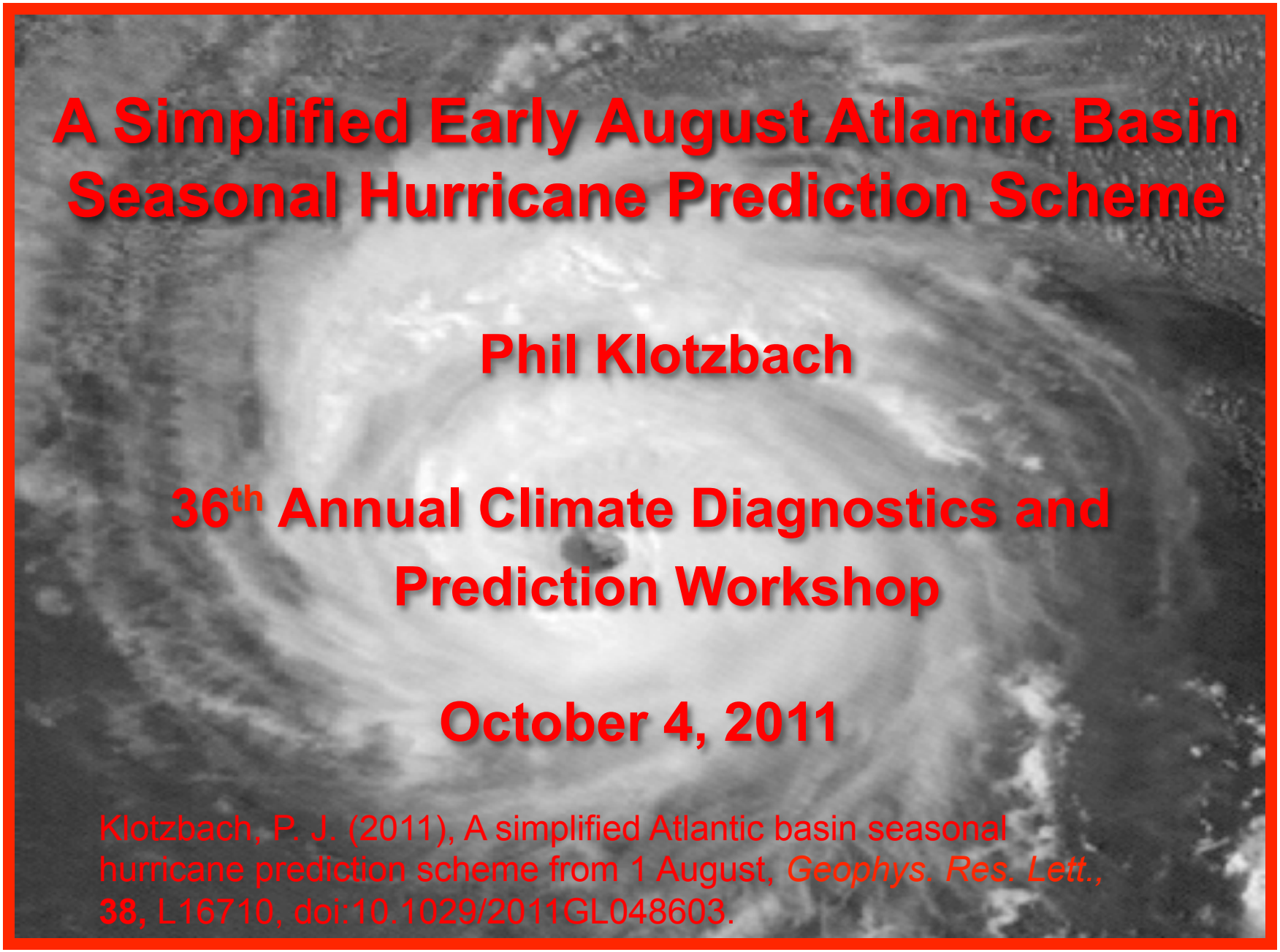


A Simplified Early August Atlantic Basin Seasonal Hurricane Prediction Scheme

Phil Klotzbach

36th Annual Climate Diagnostics and Prediction Workshop

October 4, 2011

Klotzbach, P. J. (2011), A simplified Atlantic basin seasonal hurricane prediction scheme from 1 August, *Geophys. Res. Lett.*, **38,** L16710, doi:10.1029/2011GL048603.

August Statistical Model Forecast History

- Gray (1984) – ENSO, QBO and Caribbean basin sea level pressure anomalies

- Gray et al. (1993) – ENSO, QBO, Caribbean basin zonal wind and sea level pressure anomalies, African rainfall (western Sahel and Gulf of Guinea)

- Klotzbach (2007) – ENSO, Tropical Atlantic SLP, Subtropical Atlantic SST, and pre-1 August tropical cyclone activity in the deep tropics

