~~Identification of a~~ Subsurface oxygen minim~~um~~a in British Columbian fjords

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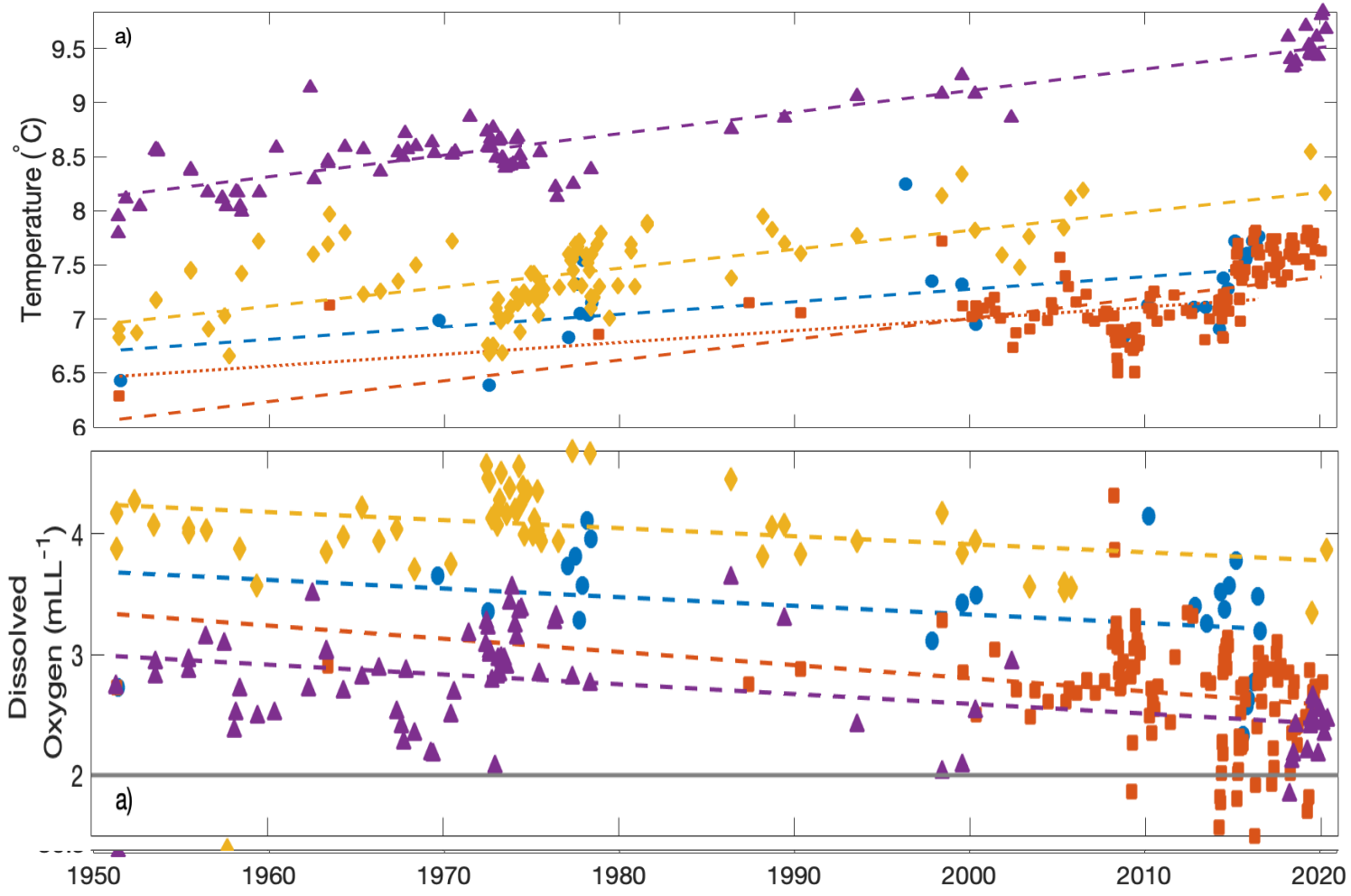
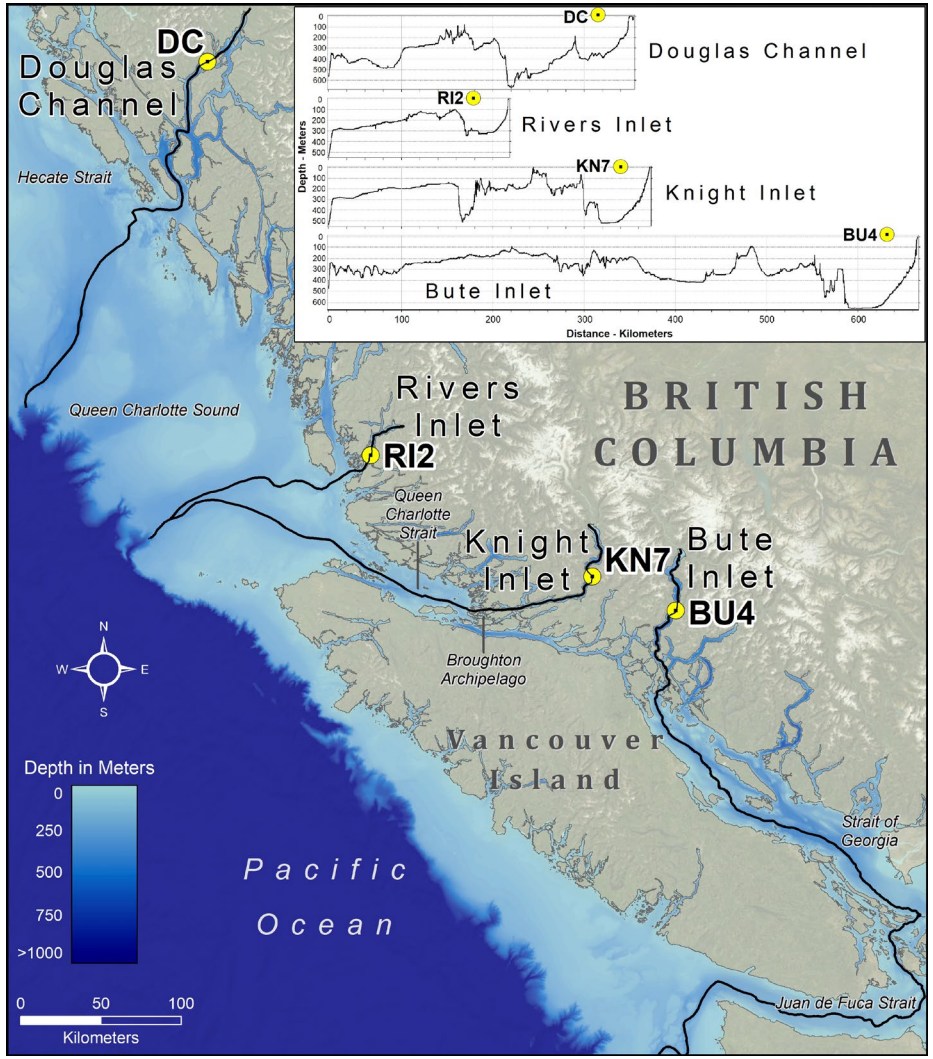
Outline

