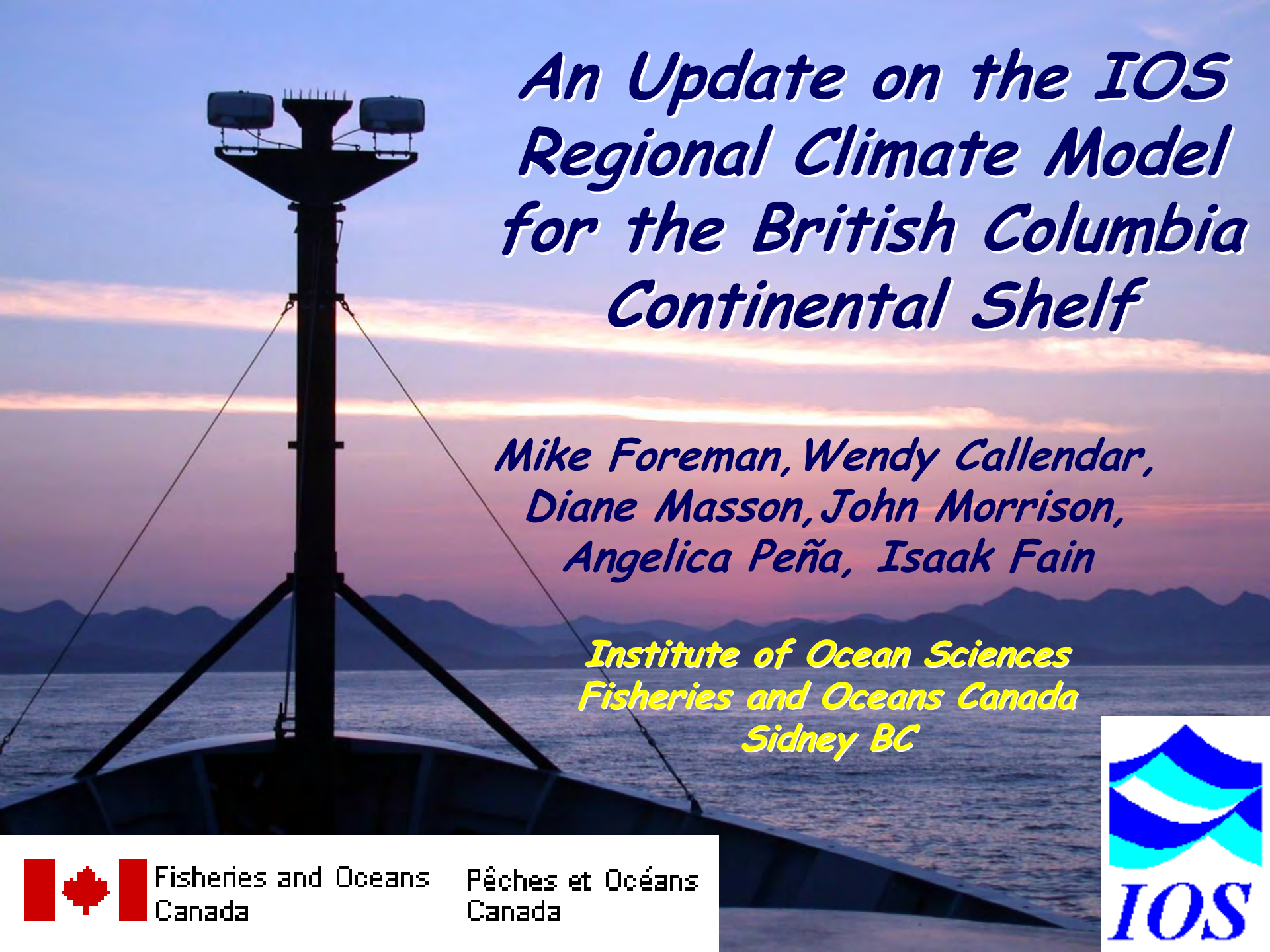

An Update on the IOS Regional Climate Model for the British Columbia Continental Shelf

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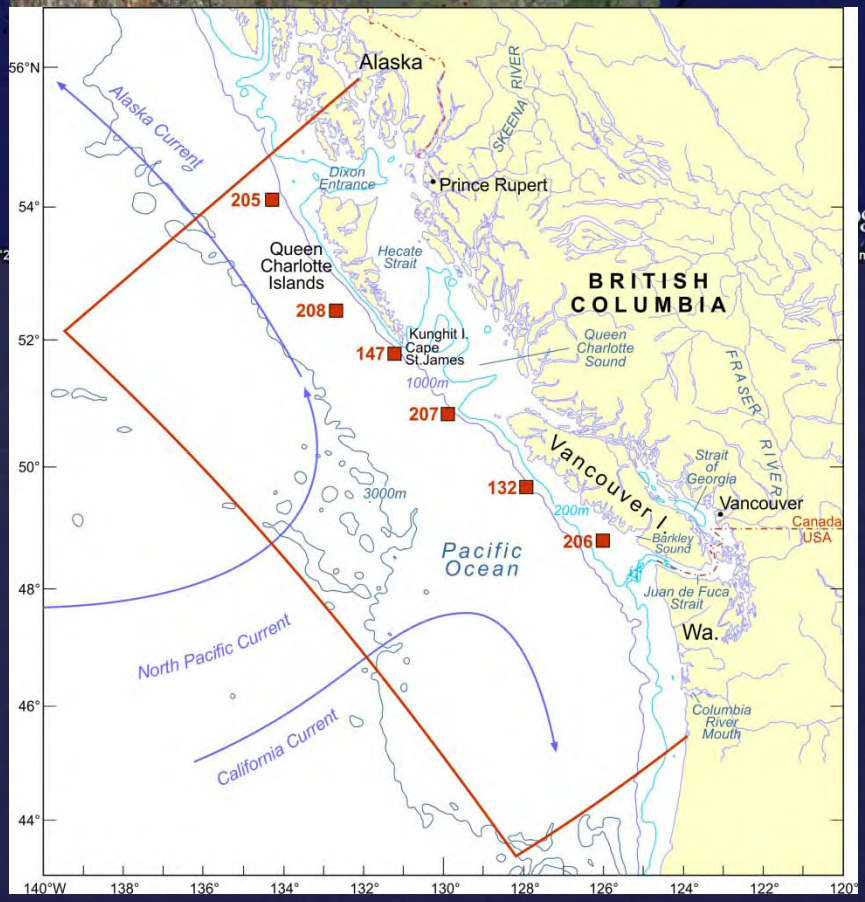
IOS

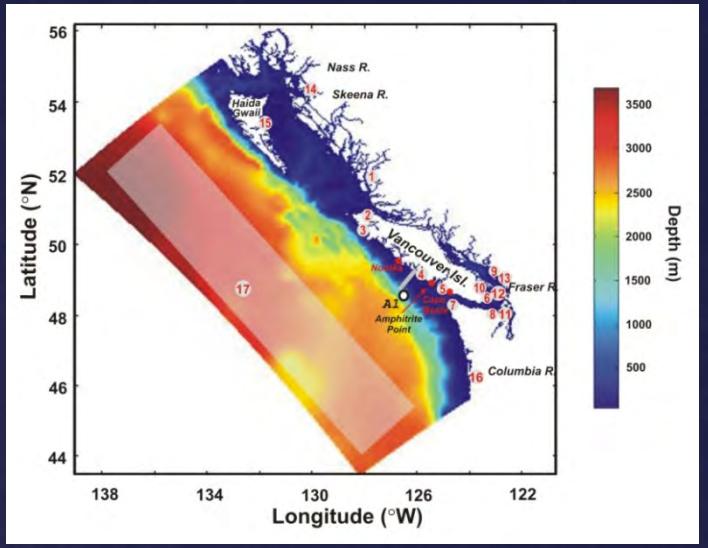
Outline

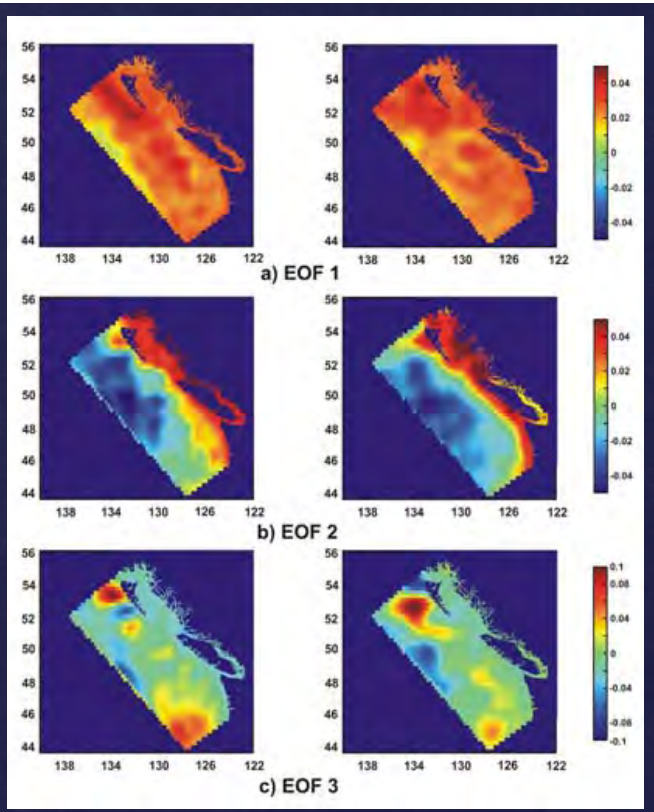
- model details
- strategy & forcing fields
- preliminary results
- summary & future work



BC Shelf Model

- Developed by Diane Masson & Isaac Fine
- Regional Ocean Modeling System (ROMS) with resolution
  - Horizontal: 3km (236 X 410),
  - Vertical: 30 sigma levels
- Forcing:
  - tides
  - 3 hourly wind and daily atmospheric forcing (NARR)
  - monthly discharge from 21 main rivers
  - monthly open boundary forcing (SODA)
- Hindcast:
  - 1995-2008
  - JGR, in press

