Improvement and Implementation of the Probability-based Microwave Ring Rapid Intensification Index (PMWRing RII) for NHC/JTWC Forecast– Year 2 Update

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1) NHC Points of Contact: ***Stacy Stewart, John Cangialosi, and Chris Landsea***
2) JTWC Point of Contact: ***Brian deCicco***
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Project Overview

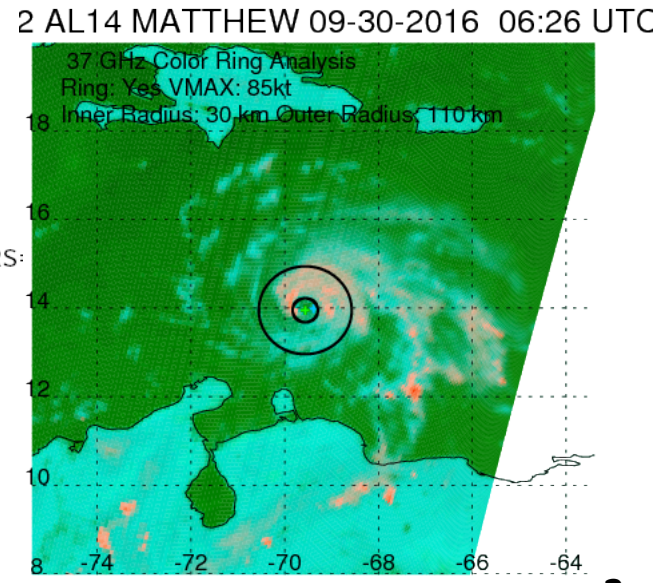
- **Two Parallel Algorithms**
  - **37 GHz Ring-Only RI Index (RII, yes & no type)**
    - **During the past funding year, ARCHER2 code *(Wimmer and Velden 2016, JAMC)* has been included for better center fixing & ring detection**
  - **Probability-based Microwave Ring RI Index (PMWRing RII)**
    - **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**
    - **Task 2: (CIRA) Generating the SHIPS RI developmental dataset**
    - **Task 3: Development of the PMWRing RII for each basin**
    - **Task 4: Real-time testing at NHC and JTWC**
    - ***Task 5: Evaluate the real-time testing results and refine the index based on lessons learned.***

2016 Real-Time Testing

- Jun 2016 – Dec 2016
- Run for NHC (AL, EP, & CP) and JTWC (WP & IO) basins
- **Problems found during real-time testing in these basins:**
  - **Sample size problem for PMWRing RII development:** We treated each microwave sensor separately to avoid the inter-calibration problem.
  - **SHIPS RII threshold problem for PMWRing RII:** For different RI thresholds (25 kt, 30 kt, 35 kt, and 40 kt), we used the corresponding SHIPS RII>15%. This tends to give increasingly favorable environmental condition threshold for increasing RI thresholds, which is not correct.

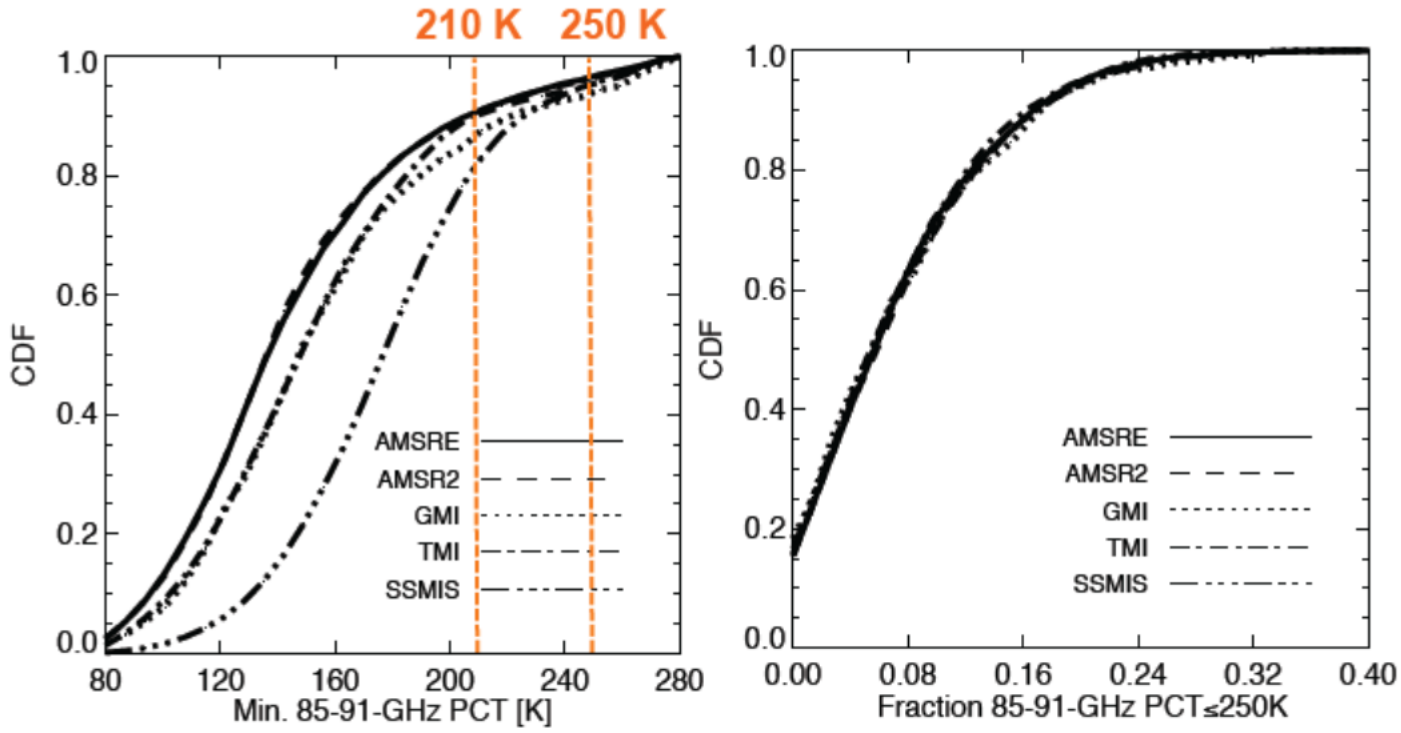
Example RI forecast:
Mathew 2016093006

```
     ATLANTIC 37 GHz Ring Only and PMWRing RI INDICES
    MATTHEW AL14 2016  09/30/16  06 UTC
   TMI,SSMI,SSMIS,AMSR2 and WINDSAT   Total Overpass Orbits:  2
===========RI FORECAST BY THE 37 GHz Ring only and PMWRing RI INDICES DURING PAST 6 HOURS:
===37 GHz Ring Only RI Forecast:===
    FUTURE 24-HOUR INTENSITY INCREASE >= 30 KT (RI):                YES
===PMWRing RI Forecast (based on 37 GHz Ring and 5 additional 37/85 GHz predictors):===
PROB OF RI FOR 25 KT RI THRESHOLD=    48%
PROB OF RI FOR 30 KT RI THRESHOLD=    75%
PROB OF RI FOR 35 KT RI THRESHOLD=   100%
PROB OF RI FOR 40 KT RI THRESHOLD=   100%
================================================================================
```



