Sea Surface Temperature Analysis Using Blended Infrared and Microwave Satellite Measurements

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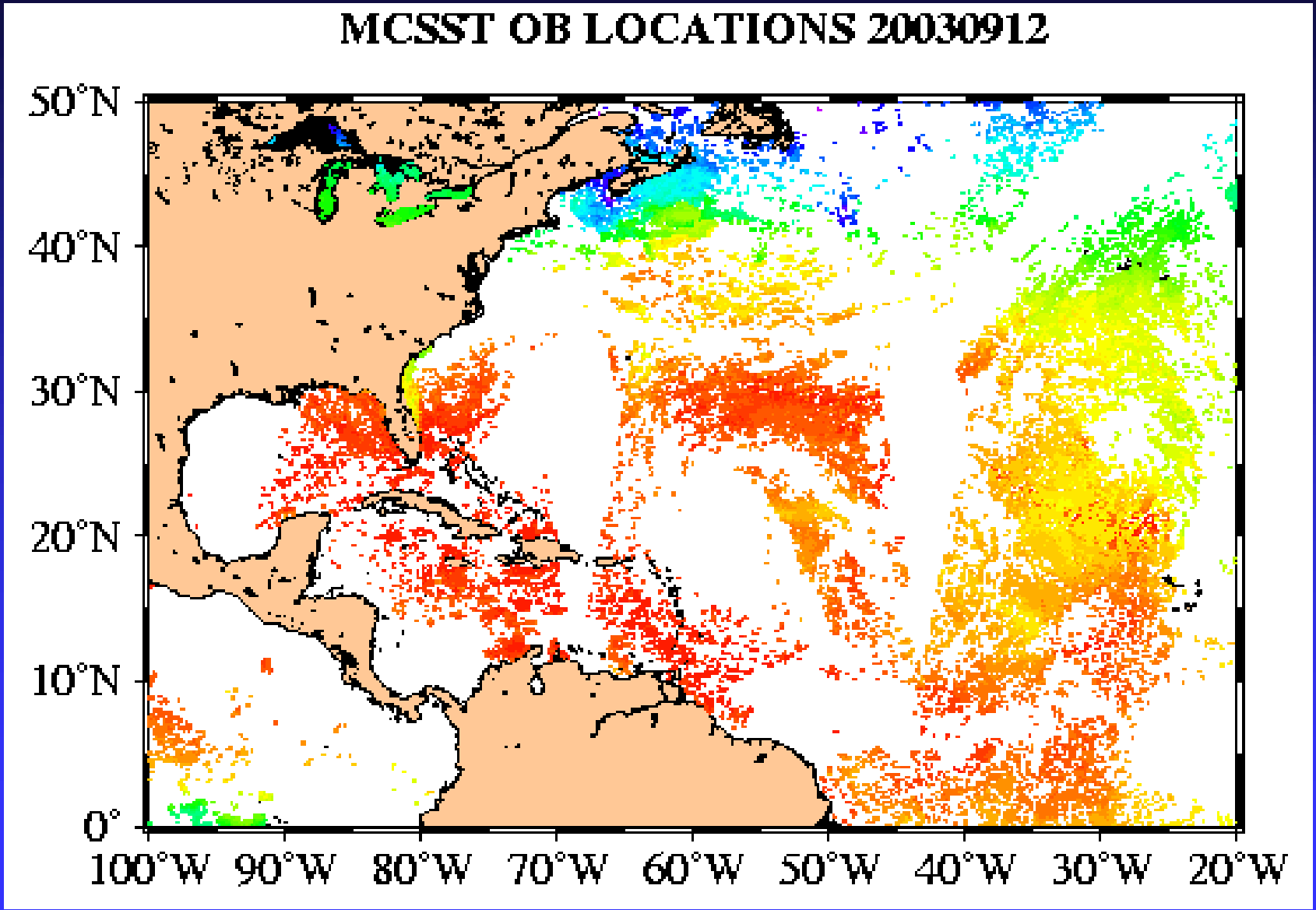
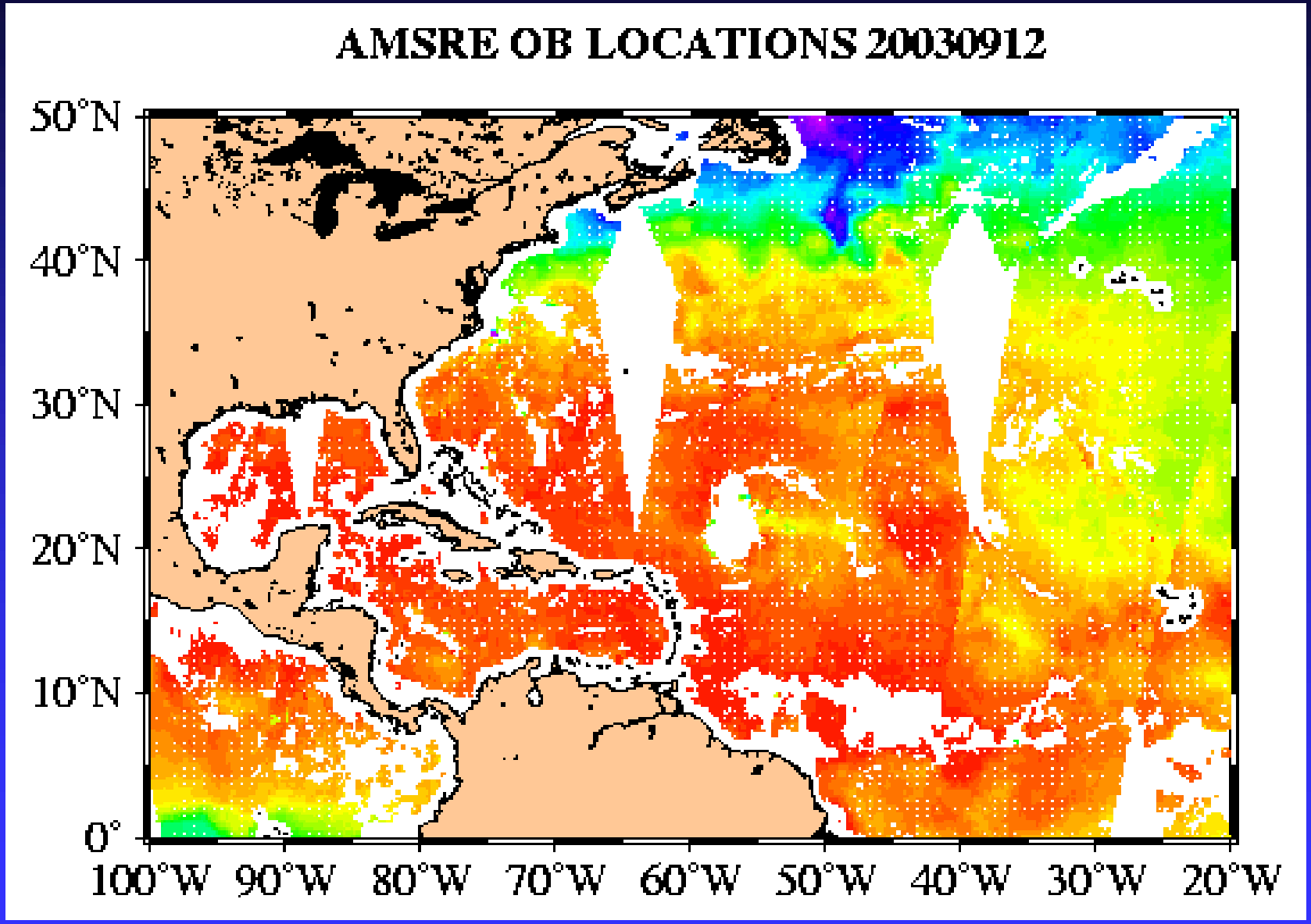
Background

