

2018 NHC Forecast Successes and Challenges

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73rd IHC
March 12, 2019



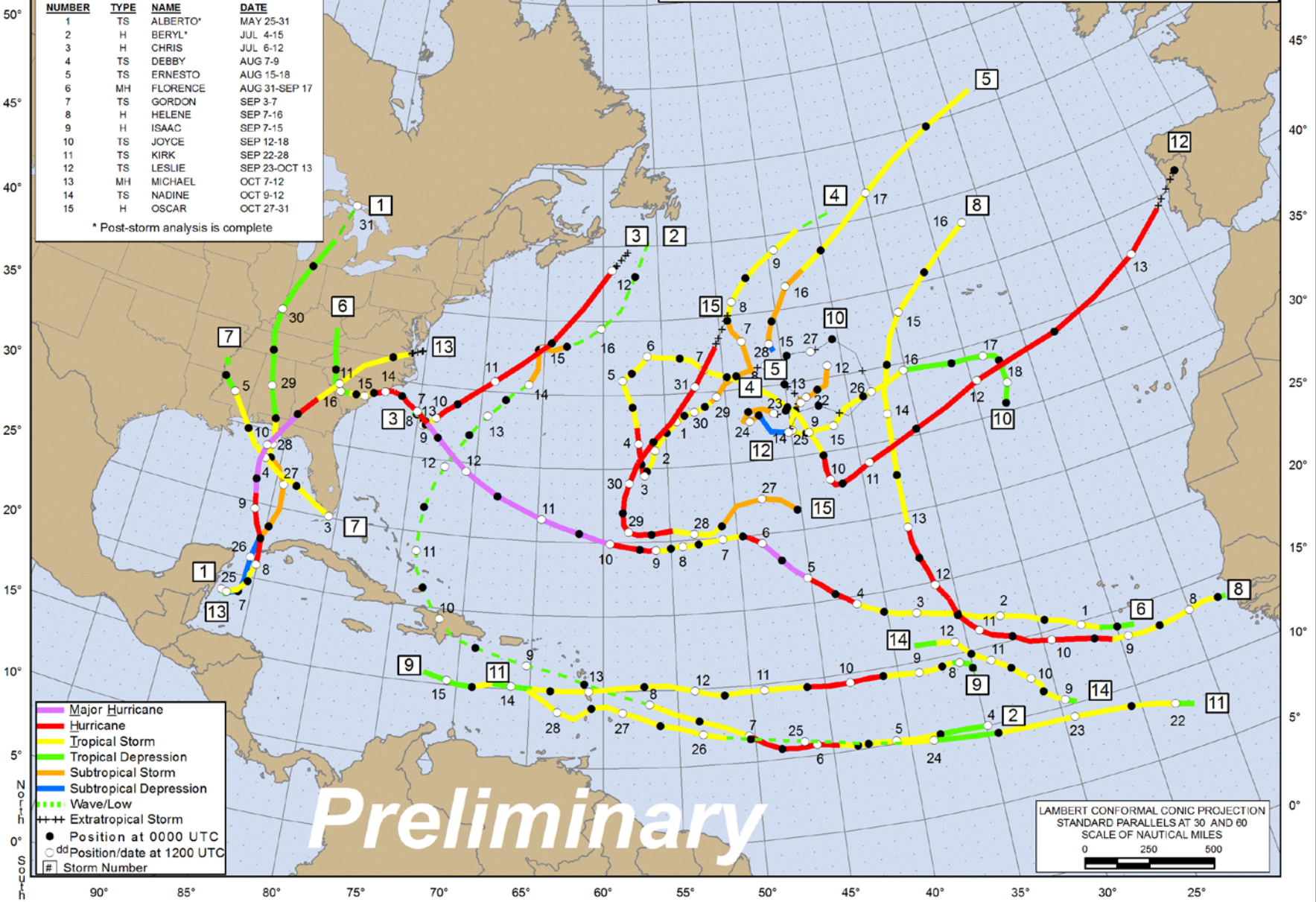
120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65° 60° 55° 50° 45° 40° 35° 30° 25° 20° 15° 10° 5° 0° 5° 10°

2018

NUMBER	TYPE	NAME	DATE
1	TS	ALBERTO*	MAY 25-31
2	H	BERYL*	JUL 4-15
3	H	CHRIS	JUL 6-12
4	TS	DEBBY	AUG 7-9
5	TS	ERNESTO	AUG 15-18
6	MH	FLORENCE	AUG 31-SEP 17
7	TS	GORDON	SEP 3-7
8	H	HELENE	SEP 7-16
9	H	ISAAC	SEP 7-15
10	TS	JOYCE	SEP 12-18
11	TS	KIRK	SEP 22-28
12	TS	LESLIE	SEP 23-OCT 13
13	MH	MICHAEL	OCT 7-12
14	TS	NADINE	OCT 9-12
15	H	OSCAR	OCT 27-31

* Post-storm analysis is complete

**U.S. DEPARTMENT OF COMMERCE, NATIONAL WEATHER SERVICE
NORTH ATLANTIC HURRICANE TRACKING CHART**



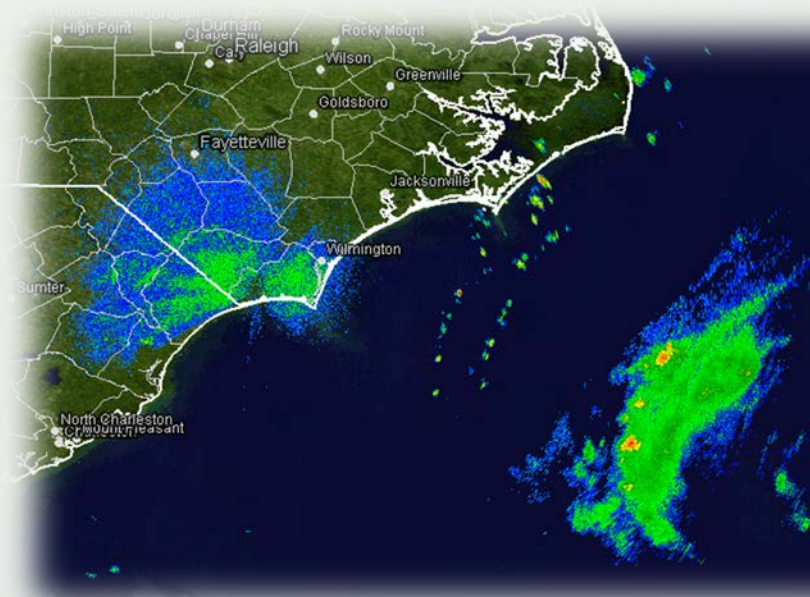
Preliminary

LAMBERT CONFORMAL CONIC PROJECTION
STANDARD PARALLELS AT 30° AND 60°
SCALE OF NAUTICAL MILES
0 250 500

Above average season with lots of high-latitude activity



Florence - \$24 Billion



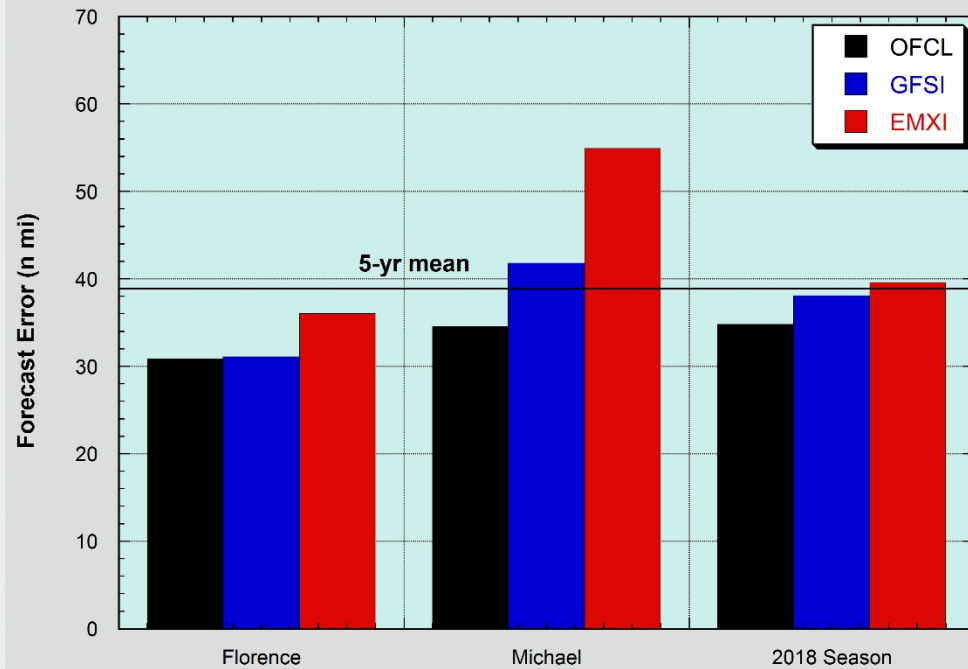
Michael - \$25 Billion



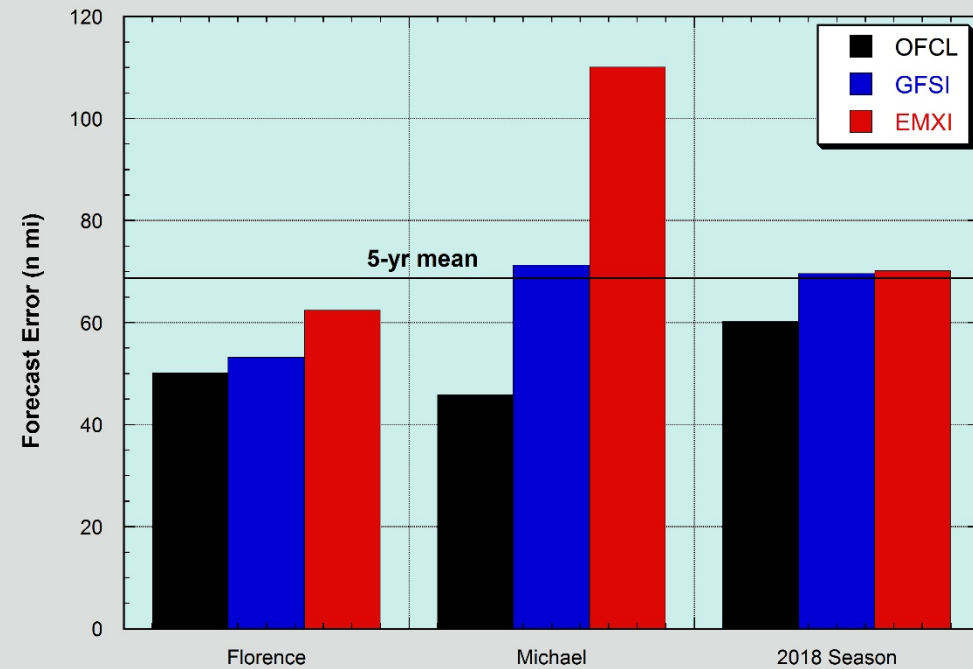
United States Facts:

- Florence produced more than 35 inches of rainfall in North Carolina breaking a state record set during Floyd (1999)
- Michael had the 3rd lowest minimum pressure at landfall in the continental United States
- Michael is the 4th strongest by maximum winds on record in the U.S.
- Michael is the strongest U.S. landfalling hurricane since Andrew (1992)

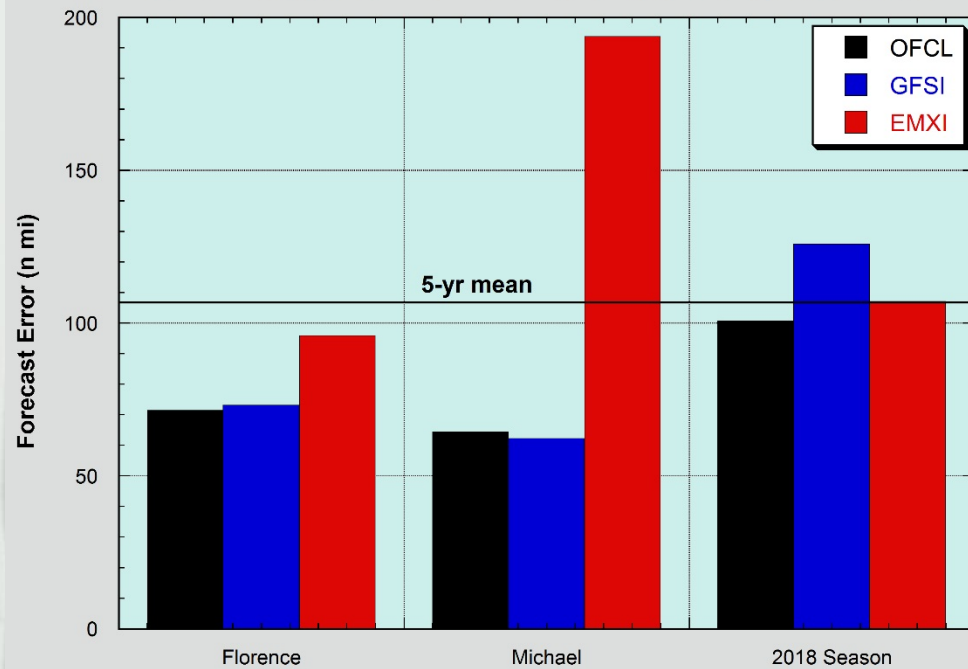
24-h Track Errors for 2018 U.S. Landfalling Hurricanes



