A compilation of essential ocean variables for British Columbia based on nine decades of observations from disparate databases: biogeochemical regionalization, variability and trends.

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thanks to Hayley Dosser and Patrick Pata
data-driven biogeochemical regionalization

- complementary to conventional methods

- dynamic regions
  - seasonal variability
  - deoxygenation
  - marine heatwaves
  - oscillations (ONI, PDO, NPGO)
  - long-term trends
  - climate change
motivation

schematic: P. Pata | icons: I. Perry & molview.org
significance

- ecosystem-based protection
- fisheries management
- habitat range shifts
- food webs
- climate variability
- climate change

icons: from previous slides/referenced sources, Yale Environment 360/L. Riviera, NOAA
data-driven biogeochemical regionalization

- ship-based CTD
  - salinity
  - temperature
  - depth (sample and bathymetry)
  - density
  - oxygen
  - date, latitude, longitude
- bottle
  - nutrient
  - chlorophyll

Rubidge et al. (2016)
data sources

Fisheries and Oceans Canada
WaterProperties.ca
CTD 1960s-present
in coordination with CIOOS efforts

NOAA
World Ocean Database
CTD 1960s-present
bottle 1930s-present

Hakai Institute
CTD 2012-present

The following slides are early examples of my approach using this data, for PICES 2019.
data for regionalization

- bulk monthly mean

- 0.1° latitude longitude

- within density ($\sigma_0$) layers
  - 20-21, near-surface inlets and Strait of Georgia
  - 23-24, < ~500 m full system (denoted as “23s”)
  - 26-27, > 0 m ocean-deep shelf exchanges
RIVERS

monthly variability

July*

temperature

salinity

oxygen

Jul temp. mean (°C)

Jul salinity mean (PSS-78)

Jul oxygen mean (μM)

\[ \sigma_0 = 23s \]
multivariate analysis and clustering

- bathymetry*
- temperature
- salinity
- oxygen

- colored dots represent different regions

*dominant component and excluded for this example
apply clustered “regions” to map...
...biogeochemical regionalization
regional variability and long-term trends

World Ocean Database CTD + bottle
**key regions** for data-driven assessment

- characterize well-sampled regions *(2012-pres)*
- **Quadra Island region**
- **Calvert Island region**
next steps...

- better assess temporal and spatial “bins” to incorporate nutrient data
  - climate change?
  - seasonal variability?
- comprehensive multivariate analysis and clustering → regionalization
- explore on smaller scale (e.g., Hakai dataset)
- essential ocean variables
  - salinity, temperature, depth, density
  - date, location, bathymetry*
  - oxygen, nutrient? chlorophyll?