Quantitative Validations of Subsurface Temperatures from the Assimilative HYCOM and NCOM

By

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INTRODUCTION

- **Two global ocean models: HYCOM and NCOM**

    o **brief description of each model**

    o **assimilation procedures**

- **Daily subsurface temperatures and SST**

    o **validation against buoy temperatures in 2004**

    o **various statistical metrics and summary**

We would like to answer the question,

**which model performs better in simulating temperatures?**

AN OVERVIEW OF THE MODELS

	NCOM	HYCOM
Grid resolution	1/8°	1/12°
Vertical layers	40 level sigma–z	32 layer hybrid
Initialization	MODAS T/S	GDEM T/S
Simulation	Inter–annual	Inter–annual
Mixed layer	Mellor-Yamada	GISS
Atm. forcing	NOGAPS	NOGAPS
River forcing	NRL database	NRL database
Turbidity	Constant	SeaWiFS data
Bulk formulae	Sensible/latent heat	Sensible/latent heat
Relaxation	None except SSS	None except SSS

MAJOR FEATURES OF THE ASSIMILATION

	NCOM	HYCOM
Observation	SST and SSH	SST, SSH, profiles
Methodology	Nudging to MODAS gridded 3D product	NCODA, MVOI Cooper–Haines (1996)
Projection	Synthetic T and S, 1/32° NLOM SSH 1/8° MODAS SST for profile calculation	Vertical projection, incremental updating of model variables
Time interval	daily assimilation	daily assimilation

SUBSURFACE TEMPERATURES FROM BUOYS
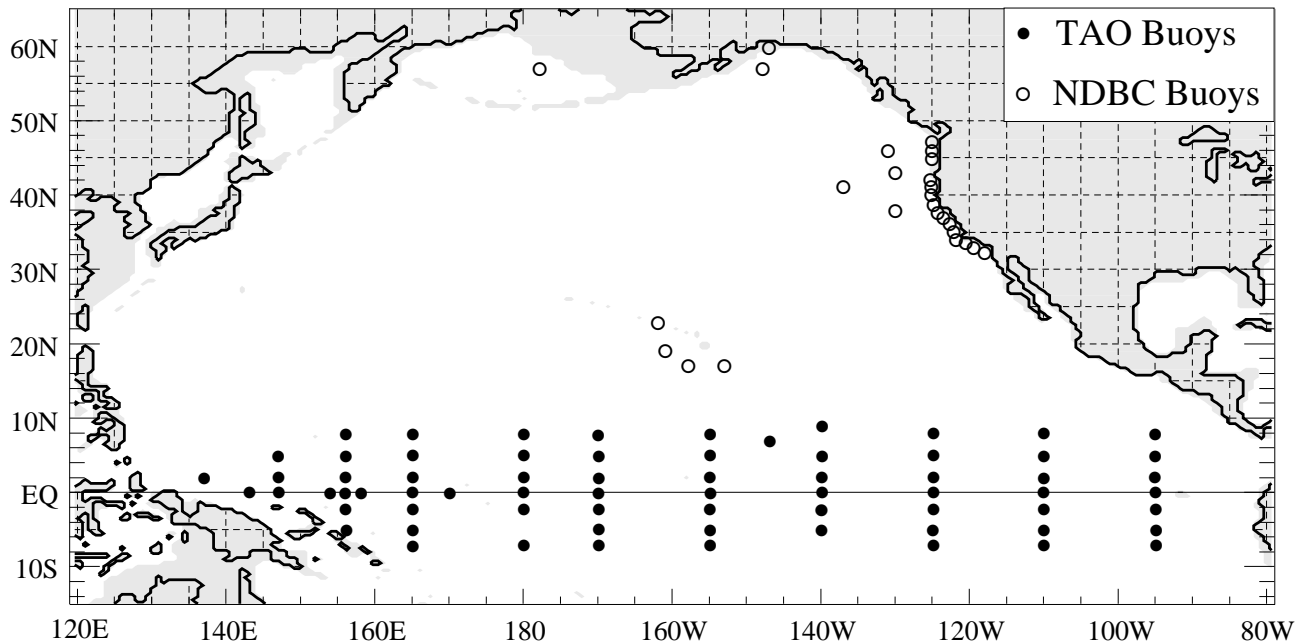
- **Tropical Atmosphere–Ocean (TAO) array**

- **Pilot Research Moored Array in the Tropical Atlantic (PIRATA)**

- **Two sets of buoys: temperatures at different depths**
    - **I: east of $155°W$**
        - 1, 20, 40, 60, 80, 100, 120, 140, 180, 300, 500 meters
    - **II: west of $155°W$, including $155°W$**
        - 1, 25, 50, 75, 100, 125, 150, 200, 250, 300, 500 meters