Solution: Algorithm Refinement

- **Combine all microwave sensors for algorithm development:**



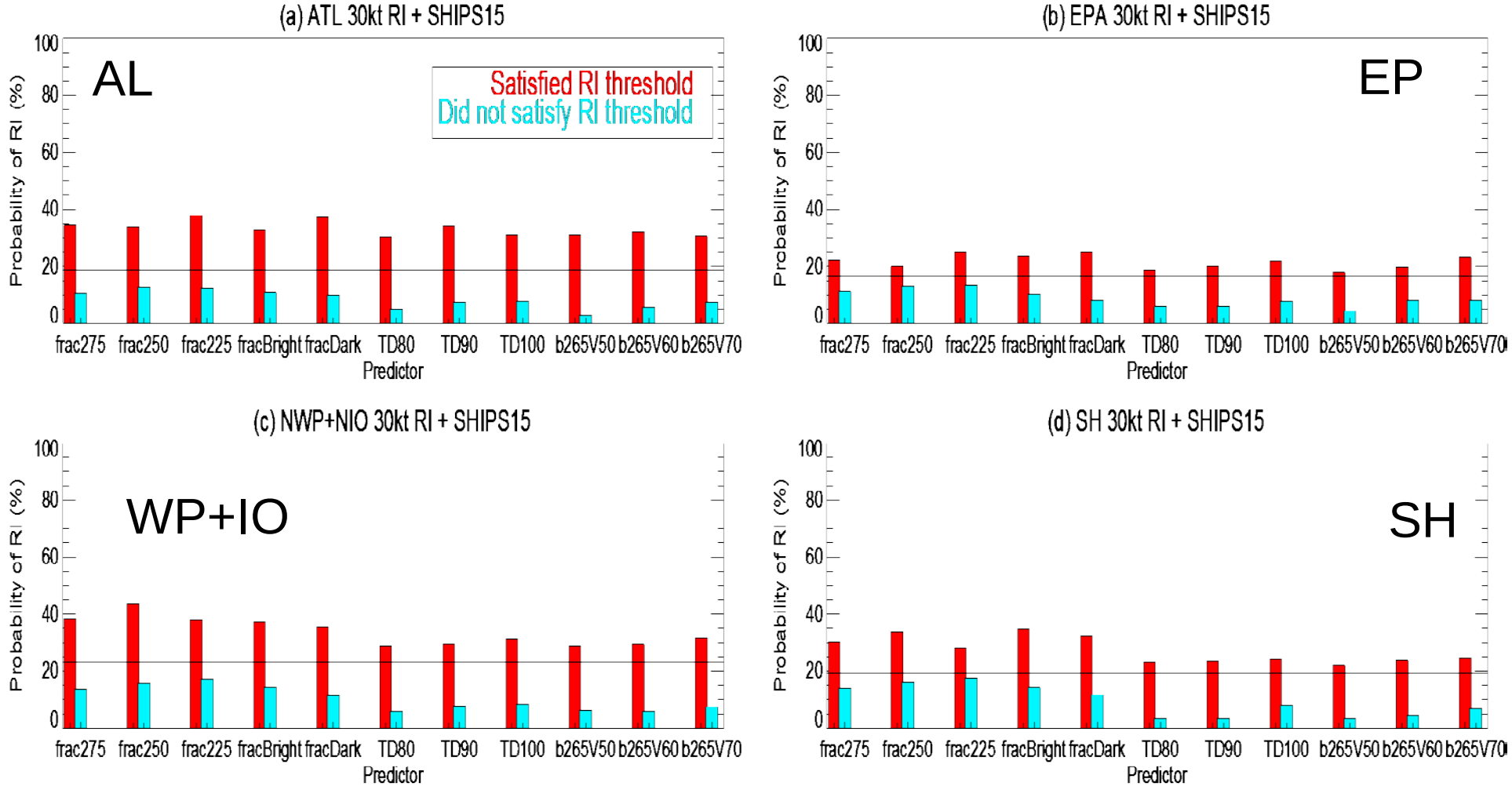
While sensor data is not inter-calibrated,

Each sensor is just as likely to detect PCT≤ 275 K, 250K, 225 K as the others.

- **Choose SHIPS_RII_30kt ≥ 15% for RI thresholds (25 kt, 30 kt, 35 kt, and 40 kt)**

Developmental Results:

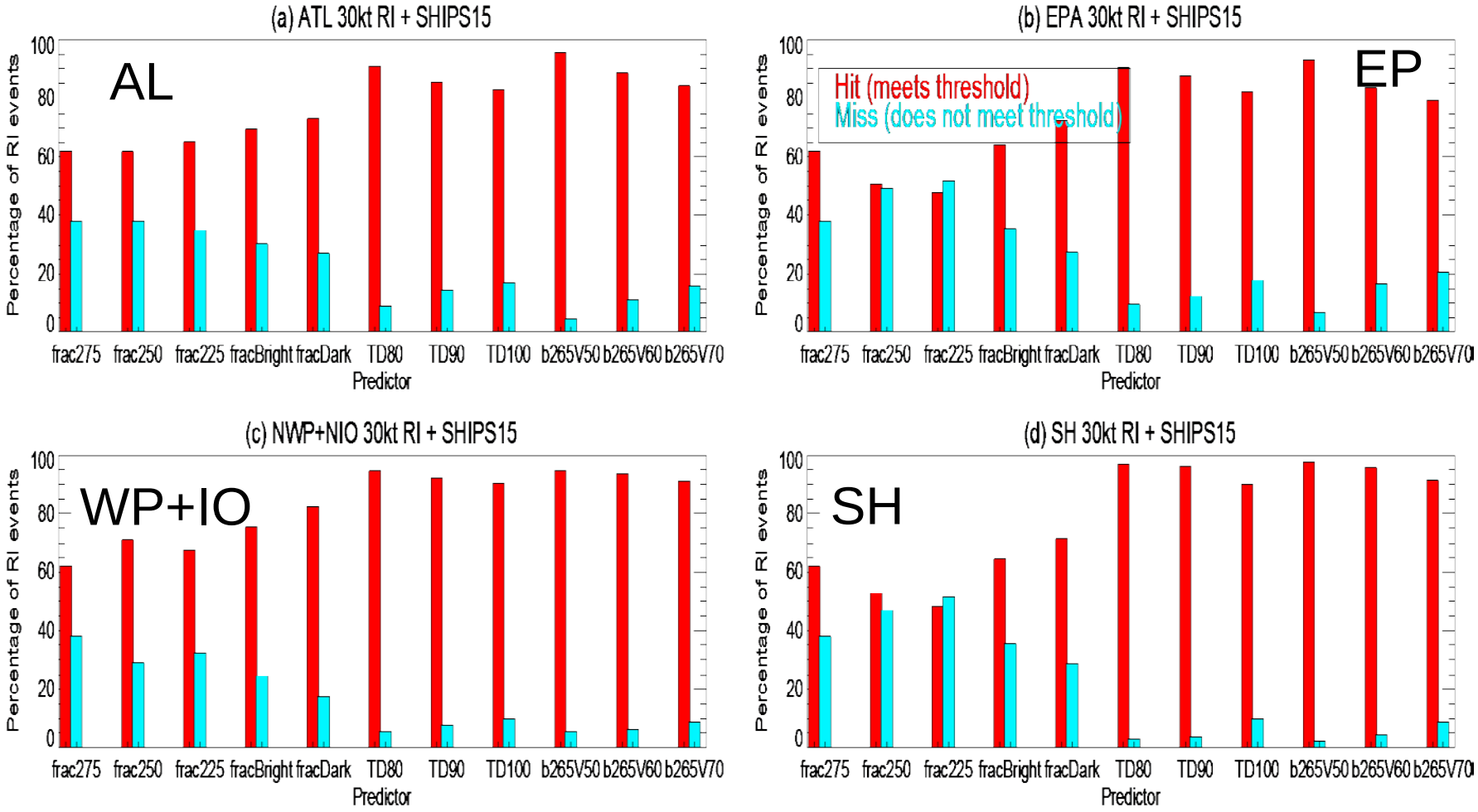
Probability of RI for predictors satisfying and not satisfying RI threshold (30 kt/day RI; SHIPS_RII_30kt >=15%)



Solid line shows the climatology mean. All predictors are skillful in each basin. Similar results for 25, 35, 40 kt/day RI categories.

