The Performance of the CWB First Generation Seasonal Forecast System in 2010 and the Development of Second Generation Seasonal Forecast System

Climate Forecast System Development Team

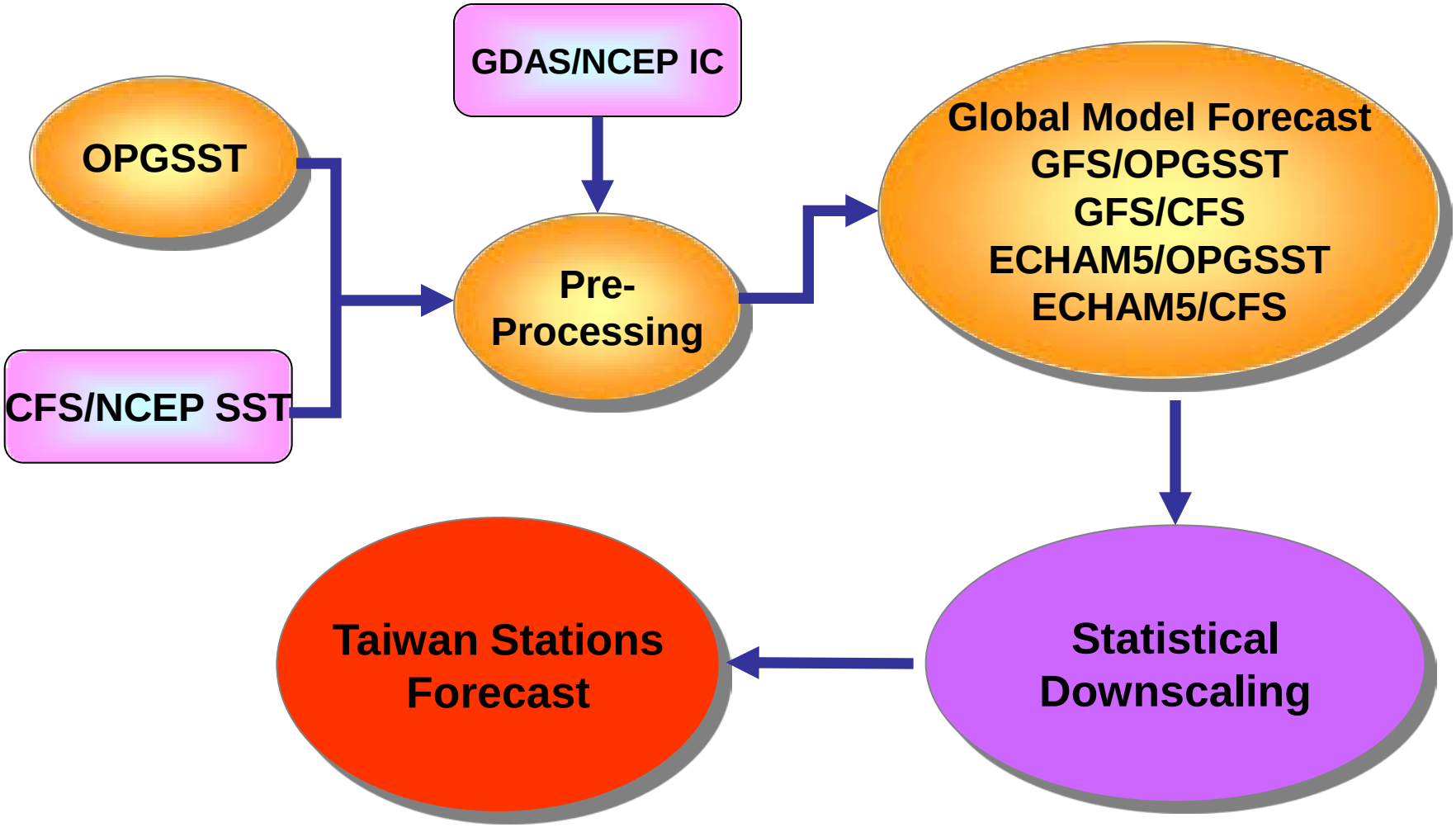
Meteorological Research and Development Center

Central Weather Bureau

Presented by

Jyh-Wen Hwu

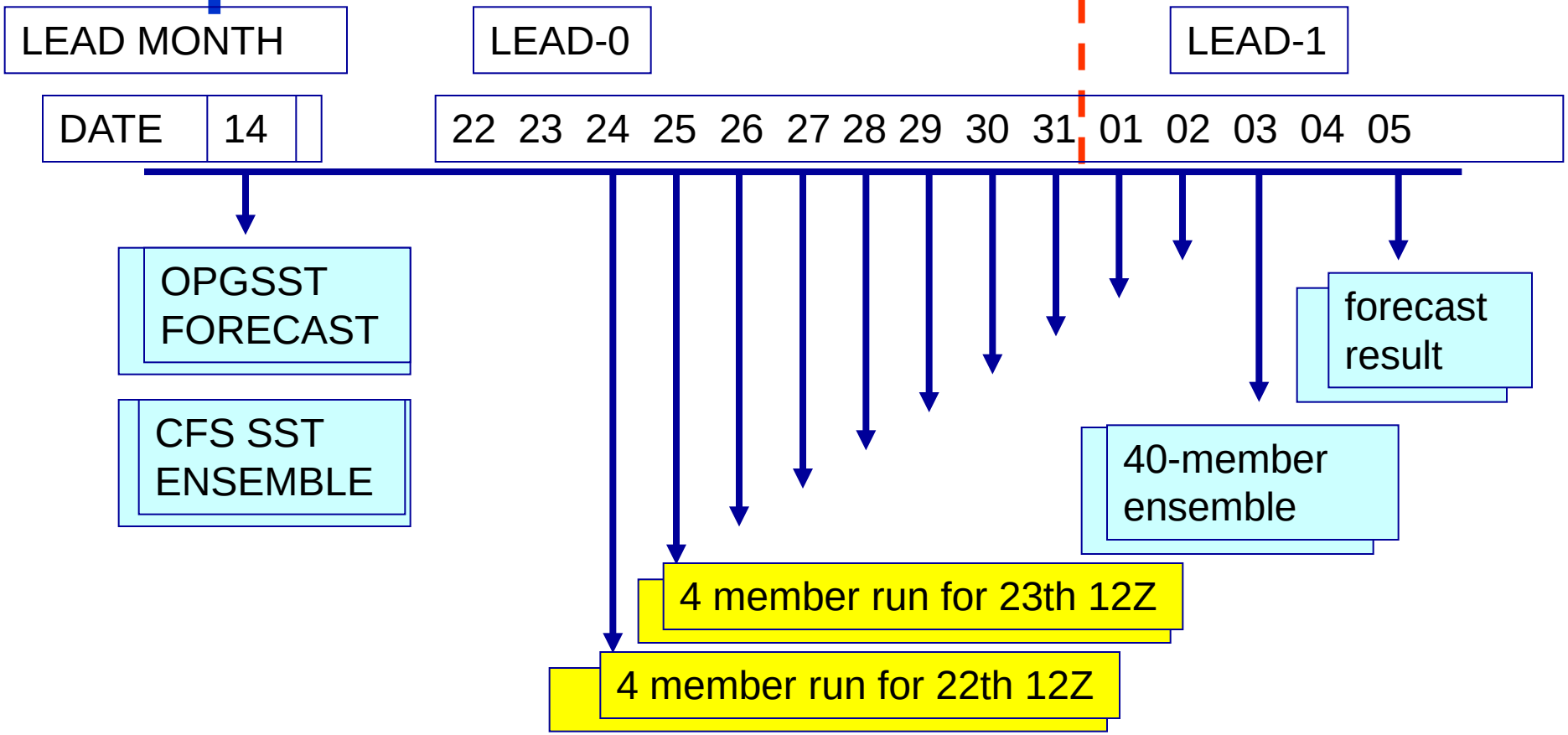
Seasonal Forecast System



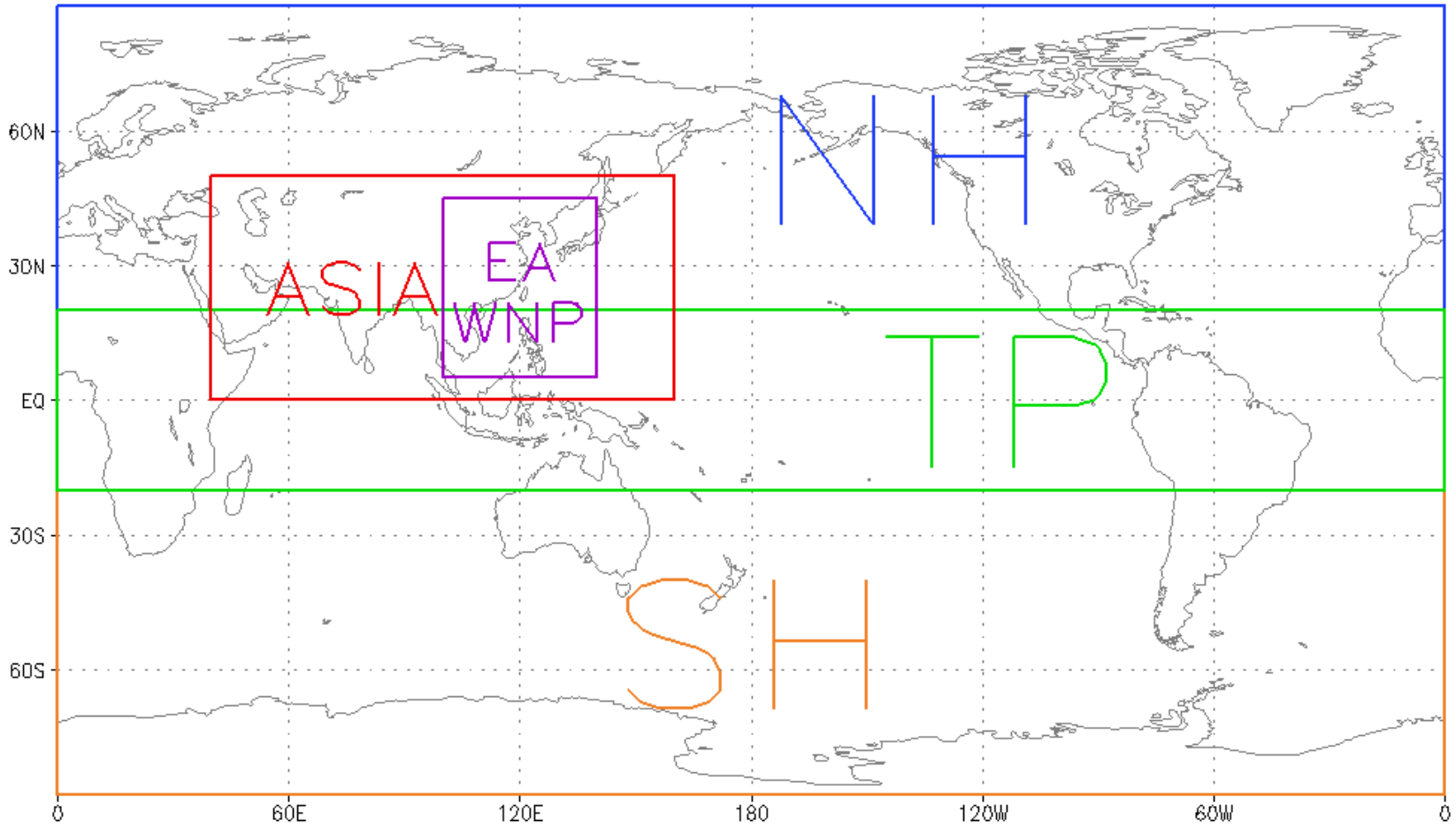
Seasonal Forecast System

- Experimental forecast from January 2006 to December 2009
- Operation in January 2010
- 40 members ensemble global forecast
- Statistical downscaling to Taiwan stations

Operational Forecast Schedule



- IC: last 10 days of lead 0 from NCEP/GDAS.
- 4 members run in all IC+2 days (GFS/OPGSST, GFS/CFS, ECHAM/OPGSST, ECHAM/CFS) with 7 months forecasting.
- Each member need about 40 minutes for model running and another 30 minutes for post process.

