Overview of the Back-to-back, Double dipping, Multi-Year La Niña of 2010/11 to 2011/12

Michelle L'Heureux
NOAA Climate Prediction Center

Outline

I. Recent Multi-year La Niña Sea Surface Temperatures (SST) compared with the Historical Record

II. N. Hemisphere Summer Anomalies in 2011

III. N. Hemisphere Winter Anomalies in 2011-12

Second half (Tony Barnston) will cover the ENSO forecasts in more detail.

A "Multi-year La Niña" is defined by whether two consecutive NDJs are less than or equal to -0.5C in Niño-3.4 (also known as the ONI).

Classification of La Niña is based on a de-trended Niño-3.4 index (ERSST.v3b data).

In the 1950-2012 record:

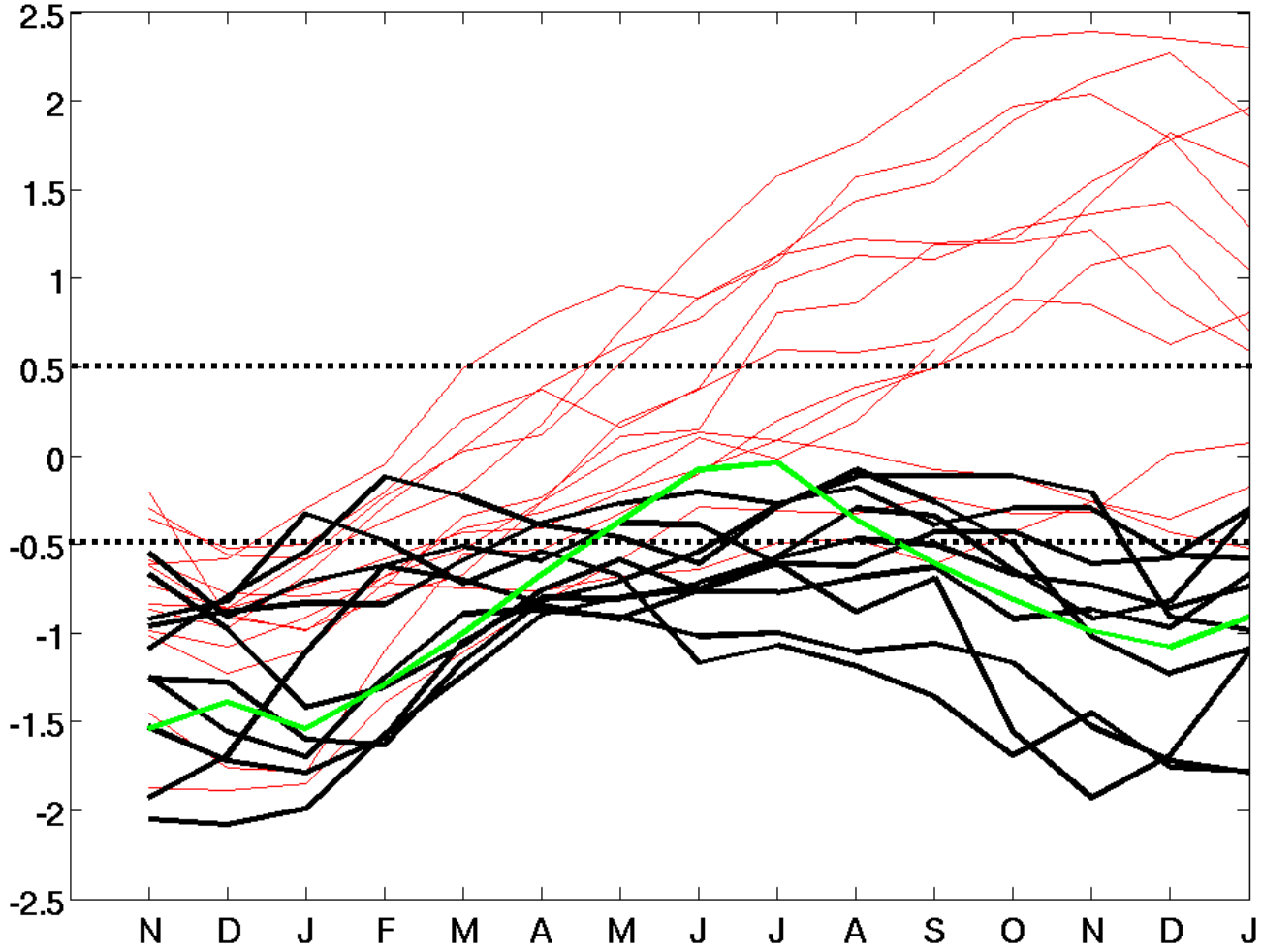
There have been 11 Multi-year La Niña events. 2011 is the 11th such event.

Five of these years occur before 1980. Six of these years occur after 1980.

"Pre-1980" includes NDJ 1954/55 to NDJ 1955/56,
NDJ 1955/56 to NDJ 1956/57
NDJ 1970/71 to NDJ 1971/72
NDJ 1973/74 to NDJ 1974/75
NDJ 1974/75 to NDJ 1975/76

"Post-1980" includes NDJ 1983/84 to NDJ 1984/85
NDJ 1995/96 to NDJ 1996/97
NDJ 1998/99 to NDJ 1999/00
NDJ 1999/00 to NDJ 2000/01
NDJ 2007/08 to NDJ 2008/09
NDJ 2010/11 to NDJ 2011/12 (excluding this recent event from sample)

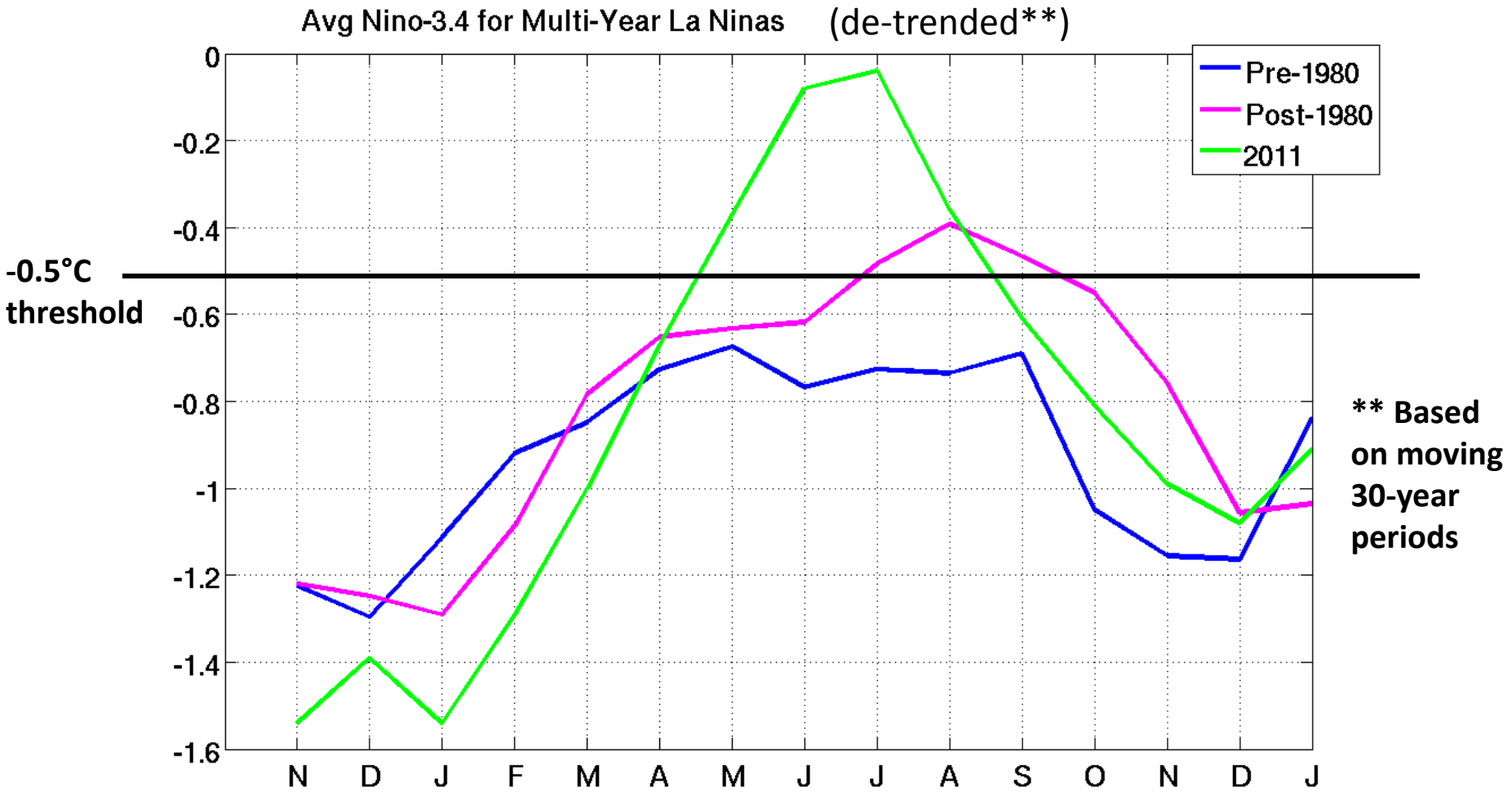
Evolution of Monthly Niño-3.4 values after La Niña events (defined by the first NDJ)



Black Lines are “Multi-Year La Niñas”

Red Lines are where the first winter (NDJ) qualified as La Niña but the following winter (second NDJ) did not

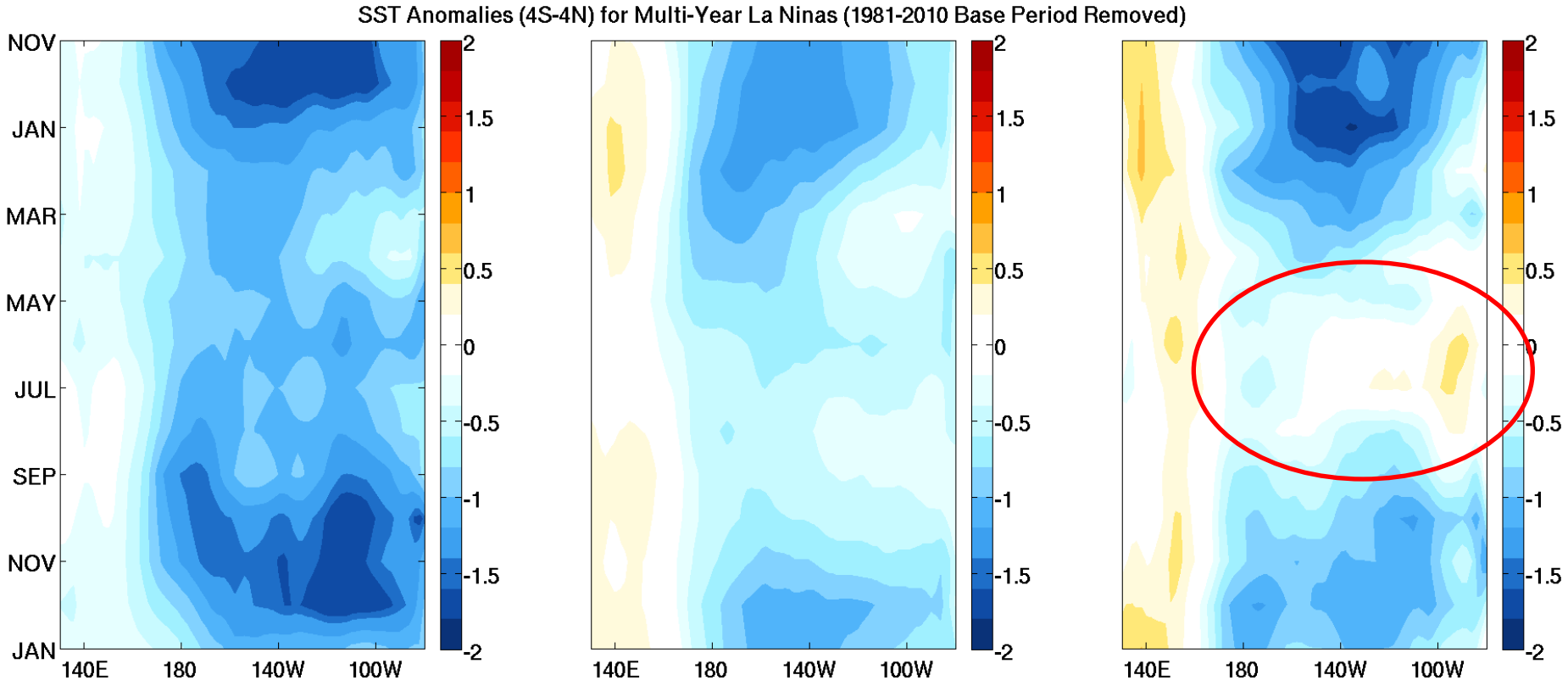
Green Line is NDJ 2010/11 to NDJ 2011/12



Post-1980 La Niña events – on average – return briefly to Neutral during July-September, whereas Pre-1980 La Niña events did not. However, the difference between the blue/pink lines is not statistically significant.

The most recent event (NDJ 2010/11 to NDJ 2011/12) returned to Neutral during the N. Hemisphere summer and then returned back to La Niña.

Evolution of equatorial Pacific SST anomalies for Multi-Year La Niñas (1981-2010 base period removed)



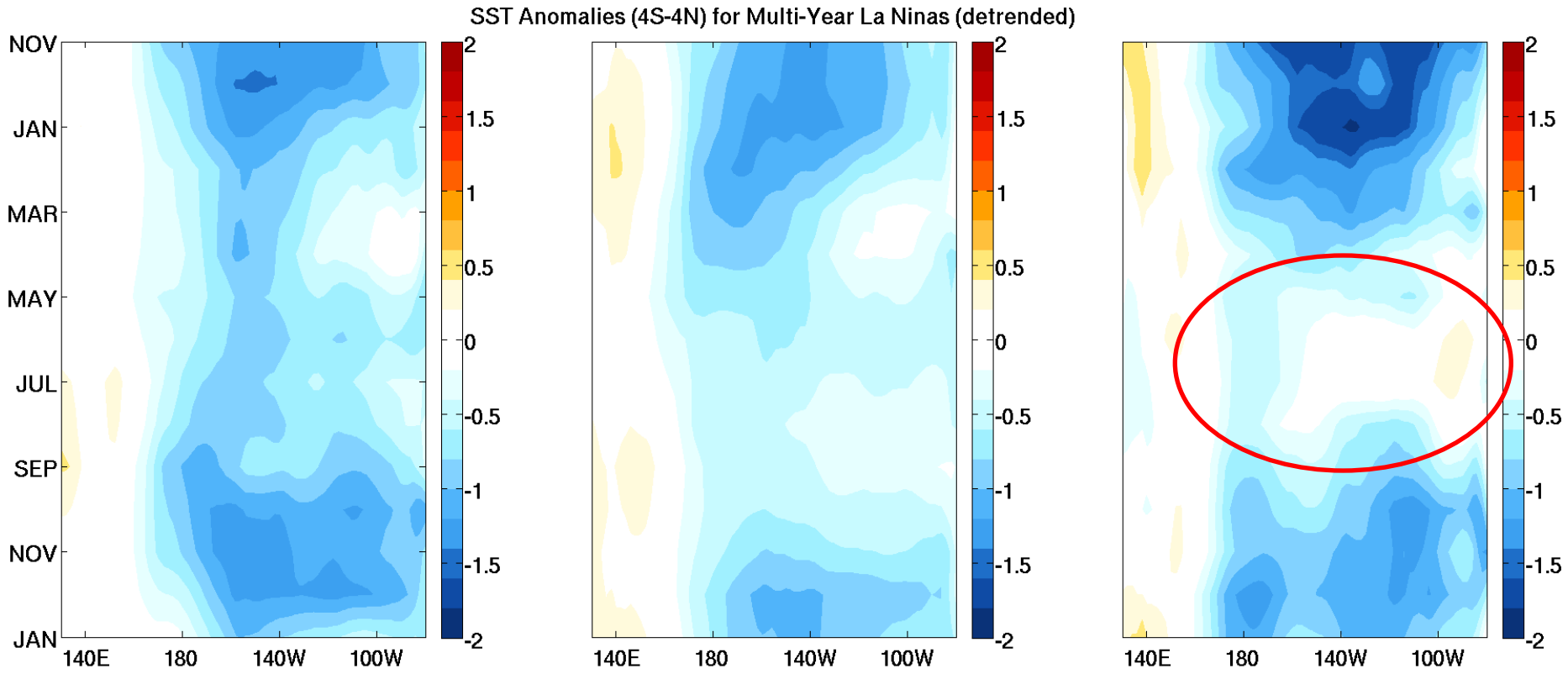
Pre-1980 Multi Year La Niña

Post-1980 Multi Year La Niña

La Niña 2010/11 to 2011/12

Recent Multi-Year La Niña event was associated with warmer SSTs during the intervening summer.

Same plots as previous slide, but here the SST anomaly data is detrended using all available months from 1950-2012.



Pre-1980 Multi Year La Niña

Post-1980 Multi Year La Niña

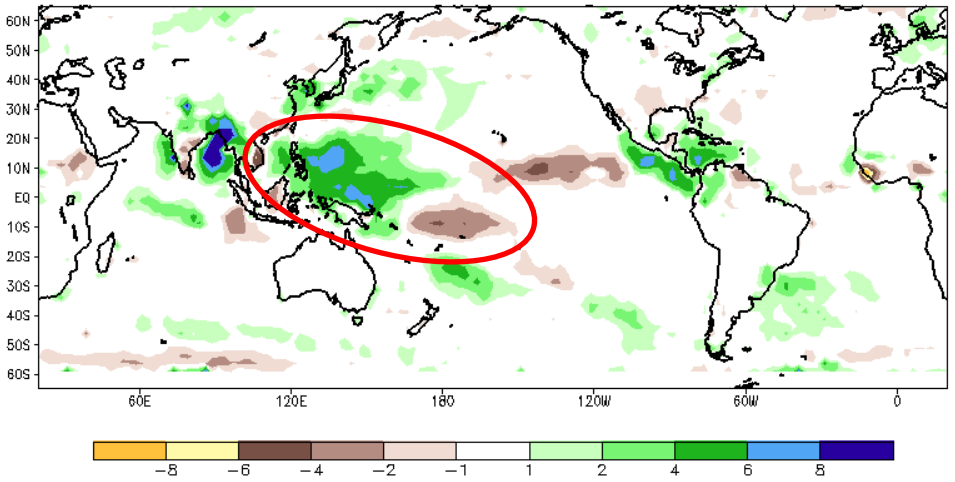
La Niña 2010/11 to 2011/12

The amplitudes change slightly using de-trended SST data, but spatial patterns remain largely the same.

Despite the re-development of ENSO-neutral, we noted in our June, July, & August ENSO Diagnostics Discussions that the atmospheric pattern remained consistent with La Niña….

