

# Activities at APCC during 2009

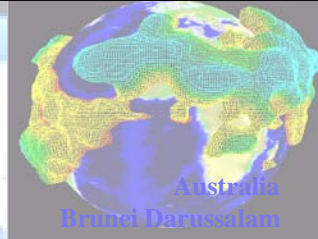
Asia

Pacific  
Economic Cooperation

Climate

Center

## APEC Climate Center



- Canada
- Chile
- People's Republic of China
- Hong Kong, China
- Indonesia
- Japan
- Korea
- Malaysia
- Mexico
- New Zealand
- Papua New Guinea
- Peru
- Philippines
- Russia
- Singapore
- Chinese Taipei
- Thailand
- United States
- Viet Nam

WG-Apcs09, Singapore July 12, 2009



## *Operations*

- Operationalization of monthly 3-month forecast since January
- Downscaled forecast provision at 60 Korean stations to KMA
- Semi-operational Drought/flood Monitoring Bulletin
- 6-month coupled prediction
- CLIK

## *Development*

- Diagnostic feedback bulletin
- Drought Prediction system
- Improvement of downscaling
- Expansion of CLIK
- Data center activities



# Goals of APEC Climate Center

- Facilitating the **sharing** of high-cost climate data and information
- **Capacity building** in prediction and sustainable social and economic applications of climate information
- Accelerating and extending socio-economic **innovation**



# APCC operational prediction products

- Rolling Monthly 3-month MME forecasts
  - The World's most extensive MME in operational basis
  - Both probabilistic and deterministic forecasts.
  - WMO' level 3 hindcast verification for seasonal MME prediction.
  - Digital downloadable data available from APCC's data server.
  - Climate Information Tool Kit
- In-house developed downscaling technology and online tools.
  - Operational statistical deterministic downscaling for Korean stations.

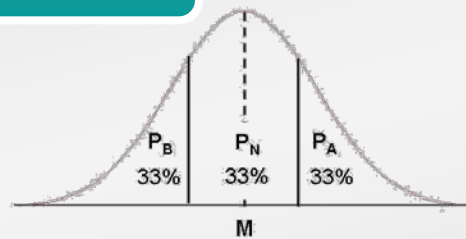
Name/Economy	Start Year/Month	End Year/Month	Variables	Model Designation	SST Specification (Hindcast/Forecast)	Ensemble (H/F)	Focal Point/E-Mail
BCC China	1983/Jan.	2008/Present	PREC,T850,Z500	NCC-CGCM T63L16	Predicted SST/	8/8	Peiqun Zhang <a href="mailto:zhangpq@cma.gov.cn">zhangpq@cma.gov.cn</a>
COLA U.S.A.	1981/Dec.	2002/Dec.	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	COLA AGCM v2.2.6 T63L18	OISSTv2/ IRI SST Forecast	10/10	Daniel Paolino <a href="mailto:paolino@cola.iges.org">paolino@cola.iges.org</a>
CWB Chinese Taipei	1979/Jan.	2003/Dec.	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500	CWB T42L18	OISSTv2/ IRI SST Forecast	5/10	Jyh-Wen Hwu <a href="mailto:jwhwu@rdc.cwb.gov.tw">jwhwu@rdc.cwb.gov.tw</a>
GCPS Republic of Korea	1979/Jan.	2008/Present	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500	GCPS T63L21	KMA/SNU SST Forecast/ KMA/SNU SST Forecast	4/4	Jeong-Seok Lee <a href="mailto:jslee@kma.go.kr">jslee@kma.go.kr</a>
GDAPS Republic of Korea	1979/Jan.	2008/Present	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500	GDAPS T106L21	OISSTv2/OISSTv2	1/20	Won-Tae Yun <a href="mailto:wtun@kma.go.kr">wtun@kma.go.kr</a>
HMC Russia	1979/Mar.	2003/Dec.	T2M, PREC, MSLP, T850, Z500	SL-AV 1.125 x 1.406, L28	Persistent SST/ Persistent SST	10/10	Dmitry Kiktev <a href="mailto:kiktev@mecom.ru">kiktev@mecom.ru</a>
IAP	1979/Jan.	2004/Jan.	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	IAP9L-AGCM 5.0 x 4.0, L9	Observed SST/ IAP-TOGA SST Forecast	7/7	Huijun Wang <a href="mailto:Wanghj@mail.iap.ac.cn">Wanghj@mail.iap.ac.cn</a>
IRI	1979/Jan.	2005/Dec.	T2M, SST, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	ECHAM4.5 T42L19	Observed SST/ Forecasted SST	24/24	David G. Dewitt <a href="mailto:daved@iri.columbia.edu">daved@iri.columbia.edu</a>
JMA	1979/Jan.	2006/Dec.	T2M,SST,PREC,MSLP,OLR,T850,Z500,U850,V850,U200,V200	GSM TL95, L40	Persistent SST/ Persistent SST	51/51	Kiyotoshi Takahashi <a href="mailto:Kiyotoshi.takahashi-a@met.kishou.go.jp">Kiyotoshi.takahashi-a@met.kishou.go.jp</a>
METRI	1979/Jan.	2008/Present	PREC, MSLP, T850, U850, V850, U200, V200, Z500	METRI AGCM 5.0 x 4.0, L17	Persistent OISST/ Persistent OISST	10/10	Won-Tae Kwon <a href="mailto:wontk@metri.re.kr">wontk@metri.re.kr</a>
MGO Russia	1979/Jan.	2004/Dec.	T2M, SST, PREC, MSLP, T850, U850, V850, Z500, OLR	MGOAM2 T42L14	Observed SST/ Persistent SST	6/10	Vadim Matyugin <a href="mailto:matyugin@main.mgo.rssi.ru">matyugin@main.mgo.rssi.ru</a>
MSC ( 4 models now) Canada	1969/Jan.	2003/Dec.	T2M, PREC, MSLP, T850, U850, V850, U200, V200, Z500	RPN GEM 1.875 x 1.875, L50	Persistent ERA40-SST/ Persistent CMC SST	10/10	Normand Gagnon <a href="mailto:Normand.gagnon@ec.gc.ca">Normand.gagnon@ec.gc.ca</a>
NASA U.S.A..	1993/Feb.	2007/Sep.	T2M, SST, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	NASA-GSFC 2.5x2.0, L34	Predicted SST/ Predicted SST	6/18	Myong-In Lee <a href="mailto:milee@gamo.gsfc.nasa.gov">milee@gamo.gsfc.nasa.gov</a>
NCEP U.S.A..	1981/Dec.	2003/Feb.	T2M, SST, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	NCEP CFS T62L64	Predicted SST/ Predicted SST	15/15	Jae-Kyung E. Schemm <a href="mailto:Jae.Shemm@noaa.gov">Jae.Shemm@noaa.gov</a>
POAMA Australia	1981/Dec.	2003/Feb.	T2M, SST, PREC, MSLP, T850, U850, V850, U200, V200, Z500, OLR	POAMA 1.5 T47L17	Predicted SST/ Predicted SST	15/15	William Wang <a href="mailto:w.wang@bom.gov.au">w.wang@bom.gov.au</a>
SENAMHI Peru	1982/Dec.	2001/Feb.	T2M, PREC, T850, U850, V850, U200, V200	CCM3 T42L18	Predicted SST/ Reynolds SST	8/8	Delia Acuna <a href="mailto:dacuna@senamhi.gov.pe">dacuna@senamhi.gov.pe</a>



# Probabilistic MME Scheme

## Defining terciles

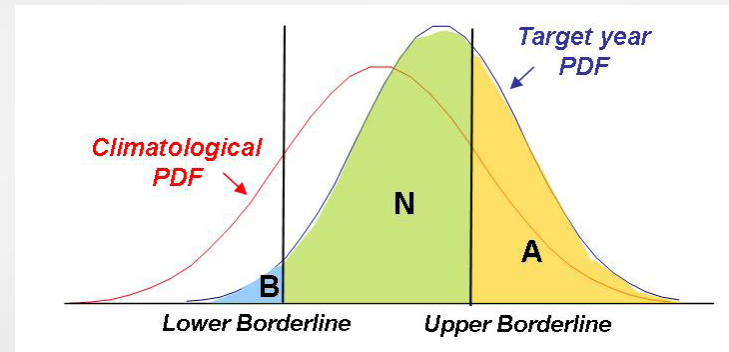
### Normal fitting method



- For the middle/upper tercile boundary :  
mean plus 0.43 times the standard deviation  
→  $\mu + 0.43\sigma$
- For the lower/middle tercile boundary :  
mean minus 0.43 times the standard deviation  
→  $\mu - 0.43\sigma$

## Forecast probability

- A** Probability of Above-normal
- N** Probability of Near-normal
- B** Probability of Below-normal





# Operational Monthly 3-Month Forecasts

- 4-deterministic and one probabilistic MME forecasts carried out each month. Best deterministic forecast for that month selected on hindcast verification.
- Forecast outlooks sent out by 25th of each month to 21 NMHSs and to larger climate prediction community.
- Review of outlook by Working Group and SAC members prior to public release

**The APEC CLIMATE CENTER**  
**Climate Outlook for June-August 2009**

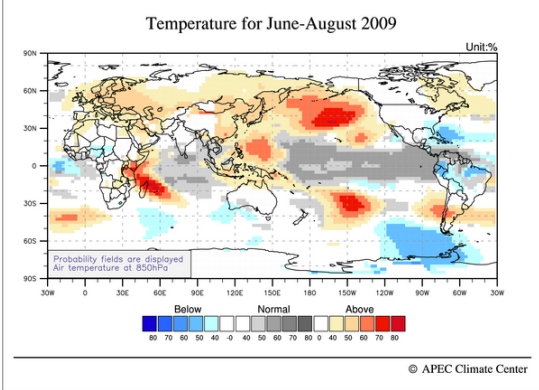
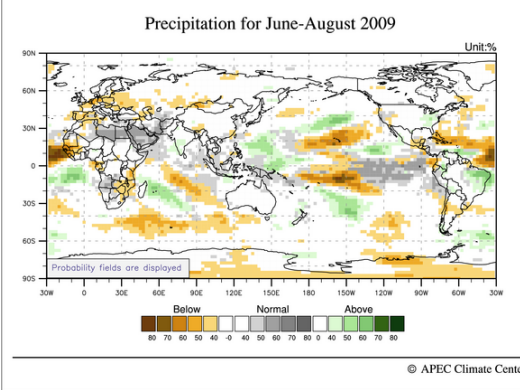
**BUSAN, 24 June, 2009** - Synthesis of the latest computer model forecasts for December 2008-February 2009 at the APEC Climate Center (APCC), located in Busan, Korea, predicts colder than normal conditions in northwest North America, and the opposite signal in the southern part as well as in some parts of the eastern seaboard. The anomalously warm and dry conditions may continue in the Middle East.

**Current Climate Conditions**

During the period from September through the second week of November, anomalously warm or near-normal temperature conditions persisted in most of land regions around the globe except in the following few during the specified sub-periods: mid-latitude west Asia in September, Alaskan region during October, and the Middle East, northwest portions of Africa, central Russia, and west Australia in November. It is to be also noted that most of the tropical through midlatitude western South America also experienced anomalously cold temperatures during different months, with the most dominant signal in Venezuela. Most of the nations in South America also received near-normal to below normal rainfall except Ecuador and Equatorial Brazil. In general, near-normal to below normal conditions of rainfall were observed around the globe, except in most of Indochina, parts of the Philippines, eastern Indonesia and adjoining Papua New Guinea, and equatorial North America. Australia and Japan seem to move from a deficit rainfall condition to surplus.

**Forecast**

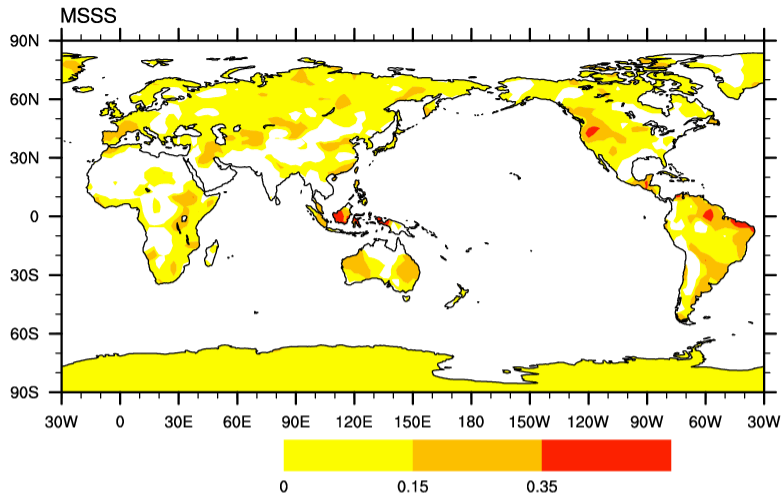
The APCC forecast for December 2008-February 2009 indicates continuing near neutral conditions in the tropical Pacific. A horse-shoe shaped structure, centered in tropical western Pacific can be seen in the anomalies of temperature as well as rainfall, extending from the Northeast Pacific through Philippines, Indochina, most of Indonesia and Malaysia, Papua New Guinea and adjoining Polynesian islands; the Indonesian region off the coast of the Indian Ocean may, on the other hand, suffer from less than normal rainfall. There is a chance that the northeast Australian continent may receive more than normal rainfall .....



