

# WHAT WILL LAKE TAHOE LOOK LIKE IN THE 21<sup>ST</sup> CENTURY?

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**Q: How many climate change skeptics does it take to screw in a light bulb?**

**A: None. It's too early to say if the light bulb needs changing.**

**A: None. It's more cost-effective to live in the dark.**

**A: None. We only know how to screw the planet.**

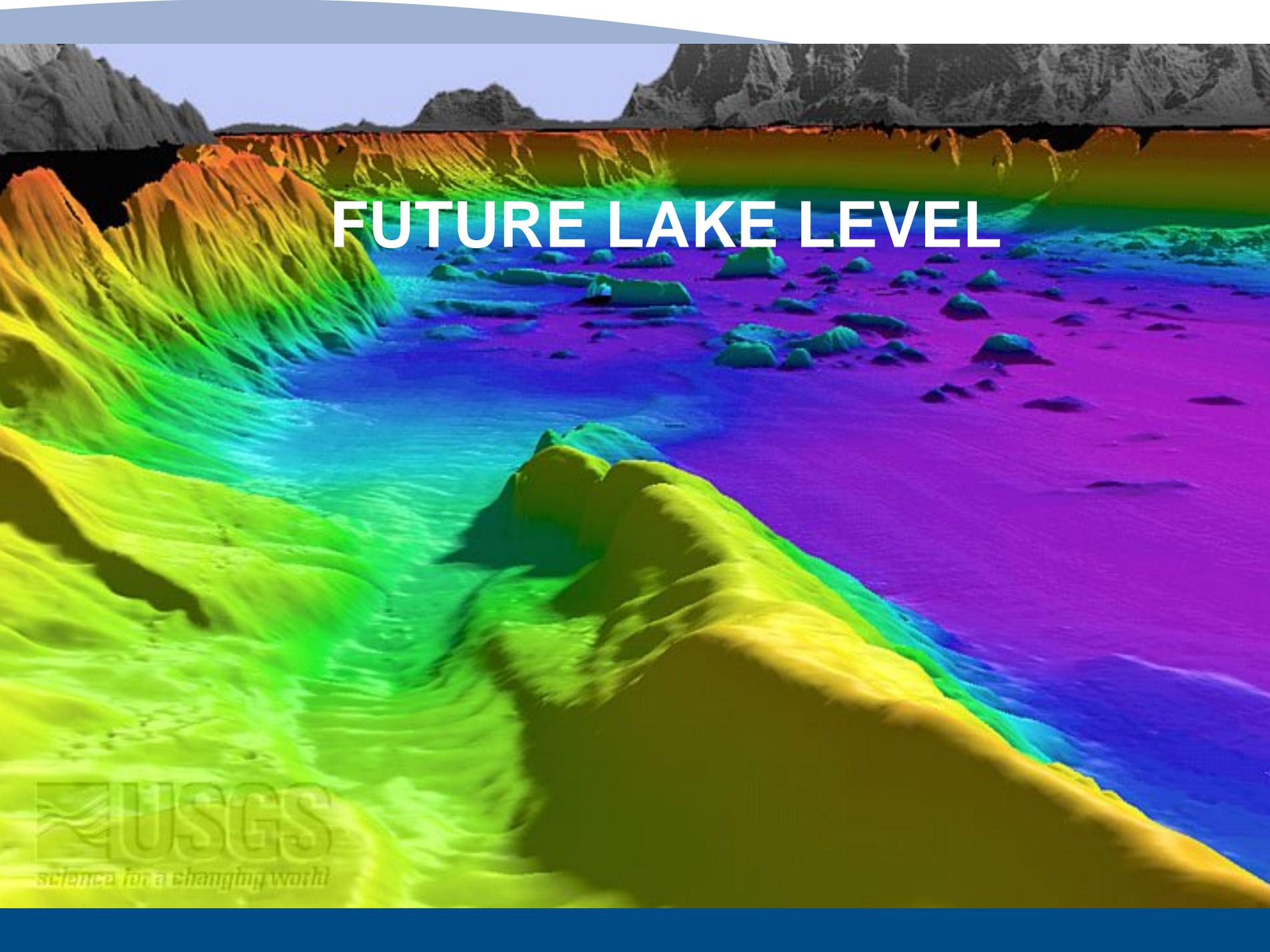
**A: None. Eventually the light bulbs will fix themselves.**

**THE TALKS IN THIS SESSION WILL FOCUS ON THIS QUESTION, FROM A RANGE OF PERSPECTIVES:**

- **THE BASE OF THE FOOD WEB**
- **INVASIVE FISH AND INVERTEBRATES**
- **WATERSHED**
- **ATMOSPHERIC LOADING**

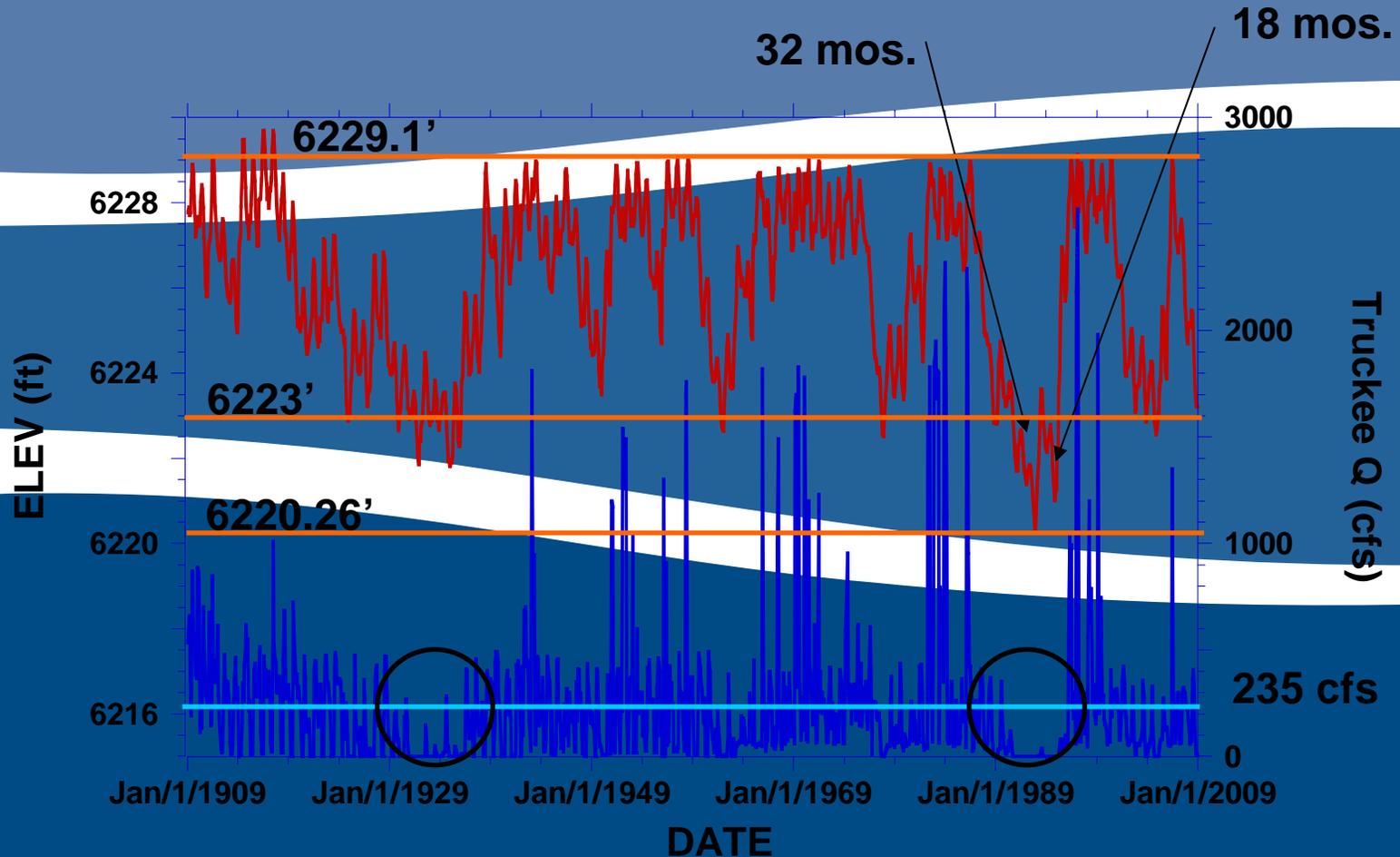
**THIS TALK ADDRESSES TWO OTHER ISSUES:**

