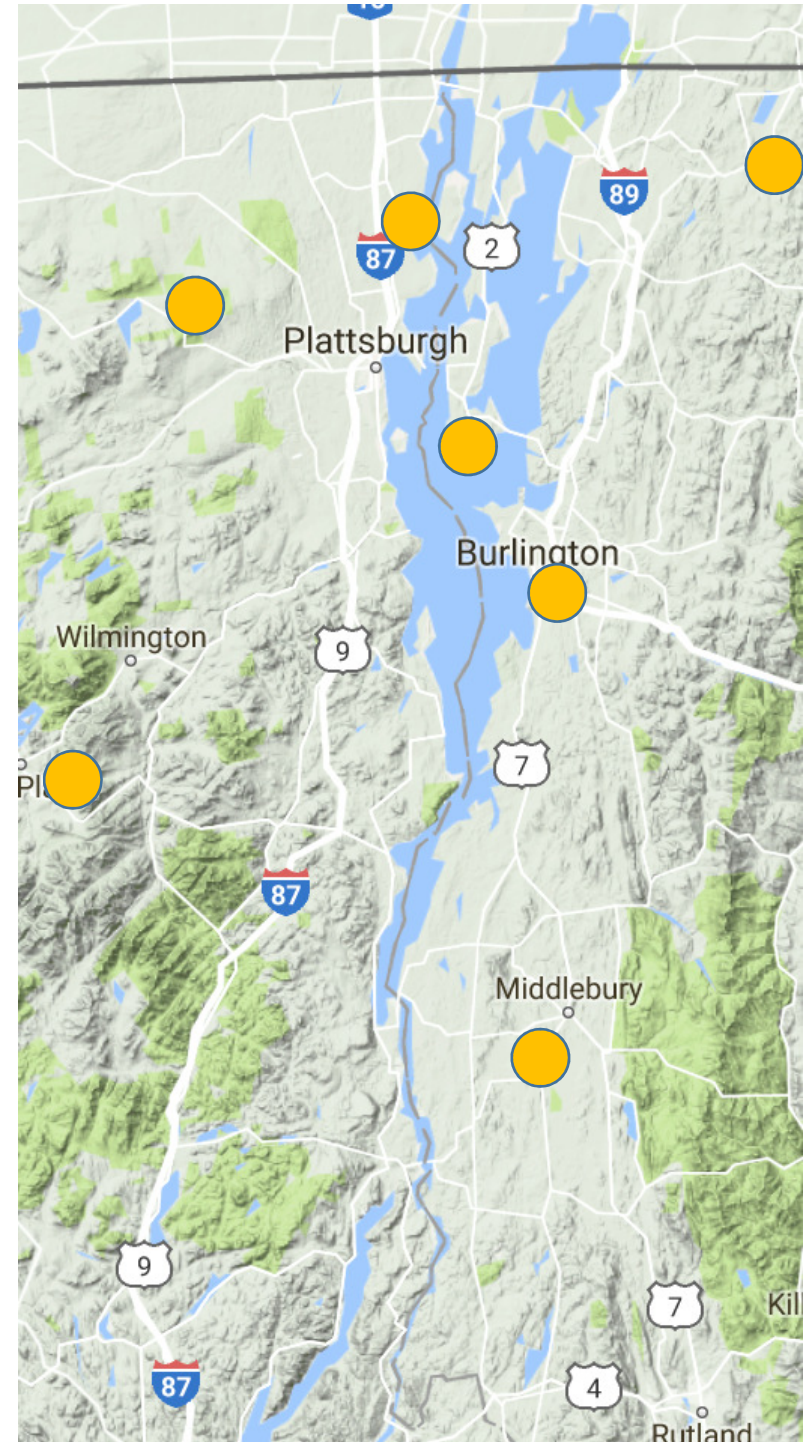


Data source: GISTEMP

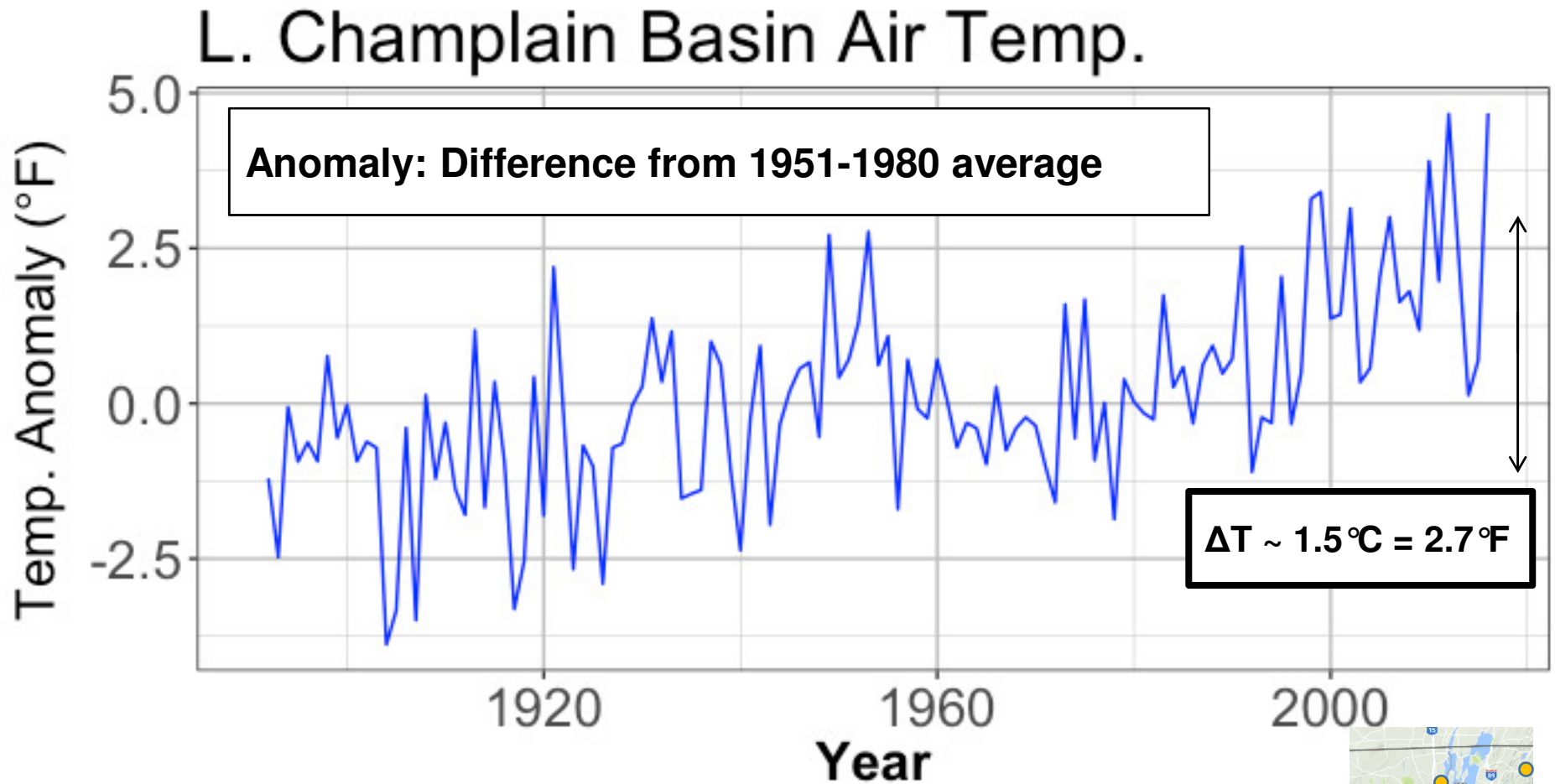
Warming w/in Champlain Basin

Long-term observations are available from:

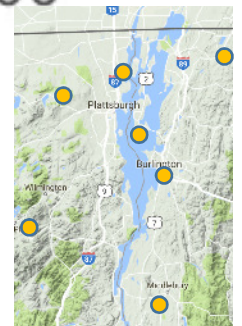
- 1) **Burlington, VT** (1892-pres.)
- 2) **Enosburg Falls, VT** (1891-pres.)
- 3) **Cornwall, VT** (1894-pres.)
- 4) **South Hero, VT** (1945-pres.)
- 5) **Lake Placid, NY** (1910-2014)
- 6) **Dannemora, NY** (1907-2015)
- 7) **Chazy, NY** (1902-2011)



Warming w/in Champlain Basin



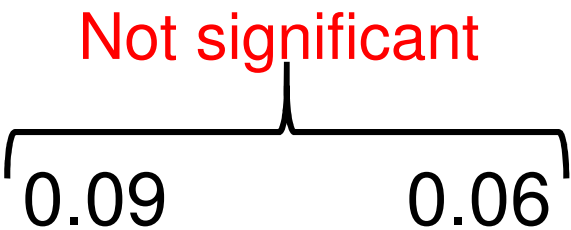
Warming has occurred in L. Champlain basin
but with even larger fluctuations



Rate of Warming Comparison

	Ann.	Winter	Summer
Global:	0.04	0.03	0.03
N. Hemisphere:	0.05	0.04	0.05
U.S.:	0.05		
Champ. Basin:	0.10	0.09	0.06

Not significant



→ Rates: How quickly temperatures are increasing
°F per year

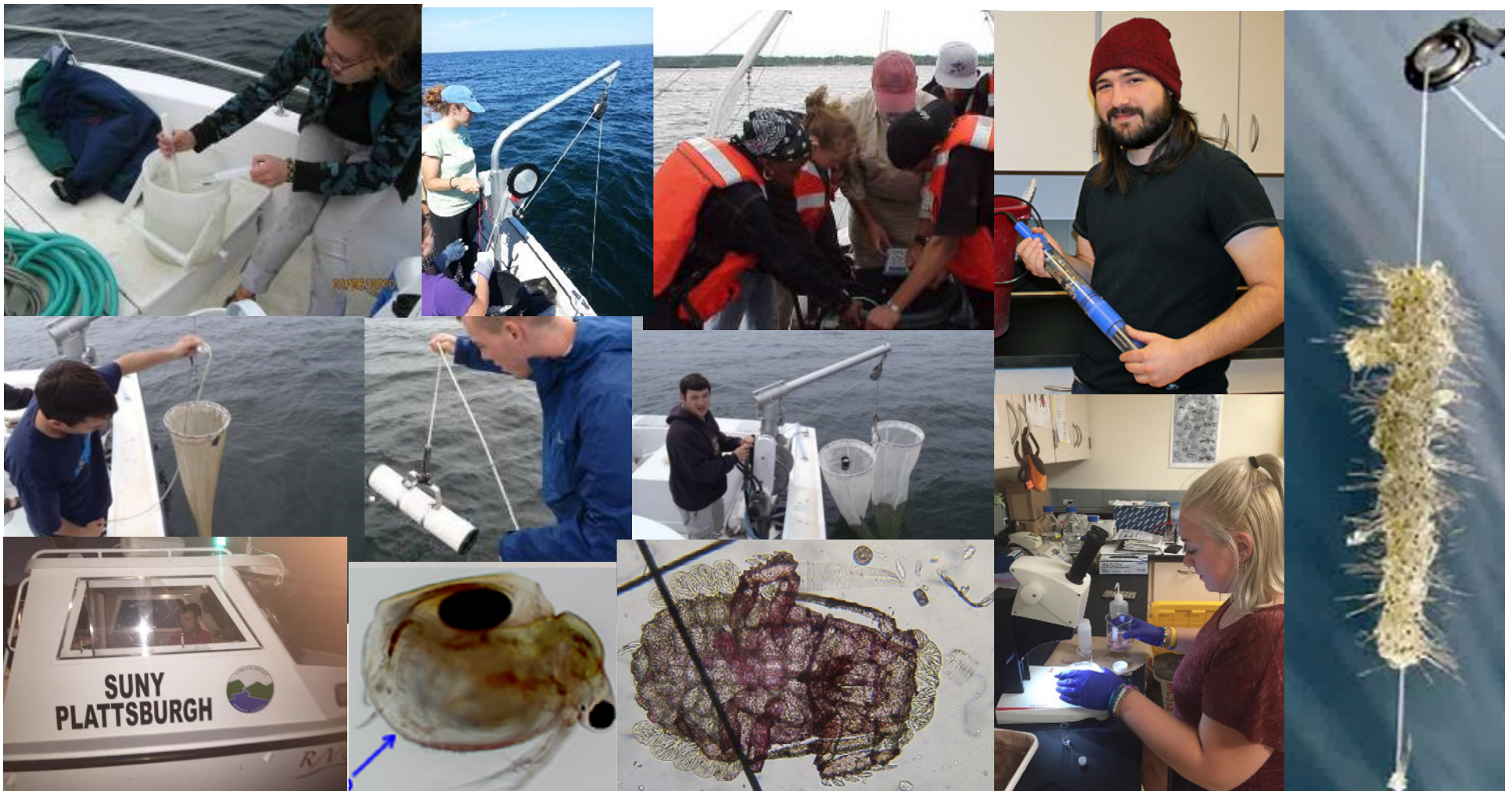
→ Champlain Basin warming faster than other regions

But what is happening *in* the
Lake?

Long-Term Water Quality and Biological Monitoring Project

Supported by:

the Lake Champlain Basin Program (U.S. EPA), NY/VT DEC



Long-term Monitoring Data

Data and Documents

The Lake Champlain Basin Program, the Clean Water Initiative, and the Vermont Department of Health, among others, use data generated through the Long-Term Water Quality and Biological Monitoring Program to identify water quality issues of concern and assess progress in reducing lake pollution. Program data are also used for the Lake Champlain Basin Program to produce State of the Lake Reports and technical reports on trends in lake phosphorus concentrations and tributary loadings.