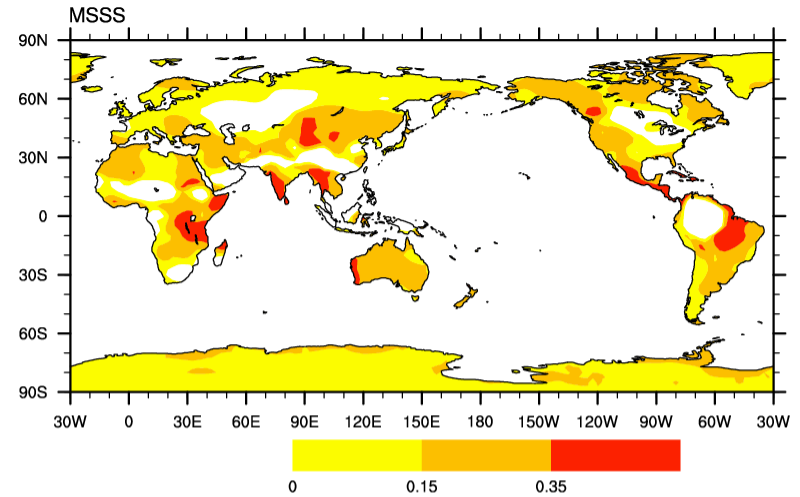


# Some verification statistics

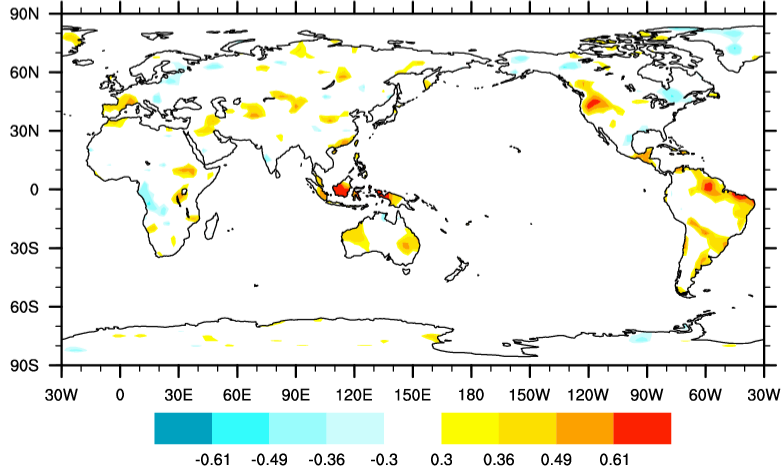
MME, prec, 1981-2003, JJA



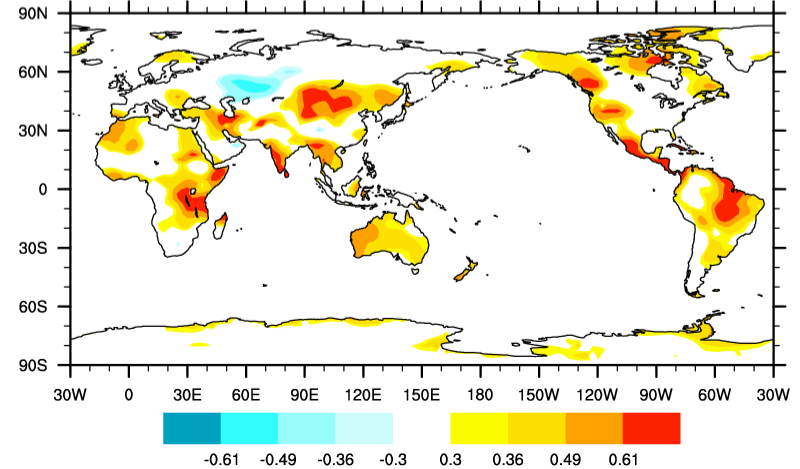
MME, t850, 1981-2003, JJA



MSSS correlation



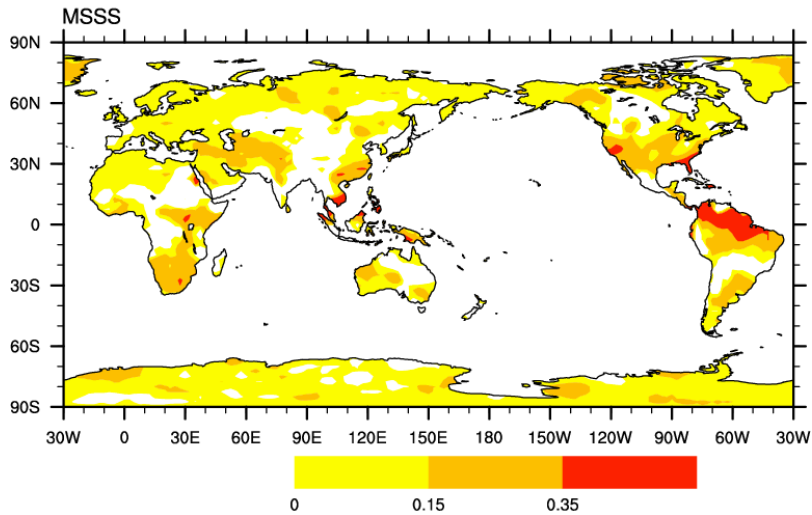
MSSS correlation



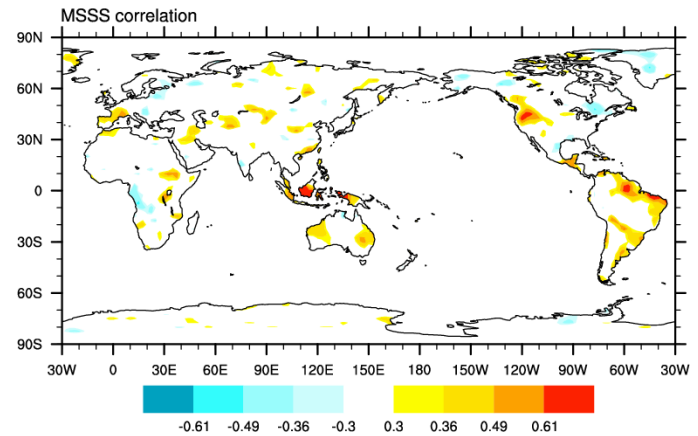
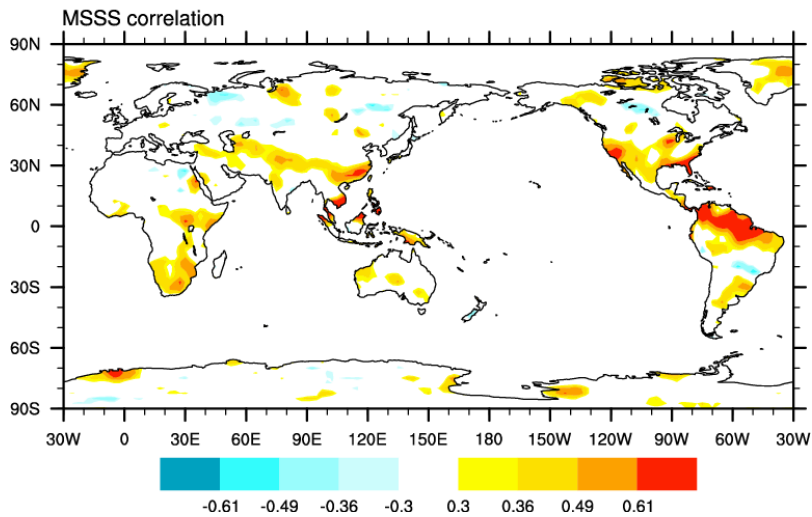
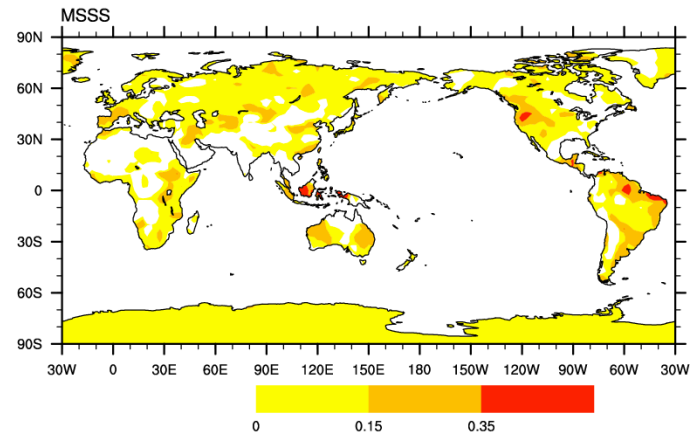


