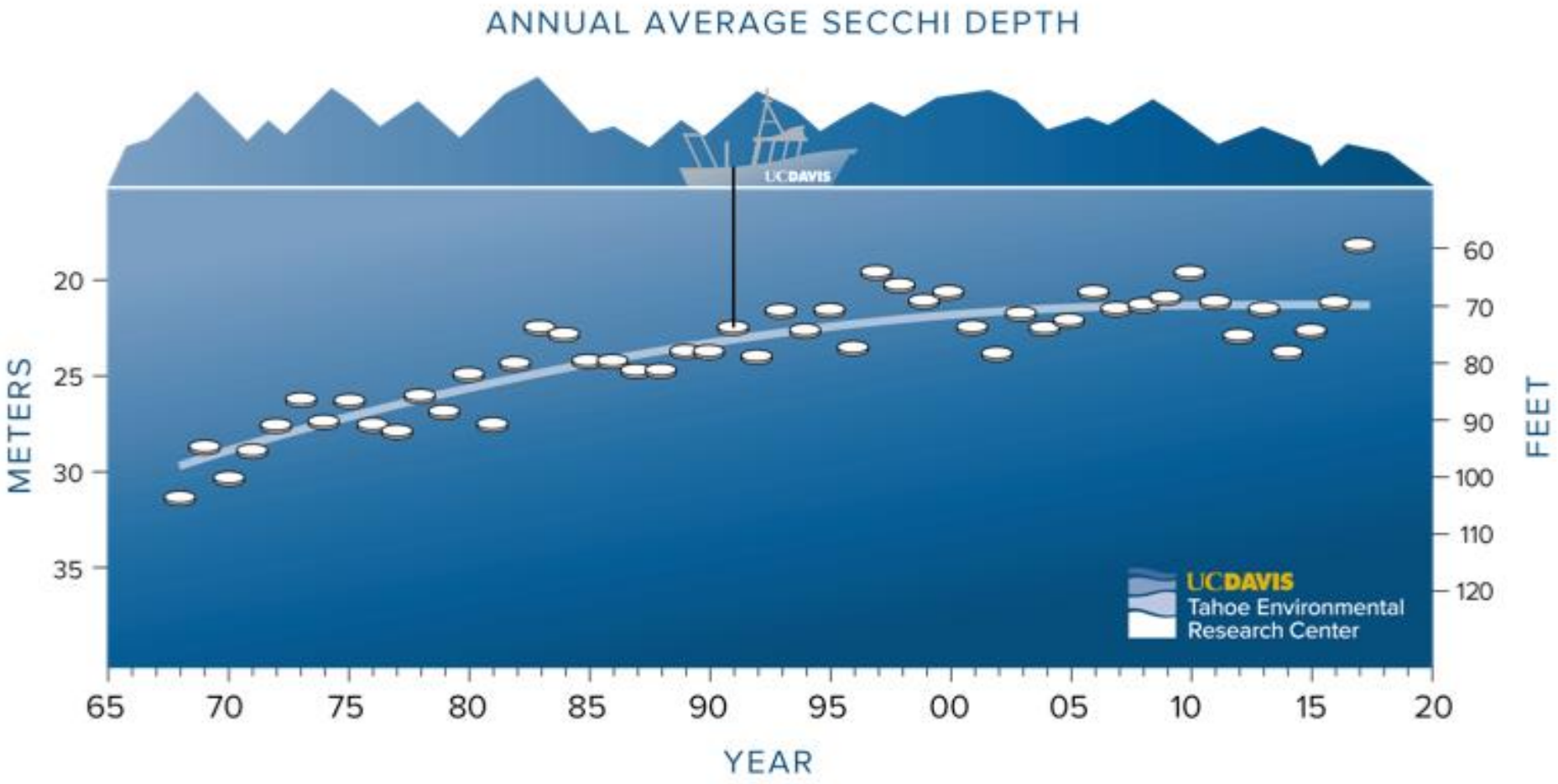
Lake Tahoe Clarity in 2017 – Harbinger of the Future or Confluence of Extreme Events?

"The average annual clarity level for 2017 was 59.7 feet. This was a 9.5-foot decrease from the previous year, surpassing the previous lowest value of 64.1 feet in 1997"



