Quantifying cross-shelf and vertical nutrient flux in the Gulf of Alaska with a spatially nested, coupled biophysical model

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- Two major currents: Alaskan Stream and Alaska Coastal Current
- ACC forced by downwelling-favorable winds and distributed runoff
- Downwelling-favorable winds, yet very productive!
Nested Biophysical Models for GLOBEC:

NCEP/MM5 -> ROMS/NPZ -> IBM
The Circulation Models

- Regional Ocean Modeling System (ROMS)
- Primitive Equations
- Terrain-following vertical coordinates (30 vertical levels)
- LMD mixed layer physics
- COADS/NCEP/MM5 wind and heat forcing
- Implemented on massively parallel (distributed memory) computers
Compare velocity in Shelikof Strait with NEP model

TOTAL depth-integrated flux (m^3/s)
Compare density at GAK line with CGOA model
Mar 2001

DATA

MODEL
NPZ model
(arrows indicate nitrogen flux)

- Nutrients (Nitrate, Ammonium, Iron)
- Phytoplankton (Small and Large)
- Microzooplankton (Small and Large)
- Copepods (Small, Large Oceanic)
- Euphausiids
- Iron
- Detritus
Wind stress vectors and curl (shaded) in 2001

April 15 – May 15 2001

Using CGOA-NPZ model, calculate **NO3 budget**

*in top 15m* (~euphotic zone) for this area
Surface NO3 and velocity May 1, 2001

IF (NO3M[K=30] LT 0) THEN 0 ELSE NO3M[K=30]
Horizontal NO3 advection May 1, 2001

(NFLX_X_B*2 + NFLX_Y_B*2)^.5
Vertical NO3 advection May 1, 2001

Contour: NFLX\_Z[Z=15]*SHELFMASK
Horizontal advection

Vertical advection

Vertical diffusion

Amatuli Trough May 01, 2001
Why upwelling in spring? The cross-shelf scenario

- Western outflow > Eastern inflow
- Input of water from deep basin
- Flow at mid-depth goes up canyons
- Upwelling in spring!

Mid-depth NO3 and velocity

April 15 - May 15, 2001
Summary

• Approximate advective balance
• Vertical diffusion is the biggest term on the shelf as a whole
• Onshelf flow and vertical advection feed the alongshore deficit
• Upwelling in the spring!