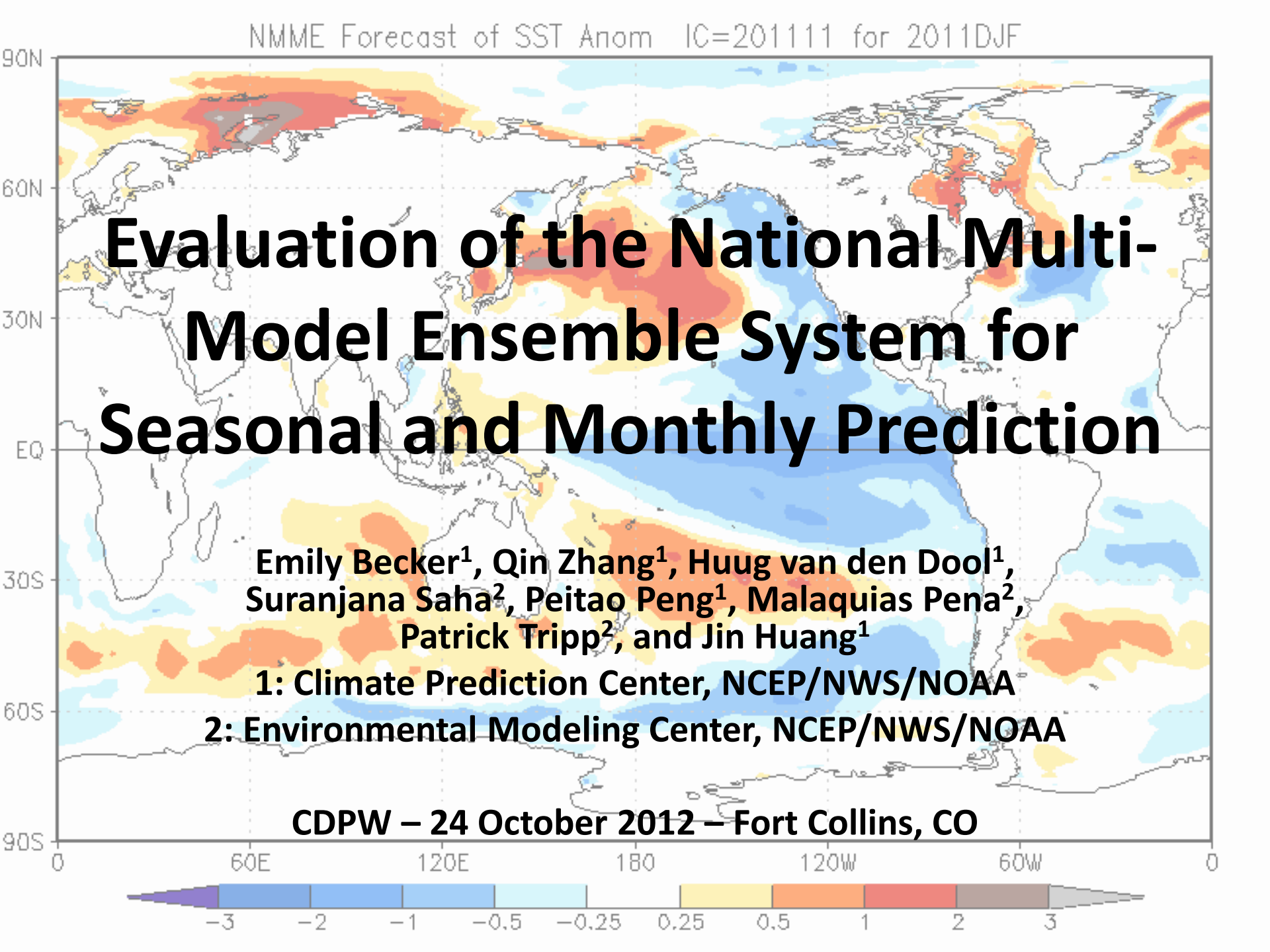


Evaluation of the National Multi-Model Ensemble System for Seasonal and Monthly Prediction

Emily Becker[1], Qin Zhang[1], Huug van den Dool[1], Suranjana Saha[2], Peitao Peng[1], Malaquias Pena[2], Patrick Tripp[2], and Jin Huang[1]

1: Climate Prediction Center, NCEP/NWS/NOAA

2: Environmental Modeling Center, NCEP/NWS/NOAA

CDPW – 24 October 2012 – Fort Collins, CO

NMME

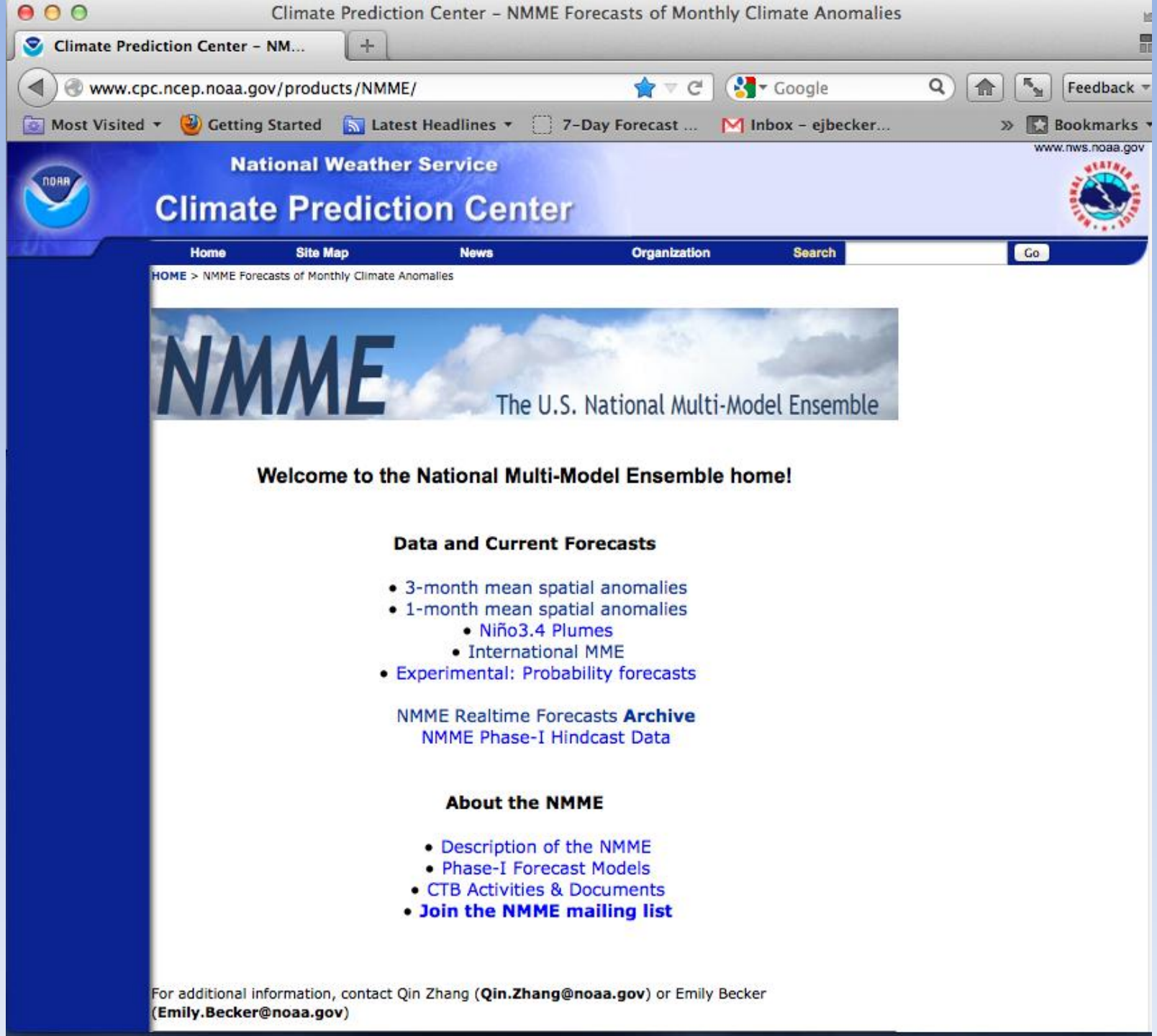
The U.S. National Multi-Model Ensemble

- The experimental (Phase I) stage of NMME project supplies routine guidance to users of the NMME forecasts; Phase II is in operation now.
- Diagnostic verification of NMME seasonal and monthly prediction
  - Anomaly correlations (AC) calculated from 29 years of hindcasts (1982-2010)
  - Phase I realtime seasonal and monthly T2m and Prate forecasts from August 2011 to July 2012 over CONUS
  - Focus on the prediction of 2011/12 winter (DJF).
- Motivation of this study: to provide skill benchmarks for future improvements of the NMME seasonal and monthly prediction system.

