1A.3 Improvements in Forecast Skill of the NCEP Production Suite

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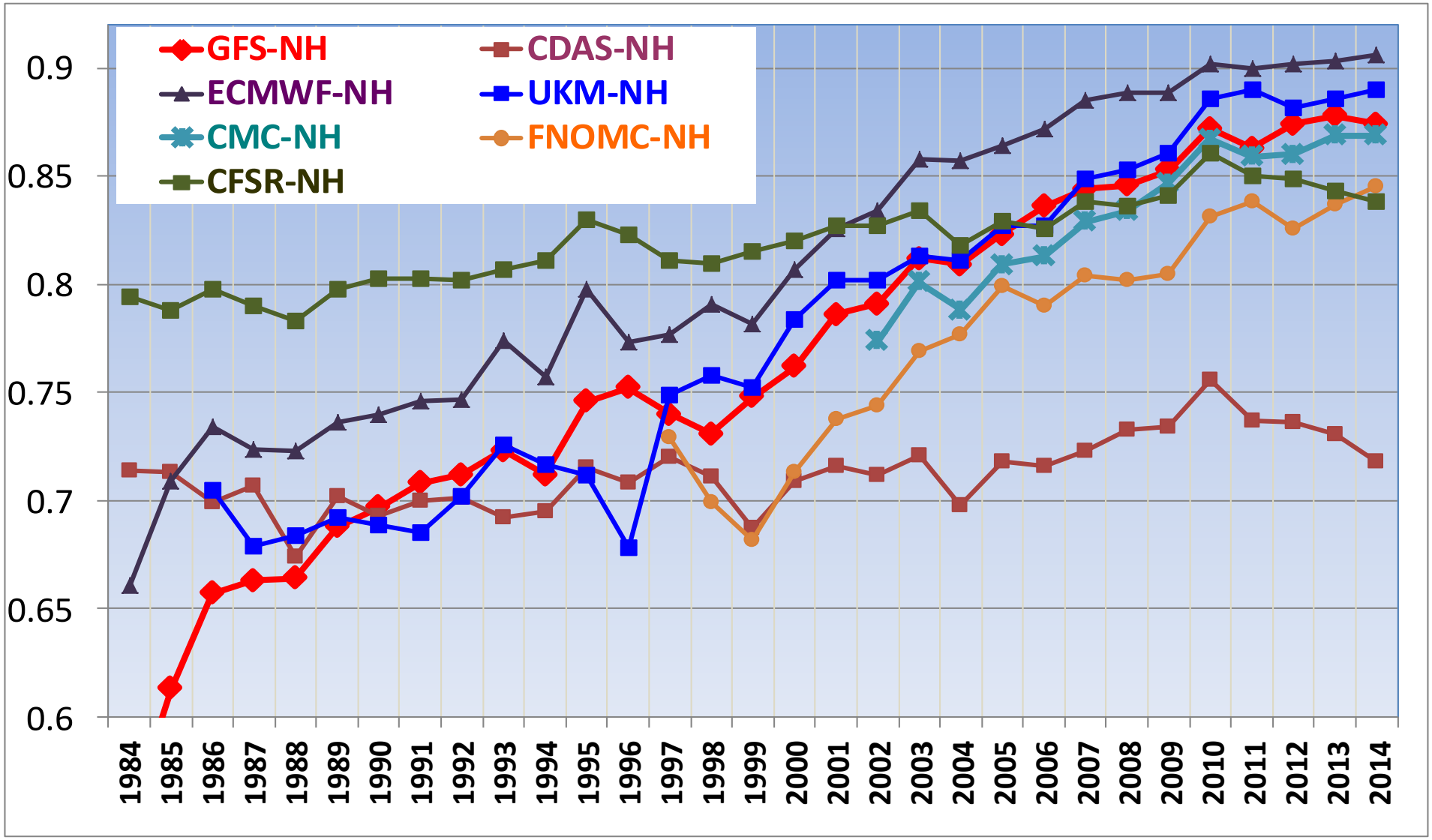
--EMC does comprehensive verification of its forecast systems against its analyses, observations, comparison to forecasts by other NWP centers

--extensive verification of lengthy tests of proposed changes to operational forecast systems