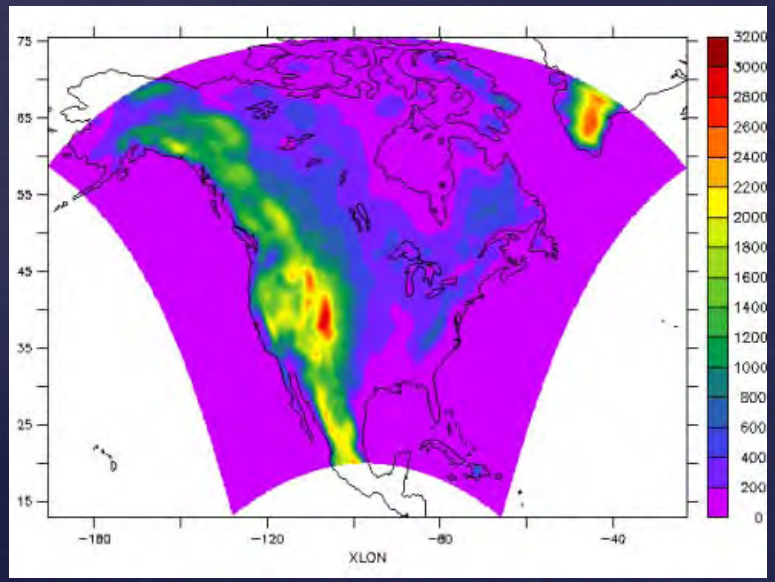




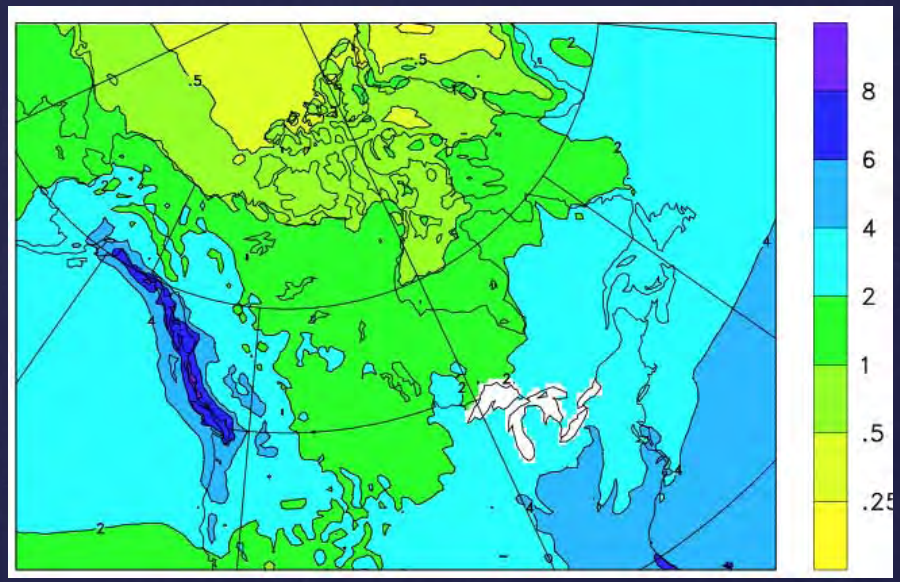
ROMS & AVISO SSH EOFs

Strategy for Future Climate Simulations

- Add anomalies to the Masson & Fine forcing & initial fields
  - Wind & heat flux from NARCCAP , IPCC AR4, A2 scenario
    - http://www.narccap.ucar.edu
    - 2041-2070 minus 1971-2000
    - So far only CRCM+ CGCM3 combination
  - Oceanic initial conditions & boundary forcing from CGCM3
  - Freshwater runoff from Morrison et al. (2011) hydrology model that uses NARCCAP precipitation & temperature
- Future 14-year run



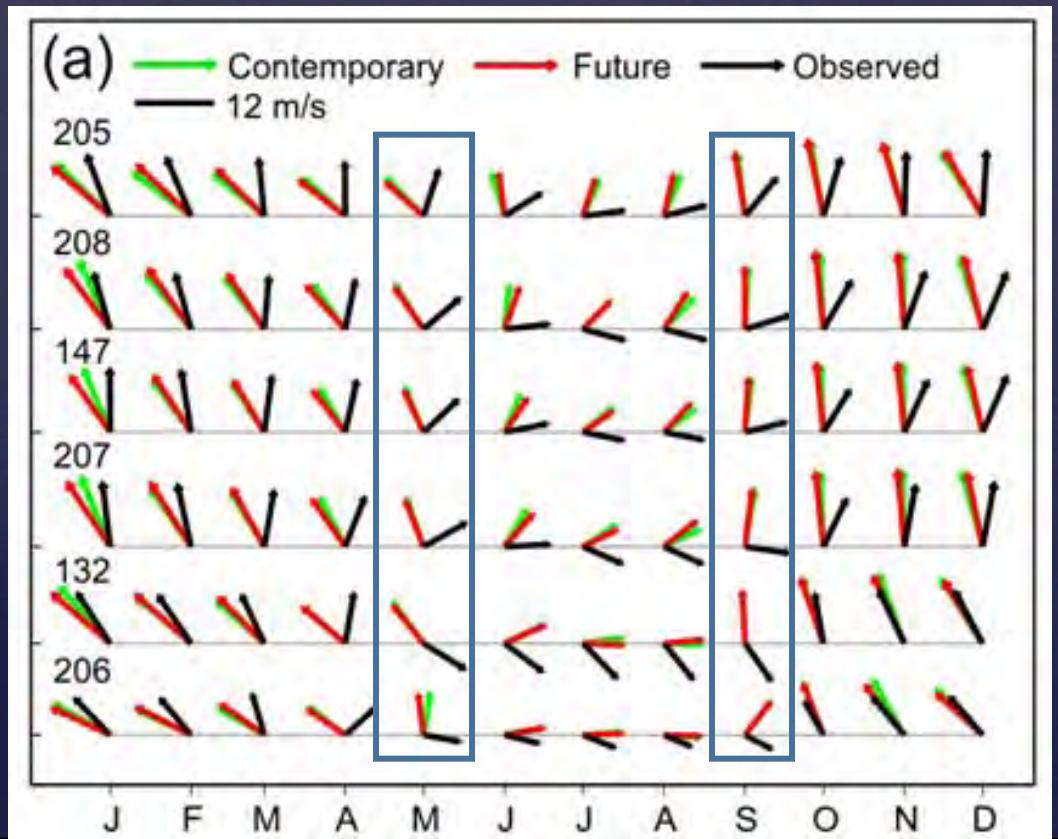
NARCCAP Model domain & orography

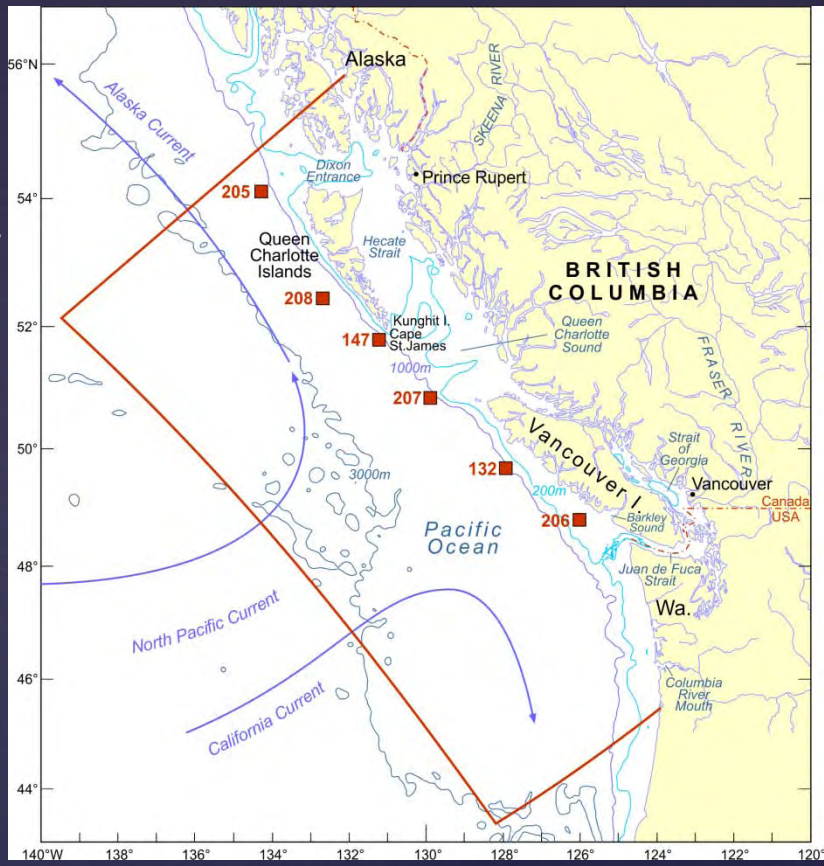


CRCM mean (1971-90) daily precipitation (mm)