Note: NDBC buoys do NOT report subsurface temperatures

MODEL–DATA COMPARISONS

- **Validation procedure**

  o **yearlong subsurface temperatures at each depth**

  o **buoys which have a nearly complete yearlong time series**

  o **temperature voids at buoys filled if < 1 month**
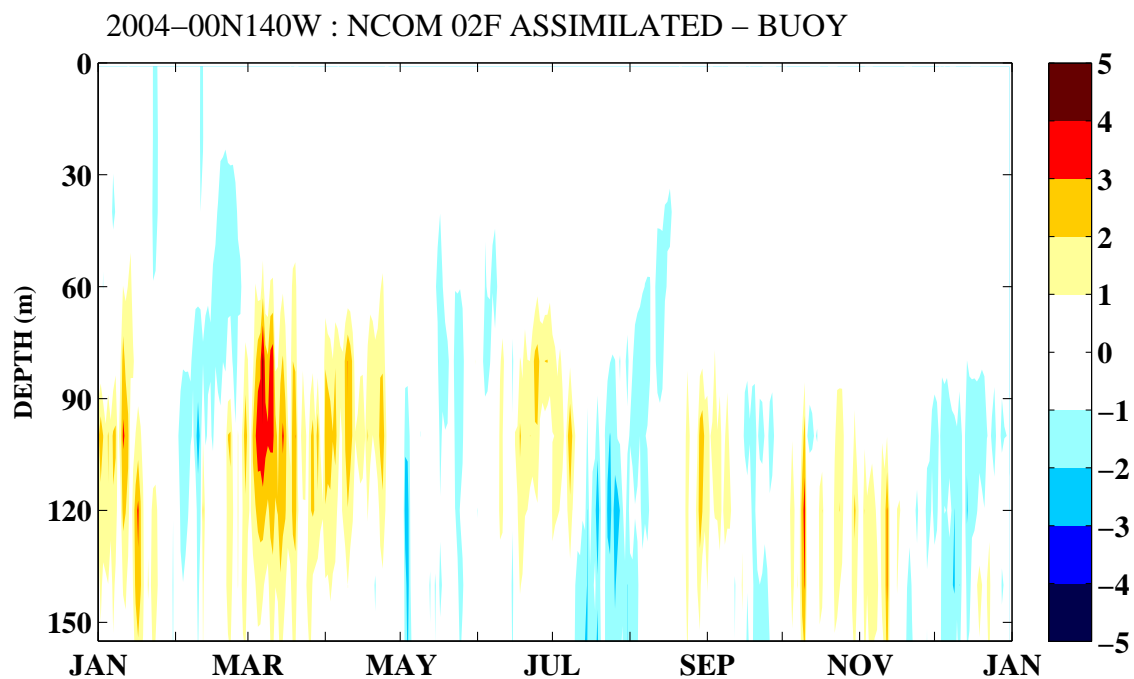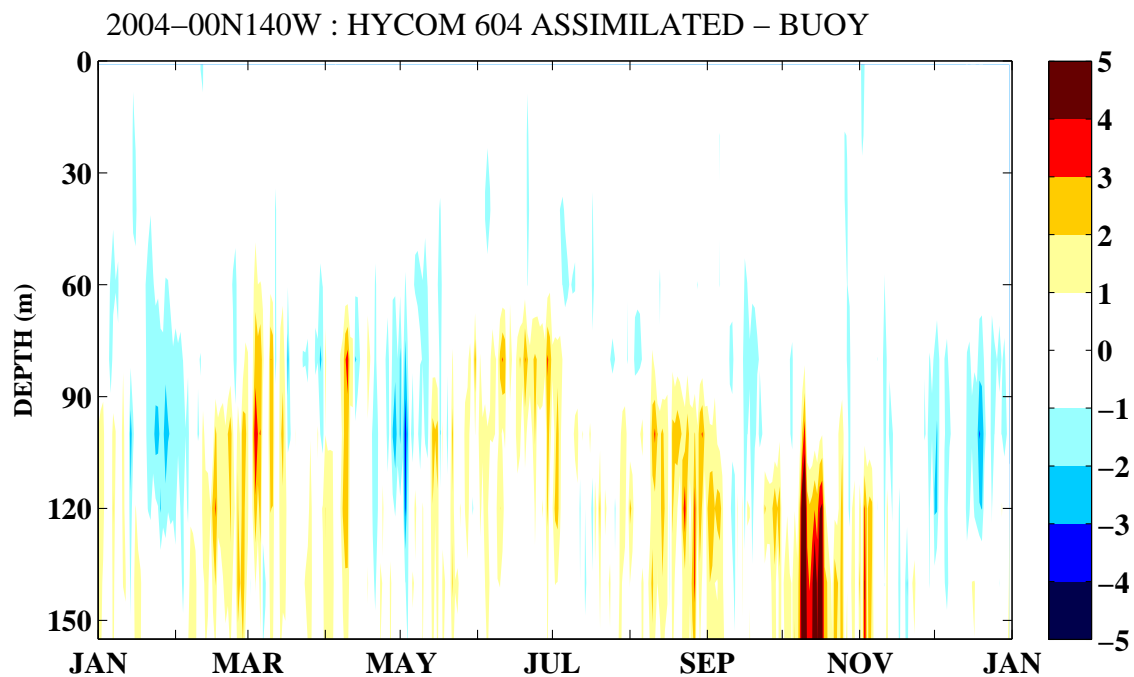
  o **voids filled by linear interolation**

- **Validation Statistics**

  o **calculate mean bias and RMS at each depth level**

  o **buoy vs NCOM and buoy vs HYCOM at each buoy**

  o **combining statistics using temperatures from all buoys**

SUBSURFACE TEMPERATURES AT (00°N, 140°W)