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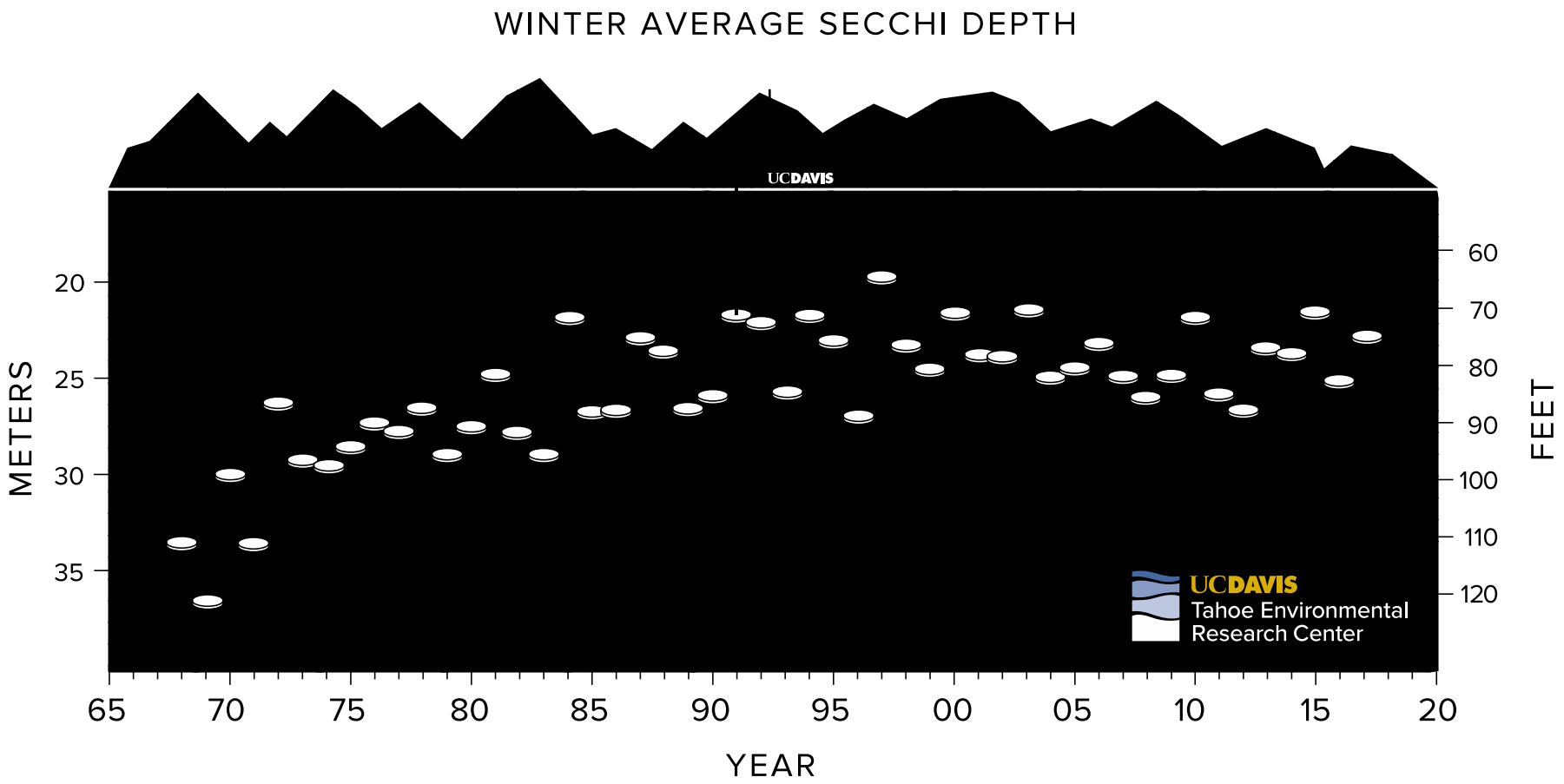

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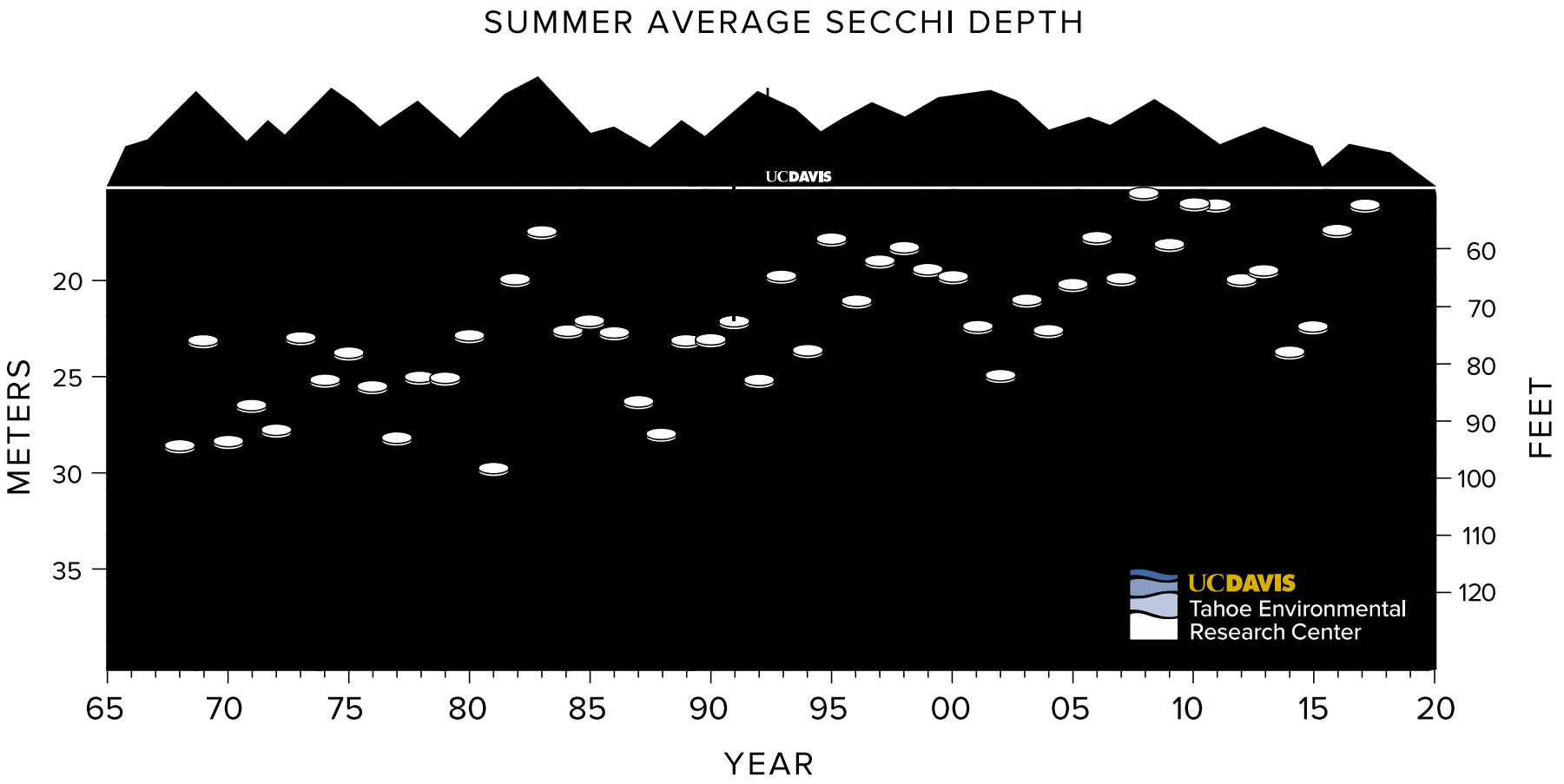

