FORECAST OF ATLANTIC SEASONAL HURRICANE ACTIVITY AND LANDFALL STRIKE PROBABILITY FOR 2014

We continue to foresee a below-average 2014 Atlantic hurricane season. The tropical Atlantic remains cooler than normal, while El Niño is in the process of developing. The transition to El Niño remains slower than previously anticipated, but the tropical Atlantic has also cooled over the past few weeks, causing us to keep our forecast the same. A more detailed forecast that includes new analog years will be released on 31 July. We are still calling for a below-average probability of United States and Caribbean major hurricane landfall.

(as of 1 July 2014)

By Philip J. Klotzbach[1] and William M. Gray[2]

This forecast as well as past forecasts and verifications are available via the World Wide Web at http://hurricane.atmos.colostate.edu/Forecasts

Kortny Rolston, Colorado State University Media Representative, (970-491-5349) is available to answer various questions about this verification.

Department of Atmospheric Science
Colorado State University
Fort Collins, CO 80523
Email: amie@atmos.colostate.edu

Project Sponsors:

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[1] Research Scientist
[2] Professor Emeritus of Atmospheric Science

ATLANTIC BASIN SEASONAL HURRICANE FORECAST FOR 2014

Forecast Parameter and 1981-2010 Median (in parentheses)	Issue Date 10 April 2014	Issue Date 2 June 2014	Issue Date 1 July 2014
Named Storms (NS) (12.0)	9	10	10
Named Storm Days (NSD) (60.1)	35	40	40
Hurricanes (H) (6.5)	3	4	4
Hurricane Days (HD) (21.3)	12	15	15
Major Hurricanes (MH) (2.0)	1	1	1
Major Hurricane Days (MHD) (3.9)	2	3	3
Accumulated Cyclone Energy (ACE) (92)	55	65	65
Net Tropical Cyclone Activity (NTC) (103%)	60	70	70

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

1) Entire U.S. coastline - 40% (average for last century is 52%)

2) U.S. East Coast Including Peninsula Florida - 22% (average for last century is 31%)

3) Gulf Coast from the Florida Panhandle westward to Brownsville - 23% (average for last century is 30%)

PROBABILITY FOR AT LEAST ONE MAJOR (CATEGORY 3-4-5) HURRICANE TRACKING INTO THE CARIBBEAN (10-20°N, 60-88°W)

1) 32% (average for last century is 42%)

ABSTRACT

Information obtained through June 2014 indicates that the 2014 Atlantic hurricane season will have less activity than the median 1981-2010 season. We estimate that 2014 will have about 4 hurricanes (median is 6.5), 10 named storms (median is 12.0), 40 named storm days (median is 60.1), 15 hurricane days (median is 21.3), 1 major (Category 3-4-5) hurricane (median is 2.0) and 3 major hurricane days (median is 3.9). The probability of U.S. major hurricane landfall is estimated to be about 80 percent of the long-period average. We expect Atlantic basin Net Tropical Cyclone (NTC) activity in 2014 to be approximately 70 percent of the long-term average. This forecast is the same as was issued in early June.

This forecast is based on a new extended-range early July statistical model which is described in detail in Klotzbach (2014). Please refer to this publication for an extensive description of the model.

Acknowledgment

We are grateful for support from Interstate Restoration and Ironshore Insurance that partially support the release of these predictions. The remainder of this year's forecasts are provided by personal funds. We thank the GeoGraphics Laboratory at Bridgewater State University (MA) for their assistance in developing the United States Landfalling Hurricane Probability Webpage (available online at http://www.e-transit.org/hurricane).

The second author gratefully acknowledges the valuable input to his CSU seasonal forecast research project over many years by former graduate students and now colleagues Chris Landsea, John Knaff and Eric Blake. We also thank Professors Paul Mielke and Ken Berry of Colorado State University for statistical analysis and guidance over many years. We thank Bill Thorson for technical advice and assistance.

1 Introduction

This is the 31st year in which the CSU Tropical Meteorology Project has made forecasts of the upcoming season's Atlantic basin hurricane activity. Our research team has shown that a sizable portion of the year-to-year variability of Atlantic tropical cyclone (TC) activity can be hindcast with skill exceeding climatology. This year's July forecast is based on a statistical methodology derived from data since 1979. This is the first time that the TMP has issued a prediction on 1 July. This is an abbreviated forecast. A full updated forecast including new analog years will be issued on 31 July.

