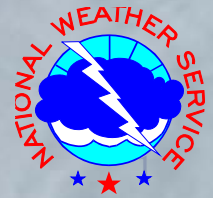


National Hurricane Center 2015 Forecast Verification (Preliminary)

John Cangialosi and James Franklin
Hurricane Specialist Unit
National Hurricane Center

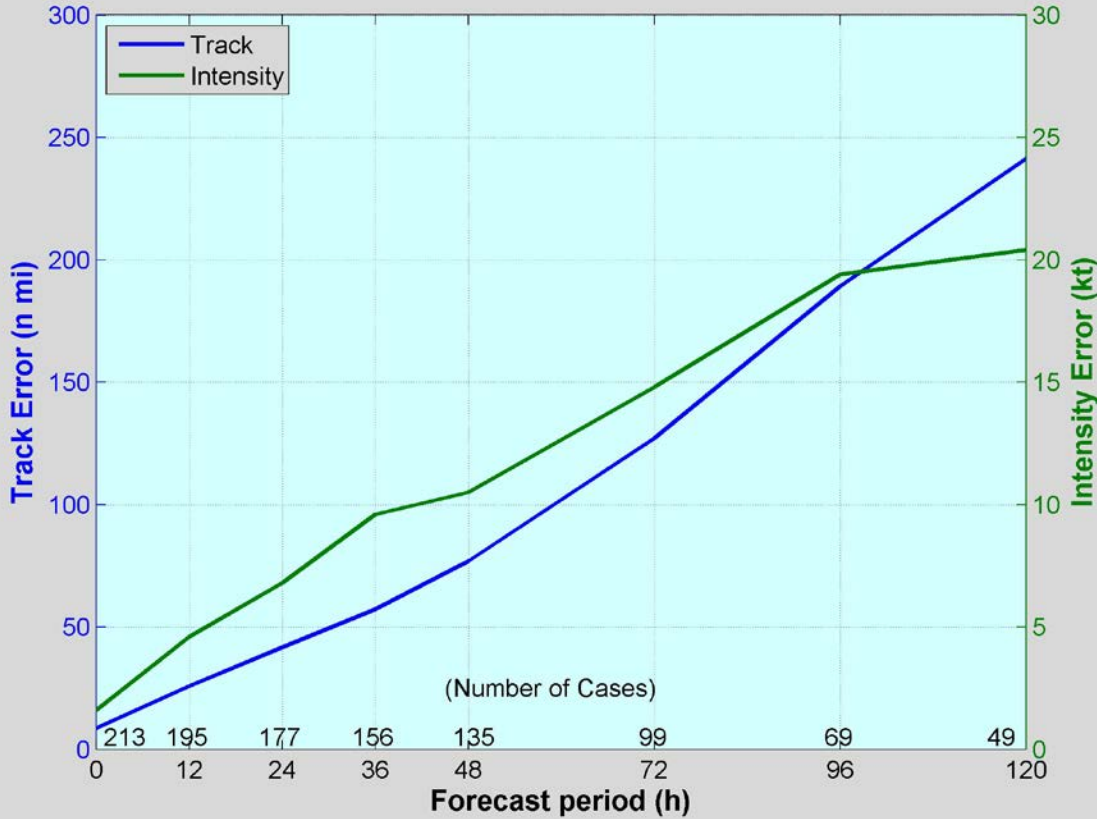




2015 Atlantic Verification



NHC Official Forecasts - 2015 Atlantic Basin



VT (h)	NT	TRACK (n mi)	INT (kt)
000	213	8.6	1.6
012	195	25.8	4.6
024	177	41.6	6.8
036	156	57.2	9.6
048	135	76.8	10.5
072	99	127.0	14.8
096	69	189.2	19.4
120	49	241.4	20.4

Values in green exceed all-time records.

GPRA 48-h track (77 n mi) and intensity (12 kt) goals were met.

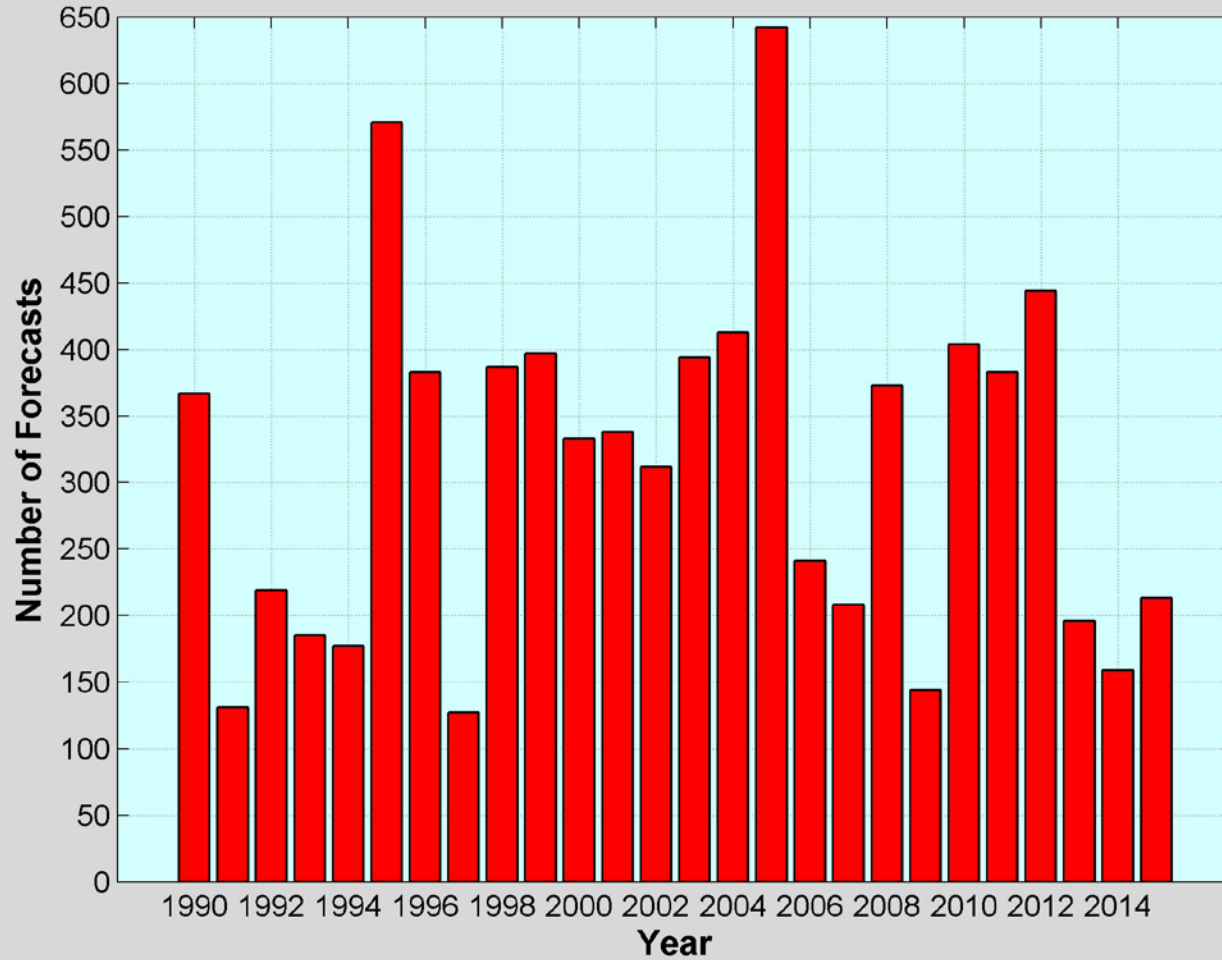
Verifications do not include Kate.



Sample Size since 1990



Number of NHC Official Forecasts By Year
Atlantic Basin

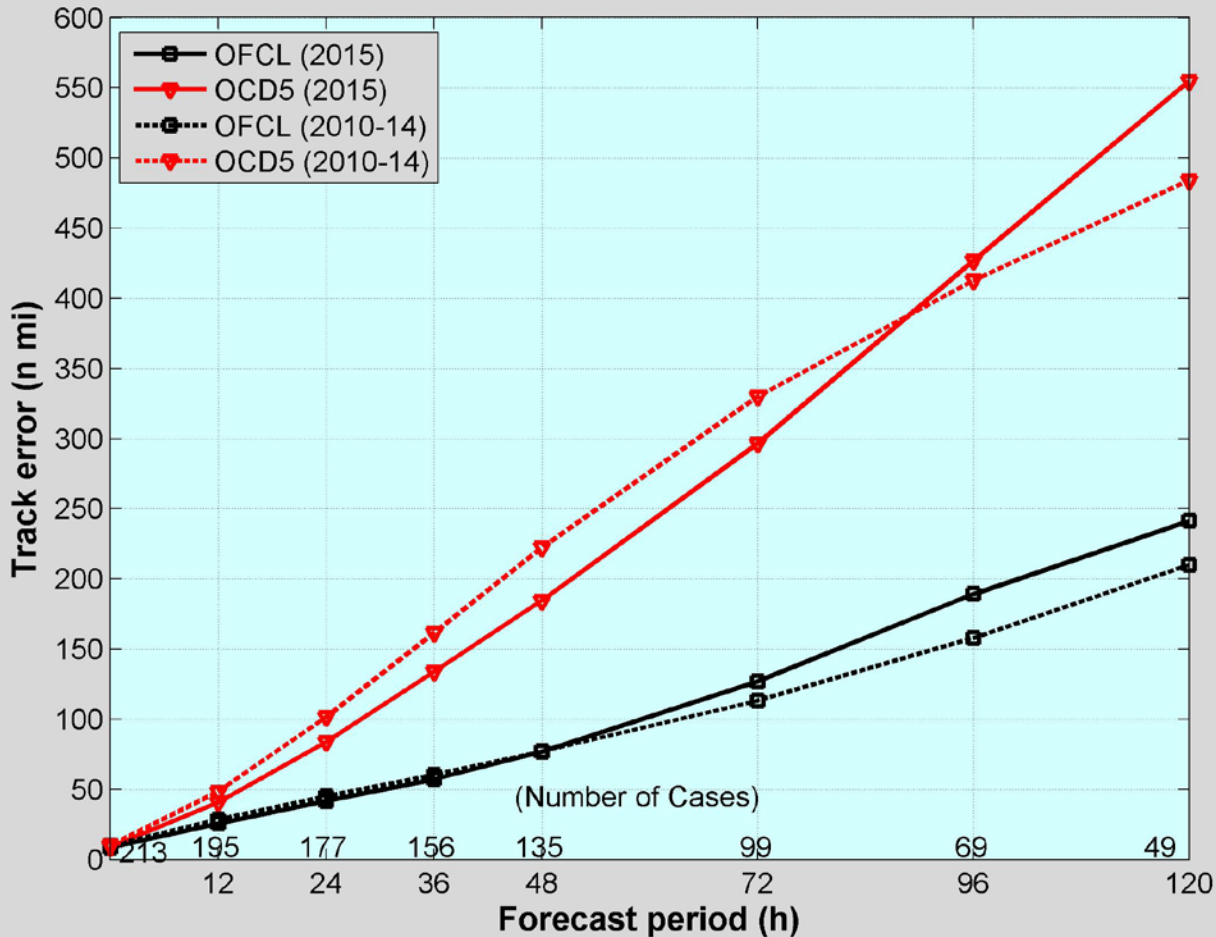


More forecasts were issued in 2015 than last year, but still below average.



Atlantic Track Errors vs. 5-yr Mean

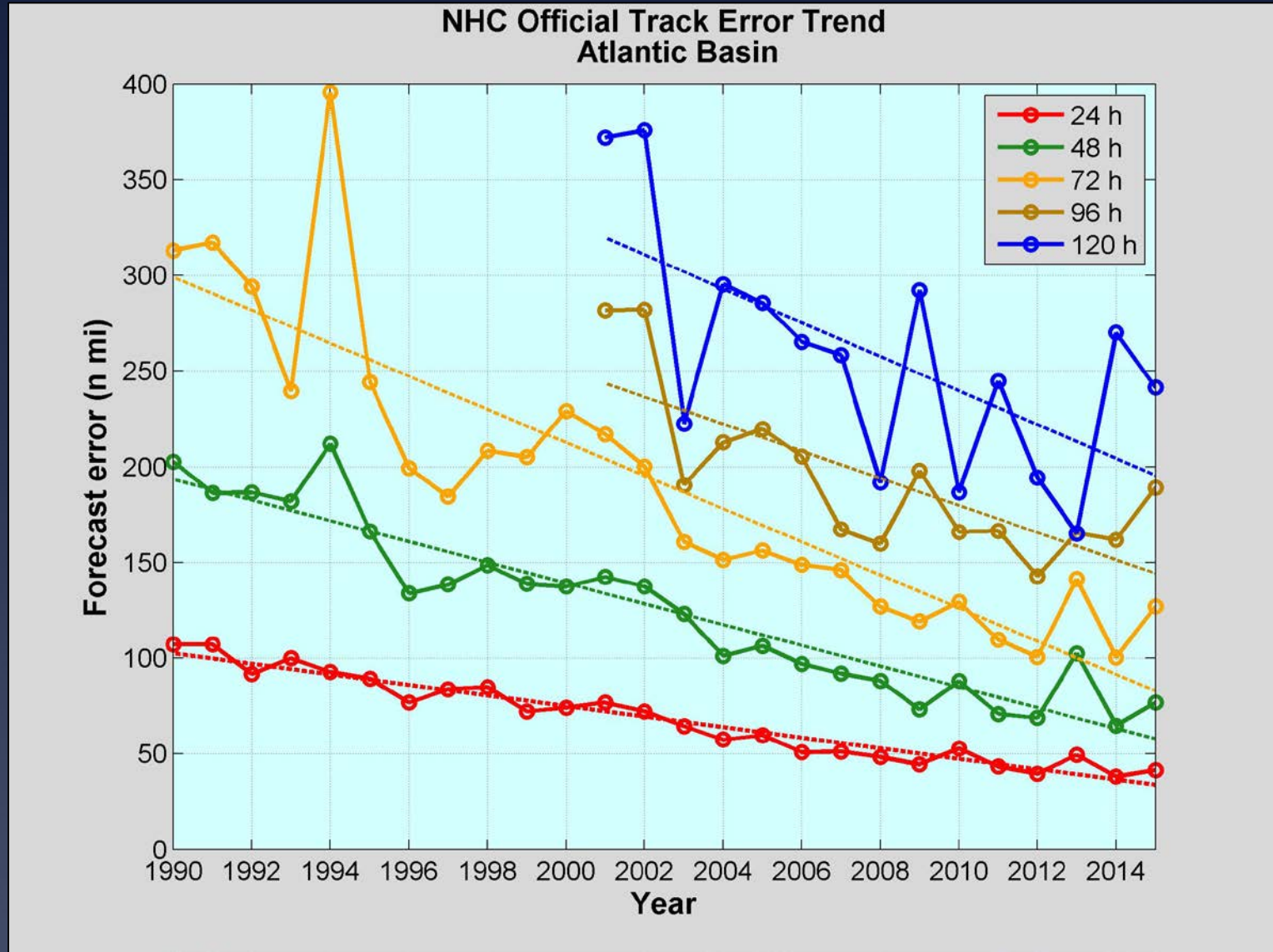
NHC Official vs. CLIPER5 Forecasts
Atlantic Basin



Official forecast errors were close to the 5-yr mean from 12 to 48 h, but higher than average after that. OCD5 errors were lower than average at the shorter leads but higher than normal at the longer leads.



Atlantic Track Error Trends

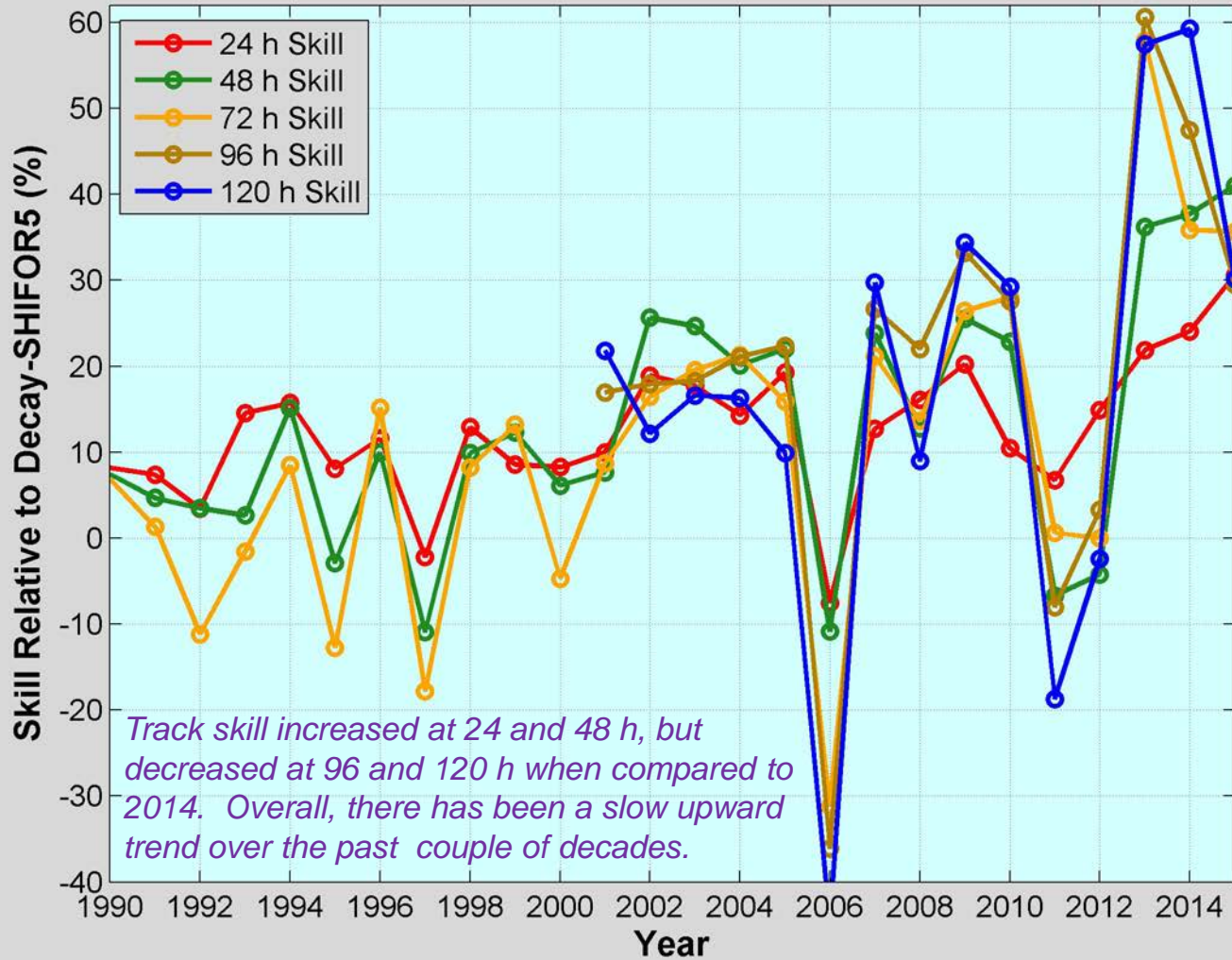


Track errors increased in 2015 compared to 2014 (except at 120 h), and the last five years have been basically flat.