NMME

The U.S. National Multi-Model Ensemble

- Forecasting system consisting of coupled models from U.S. and Canadian modeling centers
- MME approach has been proven to produce better prediction quality than any single model ensemble
- Phase I (Aug. 2011 – July 2012) included 2m surface temperature, SST, and precipitation rate
- Realtime and archived forecast graphics from Aug. 2011 – present are available at www.cpc.ncep.noaa.gov/products/NMME
- Other verification activities:http://iridl.ldeo.columbia.edu/home/.tippett/.NMME/.Verification/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• Phase-I Forecast Models
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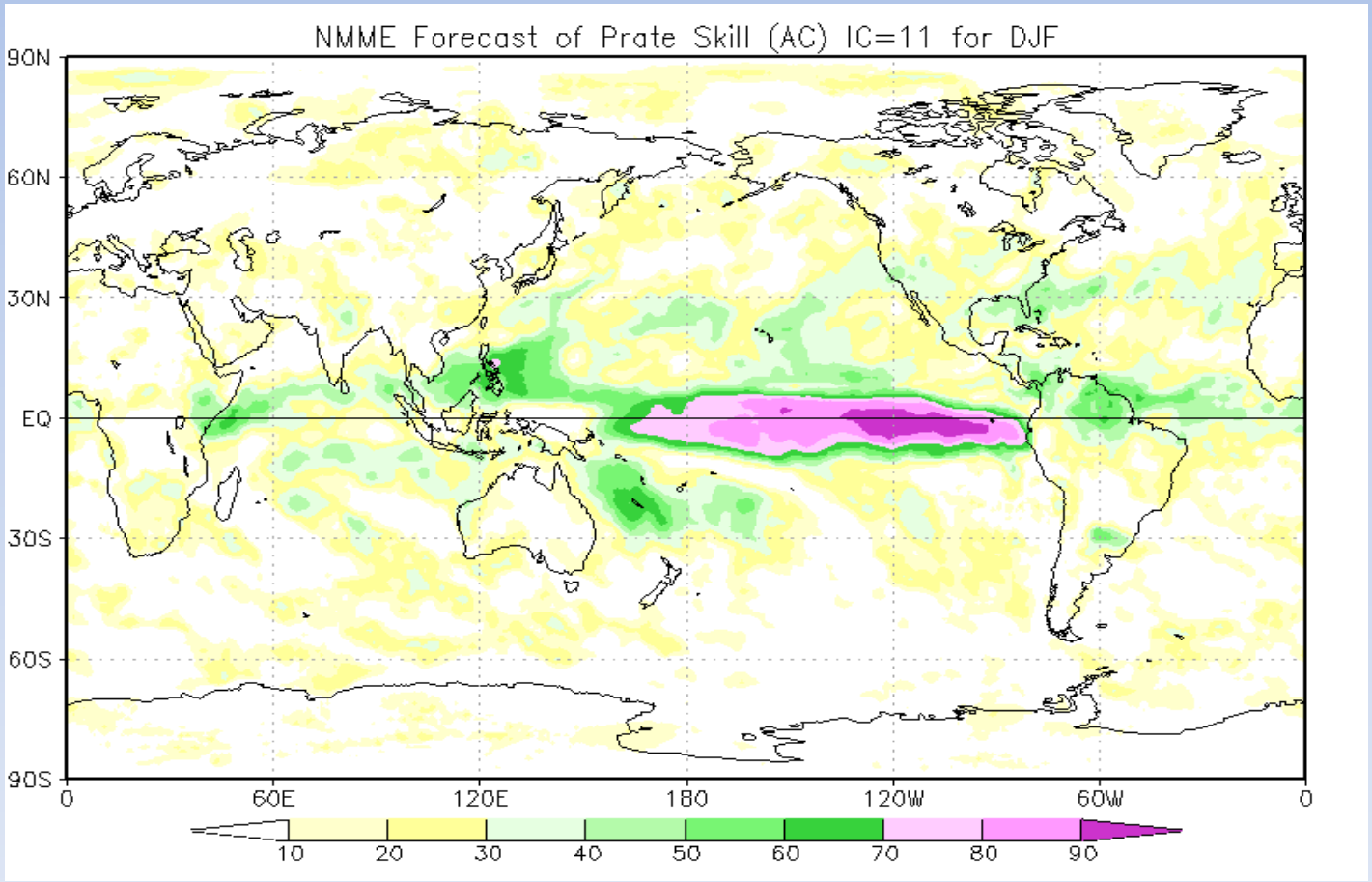
• Join the NMME mailing list
For additional information, contact Qin Zhang (Qin.Zhang@noaa.gov) or Emily Becker (Emily.Becker@noaa.gov)

NMME Phase I Forecast Providers

Model	Hindcast Period	Ensemble Size	Lead Times	Arrangement of Ensemble Members	Contact and reference
CFSv1	1981-2009	15	0-8 Months	1st 0Z +/-2 days, 21st 0Z +/-2d, 11th 0Z+/- 2d	Saha (Saha et al. 2006)
CFSv2	1982-2009	24(28)	0-9 Months	4 members (0,6,12,18Z) every 5th day	Saha (Saha et al. 2010)
GFDL-CM2.2	1982-2010	10	0-11 Months	All 1st of the month 0Z	Rosati (Zhang et al. 2007)
IRI-ECHAM4-f	1982-2010	12	0-7 Months	All 1st of the month 0Z	DeWitt (DeWitt 2005)
IRI-ECHAM4-a	1982-2010	12	0-7 Months	All 1st of the Month 0Z	DeWitt (Dewitt 2005)
CCSM3.0	1982-2010	6	0-11 Months	All 1st of the Month 0Z	Kirtman (Kirtman and Min 2009)
GEOS5	1981-2010	6	0-9 Months	1 Member every 5th day	Schubert (Vernieres et al. 2011)

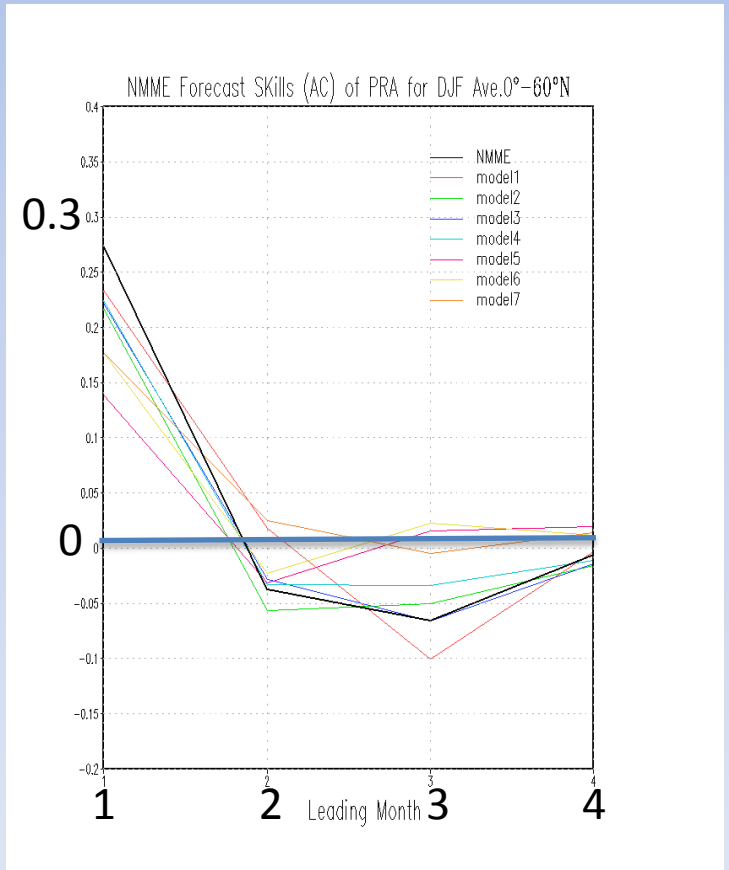
Skill assessment for winter (DJF): precipitation rate

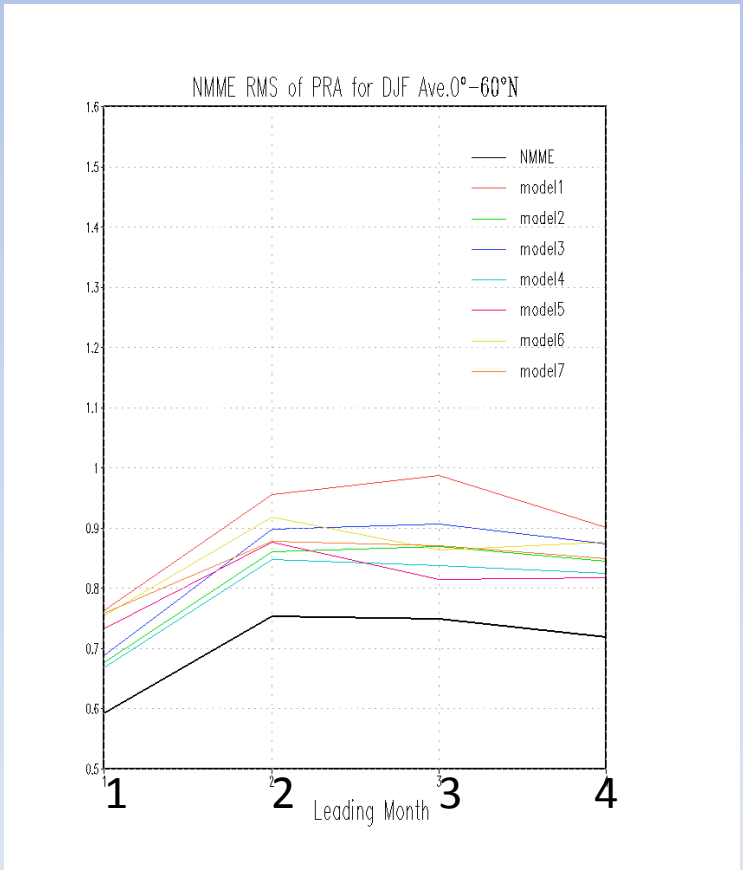
AC from 1982-2010 hindcasts



Skill assessment for winter 2011-2012: precipitation rate

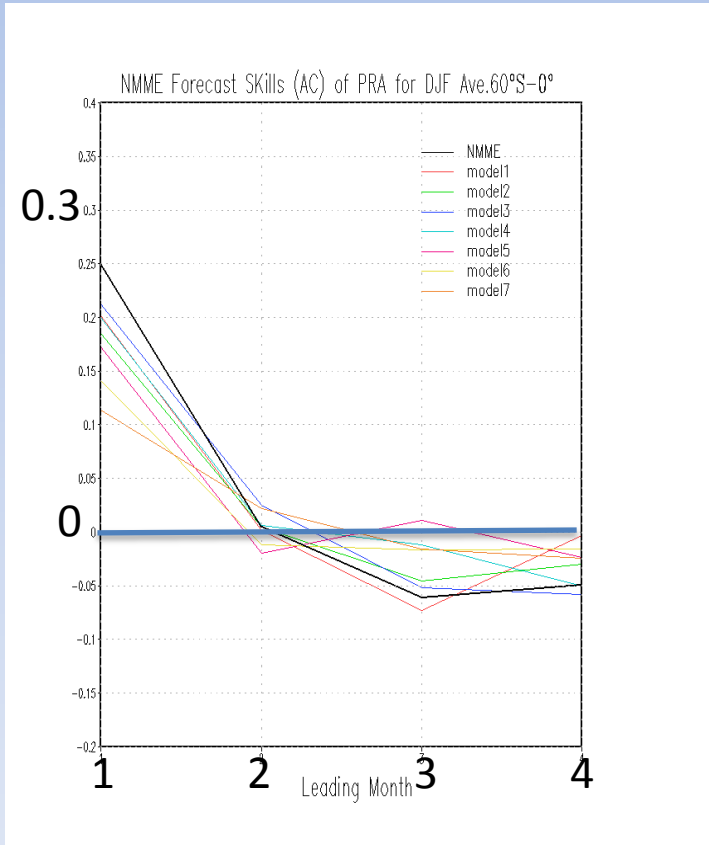
AC & RMSE from 1982-2010 hindcasts: Northern Hemisphere

