

High Resolution Biogeochemical Modelling of Canadian Northeast Pacific Water

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Fisheries and Oceans
Canada

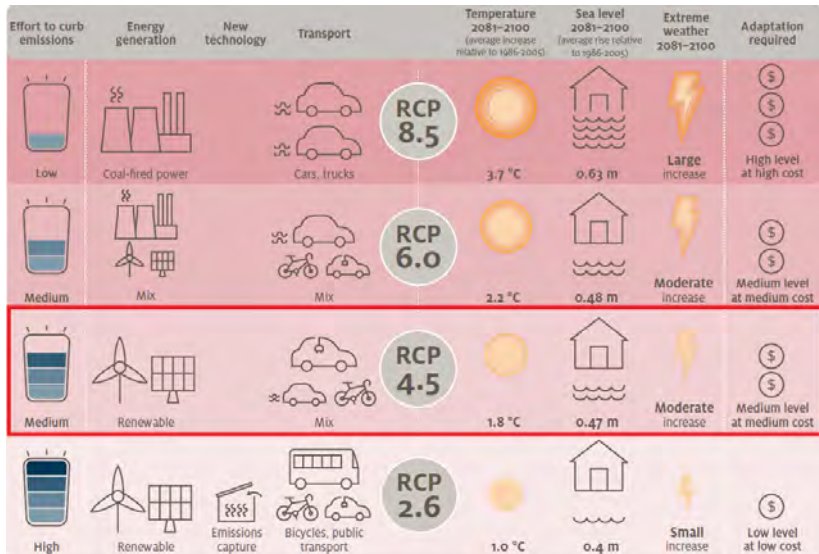
Institute of Ocean Sciences

October 2018

Projecting the Future Climate of the BC coast

- 1 Oxygen is declining (Schmidtke et al. 2017)
- 2 Ocean acidification is increasingly affecting calcifying organisms (Feely et al. 2010)
- 3 **Policy** makers require information to make **decisions**
- 4 **models** can provide **spatial maps**
 - ↪ of changes in the concentration of oxygen, and other nutrients
 - ↪ ocean acidification

Representative Concentration Pathways

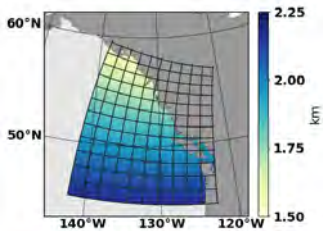


credit: www.coastadapt.com.au

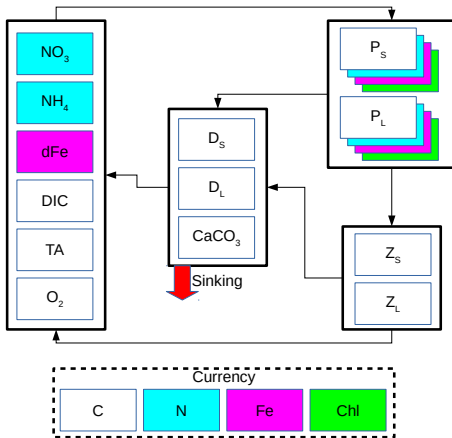
Modelling with NEMO v3.6

North-Eastern Pacific (NEP) configuration

Canadian Ocean Ecosystem Model



- 1/36° latitude and longitude
- 50 vertical levels



Model Forcing Data: Downscaling RCP 4.5

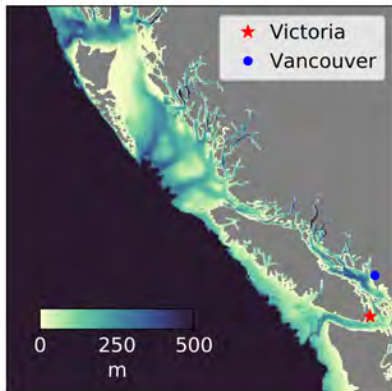
Canadian Regional Climate Model (CanRCM4)

- **Contemporary** (1986 – 2005) and **Future** (2046 – 2065) fields for wind stress, long-wave radiation, humidity, air temperature and precipitation
- Observed short wave radiation (Bishop et al. 1997)

Initialization and Boundary Data

- World Ocean Atlas (WOA) and GLObal Ocean Data Analysis Project for Carbon (GLODAP) **Observations**
- RCP 4.5 **anomalies** from Canadian Earth System Model (CANESM2)

