# Improving Forecast Guidance through the Joint Hurricane Testbed

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The JHT is funded by the US Weather Research Program in NOAA/
OAR's Office of Weather and Air Quality

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# Joint Hurricane Testbed (JHT)

- Bridges hurricane research & operations
- Began in 2001 under the USWRP
- Our Mission: successfully **transfer** new technology, research results & observational advances from research groups to operational centers
- Testing is done at the National Hurricane Center, Central Pacific Hurricane Center or at their institutions

# JHT: By the numbers

- Number of projects supported: 95
  - 82 completed
    - 54 implemented into operations at NHC/EMC/other
    - 21 not accepted
    - 5 deferred
    - 2 unable to be implemented
  - 8 projects started 1 Sep. 2015 (FY15-17: 8th round, 1 complete)
  - 6 projects started 1 July. 2017 (FY17-19: 9th round)

# Metrics for Operational Implementation

- Forecast or Analysis Benefit: expected improvement operational forecast and/or analysis accuracy
- Efficiency: adherence to forecaster time constraints and ease of user's needs
- Compatibility: IT compatibility with operational hardware, software, data, communication, etc.
- Sustainability: availability of resources to operate, upgrade, and/or provide support

# Our process

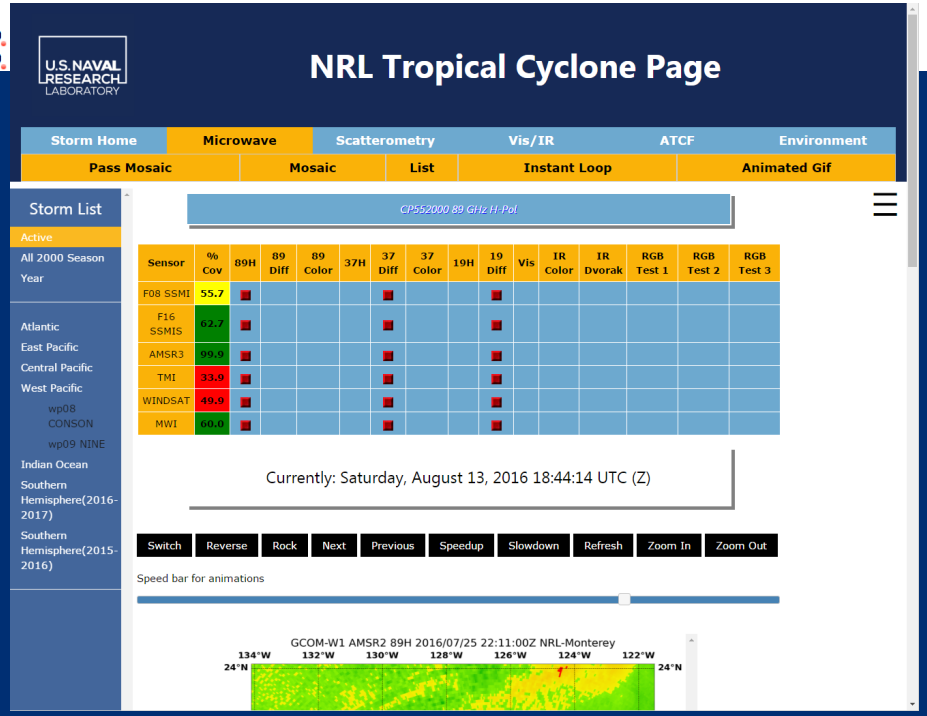
- Call for Proposals – drafted and disseminated (bi-annually)
- Principal Investigators apply for funding through NOAA
- Seven member Steering Committee rates all proposals
- Funded projects are tested during 1 or 2 hurricane seasons in conjunction with NHC points of contact
- At the project's end, each are evaluated by NHC and JHT staff
- Implementation of successful projects are then carried out by NHC staff/PIs

# Current Project Highlights - FY15-17: 8th round

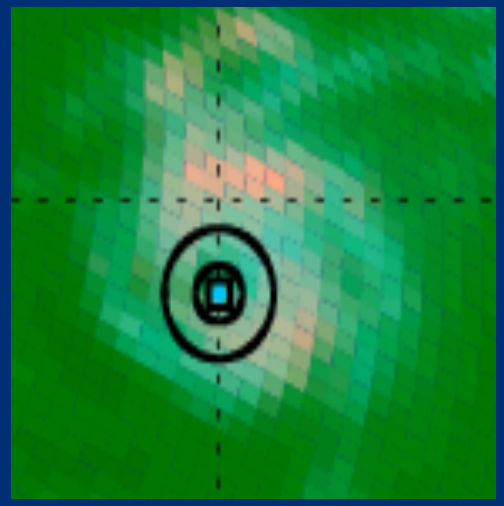
## Tropical Cyclone Genesis Index: Dunion