48-h Track Errors for 2018 U.S. Landfalling Hurricanes



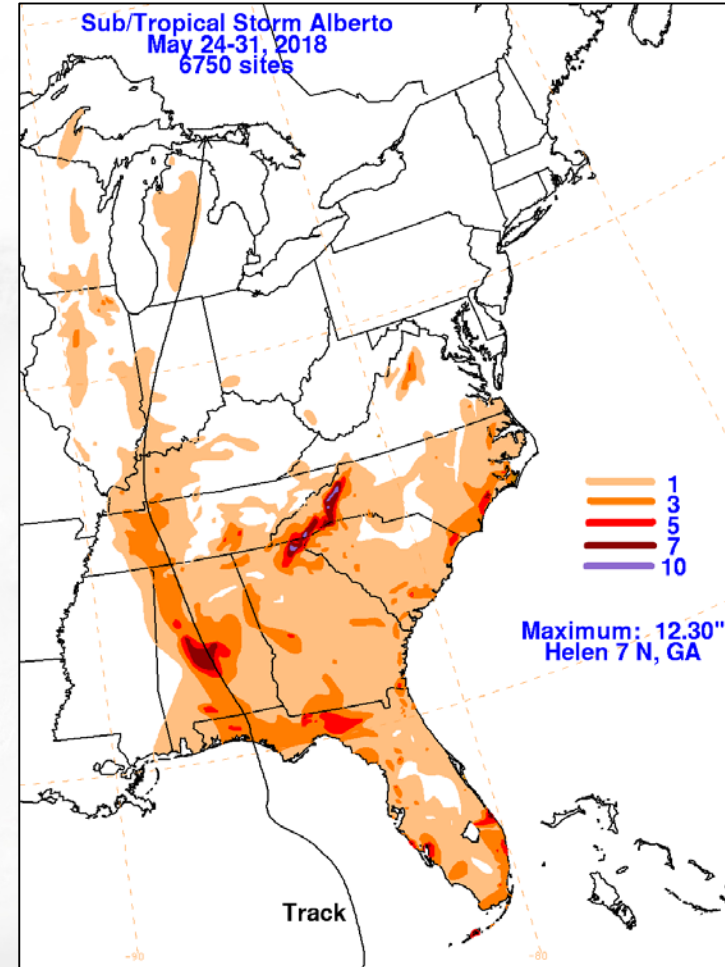
72-h Track Errors for 2018 U.S. Landfalling Hurricanes



- NHC track forecasts (in black) performed quite well.
- For the high-impact storms, better than the season average, and much better than the 5-year mean.
- ECMWF outperformed by GFS for this sample

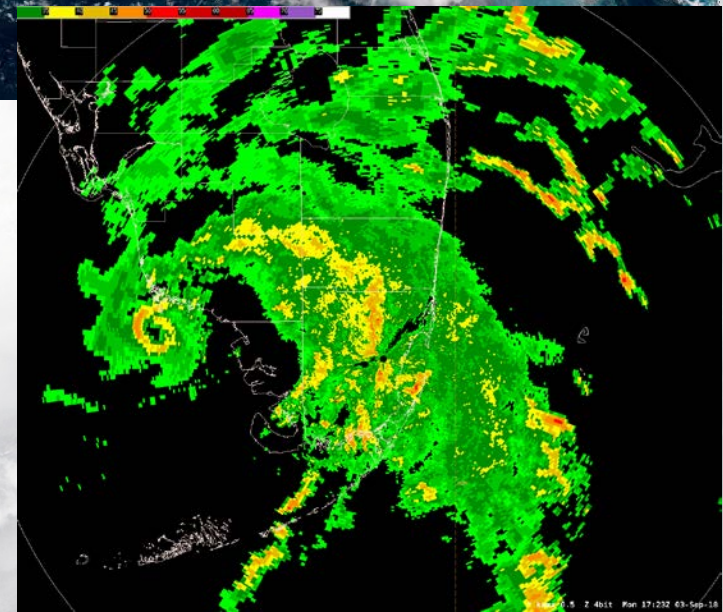
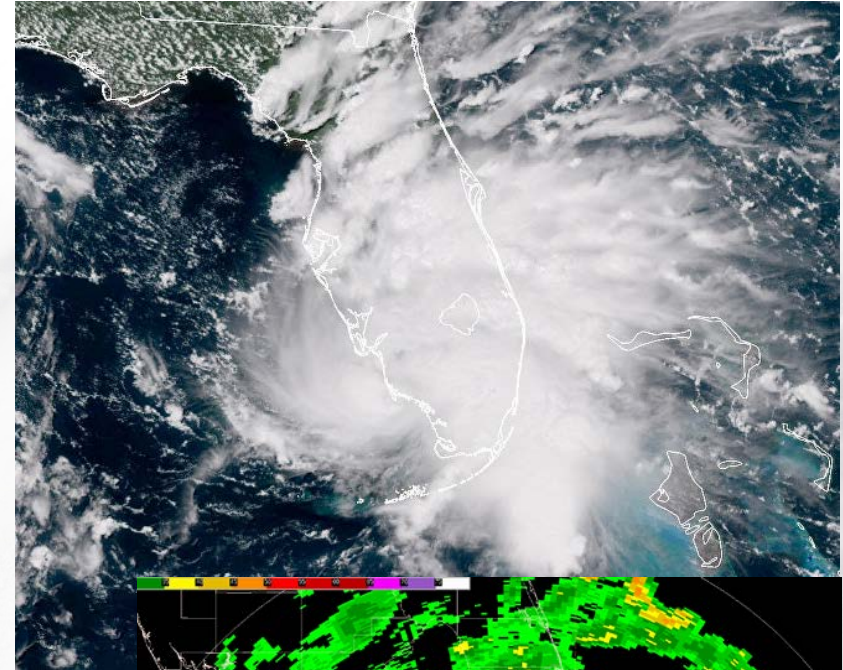
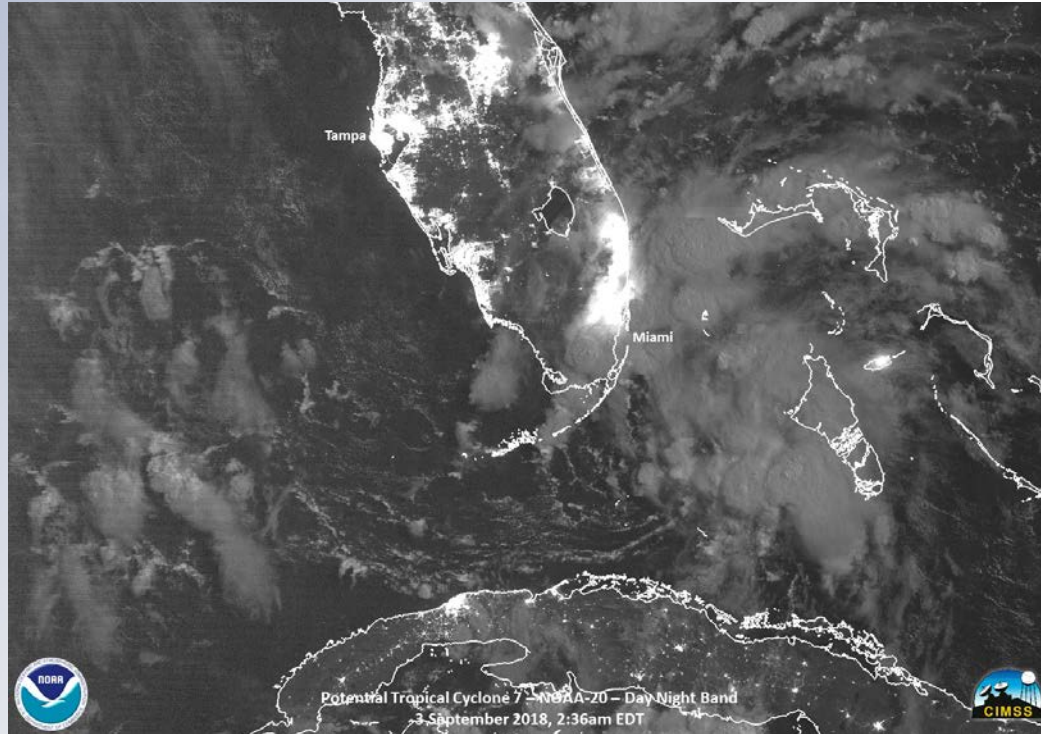
Tropical Storm Alberto

Another Pre-Season Named-Storm



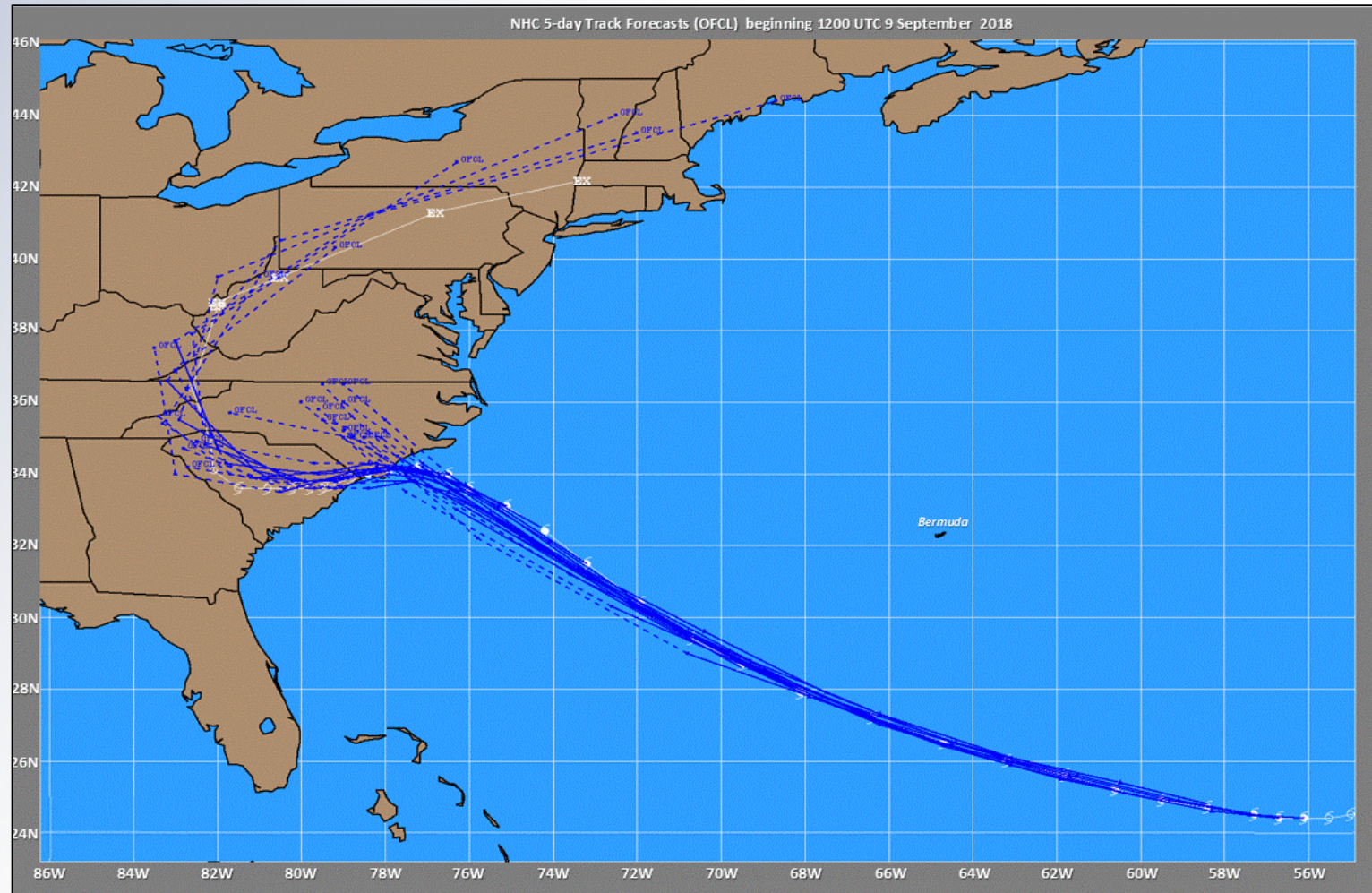
- Formed as a subtropical cyclone on May 24
- Eight direct deaths due to flooding in the southern Appalachians
- Damage estimate is \$125 million

Tropical Storm Gordon



- **Gordon formed just offshore of the Florida Keys and made landfall less than 6 h later as a 45-kt tropical storm.**
- **Brought heavy rain and winds gusts of 45-50 kt across South Florida.**
- **Potential TC, but no watches/warnings**

Track Forecast Success During Florence's Approach to the U.S.



