Results from the latest 0.°1 eddying ocean-only simulation: Physical Circulation and CFCs

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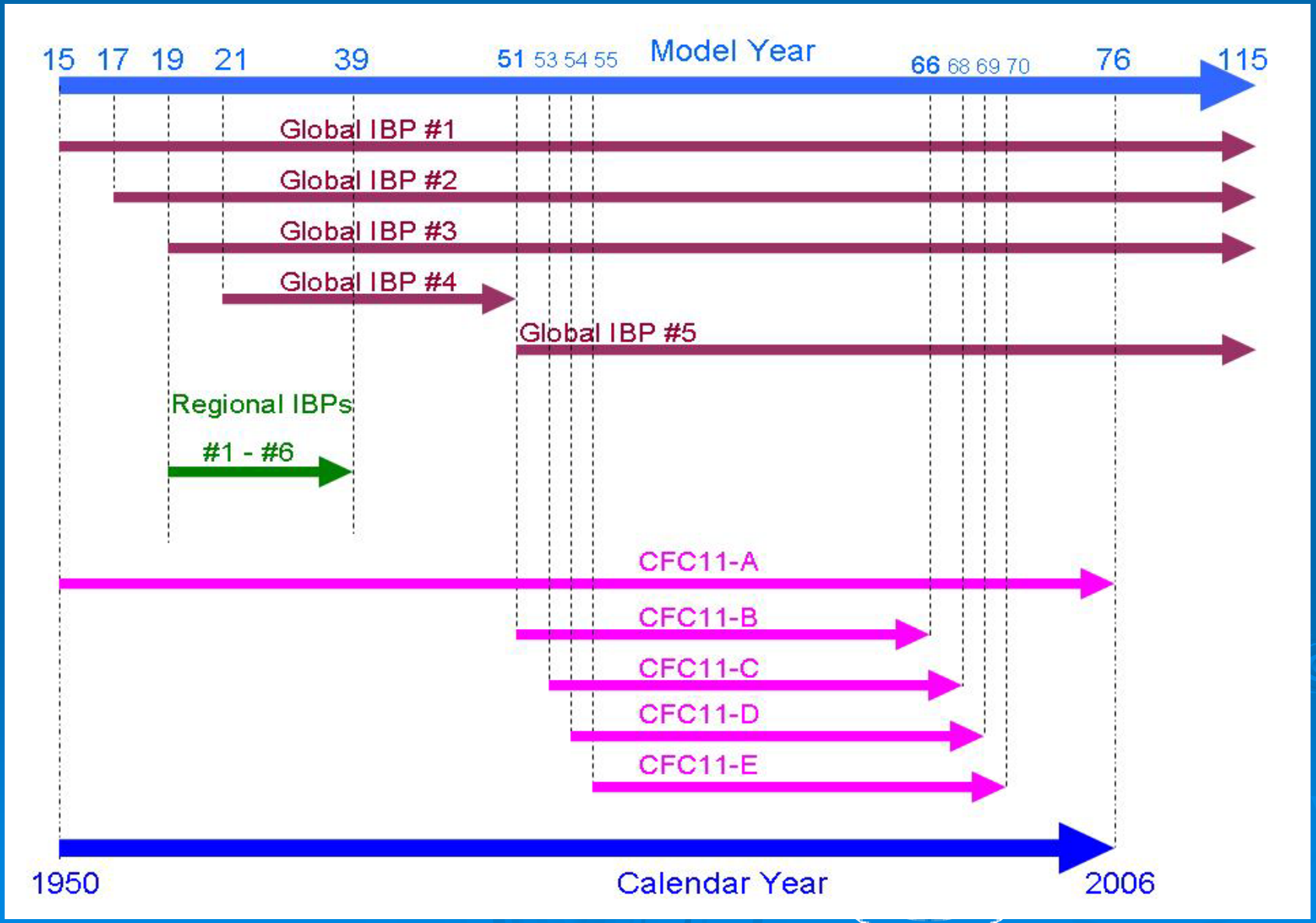
POP Configuration: changes from MM05

- 0.1° tripole (3600x2400)
- 42 levels (max depth 6000m)
- Partial bottom cells (Adcroft et al., 1997)
- Longer timestep
- Reduced biharmonic viscosity & diffusivity (T&S)
- WOCE SAC hydrography initial condition
- Monthly mean normal year CORE forcing
- Included a suite of tracers (TTDs and CFCs)
- Flux limited Lax-Wendroff advection of passive tracers
- 120-year integration

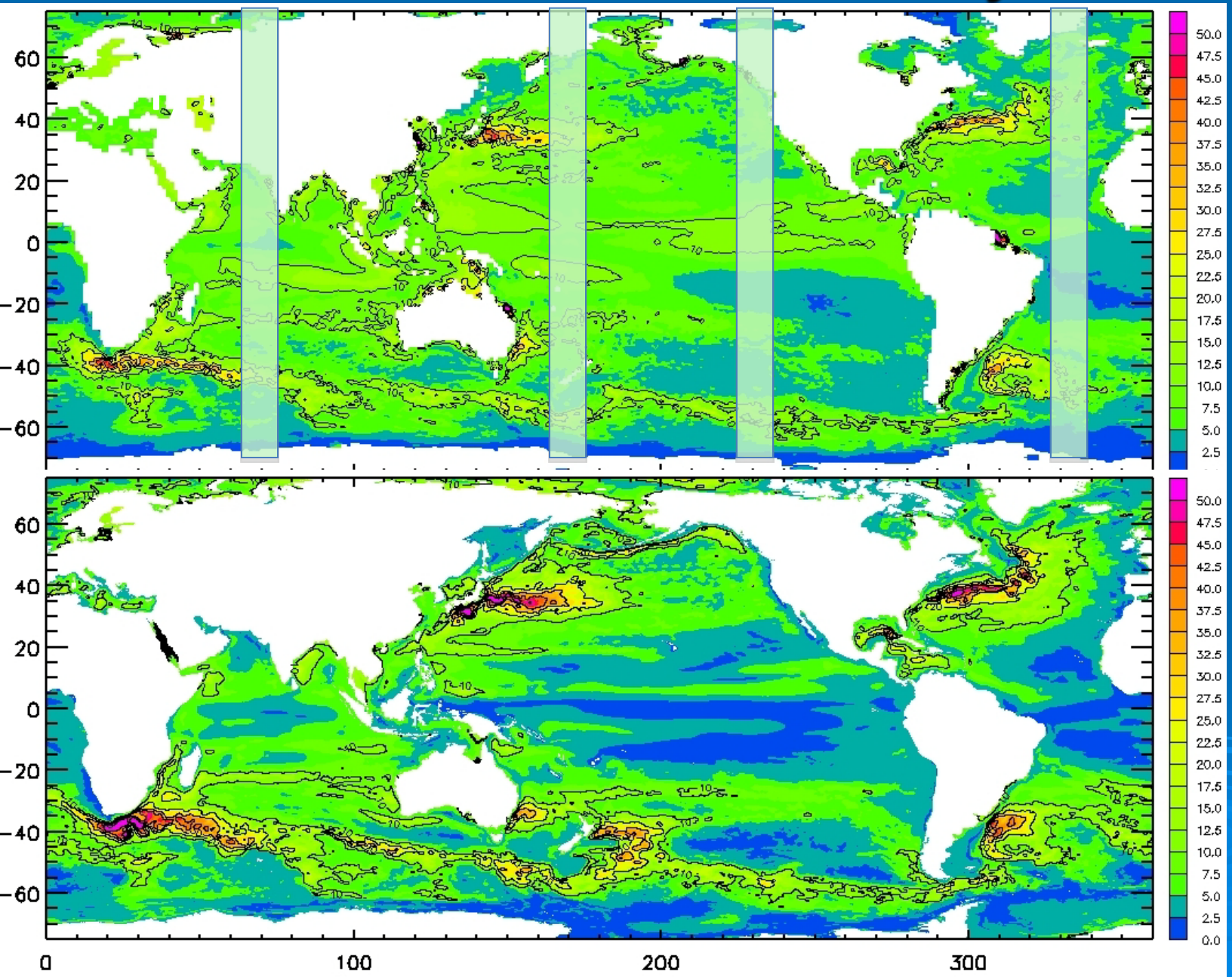
Tracer Configuration



Notable Successes

- First century-scale global eddying ocean simulation carrying multiple tracers
- Northwest Corner
- Nordic Seas
- Deep Western Boundary Current
- Equatorial Current System
- Indonesian Throughflow
- Kuroshio Variability
- CFC distribution and variability

