NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

2013 CESM Ocean Model Working Group Meeting

ESTUARY-SHELF FRESHWATER EXCHANGE PARAMETERIZATIONS FOR THE CESM

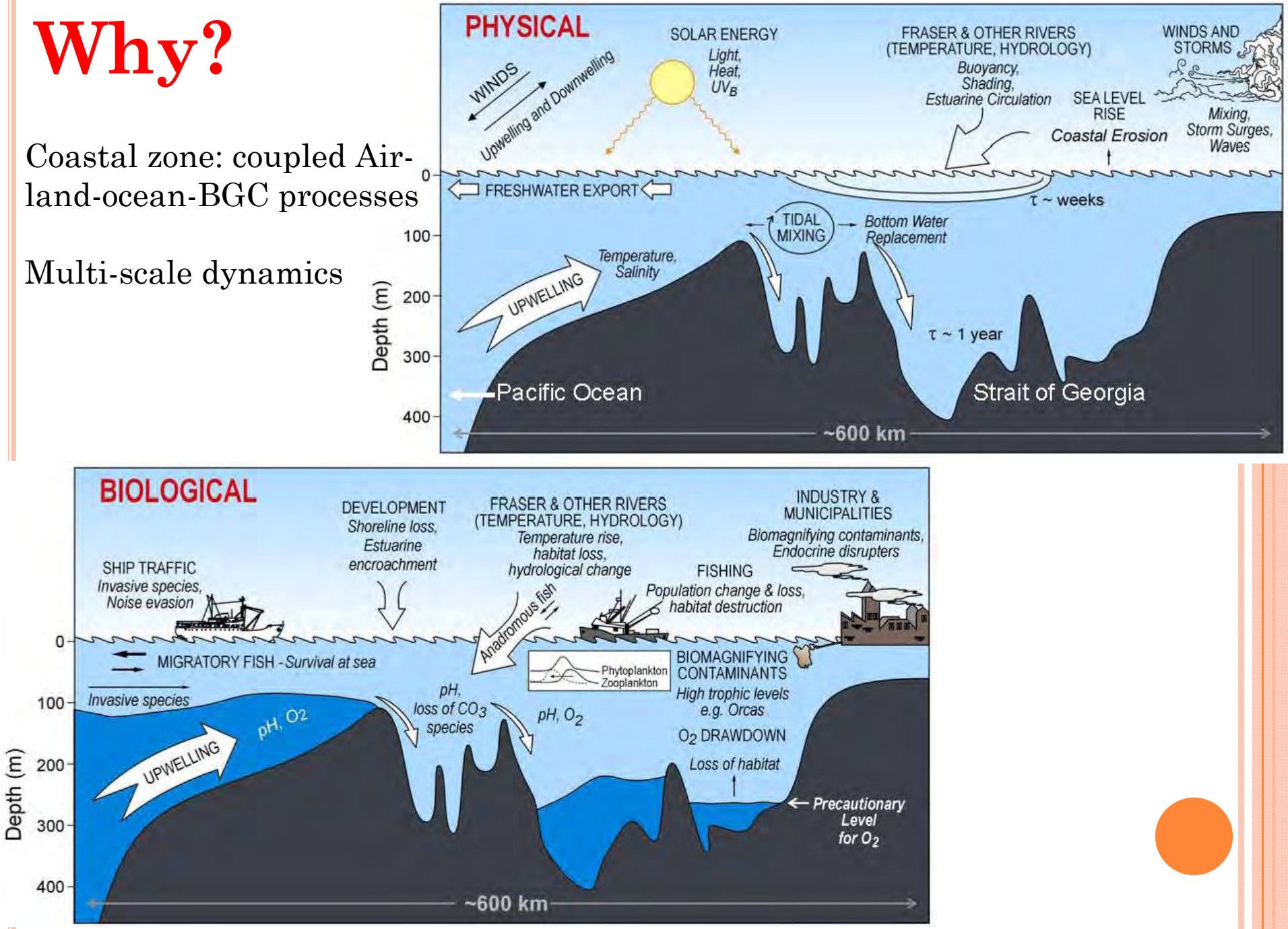
Yu-heng Tseng (NCAR), Frank Bryan (NCAR), John Dennis (NCAR), Allison Baker (NCAR), Parker MacCready (U Washington), Michael Whitney (U Connecticut)

SciDAC: Collaborative project: Improving the Representation of Coastal and Estuarine Processes in Earth System Models

Why?

Coastal zone: coupled Air-land-ocean-BGC processes

Multi-scale dynamics



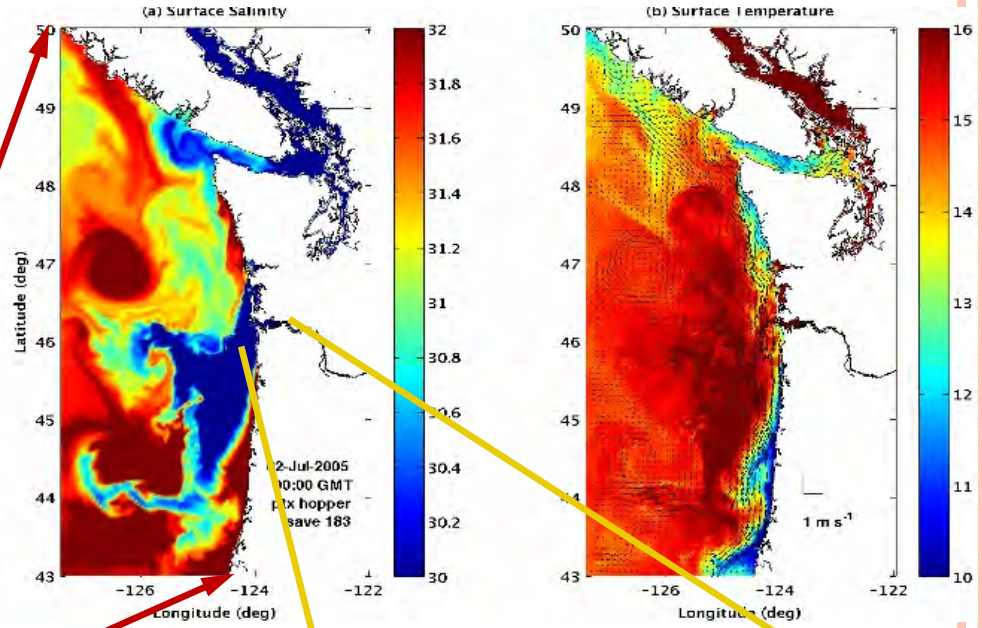
Johannessen & Macdonald (2009)

