Numerical Evaluation of Boundary Forcing from GODAE Global Products in the US West Coast

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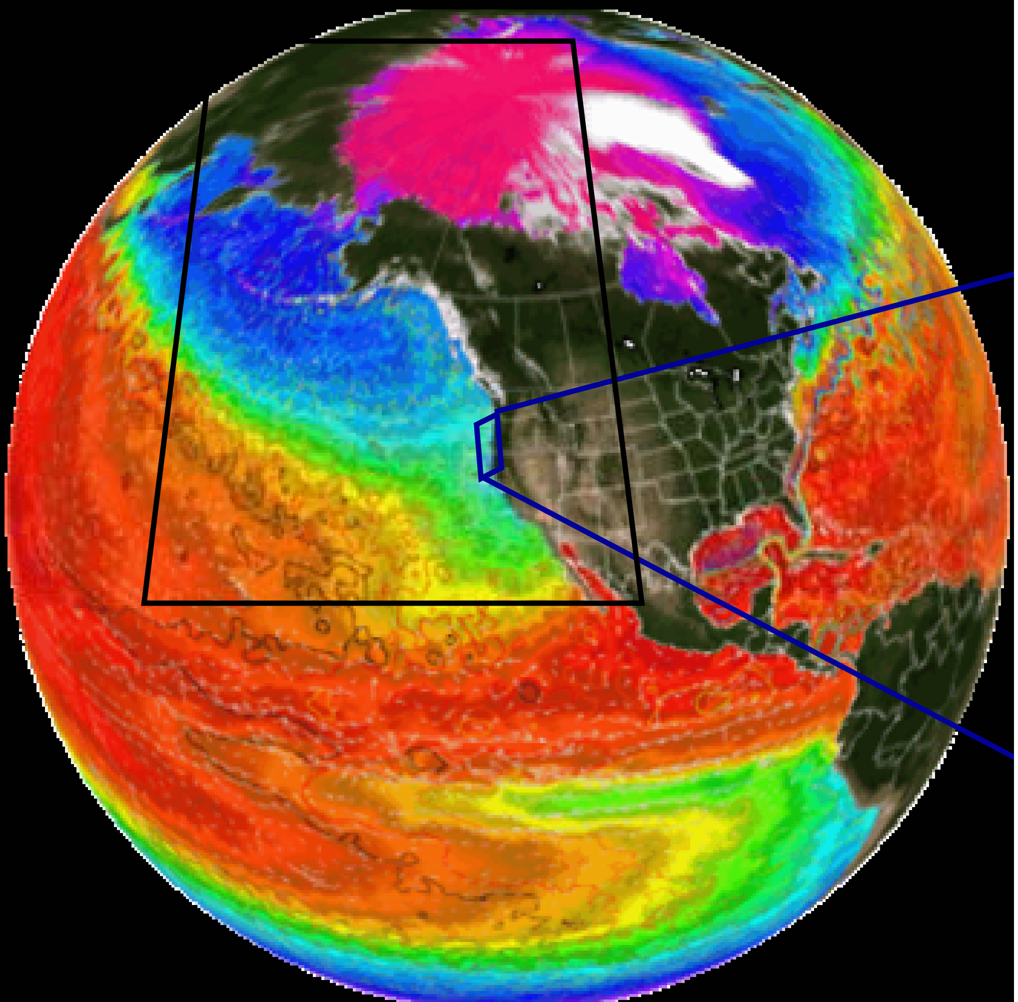
MODELS



NCOM Regional Model

NCOM Coastal Model

California Current System (CCS)

Monterey Bay (MB)

30-50N, 116-134W

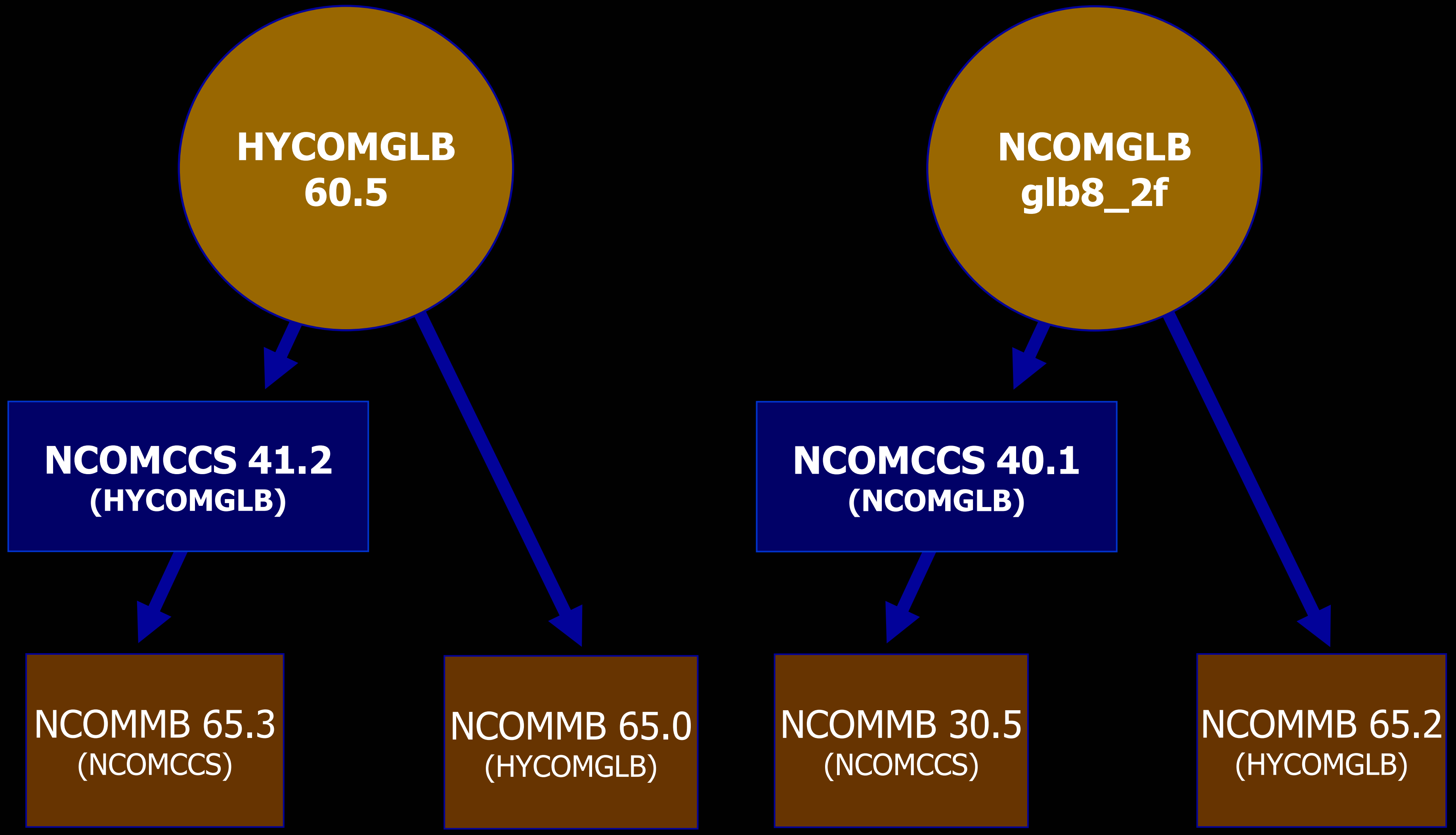
35.5-37.5N, 121.5-123.5W

- **1/12-degree**
- **~1-4Km Resolution**
- **163x229**
- **81x58**
- **40 Level σ/z (19/21)**
- **29 σ levels**
- **Lat/Lon grid (~9Km)**
- **Orthogonal Curvilinear Grid**

- Curvilinear (~12Km)
- 2048x1280
- 40 Level σ/z (19/21)
- glb8_2f (operational)

Motivation: Global->Coastal

EXPERIMENTS



EXPERIMENTS

HYCOMGLB
60.5

NCOMGLB
glb8_2f

GLOBAL:

- **HYCOM: Simulation restarts from climatological spin up**
  NCOM: Simulation started from a previous experiment (10 years)
- **3-hourly 0.5-degree NOGAPS Forcing, Bulk HF Formulation**
- **HYCOM: NCODA Assimilation**
  NCOM: MODAS (3D Temperature and Salinity relaxation)

EXPERIMENTS

HYCOMGLB
60.5

NCOMGLB
glb8_2f

NCOMCCS 41.2
(HYCOMGLB)

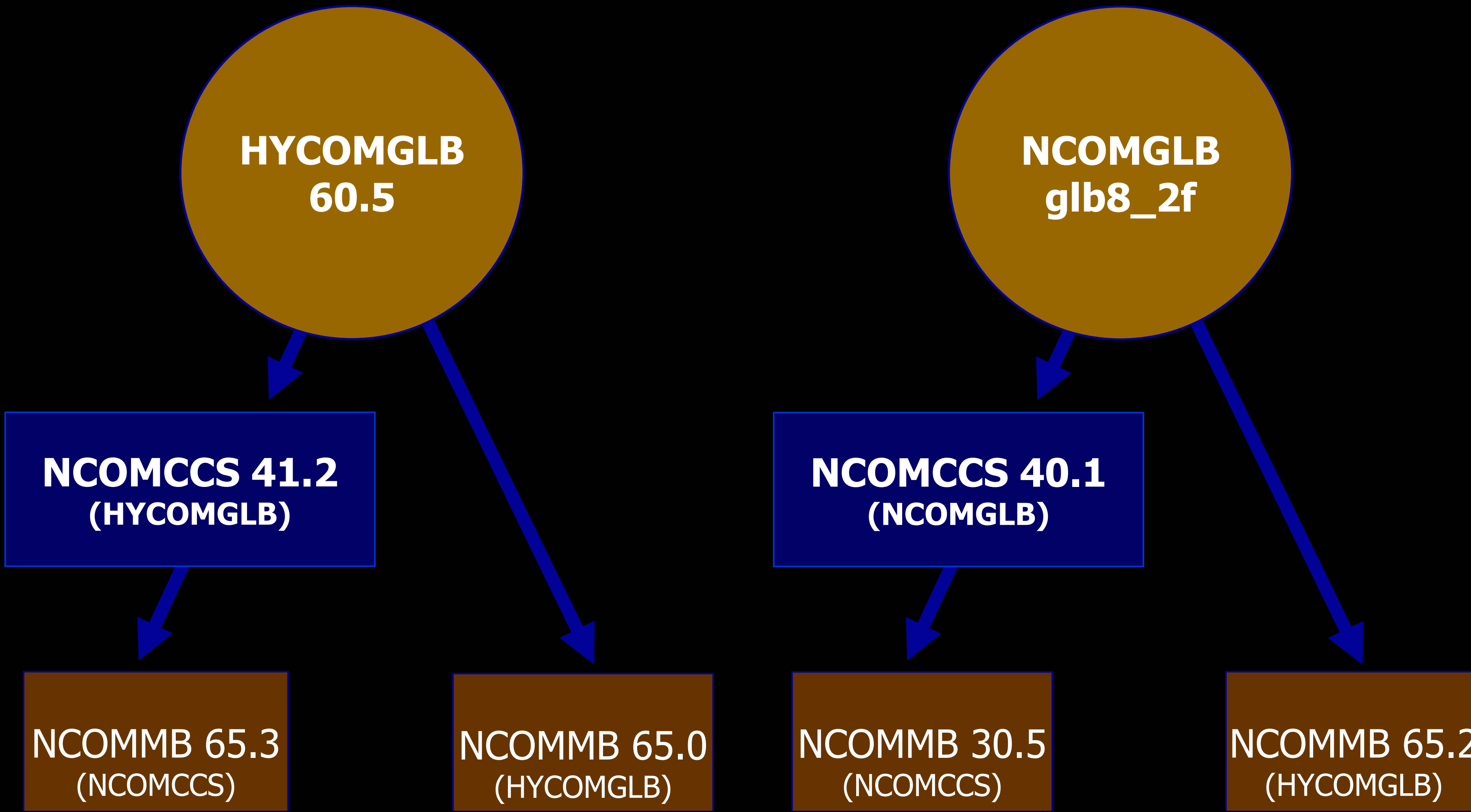
NCOMCCS 40.1
(NCOMGLB)