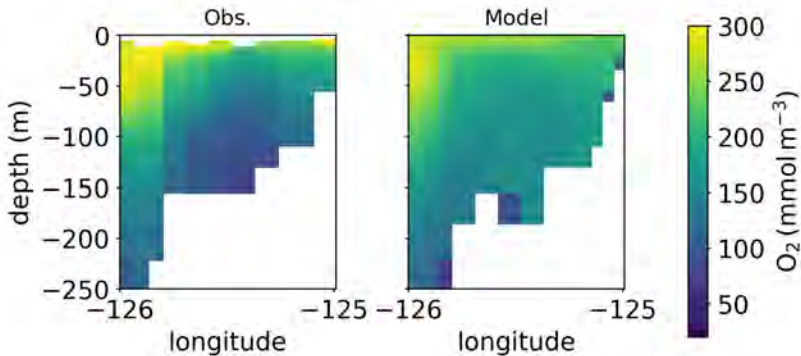
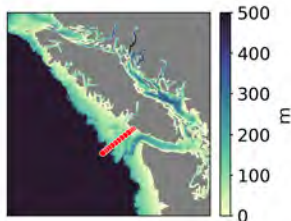
Canadian Pacific Coast



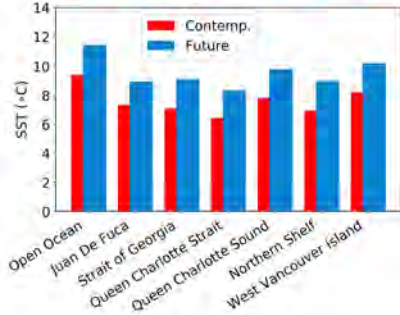
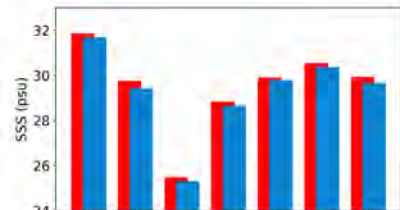
- Open ocean
- Juan De Fuca
- Strait of Georgia
- Queen Charlotte Strait
- Queen Charlotte Sound
- Northern Shelf
- Southern Shelf
- Puget Sound
- West Vancouver Island

Model Validation: In Progress

Summer Oxygen on Line B



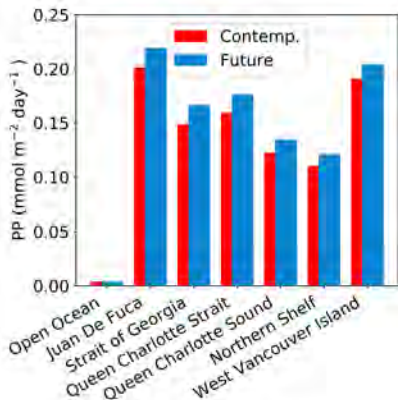
Regional Analysis



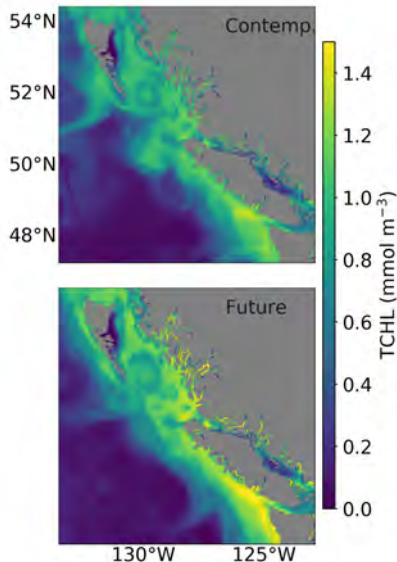
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Ocean Productivity

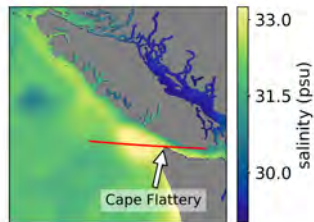
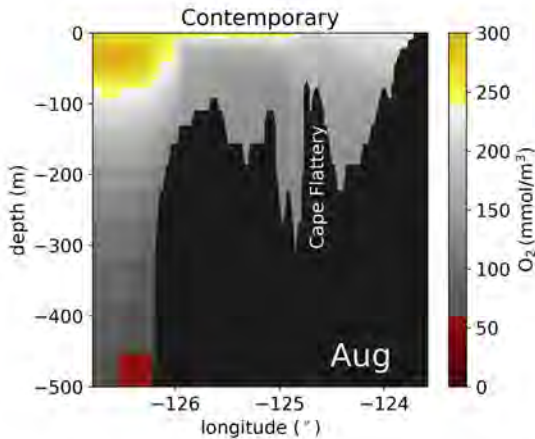
Primary Production