BUOY : 2004−00N140W

HYCOM EXPT 604 : ASSIMILATED

NCOM GLB8 02F : ASSIMILATED
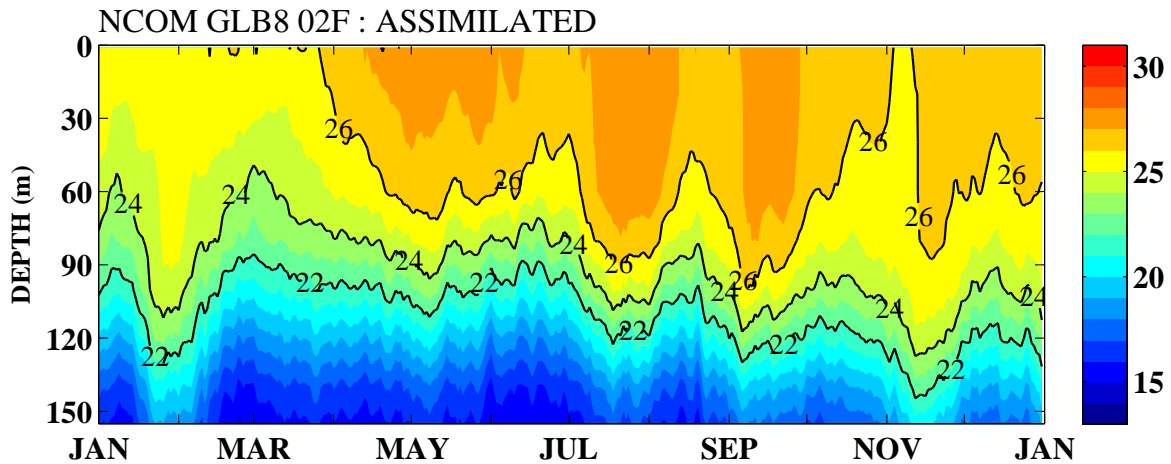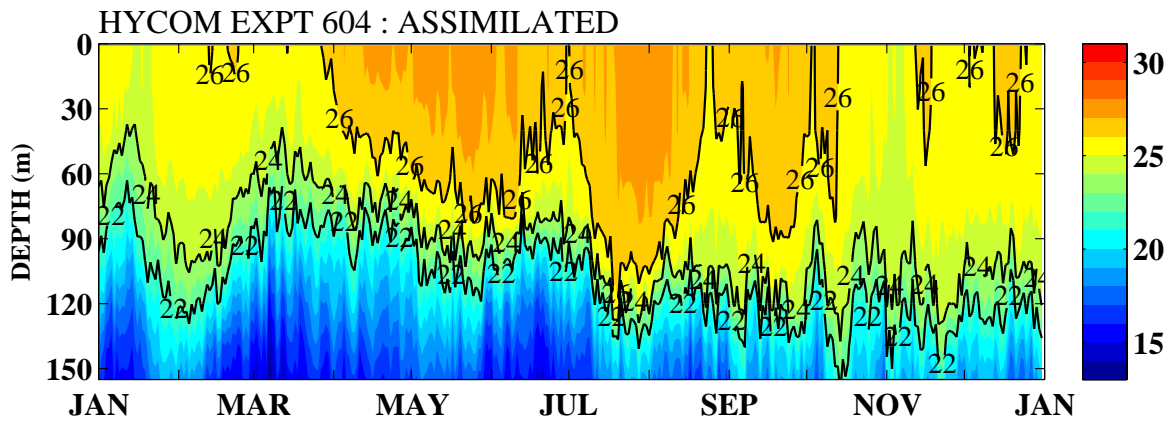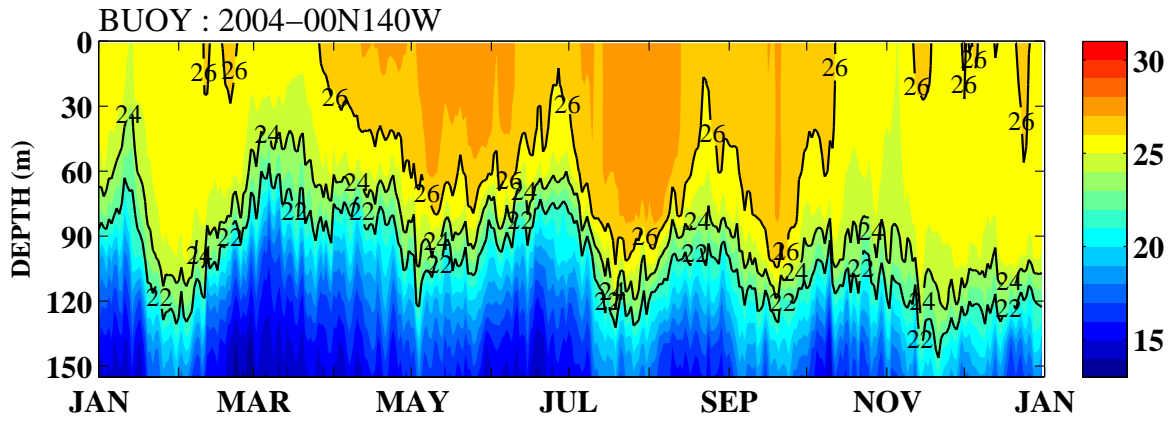
TEMPERATURE DIFFERENCES AT (00°N, 140°W)

2004–00N140W : HYCOM 604 ASSIMILATED – BUOY
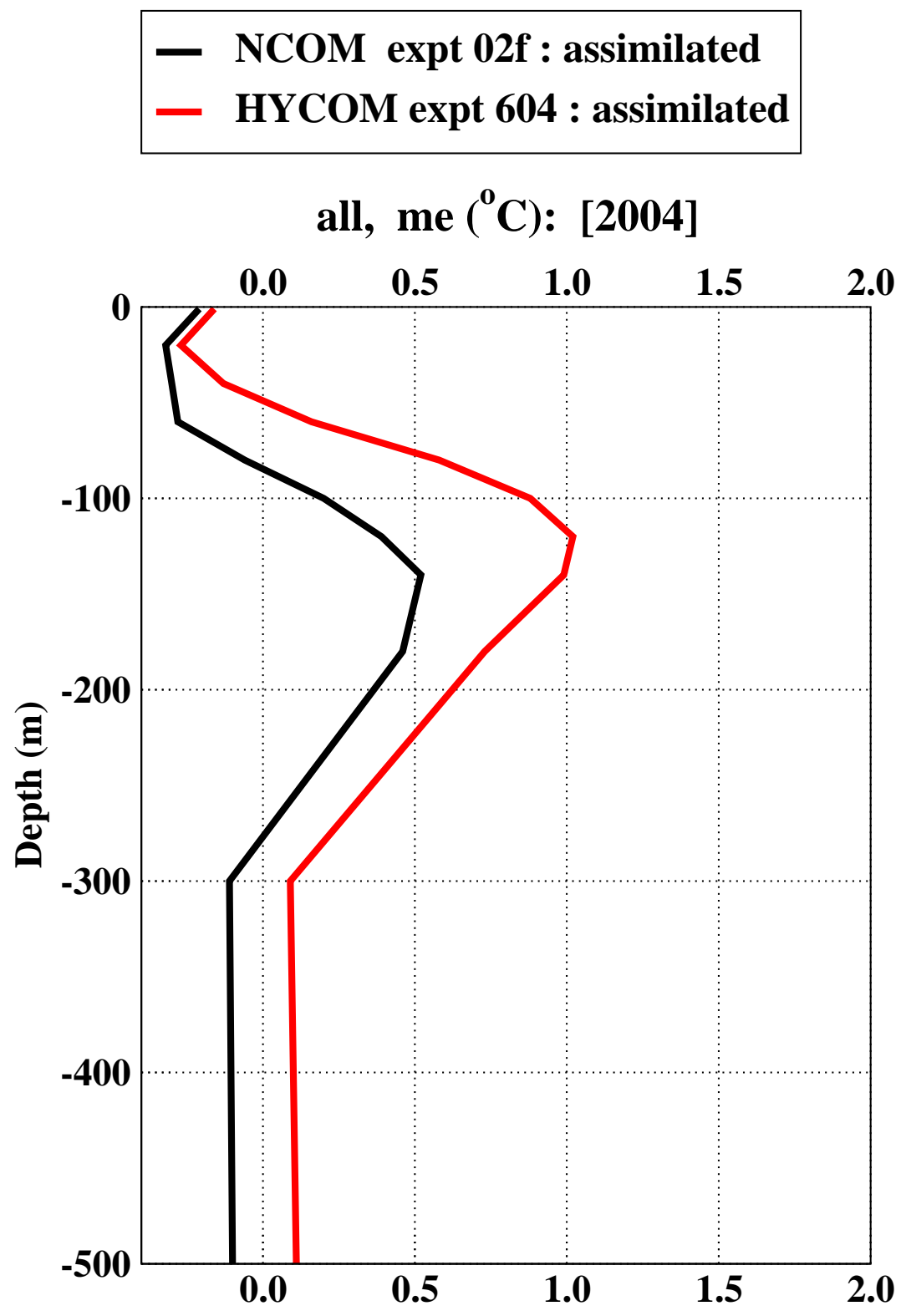

