Update on Global and Regional HYCOM Modeling for the US West Coast

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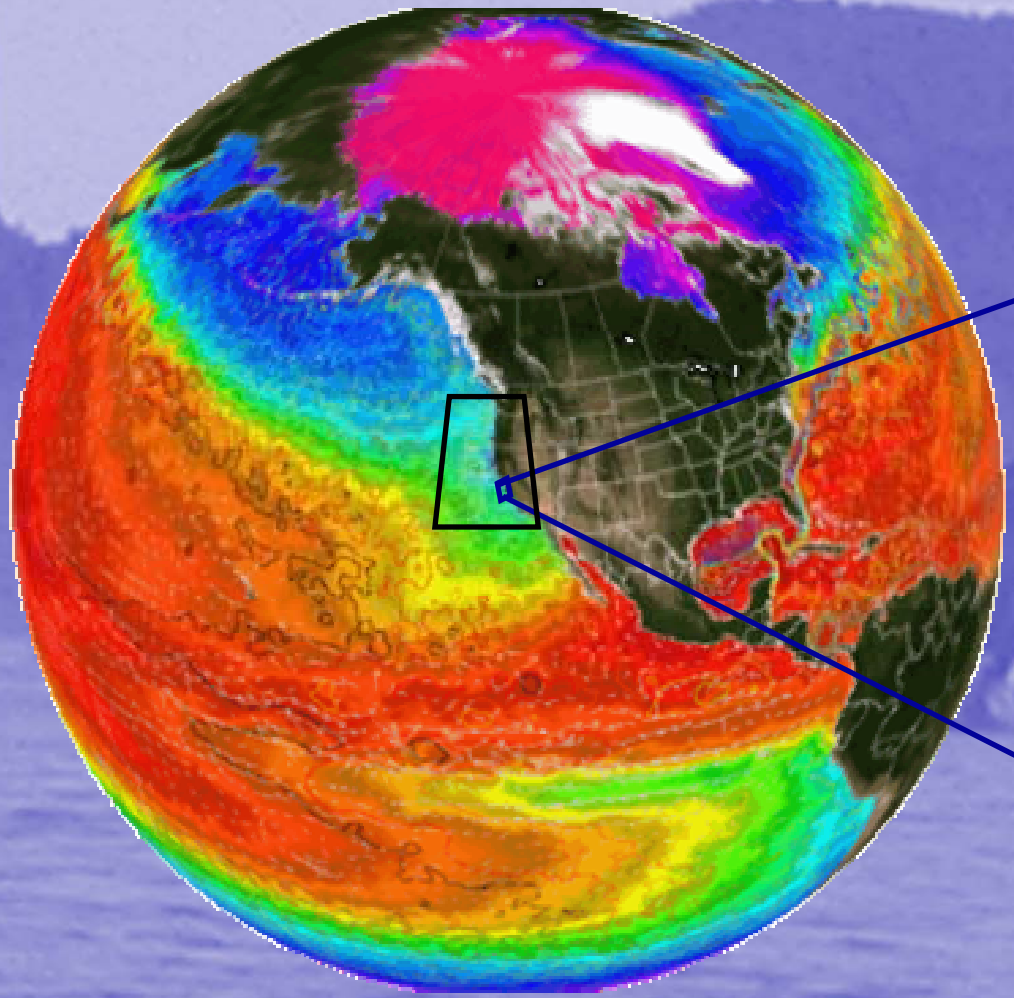
HYCOM Meeting
April 24-26 2007

MODELS



Motivation: Global->Coastal

Regional Models

California Current System (CCS)

Monterey Bay (MB)

30-50N, 116-134W

1/12-degree GLOBAL HYCOM

- Mercator Grid(+bi-polar) (~7Km)
- 32 Layer ρ/σ/z (σ2)
- ~1/4Km Resolution
- 29 σ levels
- Orthogonal Curvilinear
- 359x312

1/8-degree GLOBAL NCOM

- Curvilinear (~12Km)
- 41 Level σ/z (19/21)
- GLB8_2f (operational)
- 81x58

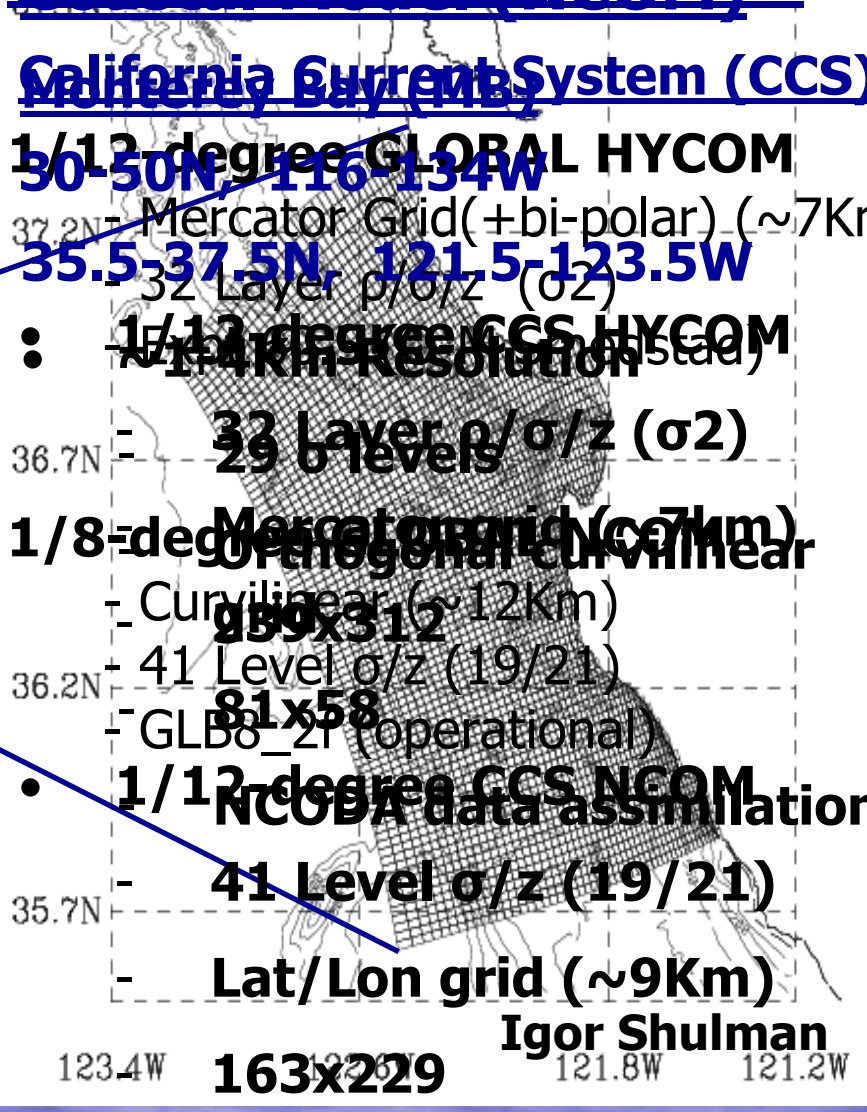
35.5-37.5N, 121.5-123.5W

1/12-degree CCS HYCOM

- ~1/4Km Resolution
- 32 Layer ρ/σ/z (σ2)
- 29 σ levels
- Mercator grid (~7km)
- 163x229

1/12-degree CCS NCOM

- NCOBA data assimilation
- 41 Level σ/z (19/21)
- Lat/Lon grid (~9Km)



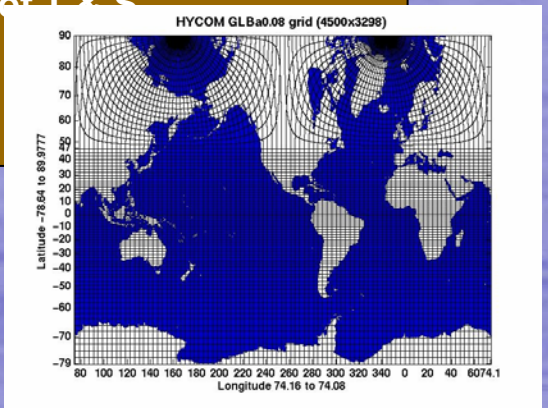
Igor Shulman

The Global Models: HYCOM

1/12º 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: 32 hybrid layers with z-levels near surface, sigma in shallow water and isopycnal interior coordinates
- KPP mixed layer model & thermodynamic sea-ice model
- Surface forcing: 3 hourly wind stress, wind speed, thermal forcing, precipitation, relaxation to climatological SSS from .5 deg. NOGAPS
- Monthly river runoff (986 rivers)
- Initialize from January climatology (GDEM3) T and S, then SSS relaxation from PHC 3.0
- NCODA used for data assimilation. Multi-variate OI scheme (see Smedstad et al poster) Assimilates altimeter SSH (3 altimteters), MCSST, observed profiles of T & S