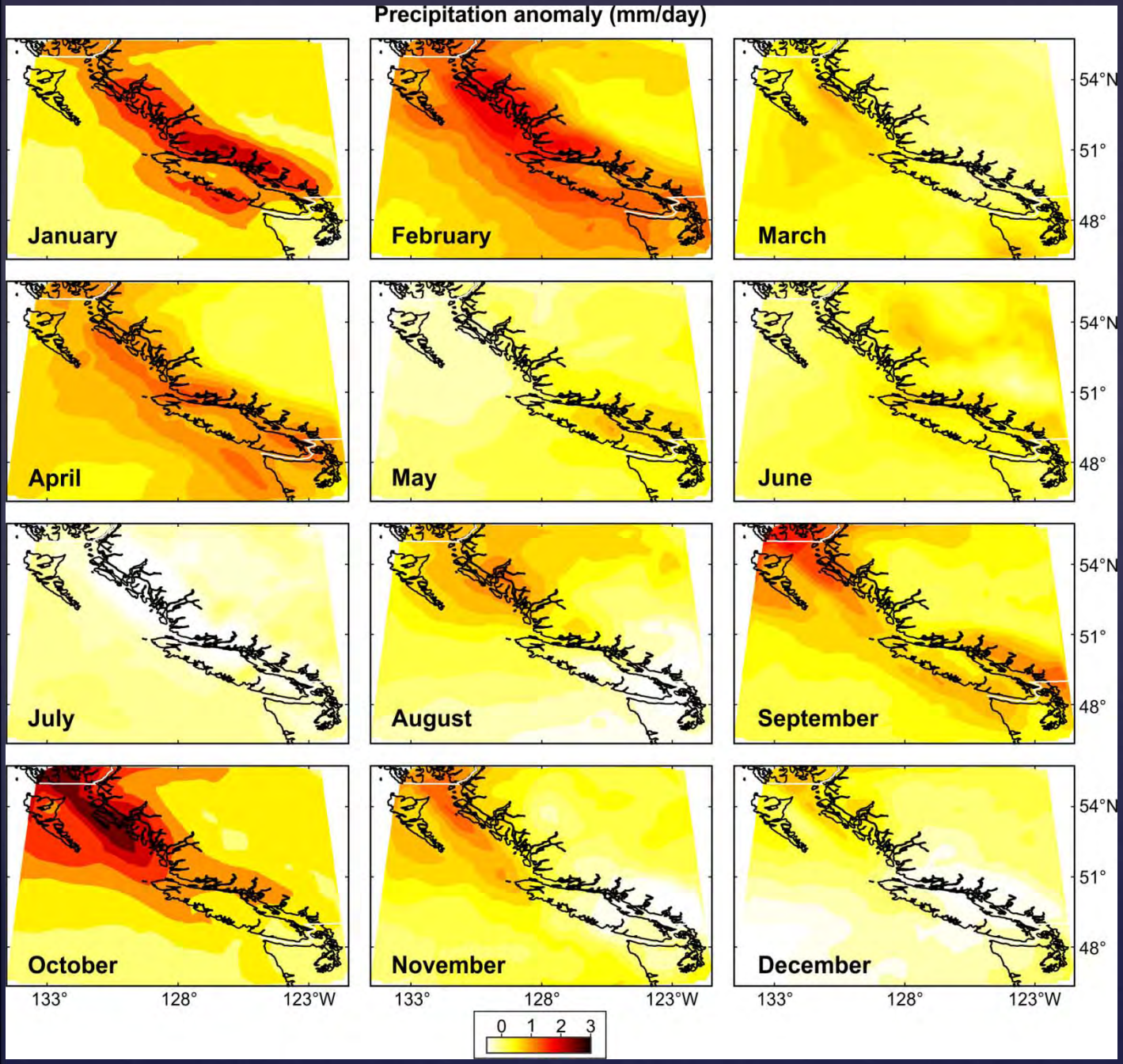
Why Anomalies?

- CRCM/CGCM3 doesn't capture 1971-2000 offshore winds accurately
  - May/Sept differences between observed (black) & CRCM (green) monthly average winds
  - Timing of spring/fall transitions critical for marine ecosystems