Summer

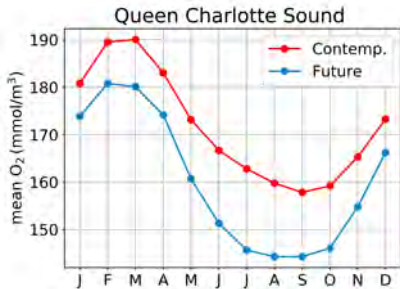
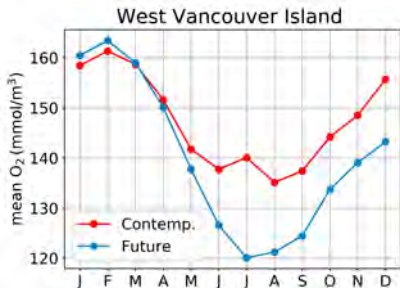


Coastal Upwelling



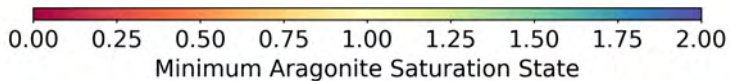
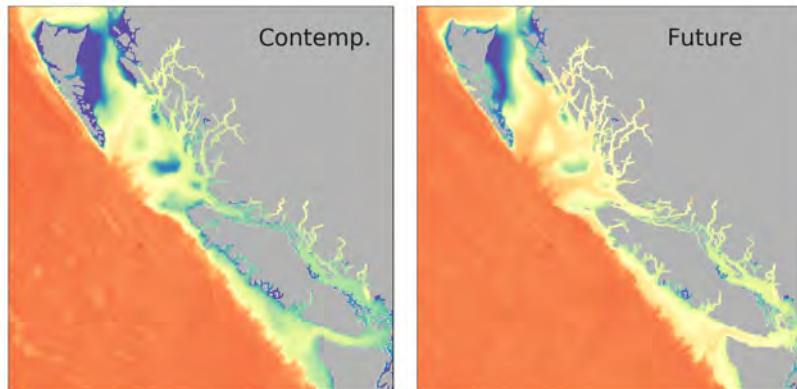
August : $z = 35m$

O₂ below 100m for Source Regions

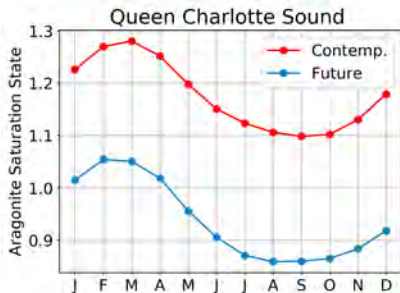
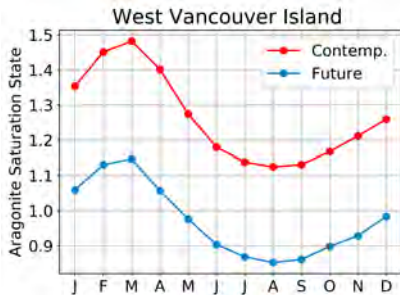


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Aragonite Saturation State: August

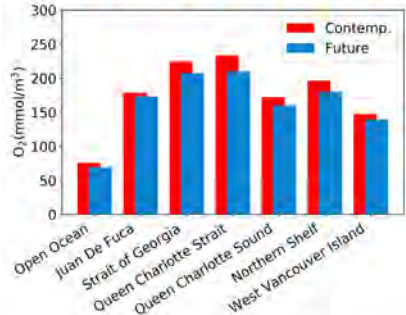
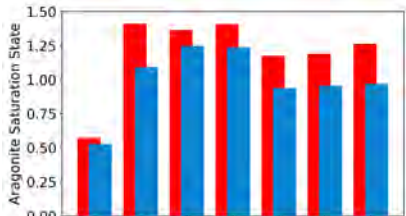


mean below 100m for Source Regions



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Projecting the Future (\approx 2055)

Canada's North Pacific Coastal Waters

- becoming **fresher** and **warmer**
- an overall **increase** in **primary productivity**
- substantially lower O_2
- increasing corrosion (**acidification**)

Marine Organisms Matter



Future directions depend on available resources

- ❶ cold bias
 - ↪ adjust the atmospheric forcing and rerun the model
 - ↪ **Or** apply a correction to existing data
- ❷ generate maps for RCP 8.5 (business as usual)
- ❸ perform a **hindcast** using realistic atmospheric forcing (HRGDS) and bathymetry
- ❹ short term **predictions!**