

Introduction to CLIK (**C**limate **I**nformation Tool**K**it)

<http://clik.apcc21.org>

Yun-Young Lee

Climate/weather related disasters

5. Jan. 13 — Flooding in the capital



Flood

Indonesia landslide: 20 dead and dozens still missing

14 December 2014 | Asia

Landslide

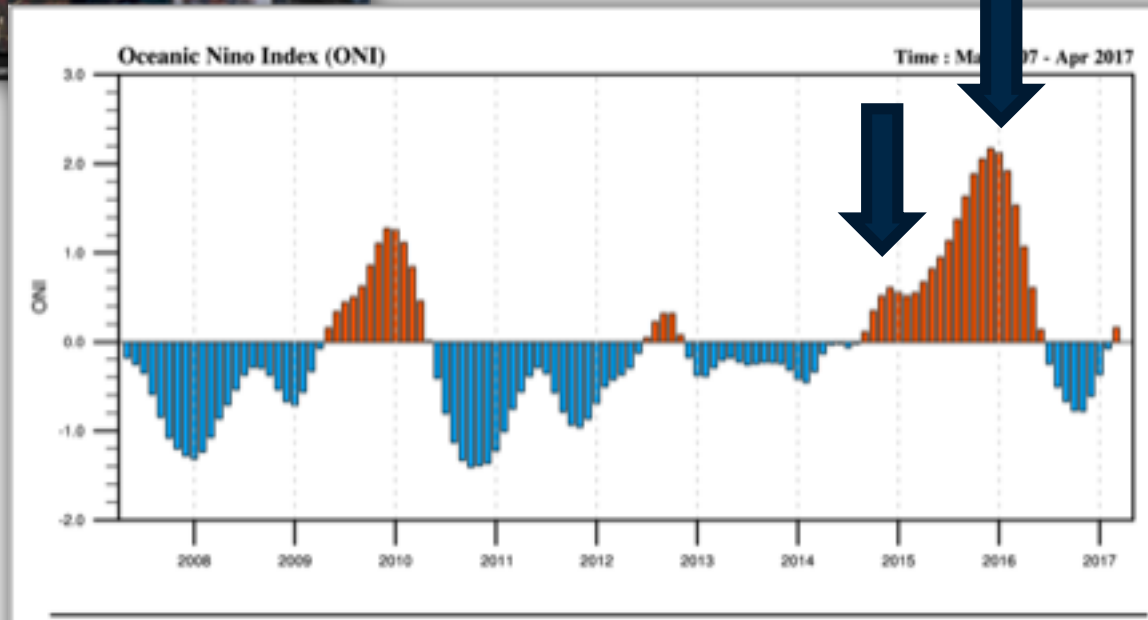
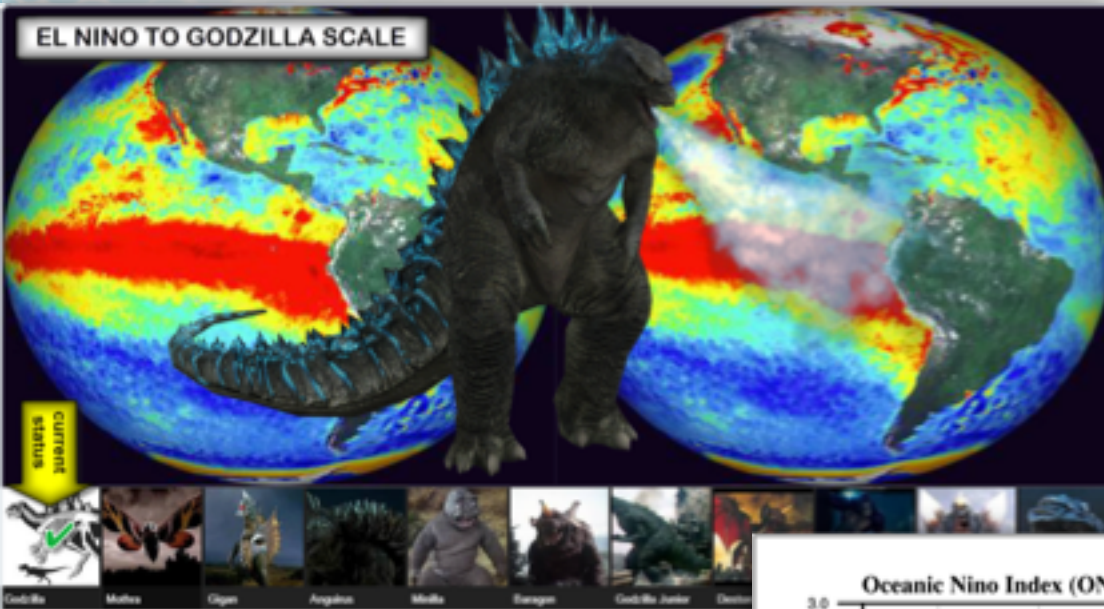


Strong wind



Rescuers, including local residents, are still hoping to find survivors

2015/16 prolonged (Godzilla) El Nino



2015 Drought in Thailand :during prolonged El Nino

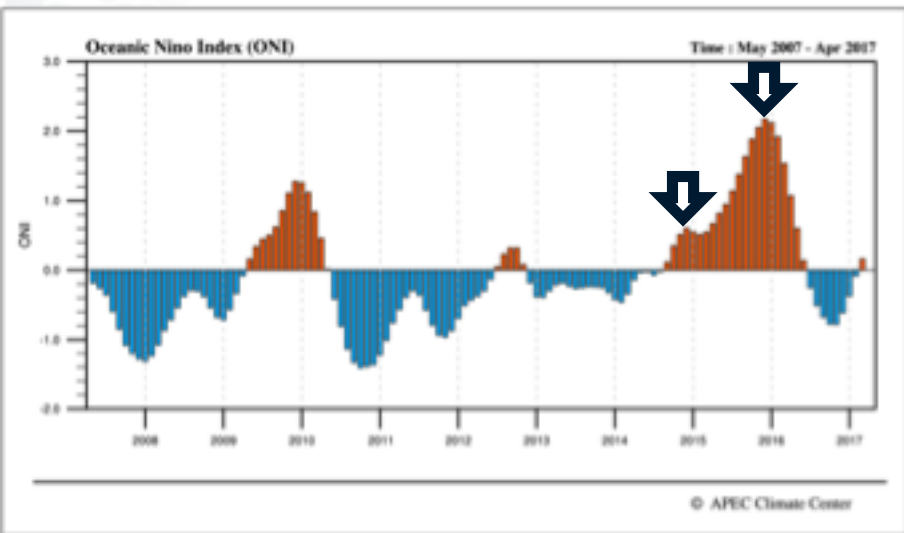
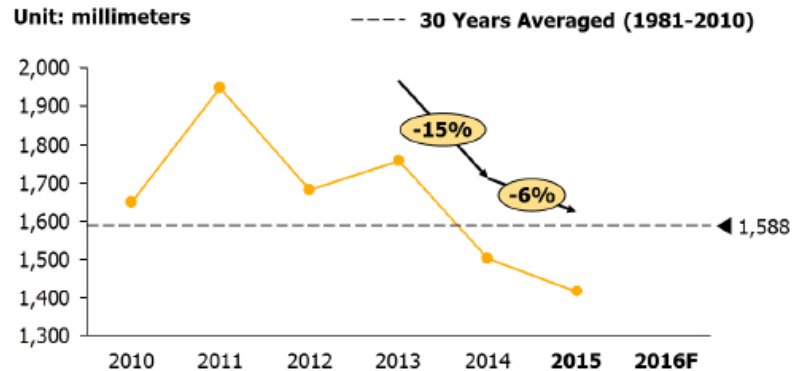
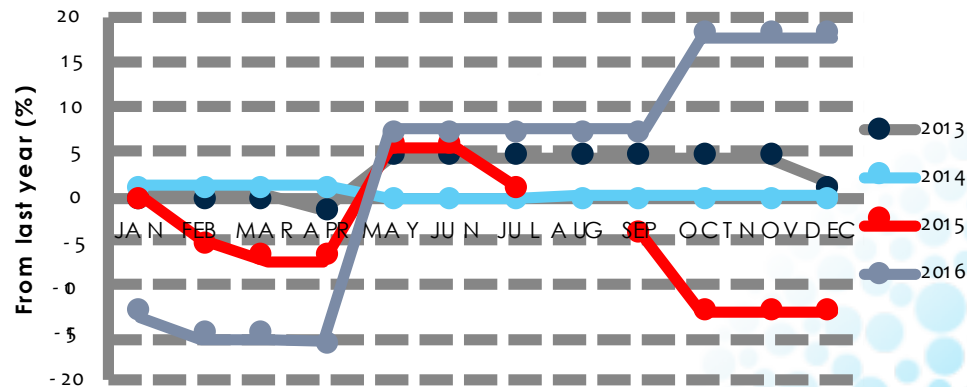


Figure 1: Cumulated rainfall in Thailand between 2010 and 2015



Source: EIC analysis based on data from Water Watch and Monitoring System, Royal Irrigation Department.

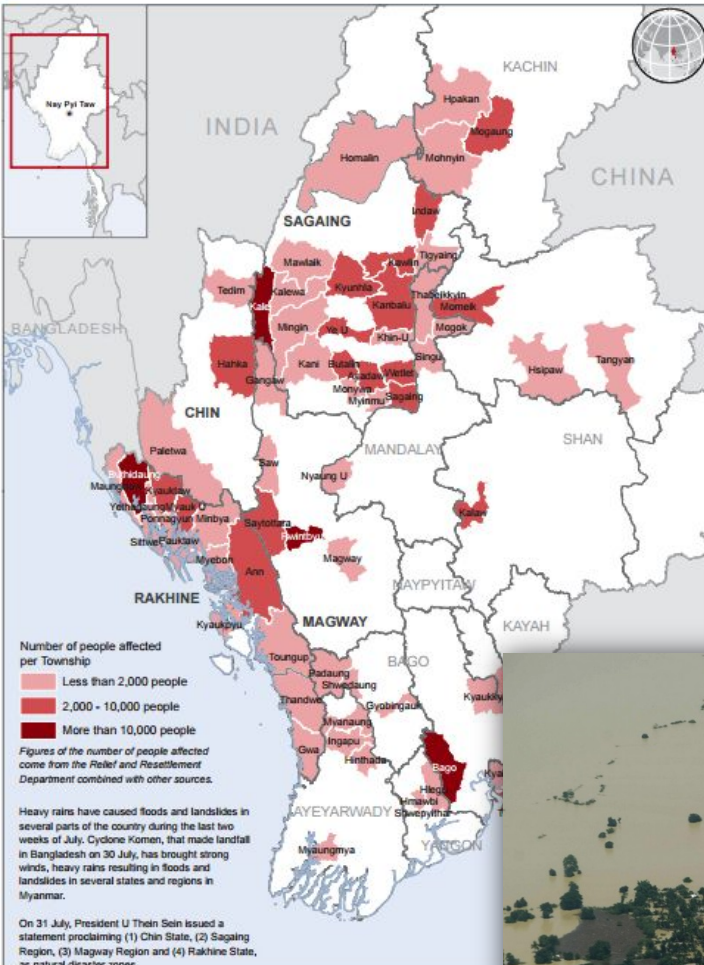
Rice: Change in production



Source: USDA World Agricultural Production

2015 Myanmar Flood :the worst for decades

MYANMAR: Flood Affected Areas (3 Aug 2015)



Beginning on 16 July 2015, **unusually heavy monsoon** rain fell on Myanmar, causing rivers and creeks to overflow with rainwater and flooding low-lying areas around waterways. In addition to the higher-than-average rainfall, ... **deforestation caused by logging** ~ **Cyclone Komen**, which struck in late July, also made the situation worse.

https://en.wikipedia.org/wiki/2015_Myanmar_floods



2015/16 Drought in Southeast Asia

Cambodia faces severe and prolonged drought

POSTED ON: March 23, 2016 | CAMBODIA - CURRENT AFFAIRS - FEATURED | By: Daniel Besant

Experts say that this year's drought will be worse than in 2015, with soaring temperatures and a delayed monsoon season likely

Cambodia is officially in a drought, and the conditions could last longer and be more severe than last year, when monsoon rains did not fall until July.



