

# HFIP Reconnaissance Data Impact Tiger Team (RDITT)

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# Purpose of RDITT

- Conduct systematic investigation of the impact of aircraft reconnaissance data from the inner core of tropical cyclones on numerical guidance provided by regional tropical cyclone models
  - Provide a better understanding of the importance of tail Doppler radar (TDR) data

# Test Plan

- Test impact of aircraft reconnaissance data in 3 regional TC models
  - PSU EnKF ARW hurricane analysis & prediction system
  - EMC operational 3-km HWRF (2013 version)
  - HRD HEDAS-HWRF (v3.2)
- Cases: Atlantic storms from 2008-2012 for which conventional aircraft reconnaissance data and/or TDR data are available in the TC inner core
- Model runs: Same end-to-end system for all configurations from a particular modeling group w/ only difference being data included in the forecast initialization
  - **Control**: no inner-core aircraft recon data assimilated - **baseline for evaluating recon impact**
  - **Standard recon**: conventional recon data (flight-level, dropsondes & SFMR) assimilated
    - PSU did not assimilate SFMR
  - **All recon**: conventional recon data & tail Doppler radar (TDR) data assimilated
  - **TDR only**: only TDR data assimilated (no conventional recon data)
    - Additional configuration delivered by EMC & HRD

# RDITT Evaluation by TCMT

Team members:

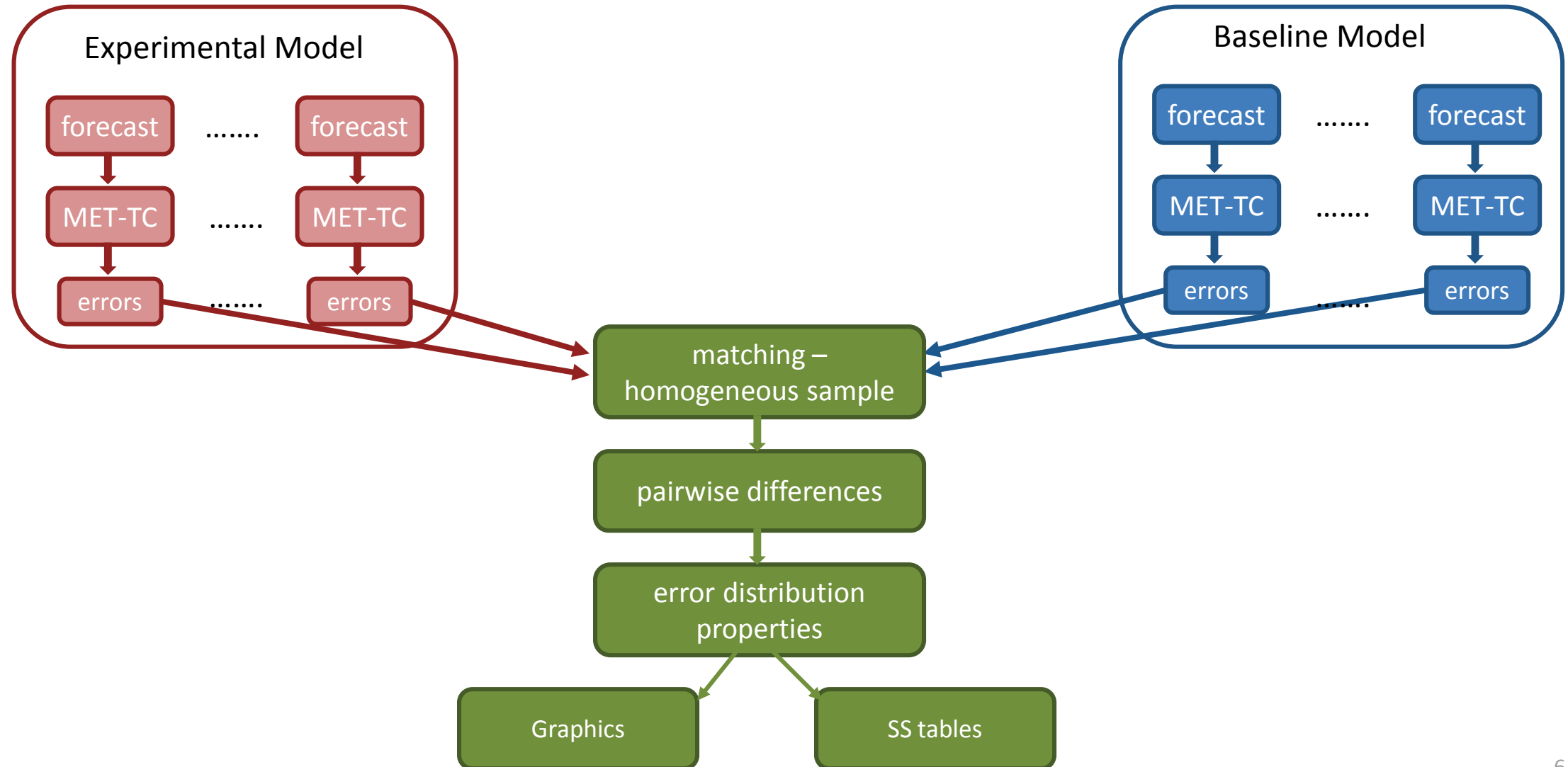
Louisa Nance, Barb Brown, Mrinal Biswas, Tressa Fowler, Eric Gilleland,  
Paul Kucera, Kathryn Newman & Christopher Williams

# Evaluation set-up

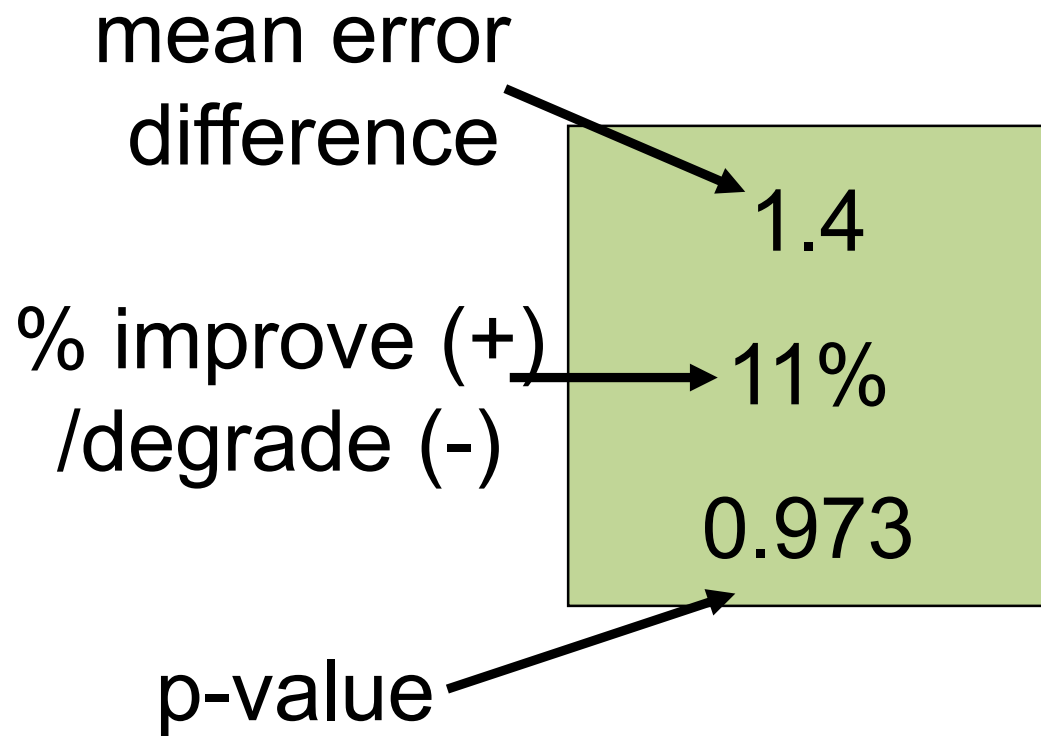
- No group delivered data for all the cases in the “required” case list – some of these differences stem from availability of input data sets needed to run their respective systems (e.g., global model for lateral boundary conditions).
- Cases delivered varied between the groups w/ EMC delivering the largest sample & HRD delivering the smallest sample.
- Evaluation focused on homogeneous samples between control & each respective recon configuration for each group – hence, sample size not only varies across groups, but also across recon configurations for each group.
- Primarily focused on only those cases for which appropriate recon data was available for the initialization – direct impact cases only
- Applied NHC criteria that storm classification must be tropical or subtropical in Best Track for case to be included in verification

Bottom line: Samples used for our evaluation will not necessarily match those used by modeling groups

# Methodology



# Statistical Significance – Pairwise Differences Summary Tables



	Track	Intensity
SS differences	$\% \leq -6$	$\% \leq -10$
	$-6 < \% \leq -4$	$-10 < \% \leq -5$
	$-4 < \% < 0$	$-5 < \% < 0$
	$0 < \% < 4$	$0 < \% < 5$
	$4 \leq \% < 6$	$5 \leq \% < 10$
	$\% \geq 6$	$\% \geq 10$
Not SS	$\% < 0$	$\% < 0$
	$\% > 0$	$\% > 0$

# Results for configurations delivered by EMC

Control (HWCT), Standard recon (HWRC), All recon (HWAR), TDR only (HWDR)

Direct impact only



# EMC configurations: SS tables – direct impact

448

Standard recon

116

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWRC	-1.3	-1.1	-1.4	-0.9	-0.3	0.1	-1	-1.8	-1.2	-2.7	-1.4	-2.2	0.1	3.2	5	6.4	9.6	11.2	10.8	14	12
	Track	-14%	-6%	-5%	-3%	-1%	0%	2%	-3%			-2%	-2%	0%	3%	4%	5%	7%	7%	6%	7%	5%
	Land/Water	0.998	0.9	0.885	0.667	0.226	0.074	0.481	0.708			0.456	0.589	0.021	0.558	0.887	0.941	0.989	0.993	0.979	0.989	0.944
	HWCT-HWRC	-4.7	-6.2	-4.2	-2.4	-0.7	0	0.2	0			0.2	-0.2	0.1	0.1	-0.2	0.3	-0.7	1.1	-0.2	-0.1	-0.1
	Intensity	-135%	-88%	-47%	-24%	-6%	0%	2%	0%			-3%	-1%	1%	1%	-1%	2%	-6%	8%	-1%	-1%	-1%
	Land/Water	0.999	0.999	0.999	0.985	0.505	0.007	0.193	0.038			0.527	0.165	0.07	0.163	0.152	0.308	0.67	0.89	0.166	0.119	0.066
Atlantic Basin	HWCT-HWRC	-4.7	-6.6	-5.1	-2.9	-1.1	-0.8	-0.5	-0.1	0.2	-0.6	-0.9	-0.8	-1.1	-0.9	0.5	1	-0.1	1	0.4	0.5	-0.1
	Intensity	-138%	-100%	-60%	-30%	-10%	-8%	-4%	-1%	1%	-5%	-7%	-6%	-9%	-7%	3%	6%	-1%	7%	3%	3%	-1%
	Water Only	0.999	0.999	0.999	0.993	0.662	0.558	0.387	0.079	0.11	0.348	0.503	0.553	0.721	0.565	0.327	0.636	0.068	0.593	0.2	0.313	0.101