- Operational daily SST analyses used for
  - Atmospheric models
  - Ocean/coupled model assimilation
- Satellite SST observations dominate analyses
  - Satellite infrared (IR)
  - Satellite microwave (MW)
- Goal
  - Preliminary evaluation of AMSR-E MW SST data in a daily cycling SST analysis
  - Impact on SST and upper ocean heat content near tropical storms

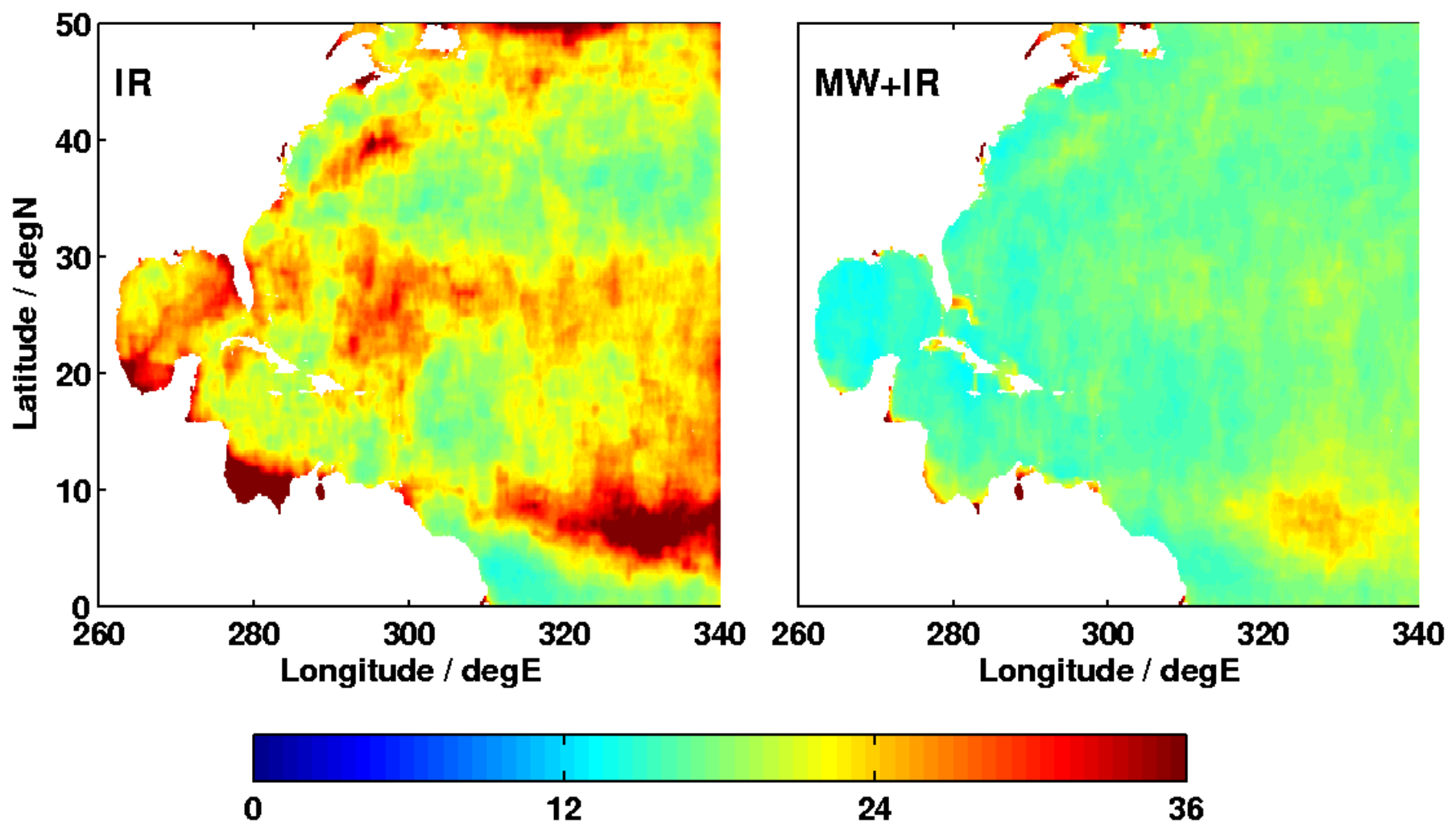
IR SSTs – Sample distribution



MW SSTs – Sample distribution



Observation age

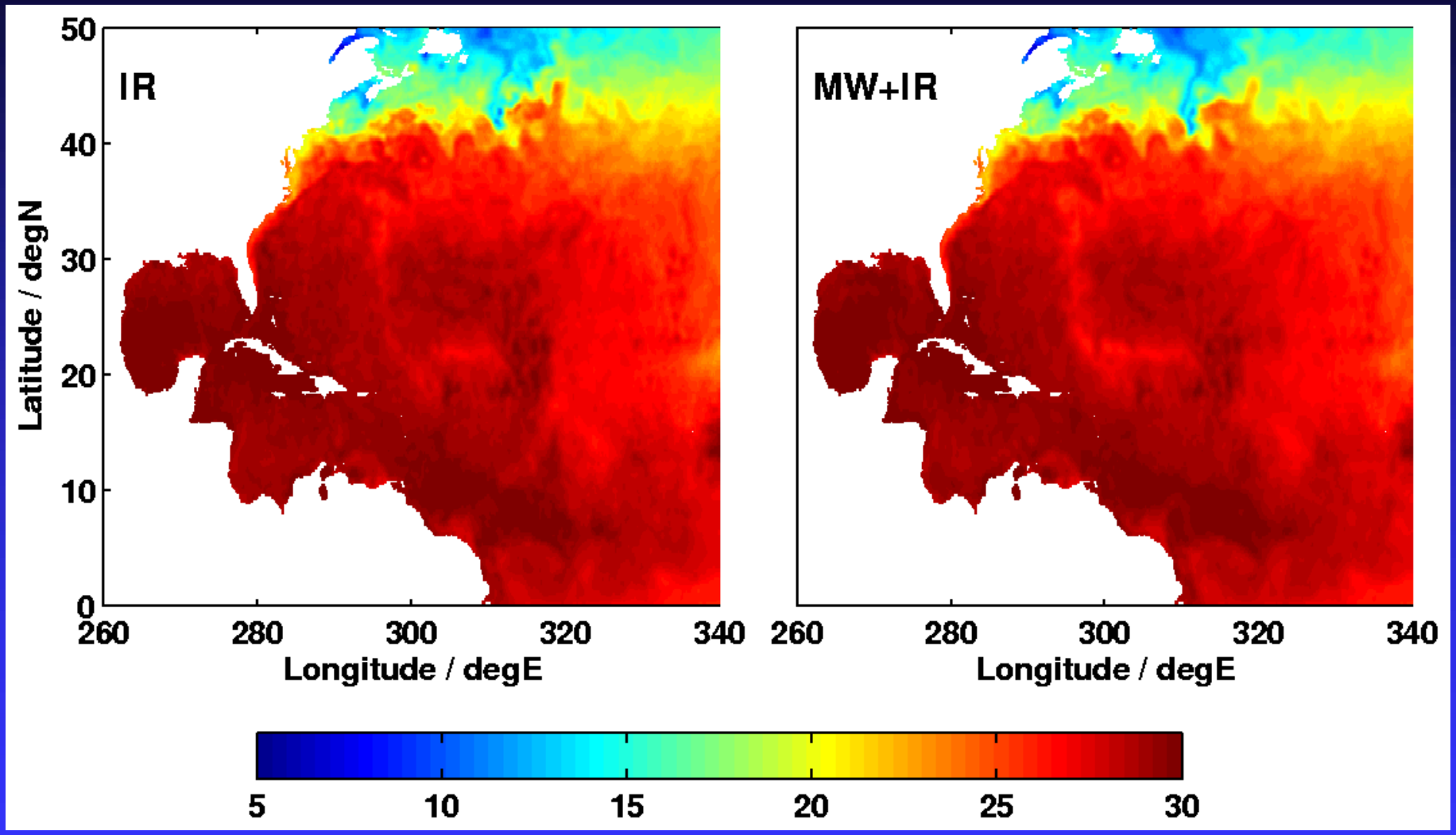


