

# Current Status of the Operational Multi-Model Ensemble Prediction System of APEC Climate Center

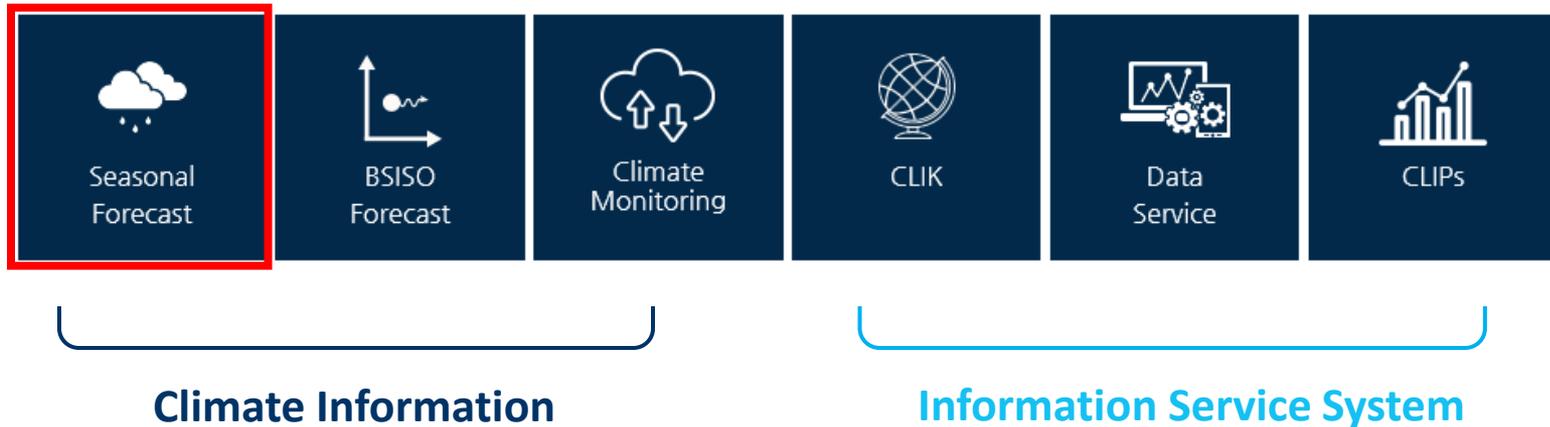
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(May 30, 2018)

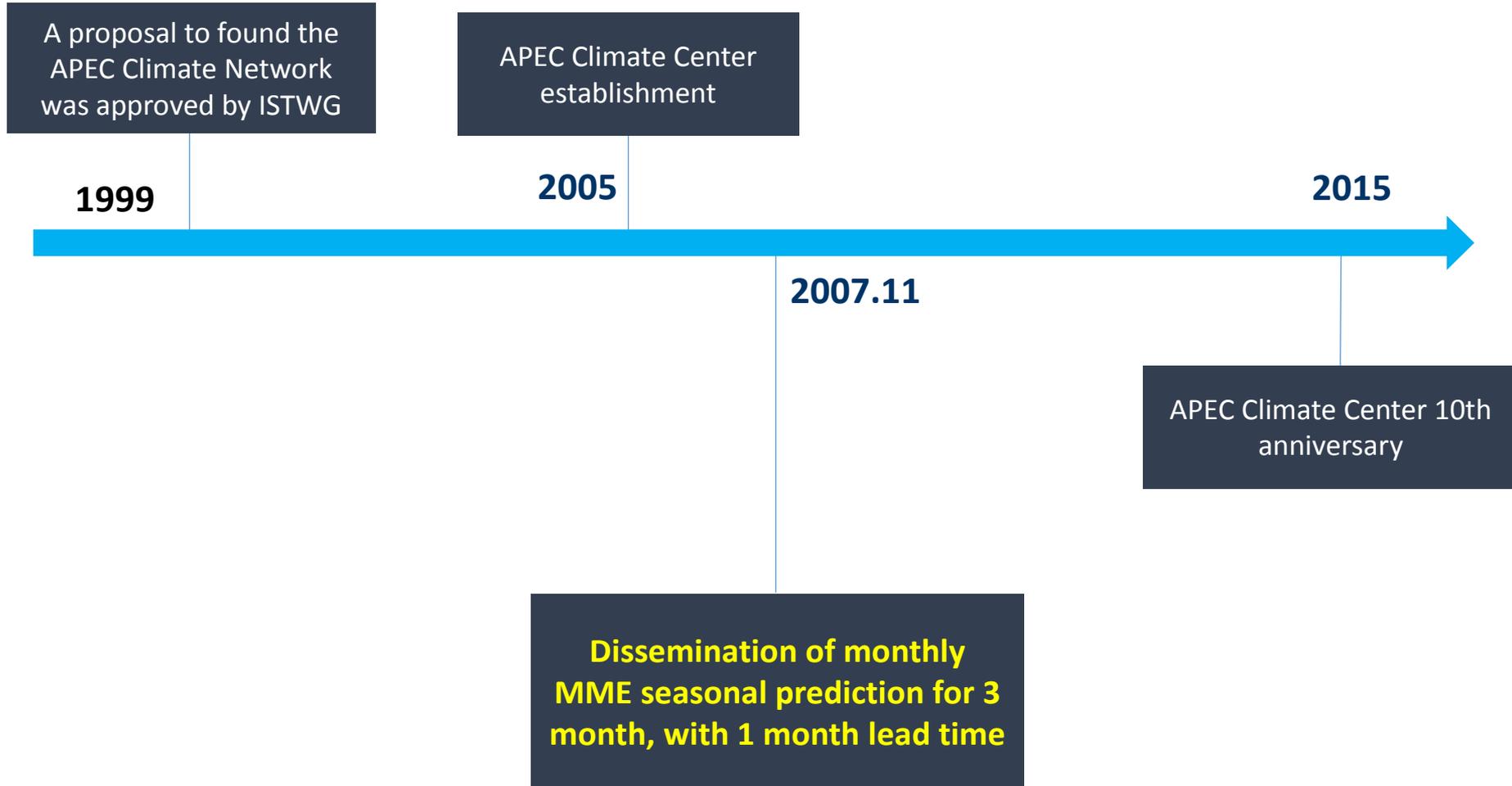
**Ji-Hyun Oh**, Young-Mi Min, Sun-Hee Shin,  
Daeun Jeong, Chang-Mook Lim, and A-Young Lim  
APEC Climate Center

# Climate Prediction & Information Service

✓ <http://www.apcc21.org>



# History of the APEC Climate Center





# Seasonal forecast: Multi-model ensemble

- Methodology of the APCC MME Prediction System (Min et al. 2014)

Deterministic method



Simple Composite Method (SCM)

Stepwise Pattern Projection Method (SPM)

Multiple Regression Method (MRG)

Synthetic Superensemble Method (SSE)

Probabilistic method

- ✓ 2m temperature
- ✓ Precipitation
- ✓ 850hPa temperature
- ✓ 500hPa geopotential height
- ✓ sea surface temperature

