NMME prediction of the 2015-16 El Niño

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NOAA/NCEP/Climate Prediction Center (CPC)

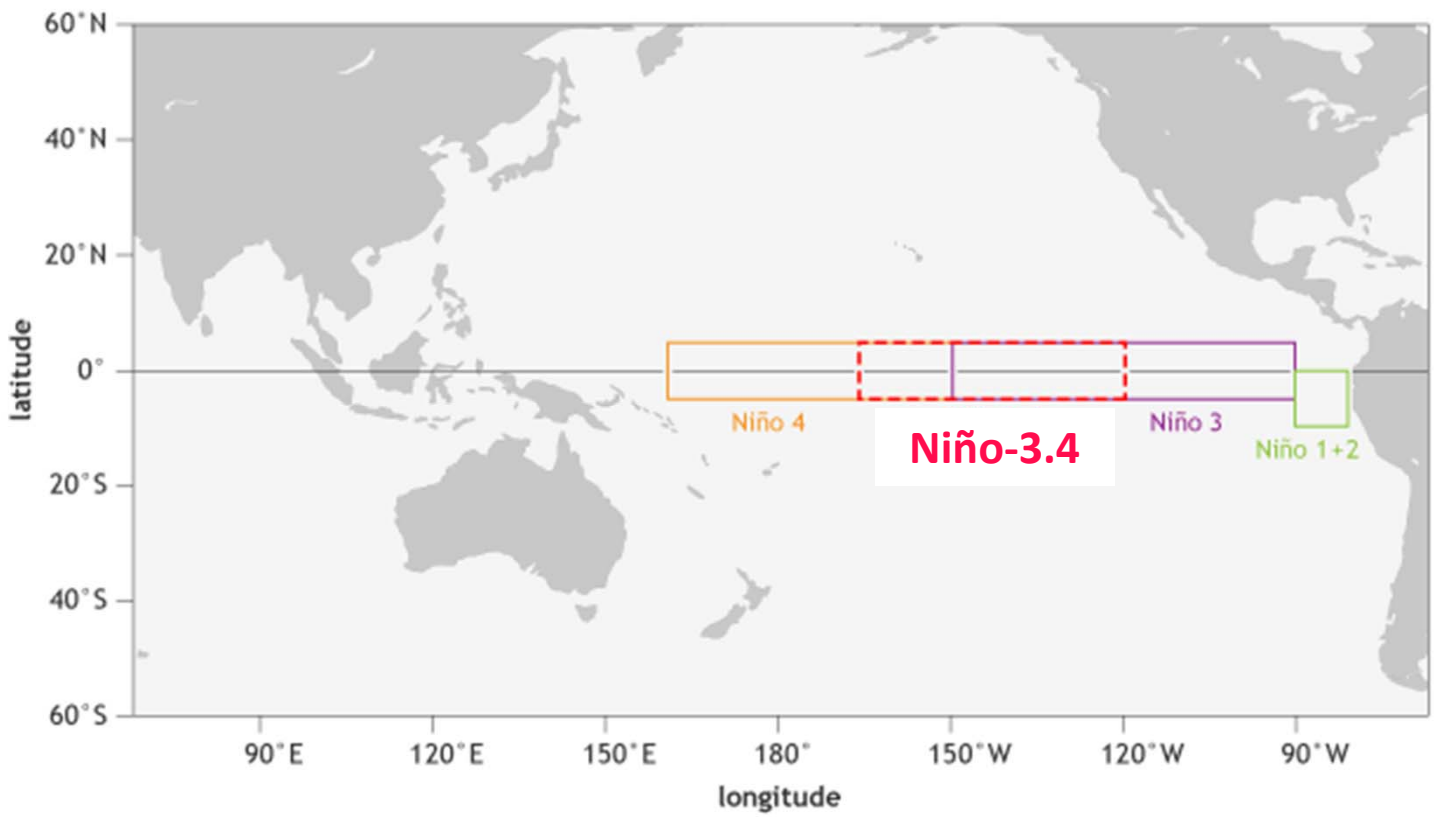
Acknowledgements: Michael Tippett and Meghana Ranganathan

NMME teleconference
November 2016

*** Verification from Jan 2015 through the July 2016.**

Updates by CPC during 2015-16

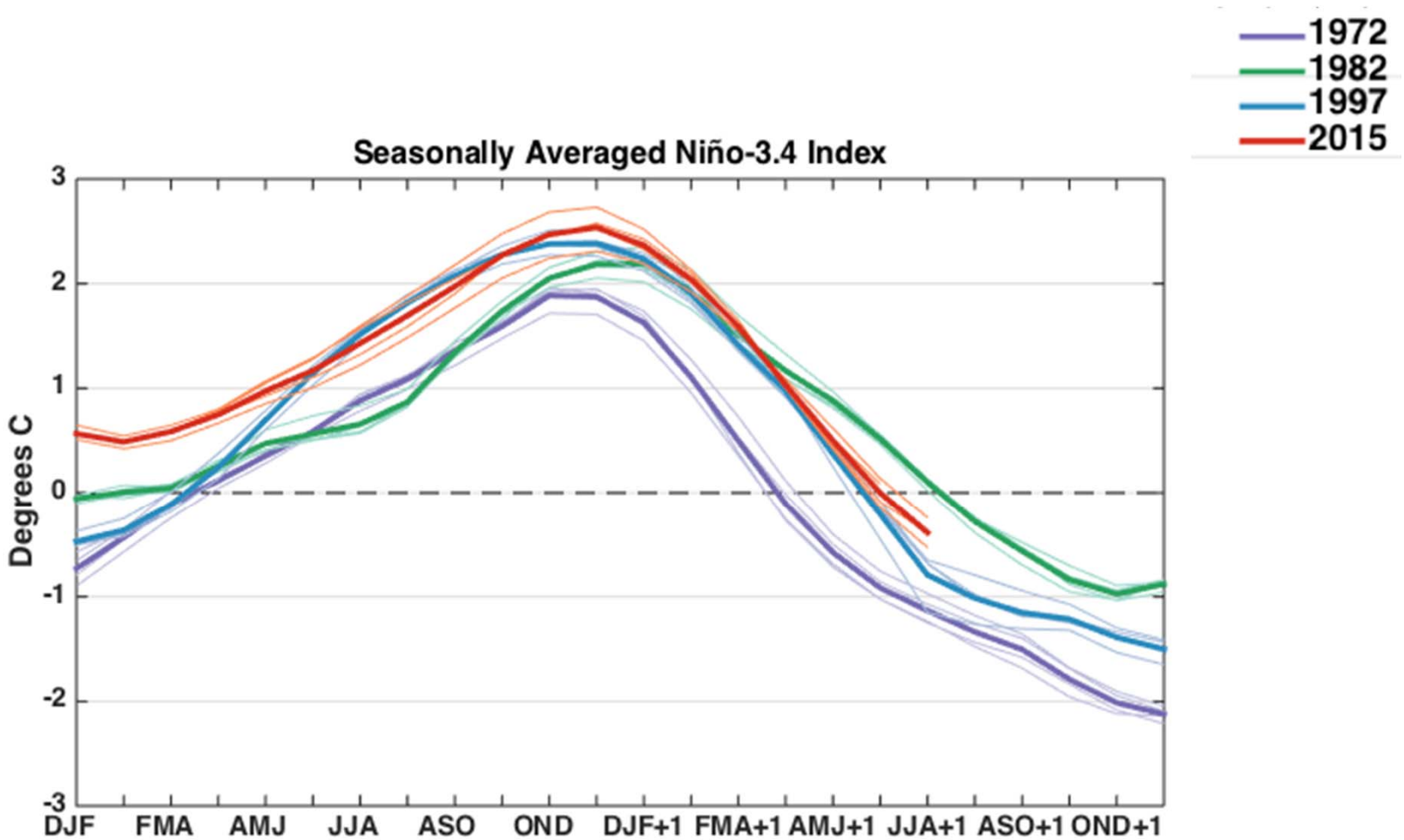
- El Niño Advisory declared in March 2015.
- During early June 2015, mentioned possibility of a strong event (3mo. Niño-3.4 >1.5°C).
- By early August 2015, seasonal Niño-3.4 SST values predicted to be in excess of 2.0°C (a Top 3 event).
- Final El Niño Advisory issued in early June 2016 with the return of ENSO-neutral.



