Effects of wind forcing in the coastal Gulf of Alaska: Results from a coupled biophysical model

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Outline

Tool (a multi-scale nested bio-physical model)

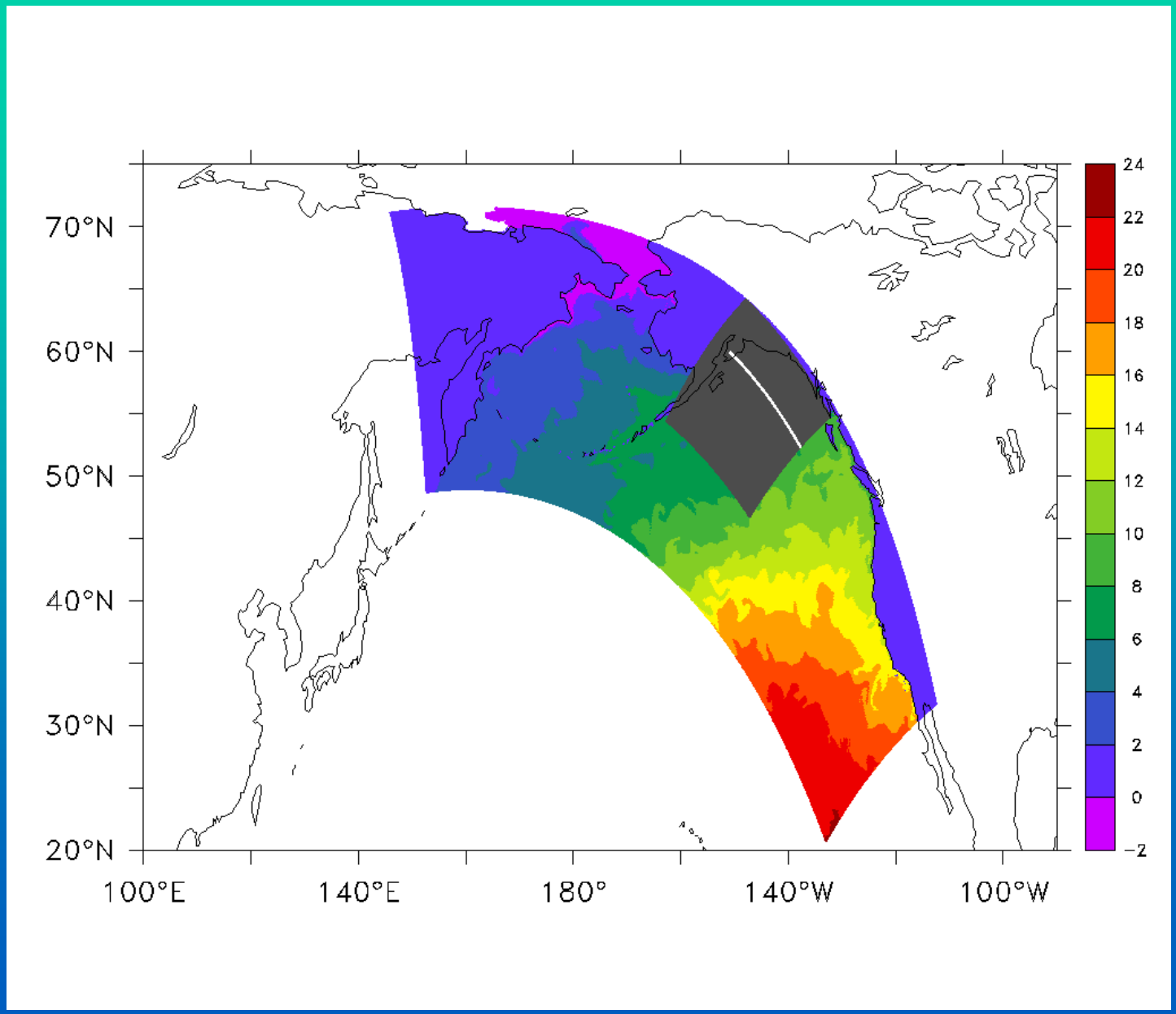
Background

Objectives and method

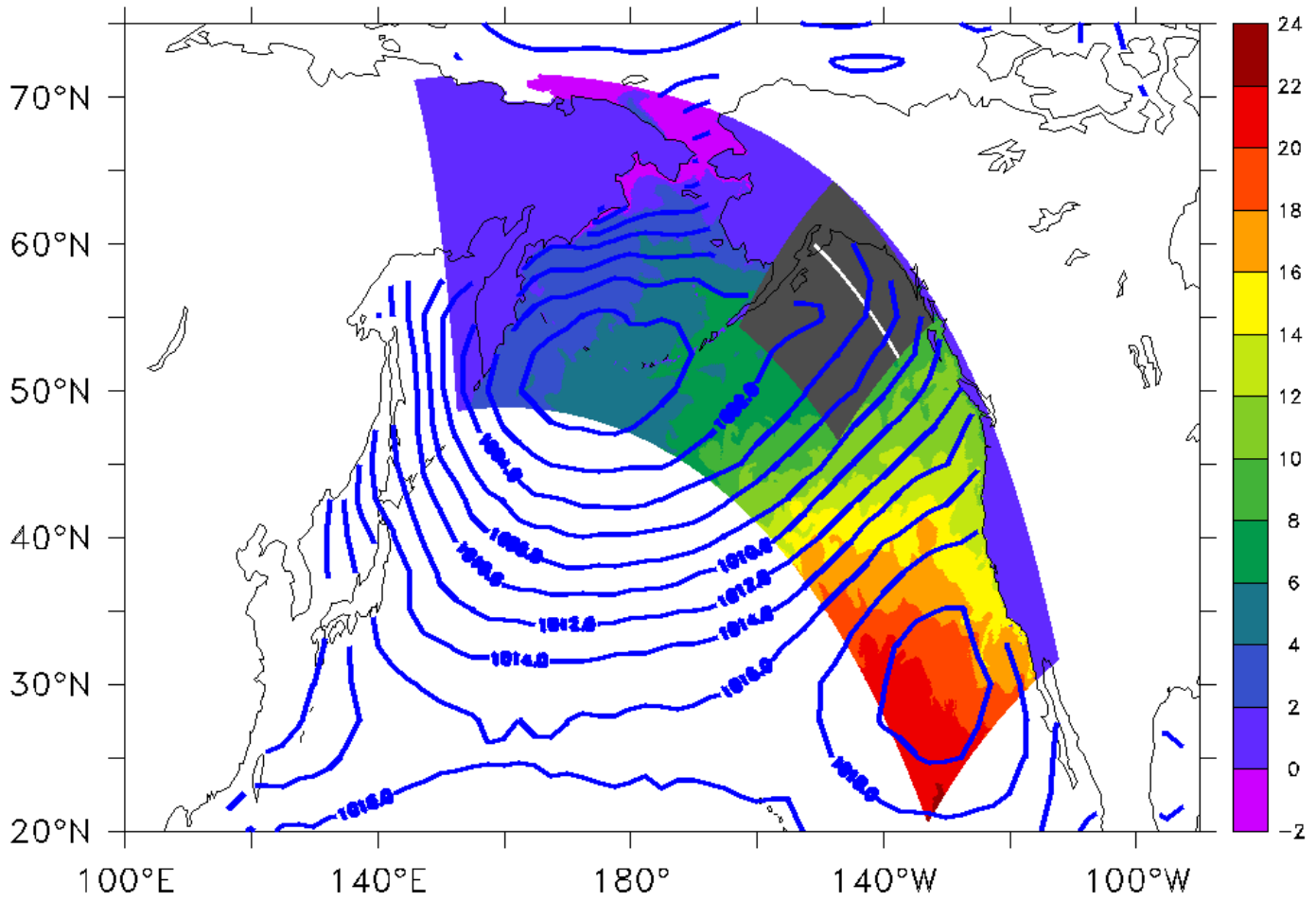
Results

Summary and future work

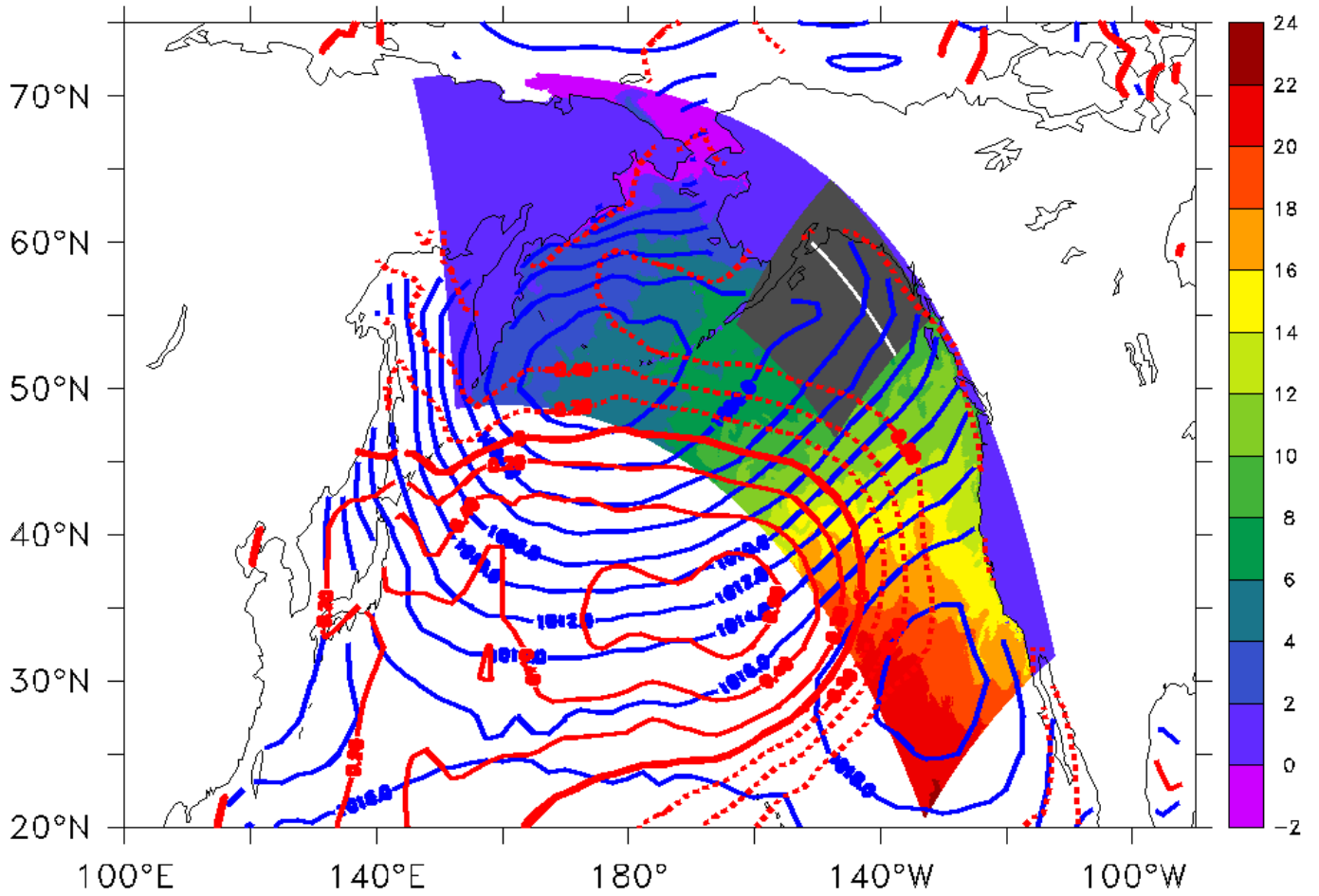
Three model grids we use: NEP, CGOA, 2D CGOA