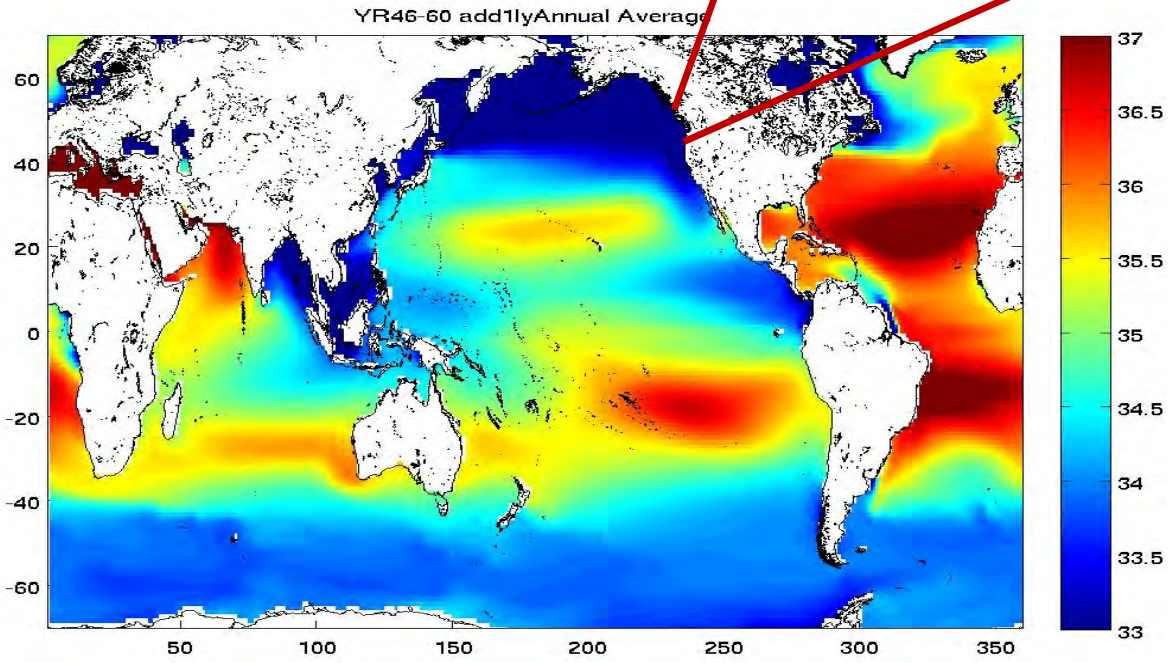
Why?

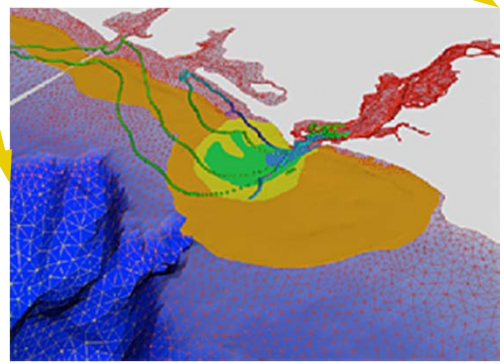
How are these features affected by climate?

Impacts of the nutrients and carbon from the river mouth

Require better representation of transport and mixing processes along the coast ->help the global simulation



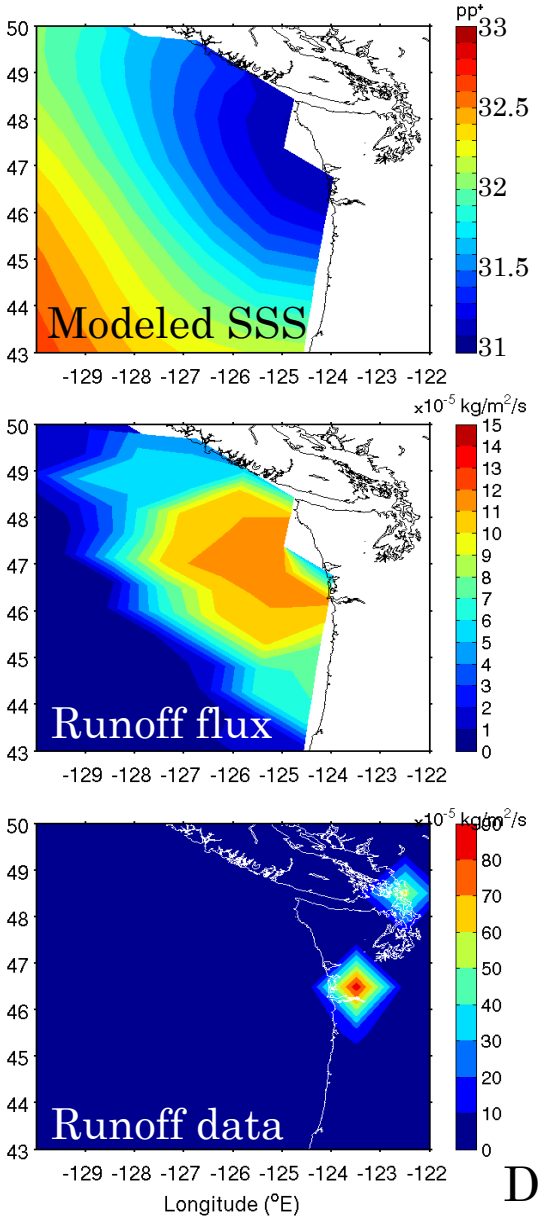




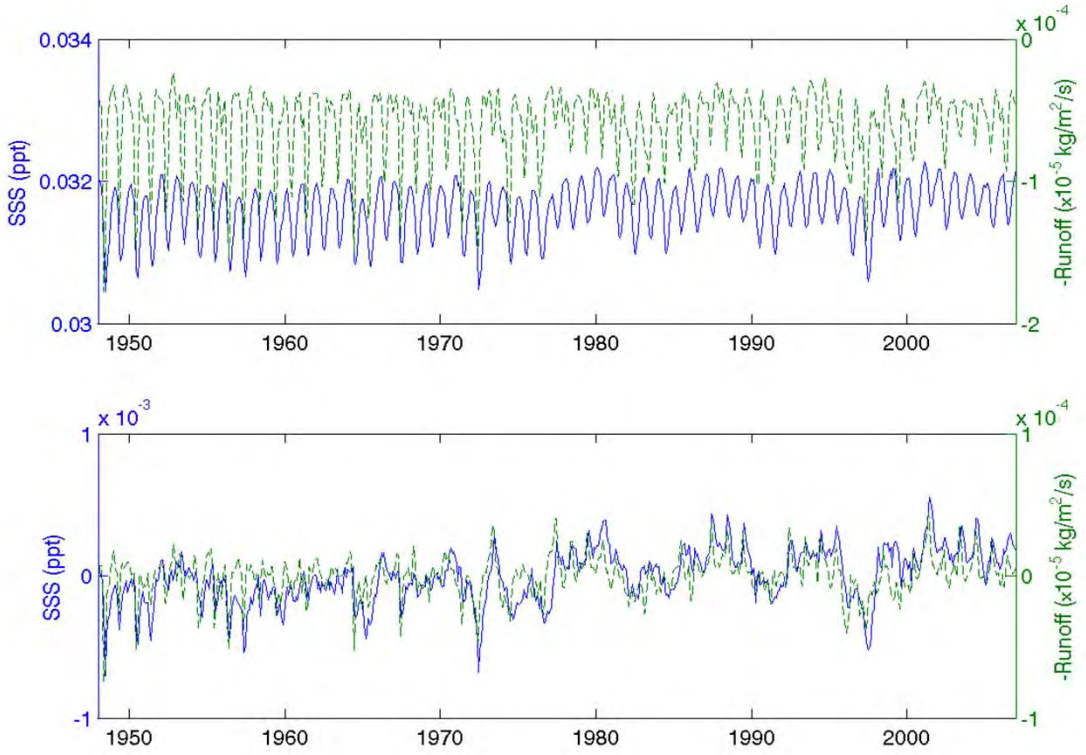
Human impacts: 40% population lives along the coast

What's the Current Status?