Some long-range forecasts suggested Florence would re-curve over the central Atlantic

You be the forecaster!

Moderate and increasing shear

Marginally warm waters

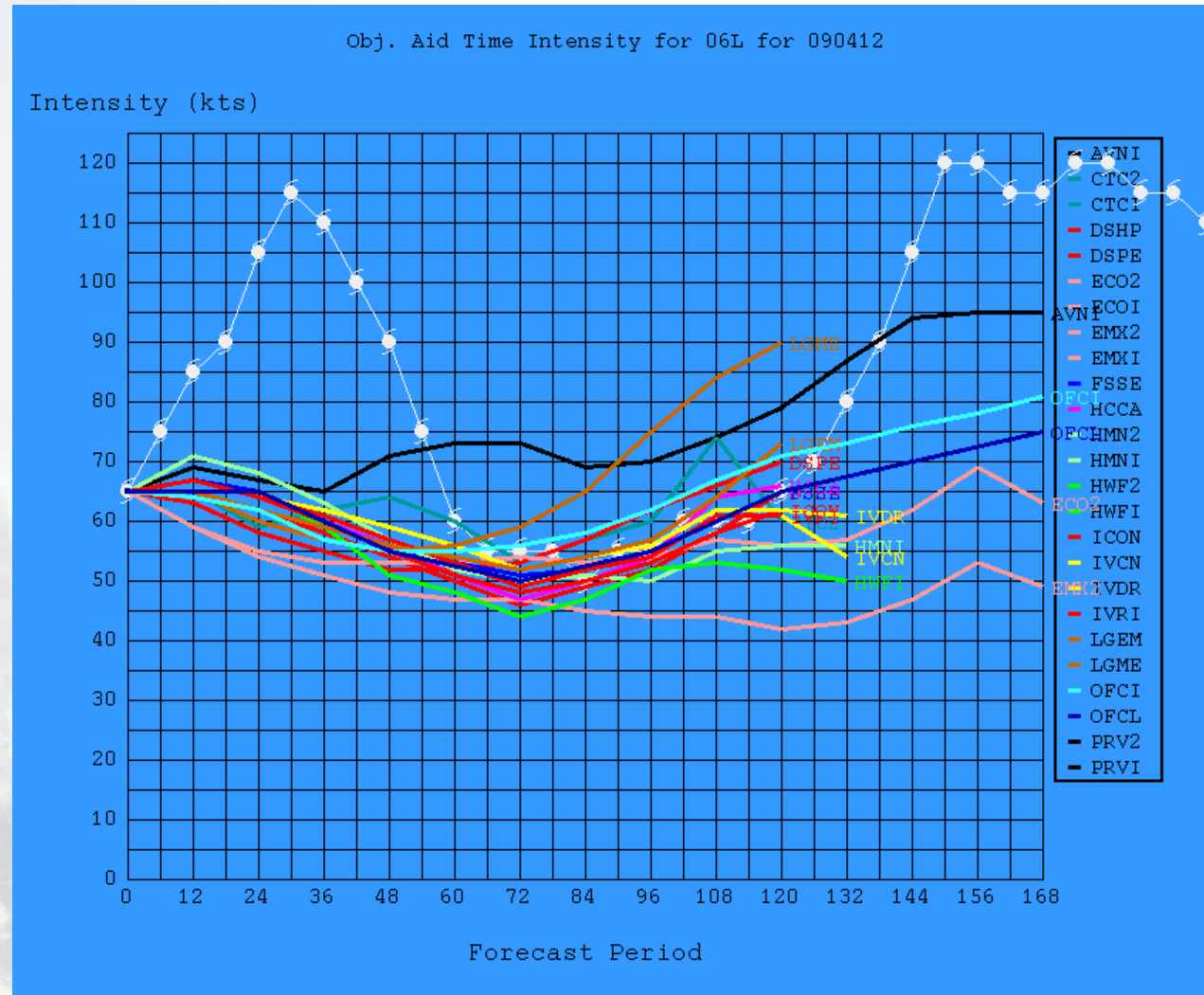
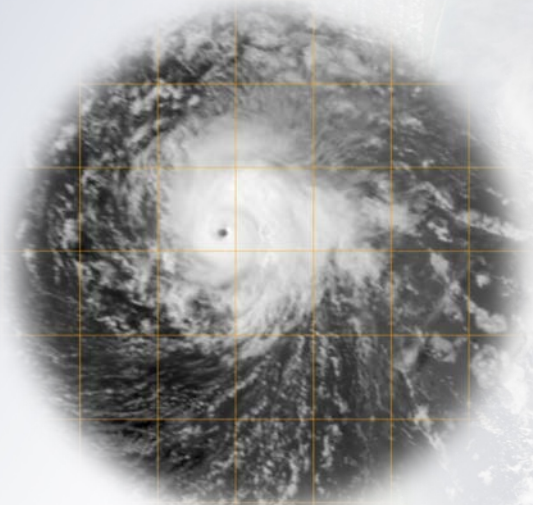
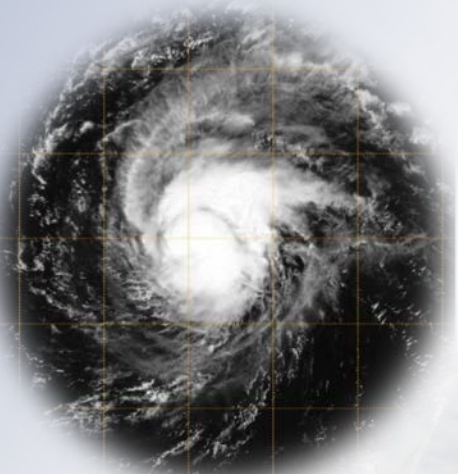
Mid-level air fairly dry

Upper-level divergence very low

* ATLANTIC 2018 SHIPS INTENSITY FORECAST *													
* IR SAT DATA AVAILABLE, OHC AVAILABLE *													
* FLORENCE AL062018 09/04/18 12 UTC *													
TIME (HR)	0	6	12	18	24	36	48	60	72	84	96	108	120
V (KT) NO LAND	65	65	65	63	62	58	54	50	46	49	52	58	65
V (KT) LAND	65	65	65	63	62	58	54	50	46	49	52	58	65
V (KT) LGEM	65	66	65	64	62	59	56	54	52	54	57	64	73
Storm Type	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP	TROP
SHEAR (KT)	18	18	17	22	22	23	22	24	26	18	12	17	24
SHEAR ADJ (KT)	6	5	4	3	6	2	12	5	5	0	-1	0	-7
SHEAR DIR	244	249	244	243	244	246	255	263	273	244	266	202	186
SST (C)	26.5	26.6	26.7	26.9	27.1	27.6	28.0	28.3	28.6	28.7	28.9	28.9	29.0
POT. INT. (KT)	119	120	121	123	126	132	137	140	144	146	149	149	150
ADJ. POT. INT.	110	111	112	114	116	122	124	124	126	126	128	127	126
200 MB T (C)	-53.3	-53.3	-53.5	-53.5	-53.6	-53.7	-53.9	-54.0	-54.2	-54.6	-54.9	-54.7	-54.8
200 MB VXT (C)	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.7	0.4	0.4	0.3	0.5	0.6
TH E DEV (C)	7	8	8	8	9	10	10	11	10	10	9	10	9
700-500 MB RH	52	51	51	51	50	48	50	54	56	56	56	52	54
MODEL VTX (KT)	20	19	20	19	20	18	18	17	17	19	20	22	26
850 MB FNV VOR	63	52	48	39	20	0	-21	-26	-34	-27	-22	-8	26
200 MB DIV	15	7	0	0	8	2	37	-7	6	11	6	2	1
700-850 TADV	17	15	15	17	19	11	7	7	1	-1	1	0	0
LAND (KM)	1977	1950	1929	1927	1927	1845	1671	1566	1519	1482	1461	1473	1505
LAT (DEG N)	19.5	19.9	20.3	20.8	21.3	22.3	23.5	24.7	25.7	26.6	27.5	28.6	29.6
LONG(DEG W)	42.0	43.1	44.1	45.1	46.2	48.5	50.6	52.2	53.3	54.4	55.5	56.6	57.5
STM SPEED (KT)	10	11	10	11	11	12	10	8	7	7	7	7	6
HEAT CONTENT	5	8	11	13	14	22	12	16	19	15	19	27	22

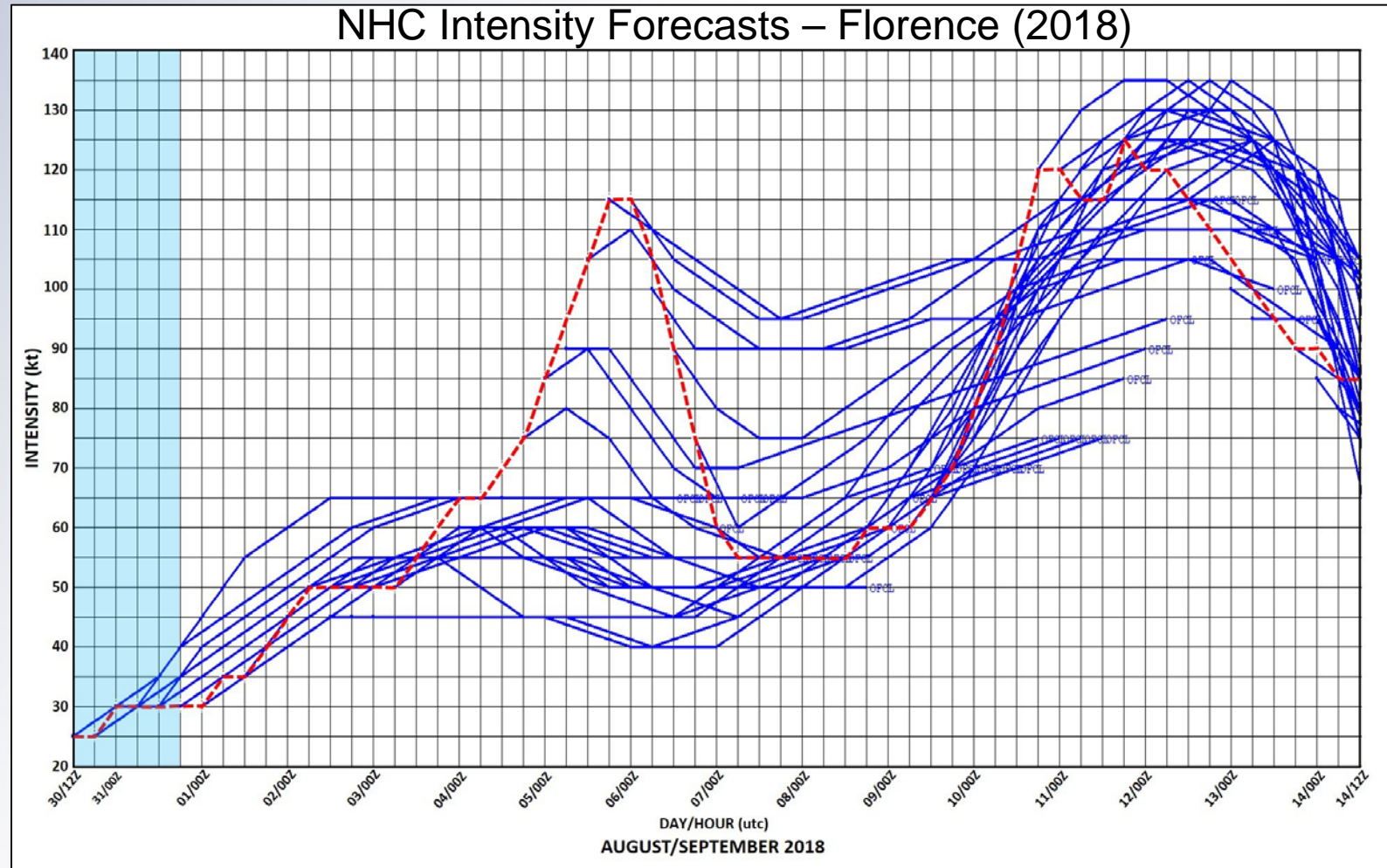
FORECAST TRACK FROM OFCI	INITIAL HEADING/SPEED (DEG/KT):295/ 9	CX,CY: -7/ 4
T-12 MAX WIND: 60	PRESSURE OF STEERING LEVEL (MB): 615	(MEAN=619)
GOES IR BRIGHTNESS TEMP. STD DEV. 50-200 KM RAD:	12.7 (MEAN=14.5)	
% GOES IR PIXELS WITH T < -20 C 50-200 KM RAD:	76.0 (MEAN=65.0)	
PRELIM RI PROB (DV .GE. 55 KT IN 48 HR):	0.2	