NCOMCCS:

- **EXPT 41.2: 20040101-20061231 IC/BC from global HYCOM, daily OB update**
- **EXPT 40.1: 19981001-present, IC/BC from global NCOM, daily OB update**

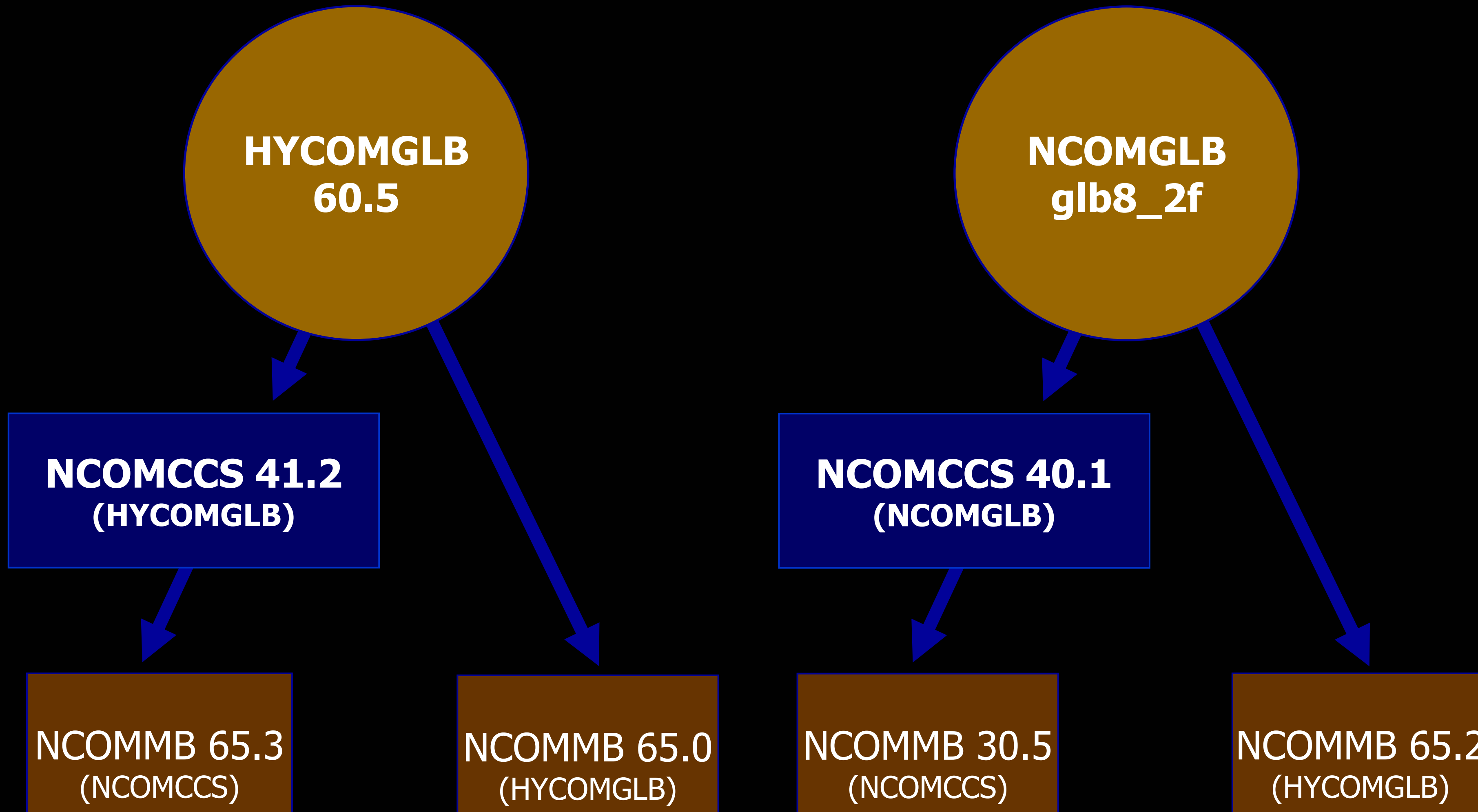
- 3-hourly 9-Km COAMPS Forcing, Net HF
- MODAS 3D Temperature and Salinity relaxation (same as NCOMGLB)
- Mellor-Yamada 2.5 (same as NCOMGLB)
- Flather scheme, vertical distribution/radiative (1-point)
- Coupled to COSIN Ecosystem Model (not shown)

EXPERIMENTS



- **20060727-20060902 (Adaptive Sampling And Prediction)**
  - **daily OB update from global models**
  - **hourly OB update from regional models**

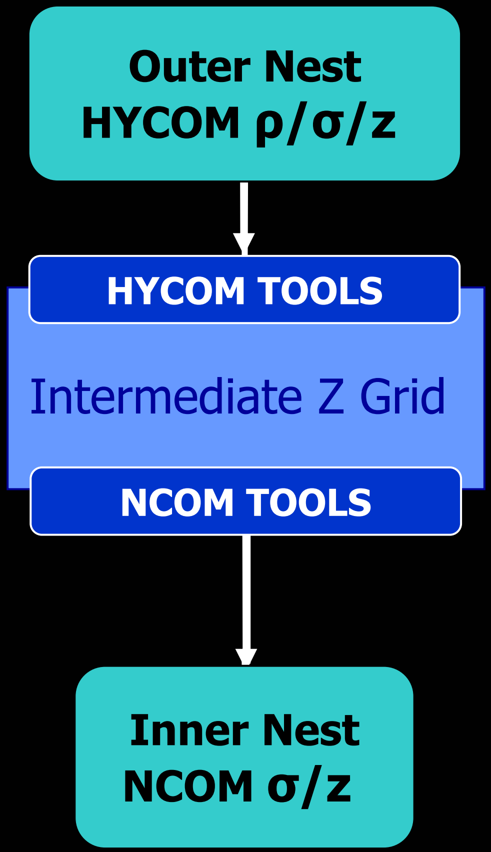
EXPERIMENTS



- Hourly 3-Km COAMPS Forcing, Net HF
- No data assimilation (contribution of Remote vs. Local Forcing)
- Tidal Forcing from OSU
- Flather and Orlansky BC scheme, MY2.5 Mixing
- Coupled to COSIN Ecosystem Model (not shown)

NESTING IMPLEMENTATION

- Generalized Methodology for mapping vertical/horizontal grids
- One Way Coupling*



On the HYCOM (source grid) side:

- **HYCOM tools**

  -layer to z

...to generate and intermediate Z grid.

(Suggested to match NCOM Z-structure)

***NCODA coupling on Z-Grid**

On the NCOM (target grid) side:

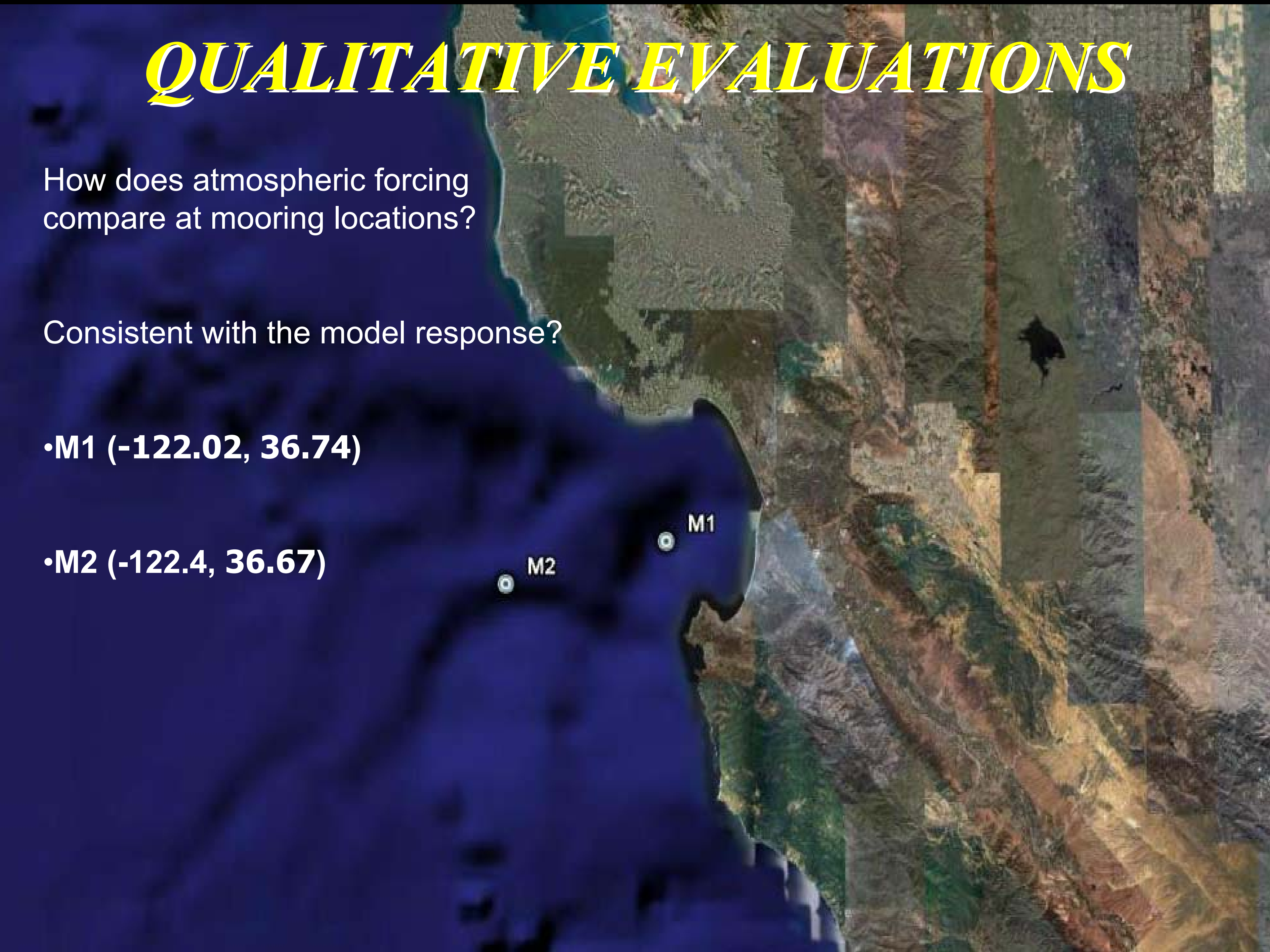
- **- to final σ or σ/z grid**
  - horizontally (optional)

QUALITATIVE EVALUATIONS

How does atmospheric forcing compare at mooring locations?

Consistent with the model response?

