

Improvements to the Tropical Cyclone Genesis Index (TCGI)

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Discussion Outline

Motivation

- Enhance the Tropical Cyclone Genesis Index (TCGI), a real-time, objective, disturbance-centric scheme for identifying the probability of TC genesis in the NATL;

Tropical Cyclone Genesis Index (TCGI)

- Background & overview
- 2011-2015 verification
- Planned refinements

Conclusions & Future Work

TC Genesis Index (TCGI)

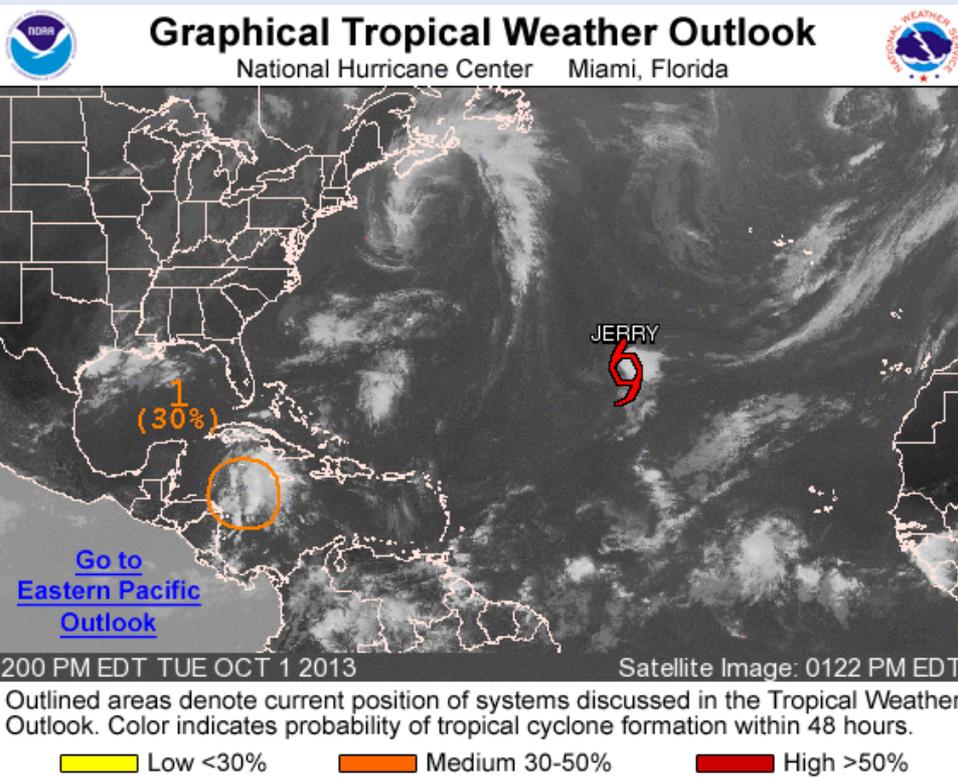
Accomplishments (Initial Project)

- Running in real-time at CIRA since 2013
- http://rammb.cira.colostate.edu/realtime_data/nhc/tcgi/
- Transitioned to operations at NHC in fall 2014
- Currently running on the NCEP Weather & Climate Operational Supercomputing System (WCOSS)
- Follow-on project successfully funded under most recent JHT cycle

What is the Tropical Cyclone Genesis Index?

TC Genesis Index (TCGI)

*Objective/disturbance centric/probabilistic scheme
for predicting TC genesis (0-48 hr & 0-120 hr)*



- Runs on NATL invests identified by NHC
- Requires TAFB Dvorak fixes (F-Deck)
- Run times: 00/06/12/18 UTC
t=-2 hr: :30 & :45
t=-1 hr: :00/:15/:30/:45/:55

TC Genesis Index (TCGI)

* ATLANTIC TC GENESIS INDEX *
* AL972013 10/01/13 18 UTC *

TIME (hr)	0	6	12	18	24	36	48	60	72	84	96	108	120
TCGI (%)							45.1						65.0
HDIV (x10 ⁻⁷ s ⁻¹)	-3.0	-4.0	-1.0	-3.0	-5.0	0.0	-6.0	1.0	-5.0	0.0	-4.0	0.0	0.0
VORT (x10 ⁻⁶ s ⁻¹)	1.3	1.6	1.6	1.7	1.6	1.5	1.1	0.8	1.0	0.5	1.1	1.1	1.1
DV24 (x10 ⁻⁶ s ⁻¹)	0.3	0.0	-0.1	-0.7	-0.5	-0.7	-0.1	-0.3	0.1	0.6	0.0	-0.1	-0.3
VSHD (kt)	5	9	11	9	9	17	19	19	19	26	24	28	27
MLRH (%)	67	67	64	63	67	64	68	62	64	52	54	52	54
PCCD (%)	42	N/A											
TNUM	1.00	N/A											
LAT (deg N)	16.8	17.2	17.8	18.5	20.3	22.9	25.0	26.3	27.6	28.3	29.2	30.1	31.4
LON (deg W)	83.0	83.5	84.4	85.1	85.8	87.0	87.4	87.5	86.8	86.5	85.5	84.4	82.9
DTL (km)	169	172	217	259	132	154	382	358	270	188	56	-5	-140
TRACK SOURCE	AVNO												

