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Hakai
Science on the Coastal Margin

Changes to water properties in Rivers Inlet, British Columbia from 1951 to 2017

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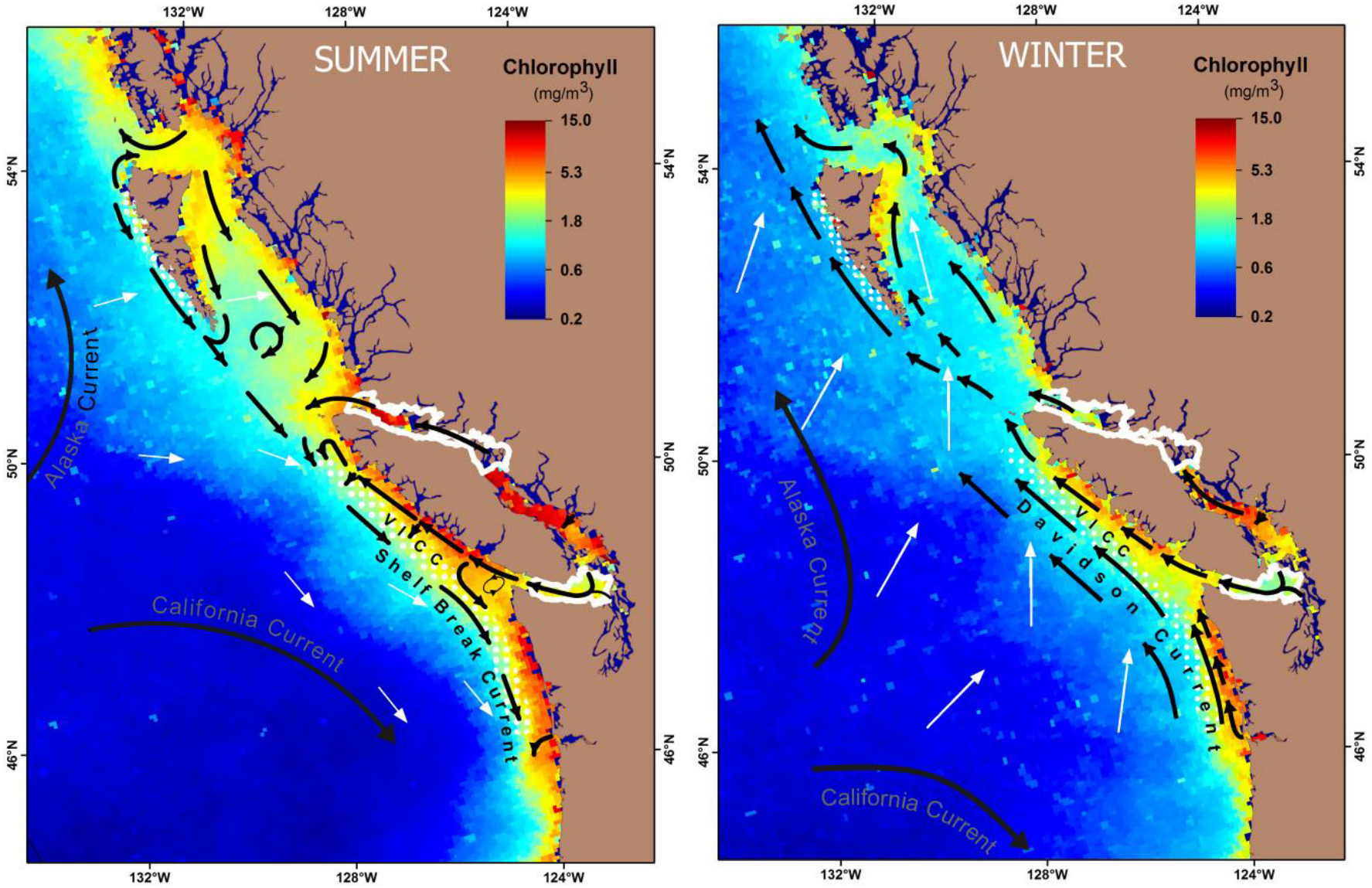
Outline

- Introduction to Rivers Inlet
  - Biological and cultural significance of Rivers Inlet
- Overview of Rivers Inlet dataset
- Description of Rivers Inlet water types
- Seasonal cycle of water types
  - Links between large scale winds and intermediate water properties
- Interdecadal variability of water types
- Summary and future research