2004–00N140W : NCOM 02F ASSIMILATED – BUOY

RMS SST DIFFERENCE AT (00°N, 140°W)

NCOM expt 02f : assimilated
HYCOM expt 604 : assimilated

00n140w, rmse (^{o}C): [2004]
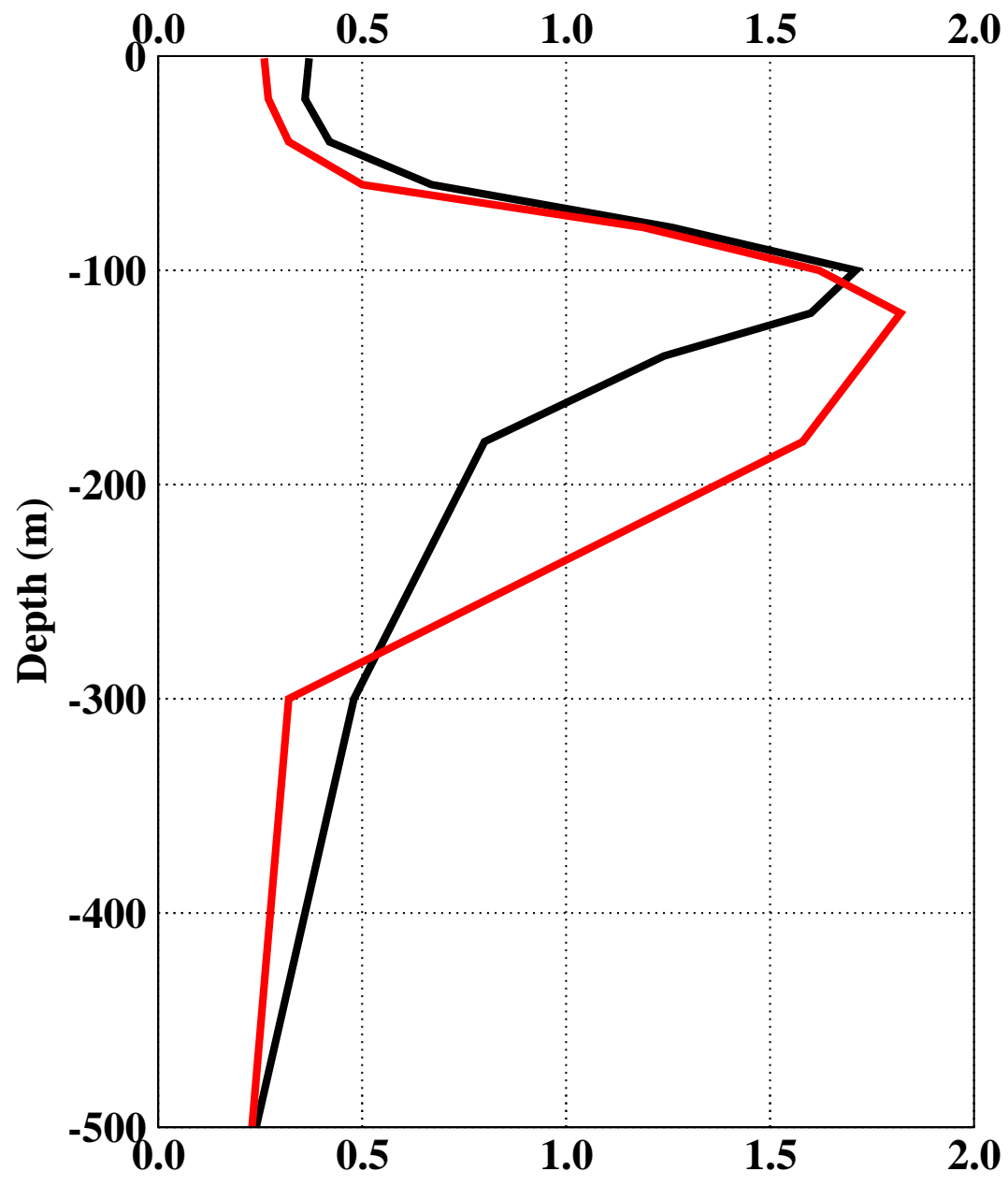
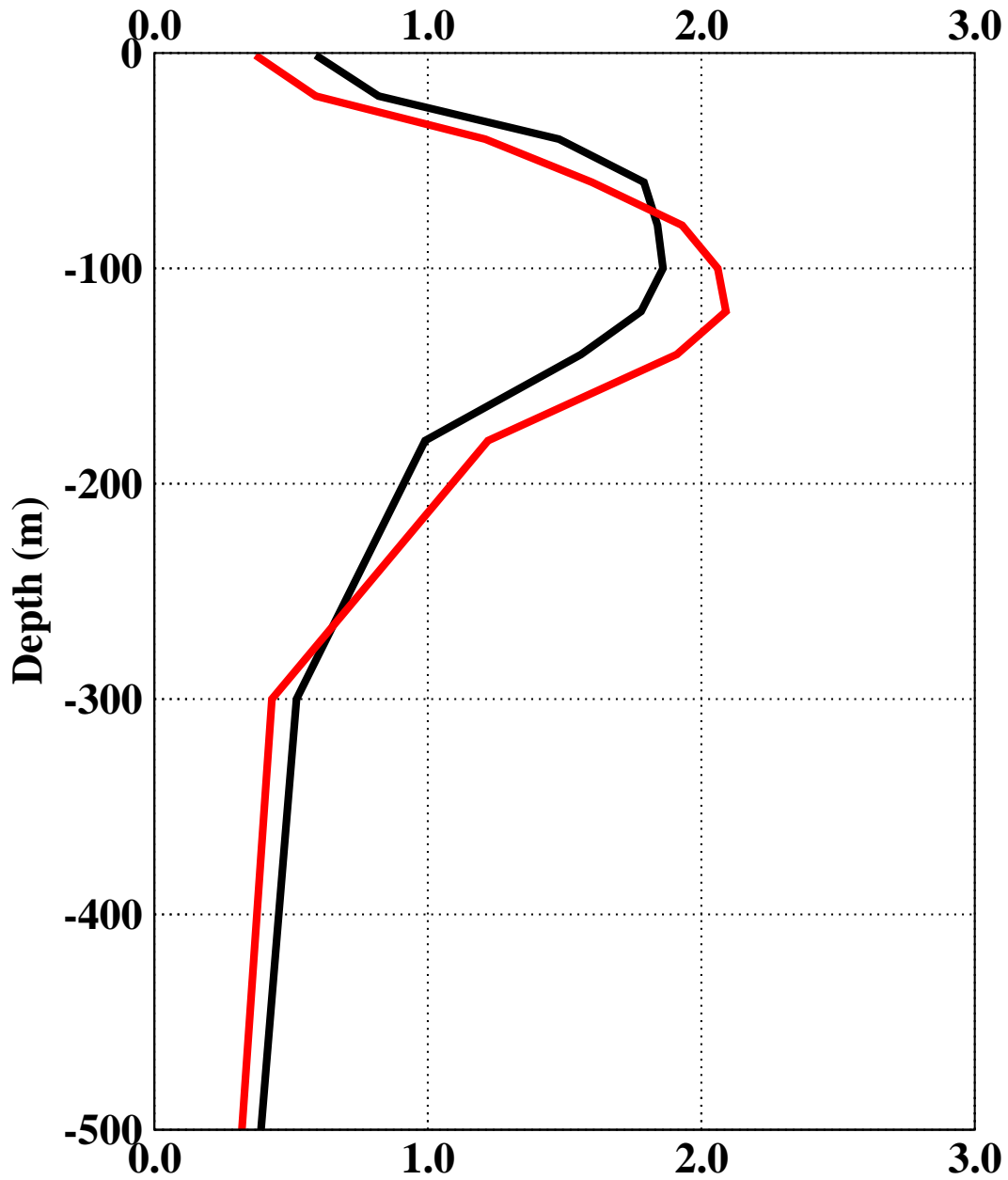**SUMMARY STATISTICS FOR SET I BUOYS: BIAS**