- Introduction to changes in British Columbia fjords
- Introduction to Rivers Inlet
- Definition of oxygen minimum layer (OML)
- Processes that form OML – downwelling, remineralization and upwelling
- Other examples of OML in British Columbia fjords

Changing British Columbia mainland fjords





Since 1951, **deep water** (i.e. below sill depth) in Rivers, Knight and Bute Inlet have lost 0.4 to 0.7 mLL^{-1}, roughly 20% of oxygen

Jackson et al., GRL, 2021

Rivers Inlet

- Rivers Inlet is a fjord on British Columbia's central coast
- It is about 45 km long and 3 km wide
- The maximum depth is 340m and the sill depth is about 140m (Pickard, 1961)
- The mouth of Rivers Inlet is exposed to Queen Charlotte Sound
- There are approximately 53 inlets at least 18.5 km long in British Columbia

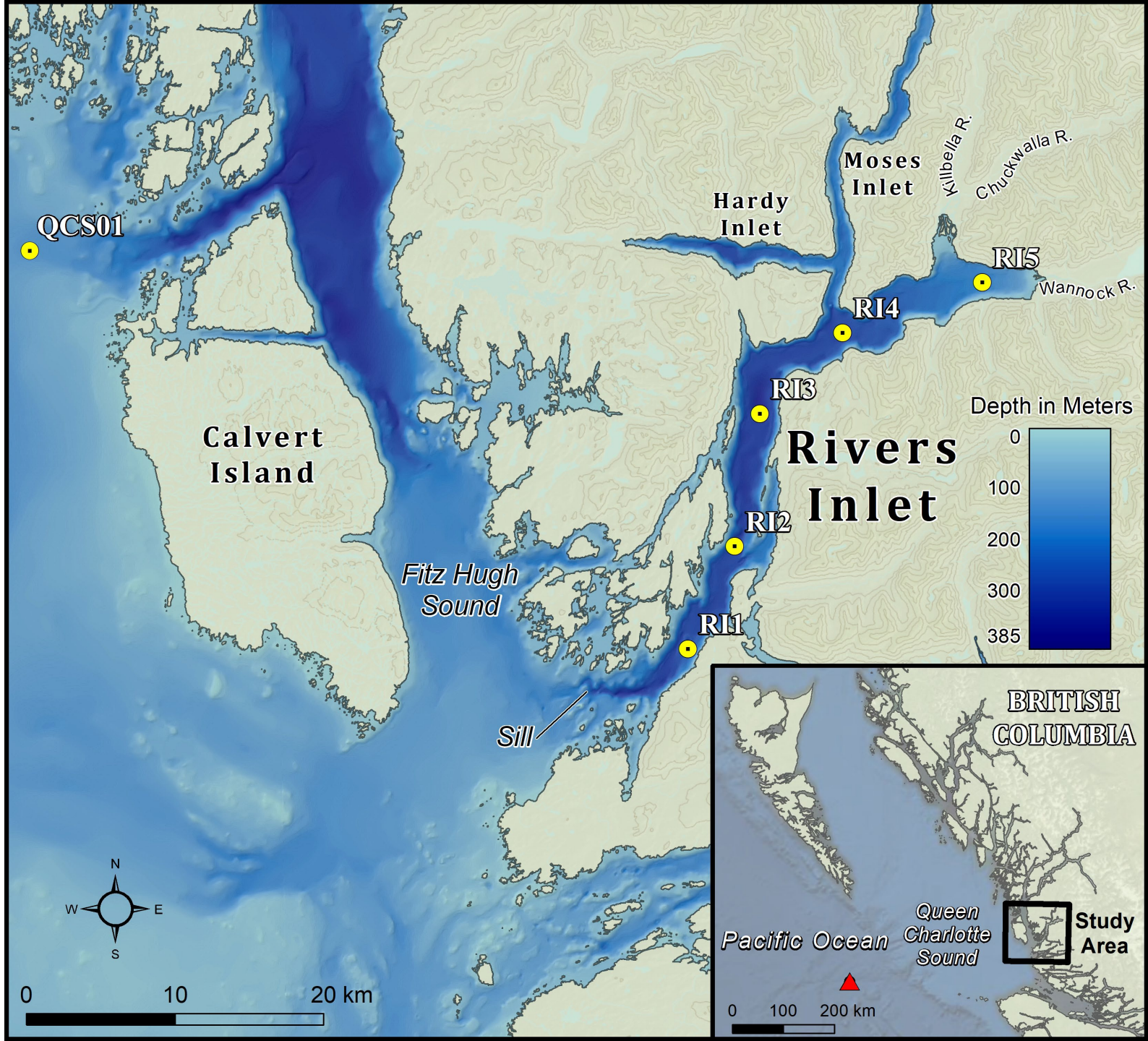
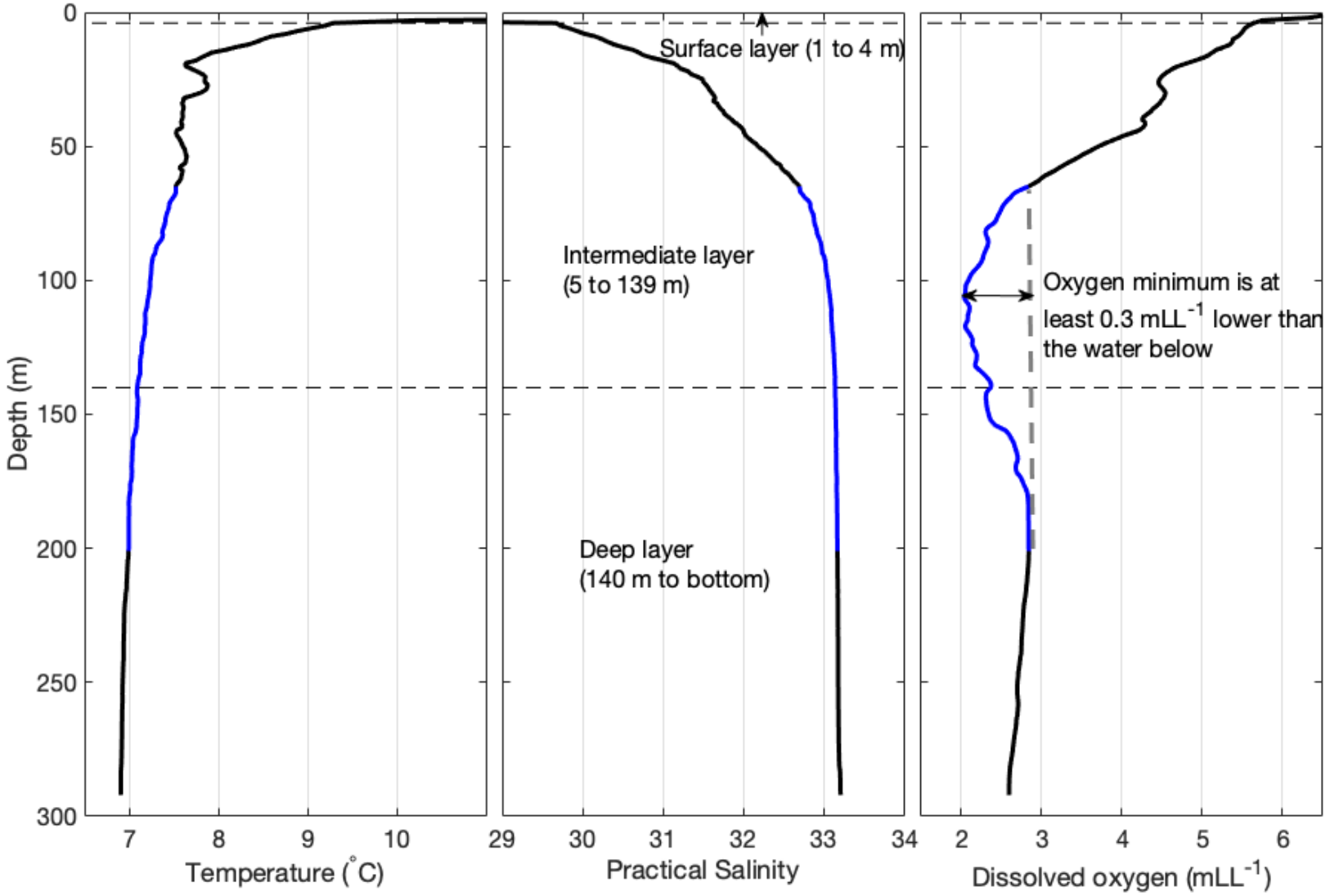