Atlantic Track Skill Trends

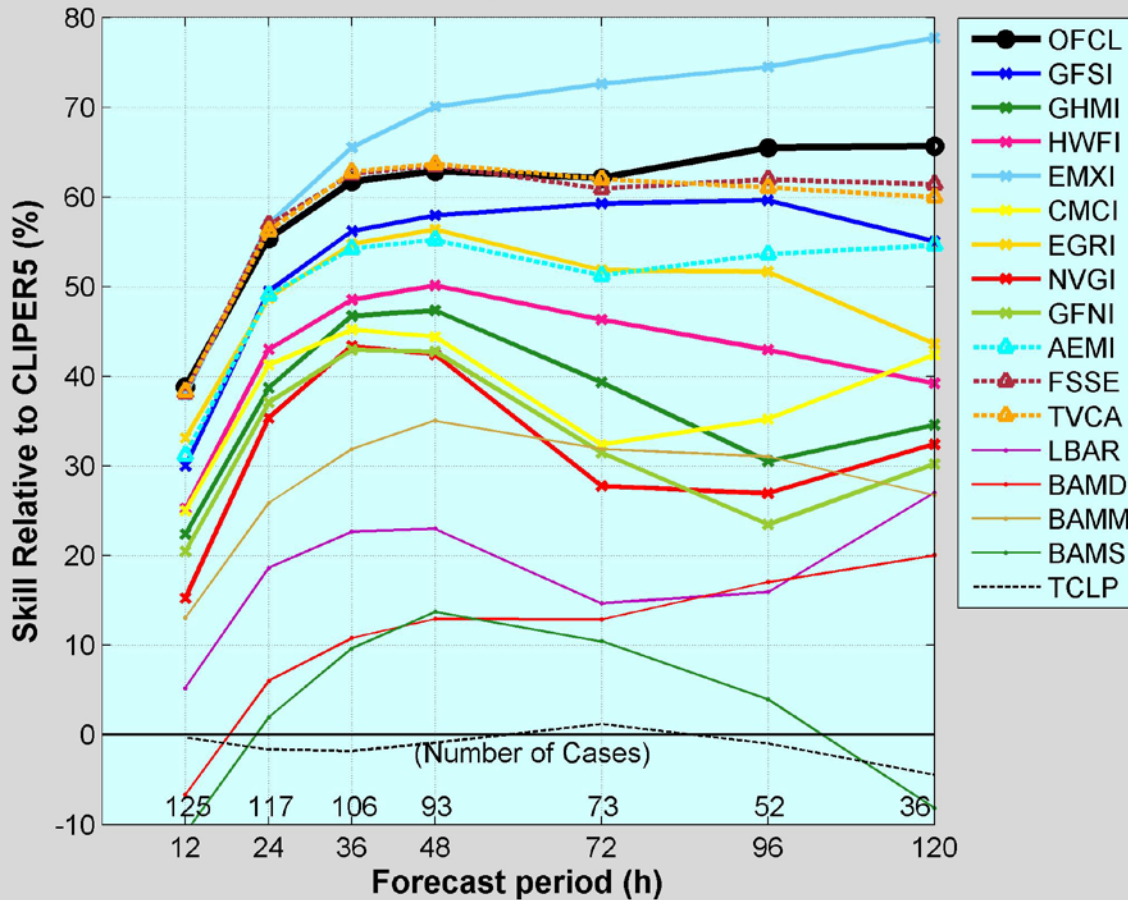
NHC Official Intensity Skill Trend Atlantic Basin





2015 Track Guidance

Track Forecast Skill (Early Models)
2015 - Atlantic Basin



Official forecasts were very skillful, near or better than the consensus aids.

EMXI best model, and the only one that beat the official forecast at 36 h and beyond.

GFSI was a fair to good performer (second best individual model) with skill just below the official forecasts and the consensus models.

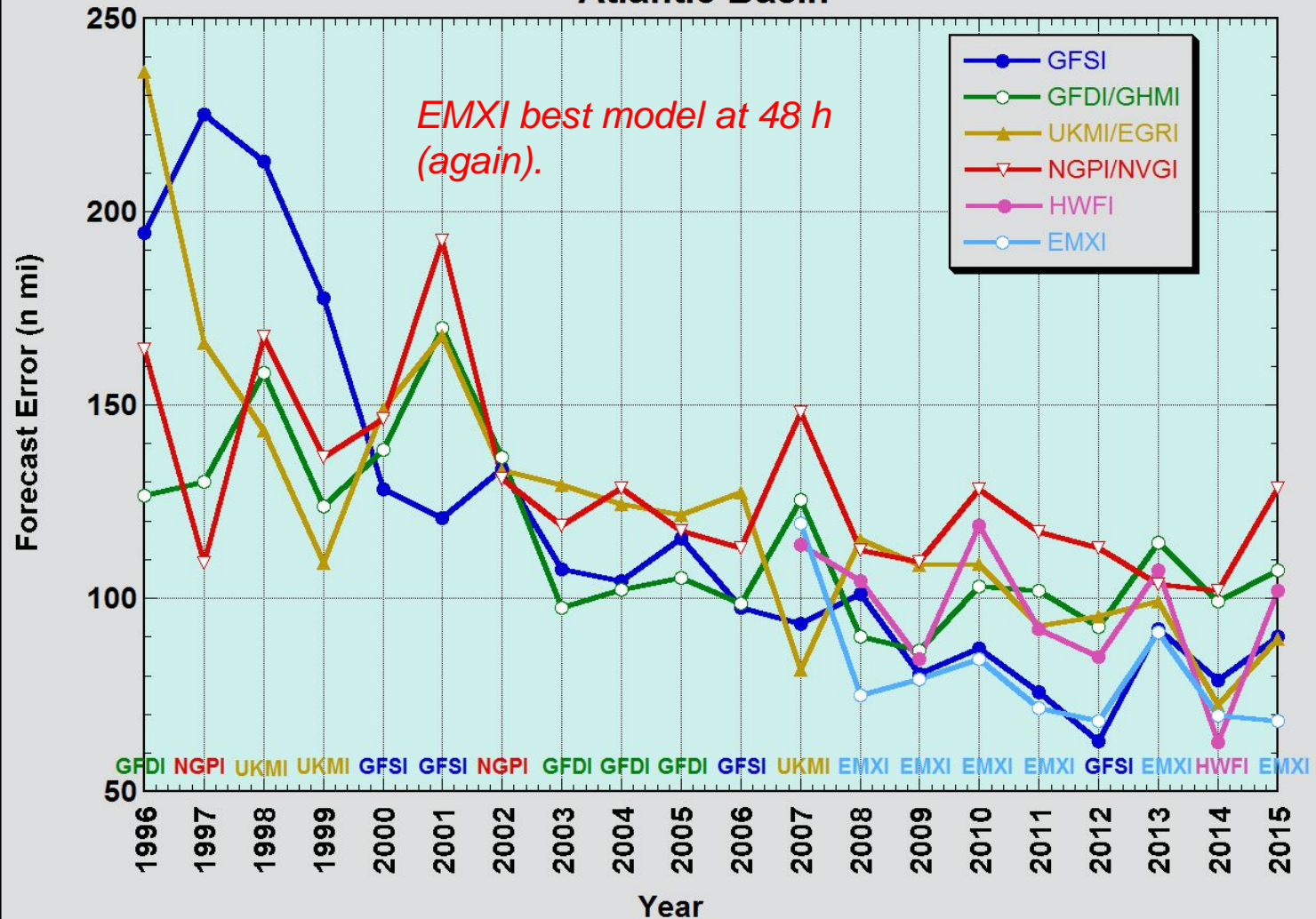
GFS ensemble mean (AEMI), HWFI, and EGRI next best models.

GHMI, CMCI, NVGI, GFNI trailed again in 2015.



Track Model Trends

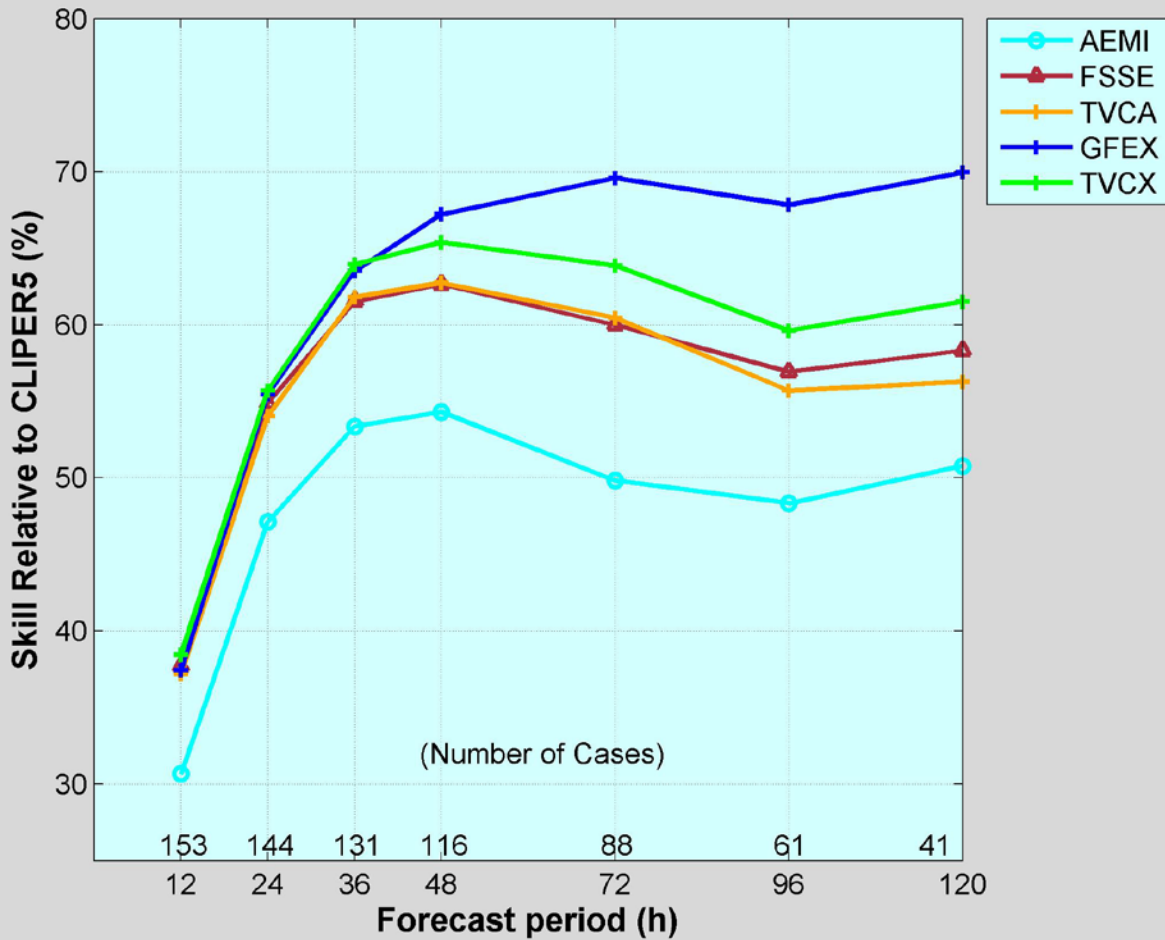
48-h Track Forecast Guidance Trends Atlantic Basin





2015 Consensus Guidance

Track Forecast Skill (Consensus Models)
2015 - Atlantic Basin



GFEX best performer.

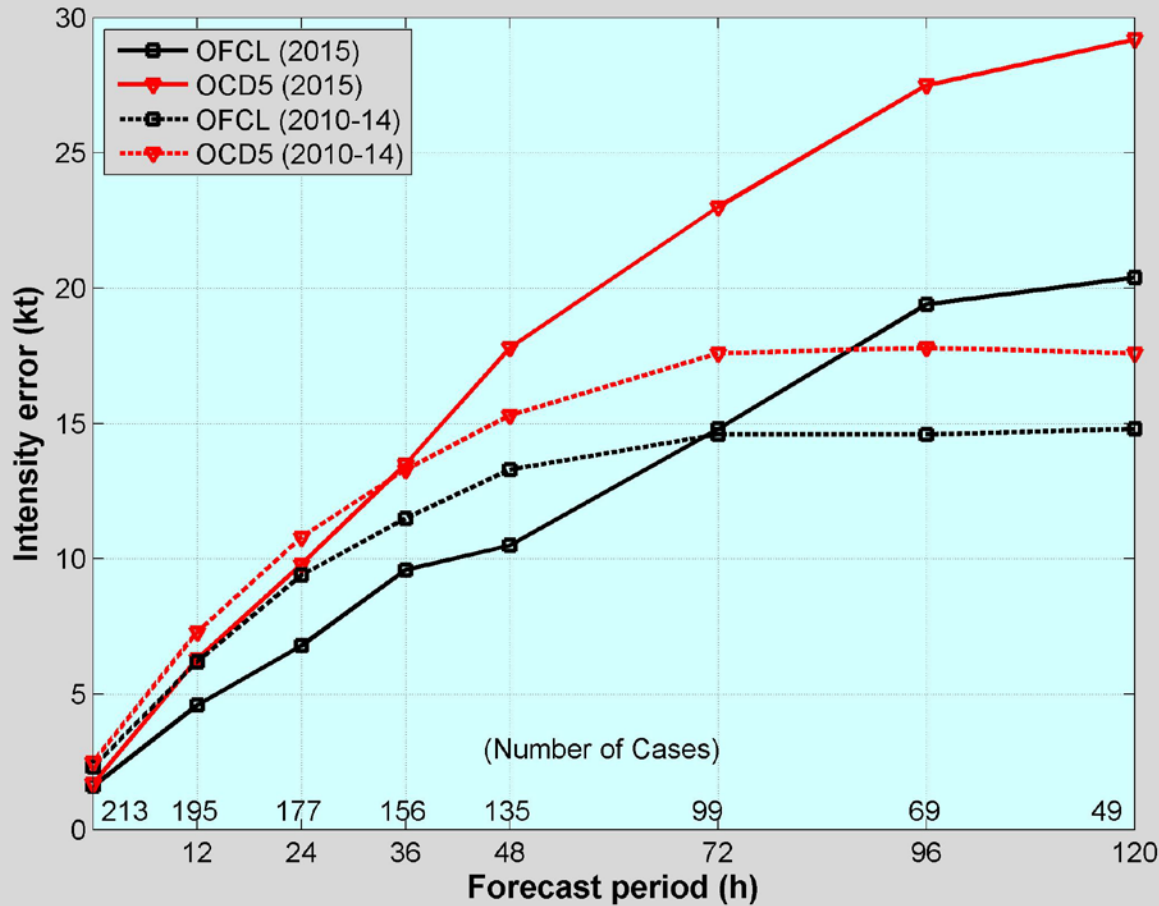
TVCX slightly better than TVCA/FSSE.

AEMI has less skill.