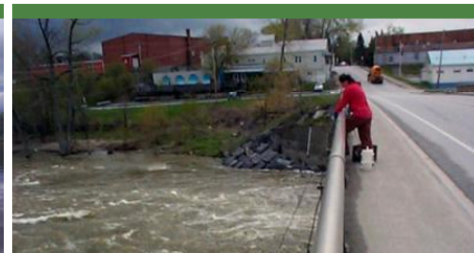
Lake Champlain Chemical and Biological Data

Lake Champlain Long-Term Water Quality and Biological Monitoring Project data (1992 to present)



Lake Champlain Multi-Probe Sonde Profiles

Lake Champlain Long-Term Monitoring Project multi-probe sonde profiles (1992 to present)



Lake Champlain Tributary Chemical Data

Lake Champlain Long-Term Water Quality and Biological Monitoring Project tributary data (1990 to present)

http://bit.do/champlain_ltm

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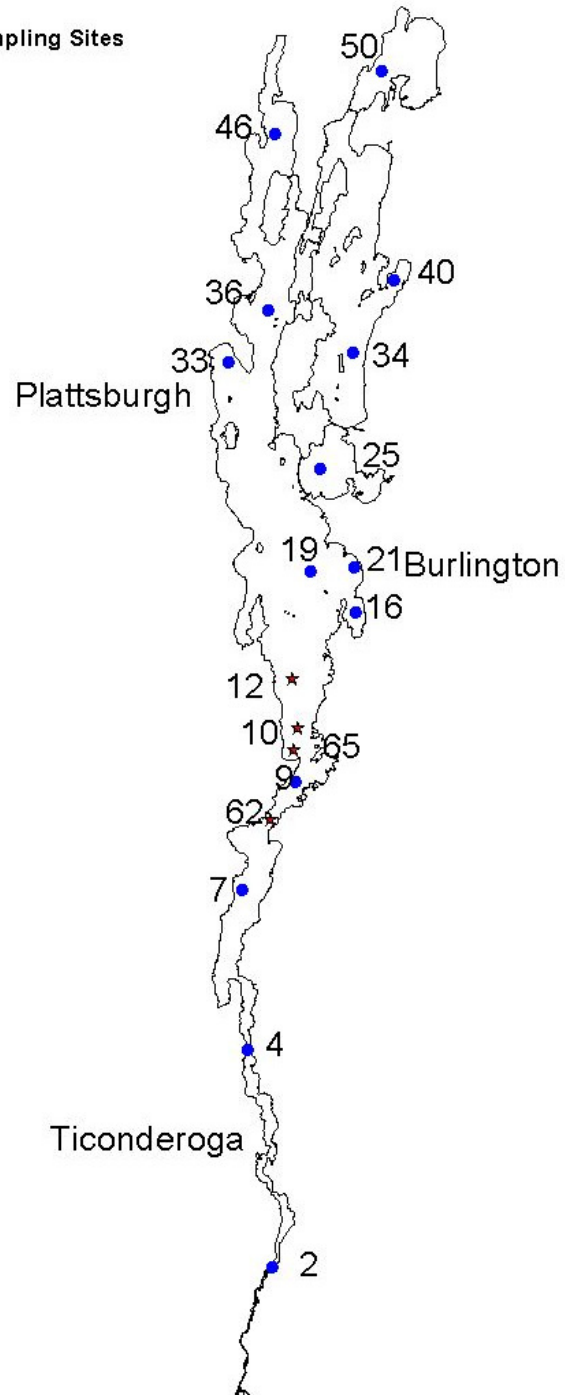
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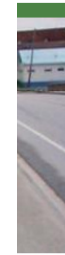
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Figure 2. Lake Sampling Sites



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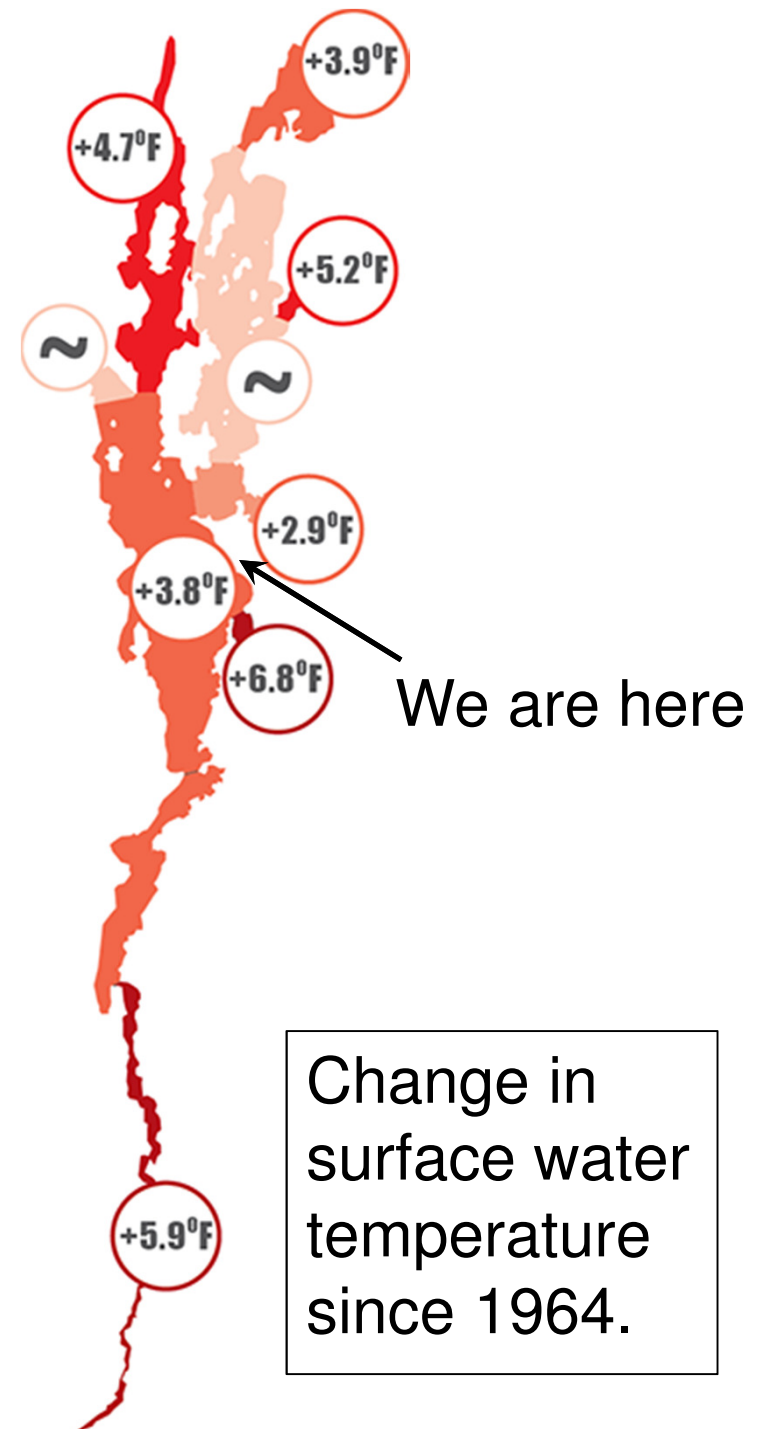
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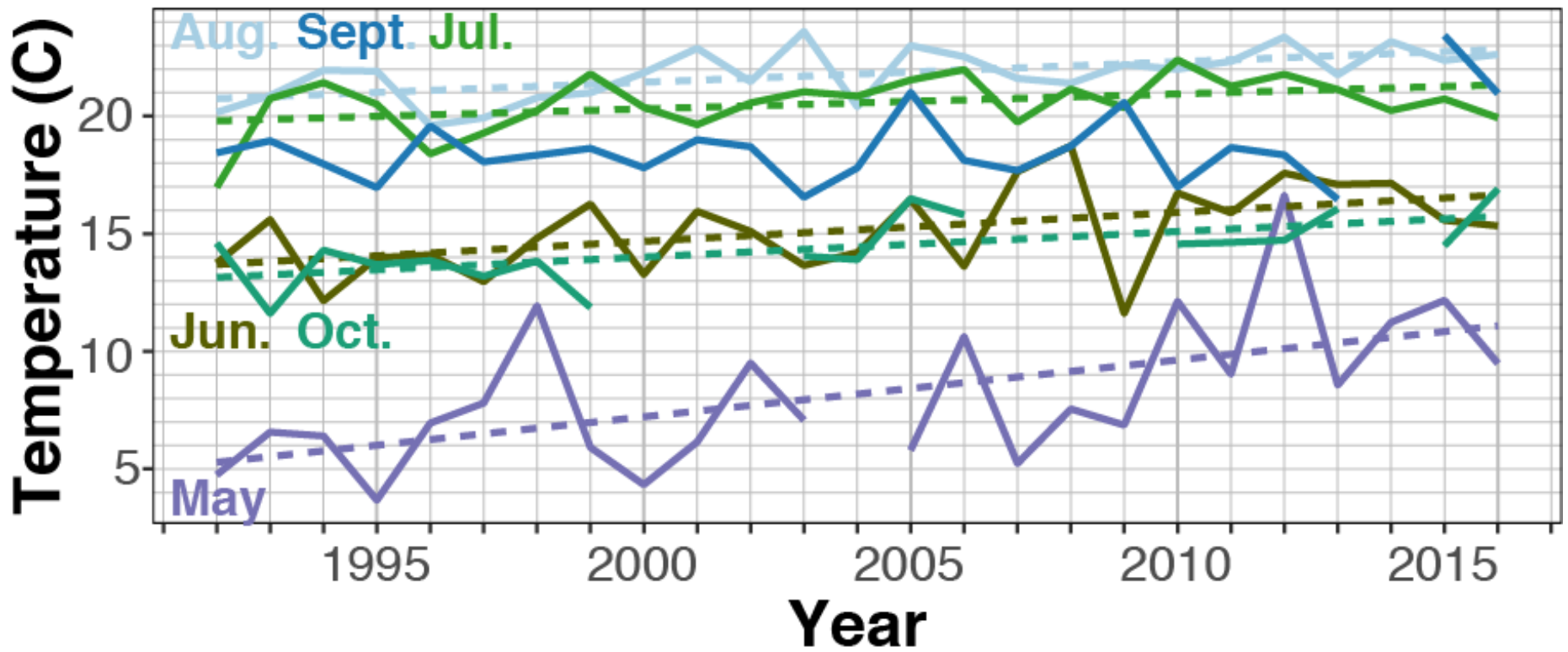
Change in Aug. Water Temp.

- Observations taken, at best, twice per month; once per month standard
- Reason to suspect temperatures have large variations within a month
- Hourly to weekly changes in water temperatures largely unknown (*until now!*)



Climate Change in L. Champlain?

L. Champlain Main Lake Temperature Trend



Lake surface water is **warming** at about 0.2°F/yr

→ Faster than Basin-wide air temperatures

→ Why/How? Is it real?

☰ Lake Champlain Sea Grant

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MONITORING LAKE CHAMPLAIN TO ASSESS FUTURE CLIMATE CHANGE IMPACTS

TIMELINE

February 1, 2016 to January 31, 2017

DESCRIPTION

This project examines the impact of climate change on Lake Champlain. The 24-month monitoring project focuses on the lake's surface and internal climate. A data buoy, to be placed near Valcour Island, will be used to gather long-term high-frequency subsurface observations and meteorological data on the Main Lake. Temperature sensors suspended below the buoy will gather data from Spring to Fall on the vertical profiles of the lake's thermal structure. In addition, two multiprobes - one placed near the surface and another lower in the hypolimnion - will continuously collect temperature, pH, conductivity and dissolved oxygen readings. The data will be transmitted from the buoys sensors via satellite to researchers at SUNY Plattsburgh. This project will provide a foundation for further assessment of Lake Champlain as a long-term climate monitoring program.

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Sea Grant's goals include knowledge application, community outreach, and conservation activities.

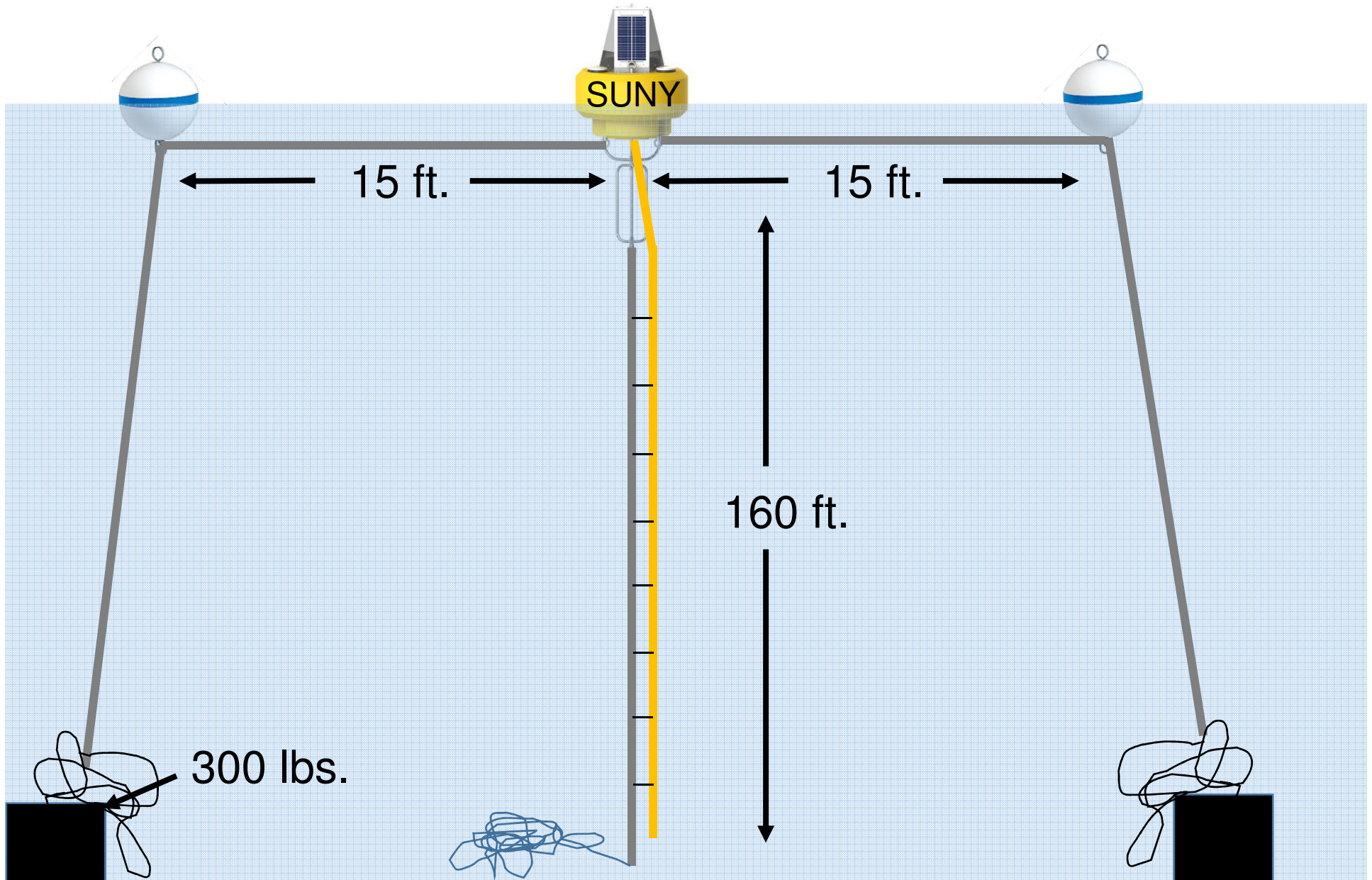
February 1, 2016 to January 31, 2017

DESCRIPTION

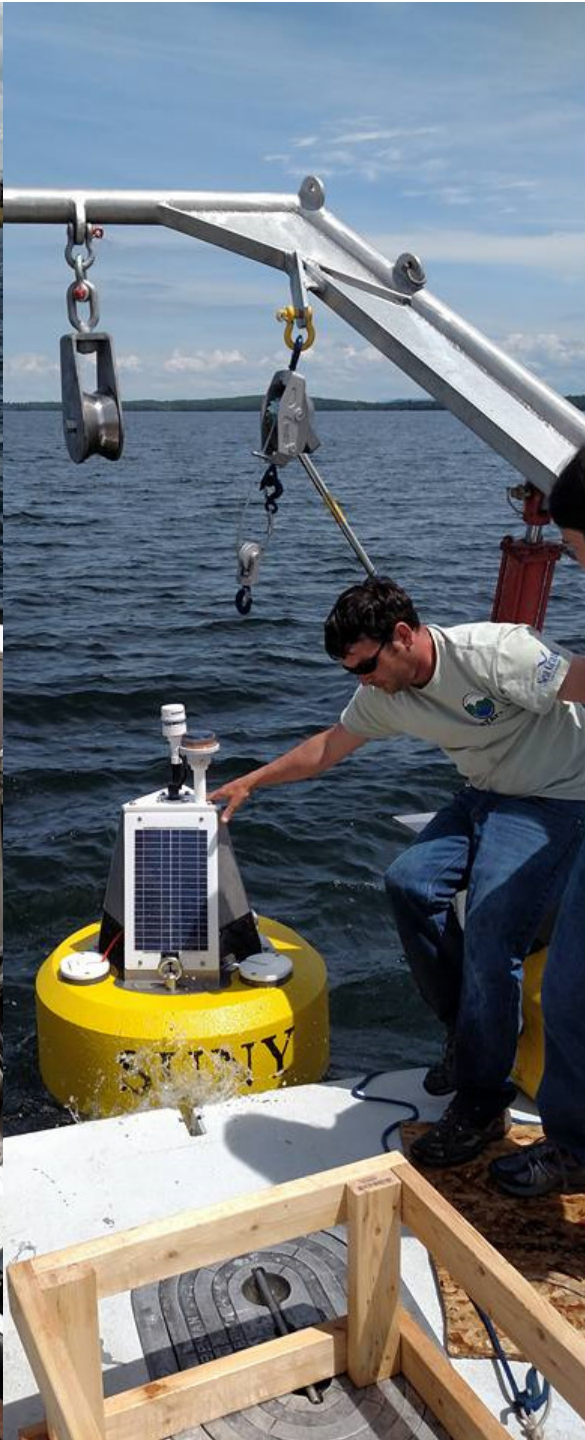
This project examines the impact of climate change on Lake Champlain. The 24-month monitoring project focuses on the lake's surface and internal climate. A data buoy, to be placed near Valcour Island, will be used to gather long-term high-frequency subsurface observations and meteorological data on the Main Lake. Temperature sensors suspended below the buoy will gather data from Spring to Fall on the vertical profiles of the lake's thermal structure. In addition, two multiprobes - one placed near the surface and another lower in the hypolimnion - will continuously collect temperature, pH, conductivity and dissolved oxygen readings. The data will be transmitted from the buoys sensors via satellite to researchers at SUNY Plattsburgh. This project will provide a foundation for further assessment of Lake Champlain as a long-term climate monitoring program.