1978-2007



- CESM 1degree sea-ice global model –GIAF
- CORE experiment (Large and Yeager, 2009)
- 1948-2007 (after 5 cycles)



Dai, A., and K. E. Trenberth, 2002

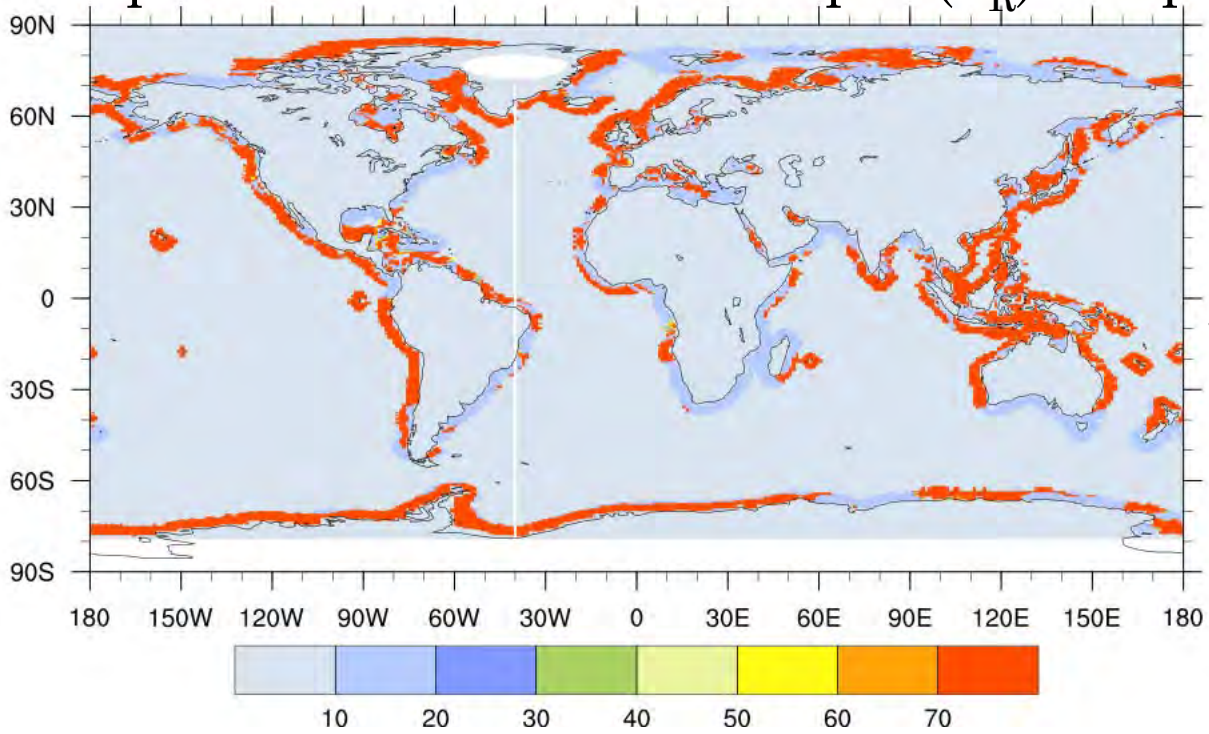
What are and will be done?

- Global scale:
  - Estuary-shelf freshwater exchange parameterizations
    - Improved "augmented precipitation" scheme
    - Estuary and shelf box models
- Regional scale:
  - Nested Coupled Ocean Model Development

How?

➢ Improved "augmented precipitation" scheme

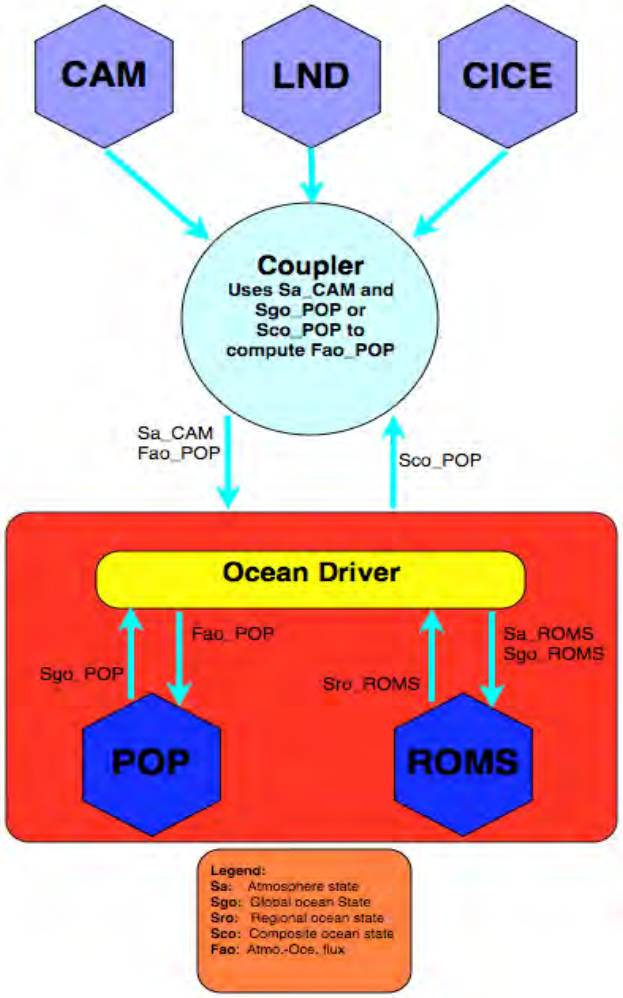
- Actual river PE inputs often form slender coastal currents/plumes.
- Redistribute the runoff flux as a source term vertically by considering the change of available potential energy (APE)=$\Delta\rho gz$
- Optimal Runoff effective depth (h_R) comparing with the WOA09