Prob of Genesis (t= 48h) = 45.1 is 1.6 times the sample mean (27.9)
 Prob of Genesis (t=120h) = 65.0 is 1.6 times the sample mean (40.3)

CONTRIBUTIONS OF CLIMATOLOGY AND INDIVIDUAL PREDICTORS TO TCGI PROBABILITY

	***** AVG	48-HR FCST	***** %CONT	***** AVG	120-HR FCST	***** %CONT
CLIM (%)			27.9			40.3
HDIV (x10 ⁻⁷ s ⁻¹)	-1.3	-3.1	9.1	-1.2	-2.2	15.9
DV24 (x10 ⁻⁶ s ⁻¹)	-0.2	-0.3	-1.8	-0.2	-0.1	3.1
VSHD (kt)	16.8	12.3	4.8	19.0	18.5	0.7
MLRH (%)	64.9	66.0	0.1	61.3	60.8	-0.1
PCCD (%)	29.1	41.8	2.9	28.7	41.8	2.6
TNUM	0.9	1.0	2.1	0.9	1.0	2.4

%CONT = % contribution to TCGI probability

PREDICTOR DEFINITIONS (Averaged Over 500 km Radius)

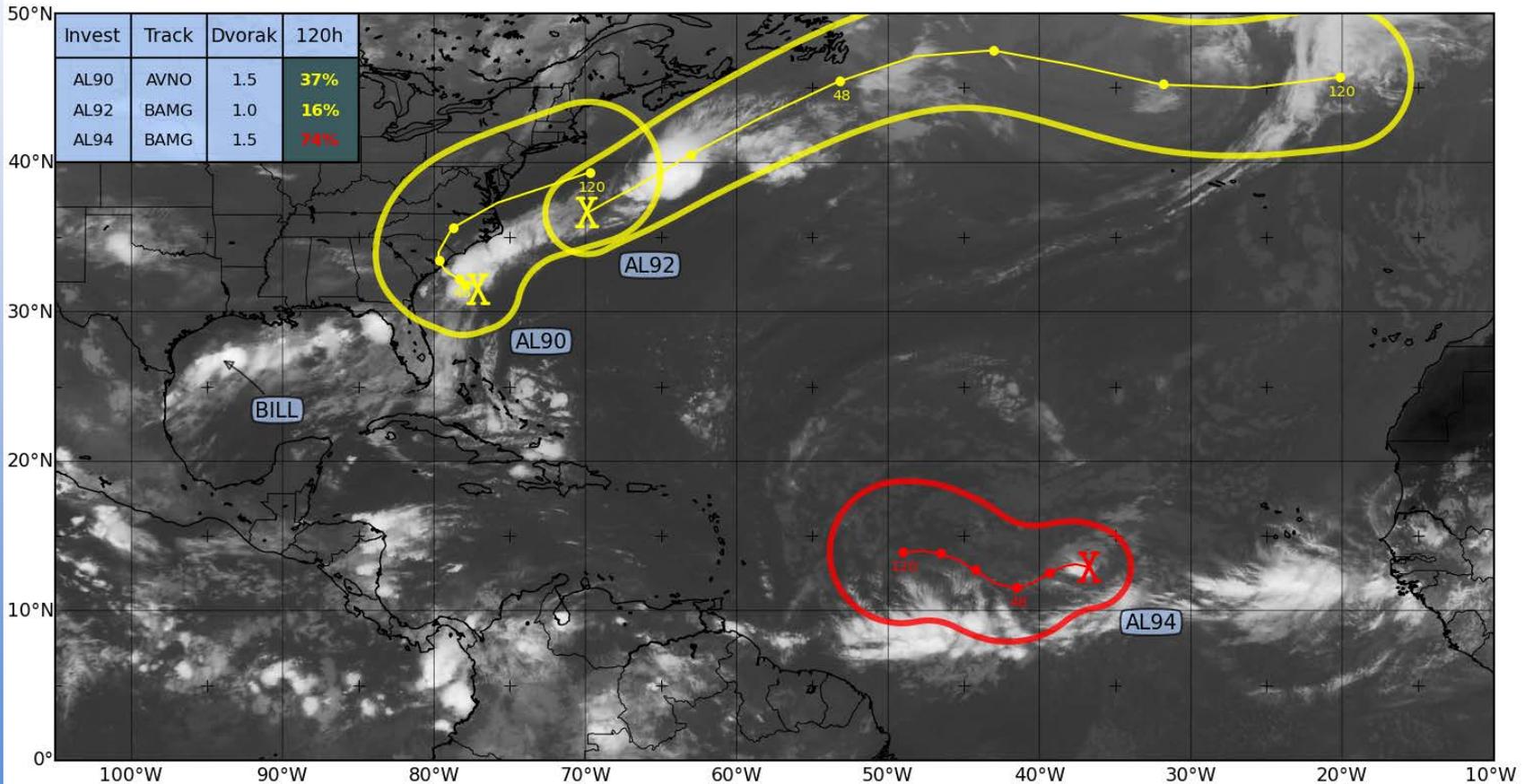
CLIM = Climatological Probability of Genesis (Source: NHC-TAFB Invest Database)
 HDIV = 850-mb GFS Horizontal Divergence
 DV24 = 24-hr Change in GFS 850-mb Vorticity (VORT)
 VSHD = 850-200 mb GFS Vertical Shear
 MLRH = 600-mb GFS Relative Humidity
 PCCD = % GOES WV Pixels Colder Than -40C
 TNUM = TAFB T-Number