Sample Size

189

All recon

46

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWAR	-0.7	0	-3	-2.3	-1.8	-1.2	-1.3	-1.2	-3	-3.5	-4.3	-5.5	-5.8	-6.4	-6	-2.5	4	2.8	3	5.3	4.7
	Track	-8%	0%	-13%	-8%	-5%	-3%	-3%	-2%	-5%	-6%	-6%	-7%	-7%	-6%	-6%	-2%	3%	2%	2%	3%	2%
	Land/Water	0.803	0.018	0.99	0.899	0.693	0.465	0.465	0.445	0.817	0.8	0.819	0.88	0.919	0.892	0.768	0.36	0.504	0.318	0.3	0.429	0.321
	HWCT-HWAR	-5.3	-7.6	-5	-2.6	0.4	1.2	1.8	1.4	1.1	0.7	0.8	1	-0.1	1.1	0.2	1.1	-0.4	0.3	0	0.1	-0.1
	Intensity	-151%	-104%	-57%	-25%	3%	10%	16%	12%	9%	5%	6%	8%	8%	8%	2%	8%	-3%	2%	0	1%	-1%
	Land/Water	0.999	0.999	0.992	0.877	0.177	0.654	0.889	0.94	0.68	0.656	0.648	0.77	0.132	0.886	0.158	0.747	0.39	0.234	0.001	0.116	0.105
Atlantic Basin	HWCT-HWAR	-5.3	-8.2	-5.7	-3	0.8	1.6	2.1	1.8	1.3	0.4	1.3	0.5	0.2	-0.4	-1	-0.5	2	2.2	1.6	3.8	0
	Intensity	-153%	-115%	-65%	-29%	7%	13%	17%	14%	10%	3%	9%	4%	2%	-3%	-7%	-3%	12%	13%	10%	21%	0%
	Water Only	0.999	0.999	0.989	0.83	0.27	0.585	0.812	0.728	0.479	0.177	0.705	0.214	0.153	0.264	0.512	0.256	0.816				

86

TDR only

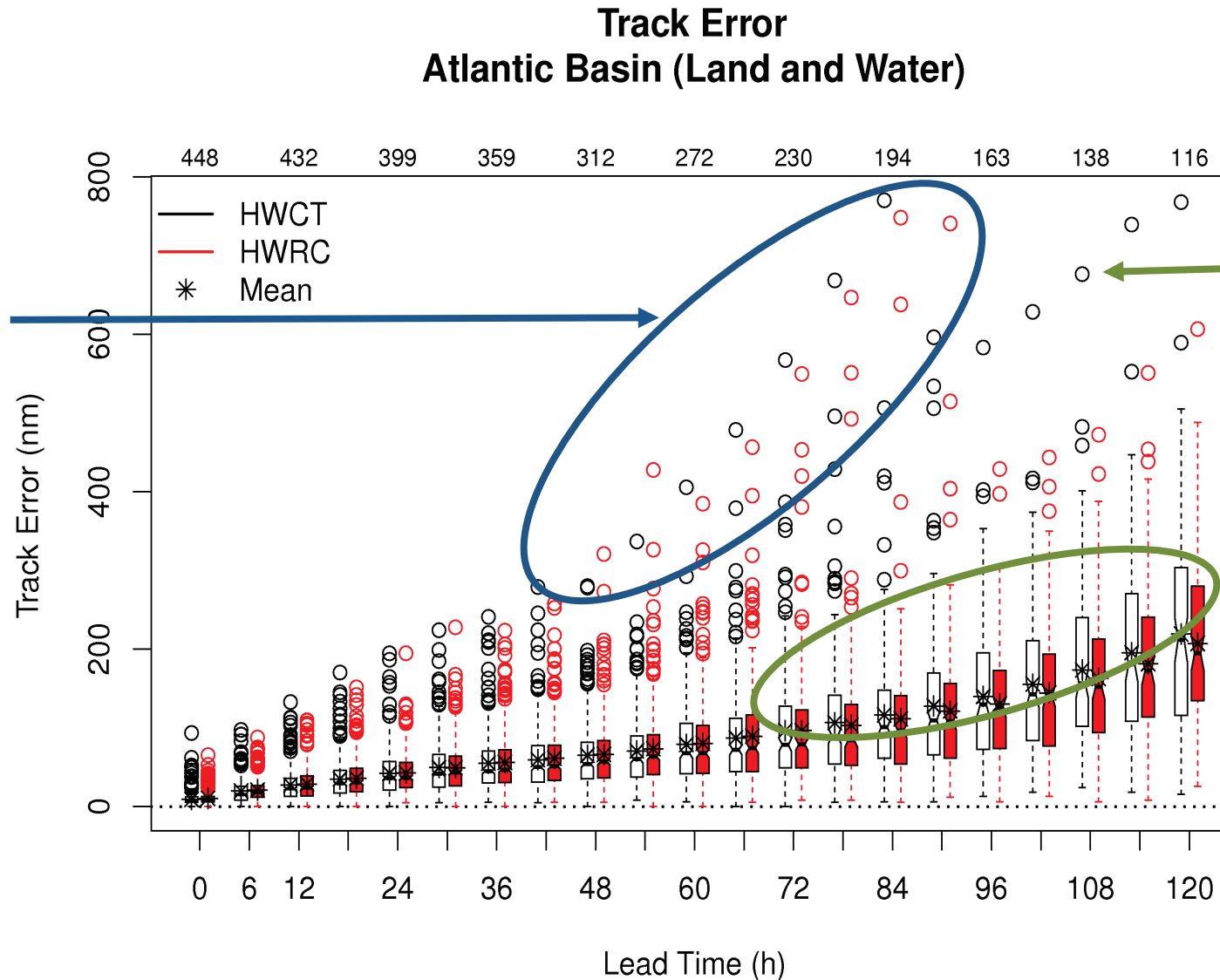
17

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWDR	0.3	2.8	-0.8	1	0.1	-0.6	-0.5	-3.7	-3.5	-5	-5.5	-3.6	-0.6	0.7	0.3	-1	6.9	2.2	2.9	2.3	-9
	Track	3%	15%	-4%	4%	0%	-2%	-1%	-8%	-7%	-8%	-8%	-4%	-1%	1%	0%	-1%	6%	2%	2%	1%	-6%
	Land/Water	0.263	0.909	0.483	0.472	0.057	0.205	0.144	0.849	0.82	0.88	0.871	0.701	0.117	0.126	0.034	0.107	0.527	0.166	0.201	0.14	0.543
	HWCT-HWDR	-3.4	-5.6	-3.9	-1.9	0.1	1.7	-0.7	-0.7	-0.5	-0.4	0.6	-0.4	-0.8	0.1	-1	0.5	-0.4	1.4	1	-0.6	-1.5
	Intensity	-94%	-75%	-46%	-18%	1%	14%	-7%	-6%	-4%	-4%	4%	-3%	-7%	1%	-9%	4%	-3%	10%	7%	-4%	-12%
	Land/Water	0.999	0.996	0.983	0.871	0.041	0.913	0.579	0.511	0.359	0.301	0.435	0.327	0.571	0.131	0.626	0.386	0.258	0.796	0.458	0.334	0.63
Atlantic Basin	HWCT-HWDR	-3.3	-5.3	-4	-2.4	0.5	1.8	-1.1	0.2	-0.3	-1.2	1	0.1	0.3	-0.4	-2.2	-2.8	2.3	2.8	1	0.4	-2.6
	Intensity	-92%	-69%	-48%	-22%	4%	14%	-9%	2%	-2%	-10%	7%	1%	2%	-3%	-18%	-23%	12%	15%	6%	3%	-34%
	Water Only	0.999	0.996	0.998	0.901	0.276	0.655	0.582	0.112	0.129	0.568	0.474	0.063	0.159	0.178	0.908						

# Track errors

EMC configurations – direct impact only

# EMC: Track error distributions Control & standard recon



Cases associated w/ large outliers presumably drop out of sample for longer lead times

Standard recon is able to reduce errors for Control's largest outlier

# EMC: SS tables for standard recon

448

All direct impact cases

116

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWRC	-1.3	-1.1	-1.4	-0.9	-0.3	0.1	-1	-1.8	-1.2	-2.7	-1.4	-2.2	0.1	3.2	5	6.4	9.6	11.2	10.8	14	12
	Track	-14%	-6%	-5%	-3%	-1%	0%	-2%	-3%	-2%	-4%	-2%	-2%	0%	3%	4%	5%	7%	7%	6%	7%	5%
	Land/Water	0.998	0.9	0.885	0.667	0.226	0.074	0.481	0.708	0.463	0.609	0.456	0.583	0.021	0.558	0.887	0.941	0.989	0.993	0.979	0.989	0.944
	HWCT-HWRC	-4.7	-6.2	-4.2	-2.4	-0.7	0	0.2	0	0.5	0	-0.4	-0.2	0.1	0.1	-0.2	0.3	-0.7	1.1	-0.2	-0.1	-0.1
	Intensity	-135%	-88%	-47%	-24%	-6%	0%	2%	0%	4%	0%	-3%	-1%	1%	1%	-1%	2%	-6%	8%	-1%	-1%	-1%
	Land/Water	0.999	0.999	0.999	0.985	0.505	0.007	0.193	0.038	0.405	0.043	0.527	0.165	0.07	0.163	0.152	0.308	0.67	0.89	0.166	0.119	0.066
Atlantic Basin	HWCT-HWRC	-4.7	-6.6	-5.1	-2.9	-1.1	-0.8	-0.5	-0.1	0.2	-0.6	-0.9	-0.8	-1.1	-0.9	0.5	1	-0.1	1	0.4	0.5	-0.1
	Intensity	-138%	-100%	-60%	-30%	-10%	-8%	-4%	-1%	1%	-5%	-7%	-6%	-9%	-7%	3%	6%	-1%	7%	3%	3%	-1%
	Water Only	0.999	0.999	0.999	0.993	0.662	0.558	0.387	0.079	0.11	0.348	0.503	0.553	0.721	0.565	0.327	0.636	0.068	0.593	0.2	0.313	0.101