# Some verification statistics

MME, prec, 1981-2003, DJF

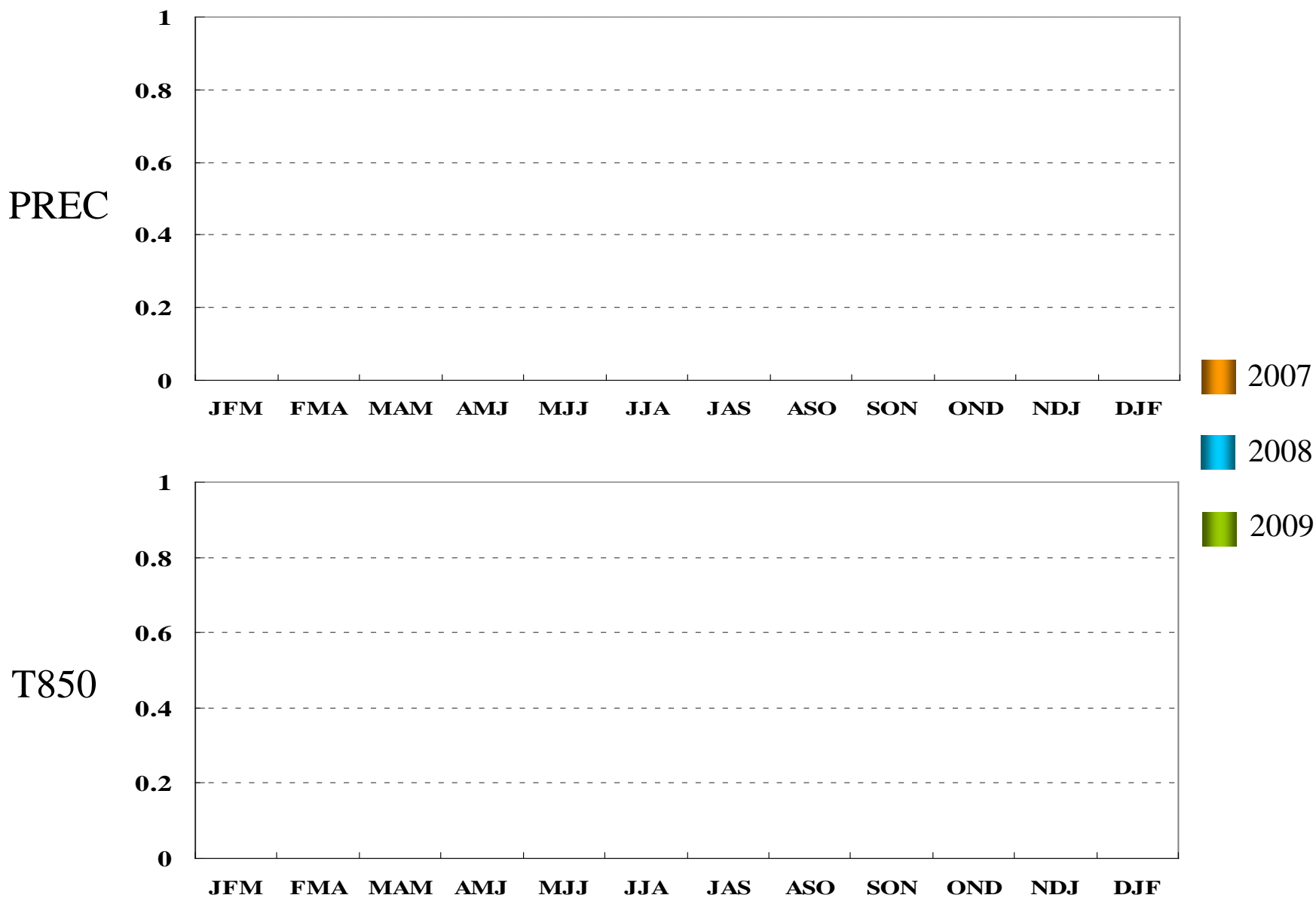


MME, prec, 1981-2003, JJA





# Anomaly Correlation Coefficients for Globe





2008  
JJA

2008  
JAS

2008  
ASO

2008  
SON

2008  
OND

2008  
NDJ

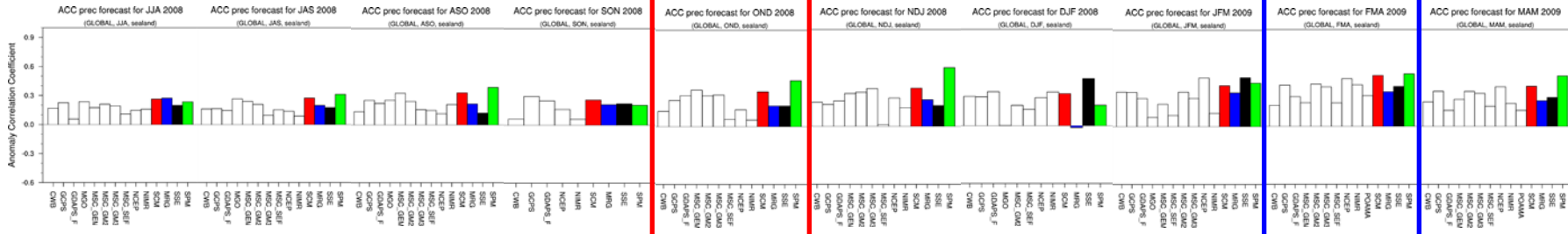
2008  
DJF

2009  
JFM

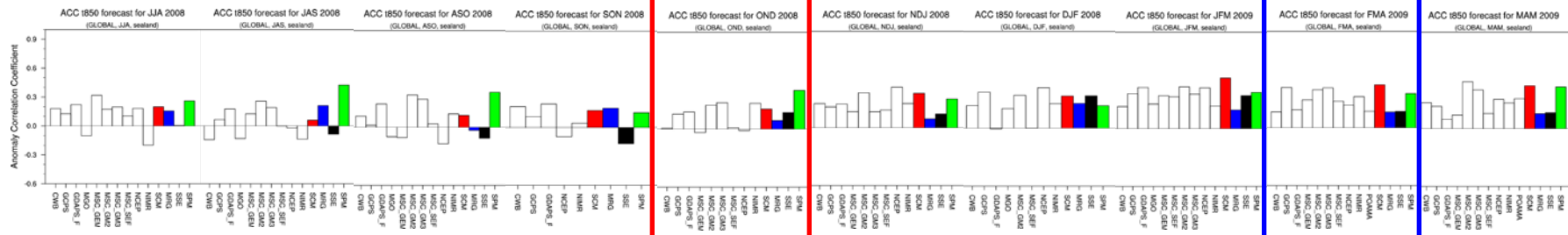
2009  
FMA

2009  
MAM

Prec

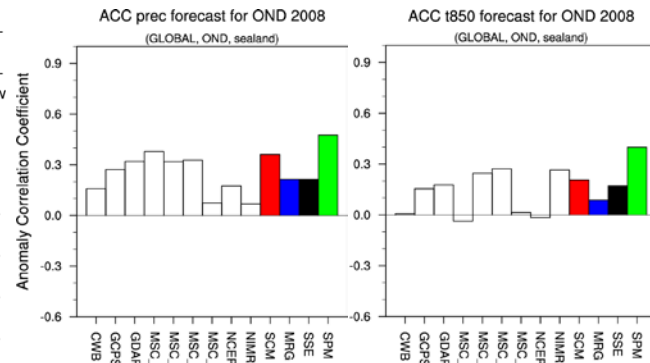
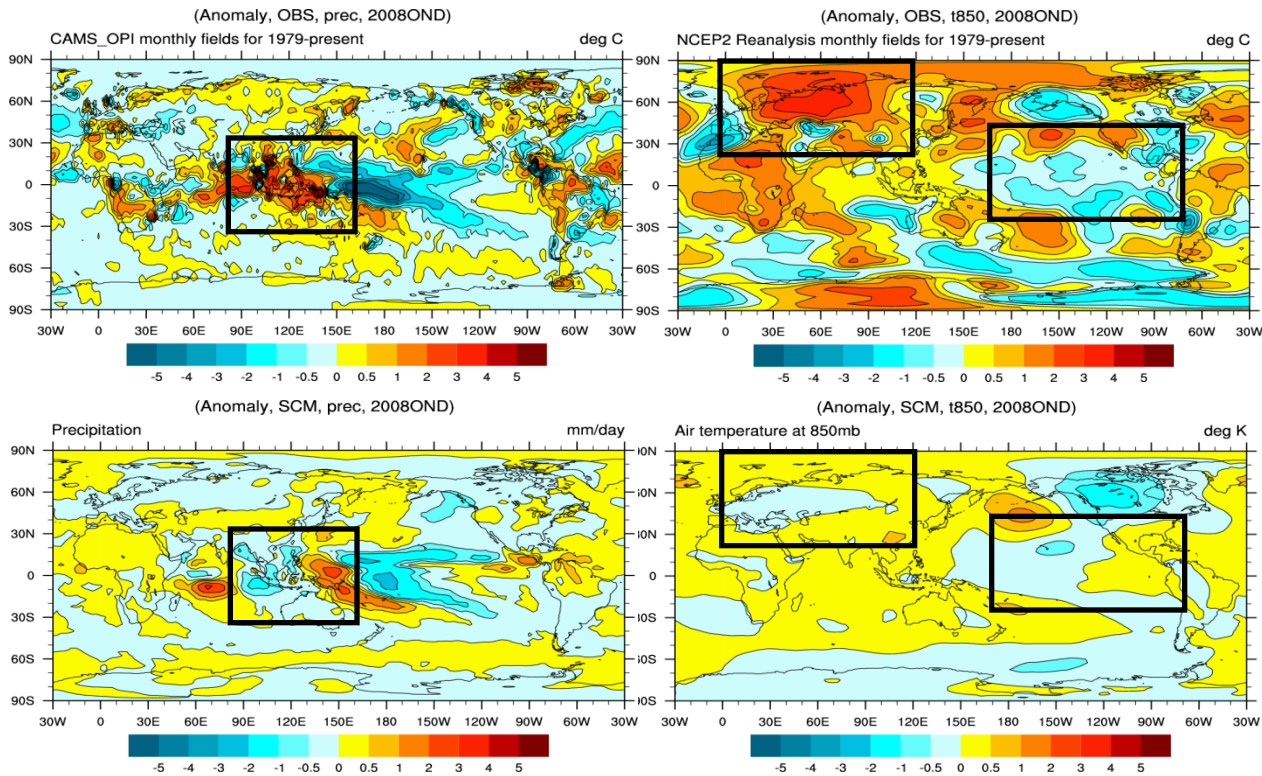


T850





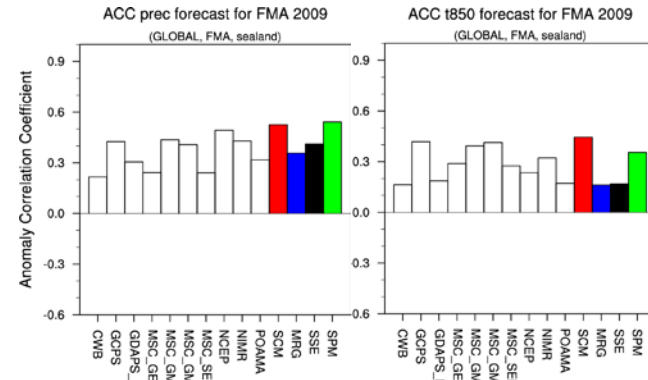
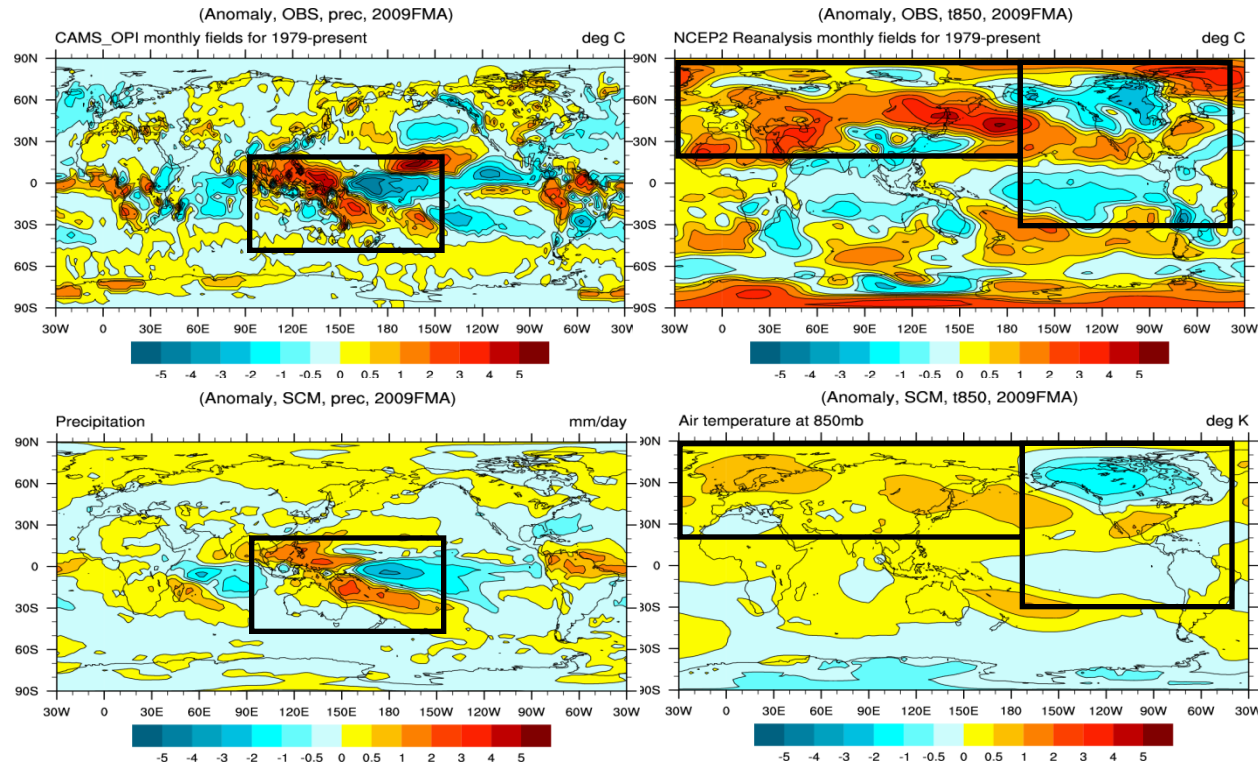
# Worst case : 2008 OND



❖ This slide shows the **worst** forecast case. For precipitation, South Asia including the maritime continent experienced more than normal rainfall at observation. But SCM predicted dry condition. In this case, we totally failed to predict precipitation over South Asia. For temperature, there was slightly La Nina event over central and eastern tropical Pacific at observation. However SCM predicted slightly warm temperature over the same area. Warm condition was shown over Eurasia continent at observation. However, SCM forecasted slightly below than normal temperature at the same region.



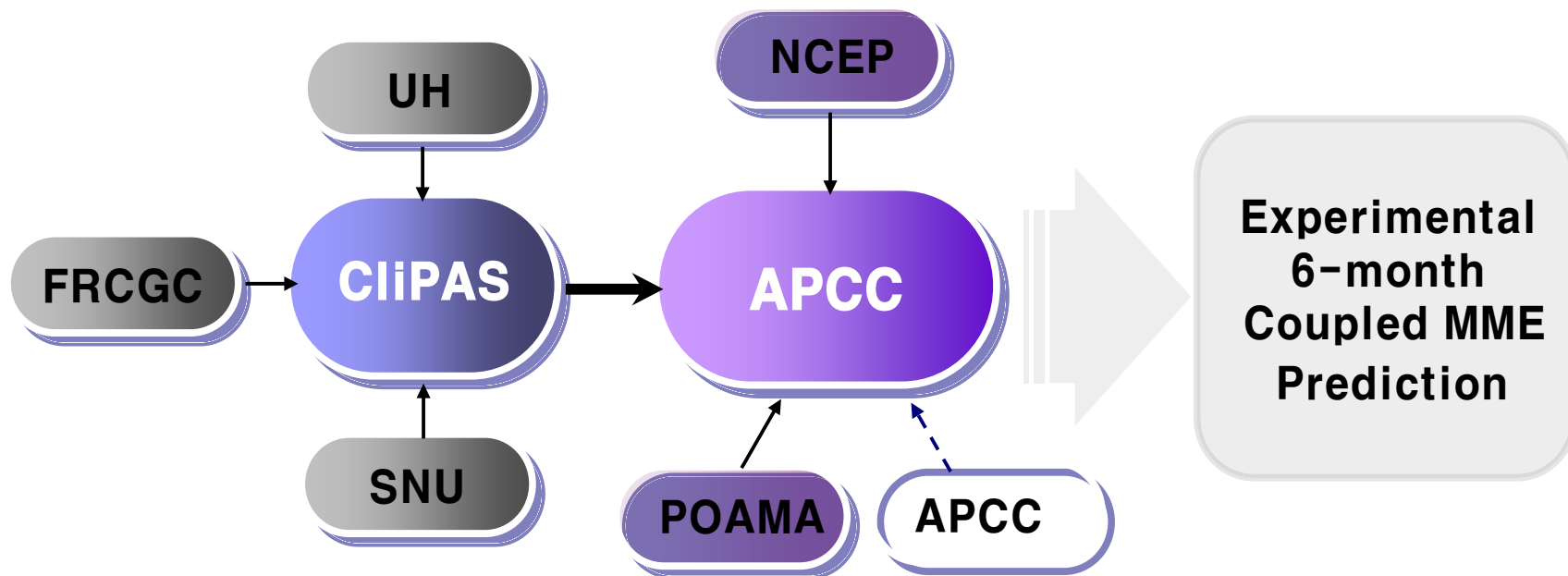
# Best case : 2009 FMA



❖ This slide shows the **best** forecast case. For precipitation, SCM totally hit over the maritime continent and SPCZ showing more than normal rainfall. For temperature, Slightly La Nina event was observed over central and eastern tropical Pacific at observation. SCM also predicted slightly below than normal conditions. Over northern hemisphere, especially Europe and Russia, observation shows positive temperature. SCM also forecasted slightly warm condition at the same region. Additionally, SCM well predicted negative PNA pattern as compared with that of observation.



# Experimental 6-month 1-tier MME Forecast



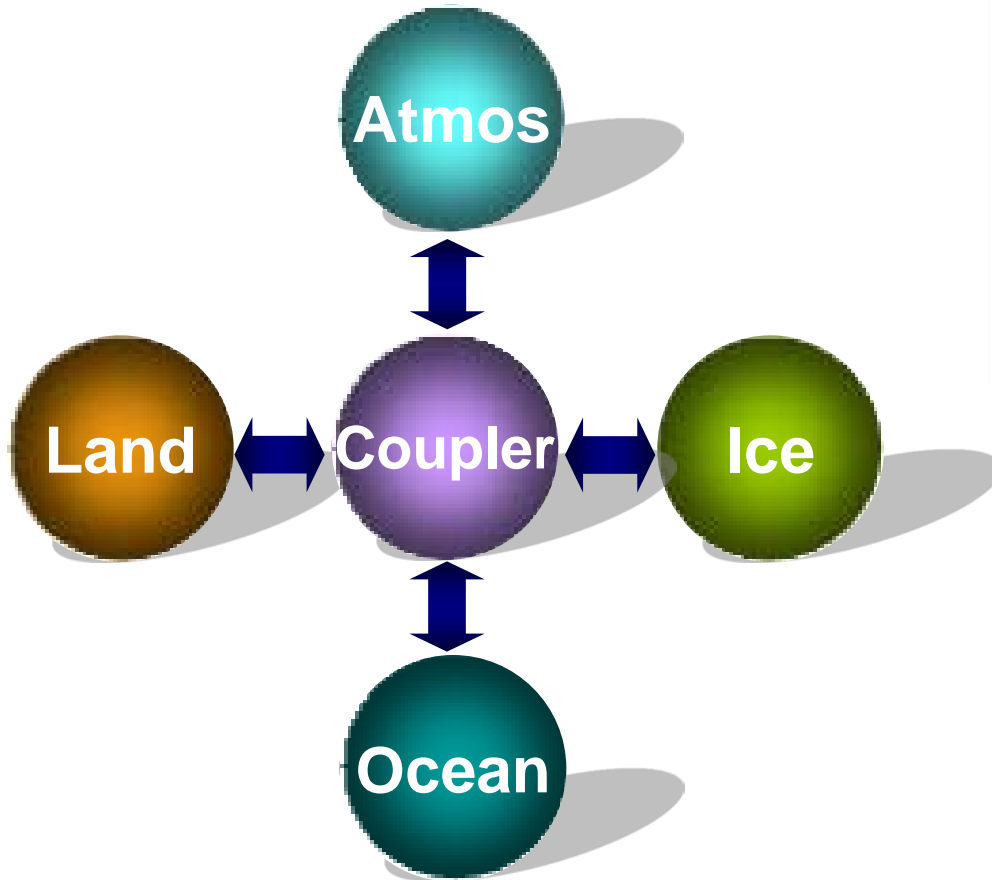
- Launched semi-operationally since late 2008.