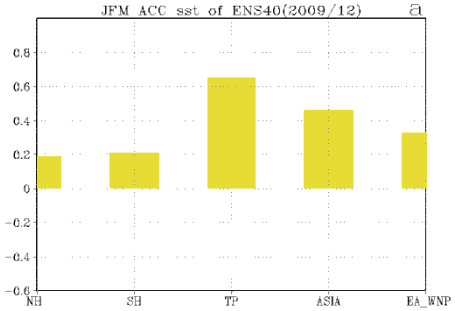


TP (20ºS-20ºN, 0º-360ºE); SH (90ºS-20ºS, 0º-360ºE）

NH (20ºN-90ºN, 0º-360ºE）

ASIA (0º-50ºN, 40ºE-160ºE）;EA-WNP (5ºN-45ºN, 100ºE-140ºE）

SST ACC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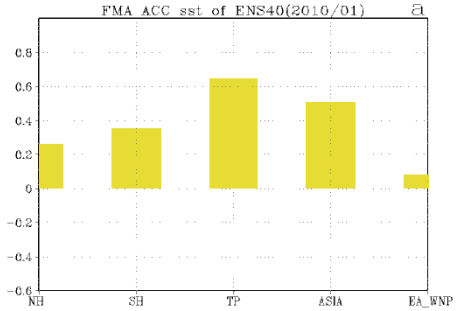
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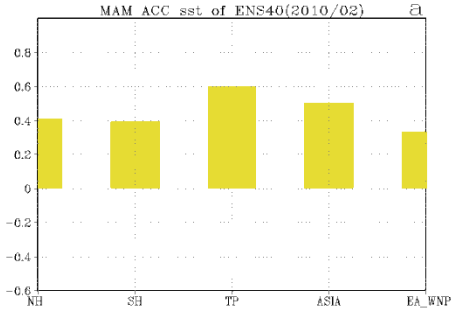
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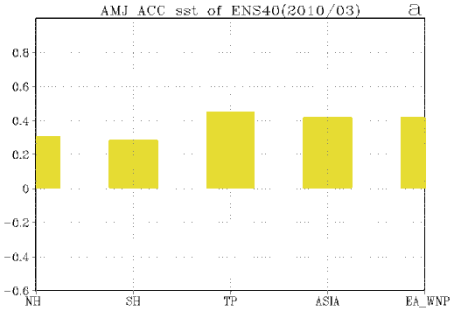
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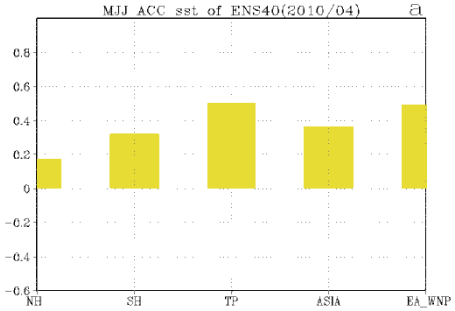
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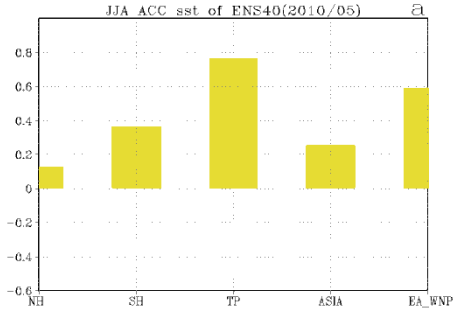
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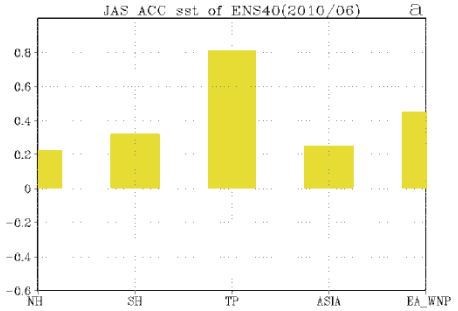
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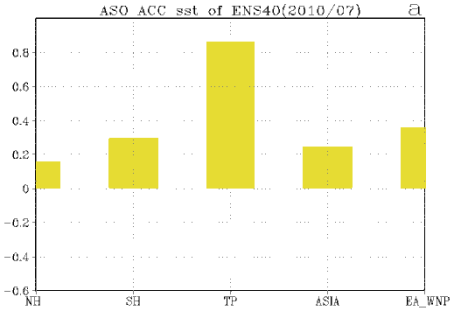
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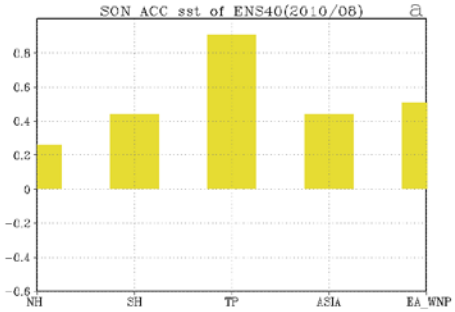
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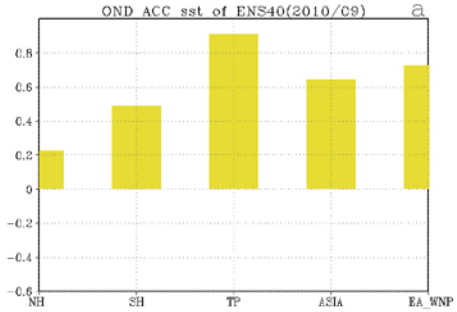
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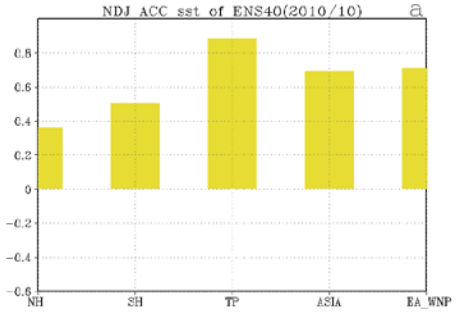
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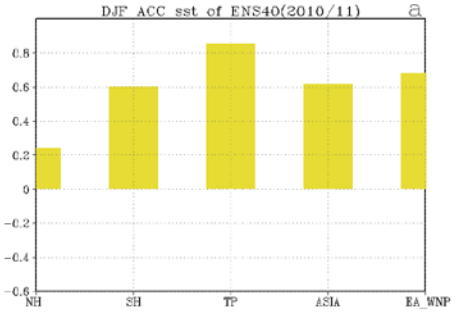
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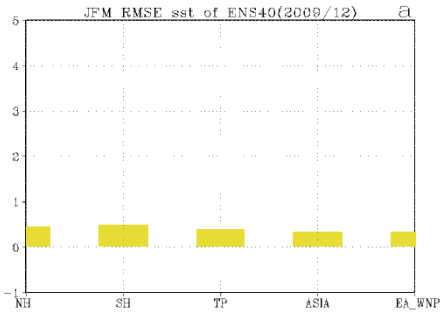
SST RMSE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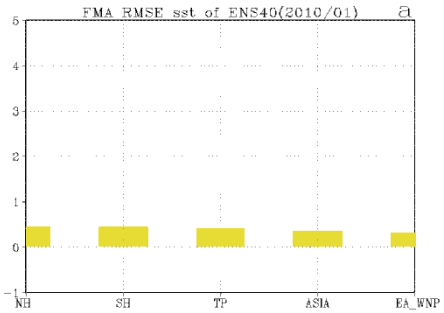
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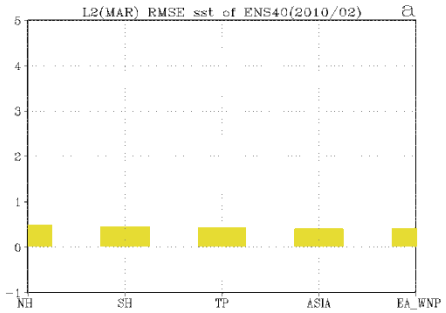
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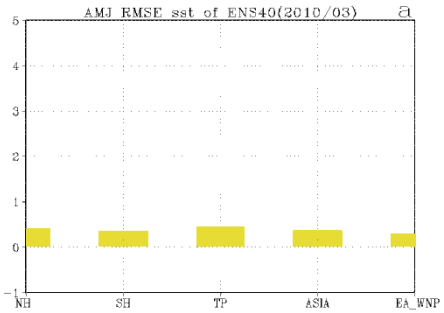
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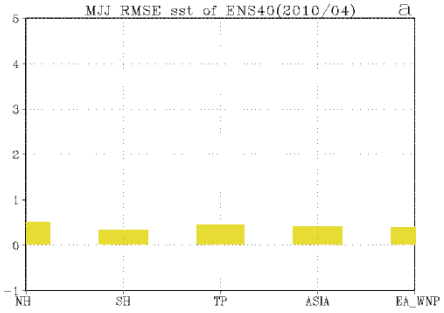
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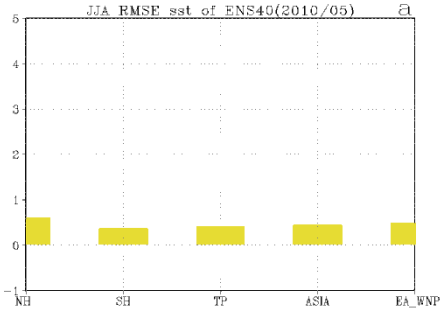
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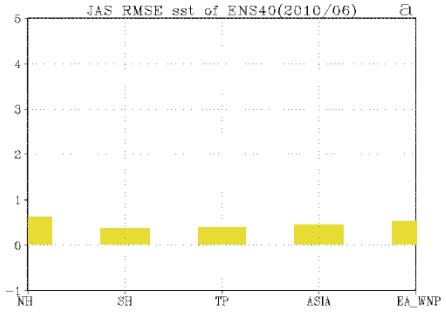
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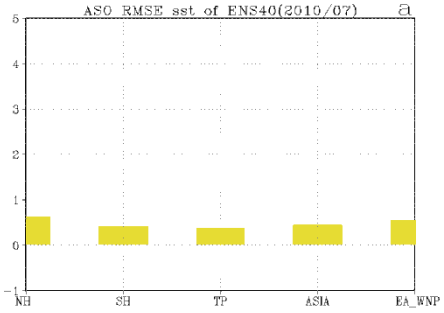
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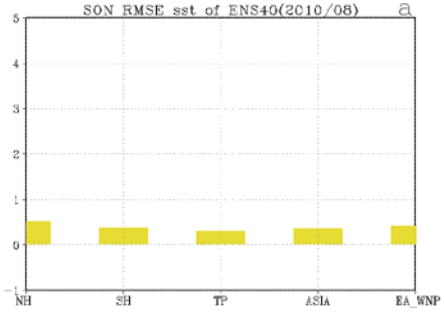
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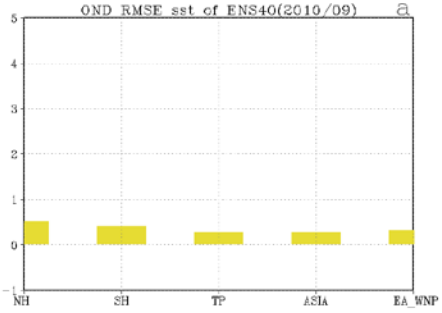
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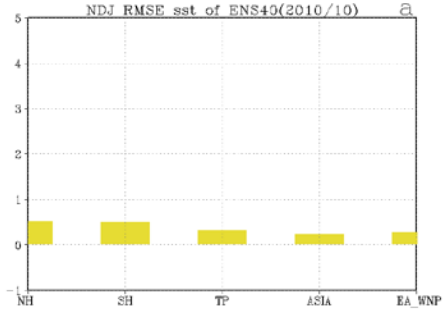
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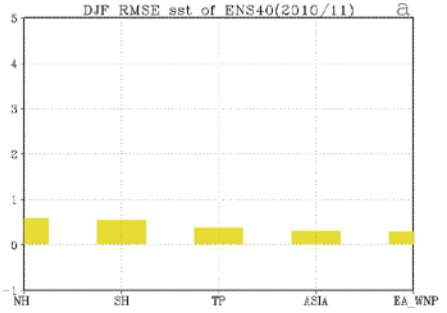
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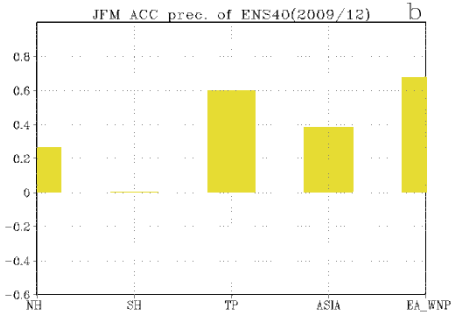
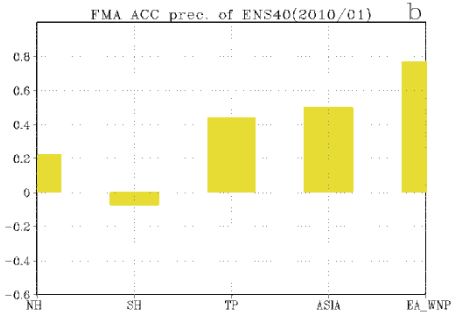
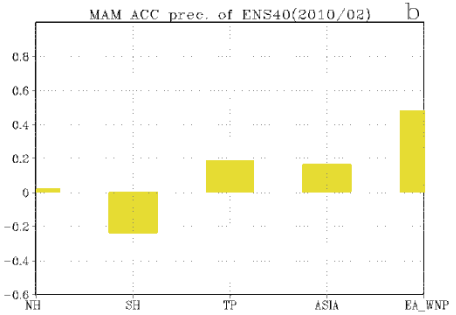
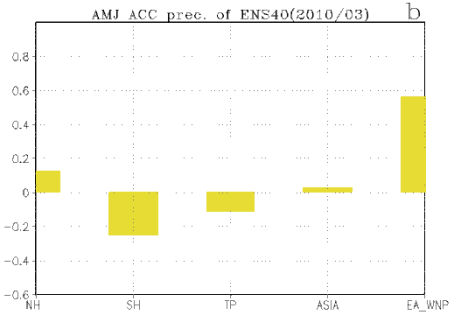
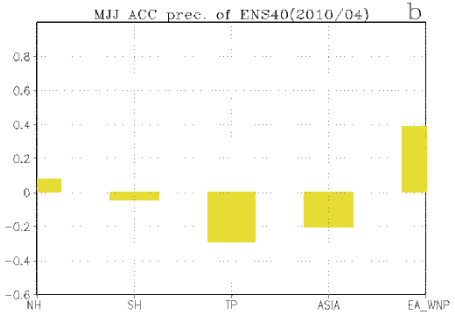
Precipitation ACC