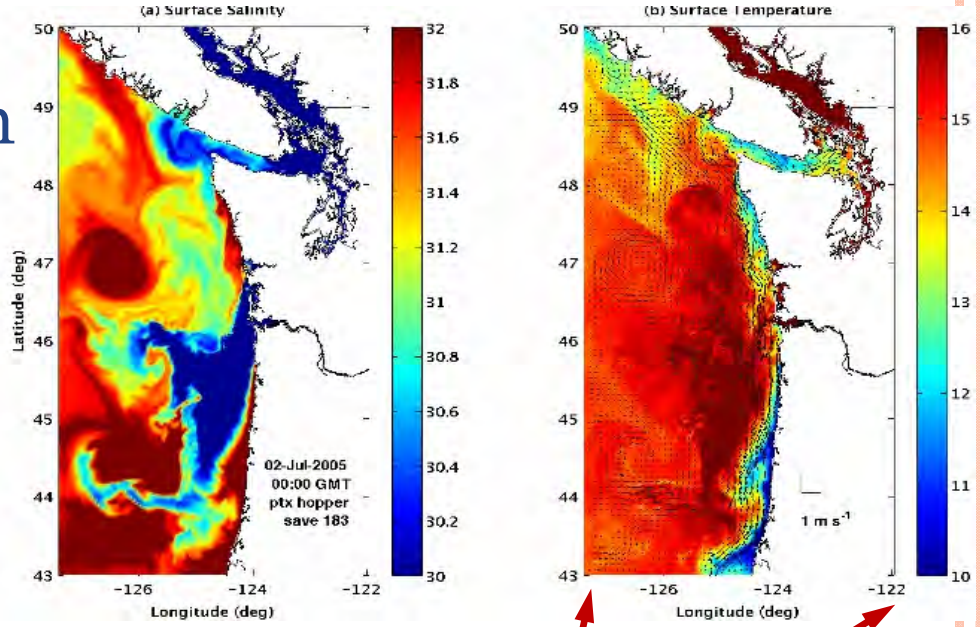
Runoff effective depth h_R can be determined by observation

How?

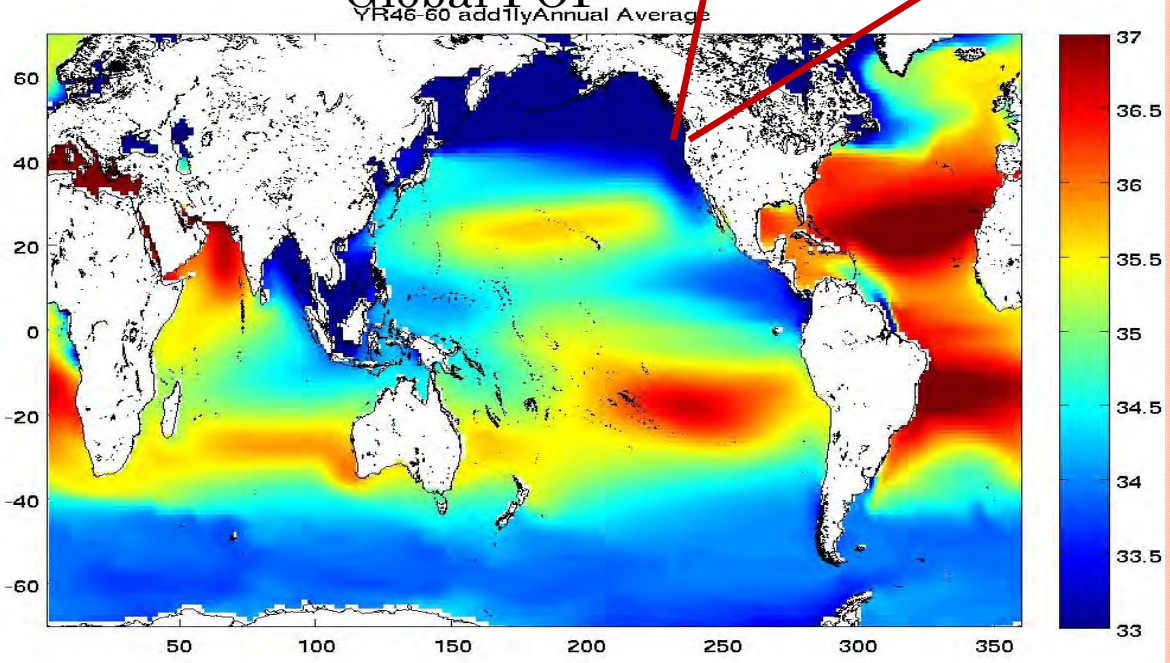
- Nested coupled ocean model development