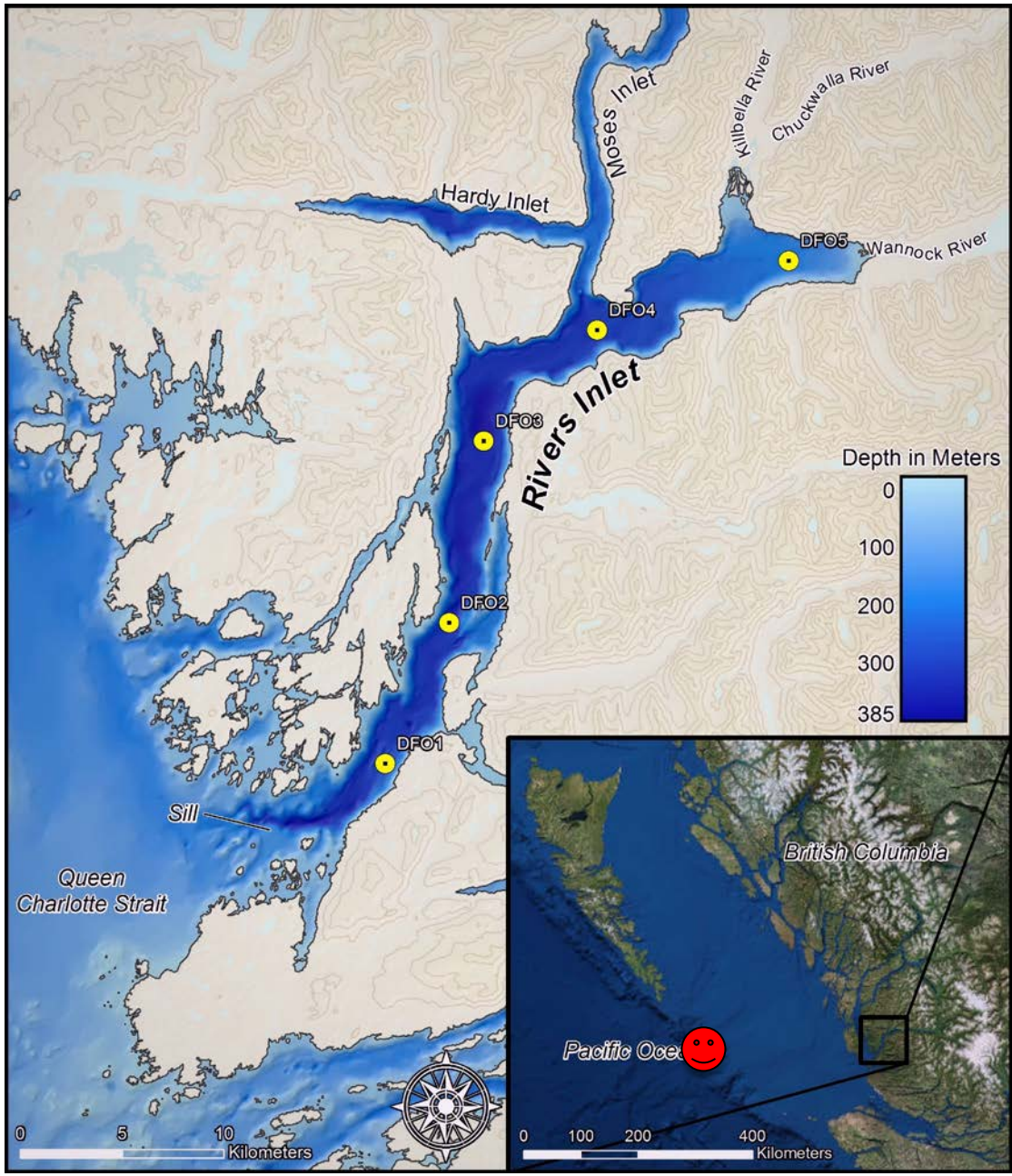
Introduction to British Columbia



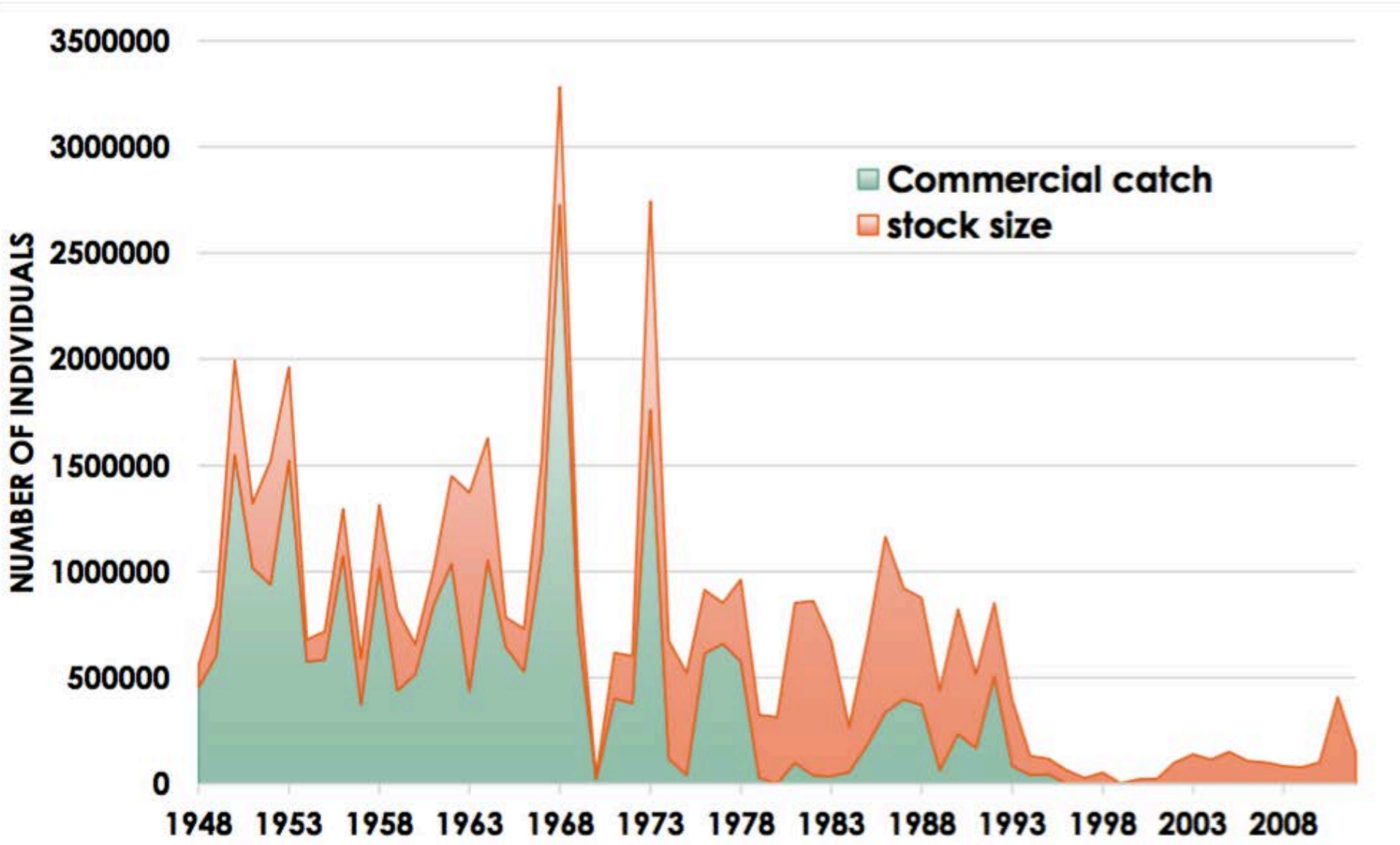
Jackson et al., JGR Oceans, 2015

Introduction to Rivers Inlet

- Rivers Inlet is a fjord on British Columbia's central coast
- It is about 45 km long and 3 km wide
- The average depth is 295m and the sill depth is about 137 m at low tide (Pickard, 1961)
- The mouth of Rivers Inlet is exposed to Queen Charlotte Sound
- There are several major rivers and dozens of tributaries that bring freshwater to Rivers Inlet