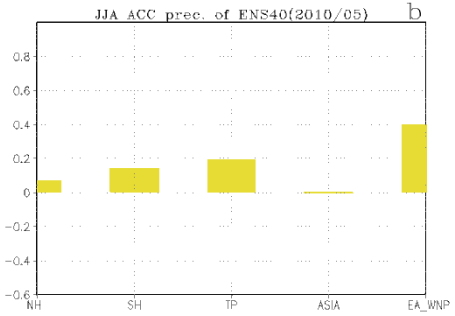


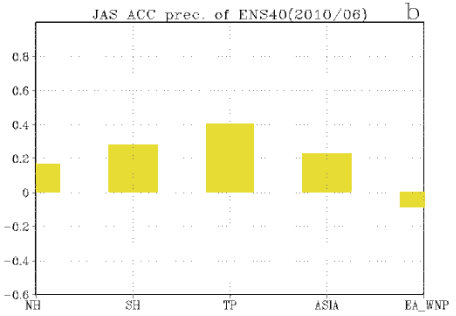


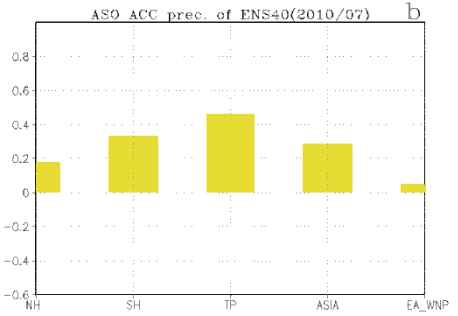


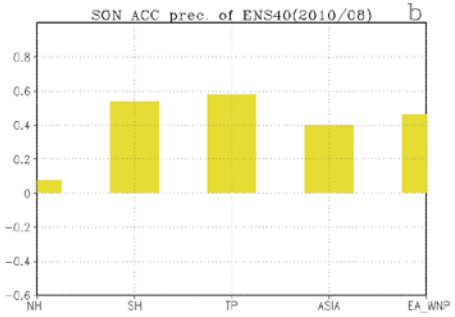


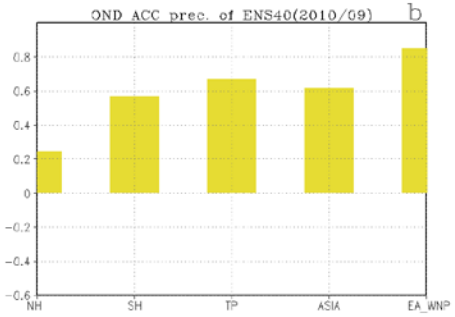


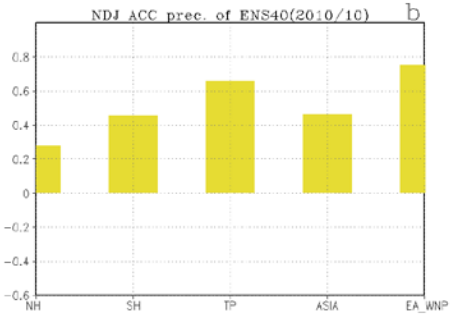


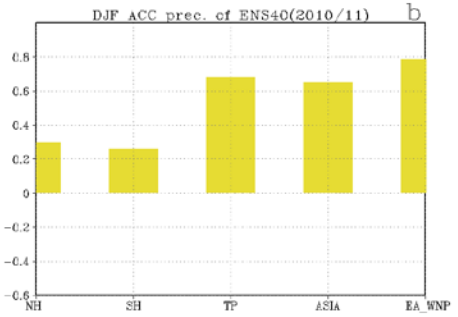




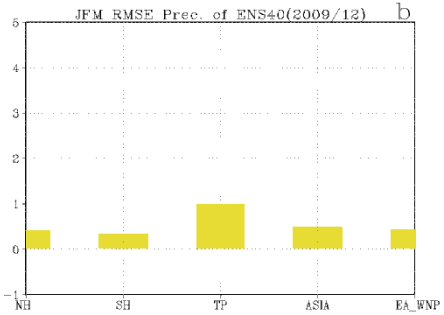


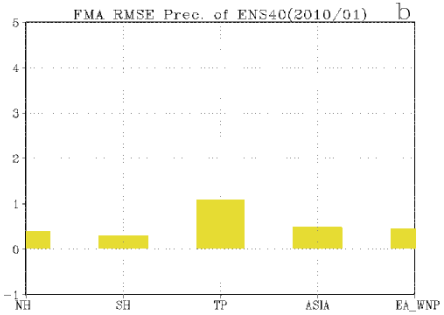


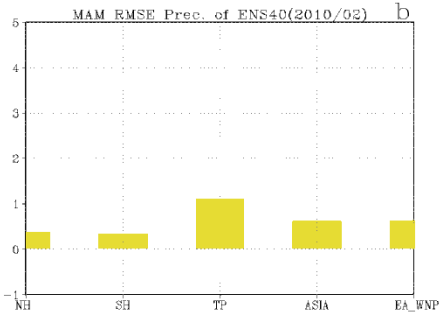


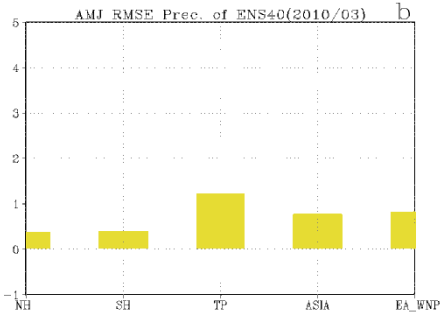


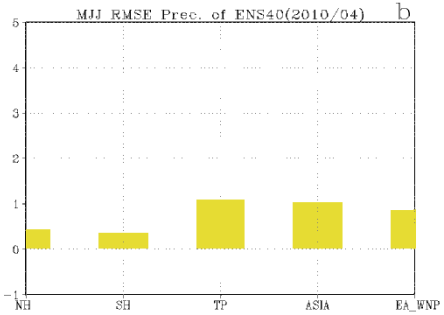
Precipitation RMSE

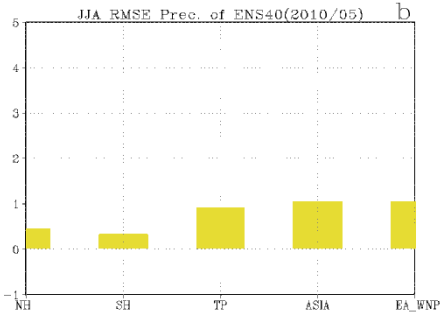


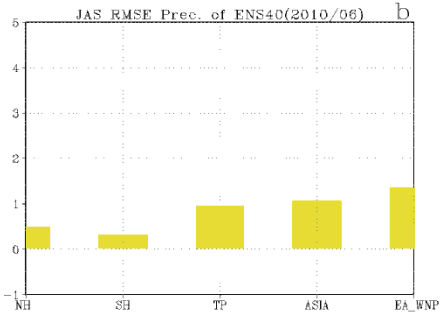


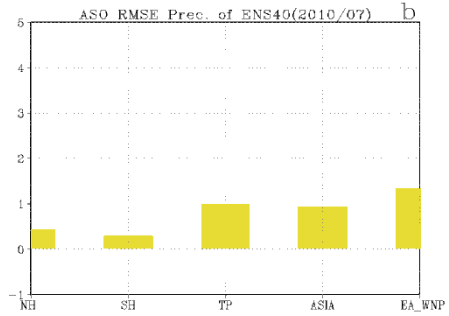


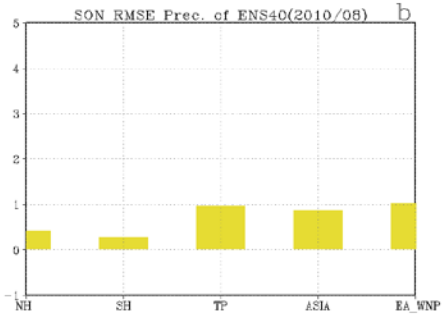


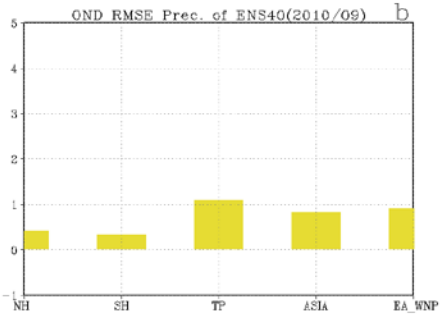


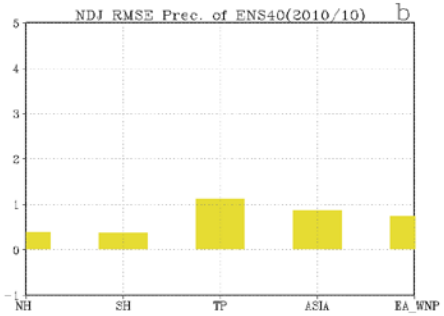


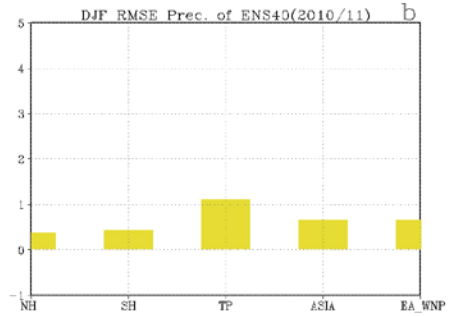




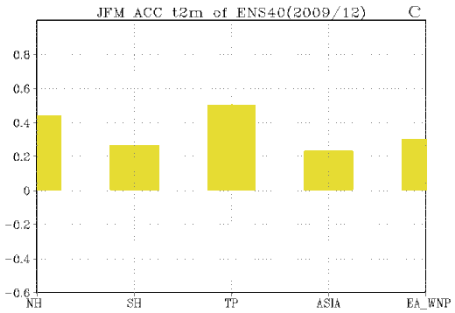








T2M ACC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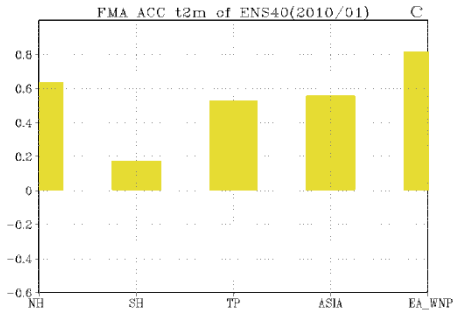
EA_WNP


FMA ACC t2m of ENS40(2010/01) C
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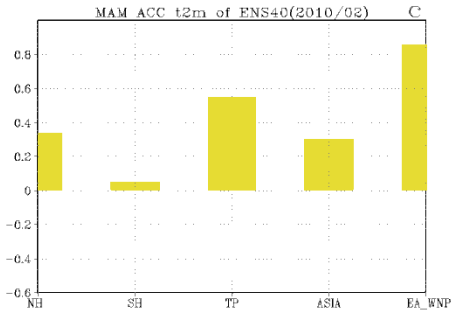
TP
ASIA
