An Update on the 1/12° Global HYCOM Effort

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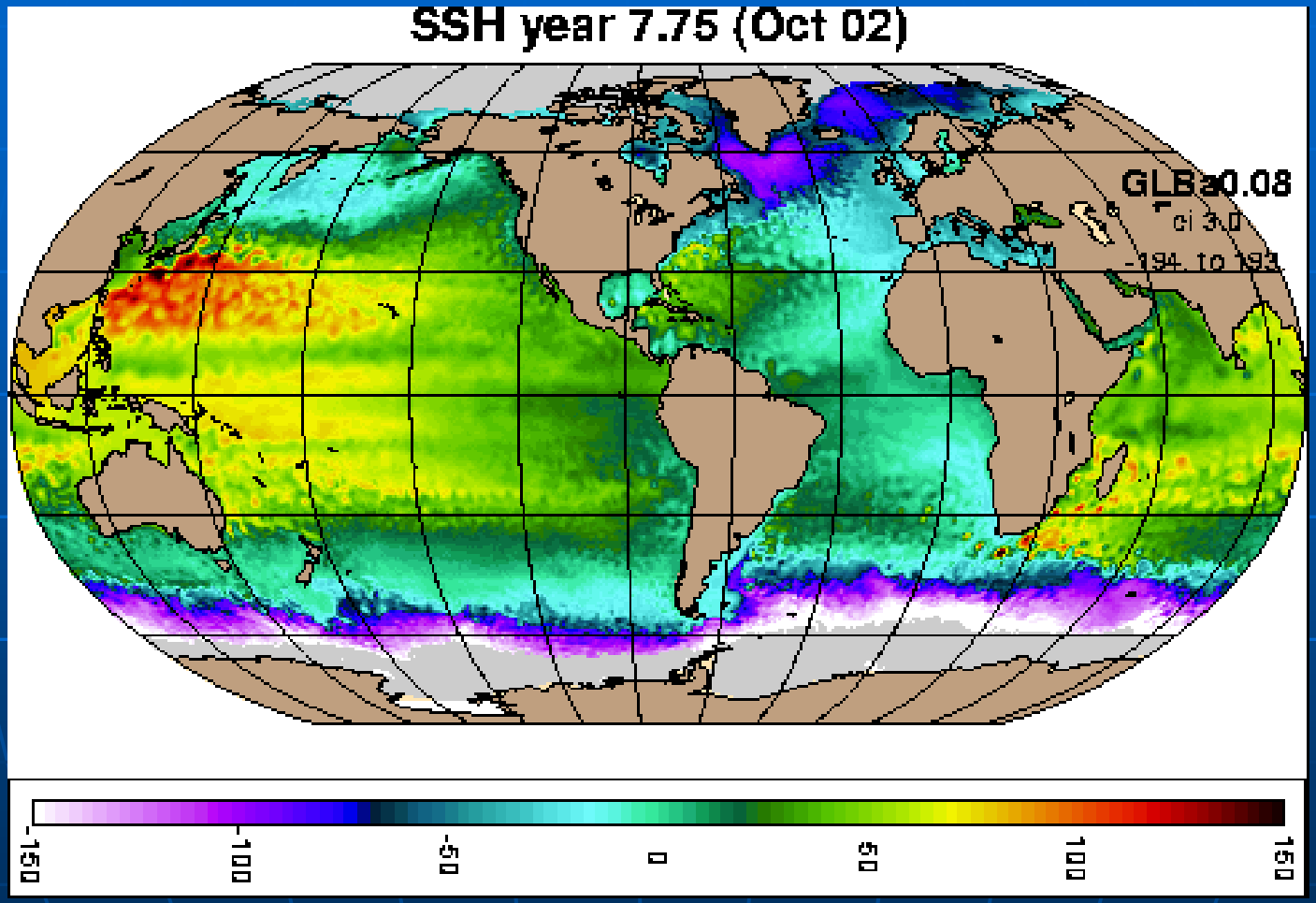
Global HYCOM Configuration

- Horizontal grid: 1/12° equatorial resolution
  - 4500 x 3298 grid points, 6.5 km spacing on average, 3.5 km at pole
- Mercator 79°S to 47°N, then Arctic dipole patch
- Vertical coordinate surfaces: 26-28 for σ_0, 32 for σ_2*
- KPP and GISS mixed layer models
- Thermodynamic (energy loan) sea-ice model
- Surface forcing: wind stress, wind speed, thermal forcing, precipitation, relaxation to climatological SSS
- Monthly river runoff (986 rivers)
- Initialize from January climatology (GDEM3) T and S, then SSS relaxation from PHC 3.0
  - No subsurface relaxation to climatology

1/12° Global HYCOM

Sea surface height and ice (gray)



- Ran in FY06 at NAVOCEANO on IBM Power 4+ (kraken)
- 216K CPU hrs/model year on 784 dedicated processors
- 3.1 Tb/model year for (compressed) daily 3-D output

- Overall global HYCOM produced reasonable circulation results, however the Gulf Stream system wasn't inertial enough and it had weak flow through Yucatan Channel and the Florida Straits

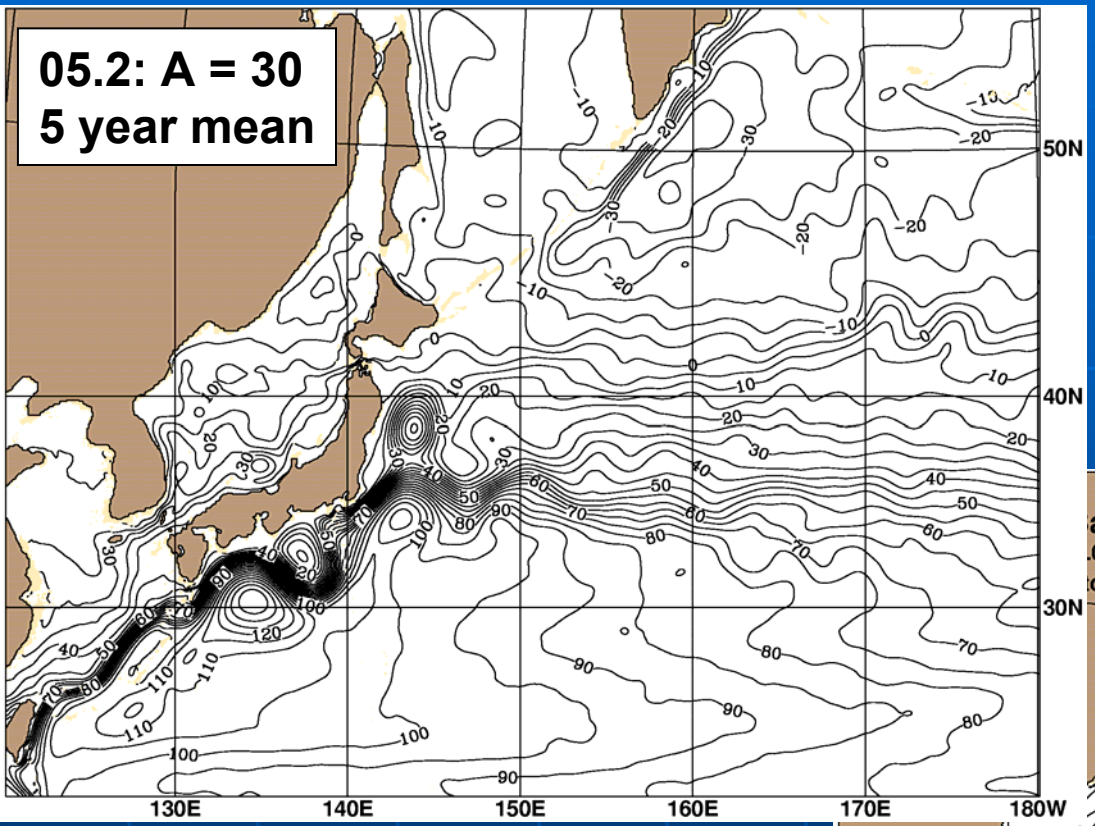
- At the December 2005 HYCOM meeting, we decided to try an experiment with reduced spatially constant viscosity, reduced Smagorinski diffusion and increased biharmonic dissipation

