

A satellite image of a hurricane, showing a well-defined eye and spiral cloud bands. The image is in grayscale and serves as the background for the text.

Seasonal Hurricane Forecasting and the 2011
Atlantic Hurricane Season Prediction

Phil Klotzbach

Department of Atmospheric Science

Colorado State University

6th Annual Energy Trader Seminar Summer
Outlook 2011

April 14, 2011

Outline

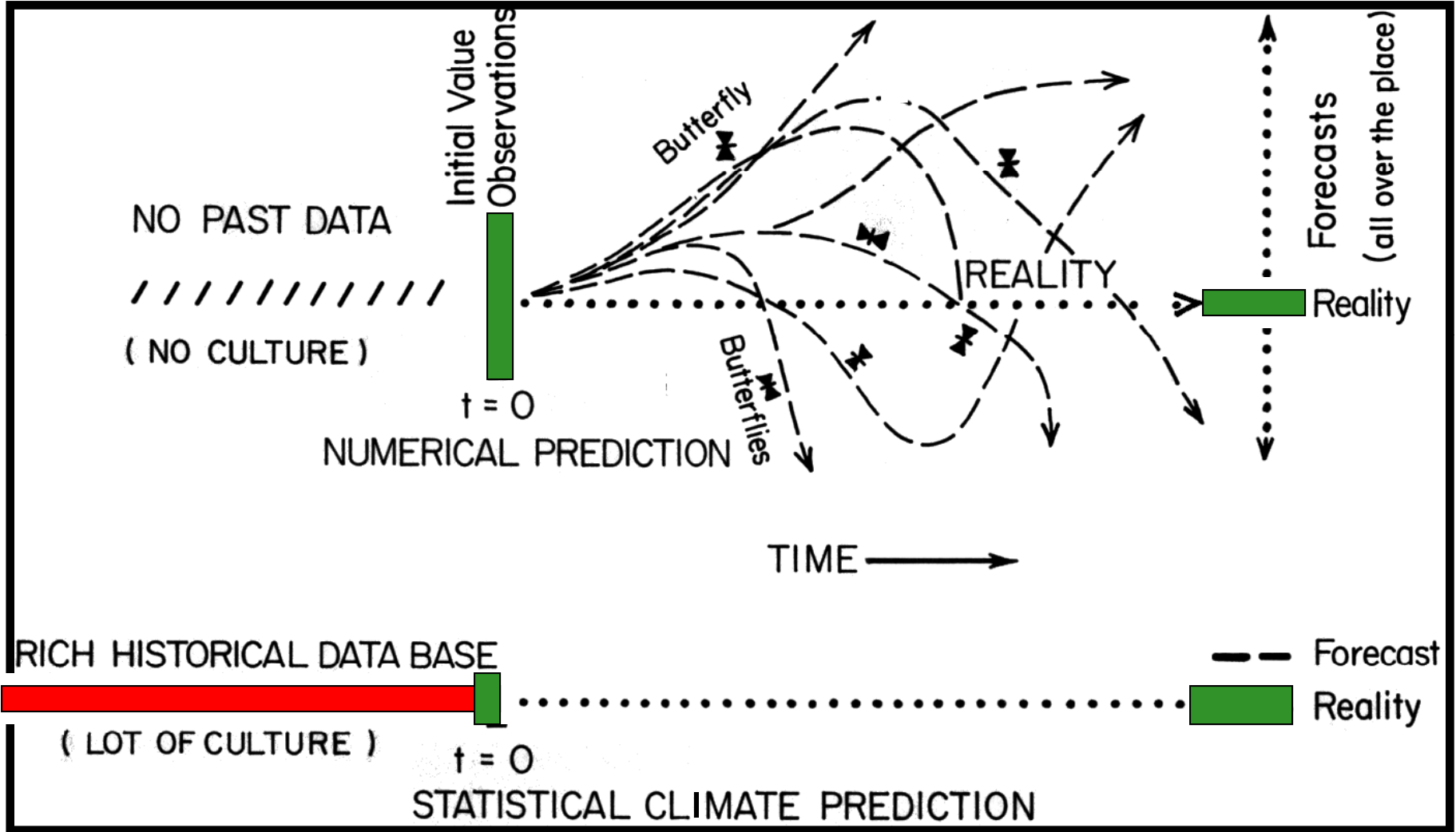
- § **Introduction**
- § **2010 Atlantic Basin Seasonal Forecast Verification**
- § **2011 Atlantic Basin Seasonal Forecast**
- § **United States Landfall Probabilities**
- § **New Forecast Products**

**“It's tough to make predictions,
especially about the future”**

HOWEVER...

“You can see a lot by looking”

Yogi Berra



2010

Hurricane

Season

2010 Hurricane Forecasts and Verification

Forecast Parameter and 1950-2000 Climatology (in parentheses)	9 Dec 2009	Update 7 April 2010	Update 2 June 2010	Update 4 Aug 2010	Observed 2010 Total
Named Storms (NS) (9.6)	11-16	15	18	18	19
Named Storm Days (NSD) (49.1)	51-75	75	90	90	89.50
Hurricanes (H) (5.9)	6-8	8	10	10	12
Hurricane Days (HD) (24.5)	24-39	35	40	40	38.50
Major Hurricanes (MH) (2.3)	3-5	4	5	5	5
Major Hurricane Days (MHD) (5.0)	6-12	10	13	13	11
Accumulated Cyclone Energy (ACE) (96.2)	100-162	150	185	185	165
Net Tropical Cyclone Activity (NTC) (100%)	108-172	160	195	195	196

2008 – 2010 Forecast Verifications

2008	7 Dec. 2007	Update 9 April	Update 3 June	Update 5 August	Obs.
Named Storms	13	15	15	17	16
Hurricanes	7	8	8	9	8
Major Hurricanes	3	4	4	5	5
Major Hurricane Days	6	9	9	11	7.5
Net Tropical Cyclone Activity	125	160	160	190	162

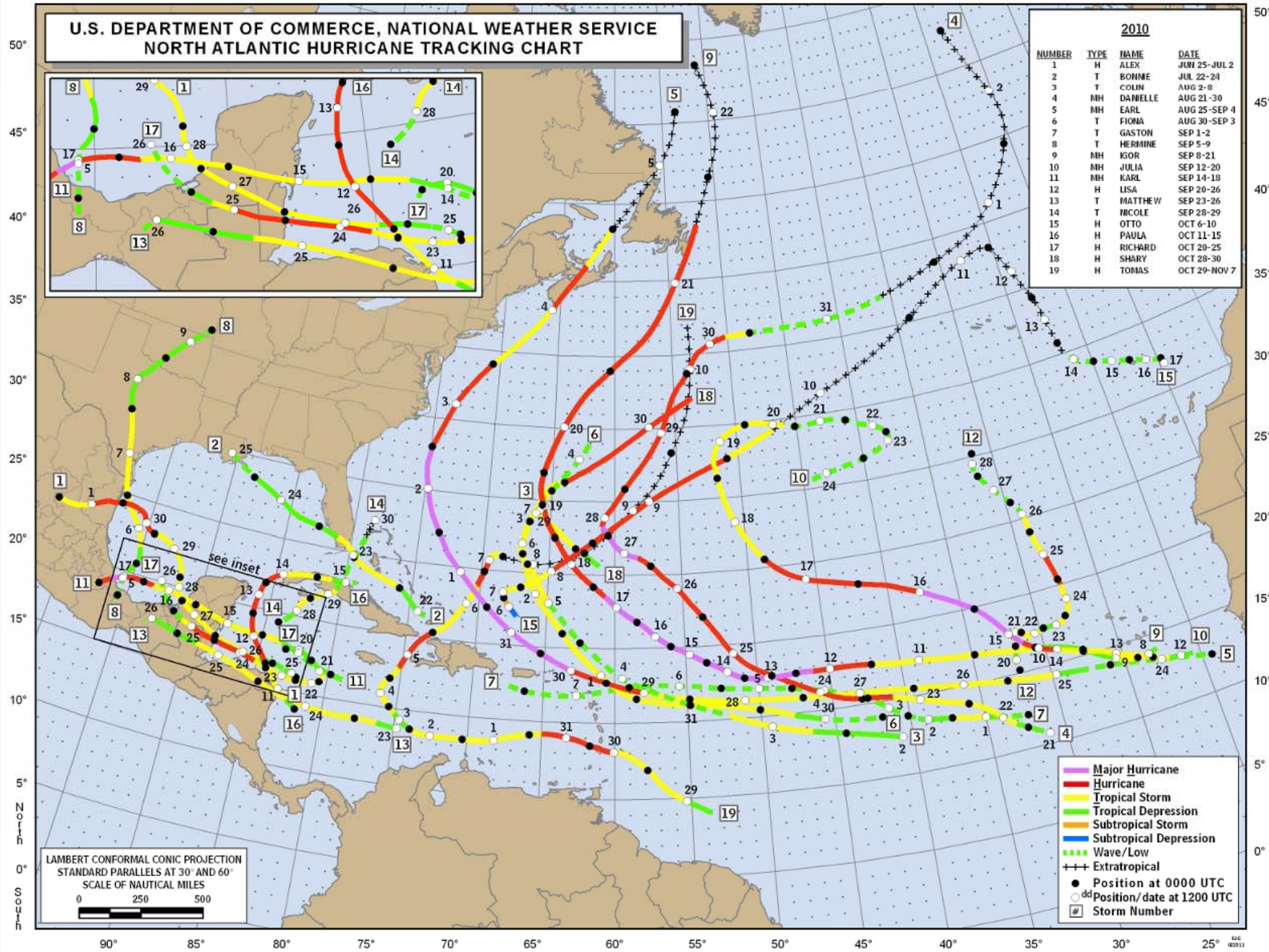
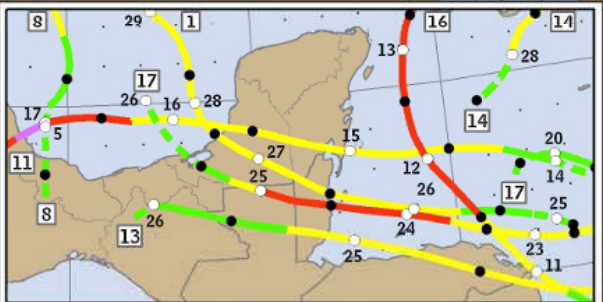
2009	10 Dec. 2008	Update 9 April	Update 2 June	Update 4 August	Obs.
Named Storms	14	12	11	10	9
Hurricanes	7	6	5	4	3
Major Hurricanes	3	2	2	2	2
Major Hurricane Days	7	5	4	4	3.5
Net Tropical Cyclone Activity	135	105	90	85	69

2010	9 Dec. 2009	Update 7 April	Update 2 June	Update 4 August	Obs.
Named Storms	11-16	15	18	18	19
Hurricanes	6-8	8	10	10	12
Major Hurricanes	3-5	4	5	5	5
Major Hurricane Days	6-12	10	13	13	11
Net Tropical Cyclone Activity	108-172	160	195	195	196

