1/12°North Atlantic HYCOM Development

T. Townsend[1], E. Chassignet[2], Z. Garraffo[2], P. Hogan[1],
H. Hurlburt[1], W. Schmitz, Jr[3], L. Smith[2], and A. Wallcraft[1]

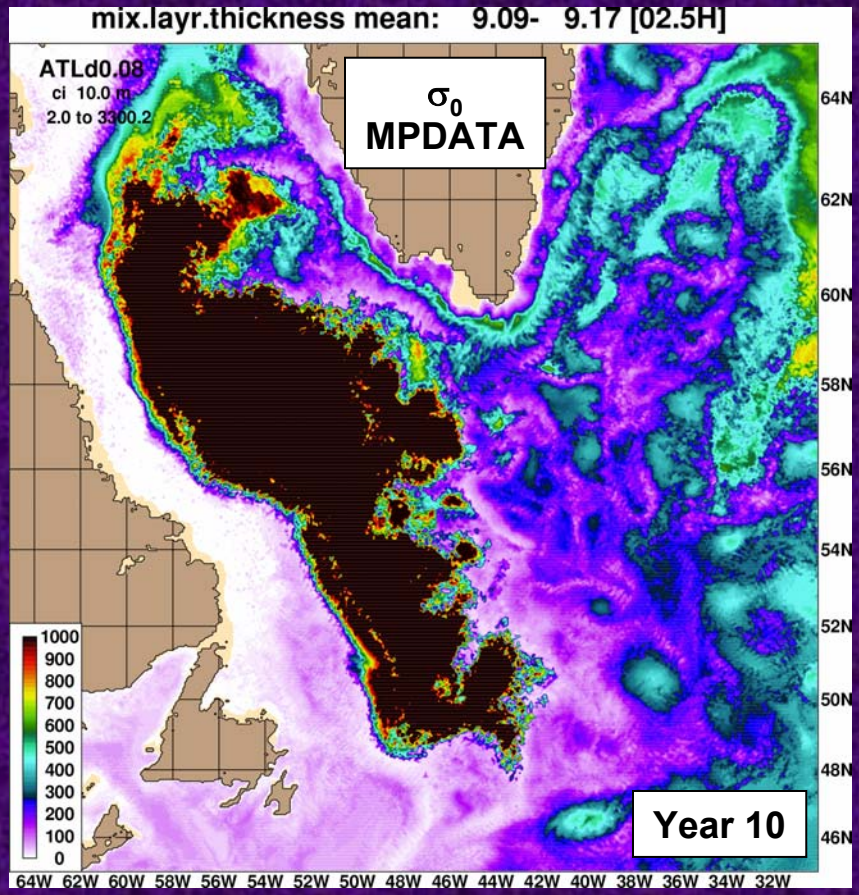
[1] Naval Research Laboratory, Stennis Space Center, MS
[2] RSMAS, University of Miami, FL
[3] Conrad Blucher Institute, TAMU-Corpus Christi, TX

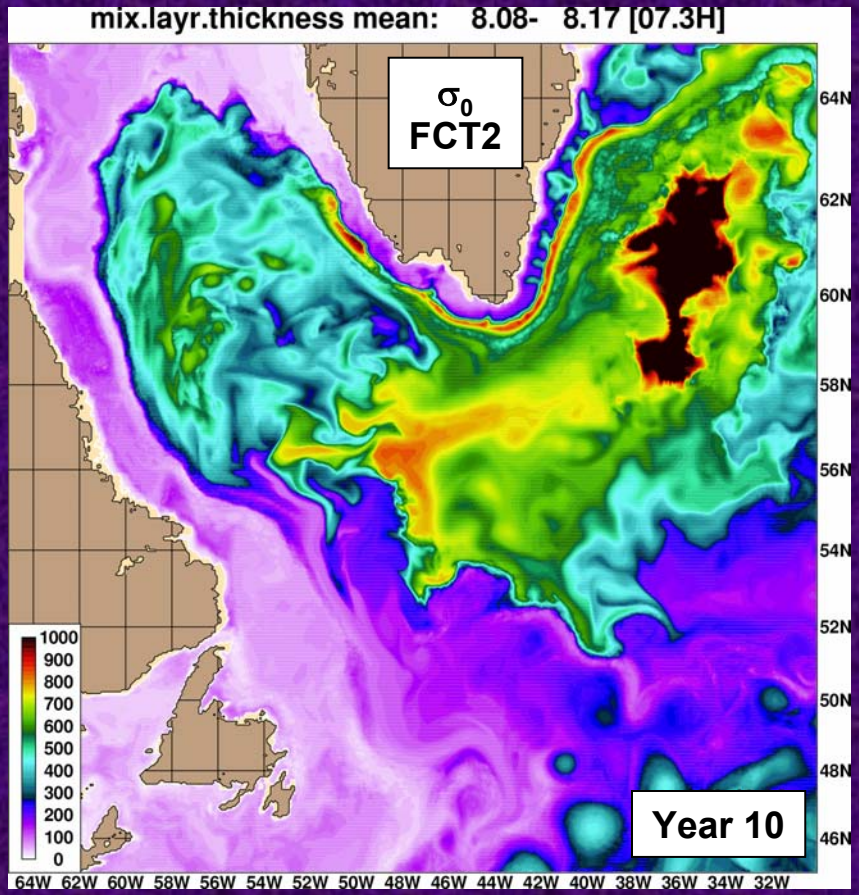
HYCOM NOPP GODAE Meeting
RSMAS, University of Miami, FL
27-29 October 2004

1/12° North Atlantic HYCOM Simulations

Experiment	Vertical Coordinate	Advection Scheme	Variable Target ρ
HYCOM-2.5	σ_0 Shallow z's	MPDATA	No
HYCOM-7.3	σ_0 Shallow z's	FCT2	Yes
HYCOM-11.4	σ_2^* Deeper z's	FCT2	No
MICOM	σ_0	MPDATA	No