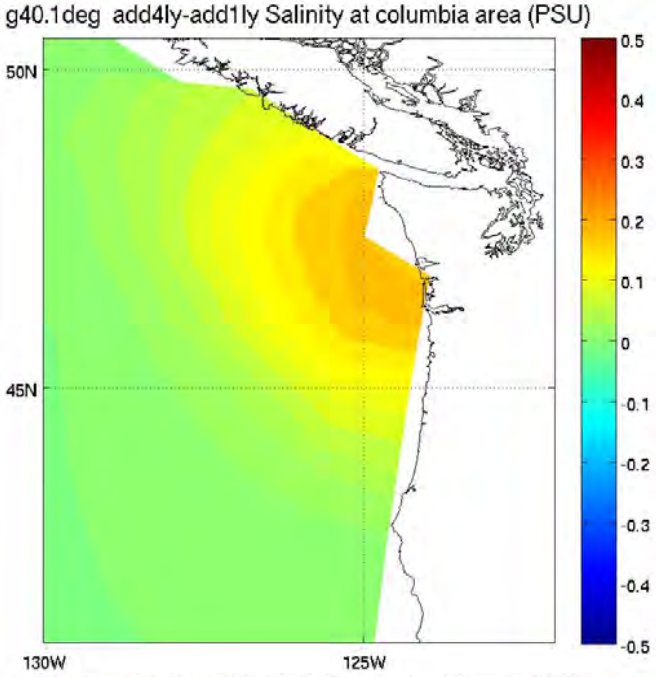
0.3-3km resolution regional ROMS

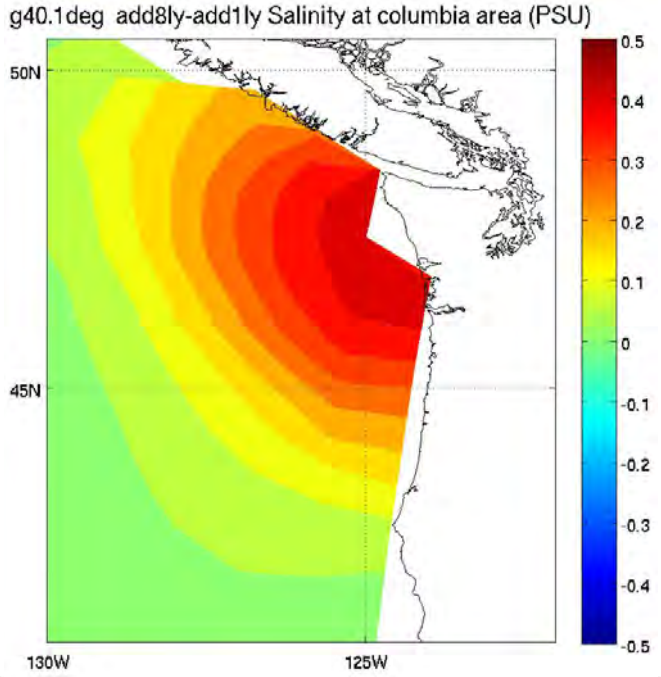


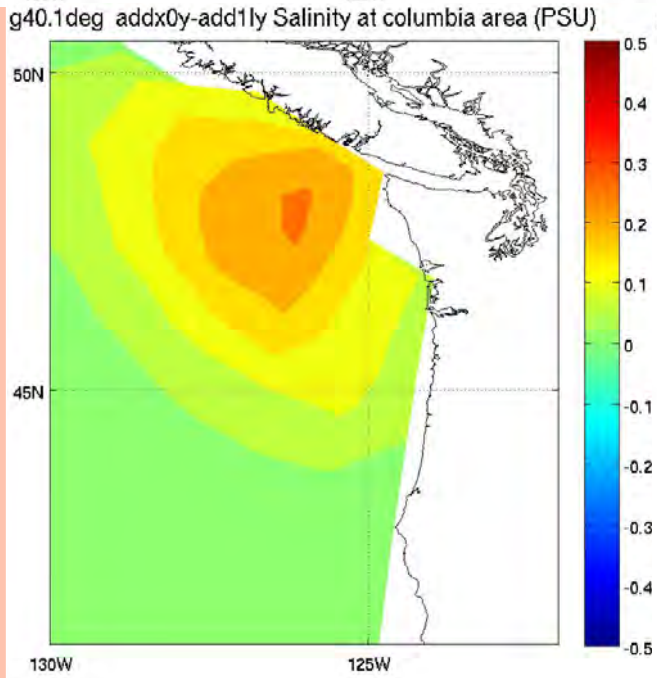
Global POP

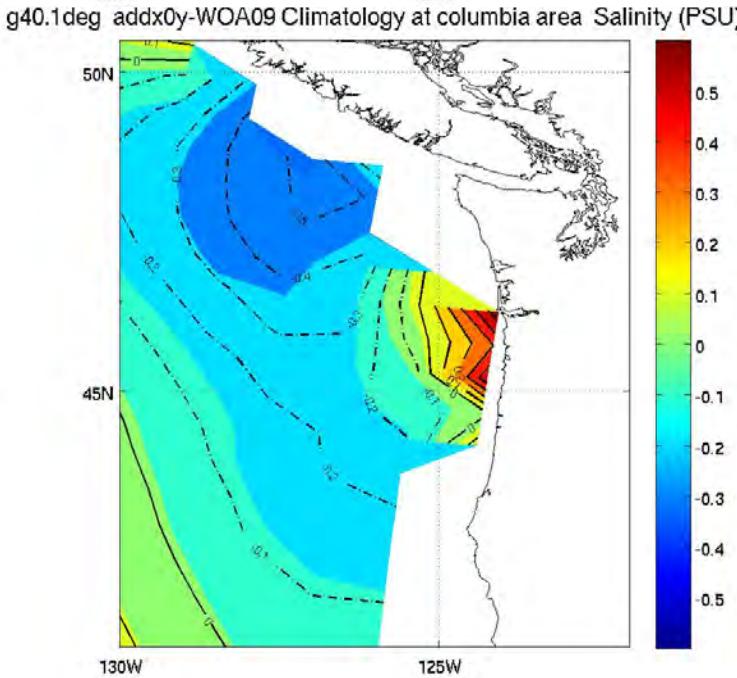


Sensitivity of different h_R on the surface salinity





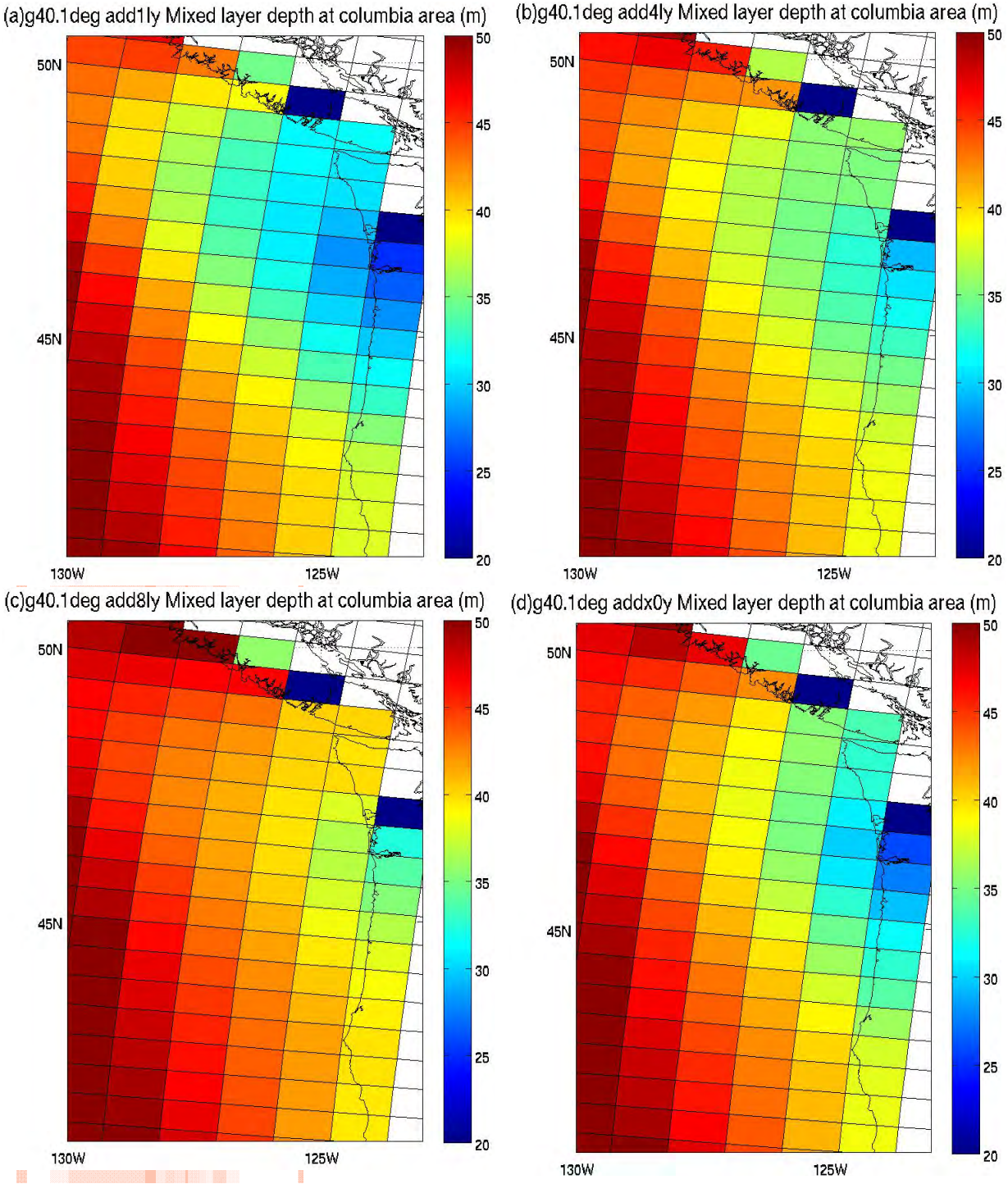




