FSU Multimodel Ensembles for HFIP

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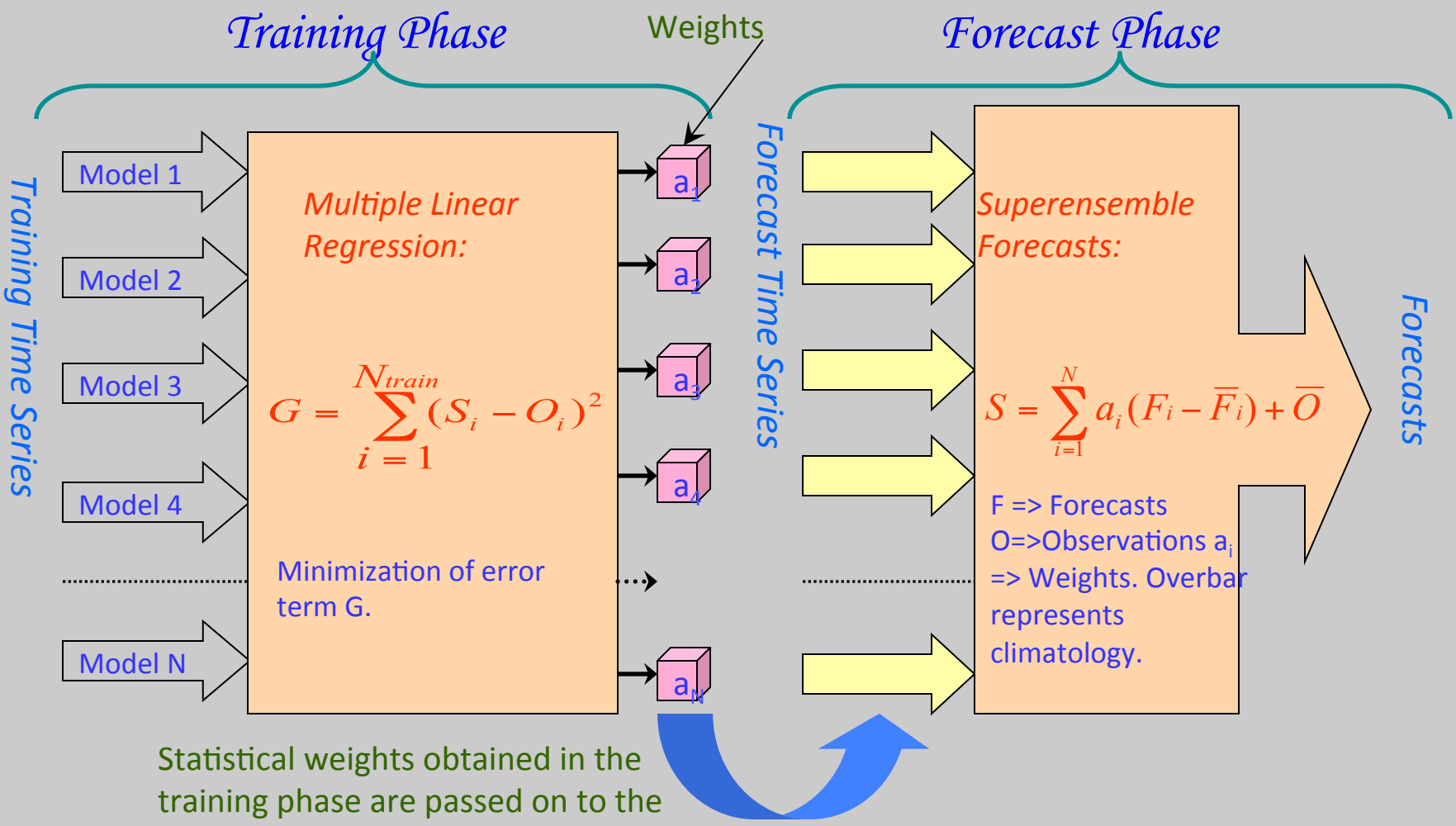
One dimensional Multimodel Superensemble Methodology for Hurricane tracks and intensity



- In addition to removing the bias, the superensemble scales the individual model forecasts contributions according to their relative performance in the training period in a way that, mathematically, is equivalent to weighting them.

- We had noted that roughly 60 forecasts per storm per map time is desirable for stabilizing the weights of the multimodel superensemble. That is always not possible in operations.

Number of Weights

1. Ensemble Mean : A single weight 1/N (where N is the number of member models) is used

Here models with good skill carry same weight as a poor model.

2. Bias removed ensemble mean : The bias removal for x-position, y-position and intensity (from poor forecasts) utilize the equation

$$Q' = Q_F - \overline{Q_F} + \overline{Q_O}$$

This is done for each member model and the ensemble mean of these bias removed model utilizes a weight 1/N. The assumption that a poor model becomes equivalent to a good model after bias removal is weak.

3. In the Multimodel superensemble weights can be positive, negative or fractional as in any statistical regression problem.

The maximum number of weights we utilize are:

Number of models= 11 *times* Number of forecast hours = 7 *times* number of variables (x-position, y-position, intensity) 3 = Total weight 231

An objective method for removing model outliers before the construction of MMEN

Chi-Square statistics is typically employed as a goodness of fit metric for iterative removal of outliers of Model forecast data (Press et al., 1986)

where $$\chi^2 = \sum \left(\frac{d_i - y_i}{\sigma_i} \right)^2$$

chi-squared = the sum of the distances between observation and model, squared, but weighted down by the uncertainties .

The procedure involves finding the slope and intercept using linear regression of the forecast error for each forecast hour. We next perturb the slope and determine the **chi-square of that data set . An iteration procedure finds the best perturbed slope that provides the minimum chi-square.**

Steps involved in the numerical method of finding the best model are:

(1) Perform a linear regression of the forecast against the observed estimate and thus obtain the first estimate of the slope and intercept.
(2) Generate the model **y**.
(3) Calculate chi-square
(4) Perturb the slope and intercept and evaluate **chi-square.**
(5) Repeat until small changes of the parameters no longer reduce the value of chi-square.
(6) From this procedure, determine which parameters provides the smallest value for the chi-square.
(7) With the best estimates of the slope and intercepts generate a new string of model variables.