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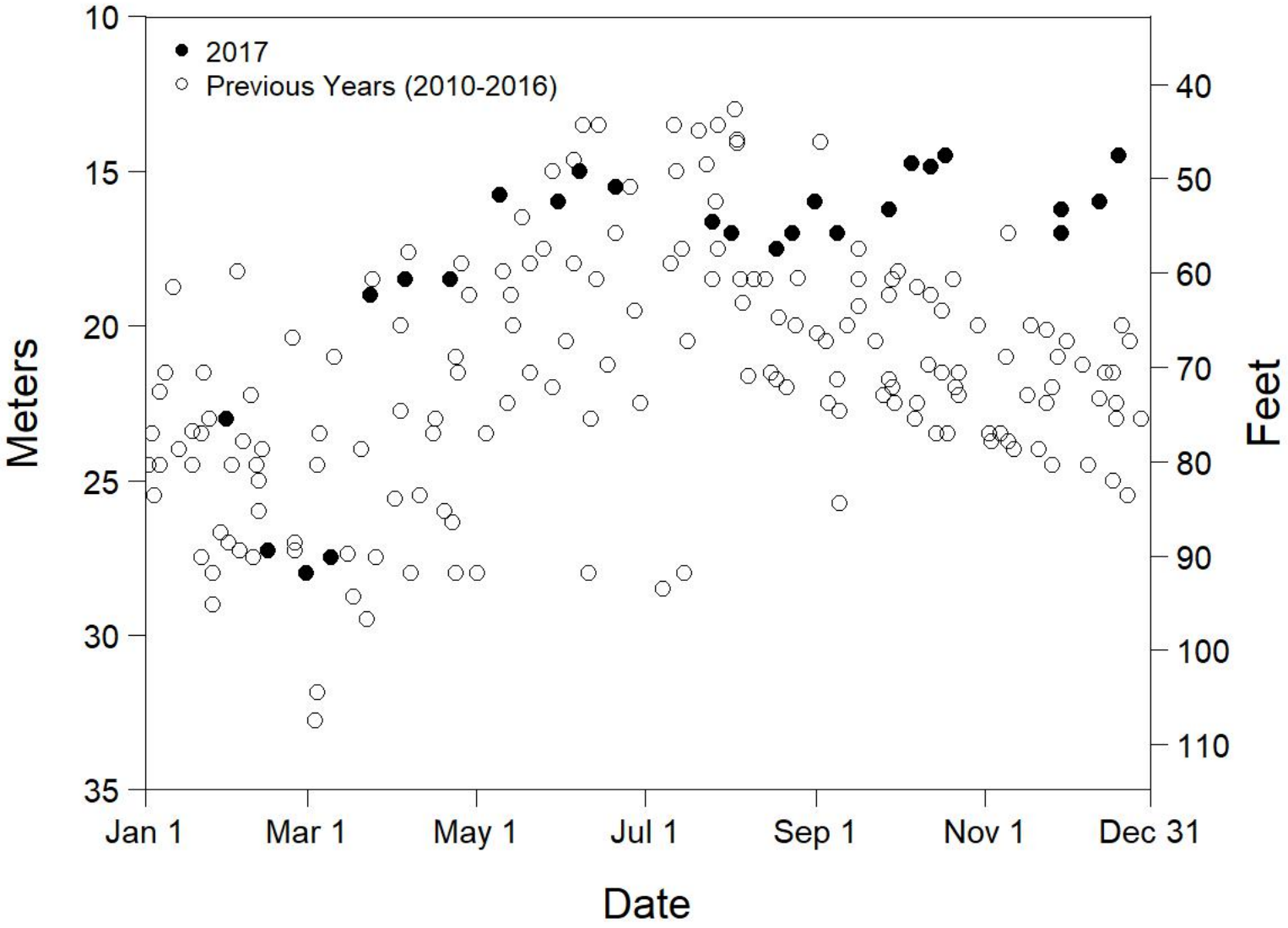
Individual Secchi depth measurements for 2010-2016 (hollow circles) and 2017 (filled circled)