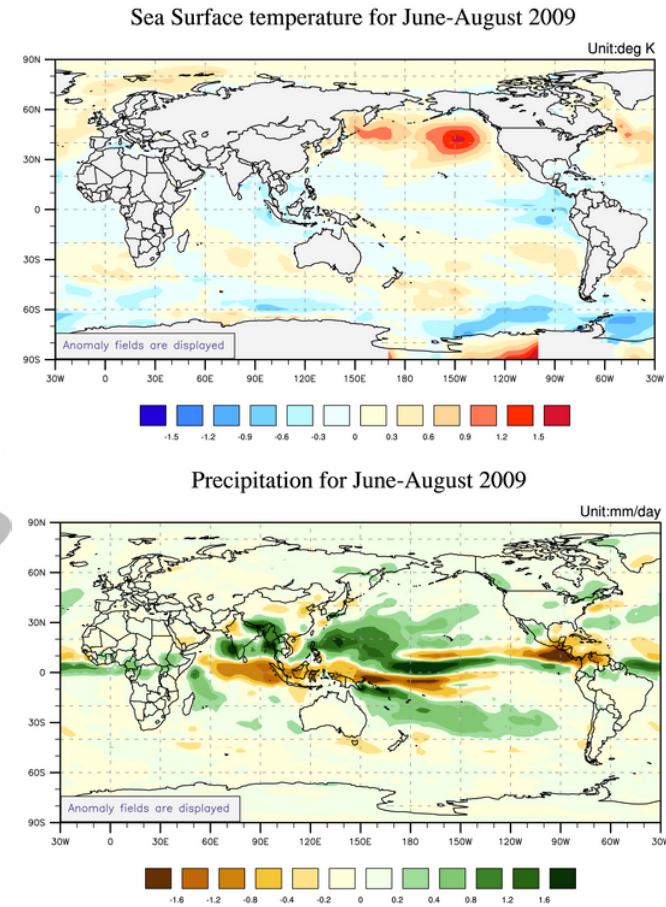
# APCC Monthly Climate Outlook Service

## II. Stretching the prediction lead time

- Experimental forecast with coupled models (4 times/year, 1-6 months in advance)



Schematic coupled model



Recent forecasts for 2009 Summer using coupled model

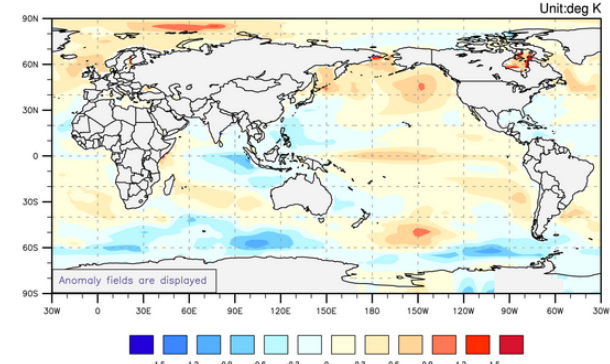
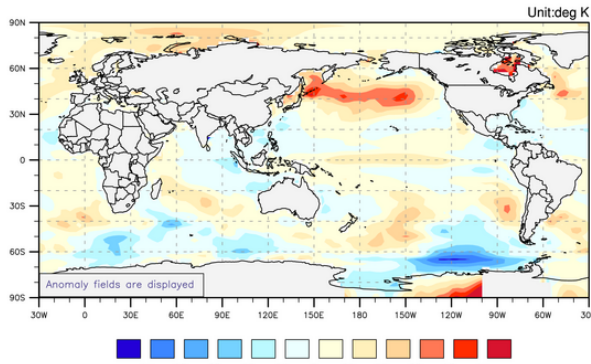


# APCC 1-tier MME Forecast for JJASON

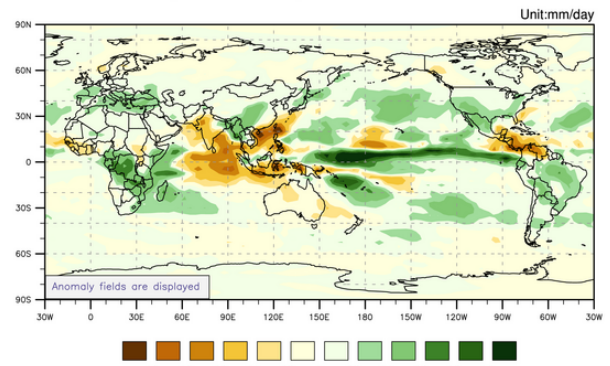
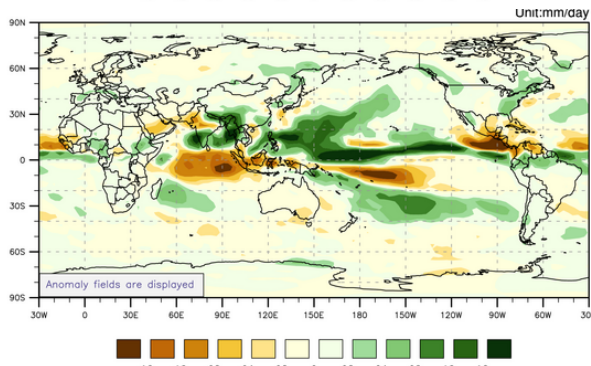
## 2009JJA

## 2009SON

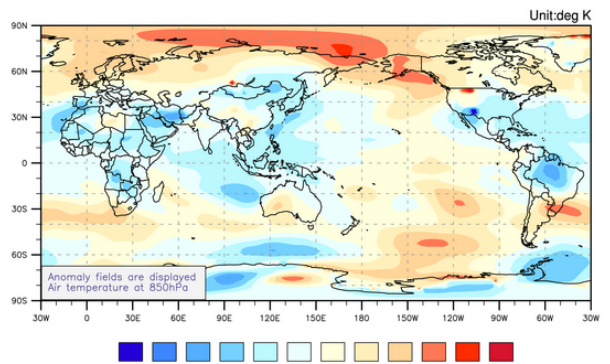
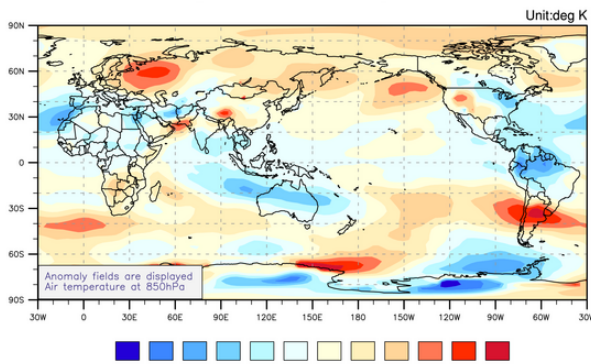
### SST



### PREC



### T850



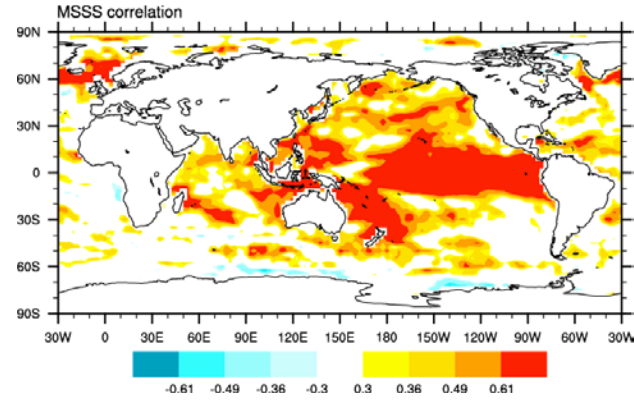
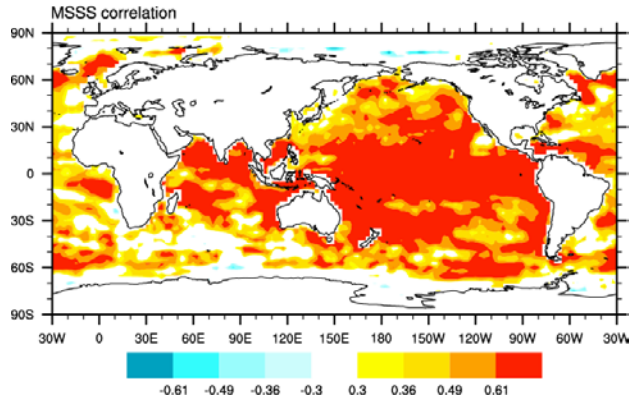


# APCC 1-tier MME Verification for JJASON

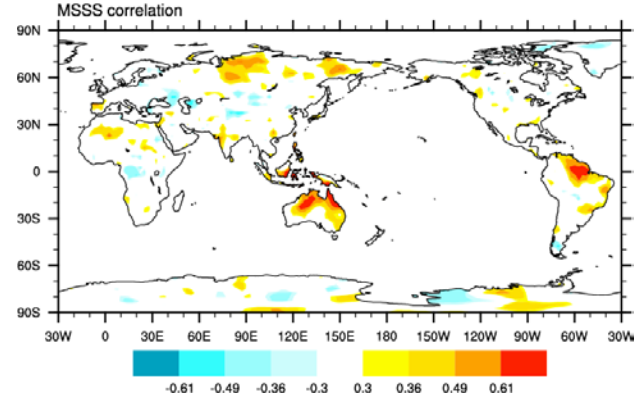
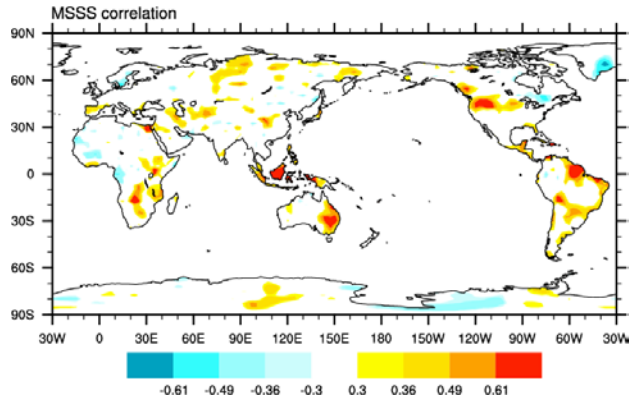
2009JJA

2009SON

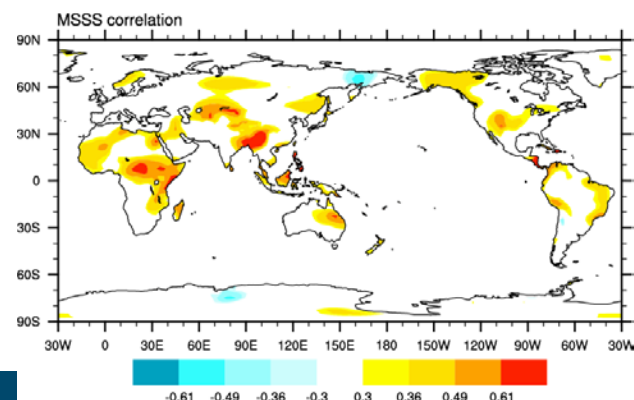
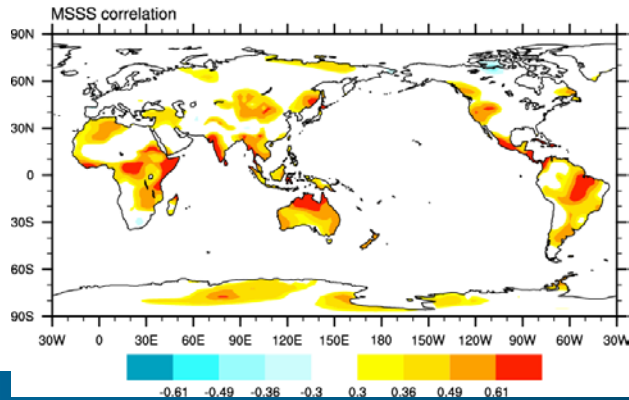
SST