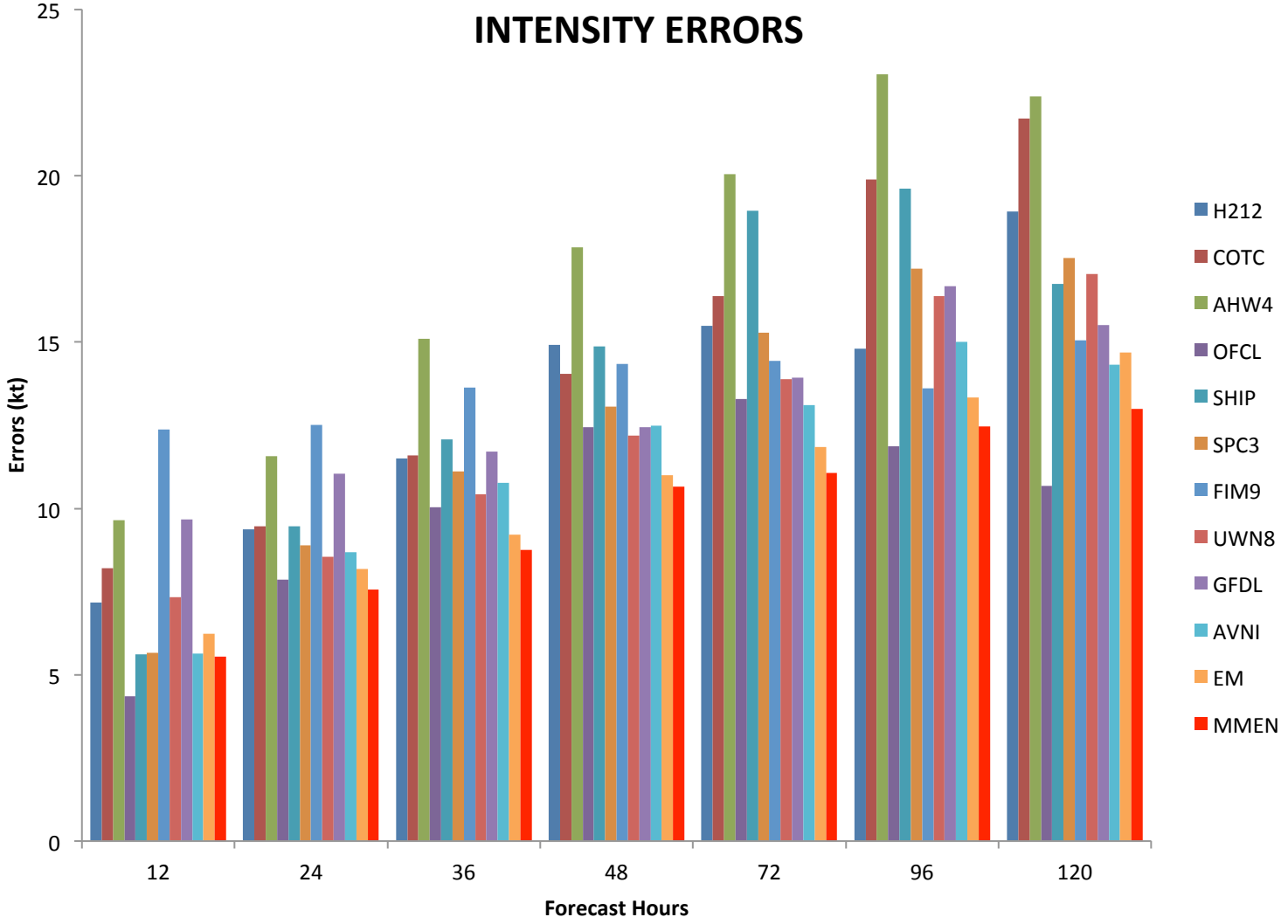
Reference

Press W H, Flannery B P, Teukolsky S A, Vetterling W T 1986 Numerical Recipes: The Art of Scientific Computing. Cambridge University Press: Cambridge, 818.

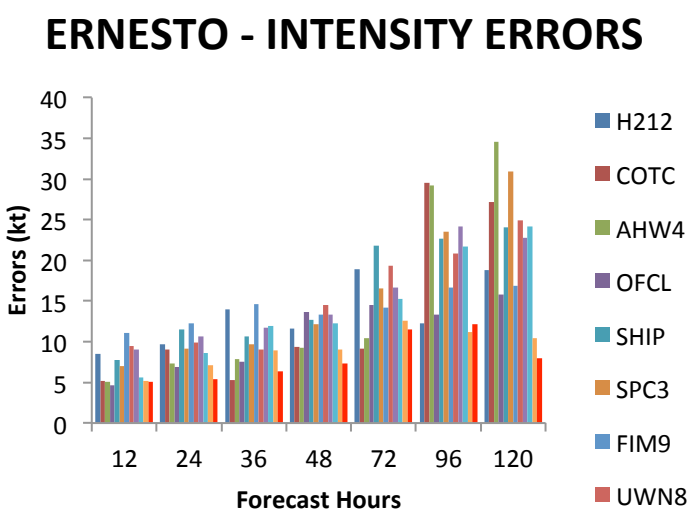
TABLE 1: List of Real time forecast models.

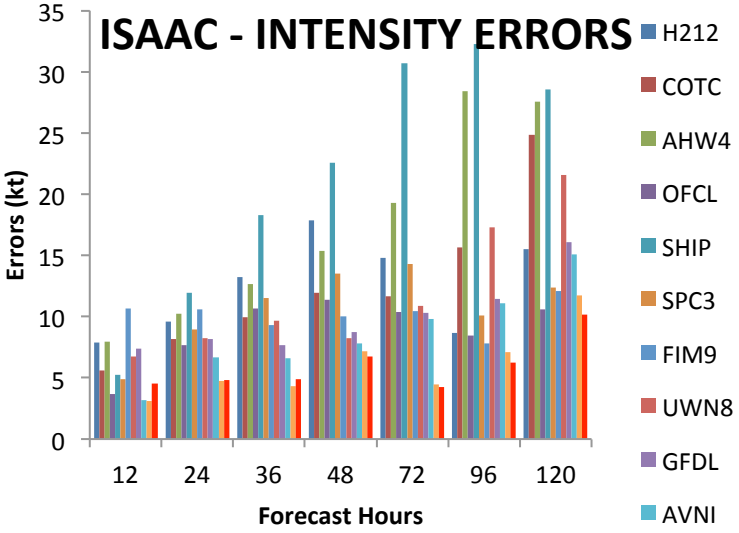
	Model (Track)	Model (Intensity)
1.	HWRF (H212) (M)	HWRF (H212) (M)
2.	COTC (M)	COTC (M)
3.	AHW4 (M)	AHW4 (M)
4.	ARFS (M)	ARFS (M)
5..	SPC3 (S)	SHIPS (S)
6.	FIM9 (L)	SPC3 (S)
7.	UWN8 (M)	UWN8 (M)
8.	GFDL (M)	GFDL (M)
9.	NGPS (L)	FIM9 (L)
10.	ECMF (only for training data from 2011) (L)	NGPS (L)
11.	AVNI (L)	AVNI (L)