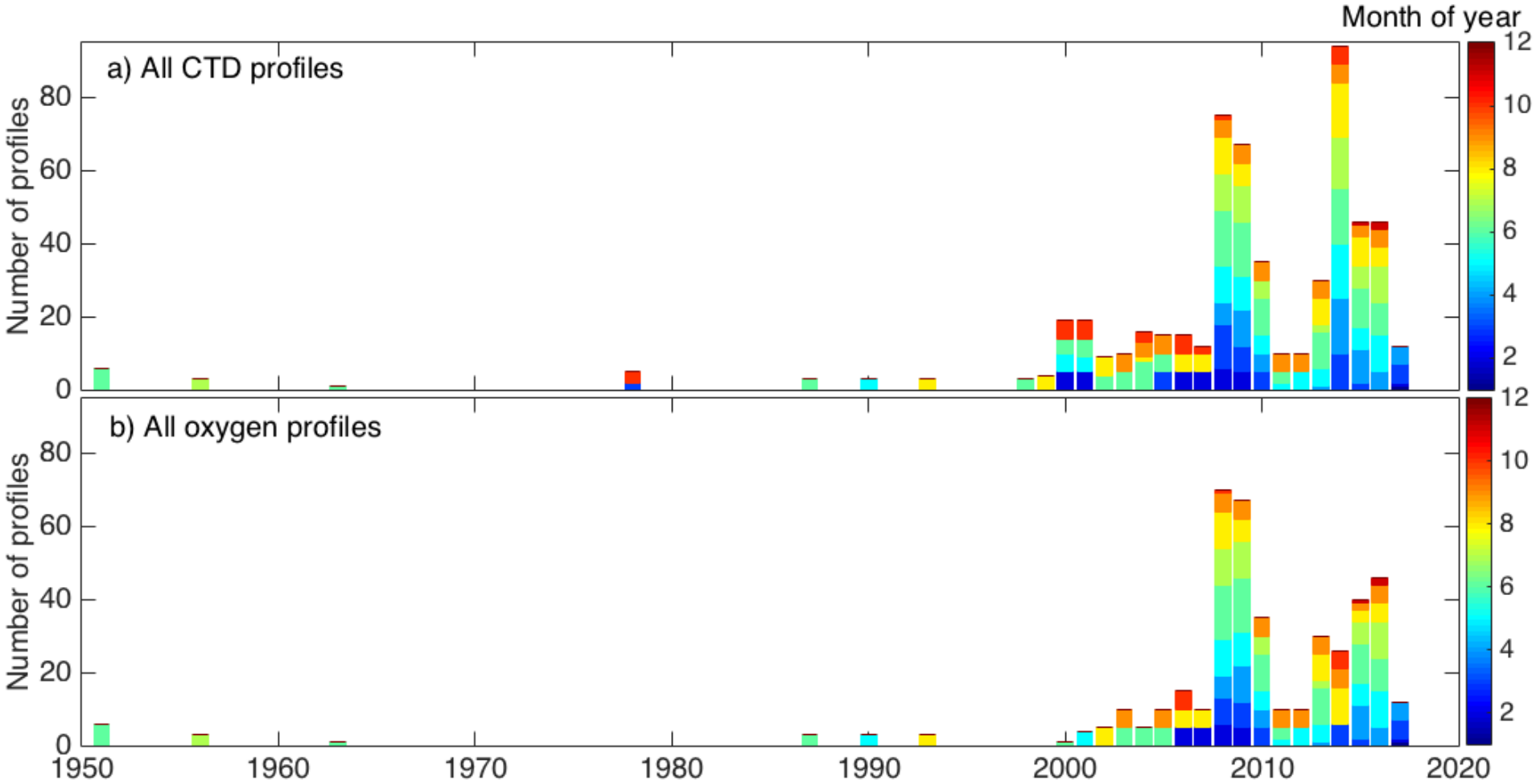


Rivers Inlet sockeye salmon 1948 - 2012



Egorova, UBC masters thesis, 2016

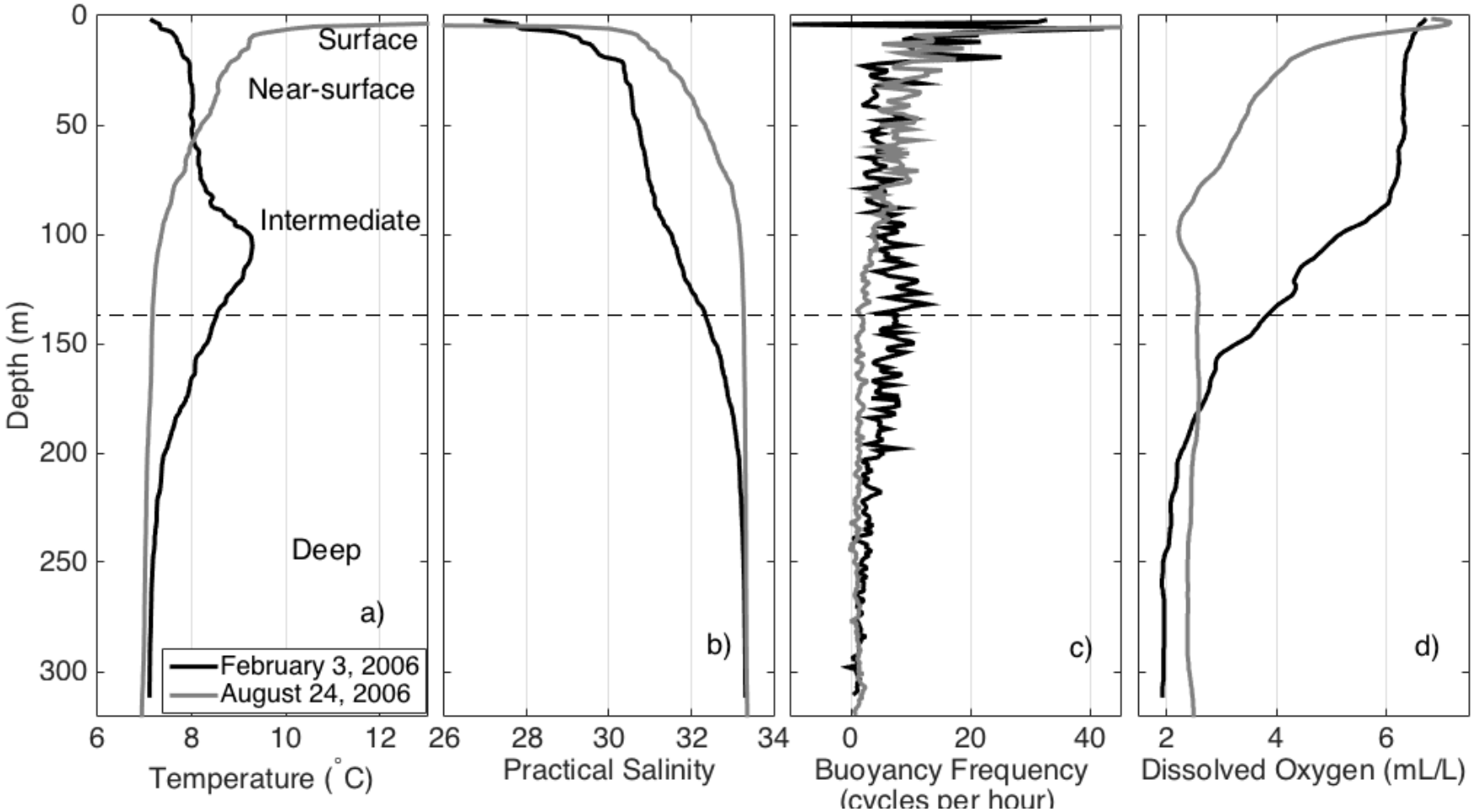
Rivers Inlet Time Series



- University of British Columbia collected data from 1951-1987 and 2008-2010