- **M1 (-122.02, 36.74)**
- **M2 (-122.4, 36.67)**

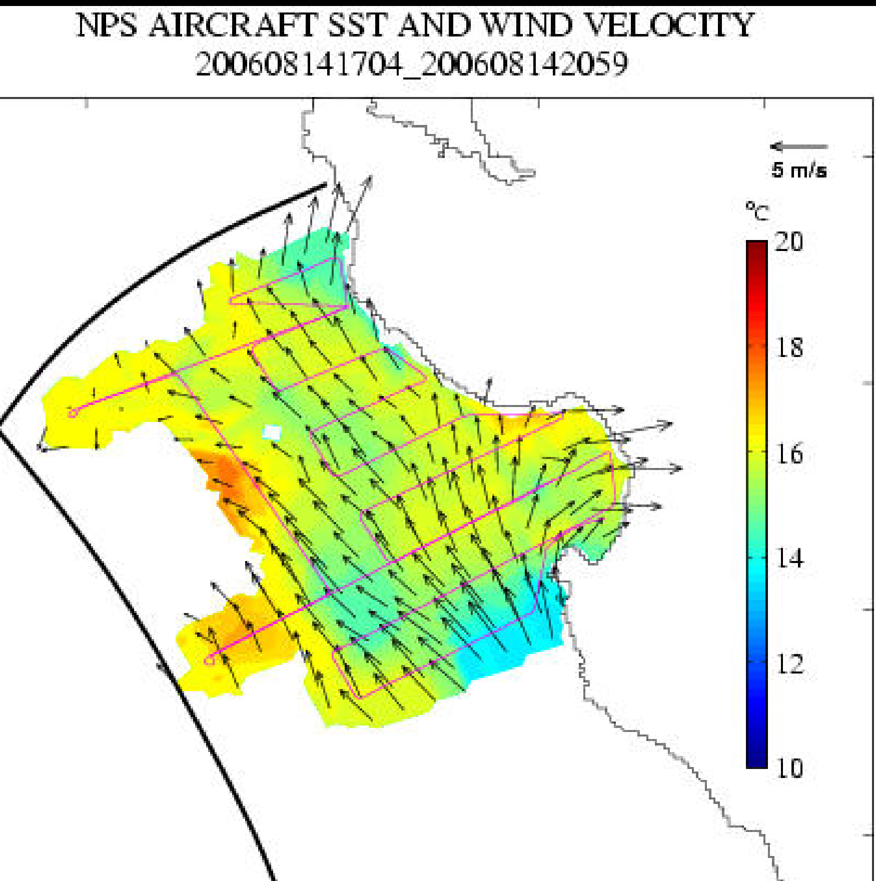


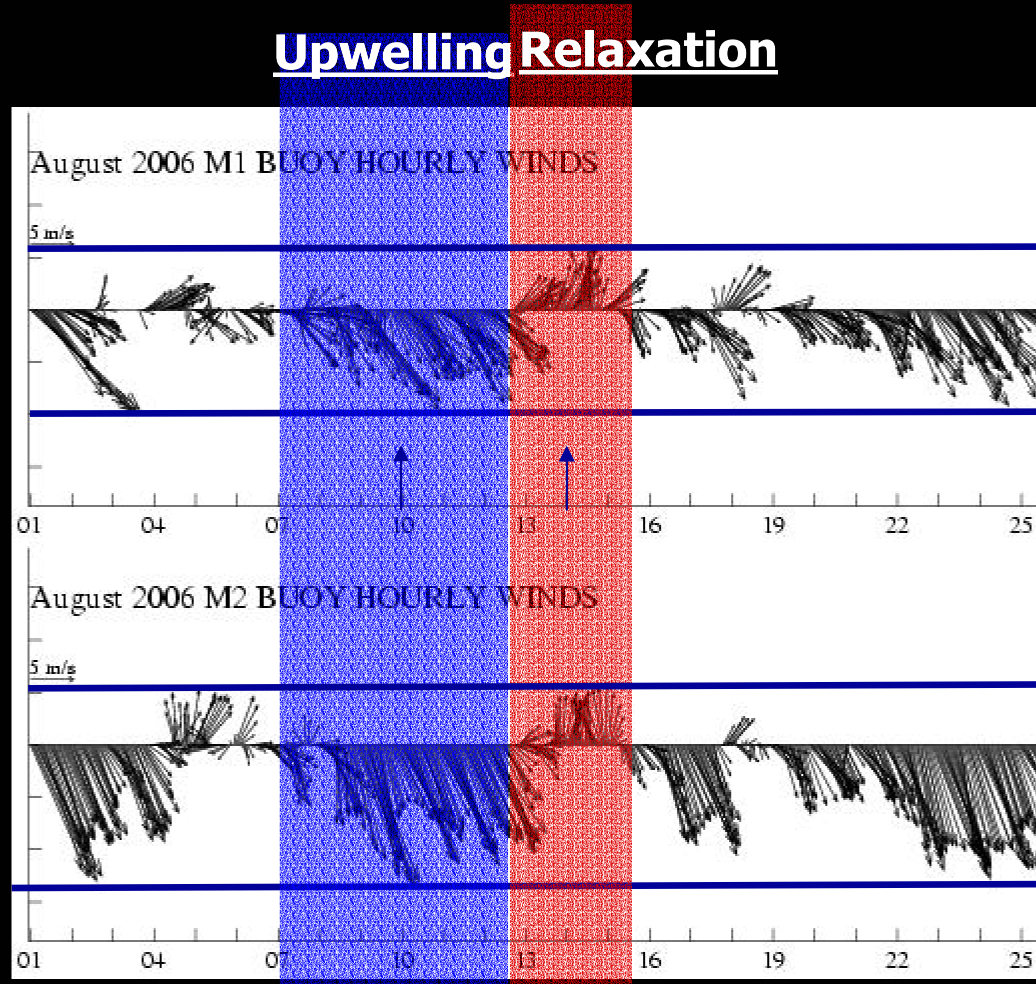
Winds and SST (Observed)

Winds and SST (observed vs. models)

Aircraft Winds and SST

10m winds at M1 and M2 moorings

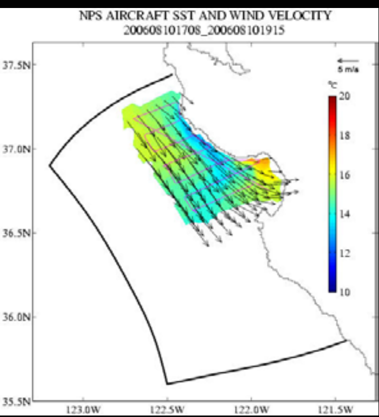


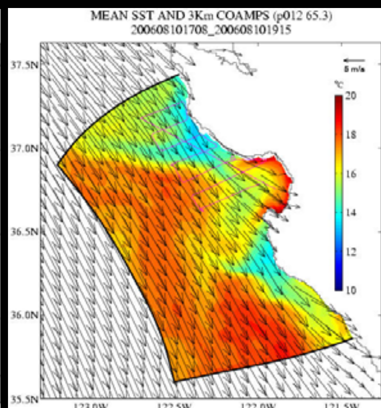


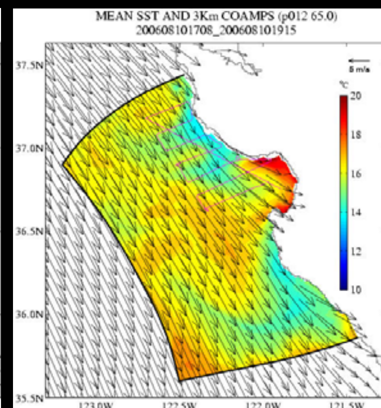
Winds and SST (Coastal Models)

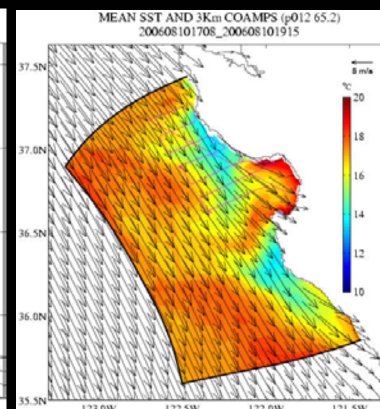
UPWELLING (August 10)

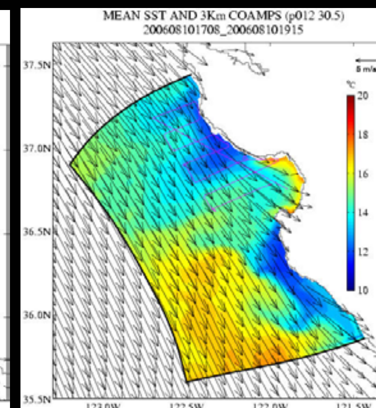
Aircraft | **GHYCOM->CCS** | **GHYCOM** | **GNCOM** | **GNCOM->CCS**





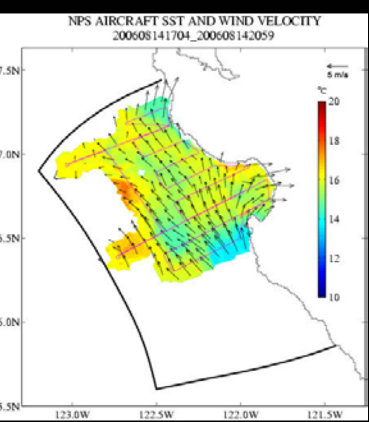


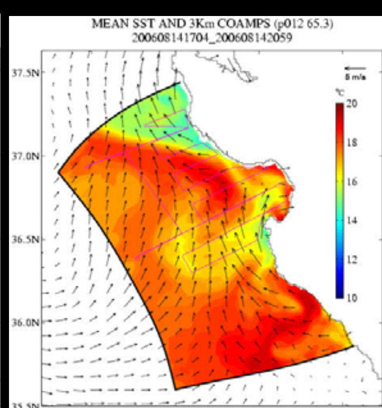


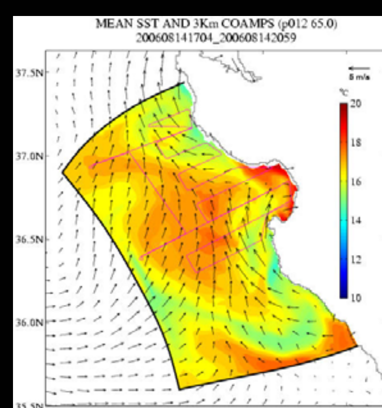


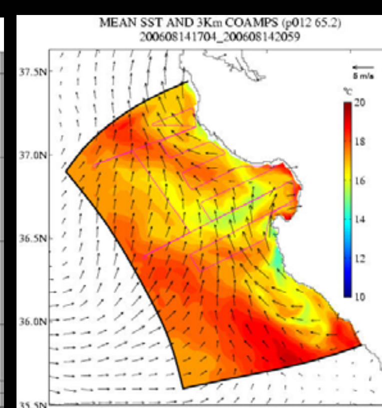
RELAXATION (August 14)

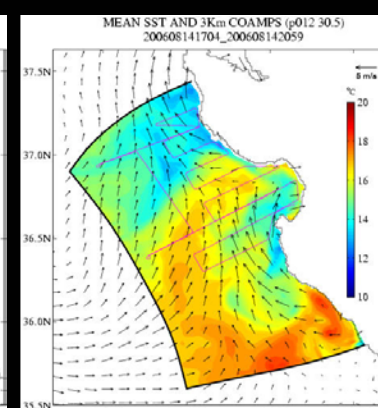
Aircraft | **GHYCOM->CCS** | **GHYCOM** | **GNCOM** | **GNCOM->CCS**







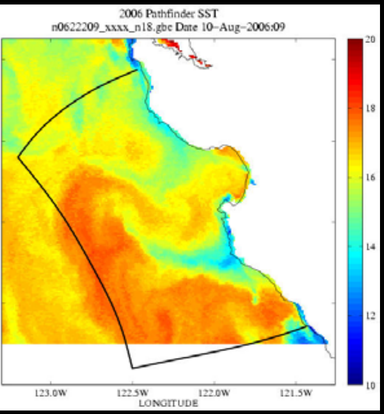




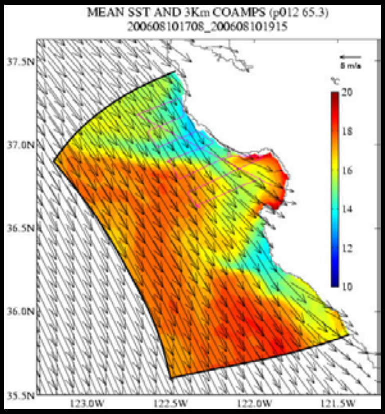
Winds and SST (Coastal Models)

UPWELLING (August 10)

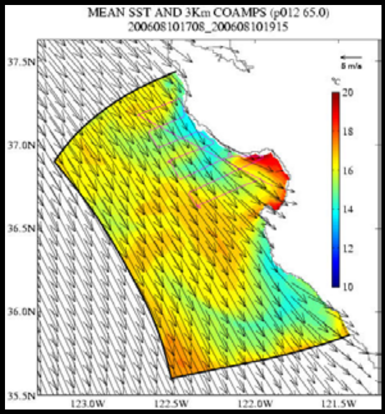
Pathfinder



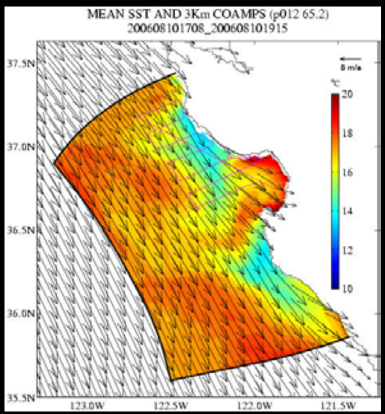
GHYCOM->CCS



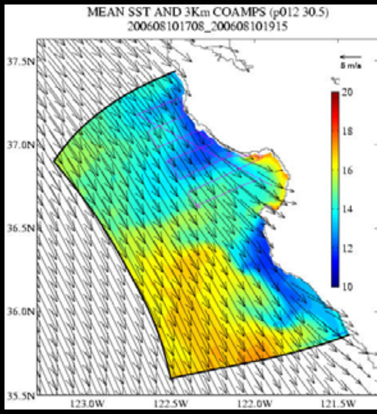
GHYCOM



GNCOM



GNCOM->CCS



	GHYCOM->CCS	GHYCOM	GNCOM	GNCOM->CCS
SST Correlation	**.88**	**.85**	**.90**	**.76**