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 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 (x10-7s-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 (x10-6s-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 (x10-6s-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 | 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) | 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 | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO | AVNO |

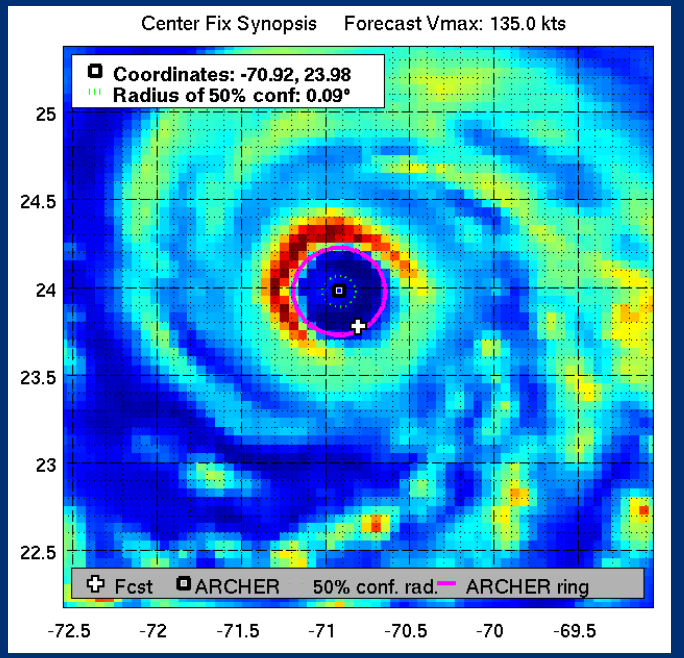
Prob
Prob




NRL web page upgrades: Cossuth



Rapid Intensity Forecasting: Jiang




Eyewall Replacement Cycle
ARCHER: Wimmers

Matrix of RI probabilities

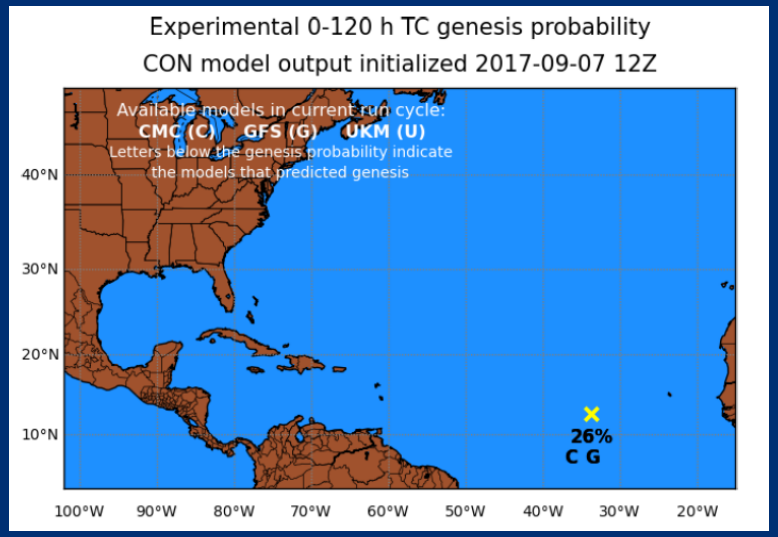
| RI (kt / h) | 20/12 | 25/24 | 30/24 | 35/24 | 40/24 | 45/36 | 55/48 |
|---|---|---|---|---|---|---|---|
| SHIPS-RII: | 17.4% | 64.3% | 54.0% | 37.1% | 30.9% | 62.9% | 70.6% |
| Logistic: | 7.1% | 42.6% | 43.0% | 19.6% | 12.3% | 55.7% | 56.8% |
| Bayesian: | 0.9% | 47.6% | 34.5% | 8.3% | 3.5% | 10.1% | 36.4% |
| Consensus: | 8.5% | 51.5% | 43.9% | 21.6% | 15.6% | 42.9% | 54.6% |

