Improved Eyewall Replacement Cycle Forecasting Using ARCHER - a Modified Microwave-Based Algorithm (Year 2)

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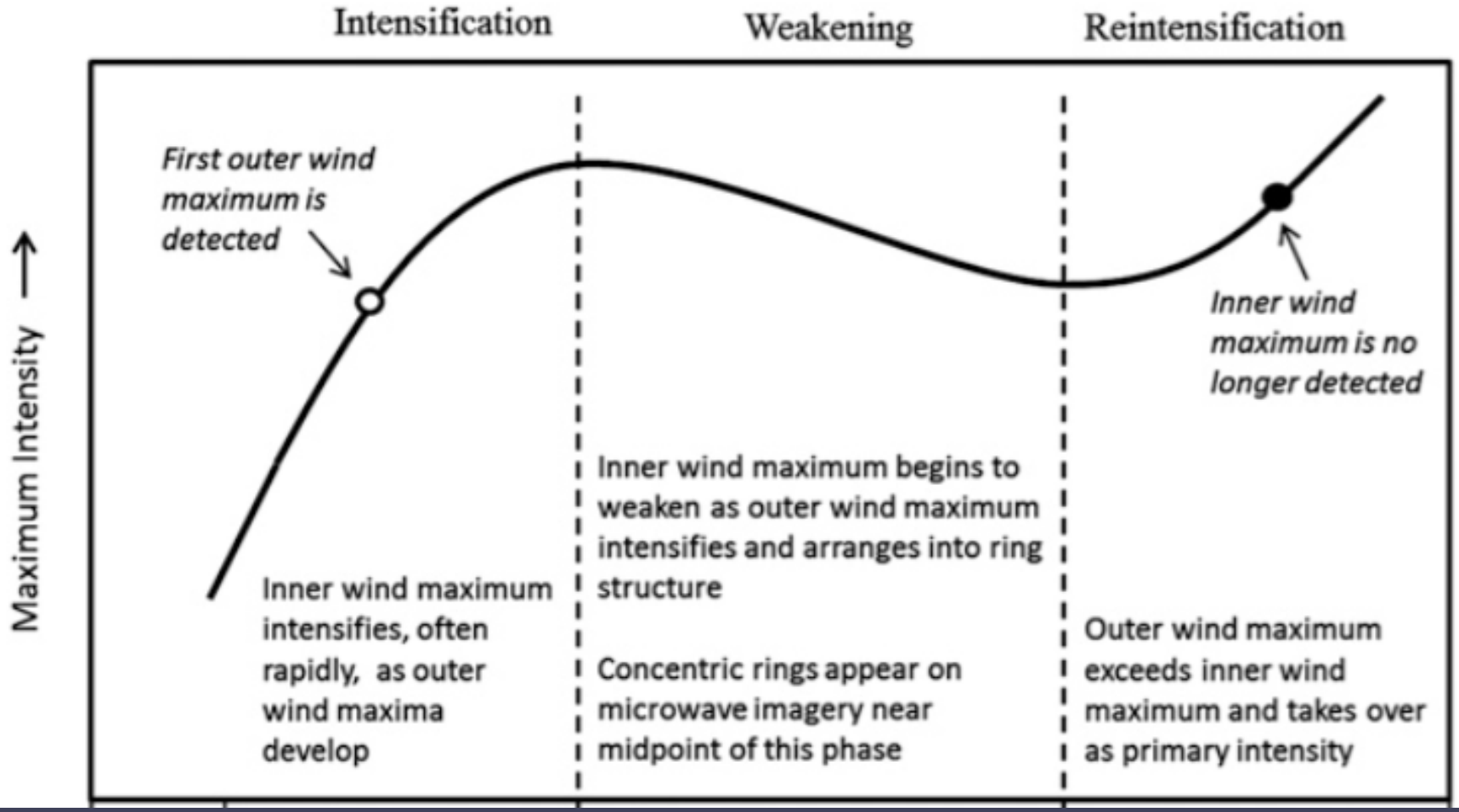
Sponsored by the NOAA Joint Hurricane Testbed

Motivation



Schematic of an eyewall replacement cycle.
Sitkowski et al 2011 Fig 8

Sitkowski, M., J. P. Kossin, and C. M. Rozoff, 2011: Intensity and structure changes during hurricane eyewall replacement cycles. *Mon. Wea. Rev.*, **139**, 3829-3847.

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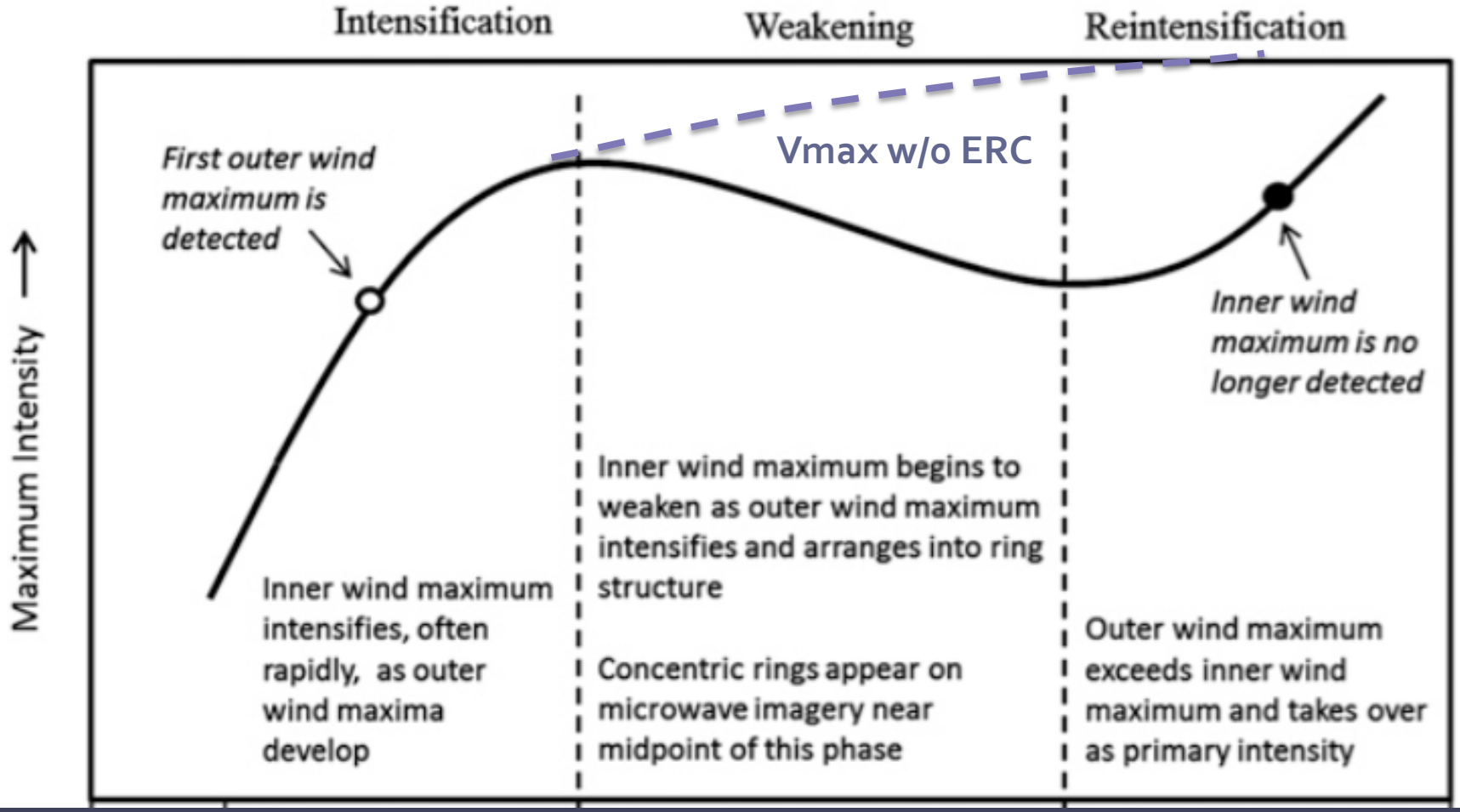

