Apr 30th, 1:30 PM - 3:00 PM

Future climate impacts on Puget Sound oceanography: the North Pacific and hydrological context

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What do we know about how the Salish Sea fits into a changing earth system?

Atmospheric, hydrological, and oceanic pathways

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many thanks to

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Manu Di Lorenzo
Curtis Deutsch

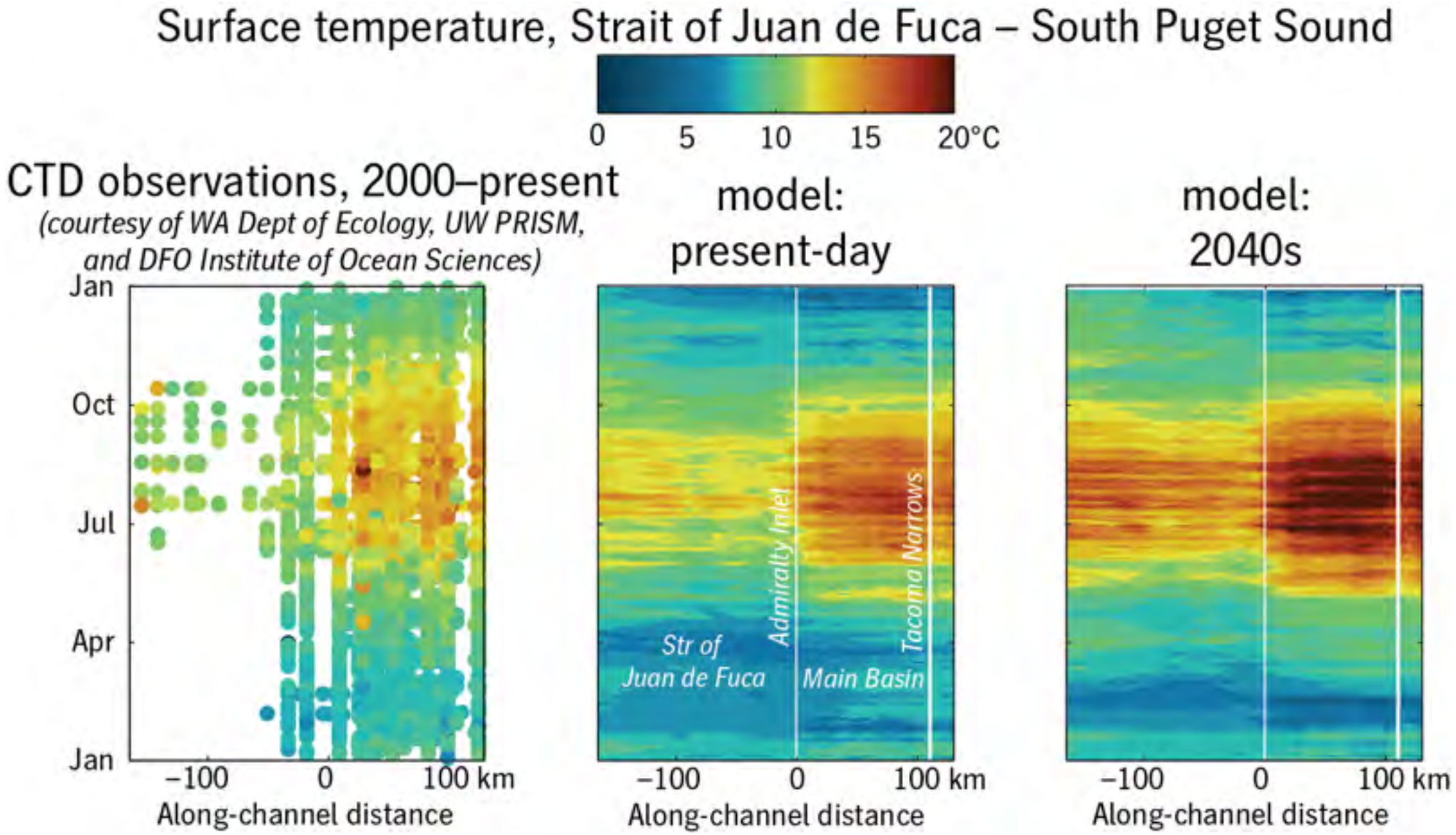
Salish Sea Ecosystem Conference
April 2014