On the banks of the Mekong River in Cambodia's Kandal Province. Photo: EPA/Mak Remissa

"Based on our monitoring, drought has been declared in Cambodia," said the Mekong River Commission's Secretary General. "The current drought is likely to be getting worse in coming months."

Last year, according to the MRC, the monsoon season was delayed until July. A similar delay is expected this year.

Schools face water shortages and government says entire nation is affected as rainy season is forecast to be delayed by months



7 photos: Children are among hardest hit by El Nino-related drought in Cambodia

2015/16 Drought in Southeast Asia

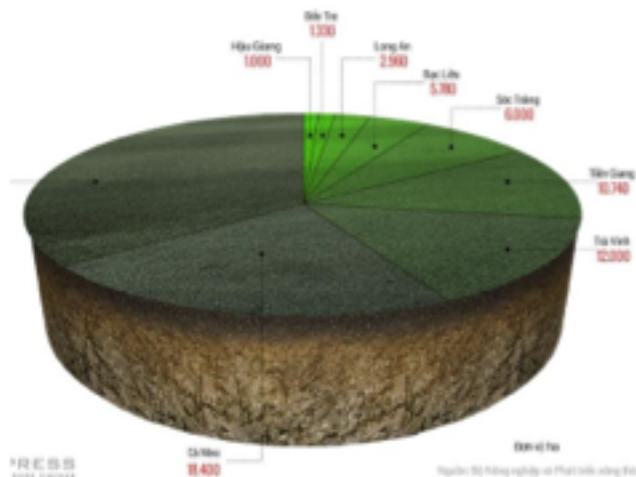
Vietnam Consolidated Report on Drought and Saltwater Intrusion

Reporting period: Oct 2015 - Mar 2016

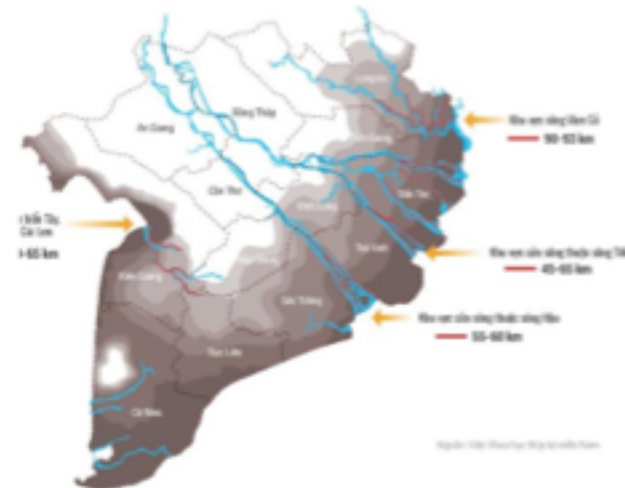


Preliminary damage caused by drought and saltwater intrusion as of 9 Mar 2016 are as follows:

Paddy Rice damaged (ha)	No. of people lacking water for daily consumption	Provinces in state of emergencies	Total affected provinces	Estimated cost for short and medium response (mil. USD)
159,000	976,000	10/39	39/63	67



Rice production lost/affected due to drought and salinity in the Mekong Delta



Saltwater intrusion mapping in Mekong Delta (as of end Feb 2016)

Mekong River Crisis: Water Conflicts

China and the Mekong Delta: Water Savior or Water Tyrant?

Don't be fooled by reports about China discharging water to alleviate drought along the Mekong.

By Margaret Zhou

March 23, 2016



1.0k Shares

The Mekong Delta is facing its worst drought in recent history, causing food and water shortages for over half a million people. The Chinese government headlines amidst the disaster for its release of water from upstream dams within a briefing that China "hopes it can b



Image Credit: [Hau Giang, Vietnam](#) Image via [Thoai / Shutterstock.com](#)

Government welcomes drought relief measures by China

17 Mar 2016, [The Cambodia Daily](#)

Government officials on Wednesday applauded China's decision to take emergency measures to counter the impact of a regional drought by releasing water into the Mekong River from the Jinghong Hydropower Station in China's southwestern Yunnan province. ...

Khy Sovuthy

<https://www.cambodiadaily.com/news/government-welcomes-drought-relief-measures-by-china-110018/>

Categories: [Disasters and disaster management](#), [Drought](#), [Environmental & Natural Resources Management](#)

Tag: [Jinghong Hydropower Station](#)

Indonesia wildfire :97/98, 2013, 2015 dry season

The Asian Forest Fires of 1997-1998

From October through November 1997, forest fires in Indonesia made front-page news around the world. The fires spread from the north, Sri Lanka to the west, Southeast Asian "tiger" economies, miles of rainforest, plantations, Sumatra, Sulawesi, Irian Jaya, Malaysia. Though official government figures (750,000 ha), environmental group WAHLI (the Indonesian Wildlife and Nature Conservation) (1,714,000 ha) went up in smoke, 12.4 million acres (4.9 million ha) alone in 1998 range from 445,000 ha). Regardless of the extent of health problems and economic



https://www.google.co.kr/search?q=indonesia+wildfire+1997&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi9oOGUhqrcAhUJFogKHTaBeEQ_AUCigB&biw=1745&bih=861#imgrc=ELAMGJFKU97fPM:



https://www.google.co.kr/search?q=indonesia+wildfire+1997&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi9oOGUhqrcAhUJFogKHTaBeEQ_AUCigB&biw=1745&bih=861#imgrc=2OnzANCTqgpQcM:



https://en.wikipedia.org/wiki/1997_Indonesian_forest_fires

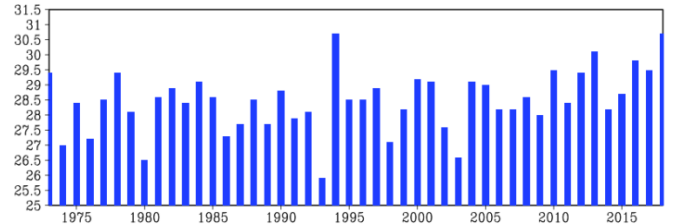
<https://rainforests.mongabay.com/>

2018 Korea Heat Wave

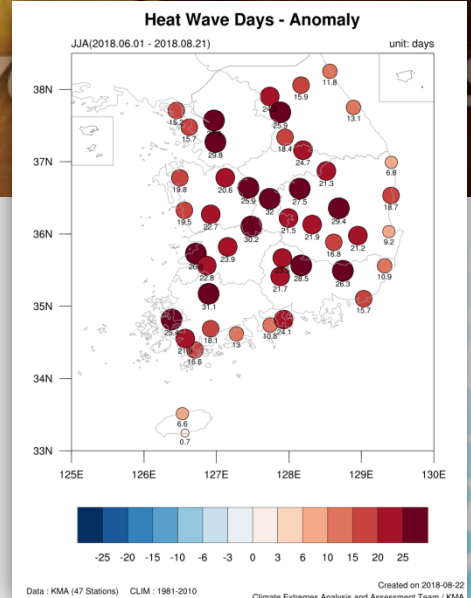
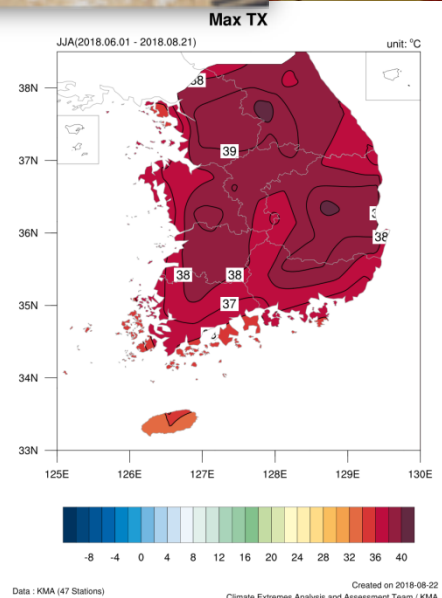


2018 Heat Wave related-	
Morbidity	4301
Fatality	48

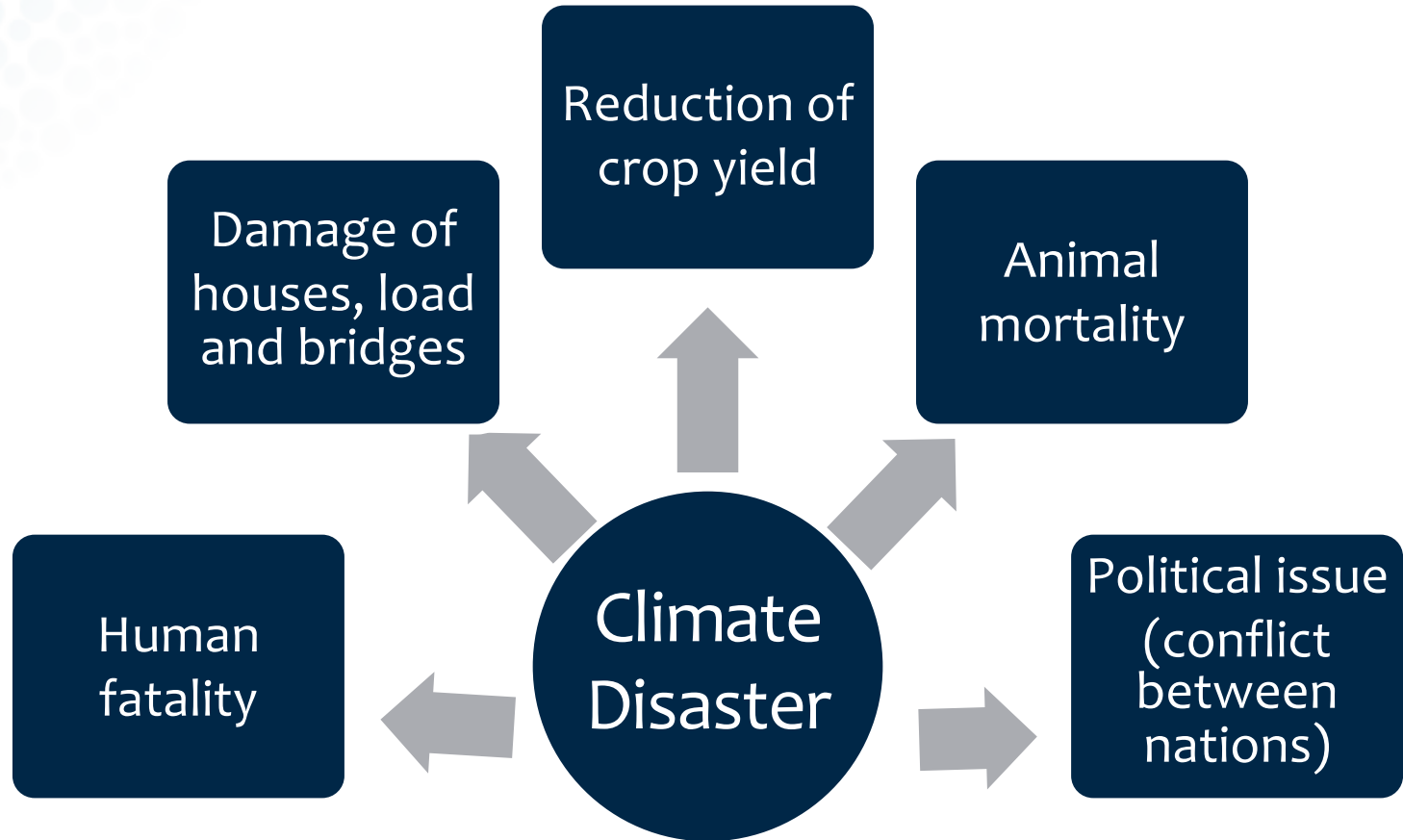
Korea (45stn)
Maximum Temperature
(01Jun2018 ~ 21Aug2018)



year	2018	30.7 (rank=1)	normal(81-10)	28.4	
rank(01)	2018	30.7	rank(24)	1988	28.5
rank(02)	1994	30.7	rank(25)	1977	28.5