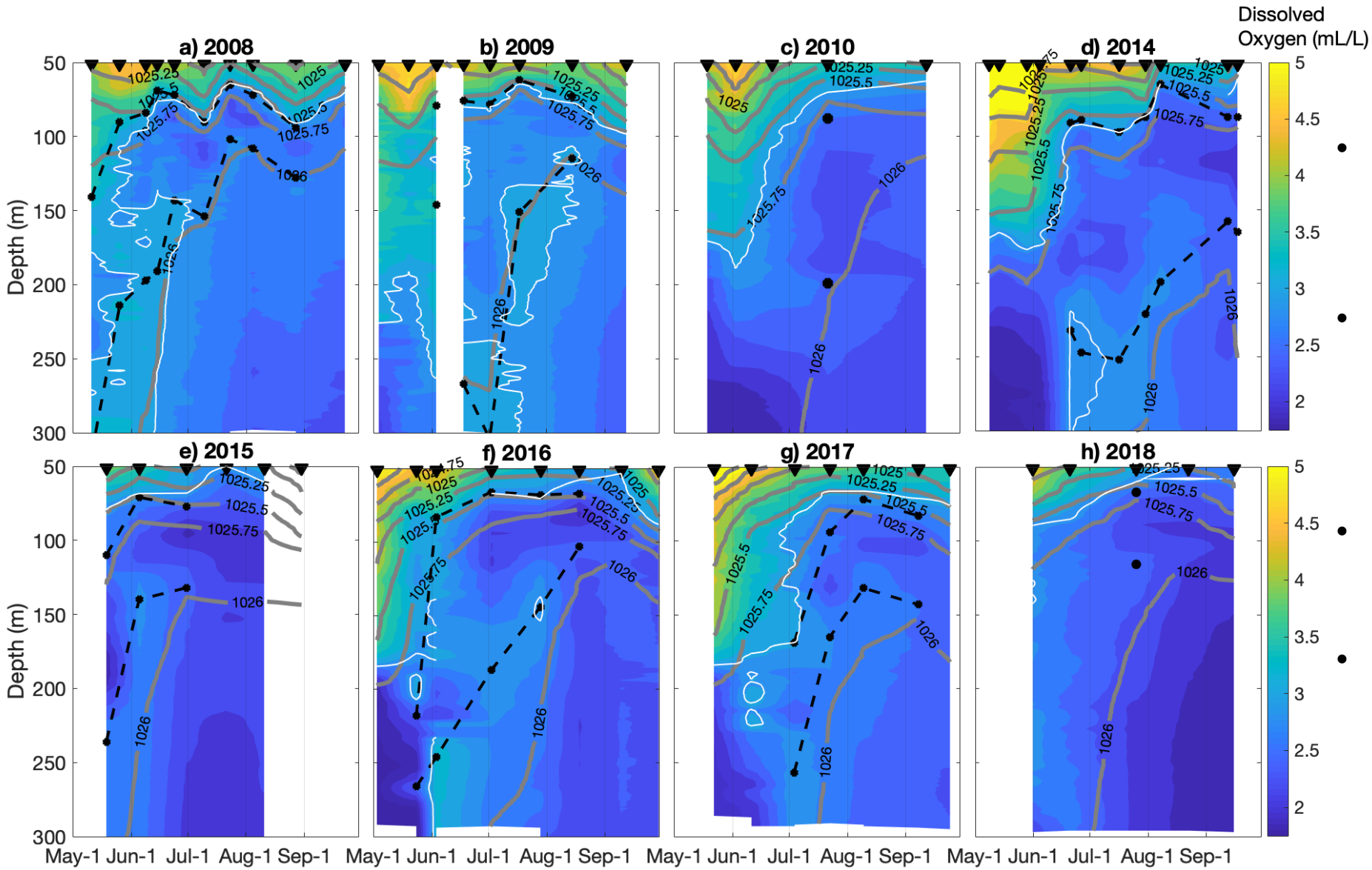
Image by Keith Holmes

Definition of Omin and OML



- The oxygen minimum (Omin) was defined as present when:
  - The minimum value was less than 3 mLL^{-1}
  - The minimum value was at least 0.3 mLL^{-1} less than the maximum oxygen value in the waters below
- The oxygen minimum layer (OML):
  - The base was the depth of the maximum oxygen below the Omin
  - The top was the depth of the same oxygen concentration as the base