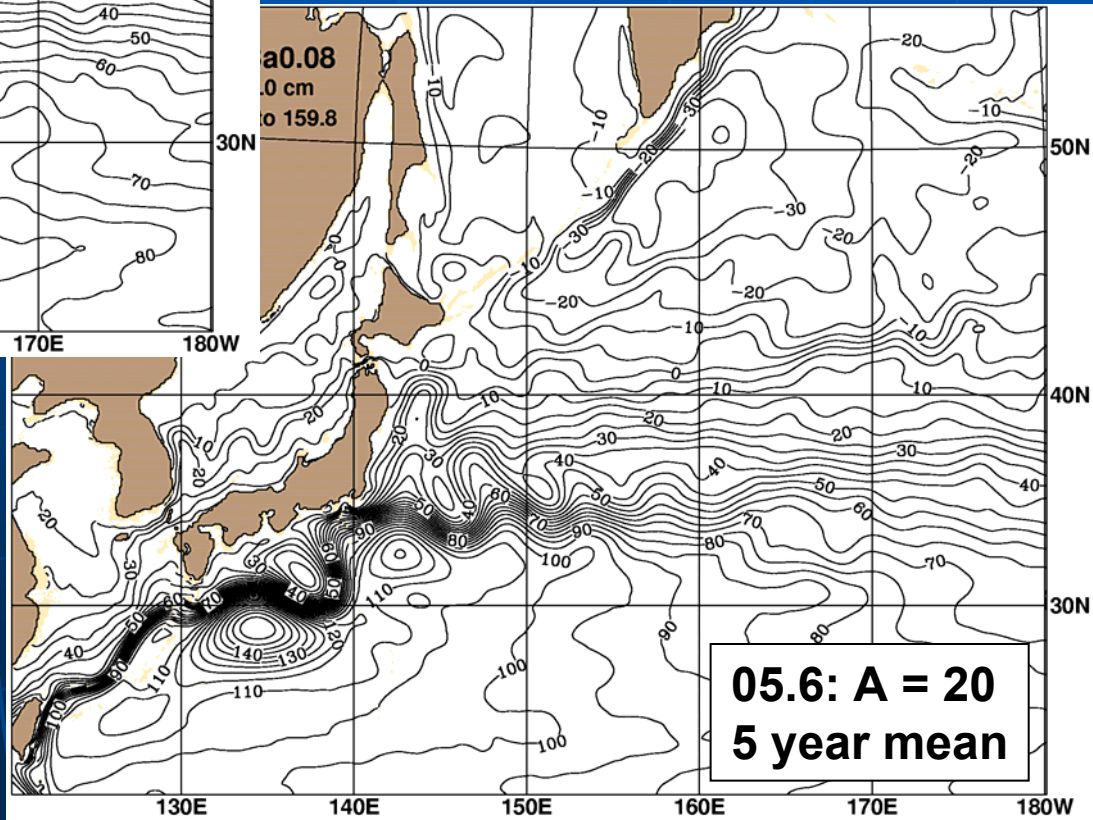
Experiment List

Experiment	Smag. diffusion	Spatially constant A	Biharm. dissipa.	Model Years	Forcing
GLBa0.08-05.2	.1	30	.01	05-09	ERA15-sea
GLBa0.08-05.6	.05	20	.02	08j-13	ERA15-sea

ERA15-sea: 1979-1993 monthly 1st ECMWF Reanalysis, sea only with Sept 1993-1994 ECMWF operational 6-hourly variability

Mean Kuroshio Pathway





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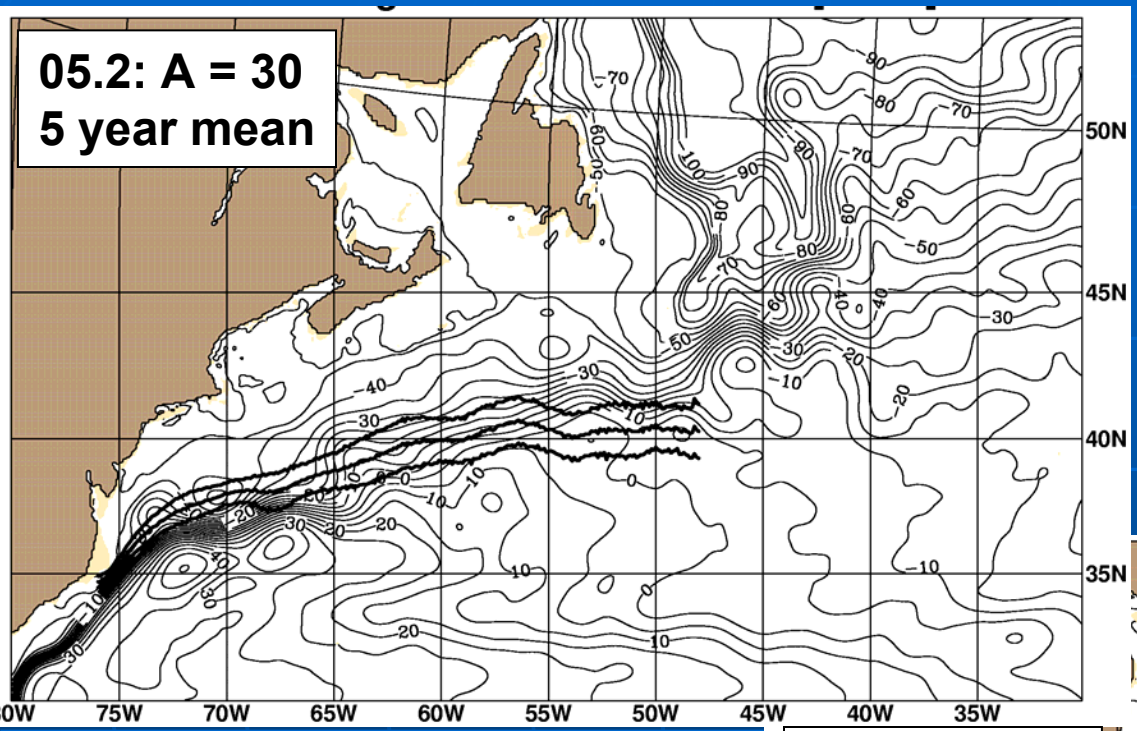
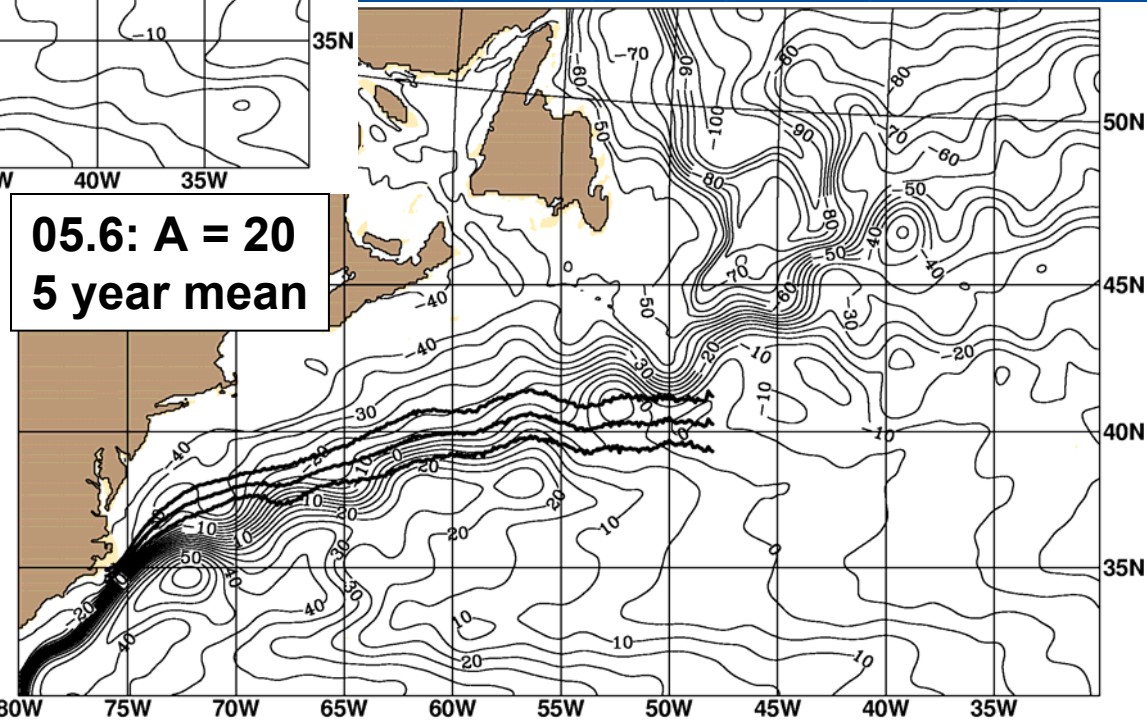
Mean Gulf Stream Pathway