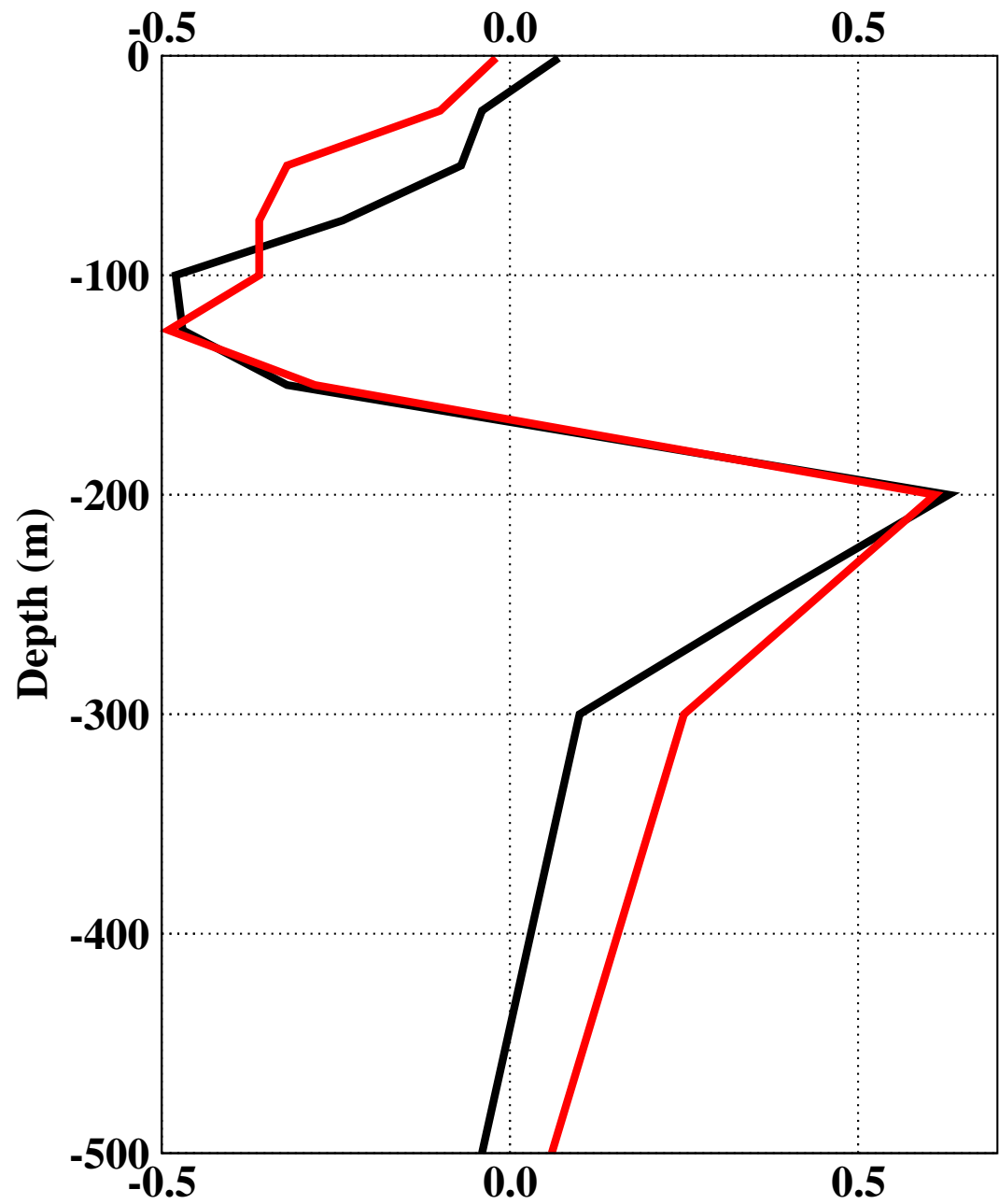# SUMMARY STATISTICS FOR SET I BUOYS: RMS
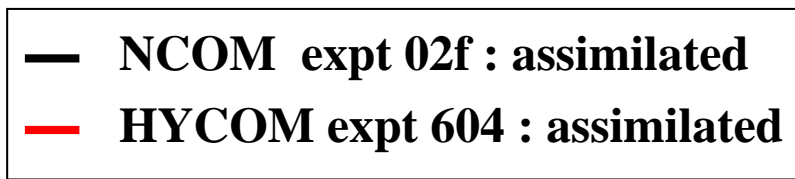
all, rmse (^{o}C): [2004]
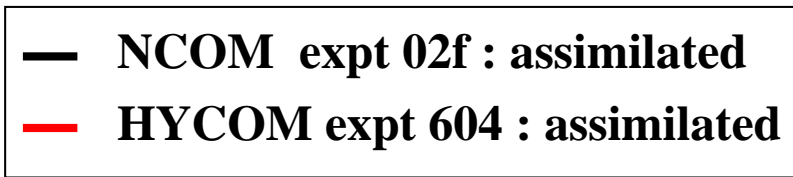
SUMMARY STATISTICS FOR SET II BUOYS: ME