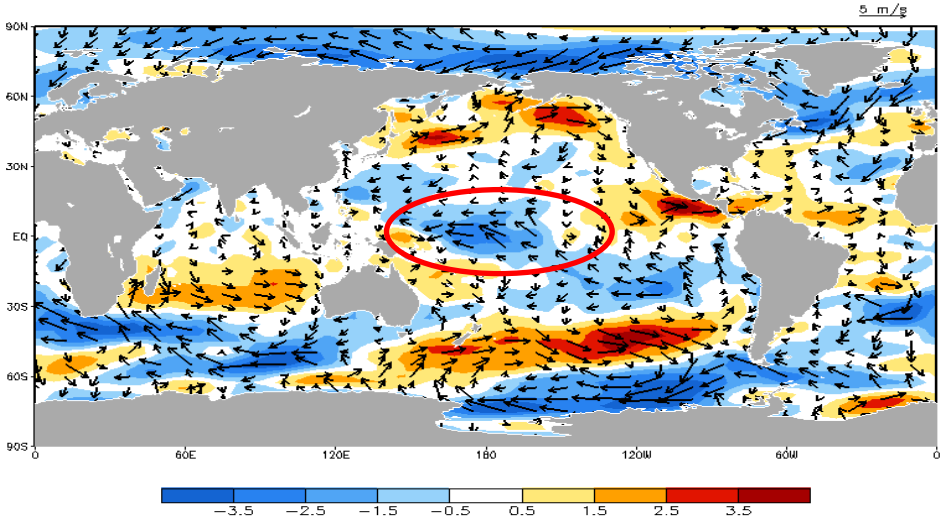
June-July-August (JJA) 2011 Average

Anomalous precipitation (GPCP, 1979-95 base period)



- Convection above average near Papua New Guinea and east of the Philippines, with suppression evident near the Date Line

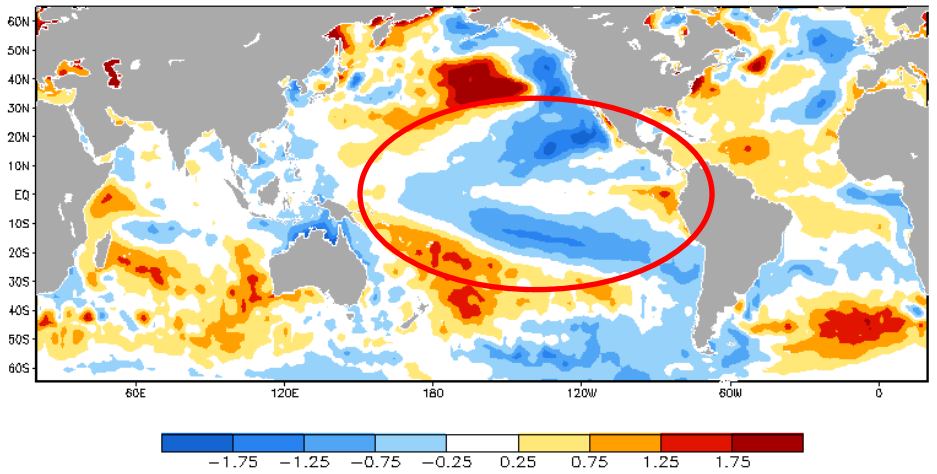
Anomalous 850-hPa winds (vector) and zonal winds (shading)



- Trade winds enhanced near Date Line

Global SST anomalies (1981-2010 base period)

June-July-August (JJA) 2011 Average



- Near average SSTs at equator.
- Strong off-equatorial SSTAs in the subtropical N. and S. Pacific

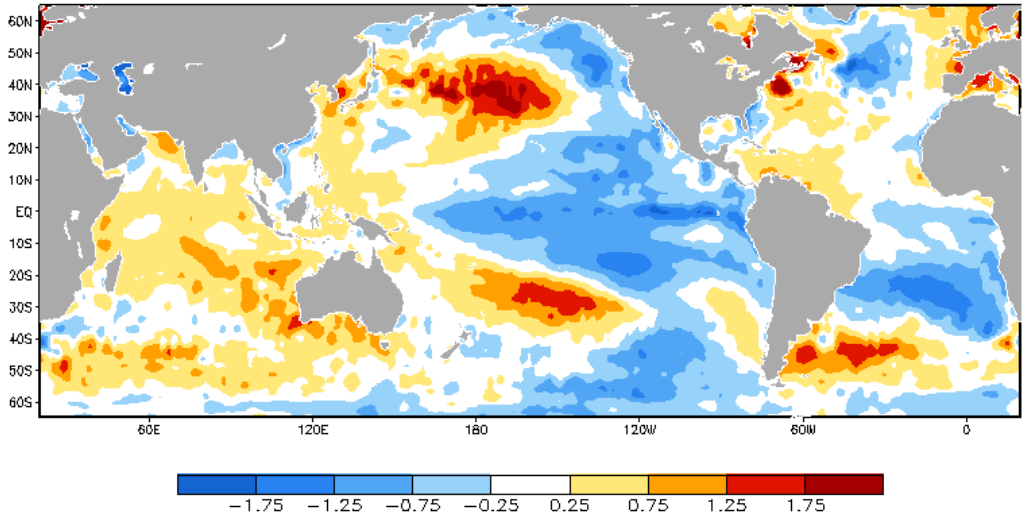
A La Niña Watch was issued on Aug. 4th

-- We were one of the first (if not the first) national agency to declare the return of La Niña on Sept. 8th 2011 after Niño-3.4 dropped below -0.5°C.

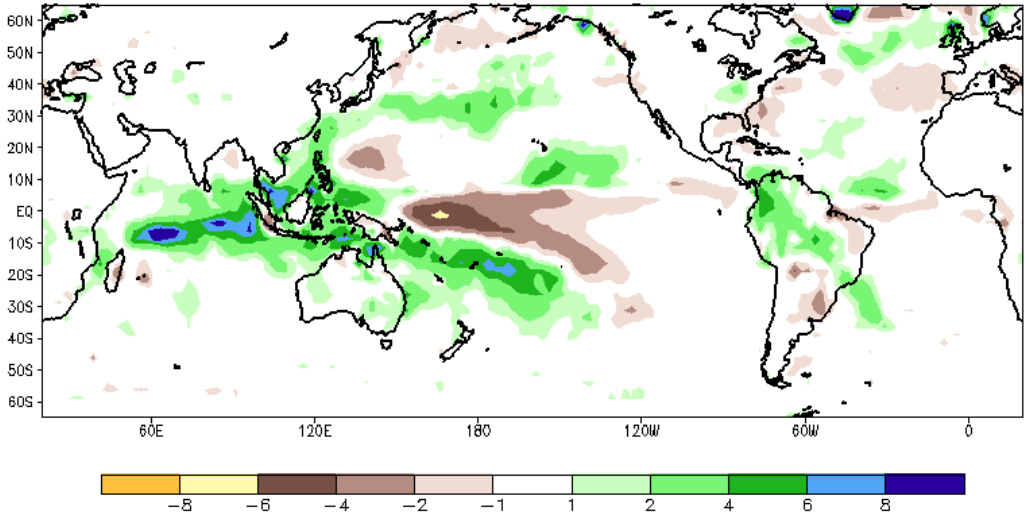
--- We already had La Niña-like atmospheric conditions across the tropical Pacific.

Wintertime (Nov-Jan) 2011/12 La Niña

SST anomalies (OISST, 1981-2010 base period)

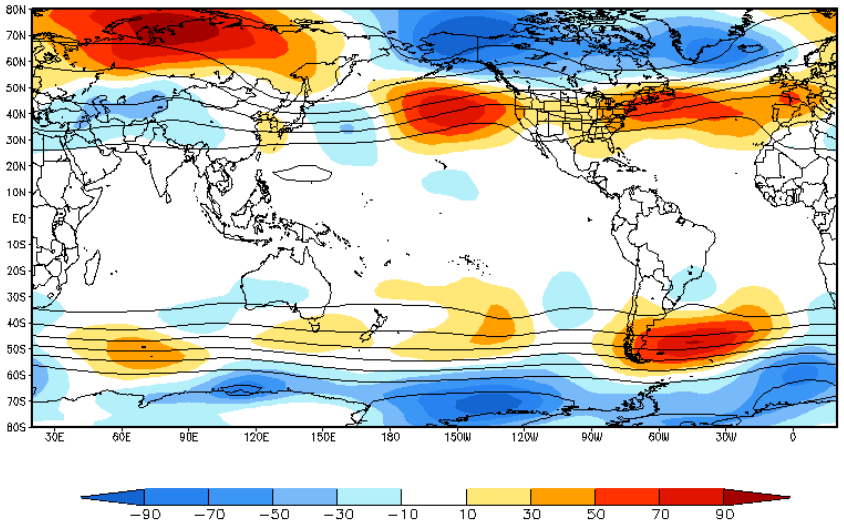


Anomalous precipitation (GPCP, 1979-95 base period)

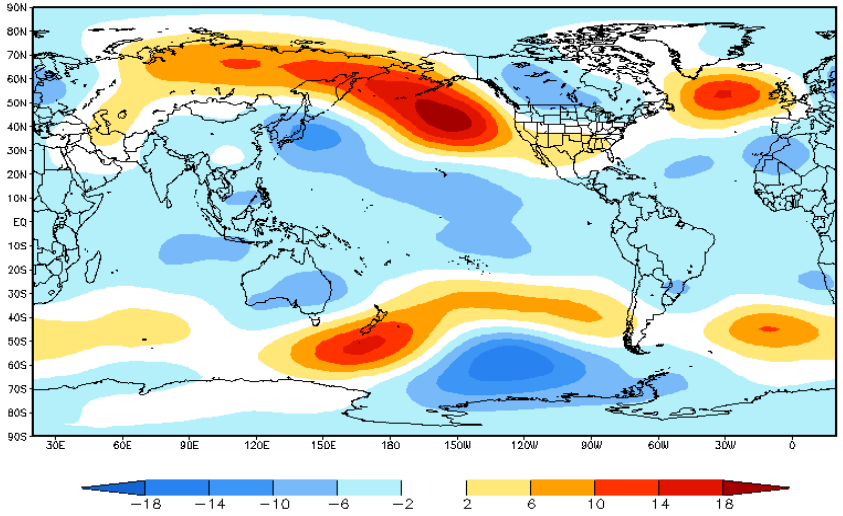


Wintertime (Nov-Jan) 2011/12 La Niña

Observed 500-hPa Geopotential Height anomalies (NCEP/NCAR, 1981-2010 base period)

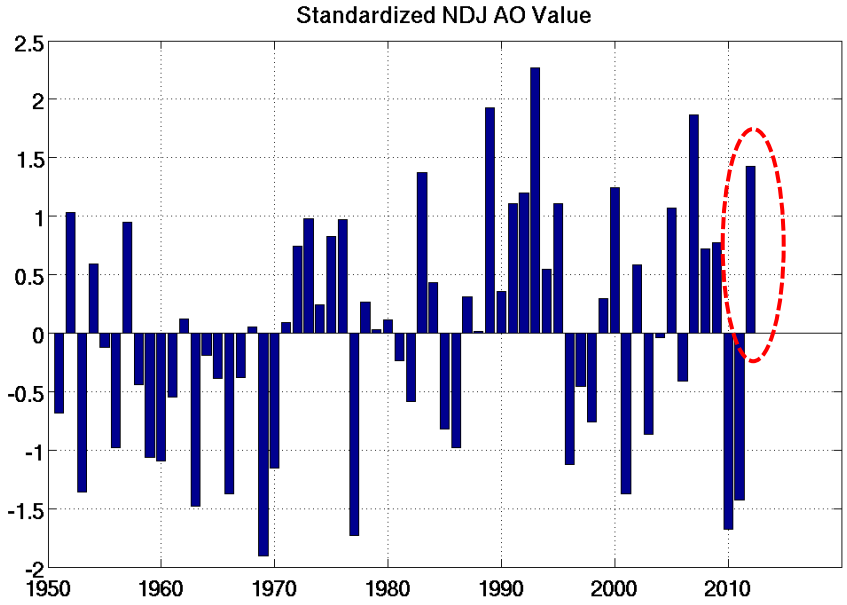


500-hPa Regression onto Niño-3.4 index "Typical La Niña Pattern"



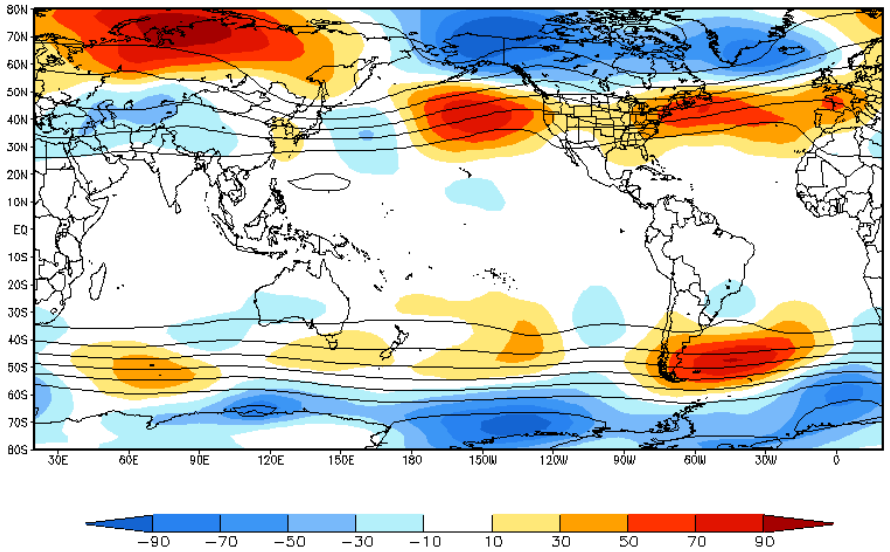
The AO/NAO was strongly positive during NDJ

-- reflected in height pattern over much of N. America/Atlantic

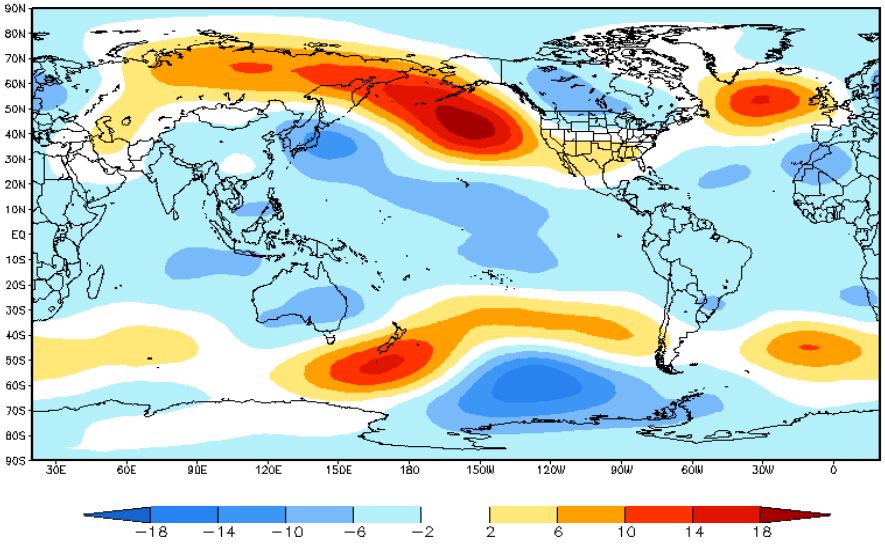


Wintertime (Nov-Jan) 2011/12 La Niña

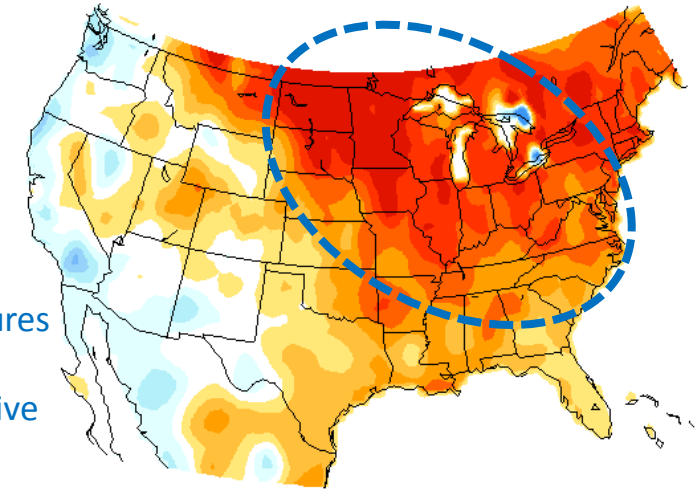
Observed 500-hPa GPH anomalies



“Typical La Niña Pattern”



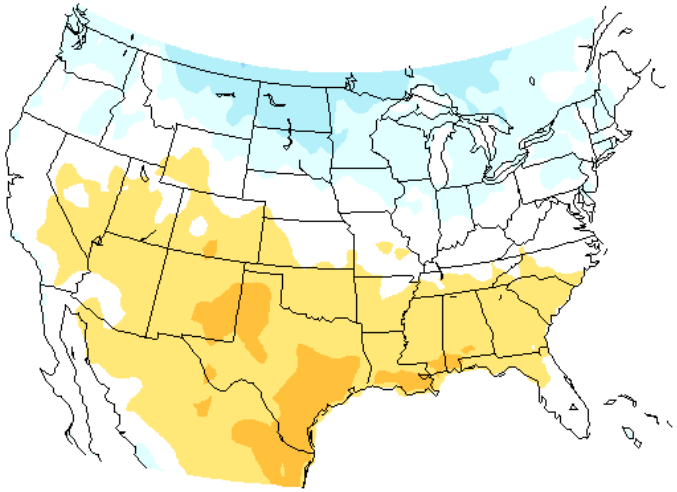
Observed Surface Temperature Anomalies



−3.3 −2.7 −2.1 −1.5 −0.9 −0.3 0.3 0.9 1.5 2.1 2.7 3.3

Above average temperatures consistent with positive AO/NAO

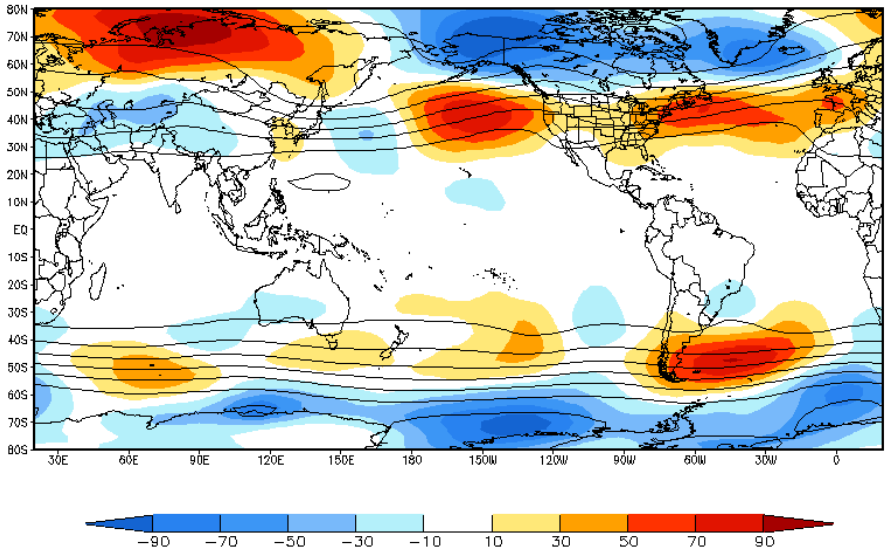
Temperature regression (Niño-3.4)