--more attention recently to verifying near surface fields in GFS

--verification web pages not well organized

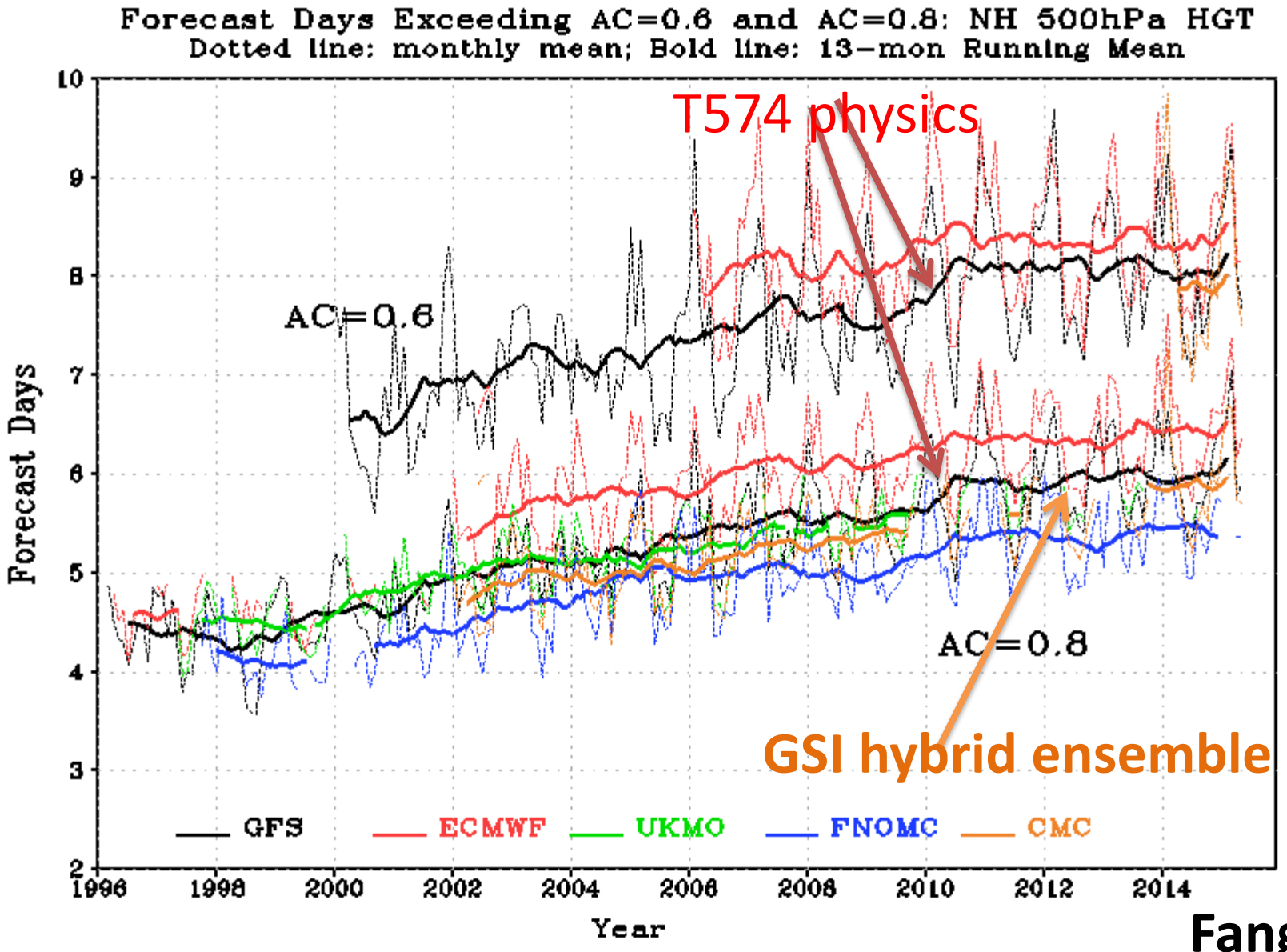
Annual Mean NH 500hPa HGT Day-5 AC



- *CFSR and CDAS frozen old versions of GFS*

Fanglin Yang

Useful Forecast Days for Major NWP Models, NH

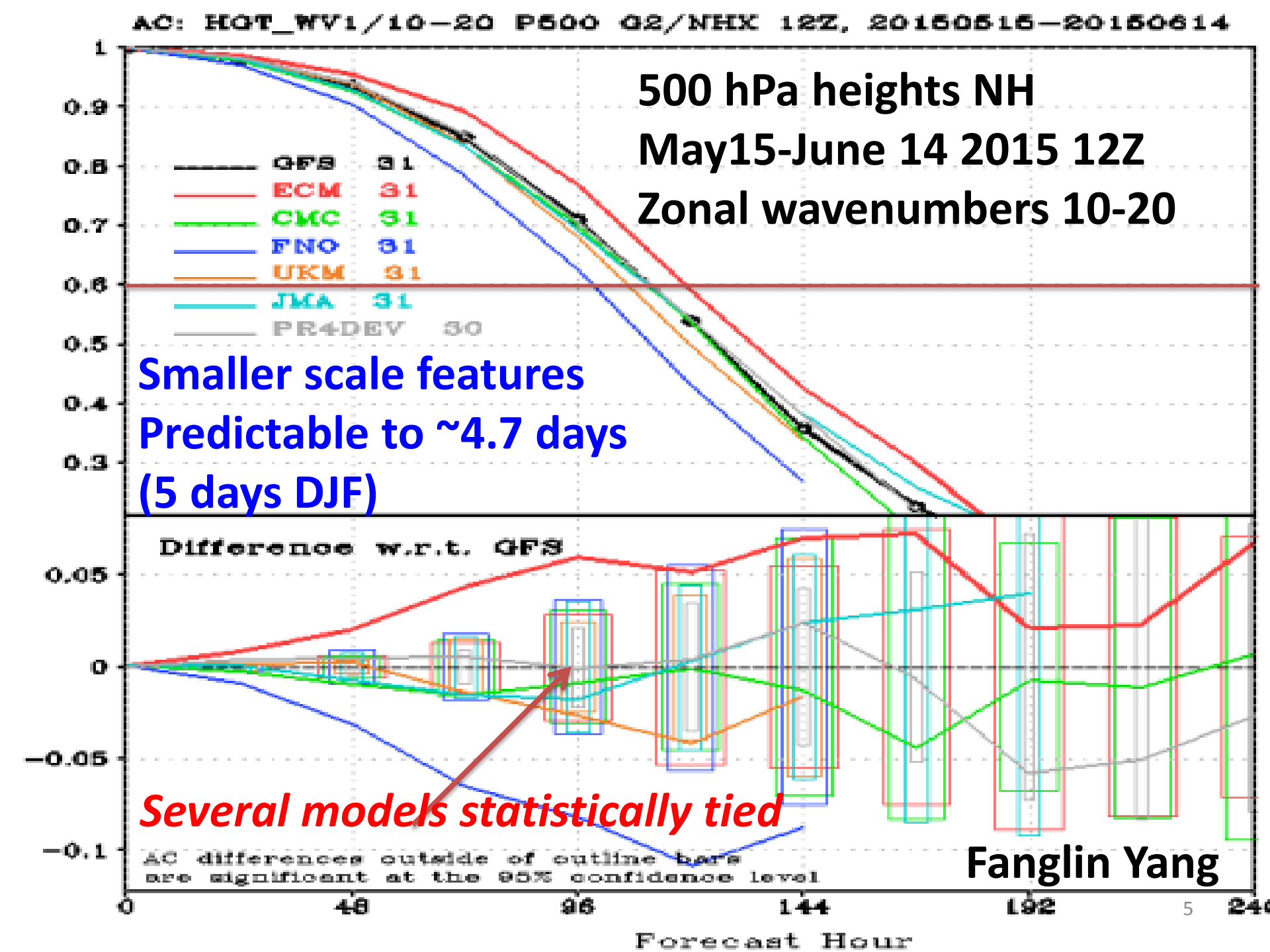


GFS lags ECM by ~0.3 day; CMC slightly behind GFS

GFS lags ECM by ~0.4 day

Fanglin Yang

http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/l


AC: HGT_WV1/10-20 P500 G2/NHX 12Z, 20150515-20150614
500 hPa heights NH
May15-June 14 2015 12Z
Zonal wavenumbers 10-20
GFS 31
ECM 31
CMC 31
FNO 31
UKM 31
JMA 31
PR4DEV 30
Smaller scale features
Predictable to ~4.7 days
(5 days DJF)
Difference w.r.t. GFS
Several models statistically tied
AC differences outside of outline bars
are significant at the 95% confidence level
Fanglin Yang
Forecast Hour

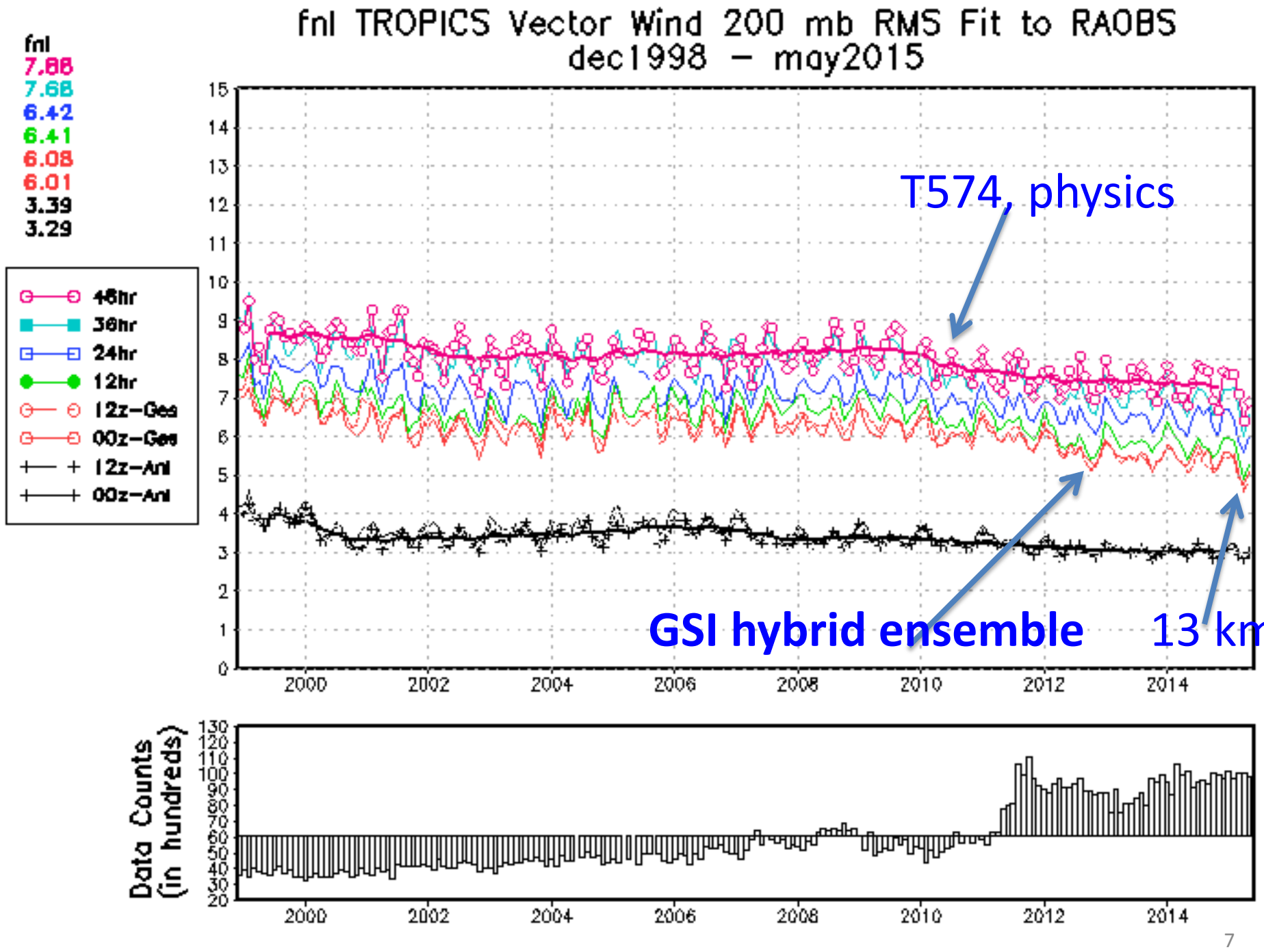
GFS range of useful skill (AC .6 500 height NH) increased from 5 to 8 days In 30 years