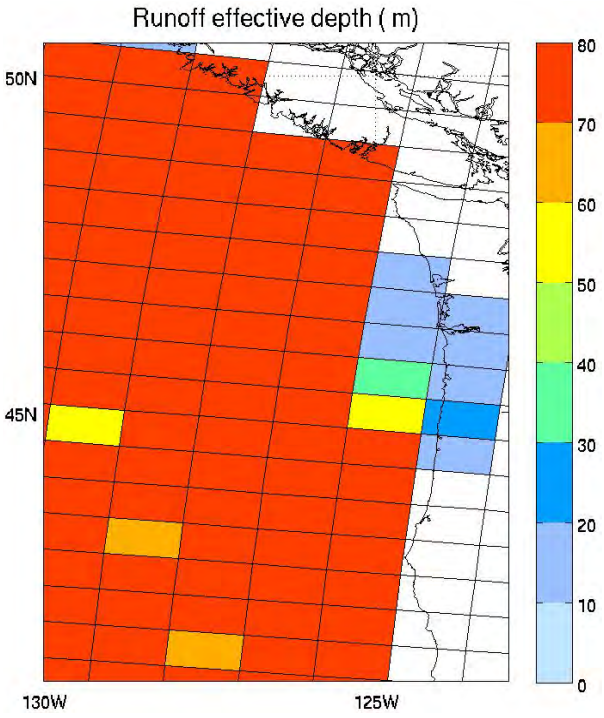
Simulated 60-year average surface salinity distribution and difference.

Only vertical distribution is modified

Columbia



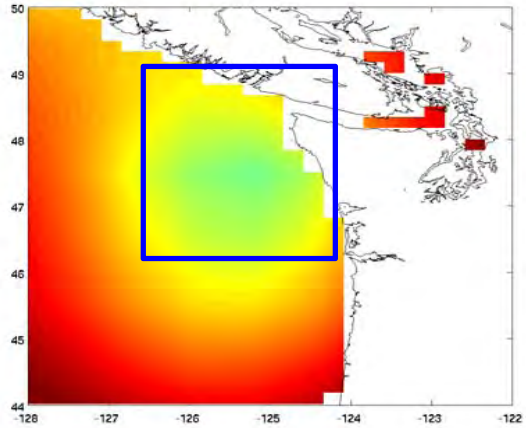
Simulated 60-year average mixed layer depth and runoff effective depth.

