

ATM 401/501

Status of Forecasting: Jan 2010

1. Forecasting at NCEP

- **Environmental Modeling Center**
<http://www.emc.ncep.noaa.gov/>
- **Ocean Prediction Center**
<http://www.opc.ncep.noaa.gov/>
- **National Hurricane Center**
<http://www.nhc.noaa.gov/>
- **Hydrometeorological Prediction Center**
<http://www.hpc.ncep.noaa.gov/>
- **Storm Prediction Center**
<http://www.spc.noaa.gov/>

2. Convection and Forecast Perishability

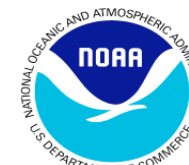
3. A Perspective on Ensemble Forecasting



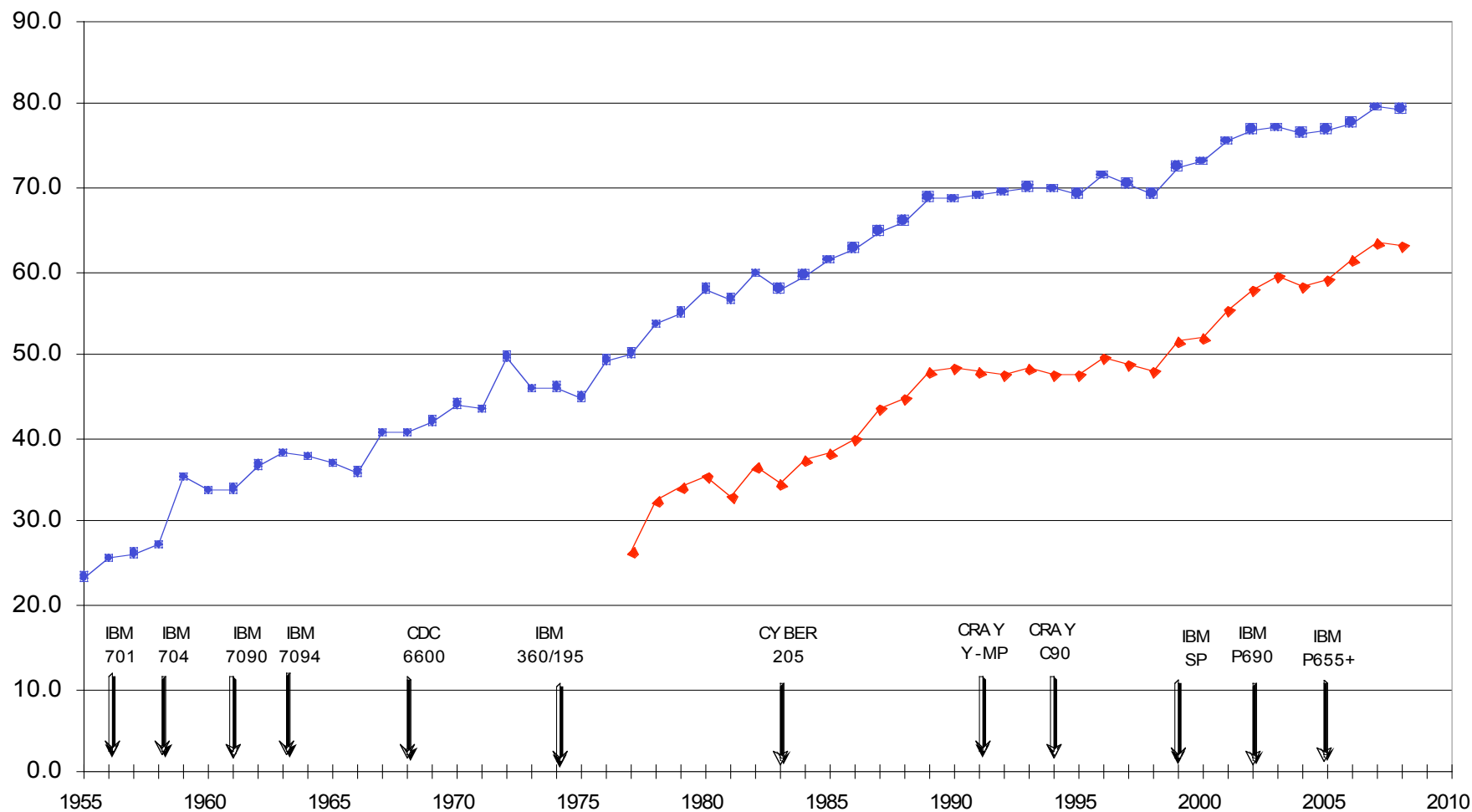
NCEP Operational Forecast Skill

36 and 72 Hour Forecasts @ 500 MB over North America

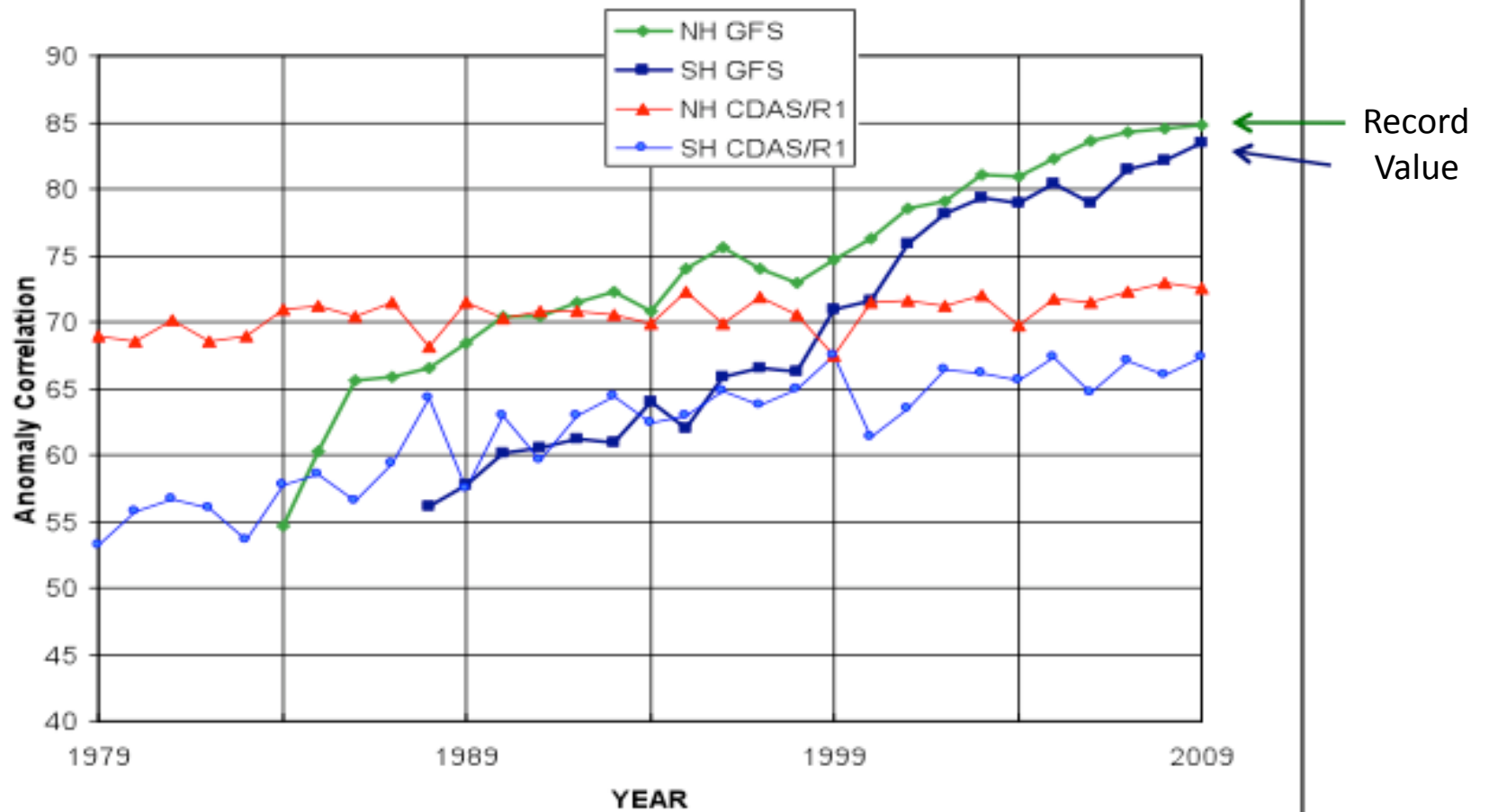
[100 * (1-S1/70) Method]



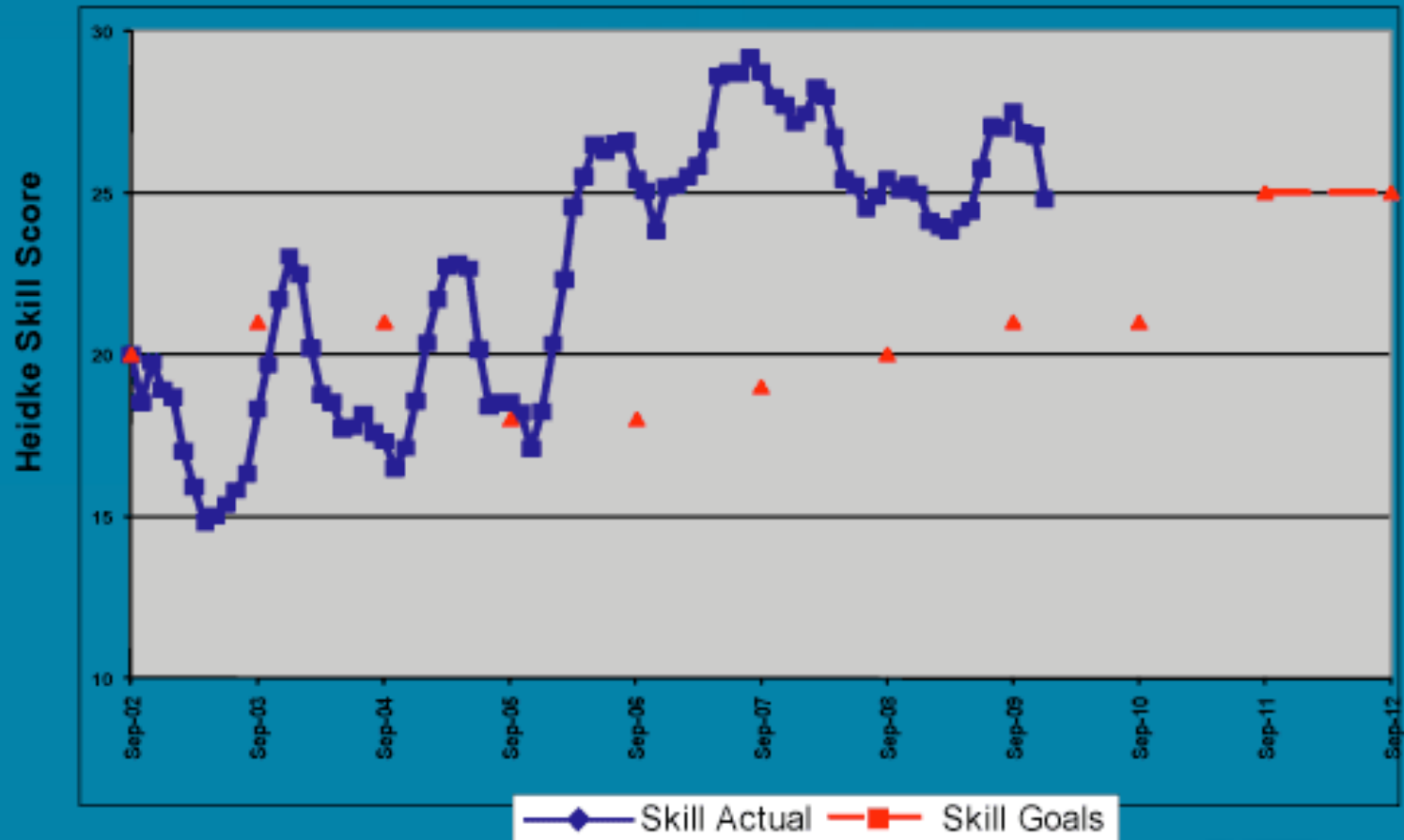
—■— 36 Hour Forecast —◆— 72 Hour Forecast



CDAS/Reanl vs GFS
NH/SH 500Hpa day 5
Anomaly Correlation (20-80 N/S)

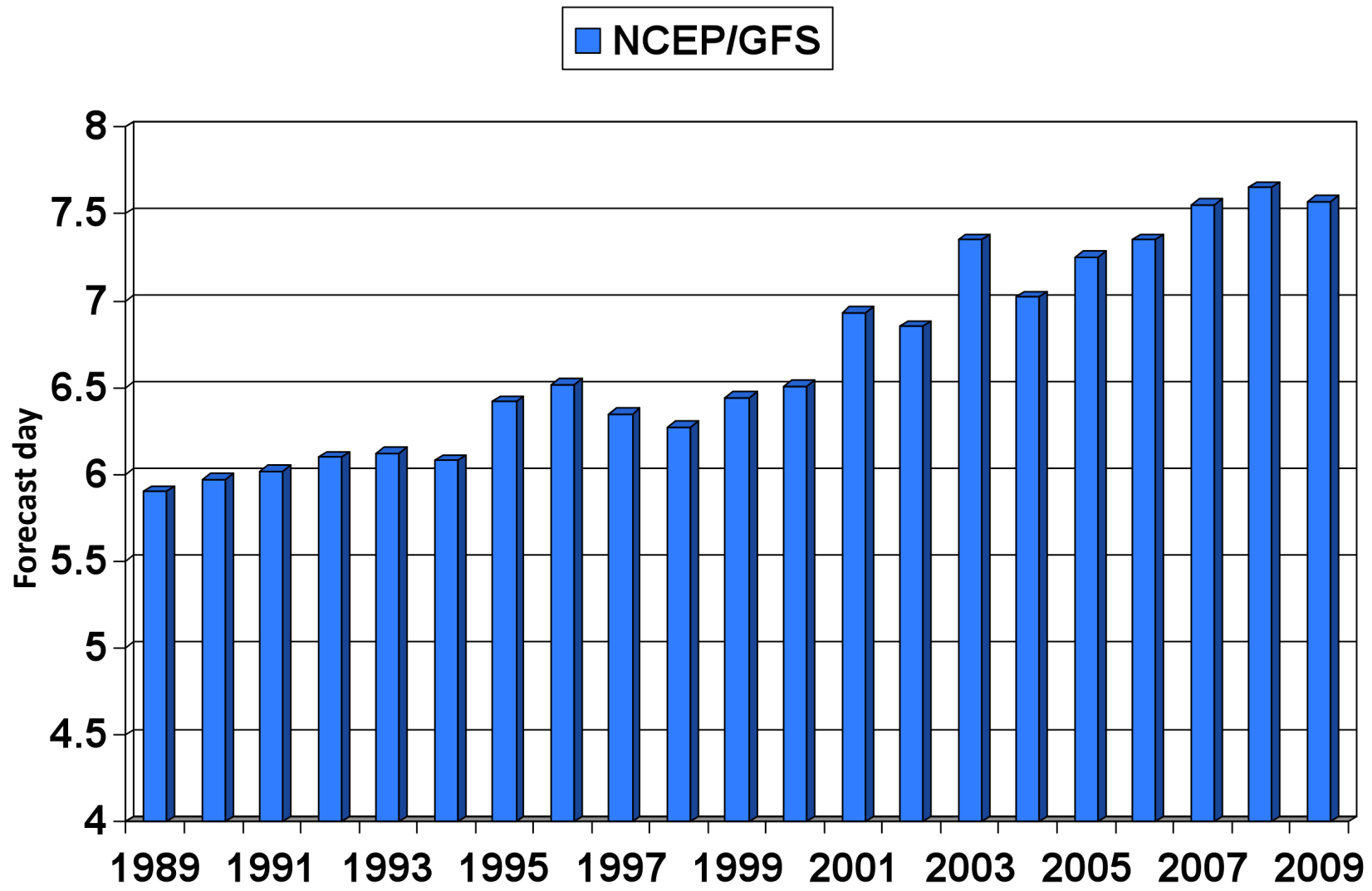


U. S. Seasonal Temperature - Skill

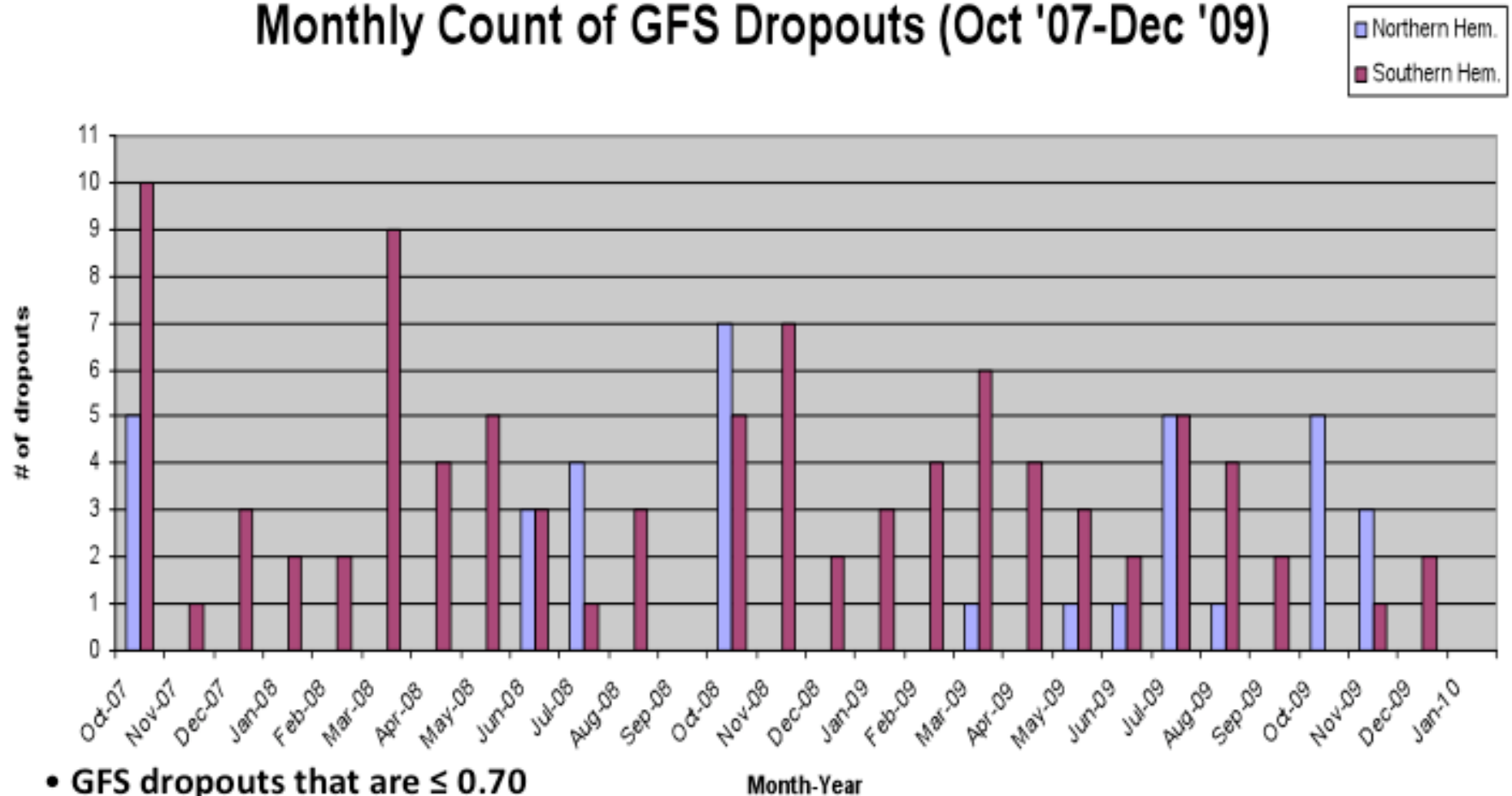


"America's Weather Enterprise: Protecting Lives, Livelihoods, and Your Way of Life"

Day at which forecast loses useful skill (500 mb AC=0.6)
N. Hemisphere calendar year means



Monthly Count of GFS Dropouts (Oct '07-Dec '09)

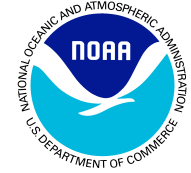


- GFS dropouts that are ≤ 0.70
- The month of October for the last 3 years has produced a total of 17 dropouts in the NH
- Decrease in NH dropouts during the winter months
- In general, almost 3 times as many dropouts in the SH compared to NH (36 NH vs. 93 SH)

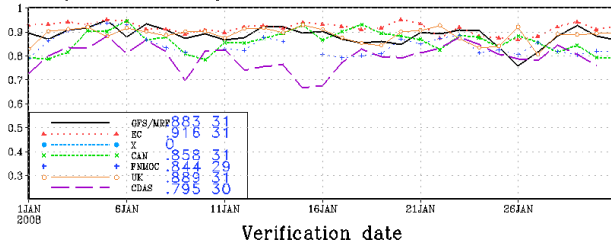


Focusing on Model Improvement

The “Drop Out” Problem

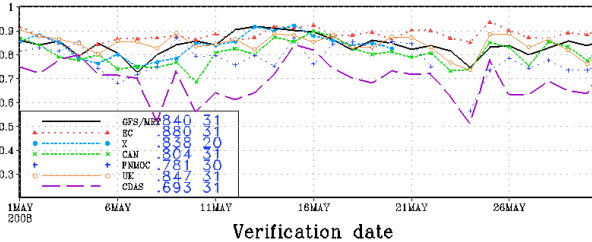


Anomaly Correl day 5 Z 500mb n hem lat 20-80



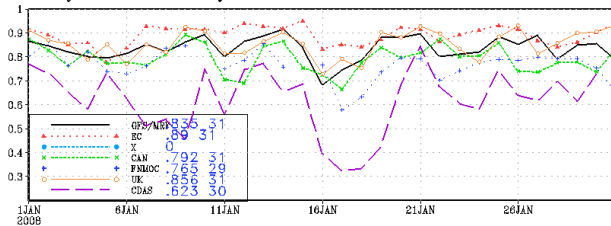
Jan '08

Anomaly Correl day 5 Z 500mb n hem lat 20-80

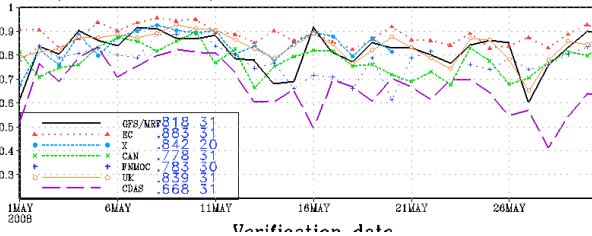


May '08

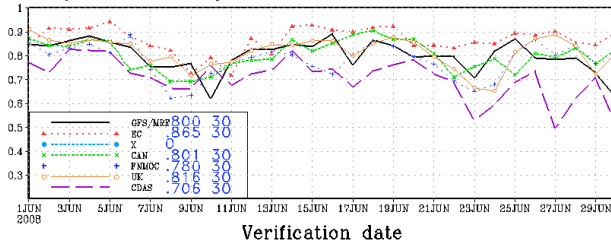
Anomaly Correl day 5 Z 500mb s hem lat 20-80



Anomaly Correl day 5 Z 500mb s hem lat 20-80

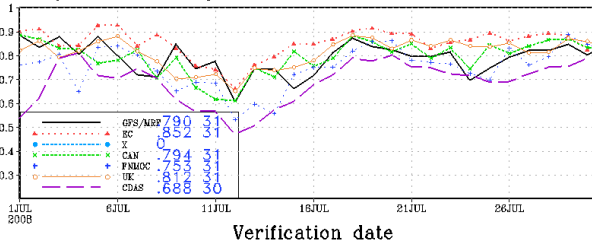


Anomaly Correl day 5 Z 500mb n hem lat 20-80



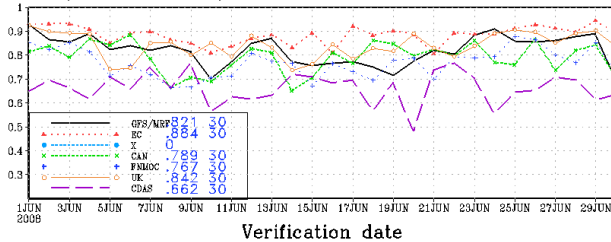
Jun '08

Anomaly Correl day 5 Z 500mb n hem lat 20-80

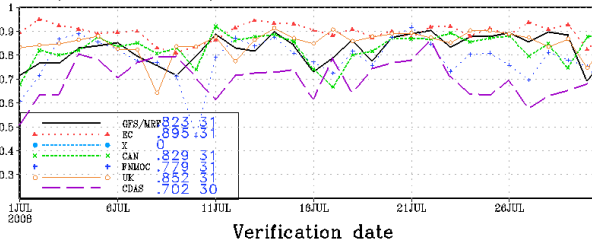


Jul '08

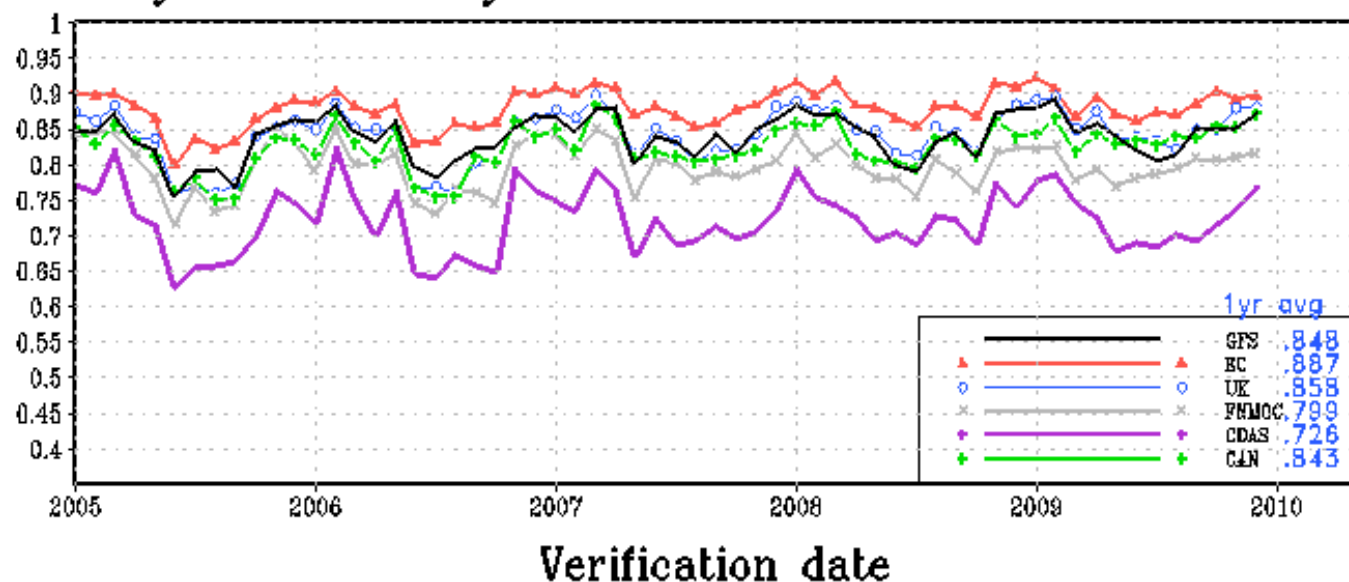
Anomaly Correl day 5 Z 500mb s hem lat 20-80



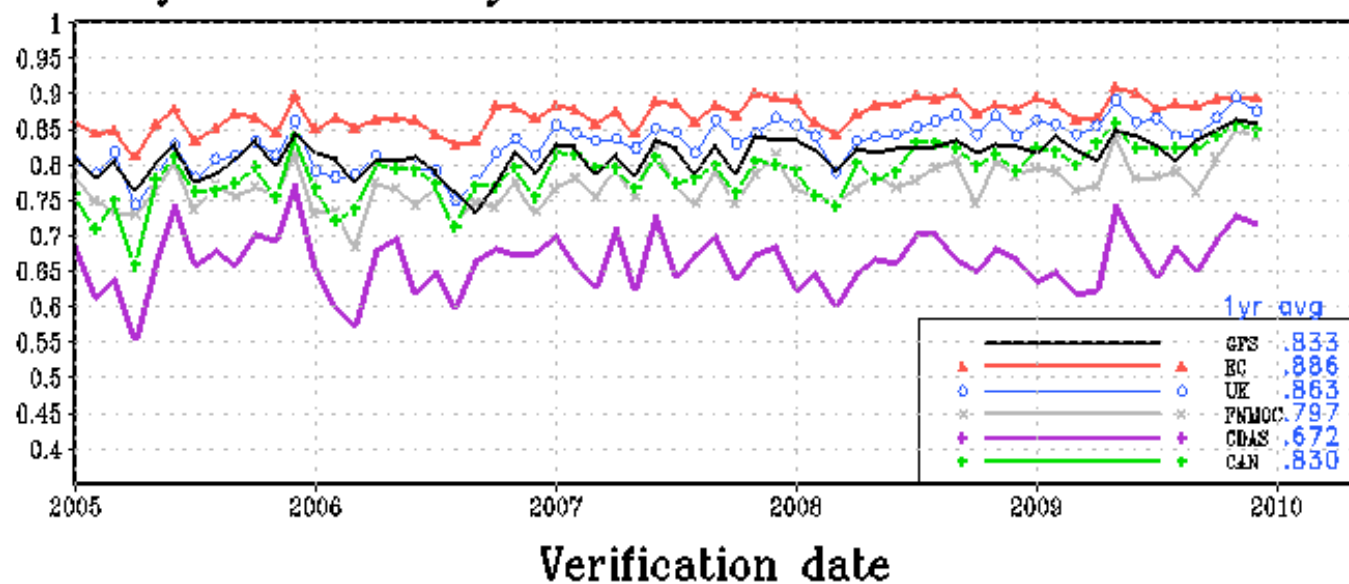
Anomaly Correl day 5 Z 500mb s hem lat 20-80



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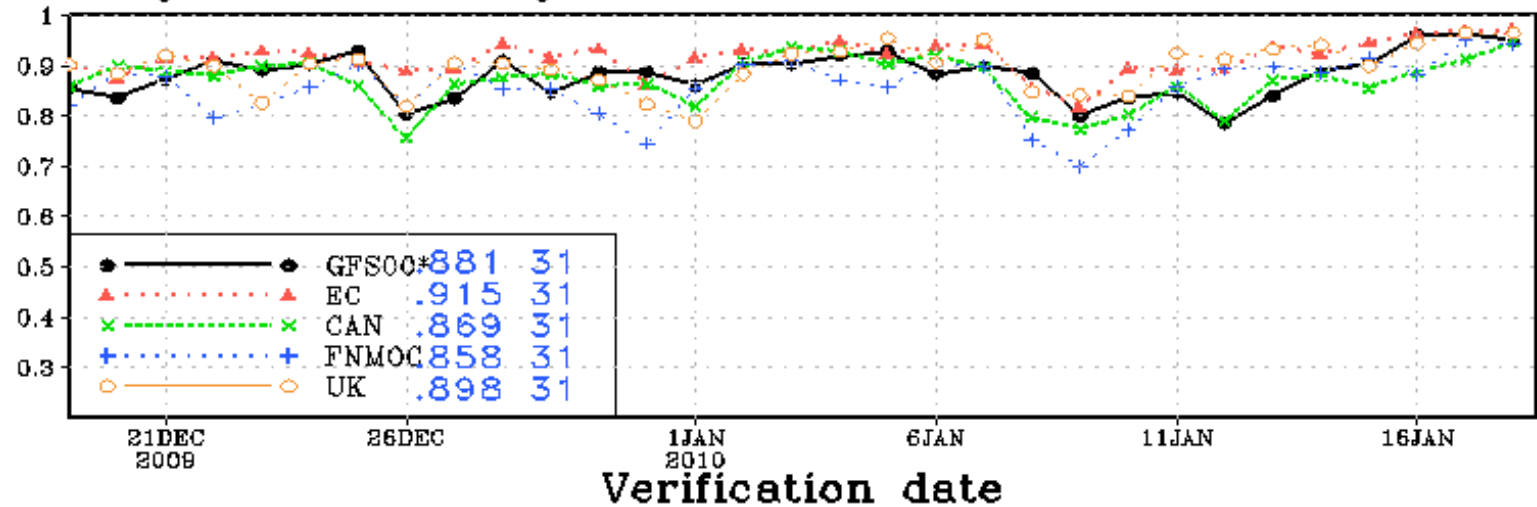