Atlantic Intensity Errors vs. 5-Year Mean

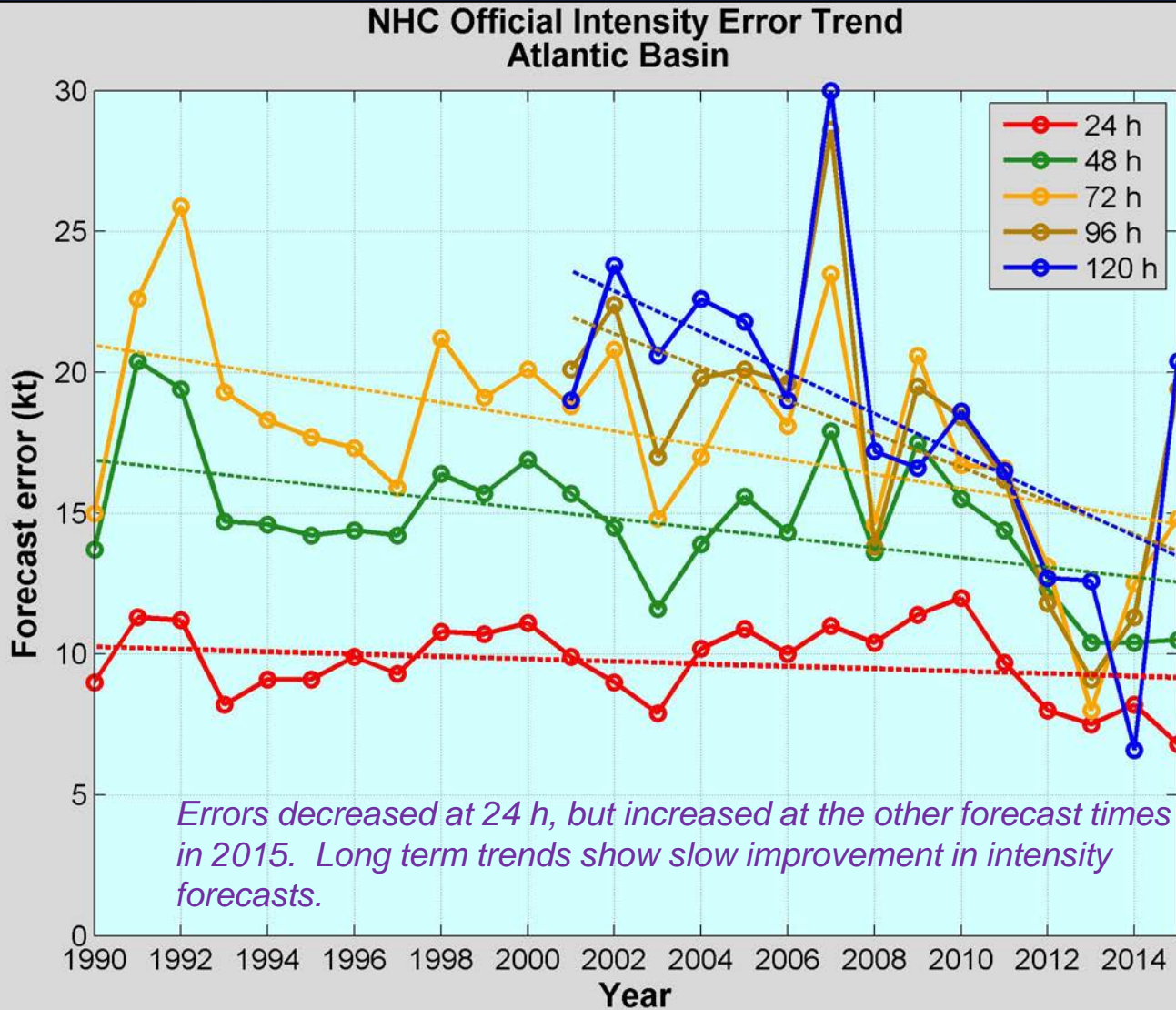
NHC Official vs. Decay-SHIFOR5 Forecasts
Atlantic Basin



Official forecast errors were lower than the 5-yr mean through 48 h, but higher than the mean at 96 and 120 h. The season's storms were slightly easier to predict in the short term, but harder than normal at 48 h and beyond.



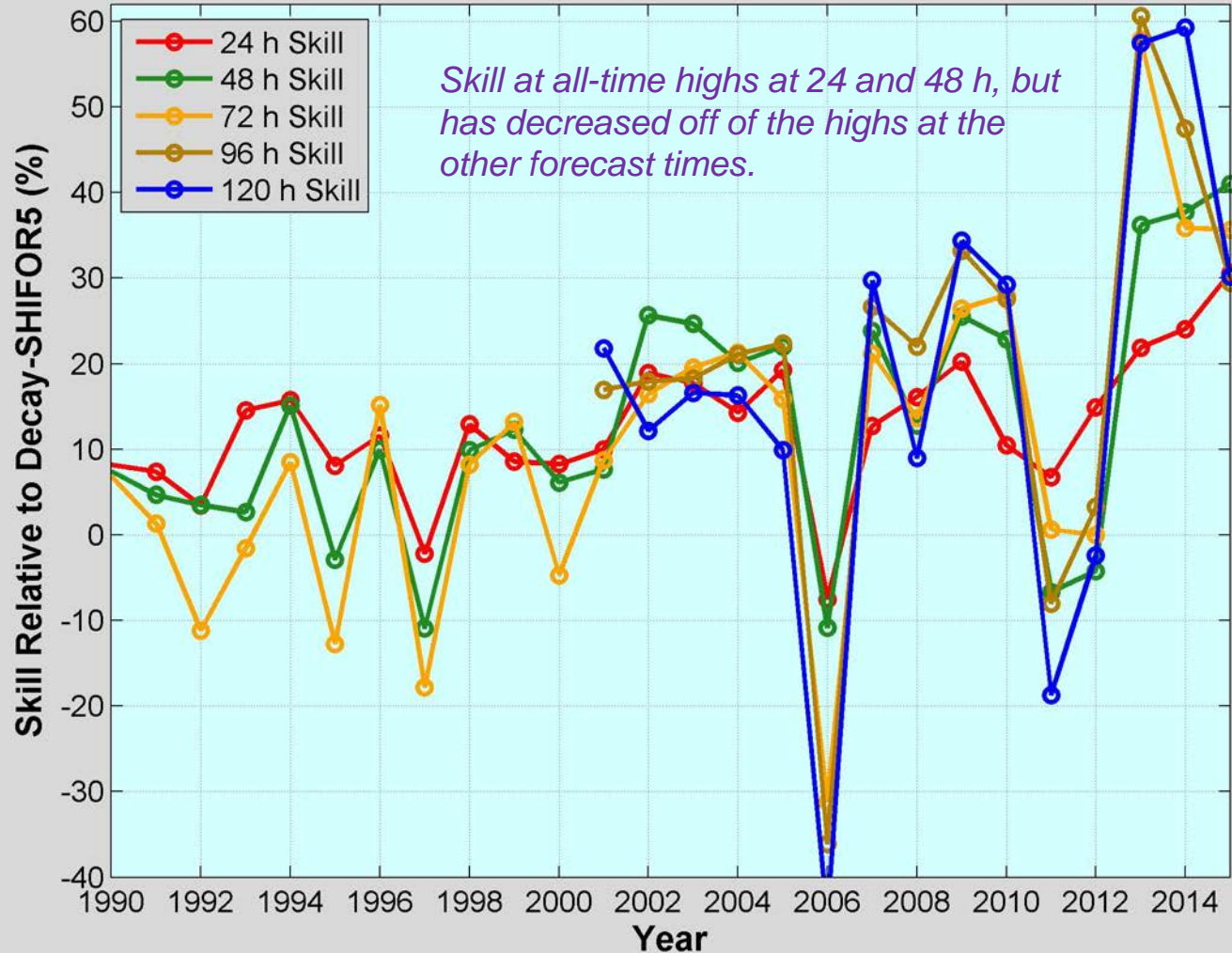
Atlantic Intensity Error Trends





Atlantic Intensity Skill Trends

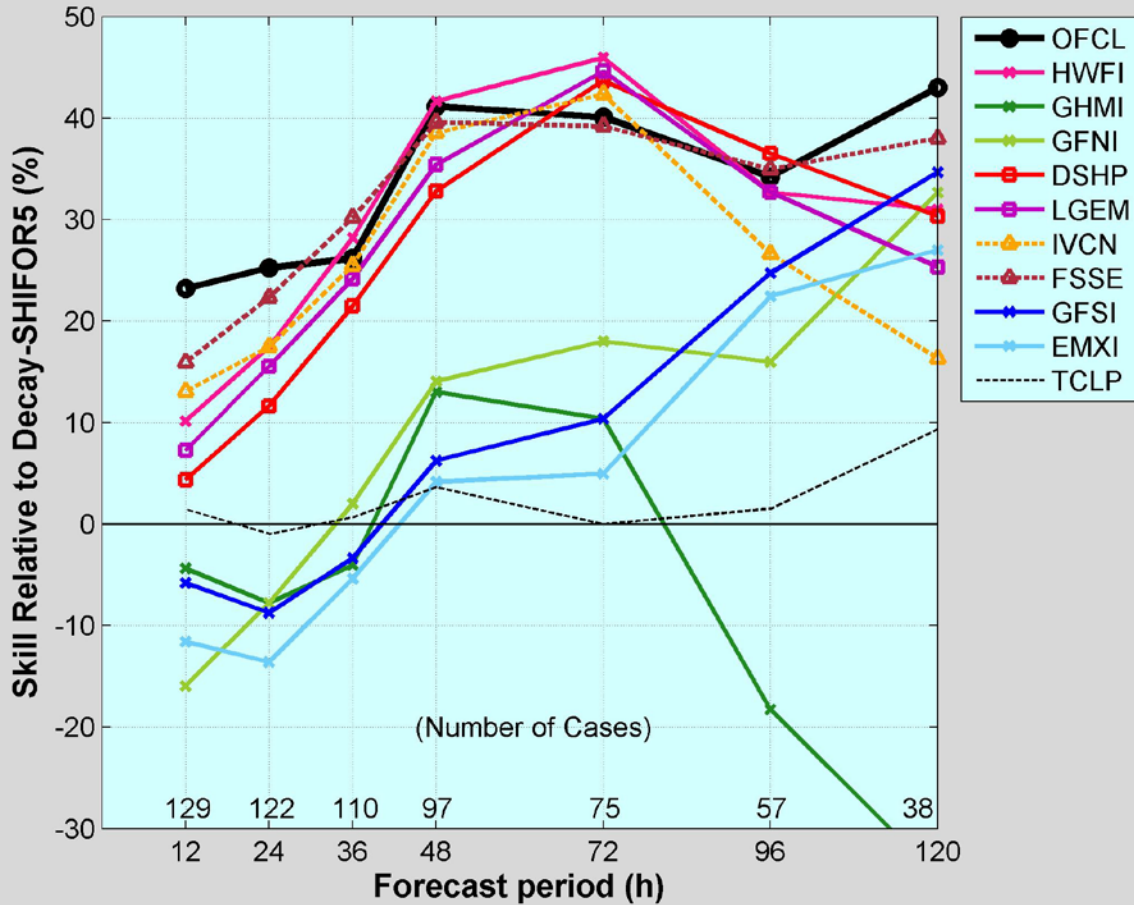
NHC Official Intensity Skill Trend
Atlantic Basin





2015 Intensity Guidance

Intensity Forecast Skill (Early Models)
2015 - Atlantic Basin



Official forecasts skillful at all times, near or better than the top models.

FSSE a little better than IVCN at most forecast times.

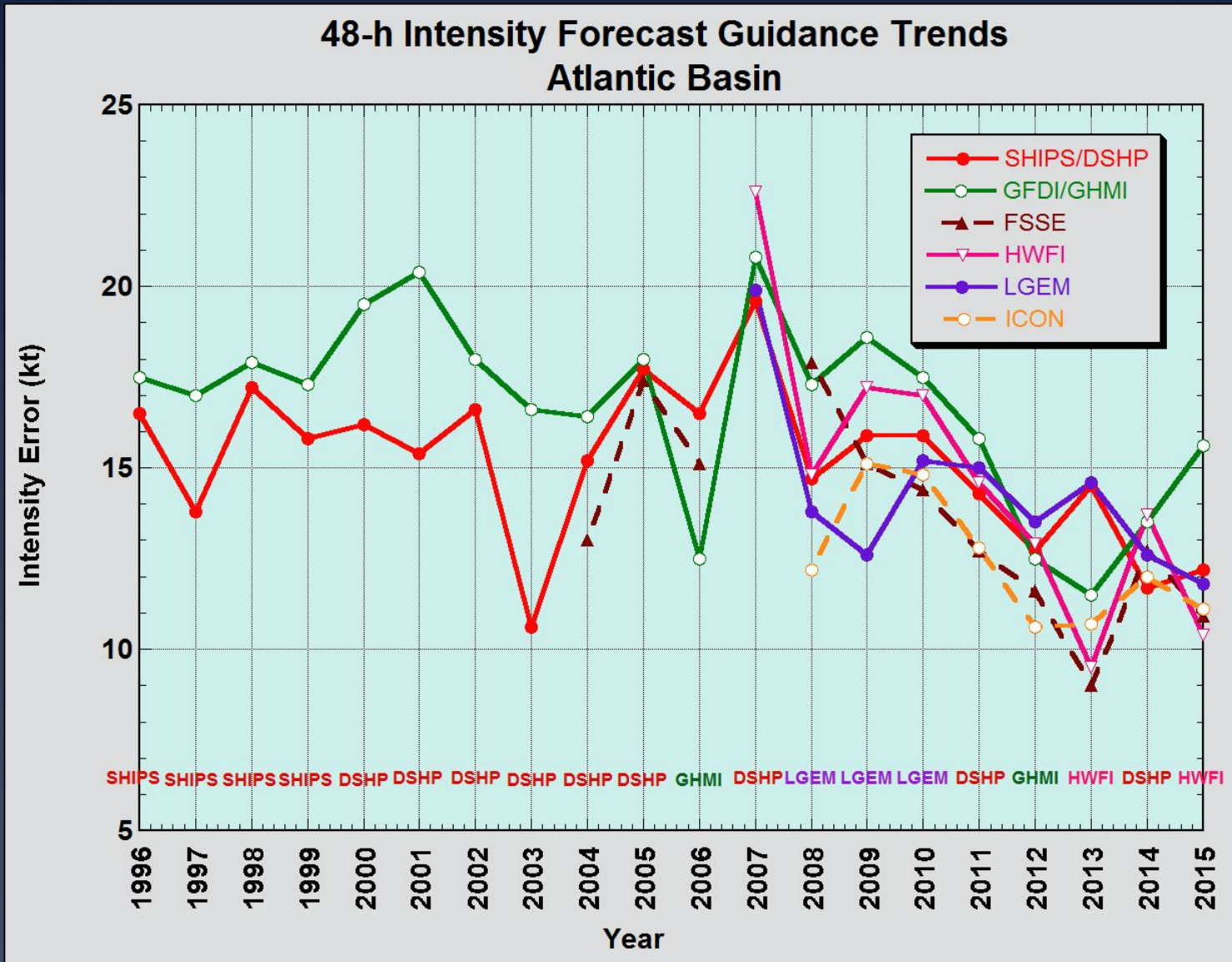
HWFI, DSHP, and LGEM were strong performers, similar to or better than the consensus aids.

GFNI much less skillful and GHMI had little or no skill in 2015.

GFSI and EMXI showed increased skill with forecast time, but not competitive with the top intensity models.



Intensity Model Error Trends



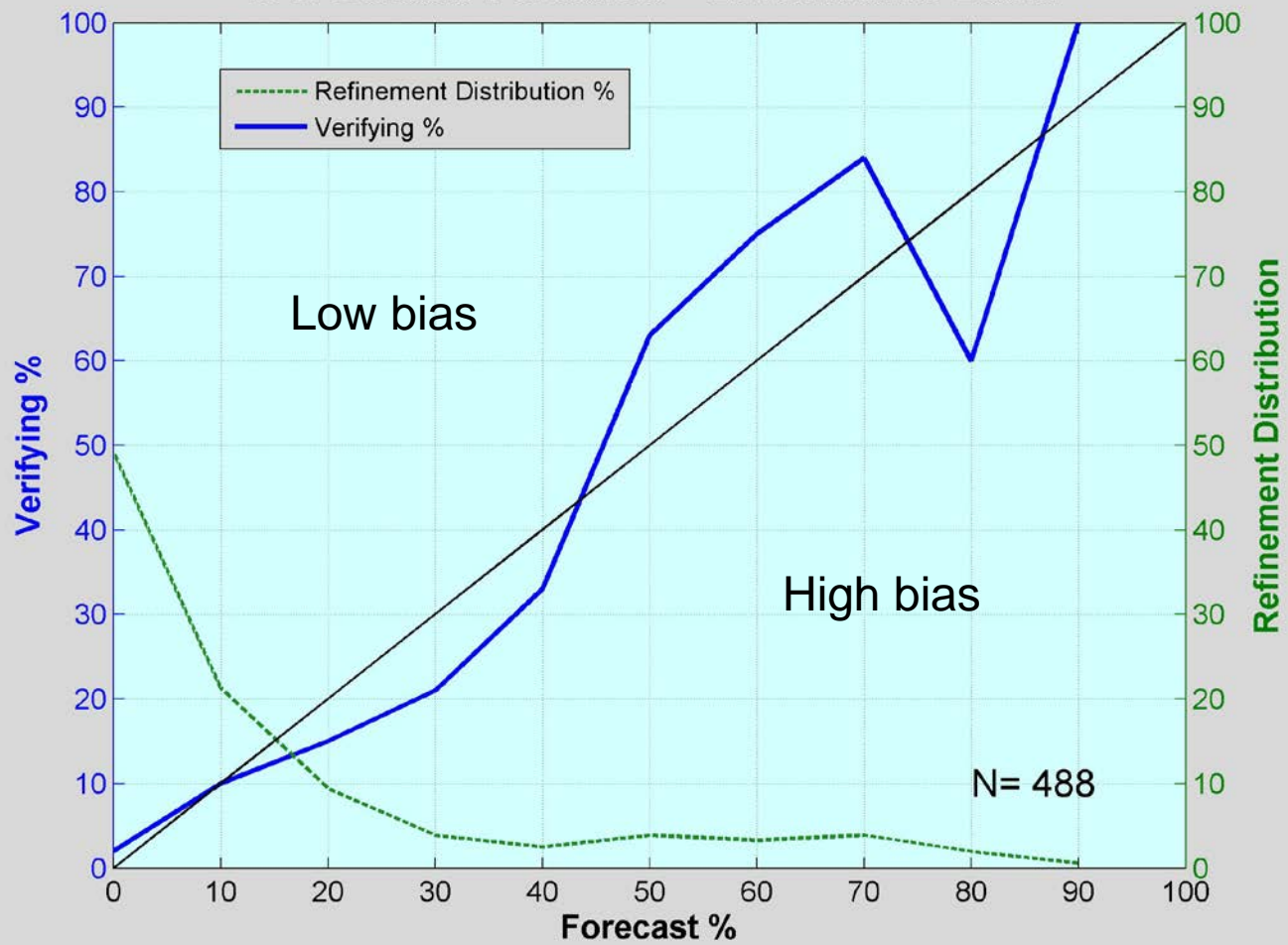
HWFI best model at 48 h in 2015. Best 48-hr forecast came from a dynamical model 3 of past 4 years.