EA_WNP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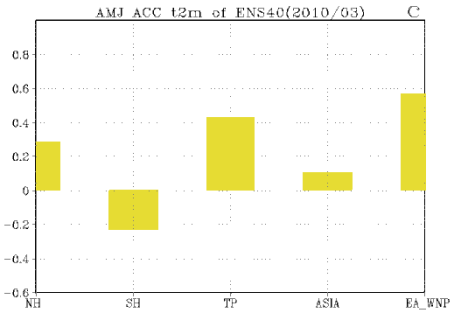
EA_WNP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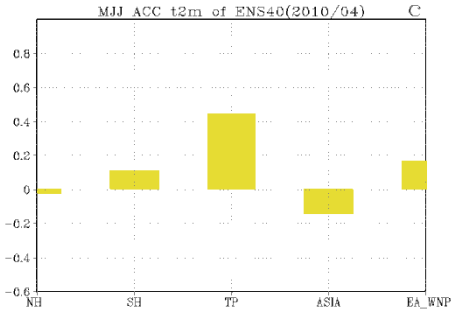
SH
TP
ASIA
EA_WNP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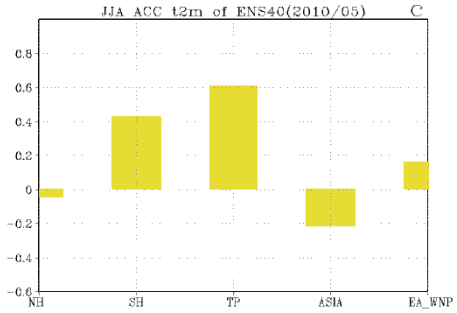
SH
TP
ASIA
EA_WNP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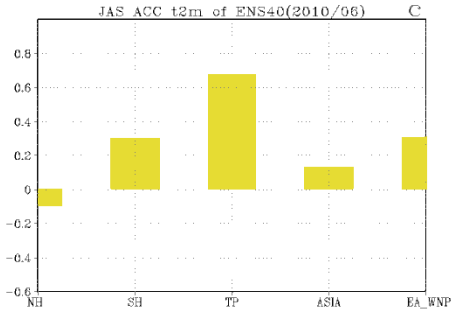
NH
SH
TP
ASIA
EA_WNP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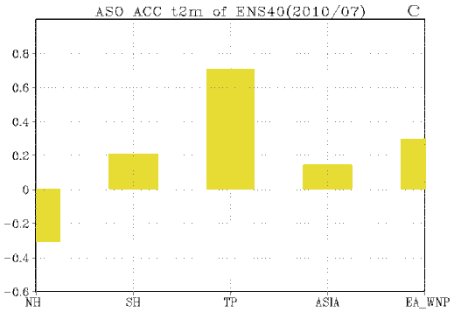
SH
TP
ASIA
EA_WNP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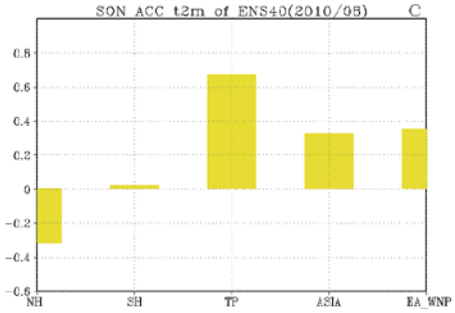
NH
SH
TP
ASIA
EA_WNP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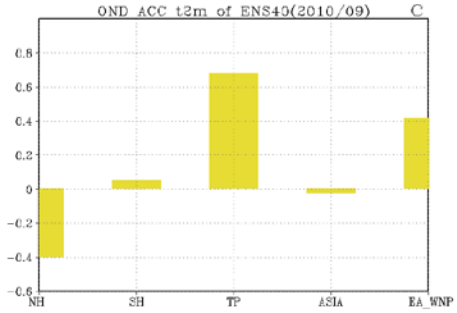
NH
SH
TP
ASIA
EA_WNP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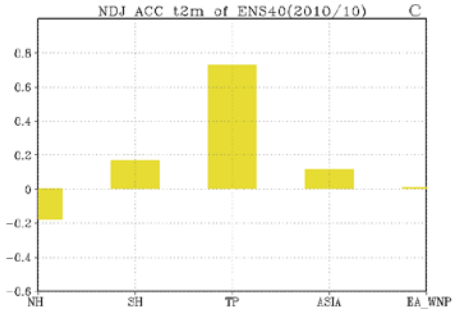
NH
SH
TP
ASIA
EA_WNP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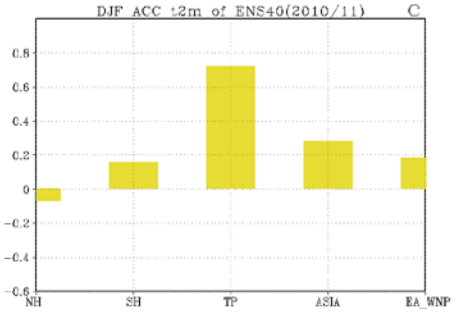
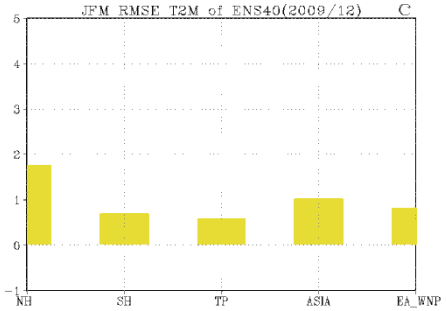
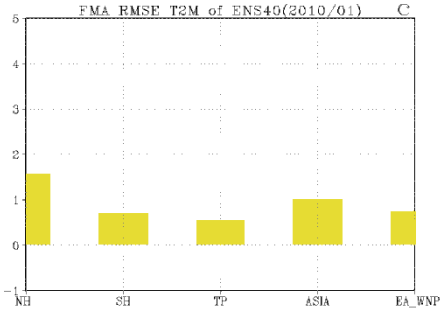
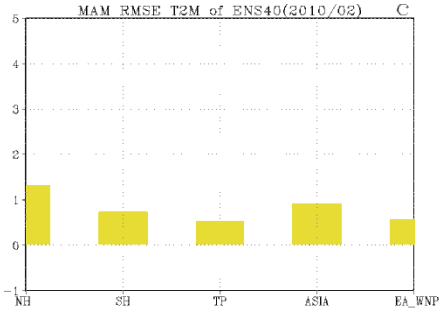
NH
SH
TP
ASIA
EA_WNP