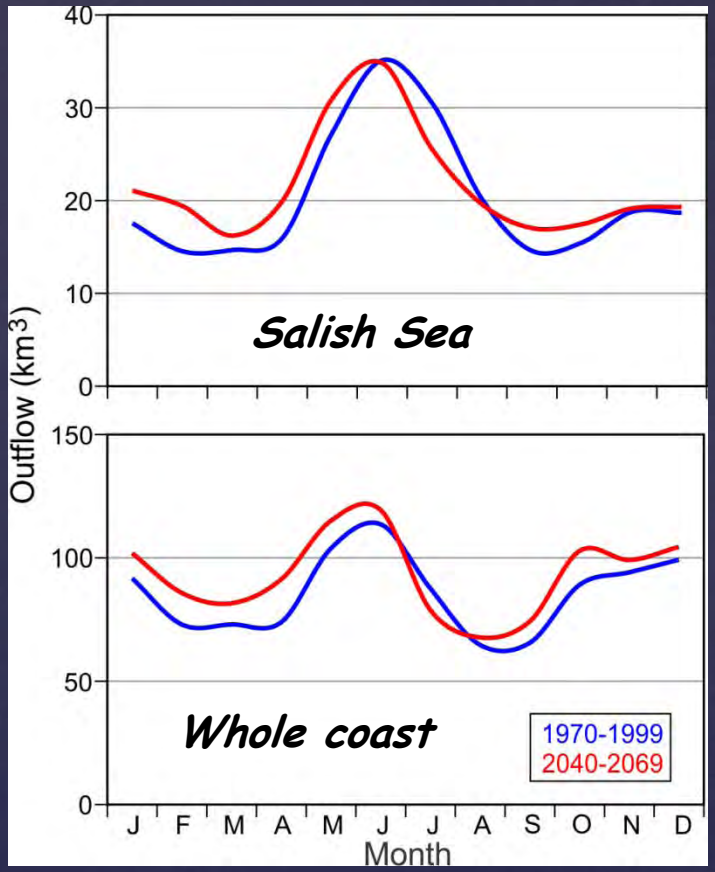


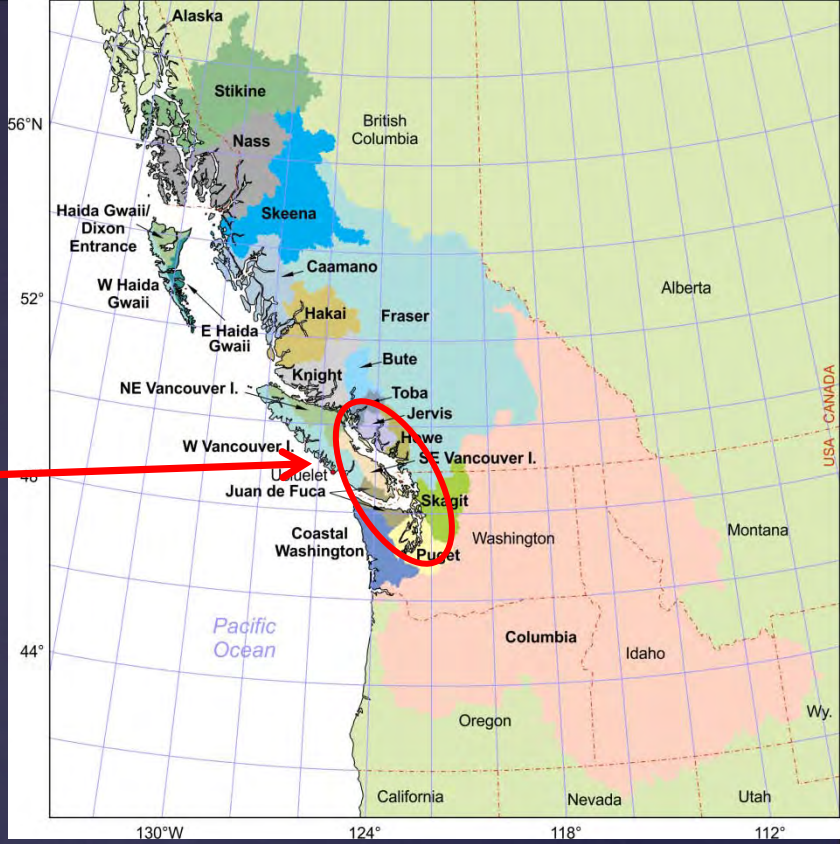
Atmospheric Forcing

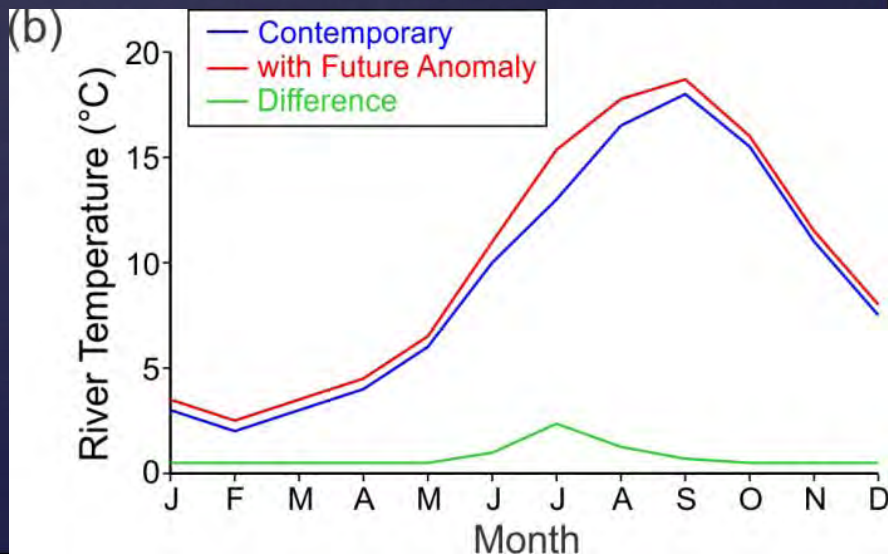


- Average annual anomaly ~ +0.5mm/day
- Seasonal & regional variations

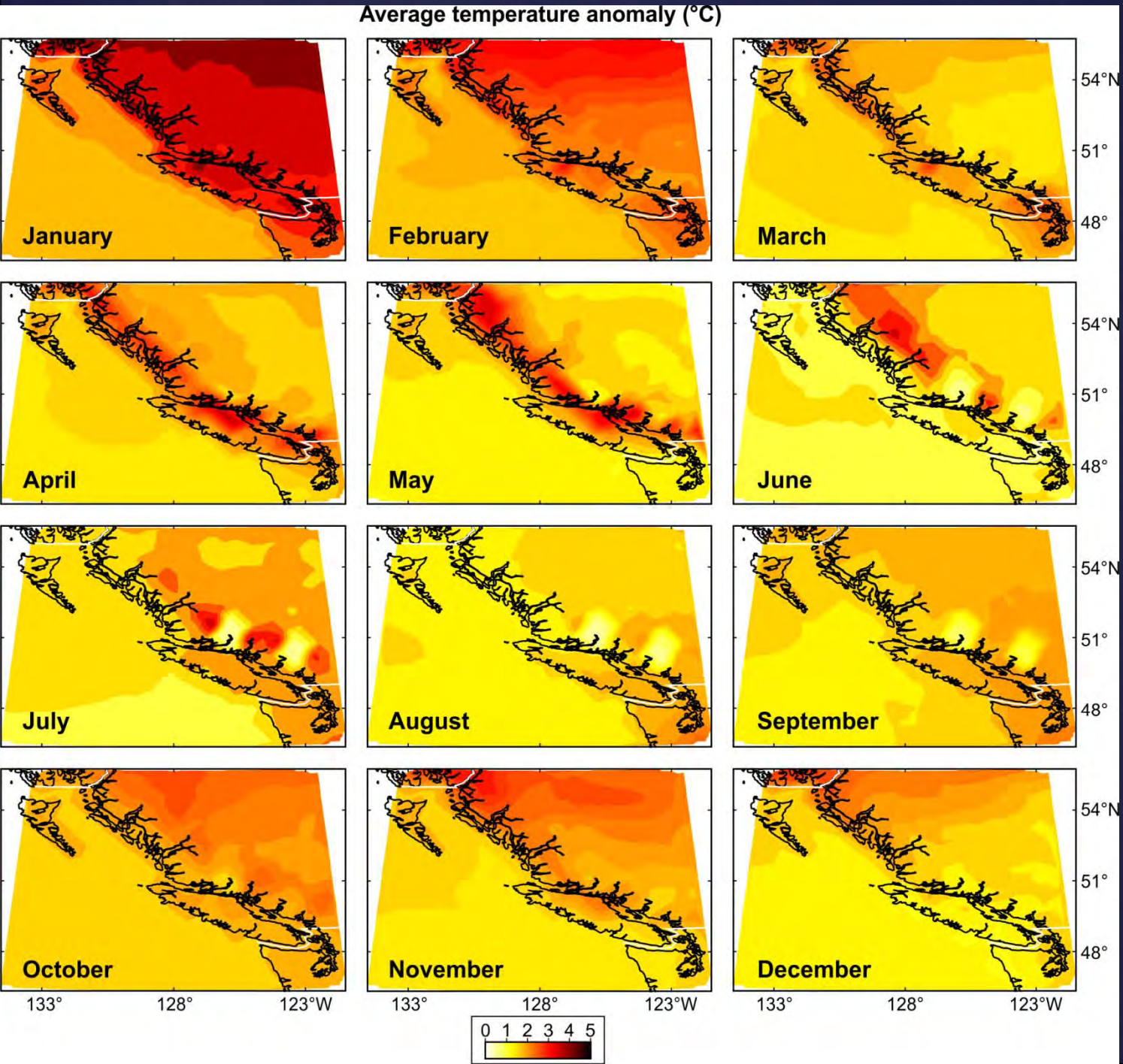
Contemporary & Future Freshwater Discharges





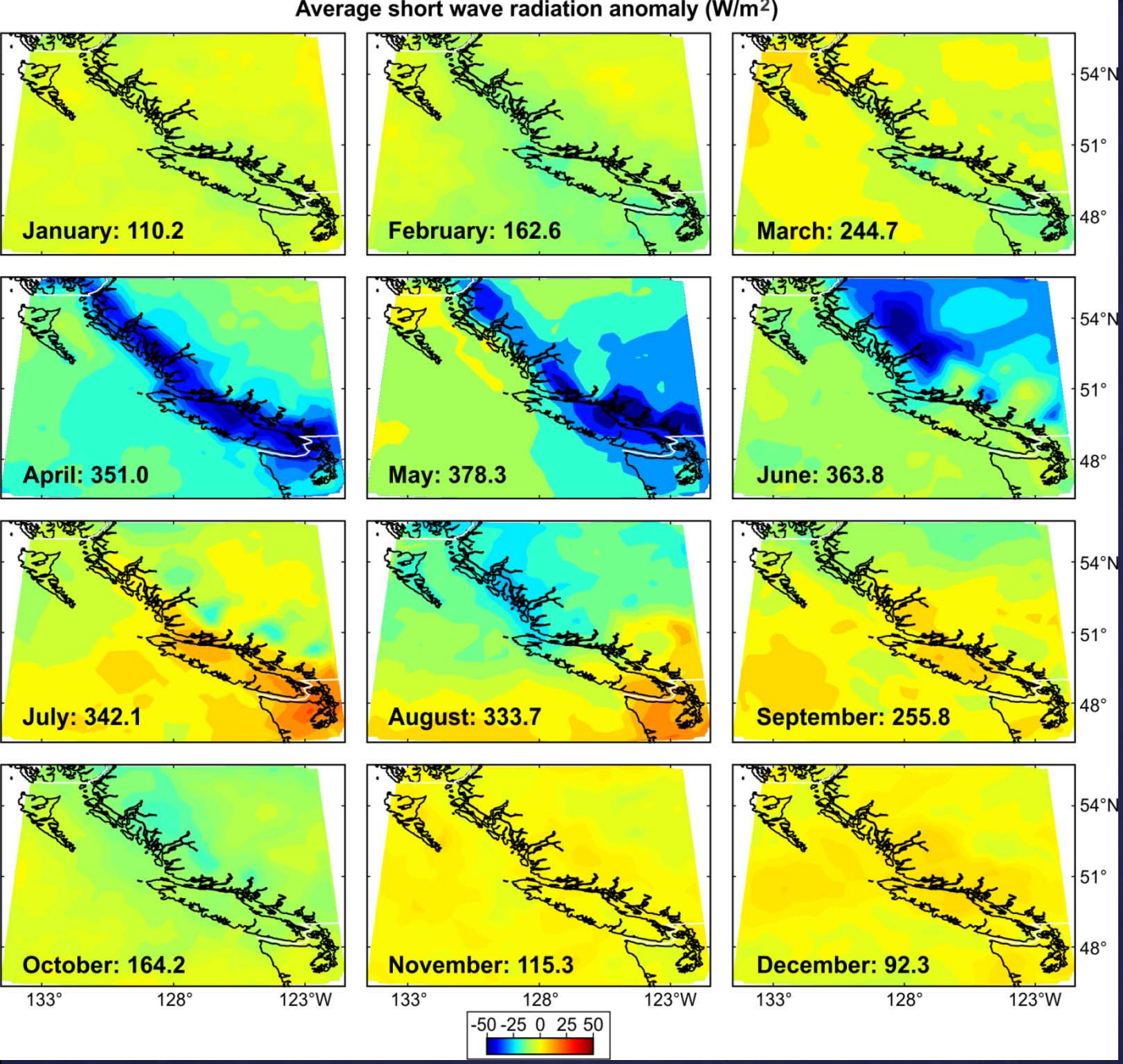


- 21 sub-basins
- Except for June-August, more discharge
- Warmer river temperatures

