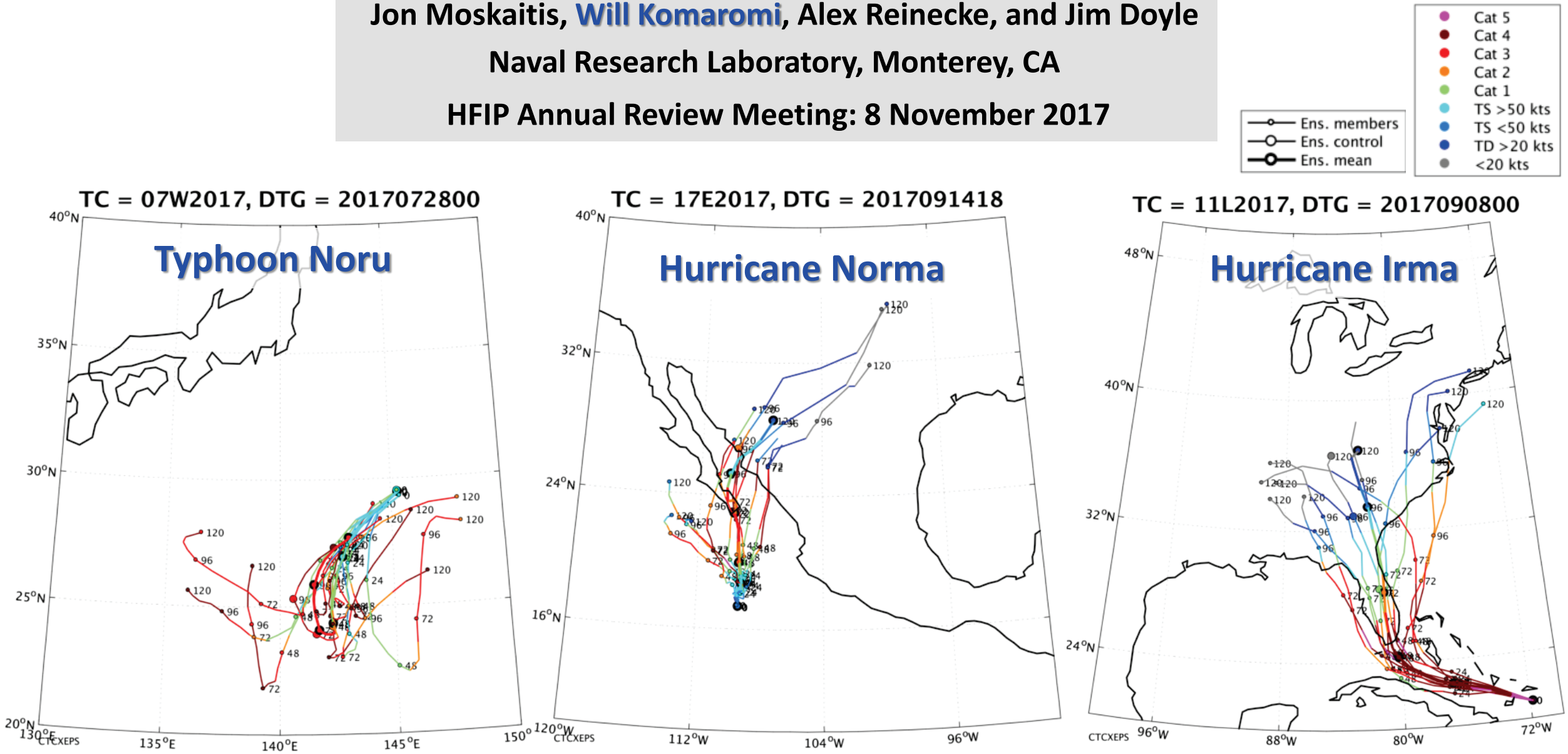
U.S. NAVAL RESEARCH LABORATORY

2017 Real-time COAMPS-TC EPS

Jon Moskaitis, Will Komaromi, Alex Reinecke, and Jim Doyle
Naval Research Laboratory, Monterey, CA

HFIP Annual Review Meeting: 8 November 2017



2017 COAMPS-TC EPS Configuration & Forecast Sample

COAMPS-TC EPS Configuration

- **Same EPS configuration as 2015/2016 real-time ensemble**
- 1 unperturbed control + 10 perturbed members
- Synoptic-scale IC, vortex scale IC, and lateral BC perturbations
- Uncoupled COAMPS-TC with simple SST-cooling parameterization
- 36/12/4 km resolution, same as 2017 ops deterministic COAMPS-TC
- GFS deterministic is "parent model" for control and perturbed members