SSHA Variability

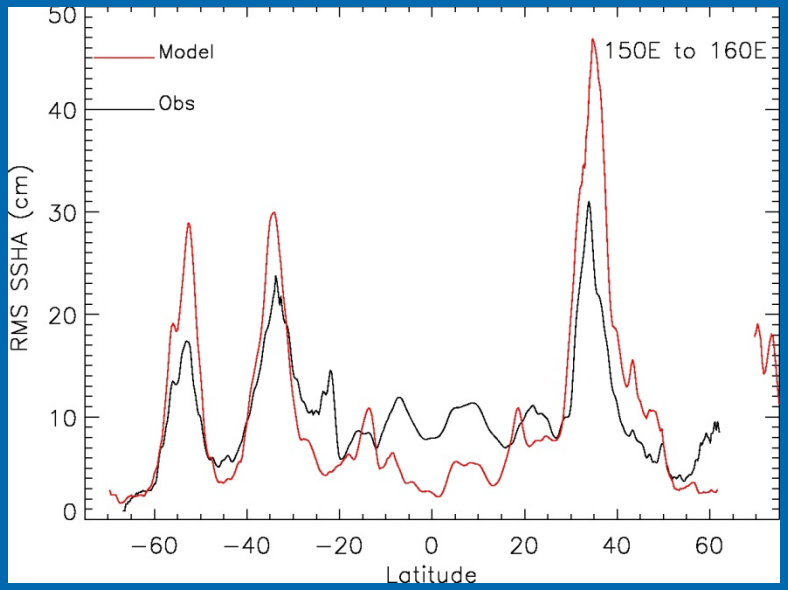


AVISO (observed)