# APCC Deterministic MME

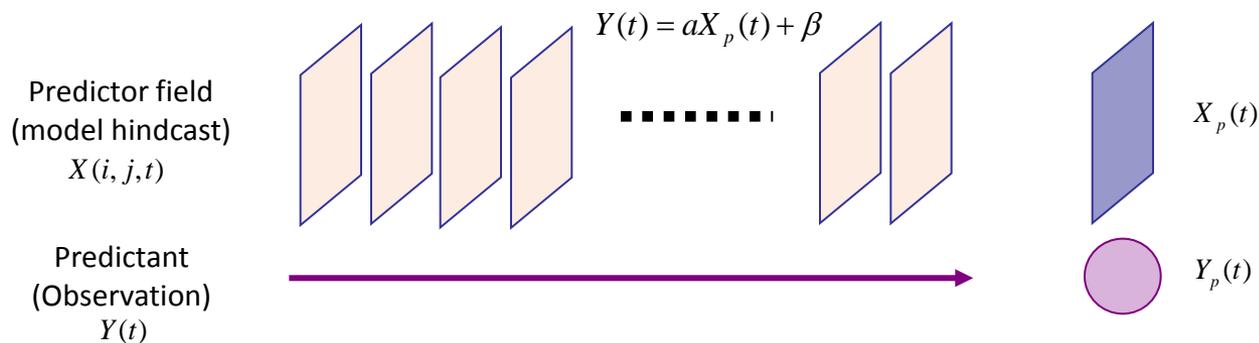
- **SCM (Simple Composite Method)**: simple averaged MME with equal weight

$$P = \frac{1}{M} \sum_{i=1}^M F_i$$

M: number of forecast models  
 $F_i$ : forecast of  $i^{\text{th}}$  model

- **SPM (Stepwise Pattern Projection Method)**: simple composite of individual model forecasts, after statistical correction (downscaling) by **pattern projection method** (Kug et al. 2008)

$$P = \frac{1}{M} \sum_{i=1}^M \hat{F}_i \quad \hat{F}_i : \text{corrected forecast of } i^{\text{th}} \text{ model}$$



# APCC Deterministic MME

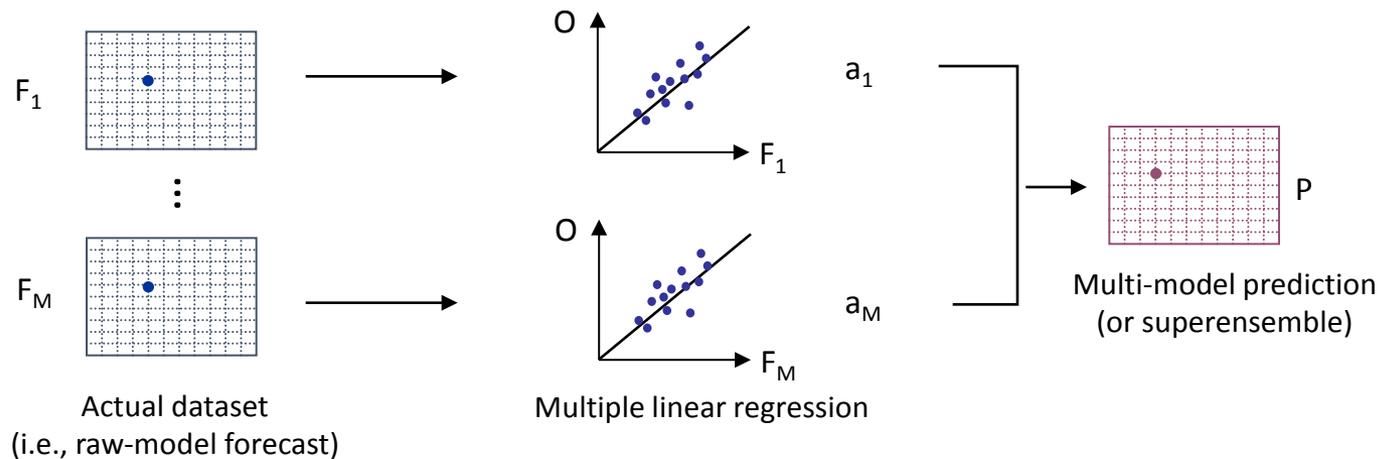
- **MRG (Multiple Regression Method)** : empirically weighted MME with regression coefficients (Yun et al. 2003)

$$P = \sum_{i=1}^M a_i F_i$$

M: number of forecast models

$F_i$ : forecast of  $i^{\text{th}}$  model

$a_i$ : regression coefficients during the training period



# APCC Deterministic MME

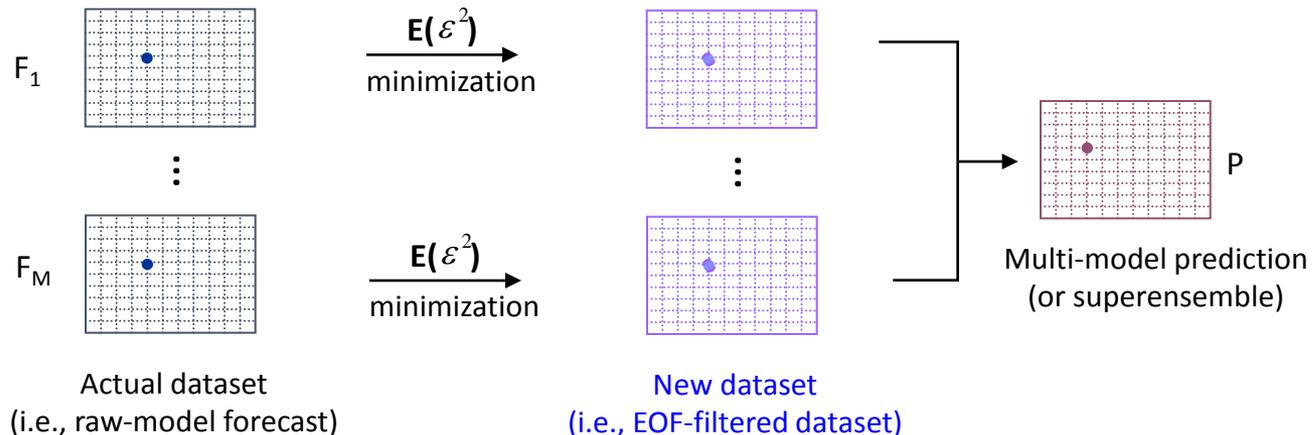
- **SSE (Synthetic Superensemble Method): empirically weighted MME** with **EOF-filtering of the actual dataset** by finding a consistent spatial pattern between the observed and individual model forecast (Yun et al. 2005)