2 July Forecast Methodology

We have developed a new July statistical forecast model which we are using for the first time this year. This model has been built over the period from 1979-2012 to incorporate data from the ERA-Interim Reanalysis (Dee et al. 2011). It was applied in real-time forecast mode last year (although the results were not publicly disseminated). As was the case for all of our statistical models, the model did not do a good job of predicting the quiet season last year. This new 1 July TC forecast model shows significant skill in predicting levels of Accumulated Cyclone Energy (ACE) over the 35-year period from 1979-2013. This hindcast model correlates with ACE at 0.81 when a drop-one cross-validation (jackknife) analysis is conducted (Figure 1). This model is described in detail in Klotzbach (2014). Please refer to this publication for an extensive description of the model.

Figure 2 displays the locations of each of our predictors, while Table 1 displays the values of each predictor for the 2014 hurricane season. Table 2 displays the combination of the two predictors as model output for the 2014 Atlantic hurricane season.

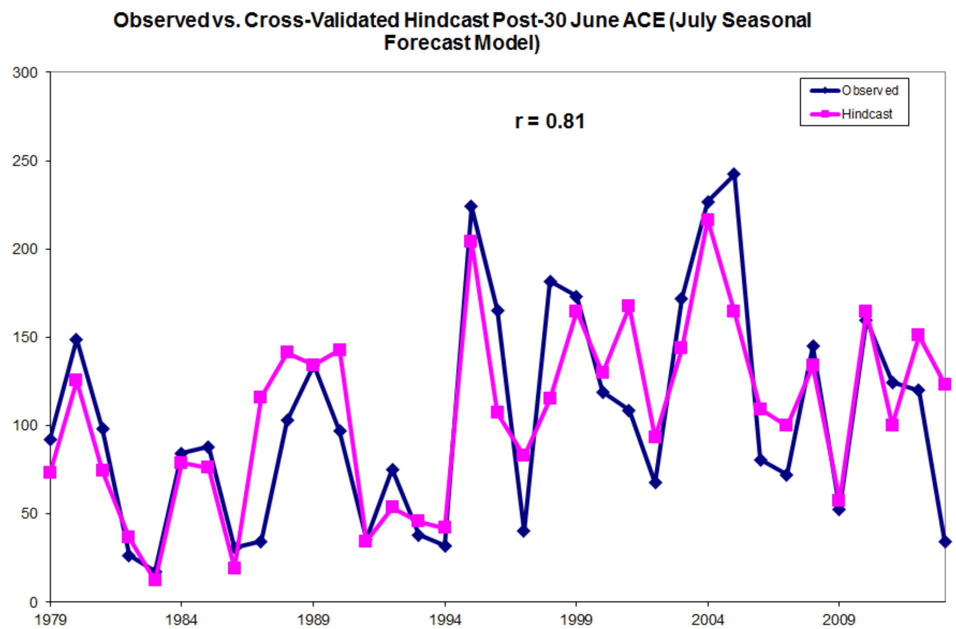

Figure 1: Observed versus early July jackknifed hindcast values of ACE for 1979-2013. The hindcast model explains approximately 65% of the variance from climatology.