Importance of “Accurate” prediction



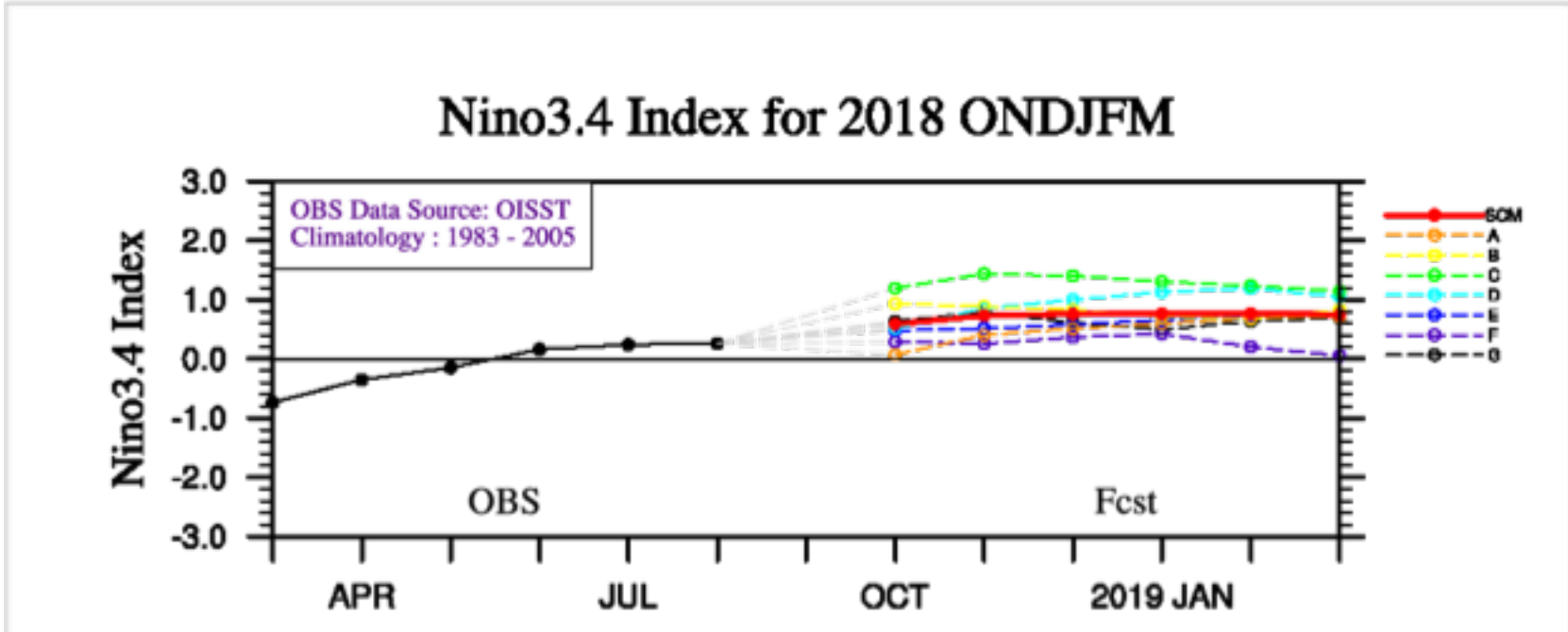
ACCURATE climate prediction optimized to our region (village) will make early warning possible and reduce economic and human losses.

18/19 ENSO Outlook

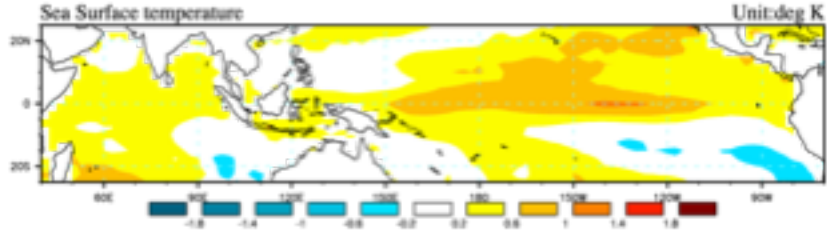
By APCC

Weak El Niño (CP-type)

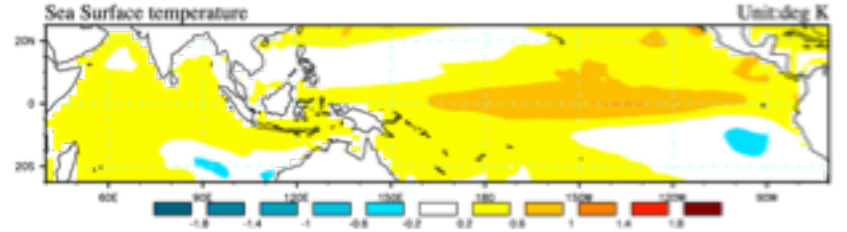
Nino3.4 of SCM slightly exceeds 0.8 from October - March.



SST Anomaly for OND 2018



SST Anomaly for JFM 2019



18/19 ENSO Outlook

By NOAA (USAPI)

El Niño WATCH

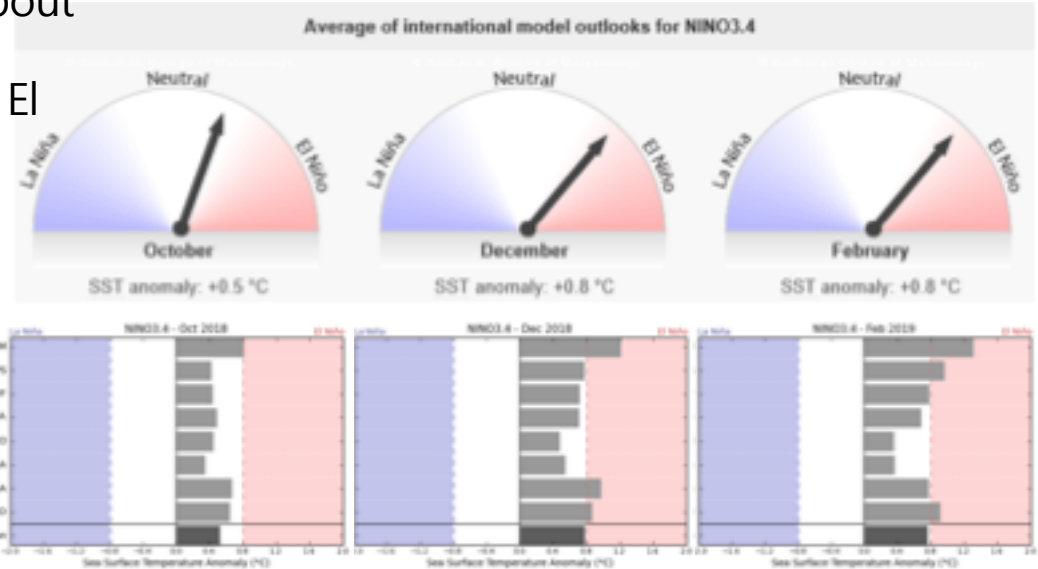
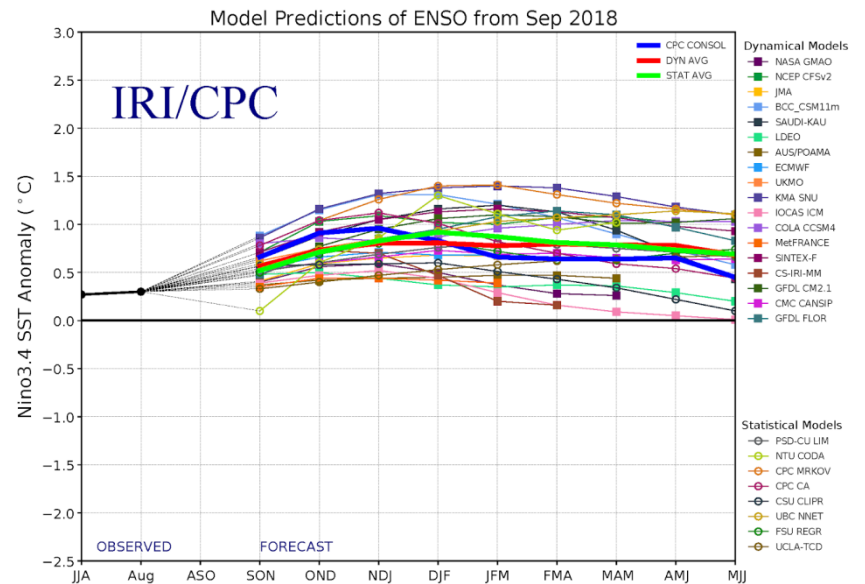
Official consensus probabilities now strongly favor El Niño from November - March.

Probabilities for El Niño peak from NDJ - MAM (>70%) with about a 65% chance prior (SON).

By BOM

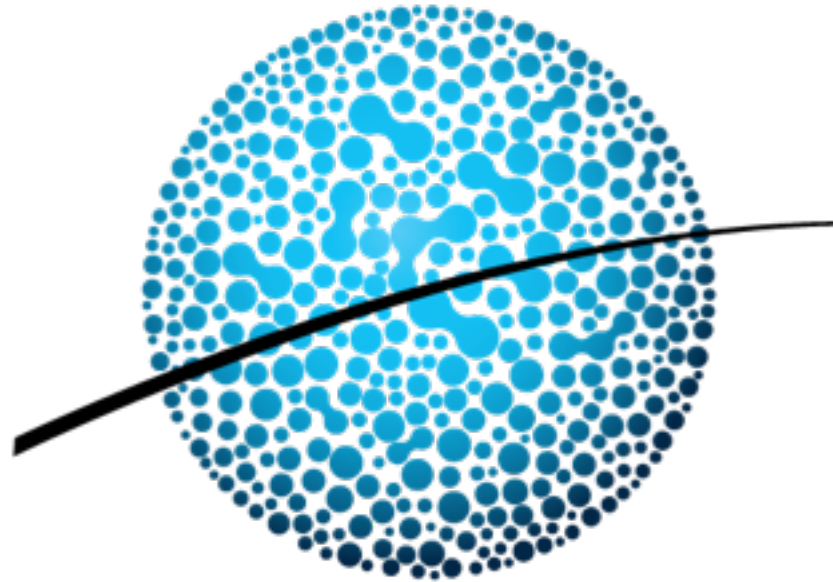
El Niño WATCH: approximately a 50% chance of El Niño developing in 2018 (about twice the normal likelihood)

History: for half of El Niño WATCH years, El Niño has developed!