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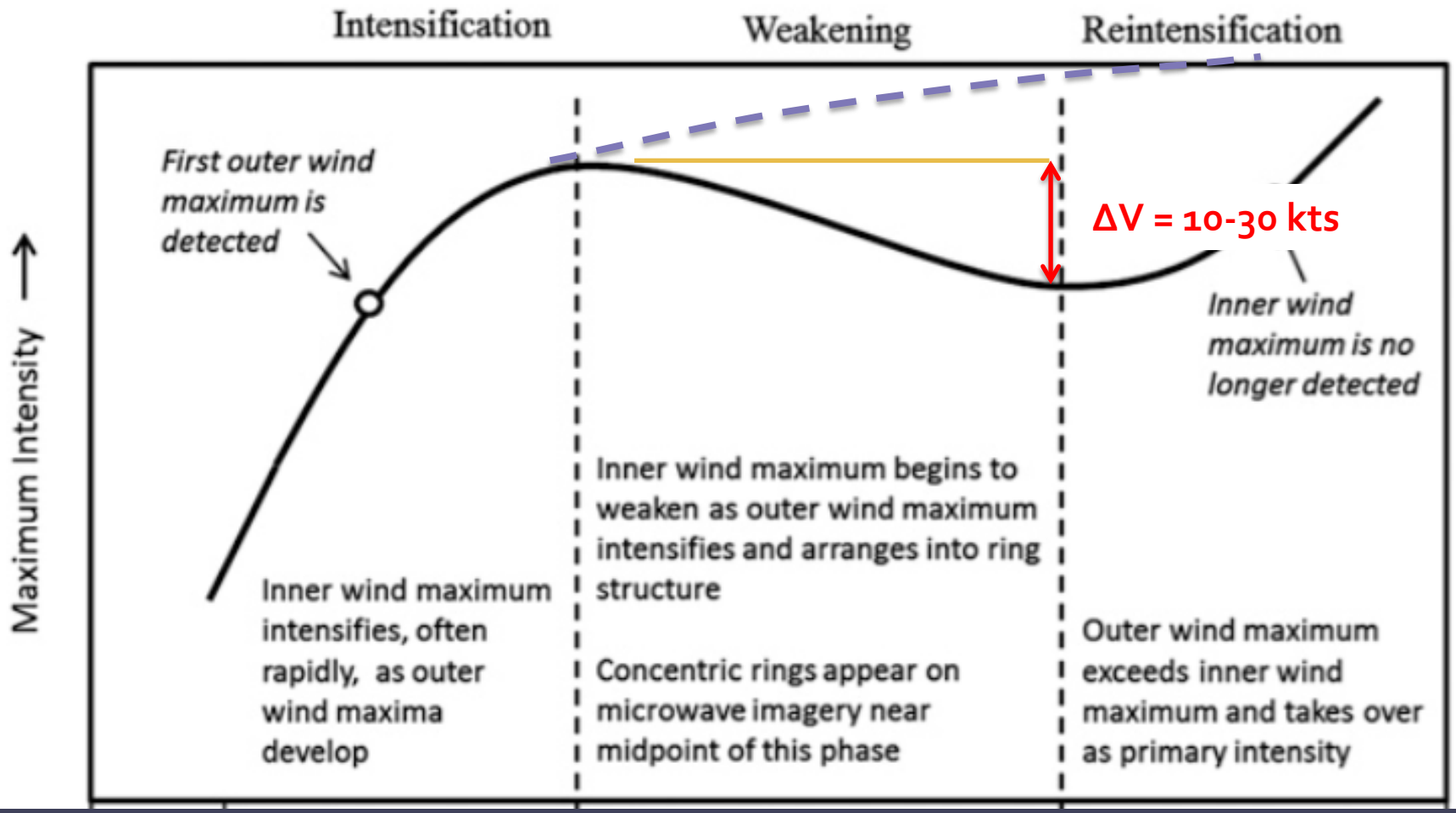

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Existing ERC tools

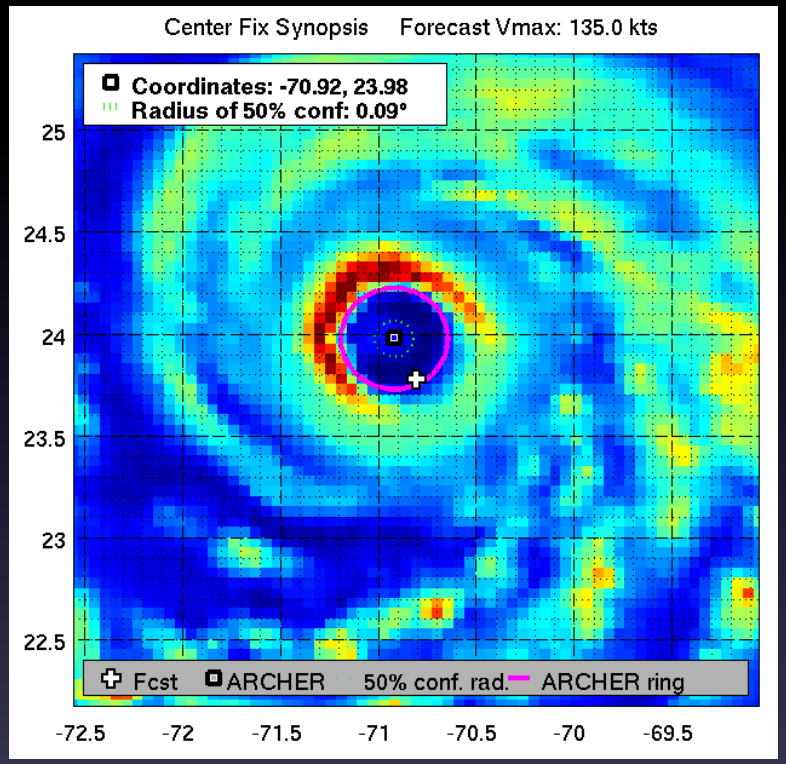
E-SHIPS

- Applies ERC climatology to an existing TC
- Requires forecaster to already know that an ERC is underway

pERC

- Predicts probability of secondary eyewall formation using environmental variables and geostationary satellite data
- *Does not use microwave imagery*

ARCHER Ring Score as an ERC diagnostic:



- Time series of ARCHER ring score confirm the close diagnostic relationship between ring score and secondary eyewall formation

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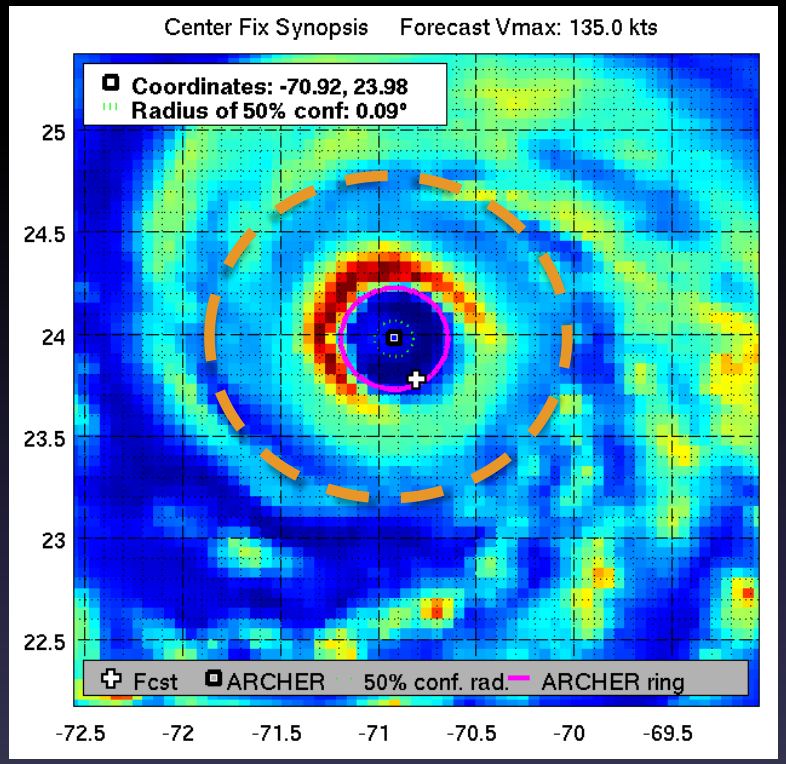

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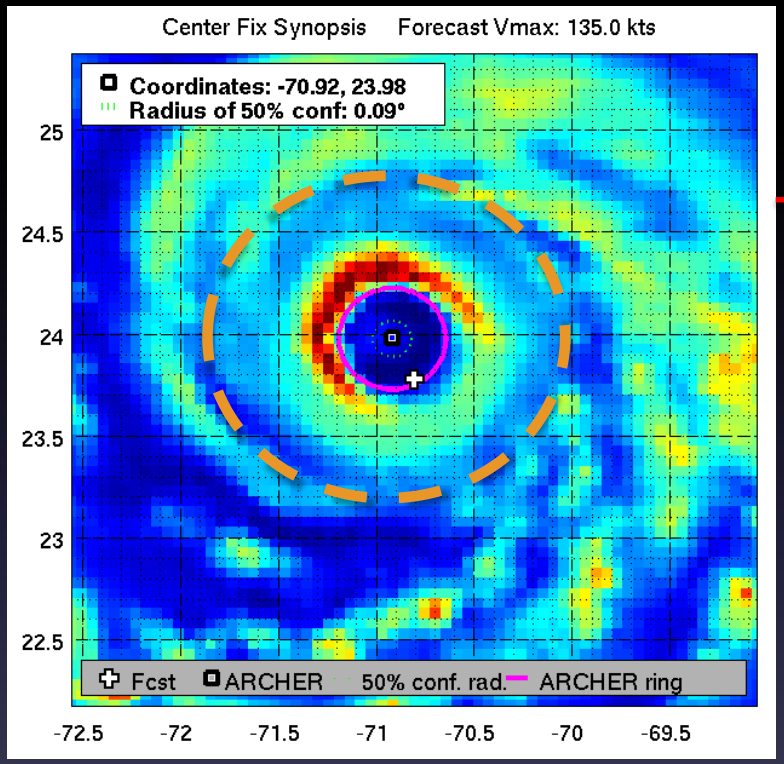