Hurricane Florence Unexpected Strengthening

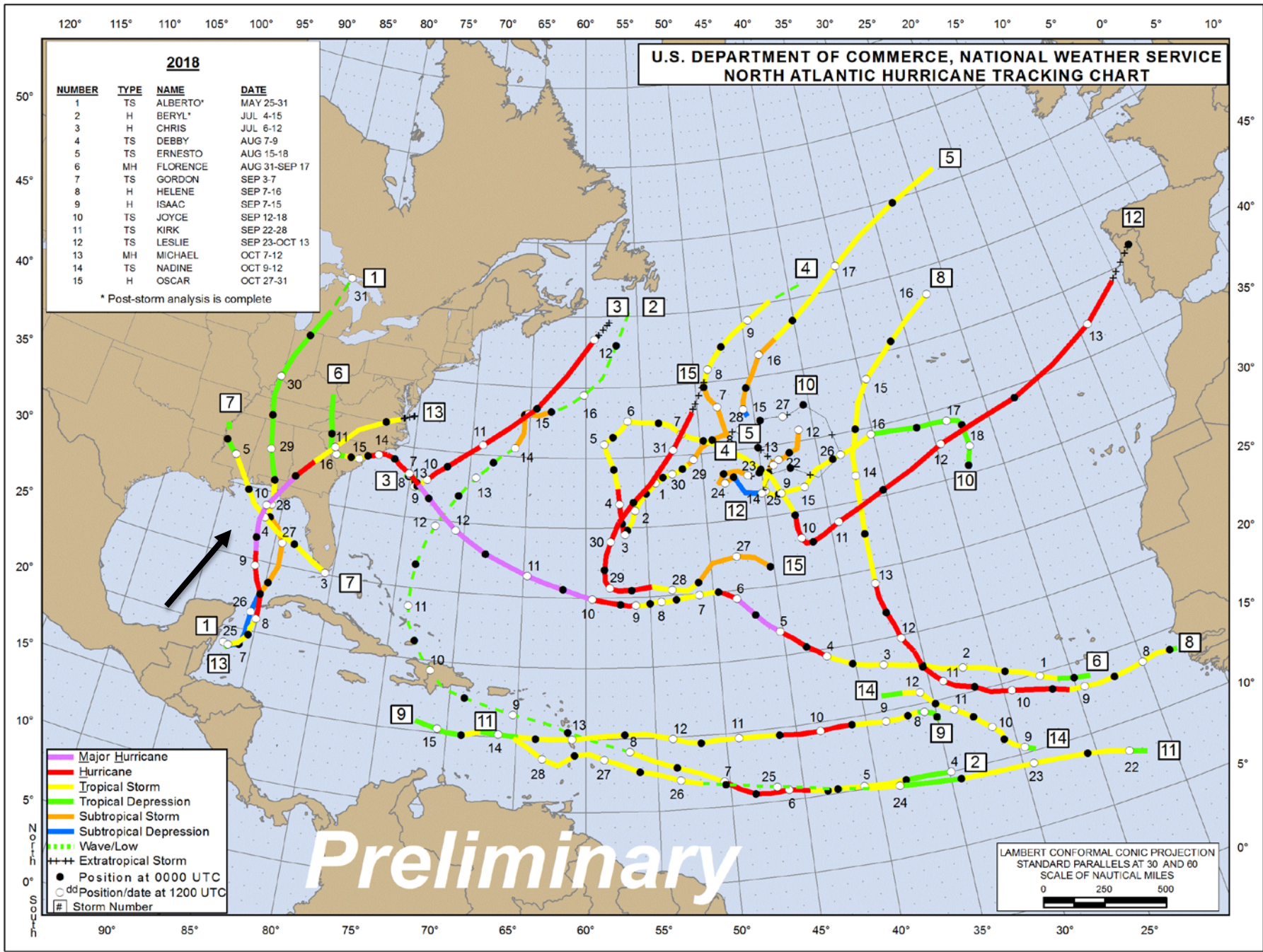


Category 1 to 4 in 36 hours – no model suggested this would occur

Hurricane Florence Intensity Forecast Difficulty



**NHC missed period of rapid strengthening and
then over-forecast intensity near landfall**



Hurricane Michael

Strongest
mainland US
landfall since
Andrew 1992



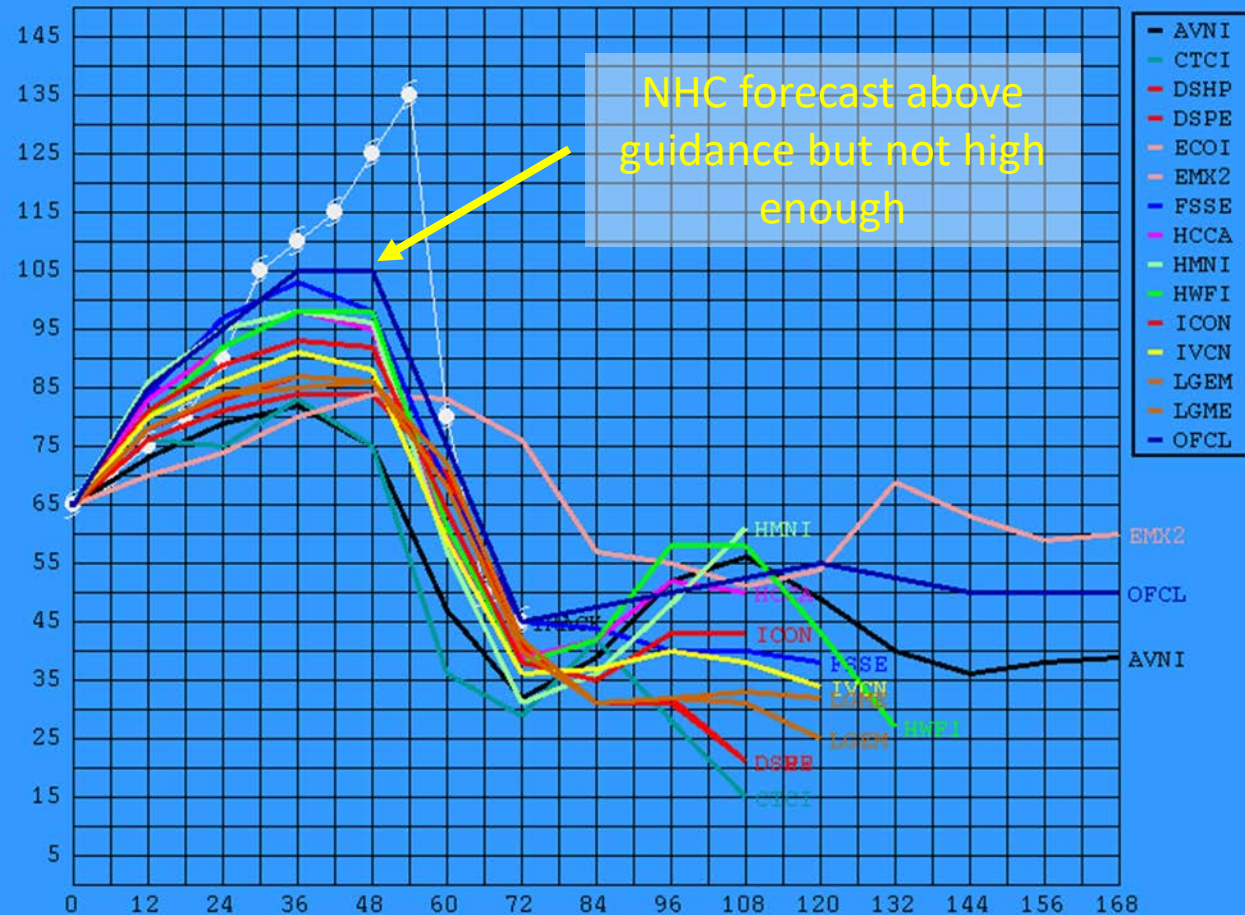
Michael Intensity Forecasting Struggles

NHC Forecasts Major Hurricane but Too Low



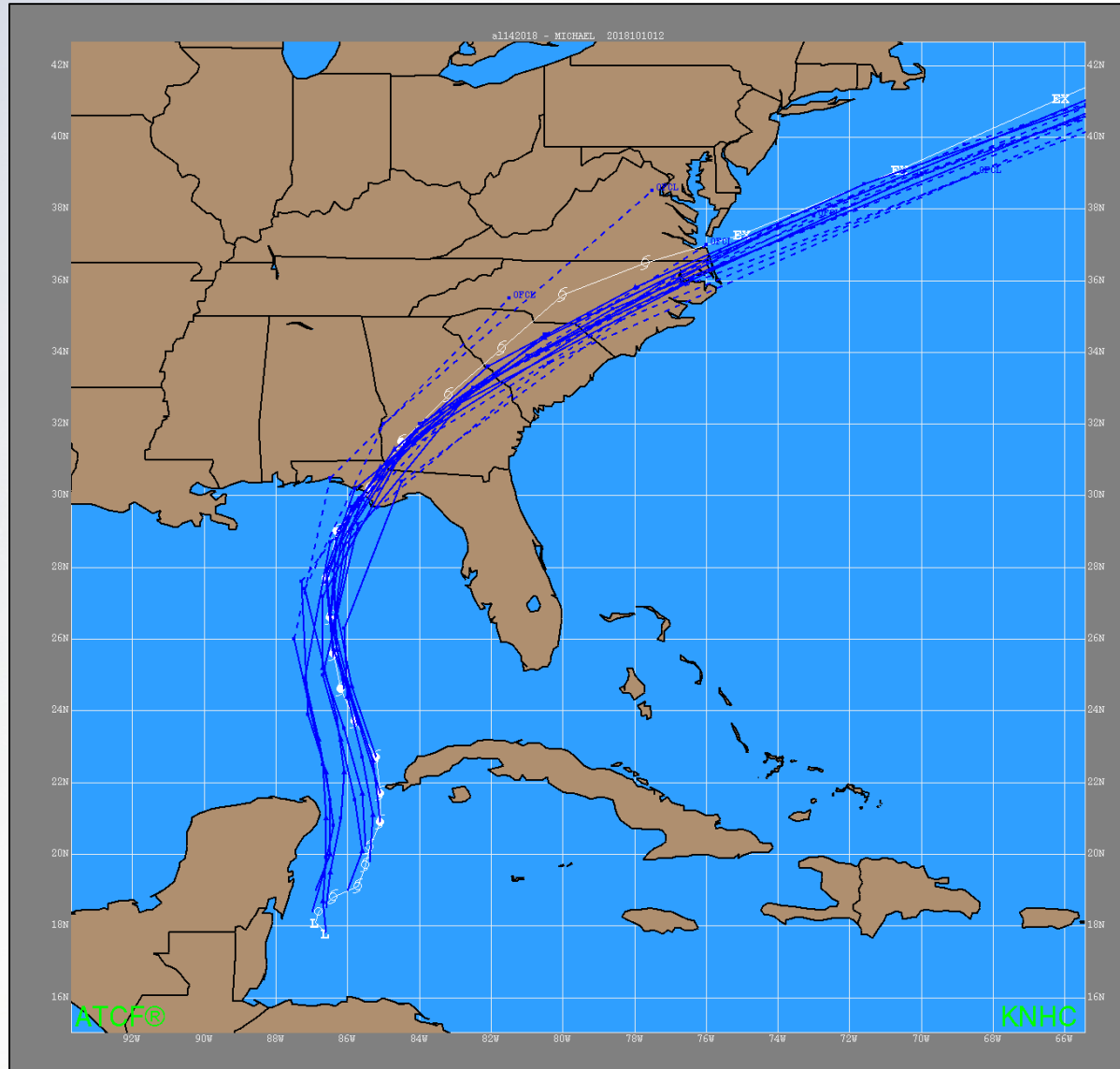
Obj. Aid Time Intensity for 14L for 100812