- **CHANGES IN LAKE LEVEL**
- **CHANGES IN LAKE MIXING**

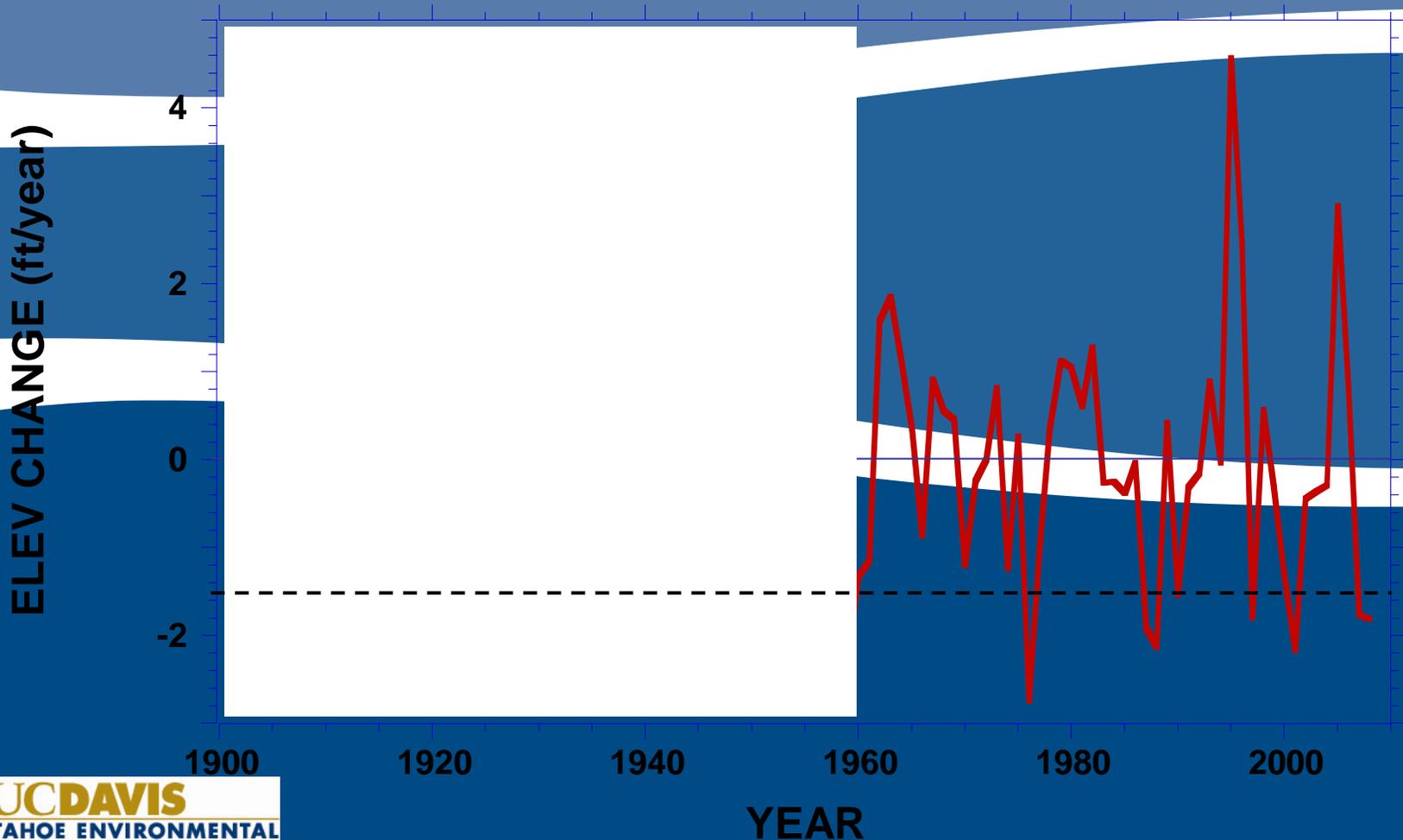


# FUTURE LAKE LEVEL

1. Truckee River – mean ann. flow little long term trend, occasional floods, rarely dry, maybe more floods of late (?)
2. Three important elevations – legal, rim, lowest
3. Lake Elev. – increasing frequency of dips below natural rim
4. Currently 6223.6'



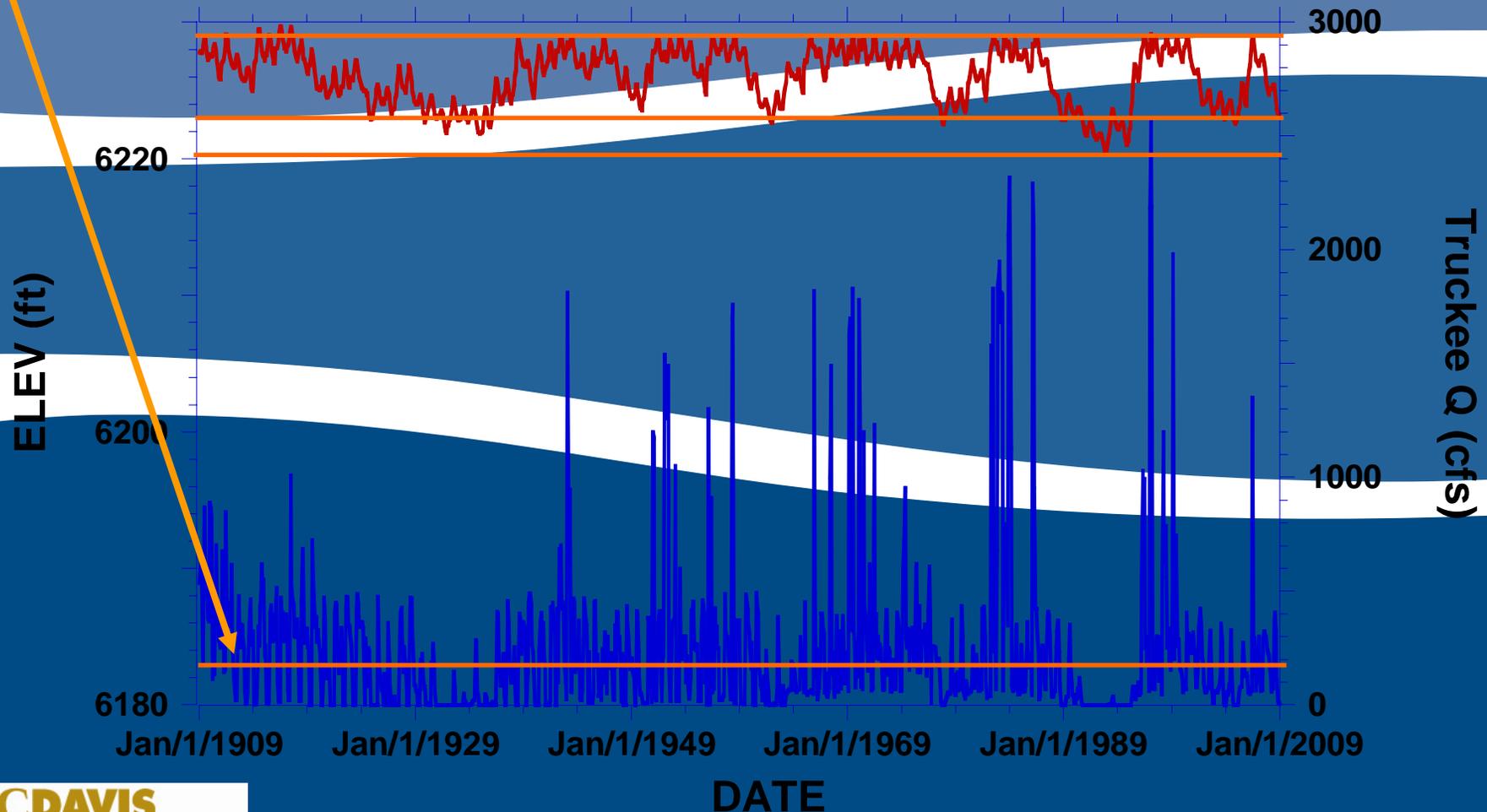
1. Long term decline in water elevation since 1960.
2. Typical elevation loss in dry years ~ 1.5 ft/yr.
3. A 5 year drought starting now  $\rightarrow$  -7.5 ft  $\rightarrow$  6215.5', or 5 ft below the 1992 levels.
4. What is scary is yesterday's talk indicating a 14 year drought is plausible in coming decades. That could take us to 28 ft below current full lake level. Maximum recorded elevation gain 4.5 ft/yr

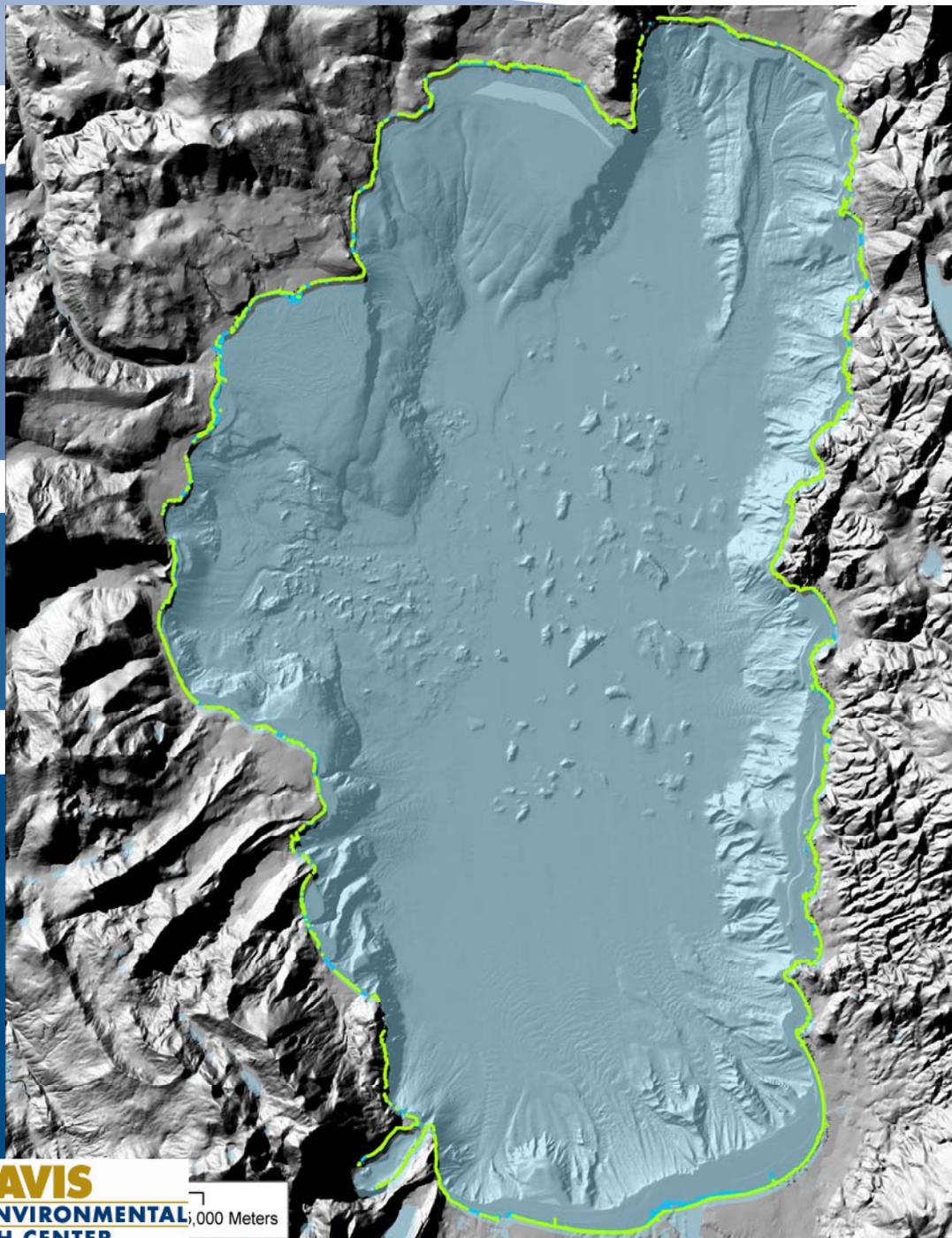


Level of submerged tree trunks in Lake Tahoe is 6183 ft (Lindstrom).

The lake fell 40 ft over 5000 years ago and stayed below that level long enough for 150 year old trees to grow.