Climatic Background



Climatic Background

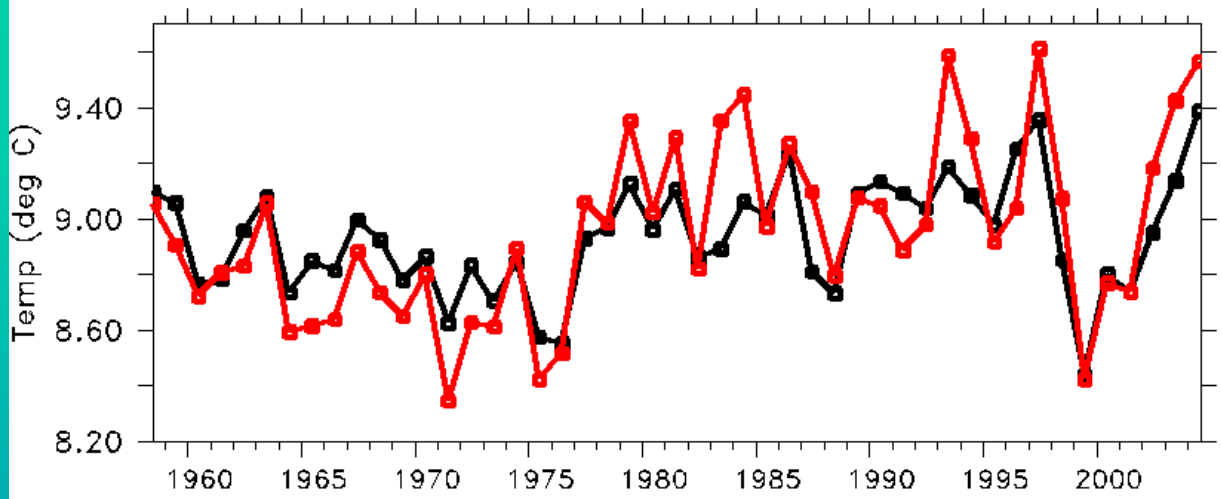


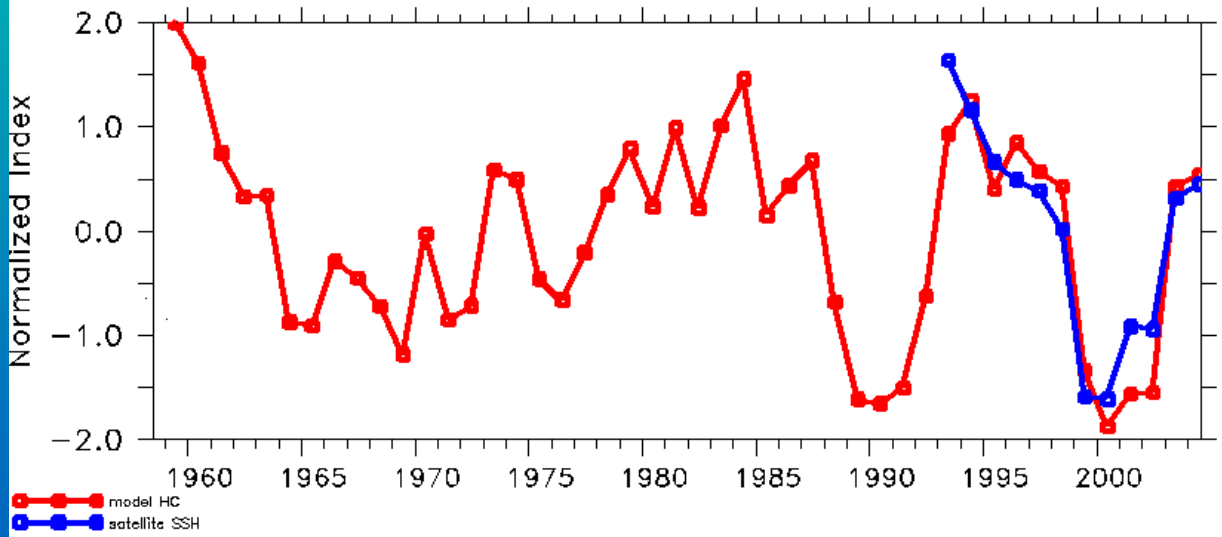
Objectives:

1. effects of wind forcing anomalies on the ocean stratification in the coastal gulf of Alaska (CGOA)
2. lower trophic level responses to wind forcing anomalies

Method:

- Control case: 2D CGOA model forced with MM5 daily forcing from 2001-2002
- Idealized wind perturbation experiment: doubling of surface wind speed