TCGI forecast
 (0-48 & 0-120-hr)
 Predictor Values
 Along the
 Invest Position
 &
 TCGI Forecasts
 Track Source
 (AVNO Relative to VMG)
 Climatology
 Predictor
 Forecast
 Contributions
 (0-48 & 0-120-hr)
 Predictor
 Information

TC Genesis Index (TCGI)

Experimental Graphical TCGI

Tropical Cyclone Genesis Index (TCGI) - Experimental 120-h Forecast Outlook
 Issued at 01 AUG 2015 12Z



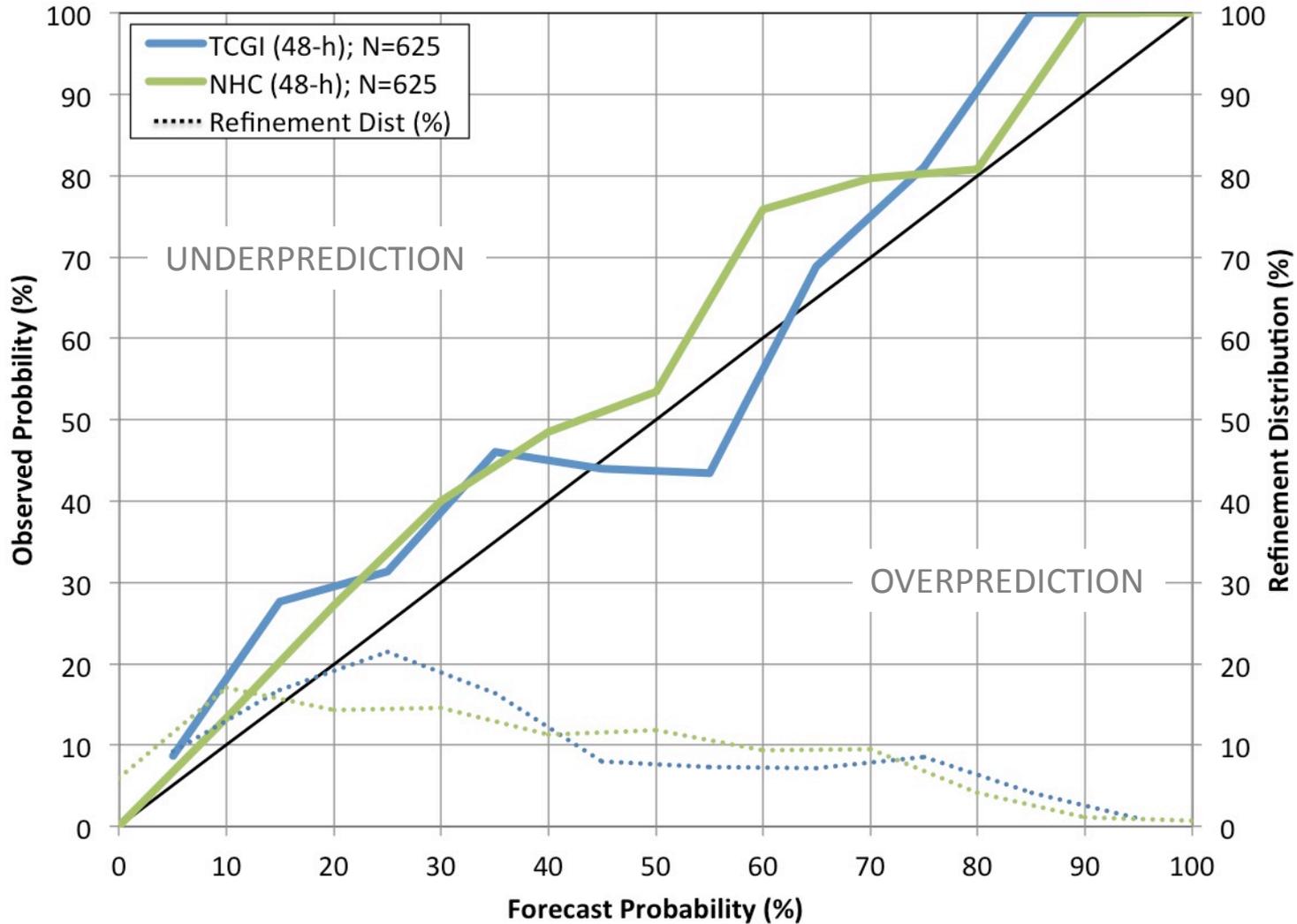
TCGI Forecast Verification

0-48 hr: 2011-2015

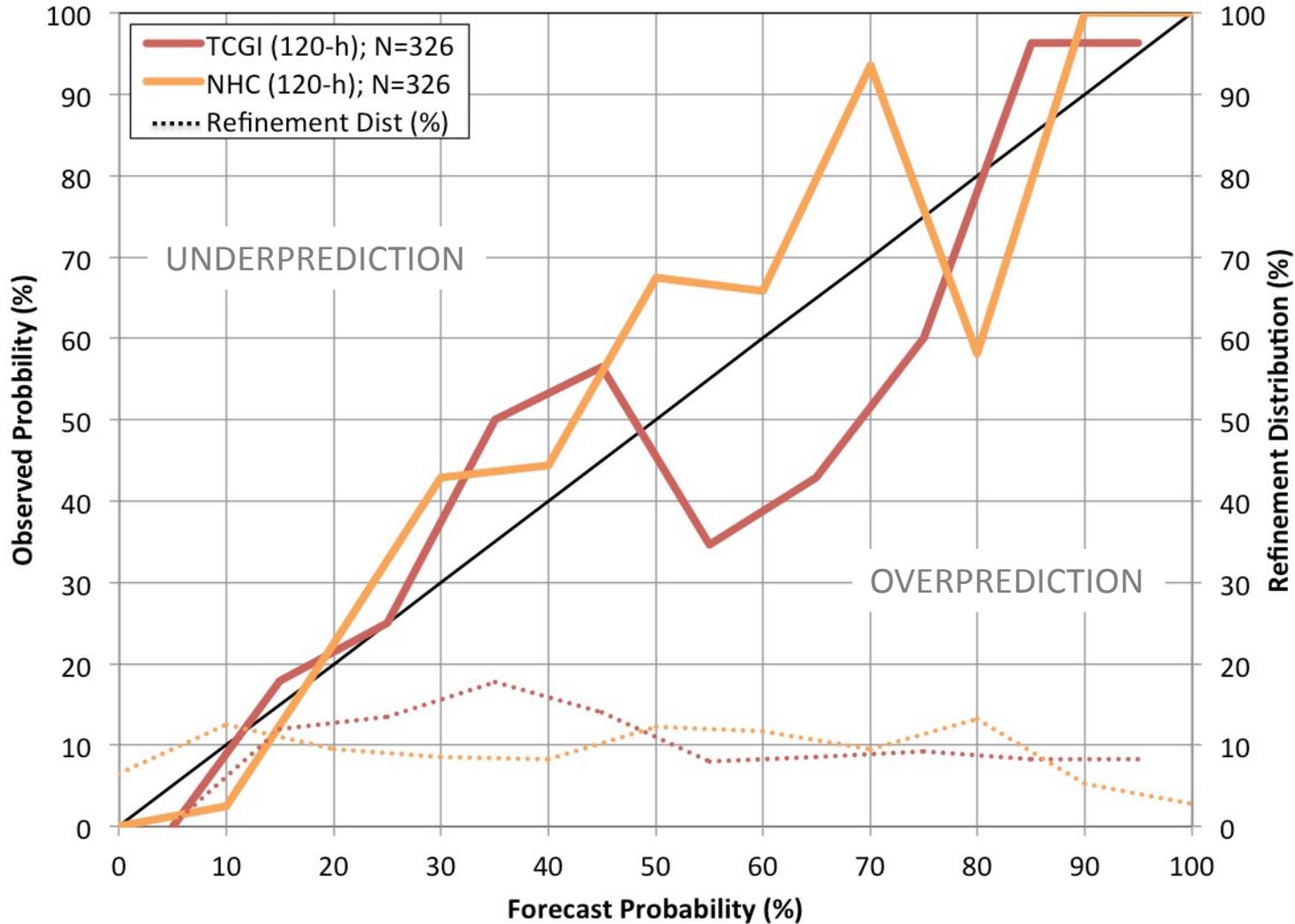
0-120 hr: 2013-2015

TC Genesis Index (TCGI)

Reliability Diagram (2011-2015)