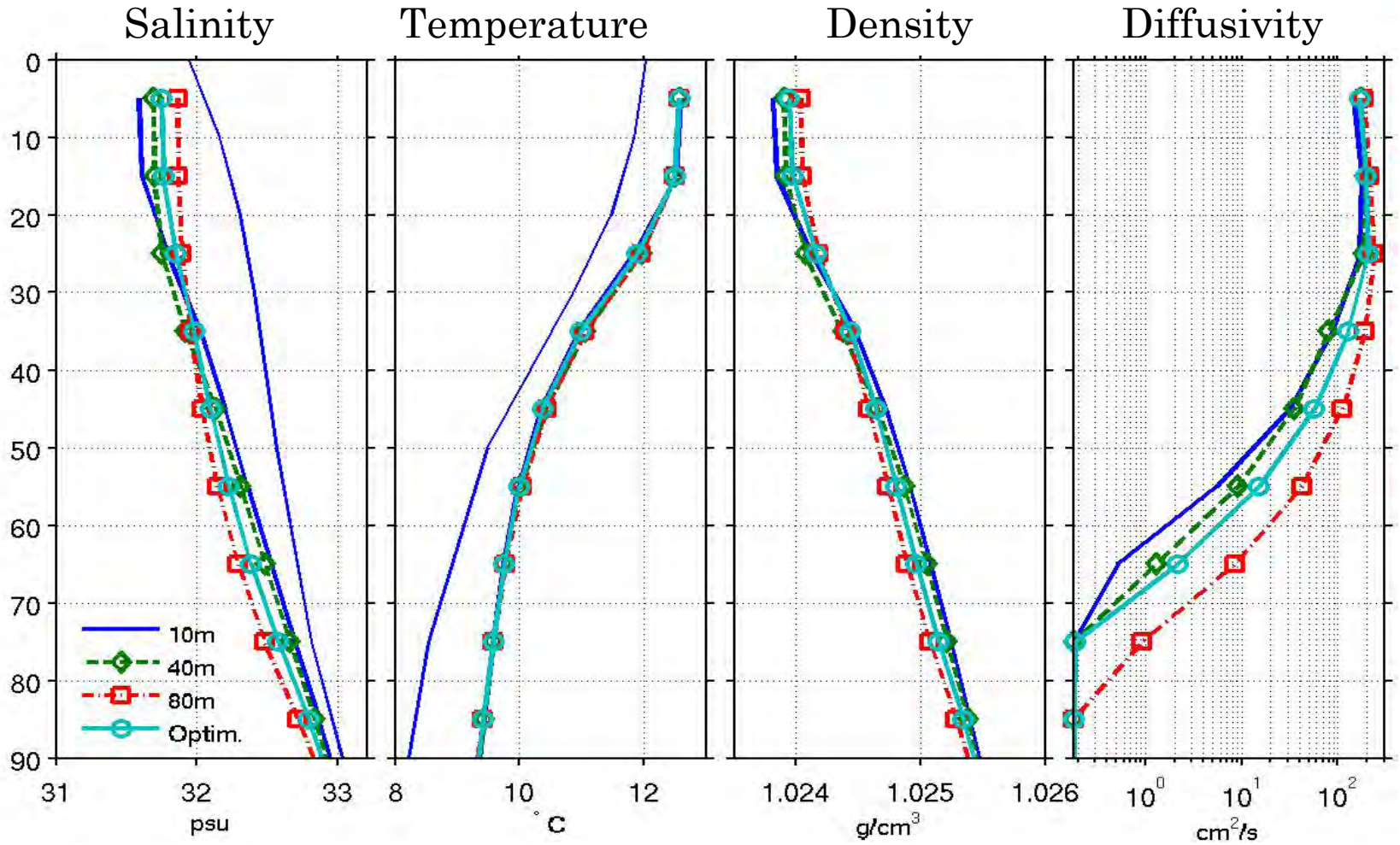


Columbia

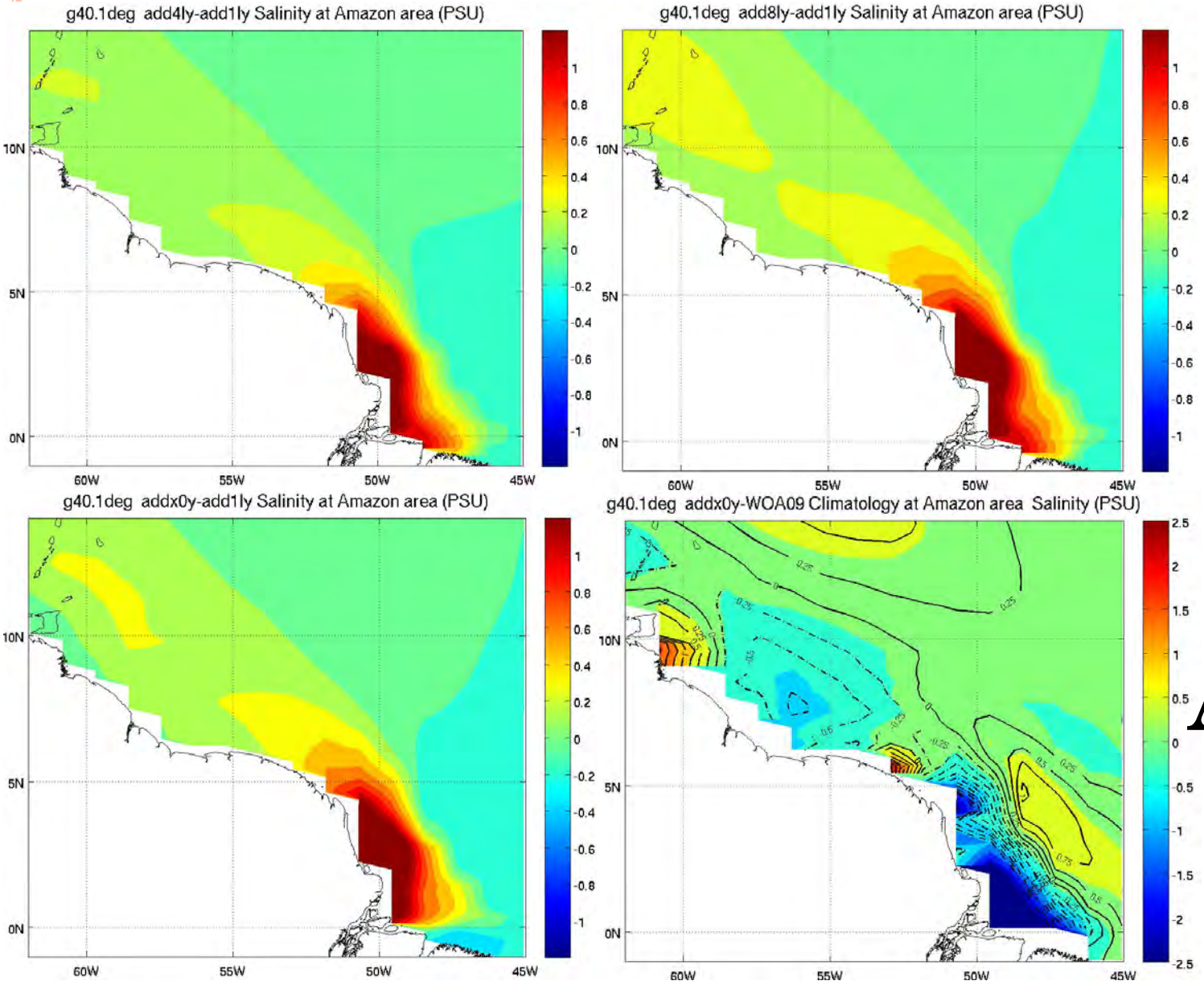
NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Vertical profiles averaged over 126.5-124W, 46.5-48.5N