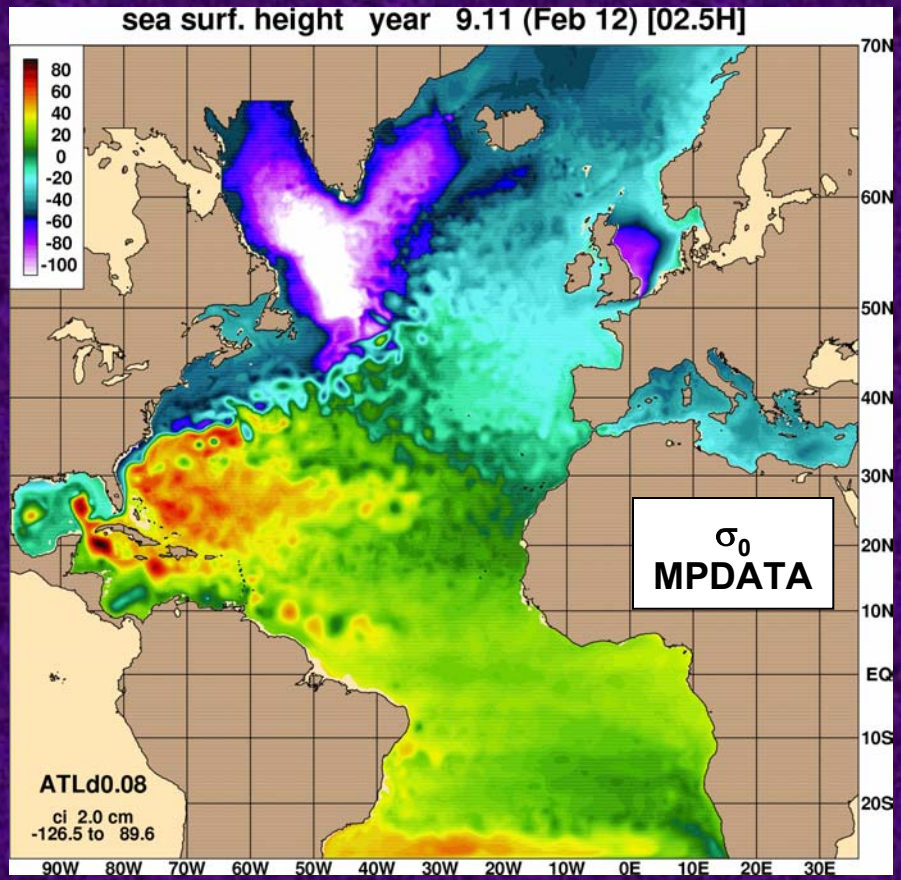
February Mean KPP Mixed Layer Thickness
1/12° North Atlantic HYCOM

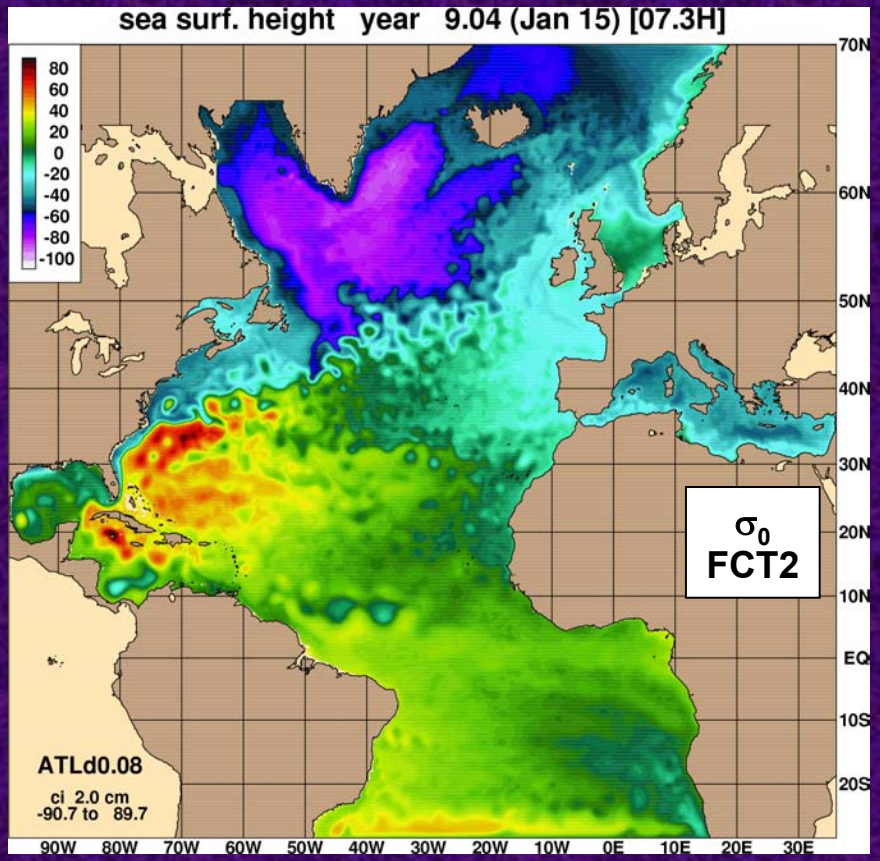




ERA-15 wind (+ high-frequency anomalies) and thermal forcing and relaxation to GDEM3 at northern and southern boundaries

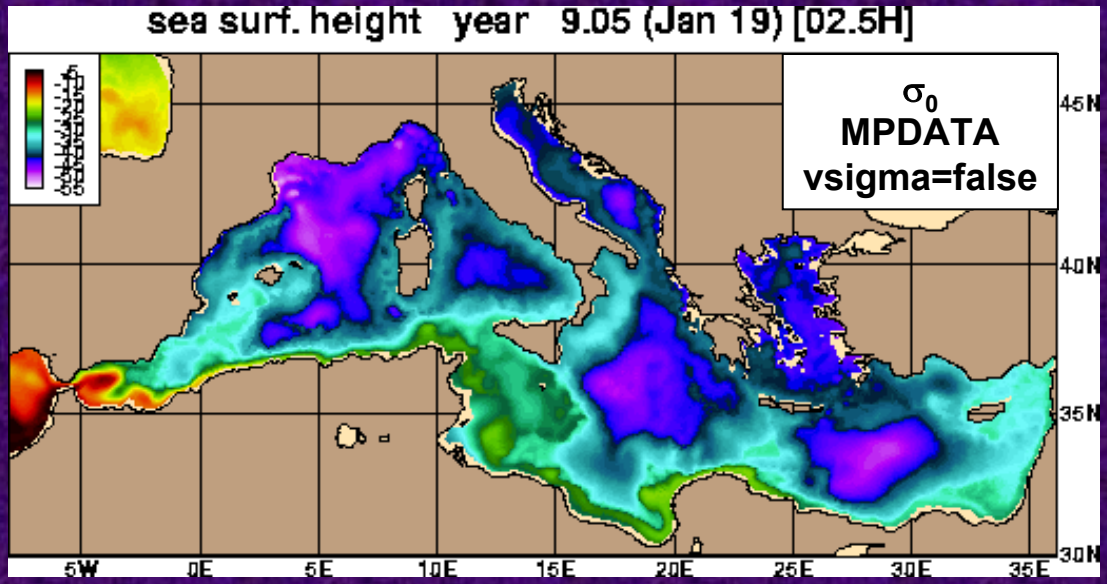
Sea Surface Height Snapshot
1/12° North Atlantic HYCOM