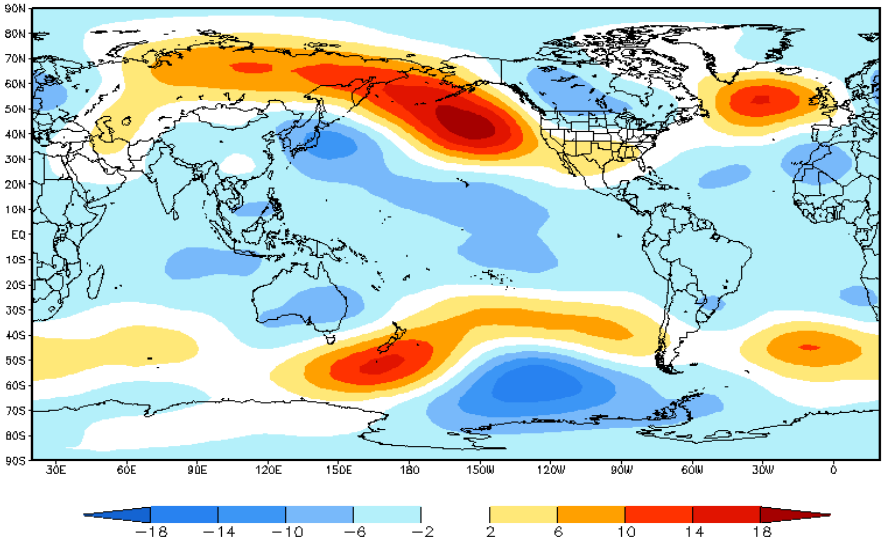
−1.1 −0.9 −0.7 −0.5 −0.3 −0.1 0.1 0.3 0.5 0.7 0.9 1.1

Wintertime (Nov-Jan) 2011/12 La Niña

Observed 500-hPa GPH anomalies

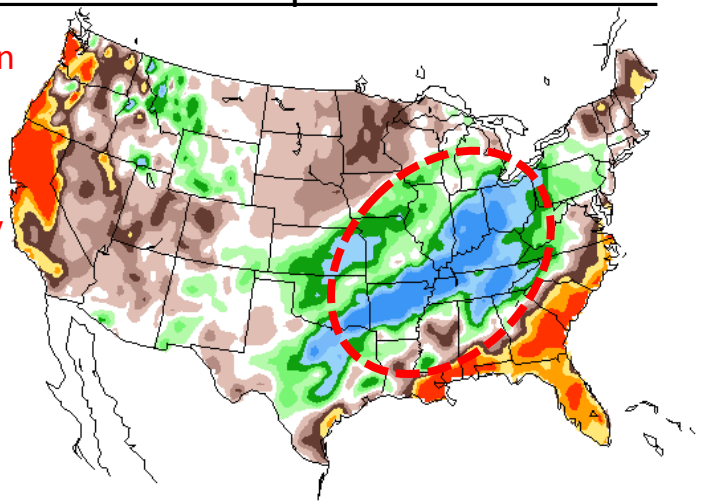


"Typical La Niña Pattern"

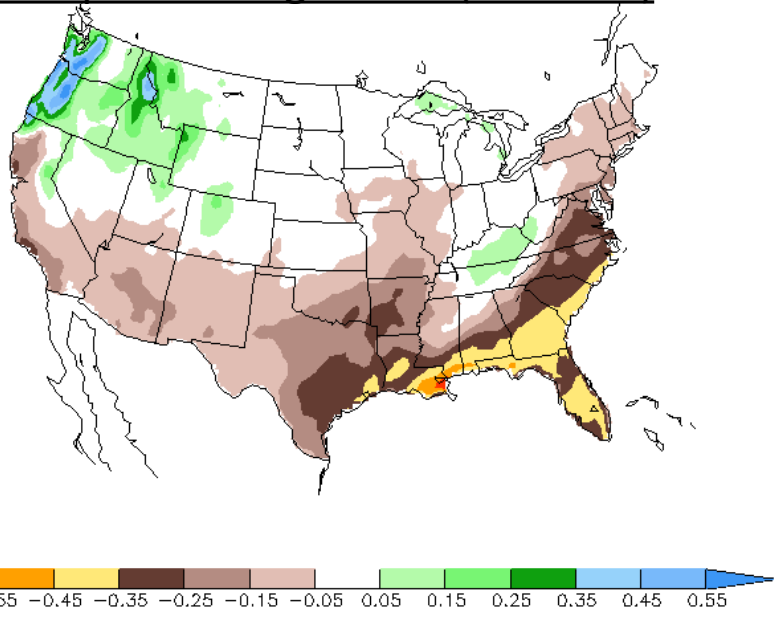


Observed Precipitation Anomalies

Wetter than average conditions over the Tennessee/ Ohio valley consistent with the positive AO/NAO



Precipitation regression (Niño-3.4)



Summary

- Summer 2011:

-- warmest ever during back-to-back La Niña winters, with SSTs returning to Neutral

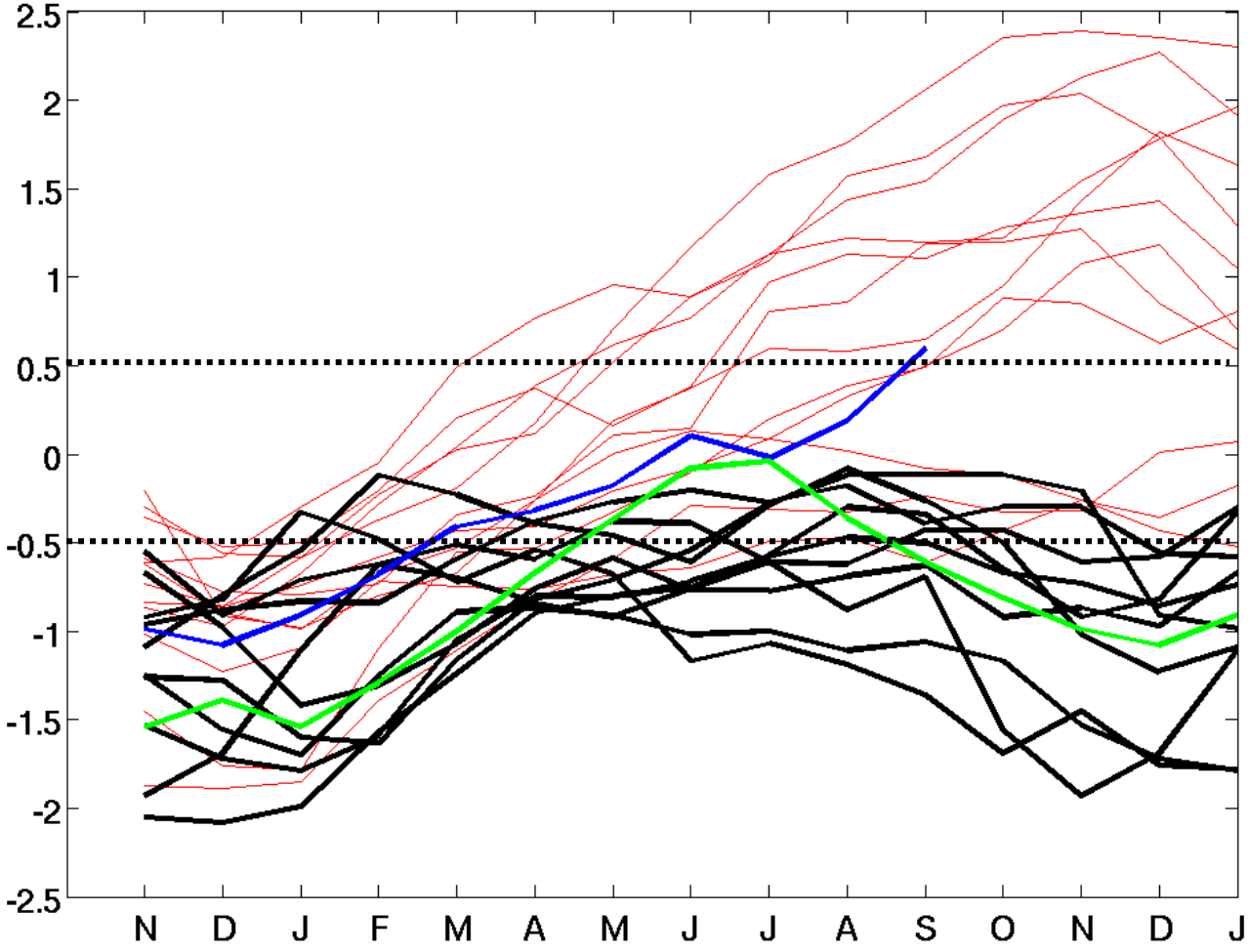
-- ongoing La Niña conditions in the atmosphere over the tropical Indo-Pacific

- Winter 2011-12:

-- La Niña strength (based on the Niño-3.4 index) was in the middle of the pack of La Niñas for all winters in the last ~60 years

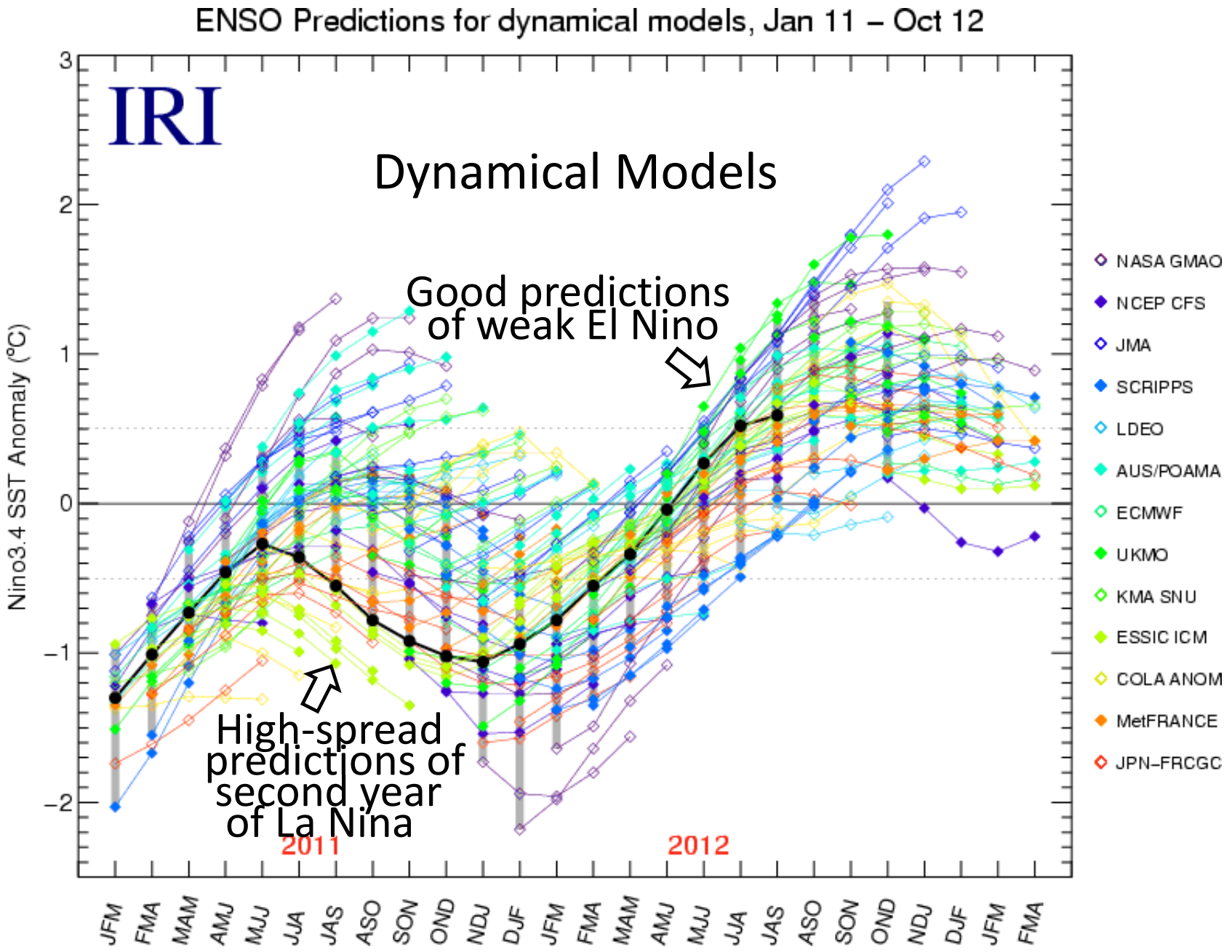
-- U.S. height, temperature, and precipitation anomalies were generally more consistent with the positive Arctic Oscillation/North Atlantic Oscillation than La Niña

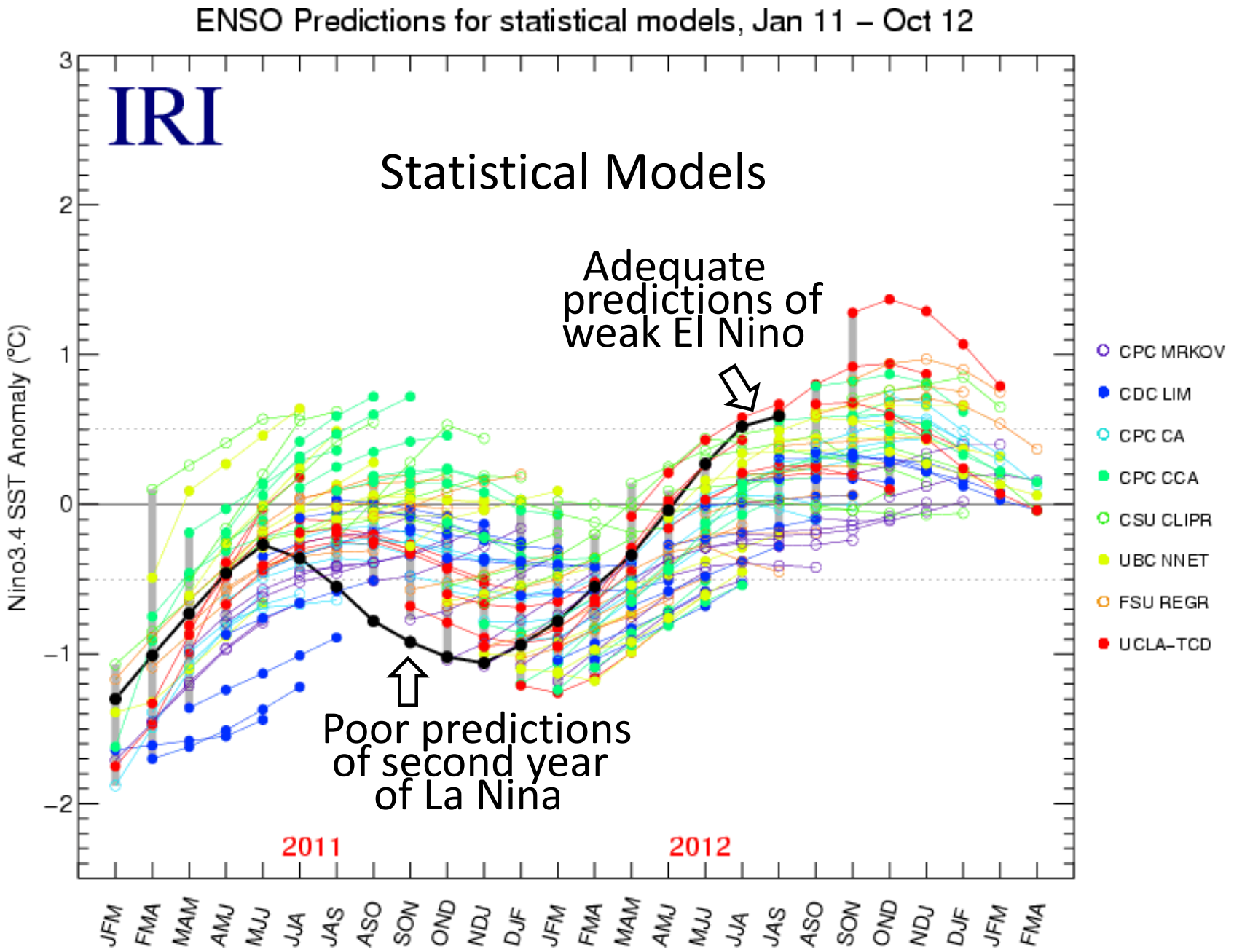
So far in 2012….