PREC



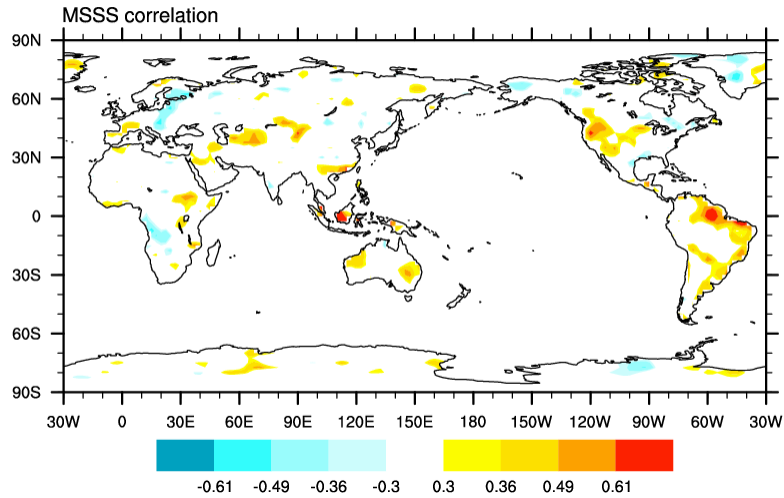
T850



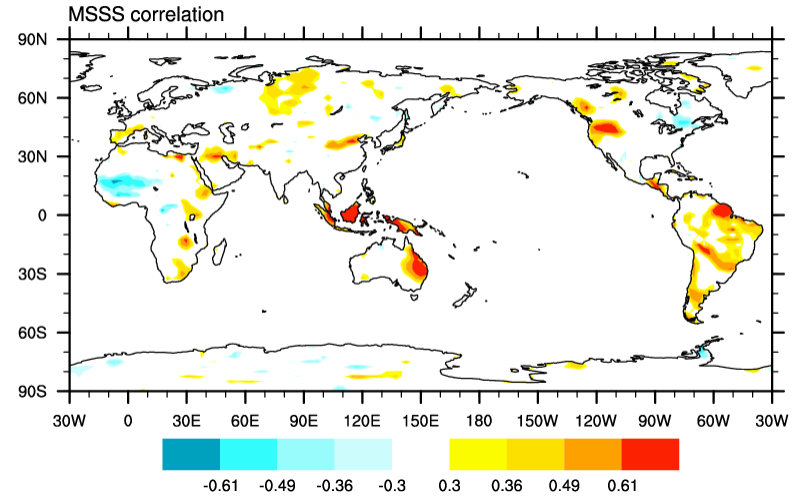


# MSSS\_correlation JJA

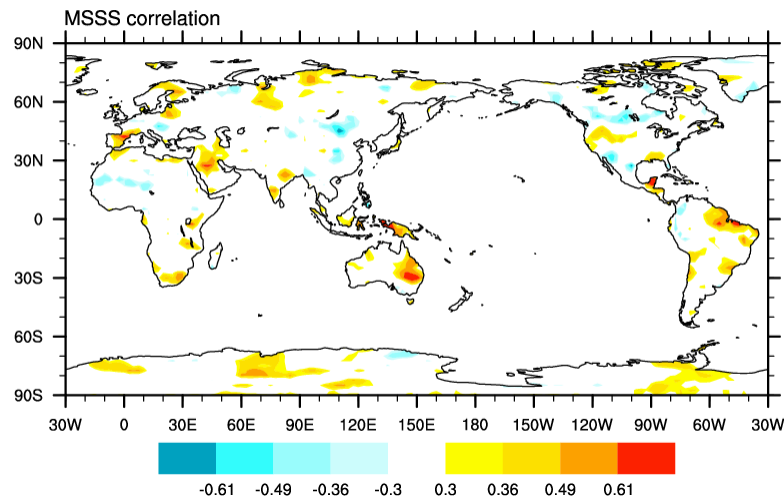
## Tier-2 JJA 1-month



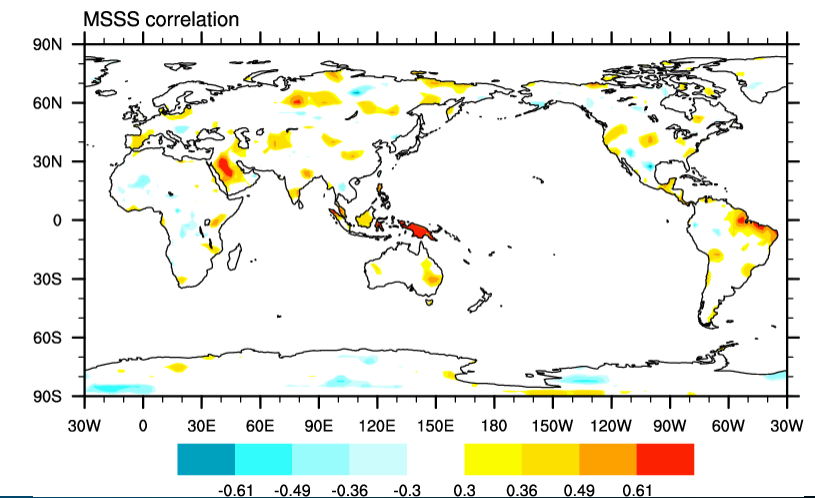
## Tier-1 JJA 1-month



## NCEP JJA 3-month



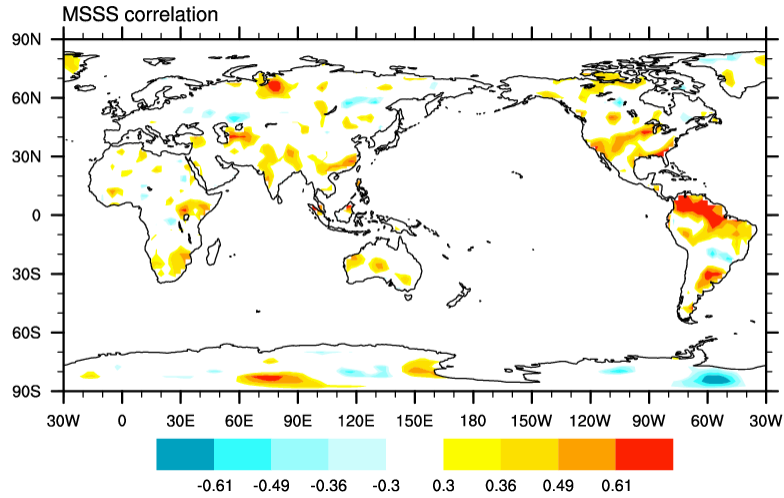
## Tier-1 JJA 3-month



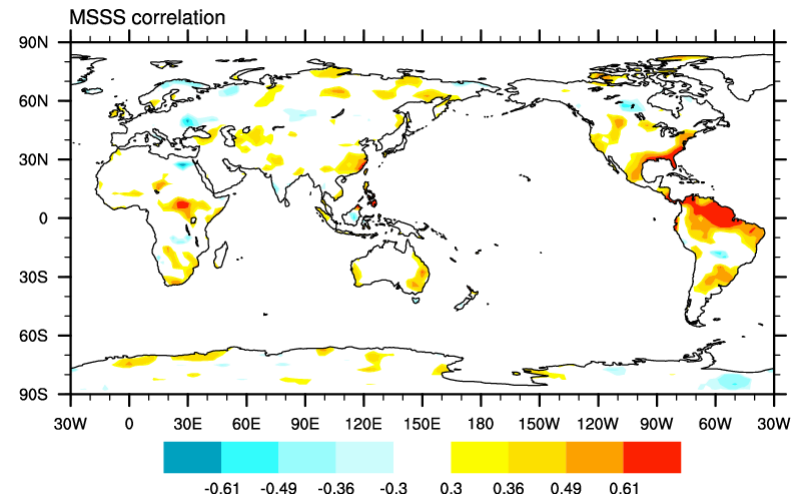


# MSSS\_correlation DJF

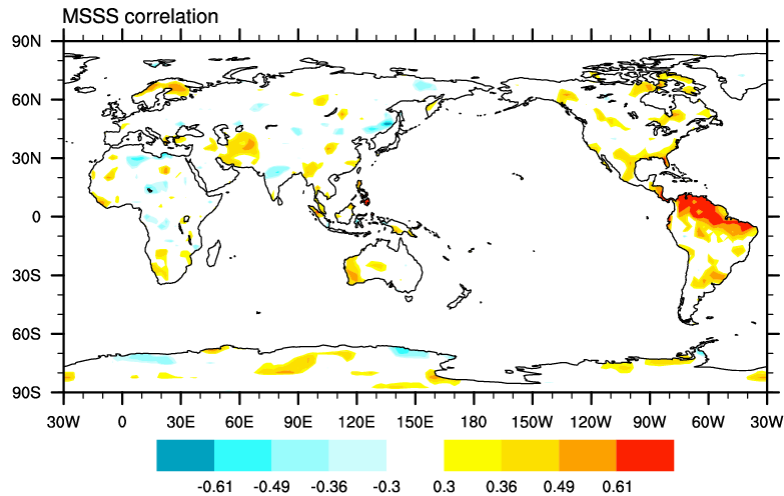
## Tier-2 DJF 1-month



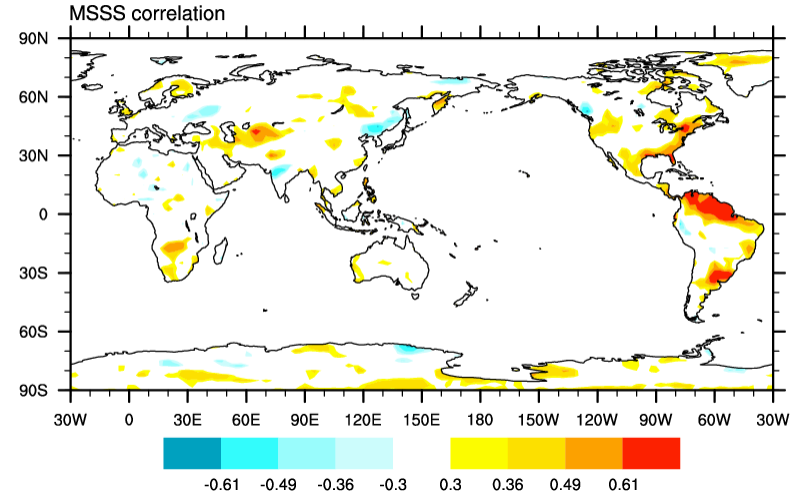
## Tier-1 DJF 1-month



## SINT DJF 3-month



## Tier-1 DJF 3-month





# Predictability of the Indo-Pacific coupled modes

**Corr. Coef. between OBS Nino3 and Model Nino3**

Target : MAM

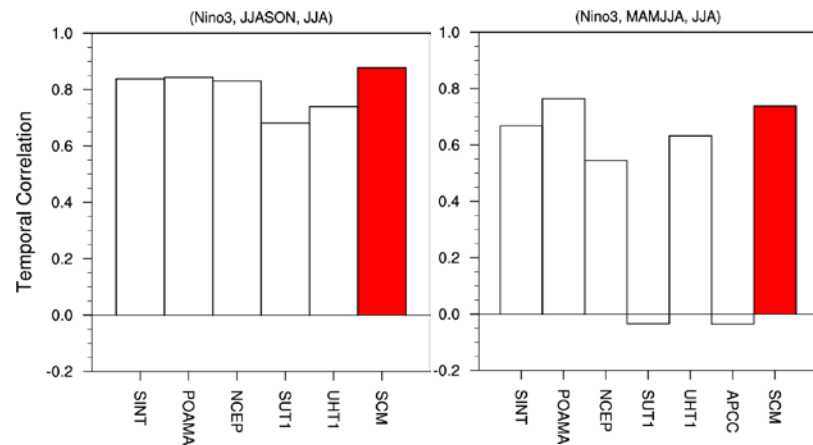
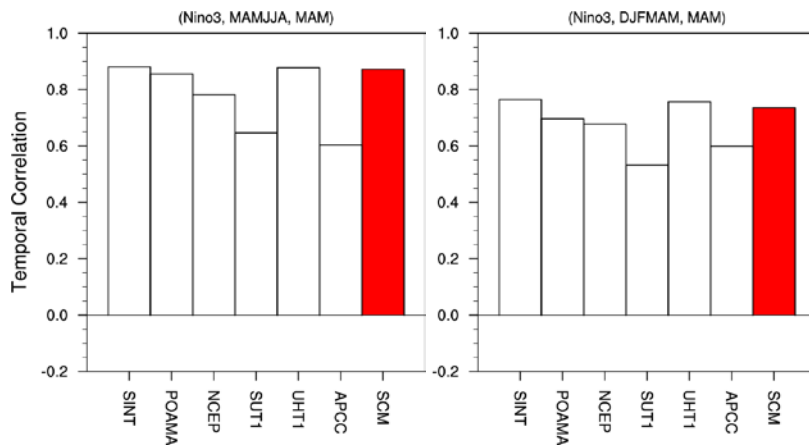
Target : JJA

1-3 month Lead

4-6 month Lead

1-3 month Lead

4-6 month Lead



Target : SON

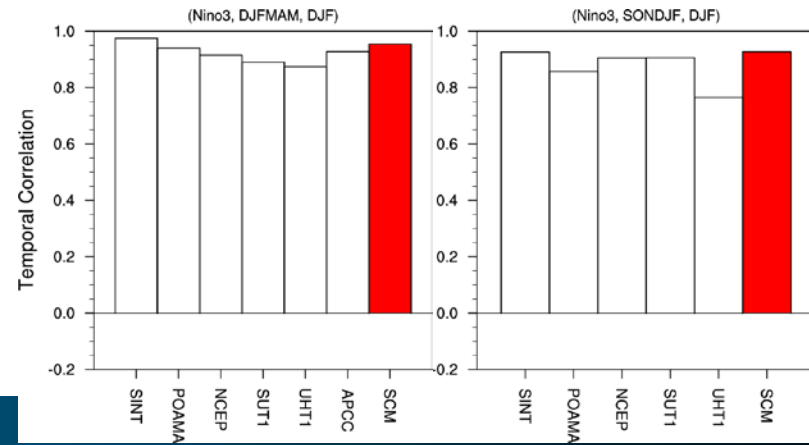
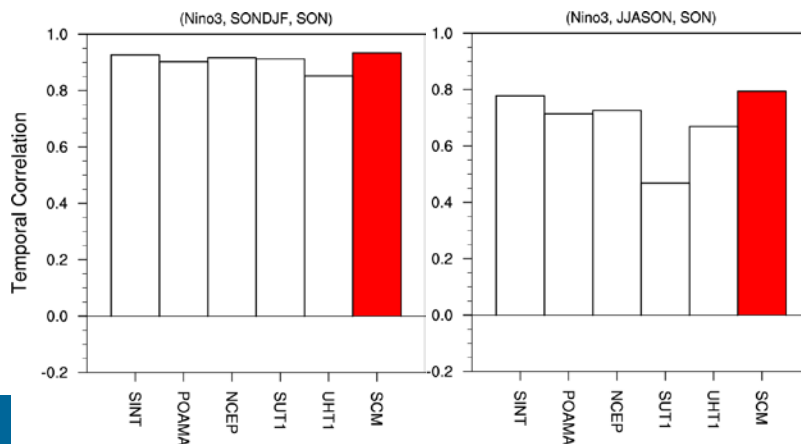
Target : DJF