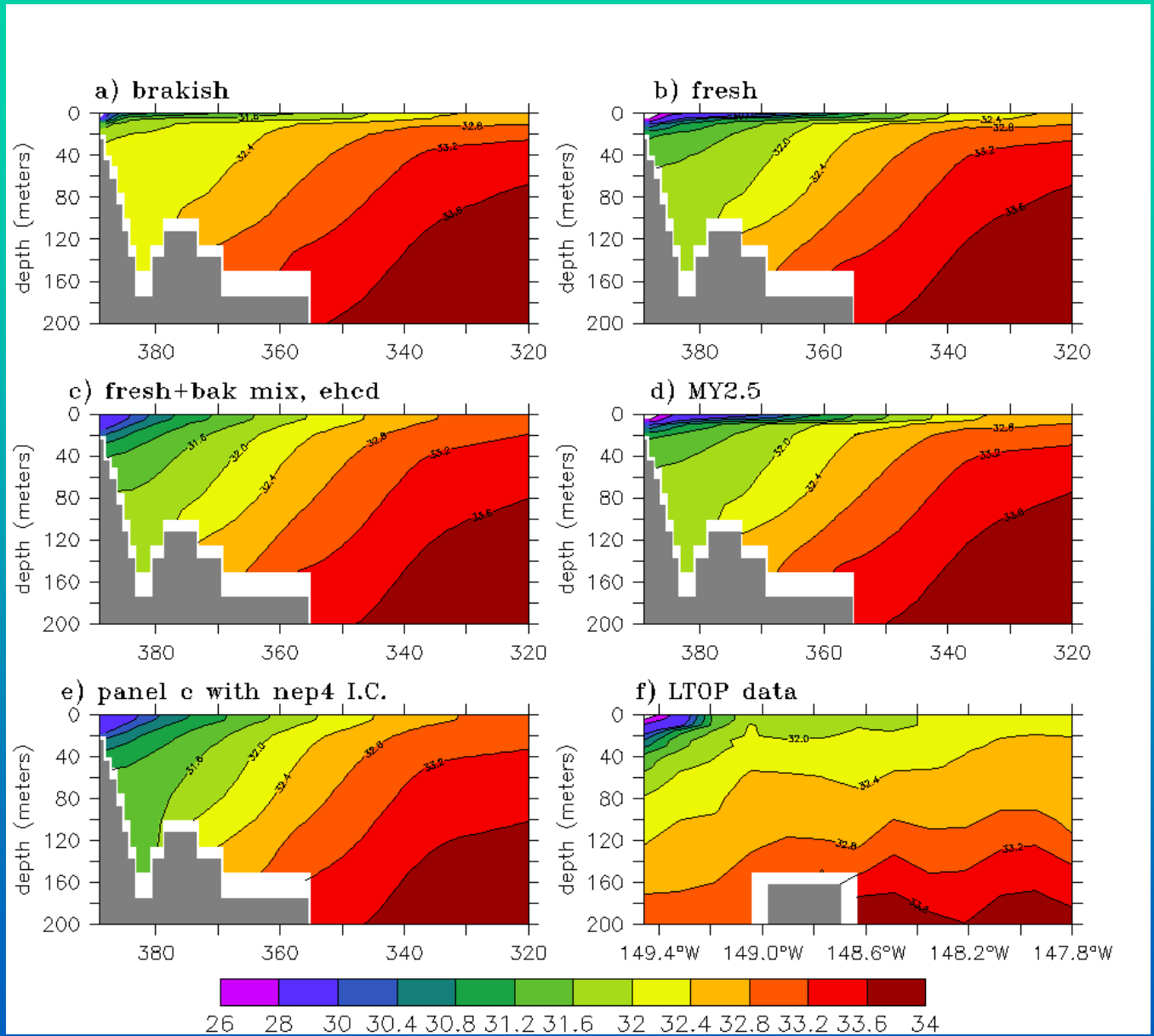
Black: modeled annual mean SST in the NEP domain