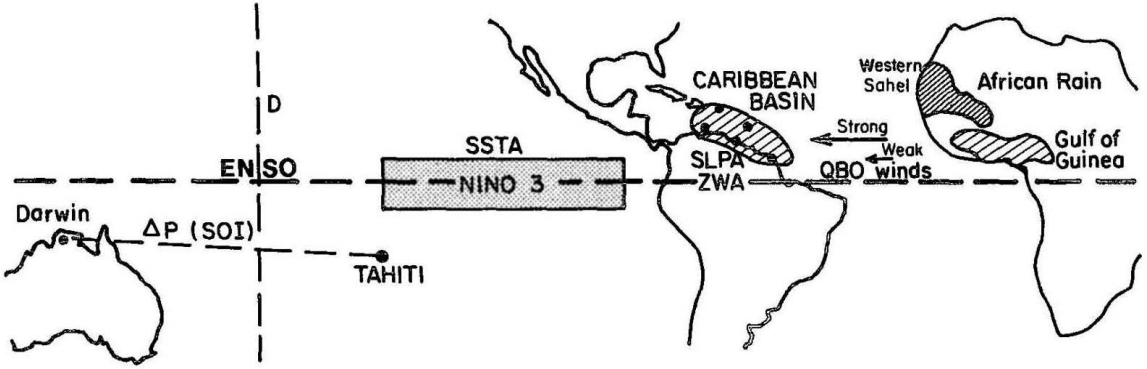
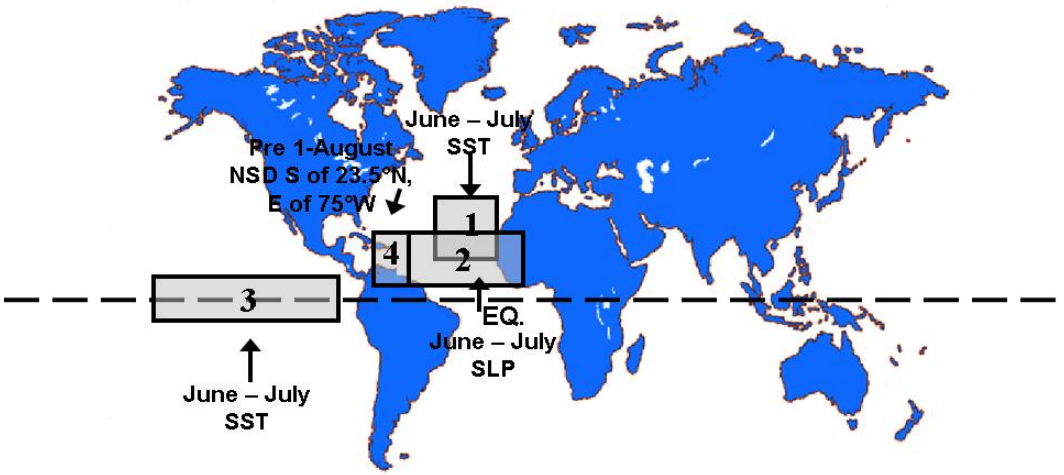


FIG. 1. Locations of areas from which meteorological parameters used in the earlier 1 Aug Atlantic basin seasonal forecast were derived. Reproduced from Gray et al. (1993).

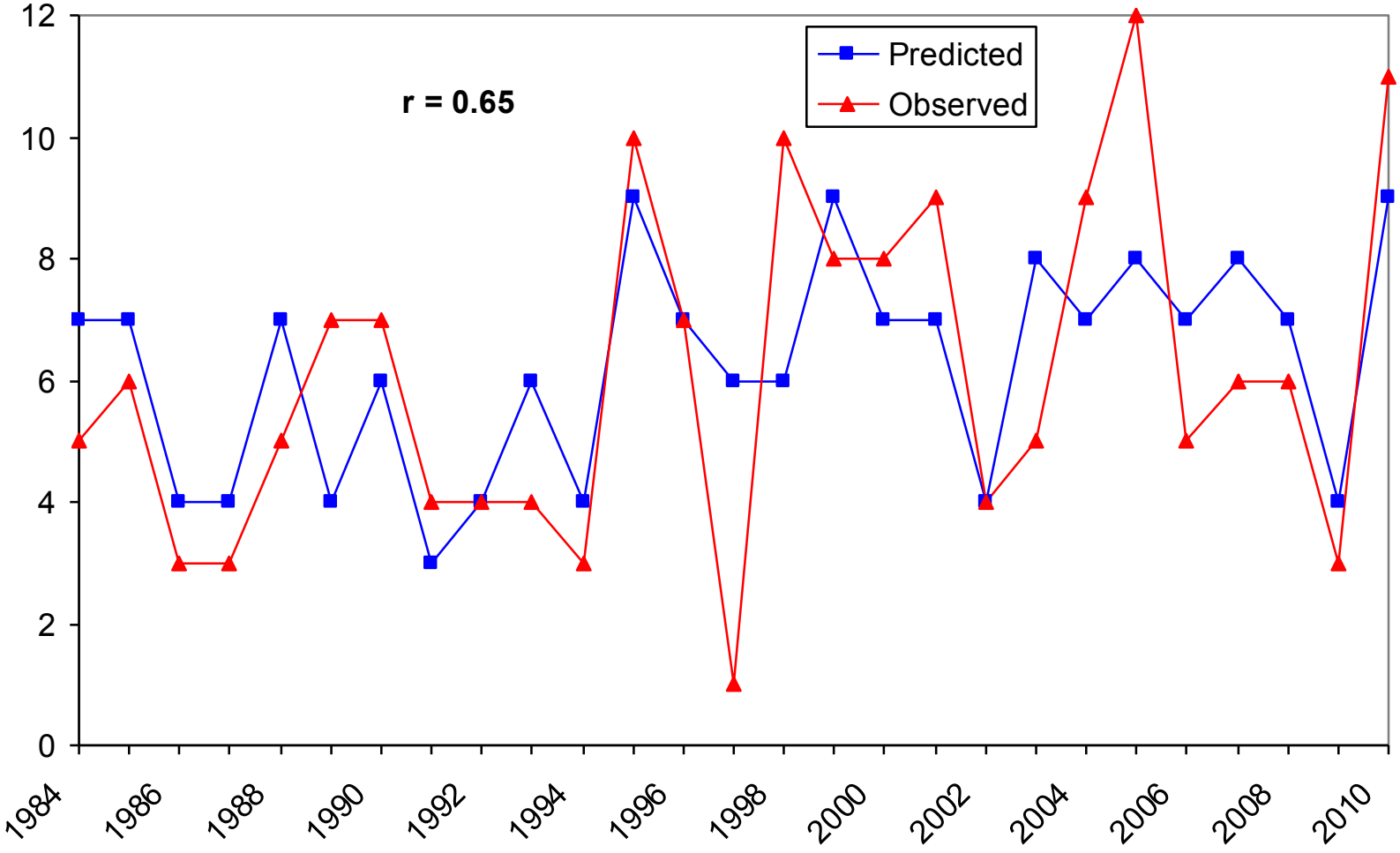
Gray et al. (1993)