Direct atmospheric effects

River inputs

Ocean inputs

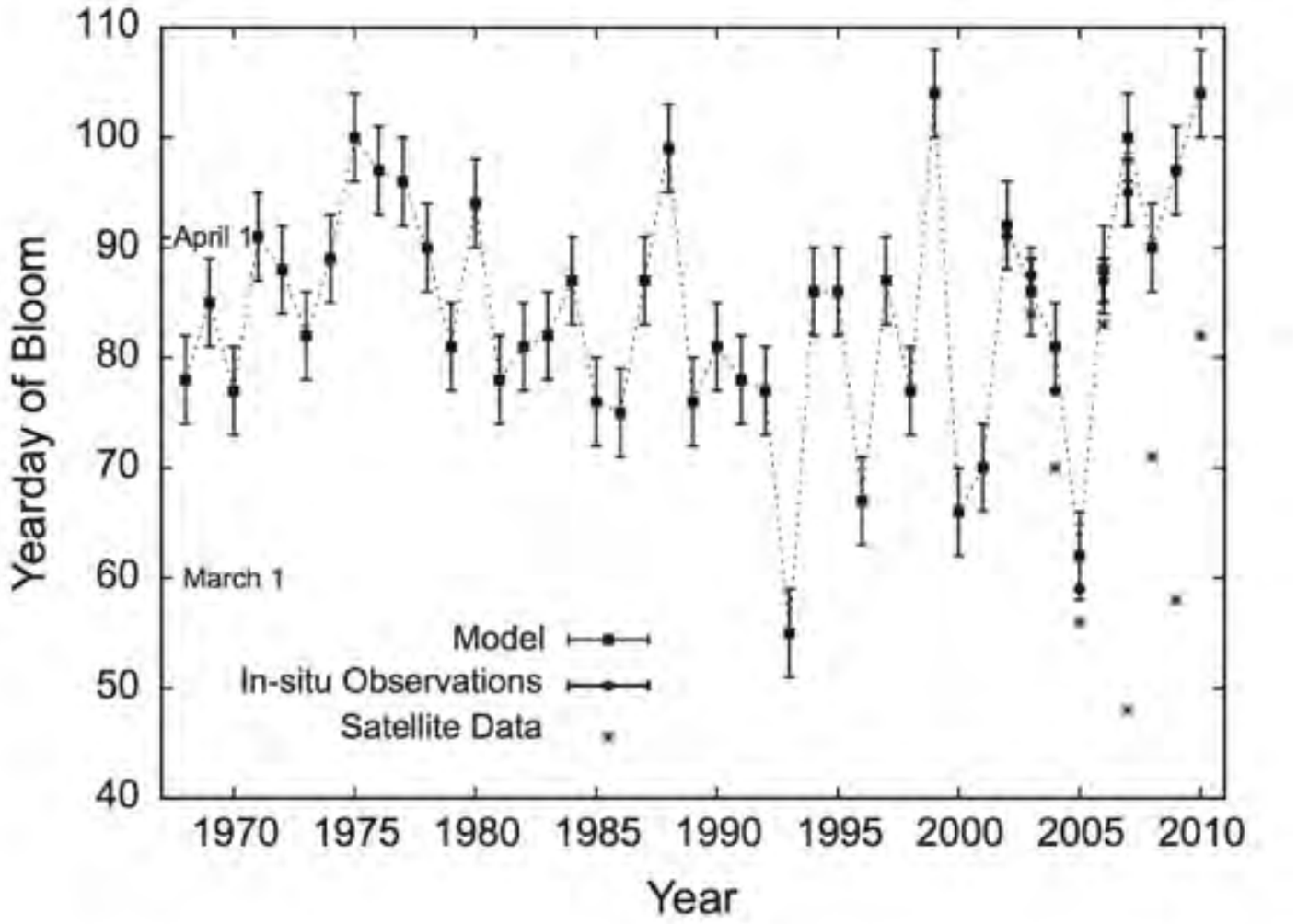
Global warming causes local warming!



(Banas and Salathé)

Warmer surface temperatures are likely to widen the seasonal window of opportunity for *Alexandrium* HABs by 1-2 months:
see talk by Stephanie Moore, Fri at 11:45, session S-9A

Wind mixing and cloudiness also affect the *timing* of phytoplankton blooms



Model hindcast of spring bloom date in the Strait of Georgia
(Allen and Wolfe, *Prog. Oceanogr.*, 2013):
climate-linked trend toward increased *variance*

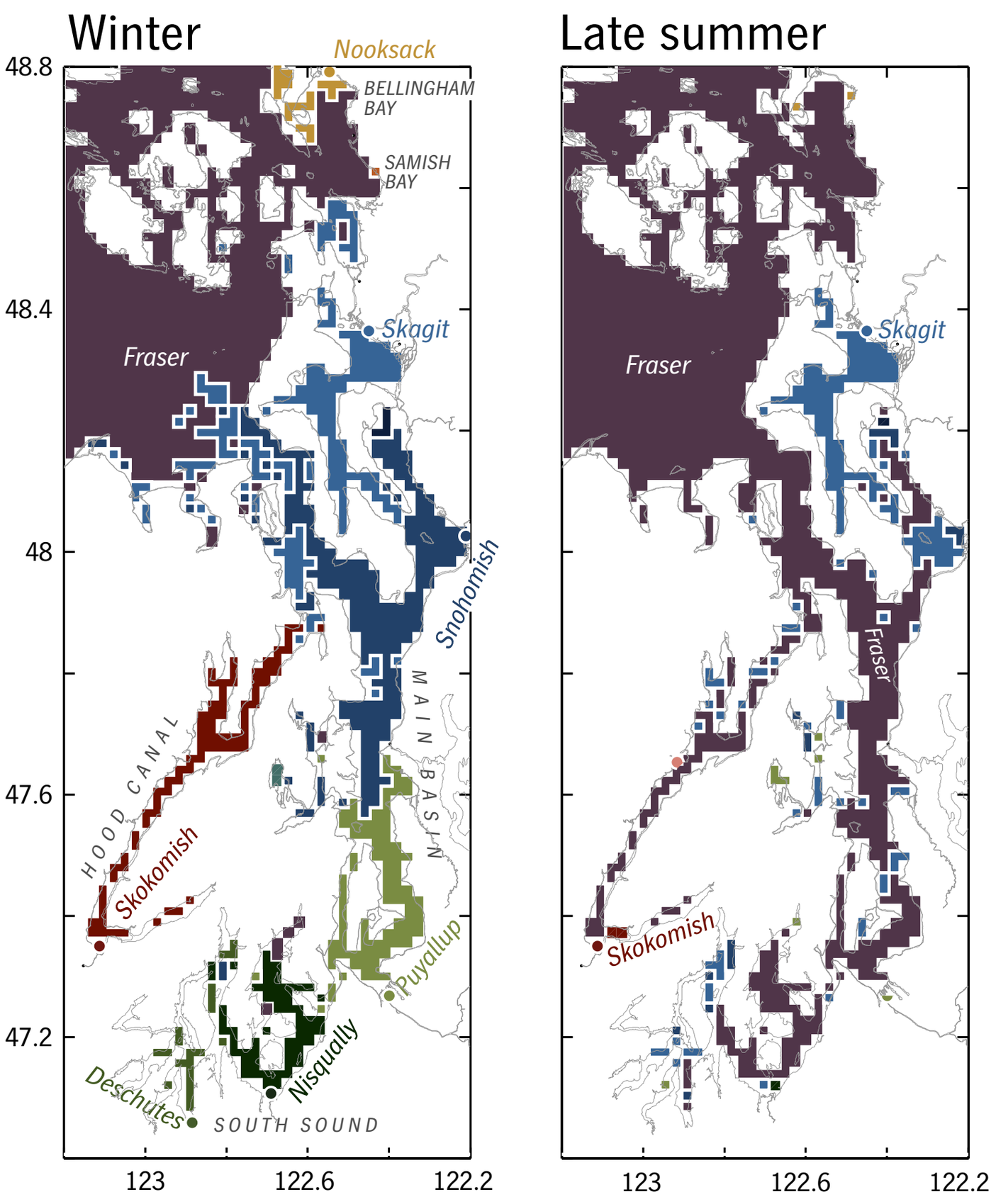
We need to learn more about how extreme weather events are changing, not just seasonal averages!