116

Only direct impact cases included in sample at 120 h

116

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWRC	-1.2	-1.9	-2.2	0.5	0.4	2	3.4	2.6	3.4	3.9	3.9	3.5	3.9	4.5	6	6.6	9.2	10.2	10.4	13.1	12
	Track	-12%	-10%	-8%	1%	1%	4%	7%	5%	5%	6%	5%	4%	4%	5%	6%	5%	7%	7%	6%	7%	5%
	Land/Water	0.893	0.832	0.789	0.205	0.172	0.72	0.903	0.829	0.889	0.923	0.885	0.818	0.844	0.837	0.915	0.927	0.971	0.978	0.959	0.978	0.944
	HWCT-HWRC	-3.2	-4.7	-3.8	-2.5	-1.8	0.2	0.2	-0.9	-0.3	-0.4	-1.3	-0.4	0.2	-0.1	-0.9	0.5	-1.3	0.9	-0.9	-0.2	-0.1
	Intensity	-80%	-72%	-40%	-23%	-16%	2%	2%	-8%	-3%	-3%	-9%	-3%	2%	-1%	-7%	4%	-11%	6%	-7%	-1%	-1%
	Land/Water	0.999	0.999	0.975	0.847	0.748	0.119	0.108	0.419	0.197	0.194	0.802	0.294	0.143	0.042	0.501	0.406	0.878	0.735	0.698	0.181	0.066
Atlantic Basin	HWCT-HWRC	-3	-8.8	-8.3	-4.9	-4.5	-2.1	-2.2	-5.4	-2.6	-4.5	-1.9	0	0.1	-2.3	0.9	2.9	1.3	0.8	-0.1	-0.7	-0.1
	Intensity	-60%	-206%	-120%	-61%	-54%	-20%	-20%	-51%	-24%	-50%	-16%	0%	0%	-17%	6%	20%	11%	7%	-1%	-6%	-1%
	Water Only	0.975	0.991	0.992	0.936	0.968	0.775	0.468	0.987	0.469	0.97	0.704	0.001	0.047	0.813	0.395	0.895	0.341	0.425	0.041	0.426	0.101

# Intensity errors

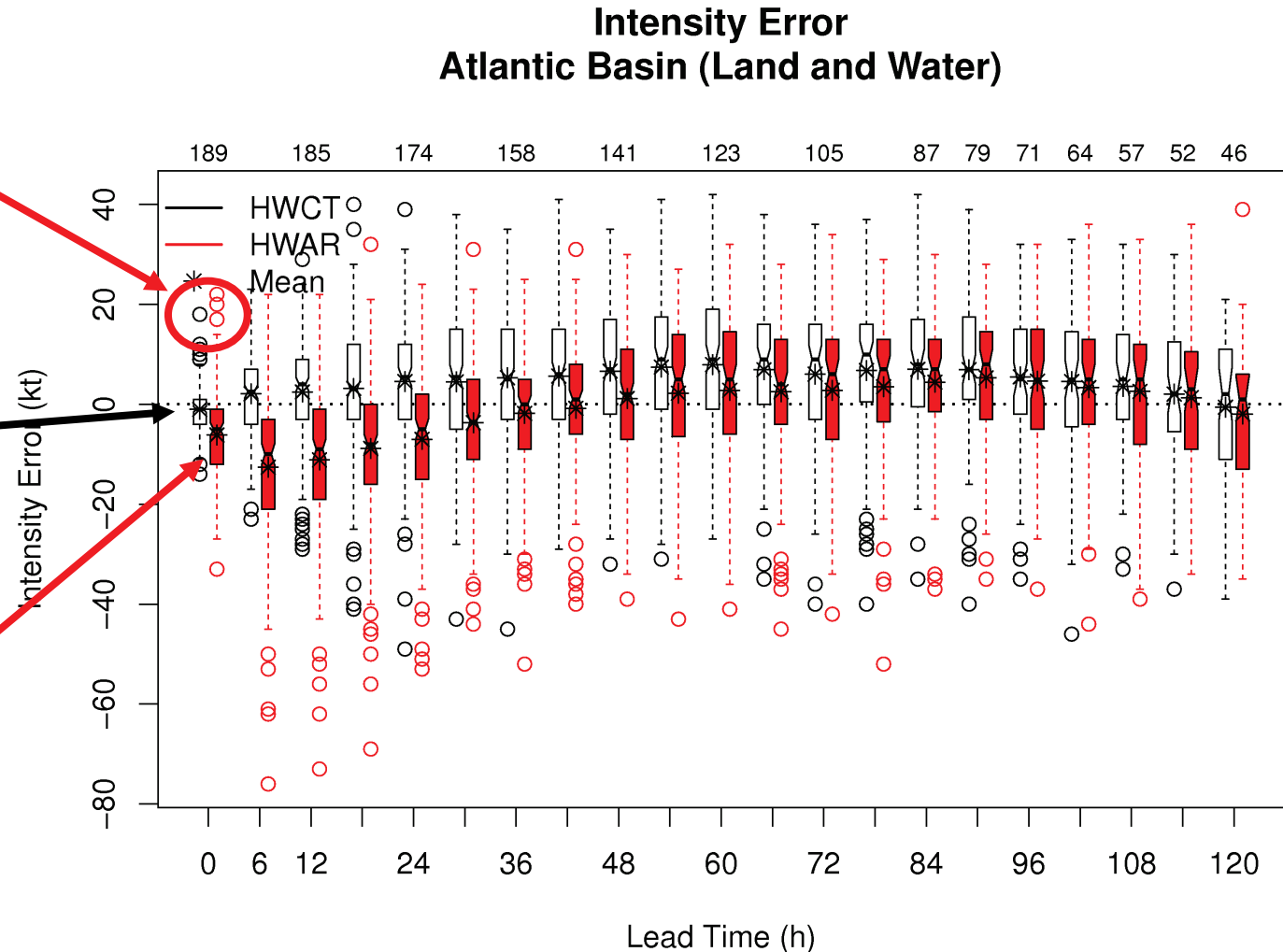
EMC configurations

# EMC: Intensity error distributions Control & all recon configurations

Recon has some positive intensity errors > control, so recon does not always weaken initial intensity

Control has initial low bias that transitions to high bias by 6 h

Recon has larger low bias that increases by 6 h, then decreases w/ lead time



# EMC all recon: Conditional aggregation based on initial Best Track intensity

SD, TD, SS, TS

Sample Size:

72 - 37

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWAR	-1.3	2.3	-3.4	-1.2	0.6	3	3.4	3.1	2.9	2.2	0.3	1.3	-0.1	-1.7	0.7	1	4.1	1.2	3.7	8.5	6
	Track	-12%	9%	-11%	-3%	1%	6%	6%	5%	5%	3%	0%	1%	0%	-1%	1%	1%	3%	1%	2%	5%	3%
	Land/Water	0.804	0.796	0.862	0.397	0.171	0.492	0.544	0.695	0.572	0.374	0.052	0.178	0.019	0.247	0.082	0.108	0.38	0.106	0.285	0.534	0.339
	HWCT-HWAR	-2.7	-1.7	0.3	1.2	2	2.6	3.1	2.9	3	1.8	2.9	2.1	0.7	1.5	0.6	1.2	-1.7	0.2	-0.8	-0.1	-0.5
	Intensity	-106%	-25%	3%	14%	20%	25%	30%	26%	23%	14%	20%	16%	5%	13%	5%	10%	-15%	2%	-7%	-1%	-4%
	Land/Water	0.999	0.911	0.166	0.776	0.729	0.982	0.991	0.992	0.993	0.853	0.98	0.859	0.419	0.808	0.296	0.593	0.829	0.123	0.487	0.074	0.331
HWCT-HWAR	-2.6	-2.3	0.8	1.9	3.4	4.5	4.6	4.4	4.6	2.4	3.2	-1.9	1.2	-1	0	-3.5	-2	2	-9	3	-7	
Intensity	-105%	-37%	9%	20%	30%	34%	35%	30%	28%	15%	18%	-17%	9%	-9%	0%	-20%	-6%	4%	-30%	18%	-140%	
Water Only	0.999	0.968	0.302	0.611	0.909	0.993	0.977	0.965	0.935	0.521	0.651											

CAT 1, 2

Sample Size:

82 - 6

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWAR	0	-0.4	-2.4	-1.7	-3.5	-4.4	-3.9	-5.4	-11.6	-13	-14.7	-21.1	-22.2	-28.1	-34.6	-23.3	-4.9	-2.9	-20.5	-25.3	-23.4
	Track	-1%	-2%	-12%	-6%	-12%	-12%	-9%	-12%	-23%	-23%	-25%	-32%	-27%	-33%	-41%	-26%	-7%	-3%	-18%	-20%	-18%
	Land/Water	0.048	0.209	0.867	0.608	0.891	0.898	0.799	0.908	0.997	0.997	0.915	0.971	0.962	0.938	0.902	0.843					
	HWCT-HWAR	-5.8	-5.7	-3.4	-0.9	2.7	3.7	3	0.9	0.4	-0.9	-1.4	-1	-2.4	1.1	-1.9	0.6	3.8	0.2	0.2	0.4	0.2
	Intensity	-132%	-75%	-37%	-8%	21%	27%	25%	8%	3%	-7%	-11%	-7%	-16%	7%	-13%	3%	24%	2%	2%	2%	1%
	Land/Water	0.999	0.971	0.854	0.302	0.79	0.973	0.957	0.569	0.139	0.502	0.618	0.451	0.826	0.419	0.538	0.258					
HWCT-HWAR	-5.7	-6.2	-4.3	-0.4	4.4	4	3.6	1.7	1.5	-1.6	0.7	0.8	-2.2	-1.4	-7.4	-1.2	1.5	1.2	-0.8	3	0.5	
Intensity	-135%	-83%	-49%	-3%	30%	29%	29%	15%	13%	-15%	5%	5%	-13%	-7%	-43%	-7%	12%	14%	-11%	19%	3%	
Water Only	0.999	0.983	0.885	0.109	0.873	0.899	0.893	0.638	0.319	0.511	0.291	0.206	0.639									

MH

Sample Size:

35 - 3

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HWCT-HWAR	-0.9	-3.8	-3.7	-5.8	-2.6	-2.5	-5.1	-2.5	-0.7	-0.8	0.8	0	1.5	6	5.1	4.5	9	12	20.5	20.2	45
	Track	-16%	-33%	-24%	-29%	-9%	-8%	-15%	-6%	-2%	-2%	1%	0%	2%	7%	5%	4%	6%	8%	12%	12%	28%
	Land/Water	0.814	0.957	0.782	0.891	0.295	0.385	0.66	0.335	0.139	0.083	0.116	0.004	0.255	0.724	0.597	0.442	0.604	0.619			
	HWCT-HWAR	-9.6	-24.3	-19.2	-13.7	-7.6	-6.4	-3.1	-0.8	-1.6	0.7	-0.5	1.3	0.8	0.3	1.2	1.2	0.2	0.6	3.4	1.3	4
	Intensity	-275%	-301%	-210%	-140%	-79%	-69%	-32%	-7%	-15%	5%	-4%	11%	8%	2%	10%	8%	2%	5%	26%	11%	67%
	Land/Water	0.999	0.999	0.999	0.999	0.951	0.983	0.79	0.243	0.72	0.509	0.289	0.619	0.405	0.247	0.693	0.601	0.128	0.232			
HWCT-HWAR	-9.3	-23	-18.4	-14.6	-8.3	-5.7	-2.3	-0.8	-1.7	0.5	0.6	1.6	1.7	0.6	2.5	0.5	2.8	3.2	6.5	5	2.5	
Intensity	-266%	-285%	-204%	-165%	-91%	-59%	-21%	-6%	-14%	3%	4%	11%	15%	5%	20%	4%	17%	17%	32%	25%	45%	
Water Only	0.999	0.999	0.999	0.999	0.962	0.885	0.545	0.194	0.606	0.266	0.274	0.524	0.573	0.37	0.888							

# Summary for EMC configurations

- Standard recon
  - Track: SS improvements over control of 6-7% at 96-114 h, but non-SS impacts are negative through 72 h
    - Aggregation for only those cases included in the 120 h sample leads to non-SS impacts that are positive except for 0-12 h
  - Intensity: SS degradations through 18 h, with little impact thereafter
- All recon and TDR only
  - No SS improvements for either track or intensity
  - SS degradations for intensity through 12 h
- Largest negative impacts for intensity forecasts are associated w/ assimilating recon data when the TC is a major hurricane



# Results for configurations delivered by PSU

Control (APCT) , Standard recon (APRC), All recon (APAR)

# PSU configurations: SS tables

## Direct impact only

332

Standard recon

94

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	
Atlantic Basin	APCT-APRO	6.4	2.7	2.2	0.6	0.2	0	-0.8	1.3	4.7	6.7	8.4	12.5	16.3	17.2	6.3	6.6	5.2	7.4	8.9	17.3	25.3	
	Track	23%	8%	6%	2%	1%	0%	-1%	2%	6%	8%	8%	11%	13%	13%	5%	5%	4%	5%	5%	9%	11%	
	Land/Water	0.999	0.871	0.74	0.229	0.074	0.007	0.186	0.274	0.745	0.832	0.773	0.738	0.574	0.478	0.919	0.91	0.767	0.856	0.837	0.966	0.979	
	APCT-APRO	-3.9	-1.6	-1.2	-0.6	0.6	1.8	1.5	0.9	0.4	1.1	1.4	1.4	0.4	0.7	1	1.9	0.5	0.7	0.8	0.9	0.3	
	Intensity	-37%	-14%	-10%	-6%	5%	14%	12%	7%	3%	8%	10%	10%	3%	5%	7%	13%	3%	5%	5%	6%	2%	
	Land/Water	0.999	0.869	0.76	0.46	0.5	0.997	0.909	0.685	0.352	0.87	0.986	0.975	0.462	0.742	0.885	0.99	0.488	0.635	0.486	0.646	0.216	
	APCT-APRO	-4.1	-1.4	-1.1	-0.3	1.4	2.6	2.9	1.8	1.8	1.1	1.7	1.8	2	1.9	1.6	2.2	2.7	0	-0.8	3.2	-0.1	
	Intensity	-39%	-13%	-9%	-2%	11%	20%	21%	14%	12%	7%	12%	13%	14%	13%	10%	14%	17%	0%	0%	-7%	24%	-1%
	Water Only	0.999	0.737	0.597	0.145	0.657	0.976	0.957	0.959	0.959	0.826	0.926	0.89	0.894	0.787	0.682	0.849	0.788	0.001	0.262			

189

All recon

30

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	
Atlantic Basin	APCT-APAR	8.3	5.7	5.2	7.9	7.7	8.4	8.4	8.6	13.3	15.7	21.1	24.9	30.8	29.5	14.1	17.8	8.8	9.9	13	21.3	32.8	
	Track	33%	19%	15%	20%	17%	16%	15%	13%	17%	18%	21%	22%	24%	22%	12%	14%	8%	8%	9%	12%	16%	
	Land/Water	0.999	0.985	0.98	0.999	0.998	0.982	0.921	0.82	0.863	0.917	0.893	0.758	0.482	0.548	0.923	0.867	0.79	0.773	0.805	0.934	0.967	
	APCT-APAR	-2.4	-1.2	-0.5	0.3	0.7	1.6	1.5	0.7	1.8	1.7	1.5	1.4	0	0.2	0.6	-0.1	-1.1	0	-1	-0.8	-1	
	Intensity	-23%	-12%	-5%	3%	6%	14%	12%	5%	14%	14%	12%	11%	0%	2%	5%	-1%	-10%	0%	0%	-9%	-7%	-8%
	Land/Water	0.982	0.631	0.331	0.183	0.414	0.822	0.752	0.378	0.859	0.878	0.967	0.889	0.008	0.164	0.555	0.059	0.762	0.02	0.713	0.436	0.342	
	APCT-APAR	-2.4	-1.5	-0.7	0.4	1	2.5	3.2	1.2	2.8	2	1.1	0.7	-0.9	-0.7	1	0	-0.6	-2.1	-1.2	0.8	-5.2	
	Intensity	-23%	-15%	-6%	3%	8%	19%	23%	9%	21%	15%	9%	6%	-7%	-5%	7%	0%	-4%	-22%	-16%	9%	-62%	
	Water Only	0.982	0.7	0.356	0.171	0.419	0.856	0.901	0.498	0.788	0.912	0.731	0.314	0.561	0.386	0.642	0.001						

# Track errors

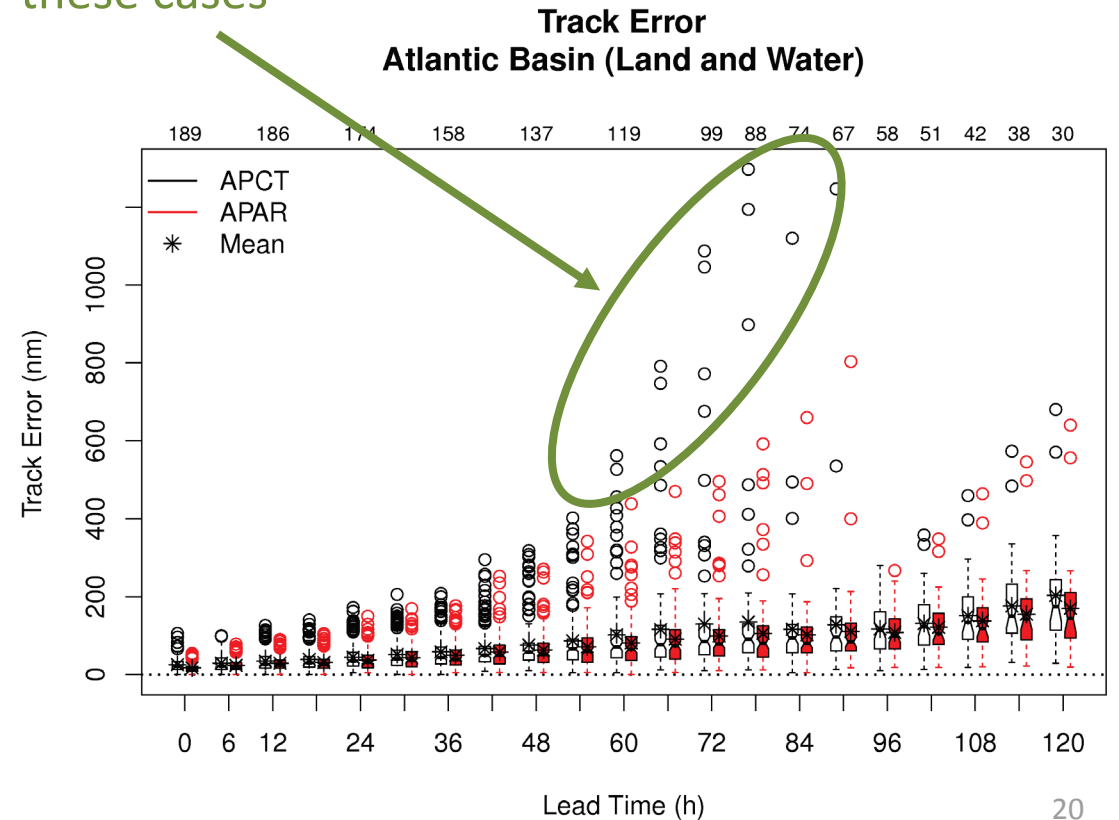
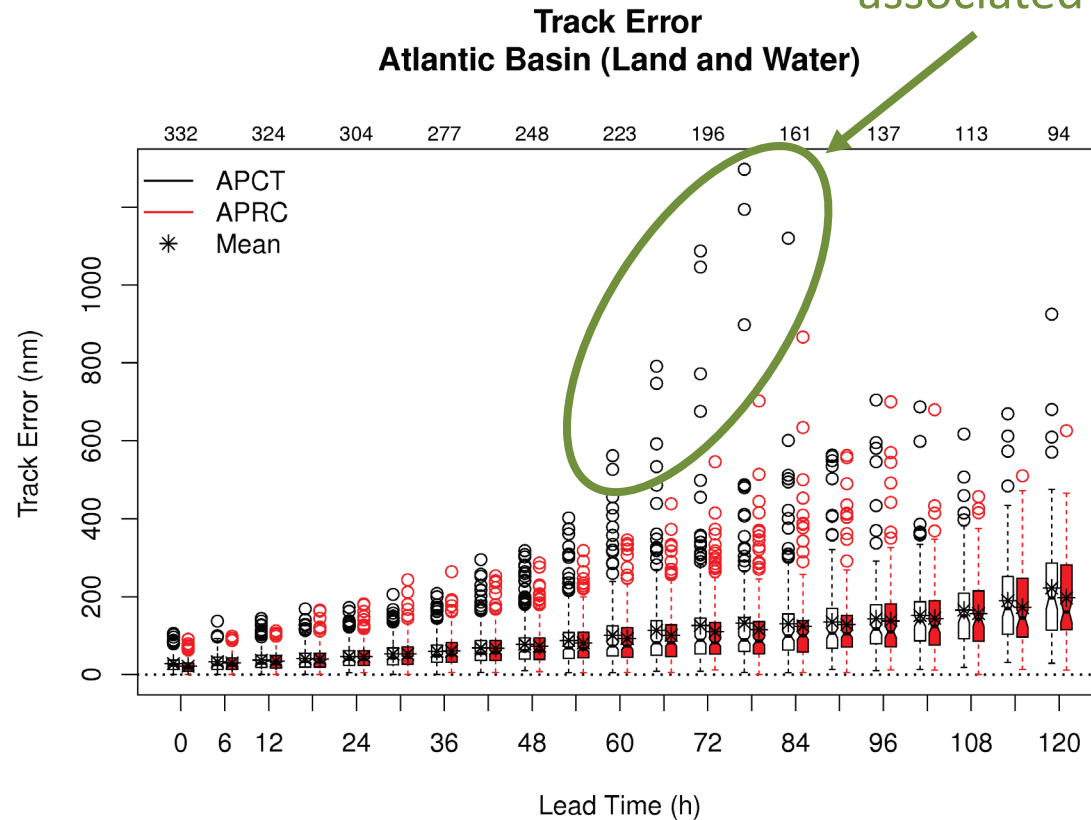
PSU configurations – direct impact only

