The Outlook for the 2015 North Atlantic Hurricane Season

Hurricane Genesis & Outlook (HUGO) Project

(June 15, 2015)

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Summary

In April 15, the CCU's HUGO team issued April forecast anticipating a below to near normal North Atlantic hurricane season for 2015.

Based on new available climate/oceanic data (April-May), especially the updated projection of ENSO index based on observation in May, and the anomalous SST observation in North Atlantic Ocean Basin (April-May), **this updated June forecast foresees a below normal hurricane season in 2015.** Prediction variables have adjustment in model estimated values and ranges comparing with April forecast. **Table 1** summarized both April and June forecasts for all six prediction categories:

Category	Forecast Value		Forecast Range		Long-term Average	CSU
	April	June	April	June	(1950-2014)	
ACE	60	45	[50~70]	[30~60]	102	40
TS	10	8	[9~11]	[6~9]	12	7
NH	5	3	[3~6]	[2~5]	6.1	3
MH	1	1	[1~2]	[1~2]	2.6	1
ECLF	0.14	0.31	[0~1]	[0~1]	0.65	N/A
GMLF	0.10	0.38	[0~1]	[0~1]	0.95	N/A

Table 1 Summary of the 2015 Atlantic Basin Seasonal Hurricane Forecast (April and June)

II. Parameter update

Historical performance shows that ENSO model forecast skills generally increase as the lead time decreases. Forecasts of June, September and October ENSO indices are much more accurate when made in May than made in March. Differences among the forecasts of the models reflect both differences in model design, and actual uncertainty in the forecast of the possible future SST scenario. Due to the continuous warming in the East Equatorial Pacific, majority of dynamical and statistical model predictions issued during May 2015 predict strengthening El Niño SST conditions through northern summer 2015, with El Niño continuing throughout the rest of 2015. (**Figure 1b**). Compared with April forecast (**Figure 1a**), an adjustment was made for ENSO index in May and projected ENSO index in June, September and October. Historically, tropical cyclone genesis in North Atlantic Ocean is restrained (inhibited) by emergence of El-Nino event.