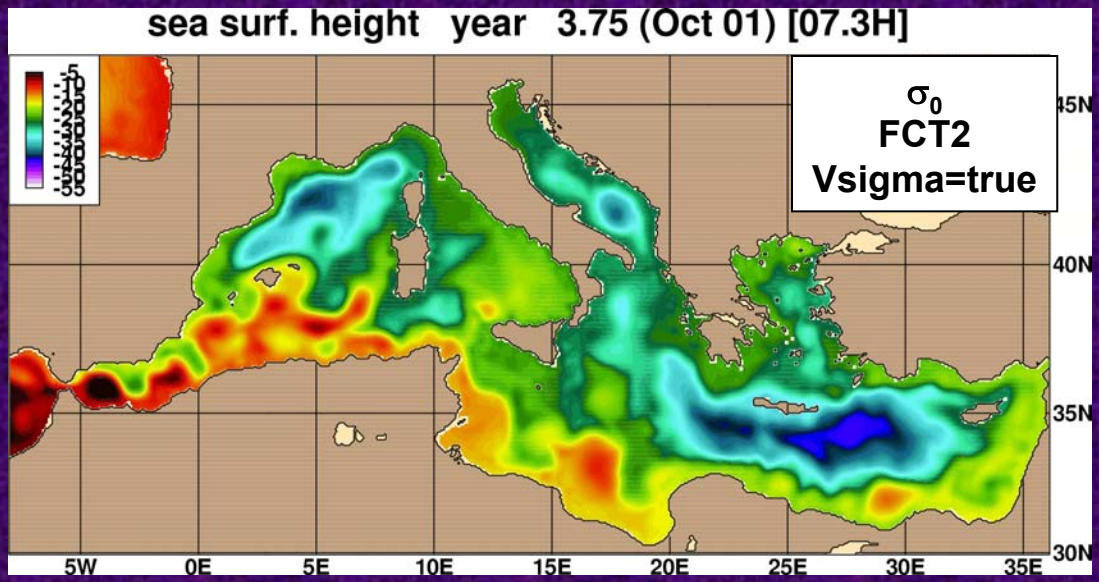




ERA-15 wind (+ high-frequency anomalies) and thermal forcing and relaxation to GDEM3 at northern and southern boundaries

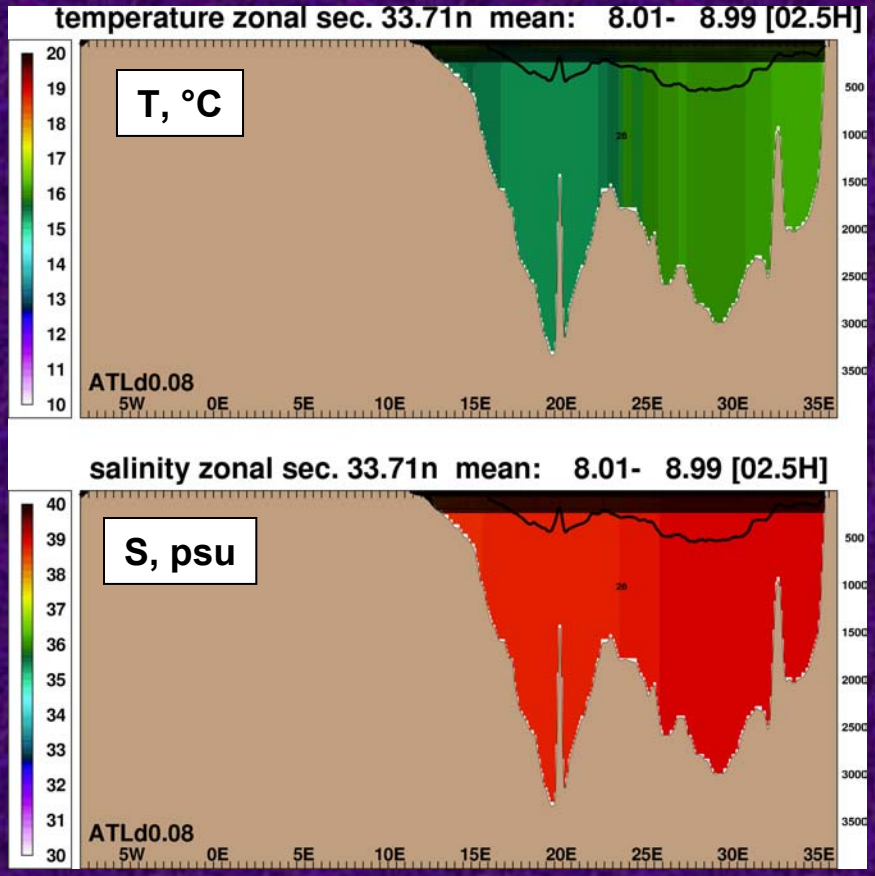
Mediterranean Sea Surface Height Snapshot
1/12° North Atlantic HYCOM