# PSU configurations: Track error distributions

Standard recon

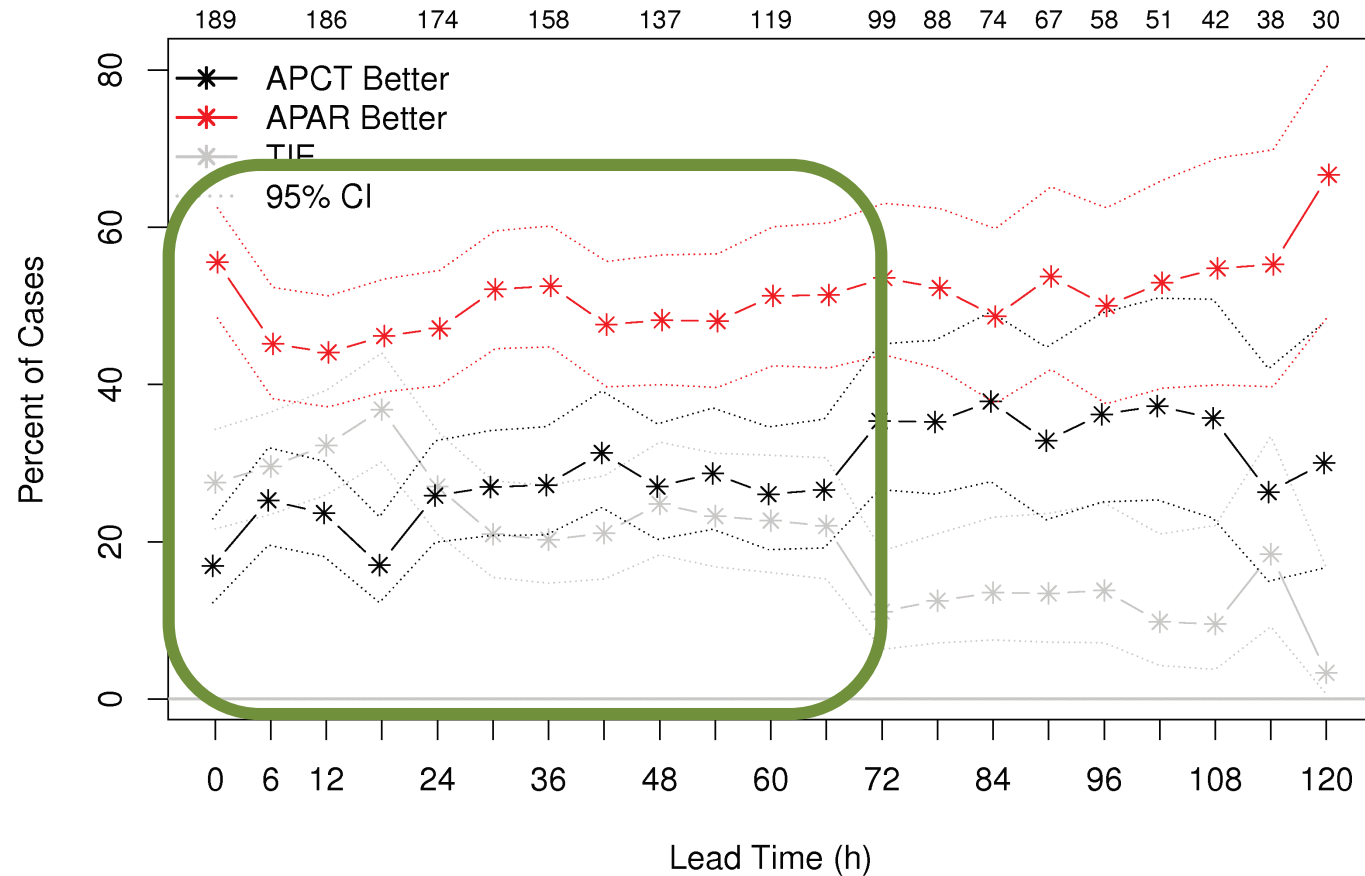
Large control outliers (Tomas):  
recon configurations able to  
substantially reduce errors  
associated w/ these cases

All recon



# PSU: Track error – Frequency of Superior Performance Control & all recon configurations

Track Error Difference  $\geq 6$  nm  
Atlantic Basin (Land and Water)



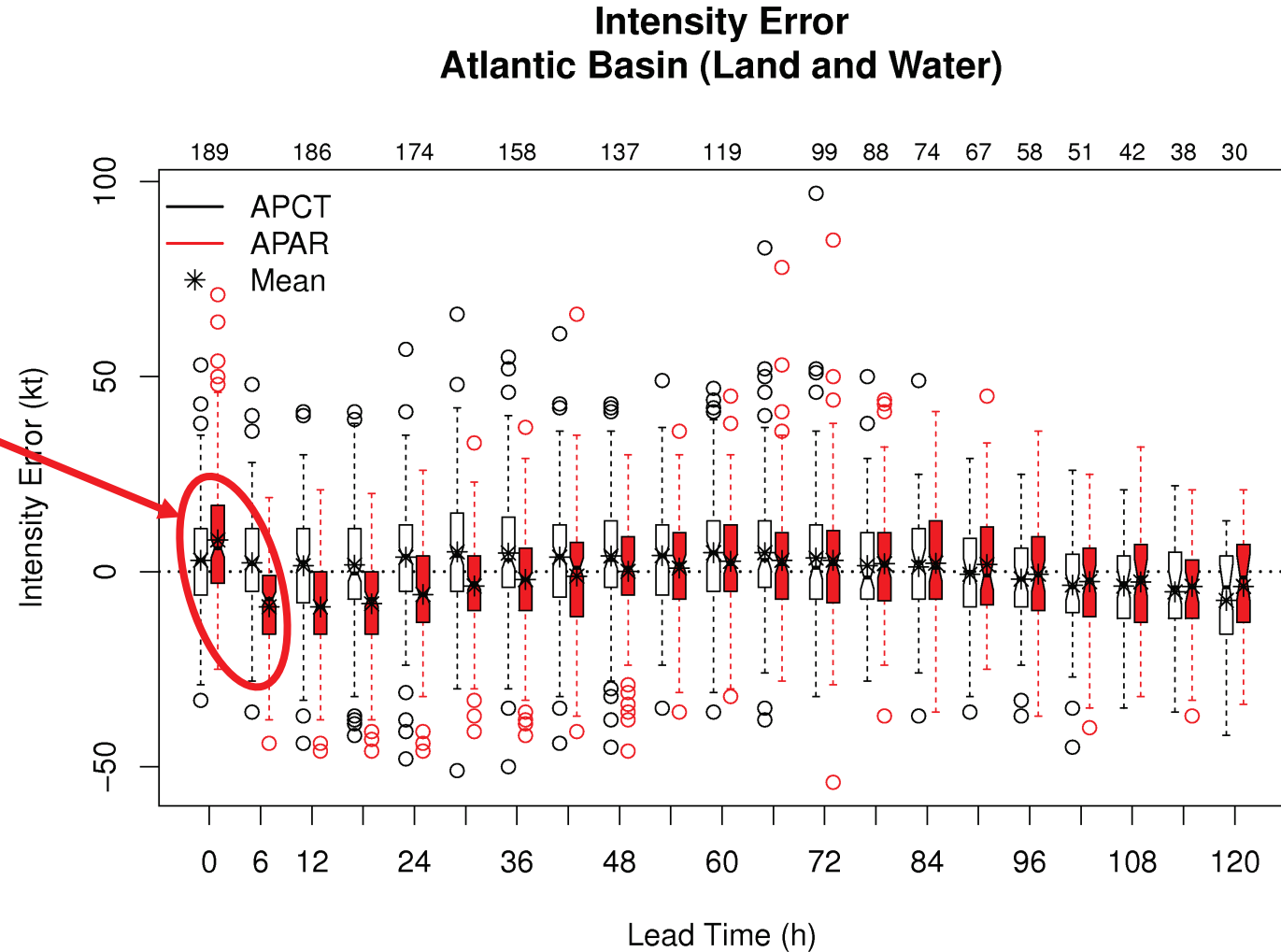
In terms of FSP, all recon outperforms control out to 72 h

# Intensity errors

PSU configurations – direct impact only

# PSU: Intensity error distributions Control & all recon configurations

Recon configurations transition from over prediction for ~ 75% of sample at 0 h to at least 75% of sample under predicting intensity at 6 h



# PSU all recon: Conditional aggregation based on initial Best Track intensity

SD, TD, SS, TS  
Sample Size:  
81 - 22

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APCT-APAR	11.5	10.1	8.6	12	10.5	10.3	11.9	11.8	14.7	22.4	32.1	43.6	57.9	57.9	25	32.2	17.6	13.5	15.6	27.2	34.6
	Track	35%	26%	18%	23%	19%	16%	16%	14%	16%	21%	24%	28%	32%	31%	17%	21%	14%	9%	9%	14%	16%
	Land/Water	0.999	0.996	0.985	0.983	0.976	0.81	0.751	0.643	0.717	0.842	0.815	0.721	0.45	0.511	0.902	0.588	0.9	0.734	0.723	0.927	0.925
	APCT-APAR	-0.4	1.9	2.2	1.8	1.4	3.2	3.6	3.1	3.9	2.9	2.5	2.9	1.6	1.2	1.1	0.1	-0.8	0.8	-0.1	-0.2	0.1
	Intensity	-5%	20%	20%	16%	12%	27%	27%	20%	26%	21%	17%	17%	9%	9%	9%	1%	-6%	6%	-1%	-2%	1%
	Land/Water	0.292	0.925	0.947	0.589	0.495	0.91	0.82	0.827	0.93	0.96	0.951	0.939	0.569	0.558	0.568	0.039	0.367	0.509	0.074	0.082	0.05
APCT-APAR	-1	2.8	2.8	2.4	2.2	5.5	7.3	4.8	7.7	4.6	3.9	4.8	1.2	1.2	5.3	-5	2	0	3	4	-8	
Intensity	-11%	27%	23%	19%	16%	37%	43%	31%	46%	31%	25%	33%	7%	5%	21%	-29%	14%	0%	23%	80%	-160%	
Water Only	0.588	0.977	0.86	0.553	0.501	0.992	0.954	0.96	0.993	0.915	0.929	0.932										