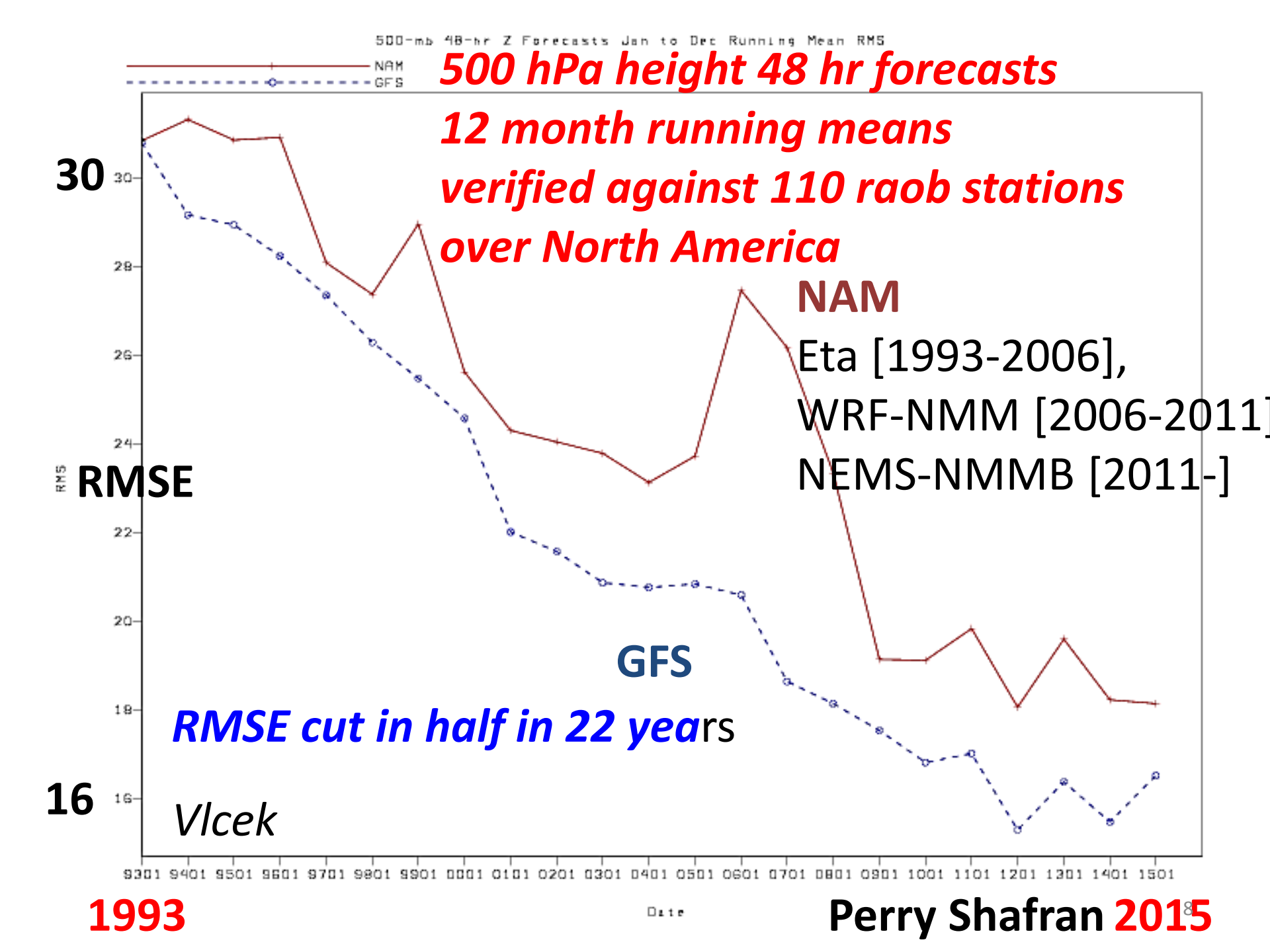
Smaller features skillful out to ~5 days