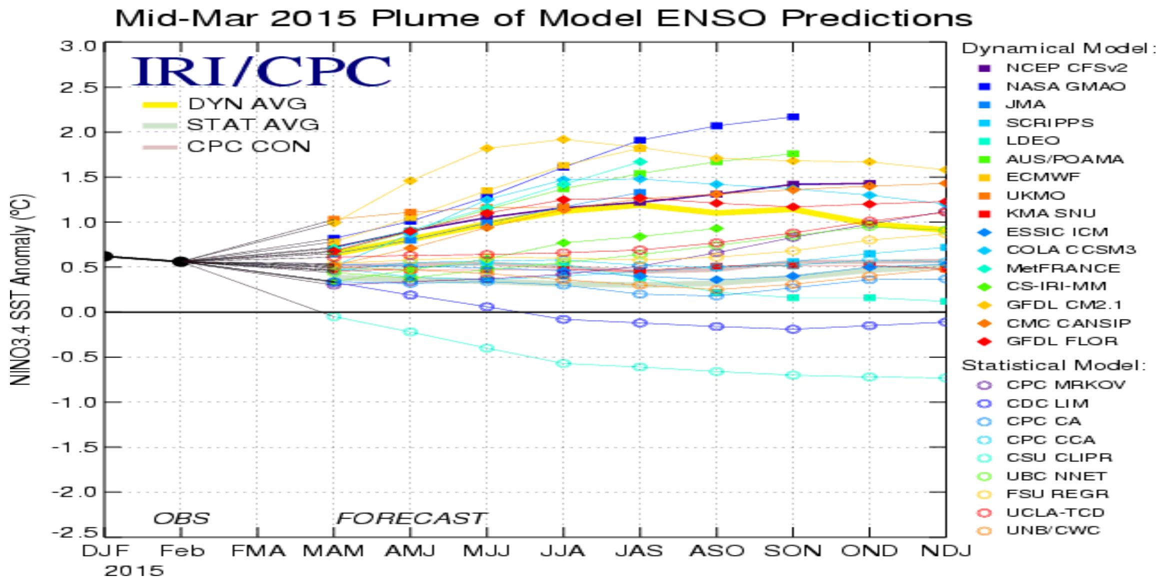


Figure 1a

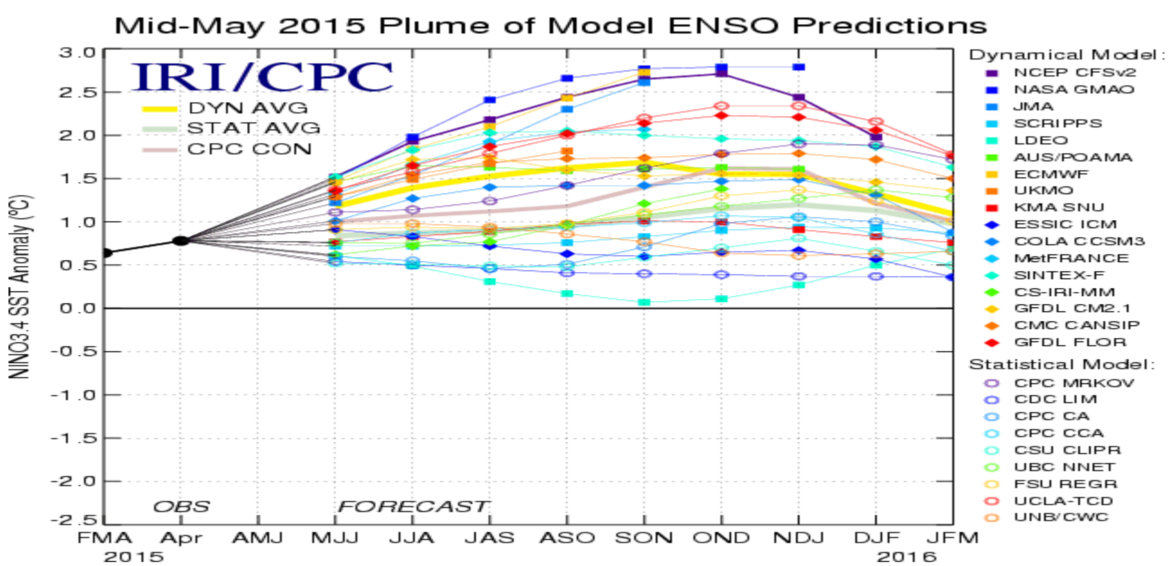


Figure 1b

(From http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/)

Table 2 shows the projection summary of major dynamical/statistic models from universities, government and research institutions in May.

Table2

Model	Seasons (2015-2016)								
Model	**MJJ**	**JJA**	**JAS**	**ASO**	**SON**	**OND**	**NDJ**	**DJF**	**JFM**
Dynamical models									
NCEP CFS version 2	1.5	1.9	2.2	2.4	2.7	2.7	2.4	2	
NASA GMAO model	1.5	2	2.4	2.7	2.8	2.8	2.8		
Japan Met. Agency model	1.2	1.5	1.9	2.3	2.6				
Scripps Inst. HCM	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9
Lamont-Doherty model	0.6	0.5	0.3	0.2	0.1	0.1	0.3	0.5	0.7
POAMA (Austr) model	1.5	1.7	1.6	1.6	1.6	1.6	1.6		
ECMWF model	1.5	1.8	2.1	2.4	2.7				
UKMO model	1.3	1.5	1.7	1.8					
KMA (Korea) SNU model	0.8	0.8	0.9	1	1	1	0.9	0.8	0.8
ESSIC Intermed. Coupled model	0.9	0.8	0.7	0.6	0.6	0.7	0.7	0.6	0.4
COLA CCSM3 model	1	1.3	1.4	1.4	1.4	1.5	1.5	1.3	0.9
MÉTÉO FRANCE model	1.3	1.7	1.9	2	2.1				
Japan Frontier Coupled model	1.5	1.8	2	2.1	2	2	1.9	1.9	1.6
CSIR-IRI 3-model MME	0.6	0.7	0.8	1	1.2	1.4			
GFDL CM2.1 Coupled Climate model	1.5	1.7	1.7	1.6	1.5	1.6	1.5	1.5	1.4
Canadian Coupled Fcst Sys	1.3	1.5	1.7	1.7	1.7	1.8	1.8	1.7	1.5
	1.4	1.7	1.9	2	2.1	2.2	2.2	2.1	1.8
Average, dynamical models	*1.2*	*1.4*	*1.5*	*1.6*	*1.7*	*1.6*	*1.6*	*1.3*	*1.1*
Statistical models									
NCEP/CPC Markov model	1.1	1.1	1.2	1.4	1.6	1.8	1.9	1.9	1.7
NOAA/CDC Linear Inverse	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
NCEP/CPC Constructed Analog	0.6	0.6	0.5	0.5	0.7	1	1.1	1	0.8
NCEP/CPC Can Cor Anal	0.8	0.9	0.9	0.9	1	1.1	1.1	0.9	0.7
Landsea/Knaff CLIPER	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.7	0.5
Univ. BC Neural Network	0.8	0.8	0.9	1	1.1	1.2	1.3	1.4	1.3
FSU Regression	0.9	0.9	0.9	1	1.1	1.3	1.4	1.2	1
TCD – UCLA	1.4	1.6	1.8	2	2.2	2.3	2.3	2.2	1.8
UNB/CWC Nonlinear PCA	1	1	0.9	0.9	0.8	0.6	0.6	0.6	0.7
Average, statistical models	*0.8*	*0.9*	*0.9*	*1*	*1.1*	*1.2*	*1.2*	*1.1*	*1*
Average, all models	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**	**1.4**	**1.4**	**1.2**	**1**