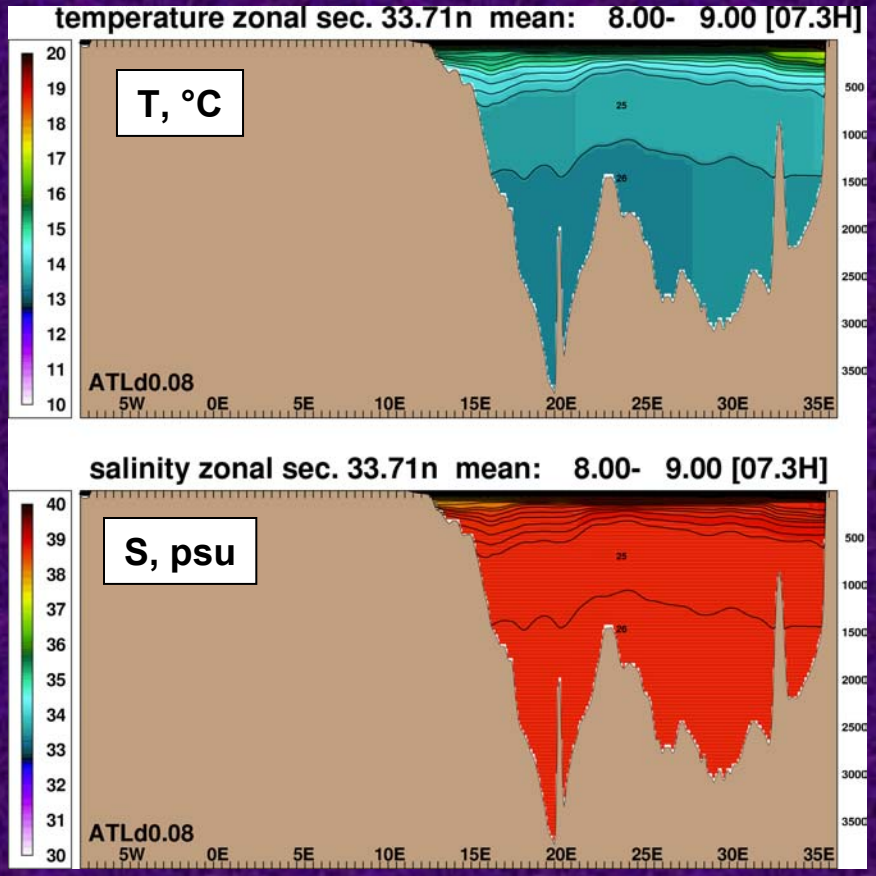


Mediterranean Sea – Vertical Discretization
1/12° North Atlantic HYCOM

σ_0, vsigma=false

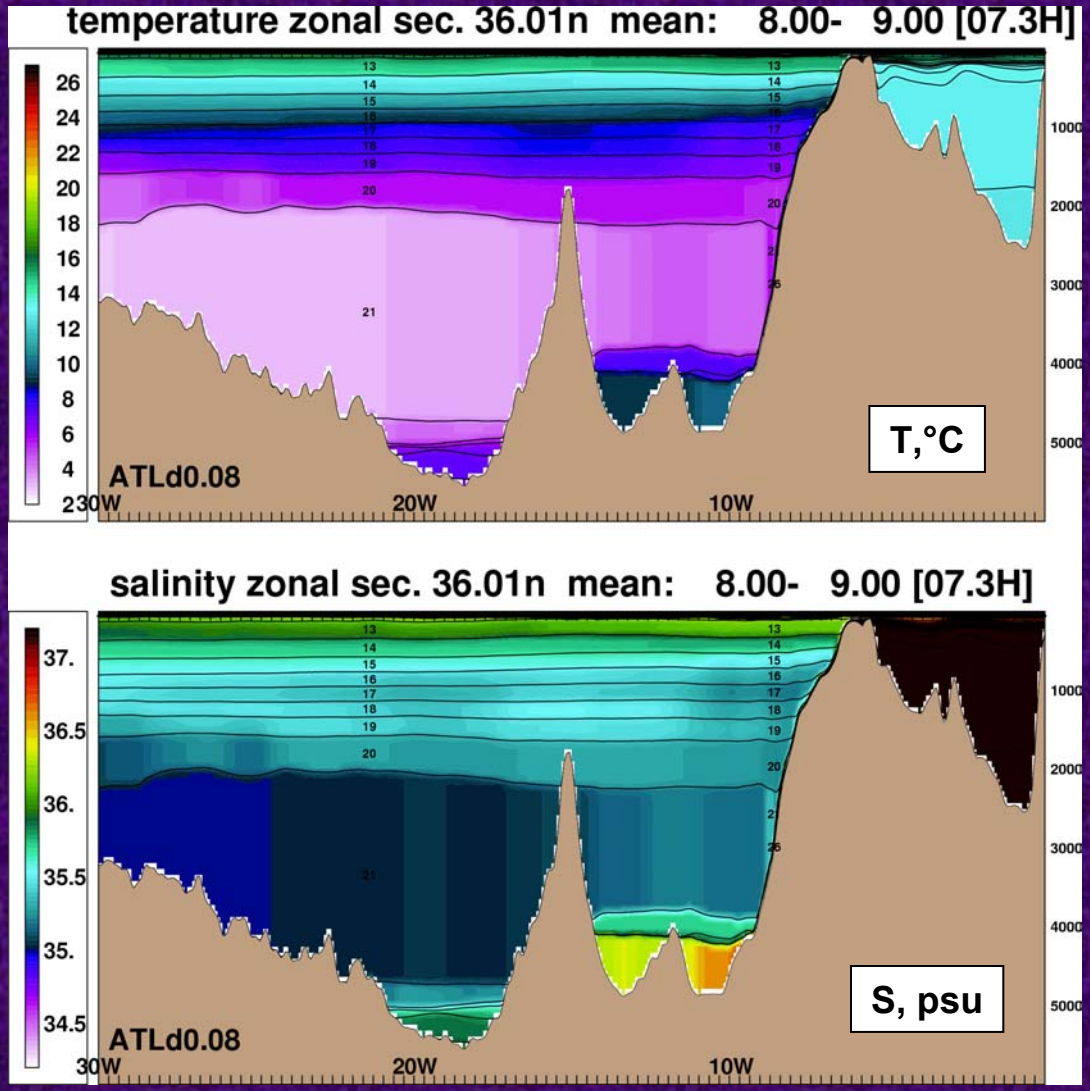