Post-31 July Seasonal Forecast Predictors



Klotzbach (2007)

Predicted vs. Observed Post-31 July Atlantic Basin Hurricanes (1984-2010)



Objectives

- To see if similar hindcast skill to earlier August seasonal forecasts could be achieved with fewer predictors (e.g., simplification)

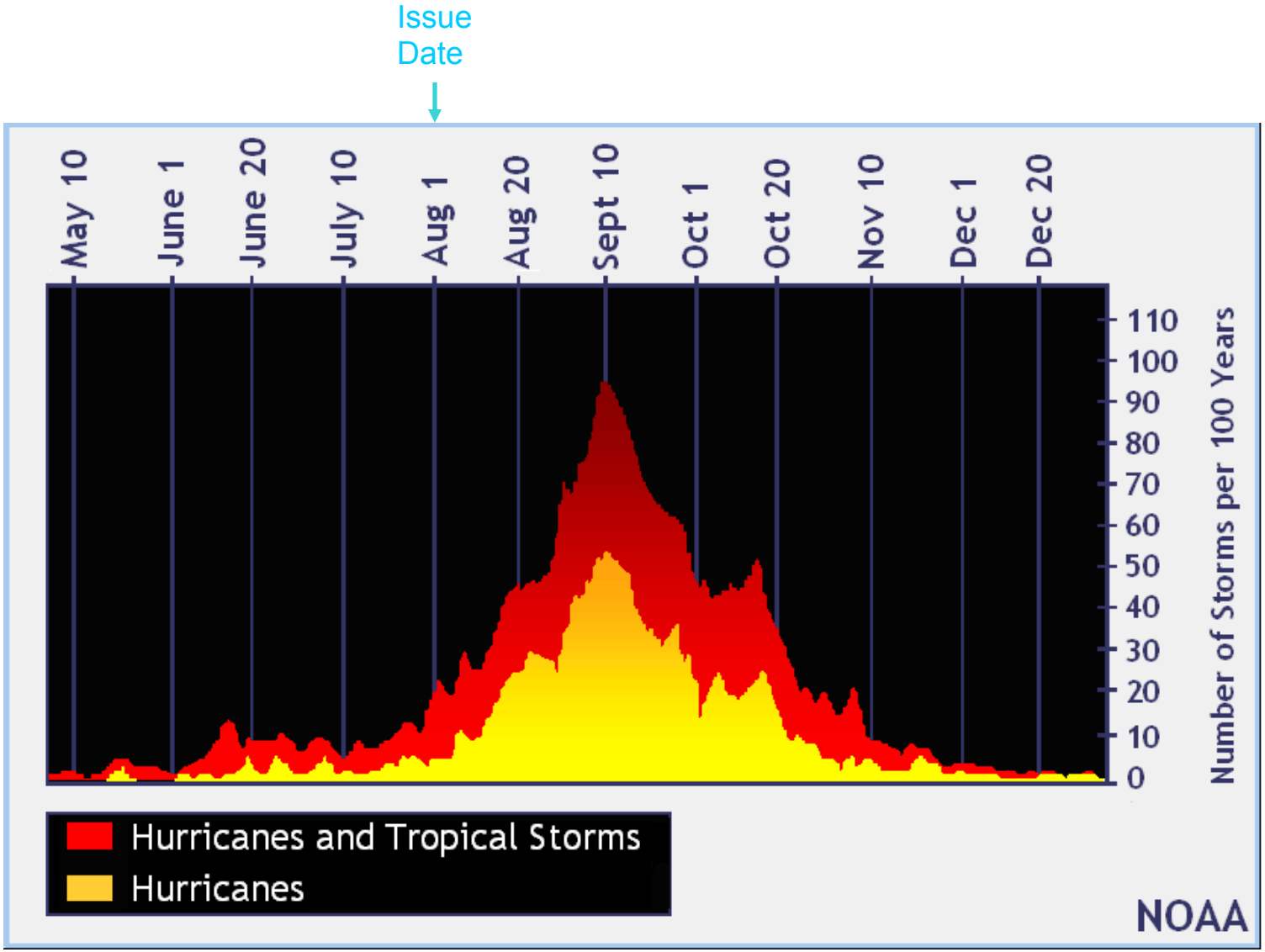
- To utilize the new Climate Forecast System Reanalysis (CFSR) and NOAA Optimum Interpolation SST (OI SST) as the developmental dataset for predictors (as opposed to station data and then NCEP/ NCAR Reanalysis I in the earlier forecast schemes)

- To incorporate a state-of-the-art forecast model (ECMWF) of ENSO into the prediction scheme

- To design a forecast that maximizes the variance explained in Net Tropical Cyclone (NTC)* activity for the Atlantic basin (1982-2010). Test on earlier period data (1900-1981).