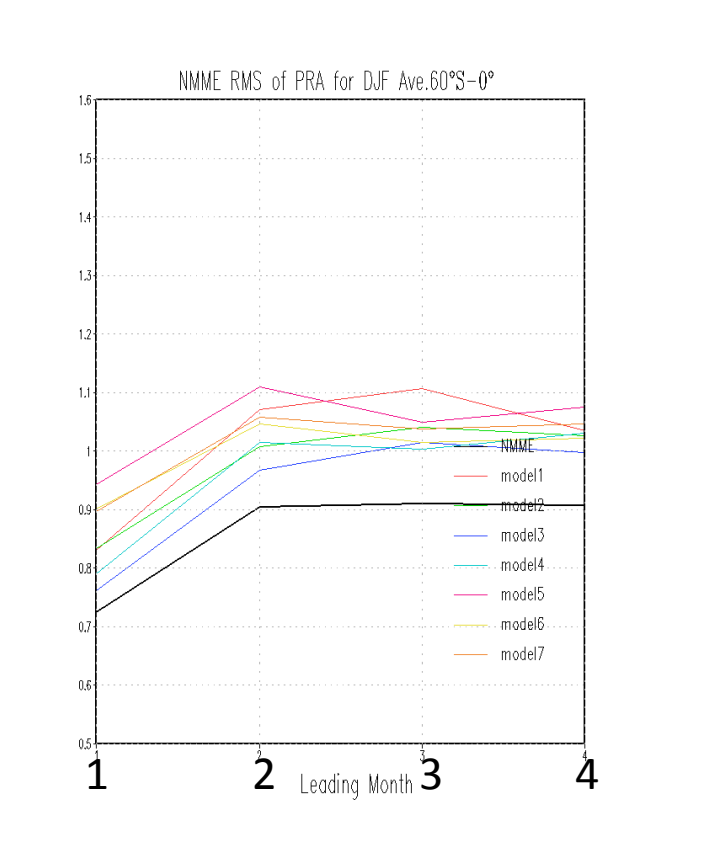




Skill assessment for winter 2011-2012: precipitation rate

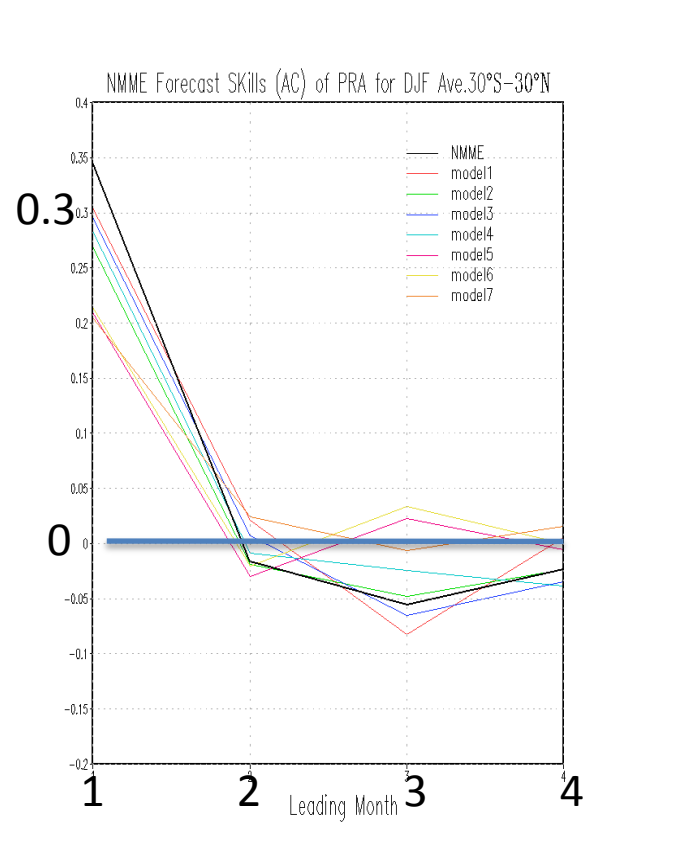
AC & RMSE from 1982-2010 hindcasts: Southern Hemisphere

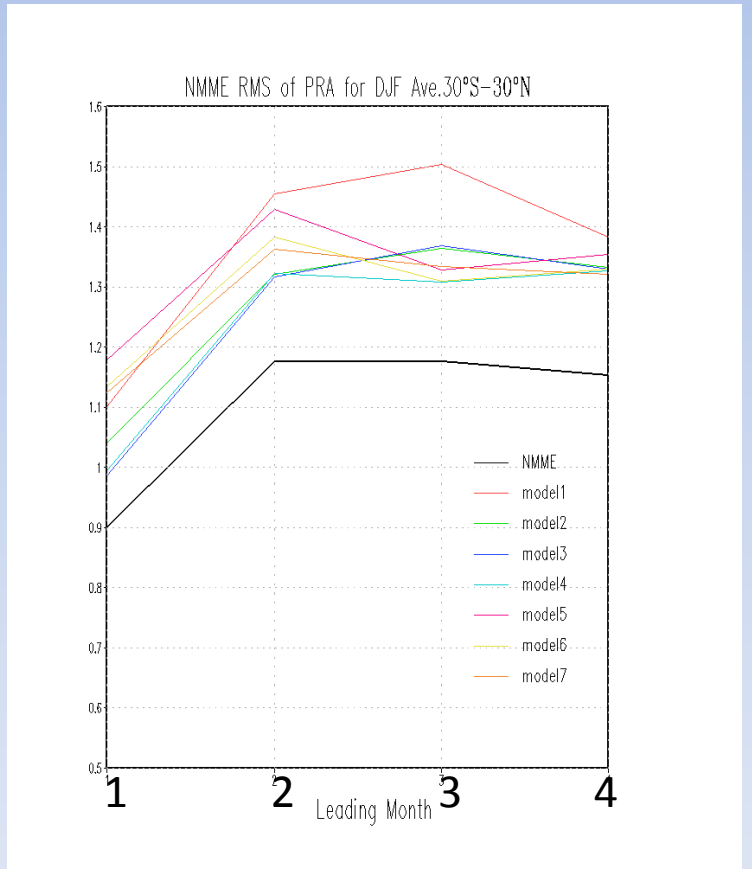




Skill assessment for winter 2011-2012: precipitation rate

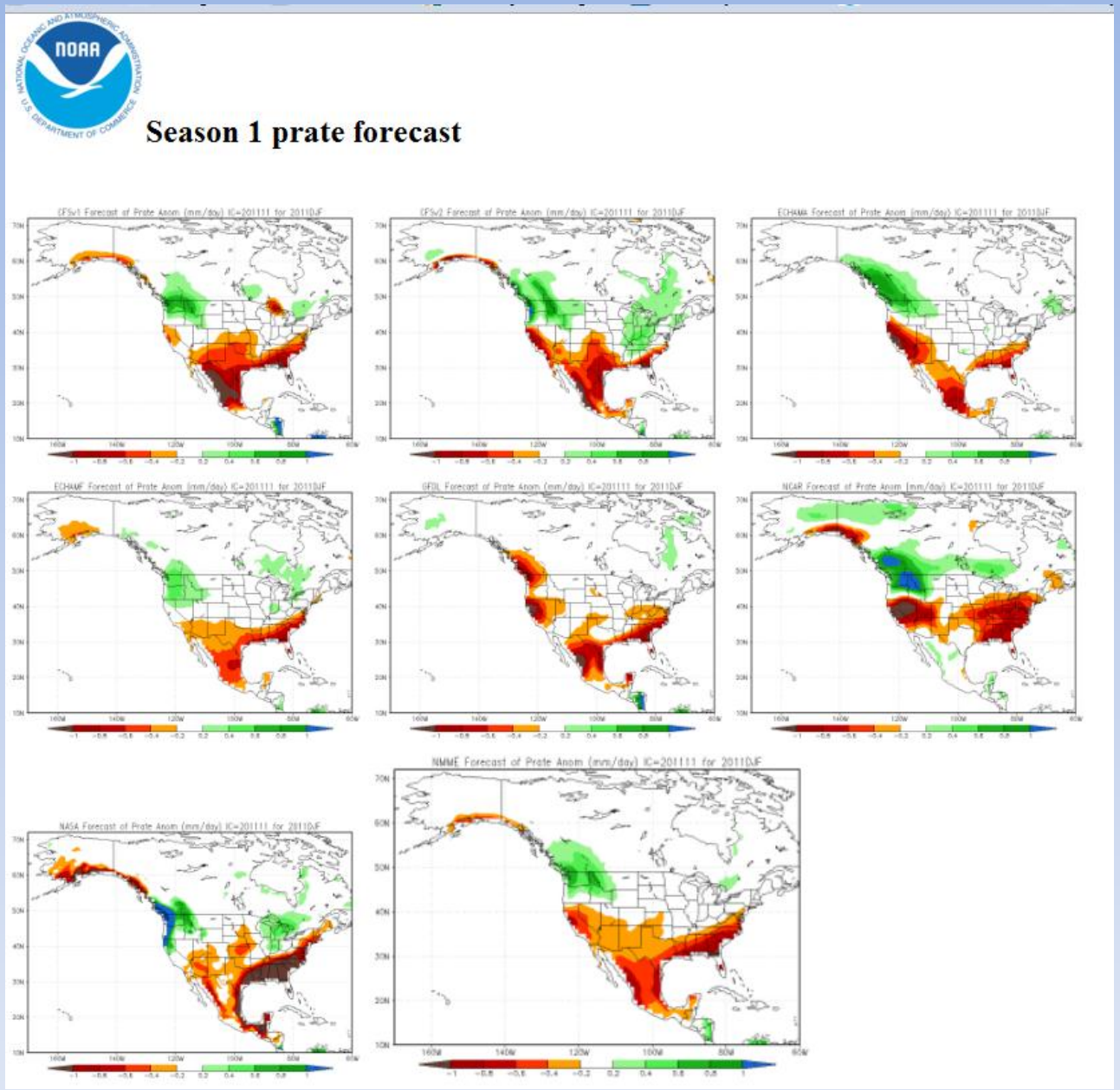
AC & RMSE from 1982-2010 hindcasts: Tropics