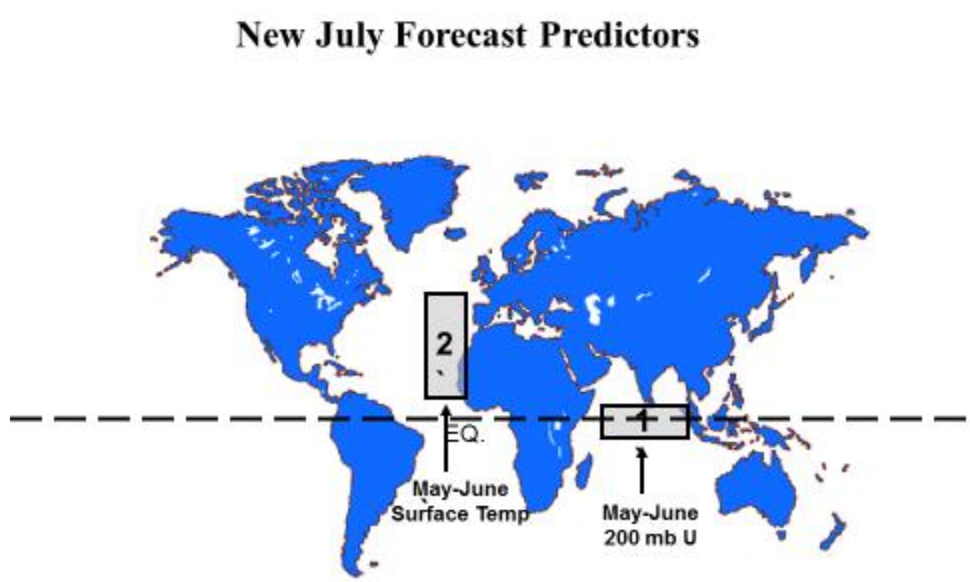

Figure 2: Location of predictors for our early July statistical prediction for the 2014 hurricane season.

Table 1: Listing of 1 July 2014 predictors for the 2014 hurricane season. A plus (+) means that positive values of the parameter indicate increased hurricane activity. Both parameters are unfavorable for TC activity.

Predictor	**2014 Forecast Value**	**Favorable/Unfavorable for TCs**
1) May-June 200 mb U (10°S-5°N, 60-90°E) (-)	0.0 SD	Neutral
2) May-June Surface Temp (10-50°N, 30-10°W) (+)	-0.7 SD	Unfavorable

Table 2: Statistical model output for the 2014 Atlantic hurricane season.

Forecast Parameter and 1981-2010 Median (in parentheses)	Statistical Forecast
Named Storms (12.0)	8.9
Named Storm Days (60.1)	39.7
Hurricanes (6.5)	4.7
Hurricane Days (21.3)	15.9
Major Hurricanes (2.0)	1.6
Major Hurricane Days (3.9)	3.0
Accumulated Cyclone Energy Index (92)	66
Net Tropical Cyclone Activity (103%)	74

3 ENSO

El Niño still appears likely to develop over the next couple of months, although its development has slowed in recent weeks. Upper ocean heat content anomalies have recently decreased to near zero (Figure 3).

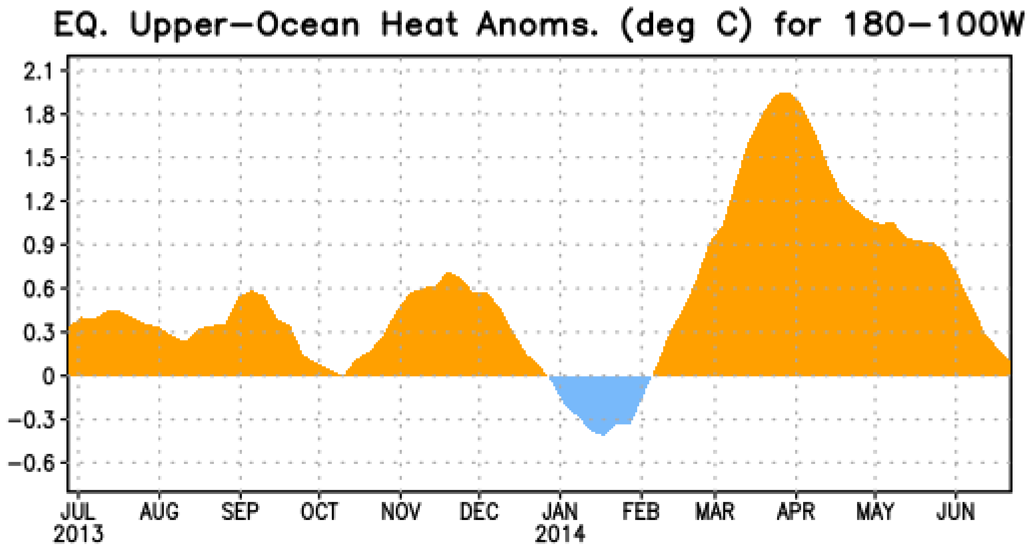

Figure 3: Central and eastern tropical Pacific upper ocean (0-300 meters) heat content anomalies over the past year. Anomalies dropped during the early portion of the winter, rapidly increased into early April and have since decreased to near-normal levels. Figure courtesy of Climate Prediction Center.