Direct atmospheric effects

River inputs

Ocean inputs

Single largest contributor of freshwater

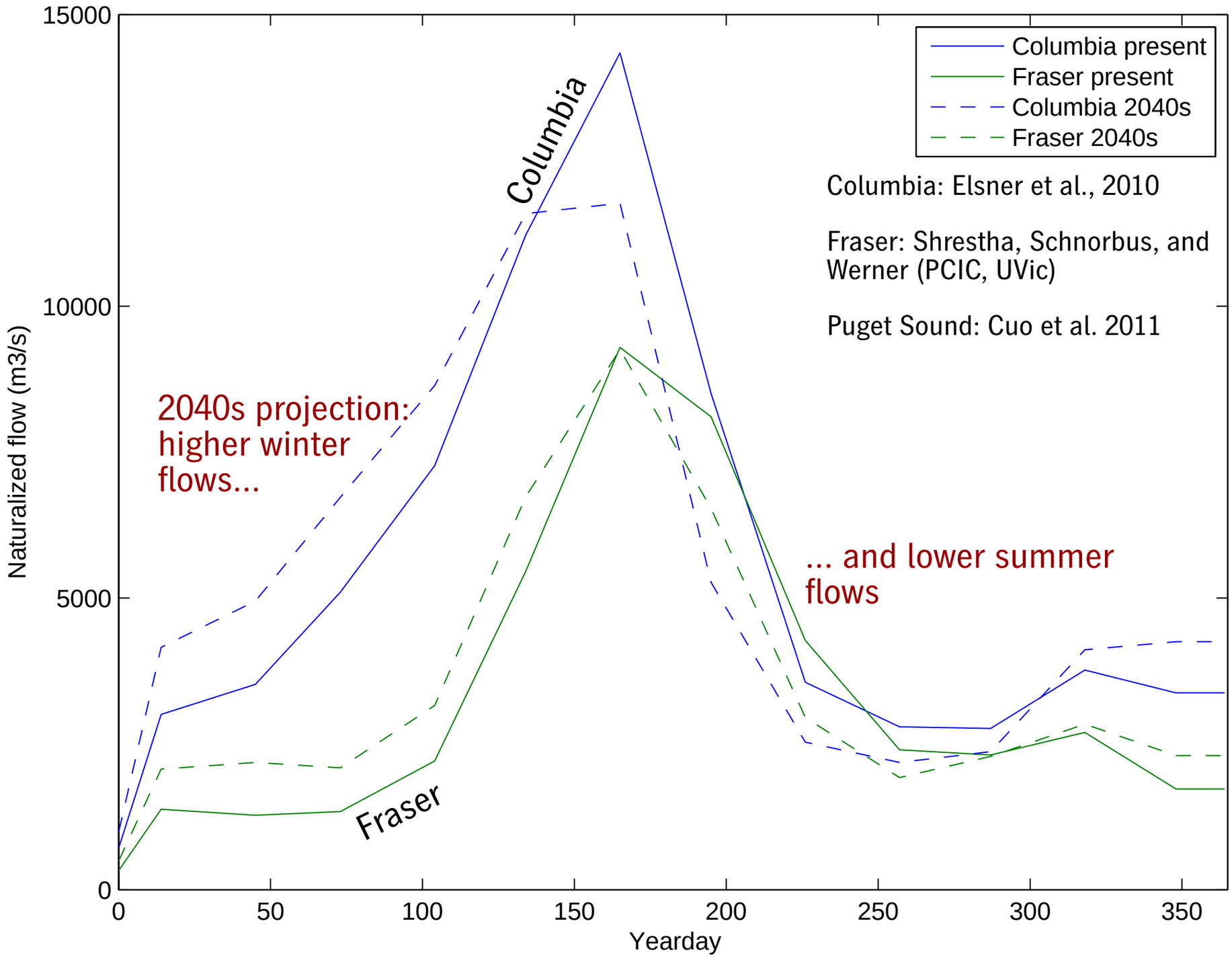


Any given corner of Puget Sound is influenced by climate and hydrology in quite distant watersheds!

(Note: river-borne fecal coliform and DIN loads are are much more localized, because of decay/utilization rates.)