Developmental Results:

% of Hit (POD, red bar) and % of Miss (FAR, blue bar) for 30 kt/day RI; SHIPS_RII_30kt >=15%



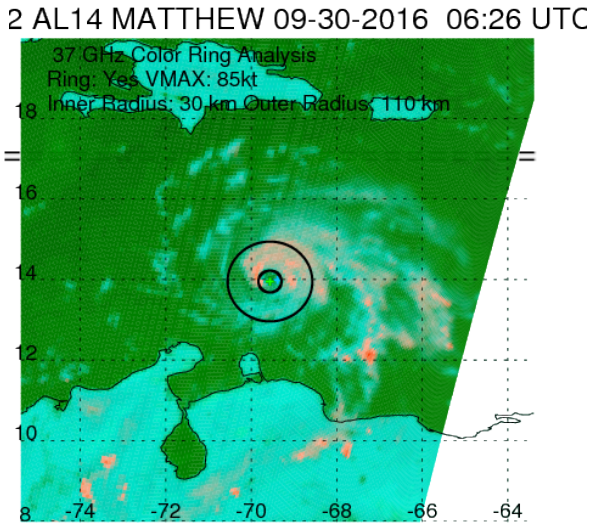
- POD is higher than FAR for all predictors in all basins, except frac225 in SH.
- The ring predictor produces the highest POD (nearly 100%) & lowest FAR (as low as less than 10%) in all basins.

2016 Post-Season Re-run

- **Preliminary Results only: No ARCHER was used for center fixing**

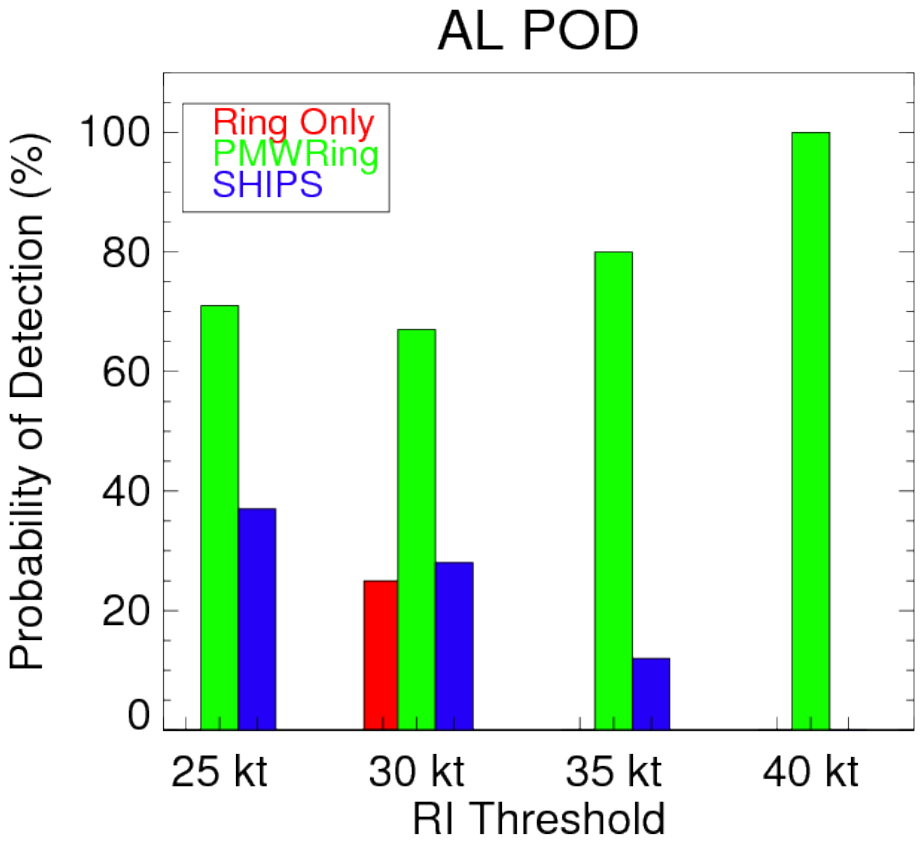
Mathew 2016093012

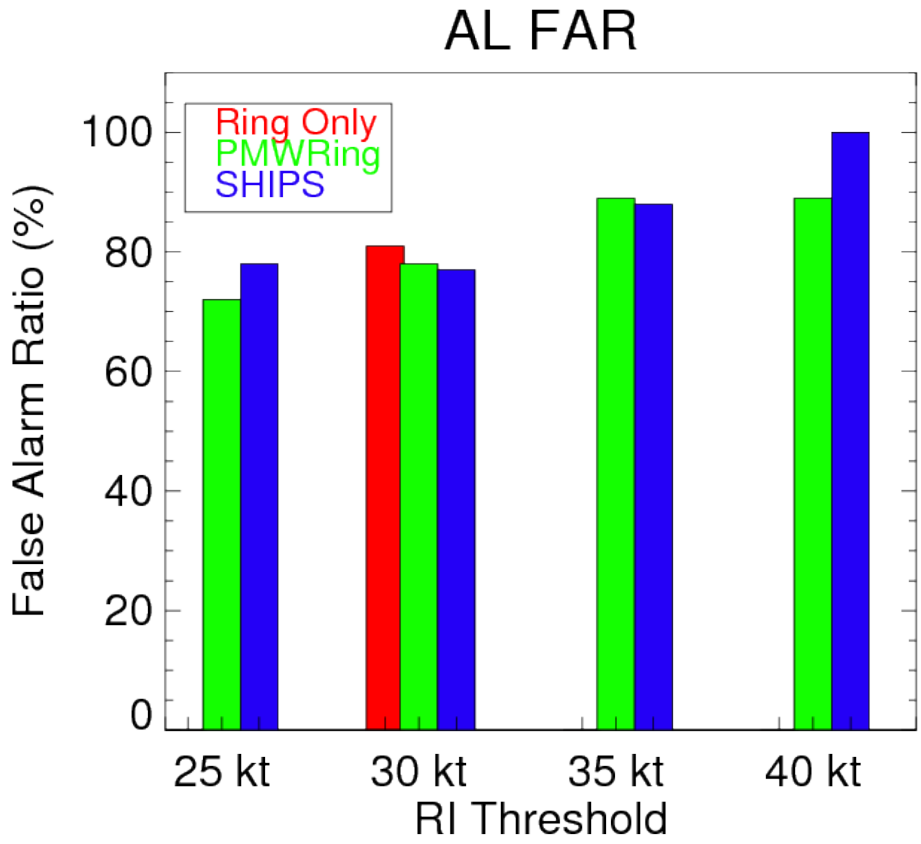
```
     ATLANTIC 37 GHz Ring Only and PMWRing RI INDICES
    MATTHEW AL14 2016  09/30/16  06 UTC
   TMI,SSMI,SSMIS,AMSR2 and WINDSAT   Total Overpass Orbits:  2
===========RI FORECAST BY THE 37 GHz Ring only and PMWRing RI INDICES DURING PAST 6 HOURS=
===37 GHz Ring Only RI Forecast:===
    FUTURE 24-HOUR INTENSITY INCREASE >= 30 KT (RI):                YES
===PMWRing RI Forecast (based on 37 GHz Ring and 5 additional 37/85 GHz predictors):===
PROB OF RI FOR 25 KT RI THRESHOLD=    41%
PROB OF RI FOR 30 KT RI THRESHOLD=    33%
PROB OF RI FOR 35 KT RI THRESHOLD=    25%
PROB OF RI FOR 40 KT RI THRESHOLD=    19%
=============================================================
```