analysis differences between centers significant in tropics

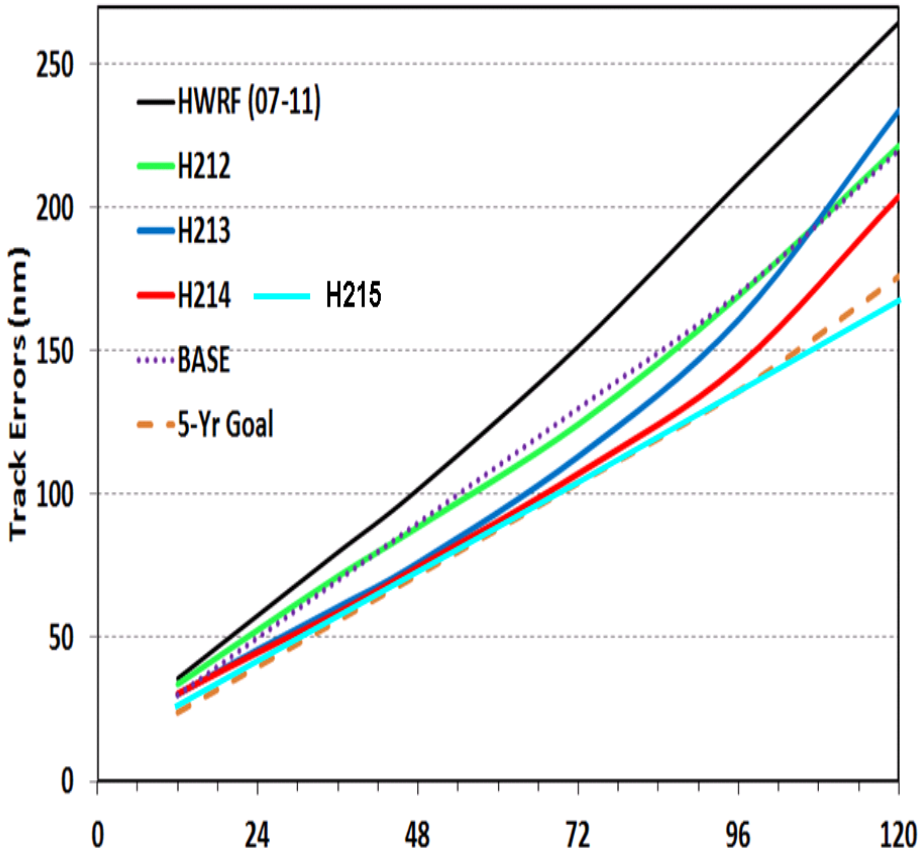
fewer radiosondes, weaker signal

--learned hard way to check apparent improvements in skill against observations

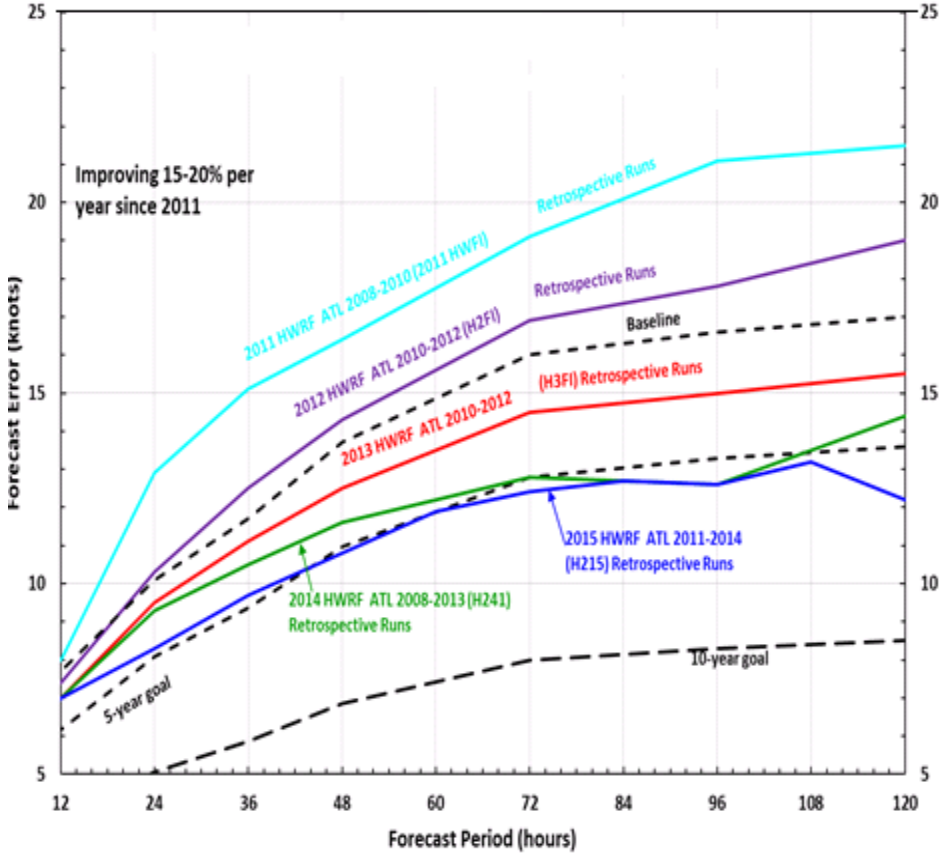

fnl TROPICS Vector Wind 200 mb RMS Fit to RAOBS
dec1998 – may2015
fnl
7.86
7.68
6.42
6.41
6.08
6.01
3.39
3.29
48hr
36hr
24hr
12hr
12z–Ges
00z–Ges
12z–Anl
00z–Anl
T574, physics
GSI hybrid ensemble
13 km
Data Counts (in hundreds)


500-mb 48-hr Z Forecasts Jan to Dec Running Mean RMS
NAM
GFS
500 hPa height 48 hr forecasts
12 month running means
verified against 110 raob stations
over North America
30
RMSE
16
NAM
Eta [1993-2006],
WRF-NMM [2006-2011]
NEMS-NMMB [2011-]
GFS
RMSE cut in half in 22 years
Vlcek
RMS
30
28
26
24
22
20
18
16
9301 9401 9501 9601 9701 9801 9901 0001 0101 0201 0301 0401 0501 0601 0701 0801 0901 1001 1101 1201 1301 1401 1501
Date
1993
Perry Shafran 2015

Significant Improvements in Track and Intensity Forecasts Demonstrated Through Systematic Multi-Season Pre-Implementation Tests Each Year Since 2012



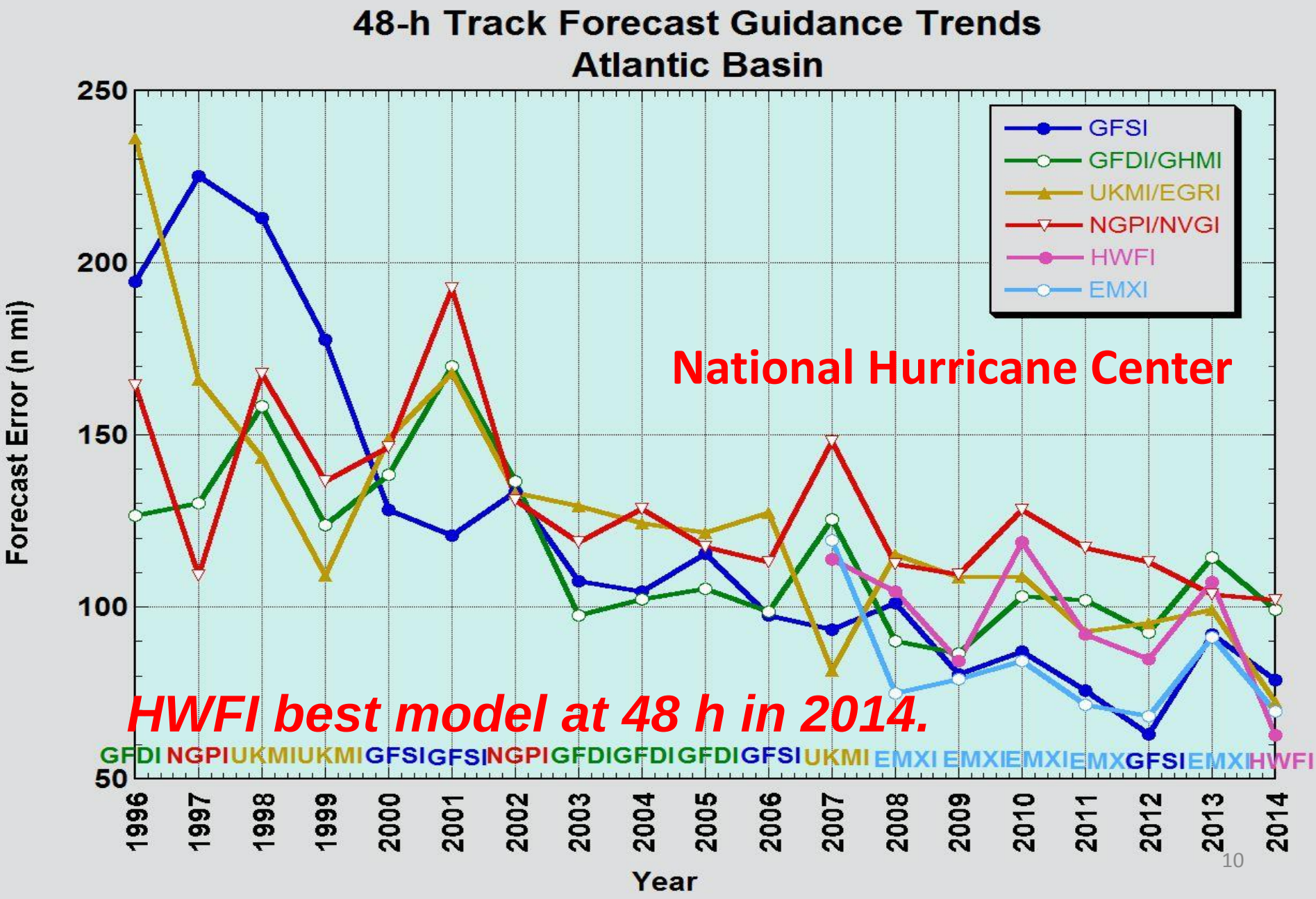
HWRF Track Forecast Improvements Atlantic Basin