Mean observation age at 00Z update 20030801-20031231

Methods and data

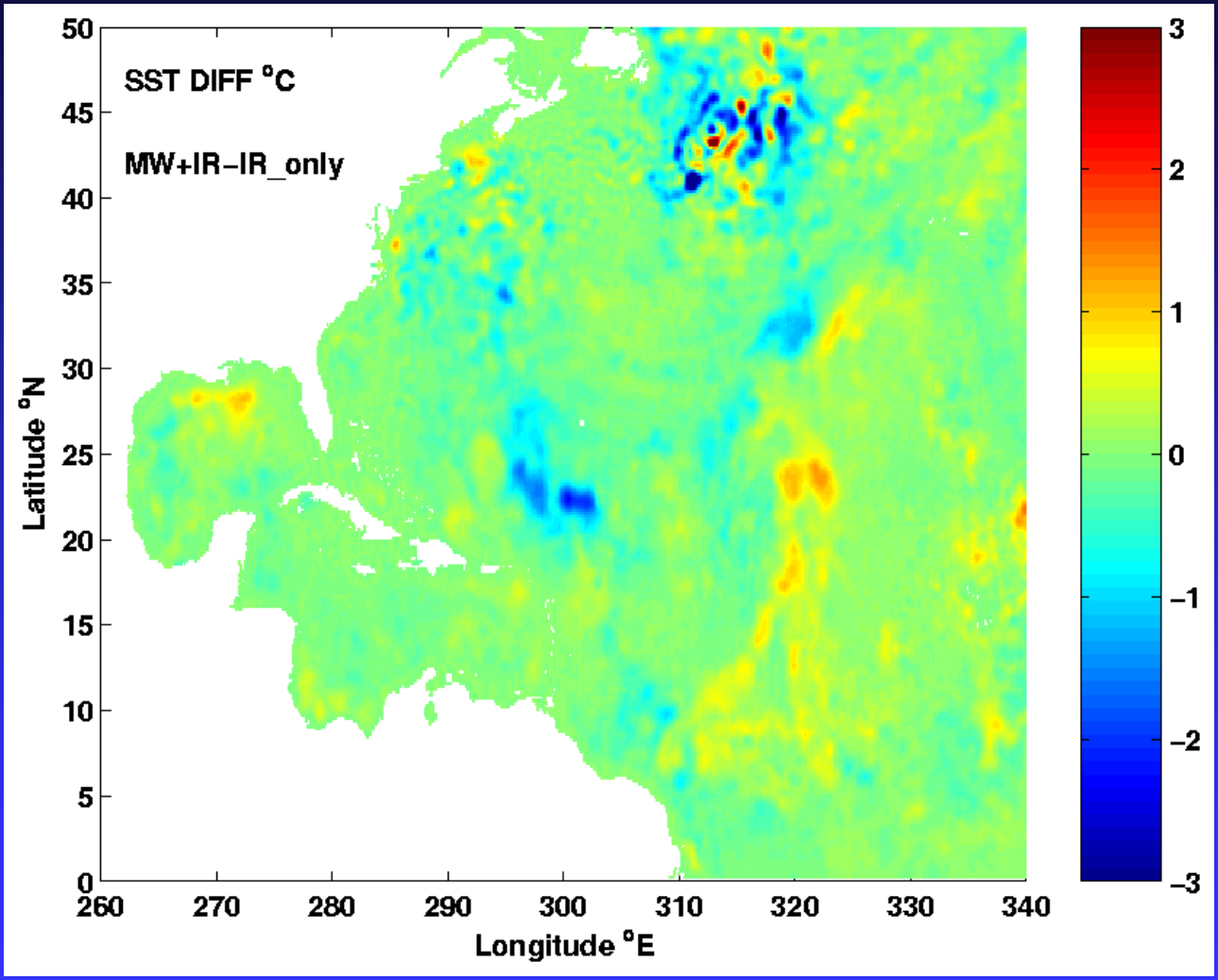
- Twin satellite-only SST analysis cycles
  - Infrared (IR) only – operational GAC MCSST
  - Blended IR plus microwave (MW) – IR plus level 3 AMSR-E (binned 0.25 deg)
- Assumed instrument error: 0.5°C IR, 0.8°C MW
- West Atlantic domain
  - 100-20 °W, 0-50 °N, Δx=0.25°
- Optimum interpolation
  - Gaussian background error correlation
  - uniform L=60km,T=60h
- 02 Jul – 31 Dec 2003 (183 cycles, 24h update)