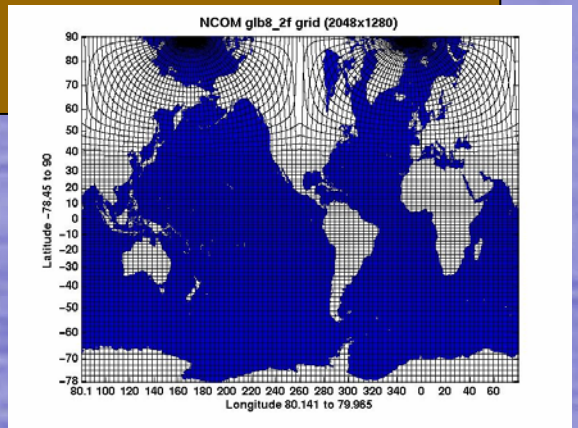
Cooper-Haines vertical projection



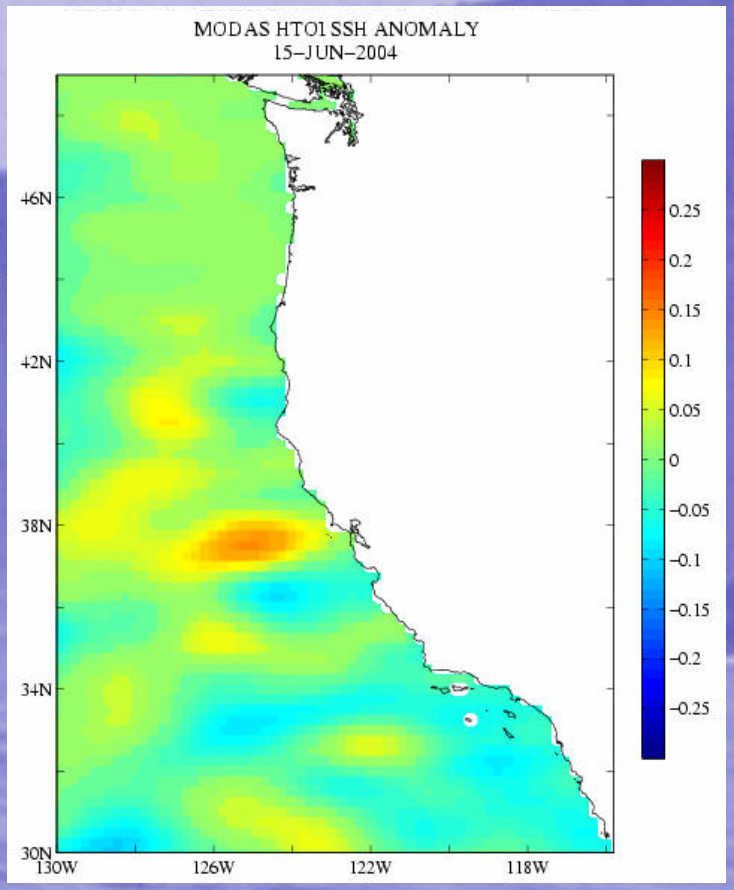
The Global Models: NCOM

1/8º Global NCOM Configuration

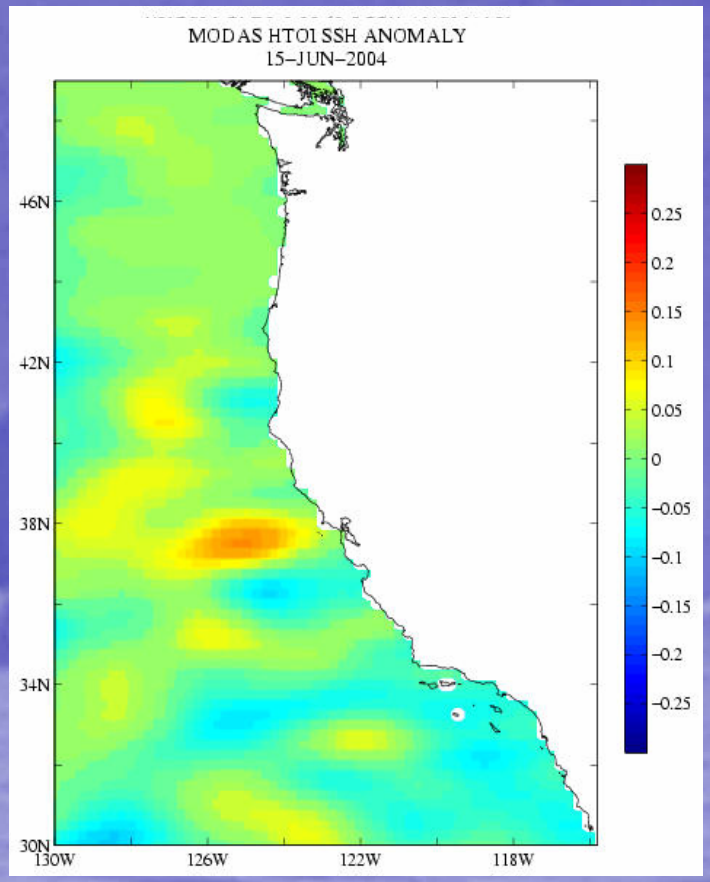
- Horizontal grid: 1/8° equatorial resolution
- Curvilinear grid from 78S to 90N
- Vertical coordinate surfaces: 40 hybrid layers with 19 sigma levels in upper 150m over 21 z-levels.
- Mellor-Yamada mixed layer model
- Surface forcing: 3 hourly wind stress, wind speed, thermal forcing, precipitation, relaxation to climatological SSS from .5 deg. NOGAPS
- Monthly river runoff (1003 rivers)
- Operationally available sea-surface temperature (MCSST) and altimetry (SSH) data are incorporated into the NAVO Modular Ocean Data Assimilation System (MODAS) and Navy Layered Ocean Model (NLOM) analyses with forecasts of SSH and SST.
- These surface fields are combined with the MODAS synthetic database to yield three-dimensional fields of temperature and salinity for assimilation into global NCOM.



COMPARISONS (Global Models)