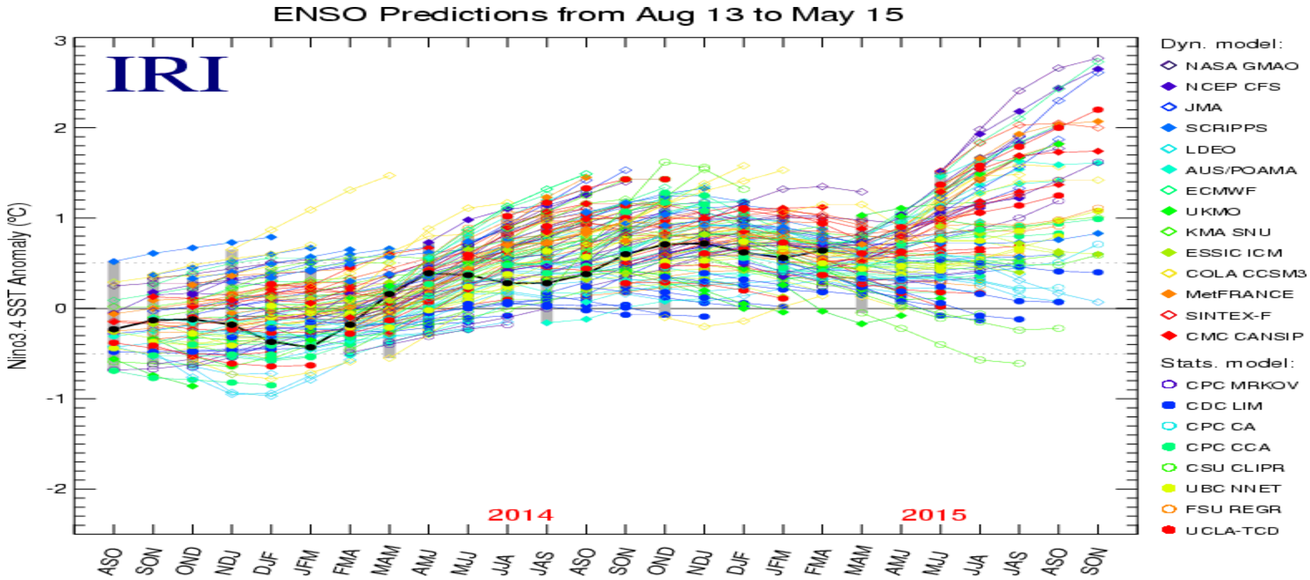


Figure 2

Figure 2 compares the model projection with observation (black solid line) during the period from August 2013 to May 2015. It seems the average projection fit observation better than individual projection.

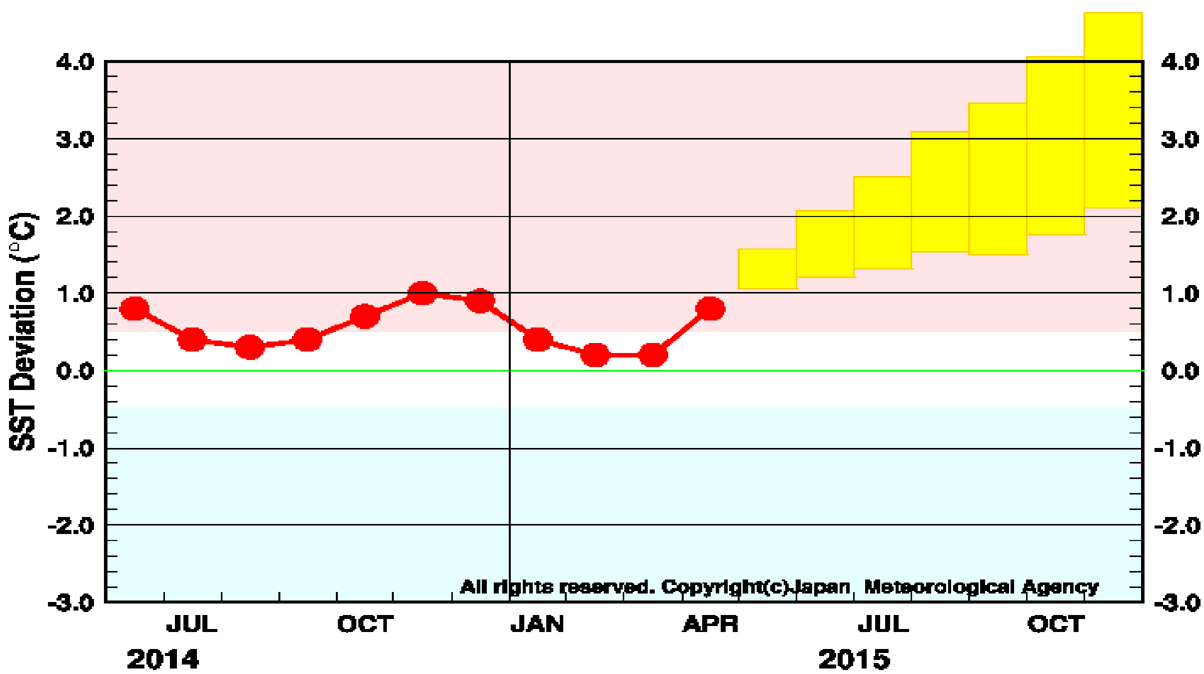


Figure 3 Projection of ENSO index from JMA model

Figure 3 indicates a time series of the monthly sea surface temperature (SST) deviation for NINO.3 (5ºN-5ºS, 150ºW-90ºW), NINO.WEST (10ºN-EQ, 130ºE-150ºE) regions. Thick line with closed circle shows the observed SST deviation and boxes show the predicted one for the next six months by JMA prediction model. Each box denotes the range where the SST deviation will be included with the probability of 70%.

Figure 4a, b displays the seasonal anomalous SST in the period of January-March and March-May. In majority of tropical Atlantic Ocean, minor change is observed in both magnitude and