Real-time Forecast Sample

Atlantic		Cases	Obs RI
05L	Don	2	
06L	Emily	7	
07L	Franklin	16	1
08L	Gert	18	
09L	Harvey	53	1
10L	PTC 10	8	
11L	Irma	49	2
12L	Jose	61	1
13L	Katia	14	1
14L	Lee	17	
15L	Maria	50	1
16L	Nate	16	1
17L	Ophelia	27	
18L	Philippe	9	
		347	8

EastPac		Cases	Obs RI
06E	Fernanda	20	
07E	Greg	34	
08E	TD08	9	
09E	Hilary	26	
10E	Irwin	33	
11E	TD11	5	
12E	Jova	8	
13E	Kenneth	21	1
14E	Lidia	19	
15E	Otis	4	
17E	Norma	2	
18E	Pilar	8	
19E	Ramon	4	
		193	1

WestPac		Cases	Obs RI
07W	Noru	75	2
08W	Sonca	16	
09W	Kulap	15	
10W	Roke	6	
11W	Nesat	16	
12W	Haitang	12	
13W	Nalgae	17	
14W	Banyan	23	1
15W	Hato	14	1
16W	Pakhar	10	
17W	Sanvu	19	1
18W	Mawar	13	
19W	Guchol	10	
20W	Talim	20	1
21W	Doksuri	9	1
23W	TD23	4	
24W	Khanun	16	1
25W	Lan	29	1
26W	TD26	5	
27W	Saola	11	
		340	9

Obs RI = # of observed independent RI events predicted by at least one 0-24 h COAMPS-TC EPS forecast

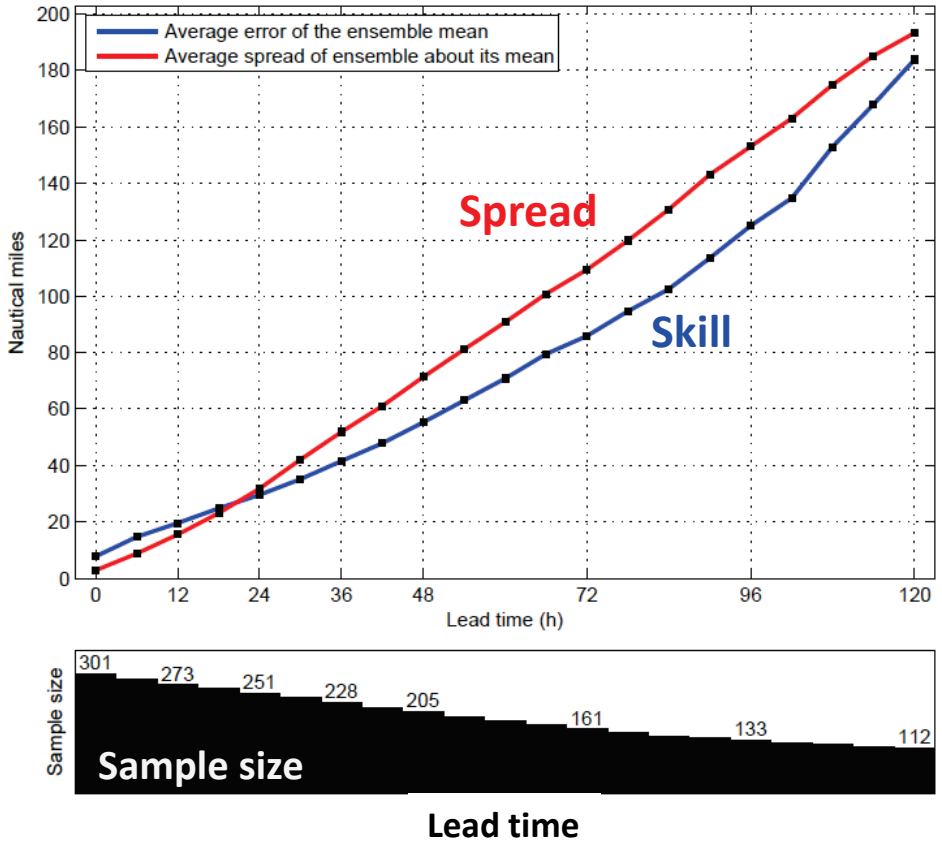
Storm not included here in validation sample

880 real-time forecasts of 46 different TCs, including 18 observed RI events from 16 different TCs