Evolution of the Seasonally Averaged Niño-3.4 SST index

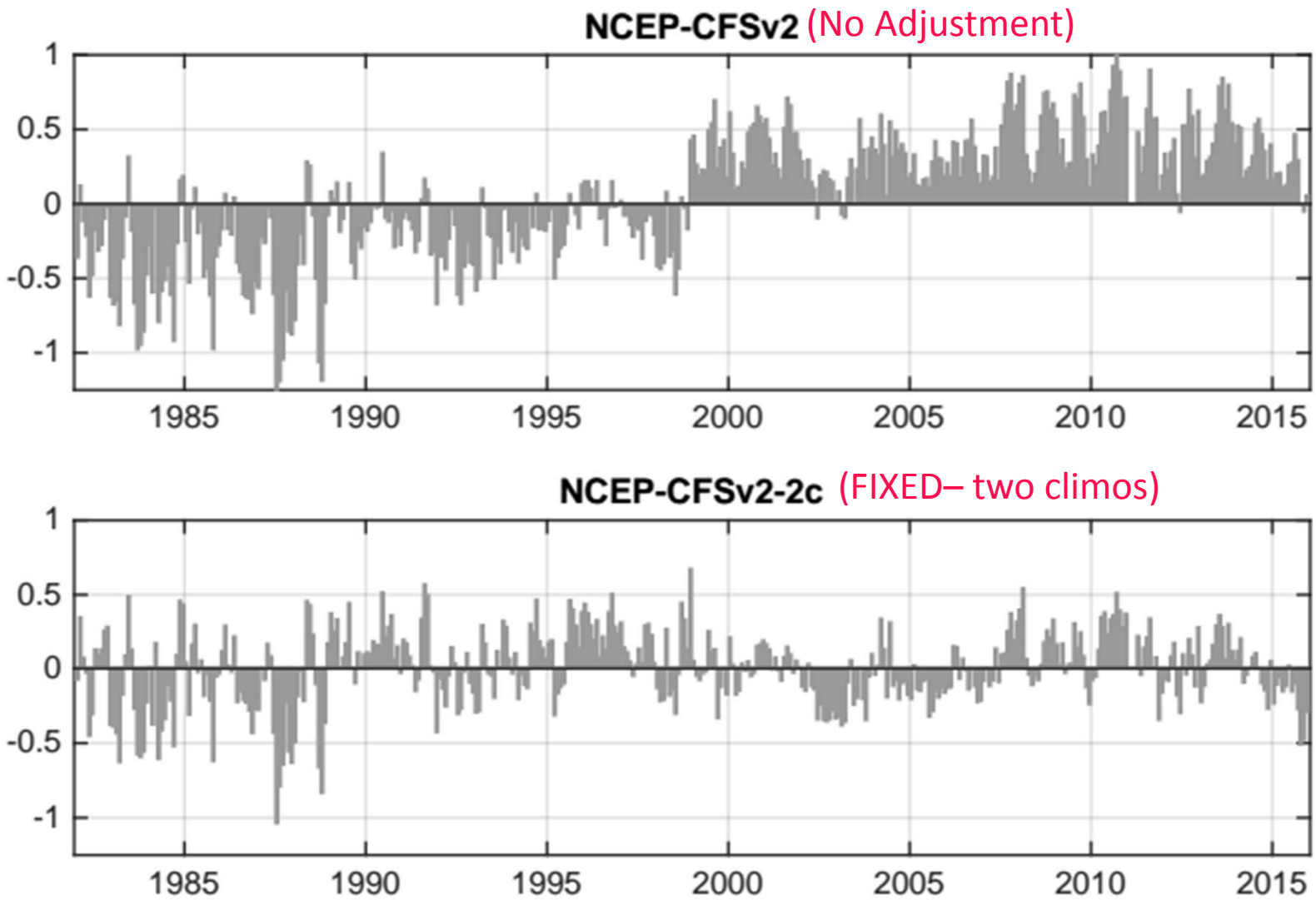
Thin Lines:
ERSSTv3b,
ERSSTv4,
HadSST, COBE

Thick Line:
All Dataset Avg.



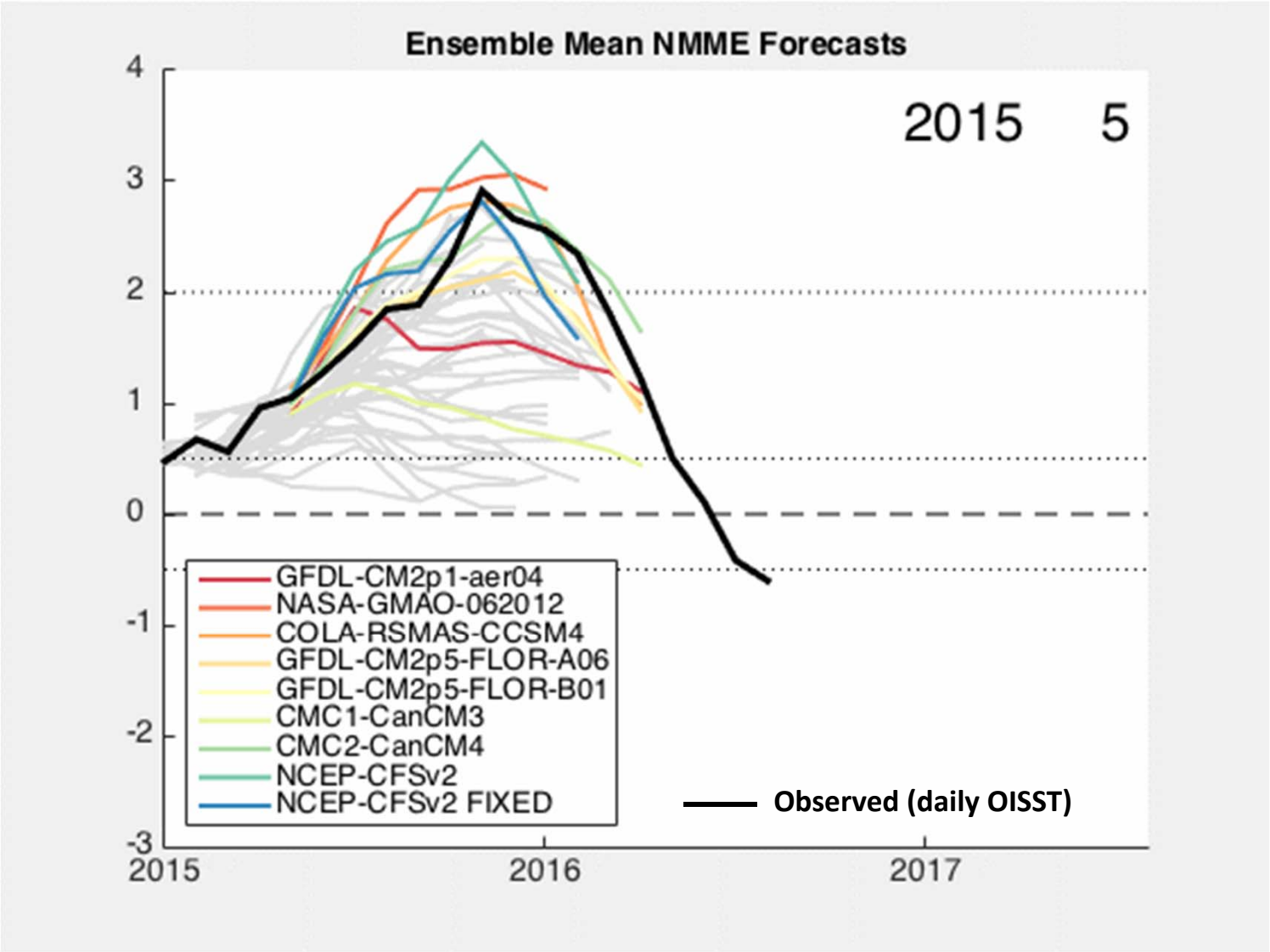
Note: NCEP CFSv2 Adjustment → CFSv2 "FIXED"

- **Displaying 0-lead RMSE with and without adjustment**



Tippett, M.K., M. Ranganathan, M. L'Heureux, A. Barnston, T. DelSole (2016): Assessing probabilistic predictions of ENSO phase and intensity from the North American Multimodel Ensemble. *Clim Dyn.,* submitted.