$$P = \sum_{i=1}^M a_i \hat{F}_i$$

M: number of forecast models

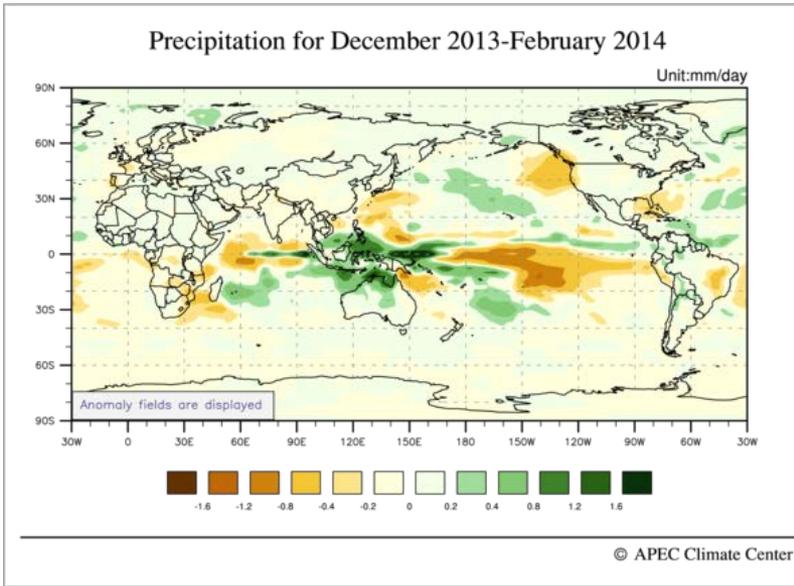
$\hat{F}_i$ : corrected forecast of  $i^{\text{th}}$  model