High-end climate information service center

: operating MME climate prediction system utilizing state-of-the-art GCMs



APCC
APEC CLIMATE CENTER

APCC mission

The mission of APCC is to enhance **the socio-economic well-being of member economies** by utilizing ***up-to-date scientific knowledge*** and applying ***innovative climate prediction techniques*** through



Climate Prediction

APCC produces value-added, reliable, and real-time climate prediction information and provides the APEC region with it.



Interdisciplinary Research

APCC leads in the development of interdisciplinary research and application techniques at the climate-environment-society nexus.



Climate Information Services

APCC strives to be a key climate database center to distribute climate data, information products, and related tools.



International Cooperation

APCC guides developing countries from the APEC region toward building their own capacity to produce reliable climate prediction information.

CLIK

CLimate Information ToolKit

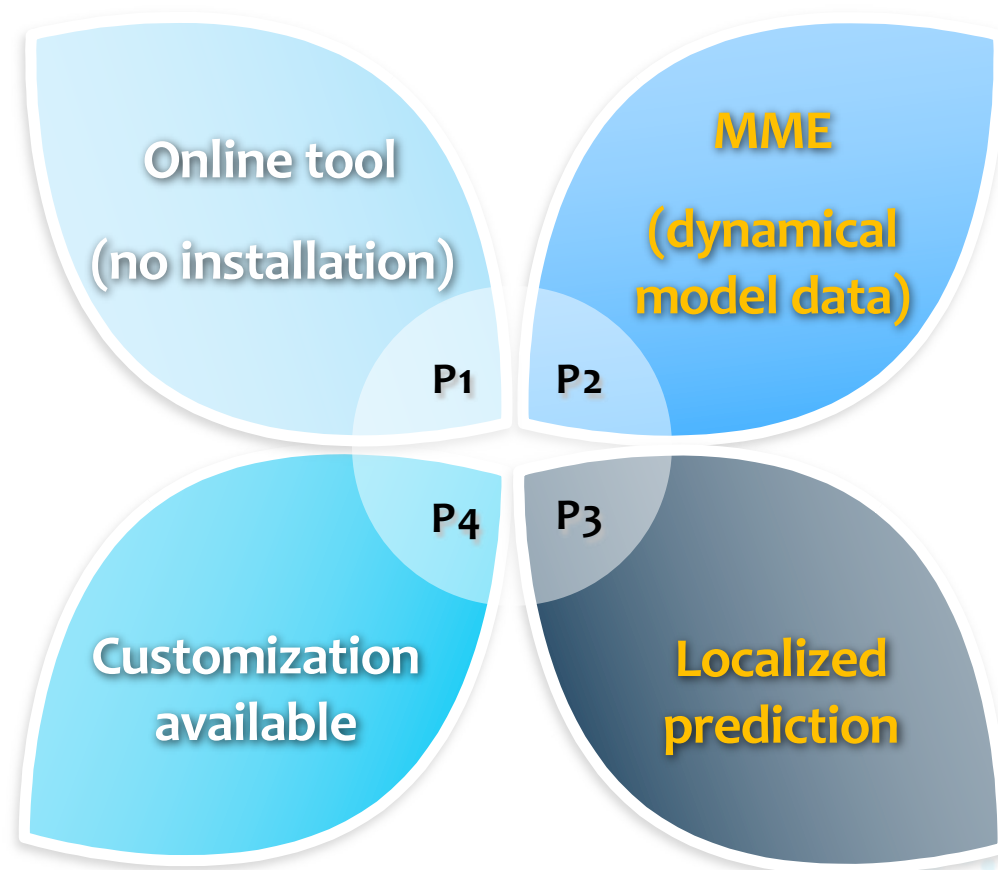
<http://clik.apcc21.org>



Climate Information Toolkit

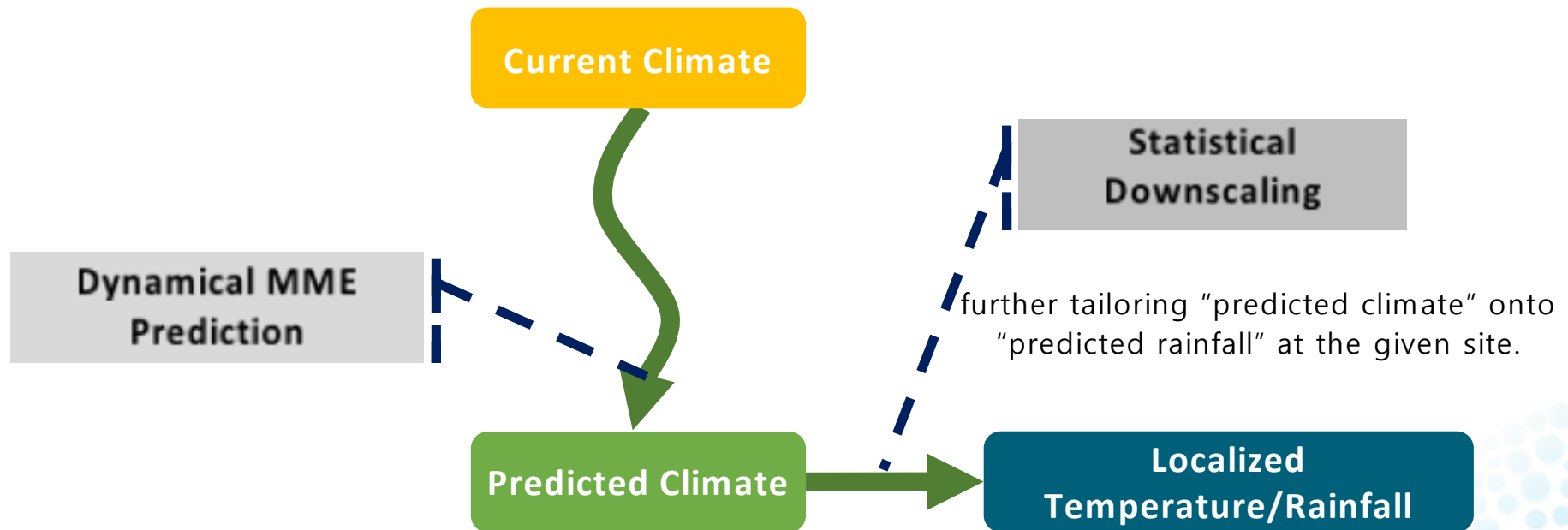
CLIK was developed and updated based on the analysis of potential users: their **status** and **needs**.

1. Limitation of manpower and computing resources
2. Desire for utilizing **dynamical forecast data**
3. Direct benefit on **regional community**
4. Thirsty for Capacity building: Interests in learning science and technology and high satisfaction when participating in the model developing process



➔ Target users are, but are **not limited to NMHS staffs** of developing countries having basic understanding of climate and meteorology.

Downscaling/tailoring of dynamical MME



- 1) Physical/dynamical process
- 2) Model biases vs Observed dynamics

CLIK (CLimate Information ToolKit)

: online prediction tool

For those **who wants to play with model data,**

- ▶ To allow **user manipulation** of **multi-model ensemble prediction** in producing his/her own forecast

MME Prediction
with different model
combination

CLIK

Downscaling:
Simulated large scale
pattern to station
matching

- ▶ To provide **statistical downscaling** capability using **MME** prediction

Output: **3-months mean (seasonal)** forecast & verification score

➔ Facilitate the cooperation in the exchange of information and services so that users are able to **cope with climate related disasters**

Development

2008

- The CLimate Information ToolKit(CLIK) version 1.0 was developed.
 - Deterministic Multi-Model Ensemble (DMME) prediction

2009-2010

- CLIK version 2.0
 - Probabilistic Multi-Model Ensemble (PMME)
 - Statistical Downscaling

2011-2013

- Clustering Computation
Enhancing Internal Algorithm

2014

- CLIK v3.0 with New Web Framework (New CLIK)
 - Enhancement of User Interface & Performance
 - Database optimization, Lightweight Map, etc.

2015-2018

- Improvement of User Interface & Functions
 - New PMME Verification Metric (HSS)
 - Downscaling Dataset Management
 - Downscaling Correlation Map

The logo for CLIK, consisting of the letters 'CLIK' in a bold, white, sans-serif font, positioned on a dark blue circular background. The logo is part of a larger graphic on the left side of the slide, which features a series of grey lines radiating from a central point, each ending in a blue circle of varying size and opacity, creating a fan-like or network-like structure.

With **only a computer and an internet connection**

For those **who wants to play with model data,**

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Why MME?

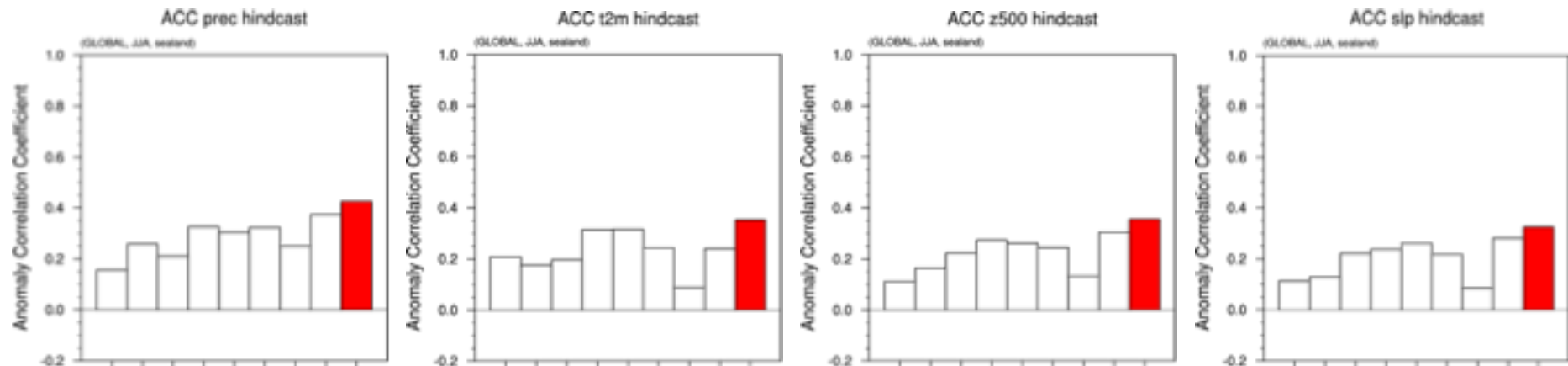
- Climate predictions have huge *uncertainty!*