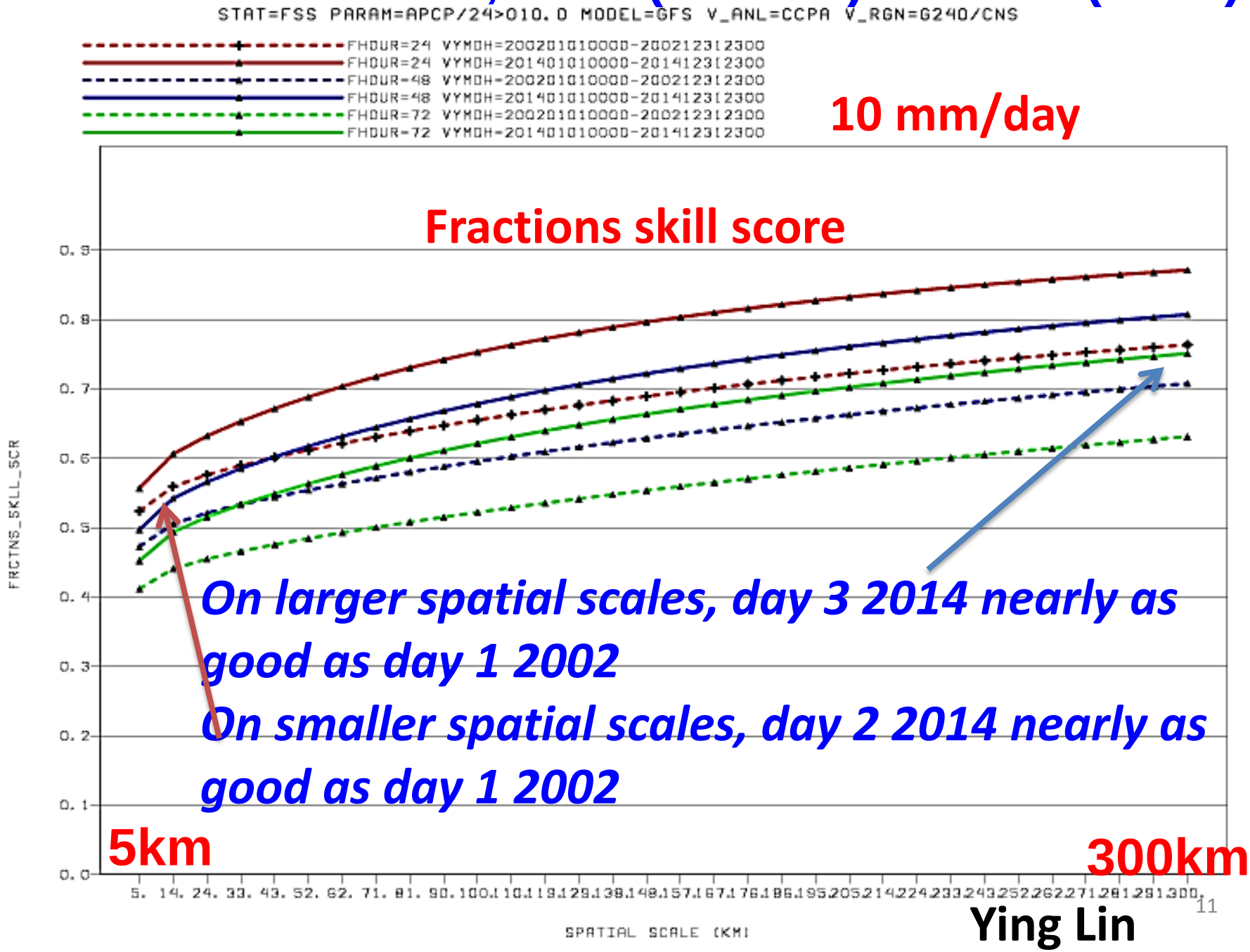
HWRF Intensity Forecast Improvements Atlantic Basin

Vijay Tallapragada

Hurricane Tracks



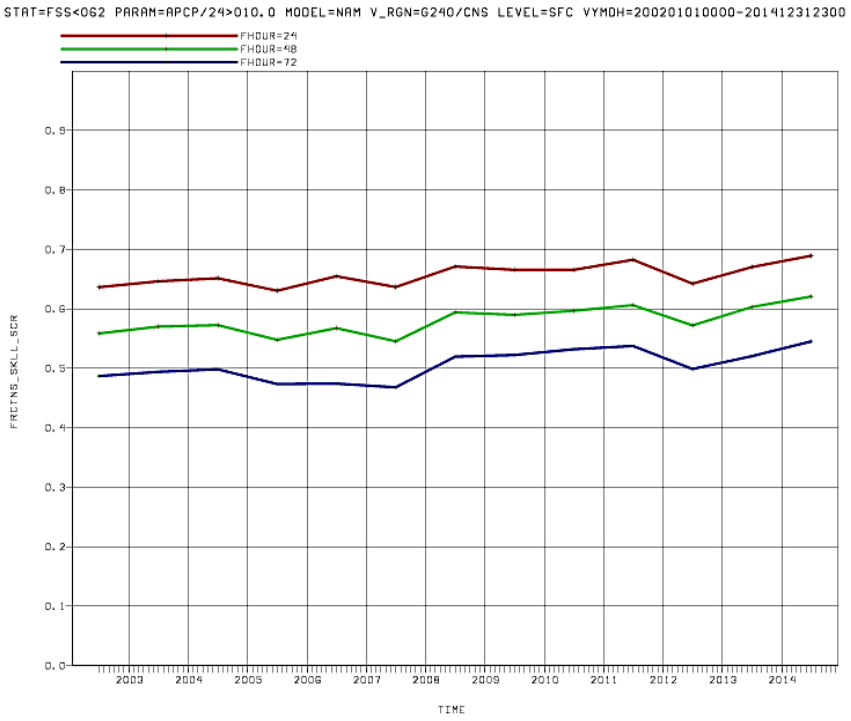
GFS 24/48/72h FSS, 2002 (dashed) *vs.* 2014(solid)



Ying Lin

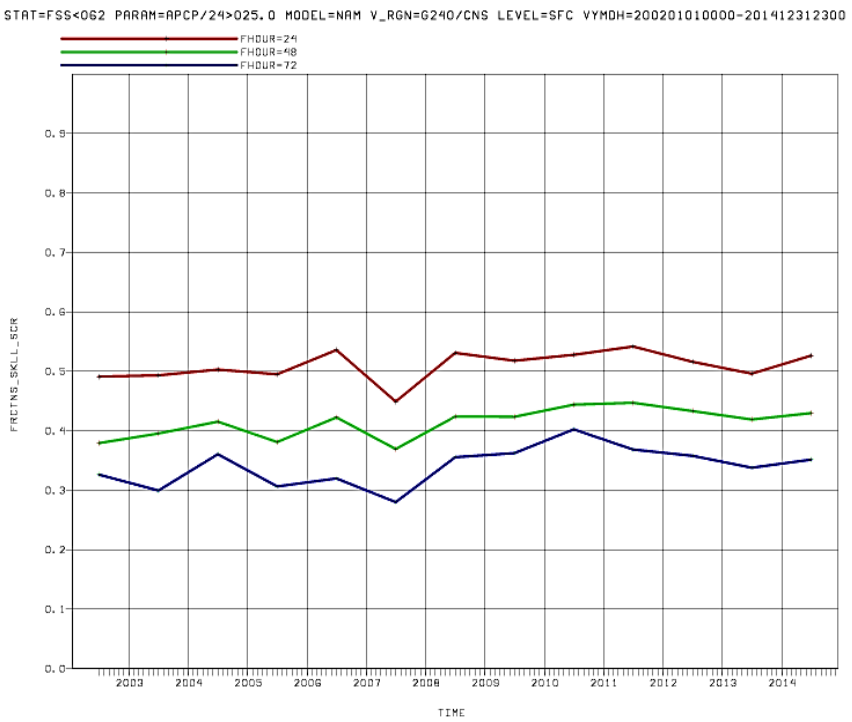
NAM 24/48/72h annual FSS, 2002-2014 at horizontal scale of 62km