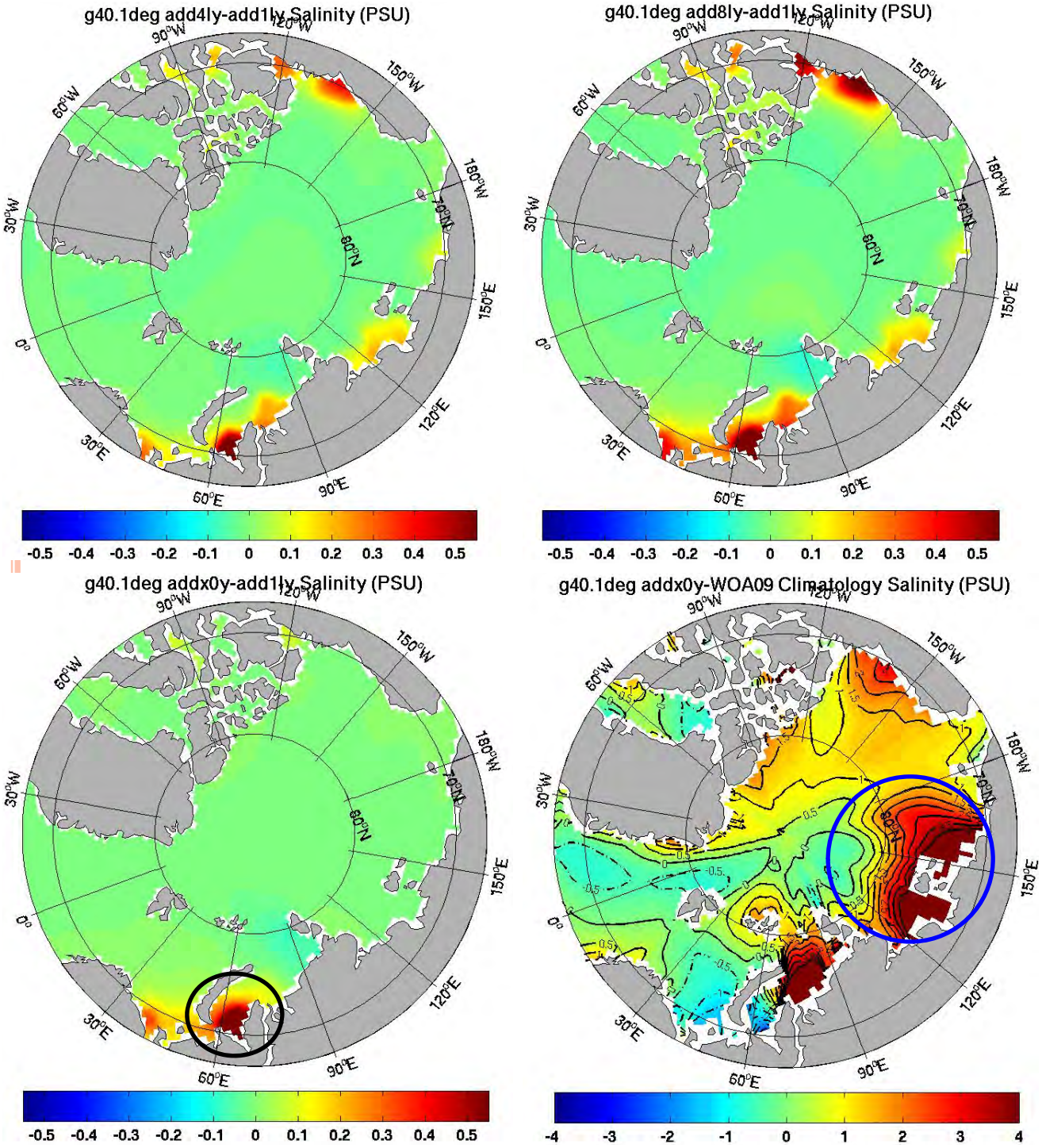




Sensitivity of different h_R on the surface salinity

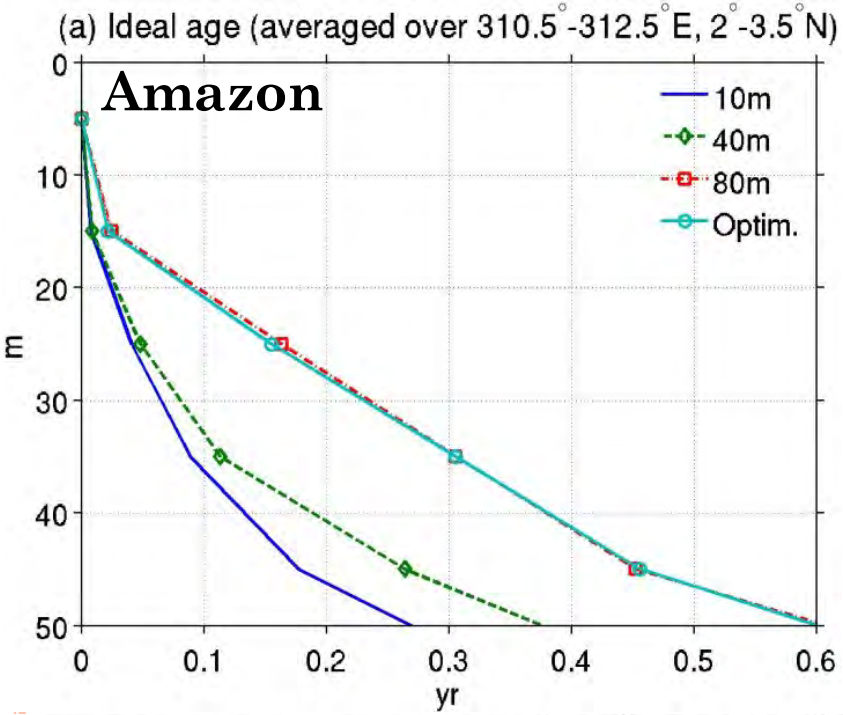


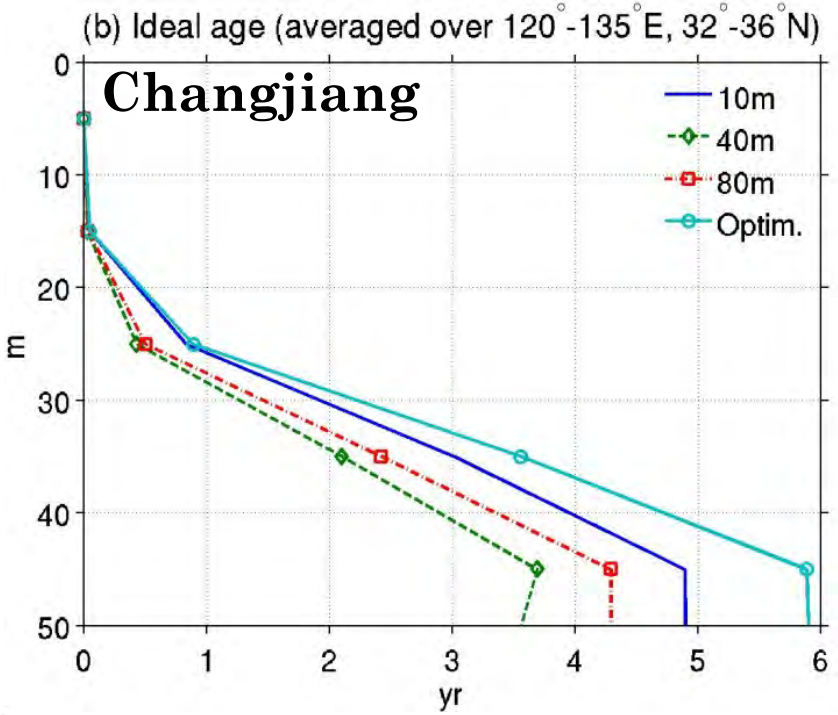
Amazon

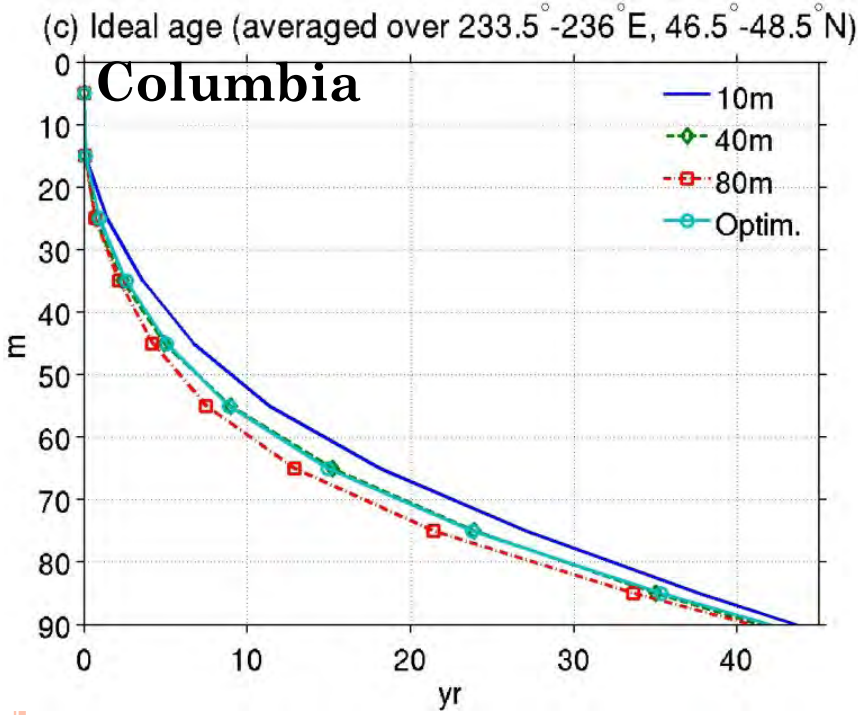


Arctic

Large warm bias cannot be corrected







Ideal age in the coupled simulations

Conclusion and future……

- A simplified estuary-shelf freshwater exchange parameterization is developed based on an augmented precipitation method (i.e., the optimal Runoff effective depth, h_R)
- Locally improved simulation due to vertical mixing with little difference in a global view
- Further complicated parameterization based on Estuary and shelf box models
- Further evaluation of the nested coupled ocean Model (data ocean in the CESM framework to force ROMS)