NOAA Joint Hurricane Testbed (JHT)
End of Year Progress Report, Year 2

Date:	September 30, 2013
Reporting Period:	March 1 2013 – July 31 2013
Project Title:	Development of a Probabilistic Tropical Cyclone Genesis Prediction Scheme
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Award Period:	August 1, 2011 – July 31, 2013

1. Long-term Objective and Specific Plans to Achieve Them:

The main goal of this project is to develop a disturbance-following tropical cyclone (TC) genesis index (TCGI) to provide forecasters with an objective tool for identifying the 0-48hr and 0-120hr probability of TC genesis in the North Atlantic basin. Predictors from a variety of sources were tested and potentially integrated into this new scheme and included Dvorak T-number / CI value estimates, environmental and convective parameters currently used in the NESDIS TC Formation Probability (TCFP) product (fixed grid scheme), environmental parameters from the Statistical Hurricane Intensity Prediction Scheme (SHIPS) that are relevant to TC genesis, and total precipitable water (TPW) retrievals from microwave satellites. Six robust TCGI predictors were identified and have been incorporated into an experimental real-time version of TCGI. The proposal team evaluated the performance of the scheme for several 2013 tropical disturbances in the Atlantic and made the TCGI code and output available to NHC forecasters on 11 September 2013. NHC forecasters are currently evaluating TCGI for possible transition to operations in the future.

2. Accomplishments:

a. Develop code for running real-time TCGI (0-48h and 0-120h)

The real-time code development phase of this project has been completed and required some re-evaluation of the TCGI predictors that were identified during the previous reporting period and resulted in a more robust scheme. These six predictors and their relative weights in TCGI for the 0-48 and 0-120 hr forecast periods are shown in Fig. 1. Figure 1 also depicts the TCGI genesis occurrence frequency relative to the range of binned discriminant function values that could be produced by TCGI during a given forecast cycle. Higher binned discriminant function values are associated with combinations of TCGI predictor values that favor higher TC genesis probabilities. The skill of the optimized TCGI relative to a climatological reference forecast derived from the developmental dataset (2001-2010) is shown in Fig. 2. These assessments indicate that TCGI has ~30 % and 40% skill relative to climatology for the 0-48 and 0-120 hr forecast periods respectively.

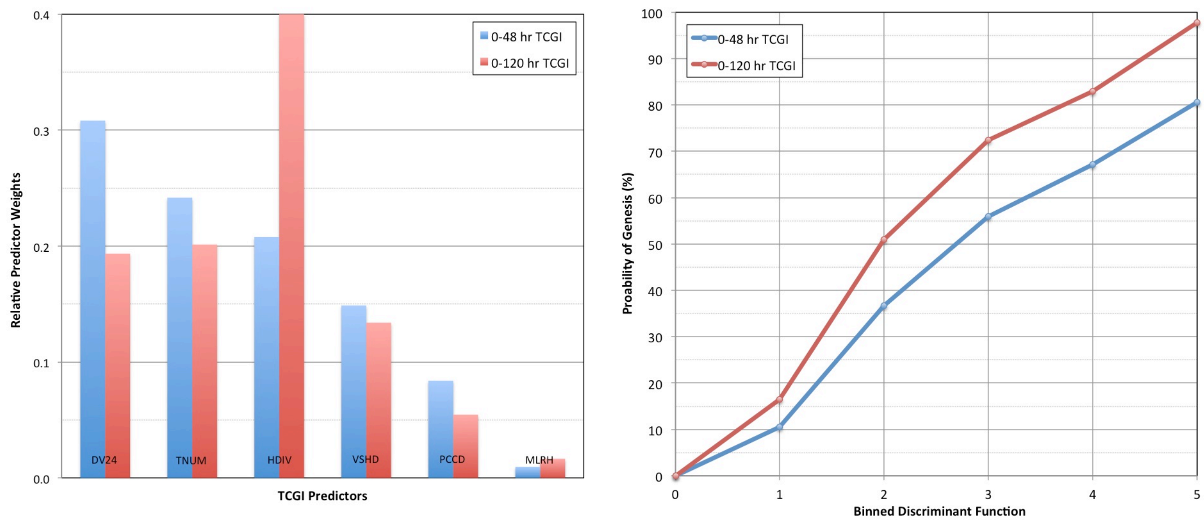

Figure 1. The relative predictor weights (left) for the real-time TCGI and the corresponding genesis occurrence frequency (%) for the five quantiles that were utilized (see Kaplan et al. 2010 for more details). The predictors used in the TCGI are GFS 24-hr vortex tendency (DV24), 850-hPa divergence (HDIV), 850-200 hPa vertical shear (VSHD), Dvorak T-number (TNUM), GOES percent of cold cloud (<-40 C) pixel coverage (PCCD), and GFS 600-hPa relative humidity (MLRH). Note that DV24, HDIV, VSHD, PCCD, and MLRH are averaged over a radius of 500km and that all predictors are evaluated along the entire disturbance forecast track with the exception of two T=0 predictors (TNUM and PCCD).