Animation of North America Multi-Model Ensemble Forecasts during 2015-16



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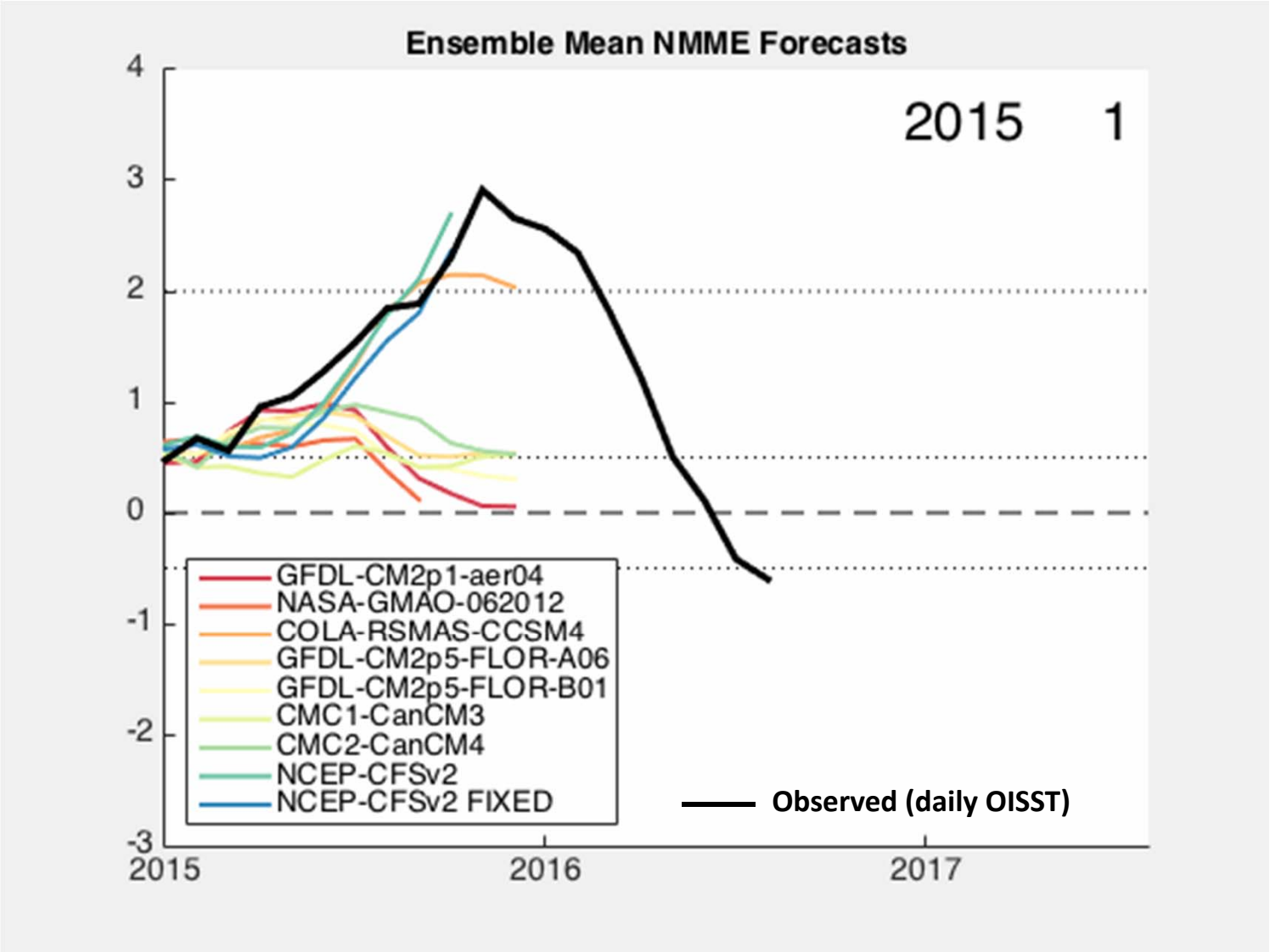
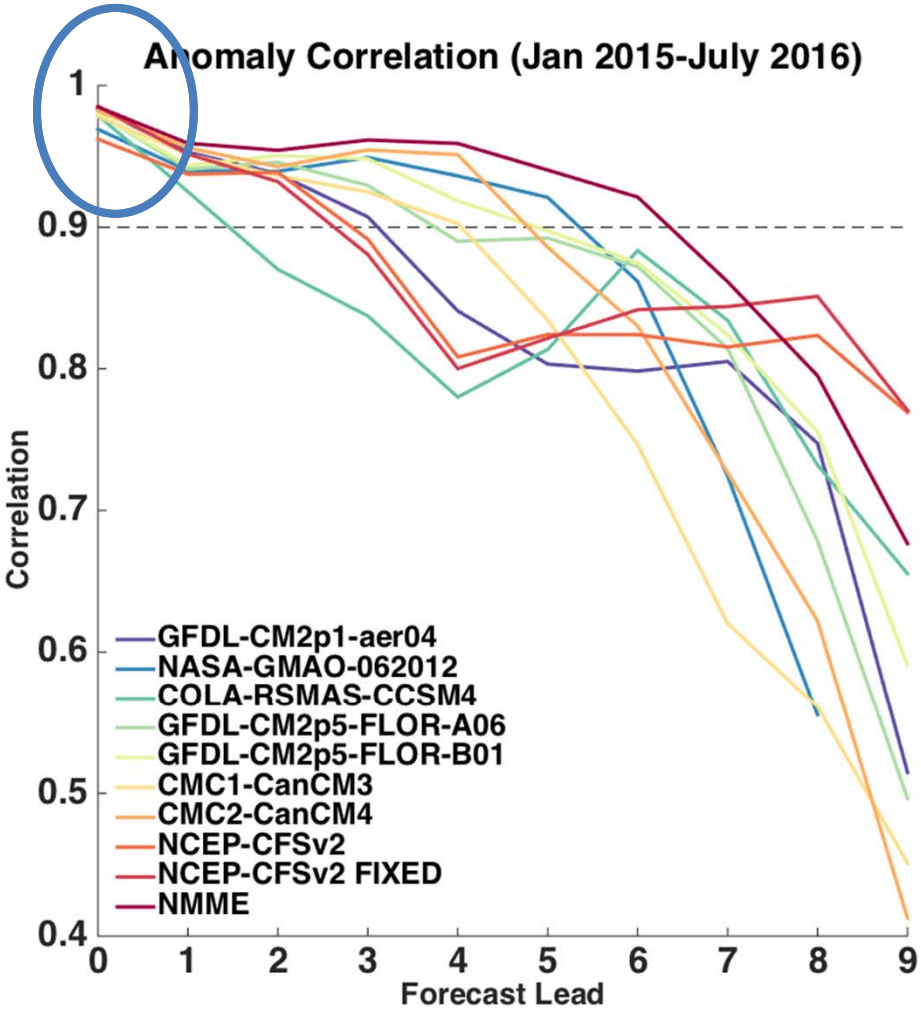
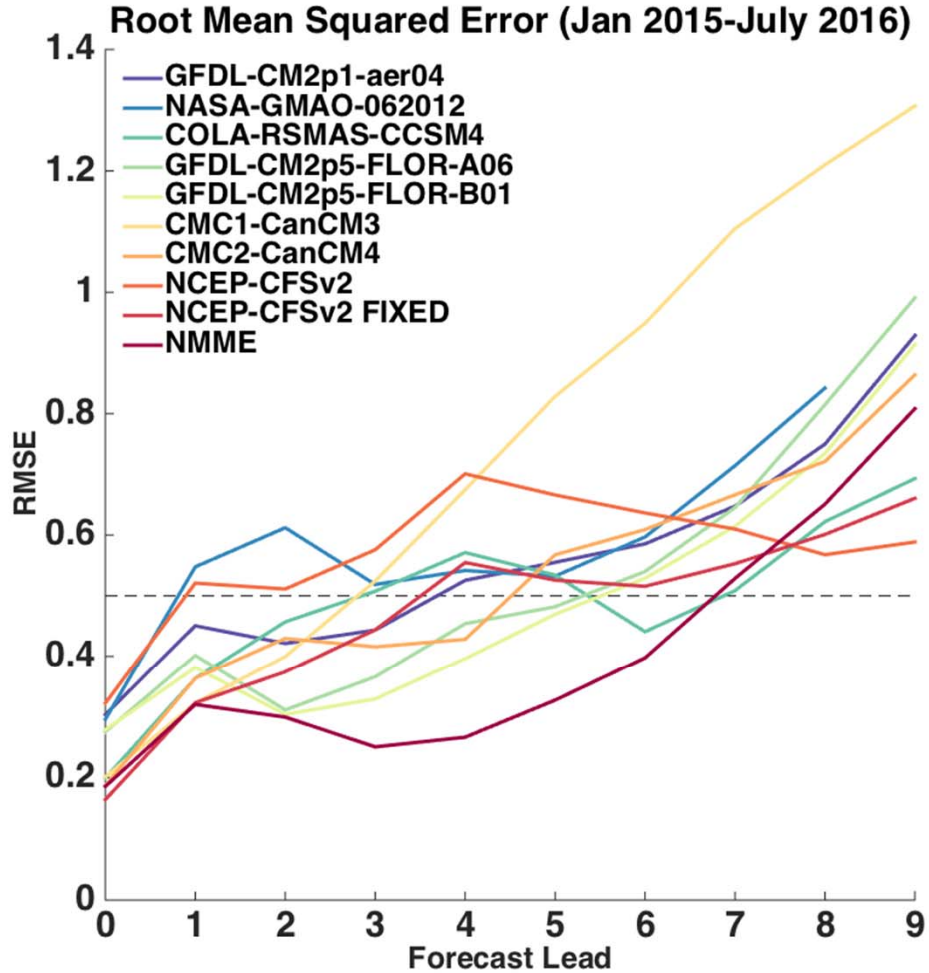



Anomaly Correlation (Jan 2015-July 2016)
Correlation
Forecast Lead
GFDL-CM2p1-aer04
NASA-GMAO-062012
COLA-RSMAS-CCSM4
GFDL-CM2p5-FLOR-A06
GFDL-CM2p5-FLOR-B01
CMC1-CanCM3
CMC2-CanCM4
NCEP-CFSv2
NCEP-CFSv2 FIXED
NMME