1-3 month Lead

4-6 month Lead

1-3 month Lead

4-6 month Lead



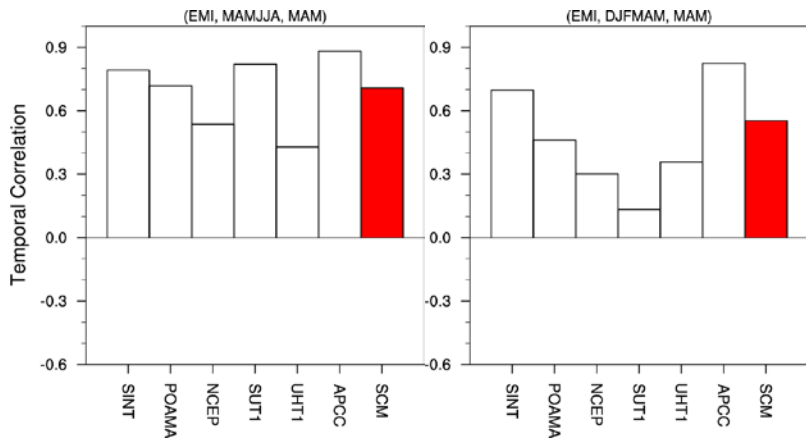


# Corr. Coef. between OBS EMI and Model EMI

Target : MAM

1-3 month Lead

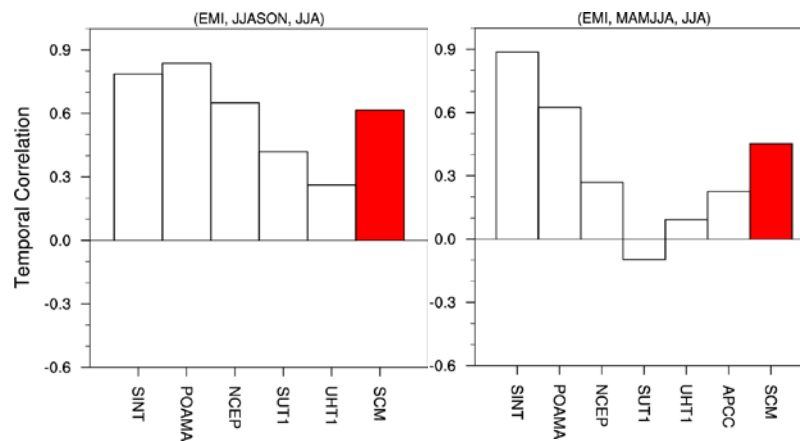
4-6 month Lead



Target : JJA

1-3 month Lead

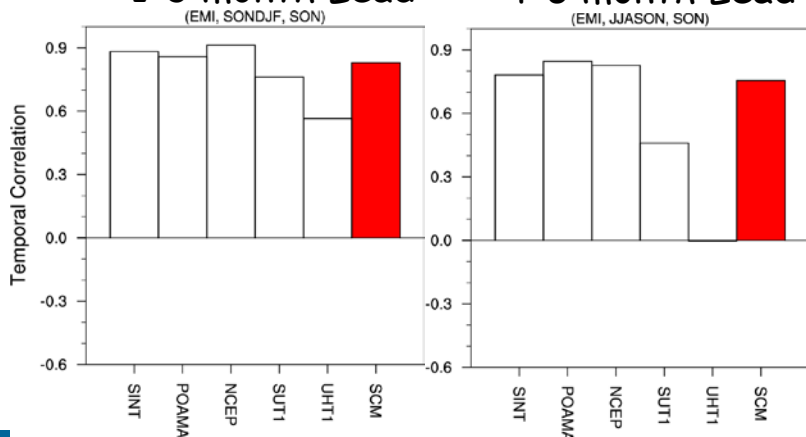
4-6 month Lead



Target : SON

1-3 month Lead

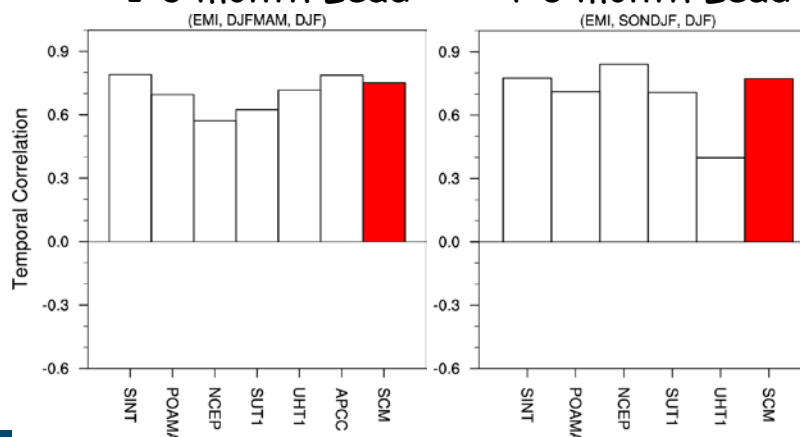
4-6 month Lead



Target : DJF

1-3 month Lead

4-6 month Lead



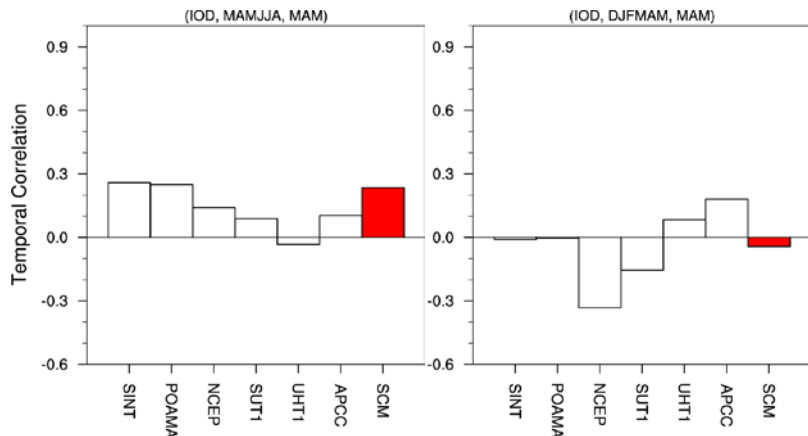


# Corr. Coef. between OBS IOD and Model IOD

Target : MAM

1-3 month Lead

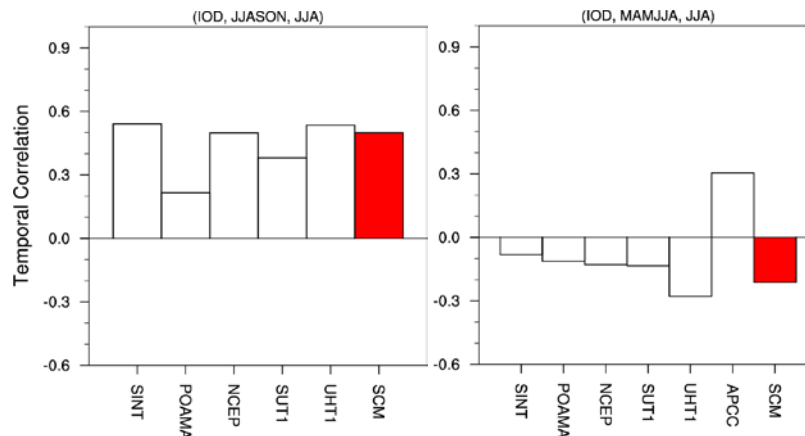
4-6 month Lead



Target : JJA

1-3 month Lead

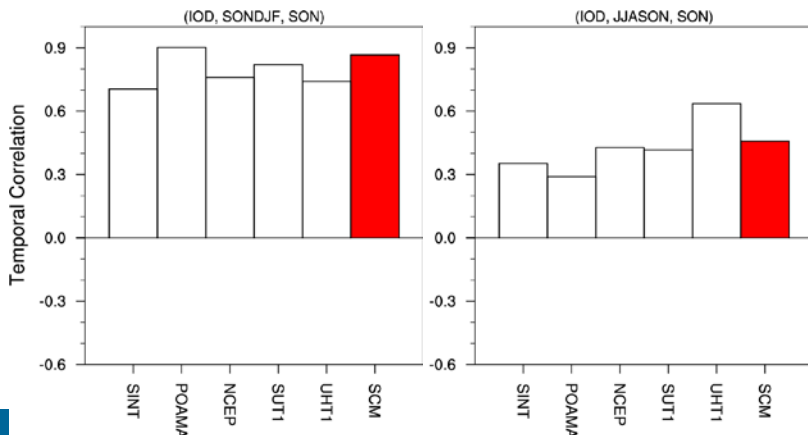
4-6 month Lead



Target : SON

1-3 month Lead

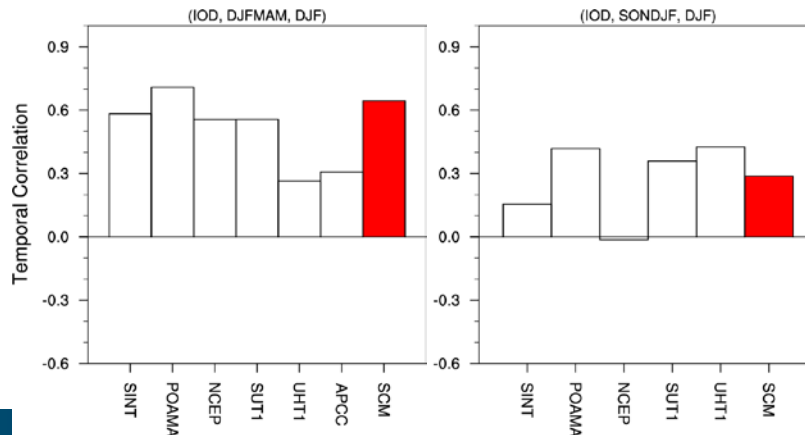
4-6 month Lead



Target : DJF

1-3 month Lead

4-6 month Lead





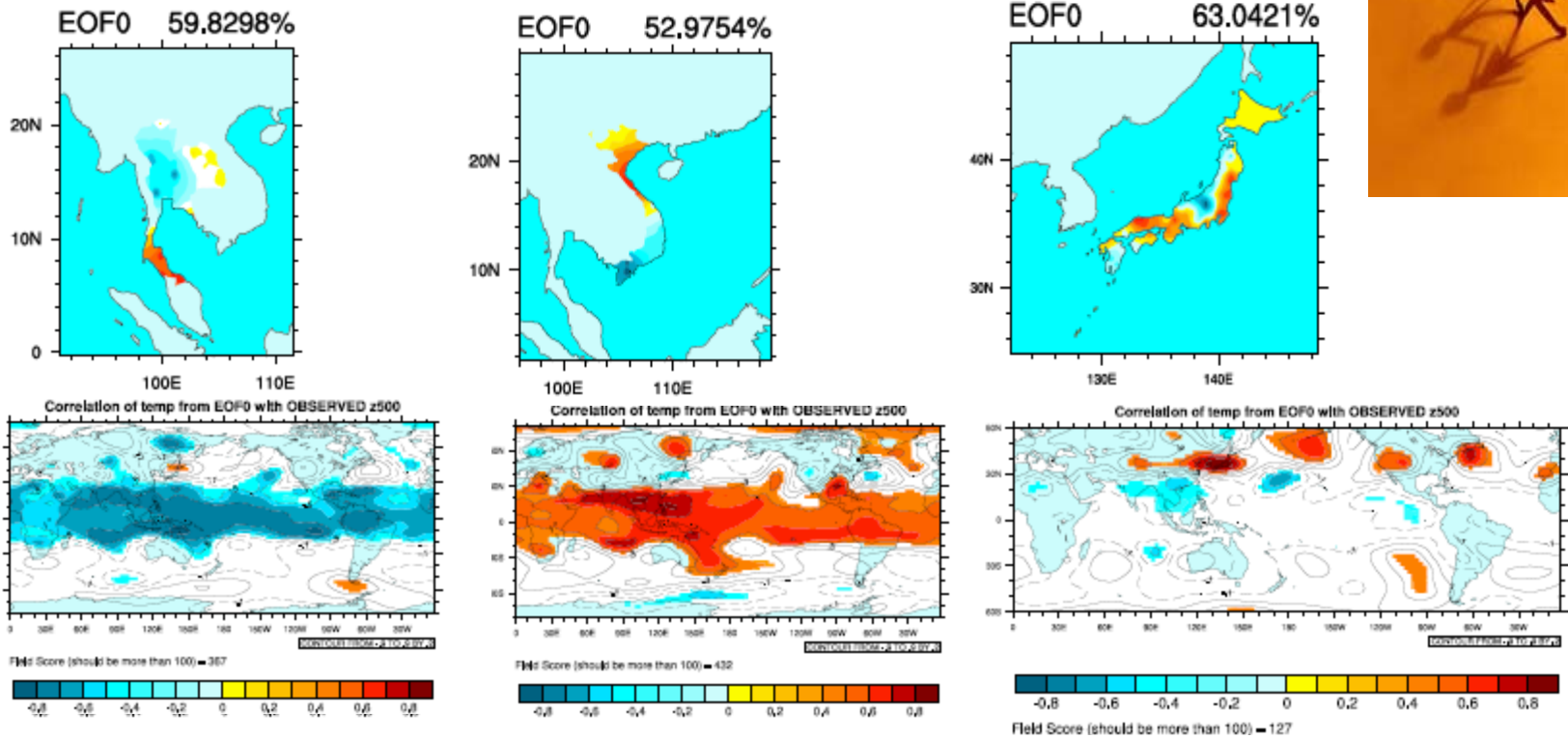
# Improved predictions for users

Year	Global Forecasts	Regional Forecasts
2006	<ul style="list-style-type: none"> <li>• 3-month MME forecast 4 times/year</li> </ul>	<ul style="list-style-type: none"> <li>• Research on impact of downscaling over Philippines, Thailand and China</li> </ul>
2007	<ul style="list-style-type: none"> <li>• Seasonal MME forecasts 4 times/year</li> <li>• Deterministic verification</li> </ul>	<ul style="list-style-type: none"> <li>• Research on impact of downscaling for Korea</li> </ul>
2008	<ul style="list-style-type: none"> <li>• 3-month MME forecasts 12 times/year</li> <li>• Probabilistic verification</li> <li>• Experimental 6-month MME</li> <li>• Development of APCC coupled prediction system</li> </ul>	<ul style="list-style-type: none"> <li>• Operational deterministic downscaling for Korea</li> <li>• Started development of a probabilistic downscaling scheme</li> </ul>
2009	<ul style="list-style-type: none"> <li>• Semi-operational 6-month MME prediction</li> <li>• APCC model takes part in 6-month MME prediction</li> </ul>	<ul style="list-style-type: none"> <li>• Semi-Operational probabilistic downscaling for Korea</li> <li>-Improving the current downscaling strategies</li> </ul>
2010	<ul style="list-style-type: none"> <li>• Experimental 12-month MME predictions</li> </ul>	<ul style="list-style-type: none"> <li>• Operational downscaling for South East Asian Economies</li> <li>• Operational probabilistic downscaling for Korea</li> </ul>



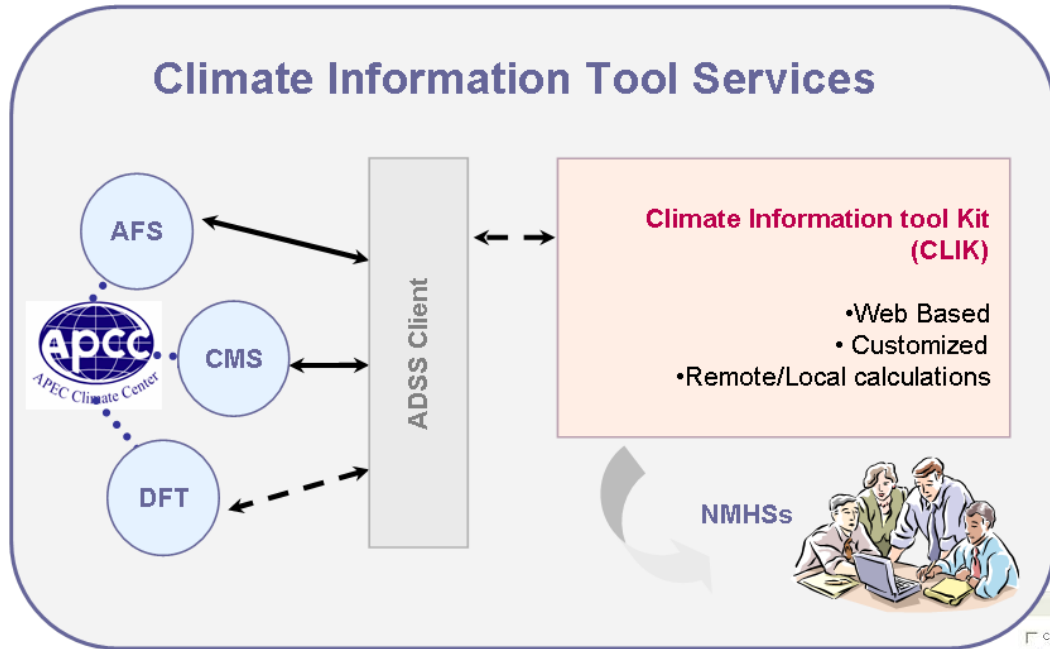
## GOALS

- How effective is statistical downscaling for various APEC economies?
- Intercomparison of schemes
- Operationalizing statistical downscaling