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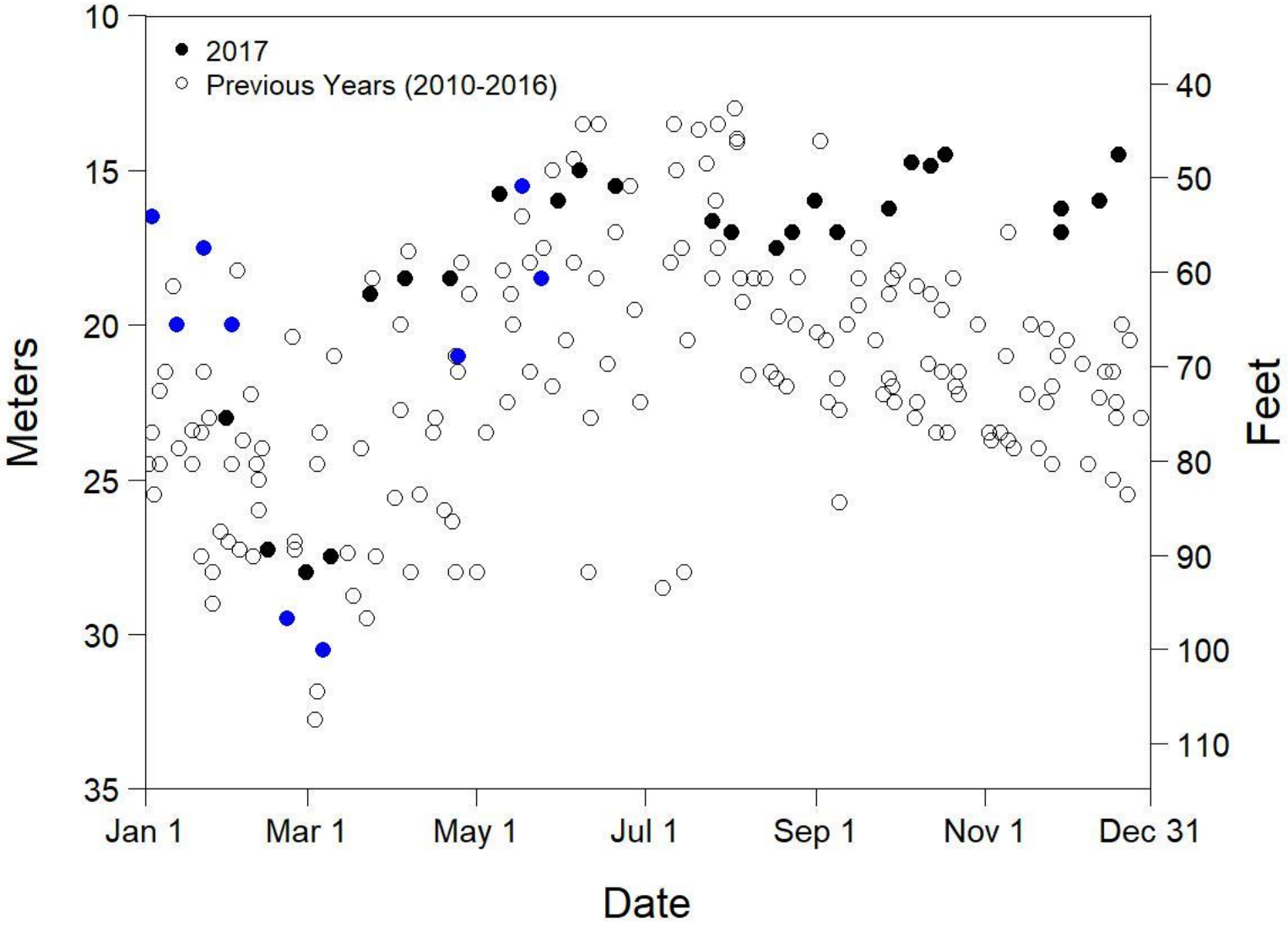

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Here is what happened

- There was a 5 year drought that was the most extreme in 1600 years
- The drought was ended with the wettest winter on record (300% of annual precipitation; 58 Atmospheric Rivers…
- 5 years of material that had accumulated in the streams PLUS a lot of new material all got washed into the lake
- The runoff occurred relatively late in the year, so the impacts persisted late into the year

Remember the Drought?

H. SEGALE

The Winter of a Lifetime

Distribution of Landfalling Atmospheric Rivers on the U.S. West Coast
(From 1 Oct 2016 to 31 March 2017)

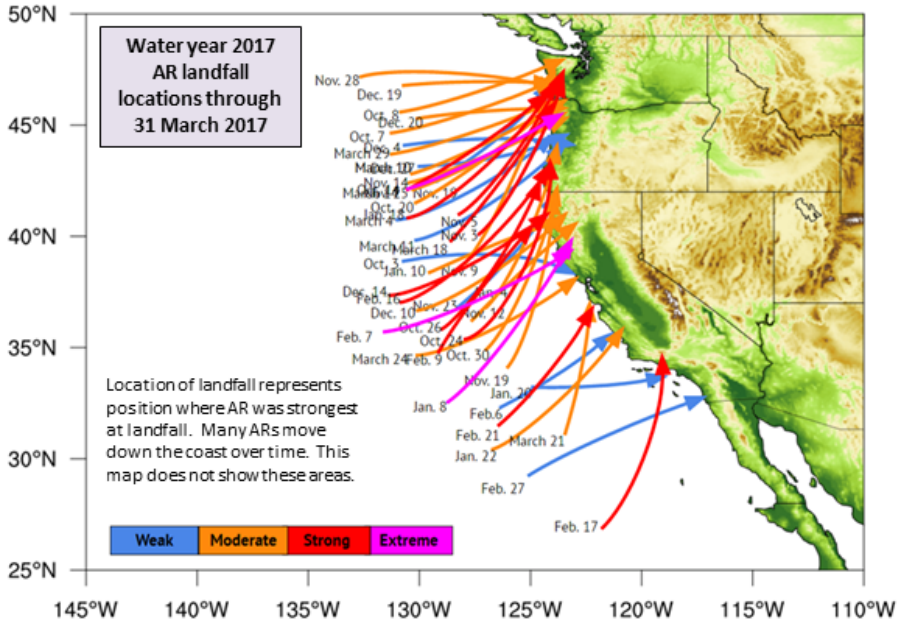
AR Strength	AR Count*
Weak	11
Moderate	20
Strong	12
Extreme	3