2-day Genesis Forecast Verification



48-h Genesis Forecasts - 2015 Atlantic Basin



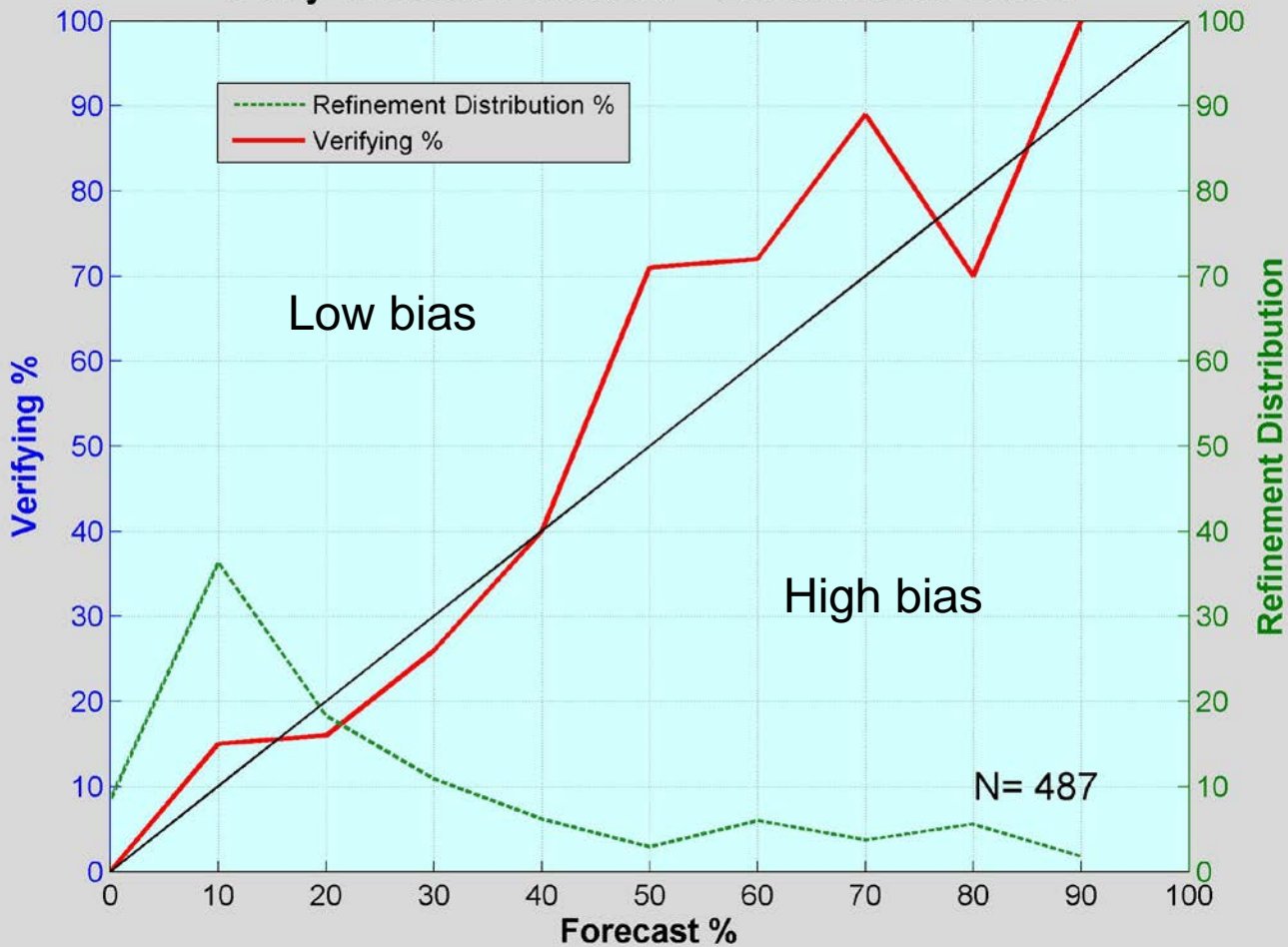
*Slight high bias for low probabilities
Slight low bias in 50-70 % range.*



5-day Genesis Forecast Verification



5-day Genesis Forecasts - 2015 Atlantic Basin

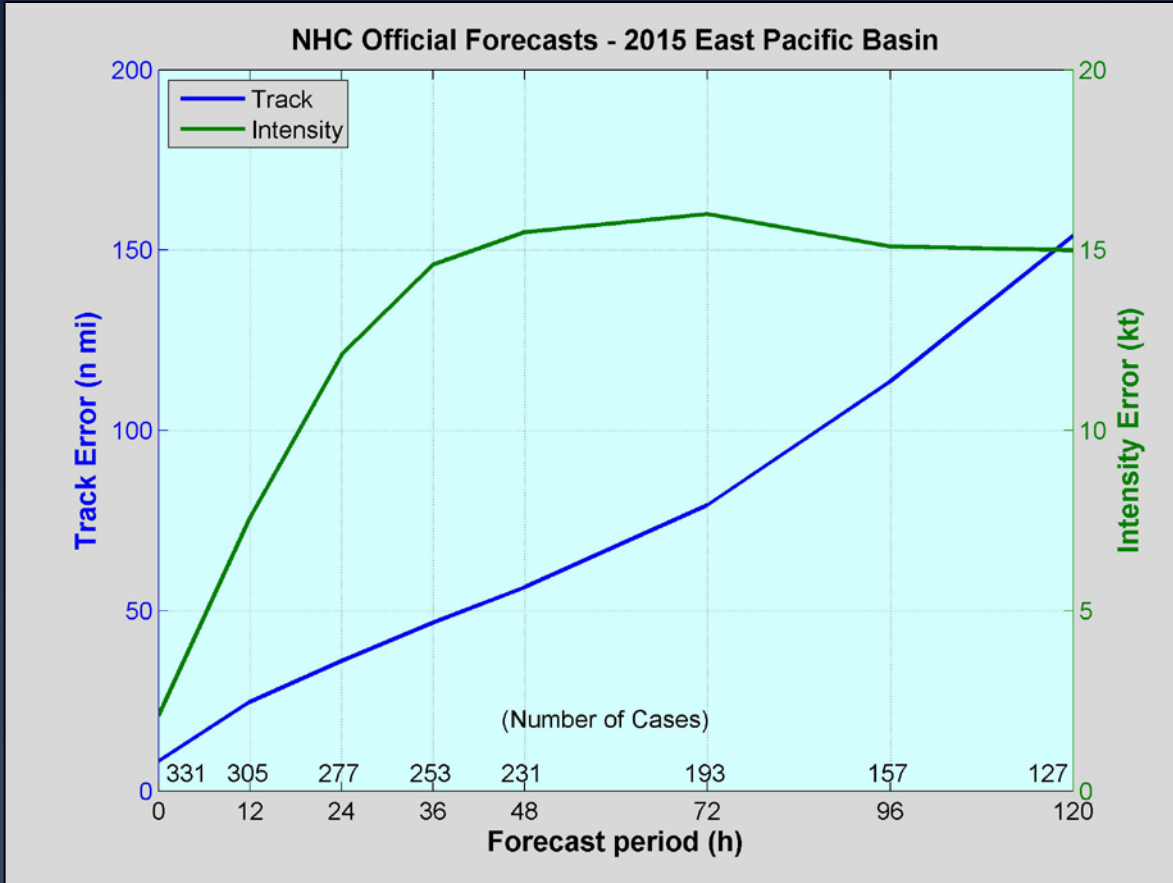


Well-calibrated from 0 to 40%.

Low bias for probabilities from 50-70 %



2015 East Pacific Verification



VT (h)	NT	TRACK (n mi)	IN (kt)
000	331	8.3	2.1
012	305	24.8	7.6
024	277	36.1	12.1
036	253	46.7	14.6
048	231	56.5	15.5
072	193	79.3	16.0
096	157	113.6	15.1
120	127	154.0	15.0

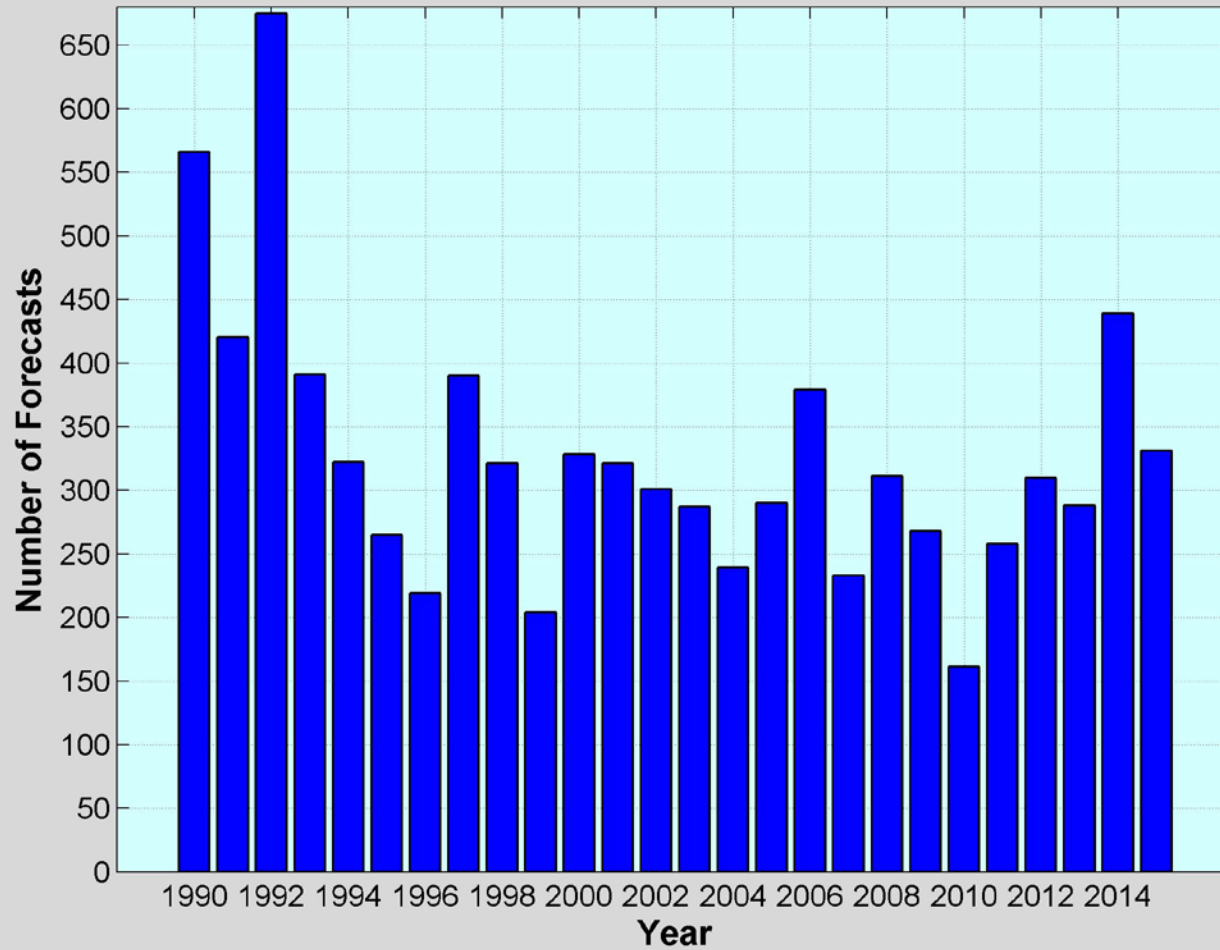
Value in green exceeded all-time record.



Sample Size since 1990



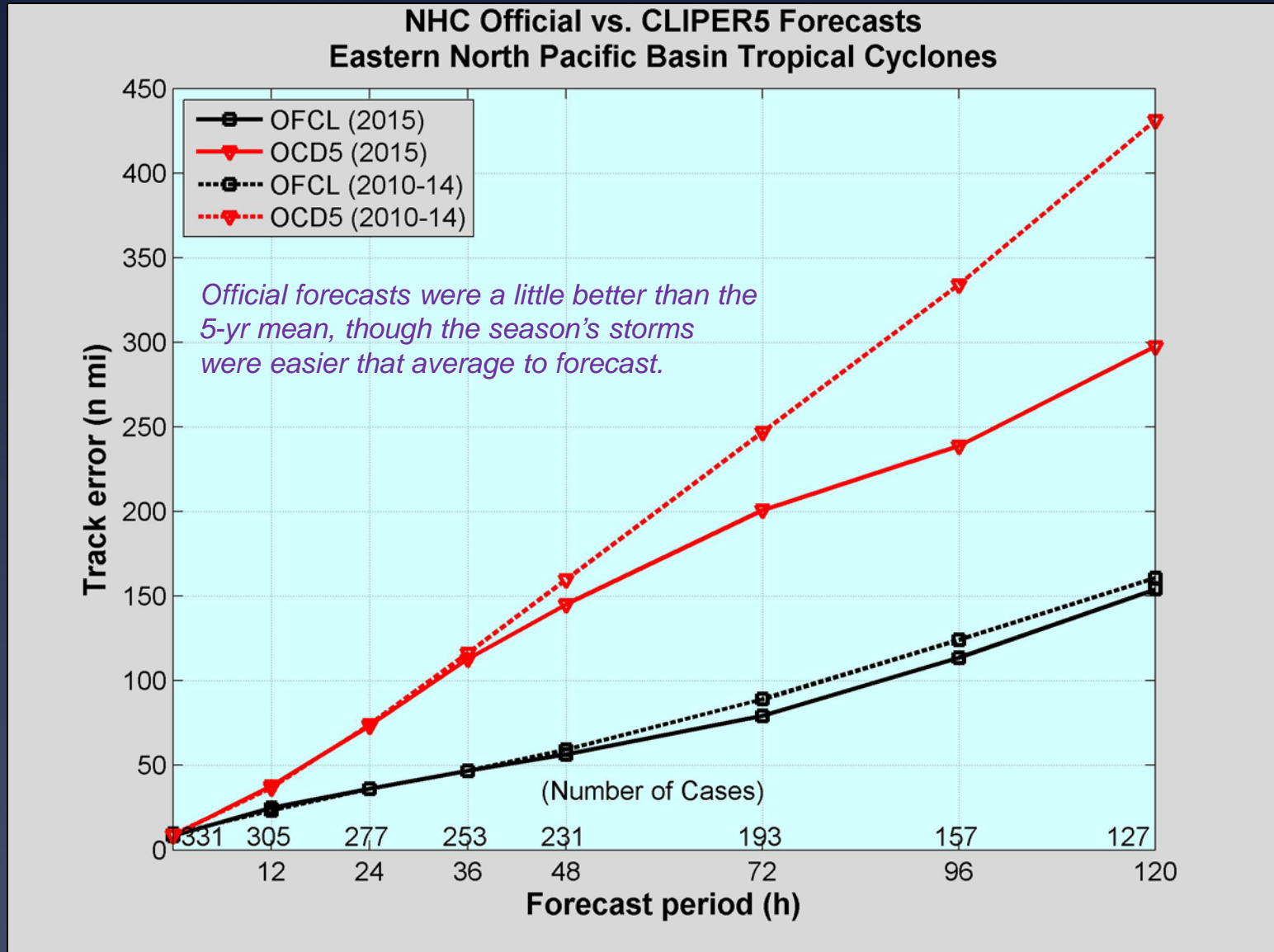
Number of NHC Official Forecasts By Year
East Pacific Basin



Less forecasts were issued in 2015 than last year, but still above average.