all, me (^{o}C): [2004]

NCOM expt 02f : assimilated

HYCOM expt 604 : assimilated

Depth (m)

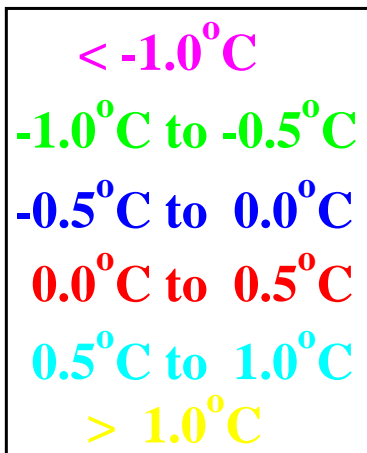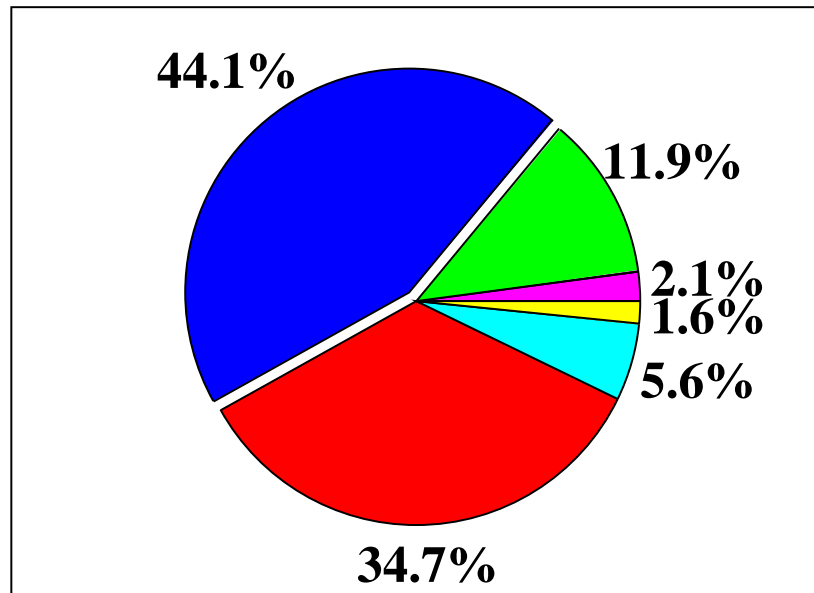**SUMMARY STATISTICS FOR SET II BUOYS: RMS**
