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

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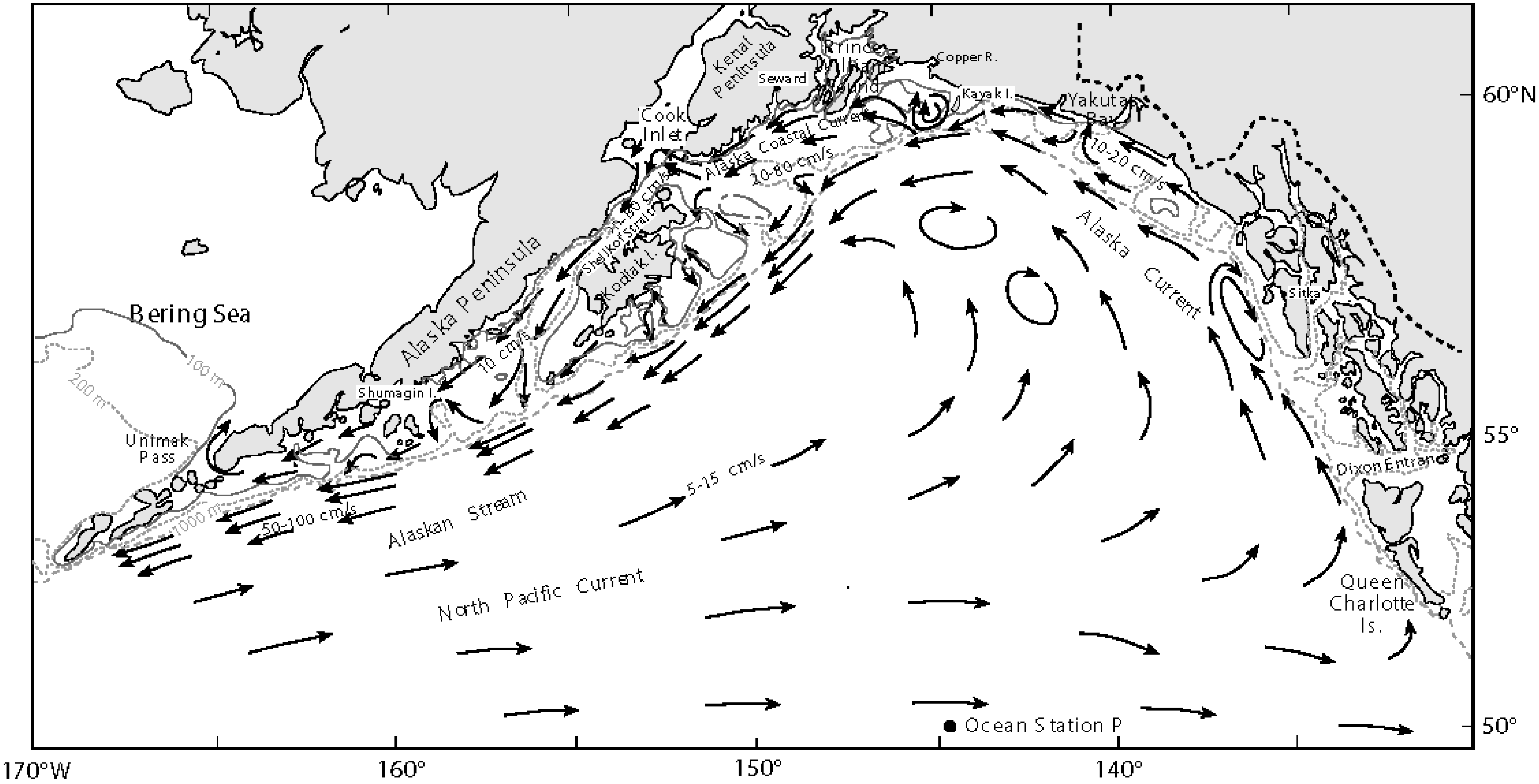
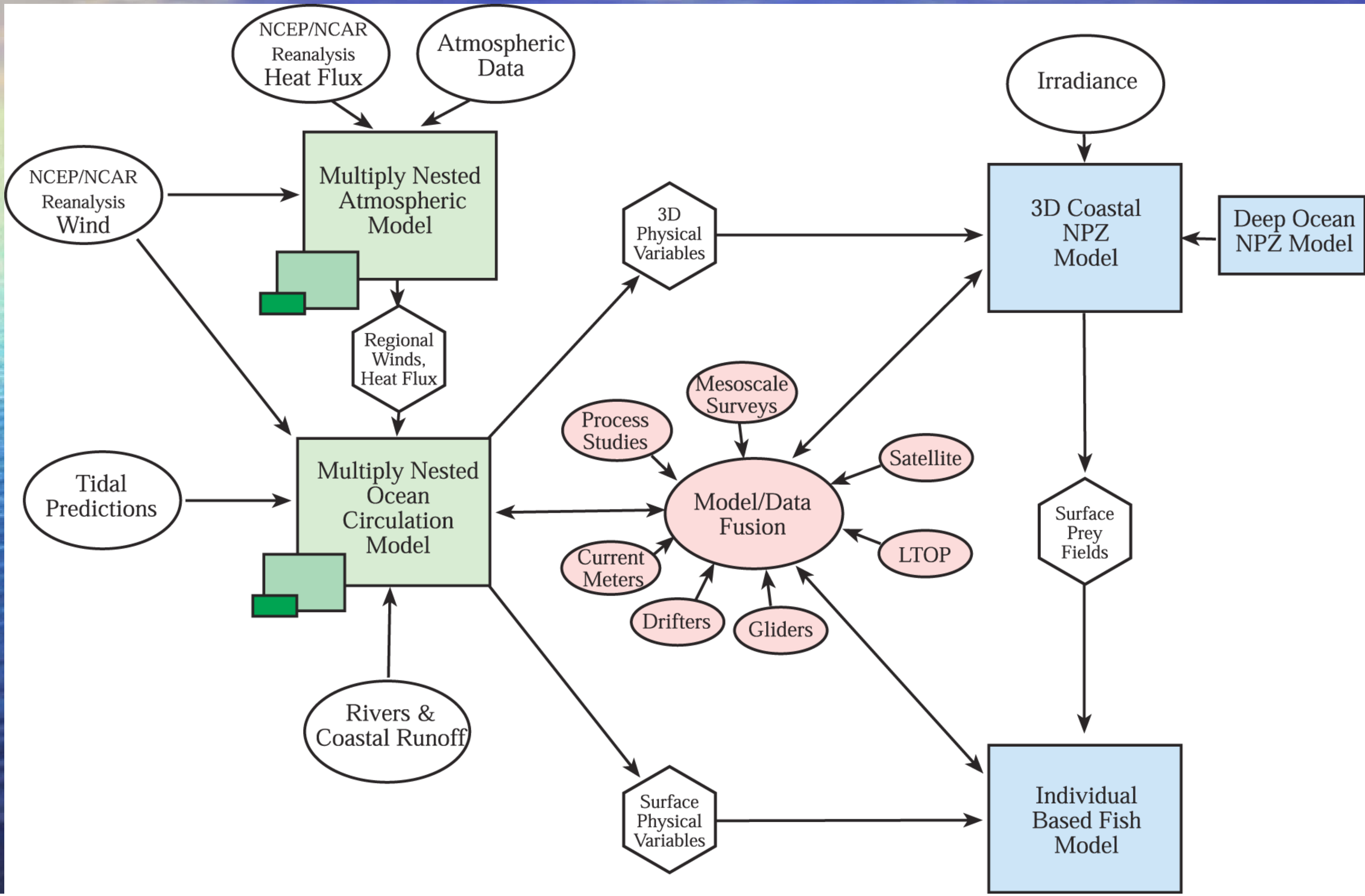
- Two major currents: Alaskan Stream and Alaska Coastal Current
- ACC forced by downwelling-favorable winds and distributed runoff
- Downwelling-favorable winds, yet very productive!