Root Mean Squared Error (Jan 2015-July 2016)
RMSE
Forecast Lead
GFDL-CM2p1-aer04
NASA-GMAO-062012
COLA-RSMAS-CCSM4
GFDL-CM2p5-FLOR-A06
GFDL-CM2p5-FLOR-B01
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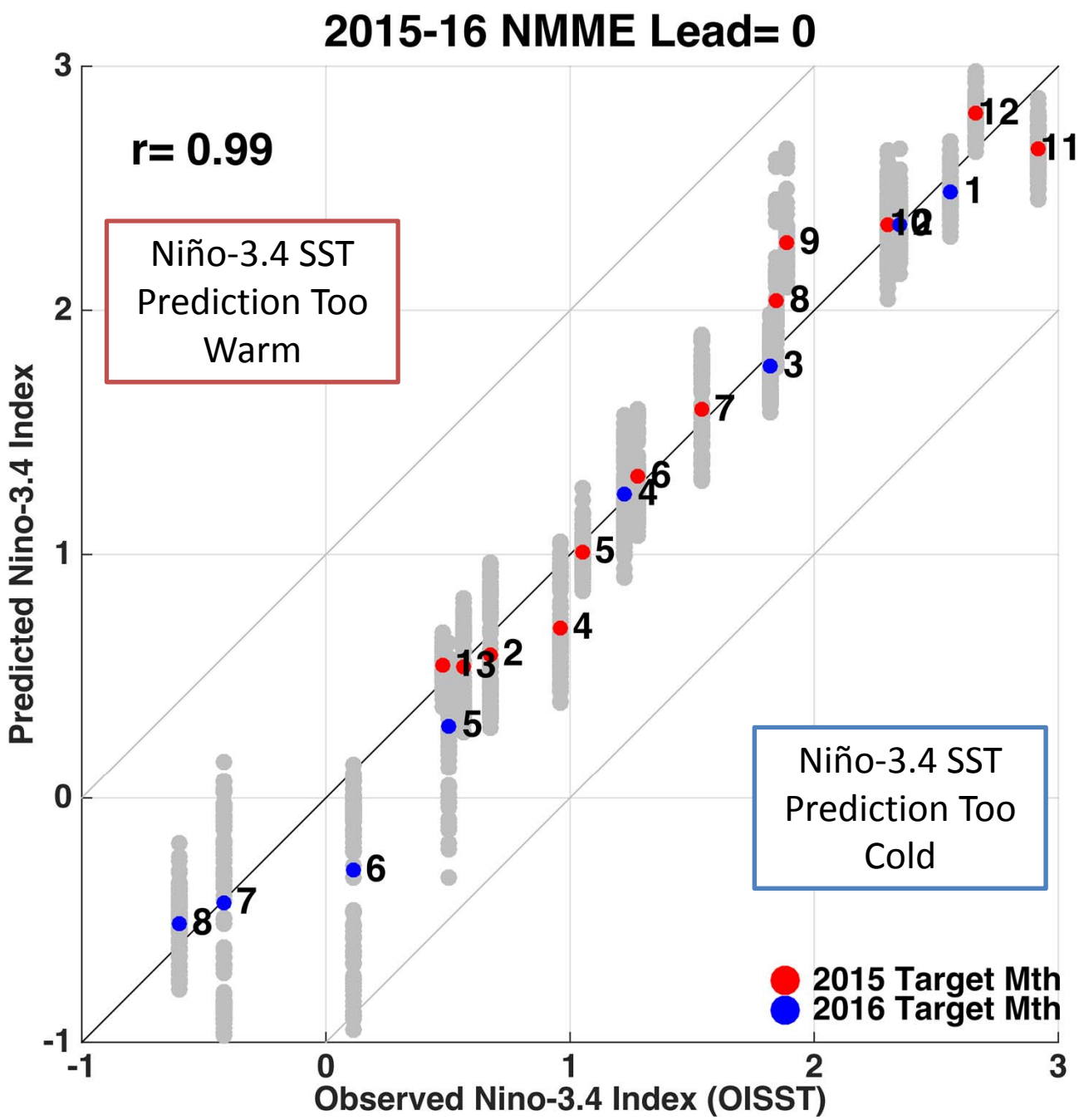
NCEP-CFSv2 FIXED
NMME