120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° West 0° East 5°

**U.S. DEPARTMENT OF COMMERCE, NATIONAL WEATHER SERVICE
NORTH ATLANTIC HURRICANE TRACKING CHART**

2010			
NUMBER	TYPE	NAME	DATE
1	H	ALEX	JUL 25-JUL 2
2	T	BONNIE	JUL 22-24
3	T	COLIN	AUG 2-8
4	MH	DANIELLE	AUG 21-30
5	MH	EARL	AUG 25-SEP 4
6	T	FIONA	AUG 30-SEP 3
7	T	GASTON	SEP 1-2
8	T	HERMINE	SEP 5-9
9	MH	IGOR	SEP 8-21
10	MH	JULIA	SEP 12-20
11	MH	KARL	SEP 14-18
12	H	LISA	SEP 20-26
13	T	MATTHEW	SEP 23-29
14	T	NICOLE	SEP 28-29
15	H	OTTO	OCT 6-10
16	H	PAULA	OCT 11-15
17	H	RICHARD	OCT 20-25
18	H	SHARY	OCT 28-30
19	H	TOMAS	OCT 29-NOV 7

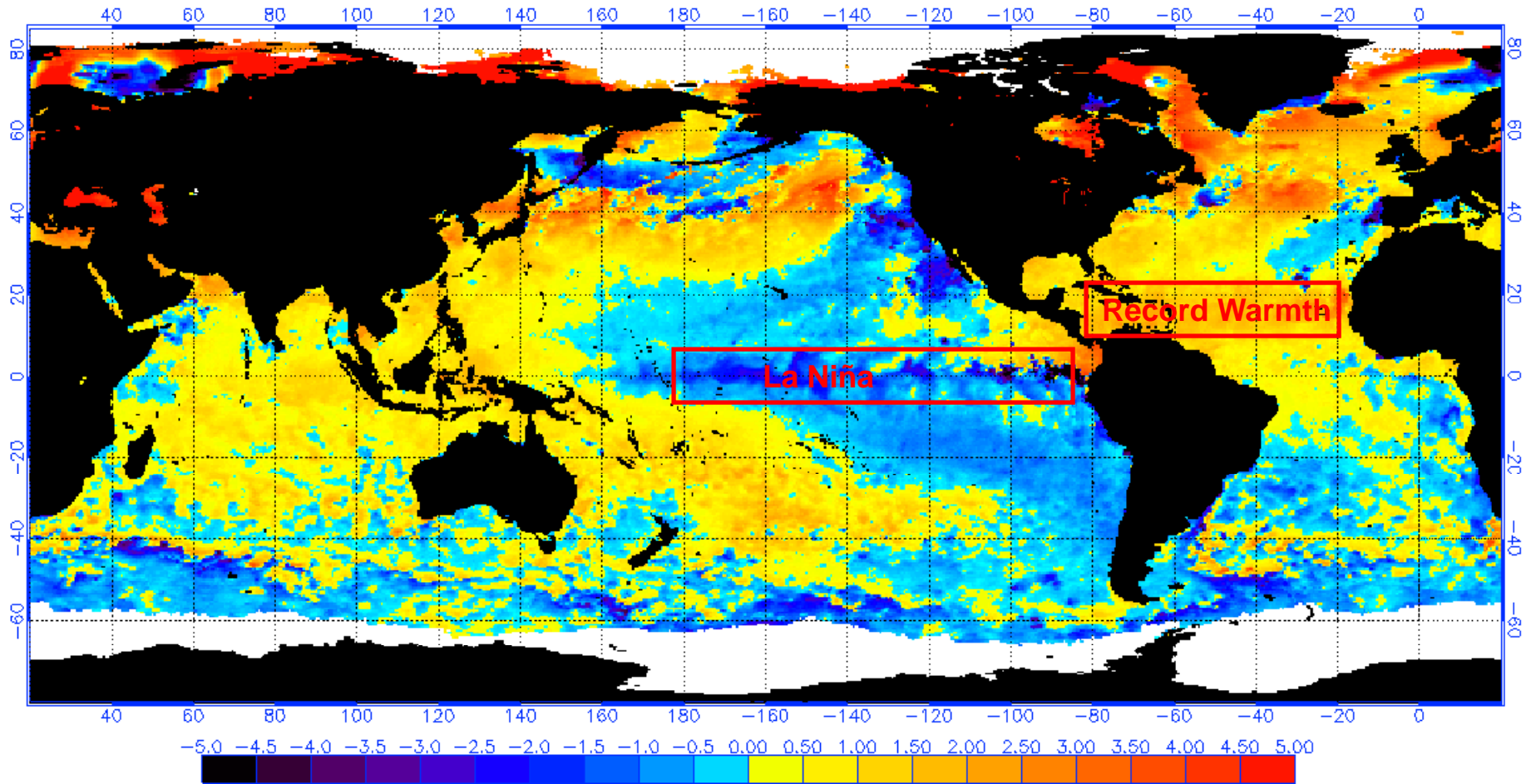


LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICAL MILES
0 250 500

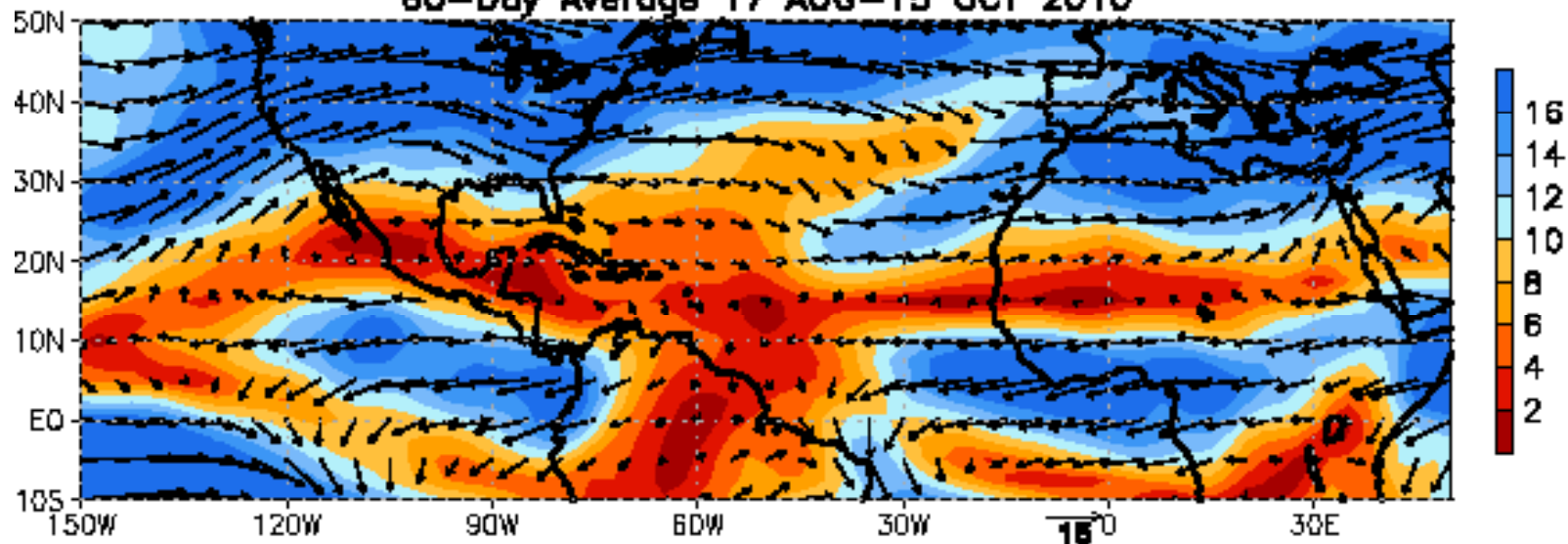
Major Hurricane
Hurricane
Tropical Storm
Tropical Depression
Subtropical Storm
Subtropical Depression
Wave/Low
--- Extratropical
● Position at 0000 UTC
○ Position/date at 1200 UTC
Storm Number

Why was 2010 so active?

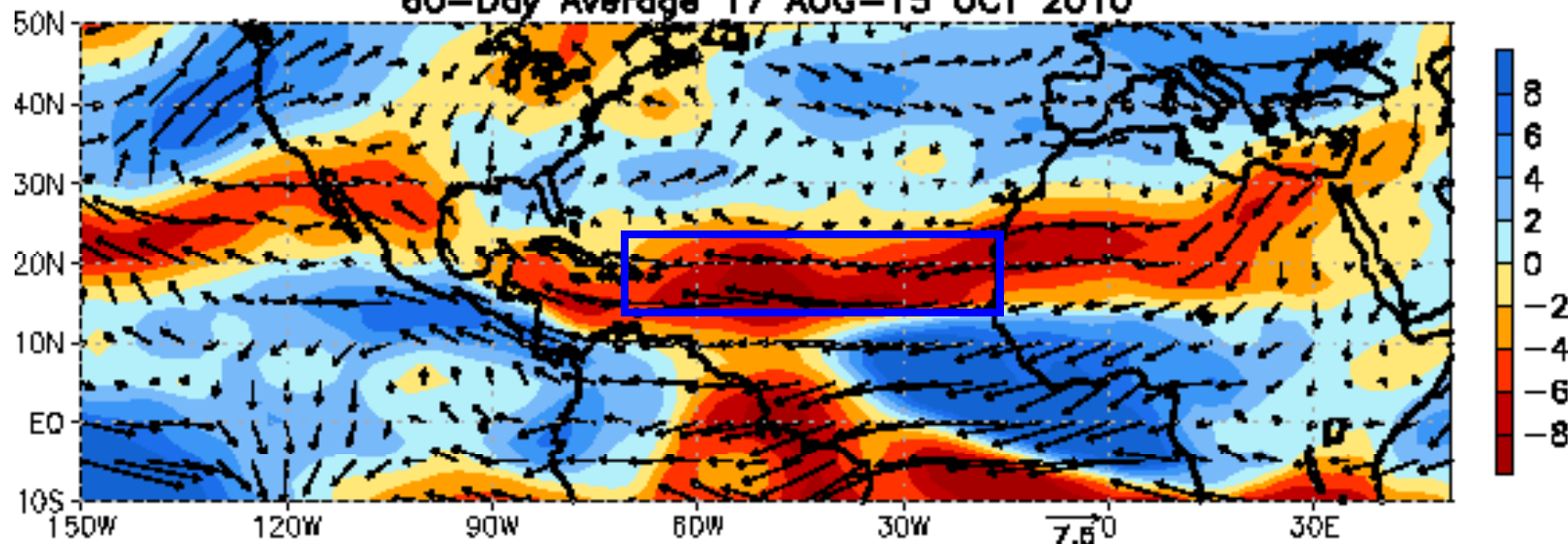
NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 8/19/2010
(white regions indicate sea-ice)