Nested Biophysical Models for GLOBEC:

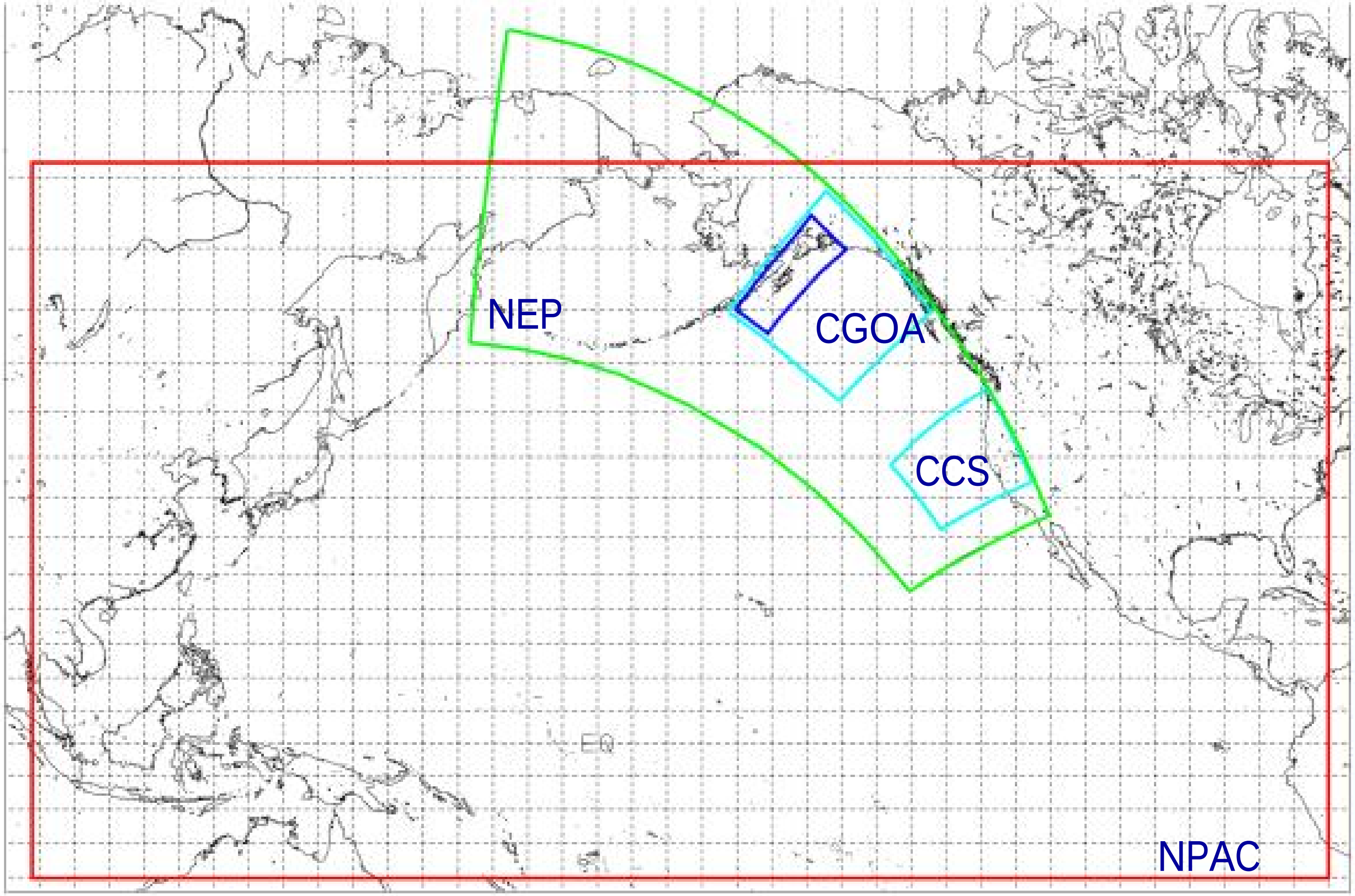
NCEP/MM5 -> ROMS/NPZ -> IBM



The Circulation Models

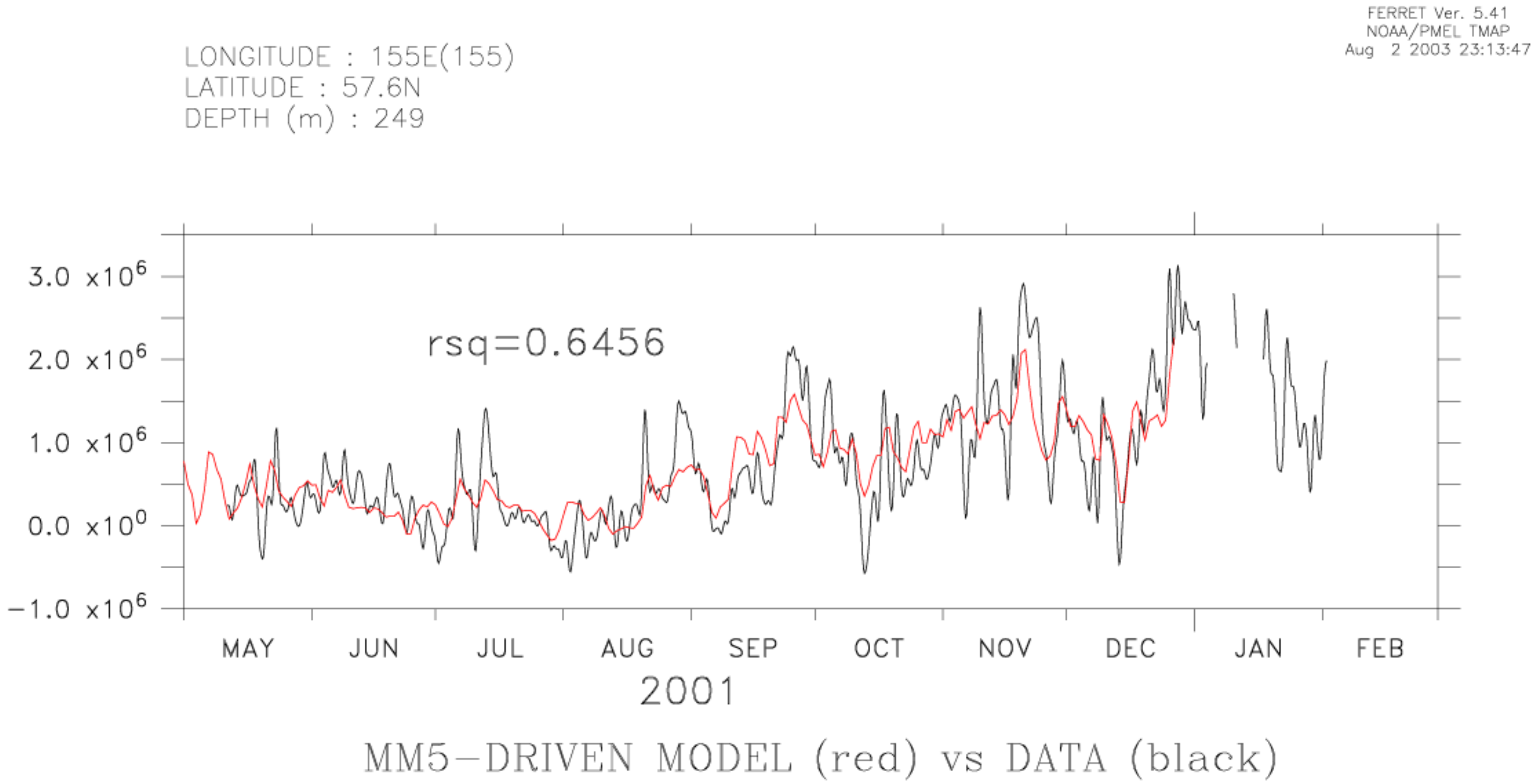
- Regional Ocean Modeling System (ROMS)
- Primitive Equations
- Terrain-following vertical coordinates (30 vertical levels)
- LMD mixed layer physics
- COADS/NCEP/MM5 wind and heat forcing
- Implemented on massively parallel (distributed memory) computers