Gridded Altimeter SSH-June 15
NAVO Data Fusion Center

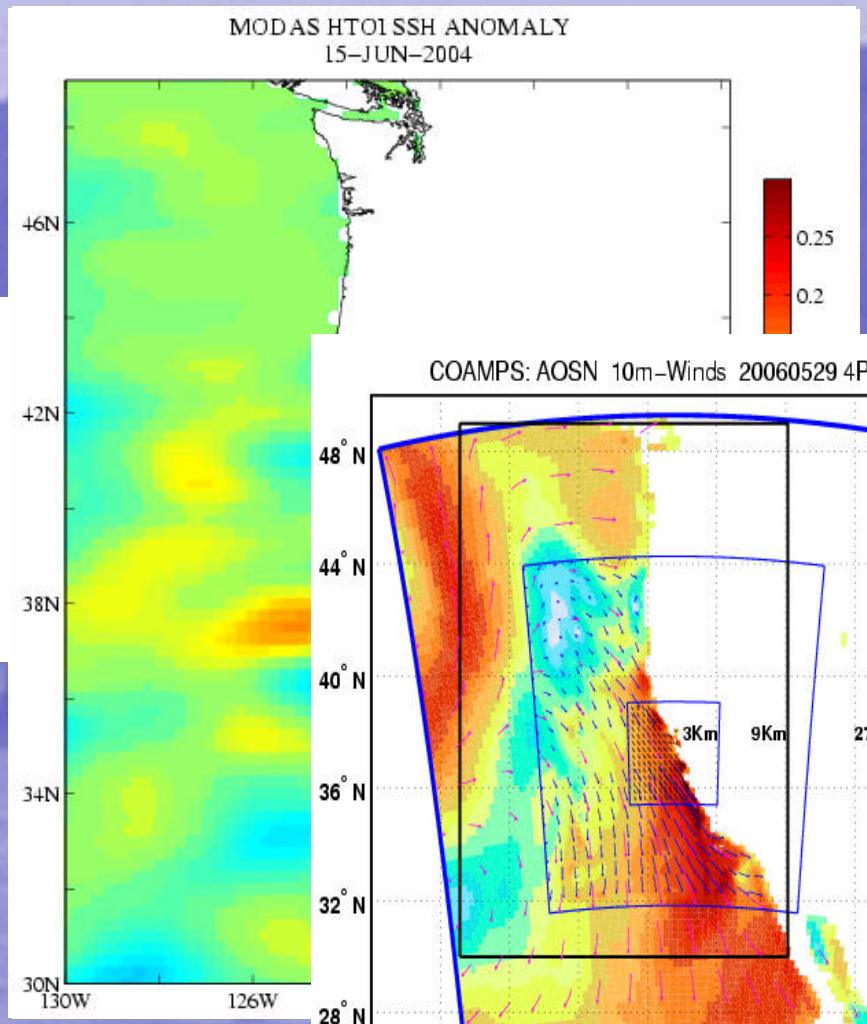


Gridded Altimeter SSH-June15 NAVO
Data Fusion Center

Model Evaluation: Regional NCOM

Gridded Altimeter SSH –June15

NAVO Data Fusion Center



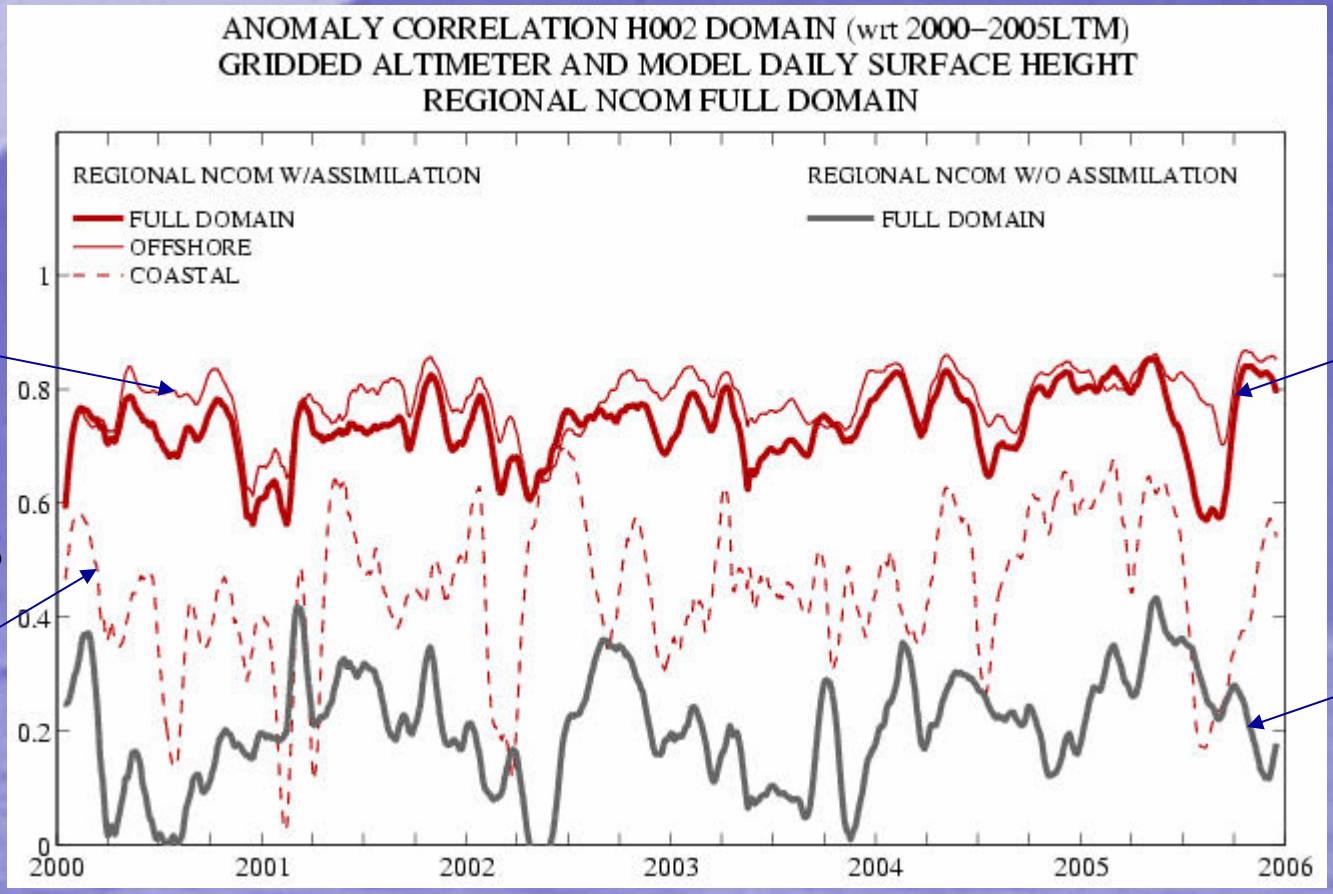
NCOM CCS

Km

Model Evaluation: Anomaly Correlations Regional NCOM-CCS

With MODAS Assimilation: Open Ocean

With MODAS Assimilation: Coastal (200Km)