Eastern Pacific Track Errors vs. 5-Year Mean

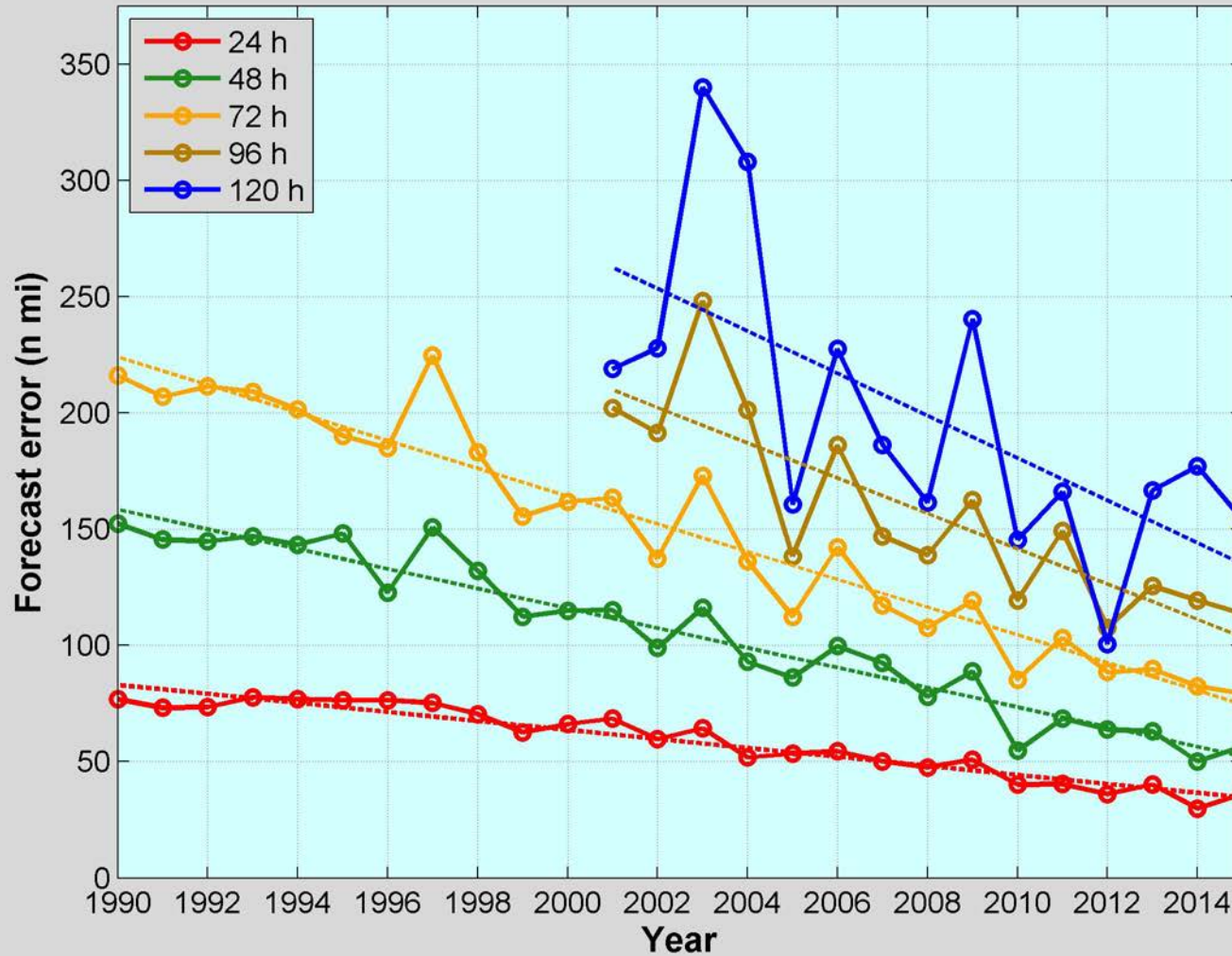




EPAC Track Error Trends



NHC Official Track Error Trend
Eastern North Pacific Basin Tropical Cyclones

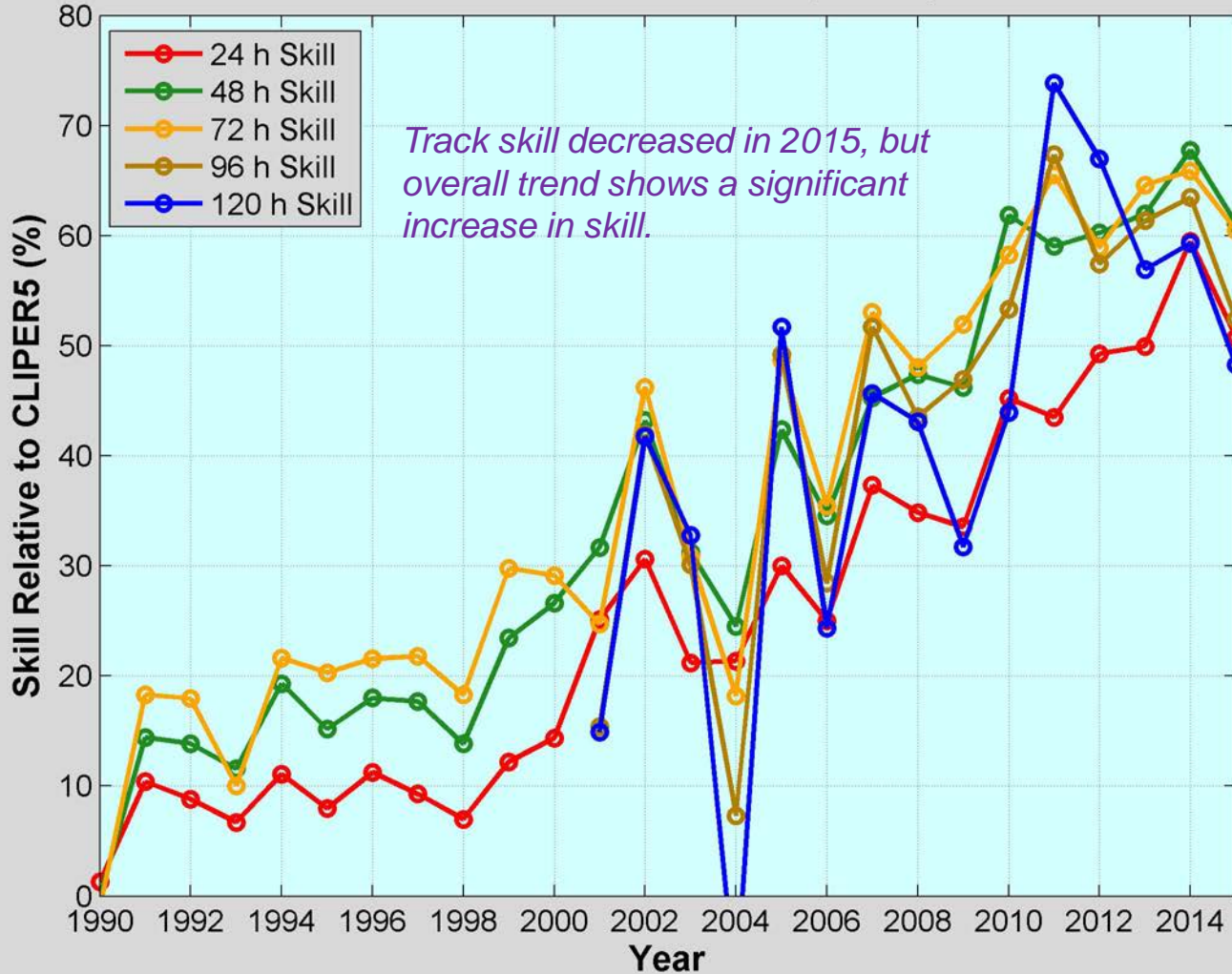


In 2015, slight increase in errors at shorter lead times but decrease in errors at longer leads. Since 1990, track errors have decreased substantially.



EPAC Track Skill Trends

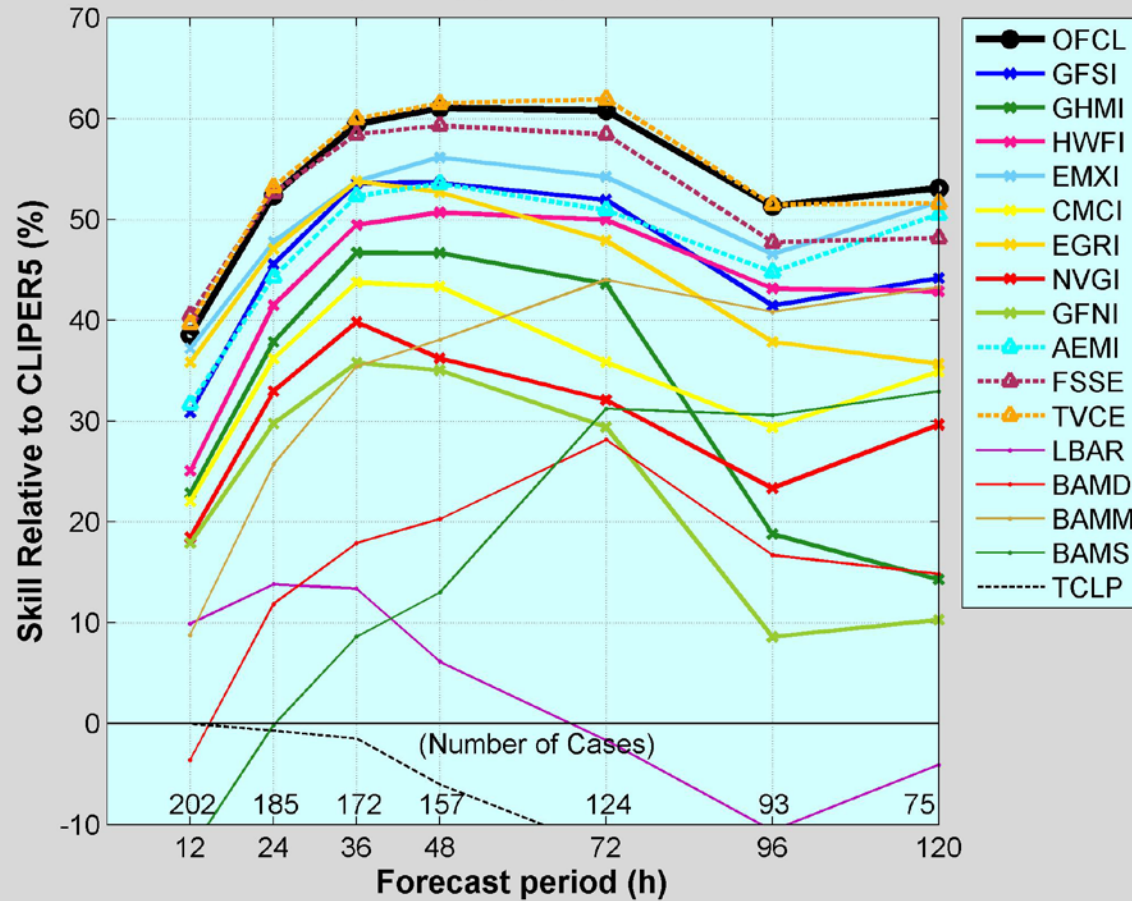
NHC Official Track Skill Trend
Eastern North Pacific Basin Tropical Cyclones





2015 Track Guidance

Track Forecast Skill (Early Models)
2015 - East Pacific Basin



Official forecasts very skillful, near the best model – TVCE.

FSSE strong performer, but not quite as good as TVCE.

EMXI best individual model, but less skill than the official forecasts and consensus models.

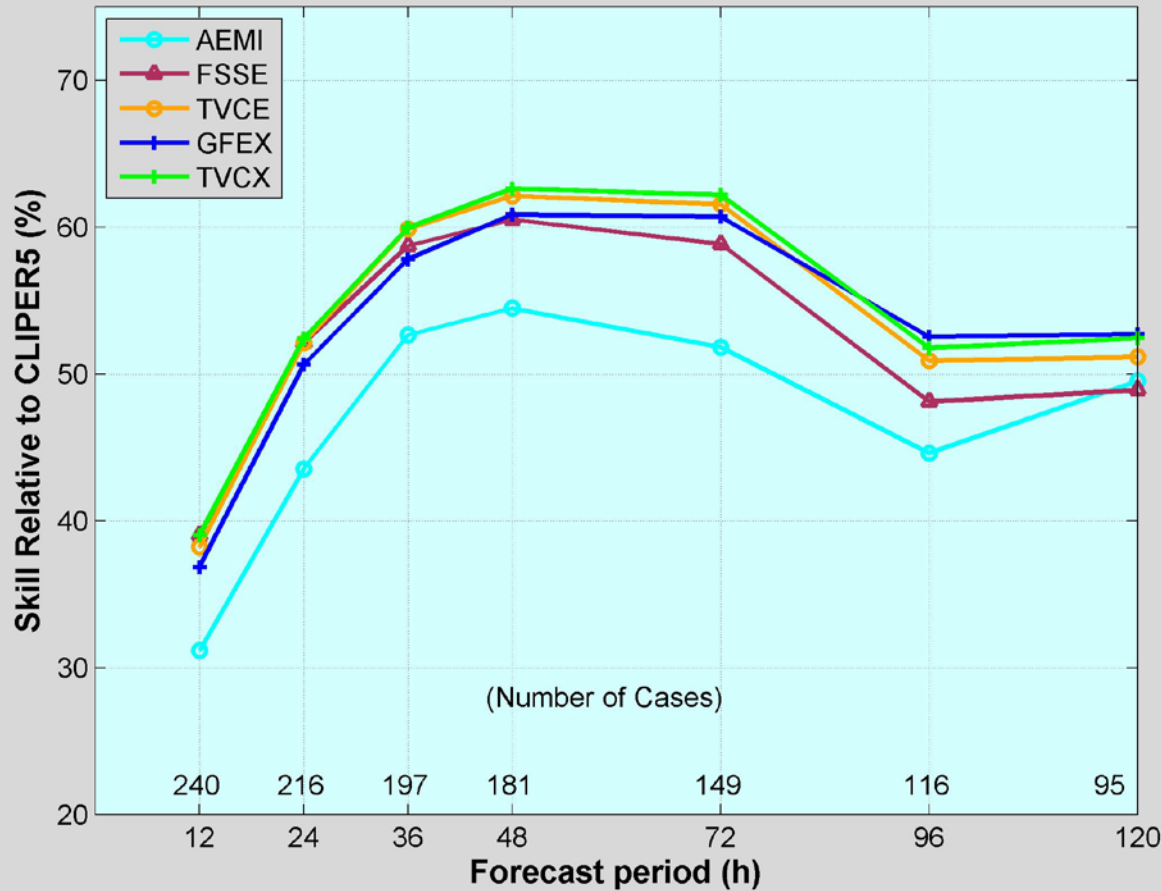
GFS ensemble mean, GFSI, HWFI, EGRI are the next best models.

CMCI, GHMI, GFNI, NVGI, trailed.



2015 Consensus Guidance

Track Forecast Skill (Consensus Models)
2015 - Eastern North Pacific Basin



TVCX slightly outperformed TVCE.

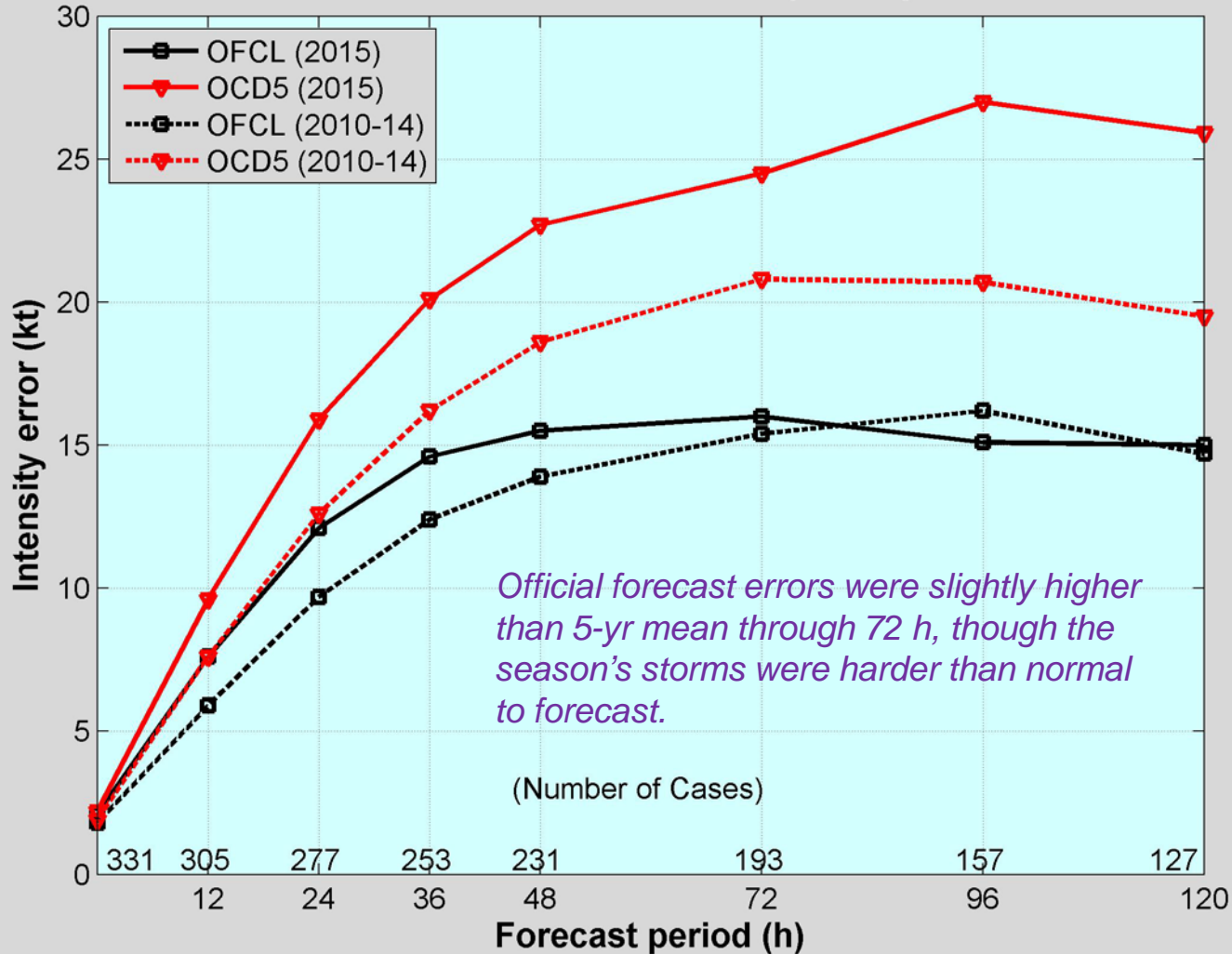
GFEX a little less skill than TVCX/TVCE through 72 h, but was the best model at 96 and 120 h.

AEMI has the lowest skill of the group.



