


# Developing a tropical cyclone genesis forecast tool: Preliminary results from 2014 quasi-operational testing

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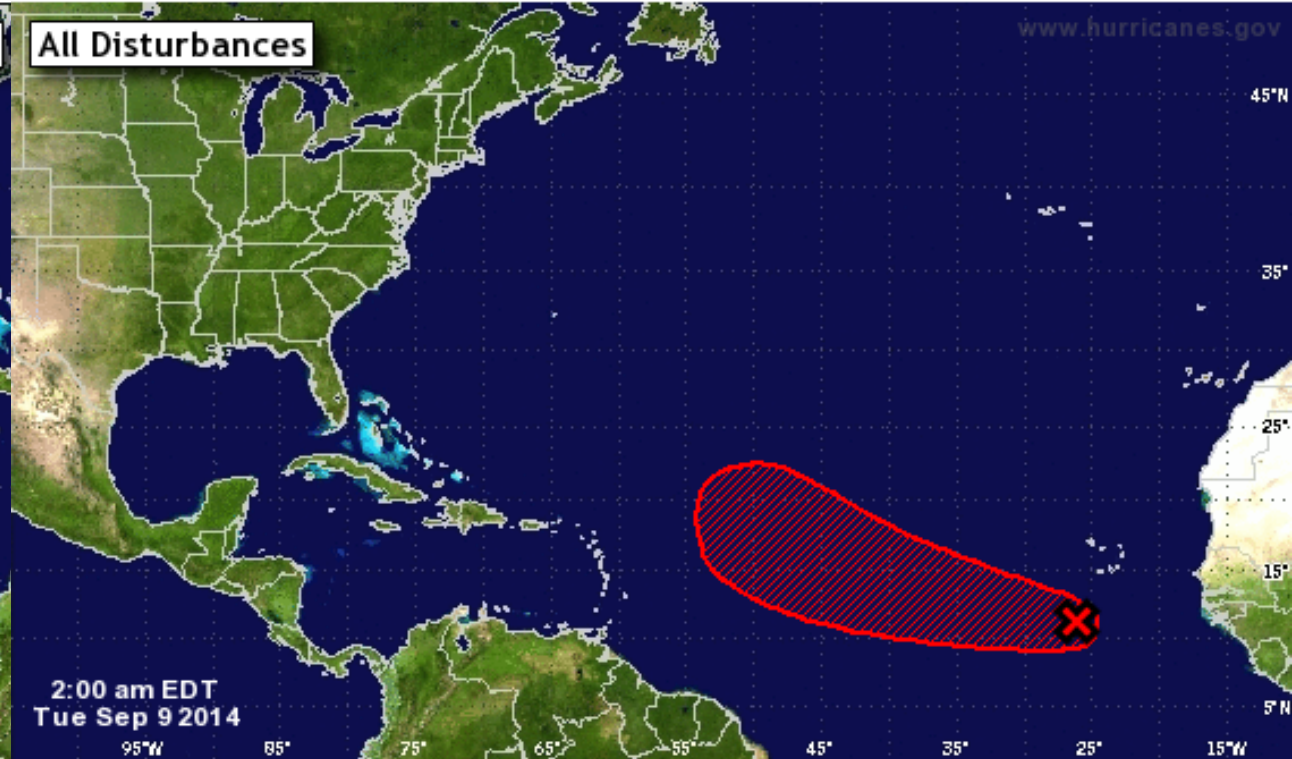
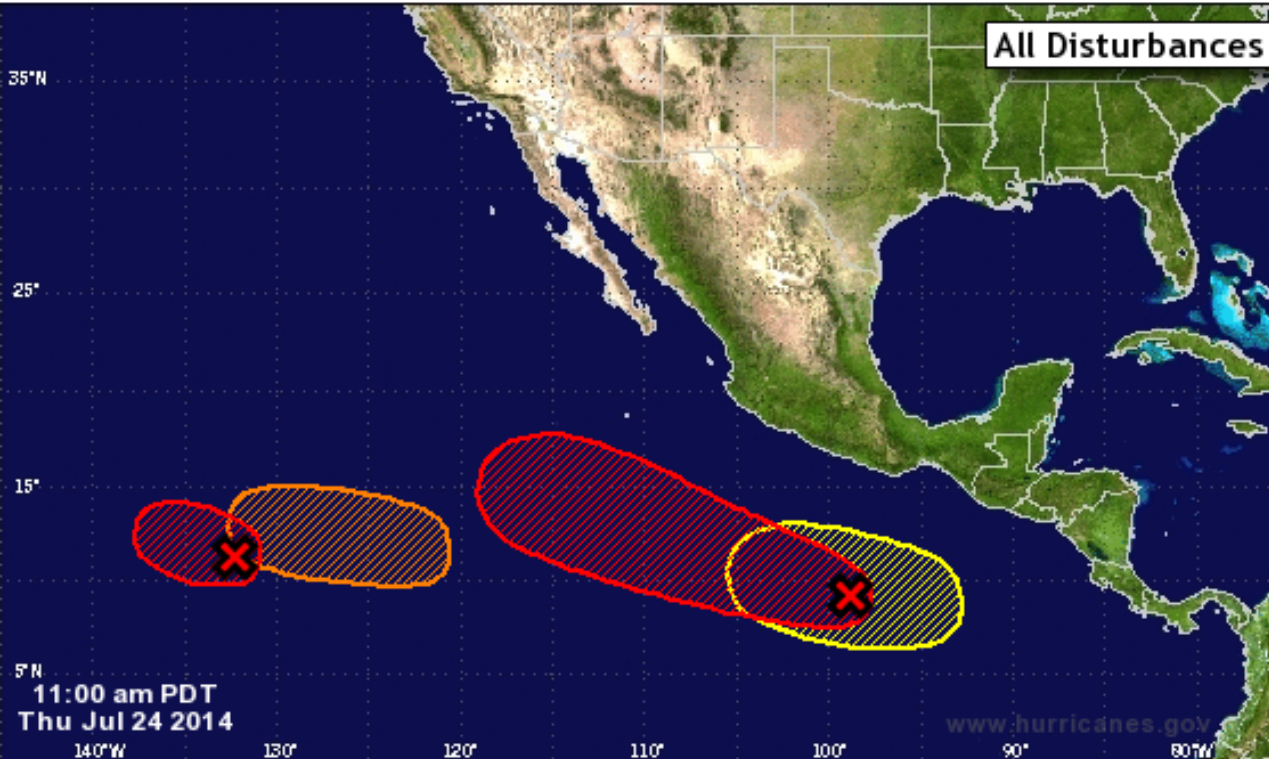
This research is supported by the Joint Hurricane Testbed

# Goal

 Experimental 5-Day Graphical Tropical Weather Outlook  
National Hurricane Center Miami, Florida



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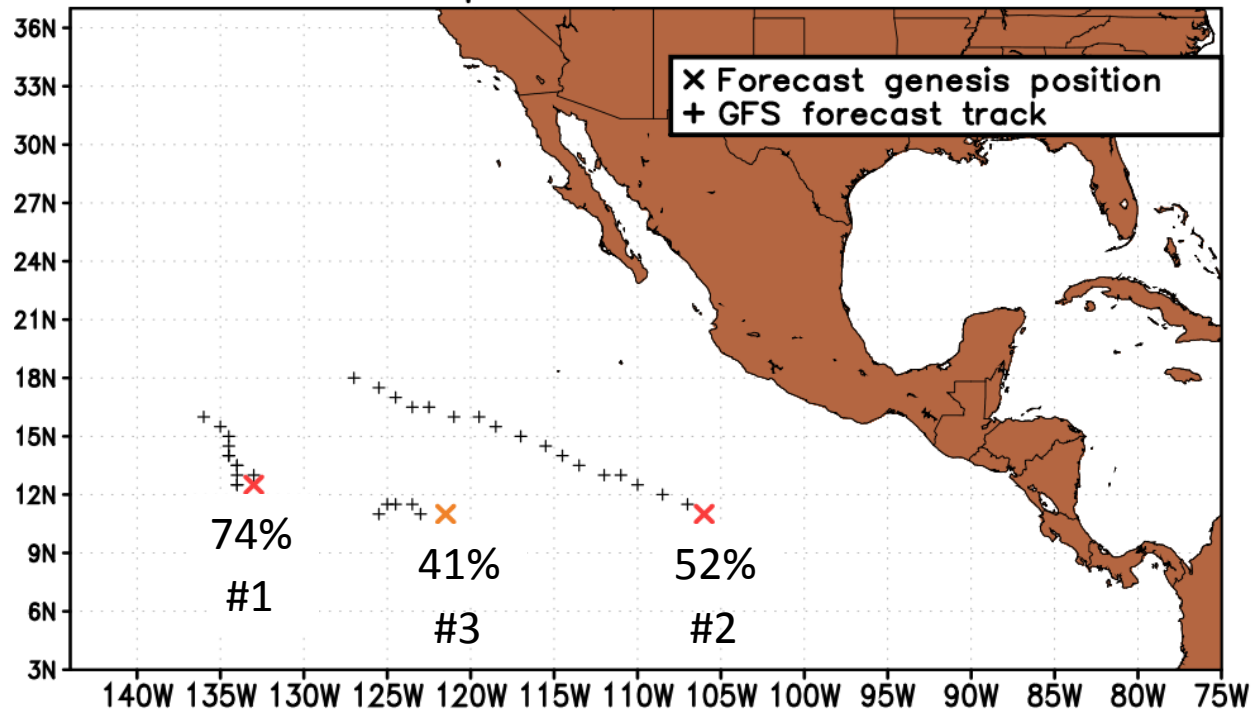
- To create an automated, objective tool that provides probabilistic TC genesis guidance based on global model genesis forecasts.

# Background

- Our prior research verified tropical cyclone (TC) genesis forecasts out to 5 days in 5 global models over the NATL and EPAC during 2004-2013 (Halperin et al. 2013).
- Using results from prior study, developed multiple logistic regression equations of TC genesis probability based on output from each global model.
  - Forecast tool provides probabilistic forecasts of TC genesis at 2 and 5 days.
  - Tested quasi-operationally during 2014 at <http://moe.met.fsu.edu/modelgen>

# Product examples

## Probability of TC genesis within 120 h – GFS



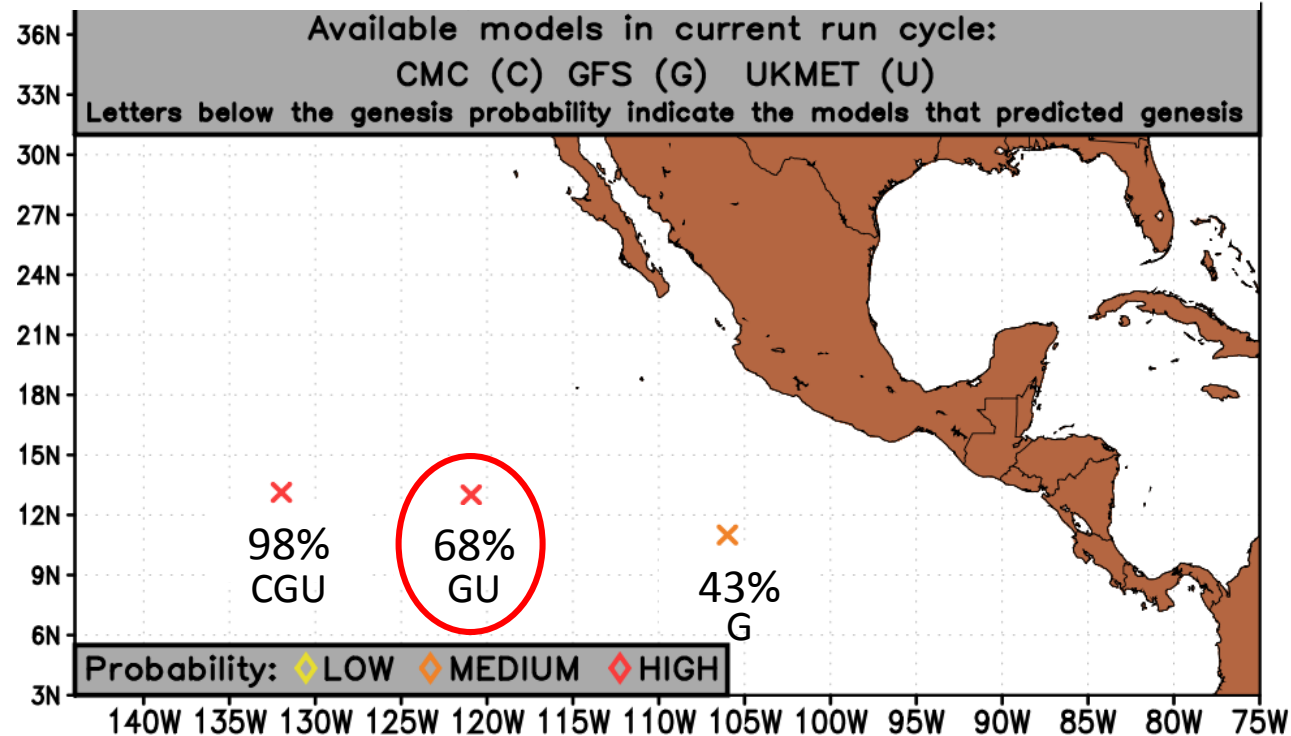
<http://moe.met.fsu.edu/modelgen>

How to calculate genesis probability:

$$\beta = \beta_0 + \beta_1[\text{FHR}] + \beta_2[\text{LAT}] + \beta_3[\text{LH}] + \beta_4[850\zeta']$$

$$P(\text{Gen}) = \frac{e^{\beta}}{1 + e^{\beta}}$$

## Probability of TC genesis within 120 h – CON



<http://moe.met.fsu.edu/modelgen>

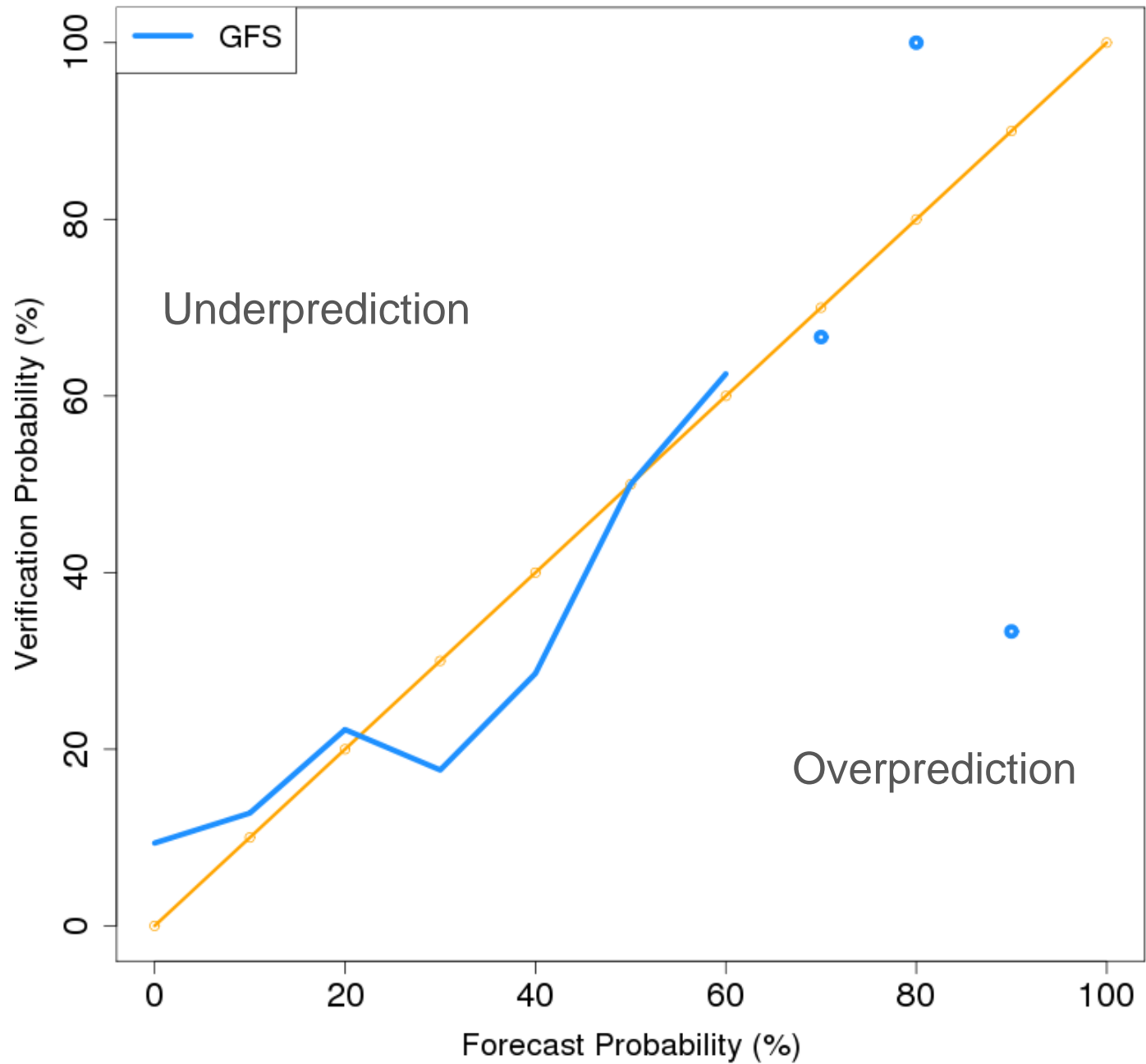
How to calculate consensus forecast:

$$\beta = \beta_0 + \beta_1[P(\text{CMC})] + \beta_2[P(\text{GFS})] + \beta_3[P(\text{UKM})]$$

$$\beta = \beta_0 + \beta_1(0) + \beta_2(0.41) + \beta_3(0.52)$$

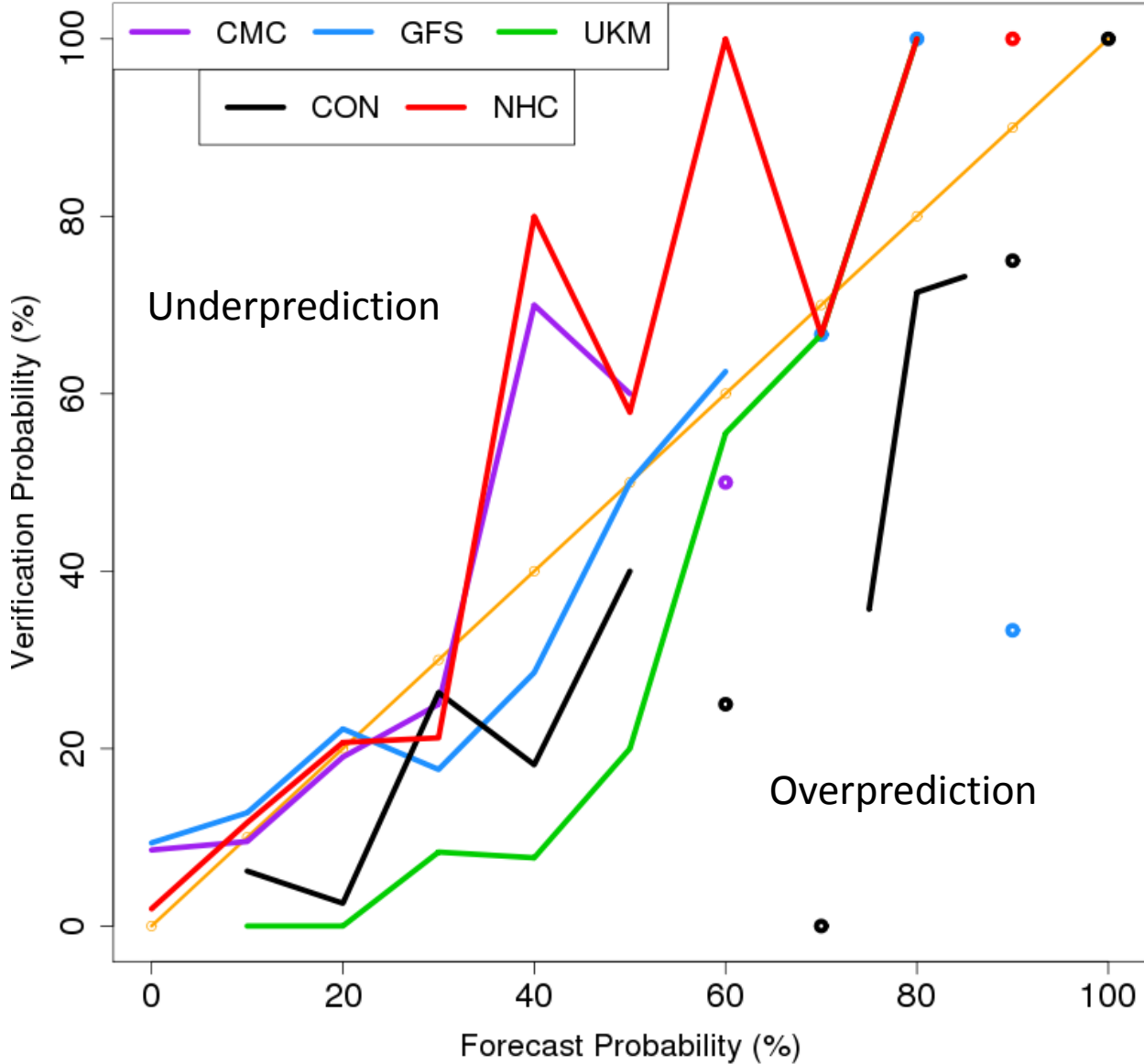
# 2014 Preliminary Verification

# NATL 48 h preliminary 2014 verification





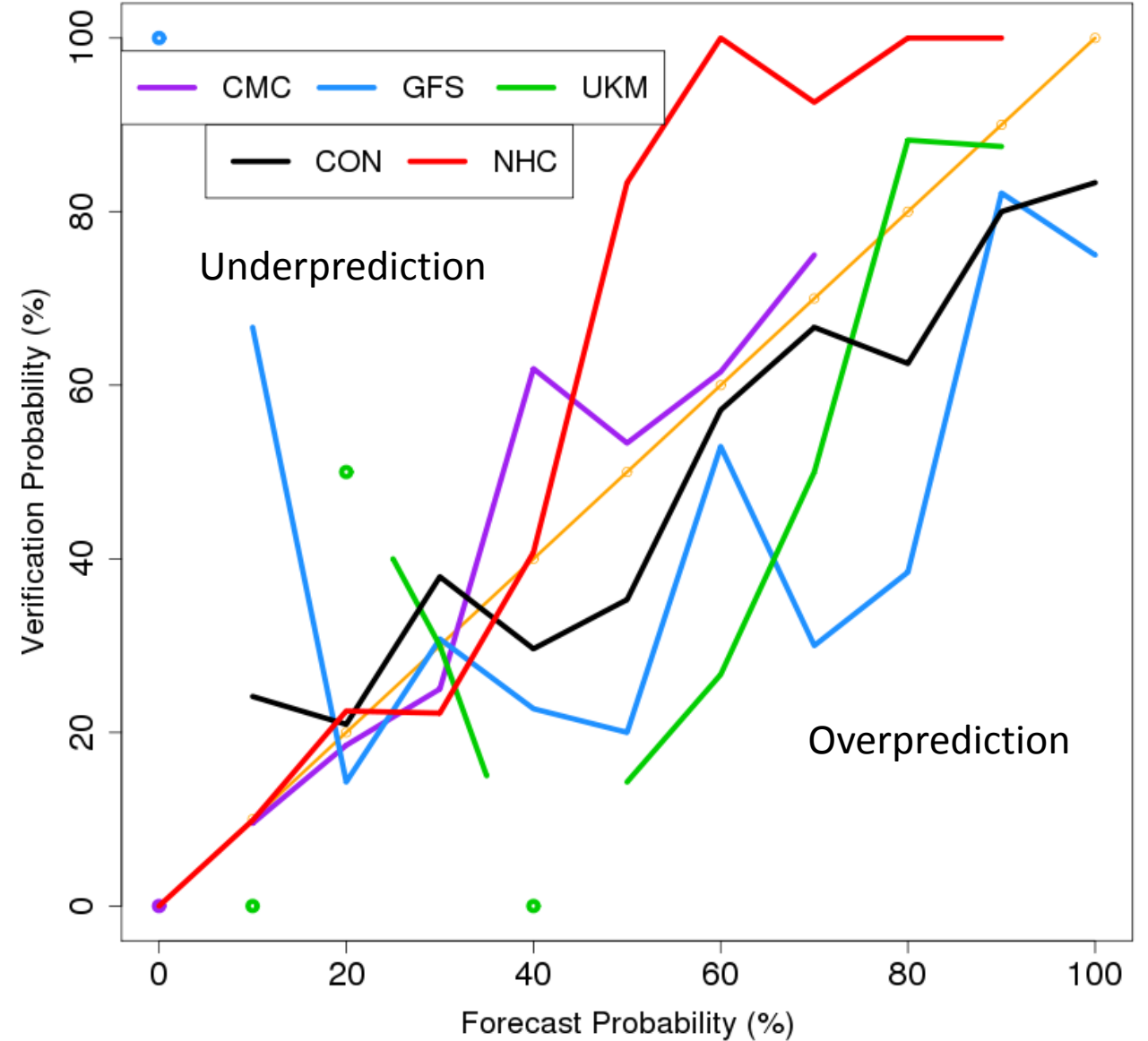
## NATL 48 h preliminary 2014 verification (non-homogeneous)



- **NHC**, **GFS**, and **CMC** well calibrated at lower probability bins.
- **NHC** and **CMC** underpredict at higher probability bins.
- **CON** and **UKM** overpredict at all probability bins.
- Small sample size (points/breaks in lines) at higher forecast probability bins.

- **NHC** well calibrated at lower probability bins, underpredicts at higher bins.
- **CON** and **CMC** fairly well calibrated.
- **GFS** and **UKM** overpredict at most probability bins.

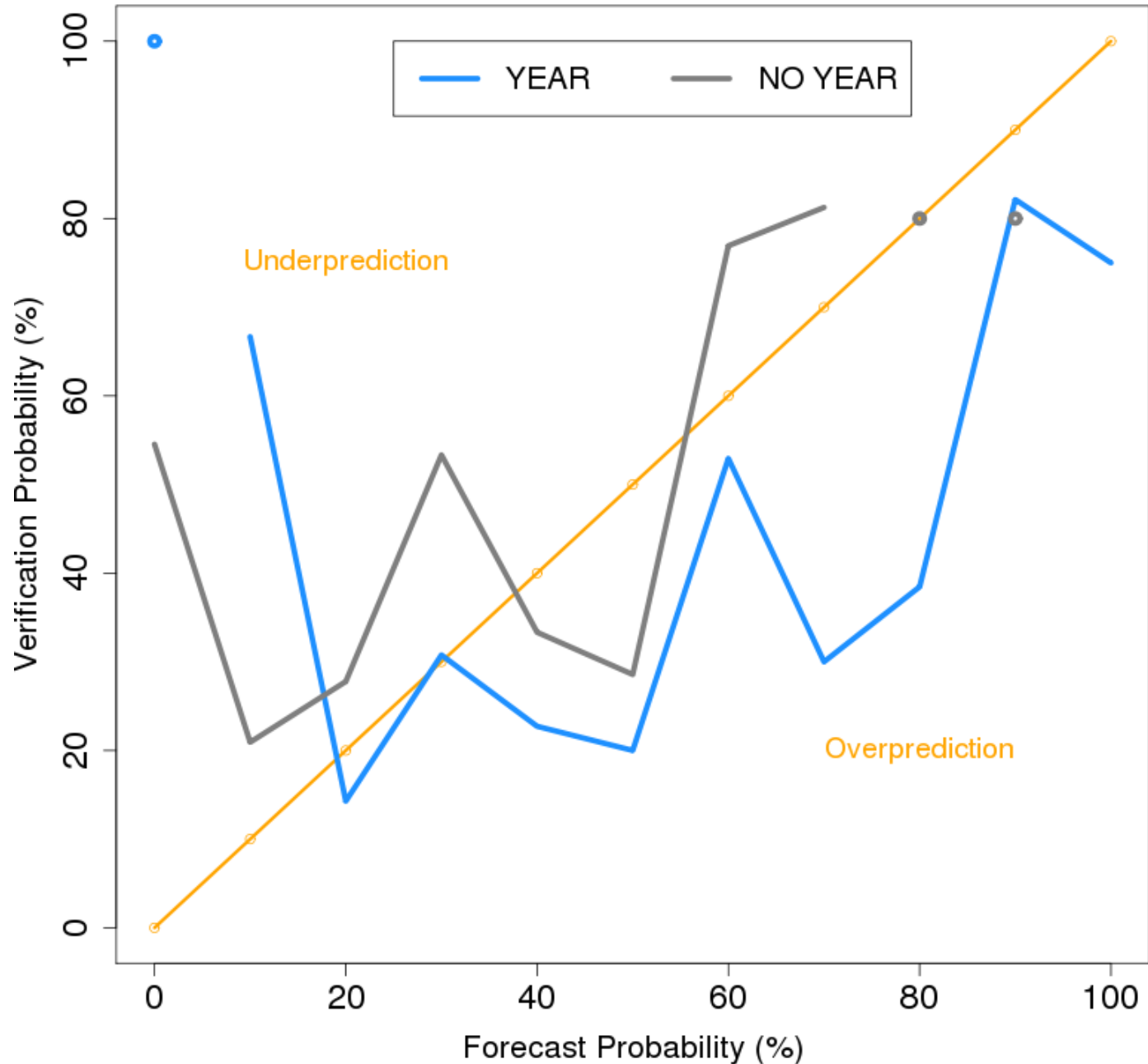
NATL 120 h preliminary 2014 verification (non-homogeneous)



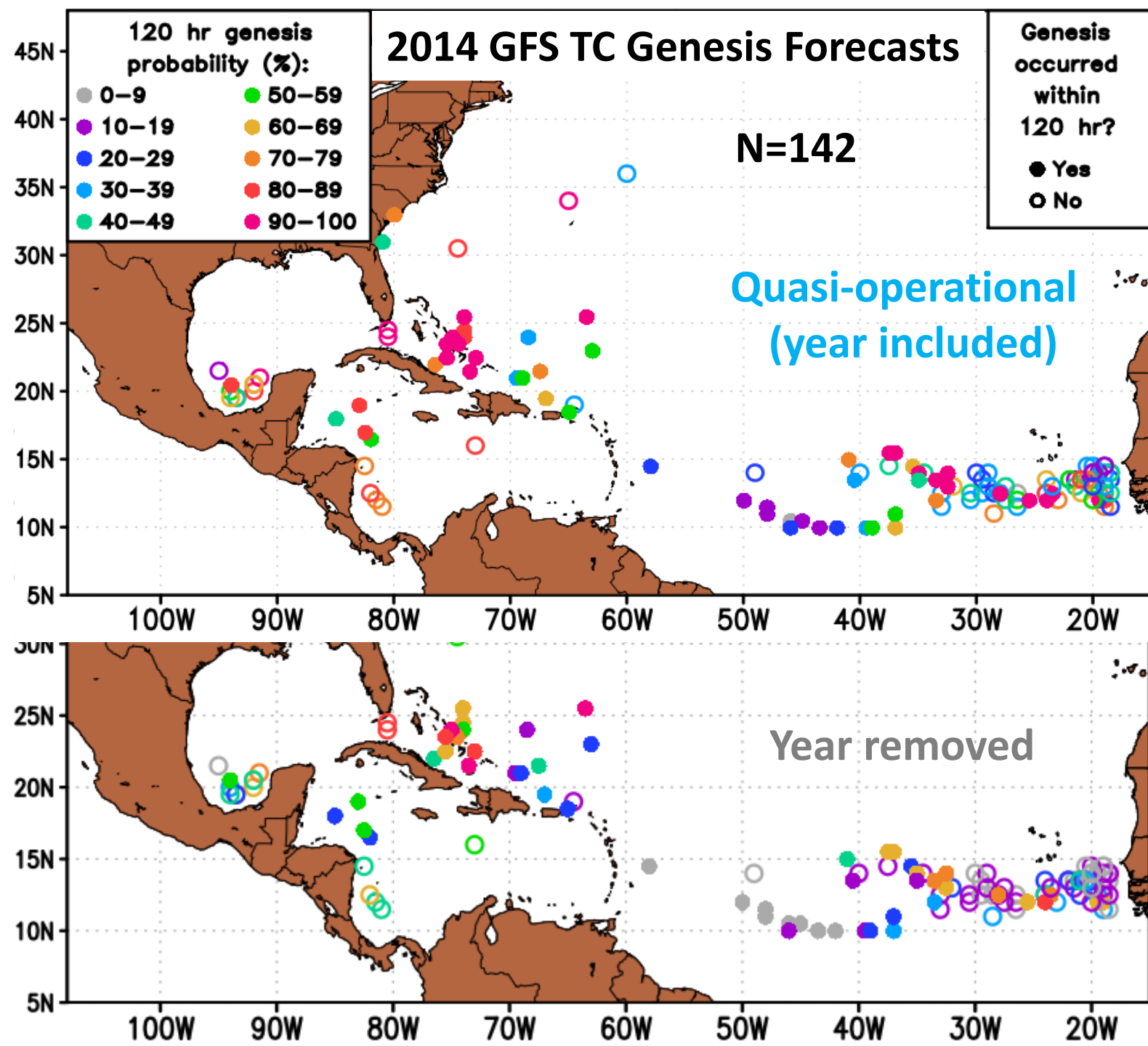
# Potential explanations for performance

- Below average activity over NATL.
- Dry air impacting several AEWs over MDR.
- Despite relatively high number of false alarms, **CMC** may have more consistent biases which regression was able to correct.
- **UKM** model upgrade (horizontal resolution, dynamical core).
- Poor predictor selection and higher false alarm rate compared to 2010-2013 for **GFS**.

## NATL 120 h preliminary 2014 verification (GFS)



- **Quasi-operational** regression equation overpredicted genesis at most forecast probability bins.
- Regression equation with **year removed** as a predictor shows a general shift to lower forecast probabilities.



- **Quasi-operational (top)** probabilities relatively higher overall. Note many of the false alarms over MDR were mid-range probabilities.

- Probabilities with **year removed** (bottom) lower over MDR, W CARIB, GOM. But, lower probabilities for Bertha.

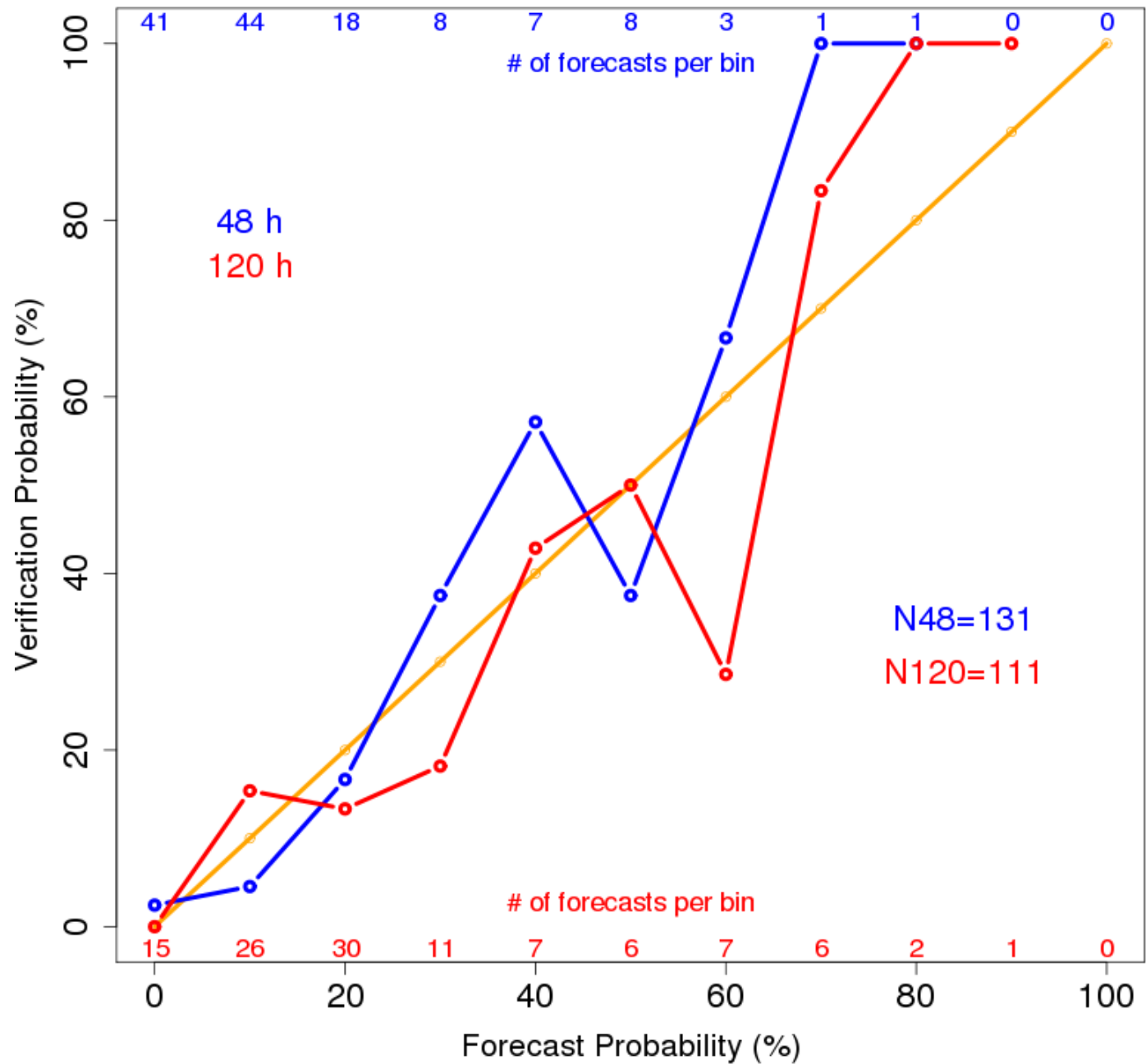
# Summary

- Automated, objective statistical-dynamical TC genesis guidance products were tested quasi-operationally during 2014.
- With some exceptions, the logistic regression equations generally provide well calibrated guidance.
- Year-to-year changes in model configurations and large-scale basin conditions prevent potentially higher reliability.
- Homogeneous comparisons of NHC TWO and the consensus regression model forecast verification indicate that the guidance products provide added value at the higher forecast probability bins (not shown).

# Plans for 2015

- Update regression equations with 2014 cases included in the historical dataset.
- If real-time data are available, add ECMWF based products to the guidance suite.
- Test products quasi-operationally this season.
- <http://moe.met.fsu.edu/modelgen>

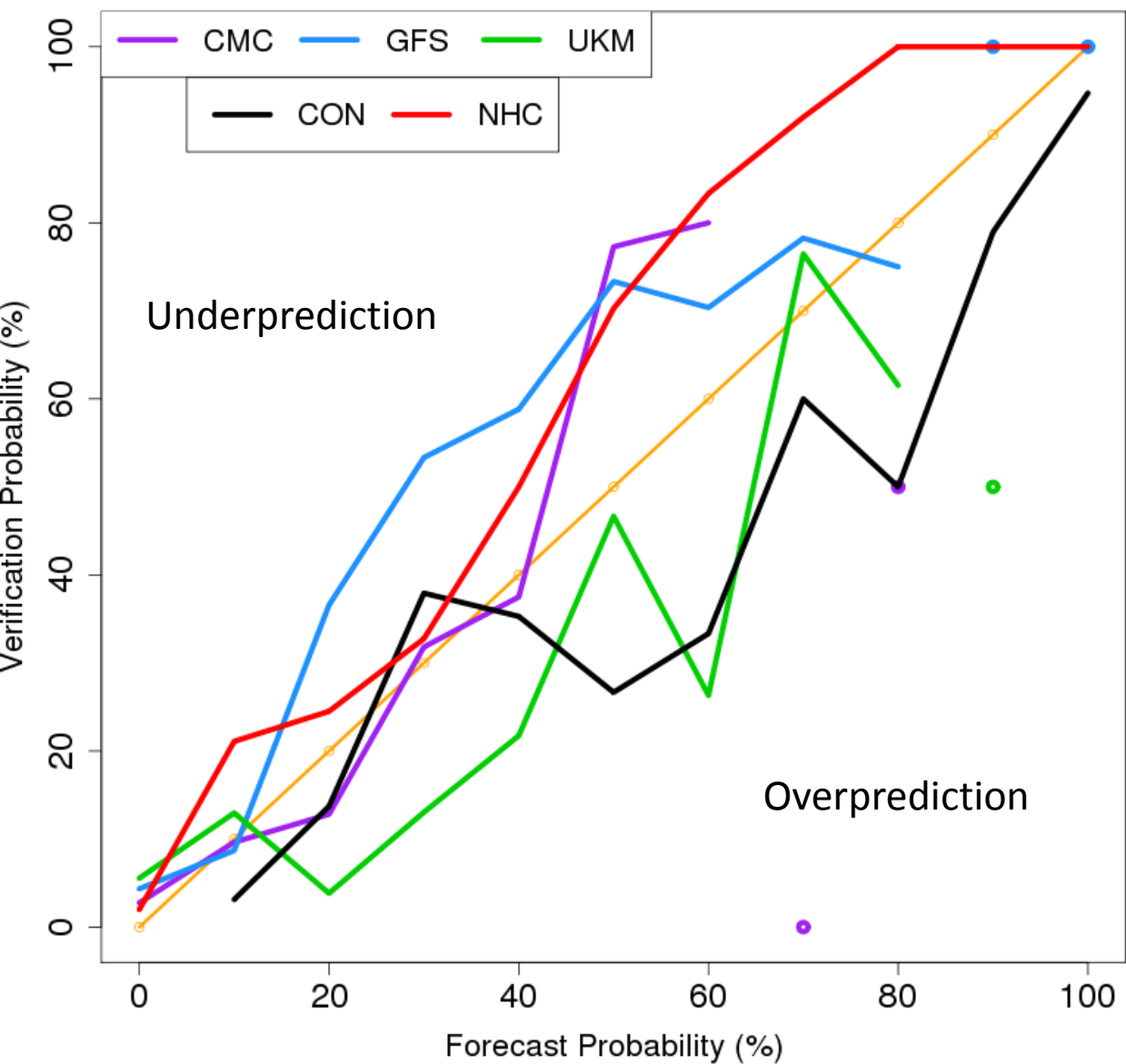
2013-14 NATL TWO probabilities (Forecaster ?)



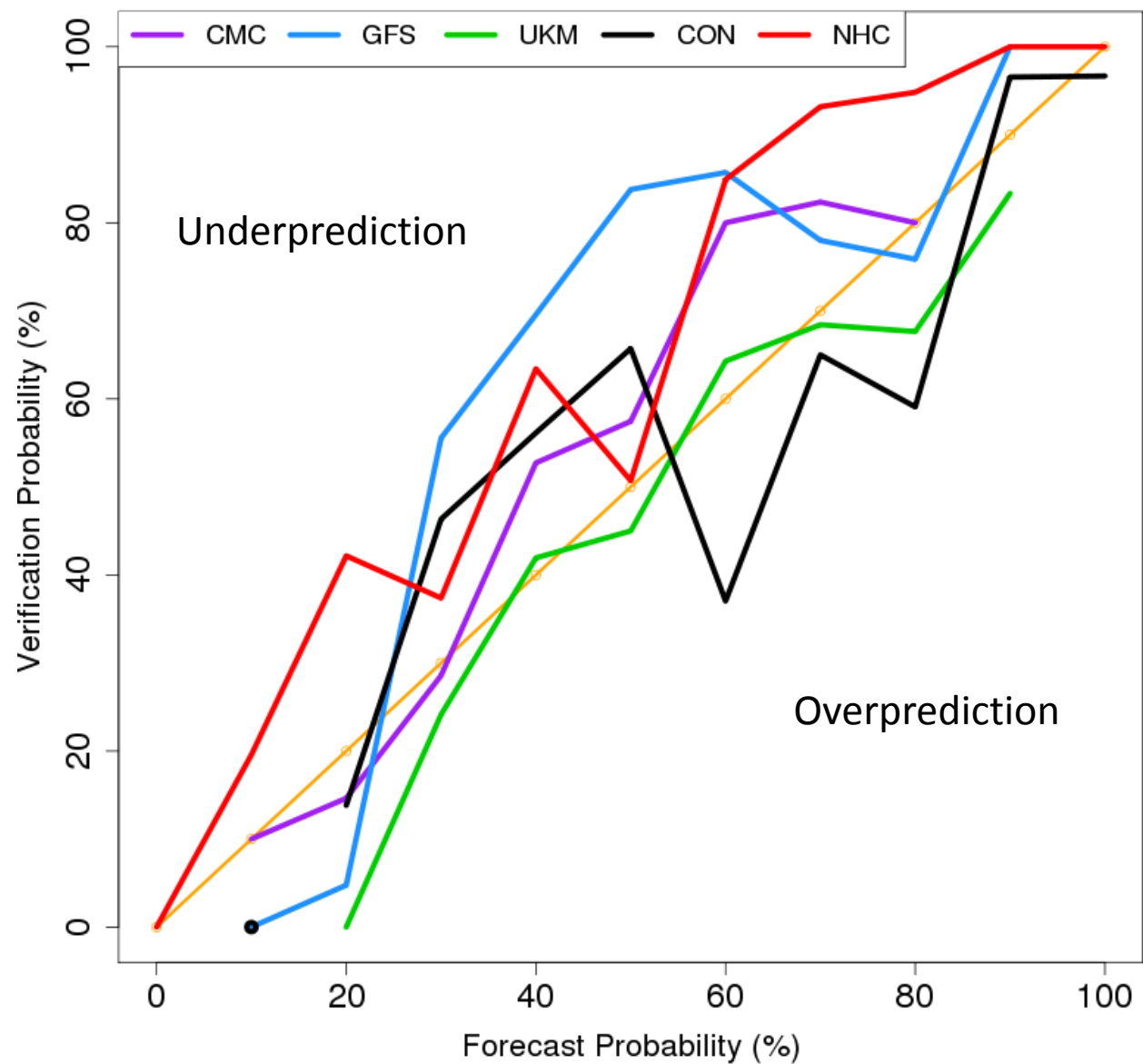


# Backup Slides

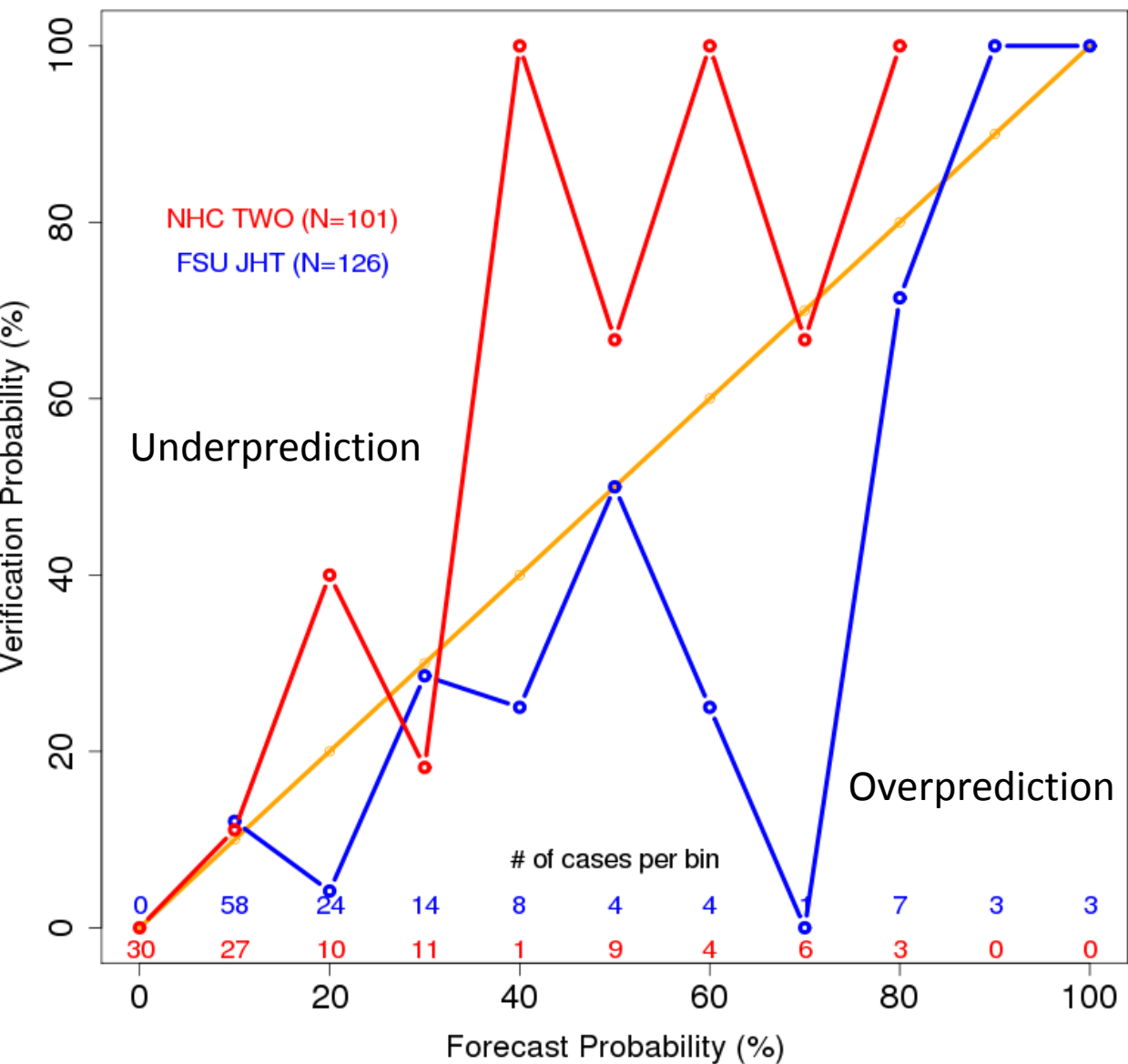
EPAC 48 h preliminary 2014 verification (non-homogeneous)



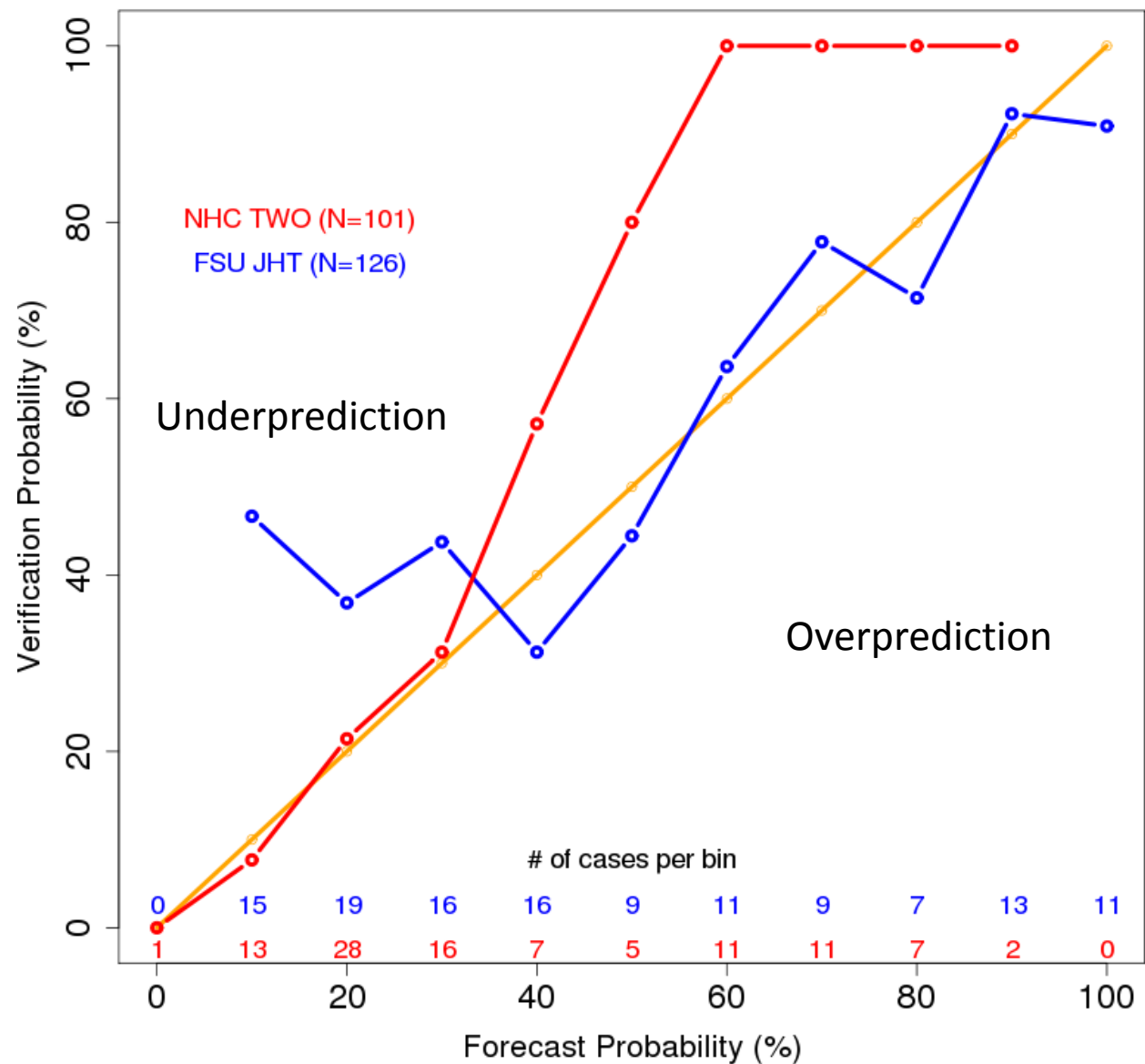
EPAC 120 h preliminary 2014 verification (non-homogeneous)



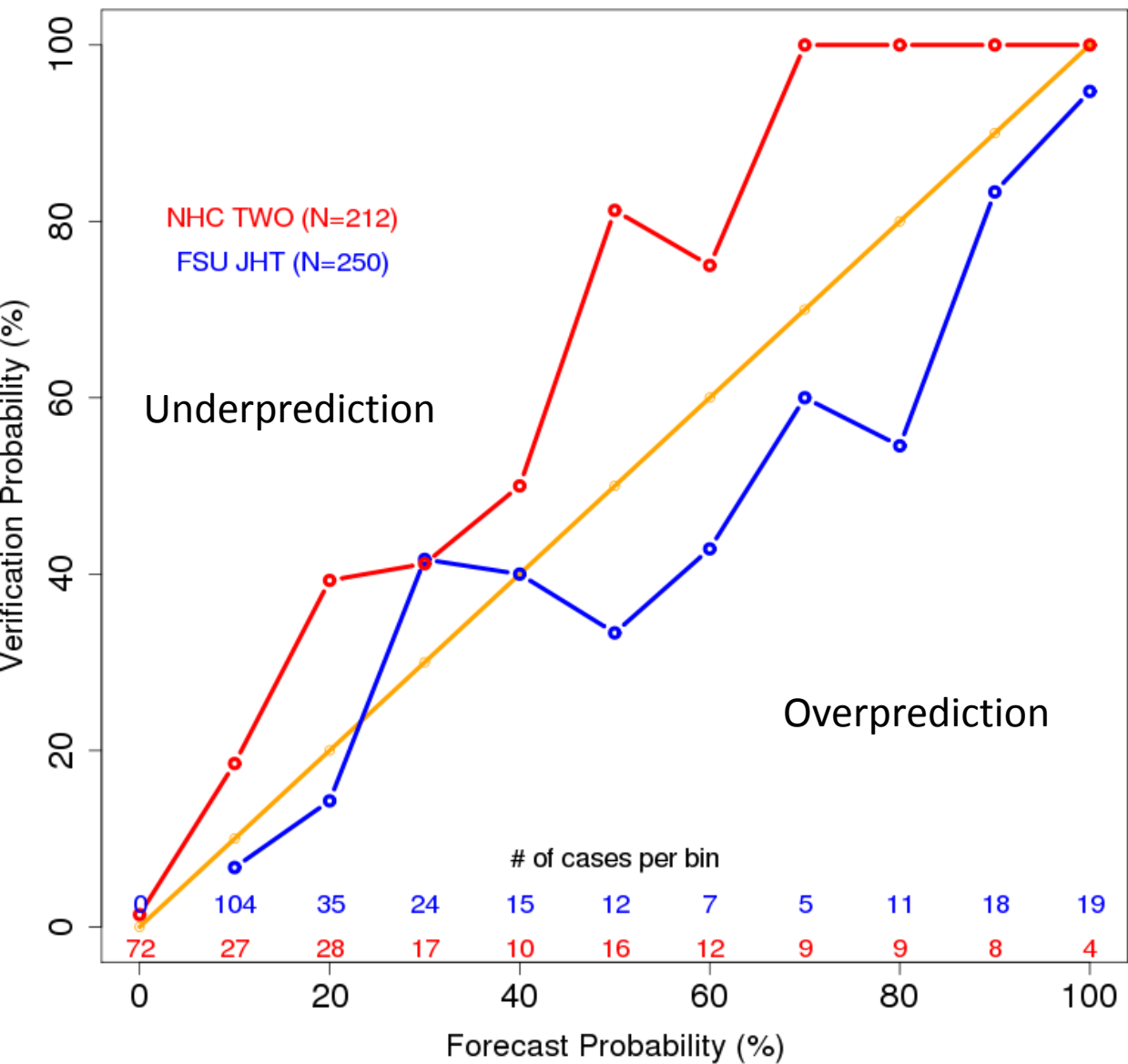
NATL 48 h preliminary 2014 verification (homogeneous)



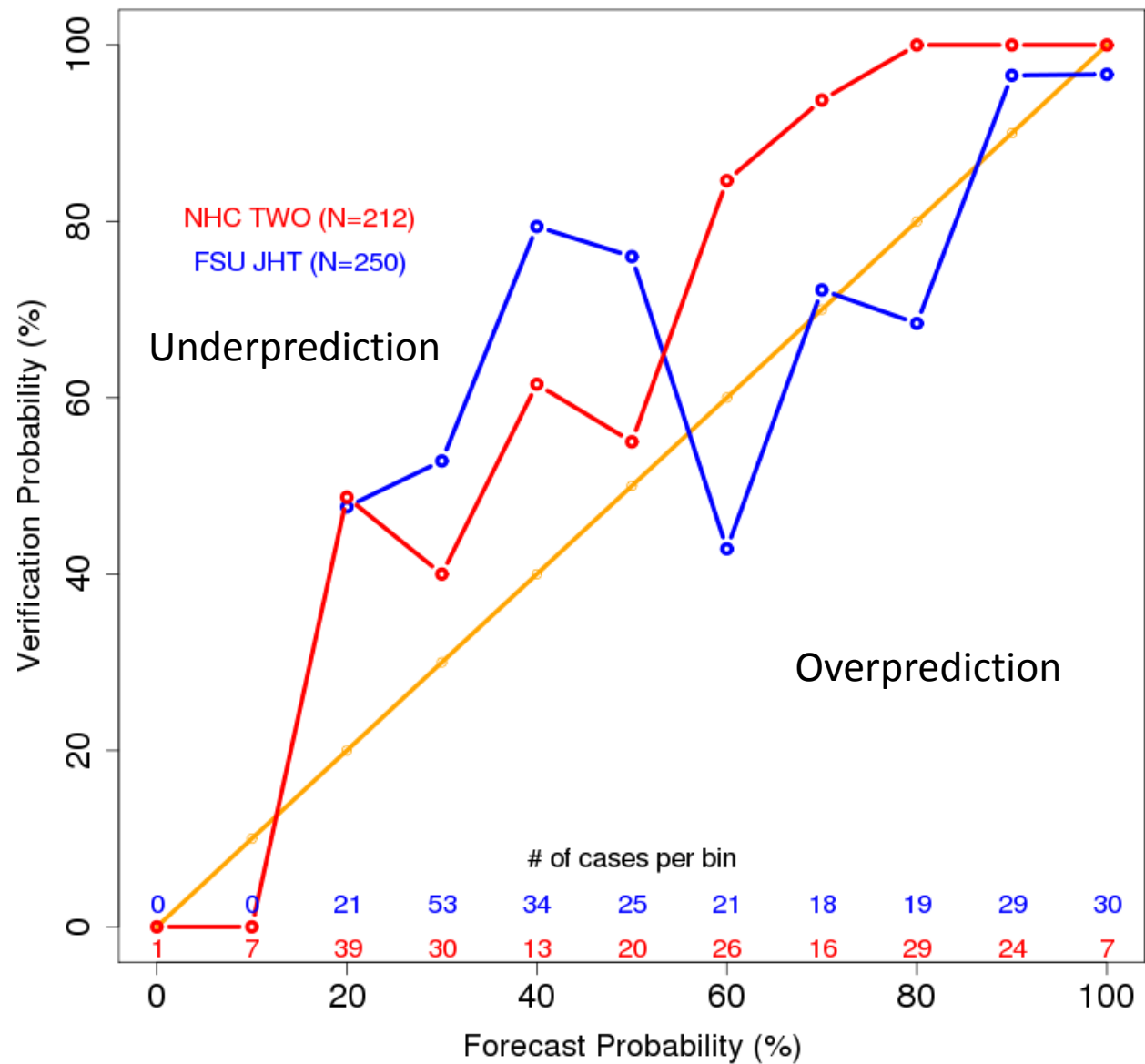
NATL 120 h preliminary 2014 verification (homogeneous)



EPAC 48 h preliminary 2014 verification (homogeneous)



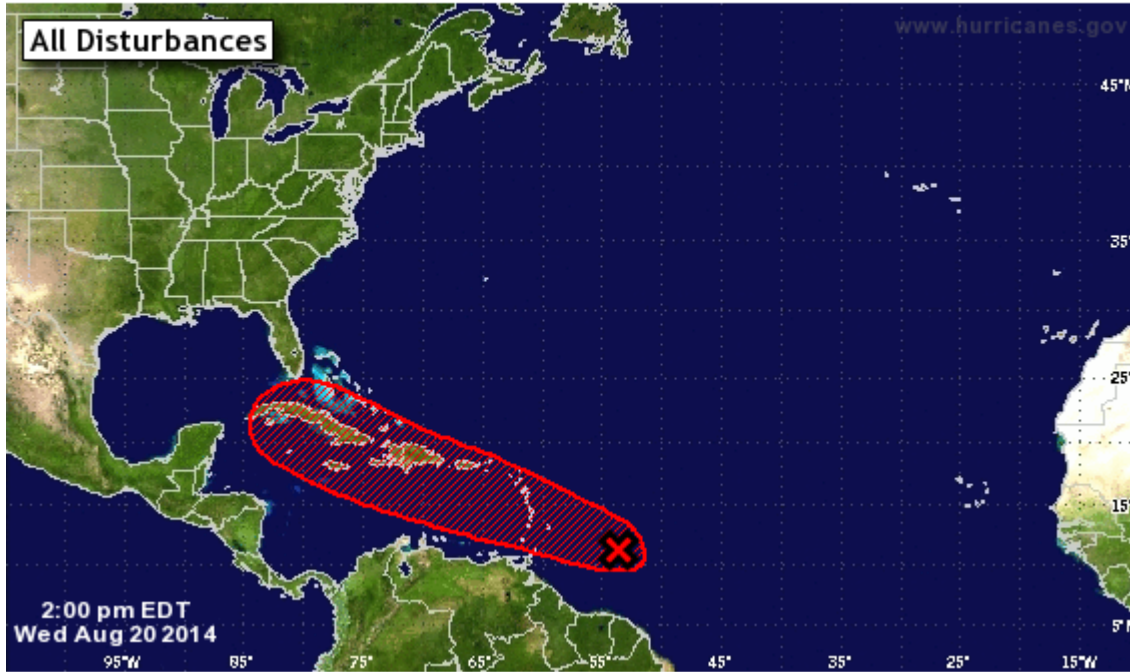
EPAC 120 h preliminary 2014 verification (homogeneous)



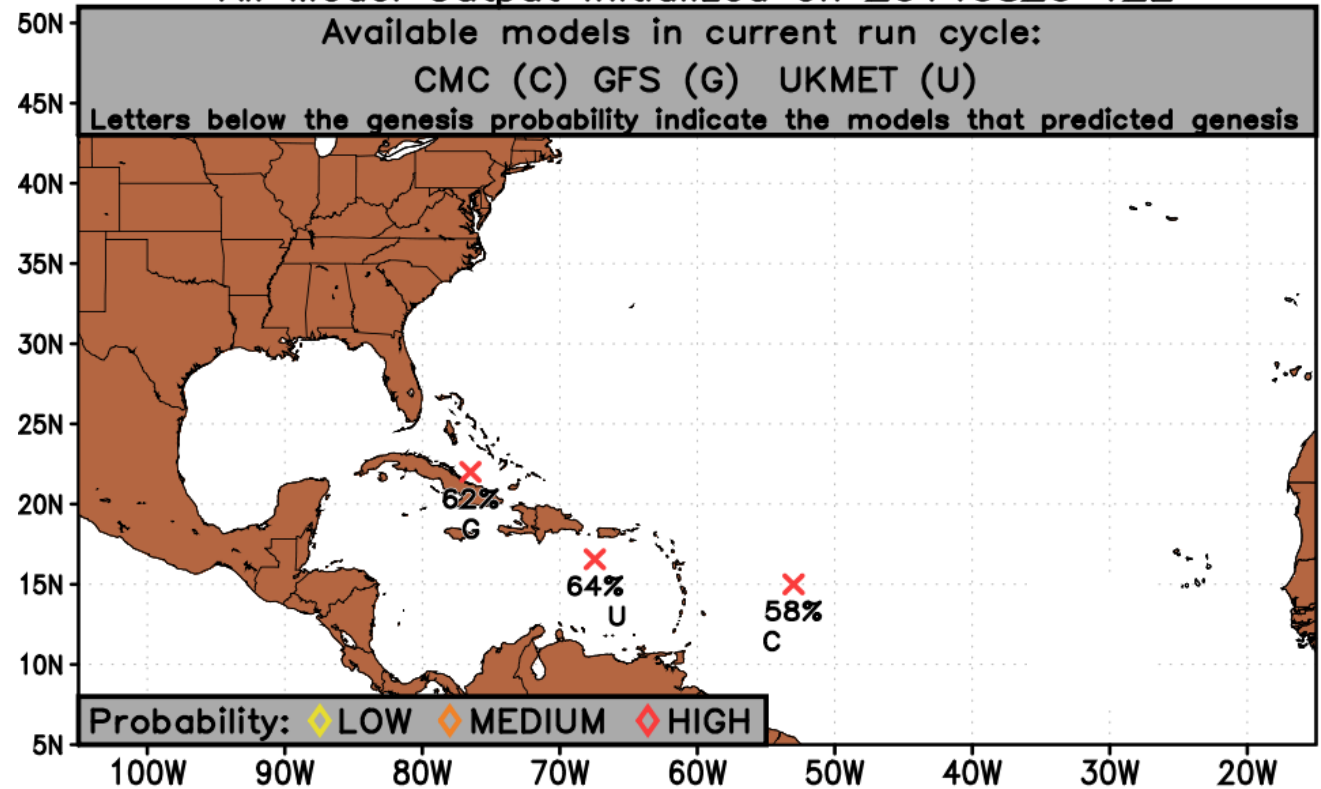


# Experimental 5-Day Graphical Tropical Weather Outlook

National Hurricane Center Miami, Florida



## Experimental Probability of TC Genesis at Anytime Within 120 Hours All Model Output Initialized on 20140820 12Z



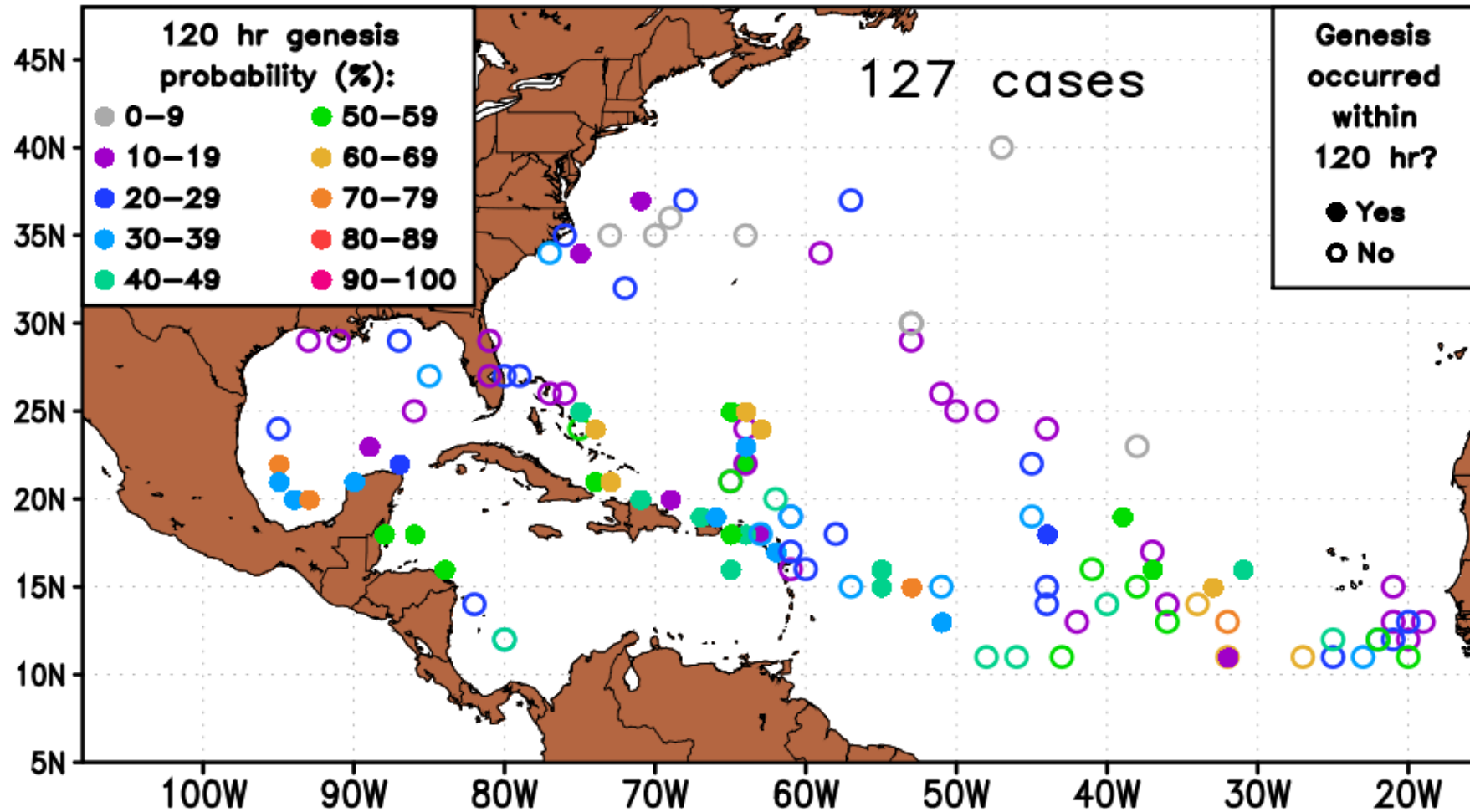
<http://moe.met.fsu.edu/modelgen>

<b>BRIER SCORES (NON-HOMOGENEOUS DATASET)</b>		
<b>BASIN/TIME</b>	<b>NHC TWO</b>	<b>FSU JHT Consensus</b>
NATL48	0.088	0.097
NATL120	0.129	0.209
EPAC48	0.116	0.103
EPAC120	0.194	0.198

<b>BRIER SCORES (HOMOGENEOUS DATASET)</b>		
<b>BASIN/TIME</b>	<b>NHC TWO</b>	<b>FSU JHT Consensus</b>
NATL48	0.119	0.131
NATL120	0.152	0.225
EPAC48	0.131	0.139
EPAC120	0.176	0.224

# Season-to-Date TC Genesis Forecast Verification

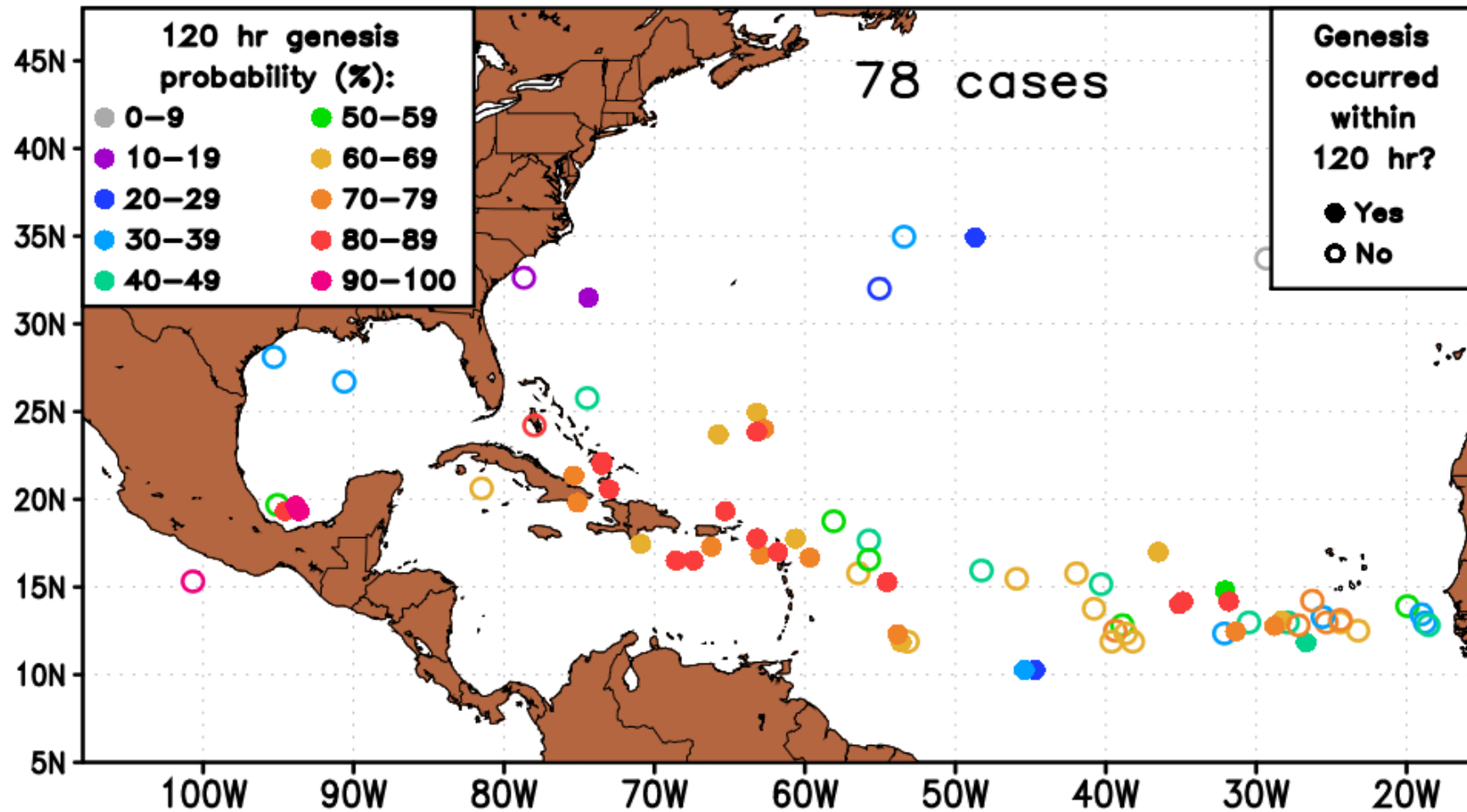
## 2014 CMC-based 120 Hour Genesis Forecasts Through 12/12 15Z



<http://moe.met.fsu.edu/modelgen>

# Season-to-Date TC Genesis Forecast Verification

## 2014 UKM-based 120 Hour Genesis Forecasts Through 12/12 15Z



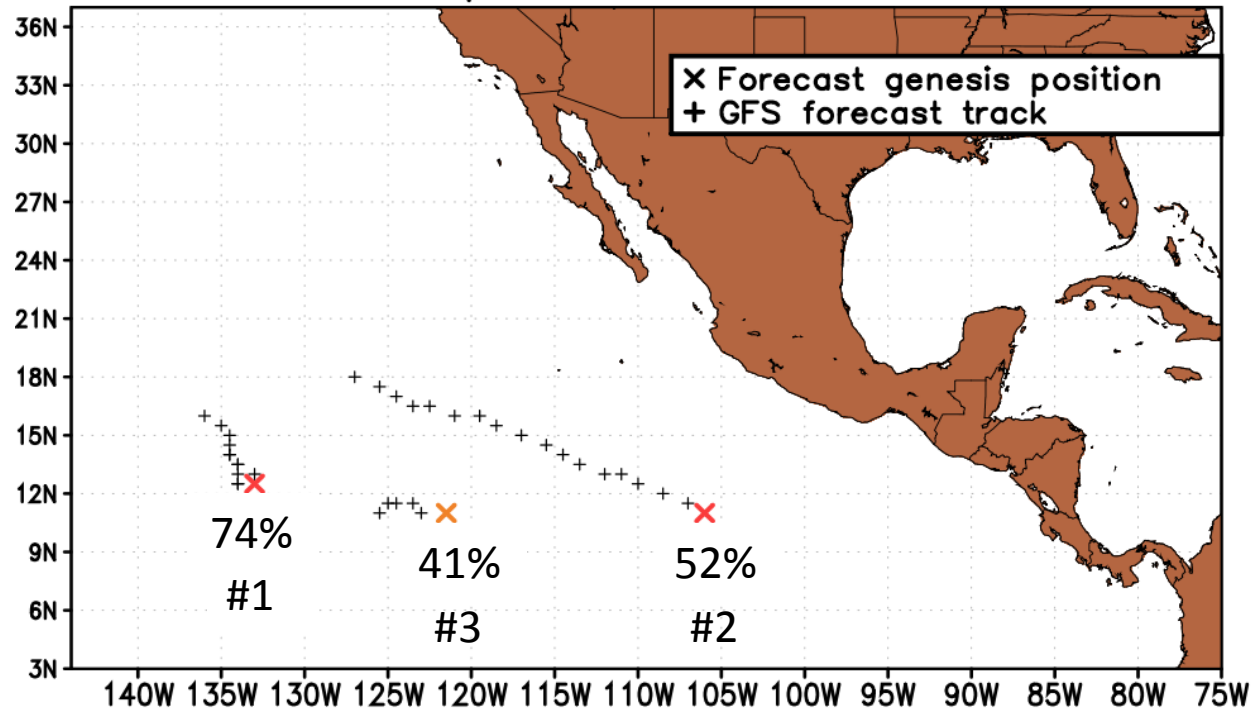
<http://moe.met.fsu.edu/modelgen>



\*\* TC Genesis Summary \*\*  
 \*\* GFS output initialized 2014072412 \*\*

ID #	FHR	LAT (N)	LON (W)	PROB48(%)	PROB120 (%)
1	12	12.50	133.00	70	74
2	48	11.00	106.00	27	52
3	66	11.00	121.50	14	41

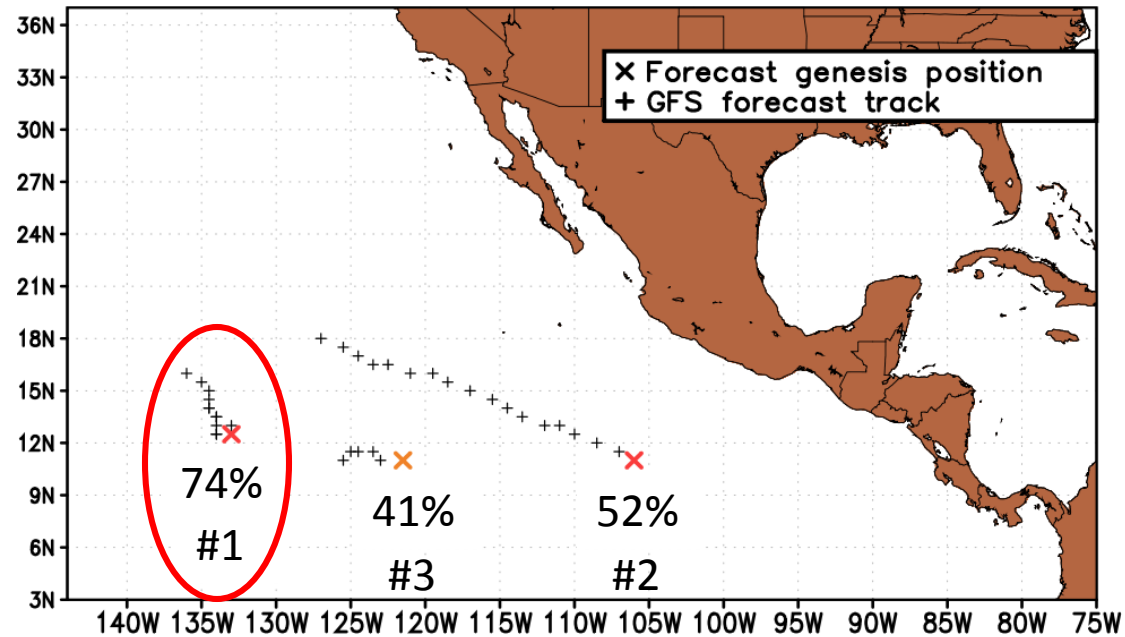
Probability of TC genesis within 120 h – GFS



\*\* TC Genesis Summary for GFSEP9009\*\*

INIT TIME	FHR	LAT (N)	LON (W)	PROB48 (%)	PROB120 (%)
14072212	90	12.00	133.00	8	39
14072218	60	12.00	133.00	21	48
14072300	54	13.00	132.50	34	58
14072306	36	12.50	130.50	51	63
14072312	30	12.50	131.00	56	66
14072318	18	12.50	130.50	65	69
14072400	12	12.50	130.50	70	70
14072406	18	12.50	132.50	65	72
14072412	12	12.50	133.00	70	74

Probability of TC genesis within 120 h – GFS



\*\* Tropical Disturbance #3 Information \*\*  
 \*\* GFS output initialized 2014072412 \*\*

\*\*GENESIS PREDICTED? YES, at forecast hour 66\*\*

TIME (hr)	48	54	60	66	72	78	84	90
GEN PROB (%)	14							
CRIT MET?	Y	N	N	Y	Y	Y	Y	Y
LAT (N)	10.50	10.50	11.00	11.00	11.00	11.50	11.50	11.50
LON (W)	119.50	120.00	120.50	121.50	123.00	123.50	124.50	125.00
925VMAX (m/s)	14.00	13.58^	13.36^	15.14	15.40	15.54	15.32	14.66
850RV (*10^-5 1/s)	25.52	22.87	22.27	22.22	19.21	18.64	18.62	18.99
250-850 THCK (m)	9495	9506	9509	9504	9503	9507	9512	9507
SFC LH FLUX	144.43	150.54	150.16	156.04	157.92	156.68	148.75	149.13
850RVPERT	25.52	22.87	22.27	22.22	19.21	18.64	18.62	18.99

^ indicates that the threshold value was not met