Anomaly Correl day 5 Z 500mb s hem lat 20-80



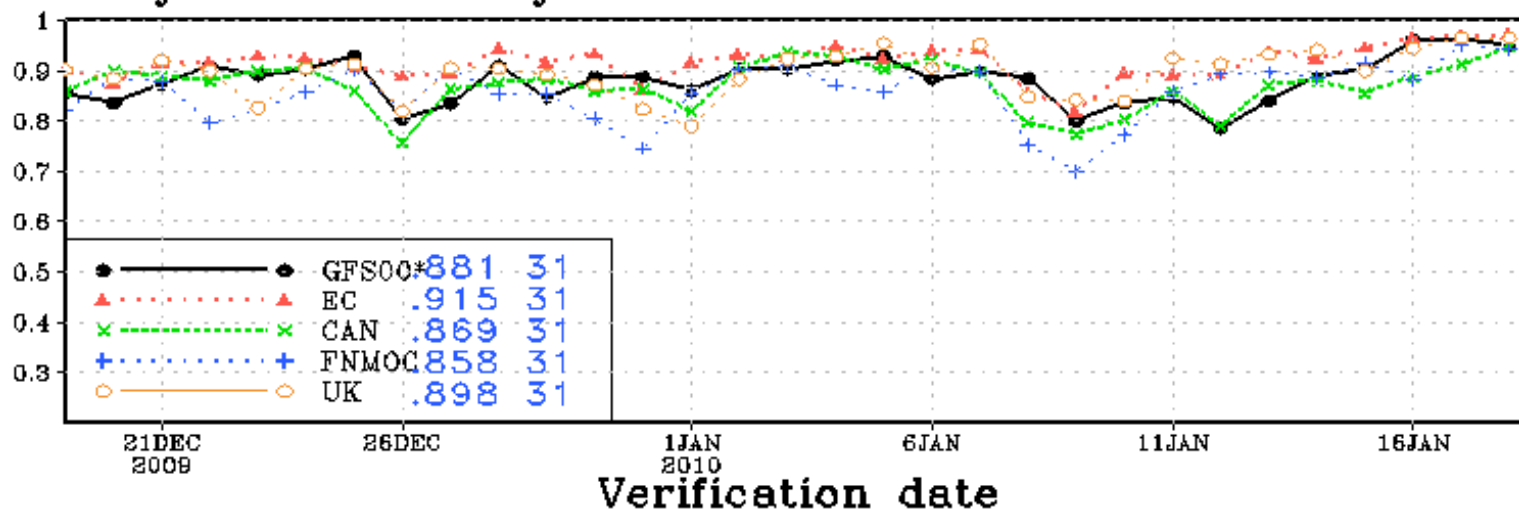
Most Current

Anomaly Correl day 5 Z 500mb n hem lat 20-80

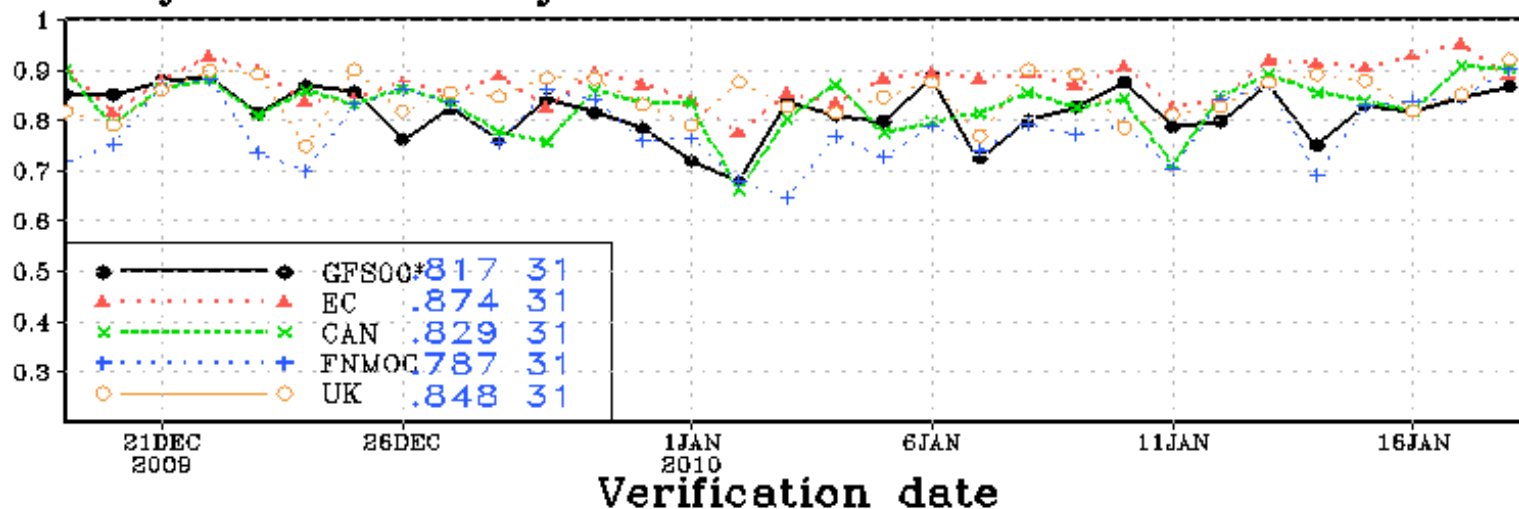


Most Current

Anomaly Correl day 5 Z 500mb n hem lat 20-80



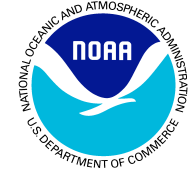
Anomaly Correl day 5 Z 500mb s hem lat 20-80





Some “Findings”

Still Very Preliminary

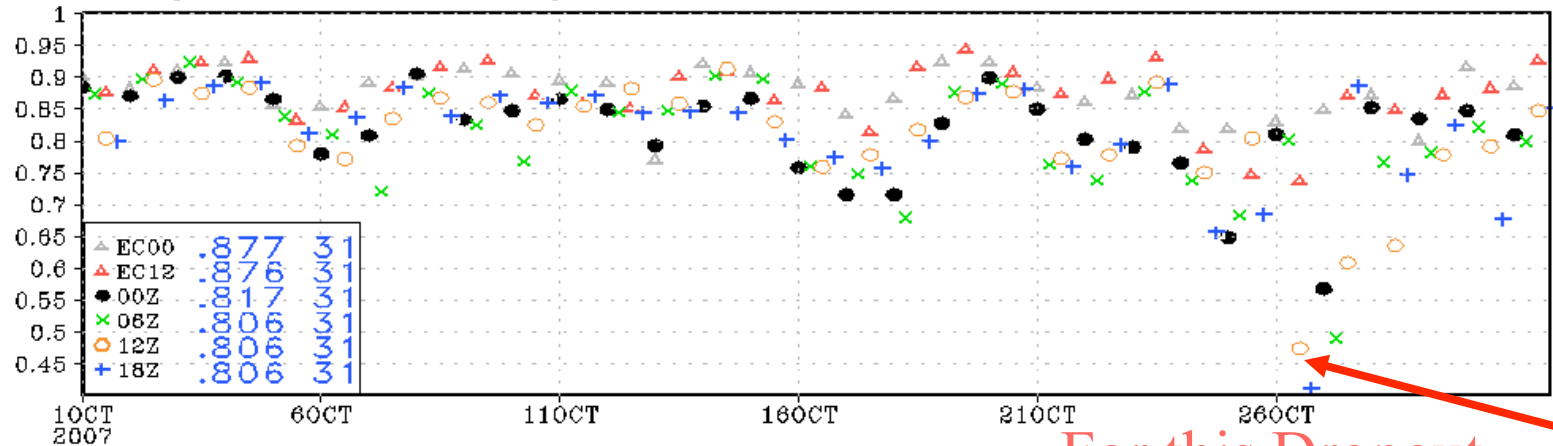


- Data focus on satellite and aircraft
- Could be bias issues
 - Potential warm bias in aircraft data
 - Several bias issues in satellite
 - Potential impact from over sampling (aircraft and satellite)
- Could have analysis issue with respect to how the observation biases are handled, especially in the tropics and the SH
 - Size of analysis window (2.5 hr vs 6 hr vs 12 hr) could be an important issue

Poor Forecasts or Skill Score “Dropouts” Lower GFS Performance

October 26, 2008

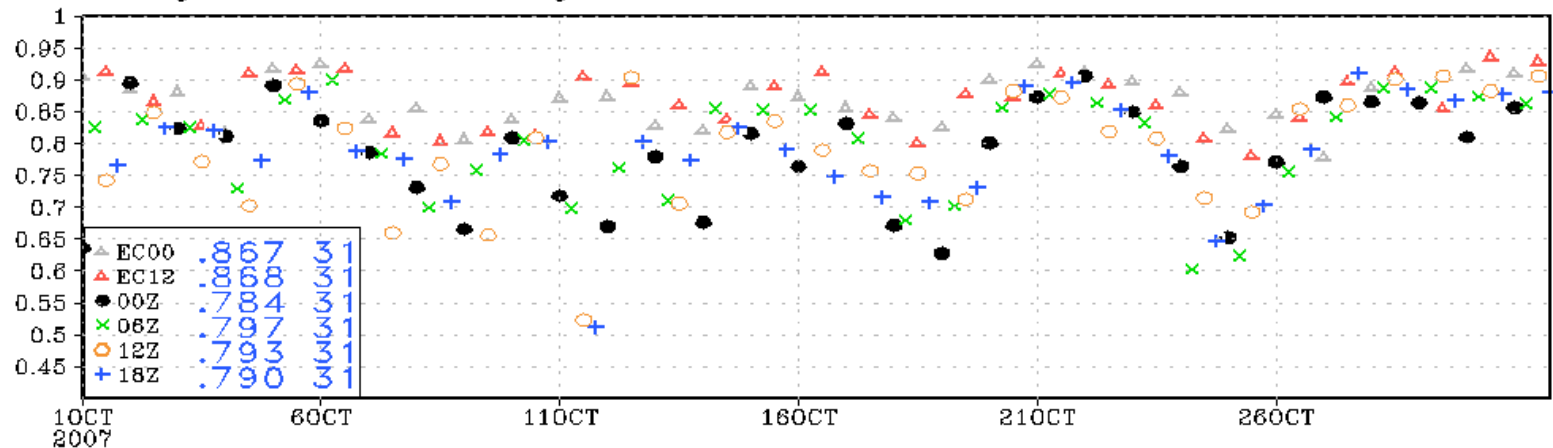
Anomaly Correl day 5 Z 500mb n hem lat 20–80



Verification date

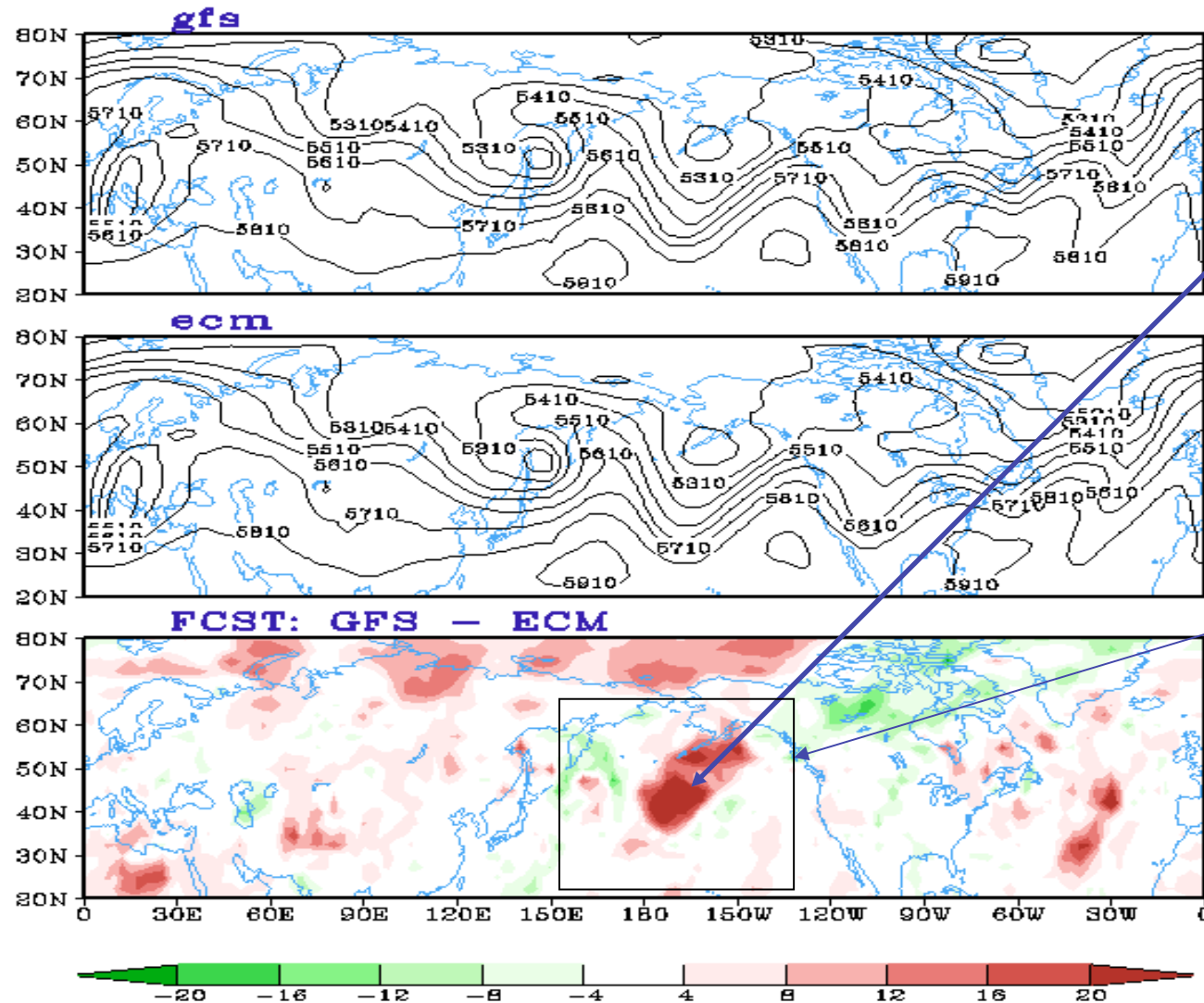
For this Dropout
see IC on next slide...

Anomaly Correl day 5 Z 500mb s hem lat 20–80



Verification date

HGT (m), 500hPa, 2007102112 Cycle, Fcst Hour 100
 Verification Time: 2007102112
 Contour: FCST; Color: FCST-ANL



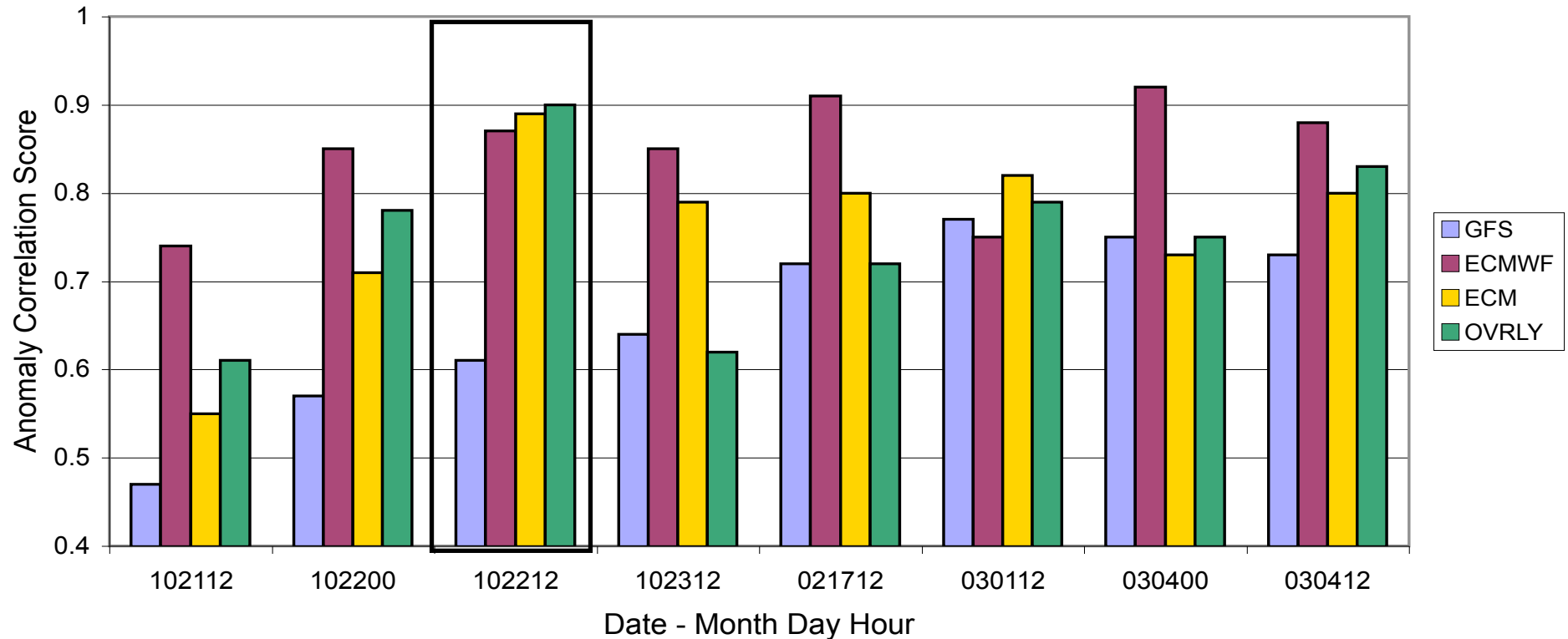
Trough in central Pacific shows differences between ECMWF (no dropout) and GFS (had dropout)

Ovrly “patch” box ECM in this area but GSI elsewhere

5 Day Anomaly Correlation Scores at 500 hPa for Dropout Cases ECM Performs Better than GFS (NH)

2007-2008

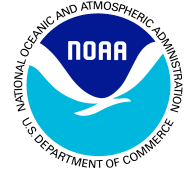
5 Day Anomaly Correlation Scores at 500 hPa for Dropout Cases



- ECM runs are a good representation for ECMWF analysis.
- OVRLY runs with ECM psuedo-obs over the Central Pacific drastically improve two October 2007 dropout cases (102200 & 102212).

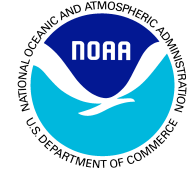


Actions Undertaken through “Drop Out” Team



Goal: Improvement of the GFS using dropouts as case studies measuring ECMWF differences with GFS and other statistics to solve QC and other related problems

- Currently operational:
 - Updated the station dictionary (dropout relieved during the testing period)
 - Regional ATOVS Retransmission (RARS) resulting in more polar orbits
 - P5 to P6 transition change in data dump time for longer data window
 - NESDIS response to satellite data issue more prompt
- Pending:
 - Asymmetric satellite wind quality control
 - Real Time Data Monitoring System (RTDMS) extended to 30 day archive



FY2010 Model Implementations

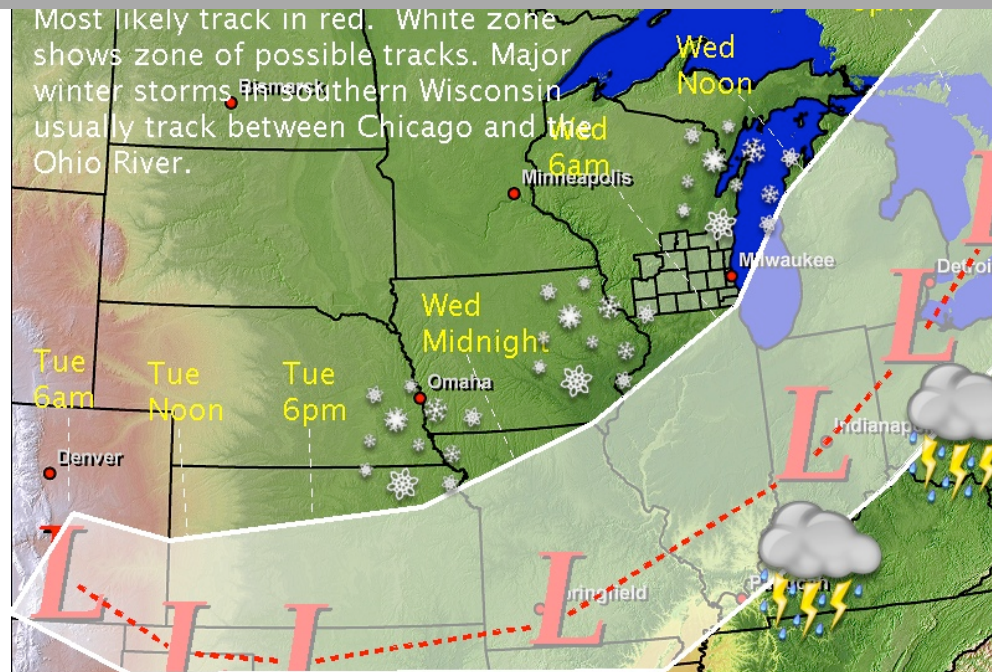
- SREF: Increase resolution to 32 km
- GEFS/NAEFS: T126→T190
- GFS: Increase resolution to T574 (27 km)
- NAEFS: Include FNMOC
- WaveWatch III: Global multi-grid wave model
- HIRES window: Improved high res WRF model
- Test Mode: Data Assimilation GSFC/GMAO/NCEP 4D VAR is proceeding

Prediction of December 8-9 Midwest Storm

Dec 8-9th Midwest Snowstorm

model "spread" from 5 days out, with the white swath being the spread of the ECWME, Canadian, and GFS Ensembles

Most likely track in red. White zone shows zone of possible tracks. Major winter storms in southern Wisconsin usually track between Chicago and the Ohio River.



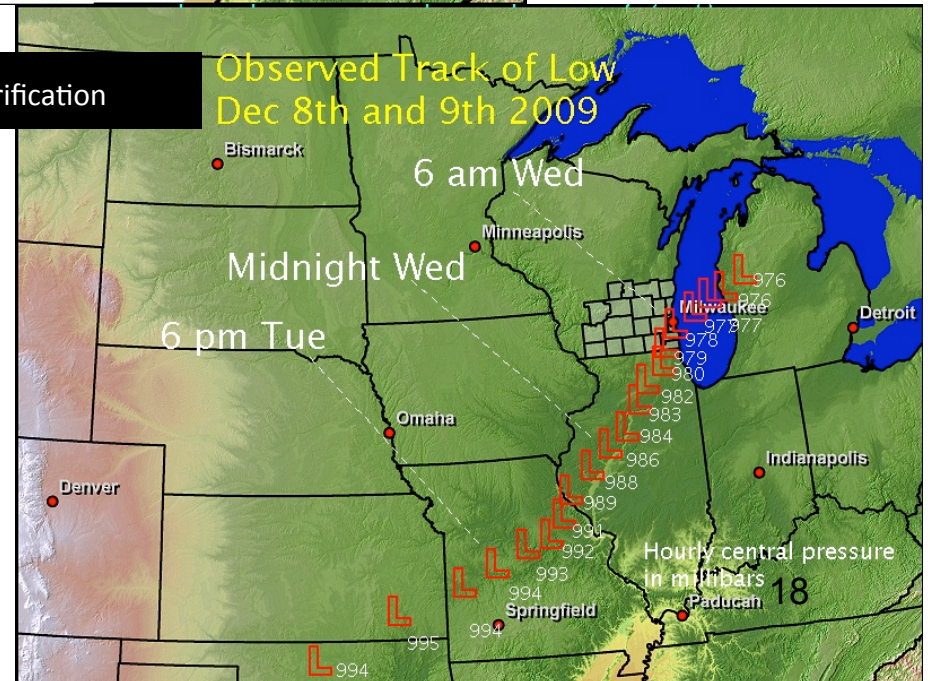
Increasing realization that NAM and SREF are becoming important tool for Days 1-3 forecast of extreme events

48 hours out, with the NAM, GFS, ECMWF, UKMET, and Canadian plotted. The NAM is the left outlier, which tracked it right over Milwaukee 48 hours out. The SREF had a similar track.



Verification

Observed Track of Low Dec 8th and 9th 2009





NCS Climate Portal: Data & Services



Explore: [ClimateWatch Magazine](#)

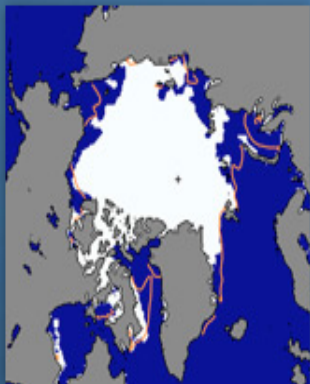
[Data & Services](#)

[Understanding Climate](#)

[Education](#)

NOAA is developing a comprehensive, [Climate Portal](#) that provides **ready access** to all NOAA climate data, products, and services.

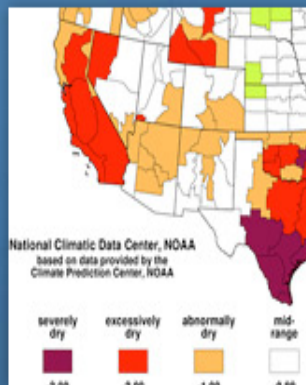
Past & Present Climate ▶



Climate at a Glance

Read and explore summaries and digests of recent climate-related phenomena from NOAA's distributed climate service community.

Outlooks ▶



Looking Ahead

Discover explorations short-term evaluations of how climate phenomena are likely to unfold in coming days, weeks, and months.

US & Global Regions ▶



Explore NOAA by Region

Explore the climate services and products NOAA experts prepare for specific regions of our nation and the world.

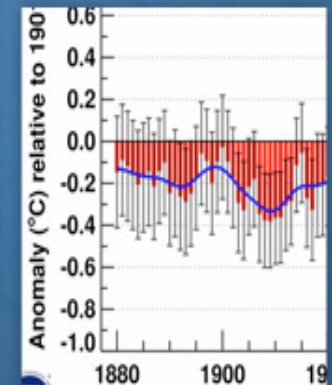
Serving Society ▶



Utilizing Climate Data

Climate information is essential for business and community planning. These resources focus on needs of specific sectors of society.

Data Library ▶



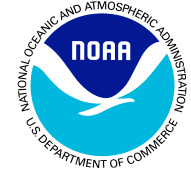
Visualizing & Explore

NOAA is a leading provider of access to data from research projects, stations, and satellites to the nation and the world.

www.climate.gov



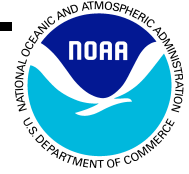
NCEP Climate Forecast System Reanalysis



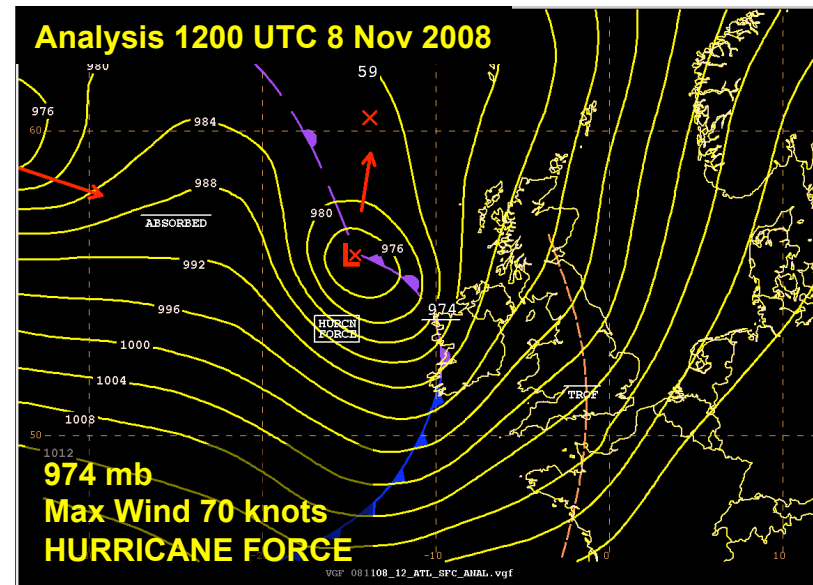
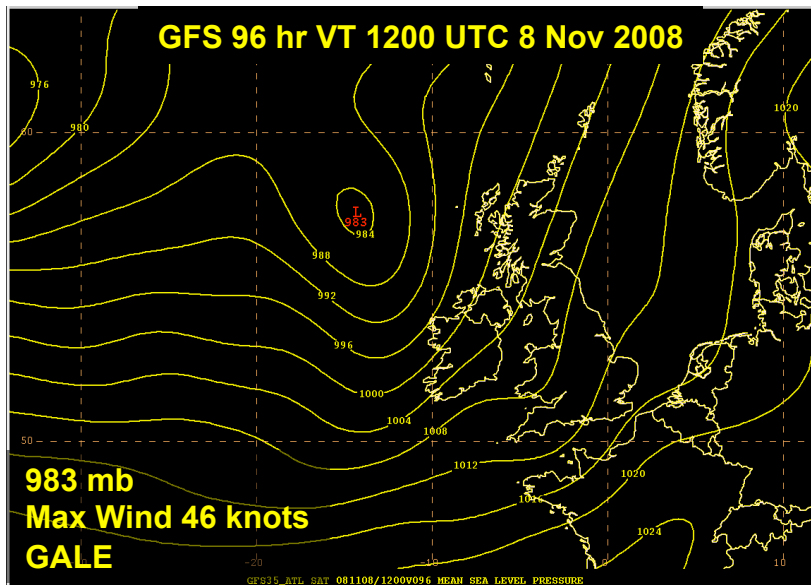
- Complete as of November 2009
- A global, high resolution, coupled atmosphere-ocean-land surface-sea ice system for the period 1979-2009.
- Atmosphere resolution: 38 km (T382), 64 levels extending to 0.26 hPa
- Ocean resolution: 0.25 degree at the equator, 40 levels to 4737 m depth
- Products available at hourly time resolution, 0.5 degree horizontal resolution, and at 37 standard pressure levels
- CFSR products began being transmitted on December 7, 2009, to the NOAA National Climate Data Center (NCDC), the official dissemination outlet for the CFSR. NCAR will also host a copy of the CFSR.
- CPC is in the process of generating its operational climate diagnostics products from the CFSR data.
- An operational implementation of the entire CFSR system, including all hindcast model runs, is scheduled for Q1 of FY11.



