NOAA FY 15 Joint Hurricane Testbed (JHT) program

NOAA AWARD NUMBER: NA15OAR4590200

Project Title: Improvement and Implementation of the Probability-based Microwave Ring Rapid Intensification Index for NHC/JTWC Forecast Basins

PI: Haiyan Jiang, Associate Professor, Ph: 305-348-2984, haiyan.jiang@fiu.edu
Co-PI: Kate Musgrave, Research Scientist, Ph: 970-491-8382, kate.musgrave@colostate.edu

Submission Date: September 29, 2016

Recipient Organization: Cooperative Institute for Research in the Atmosphere,
Colorado State University,
1375 Campus Delivery, Fort Collins, CO 80523-1375

Project/Grant Period: 09/01/2015 – 08/31/2017

Reporting Period: 03/01/2016-08/31/2016

Report Term or Frequency: semi-annual

Final Annual Report? No

1. ACCOMPLISHMENTS

The major proposed goal was to improve the probability-based tropical cyclone (TC) rapid intensification (RI) forecast method under our JHT FY-13 project by adding two additional 37 GHz predictors on top of the original the 37 GHz ring and three 85 GHz predictors. The final product is called the **probability-based microwave ring RI index (hereafter PMWRing RII).** It was proposed to implement the PMWRing RII in the NHC and JTWC forecast basins, including Atlantic (ATL), Eastern & Central North Pacific (EPA), North Western Pacific (NWP), North Indian Ocean (NIO), and Southern Hemisphere (SH) basins. Under this major goal, there were two tasks proposed. Please see the table below for the planned vs. actuals for these tasks.

Tasks	Planned	Actuals
Task 1	*Collecting historical microwave data from AMSR-E, SSM/I, and SSMIS and calibrating their T_B's to be compatible with TMI T_B's*	Completed, although we made some changes from the original plan. We chose to we choose to treat each sensor differently to avoid the sensor inter-calibration and different sensor resolution issue. The sample size is large enough for each sensor.
Task 2	*(CIRA) Generating the SHIPS RI developmental dataset for JHT basins*	Completed for North Hemisphere basins (ATL, EPA, NWP & NIO); need to complete the SH basin during year-2 as planned.
Task 3	*Development of the PMWRing RII for each basin*	Completed for North Hemisphere basins (ATL, EPA, NWP & NIO); need to complete the SH basin during year-2 as planned.
Task 4	*Real-time testing at NHC and JTWC*	Real-time testing ongoing for the 2016 season for ATL, EPA, NWP & NIO basins; will do the SH basin during year-2 as planned.
Task 5	*Evaluate the real-time testing results and refine the index based on lessons learned*	Not started yet. Will do it during year-2 as planned.

There were 6 milestones proposed for year-1 and 7 milestones for year-2. All 6 milestones for year-1 have been completed as planned. Please see the table below.

Milestones for year-1	Planned	Actuals
Milestone 1 (Sep 2015)	FIU: Generate the developmental microwave data including TMI, AMSR-E, SSM/I, and SSMIS data for ATL, EPA, NWP and NIO basins; CIRA: Generate the developmental SHIPS RII dataset for NWP and NIO basins	Completed as planned
Milestone 2 (Nov 2015)	FIU: develop RI thresholds for SHIPS RII and microwave predictors for ATL, EPA, NWP and NIO basins	Completed as planned

Milestone 3 (Jan 2016)	Begin development of the PMWRing RII for ATL, EPA, and NWP/NIO basins	Completed as planned
Milestone 4 (Mar 2016)	Present preliminary results at the IHC; Mid-year report	Completed as planned
Milestone 5 (May 2016)	Complete the algorithm development and implement the real-time testing code for 2016 Hurricane/Typhoon season in ATL, EPA, NWP, and NIO basins	Completed as planned
Milestone 6 (June 2016-Nov 2016)	Real-time testing in ATL, EPA, NWP, and NIO basins	In progress

This project has provided training and professional development opportunities for one post-doctoral research scientist (Jon Zawislak) and two graduate students (Yongxian Pei and Margie Kieper). The results of the real-time RI index have been disseminated to NHC & JTWC points of contact through emails and a website at http://tcpf.fiu.edu/JHT/ during 2016 hurricane/Typhoon season. Publications and conference presentations have also been made (please see the following section).

2. PRODUCTS

There were two products/deliverables proposed. See the table below for the planned vs. actuals:

products/deliverables	Planned	Actuals
Product 1	Code (in IDL) that will produce the PMWRing RI index	Not completely finished yet
Product 2	A detailed document of the guidance for running the code, and predicting RI using the 37 GHz index with the SHIPS RI index	The document for predicting RI using the PMWRing RI index with the SHIPS RI index has been completed. The document of the guidance for running the code will be done at the ending period of this project by closely collaborating with NHC/JTWC folks.
Product 3	Not planned	1)A product of the FIU PMWRing RI Index 2) A real-time RI forecast website: http://tcpf.fiu.edu/JHT/; 3) Publications (please see the list below)

Publications and presentations from this reporting period:

Rogers, R. F., J. Zhang, Zawislak, J., H. Jiang, G. R. Alvey III, E. J. Zipser, and S. Stevenson, 2016: Observations of the structure and evolution of Hurricane Edouard (2014) during intensity change. Part II: Kinematic structure and the distribution of deep convection. *Mon. Wea. Rev.*, **144**, 3355–3376. http://tcpf.fiu.edu/Jiang/research/Rogers_et_al_MWR_2016.pdf

Zawislak, J., H. Jiang, G. R. Alvey III, E. J. Zipser, R. F. Rogers, J. Zhang, and S. Stevenson, 2016: Observations of the structure and evolution of Hurricane Edouard (2014) during intensity change. Part I: Relationship between the thermodynamic structure and precipitation. *Mon. Wea. Rev*., **144**, 3333–3354. http://tcpf.fiu.edu/Jiang/research/Zawislak_et_al_MWR_2016.pdf

Jiang, H. and C. Tao, 2016: The TRMM Tropical Cyclone Precipitation Feature (TCPF) database and Its Usage in Rapid Intensification Studies. *AMS 32nd Conference on Hurricanes and Tropical Meteorology Session 15B.6*, San Juan, Puerto Rico, April 17-22, 2016.

Pei, Y. and H. Jiang, 2016: Quantification of Shear-relative Precipitation Asymmetries of Tropical Cyclones in Different Intensity Change Stages. *AMS 32nd Conference on Hurricanes and Tropical Meteorology Session 9D.2*, San Juan, Puerto Rico, April 17-22, 2016.

Tao, C. and H. Jiang, 2016: The Evolution of Rainfall and Convection in Rapidly Intensifying Tropical Cyclones based on 16 years of TRMM Data. *AMS 32nd Conference on Hurricanes and Tropical Meteorology Session 6D.1*, San Juan, Puerto Rico, April 17-22, 2016.

Rogers, R. F., J. Zhang, Zawislak, J., H. Jiang, G. R. Alvey III, E. J. Zipser, and S. Stevenson, 2016: Observations of the structure and evolution of Hurricane Edouard (2014) during intensity change. Part II: Kinematic structure and the distribution of deep convection. *AMS 32nd Conference on Hurricanes and Tropical Meteorology Session 1C.2*, San Juan, Puerto Rico, April 17-22, 2016.

Zawislak, J., H. Jiang, G. R. Alvey III, E. J. Zipser, R. F. Rogers, J. Zhang, and S. Stevenson, 2016: Observations of the structure and evolution of Hurricane Edouard (2014) during intensity change. Part I: Relationship between the thermodynamic structure and precipitation. *AMS 32nd Conference on Hurricanes and Tropical Meteorology Session 1C.1*, San Juan, Puerto Rico, April 17-22, 2016.

Jiang, H., 2016: JHT Project 5: Improvement and Implementation of the Probability-based Microwave Ring Rapid Intensification Index for NHC/JTWC Forecast Basins. 70th *Interdepartmental Hurricane Conference/2016 Tropical Cyclone Research Forum*, Mar 15-17, 2016.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

Individuals have worked on this project include Haiyan Jiang (PI), Jon Zawislak (research scientist), Yongxian Pei (PhD student), and Margie Kieper (PhD student). There have been no changes in the PI and senior/key personnel since the last reporting period. FIU is partnering with CSU CIRA on this project. NHC points of contact (Chris Landsea, John Cangialosi, and Stacy Stewart) and JTWC point of contact (Brian DeCicco) have been involved.

4. IMPACT

The impact of this project on the prediction of rapid intensification will be assessed in year 2 as part of the evaluation of real-time testing results. The education and professional training impact is addressed in Section 1. None of the CSU/CIRA portion of the budget has been spent in foreign countries.

5. CHANGES/PROBLEMS

No significant changes have occurred in the planned/completed work in the CIRA/CSU portion of the project. The NWP/NIO datasets were delivered, as well as updated ATL/EPA in year 1, and the SH will be delivered in year 2 as planned.

6. SPECIAL REPORTING REQUIREMENTS

a. The project's Readiness Level:

Current: RL 6-7
At the start of project: RL 3

b. Transition to operations activities and summary of testbed-related collaborations, activities, and outcomes:

The quasi-real-time testing of the PMWRing RI index (RII) for ATL and EPA basins for NHC and NWP & NIO basins for JTWC has started in June 2016 and is still ongoing. The real-time forecasts are provided to NHC/JTWC points of contact through emails (only when a positive RI forecast is made) and our JHT project webpage (http://tcpf.fiu.edu/JHT/).

c. Has the project been approved for testbed testing yet? What was transitioned to NOAA?

Yes, the project has been approved for testbed testing. But it wasn't transitioned to NOAA because NHC and/or JTWC haven't decided to either transition it or not. The final decision will be made after this project is completed (08/31/2017).

7. BUDGETARY INFORMATION

No significant changes to the budget have occurred for the CIRA/CSU portion of this project.

8. PROJECT OUTCOMES

The milestones of this project and the progress towards them are discussed in Section 1, with the deliverables discussed in Section 2. The outcome of this award will be the implementation of the PMWRing RII if NHC and/or JTWC decide to transition the product, which will be decided after the project is completed (as discussed in Section 6). An additional outcome of this project is the list of products contained in Section 2.