QUANTITATIVE EVALUATION

Phase Plots

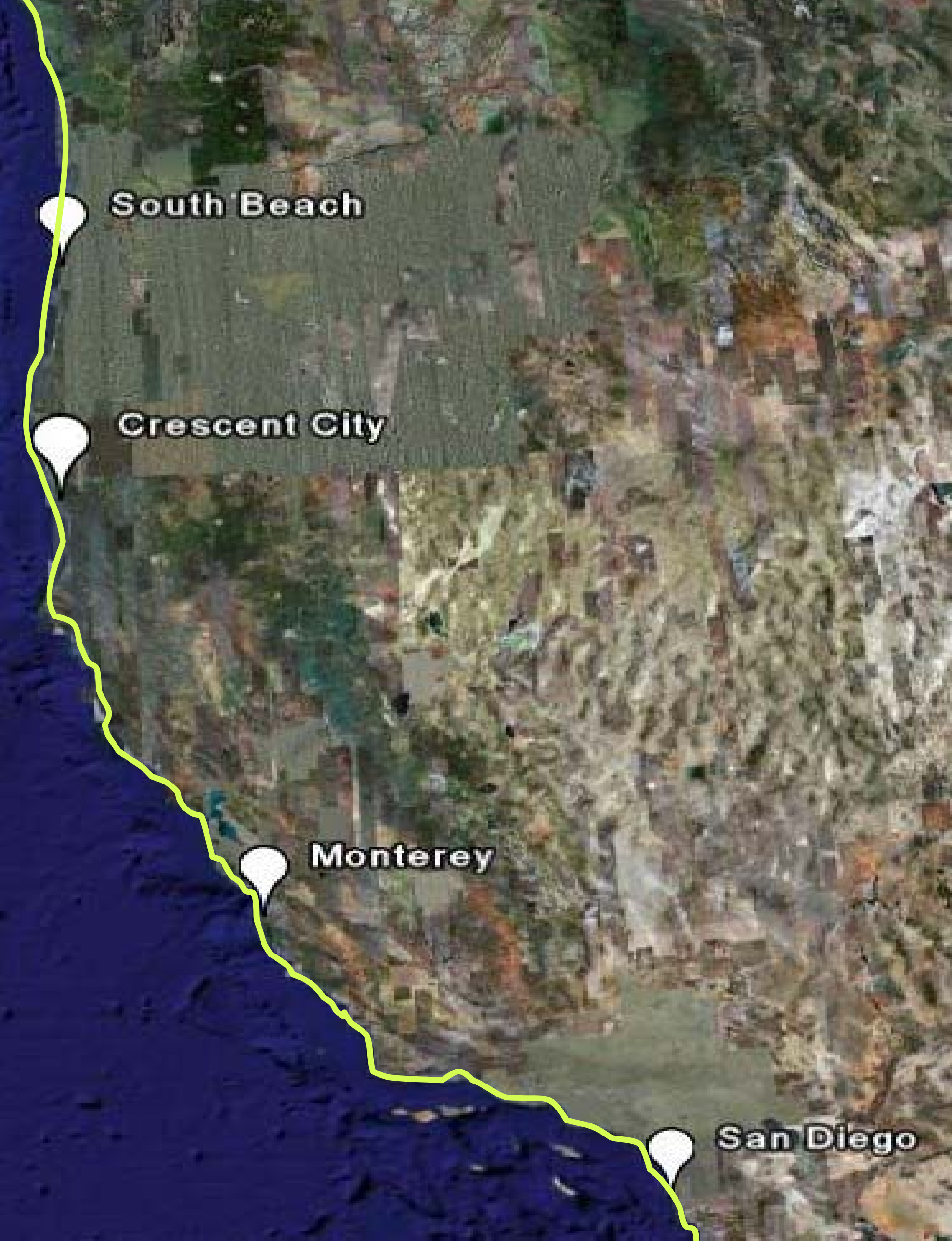
- SSH (qualitative)
- Capture barotropic information
- Trace signals propagating in time along the coast
- Measuring the response of the nest to the remote forcing

@ Monterey

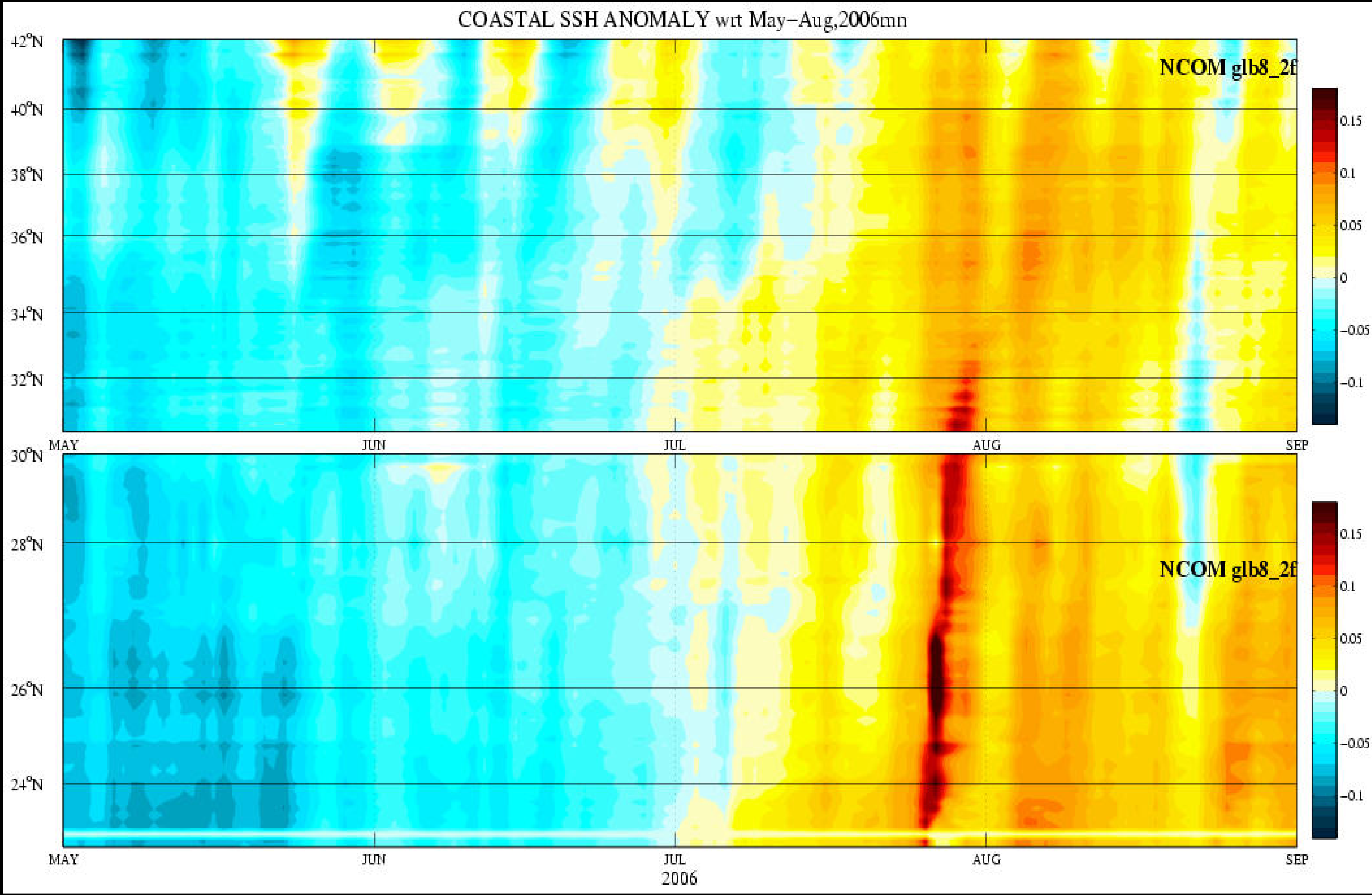
Within all domains
Influence of local forcing