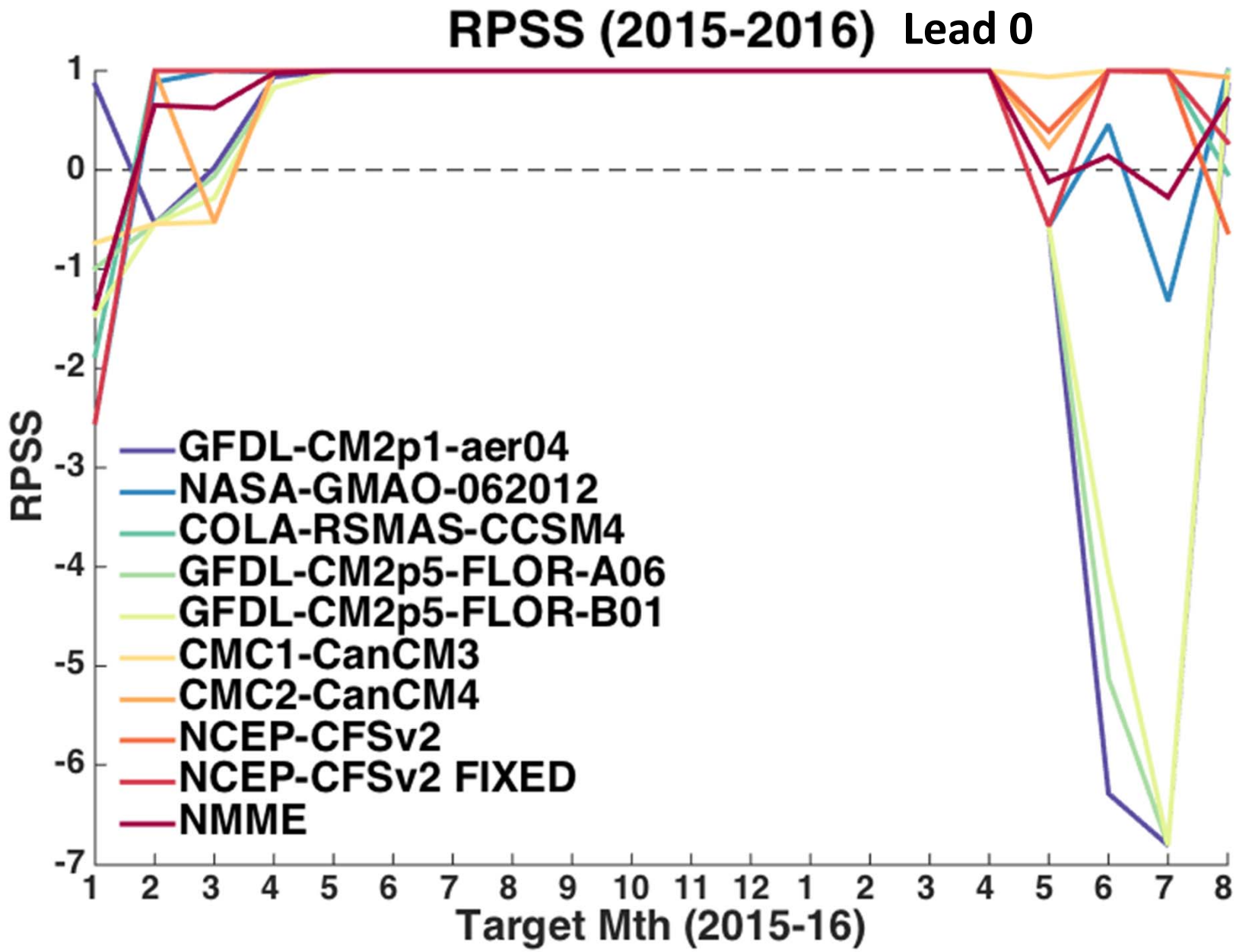


Grey dots: 24 members from CFSv2

Red dot: 2015 Target month

Blue dot: 2016 Target month

on scatterplot corresponds to the Target Month **(12 = Dec.)**


RPSS (2015-2016) Lead 0
RPSS
Target Mth (2015-16)
GFDL-CM2p1-aer04
NASA-GMAO-062012
COLA-RSMAS-CCSM4
GFDL-CM2p5-FLOR-A06
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NCEP-CFSv2 FIXED
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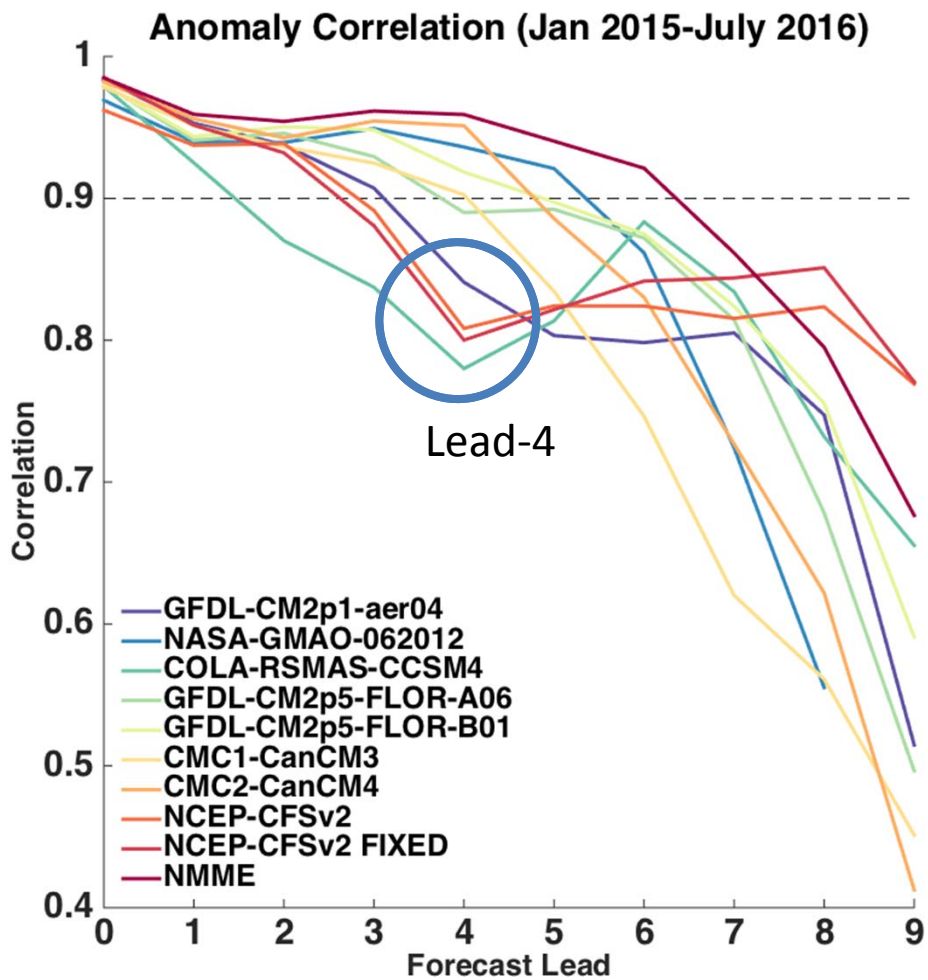
Anomaly Correlation (Jan 2015-July 2016)
Correlation
Forecast Lead
1
0.9
0.8
0.7
0.6
0.5
0.4
0
1
2
3
4
5
6
7
8
9
Lead-4
GFDL-CM2p1-aer04
NASA-GMAO-062012
COLA-RSMAS-CCSM4
GFDL-CM2p5-FLOR-A06
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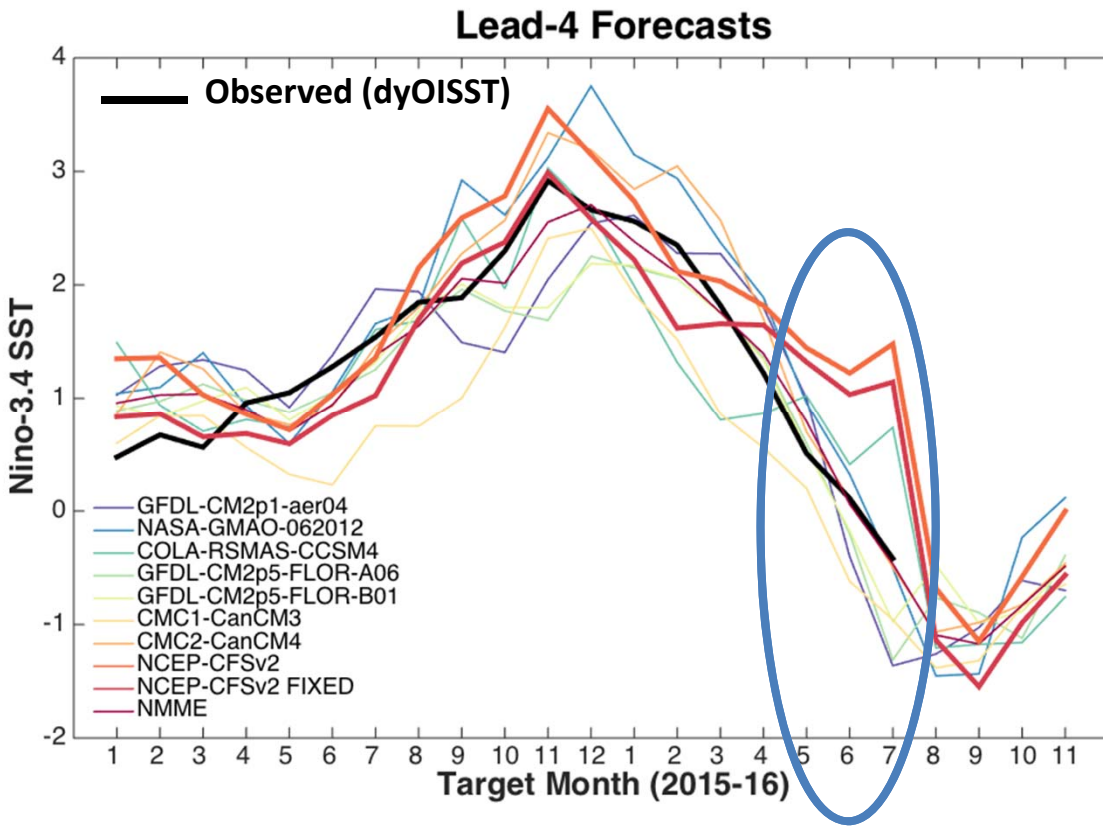
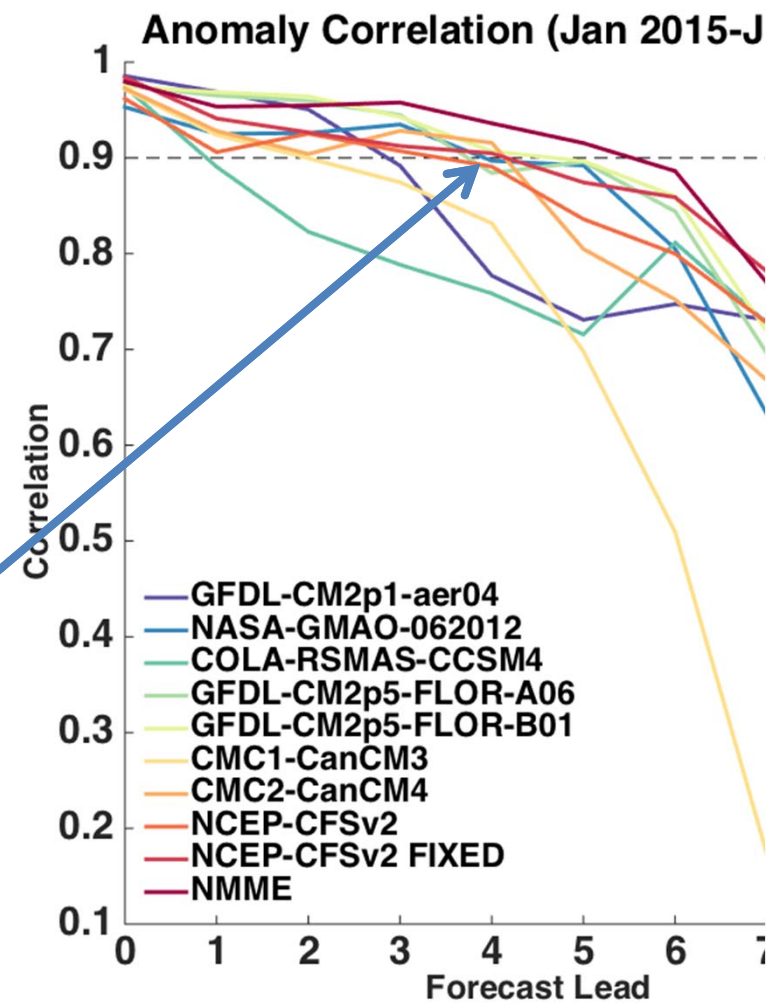
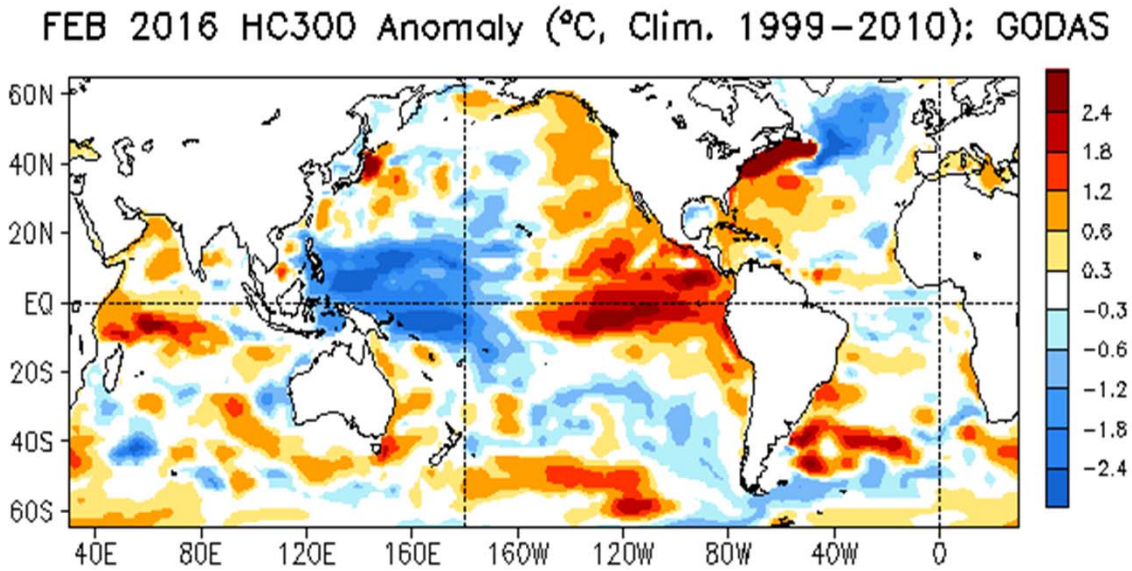