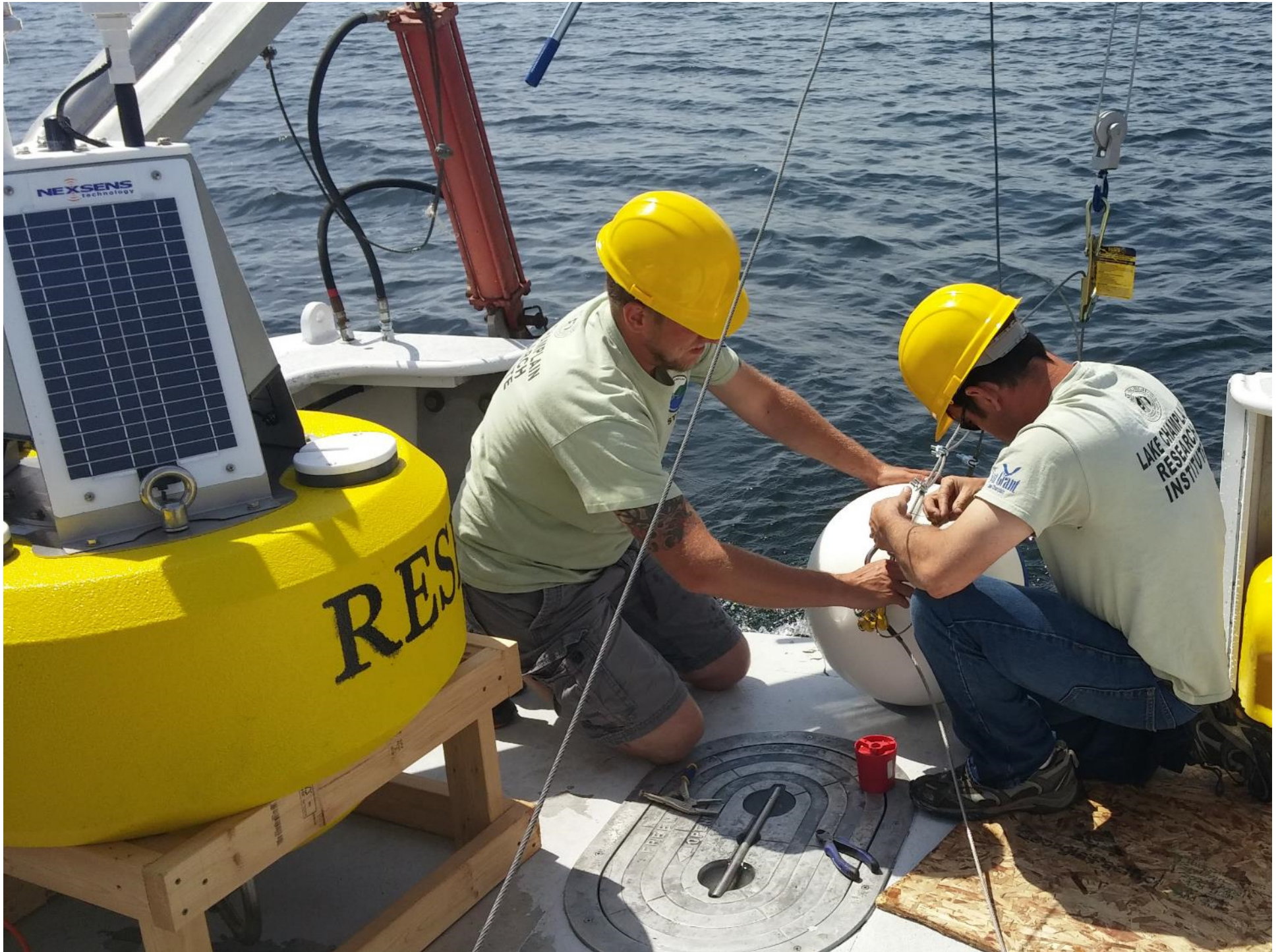
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SUNY Plattsburgh Data Buoy



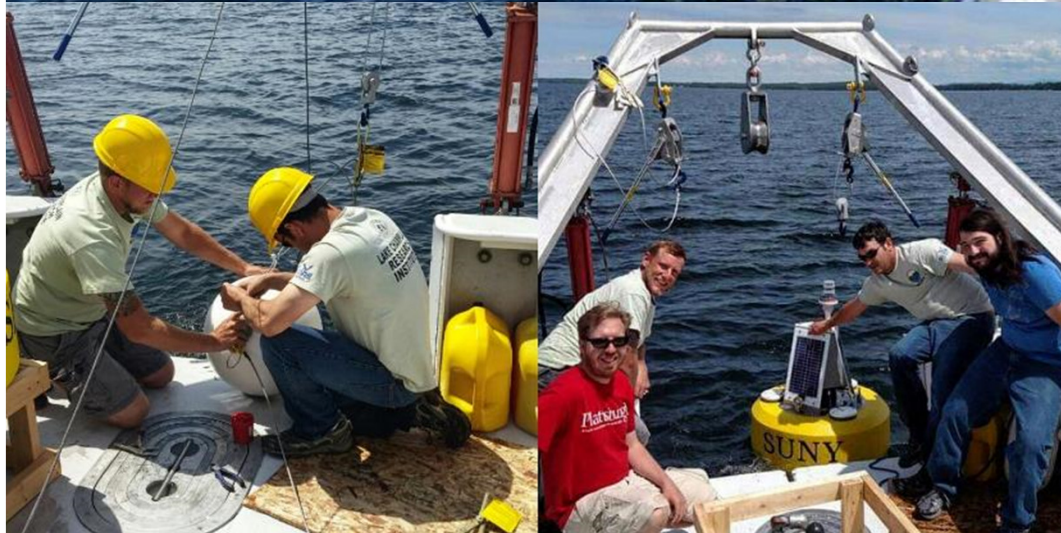








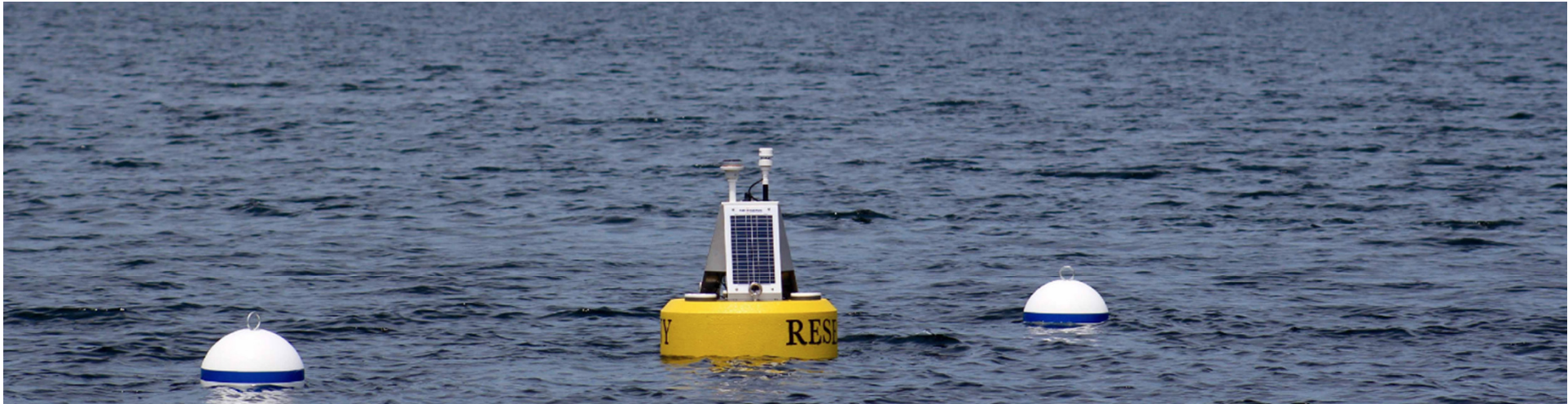
Lake Champlain Data Buoy



LAKE
CHAMPLAIN *Sea Grant*



http://bit.do/plattsburgh_buoy



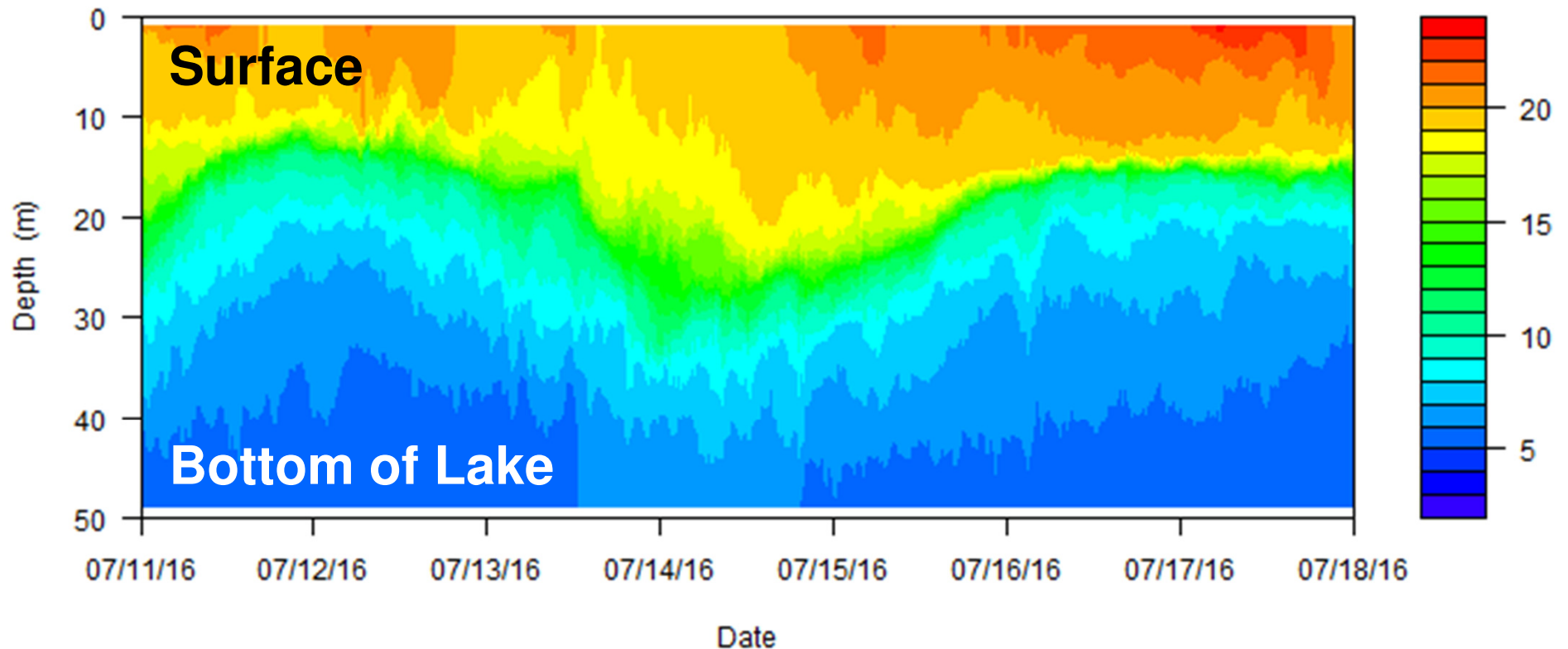
Current conditions as of: 2016-07-18 09:00:00

Upgraded next year ... hopefully	Surface Air Temp.:	18.9 ° C	66 ° F
	Wind Speed:	8.2 m/s	15.9 knots
		from the South (169 °)	
	1m Water Temp.:	20.74 ° C	69.33 ° F
	5m Water Temp.:	20.73 ° C	69.31 ° F
	10m Water Temp.:	20.19 ° C	68.34 ° F
	20m Water Temp.:	8.43 ° C	47.17 ° F
	49m Water Temp.:	5.74 ° C	42.33 ° F

http://bit.do/plattsburgh_buoy

011346

L. Champlain Temp. (C)



- Data is used by:
 - National Weather Service; U.S. Coast Guard; L. Champlain researchers; anglers; sailors
- Hoping for additional funding from the International Joint Commission/NOAA
- Research paper with undergraduate (Will Pierce) expected

How Does This Information Affect You (and fish)?

The Lake Champlain ecosystem is dependent on environmental factors (water quality, invasive species, fishing management, etc.).