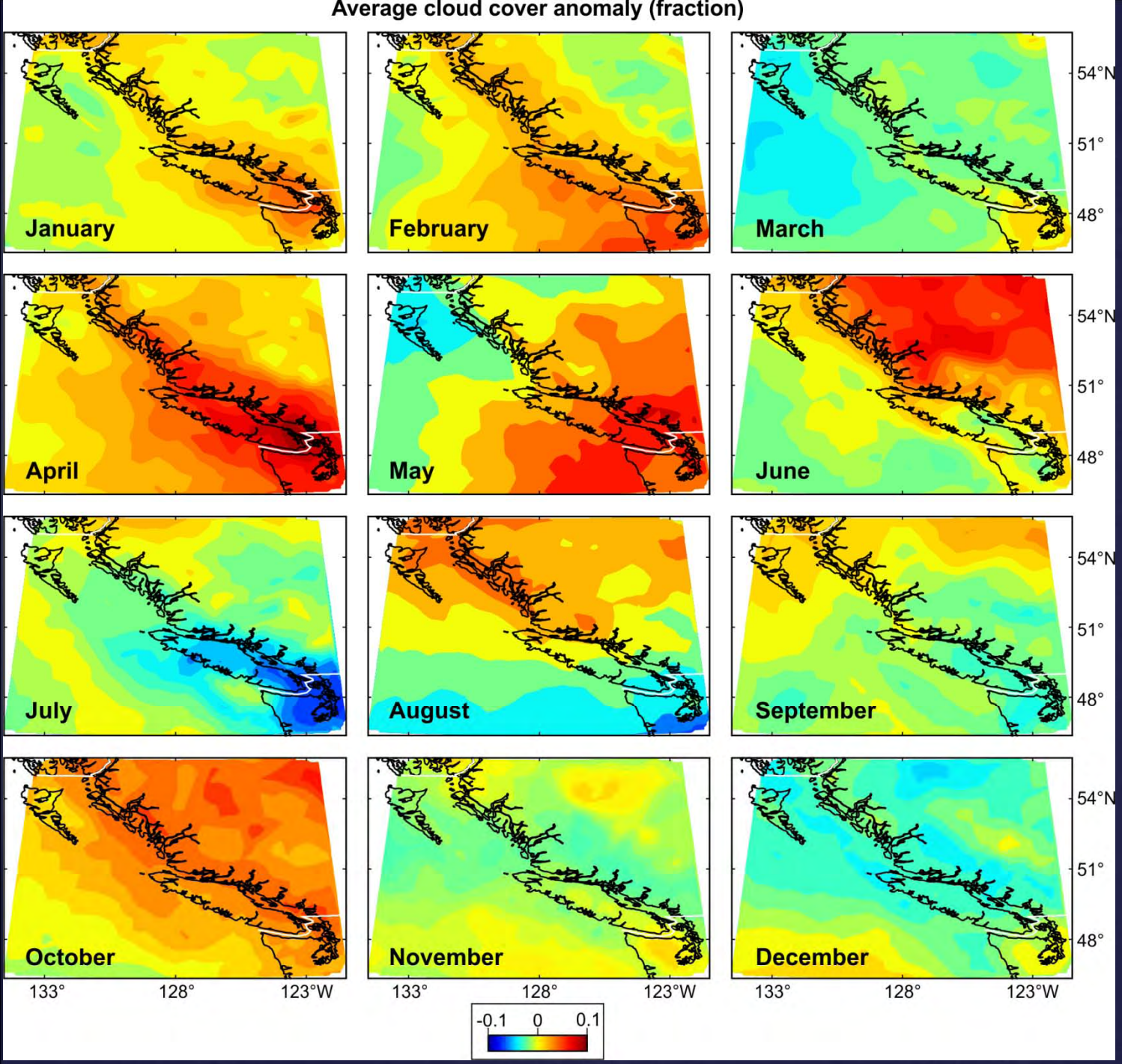


Atmospheric Forcing

- Slightly different patterns for day and night
- Note land/sea differences



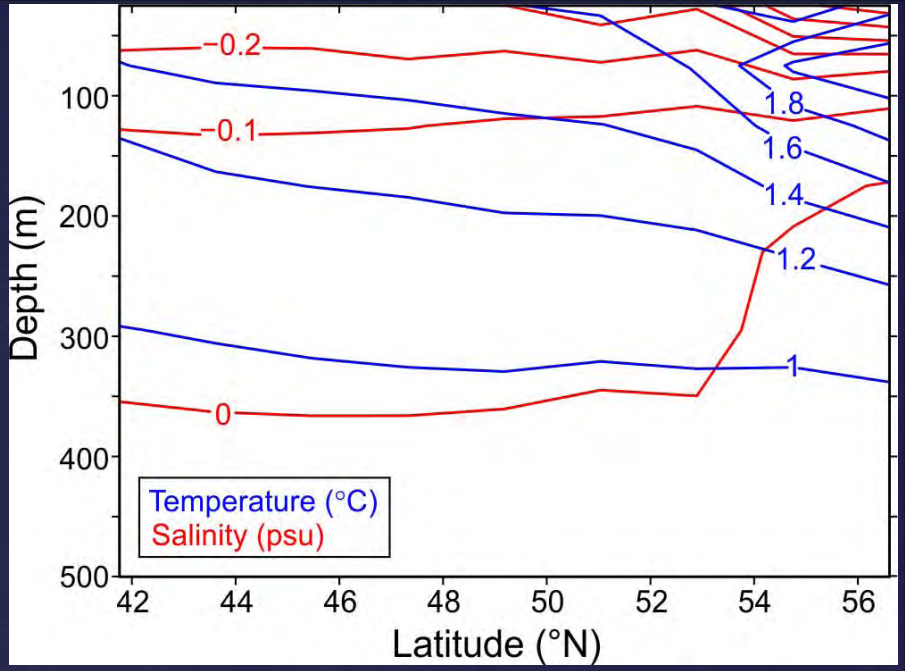
- *Less in April – June (%) because more cloud cover*
  - *Could be important for marine photo-synthesis*



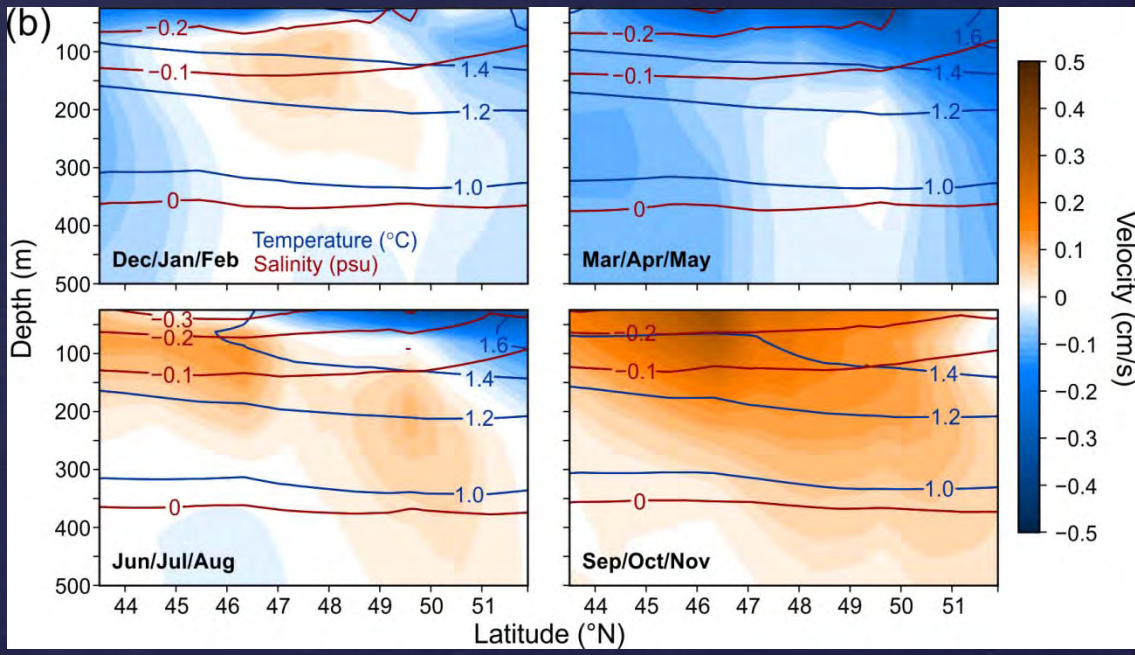
NB: Slightly different patterns for day vs night

Initial and Lateral Boundary Ocean Conditions

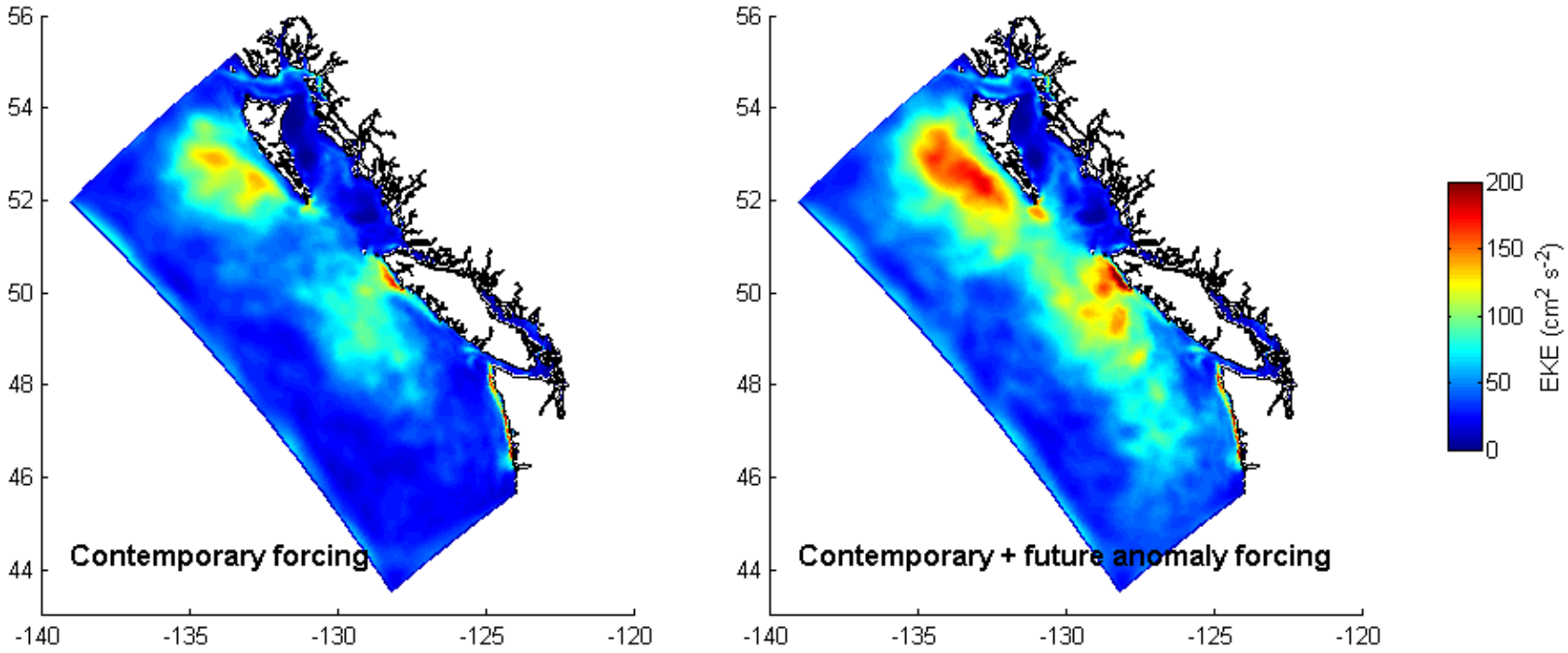
- 3D temperature/salinity initial anomalies from CGCM3
  - no active ocean in CRCM
  - Only latitudinal anomalies
  - future will be warmer and fresher



- Seasonal anomalies in temperature, salinity, normal velocity forcing along northern, western, southern boundaries



