Joint Hurricane Testbed (JHT) since 2001

- Bridge hurricane research and operations
- Began in 2001 under the USWRP
- **Mission:** successfully transfer new technology, research results and observational advances from research groups to operational centers
- Testing is done at NHC or EMC
US Weather Research Program’s vision
USWRP Goals relating to hurricane landfall forecasting

- To reduce landfall track and intensity forecast errors by 20%.
- To increase warning lead-time to and beyond 24 hours with 95% confidence without increasing the present 3-to-1 over warning.
- To make skillful (compared to persistence) forecasts of gale-and hurricane-force radii out to 48 hours with 95% confidence.
- To extend quantitative precipitation forecasts out to 3 days and enhance skill of day-3 predictions to improve inland flooding forecasts.
Major Activities 2001-2011

Building the JHT 2001-02

- Funded initial round of 10 projects for a first year (FY01) (Mar - Sep 2001)
- Developed Terms of Reference (Mar 2001- May 2002)
- Appointed Director and 2 administrative assistants (all 25% NOAA FTE) (2001)
- Formed Steering Committee (Mar 2002)
- Procured hardware (Q3 2002)
- Hired IT Facilitator (Jul 2002)
PIs/POCs connect on public JHT side
Major Activities 2001-2011

Activities associated with each funding cycle

• Preparation, revision, and legal review of Announcement of Federal Funding Opportunities (AFFO)
• AFFO released through Federal Register Notice (FRN)
  - Open to government, academic, and private sector applicants worldwide
  - List forecast center priorities
  - List forecast center IT configuration, available data and format
  - List project selection criteria
  - List criteria for operational acceptance
• Review of pre-applications
• Review and score of full proposals
Activities associated with each funding cycle

- JHT Directors recommend projects for funding
- NHC assigns Point of Contacts (POC) for each project. POCs work with PIs and forecasters to define timelines/deliverables
- Real-time testing and evaluation activities
- PIs present progress (annual reports) at annual Interdepartmental Hurricane Conference (IHC) (www.ofcm.gov)
- Review of second year funding for 2-year projects
Activities associated with each cycle

- PIs submit final reports when projects end
- POCs and forecasters provide feedback to the JHT
- JHT document IT evaluation on each project
- JHT prepare final evaluation results and submit to NHC Director
- NHC Director makes final decisions on operational acceptance (for non-modeling projects)
- NHC/EMC/NCO implement accepted projects/techniques
Major Activities 2001-2011

• Completed five rounds of projects
  • Final evaluations on fifth round projects completed
• Sixth round projects started in 2011
JHT Infrastructure

**Personnel**

- Quarter-time Director (NOAA FTE)
- 7-member Steering Committee
  - Three from NOAA (one NHC), two from DOD, and two from the academic community
  - NHC member serves as co-Chair
- Two quarter-time administrative assistants (NOAA FTE)
- One IT Facilitator (contractor)

**Computing Resources**

- Server and workstations
- Software
What does it take to support the JHT?

**JHT Staff:**
- Jiann-Gwo Jiing (JHT Director)
- Jose Salazar (JHT IT specialist)
- Shirley Murillo (JHT Admin. Asst.)
- Chris Landsea (JHT Admin. Asst.)

**JHT Steering Committee:**
- Ed Rappaport (NHC - Co-chair)
- Ed Fukada (Joint Typhoon Warning Center)
- Jeff Hawkins (Naval Research Laboratory)
- John Gamache (Hurricane Research Division)
- Liz Ritchie (University of Arizona)
- Vijay Tallapragada (Environmental Modeling Center)
- Hugh Willoughby (Florida International University)

**JHT Principal Investigators and other funded participants**
- John Cortinas and staff (OWAQ)
- NHC and EMC forecaster and technical points of contact
- NHC/Technical Support Branch IT staff
NHC Contributions to JHT

**Logistics**

- Dedicated physical space in operations, offices

**Personnel**

- TPC dedicating about 1.5 FTE spread across ~12 people
  - 0.5 FTE reimbursed by USWRP for quarter-time JHT Director and one quarter-time JHT administrative assistant
  - TPC contributing 1.0 FTE, including TPC member on JHT Steering Committee, forecasters, and technical support staff
- Forecaster and technical points of contact (POC)
- Programming, system administration, and network support
- Administrative support