CAT 1, 2  
Sample Size:  
76 - 6

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APCT-APAR	6.9	3.6	4.1	7.3	7.5	7.8	5.7	7.5	17	14.2	16.1	10.9	12.1	10	11.7	15	11.5	17.3	15.2	25.5	41
	Track	35%	16%	16%	23%	19%	17%	12%	14%	26%	21%	22%	15%	15%	12%	13%	13%	9%	14%	12%	18%	22%
	Land/Water	0.999	0.77	0.844	0.999	0.973	0.911	0.788	0.744	0.37	0.695	0.986	0.826	0.697	0.744	0.715	0.78					
	APCT-APAR	-6.3	0.2	0.5	1.6	2	2.5	0.9	-0.9	-0.6	0.1	1	0.6	-1.7	-0.7	0.9	0.4	-0.9	-1.2	-4.9	-2.6	-4.2
	Intensity	-60%	2%	4%	13%	16%	19%	8%	-10%	-6%	1%	11%	7%	-20%	-8%	9%	4%	-11%	-17%	-71%	-29%	-47%
	Land/Water	0.999	0.12	0.206	0.609	0.774	0.748	0.531	0.652	0.294	0.07	0.528	0.308	0.907	0.479	0.438	0.181					
APCT-APAR	-5.7	-0.7	0.2	1.8	2.8	3.4	2	-1.2	-0.8	0.1	0.7	-0.8	-2.2	-1.9	0.6	5.5	1	-1.5	-4.5	1.5	-6	
Intensity	-55%	-7%	2%	14%	21%	25%	15%	-12%	-7%	1%	7%	-10%	-22%	-18%	5%	32%	9%	-60%	-450%	17%	-52%	
Water Only	0.999	0.389	0.07	0.565	0.769	0.81	0.551	0.322	0.102	0.029	0.166	0.354	0.768									

MH  
Sample Size:  
32 - 2

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APCT-APAR	3.6	-0.1	-0.7	-0.3	1.8	5.6	5.9	2.9	3.8	2.8	2.5	-0.9	-5.9	-6.4	-4.1	-6	-8.9	-4.8	0.5	-15.5	-11.4
	Track	21%	-1%	-3%	-1%	6%	16%	15%	6%	7%	4%	3%	-1%	-7%	-8%	-5%	-6%	-9%	-5%	0%	-12%	-10%
	Land/Water	0.743	0.024	0.162	0.151	0.636	0.959	0.786	0.614	0.69	0.474	0.416	0.184	0.568	0.758	0.474	0.568	0.683	0.286			
	APCT-APAR	1.8	-12.3	-9.7	-6.3	-3.8	-3.8	-2.4	-2.1	0.8	1.1	0	-1.2	-1.4	-1	-0.6	-0.7	-1.8	-1.2	0.1	-1.4	-4
	Intensity	12%	-105%	-94%	-63%	-38%	-40%	-24%	-21%	7%	9%	0%	-12%	-15%	-9%	-5%	-7%	-20%	-13%	2%	-16%	-80%
	Land/Water	0.459	0.999	0.997	0.902	0.767	0.976	0.888	0.593	0.527	0.642	0.001	0.522	0.547	0.37	0.522	0.62	0.929	0.75			
APCT-APAR	1.6	-13.1	-10.8	-6.5	-4.5	-4.4	-2.3	-1.6	0.5	0.8	-1.4	-1.5	-1.1	-0.6	0.2	-0.9	-1.5	-3	0	-4	-1	
Intensity	11%	-124%	-110%	-63%	-47%	-46%	-23%	-15%	4%	6%	-12%	-13%	-10%	-5%	1%	-7%	-12%	-29%	0%	0%	-36%	-17%
Water Only	0.402	0.999	0.997	0.763	0.82	0.973	0.88	0.701	0.306	0.457	0.822	0.69	0.516	0.225	0.125	0.449						



# PSU all recon: SS tables

189

Direct impact cases for both standard recon and TDR

30

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APCT-APAR	8.3	5.7	5.2	7.9	7.7	8.4	8.4	8.6	13.3	15.7	21.1	24.9	30.8	29.5	14.1	17.8	8.8	9.9	13	21.3	32.8
	Track	33%	19%	15%	20%	17%	16%	15%	13%	17%	18%	21%	22%	24%	22%	12%	14%	8%	8%	9%	12%	16%
	Land/Water	0.999	0.985	0.98	0.999	0.998	0.982	0.921	0.82	0.863	0.917	0.893	0.758	0.482	0.548	0.923	0.867	0.79	0.773	0.805	0.934	0.967
	APCT-APAR	-2.4	-1.2	-0.5	0.3	0.7	1.6	1.5	0.7	1.8	1.7	1.5	1.4	0	0.2	0.6	-0.1	-1.1	0	-1	-0.8	-1
	Intensity	-23%	-12%	-5%	3%	6%	14%	12%	5%	14%	14%	12%	11%	0%	2%	5%	-1%	-10%	0%	-9%	-7%	-8%
	Land/Water	0.982	0.631	0.331	0.183	0.414	0.822	0.752	0.378	0.859	0.878	0.967	0.889	0.008	0.164	0.555	0.059	0.762	0.02	0.713	0.436	0.342
	APCT-APAR	-2.4	-1.5	-0.7	0.4	1	2.5	3.2	1.2	2.8	2	1.1	0.7	-0.9	-0.7	1	0	-0.6	-2.1	-1.2	0.8	-5.2
	Intensity	-23%	-15%	-6%	3%	8%	19%	23%	9%	21%	15%	9%	6%	-7%	-5%	7%	0%	-4%	-22%	-16%	9%	-62%
	Water Only	0.982	0.7	0.356	0.171	0.419	0.856	0.901	0.498	0.788	0.912	0.731	0.314	0.561	0.386	0.642	0.001					

98

Direct TDR impact cases only

13

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APCT-APAR	11.1	6.4	6	8.3	8.6	10.7	9.7	8.9	15.5	19.2	22.4	24.1	28.9	29.1	22.3	23.6	7	3.6	6.2	8.4	22.5
	Track	43%	23%	19%	22%	20%	21%	17%	13%	20%	21%	21%	19%	21%	19%	16%	16%	6%	3%	5%	6%	15%
	Land/Water	0.999	0.996	0.977	0.996	0.996	0.999	0.953	0.879	0.972	0.977	0.958	0.859	0.319	0.398	0.894	0.896	0.616	0.337	0.477	0.523	0.885
	APCT-APAR	-0.5	-1.5	-1.1	0.5	1.6	2.1	2.5	-0.1	1.4	0.9	1.9	1.9	-0.4	0	0.9	-0.3	-0.6	-0.2	-1.9	-1.3	-1.6
	Intensity	-9%	-14%	-9%	4%	13%	16%	18%	-1%	12%	8%	17%	18%	-4%	0%	8%	-4%	-6%	-2%	-18%	-13%	-14%
	Land/Water	0.339	0.747	0.614	0.206	0.831	0.912	0.923	0.077	0.601	0.614	0.95	0.91	0.366	0.042	0.648	0.252	0.45	0.133	0.839	0.502	0.593
	APCT-APAR	-0.8	-1.7	-0.9	1.1	2.3	3.6	4	0.1	2.2	1	1.7	1.5	-1.8	-0.3	1	-0.7	-1.2	-2.4	-0.2	1	-4.3
	Intensity	-7%	-16%	-8%	8%	18%	23%	25%	1%	17%	7%	14%	13%	-15%	-2%	8%	-5%	-7%	-18%	-3%	14%	-62%
	Water Only	0.487	0.76	0.478	0.353	0.675	0.955	0.958	0.075	0.485	0.34	0.61	0.466	0.777	0.142	0.395						

98

Direct TDR impact cases only - Standard recon configuration baseline

13

Forecast Hour		0	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	APRC-APAR	1.9	3.5	2.3	2.9	4.3	4.6	5.6	3.8	3.6	4	4	1	0.5	2.1	9.4	2.3	-0.1	-3.8	-1.9	-4.6	-15.8
	Track	12%	14%	8%	9%	11%	10%	11%	6%	5%	5%	5%	1%	0%	2%	7%	2%	0%	-4%	-2%	-4%	-14%
	Land/Water	0.857	0.962	0.666	0.847	0.979	0.773	0.97	0.848	0.757	0.76	0.713	0.179	0.063	0.216	0.811	0.336	0.018	0.348	0.151	0.303	0.593
	APRC-APAR	2.2	0.3	0.5	0.3	-0.6	-0.6	-1	-0.3	0.8	-0.8	0.3	0.4	-0.4	-0.3	0.8	-1	-1.4	-1.3	-1.8	-0.2	-0.9
	Intensity	15%	3%	4%	2%	-6%	-5%	-10%	-3%	7%	-9%	3%	5%	-4%	-3%	8%	-12%	-15%	-13%	-17%	-1%	-7%
	Land/Water	0.968	0.383	0.538	0.325	0.64	0.583	0.839	0.283	0.491	0.743	0.378	0.443	0.455	0.297	0.726	0.702	0.812	0.861	0.591	0.104	0.277
	APRC-APAR	2.3	0.2	0.2	0.2	-1.2	-0.9	-1.9	-0.5	0.5	-1.8	-1.1	-0.1	-2.2	-1.3	1.7	-2.6	-1.7	-0.5	2.4	-0.2	-4.2
	Intensity	16%	2%	2%	1%	-12%	-8%	-19%	-4%	4%	-17%	-12%	-1%	-20%	-11%	14%	-22%	-11%	-4%	20%	-3%	-59%
	Water Only	0.973	0.222	0.222	0.15	0.853	0.677	0.84	0.293	0.297	0.83	0.699	0.05	0.915	0.492	0.803						