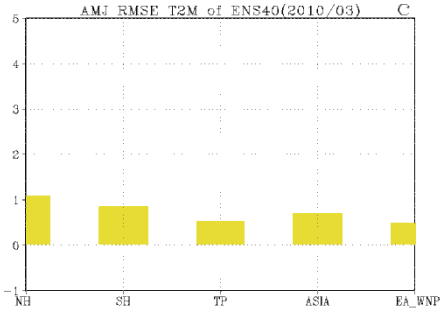

DJF ACC t2m of ENS40(2010/11) C
NH
SH
TP
ASIA
EA_WNP

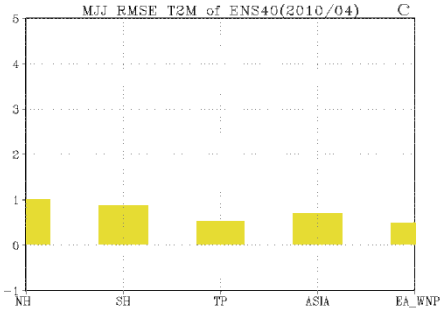
T2M RMSE

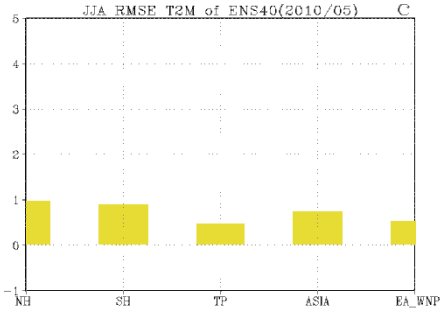

JFM RMSE T2M of ENS40(2009/12) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

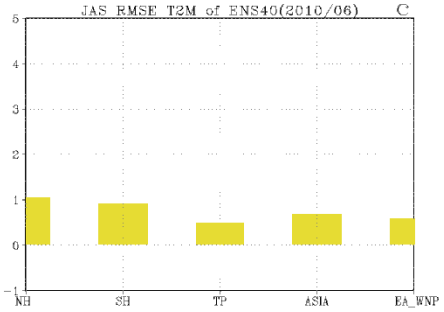

FMA RMSE T2M of ENS40(2010/01) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

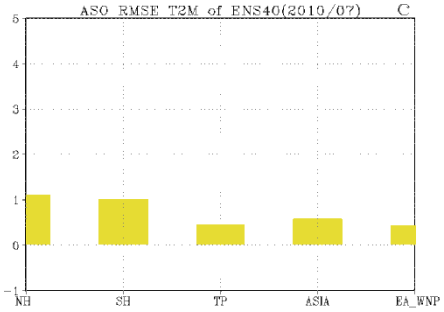

MAM RMSE T2M of ENS40(2010/02) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

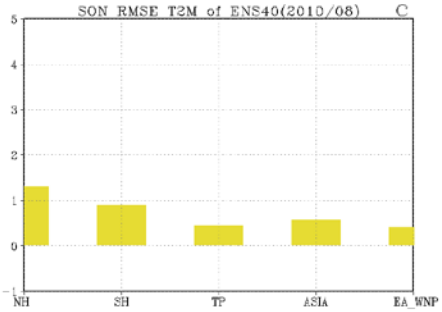

AMJ RMSE T2M of ENS40(2010/03) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

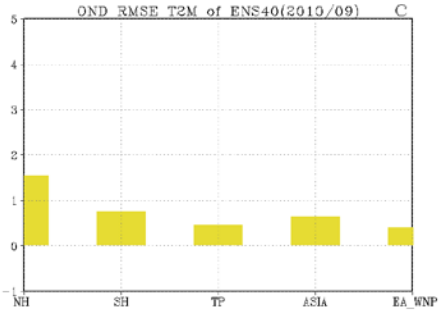

MJJ RMSE T2M of ENS40(2010/04) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

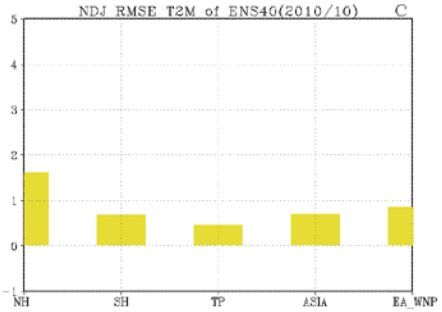

JJA RMSE T2M of ENS40(2010/05) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

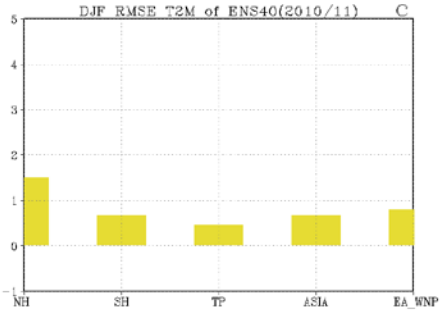

JAS RMSE T2M of ENS40(2010/06) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP


ASO RMSE T2M of ENS40(2010/07) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP


SON RMSE T2M of ENS40(2010/08) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP


OND RMSE T2M of ENS40(2010/09) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP


NDJ RMSE T2M of ENS40(2010/10) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP


DJF RMSE T2M of ENS40(2010/11) C
5
4
3
2
1
0
−1
NH
SH
TP
ASIA
EA_WNP

Precipitation (SD)

	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
Taipei					N	N		N		A		
Hsinchu				N	N	N		N		A		
Taichung								N				
Tainan					N	N	N			A		
Kaohsiung				N					A	A		
Hengchun					N				A	A		
Taitung				N	B				A	A	N	B
Hualien	N							N	A	A		B
Ilan			A		B	B			A	A		

	OBS			
FCST		B	N	A
	B	5	12	1
	N	15	17	10
	A	14	1	14

Total=108
HR=0.33

Station Temperature (SD)

	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
Taipei		N		N	N	N	A	A	N	N		B
Hsinchu		N					A		N	N		
Taichung		N	N	N			A		N	N		
Tainan				N	N	N		A			B	B
Kaohsiung								A	N		B	B
Hengchun				N	N					N		
Taitung				N	N	A	A	A		N		B
Hualien			N	A	N	N		A	N	N		
Ilan				N	N	N	A	A	A	N		

	OBS			
FCST		B	N	A
	B	6	2	0
	N	7	33	27
	A	0	19	14

Total=108
HR=0.49

Summary

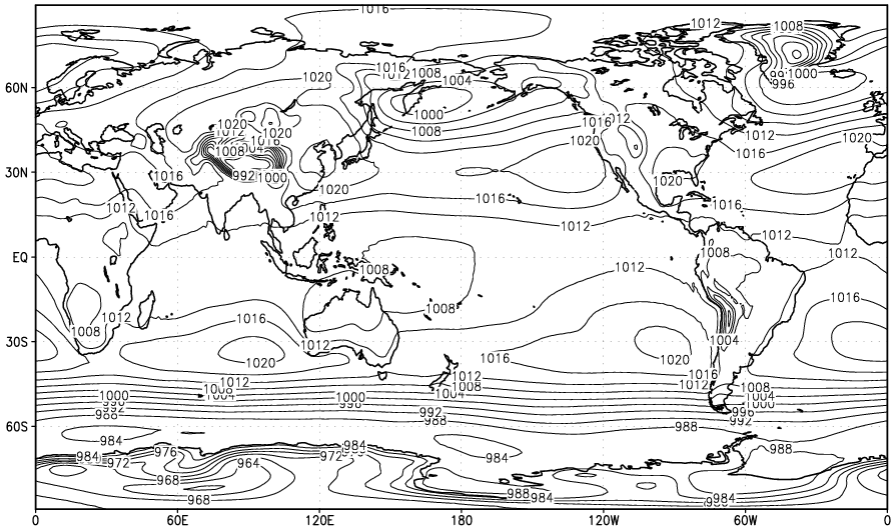
- The first generation of Seasonal Forecast System of Central Weather Bureau is in operation.
- Seasonal Forecast System provides seasonal and monthly outlooks to forecaster.
- Preliminary diagnostic shows that system has reasonable ability in seasonal forecast.
- The forecast skills in 2-tier dynamical forecast are better from Winter to Spring.
- The forecast skills in downscaling are better during later half of the year.

Next Generation AGCM

Resolution	T119L40	T42L18
Radiation	Unified two-stream calculation with K-correlated method (Fu and Liou 1992, 1993; Fu et al. 1997)	Harshvardhan et al. (1987)
Cumulus	Simplified Arakawa-Schubert (Pan and Wu 1994)	Simplified Arakawa-Schubert (Pan and Wu 1994)
Large Scale	Predict could water scheme (Zhao and Frederick 1997)	Base on Relative Humidity
Shallow Convection	Li and Young (1993)	Li (1994)
Vertical Mixing	First-order nonlocal scheme (Troen and Mahrt 1986)	TKE-ε scheme (Detering and Etling 1985)
Surface Flux	Similarity theory (Businger 1971)	Similarity theory (Businger 1971)
Land Model	Noah Land Model (Ek et al. 2003)	Bucket method (Manebe 1969)
Gravity Wave Drag	Palmer et al. (1986)	Palmer et al. (1986)

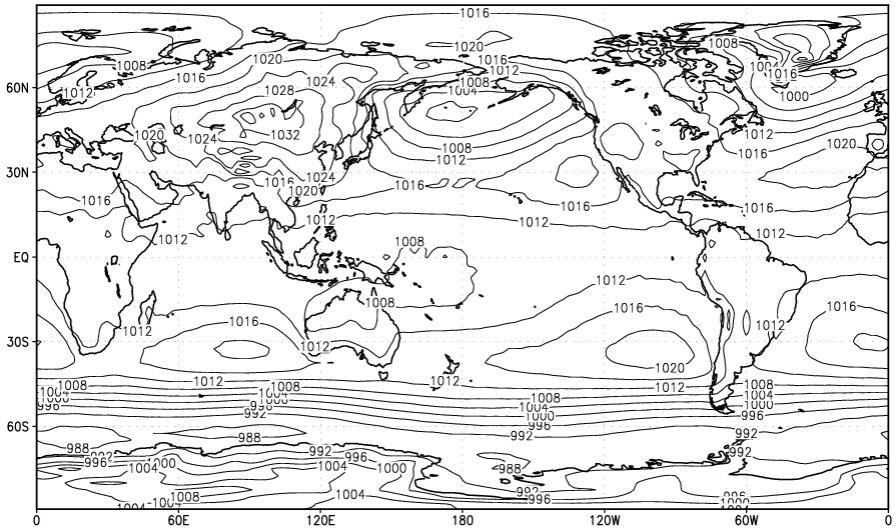
Sea Level Pressure

T119L40amip DJF Sea Level Pressure (hPa)



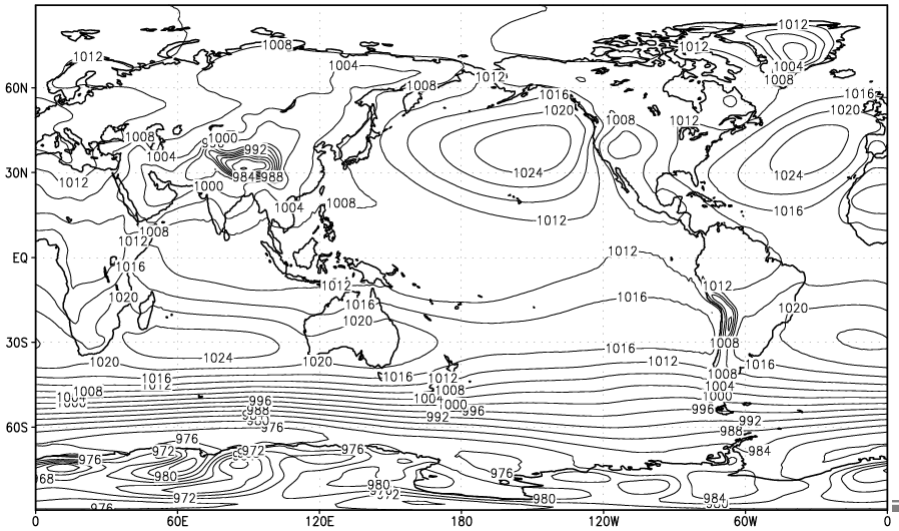
Contouring: 960 to 1024 interval 4

NCEP_RA1 DJF Sea Level Pressure (hPa)



