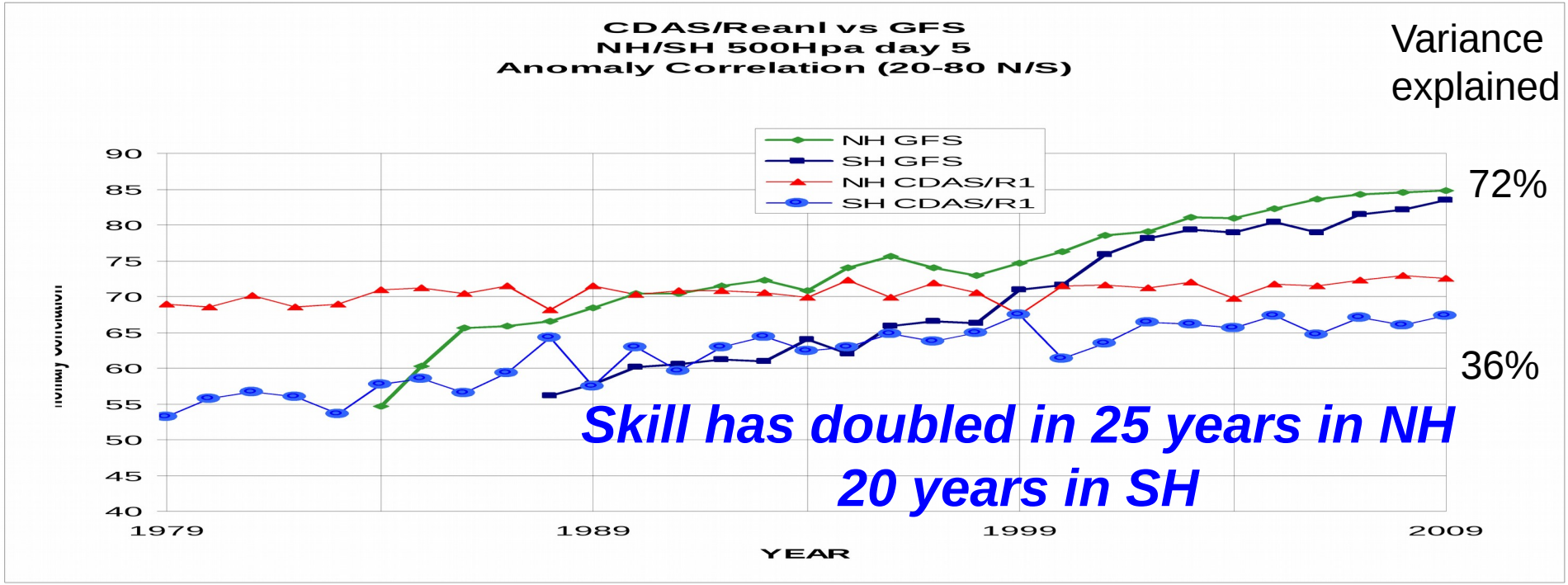
Review of forecast skill

Skill of 5-day forecasts has doubled in 20 years in Southern Hemisphere, 25 years in Northern Hemisphere

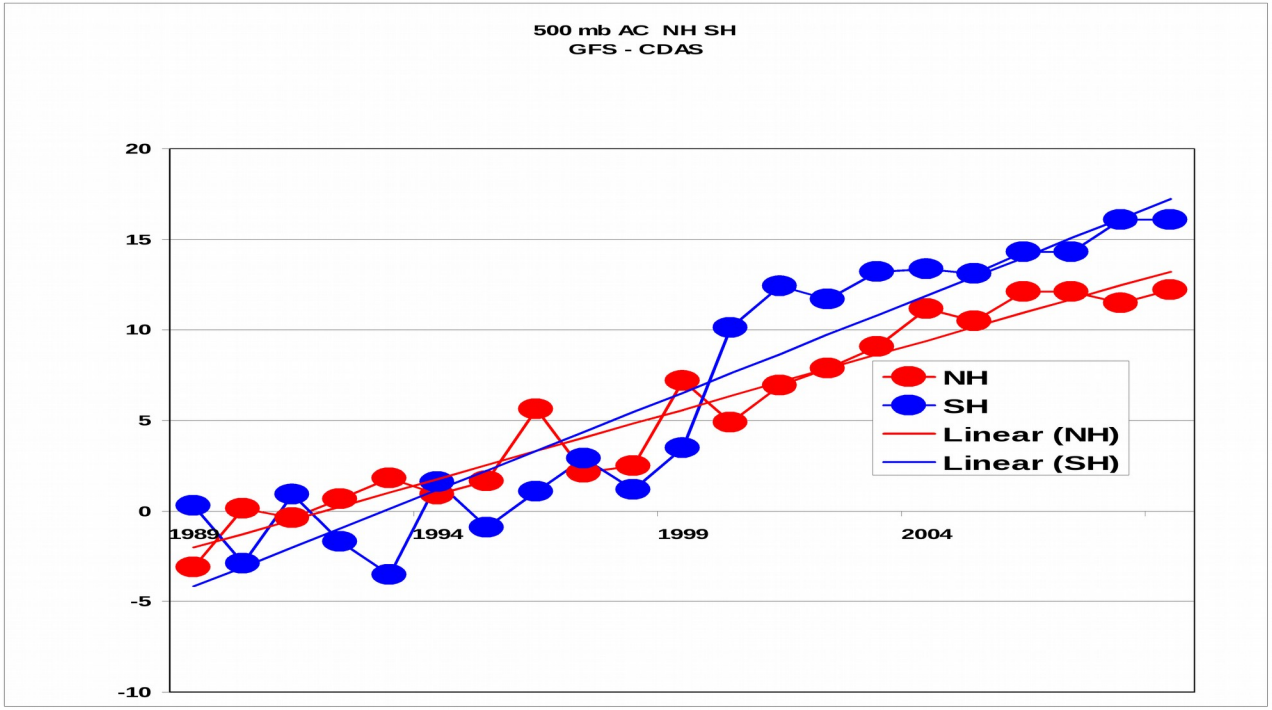
GFS gained slightly last year, more than ECMWF
Met Office and CMC gained more than GFS

Progress over past 2 years slow, especially in Northern Hemisphere heights, tropical winds, Since implementation of GSI in May 2007

Figures from R. Kistler, Fanglin Yang, HPC


CDAS/Reanl vs GFS
NH/SH 500Hpa day 5
Anomaly Correlation (20-80 N/S)
Variance explained
NH GFS
SH GFS
NH CDAS/R1
SH CDAS/R1
72%
36%
Skill has doubled in 25 years in NH
20 years in SH
90
85
80
75
70
65
60
55
50
45
40
1979
1989
1999
2009
YEAR

R. Kistler


500 mb AC NH SH
GFS - CDAS
NH
SH
Linear (NH)
Linear (SH)
20
15
10
5
0
-5
-10
1989
1994
1999
2004

GFS vs CDAS

2009

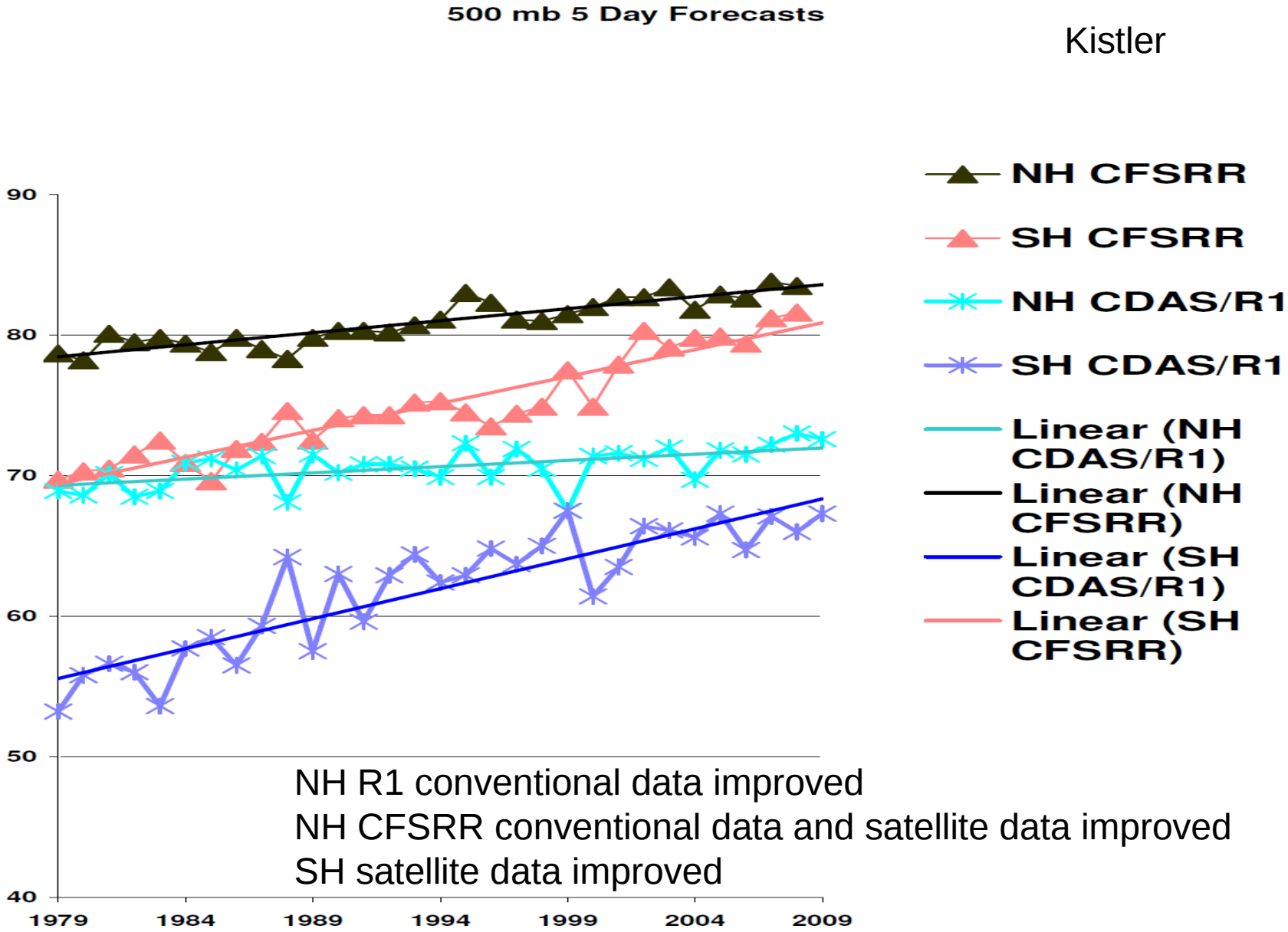
	NH	SH
GFS	84.8*(84.5)	83.4*(82.1)
CDAS	72.6	67.3
GFS-CDAS	12.2*	16.1**

* Record

** Ties Record of 2008

R. Kistler

Kistler



NH R1 conventional data improved
NH CFSRR conventional data and satellite data improved
SH satellite data improved

