

C I C S - M D

Cooperative Institute for Climate and Satellites

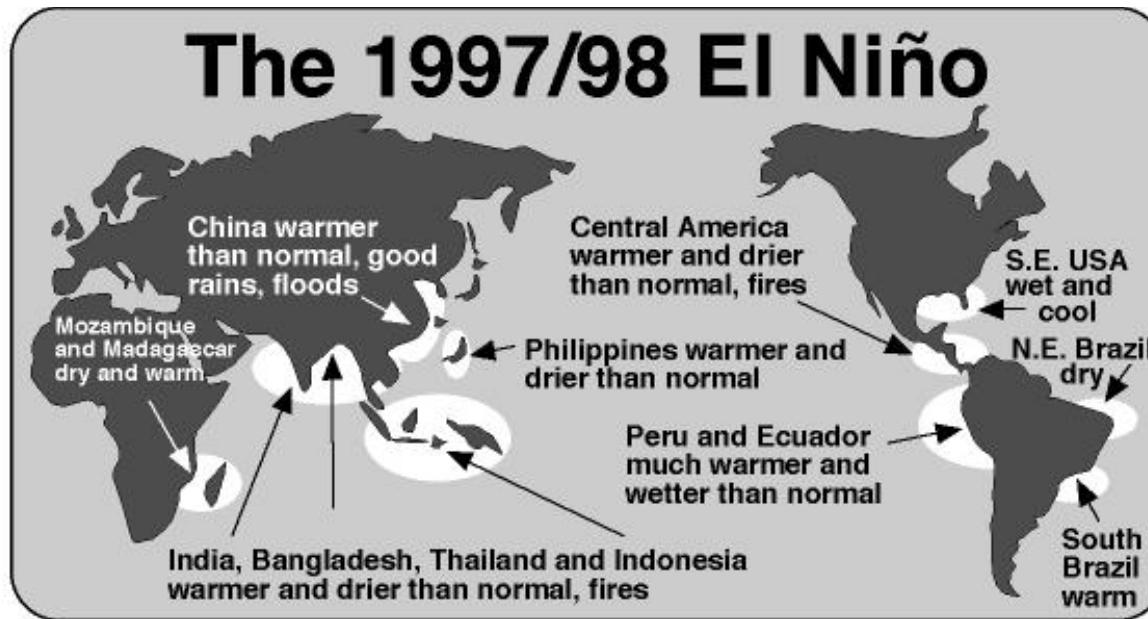
ENSO Simulations in the North American Multi-Model Ensemble: A First Look

Li-Chuan Chen¹, Huug van den Dool², Emily Becker², and Qin Zhang²

1. ESSIC/CICS-MD, University of Maryland, College Park
2. Climate Prediction Center/NCEP/NOAA



ENSO Impacts

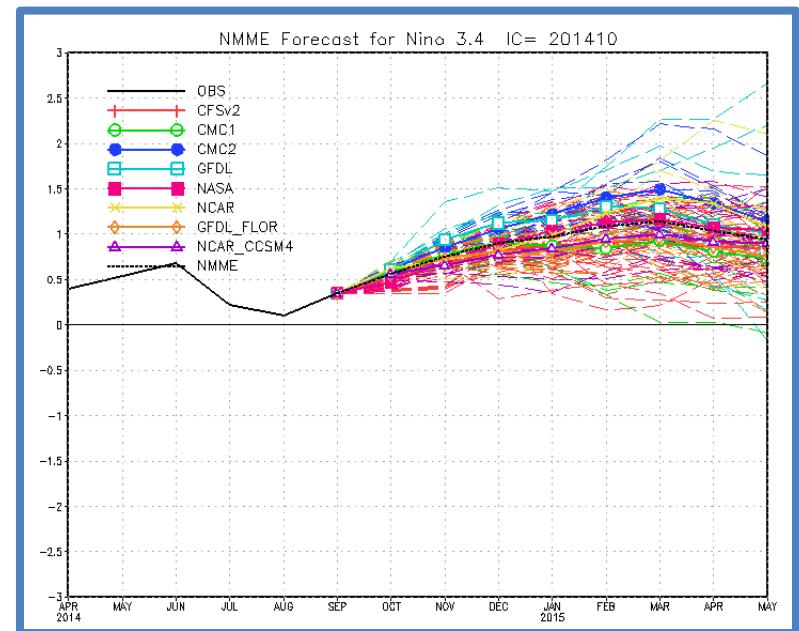


- Strong influence on the seasonal P and T patterns around the globe and over the U.S.
- Improved P and T forecast skill in climate models can be attributed to the known impacts of ENSO signals.

ENSO Prediction

Questions:

- Can climate models predict the onset of ENSO events?
- If ENSO is in progress, can climate models adequately predict its impacts on P and T patterns?





The North American Multi-Model Ensemble

- NMME is an experimental multi-model seasonal forecasting system consisting of coupled climate models from U.S. modeling centers and Canadian Meteorological Centre, aimed at improving intraseasonal to interannual prediction capability.
- The multi-model ensemble approach has proven effective at quantifying prediction uncertainty due to uncertainty in model formulation, and has proven to produce better forecast quality (on average) than any single model ensemble.
- CTB NMME documents:
<http://www.cpc.ncep.noaa.gov/products/ctb/nmme/>
- CPC NMME forecasts:
<http://www.cpc.ncep.noaa.gov/products/NMME/>

NMME Phase-2 Forecast Providers

Model	Hindcast Period	No. of Member	Arrangement of Members	Lead (months)	Model Resolution: Atmosphere	Model Resolution: Ocean	Reference
NCEP-CFSv2	1982-2010	24	4 members (0,6,12,18Z) every 5th day	0-9	T126L64	MOM4 L40 0.25 deg Eq	Saha et al. (2014)
GFDL-CM2.1	1982-2010	10	All 1st of the month 0Z	0-11	2x2.5deg L24	MOM4 L50 0.30 deg Eq	Zhang et al. (2007)
CMC1- CanCM3	1981-2010	10	All 1st of the month 0Z	0-11	CanAM3 T63L31	CanOM4 L40 0.94 deg Eq	Merryfield et al. (2013)
CMC2- CanCM4	1981-2010	10	All 1st of the month 0Z	0-11	CanAM4 T63L35	CanOM4 L40 0.94 deg Eq	Merryfield et al. (2013)
NCAR- CCSM3	1982-2010	6	All 1st of the month	0-11	T85L26	POP L40 0.3 deg Eq	Kirtman and Min (2009)
NASA- GEOS5	1981-2010	11	4 members every 5th days; 7 members on the last day of the previous month	0-9	1x1.25deg L72	MOM4 L40 1/4 deg at Eq	Rienecker et al. (2008)

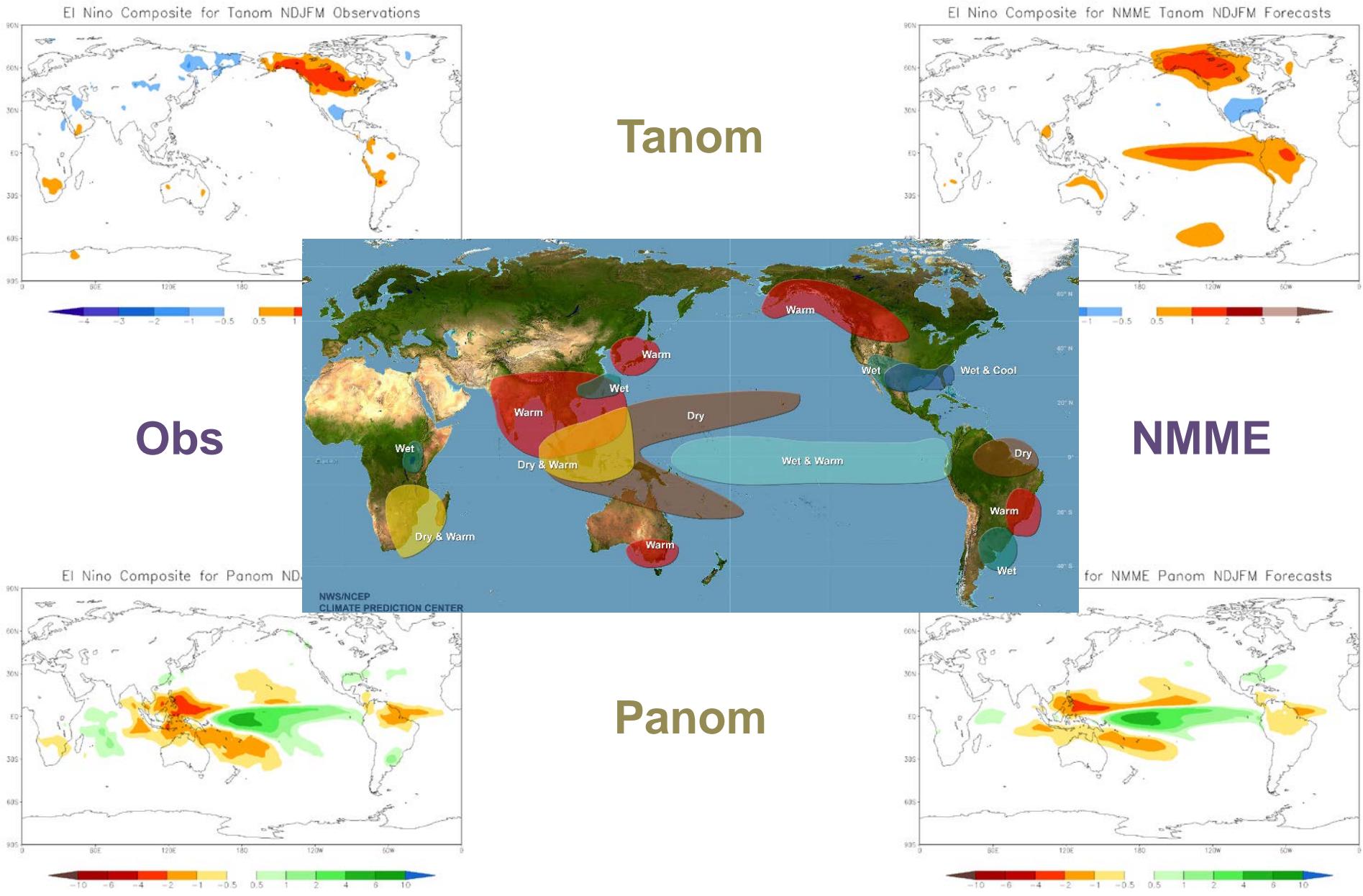
ENSO Composites

- The ENSO composite analysis is conducted **using the 1982-2010 hindcasts** from each of the six models in NMME.
- Composite years are selected based on the historical Ocean Nino Index (ONI).
- If the seasonal ONI just prior to the date the forecasts were initiated indicates a warm or cold ENSO episode, the forecasts are selected for the composite analysis.
- The composites apply to monthly mean conditions in **November, December, January, February, and March**, respectively, as well as to the five-month aggregates (NDJFM) resembling the **winter** conditions.
- The NMME composites are the equally weighted mean of the six models' composites.