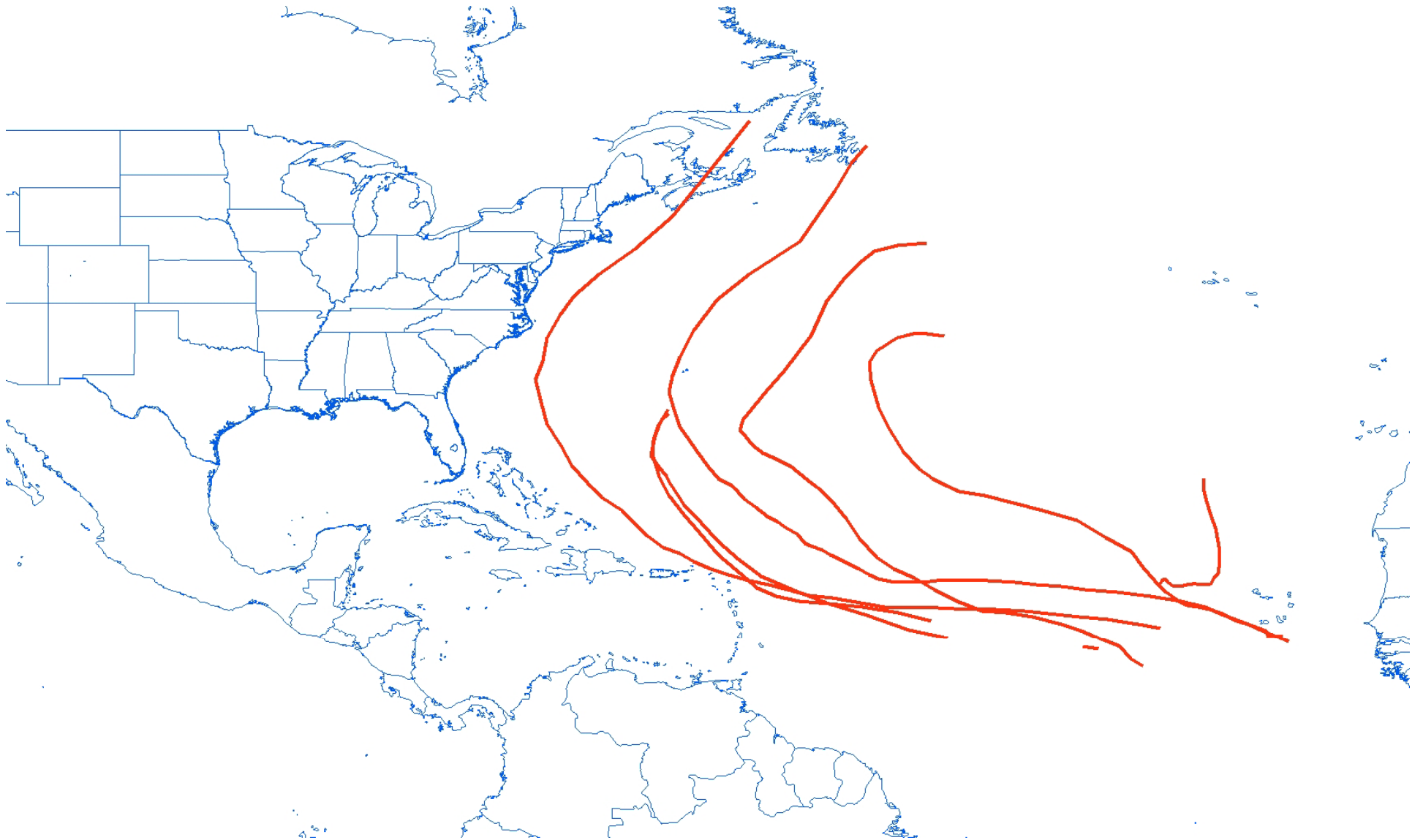
200–850 hPa Vertical Wind Shear (m/s)
Magnitude and Vector
60-Day Average 17 AUG–15 OCT 2010



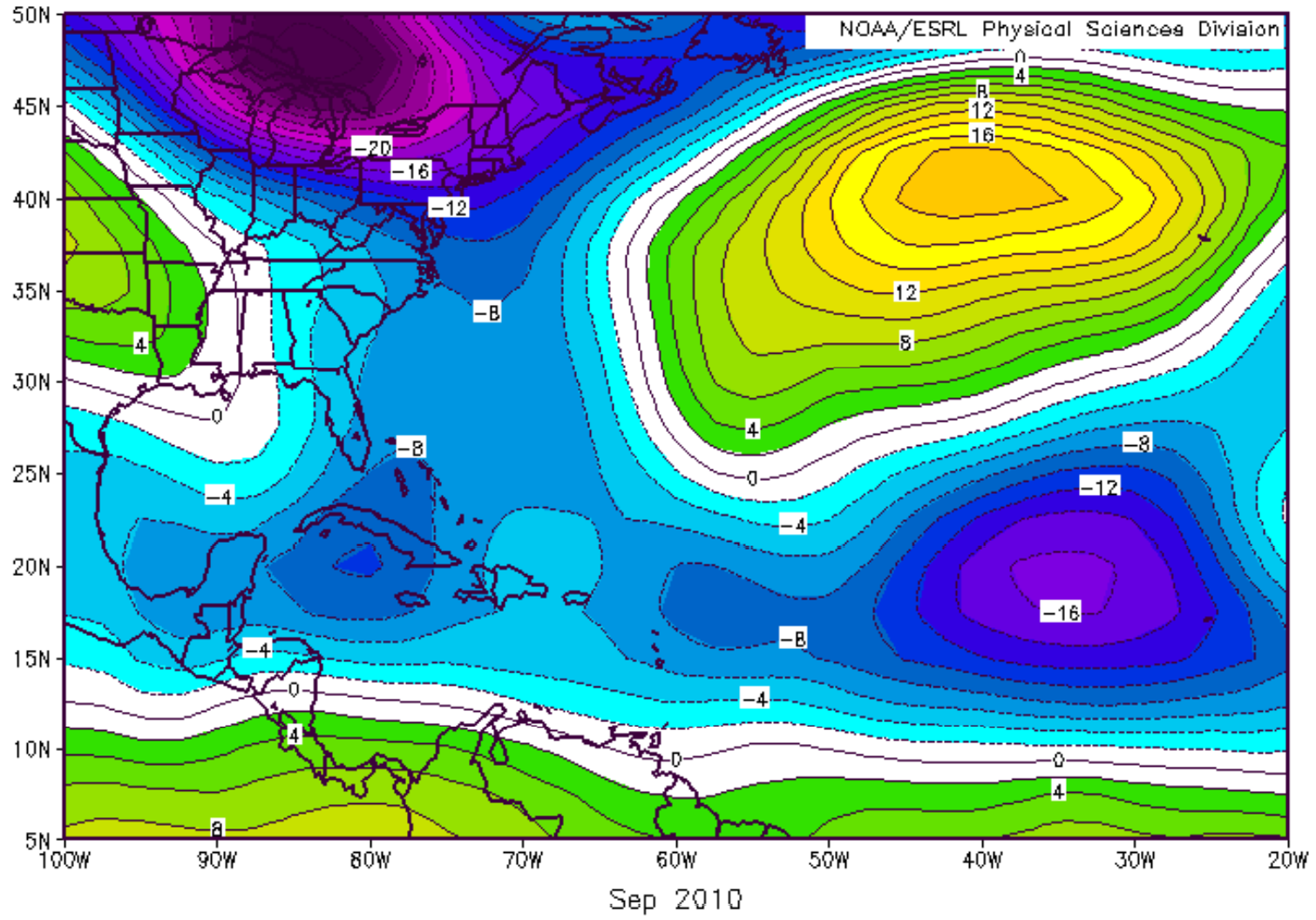
200–850 hPa Anomalous Vertical Wind Shear (m/s)
Magnitude and Vector
60-Day Average 17 AUG–15 OCT 2010



Recurving Eastern Atlantic Tropical Cyclones



NCEP/NCAR Reanalysis
700mb Geopotential Height (m) Composite Anomaly 1968-1996 climo



A satellite image of a hurricane, showing a distinct eye and spiral cloud bands, centered in the Atlantic Ocean. The image is in grayscale and framed by a thick red border.

2011 Atlantic Basin Hurricane Forecast

All forecasts and verifications are available on
our project's website:

<http://tropical.atmos.colostate.edu>

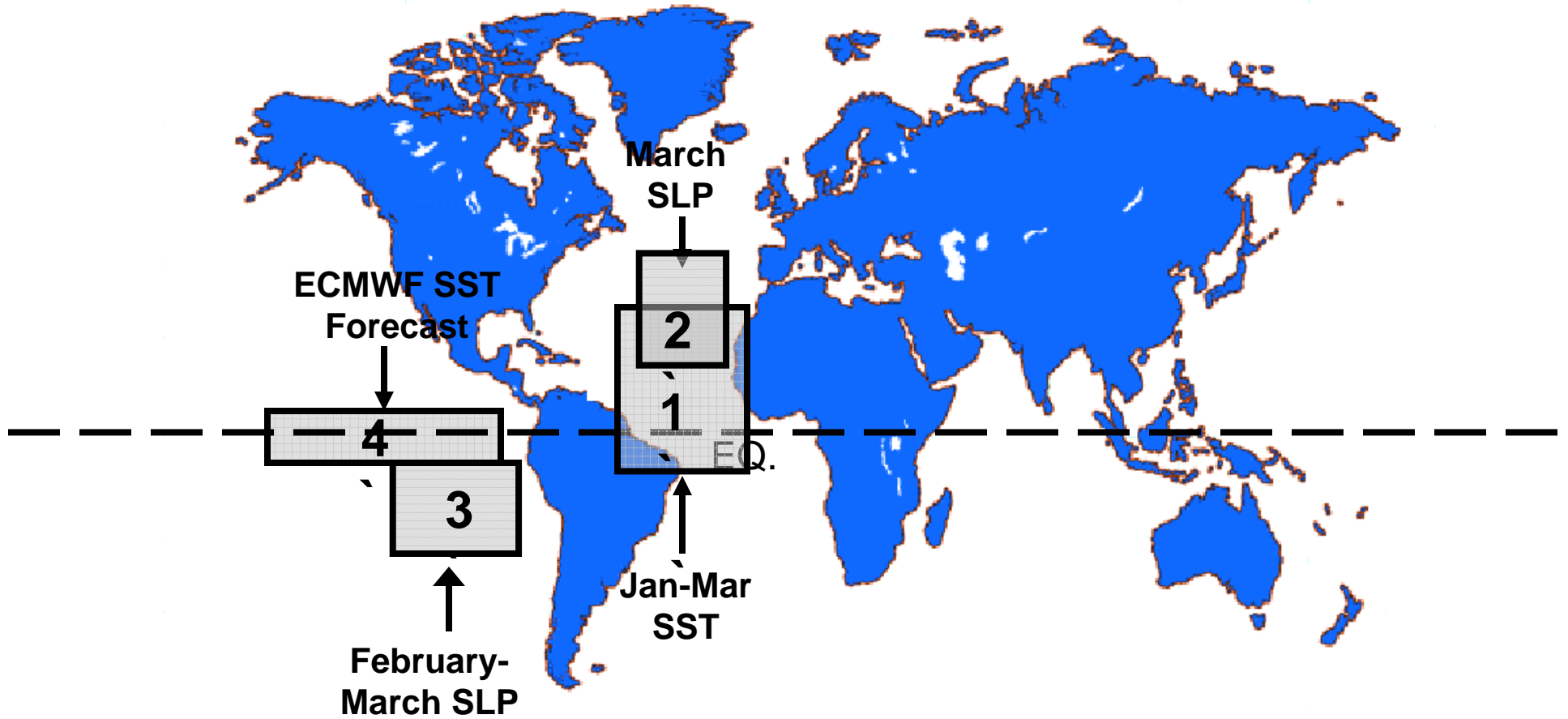
2011 FORECAST AS OF 6 APRIL 2011

Forecast Parameter	Statistical Forecast	Final Forecast	1950-2000 Climatology
Named Storms (NS)	15.2	16	9.6
Named Storm Days (NSD)	85.7	80	49.1
Hurricanes (H)	9.5	9	5.9
Hurricane Days (HD)	43.2	35	24.5
Major Hurricanes (MH)	5.1	5	2.3
Major Hurricane Days (MHD)	13.4	10	5.0
Accumulated Cyclone Energy (ACE)	180	160	96
Net Tropical Cyclone Activity (NTC)	192	175	100