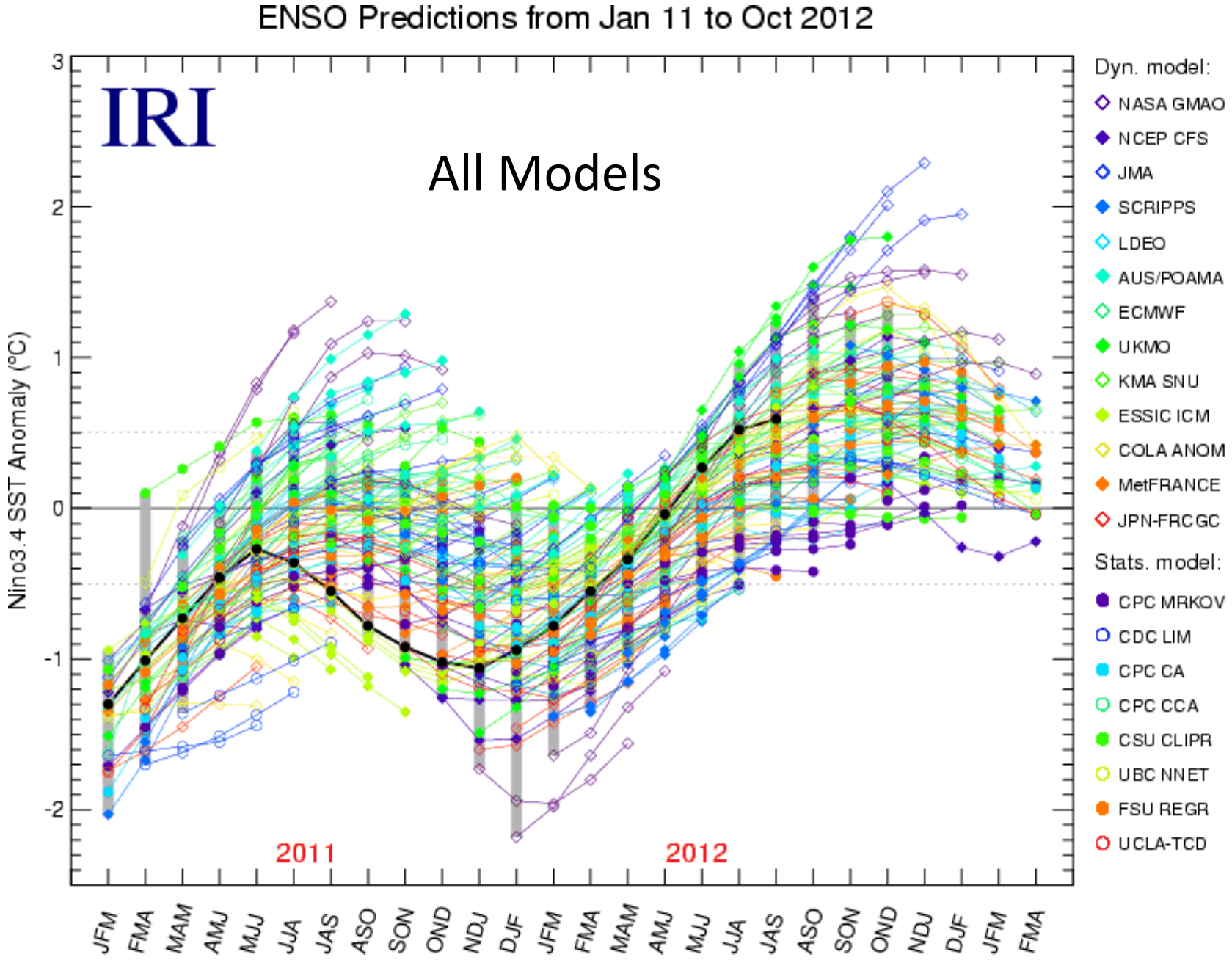


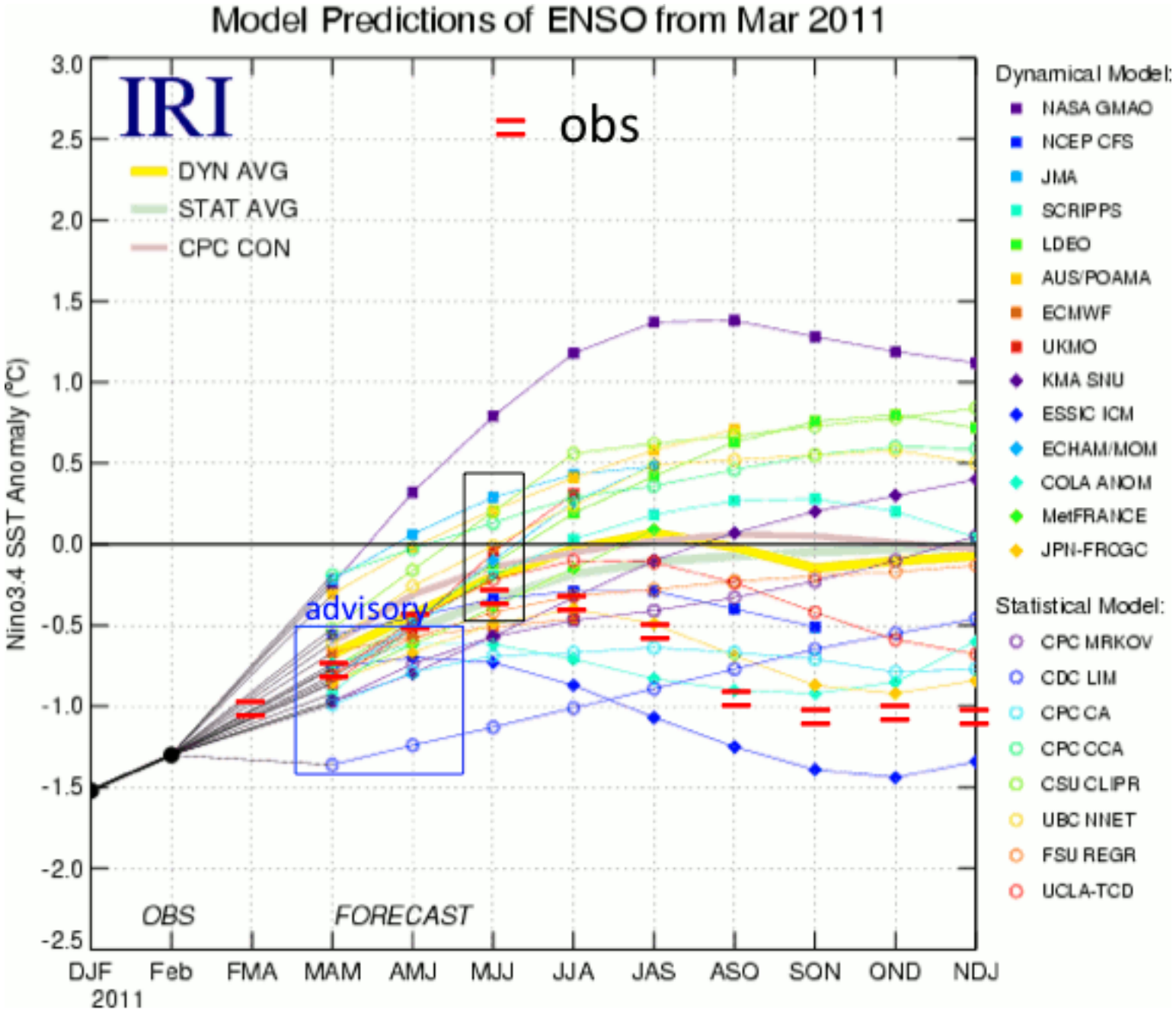
Verification of ENSO forecasts for the 2011-12 ENSO Cycle and Onset of the 2012-13 ENSO Cycle: Plume Forecasts and Official Forecasts

Anthony G. Barnston
IRI, Columbia University, Palisades, NY


ENSO Predictions for dynamical models, Jan 11 – Oct 12
IRI
Dynamical Models
Good predictions of weak El Nino
High-spread predictions of second year of La Nina
2011
2012
Nino3.4 SST Anomaly (°C)
3
2
1
0
−1
−2
JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ DJF JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ DJF JFM FMA
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
COLA ANOM
MetFRANCE
JPN-FRCGC


ENSO Predictions for statistical models, Jan 11 – Oct 12
IRI
Statistical Models
Adequate predictions of weak El Nino
Poor predictions of second year of La Nina
Nino3.4 SST Anomaly (°C)
3
2
1
0
−1
−2
2011
2012
JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ DJF JFM FMA MAM AMJ MJJ JJA JAS ASO SON OND NDJ DJF JFM FMA
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA–TCD

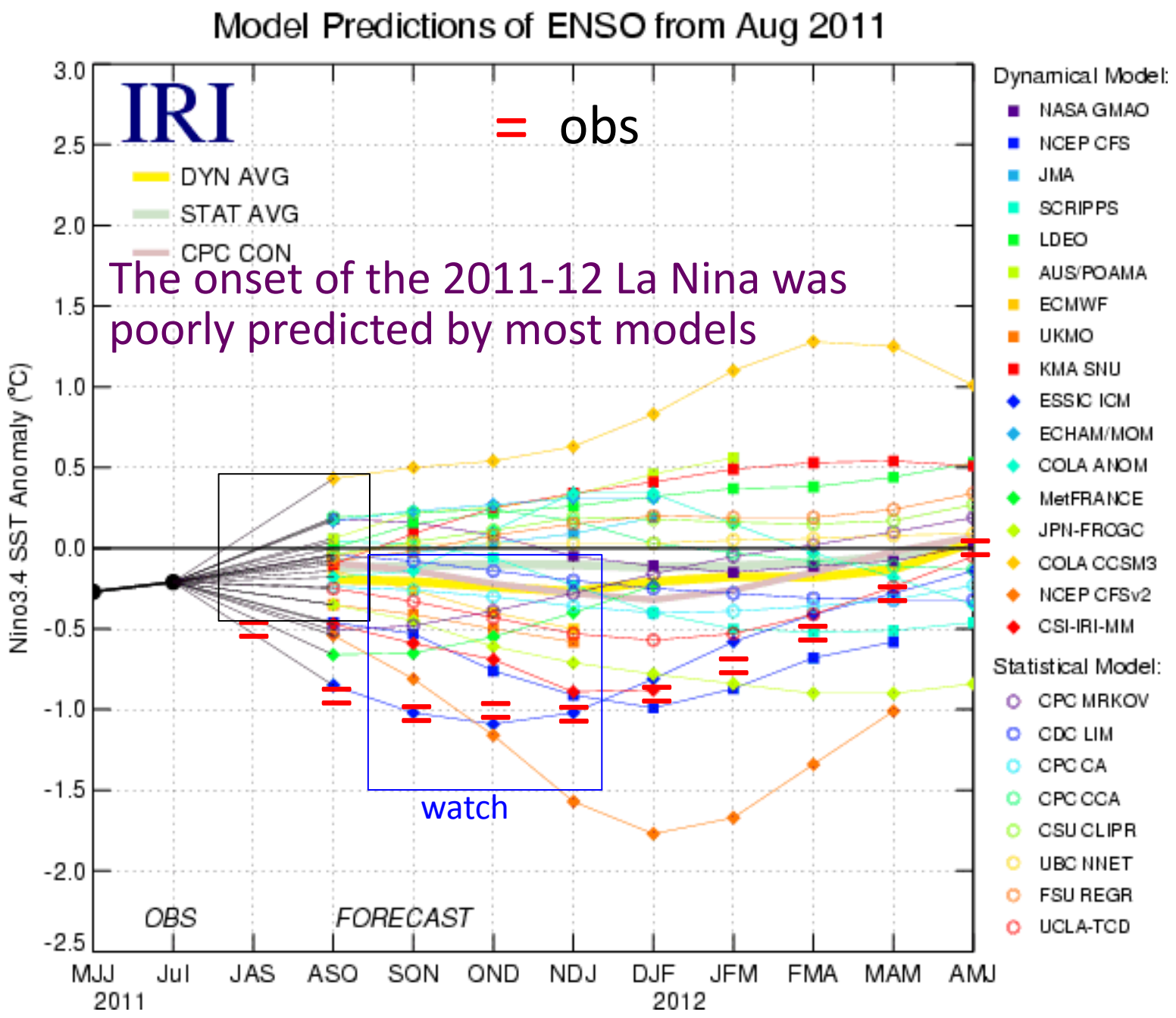

ENSO Predictions from Jan 11 to Oct 2012
IRI
All Models
Nino3.4 SST Anomaly (°C)
3
2
1
0
-1
-2
2011
2012
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
Dyn. model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
COLA ANOM
MetFRANCE
JPN-FRCGC
Stats. model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

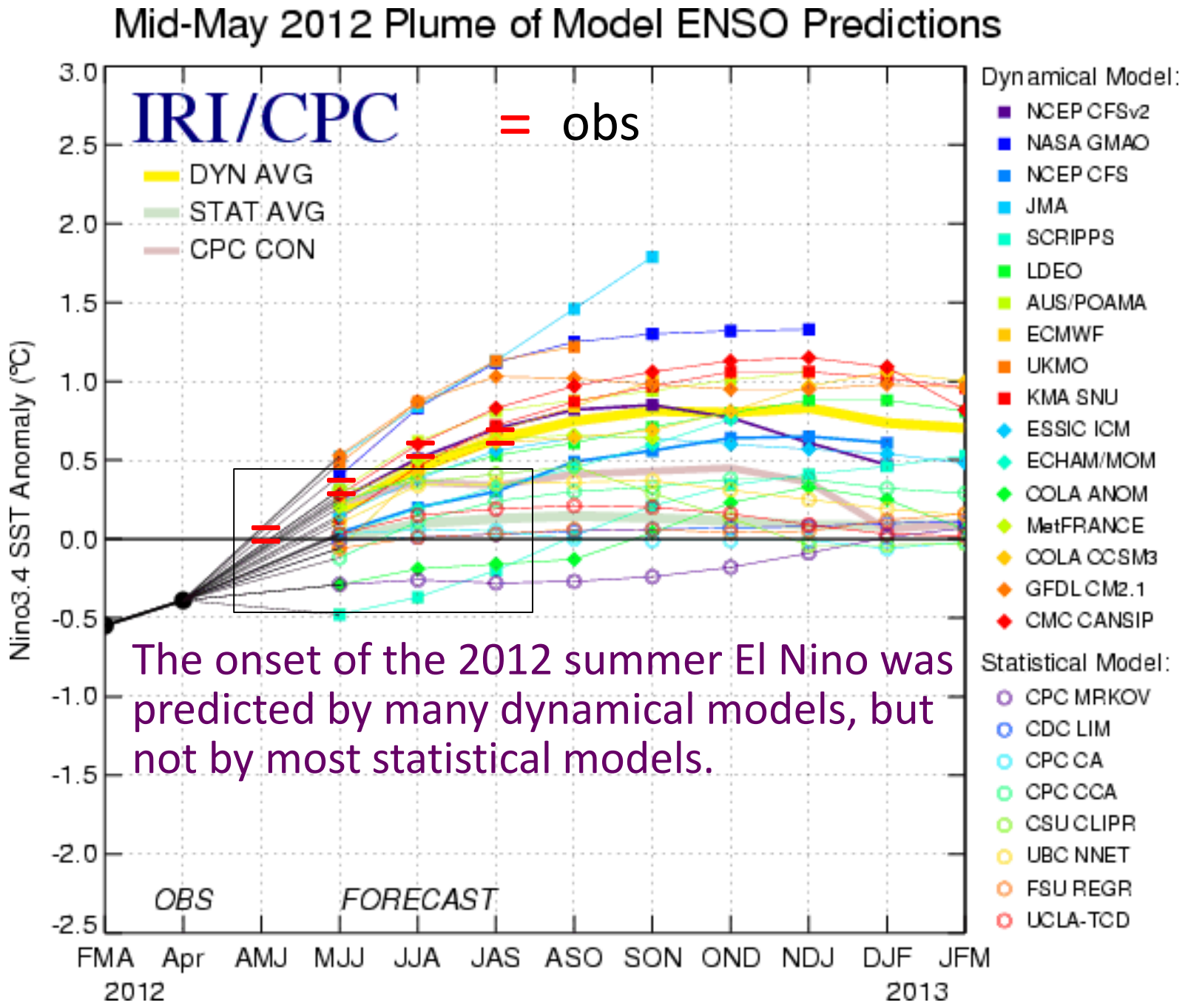

Model Predictions of ENSO from Mar 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
advisory
OBS
FORECAST
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
DJF
2011
Feb
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

Two most difficult ENSO prediction start times during the 2011-12 study period:

(1) August 2011 (“Is a second La Nina starting?”)

(2) May 2012 (“Is an El Nino about to begin, or not?”)


Model Predictions of ENSO from Aug 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
The onset of the 2011-12 La Nina was poorly predicted by most models
watch
OBS
FORECAST
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
MJJ
Jul
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
NCEP CFSv2
CSI-IRI-MM
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-May 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
FMA
Apr
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD
The onset of the 2012 summer El Nino was predicted by many dynamical models, but not by most statistical models.

Verification: LEAD 0 mon

2011 Starts

Dat	CPC	Con	Dyn	Stat
Jan				
Feb				
Mar	ok	ok	ok	ok
Apr	ok	ok	ok	ok
May	ok	ok	ok	ok
Jun	ok	ok	ok	ok
Jul	F	F	F	F
Aug	F	F	F	F
Sep	ok	ok	F	F
Oct	ok	ok	ok	F
Nov	ok	ok	ok	ok
Dec	ok	ok	ok	ok

2012 Starts

Dat	CPC	Con	Dyn	Stat
Jan	ok	ok	ok	ok
Feb	ok	ok	ok	ok
Mar	ok	ok	ok	ok
Apr	ok	ok	ok	ok
May	ok	ok	ok	ok
Jun	ok	ok	ok	F
Jul	ok	ok	ok	ok
Aug				
Sep				
Oct				
%	.88	.88	.80	.67

Verification: LEAD 2 mon

2011 Starts					2012 Starts				
Dat	**CPC**	**Con**	**Dyn**	**Stat**	**Dat**	**CPC**	**Con**	**Dyn**	**Stat**
Jan					Jan		ok	ok	ok
Feb					Feb	ok	ok	ok	**F**
Mar	ok	ok	ok	ok	Mar		ok	ok	ok
Apr		ok	ok	ok	Apr		**F**	ok	**F**
May	**F**	**F**	**F**	**F**	May	**F**	ok	ok	**F**
Jun		**F**	**F**	**F**	Jun				
Jul		**F**	**F**	**F**	Jul				
Aug	ok	**F**	**F**	**F**	Aug				
Sep	ok	ok	**F**	**F**	Sep				
Oct	ok	ok	ok	ok	Oct				
Nov	ok	ok	ok	ok					
Dec		ok	ok	ok	**%**	**.75 (.63)**	**.67**	**.67**	**.47**

Conclusions

Two northern spring predictability barriers challenged the models during 2011-2012:

(1) April – August 2011, following a significant La Nina

(2) April – June 2012, following a second (weaker) La Nina

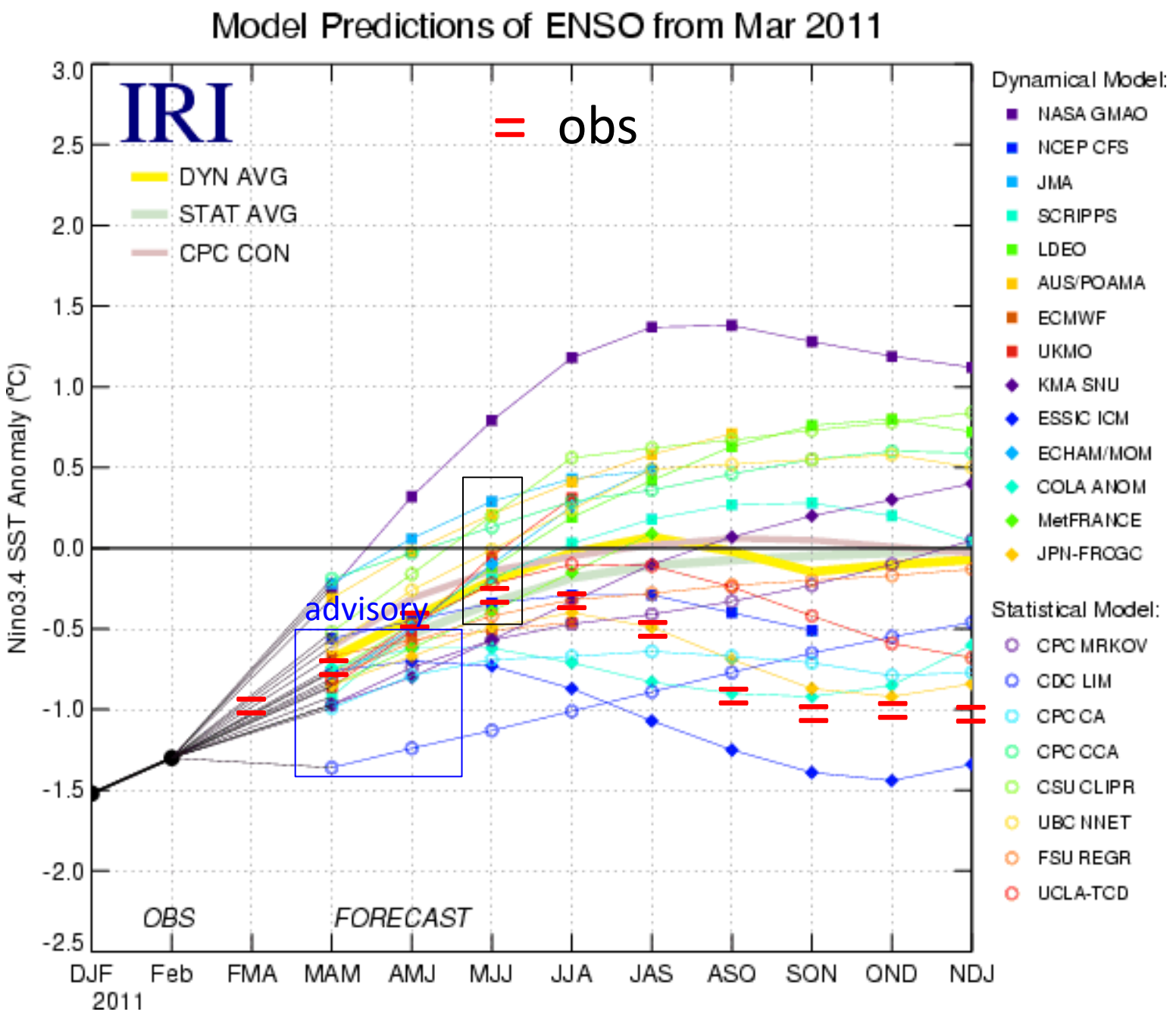
(1) In northern spring 2011, the CPC consolidation (regression from 4 models) and the CPC's ENSO outlook verified better than the dynamical dynamical models alone, and the dynamical models alone verified better than the statistical models alone. **The second La Nina year snuck up on all, but was missed to greatest degree by the statistical models.**