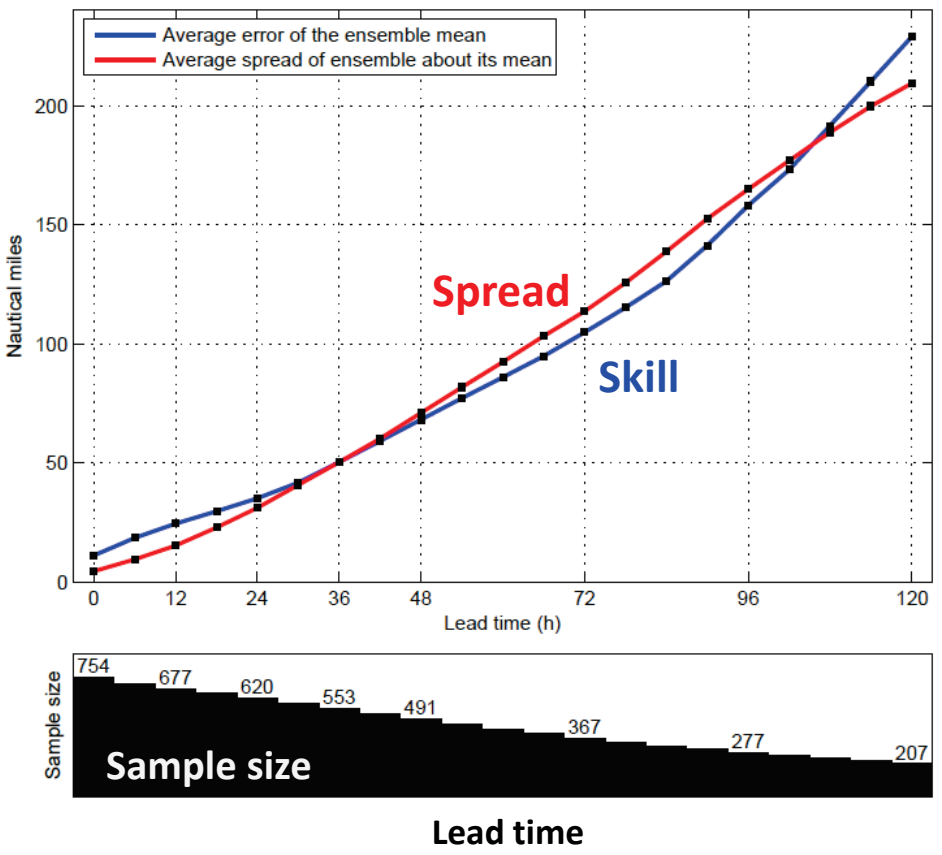
2017 COAMPS-TC EPS Performance

Track: Ensemble mean error vs Ensemble spread

Atlantic

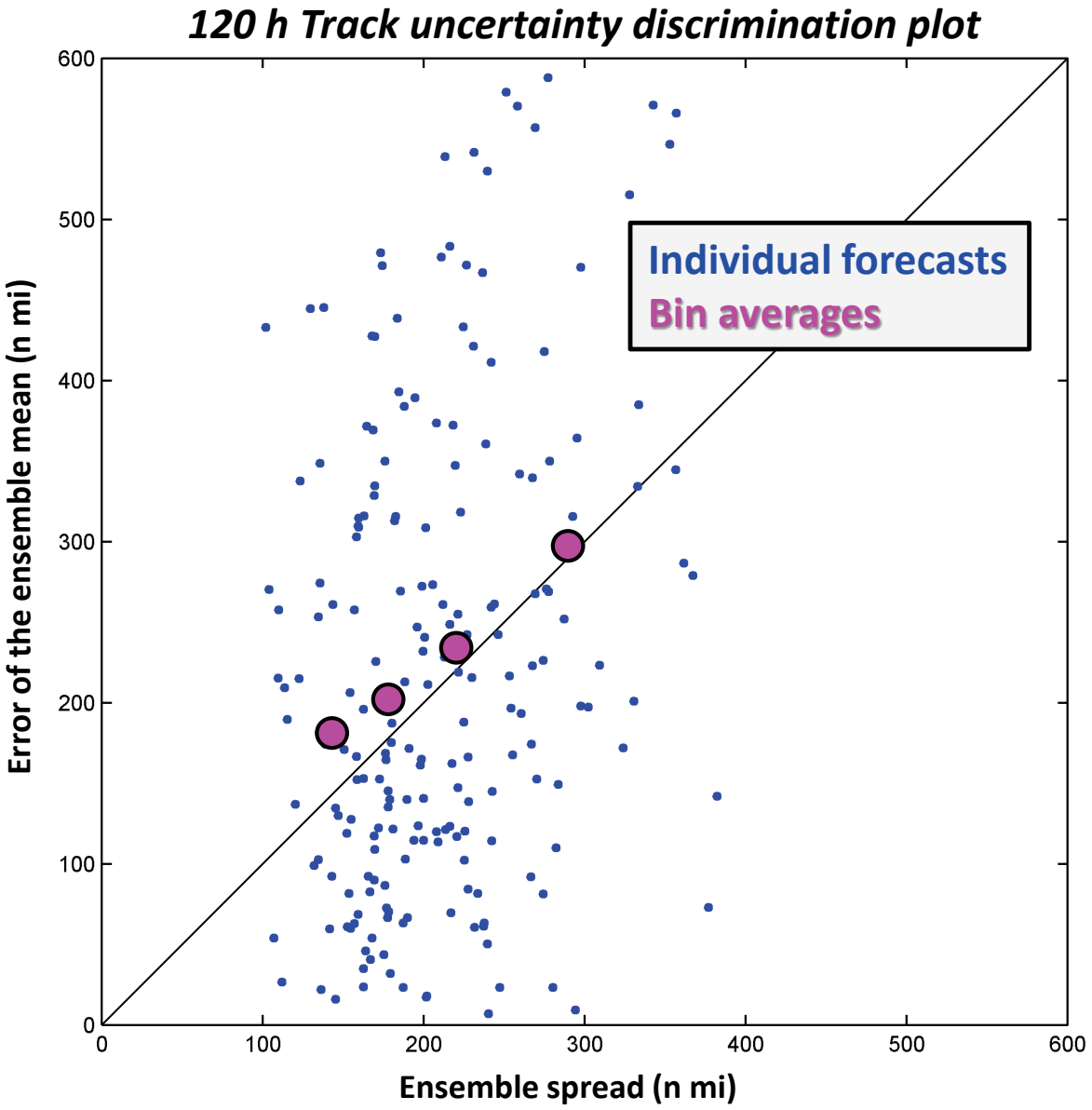


Atlantic, EastPac, and WestPac



Track spread is very well calibrated in the COAMPS-TC EPS for a large sample of cases, consistent with results of previous years

2017 COAMPS-TC EPS Performance