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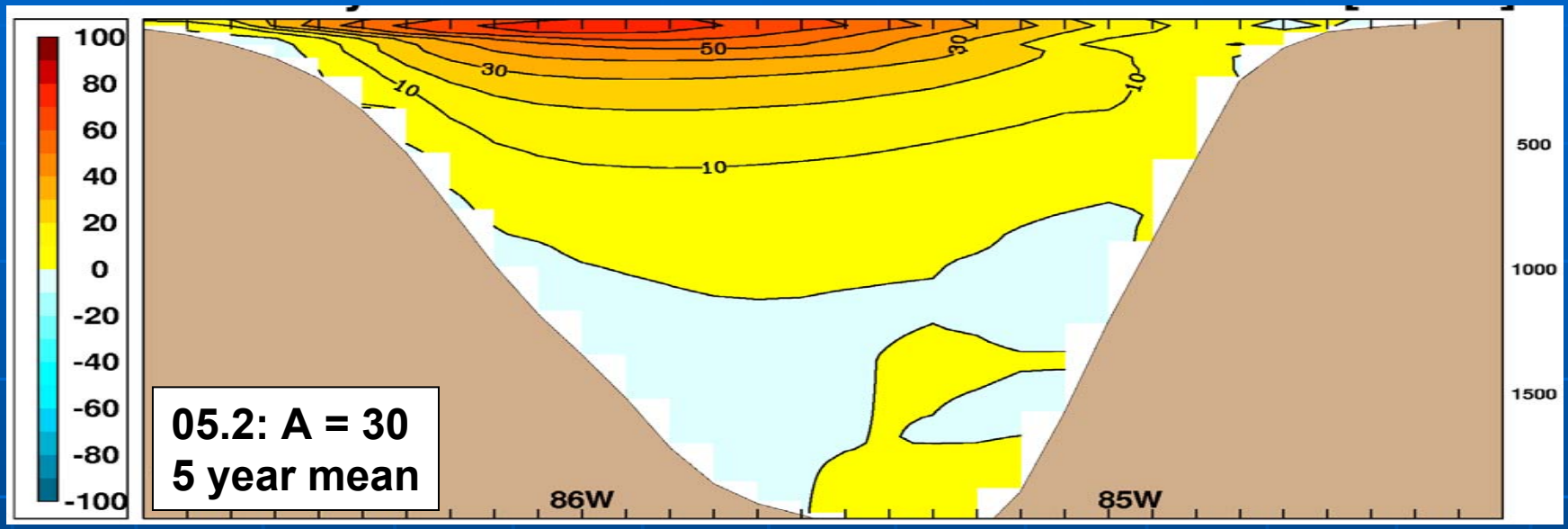
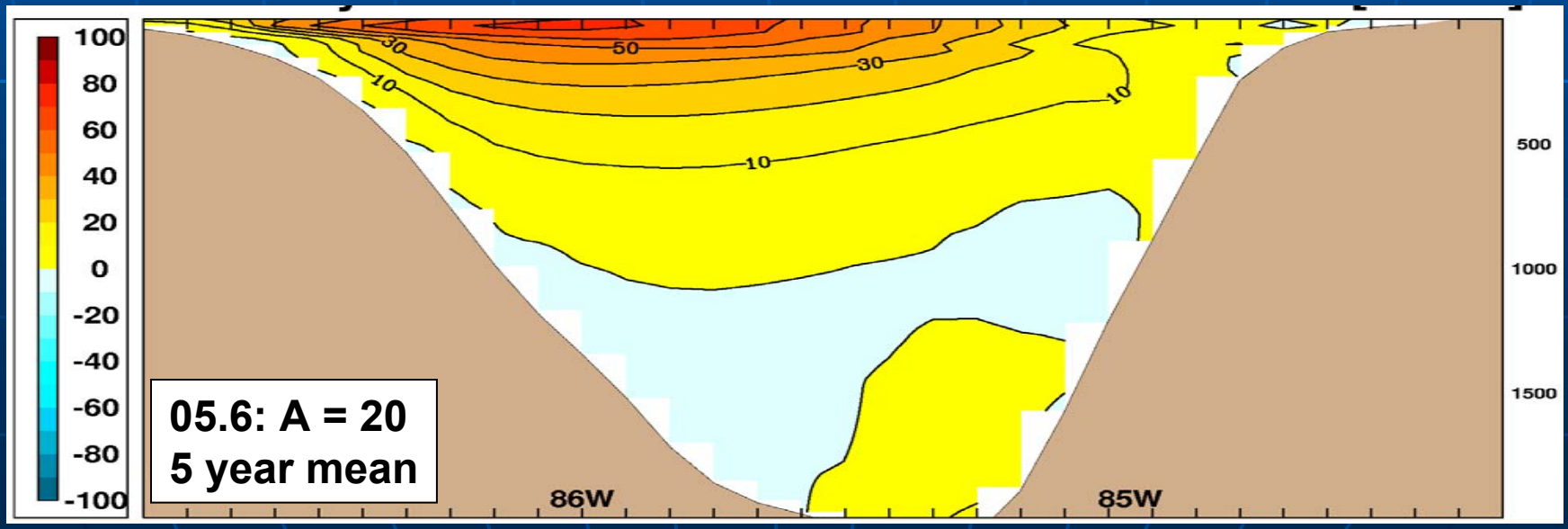
Yucatan Channel

Meridional velocity cross-section





Mean Transports in the IAS*

Expt.	FC 27°N	Abaco north ward	FC + Abaco	NWP	OBC	Yuc Chan	WW	Mona	Aneg	Less Antil	Lucia Vince Gren
Obs.	30-34	5	37	-1.2	-1.9	23-27	-7.0	-2.6	-2.5	-17.1 (resid)#	-10.1
05.2 (7-9)	24.0	8.0	31.8	-2.2	0.0	22.3	-3.6	-2.1	-4.2	-12.1	-8.3
05.6 (9-13)	24.9	3.1	26.9	-2.4	-0.3	22.6	-2.8	-2.4	-4.6	-12.5	-8.0

* Positive transport defined northward and eastward
# Residual of Yucatan – WW – Mona - Anegada

- Weak NWP wind forcing is a second hypothesis regarding the anemic Gulf Stream and IAS circulation

- A regression analysis between the 1978-2002 climatological ERA40-sea wind speed and the 1999-2002 QuikScat wind speed reveals a low bias in ERA40