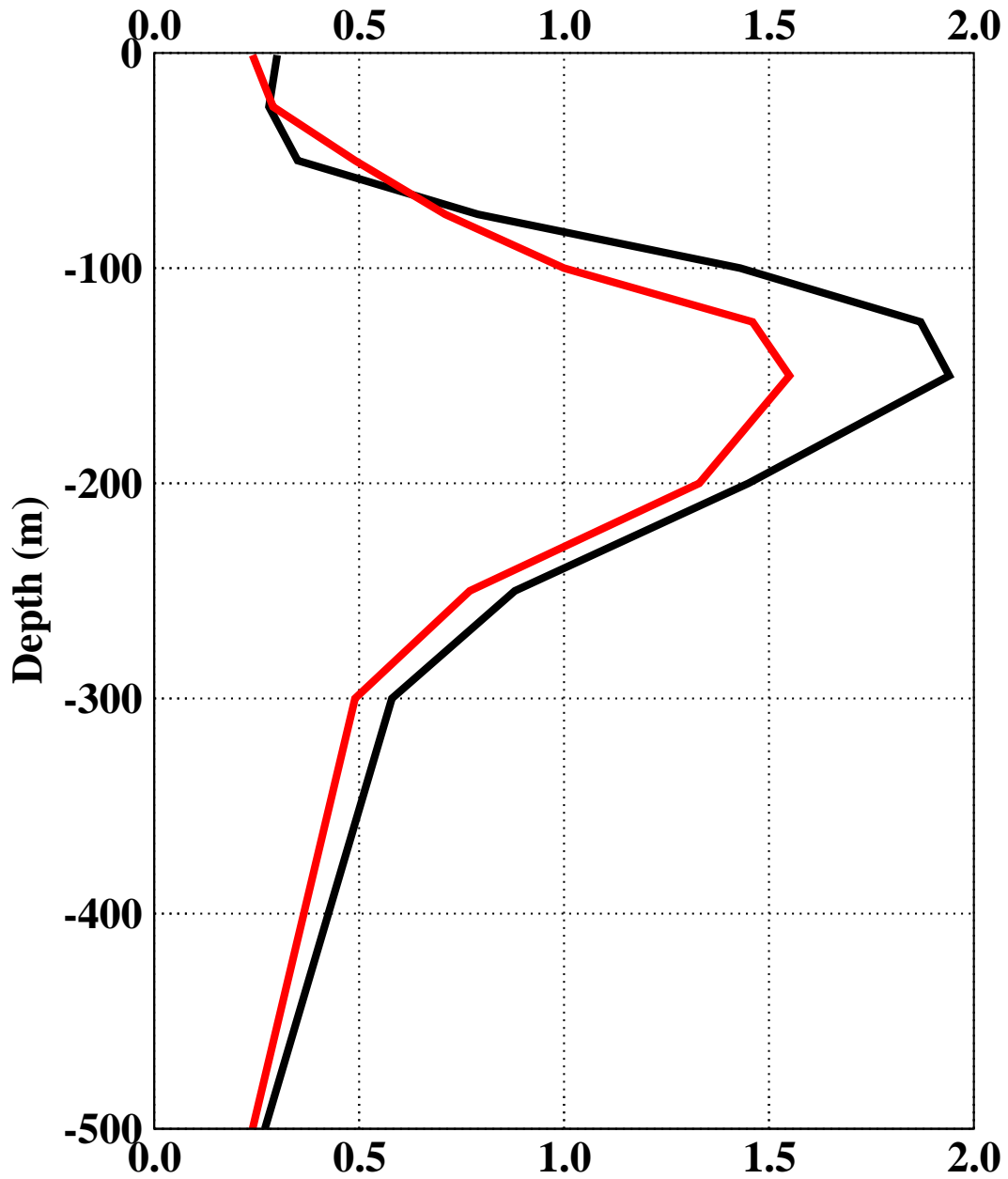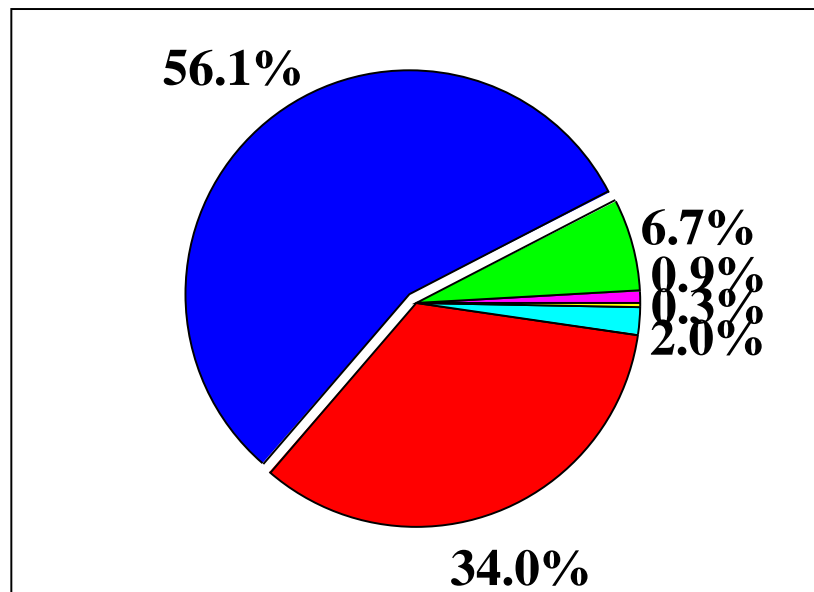
SST VALIDATION : SET I and SET II BUOYS
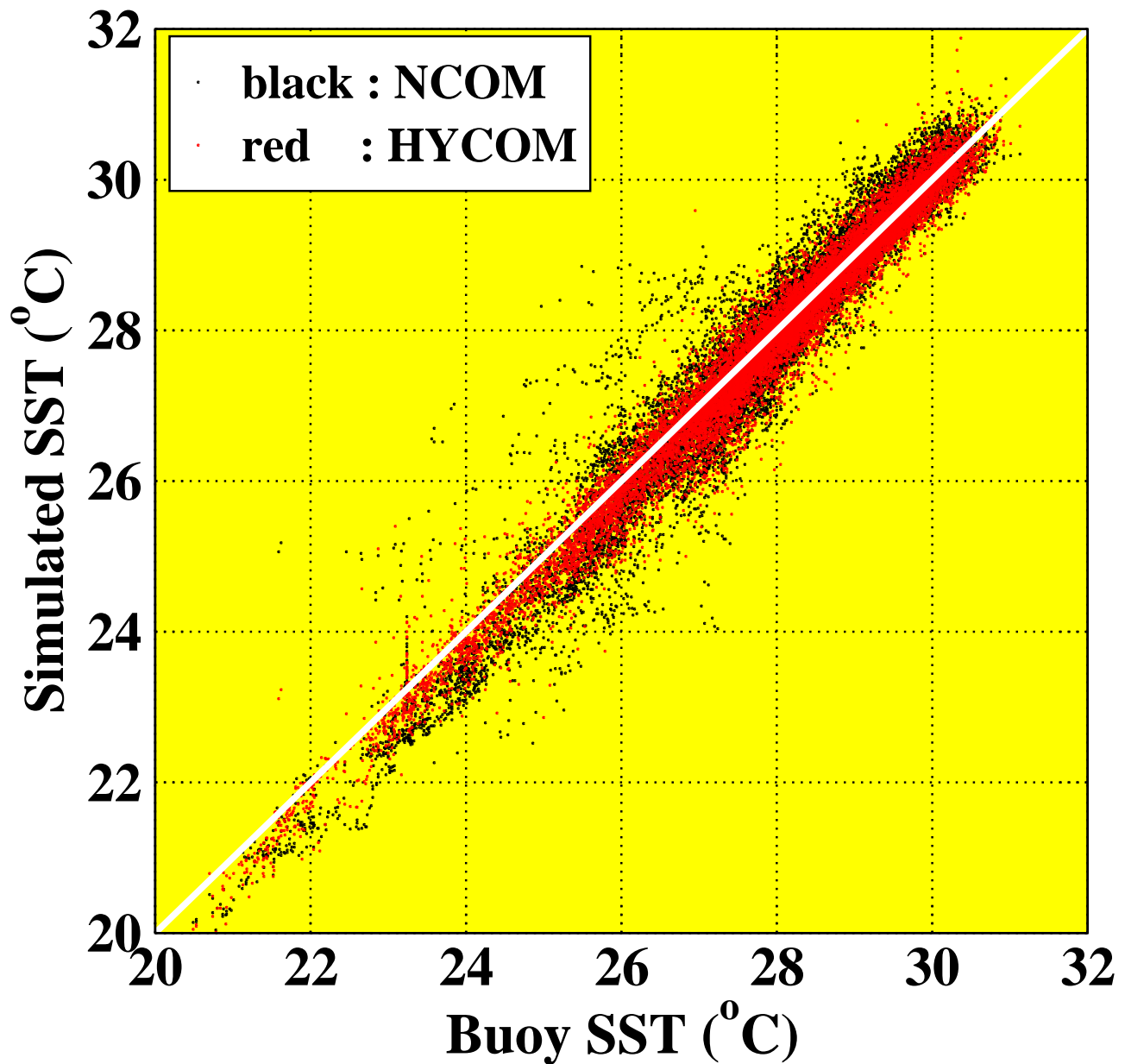
- **17,202 daily SSTs from all TAO buoys**