It's all about mixing:

- 1) Seasonal mixing (dimictic)**
- 2) Weather-forced mixing**

Mixing determines amount of dissolved oxygen, nutrients, and smaller organisms

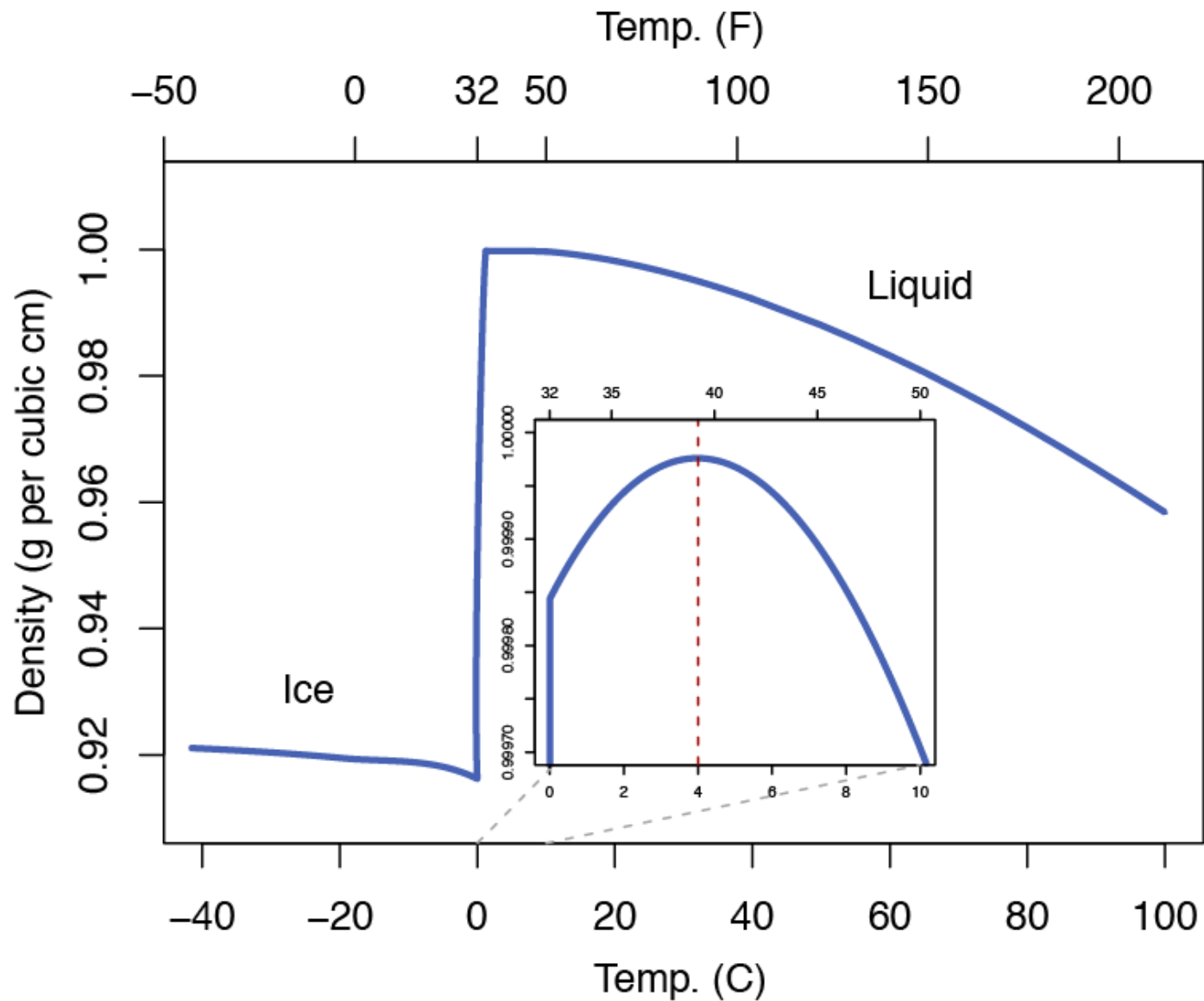


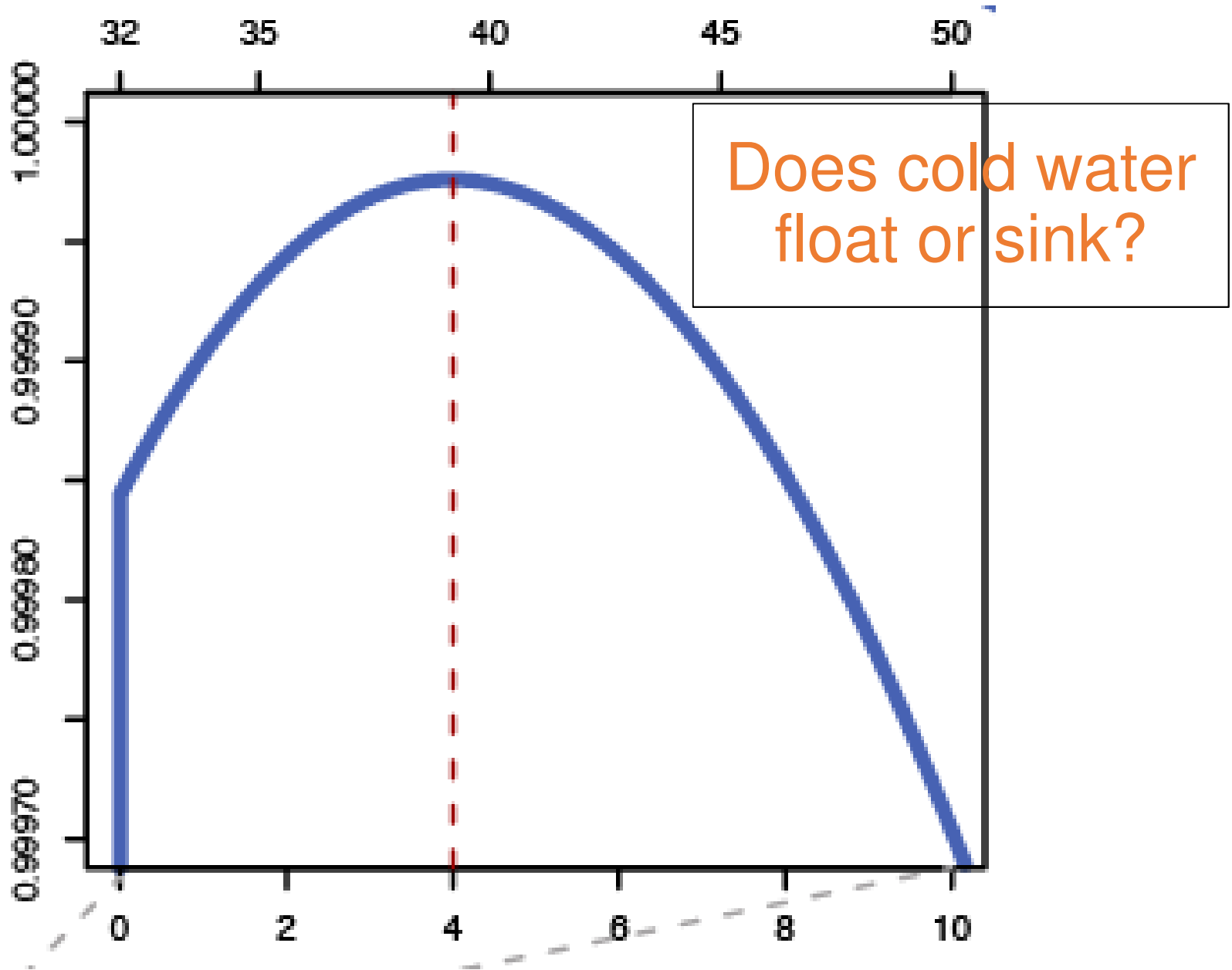
May 7 track



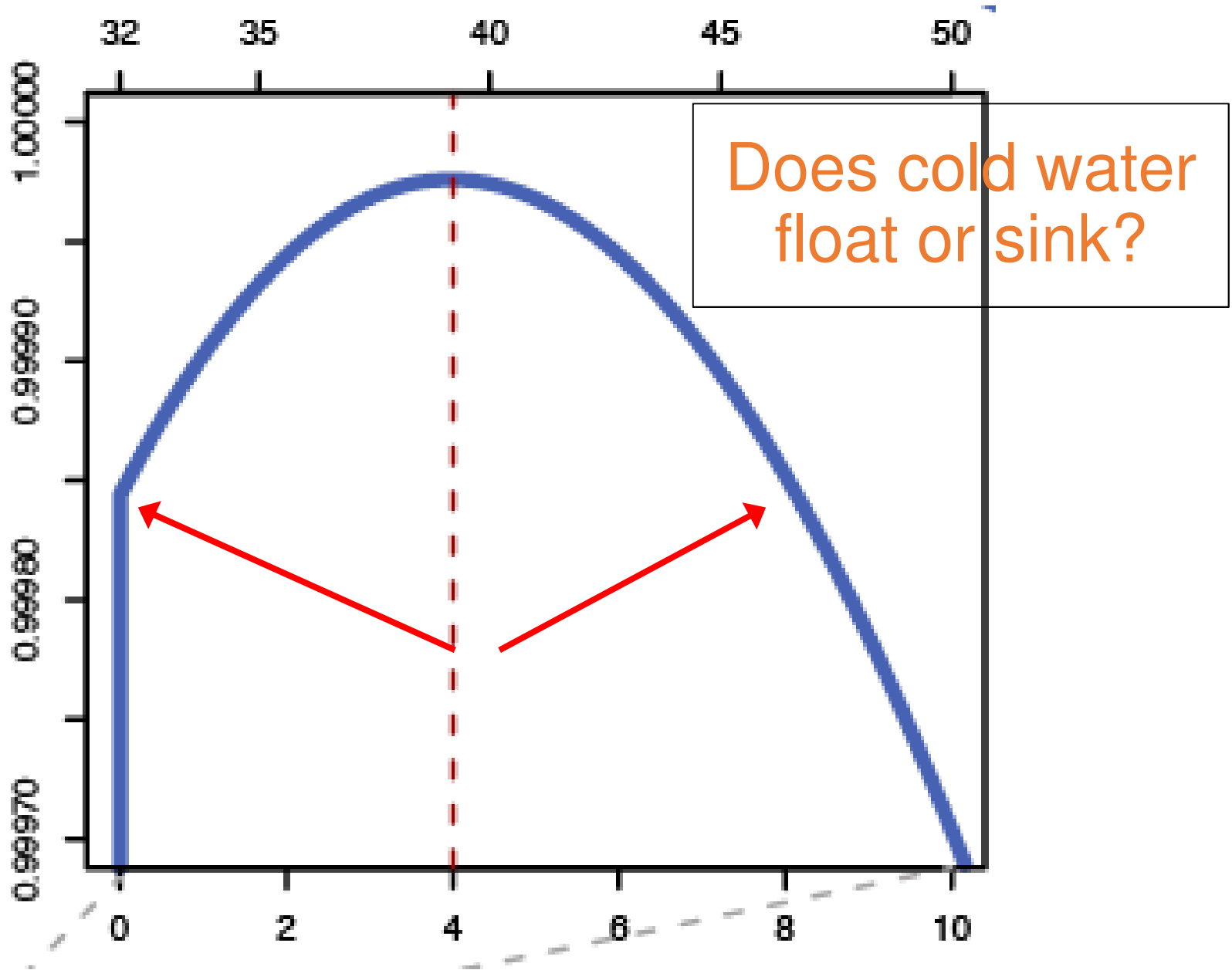
Google Earth
imagery Date: 5/13/2015 44°16'30.06" N 73°20'12.01" W elev 92 ft eye alt 7235 ft

H₂O Temperature vs. Density



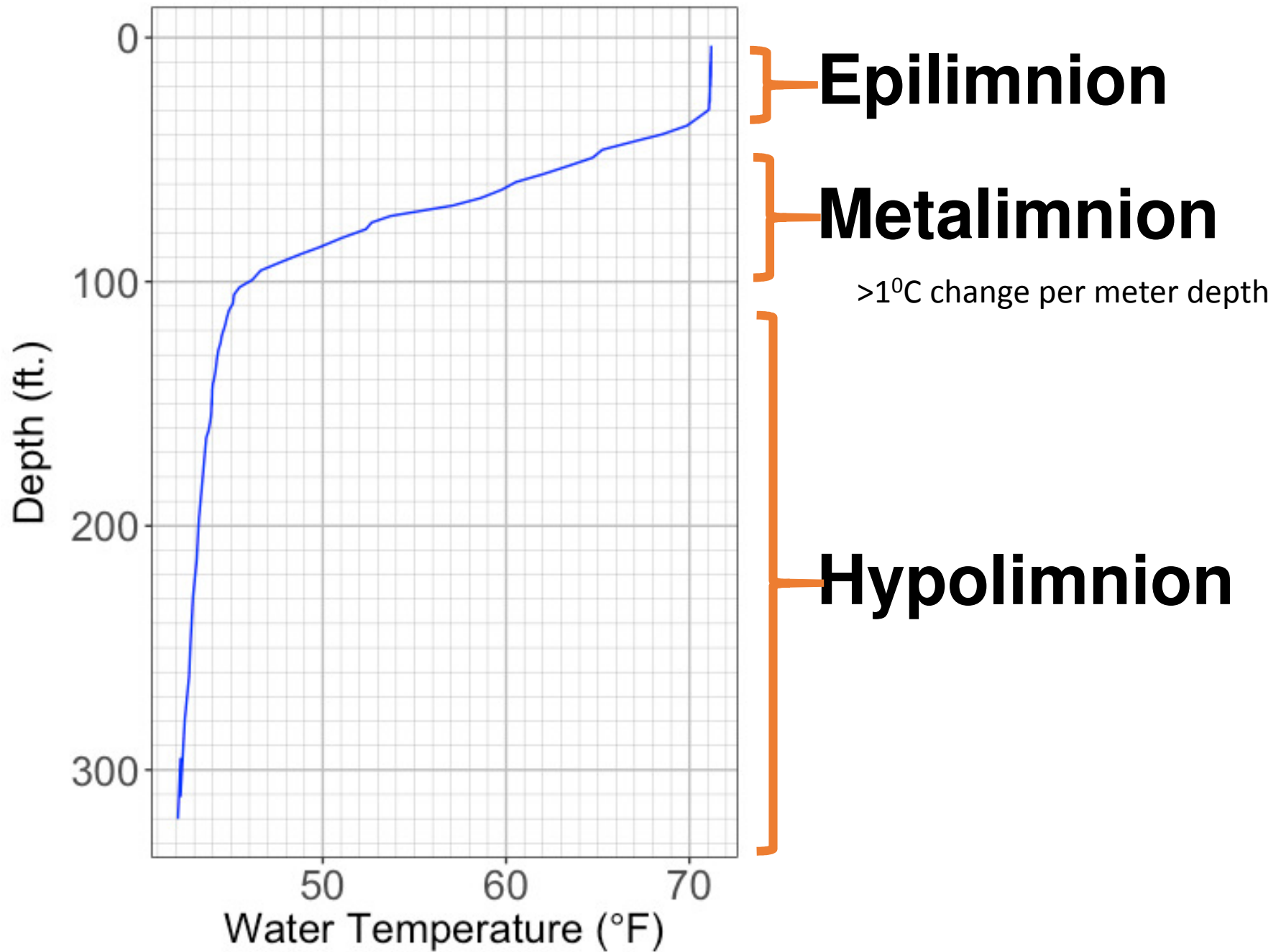


at which temperatures is the density of water 0.99985 grams per cubic centimeter?