10mm/day



2002 2014

25mm/day



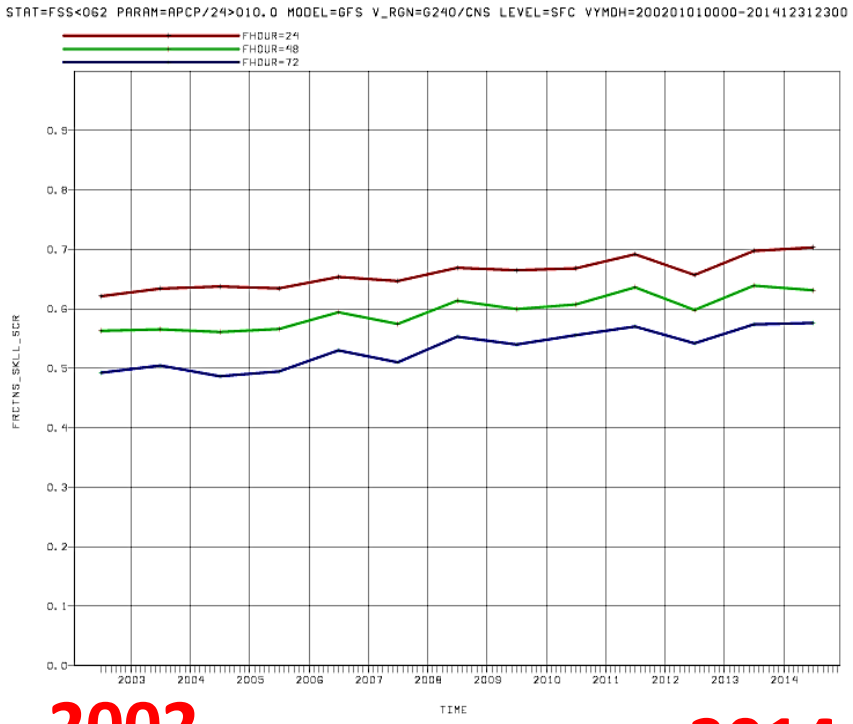
2002 2014

Fractions skill score

Ying Lin

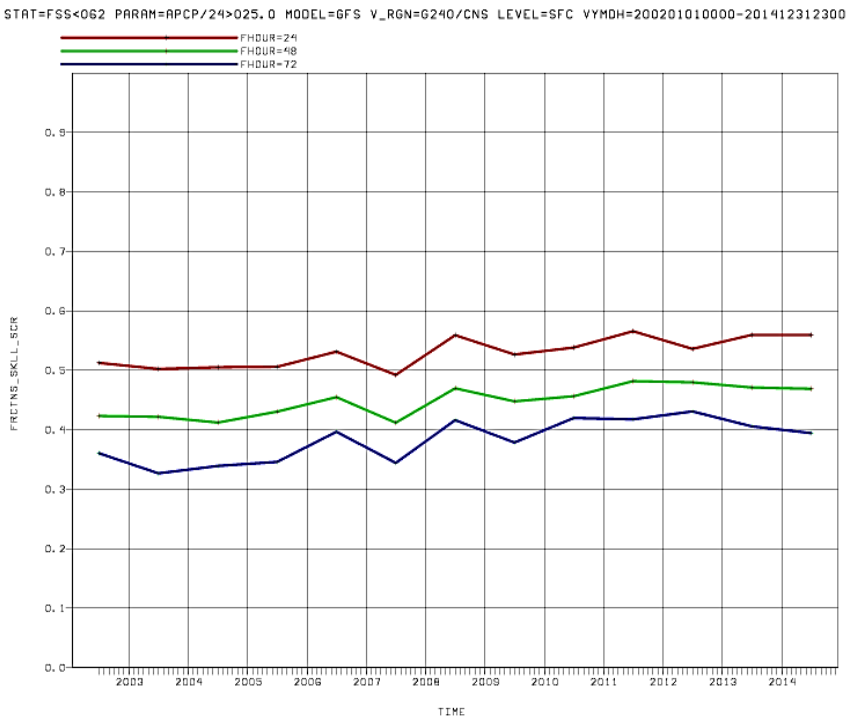
GFS 24/48/72h annual FSS, 2002-2014 at horizontal scale of 62km

10mm/day



2002 2014

25mm/day



2002 2014

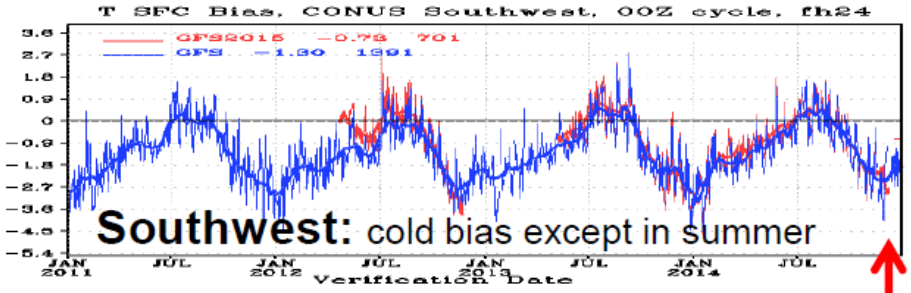
Fractions skill score **Ying Lin**

Less gain in skill for higher amounts

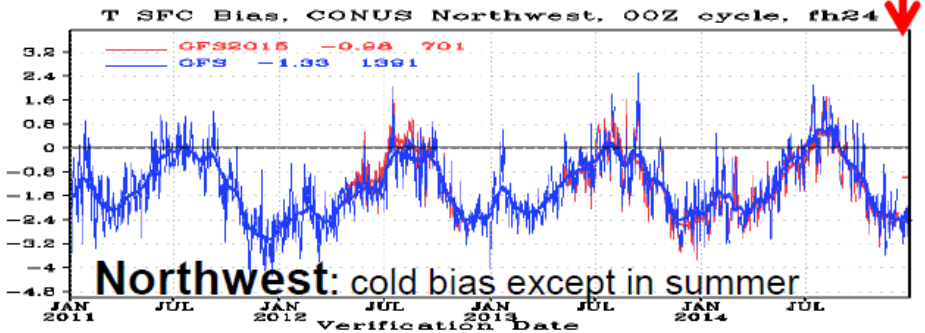
GFS

Afternoon (00Z) T2m Bias, 2011 ~ 2014

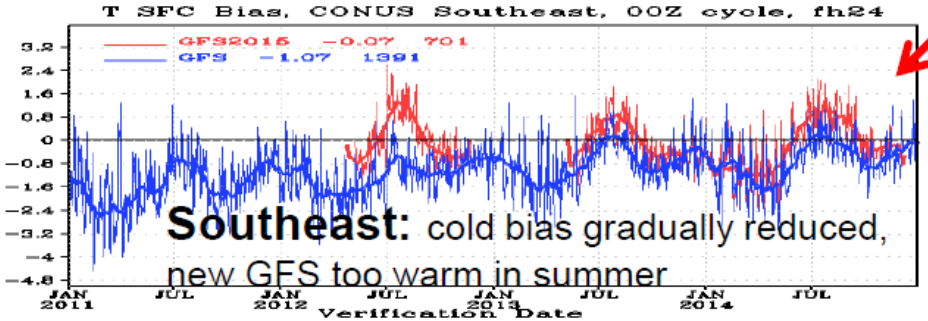
Red: T1534 GFS retro runs
Blue: T574 ops GFS