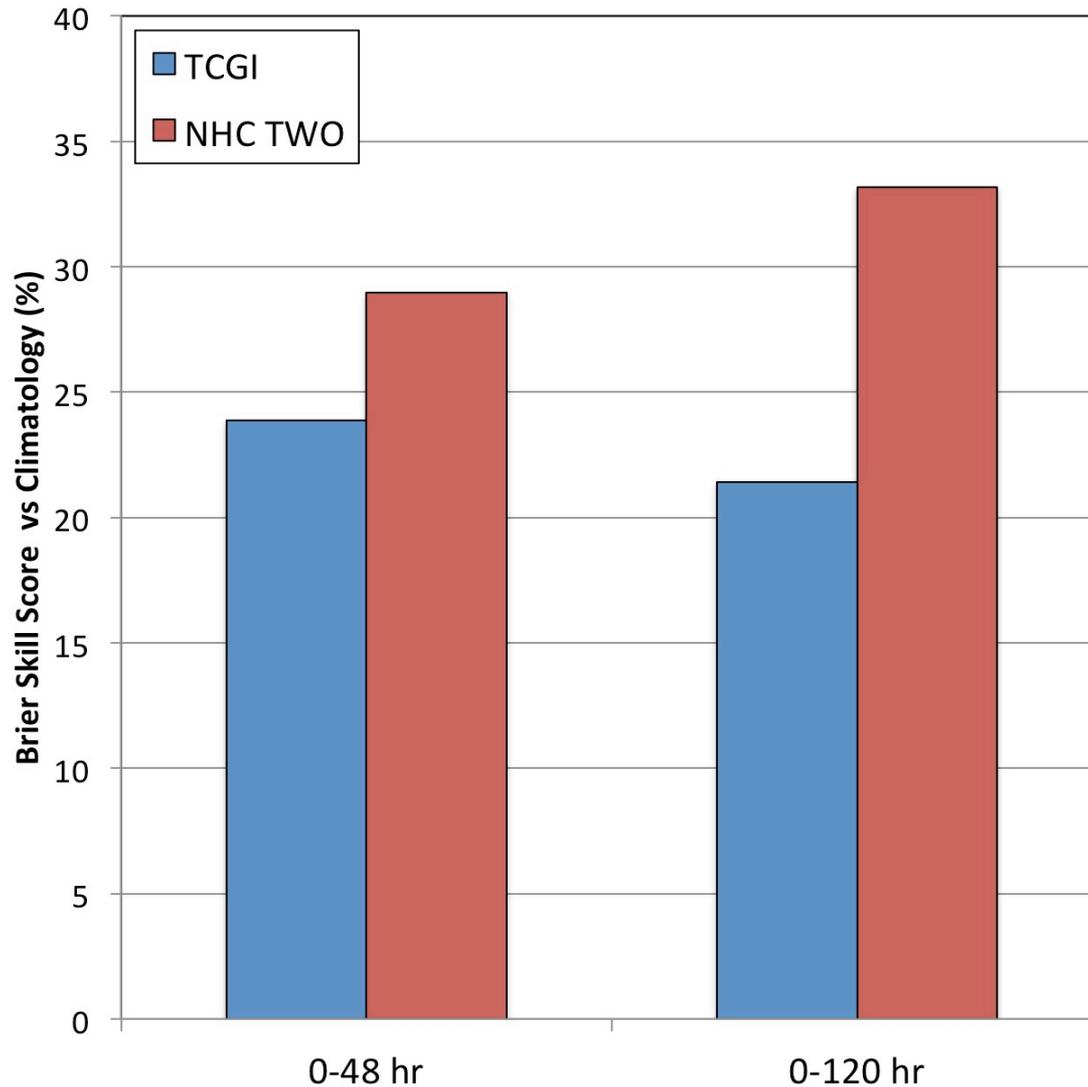
TC Genesis Index (TCGI) Reliability Diagram (2013-2015)



TC Genesis Index (TCGI)

Brier Skill Score

0-48 hr (2011-2015); 0-120 hr (2013-2015)



TCGI Year-1

Plans and Early Results

TC Genesis Index (TCGI)

Year-1 Work Plan: Completed -- In Progress -- Not Begun

Oct-Dec 2015

- Collect, QC, and format 2011-2014 NATL & EPAC Dvorak invest databases

Jan-Feb 2016

- Complete identification/development of new NATL/EPAC TCGI predictors

April 2016

- Begin development of an ECMWF-based Atlantic TCGI using predictors and predictor weights that were developed for the GFS version of TCGI

TC Genesis Index (TCGI)

Year-1 Work Plan: Completed -- In Progress -- Not Begun

June-Nov 2016

- Begin sensitivity testing for optimal combinations of Atlantic and Pacific TCGI predictors (GFS version)