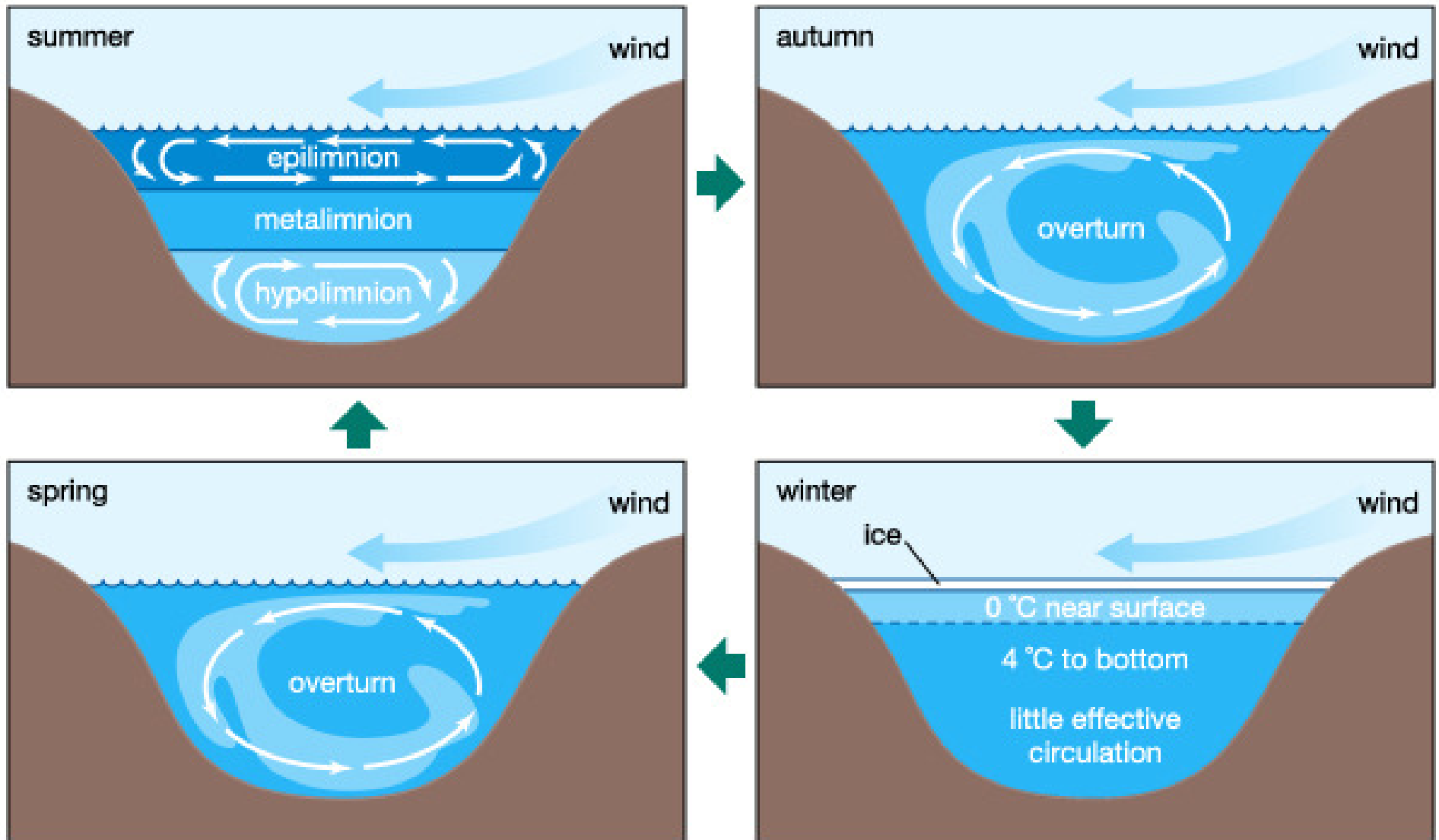


at which temperatures is the density of water 0.99985 grams per cubic centimeter?

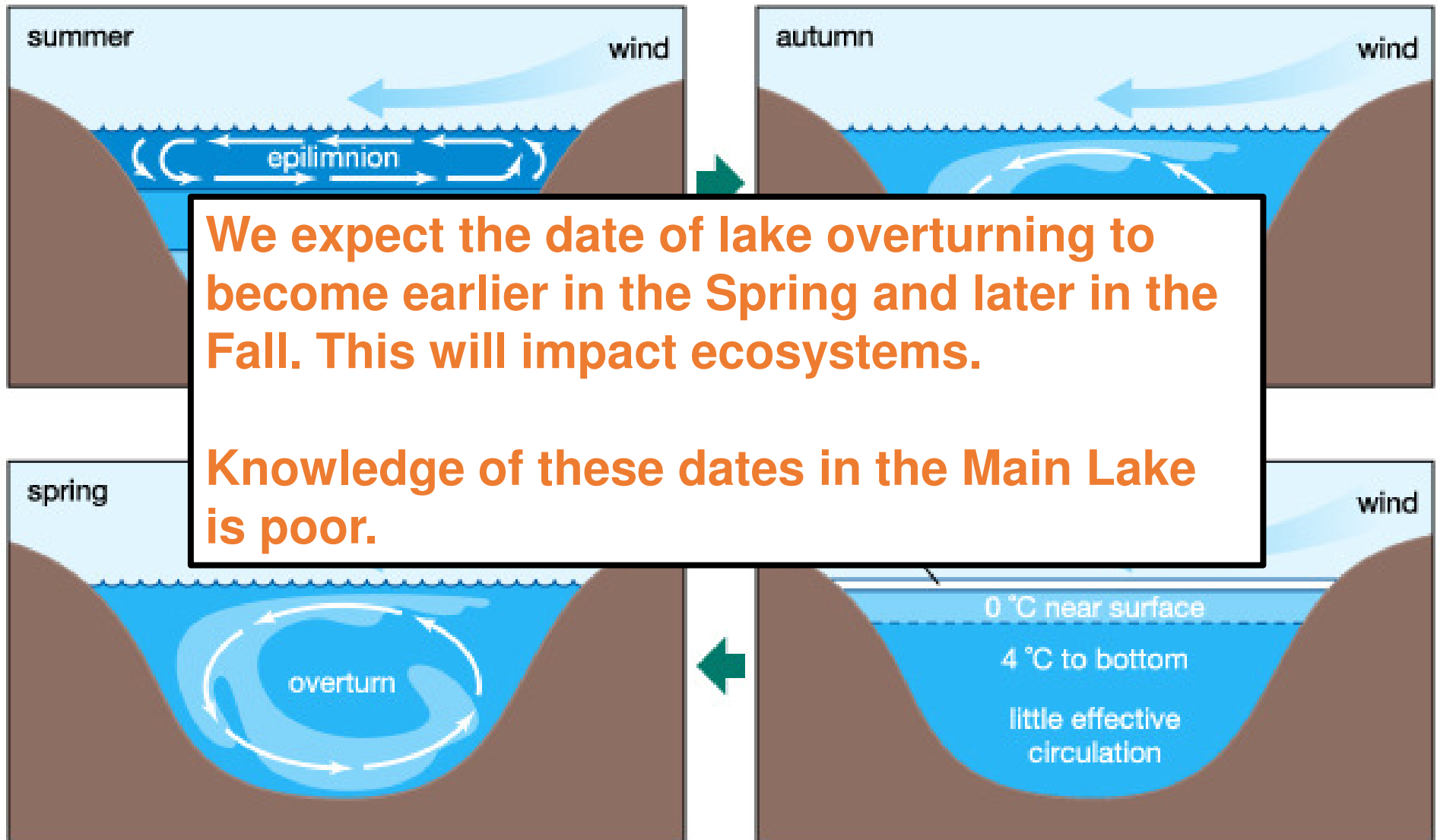
August 5, 2017



Seasonal Lake Mixing



Seasonal Lake Mixing



We expect the date of lake overturning to become earlier in the Spring and later in the Fall. This will impact ecosystems.

Knowledge of these dates in the Main Lake is poor.

**2007-2011 CRF Met Station 15 Minute Wind
Direction, Frequency, and Magnitude**

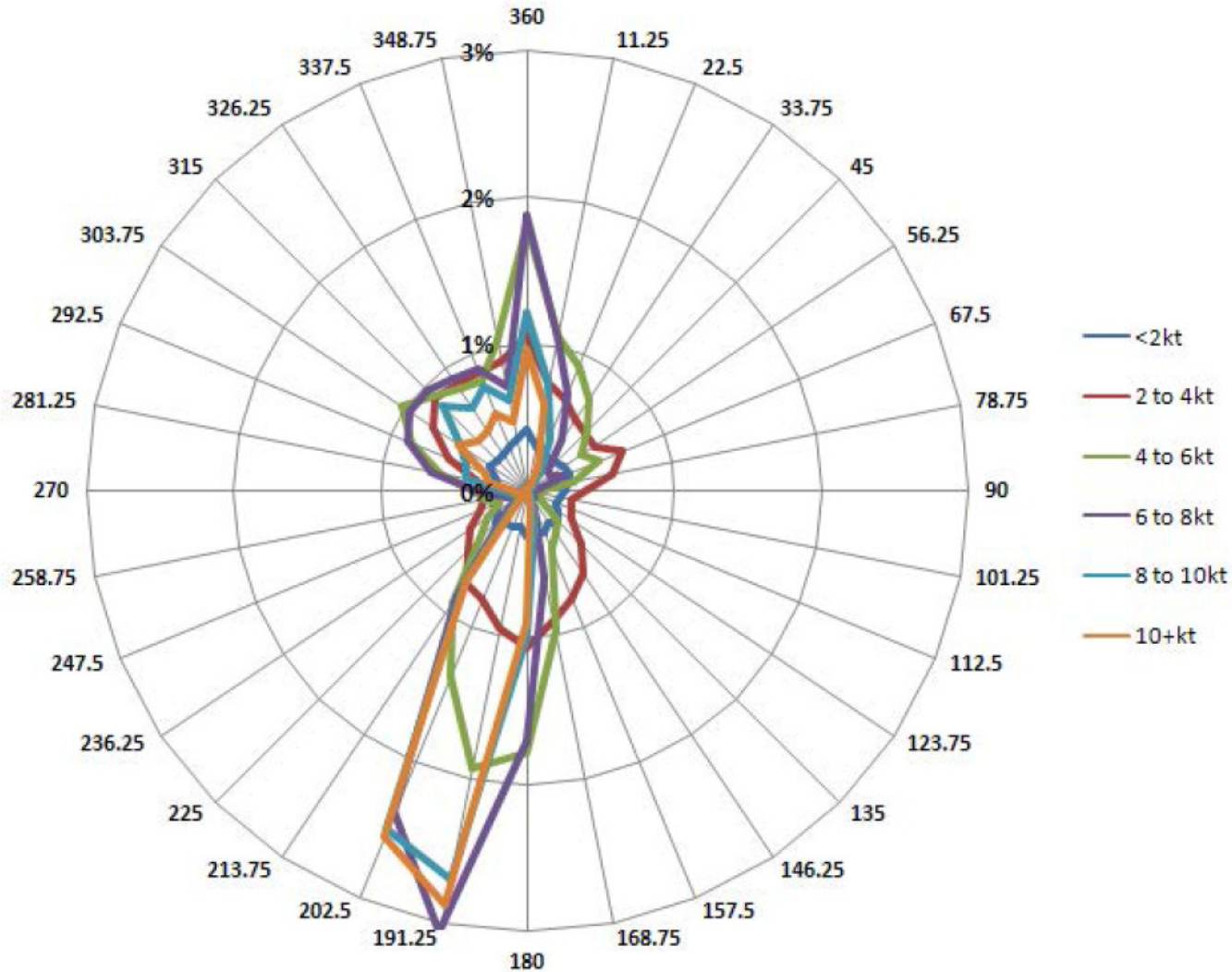
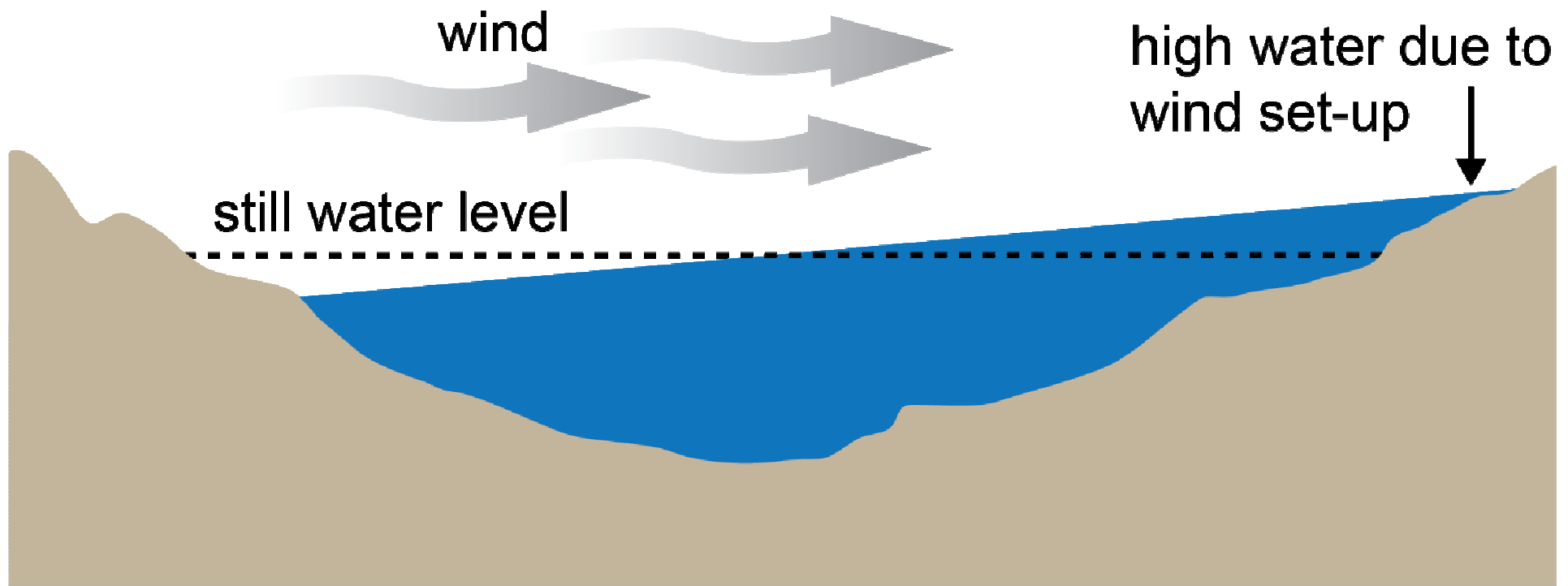


Figure 2.4: Wind rose showing wind direction, magnitude, and frequency (rings) for six wind speed classes from 32 bearings.

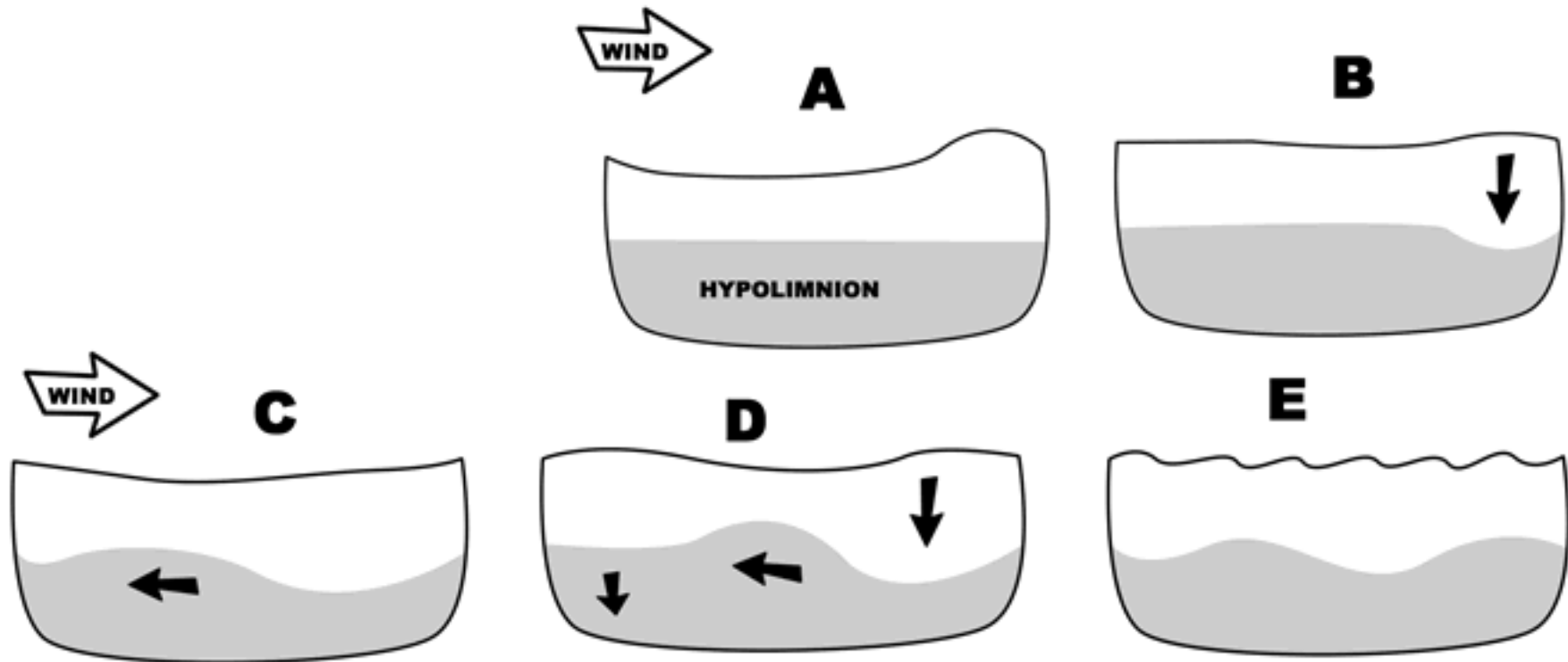
Source: Fitzgerald Environ. Assoc., LLC for LCBP, 2013

Lake Seiche



Wind setup is a local rise in water level caused by wind.

Lake Surface and Internal Seiche

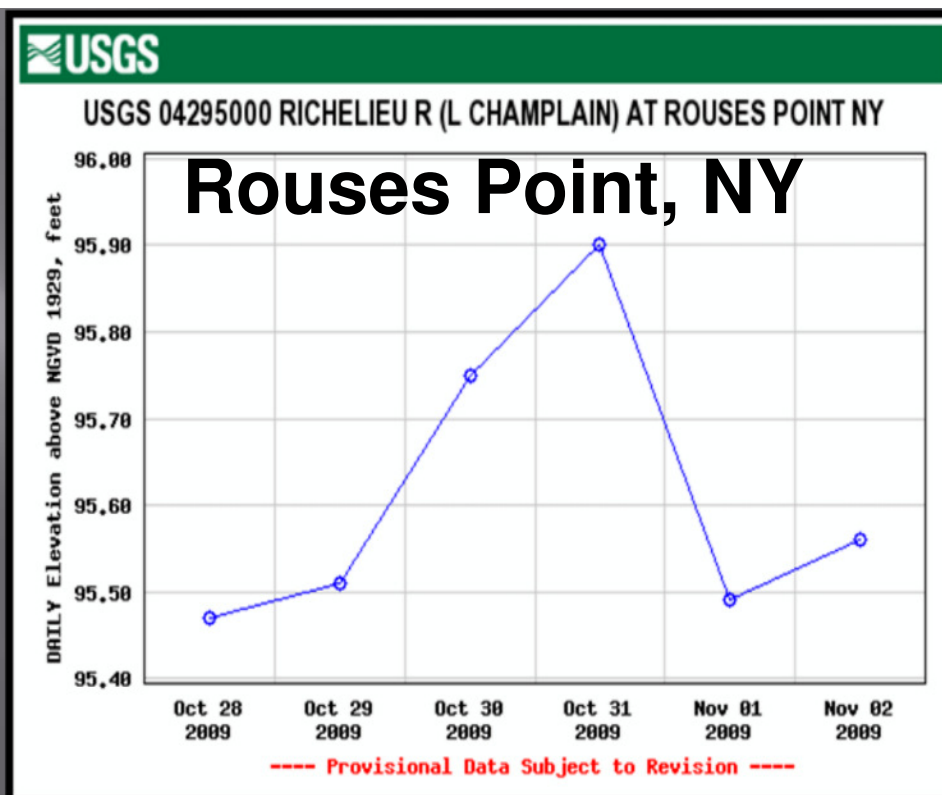
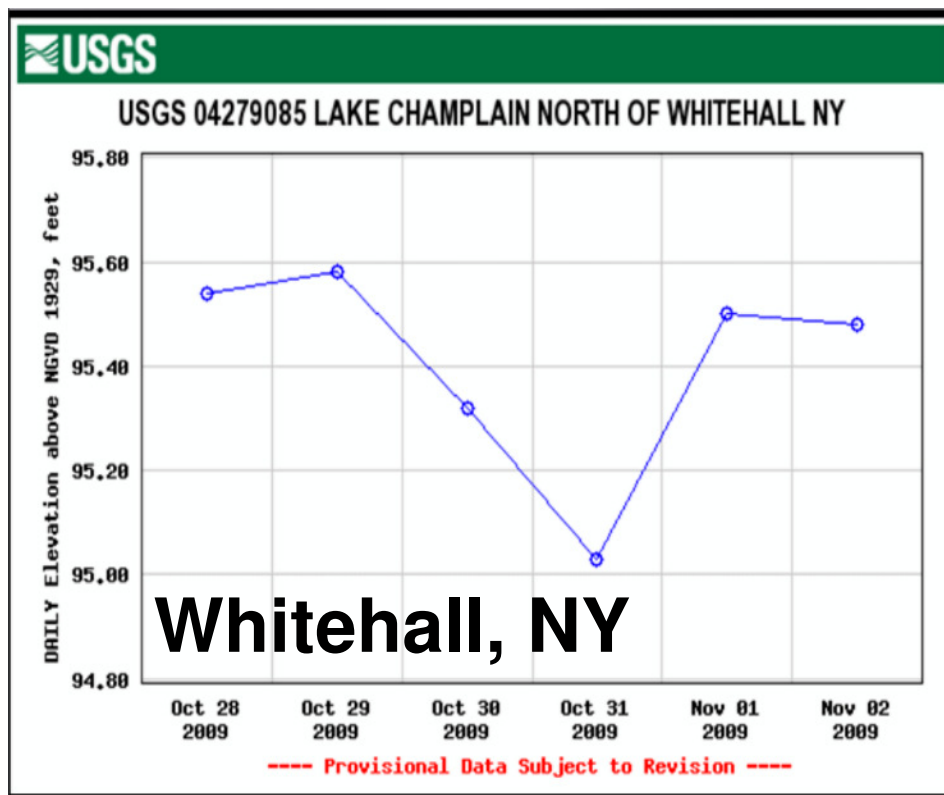


Changes at surface: ~ 1 ft. (generally ~inches)

Changes of thermocline (epilimnion depth): ~ 60 ft.

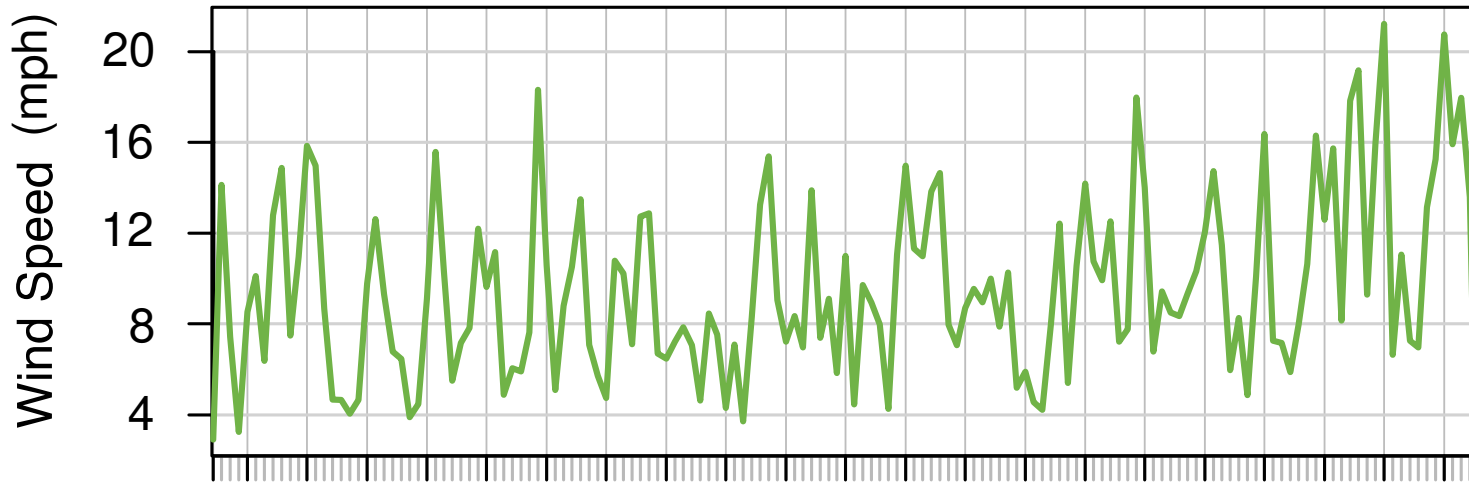
Images from Lakes of Missouri Volunteer Program

Example of a Strong Seiche Event



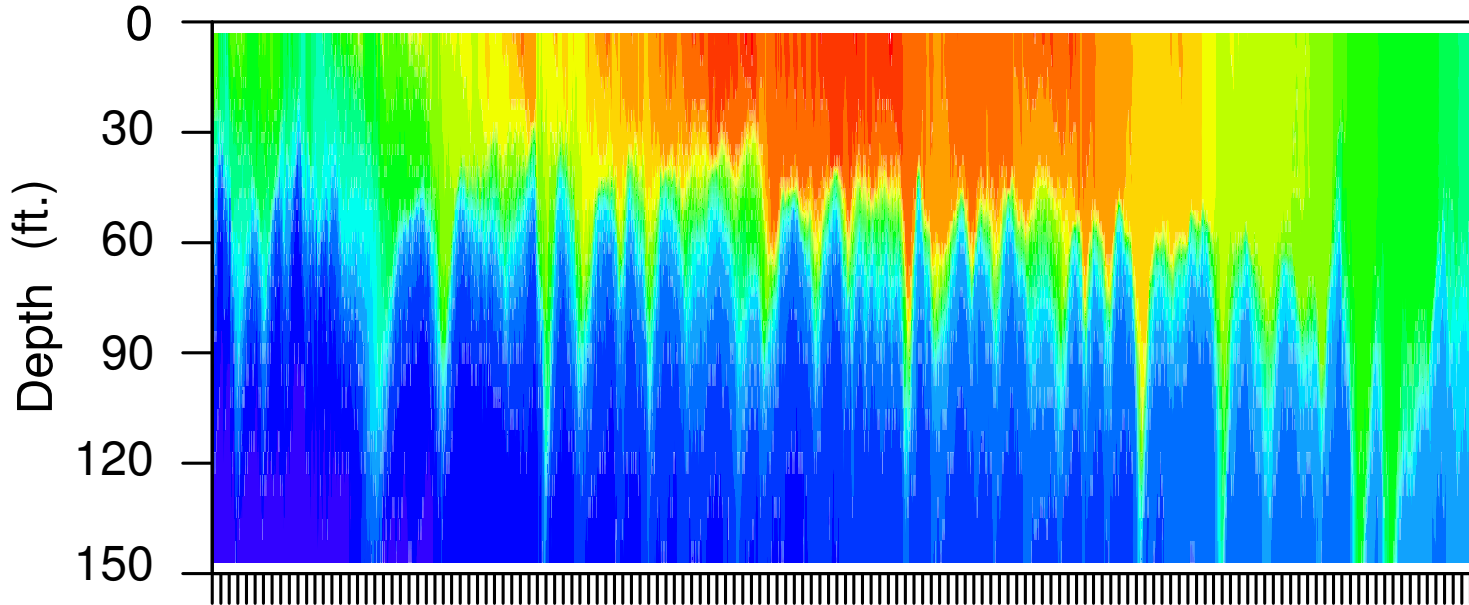
After 9 hours of > 40mph winds, water is ~1 ft. higher downwind

Data: USGS; Images from John Goff (NWS/BTV)