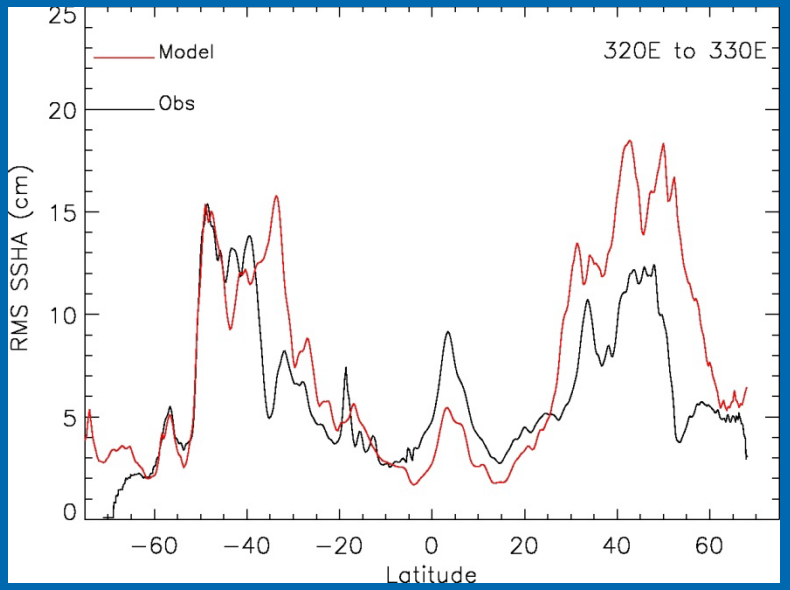
Model

RMS SSHA

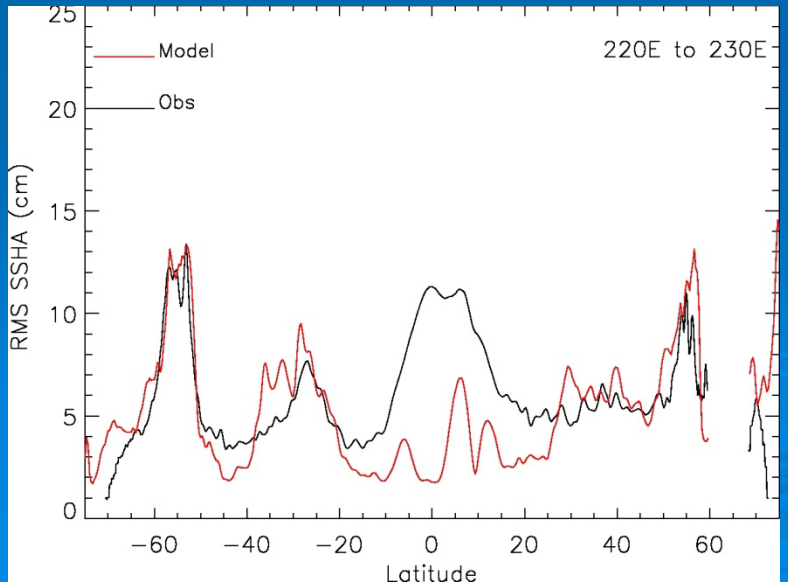
Western Pacific



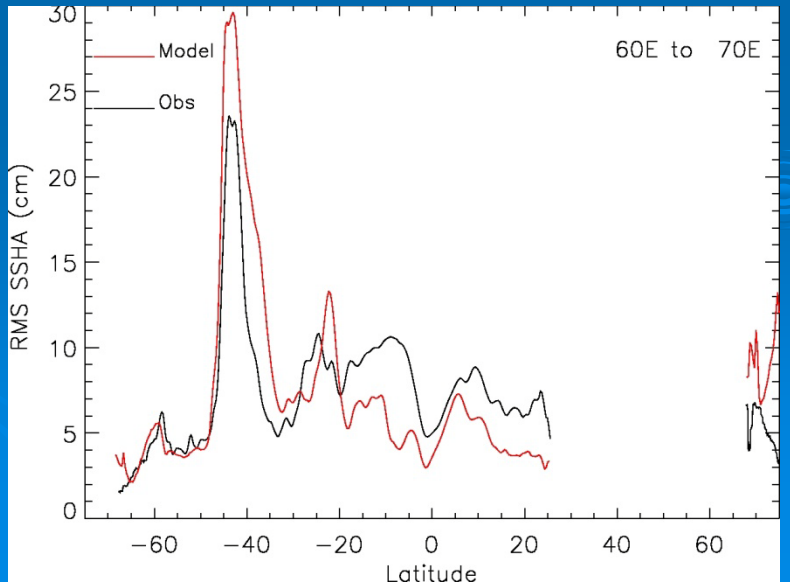
Atlantic



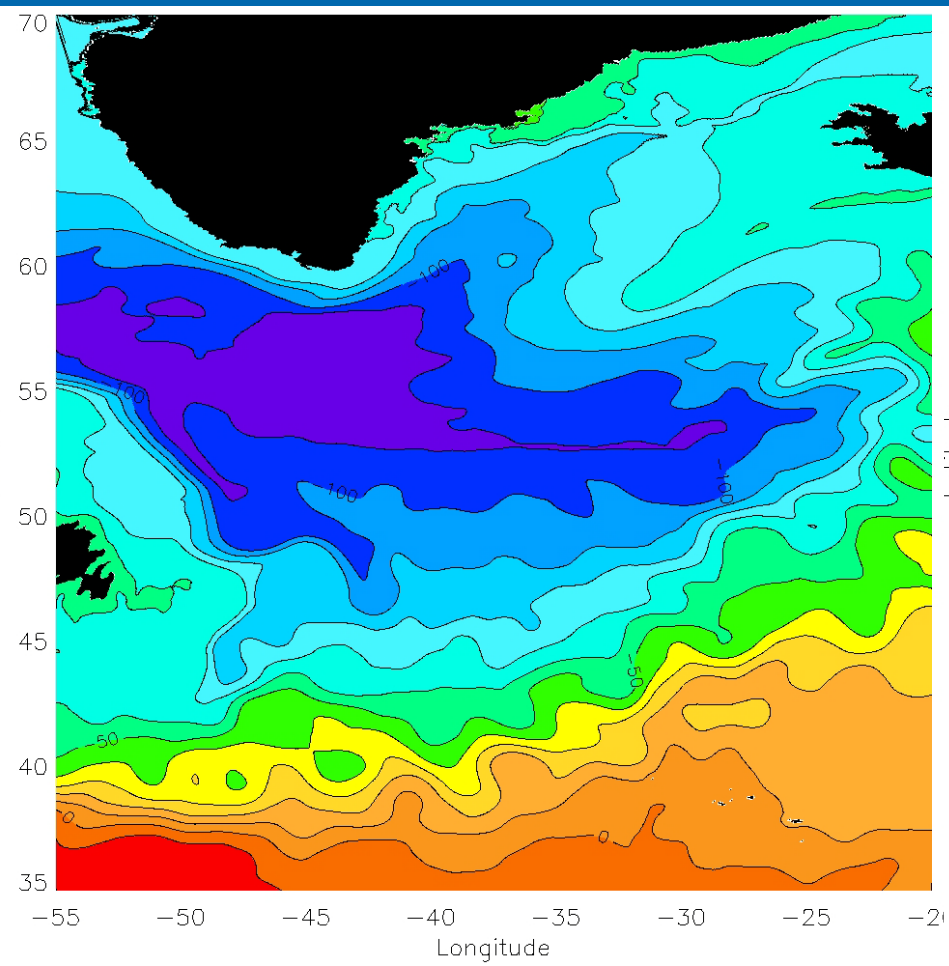
Eastern Pacific

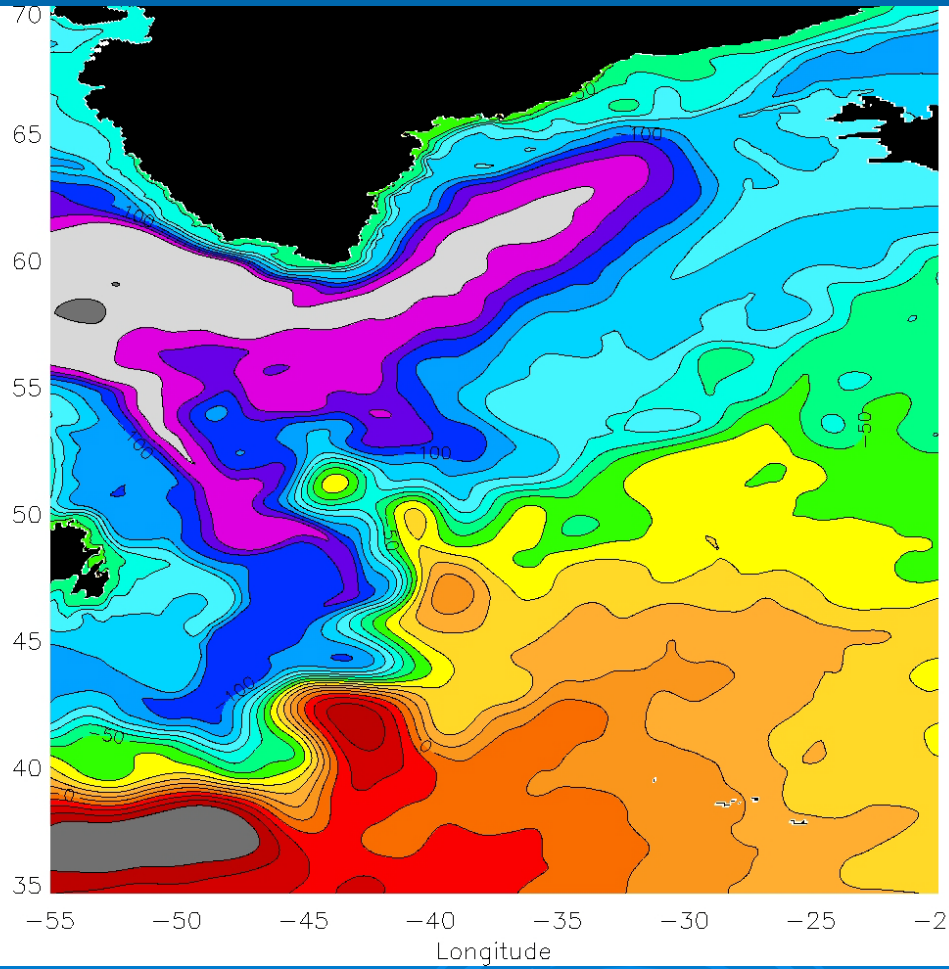


Indian



North Atlantic Current

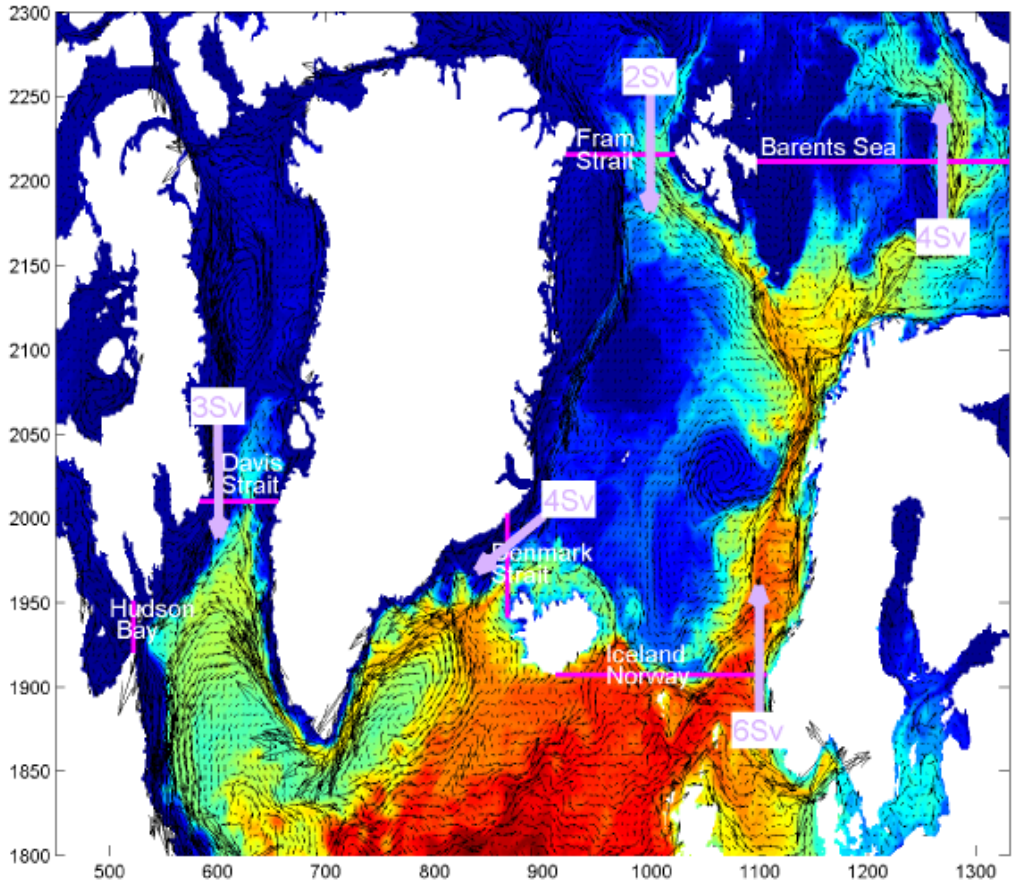


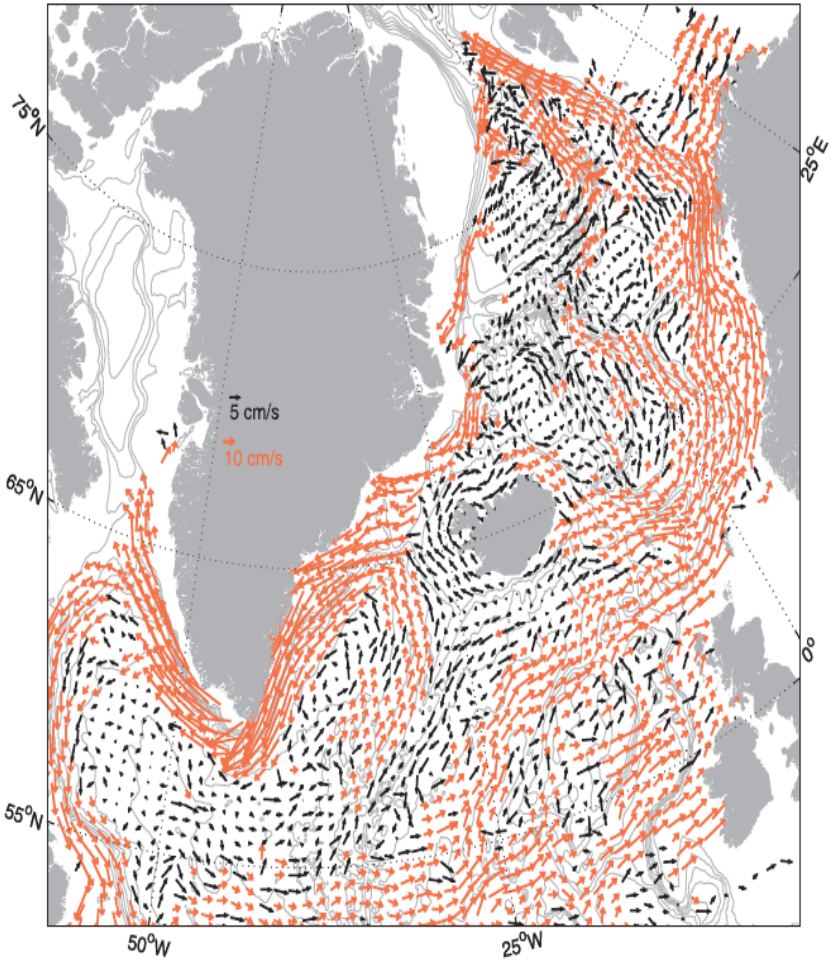


Maltrud & McClean(2005)