NESTED CIRCULATION MODEL DOMAINS



Delta x = 20 40 km   Delta x = 10 km   Delta x = 3 km   Delta x = 1 km

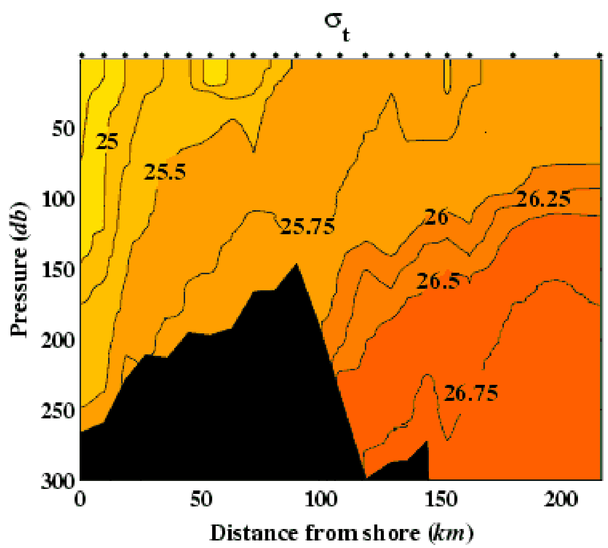
Compare velocity in Shelikof Strait with NEP model

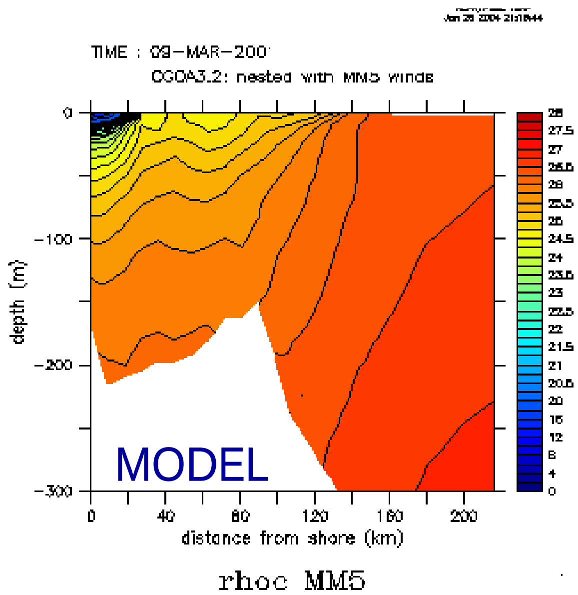


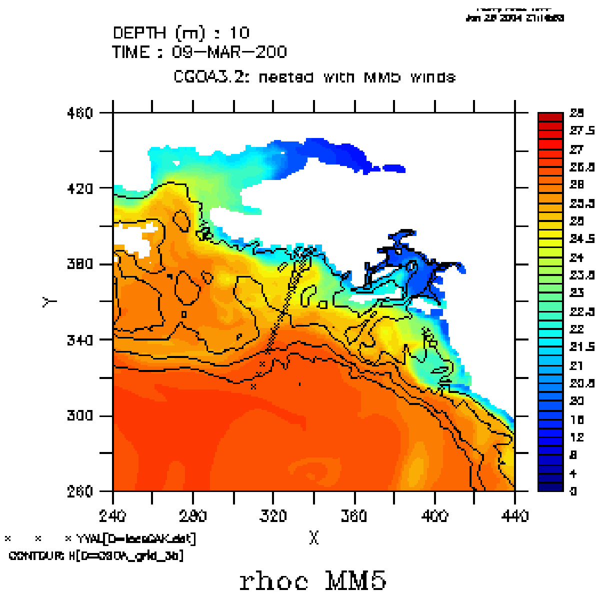
TOTAL depth-integrated flux (m^3/s)

Compare density at GAK line with CGOA model
Mar 2001

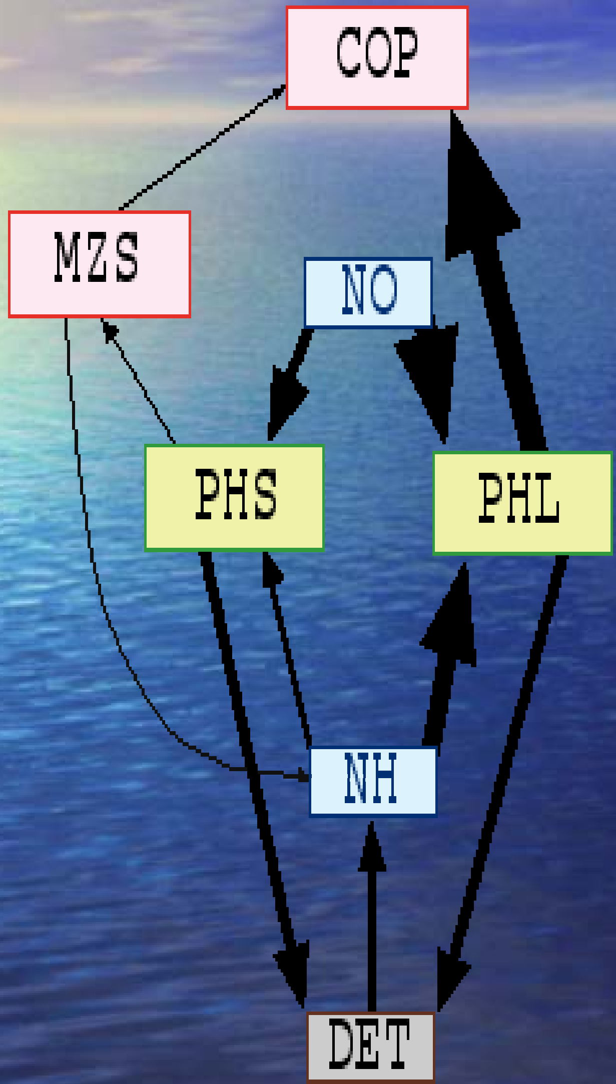
DATA







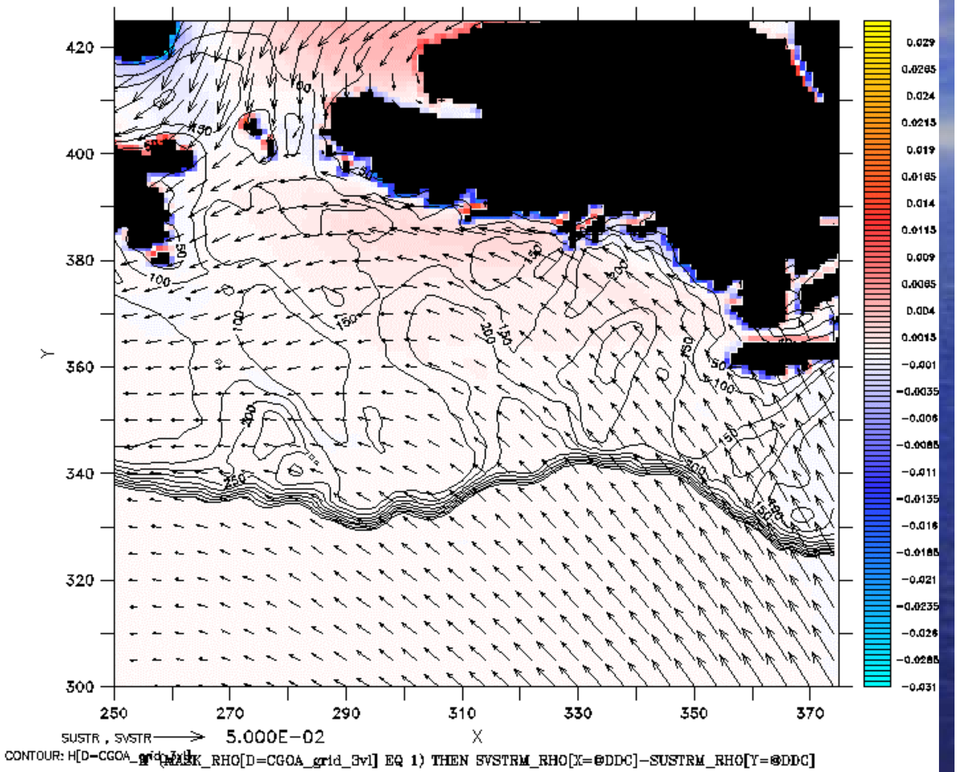
NPZ model
(arrows indicate *nitrogen flux*)