(Banas et al., *Estuaries and Coasts*, in revision)

The most significant climate-linked trend in riverflow (both observed and predicted) is a shift in *timing*



See Snover et al. 2013 (UW Climate Impacts Group)

Summary so far

We understand the *physics* of pathways linking the Salish Sea to global climate via atmospheric and hydrological pathways pretty well.

The biggest uncertainty is *ecological* dynamics.

We should pay particular attention to **phenology:**

- timing of mixing and stratification
- timing of spring phytoplankton blooms
- interaction with zooplankton and fish life histories

Direct atmospheric effects

River inputs

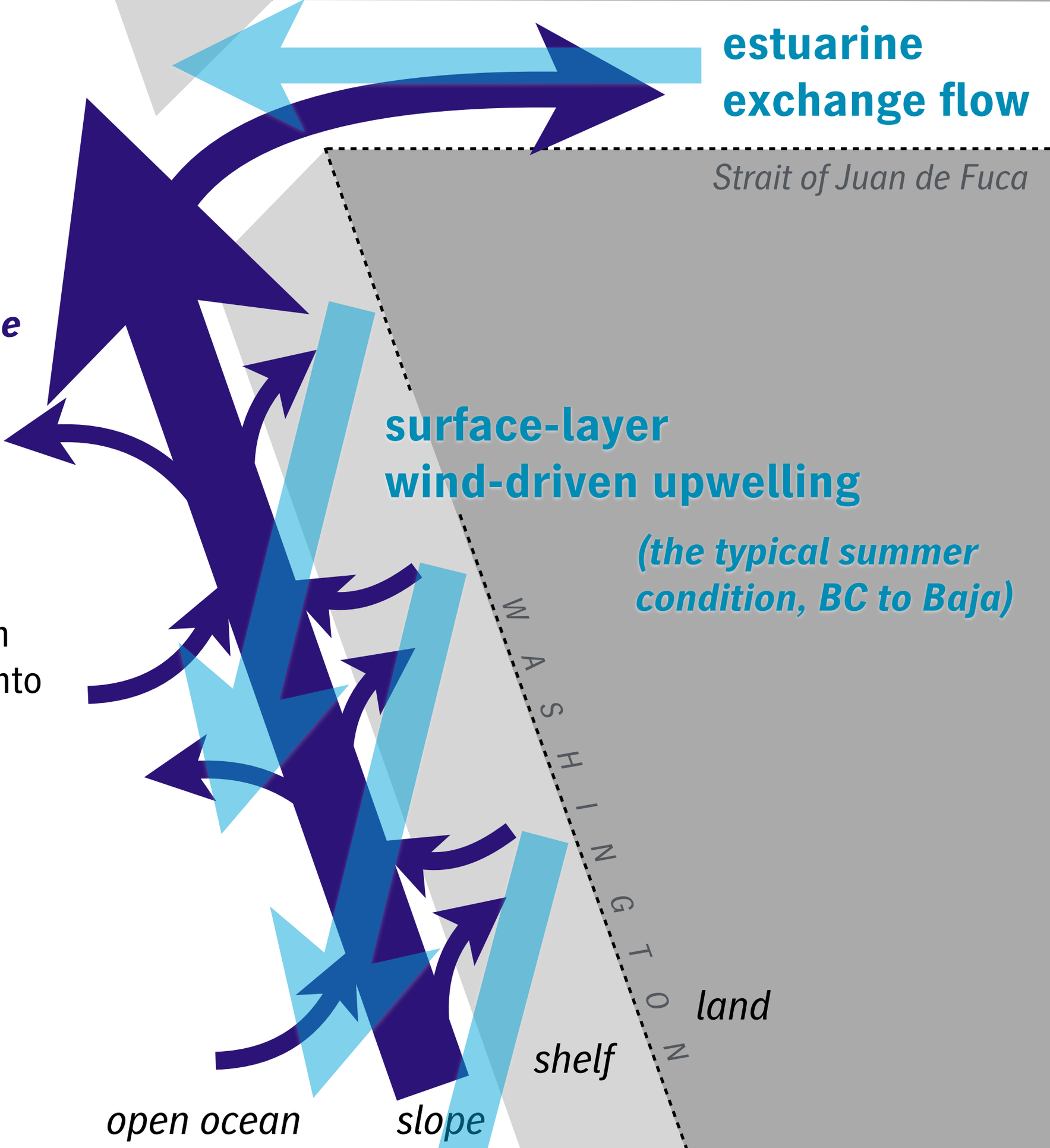
Ocean inputs

Poleward Undercurrent

(the deep sourcewater for the Salish Sea and coastal zone)