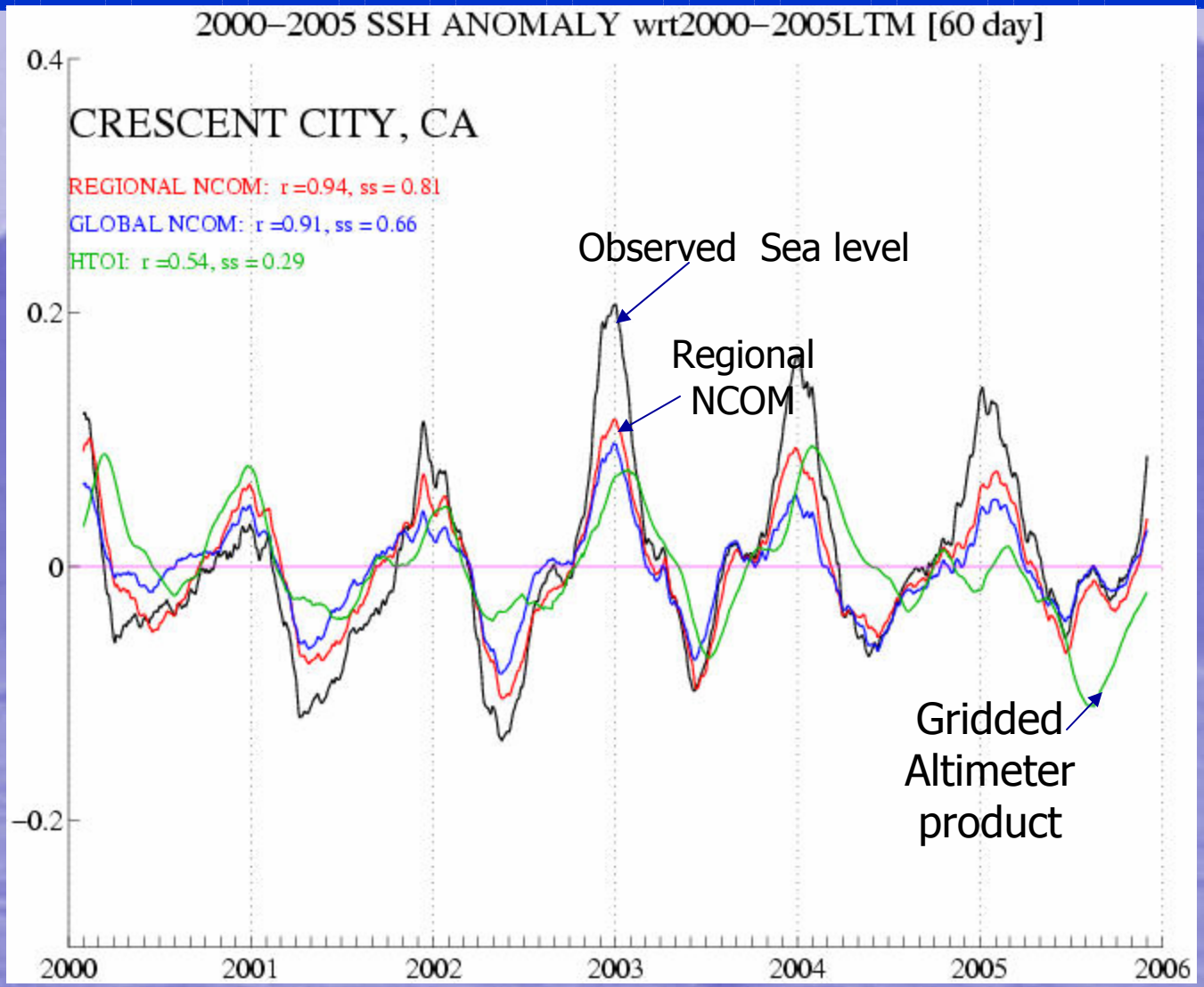


With MODAS Assimilation

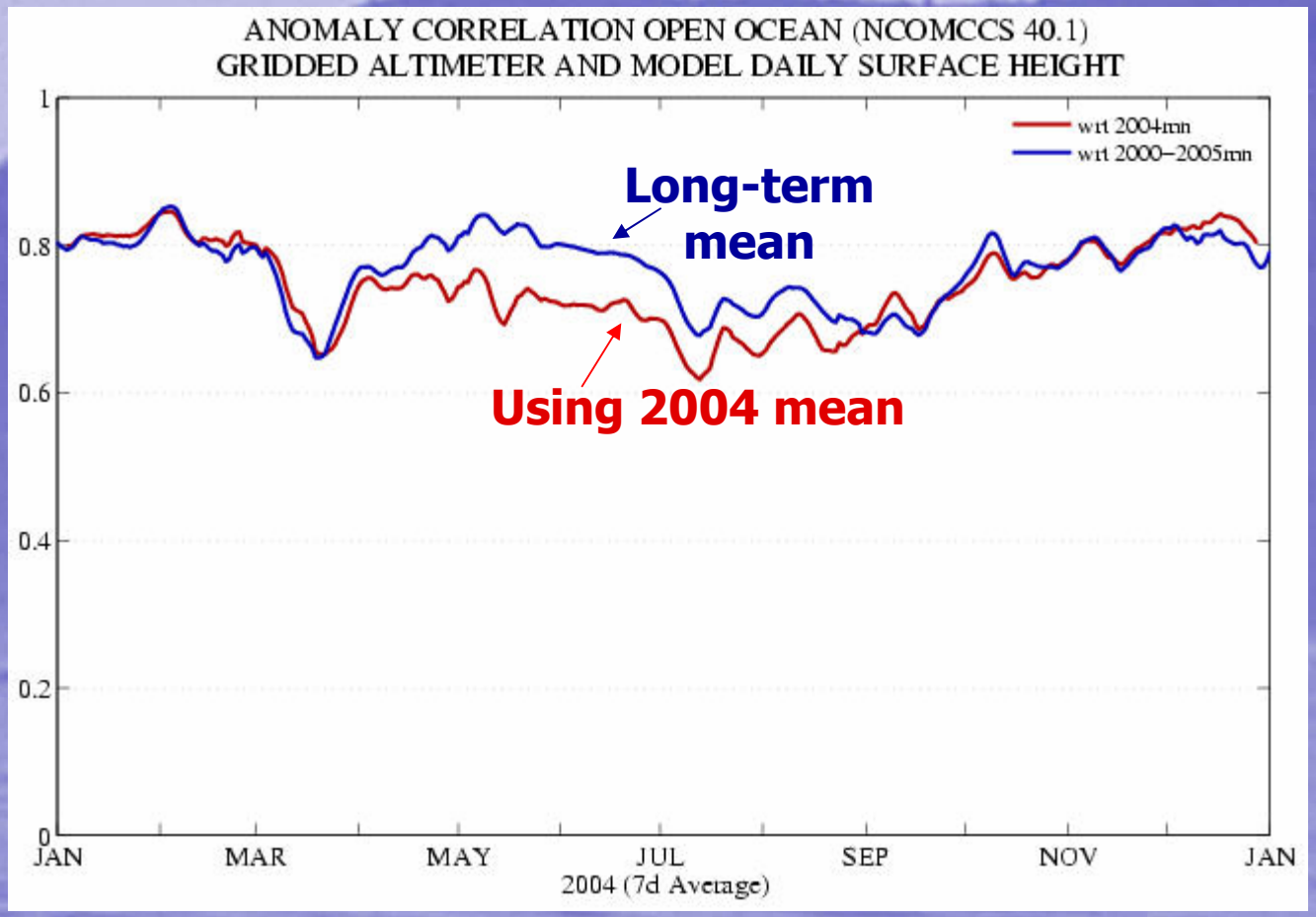
No Assimilation

Anomaly Correlations Relative to Gridded Altimeter Field from NAVO

Model Evaluation: Tide Gauges



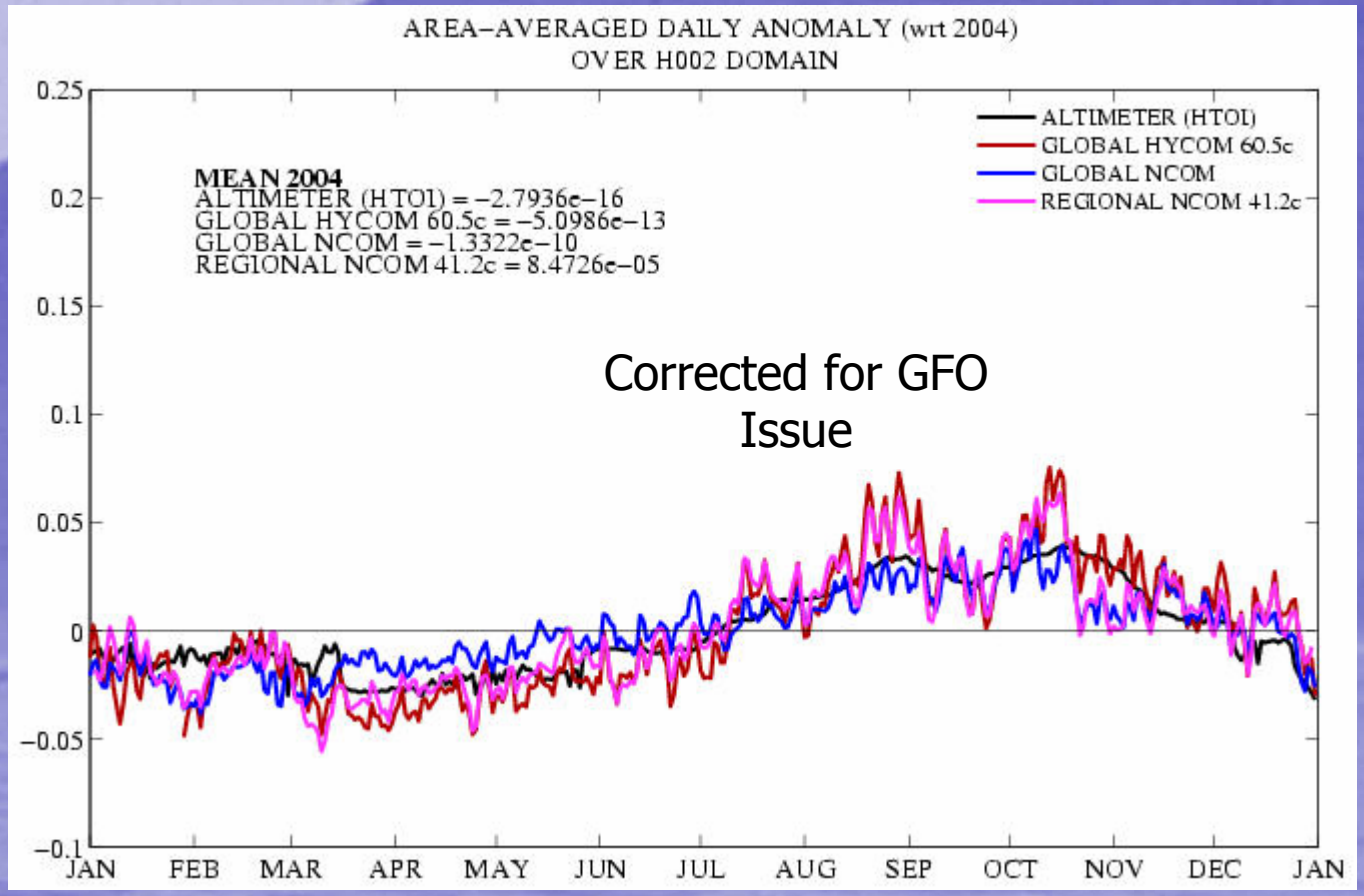
Model Evaluation: Anomaly Correlations
Regional NCOM using different means to form anomalies



Which mean is used makes a difference.

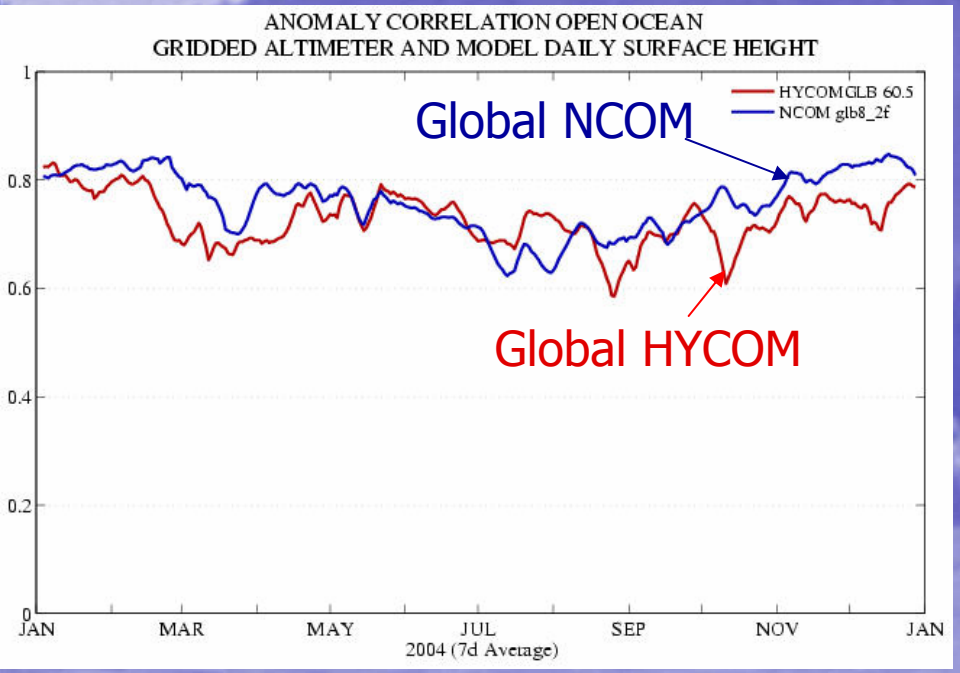
To be fair to HYCOM simulation , all analyses performed with 2004 mean