$a_i$ : regression coefficients during the training period

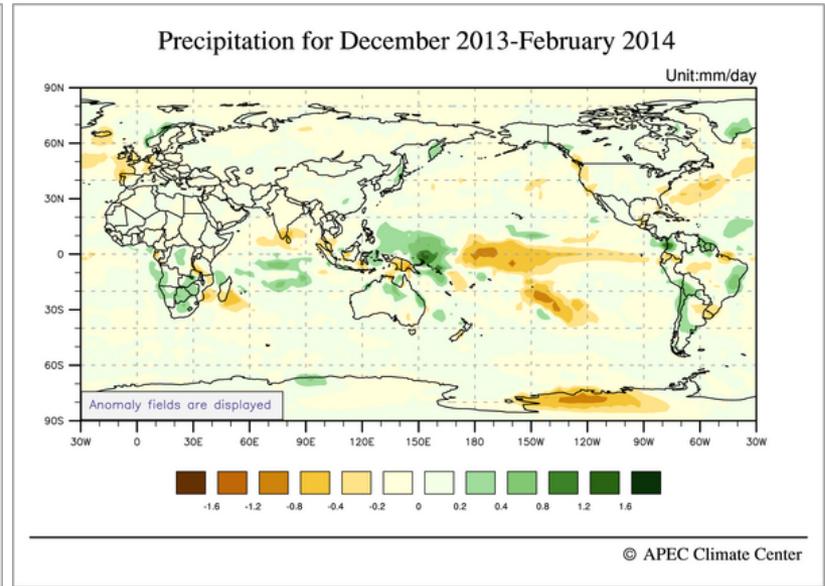


# APCC Deterministic MME

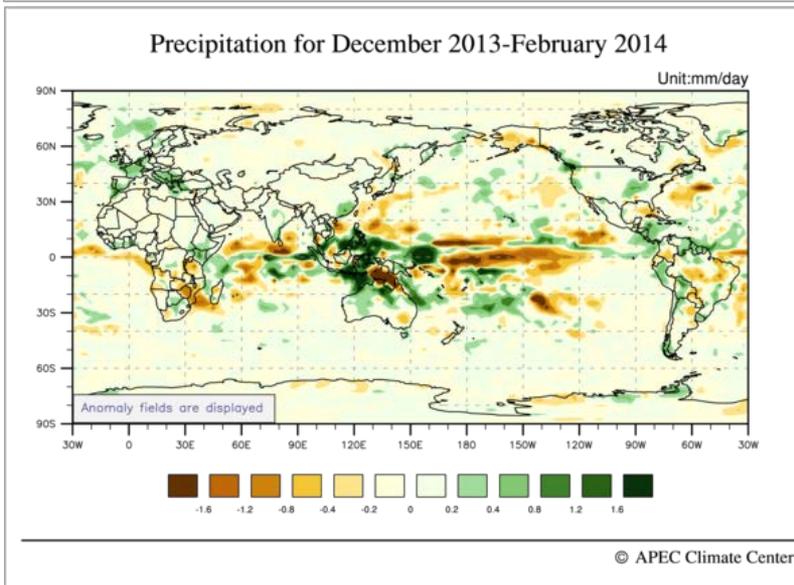
SCM