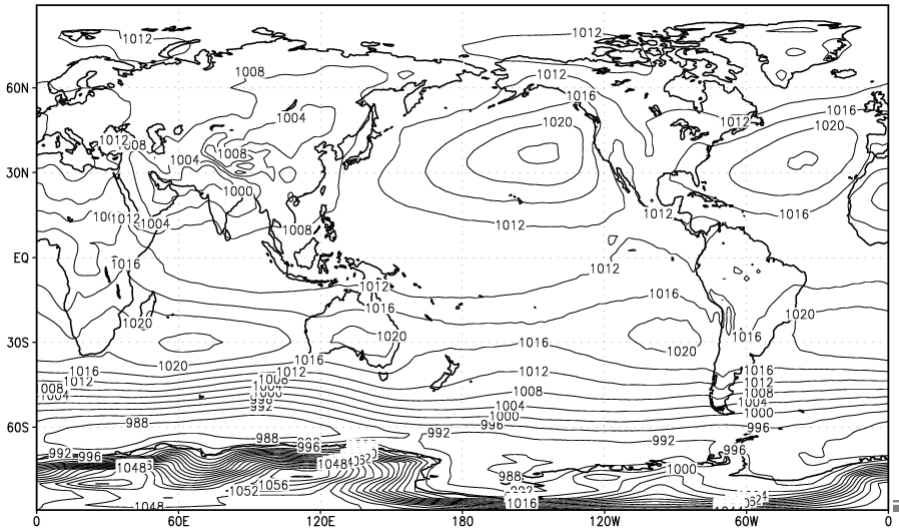
Contouring: 988 to 1036 interval 4

T119L40amip JJA Sea Level Pressure (hPa)



Contouring: 960 to 1024 interval 4

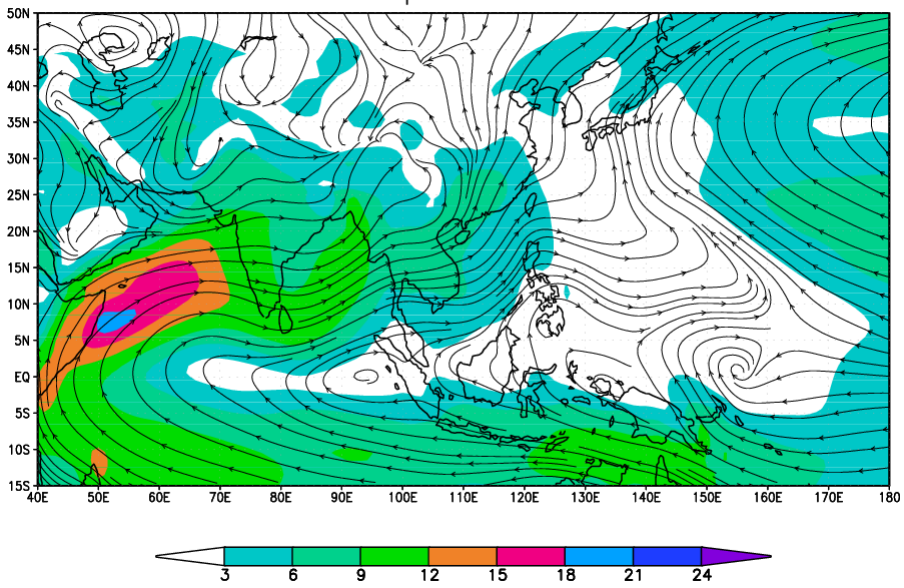
NCEP_RA1 JJA Sea Level Pressure (hPa)



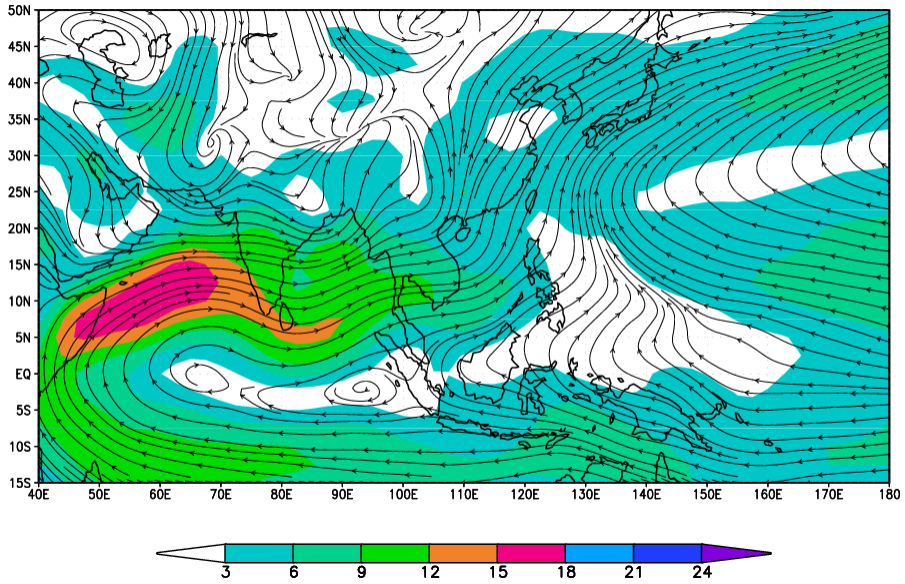
Contouring: 988 to 1064 interval 4

850 Wind (JJA)

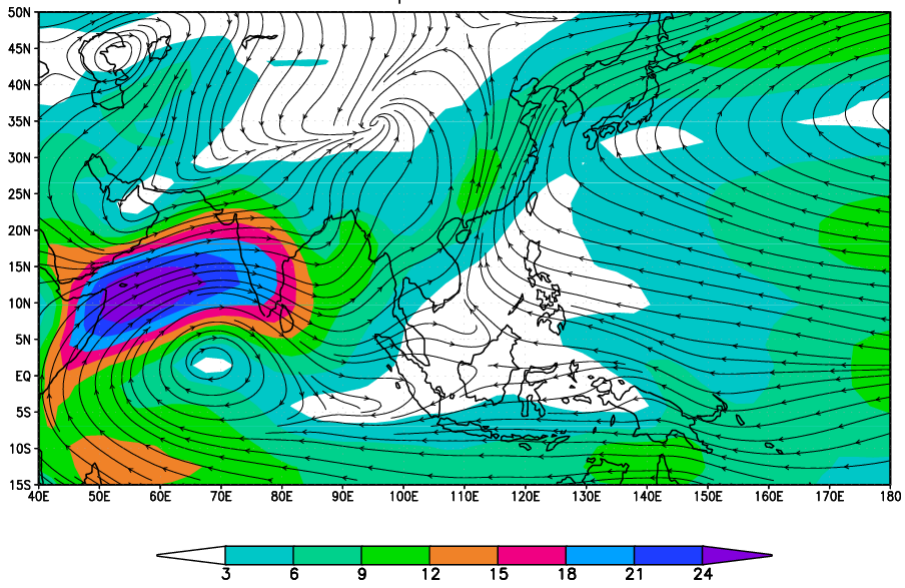
T119L40amip JJA 850hPa Wind



NCEPRA JJA 850hPa Wind

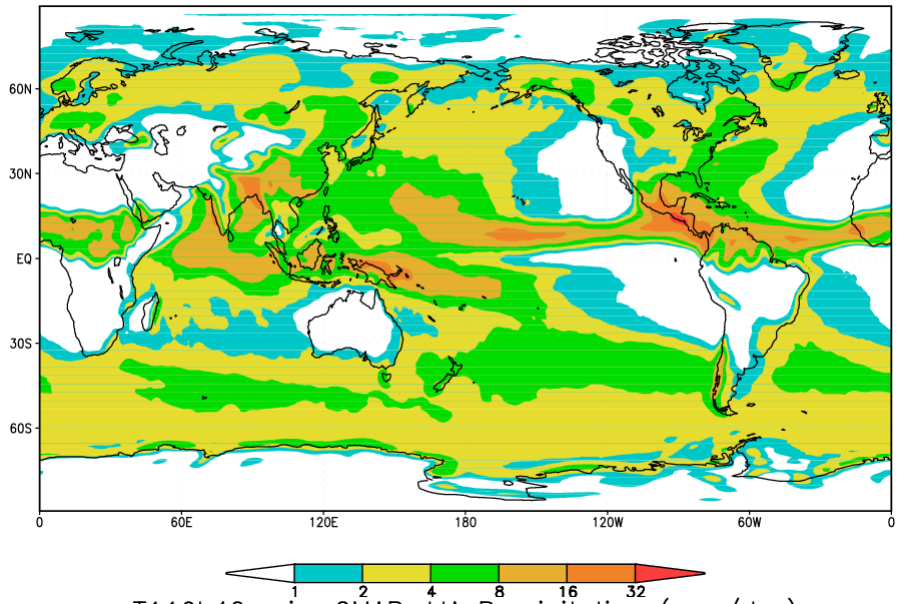


T42L18amip JJA 850hPa Wind

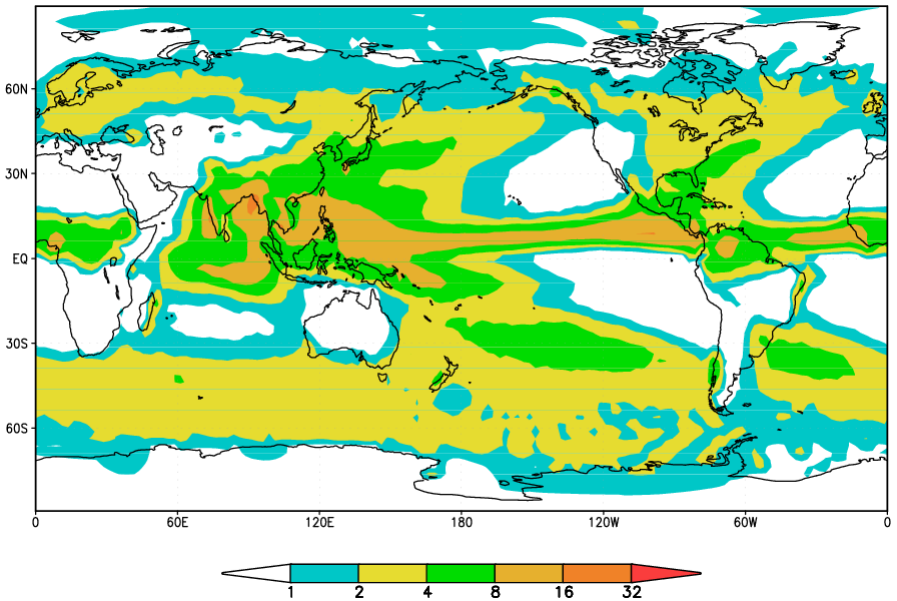


Precipitation (JJA)