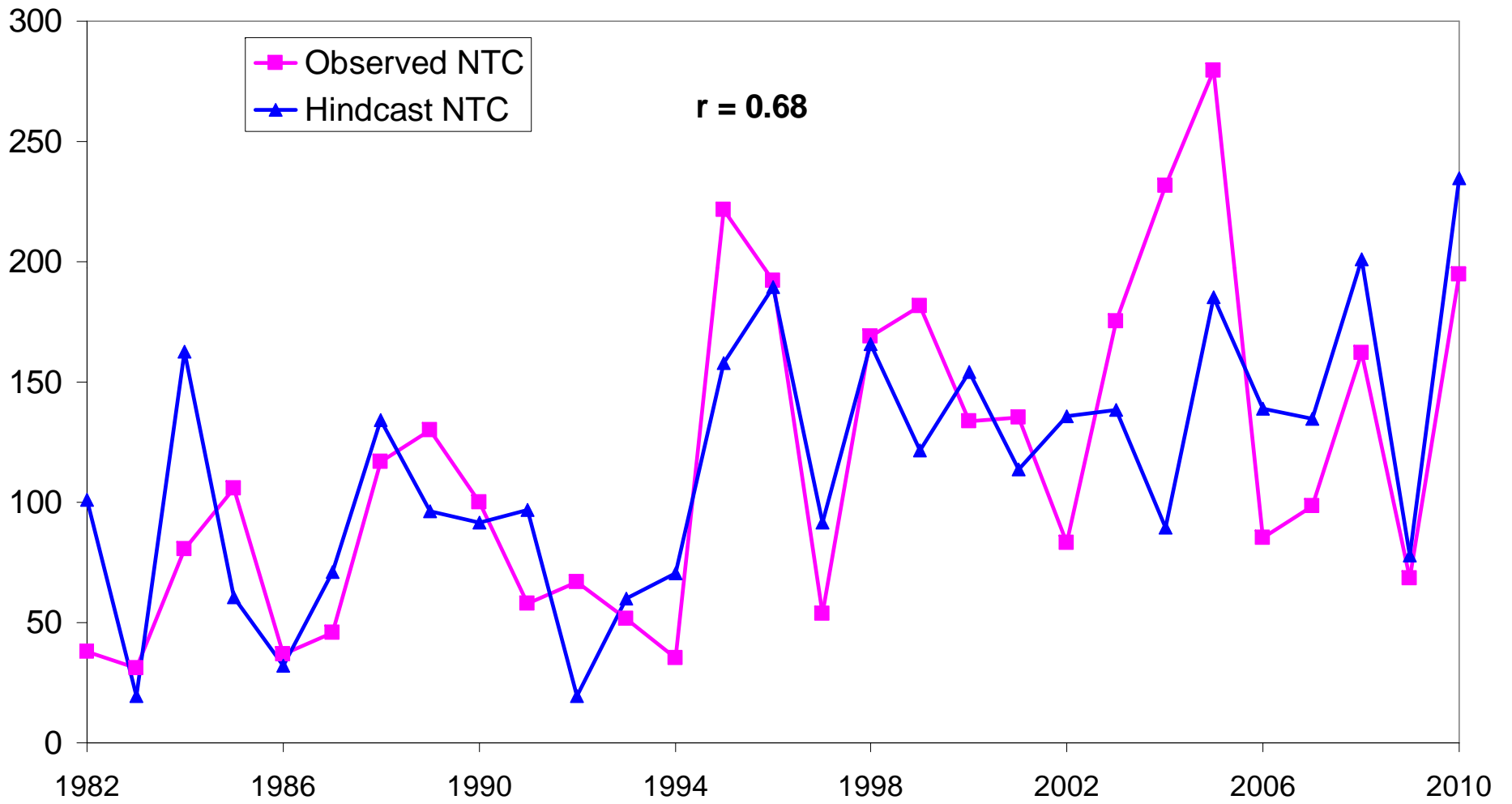
2011 FORECASTS

Forecast Parameter	8 December Forecast	6 April Forecast
Named Storms (NS)	17	16
Named Storm Days (NSD)	85	80
Hurricanes (H)	9	9
Hurricane Days (HD)	40	35
Major Hurricanes (MH)	5	5
Major Hurricane Days (MHD)	10	10
Accumulated Cyclone Energy (ACE)	165	160
Net Tropical Cyclone Activity (NTC)	180	175

New April Forecast Predictors



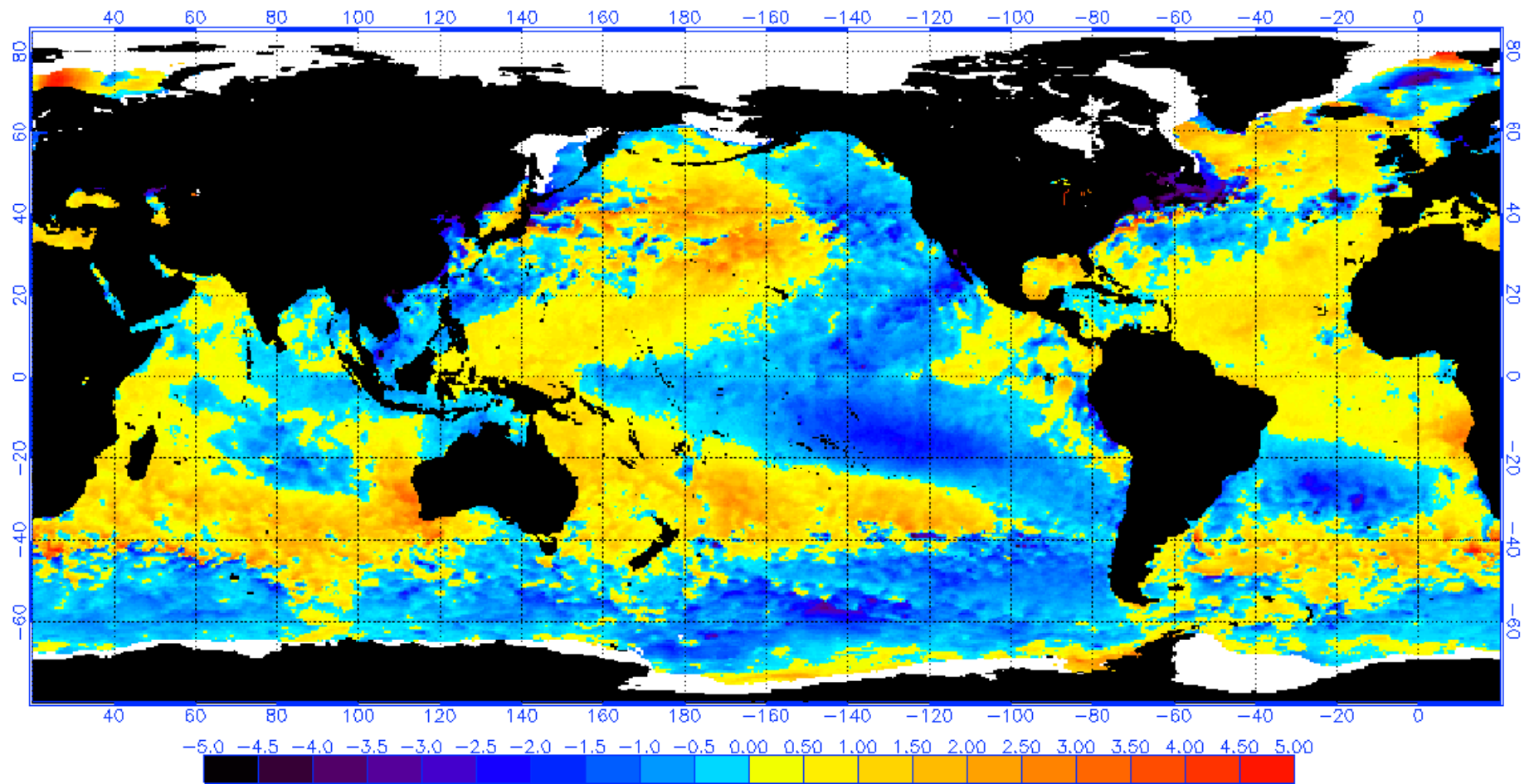
Observed vs. April Model Jackknifed NTC



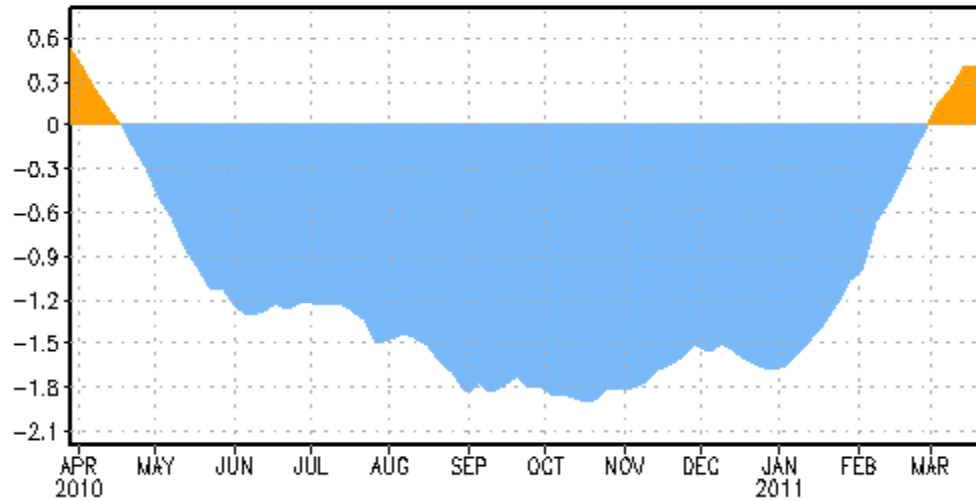
BEST ANALOG YEARS FOR 2011 (APRIL FORECAST)

	NS	NSD	H	HD	MH	MHD	ACE	NTC
1955	12	82.75	9	46.75	6	17.25	199	207
1996	13	79.00	9	45.00	6	13.00	166	192
1999	12	78.50	8	41.00	5	14.25	177	182
2006	10	52.75	5	21.25	2	2.00	79	85
2008	16	88.25	8	30.50	5	7.50	146	162
MEAN	12.6	76.3	7.8	36.9	4.8	10.8	153	166
2011 Forecast	16	80	9	35	5	10	160	175