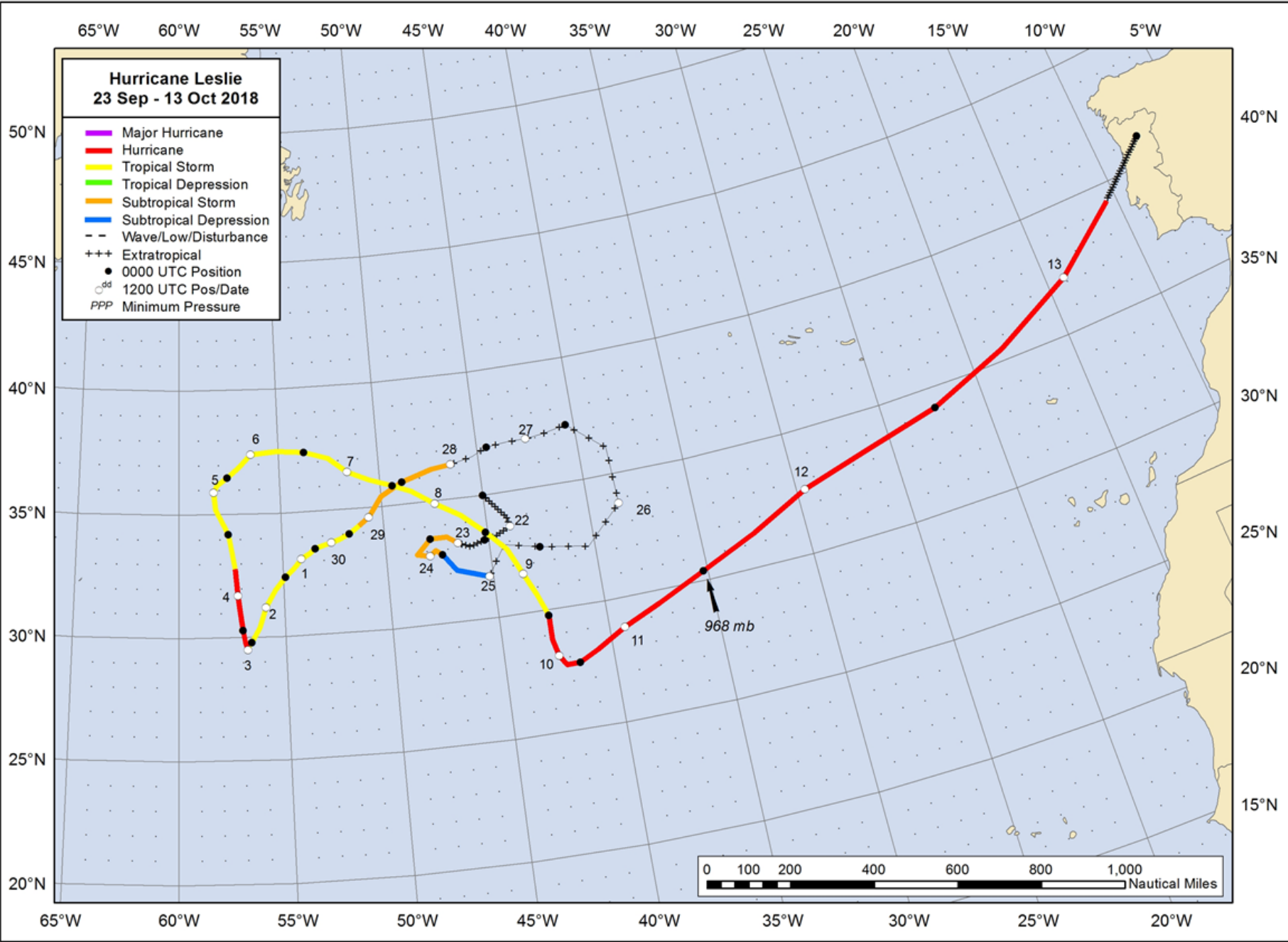
Intensity (kts)



Forecast Period

Track Forecasts Very Consistent in Showing Threat to the Florida Panhandle

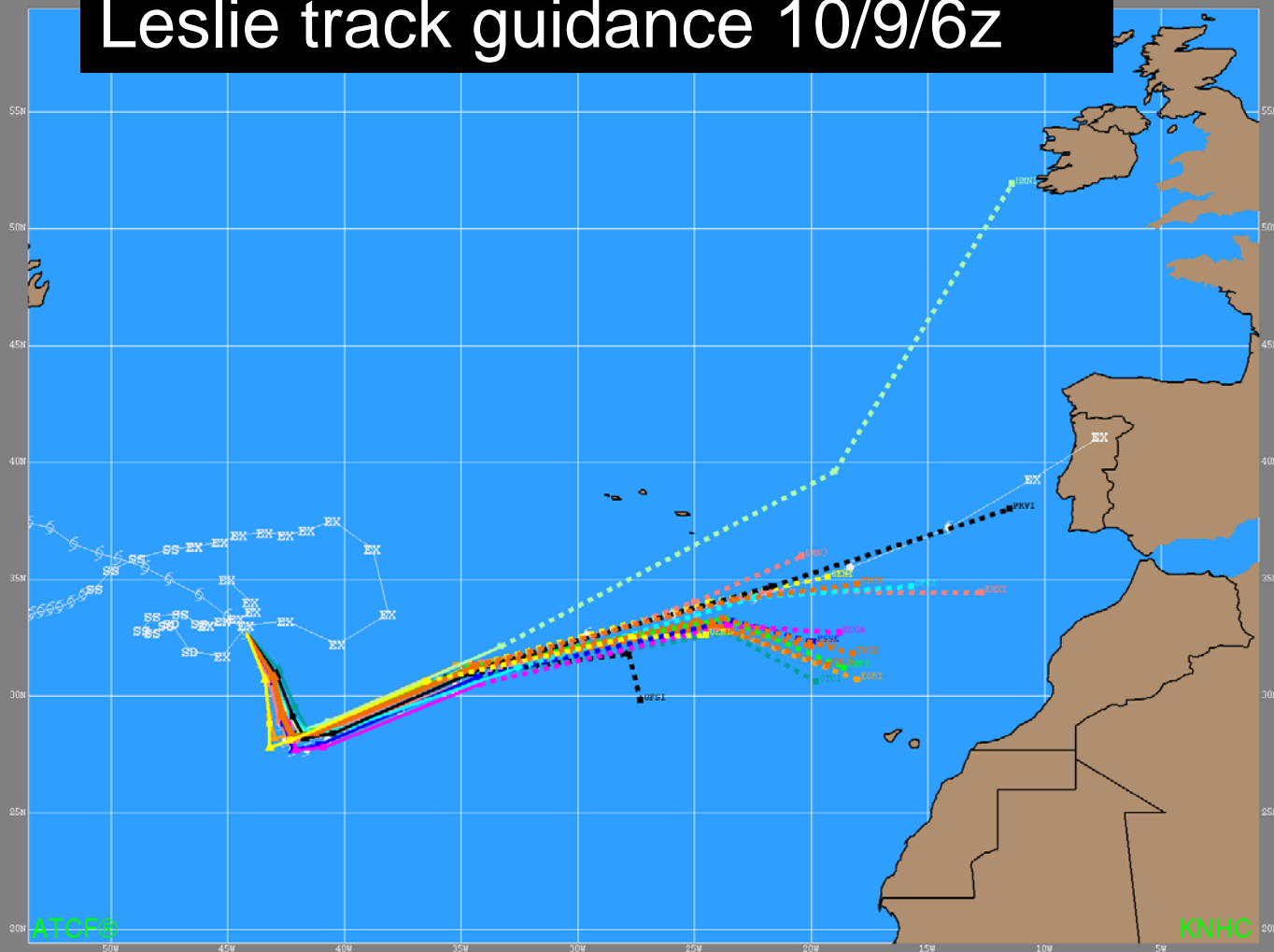




Hurricane Leslie

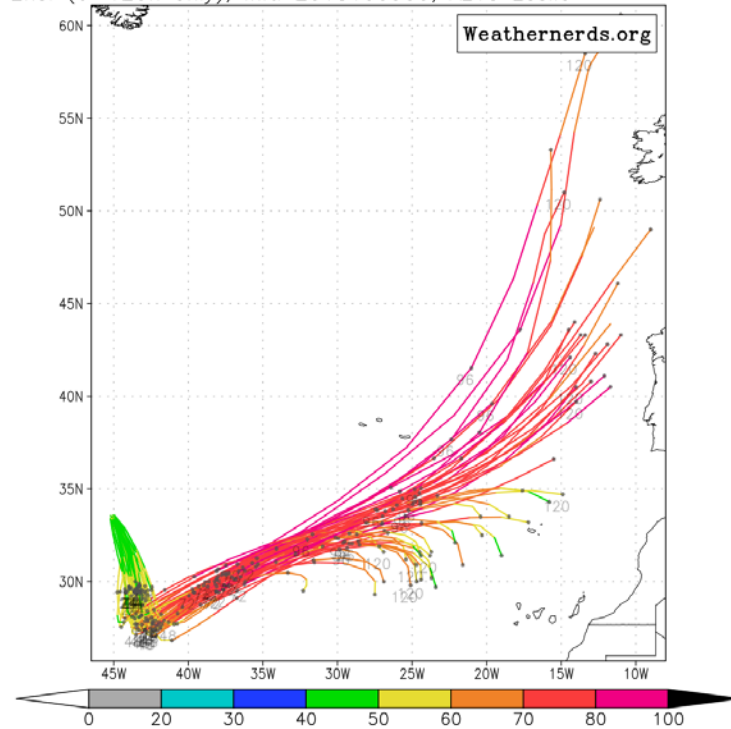
Long lasting and *highly* annoying

Leslie track guidance 10/9/6z

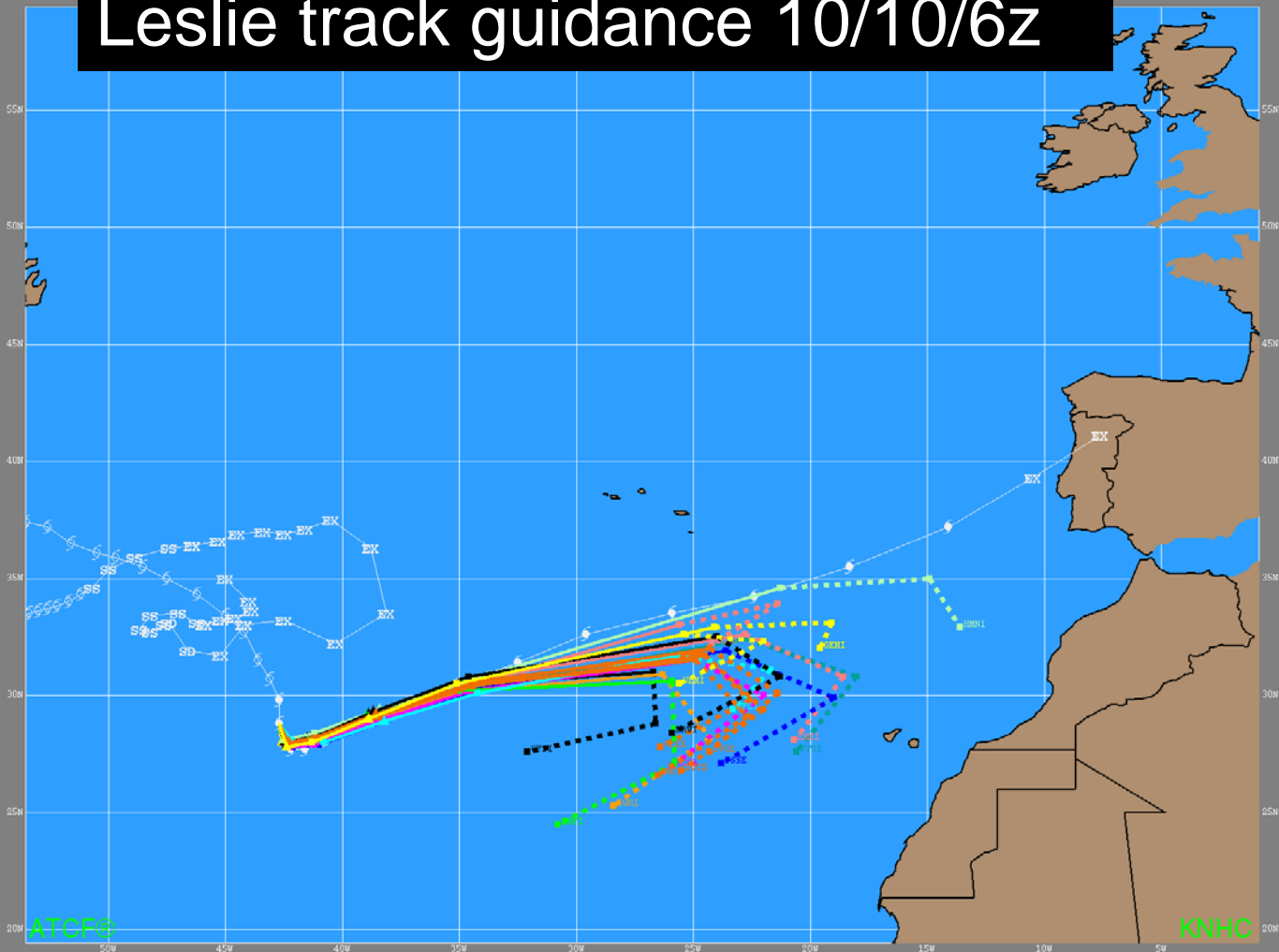


Major model spread, but best models farthest south

ECMWF Ens. (0-120h only), init: 2018100900, AL13 Leslie color = max wind (kt)