We had several strong Kelvin waves propagate across the tropical Pacific during the late winter and spring (Figure 4). These Kelvin waves are characterized by a downwelling (warming) phase followed by an upwelling (cooling) phase. In the mean sense, these Kelvin waves typically increase SSTs in the eastern and central tropical Pacific. Kelvin waves are triggered by strong anomalous westerlies near the International Date Line. These anomalous westerlies which were present during the spring months have tended to be absent in recent weeks (Figure 5).

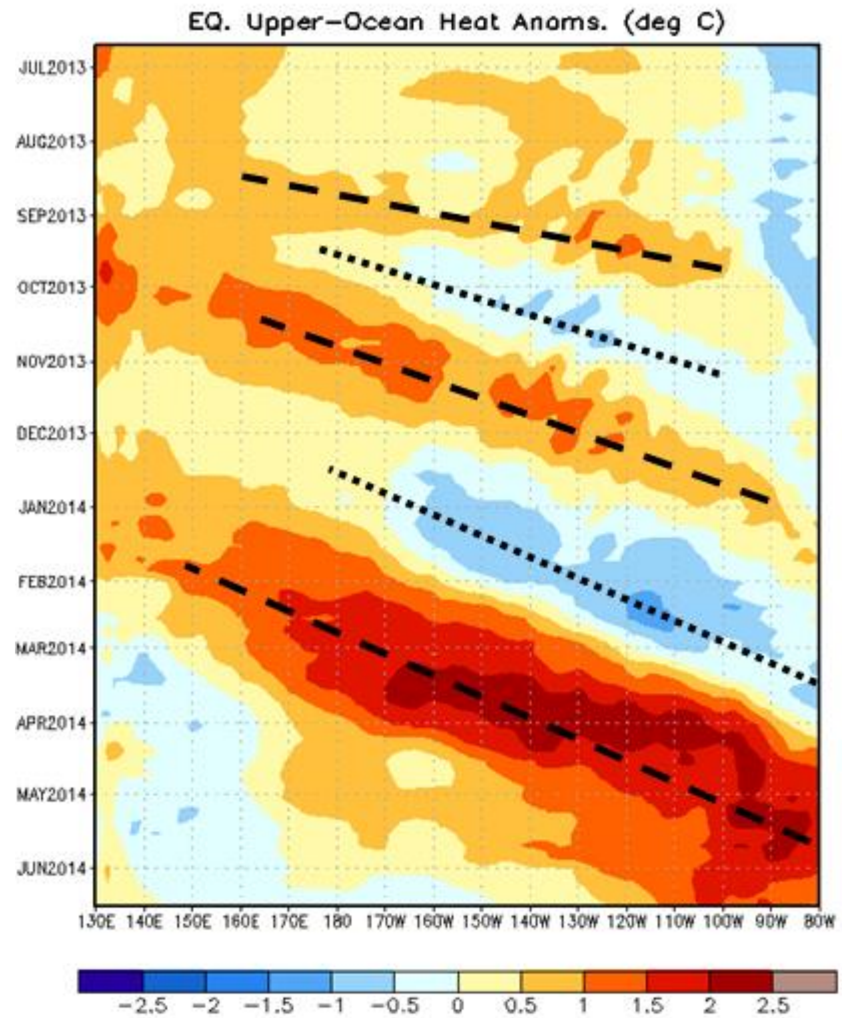

Figure 4: Upper ocean content heat anomalies (0-300 meters depth) across the tropical Pacific. Downwelling (warming) phases of Kelvin waves are highlighted by dashed lines, while upwelling (cooling) phases of Kelvin waves are highlighted by dotted lines. Figure courtesy of Climate Prediction Center.