- **Median SST bias:** $-0.1°C$ **for NCOM and HYCOM**

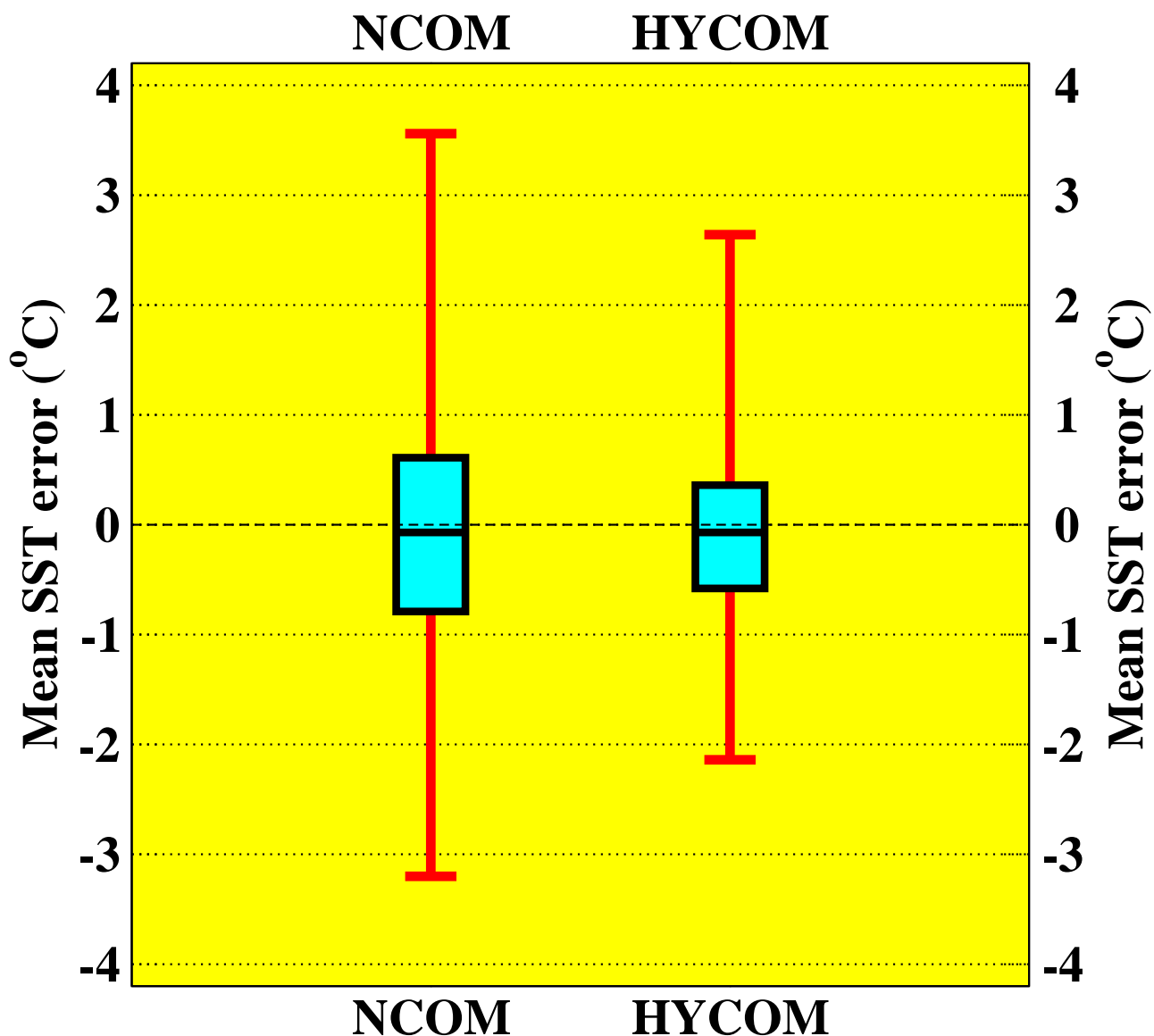# SST ERROR INTERVALS FOR ALL BUOYS

SST bias: NCOM vs TAO Buoys

44.1%
11.9%
2.1%
1.6%
5.6%
34.7%

Legend:
< -1.0^{o}C
-1.0^{o}C to -0.5^{o}C
-0.5^{o}C to 0.0^{o}C
0.0^{o}C to 0.5^{o}C
0.5^{o}C to 1.0^{o}C
> 1.0^{o}C

SST bias: HYCOM vs TAO buoys

56.1%
6.7%
0.9%
0.3%
2.0%
34.0%

Results are based on 17,202 daily SST values

PERCENTILES OF THE SST ERRORS

- **The ends of the whiskers**: Min and Max SST biases

- **The upper (lower) edge of the box**: 95th (5th) percentiles

- **The line in the box**: Median SST bias

- Note: SST biases from NCOM and HYCOM are NOT skewed.

SUMMARY AND CONCLUSIONS

● **HYCOM and NCOM were evaluated in 2004:**

     o **Subsurface temperatures**

     o **SST**

● **Both models yield realistic results**