Blended analysis



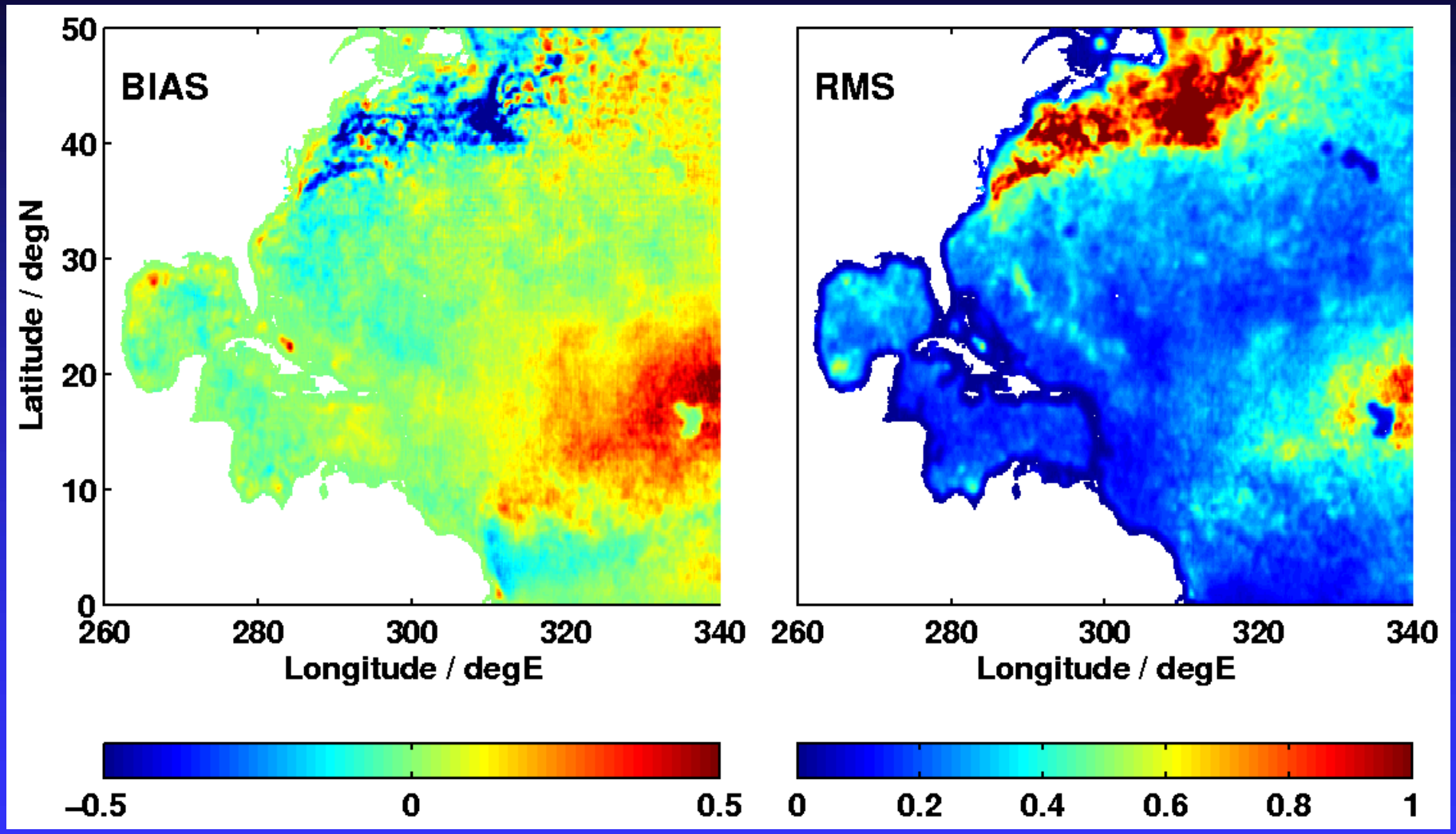
SST analyses (°C) valid 00Z 20030915

Difference MW+IR – IR-only



SST difference field valid 00Z 20030915

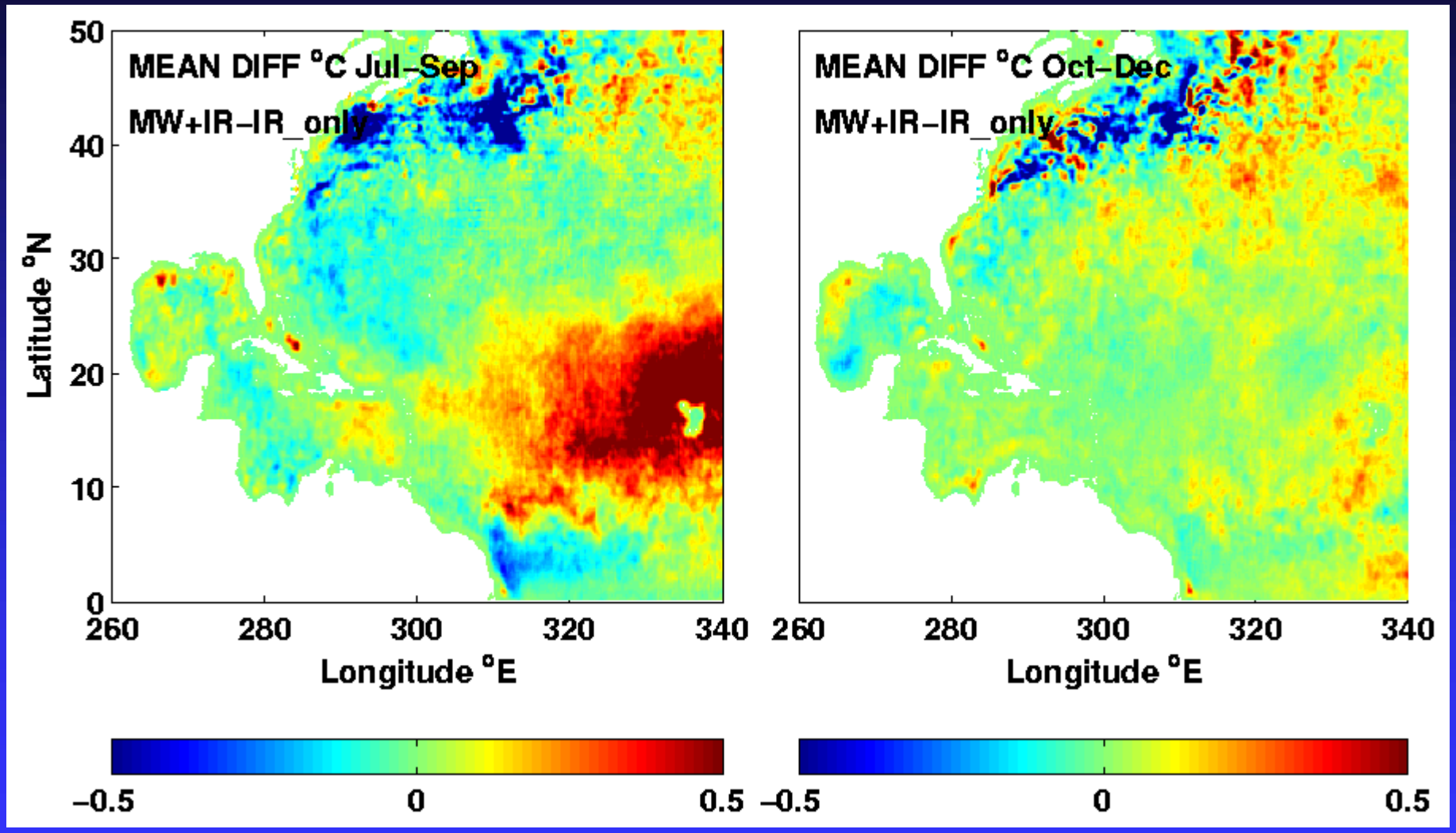
Difference MW+IR – IR-only



Mean SST analysis bias and RMS (°C)

