Microwave Probability of Eyewall Replacement Cycle (M-PERC)

Joint Hurricane Testbed Project Update

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“The disparity between SHIPS forecasts and the observed intensity changes during ERCs is strongly suggestive that the typical environmental controls of intensity change, on which SHIPS is largely based, are temporarily countermanded while dynamic processes internal to the storm dominate the intensity evolution.” - Kossin
ERC forecast tools available to forecasters currently

**E-SHIPS** – ERC adjustments to SHIPS forecast when ERC onset is known
- Our work with M-PERC is helping to inform meaningful updates to E-SHIPS

**PERC** – Probability of ERC (based on environment, Vmax and infrared satellite information)
- An Atlantic-only model currently but will be developed to work in East Pacific

**PROBABILITY OF AT LEAST 1 SCNDRY EYEWAL FORMTN EVENT AL142016 MATTHEW 10/01/2016 00 UTC**

```
TIME(HR) 0-12 12-24(0-24) 24-36(0-36) 36-48(0-48) <--- PROB BASED ON INTENSITY ONLY
CLIMO(%) 48 43( 70) 28( 79) 23( 84)
PROB(%)  47   51( 74) 92( 98) 97(100) PC4 UNAVAIL...MODEL SKILL DEGRADED
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**DSHIPS INTENSITY FORECAST ADJUSTED RELATIVE TO ONSET OF ERC WEAKENING PHASE**

```
TIME (HR) 0 6 12 18 24 36 48 60 72 84 96 108 120
>24HR AGO (DSHIPS) 135 136 128 117 108 101 102 107 104 67 71 69 72
18HR AGO 135 134 126 115 106 99 100 105 102 65 69 67 70
12HR AGO 135 132 131 120 111 104 105 110 107 70 74 72 75
6HR AGO 135 129 126 125 116 109 110 115 112 75 79 77 80
NOW 135 126 120 117 116 109 110 115 112 75 79 77 80
IN 6HR 135 136 127 121 118 115 116 121 118 81 85 83 86
IN 12HR 135 136 128 119 113 109 110 115 112 75 79 77 80
```
ERC Onset Guidance: M-PERC

89 GHz ring scores can be displayed in hovemuller form to show time and space evolution of the features.

*ARCHER ring score plotted versus time shows a branching/merging pattern during ERCs
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Web page output for M-PERC
On CIMSS ARCHER page

Training Data 1999-2011 -> 41 storms with 84 ERC events (1787 profiles)

Completed Work to Date

Develop baseline validation of Atlantic data

Baseline validation of Eastern Pacific cases

Updated web products
  - Incorporate lessons learned to update product description page
  - Created archive page for direct links

Held virtual product training for JTWC

Established training dataset for EPac model

Started porting work. Move graphics production away from MATLAB and to Python
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Verification Atlantic data

Verification data 2012-2019 -> 20 storms with 41 events

Evaluate performance of existing model in Atlantic

Using prob of >25% 37 hits and 11 misses

BSS for the sample (climatology of 13%) is 35% vs 27 % for Vmax only model

Average delta-Vmax following SEF is -13 knots
Average forecast intensification was +4 knots

Verification East Pacific data

Verification data 2017-2019 -> 17 storms with 27 events

BSS for the sample (climatology of 13%) is 48% vs 38 % for Vmax only model
M-PERC

Active 2020 Atlantic season!
Archive page for direct links to M-PERC storm pages

http://tropic.ssec.wisc.edu/real-time/archerOnline/cyclones/mperc_archive.html
Hurricane Genevieve 2020

Hurricane Genevieve Discussion Number 9 NWS National Hurricane Center Miami FL EP122020 900 AM MDT Tue Aug 18 2020

Since the issuance of the last advisory, Genevieve has continued to rapidly intensify. The major hurricane has a very well-defined and clear eye and microwave imagery as recent as 12Z did not show any indication of a secondary eyewall.

Additional rapid strengthening is possible for at least the next 12 h given the current structure of the hurricane and the extremely favorable environment it is moving through.
Types of ERC events

Fast evolving early events with lower probabilities have less impact on Vmax. Intensification rate may decrease briefly.

Higher probability events have larger impact on Vmax. More likely to cause weakening.
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ERC process can aid in RW

SEF development

Erosion in NW quad

Entrainment of stable air into inner core interrupts ERC process. Core rapidly weakens

Hurricane Kenneth (13E) 2017
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Analysis of model performance has improved ability to provide guidance to forecasters.

- Increase attention when probabilities exceed 25%
- Probabilities > 70% likely will result in weakening

Model is sensitive to Vmax. Probabilities only output for Vmax > 65 knots. Uncertainty of 10 knots in Vmax results in ~ 10% change in M-PERC

**Moving Forward**

Post-process remaining Epac data back to 1999

Continue building out new Epac model and verify

Develop Epac-based PERC model

Improve web display with environmental data such as shear and sst

Manuscript documenting M-PERC and changes to E-SHIPS submitted soon