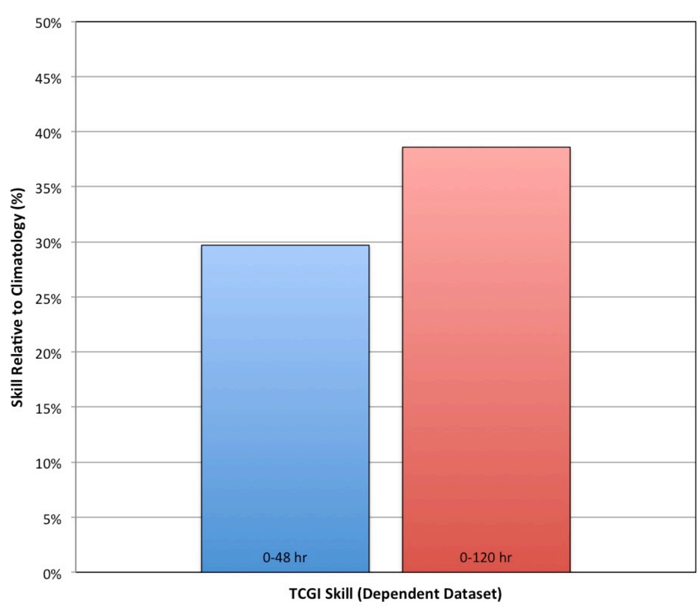

Figure 2. Skill of the 0-48 and 0-120 hr TCGI relative to climatology (2001-2010 dependent TCGI dataset).

b. Perform real-time tests of TCGI (0-48h and 0-120h) either on NESDIS computers at CIRA with output being made available via an ftp site or on JHT computers

The real-time TCGI code that has been developed is currently running at CIRA and was tested and evaluated by the proposal team from July-September 2013. This evaluation period helped the team identify a few potential areas for TCGI improvement. TCGI utilizes both early and late cycle track guidance from the NOAA Global Forecast System (GFS) to determine positions for analyzed tropical disturbances. However, GFS forecast positions are not always available for weak disturbances (especially out to the 144 hours needed for TCGI runs) and therefore, a special Beta and Advection Model, Medium Layer (BAMM) was developed to support the TCGI project. This model, BAMG, required significant testing and evaluation by the proposal team in recent weeks and has resulted in its successful integration into the real-time TCGI scheme. BAMG is now a vital component of TCGI and allows the scheme to run even if GFS tracks are not available or other forecast model guidance is not run by NHC. One important aspect of integrating a new forecast tool such as TCGI into an operational environment is to maximize product transparency to potential users. The proposal team has incorporated predictor information into the TCGI real-time output that describes the specific contributions of each predictor for both the 0-48 and 0-120 hr forecast periods (Fig. 3). This information is designed to help the user more easily interpret the TCGI forecasts.

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                       *         ATLANTIC TC GENESIS INDEX           *
                       *          AL912013 07/24/13 00 UTC           *

TIME (hr)          0     6    12    18    24    36    48    60    72    84    96   108   120
TCGI (%)                                              39.5                                45.9

HDIV (x10-7s-1)  0.0  -2.0  -3.0  -2.0  -1.0  -1.0   1.0   1.0   0.0  -1.0   0.0   0.0   1.0
VORT (x10-6s-1)  2.1   2.0   2.5   2.3   2.7   2.7   2.3   2.1   1.7   1.7   1.3   1.4   1.2
DV24 (x10-6s-1)  0.6   0.6   0.2   0.3  -0.4  -0.6  -0.6  -0.4  -0.4  -0.3  -0.1  -0.2   0.1
VSHD (kt)         14    12     9     2     1     3     5     1     3     6     6     9    10
MLRH (%)          81    83    82    81    81    77    65    58    56    55    57    62    60
PCCD (%)          26   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A
TNUM            1.00   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A   N/A

LAT  (deg N)    12.8  13.4  13.9  14.3  14.9  15.5  15.4  15.7  16.1  16.8  17.3  17.9  18.3
LON  (deg W)    25.6  27.6  29.6  31.6  33.4  37.1  40.7  43.9  47.3  50.4  53.7  56.6  59.3
DTL  (km)        901  1099  1306  1517  1707  2002  1713  1520  1357  1294  1068   920   675
TRACK SOURCE    AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO  AVNO

Prob of Genesis (t= 48h) =  39.5 is  1.3 times the sample mean ( 27.9)
Prob of Genesis (t=120h) =  45.9 is  1.1 times the sample mean ( 40.3)

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CONTRIBUTIONS OF CLIMATOLOGY AND INDIVIDUAL PREDICTORS TO TCGI PROBABILITY

               ******* 48-HR ******    ******* 120-HR ******
                  AVG   FCST  %CONT       AVG   FCST  %CONT
CLIM (%)                       27.9                    40.3
HDIV (x10-7s-1)  -1.3   -0.9   -0.4      -1.2   -0.1   -8.6
DV24 (x10-6s-1)  -0.2   -0.1    1.5      -0.2   -0.2    0.2
VSHD (kt)        16.8    5.9    9.6      19.0    5.5   12.0
MLRH (%)         64.9   77.9   -0.2      61.3   66.3    0.6
PCCD (%)         29.1   25.6   -0.7      28.7   25.6   -0.5
TNUM              0.9    1.0    1.8       0.9    1.0    1.8

%CONT = % contribution to TCGI probability

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PREDICTOR DEFINITIONS (Averaged Over 500 km Radius)

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
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Figure 3. Experimental TCGI output format.

3. Current / Future Year 2 Efforts:

The proposal team has completed the TCGI project and turned over the real-time output (available on a CIRA web link) to the assigned NHC JHT points of contact on 11 September 2013. The proposal team has been and will continue to work closely with NHC forecasters as they evaluate TCGI for possible transition to operations. The TCGI code will be made available to NHC upon request.