182 cycles 20030702 to 20031231

Seasonal bias MW+IR – IR-only



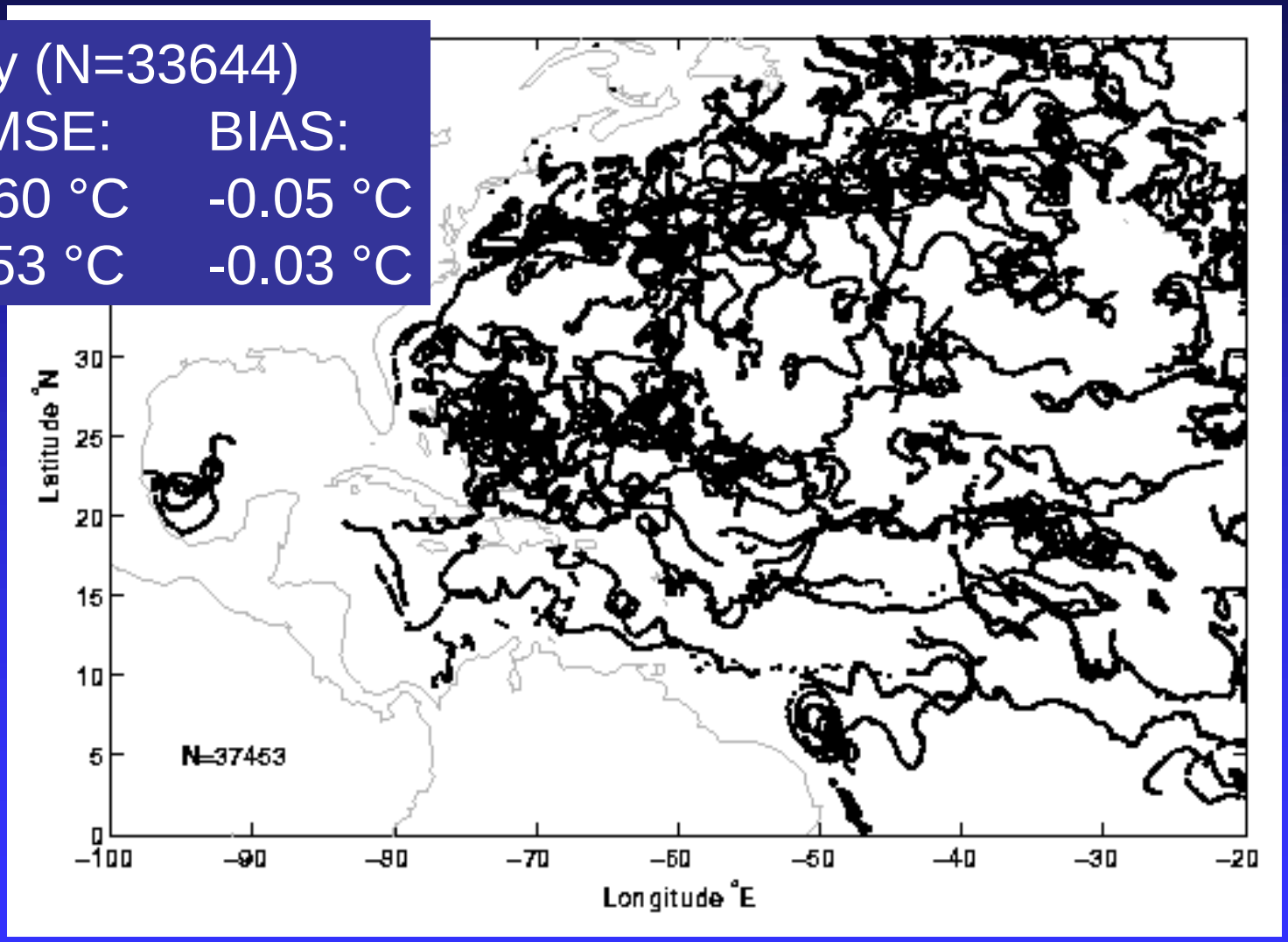
Mean SST analysis bias and RMS (°C)

20030702 to 20030930 **20031001 to 20031231**

Validation with *in situ* drifter SSTs 20030702 - 20031231

Drifting buoy (N=33644)