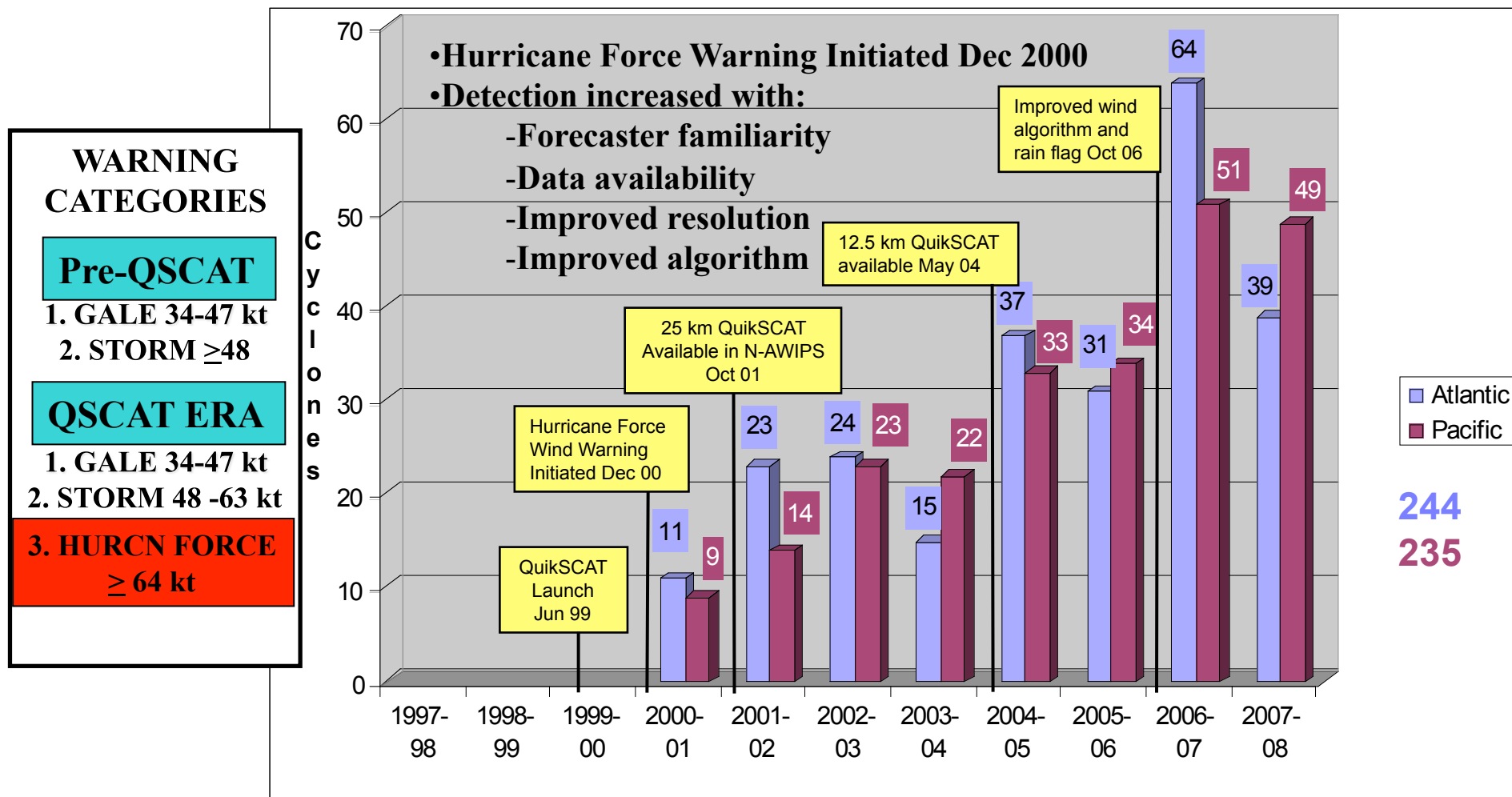
Extratropical Oceanic Cyclogenesis - Major Forecast Challenges Remain



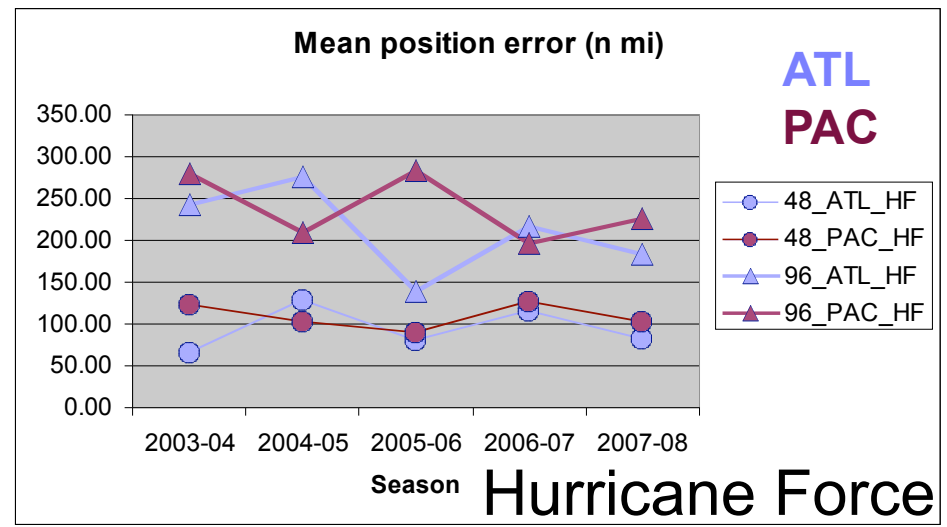
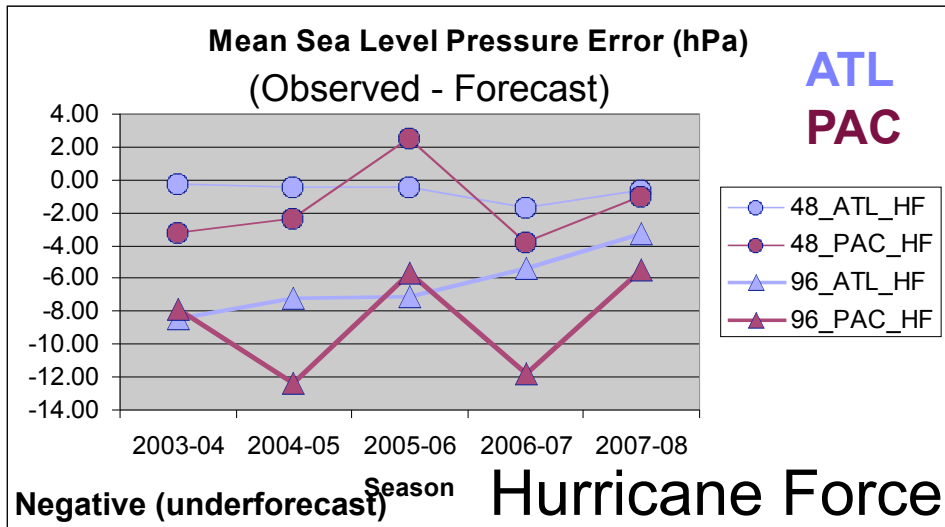
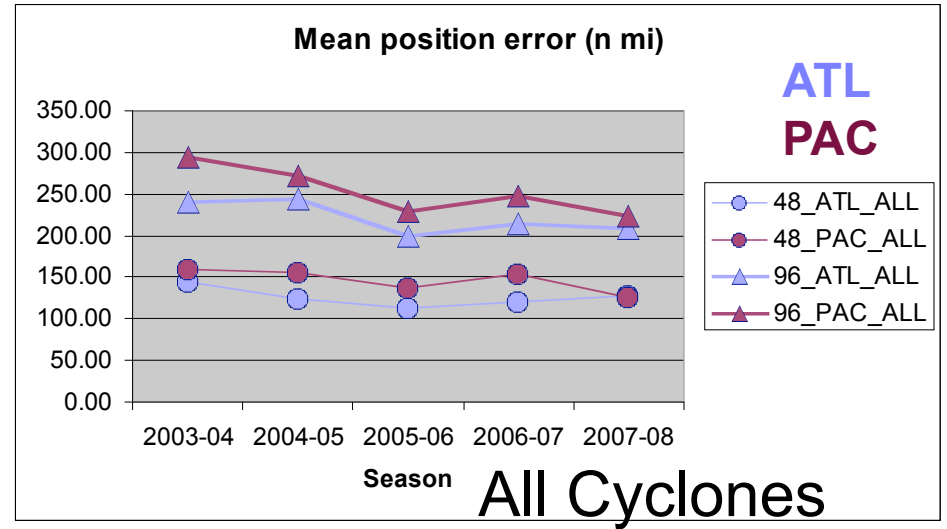
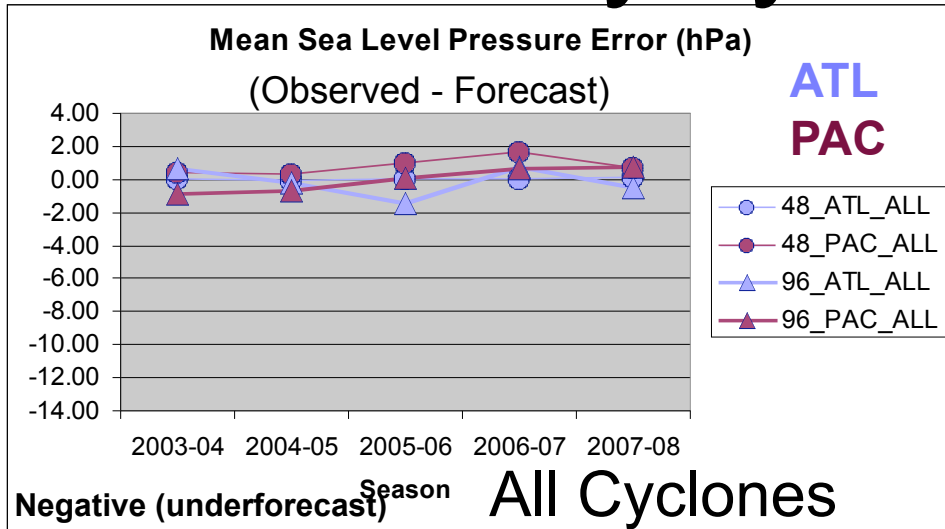
- Under-prediction of most rapid intensification phase of extratropical cyclogenesis – hurricane force winds
(It is not just a tropical problem!!)



Hurricane Force Extratropical Cyclones Detection and Warning Trend using QuikSCAT



2 & 4 day cyclone forecast skill



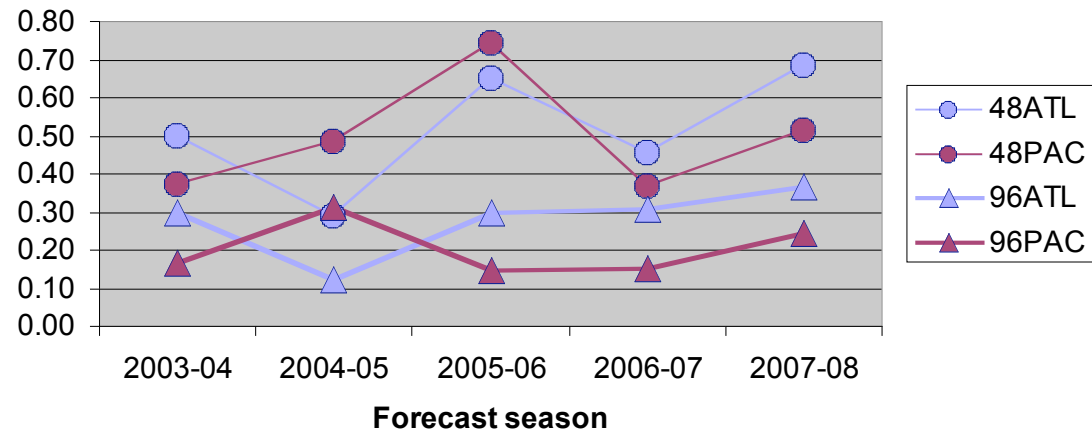
Intensity (hPa)

Track (n mi)

2 & 4 day warning skill

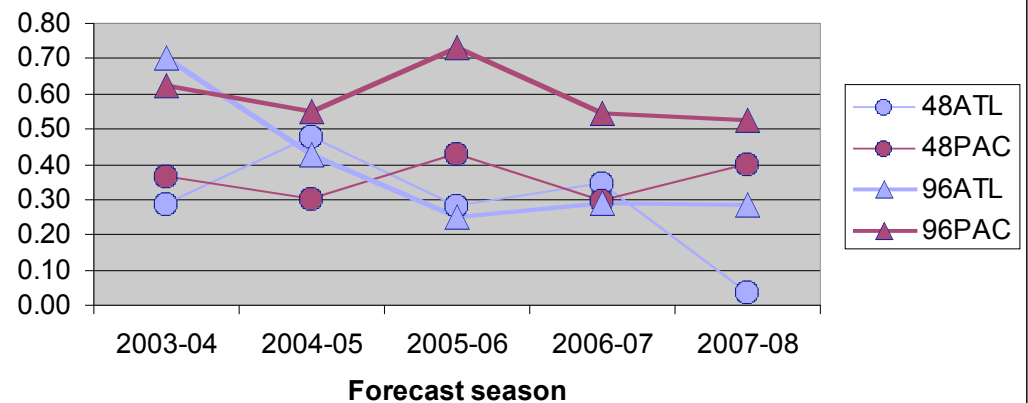
Hurricane Force Warning Skill
Probability of Detection

POD

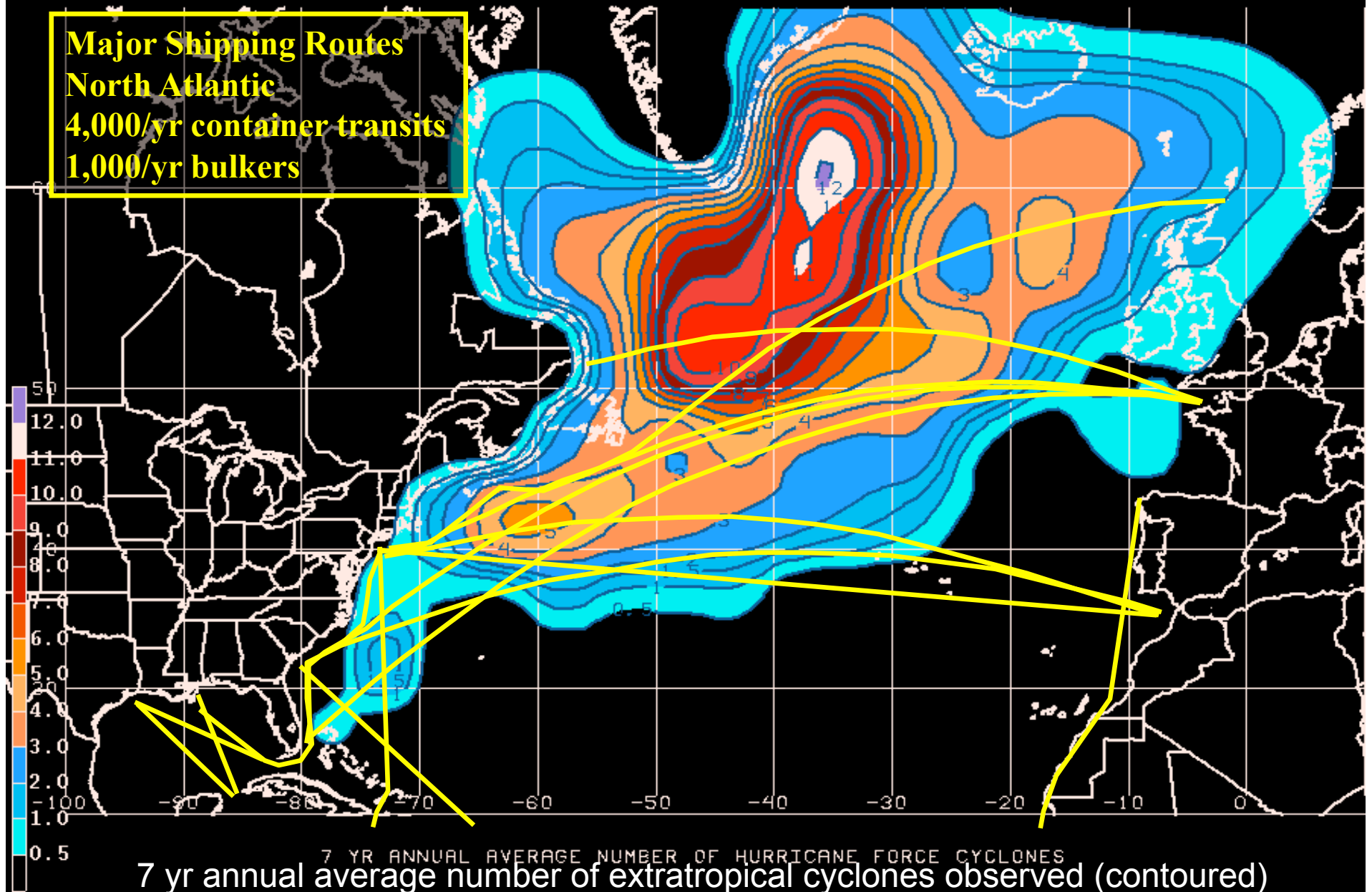


Hurricane Force Warning Skill
False Alarm Ratio

FAR

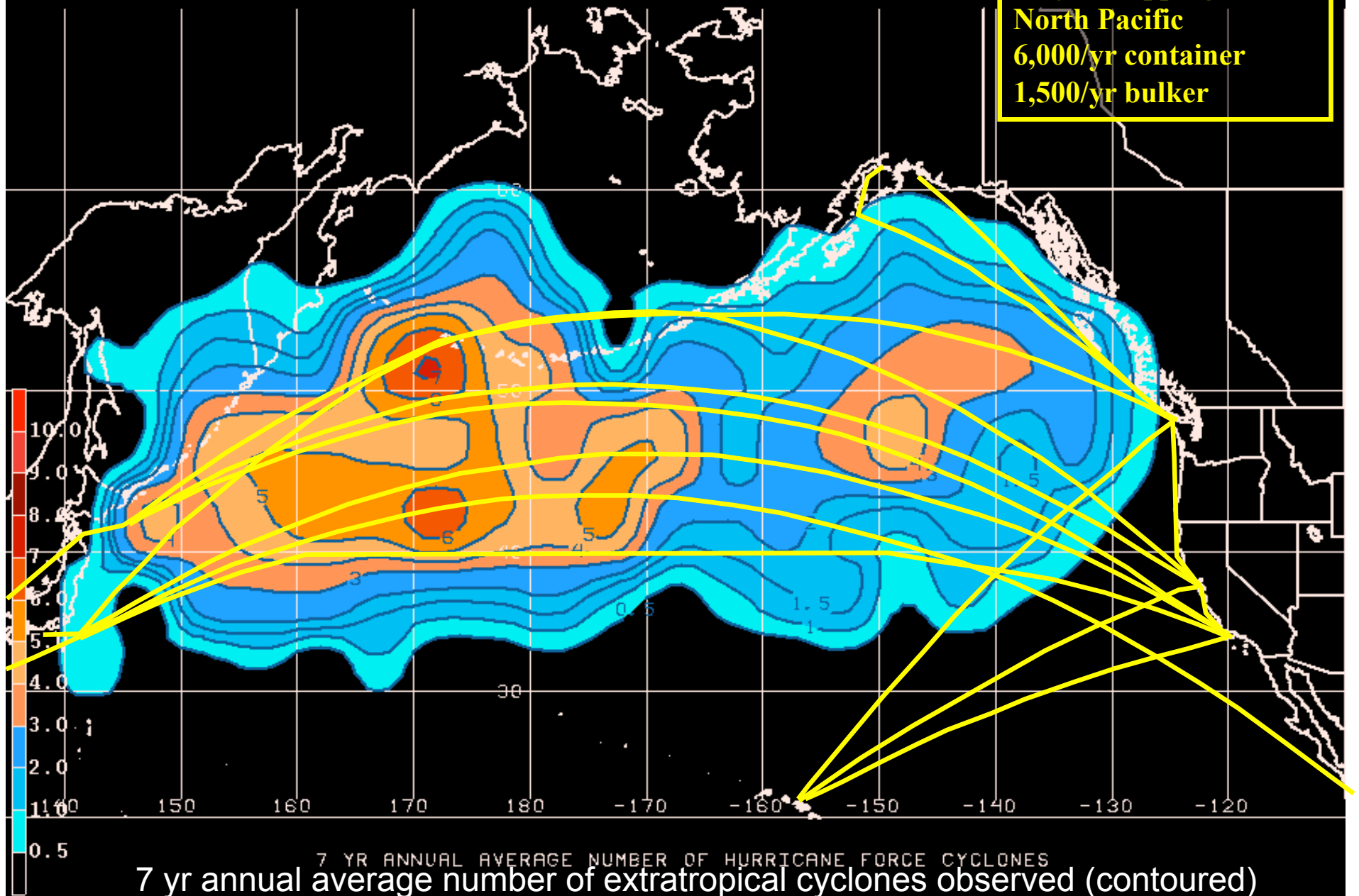


Major Shipping Routes
North Atlantic
4,000/yr container transits
1,000/yr bulkers

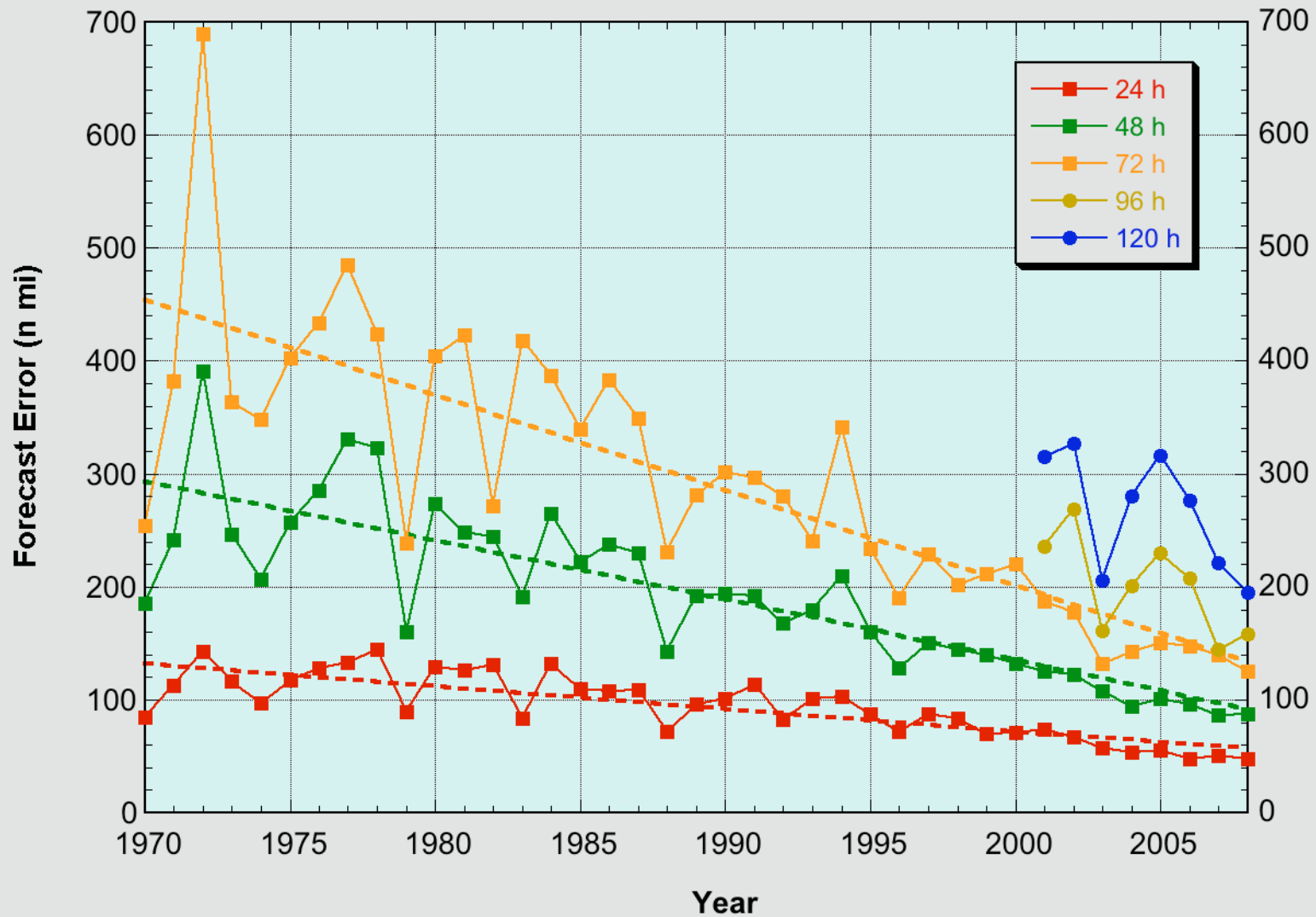


7 yr annual average number of extratropical cyclones observed (contoured)
with hurricane force winds for the years 2001 - 2008

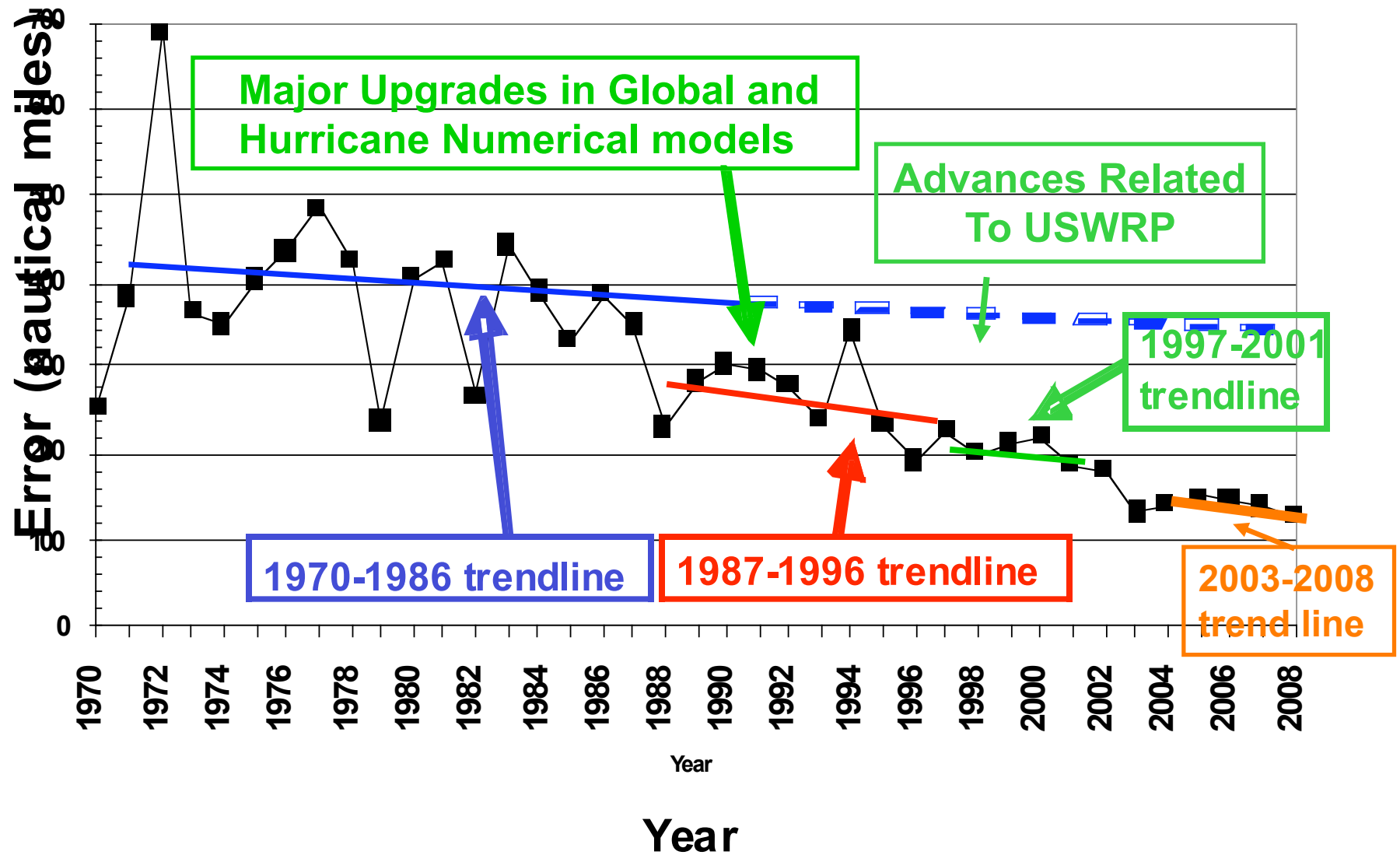
Major Shipping Routes
North Pacific
6,000/yr container
1,500/yr bulker



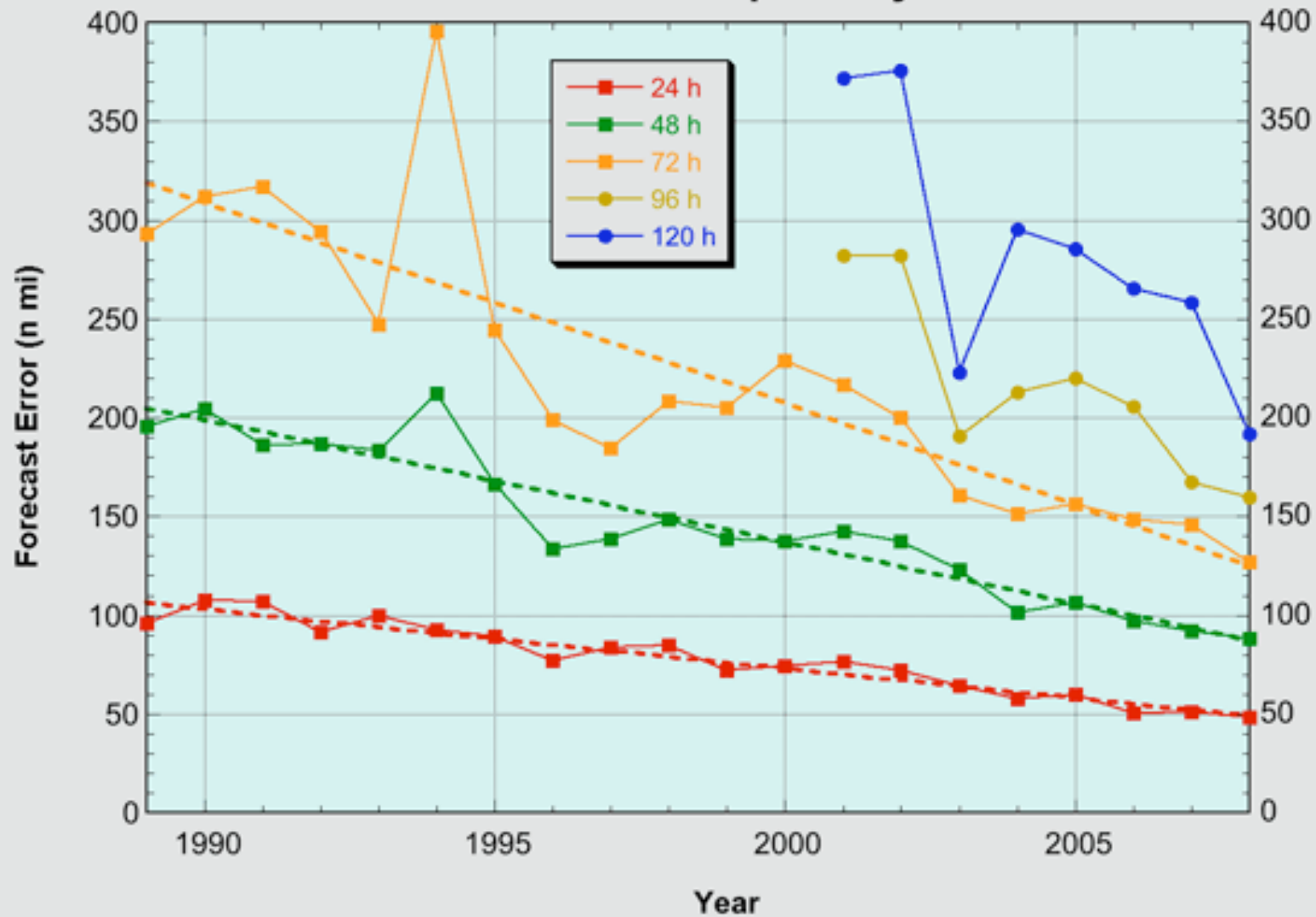
NHC Official Annual Average Track Errors Atlantic Basin Tropical Storms and Hurricanes



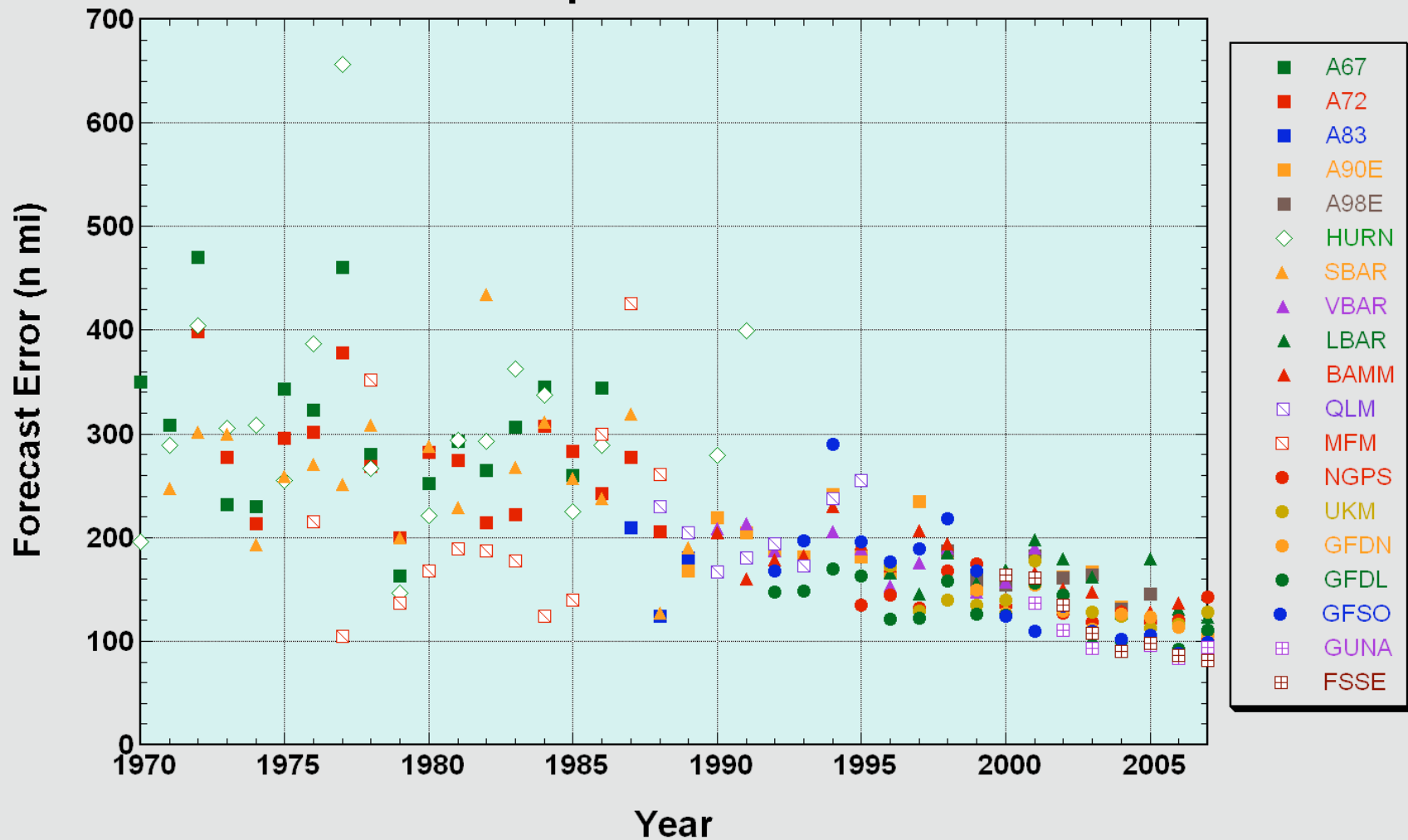
NHC Atlantic 72 hr Track Forecast Errors



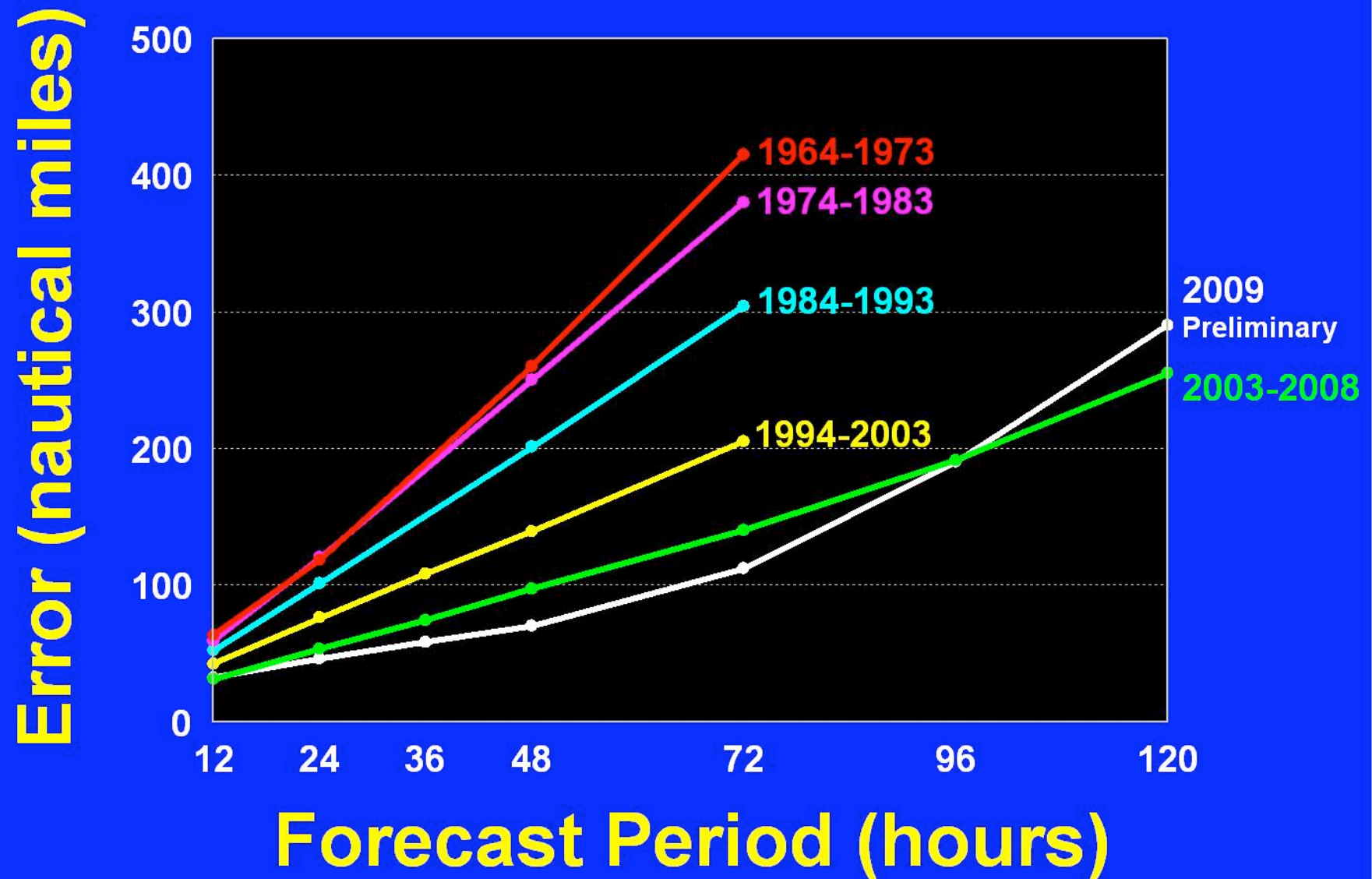
NHC Official Annual Average Track Errors Atlantic Basin Tropical Cyclones