**Computing Resources**

- Network connectivity
- Operational data flow
JHT Proposal Review Criteria

- **Relevance to program goals** (40 pts)
  - Research maturity (10 pts)
  - Priority-to-payoff factors (25 pts)
  - Other agency use (5 pts)

- **Technical merit** (40 pts)
  - Risk-to-payoff factors (10 pts)
  - Testing (10 pts)
  - Operational usage (10 pts)
  - Technical compatibility (10 pts)

- **Overall qualification of applicants** (10 pts)

- **Project costs** (10 pts)
Factors in NHC Director’s Decisions for Operational Implementation
(Listed in the AFFO announcement)

- **Forecast or Analysis Benefit**: expected improvement in operational forecast and/or analysis accuracy

- **Efficiency**: adherence to forecaster time constraints and ease of use needs

- **Compatibility**: IT compatibility with operational hardware, software, data, communications, etc.

- **Sustainability**: availability of resources to operate, upgrade, and/or provide support
JHT Summary 2001-12

- Number of projects supported: 75
  - 62 completed
    - 39.5 accepted for operational implementation
    - 6 projects completed but rejected
    - 9.5 projects completed but pending further investigation (decisions deferred)
  - 12 projects started in fall 2011

- Implementation
  - 35.5 projects implemented: (including 4 5th round projects)
    - 10 numerical modeling related projects implemented by EMC/NCO:
    - 24.5 projects implemented by NHC:
    - 4 projects accepted but not yet fully implemented by NHC:
Implementation

• Some relatively easy
• Some very complicated
• NHC contributes ~0.5 FTE/yr on implementation
• JHT IT facilitator assists in the process
• NCEP/EMC and NCO also contributed

*Operational Centers are not funded for this task*
JHT first five rounds
62 projects by topic area

Highlights of implemented projects

Track guidance

2005 Tropical Cyclone Tracks
Storm: AL2405 (WILMA)

HURRICANE KATRINA (AL12)
INIT. TIME: 20050802 (9:00 UTC)

20050825 12Z HWRF(fb1dt) 0,2,4,5 days

GFDL

Guidance on guidance

HWRF
Highlights of implemented projects

Intensity guidance

Revised SHIPS intensity forecast scheme

Inner core SST

Probability of rapid intensification
Highlights of implemented projects

Improved use of observations

VORTARC (Intensity estimates using coastal 88-D radars)

Airborne Doppler Winds

Satellite intensity and size estimates

SFMR
Highlights of implemented projects

New products

Rainfall CLIPER

Probabilistic wind forecast
Funding Distribution

**5th Round (2009-2011)**
- University: 61%
- NOAA: 22%
- Private: 9%
- DOD/Navy: 8%

**6th Round (2011-2013)**
- University: 80%
- NOAA: 12%
- Private 2%
- DOD/Navy: 6%

Includes NOAA cooperative inst.
Figure from Rappaport et al. 2012

Distribution of JHT Funds 2001 - 2010

- Academia: 36%
- Private Sector: 14%
- Infrastructure: 15%
- NOAA: 25%
- Other Federal Agencies: 8%

Figure from Rappaport et al. 2012
2011-2012 Major JHT Activities - 5th round

- **February – August 2011**
  - Testing of 5th round (2009-2011) projects

- **August 2011**
  - 9 Projects completed (5th Rd)
  - JHT final evaluation/report on 5th round projects (through December)
  - Decision on acceptance for implementation (NHC and EMC Directors)

- **March 2012**
  - Final decision made
Highlights of 5th Round Completed Projects

- HWRF-GFDN coupled model - Ginis
- Ocean Model Parameterizations - Shay
- Improved Wind Probabilities – DeMaria/Knaff
- Enhanced ATCF - Sampson
JHT: The Process

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

(Listed in the AFFO announcement)

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Intensity change, rapid intensification</td>
<td>1. intensity change, rapid intensification</td>
</tr>
<tr>
<td>2. “Guidance on guidance” for track, intensity and precipitation - probabilistic</td>
<td>2. Improved observational systems in the storm and its environment</td>
</tr>
<tr>
<td>3. Precipitation amount and distribution</td>
<td>3. “Guidance on guidance” for track, intensity and precipitation</td>
</tr>
<tr>
<td>4. Reduce the occurrence of guidance and official track outliers</td>
<td>4. Storm surge, coastal inundation modeling/applications</td>
</tr>
<tr>
<td>5. Implement improved observational systems in the storm and its environment</td>
<td>5. Improved and extended track guidance) and identify and removal of outliers</td>
</tr>
</tbody>
</table>
Modeling Priorities
(Provided by EMC)