- Scale ERA40-sea to QuikScat wind speed → ERA40-sec

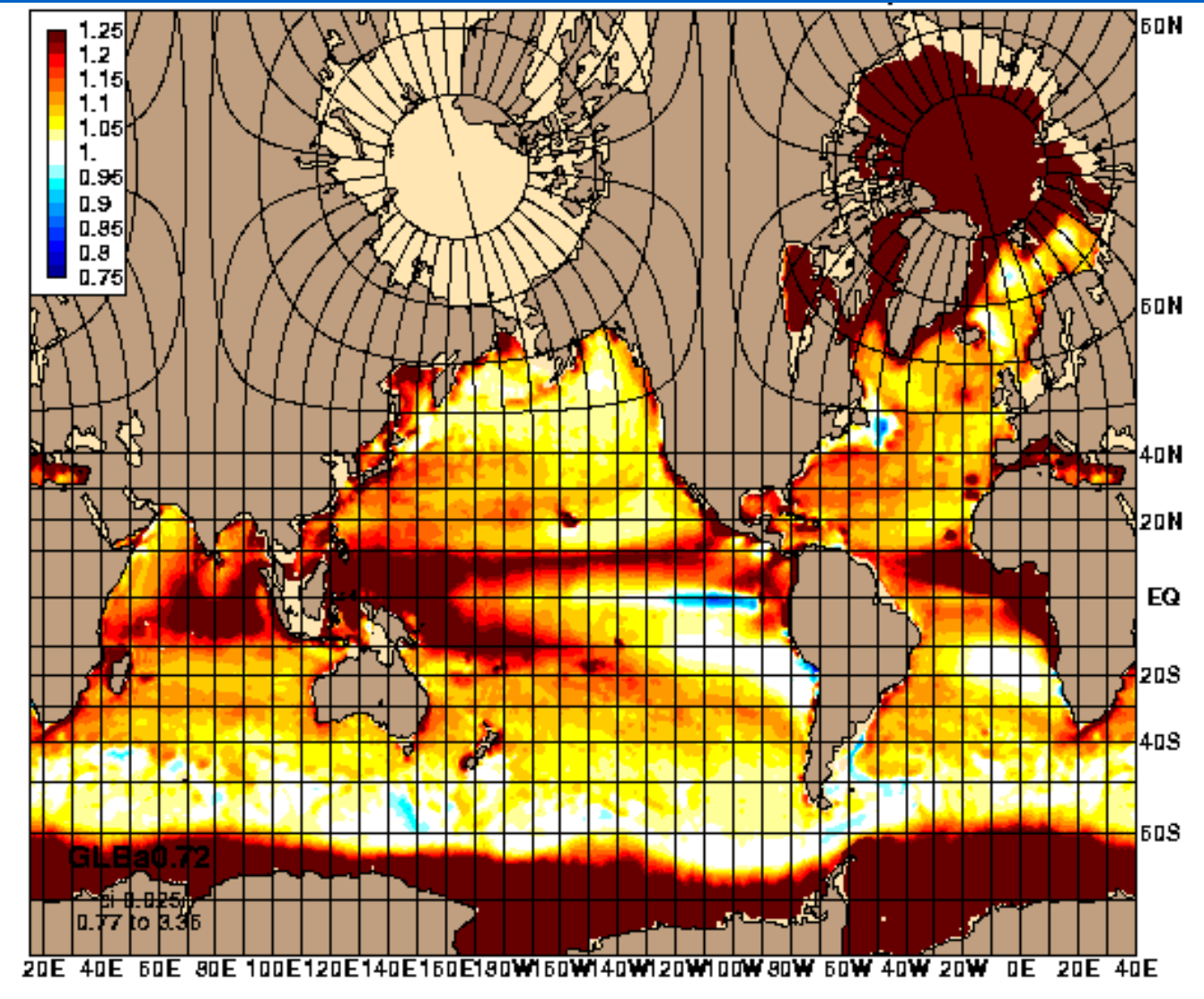
Experiment List

Experiment	Smag. diffusion	Spatially constant A	Biharm. dissipa.	Model Years	Forcing
GLBa0.08-05.6	.05	20	.02	08j-13	ERA15-sea
GLBa0.08-07.1	.05	20	.02	03-04	ERA40-sec

ERA15-sea: 1979-1993 monthly 1st ECMWF Reanalysis, sea only with Sept 1993-1994 ECMWF operational 6-hourly variability

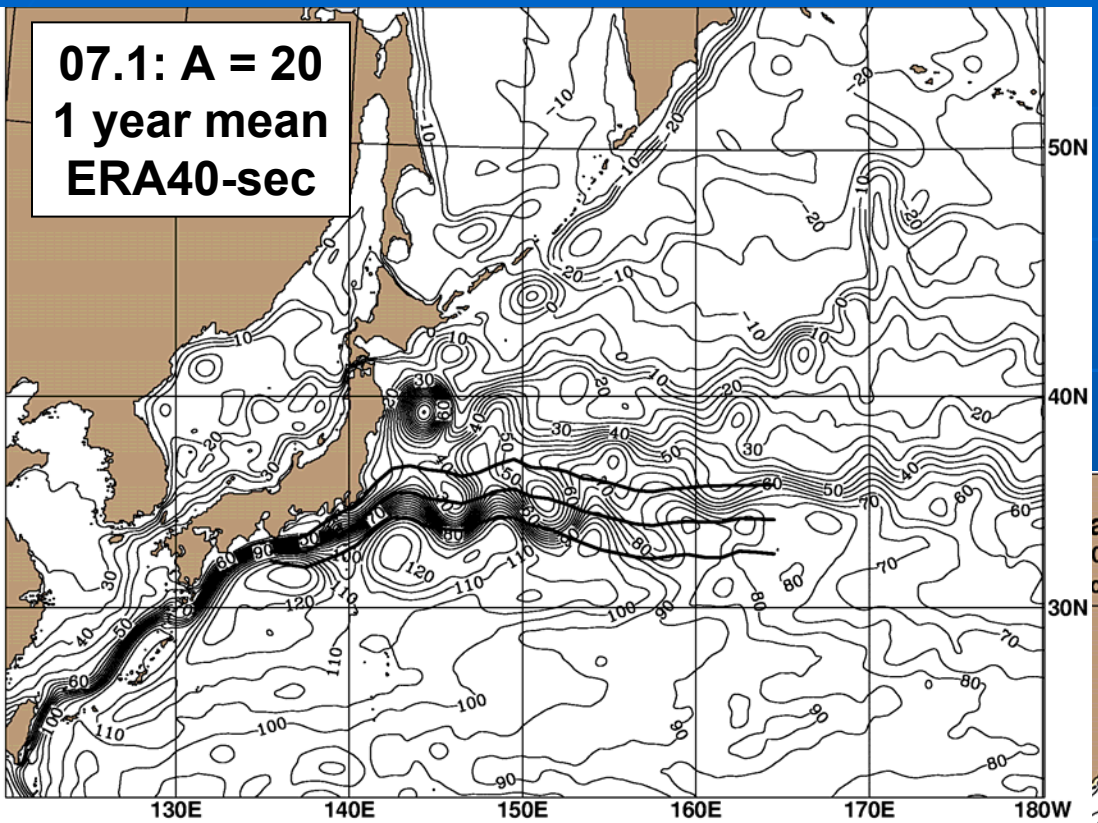
ERA40-sec: 1978-2002 monthly 2nd ECMWF Reanalysis, sea only and wind speed corrected to 1999-2002 QuikScat wind speed with Jan 2003-2004 0.5° computational grid NOGAPS 6-hourly variability