NTC: Defined to be the sum of named storms, named storm days, hurricanes, hurricane days, major hurricanes and major hurricane days, divided by their long-period averages, so that 100 by definition represents the average 1950-2000 season.

Atlantic Seasonal Climatology



92% of seasonal NTC occurs after 1 August

Data

- Hurricane Data: National Hurricane Center Best Track Data – available online at:

http://www.nhc.noaa.gov/data/hurdat/tracks/1851to2010_atl_reanal.txt

- Predictor Data (1982-2010)

  Climate Forecast System Reanalysis (SLP, low-level wind)

  NCEP/NCAR Reanalysis I used for 2010 values

  NOAA OI SST (sea surface temperature)

  ECMWF System 3 Forecast for Nino 3

- Predictor Data (1900-1981)

  20th Century Reanalysis

  NOAA Extended Reconstructed SST v3b

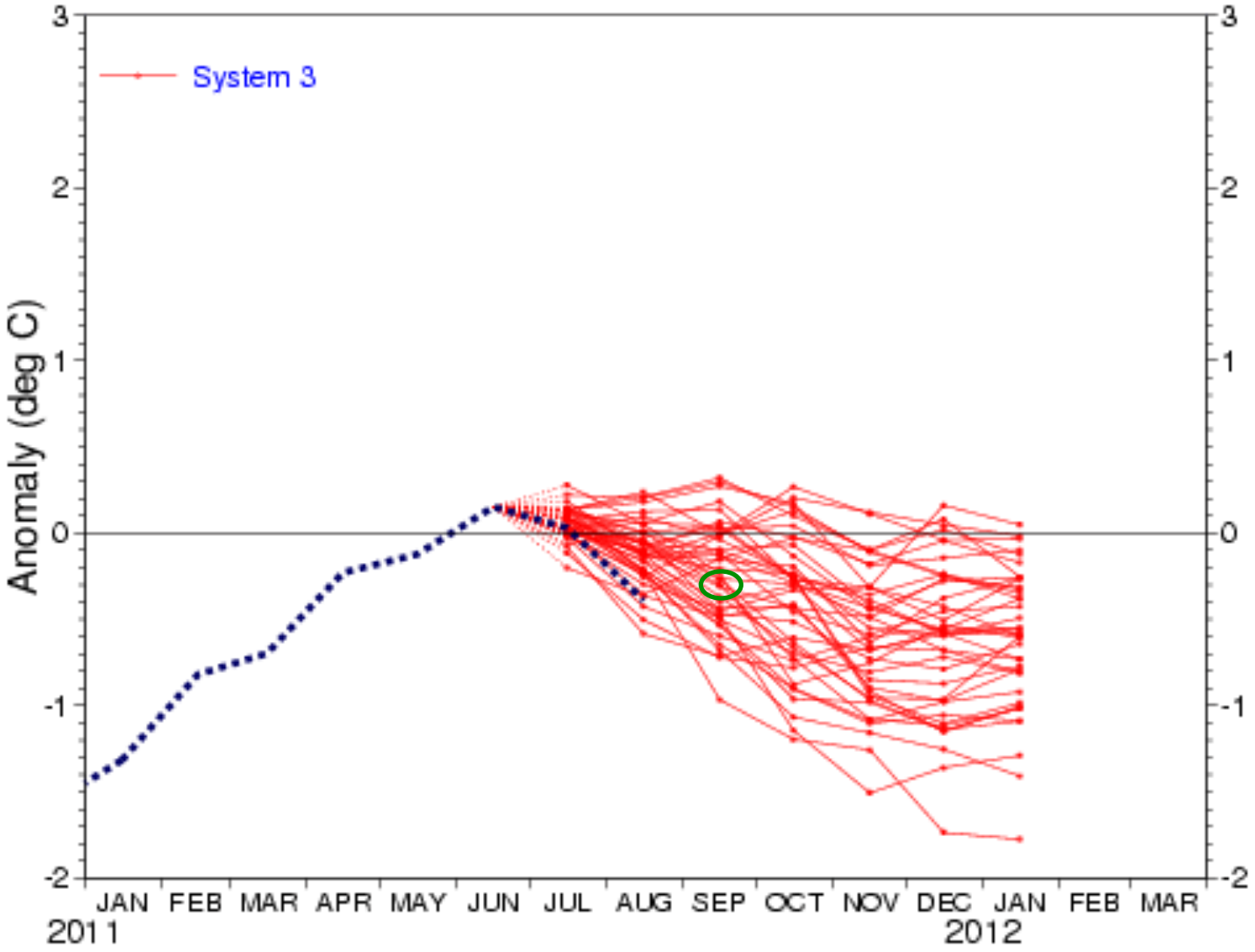
Methodology

- Investigate precursor signals (June and July) that correlate with post-31 July NTC over the period from 1982-2010 (look at low-level fields: SLP, 10-meter wind and SST) – low-level fields utilized due to earlier 20th century verification

- Examine hindcast skill of ECMWF seasonal forecast system 3 for a 1 July forecast (made publicly available on July 22) for the Nino 3 and Nino 3.4 regions

- Add additional predictors in a stepwise manner to the linear regression forecast scheme until less than 3% of the variance in NTC (1982-2010) is explained by the addition of another predictor – predictors also had to significantly correlate with NTC by themselves