Other lakes in the Sierra have shown more recent elevation drops



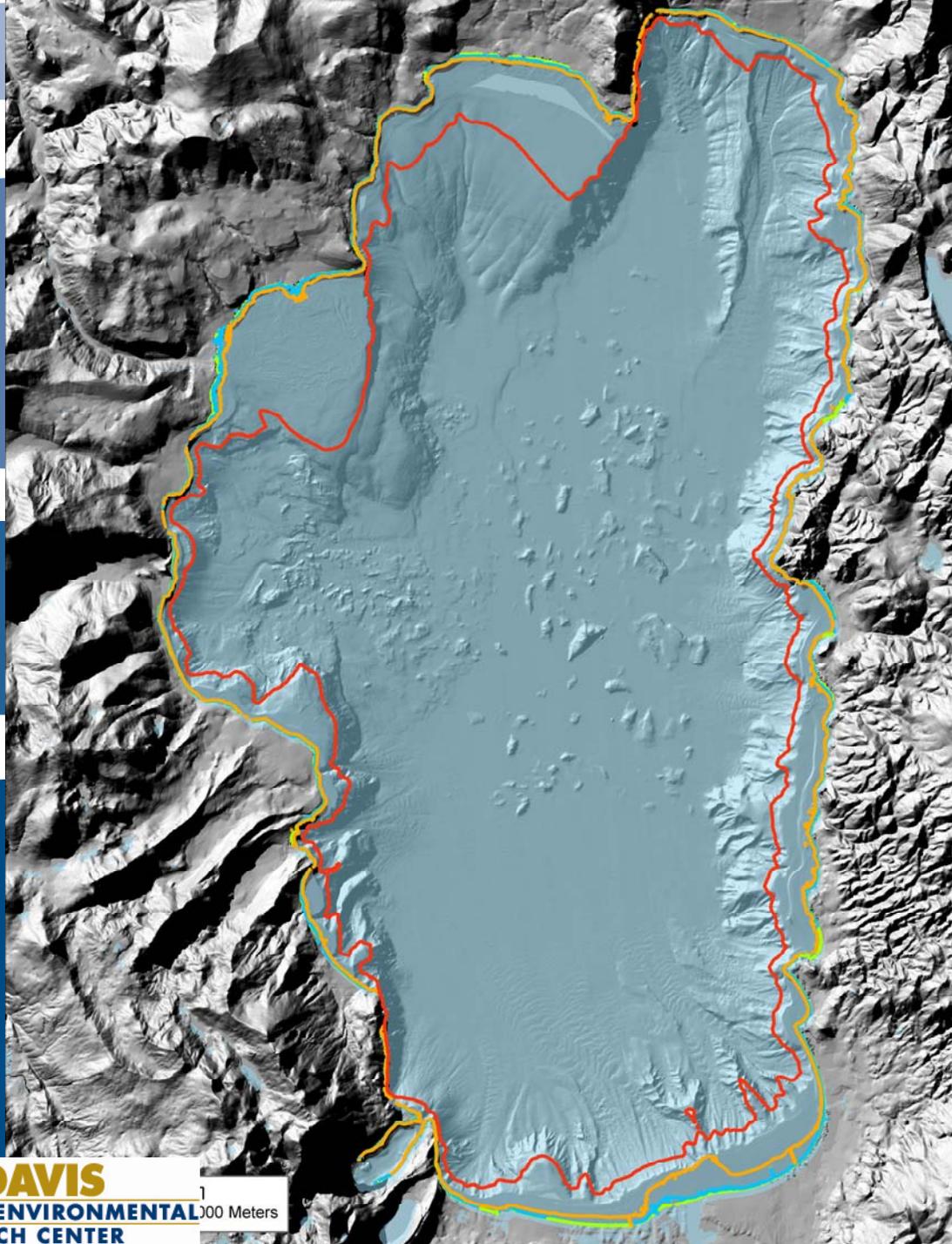


Natural rim



1992





Natural rim



1992 level

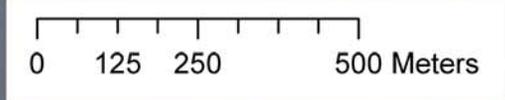


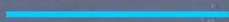
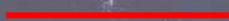
5 y drought

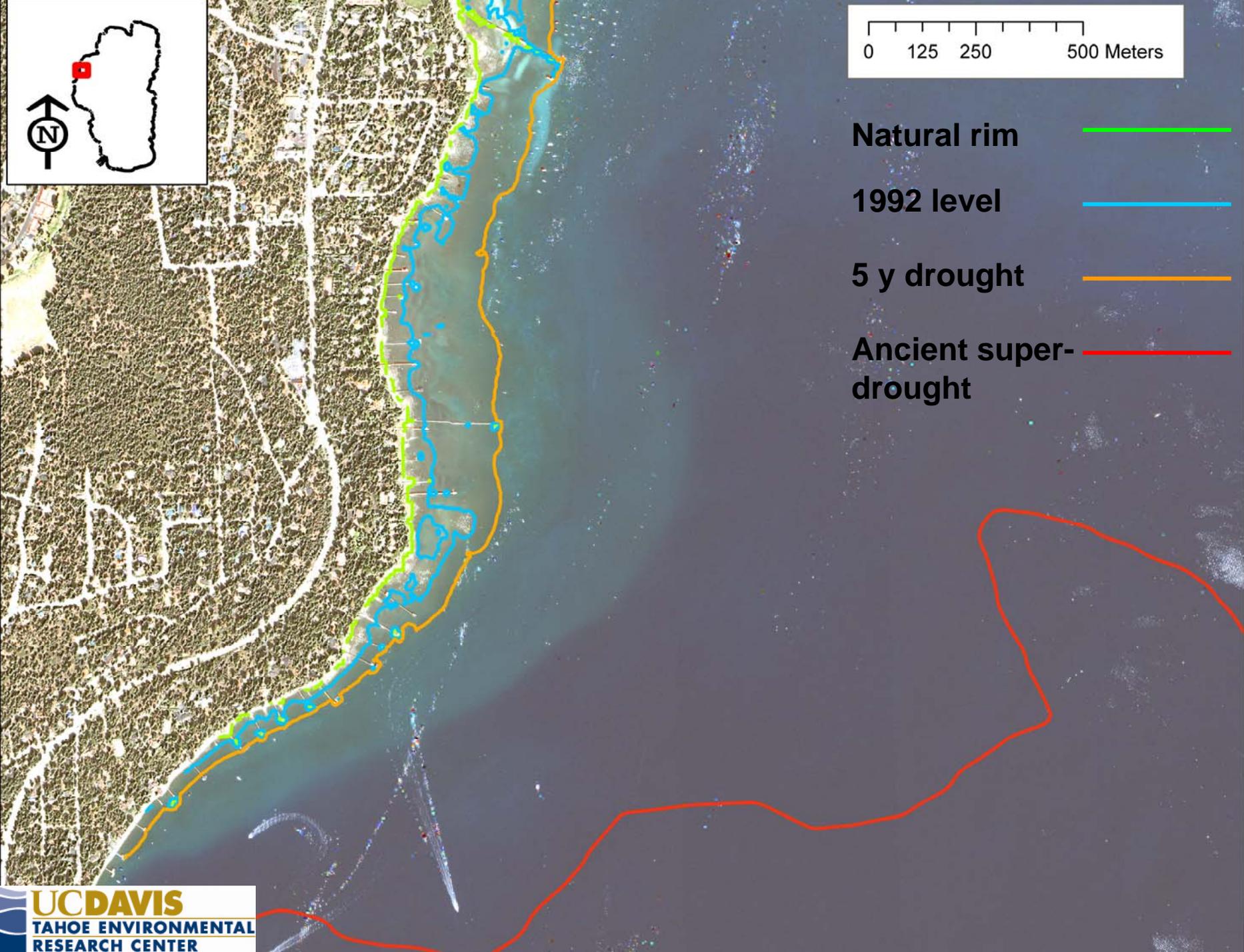


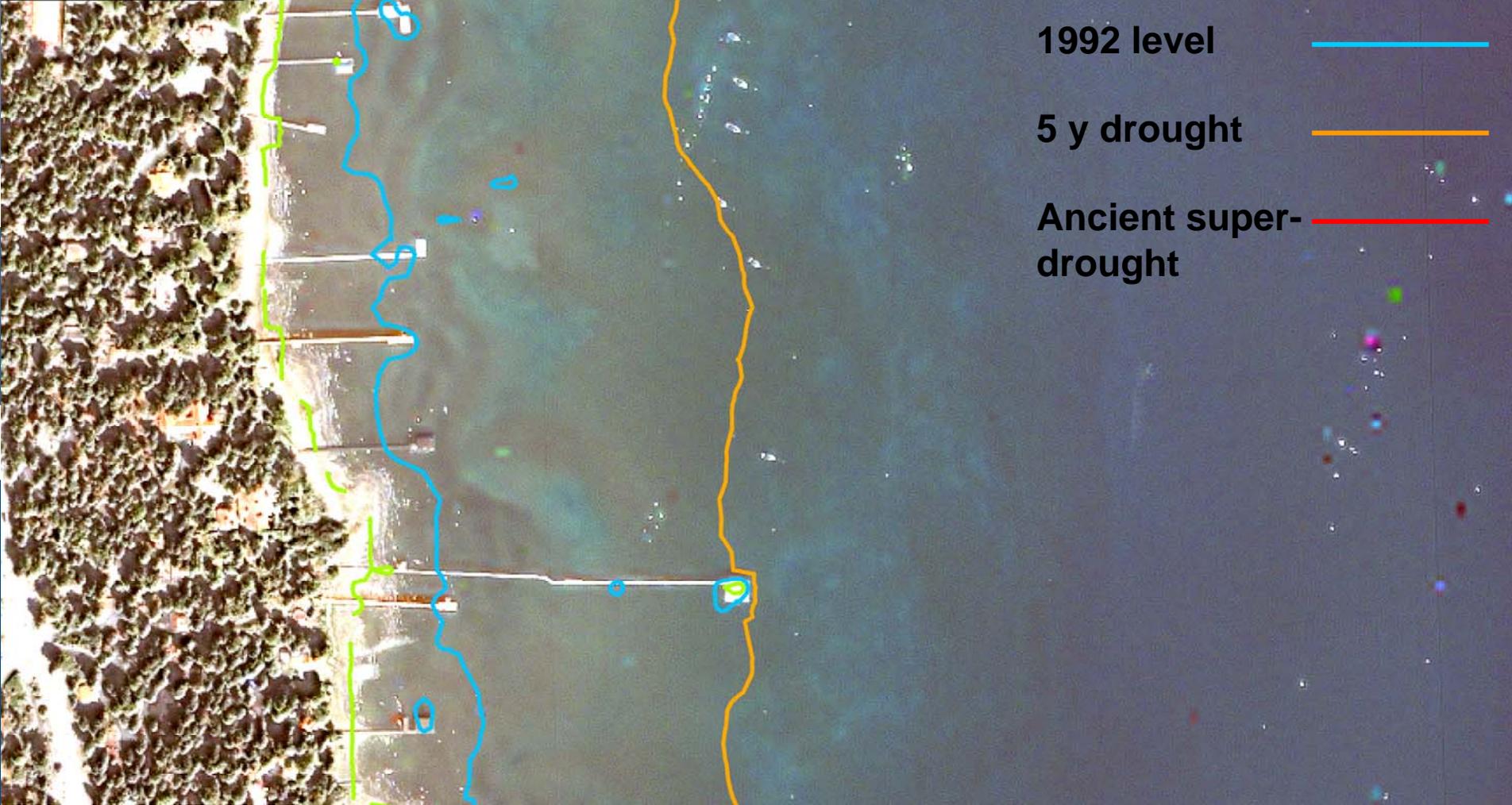
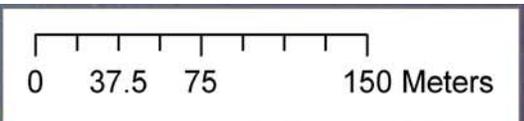
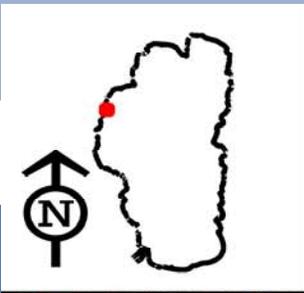
Ancient super-drought