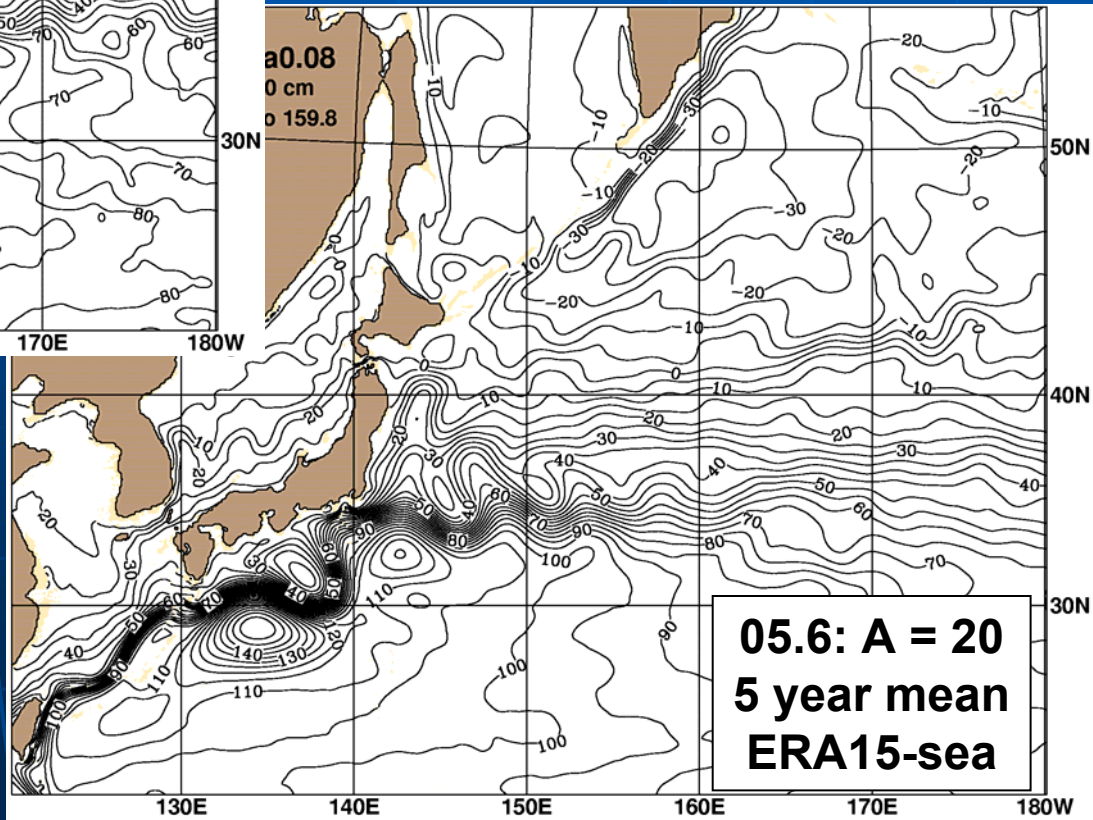
Ratio of QuikScat / ERA40 wind speed



Mask applied to ice covered areas

Mean Kuroshio Pathway





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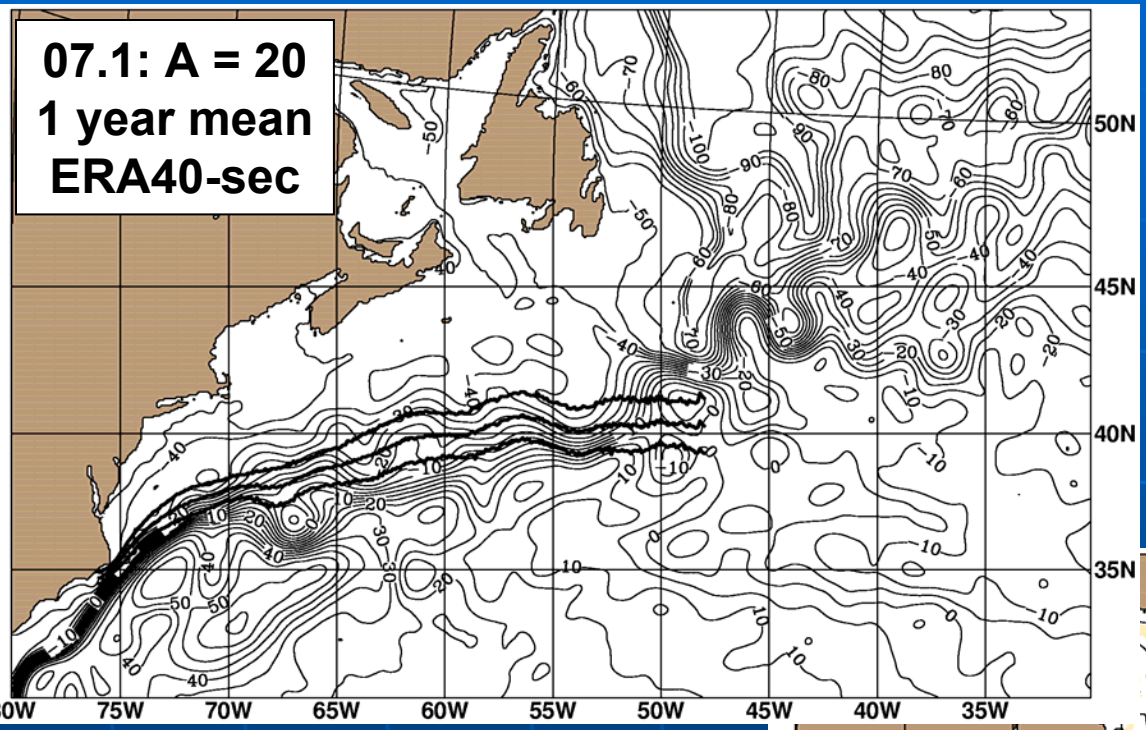
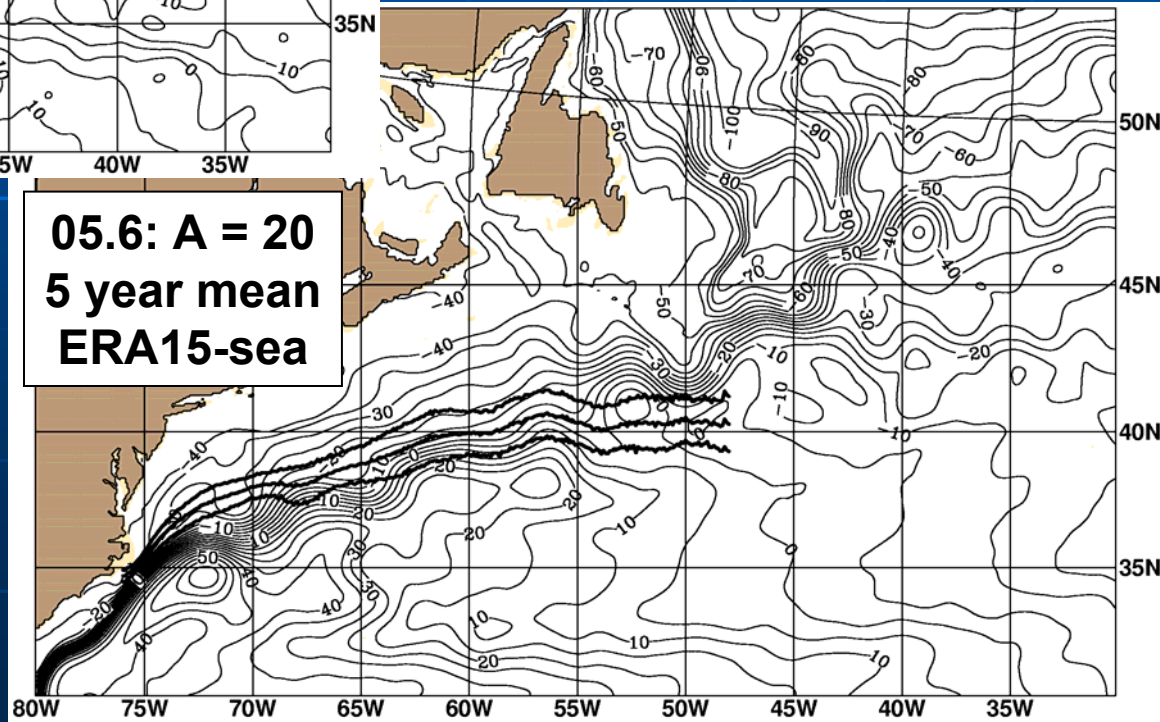
Mean Gulf Stream Pathway





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Yucatan Channel

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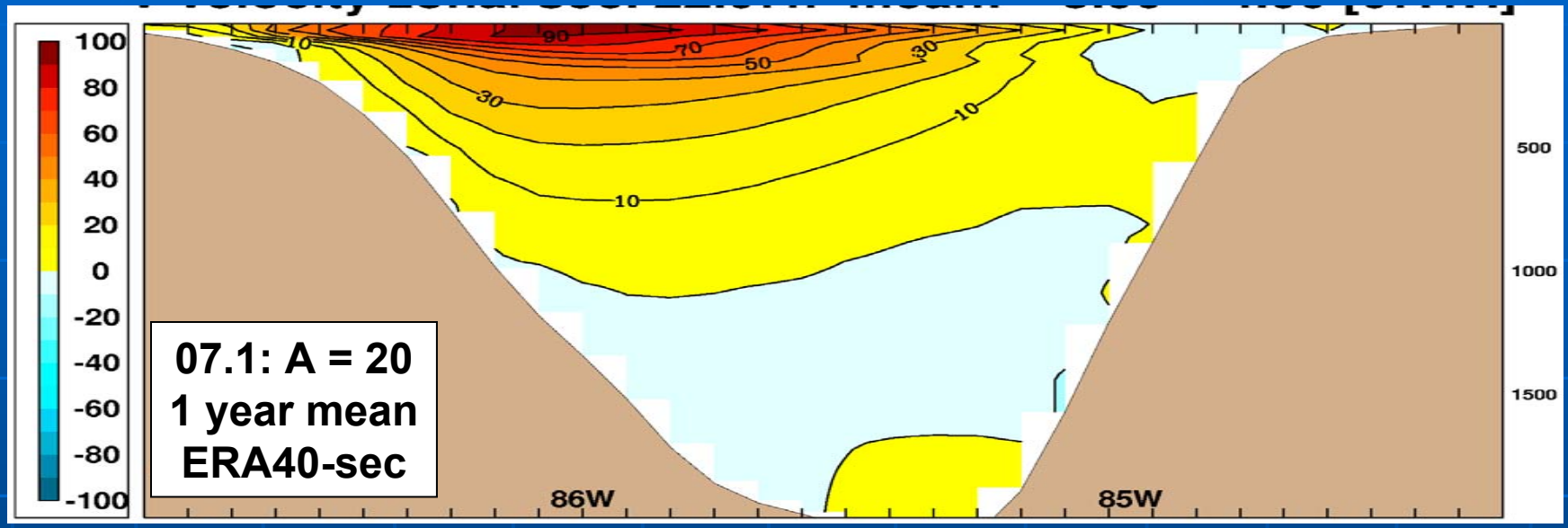