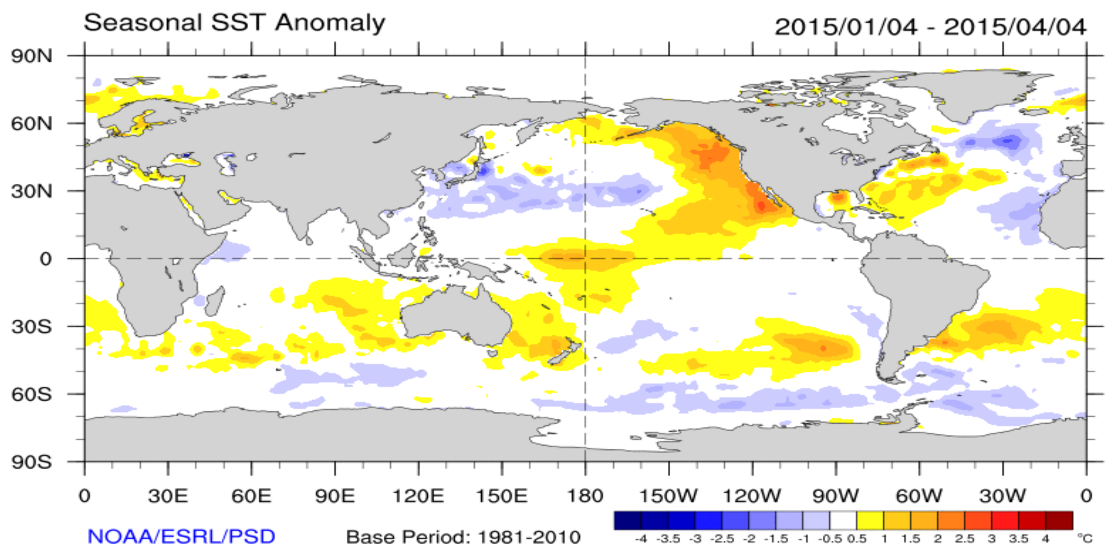


Figure 4a Anomalous SST in the period of January-March
(Anomalies are based on the 1951-1980 time period)

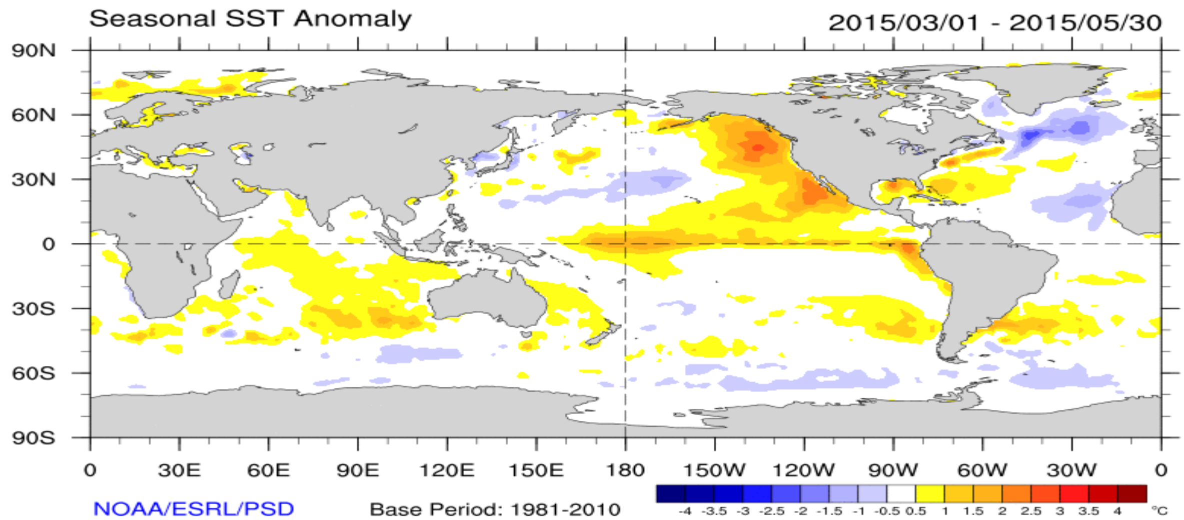


Figure 4b Anomalous SST in period of January-May
(Anomalies are based on the 1951-1980 time period)

distribution pattern, therefore SSTA index applied in April and June forecasts are similar.

The spatial distribution of SST in the Atlantic Basin plays a crucial role in tropical cyclone formation and development. Based on 65 years (1950-2014) historical record, correlations between hurricane predicted categories (ACE, TS, NH, MH, ECLF, GMLF) and 2-dimensional SST in Atlantic Basin during the period of January-May is analyzed. In each case, anomalous SST time series are extracted from those most significant correlation domains, and applied as predictors by TC category. For ACE prediction, the anomalous SST time series is taken at longitude from 4ºW to 22ºW, latitude from 24ºN to 42ºN; For TS & NH, longitude from 22ºW to 48ºW, latitude from 0º to 16ºN; For MH, longitude from 24ºW to 50ºW, latitude from 0º N to 18ºN; For ECLF, longitude from 24 ºW to 40ºW, latitude from 18º S to 40ºS; For GMLF, longitude from 36ºW to 10ºW, latitude from 28ºS to 38ºS (**Figure 5)**.