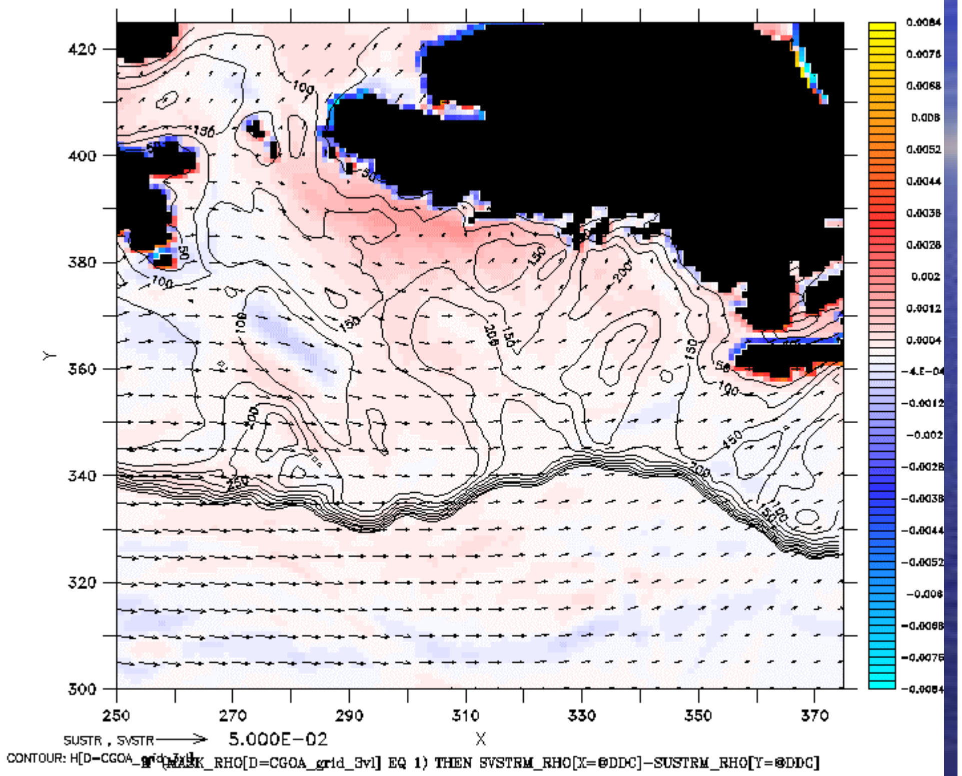
- *Nutrients (Nitrate, Ammonium, Iron)*
- *Phytoplankton (Small and Large)*
- *Microzooplankton (Small and Large)*
- *Copepods (Small, Large Oceanic)*
- *Euphausiids*
- *Iron*
- *Detritus*