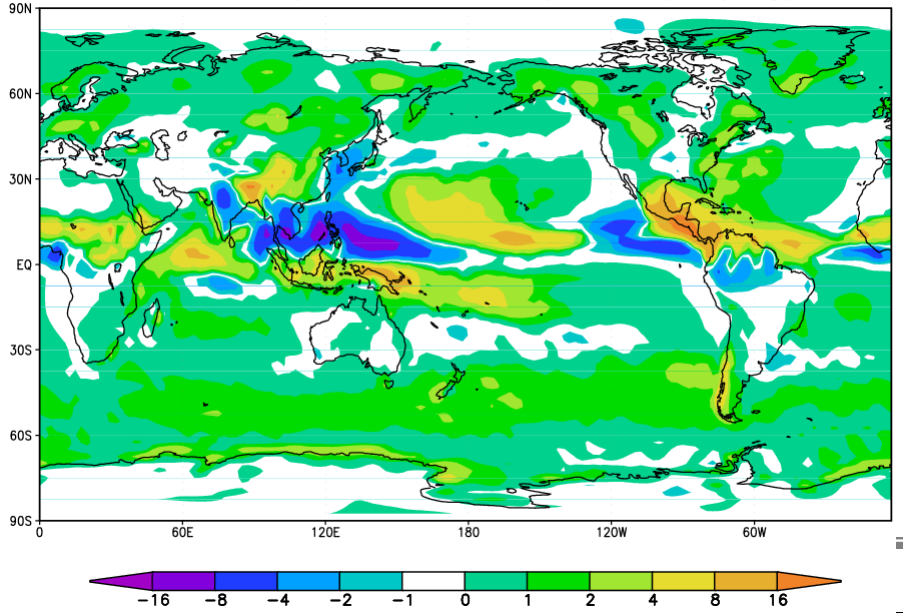
T119L40amip JJA Precipitation (mm/day)



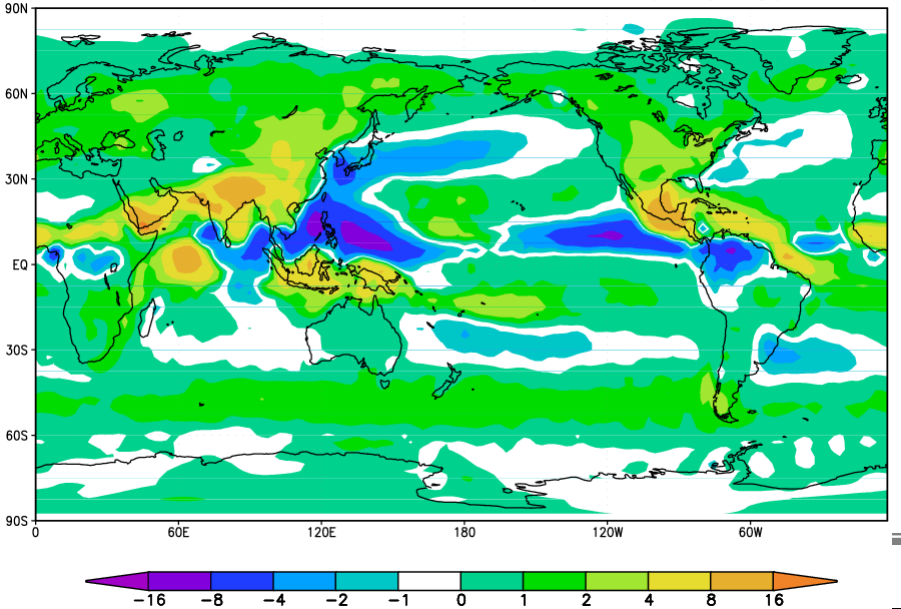
CMAP JJA Precipitation (mm/day)



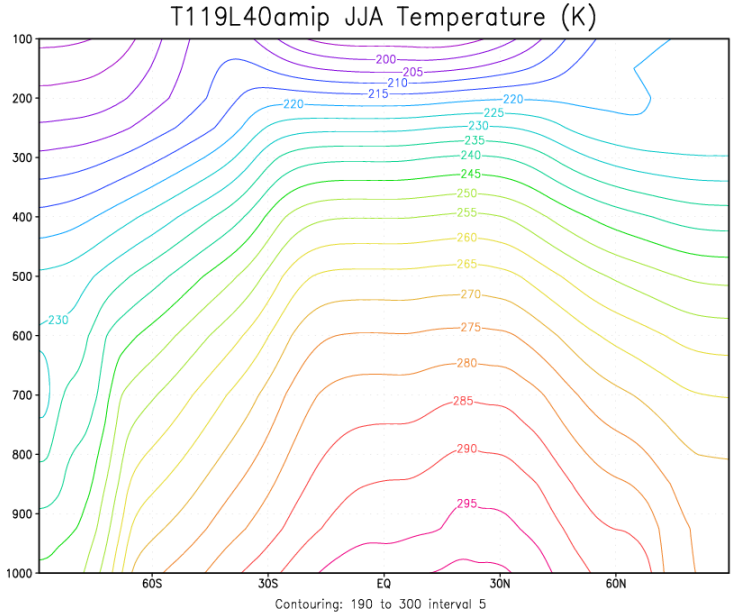
T119L40amip−CMAP JJA Precipitation (mm/day)

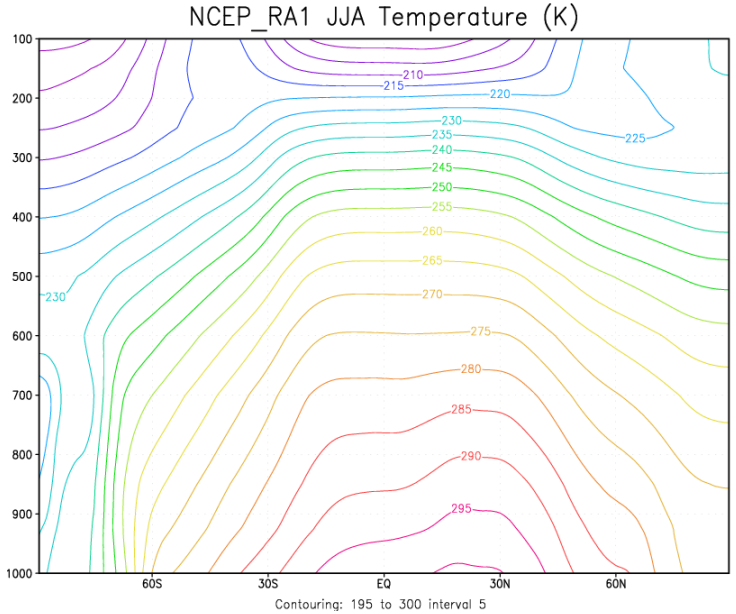


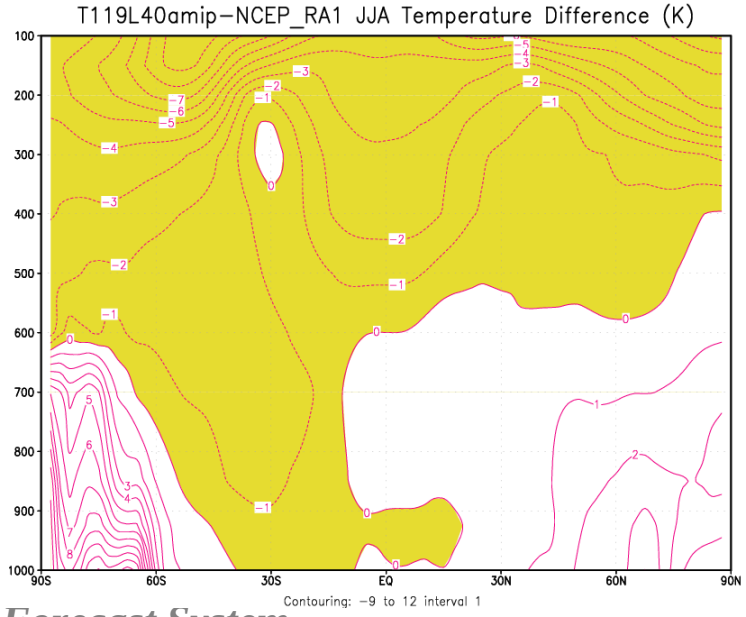
T42L18amip−CMAP JJA Precipitation (mm/day)

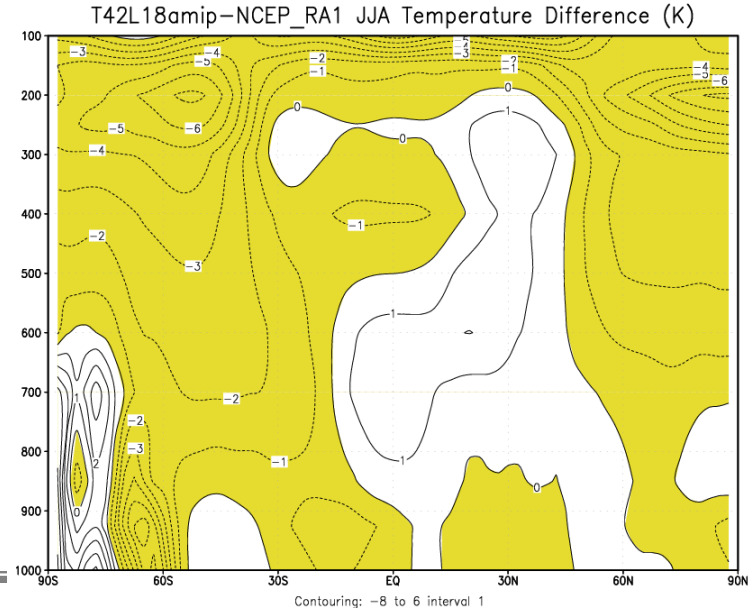


Temperature (JJA)