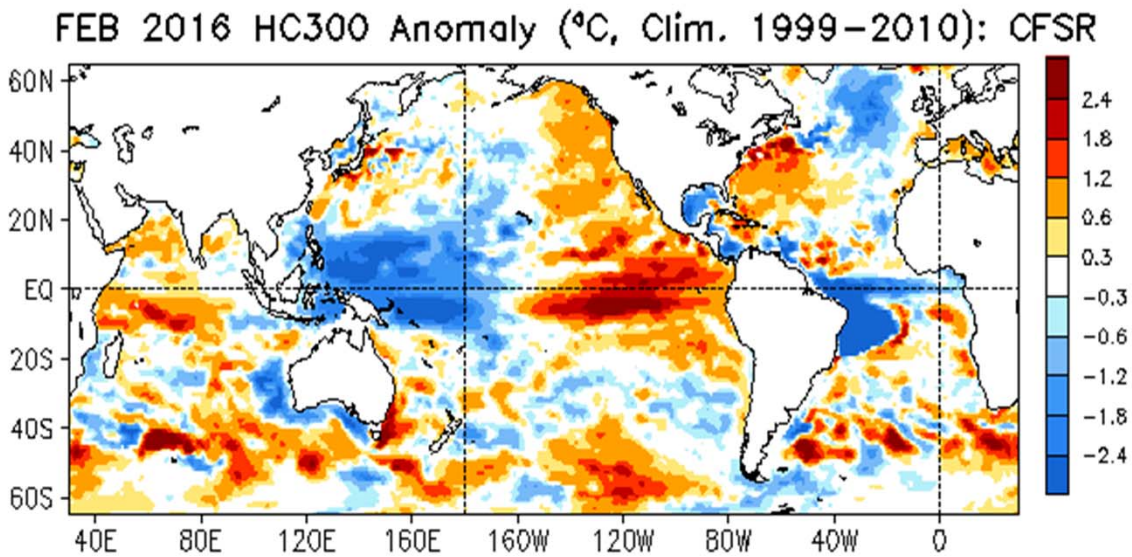


If the runs initialized in Jan, Feb, Mar 2016 are *removed*, the CFSv2 AC improves from 0.80 to 0.90 (lead=4).

CFSR adjustments made due to cold biases in the tropical Atlantic Ocean

http://www.nco.ncep.noaa.gov/pmb/changes/downloads/CFSv2_Atlantic_cold_bias_problem.pdf

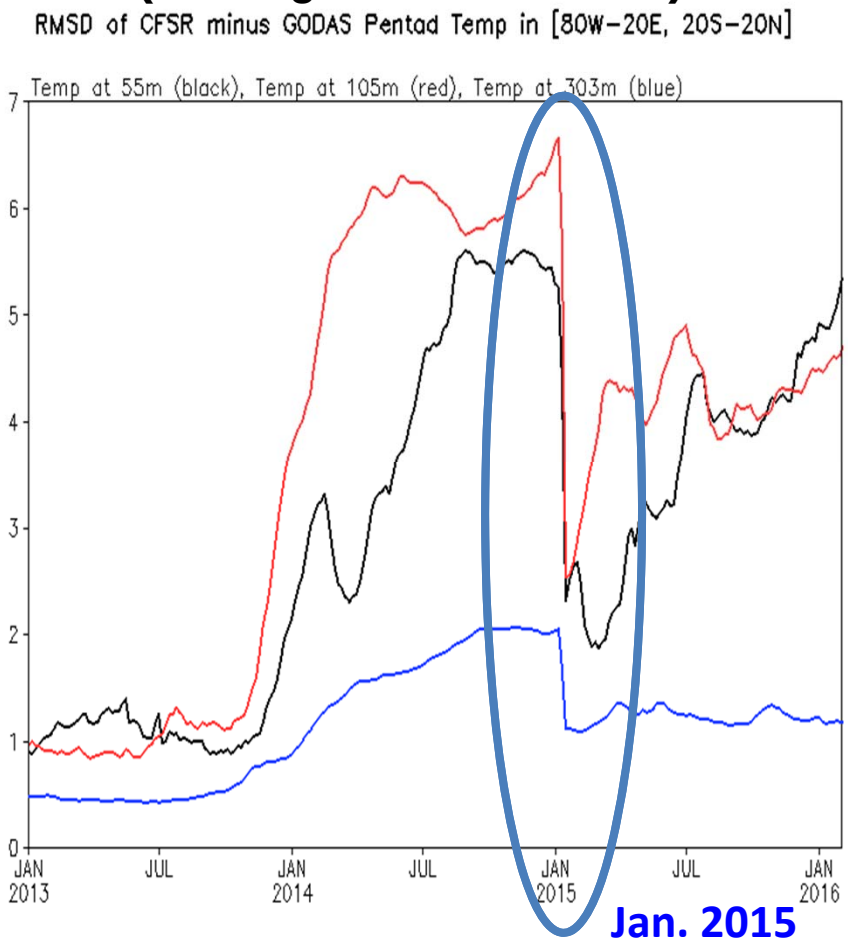




Figures by Yan Xue (CPC)

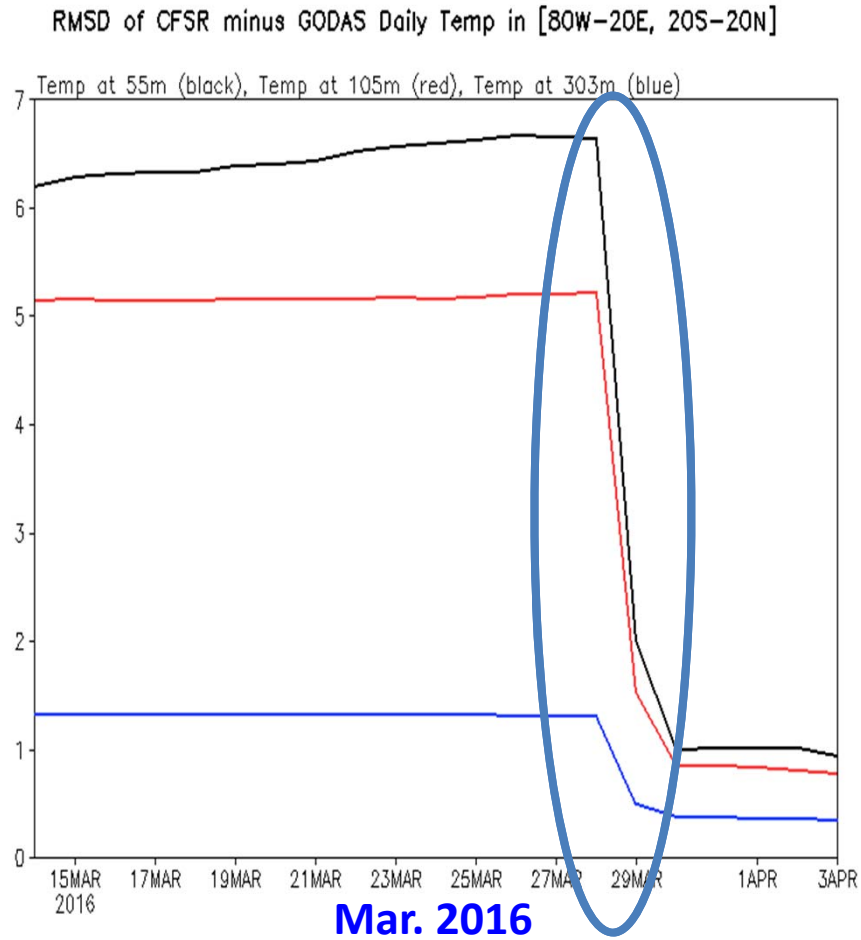
CFSR adjustments made during Jan. 2015 and Mar. 2016…

Pentad Temperature
(through Mar 27 2016)