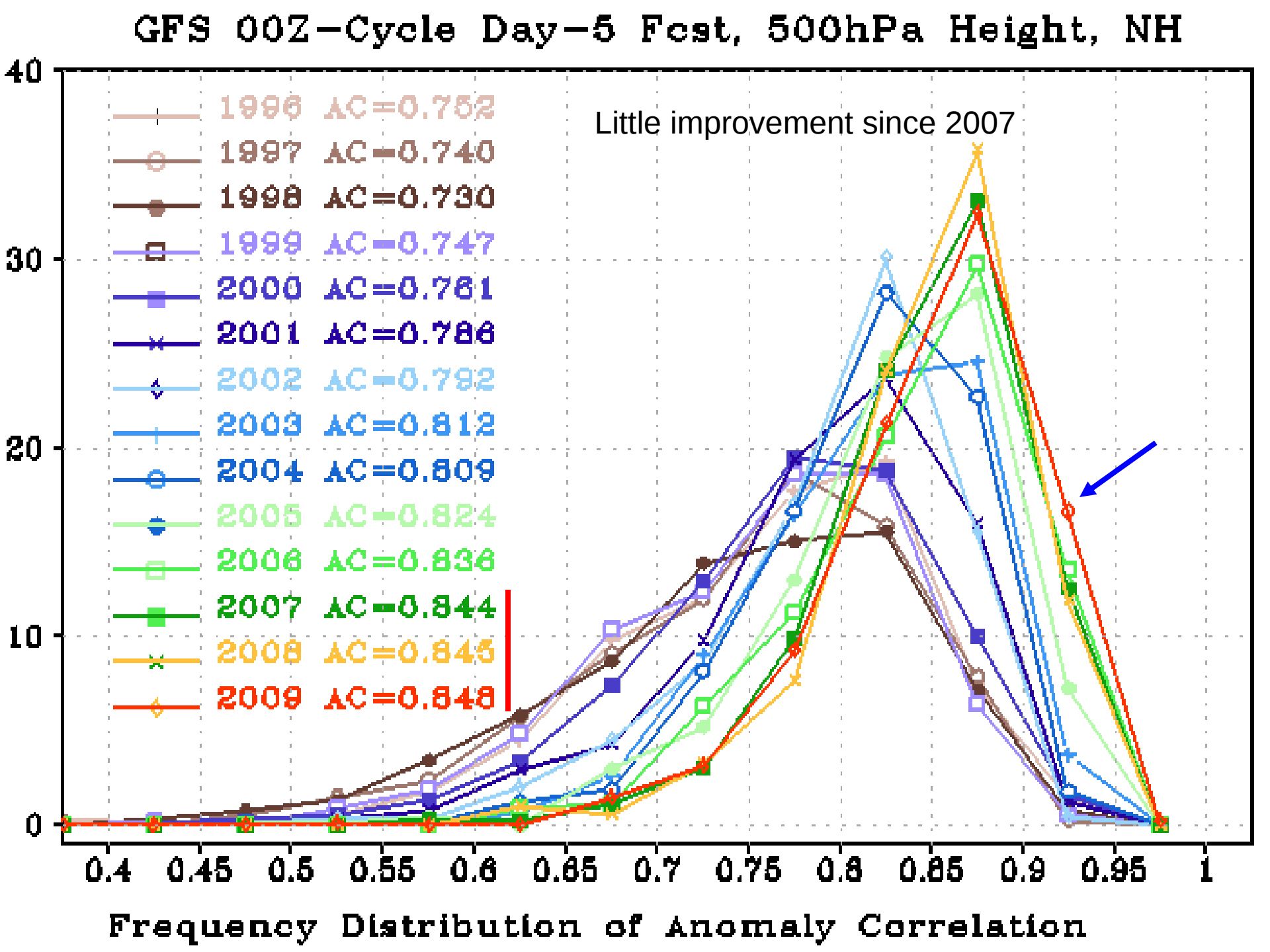
R1 underestimates role of data improvements in NH

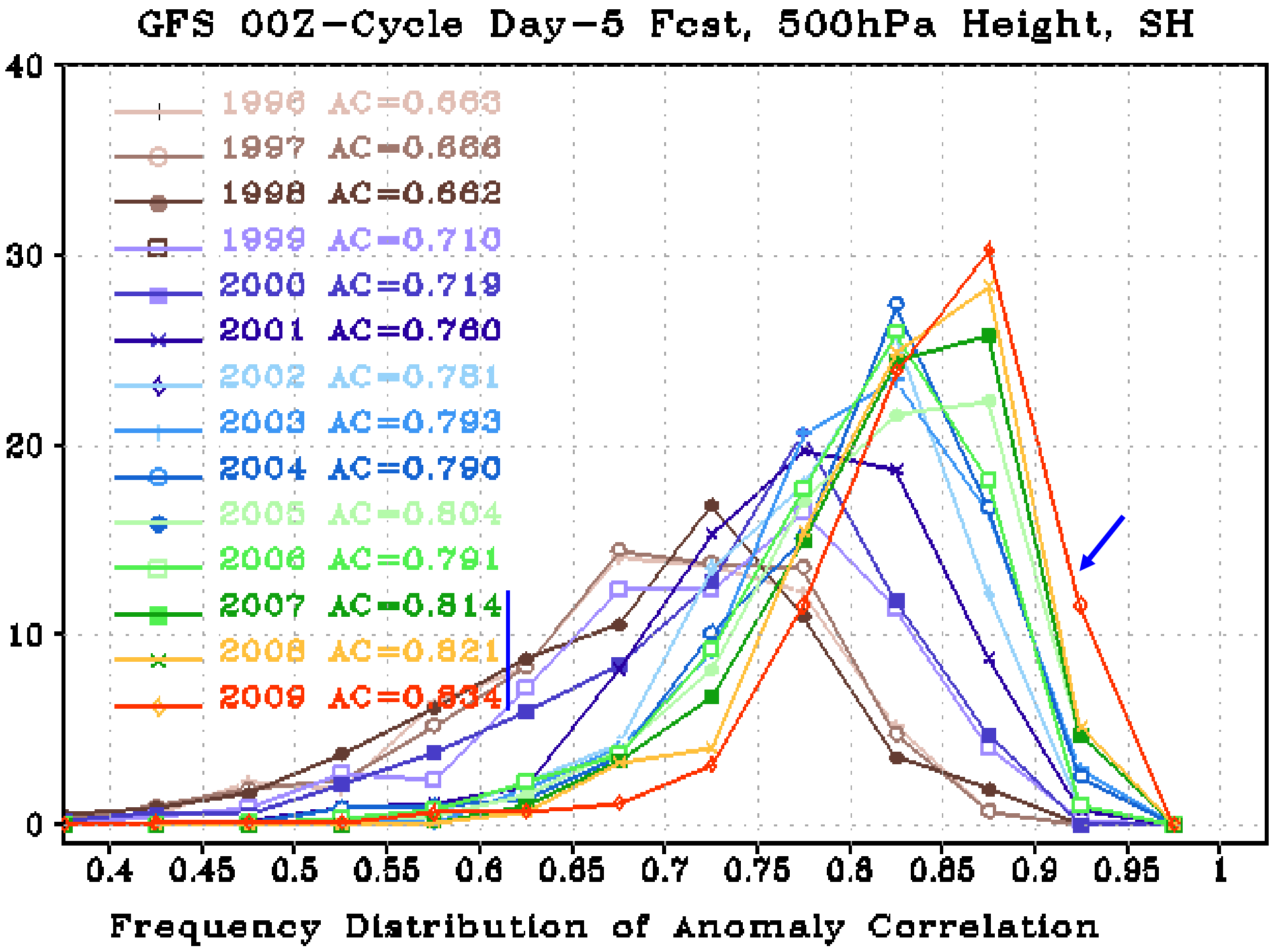
GFS and ECMWF Annual Mean AC and Frequency Distribution 500 hPa Height, 00Z-Cycle Forecast 1996 - 2009

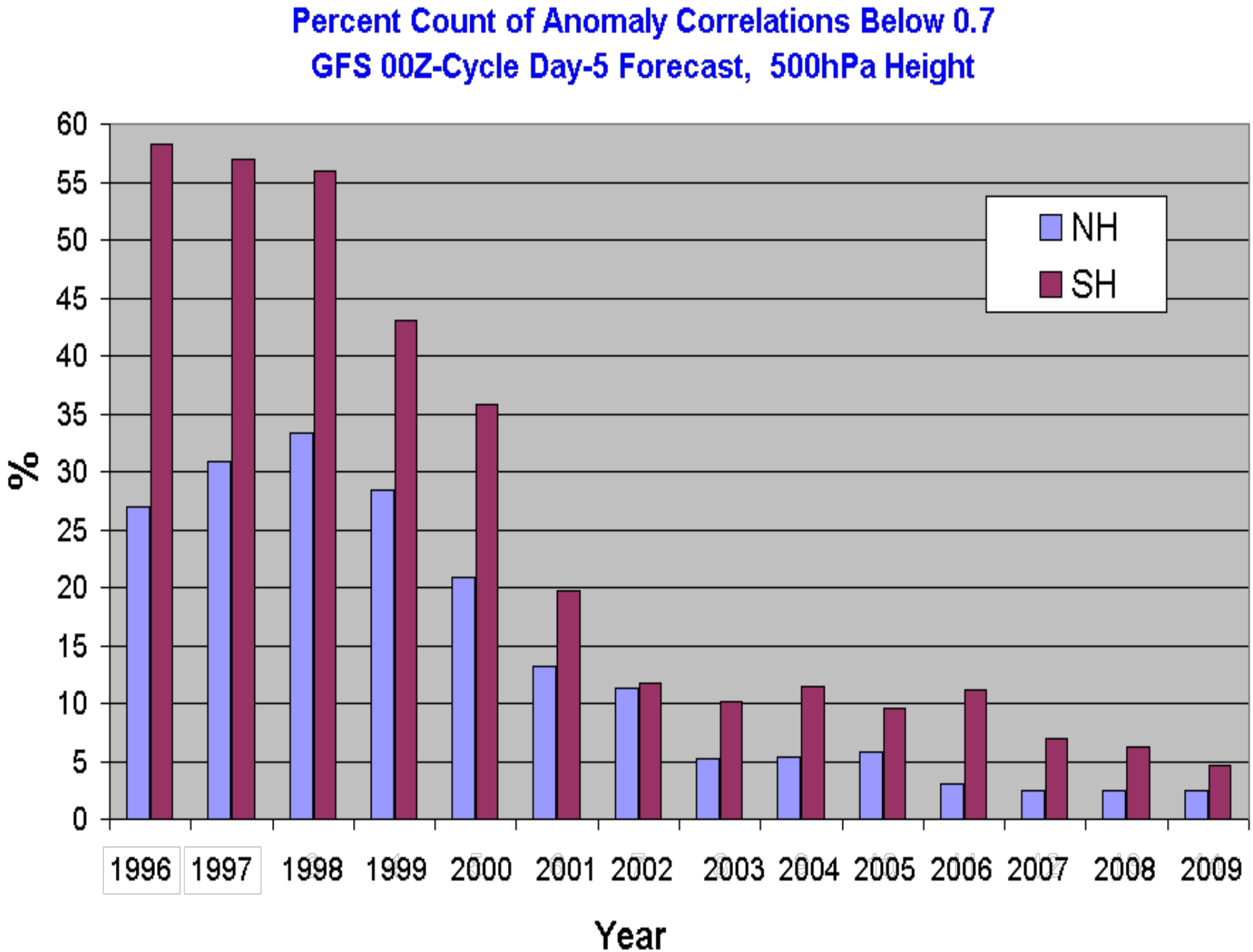
Twenty bins were used to count for the frequency distribution, with the 1st bin centered at 0.025 and the last been centered at 0.975. The width of each bin is 0.05.