Wind stress vectors and curl (shaded) in 2001

April 15 – May 15 2001

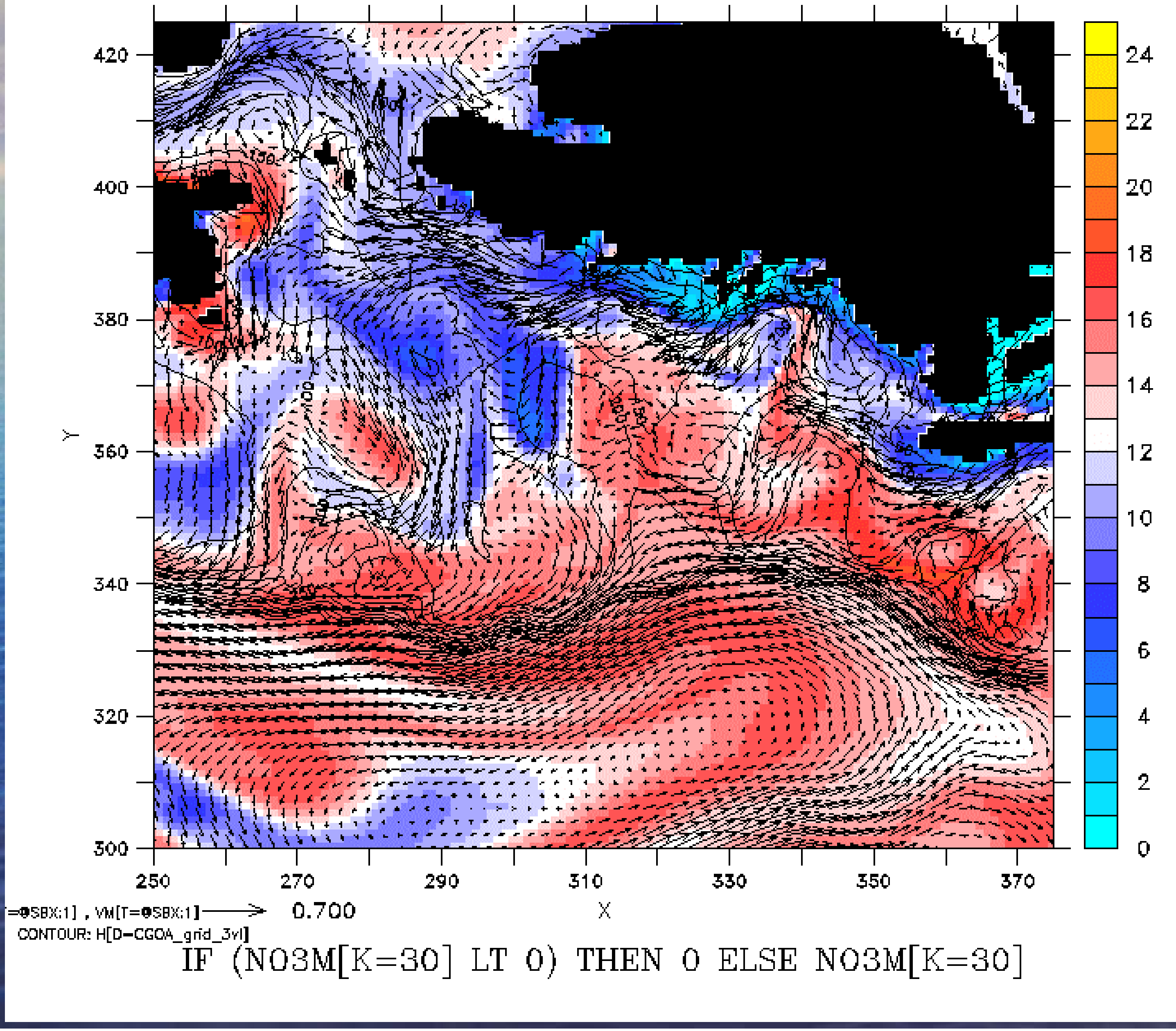


July 15 – Aug 15 2001

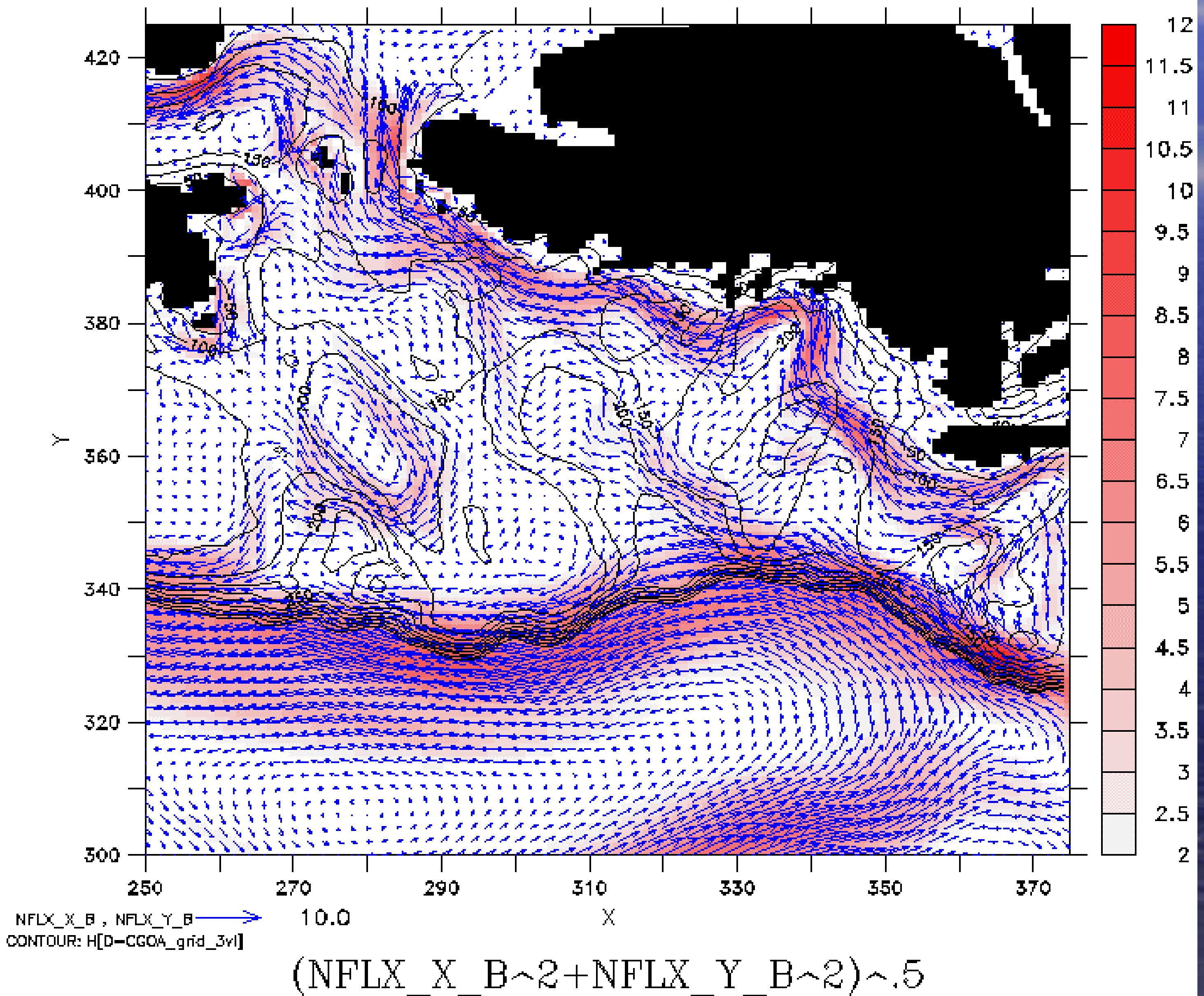


Using CGOA-NPZ model, calculate ***NO3 budget in top 15m*** (~euphotic zone) for this area