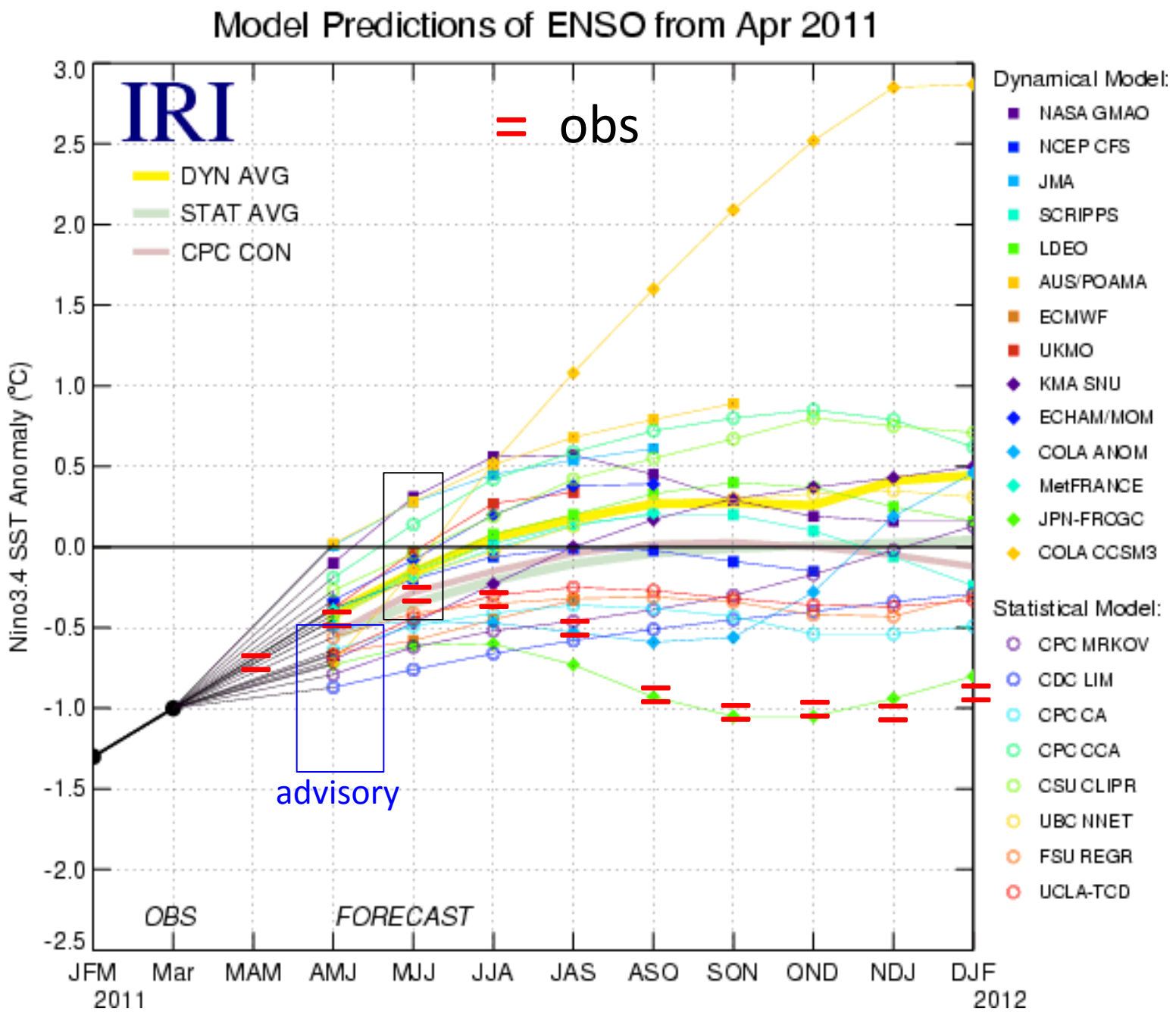
(2) In northern spring 2012, the statistical models were least forthcoming regarding development of El Nino. But whether the weak summer El Nino will last into autumn is doubtful.

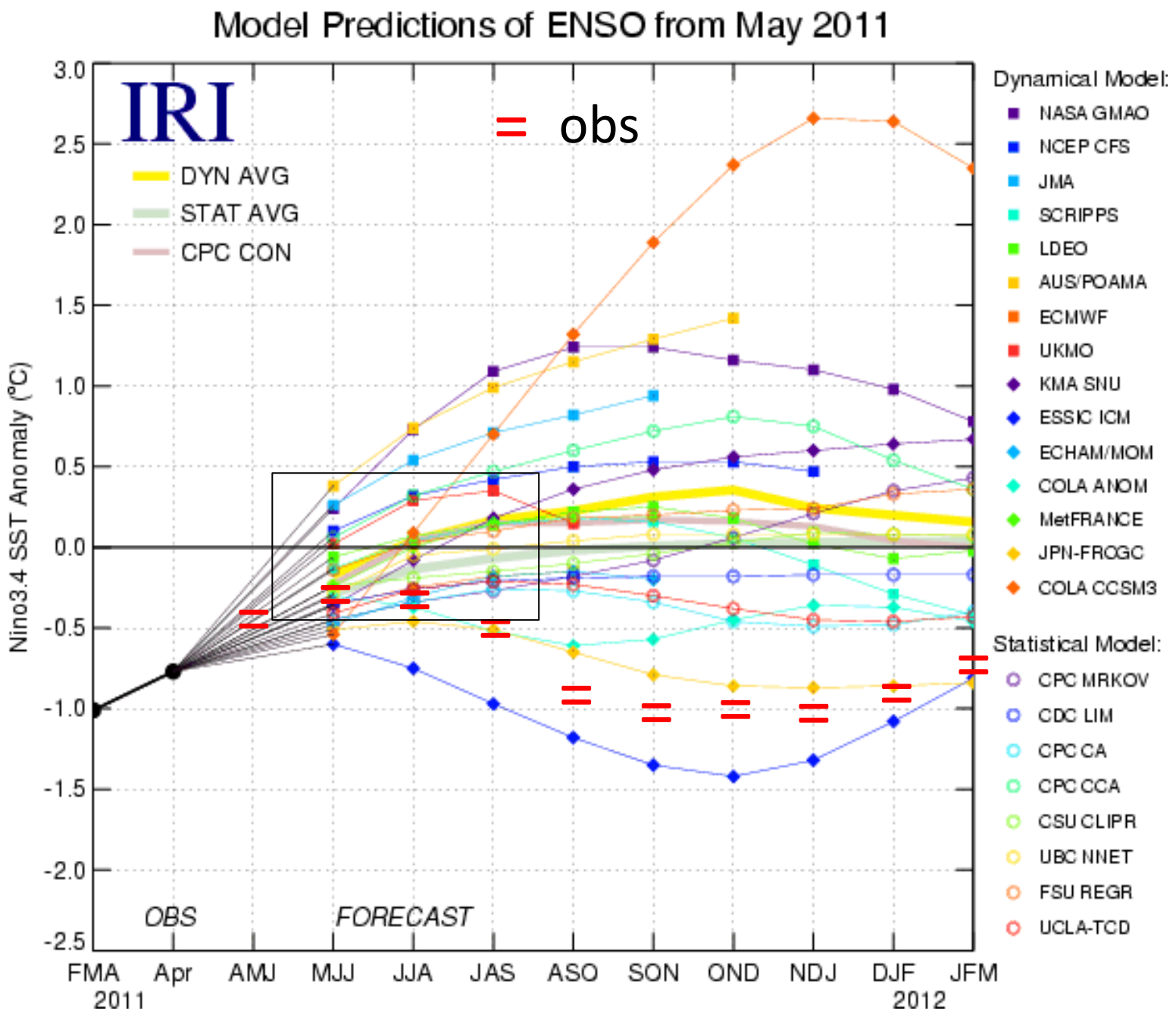
Conclusions

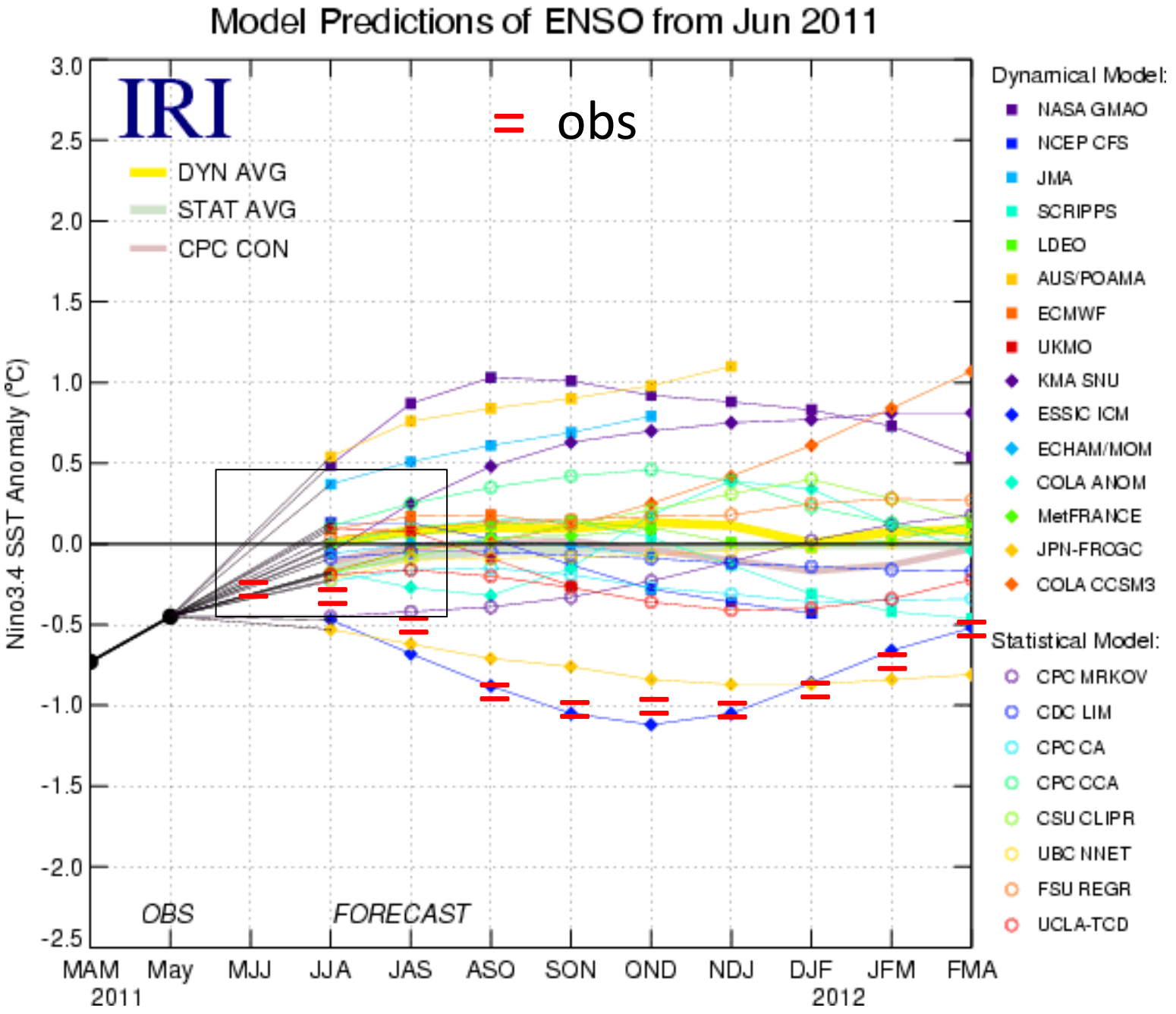
Overall, the CPC's ENSO outlooks verified better than the three objective model systems examined here, but no 2-month (or longer) lead forecasts were issued in 7 out of the 15 verifiable start times except to express large uncertainty and fairly vague expectations regarding deviations from climatological probabilities. In those cases, the model systems were most likely to fail.

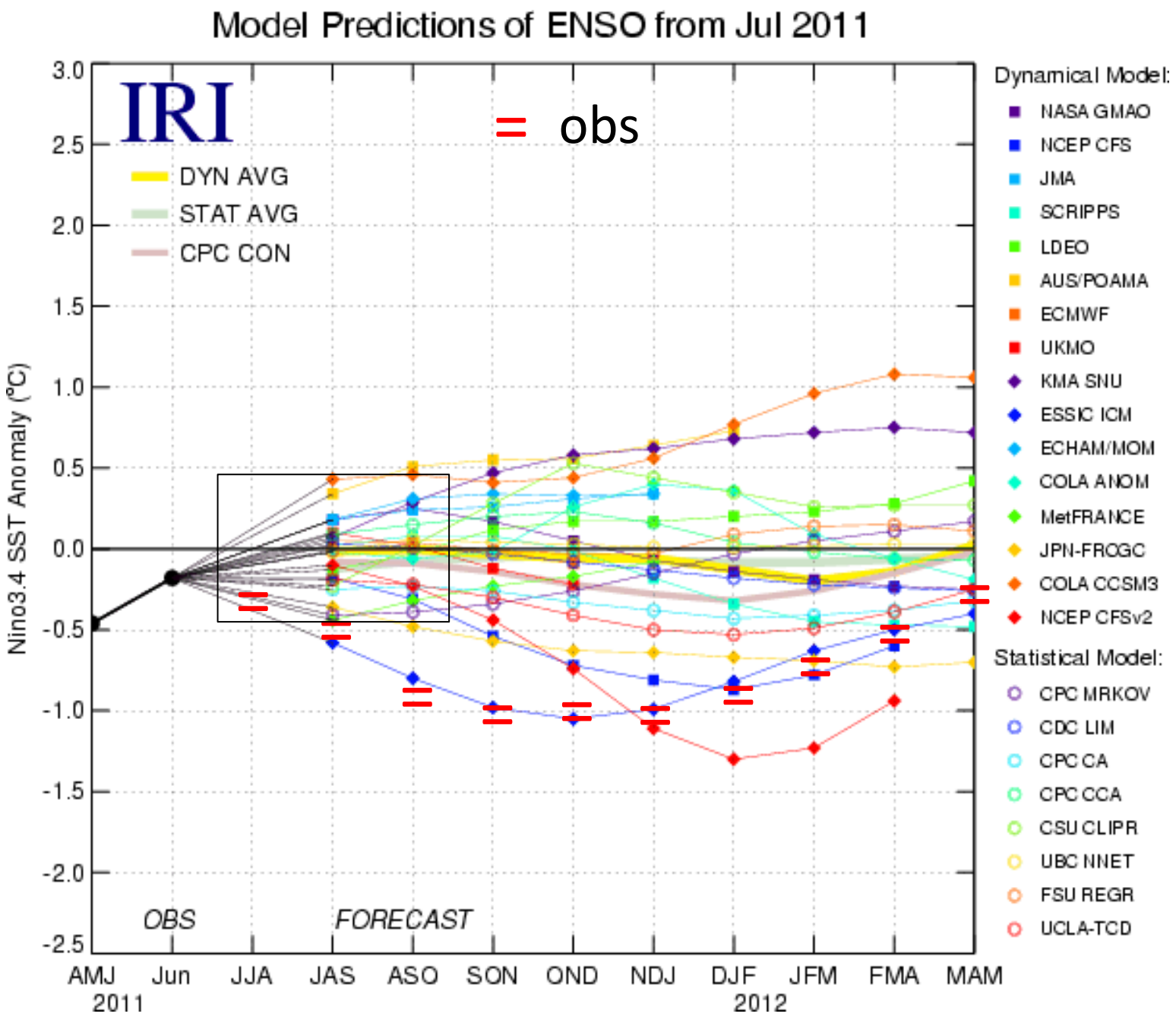
Individual plume predictions as shown in the preceding animation follow.