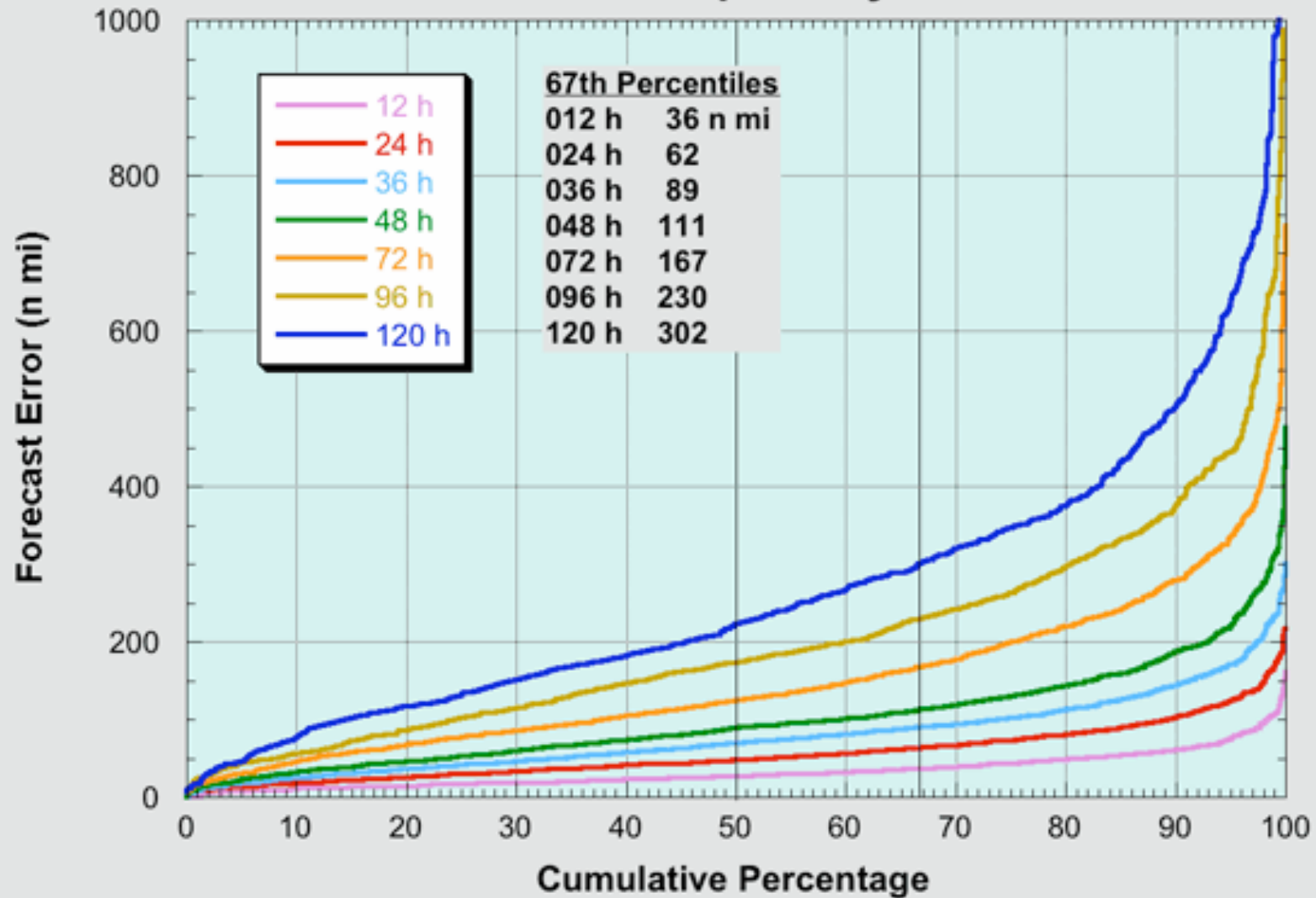
48-h Track Errors - Model Guidance Atlantic Basin Tropical Storms and Hurricanes



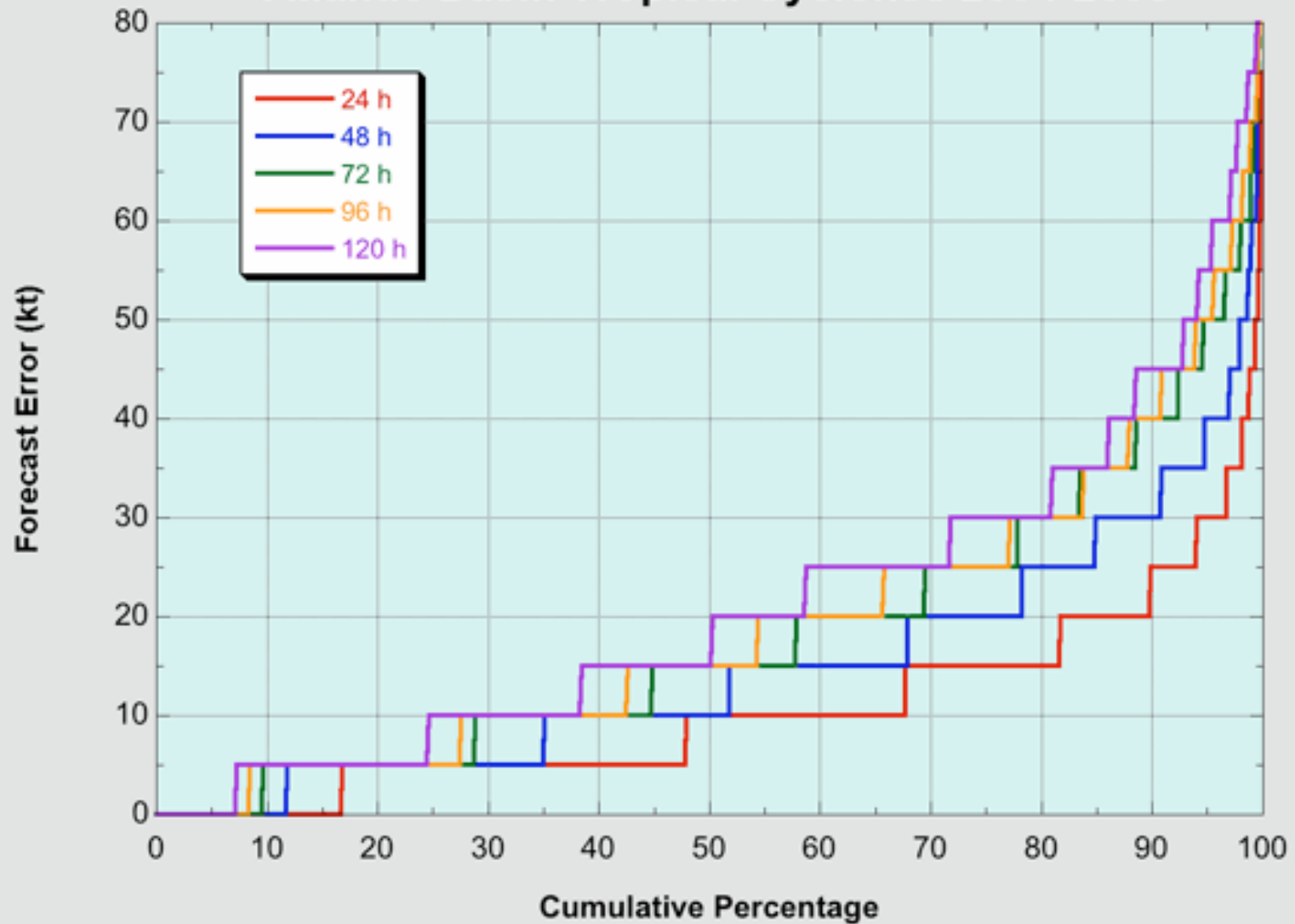
NATIONAL HURRICANE CENTER ATLANTIC TRACK FORECAST ERRORS



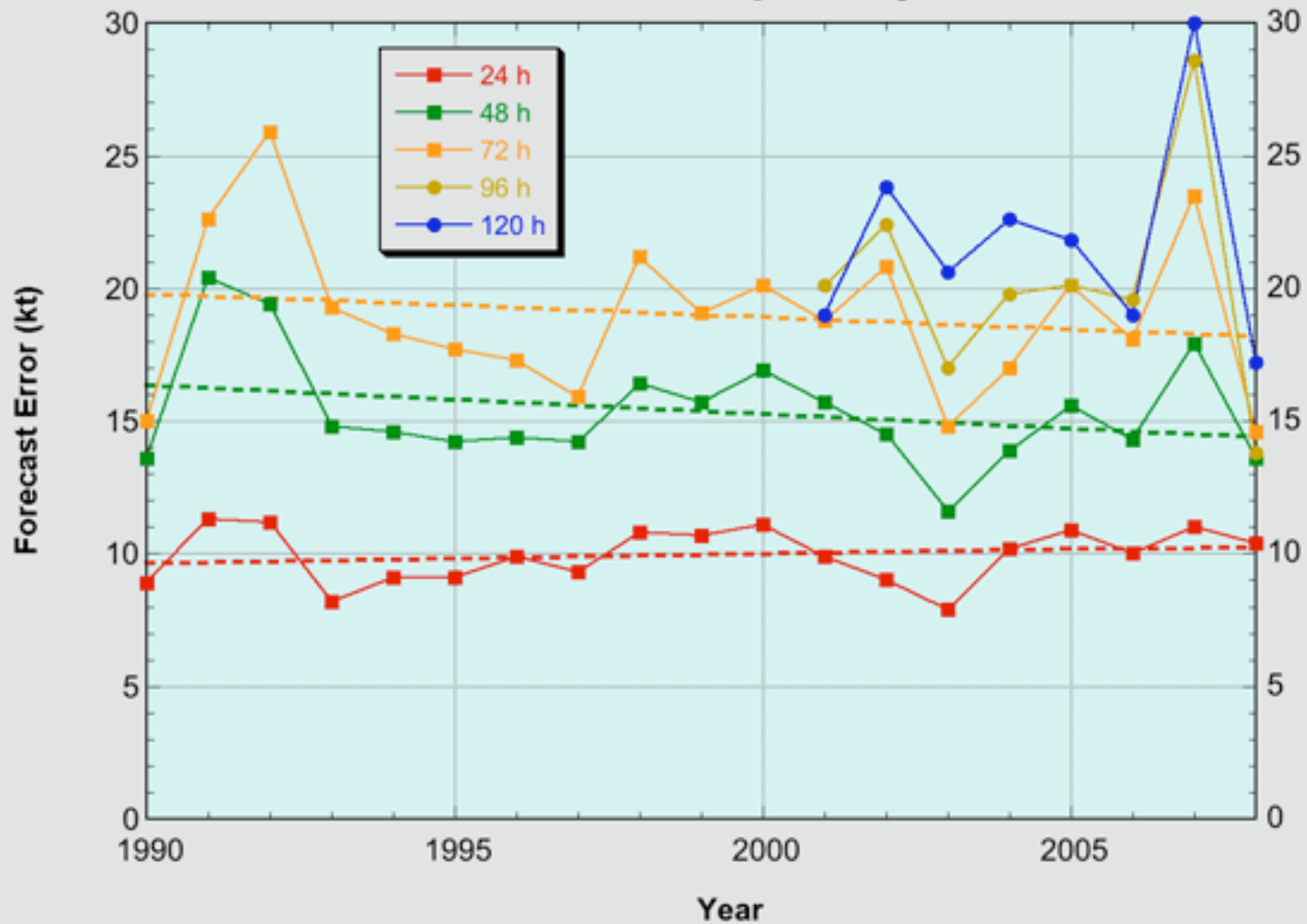
NHC Official Track Error Cumulative Distribution Atlantic Basin Tropical Cyclones 2004-8



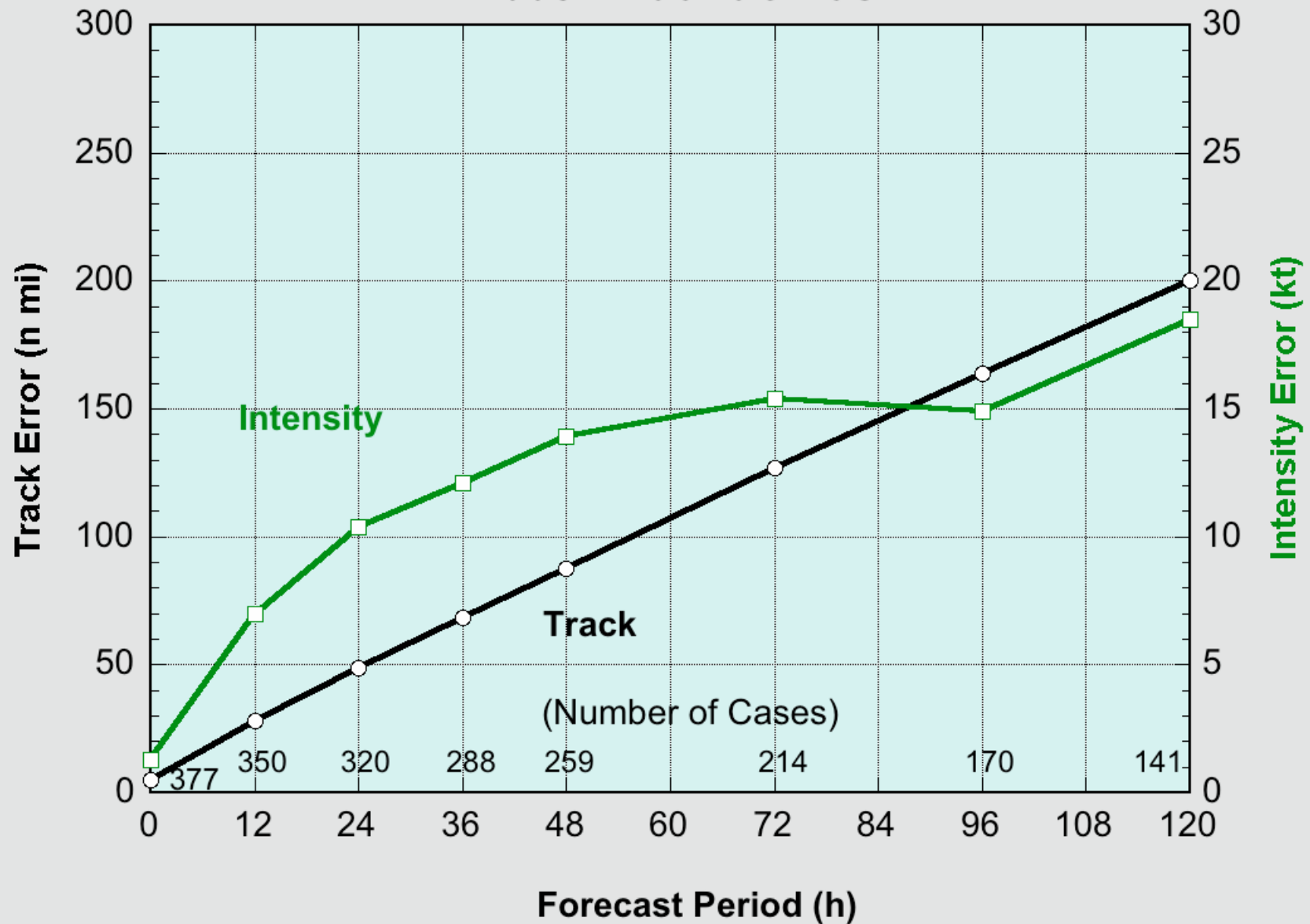
NHC Official Intensity Error Cumulative Distribution Atlantic Basin Tropical Cyclones 2004-2008



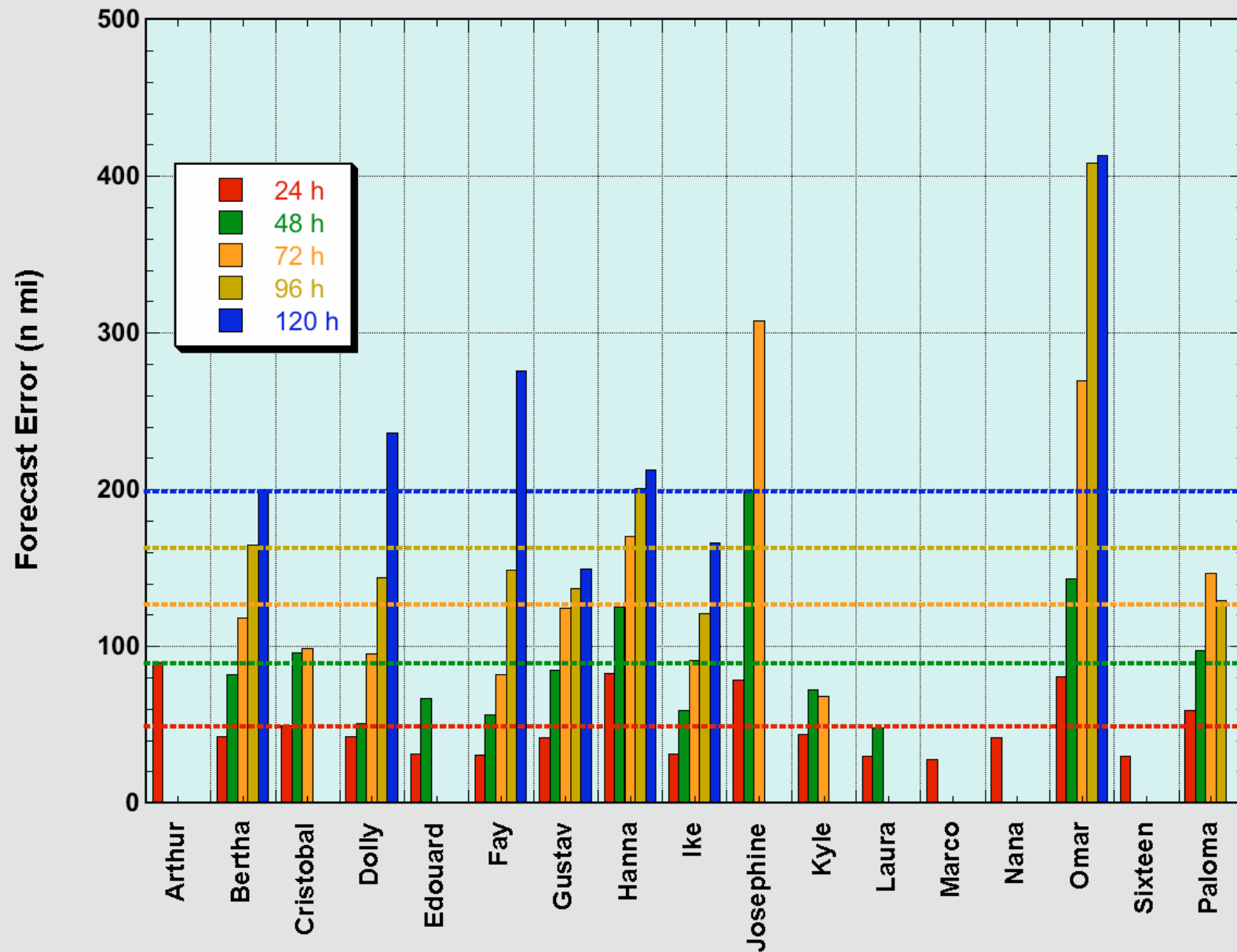
NHC Official Annual Average Intensity Errors Atlantic Basin Tropical Cyclones



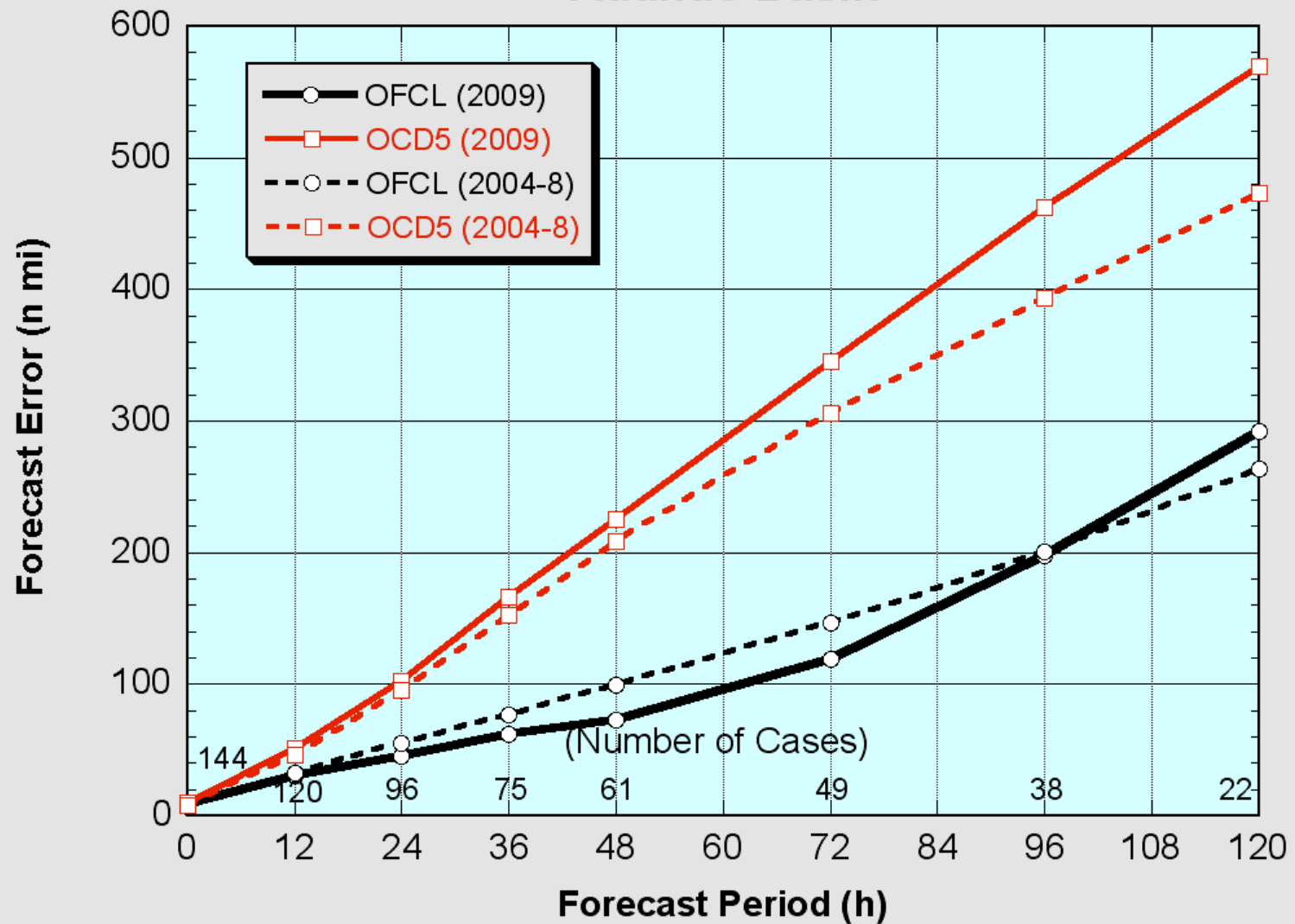
NHC Official Forecasts 2008 - Atlantic Basin



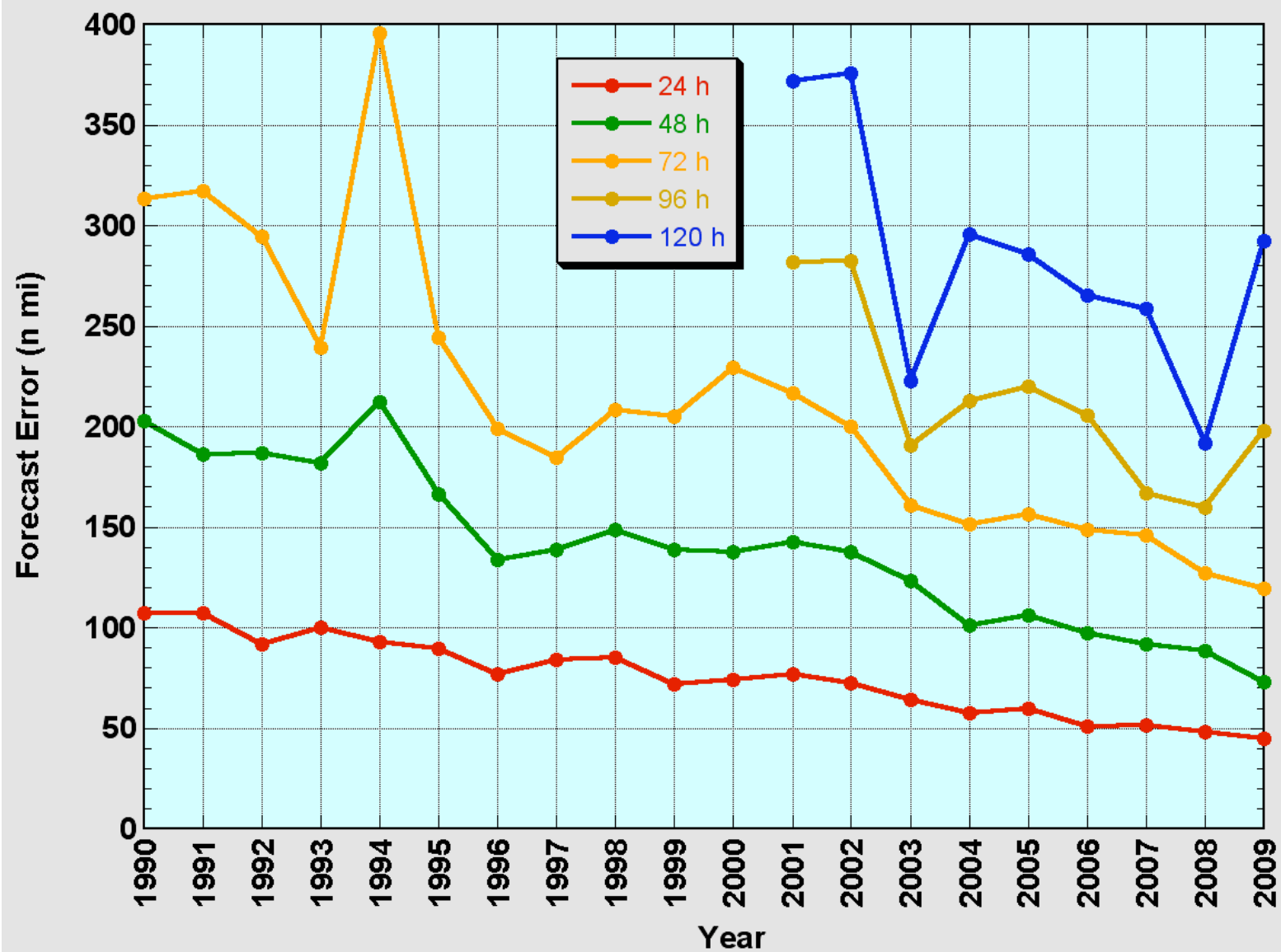
NHC Official Track Forecast Error by Storm 2008 - Atlantic Basin



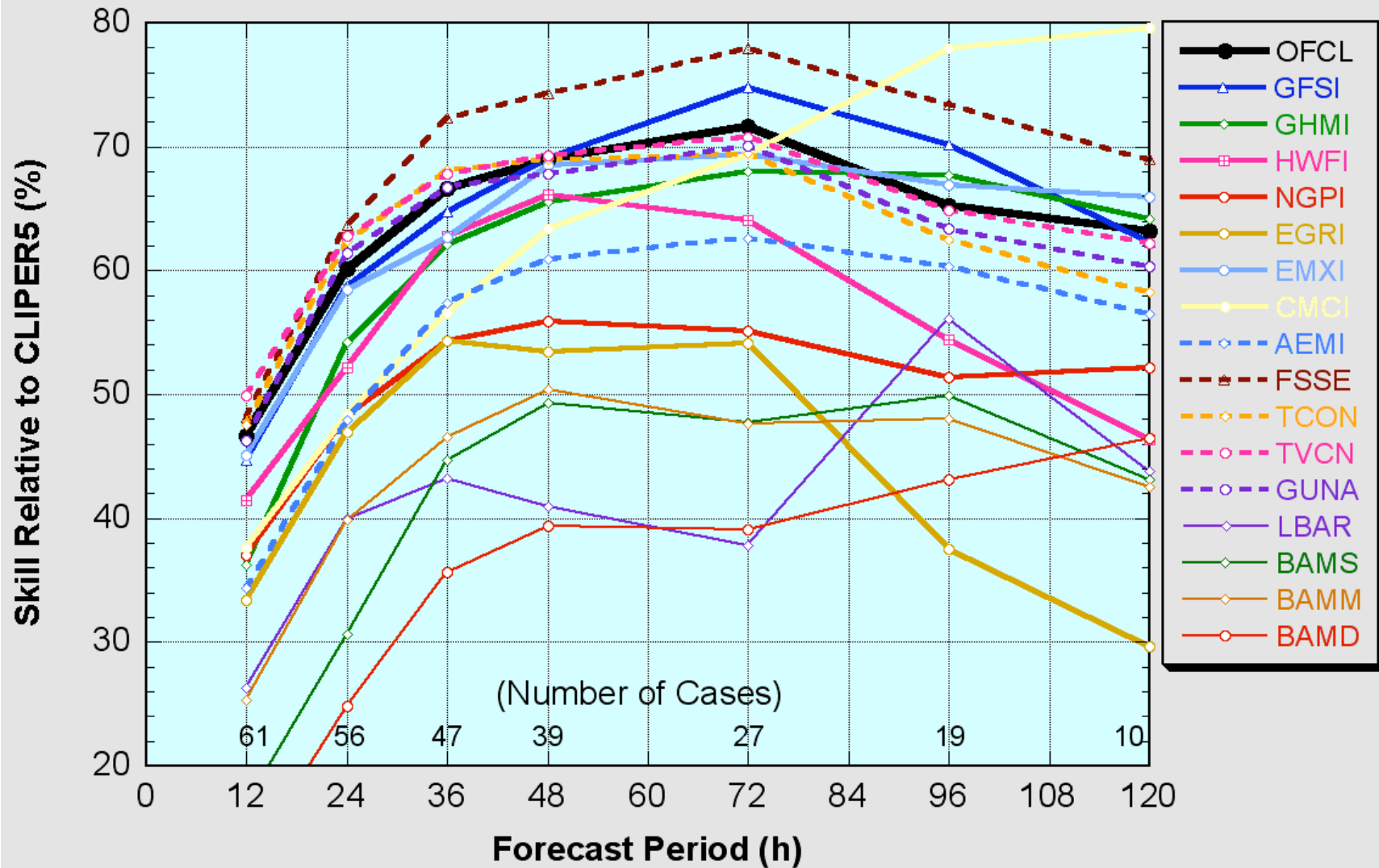
NHC Official vs. CLIPER5 Track Forecasts Atlantic Basin



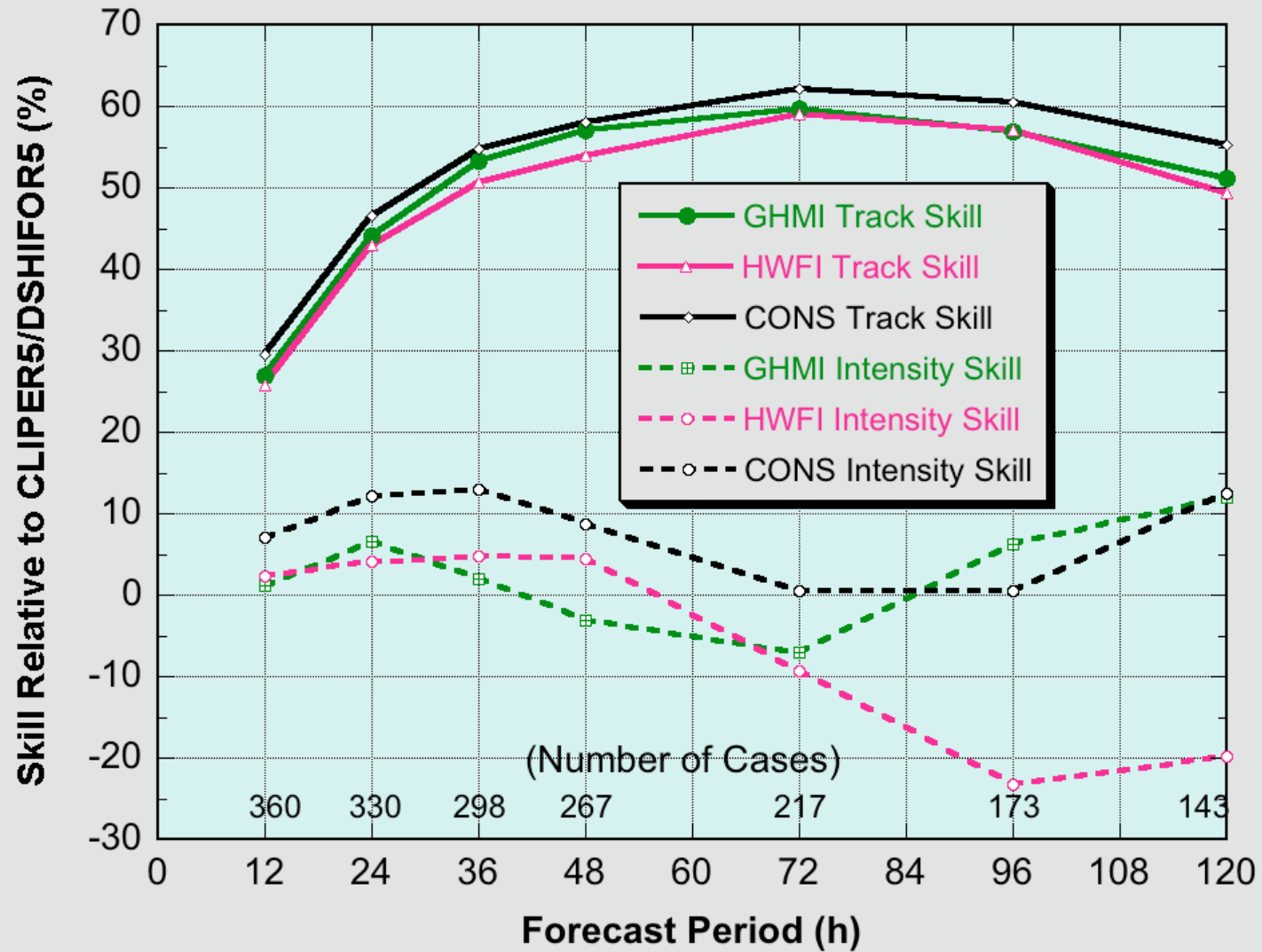
NHC Official Track Error Trend Atlantic Basin



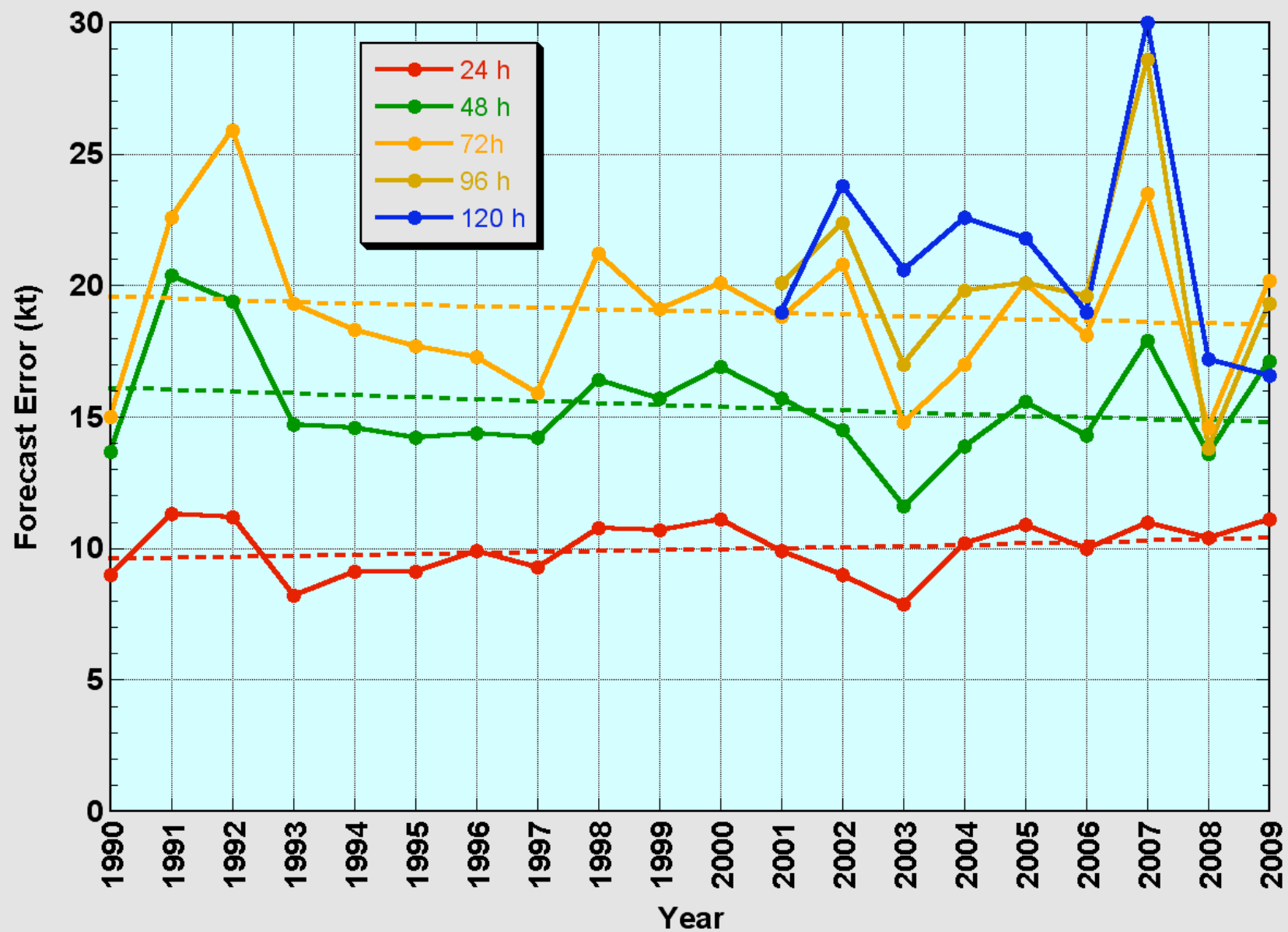
Track Forecast Skill (Early Models) 2009 - Atlantic Basin



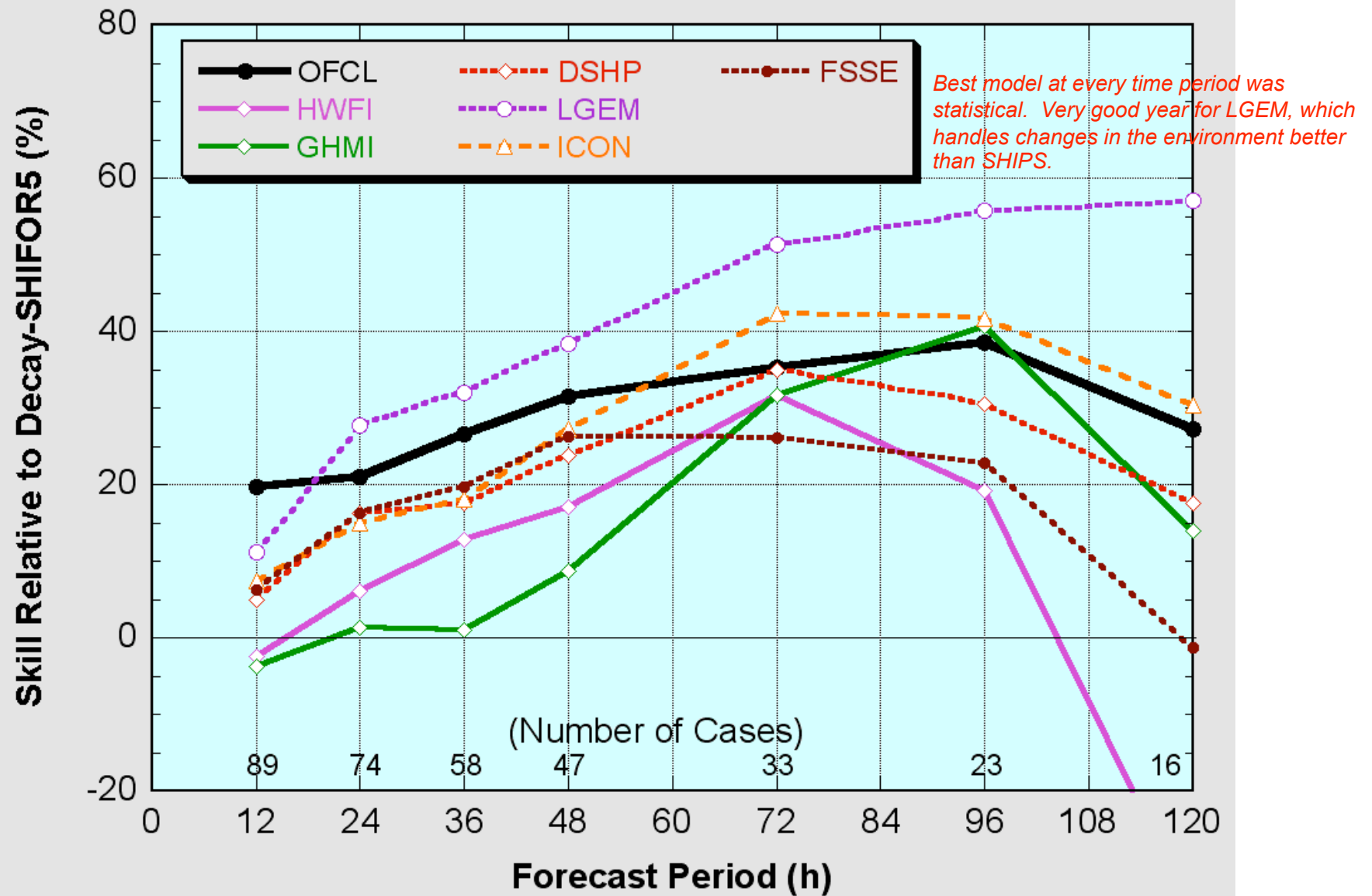
GFDL vs HWRF 2008 - Atlantic Basin



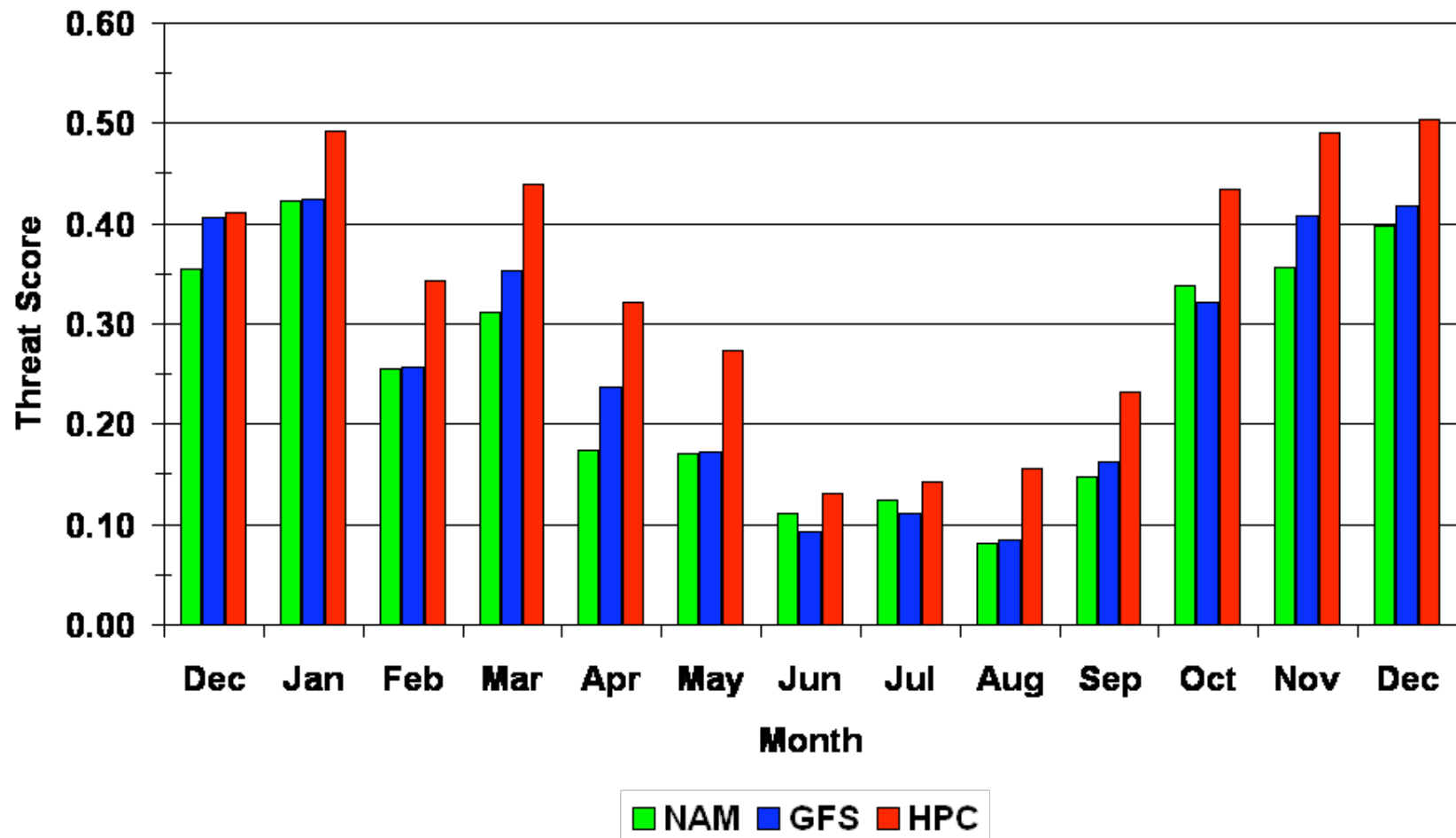
NHC Official Intensity Error Trend Atlantic Basin



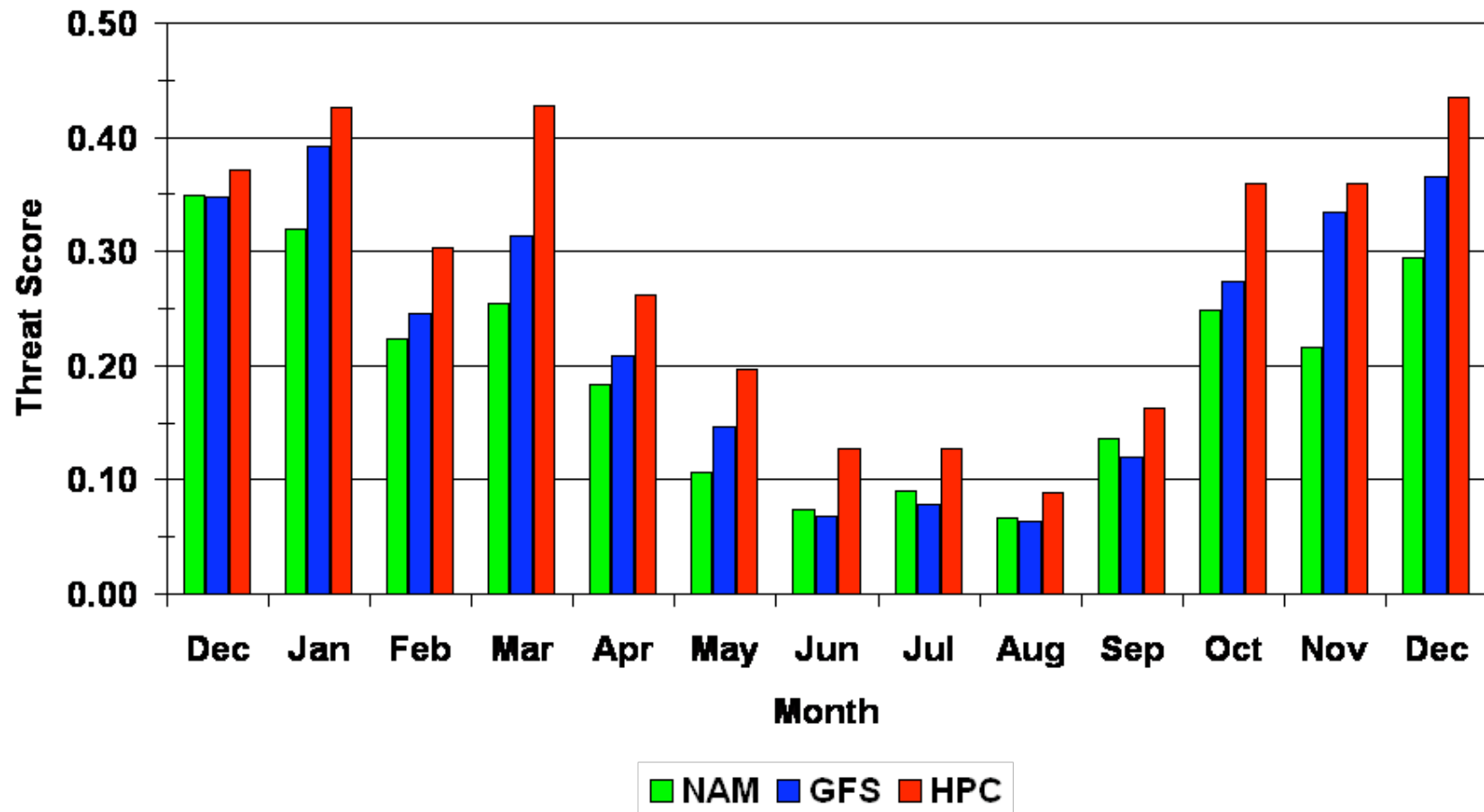
Intensity Forecast Skill (Early Models) 2009 - Atlantic Basin



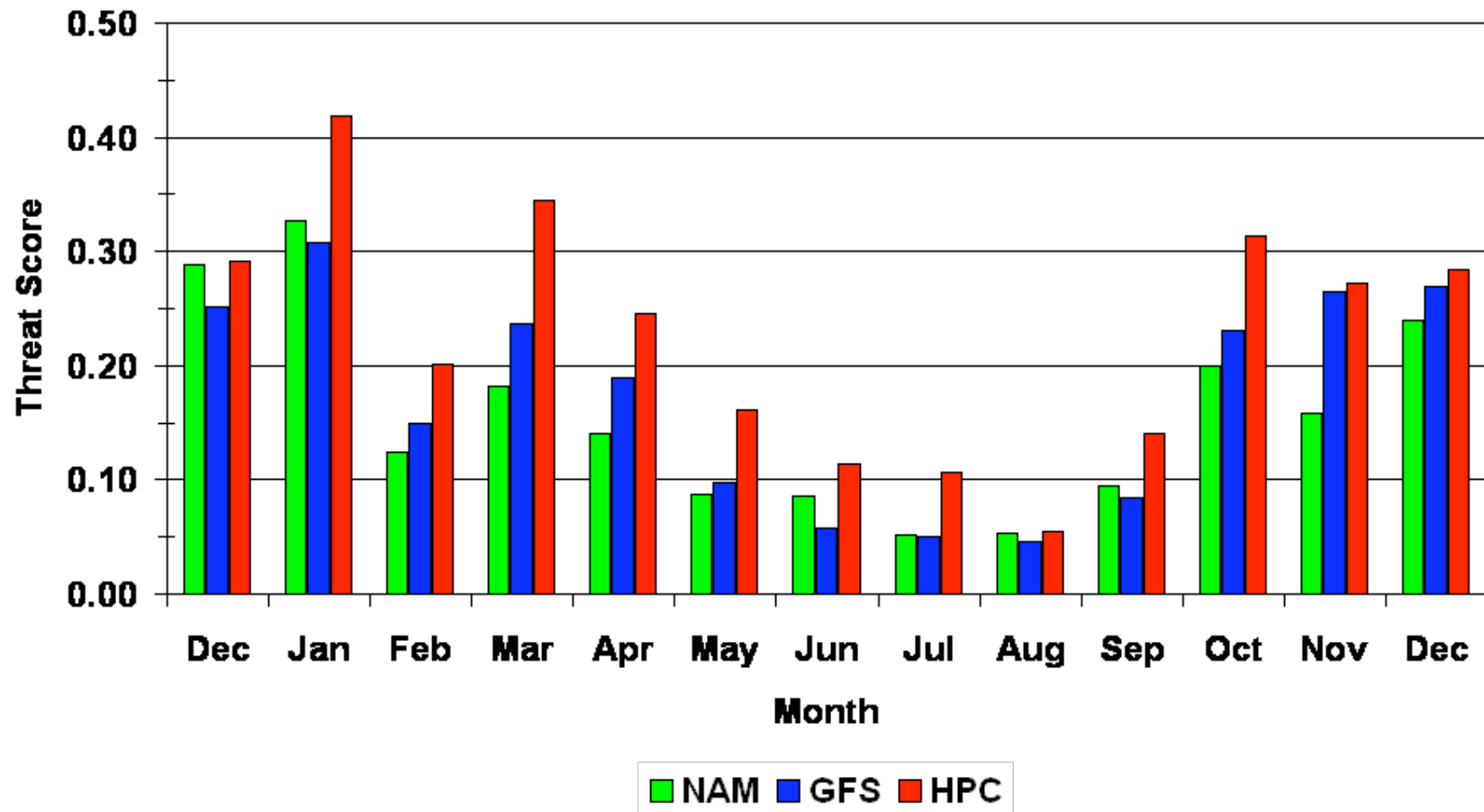
Threat Scores: 1-Inch QPF Day 1 Dec 2008 through Dec 2009



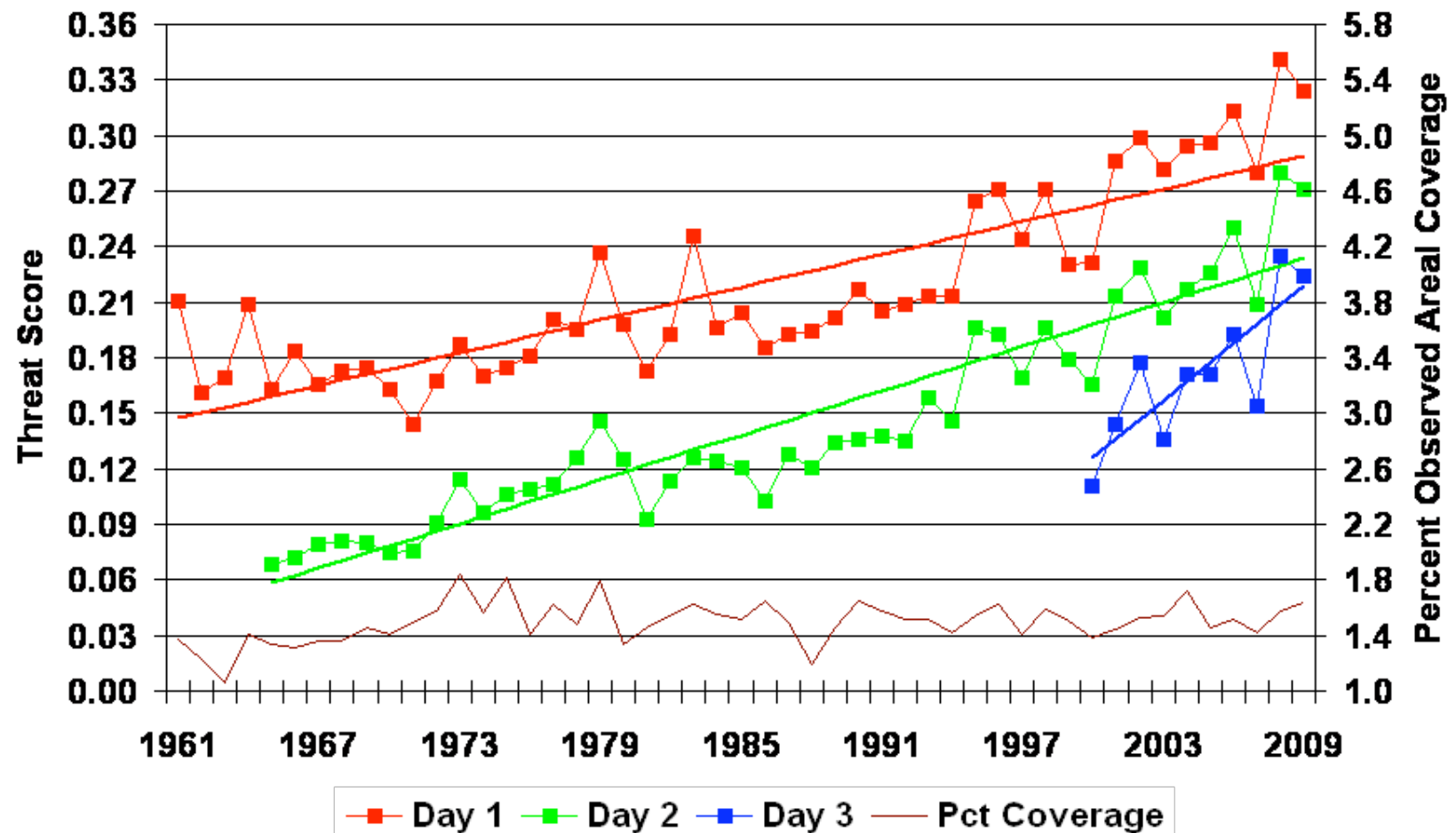
Threat Scores: 1-Inch QPF Day 2 Dec 2008 through Dec 2009



Threat Scores: 1-Inch QPF Day 3 Dec 2008 through Dec 2009

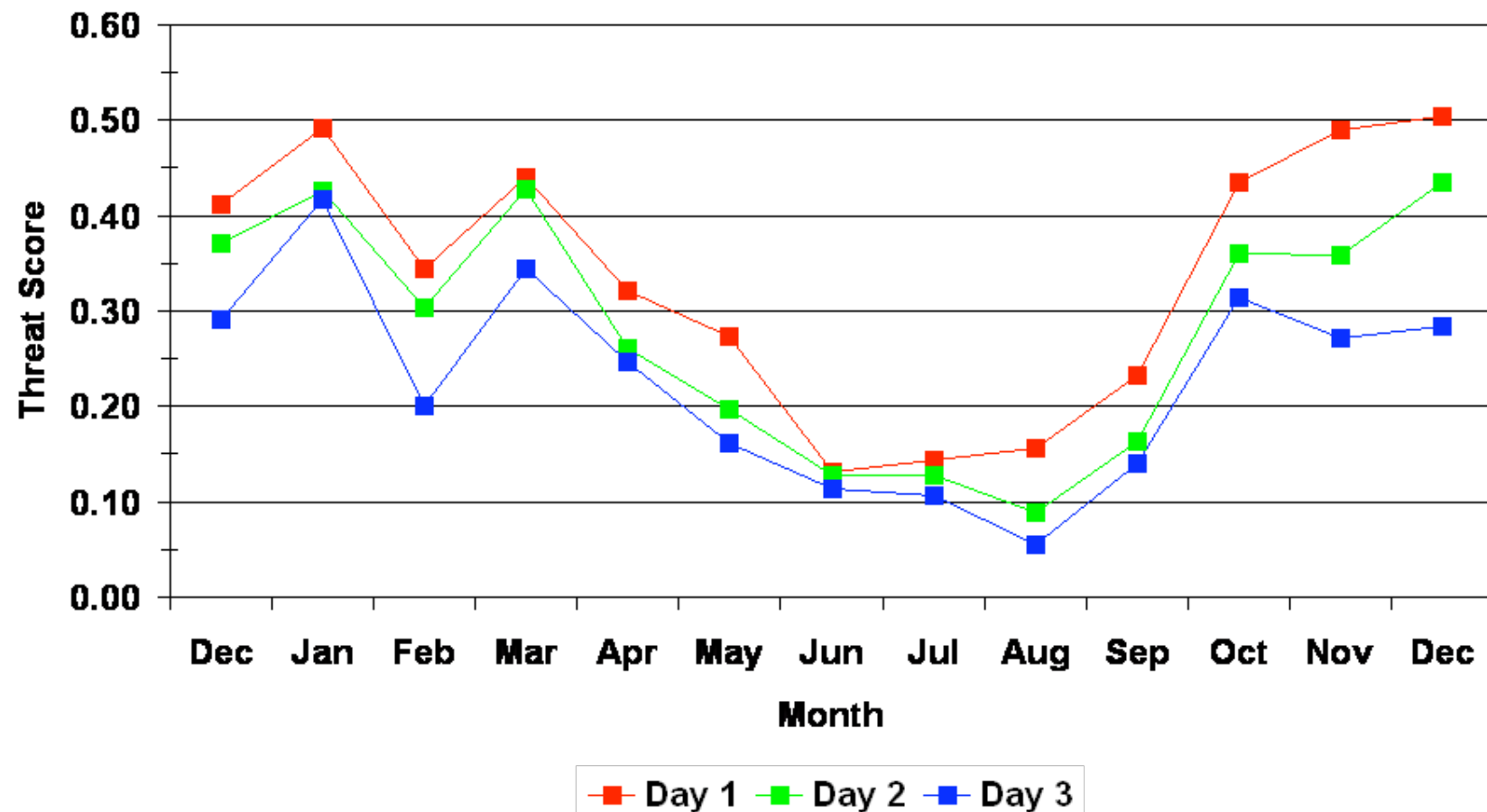


Annual HPC Threat Scores: 1.00 Inch Day 1 / Day 2 / Day 3



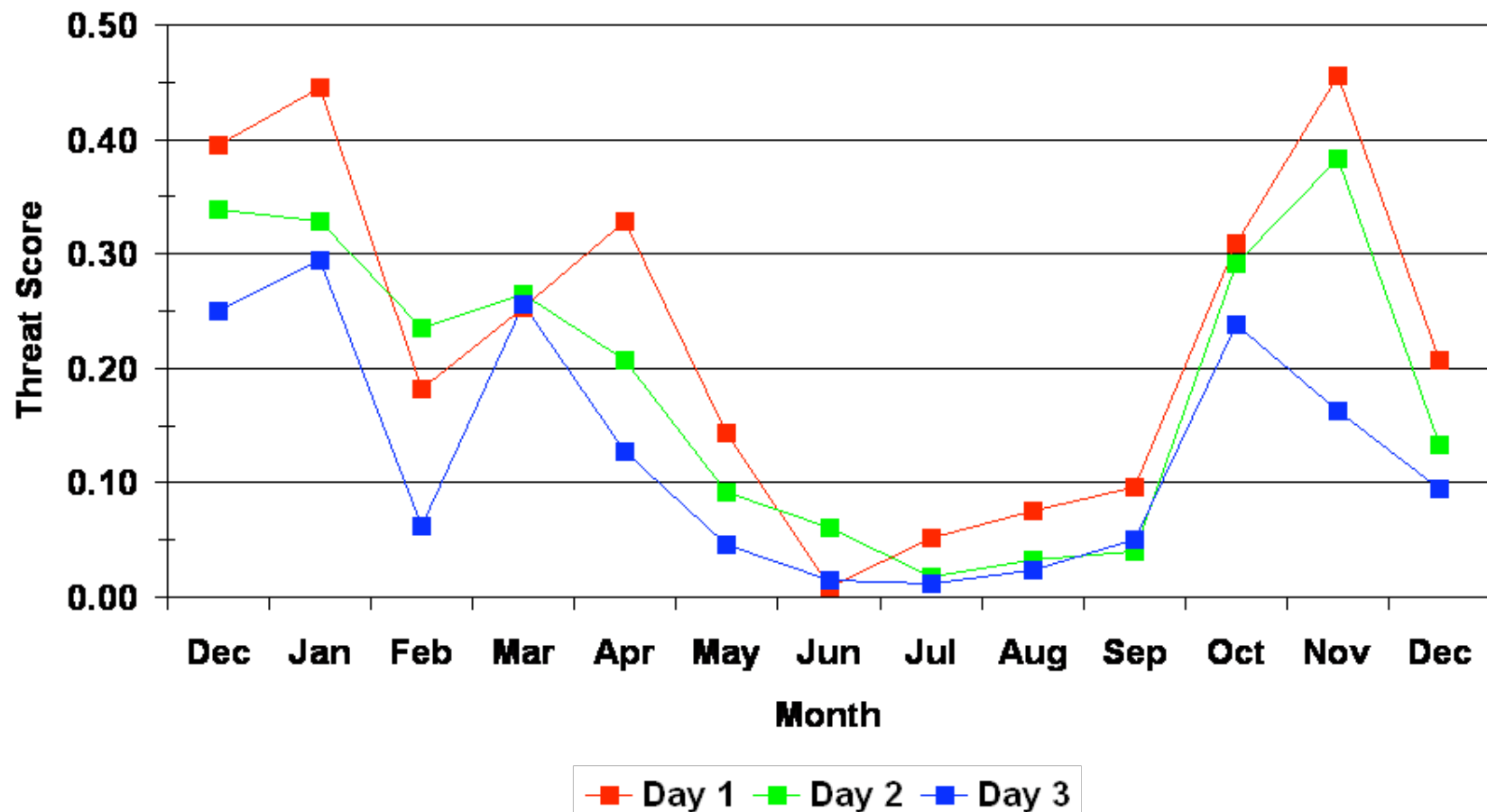
HPC QPF Threat Scores: 1.00"