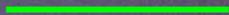
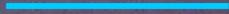


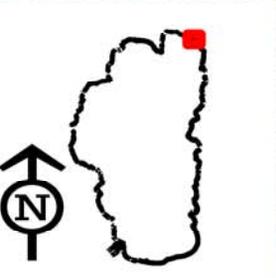
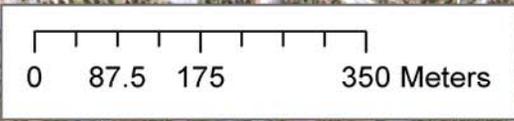
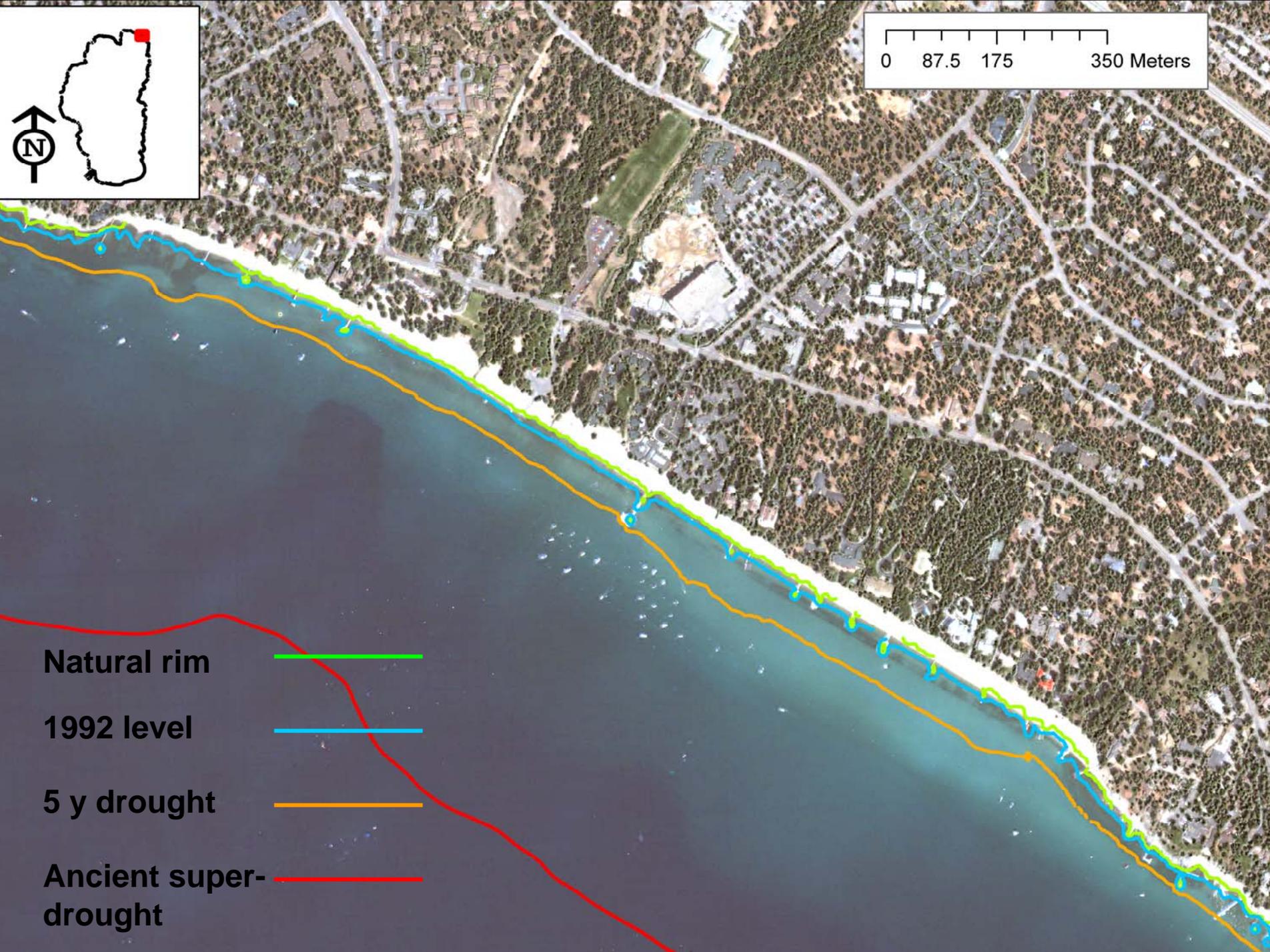


- Natural rim 
- 1992 level 
- 5 y drought 
- Ancient super-drought 

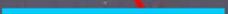




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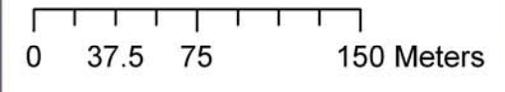
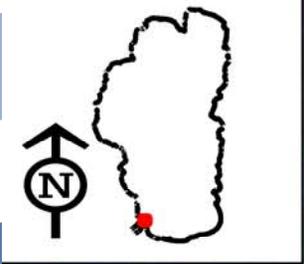