Aug-Oct 2016

- Develop and test graphical TCGI products with real-time cases

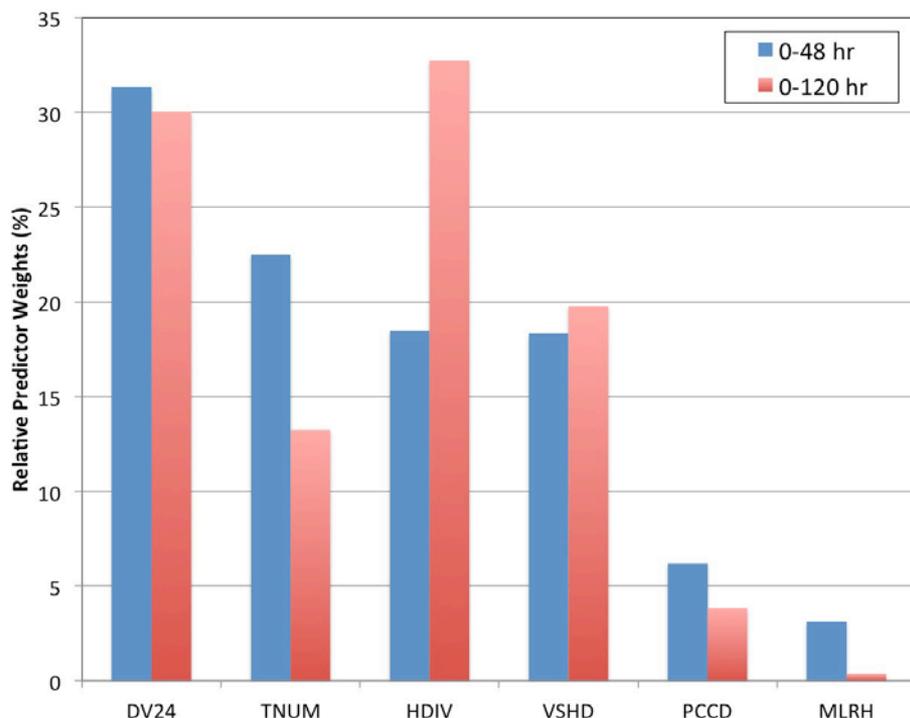
Dec 2016

- Develop code for running a real-time version of the Atlantic and Pacific TCGI (GFS version)

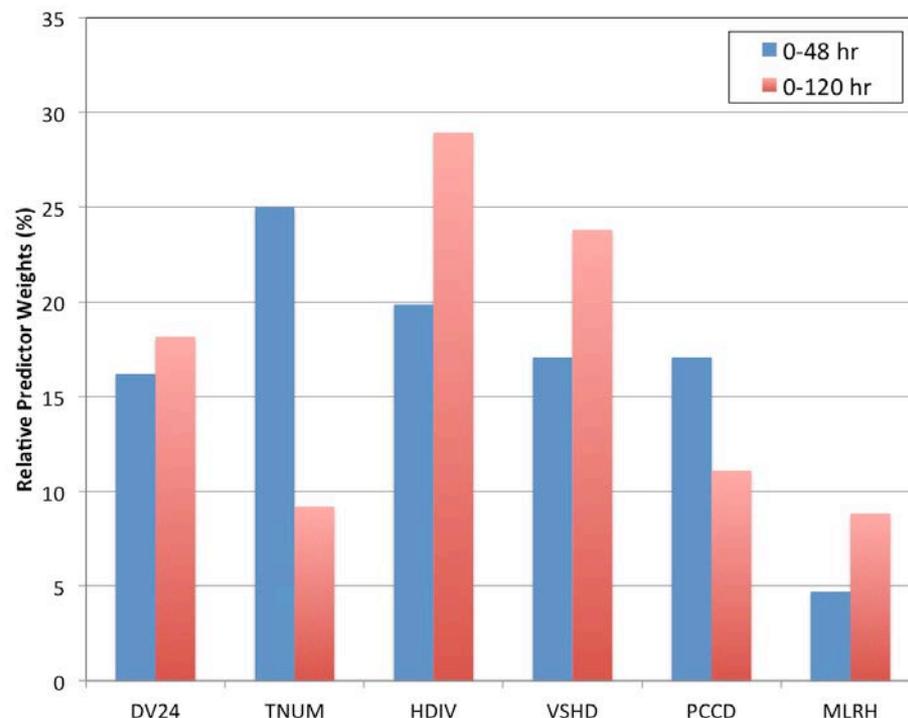
TC Genesis Index (TCGI)

Relative Predictor Weights (2001-2014 Invest Database)

North Atlantic (2001-2014)



EPAC (2001-2014)



DV24: 24-hr change in 850 hPa vorticity (GFS)

TNUM: NOAA TAFB Dvorak T-number

HDIV: 850 hPa horizontal divergence (GFS)

VSHD: 200-850 hPa vertical shear (GFS)