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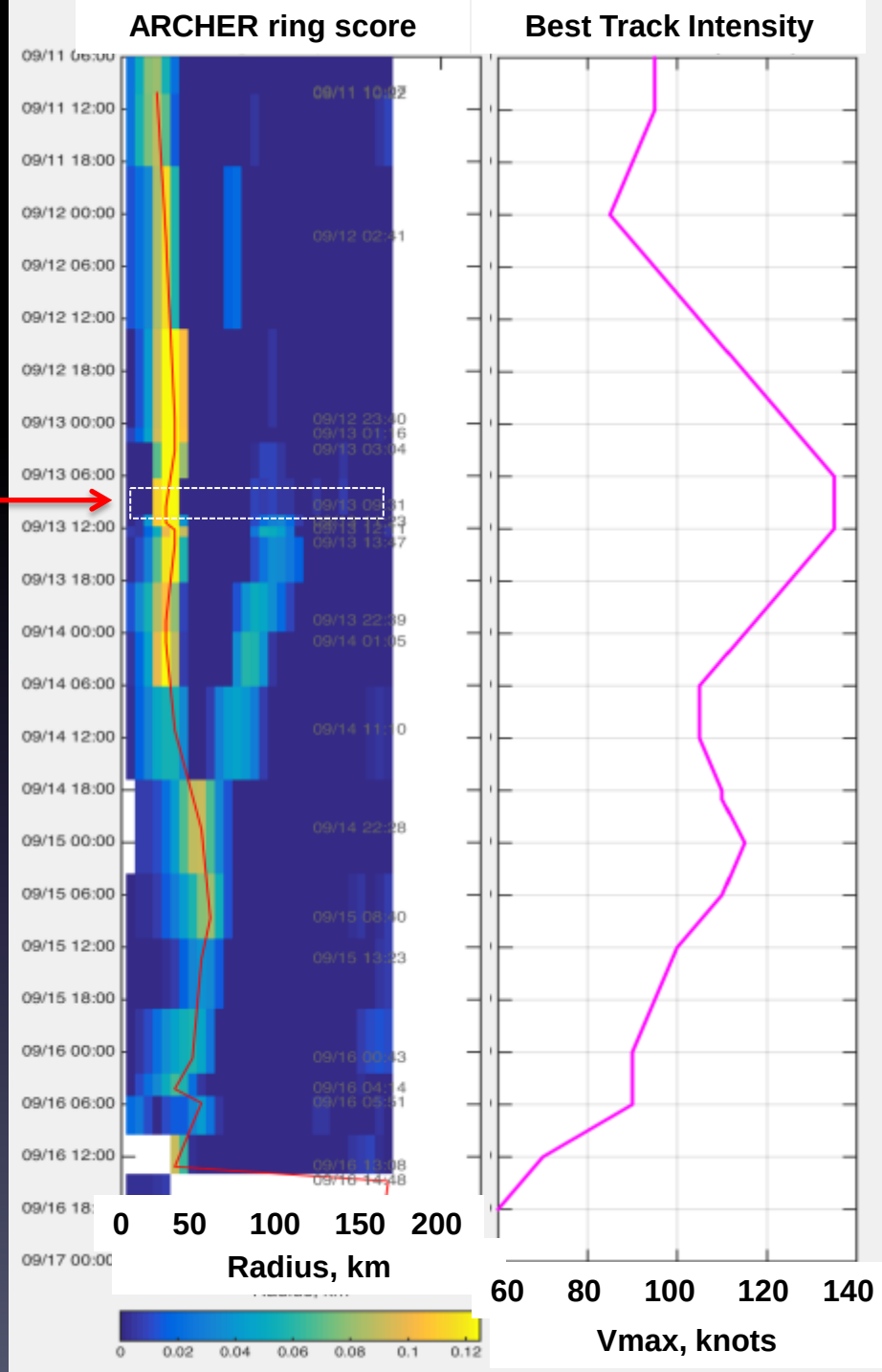

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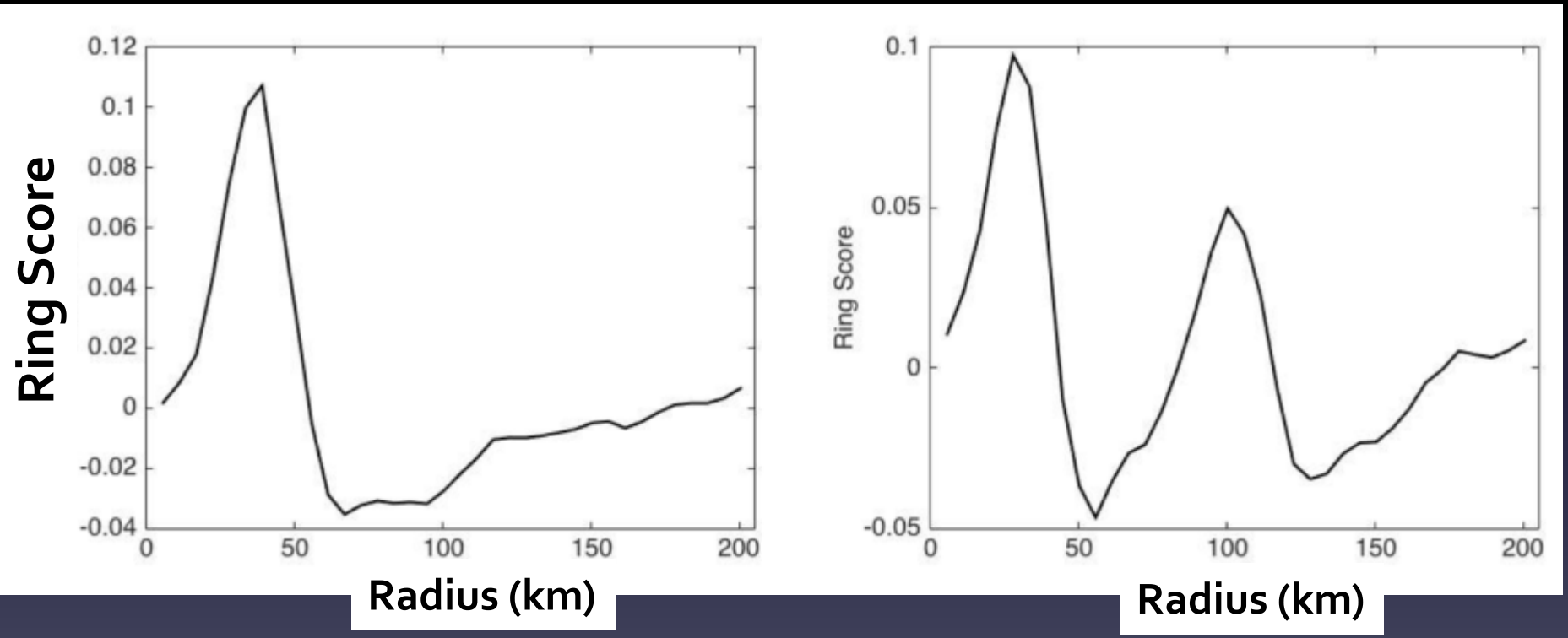
Project Summary

1. Adapt ARCHER to analyze the full range of eyewall patterns out from the center-fix point. (Done)
2. Create a real-time display of this analysis as a forecasting/diagnostic aid. (Done)
3. Integrate this information into a new, microwave-based ERC prediction tool.

ARCHER 'Ring Score' example profiles



Single eyewall

Double eyewall

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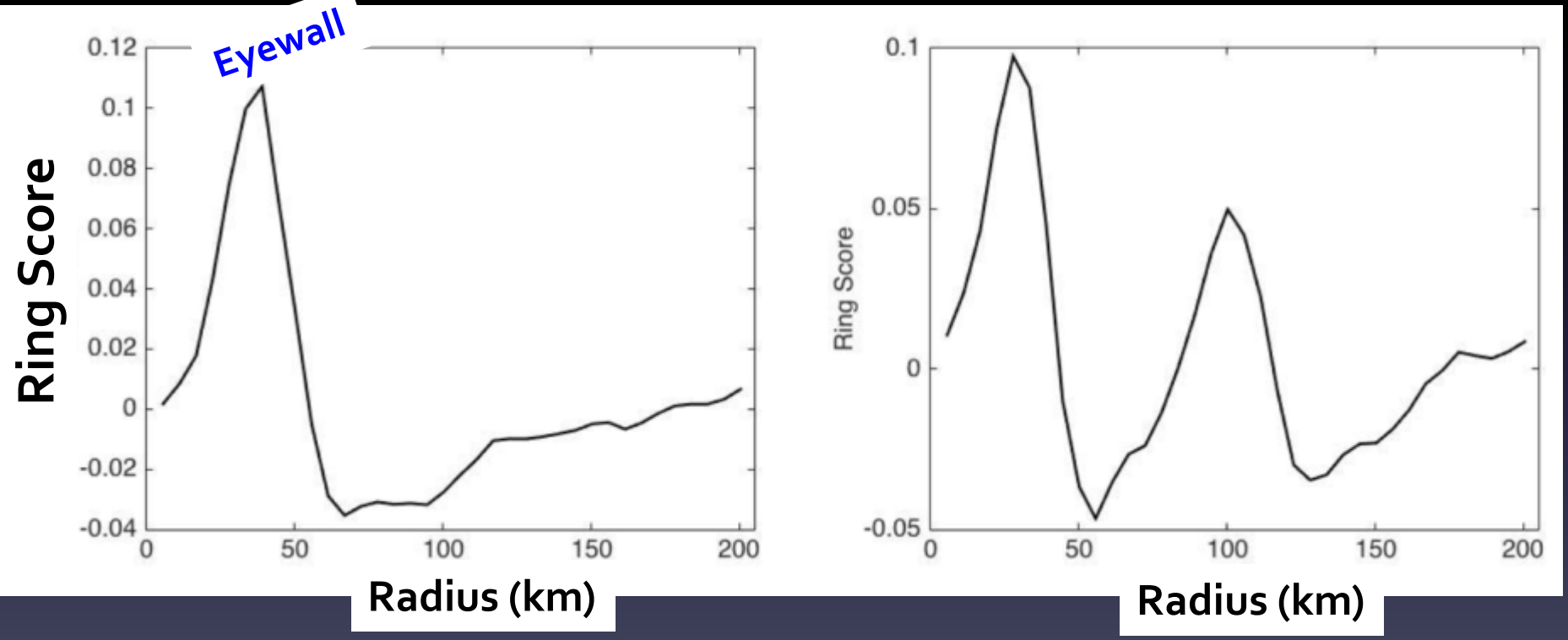

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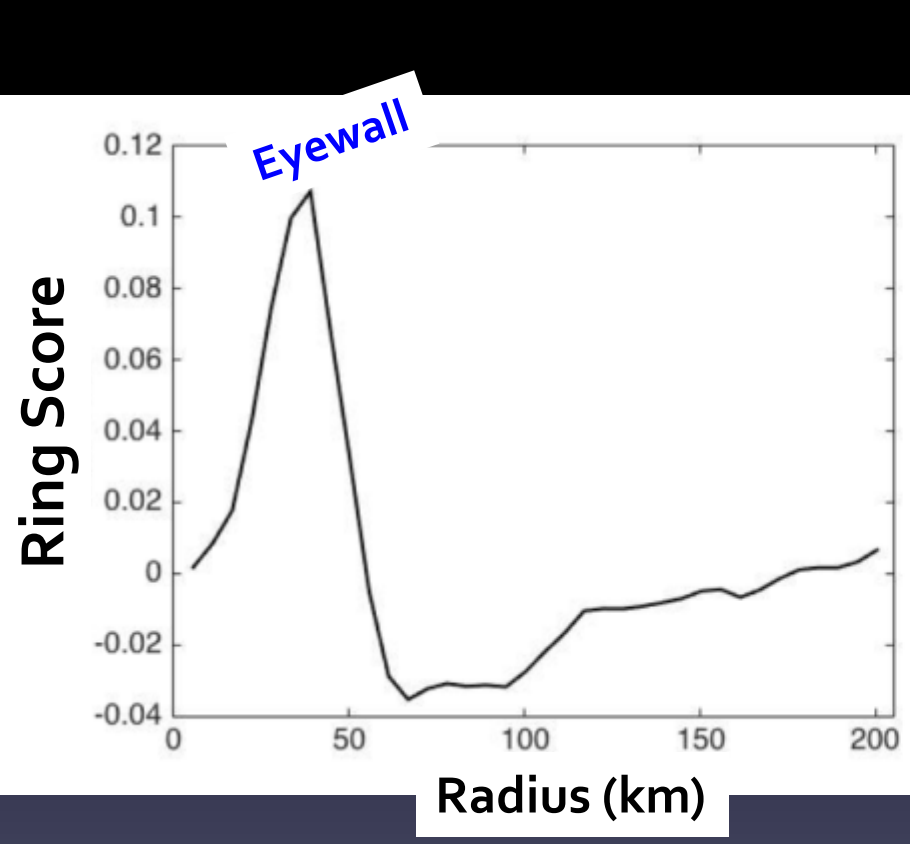

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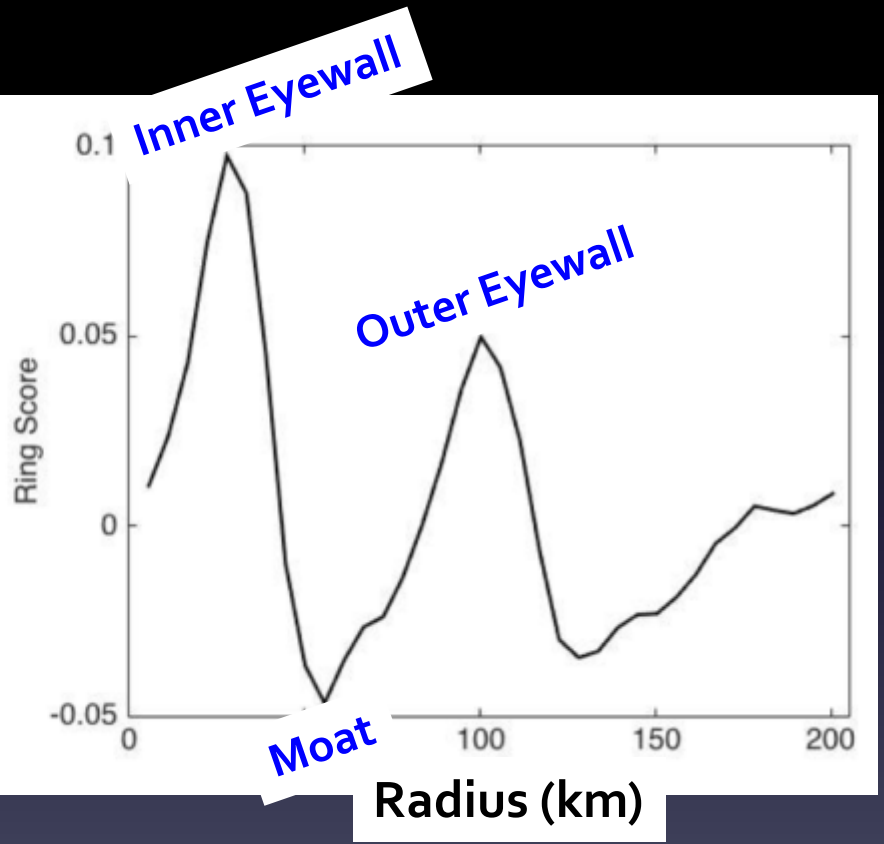
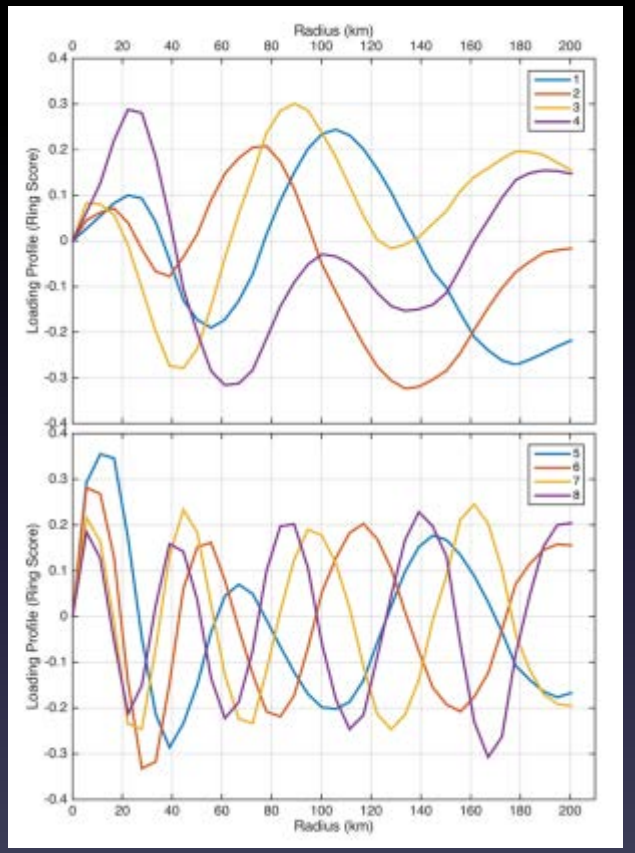


Double eyewall

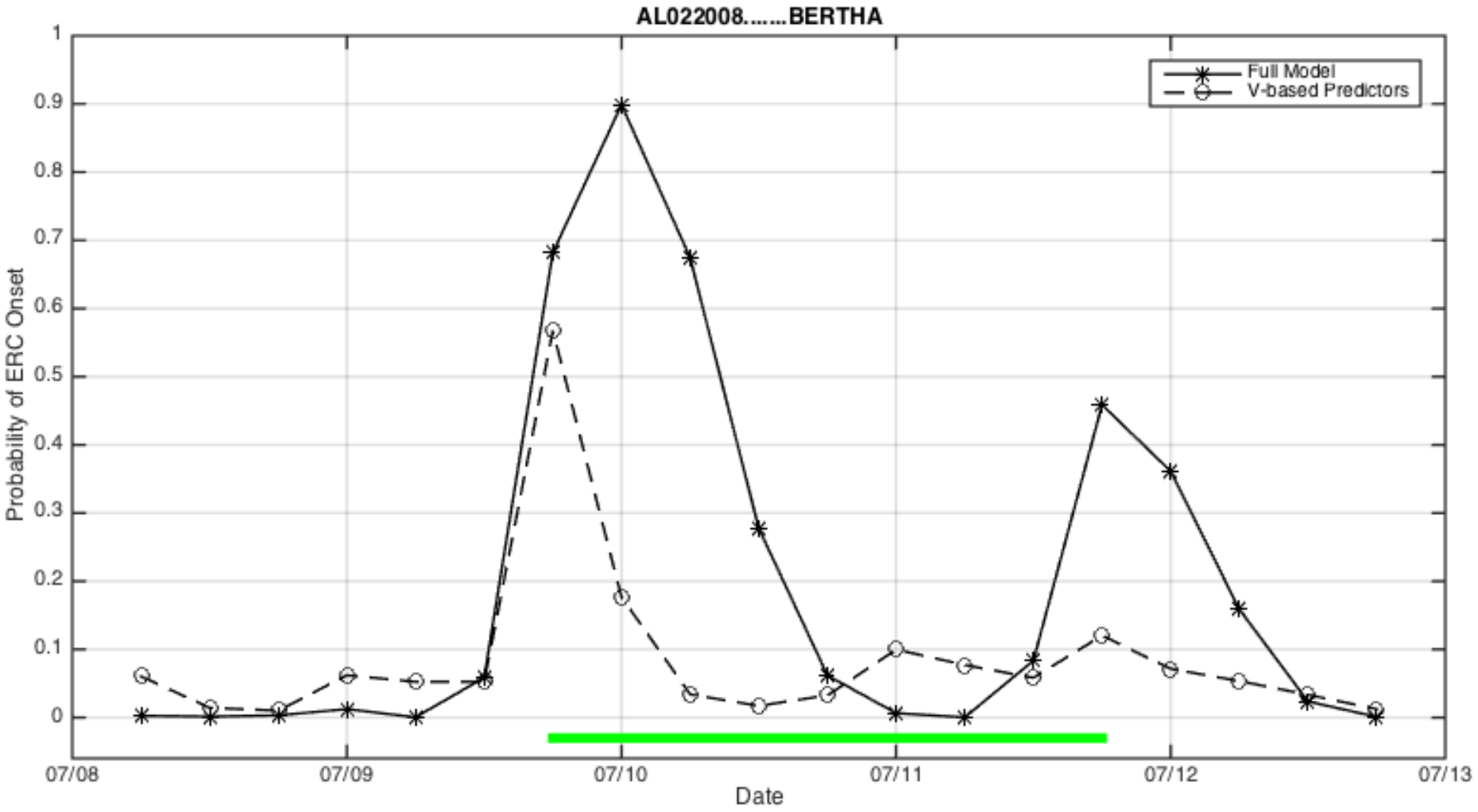
New Product: 'M-PERC' (Microwave-based Probability Of ERC)

- Statistical model of ARCHER output* built from about 1500 profiles.
- In validation, Brier Skill Score = 0.49.



* Decomposes Ring Score profile into 8 Empirical Orthogonal Functions (EOFs). Then it applies a binomial regression of the 8 EOF weights, Vmax, and the change in these predictors from -6, -12, -18 and -24 hrs.

M-PERC examples



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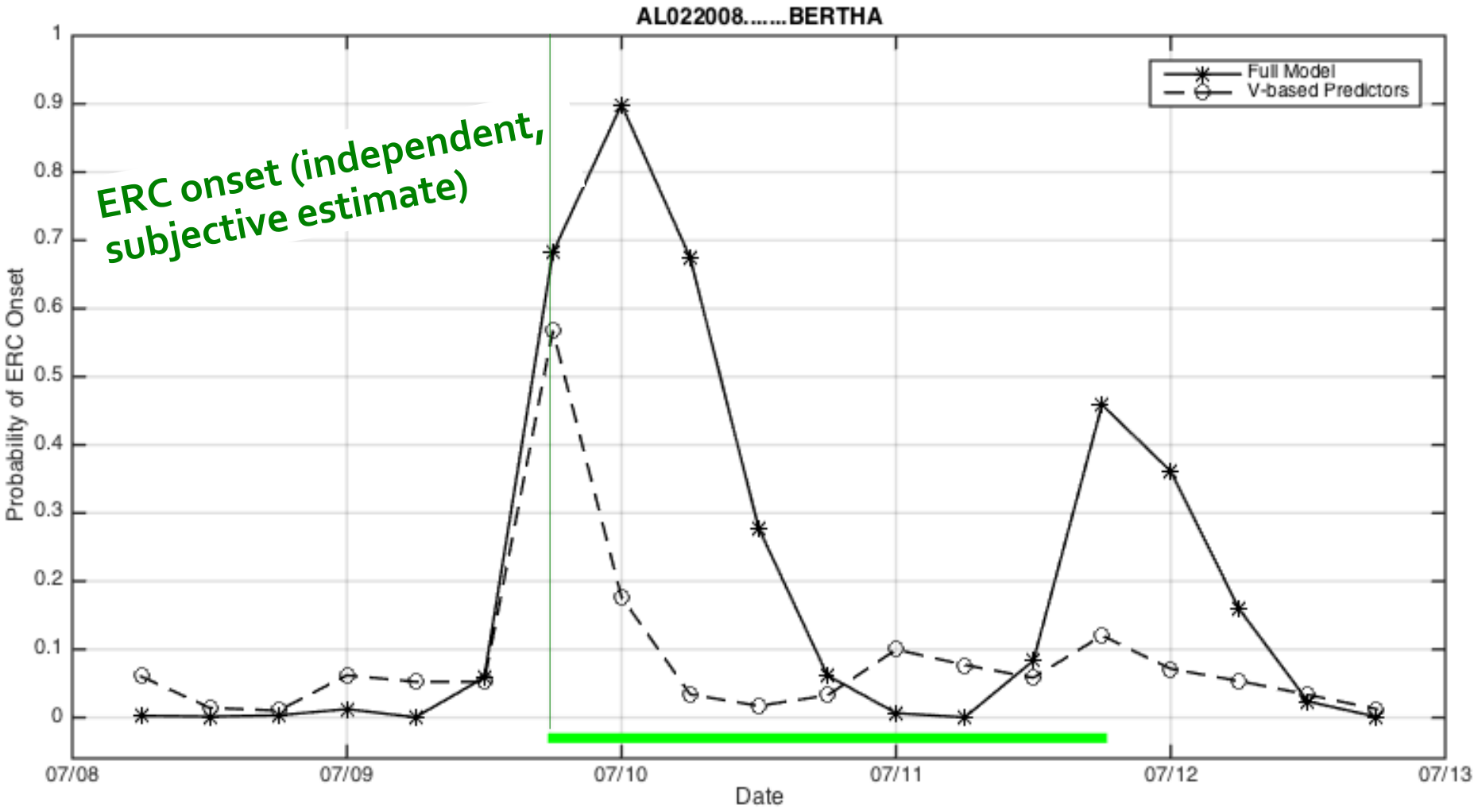

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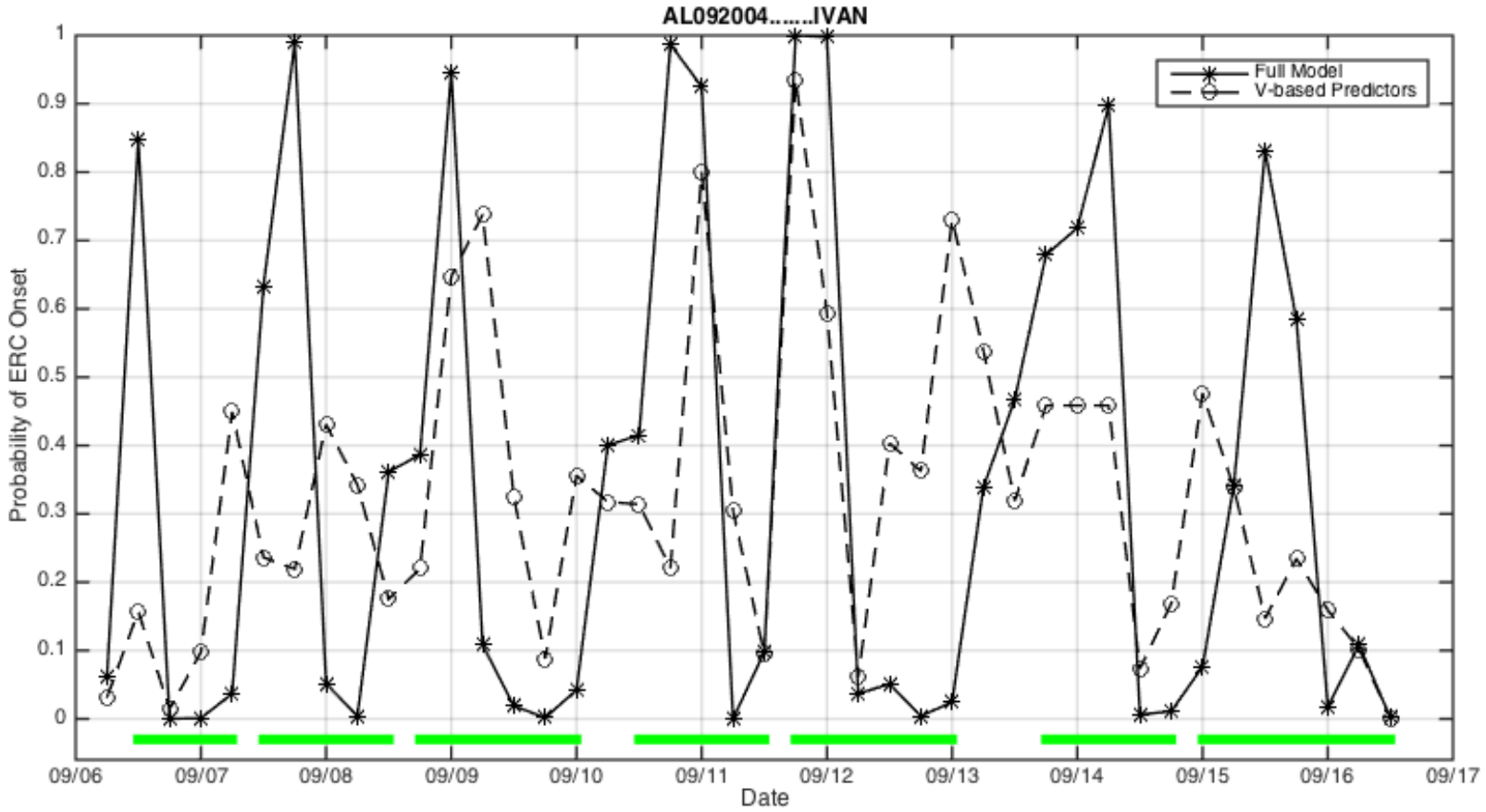

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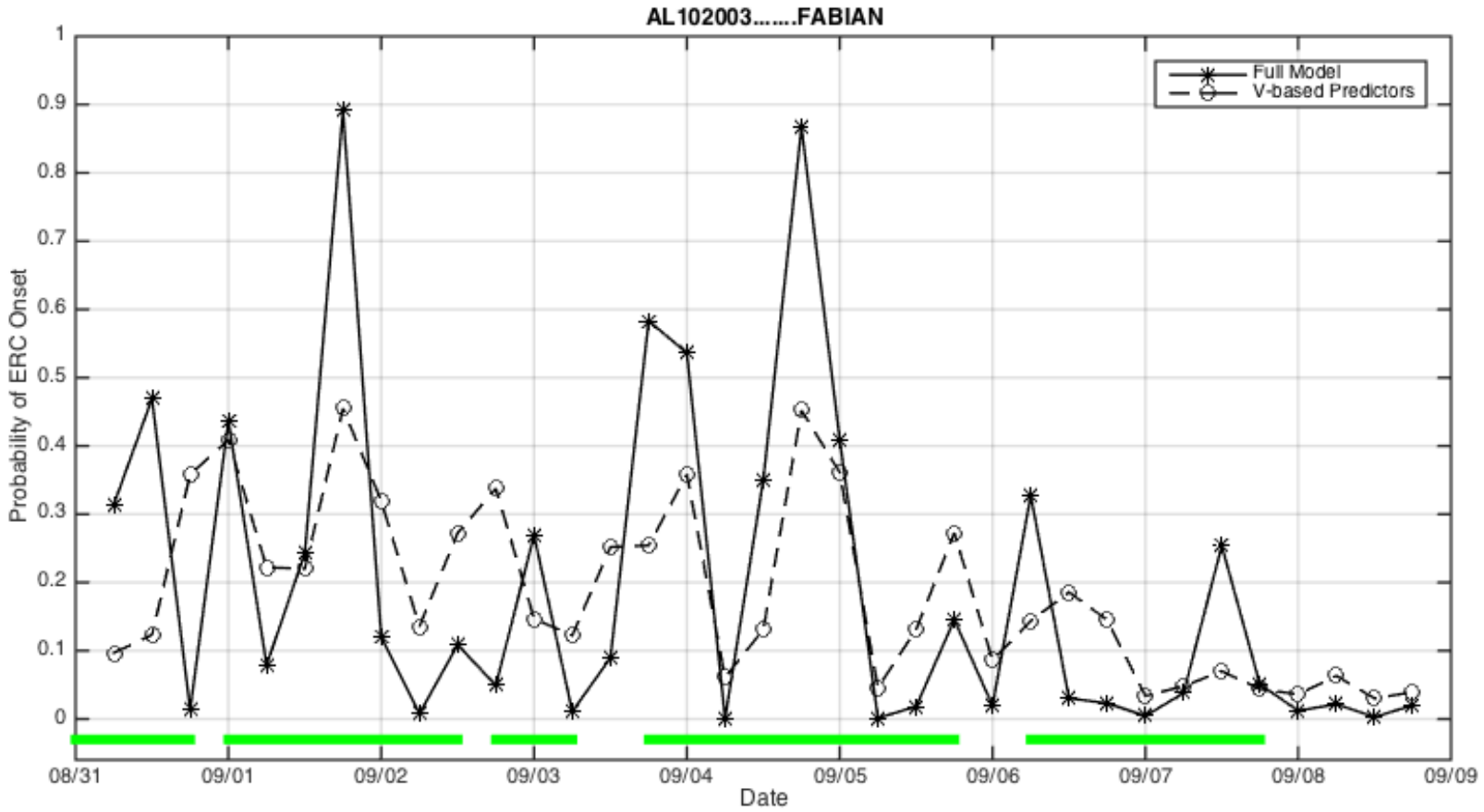

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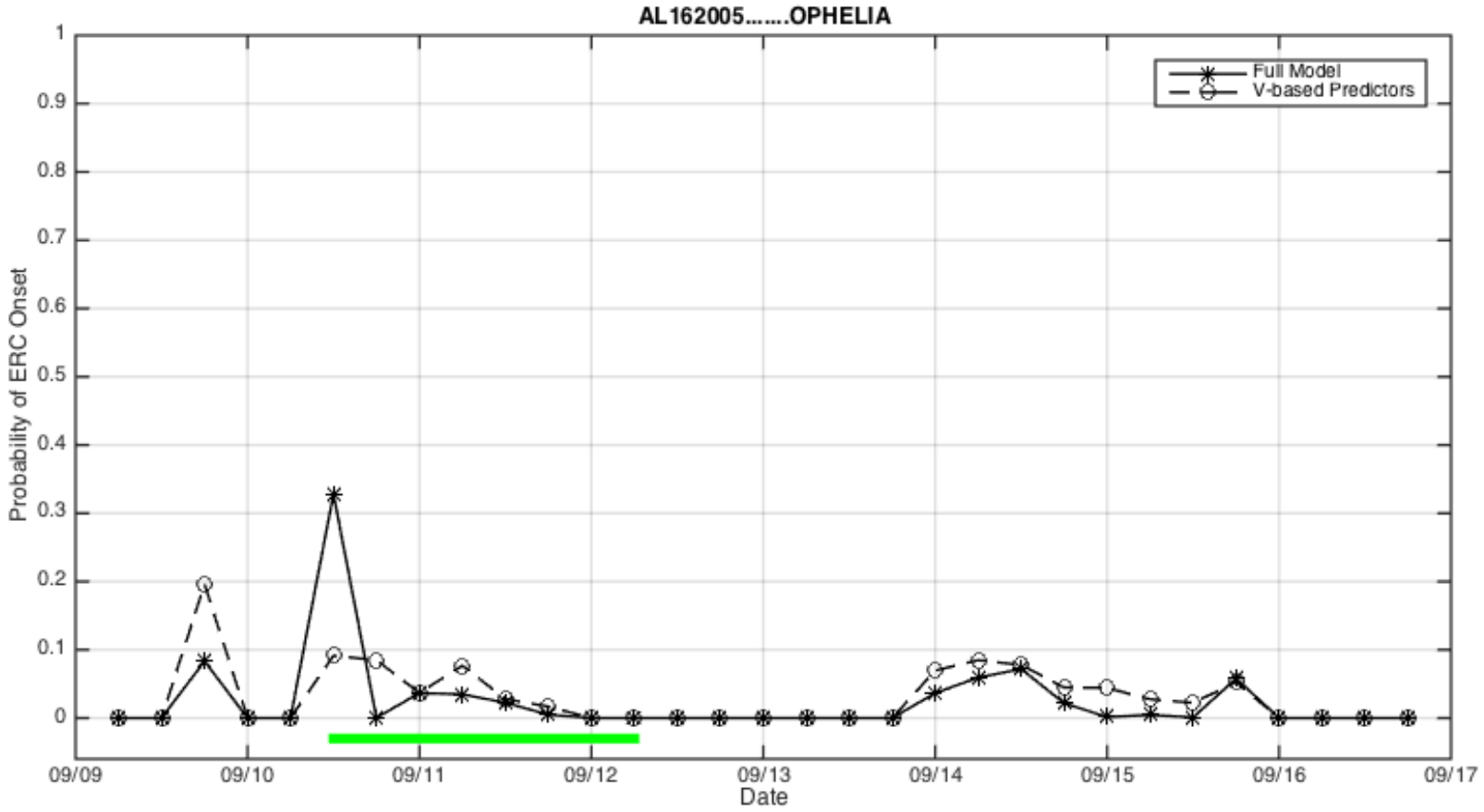

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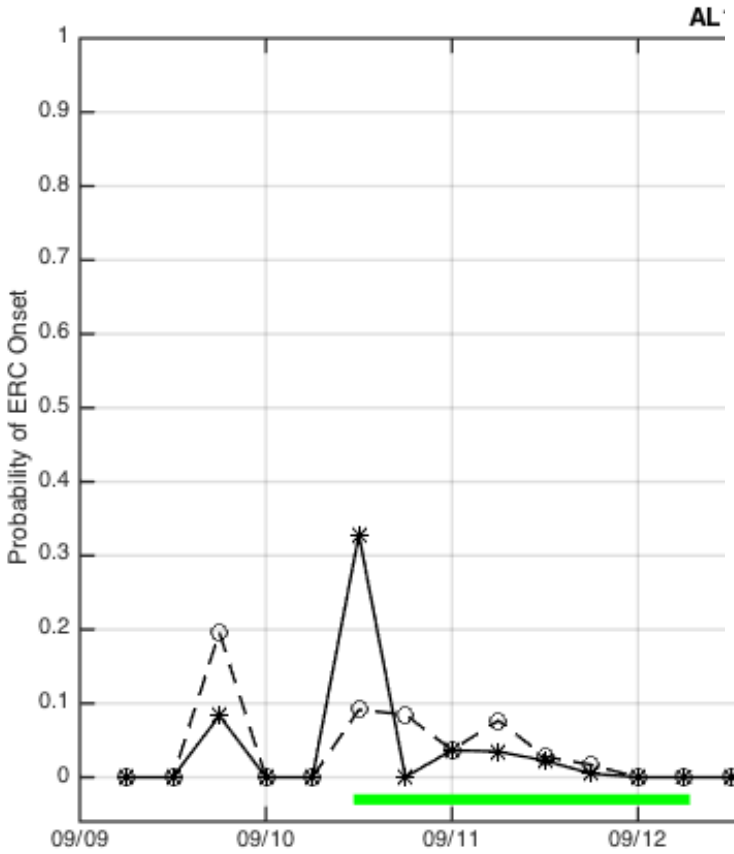
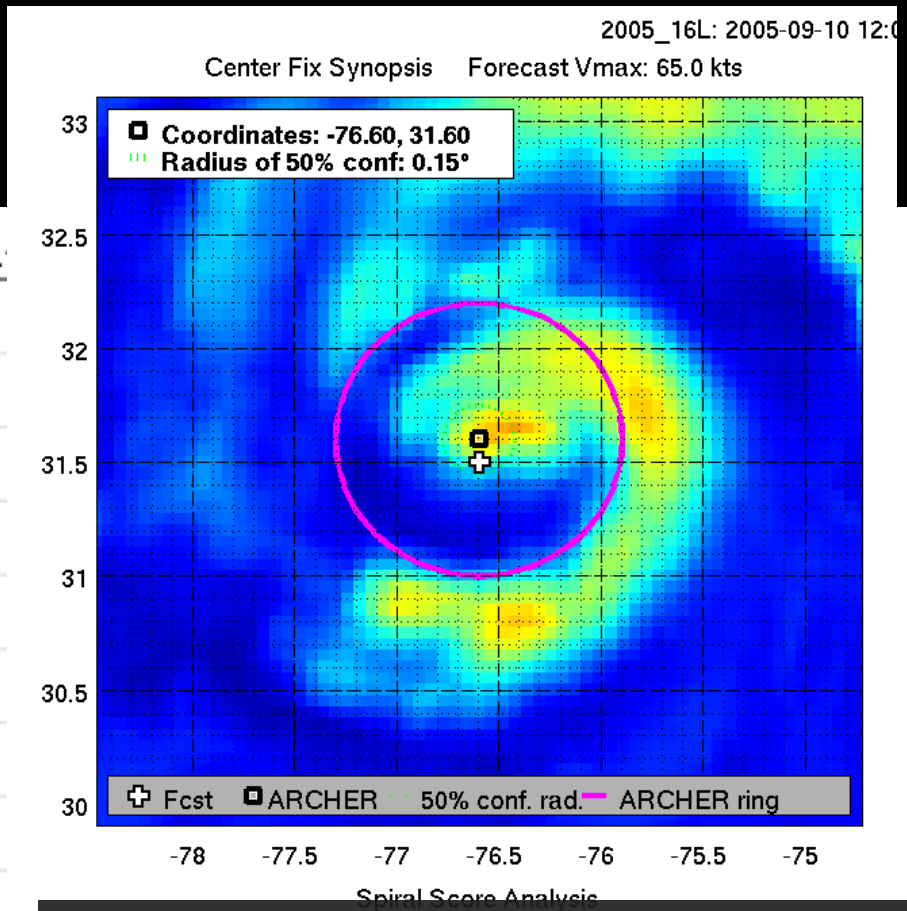




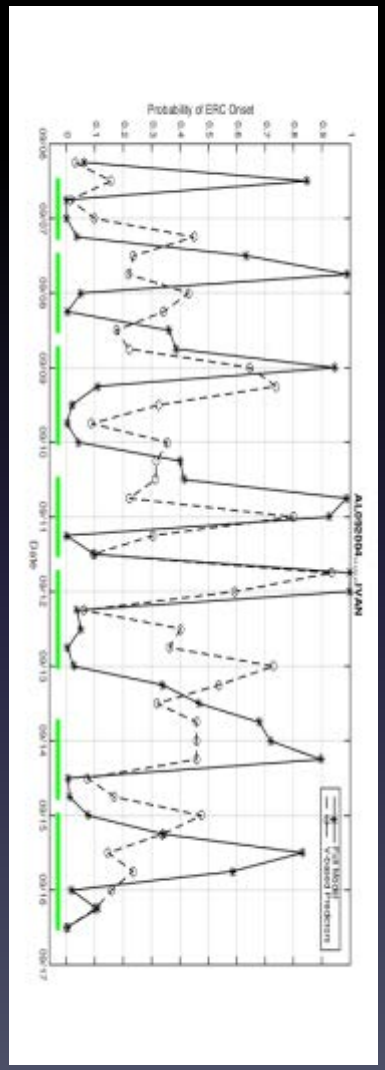
Common features of lower probability predictions:

- Weak TCs (~Cat 1)
- Less organized, often shearing
- Does not lead to a major change in Vmax

Remaining work (Year 2)

- Add the M-PERC model to the real-time ARCHER-ERC diagnostic webpage

Google
'ARCHER-ERC'



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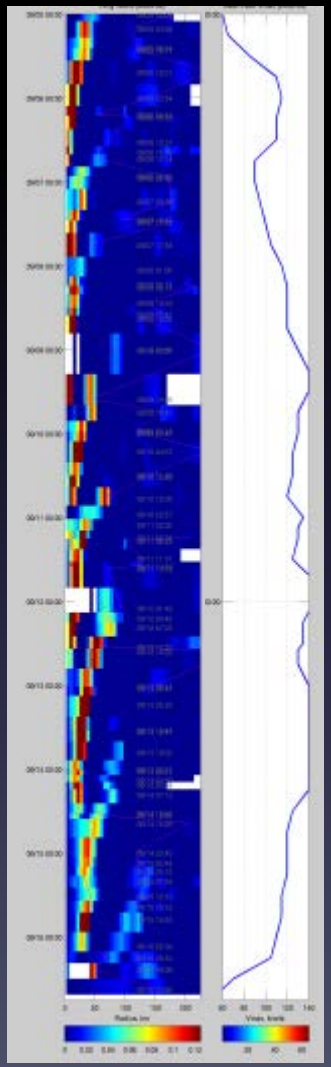
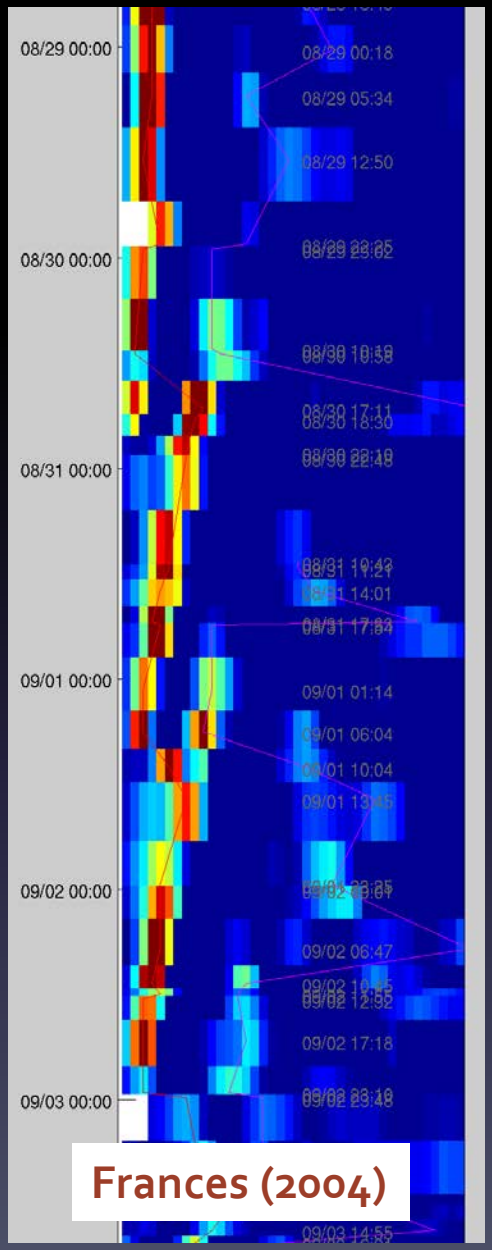
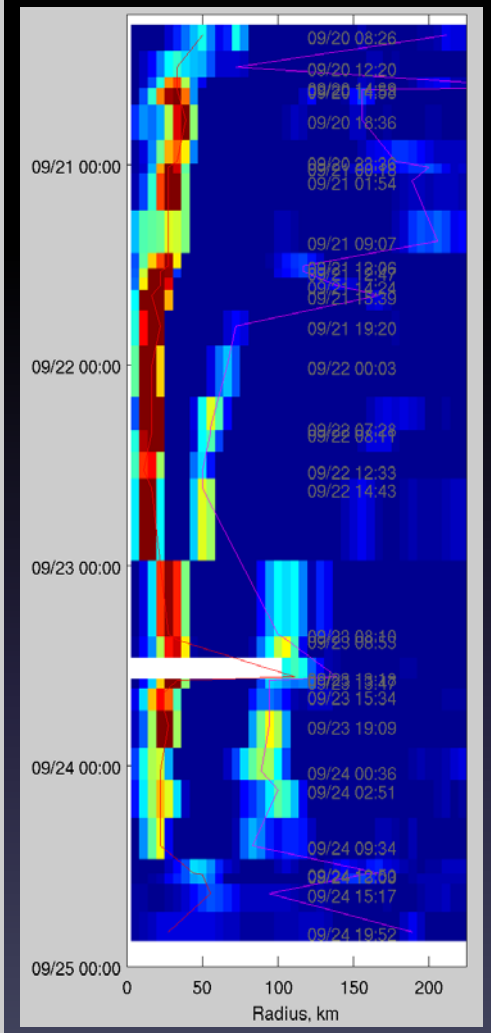