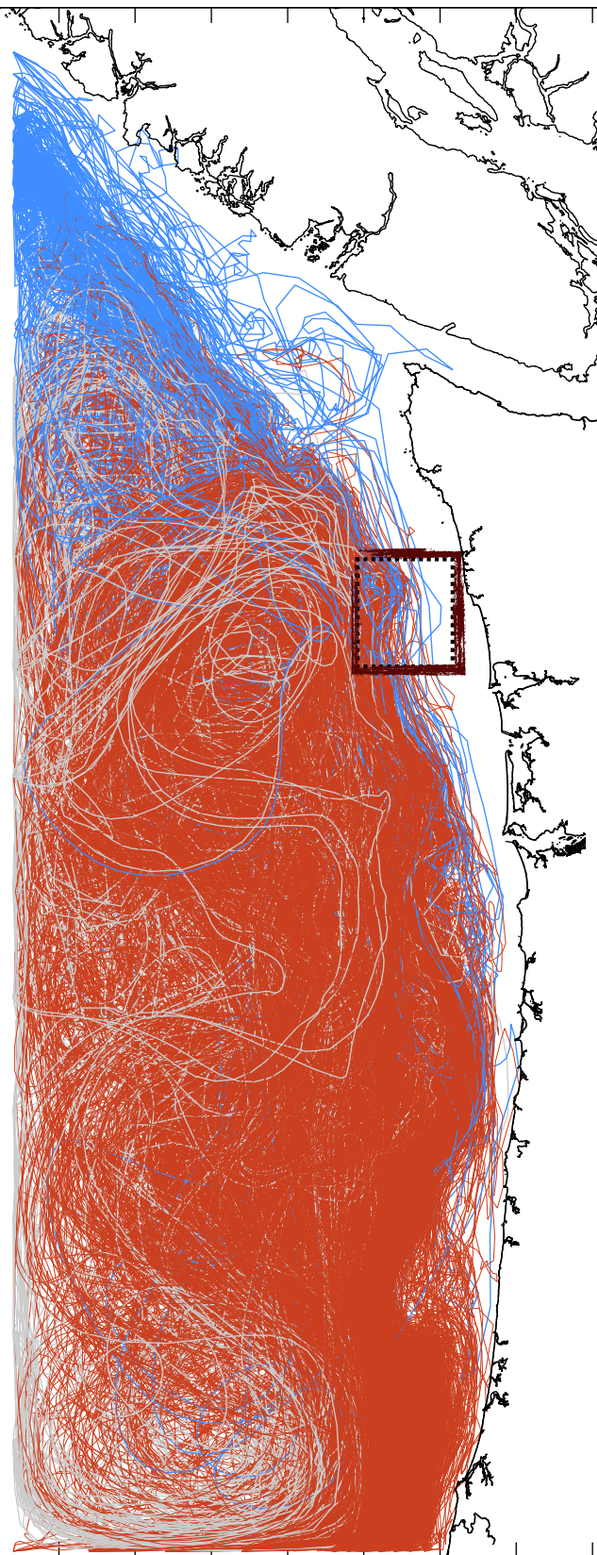
Wind-, river-, and tide-driven circulation all pull water from the Poleward Undercurrent into the Strait of Juan de Fuca: the source of 80–95% of the Salish Sea's nutrients!

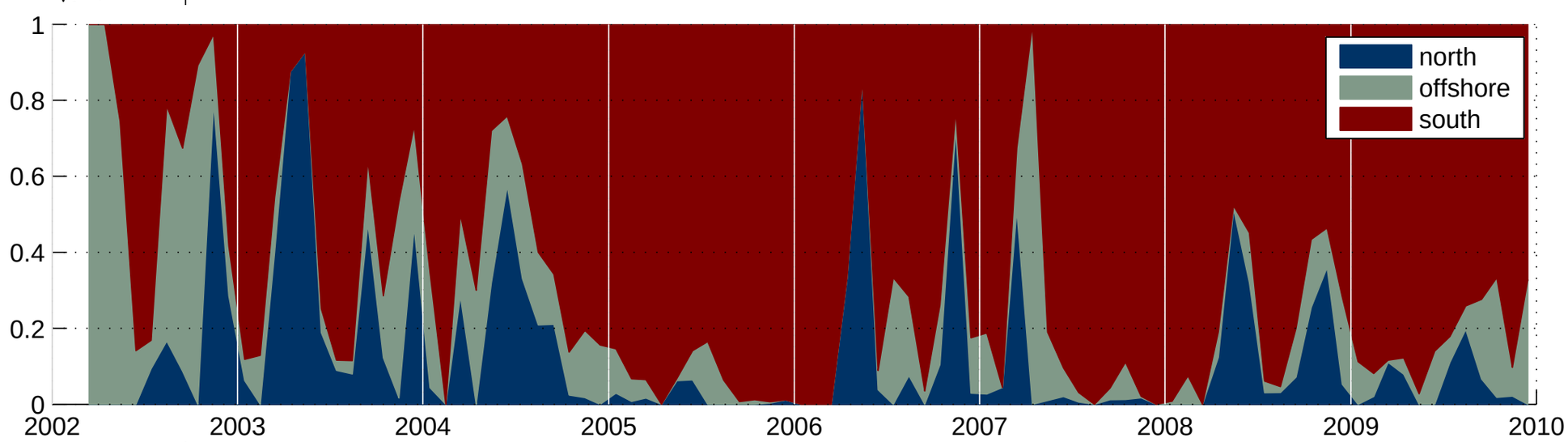
(Mackas and Harrison 1997, Hickey and Banas 2008, Mohamedali et al. 2011)