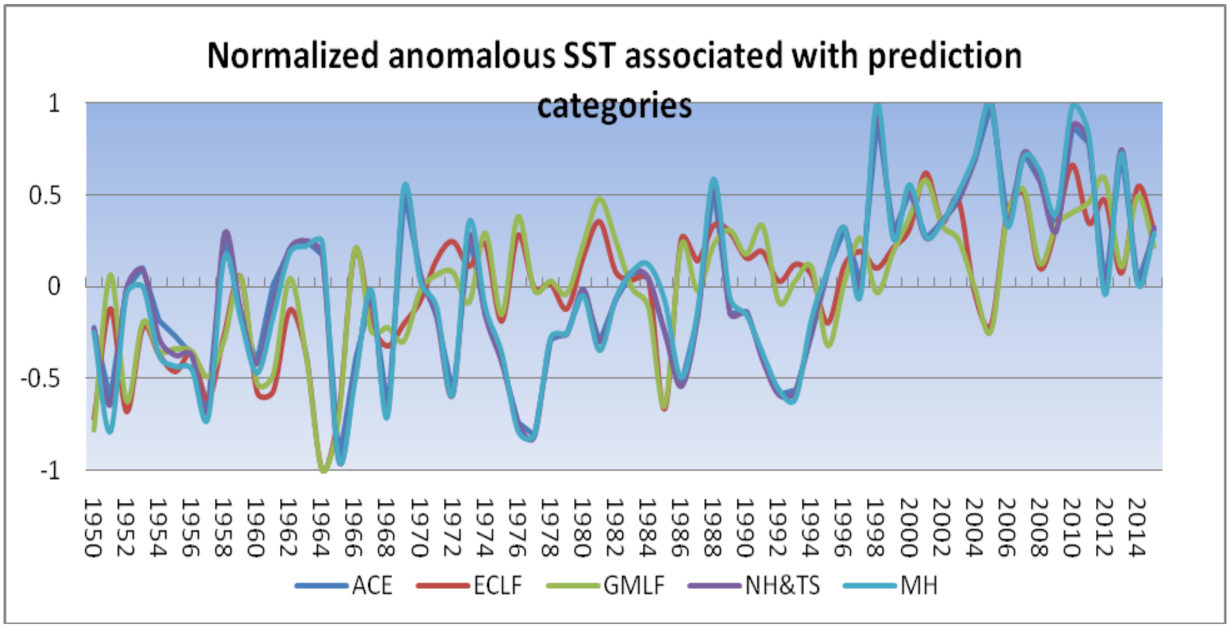


Figure 5 Anomalous SST for different prediction categories

Table 2 provides a list of updated predictors applied in June 2014 forecasting scheme.

Table2. Listing of June (April) 2015 predictors: A plus (+) means that positive values of the parameter indicate increased hurricane activity this year, and a minus (-) means that positive values of the parameter indicate decreased hurricane activity this year.

Predictors		Anomalies for June (April) 2015 forecast
a) Atlantic Multi-decadal Oscillation (AMO) (January-May)	(+)	0.0646 (0.0023)
b) Atlantic Multi-decadal Oscillation (AMO) (December 2014 -January)	(+)	0.2092 (0.2092)
c) Tropical Atlantic Meriditional Mode (AMM) (February-May)	(+)	-0.5941 (-0.2313)
d) Tropical South Atlantic (TSA) (January-May)	(-)	0.4296 (0.6674)
e) SST anomaly selected for ACE prediction (January-May)	(+)	0.2878 (0.3393)
f) SST anomaly selected for TS/NH prediction (January-May)	(+)	0.3212 (0.3487)
g) SST anomaly selected for MH prediction (January-May)	(+)	0.2880 (0.3072)
h) SST anomaly selected for ECLF prediction (January-May)	(-)	0.3107 (0.7761)
i) SST anomaly selected for GMLF prediction (January-May)	(+)	0.2215 (0.2382)
j) JMA El Nino-Southern Oscillation index (ENSO) (May-June)	(-)	1.40 (0.95)
k) JMA El Nino-Southern Oscillation index (ENSO) (September-October)	(-)	2.60 (1.55)

Predictors (a-i) in Table2 are observed values. ENSO index in June and September-October are projected values. In the following, prediction schemes for the listed category in Part II are analyzed.

III. June forecast for the 2015 hurricane season

1) North Atlantic Accumulated Cyclone Energy (ACE)

Table3. Analog years for 2015 ACE with associated predictors (**updated in June**)

Year	ACE	SSTA	ENSO	AMM	AMO
1965	**84**	**-0.2310**	**1.2000**	**-0.2386**	**-0.2415**
1982	**29**	**0.3475**	**1.9500**	**-0.0439**	**-0.1995**
1987	**34**	**0.2789**	**1.5000**	**-0.1881**	**-0.1092**
1997	**40**	**0.0052**	**3.1000**	**0.5443**	**0.0107**
2009	**53**	**0.1089**	**1.1000**	**-0.5596**	**-0.1830**
2014	**60**	**0.1621**	**0.7000**	**-0.4834**	**-0.0392**
2015	**?**	**0.2878**	**2.6000**	**-0.5941**	**0.0646**
Average (1950-2014)	**101**				

The ACE is a measure of total North Atlantic TC activity. It is defined as the sum of the squares of the maximum sustained surface wind speed (knots) measured every six hours for all named systems while they are at least of tropical storm strength (Bell, et al. 2000). The 65-year (1950-2014) long-term mean ACE is 101 (10^4 kt^2) and the median ACE value is 89.5. Using new data available in June, model estimation of this year's ACE is 68, which is 67.3% of the 1950-2014 average. The upper and lower bounds of model estimation within 70% confidence level (CFL) are [64, 72]. However, model yielded ACE might be overestimated compared to the analog year observation. There were total six years in history with similar predictor combination to the year 2015 (**Table 3**), All of them fell in below-normal hurricane season category (1965, 1982, 1987, 1997, 2009 and 2014). In these six analog years, ACE ranged from 29 to 84 with median (34) and average (50). Combined the analog year observation with model output, the CCU HUGO June forecast for ACE in 2015 ranges from 30~60, centered at 45.

2) The number of hurricanes (NH) and tropical storms (TS) in the North Atlantic Ocean Basin, including the Gulf of Mexico and the Caribbean Sea

Over the past 65 years (1950-2014), the number of TS has ranged from 4 (1983) to 28 (2005). From the analog table (**Table 4**), there were six years in history with the similar predictor combination as 2015. The number of TS in those six years ranges from 4 to 9, average is 7.2. For the year 2015, model predicted theoretical value for this category is 8.5 (10.8 in April forecast), which is 70.8% of the 65-year average (12). The range of the TS number at the 70% confidence level is [7 10]. Combined with analog analysis, the most likely number of TS in the year 2015 is 8 (10 in April), and the likely range is [6, 9].