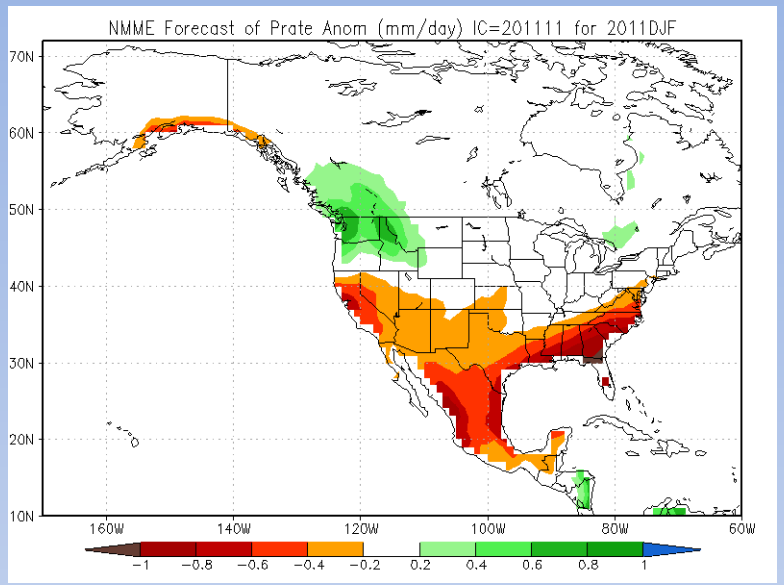


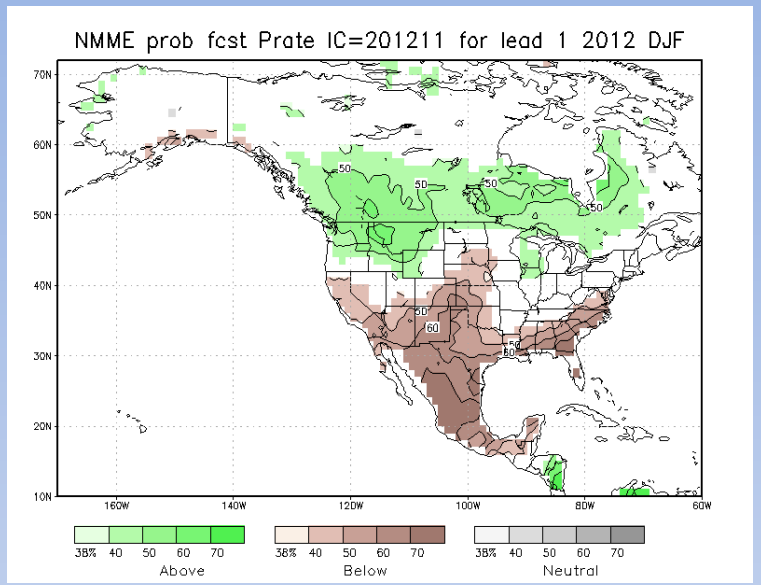


Skill assessment for winter 2011-2012: precipitation rate

US DJF forecast from November initial conditions

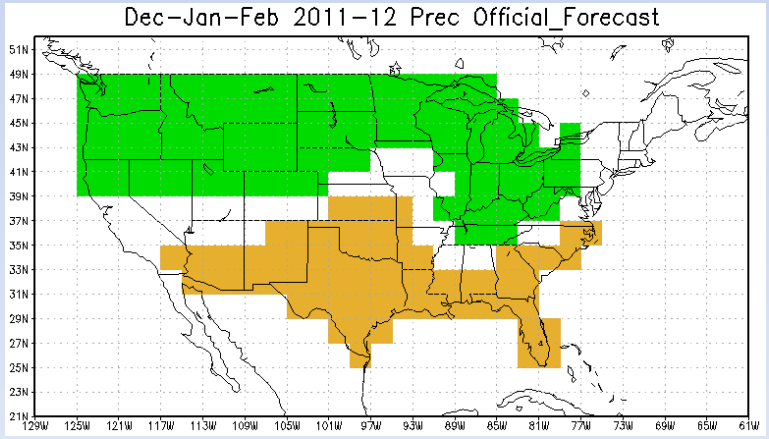


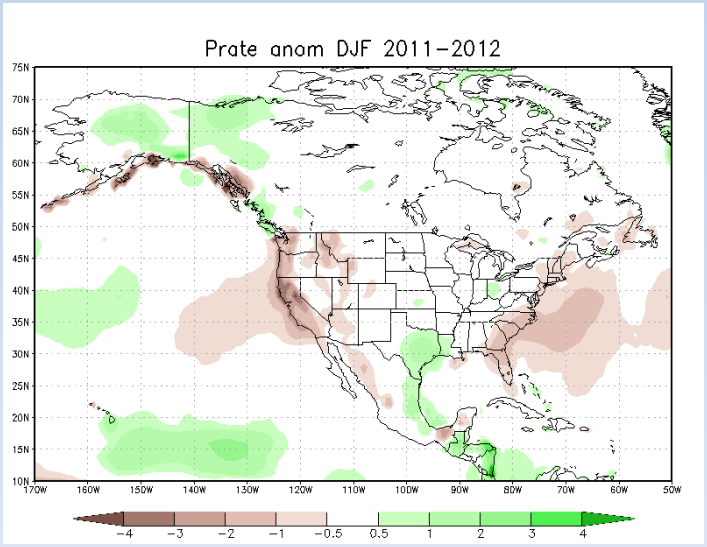




November 2011 initial conditions lead-1 forecast for US DJF 2012 prec. rate forecast (NMME lower 48 SS=-04)

CPC official forecast



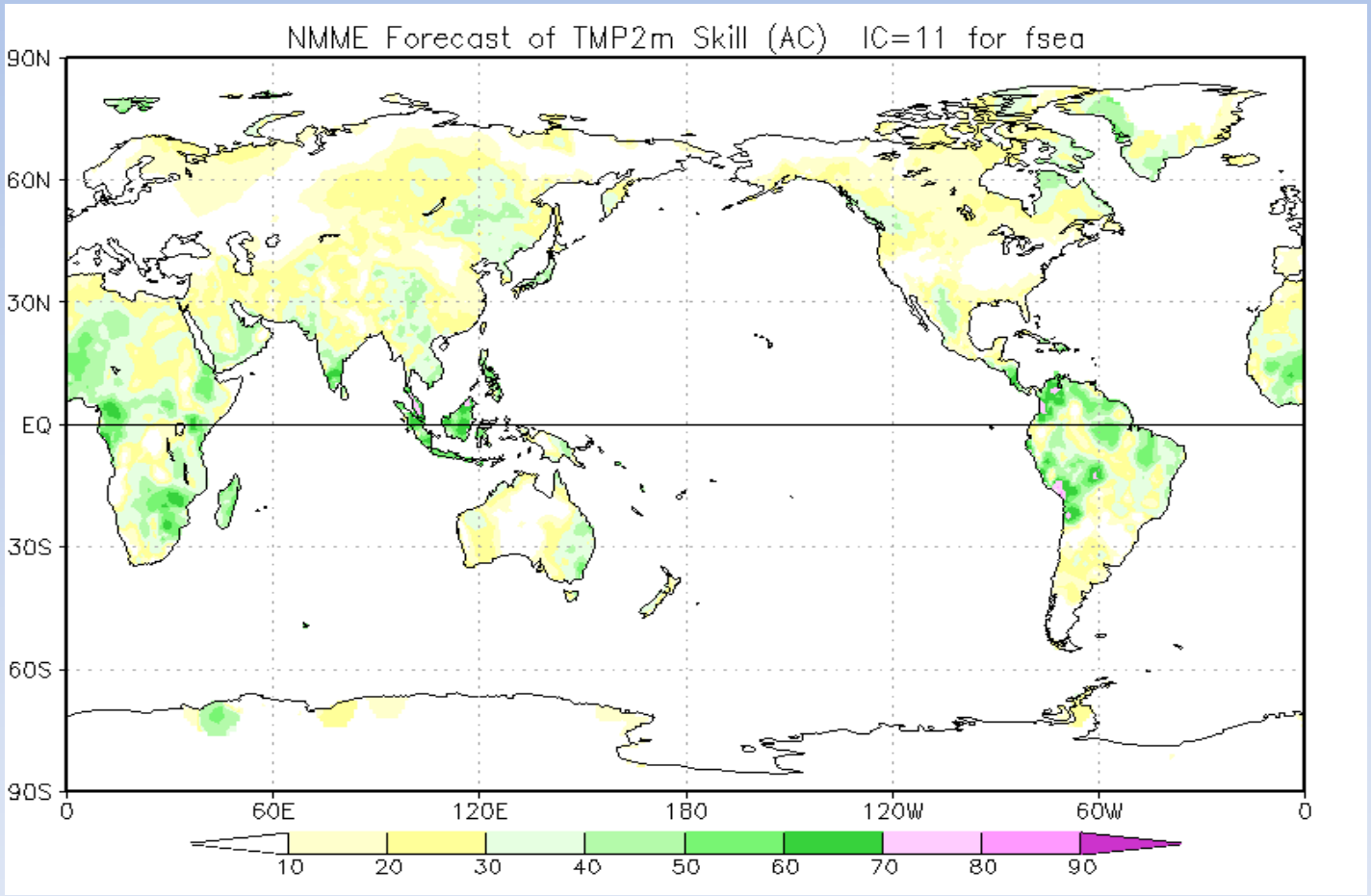


Prate over lower-48 US: monthly mean forecast skill scores

	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
201109	-03	-02	-31	27	12	23	15			
201110		0	-16	41	12	17	11	33		
201111			-31	34	06	09	04	58	35	
201112				18	15	11	05	39	60	05
201201					20	10	14	40	54	39
201202						15	15	40	49	21
201203							13	46	53	28