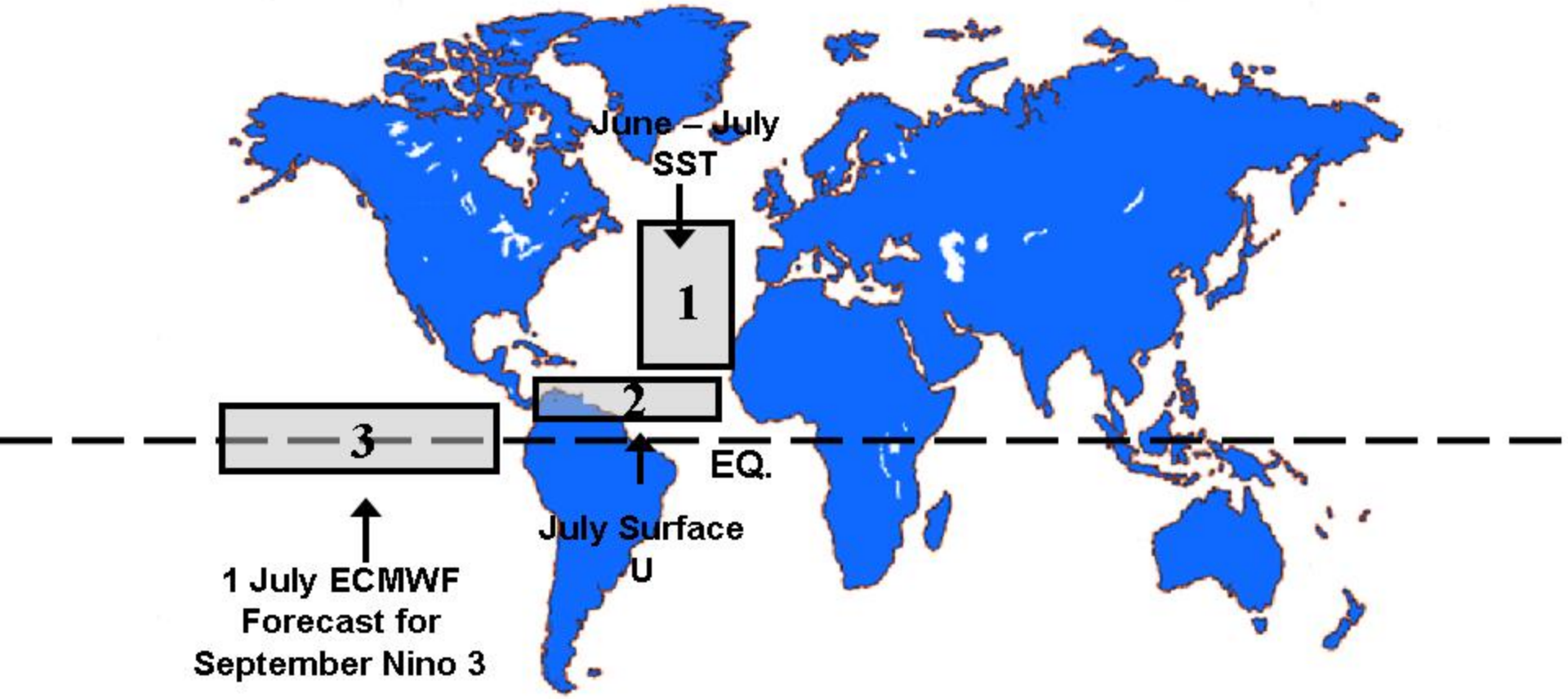
- Check for stability in the forecast scheme by evaluating correlation of the predictors with NTC during the earlier part of the 20th century (1900-1981)