Model Evaluation: Domain Averaged Anomalies

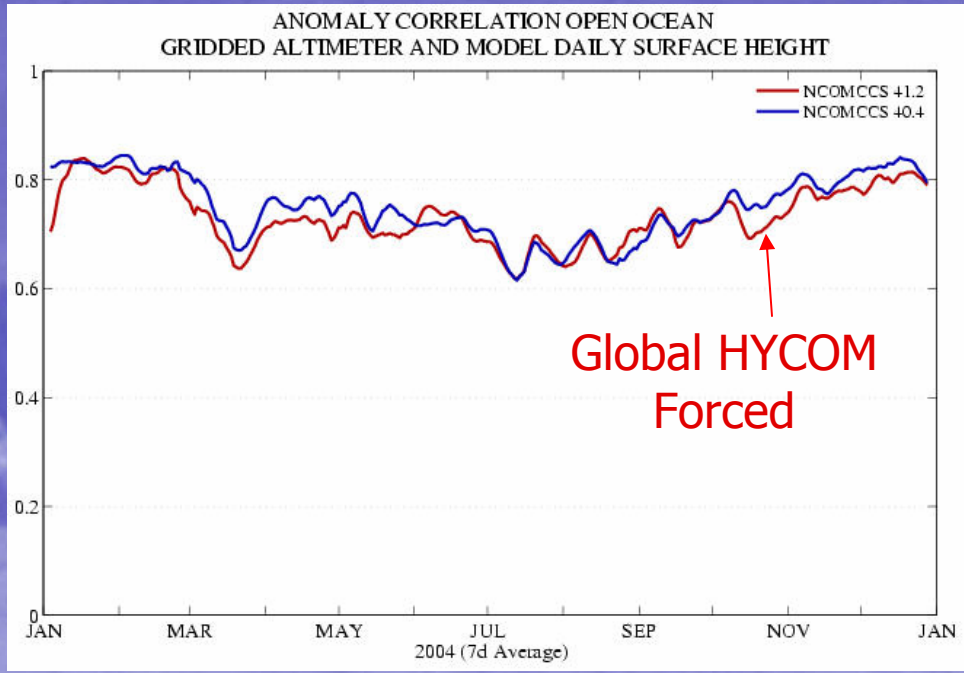


Model Evaluation: Anomaly Correlations Global HYCOM and NCOM; Regional NCOM-CCS

Global NCOM and HYCOM

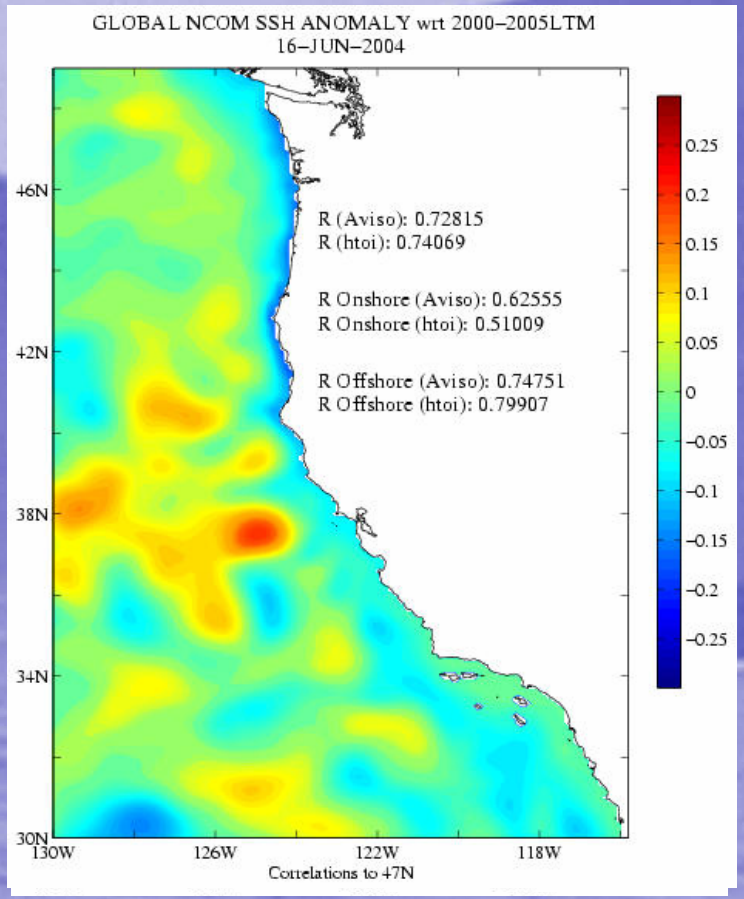


Regional NCOM: Forced by NCOM and HYCOM



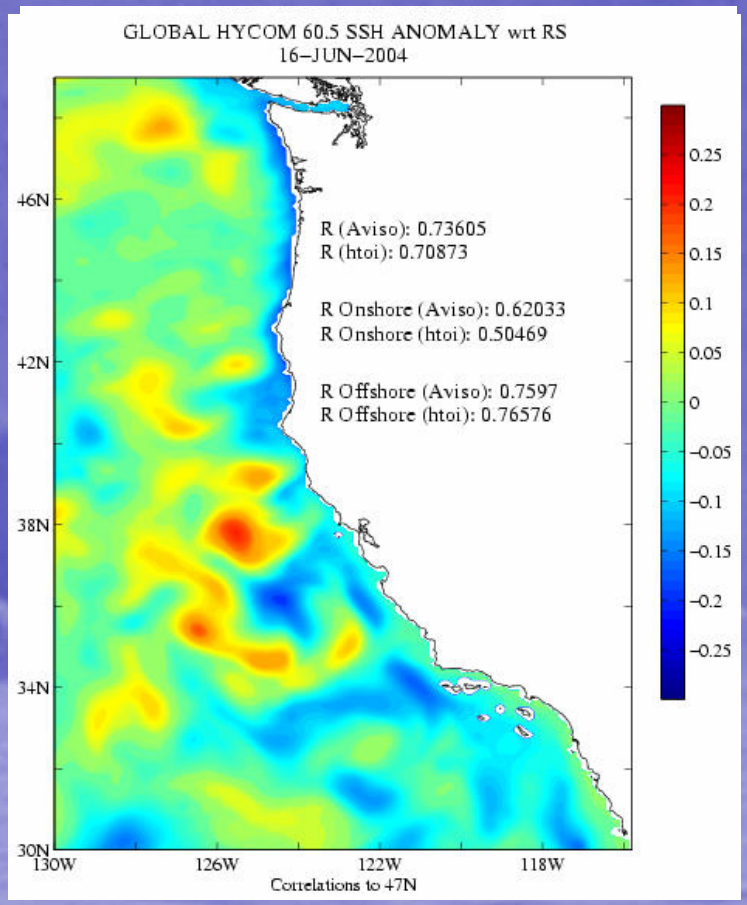
Anomaly Correlations Relative to Gridded Altimeter Field from NAVO

COMPARISONS (Global Models)



Global NCOM SSH Anomaly

June 16 2004



Global HYCOM SSH Anomaly

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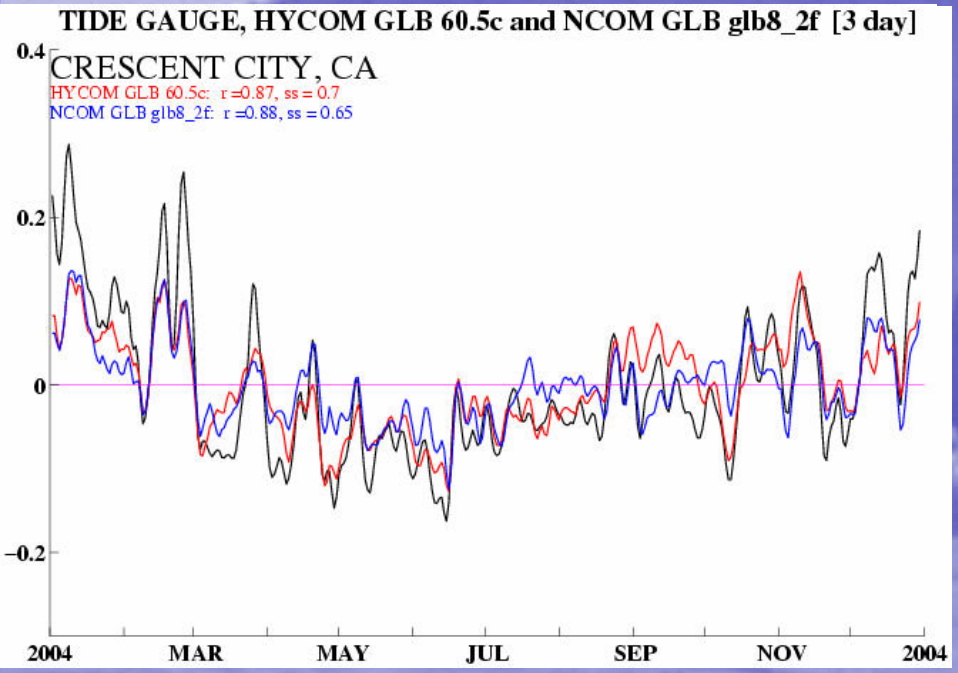
Model Evaluation: Tide Gauges

Global NCOM and HYCOM



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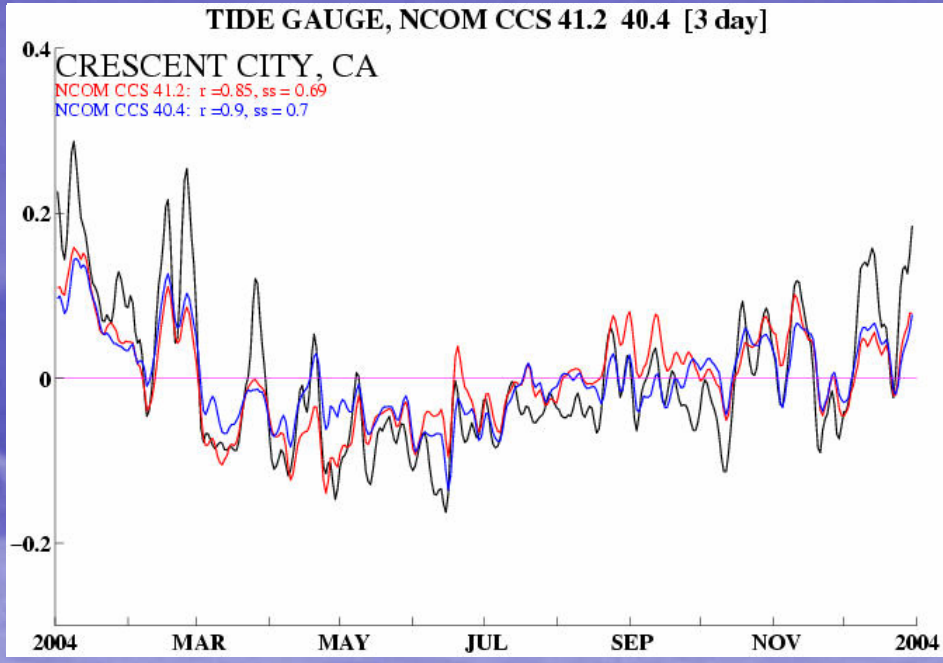
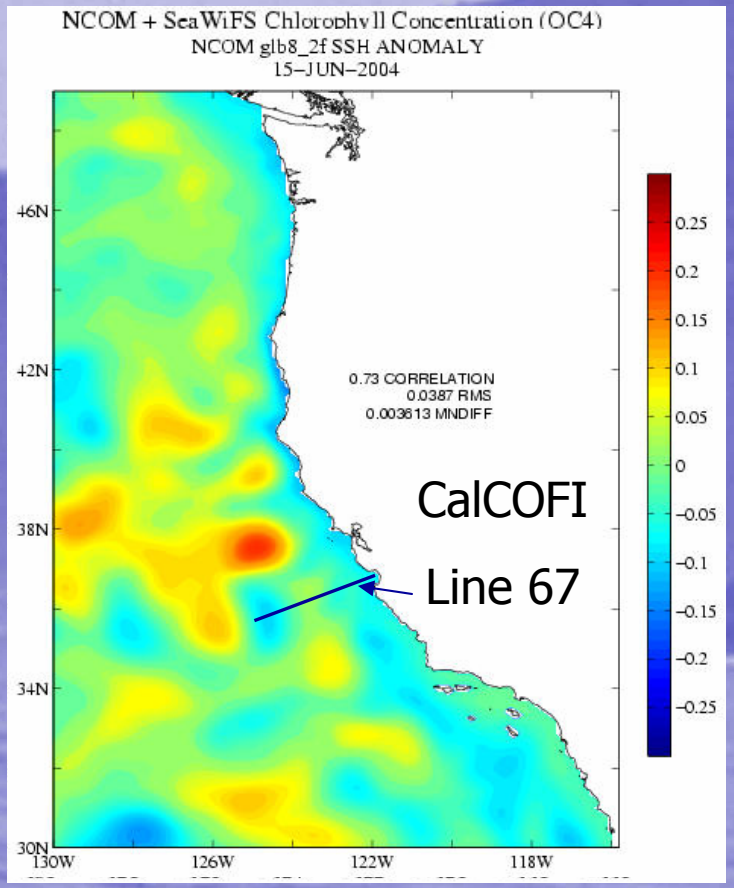