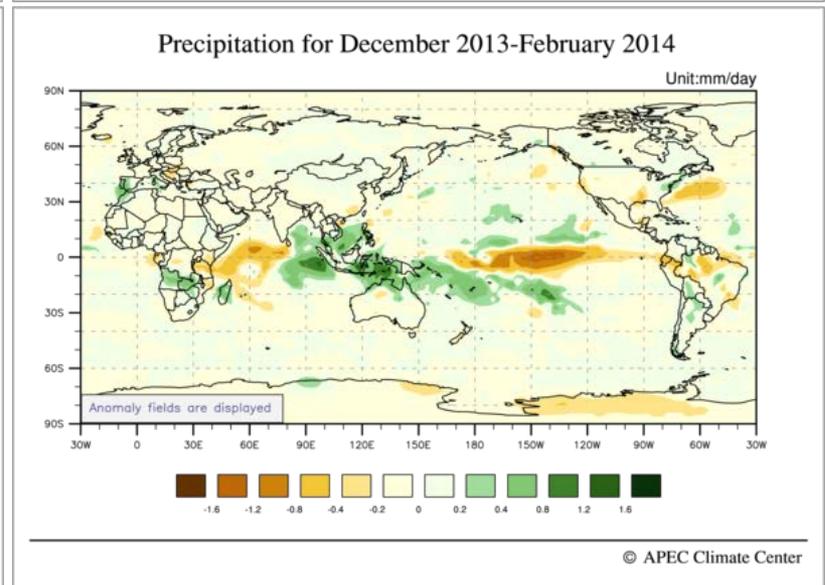
SPM



MRG



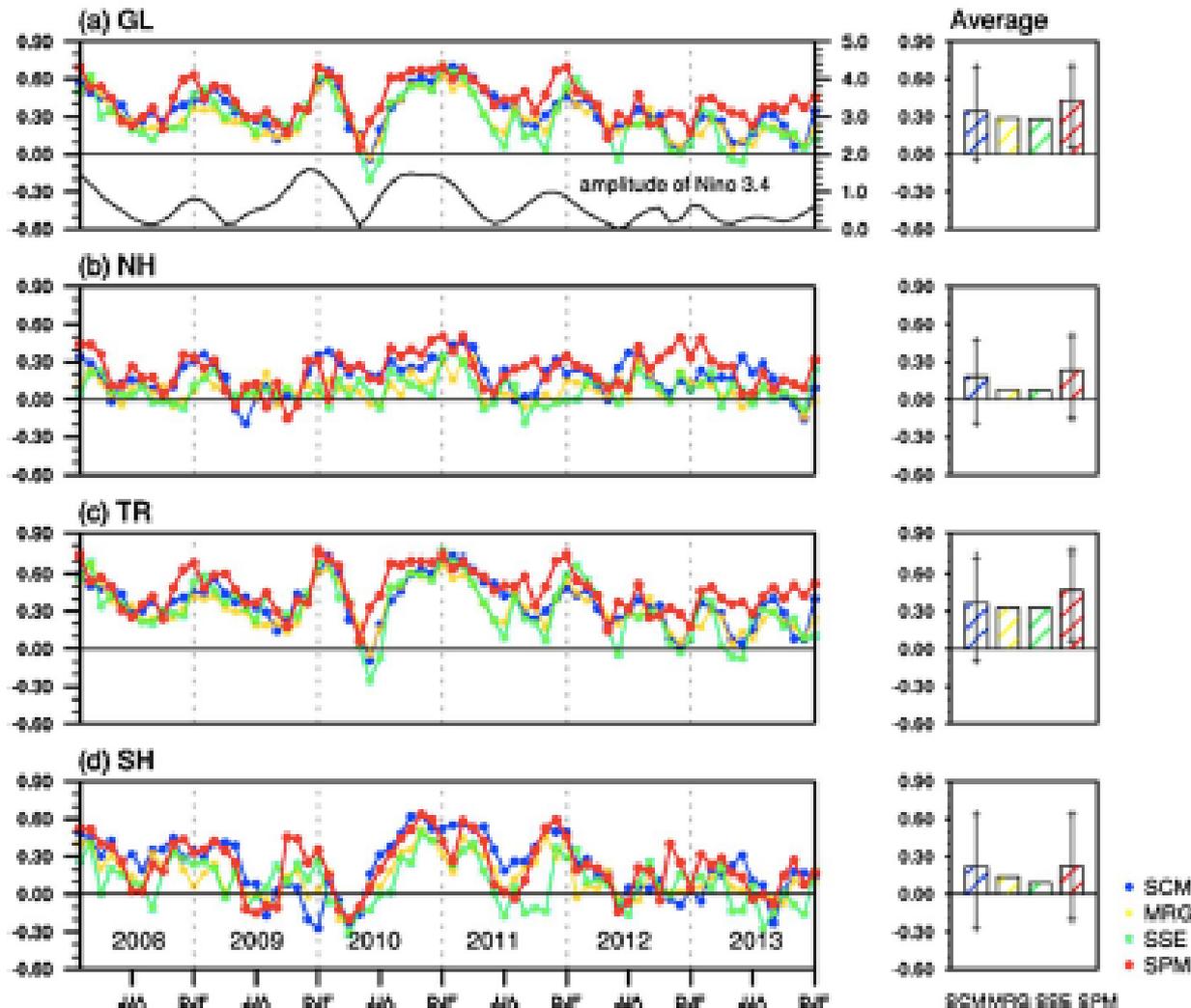
SSE



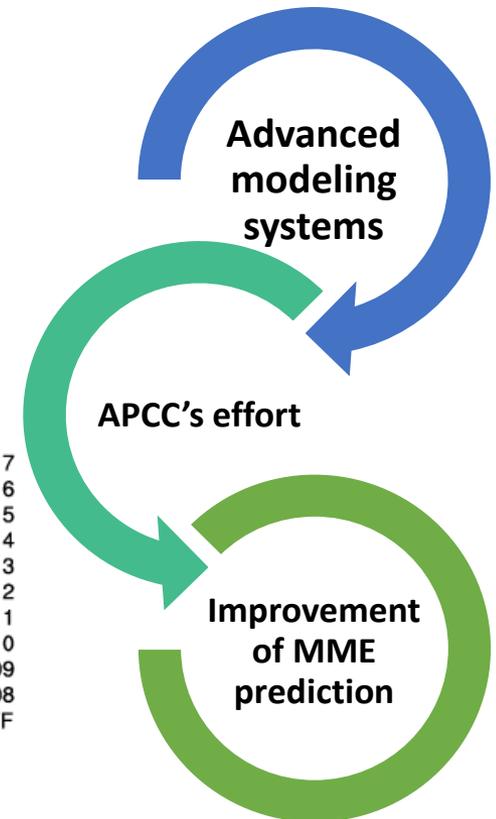
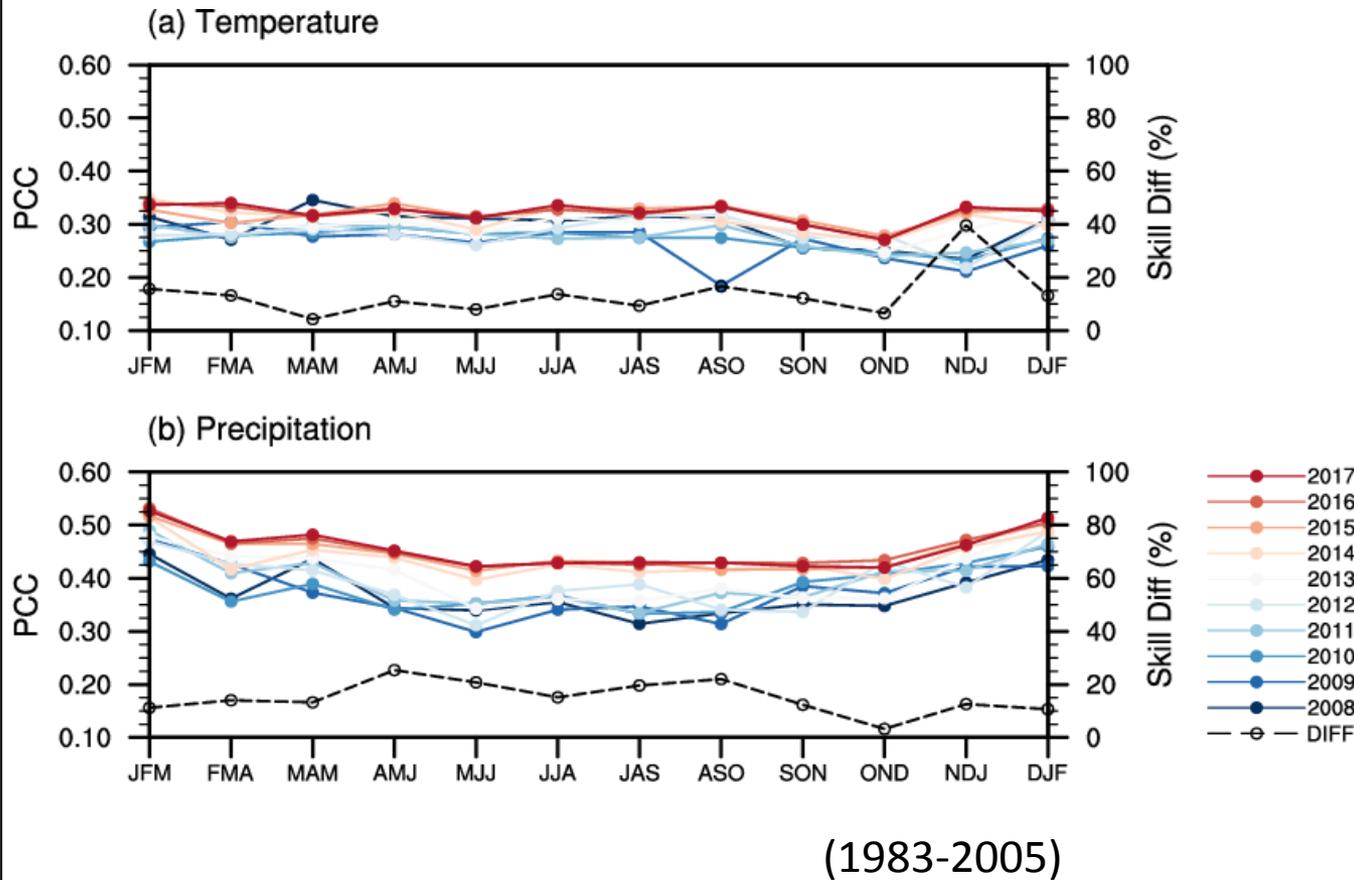
# APCC Deterministic MME