σ_0, vsigma=true



Mediterranean Outflow
1/12° North Atlantic HYCOM

σ_0
FCT2



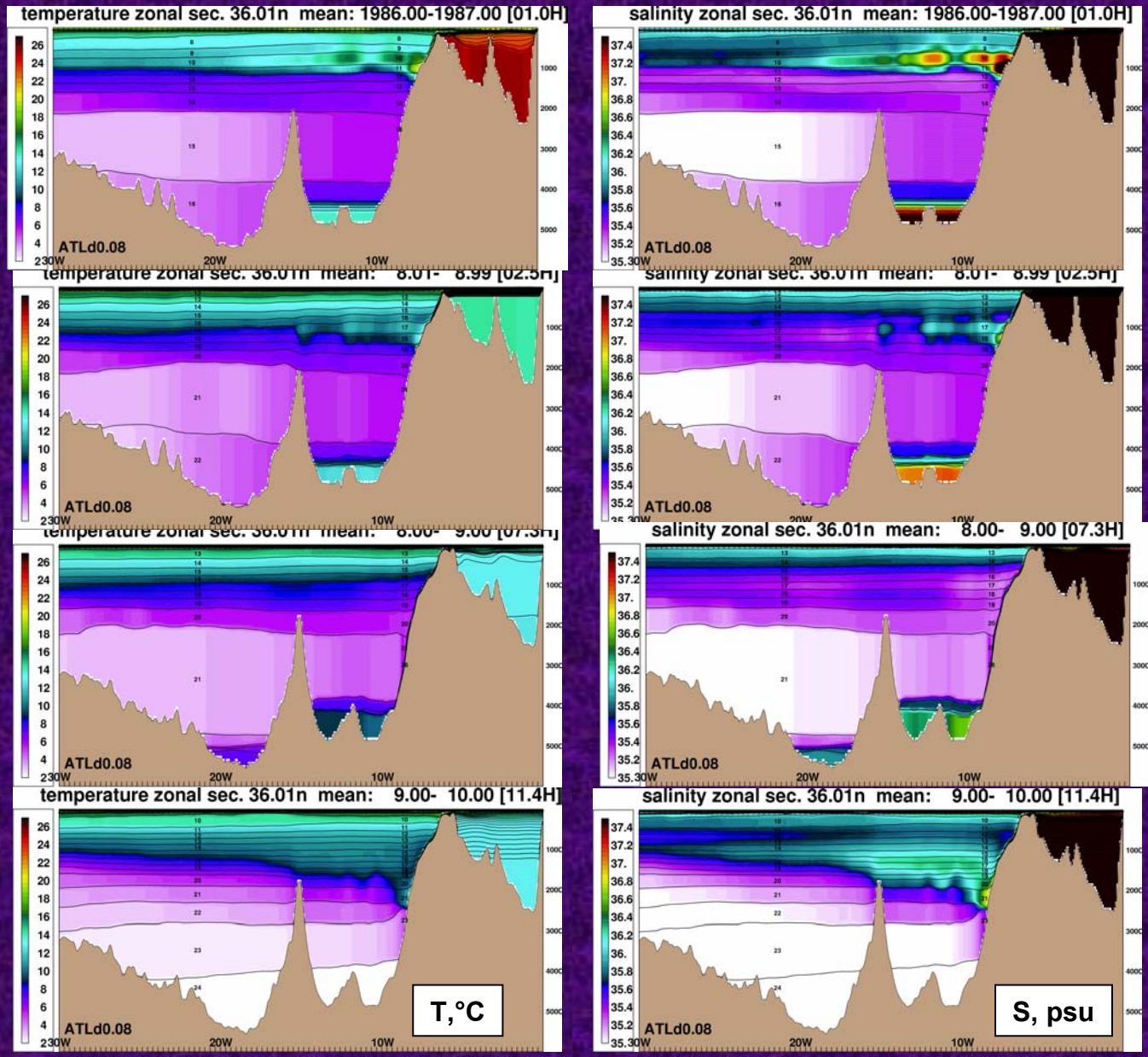
Mediterranean Outflow -1/12° North Atlantic HYCOM