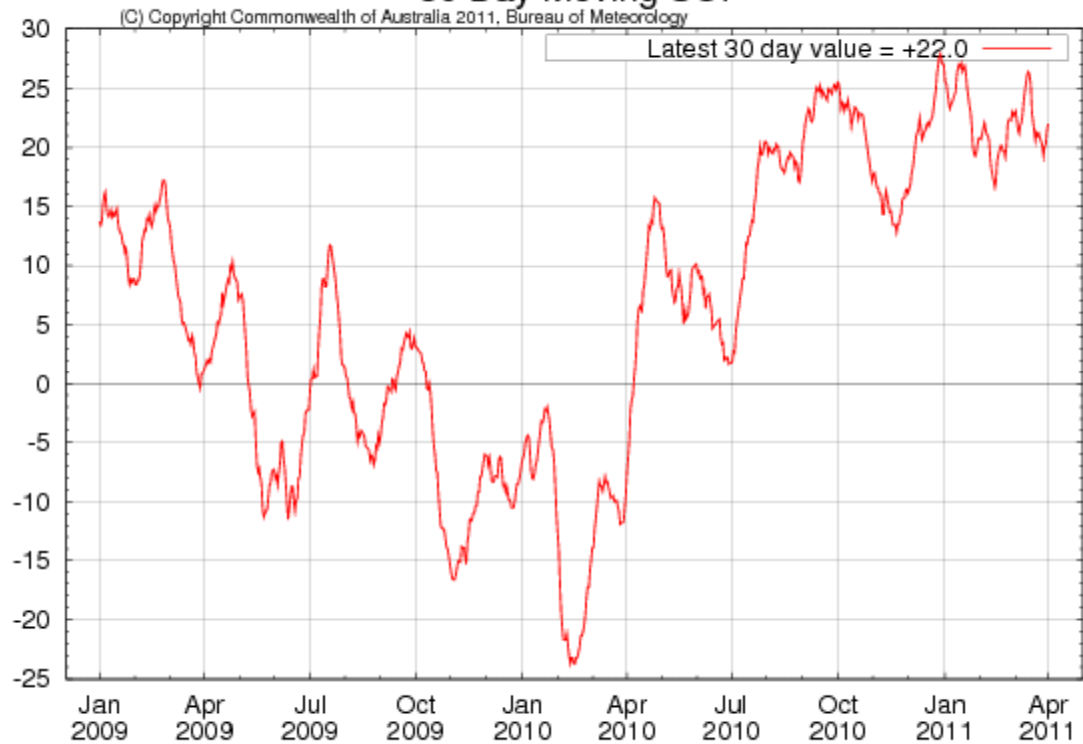
NOAA/NESDIS 50 KM GLOBAL ANALYSIS: SST Anomaly (degrees C), 3/31/2011
(white regions indicate sea-ice)



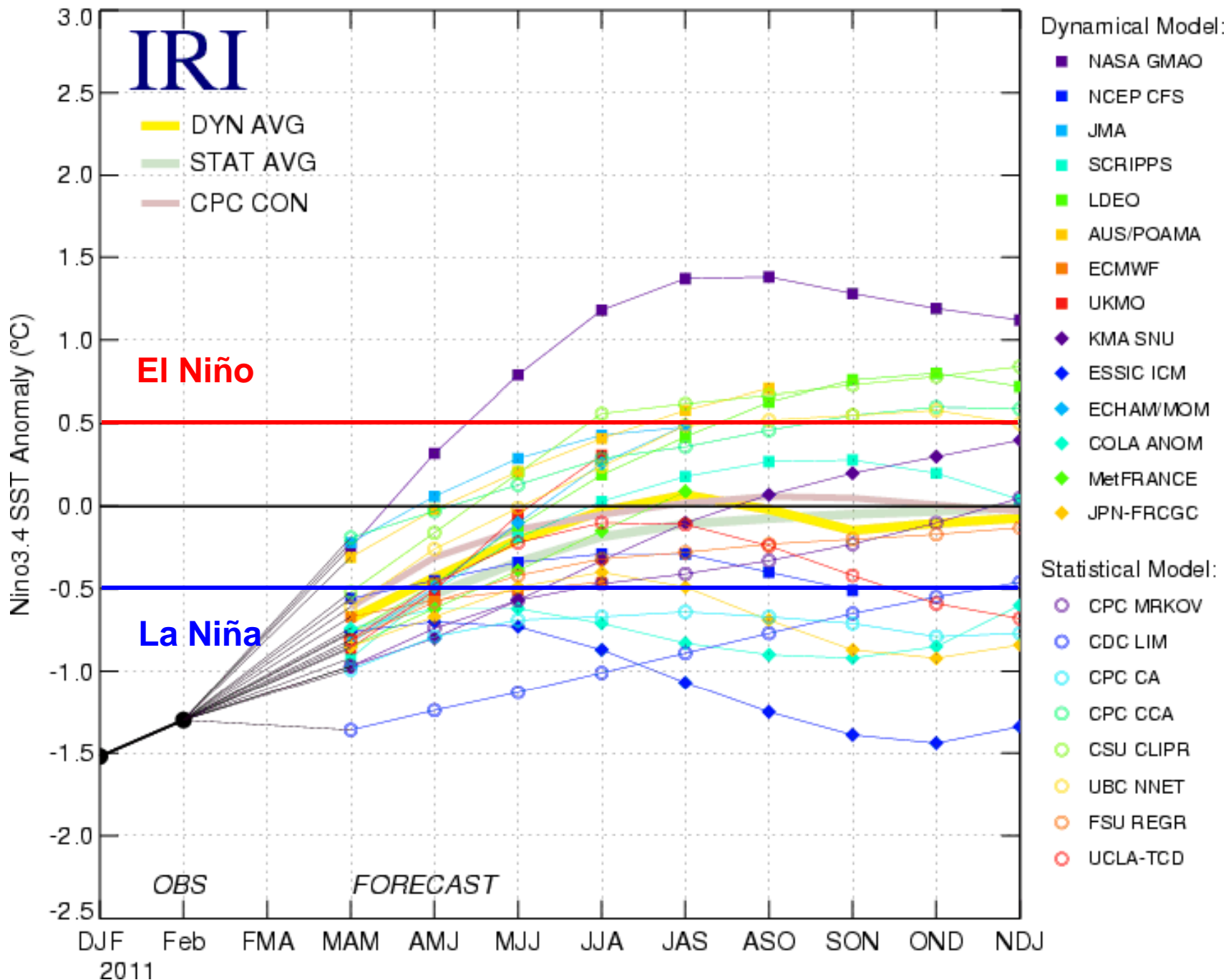
EQ. Upper-Ocean Heat Anoms. (deg C) for 180-100W