Ralph/CW3E AR Strength Scale

- Weak: IVT=250–500 kg m^{-1} s^{-1}
- Moderate: IVT=500–750 kg m^{-1} s^{-1}
- Strong: IVT=750–1000 kg m^{-1} s^{-1}
- Extreme: IVT>1000 kg m^{-1} s^{-1}

*Radiosondes at Bodega Bay, CA indicated the 10–11 Jan AR was strong (noted as moderate based on GFS analysis data) and 7–8 Feb AR was extreme (noted as strong)

- 45 Atmospheric Rivers have made landfall on the West Coast thus far during the 2017 water year (1 Oct. – 31 March 2017)
- This is much greater than normal
- 1/3 of the landfalling ARs have been "strong" or "extreme"



Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO

By F.M. Ralph, B. Kawzenuk, C. Hecht, J. Kalansky

Experimental

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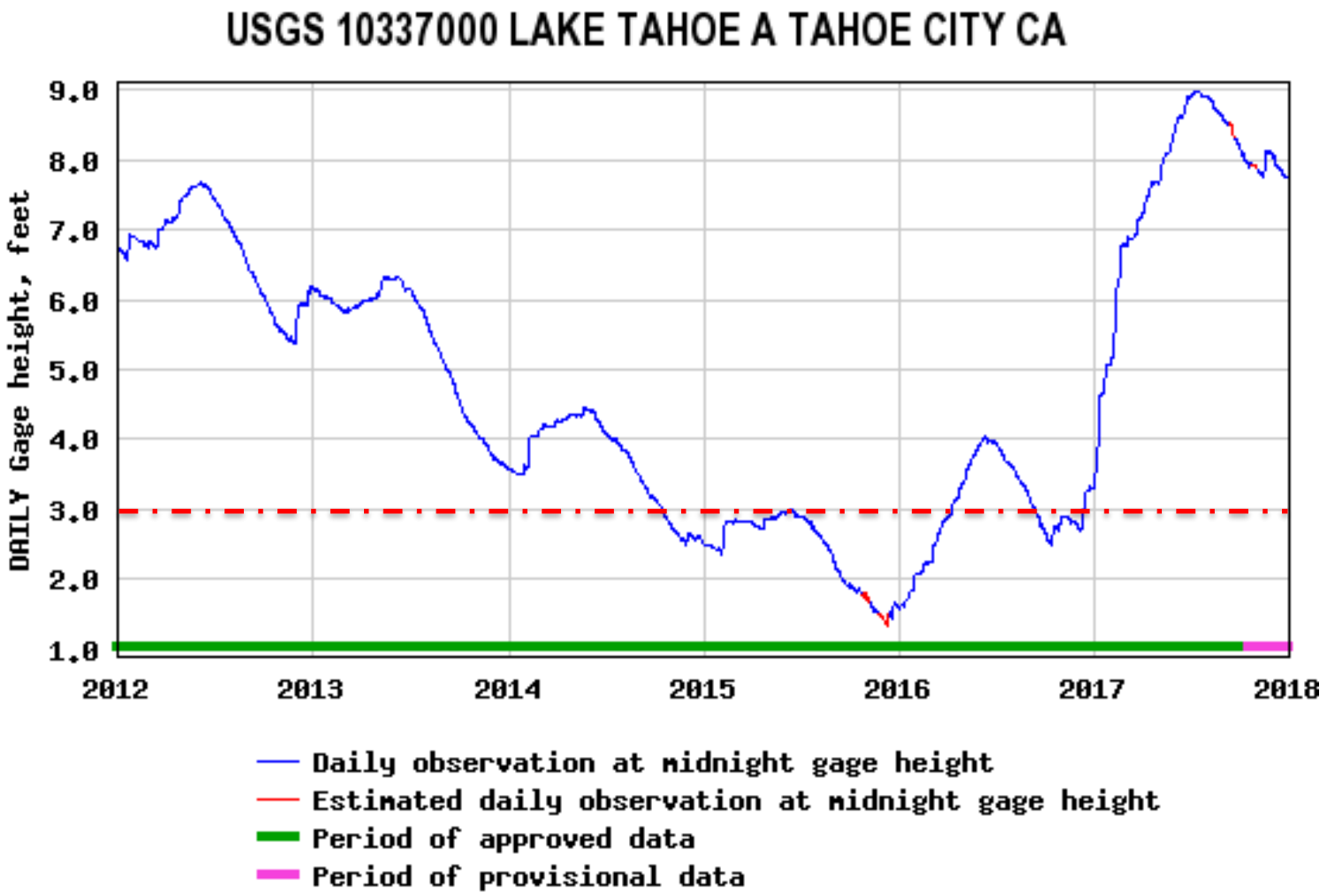
This is What they Did to the Lake



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The Evidence in the Watershed

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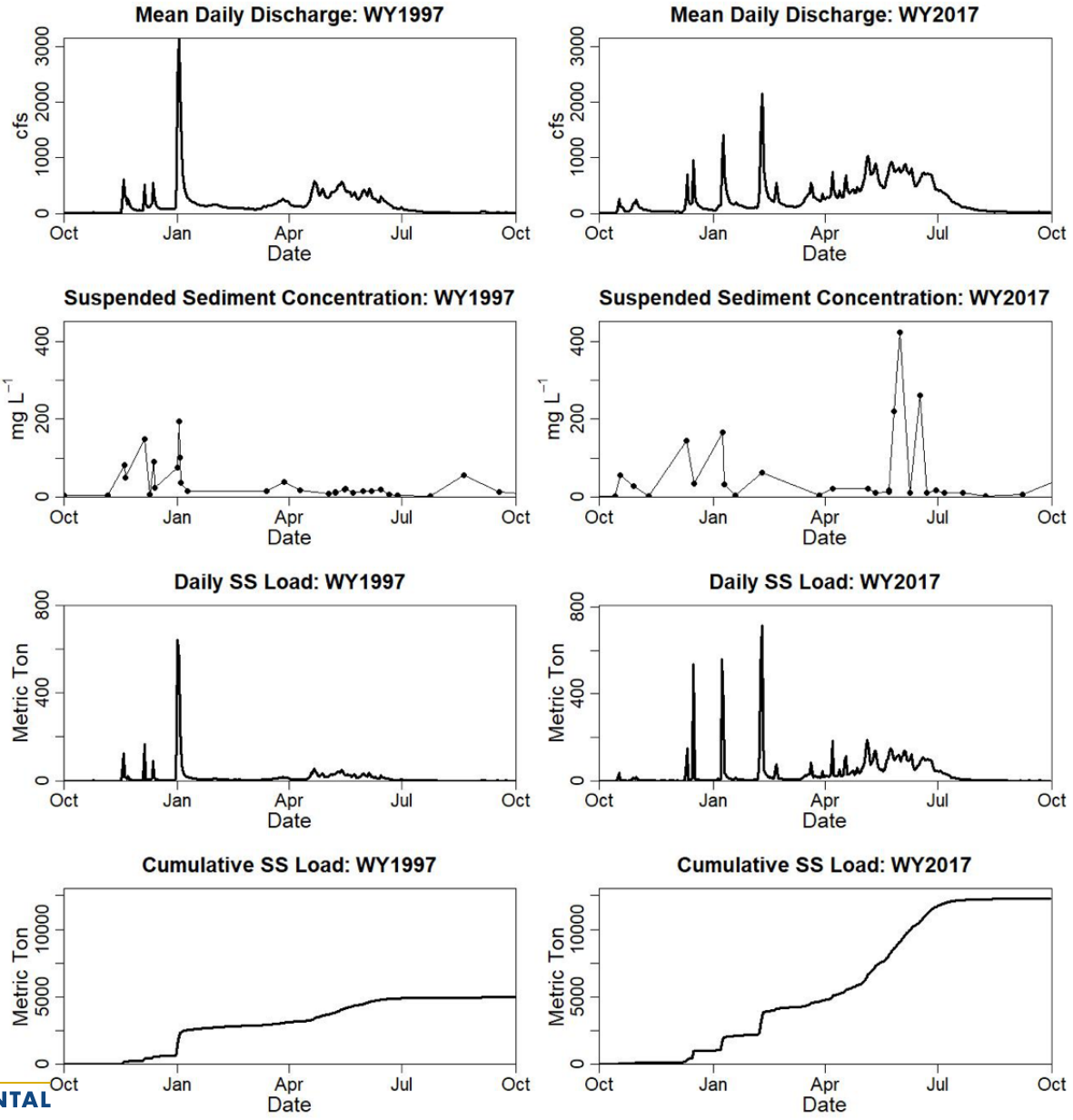
1997 2017