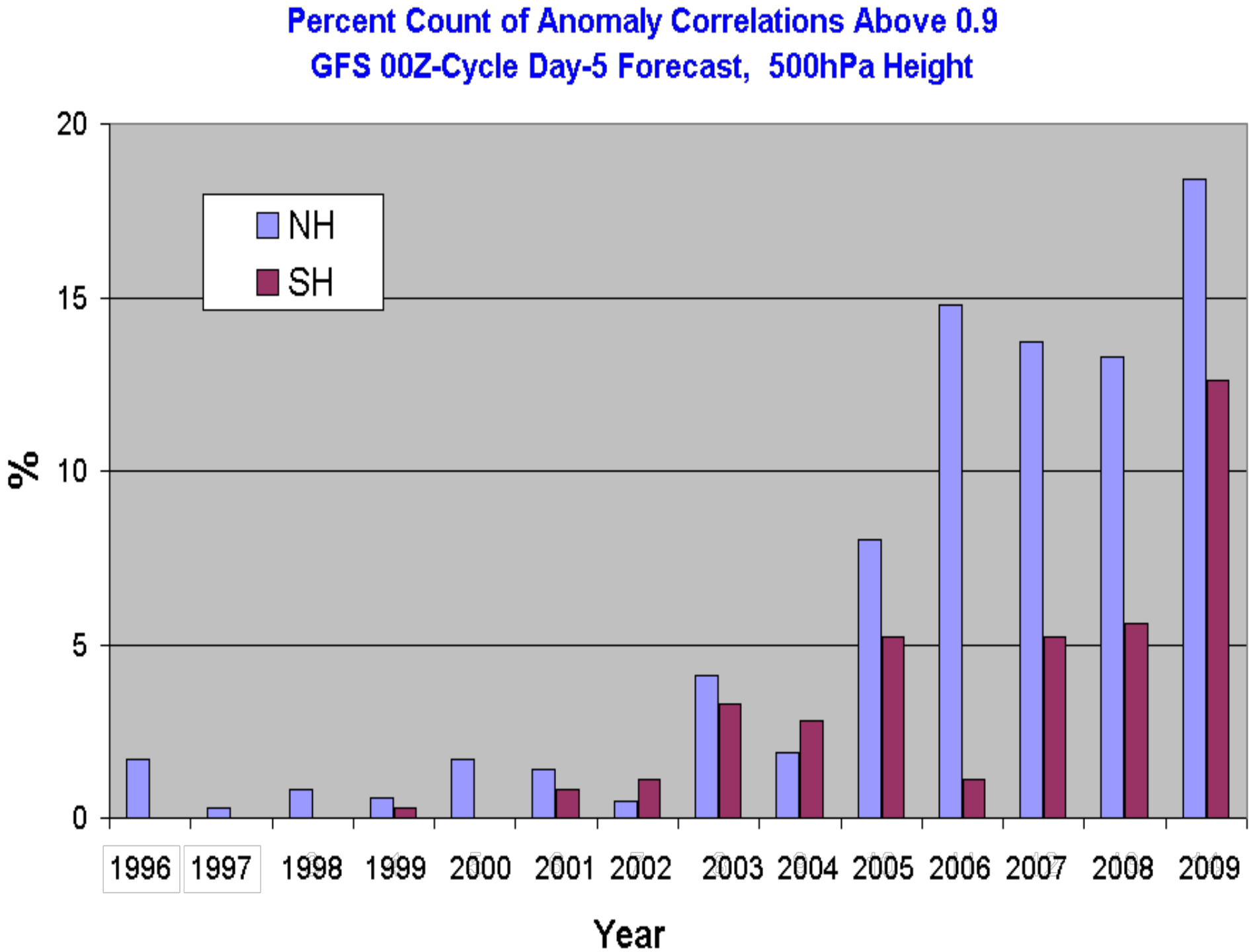
Fanglin Yang

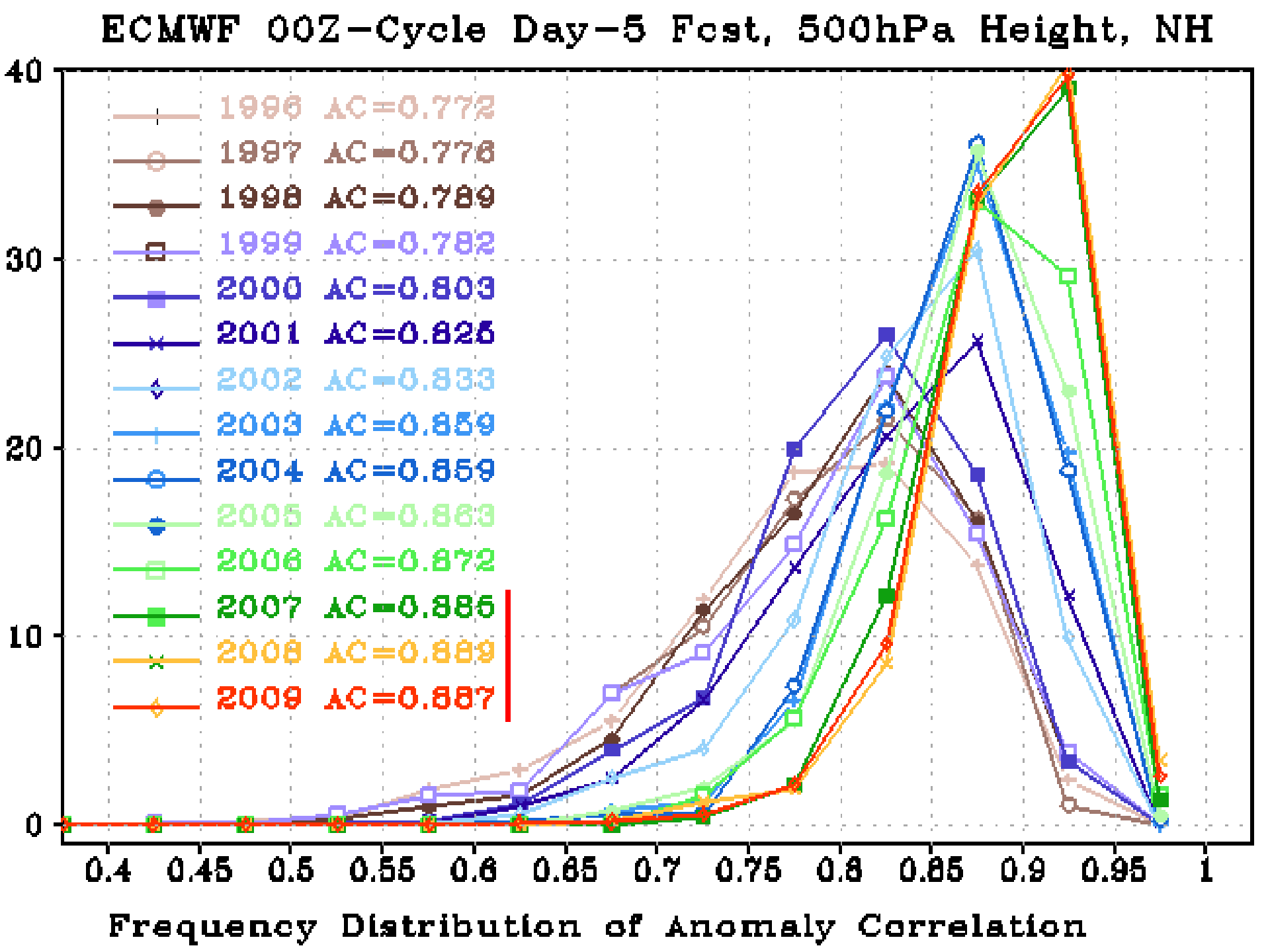
EMC/NCEP

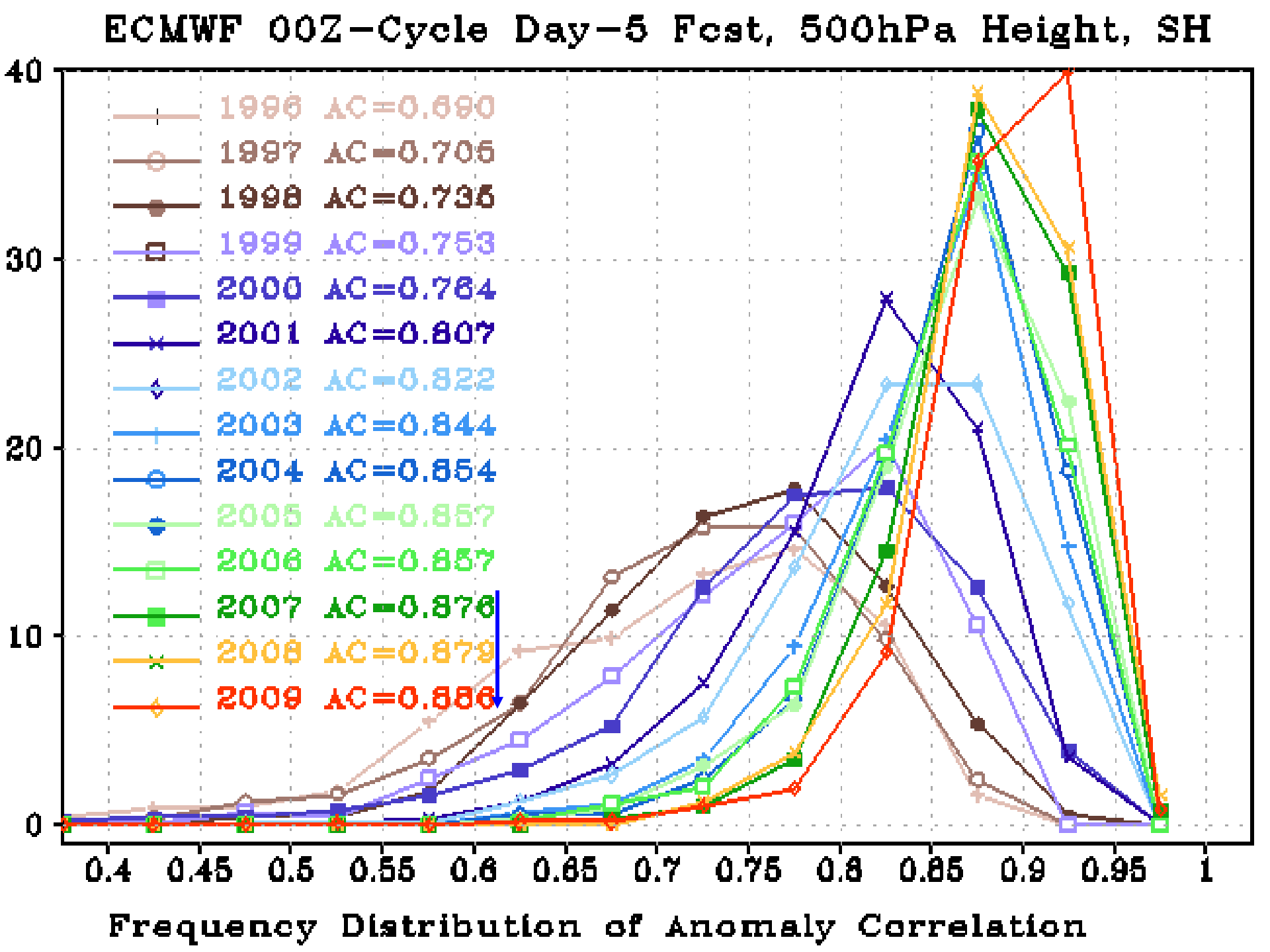

GFS 00Z-Cycle Day-5 Fcst, 500hPa Height, NH
Little improvement since 2007
1996 AC=0.752
1997 AC=0.740
1998 AC=0.730
1999 AC=0.747
2000 AC=0.761
2001 AC=0.786
2002 AC=0.782
2003 AC=0.812
2004 AC=0.809
2005 AC=0.824
2006 AC=0.836
2007 AC=0.844
2008 AC=0.845
2009 AC=0.848
0
10
20
30
40
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Frequency Distribution of Anomaly Correlation

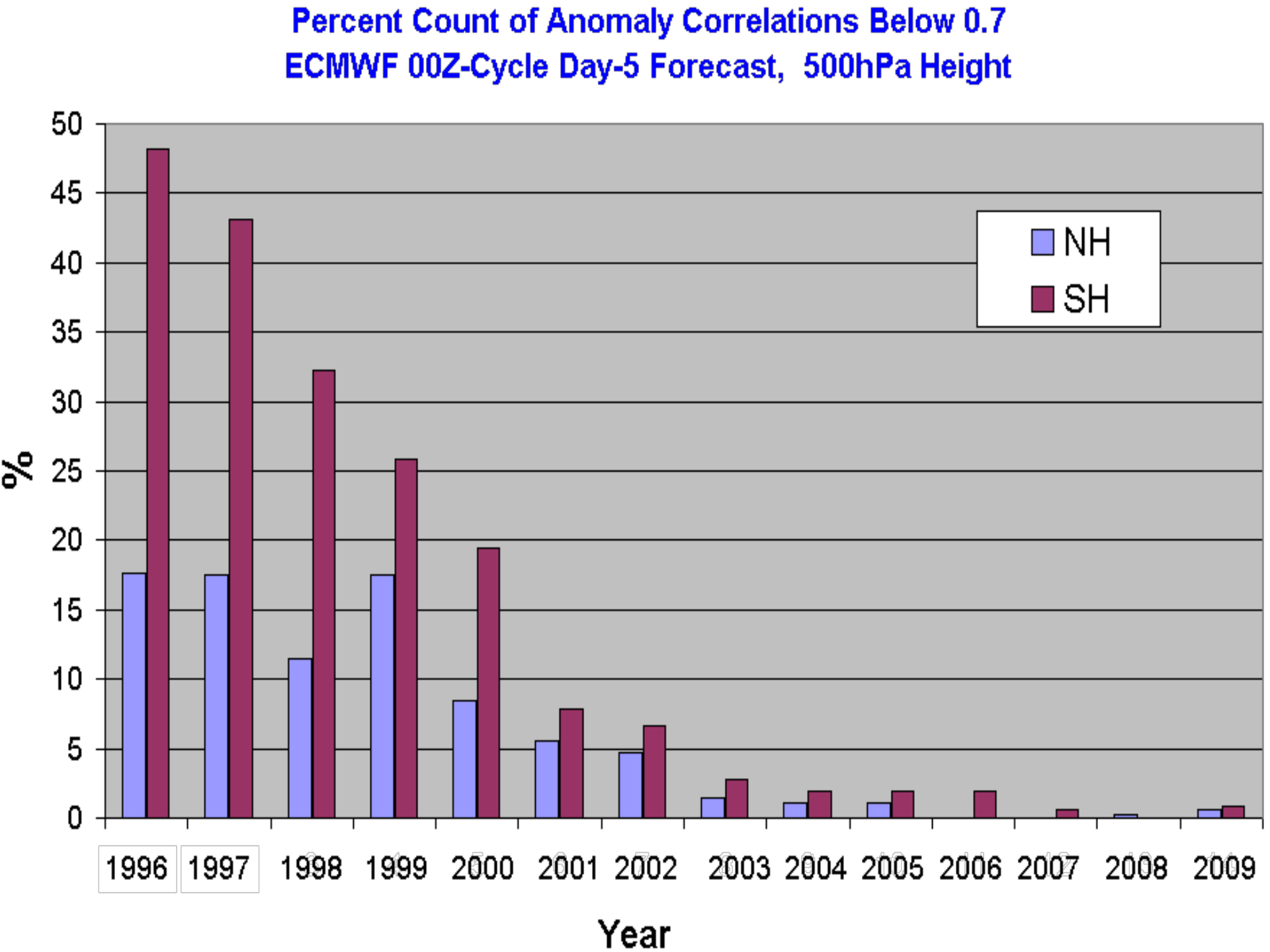

GFS 00Z-Cycle Day-5 Fcst, 500hPa Height, SH
1996 AC=0.663
1997 AC=0.666
1998 AC=0.662
1999 AC=0.710
2000 AC=0.719
2001 AC=0.760
2002 AC=0.781
2003 AC=0.793
2004 AC=0.790
2005 AC=0.804
2006 AC=0.791
2007 AC=0.814
2008 AC=0.821
2009 AC=0.834
40
30
20
10
0
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Frequency Distribution of Anomaly Correlation