Present Simulation

Nordic Seas

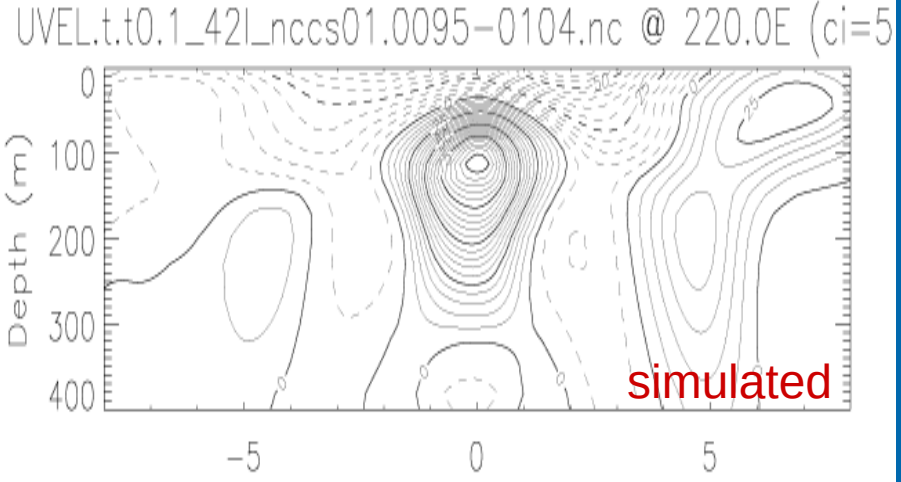




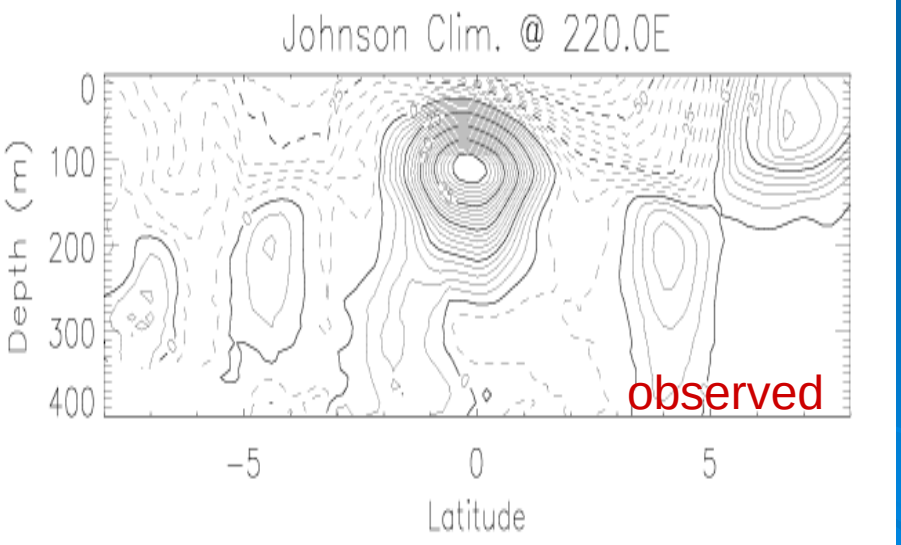
Model SST and 5-yr average velocity field