**SURFACE
TEMP.:**
MAX:
78.3°F

MIN:
52.3°F

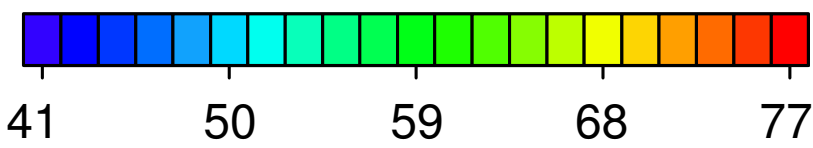


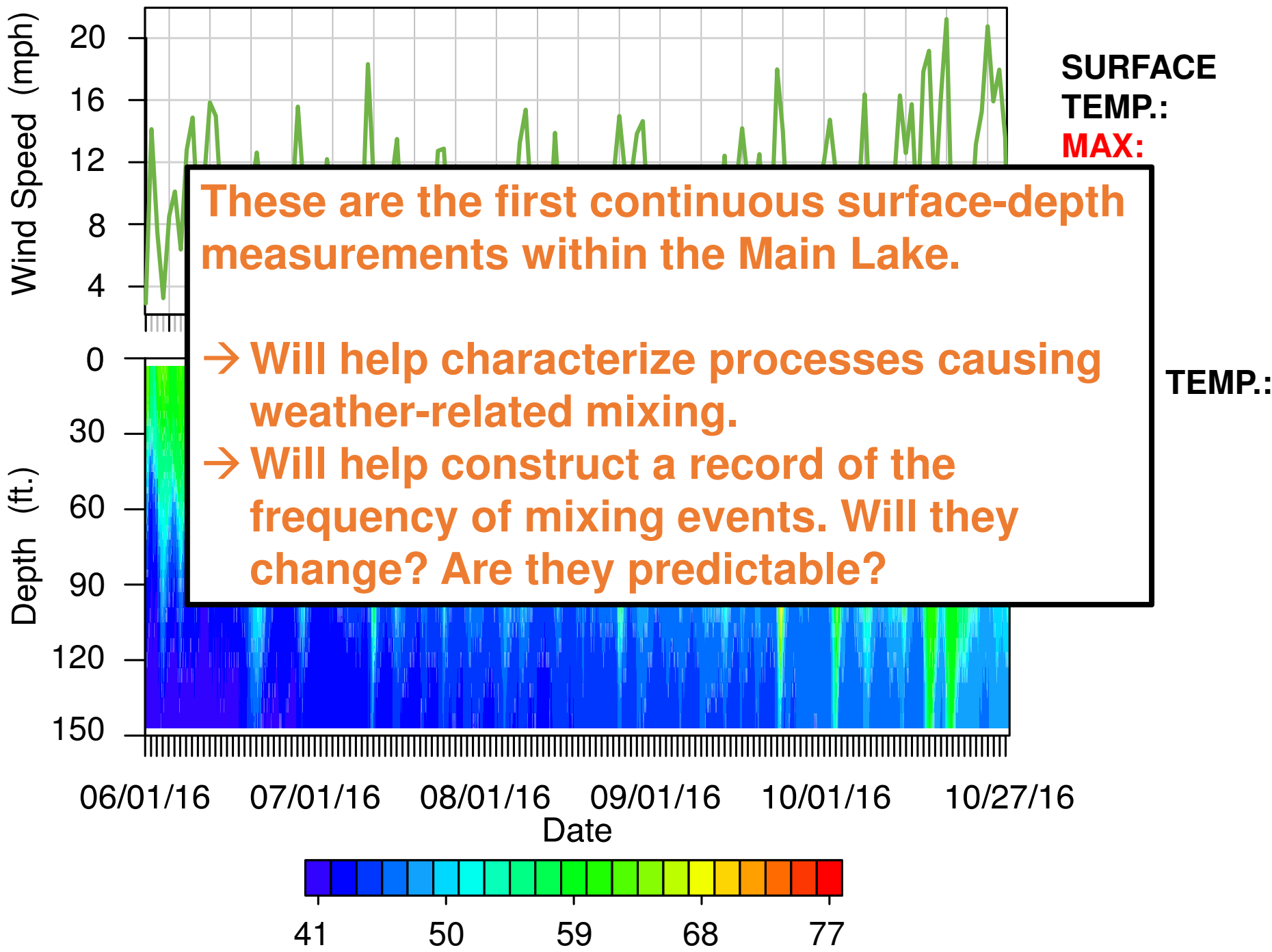
150 ft. TEMP.:
MAX:
58.6°F

MIN:
40.0°F

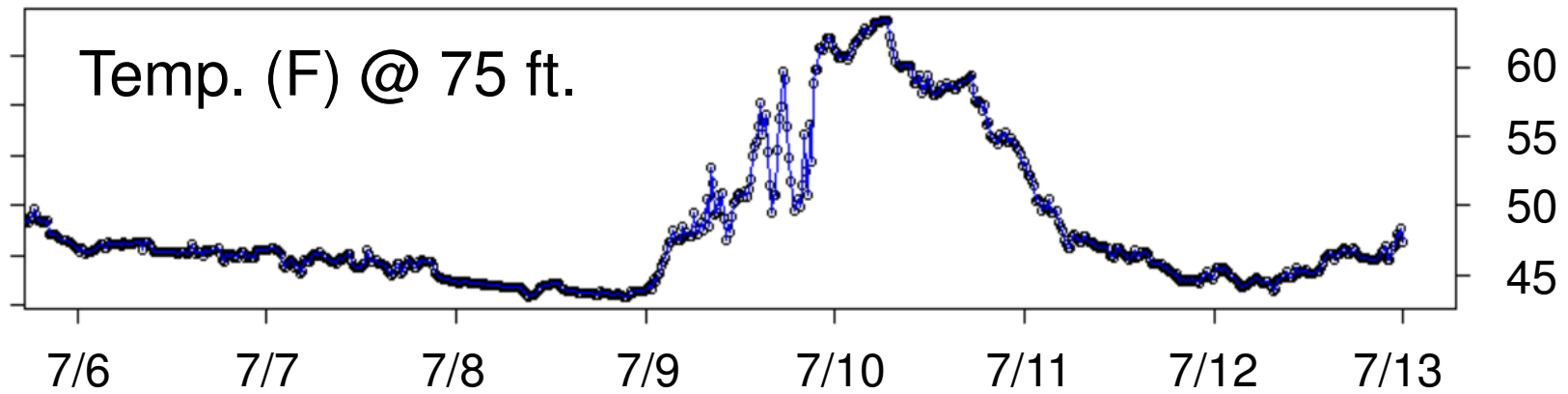
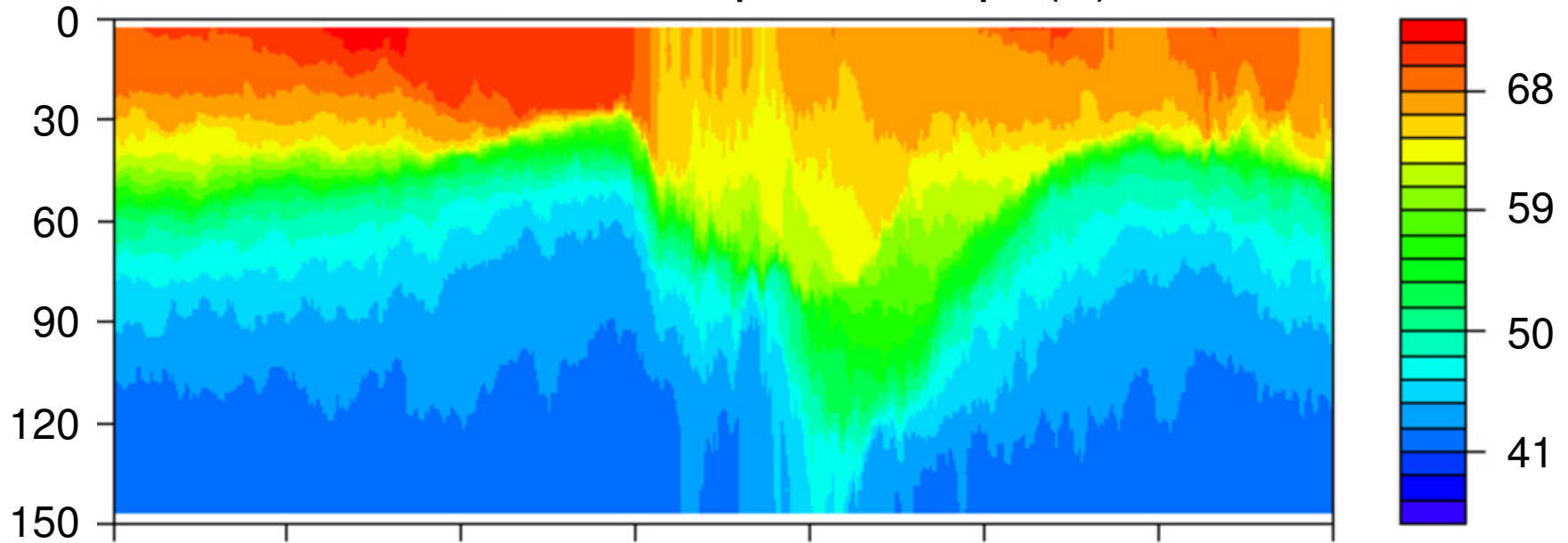
06/01/16 07/01/16 08/01/16 09/01/16 10/01/16 10/27/16

Date

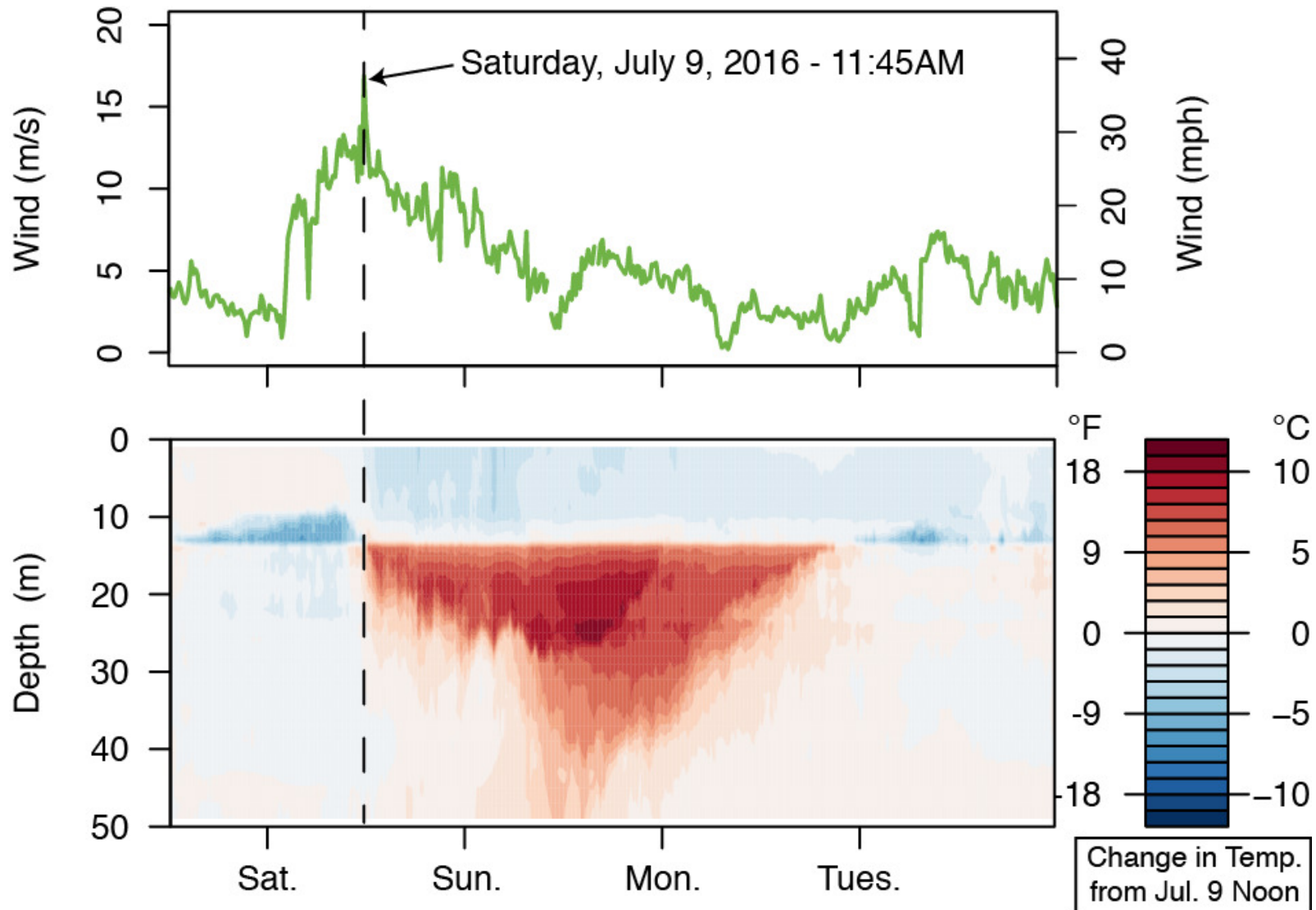


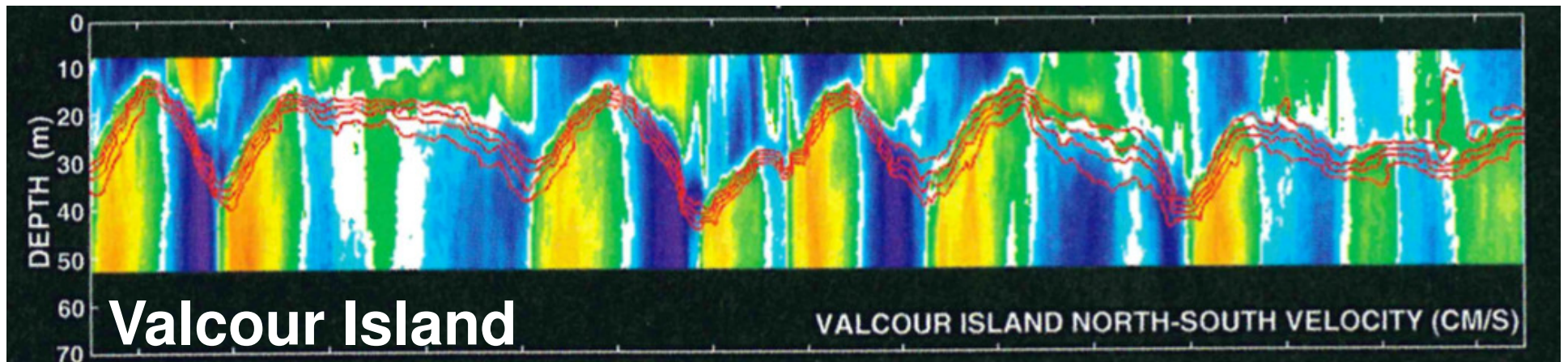


L. Champlain Temp. (F)



July 9-10 Wind Forcing: Lake Champlain Main Lake





Green/Yellow/Orange

Light Blue/Dark Blue/Purple

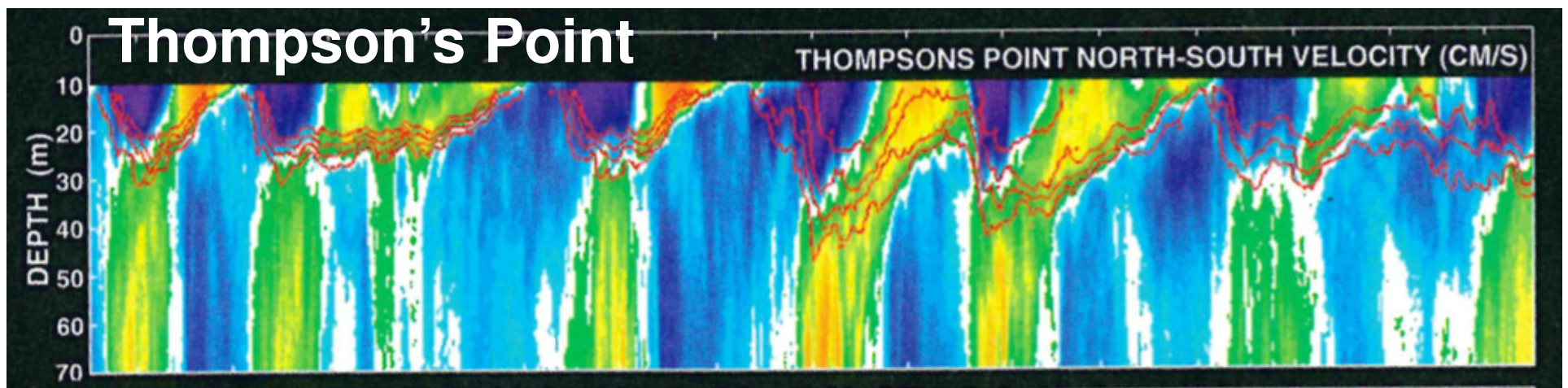
Northward Current

Southward Current

Thermocline



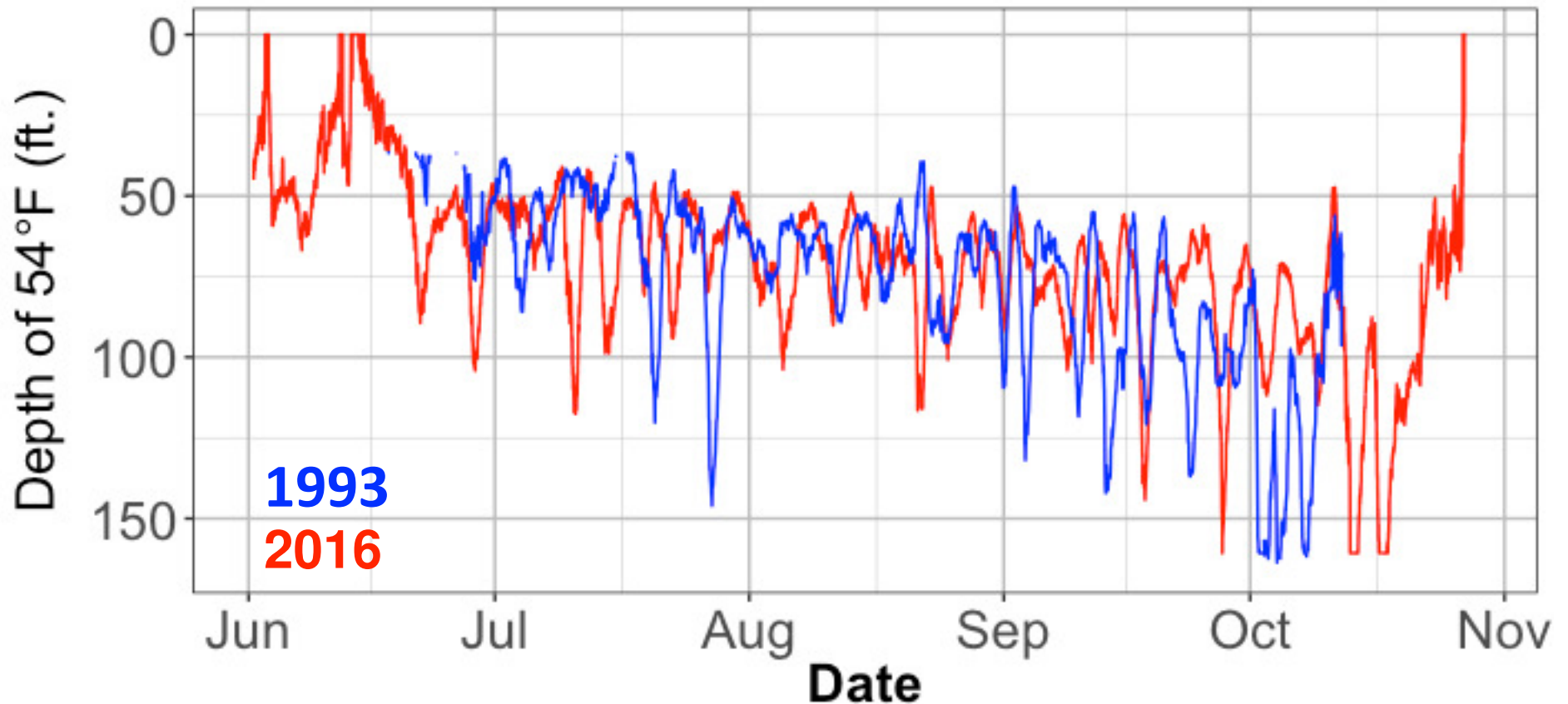
Data from Manley et al. (1999)



Putting the buoy to work...