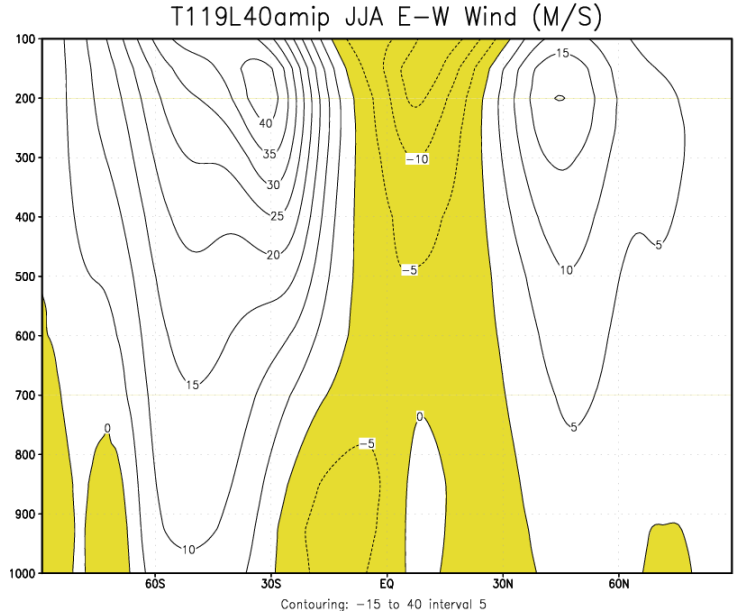


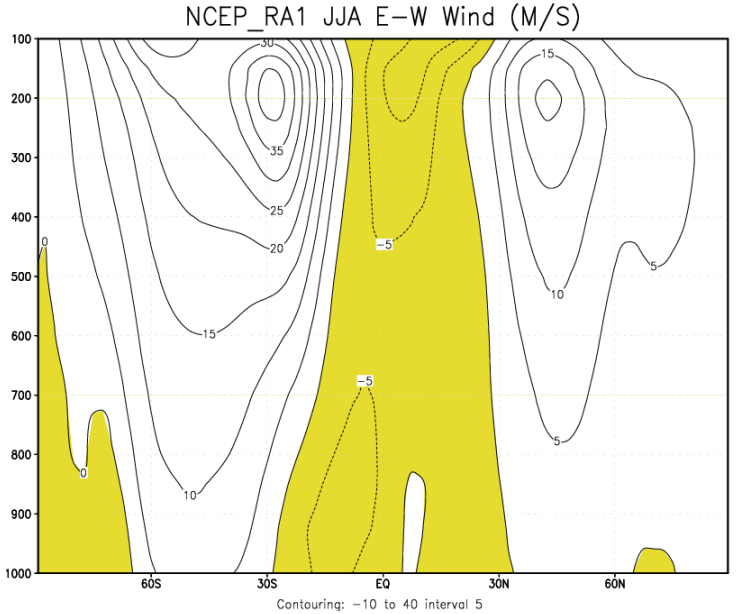


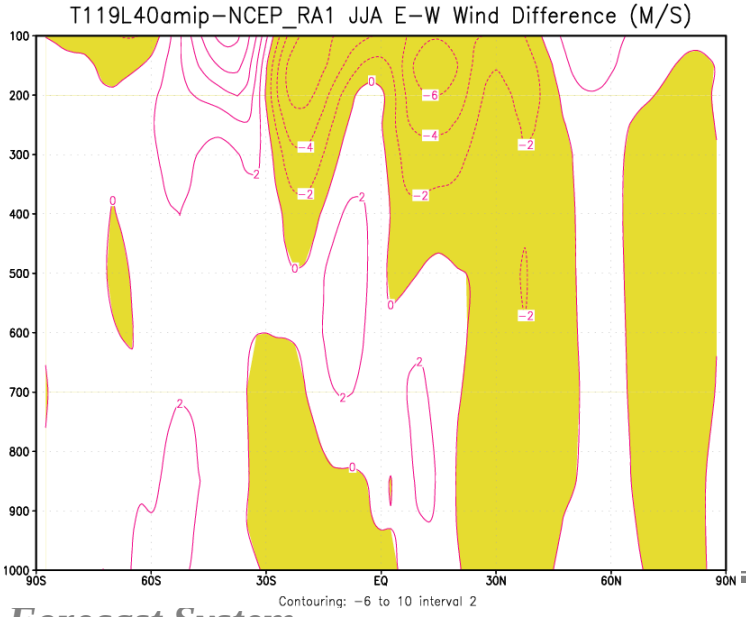


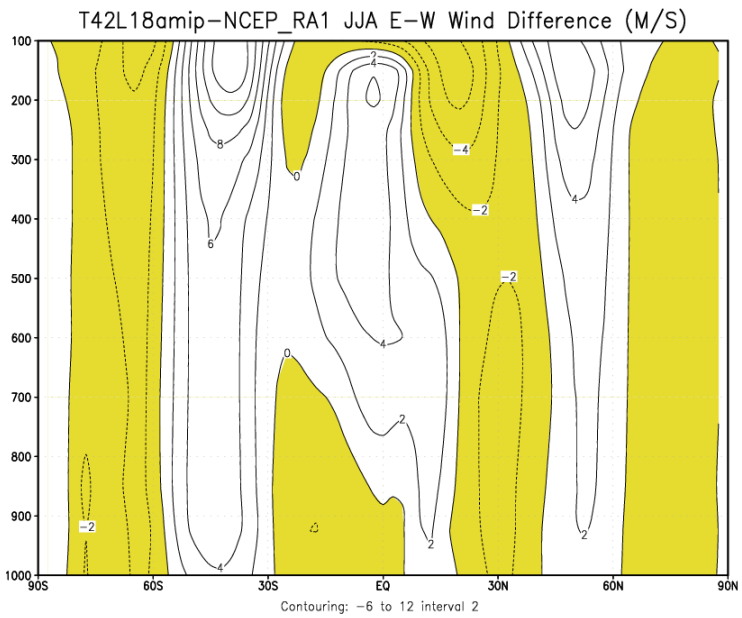


U (JJA)


T119L40amip JJA E-W Wind (M/S)
100
200
300
400
500
600
700
800
900
1000
60S
30S
EQ
30N
60N
Contouring: -15 to 40 interval 5


NCEP_RA1 JJA E-W Wind (M/S)
100
200
300
400
500
600
700
800
900
1000
60S
30S
EQ
30N
60N
Contouring: -10 to 40 interval 5


T119L40amip-NCEP_RA1 JJA E-W Wind Difference (M/S)
100
200
300
400
500
600
700
800
900
1000
90S
60S
30S
EQ
30N
60N
90N
Contouring: -6 to 10 interval 2


T42L18amip-NCEP_RA1 JJA E-W Wind Difference (M/S)
100
200
300
400
500
600
700
800
900
1000
90S
60S
30S
EQ
30N
60N
90N
Contouring: -6 to 12 interval 2

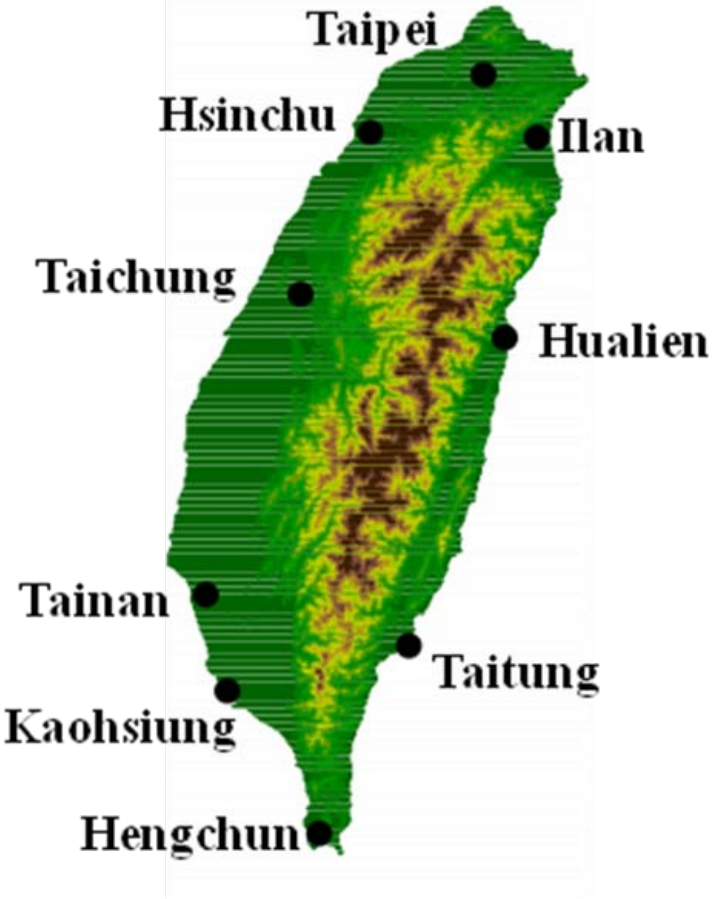
Energy Budget

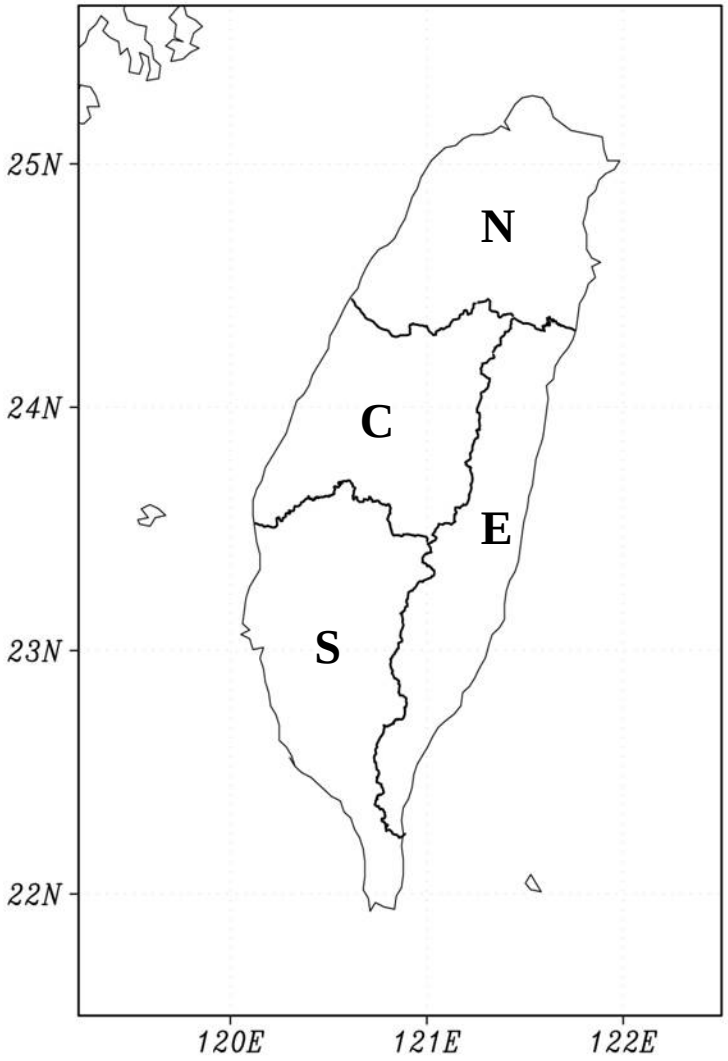
	ASR	OLR	Net Down	LH Evap	SH	Net LW	Net SW Down	Prec. In mm/day	Prec in W/M2	LH+SH	LW out	SW in	SW in-LW out
KT09	239	239.000	0	80	17	63	138						
KT97	235	235.000	0	78	24	66	144						
T119L40	237.305	243.193	-5.888	100.497	17.2655	64.415	172.502	3.43683	100.2409	117.7625	178.778	64.803	113.975
T42L18		235.382		92.2755	18.0018	62.7652	166.413	3.18593	92.92296	110.2773	172.617		

Future Plan

- Air-Sea couple model with MOM3
- MME forecast with ECHAM5 and CFSv1
- Statistical downscaling into Taiwan stations
- MJO and Typhoon forecast

THANK **YOU** !


Taipei
Hsinchu
Ilan
Taichung
Hualien
Tainan
Taitung
Kaohsiung
Hengchun


25N
24N
23N
22N
120E
121E
122E
N
C
E
S

Precipitation (DD)

	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
Northern				N				A	A	A		B
Central		N		N			N		N			N
Southern				N		B			A	A		N
Eastern						B	N	N	A	A	B	B

		OBS		
		B	N	A
FCST	B	5	7	0
	N	7	10	2
	A	7	3	7

Total=44
HR=0.5

2 Meter Temperature (DD)

	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ	DJF
Northern		A			N	N	A		A	N		
Central		A				N	A	A	N	N	B	
Southern		A	A		A	A	A	A		N	B	
Eastern		A	A		A	A	A	A	N	N	B	B

	OBS			
FCST		B	N	A
	B	4	0	1
	N	4	9	0
	A	3	6	18

Total=44
HR=0.7