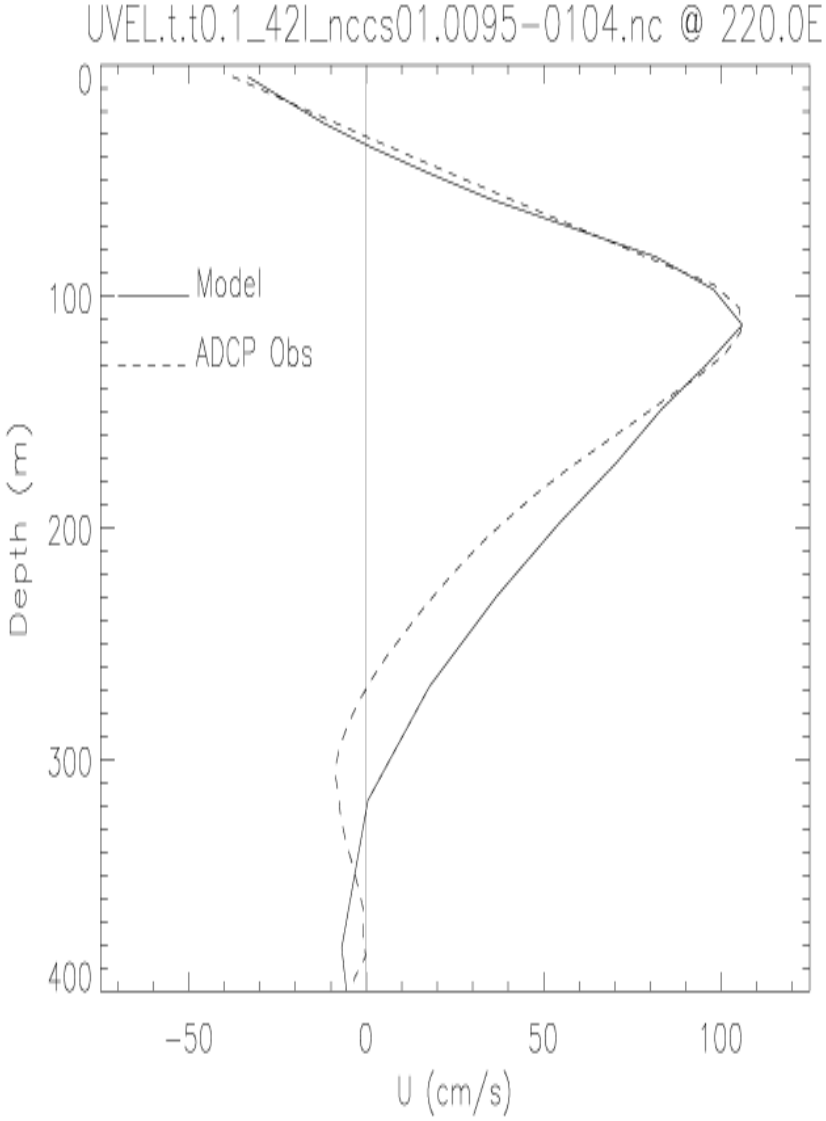
Jakobsen et al 2003, JGR

Equatorial Undercurrent at 220°E



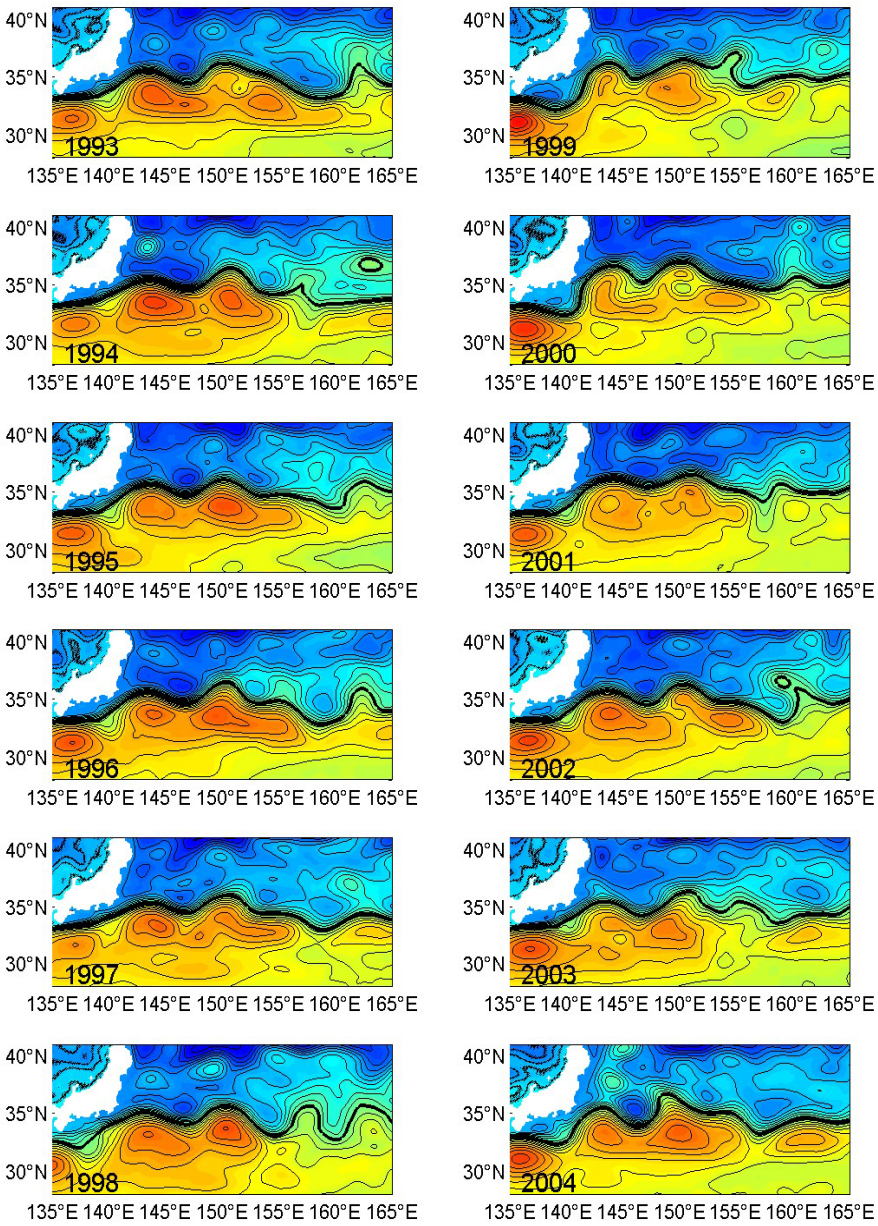
Zonal Velocity

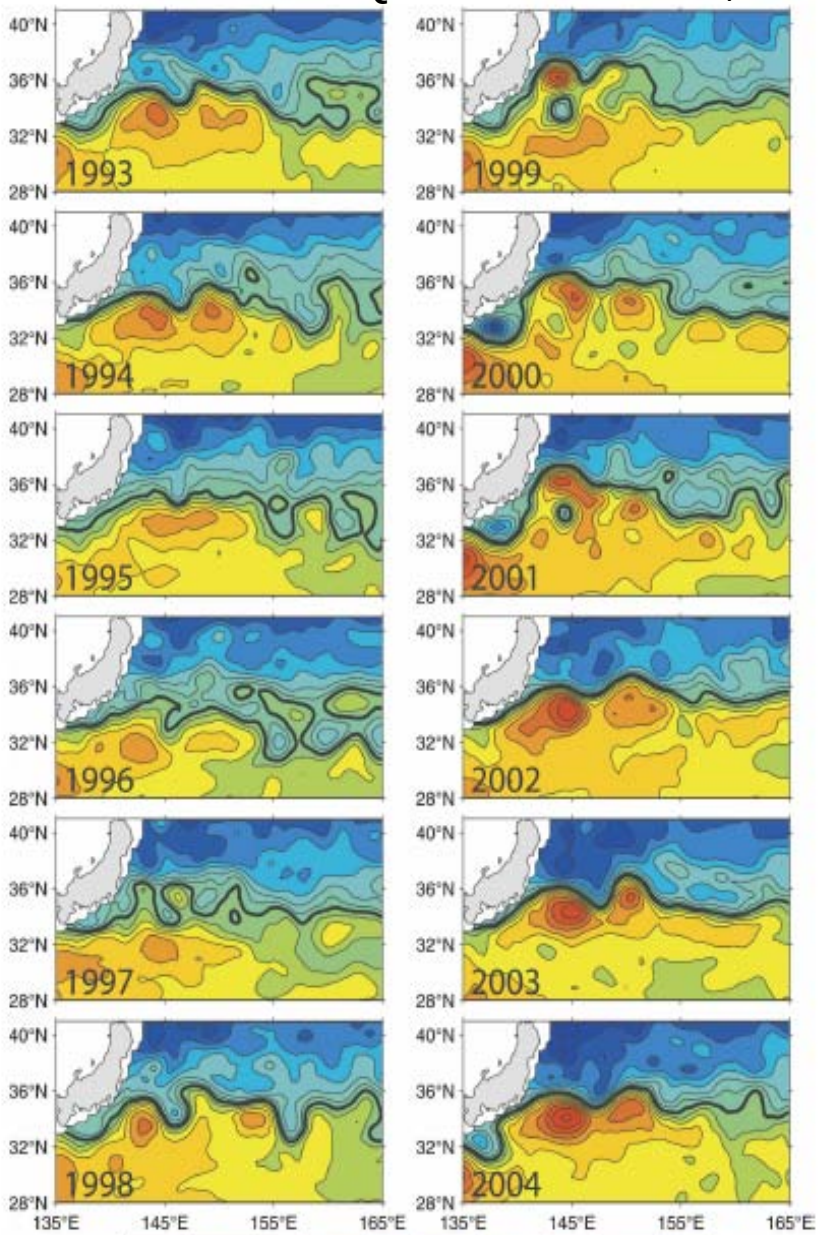




Kuroshio SSH Variability 1993-2004: model (left) and observations (right)