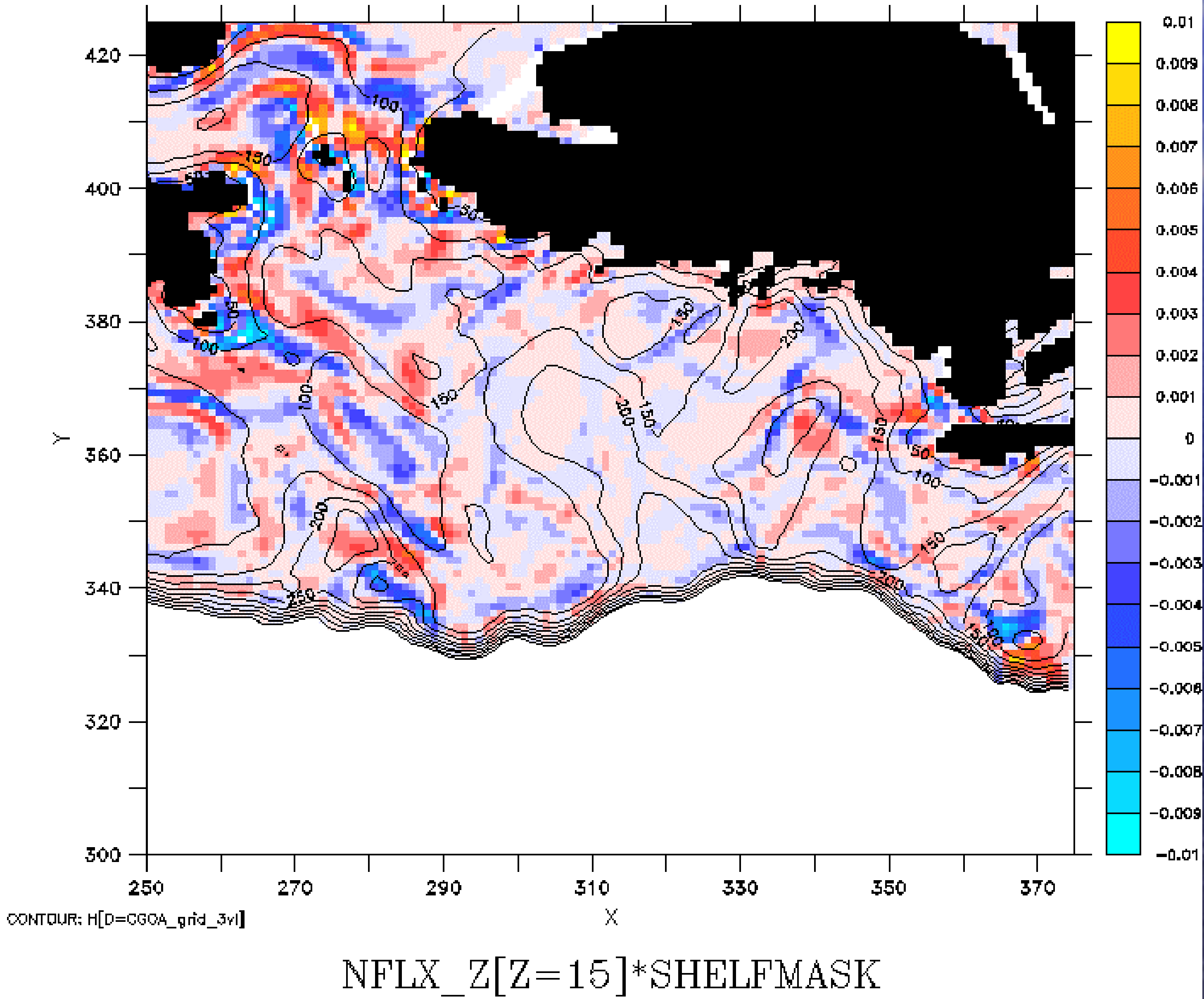
Surface NO3 and velocity May 1, 2001



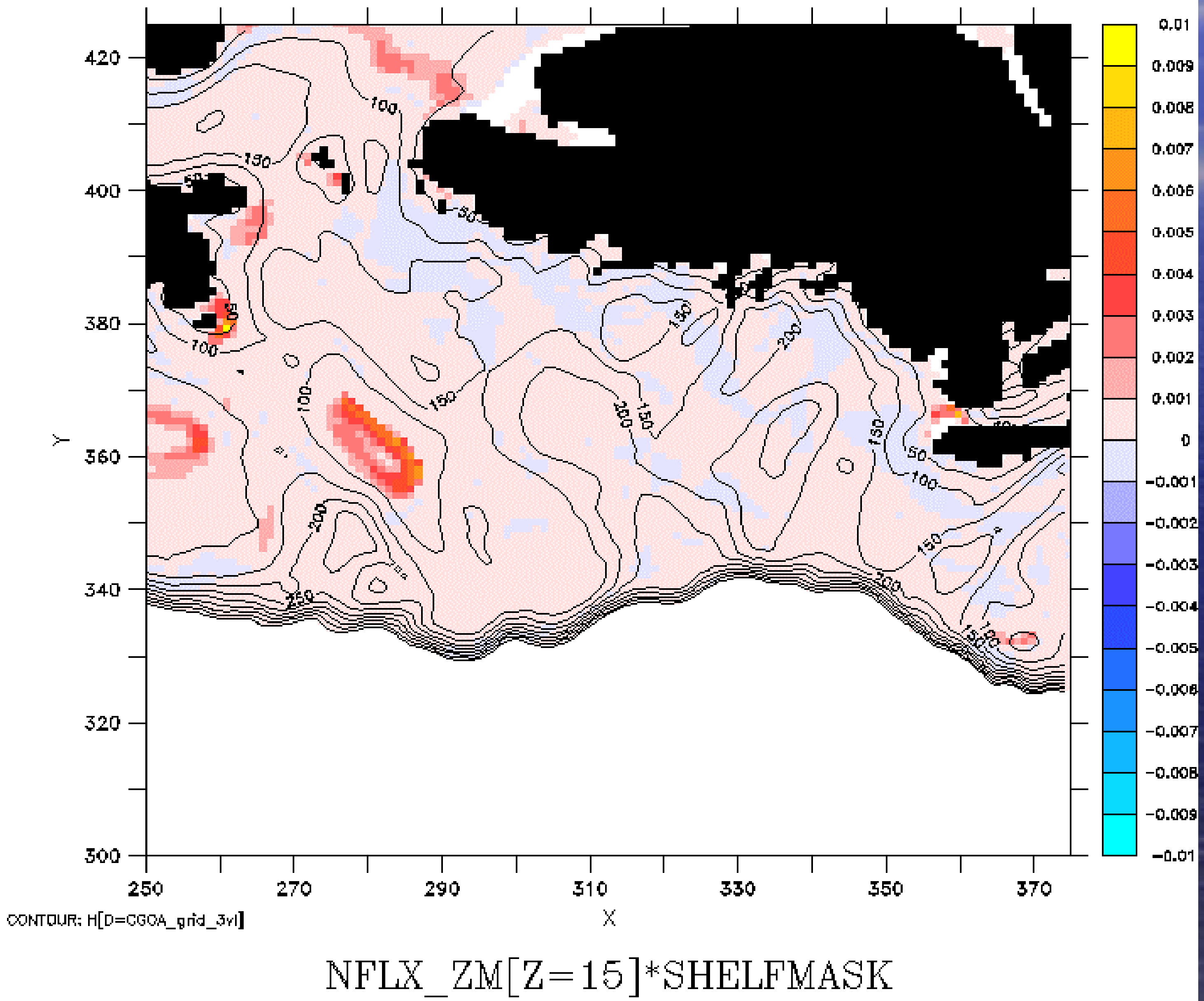
Horizontal NO3 advection May 1, 2001



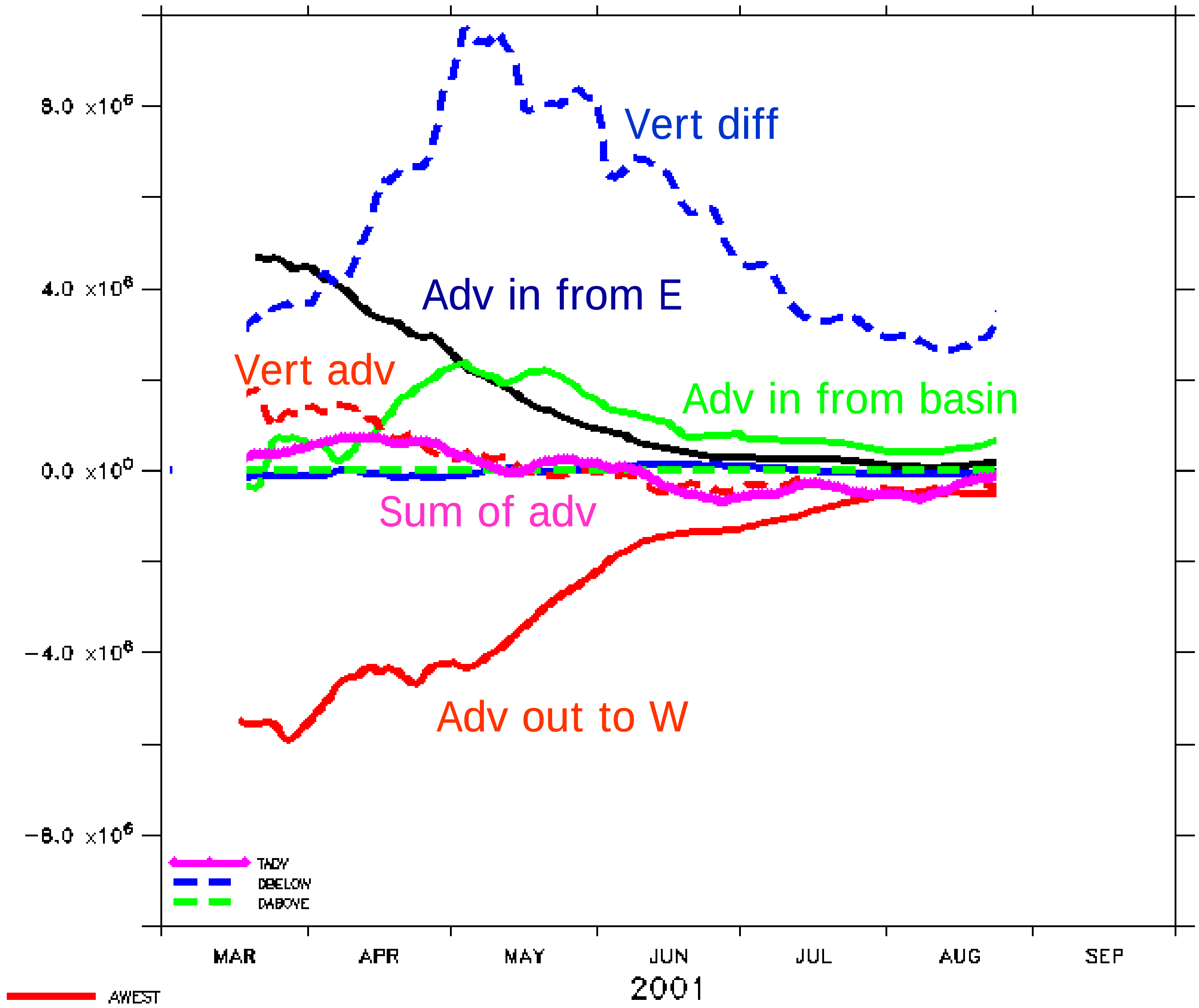