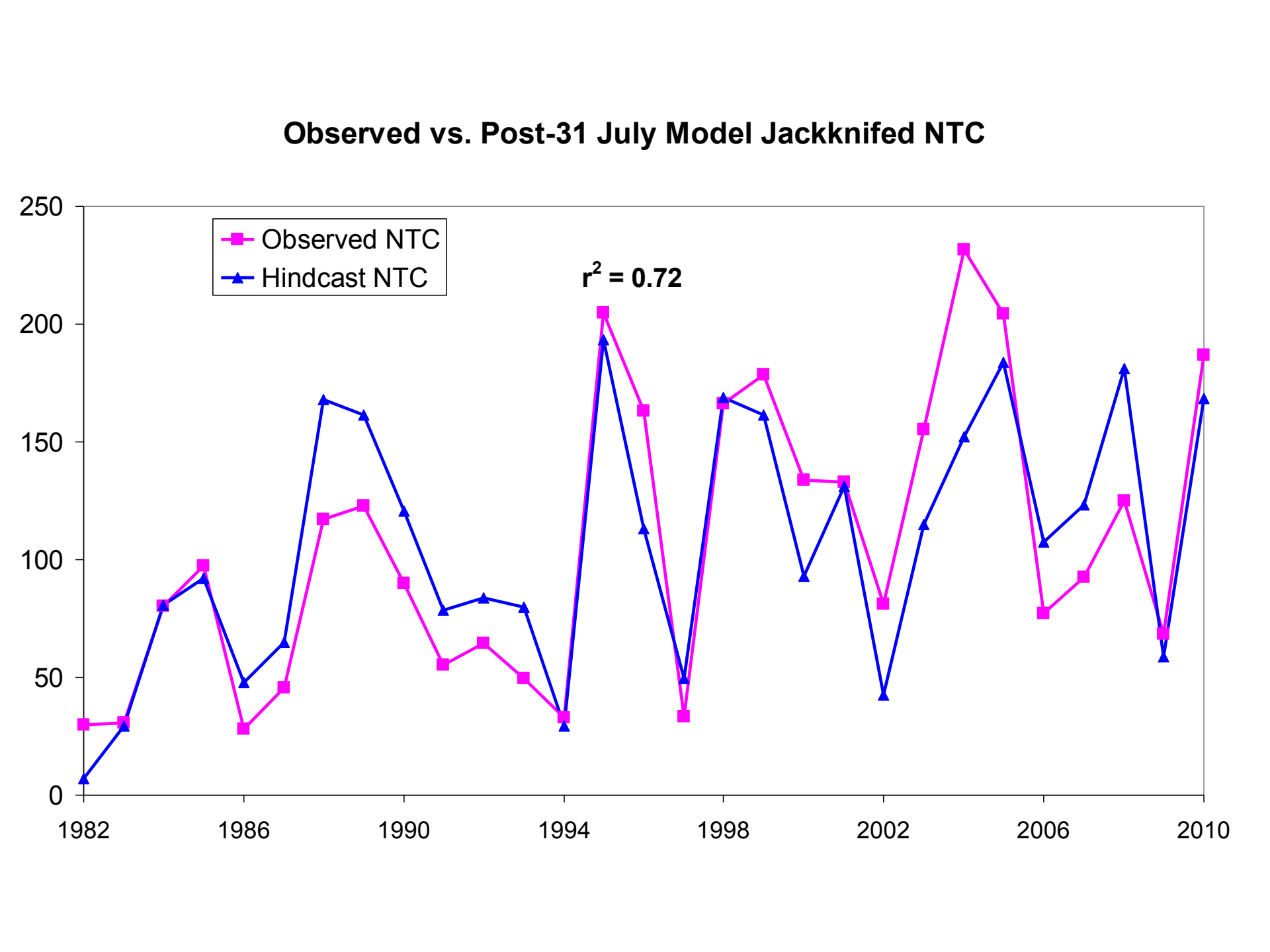


Forecast issue date: 15 Jul 2011

ECMWF

Post-31 July Seasonal Forecast Predictors




Observed vs. Post-31 July Model Jackknifed NTC
Observed NTC
Hindcast NTC
r2 = 0.72
250
200
150
100
50
0
1982
1986
1990
1994
1998
2002
2006
2010

Physical Explanation Hypothesis – Surface Wind Predictor – Atlantic TC Activity

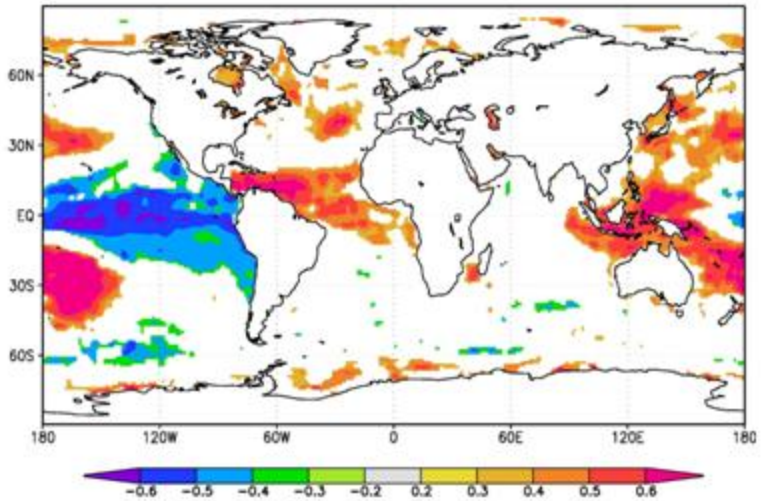
- Weaker trades in July correlate very strongly with a warm tropical Atlantic (due to less upwelling and evaporation)

- Consequently, a larger-than-normal Atlantic Warm Pool (AWP) develops

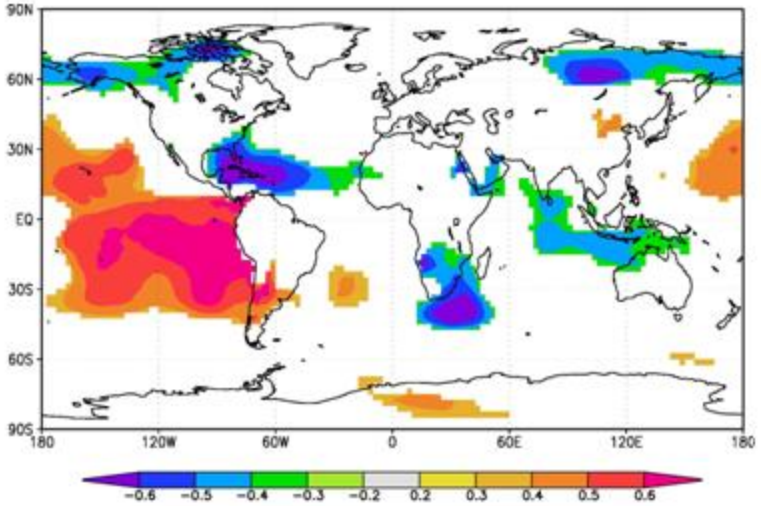
- A large AWP correlates with reduced vertical shear across the tropical Atlantic and Caribbean

August-October Correlations w/ Predictor 2 (1982-2010)