Table4. Analog years for 2015 with TS/NH with associated predictors (**updated in June**)

Year	NH	TS	ACE	SSTA	ENSO	AMM	AMO
1982	**2**	**6**	**29**	**0.0749**	**1.95**	**-0.0439**	**-0.1995**
1983	**3**	**4**	**17**	**0.0810**	**0.25**	**-0.4521**	**-0.1441**
1987	**3**	**7**	**34**	**0.1334**	**1.50**	**-0.1881**	**-0.1092**
1997	**3**	**8**	**40**	**0.0052**	**3.10**	**0.5543**	**0.0107**
2009	**3**	**9**	**51**	**0.0698**	**1.10**	**-0.5596**	**-0.1830**
2014	**6**	**9**	**60**	**0.2215**	**0.70**	**-0.3564**	**-0.0328**
2015	**?**	**?**	**45**	**0.3487**	**2.60**	**-0.5941**	**0.0646**
Average (1950-2014)	**6**	**12**					

3) The number of hurricanes (NH) in the North Atlantic Ocean Basin, including the Gulf of Mexico and the Caribbean Sea

The NH for the NAOB has varied across a large range over the past few decades. There was a low of 2 in 1982 and a record high of 15 in 2005. The average NH from 1950 to 2014 is 6.1. With the similar predictors applied (**Table 4**) in those analog years, the average number of hurricanes was 3.3, varying in the range from 2 to 6. Our model estimation for this variable for 2015 is 4.2, which is 69% of the 1950-2014 average (6.1). The predicted range of NH associated with 70% confidence level is [3, 5]. Combined with analog year observation, the most likely NH number is 3, range is 2~5. A probability forecast is presented in **Table 5**.

Table5. Probabilities associated with estimated hurricane number in 2015

Number	0	1	2	3	4	5	6	7
Probability	5.0%	14.9%	22.3%	22.4%	16.8%	10.1%	5.0%	2.6%

4). Number of major hurricanes (MH) in the NAOB, including the Gulf of Mexico and the Caribbean Sea

The annual number of MH in history (1950-2014) ranges from 0 to 8, with 2.6 on average. From the 8 analog year analysis (**Table 6**), all those MH numbers fell in the range of [1, 2] with average 1.25. The most likely major hurricane number is one.

Table6. Analog years for 2015 MH with associated predictors (**updated in June**)

Year	MH	SSTA	ENSO	AMM	AMO
1982	**1**	**-0.0764**	**1.9500**	**-0.0439**	**-0.1995**
1983	**1**	**0.3033**	**0.2500**	**-0.1614**	**-0.0512**
1987	**1**	**0.1050**	**1.5000**	**-0.1881**	**-0.1092**
1990	**1**	**0.1580**	**0.1500**	**-0.1354**	**-0.3018**

1993	**1**	**-0.0933**	**0.3000**	**-0.4995**	**-0.3974**
1997	**1**	**-0.0493**	**3.1000**	**0.5443**	**0.0107**
2009	**2**	**-0.0582**	**1.1000**	**-0.5596**	**-0.1831**
2014	**2**	**0.3427**	**0.7000**	**-0.4838**	**-0.0392**
2015	**?**	**0.2880**	**2.6000**	**-0.5941**	**0.0646**
Average (1950-2013)	**2.6**				

The theoretical estimation from the prediction model is 1.3, which is only 50% of the long-term average. Predicted range with 70% confident is [0.9, 1.8]. Combined with the above analog year analysis, the most likely number of major hurricane is one with a range of 1~2. Probability forecast is given in **Table 7**.

Table7. Probabilities associated with the estimated MH number

Number	0	1	2	3	4
Probability	27.2%	35.4%	23.0%	10.0%	3.2%

5) Landfall hurricane numbers along the U.S. Eastern Seaboard.

Our ECLF prediction model largely depends on the identification of hurricane season type (Yan, et al 2014b). According to NOAA's classification of hurricane season type (Bell, et al. 2000), a below normal season should meet: a) An ACE index below 66 x 10^4 kt^2, or b) An ACE index below 64 with 9 or fewer named storms, 4 or fewer hurricanes, 1 or fewer major hurricanes. A near-normal season will typically have an ACE range of 66~111 x 10^4 kt^2 (**Table 8**)

Table8. Classification of hurricane season type

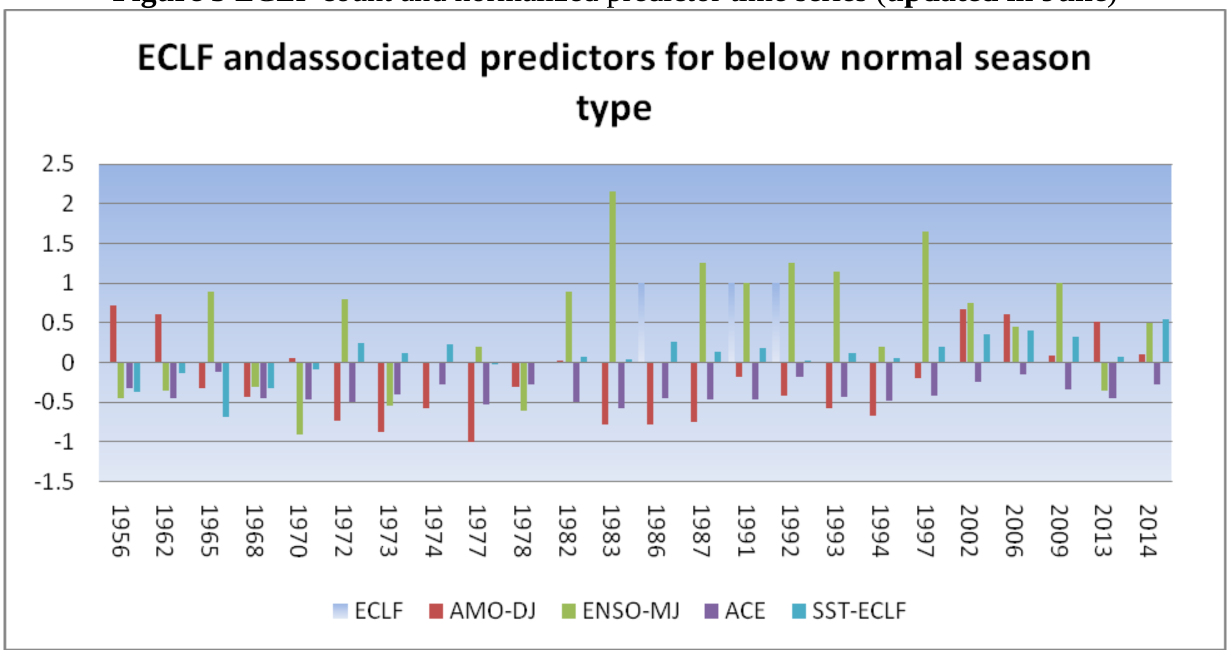
Season Type	Mean # of Tropical Storms	Range of Named Storms	Mean # of Hurricanes	Range of Hurricanes	Mean # of Major Hurricanes	Range of Major Hurricanes
Near-Normal	12.3	10 to 15	6.3	4 to 9	2.3	1 to 4
Below-Normal	6.7	4 to 9	3.3	2 to 4	1.0	0 to 2
All Seasons	12.1	4 to 28	6.4	2 to 15	2.7	0 to 7