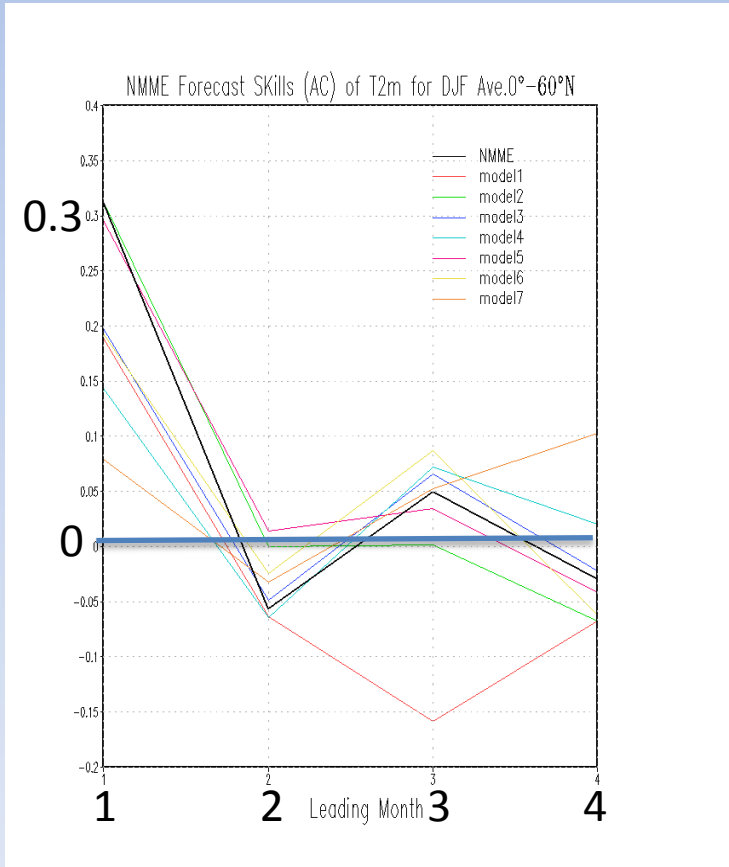
Skill assessment for winter (DJF): 2m temperature

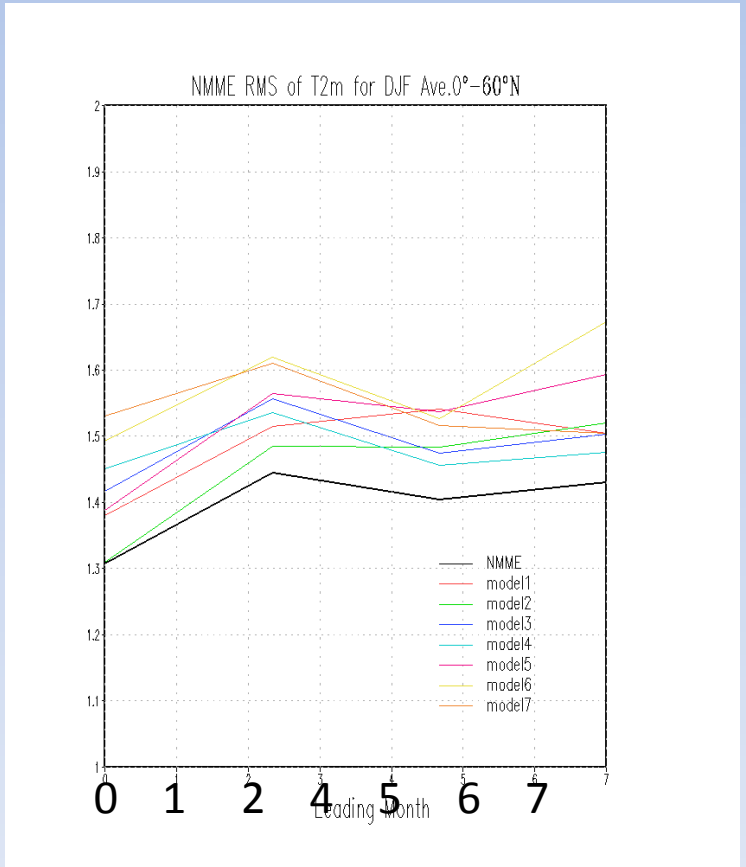
AC from 1982-2010 hindcasts



Skill assessment for winter (DJF): 2m temperature

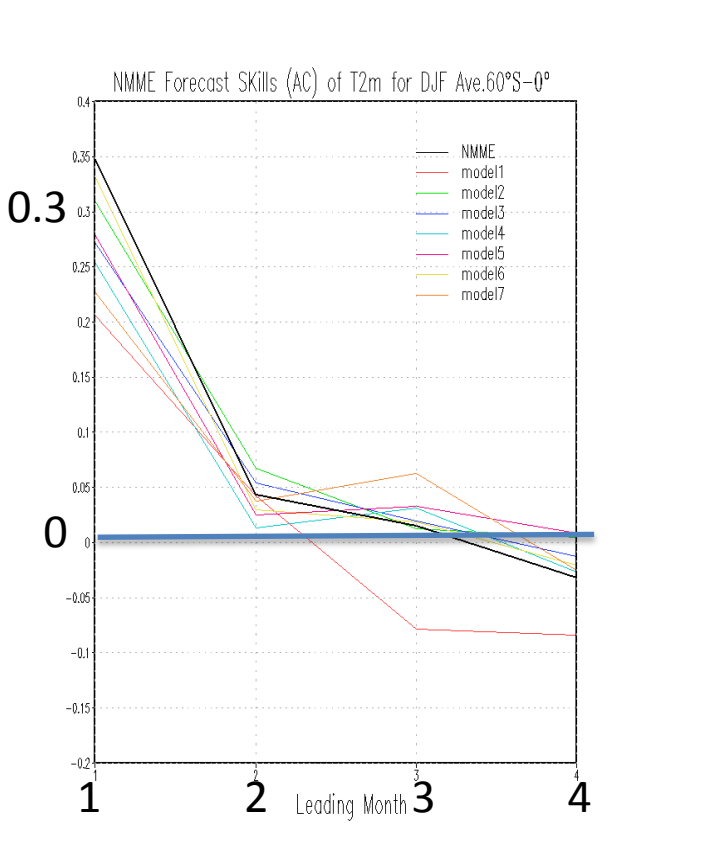
AC & RMSE from 1982-2010 hindcasts: Northern Hemisphere

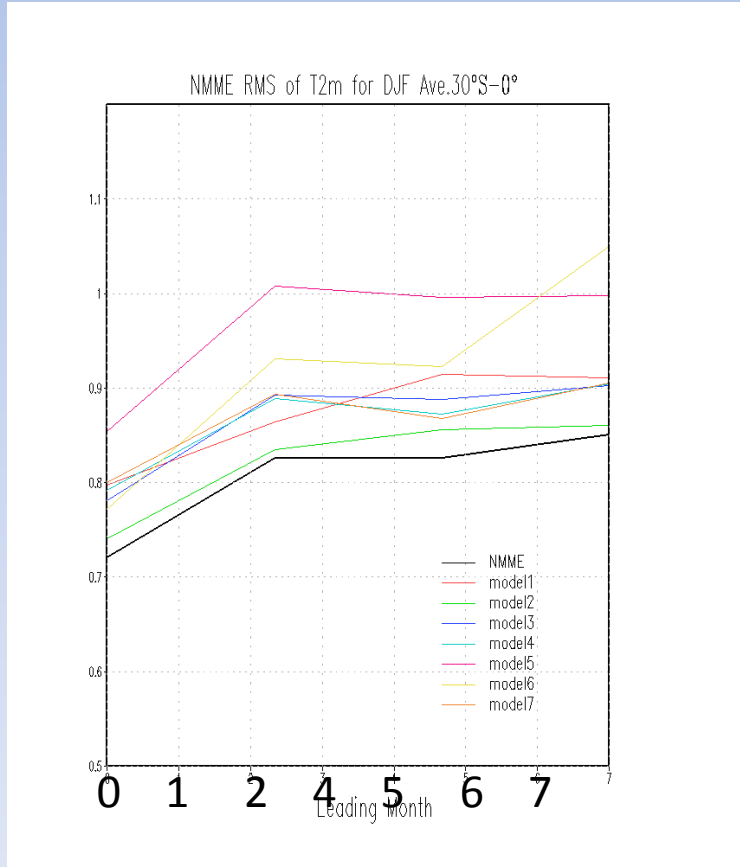




Skill assessment for winter (DJF): 2m temperature

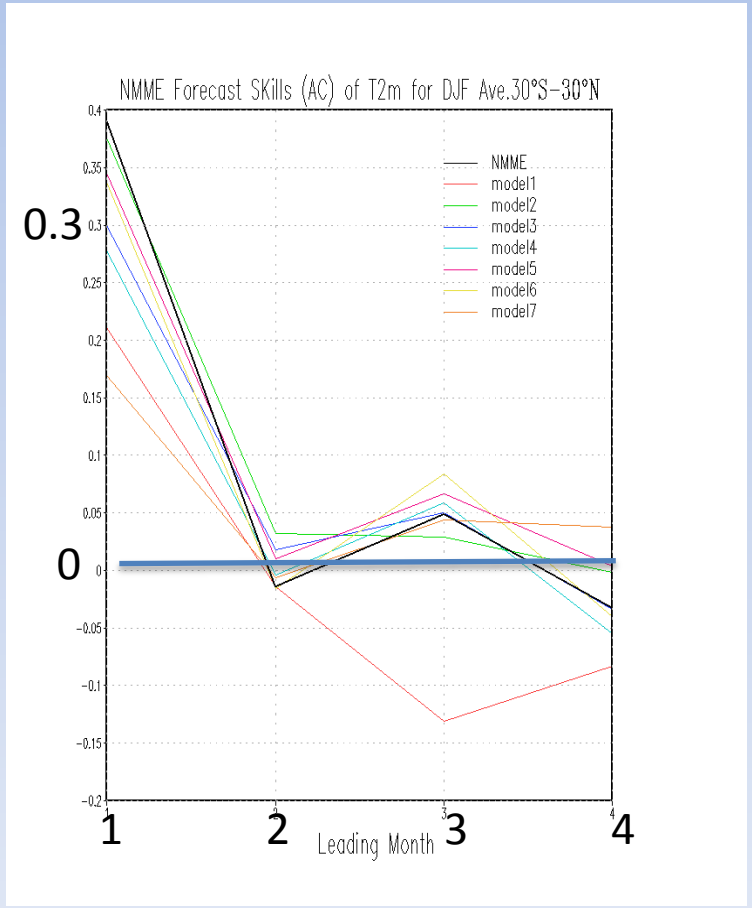
AC & RMSE from 1982-2010 hindcasts: Southern Hemisphere