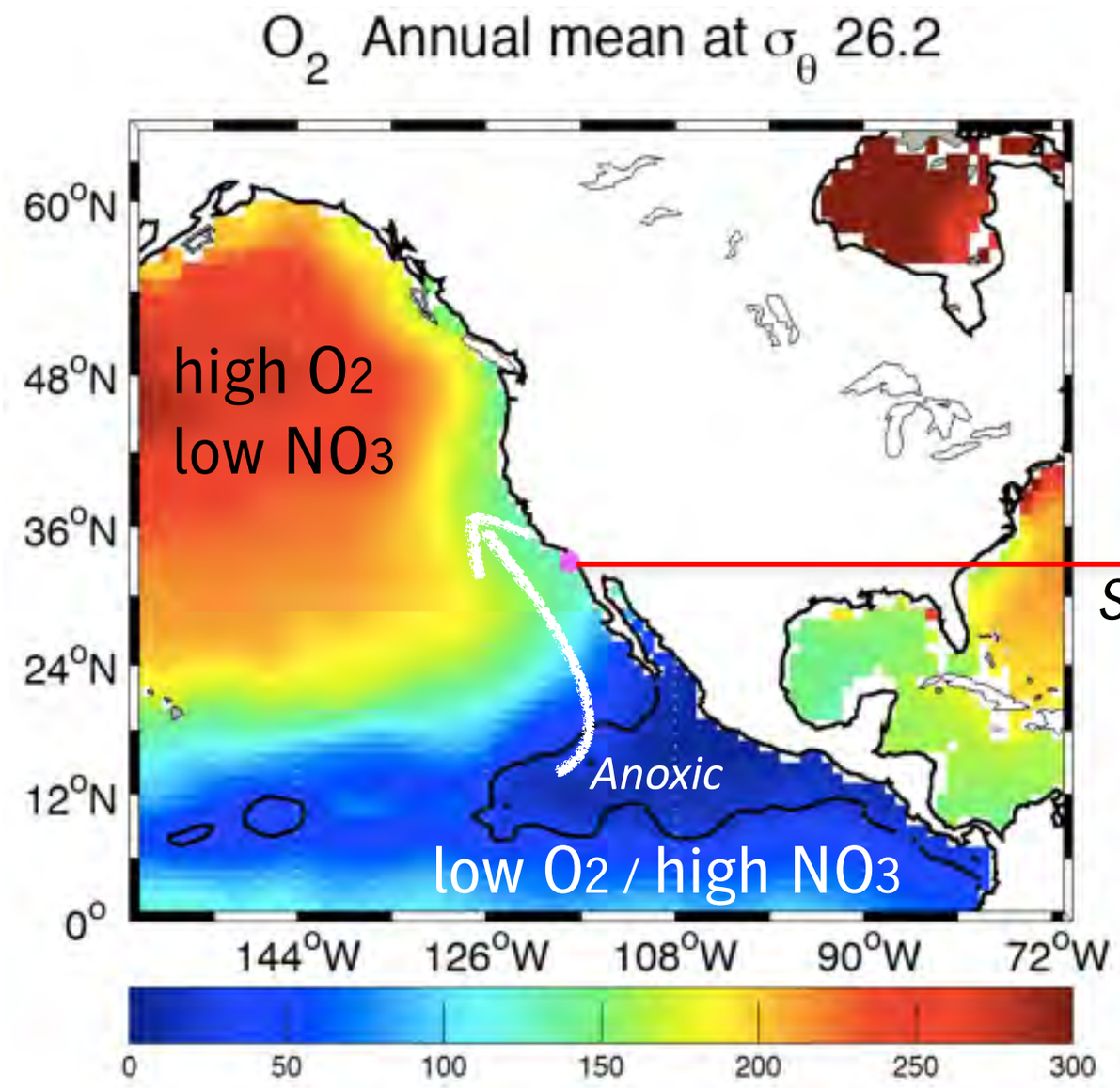
What is the source of our sourcewater?

Modeled particle tracks leading to 200–500 m water depth on the mid-Washington coast, 2002–09

