NOAA FY 17 Joint Hurricane Testbed (JHT) program

NOAA AWARD NUMBER: NA17OAR4590142

Project Title: Estimation of Tropical Cyclone Intensity Using Satellite Passive Microwave Observations

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Recipient Organization: Florida International University,
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Project/Grant Period: 07/01/2017 – 06/30/2019

Reporting Period: 07/01/2018-12/31/2018

Report Term or Frequency: semi-annual

Final Annual Report? No

1. ACCOMPLISHMENTS

The major proposed goal was to develop an operational algorithm to estimate the current intensity of tropical cyclones (TCs) using most of the current available microwave satellite sensors. The developmental dataset will be the Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) data during 1998-2013 and Global Precipitation Mission (GPM) 1C-constelation and 2A-GPROF-constellation post-real-time products during 2014-2016. A set of 85 GHz and rain related variables will be used as the input variables of the algorithm. The TC intensity will be estimated from a linear combination of these estimators. Regression models will be developed for the Atlantic and East Pacific basins. The real-time input will be the inter-calibrated 85-91 GHz microwave brightness temperatures and retrieved rain rates from the GPM 1C-constelation and 2A-GPROF-constellation near-real-time products, respectively. The GPM constellation sensors to be used in real-time includes GPM Microwave Imager (GMI), Special Sensor Microwave Imager/Sounder (SSMIS), and Advanced Microwave Scanning Radiometer 2 (AMSR-2). This algorithm will be referred to as the **Passive Microwave Intensity Estimation (PMW-IE)** model.

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	% completion
Task 1	*Complete a revised version of the model by using more historical microwave data*	1) Data collection of 2009-2013 TMI and 2014-2016 GPM data for AL/EP basins is done. 2) Sensitivity tests have been done for the radius threshold of inner-core for AL/EP 3) Revised version of the model is done for both AL and EP basins.	100%
Task 2	*Implement the real-time version of the PMW-IE model, evaluate the real-time testing results, refine the model, and eventually finalize the model*	1) AL: Real-time version for the AL basin was implemented and tested in 2018 hurricane season. Post-season evaluation is underway. 2) EP: EP model will be tested in 2019 hurricane season.	50%

There were 7 milestones proposed for year-1 and 8 milestones for year-2. Please see the table below for the planned vs. actuals for these milestones.

Milestones for year-1	**Planned**	**Actuals**
Milestone 1 (Aug 2017)	Collect 2009-2013 TMI and 2014-2016 GPM 1C-constellation and 2A-GPROF-constellation data for the AL basin	Completed as planned
Milestone 2 (Oct 2017)	Conduct the sensitivity tests and determine the fixed radius threshold for inner-core region definition for the AL basin	Completed as planned

Milestone 3 (Dec. 2017)	Year 1 semi-annual report	Completed as planned
Milestone 4 (Jan. 2018)	Begin development of the revised version of PMW-IE model	Completed as planned
Milestone 5 (Mar 2018)	Present preliminary results at the IHC	Completed as planned
Milestone 6 (May 2018)	Complete the revised PMW-IE model and implement for the AL 2018 Hurricane season (Jun-Nov 2018)	Completed on July 01, 2018 (one-month delay due to satellite data access issues)
Milestone 7 (Jun 2018)	Year 1 final report	Completed as planned *(this report)*
Milestones for year-2	**Planned**	**Actuals**
Milestone 1 (Jul 2018)	Collect 2009-2013 TMI and 2014-2016 GPM 1C-constellation and 2A-GPROF-constellation data for the EP basin	Completed as planned
Milestone 2 (Sep 2018)	Conduct the sensitivity tests and determine the fixed radius threshold for inner-core region definition for the EP basin	Completed as planned
Milestone 3 (Nov 2018)	Evaluate the results from the 2018 AL hurricane season	Has started, but not finished yet.
Milestone 4 (Dec 2018)	Year 2 semi-annual report	Completed as planned (this report)
Milestone 5 (Jan 2019)	Adjust PMW-IE model based on 2018 results, rerun AL & EP for 2018 season	Not started yet. Will do as planned.
Milestone 6 (Mar 2019)	Present preliminary results at the IHC	Not started yet. Will do as planned.
Milestone 7 (May 2019)	Complete the algorithm refinement and implement for the AL and EP 2019 Hurricane season	Not started yet. Will do as planned.
Milestone 8 (Jun 2019)	Year 2 final report	Not started yet. Will do as planned.