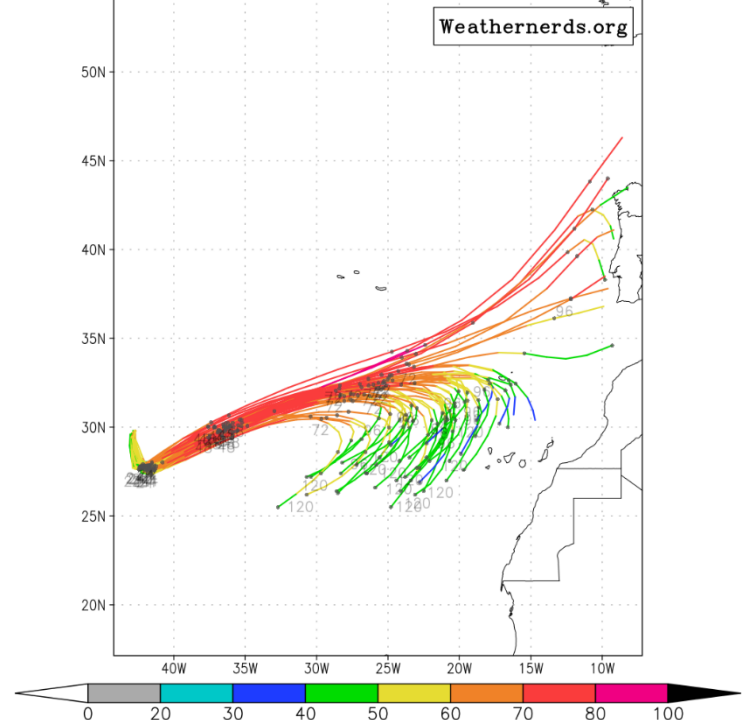


Leslie track guidance 10/10/6z

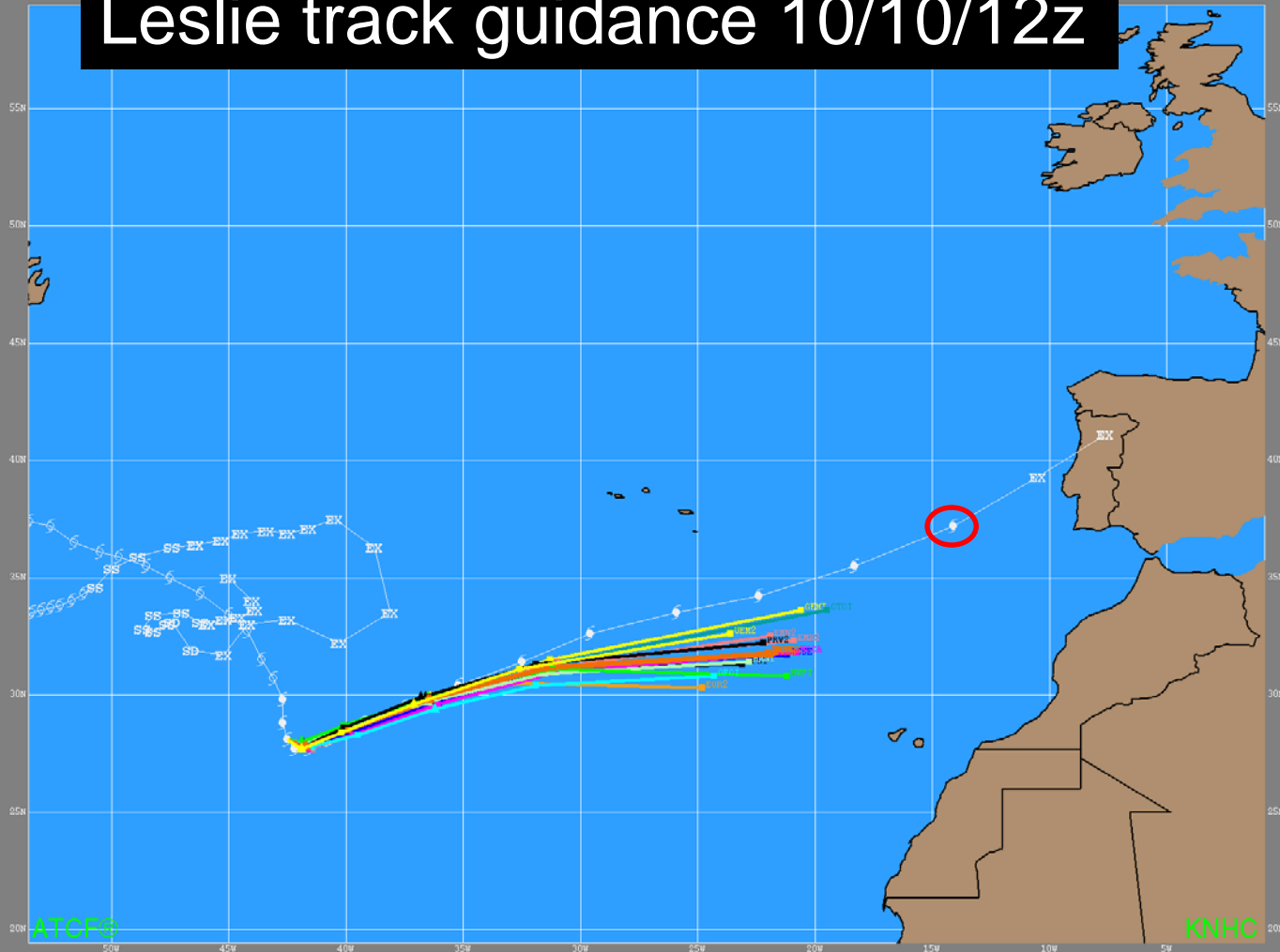


EC ensemble
not as definitive

ECMWF Ens. (0-120h only), init: 2018101000, AL13 Leslie color = max wind (kt)