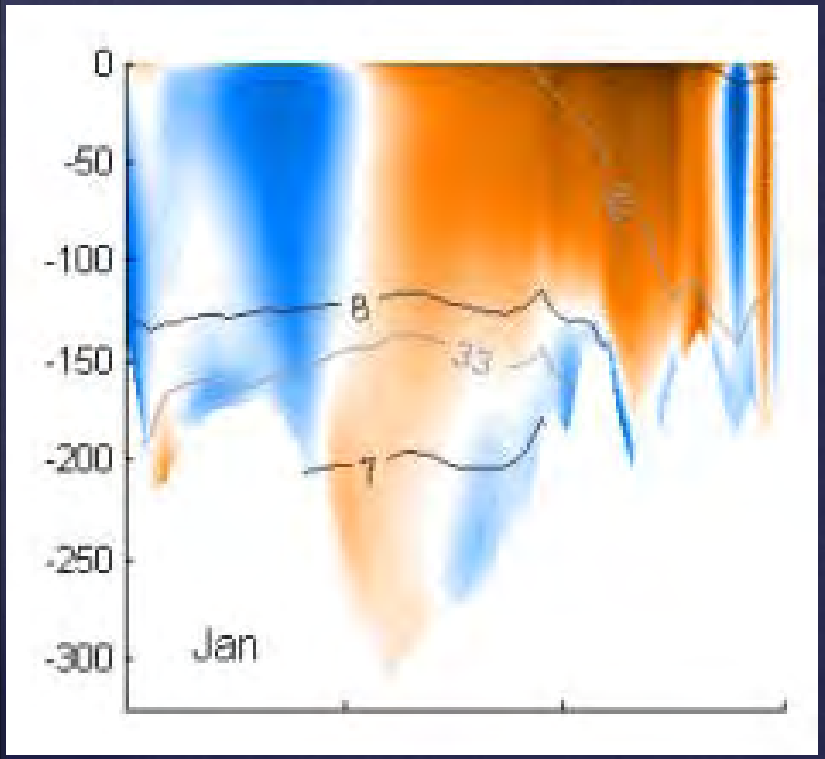
Results: Eddy Kinetic Energy



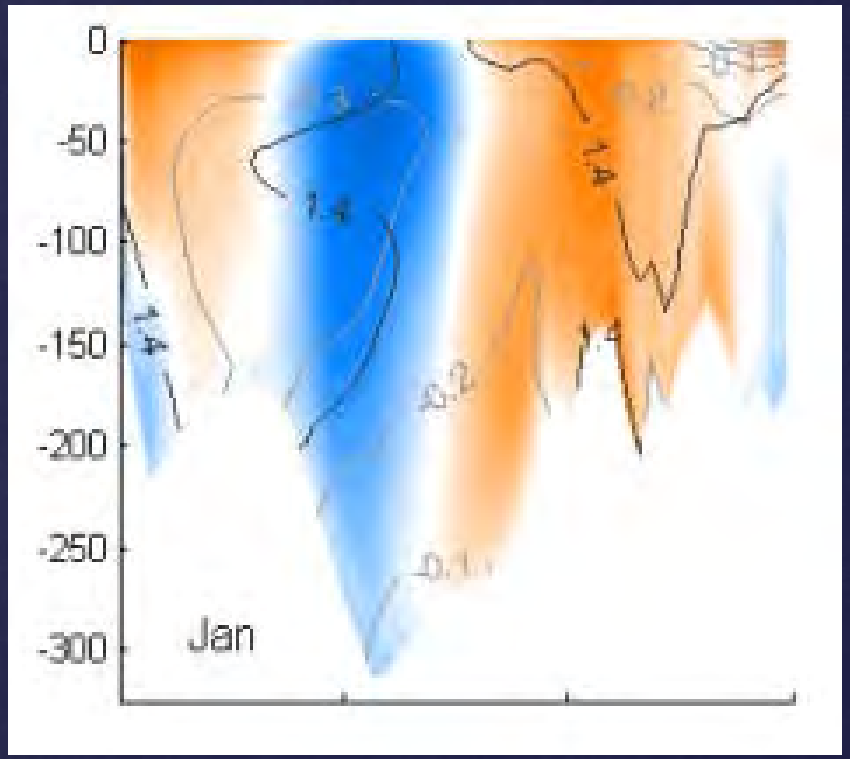
- Runs with different combinations of contemporary & future forcing show these differences mainly arise from wind

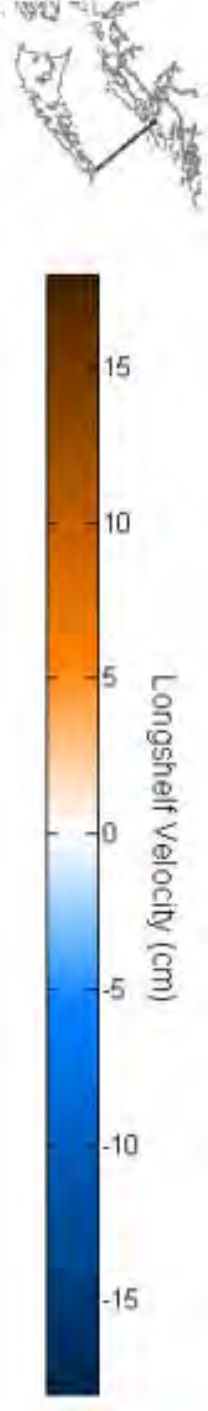
Hecate Current Intensification Producing stronger Haida Eddies

Contemporary



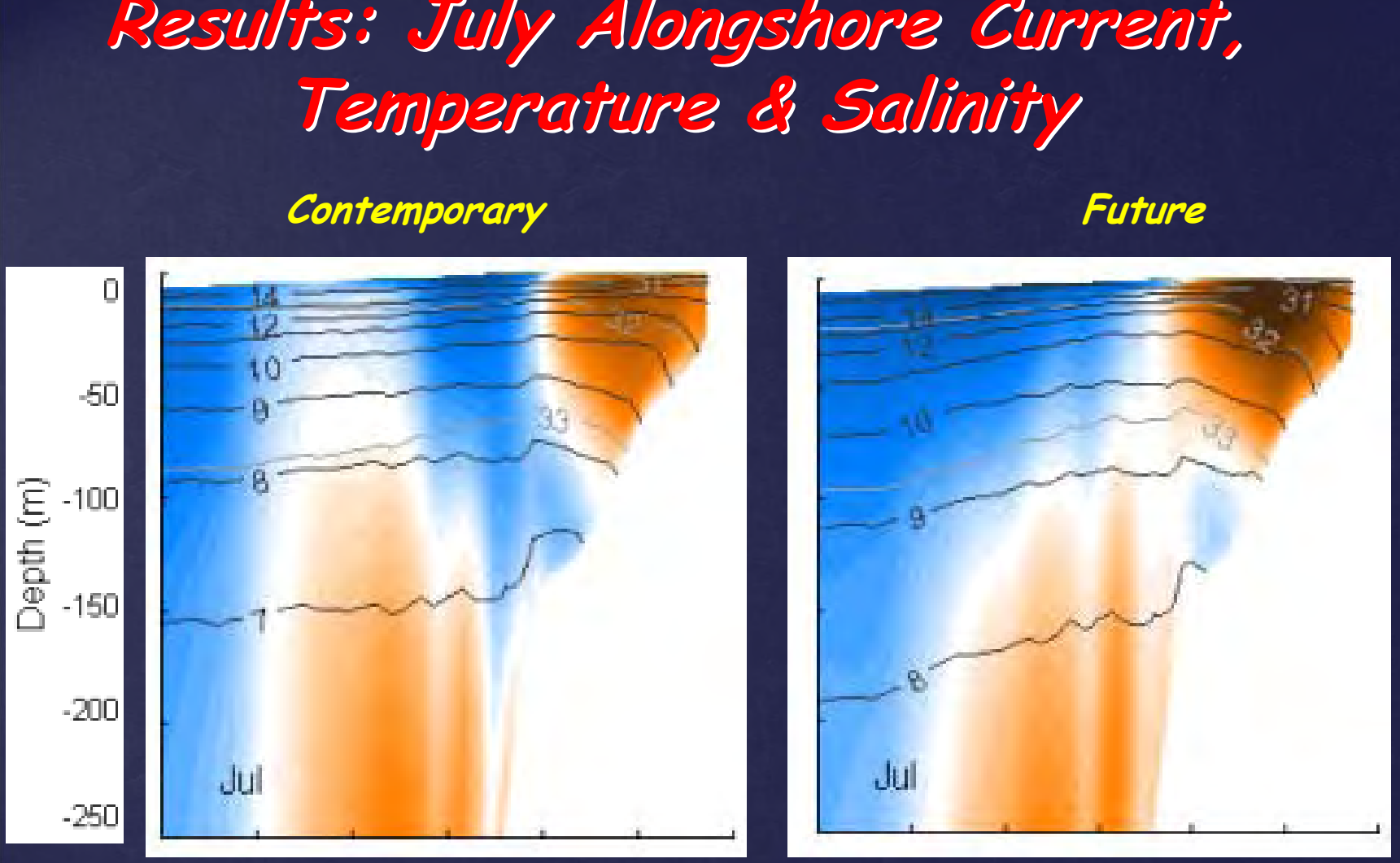
Future-contemporary





- *Stronger counter-clockwise gyre & flows past Cape St James*

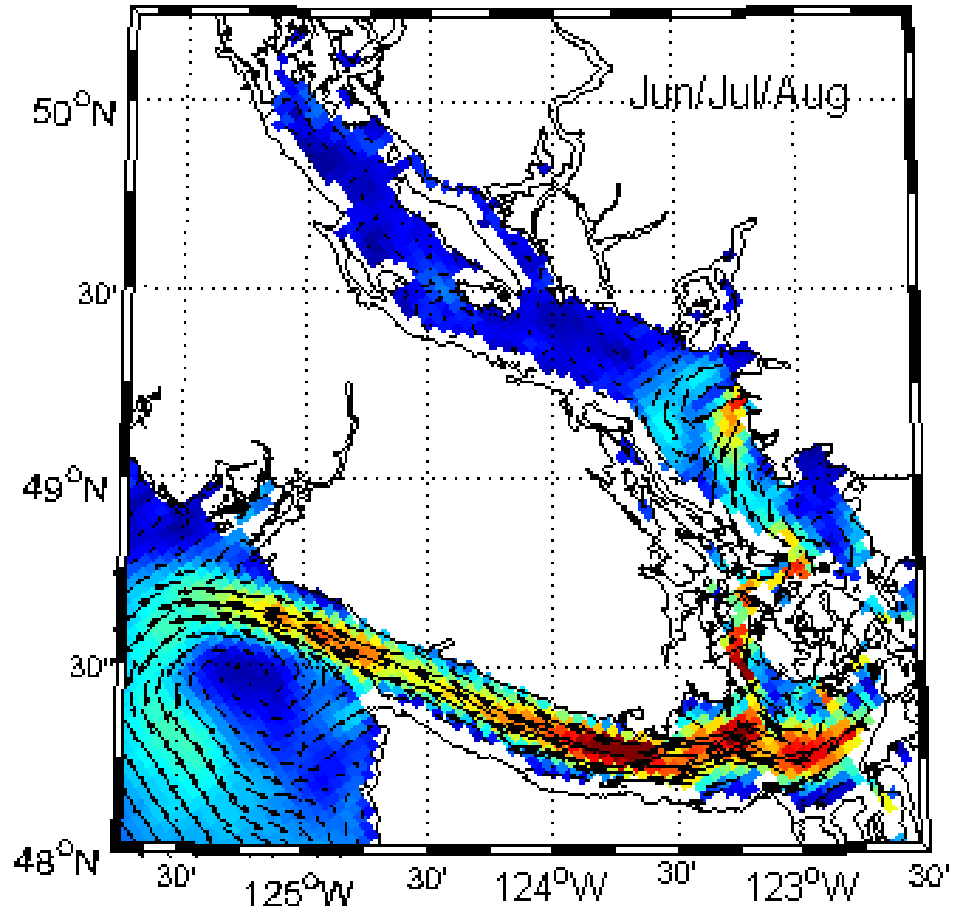
Results: July Alongshore Current, Temperature & Salinity