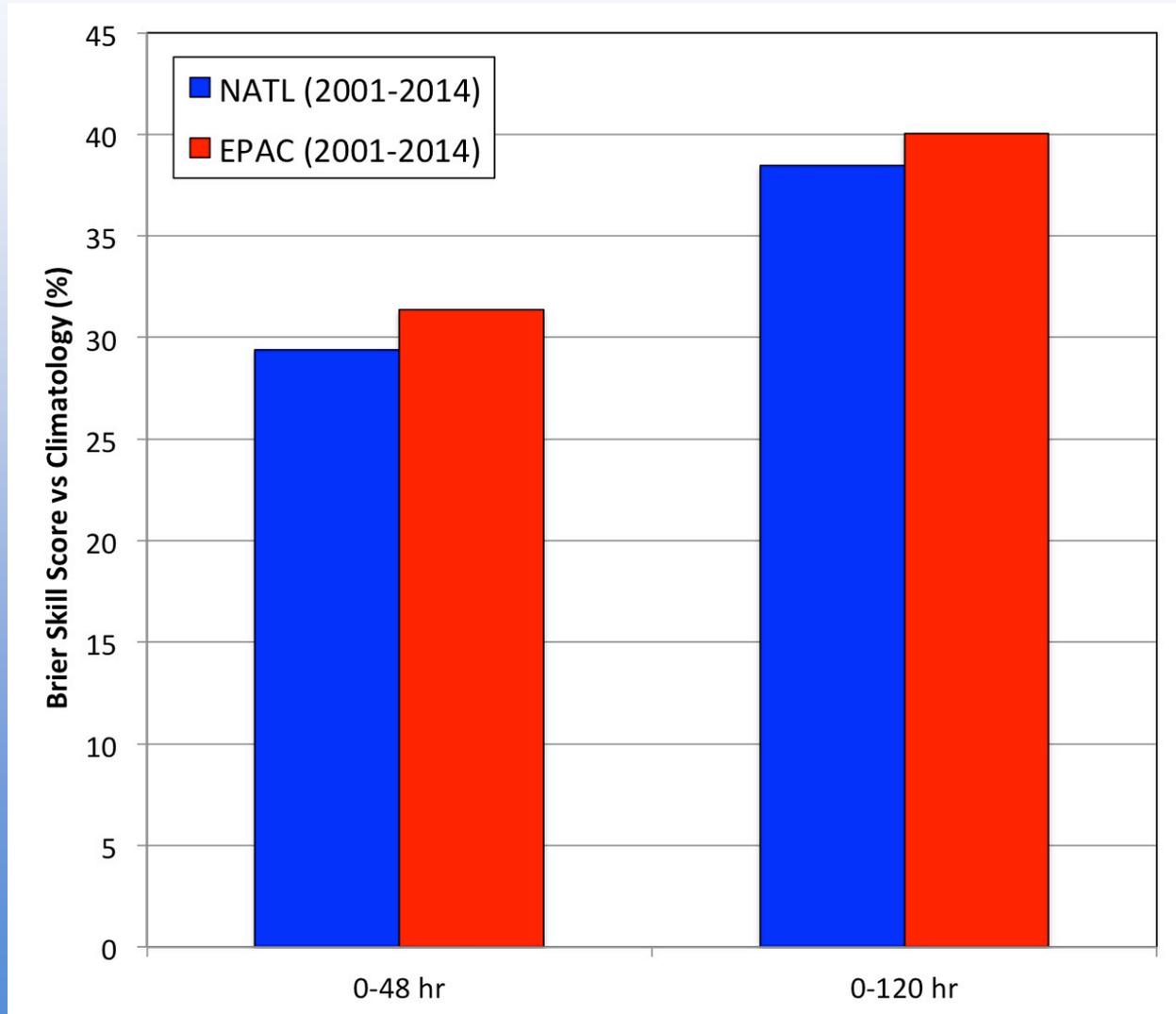
PCCD: % GOES water vapor pixels <-40 C

MLRH: 600 hPa RH (GFS)

TC Genesis Index (TCGI)

Brier Skill Score

2001-2014; cross validated



Conclusions & Future Work

TC Genesis Index (TCGI)

- Disturbance-centric/objective/probabilistic (48 & 120-hr)
- 2014: transitioned to operations at NOAA NHC
- 0-48 hr (2011-2015) & 0-120 hr (2013-2015) verifications
 1. Reliability diagrams: competitive with NHC TWO
 2. Brier Skill Scores (vs climatology)
 - 0-48-hr: TCGI: 24% NHC TWO: 29%
 - 0-120 hr: TCGI: 21%; NHC TWO: 33%

Conclusions & Future Work (Cont'd)

TCGI Year-1 Efforts (Completed)

- 2001-2014 NATL & EPAC invest database development
- TCGI (NATL): tested and re-run
- TCGI (EPAC): tested and run using NATL predictors