(From http://www.cpc.ncep.noaa.gov/products/outlooks/background_information.shtml)

Based on predictors available in June, the AMO based model estimation of this year's ACE ranged 64~72. However, analog year analysis suggests a downward adjustment of the model estimation. As shown in **Table 3**, all of the total six analog years fell into the below normal season category with ACE values ranging from 29 to 84 with median of 34 and average of 50, and five out of the total six analog years' ACE are below the 64 threshold. Combined model output with historical analog year analysis, predicted ACE in 2015 ranged from 30 to 60, which is well below the 65-year average (101); number of tropical storm ranged 6~9; hurricane number ranged 2~5; major hurricane number ranged from 1 to 2. Checking with the criteria listed in **Table 8**, the 2015 hurricane season very likely falls in below normal season type. Combining the model outputs and analog analyses, we therefore call for a below normal hurricane season, and the landfall prediction model will be run for below normal season types.

From 1950 to 2014, a total of 25 years fell into the below normal season type category (**Figure 5**). Landfall numbers varied from 0 to 1. No landfalls occurred in 22 years (88%), one landfall in 3 years (12%). The average landfall count in those 25 years is 0.12. Based on these statistics, we conclude that the most likely range of the landfall number is 0 or 1; with 0 at a higher probability.

Figure 5 ECLF count and normalized predictor time series (**updated in June**)



There were 7 years in history (1950-2014) with similar predictor combinations alike those of 2015 (**Table 9**). While years 2002 and 2006 fell into the near-normal category, the other five years (1982, 1997, 2009, 2013 and 20134) fell into the below-normal category. Four out of the five below-normal years experienced no landfalls on the U.S. Eastern Seaboard. Therefore from those analog year analysis, the highest probability number of ECLF in 2015 is 0, with 1 the second most probable.

Table9. Analog years of 2015 with predictors and associated landfall events listed (**updated in June**)

Year	Landfalls	AMO	ENSO (May-June)	ACE	SST
1982	0	0.0267	0.9	-0.4937	0.0929
1997	0	-0.2022	1.65	-0.4187	0.1924
2002	0	0.6792	0.75	-0.2413	0.3782
2006	0	0.6065	0.45	-0.1527	0.4747
2009	0	0.087	1	-0.3437	0.3744
2013	0	0.5147	-0.35	-0.446	0.0744
2014	1	0.1103	0.80	-0.2823	0.5018
2015	?	0.2092	1.40	-0.3764	0.3107

It is of note that for below normal season type, our model performance is degraded due to too many zeros of the prediction variables (landfall numbers), in the time series records. Therefore we must necessarily combine model(s) output with analog year analyses.

The AMO value (0.2092) (average of Dec. 2014 and Jan 2015) suggests an ocean condition that may not significantly increase or decrease hurricane landfall activity along the U.S. Eastern Seaboard. The ENSO index in June was derived from the JMA forecast model, which has proposed a value of 1.6. Observation in Mid-May and majority of the ENSO prediction models (**Figure 2**) suggested that an El-Nino event has developed in May. The average ENSO index used in this scheme is 1.40. A positive ENSO phase generally inhibits tropical storms from being generated and or further developed by destroying the vertical wind shear structure in the main development region of the cyclone. Since the projected ENSO index is one of the dominant predictors in the model, we will need to update it as new observations becomes available. The anomalous SST time series extracted from the domain (24 ºW to 40ºW, 18º S to 40ºS) displays a negative correlation with the ECLF (Yan, et al, 2010). Therefore, a positive value of SST (0.3107) in 2015 suggests an unfavorable condition for hurricanes making landfall on U.S Eastern Seaboard. The predictors applied in this forecasting scheme are shown in **Figure 5**.

Using updated predictors and CCU HUGO ECLF prediction model for below normal season types, the model yields an estimated intensity = 0.3048, with the lower and upper bounds at the 70% confidence level: [0.012 and 0.6729]. Since the 65-year (1950-2014) ECLF average is 0.65, we therefore estimate the 2015 ECLF is only 46.9% of the long-term average. This percentage was computed via: Estimated intensity (0.3048)/average landfall hurricane number per year (0.65)*100.