# System Configuration for User Support

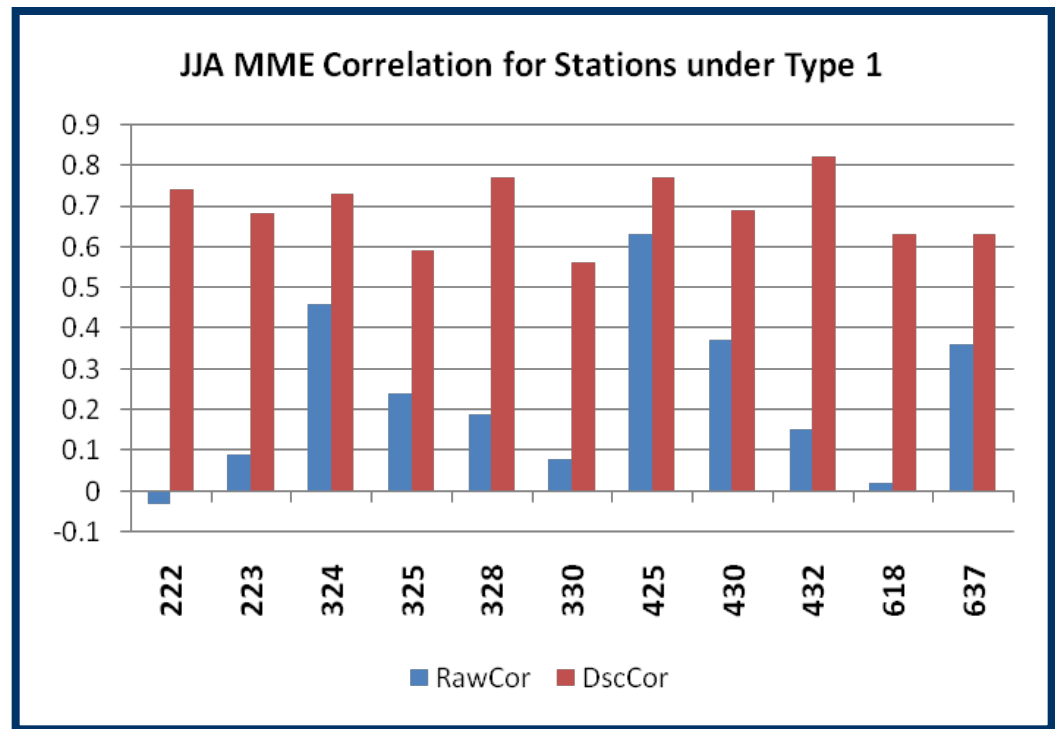
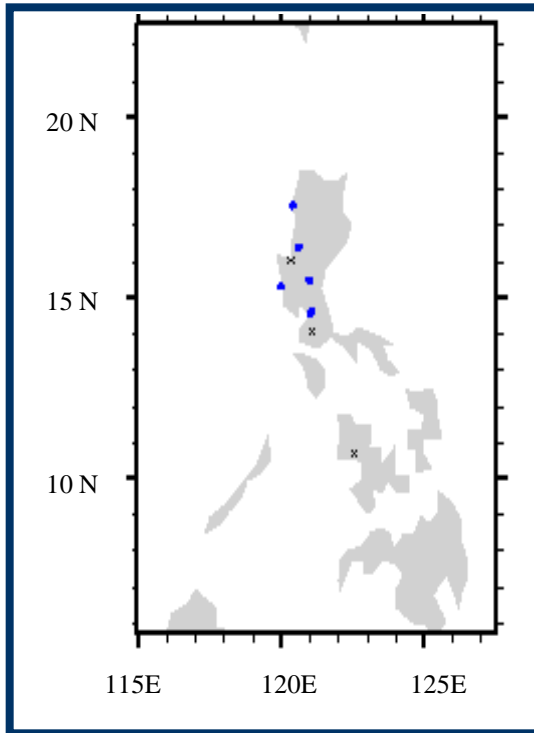


<http://clik.apcc21.net>

\* AFS : Automated Forecast System/ CMS : Climate Monitoring System/ DFT: Downscale Forecast Tool



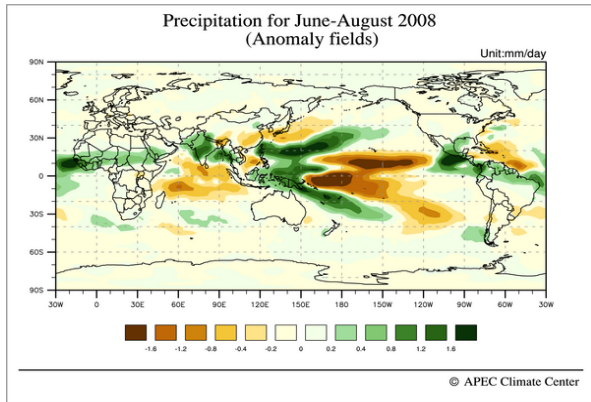
# Example for Philippines (rainfall)





# Statistical Temporal Downscaling

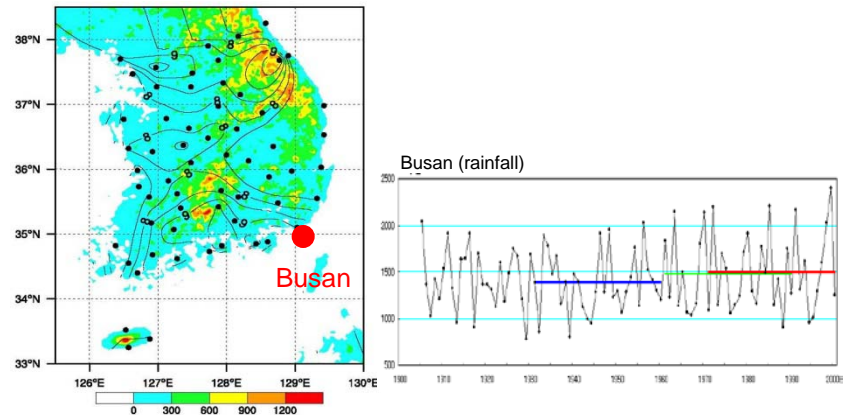
Fine-scale temporal data  
(e.g., monthly or seasonal data)



Climate information  
from GCM



Historical daily weather record  
for a particular station



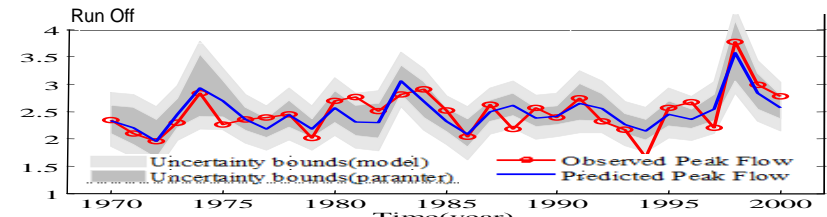
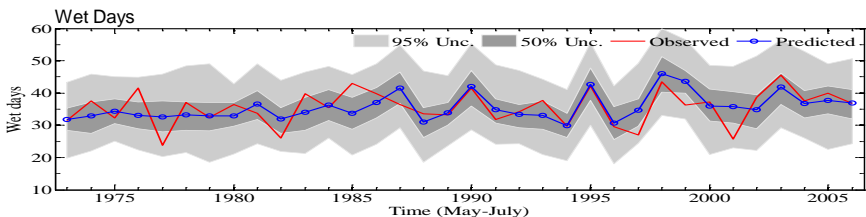
Statistical characteristics  
of observed weather



**Spatial Downscaling Methods : Stochastic Weather Generators**  
(e.q., Markov chains, stochastic models, etc)

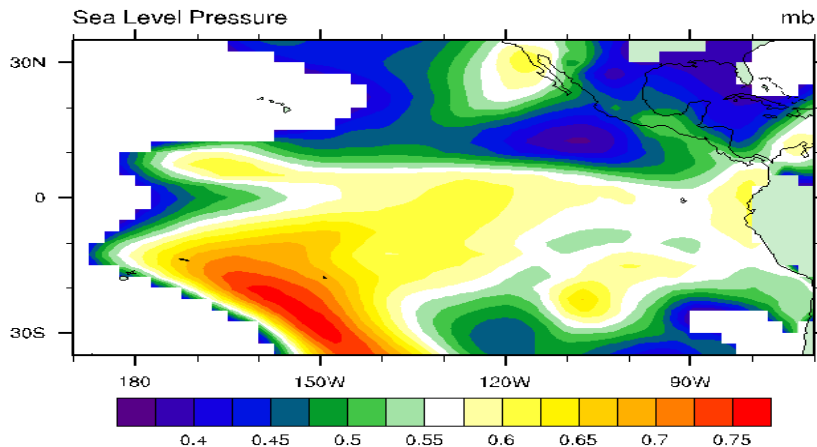


**Artificial timeseries of weather data for a location**  
(e.q., wet/dry days, rainfall amount, etc.)



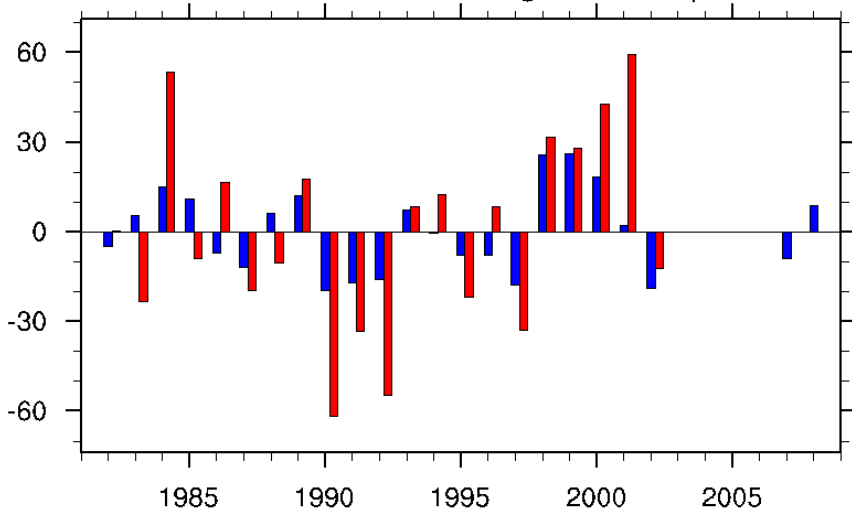


# Example for Peru



Downscaled using MME

Rain - Average over multiple stations

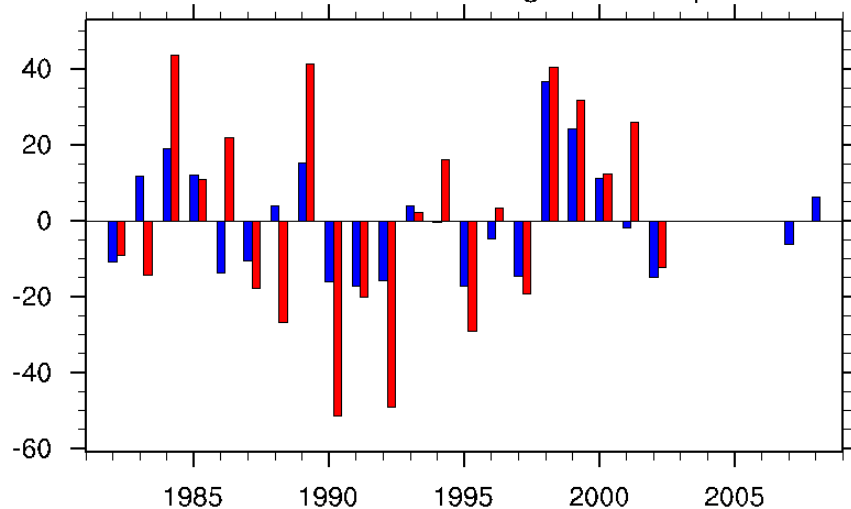


Correlation = 0.72  
RMSE = 23.91

■ PRED  
■ OBS

Downscaled using MME

Rain - Average over multiple stations



Correlation = 0.73  
RMSE = 19.50

■ PRED  
■ OBS





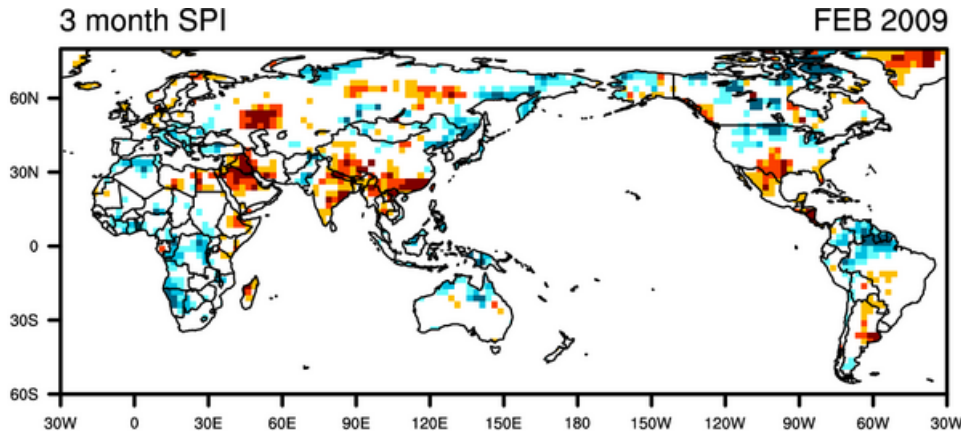
# Improved Use of Climate Information

Year	Sharing/Technology transfer	Training
2006		<ul style="list-style-type: none"> <li>• Visiting Scientist Program – trained personnel from <b>China, Philippines, Russia, India, Thailand</b> in MME techniques (5)</li> <li>• KOICA – course on MME techniques (2)</li> </ul>
2007	<ul style="list-style-type: none"> <li>• APEC Data Service System (ADSS)</li> </ul>	<ul style="list-style-type: none"> <li>• KOICA – course on MME techniques (5)</li> </ul>
2008	<ul style="list-style-type: none"> <li>• Provision of digital MME through ADSS</li> <li>• Climate Information Tool Kit (CLIK)</li> <li>• Downscaling Tools</li> <li>• APCC Data Client</li> </ul>	<ul style="list-style-type: none"> <li>• APN Program - course on statistical downscaling (5)</li> <li>• KOICA Program - course in statistical downscaling (9)</li> </ul>
2009	<ul style="list-style-type: none"> <li>• Provision of WCRP CHFP data sets</li> <li>• New training facilities</li> <li>• Implement CLIK in <b>Vietnam, Thailand, Philippines</b></li> <li>• Climate Adaptation Portal</li> </ul>	<ul style="list-style-type: none"> <li>• Training in APCS09</li> <li>• Visiting scientist from CWB</li> <li>• Non-APEC nations such as India and Nepal express interest</li> </ul>
2010	<ul style="list-style-type: none"> <li>• Serve as data portal for WCRP/AMY project</li> <li>• Implement CLIK in other <b>South East Asian Countries</b></li> </ul>	<ul style="list-style-type: none"> <li>• Visiting positions</li> <li>• Funds from APN etc.</li> </ul>