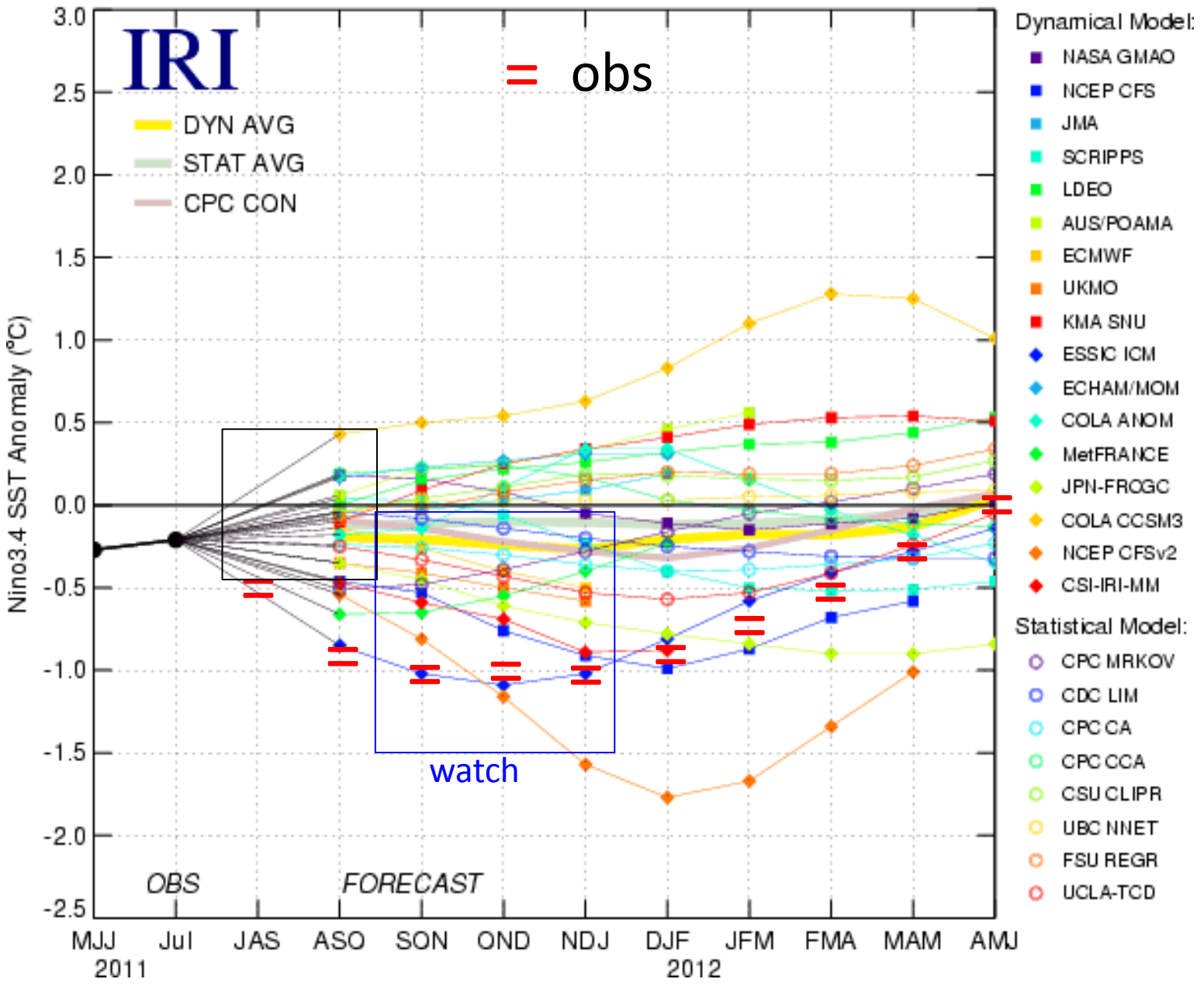

Model Predictions of ENSO from Mar 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
advisory
OBS
FORECAST
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
DJF
2011
Feb
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FROGC
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

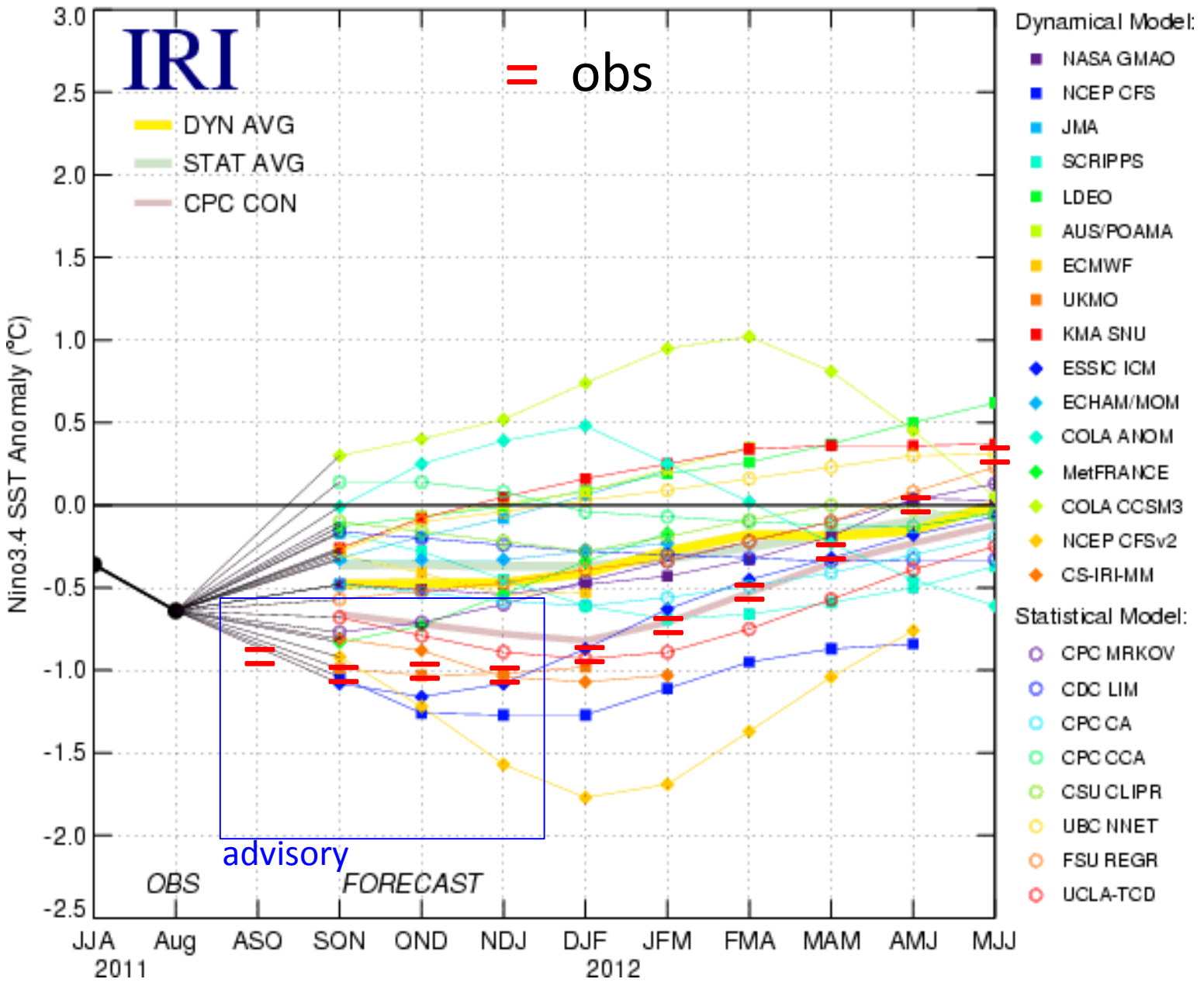

Model Predictions of ENSO from Apr 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
JFM
2011
Mar
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FROGC
COLA CCSM3
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

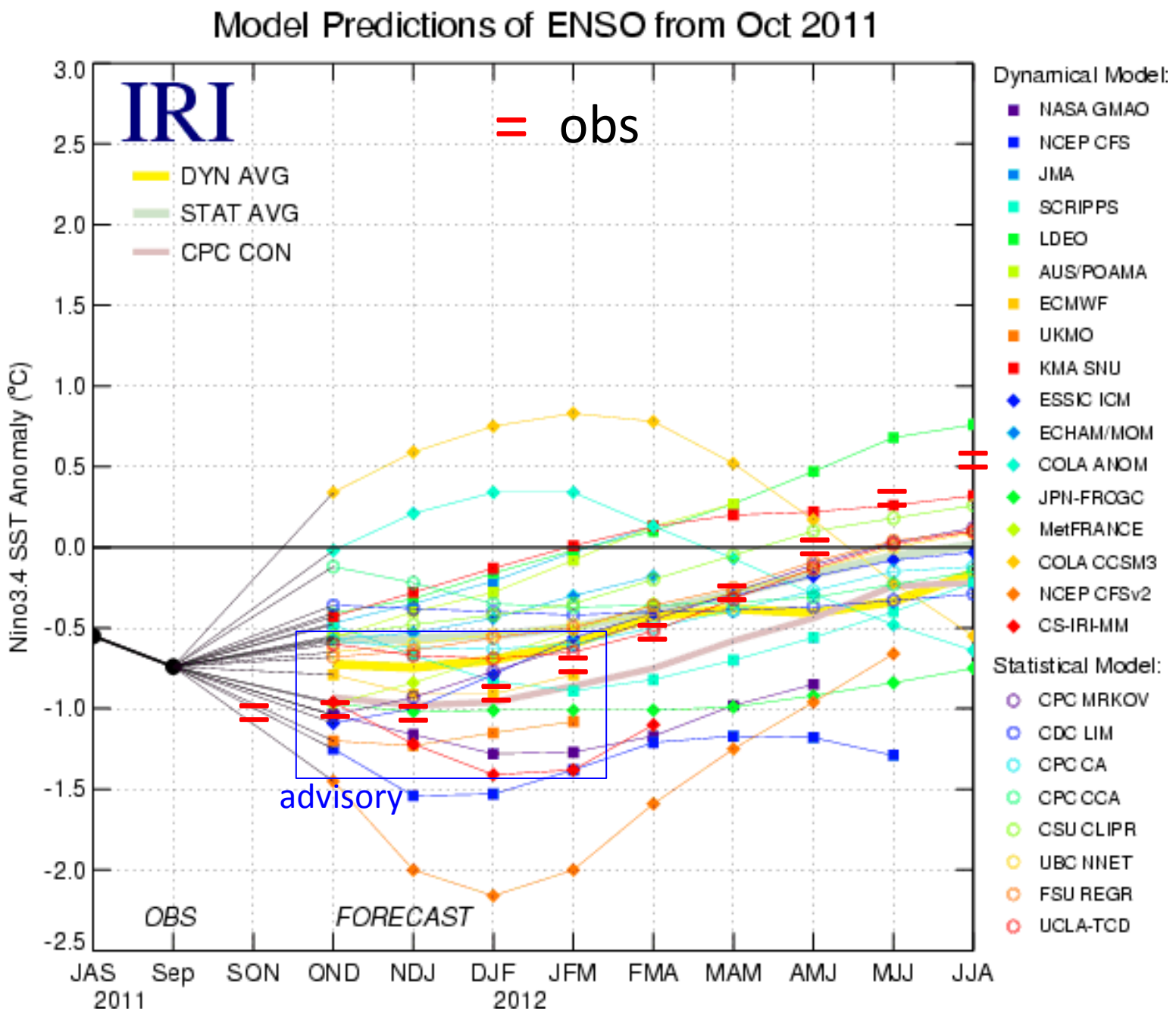

Model Predictions of ENSO from May 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
FMA
Apr
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

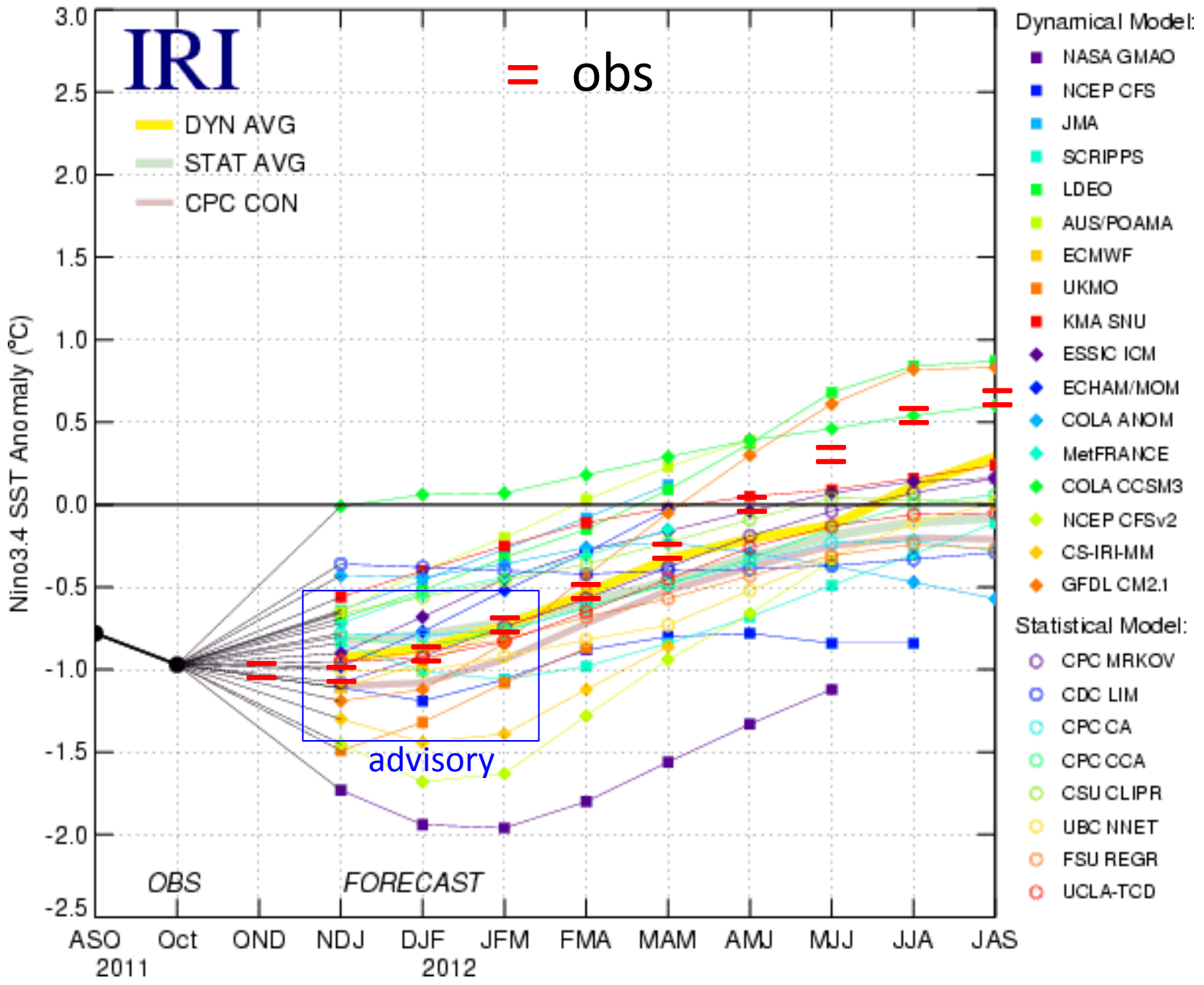

Model Predictions of ENSO from Jun 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
MAM
May
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

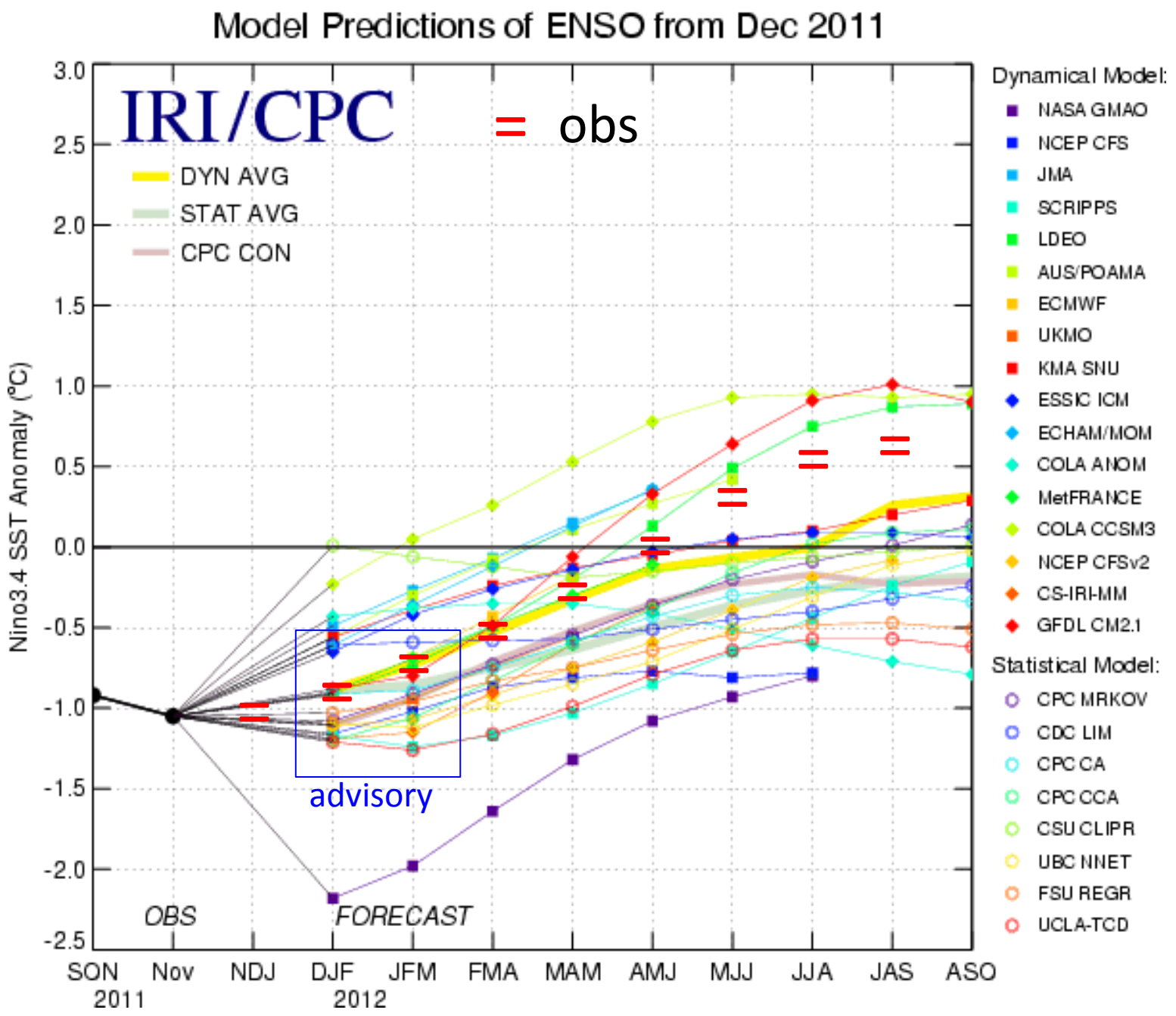

Model Predictions of ENSO from Jul 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
AMJ
Jun
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
NCEP CFSv2
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

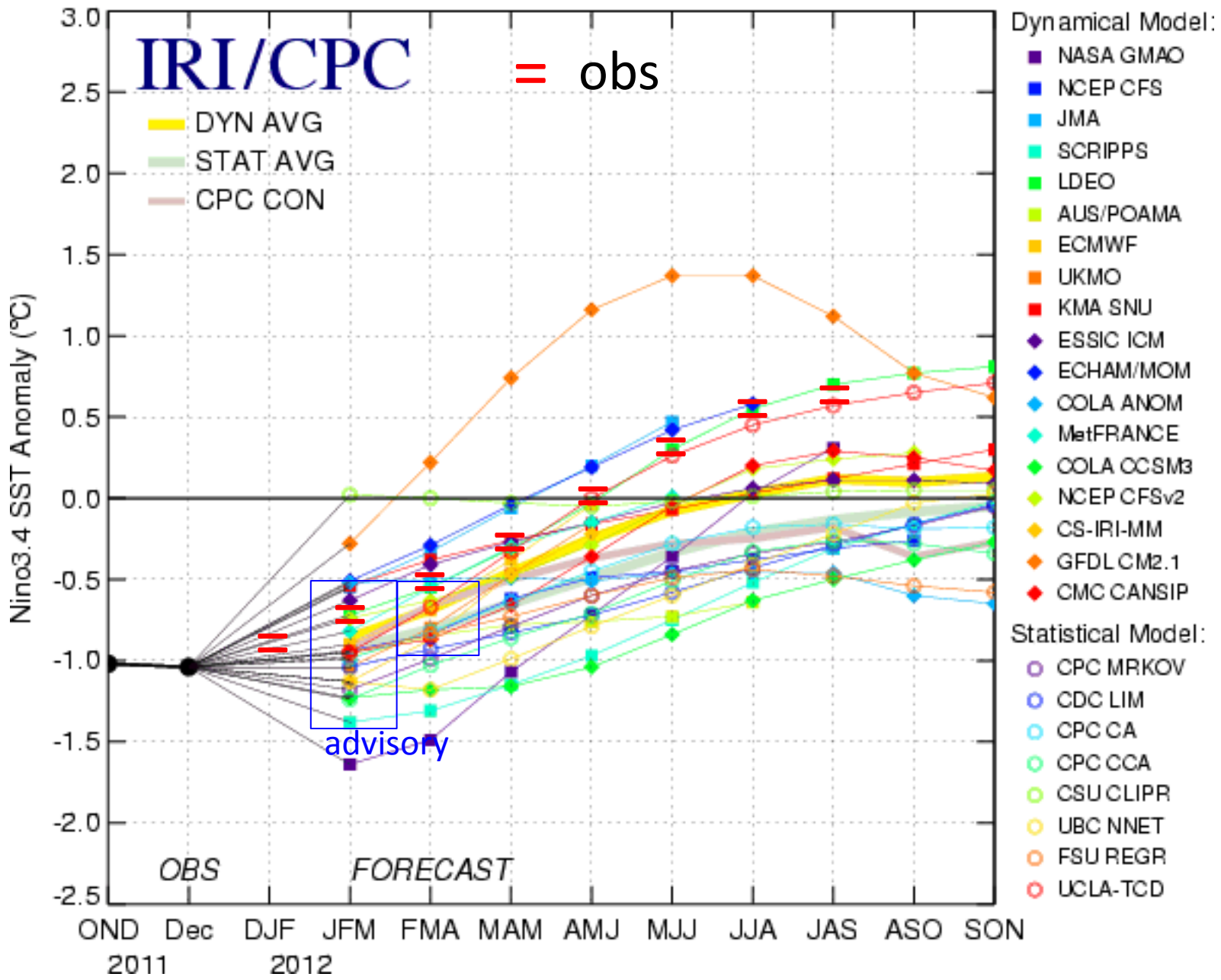

Model Predictions of ENSO from Aug 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
watch
MJJ
Jul
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FROGC
COLA CCSM3
NCEP CFSv2
CSI-IRI-MM
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