Following the computation of the Poisson distribution, a probability forecast for the ECLF for 2015 is presented in **Table 10.** It shows that**:** 1) the maximum probability, 73.7%, is associated with 0 landfalls. The long term (1950-2014) mean of having zero landfall events is 56%; 2) the probability associated with having 1 landfall is 22.5%, where the long-term mean is 30%); and 3) the probability of realizing 2 or more landfalls is 3.8%, with a 65 year mean of 14%. So, the overall estimated probability for 0 or only 1 hurricane making landfall is 96.6%, and where the total 65 year mean is 86%, and for at least 2 landfalls is only 3.8%, where the 65 year mean is 14%.

Table10. Probabilities for U.S. Eastern Seaboard landfall counts (**updated in June**)

Number	0	1	2 or more
Probabilities	73.7%	22.5%	3.8%
Average (1950-2014)	56.0%	30.0%	14%

Based on the CCU HUGO analog analyses of the past 65-years (1950-2014) and our model prediction output, we conclude that the most likely ECLF is 0, the most likely range of ECLF in 2015 is 0 to 1, in that order. As input predictors of the ECLF improve with early August we will update our forecast.

It is of note here that Colorado State University has recently issued a landfall forecast, for the first time, which proposes a 22% probability of 1 land-falling hurricane on the east coast of the U.S.; nominally in keeping with our model prognostication of 22.5%. We assume that they conducted statistical regressions to arrive at their forecast; but do not know for certain.

6) Land-falling hurricanes along the coastline of U.S. Gulf of Mexico (GMLF) states

Many predictors which apply to forecasts of GMLF are not available until July and early August; so an April or June forecast is problematic. Predictors available for this June forecast are the Tropical South Atlantic (TSA) index, and the estimated ACE and SST anomalies extracted from the selected domain (Yan et al, 2010). TSA is derived from mean monthly SST anomalies from 0^{o} to 20ºS and from 10ºE to 30ºW. Its normalized value to date is 0.4296 (comparing with 0.6674 in April forecast), which suggests slightly favorable landfall conditions. The 2015 hurricane season is expected to be below to near normal. A normalized ACE (-0.3764) signals an unfavorable condition for GMLF. Anomalous SST in the selected domain in 2015 is well above normal (0.2215) (comparing with 0.2382 in April forecast), which also signals an unfavorable condition for GMLF. **Table 11** lists eight analog years in history that have similar predictor combinations as 2015. There were 0 landfalls in six years, 1991, 1994, 2006, 2009, 2013 and 2014 and 1 landfall in two years (1986 and 2007). Based on analog year analysis, we conclude that the most likely number of GMLF for 2015 is 0, but in the range from 0 to 1.

Table11. Analog years of 2014 with predictors and associated landfall events listed (**updated in June**)

Year	GMLF	TSA	ACE	SST
1986	**1**	**0.3008**	**-0.446**	**0.1693**
1991	**0**	**0.0295**	**-0.4596**	**0.4770**
1994	**0**	**0.1735**	**-0.4732**	**0.0454**

2006	**0**	**0.0794**	**-0.1527**	**0.5094**
2007	**1**	**0.1790**	**-0.1868**	**0.5576**
2009	**0**	**0.3727**	**-0.3437**	**0.4028**
2013	**0**	**0.2842**	**-0.446**	**0.1084**
2014	**0**	**0.1126**	**-0.2823**	**0.4819**
2015	**?**	**0.4296**	**-0.3764**	**0.2215**

Based on updated TSA and SST in April and May, CCU HUGO Model estimated GMLF theoretical value is 0.38 (comparing with 0.10 in April forecast). Low and upper bounds at the 70% confidence level are 0.21 and 0.67. The 65 year (1950-2014) mean number of GMLF is 0.94. We conclude that the GMLF in 2015 will be 40.4% of the long-term average.

Table12 displays the forecasted landfall probabilities associated with landfall numbers

Table 12 Landfall probability associated with Gulf of Mexico landfall counts

(**Updated in June**)

Number	0	1	>= 2
Probabilities	73.7%	22.5%	3.8%
Climatology	35.0%	41.7%	18.3%

Suppose the GMLF count follows Poisson distribution, the probability of 0 hurricanes making landfall is 73.7%. The probability of 1 landfall is 22.5%. The probability of at least 2 landfalls is only 3.8%. Combined model estimation with our analog analysis, the most likely individual number of GMLF in 2015 is 0. A range with most likely occurrences is 0 and 1 in that order. However, we will update this GMLF forecast when more predictors become available in July and early August.

IV. Conclusions

Analog year analyses for the CCU HUGO 2015 ACE prediction showed that over the 65 year period of 1950 – 2014, all of 6 analog years with similar predictor combinations to that of 2015 fell in the below normal hurricane season category. Combined with our prediction model outputs, the estimated ACE value ($60 \times 10^4 kt^2$) is in the range of 30 ~ 60 ($10^4 kt^2$), which falls in the below-normal category, and is 29.7% ~ 59.4% of the 1950-2014 average. The number of tropical storms is expected to be in the range of 6 to 9, with the hurricane number in the range of 2 ~ 5, and the major hurricane number in the range of 1 ~ 2. In keeping with the NOAA hurricane season classification criterion (Bell et al, 2000), we anticipate a below-normal North Atlantic Hurricane Season for 2015.

Estimated landfall hurricane probabilities for 2015 are given for two target scenarios, strikes along the U.S. Eastern Seaboard, from Key West FL to Nova Scotia, and along the U.S. coastline of the Gulf of Mexico, from Brownsville TX to Key West FL. For each scenario, the individual numbers with maximum estimated probability is 0 for both the U.S. East Coast and along the U.S. coastline of the Gulf Coast, with 1 landfall next in probability for both coastlines. At this time, the range for those two scenarios is zero and then one or [0 ~ 1].

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