Natural rim 

1992 level 

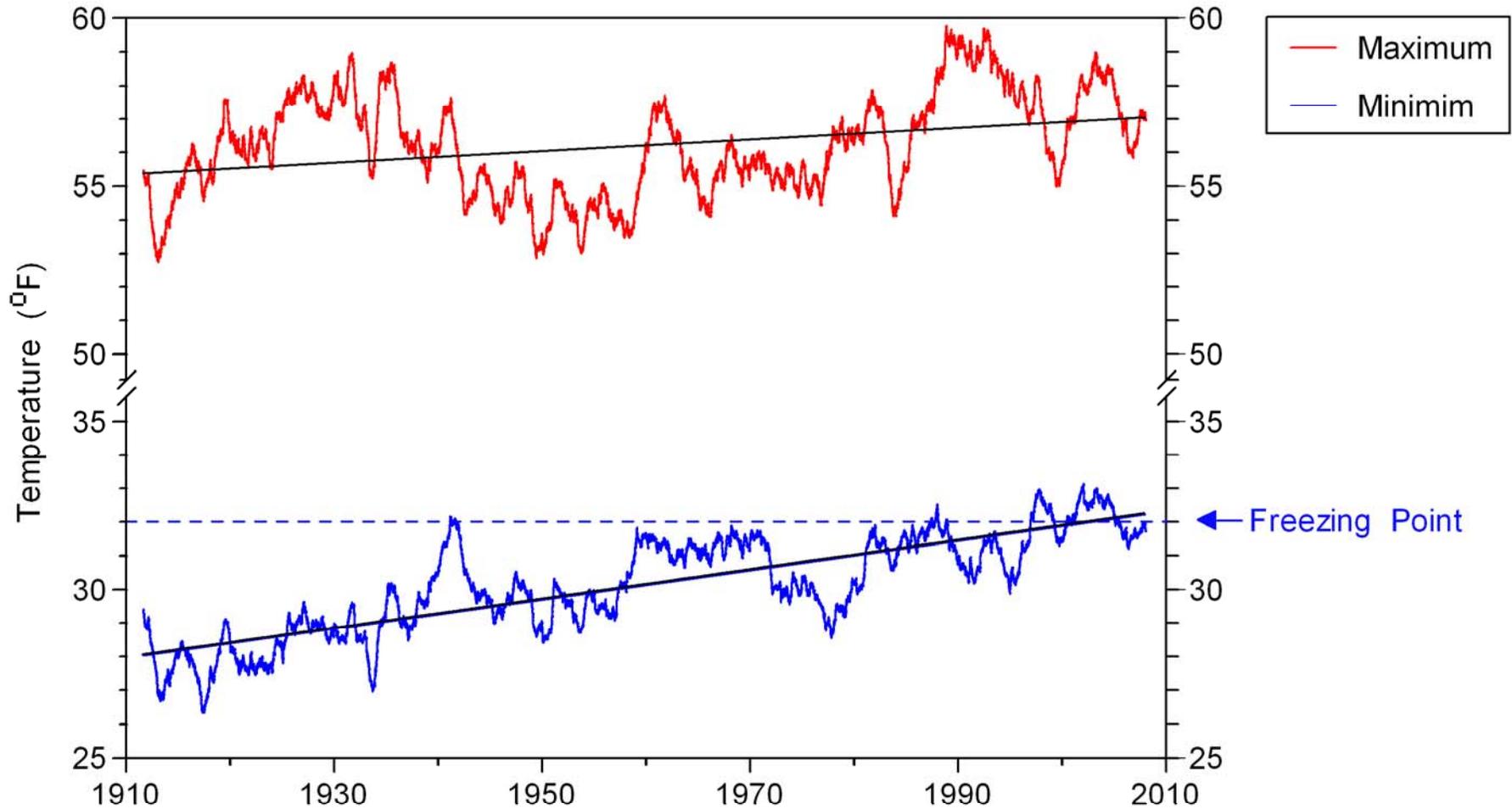
5 y drought 

Ancient super-drought 



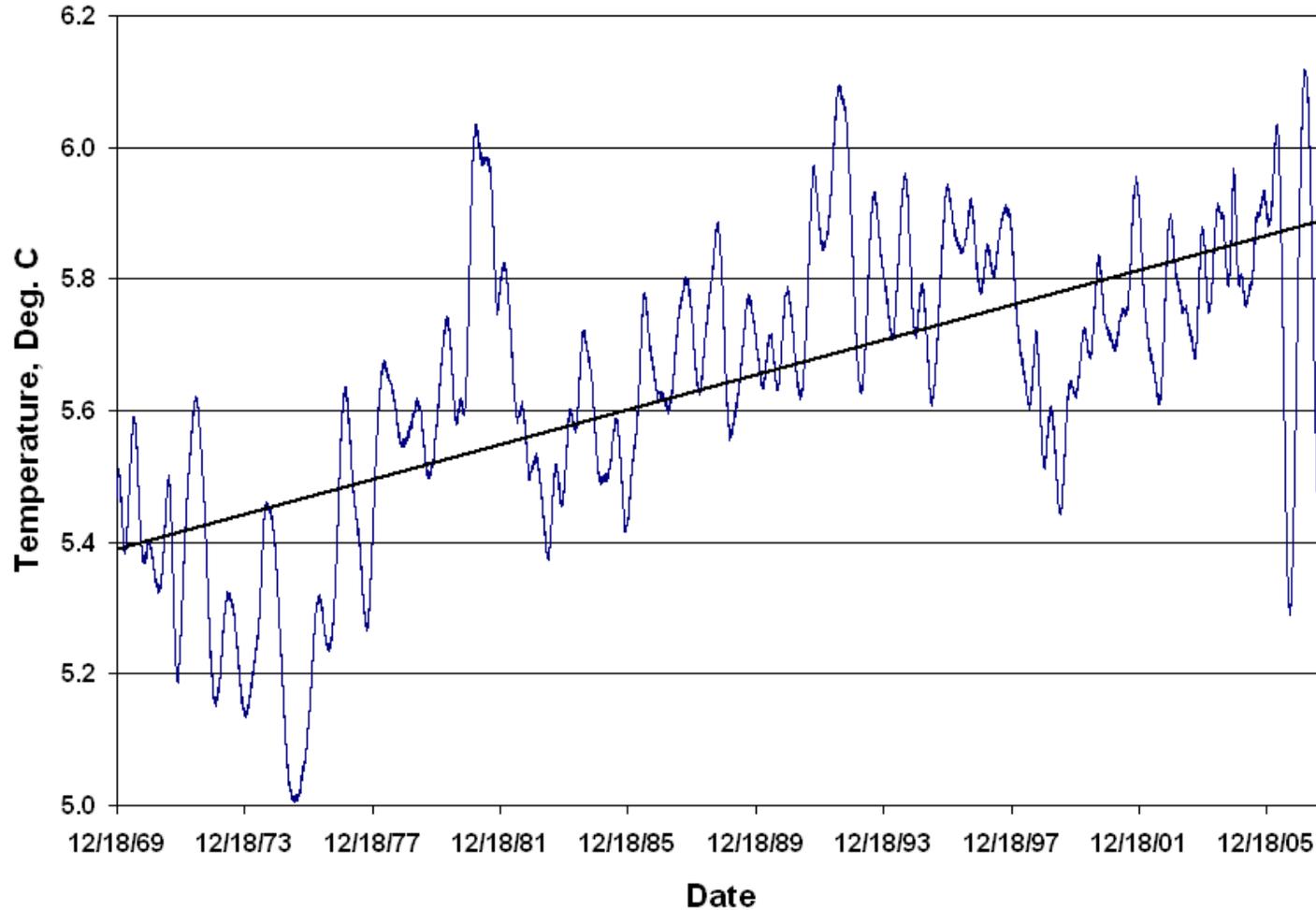
# PAST CLIMATE CHANGE IMPACTS

## AIR TEMPERATURE

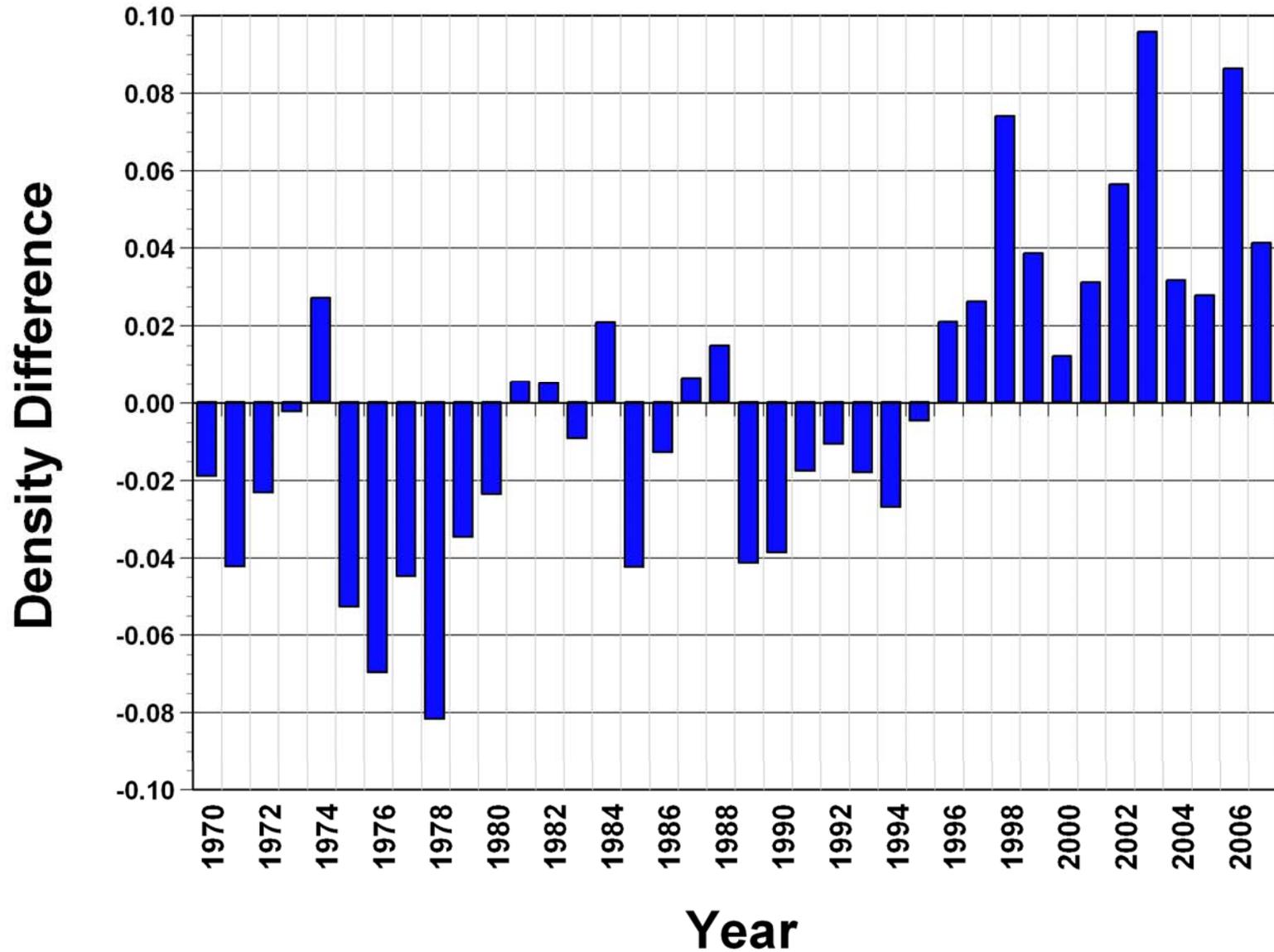


# LAKE TEMPERATURE

Mean lake temperature increasing **0.15 °C/decade** from 1970 - 2002