Vertical NO3 advection May 1, 2001



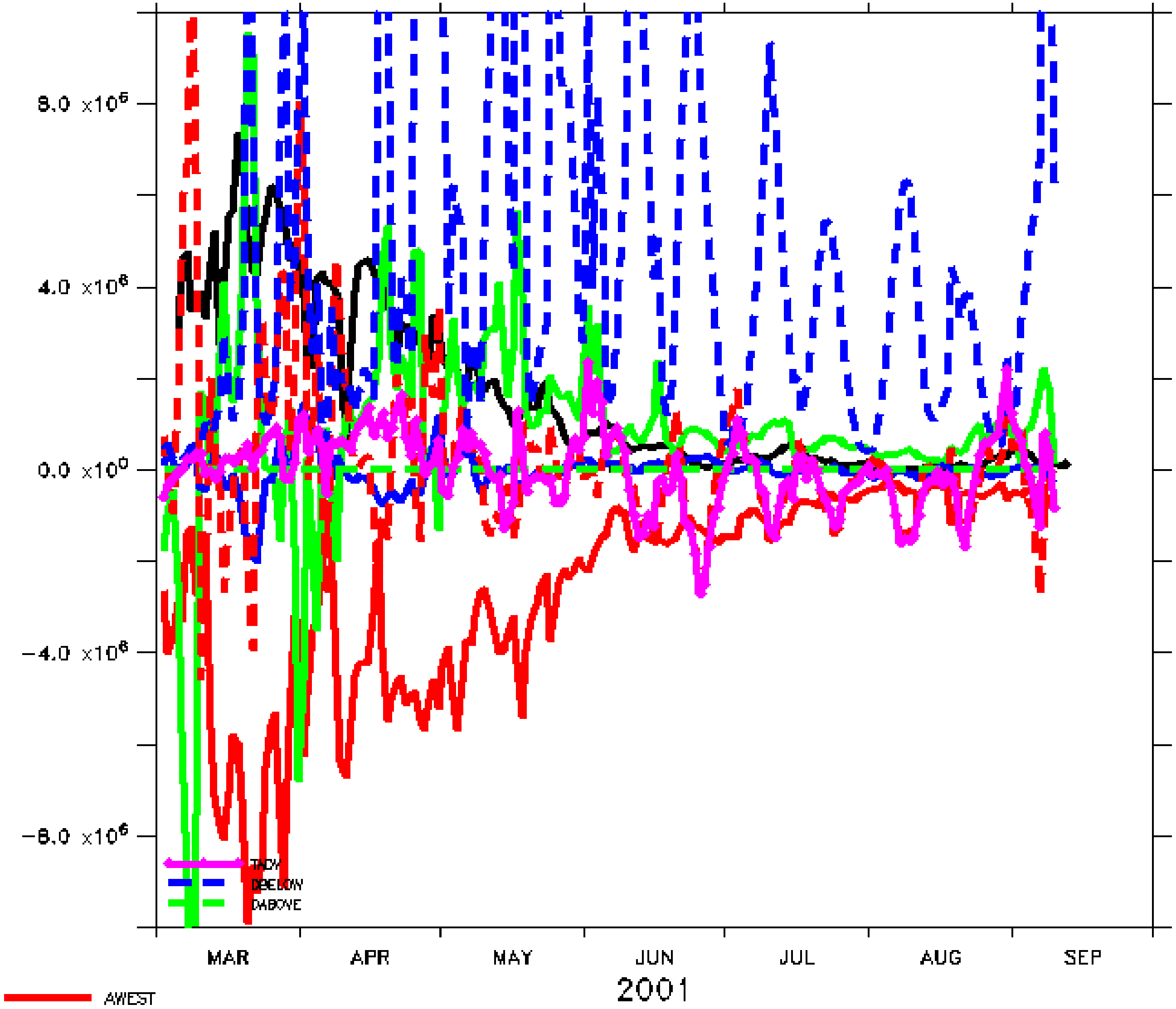
Vertical NO3 diffusion May 1, 2001



NO3 flux summary (lowpass)

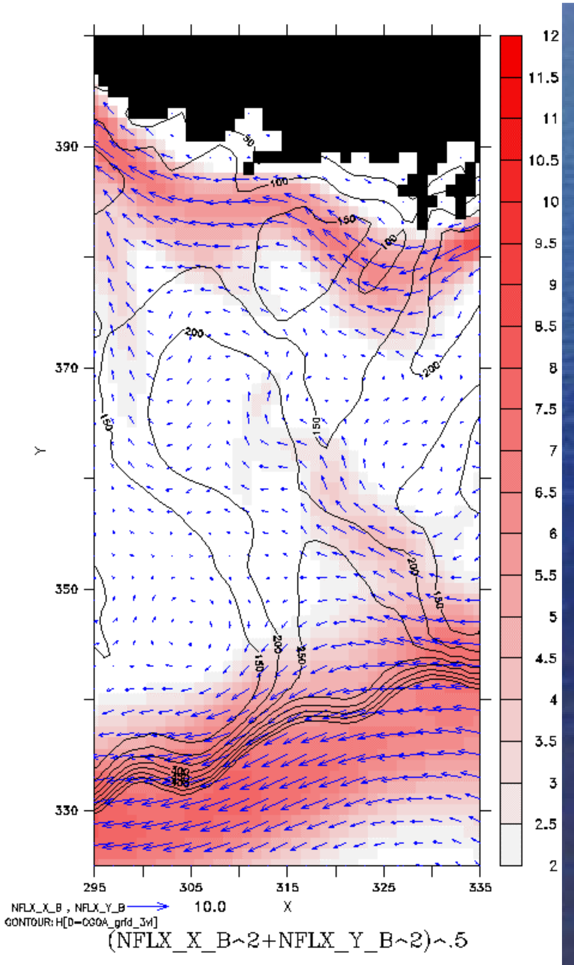


NO3 flux summary (unfiltered)