NO perfect GCM

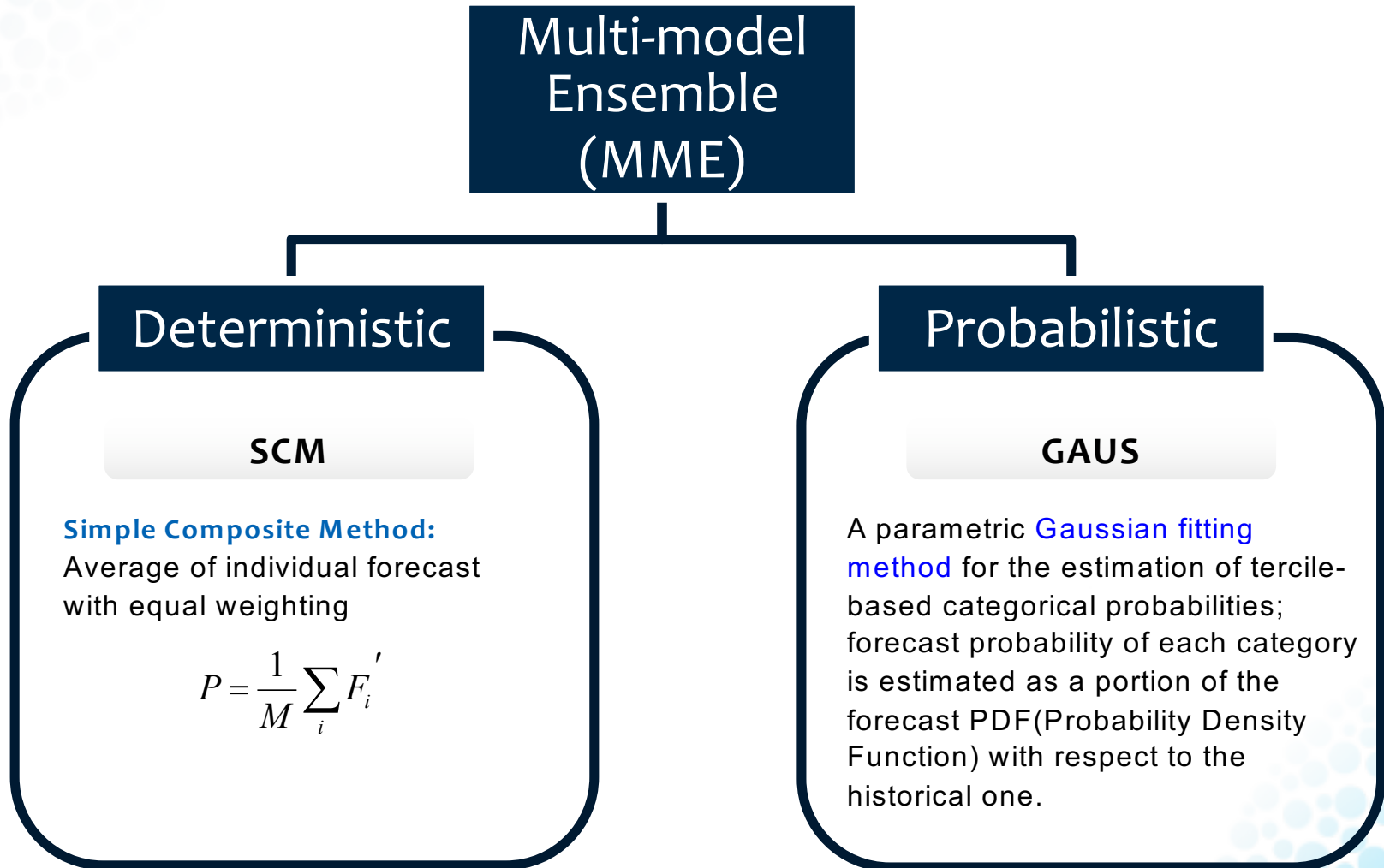
NOT the same with NATURE

➔ multi-institutional multi-model ensemble approach to **minimize the uncertainty**

➔ multi-model ensemble (MME) approach yields **superior forecasts** compared to any single model.



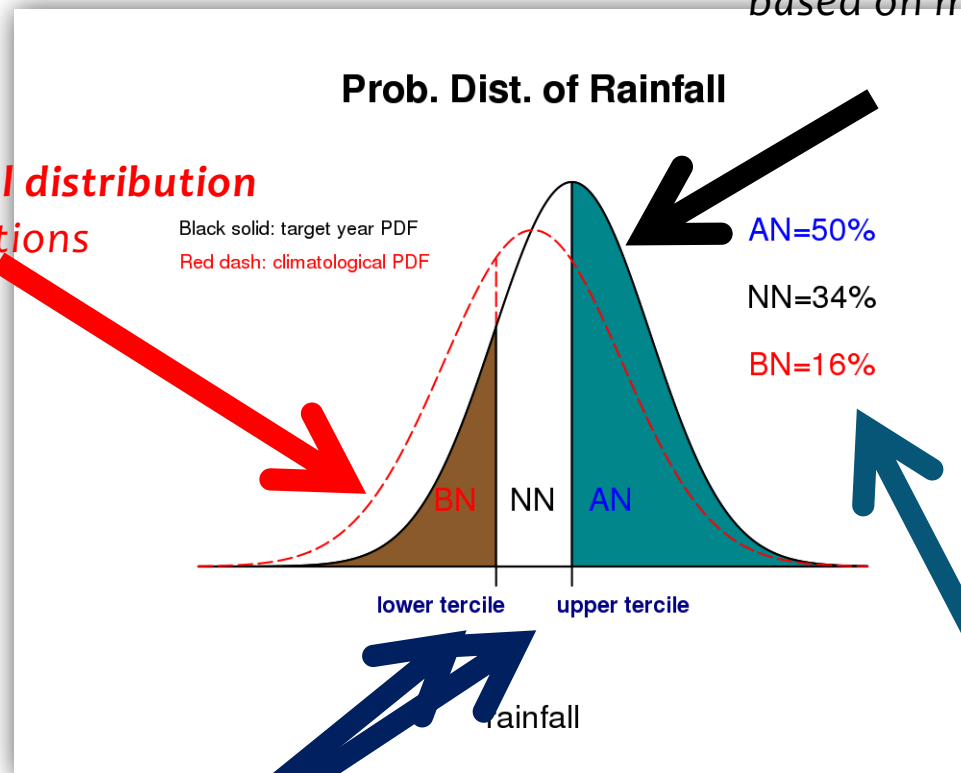
MME methodology



Tercile Probabilistic Forecast

Target year/season distribution based on model ensembles

Climatological distribution from observations



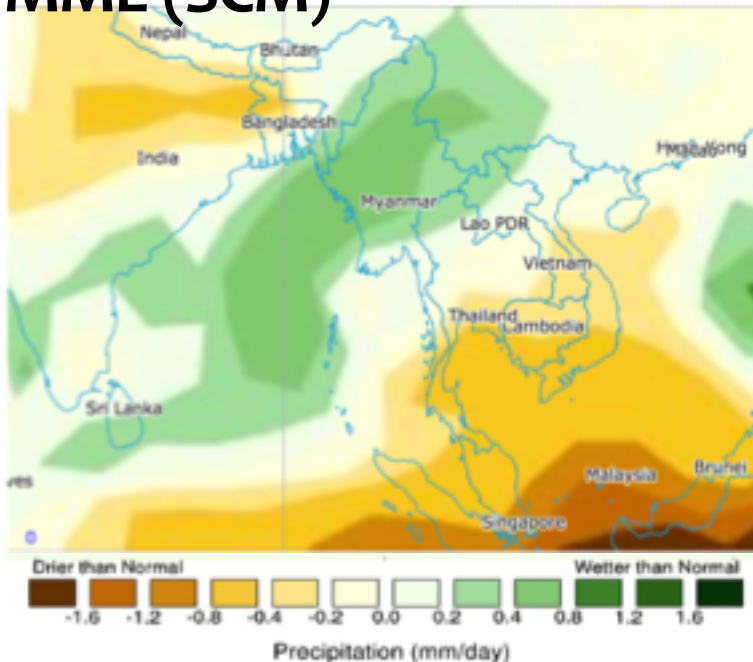
LT & UT
(thresholds to separate area under curve into 1/3)

Probability of AN/NN/BN condition = percentile of brown/white/green area under curve

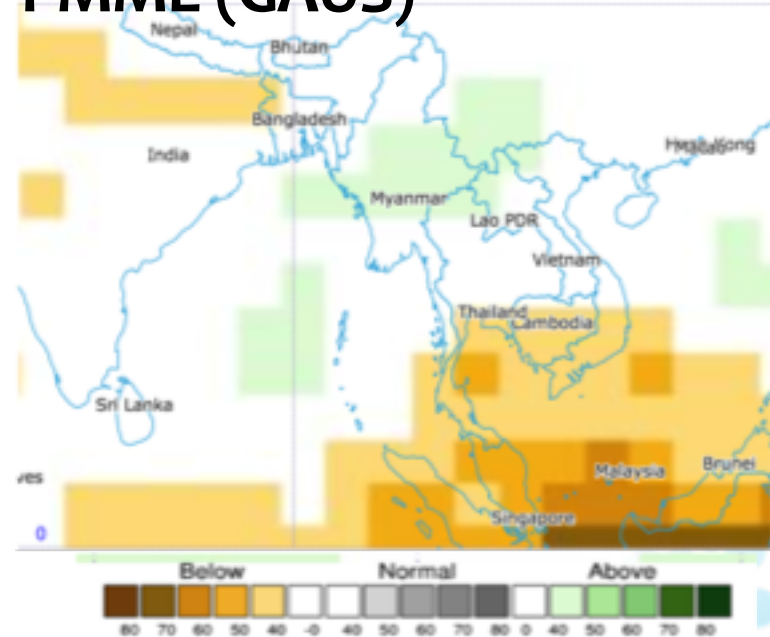
PREDICTION_product

Lead Month <input checked="" type="radio"/> 3Month	When Year: 2015 Search: JAS
Variables <input checked="" type="radio"/> PREC <input type="radio"/> TB50	Model <input checked="" type="checkbox"/> ALL <input checked="" type="checkbox"/> APCC <input checked="" type="checkbox"/> BCC <input checked="" type="checkbox"/> CMCC <input checked="" type="checkbox"/> COLA <input checked="" type="checkbox"/> CWB <input checked="" type="checkbox"/> HMC <input checked="" type="checkbox"/> IRI_CA <input checked="" type="checkbox"/> MGO <input checked="" type="checkbox"/> MSC_CANCM3 <input checked="" type="checkbox"/> MSC_CANCM4 <input checked="" type="checkbox"/> NASA <input checked="" type="checkbox"/> NCEP <input checked="" type="checkbox"/> PNI <input checked="" type="checkbox"/> POAMA

DMME (SCM)



PMME (GAUS)



PREDICTION_verification_score

Success Rate

the fraction or percentage of success among a number of attempts.

CLIK provides a simple success rate as DMME verification score.