MICOM

σ_0 MPDATA

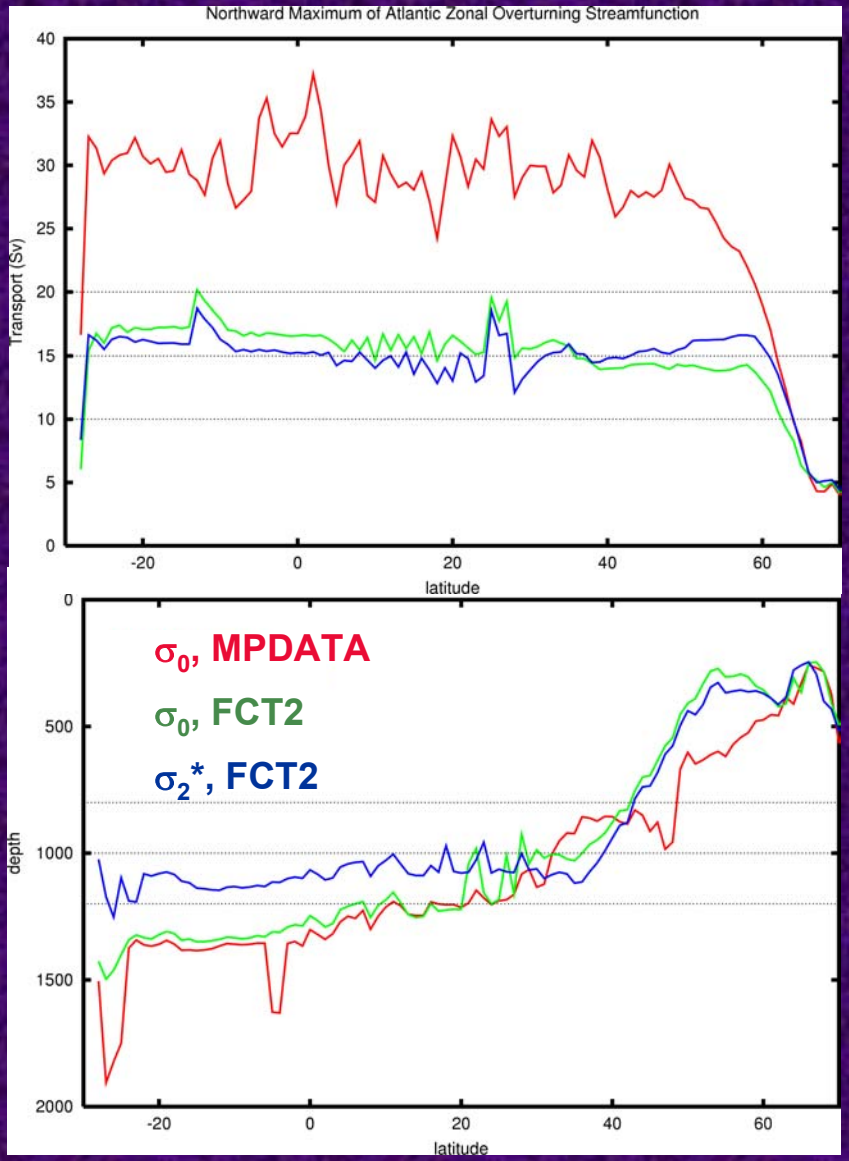
σ_0 FCT2

σ_2* FCT2



Meridional Overturning Streamfunction 1/12° North Atlantic HYCOM

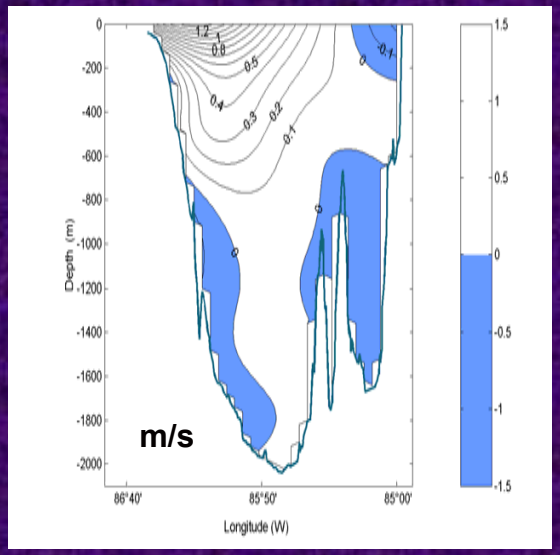
Upper Net Northward Transport (Sv)



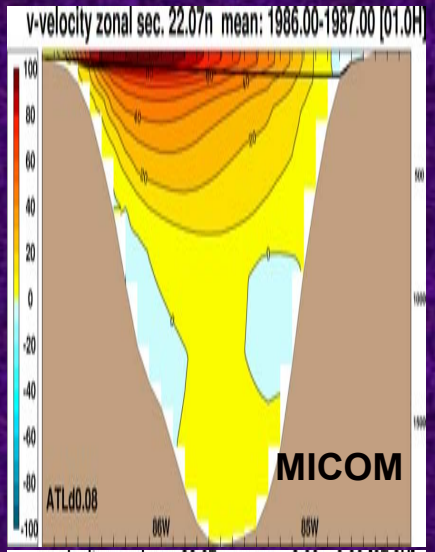
Depth of switch to net southward transport

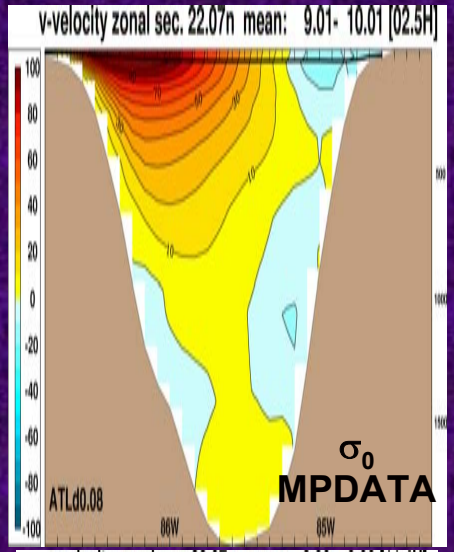
Yucatan Channel Annual Mean Velocity
1/12° North Atlantic HYCOM