OML present in all years since at least 2008



- The OML started to form after the 1025.75 kgm^{-3} isopycnal started shoaling
- The 1026 kgm^{-3} isopycnal shoaled about 1-2 months after the 1025.75 kgm^{-3} isopycnal
- The base of the OML is formed by oxygen-rich upwelled waters
- There is a lot of interannual variability

Summary of OML formation

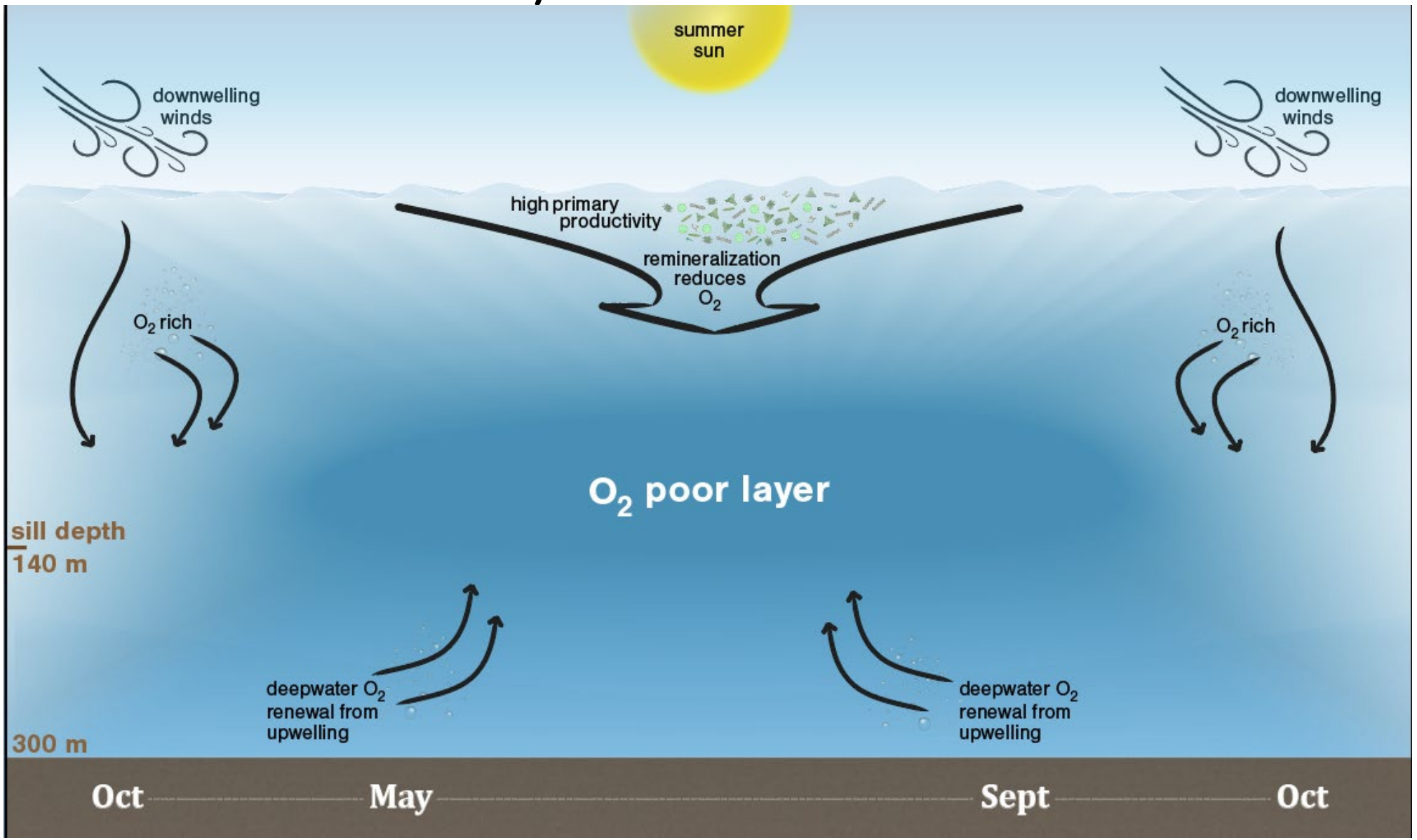
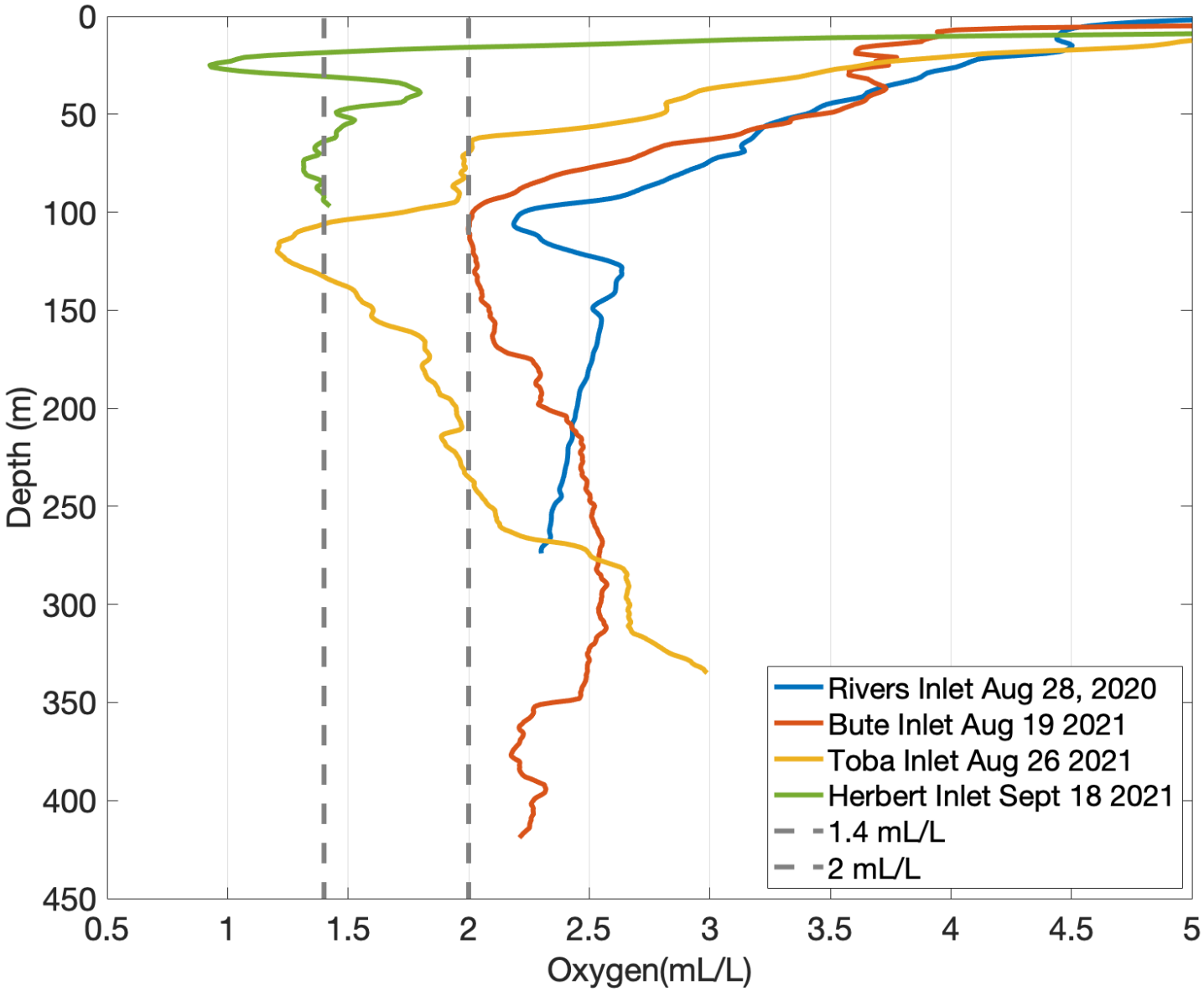
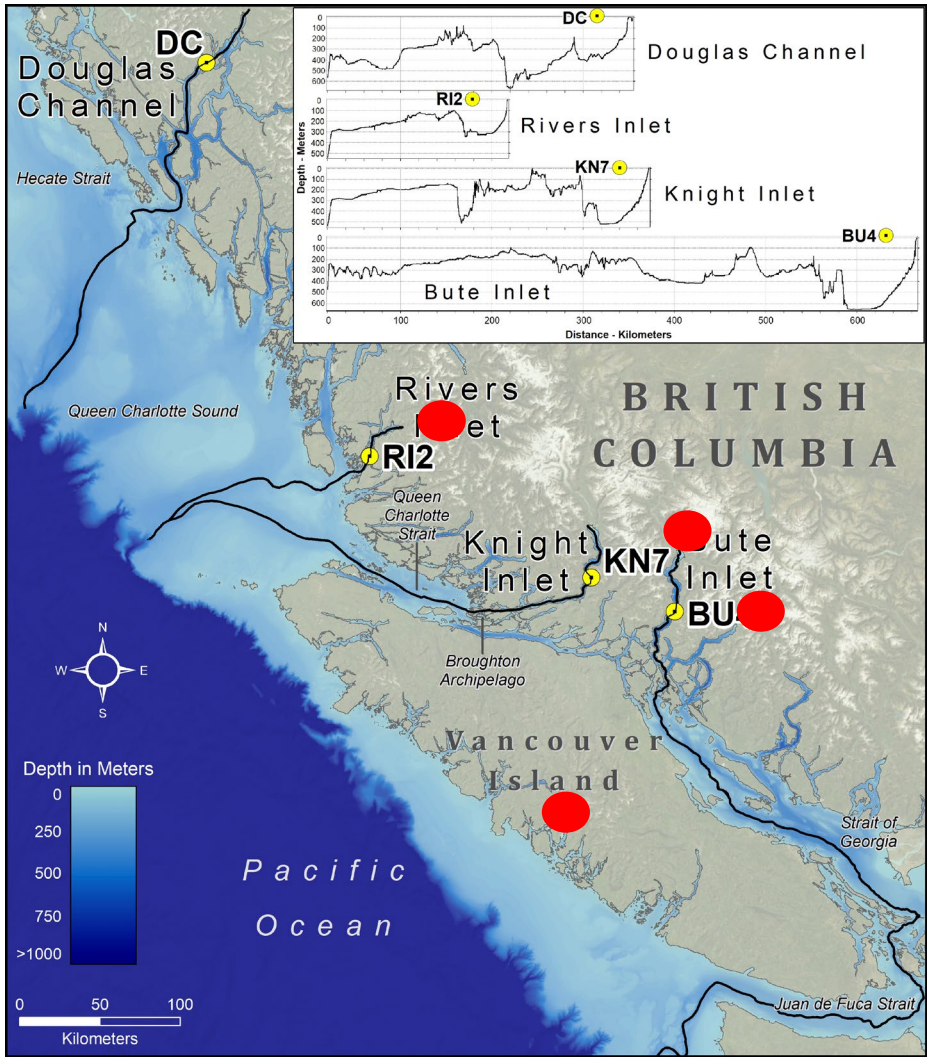