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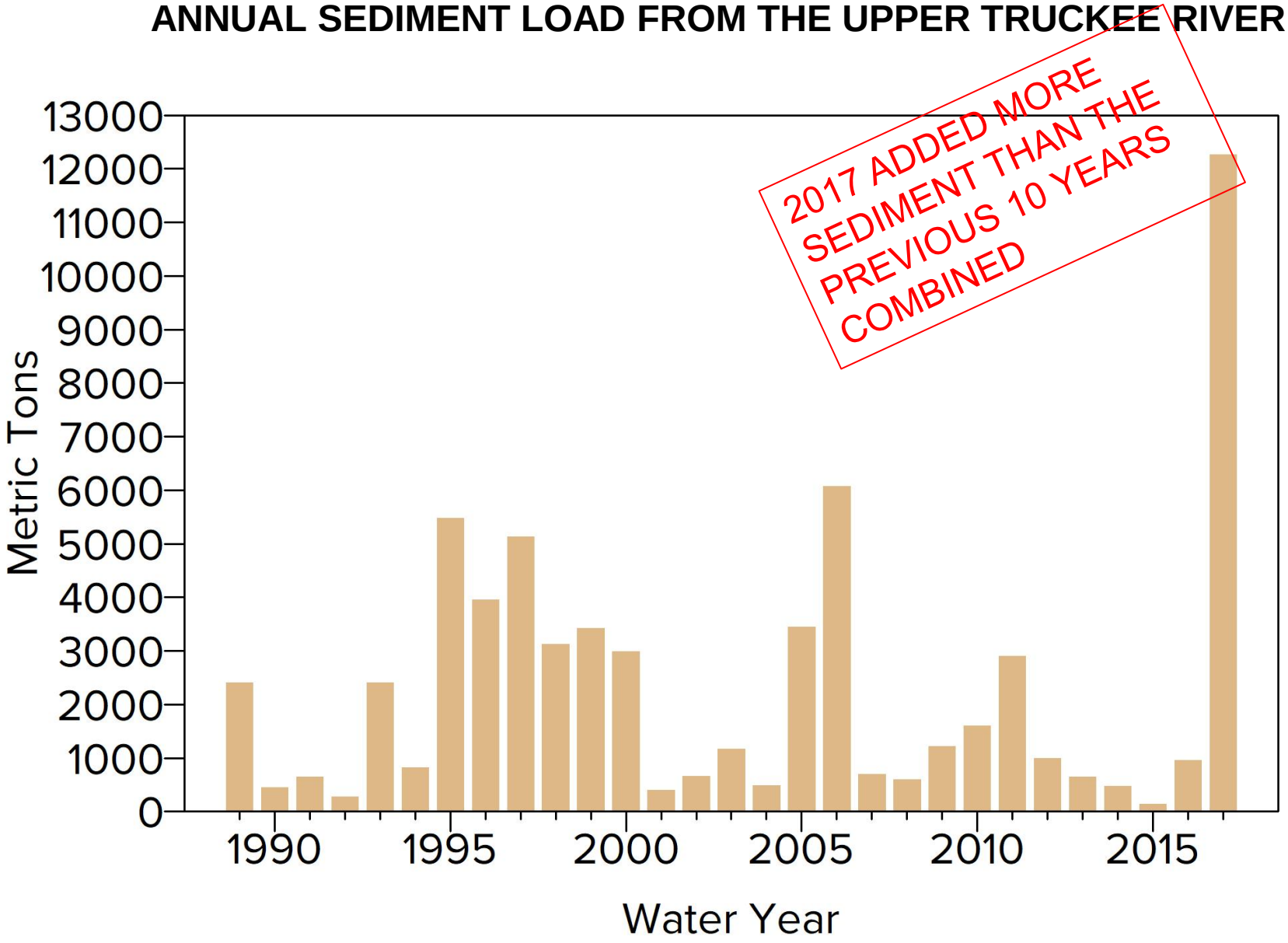
ANNUAL SEDIMENT LOAD FROM THE UPPER TRUCKEE RIVER



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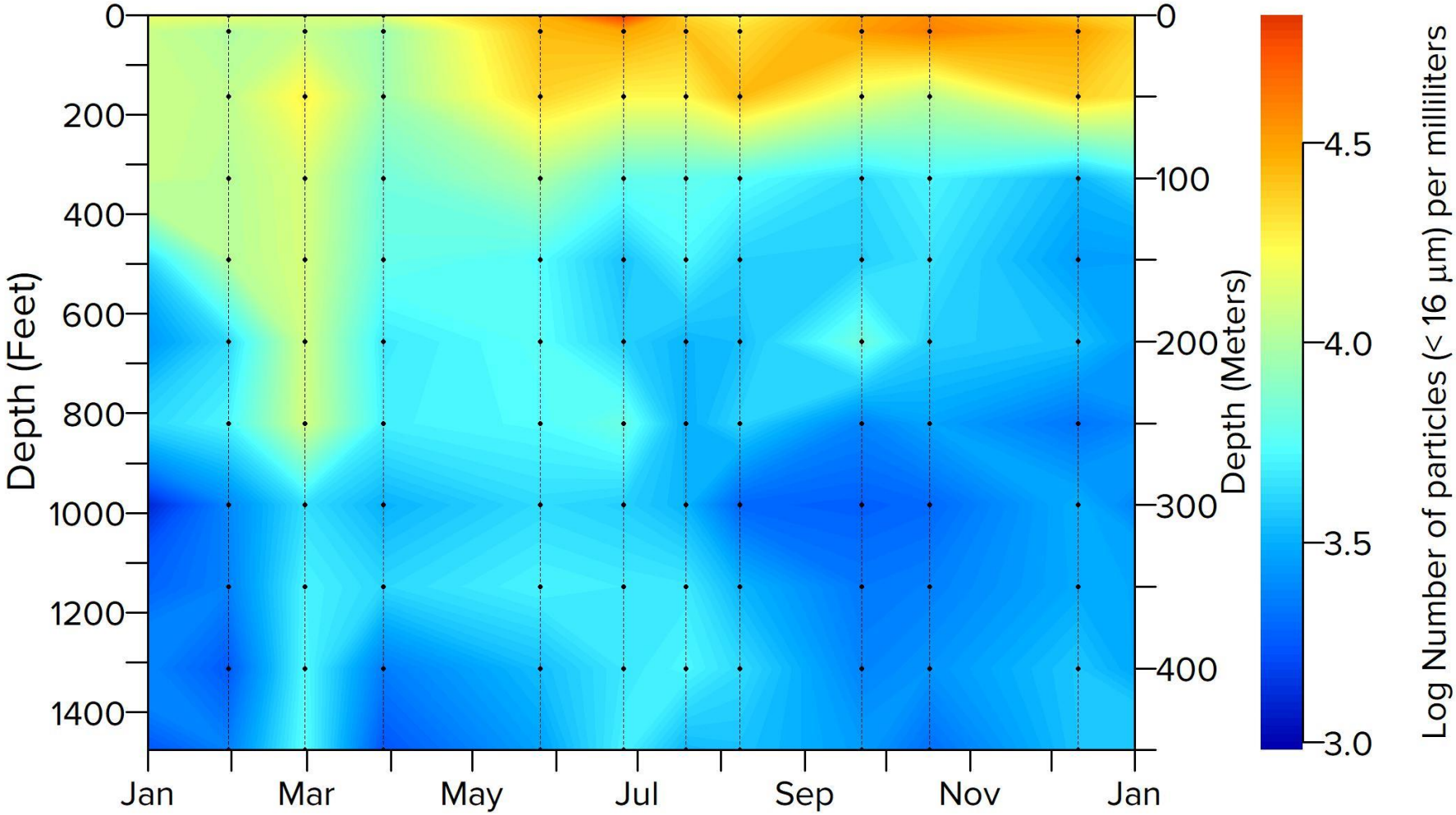
Fine particle distribution in Lake Tahoe during 2017