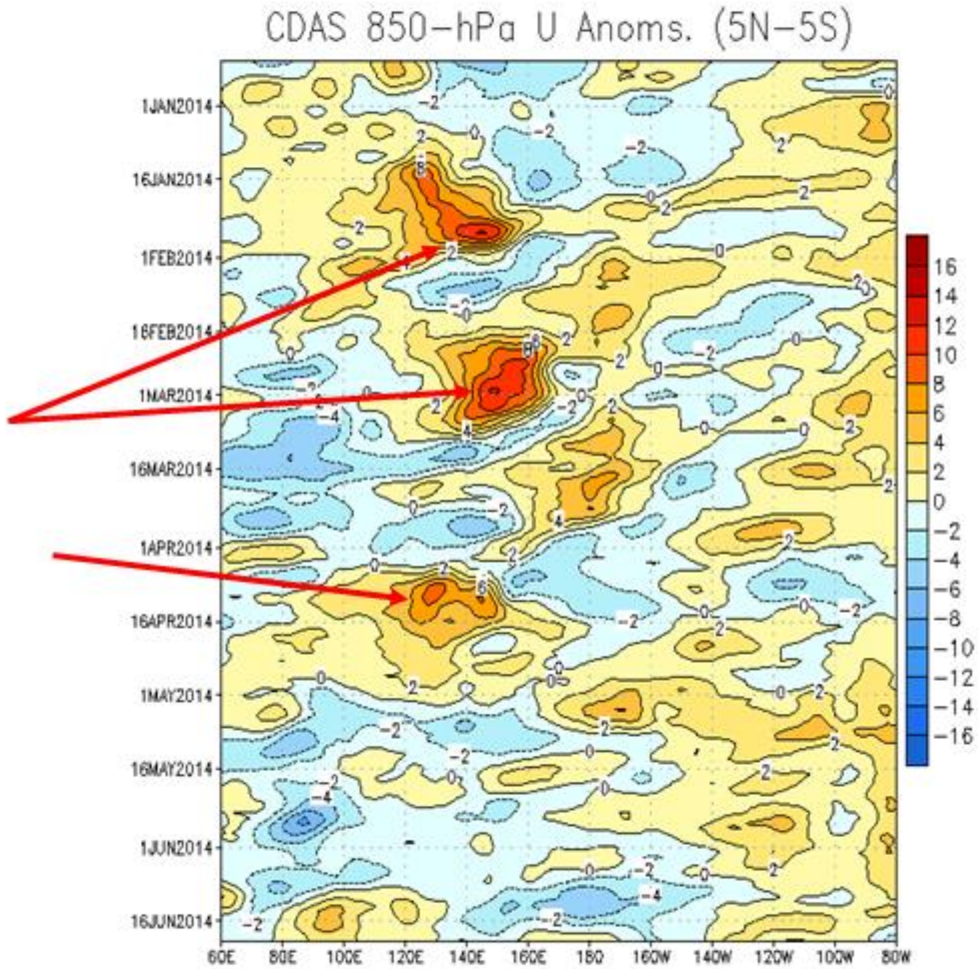

Figure 5: Anomalous 850-mb zonal wind flow across the tropical Pacific since late December 2013. The red lines highlight westerly wind bursts that have occurred over the past few months. Flow has generally been near normal in recent weeks. Figure courtesy of Climate Prediction Center.

Currently, SSTs are running above average across most of the eastern and central tropical Pacific. Table 3 displays the May and June SST anomalies across the tropical Pacific. The eastern part of the tropical Pacific has warmed, while the central part of the tropical Pacific has cooled slightly over the past month.

Table 3: May and June SST anomalies for Nino 1+2, Nino 3, Nino 3.4, and Nino 4, respectively. June minus May SST anomaly differences are also provided.

Region	May SST Anomaly (°C)	June SST Anomaly (°C)	June minus May SST Anomaly (°C)
Nino 1+2	+1.3	+1.8	+0.5
Nino 3	+0.6	+0.9	+0.3
Nino 3.4	+0.8	+0.5	-0.3
Nino 4	+0.5	+0.5	0.0

Based on the above information, our best estimate is that we will continue to transition to warm ENSO conditions for the peak of the Atlantic hurricane season. There remains a need to closely monitor ENSO conditions over the next few months. Additional discussion of ENSO will be included with the July 31 update.