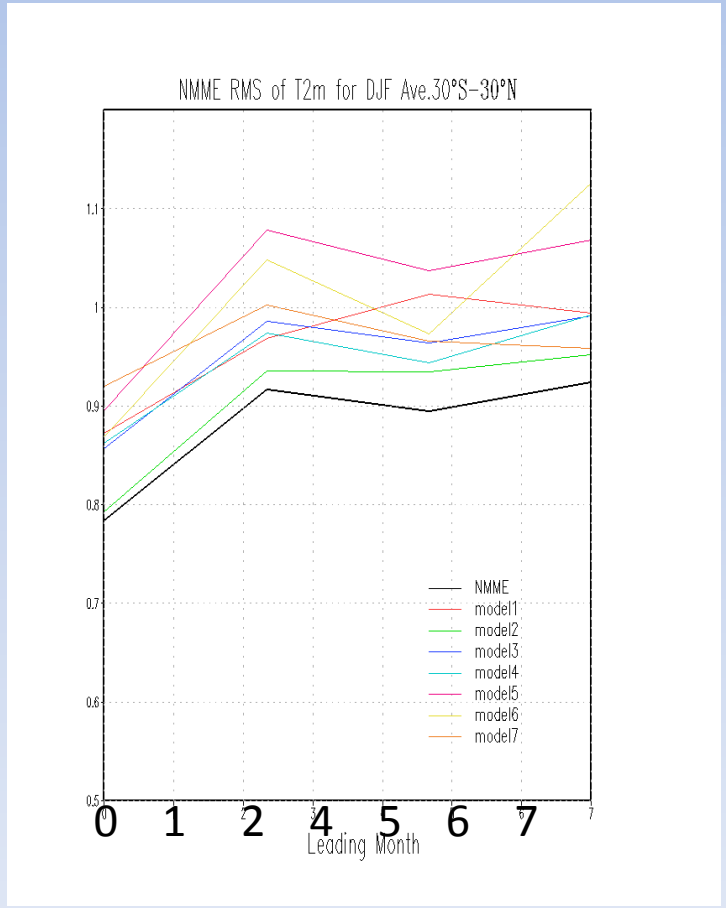




Skill assessment for winter (DJF): 2 m temperature

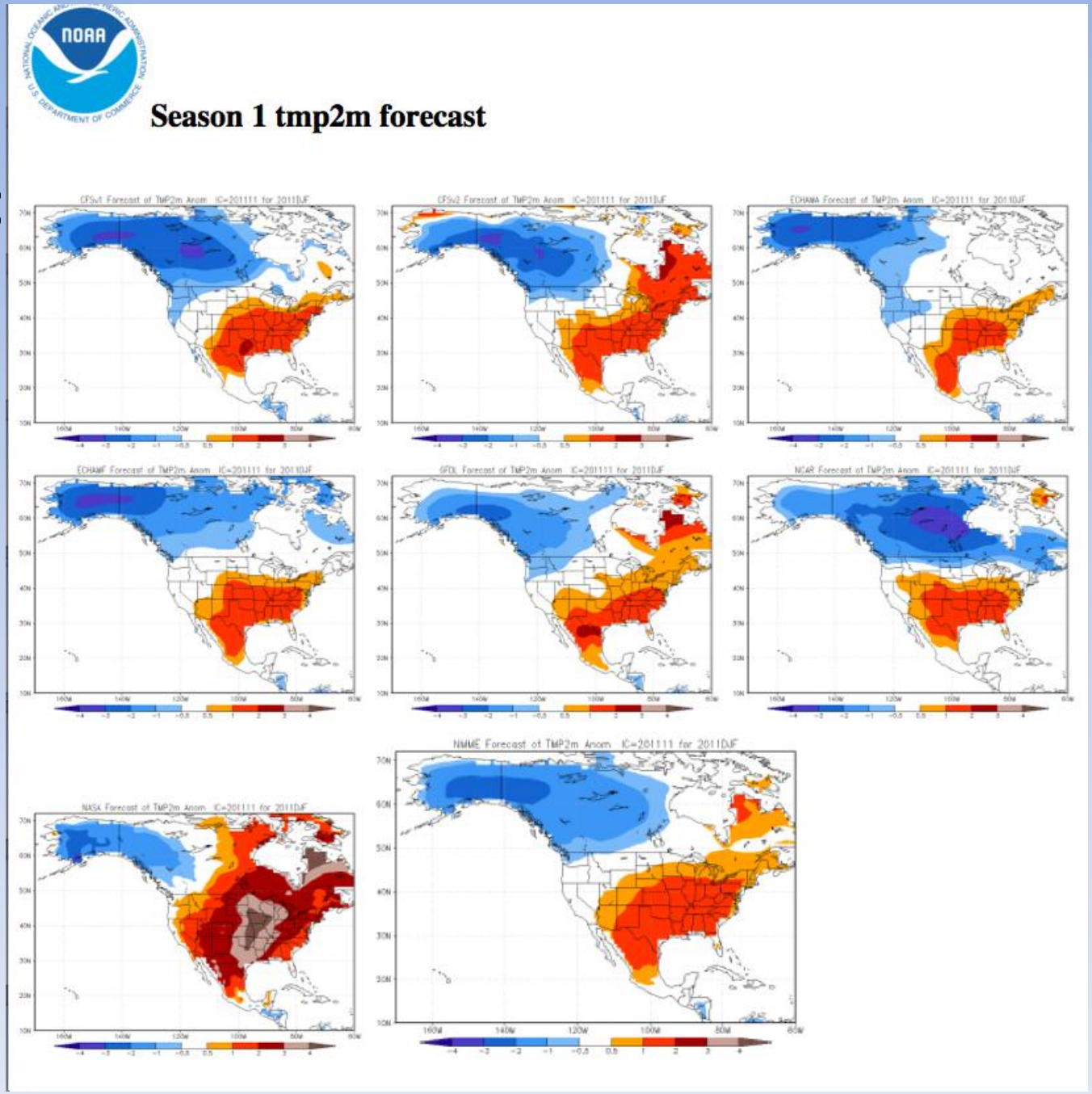
AC & RMSE from 1982-2010 hindcasts: Tropics