This project has provided training and professional development opportunities for two post-doctoral research scientists (Drs. Yongxian Pei and Cheng Tao) and one PhD graduate student (Xinxi Wang). The results of the real-time TC intensity estimates are being disseminated to NHC & CHPC points of contact, and the general public through a website at http://tcpf.fiu.edu/JHT/. Publications and conference presentations have also been made (please see the following section). During the next reporting period, we plan to finish yr-2 milestones # 3-8. We also plan to apply for one-year no-cost extension in order to complete the real-time testing for the whole 2019 hurricane season (May-Nov. 2019).

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 **PMW-IE** outputs	75% of the code has been finished. Will continue as planned.
Product 2	A detailed document of the guidance for running the code, and interpreting the intensity estimates	Not started yet. Will do as planned.

Other products:

Datasets:

1) TMI 85 GHz brightness temperature and 2A12 rain data for TCs in AL/EP basins during 1998-2013
2) GPM 1C-constellation 85 GHz brightness temperature and 2A-GPROF-constellation rain data for TCs in AL/EP basins during 2014-2016

Publications and presentations from this reporting period:

Jiang, H., C. Tao, and Y. Pei, 2019: Estimation of Tropical Cyclone Intensity Using Satellite Passive Microwave Observations. *J. Appl. Meteor. Climatol.*, in press.

Jiang, H. 2018: Tropical Cyclone Passive Microwave Intensity Estimation (PMW-IE) Model. *AMS 33rd Conference on Hurricanes and Tropical Meteorology Session 15C,* Ponte Vedra, FL, April 16-20, 2018.

Jiang, H., Y. Pei, and C. Tao, 2018: Estimation of Tropical Cyclone Intensity Using Satellite Passive Microwave Observations, *72nd Interdepartmental Hurricane Conference/Tropical Cyclone Research Forum*, Miami, Florida, Mar 13-15, 2018.

Website:

http://tcpf.fiu.edu/JHT/

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

Individuals have worked on this project include Haiyan Jiang (PI), Cheng Tao (Postdoc Research Associate), Yongxian Pei (PhD student previously, postdoc since Jan. 1, 2018), and Xinxi Wang (PhD student). Both Dr. Cheng Tao and Dr. Yongxian Pei have left FIU and will no longer working on this project. The PI is actively seeking to hire a post-doc or programmer for this project. There have been no other changes in the PI and senior/key personnel. NHC points of contact (Jack Beven, Dave Roberts, and Chris Landsea) and CHPC point of contact (Bob Ballard) have been involved in the testbed plan. NHC Technology & Science Branch (TSB) branch chief Dr. Mark DeMaria has been involved in the test and R2O transition plans. Dr. Chris Landsea has also been involved in the R2O transition plan.

4. IMPACT

The impact of this project on TC intensity estimates and intensity prediction in AL and EP/CP will be assessed later 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 FIU portion of the budget has been spent in foreign countries.

5. CHANGES/PROBLEMS

No significant changes have occurred in the planned/completed work of the project.

6. SPECIAL REPORTING REQUIREMENTS

a. The project's Readiness Level:

Current: RL 5-6
At the start of project: RL 4-5

(RL is defined based on the following:
RL1: Basic Research
RL2: Applied Research
RL3: Proof of Concept
RL4: Validation of system in the lab or equivalent
RL5: Validation of the system in a relevant environment
RL6: Demonstration in a test environment
RL7: Demonstration in a relevant environment
RL8: Demonstrated in the actual environment
RL9: Deployment and regular use)

b. Summary of testbed-related collaborations, activities, and outcomes:

Original version of the test plan was submitted with the year-1 semi-annual report. The revised version (with minor changes mainly to correct some typos) was submitted with the year-1 annual report submitted in June 30, 2018.

c. Research to operation (R2O) transition plan:

The R2O transition plan was submitted with the year-1 semi-annual report.

d. 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 hasn't decided to either transition it or not. The final decision will be made after this project is completed.

7. BUDGETARY INFORMATION

The spending is delayed. A postdoc researcher or programmer will be hired soon and supported by this project. The PI Jiang's summer salary will be charged from this project during summer (May-Aug.) 2019 and the first half (May-Jun.) of summer 2020 after requesting one-year no-cost extension.

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 PMW-IE model if NHC decides 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.