RI SHIPS improvement: Rozoff

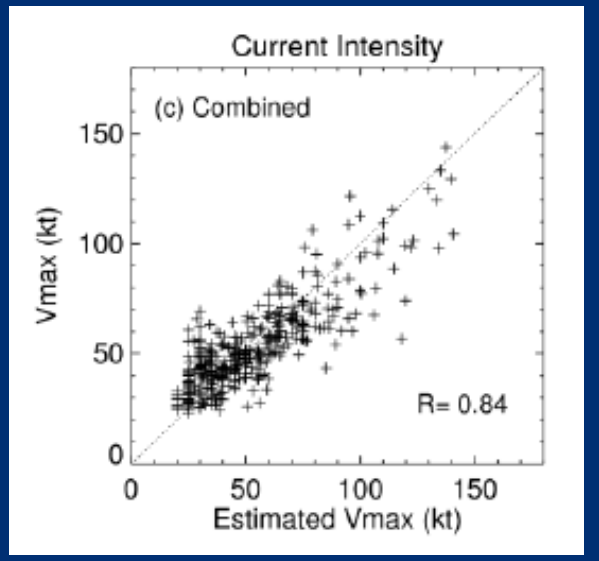
# New JHT Projects - FY17-19: 9th round

| Project Title | Principal Investigator(s) |
|---|---|
| Improvements to Operational Statistical Tropical Cyclone Intensity Forecast Models Using Wind Structure and Eye Predictors | Galina Chirokova (CSU/CIRA), John Kaplan (AOML/ HRD) |
| Ensemble-based Pre-genesis Watches and Warnings for Atlantic and North Pacific Tropical Cyclones | Russ Elsberry (UC-CS) |
| Improvements and Extensions to an Existing Probabilistic TC Genesis Forecast Tool Using and Ensemble of Global Models | Bob Hart (FSU), Dan Halperin (Embry-Riddle) |
| Estimation of Tropical Cyclone Intensity Using Satellite Passive Microwave Observations | Haiyan Jiang (Florida Intl Univ.) |
| Transition of Machine-Learning Based Rapid Intensification Forecasts to Operations | Andrew Mercer and Kimberly Wood (MSU) |
| Evolutionary Programming for Probabilistic Tropical Cyclone Intensity Forecast | Paul Roebber and Clark Evans (UW-Milwaukee) |

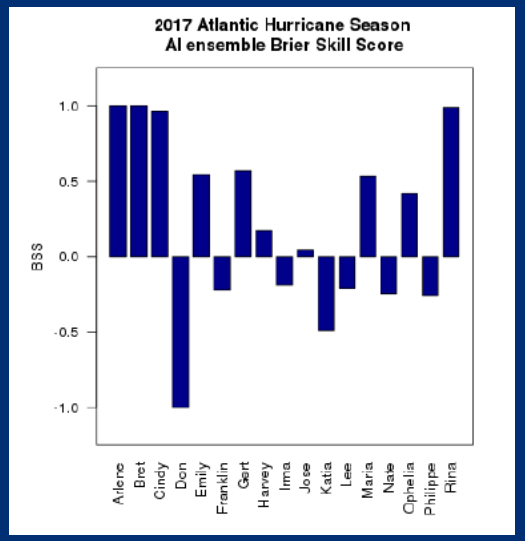
# New JHT Project Highlights




TC Genesis probability: Hart/Halperin

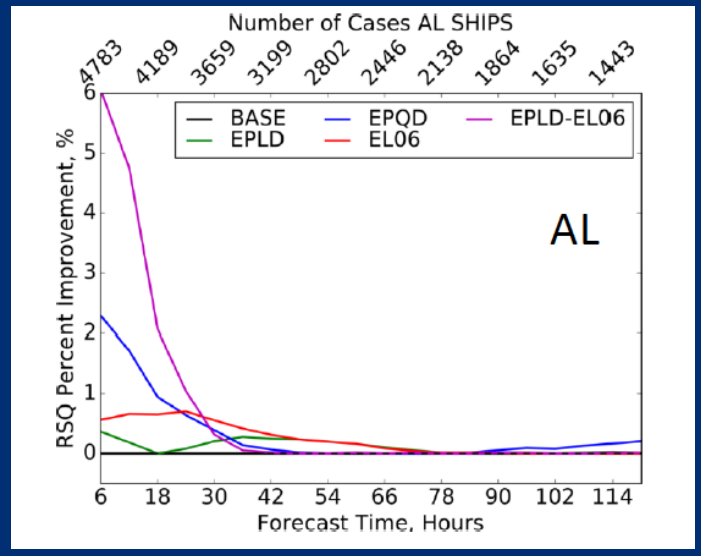



Estimating TC intensity with PMW obs: Zhang




Improving RI forecasts with machine learning: Mercer

Improving intensity forecasts with size predictors: Chirokova



# The Joint Hurricane Testbed

Rappaport et. al., 2012 - *BAMS*

## THE JOINT HURRICANE TEST BED

### Its First Decade of Tropical Cyclone Research-To-Operations Activities Reviewed

BY EDWARD N. RAPPAPORT, JIANN-GWO JIING, CHRISTOPHER W. LANDSEA, SHIRLEY T. MURILLO, AND JAMES L. FRANKLIN

Collaboration between researchers, forecasters and technology specialists facilitated the development and implementation of numerous projects benefitting forecast operations.

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