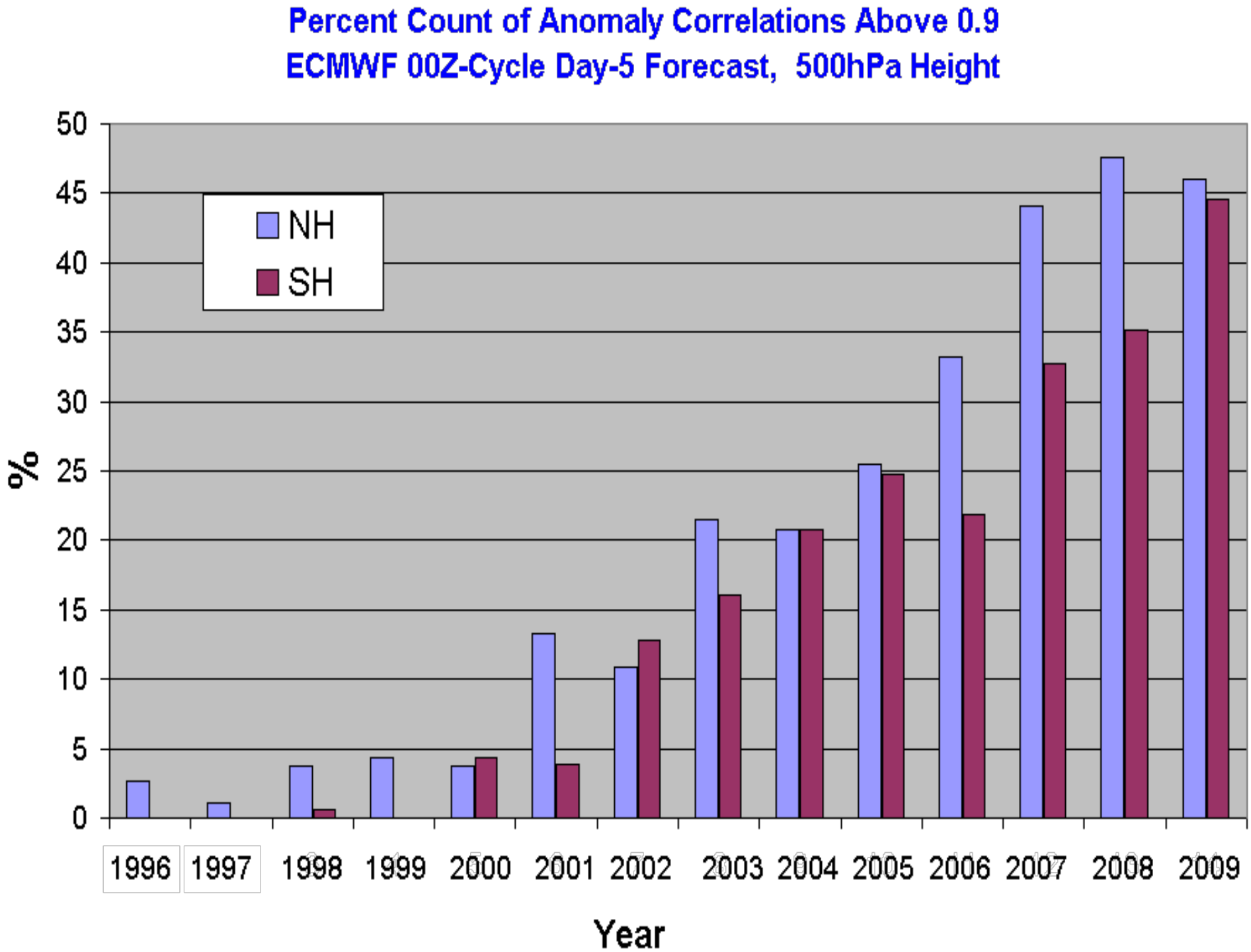

Percent Count of Anomaly Correlations Below 0.7
GFS 00Z-Cycle Day-5 Forecast, 500hPa Height
%
60
55
50
45
40
35
30
25
20
15
10
5
0
NH
SH
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year

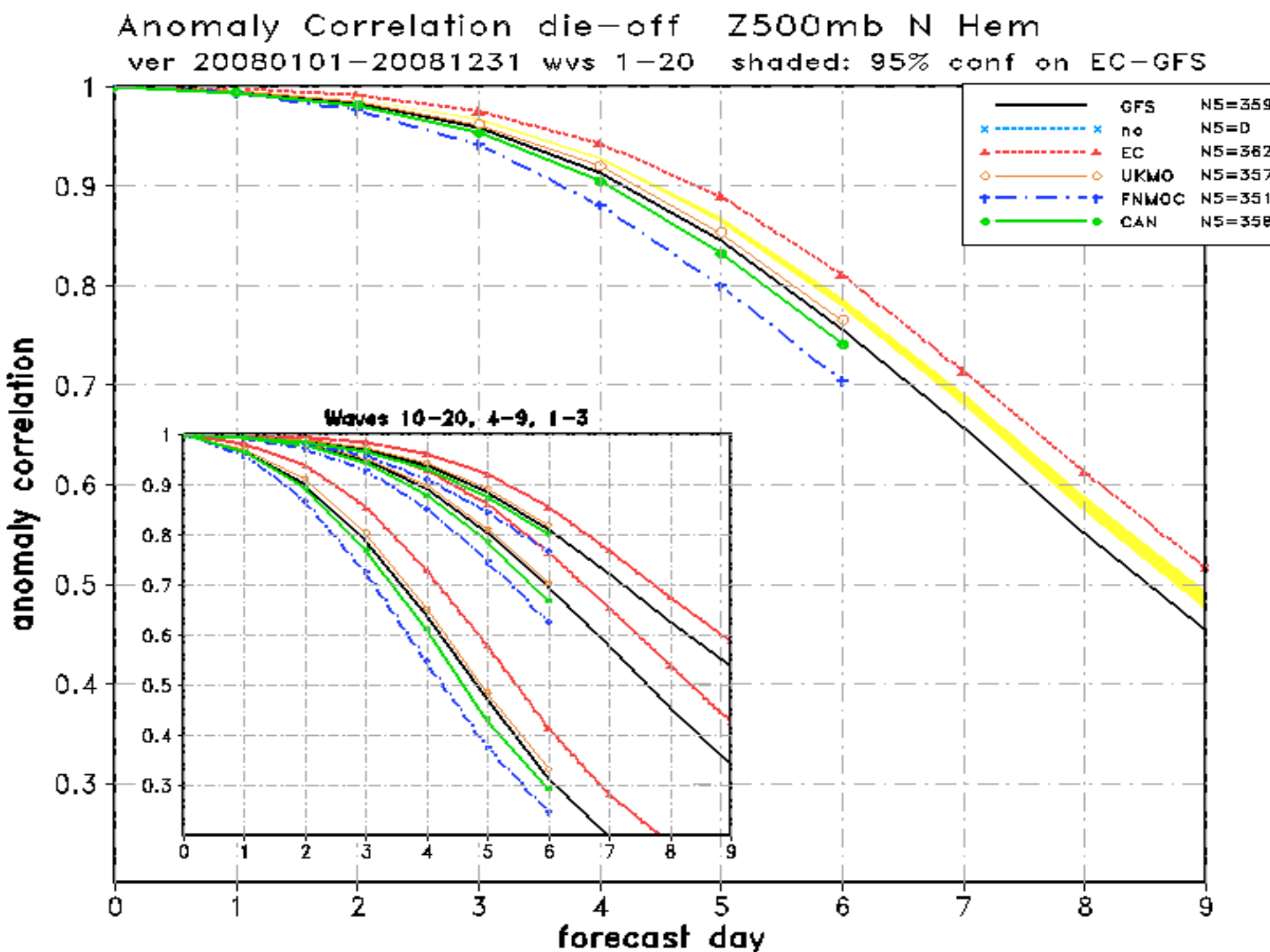

Percent Count of Anomaly Correlations Above 0.9
GFS 00Z-Cycle Day-5 Forecast, 500hPa Height
NH
SH
%
20
15
10
5
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year

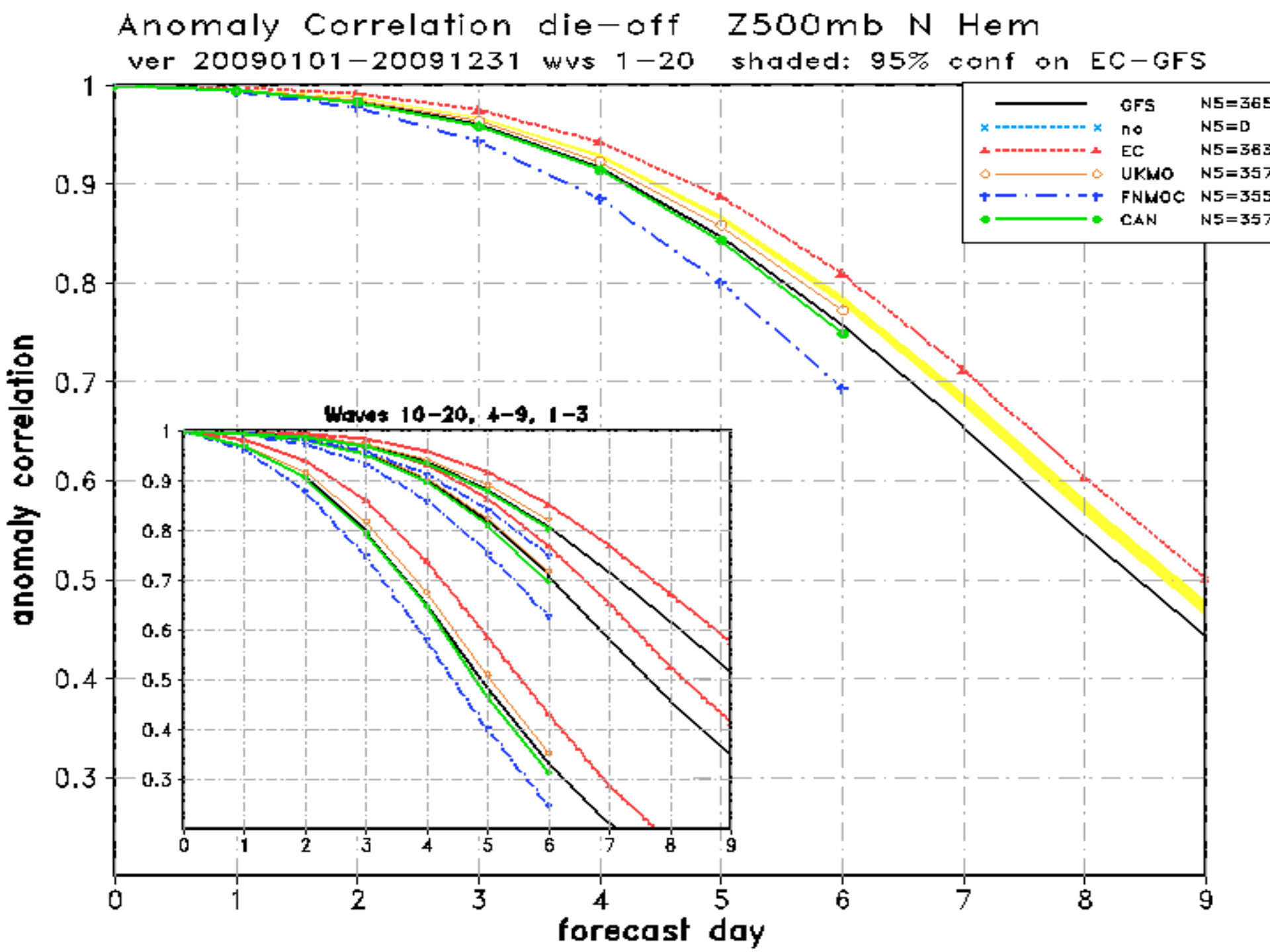

ECMWF 00Z-Cycle Day-5 Fcst, 500hPa Height, NH
1996 AC=0.772
1997 AC=0.776
1998 AC=0.789
1999 AC=0.782
2000 AC=0.803
2001 AC=0.825
2002 AC=0.833
2003 AC=0.859
2004 AC=0.859
2005 AC=0.863
2006 AC=0.872
2007 AC=0.885
2008 AC=0.889
2009 AC=0.887
0
10
20
30
40
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Frequency Distribution of Anomaly Correlation

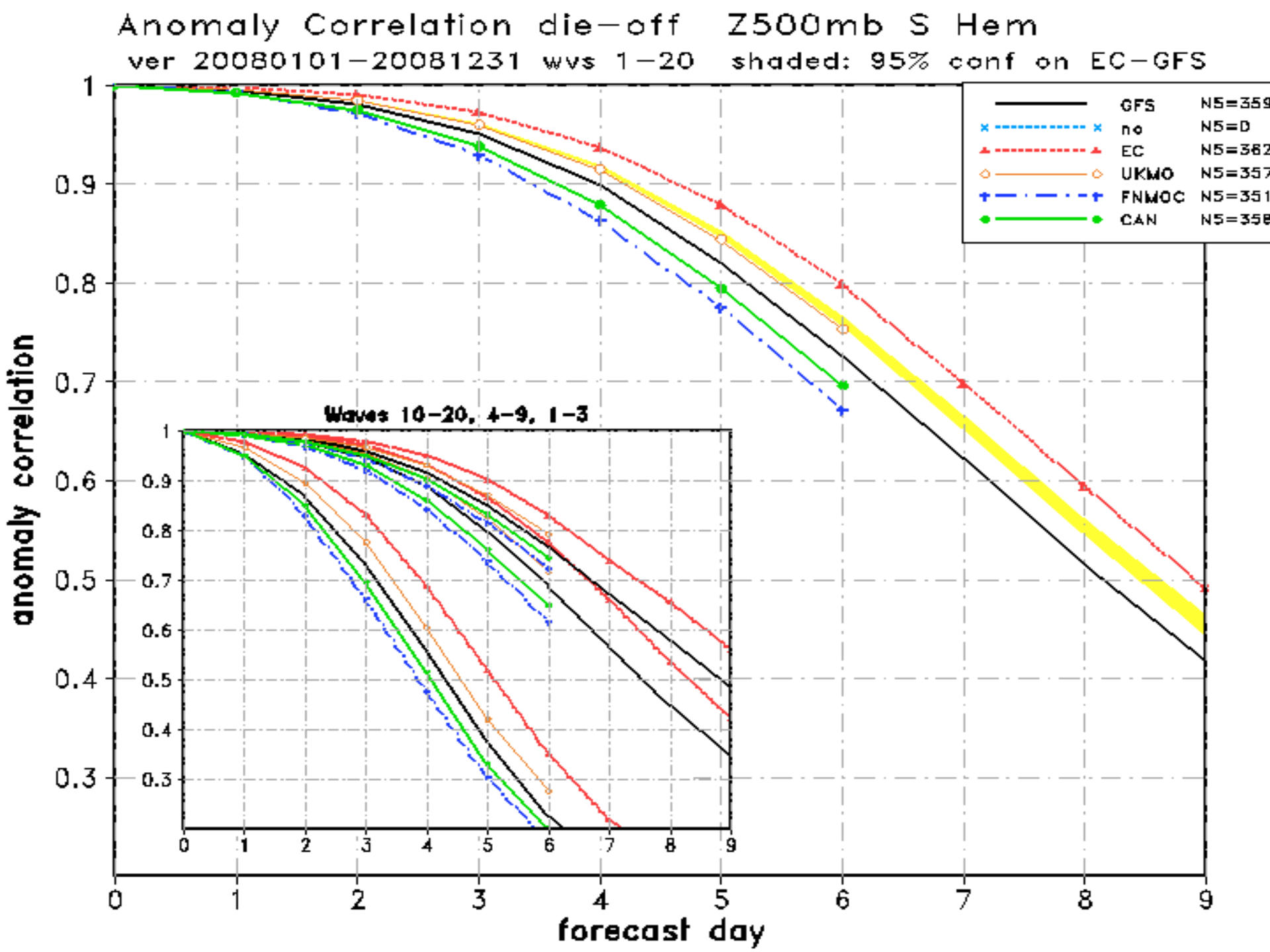

ECMWF 00Z-Cycle Day-5 Fcst, 500hPa Height, SH
1996 AC=0.690
1997 AC=0.705
1998 AC=0.735
1999 AC=0.753
2000 AC=0.764
2001 AC=0.807
2002 AC=0.822
2003 AC=0.844
2004 AC=0.854
2005 AC=0.857
2006 AC=0.857
2007 AC=0.876
2008 AC=0.879
2009 AC=0.886
0
10
20
30
40
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Frequency Distribution of Anomaly Correlation

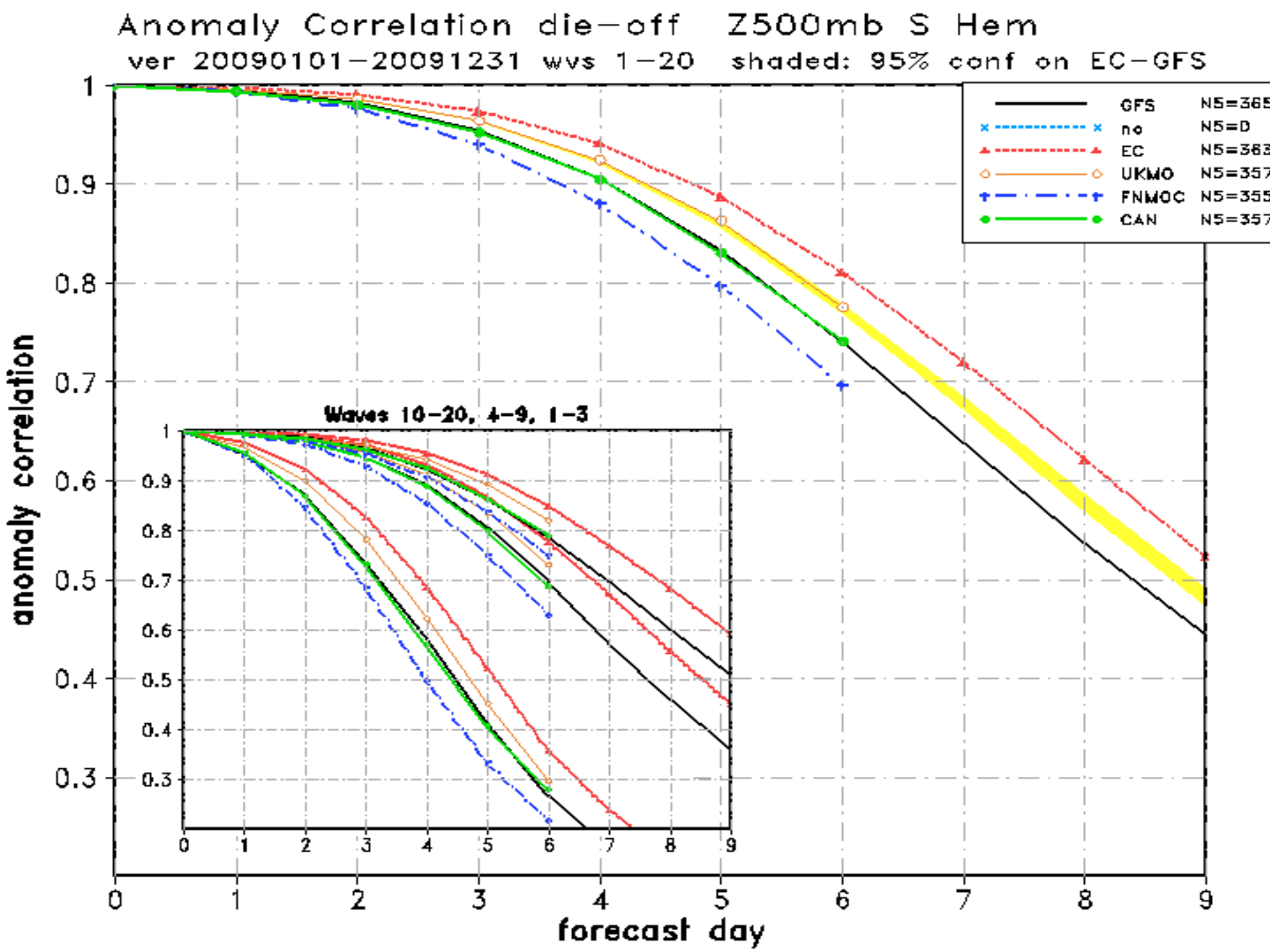

Percent Count of Anomaly Correlations Below 0.7
ECMWF 00Z-Cycle Day-5 Forecast, 500hPa Height
%
50
45
40
35
30
25
20
15
10
5
0
NH
SH
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year


Percent Count of Anomaly Correlations Above 0.9
ECMWF 00Z-Cycle Day-5 Forecast, 500hPa Height
NH
SH
%
0
5
10
15
20
25
30
35
40
45
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year


Anomaly Correlation die-off Z500mb N Hem
ver 20080101-20081231 wvs 1-20 shaded: 95% conf on EC-GFS
GFS N5=359
no N5=0
EC N5=362
UKMO N5=357
FNMOC N5=351
CAN N5=358
Waves 10-20, 4-9, 1-3
anomaly correlation
forecast day


Anomaly Correlation die-off Z500mb N Hem
ver 20090101-20091231 wvs 1-20 shaded: 95% conf on EC-GFS
GFS N5=365
no N5=0
EC N5=363
UKMO N5=357
FNMOC N5=355
CAN N5=357
Waves 10-20, 4-9, 1-3
anomaly correlation
forecast day


Anomaly Correlation die-off Z500mb S Hem
ver 20080101-20081231 wvs 1-20 shaded: 95% conf on EC-GFS
GFS N5=359
no N5=0
EC N5=362
UKMO N5=357
FNMOC N5=351
CAN N5=358
Waves 10-20, 4-9, 1-3
anomaly correlation
forecast day


Anomaly Correlation die-off Z500mb S Hem
ver 20090101-20091231 wvs 1-20 shaded: 95% conf on EC-GFS
GFS N5=365
no N5=0
EC N5=363
UKMO N5=357
FNMOC N5=355
CAN N5=357
Waves 10-20, 4-9, 1-3
anomaly correlation
forecast day