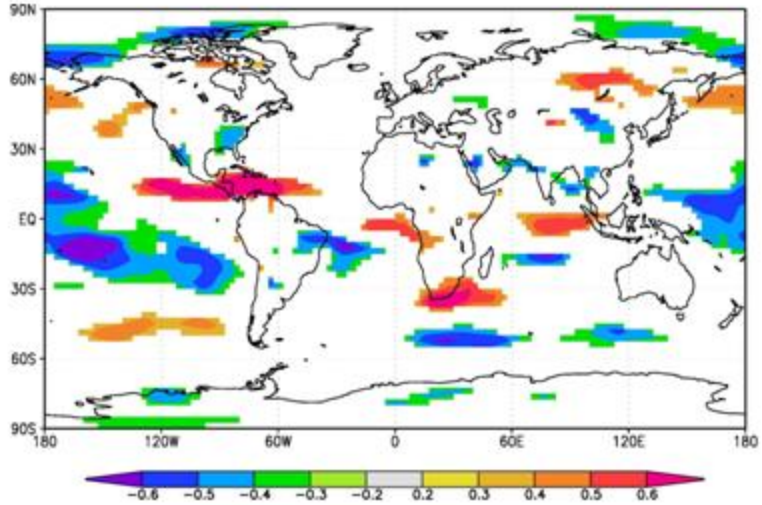
(a) SST



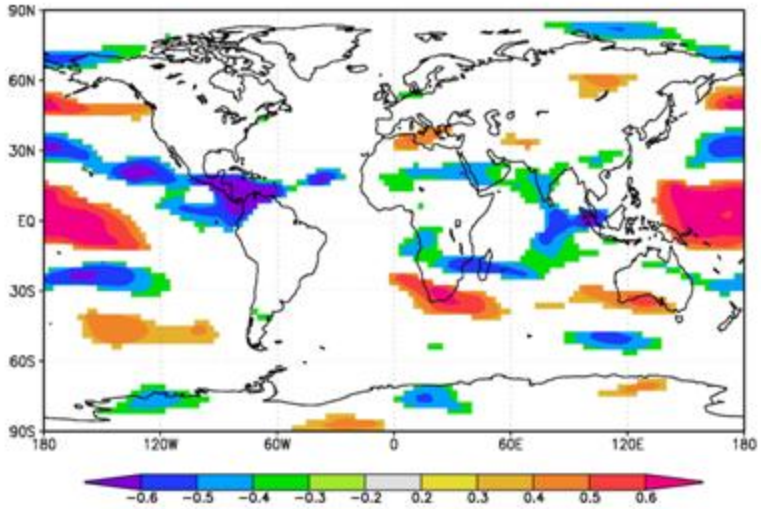
(b) SLP

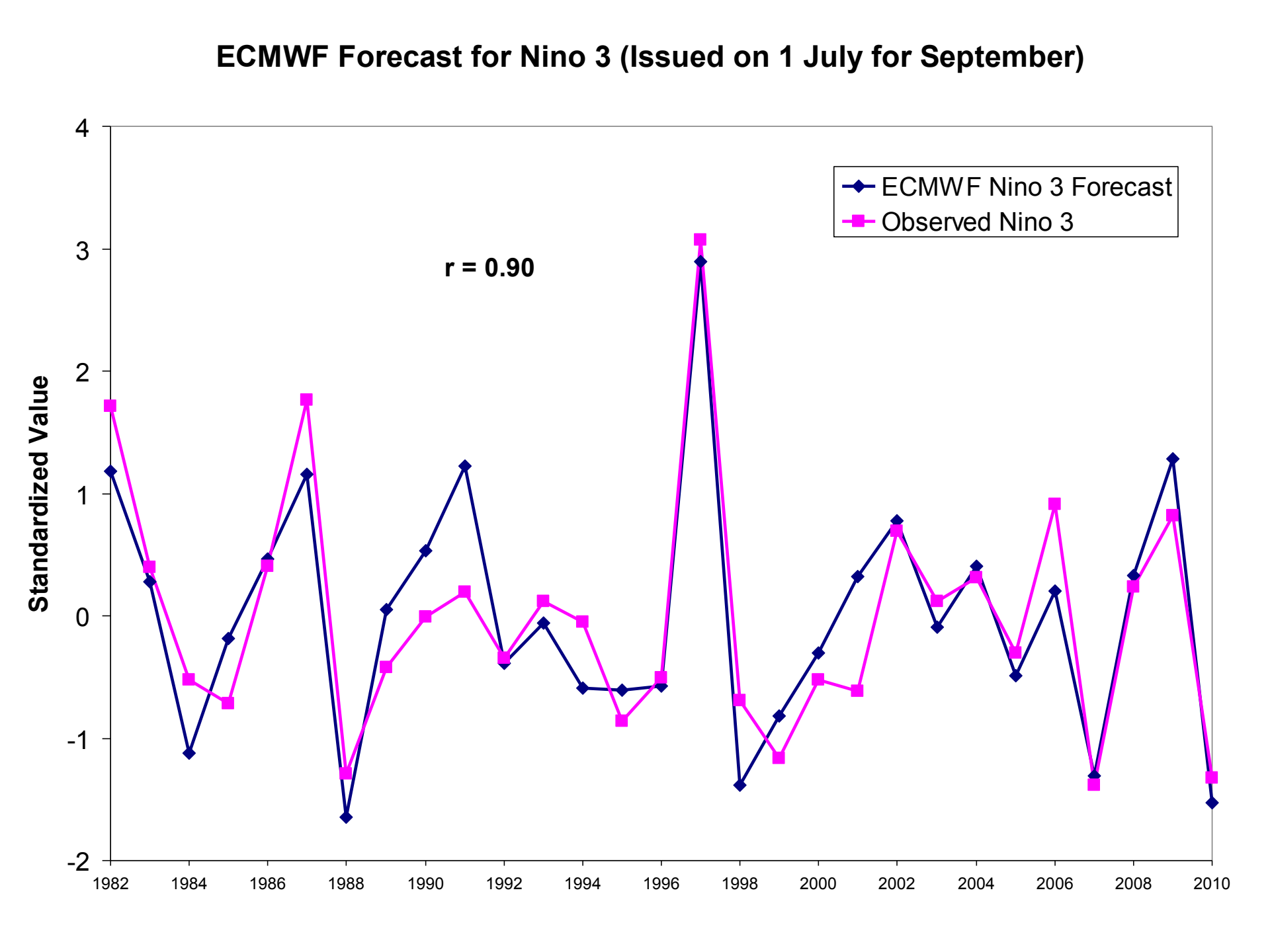


(c) 850 mb U



(d) 200 mb U




ECMWF Forecast for Nino 3 (Issued on 1 July for September)
ECMWF Nino 3 Forecast
Observed Nino 3
r = 0.90
Standardized Value
4
3
2
1
0
-1
-2
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010