Can the ensemble discriminate between forecast cases with high uncertainty vs. low uncertainty? (i.e. high vs. low expected ensemble mean error)

For track, at least at later lead times, the COAMPS-TC EPS is excellent at discriminating between high and low uncertainty forecast cases

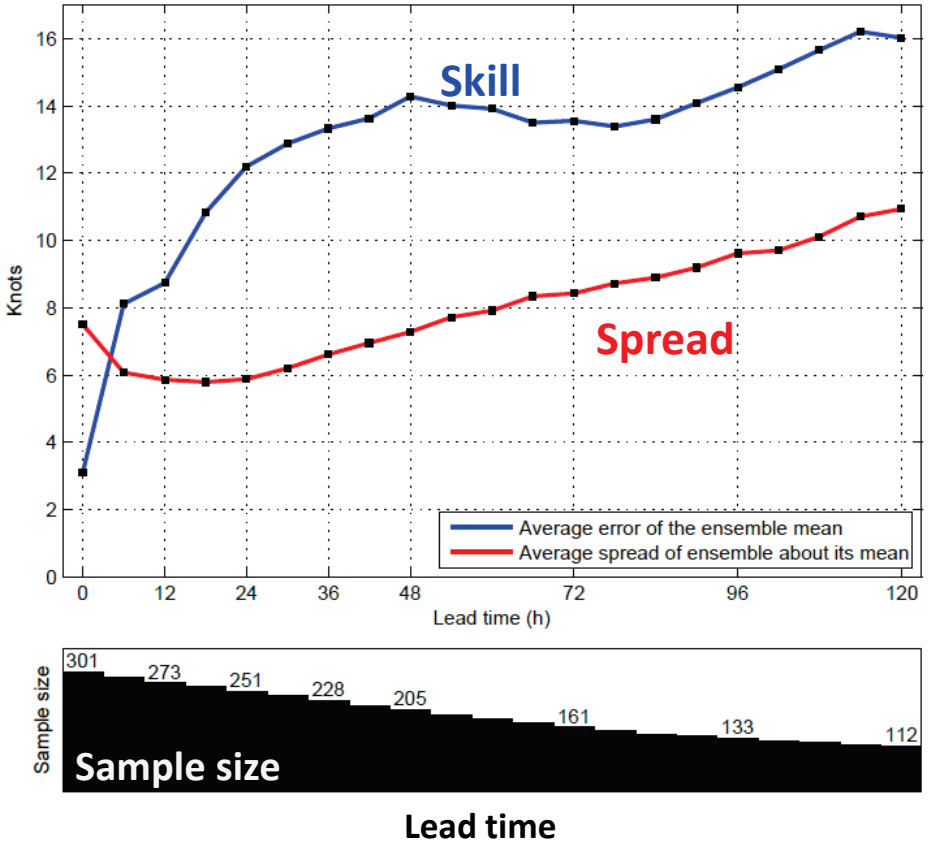
Would like to see red dots increasing from left to right (indicating discrimination), ideally along the diagonal (indicating good spread calibration)