Selected years used in the ENSO composite analysis

Month	Nov		Dec		Jan		Feb		Mar	
ENSO	Warm	Cold								
Years	1982	1985	1982	1983	1982	1983	1983	1984	1983	1984
	1986	1988	1986	1985	1986	1984	1987	1985	1987	1985
	1987	1998	1987	1988	1987	1988	1988	1989	1988	1989
	1991	1999	1991	1995	1991	1995	1992	1996	1992	1996
	1997	2000	1994	1998	1994	1998	1995	1999	1995	1999
	2002	2007	1997	1999	1997	1999	1998	2000	1998	2000
	2004	2010	2002	2000	2002	2000	2003	2001	2003	2001
	2009		2004	2007	2004	2007	2005	2006	2005	2006
			2006	2010	2006	2010	2007	2008	2007	2008
			2009		2009		2010	2009	2010	2009
Total No. of years	8	7	10	9	10	9	10	10	10	10

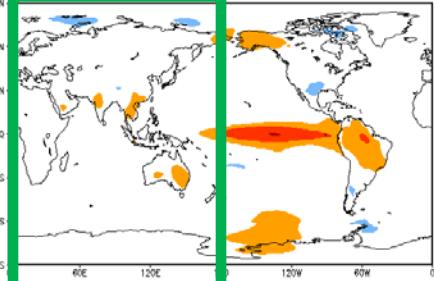
El Nino Winter Patterns (Global)



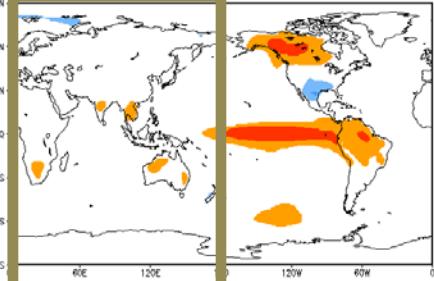
El Nino Tanom Composites (Global)

El Nino Composite for Ensemble Tanom Lead-1 Forecasts

a) Nov forecasts (IC: 100100)

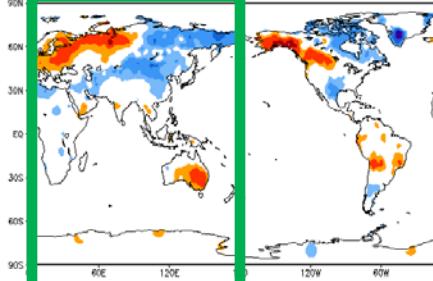


b) Dec forecasts (IC: 110100)

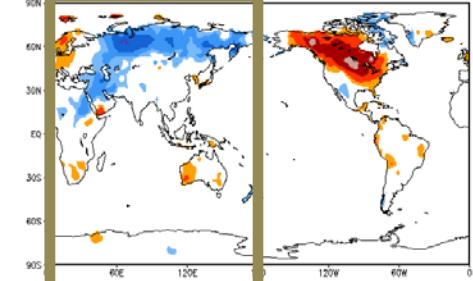


El Nino Composite for Tanom Observations

a) Nov

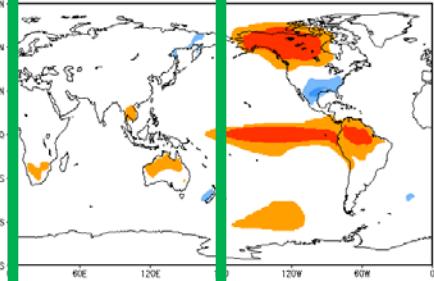


b) Dec

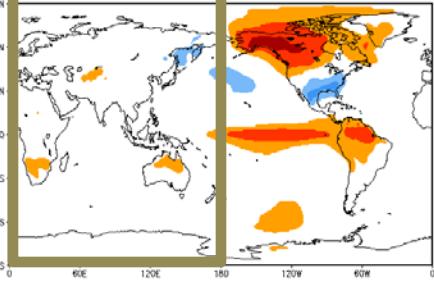


NMME

c) Jan forecasts (IC: 120100)

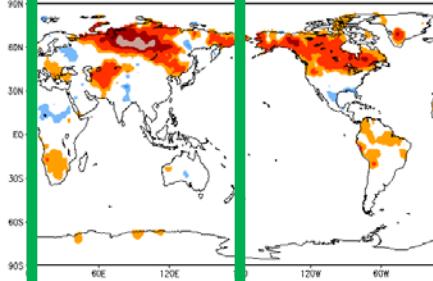


d) Feb forecasts (IC: 010100)

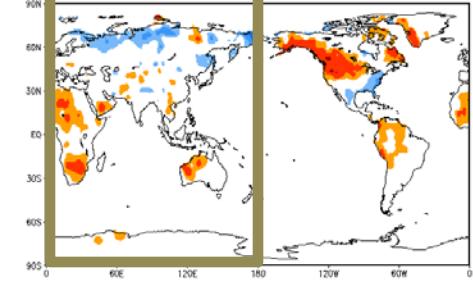


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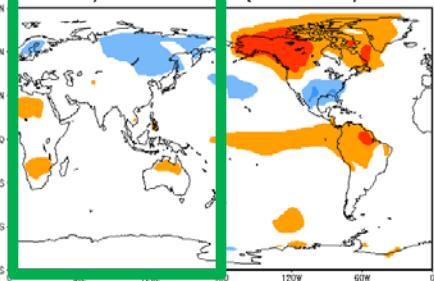
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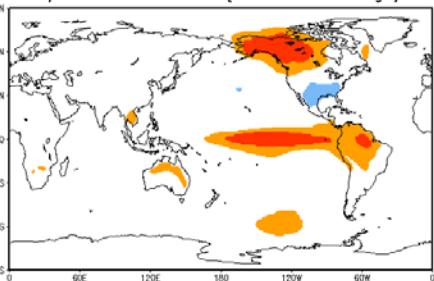
d) Feb



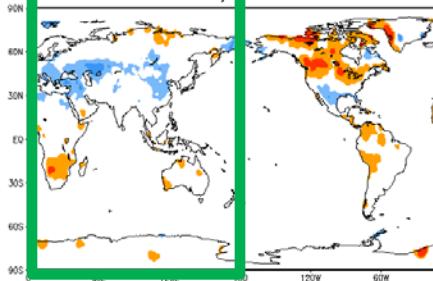
e) Mar forecasts (IC: 020100)



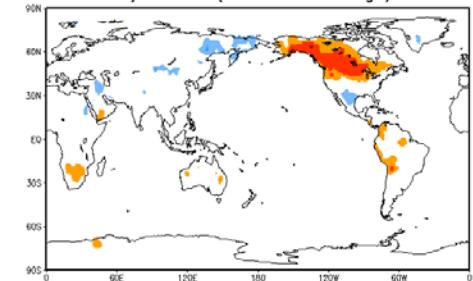
f) NDJFM forecasts (5-month average)



e) Mar



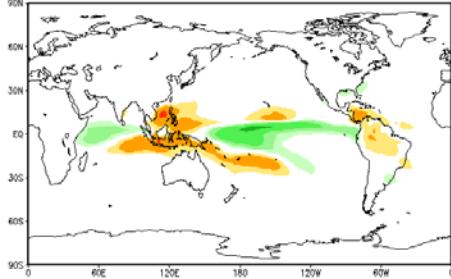
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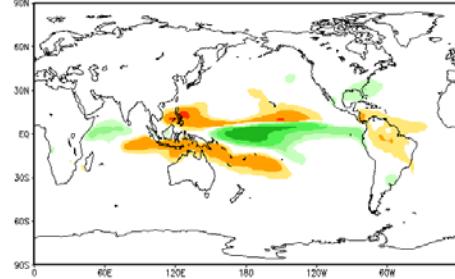
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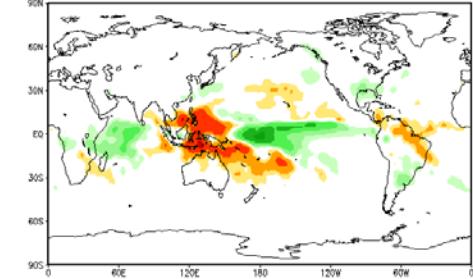


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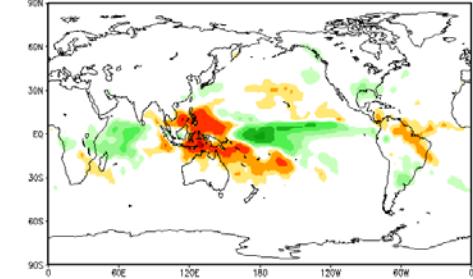


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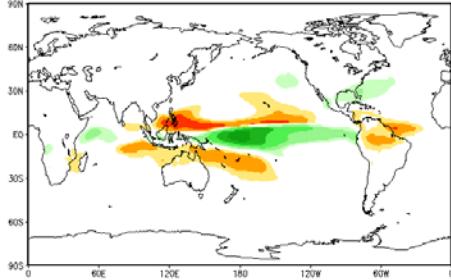


b) Dec

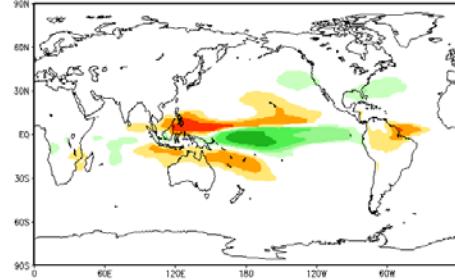


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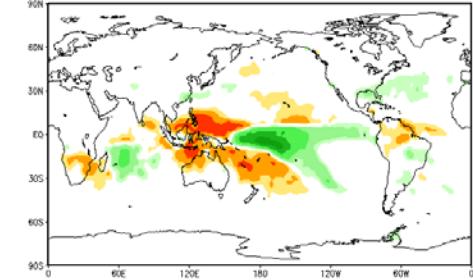
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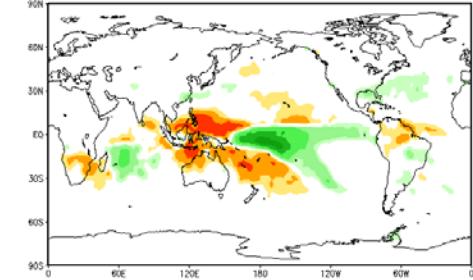
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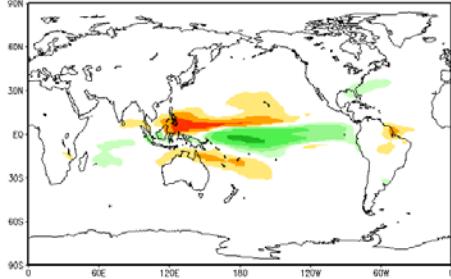
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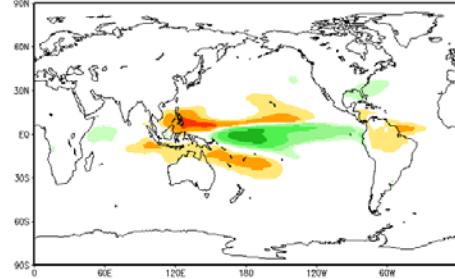
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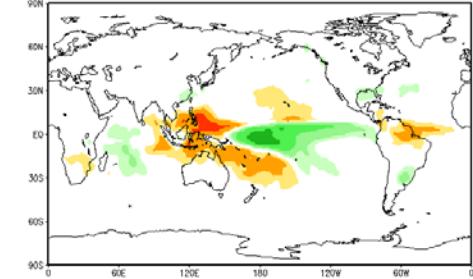
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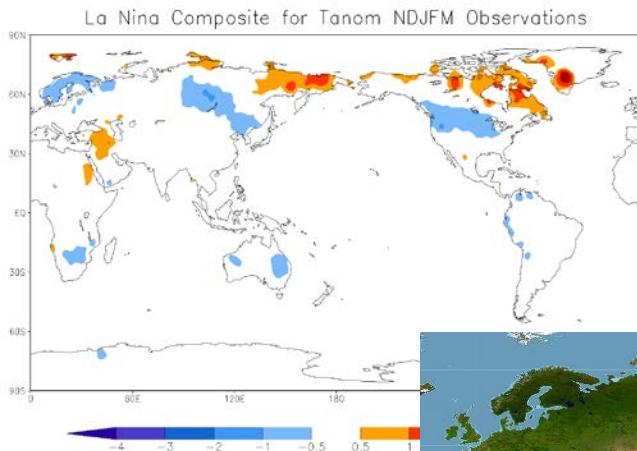
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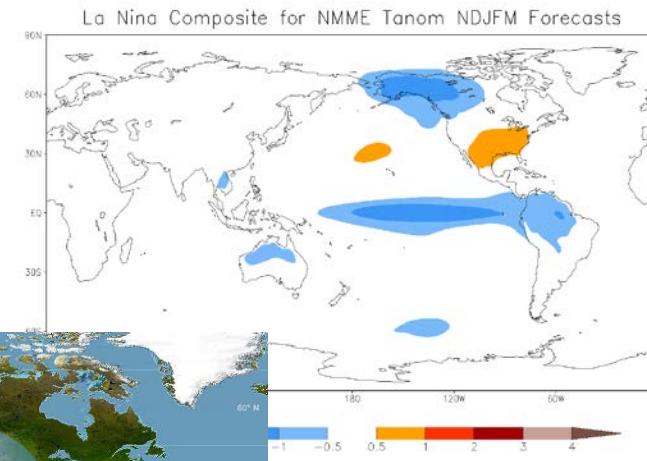


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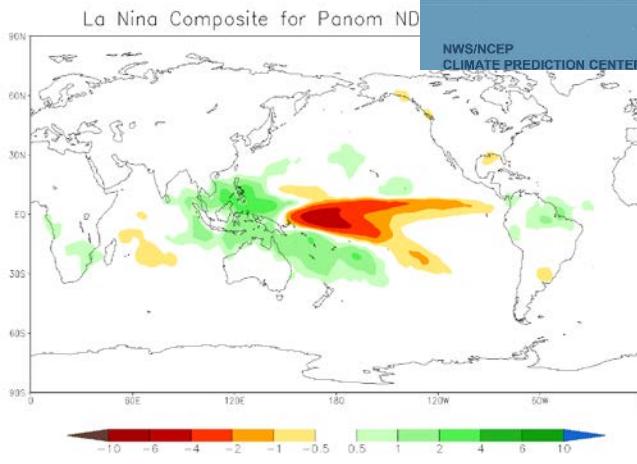


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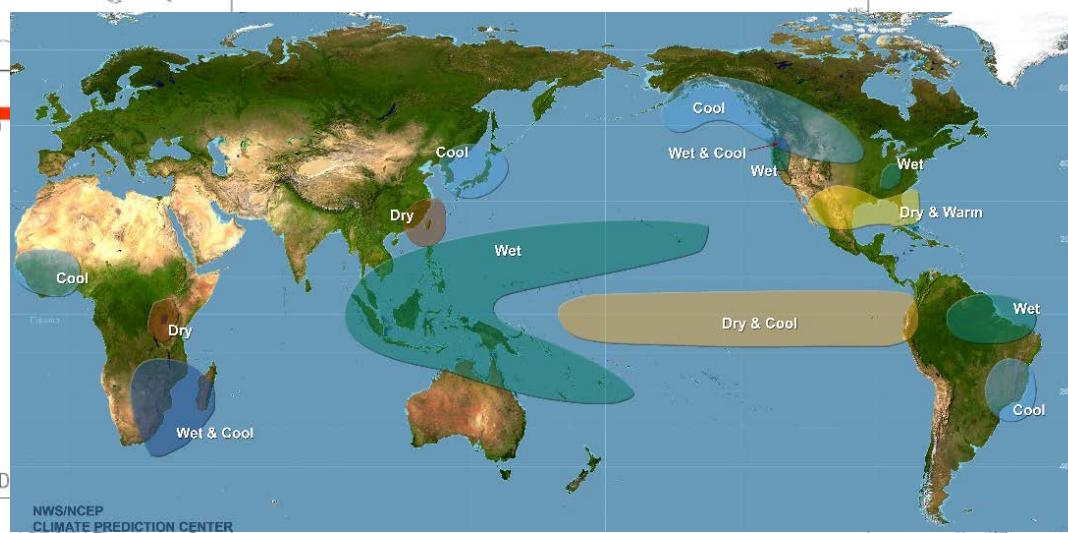
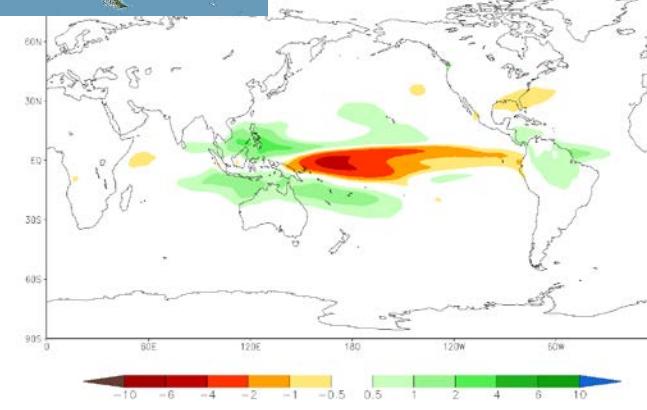
Tanom



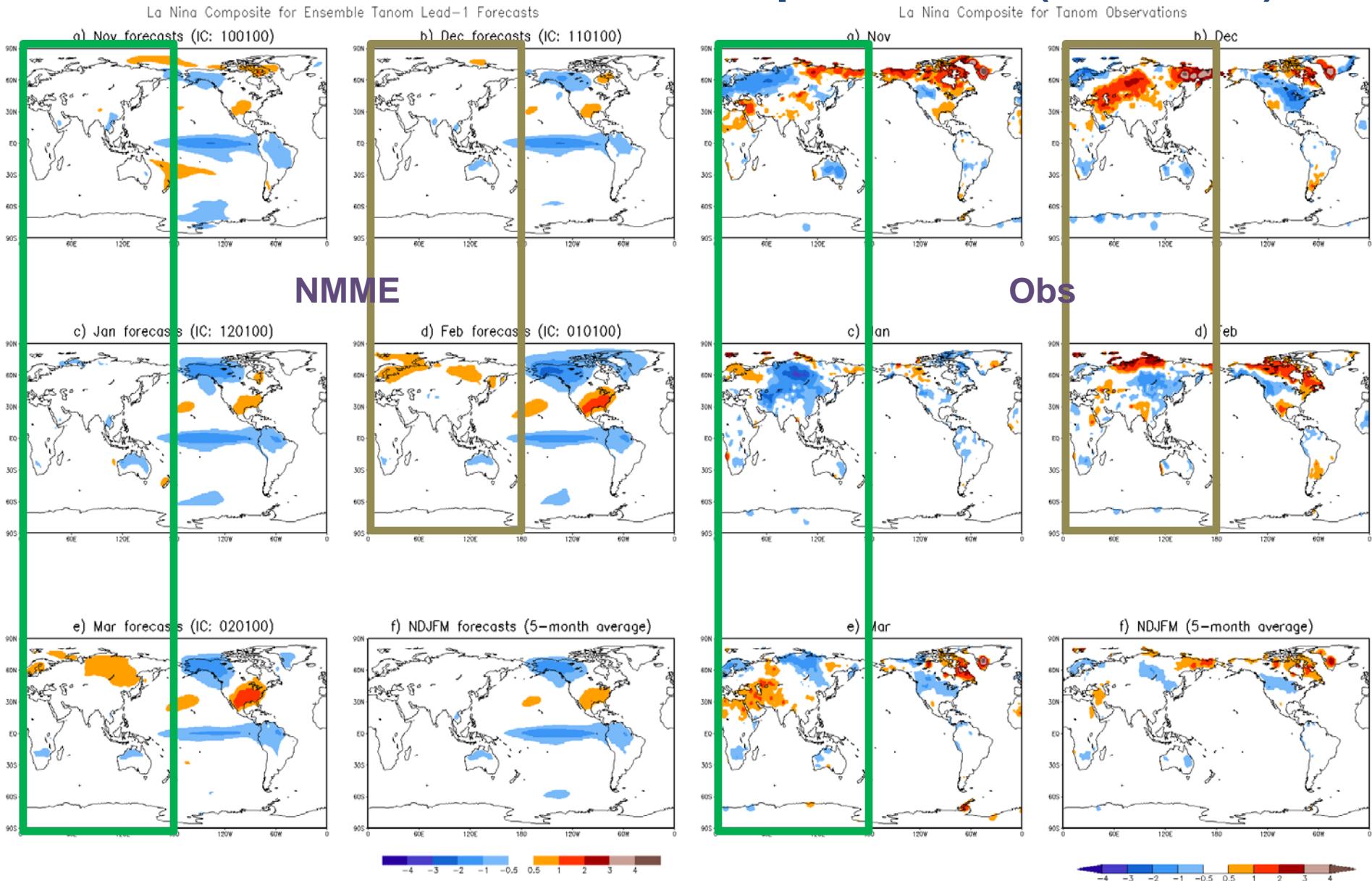
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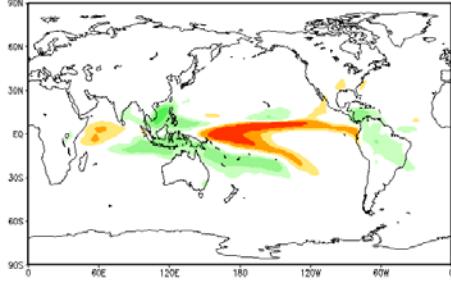
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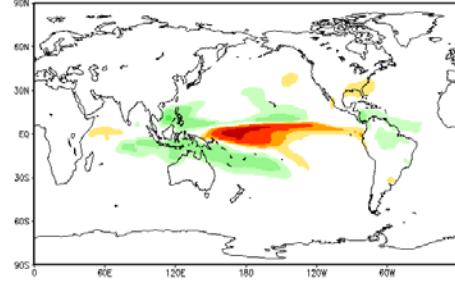
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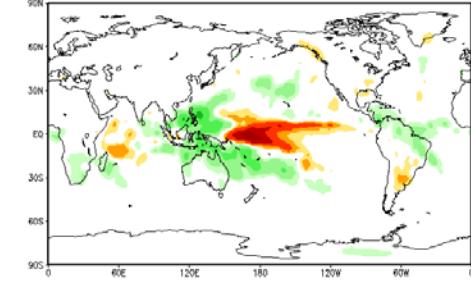


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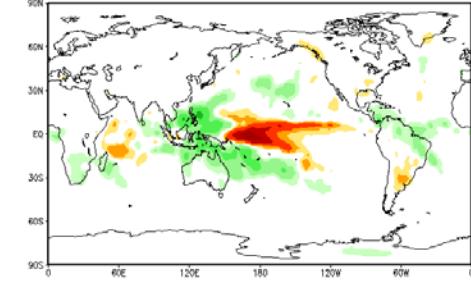


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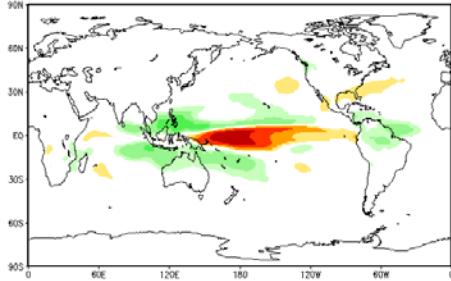


b) Dec

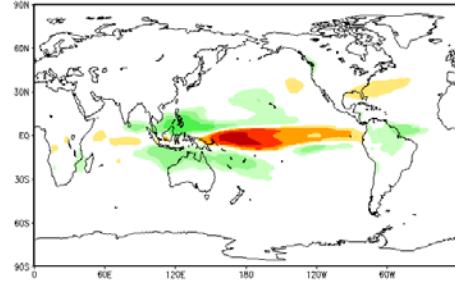


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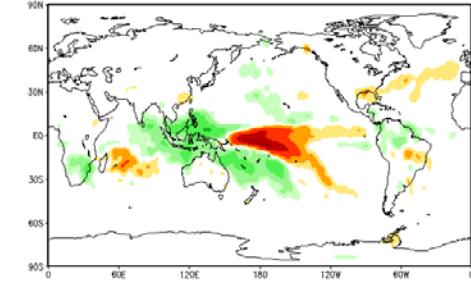
c) Jan forecasts (IC: 120100)



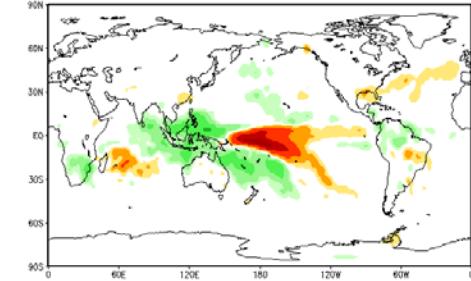
d) Feb forecasts (IC: 010100)



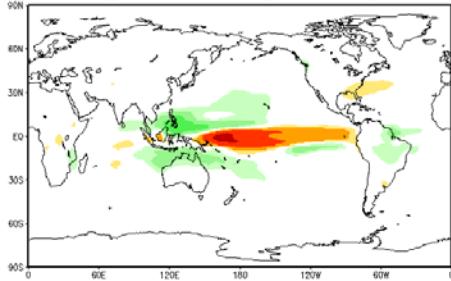
c) Jan



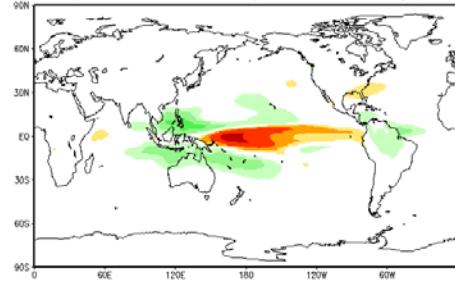
d) Feb



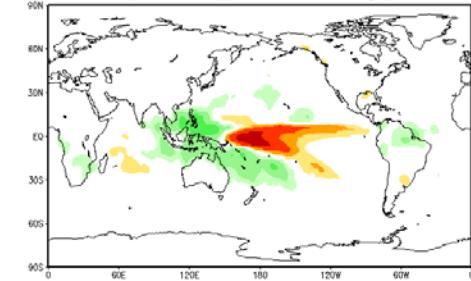
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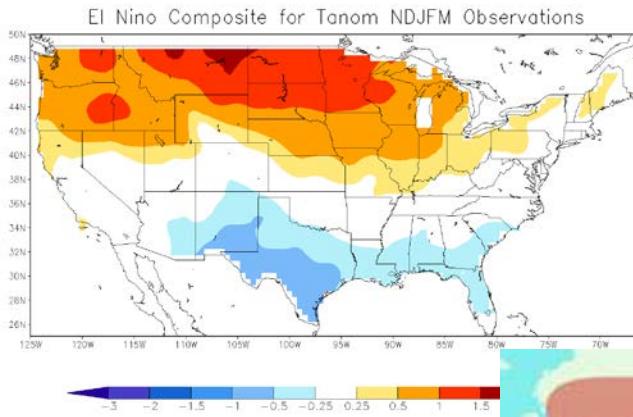
e) Mar



Obs

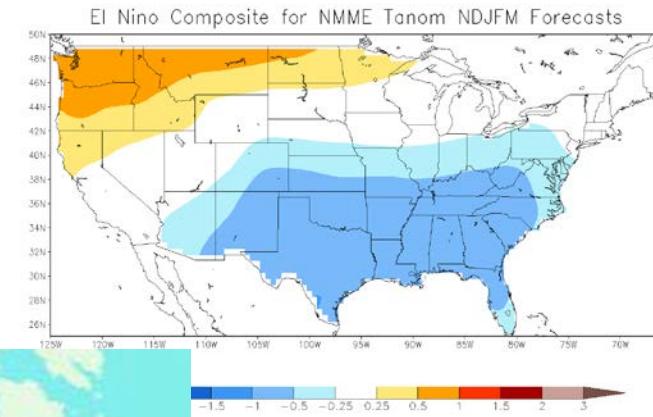


El Nino Winter Patterns (US)

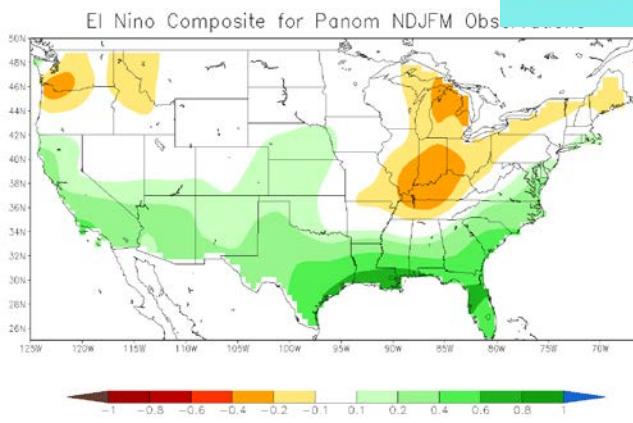
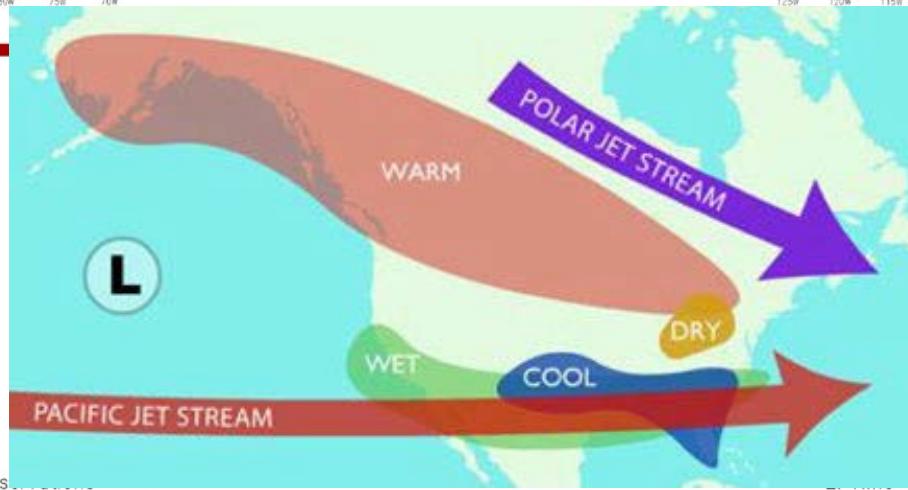


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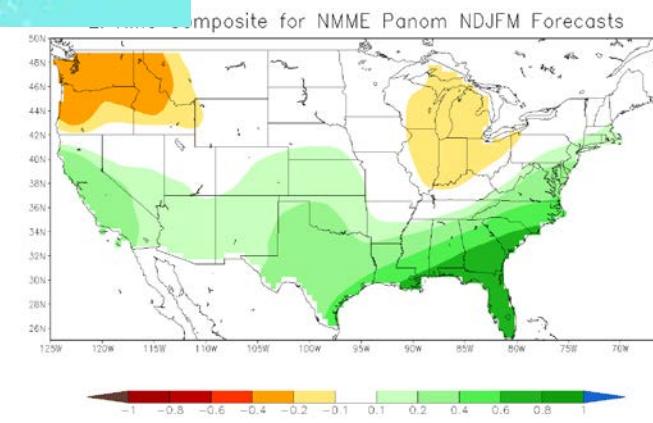
Tanom



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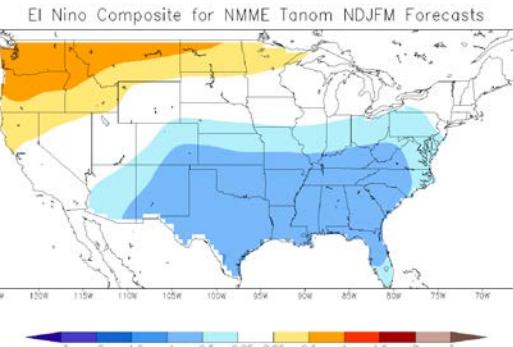


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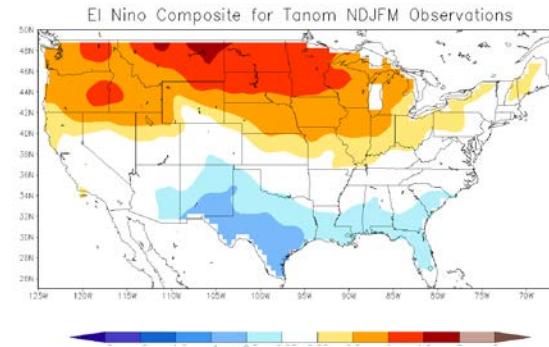


El Nino Tanom NDJFM Composites (US)

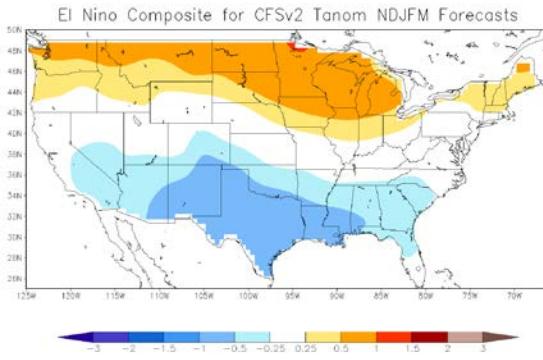
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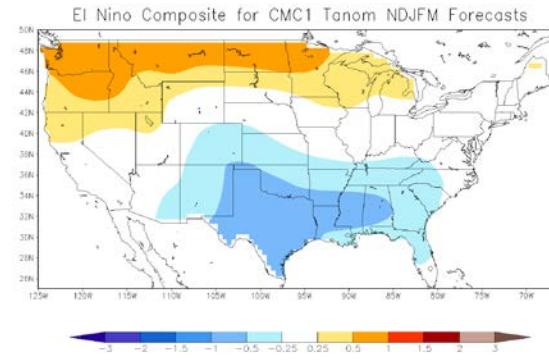
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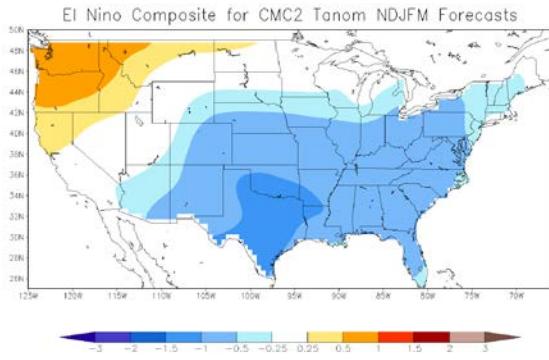
CFSv2



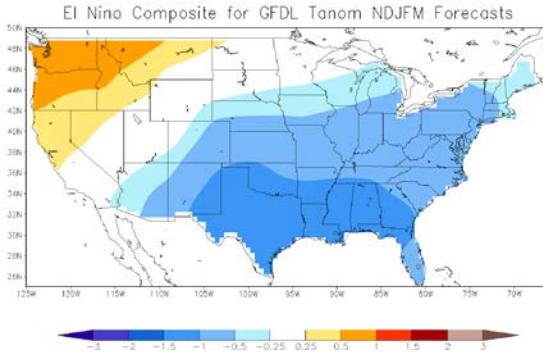
CMC1



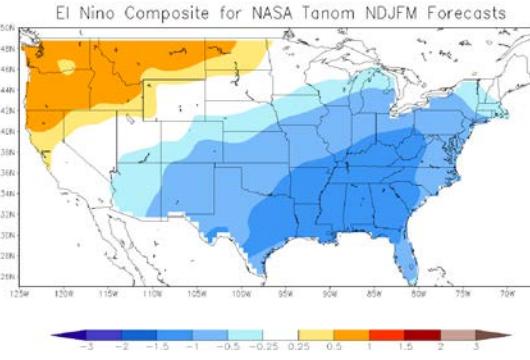
CMC2



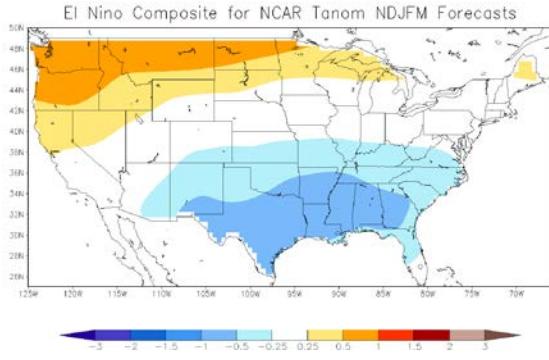
GFDL



NASA

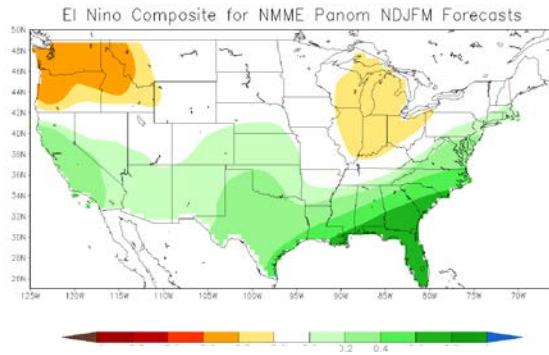


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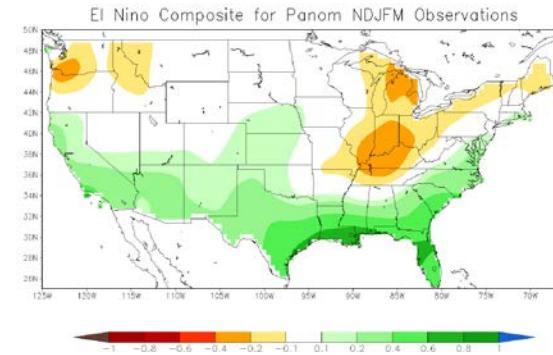


El Nino Panom NDJFM Composites (US)

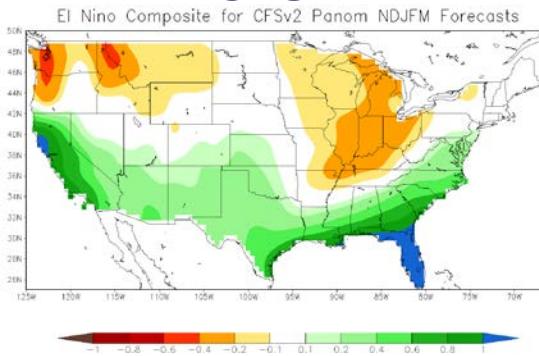
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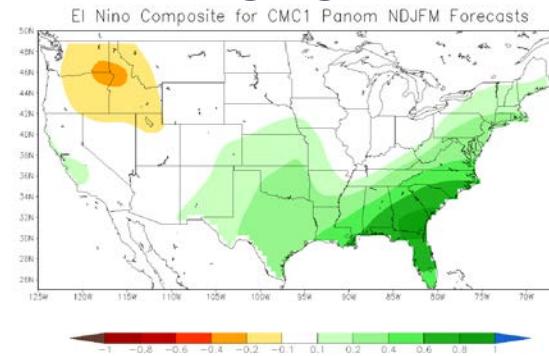
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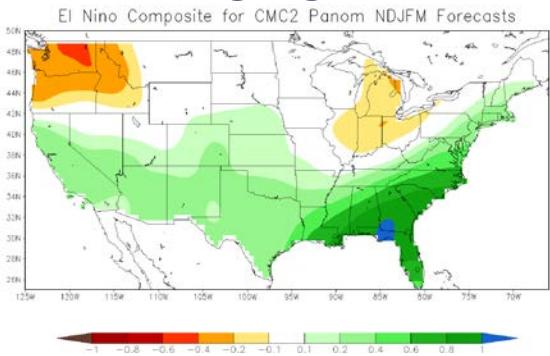
CFSv2



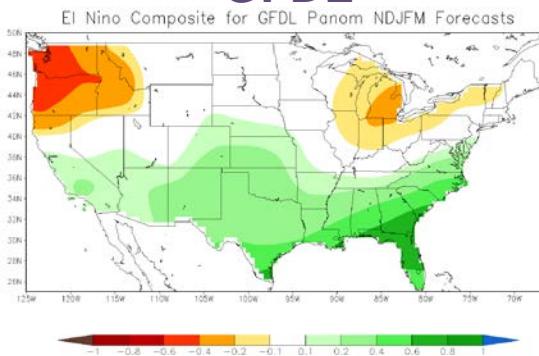
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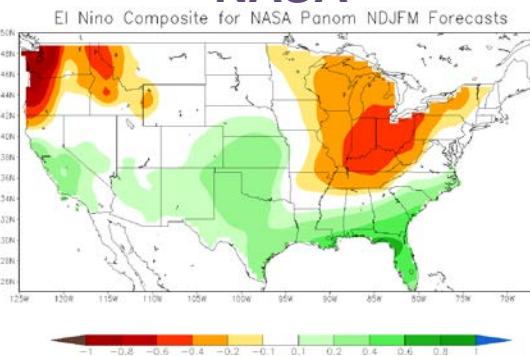
CMC2



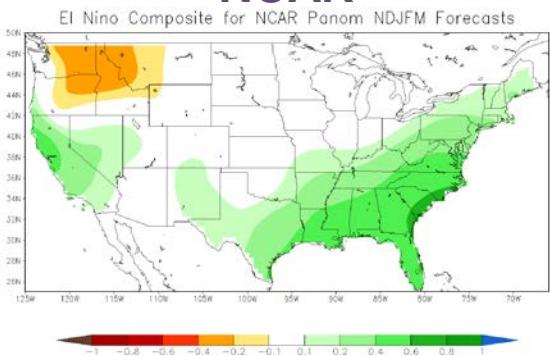
GFDL



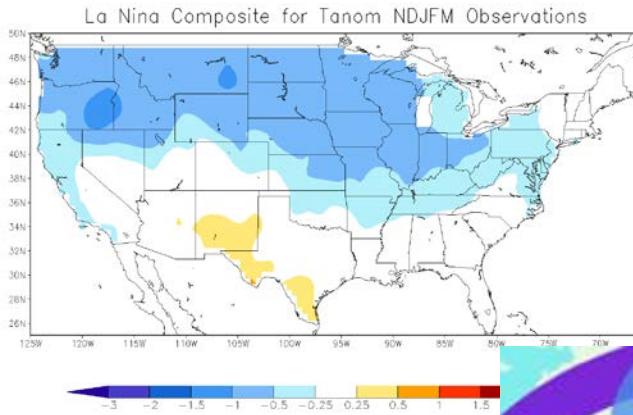
NASA



NCAR

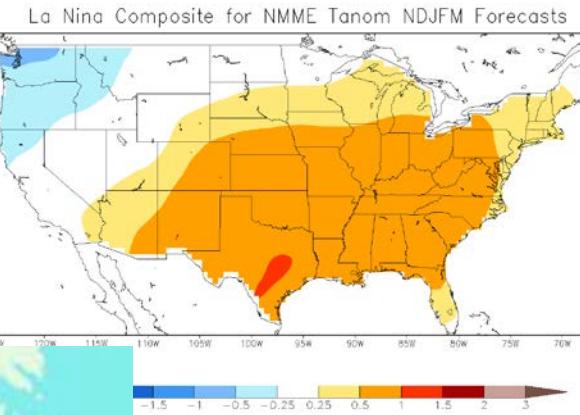


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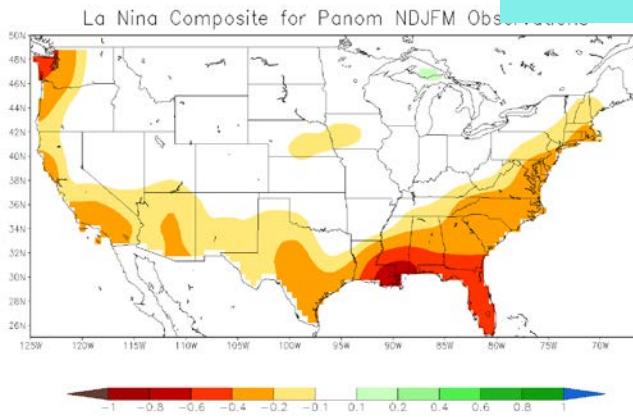


Obs

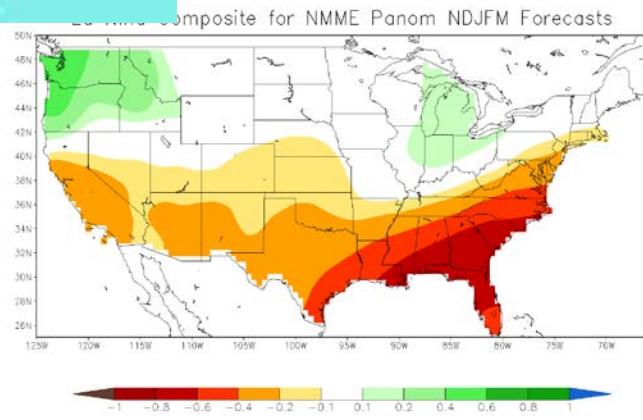
Tanom



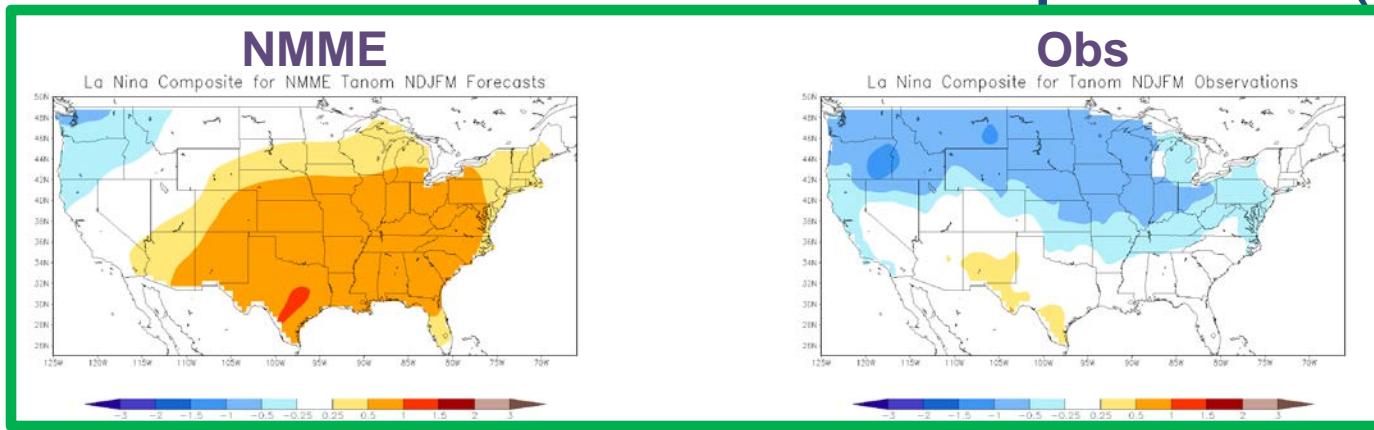
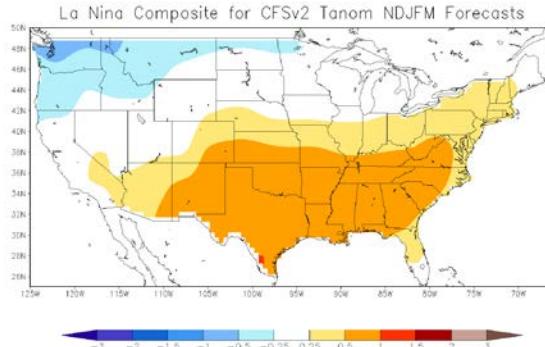
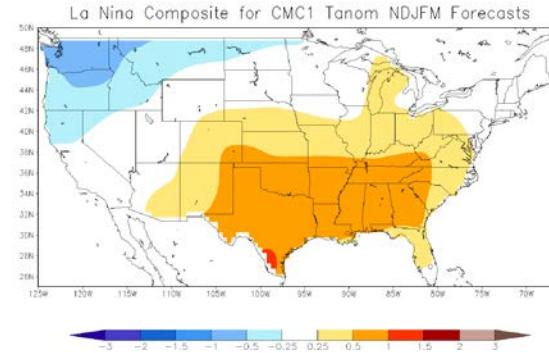
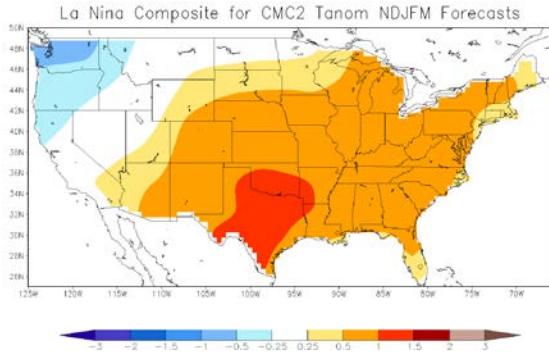
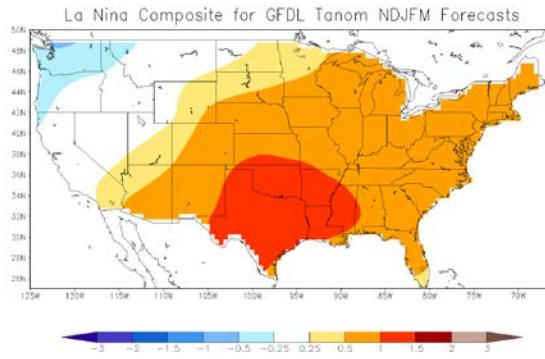
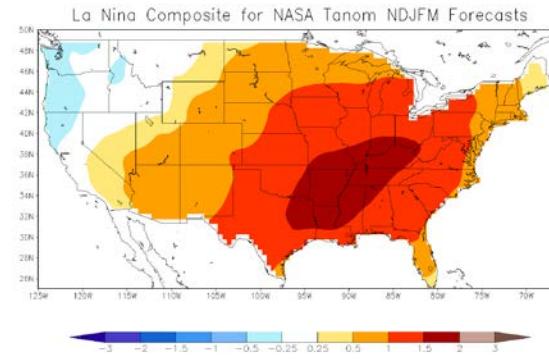
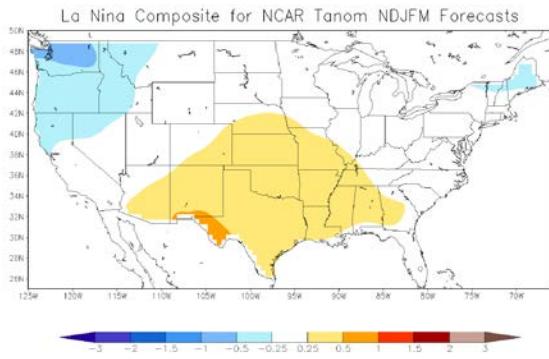
NMME



Panom

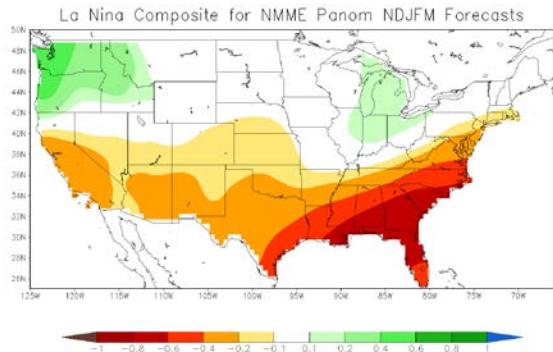


La Nina Tanom NDJFM Composites (US)

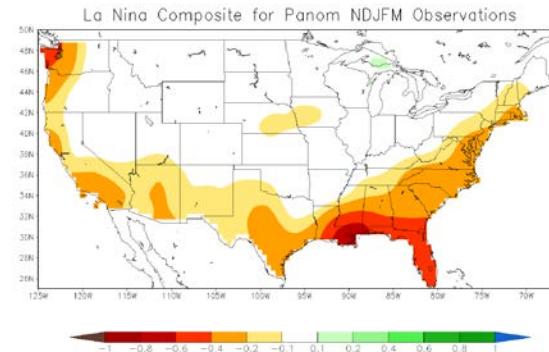
**CFSv2****CMC1****CMC2****GFDL****NASA****NCAR**

La Nina Panom NDJFM Composites (US)

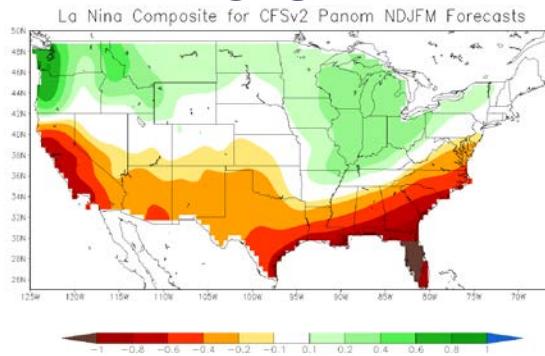
NMME



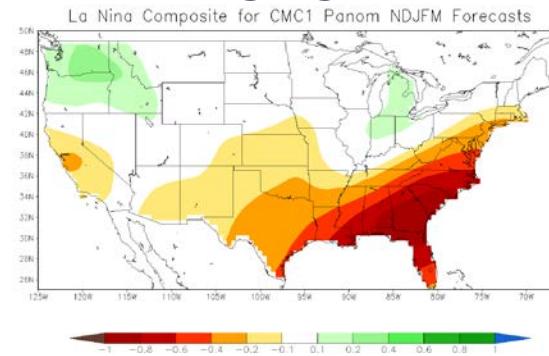
Obs



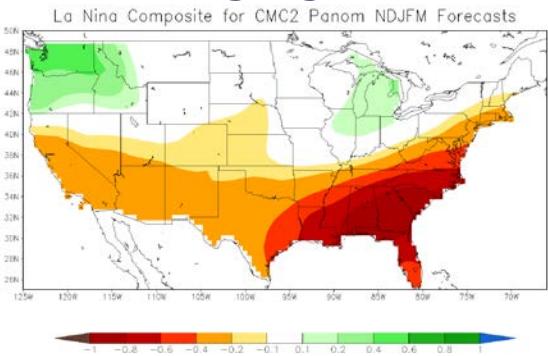
CFSv2



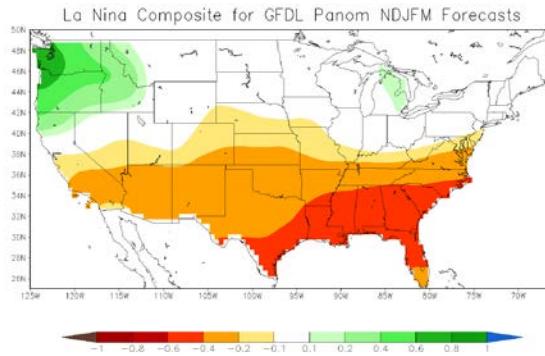
CMC1



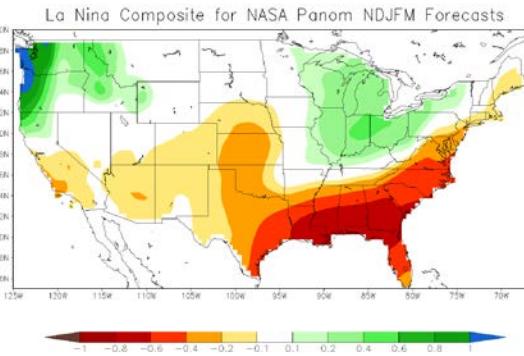
CMC2



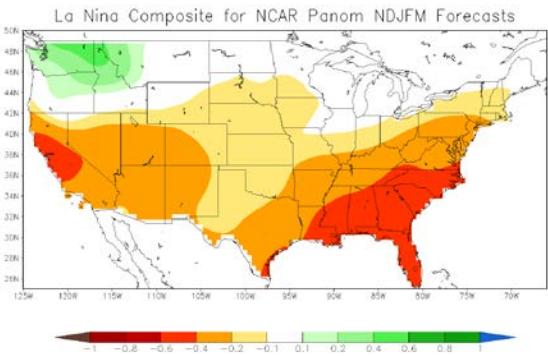
GFDL



NASA



NCAR



Summary

- NMME simulate ENSO P patterns well during wintertime. All models are reasonably good.
- There are discrepancies between the model and observed composites for T anomaly over the U.S.
- The T differences are dominated by the large discrepancies in NASA, GFDL, and CMC2 models.
- The T differences are sensitive to how global warming is simulated in these models (a different topic).
- Model T composites do not capture the seasonal evolution over Asia for both El Nino and La Nina events.
- Further investigation is underway.

Thank you and questions

NMME ENSO webpage:

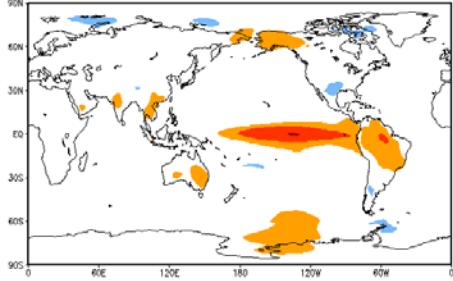
<http://www.cpc.ncep.noaa.gov/products/NMME/enso/>

Contact: lichuan.chen@noaa.gov

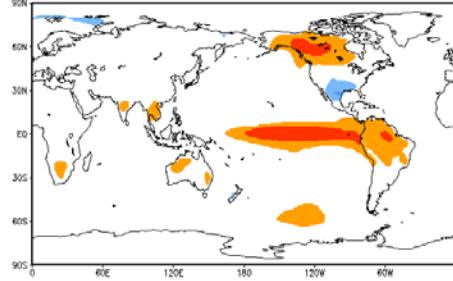
NMME Tanom Composites (Global)

El Niño Composite for Ensemble Tanom Lead-1 Forecasts

a) Nov forecasts (IC: 100100)

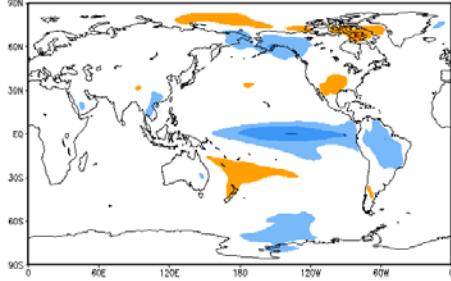


b) Dec forecasts (IC: 110100)

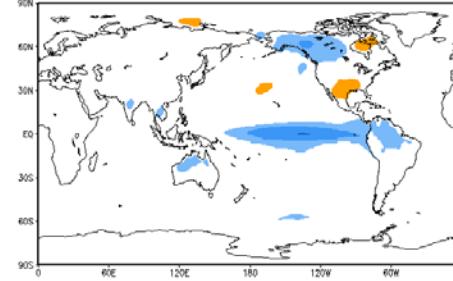


La Niña Composite for Ensemble Tanom Lead-1 Forecasts

a) Nov forecasts (IC: 100100)

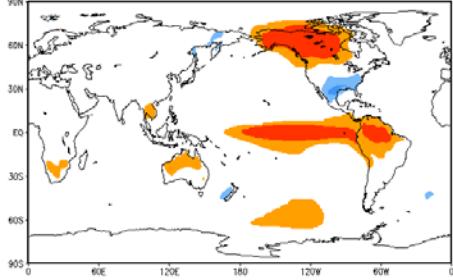


b) Dec forecasts (IC: 110100)

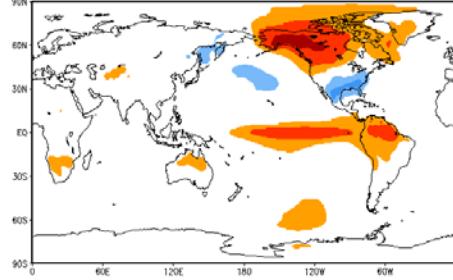


El Niño

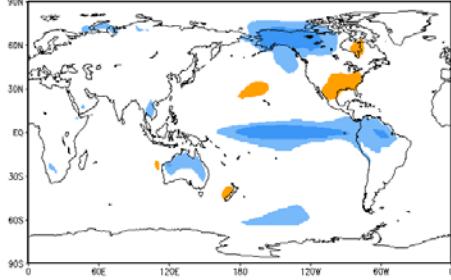
c) Jan forecasts (IC: 120100)



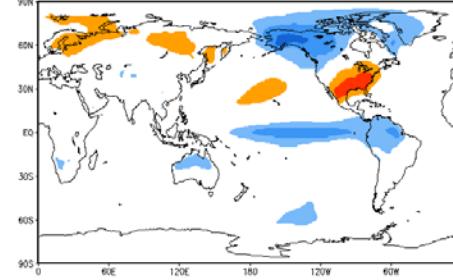
d) Feb forecasts (IC: 010100)



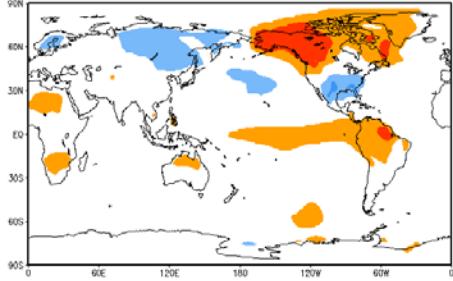
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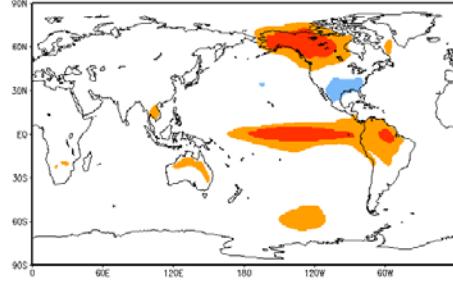
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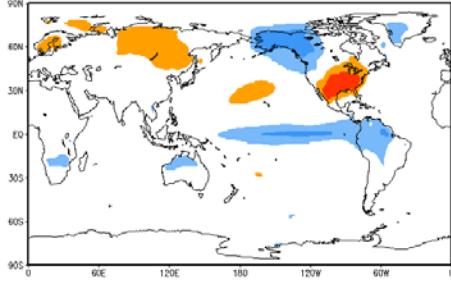
e) Mar forecasts (IC: 020100)



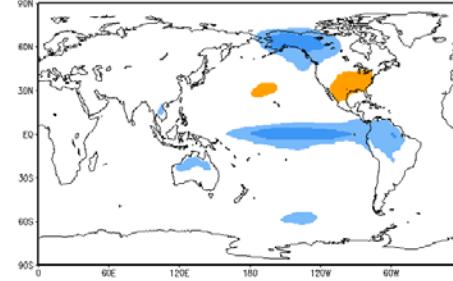
f) NDJFM forecasts (5-month average)



e) Mar forecasts (IC: 020100)



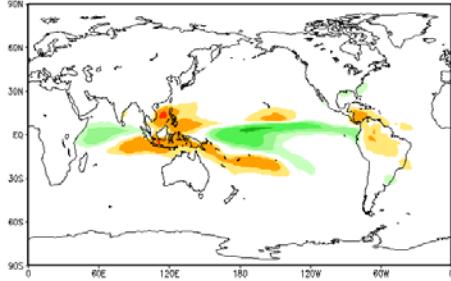
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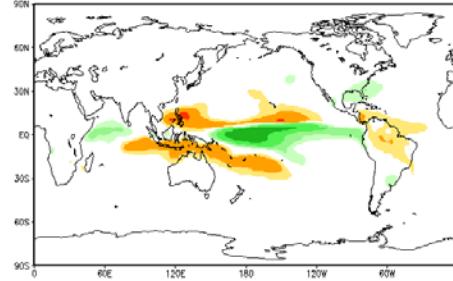
NMME Panom Composites (Global)

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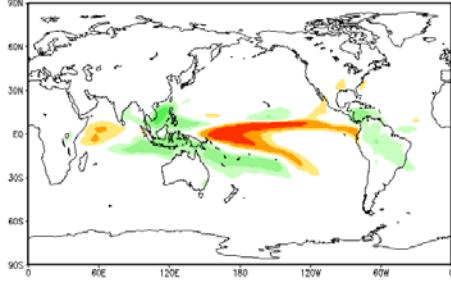


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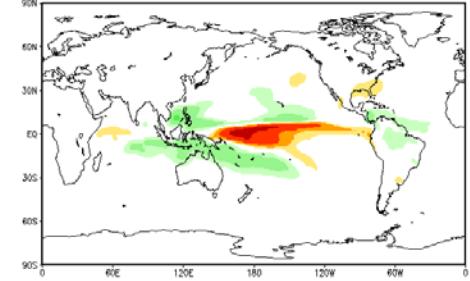


La Niña Composite for Ensemble Panom Lead-1 Forecasts

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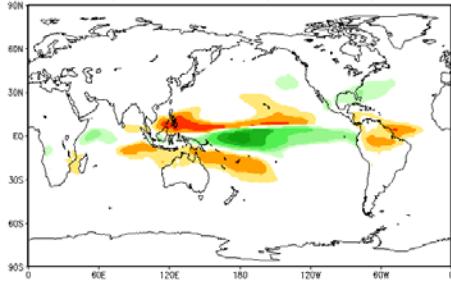


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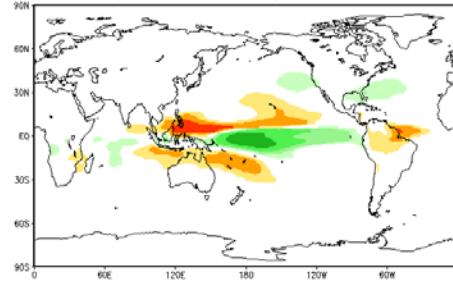


El Niño

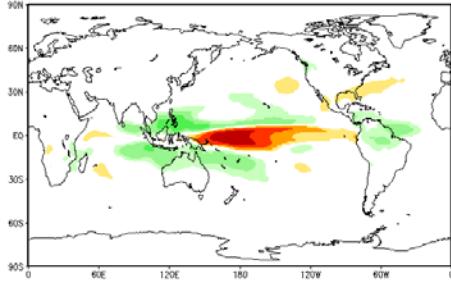
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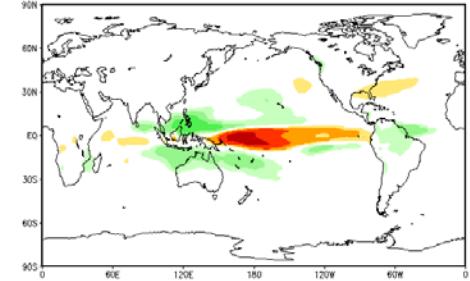
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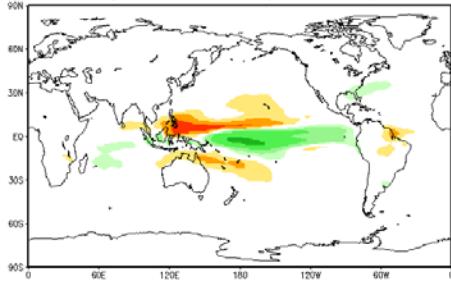
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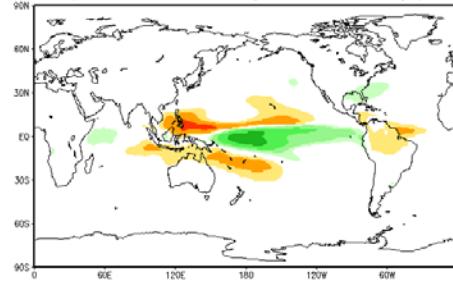
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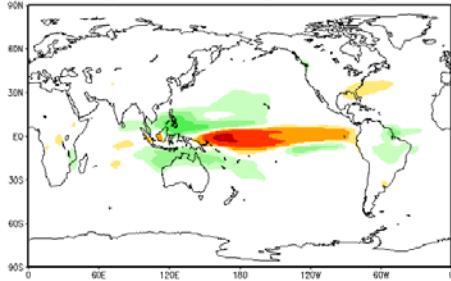
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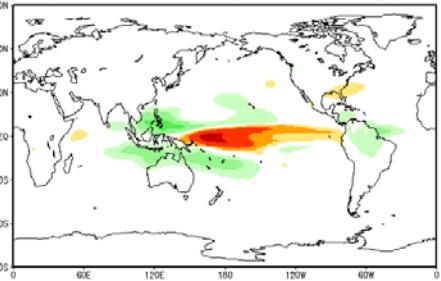
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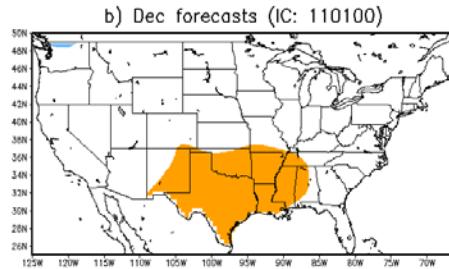
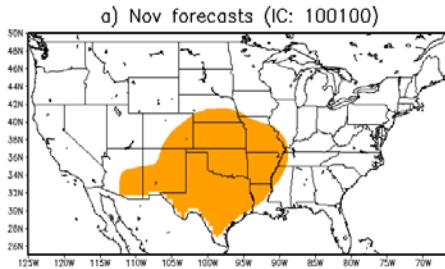
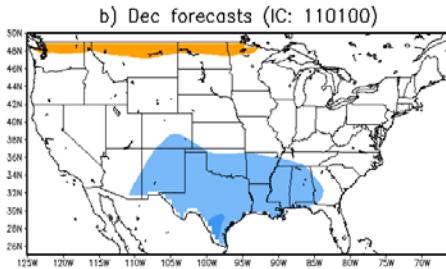
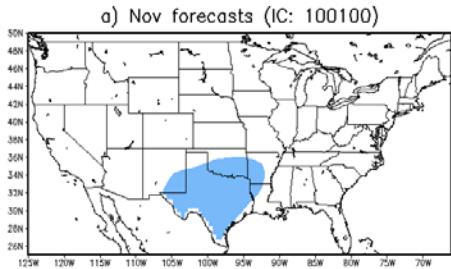


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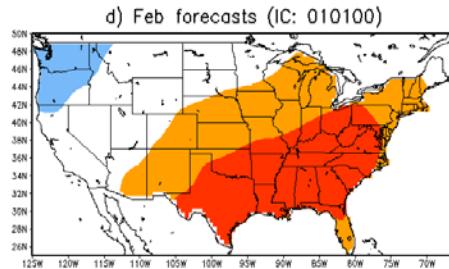
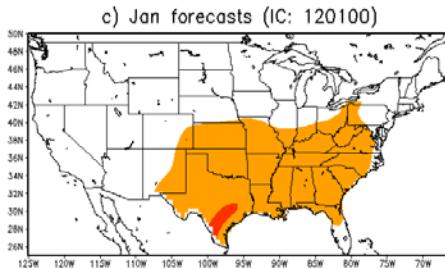
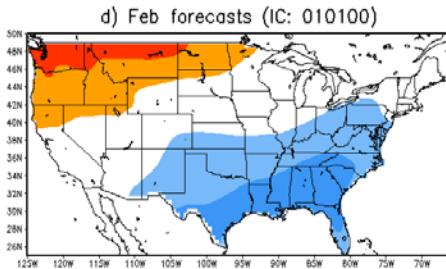
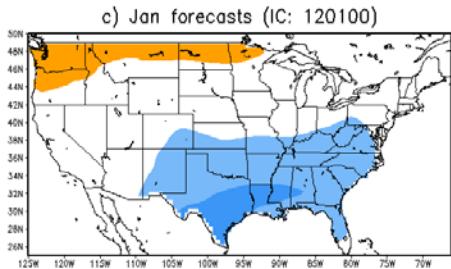


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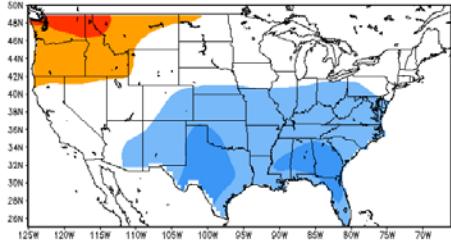
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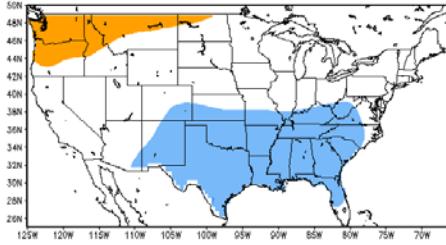
El Niño



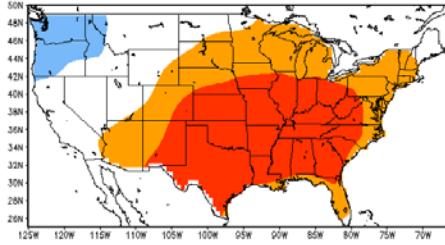
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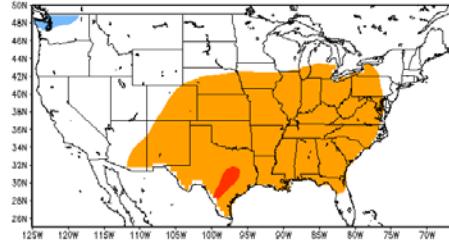
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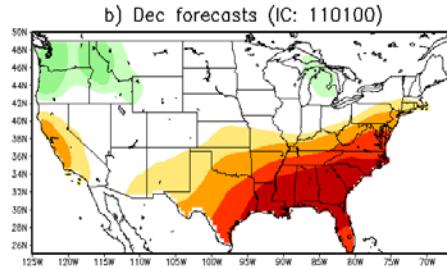
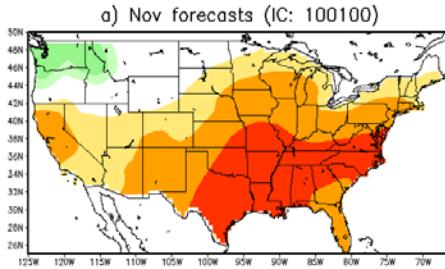
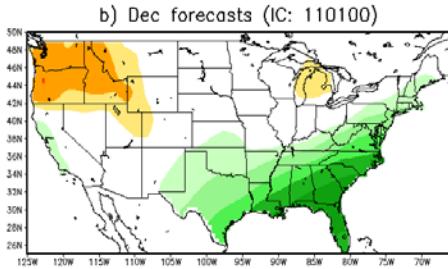
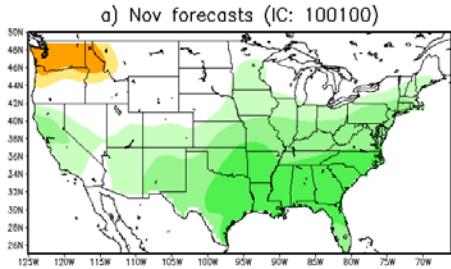


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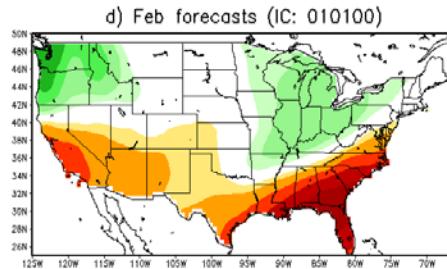
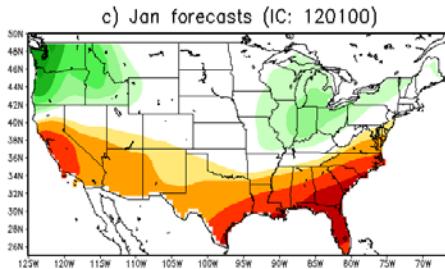
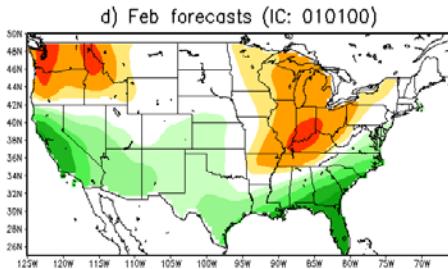
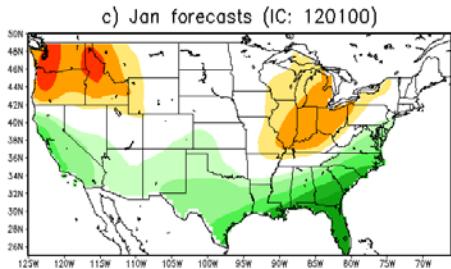


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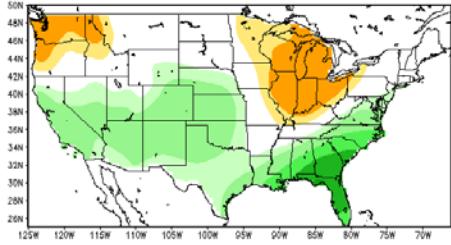
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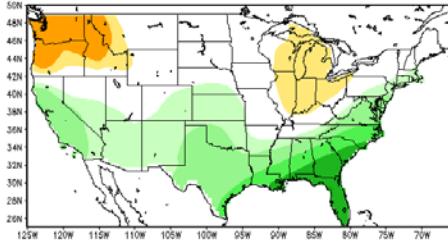
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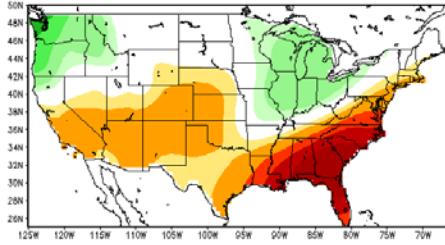
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