- Fisheries and Oceans Canada collected data from 1990-2017
- Hakai Institute collected data from 2012-2017

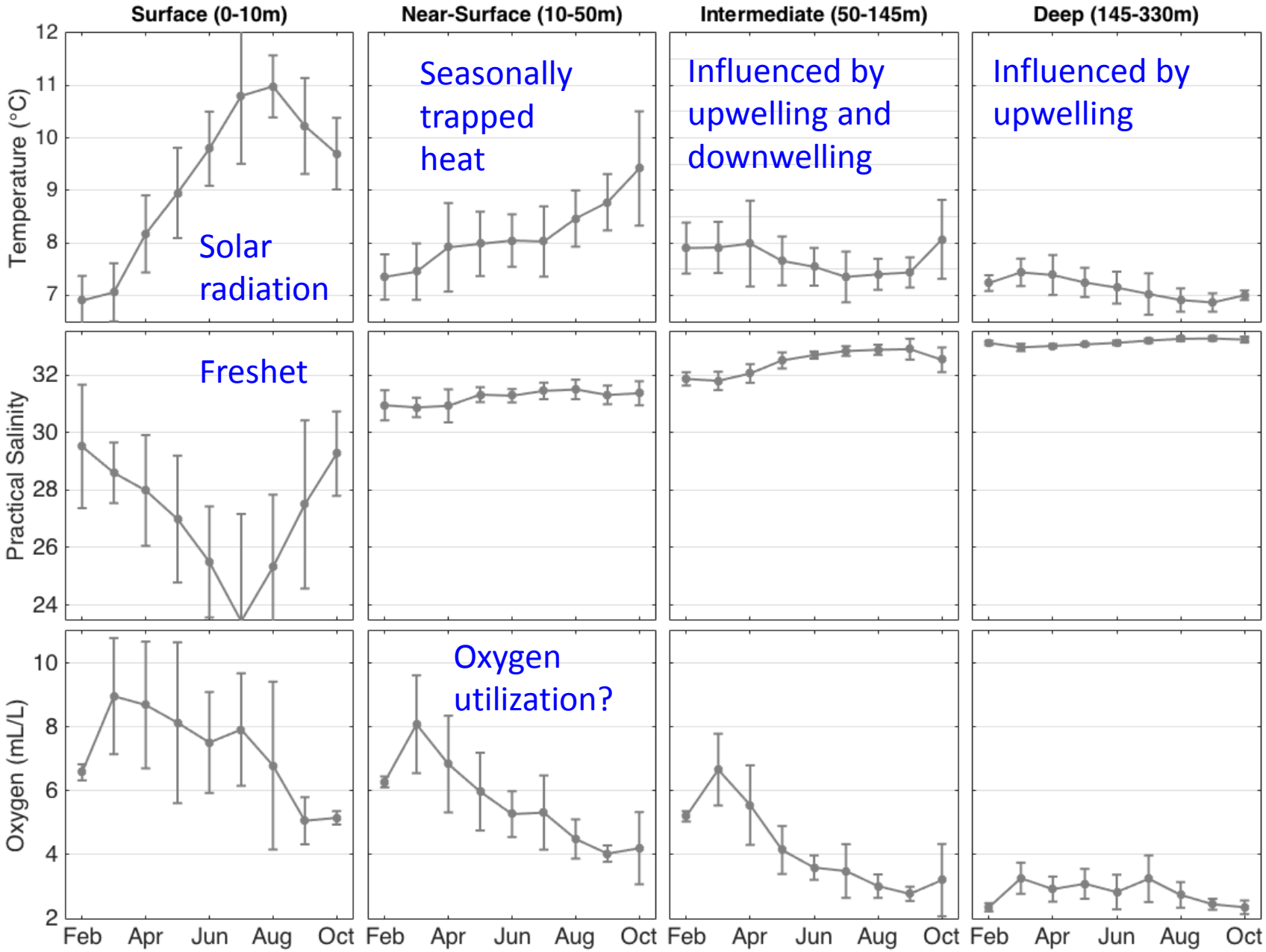
Seasonal cycle and predictability of water types

Rivers Inlet water types



- Based on seasonal differences, we define the following water types:
  - Surface water (0-10m)
  - Near-surface water (10-50m)
  - Intermediate water (50-145m)
  - Deep water (145 m to bottom)

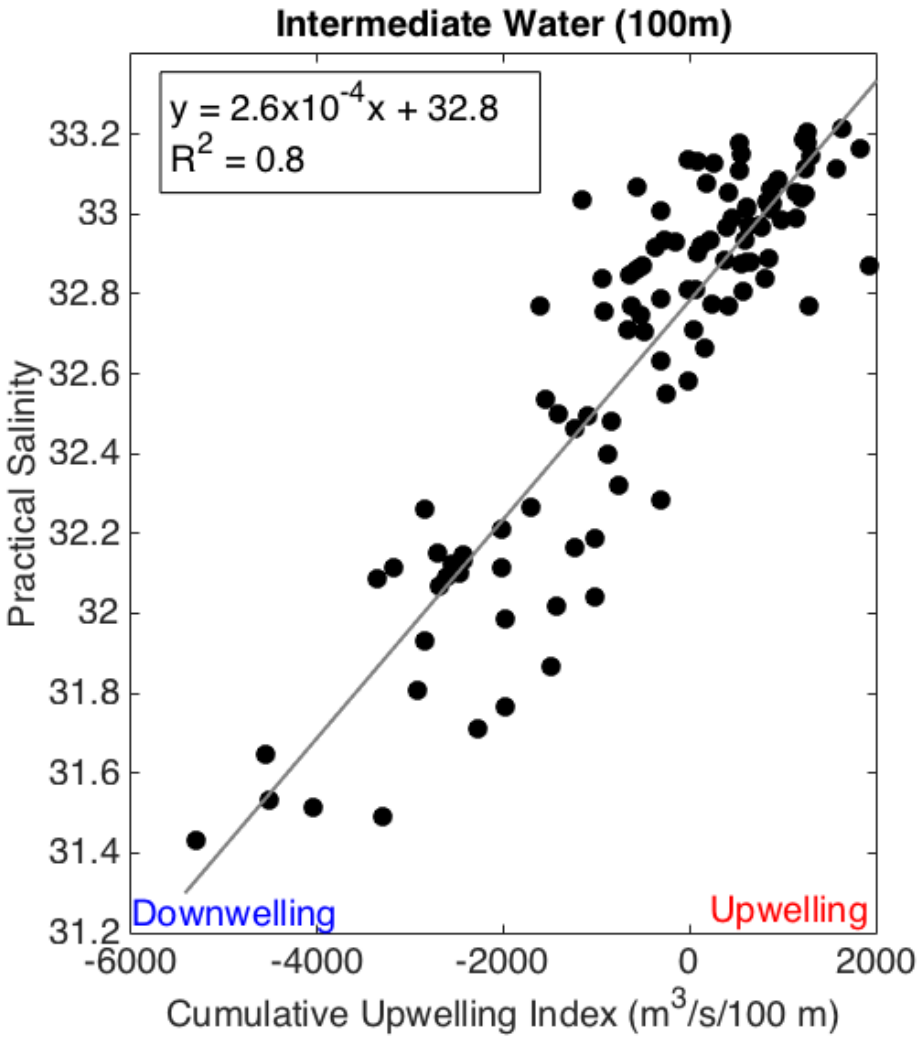
Seasonal cycle of water types

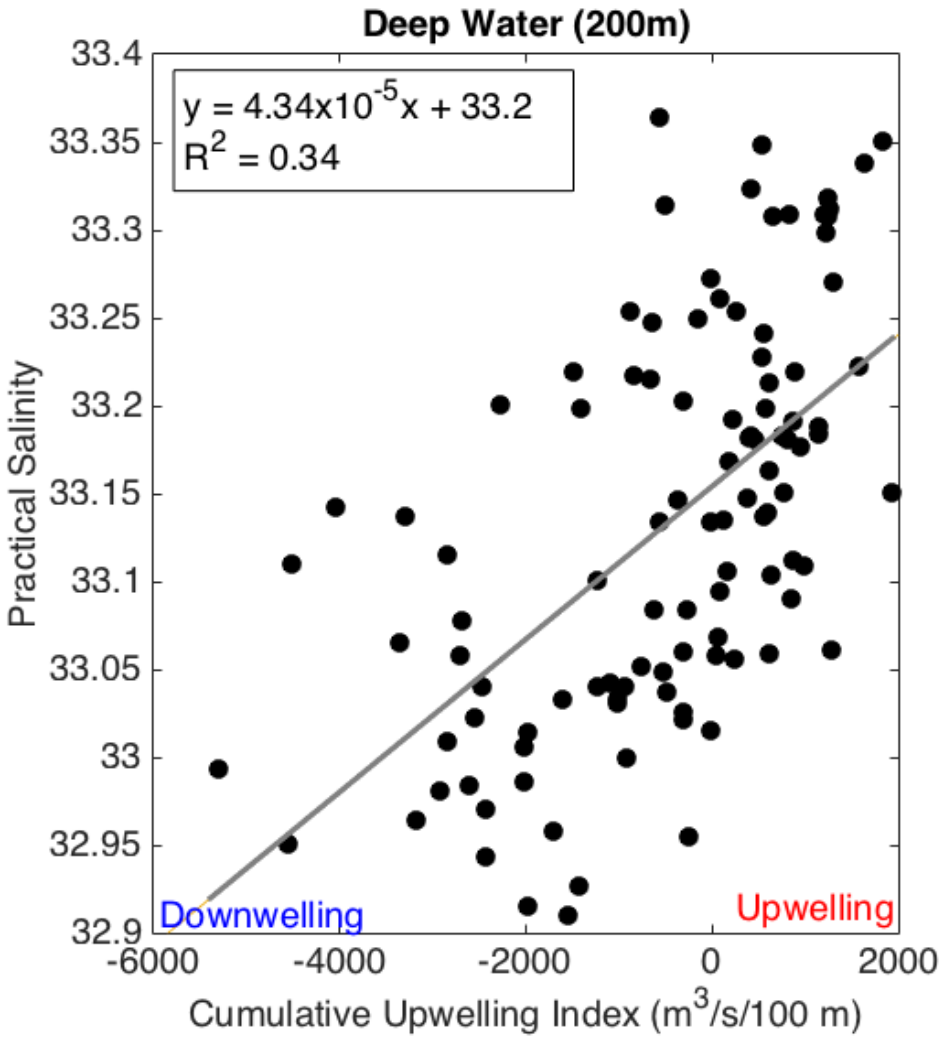


Influence of seasonal large scale winds

- The mouth of Rivers Inlet is about 150 km from the edge of the shelf break, where seasonal wind shifts force upwelling and downwelling
- To address how important upwelling and downwelling is in Rivers Inlet, shelf break winds from 51°N, 131°W were examined
  - Wind data are from 1967 to 2016
- Following Foreman et al. (2011), the Cumulative Upwelling Index (CUI) was calculated from the Bakun Index
  - CUI was calculated for 2, 3, 4, 6, 8, 12, and 14 weeks before observations in Rivers Inlet

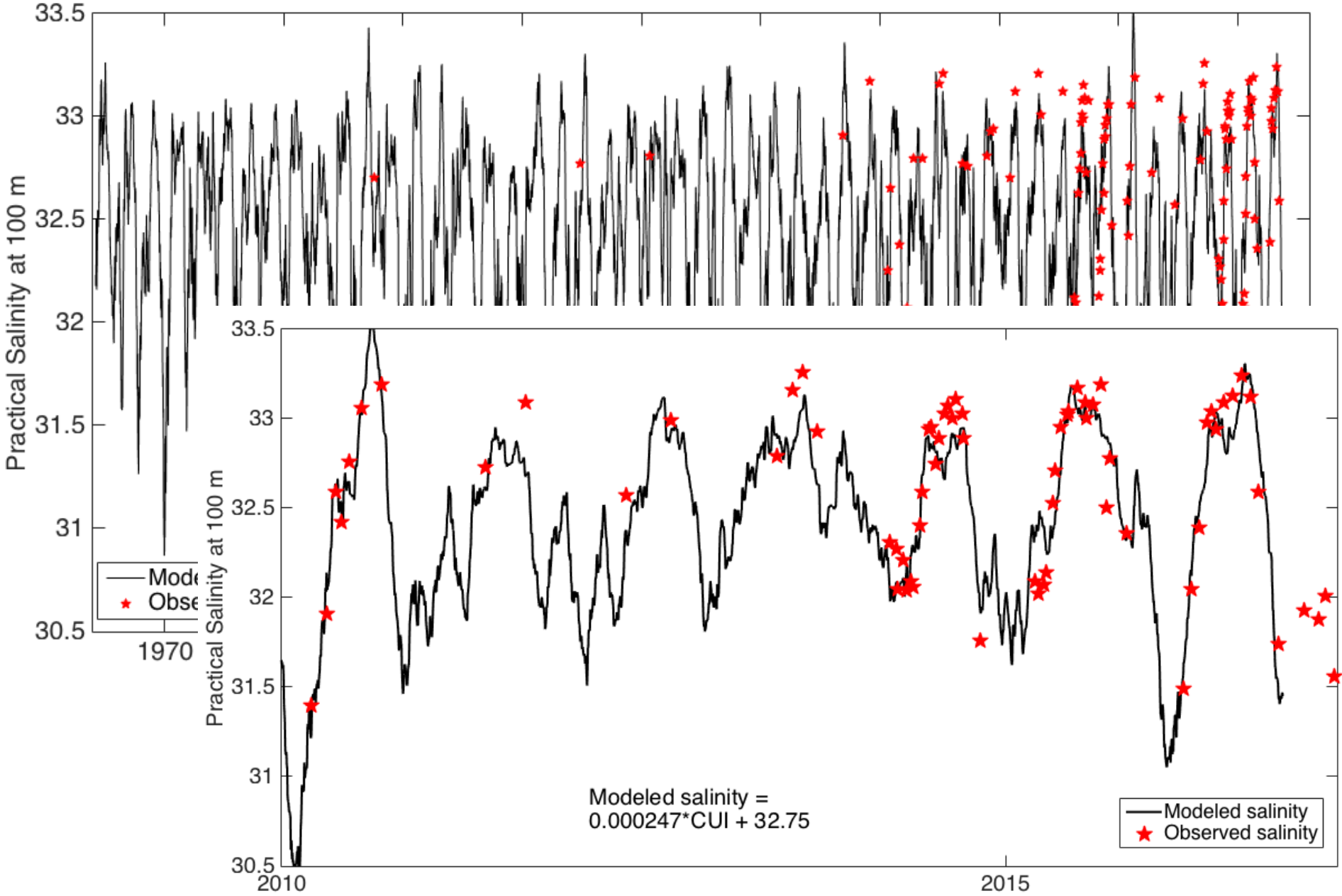
Influence of CUI on salinity



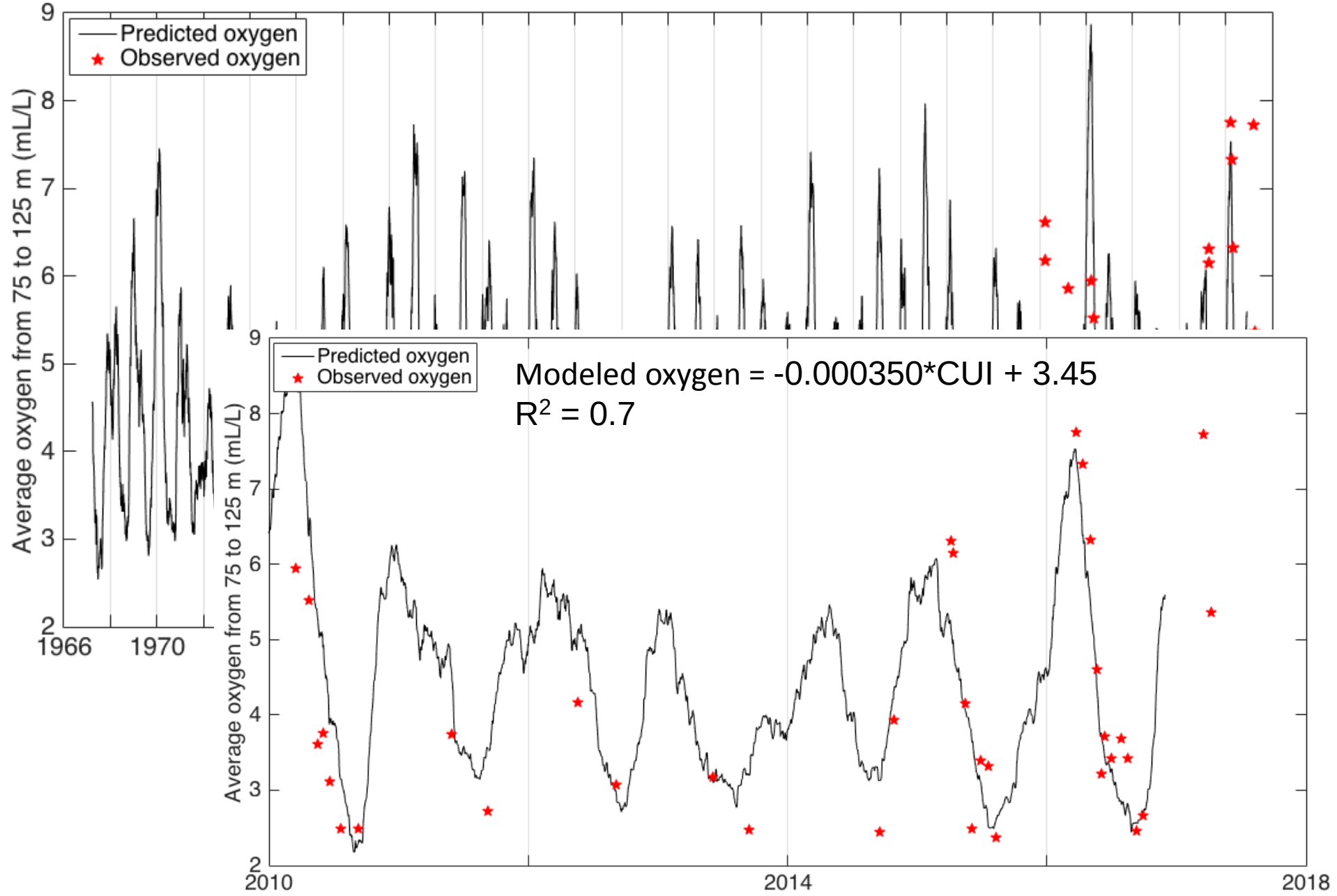


- These results suggest that the salinity of intermediate water in Rivers Inlet can be predicted by large-scale winds