Time series of anomaly pattern correlation for 1 month lead seasonal mean precipitation

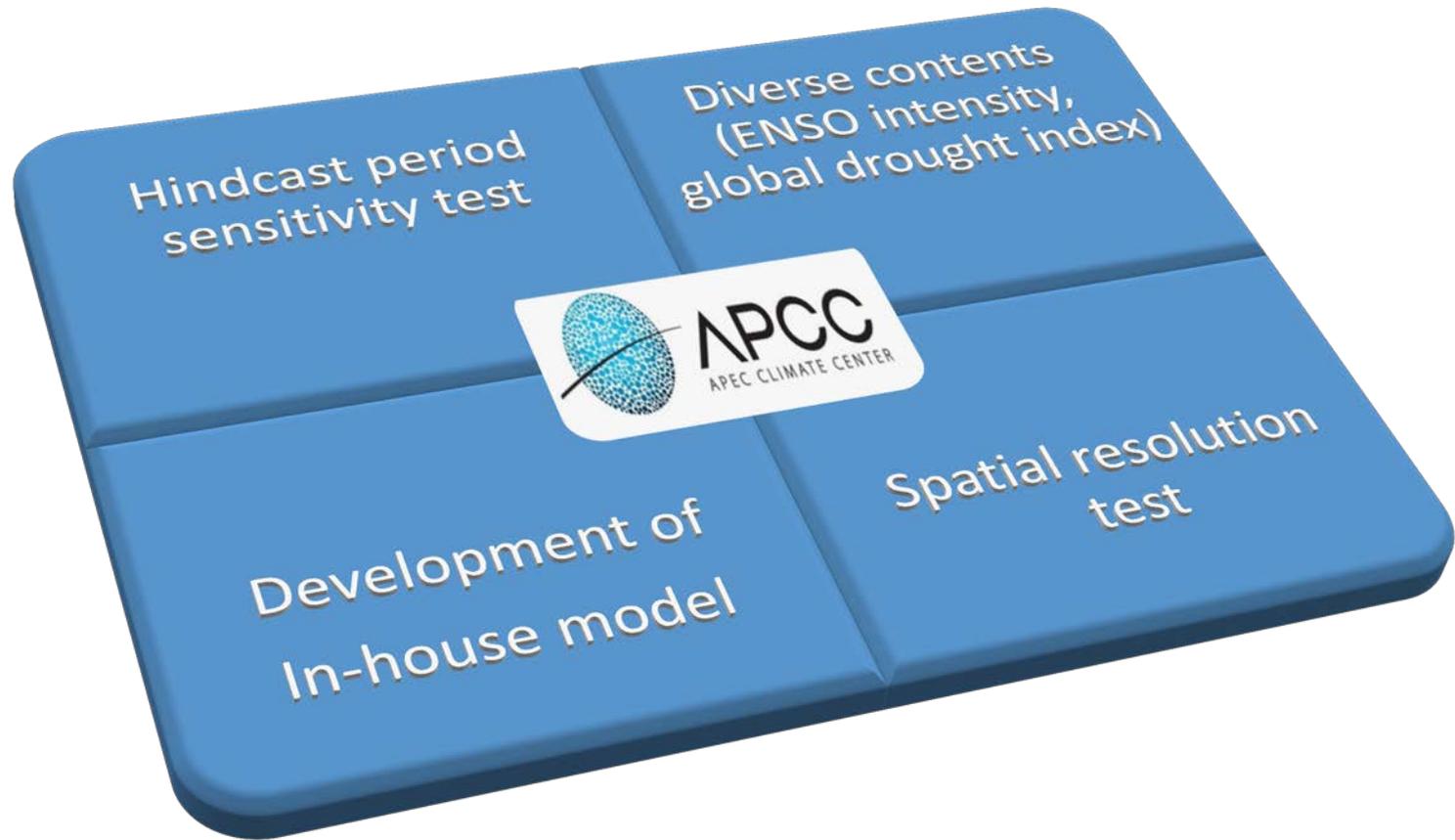
The averaged scores



# Continuous improvement of MME prediction



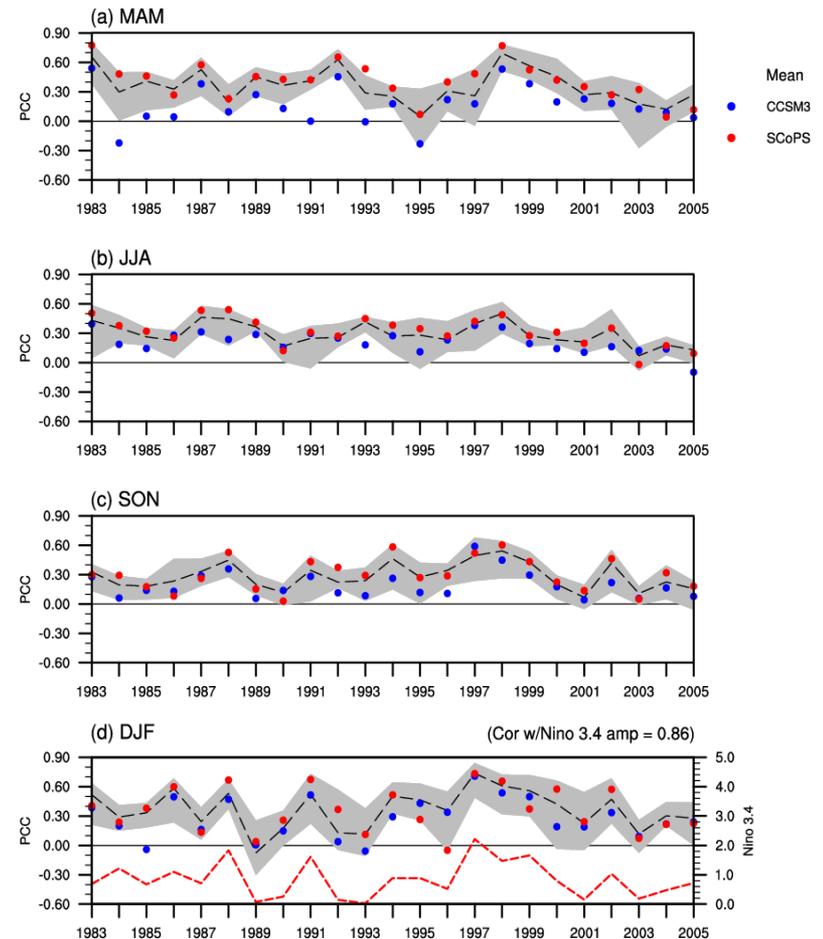
# APCC's on-going effort



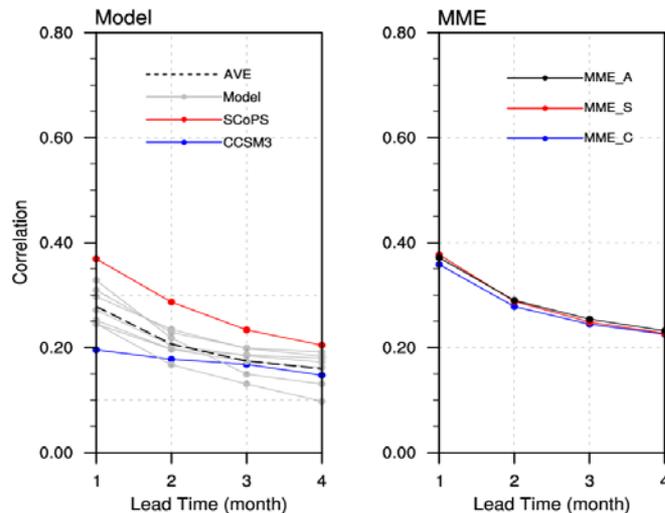
# Upgrading APCC's forecast system

		SCoPS ←	CCSM3
Model Description	Atmos.	ECHAM v5.3	CAM3
	Ocean	POP v2.0.1	POP v1.4.3
	Sea ice	CICE v4.1	CSIM4
Resolution	Atmos.	T159 // 31 levels	T85 // 26 levels
	Ocean	1° X 0.5 // 40 levels	
Initial condition	Atmos.	3D nudging from CFSR	—
	Ocean	EAKF from CFSR SST and profile data (WOD)	3D nudging from GODAS
Hindcast period		1982~2013	1983~2013
Ensemble configuration		Time lagged with perturbation on Gaussian noise	Time lagged
Ensemble		10	

## Interannual Variation: GL, PREC



## SST Skill: Averaged TCC over GL



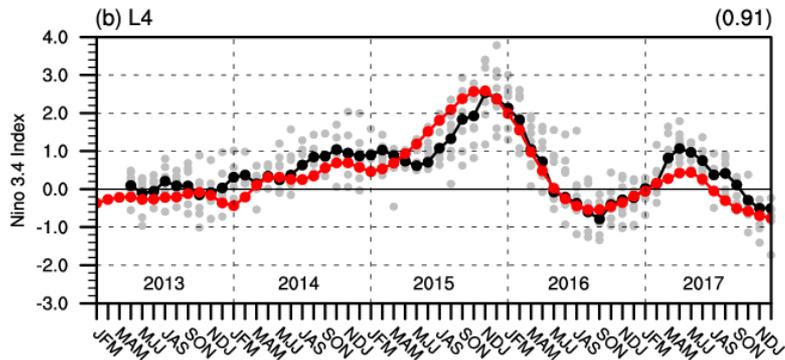
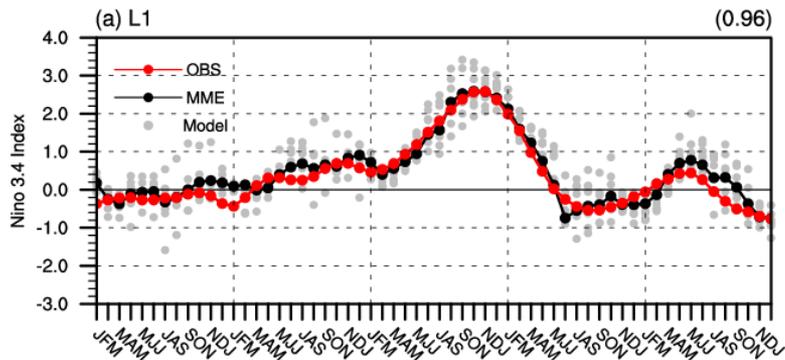