Red: modeled annual mean SST in the CGOA domain

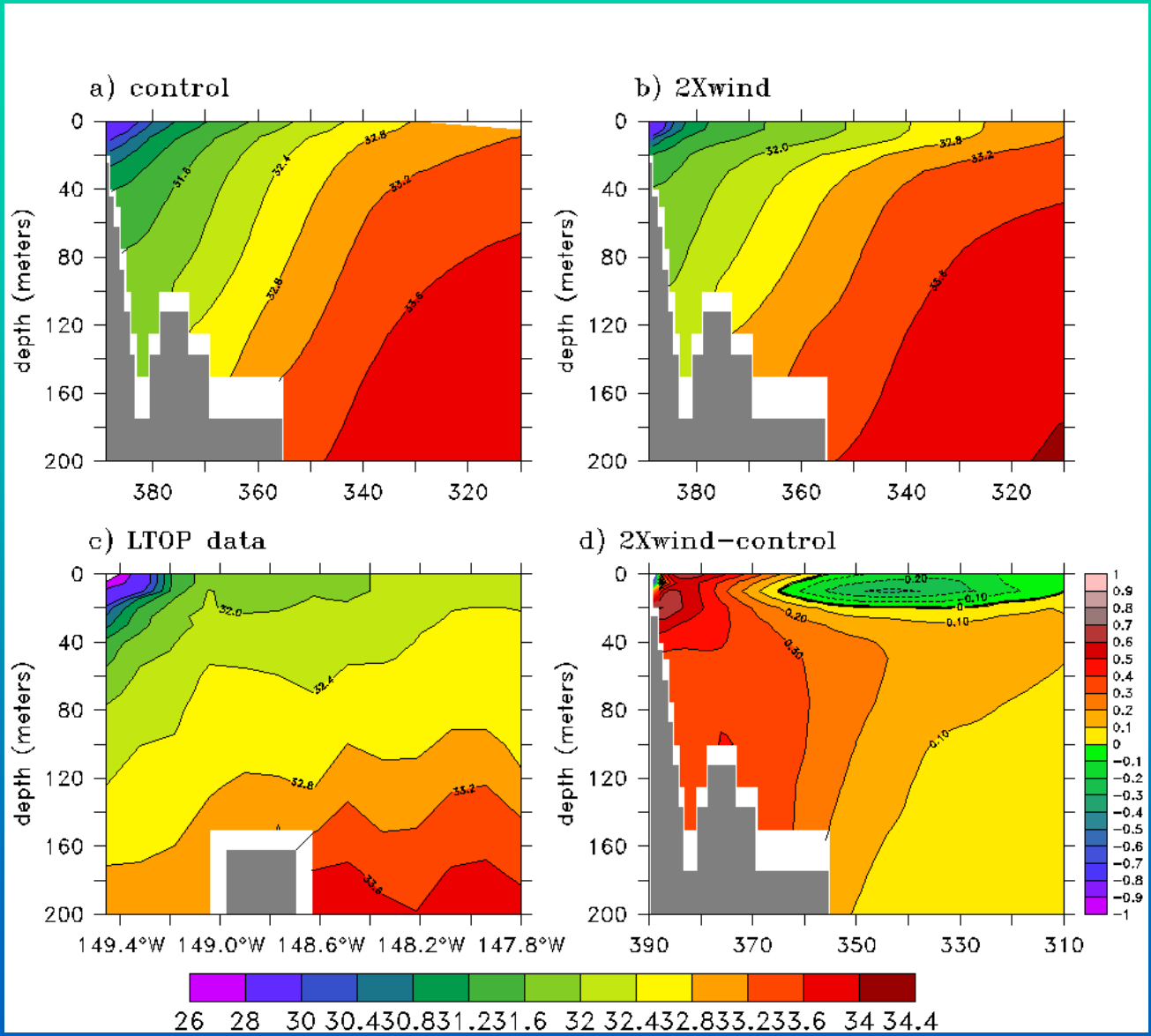
Red: modeled 0-400m OHC in the CGOA

Blue: Satellite SSH anomaly over the same spatial domain

The CGOA "runaway estuary" problem