# Stability has also risen 1970 - 2007

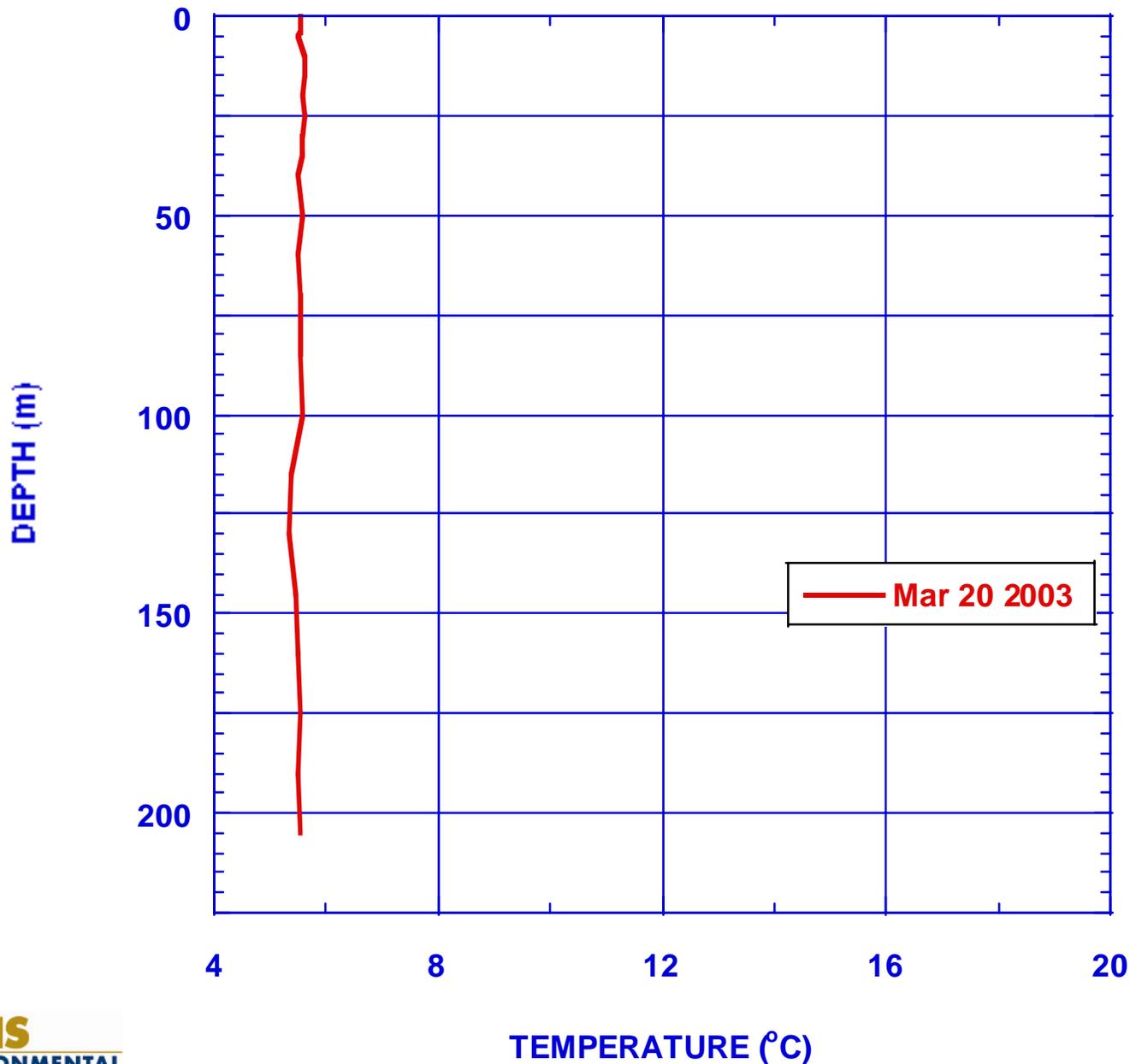


# WHAT WILL HAPPEN IN THE NEXT 40 YEARS?

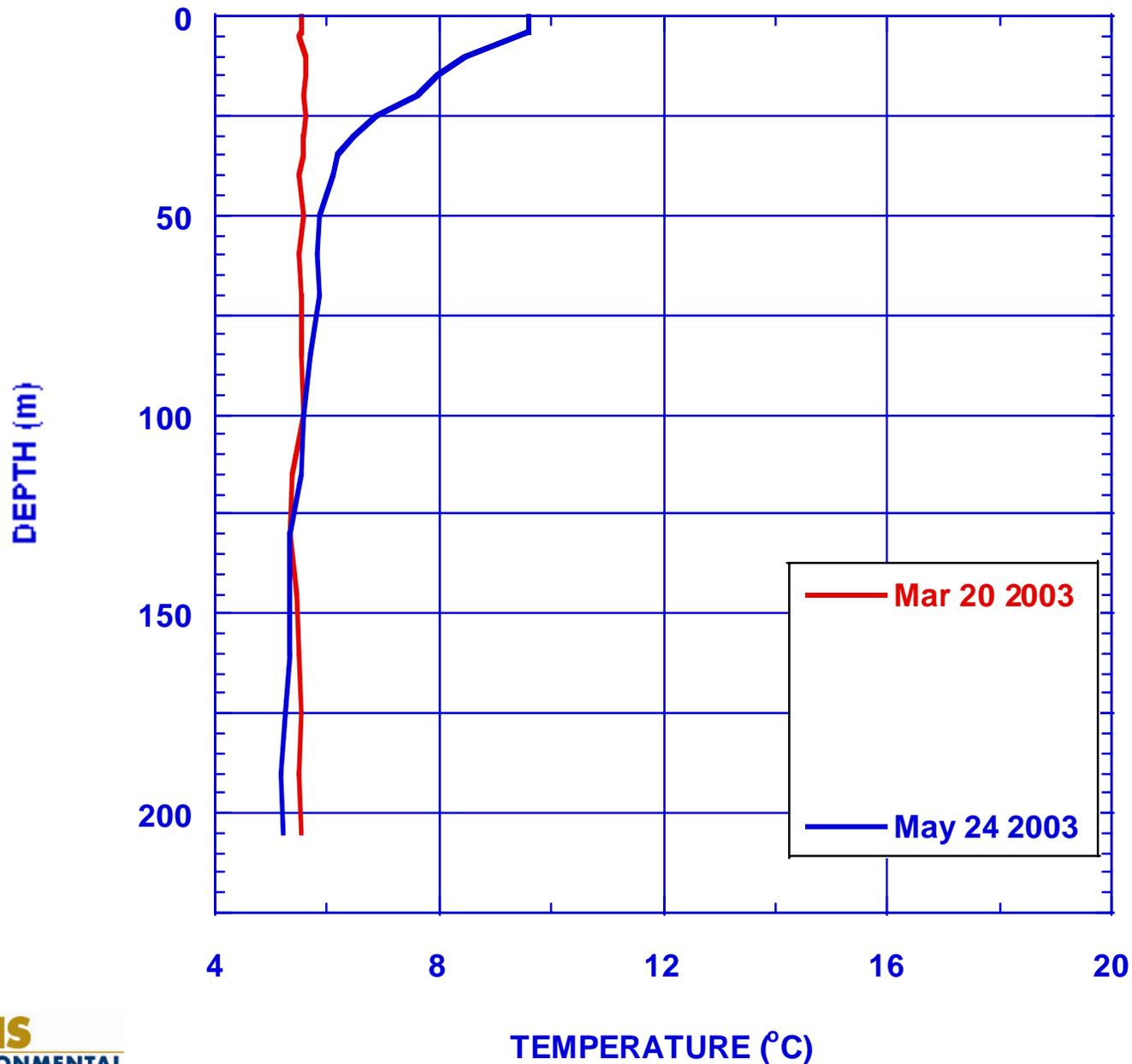
Focus on the MIXING DEPTH, the maximum depth to which the lake mixes in a given year.

This is an important process as it redistributes nutrients, adds oxygen to the hypolimnion, and cools the deep waters.