Predictability of intermediate water salinity

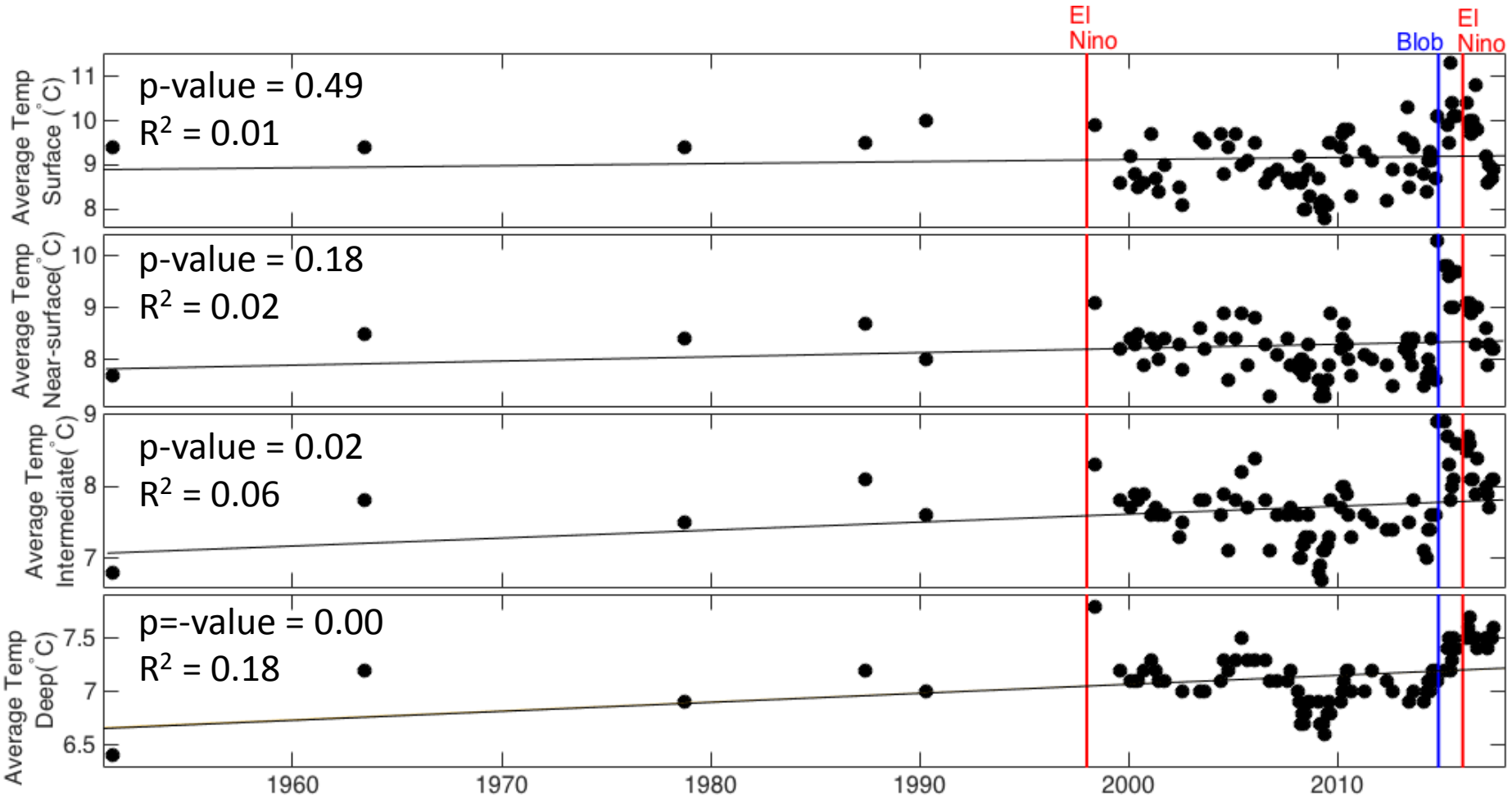


Predictability of intermediate water oxygen



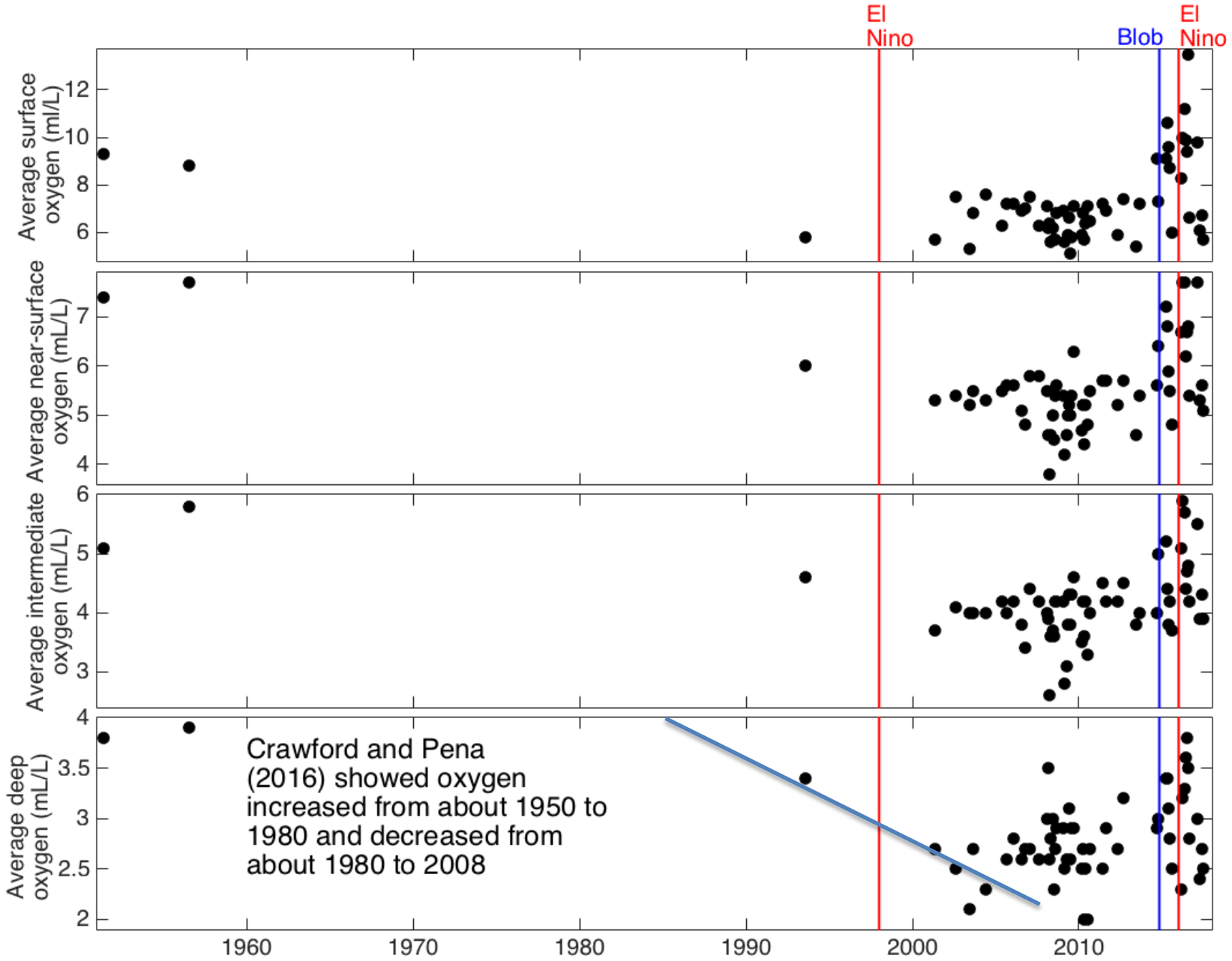
Interdecadal trend of water types

Temperature time series with seasonal cycle removed



- Surface, near-surface and intermediate waters warmest during Blob
- Deep waters warmest during 1998 and 2016 El Nino
- There was no trend in salinity or density

Oxygen time series with seasonal cycle removed



Summary

- A time series of temperature, salinity and oxygen was constructed from Rivers Inlet, British Columbia from 1951 to 2017
- Based on seasonal trends, Rivers Inlet water types can be defined as:
  - Surface (0 to 10 m)
  - Near-surface (10 to 50 m)
  - Intermediate (50 to 145 m)
  - Deep (145 m to bottom)

Summary

- The salinity of Rivers Inlet intermediate water is very well correlated with winds observed at the shelf break, about 150 km away
  - This suggests that large scale winds transport intermediate water into Rivers Inlet
- A statistically significant warming from 1951-2017 was observed:
  - Intermediate water warmed from about 7 to 7.6°C
  - Deep water warmed from about 6.6 to 7.3°C
- Oxygen in all layers appears to have increased since 2010