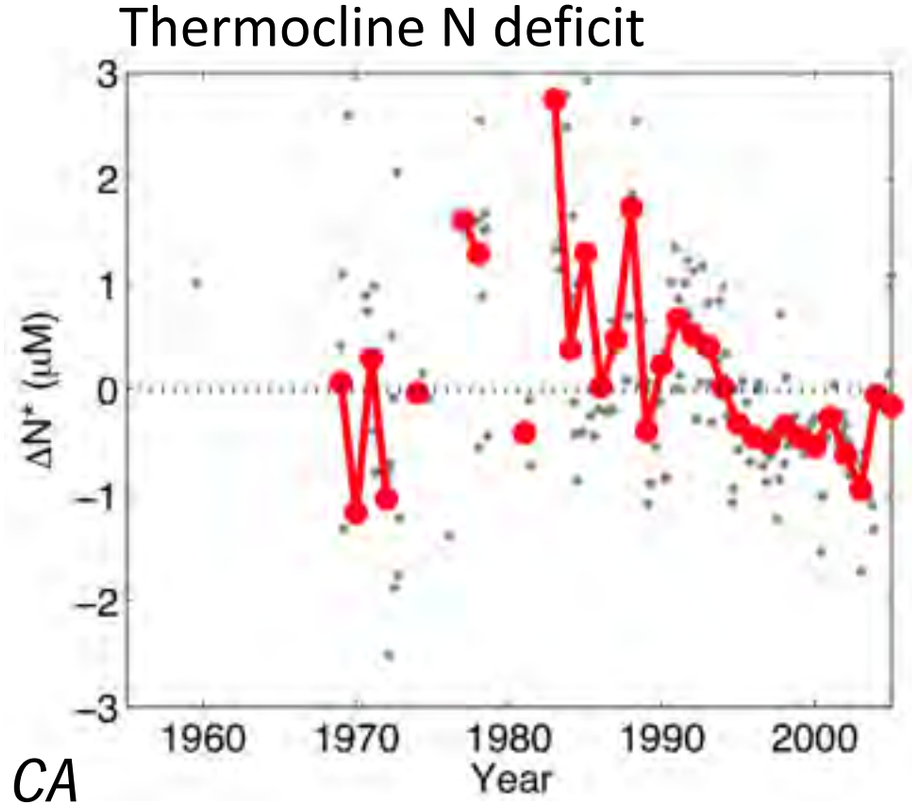


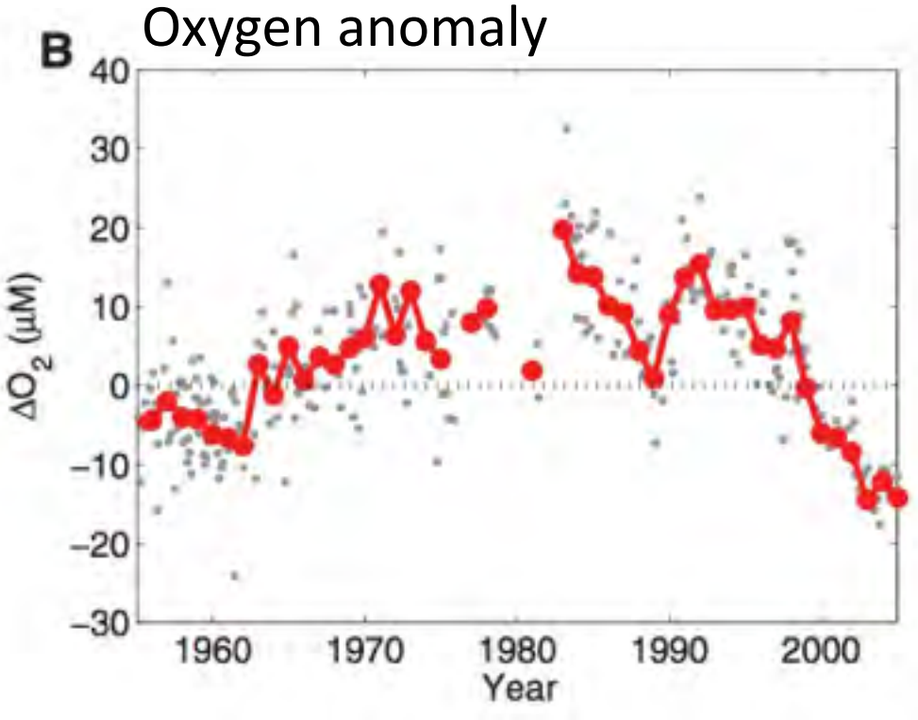


Climate-driven variations in the southern (**equatorial**) source



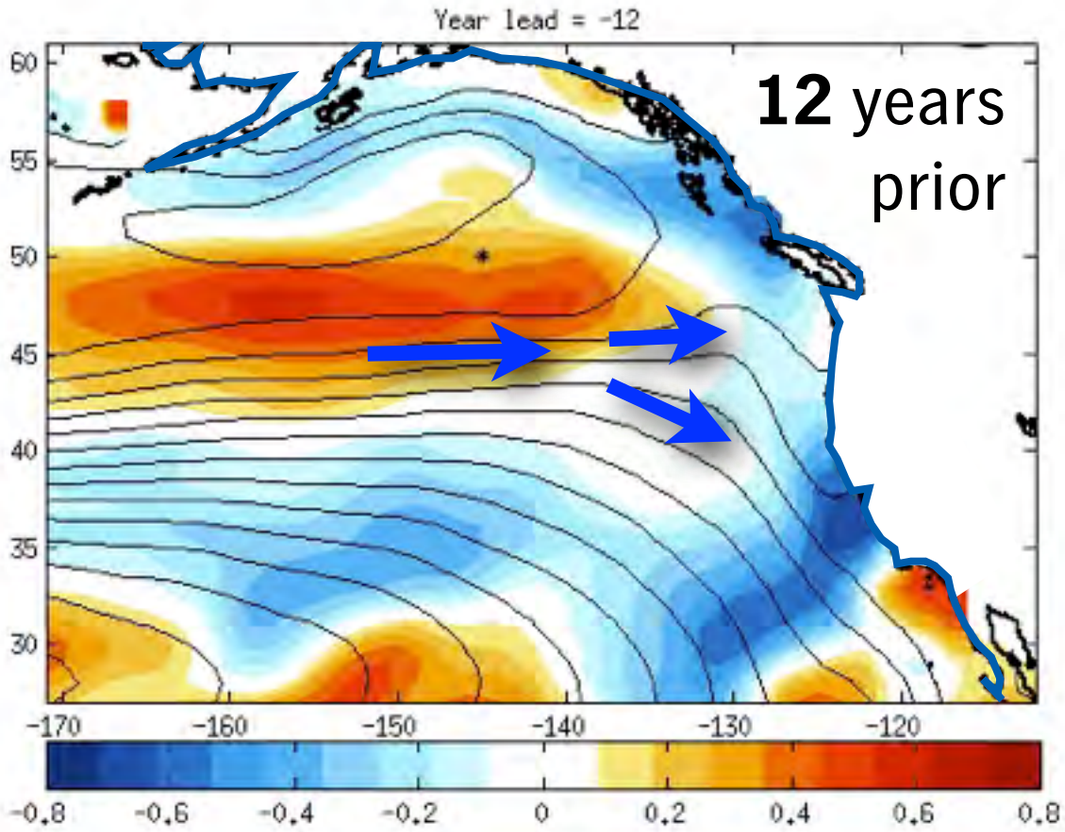
Southern CA

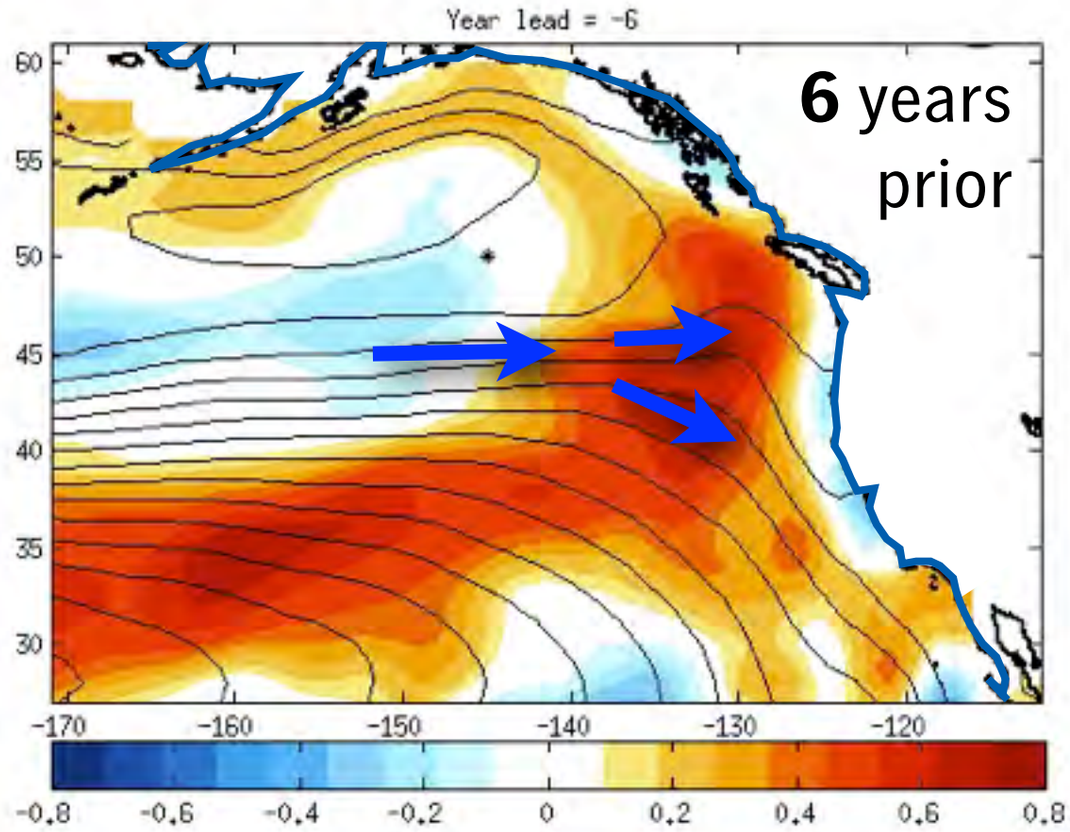


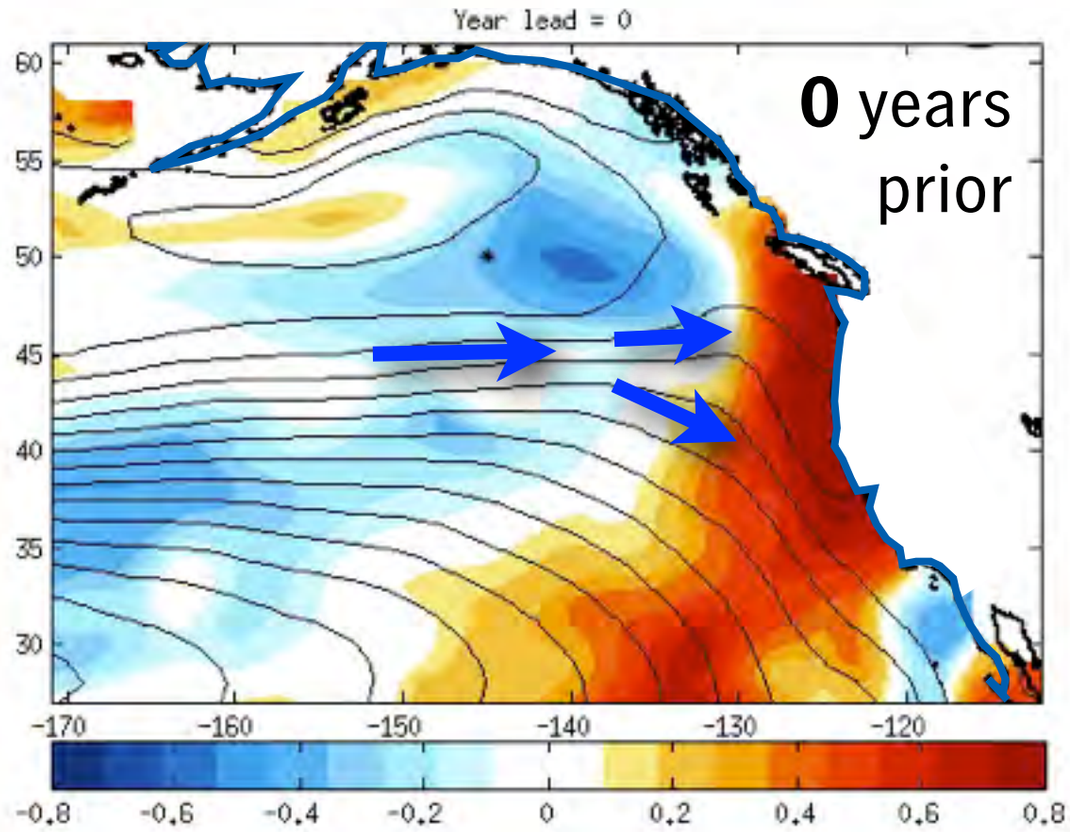


*(**C. Deutsch**, UW: see Deutsch et al.,* Science, *2011)*

Sourcewater chemistry anomalies from the **subarctic** N Pacific







Salinity-based proxy for oxygen anomalies in a multi-decadal hindcast model

*(**E. Di Lorenzo** et al., Georgia Tech)*

Summary part 2

Circulation trends in the **subarctic Pacific**,
biogeochemical trends in the **tropical Pacific**,
and a variety of processes in the **local upwelling zone**
are all likely to be important determinants of Salish Sea sourcewater chemistry.

Uncertainty in these trends is large—except for ocean acidification.

Some of the uncertainty will be unresolvable until/unless global projections come into agreement. Some of it is simply a matter of research effort and cross-scale coordination.