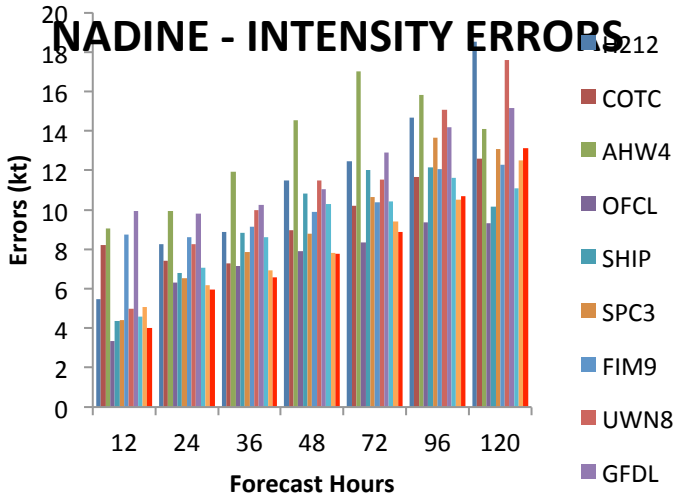
2012 all storms

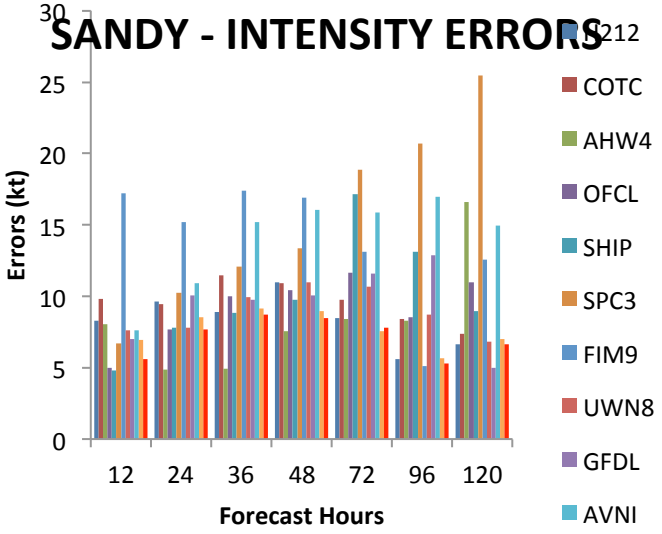


No. of cases	136	135	129	122	113	97	79


ERNESTO - INTENSITY ERRORS
Errors (kt)
0
5
10
15
20
25
30
35
40
12
24
36
48
72
96
120
Forecast Hours
H212
COTC
AHW4
OFCL
SHIP
SPC3
FIM9
UWN8


ISAAC - INTENSITY ERRORS
Errors (kt)
0
5
10
15
20
25
30
35
12
24
36
48
72
96
120
Forecast Hours
H212
COTC
AHW4
OFCL
SHIP
SPC3
FIM9
UWN8
GFDL
AVNI


NADINE - INTENSITY ERRORS
Errors (kt)
0
2
4
6
8
10
12
14
16
18
20
12
24
36
48
72
96
120
Forecast Hours
H212
COTC
AHW4
OFCL
SHIP
SPC3
FIM9
UWN8
GFDL


SANDY - INTENSITY ERRORS
Errors (kt)
0
5
10
15
20
25
30
12
24
36
48
72
96
120
Forecast Hours
H212
COTC
AHW4
OFCL
SHIP
SPC3
FIM9
UWN8
GFDL
AVNI

Examining the consistency of MMEN Intensity forecast errors (kts)(FSU)

Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	8.48	5.14	5.07	**4.61**	**4.91**	6.35	7.7	6.99	11.05	9.48	9.06	5.56	5.18	**5.03**	14
24	9.7	9.06	7.37	**6.91**	**6.68**	8.56	11.55	9.11	12.26	9.9	10.6	8.63	7.07	**5.4**	14
36	13.97	**5.24**	7.9	7.49	**6.74**	10.21	10.6	9.7	14.59	9.09	11.67	11.98	8.91	**6.41**	13
48	11.65	9.35	9.26	13.61	**8.89**	13.48	12.64	12.12	13.31	14.47	13.31	12.31	**9.02**	**7.37**	12
72	18.88	**9.17**	**10.44**	14.52	**9.07**	17.8	21.79	16.54	14.16	19.34	16.7	15.22	12.58	11.48	11
96	**12.28**	29.57	29.17	13.31	14.26	23.56	22.66	23.56	16.67	20.82	24.18	21.66	**11.2**	**12.11**	10
120	18.82	27.15	34.6	15.8	**10.23**	27.66	24.1	30.94	16.83	24.95	22.76	24.12	**10.48**	**7.92**	7

ERNESTO

Id	H212	COTC	AHW4	OFCL	ICON	LGEM	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	7.92	5.59	7.99	**3.66**	4.86	5.59	5.26	4.92	10.65	6.72	7.39	**3.19**	**3.08**	4.56	15
24	9.58	8.19	10.25	7.65	7.19	9.18	11.98	8.98	10.58	8.25	8.19	**6.65**	**4.74**	**4.84**	15
36	13.24	9.92	12.64	10.65	7.12	11.45	18.3	11.51	9.32	9.65	7.65	**6.59**	**4.33**	**4.9**	15
48	17.9	11.98	15.4	11.41	9.63	14.83	22.6	13.55	10.05	8.27	8.77	**7.84**	**7.2**	**6.74**	14
72	14.81	11.65	19.3	10.4	**9.4**	16.14	30.69	14.31	10.48	10.9	10.31	9.82	**4.44**	**4.27**	12
96	8.68	15.67	28.45	8.48	**6.77**	9.88	32.24	10.08	7.79	17.27	11.48	11.08	**7.07**	**6.23**	10
120	15.53	24.83	27.58	**10.61**	**10.69**	11.35	28.57	12.35	12.1	21.59	16.1	15.1	11.76	**10.15**	8