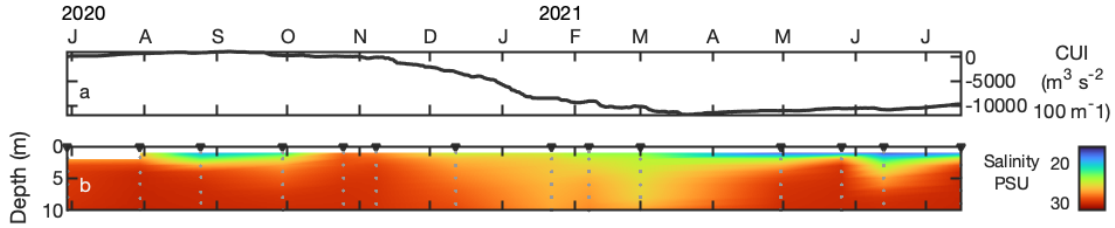
Image by Josh Silberg

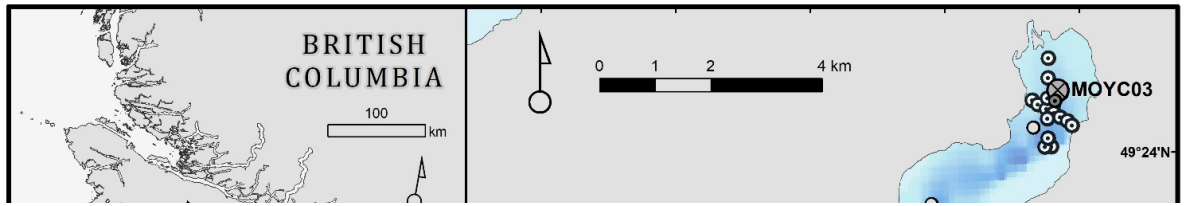
Subsurface OMLs in other inlets

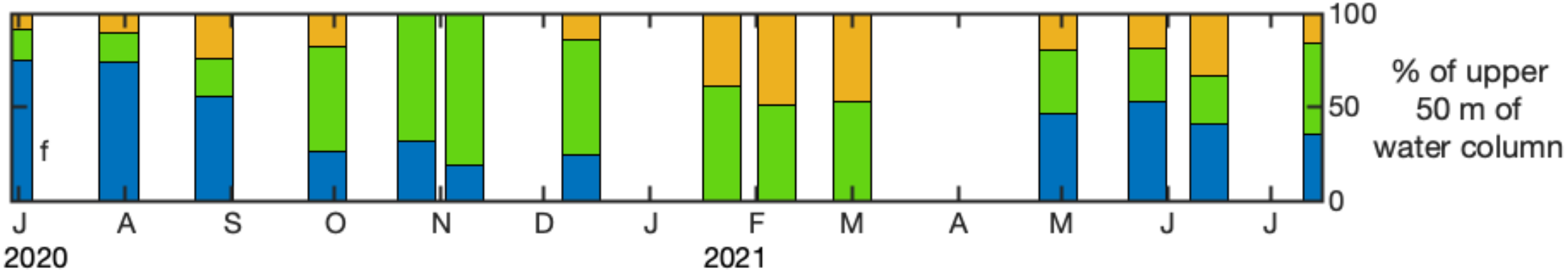


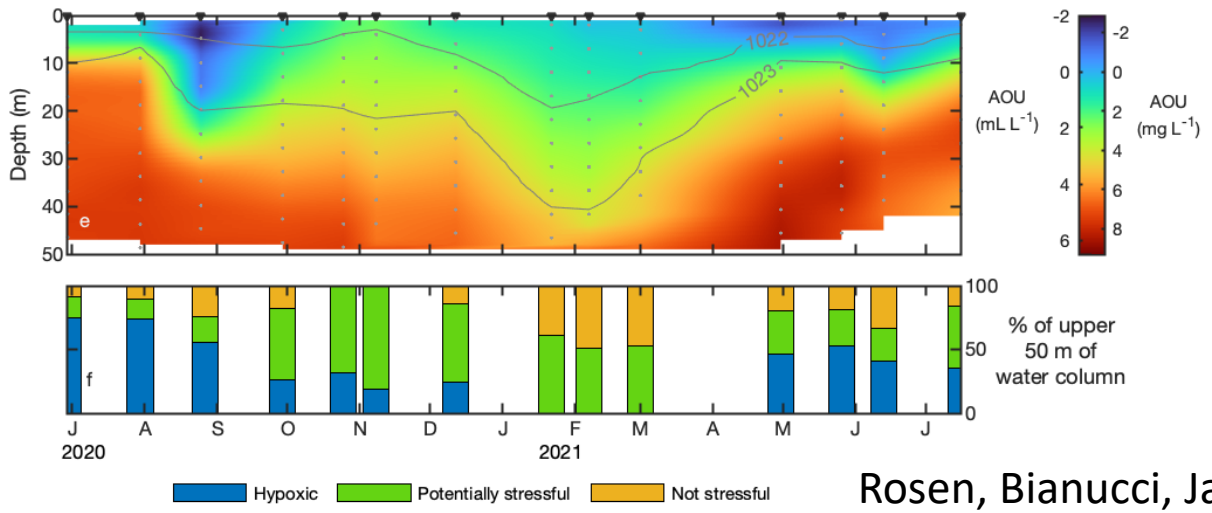


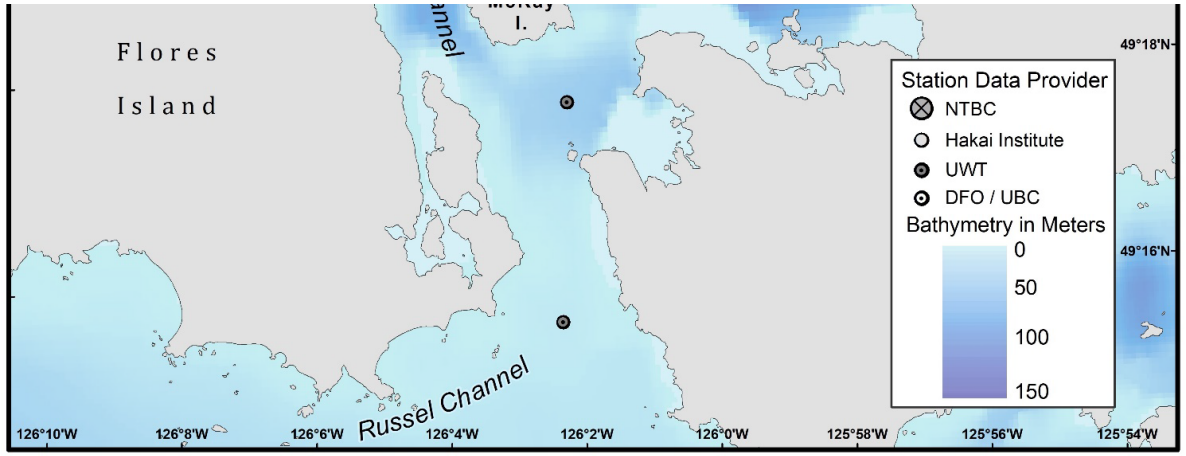
The extreme oxygen example of Herbert Inlet











Rosen, Bianucci, Jackson, Hare, Greengrove, Monks, Bartlett, Dick, FMS, in revision

Summary and future research

- Deep water (below sill depth) in British Columbia fjords is warming and losing oxygen (Jackson et al., 2021)
- A seasonal subsurface mid-depth (above sill depth) oxygen minimum layer was identified in Rivers Inlet (Jackson et al., 2022)
- A subsurface OML was observed in at least 4 other inlets in British Columbia
- Herbert Inlet is an extreme example, where hypoxic waters were observed in the upper 50 m in all months except November to February
  - Future research on the impact of these low oxygen concentrations on salmon is needed