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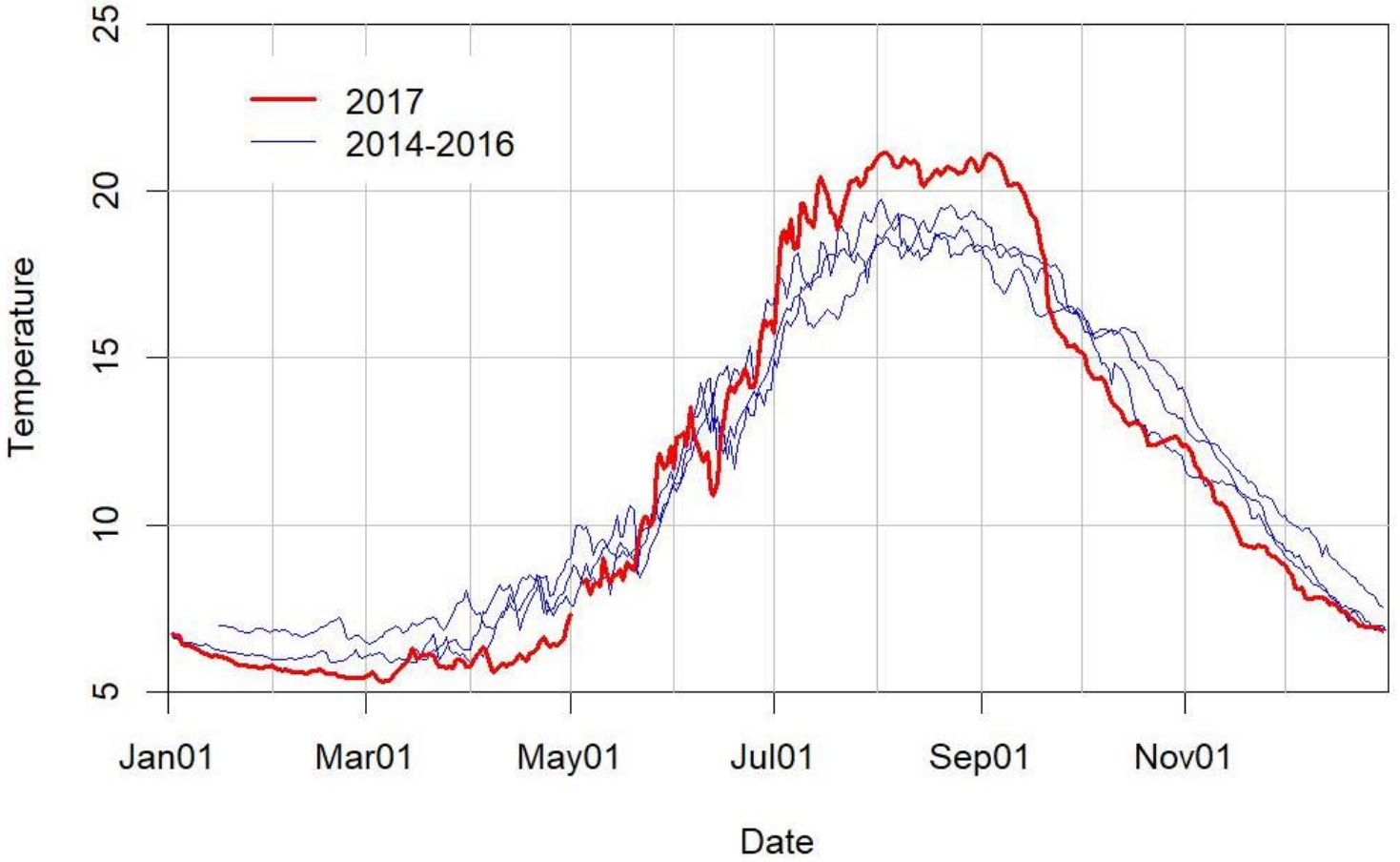
Did Lake Conditions Play a Role?

Yes, they amplified the watershed impacts.



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What We Learned

1. The recent notion of mid-lake conditions no longer matter was proved wrong. Mid-lake and nearshore both matter.
2. We had a very rare confluence of two extreme events – that is the primary cause of the 2017 clarity loss.
3. The lake can/did recover from episodic events like 2017.
4. The public and elected officials understood and accepted the reasoning provided by independent science experts.
5. Are we on track to adequately UNDERSTAND future ”shocks” of a different type? Are we doing the science necessary to guide the decades of recovery?
6. Current mid-lake monitoring provides a very static view – weekly to monthly frequency. Real-time measurements of lake processes only available through transient research projects.
7. The external drivers – meteorology (zero funding), streams and urban flows (limited funding), atmospheric (even less funding), predictive modeling (zero funding), lake metabolism... Analysis is needed. Need to move from a reactionary mindset.
8. Sustained programmatic monitoring and applied science is needed. This is precisely what the LTRA specifies. This is what TRPA should be demanding.