**THANK YOU**

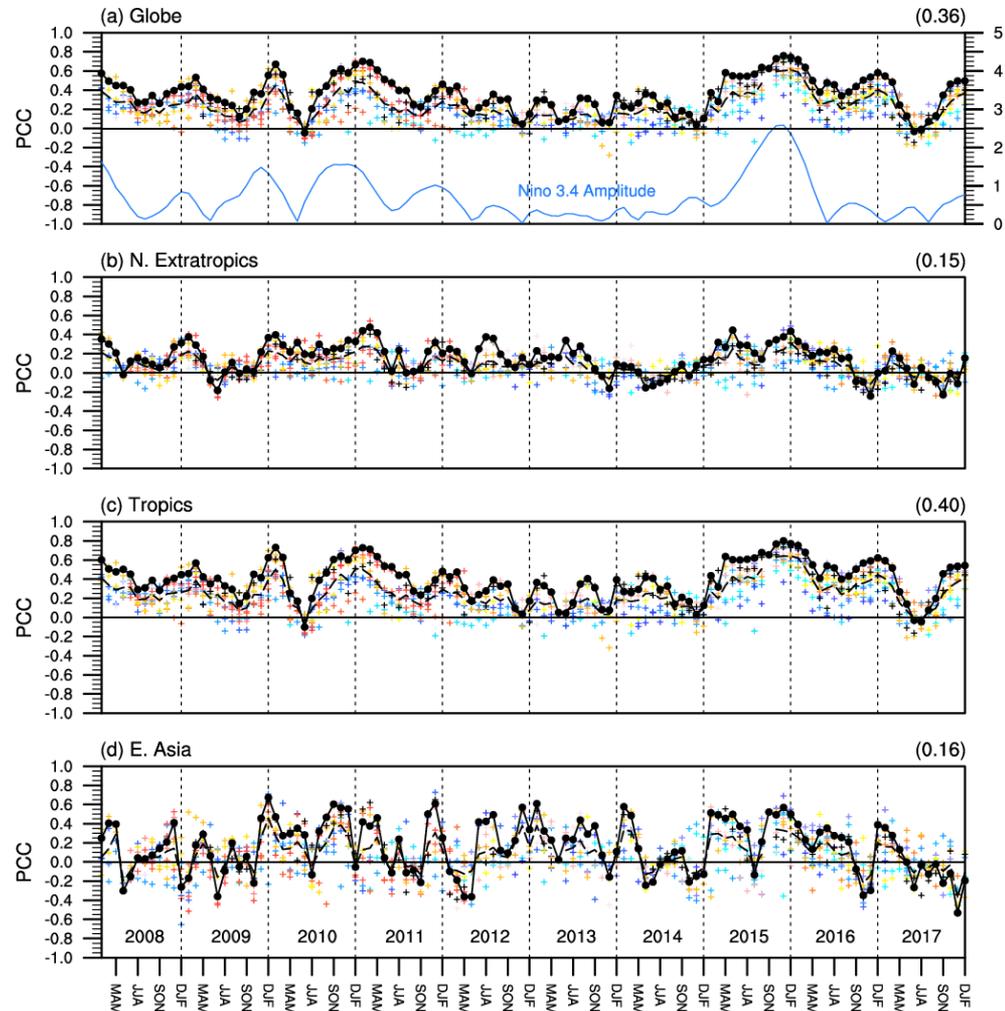
**(<http://www.apcc21.org>)**

# Performance of APCC MME

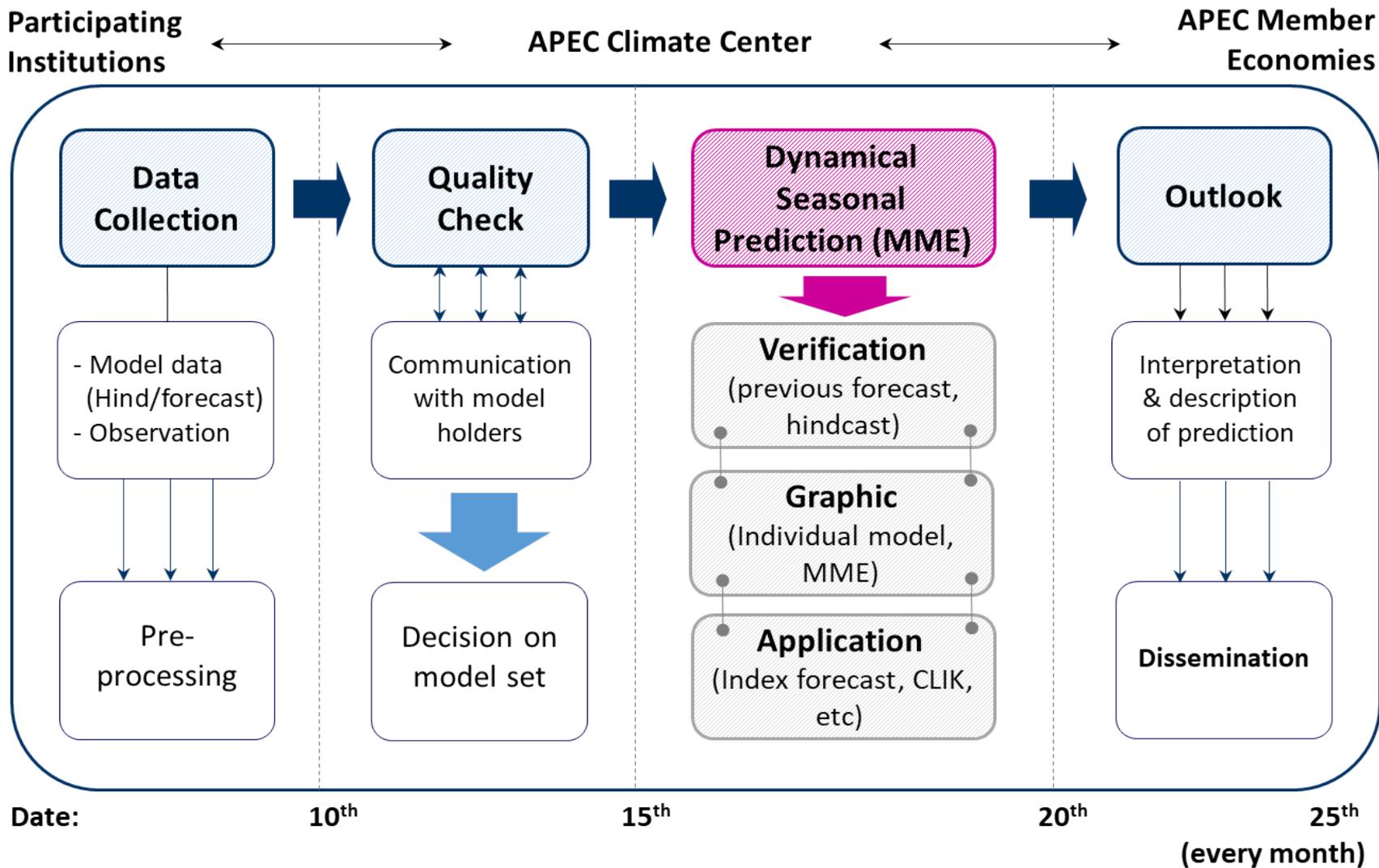
## Time Series: Nino 3.4 Index



## RT Forecast Skill: PREC, ACC

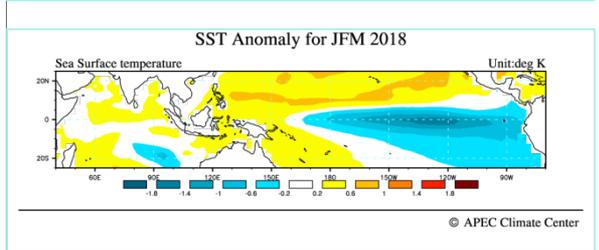
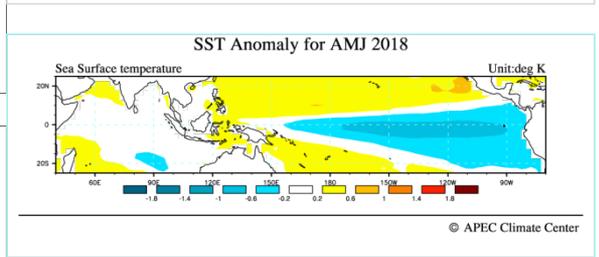
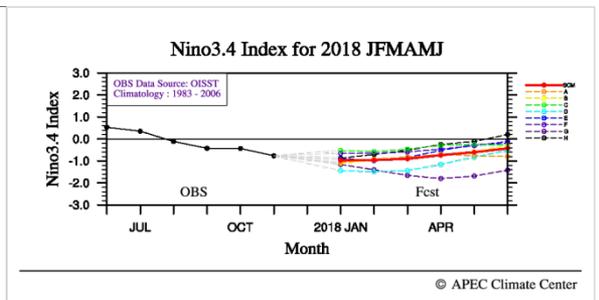
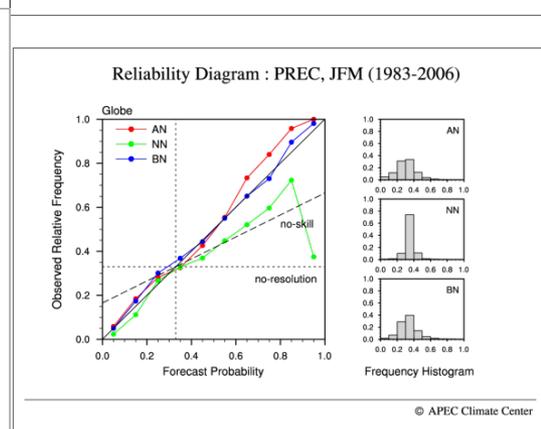
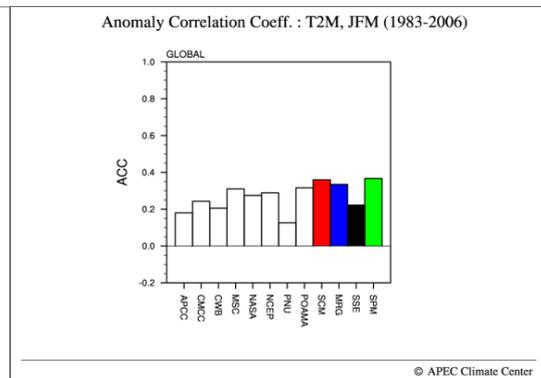
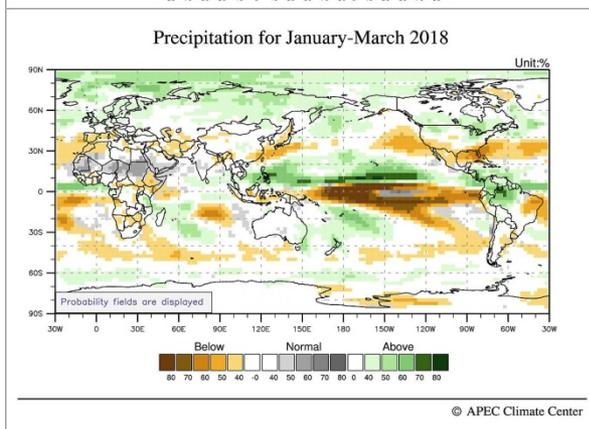
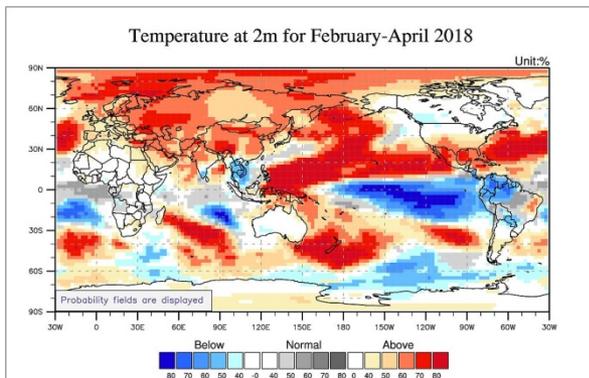


# Operation Schedule



# Seasonal Forecast Products

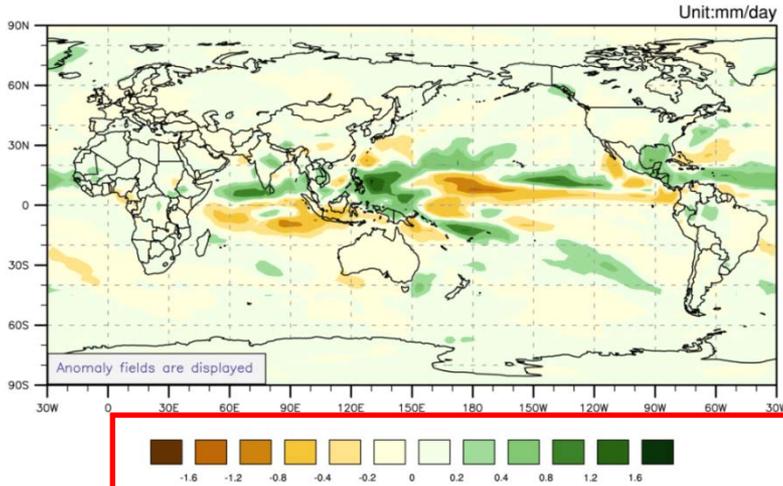