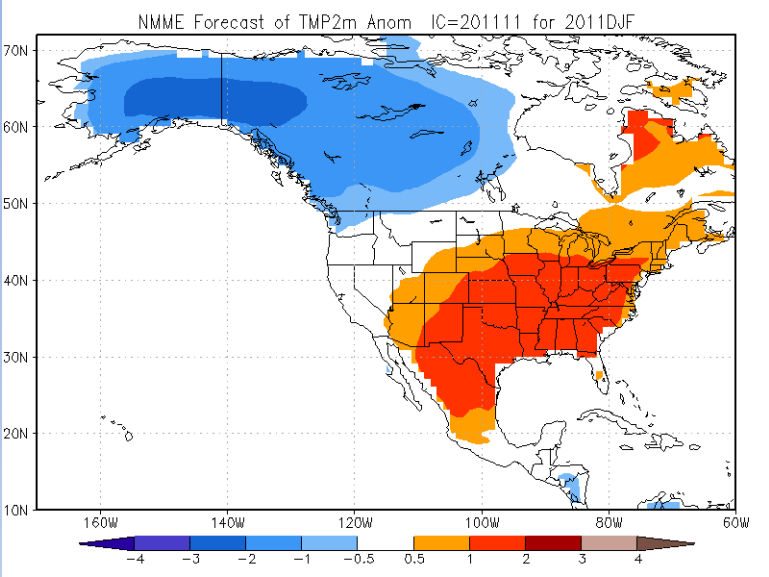


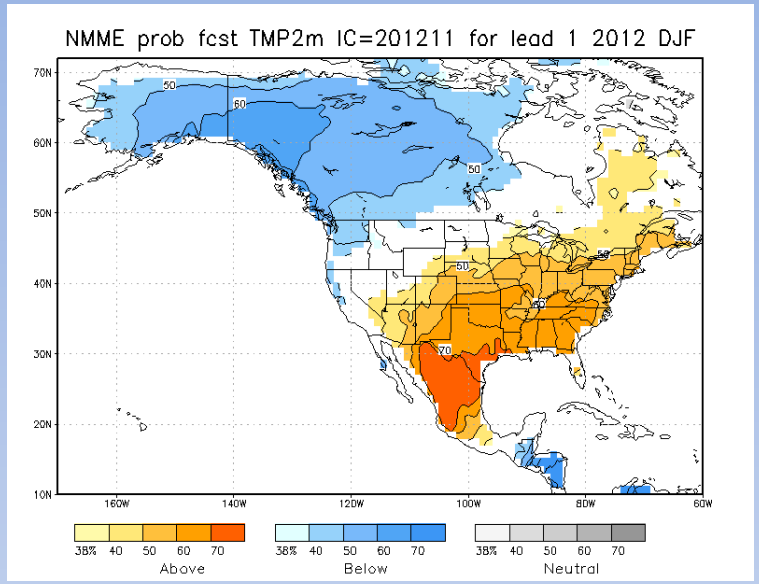


Skill assessment for winter 2011-2012: 2m Tmp

DJF forecast from November 2011 initial conditions

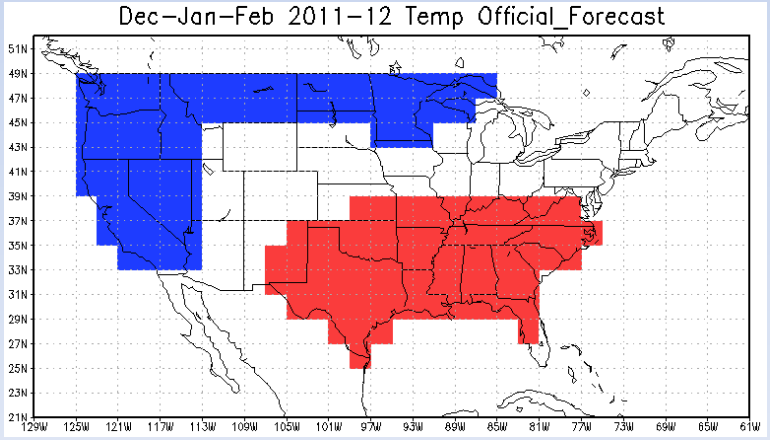


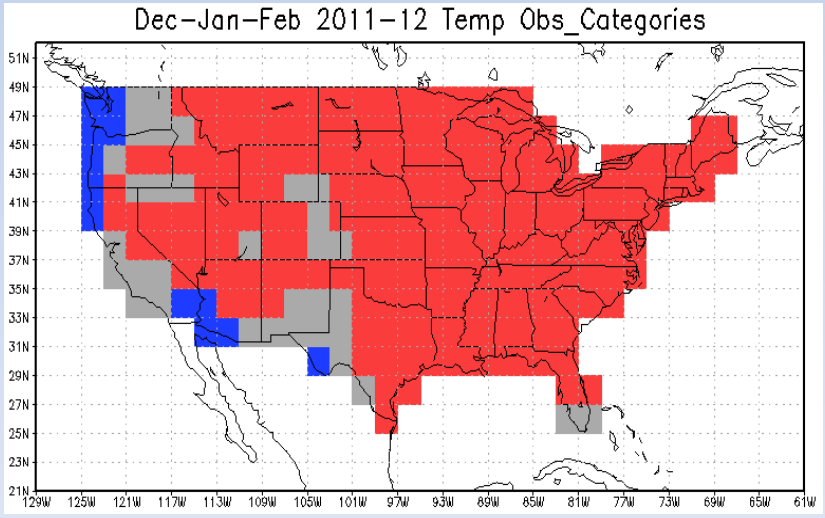




US DJF 2012 t2m forecast from November 2011 initial conditions (NMME lower 48 SS=47)

CPC official forecast



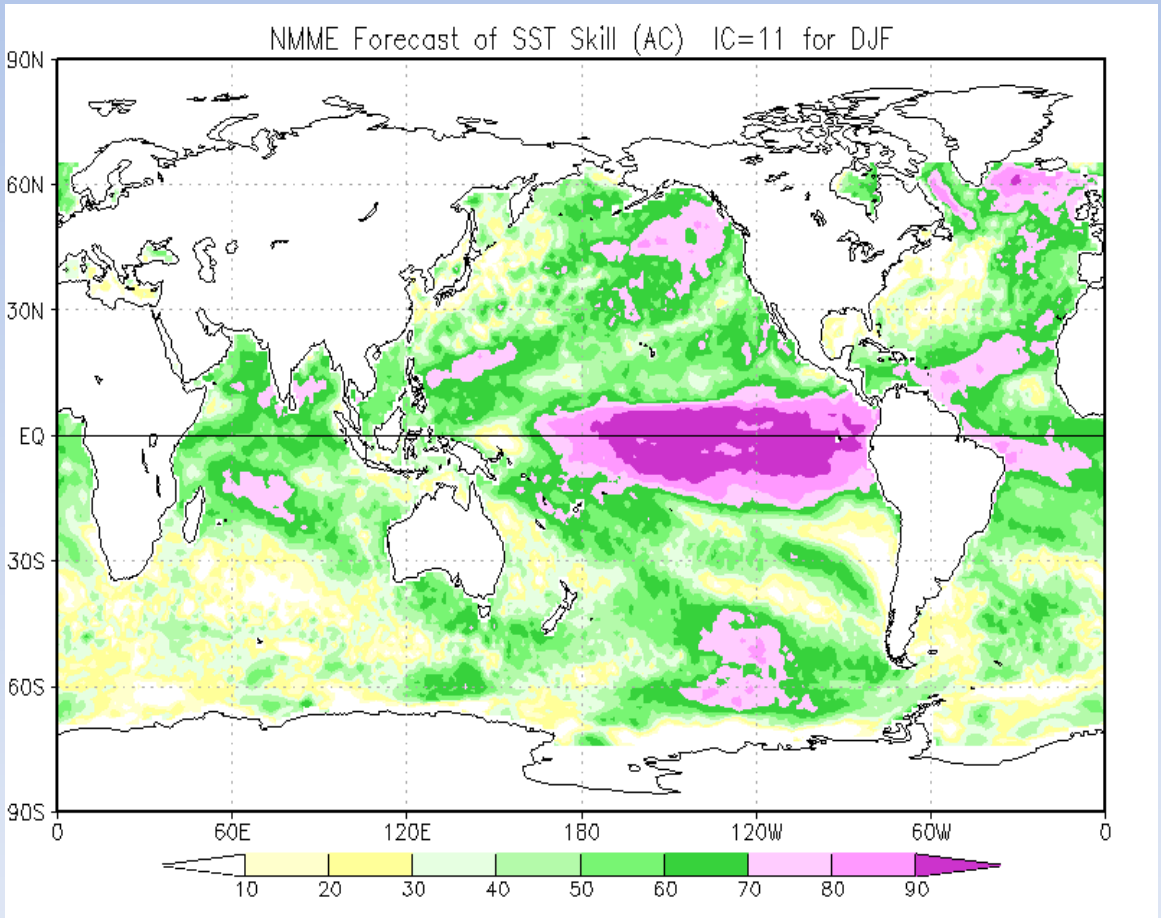


Tmp2m over lower-48 US: monthly mean forecast skill scores

	Oct 2011	Nov 2011	Dec 2011	Jan 2012	Feb 2012	Mar 2012	Apr 2012	May 2012	Jun 2012	Jul 2012
201109	35	17	36	85	30	65	51			
201110		24	0	83	23	64	58	59		
201111			17	69	48	70	54	64	46	
201112				62	21	58	31	12	44	39
201201					34	71	61	61	42	18
201202						76	59	61	38	61
201203							55	53	28	64

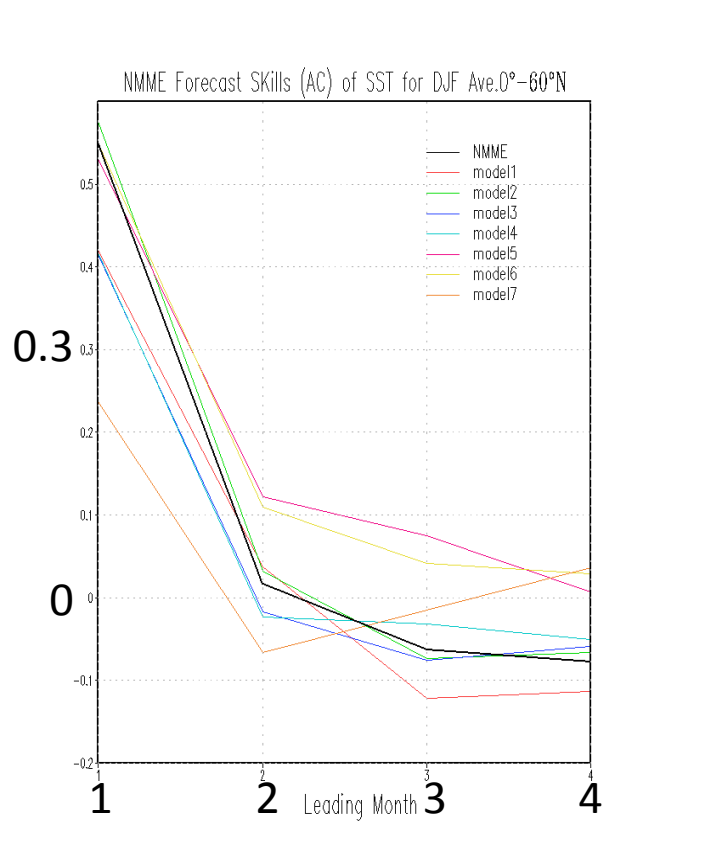
Skill assessment for winter (DJF): sea-surface temperature

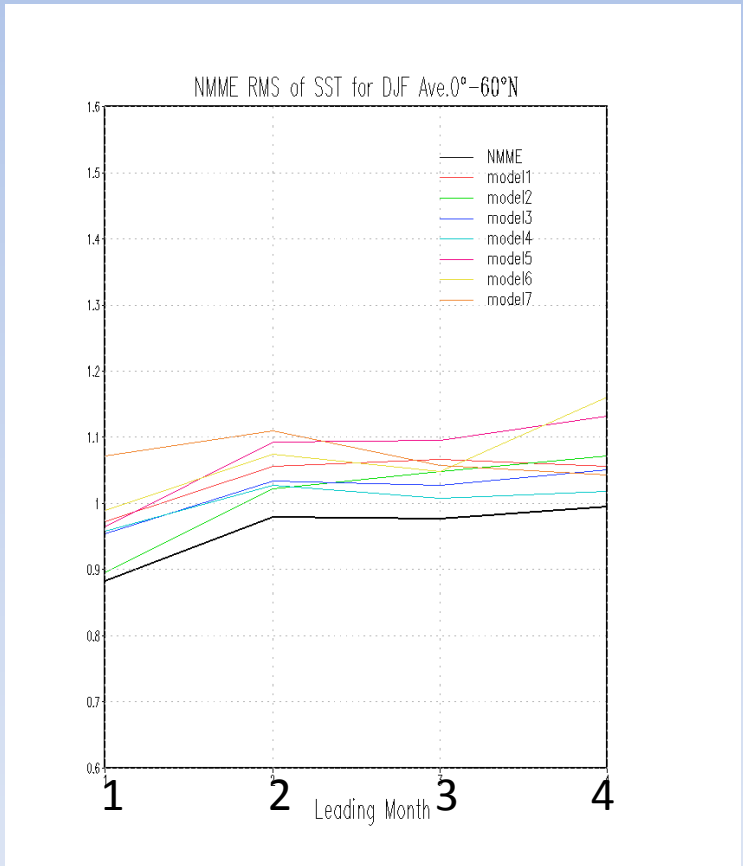
AC from 1982-2010 hindcasts



Skill assessment for winter (DJF): sea-surface temperature

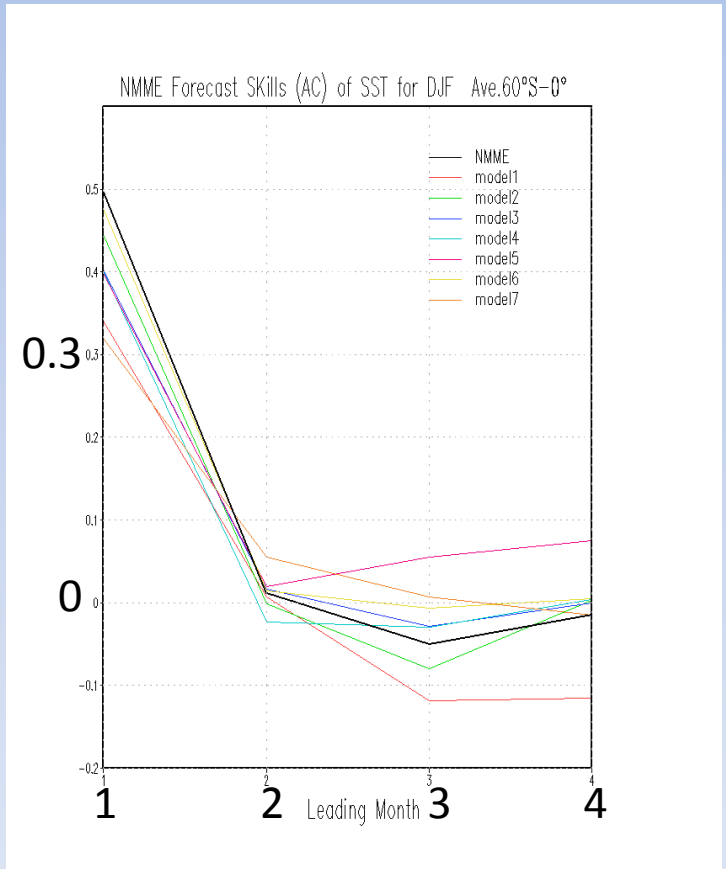
AC & RMSE from 1982-2010 hindcasts: Northern Hemisphere

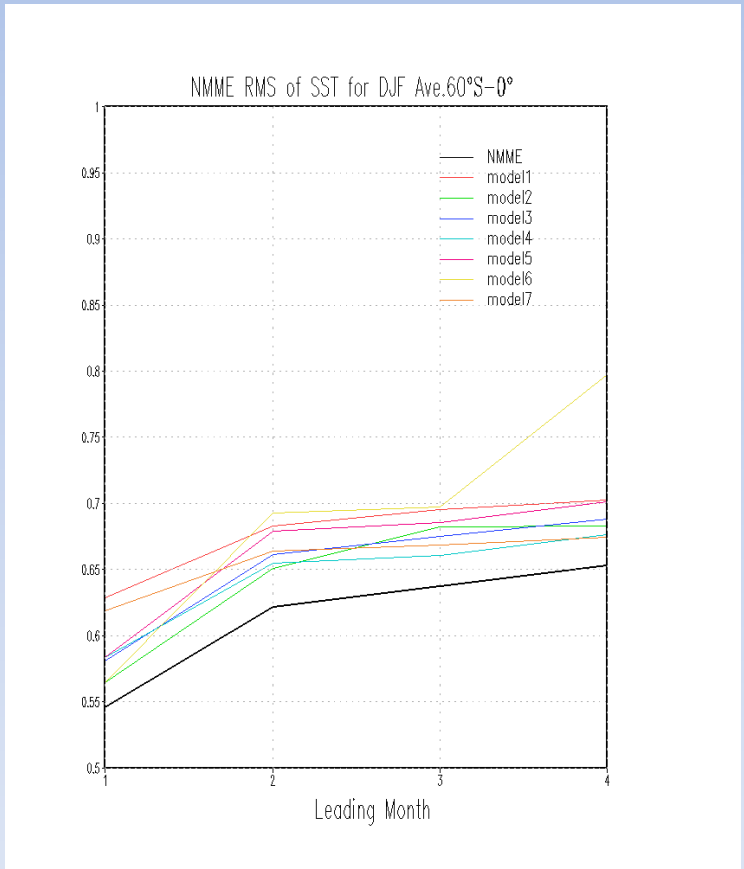




Skill assessment for winter (DJF): sea-surface temperature

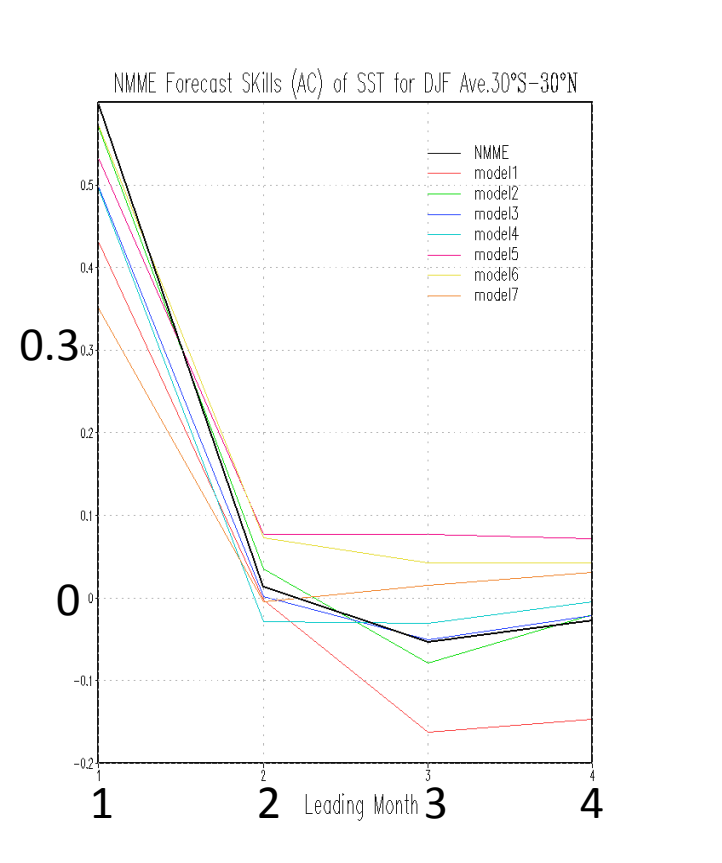
AC & RMSE from 1982-2010 hindcasts: Southern Hemisphere

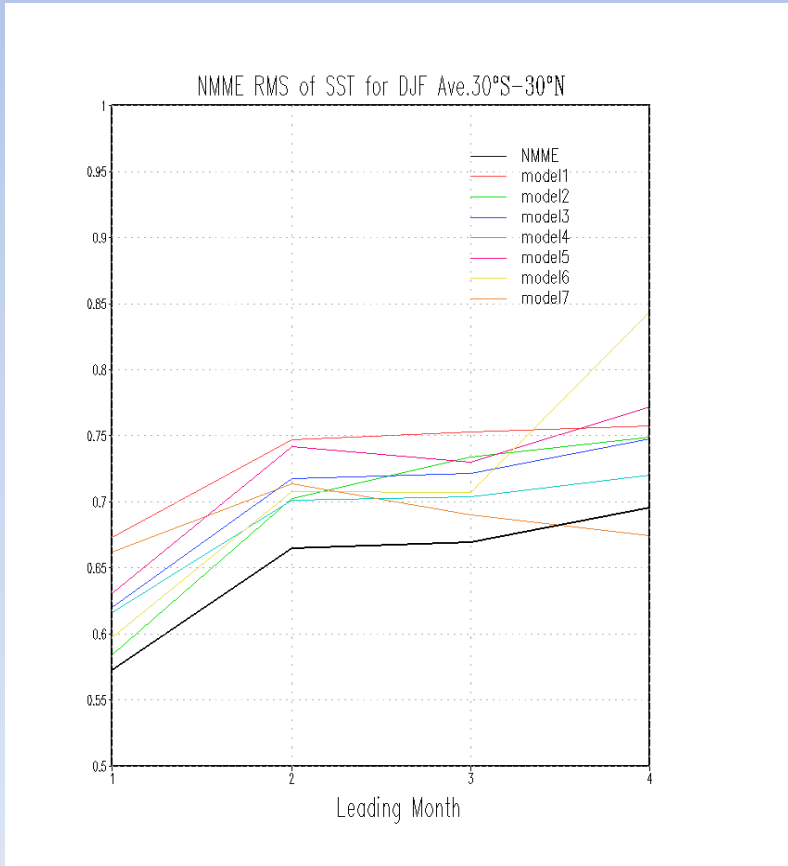




Skill assessment for winter (DJF): sea-surface temperature

AC from 1982-2010 hindcasts: Tropics





Summary

- At lead 1, NMME anomaly correlations for DJF are higher than those of individual models
- DJF 2011-2012 was a difficult case, but Lead-1 T2m forecasts over CONUS were reasonably good; precipitation rate forecast had low skill
- Warm late winter and spring over CONUS were fairly well forecast, even at long leads
- Full verification analysis should help to identify sources of strength/weakness