ISSAC

Id	H212	COTC	AHW4	OFCL	ICON	LGEM	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	5.45	8.22	9.06	**3.33**	**3.79**	4.31	4.38	4.39	8.76	4.97	9.93	4.57	5.08	**4**	41
24	8.26	7.41	9.96	**6.3**	6.35	6.86	6.79	6.53	8.63	8.24	9.81	7.06	**6.17**	***5.97***	40
36	8.88	7.29	11.92	**7.15**	7.85	8.88	8.83	7.85	9.16	9.98	10.26	8.62	**6.92**	**6.57**	39
48	11.51	8.95	14.55	**7.9**	8.07	9.88	10.82	8.78	9.9	11.49	11.03	10.28	**7.81**	**7.79**	38
72	12.48	10.21	17.03	**8.37**	**9.19**	10.76	12.03	10.65	10.37	11.52	12.89	10.41	9.41	**8.86**	36
96	14.68	11.65	15.84	**9.36**	12.34	12.33	12.15	13.68	12.07	15.09	14.21	11.62	**10.5**	**10.7**	34
120	18.53	12.6	14.11	**9.32**	11.65	11.32	**10.17**	13.08	12.29	17.62	15.18	**11.08**	12.5	13.12	32

NADINE

SANDY

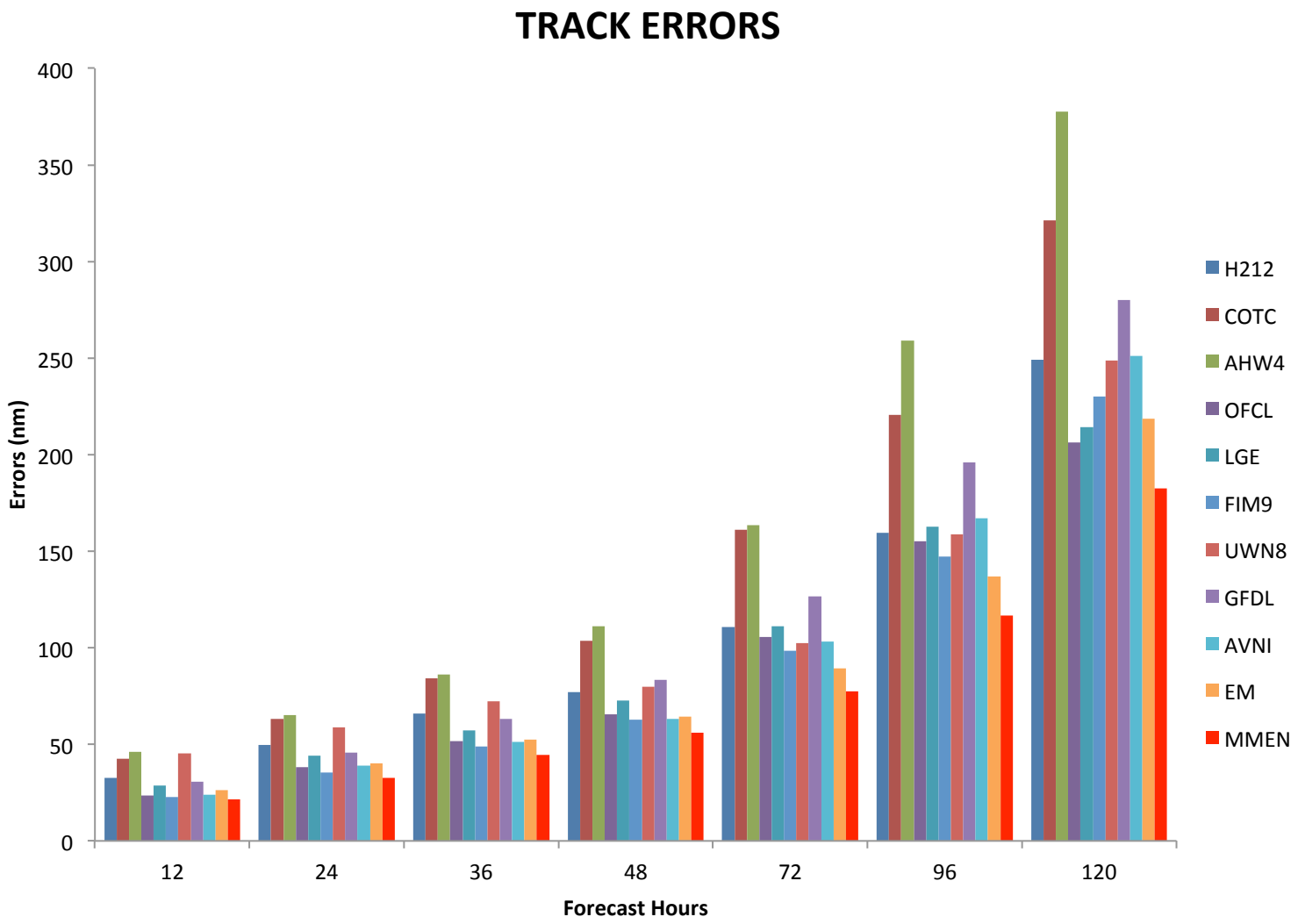
Id	H212	COTC	AHW4	OFCL	ICON	LGEM	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	8.27	9.83	8.06	**4.99**	5.78	6.7	**4.78**	6.7	17.2	7.63	6.99	7.63	6.97	**5.6**	13
24	9.63	9.44	**4.84**	**7.68**	8.56	11.05	7.77	10.27	15.2	7.77	10.05	10.91	8.53	**7.67**	13
36	8.91	11.48	**4.91**	9.98	9.52	13.51	**8.83**	12.06	17.39	9.91	9.75	15.2	9.14	**8.7**	12
48	10.98	10.89	**7.53**	10.44	11.23	15.8	9.73	13.39	16.88	10.98	10.07	16.05	**8.95**	**8.46**	11
72	8.48	9.76	**8.43**	11.65	12.08	23.26	17.17	18.87	13.09	10.68	11.58	15.87	**7.57**	**7.8**	9
96	**5.61**	8.41	8.27	8.56	10.61	24.21	13.1	20.71	**5.13**	8.73	12.85	16.97	5.65	**5.29**	7
120	**6.65**	7.39	16.57	10.98	15.64	28.95	8.98	25.45	12.58	**6.82**	**4.99**	14.97	6.99	**6.65**	5

KIRK

Id	H212	COTC	AHW4	OFCL	ICON	LGEM	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	9.55	**5.56**	9.41	**7.84**	10.27	7.84	9.41	9.84	16.54	8.27	10.41	**6.84**	8.23	**7.84**	7
24	15.26	**13.26**	14.12	13.55	18.97	13.69	15.69	16.54	18.11	**11.69**	19.96	**12.69**	16.08	16.02	7
36	20.96	24.46	23.46	19.13	22.76	**18.13**	19.96	20.13	22.29	**17.14**	23.12	**15.8**	20.88	21.16	6
48	30.35	24.95	30.35	20.96	**20.71**	21.16	23.76	21.56	23.36	**18.17**	25.95	**18.37**	23.96	24.17	5
72	25.7	26.45	36.43	19.96	19.96	13.48	16.47	**14.72**	**10.73**	27.45	18.97	**11.73**	18.97	18.74	4
96	22.46	16.97	27.45	12.48	18.97	23.96	20.46	21.46	**5.99**	24.46	**11.98**	13.48	13.35	**10.49**	2