@ San Diego

Global Boundary
Global->Regional assessment

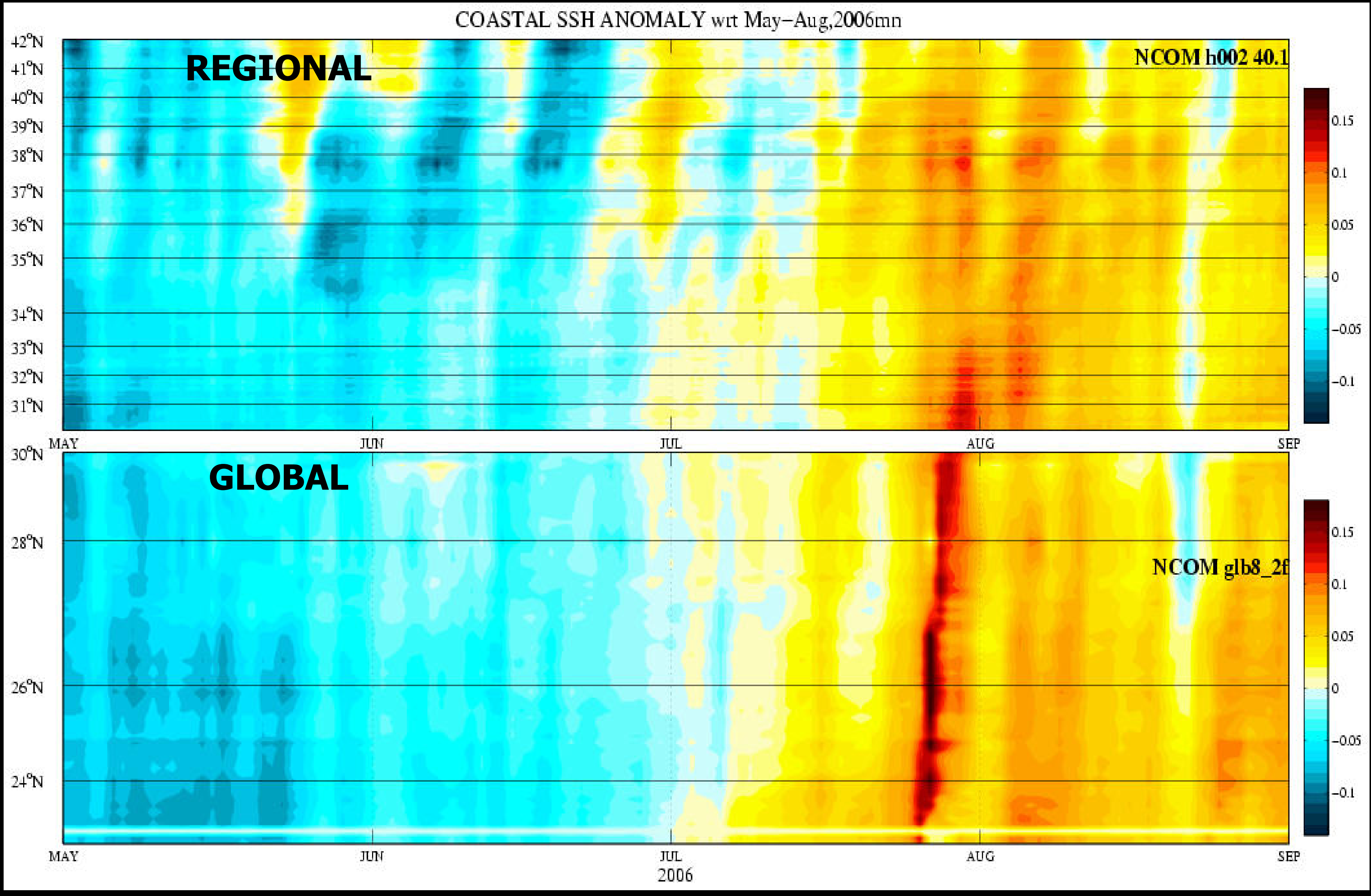


GLBNCOM

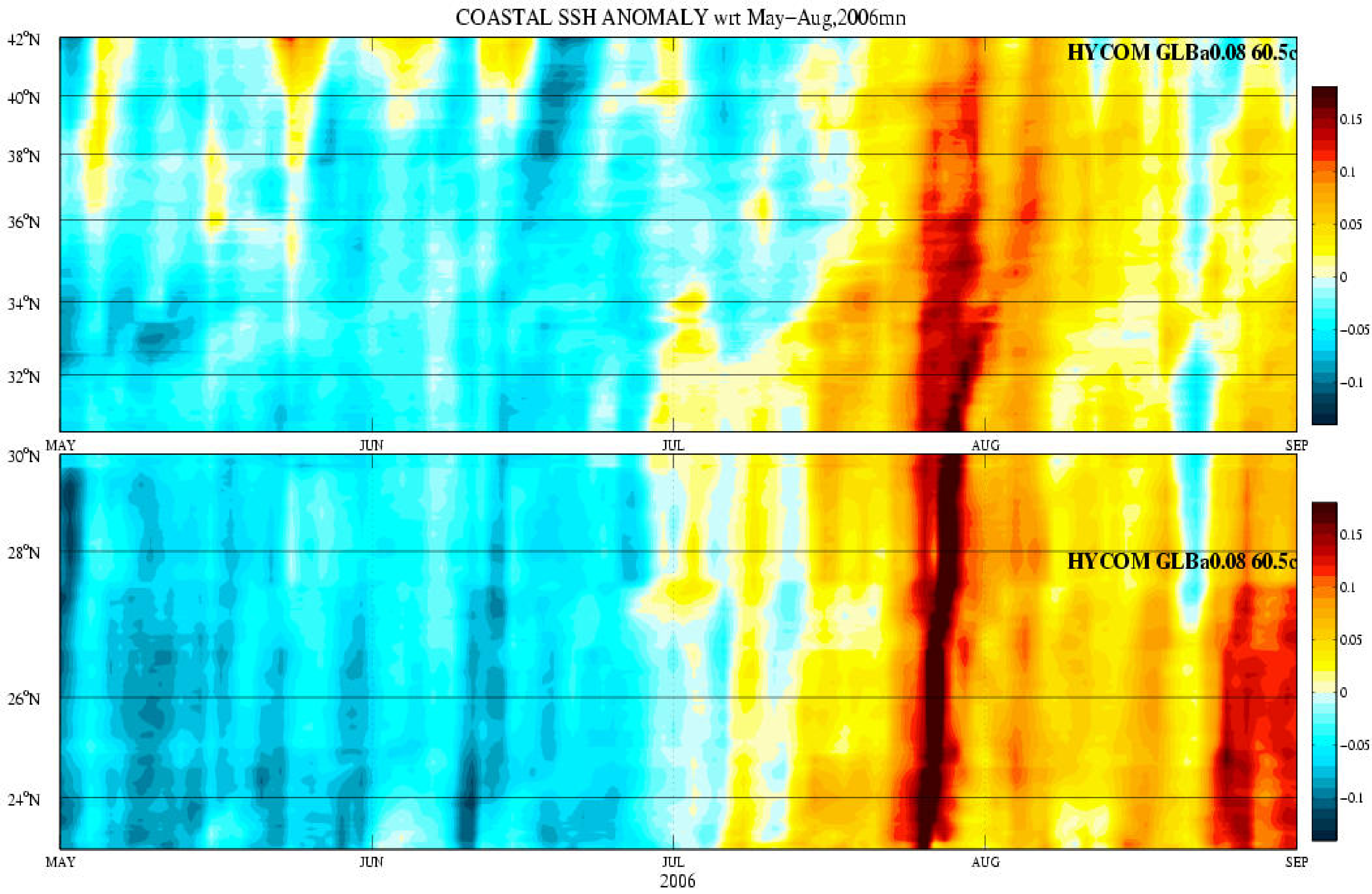


COASTAL SSH ANOMALY wrt May−Aug,2006mn
42°N
40°N
38°N
36°N
34°N
32°N
30°N
28°N
26°N
24°N
MAY
JUN
JUL
AUG
SEP
2006
NCOM glb8_2f
NCOM glb8_2f
0.15
0.1
0.05
0
−0.05
−0.1

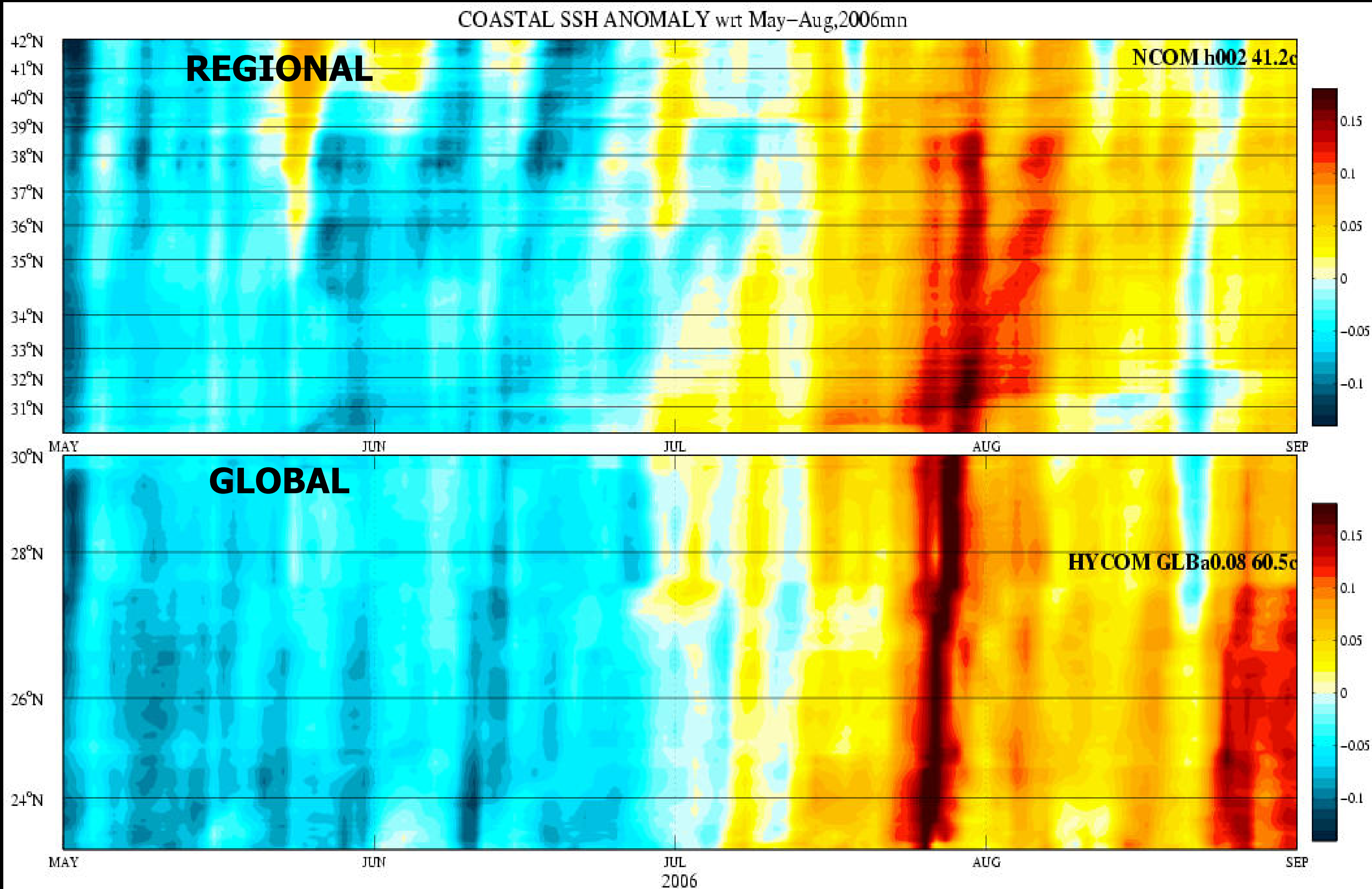
GLBNCOM->CCSNCOM



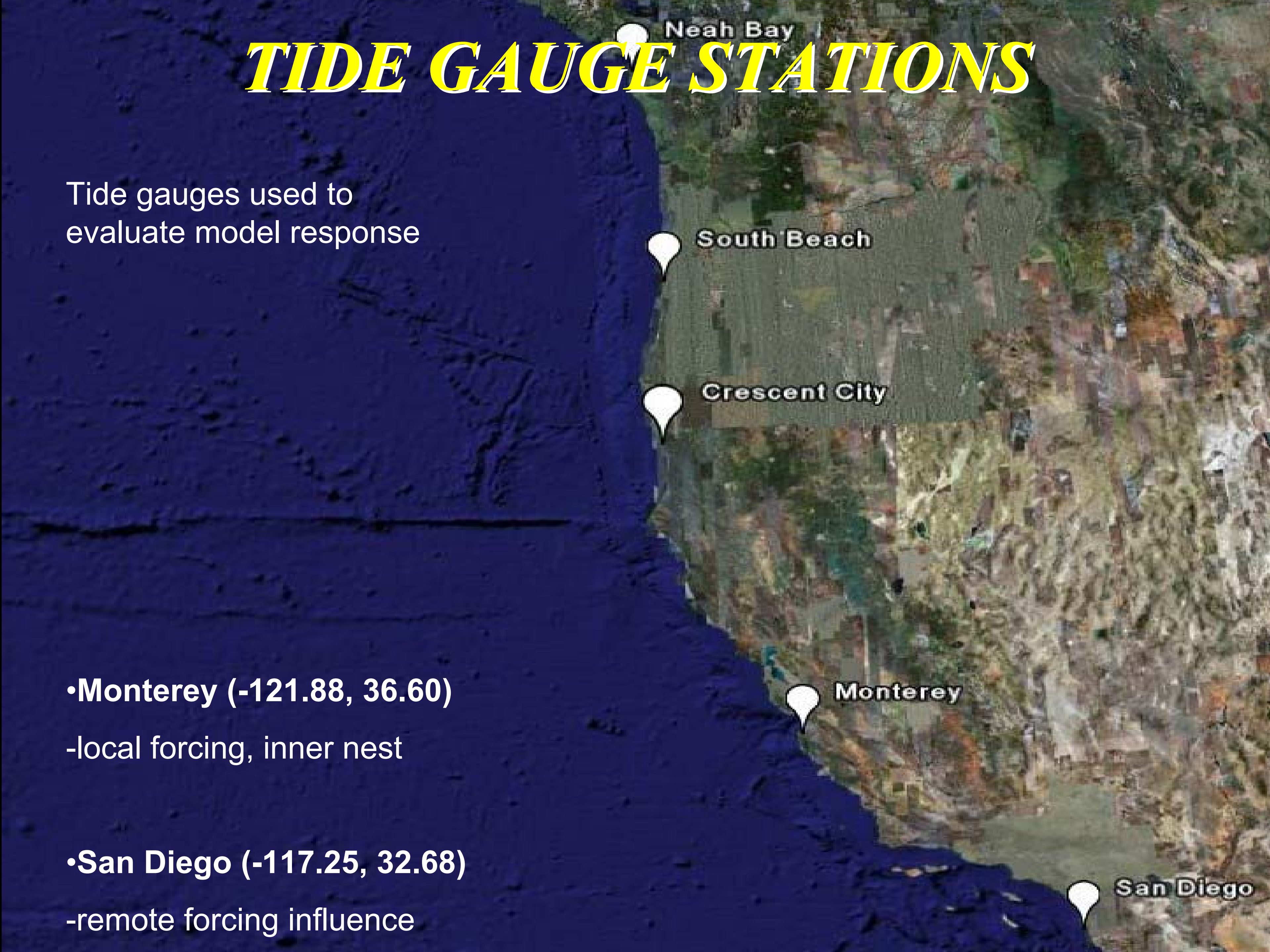
GLBHYCOM


COASTAL SSH ANOMALY wrt May−Aug,2006mn
HYCOM GLBa0.08 60.5c
42°N
40°N
38°N
36°N
34°N
32°N
0.15
0.1
0.05
0
−0.05
−0.1
MAY
JUN
JUL
AUG
SEP
30°N
28°N
26°N
24°N
HYCOM GLBa0.08 60.5c
0.15
0.1
0.05
0
−0.05
−0.1
MAY
JUN
JUL
AUG
SEP
2006