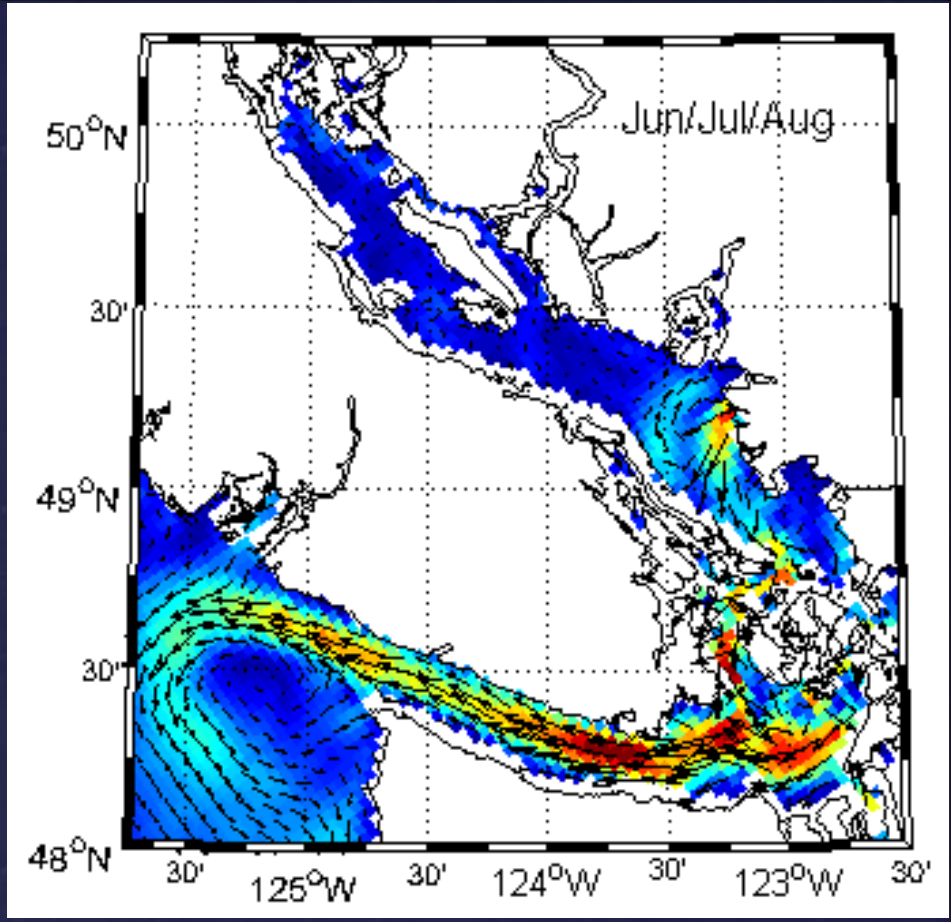


- Black lines = temperature, grey lines = salinity
- Future has stronger Vancouver Island Coastal Current and Shelf Break Current
- Possibly stronger upwelling & California Undercurrent ?