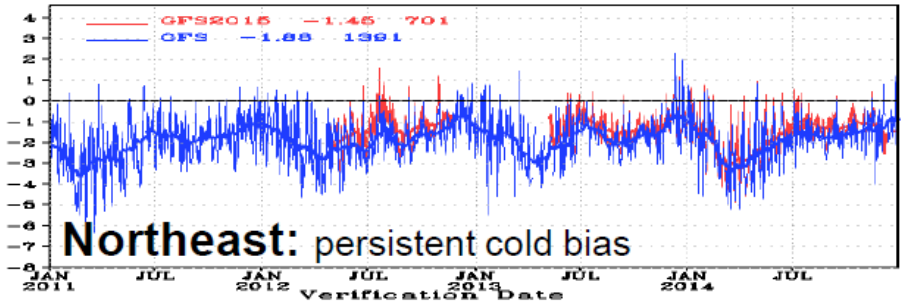
Southwest: cold bias except in summer



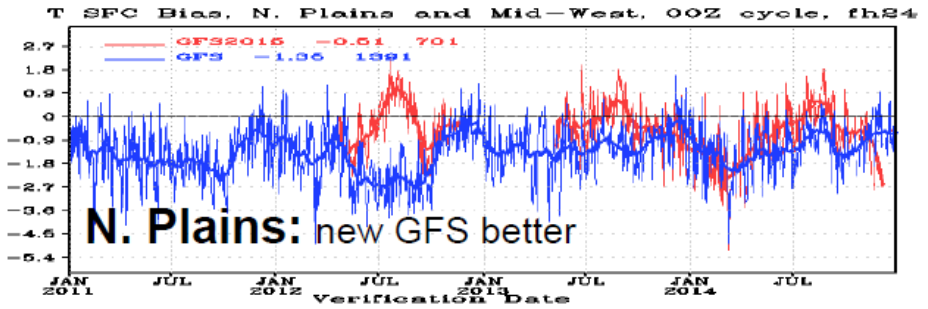
Northwest: cold bias except in summer



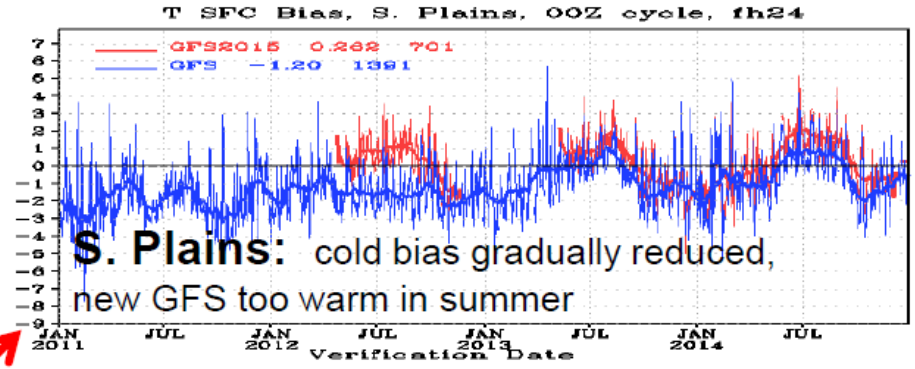
Southeast: cold bias gradually reduced, new GFS too warm in summer



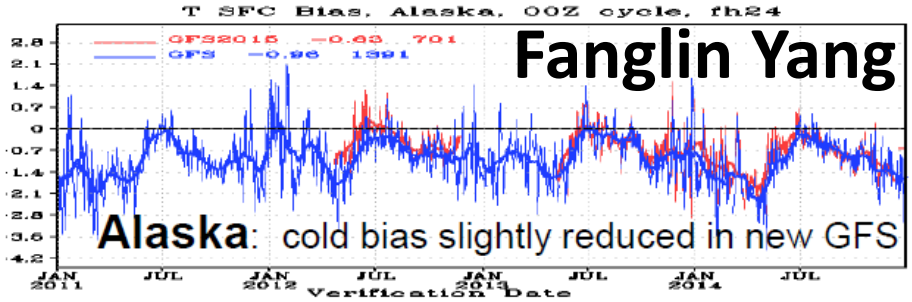
Northeast: persistent cold bias



N. Plains: new GFS better



S. Plains: cold bias gradually reduced, new GFS too warm in summer



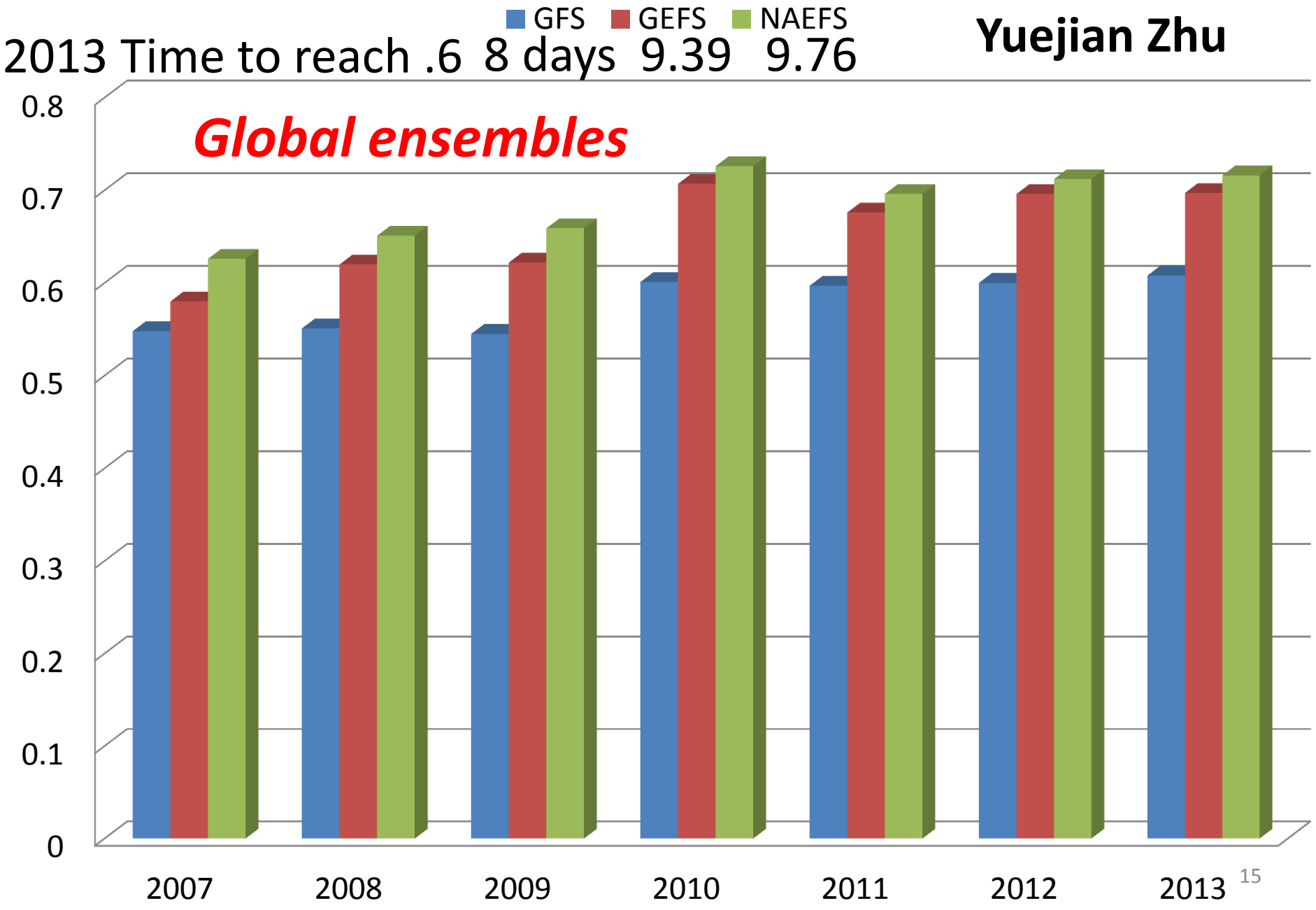
Alaska: cold bias slightly reduced in new GFS