Cross-shore transect of Salinity Sep 2001



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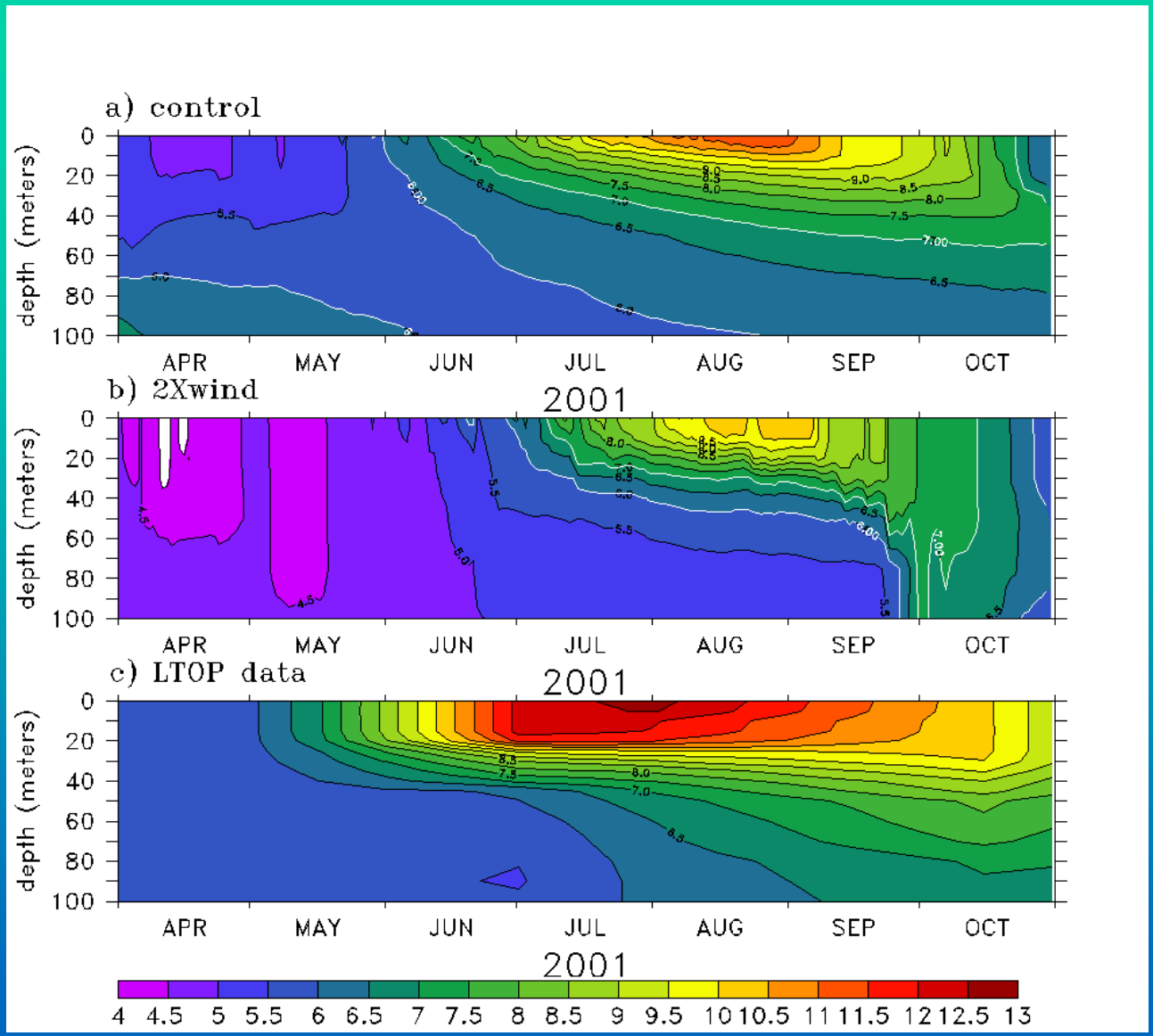
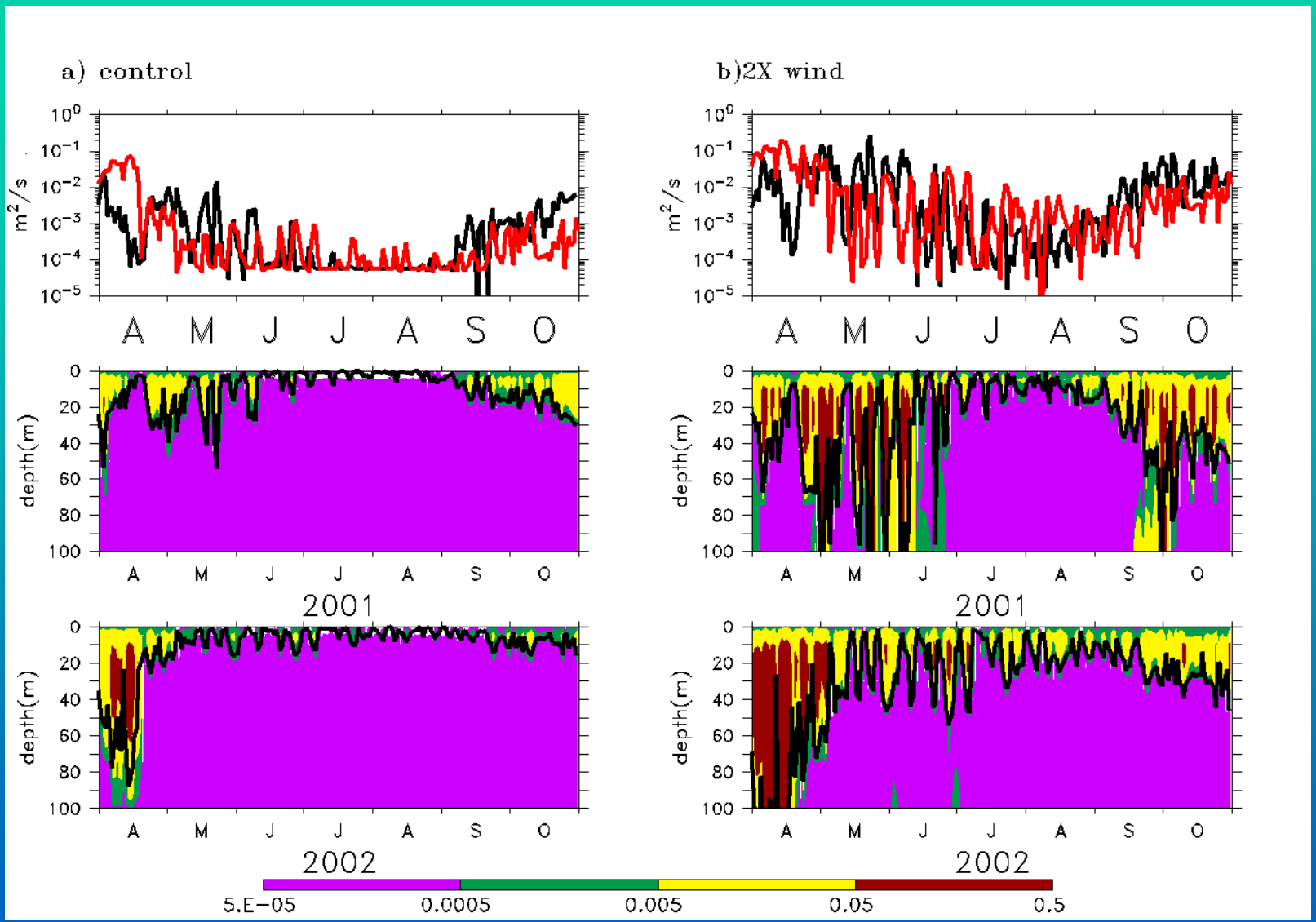
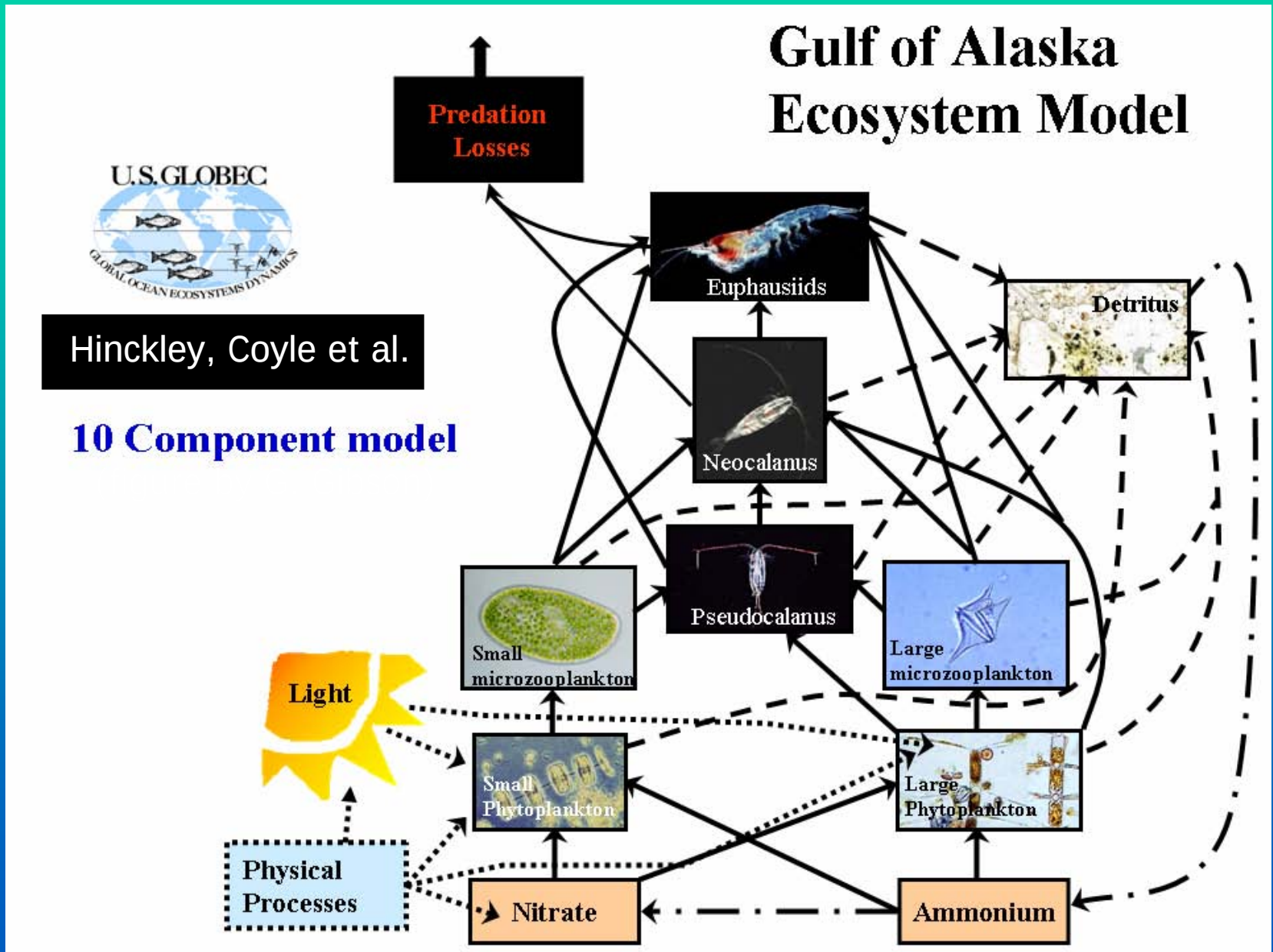