Dec 2008 - Dec 2009

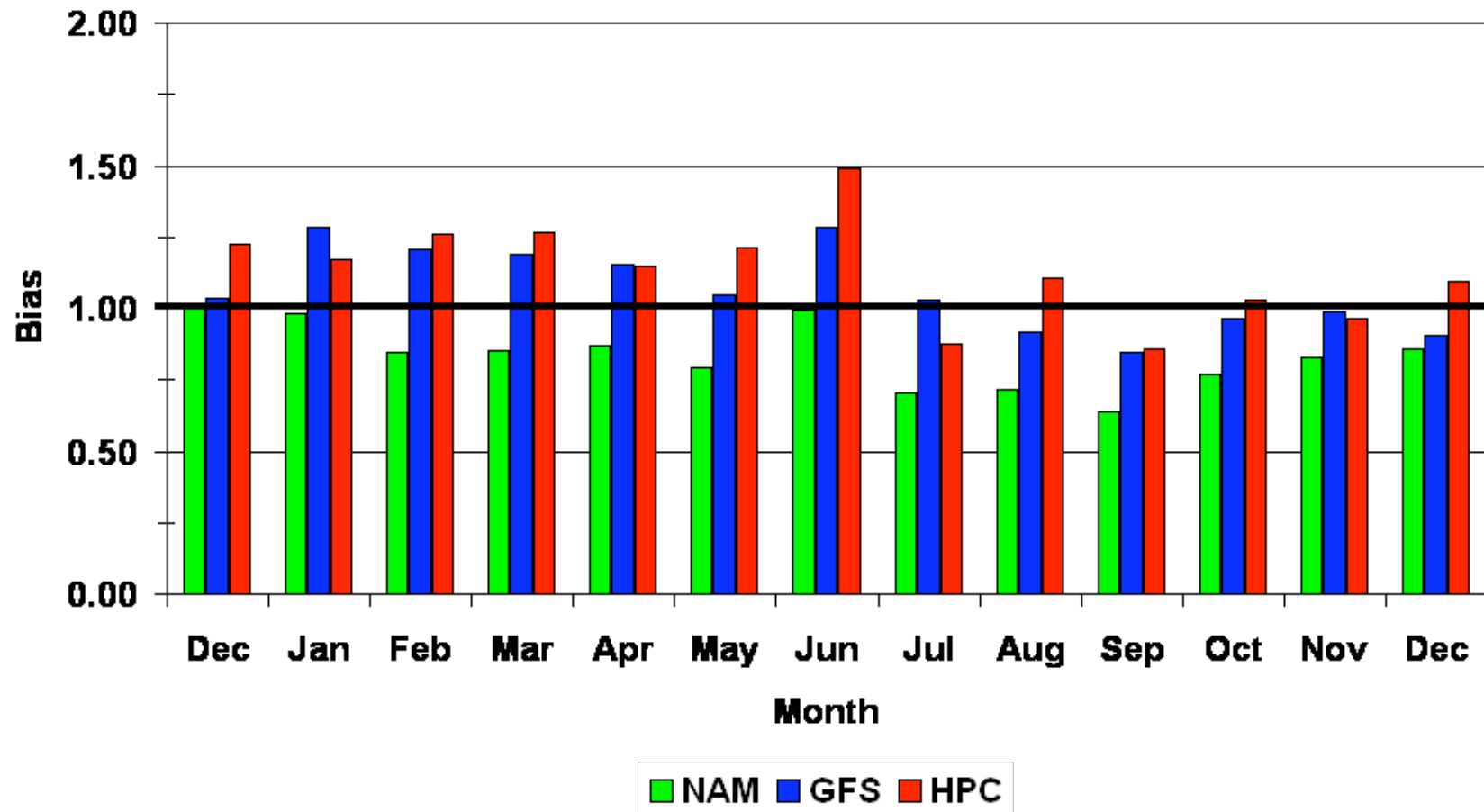


HPC QPF Threat Scores: 2.00"

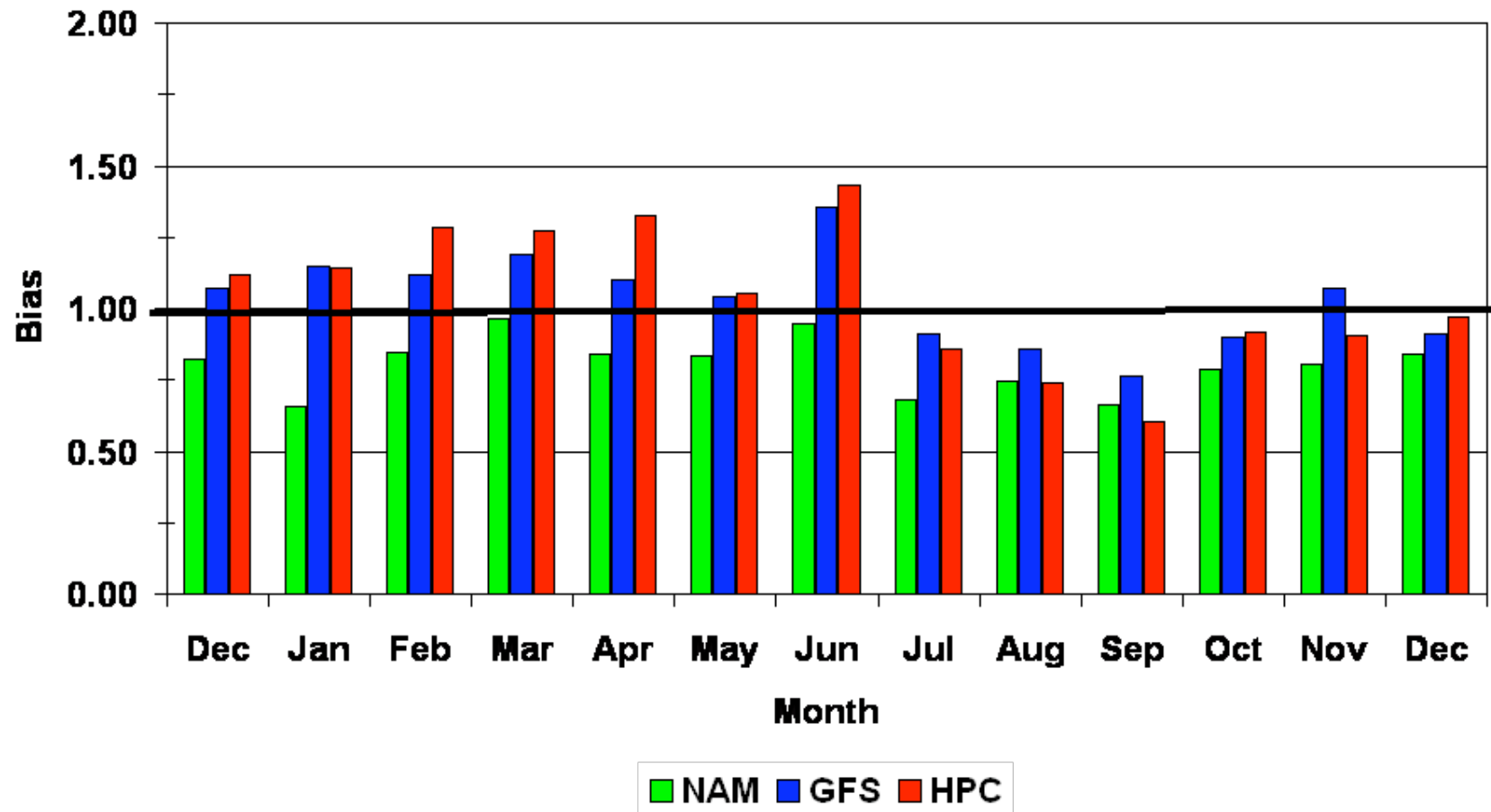
Dec 2008 - Dec 2009



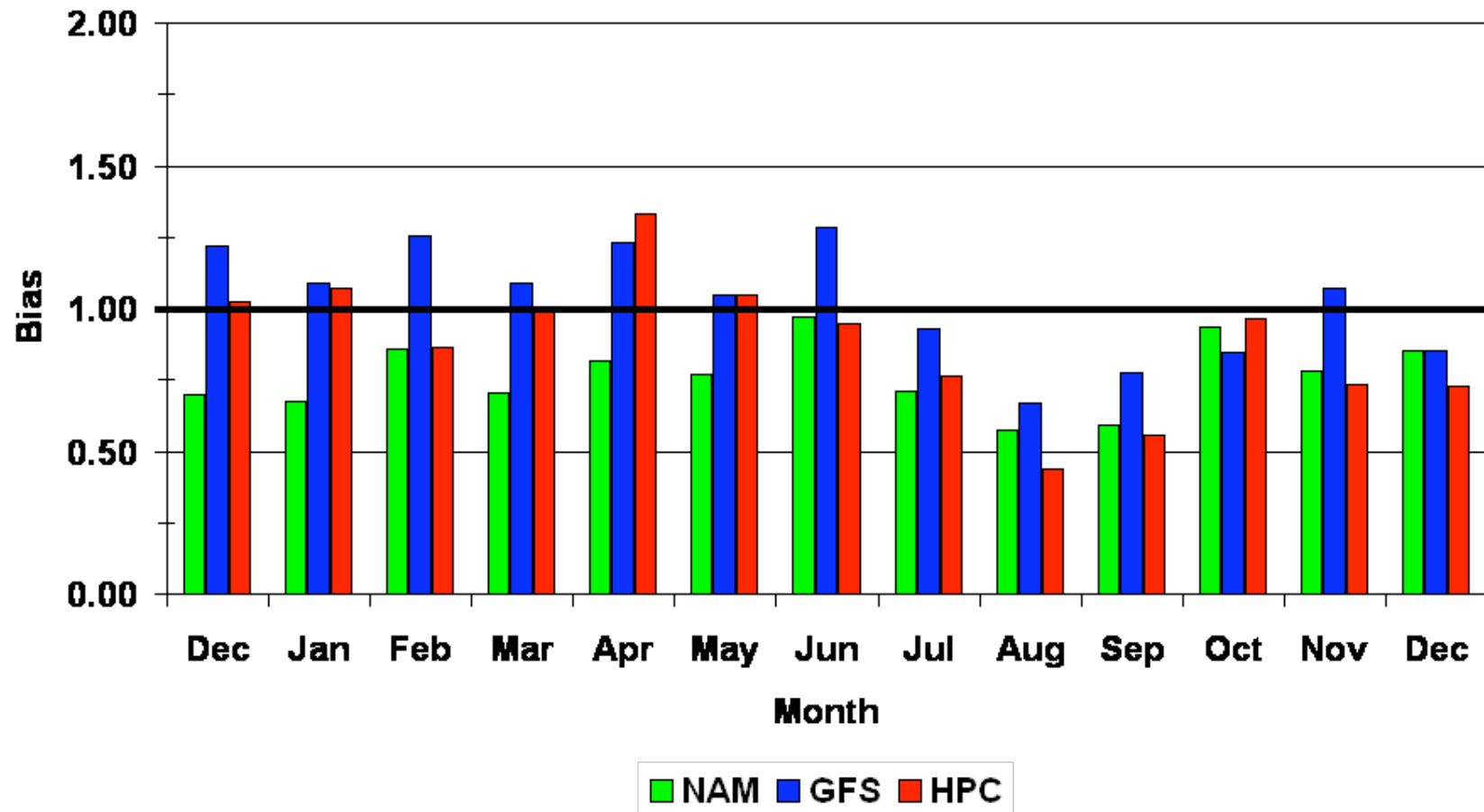
Bias: 1-Inch QPF Day 1
Dec 2008 through Dec 2009



Bias: 1-Inch QPF Day 2
Dec 2008 through Dec 2009

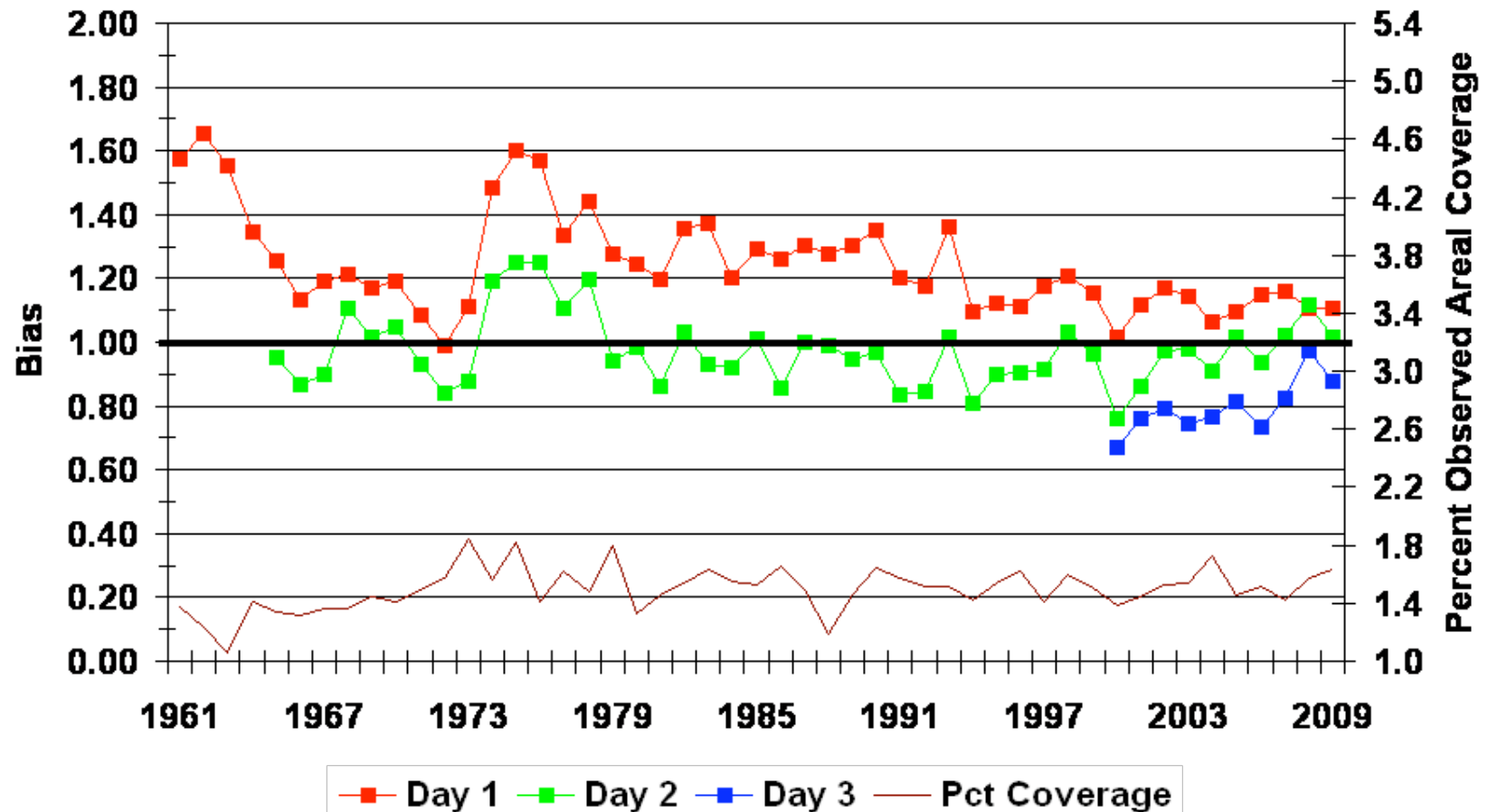


Bias: 1-Inch QPF Day 3
Dec 2008 through Dec 2009

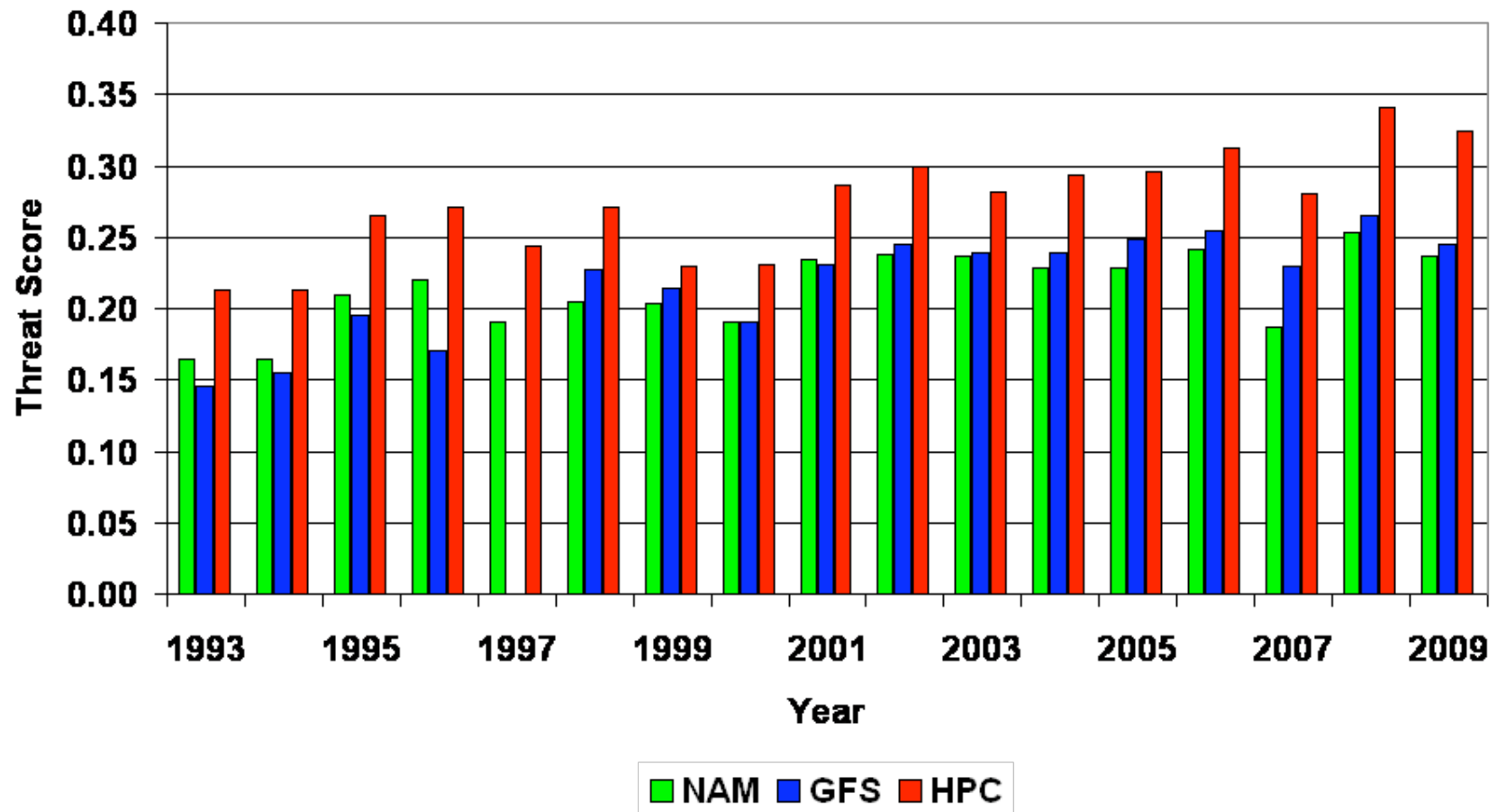


Annual HPC Bias: 1.00 Inch

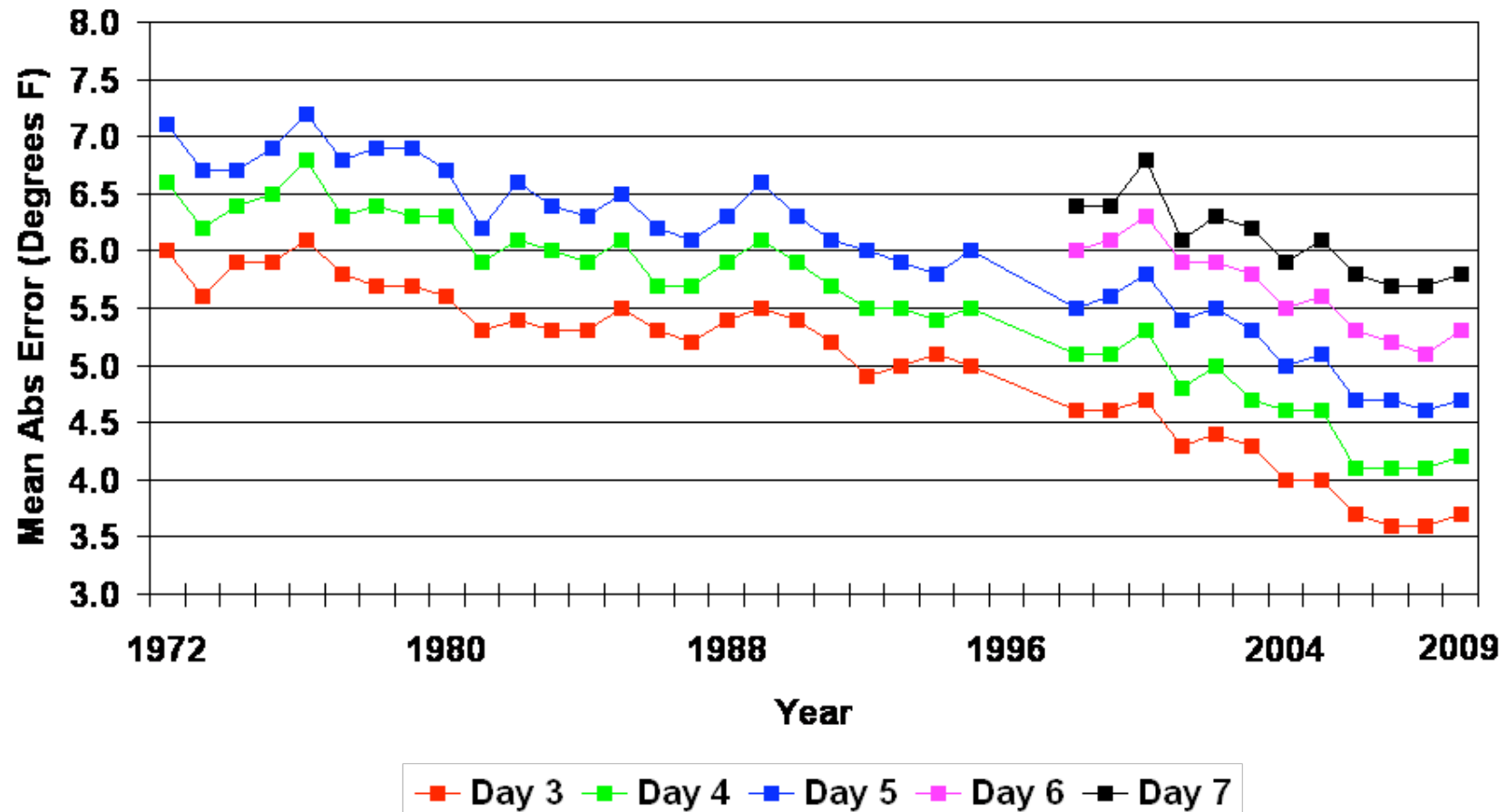
Day 1 / Day 2 / Day 3



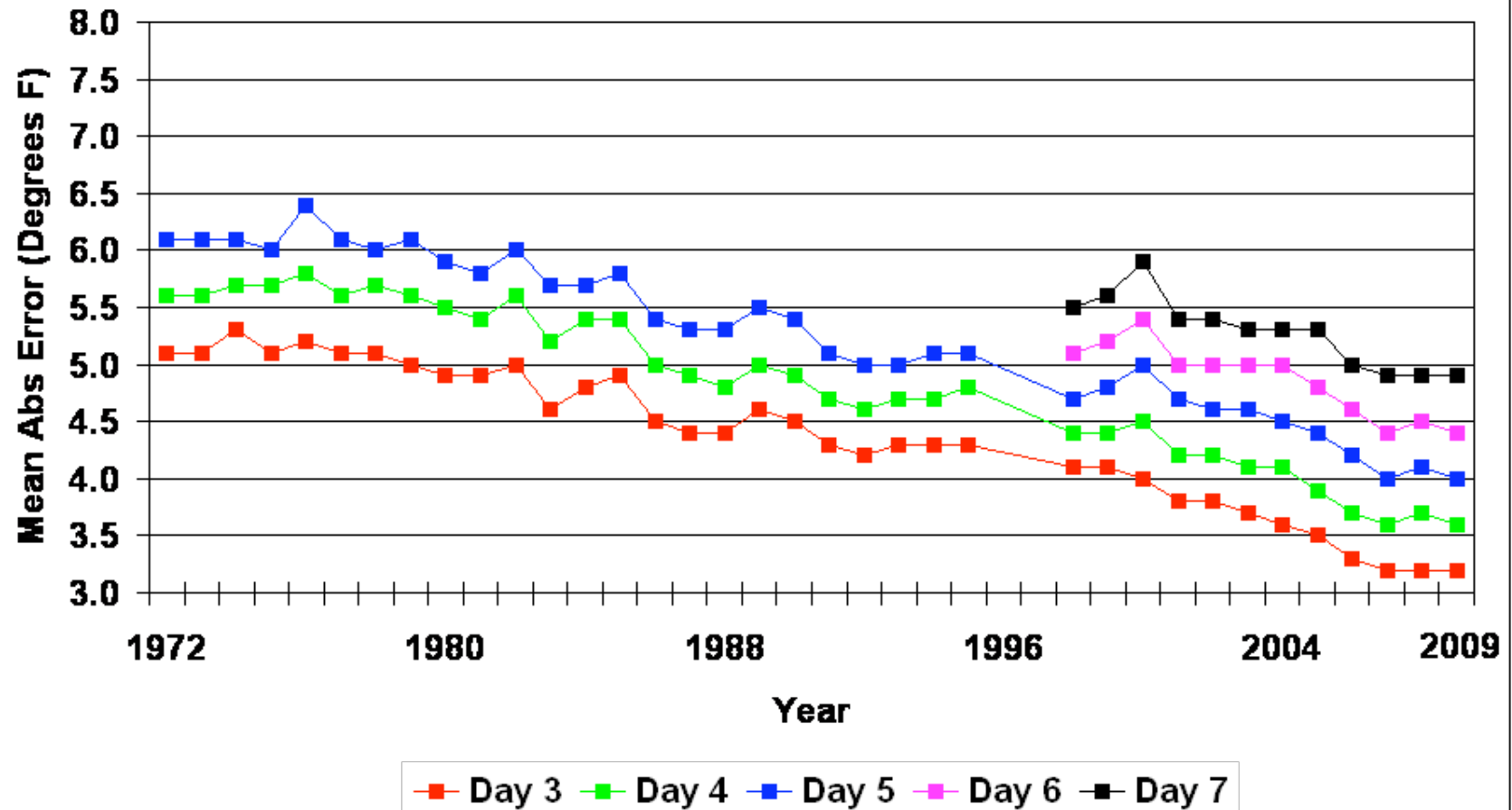
24-Hour 1-Inch Day 1 QPF Verification Annual Threat Scores



Annual HPC Mean Absolute Errors Maximum Temperatures

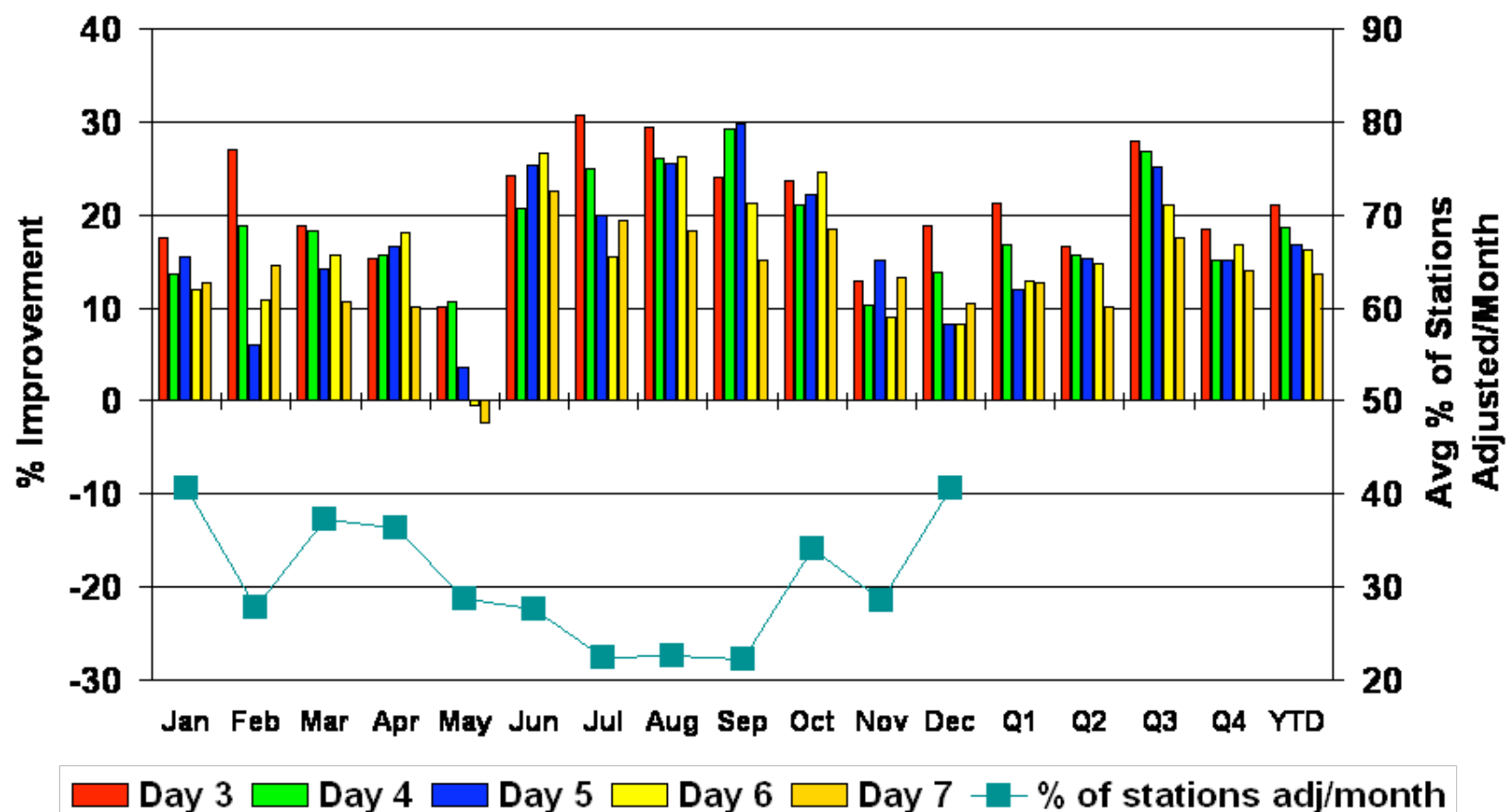


Annual HPC Mean Absolute Errors Minimum Temperatures

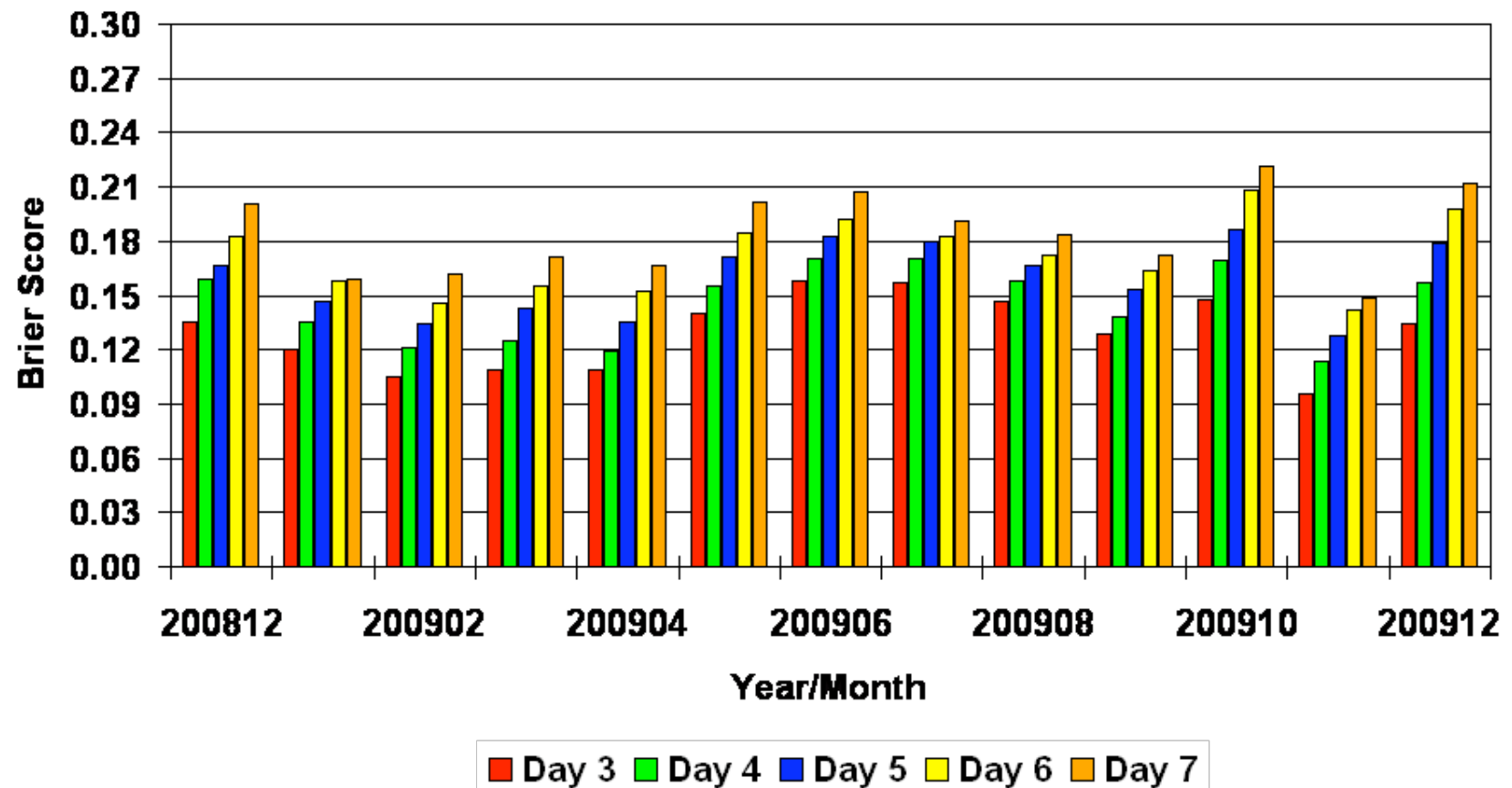


2009 HPC Pct Improvement vs MOS

Max Temp MAE: Stations Adjusted ≥ 3 F

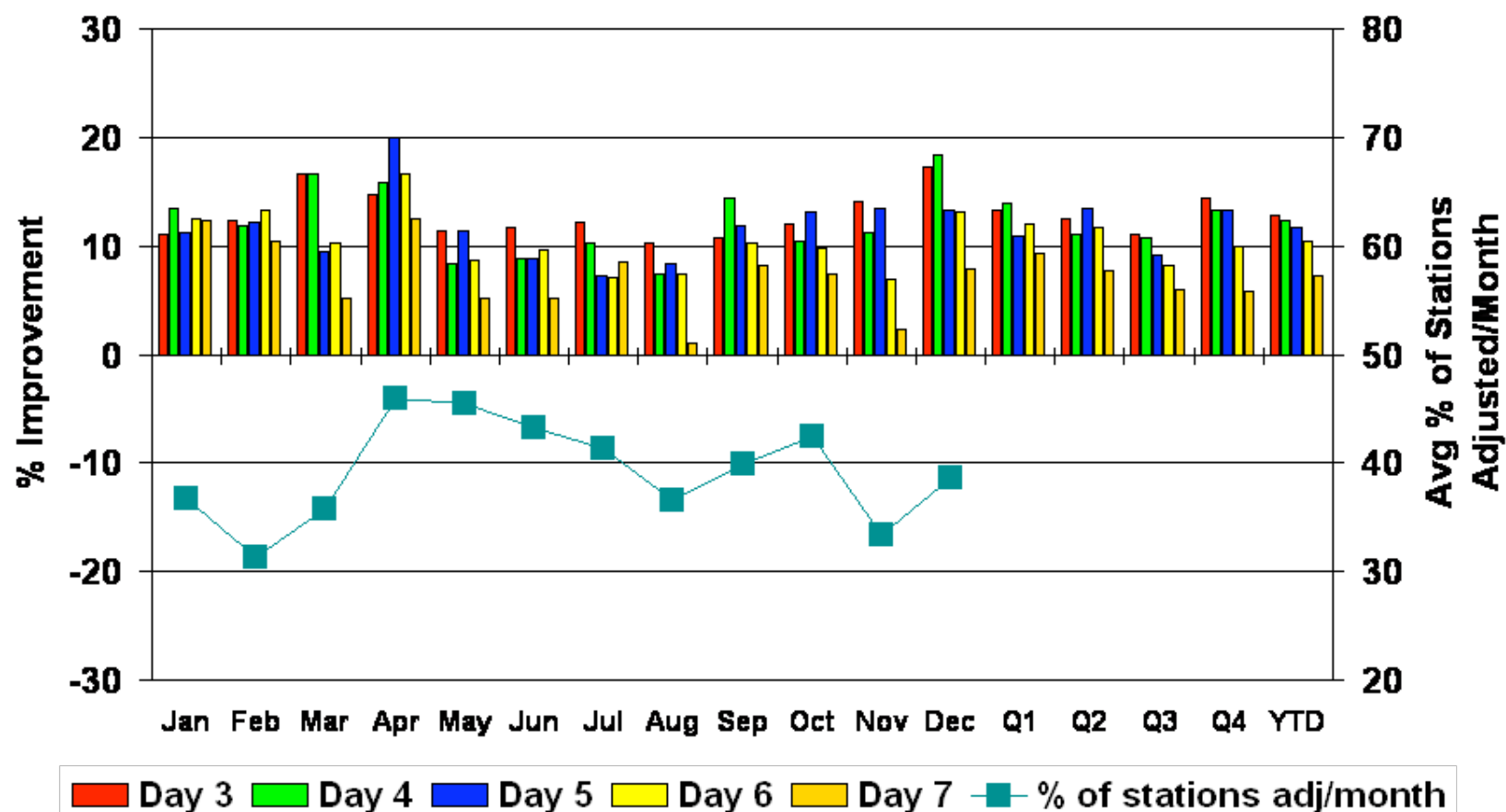


HPC Medium Range POPs Brier Scores



2009 HPC Pct Improvement vs MOS

POP Brier Score: Stations Adjusted $\geq 5\%$



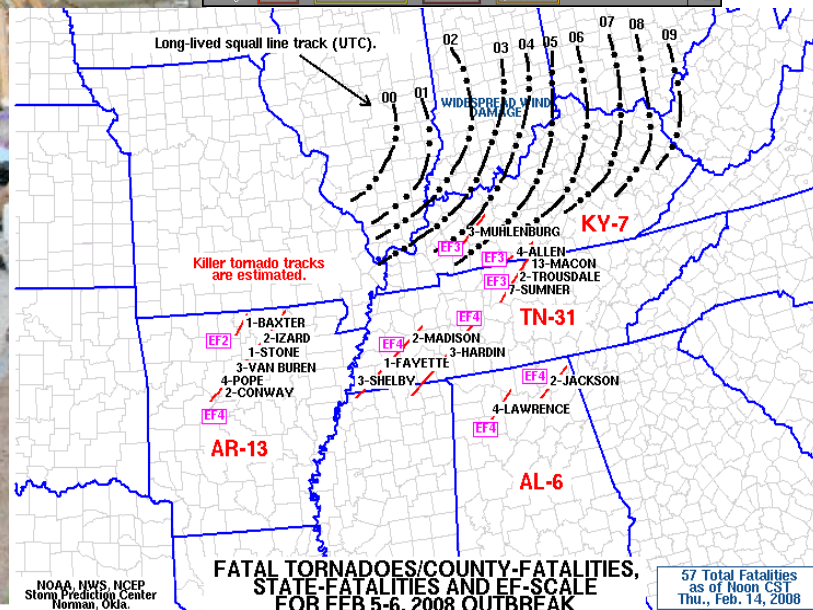
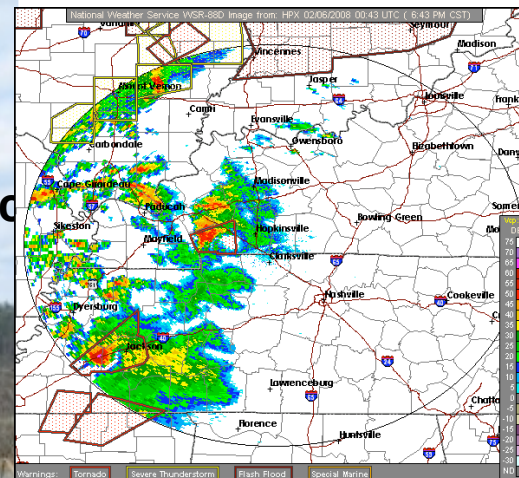


Super Tuesday Tornado Outbreak



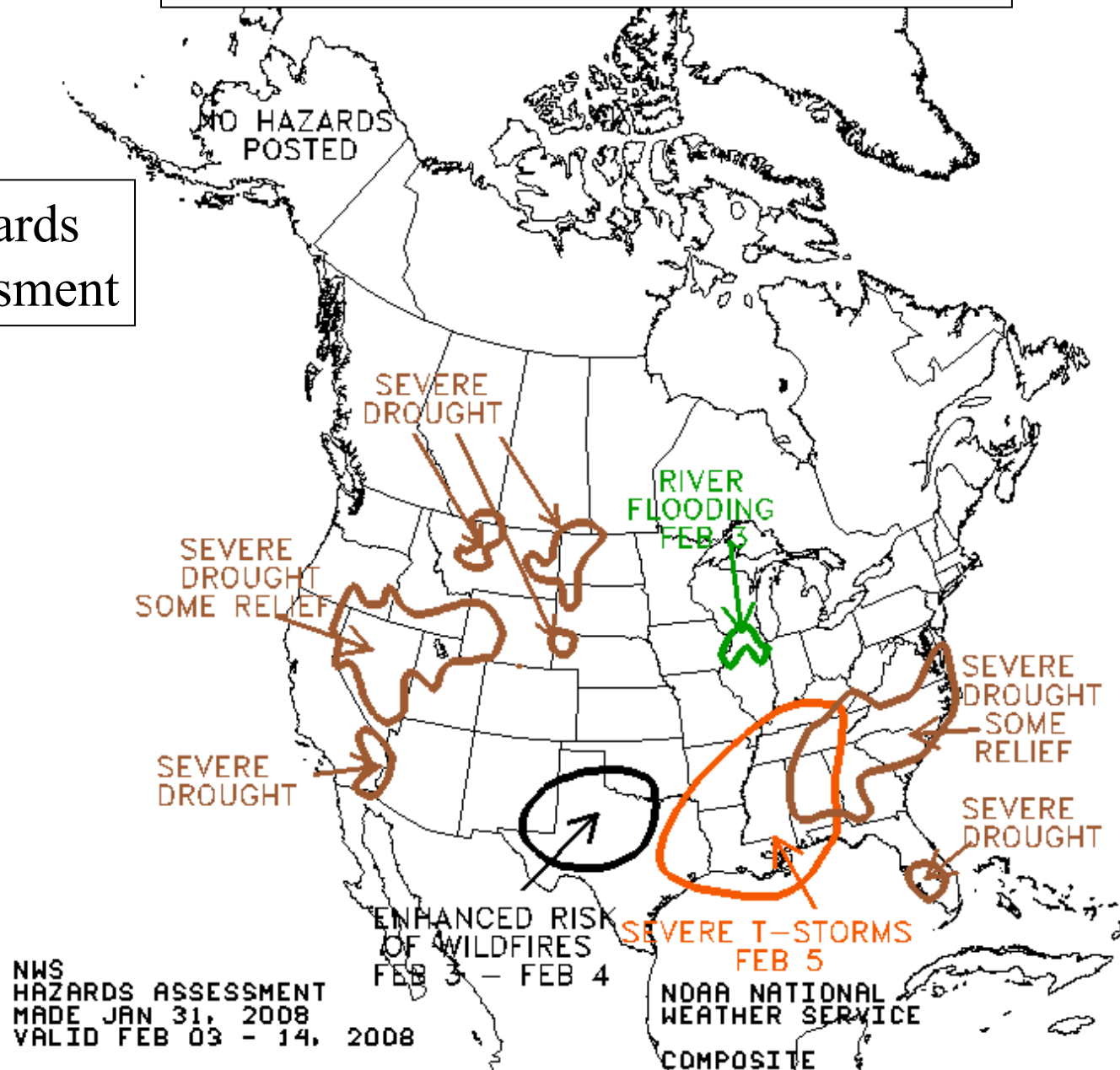
February 5-6, 2008

- 63 tornadoes, 57 fatalities
- Deadliest event since '85
- Outlook issued 6 days prior
- POD 100% for tornadoes occurring in SPC watch
- Average warning lead time 17 min



February 5-6, 2008 Tornado Outbreak

Hazards Assessment



February 5-6, 2008 Tornado Outbreak

 SPC DAY4-8 CONV OUTLOOK
ISSUED: 0930Z 01/31/2008
VALID: 03/1200Z-08/1200Z
FORECASTER: RACY
National Weather Service
Storm Prediction Center Norman, Oklahoma

Day 4-8

 SPC DAY4-8 CONV OUTLOOK
ISSUED: 0947Z 02/02/2008
VALID: 05/1200Z-10/1200Z
FORECASTER: GOSS
National Weather Service
Storm Prediction Center Norman, Oklahoma

Day 3

Categorical

Probabilistic

SLGT


SPC DAY3 SVR TSTM OUTLOOK
ISSUED: 0826Z 02/03/2008
VALID: 05/1200Z-06/1200Z
FORECASTER: GOSS
National Weather Service
Storm Prediction Center Norman, Oklahoma


SPC DAY3 PROB OUTLOOK
ISSUED: 0826Z 02/03/2008
VALID: 05/1200Z-06/1200Z
FORECASTER: GOSS
National Weather Service
Storm Prediction Center Norman, Oklahoma

February 5-6, 2008 Tornado Outbreak

Categorical

Probabilistic

SLGT

MDT

Day 2


SPC DAY2 CONV OUTLOOK
ISSUED: 1705Z 02/04/2008
VALID: 05/1200Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma


SPC DAY2 PROB OUTLOOK
ISSUED: 1705Z 02/04/2008
VALID: 05/1200Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma

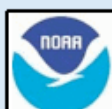
Day 1

Convective

High Winds



SPC DAY1 CONV OUTLOOK
ISSUED: 1616Z 02/05/2008
VALID: 05/1630Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma



SPC DAY1 WIND OUTLOOK
ISSUED: 1616Z 02/05/2008
VALID: 05/1630Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma

February 5-6, 2008 Tornado Outbreak

Hail

Tornado



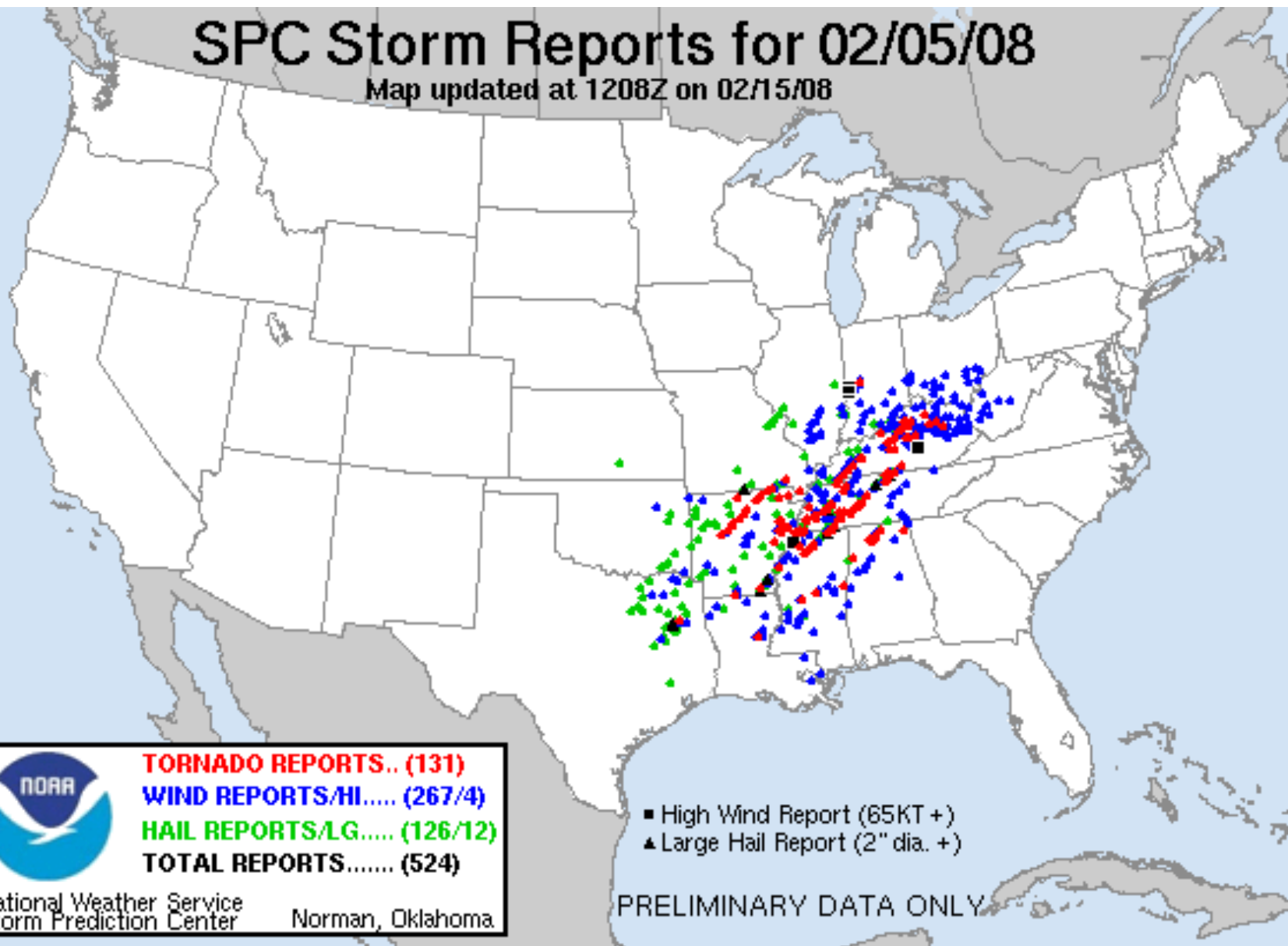
SPC DAY1 HAIL OUTLOOK
ISSUED: 1616Z 02/05/2008
VALID: 05/1630Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma



SPC DAY1 TORN OUTLOOK
ISSUED: 1616Z 02/05/2008
VALID: 05/1630Z-06/1200Z
FORECASTER: HALES
National Weather Service
Storm Prediction Center Norman, Oklahoma

SPC Storm Reports for 02/05/08

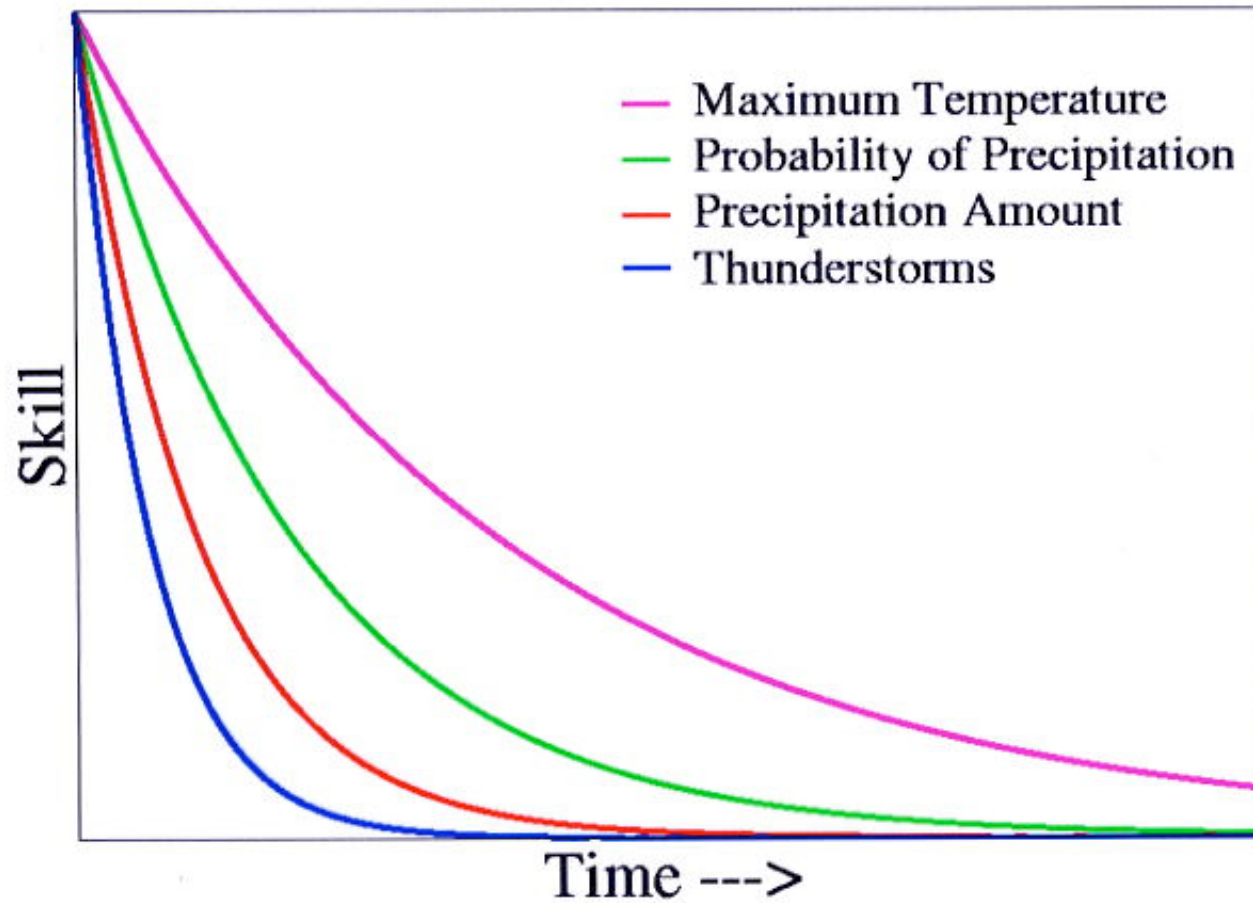
Map updated at 1208Z on 02/15/08



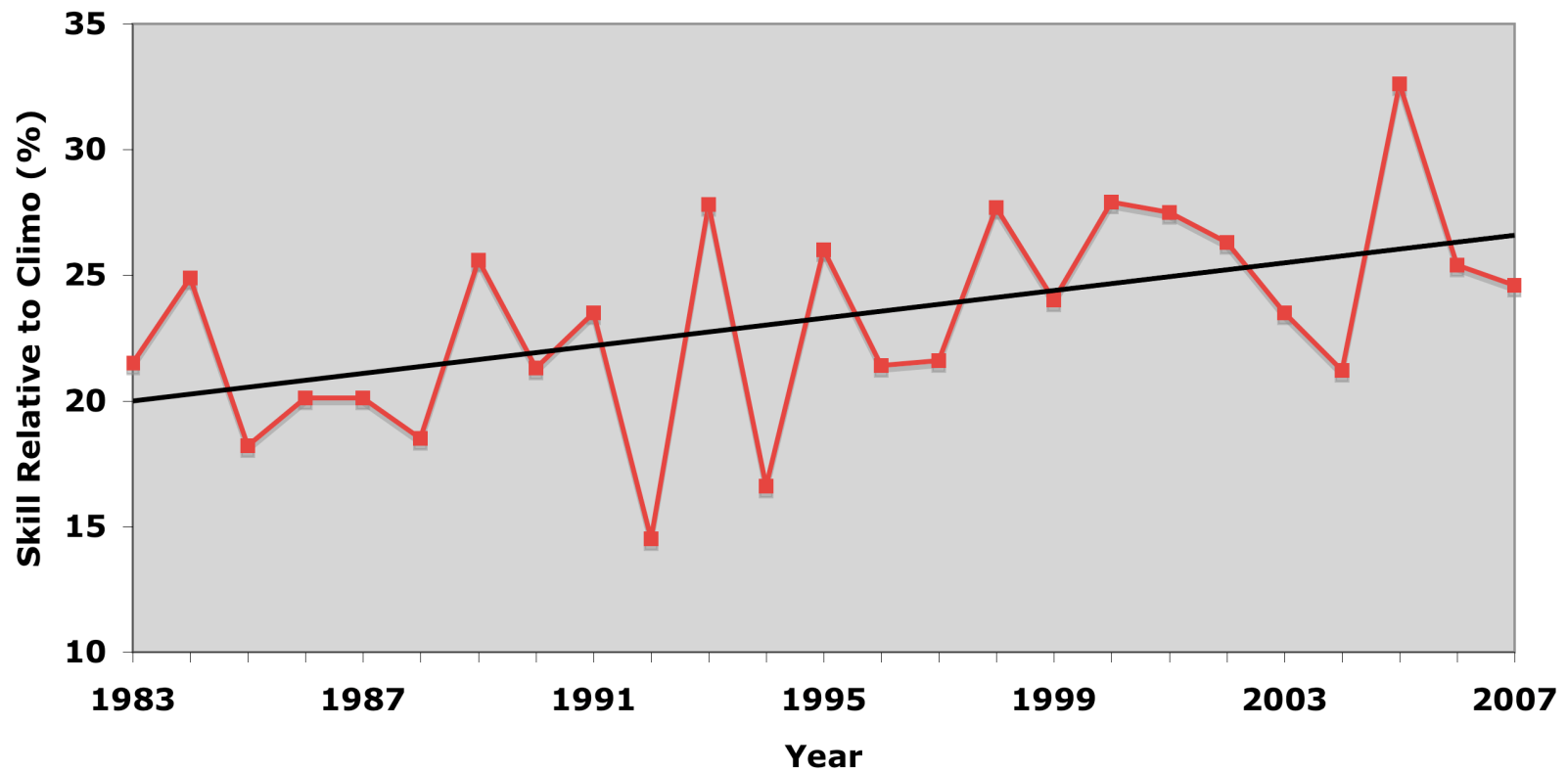
National Weather Service
Storm Prediction Center

Norman, Oklahoma

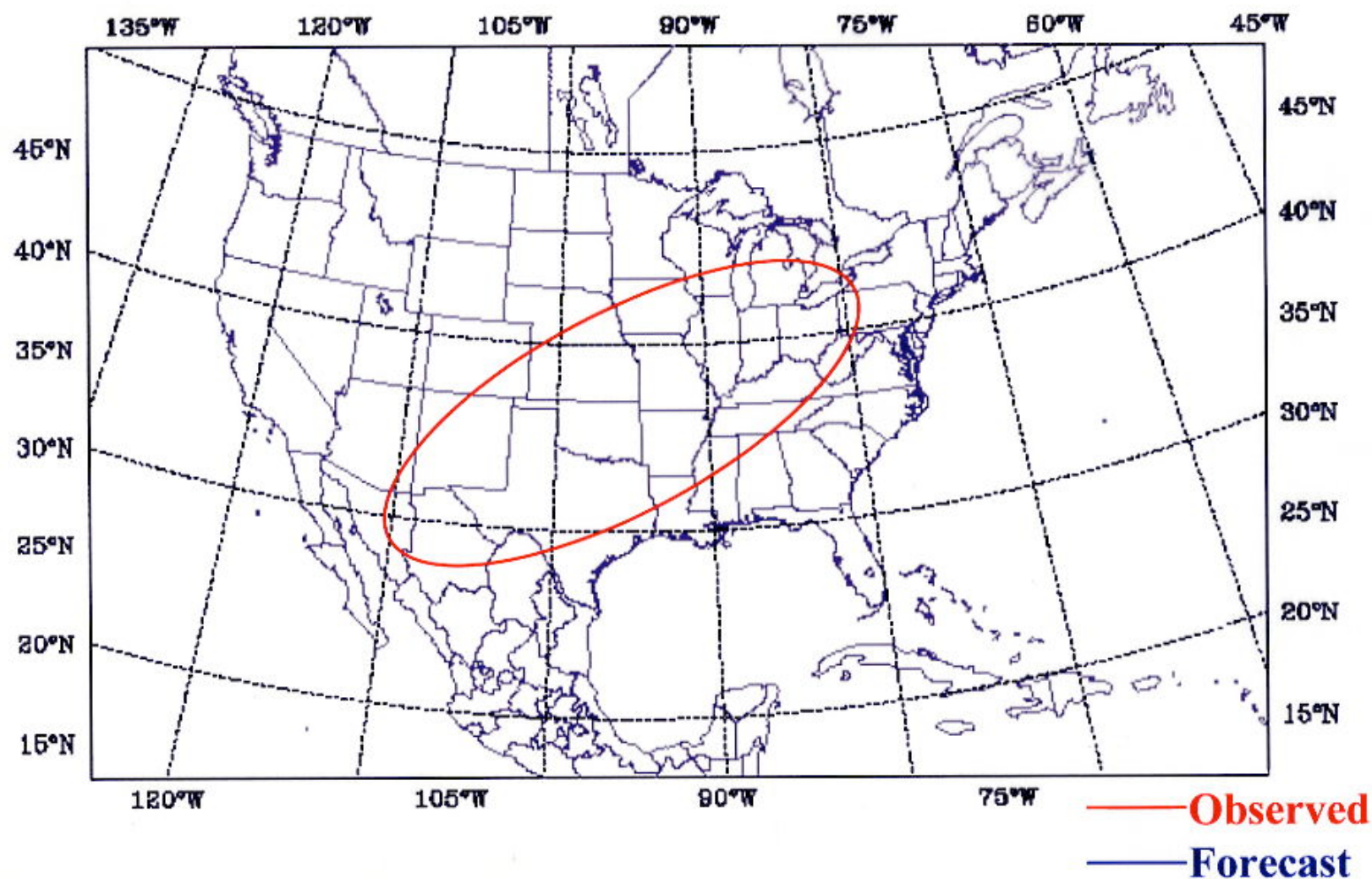
Forecast Perishability



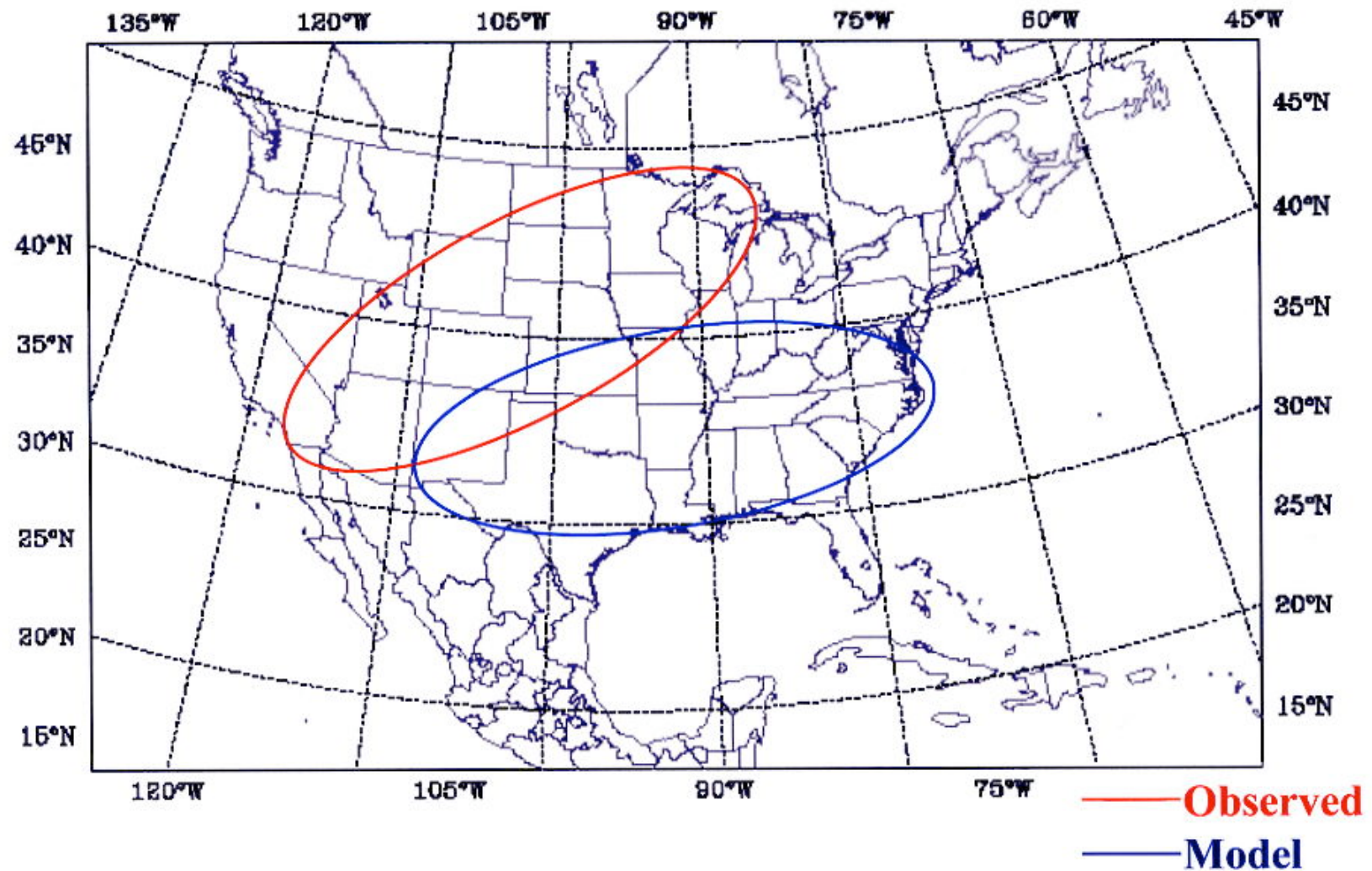
SUNY Albany Thunderstorm Contest Consensus Skill Relative to Climatology 1983-2007



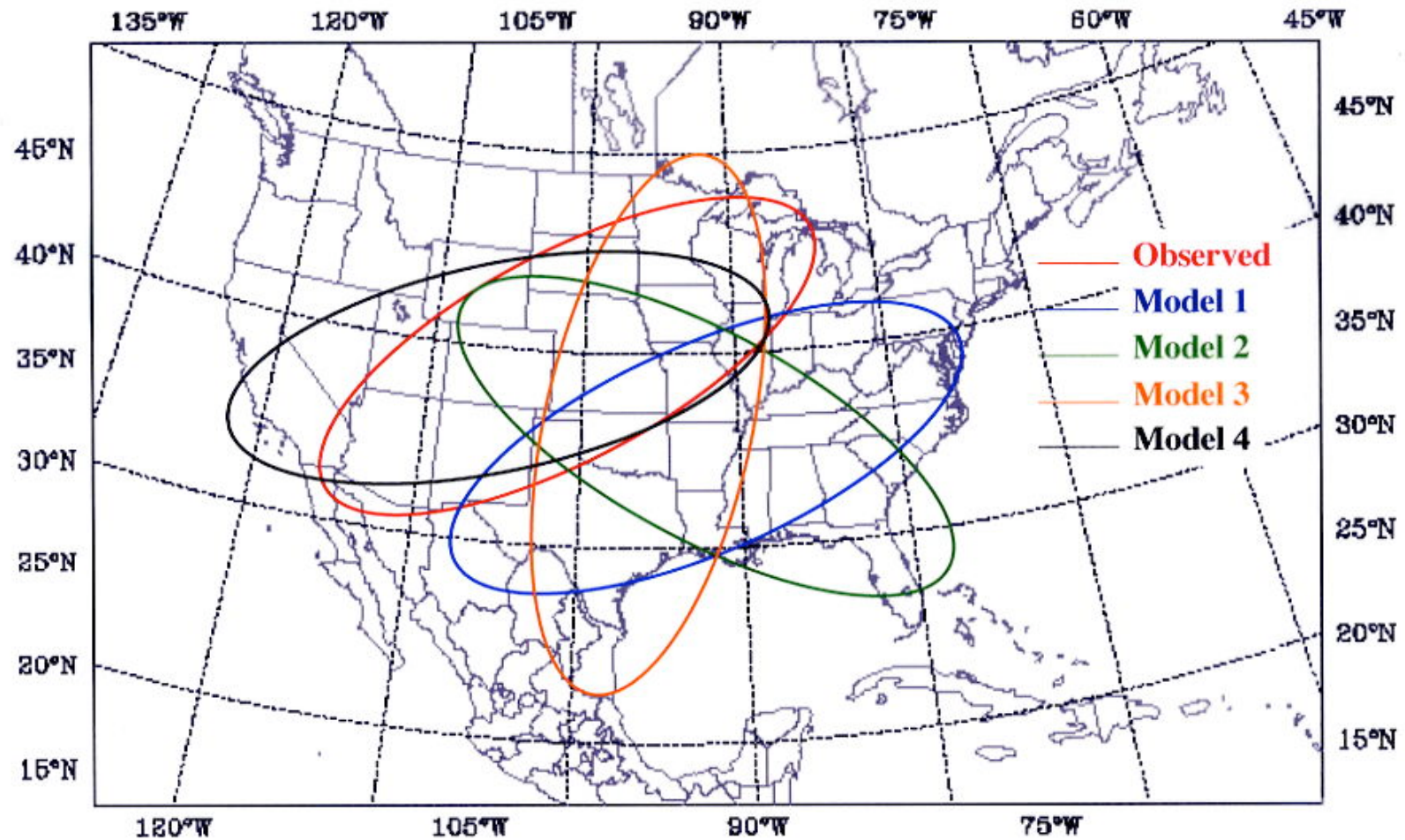
24 h Forecast Area > 2.5 cm Precipitation: 1970