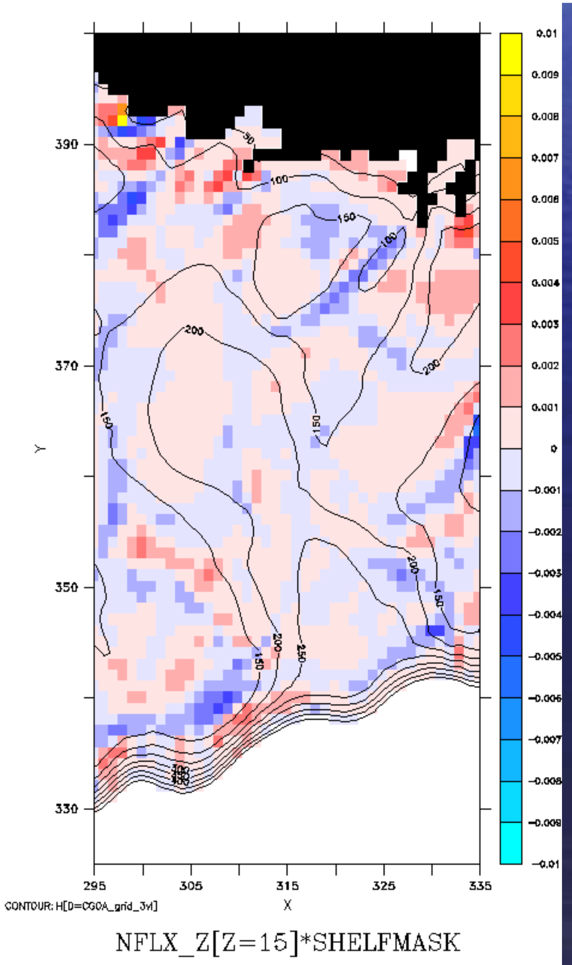


Amatuli Trough May 01, 2001

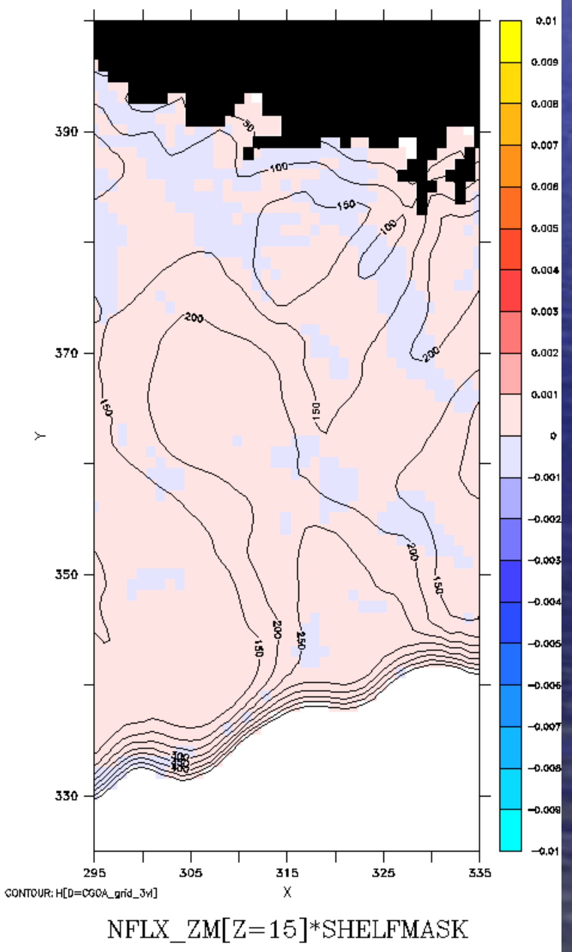
Horizontal advection



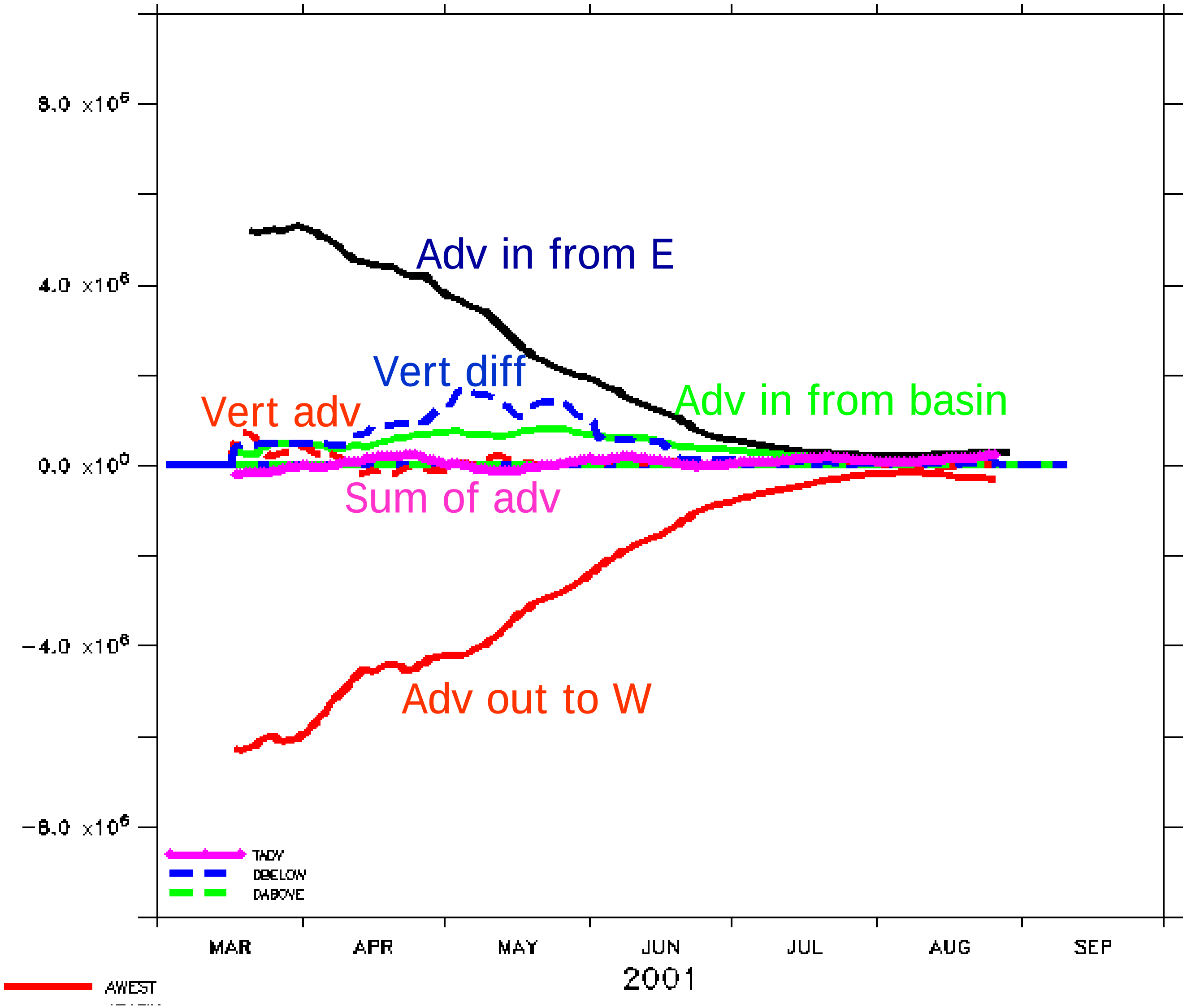
Vertical advection



Vertical diffusion



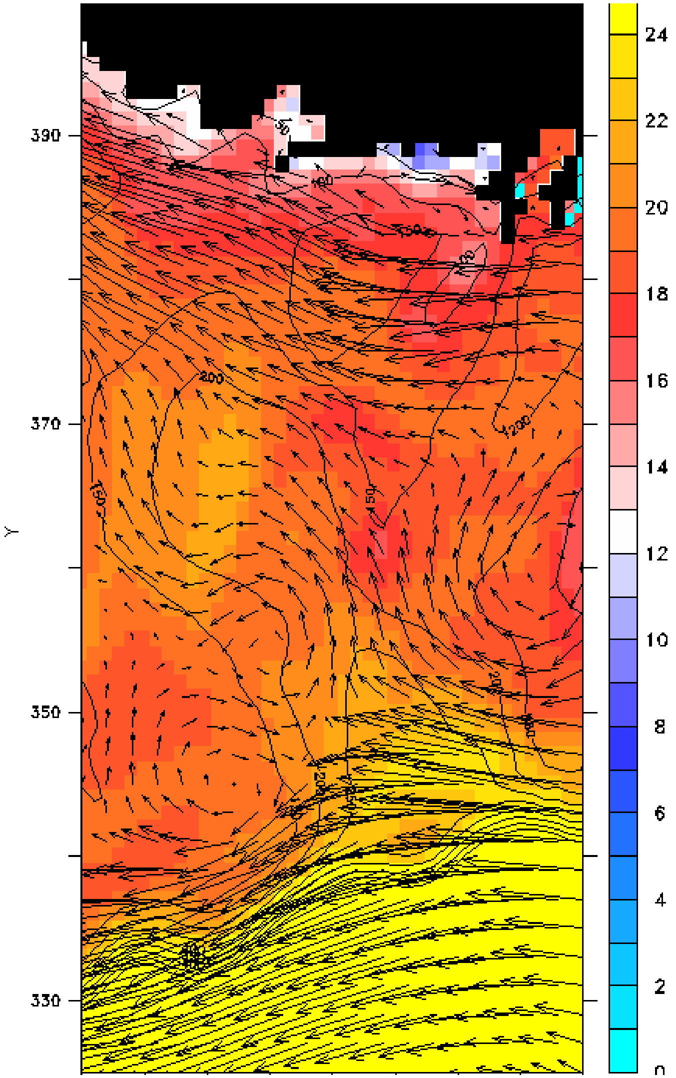
Amatouli NO3 flux summary (lowpass)



Why upwelling in spring? The cross-shelf scenario

Mid-depth NO3 and velocity

April 15 – May 15, 2001



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

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!