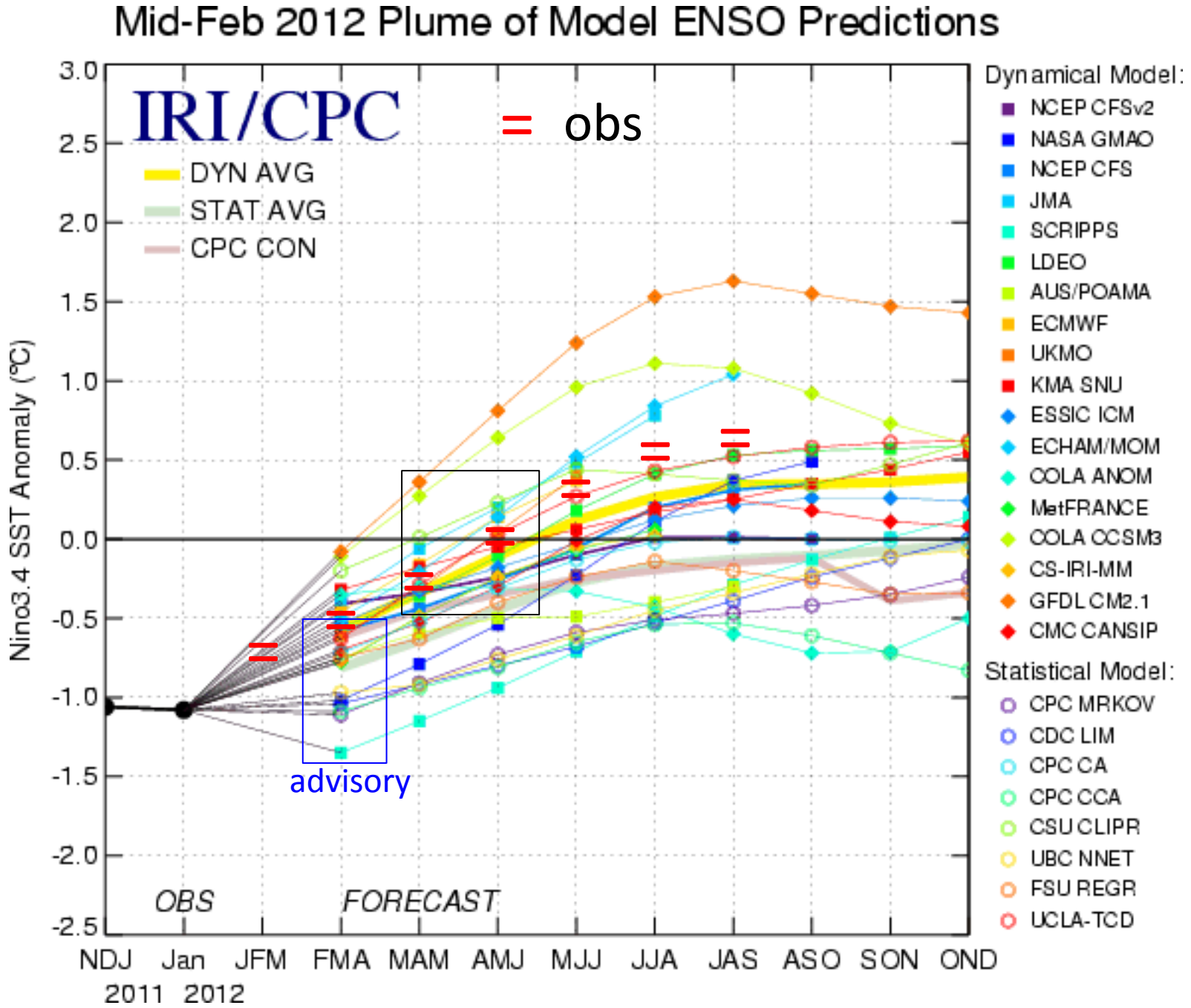

Model Predictions of ENSO from Sep 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
JJA
Aug
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
NCEP CFSv2
CS-IRI-MM
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

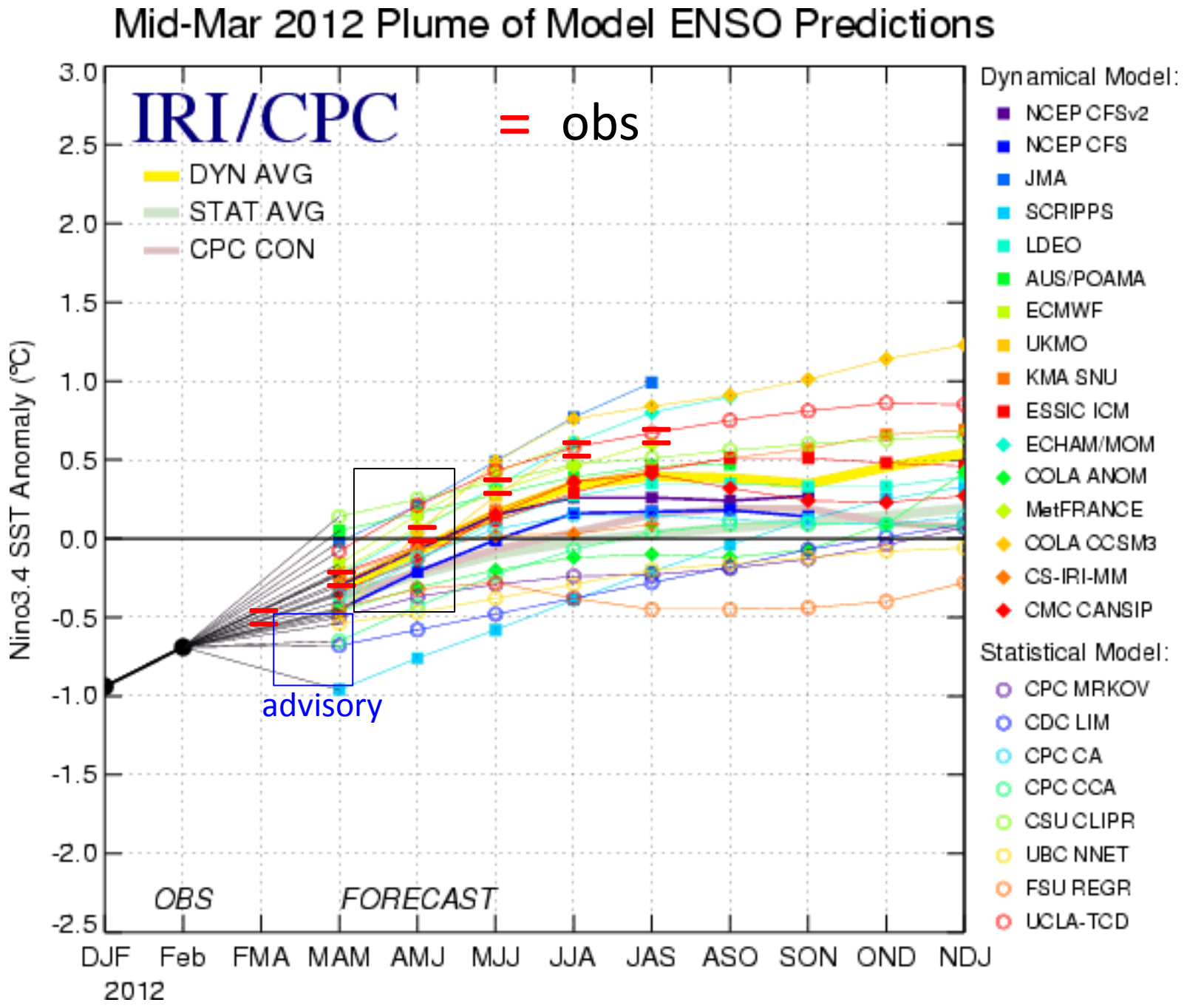

Model Predictions of ENSO from Oct 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
JAS
2011
Sep
SON
OND
NDJ
DJF
2012
JFM
FMA
MAM
AMJ
MJJ
JJA
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
JPN-FROGC
MetFRANCE
COLA CCSM3
NCEP CFSv2
CS-IRI-MM
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

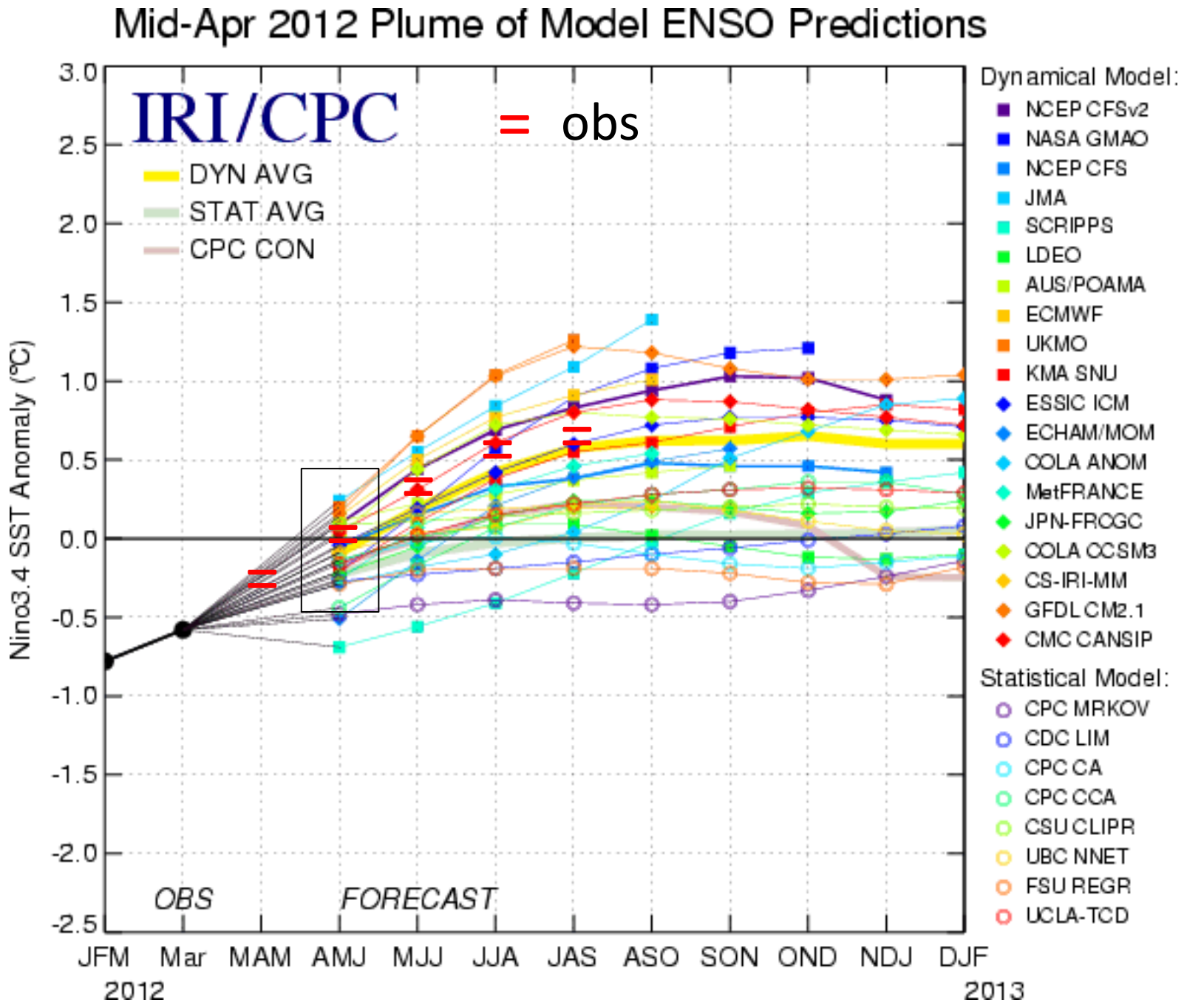

Model Predictions of ENSO from Nov 2011
IRI
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
advisory
ASO
2011
Oct
OND
NDJ
DJF
2012
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
NCEP CFSv2
CS-IRI-MM
GFDL CM2.1
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

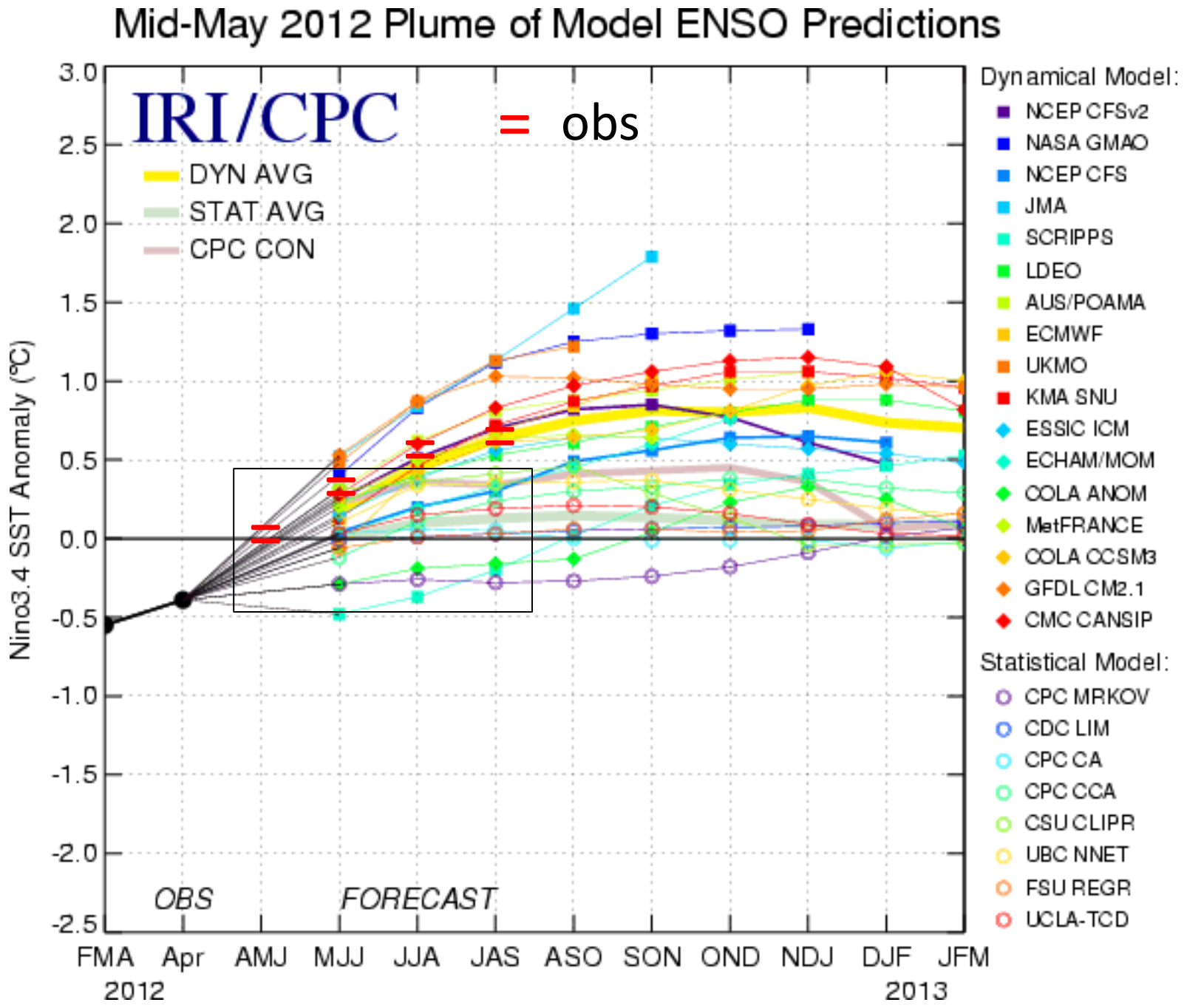

Model Predictions of ENSO from Dec 2011
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
SON
2011
Nov
NDJ
DJF
2012
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
NCEP CFSv2
CS-IRI-MM
GFDL CM2.1
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