TCGI Year-1 Efforts (In Progress/Planned)

- Develop new TCGI predictors (NATL/EPAC)
- ECMWF-based TCGI (NATL); Graphical TCGI
- Sensitivity testing >> optimal predictor combinations (NATL & EPAC)
- Develop code >> real-time versions of TCGI (NATL & EPAC)

Questions

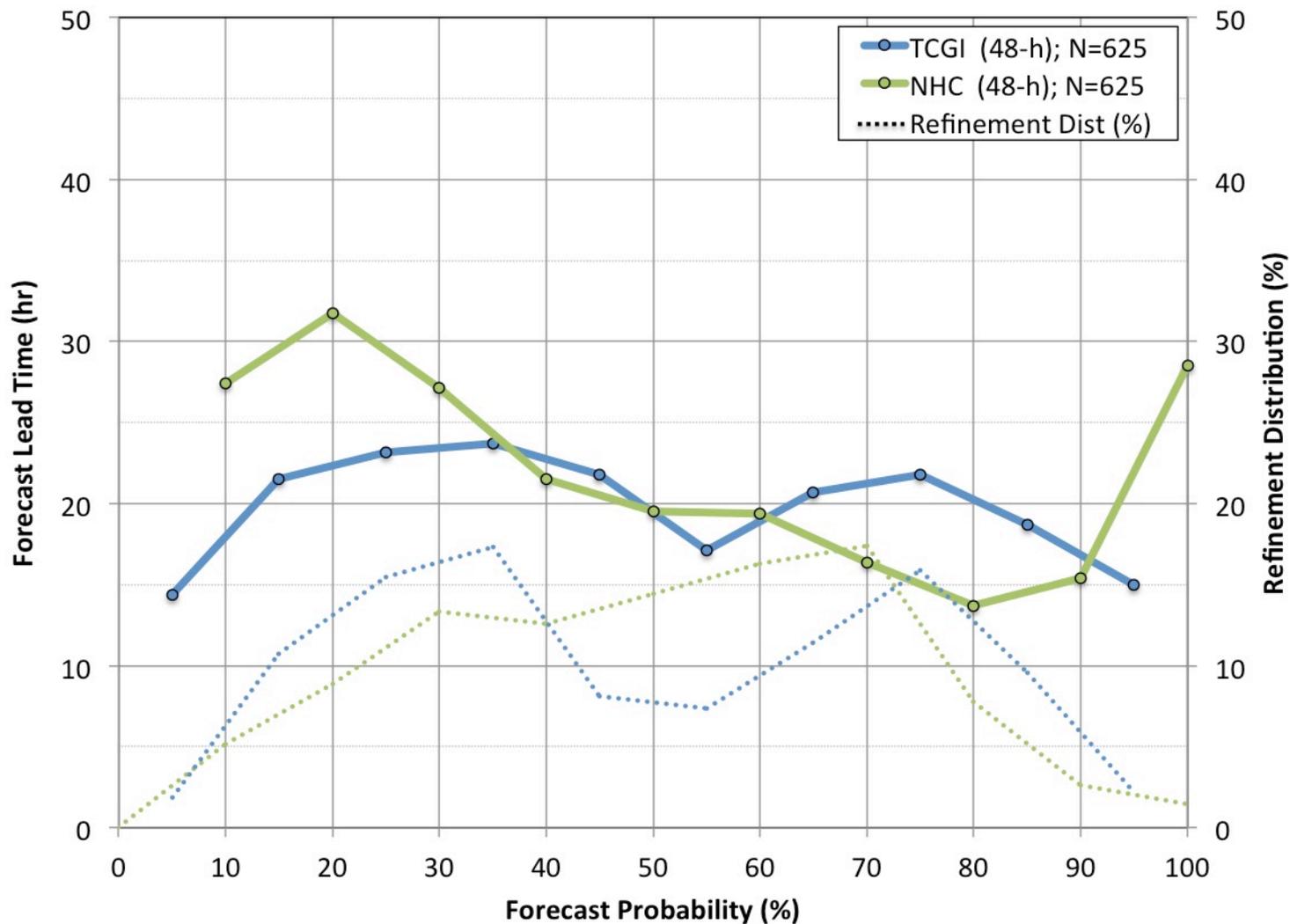
TC Genesis Index (TCGI)

New TCGI Predictors

- Variable search box sizes for 0-48 (e.g. 0-200 km or 0-300 km) and 0-120 hr (0-500 km)
- Additional moisture levels (e.g. 600-800 & 925-1000 hPa)
- Theta-e excess (similar to CAPE)
- Test 850 hPa vorticity x DVG
- Test 850 mb moisture convergence

TC Genesis Index (TCGI)

Forecast Lead Time (2011-2015)



TC Genesis Index (TCGI)

Forecast Lead Time (2013-2015)