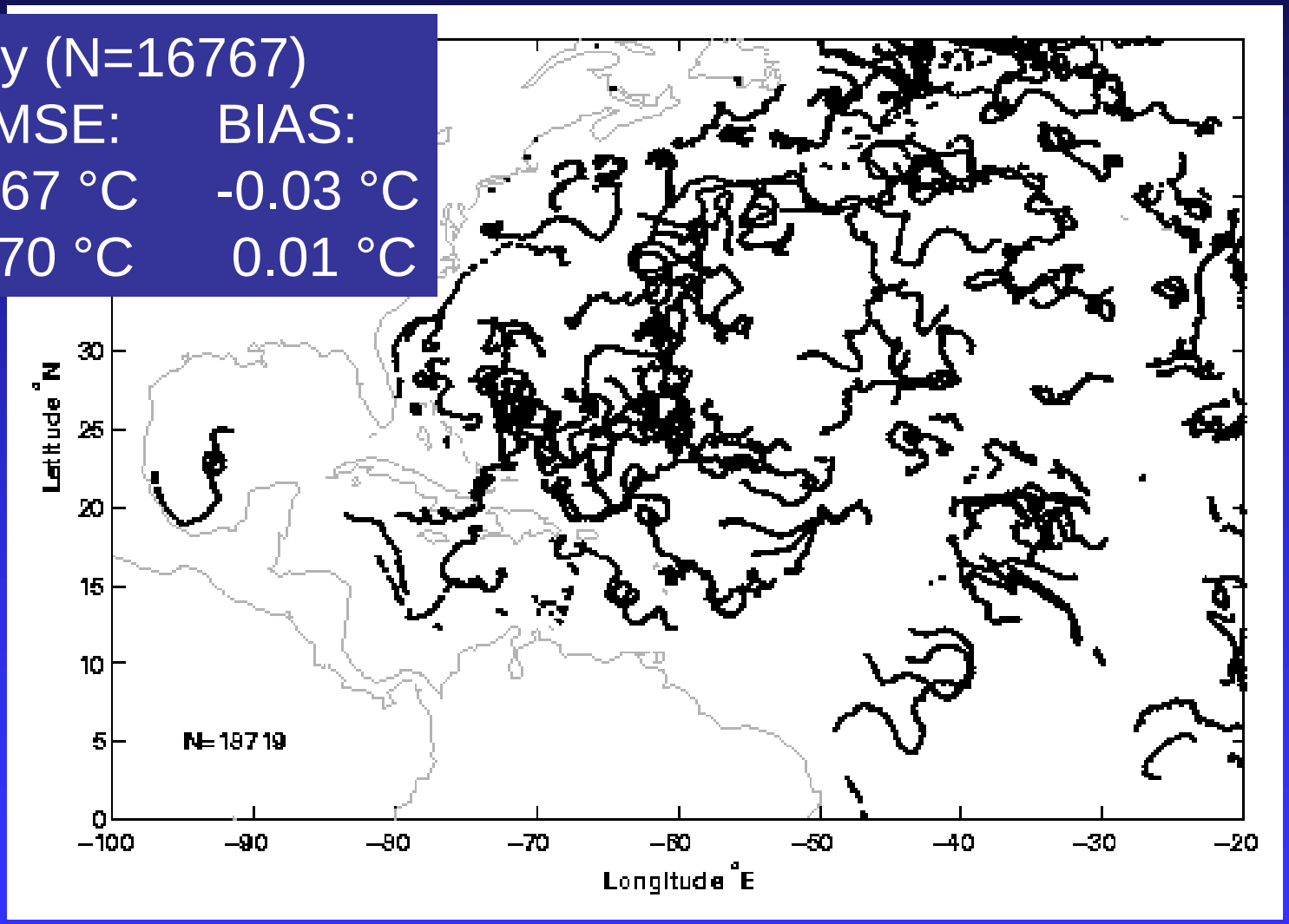
	RMSE:	BIAS:
IR-only	0.60 °C	-0.05 °C
IR+MW	0.53 °C	-0.03 °C



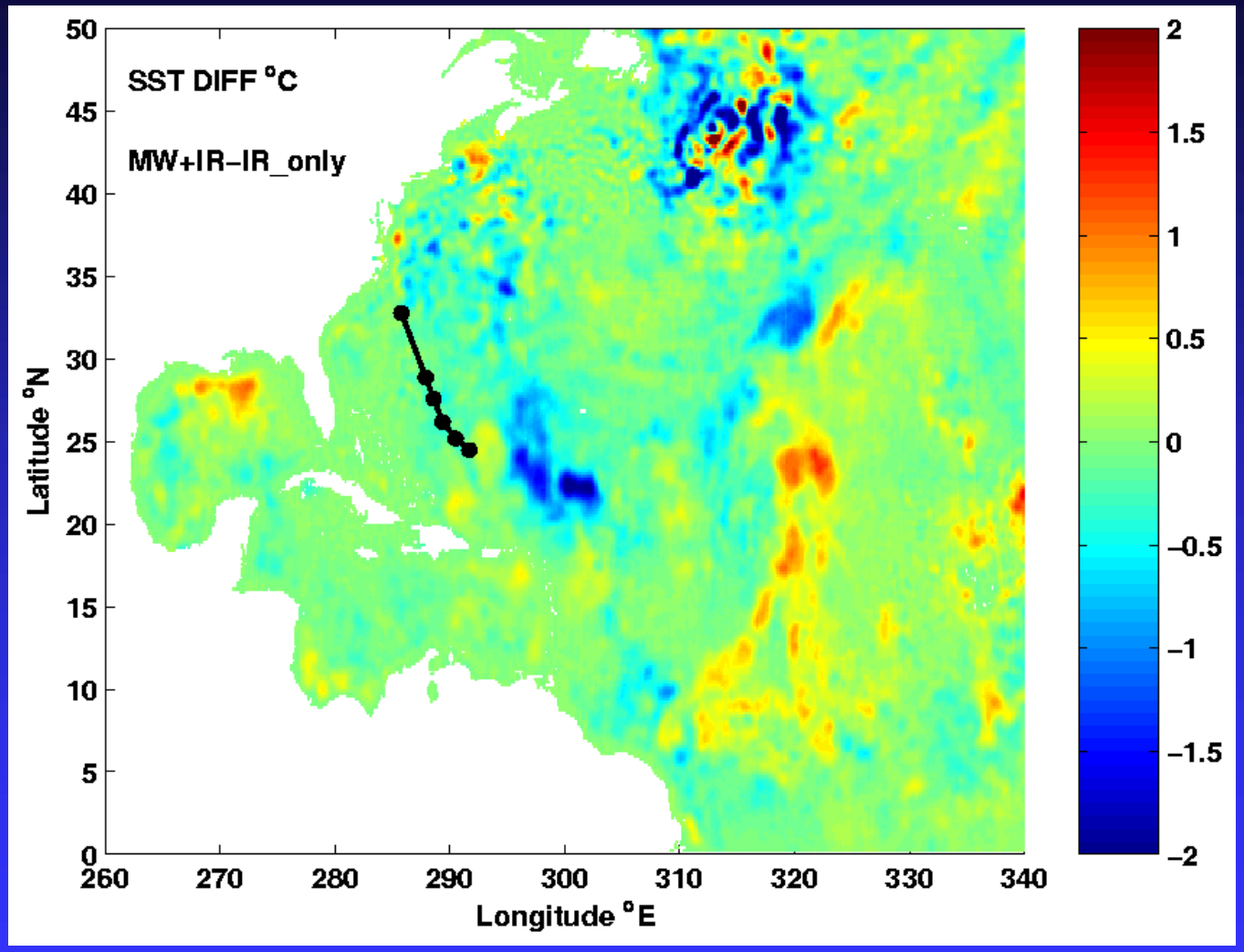
Validation with *in situ* drifter SSTs 20031001 - 20031231