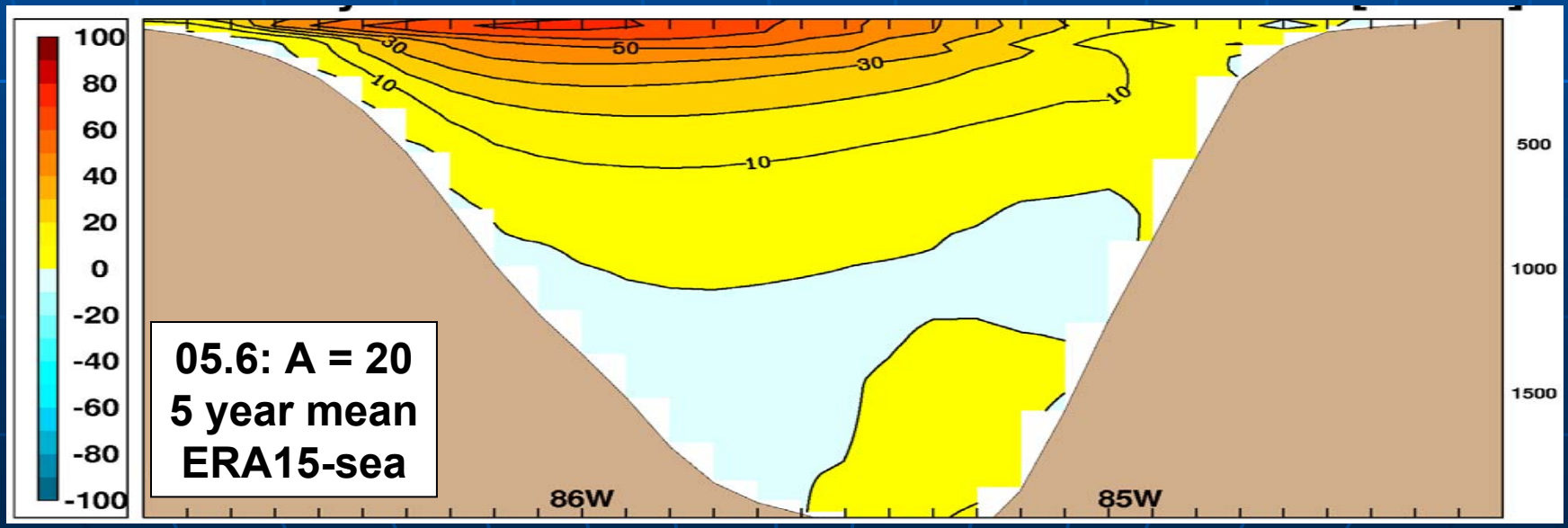

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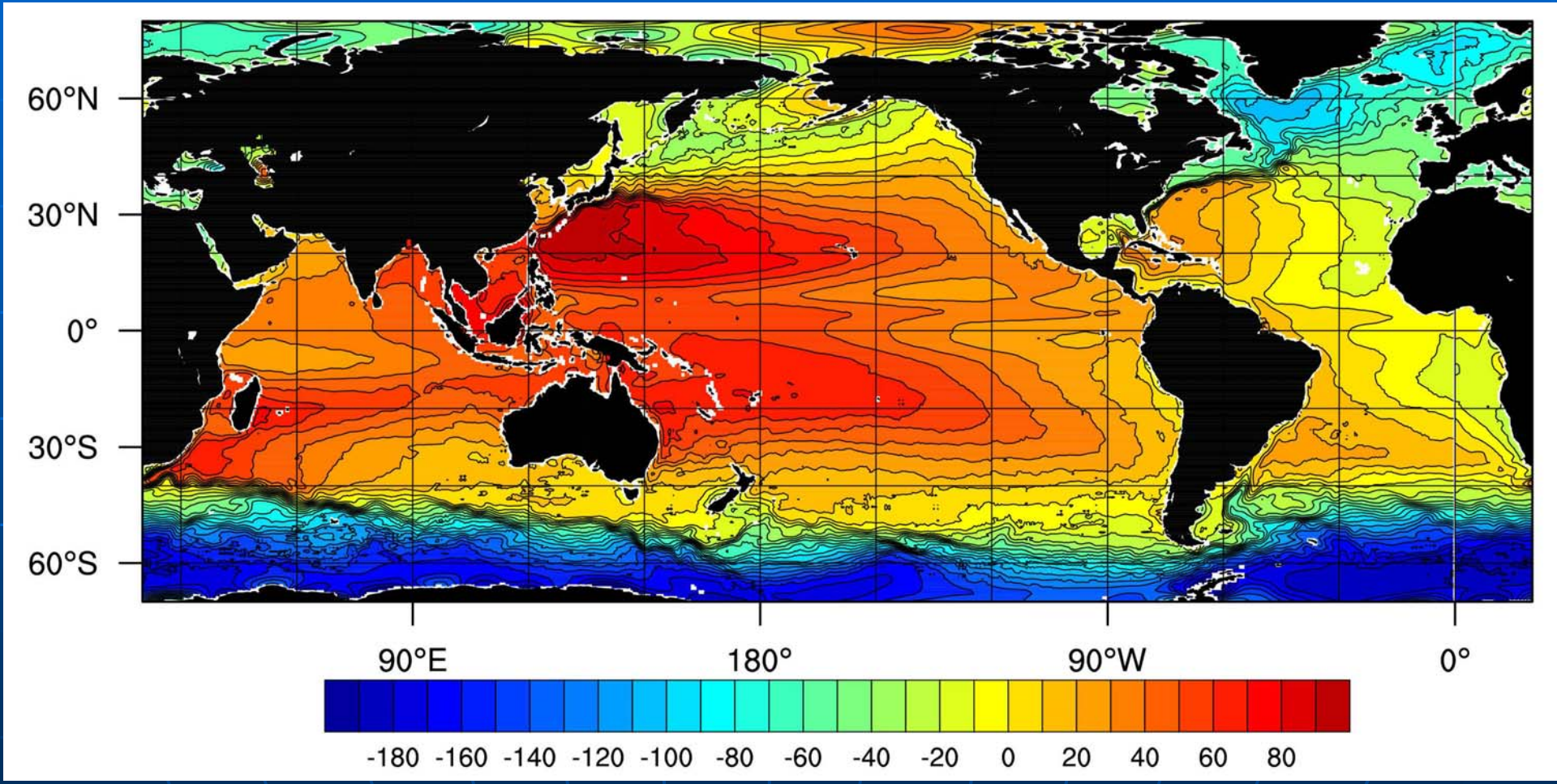
07.1 (4)	26.5	8.0	34.4	-2.5	0.7	24.6	-0.2	-2.2	-4.7	-17.5	-11.7

* Positive transport defined northward and eastward
# Residual of Yucatan – WW – Mona - Anegada