F \ O	AN	NN	BN
AN	1	4	9
NN	2	3	4
BN	2	6	3

$$= 7/34 \sim 0.20$$

~0.33 : Poor skill region

0.33~0.66 : Reasonable skill region

0.66~ : High skill region

Heidke Skill Score (HSS)

Commonly used Skill Score for the verification of **categorical** probabilistic forecast

Measuring the fractional improvement of the forecast over random forecast

F \ O	Yes	No
Yes	Hit (H)	False Alarm (F)
No	Miss (M)	Correct Rejection (C)

$$HSS = (\text{score} - \text{score by chance})$$

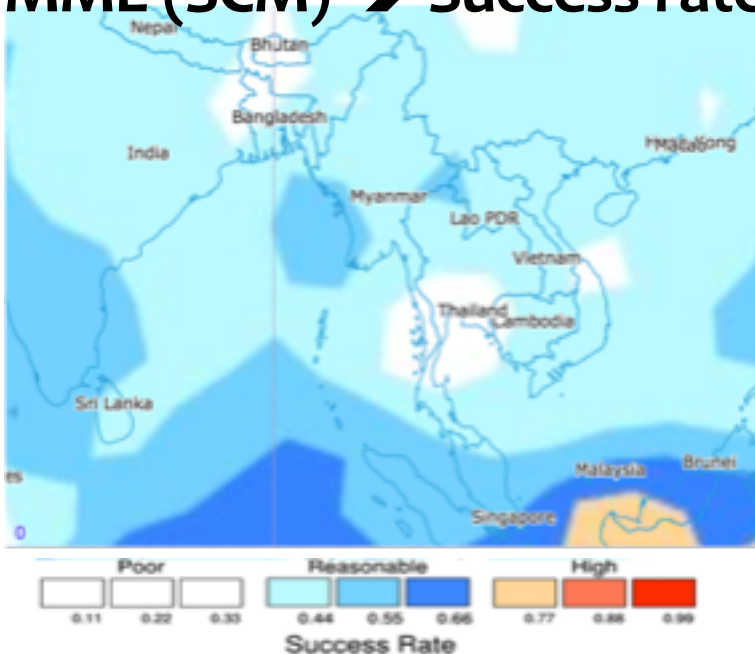
$$/(\text{perfect score} - \text{score by chance})$$

$$\frac{\{(h+c)/n - [(h+f)(h+m) + (f+c)(m+c)]/n^2\}}{\{1 - [(h+f)(h+m) + (f+c)(m+c)]/n^2\}}$$

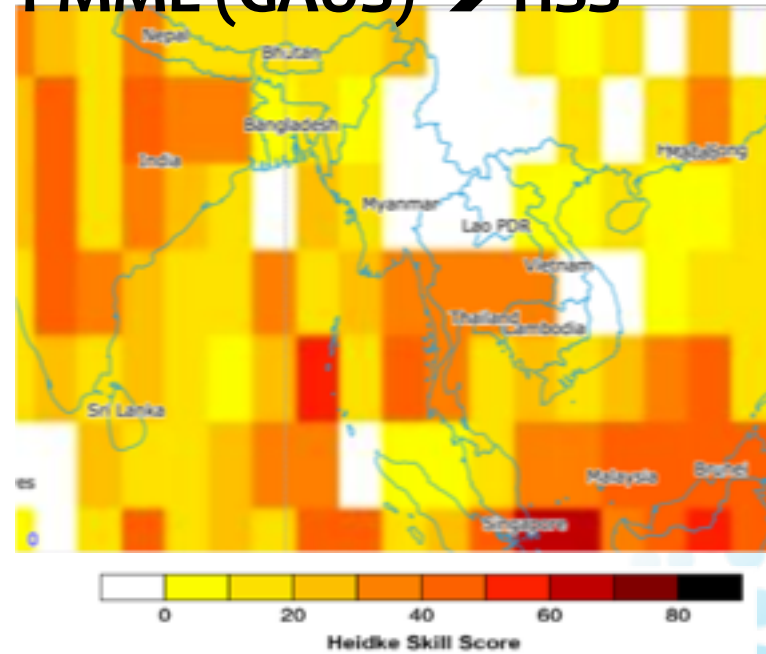
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DMME (SCM) → Success rate

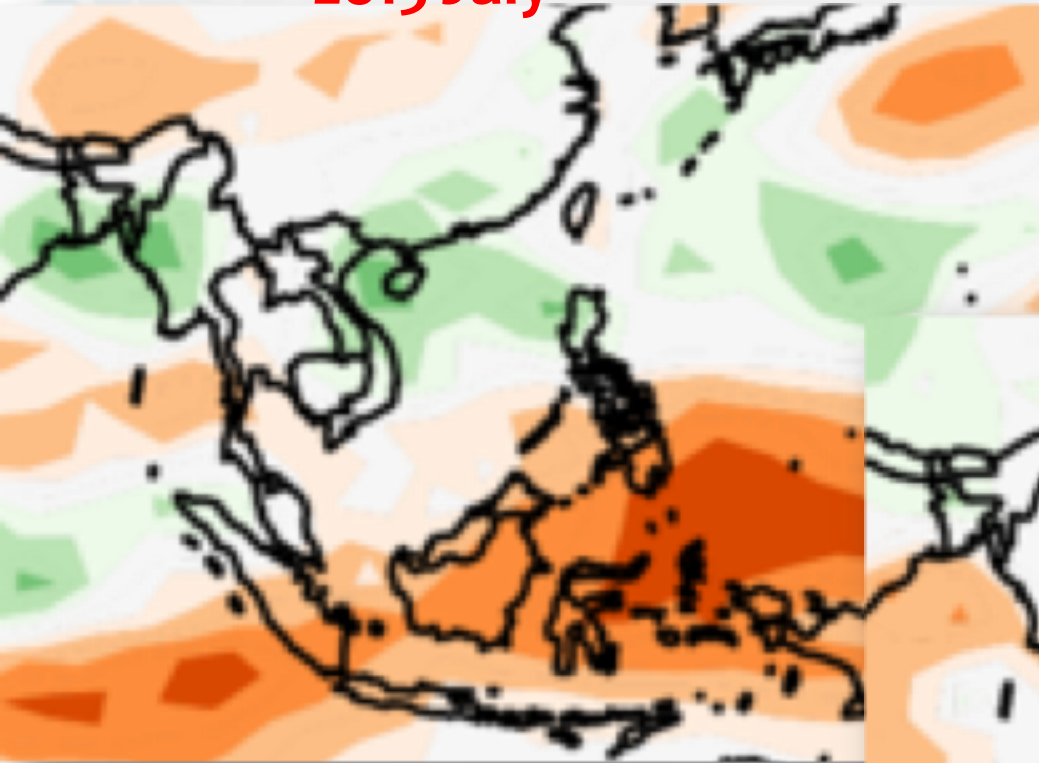


PMME (GAUS) → HSS

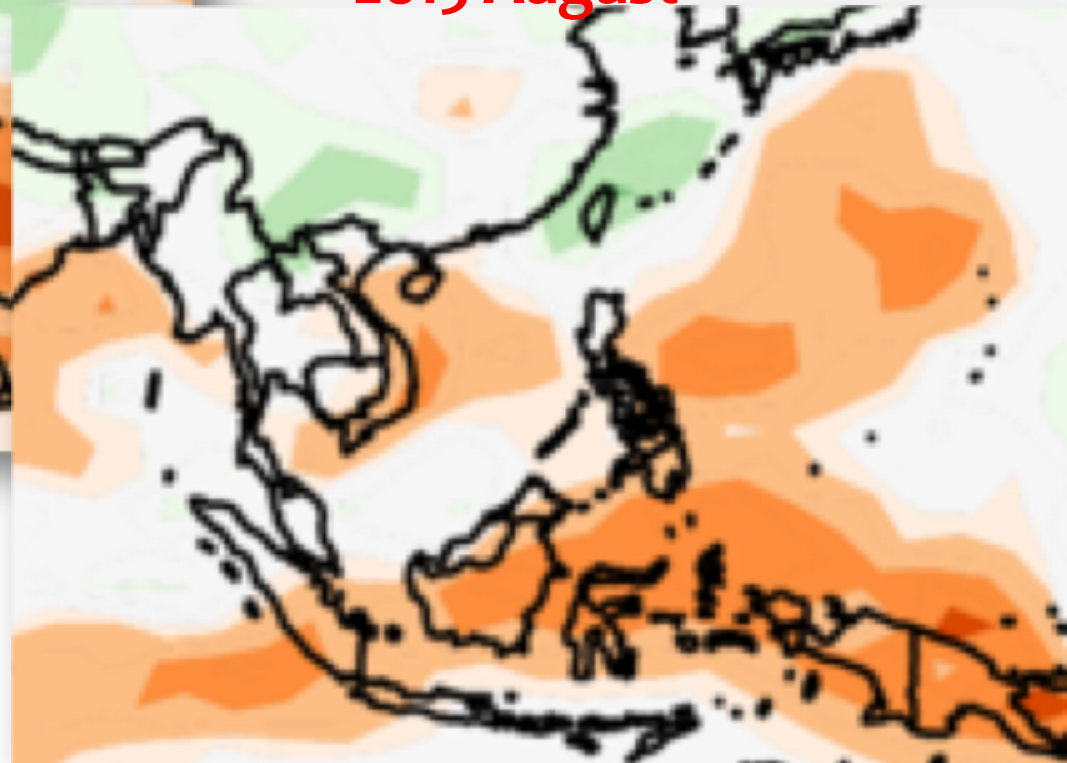


2015 JA Flood

2015 July



2015 August



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CLIK

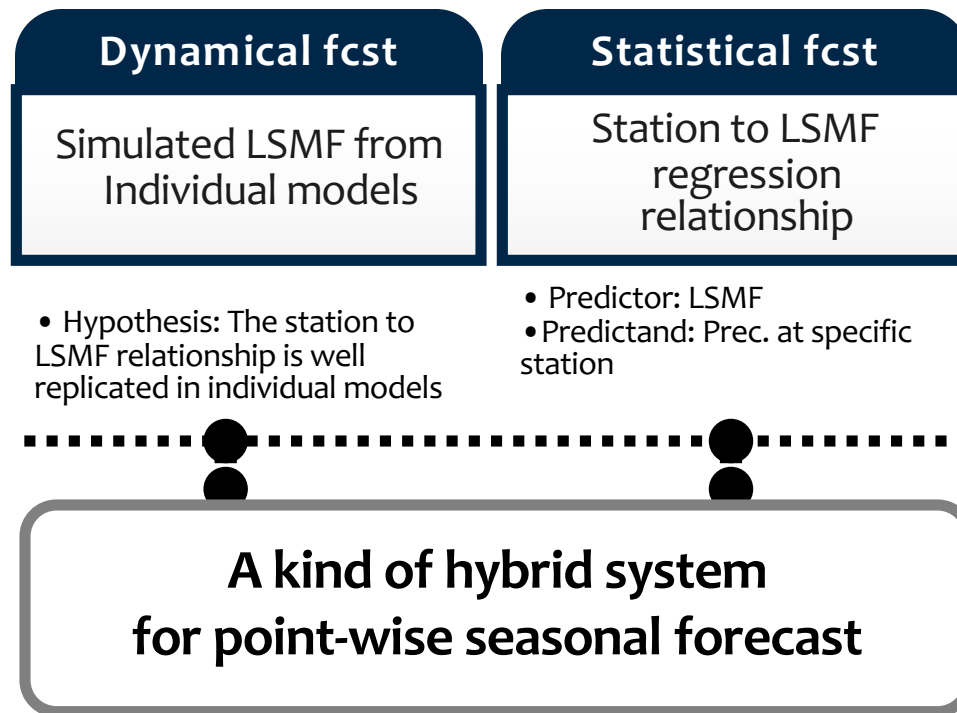
Downscaling:
Simulated large scale
pattern to station
matching

- ▶ To provide **statistical downscaling** capability using **MME** prediction

CLIK downscaling

➤ A way to localize existing coarse climate information

CLIK downscaling is mainly based on station to Large Scale Meteorological Field (LSMF) relationship. ($Y = a * X + b$) By utilizing the simulated LSMF (X, predictor), CLIK estimates seasonal mean precipitation/temperature (Y, predictand) at specific station.