Preliminary Results for 2016 Post-Season Re-run: AL

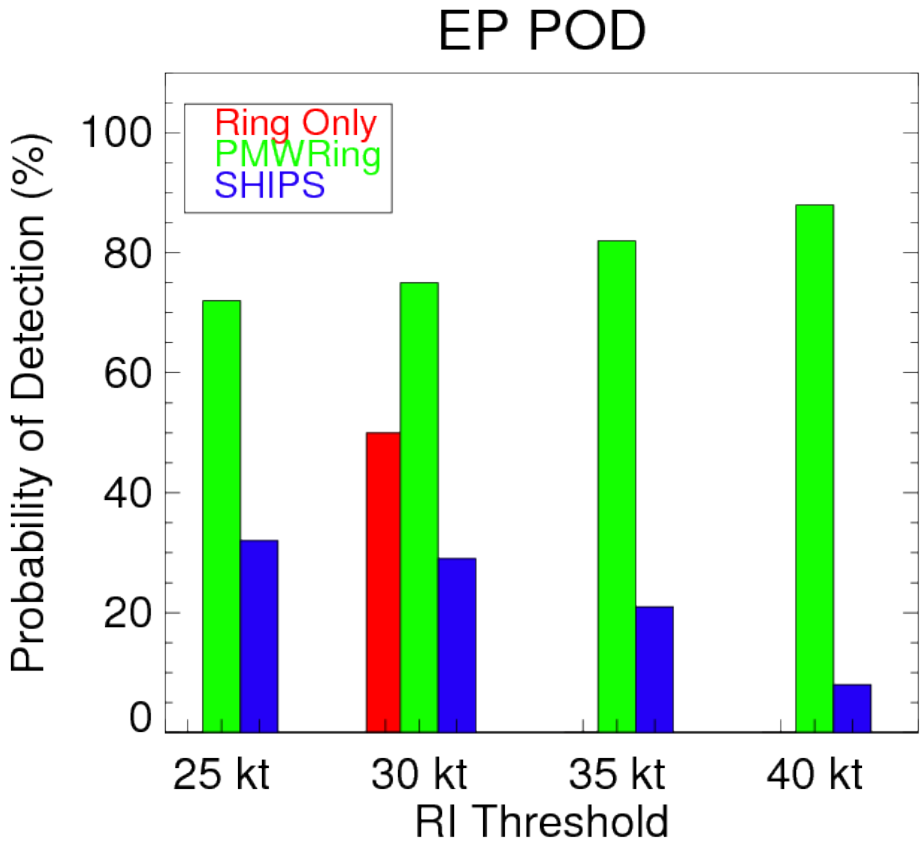
- **SHIPS RI thresholds for each basin were based on Kaplan et al. (2010).**
- **PMWRing RI thresholds were determined similarly as Kaplan et al. (2010).**

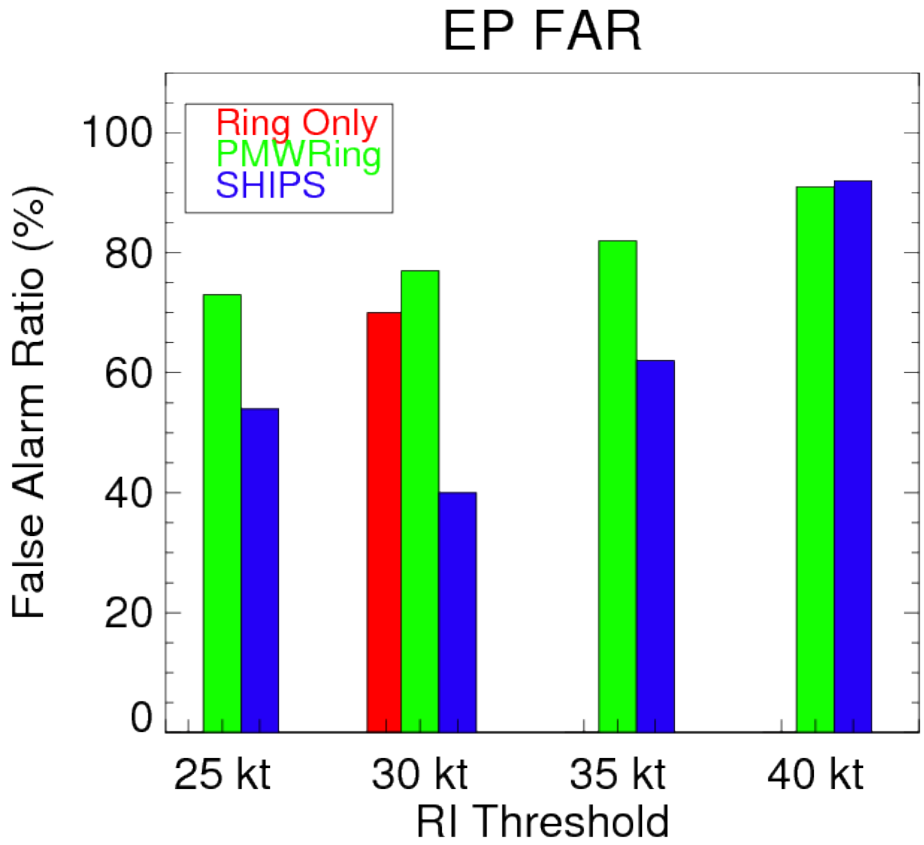




- **AL was tough this year; both ring-only & SHIPS RII had low POD & high FAR**
- **PMWRing RII was better in POD, but not in FAR**

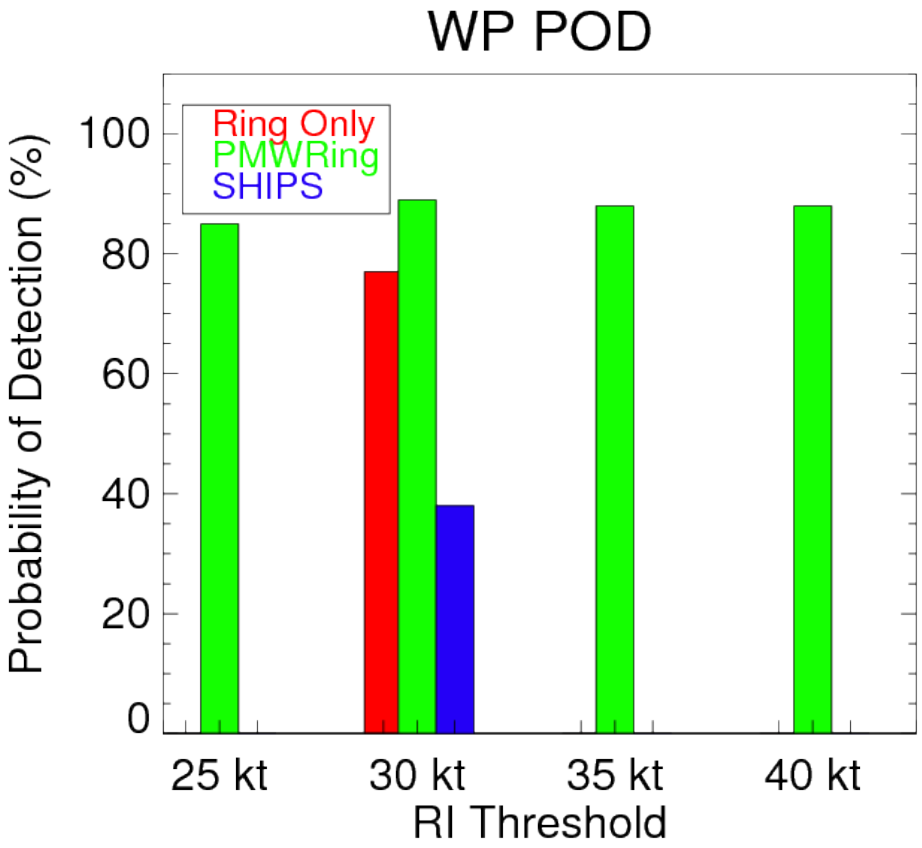
Preliminary Results for 2016 Post-Season Re-run: EP

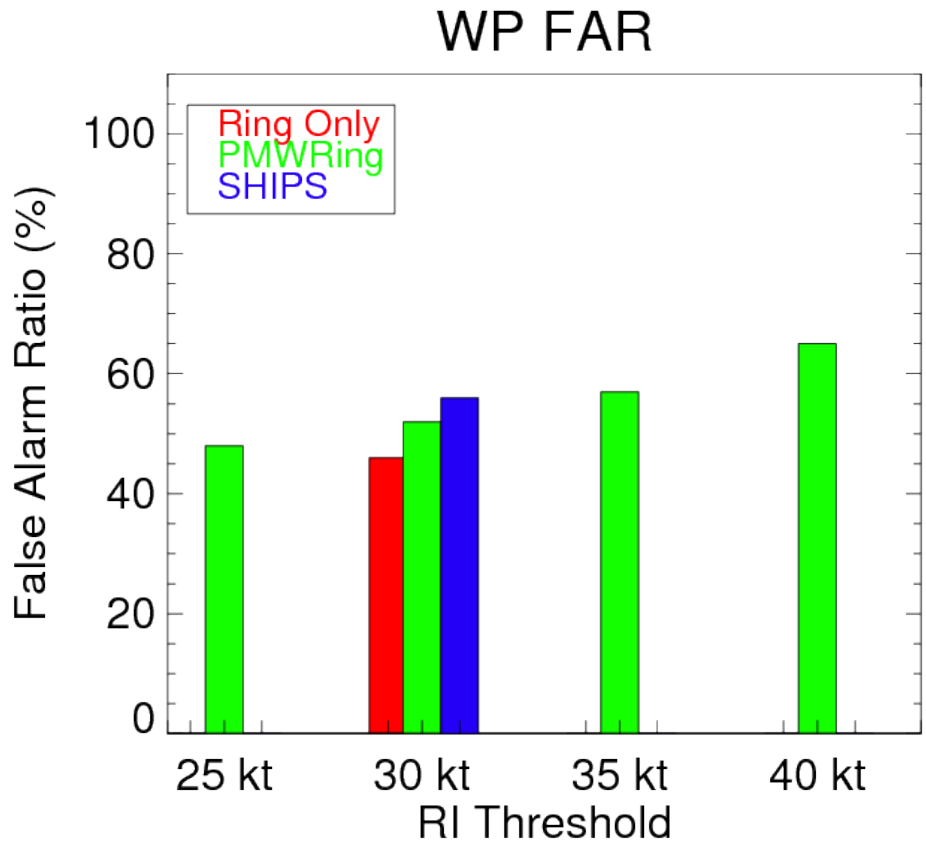




- **SHIPS RII has low POD & low FAR**
- **Ring-only and PMWRing RII has high POD, but also higher in FAR**

Preliminary Results for 2016 Post-Season Re-run: WP





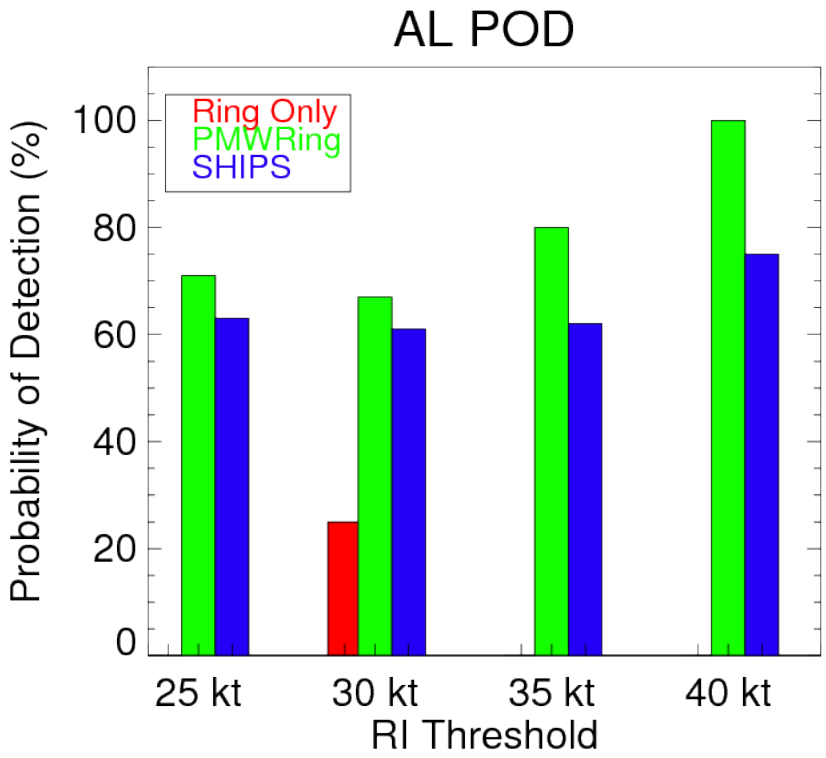
- **Performance in WP was much better**
- **Both ring-only & PMWRing RII had high POD & lower FAR**
- **But SHIPS RII had a low POD and a higher FAR**

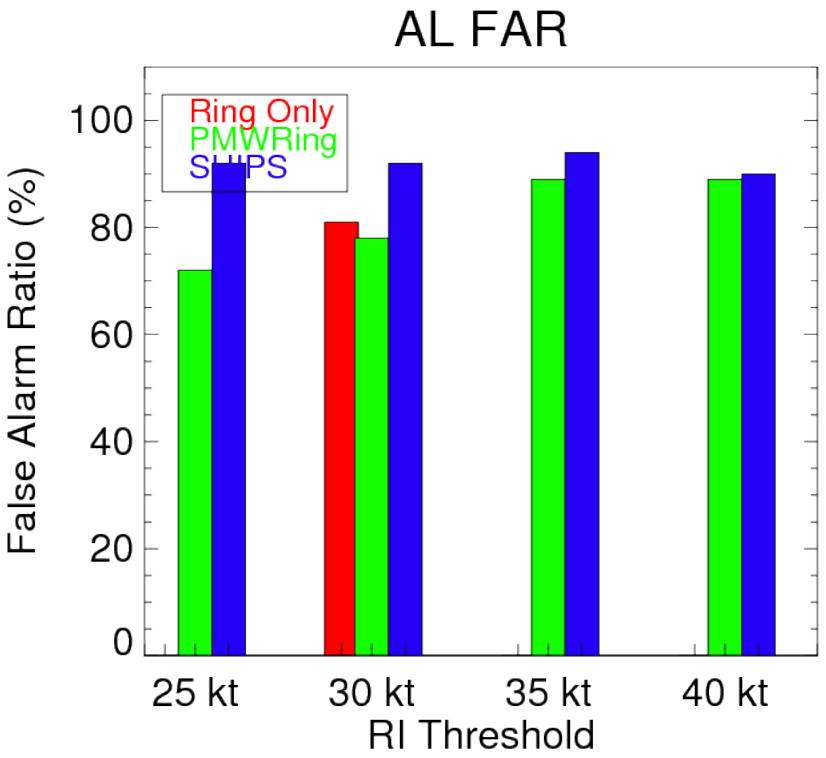
Summary of Progress and Next-Step Plan

- **PMWRing algorithm refinement is done, preliminary results for 2016 season were promising, especially in WP basin**
- **2016 post-season evaluation needs some more work: adding ARCHER into the code**
- **SH real-time testing in 2017: we just received SHIPS RII developmental data from CIRA a few weeks ago. Will finish the code and start testing in April 2017.**

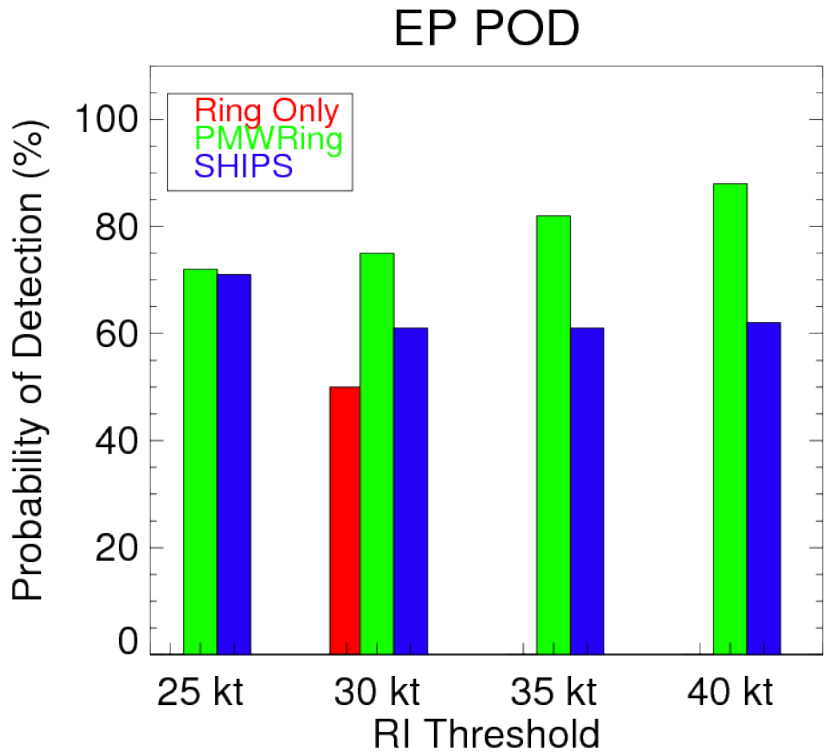
Back-up Slides

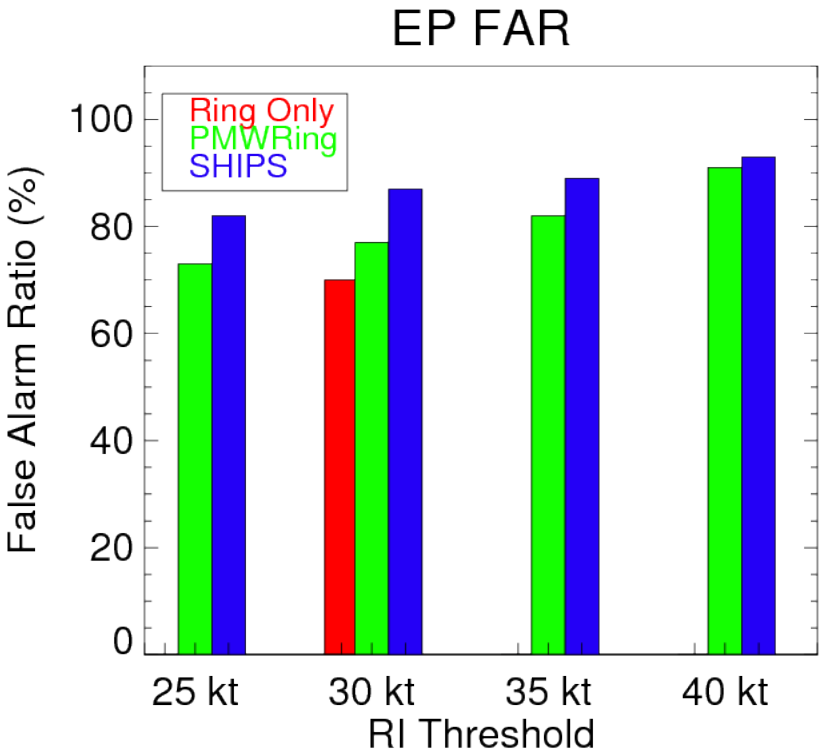
SHIPS-RII>=10%


AL POD
Ring Only
PMWRing
SHIPS
Probability of Detection (%)
100
80
60
40
20
0
25 kt
30 kt
35 kt
40 kt
RI Threshold


AL FAR
Ring Only
PMWRing
SHIPS
False Alarm Ratio (%)
100
80
60
40
20
0
25 kt
30 kt
35 kt
40 kt
RI Threshold

SHIPS-RII>=10%


EP POD
Ring Only
PMWRing
SHIPS
Probability of Detection (%)
100
80
60
40
20
0
25 kt
30 kt
35 kt
40 kt
RI Threshold


EP FAR
Ring Only
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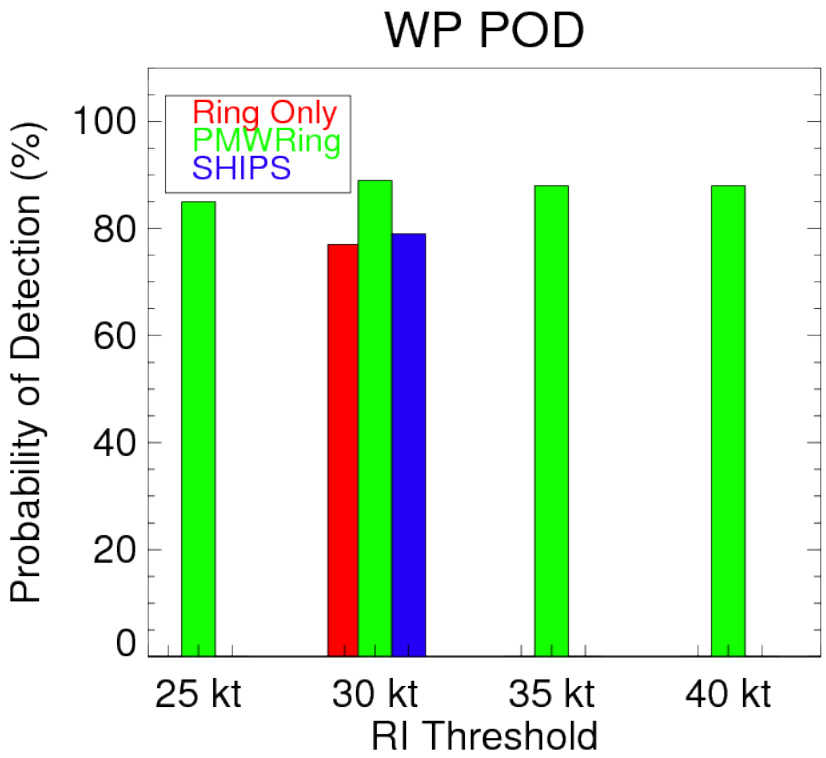
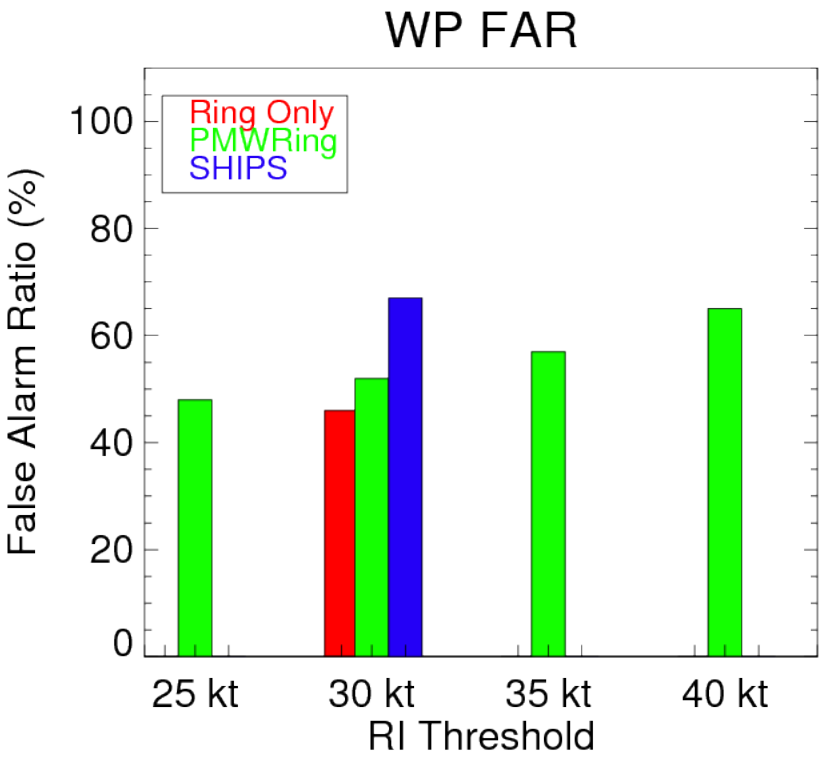
SHIPS
False Alarm Ratio (%)
100
80
60
40
20
0
25 kt
30 kt
35 kt
40 kt
RI Threshold

SHIPS-RII>=10%


WP POD
Ring Only
PMWRing
SHIPS
Probability of Detection (%)
100
80
60
40
20
0
25 kt
30 kt
35 kt
40 kt
RI Threshold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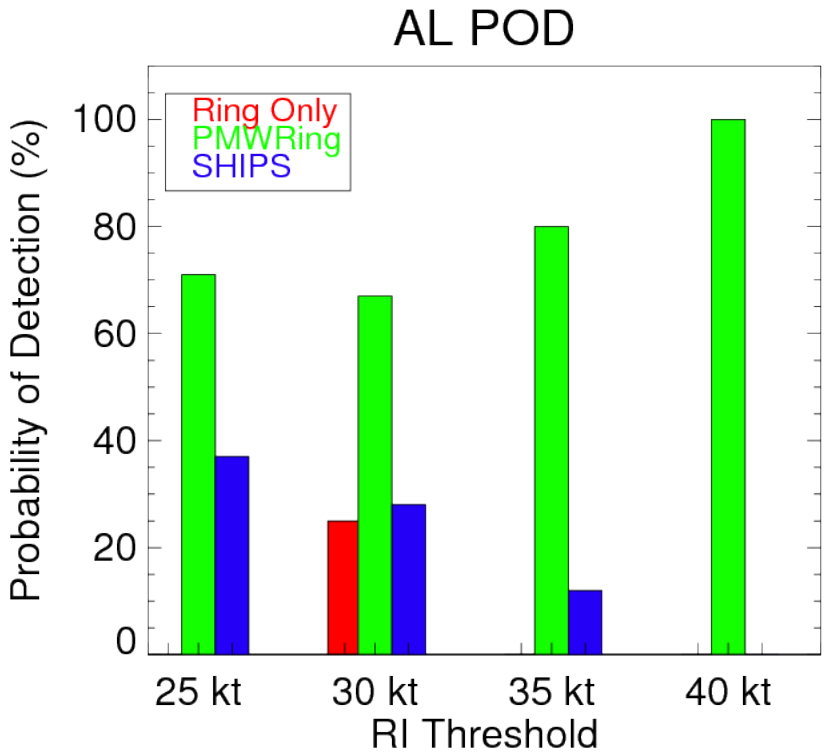
35 kt
40 kt
RI Threshold