Jan. 2015 Adjustment

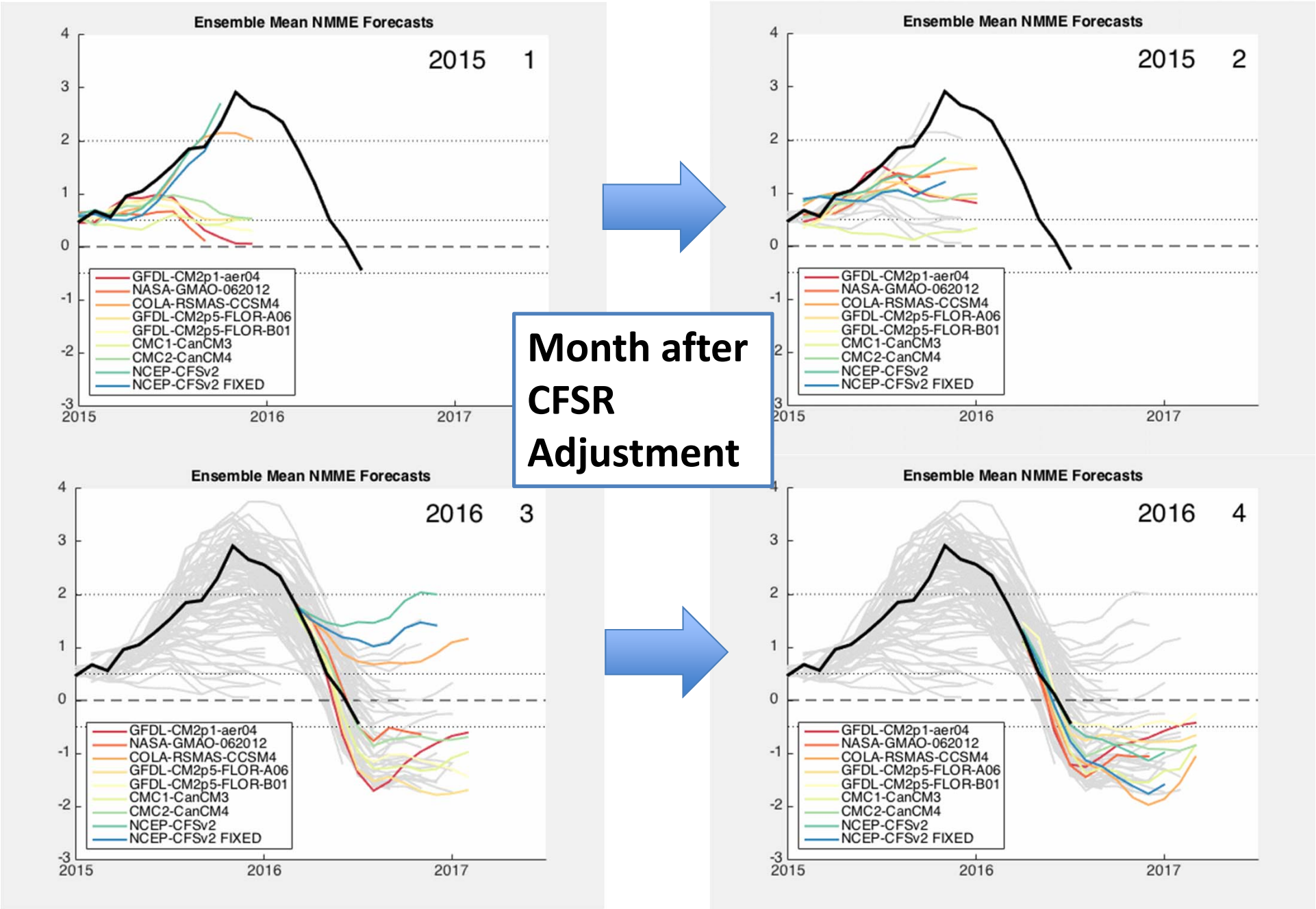
Daily Temperature
(through Apr 3)

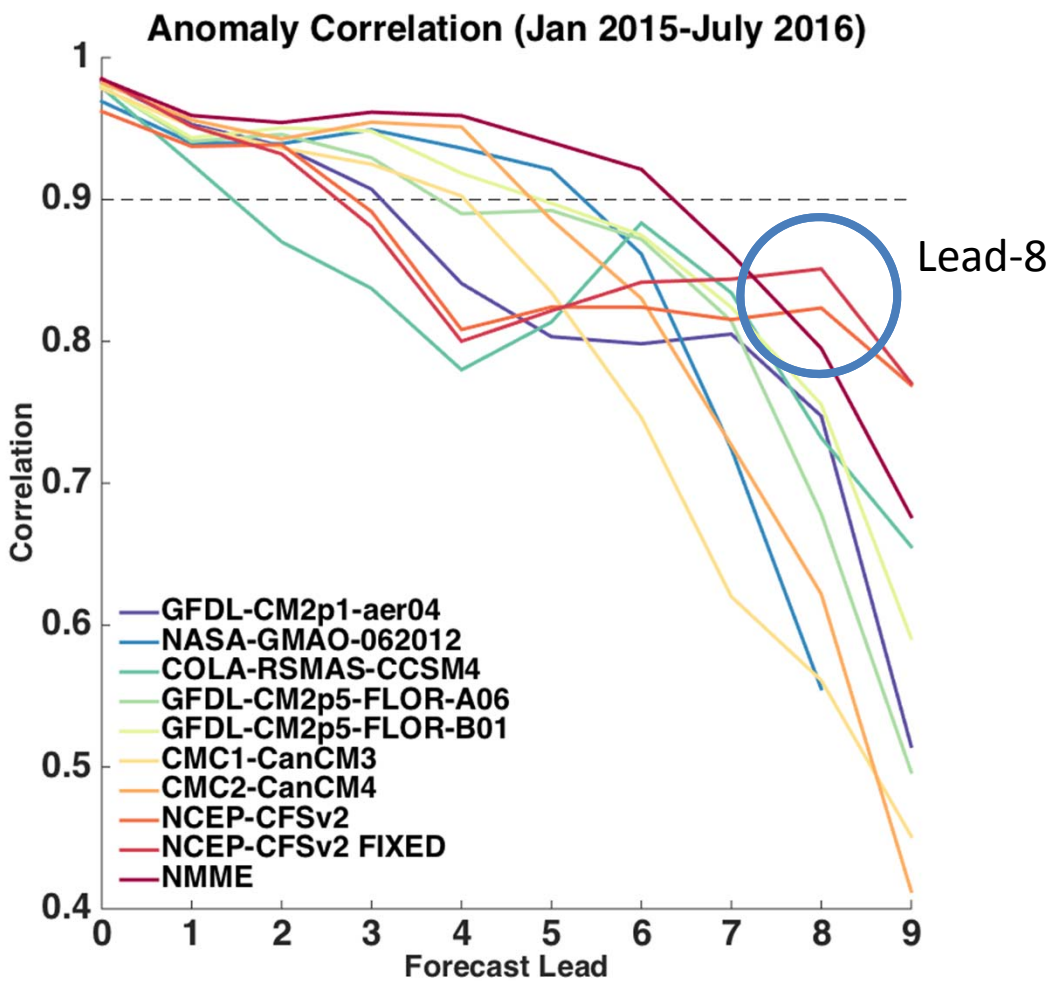


Mar. 2016 Adjustment

Figures by Yan Xue (CPC)

Month after CFSR adjustment in Jan. 2015 and Mar. 2016….