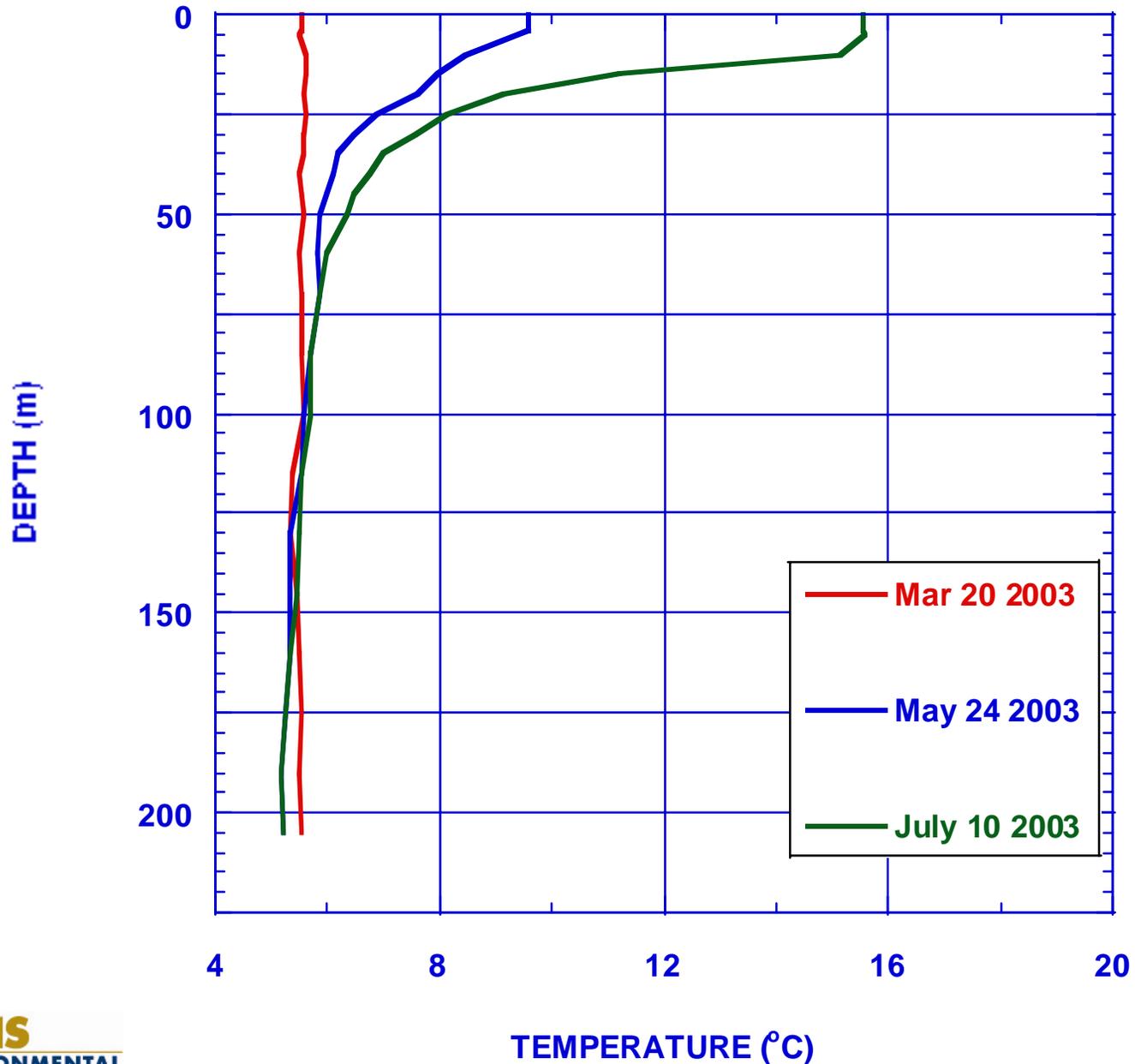
# THERMAL STRATIFICATION VARIES THROUGHOUT THE YEAR



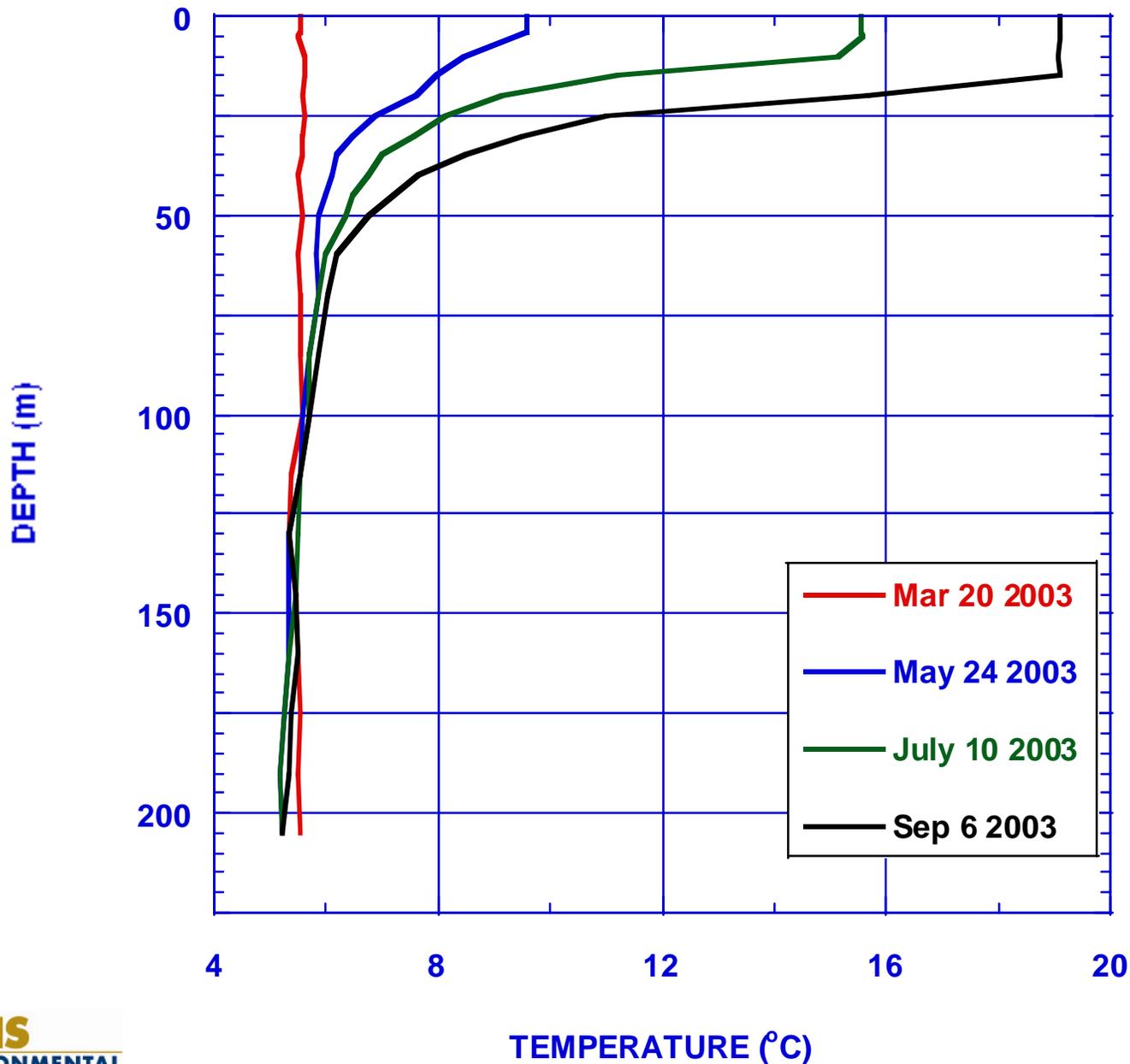
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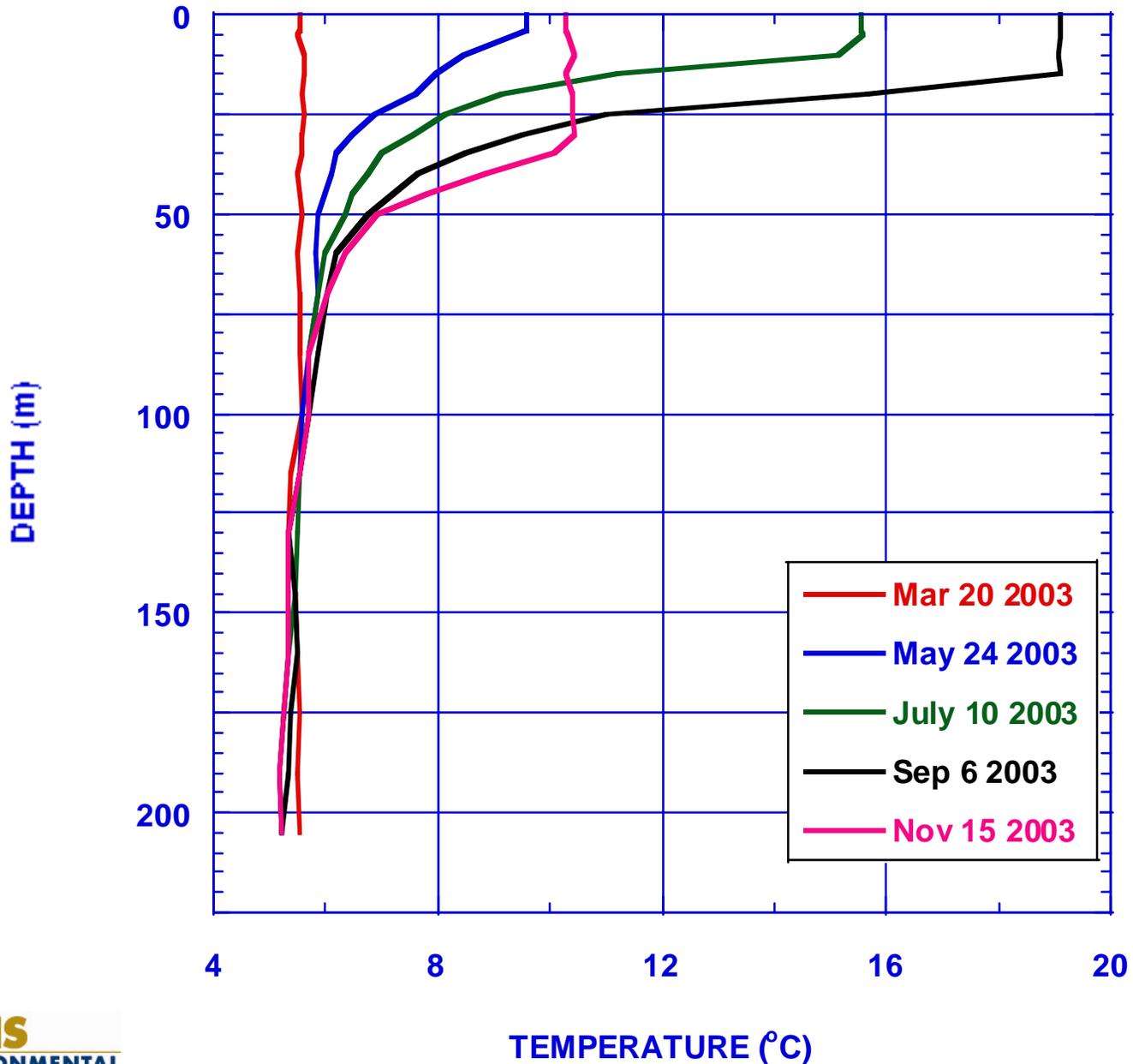
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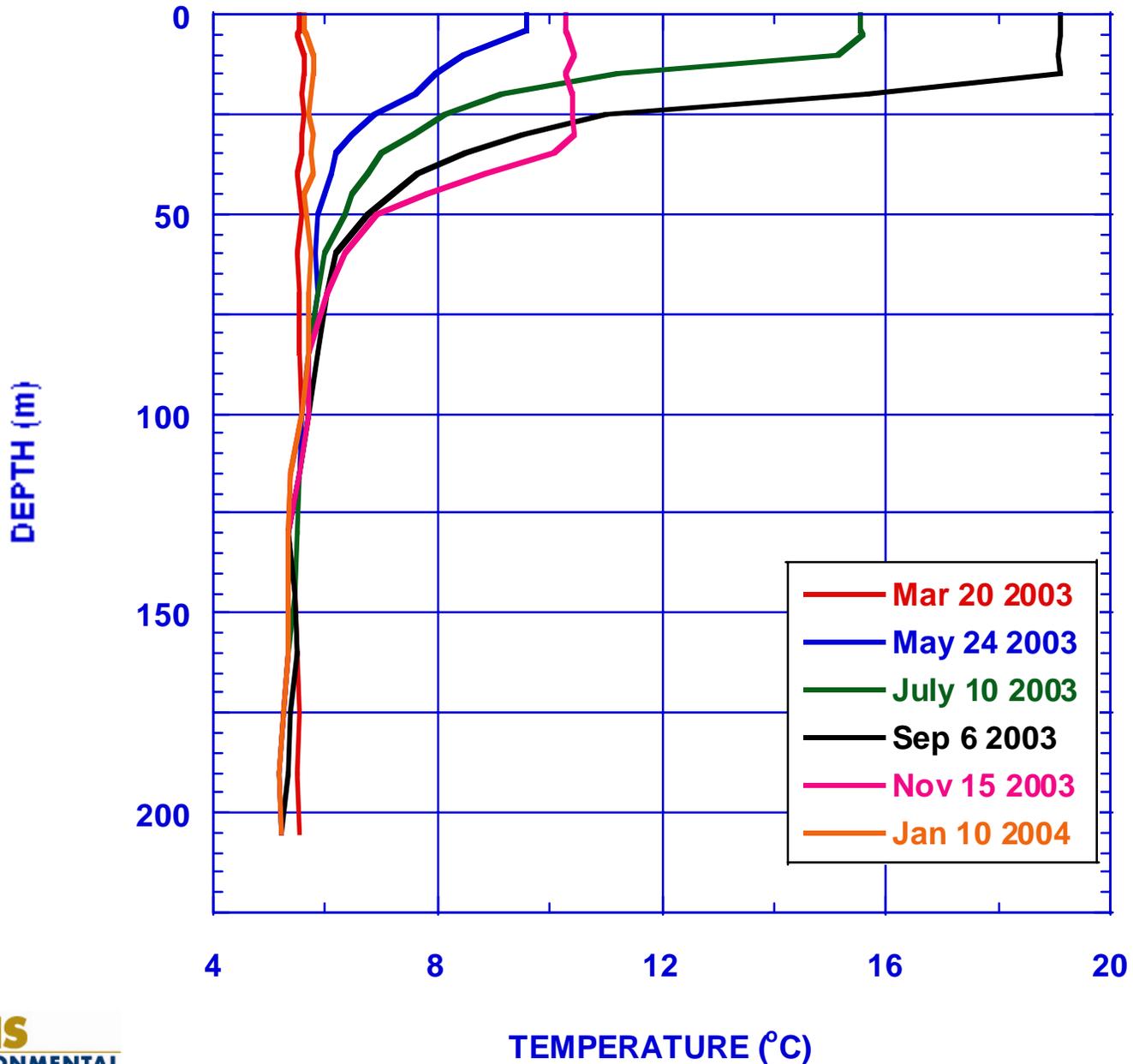
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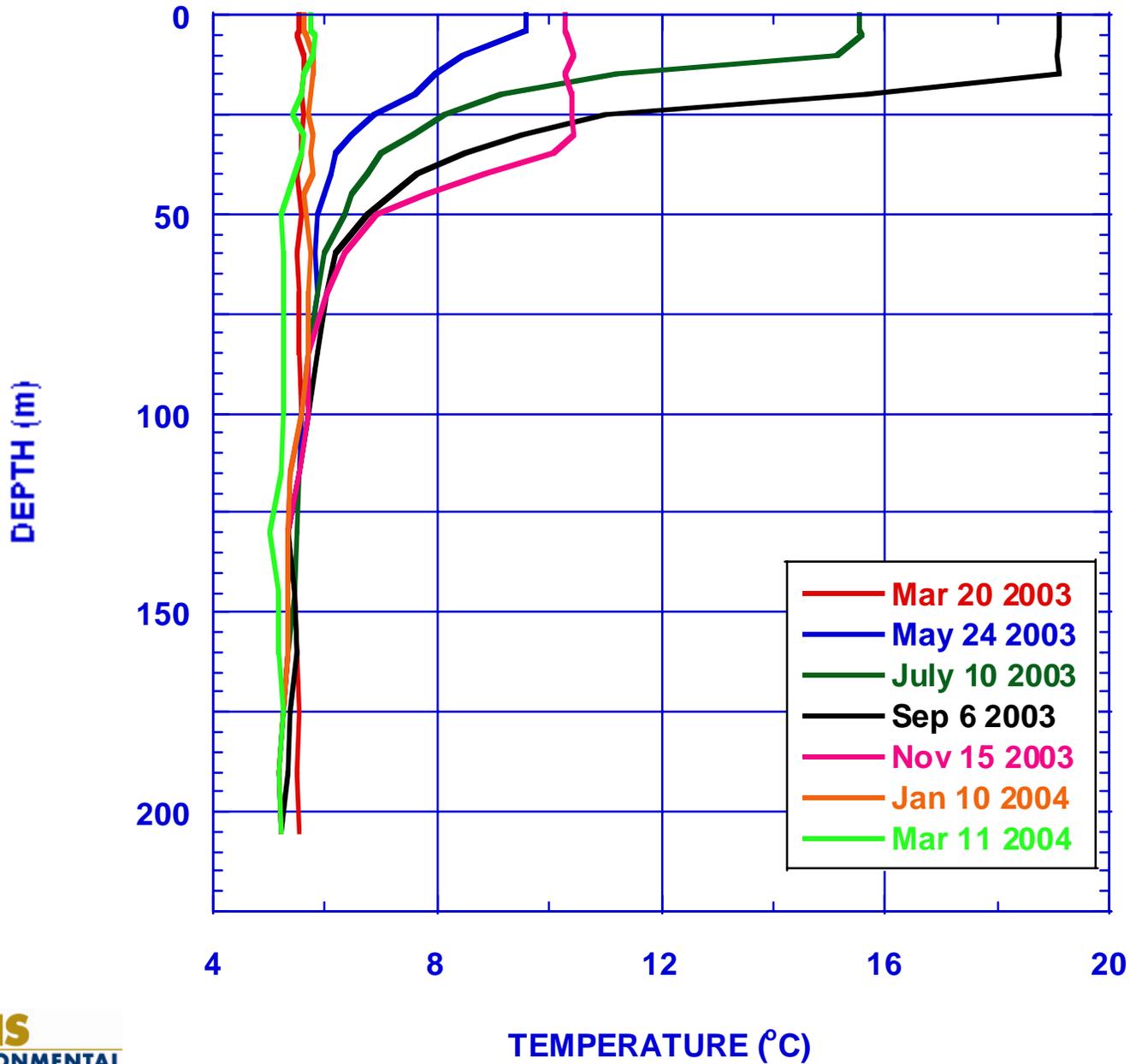
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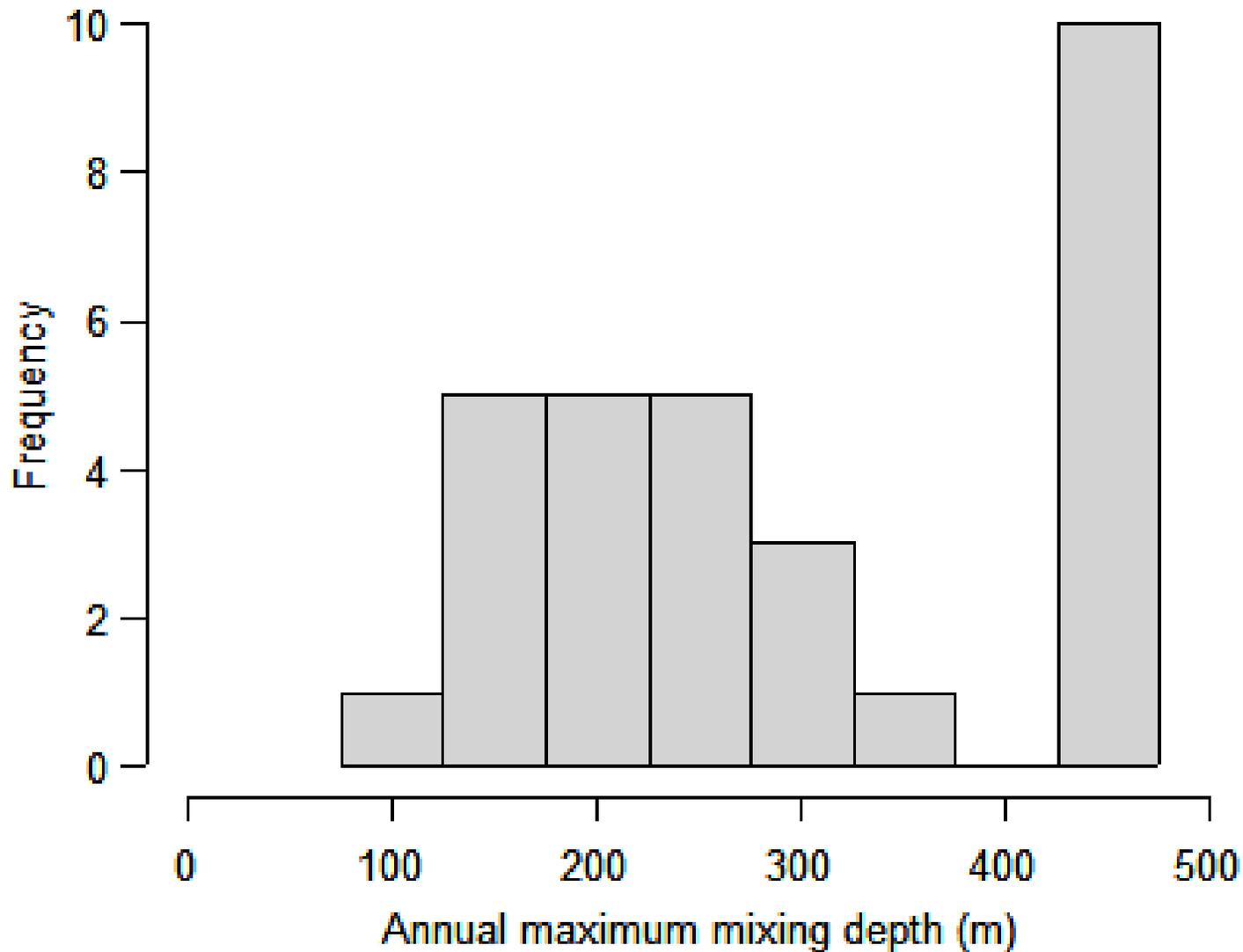
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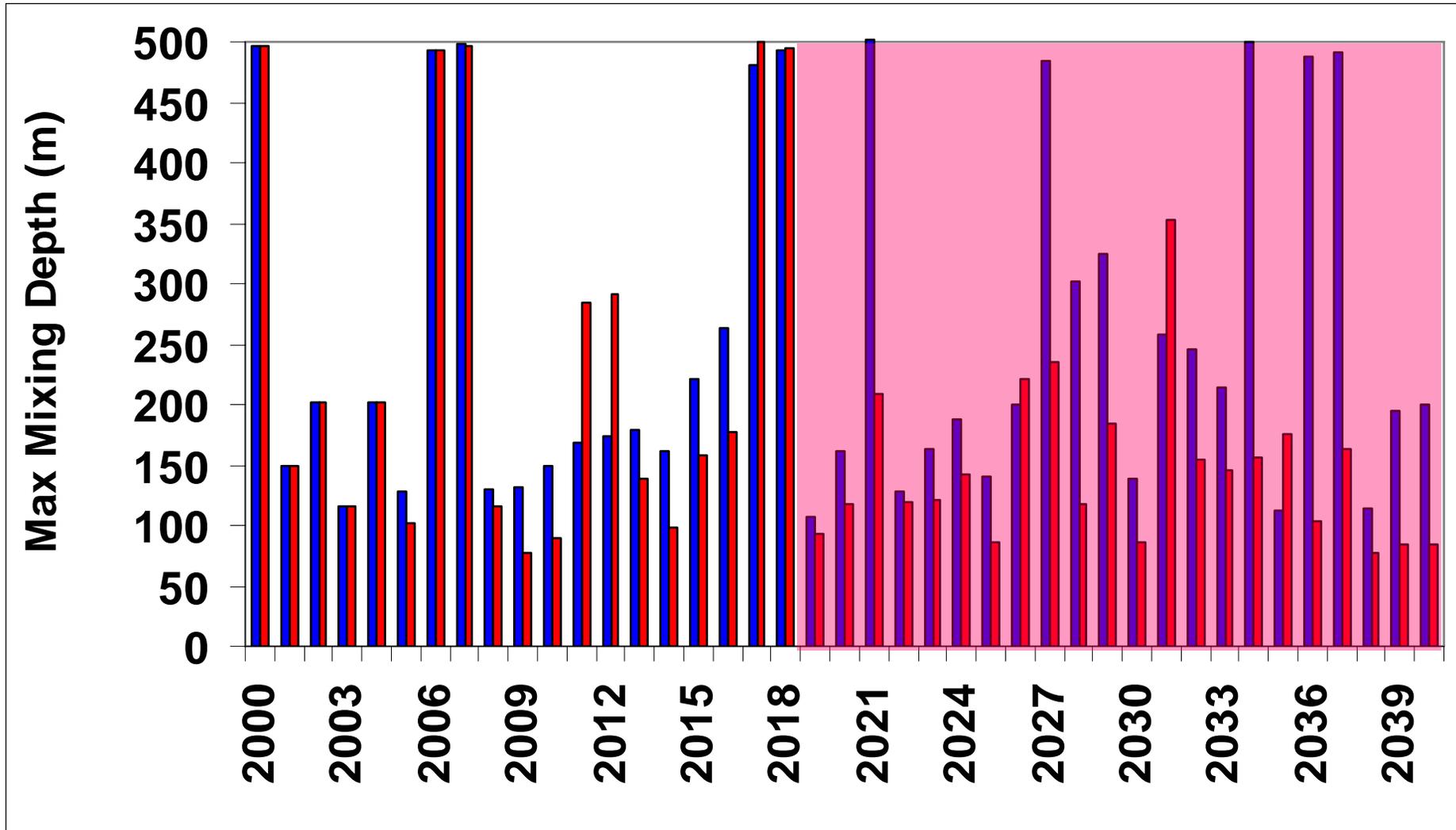


# MIXING DEPTH DISTRIBUTION OVER LAST 40 YEARS



# AIR TEMP + 2 °C , LONGWAVE + 10%

## NO DEEP MIXING AFTER 2018



# CONCLUSIONS

**By 2040, even assuming progress in curtailing C-emissions worldwide:**

- **Lake Tahoe is likely to experience drought periods longer than those measured previously**
- **Lake levels could fall 14-28 ft below present levels for periods of years to more than a decade**
- **In places the shoreline could recede 600-1000 ft from the current shoreline**
- **The lake may warm by a further 0.5 – 1 °C**
- **Surface temperatures may warm by 2 – 4 °C**
- **Lake Tahoe may stratify for decades at a time, leading to the lower half of the lake to become devoid of oxygen**

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**Climate Change Snowman**