# Summary for PSU configurations

- Standard recon
  - Track: improved forecasts over control for all but 2 lead times, at times by 10%, w/ SS improvements at 0 h & 114-120 h
  - Intensity: improved forecasts over control after 18 h, w/ several SS improvements noted between 30-90 h
- All recon
  - Track: improved forecasts over control for all lead times, at times by 20%, w/ SS improvements through 30 h & a few near misses after that
  - Intensity: 1 SS degradation @ 0 h & 1 SS improvement at 60 h w/ strongest positive impact from 30-60 h – impacts for longer lead time mostly negative but not SS
    - Conditional aggregations point to negative impacts of recon data for short lead times being associated w/ assimilating recon data when the TC is a major hurricane
- TDR direct impact cases – all recon vs standard recon
  - Track: SS improvements of ~10-15% at 6, 24 & 36 h, non-SS improvements through 90 h, w/ negative (not SS) at longer lead times
  - Intensity: SS improvement at 0 h, results beyond that mixed & predominately negative



# Results for configurations delivered by HRD

Control (HECT) , Standard recon (HERC), All recon (HEAR) & TDR only (HEDR) –  
direct impact only

# HRD configurations: SS tables

224

Standard recon

42

Forecast Hour		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HECT-HERC	7	5.6	6.4	6.4	6.2	2.4	1.1	1.8	2.9	2.8	1.2	1.5	2.2	-3.1	-1.2	-2	-1.6	-0.8	-2.8	-3.9
	Track	20%	13%	13%	11%	10%	4%	1%	2%	3%	3%	1%	1%	2%	-2%	-1%	-1%	-1%	0%	-1%	-1%
	Land/Water	0.999	0.999	0.999	0.999	0.999	0.935	0.555	0.721	0.882	0.844	0.417	0.492	0.572	0.627	0.251	0.348	0.289	0.134	0.376	0.486
	HECT-HERC	4.3	2.4	1.9	0.9	0.9	0.5	0.8	1.2	0.2	-0.2	0.3	-0.7	-0.6	-0.6	-1.4	-1.4	-2.5	2.6	1.6	-1.4
	Intensity	26%	16%	14%	7%	7%	3%	6%	8%	1%	-1%	2%	-5%	-4%	-4%	-8%	-8%	-14%	12%	8%	-8%
	Land/Water	0.999	0.999	0.999	0.952	0.911	0.603	0.813	0.88	0.211	0.2	0.28	0.604	0.54	0.42	0.847	0.795	0.948	0.929	0.561	0.567
	HECT-HERC	4.4	2.6	2.3	0.9	0.7	0.5	0.8	1.2	0.5	1.2	-0.5	-1.1	-0.9	-2	-1.9	-4	-4.5	-1.1	-4.9	-1.6
	Intensity	27%	18%	16%	7%	5%	4%	6%	8%	3%	7%	-3%	-7%	-6%	-12%	-11%	-20%	-21%	-4%	-20%	-6%
	Water Only	0.999	0.999	0.999	0.914	0.696	0.521	0.725	0.756	0.356	0.744	0.3	0.602	0.577	0.816	0.814	0.952	0.965	0.365		

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All recon

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Forecast Hour		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HECT-HEAR	12.1	9.1	9.4	7.9	9.6	4.6	0.1	0.7	5.5	6.1	3.6	4	6.5	1.6	4.3	9.9	12.7	7.3	1.1	4
	Track	37%	21%	19%	14%	15%	7%	0%	1%	6%	6%	3%	3%	4%	1%	2%	5%	6%	3%	0%	2%
	Land/Water	0.991	0.99	0.996	0.968	0.98	0.73	0.018	0.173	0.89	0.89	0.635	0.664	0.807	0.234	0.558	0.881	0.923	0.735	0.119	
	HECT-HEAR	7	4.1	4.7	2.9	2.3	1.4	0.2	1.8	-0.4	0.4	-0.9	-0.3	-0.1	-1.7	-4.4	-2.6	-1.6	-0.1	1.8	-4.2
	Intensity	38%	24%	30%	20%	16%	9%	1%	12%	-3%	3%	-6%	-2%	-1%	-12%	-30%	-14%	-8%	0%	8%	-17%
	Land/Water	0.999	0.999	0.996	0.992	0.972	0.667	0.131	0.871	0.244	0.252	0.531	0.166	0.071	0.49	0.8	0.707	0.431	0.035	0.356	
	HECT-HEAR	7.1	4.6	5.4	3.2	2.6	1.6	-0.2	2.2	-0.8	0.9	-1.8	-2.4	-2.8	-5.9	-9.8	-8.8	-5.4	-3.9	-1.2	-2.6
	Intensity	38%	27%	32%	21%	17%	10%	-1%	13%	-4%	4%	-10%	-14%	-17%	-38%	-63%	-55%	-29%	-20%	-5%	-10%
	Water Only	0.999	0.999	0.996	0.987	0.953	0.466	0.1	0.776	0.253	0.289	0.546	0.65	0.796	0.932						

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TDR only

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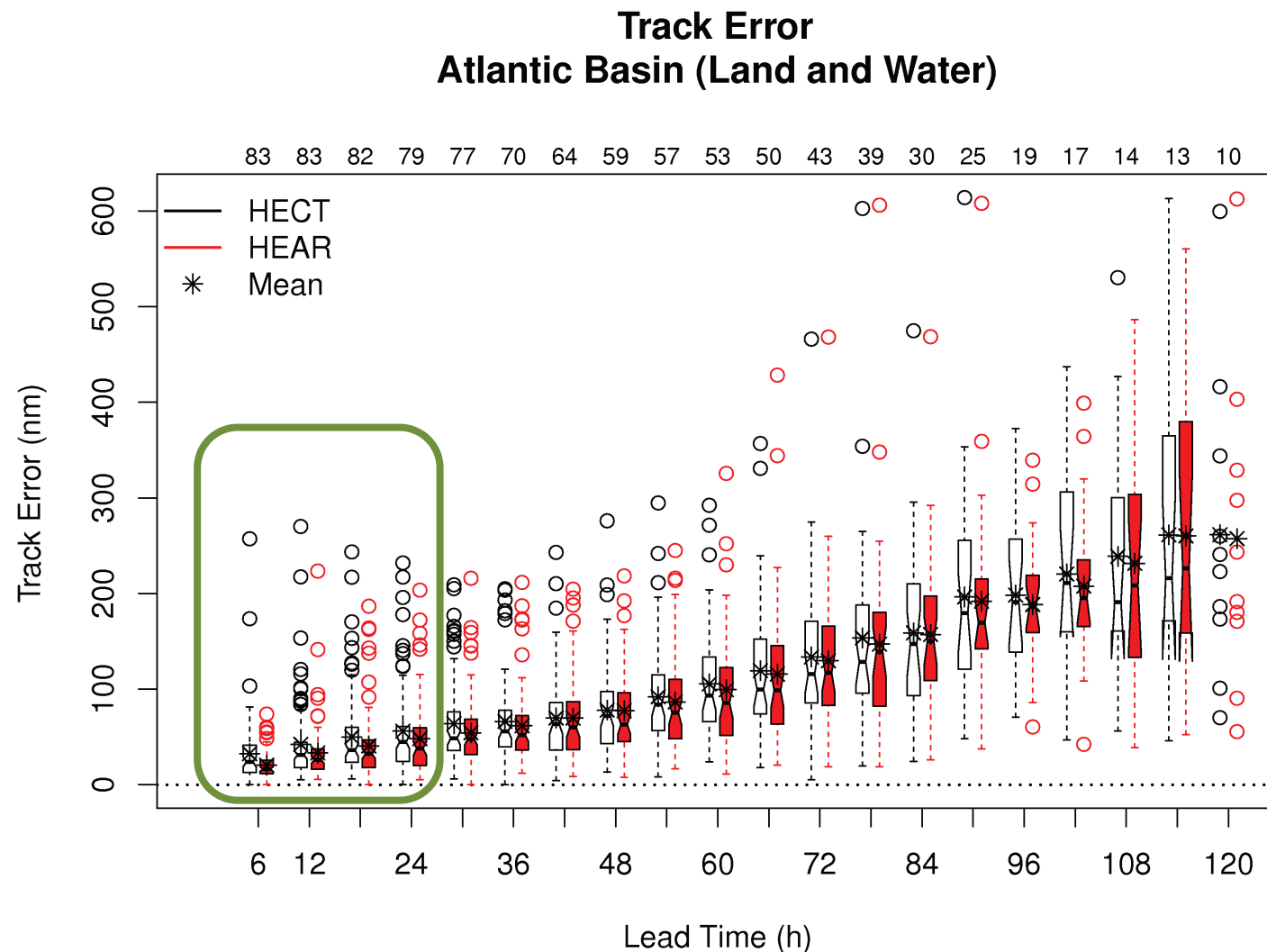
Forecast Hour		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HECT-HEDR	9.9	10	9.5	9	8.4	5.7	1.6	0.8	1.4	1	0.2	2.2	6	4.3	8.7	11	11.3	6.1	6.7	5.3
	Track	30%	24%	19%	16%	13%	9%	2%	1%	2%	1%	0%	2%	4%	3%	5%	6%	5%	3%	3%	2%
	Land/Water	0.999	0.991	0.994	0.985	0.96	0.838	0.411	0.234	0.343	0.236	0.038	0.424	0.757	0.632	0.866	0.887	0.907	0.736	0.712	
	HECT-HEDR	7.2	4.4	5.1	2.4	1.1	0	-1.3	-1.2	-1.2	-0.5	-0.6	-0.8	0	-2.5	-4.5	-3	-3.8	-1	-0.7	-4.8
	Intensity	39%	26%	33%	16%	8%	0%	-9%	-8%	-8%	-3%	-4%	-6%	0%	-17%	-30%	-17%	-19%	-4%	-3%	-20%
	Land/Water	0.999	0.999	0.999	0.976	0.684	0.025	0.673	0.568	0.636	0.305	0.439	0.463	0.015	0.814	0.921	0.853	0.934	0.251	0.154	
	HECT-HEDR	7.3	4.6	5.6	2.5	1	-0.9	-2.1	-1	-1.6	0.1	-0.7	-4	-3.8	-6.9	-6.3	-8.5	-7.1	-5.7	-4.2	-4
	Intensity	39%	27%	33%	17%	7%	-6%	-15%	-6%	-9%	0%	-4%	-22%	-23%	-43%	-40%	-54%	-39%	-29%	-19%	-16%
	Water Only	0.999	0.999	0.999	0.964	0.547	0.328	0.833	0.372	0.577	0.03	0.281	0.911	0.94	0.956						

# Track errors

HRD configurations – direct impact only

# HRD configurations: Track error distributions Control & all recon configurations

Recon data reduces magnitude of outliers, as well as errors associated w/ central portion of distribution