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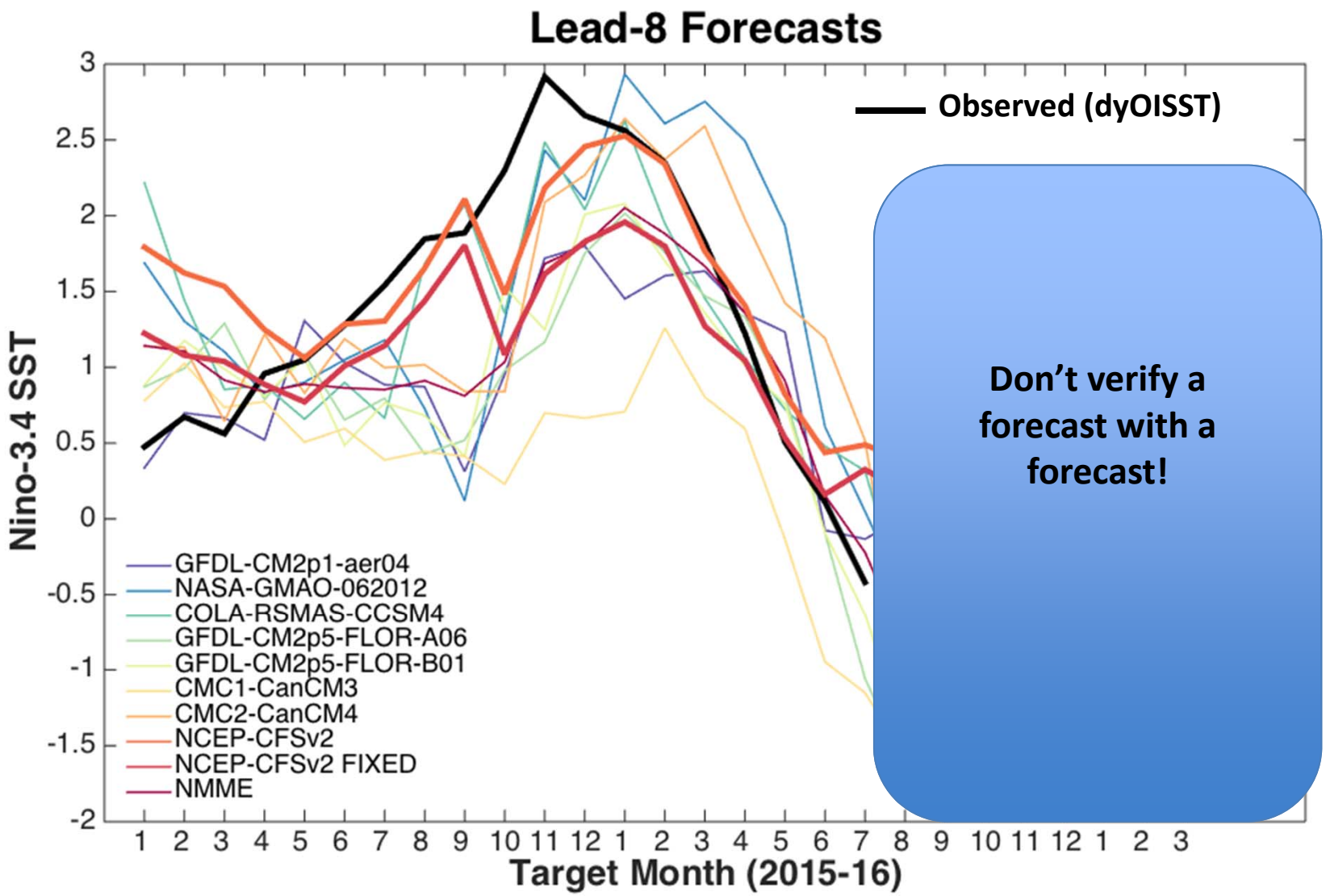
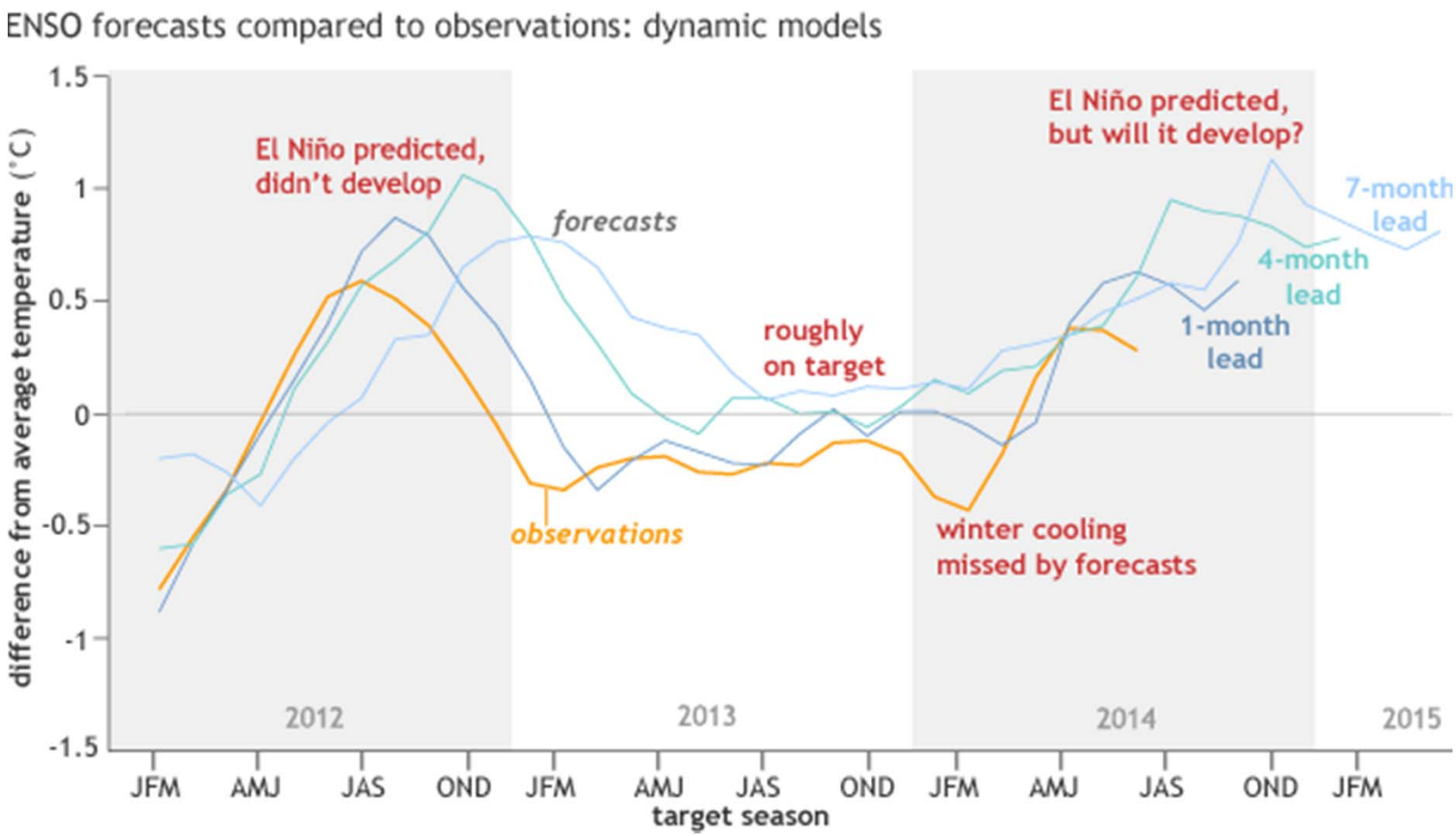
NCEP-CFSv2
NCEP-CFSv2 FIXED
NMME
Lead-8



Don't verify a forecast with a forecast!

ENSO during 2012-2014 from IRI/CPC Model Plume

(figure taken from Sept 2014 post in climate.gov ENSO blog)



Target Period Slippage

- When the predictions that correspond best with observations occur later than the intended target season. Or when the model forecasts lag the observations.

- Slippage is evident in NMME/dynamical models and statistical models from the IRI/CPC plume.

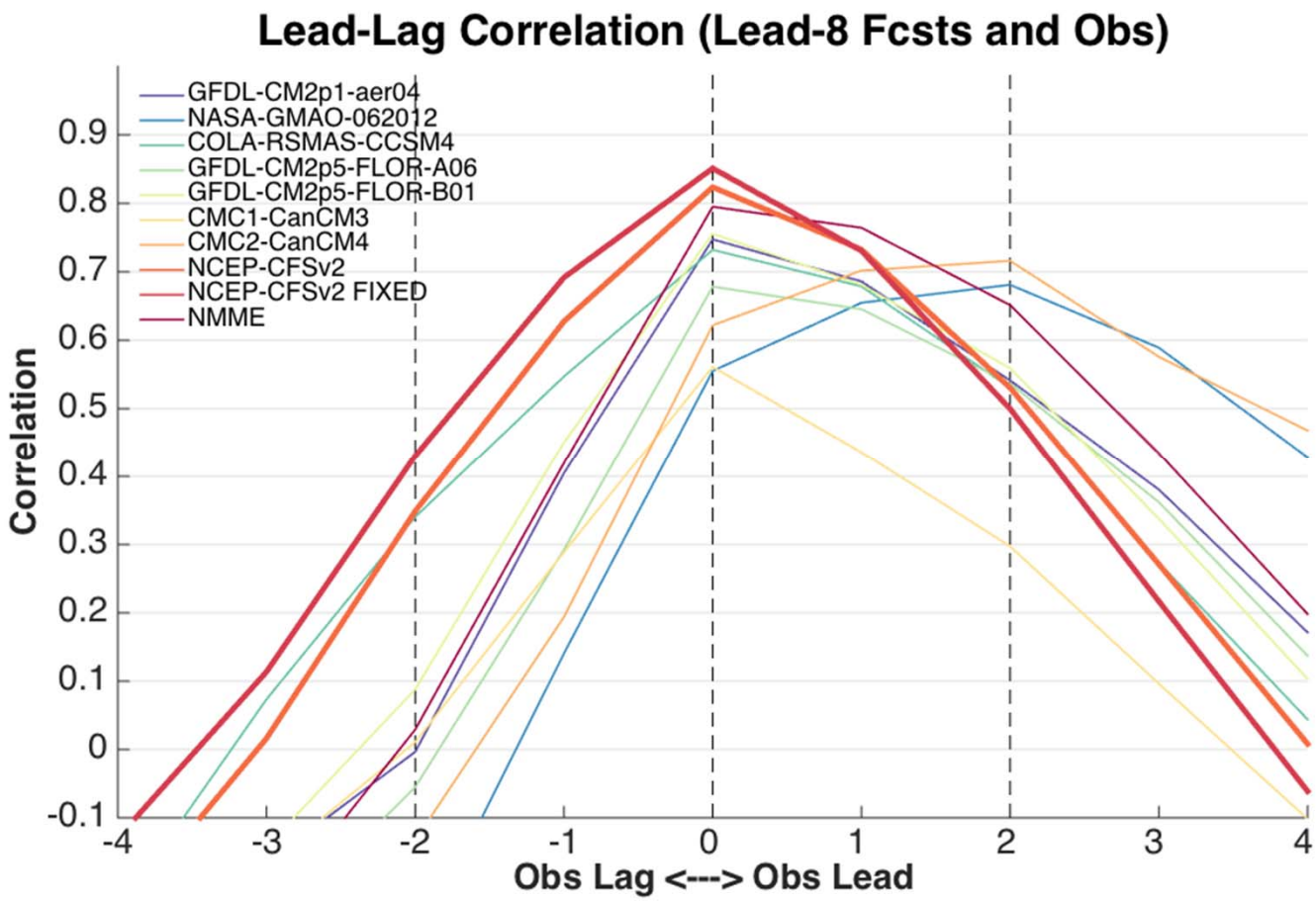
- Appears to affect longest lead forecasts the most. These forecasts are slow to transition into and out of ENSO events.

- It appears to be more severe during lower skill/lower variability ENSO periods

- See Barnston et al. 2012 (BAMS) and Tippett et al. 2012 (JAMC) for more documentation on this feature.

Target Period Slippage for Lead = 8 Fcsts during 2015-16

- Ideally, want to see symmetric shape, with the largest correlation at zero lag (peak in the observations near peak in the forecasts).
- Many models tend to "slip." NASA and CanCM4 have peak correlation at +2mo. lead.
- Most have elevated correlations when the *observations lead* (right skewed)



Wrap-Up

- Niño-3.4 SST (ENSO) forecasts during 2015-16 were overall quite good.
- Official messages noted the development of El Niño during March 2015 with a potential of a strong event by June 2015 (Top 3 event by August 2015).
- Initialization/reanalysis is important! Apparent CFSR issues impacted the CFSv2 skill scores during the 2015-16 event.
- North American Multi-Model (NMME) and other multi-model plumes (e.g. IRI/CPC) were valuable, providing a backstop for ENSO forecasters
- Still dealing with “target period slippage” for longer lead forecasts of the Niño-3.4 SST index