OVERALL

Id	H212	COTC	AHW4	OFCL	ICON	LGEM	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Cases
12	7.18	8.21	9.65	**4.36**	**5.5**	**5.57**	5.61	5.67	12.36	7.34	9.66	5.64	6.24	**5.54**	136
24	9.38	9.47	11.57	**7.85**	**8.11**	8.81	9.46	8.89	12.51	8.54	11.04	8.68	8.19	**7.55**	135
36	11.49	11.6	15.09	10.03	**9.47**	11.31	12.08	11.11	13.63	10.42	11.71	10.76	**9.21**	**8.76**	129
48	14.92	14.04	17.84	12.43	**10.97**	13.92	14.86	13.05	14.35	12.19	12.44	12.48	**10.99**	**10.66**	122
72	15.49	16.39	20.04	13.29	**11.9**	16.36	18.95	15.27	14.44	13.89	13.93	13.1	**11.84**	**11.06**	113
96	14.8	19.89	23.04	**11.87**	**12.7**	18.08	19.6	17.21	13.61	16.39	16.68	15.01	13.33	**12.47**	97
120	18.92	21.71	22.38	**10.67**	**11.77**	16.54	16.75	17.52	15.04	17.05	15.52	14.32	14.69	**12.99**	79


TRACK ERRORS
Errors (nm)
400
350
300
250
200
150
100
50
0
12
24
36
48
72
96
120
Forecast Hours
H212
COTC
AHW4
OFCL
LGE
FIM9
UWN8
GFDL
AVNI
EM
MMEN

Examining the consistency of MMEN Track forecast (FSU)

Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	39.05	44.52	54.86	29.88	49.95	33.06	**26.59**	61.83	35.87	29.72	34.68	**28.82**	14
24	60.34	78.61	98.29	58.02	79.83	48.96	**40.11**	93.71	50.35	50.77	53.88	**41.39**	14
36	78.88	104.78	125.82	68.66	100.3	55.59	**52.61**	90	73.58	65.88	64.73	**53.18**	13
48	88.64	121.94	145.66	79.18	120.2	77.69	81.27	95.29	91.45	82.21	**76.14**	**69.01**	12
72	116.89	174.63	201.35	99.22	146.66	120.79	113.11	111.27	135.4	113.66	**94.1**	**48.35**	11
96	154.4	226.22	294.92	**143.2**	212.43	198.67	174.35	152.03	214.47	180.53	144.75	**103.13**	10
120	279.58	332.31	343.2	**196**	276.29	248.77	261.85	238.63	364.2	228.75	248.08	**169.54**	7

ERNESTO

Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	44.45	50.98	57.77	35.5	37.67	42.31	**25.94**	64.17	37.47	30.48	32.53	**28.75**	21
24	63.98	66.53	72.08	42.9	49.12	54.62	**39.08**	73.82	50.63	44.94	44.49	**41.76**	21
36	72.45	95.17	82.82	51.22	59.29	61.21	**48.34**	91.53	61.84	54.29	54.53	**46.24**	21
48	71.1	120.69	105.41	62.5	69.21	80.52	**52.5**	102.62	71.56	66.7	60.6	**50.28**	20
72	88.81	204.79	189.07	83.76	98.09	107.09	**59.96**	110.43	110.26	89.7	72.52	**55.56**	18
96	128.62	290.08	344.12	144.21	157.71	138.92	**94.19**	171.14	170.25	132.03	139.57	**81.63**	16
120	215.69	491.5	620.93	210.36	222.2	194.99	**157.01**	262.28	258.58	195.14	260.93	**170**	13

SANDY

Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	28.53	58.11	71.35	**23.26**	31.68	43.6	29.92	59.32	34.76	30.99	30.14	**21.85**	7
24	**48.5**	107.35	112.77	51.13	55.63	261.69	57.05	94.74	69.1	58.06	59.7	**42.76**	7
36	**67.77**	141.33	146.92	74.19	82.71	260.52	82.06	121.98	102.99	72.8	81.33	**63.95**	6
48	77.06	122.31	182.92	96.44	109.27	261.9	90.06	124.85	112.63	68.68	82.75	**68.49**	5
72	**153.39**	210.12	335.23	204.19	236.2	296.14	180.29	203.47	164.28	158.41	155.83	**133**	4
96	**154.44**	402.45	576.09	473.78	539.26	504.8	210.52	217.68	226.76	287.84	196.89	**147**	2