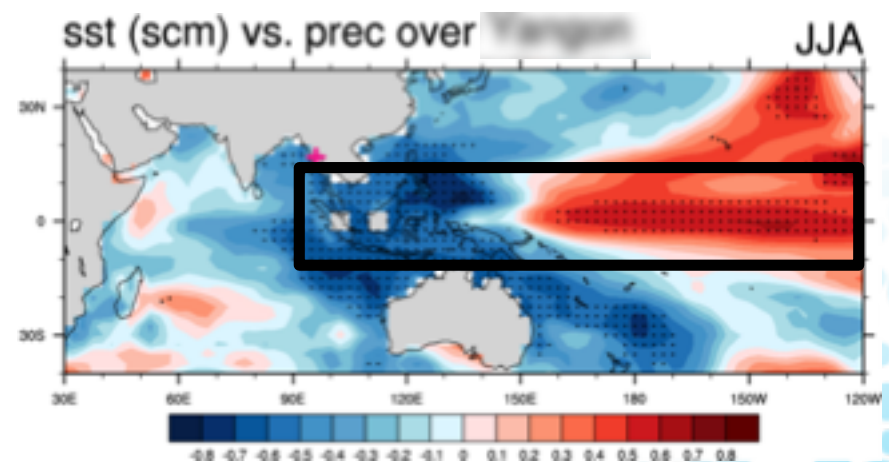
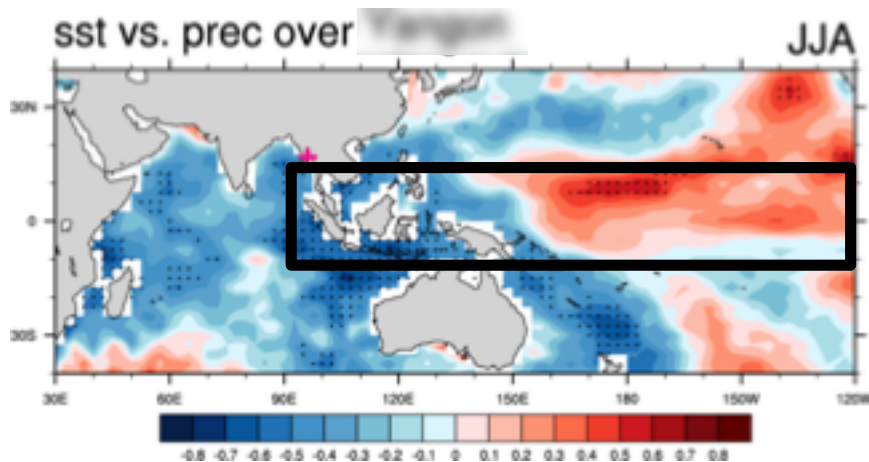
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Empirical relationship: LSMP (OBS) ~ local station rainfall

LSMP (MME) → Local station rainfall



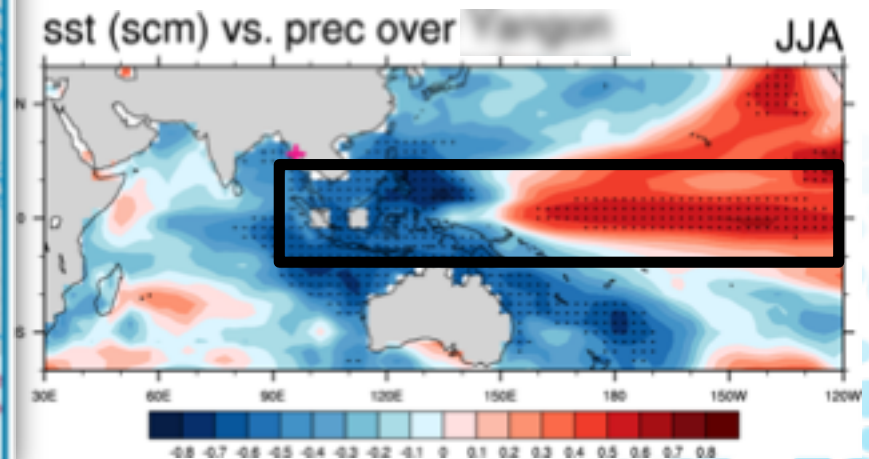
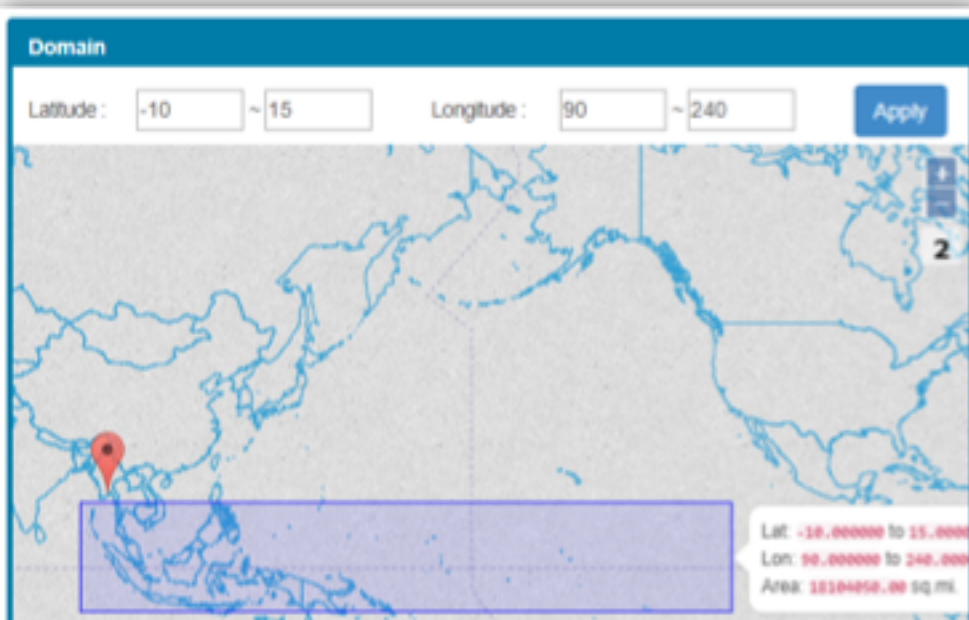
CLIK downscaling

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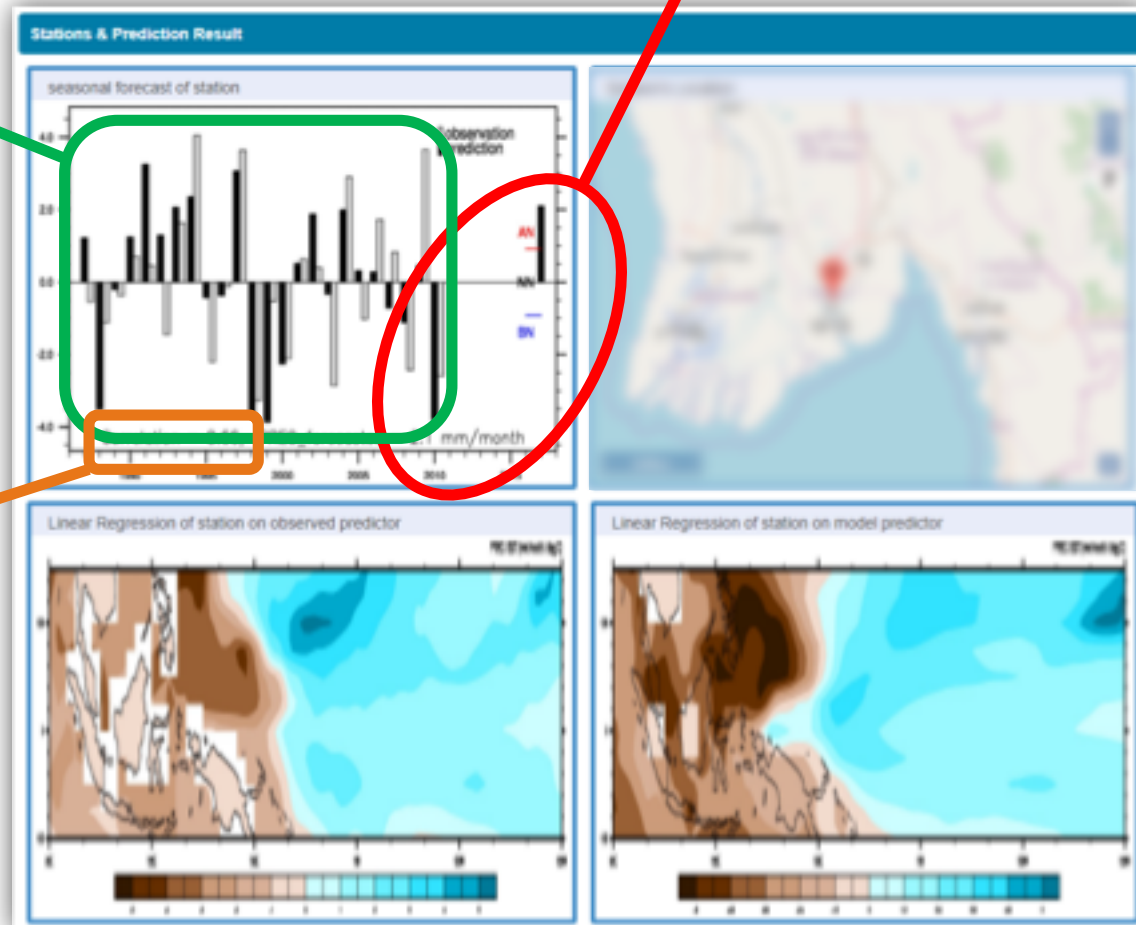
LSMP (MME) → Local station rainfall