SHIPS-RII>=20%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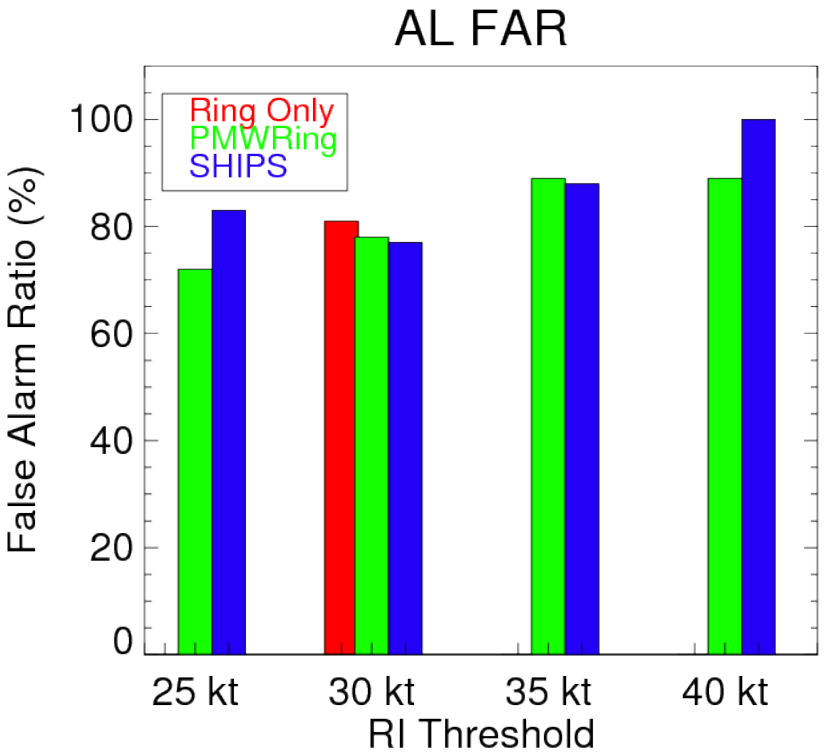
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40 kt
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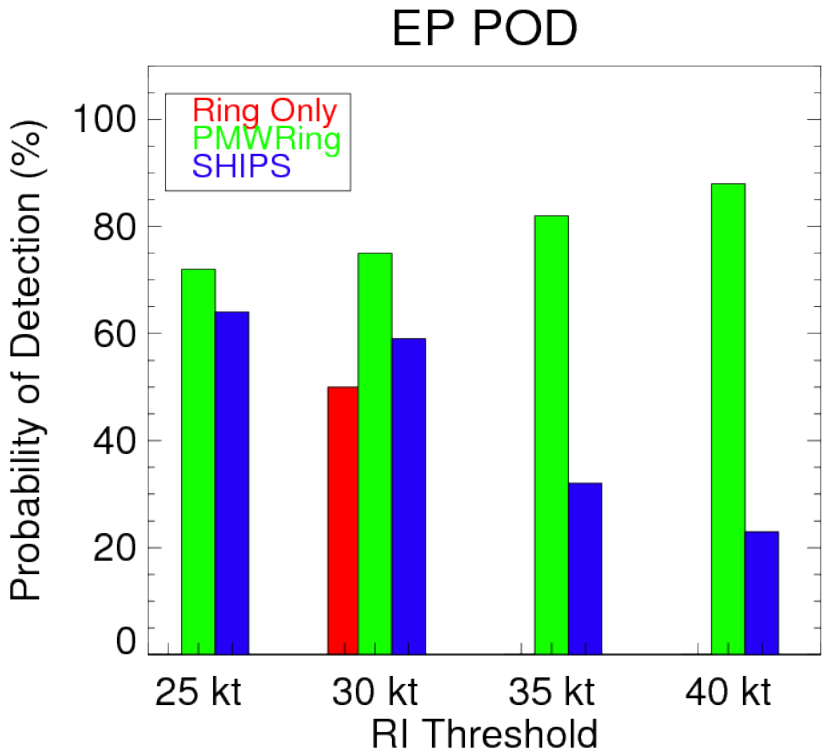
SHIPS-RII>=20%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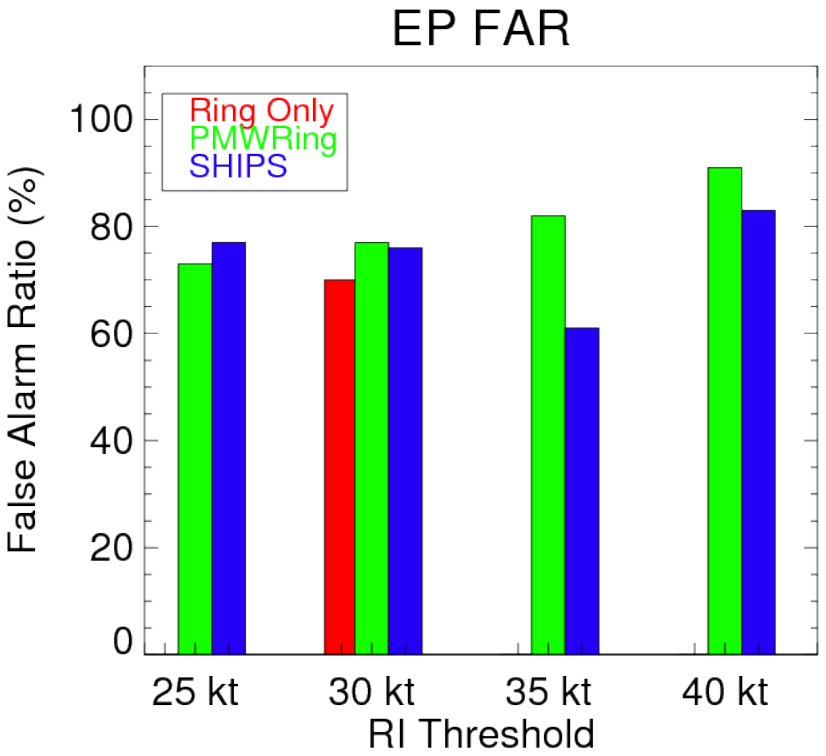
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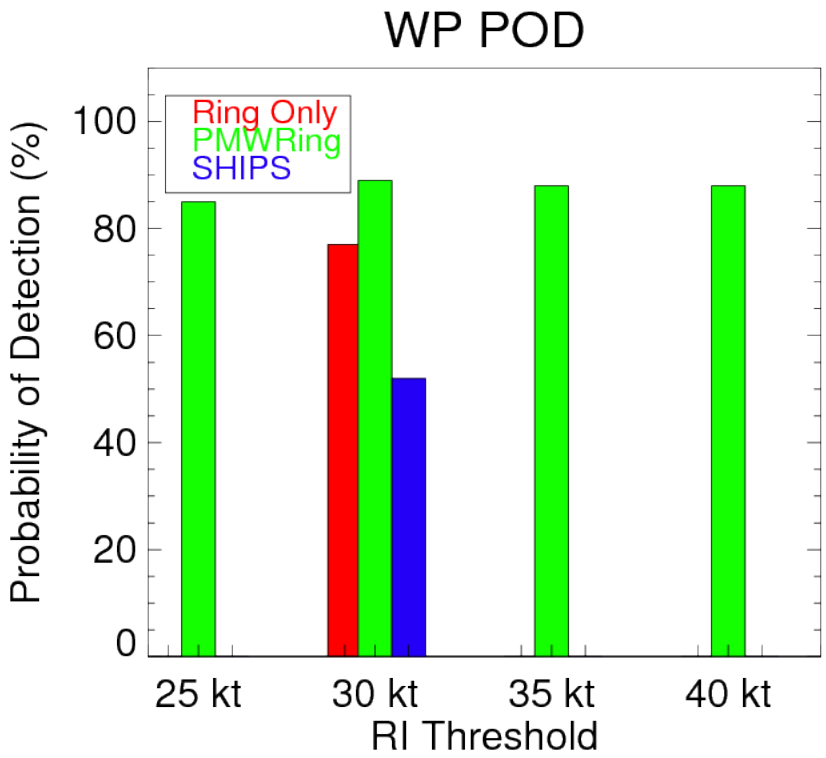
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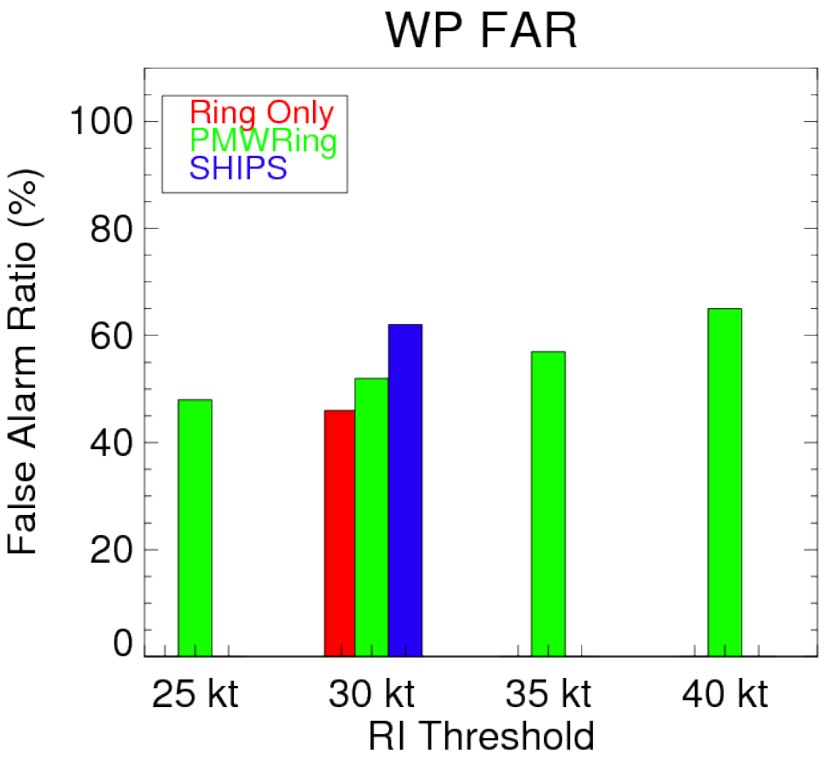
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