KIRK

NADINE

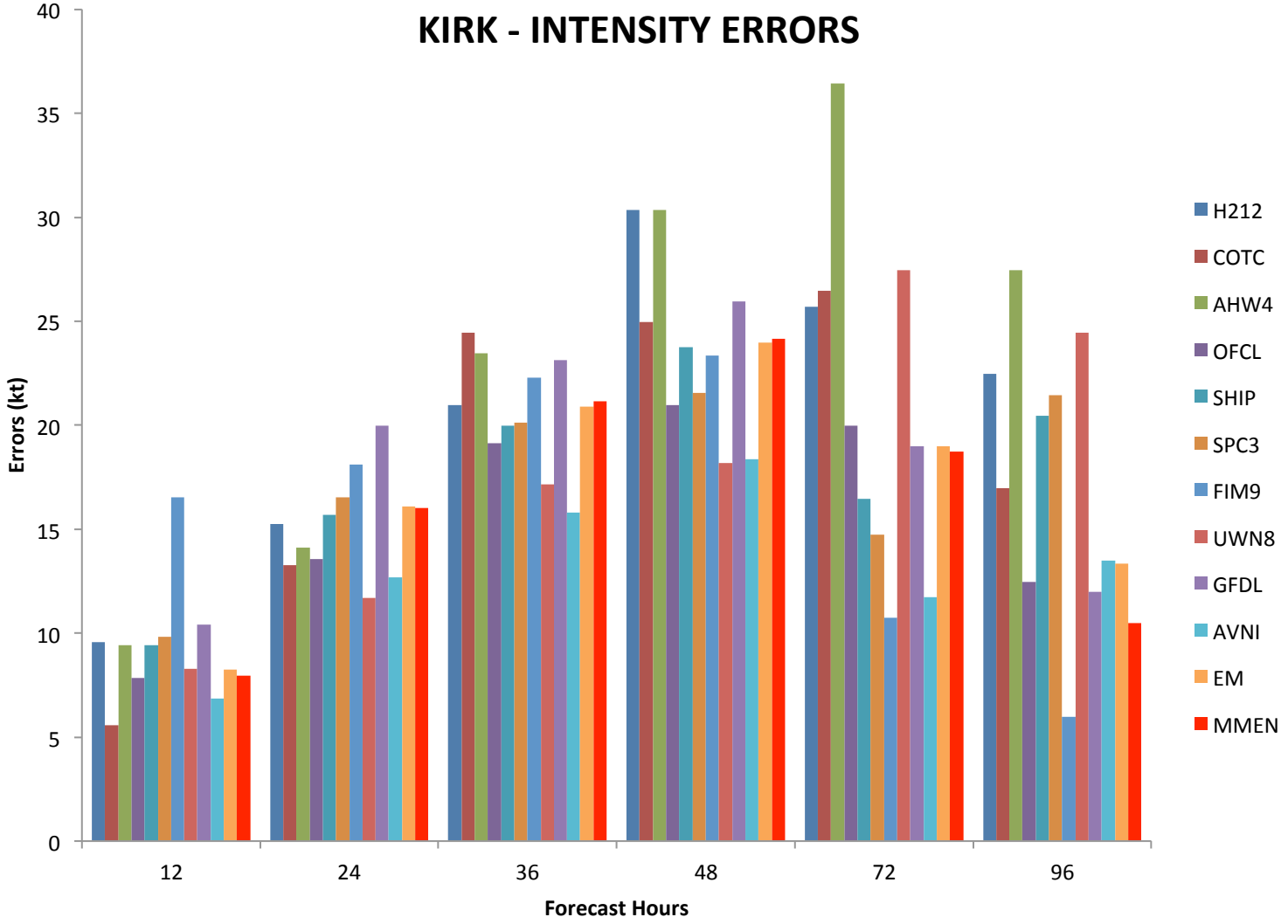
Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	26.84	39.55	30.02	20.66	27.82	28.45	19.79	37.77	27.01	**19.57**	21.32	**19**	40
24	42.82	53.04	43.57	36.87	45.46	46.91	**30.11**	53.21	41.6	34.64	33.74	**29.63**	39
36	57.84	69.74	72.37	52.55	60.87	64.67	**48.88**	70.56	68.21	51.29	50.27	**45.03**	38
48	75.54	100	104.88	67.93	77.69	90.95	67.44	83.07	101.85	**67.28**	70.26	**63.9**	37
72	115.93	190.49	167.1	115.73	120	157.91	115.65	**104.21**	178.75	113.14	106.37	**98.84**	35
96	198.92	283.32	301.48	**175.39**	175.59	230.8	190.01	176.21	304.55	195.95	184.64	**170**	33
120	294.2	356.83	440.97	**237.1**	**244.46**	306.84	291.77	291.25	405.31	323.32	286.92	256	32

SANDY

Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	43.22	37	57.74	21.26	24.4	235.94	**18.3**	38.06	29.05	26.89	23.77	**19.04**	13
24	60.16	54.37	73.63	**27.86**	32.24	238.21	29.28	40.03	36.35	36.83	33.43	**25.96**	13
36	68.44	72.27	77.01	**34.69**	**33.06**	251.6	43.98	49.91	52.15	47.85	**39.71**	41.07	12
48	70.7	79.39	102.09	**39.57**	48.07	270.02	56.4	54.25	59.36	51.86	40.58	**38.32**	11
72	71.55	72.93	67.12	57.83	72.28	337.01	75.82	59.74	74.8	68.7	**42.11**	49.81	9
96	165.67	100.94	90.82	92.63	113.75	466.35	111.92	96.07	101.72	142.4	**88.08**	**75.6**	7
120	285.88	182.25	159.81	151.96	185.48	690.49	186.78	192.04	**120.43**	246.07	182.71	**97.23**	5

OVERALL

Id	H212	COTC	AHW4	OFCL	LGE	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN	Case
12	32.65	42.43	46.24	23.48	28.84	53.83	**22.6**	45.46	30.6	23.86	26.31	**21.45**	137
24	49.76	63.01	65.21	38.13	44.12	80.08	**35.49**	58.76	45.64	38.83	40.15	**32.8**	136
36	65.74	84.29	86.06	51.76	57.03	91.79	**48.78**	72.21	62.97	51.18	52.28	**44.63**	129
48	77.22	103.49	111.15	65.68	72.71	112.25	**62.96**	79.99	83.55	63.13	64.21	**56.06**	121
72	110.76	161.08	163.44	105.44	111.16	155.32	98.26	102.5	126.71	103.36	**89.27**	**77.46**	108
96	159.54	220.57	259.15	155.08	162.74	213.36	147.29	158.65	195.88	167.05	**136.96**	**116.72**	91
120	249.08	321.09	377.76	**206.49**	214.25	281.9	230.28	248.72	279.94	251.09	218.76	**182.35**	73


KIRK - INTENSITY ERRORS
Errors (kt)
0
5
10
15
20
25
30
35
40
12
24
36
48
72
96
Forecast Hours
H212
COTC
AHW4
OFCL
SHIP
SPC3
FIM9
UWN8
GFDL
AVNI
EM
MMEN

Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN
12	3.99	8.98	21.96	4.99	3.99	**2**	3.99	4.99	7.99	15.97	**1.5**	3.99	**1.2**	3.25
24	**2**	25.95	28.95	14.97	11.98	9.98	13.97	13.97	**2.99**	28.95	5.99	13.97	7.73	11.72
36	4.99	37.93	33.94	14.97	14.97	13.97	17.97	17.97	5.99	29.95	17.97	12.98	16.72	18.63

Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN
12	17.97	**0**	**2**	19.96	19.96	20.96	21.96	20.96	22.96	18.97	**2**	12.98	2.75	3.5
24	34.94	21.96	21.96	24.95	25.95	25.95	28.95	28.95	**4.99**	24.95	**12.98**	18.97	**16.22**	20.2
36	37.93	27.95	28.95	29.95	31.94	29.95	38.93	34.94	**3.99**	31.94	27.95	27.95	**24.46**	**26.36**
48	35.94	40.93	38.93	29.95	32.94	28.95	40.93	34.94	**11.98**	34.94	**24.95**	33.94	**28.45**	29.1