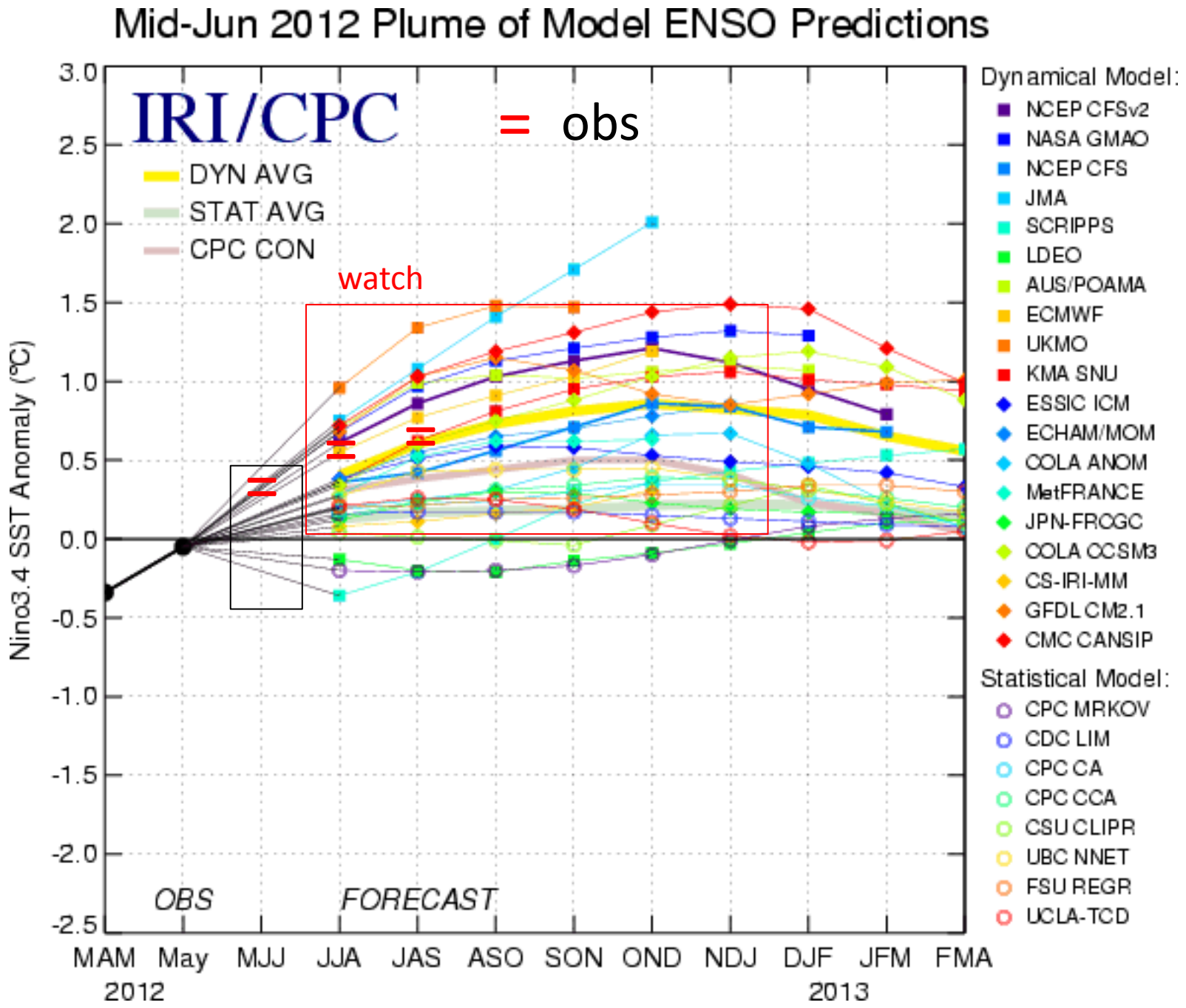

Mid-Month Plume of Model ENSO Predictions from Jan 2012
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
OND
Dec
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
2011
2012
Dynamical Model:
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
NCEP CFSv2
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

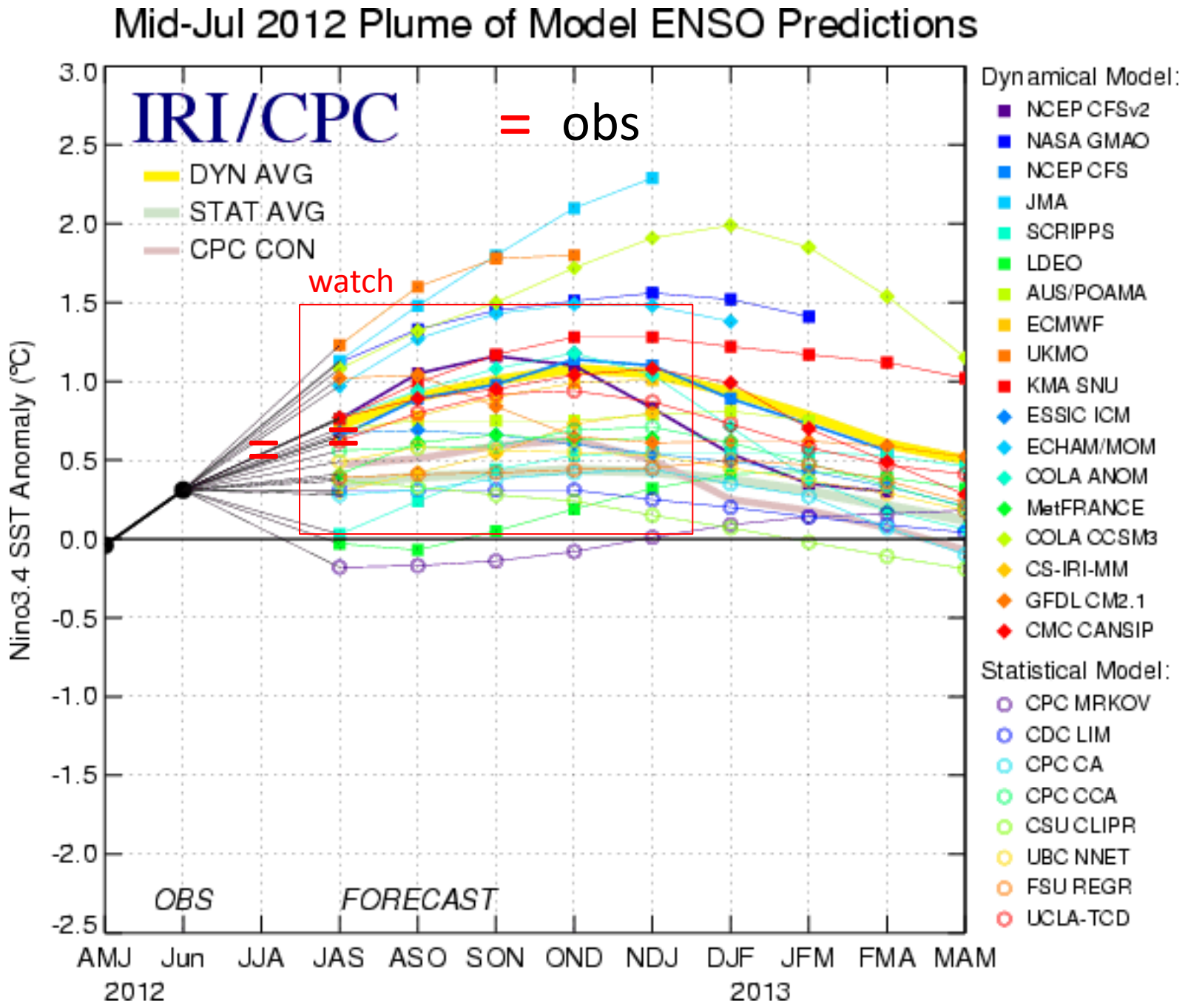

Mid-Feb 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
NDJ
Jan
JFM
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
2011
2012
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

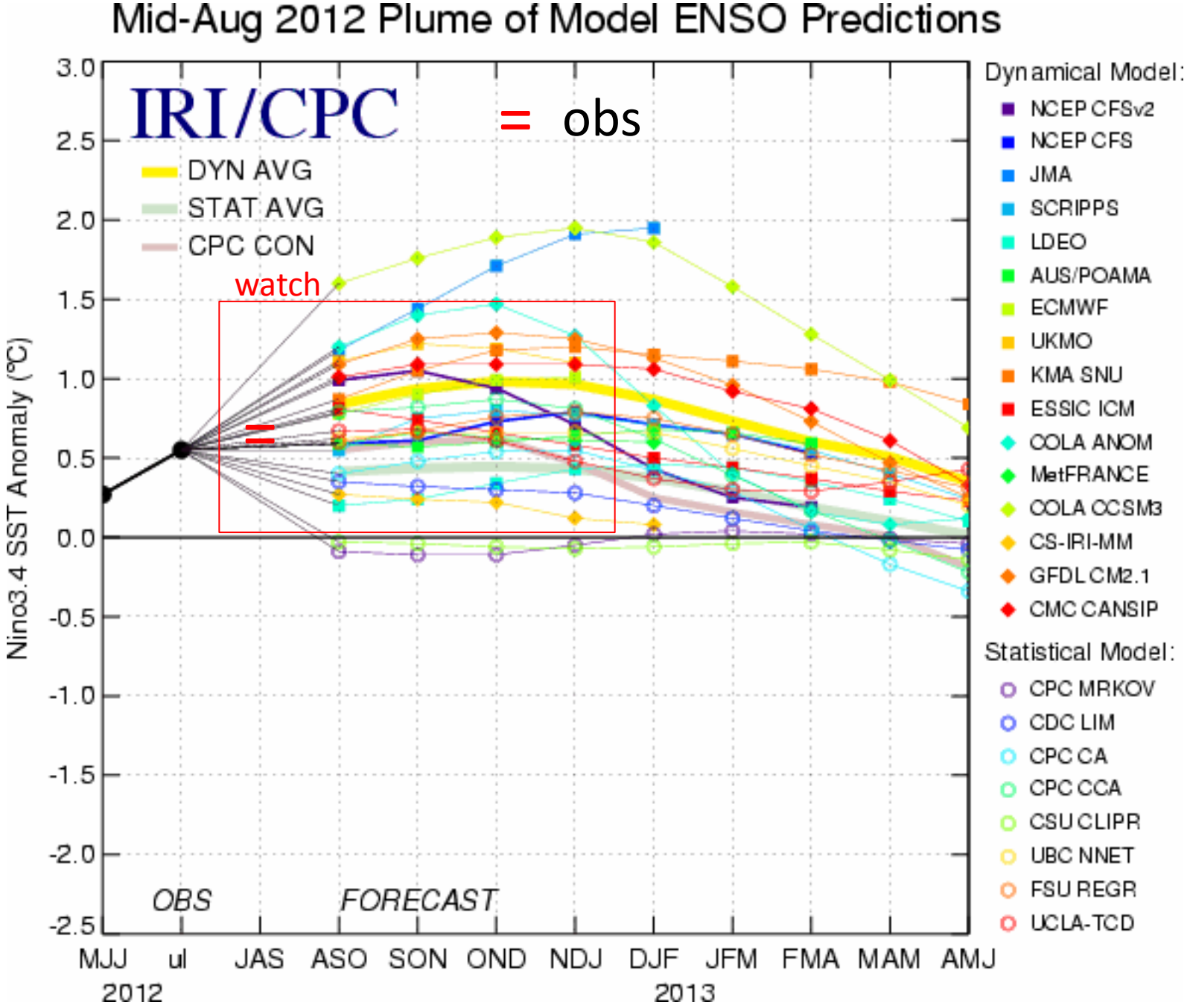

Mid-Mar 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
advisory
OBS
FORECAST
DJF
Feb
FMA
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
2012
Dynamical Model:
NCEP CFSv2
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
CS-IRI-MM
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

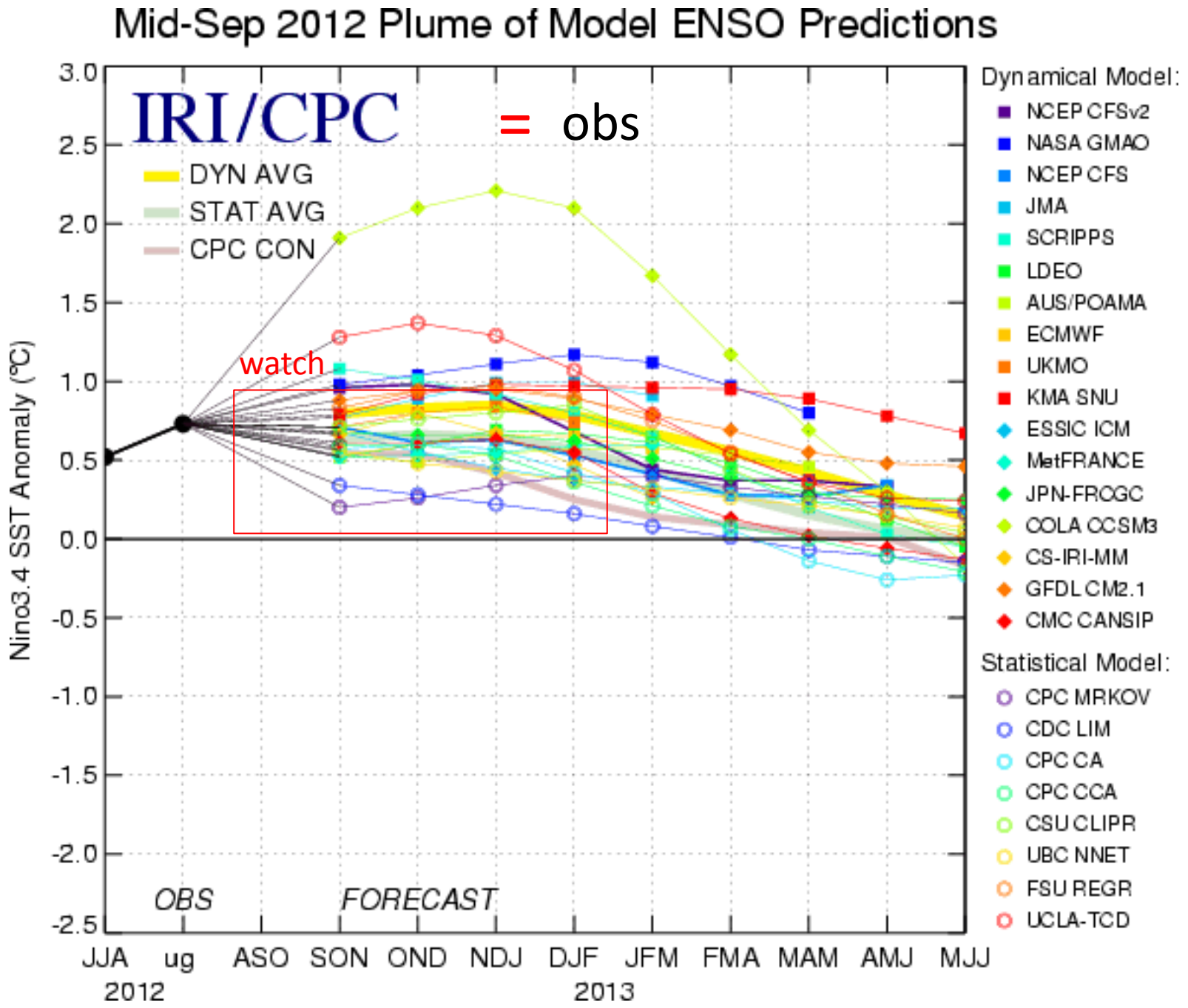

Mid-Apr 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
JFM
Mar
MAM
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD

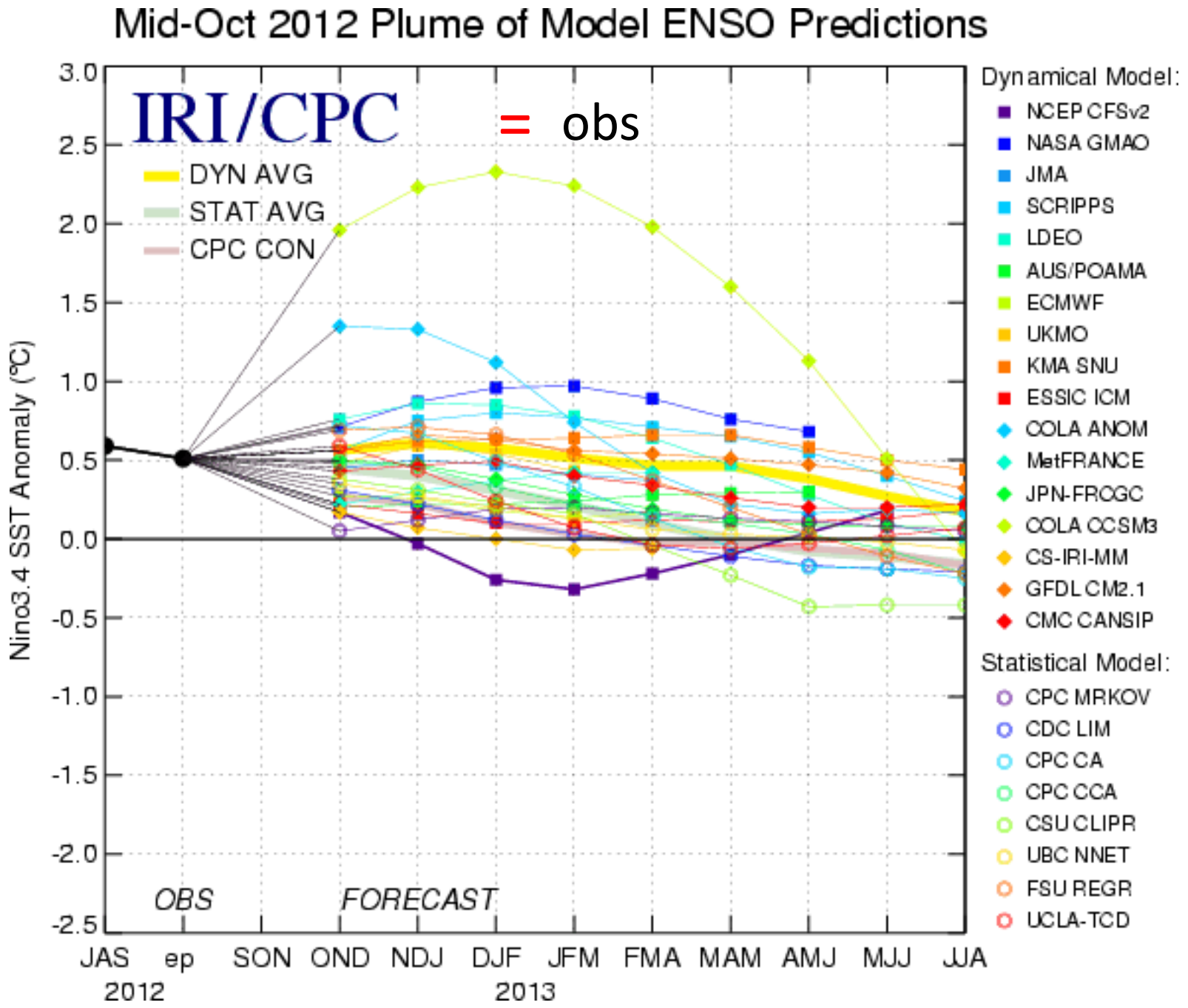

Mid-May 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
FMA
Apr
AMJ
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-Jun 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
watch
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
MAM
May
MJJ
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
JPN-FRCGC
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-Jul 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
watch
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
AMJ
Jun
JJA
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
ECHAM/MOM
COLA ANOM
MetFRANCE
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-Aug 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
watch
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
MJJ
ul
JAS
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
2012
2013
Dynamical Model:
NCEP CFSv2
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
COLA ANOM
MetFRANCE
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-Sep 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
watch
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
JJA
ug
ASO
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
NCEP CFS
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
MetFRANCE
JPN-FROGC
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD


Mid-Oct 2012 Plume of Model ENSO Predictions
IRI/CPC
= obs
DYN AVG
STAT AVG
CPC CON
Nino3.4 SST Anomaly (°C)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
OBS
FORECAST
JAS
ep
SON
OND
NDJ
DJF
JFM
FMA
MAM
AMJ
MJJ
JJA
2012
2013
Dynamical Model:
NCEP CFSv2
NASA GMAO
JMA
SCRIPPS
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
ESSIC ICM
COLA ANOM
MetFRANCE
JPN-FROGC
COLA CCSM3
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
Statistical Model:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD