



Issues with Current ENSO Forecasts: Interpreting it and how to use it

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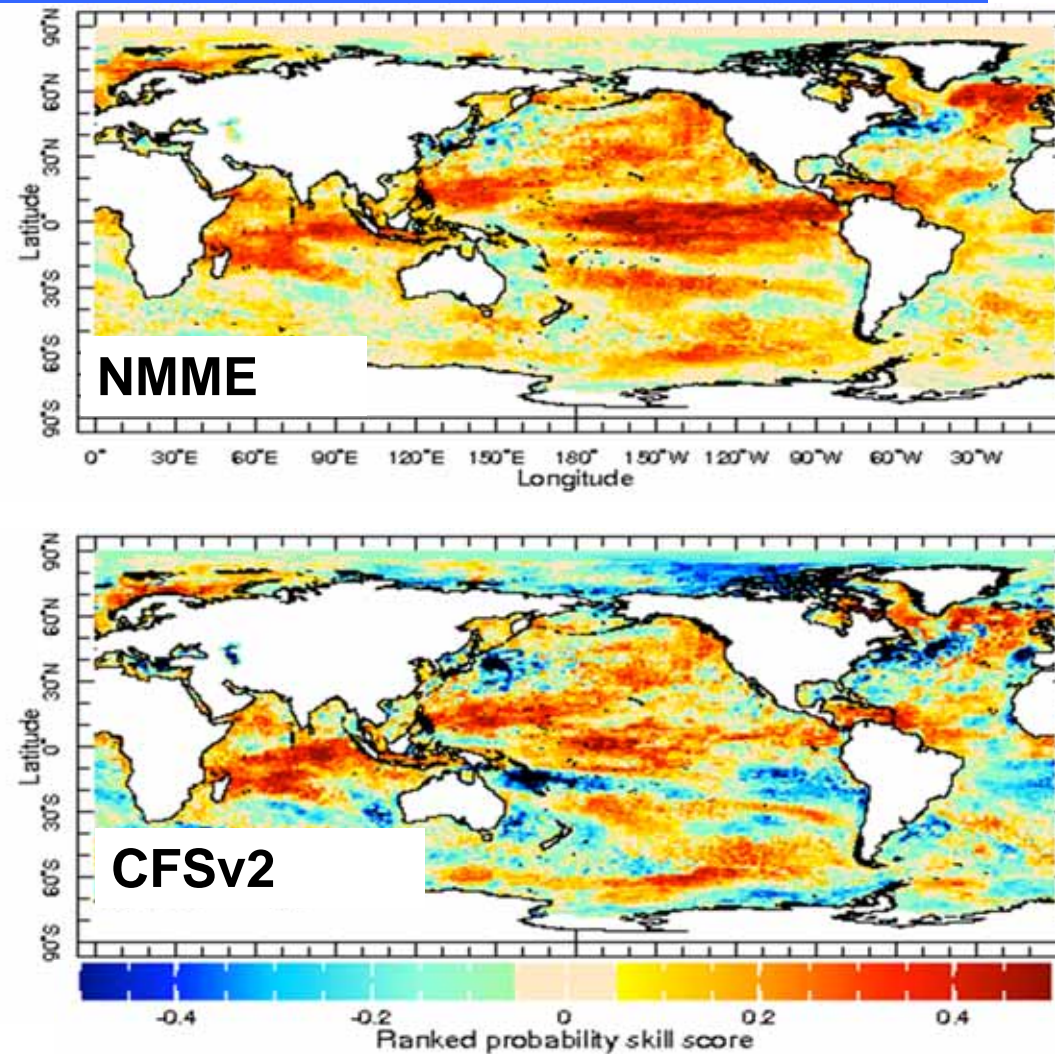
Model	Hindcast Period	No. of Members	Arrangement of Members	Lead (month)	Model resolution (atmosphere)	Model resolution (ocean)	Reference
NCEP/CF Sv2	1982-2010	24 (20)	4 members (0, 6, 12, 18z)	0-9	T126L64	MOM4L40 .25deg Eq	Saha et al (2010)
GFDL/CM 2.1	1982-2010	10	All 1 st of the month 0Z	0-11	2x2.5degL24	MOM4L50 .3deg Eq	Delworth (2006)
GFDL/CM 2.5 (FLOR)	1982-present	24	All 1 st of the month 0Z	0-11	C18L32 (50km)	MOM5 L50 0.30 deg Eq 1degPolar1.5	Vecchi et al (2014)
CMC1-CanCM3	1981-2010	10	All 1 st of the month 0Z	0-11	CanAM3 T63L31	CanOM4L40 .94deg Eq	Merryfield et al (2013)
CMC1-CanCM4	1981-2010	10	All 1 st of the month 0Z	0-11	CanAM4 T63L35	CanOM4L40 .94deg Eq	Merryfield et al (2013)
NCAR/CC SM3	1982-2010	6	All 1 st of the month 0Z	0-11	T85L26	POPL42 0.3deg Eq	Kirtman and Min2009)
NCAR/CC SM4	1982-2010	10	All 1 st of the month 0Z	0-11	0.9x1.25degL26	POPL60 .25deg Eq	Kirtman et al. (in prep)
NCAR/CE SM1	1982-2010	10	All 1 st of the month 0Z	0-11	0.9x1.25degL30	POPL60 .25deg Eq	
NASA/GE OS5	1981-2010	11	4 members every 5 th days; 7 members on the last day of last month	0-9	1x1.25 deg L72	MOM4L40 .25deg Eq	Vernieres et al (2012)
IRI-ECHAM4f	1982-2010	12	All 1 st of the month 0Z	0-7	T42L19	MOM3L25(1.5x0.5)	DeWitt (2005)
IRI-ECHAM4a	1982-2010	12	All 1 st of the month 0Z	0-7	T42L19	MOM3L25(1.5x0.5)	DeWitt (2005)

Model Diversity

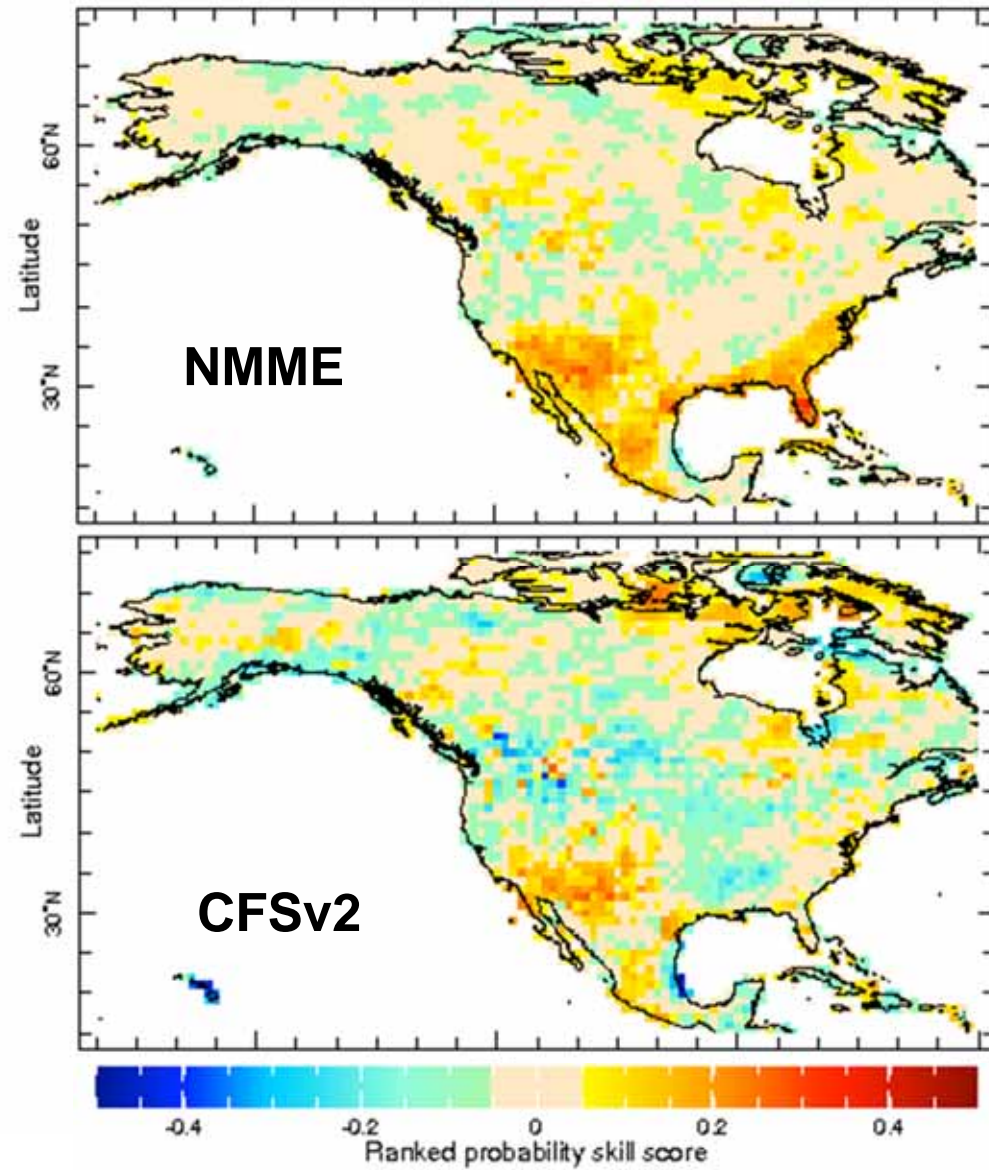
- **Comparing CFSv2 with NMME**
 - **Skill Comparison: Model Diversity or Ensemble Size**
- **Comparing Any Model with NMME**
 - **Skill Comparison: Model Diversity or Ensemble Size**

Comparison of CFSv2 skill vs NMME

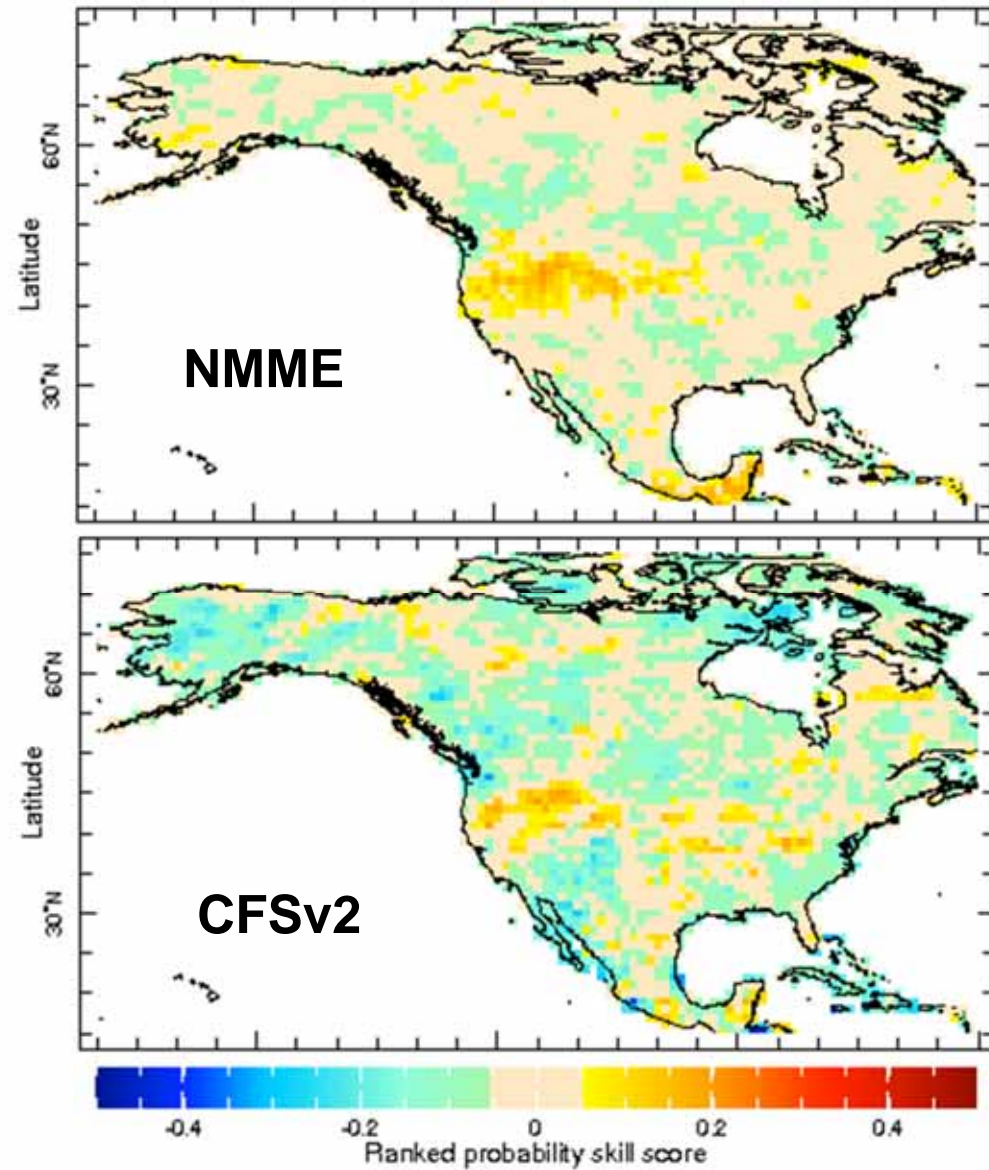
July 1 start
DJF SST forecast
Ranked Probability Skill
Score



July 1 start
DJF prec
forecast
RPSS

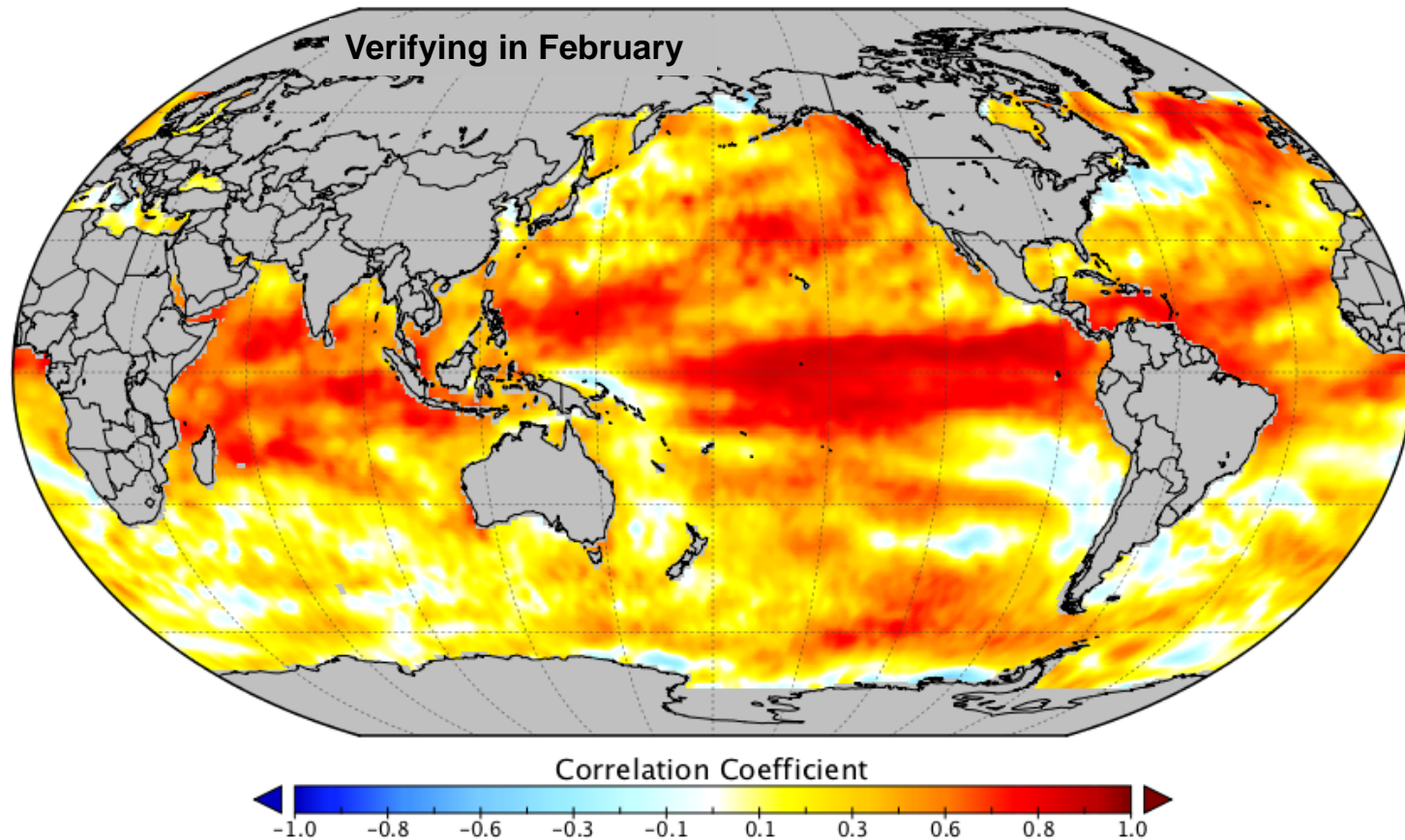


Jan 1 start
JJA prec
forecast
RPSS



Multi-Model: Complementary Skill

US NMME SSTA Correlation Coefficient
6 Month Lead August Initial Conditions (1982-2010)

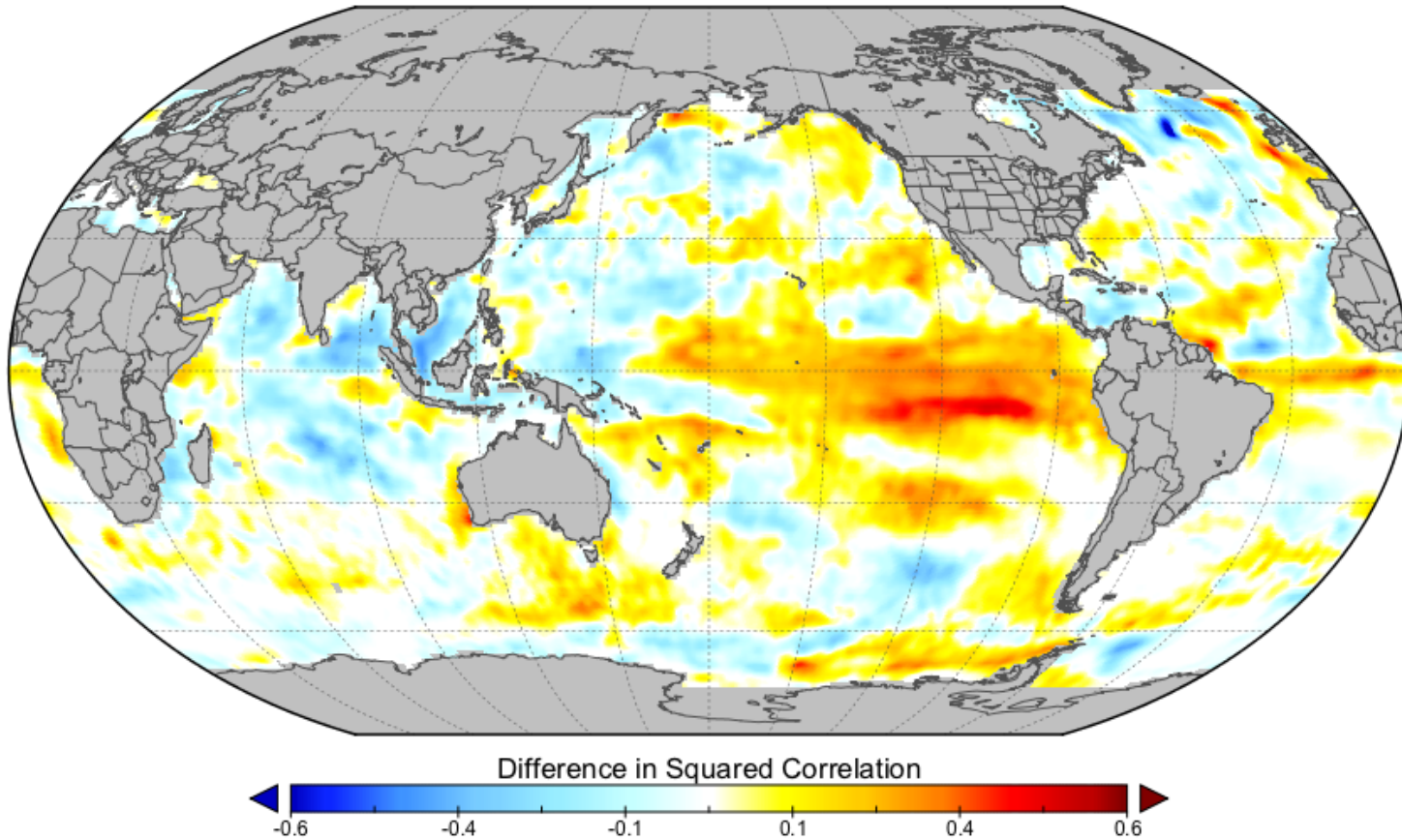


Each Ensemble Member from Each Model Weighted Equally – 83 Ensemble Members

Complementary Correlation

All Others (24 Member Ensemble) vs. CFSv2

Lead Time 6 Months (August Initial Conditions)

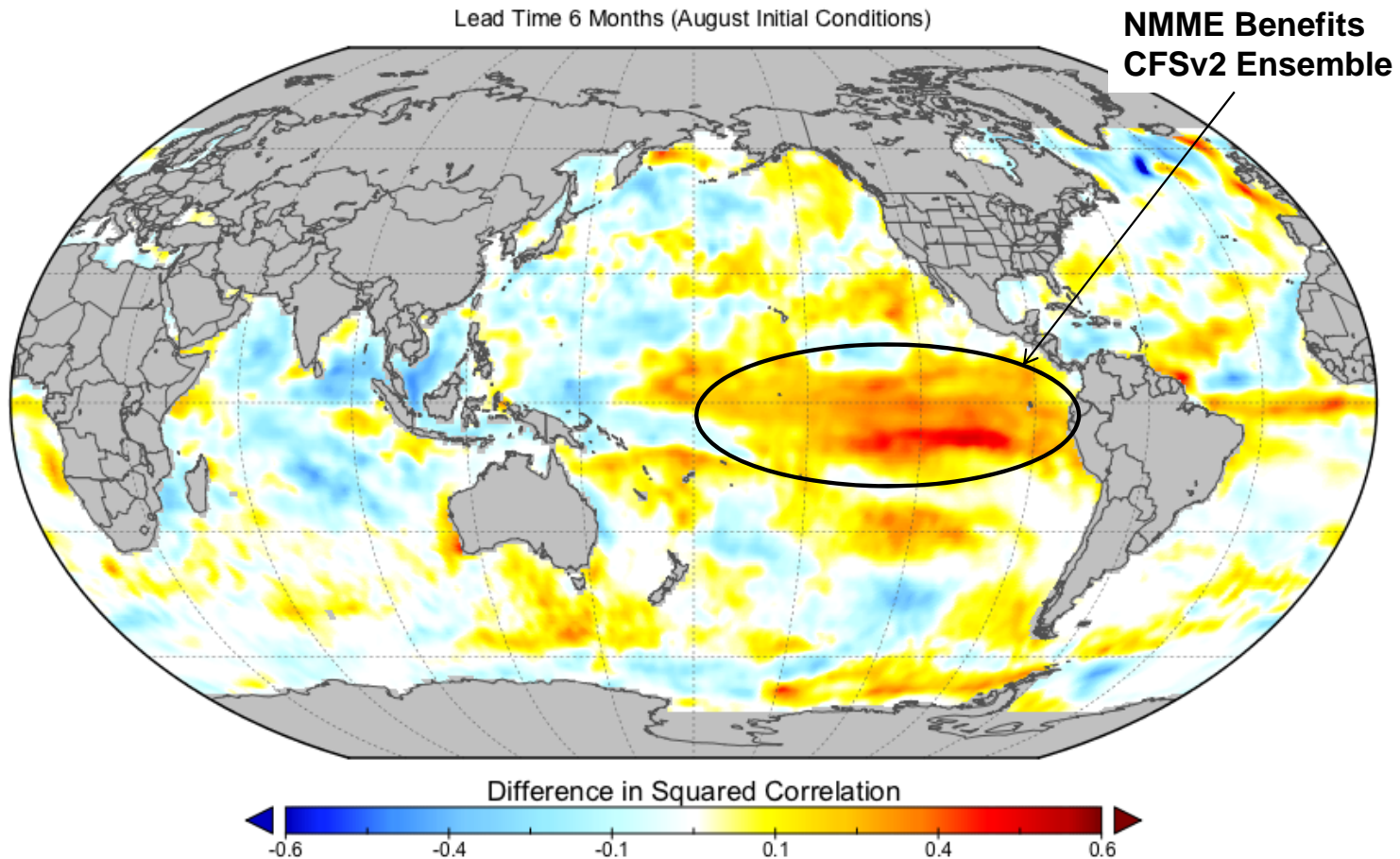


CCSM3(4)+IRIa(4)+IRId(4)+CM2.1(4)+GEOS5(4)+CFSv1(4) vs. CFSv2(24)

Complementary Correlation

All Others (24 Member Ensemble) vs. CFSv2

Lead Time 6 Months (August Initial Conditions)

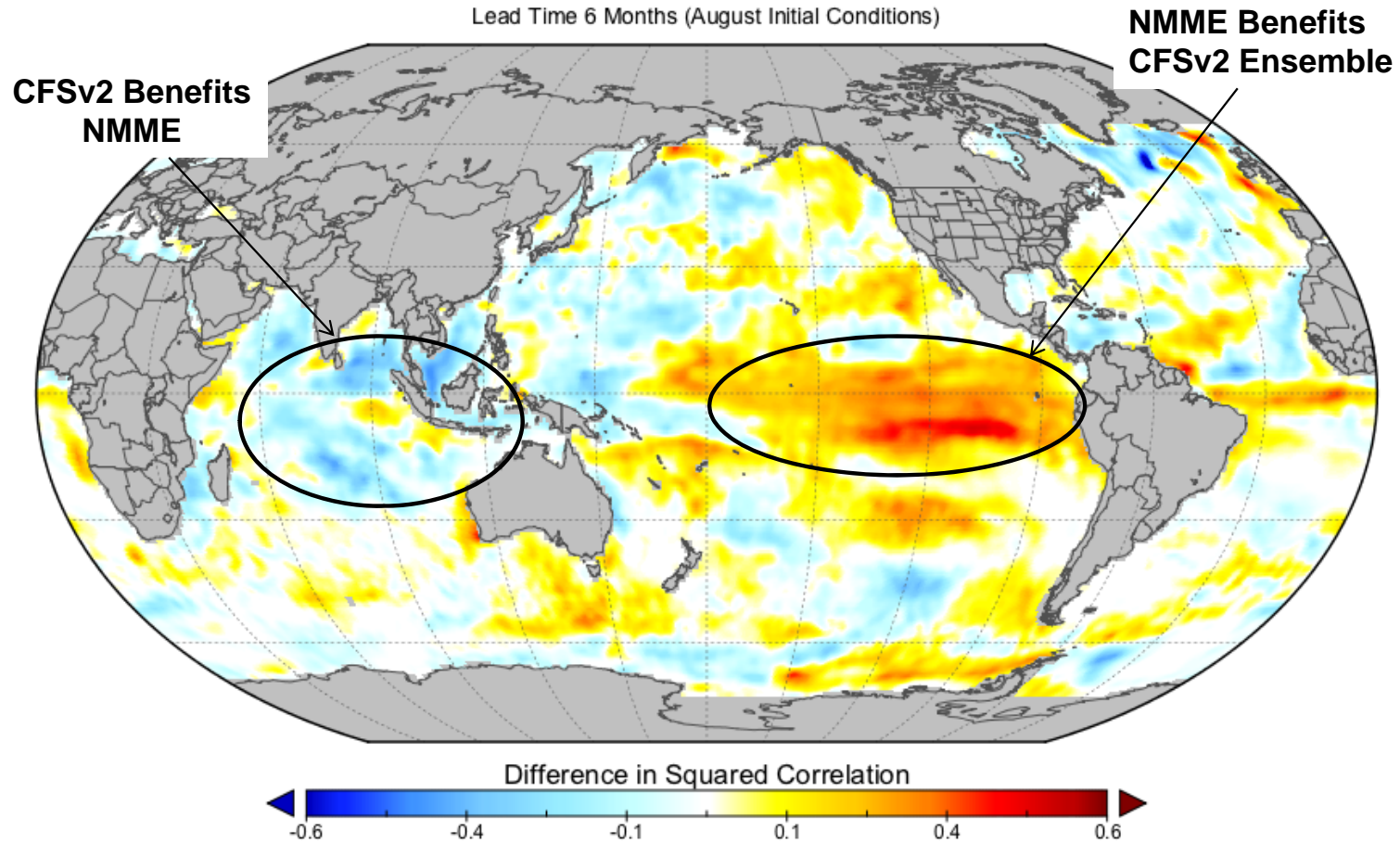


CCSM3(4)+IRIa(4)+IRId(4)+CM2.1(4)+GEOS5(4)+CFSv1(4) vs. CFSv2(24)

Complementary Correlation

All Others (24 Member Ensemble) vs. CFSv2

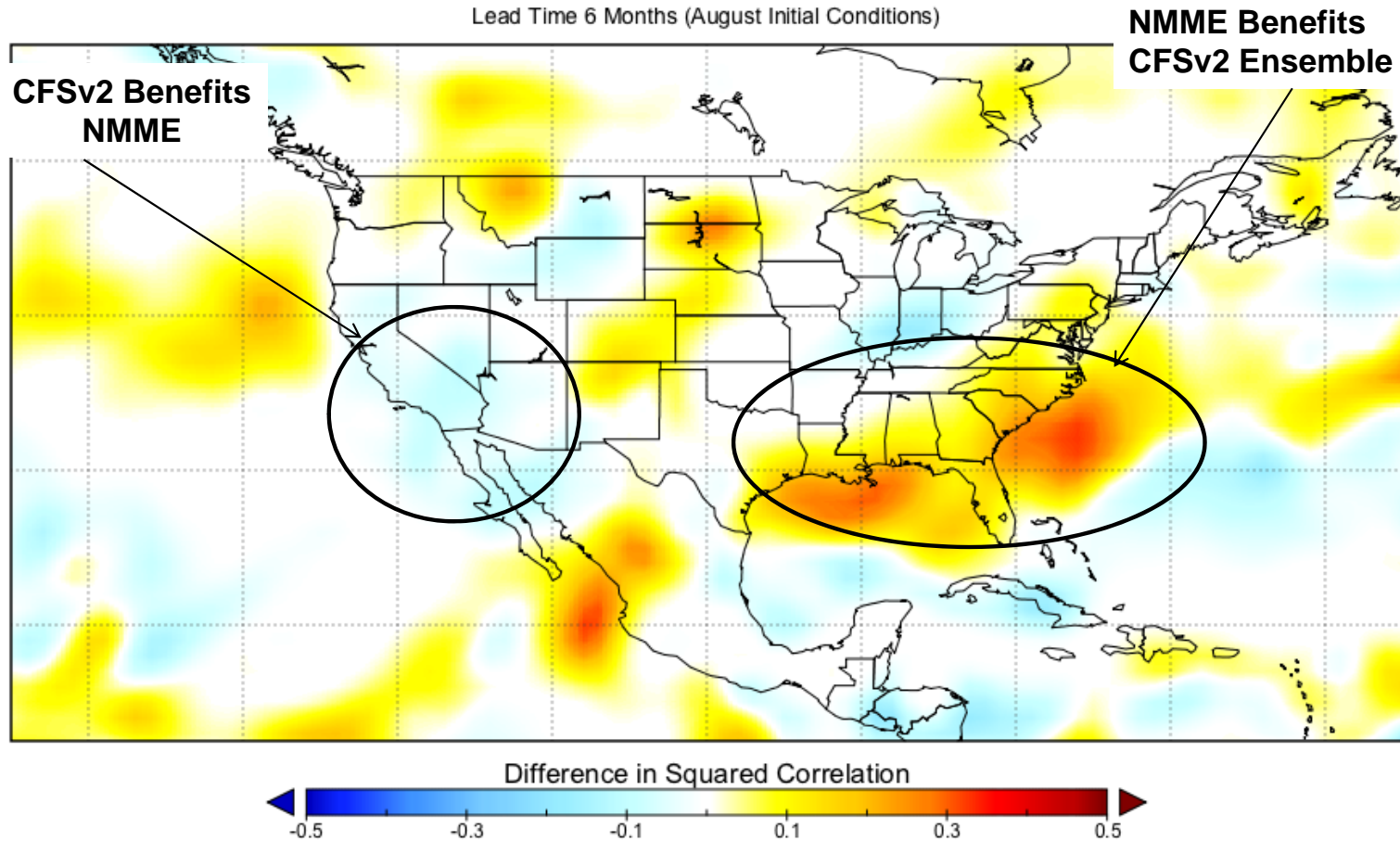
Lead Time 6 Months (August Initial Conditions)



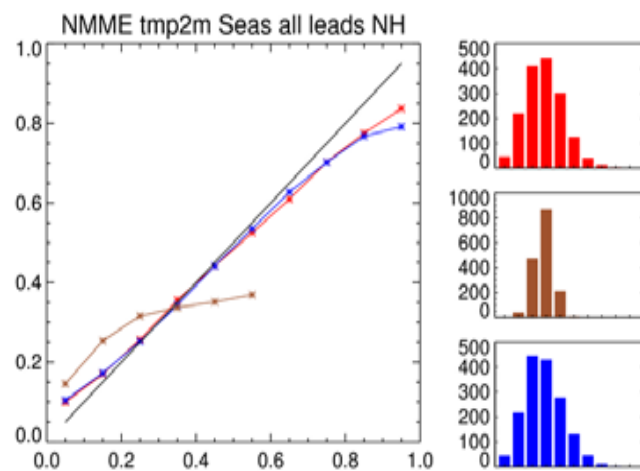
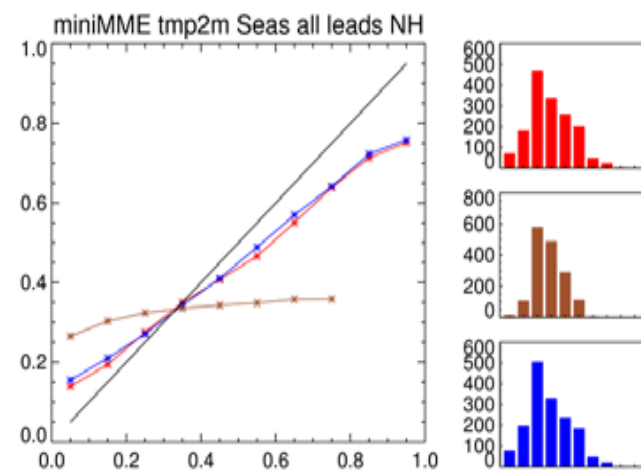
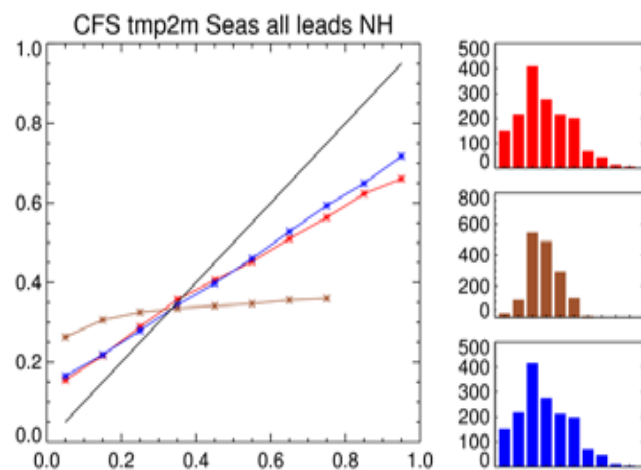
CCSM3(4)+IRIa(4)+IRId(4)+CM2.1(4)+GEOS5(4)+CFSv1(4) vs. CFSv2(24)

All Others (24 Member Ensemble) vs. CFSv2

Lead Time 6 Months (August Initial Conditions)



CCSM3(4)+IRIa(4)+IRId(4)+CM2.1(4)+GEOS5(4)+CFSv1(4) vs. CFSv2(24)

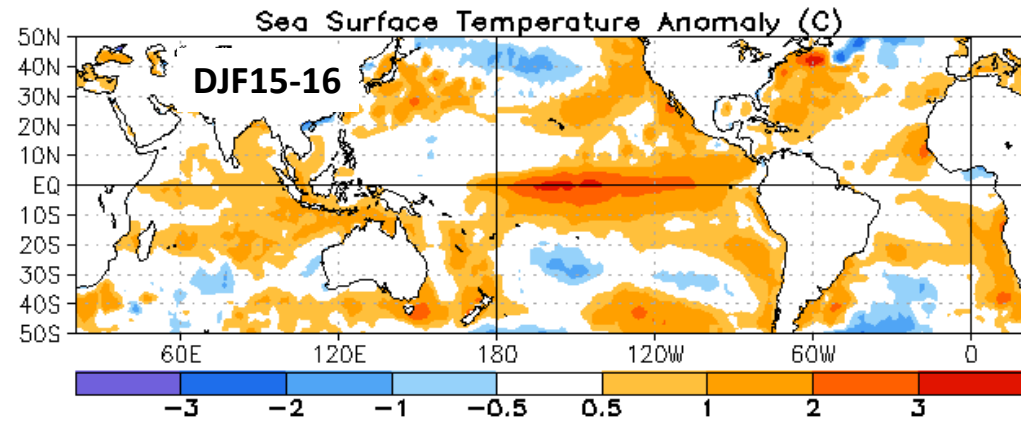
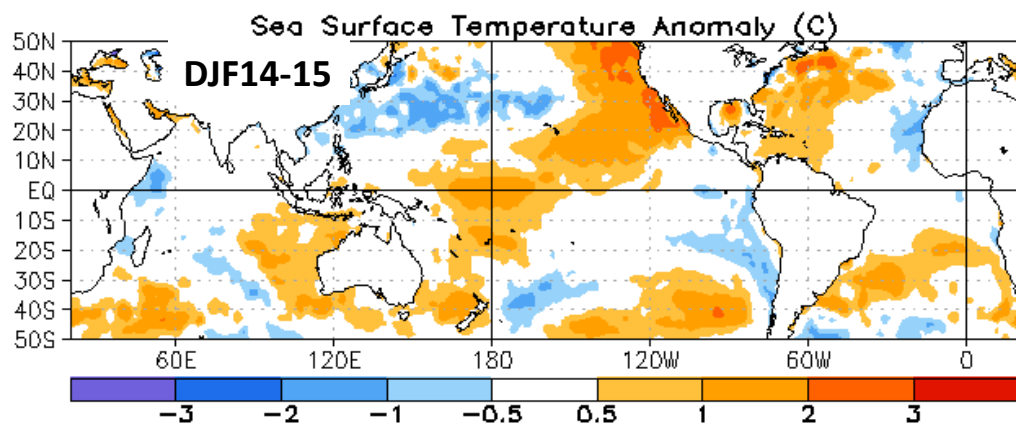
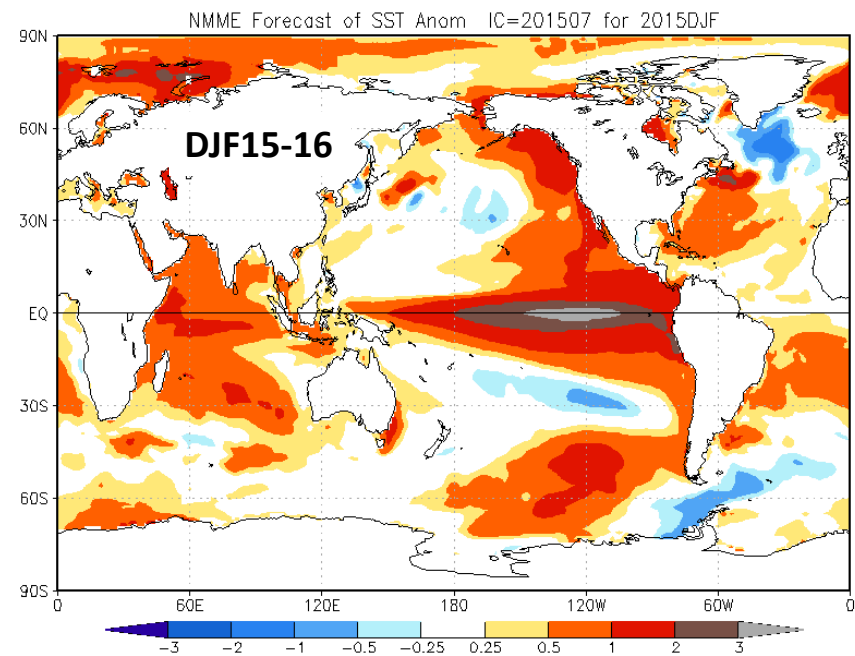
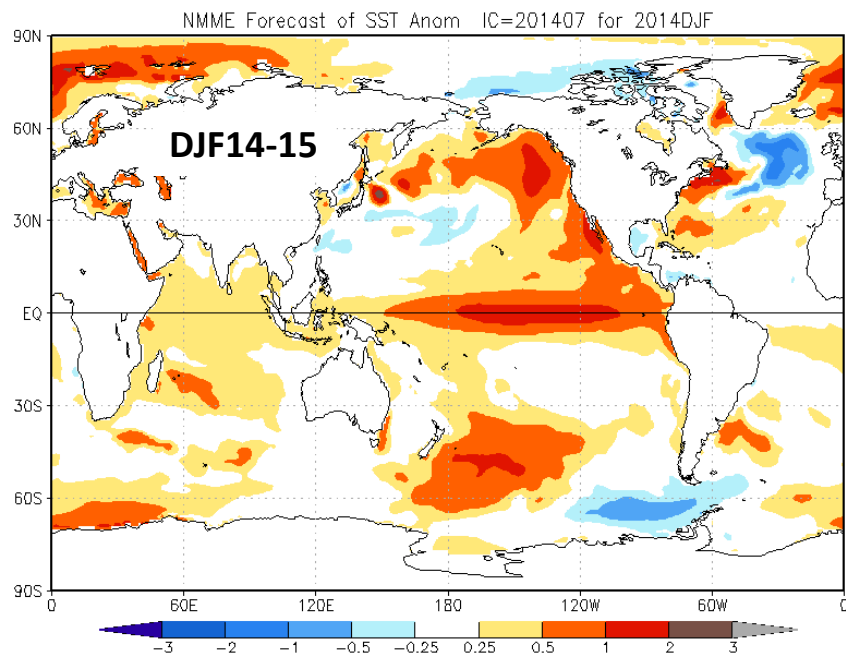


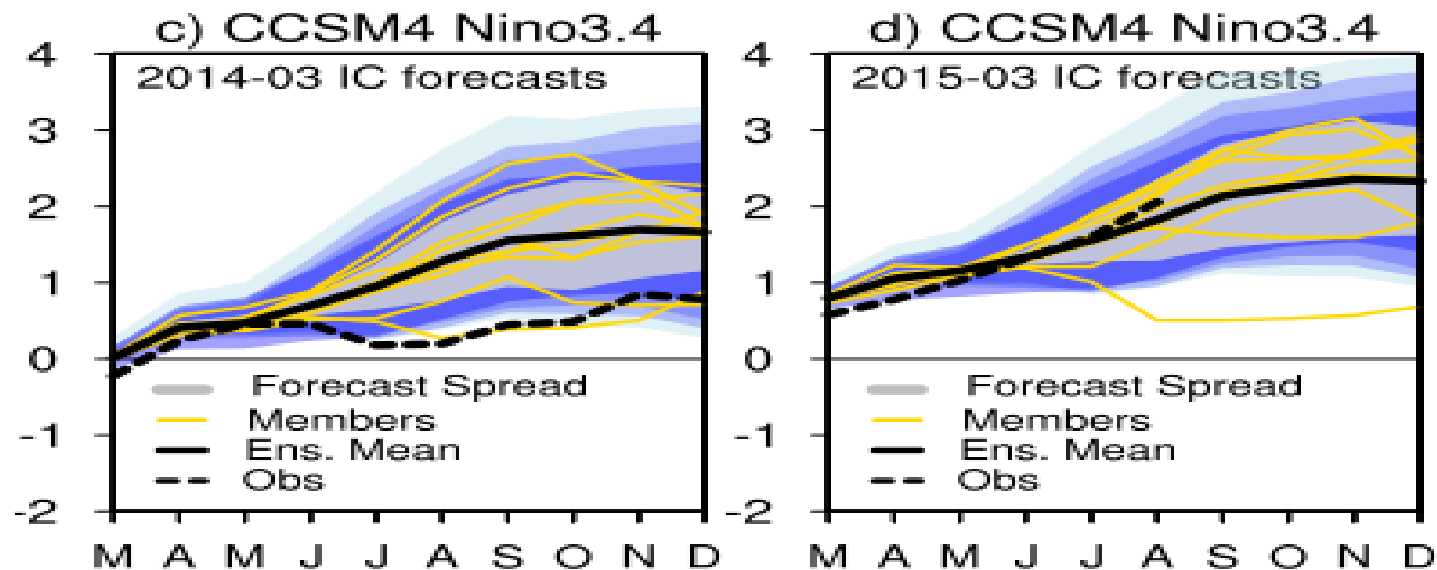
Brier Skill Score for T2m Northern Hemisphere Extra-tropics Land (23N-75N)

	A/N/B	Lead 0	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5
CFS (24 Members)	Above	0.10	0.03	0.01	0.01	0.01	0.01
	Normal	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04
	Below	0.10	0.04	0.03	0.02	0.02	0.02
Mini-NMME (24 Members)	Above	0.12	0.05	0.03	0.03	0.02	0.02
	Normal	-0.02	-0.04	-0.04	-0.04	-0.04	-0.04
	Below	0.11	0.05	0.04	0.03	0.03	0.03
Full NMME	Above	0.14	0.07	0.06	0.06	0.05	0.05
	Normal	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
	Below	0.14	0.08	0.06	0.06	0.06	0.05

Brier Skill Score for Nino3.4

	A/N/B	Lead 0	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5
CFS (24 Members)	Above	0.54	0.45	0.39	0.33	0.28	0.25
	Normal	0.10	0.05	0.03	0.03	0.03	0.02
	Below	0.49	0.43	0.40	0.38	0.36	0.35
Mini-NMME (24 Members)	Above	0.68	0.60	0.55	0.48	0.42	0.37
	Normal	0.34	0.24	0.18	0.15	0.13	0.09
	Below	0.66	0.59	0.56	0.53	0.49	0.45
Full NMME	Above	0.68	0.61	0.55	0.49	0.43	0.38
	Normal	0.35	0.25	0.19	0.16	0.14	0.11
	Below	0.65	0.58	0.54	0.52	0.49	0.46

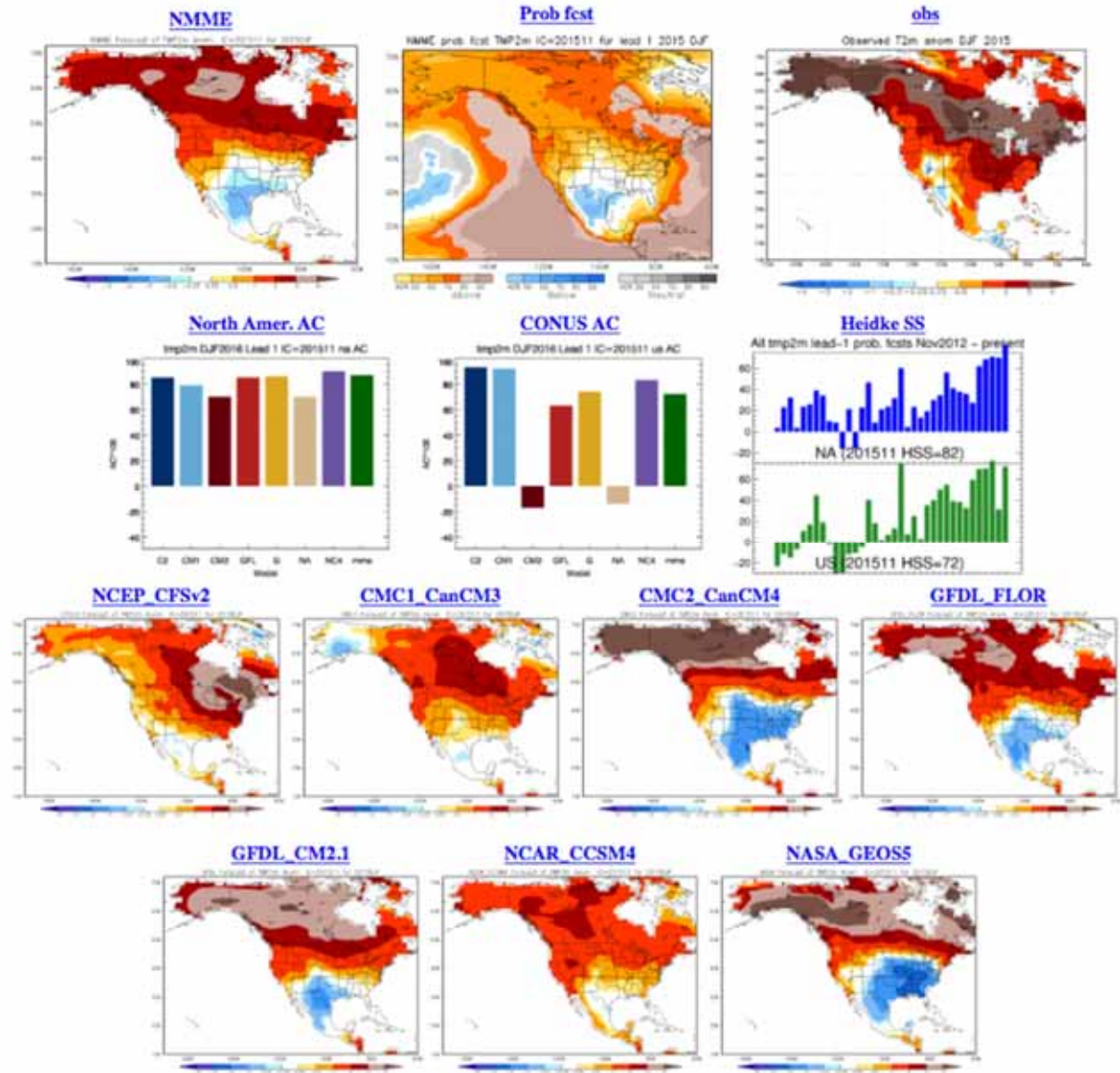




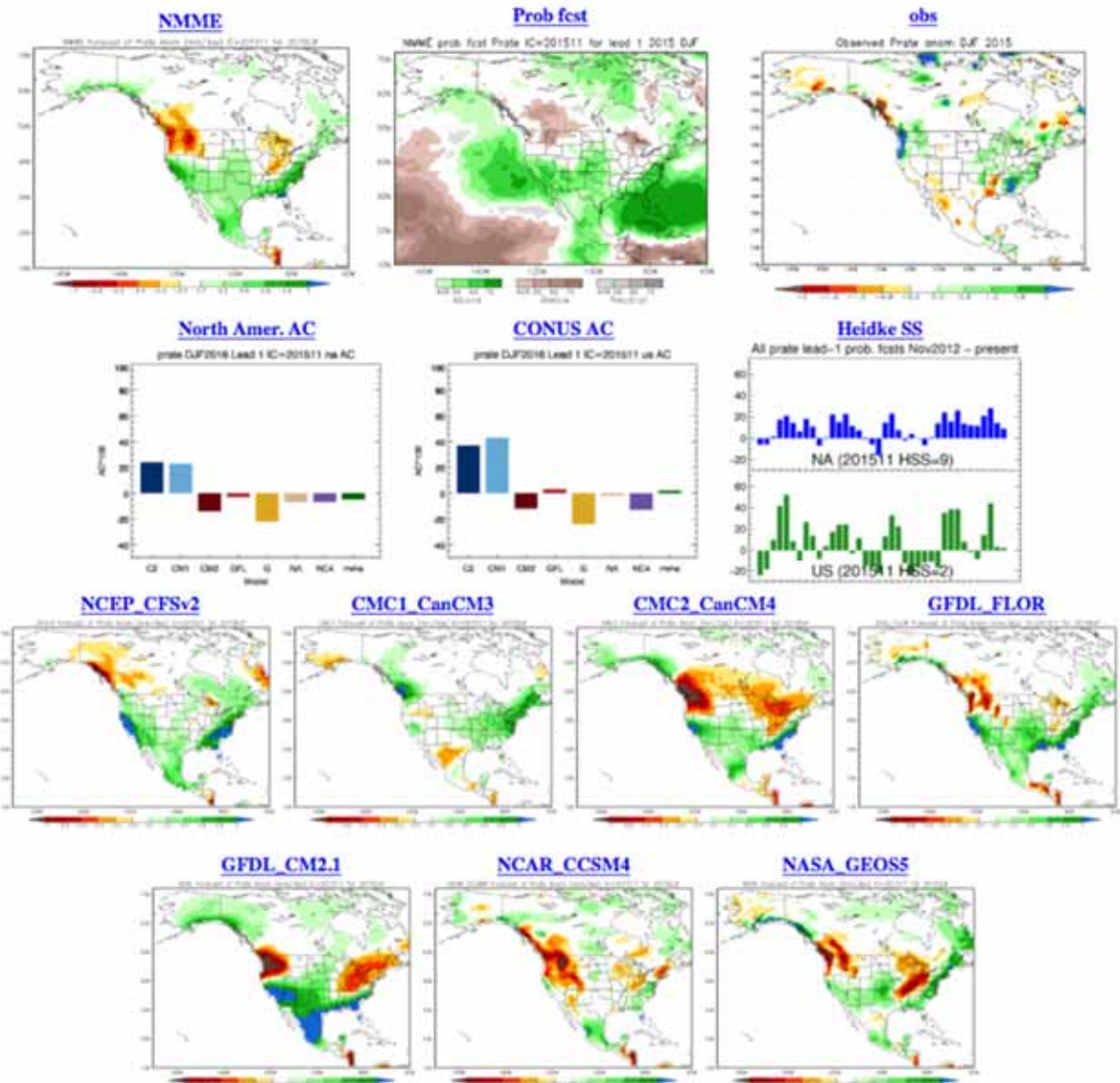
- Observed 2014 Nino-3.4 falls within the “expected” noise-driven spread
- “Expert assessment” of longer lead-time forecasts may benefit from a measure of the noise-driven “expected” spread

Larson and Kirtman (2015a)

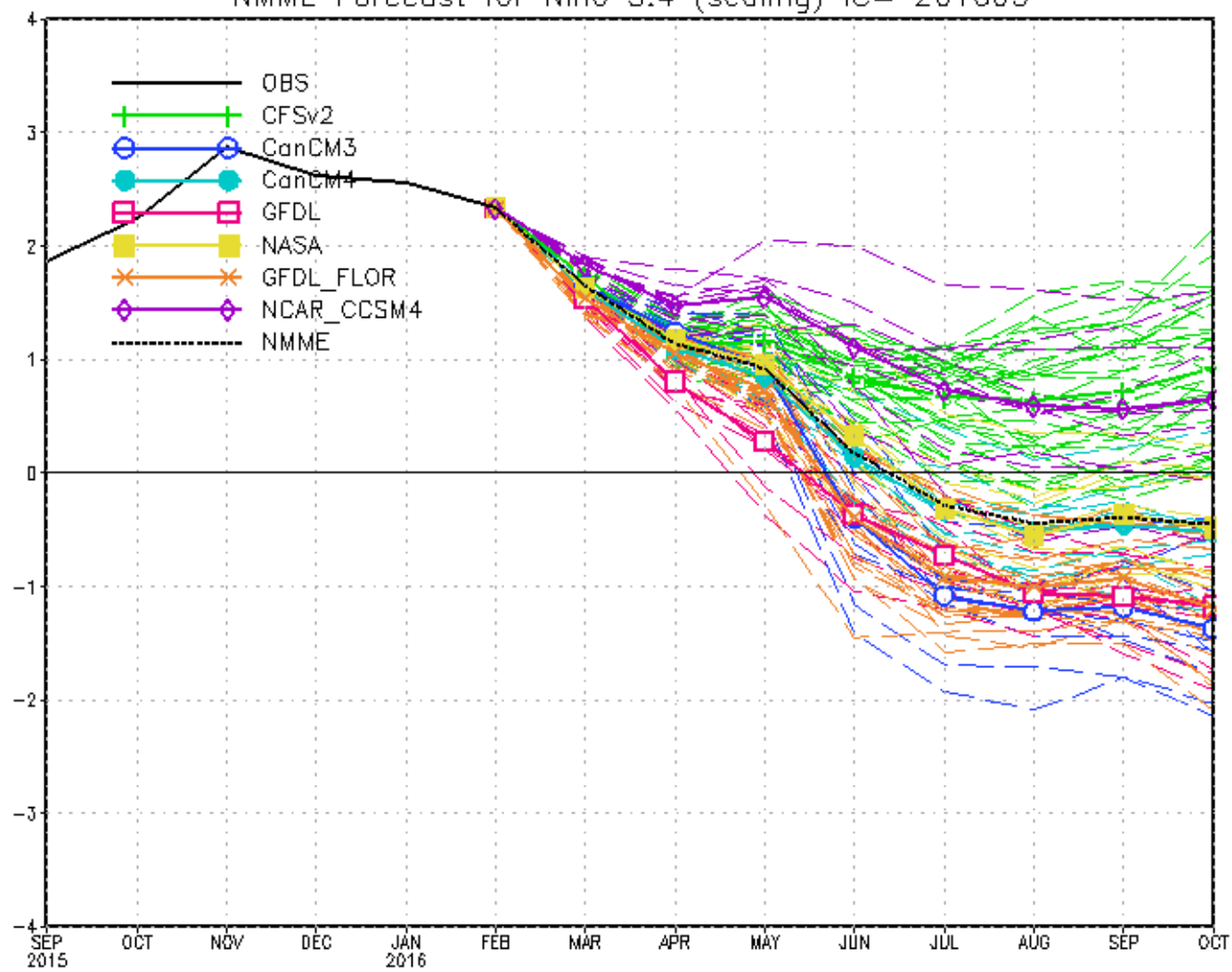
DJF 2016 T2m Forecast Verification November 2016 Initial Condition

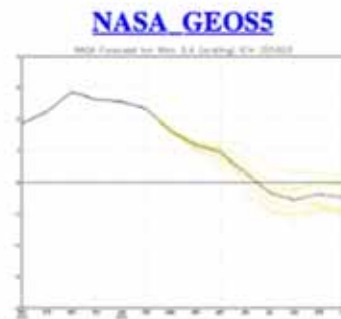
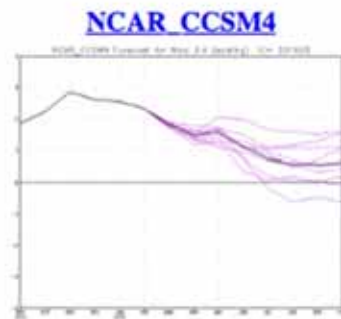
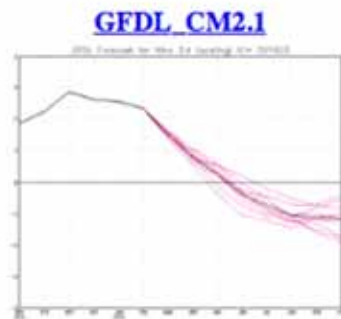
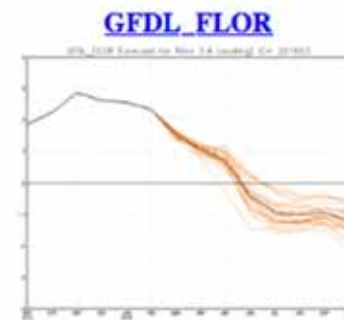
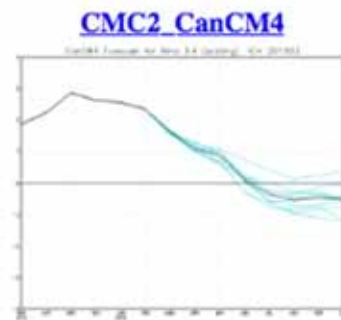
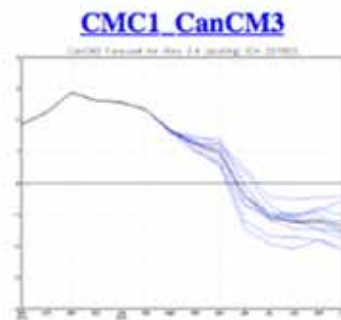
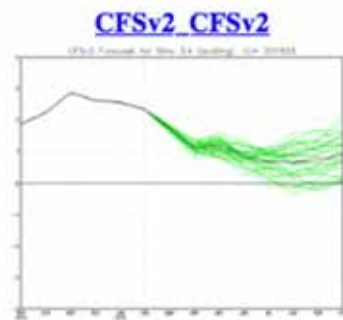


DJF 2016 Precipitation Forecast Verification November 2016 Initial Condition

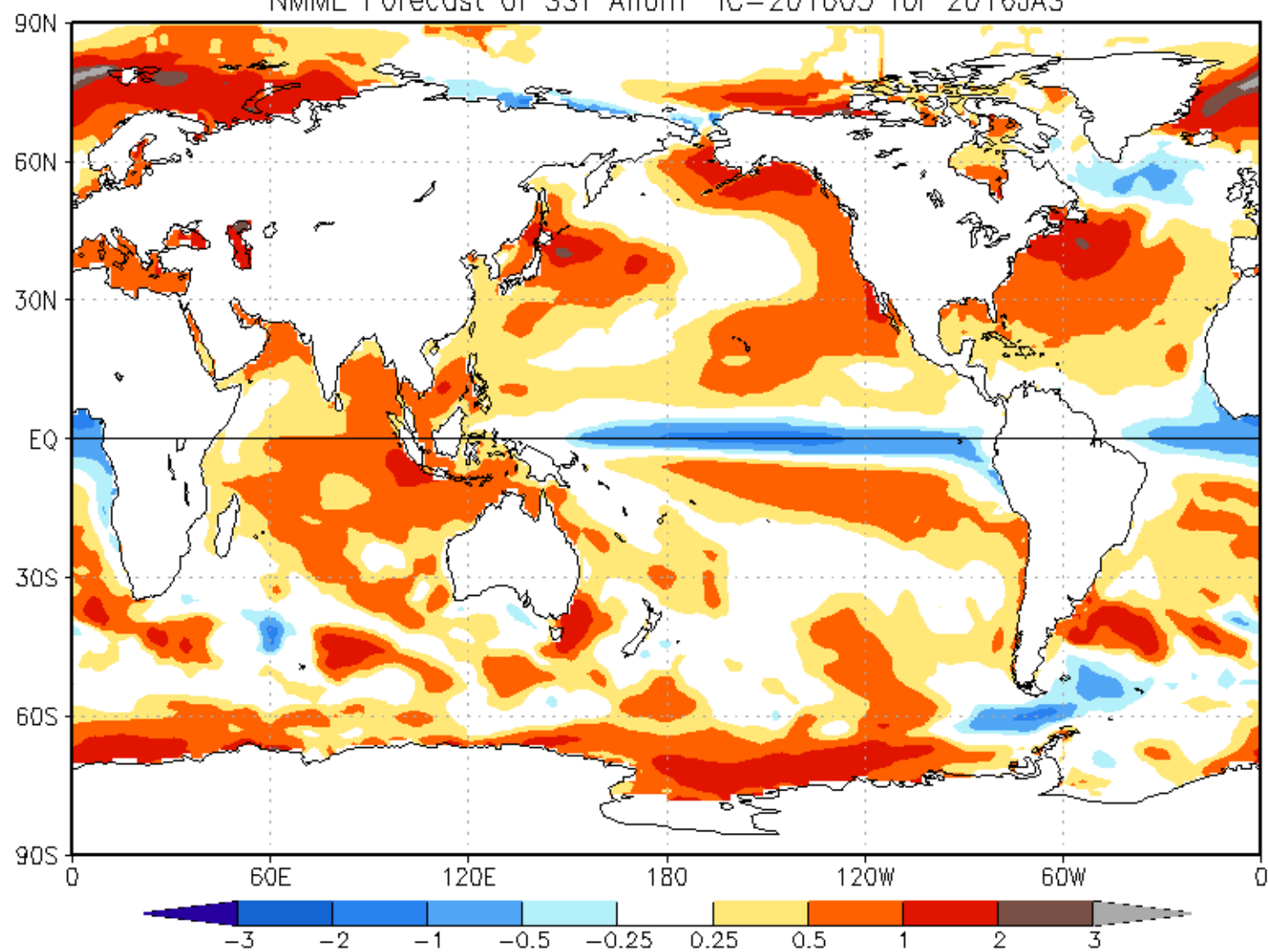


NMME Forecast for Nino 3.4 (scaling) IC= 201603

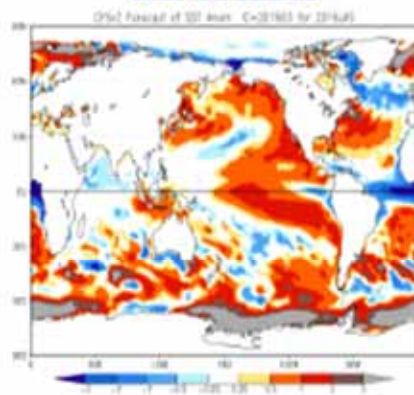




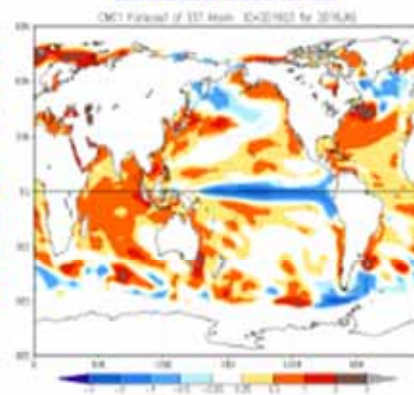
NMME Forecast of SST Anom IC=201603 for 2016JAS



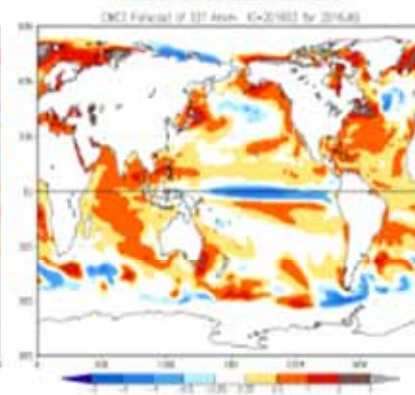
NCEP_CFSv2



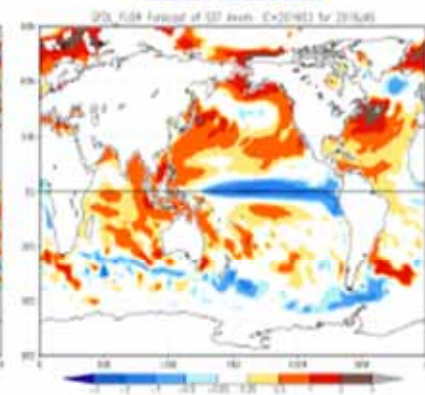
CMC1_CanCM3



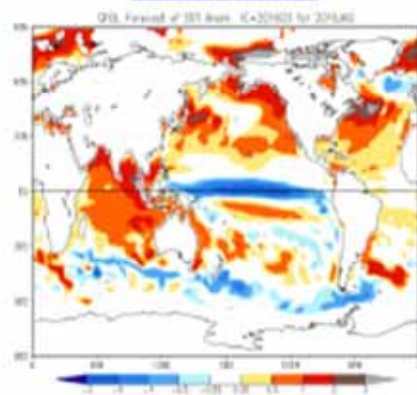
CMC2_CanCM4



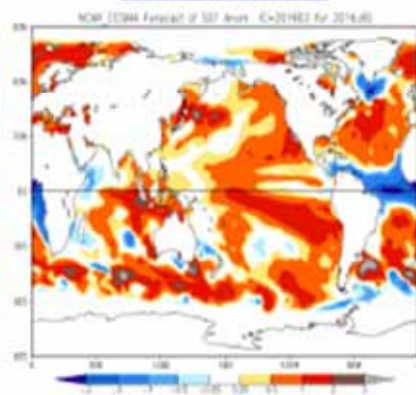
GFDL_FLOR



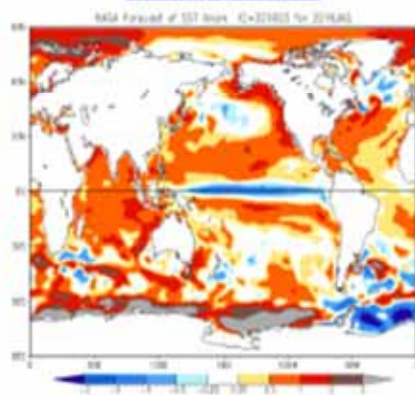
GFDL_CM2.1



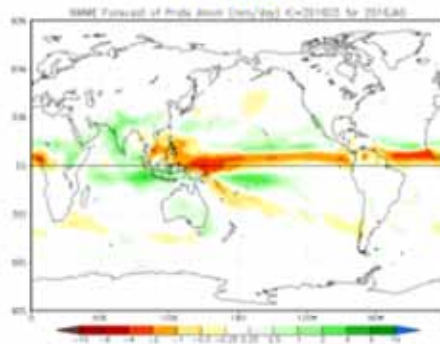
NCAR_CCSM4



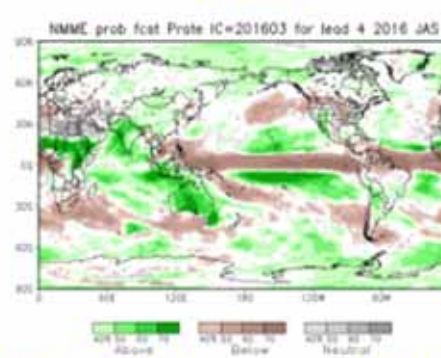
NASA_GEOS5



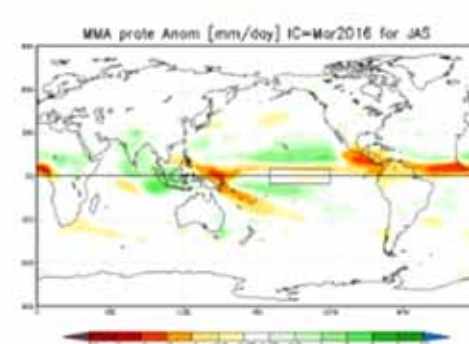
NMME



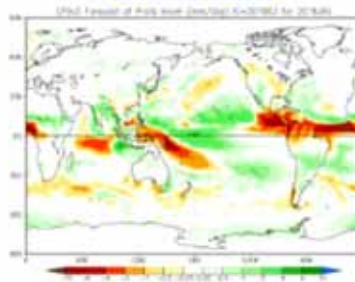
Prob fcst



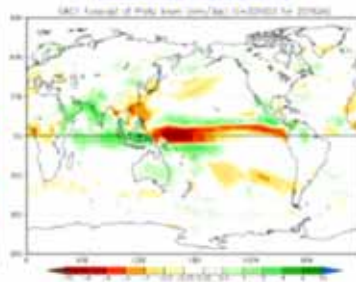
IMME



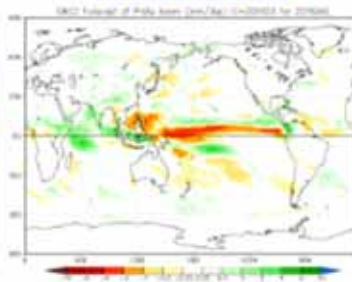
NCEP_CFSv2



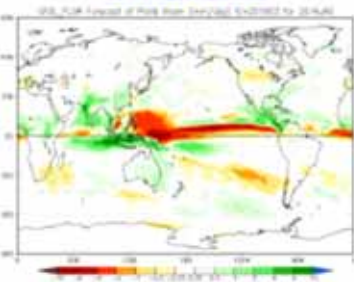
CMC1_CanCM3



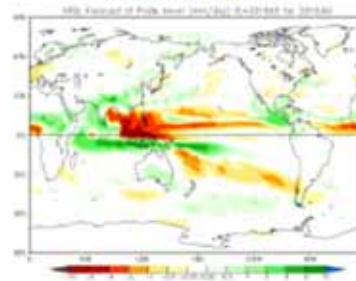
CMC2_CanCM4



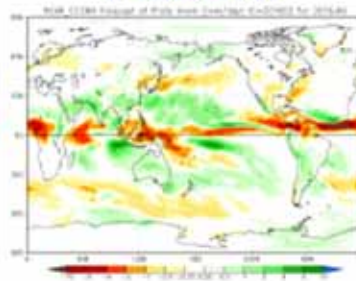
GFDL_FLOR



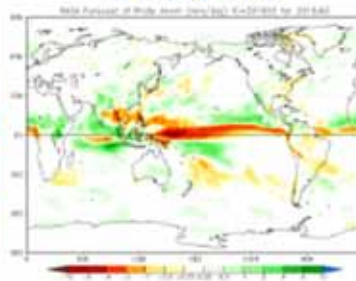
GFDL_CM2.1



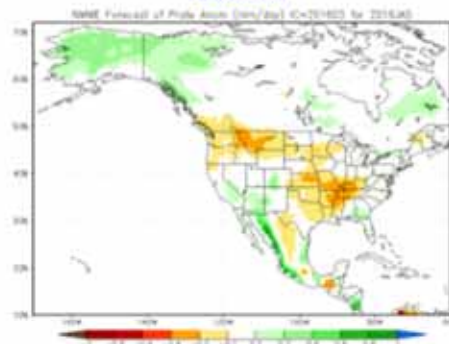
NCAR_CCSM4



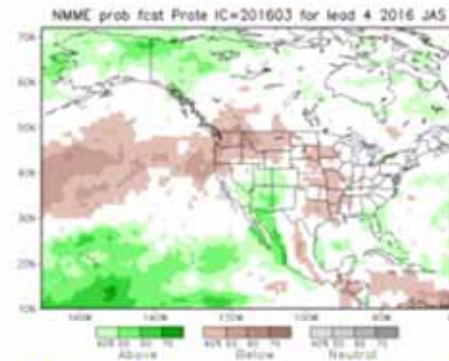
NASA_GEOS5



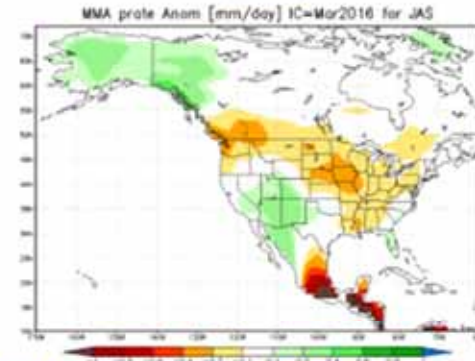
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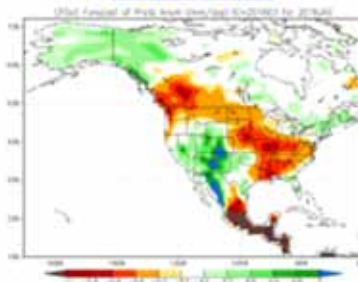
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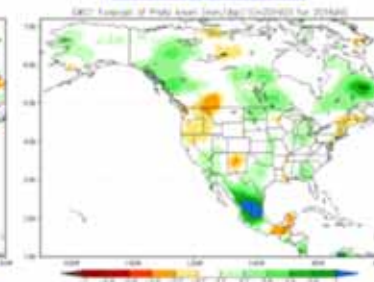
IMME



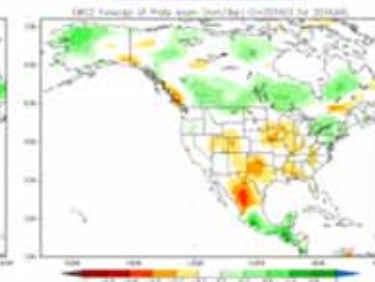
NCEP_CFSv2



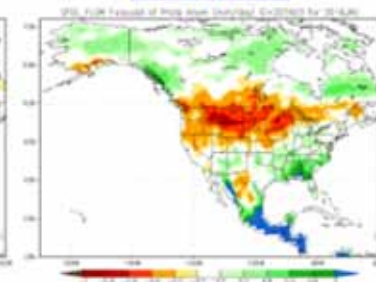
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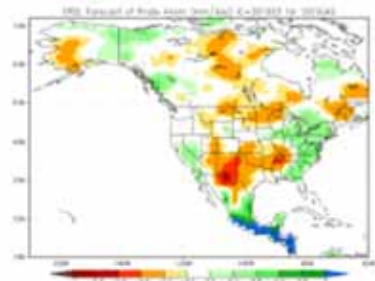
CMC2_CanCM4



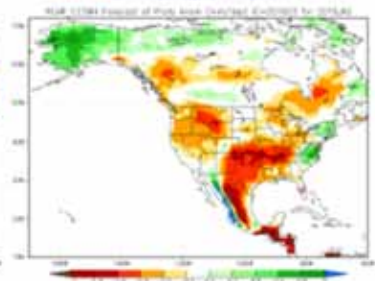
GFDL_FLOR



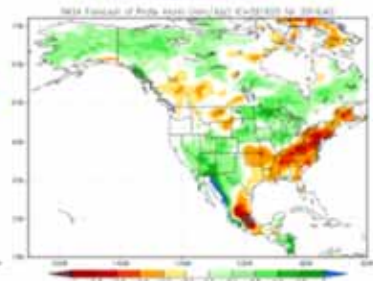
GFDL_CM2.1



NCAR_CCSM4



NASA_GEOS5

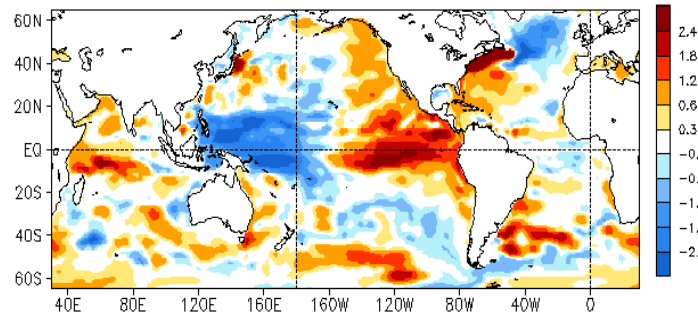




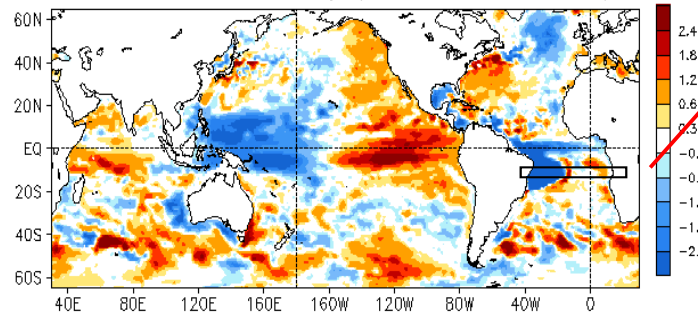
Recent CFSv2 Cold Biases in Tropical South Atlantic



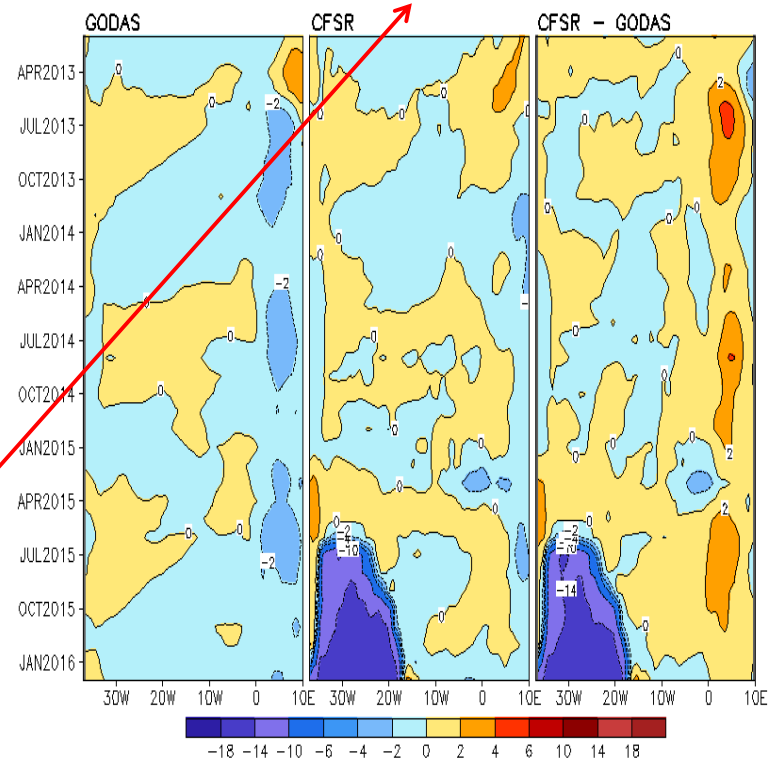
FEB 2016 HC300 Anomaly ($^{\circ}\text{C}$, Clim. 1999–2010): GODAS



FEB 2016 HC300 Anomaly ($^{\circ}\text{C}$, Clim. 1999–2010): CFSR



Temperature Anomaly at $z=55\text{m}$ in 9°S – 11°S ($^{\circ}\text{C}$, Clim. 1999–2010)

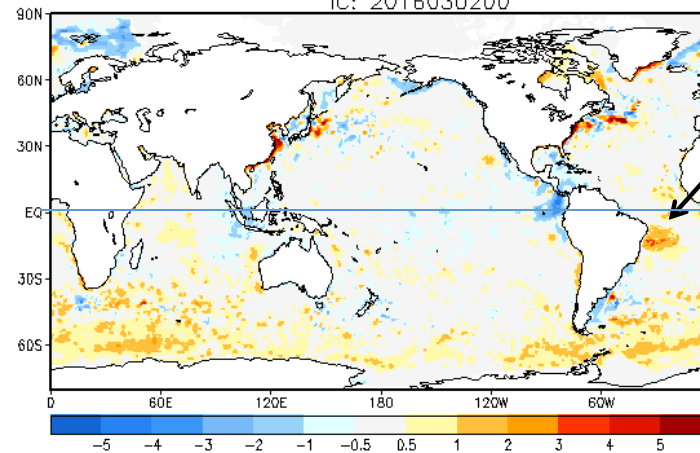


- A cold bias emerged around 10S in the South Atlantic around **Jul 2015** and enhanced quickly with time.
- It reached **-18 degree at 55m depth** since Oct 2015.

CFSv2 : 1-8 March 2016 Initial conditions

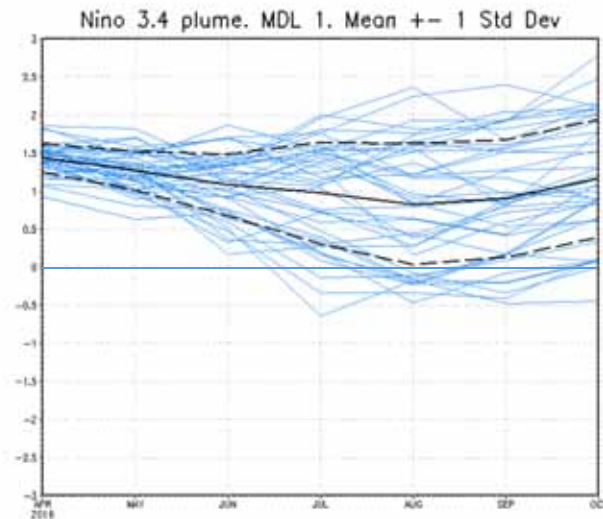
OCN -5m Temp Analysis. Exper minus Oper

IC: 2016030200



Noticeably warmer,
Elimination of the cold
bias in all 4 initial months
of testing.
Also, CFSv2 is not an
outlier as shown on slide 5
for the ENSO evolution.

Operational



Experimental