24 h Forecast Area > 2.5 cm Precipitation: 1990

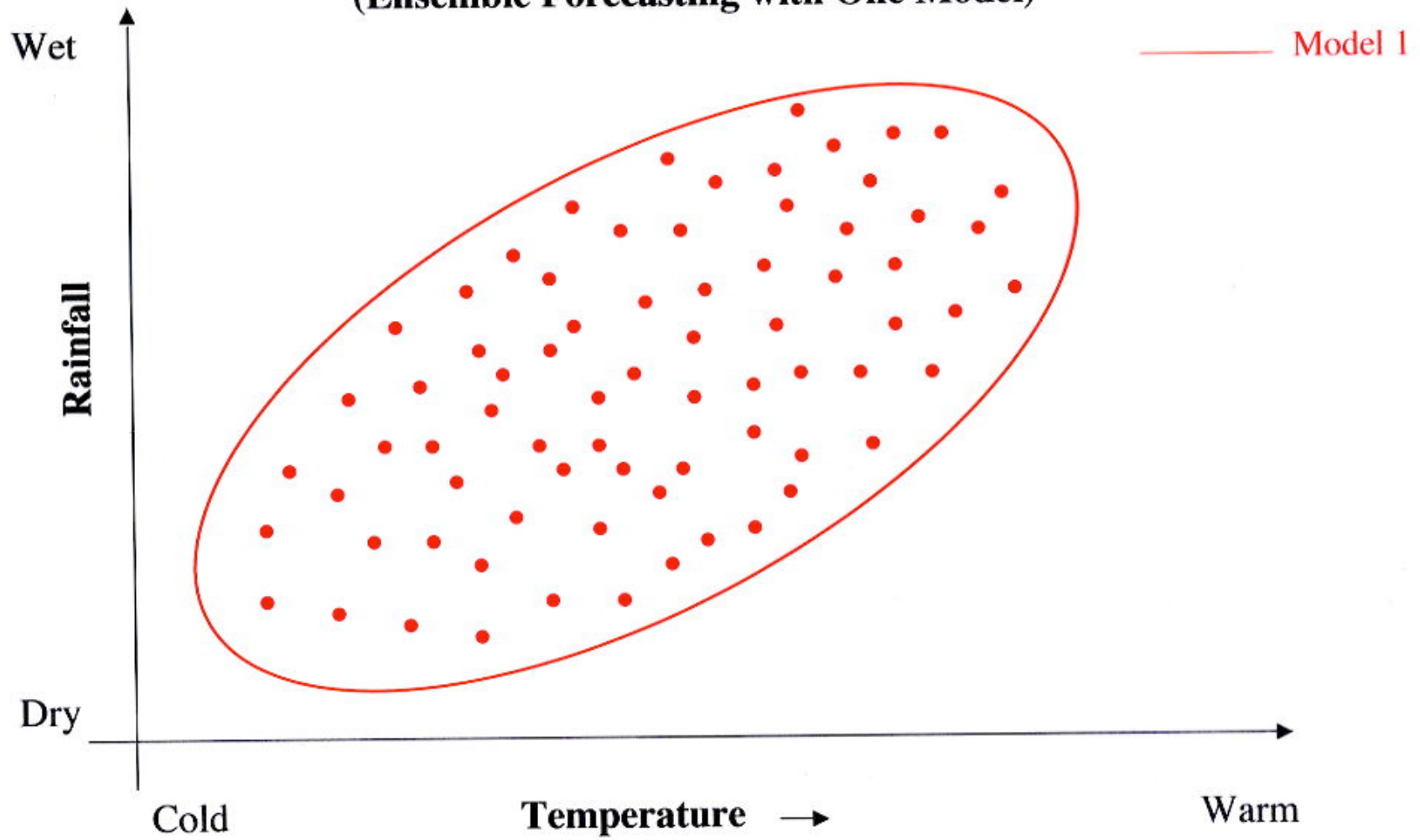


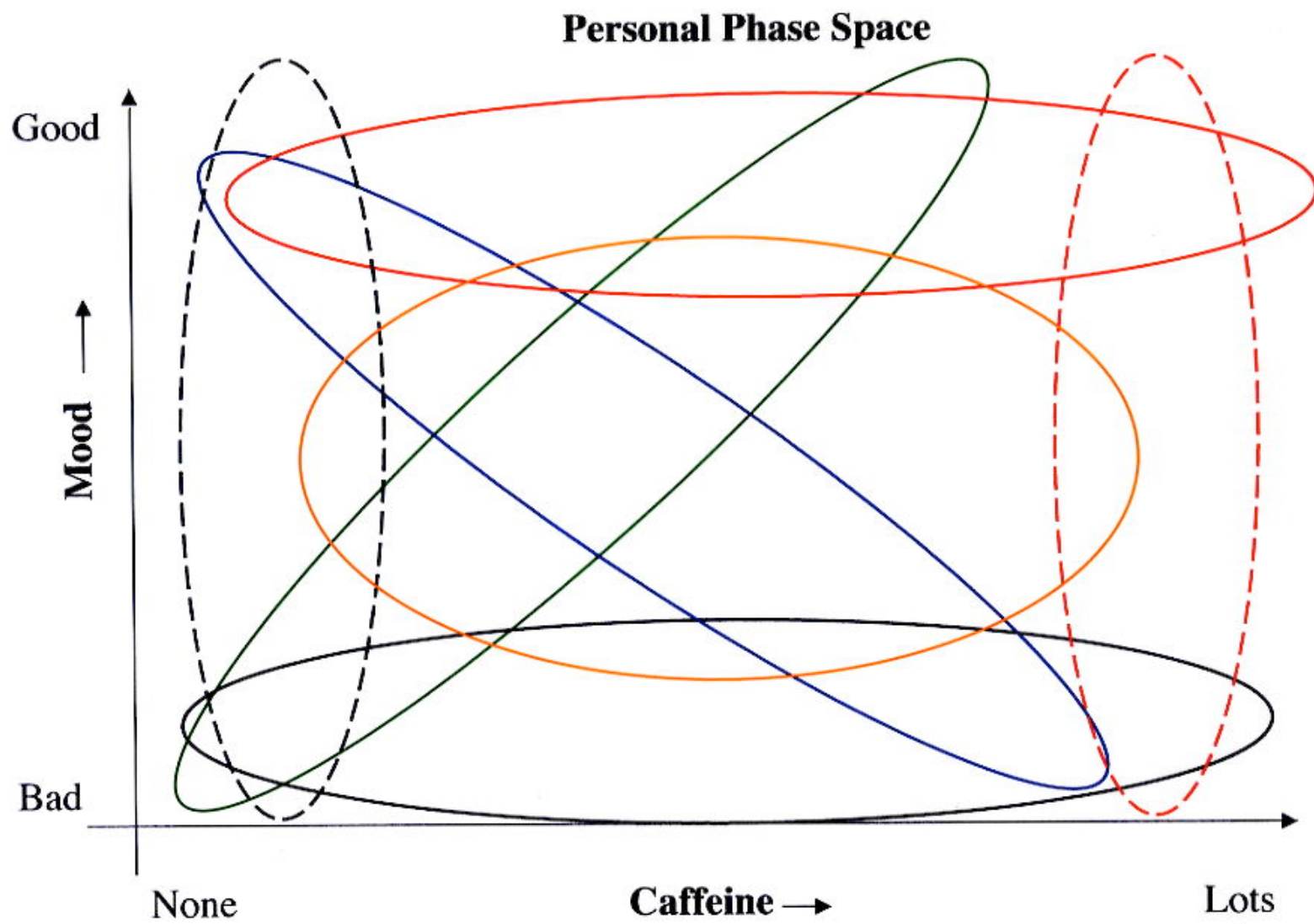
24 h Forecast Area > 2.5 cm Precipitation: 2009



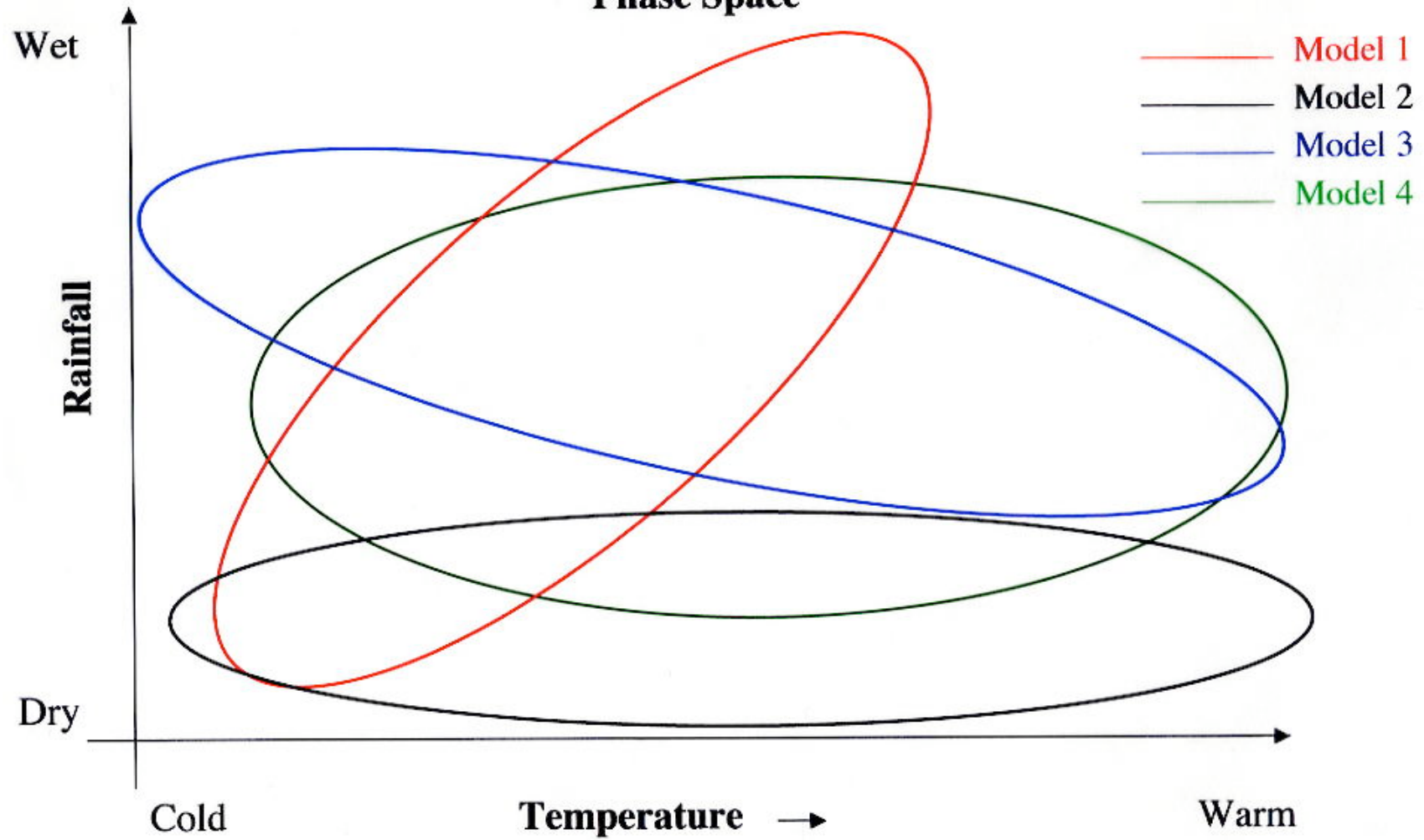
Basis for Ensemble Probability Forecasting

Forecast Model Climatological Phase Space (Ensemble Forecasting with One Model)

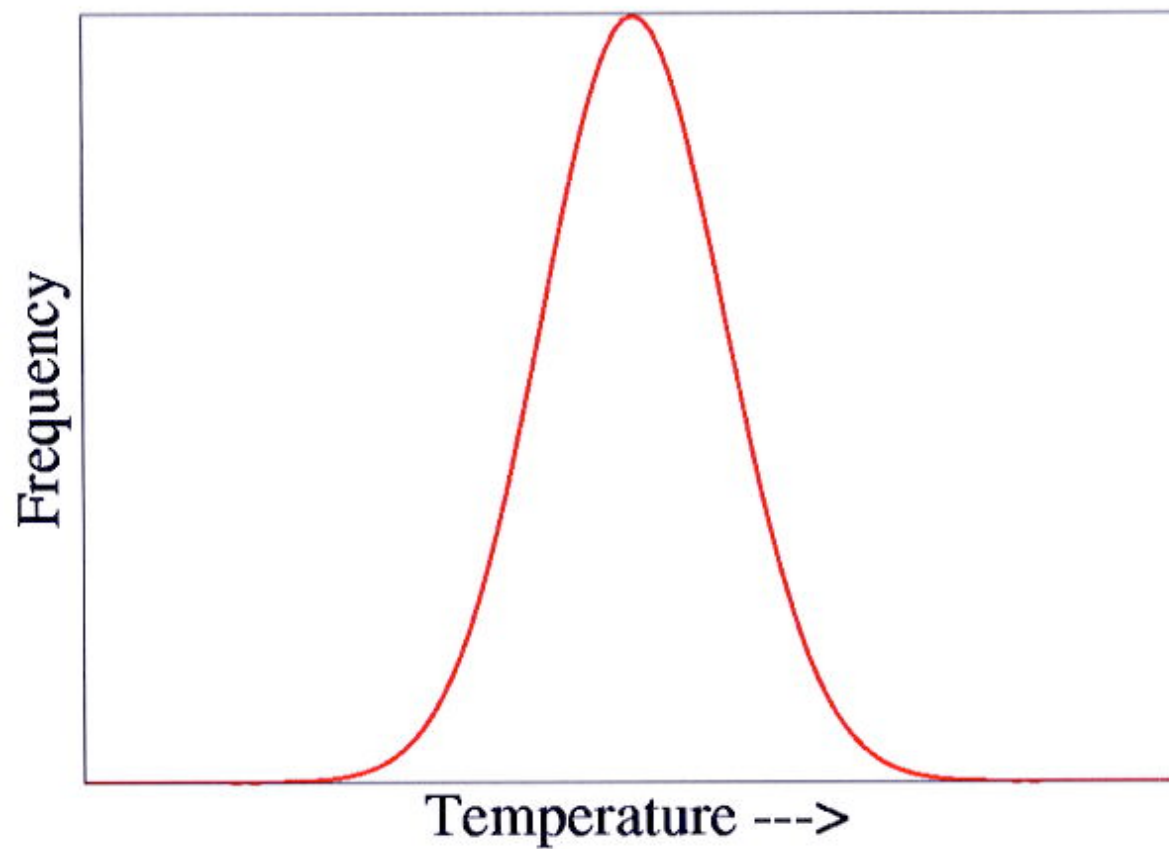




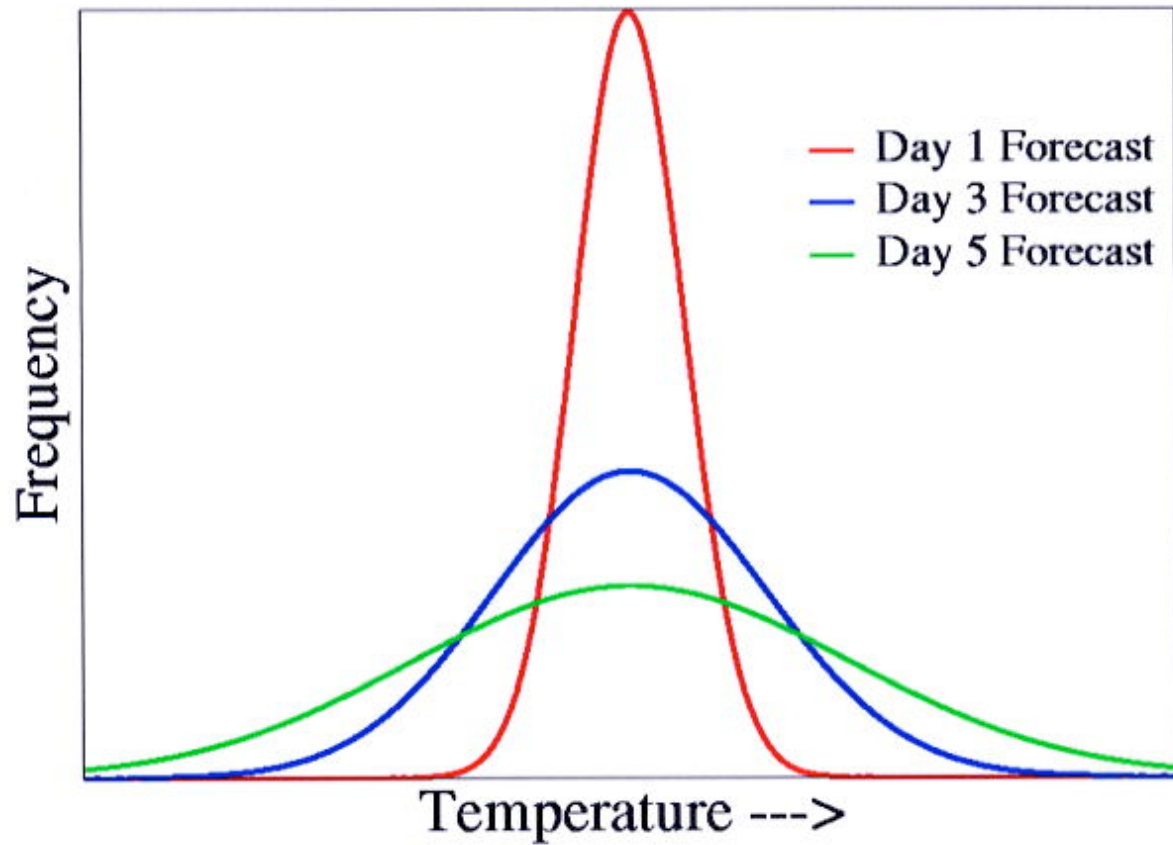
Forecast Multimodel Ensemble Climatological Phase Space



State Probability Distribution



Forecast Probability Distribution

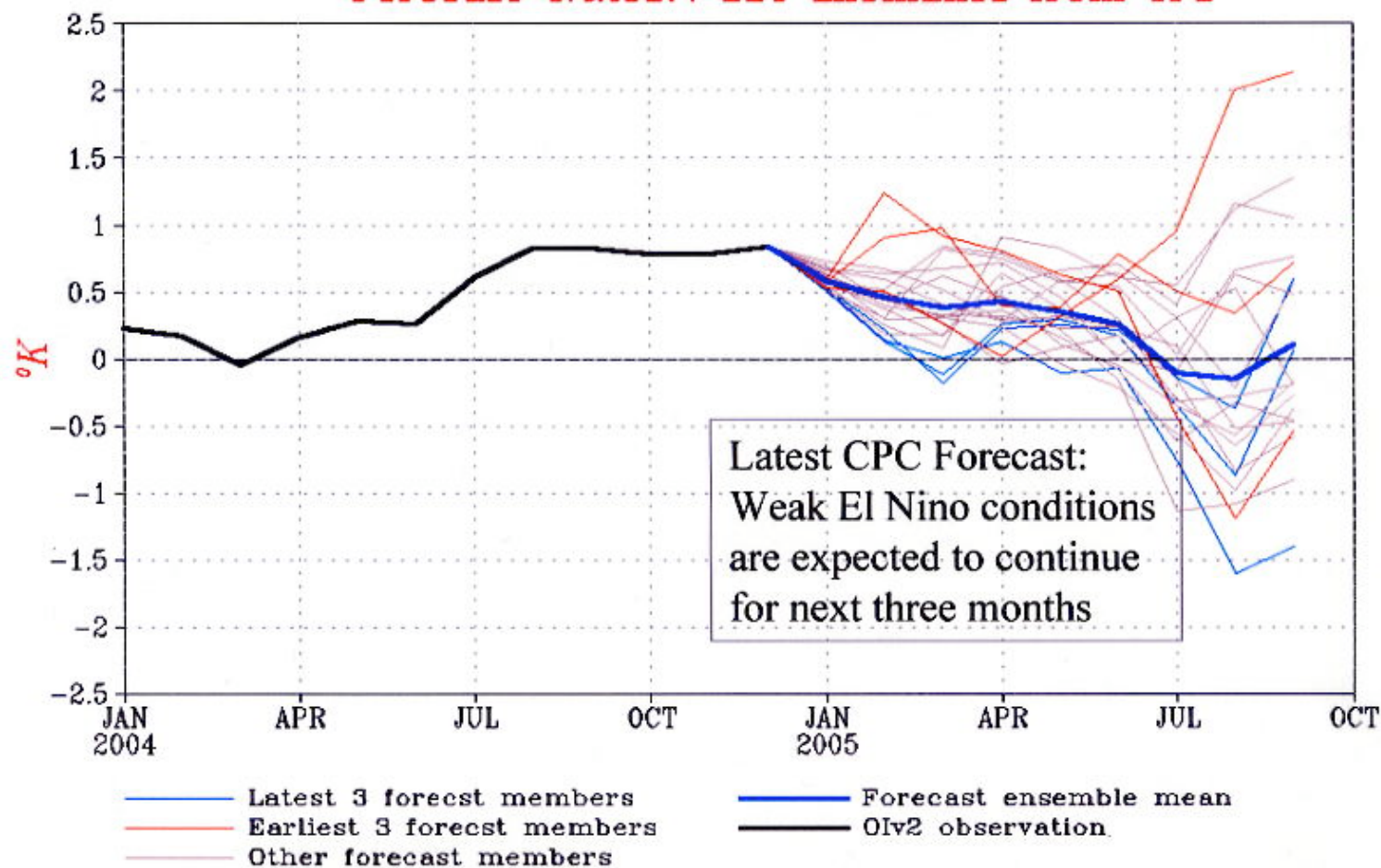




NWS/NCEP

Last update: Thu Jan 6 2005
Initial conditions: 9Dec2004–28Dec2004

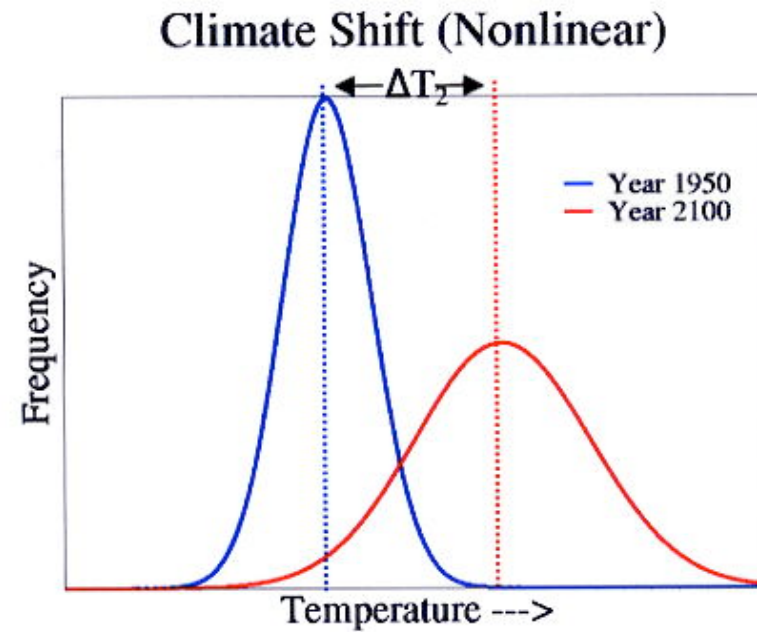
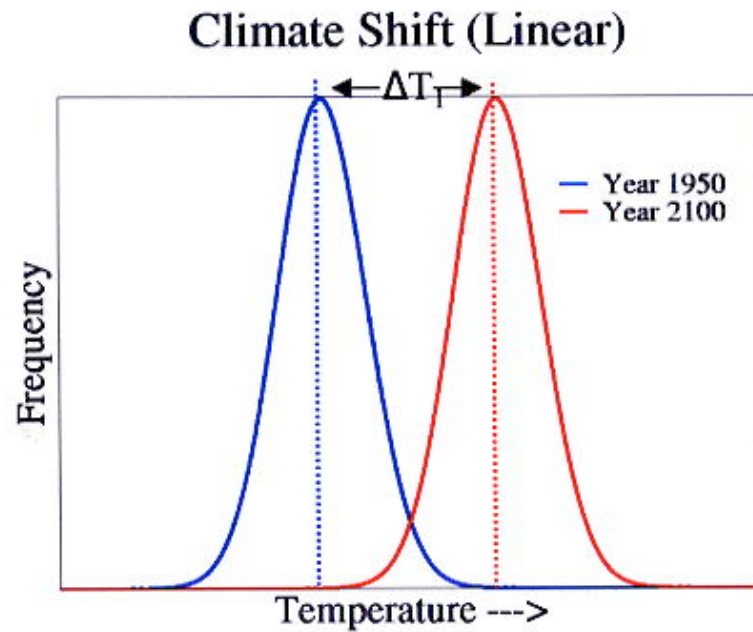
Forecast *Nino3.4* SST anomalies from CFS



Forecast initial conditions: 9Dec2004 to 28Dec2004.

Base period for climatology is 1971–2000. Base period for bias correction is 1982–2003.

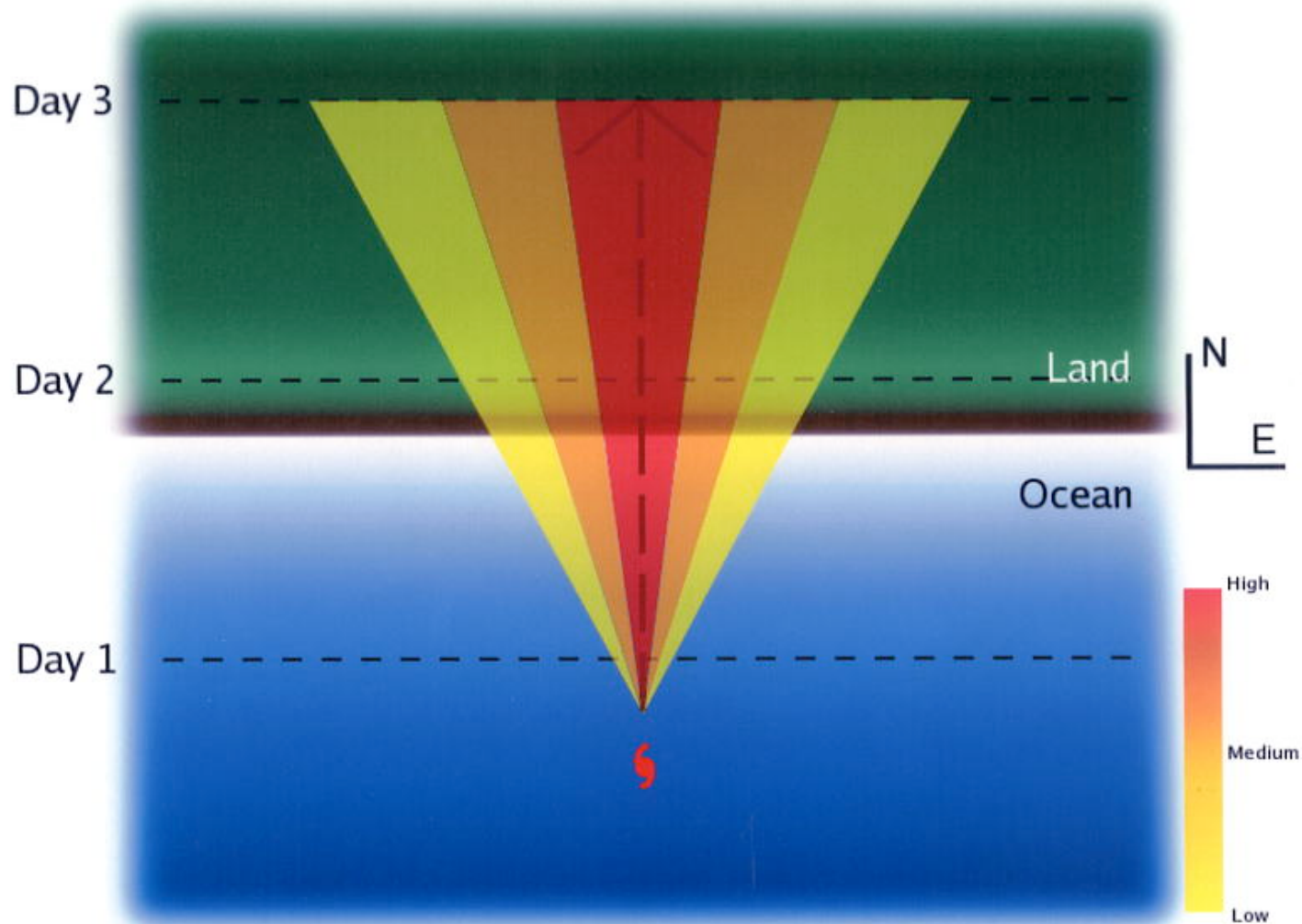
Climate Change Scenarios



$$\Delta T_1 = \Delta T_2$$

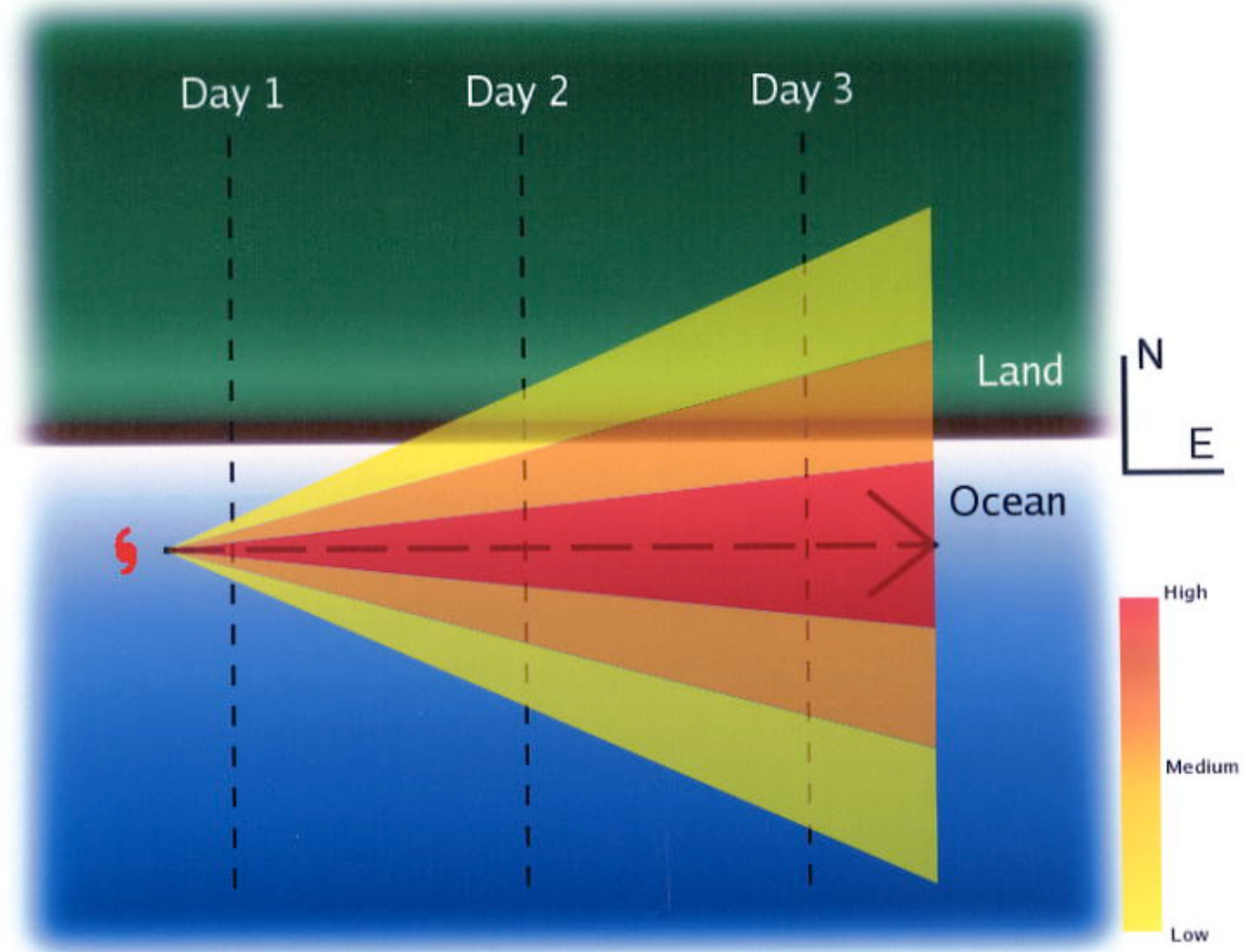
Cone of Uncertainty

Hurricane Strike Probability: Perpendicular to Coast



Cone of Uncertainty

Hurricane Strike Probability: Parallel to Coast



Cone of Uncertainty

Hurricane Strike Probability: Near-Parallel to Coast