Long-term Mean Global Sea Level

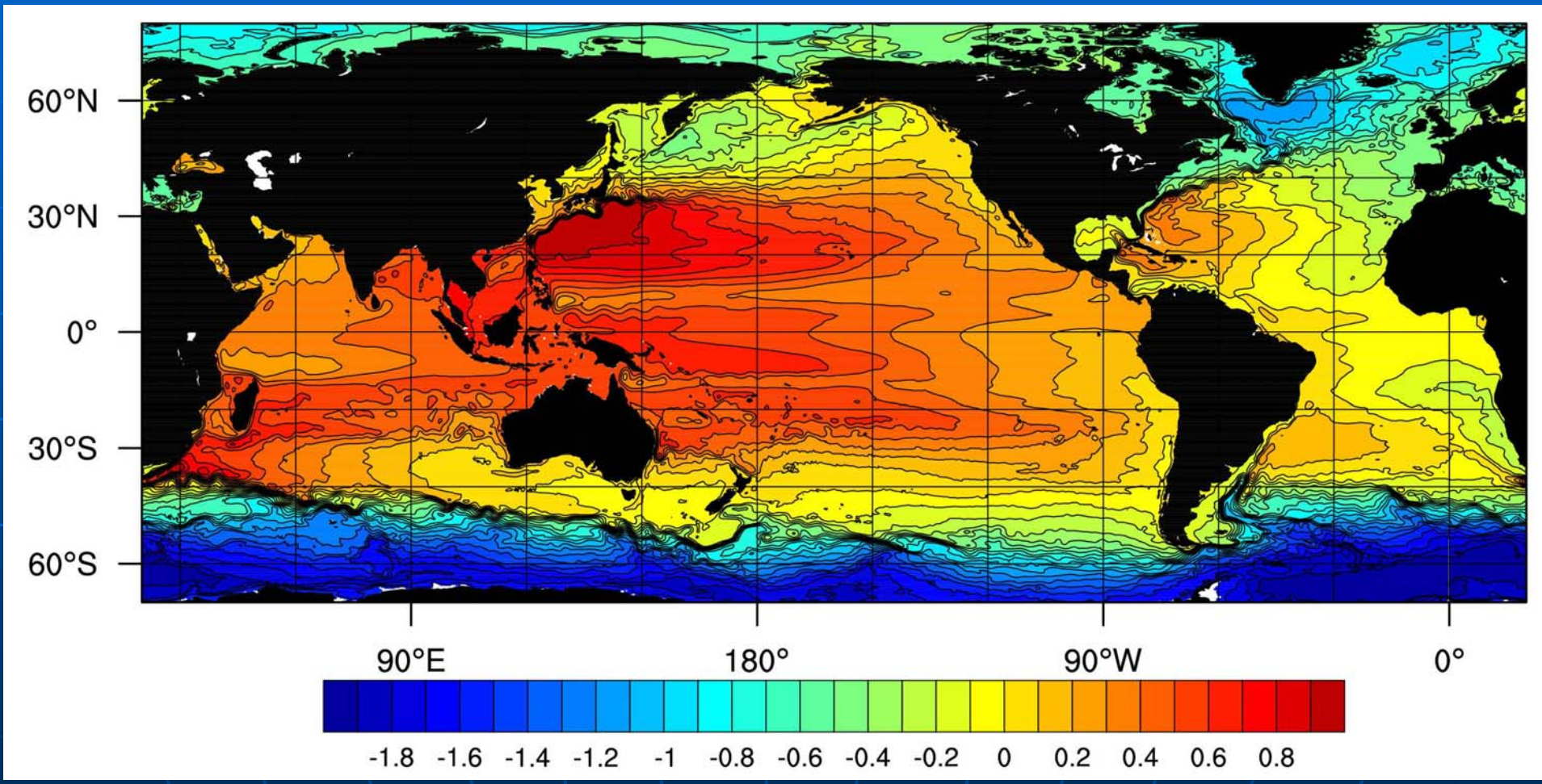
1992-2002 Mean Dynamic Ocean Topography (0.5°)



The 1992-2002 mean ocean dynamic topography data has been obtained from Nikolai Maximenko (IPRC) and Peter Niiler (SIO)

Long-term Mean Global Sea Level

1/12° global HYCOM

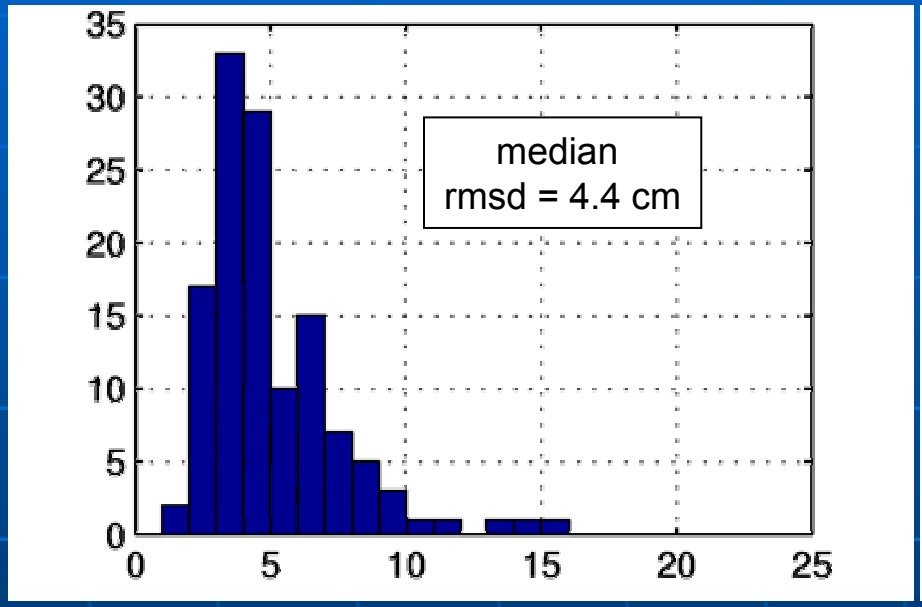


5 year model mean using climatological ERA15 wind and thermal forcing
HYCOM mean shifted by 10 cm

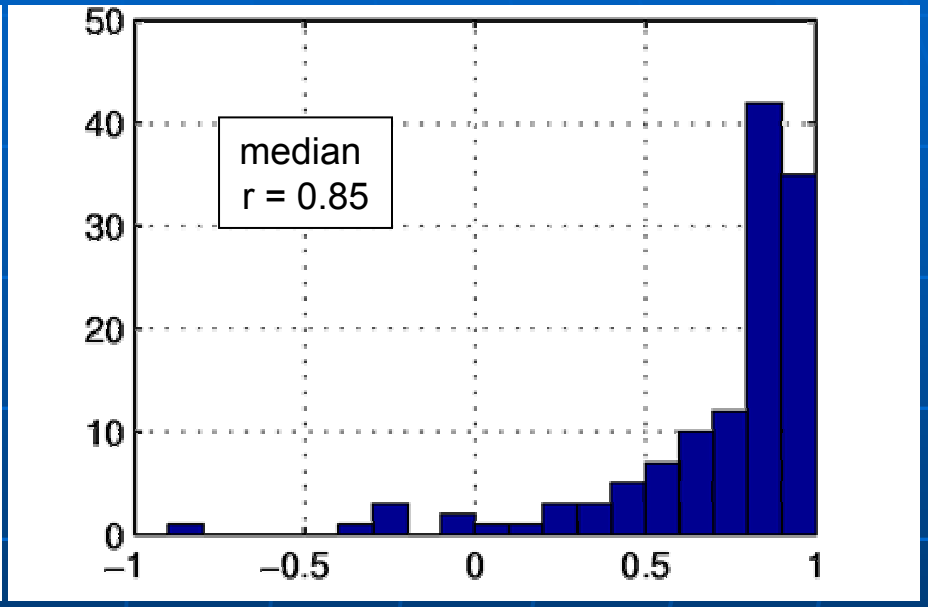
Coastal/Island Sea Level Comparison From 1/12° Global HYCOM