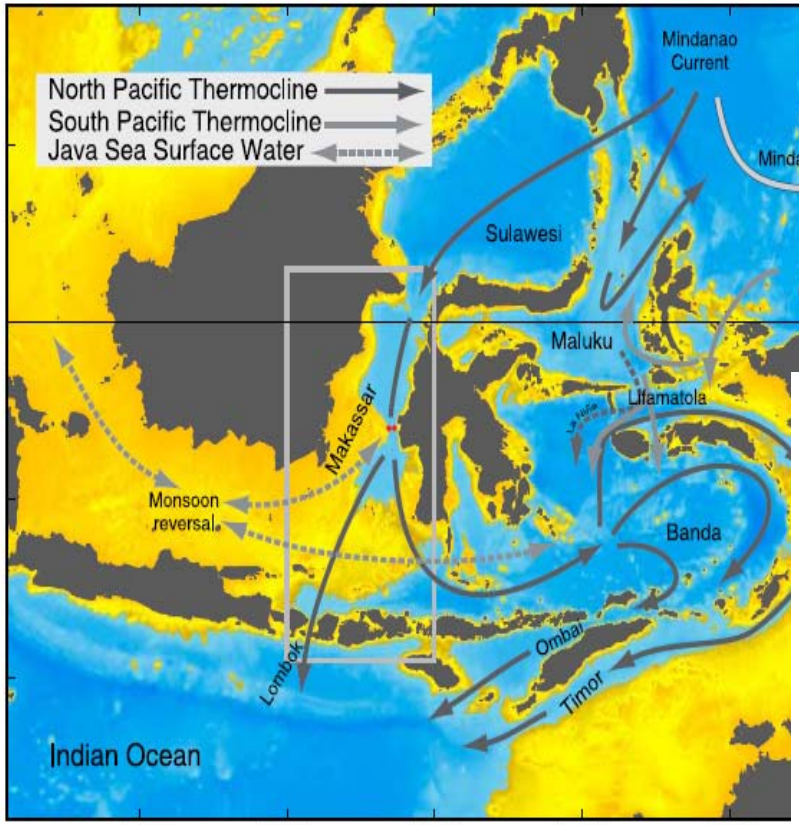
Qiu & Chen 2005, JPO

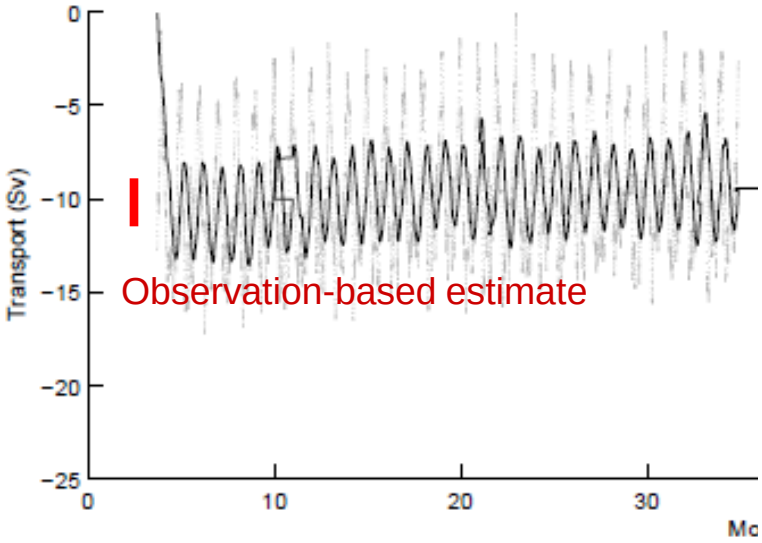


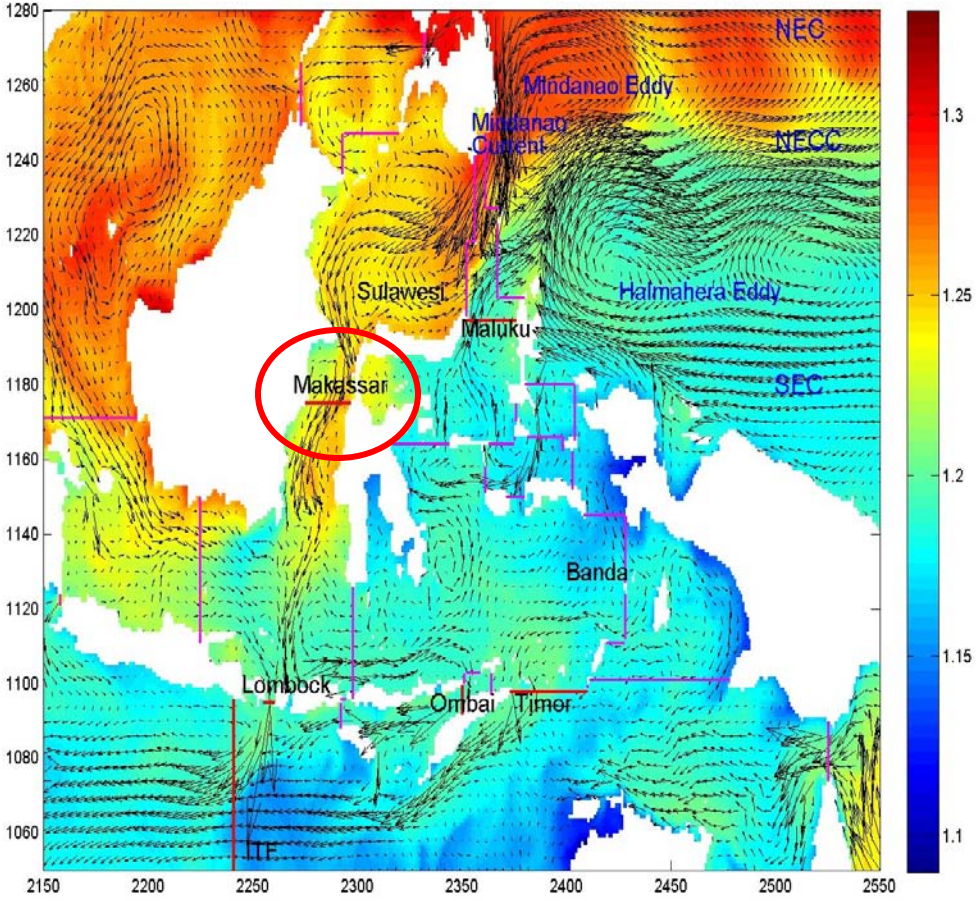


Indonesian Throughflow

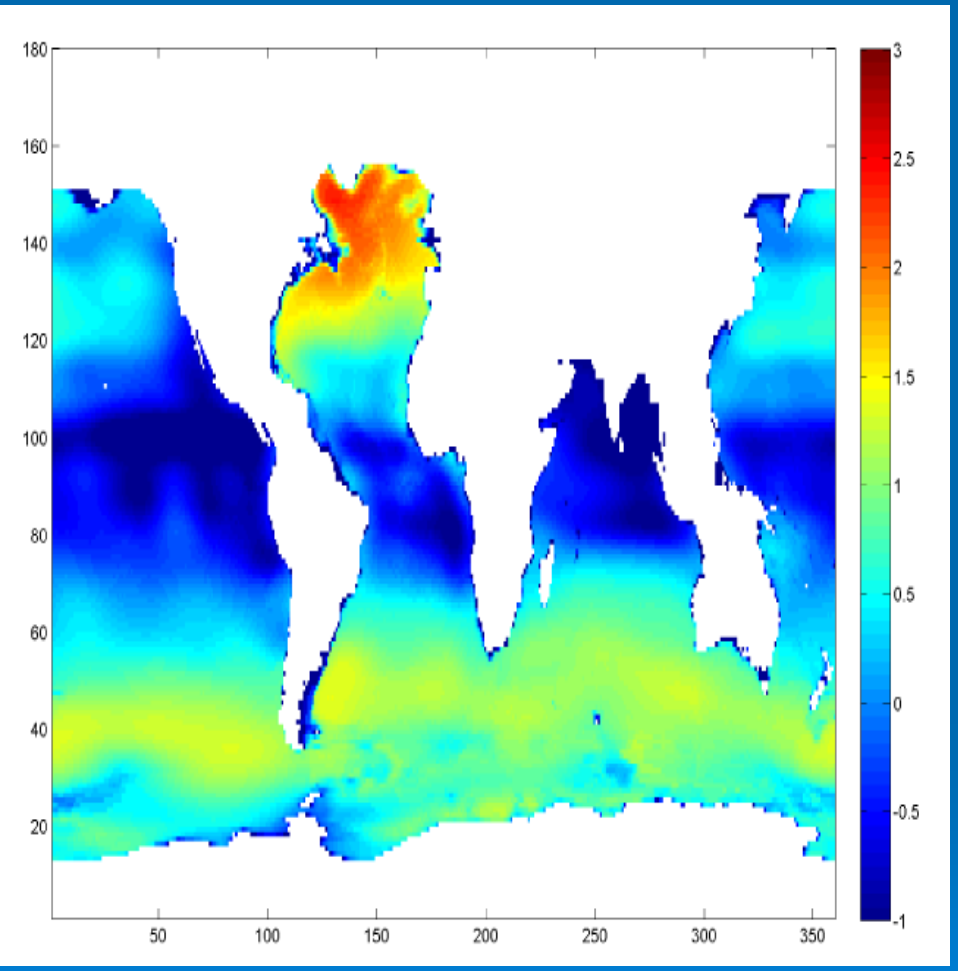
Gordon et al., 2008



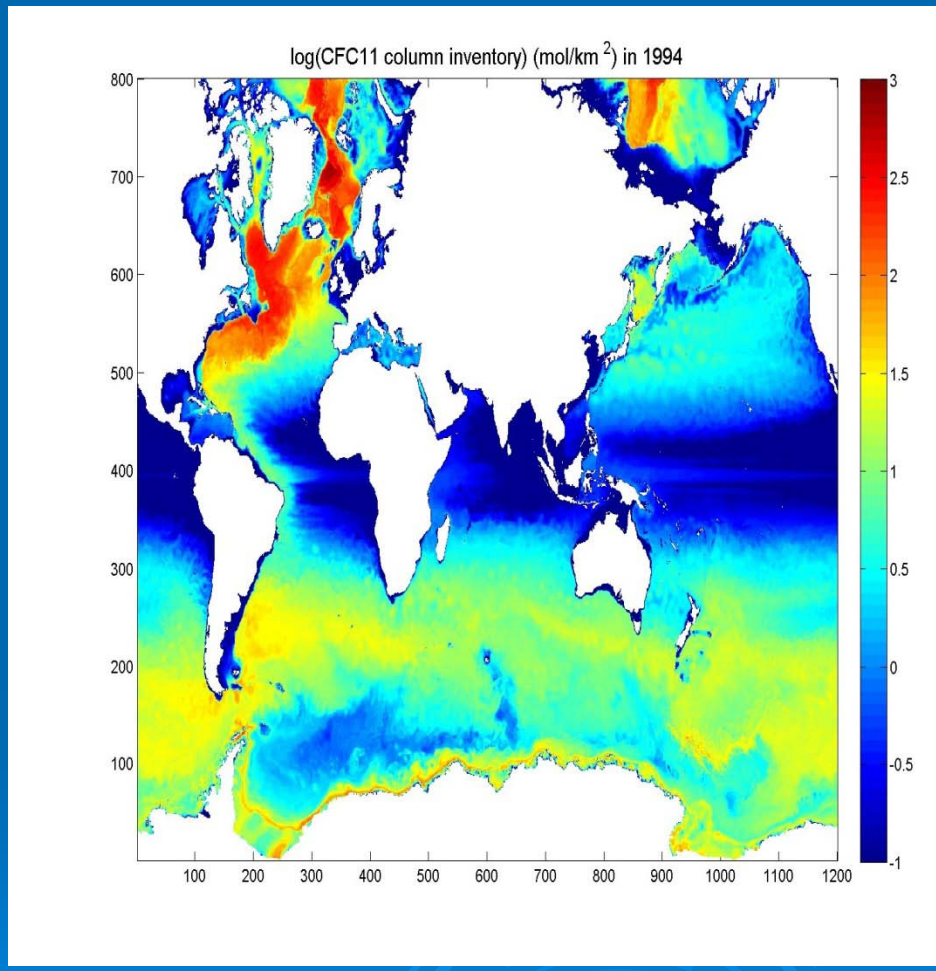




CFC-11 column inventory (log scale)