Fanglin Yang

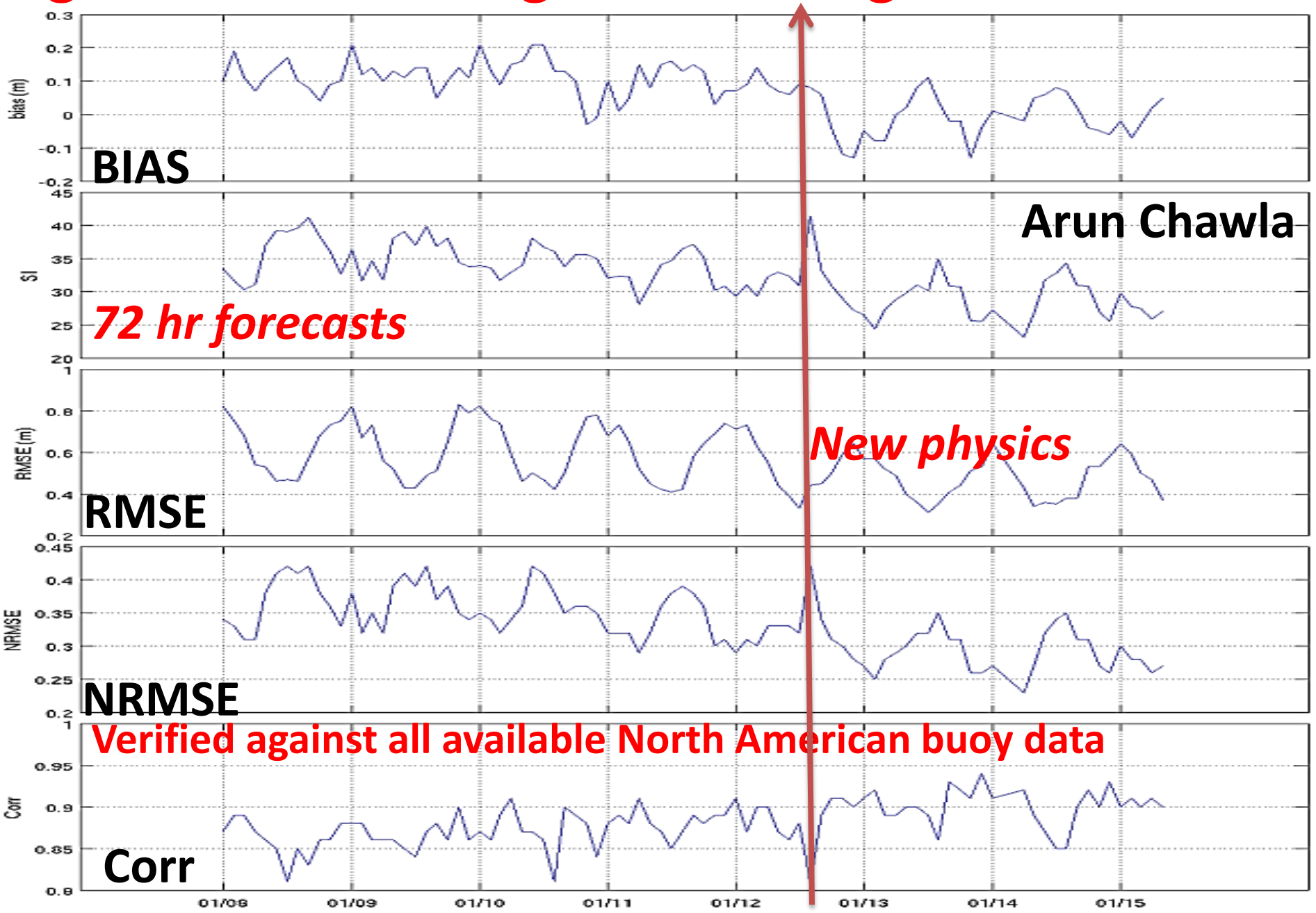
- **Biases change with season**
- **Cold biases in all regions and all season except summer**
- **T1534 is generally warmer**

http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/annual/g2o_20112014/g2o/

NH 500 hPa height AC for day 8 of calendar year mean



Significant wave height for multi-grid wave model



Weather prediction surely is one of… mankind's great positive achievements...—Cliff Mass

--EMC plans to improve users' access to verification statistics

17 Application of MODE to GFS (T574) and GFS (T1534) Precipitation Verification Tracey A. Dorian and F. Yang Thursday, 2 July 2015 Salon A-3 & A-4 (Hilton Chicago)

Thursday 3:00 PM 14A.7 Web-based Verification Capability using NCEP's Verification Database and DTC's METviewer Perry Shafran, T. L. Jensen, J. H. Gotway, B. Zhou, K. Nevins, Y. Lin, and G. DiMego

Friday 8:00 AM 15A.1 Comparison of Forecast Skills between NCEP GFS Four Cycles and on the Value of 06Z and 18Z Cycles Fanglin Yang

GFS

http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/

GFS Fits to radiosondes

http://www.emc.ncep.noaa.gov/gmb/ssaha/

Precipitation skill scores

Equitable threat scores

http://www.emc.ncep.noaa.gov/mmb/ylin/pcpverif/scores/

MODE scores

http://www.emc.ncep.noaa.gov/gc_wmb/tdorian/

http://www.wpc.ncep.noaa.gov/verification/mode/mode.php#page=page-1

Radiosondes and CONUS surface observations

http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/g2o/

Global ensemble scores

http://www.emc.ncep.noaa.gov/gmb/yzhu/html/opr/naefs.html

NAM, GFS fits to radiosondes over CONUS

http://www.emc.ncep.noaa.gov/mmb/verif/vlcek/

Mesoscale documentation, verification

http://www.emc.ncep.noaa.gov/mmb/mmbpll/eric.html

NCEP-EMC GFS Forecast Monitoring and Verification

Main Verification Web Page http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/,

including 1) verification statistics of AC, RMSE, Bias etc for major international NWP models and GFS implementation parallels in the past 31 days, 2) real-time weather forecast maps of GFS and GFS implementation parallels, 3) links to other verifications.

Grid-to-Obs Verification http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/g2o/ and http://www.emc.ncep.noaa.gov/gmb/ssaha/

Including 1) verifications of surface 2-m T, RH, Td, 10-m winds, SLP and total clouds against ground observations over the CONUS and its sub-regions and, 2) verifications of atmospheric T, Q, RH and Winds against rawinsonde and aircraft observations over the globe and its sub-regions.

Precipitation Verification http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/www/rain2/rain.html

Including precipitation forecast maps verified against CCPA over the CONUS and CPC gauge observations over the globe, and precipitation Equitable Threat Scores for major international models

Objected-Oriented (MODE) Verification http://www.emc.ncep.noaa.gov/gc_wmb/tdorian/

Including MODE verifications of precipitation over CONUS and jet streams over the globe.

Historical Performance http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/longterm/

Including annual review of GFS forecast skills and historical performances of major international NWP models.

Ensemble Forecast Verification http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/ensm/, and http://www.emc.ncep.noaa.gov/GEFS/verif.php

including GEFS, NAEFS and other international global ensemble forecasts.

Data Assimilation Monitoring http://www.emc.ncep.noaa.gov/gmb/gdas/

GFS Experimental Parallels Verification: http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/ and http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/

Others : http://www.emc.ncep.noaa.gov/GFS/perf.php contains a list of all verifications related to GFS and GEFS. http://www.emc.ncep.noaa.gov/gmb/STATS/MAPS.html presents daily weather forecast maps.