2 Years, 13 Years Apart

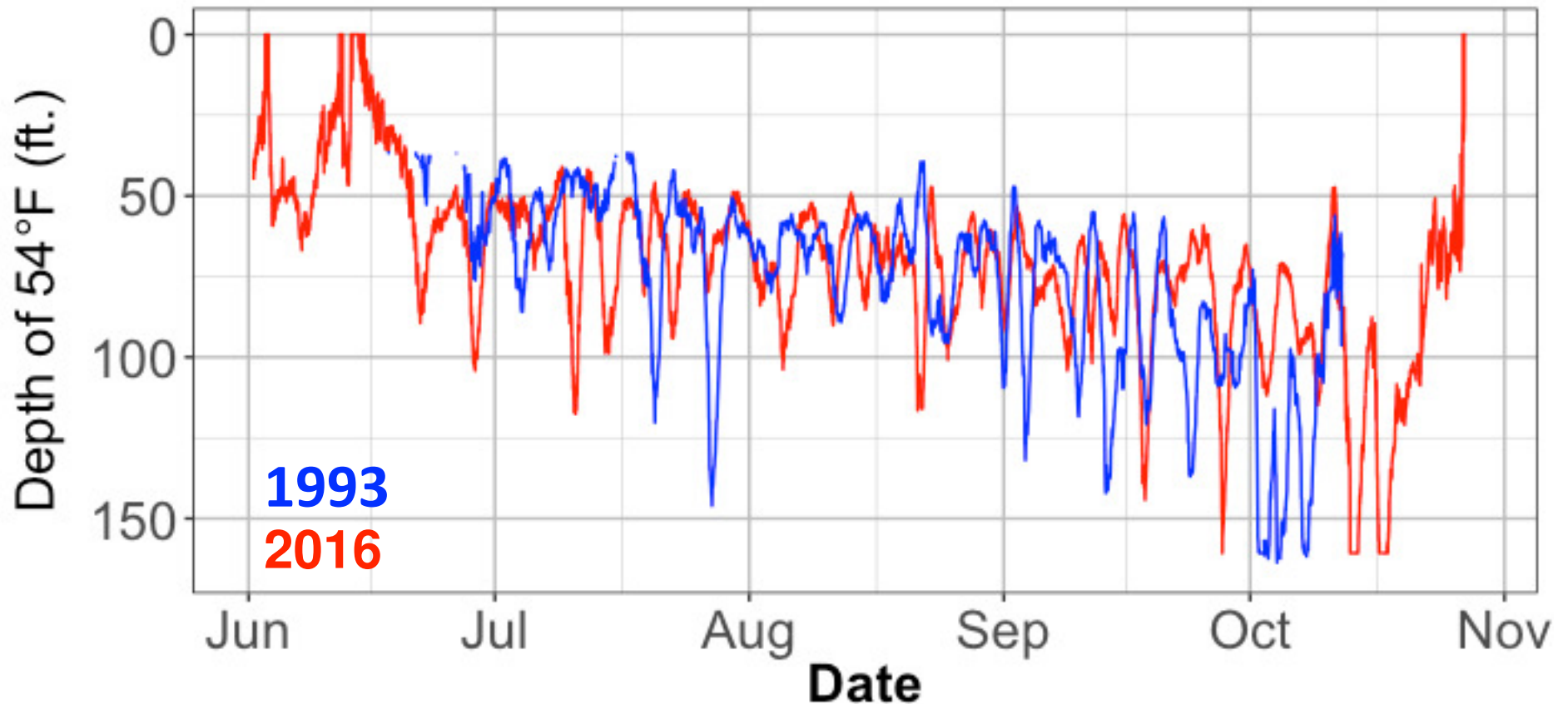
Where to Find 54°F



In general, 54°F was found at greater depth in **1993** vs **2016**

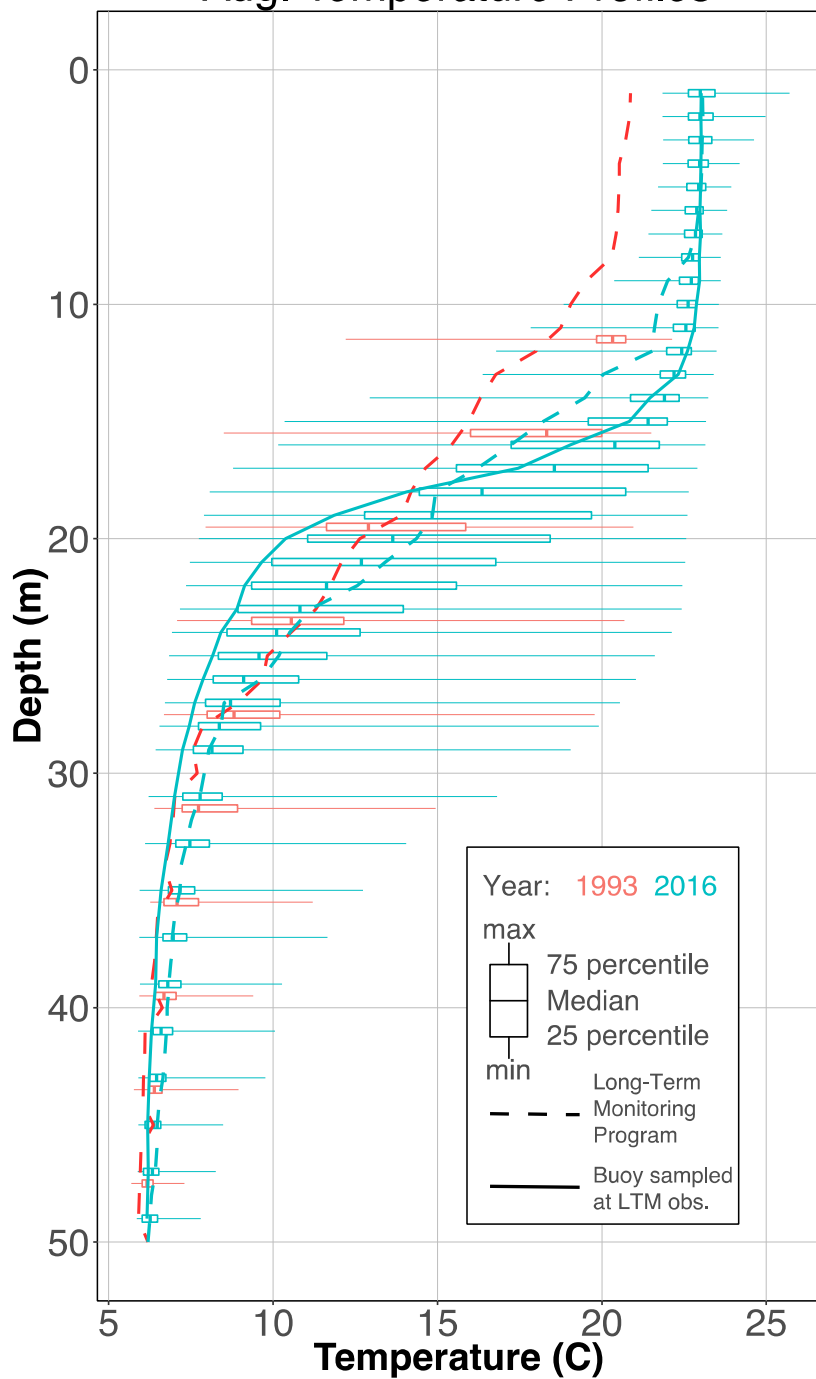
2 Years, 13 Years Apart

Where to Find 54°F



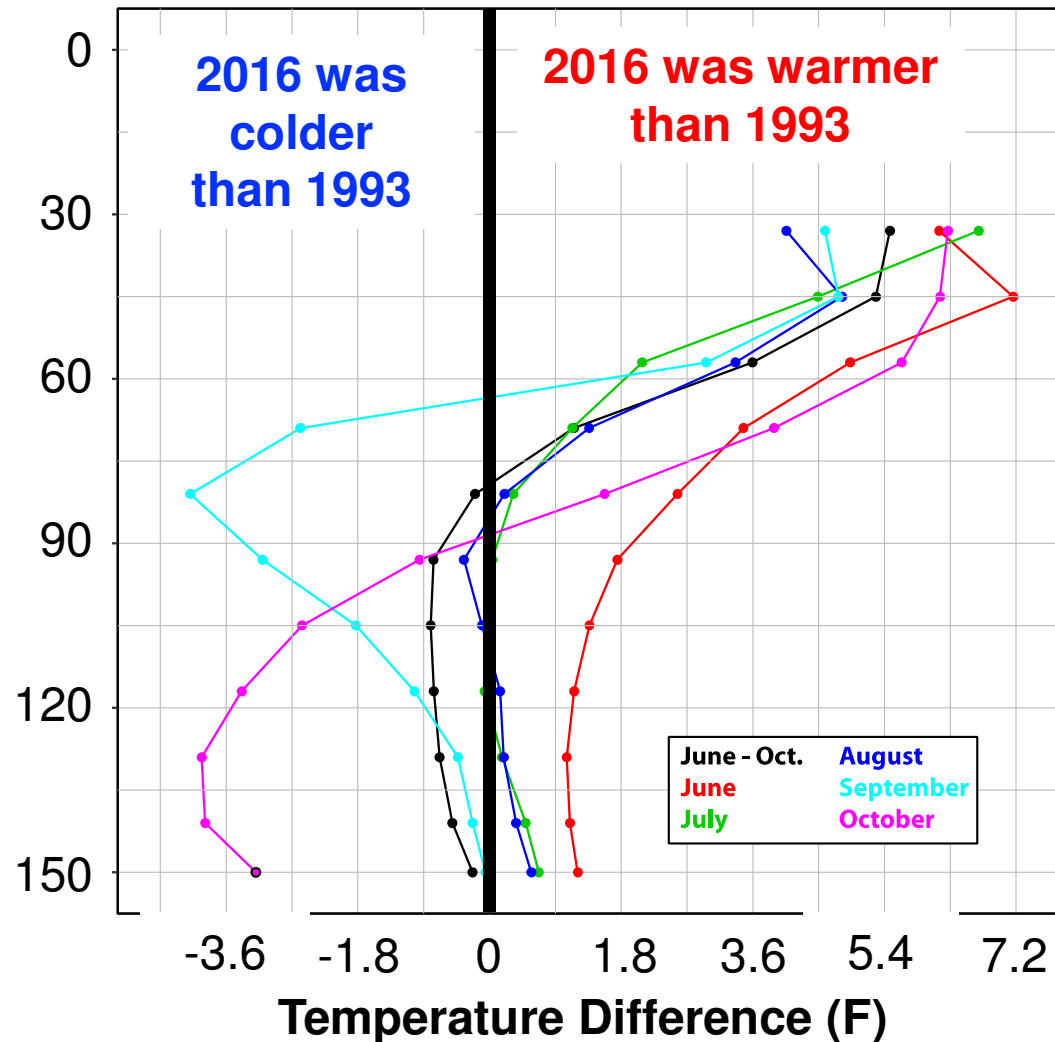
Variations caused by weather (vertical mixing) and seasonal cycle

Aug. Temperature Profiles



2 Years, 13 Years Apart

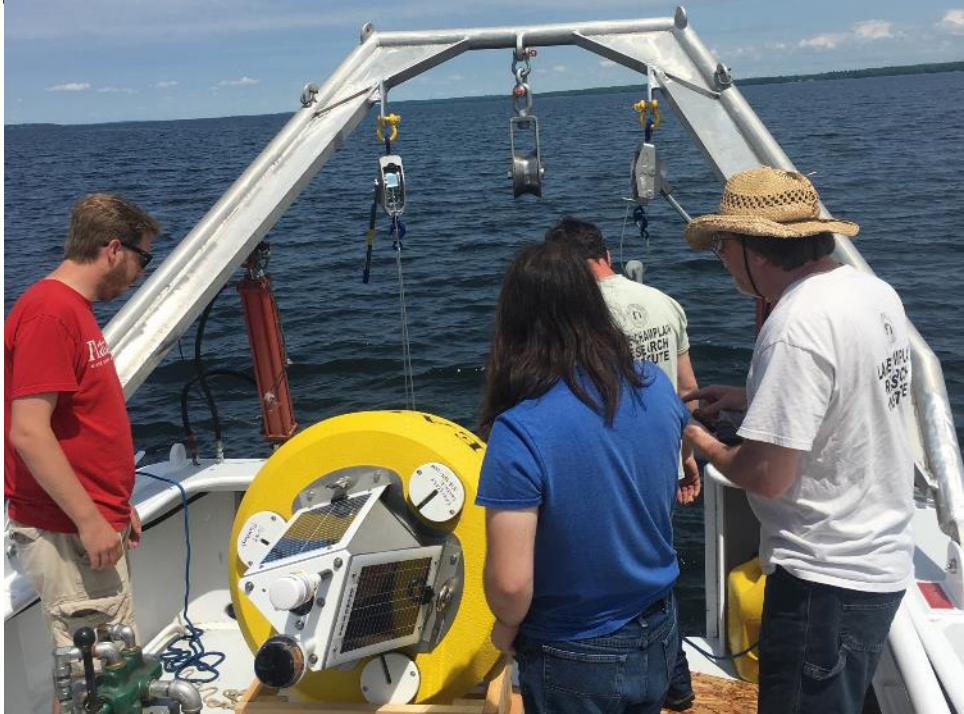
Temp. Change Between 1993 and 2016



2016 was much warmer than 1993 in the epilimnion

2016 was comparable to 1993 at depth

→ Increased stratification (layering)/shallower thermoclines in 2016



**Redeployment
planned for May 2017**

A lot of data... In one location

The data buoy measures a lot of data, but it is located in just one region of the lake.

We need *more* data from around the lake. This is Amazing Data! Can you add one of these right off Splitrock? LOL

“What is the approximate cost associated with a second buoy? Is it something that the forum could get behind and ask for donations to fund it if there was enough interest? The data could be fantastic as a fishing tool.”

Exploring the creation of a data sharing app/web form that allows **you to share your data with each other** and us.

→ Key: We *all* gain

Citizen science data collection opportunity?



Date	Latitude	Longitude	Depth (ft)	Temp (F)

Details to follow with announcement on Lake Champlain United!

Eric M. Leibensperger
(eleib003@plattsburgh.edu)



Thank You!!
Please feel free to write!

Mark Malchoff
(malchom@plattsburgh.edu)