Plot pertains to Atlantic, EastPac & WestPac sample

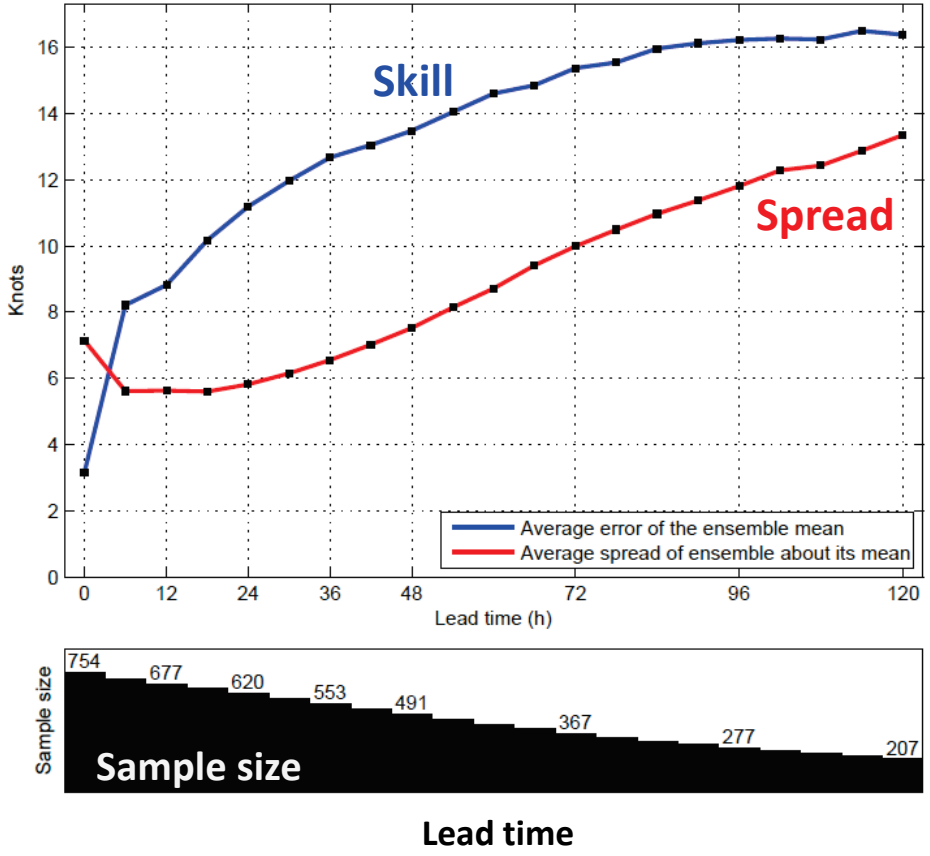
2017 COAMPS-TC EPS Performance

Intensity: Ensemble mean error vs Ensemble spread

Atlantic

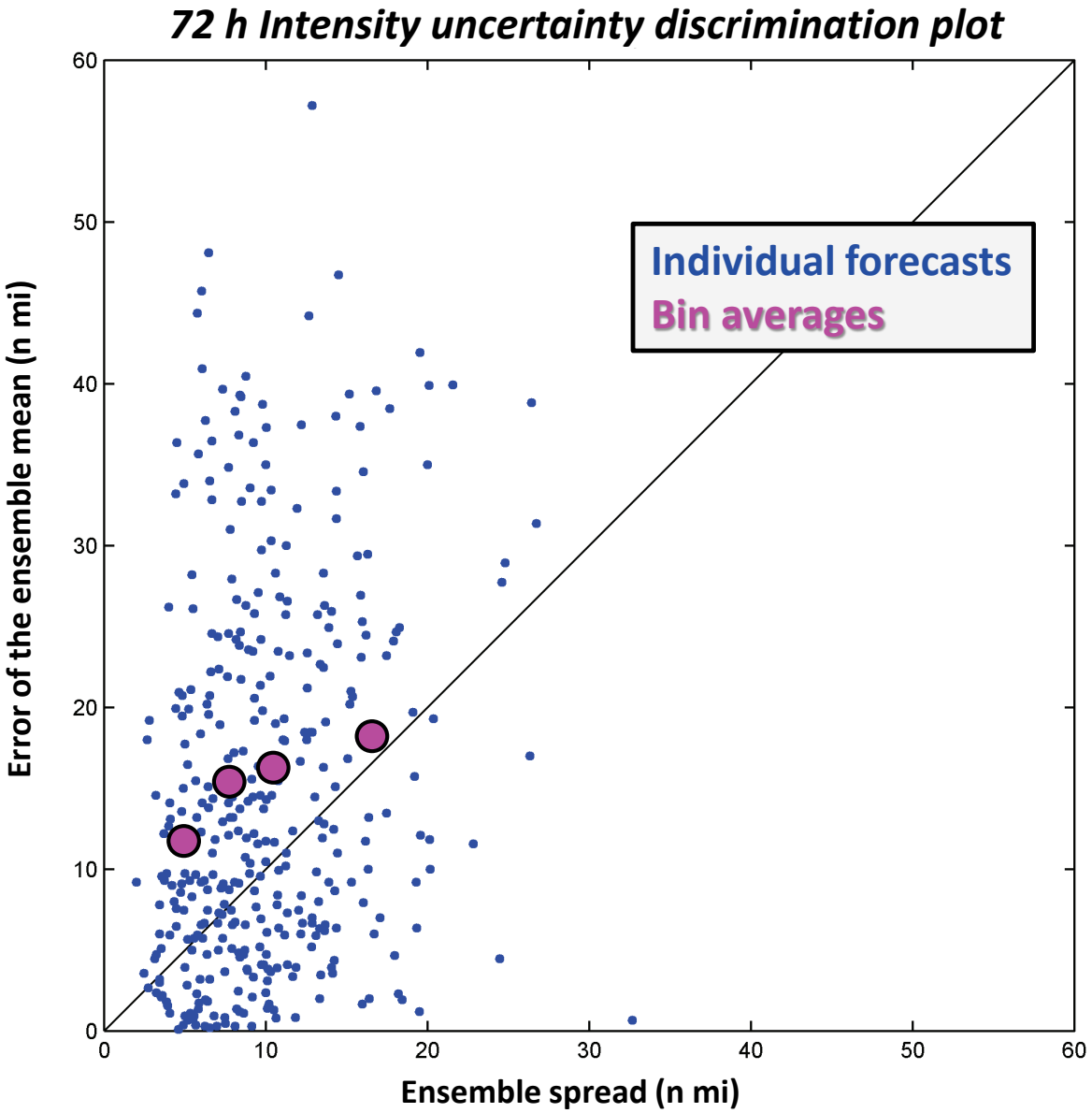


Atlantic, EastPac, and WestPac



The intensity forecasts remain underdispersive. Although spread grows with time after ~24 h, the spread at 24 h is only about 80% of the initial time spread

2017 COAMPS-TC EPS Performance



Can the ensemble discriminate between forecast cases with high uncertainty vs. low uncertainty? (i.e. high vs. low expected ensemble mean error)