In 2009

GFS gained on ECMWF both hemispheres

CMC, MO gained on GFS both hemispheres

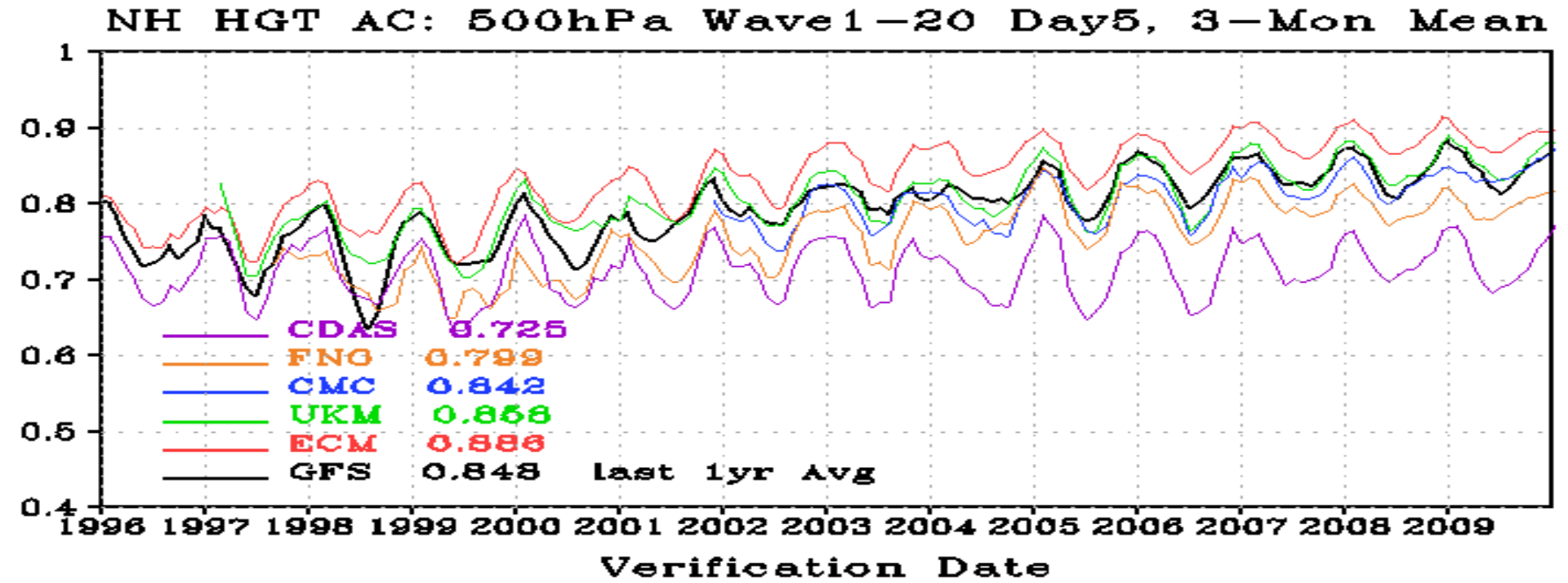
GFS gained on FNMOC Northern Hemisphere

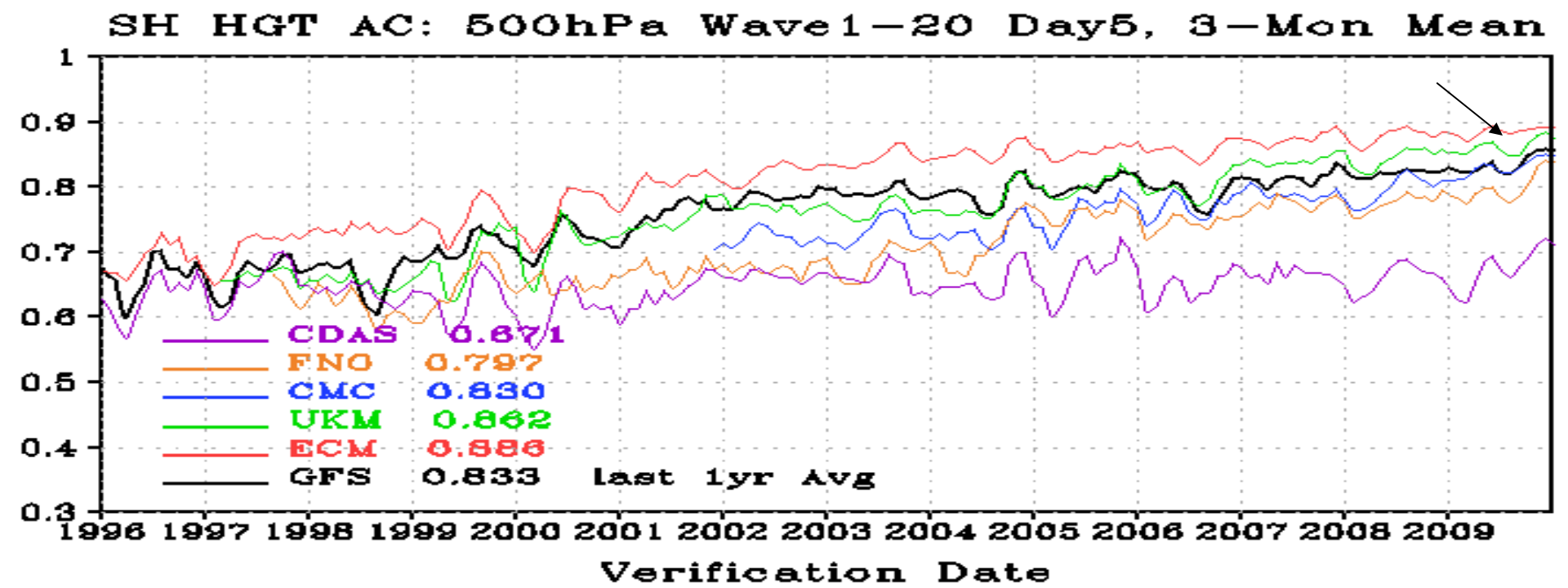
FNMOC gained on GFS Southern Hemisphere

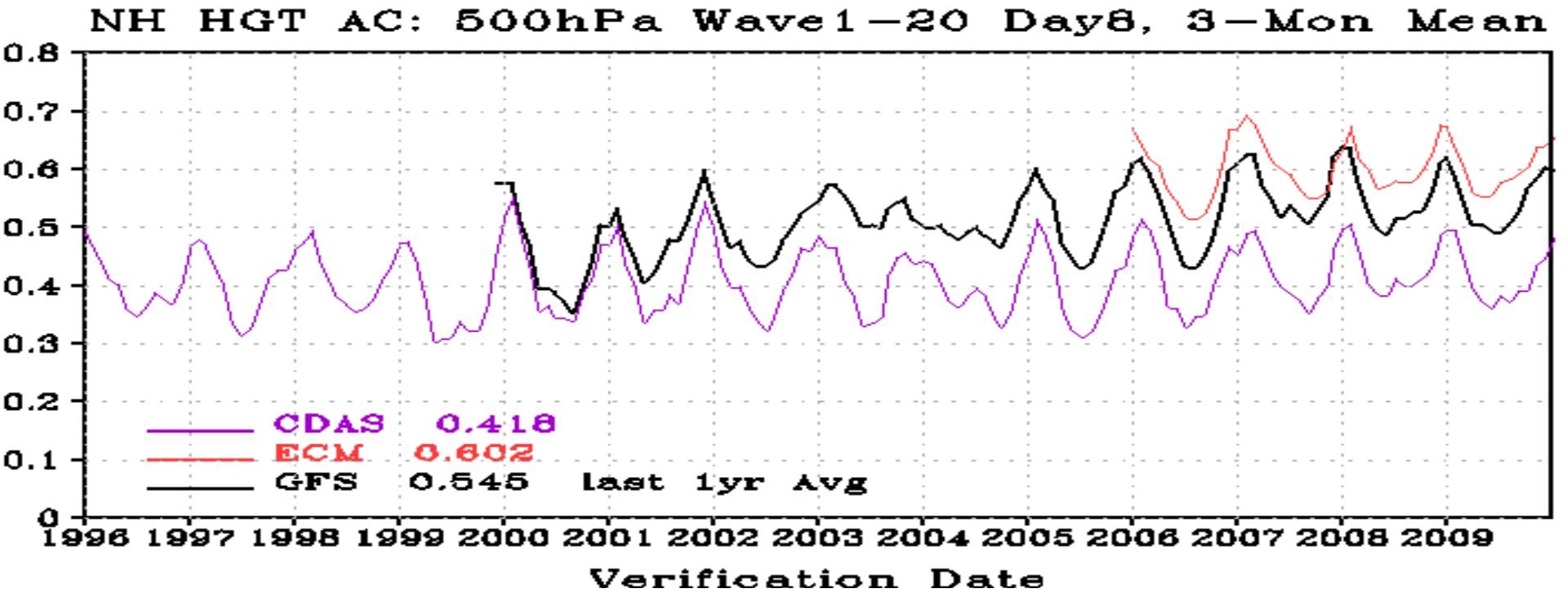
ECMWF signficantly ahead of GFS both hemispheres

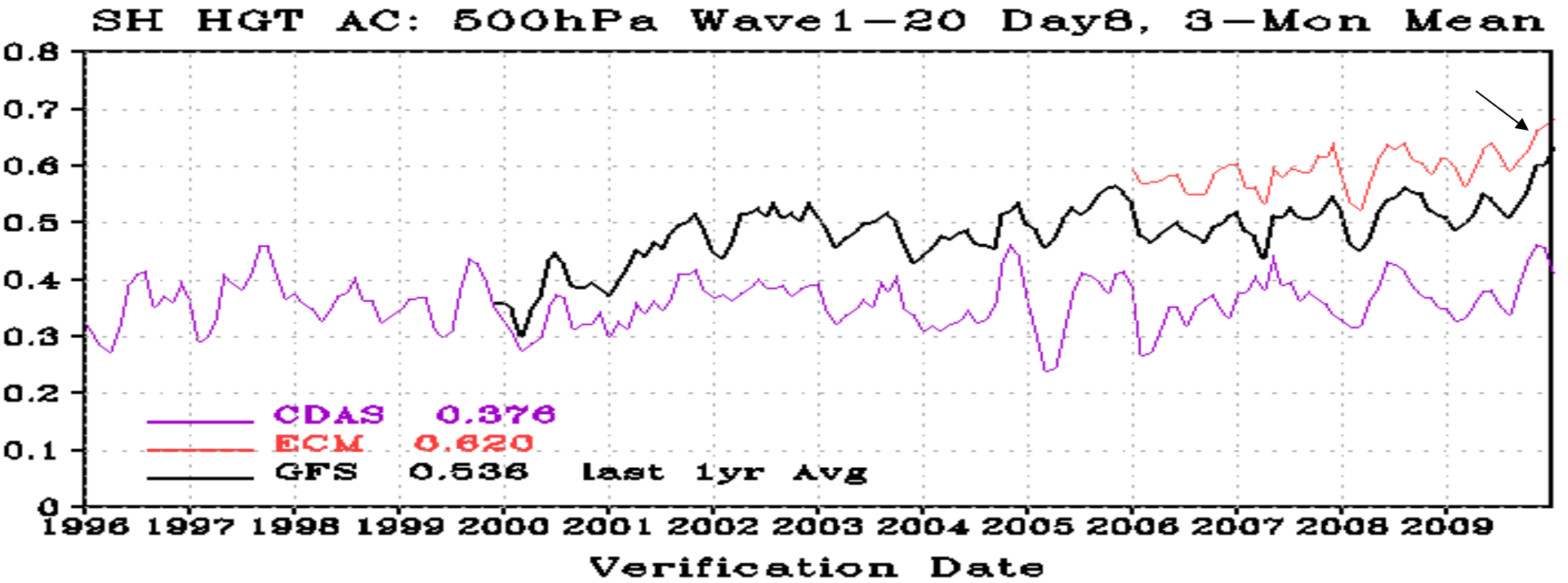
MO significantly ahead of GFS Southern Hemisphere

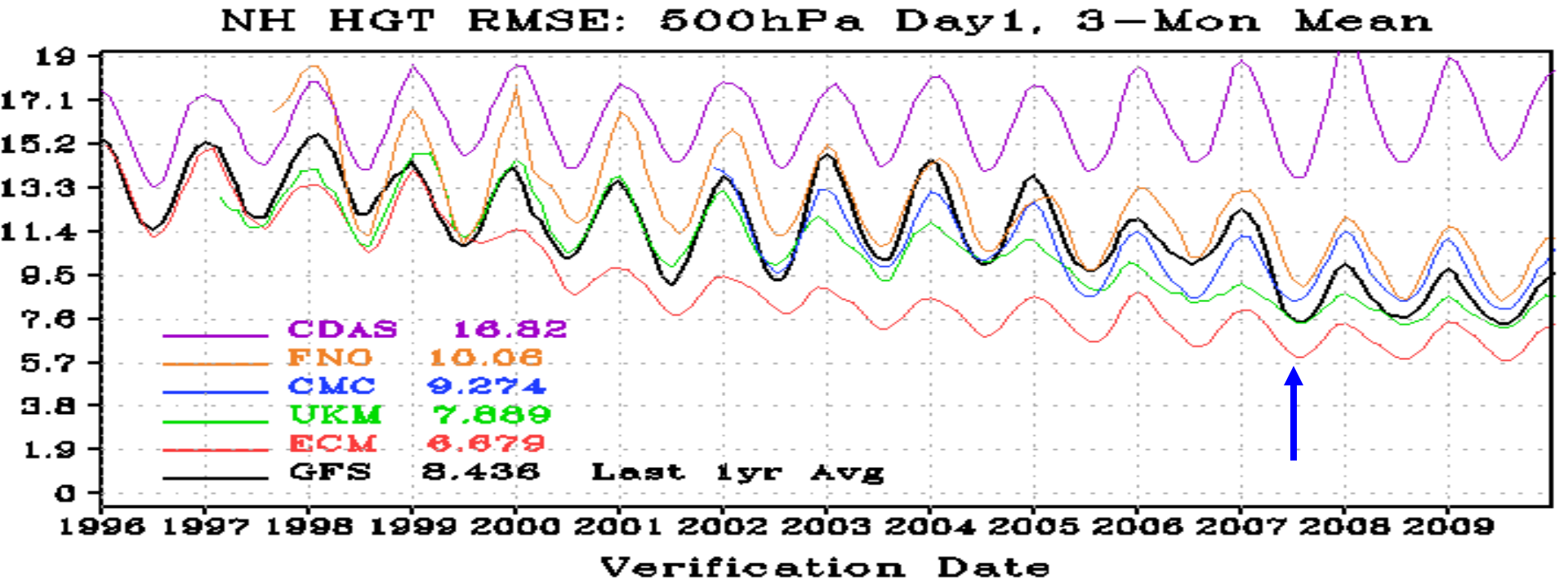
GFS signficantly ahead of FNMOC both hemispheres