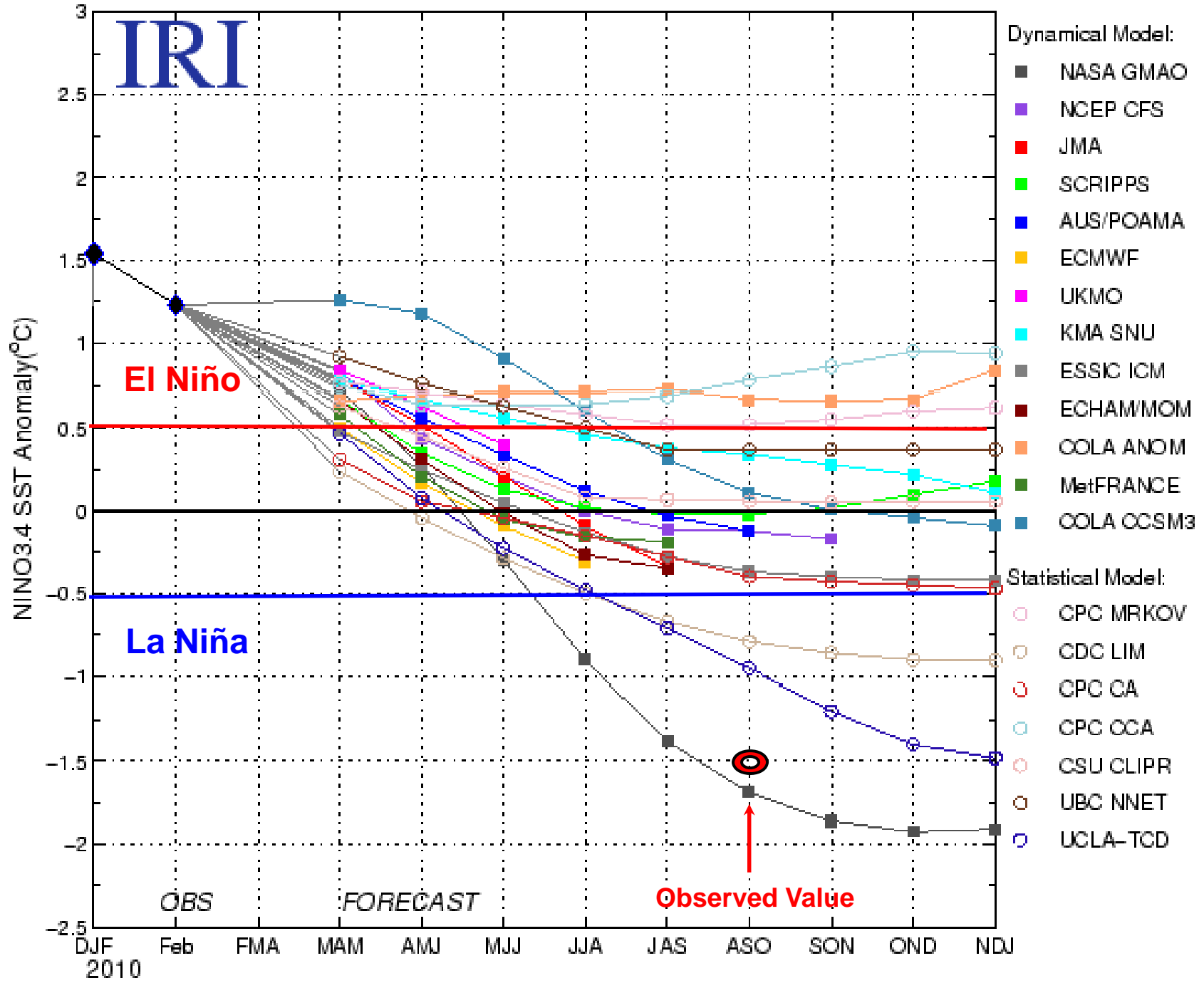
30 Day Moving SOI



Model Predictions of ENSO from Mar 2011

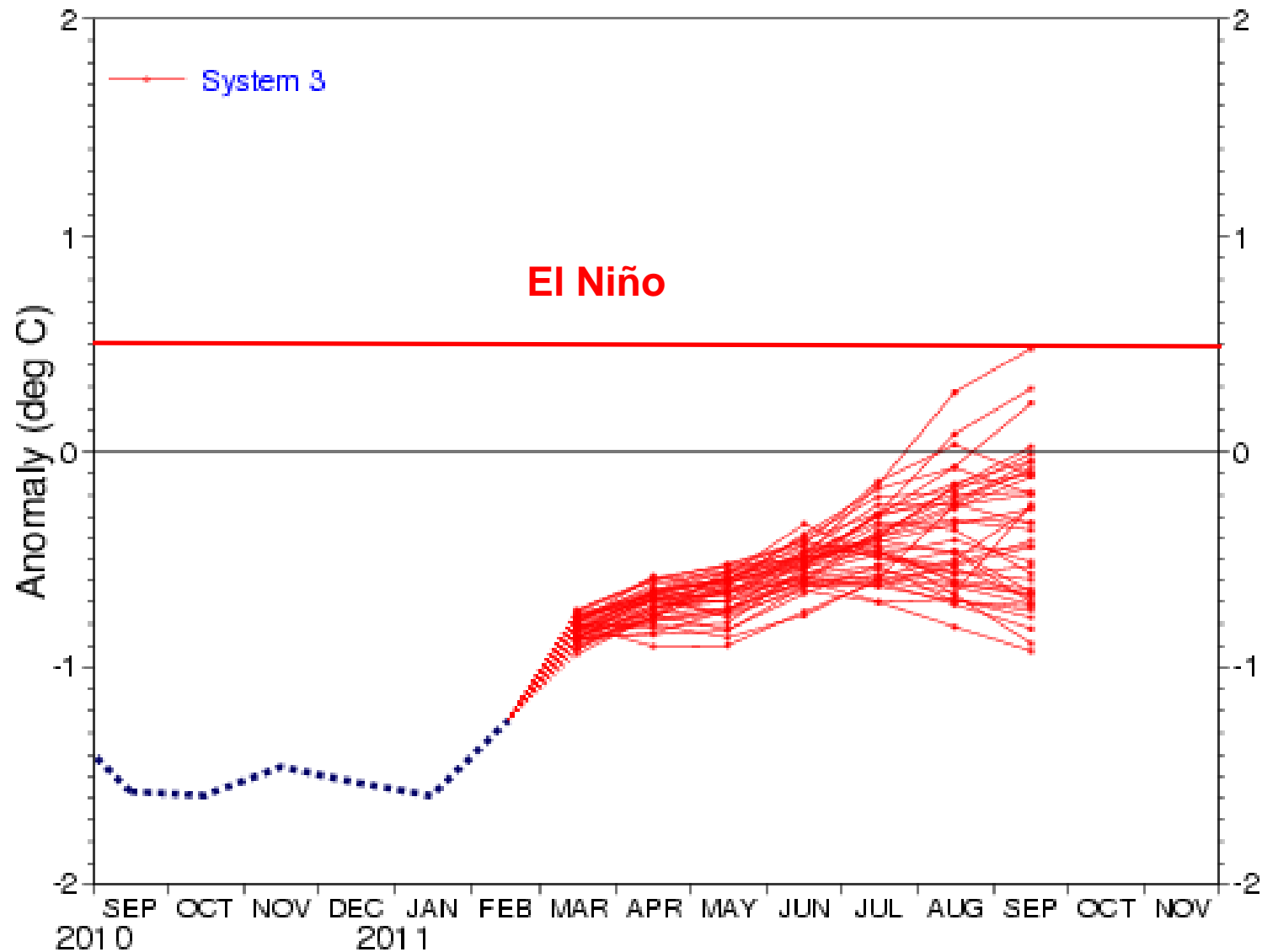


Model Forecasts of ENSO from Mar 2010



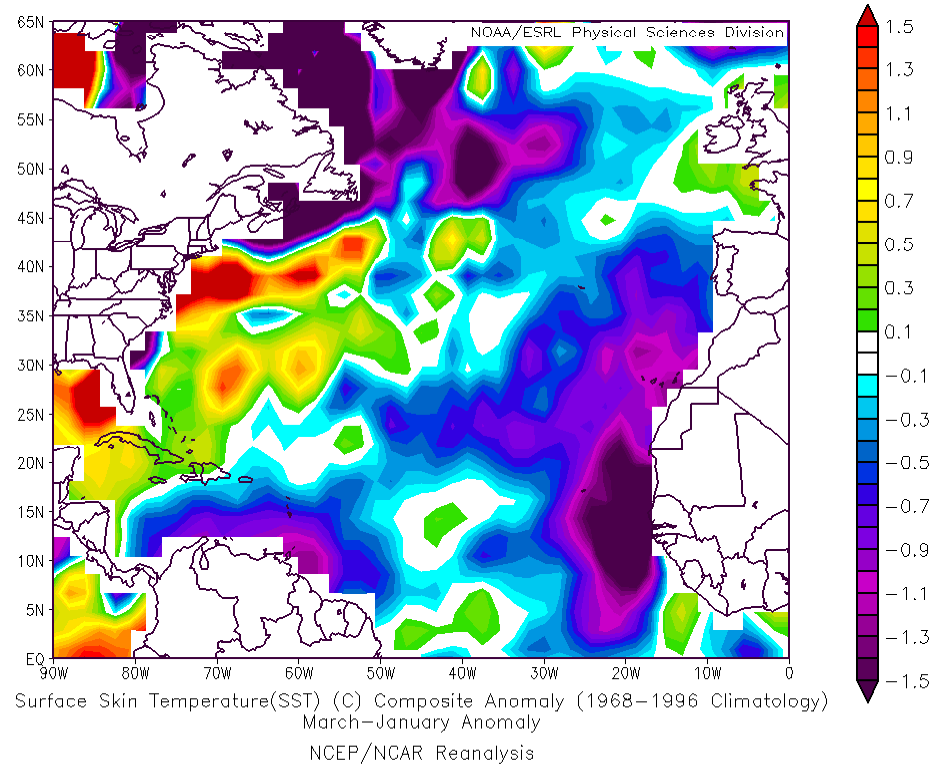
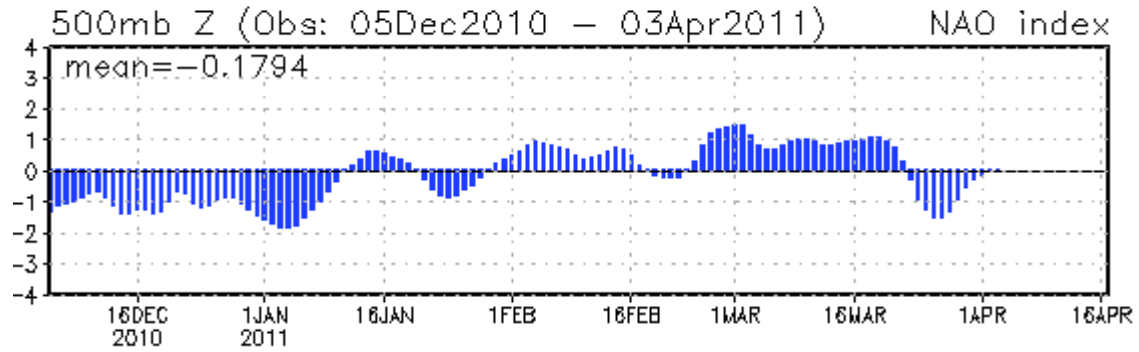
NINO3.4 SST anomaly plume ECMWF forecast from 1 Mar 2011

Monthly mean anomalies relative to NCEP adjusted OIv2 1971-2000 climatology



Forecast issue date: 15 Mar 2011

NAO: Observed & GFS forecasts



2011

Forecast Schedule

Date	8 Dec.	6 Apr.	1 June	3 Aug.
Seasonal Forecast	X	X	X	X

PROBABILITIES FOR AT LEAST ONE MAJOR (CATEGORY 3-4-5) HURRICANE LANDFALL IN EACH OF THE FOLLOWING AREAS FOR 2011

- 1) Entire U.S. coastline – **73%** (average for last century is **52%**)
- 2) U.S. East Coast including Peninsula Florida - **49%** (average for last century is **31%**)
- 3) Gulf Coast from the Florida Panhandle westward to Brownsville – **48%** (average for last century is **30%**)
- 4) Caribbean (10-20°N, 60-88°W) - **62%** (average for last century is **42%**)

Landfalling Hurricane Web Application

**Currently Available at the
following URL:**

<http://www.e-transit.org/hurricane>

**In partnership with the GeoGraphics
Laboratory – Bridgewater State College,
Bridgewater MA**

State Probabilities

- **Climatological and current-year probabilities of a hurricane and major hurricane impacting each coastal state**

Current Year and Climatological (1900-2000) Probabilities

State	Hurricane Impact Prob.	MH Impact Prob.
Florida	71% (51%)	34% (21%)
Louisiana	47% (30%)	20% (12%)
Massachusetts	12% (7%)	3% (2%)
Mississippi	18% (11%)	8% (4%)
New York	13% (8%)	6% (3%)
North Carolina	44% (28%)	13% (8%)
Texas	50% (33%)	20% (12%)

Climatological probabilities are in parentheses

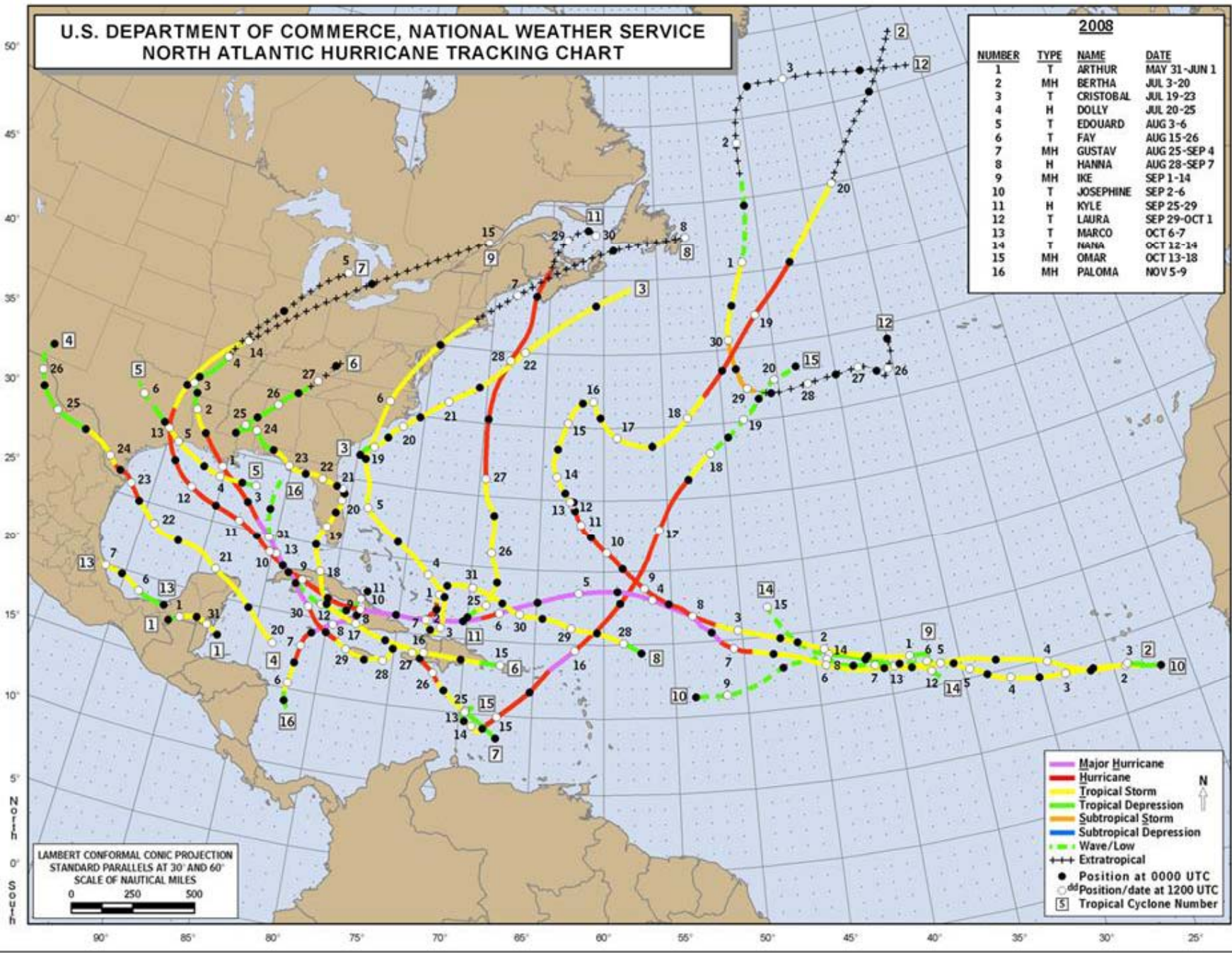
Other CSU Forecast Products

- Two-Week Atlantic Basin Forecasts
- October-November Caribbean Basin Hurricane Forecast (new for 2011)