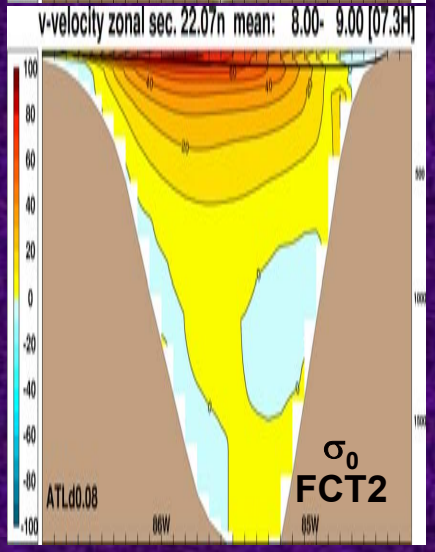
Observed

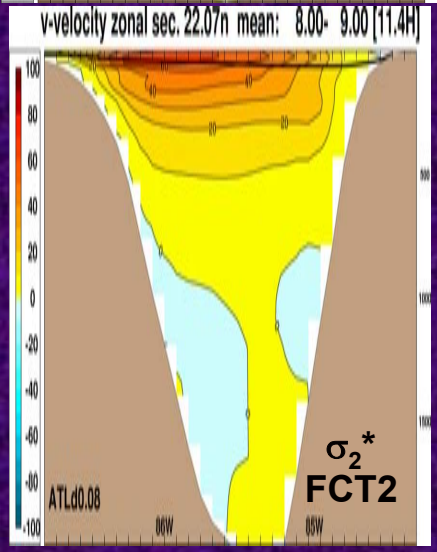


Abascal et al., 2001

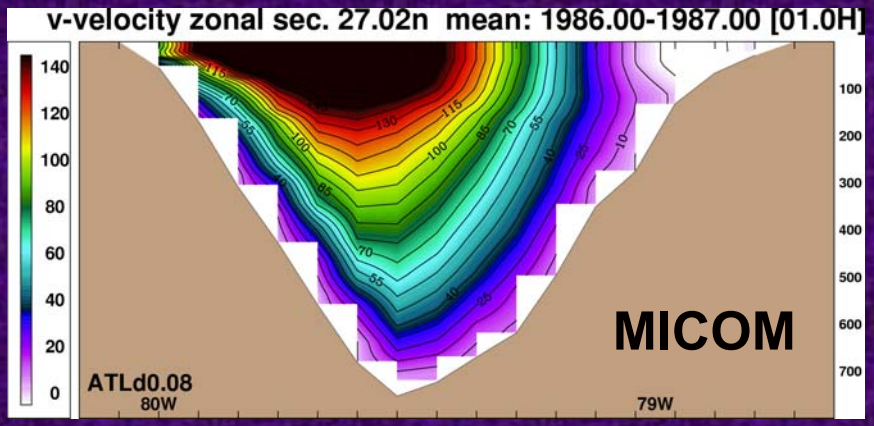


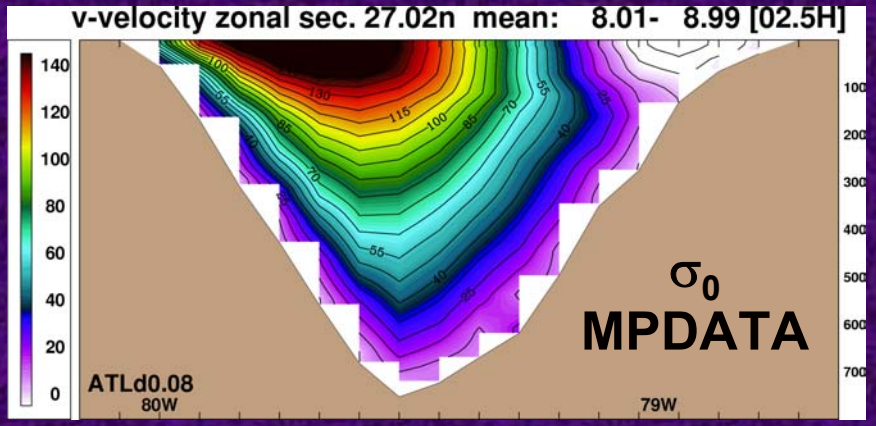


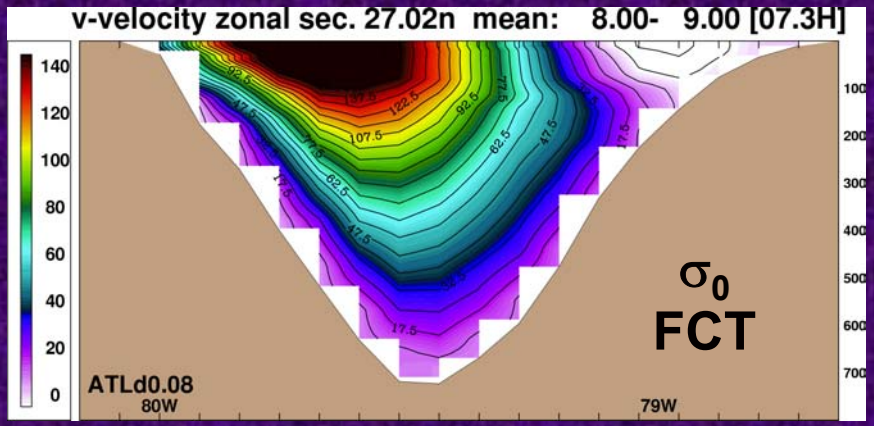


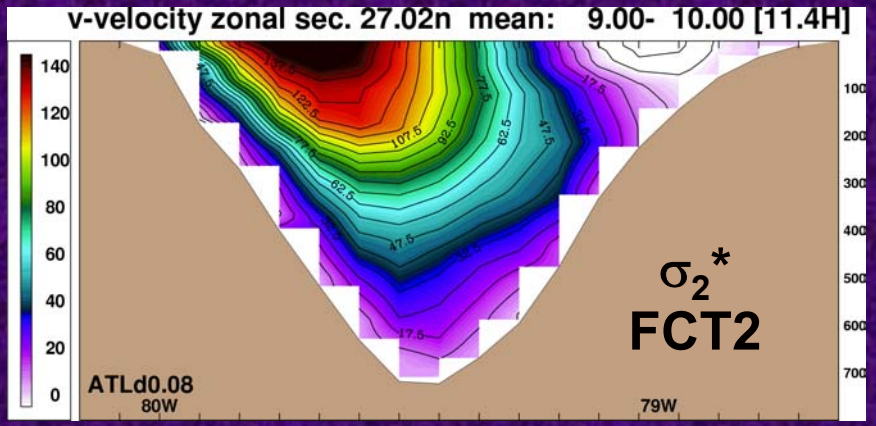


Florida Current Annual Mean Velocity
1/12° North Atlantic HYCOM

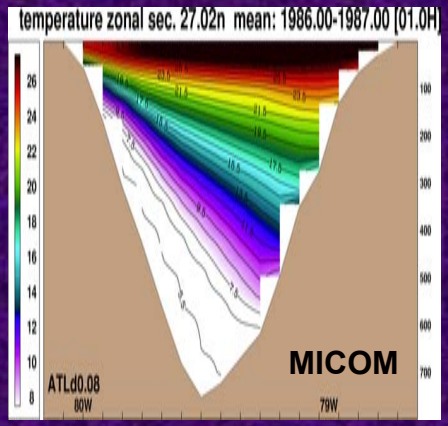


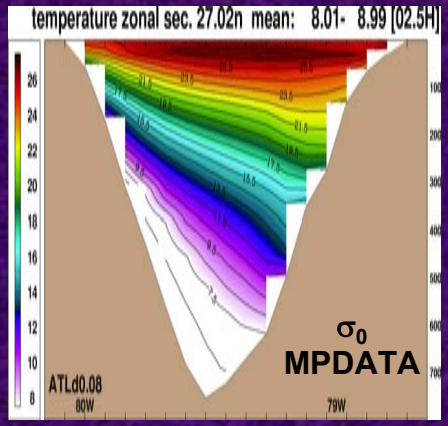


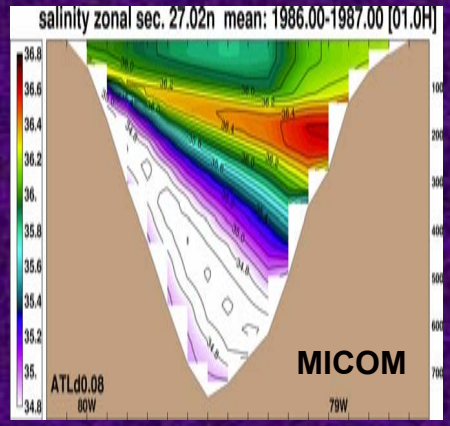


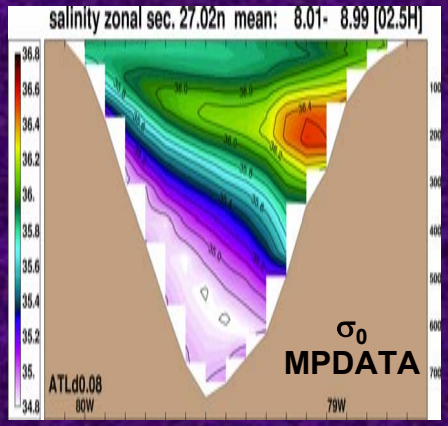


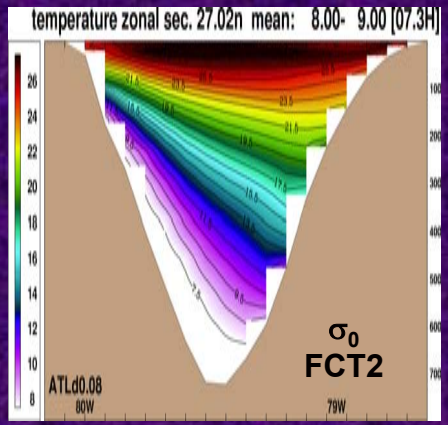
Florida Current Annual Mean T & S
1/12° North Atlantic HYCOM

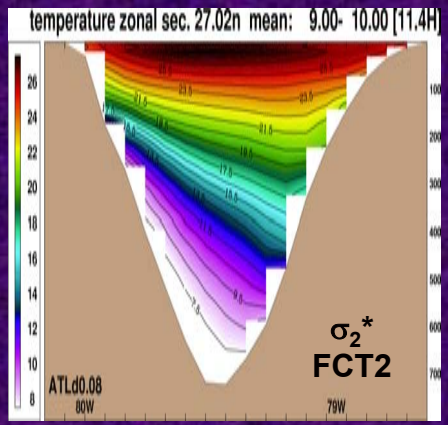


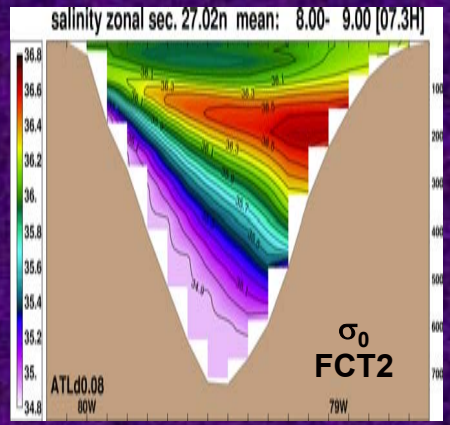


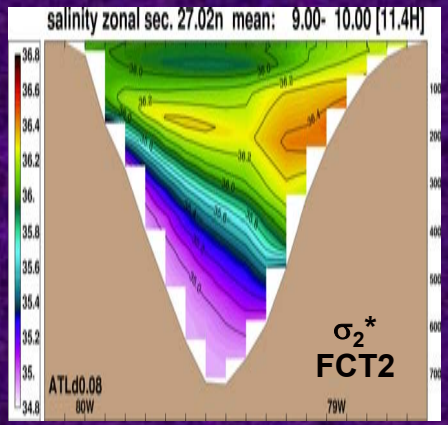












T, °C

S, psu

Atlantic-to-Caribbean 1-Yr Mean Transports
1/12° North Atlantic HYCOM

Expt	FC 27N	Abac	FC + Abac	NWP	OBC	Yuc Ch	WW	Mona	Aneg	Gren	L.A.	MOC N'wd	DWBC Abac	Avg Dep
M	32.7	23.7	56.4	1.0	-0.7	32.5	-4.4	2.4	4.8	6.8	29.6		22.1	
σ_0 MP	28.1	14.8	42.9	1.3	-0.6	27.6	-3.9	1.9	7.7	5.7	21.6	~30	16.2	1250
σ_0 MP[1]	30.0	10.2	40.2	1.22	-0.7	29.6	0.7	2.2	5.0	5.5	21.6	~25	32.6	1700 or 1300
σ_0 FCT	25.1	10.1	35.2	2.1	-1.0	23.8	3.3	2.2	2.6	3.0	16.0	~17	16.2	1250
σ_2^* FCT	24.2	7.8	32.0	2.9	-1.0	22.0	0.4	3.7	2.4	2.7	15.8	~15	22.5	1050

[1] Interim experiment with longer relaxation time scale at southern boundary

Summary of Improvements
1/12° North Atlantic HYCOM

MPDATA vs FCT2:

- Eliminated excessive deep mixing in subpolar gyre.
- Restored MOC amplitude to observed value; depth of switch from net northward to net southward flow still too deep.
- Dramatically improved subpolar gyre circulation.
- Much improved Mediterranean circulation and vertical discretization (even in σ_2* case due to deeper z-levels).

σ_2* vs σ_0:

- More realistic Med salinity tongue and elimination of un-observed dense pool sitting on bottom.
- More realistic depth of change from net northward flow to net southward flow of MOC, but is it Shallow enough?.
- AABW present (How realistic?).

What Next?
1/12° North Atlantic HYCOM

Further & more detailed analysis of water mass and transport pathways.

Examination of Sverdrup flow from different wind forcing fields for clues about the realism of the wind-driven transport in the model.

Investigate ways to handle the sill depth error(s) in the bottom topography?

1/12° North Atlantic HYCOM…

Stay Tuned