GLBHYCOM->CCSNCOM



TIDE GAUGE STATIONS



Tide gauges used to evaluate model response

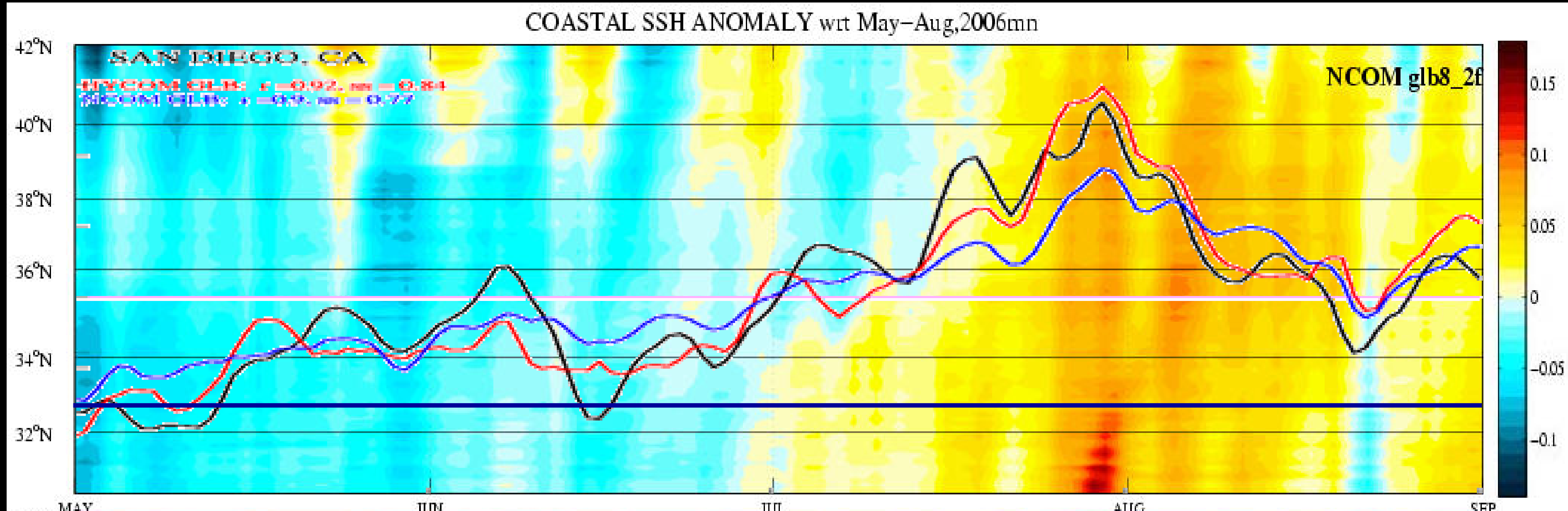
•**Monterey (-121.88, 36.60)**

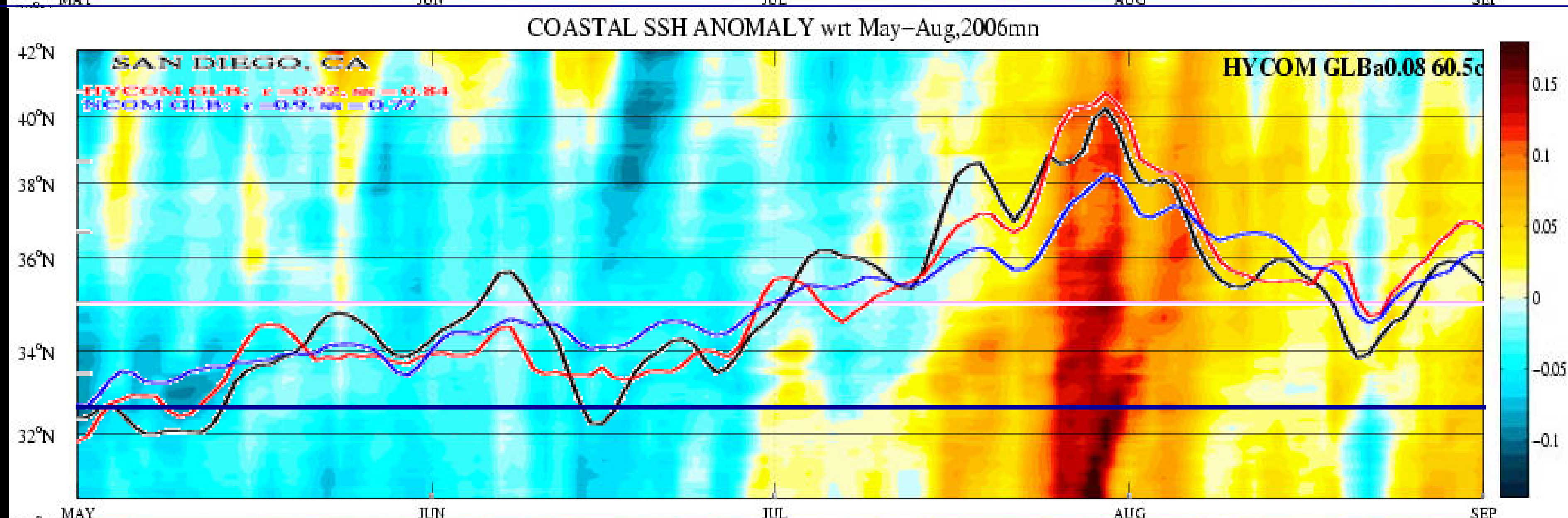
-local forcing, inner nest

•**San Diego (-117.25, 32.68)**

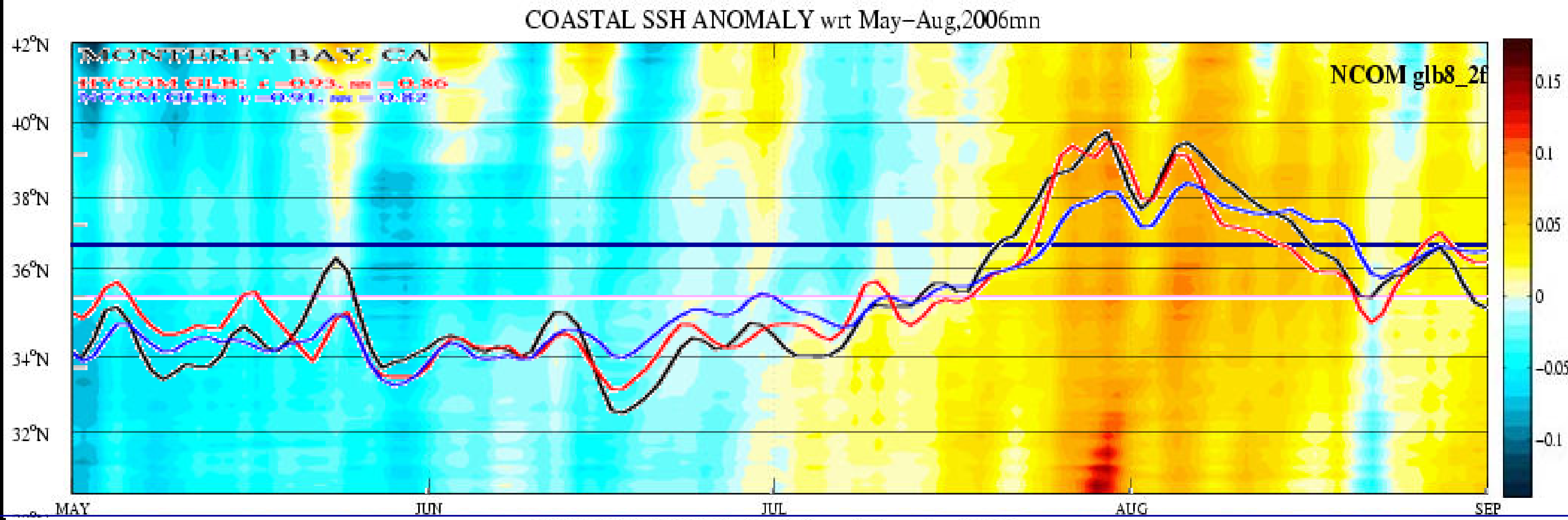
-remote forcing influence

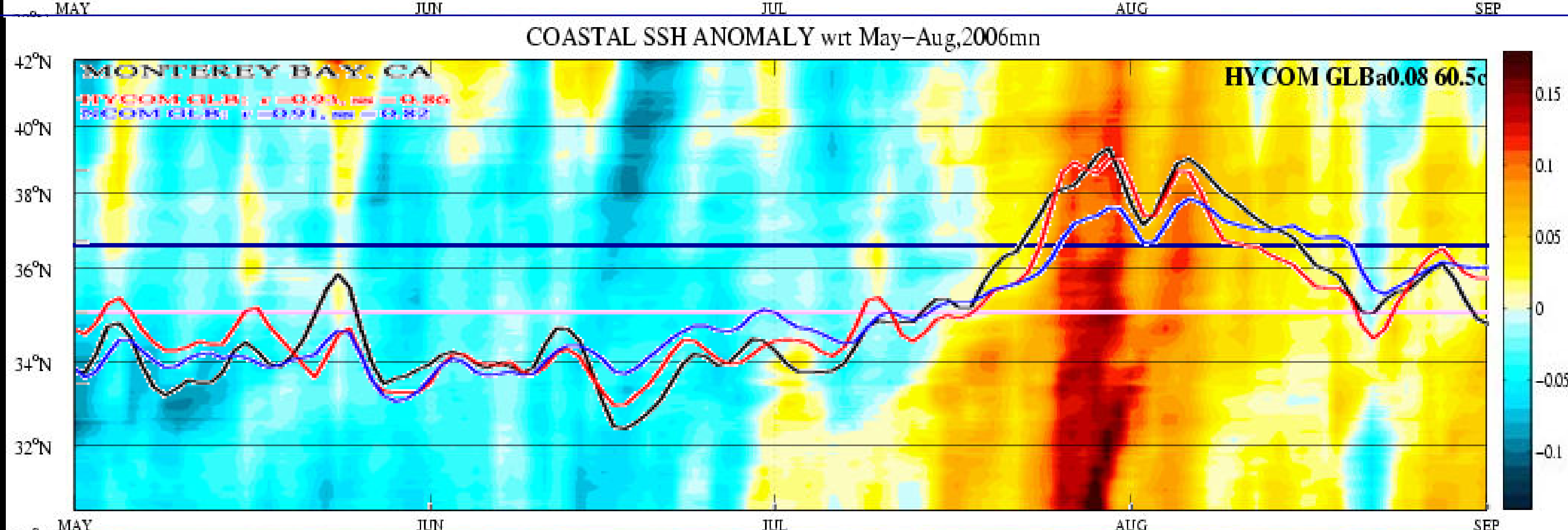
GLBNCOM (top) | GLBHYCOM (bot)