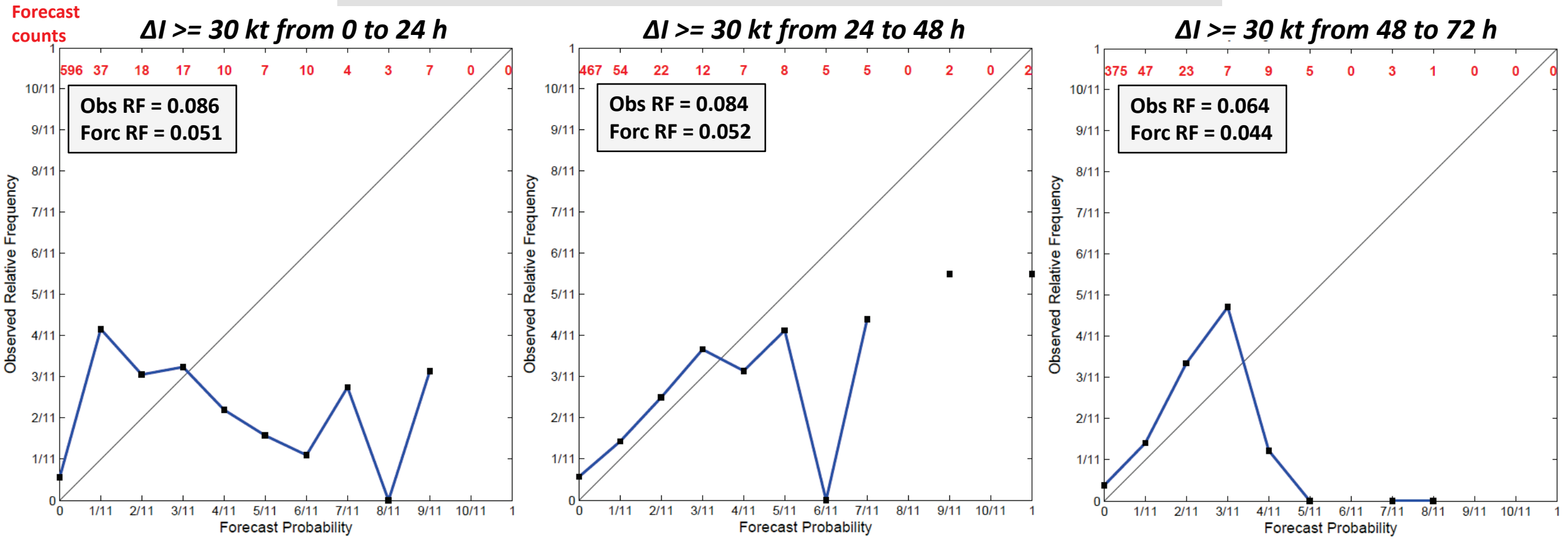
For intensity, discrimination is good for early and middle lead times. However, the spread calibration is poor for all lead times (underdispersive)

Would like to see red dots increasing from left to right (indicating discrimination), ideally along the diagonal (indicating good spread calibration)

Plot pertains to Atlantic, EastPac & WestPac sample

2017 COAMPS-TC EPS Performance

Rapid Intensification Validation: Reliability Diagrams



- The overall rel. freq. at which ensemble members predict RI (~4-5%) is lower than the observed rel. freq (~6-8%)
- 24 – 48 h RI forecasts are reliable for low to mid-range probabilities. 48 to 72 h RI forecasts are reliable for low probabilities. 0 – 24 h forecasts are not reliable, likely due to adjustment of the initial vortex

2017 COAMPS-TC EPS Performance

Rapid Intensification Validation: Examples

Harvey (09L)

CTCX EPS — *Forecast Probability of RI (%)*

Valid time	τ = 0-24 h	τ =24-48 h	τ = 48-72 h	Prob of RI (%)
22/18z	0			0
23/00z	0			9
23/06z	0			18
23/12z				27
23/18z	9	0		36
24/00z	18	18		45
24/06z	82	0		55
24/12z	82			64
24/18z	55	27	18	73
25/00z	9	27	0	82
25/06z	0	36	9	91
25/12z	0	0		100
25/18z	0	0	0	No forecast
26/00z	0	0	0	

RI validated

- Three 0-24 h forecasts had high RI prob. during Harvey's RI event
- Ensemble rarely produces high prob. for beginning portion of RI event

Noru (07W)

CTCX EPS — *Forecast Probability of RI (%)*

Valid time	τ = 0-24 h	τ =24-48 h	τ = 48-72 h	Prob of RI (%)
20/18z	0			0
21/00z	18			9
21/06z	0			18
21/12z	0			27
21/18z	0	9		36
22/00z	0	0		45
22/06z	0	0		55
22/12z	0	9		64
22/18z	0	0	18	73
23/00z	9	45	27	82
23/06z	36	64	18	91
23/12z	73	82	64	100
23/18z	36	18	36	No forecast
24/00z	27	18	36	
24/06z	0	0	0	
24/12z	0	0	0	

RI validated

- Example of uncertainty in RI timing. Prediction of most likely time of RI is after observed RI event in this case.

Nate (16L)

CTCX EPS — *Forecast Probability of RI (%)*

Valid time	τ = 0-24 h	τ =24-48 h	τ = 48-72 h	Prob of RI (%)
04/12z	0			0
04/18z	0			9
05/00z	0			18
05/06z	0			27
05/12z	0	0		36
05/18z	0	9		45
06/00z	0	9		55
06/06z	0	0		64
06/12z	0	0	0	73
06/18z	0	9	9	82
07/00z	0	0	0	91
07/06z	0	0	9	100
07/12z	0	0	9	No forecast

RI validated

- Example of missed RI event. Almost no members predict the observed RI.