120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° West 0° East 5°

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NORTH ATLANTIC HURRICANE TRACKING CHART**

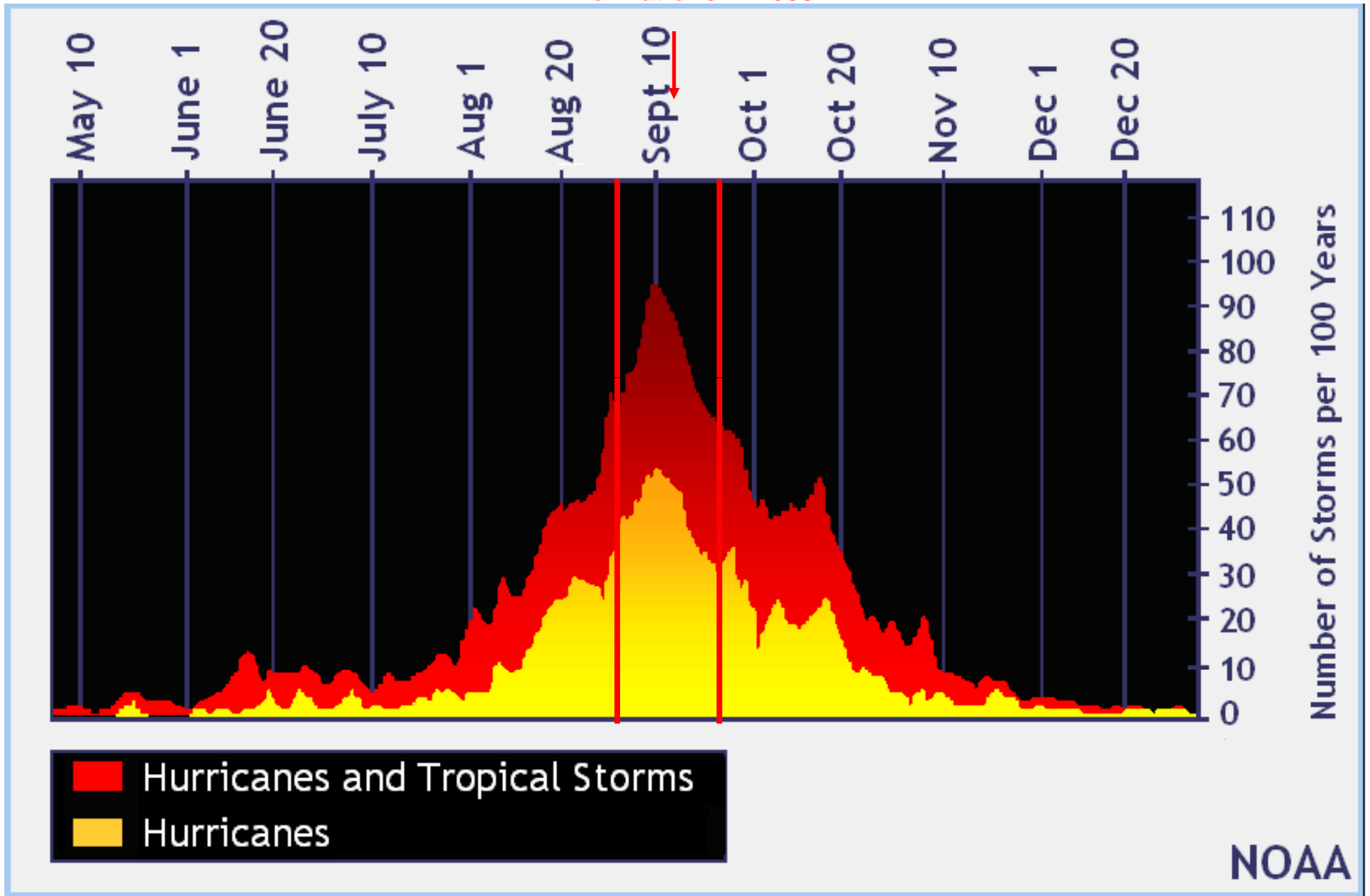
2008			
NUMBER	TYPE	NAME	DATE
1	T	ARTHUR	MAY 31-JUN 1
2	MH	BERTHA	JUL 3-20
3	T	CRISTOBAL	JUL 19-23
4	H	DOLLY	JUL 20-25
5	T	EDOUARD	AUG 3-6
6	T	FAY	AUG 15-26
7	MH	GUSTAV	AUG 25-SEP 4
8	H	HANNA	AUG 28-SEP 7
9	MH	IKE	SEP 1-14
10	T	JOSEPHINE	SEP 2-6
11	H	KYLE	SEP 25-29
12	T	LAURA	SEP 29-OCT 1
13	T	MARCO	OCT 6-7
14	T	NANA	OCT 12-14
15	MH	OMAR	OCT 13-18
16	MH	PALOMA	NOV 5-9



LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICAL MILES
0 250 500

- Major Hurricane
- Hurricane
- Tropical Storm
- Tropical Depression
- Subtropical Storm
- Subtropical Depression
- Wave/Low
- - - Extratropical
- Position at 0000 UTC
- Position/date at 1200 UTC
- 5 Tropical Cyclone Number