4 Current Atlantic Basin Conditions

Most of the tropical Atlantic is relatively cold right now (Figure 6). The overall SST pattern across the Atlantic basin appears to resemble the negative phase of the AMO or weak phase of the THC. This is a significant negative factor in this current prediction.

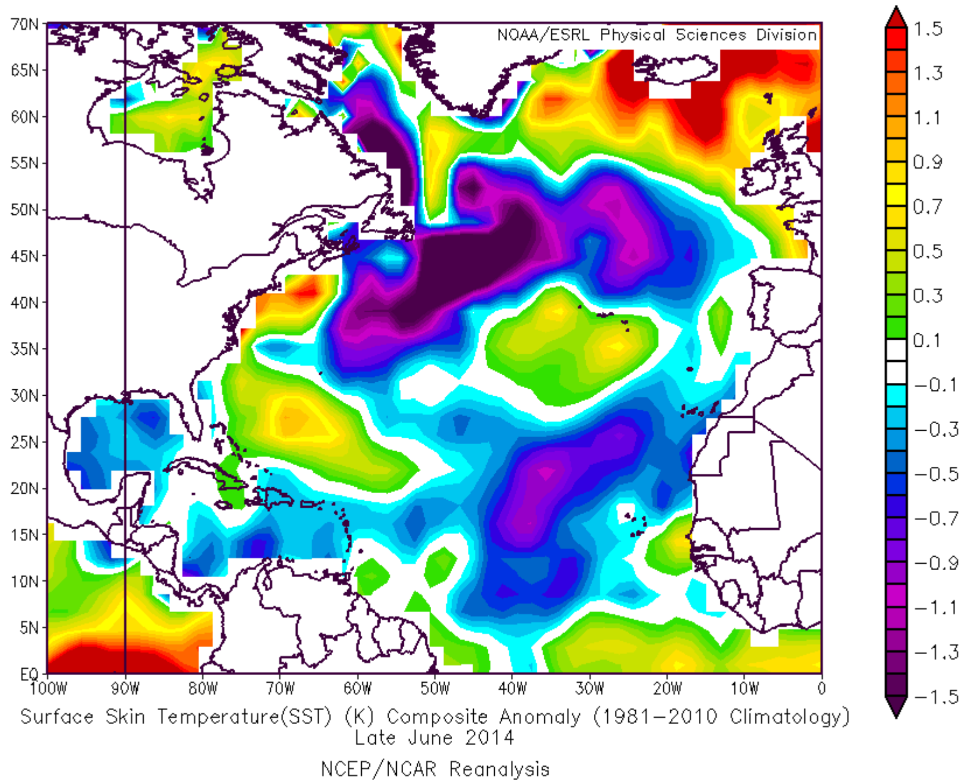

Figure 6: Late June SST anomalies across the Atlantic.

One of the primary reasons why we believe the 2013 Atlantic hurricane season was so quiet was due to a very strong weakening of the THC/AMO during the spring months of last year. We have created a new index to assess the strength of the THC that is defined as a combination of SST in the region from 20-70°N, 40-10°W and SLP in the region from 15-50°N, 60-10°W (Figure 7). The index is created by weighing the two parameters as follows: 0.6*SST – 0.4*SLP. The index has been much more stable this year and is currently running near average (Figure 8). We do not see any major changes at this point to the THC that would cause us to significantly adjust our forecast.

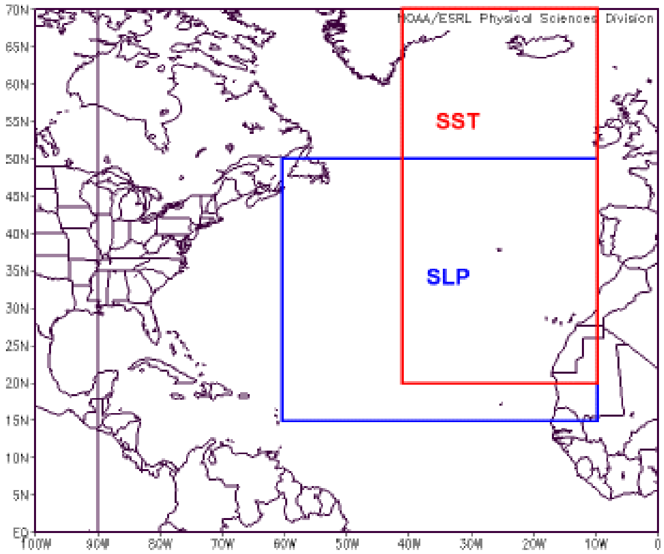

Figure 7: Regions which are utilized for calculation of the new THC/AMO index.