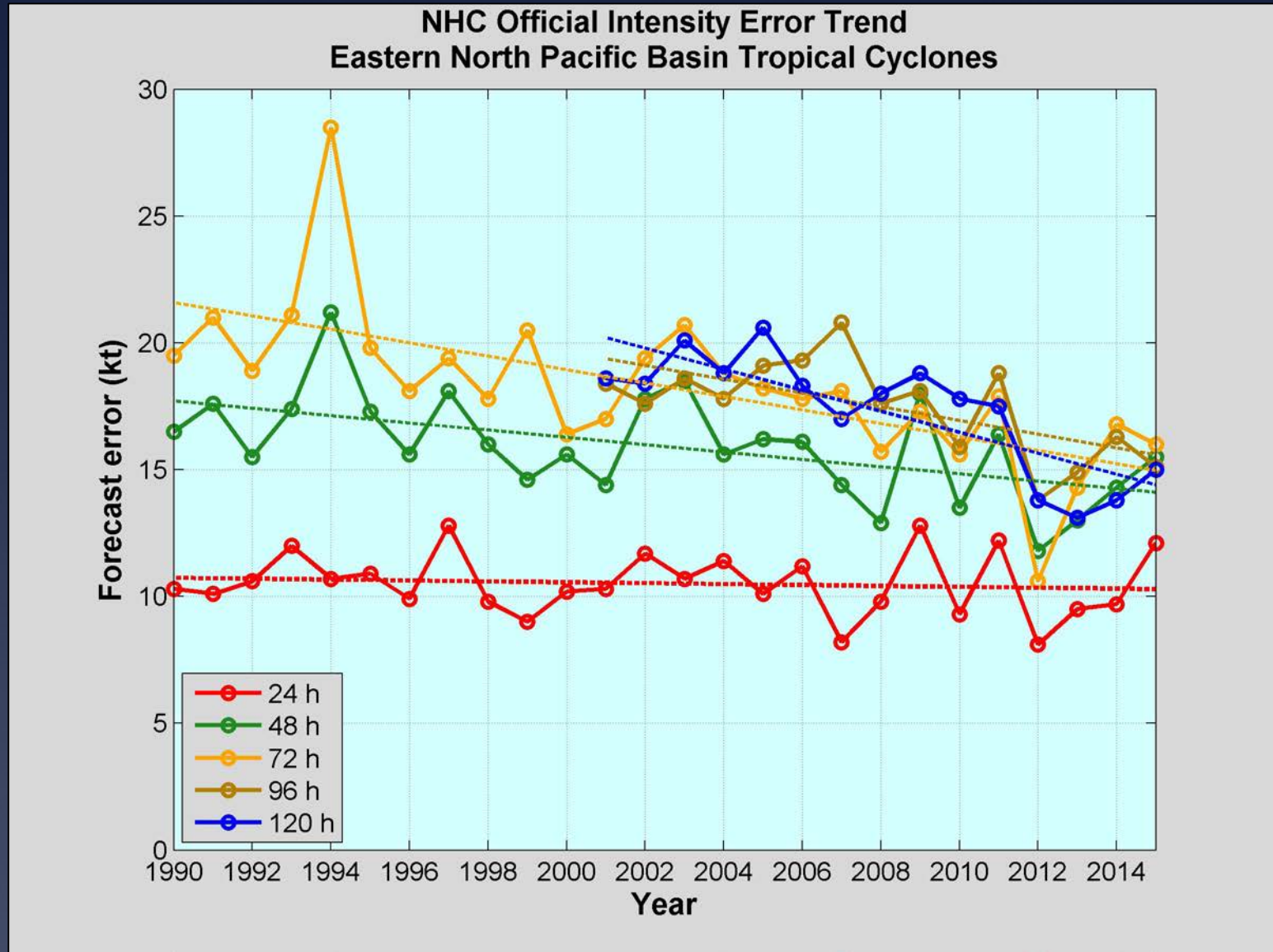
EPAC Intensity Errors vs. 5-Year Mean

NHC Official vs. Decay-SHIFOR5 Forecasts Eastern North Pacific Basin Tropical Cyclones





EPAC Intensity Error Trends

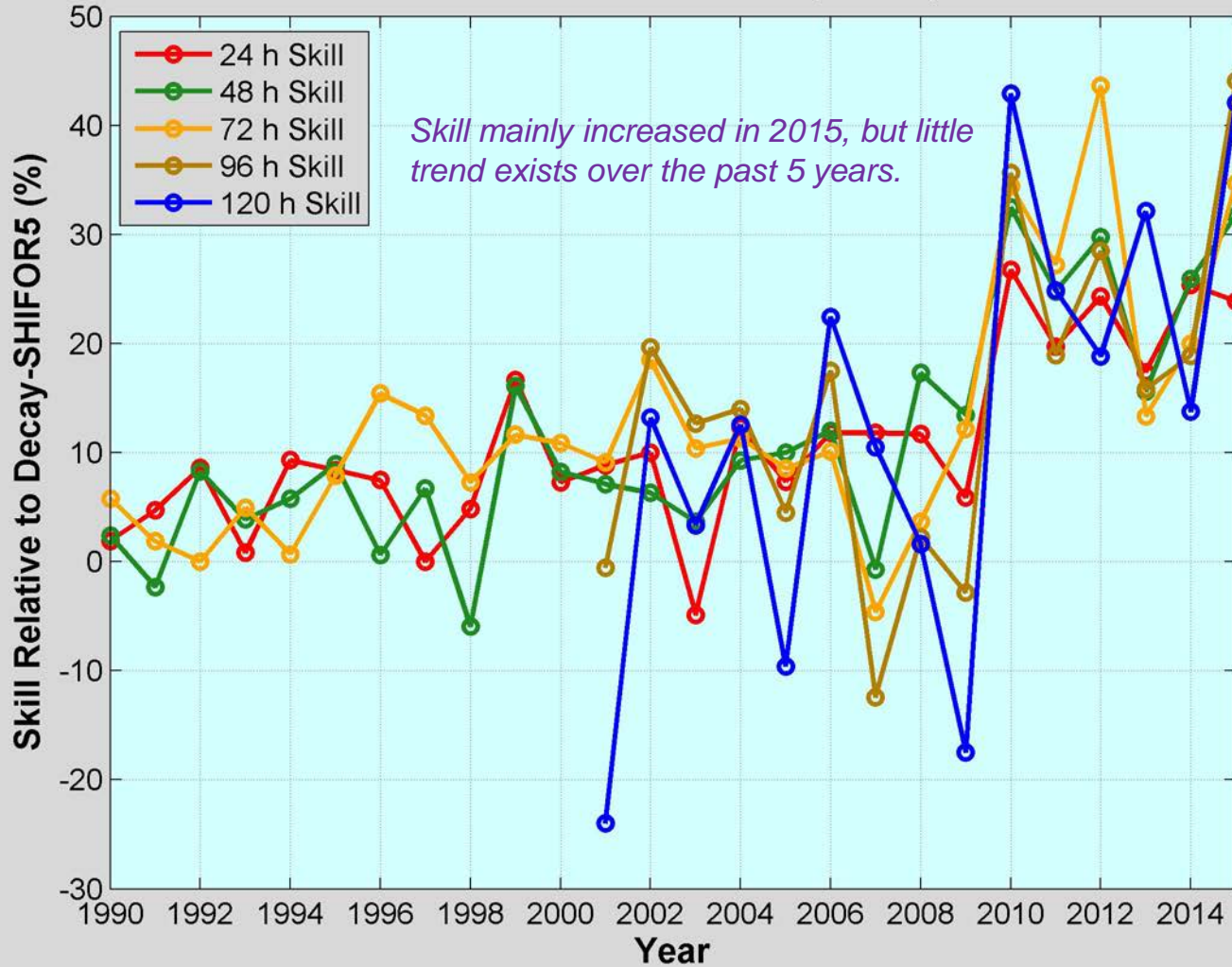


Errors went up a little in 2015. No trend at 24 h, slight downward long-term trend at 48 h and beyond.



EPAC Intensity Skill Trends

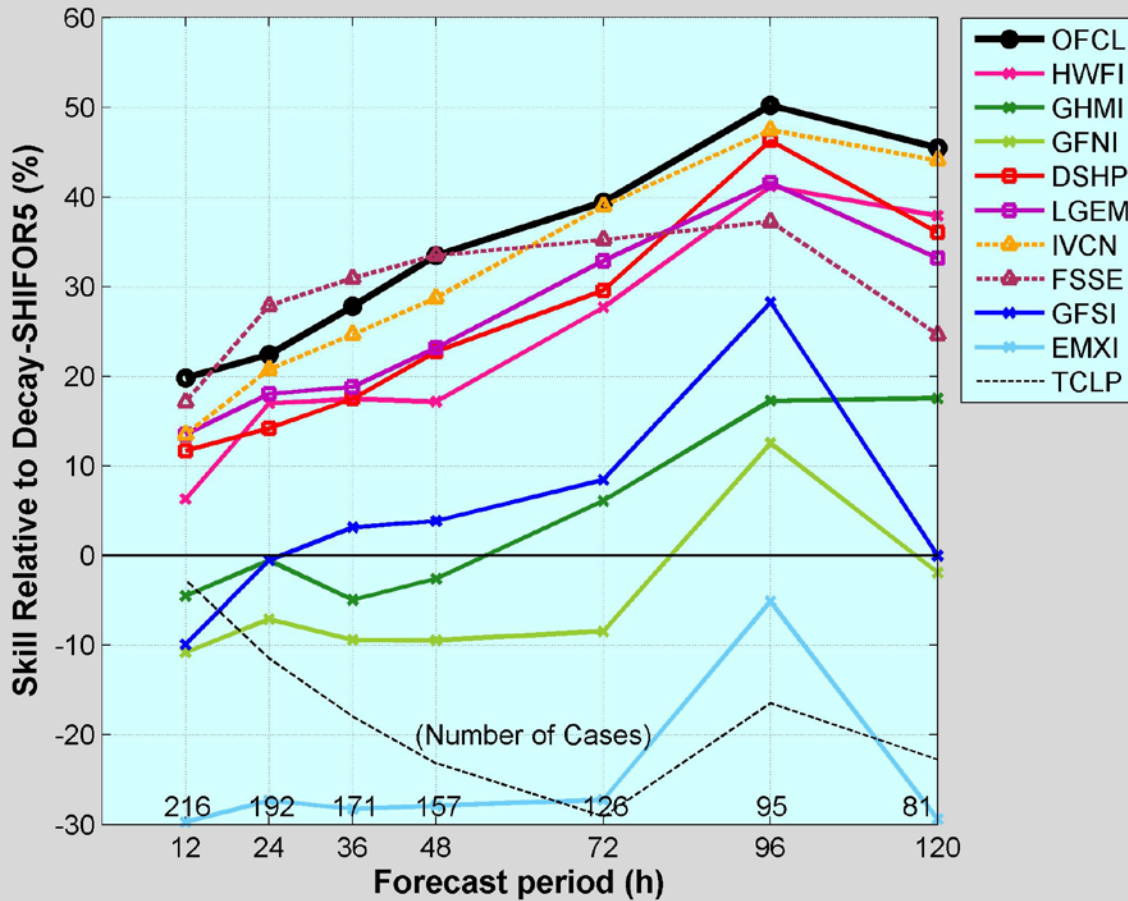
NHC Official Intensity Skill Trend
Eastern North Pacific Basin Tropical Cyclones





2015 Intensity Guidance

Intensity Forecast Skill (Early Models)
2015 - Eastern North Pacific Basin



Official forecasts performed as good as or better than the best models.

FSSE best model in short term and only one to beat the official forecast. However, not as skillful as IVCN at longer leads.

HWFI, DSHP, and LGEM about equally skillful and showed increased skill through the period.

GHMI, GFNI, and GFSI have little skill and are not competitive.

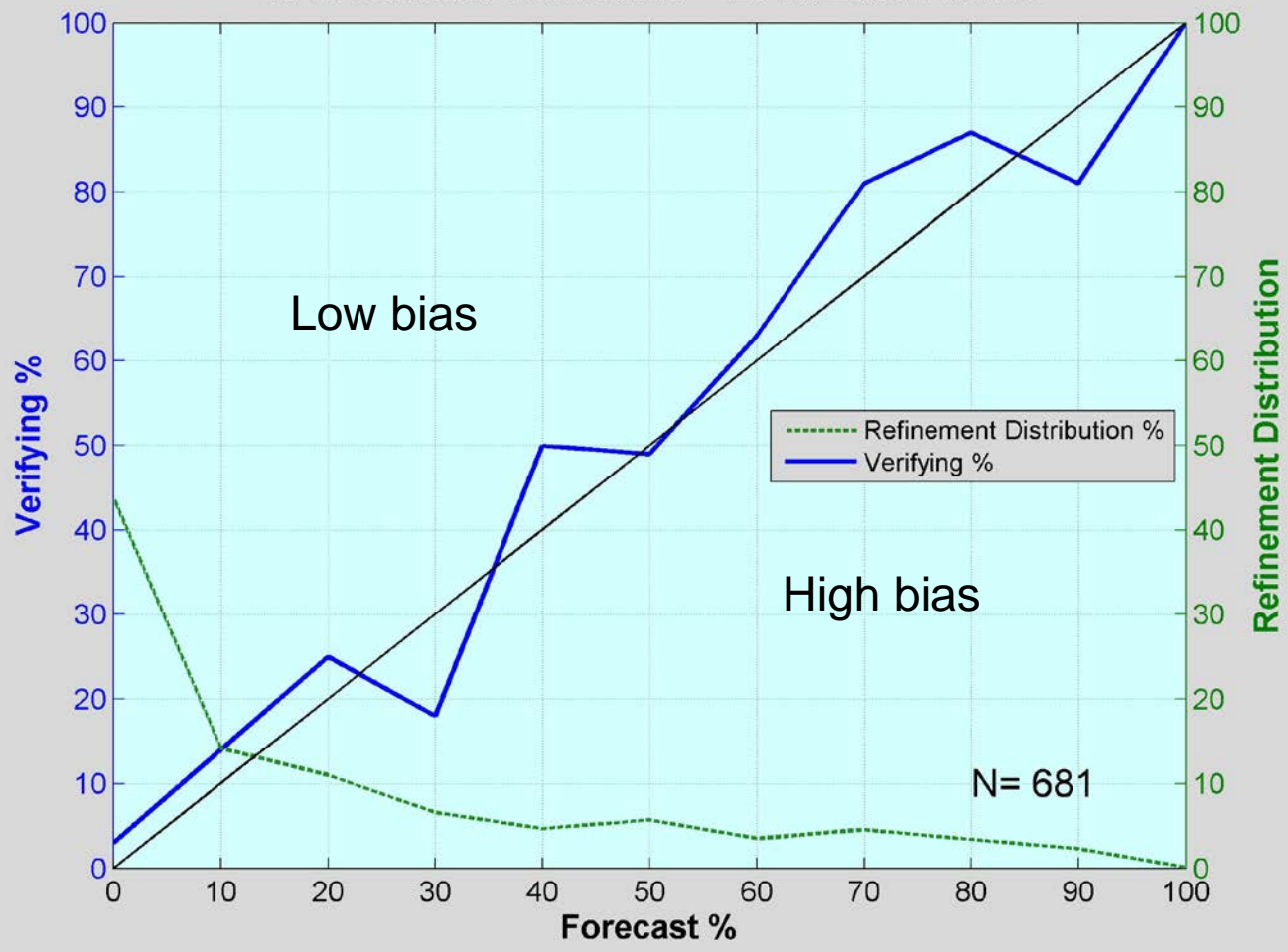
EMXI not skillful.



2-day Genesis Forecast Verification



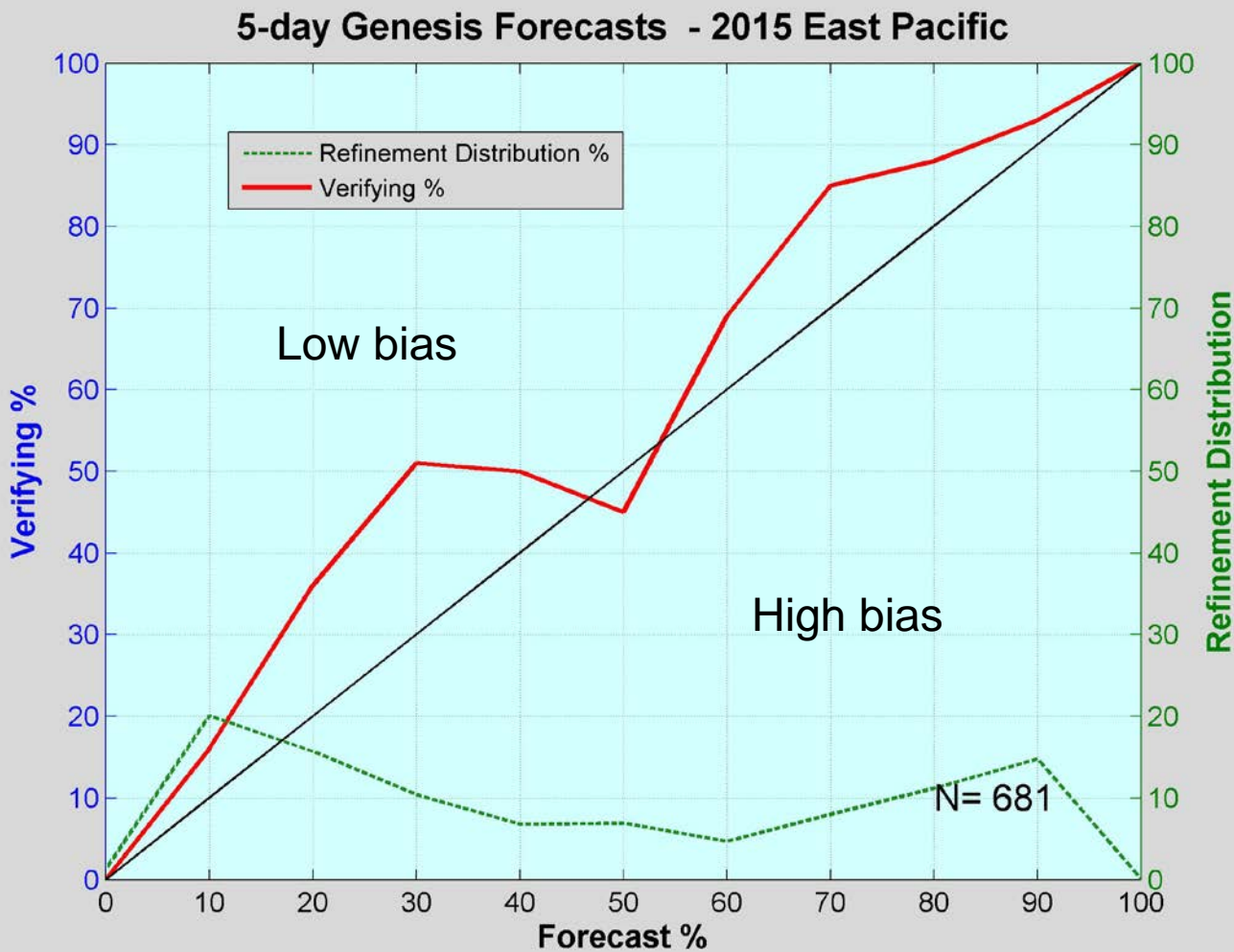
48-h Genesis Forecasts - 2015 East Pacific



Well calibrated, much improved compared to previous years.