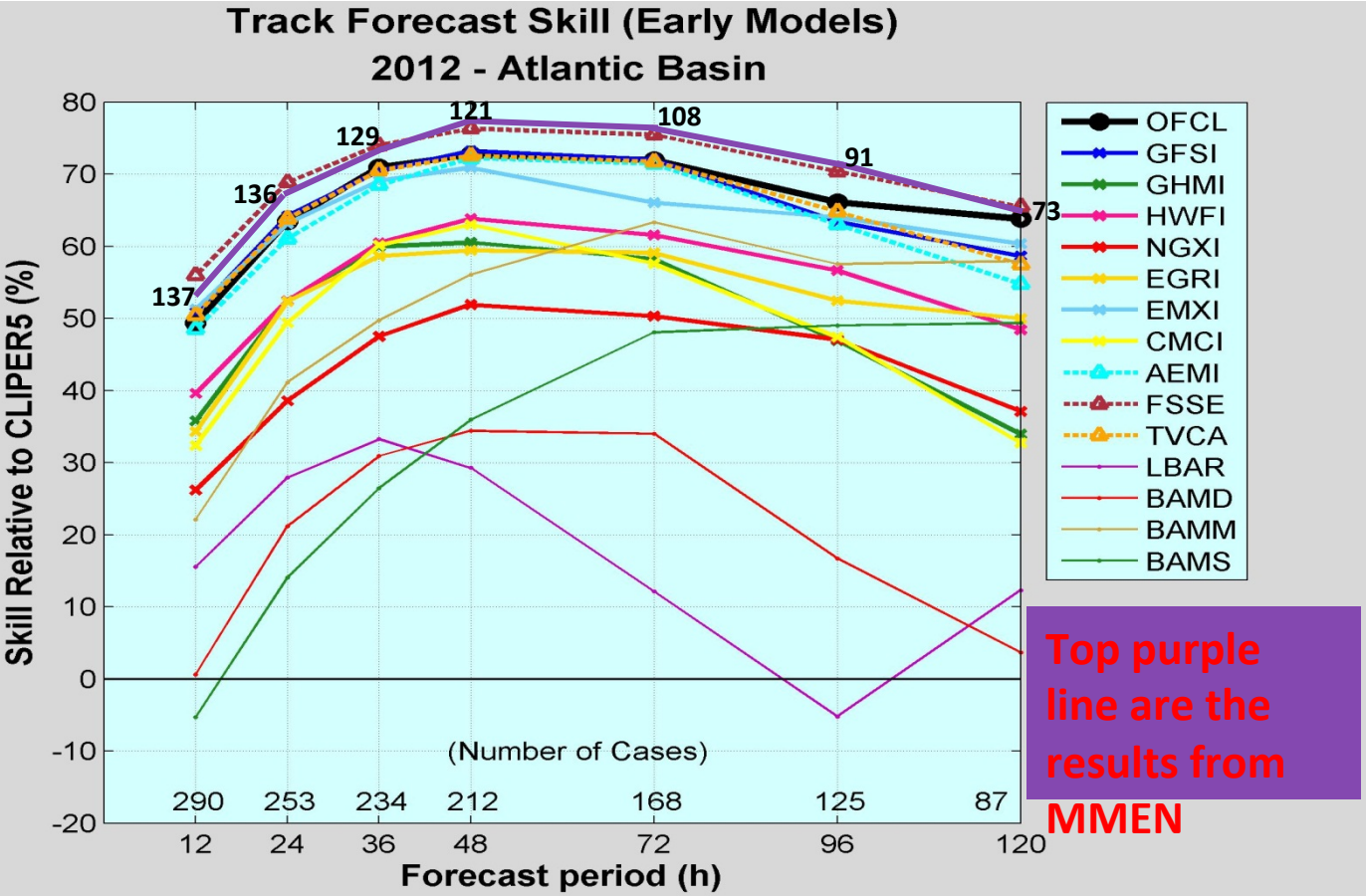
Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN
12	**3.99**	13.97	**2**	9.98	13.97	12.98	13.97	15.97	37.93	**3.99**	18.97	15.97	18.71	14.47
24	4.99	**3.99**	**2.99**	9.98	12.98	12.98	12.98	16.97	31.94	**1.25**	15.97	17.97	14.23	10.24
36	17.97	16.97	20.96	9.98	4.99	**3.99**	**3.99**	**3.99**	19.96	16.97	**3.2**	4.2	3.25	5.15
48	28.95	23.96	29.95	19.96	15.97	12.98	15.97	11.98	**4.99**	24.95	**7.99**	**9.98**	13.97	14.63
72	36.93	22.96	41.92	29.95	28.95	22.96	31.94	24.95	**8.98**	38.93	27.95	**18.97**	24.21	**22.59**

Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN
12	10.98	**2**	**4.99**	**4.99**	9.98	8.98	9.98	8.98	14.97	**5.99**	20.96	**5.99**	12.23	7.98
24	18.97	23.96	**8.98**	19.96	24.95	22.96	20.96	19.96	25.95	**4.99**	36.93	**12.98**	26.45	22.47
36	32.94	27.95	**20.96**	29.95	37.93	34.94	32.94	32.94	41.92	**8.98**	47.91	**23.96**	37.68	35.78
48	25.95	**11.98**	**4.99**	29.95	32.94	35.94	33.94	32.94	39.93	**1**	41.92	26.95	29.95	29.3
72	23.96	16.97	39.93	4.99	4.99	**0**	**1**	**2**	4.99	21.96	6.99	3.99	7.24	5.62
96	37.93	33.94	47.91	19.96	18.97	23.96	22.96	21.96	**7.99**	24.95	**12.98**	**11.98**	23.21	19.94

Id	H212	COTC	AHW4	OFCL	ICON	LGE	SHIP	SPC3	FIM9	UWN8	GFDL	AVNI	EM	MMEN
12	9.98	2	3.99	**0**	2.99	2	**1**	2	8.98	2.99	16.97	**0**	9.48	5.23
24	12.98	6.99	5.99	**0**	-99.9	**0**	1	2.99	17.97	2	23.96	**0**	15.48	11.49
36	20.96	27.95	30.94	**9.98**	-99.9	11.98	10.98	14.97	28.95	13.97	23.96	**8.98**	25.46	23.55
48	40.93	39.93	51.91	24.95	-99.9	23.96	23.96	26.95	42.92	**9.98**	47.91	**18.97**	42.92	42.28
72	**2.99**	32.94	24.95	14.97	-99.9	**5.99**	**5.99**	8.98	23.96	12.98	**5.99**	**2.99**	16.47	18.08
96	6.99	**0**	6.99	4.99	-99.9	23.96	17.97	20.96	3.99	23.96	10.98	14.97	**3.5**	**0.23**