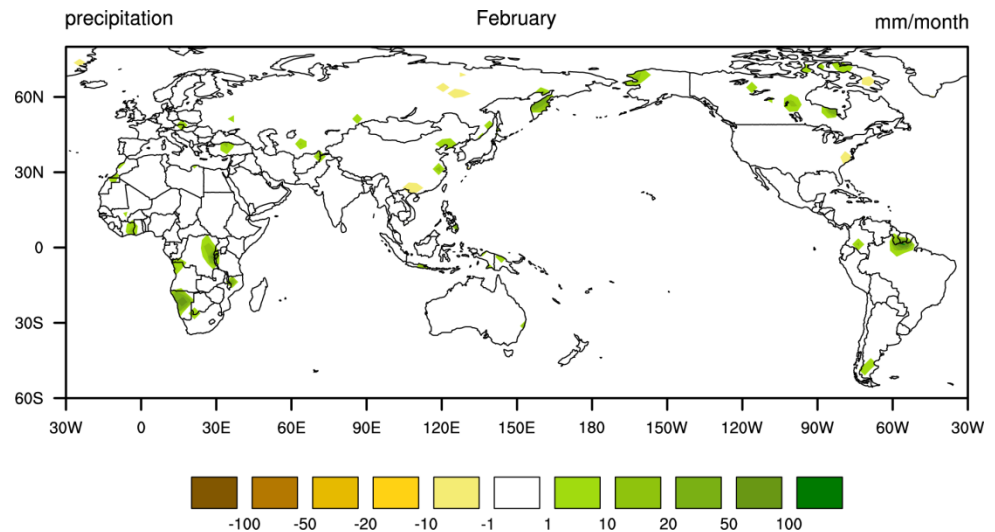
# Global Hydrological Extreme Drought / Flood Monitoring

- A global hydrological extreme drought/flood monitoring service has been launched since January 2009 ([http://www.apcc21.net/climate/climate03\\_11.php](http://www.apcc21.net/climate/climate03_11.php))

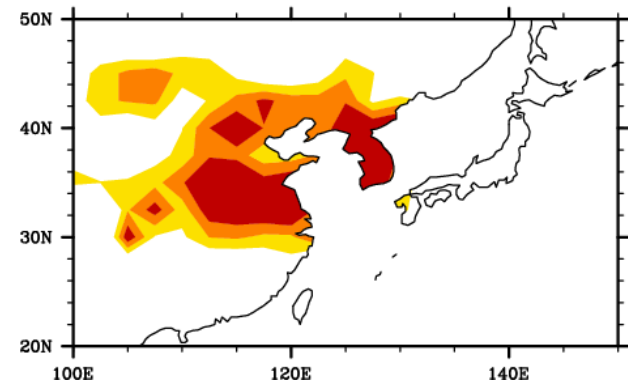


- Severe drought conditions continued in southern China for the last 3 months

- Eastern edge of China experienced very wet condition on the record in February 2009

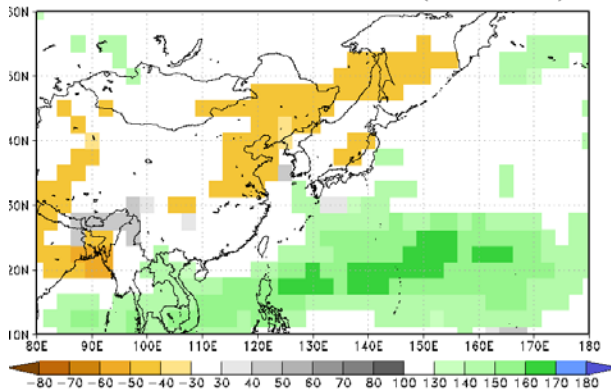


# Early warning system using MME-based Drought /Flood Prediction



drought monitoring (SPI)  
(May, 2001)

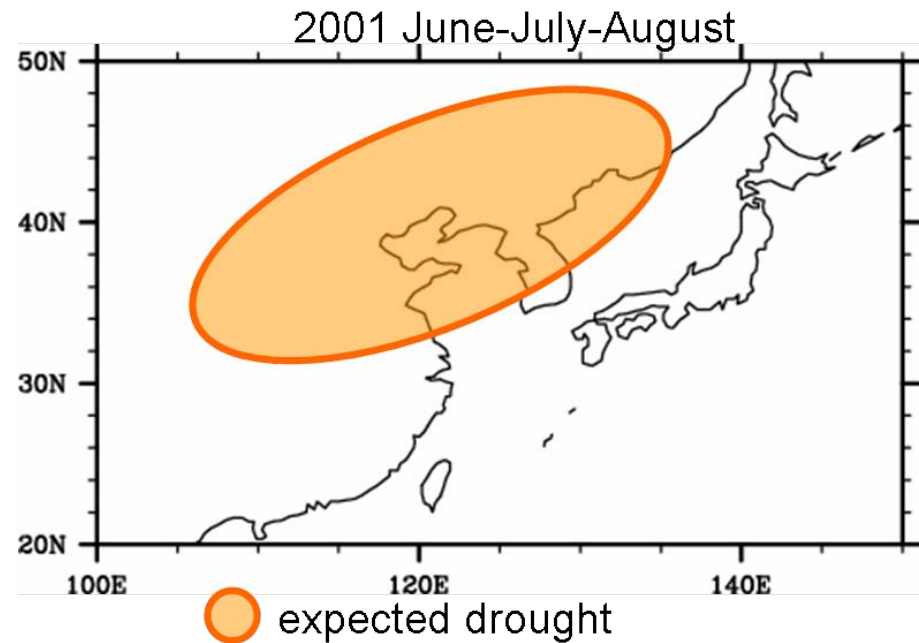
Probabilistic FCST : PREC (2001 JJA)



seasonal precipitation forecast  
(JJA, 2001)

**combine**

MME  
SPI  
NDVI  
etc



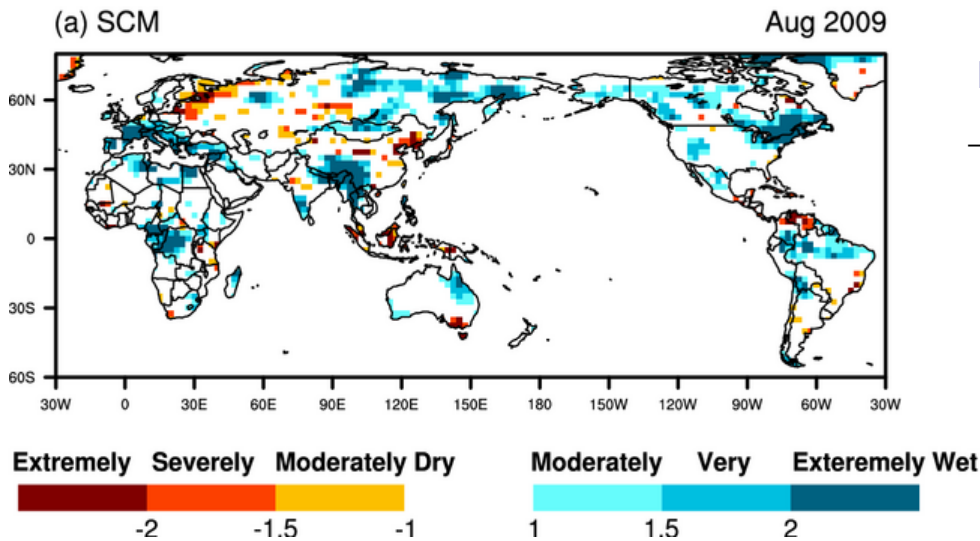
Drought Forecast  
Usage:

- planning water supply
- agriculture



# Global Hydrological Extreme Forecast

- Experimental monthly 3-month experimental drought/flood prediction is been carried out since January, 2009.
- 7-month lead drought/flood prediction is been carried out since January, 2009



From a 6-month time scale (hydrologic)\* view

→ prediction indicates that most of inland areas around the globe are likely to see flood conditions, while maritime continent, equatorial Latin America, East Asia, and northern Europe may experience drought condition.

Forecast: global hydrological extremes based on 6-month SPI

- Downscaled drought/flood prediction being planned.



# New Products launched

Launched three new bulletins

- Semi-operational 6-month lead prediction bulletin issued seasonally.
- Extreme hydrological drought/flood bulletin
- Model feedback diagnostics.



# Extreme Climate Prediction

Year	System
2006	
2007	<ul style="list-style-type: none"><li>• Development of Drought Monitoring Methodology</li></ul>
2008	<ul style="list-style-type: none"><li>• Experimental Drought Monitoring</li><li>• Experimental ENSO monitoring</li></ul>
2009	<ul style="list-style-type: none"><li>• Develop MME system for ISV prediction (<b>CliPas</b>)</li><li>• Development of Downscaling of weather statistics</li><li>• Experimental ENSO Prediction</li><li>• Experimental Drought Prediction</li></ul>
2010	<ul style="list-style-type: none"><li>• Experimental MME based ISV prediction</li><li>• Operational Drought Prediction</li><li>• Testing of weather statistics technology</li></ul>



# Fostering Collaboration

- APCS achievements
  - Operational MME
  - Digital Climate Prediction Service
  - Extended predictions- 6months & longer
- 
- MME based ISV predictions
  - Operational regional downscaling
  - Climate Adaptation



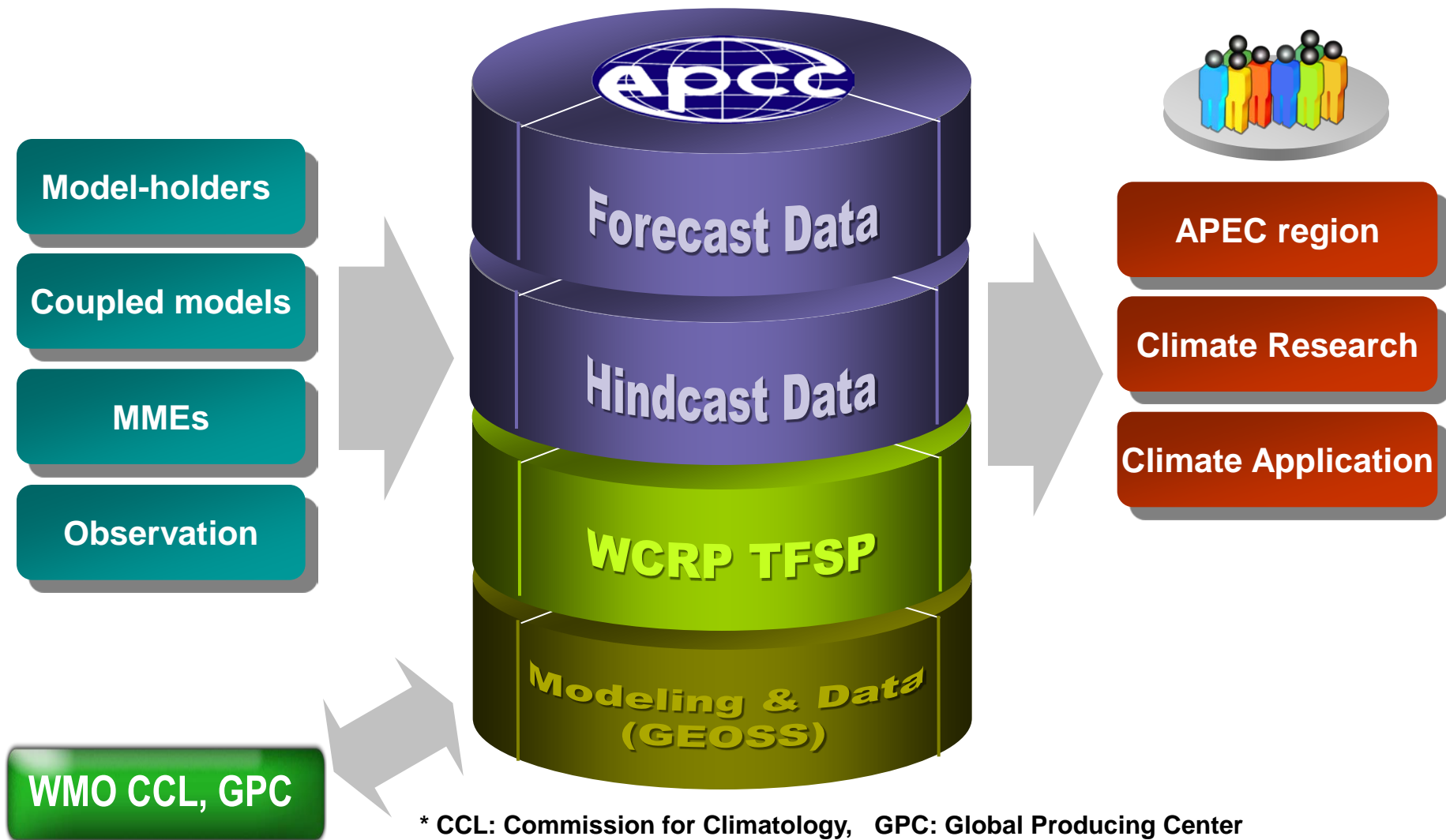
# 2008-09 Publication List

<b>Title</b>	<b>Authors</b>	<b>Journal Name</b>	<b>etc</b>
Interannual variations of the boreal summer Intraseasonal variability predicted by ten atmosphere-ocean coupled models	Kim, H.-M. et al.	Climate Dynamics	Published
Global monsoon: Dominant mode of annual variation in the tropics	Wang, Bin and Q. Ding	Dynamics of Atmospheres and Oceans	Published
Optimal multi-model ensemble method in seasonal climate prediction	Kug, J.-S. et al.	Asia-Pacific Journal of Atmospheric Sciences	Published
Experimental dynamical forecast of an MJO Event Observed during TOGA-COARE Period	Fu, Xiuhua et al.	Atmospheric and Oceanic Science Letters	Published
Effects of multicumulus convective ensemble on East Asian summer monsoon rainfall simulation	Lee, D. Y. et al.	Journal of Geophysical Research	Published
Seasonal forecast for local precipitation over northern Taiwan using statistical downscaling	Chu, J.-L. et al.	Journal of Geophysical Research	Published
Mechanisms of South Indian Ocean intraseasonal cooling	P.N.Vinayachandran and N.H. Saji	Geophysical Research Letters	Published



# Access to Climate Data base

## APCC Data Service



- \* CCL: Commission for Climatology, GPC: Global Producing Center
- \* WCRP TFSP: World Climate Research Program Task Force on Seasonal Prediction
- \* GEOSS: Global Earth Observation System of Systems



Thank You.