2003 statistics at 126 tide gauge stations

RMS Difference

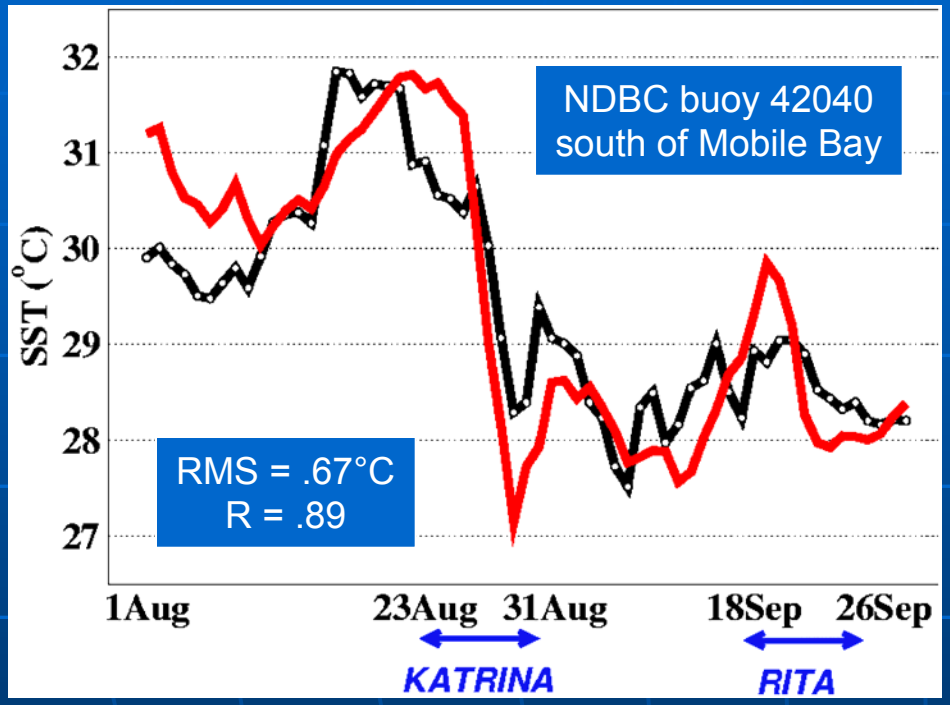


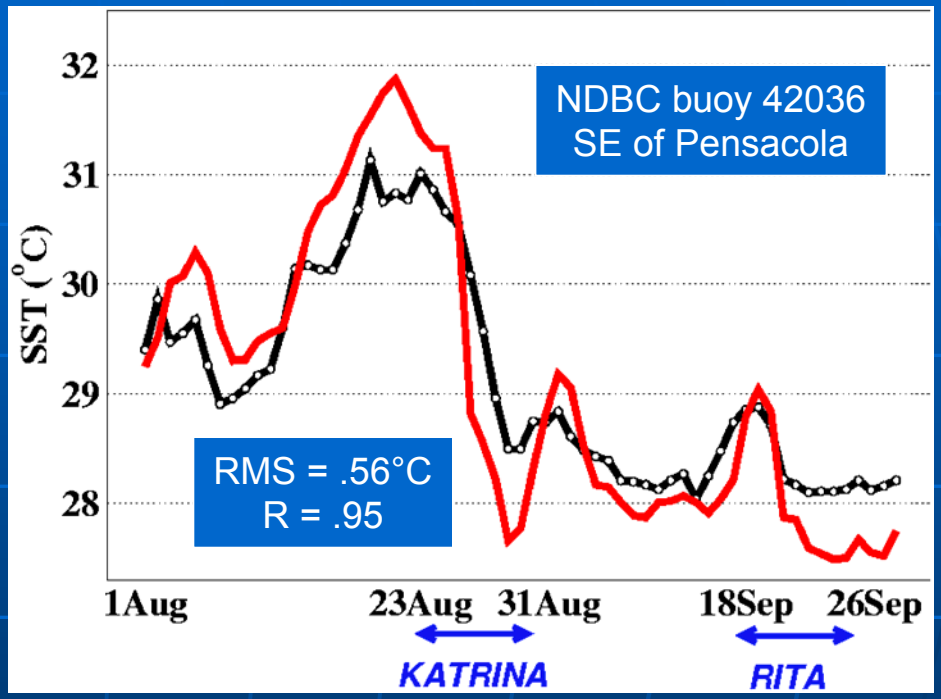
Correlation



Forced with 0.5° computational grid NOGAPS, global HYCOM is reproducing the deterministic response to the wind-driven circulation

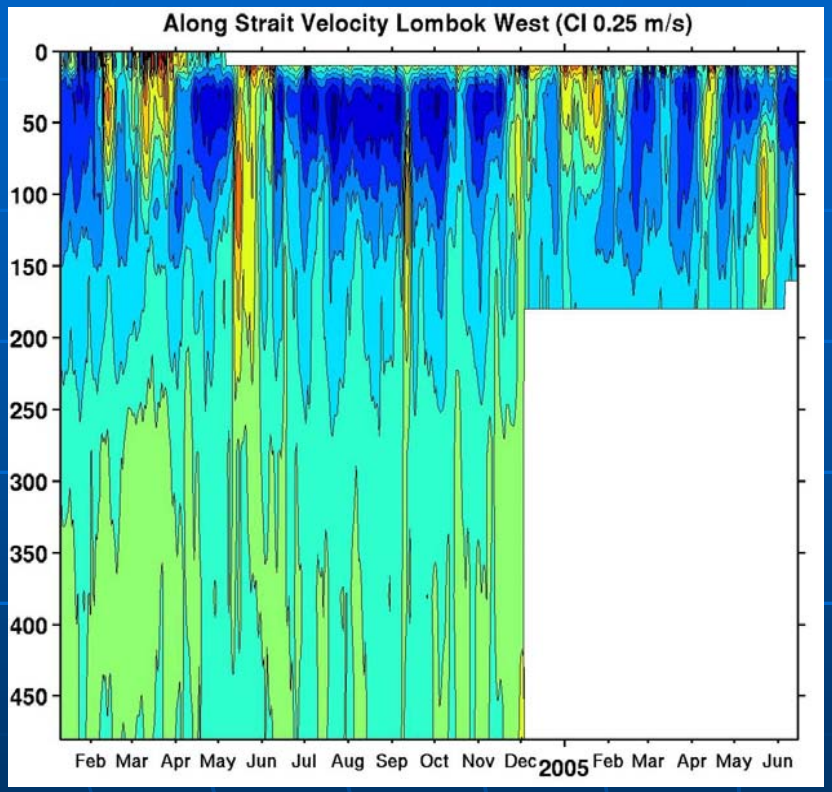
SST Response in 1/12° Global HYCOM to Hurricanes Katrina and Rita

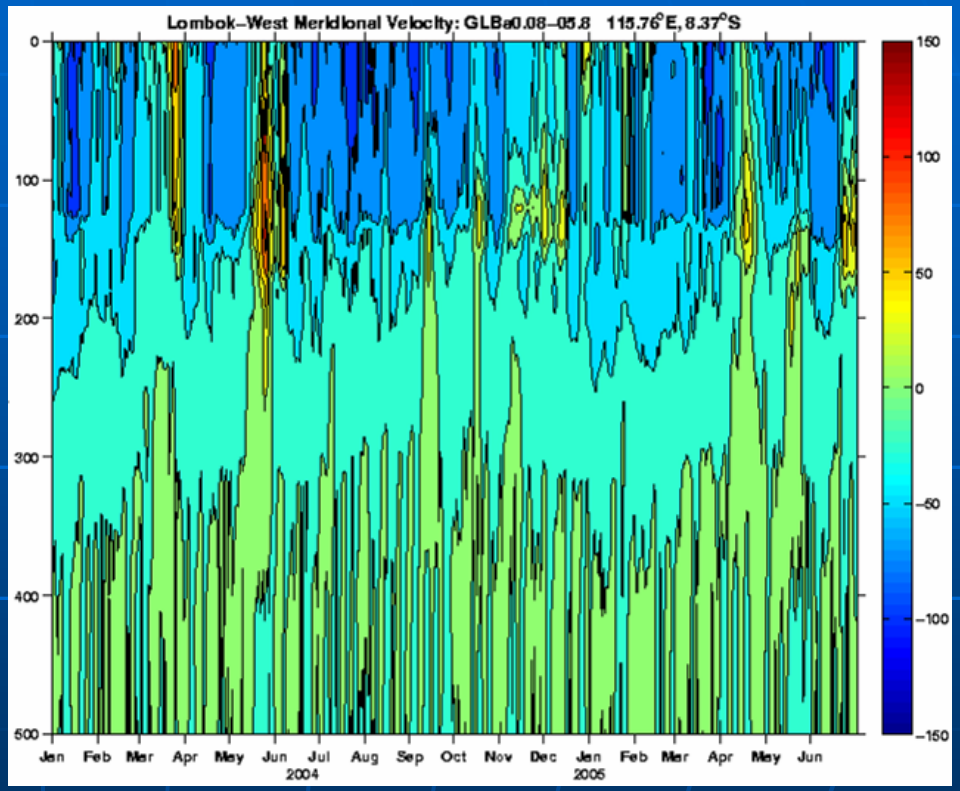




HYCOM reproduces the deterministic SST response to the wind forcing. Implies realistic upwelling and mixing of subsurface waters as well as realistic atmospheric wind and heat flux forcing in HYCOM.

West Lombok Meridional Velocity
INSTANT (left) vs. GLBa0.08-05.8 (right)





INSTANT data courtesy Janet Sprintall, UCSD-SIO

FY07 Plans

- Multiple 2004 data-assimilative experiments
- 2005 – present near real-time run
- Complete a 1993-present "ocean reanalysis" by running a data-assimilative hindcast
- Two non-assimilative simulations:
  - 1995-2007 NOGAPS forcing
  - 1979-2006 ECMWF forcing
- Ten year 1/25° Atlantic demonstration

HYCOM Long-term Goals for Operational Ocean Prediction

- 1/12° fully global ocean prediction system transitioned to NAVO in 2007
  - Include shallow water, minimum depth 5 m
  - Coupled sea-ice model (LANL CICE)
- Increase to 1/25° resolution globally by the end of the decade
  - Optimal resolution for basin-scale
  - Boundary conditions for coastal models