- Monthly & Seasonal mean forecast of Tsfc, Prec, T850, Z500, SLP, SST, UV (deterministic & probabilistic)
- Verification results (hindcast, realtime forecast)
- ENSO Outlook



# Seasonal forecast: Multi-model ensemble

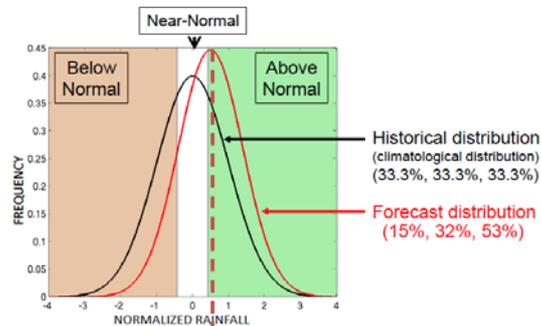
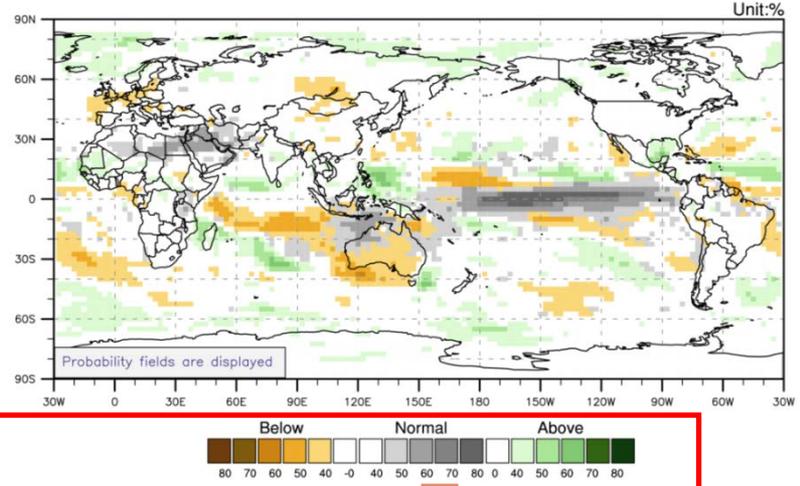
Deterministic

Precipitation for August-October 2017



Probabilistic

Precipitation for August-October 2017



Map showing probability of rainfall falling in one of three categories (with respect to climatology) : BN vs NN vs AN