Drifting buoy (N=16767)

	RMSE:	BIAS:
IR-only	0.67 °C	-0.03 °C
IR+MW	0.70 °C	0.01 °C

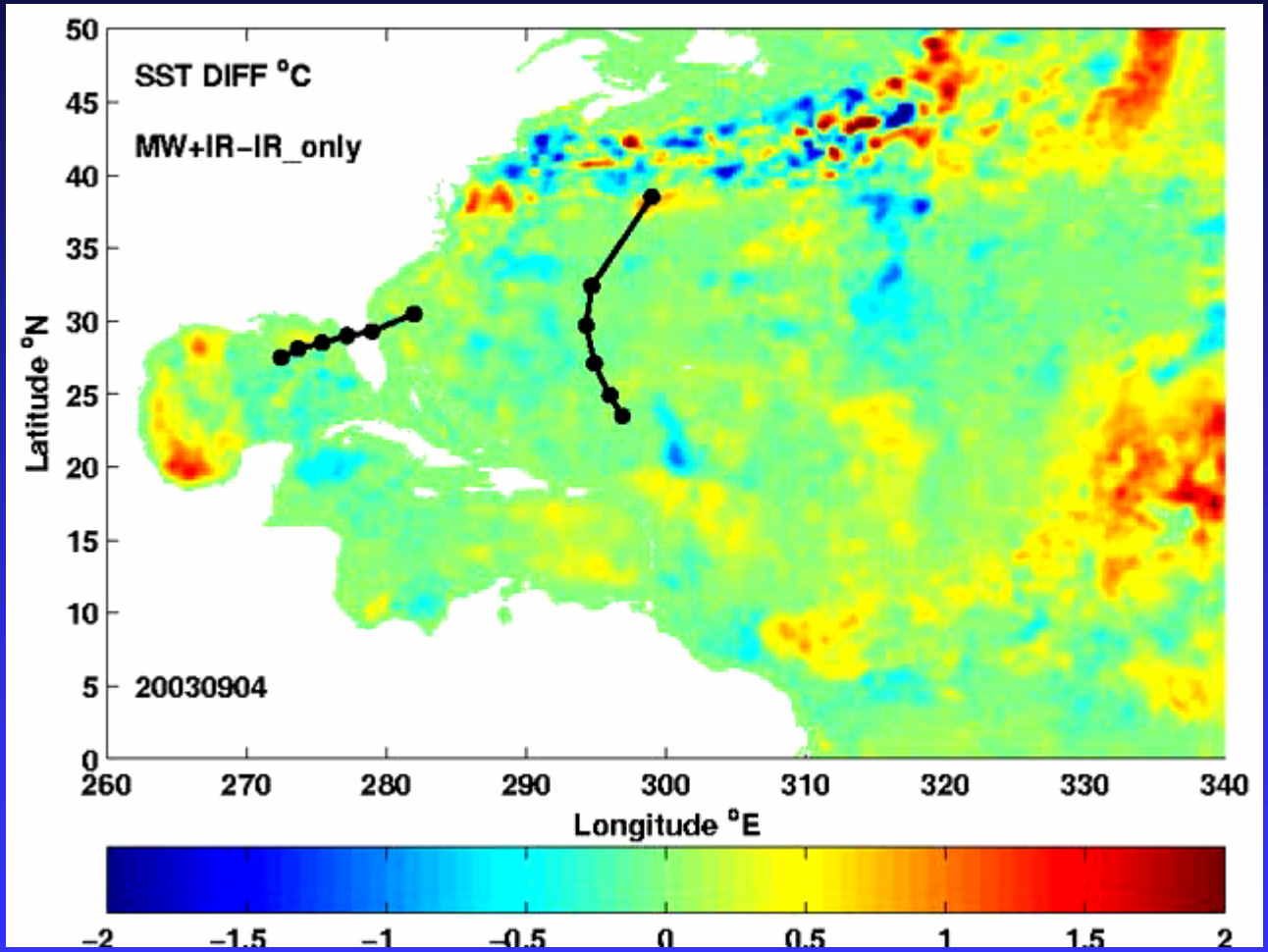


Hurricane Isabel forecast track



SST difference field valid 00Z 20030915
Hurricane Isabel track forecast 03Z 20030915

Fabian and Isabel forecast tracks



Summary

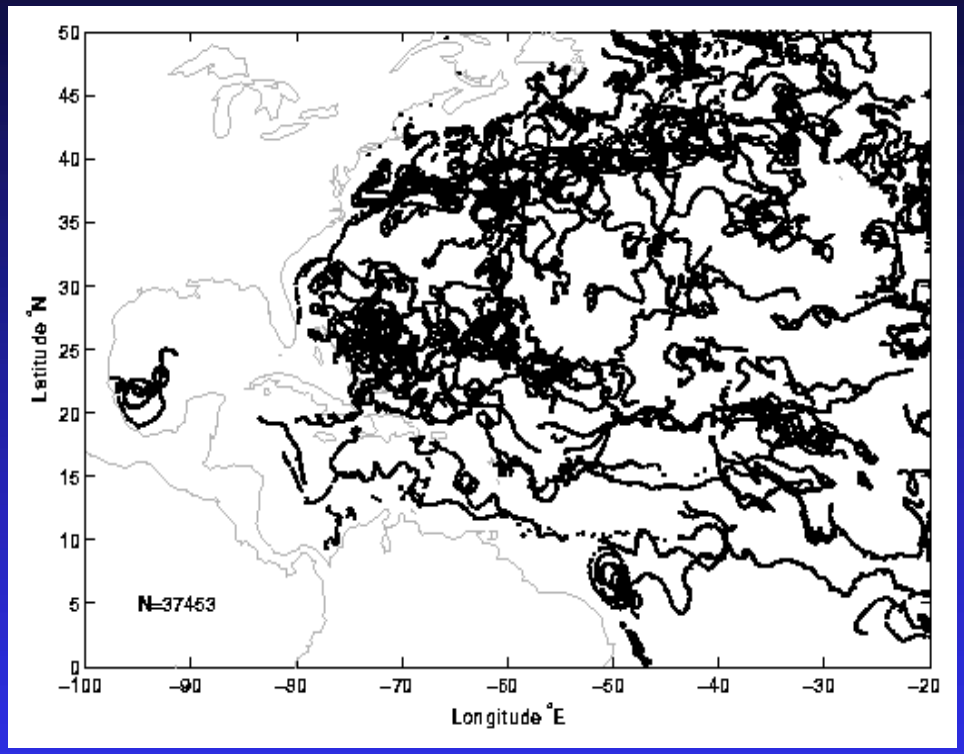
The addition of level-3 AMSR-E microwave SSTs to the MCSST infrared SSTs decreased only slightly the bias and RMS error of these daily cycling analyses compared with in situ observations. This appears to be due to reducing the IR bias from aerosol contamination in the July to September months.