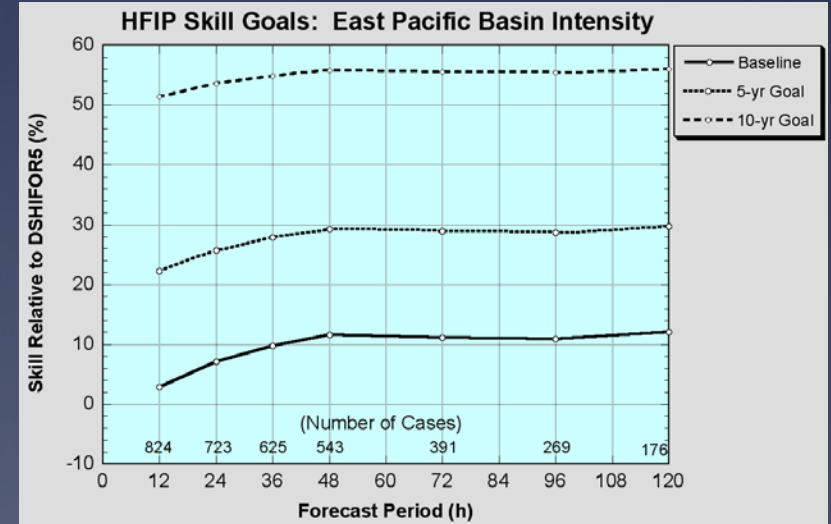
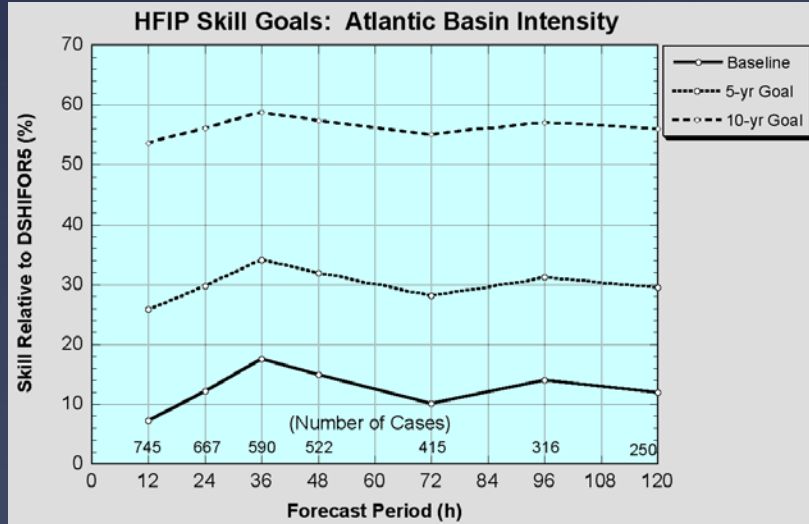
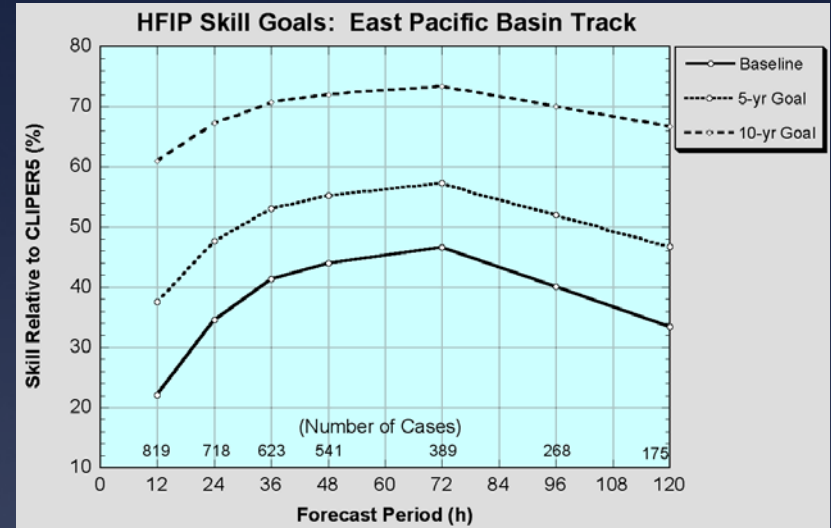
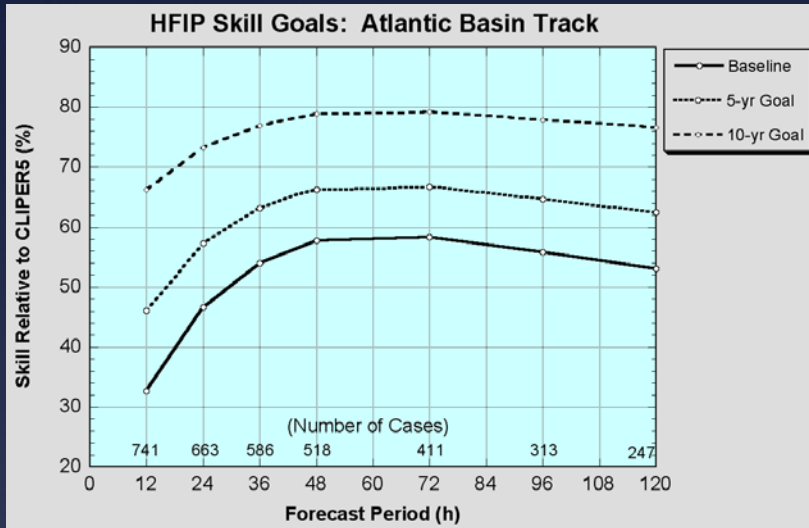
5-day Genesis Forecast Verification



Slight low bias at most probabilities.



HFIP Progress Assessment

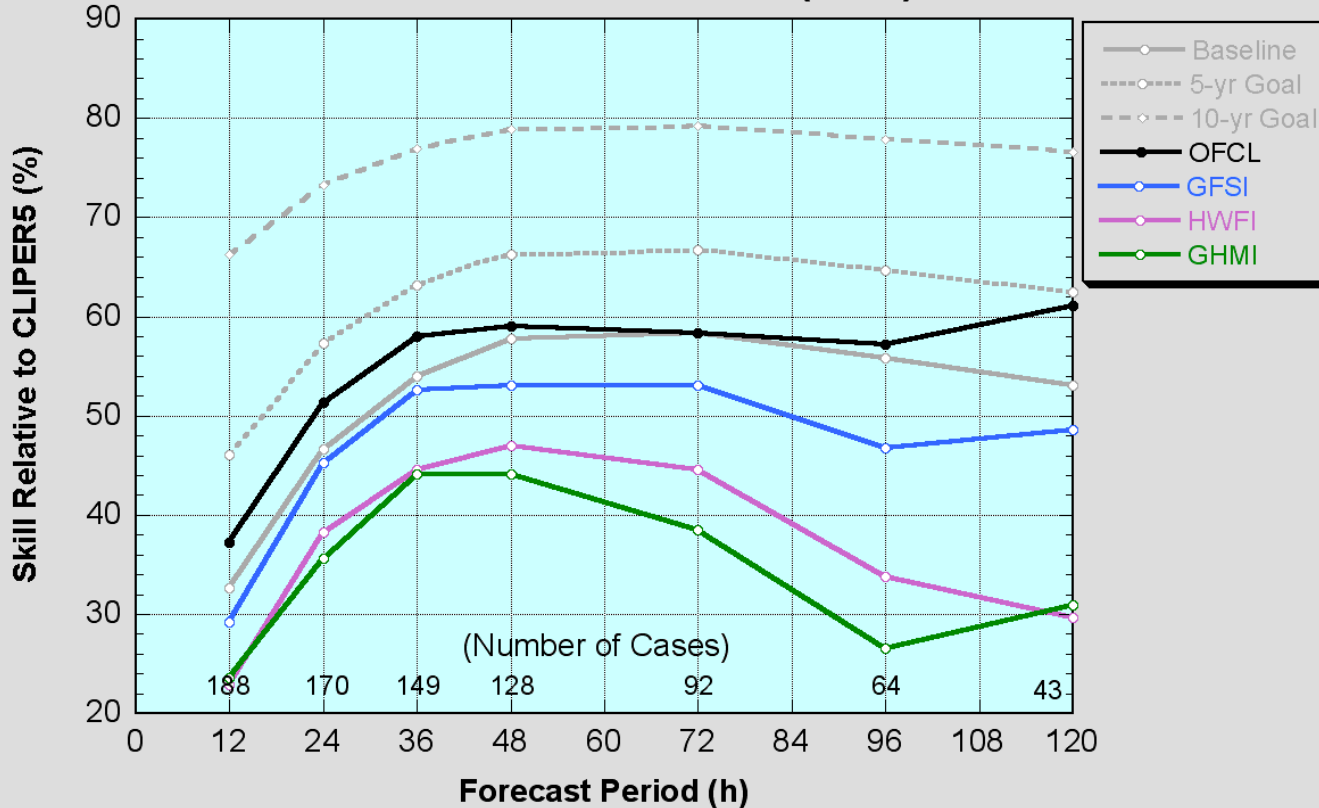


Baseline error was determined from a consensus of operational models evaluated for the period 2006-8. Reducing the baseline error by 20% (50%) and normalizing by CLIPER/SHIFOR yielded the 5-yr (10-yr) HFIP skill goals.



HFIP Progress Assessment

Atlantic Basin Track Skill (2015)



Will use OFCL as a measure of the state of the science (could have used model consensus). Also will show the operationally accessible models HFIP is contributing to.

Atlantic Basin Track:

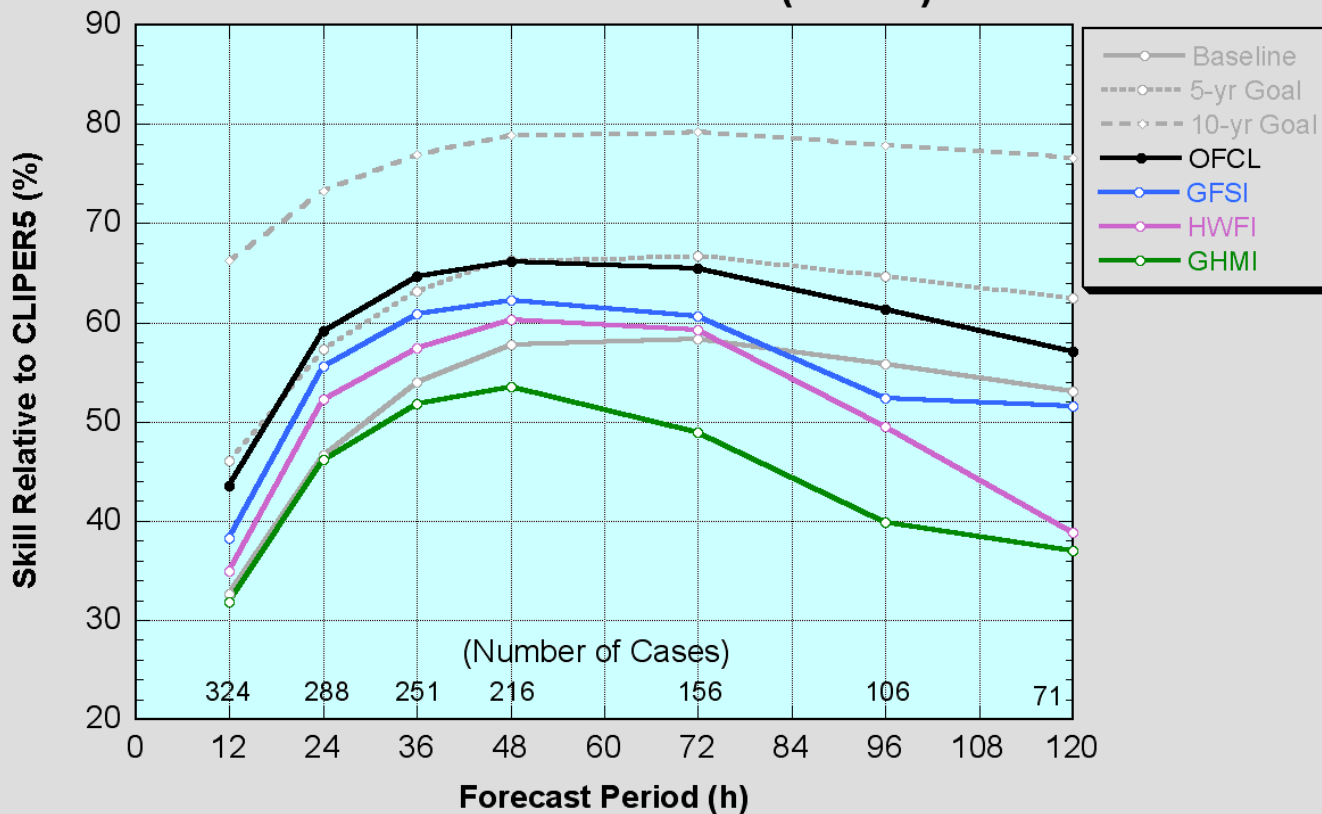
2015 was a tough year in the Atlantic. OFCL performance was near or above the 2006-8 baseline, but not at the 5-yr HFIP goal.

GFS performance was below the 5-yr goal.



HFIP Progress Assessment

Atlantic Basin Track Skill (2014-5)



Atlantic Basin Track:

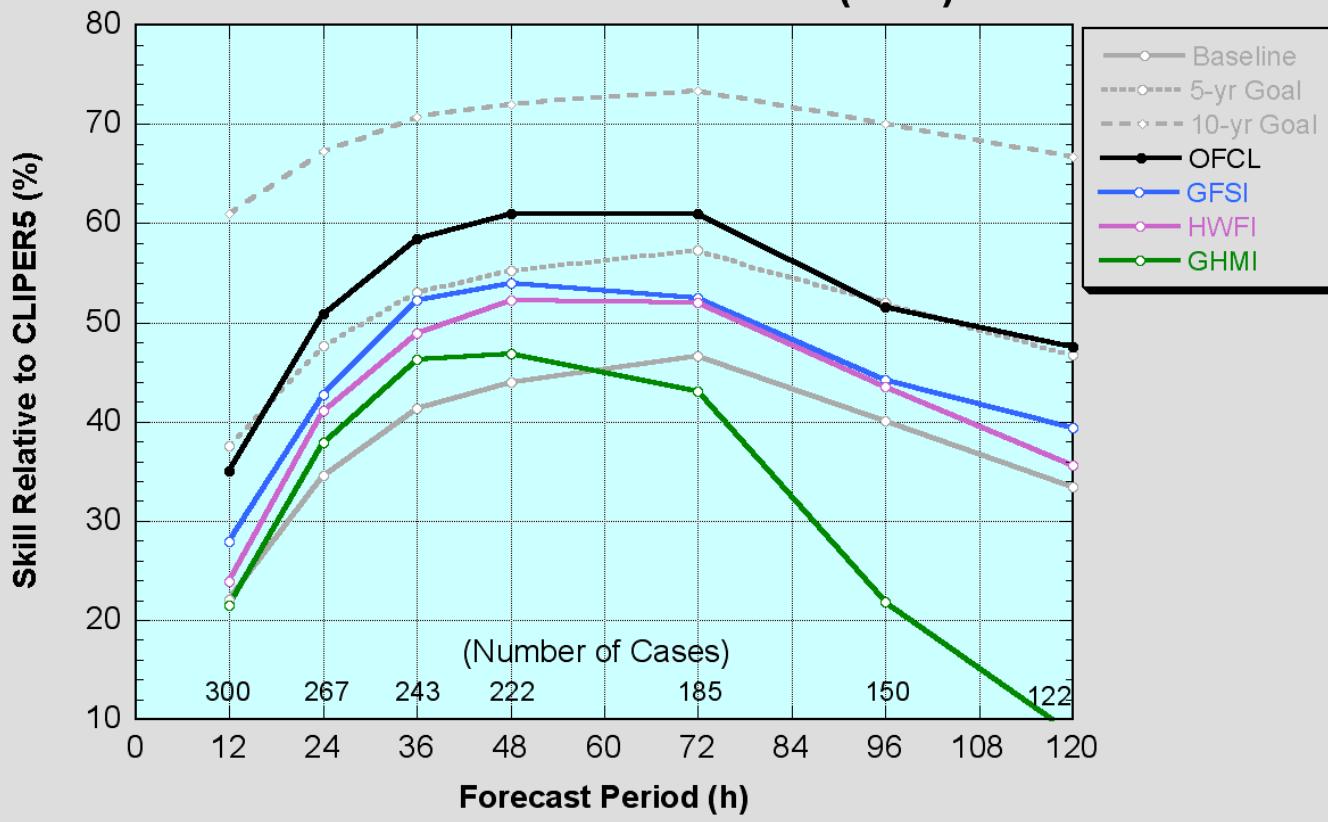
Looking at a 2-yr sample to get a more representative result, shows that we're near the 5-yr goal, at least through 72 h.

HWRF is competitive but less skillful than the GFS.