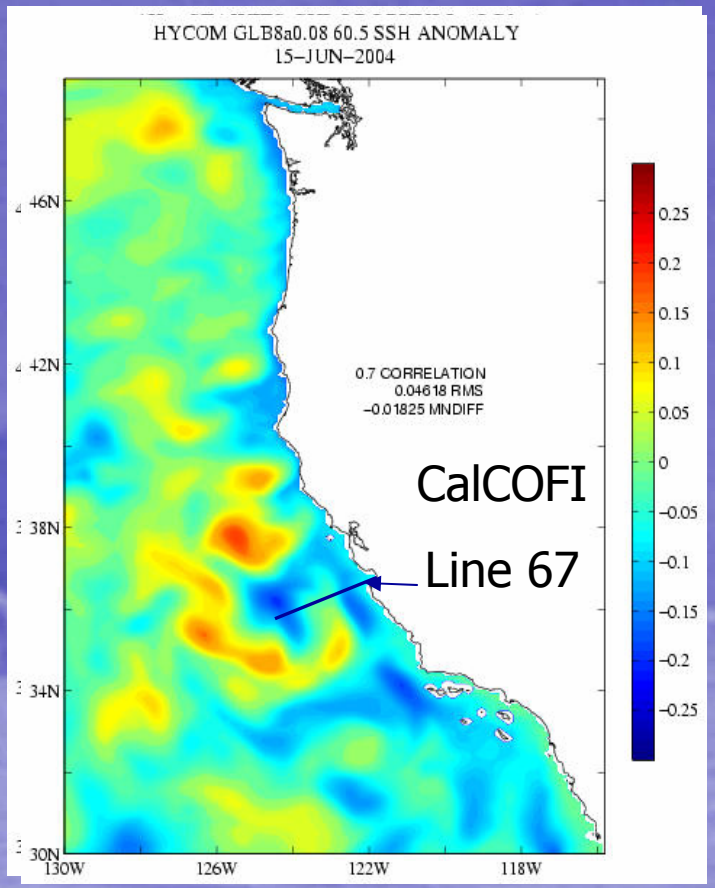
Global HYCOM and NCOM nest represent Coastal Kelvin Wave Pulses More Accurately

Sub-surface Evaluation of Global Models: Line 67



Global NCOM SSH Anomaly

June 15 2004



Global HYCOM SSH Anomaly

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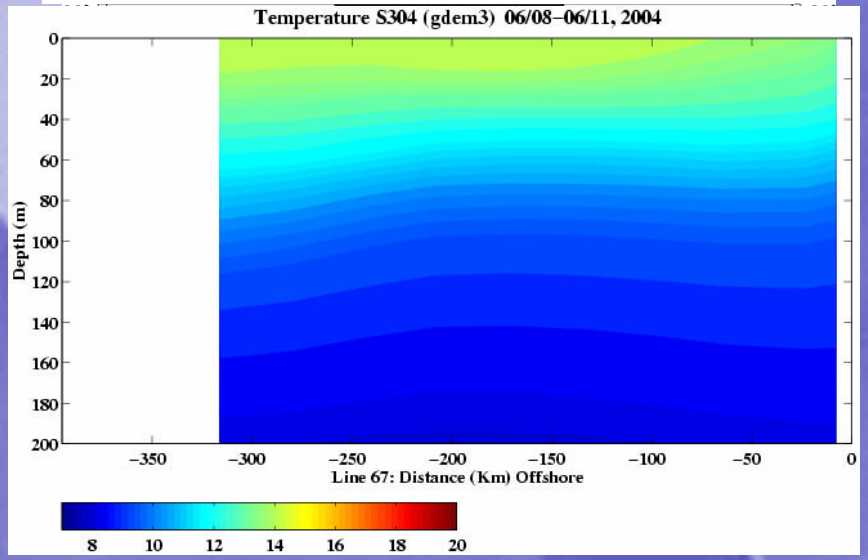
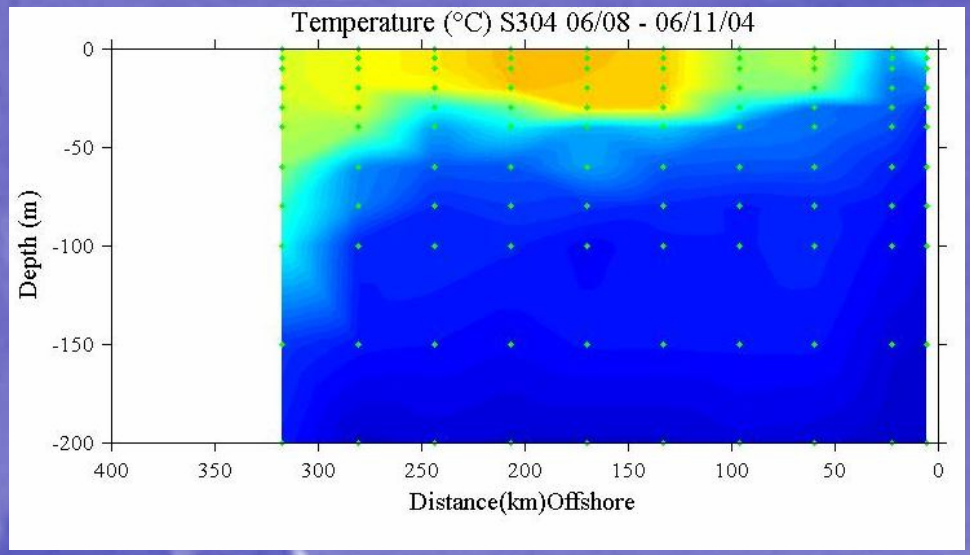
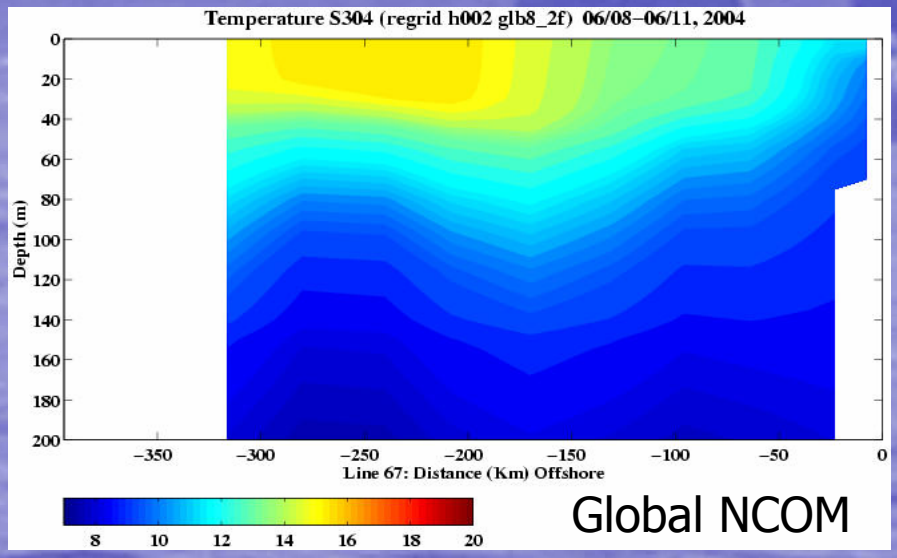
Sub-surface Evaluation of Global Models: Line 67