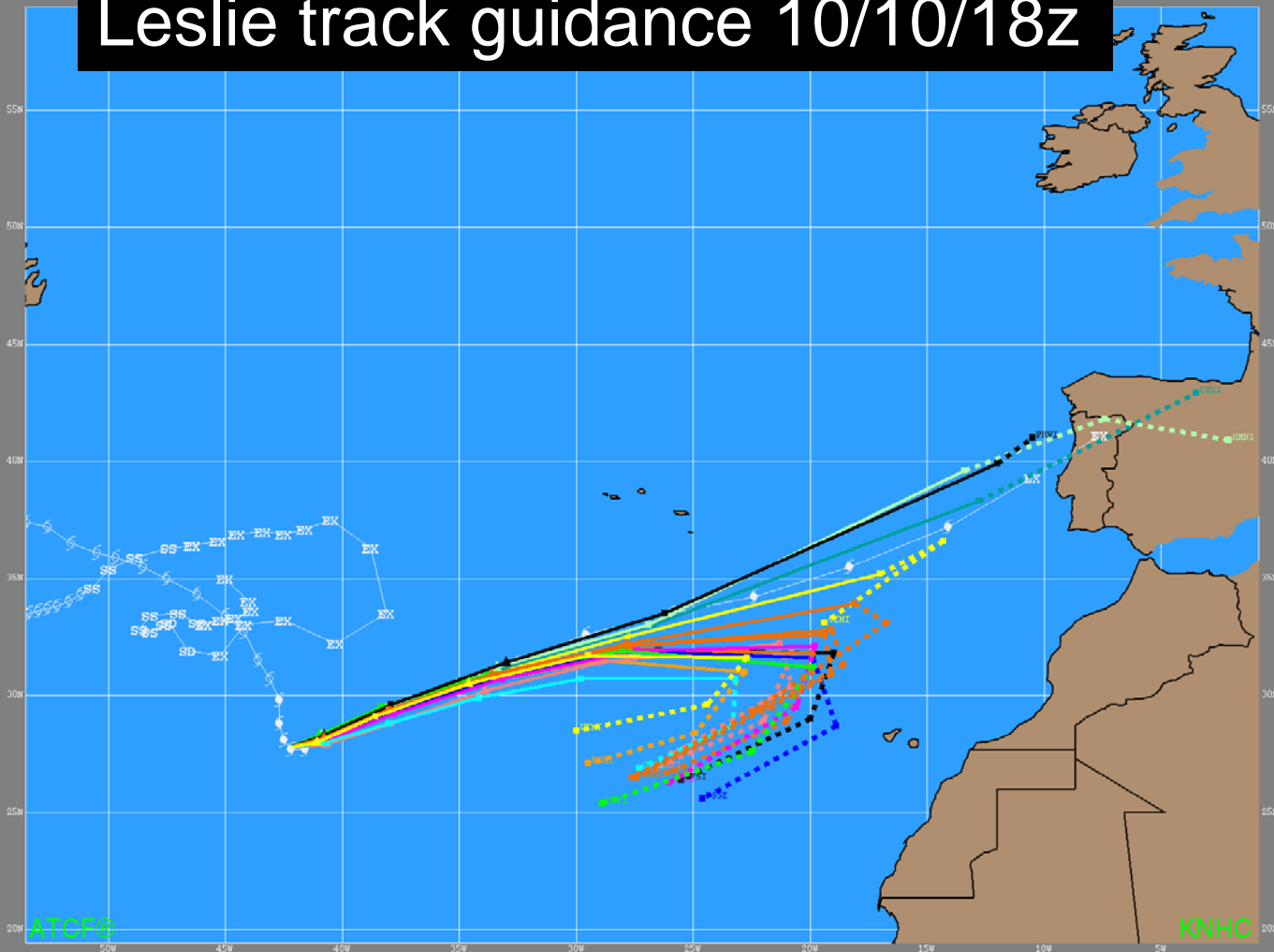


Leslie track guidance 10/10/12z



72 hour zoom –
All models have a 400-
600 n mi error

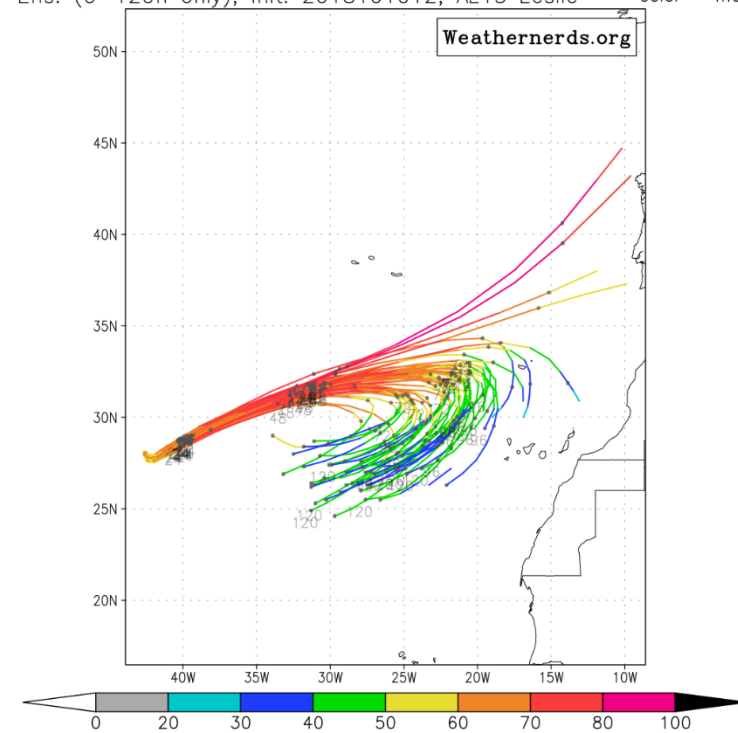
Leslie track guidance 10/10/18z



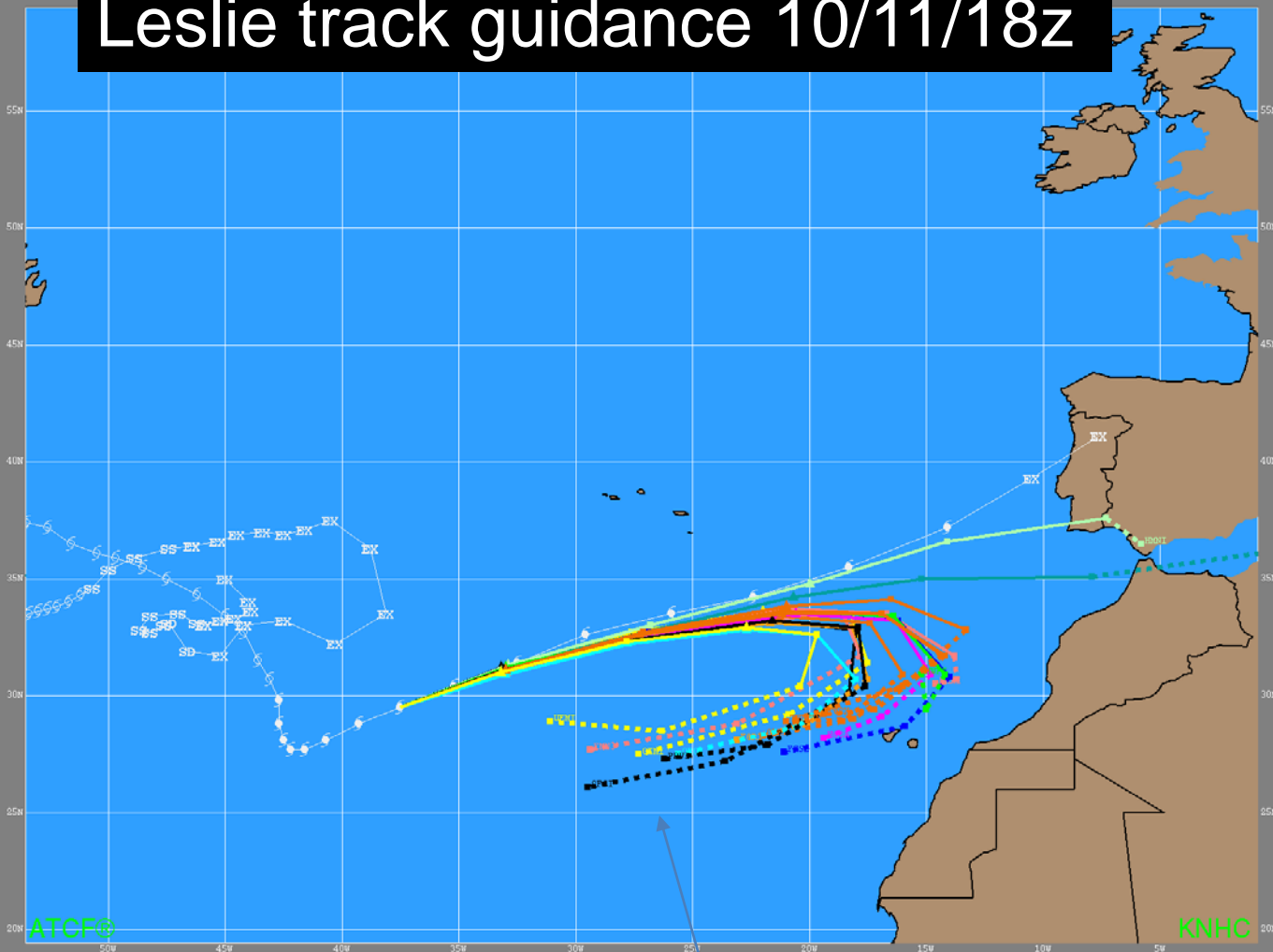
Few more models shift north, but most still miss the trough

EC ensemble continues to shift south

ECMWF Ens. (0-120h only), init: 2018101012, AL13 Leslie color = max wind (kt)



Leslie track guidance 10/11/18z

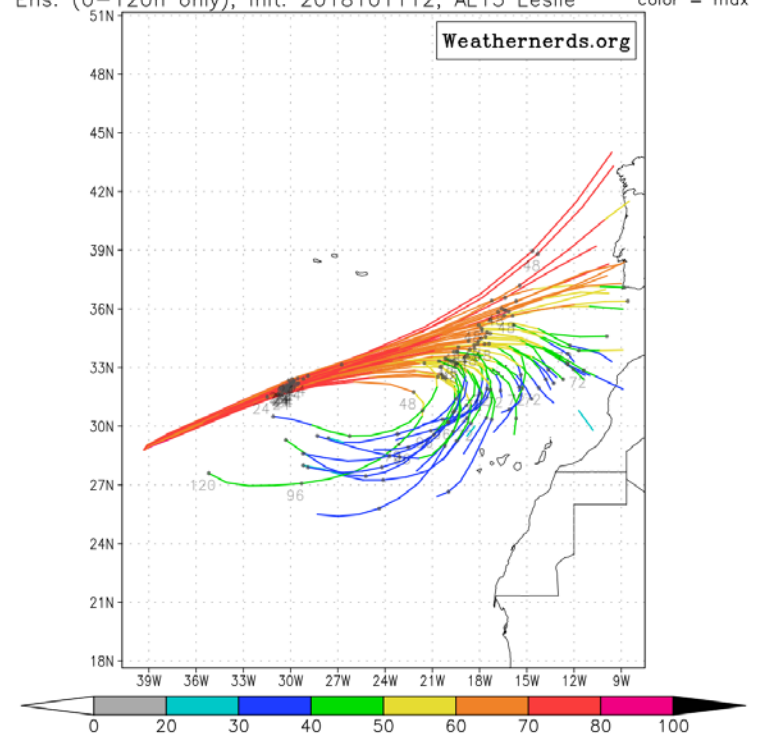


Deterministic models shift south, but little change in EC ensemble

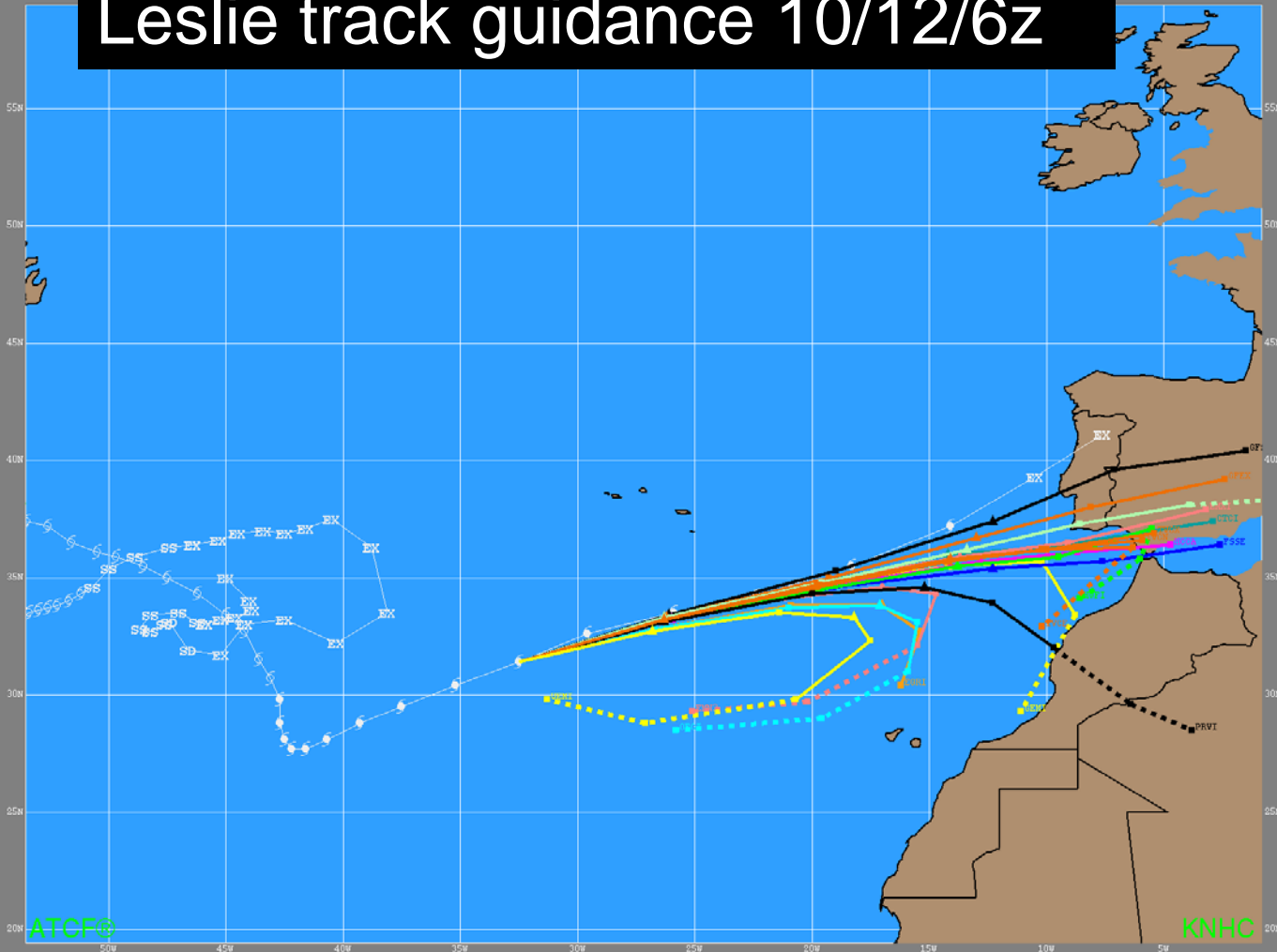
FV3 shifts over 1500 n mi

~400 n mi errors in < 48 h

ECMWF Ens. (0-120h only), init: 2018101112, AL13 Leslie color = max wind (kt)