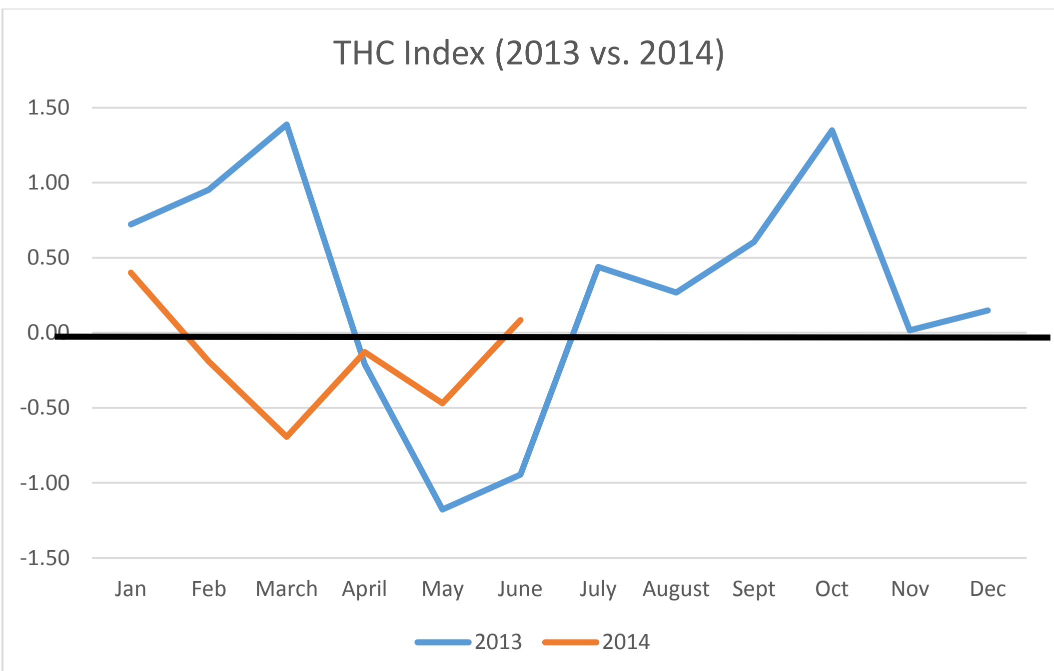

Figure 8: Standardized values of the THC/AMO index by month in 2013 and 2014. Month-to-month changes have been much less in 2014 than they were in 2013.

5 Forthcoming Updated Forecasts of 2014 Hurricane Activity

We will be issuing a final seasonal update of our 2014 Atlantic basin hurricane forecasts on **Thursday 31 July**. We will also be releasing two-week forecasts for Atlantic TC activity during the climatological peak of the season from August-October. A verification and discussion of all 2014 forecasts will be issued in late November 2014. All of these forecasts will be available on the web at: http://hurricane.atmos.colostate.edu/Forecasts.

6 Acknowledgments

Besides the individuals named on page 3, there have been a number of other meteorologists that have furnished us with data and given valuable assessments of the current state of global atmospheric and oceanic conditions. These include Brian McNoldy, Art Douglas, Ray Zehr, Mark DeMaria, Todd Kimberlain, Paul Roundy and Amato Evan. In addition, Barbara Brumit and Amie Hedstrom have provided excellent manuscript, graphical and data analysis and assistance over a number of years. We have profited over the years from many in-depth discussions with most of the current and past NHC hurricane forecasters. The second author would further like to acknowledge the encouragement he has received for this type of forecasting research application from Neil Frank, Robert Sheets, Robert Burpee, Jerry Jarrell, Max Mayfield, and Bill Read former directors of the National Hurricane Center (NHC), and the current director, Rick Knabb.