NOAA/OAR Joint Hurricane Testbed

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Improved Eyewall Replacement Cycle Forecasting
Using a Modified Microwave-Based Algorithm (ARCHER)

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1. ACCOMPLISHMENTS DURING THIS PERIOD

The milestones for this project, first described in the project proposal, are summarized in the following table. The major goals for this reporting period (Sep 2017-Feb 2018) are highlighted in yellow and described in turn directly below.

Milestones/Deliverables

Milestone	Start Date	Forecasted Completion	Actual Completion	% Complete
1. Create a double eyewall module for ARCHER	July 2015	Dec 2015	Dec 2015	100%
2. Create real-time online display of ARCHER-ERC output	Jan 2016	June 2016	June 2016	100%
3. Evaluate performance of online ARCHER module display	Jan 2016	June 2016	June 2016	100%
4. Produce initial online technical documentation	Jan 2016	June 2016	June 2016	100%
5. Calibrate/validate the ERC probability product	Jan 2016	June 2016	Feb 2017	100%
6. Finalize double eyewall ARCHER module to optimize performance	July 2016	Dec 2016	Dec 2016	100%
7. Finalize online display of algorithm	July 2016	Dec 2016	(May 2017)	100%
8. Complete online technical documentation	Jan 2017	June 2017	(Feb 2018)	100%
9. Deliver ERC module for SHIPS	Jan 2017	Feb 2018	(June 2018)	50%
10. Create real-time online text file output of ERC module for SHIPS	Jan 2017	Feb 2018	(June 2018)	0%

Here we report on the progress on **Milestones 8-9** in the previous six-month period, and update on the evaluation of the real-time performance of the algorithm in this particularly active hurricane season:

Milestone 8. Complete online technical documentation

The online technical documentation was produced as a wiki collaborative document hosted at SSEC (https://groups.ssec.wisc.edu/groups/archer/archer-erc-introduction), and linked from the ARCHER-ERC page. The documentation is complete, and we have found that the guidelines for interpreting the probabilistic model are consistent with our experience of the 2017 hurricane season.

Milestone 9. Deliver ERC module for SHIPS

We have observed and did troubleshooting on the ERC module during the 2017 hurricane season. The model is now in its final form, and we have determined that it is working at an optimal level of accuracy (see Year 2 report for details). The reported level of completion for this Milestone is 50% because the MPERC model is ready for incorporation into SHIPS, but this work on incorporation is still underway.

Further, at the completion of this project in July, we will begin on a newly supported JPSS Risk Reduction grant to incorporate ARCHER into a real-time data processing environment for NHC, CPHC and JTWC ("Real-time acquisition, processing, analysis, and operational integration of TC-centric polar orbiting data. Part II: Serving forecasters with advanced satellite-based TC center-fixing and intensity information", UW-CIMSS). This will serve as a clear pathway for putting M-PERC into operations as well. It is likely that the final form of the M-PERC to SHIPS integration will be done through this system.

2. PRODUCTS

As described in Section 1, we have revised and done troubleshooting on the following deliverables/products during this reporting period:

a. The real-time ERC guidance website at CIMSS, showing Hovmoller plots of ARCHER ring score, the M-PERC model output, and a directory of TC microwave imagery that the model is built from.
b. A website of online technical documentation.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

As this is a fairly small project, we have kept the activity limited to the three original participants – Anthony Wimmers, Derrick Herndon and Jim Kossin. We have provided regular updates to our colleagues at the NHC.

4. IMPACT

The expected impact of this project is to improve the forecasting accuracy for intense hurricanes in one of the current areas of need for the NHC: understanding and predicting eyewall replacement cycles. We attempt to do this using an automated analysis of eyewall (and developing eyewall) sizes and trends from 85-92 GHz microwave imagery. The information is organized into real-time online graphics and an associated probabilistic model. These new tools under development will offer a more rigorous analysis of a phenomenon that requires greater understanding and analysis to provide adequate warning during weather-related emergencies.

5. CHANGES/PROBLEMS

We have requested and received a one year no-cost extension to this project in order to further evaluate the real-time performance of the probabilistic model, and develop optimal methods for interpreting the output. This has also allowed us to use these later improvements to develop an optimal end-product to incorporate into operations.

6. SPECIAL REPORTING REQUIREMENTS

Test Plans for the ARCHER-ERC / M-PERC Project

As stated in Sections 1 and 5, we will continue to run the automated ARCHER-ERC and MPERC for the real-time website at CIMSS through the next year and beyond.

The primary criterion for success is a positive review from NHC participants within the JHT. Their decision will be based on quantitative performance metrics compiled by the CIMSS team (accuracy, Brier Skill Score), case histories, as well as the NHC's professional judgment of the skill of the algorithm in real-time.

Project Readiness Level

The online tools (Milestones 2 and 3) and the M-PERC probability model can be considered "RL 7: Prototype system." (This is 7 of 9). These tools are currently working in an operational environment in a demonstration phase and user documentation is online

and ready for further feedback. The remaining criterion for reaching the next level is receiving the operator approval.

Transition to Operations Activities

In preparation for transition to operations, we are testing the final products in real time and continue to explore options for recoding the full ARCHER system into a format that is compatible with the NHC system.

Testbed Approval

The decision to transition to operations will occur after the close of the project, in mid 2018.

7. BUDGETARY INFORMATION

We are currently on budget and our planned expenditures are as expected. Our proposal stated that the product development should proceed quickly by following the development pathways of the original ARCHER project and the pERC model. This has gone as expected. The approved budget is $80,299 and spending to date through the reporting period of February 2018 is $58,932, which is 74% spent into this three-year project. Note that from an accounting perspective, there is a one month posting lag time (ie. charges from February post in March), which often gives the appearance of being underspent.

8. PROJECT OUTCOMES

The anticipated outcome of this project is a new system to automatically analyze near real-time microwave imagery of hurricanes and provide comprehensive forecaster guidance on the potential for an upcoming eyewall replacement cycle. This guidance will take the form of an online graphical depiction of the relevant image characteristics, and a probabilistic model using microwave image information in the same fashion as the pERC model.

REFERENCES

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