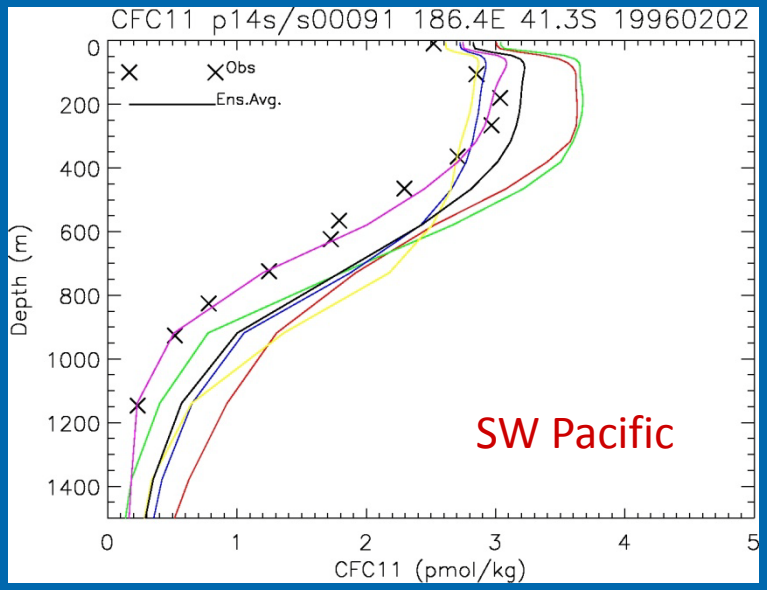


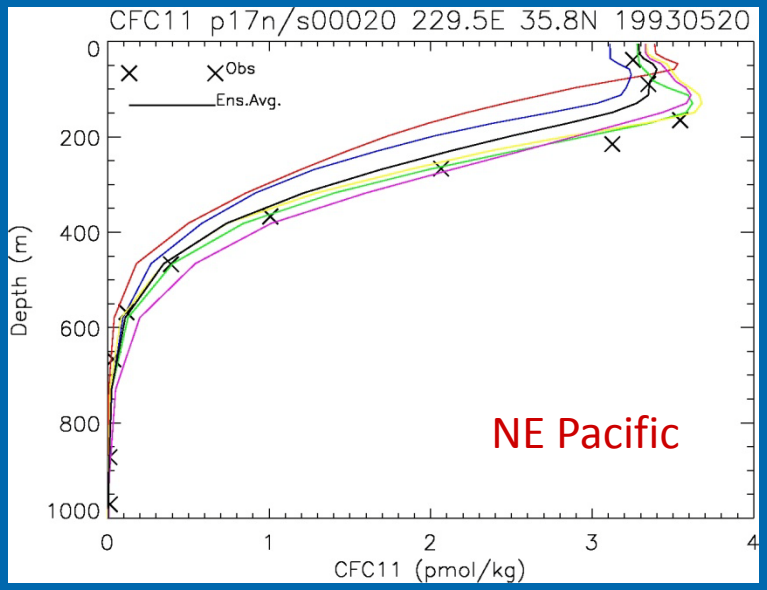
Observation-based estimate (GLODAP)

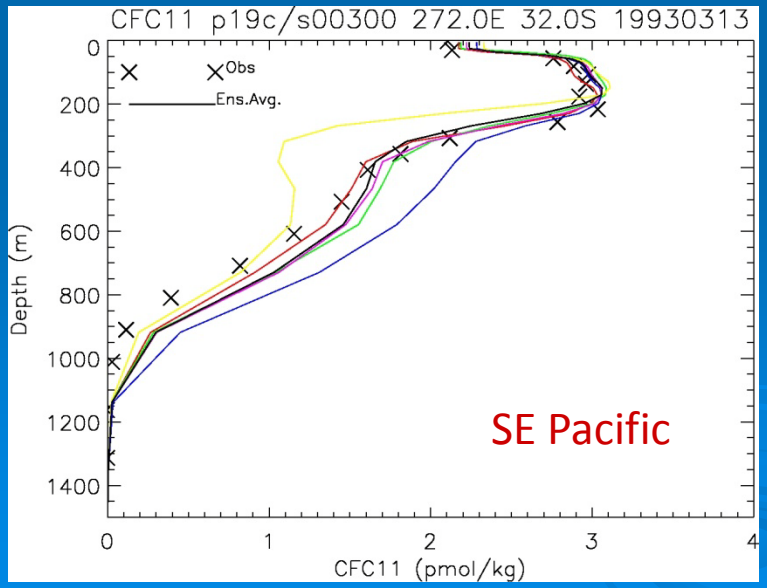


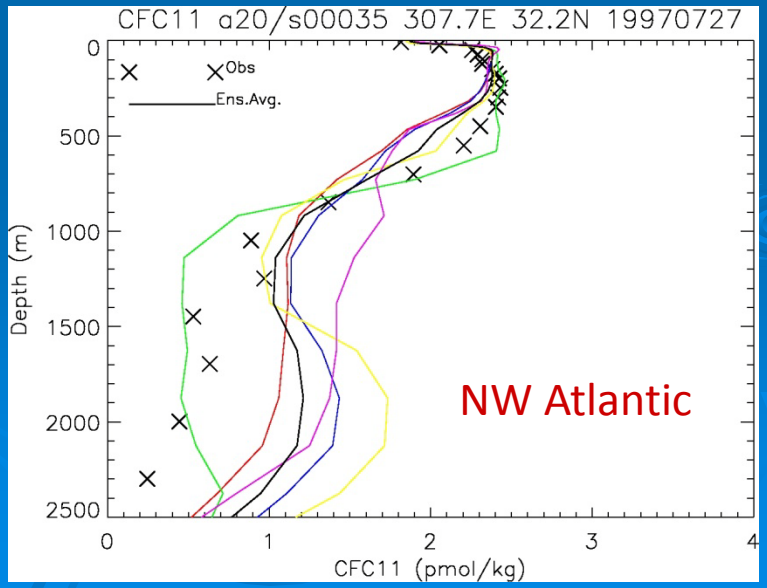
POP 0.1-degree model

CFC-11 profiles: simulated (lines) and observed (crosses)