KIRK (absolute intensity errors in kts) all intensity forecasts for all models

2012 Preliminary Verifications

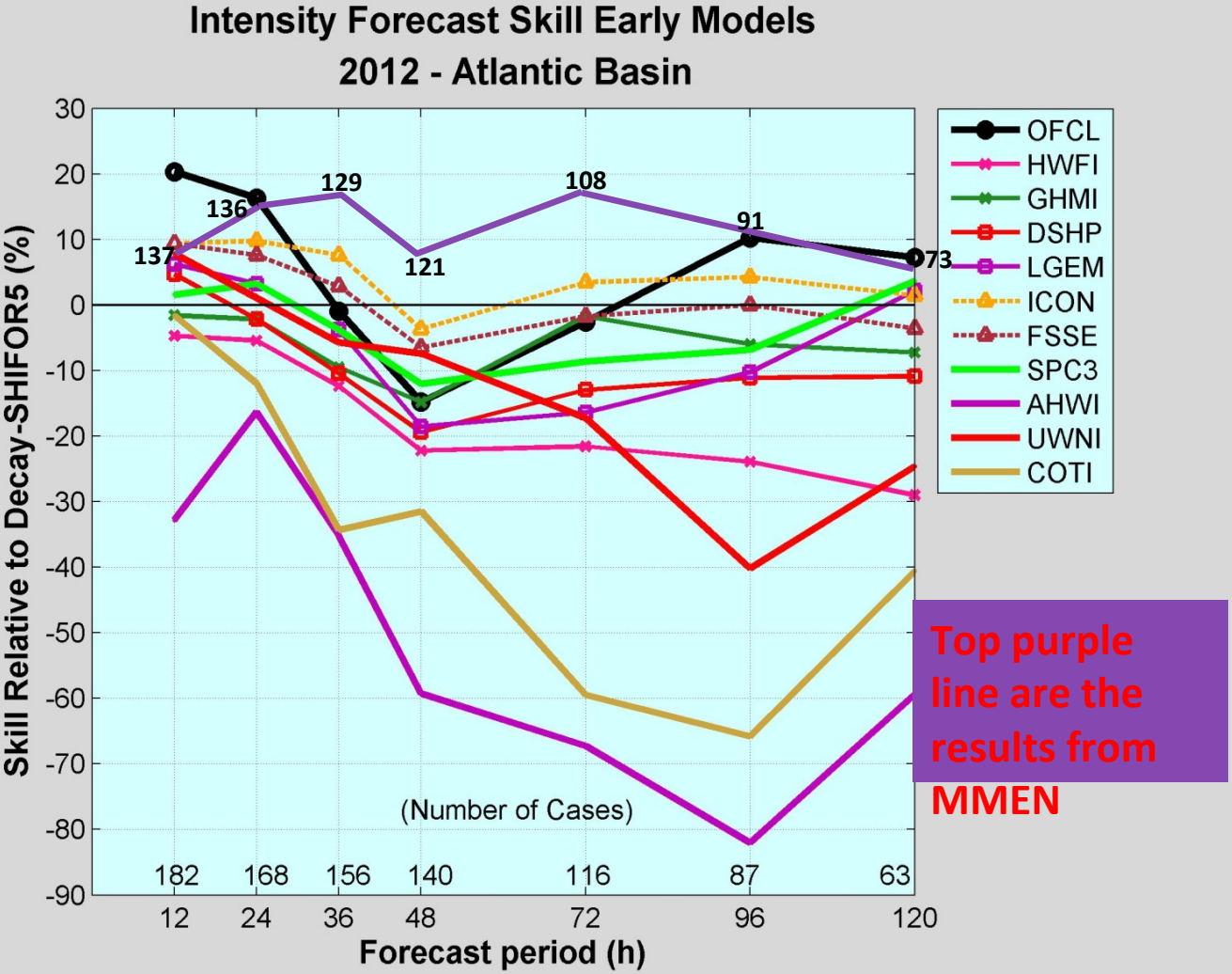


Among the operational dynamical models, GFS was the best performer, with ECMWF close behind.

Second tier comprises the regional models, CMC and UKMET. NOGAPS trails. BAMM beat the more sophisticated members of this group at longer ranges.

FSU Superensemble best consensus model.

2012 Preliminary Verifications



A4PI (radar) omitted due to sample size.

UWNI, COTI were poor performers and much worse than all of the operational models.

SPC3 beat DSHP and LGEM but still had little skill.

SUMMARY

WE ARE A STREAM 2 FORECAST TEAM FROM FSU.

WE USE A SUITE OF MOSTLY MESOSCALE AND A FEW GLOBAL MODELS IN OUR SUPERENSEMBLE SUITE.

ON THE WHOLE WE ARE VERY SATISFIED WITH THE PERFORMANCE FOR THE HURRICANE FORECASTS FOR 2012 .

THE FORECAST SUMMARY FOR TRACK AND INTENSITY FOR THE ENTIRE SEASON WERE NEAR THE BEST IN TERMS BOTH TRACK AND INTENSITY. THE MMEN INTENSITY FORECASTS FOR HOURS 24 THROUGH 96 STAND OUT. THAT IS THE MAJOR RESULT HERE.

THE FORECASTS AT HOUR 12 ARE STRONGLY INFLUENCED BY THE SPIN UP OF INTENSITY FOR MANY OF THE MESOSCALE MODELS OF OUR SUITE.

WE HAVE ADDRESSED THE OUTLIER PROBLEM BY BRINGING IN A CHI SQUARE MINIMIZATION ALGORITHM FOR WEEDING OUT OUTLIERS FROM THE MEMBER MODEL FORECASTS PRIOR TO THE CONSTRUCTION OF THE MULTIMODEL SUPERENSEMBLE. THIS HAS MUCH IMPROVED OUR FORECASTS.

THE FSSE INCLUDES ECMWF FORECAST DATA SETS FOR THE CONSTRUCTION OF THE SUPERENSEMBLE. THE MMEN DOES NOT INCLUDE ECMWF FORECASTS IN ITS SUITE OF MODELS. OVERALL THE PERFORMANCE OF MMEN WAS CLOSE TO THE BEST PERFORMANCE.

Future Work

ONE OF THE PROBLEMATIC STORM WAS KIRK DURING THE 2012 SEASON WHERE WE HAD NOTED RATHER LARGE SKILL VARAITIONS FROM ONE FORECAST TO THE NEXT FOR SEVERAL MEMBER MODELS. WE ARE CURRENTLY EXPLORING SOME MODIFICATIONS OF THE SUPERENSEMBLE STRATEGY TO ADDRESS THIS ISSUE.

WE ARE ALSO CONDUCTING SOME OSSE'S (DATA ADDITION/DENIAL TYPE EXPERIMENTS) ON POSSIBLE FLIGHT TRACKS THAT CAN PROVIDE IMPORTANT INSIGHTS ON RAPID INTENSIFICATION THAT RELATE TO CLOUD FLARE UPS. THESE RESULTS WILL BE PRESENTED IN OUR NEXT TECHNICAL REPORT.