T at GAK6 as a function of depth and time

Vertical diffusivity of salinity at GAK6

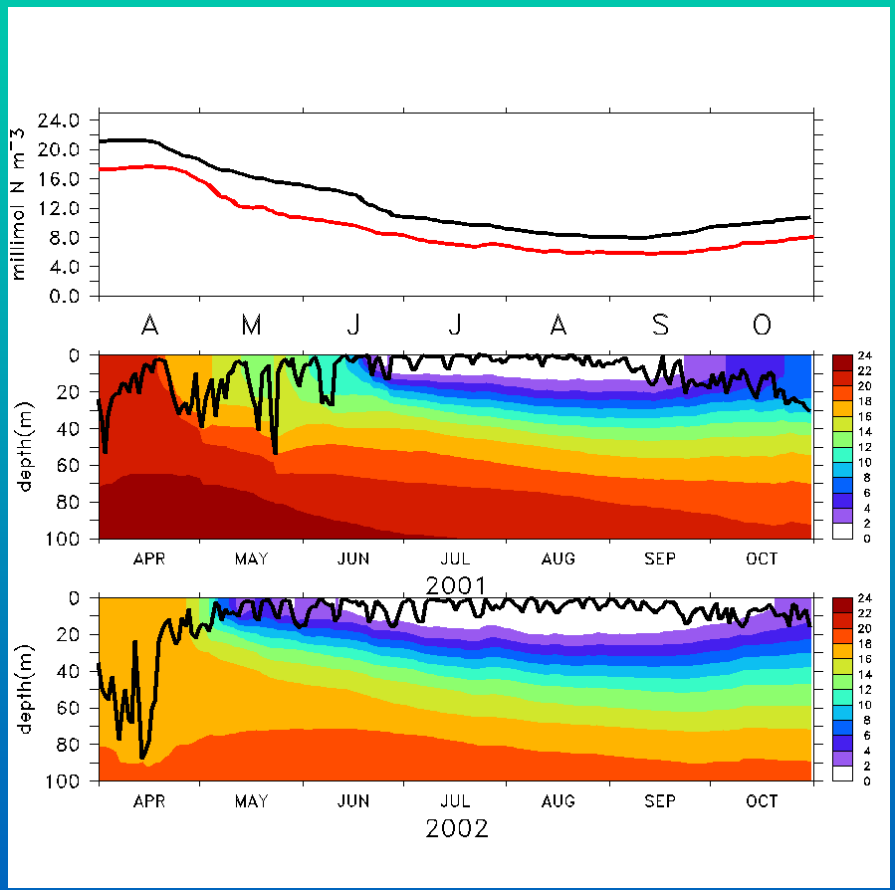


CGOANPZ model (Hinckley et al., in review)

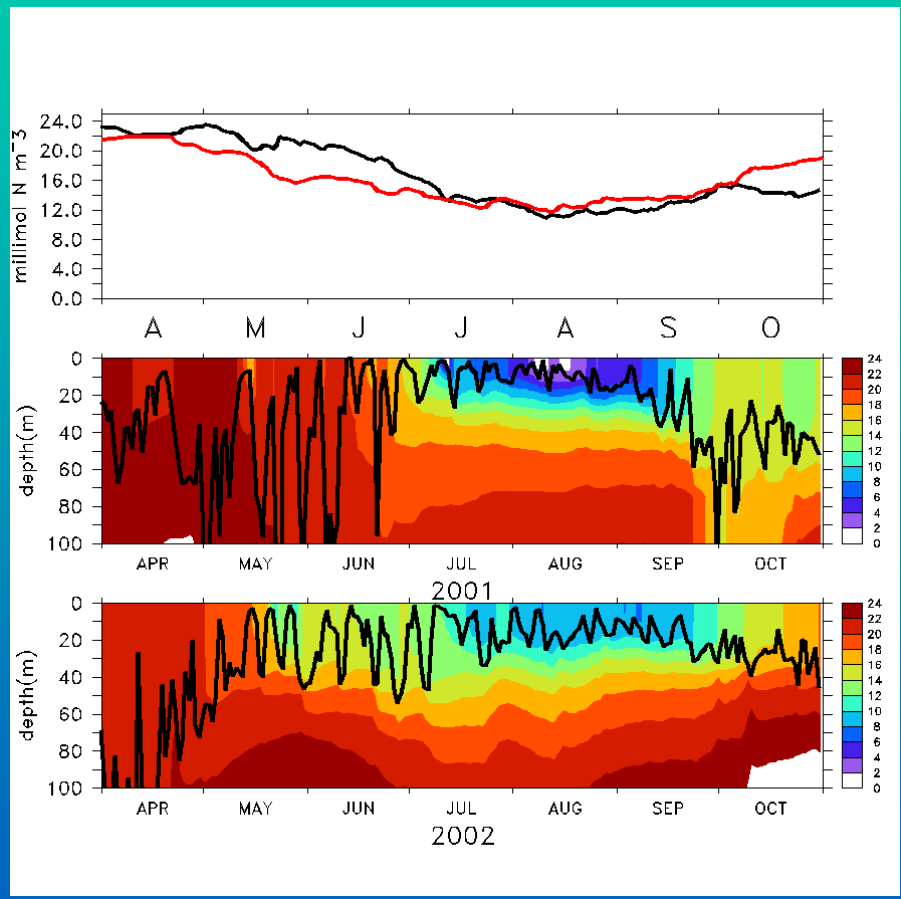


Nutrient (NO3) distribution

Control:

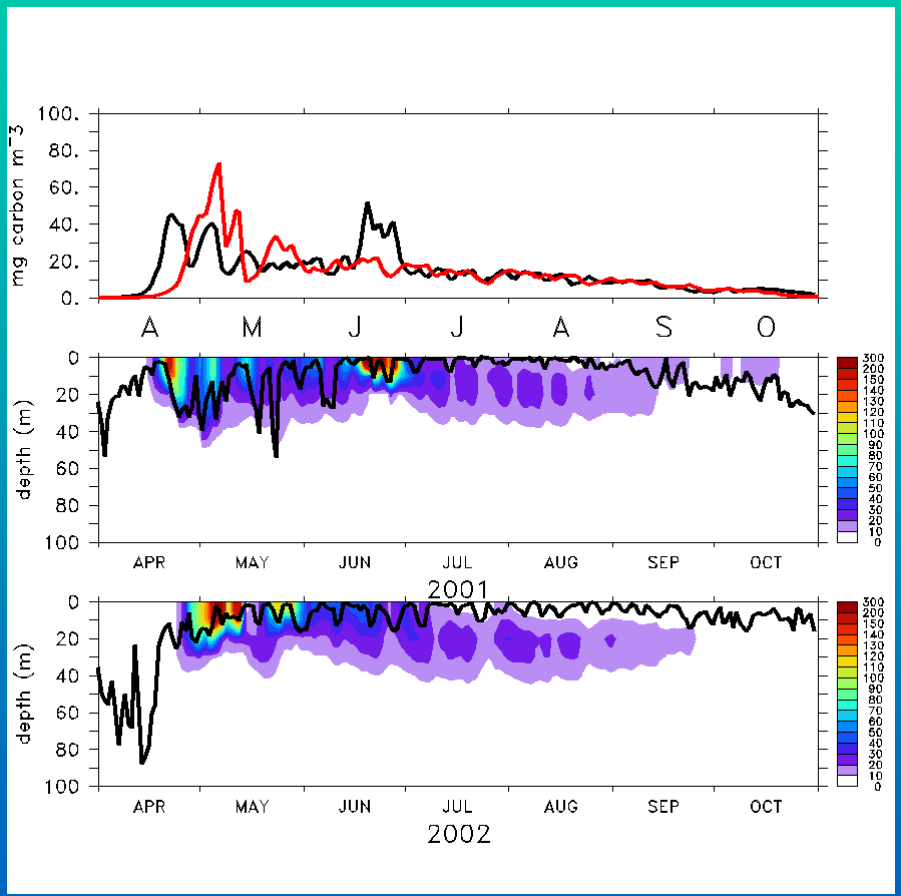


2X winds:

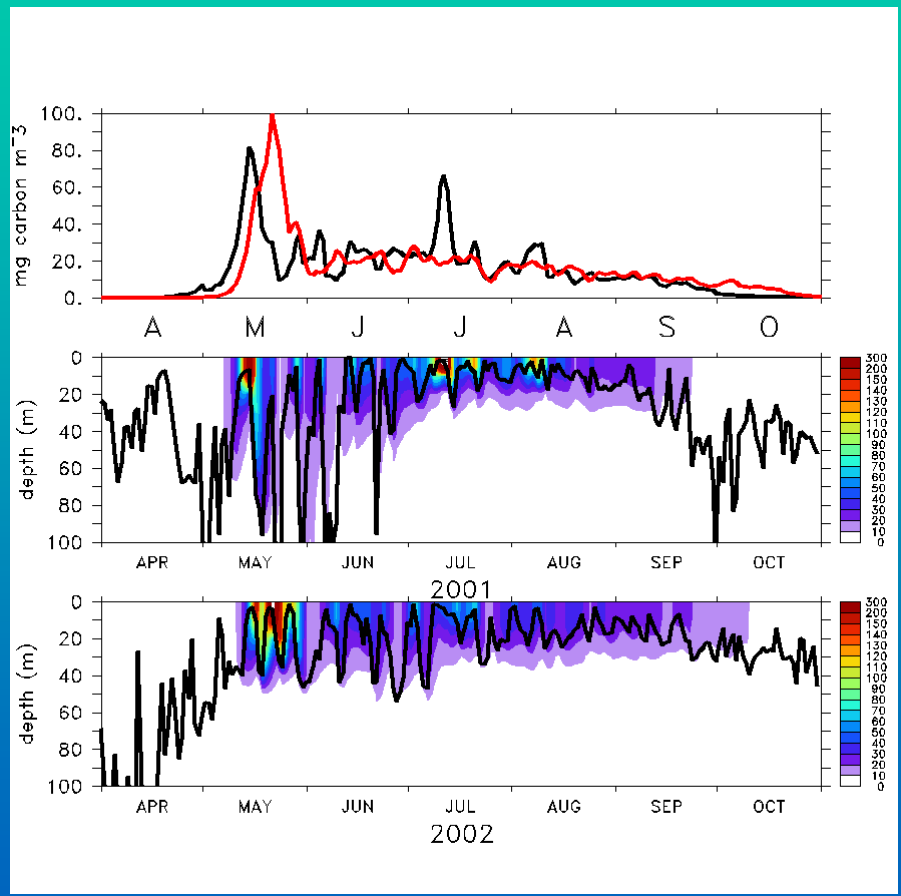


Total phytoplankton biomass: delayed bloom via light limitation?

Control:



2X wind:



Summary

The effect of surface wind changes on the CGOA ocean stratification and lower trophic level responses, in particular, the relative importance of wind stress curl versus wind induced mixing, is unclear.

Wind stress curl appears important for maintaining the sharp thermocline and ocean salinity stratification. This calls for use of high spatial resolution surface wind products.

Nutrient distribution and phytoplankton production respond strongly to changed wind, perhaps due to a combination of both effects.

Future work

Investigate changes in surface wind in the northeast Pacific in the IPCC models.

Improve model physics crucial for biological responses. Too weak thermocline gradient in the current model is a particular concern.

Extend model integration to longer period and investigate interannual variability in the CGOA; understand its relationship with surface wind forcing.