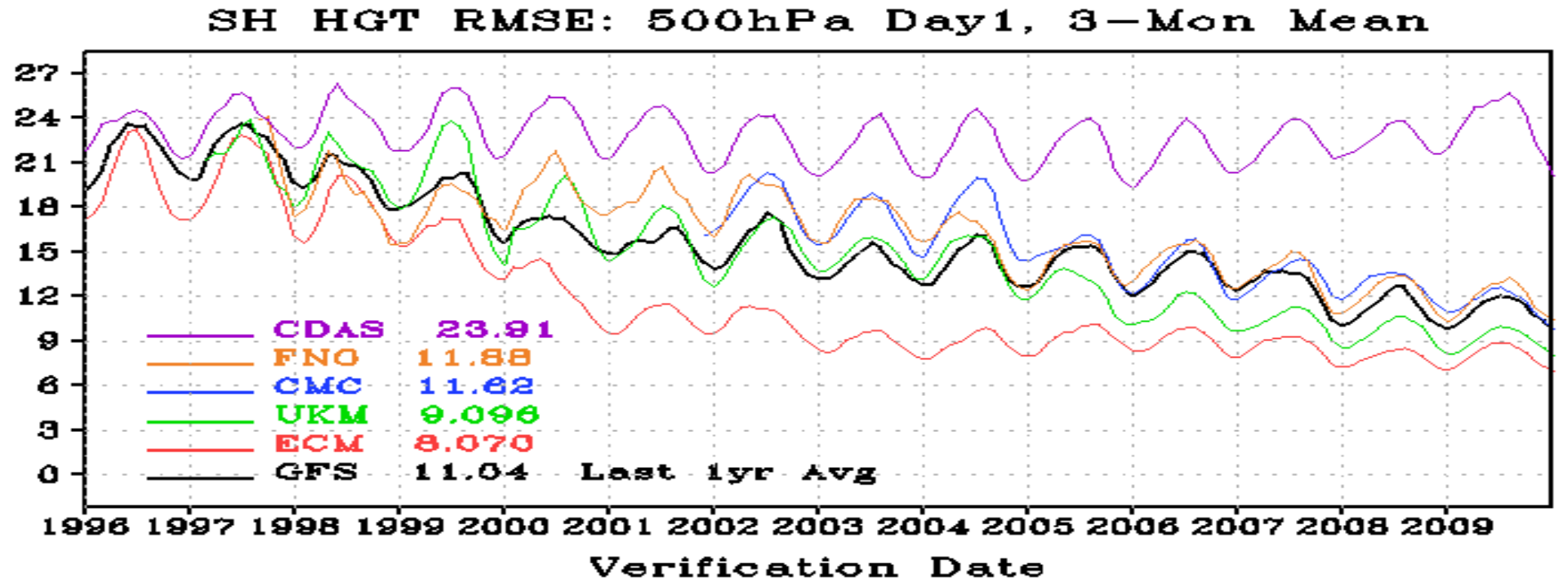

NH HGT AC: 500hPa Wave1-20 Day5, 3-Mon Mean
1
0.9
0.8
0.7
0.6
0.5
0.4
CDAS 0.725
FNO 0.799
CMC 0.842
UKM 0.858
ECM 0.886
GFS 0.848 last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date

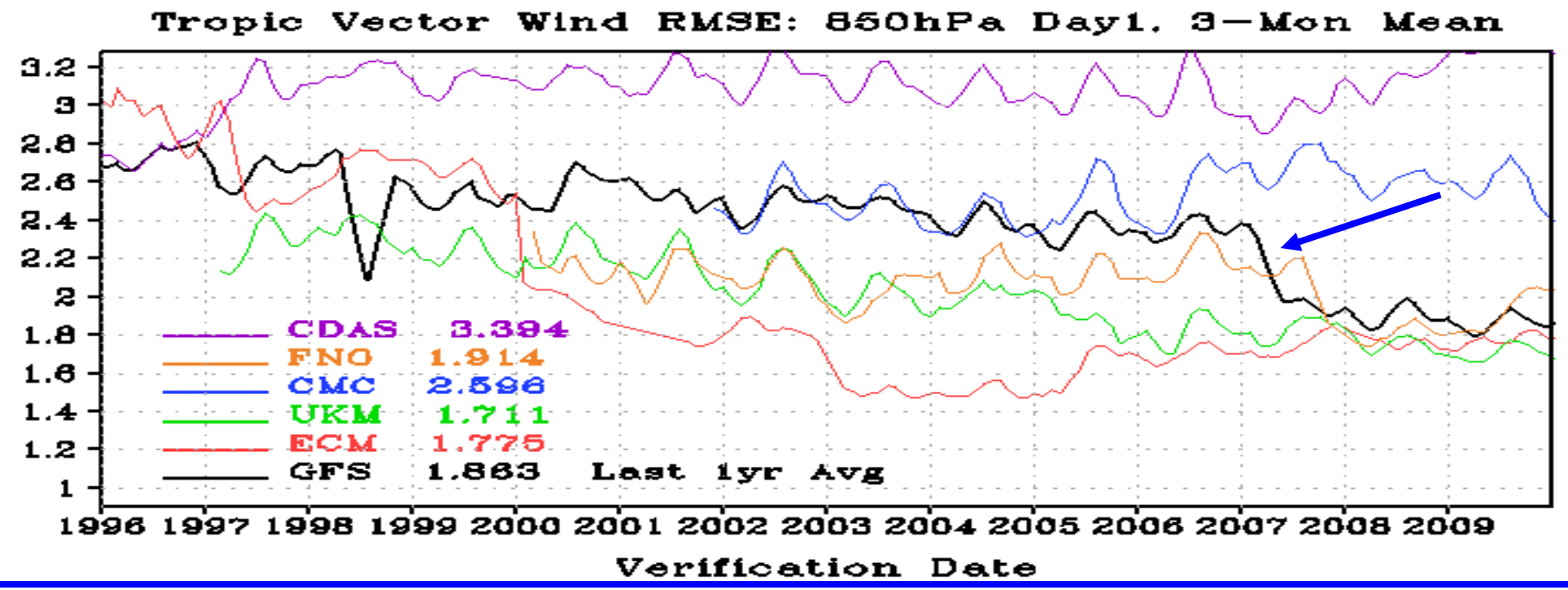

SH HGT AC: 500hPa Wave1-20 Day5, 3-Mon Mean
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
CDAS 0.671
FNO 0.797
CMC 0.830
UKM 0.862
ECM 0.886
GFS 0.833 last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date

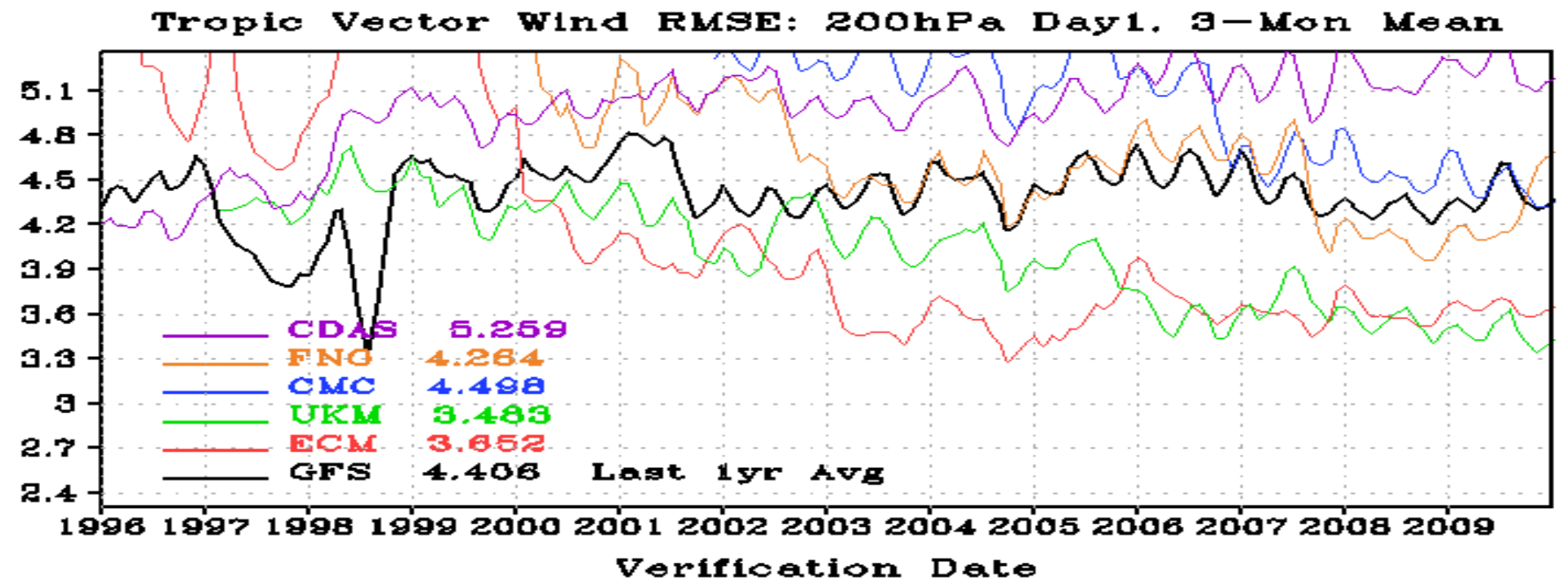

NH HGT AC: 500hPa Wave1-20 Day8, 3-Mon Mean
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CDAS 0.418
ECM 0.602
GFS 0.545 last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date

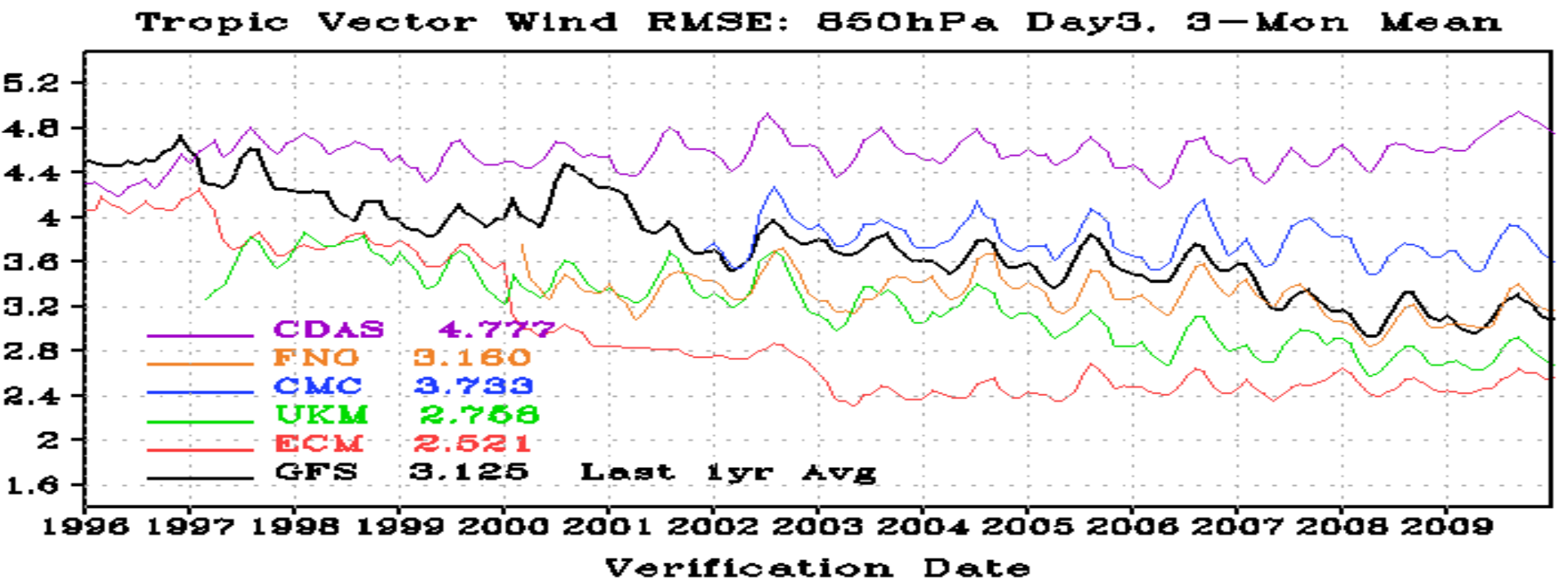

SH HGT AC: 500hPa Wave1-20 Day8, 3-Mon Mean
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CDAS 0.376
ECM 0.620
GFS 0.536 last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date