HFIP Progress Assessment

East Pacific Basin Track Skill (2015)



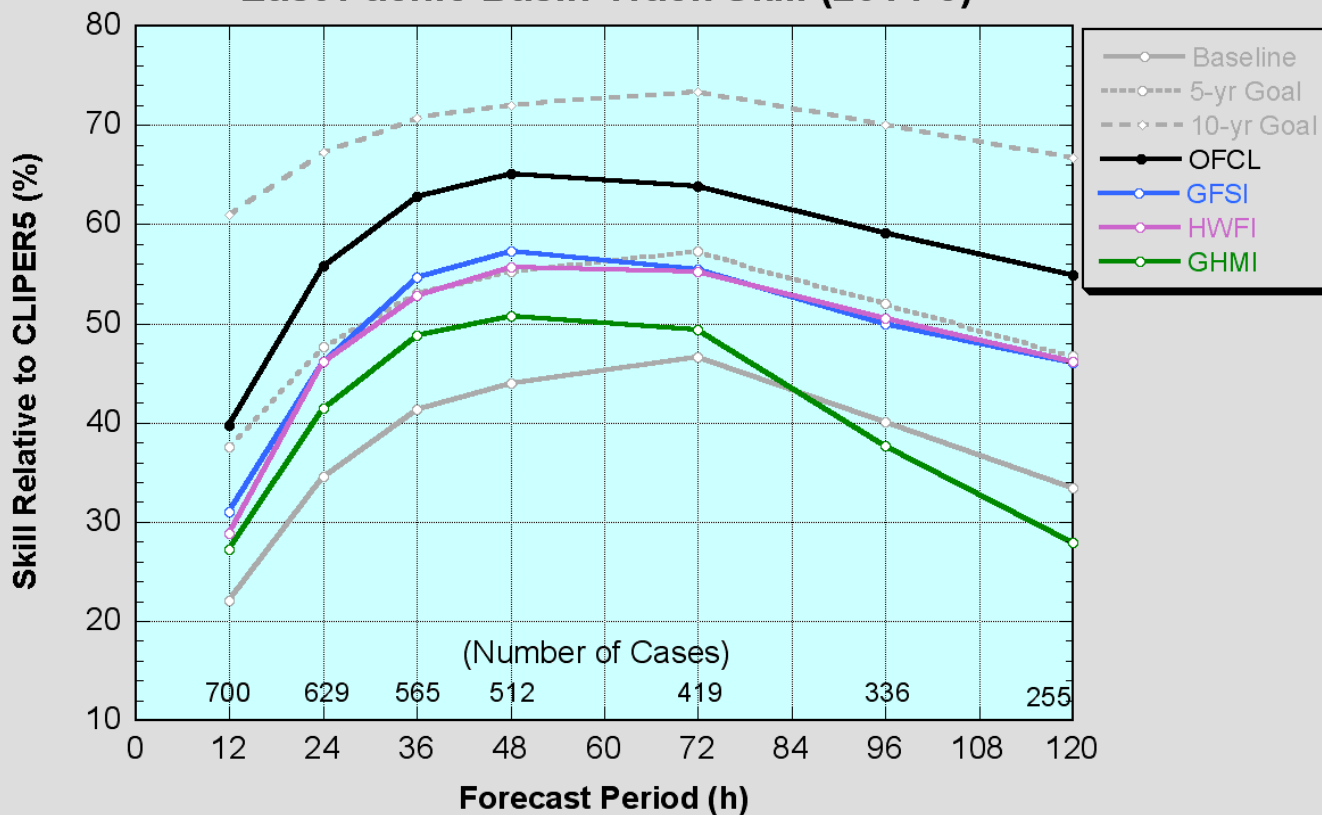
East Pacific Basin Track:

Near or above the 5-yr goal in 2015.



HFIP Progress Assessment

East Pacific Basin Track Skill (2014-5)



East Pacific Basin Track:

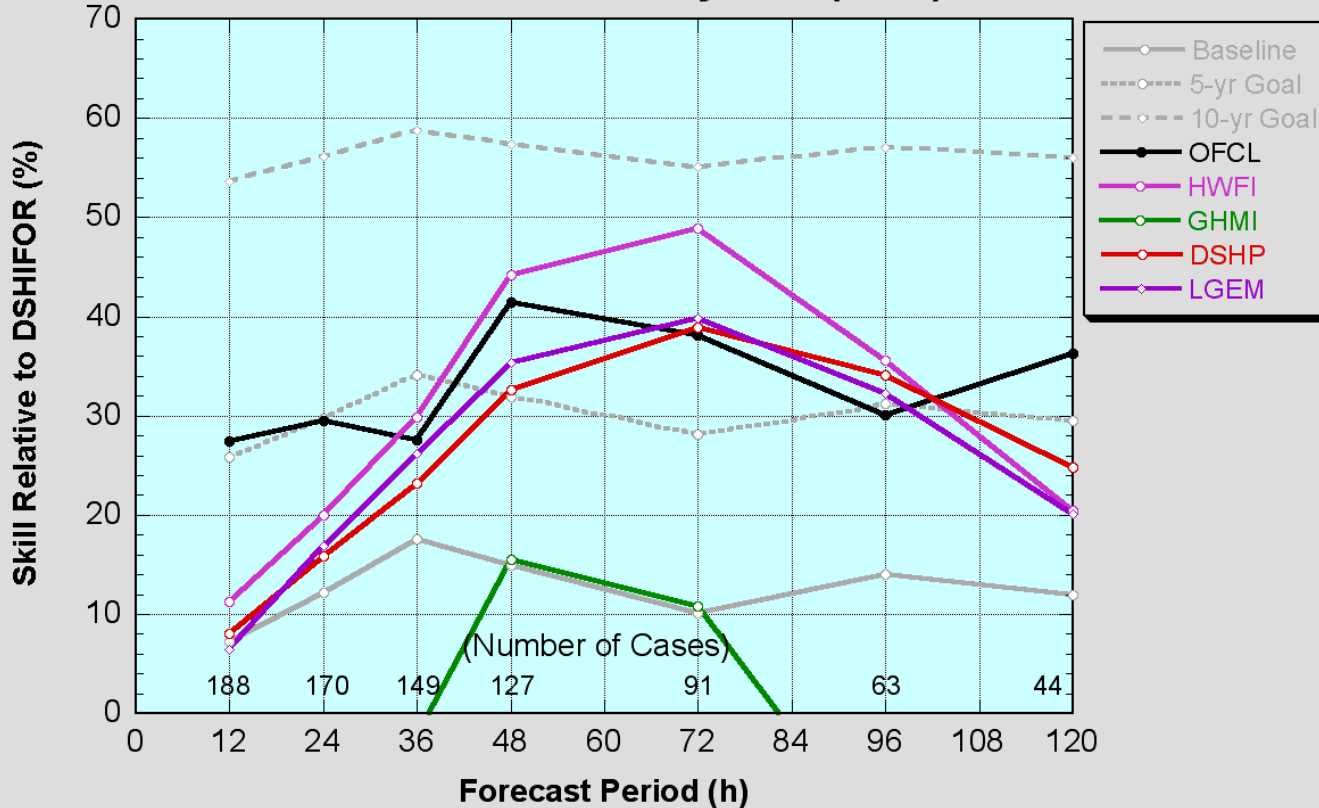
For the 2-yr sample, OFCL is well above the 5-yr goal and seemingly within reach of the 10-yr goal.

HWRF and GFS neck and neck, and individually have reached the 5-yr goal.



HFIP Progress Assessment

Atlantic Basin Intensity Skill (2015)



Atlantic Basin Intensity:

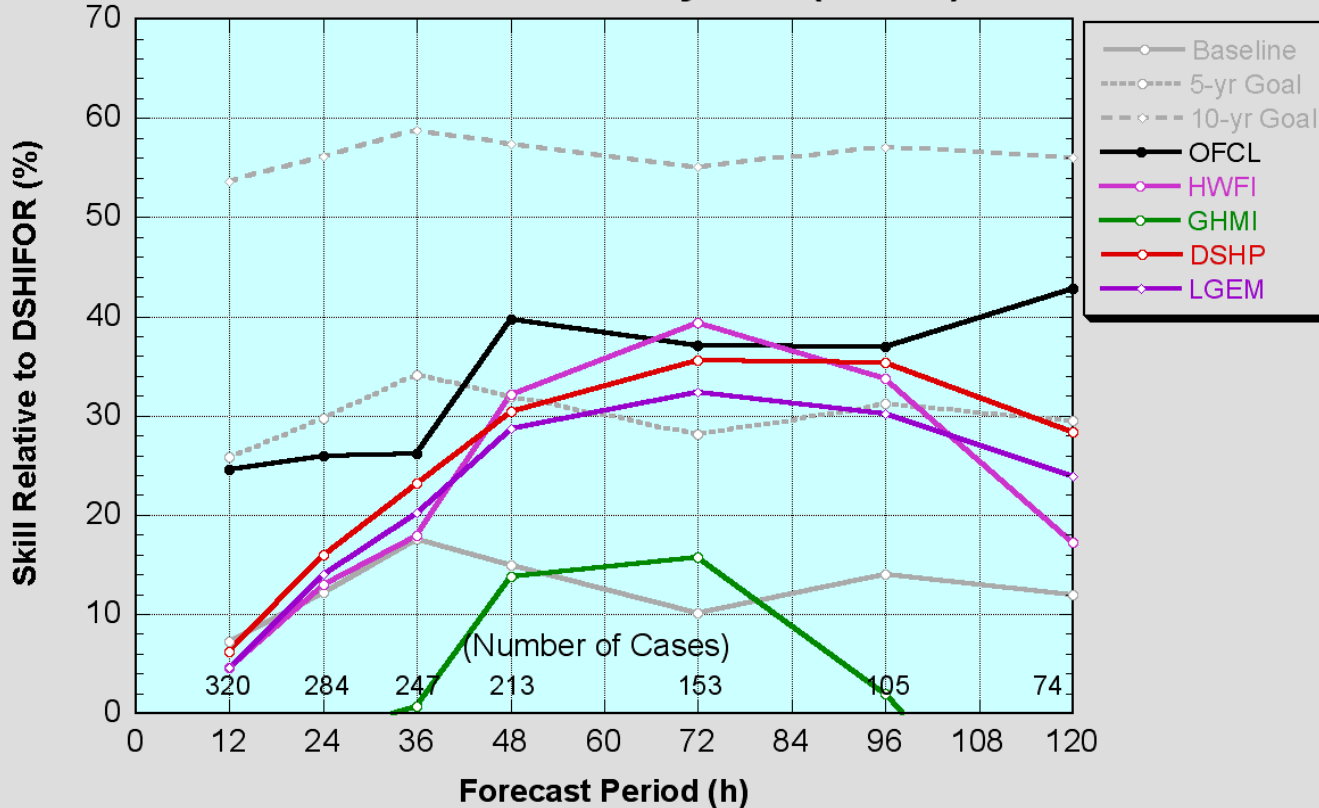
OFCL was near the 5-yr goal overall.

HWRF was near or above the 5-yr goal from 24-96 h. Tough year for GFDL.



HFIP Progress Assessment

Atlantic Basin Intensity Skill (2014-5)



Atlantic Basin Intensity:

For the 2-yr sample, OFCL was near or above the 5-yr goal.

HWRF skill very close to the skill of DSHP and LGEM.

Caution advised due to the relative lack of RI events in recent years. RI events were 50% more common during the baseline period than during the last two years.

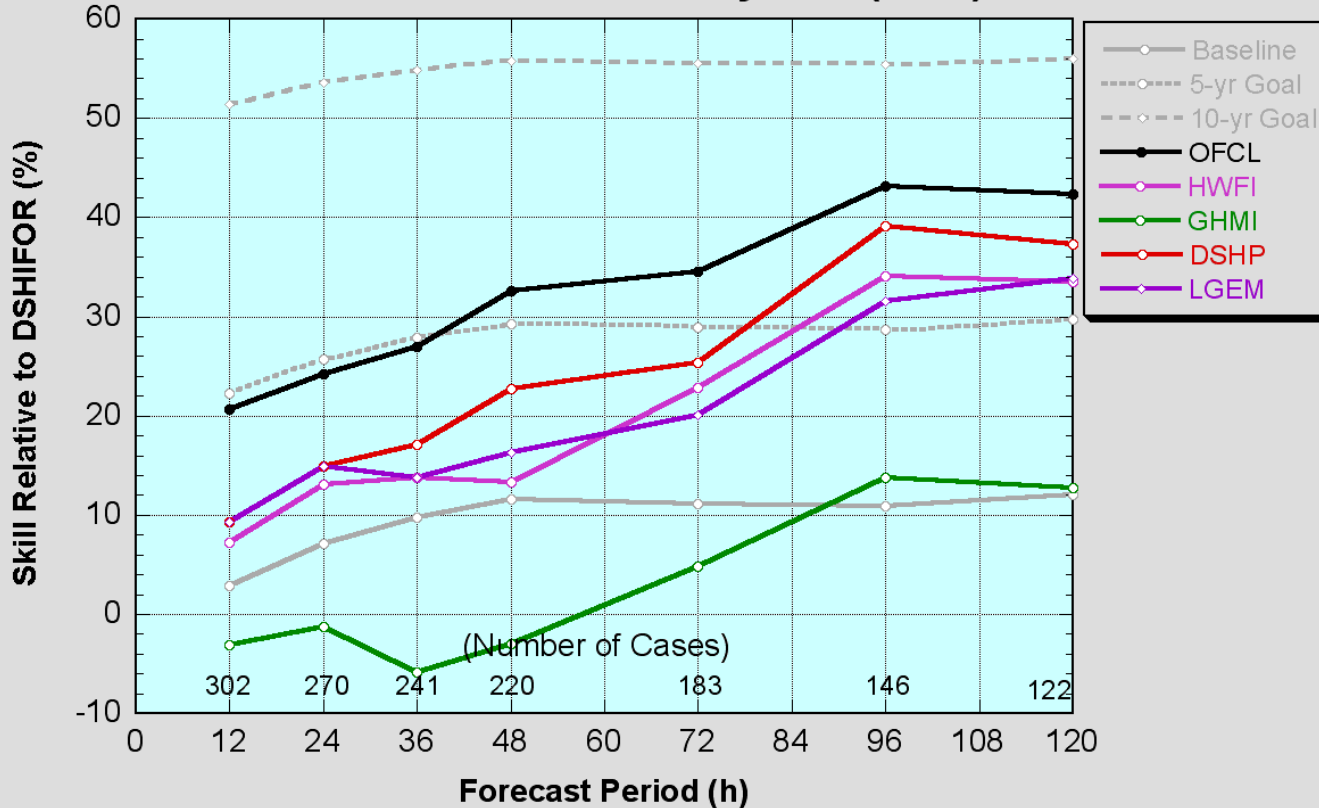
During the baseline period, the ratio of RI events to total forecasts was $54:705 = 7.7\%$. Same ratio for 2014-15 was $18:351 = 5.1\%$.

When there are few RI events, OFCL errors go down. When storms are unusually weak, SHIFOR errors can actually go up.



HFIP Progress Assessment

East Pacific Basin Intensity Skill (2015)



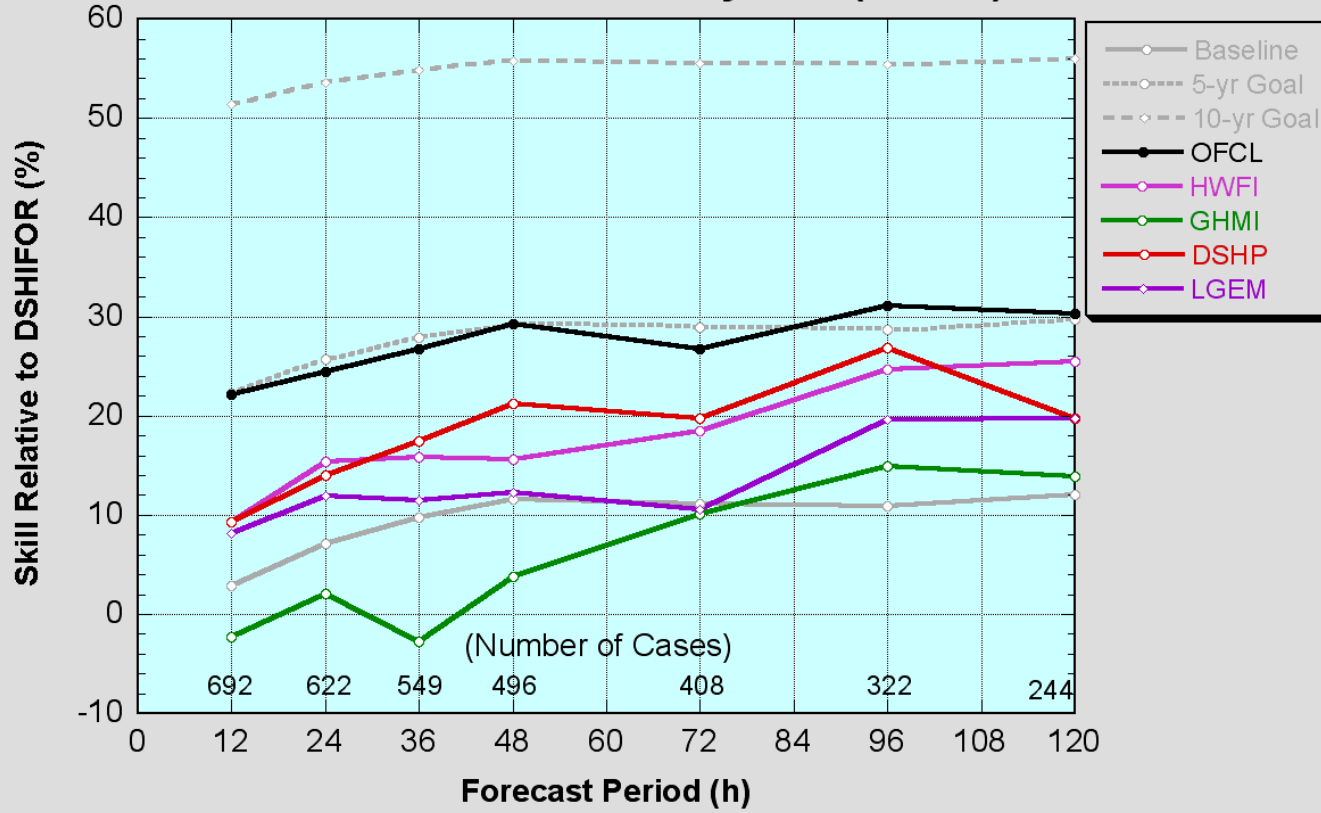
East Pacific Basin Intensity:

OFCL was at or above the 5-yr goal, as was some of the guidance.



HFIP Progress Assessment

East Pacific Basin Intensity Skill (2014-5)



East Pacific Basin Intensity:

For the 2-yr sample, OFCL was right at the 5-yr goal.

HWRF competitive with DSHP.



Highlights

- * Tough year in the Atlantic for both track and intensity (Erika and Joaquin). ECMWF far and away better than anything else for Atlantic track. Also best in the eastern Pacific, but not by as much.
- * Genesis forecasts were very well calibrated.
- * The NHC official track and intensity forecasts, overall, seem to have reached the 5-yr (guidance) goals for both track and intensity (although caution advised for Atl intensity).