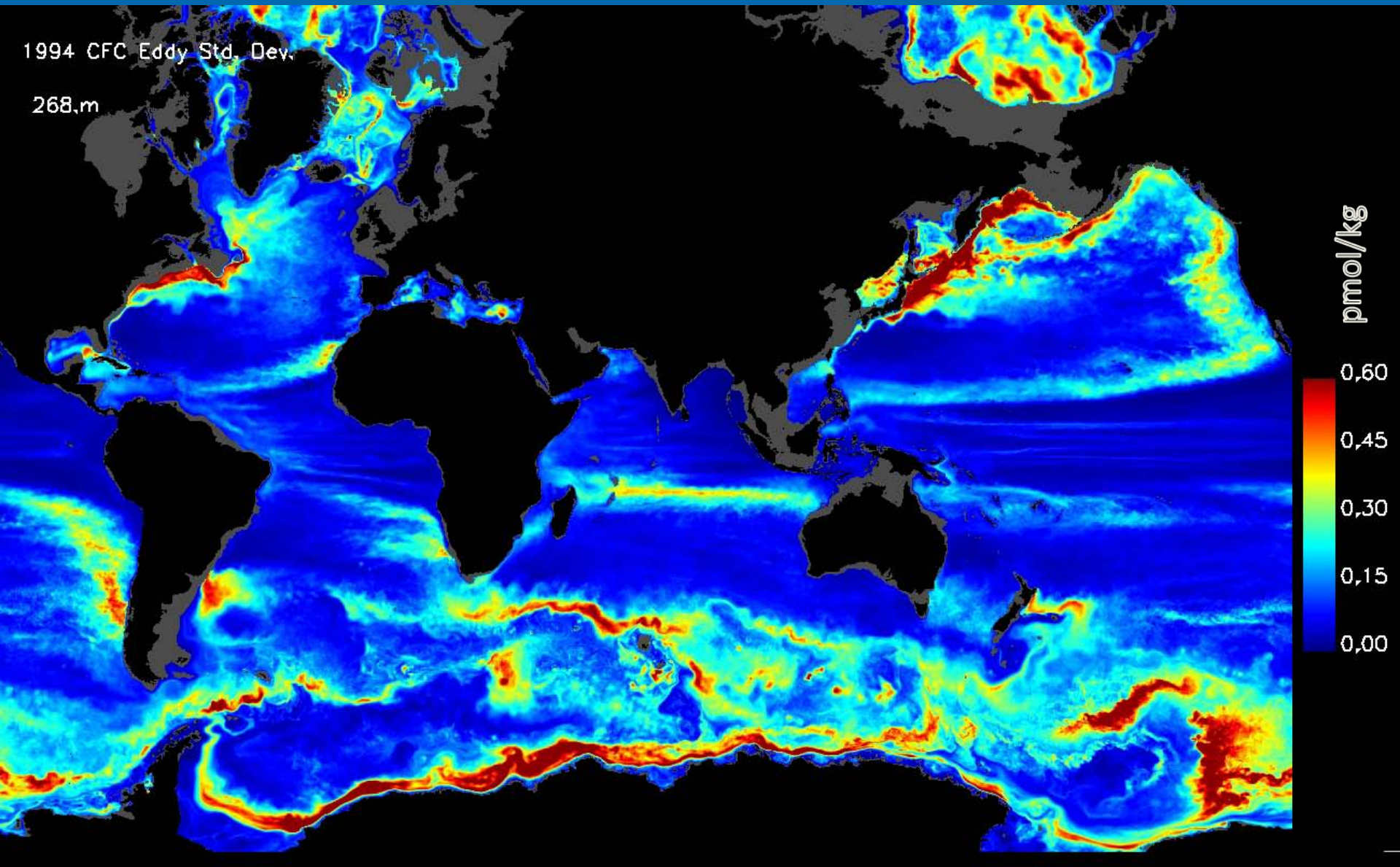




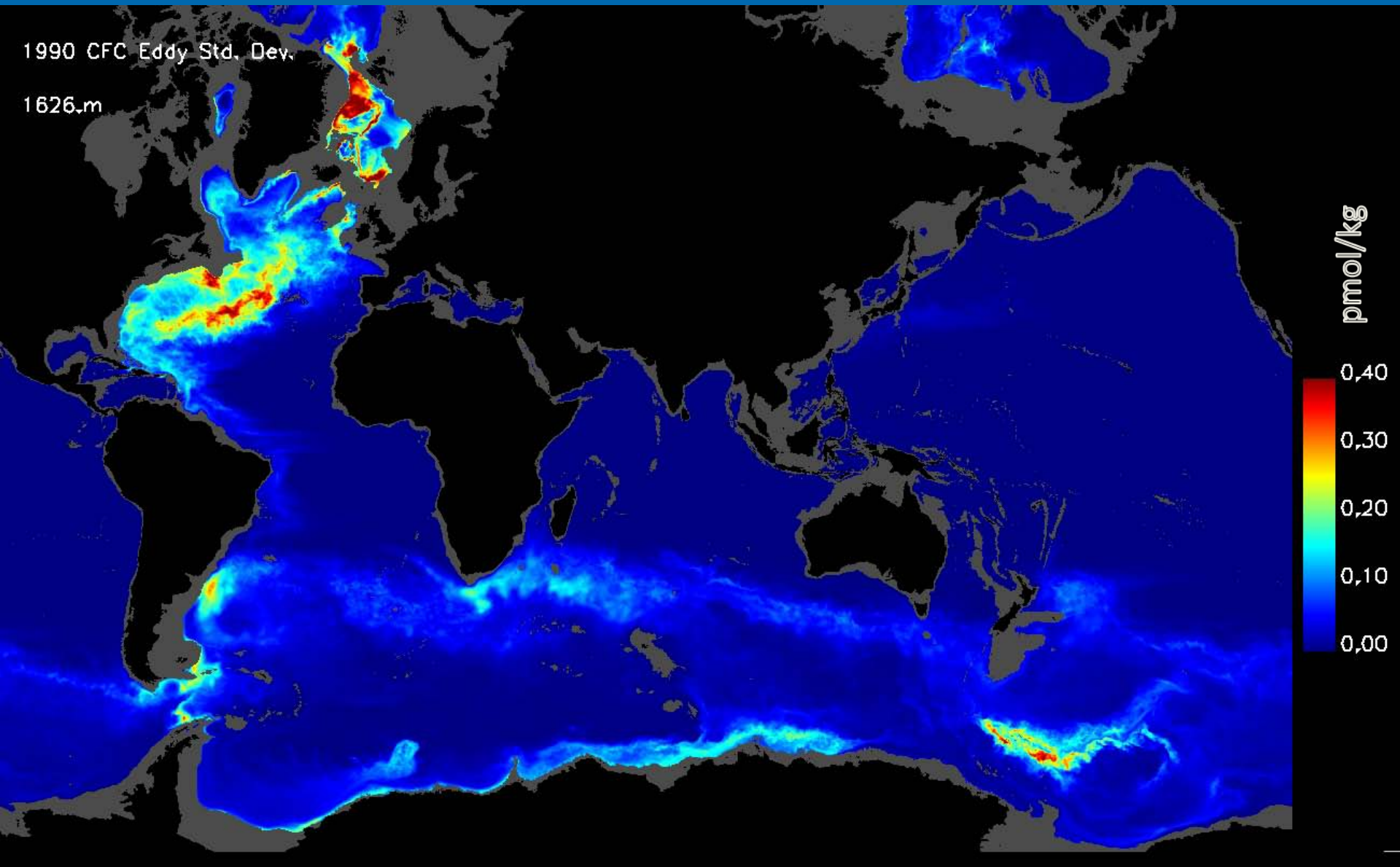


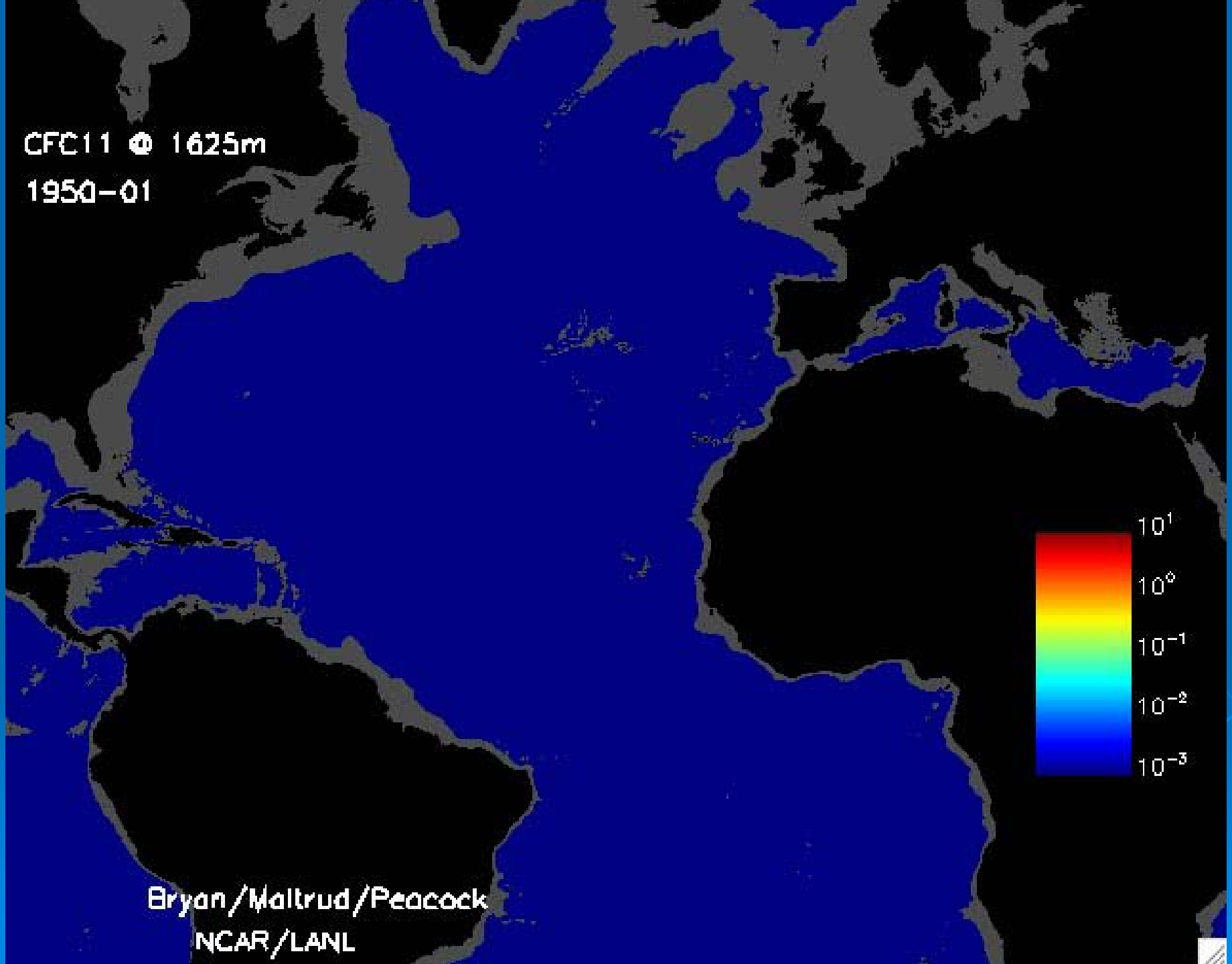


CFC11 Variability @ 270m



CFC11 Variability @ 1626m




CFC11 @ 1625m
1950-01
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
Bryan/Maltrud/Peacock
NCAR/LANL

Summary

- We have completed the first centennial scale global eddying ocean simulation carrying multiple tracers (under DOE/INCITE and NCAR/ASD allocations)
- The physical ocean circulation compares very well to observations
- The simulated CFC distribution also matches extremely well with observations
- We are, for the first time, able to asses the amount of internal ocean tracer variability, and use this as an aid to interpreting data from repeat cruises
- The ensemble TTD simulations also provide useful information about timescales of upper-ocean ventilation