No Storm
Formations in 2008

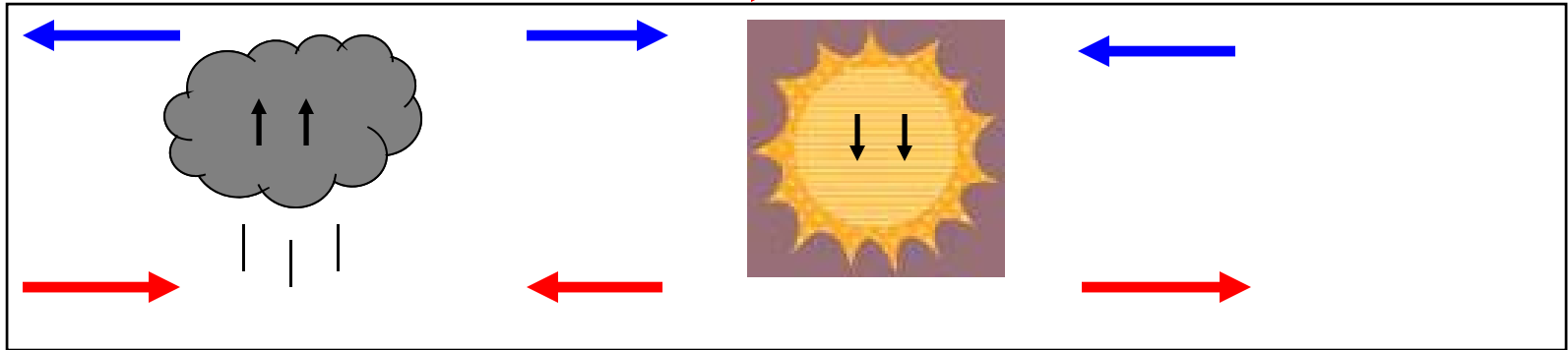


MJO Propagation



200 mb

Day 0



850 mb

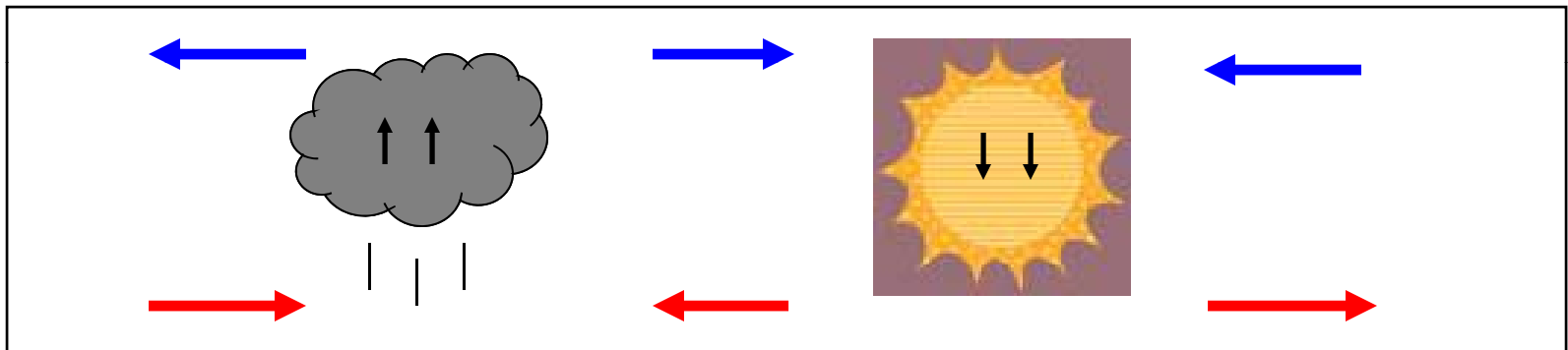
Indian Ocean

Pacific Ocean

Atlantic Ocean

200 mb

Day 10



850 mb

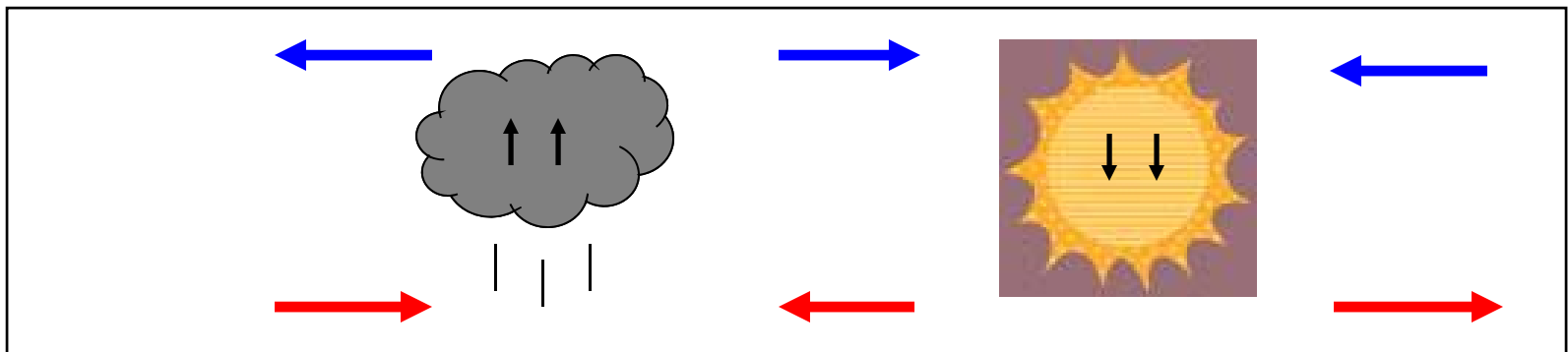
Indian Ocean

Pacific Ocean

Atlantic Ocean

200 mb

Day 20



850 mb

Indian Ocean

Pacific Ocean

Atlantic Ocean

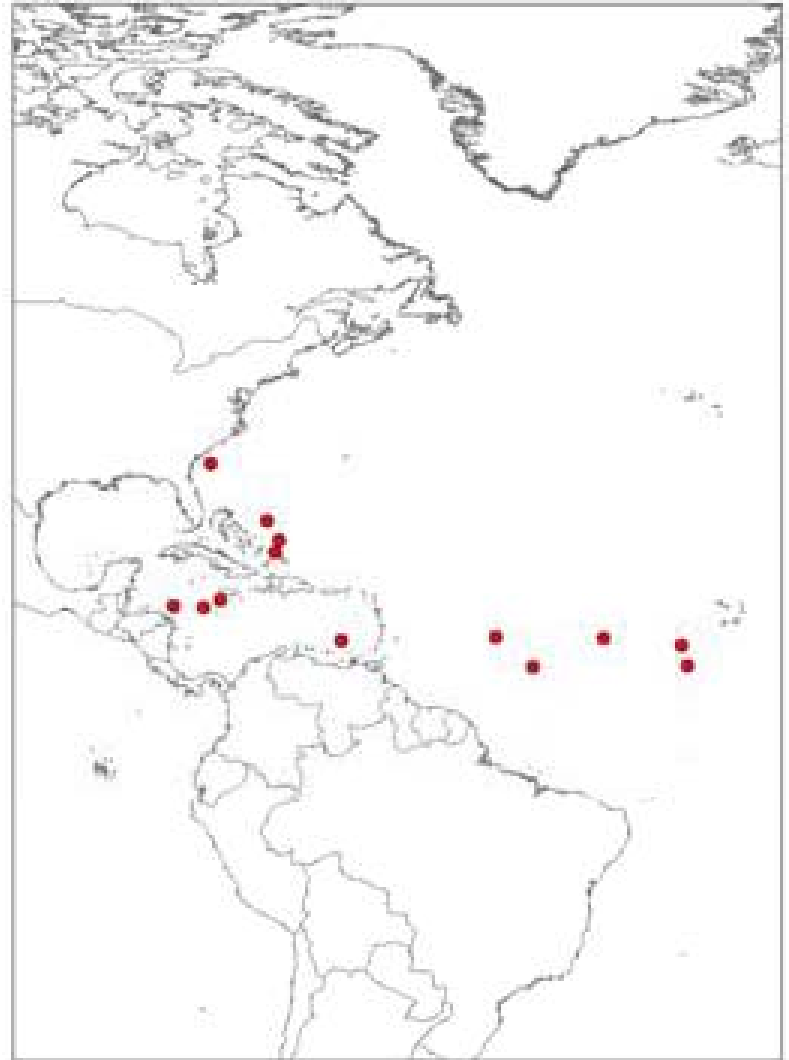
36 Major Hurricanes

MJO Phases 1-2 - Atlantic Major Hurricane Formations

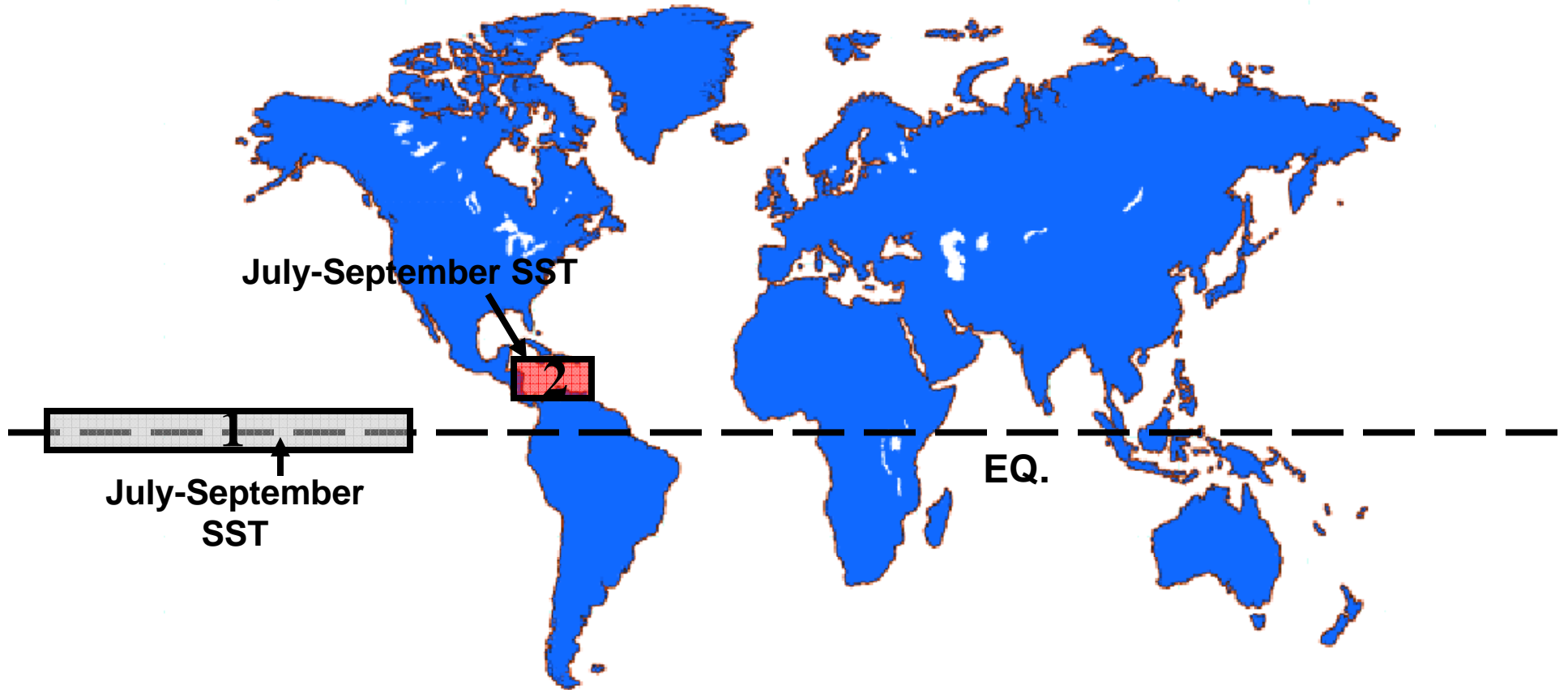


13 Major Hurricanes

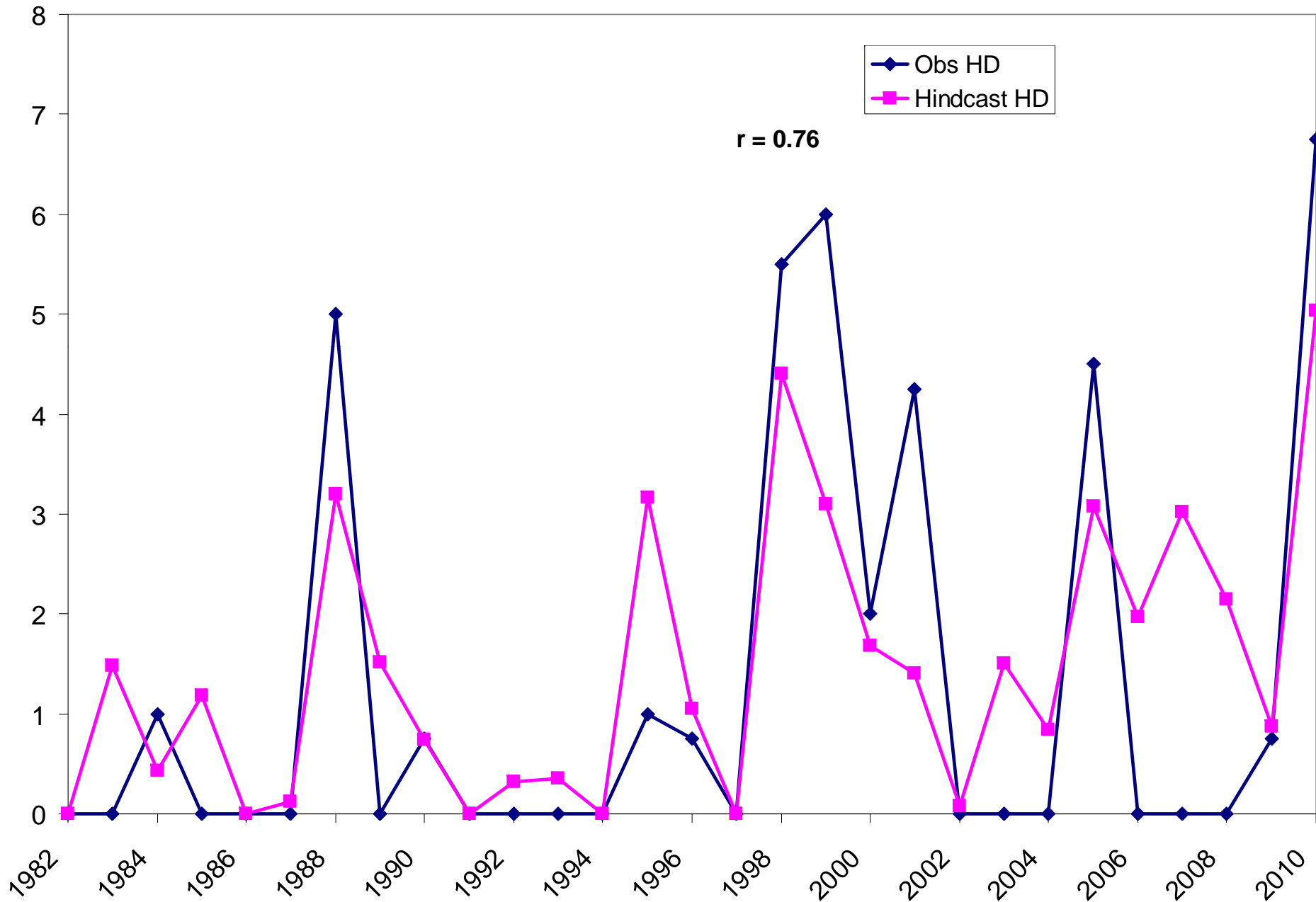
MJO Phases 6-7 - Atlantic Major Hurricane Formations



October-November Caribbean Forecast Predictors



Observed vs. Hindcast Jackknife Caribbean Oct-Nov Hurricane Days (1982-2010)



Arago's Admonition:

“Never, no matter what may be the progress of science, will honest scientific men who have regard for their reputations venture to predict the weather.”