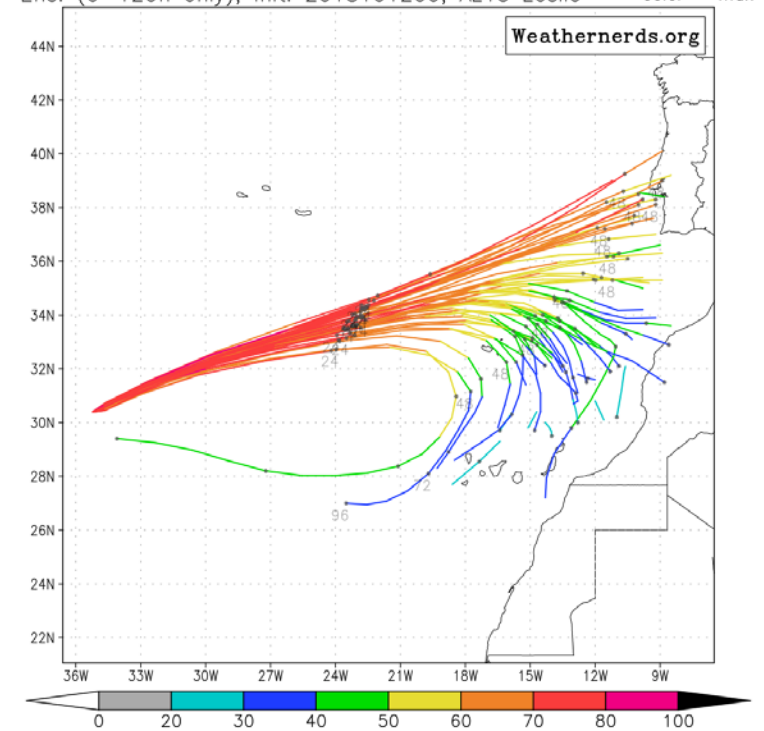


Leslie track guidance 10/12/6z

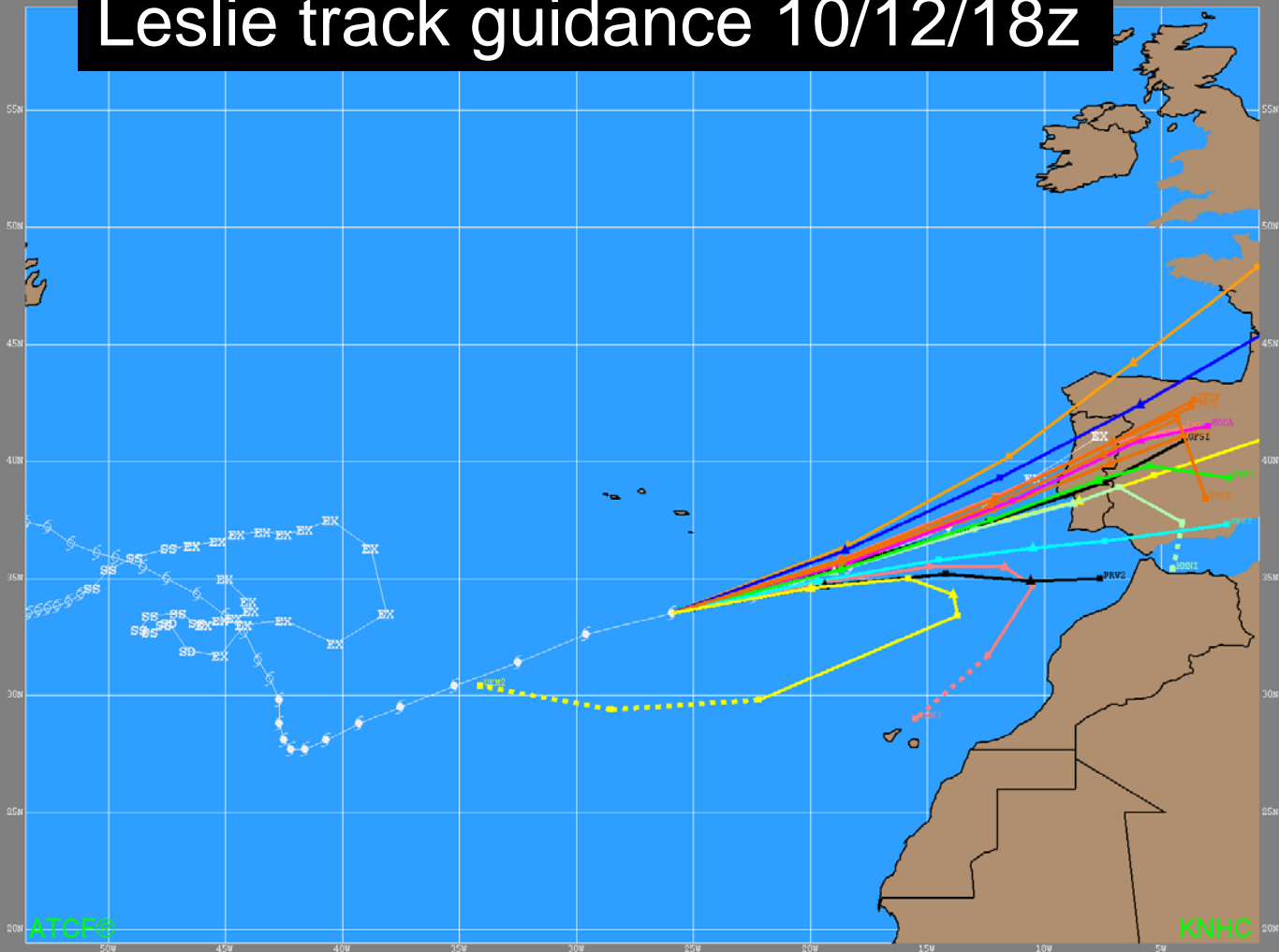


Models mostly jump northward

ECMWF Ens. (0-120h only), init: 2018101200, AL13 Leslie color = max wind (kt)

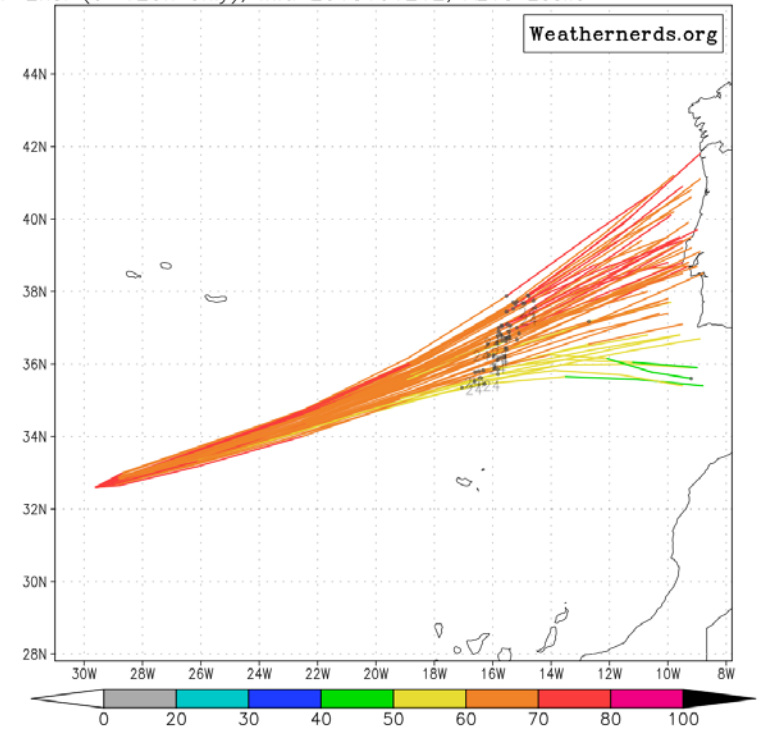


Leslie track guidance 10/12/18z

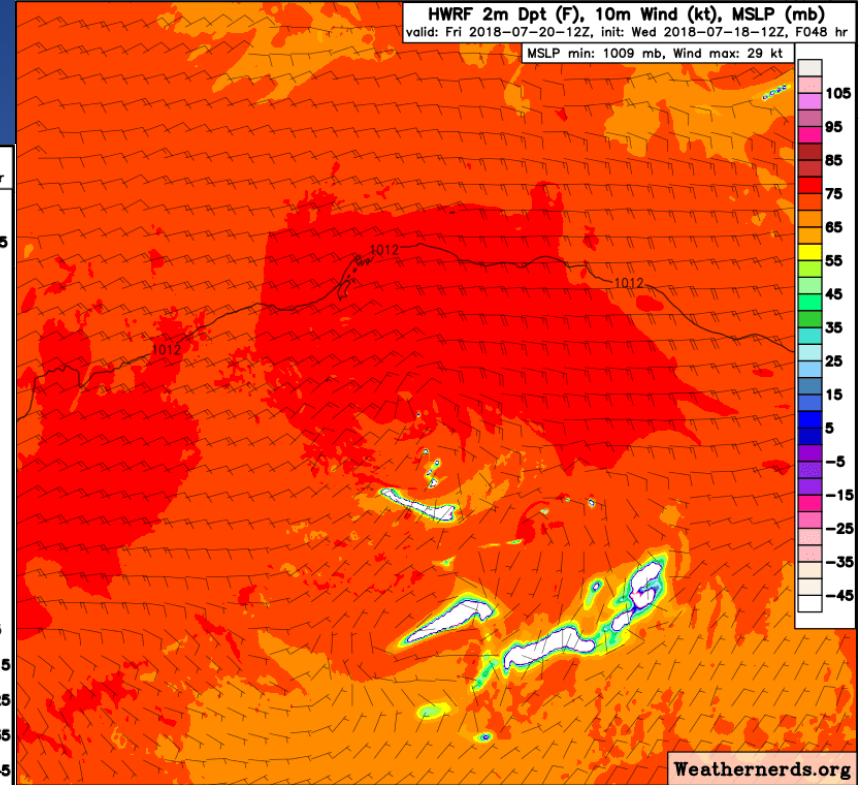
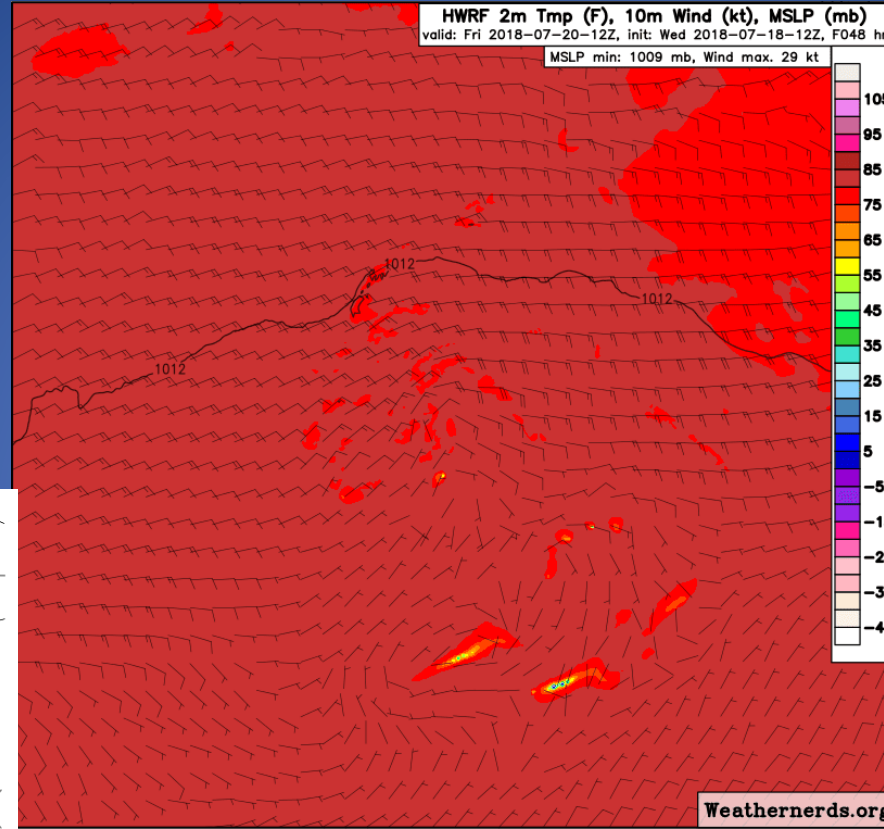


Finally!

ECMWF Ens. (0-120h only), init: 2018101212, AL13 Leslie color = max wind (kt)

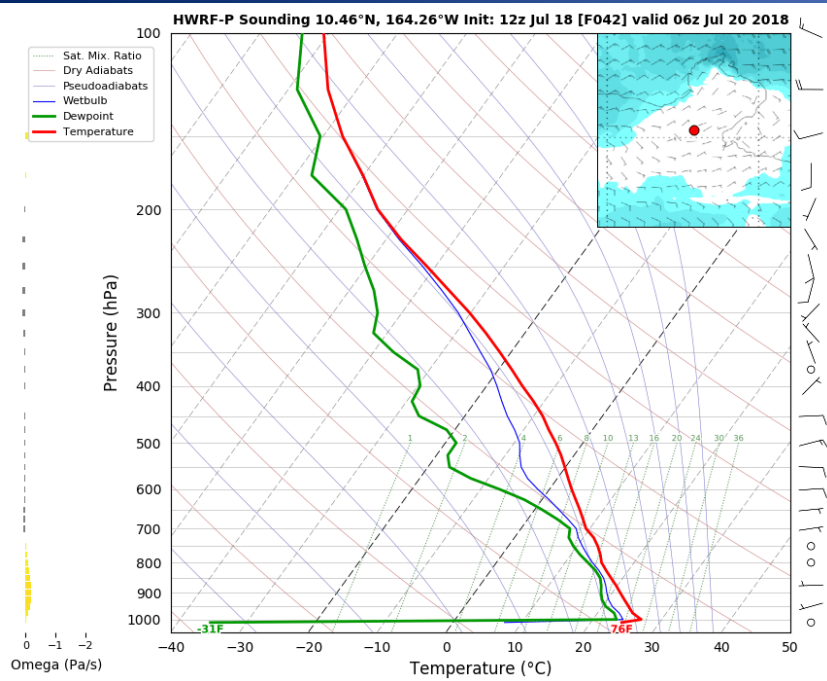


Strange Model Initializations/Forecasts



48 h forecasts with subzero dewpoints

48 h forecasts with sub 50F sfc temps



Very dry low-levels forecast

Questions/Comments?

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