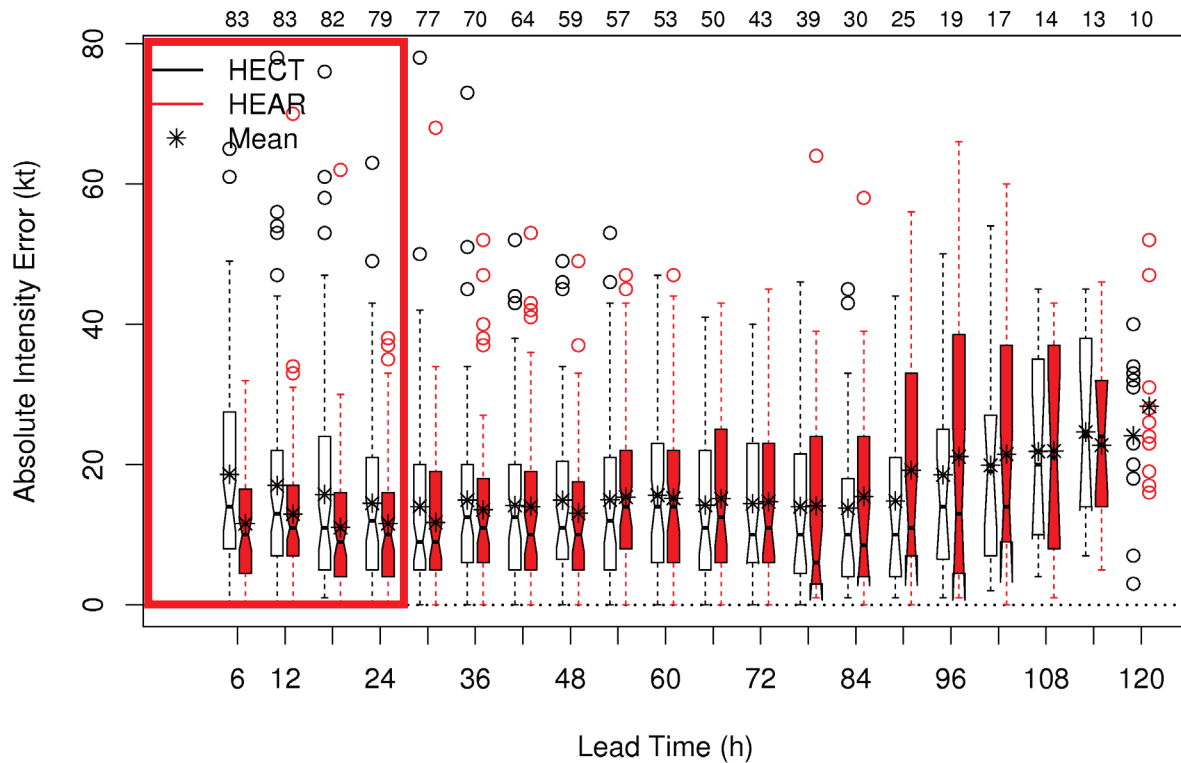


# Intensity errors

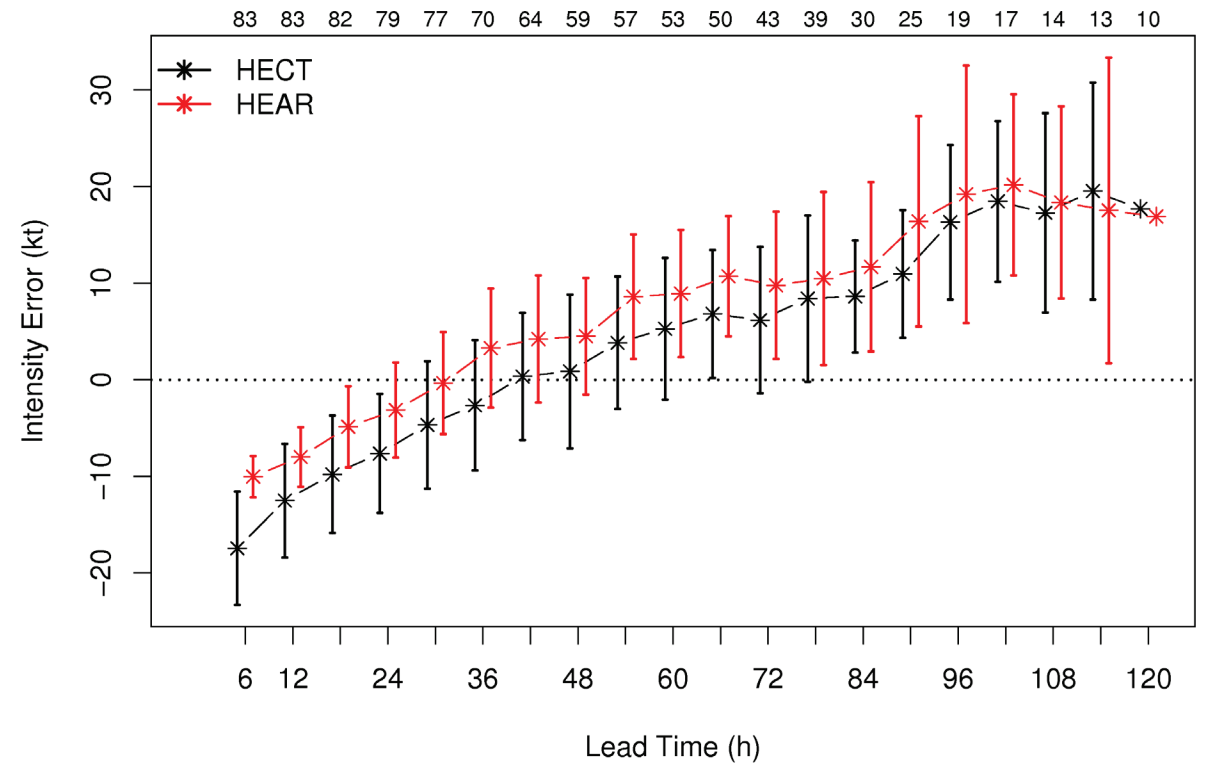
HRD configurations – direct impact only

# HRD all recon: Intensity errors

**Absolute Intensity Error  
Atlantic Basin (Land and Water)**



**Mean Intensity Error  
Atlantic Basin (Land and Water)**





# HRD configurations: SS tables

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## All recon configuration w/ control baseline

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Forecast Hour		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HECT-HEAR	12.1	9.1	9.4	7.9	9.6	4.6	0.1	0.7	5.5	6.1	3.6	4	6.5	1.6	4.3	9.9	12.7	7.3	1.1	4
	Track	37%	21%	19%	14%	15%	7%	0%	1%	6%	6%	3%	3%	4%	1%	2%	5%	6%	3%	0%	2%
	Land/Water	0.991	0.99	0.996	0.968	0.98	0.73	0.018	0.173	0.89	0.89	0.635	0.664	0.807	0.234	0.558	0.881	0.923	0.735	0.119	
	HECT-HEAR	7	4.1	4.7	2.9	2.3	1.4	0.2	1.8	-0.4	0.4	-0.9	-0.3	-0.1	-1.7	-4.4	-2.6	-1.6	-0.1	1.8	-4.2
	Intensity	38%	24%	30%	20%	16%	9%	1%	12%	-3%	3%	-6%	-2%	-1%	-12%	-30%	-14%	-8%	0%	8%	-17%
	Land/Water	0.999	0.999	0.996	0.992	0.972	0.667	0.131	0.871	0.244	0.252	0.531	0.166	0.071	0.49	0.8	0.707	0.431	0.035	0.356	
HECT-HEAR	7.1	4.6	5.4	3.2	2.6	1.6	-0.2	2.2	-0.8	0.9	-1.8	-2.4	-2.8	-5.9	-9.8	-8.8	-5.4	-3.9	-1.2	-2.6	
Intensity	38%	27%	32%	21%	17%	10%	-1%	13%	-4%	4%	-10%	-14%	-17%	-38%	-63%	-55%	-29%	-20%	-5%	-10%	
Water Only	0.999	0.999	0.996	0.987	0.953	0.466	0.1	0.776	0.253	0.289	0.546	0.65	0.796	0.932							

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## All recon configuration w/ standard recon configuration baseline

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Forecast Hour		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
Atlantic Basin	HERC-HEAR	5.2	2.2	1.1	-0.2	1.1	-0.4	-1.4	-0.2	0.5	0.5	-2.6	-1.2	-3.1	-2.7	-2	2.4	3.4	-0.7	-4.8	-5
	Track	20%	6%	3%	0%	2%	-1%	-2%	0%	1%	0%	-2%	-1%	-2%	-2%	-1%	1%	2%	0%	-2%	-2%
	Land/Water	0.771	0.547	0.291	0.066	0.344	0.116	0.44	0.068	0.152	0.131	0.576	0.295	0.606	0.446	0.252	0.286	0.272	0.078	0.493	
	HERC-HEAR	2.4	1.1	1.4	1.3	1.1	0	-1.3	0.4	-1	-0.4	-1	-0.1	-0.1	-0.3	-1.2	0.6	4.4	0.8	-1.3	-3.5
	Intensity	17%	8%	12%	10%	8%	0%	-10%	3%	-7%	-3%	-7%	0%	-1%	-2%	-7%	3%	17%	3%	-6%	-14%
	Land/Water	0.996	0.908	0.948	0.871	0.87	0.022	0.838	0.405	0.78	0.221	0.696	0.057	0.082	0.194	0.329	0.236	0.89	0.349	0.323	
HERC-HEAR	2.4	1.2	1.4	1.3	1.3	0	-1.7	0.6	-1.9	-2.3	-1.4	-0.7	-1.1	-3.6	-5.6	-2.1	1	0.6	3.8	3	
Intensity	17%	9%	11%	10%	9%	0%	-13%	4%	-11%	-14%	-7%	-3%	-6%	-20%	-28%	-9%	4%	2%	14%	10%	
Water Only	0.997	0.923	0.9	0.805	0.867	0.015	0.892	0.42	0.812	0.867	0.565	0.364	0.411	0.954							

# Summary for HRD configurations

- Control baseline
  - Track: SS improvements through 30 h for all 3 recon configurations
  - Intensity: SS improvements through 24-30h for all 3 recon configurations
- All recon –vs- standard recon – direct TDR cases only
  - Track: no SS differences – mixture of positive and negative non-SS impacts
  - Intensity: only SS difference at 6 h, but hints of improvements out to 30 h – results mixed for longer lead times

# Overall preliminary conclusions

- Given the cost of outfitting the C-130s with tail Doppler radars and the mixed impacts found in this test, there does not appear to be a compelling argument for recommending this investment
- While standard recon data did result in some SS improvements, particularly for track, results lacked consistency in the lead times that were improved across the regional models tested.
  - Results suggest inner core observations offer promise for improving operational TC guidance, but more work lies ahead to make optimal use of these data.