Individual Predictor Correlations with Post-31 July NTC

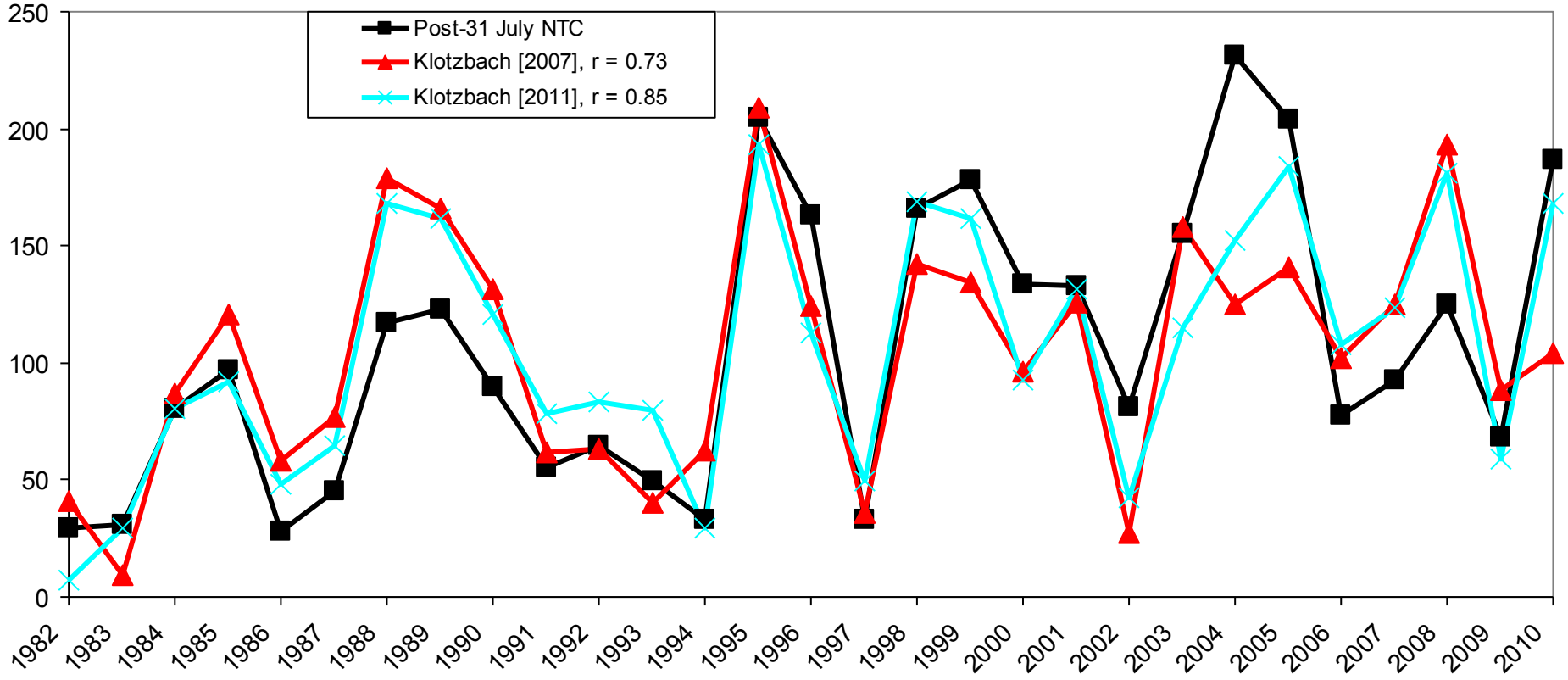
Predictor	1982-2010 (r) (29 Years)
June-July SST (20-50°N, 35-15°W)	0.67
July 10 Meter U (10-17.5°N, 80-40°W)	0.83
ECMWF September SST Forecast (Model Initialized 1 July) (5°S-5°N, 170-120°W)	-0.49

Individual Predictor Correlations with Post-31 July NTC

Predictor	1900-1981 (r) (82 Years)	1900-1947 (r) (48 years)	1948-1981 (r) (34 Years)
June-July SST (20-50°N, 35-15°W)	0.31	0.34	0.25
July 10 Meter U (10-17.5°N, 80-40°W)	0.41	0.50	0.48
Observed September SST (5°S-5°N, 170-120°W)	-0.32	-0.46	-0.25

All correlations statistically significant at the 90% level using a one-tailed Student's t-test

Improvement upon Klotzbach [2007] Scheme



Post-31 July Atlantic Basin Forecast for 2011

Date	NTC
Post-31 July NTC Forecast	123
Observed (Through September 30)	95
Climatology (Through September 30)	80

Climatology is calculated from the 1981-2010 base period.

Future Work

- Evaluate predictors in the ERA-Interim Reanalysis
- Consider possibility of using mid-level moisture predictors

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

Yogi Berra