U.S. NAVAL RESEARCH LABORATORY

Future Plans

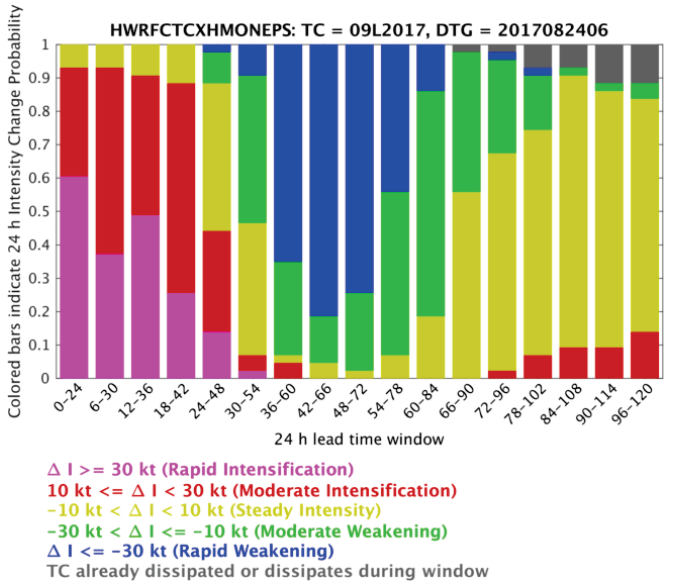
Goal for FY18: Transition COAMPS-TC EPS to FNMOC for operational implementation

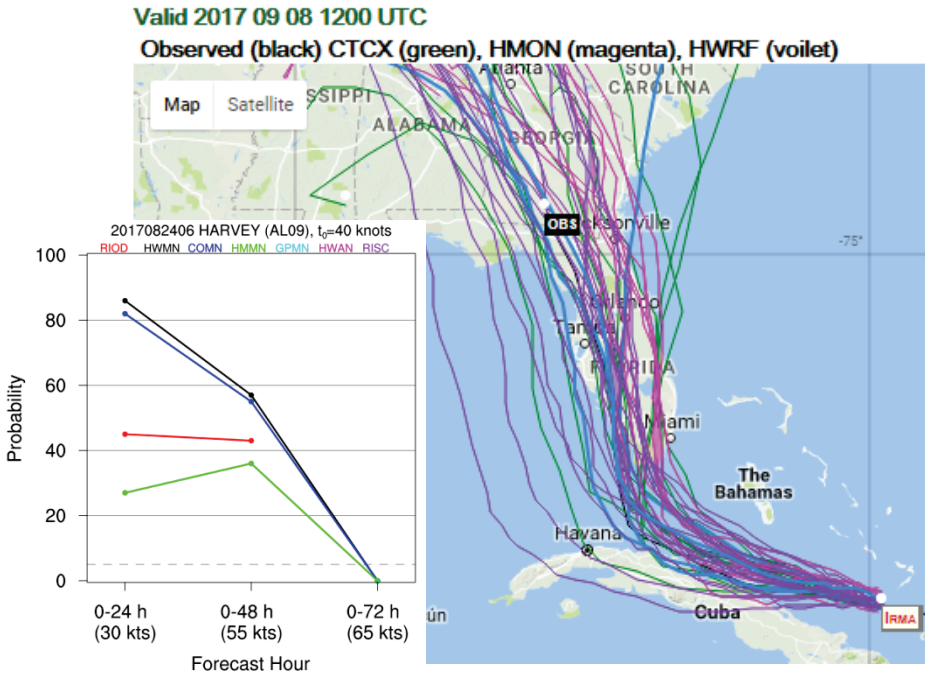
- 11 members, 36/12/4 km resolution, Uncoupled COAMPS-TC (as in 2017 demo)
- Operational configuration will include: Synoptic-scale perturbations from NAVGEM deterministic + correlated noise, and possibly some members GFS deterministic + correlated noise
- Implement measures to improve intensity spread calibration, such as (1) SST perturbations, (2) initial time vortex moisture perturbations, and (3) stochastic physical parameters, e.g. surface drag coefficient

Additional objectives for FY18+:

- Continued product development (e.g. for wind radii), interfacing with JTWC and NHC
- Continued contribution to HFIP multi-model ensemble →

https://www.nrlmry.navy.mil/coamps-web/web/ens





U.S. NAVAL RESEARCH LABORATORY

Extra Slides