GEDEM Climatology

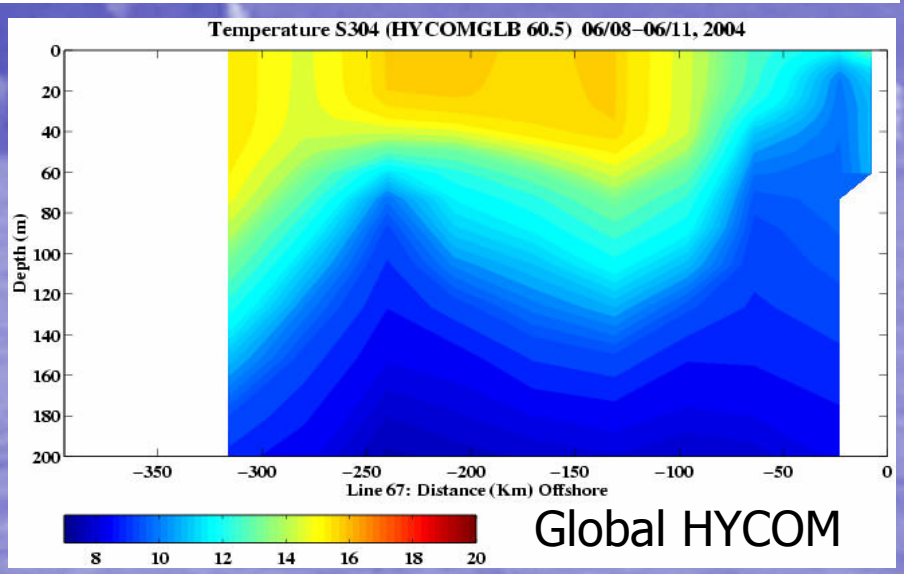


June 8-11 2004





Global NCOM



Global HYCOM

Sub-surface Evaluation of Global Models: Line 67

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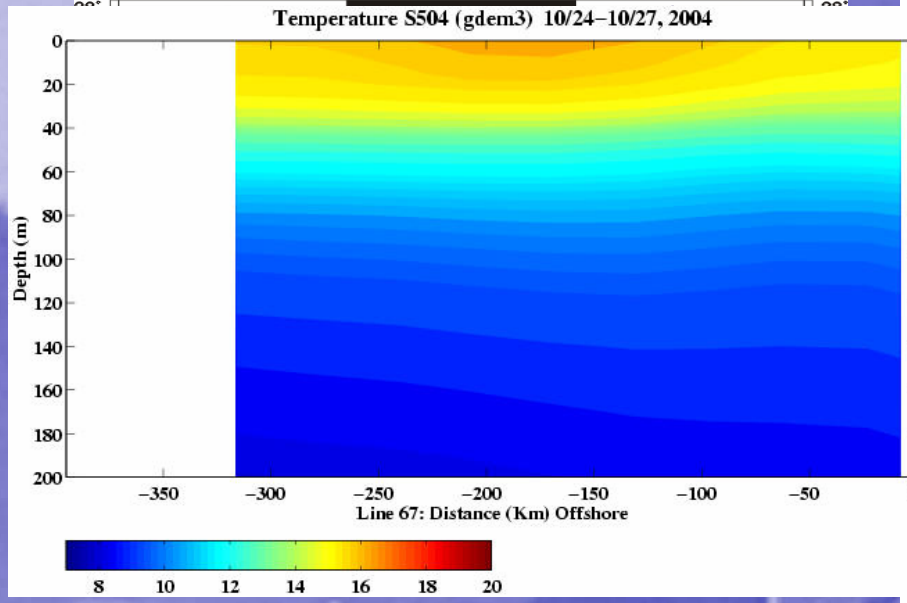
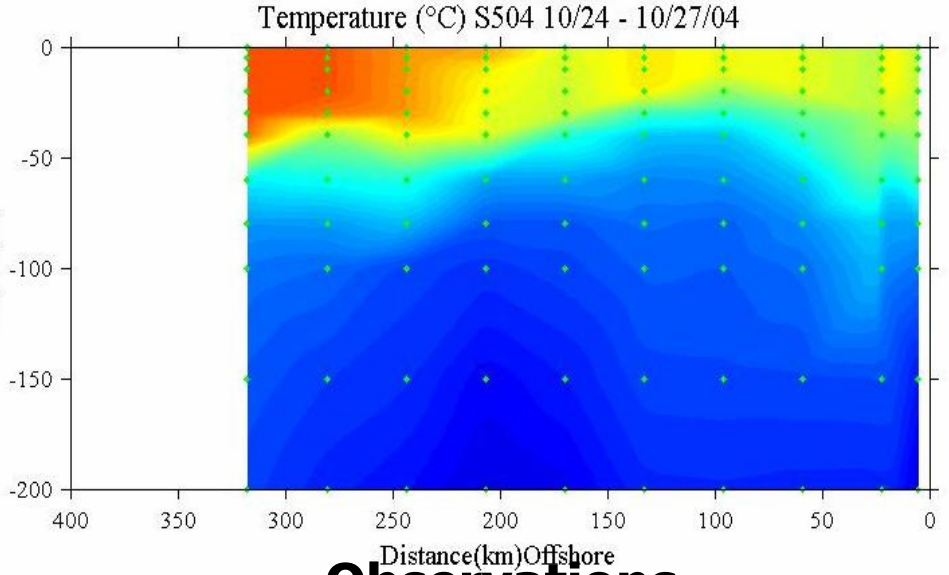
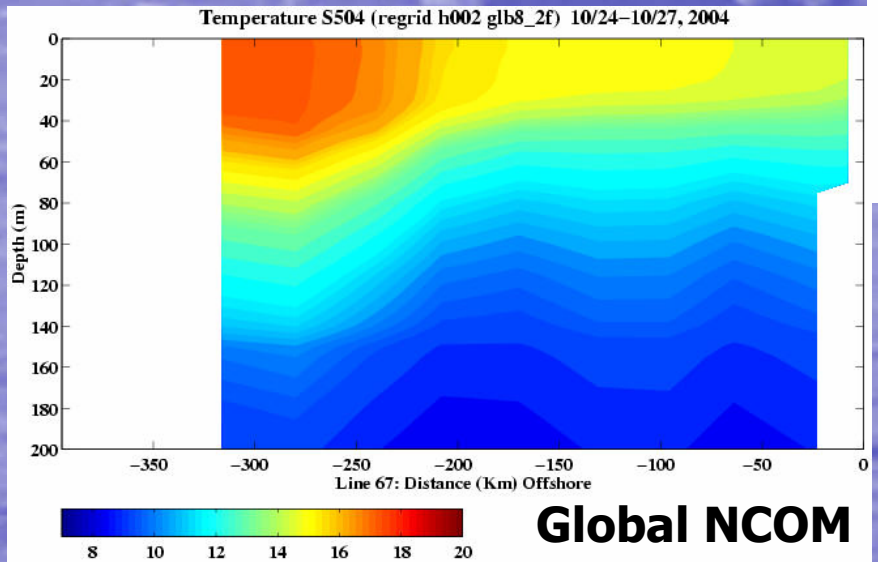


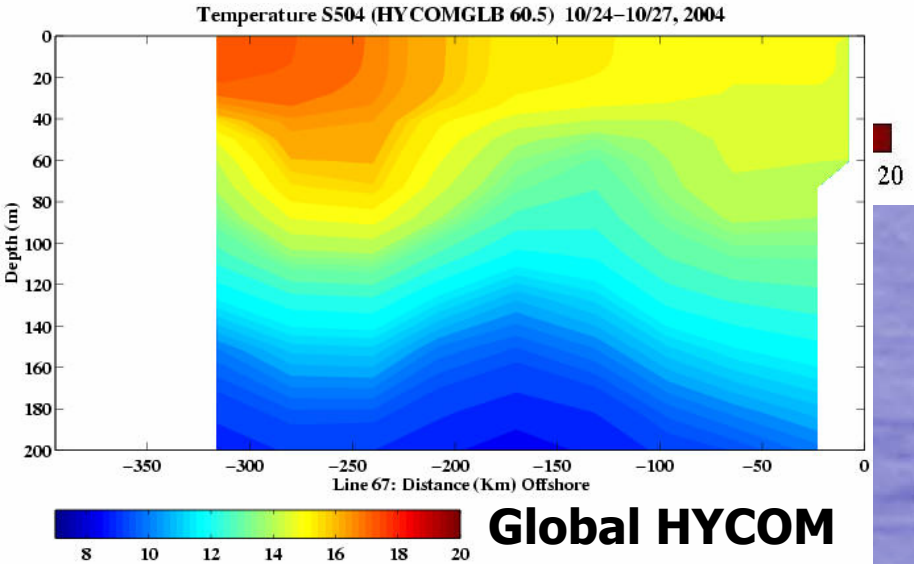
October 24-27 2004



Observations

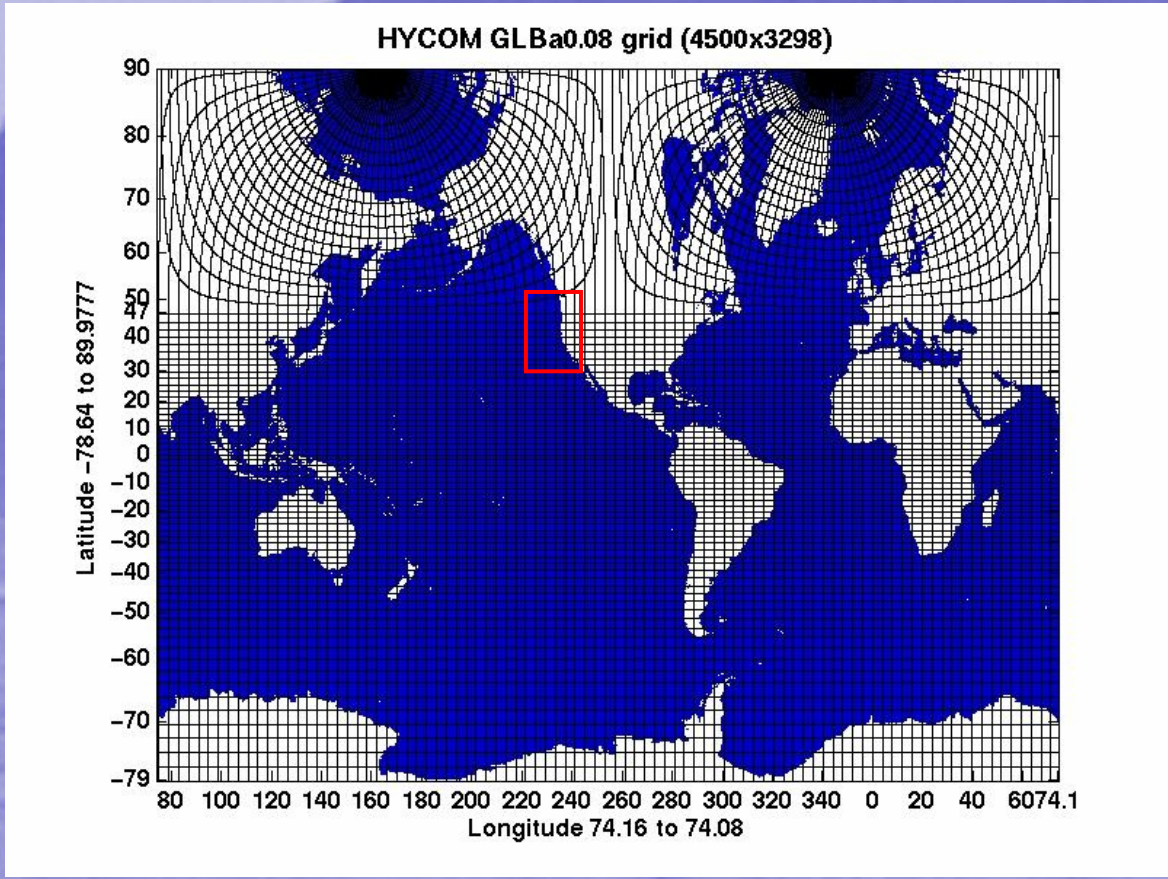


Global NCOM



Global HYCOM

Regional: HYCOM CCS



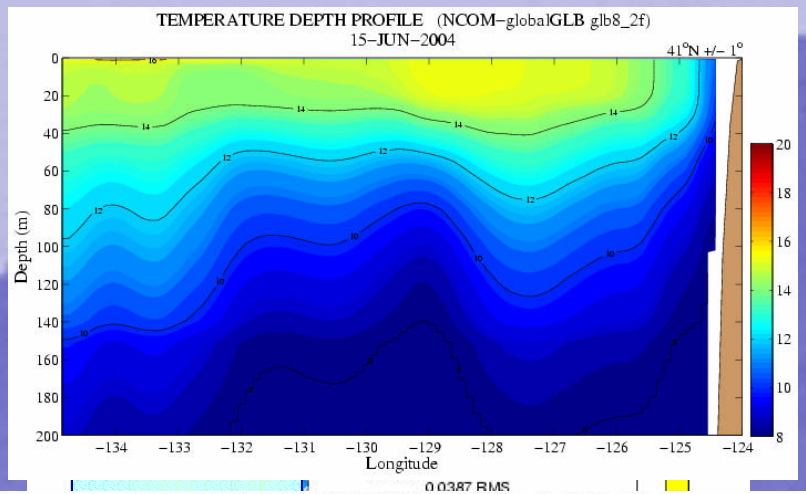
For Nests that span 47N:

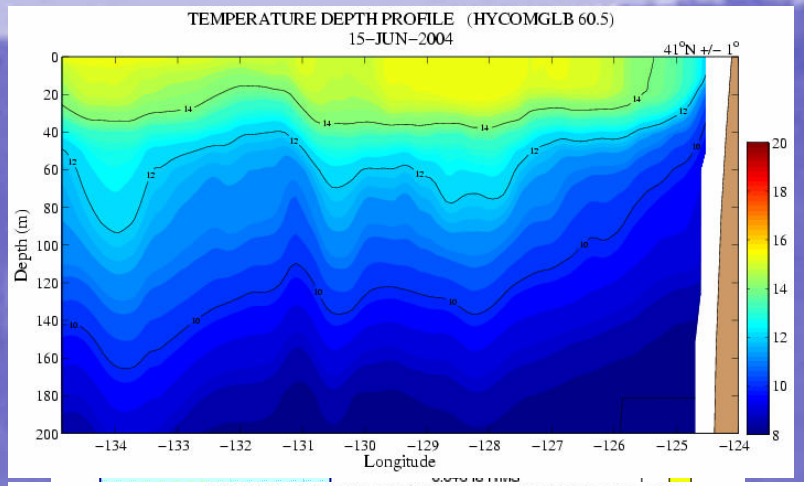
- **HYCOM tools do not generate geometry**
- **Use 'ISUBAREGION" to re-grid from outer to inner nest**
- **Re-grid from Global HYCOM after extracting a cut-out**

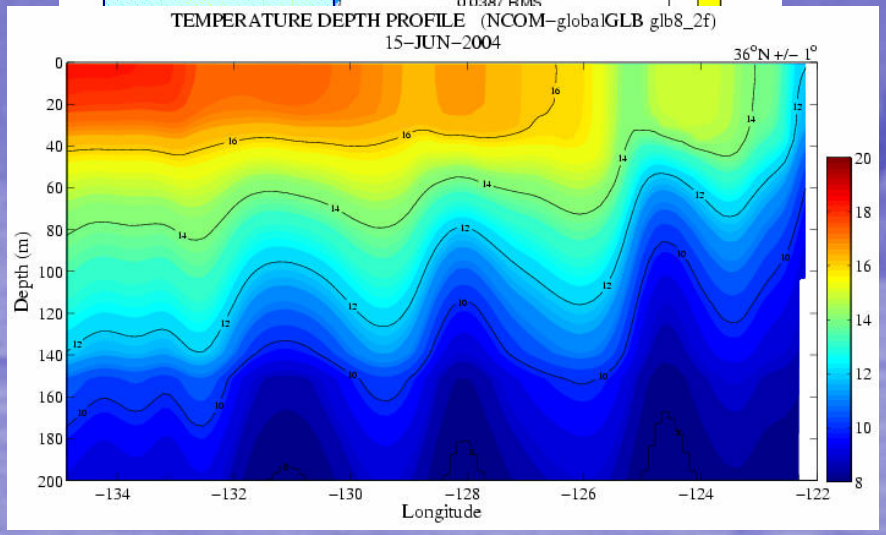
CONCLUSIONS and Plans

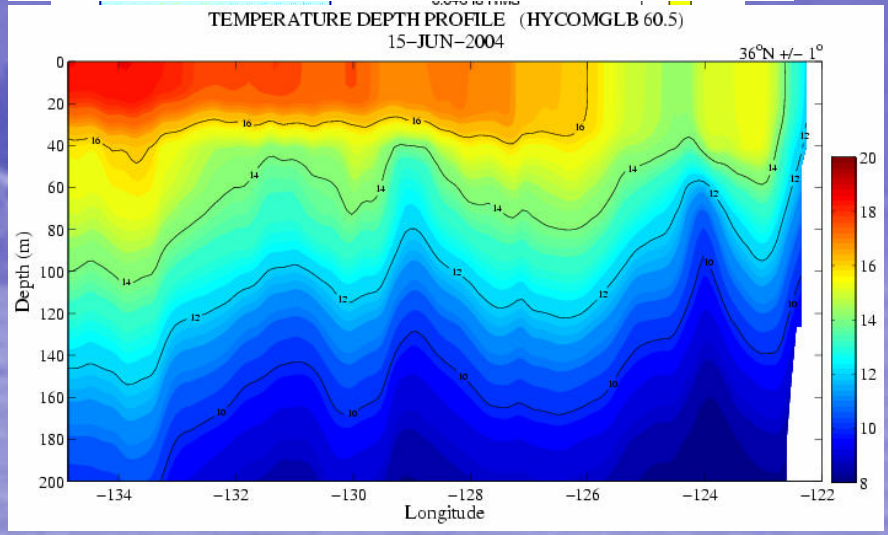
- Data Assimilative Global HYCOM vs. Global NCOM
  - Open Ocean : Both Global NCOM and HYCOM provide adequate representations of mesoscale variability in CCS domain; variance of HYCOM SSH may be more accurate
  - Coastal: Global HYCOM provides more accurate representation of coastal Kelvin waves and remote forcing for coastal nests
  - Sub-surface: 'Thermocline spread' produces a warm bias in upper 200m ;slightly worse in HYCOM relative to NCOM
- Plans:
  - Impact of remote forcing on biological response: HYCOM/NCOM
  - Examine global HYCOM for 2004-2007 period
  - Sensitivity to boundary values(Global HYCOM/NCOM, HYCOM-CCS/NCOM-CCS: Monterey Bay NCOM and 2006 ASAP experiment
  - Real-time NCOM-CCS forced by Global HYCOM
  - Real-time data assimilative HYCOM-CCS

Evaluation of Global Models: Cross Sections







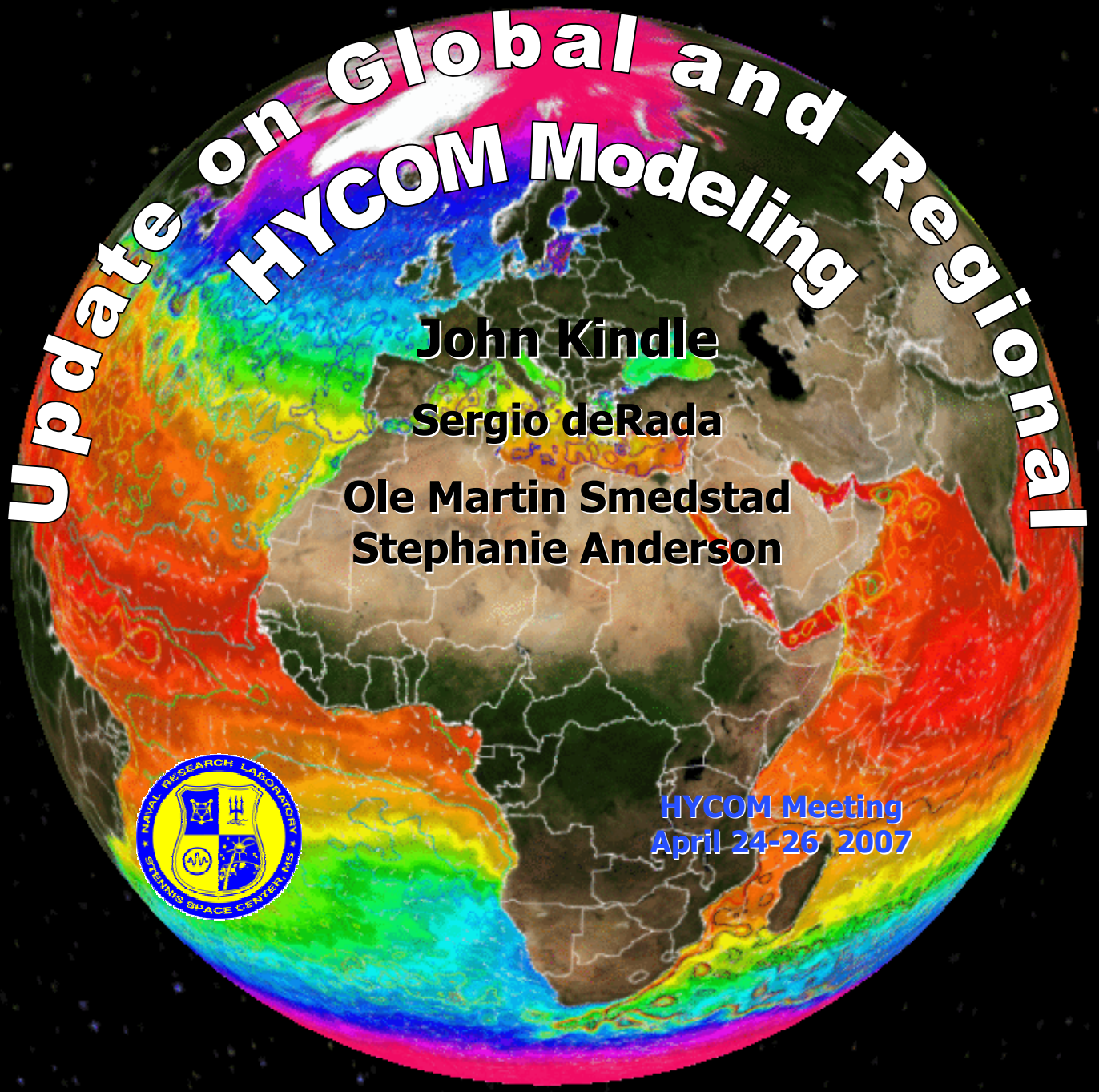


Global NCOM T Section@41 +/-1

June 15 2004

Global HYCOM T Section@41 +/-1

June 15 2004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