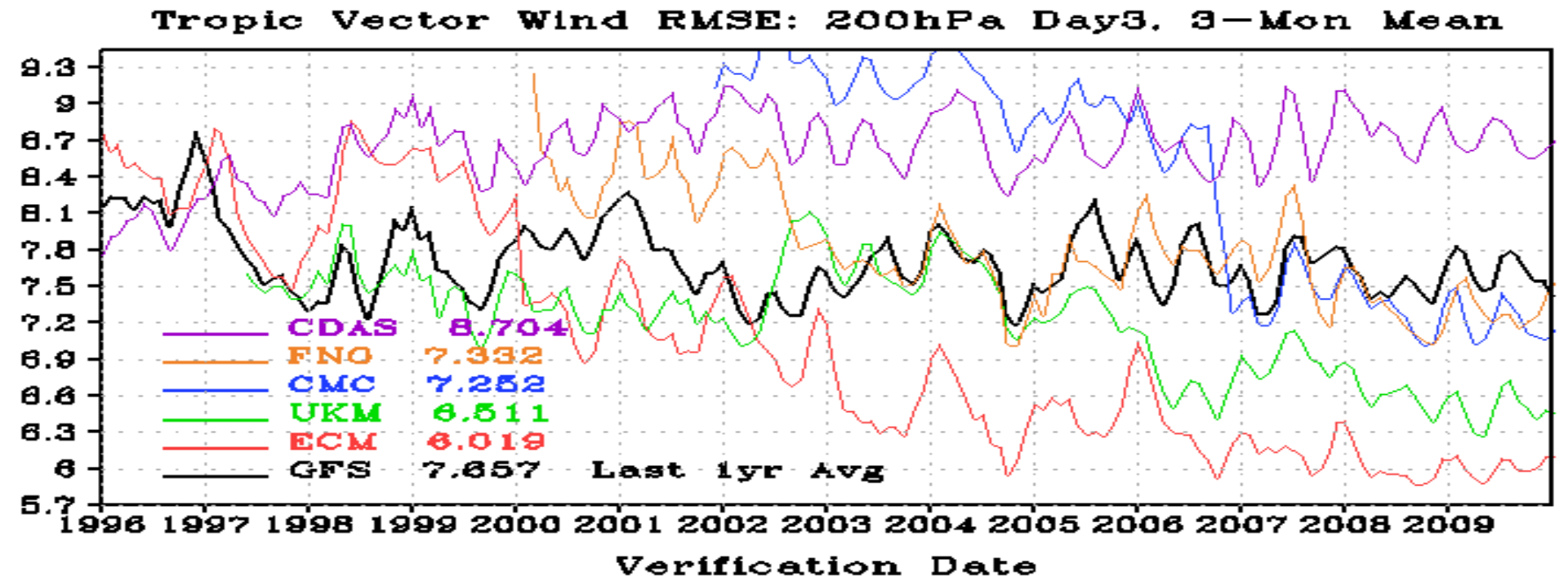

NH HGT RMSE: 500hPa Day1, 3-Mon Mean
19
17.1
15.2
13.3
11.4
9.5
7.6
5.7
3.8
1.9
0
CDAS 16.82
FNO 10.06
CMC 9.274
UKM 7.889
ECM 6.679
GFS 8.436 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date


SH HGT RMSE: 500hPa Day1, 3-Mon Mean
27
24
21
18
15
12
9
6
3
0
CDAS 23.91
FNO 11.88
CMC 11.62
UKM 9.096
ECM 8.070
GFS 11.04 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date


Tropic Vector Wind RMSE: 850hPa Day1, 3-Mon Mean
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
CDAS 3.394
FNO 1.914
CMC 2.596
UKM 1.711
ECM 1.775
GFS 1.863 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date


Tropic Vector Wind RMSE: 200hPa Day1, 3-Mon Mean
5.1
4.8
4.5
4.2
3.9
3.6
3.3
3
2.7
2.4
CDAS 5.259
FNO 4.264
CMC 4.498
UKM 3.483
ECM 3.652
GFS 4.406 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date


Tropic Vector Wind RMSE: 850hPa Day3, 3-Mon Mean
5.2
4.8
4.4
4
3.6
3.2
2.8
2.4
2
1.6
CDAS 4.777
FNO 3.160
CMC 3.733
UKM 2.758
ECM 2.521
GFS 3.125 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date


Tropic Vector Wind RMSE: 200hPa Day3, 3-Mon Mean
9.3
9
8.7
8.4
8.1
7.8
7.5
7.2
6.9
6.6
6.3
6
5.7
CDAS 8.704
FNO 7.332
CMC 7.252
UKM 6.511
ECM 6.019
GFS 7.657 Last 1yr Avg
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Verification Date

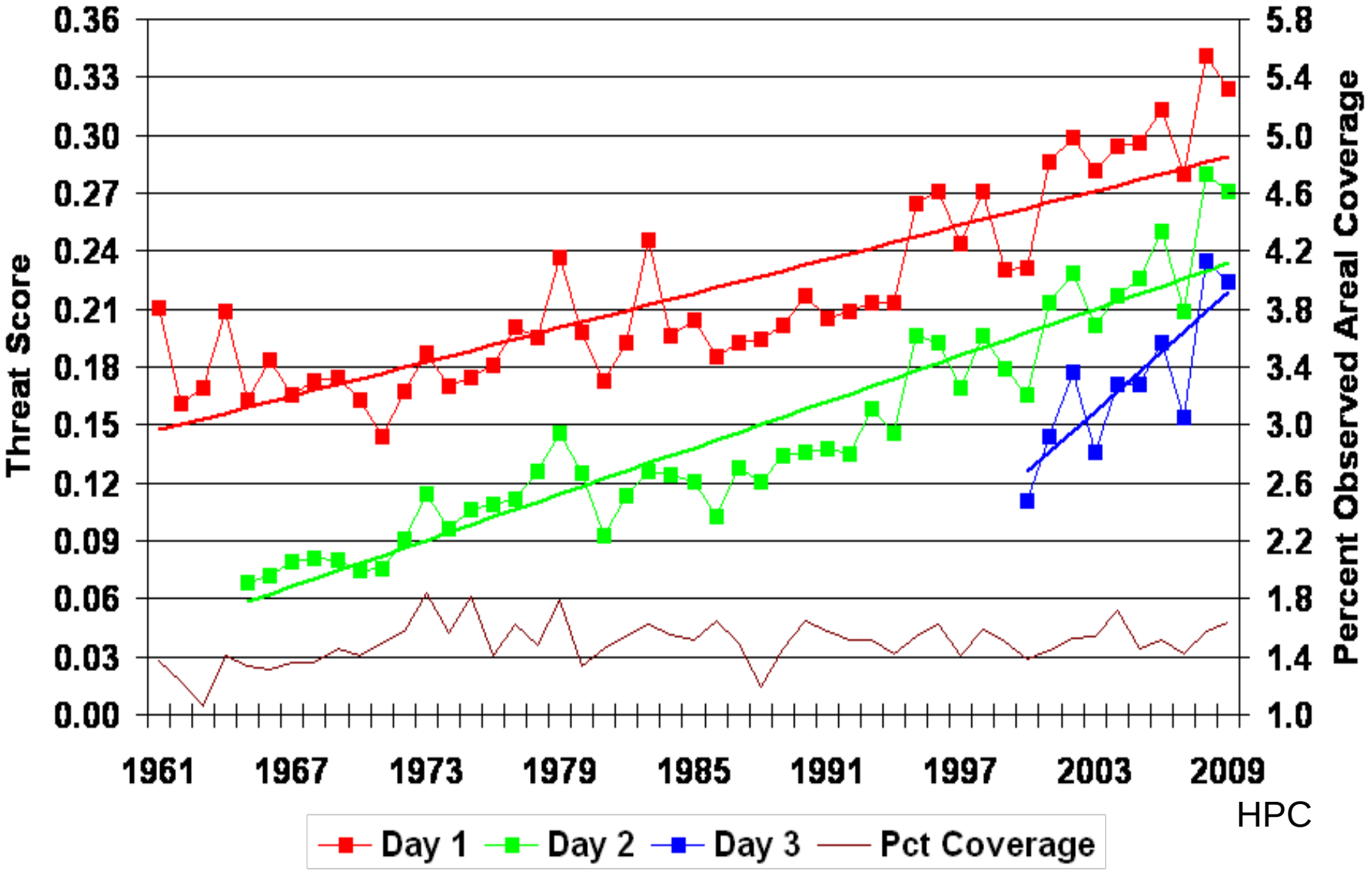
HPC FORECAST OPERATIONS BRANCH MONTHLY RECORD THREAT SCORES
24-HOUR QPF

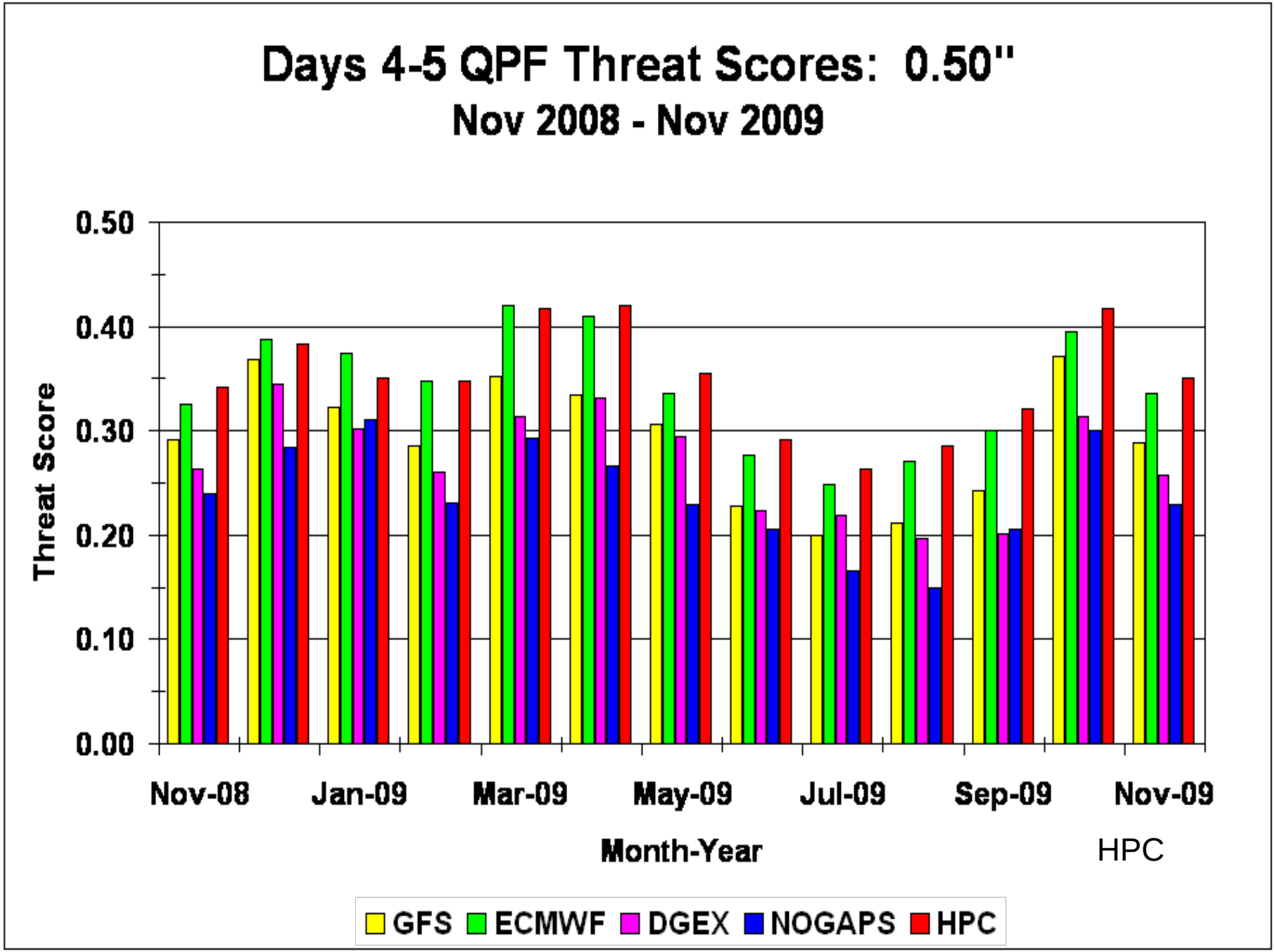
(*NUMBERS IN BOLD ARE ALL TIME RECORDS FOR THAT CATEGORY*) *Statistics updated January 6, 2010*

Alltime Records

Day 1	**0.50**	0.597	(Dec 02)
	1.00	0.504	***(Dec 09)***
	2.00	0.491	(Sep 08)
	3.00	0.448	(Sep 04)
Update	**0.50**	0.557	(Dec 02)
	1.00	0.463	***(Dec 09)***
	2.00	0.512	***(Jan 09)***
Day 2	**0.50**	0.507	(Dec 02)
	1.00	0.435	***(Dec 09)***
Day 3	**0.50**	0.437	***(Dec 09)***
	1.00	0.421	***(Jan 09)***

HPC


Annual HPC Threat Scores: 1.00 Inch
Day 1 / Day 2 / Day 3
Threat Score
0.36
0.33
0.30
0.27
0.24
0.21
0.18
0.15
0.12
0.09
0.06
0.03
0.00
Percent Observed Areal Coverage
5.8
5.4
5.0
4.6
4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
1961
1967
1973
1979
1985
1991
1997
2003
2009
HPC
Day 1
Day 2
Day 3
Pct Coverage


Days 4-5 QPF Threat Scores: 0.50"
Nov 2008 - Nov 2009
Threat Score
0.50
0.40
0.30
0.20
0.10
0.00
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Month-Year
HPC
GFS
ECMWF
DGEX
NOGAPS
HPC