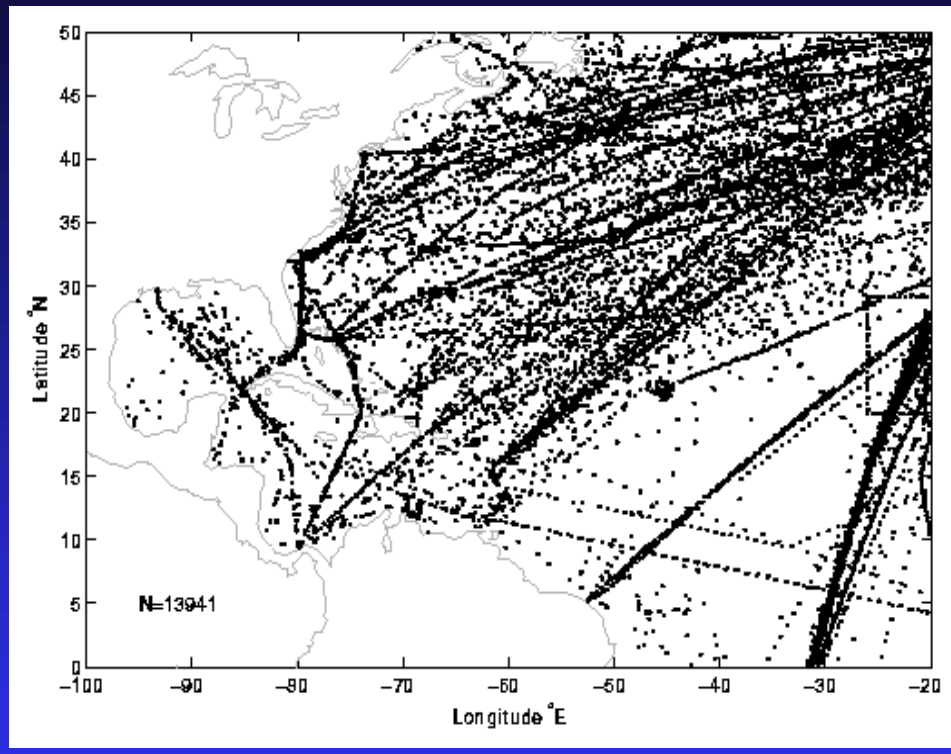
In most situations, microwave SSTs do not have a large impact on the analyzed SST along forecast tropical cyclone track. Tropical cyclone cold wakes do appear sooner in the blended analysis, so in some cases the additional data may impact SST and storm intensity forecasts.

To do

- Obtain/use the orbital AMSR-E data
- Evaluate observing system performance in the analysis
- Extend the analysis (global, longer time series)
- Use data QC (use collocated wind, AOD)
- Evaluate the impact on TC forecasts in an atmospheric model (COAMPS)

Validation with in-situ obs





Drifting buoy (N=33828)

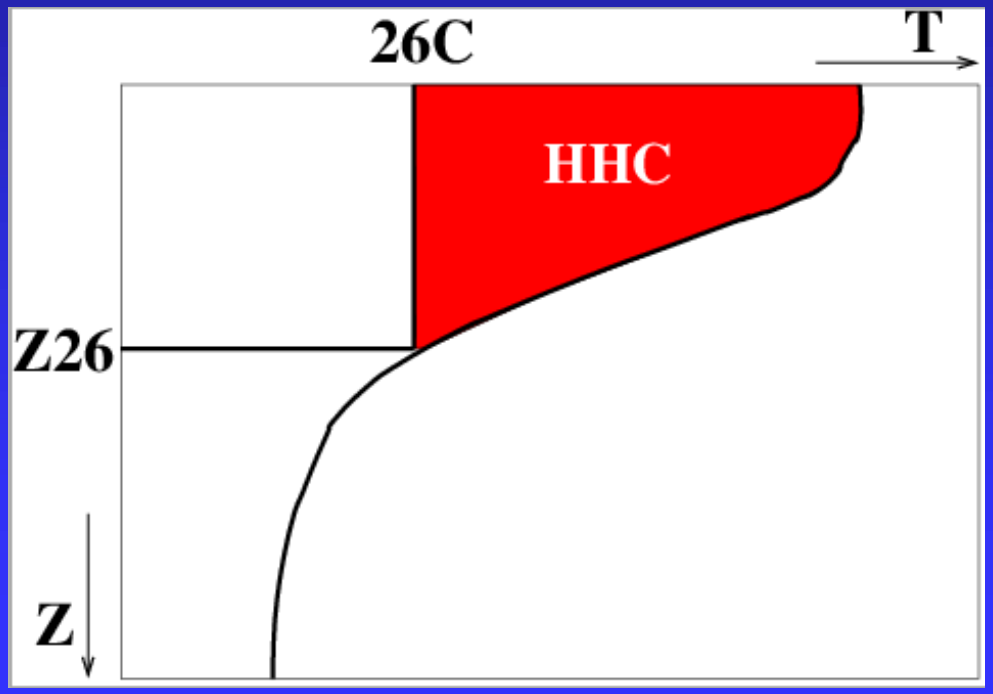
	RMSE:	BIAS:
IR-only	0.62 °C	-.04 °C
IR+MW	0.56 °C	-.02 °C

Hull sensor (N=10087)

	RMSE:	BIAS:
IR-only	0.74 °C	-0.27 °C
IR+MW	0.69 °C	-0.23 °C

Hurricane Heat Content (HHC)

- 3D T/S synthetics derived from the MODAS dynamic climatology
  - SST analyses
  - Operational daily SSHA analysis



HHC is the integrated heat content down to the 26 °C isotherm, referenced to water of uniform 26 °C.