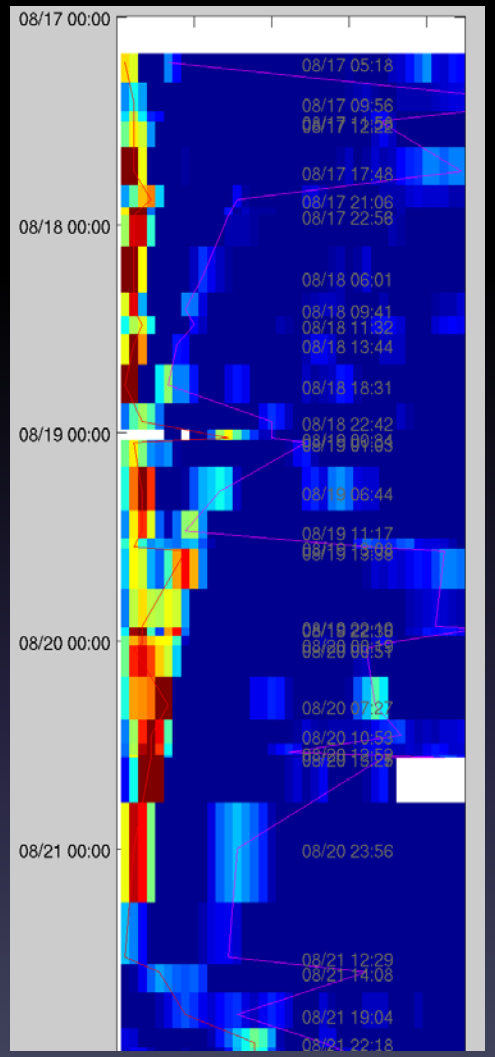
Extras



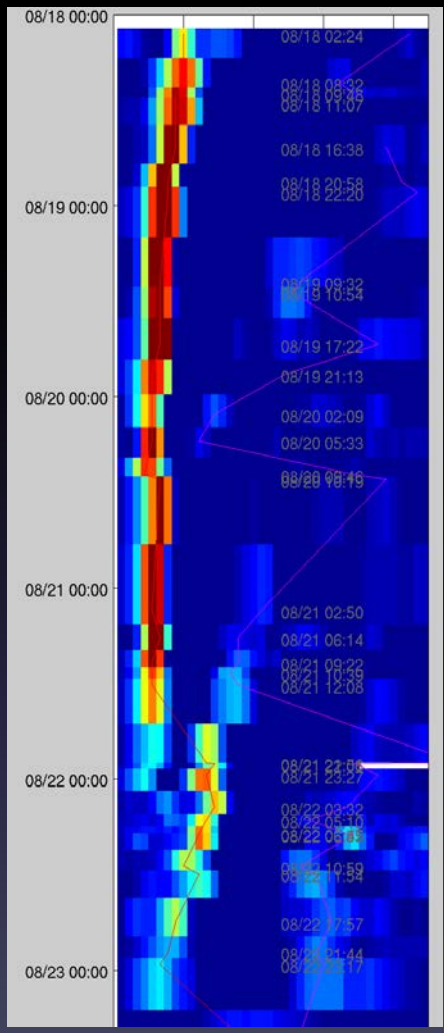
Frances (2004)



Rita (2005)



Dean (2007)

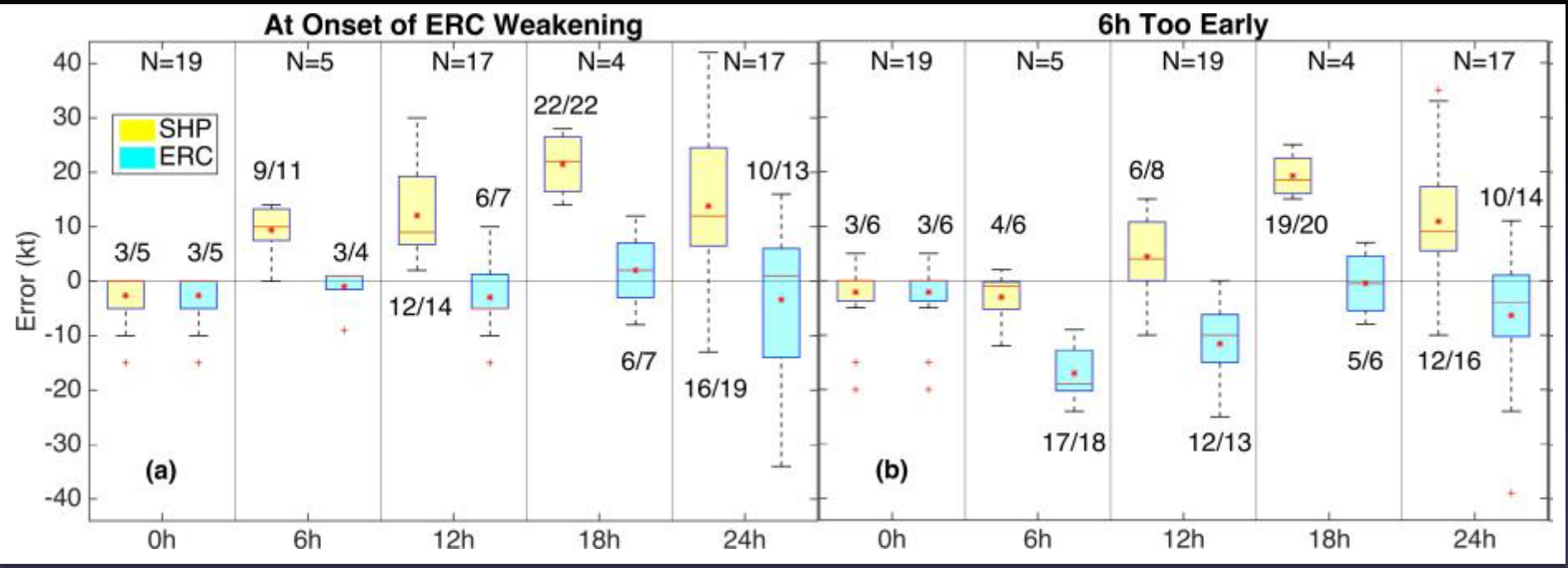


Bill (2009)

Background:

'E-SHIPS' model (J. Kossin and M. DeMaria)

- Forecast guidance tool (complement to SHIPS) to correct for SHIPS intensity during ERC.
- *Requires outside knowledge of the timing of the actual ERC*



SHIPS (SHP) versus E-SHIPS (ERC) Intensity Errors

Kossin, J. P., and M. DeMaria, 2016: Reducing operational hurricane intensity forecast errors during eyewall replacement cycles. *Wea. Forecasting*,.

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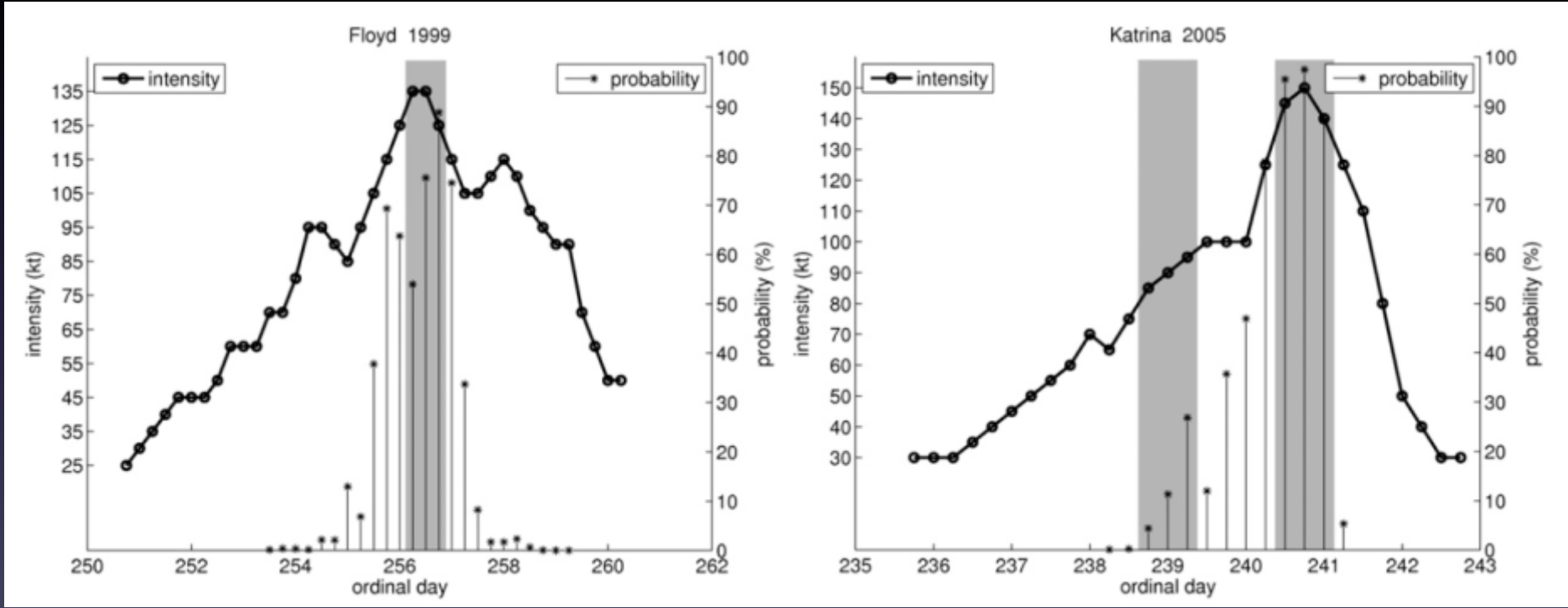
- Predicts the probability of a secondary eyewall formation using environmental and geostationary-satellite derived quantities.
- Does not use microwave imagery



pERC performance for Floyd (1999) and Katrina (2005)

Kossin, J. P., and M. Sitkowski, 2009: An objective model for identifying secondary eyewall formation in hurricanes. *Mon. Wea. Rev.*, **137**, 876-892.