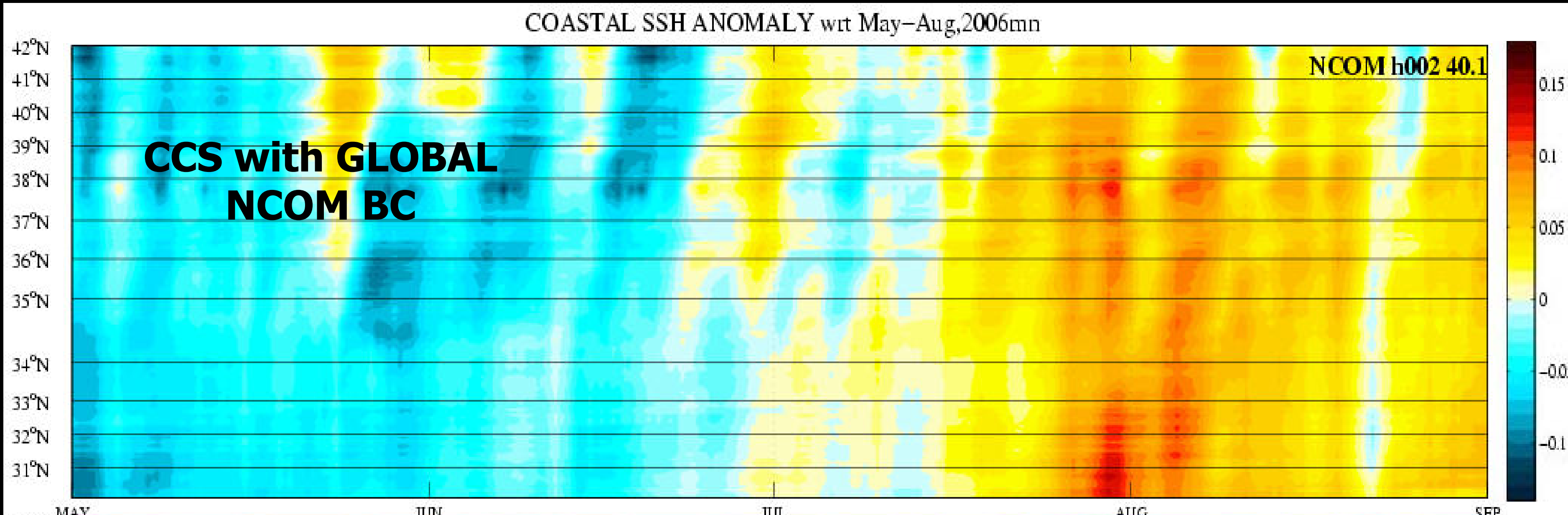


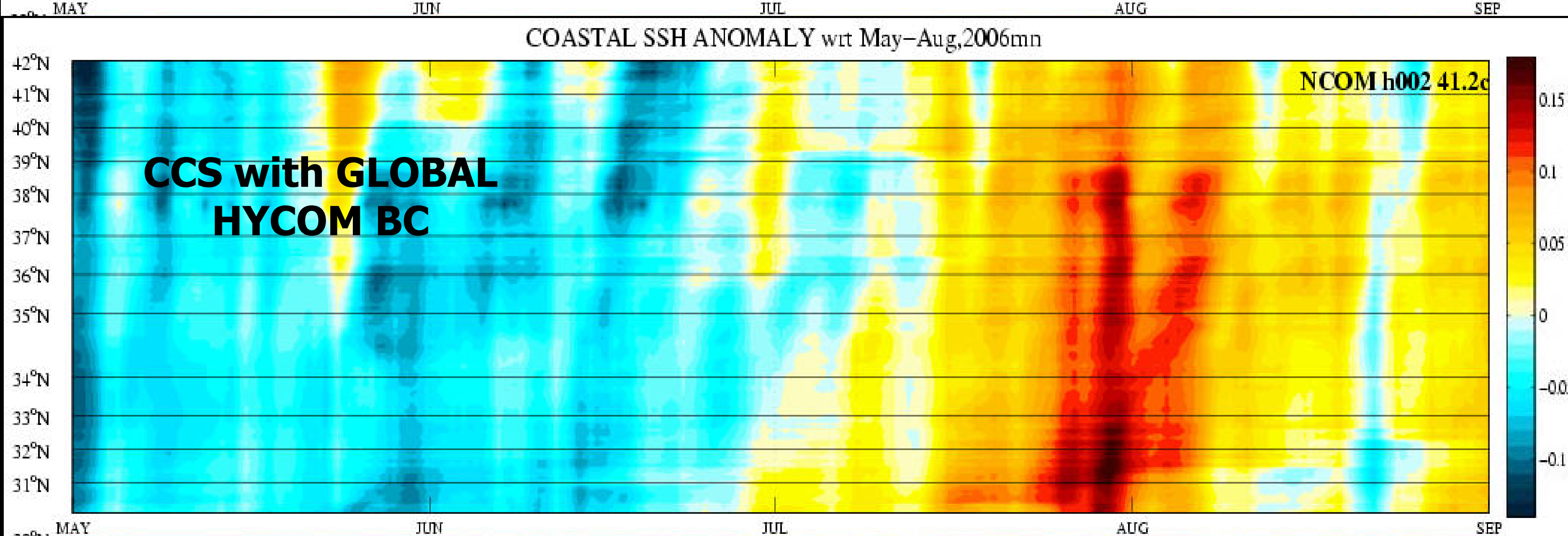
GLBNCOM (top) | GLBHYCOM (bot)



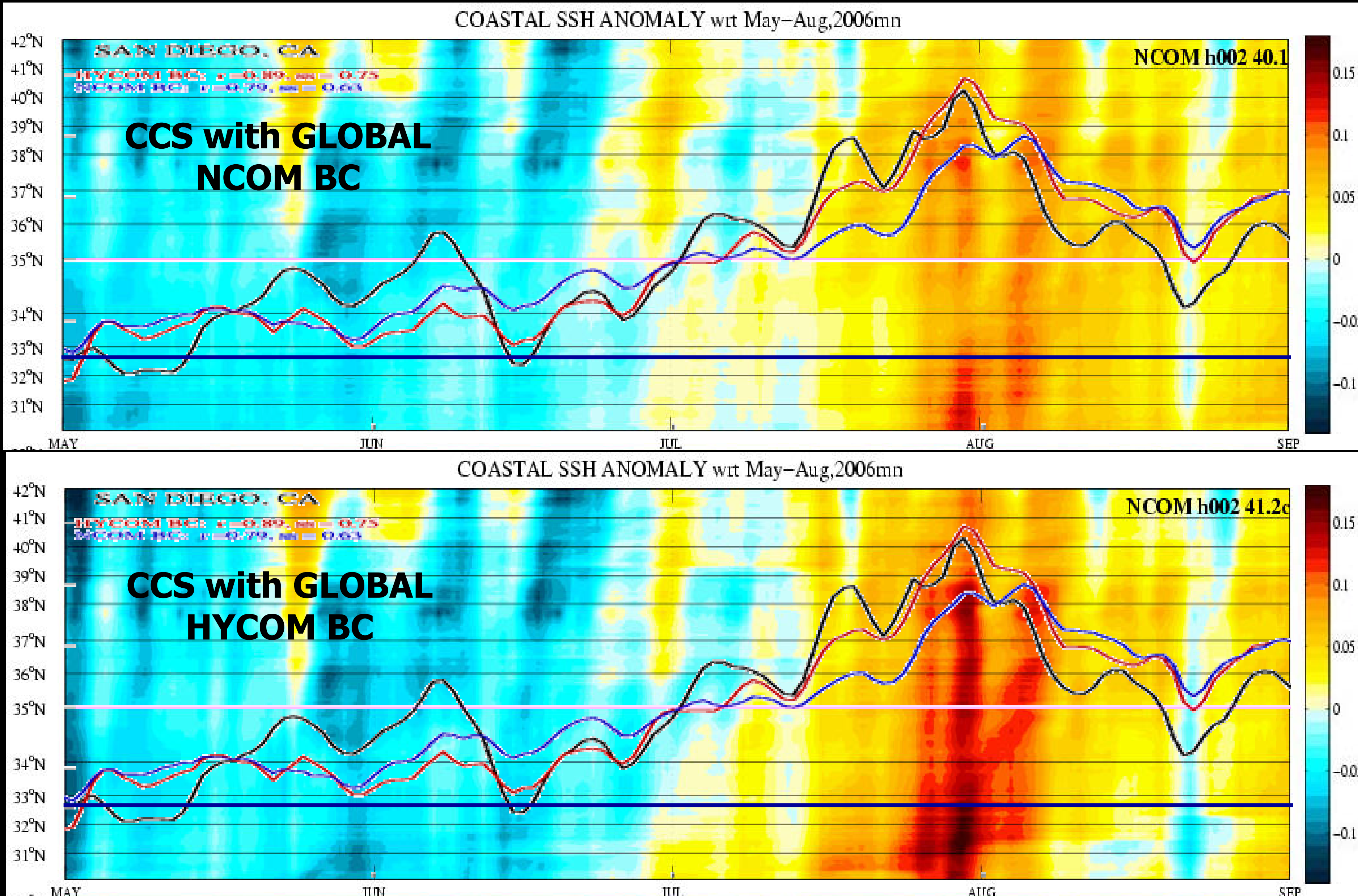


NCOM BC (top) | HYCOM BC (bot)

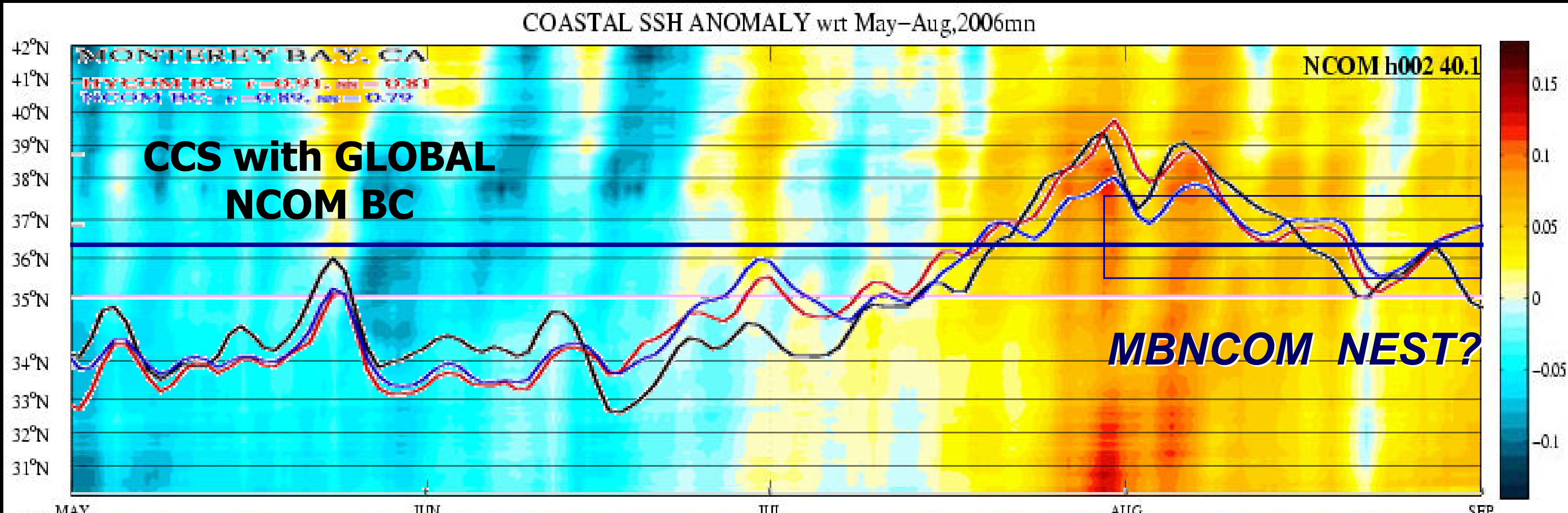


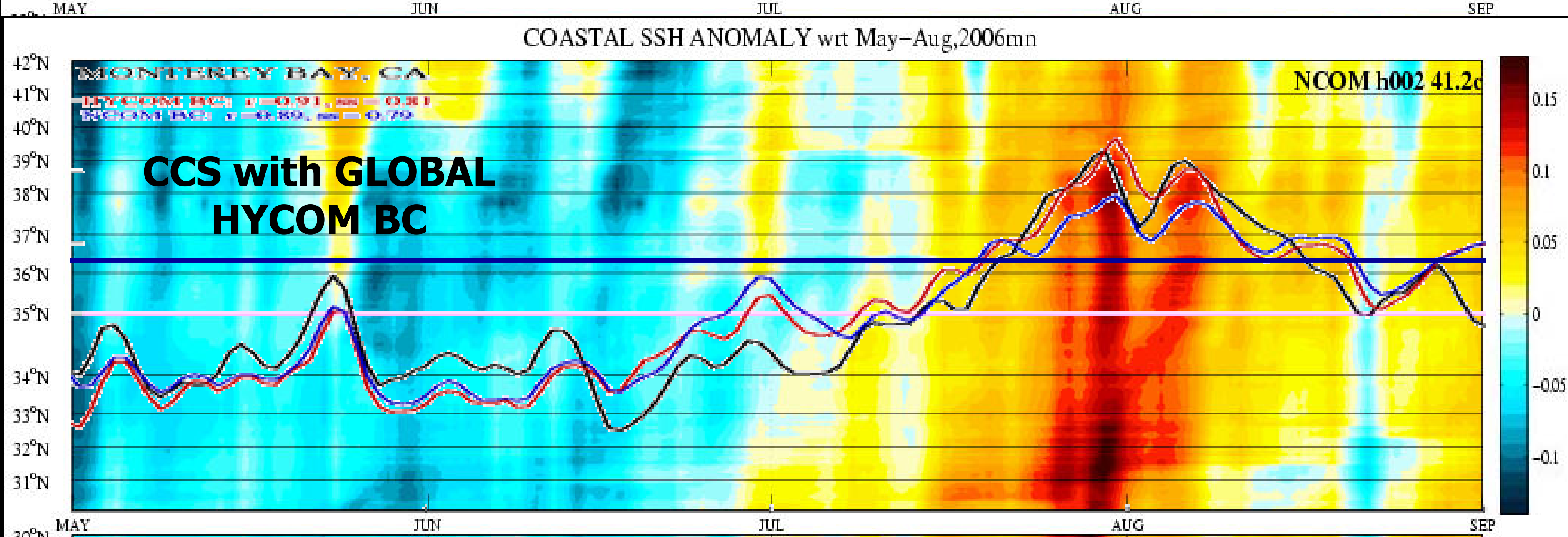


NCOM BC (top) | HYCOM BC (bot)