**Second Round (2003)**

1. Improved model development to advance track and intensity forecasts
2. Improved boundary layer representation for coupled air/sea/land models-hurricane rainfall and inland flooding problem
3. Improved targeting strategies for hurricane surveillance missions
4. Transforming results from field programs, e.g., Coupled Boundary Layers/Air-Sea Transfer (CBLAST), into tangible results for NWP models.
5. Diagnostic studies of storm scale structure changes from high resolution models

**Sixth Round (2011)**

1. General model improvements to advance NCEP global model track forecasts, improve 5-7 day
2. Diagnostic techniques to further increase the utility of global models in forecasting tropical cyclone genesis
3. Improvements specific to operational HWRF modeling system
2011-2012 Major JHT Activities - 6th round

- 6th round funding recommendation
  - Steering committee review proposals - Complete Feb 2011
  - Rank and select proposals for funding
  - Work with Grants Office to fund selected projects
  - Find Point of contacts among NHC forecasters and support staff
  - Work with PIs to setup timelines for their projects
- 6th round Projects (12) began Aug-Sept 2011

<table>
<thead>
<tr>
<th>Primary Area of Focus</th>
<th># of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvements to dynamical models (for track, intensity, and precipitation forecasts)</td>
<td>3</td>
</tr>
<tr>
<td>Statistical intensity forecast guidance</td>
<td>4</td>
</tr>
<tr>
<td>Enhancements to observed data, assimilation</td>
<td>4</td>
</tr>
<tr>
<td>Tropical cyclone structure/wind/wave distribution</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>
THE JOINT HURRICANE TEST BED
Its First Decade of Tropical Cyclone Research-To-Operations Activities Reviewed

by Edward N. Rappaport, Jiann-Gwo Jing, Christopher W. Landsea, Shirley T. Murolo, and James L. Franklin

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

The National Oceanic and Atmospheric Administration (NOAA), in conjunction with the U.S. Weather Research Program (USWRP), established the Joint Hurricane Test Bed (also popularly, "Testbed") in 2001 to expedite the transfer of tropical cyclone research into forecast operations (Rappaport et al. 2009; Knabb et al. 2008). The JHT's first decade coincided with several significant advances at the National Hurricane Center (NHC; see Rappaport et al. 2009; Franklin 2010). NHC extended its forecast horizon from 3 to 5 days and its track forecast errors decreased significantly, in large part due to improvements in operational computer model forecast guidance and tools available to forecasters. During that period the JHT funded 62 projects, with operational offices implementing most of them.

In this review of the JHT, we look at the program's contribution to the forecast process. We present the JHT's primary objectives and processes, along with key characteristics of the resulting applied research projects it supported. The evaluation describes the operational impact of the program as indicated by the JHT's primary customer, NHC's "hurricane specialists" (forecasters); considers the effect of JHT projects on conventional forecast metrics; and highlights a few nontraditional measures of the test bed's contributions. Along the way, we introduce the projects that have had the greatest impact as a way to give a sense of the kind of successfully applied research that the JHT has sponsored. We also identify some of the program's limitations and discuss prospects for the test bed.

PROGRAM OBJECTIVES AND PRACTICES.
Two JHT documents and the test bed's annual budget define the focus and scope of JHT activities, including the type and number of funded projects. The NOAA/NHC terms of reference (TOR; NOAA/NHC 2002) provide the test bed's mission "to transfer more rapidly and smoothly new technology, research results, and observational advances of the USWRP, its sponsoring agencies, the academic community and other groups..."
Average forecaster rating by topic area

50 projects (1-4 JHT rounds)
Upcoming in 2012

- Decision on 5th round projects
  - Final reports for 5th round projects
  - POC feedback
  - JHT final review/reports to NHC Director for acceptance
- Test and evaluation
  - Prepare real-time testing & evaluation for 6th round projects
  - Set up necessary software code and data flow
- Implement newly accepted projects (NHC)
- Draft and publish 7th round announcement
  - Funding Opportunity (summer 2012)
- Review and recommend pre-applications
Thank you
Joint Hurricane Testbed
Transitioning from Research to Operations

Shirley Murillo - NOAA/AOML

Jiann-Gwo Jiing and Chris Landsea - NOAA/NHC

Joint Hurricane Testbed is funded by the US Weather Research Program in NOAA/OAR's Office of Weather and Air Quality.