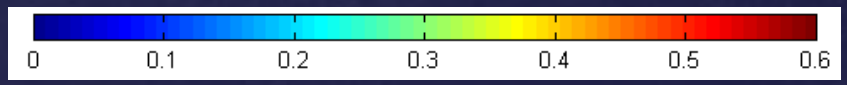
Salish Sea Summer Surface Currents

Future



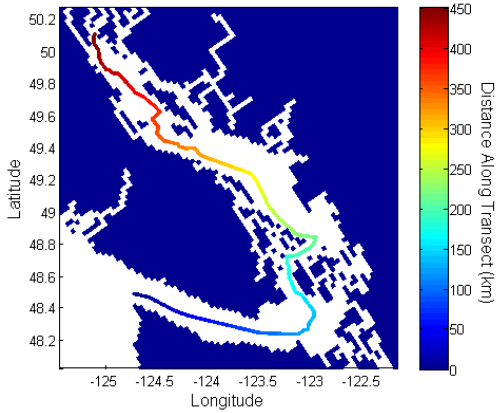


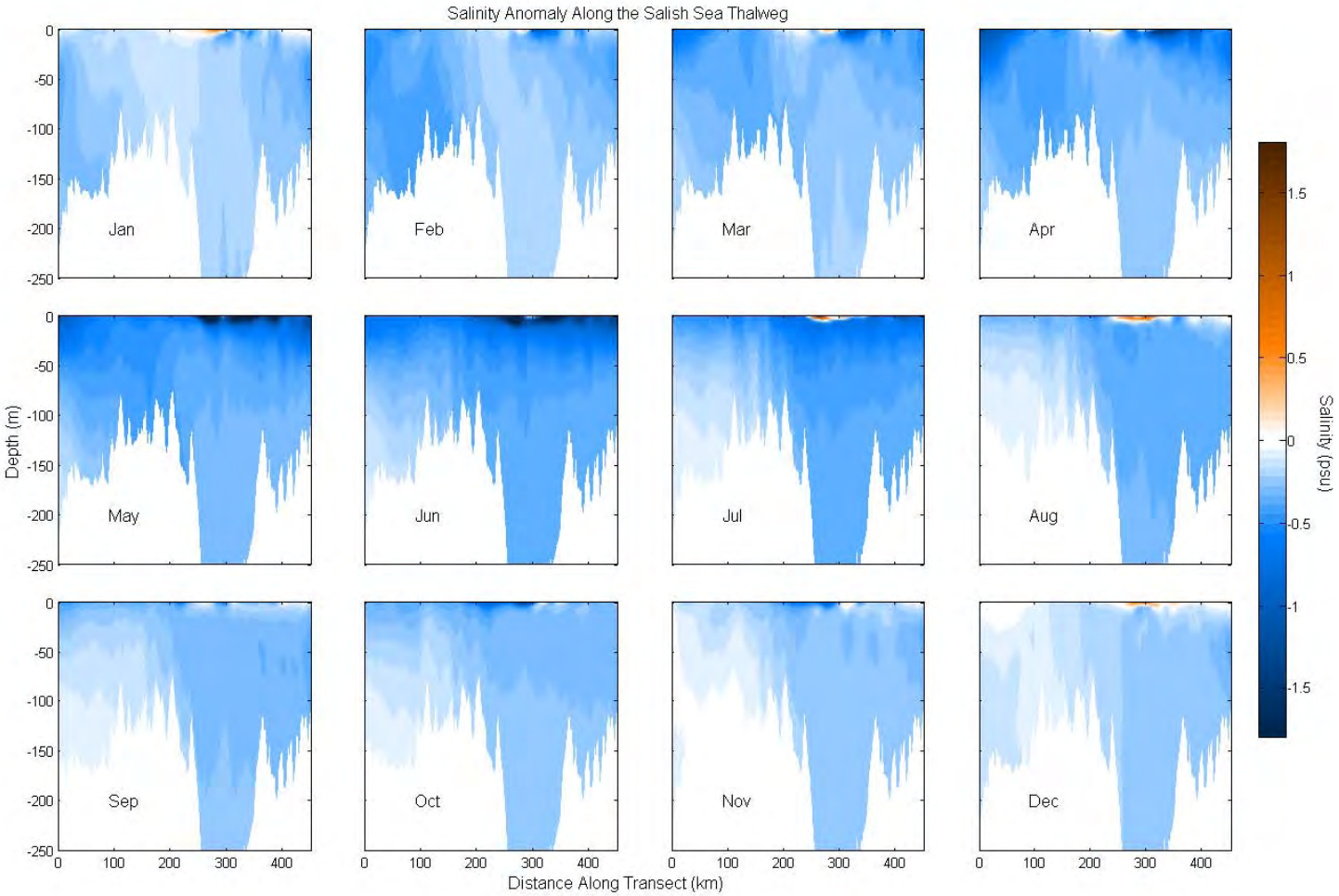
Contemporary



- Not much difference

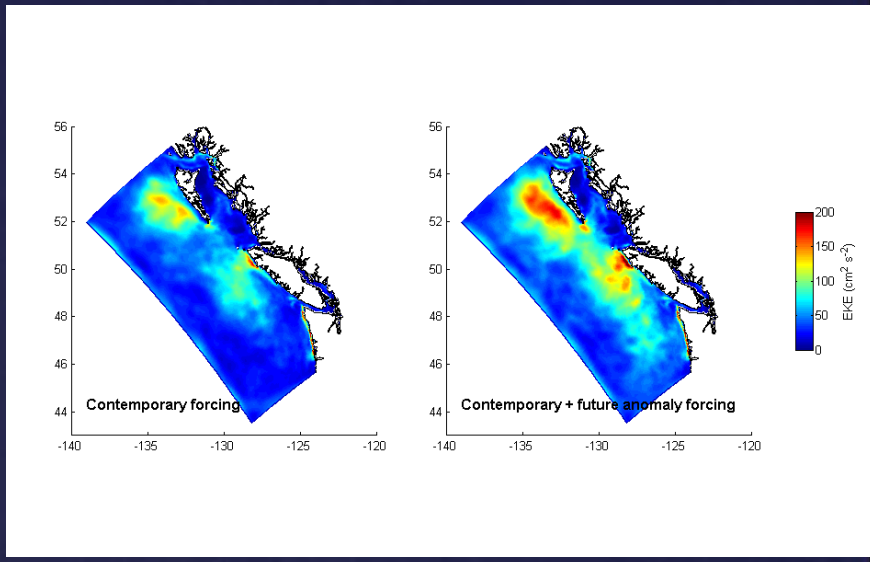
Salish Sea Salinity Anomalies

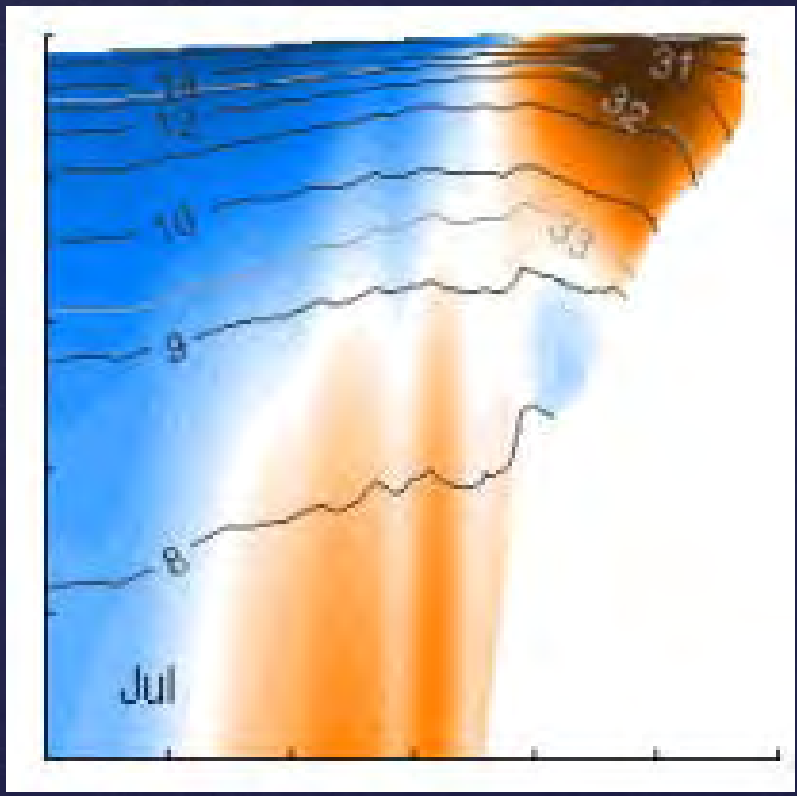




Summary

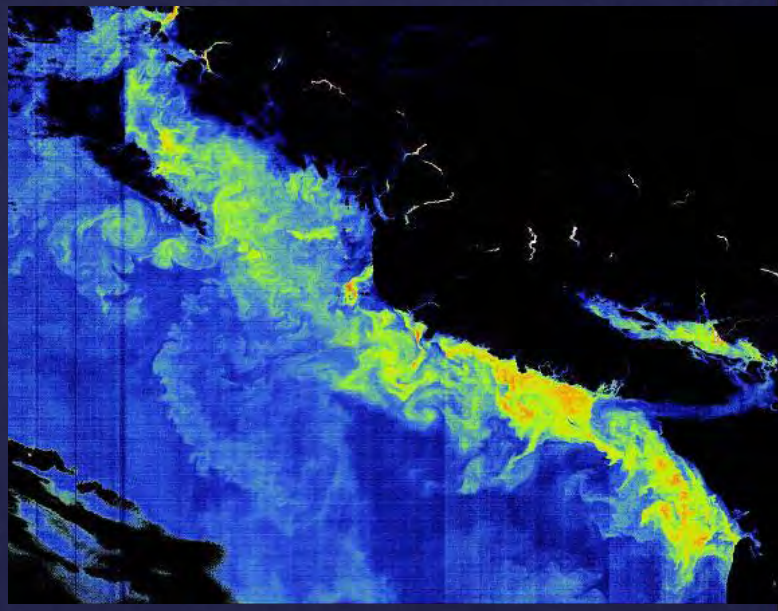
- described development & preliminary results from BC shelf, ocean-only, RCM
  - Future forcing & initial field anomalies computed from NARCCAP CRCM/CGCM fields
  - Run with combinations of future & contemporary forcings to understand changes





Future Work

- More analyses of results
- Other NARCCAP AR4 RCM combinations
  - AR5 RCM anomalies
- Couple to NPZD & marine geochemical ecosystem model (Angelica Peña)

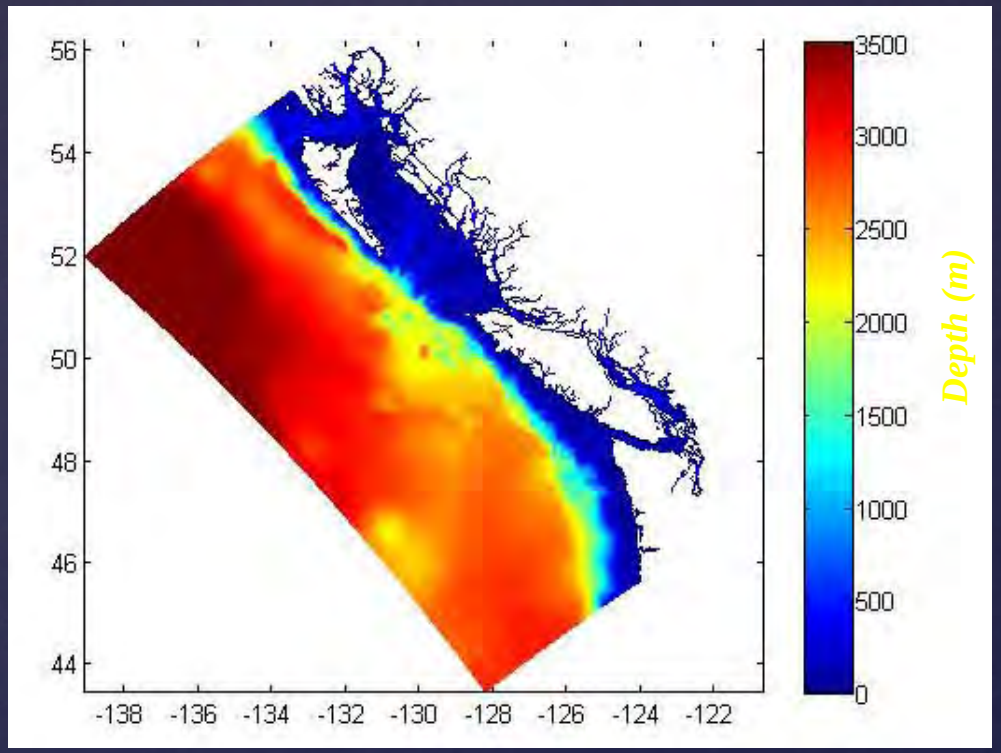


Meris chlorophyll, Sept 11, 2011, courtesy Jim Gower & Erika Young

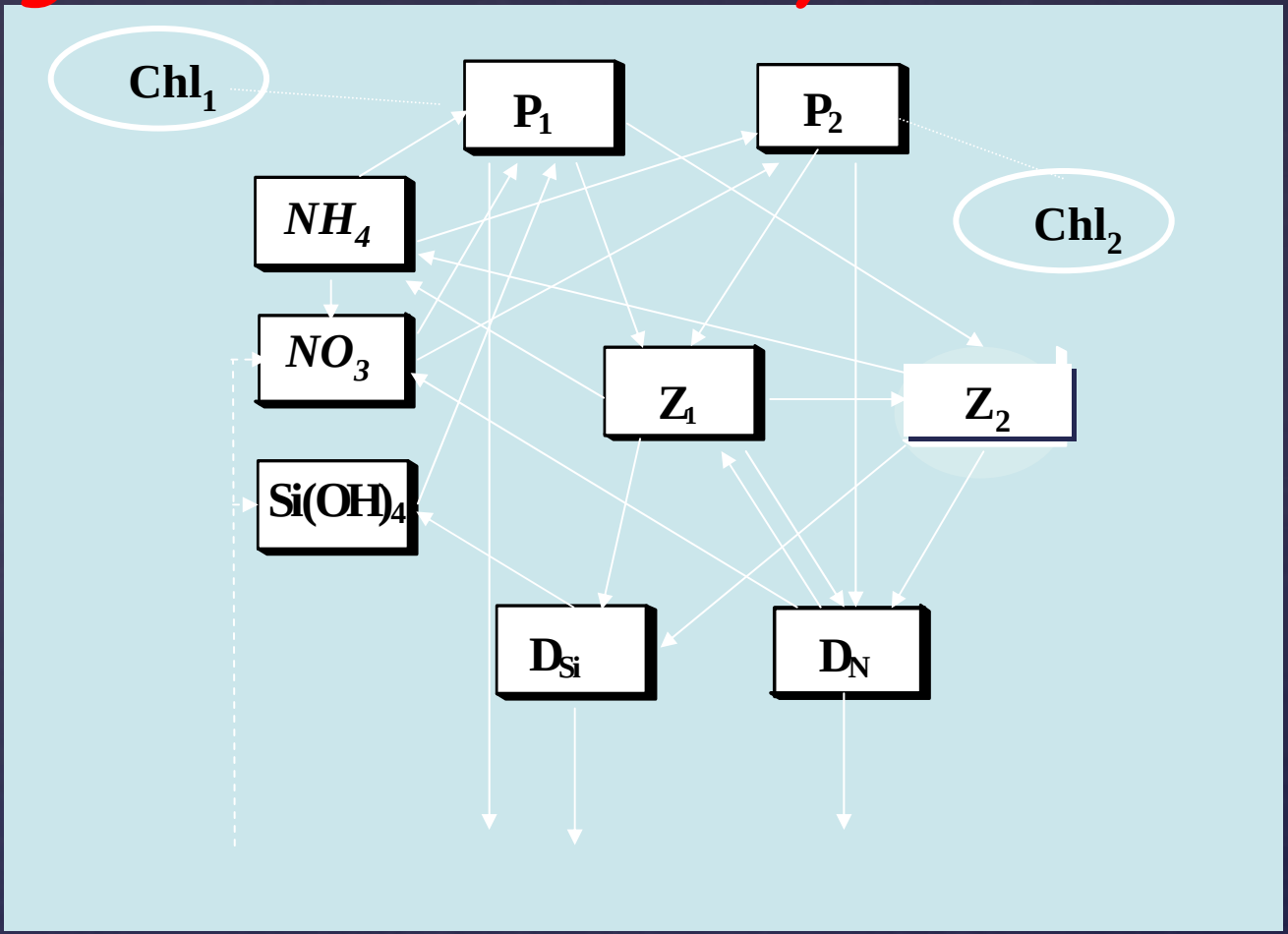
ROMS BC RCM + NPZD-O_2-pH model

Objectives:

- To detect, understand and predict climate change impacts on:
  - Plankton productivity
  - Nutrient supply, oxygen and carbon content
- Evaluate the potential risk (likelihood) for the development of hypoxia events and corrosive conditions



Biogeochemical / ecosystem model



- Cycle of several biogeochemical elements (N, C, Si(OH)4 and O_2)
- Two-types of phytoplankton and of zooplankton
- Multiple nutrient limitation of phytoplankton growth
- Dynamic chlorophyll compartments
- Temperature dependence of physiological rates

Acknowledgements

- Fisheries and Ocean Canada:
  - Climate Change Science Initiative
  - Aquatic Climate Change Adaptation Services Program
  - Centre for Ocean Model Development for Application
- Environment Canada
- North American Regional Climate Change Assessment Program (NARCCAP)

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