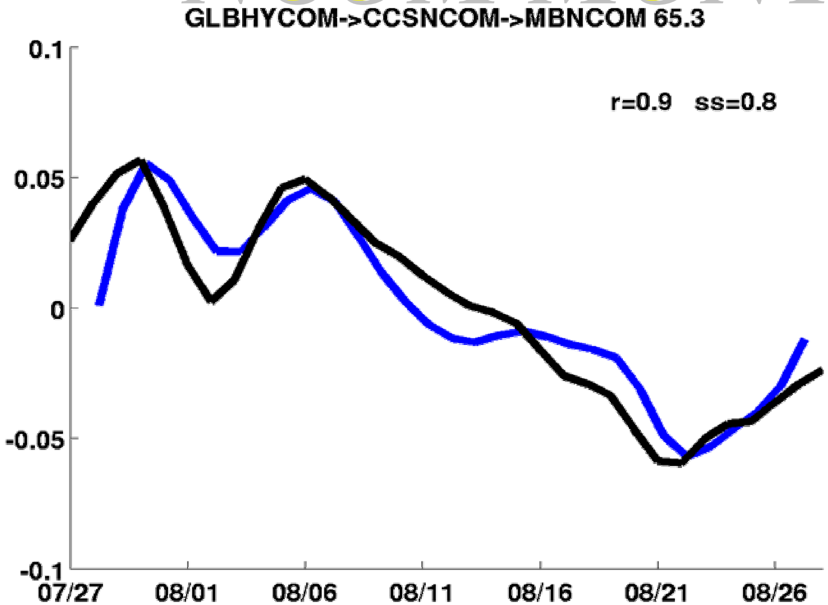


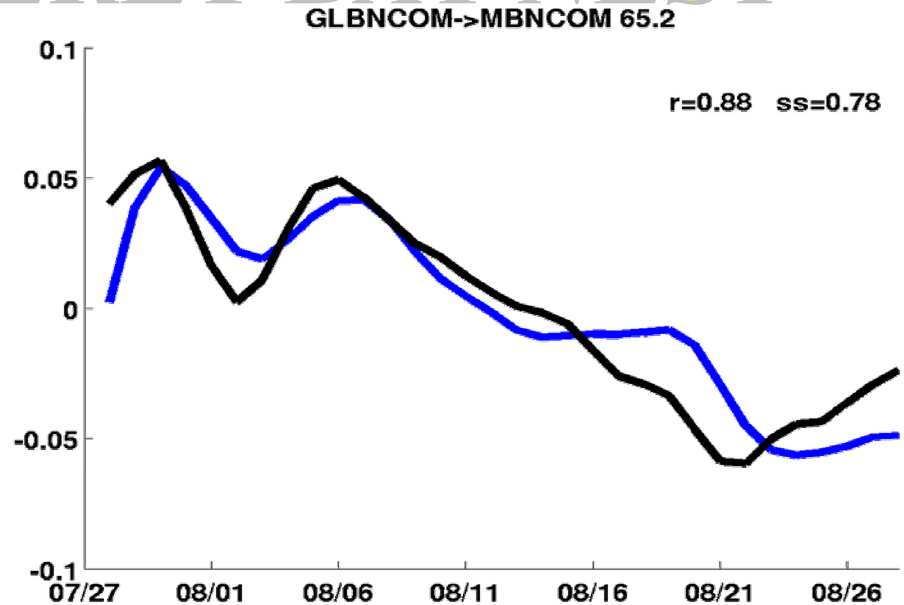
NCOM IC/BC (top) | HYCOM IC/BC (bot)

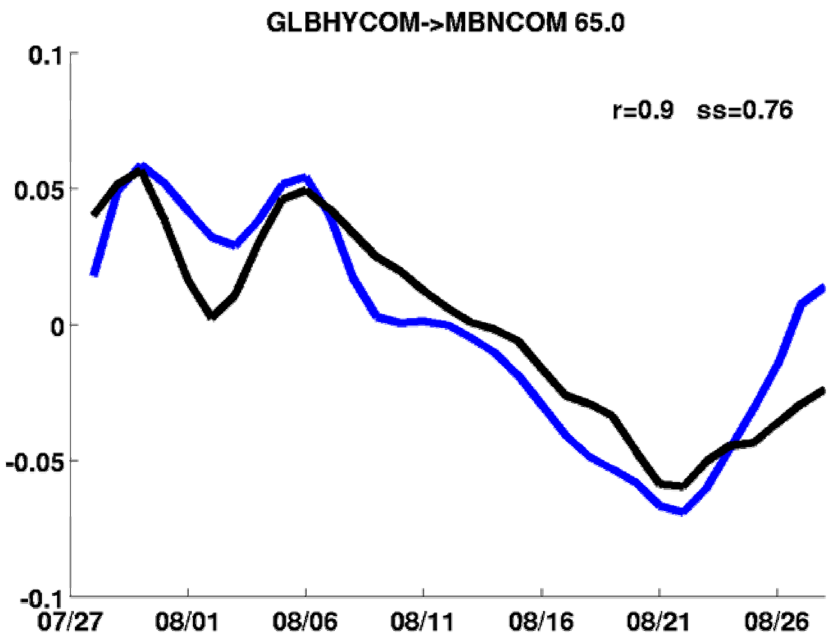




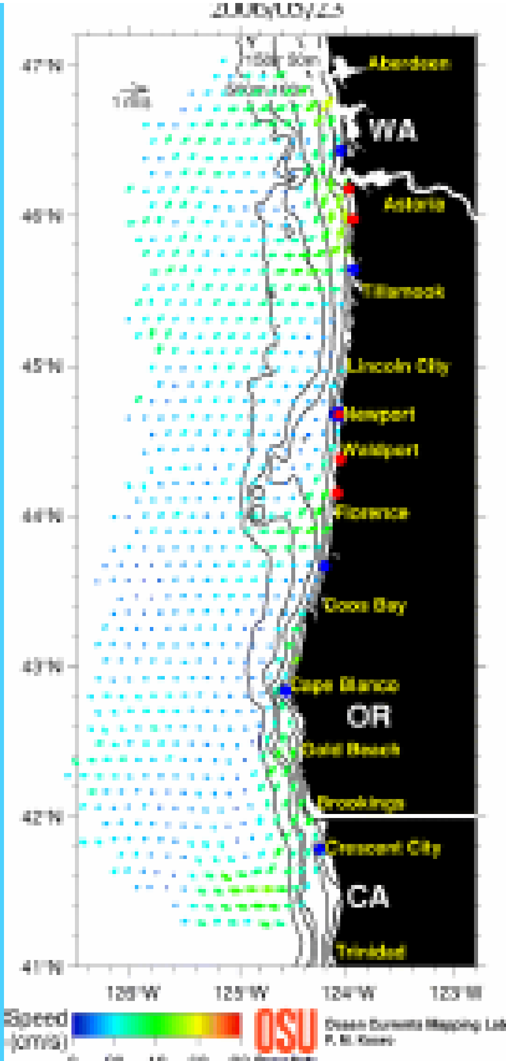
NCOM MONTEREY BAY NEST

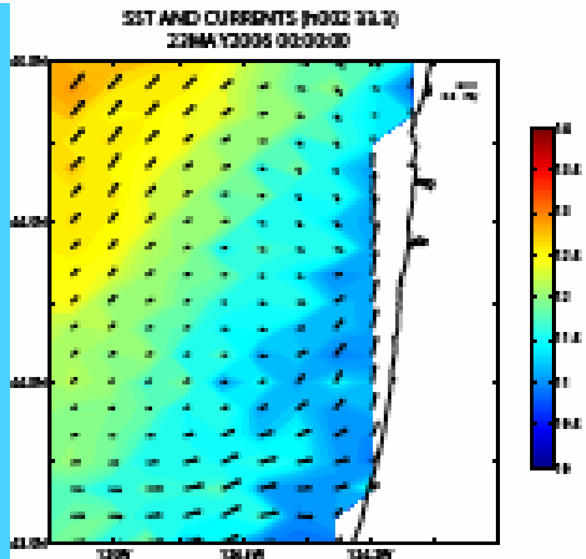


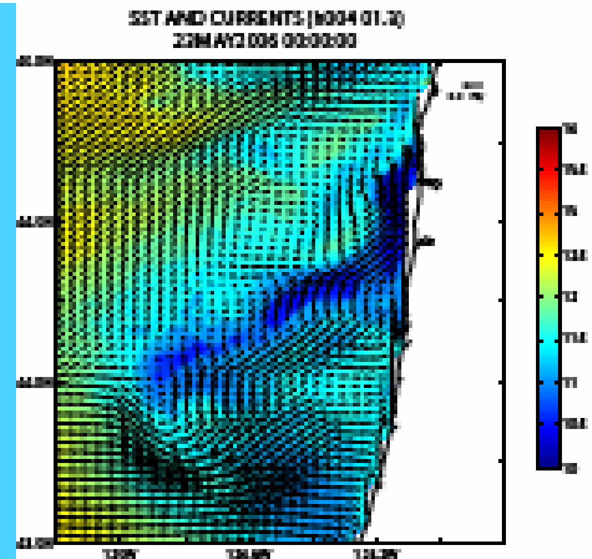




CURRENT WORK







CENTRAL OREGON COAST REGION

The central Oregon coast exhibits wind-driven upwelling/downwelling responses which are mainly characterized by the prominent topographical features of the region where the uniform alongshore shelf breaks drastically by the Heceta Bank to the south. Recent papers [1, 2] discuss the reversal of ocean currents due to wind relaxation events and topography/flow interactions. For this initial evaluation, the OSU/COAS Radar-based Ocean Currents (http://bragg.coas.oregonstate.edu) are used as a comparison basis. It is sufficient to show 3 figures (May 21, May 22, May 23) to demonstrate that both models capture the reversal of the currents along the Heceta Bank, but this feature is much better represented by the 4Km model. Furthermore, the persistence of the coastal upwelling jet following the bank topography until it reaches its end and meanders anticyclonically in the lee of the bank, as described in the papers, is fully captured by the 4Km model, but completely missed by the 9Km.

1) J.A. Barth, S.D. Pierce, and R. M. Castelao. JGR. Vol 110. 2006. Time-dependent, wind-driven flow over a shallow midshelf submarine bank

2) J. Gan, J.S. Allen. JGR. Vol 110. 2005. Modeling upwelling circulation off the region coast

CONCLUSIONS / PLANS

- HYCOM and NCOM viable as IC/BC providers
- Regional Model Nesting adds value to coastal model
- Warm bias in HYCOM has subsided
  - DA, NOGAPS 0.5 Forcing
- Better than expected results seen with HYCOM OBC
  - Possibly due to higher horizontal resolution

- Global Model back to Jan 2003 (Currently Nov, 2003)
  - AOSN 2003 and ASAP 2006 periods

- PAPER