Downscaled forecast at a given site

Deterministic forecast with tercile range for target year/season

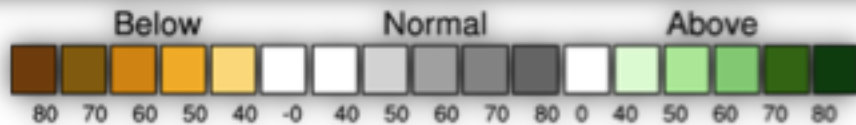
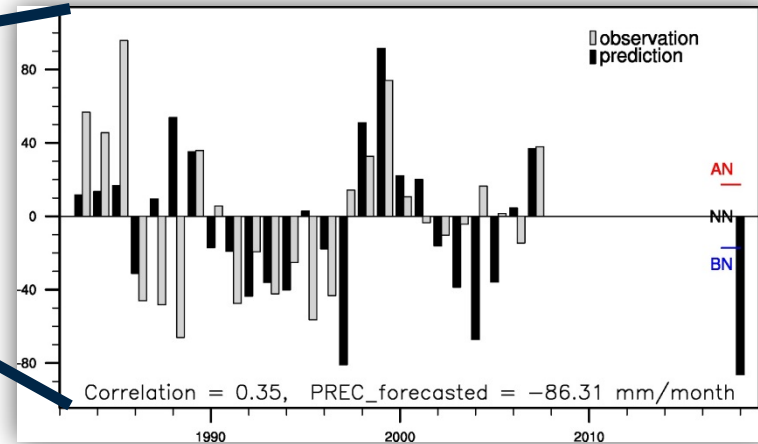
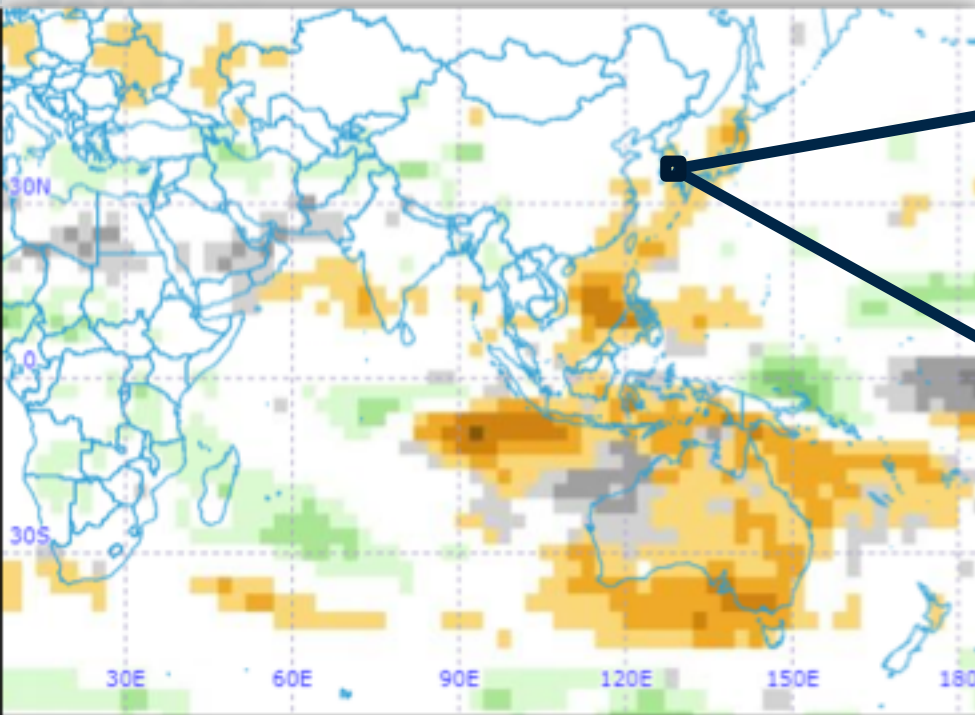
Historical time series:
obs & downscaled from MME



Temporal Correlation Coefficient (TCC) skill

2018 SON Rainfall forecast (Busan, KOREA)

PMME (dynamical, grid) & Downscaled (pointwise)



Lead Month: 3, Year: 2018, Season: 9, Methods: GAUS

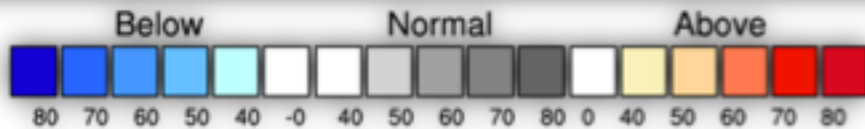
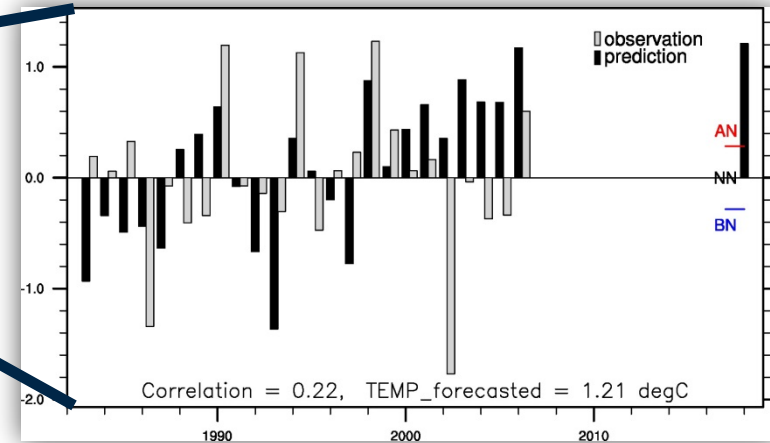
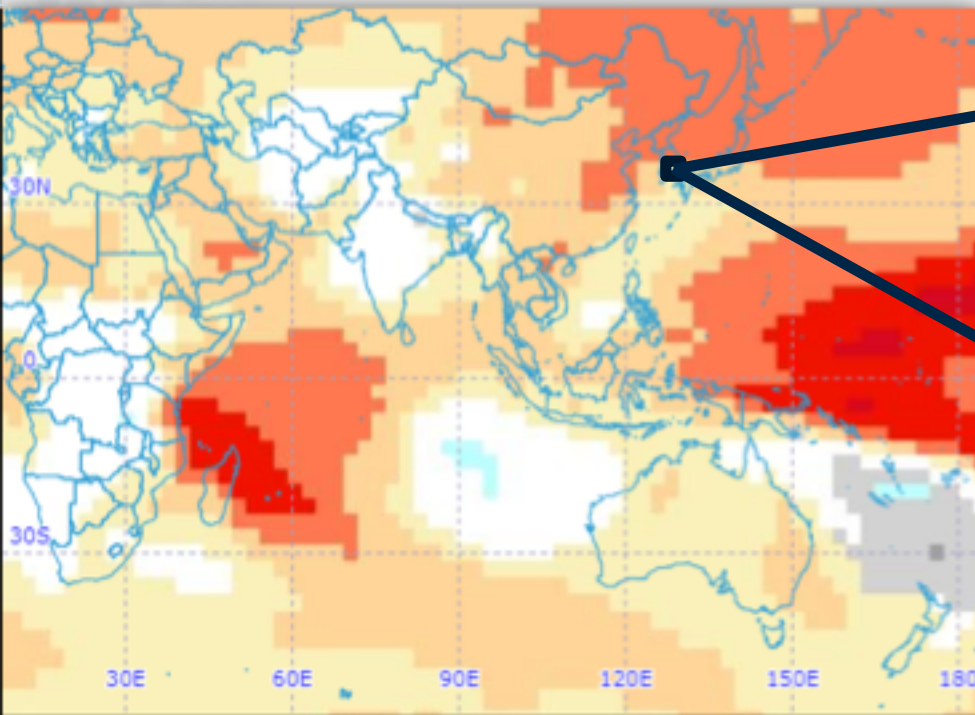
Model: APCC,CMCC,CWB,MSC,NASA,NCEP,PNU,POAMA

created by CLIK(2018-8-22)

© APEC Climate Center

2018 SON Temp. forecast (Busan, KOREA)

PMME (dynamical, grid) & Downscaled (pointwise)



Lead Month: 3, Year: 2018, Season: 9, Methods: GAUS

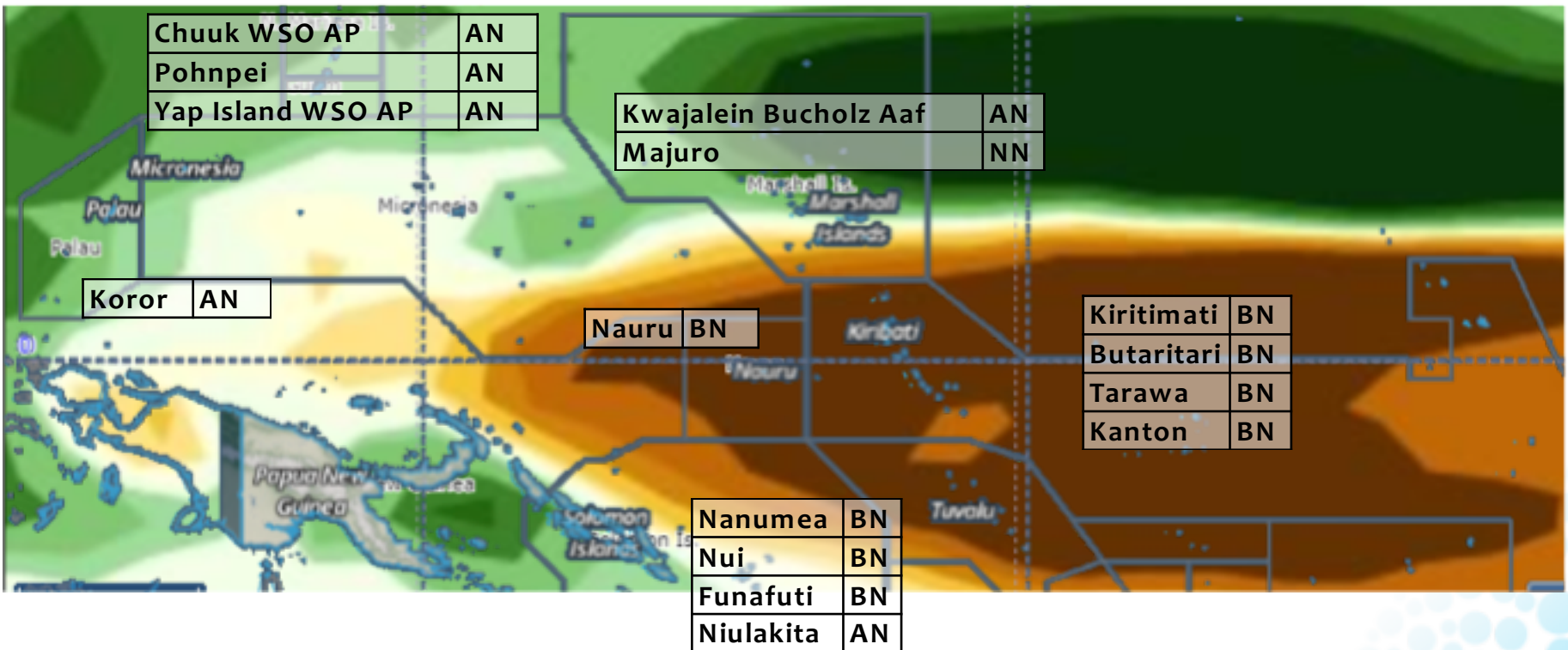
Model: APCC,CMCC,CWB,MSC,NASA,NCEP,PNU,POAMA

created by CLIK(2018-8-22)

© APEC Climate Center

2018 MJJ Rainfall forecast (Pacific Islands)

APCC MME (dynamical) & Downscaled (hybrid & downscaled)



CLIK

CLimate Information ToolKit

<http://clik.apcc21.org>



CLIK - main page



MME Downscale My Page

Register Login

Background

The CLiMate Information ToolKit version 1.0 (CLIK1.0) was developed in line with APCC's mission of empowering users to maximize the use of climate information and forecasts. The CLIK system provides customized multi-model ensemble (MME) prediction with verification. It also has a statistical downscaling tool which conducts predictor variable pre-screening, basic diagnostic testing, and graphing of climate data from January 2008 onwards. More than 1,200 registered users enjoy the service and about 7,500 predictions have been generated based on the users' request since 2008. Building on the success of CLIK 1.0, new features such as inclusion of other MME methods, improving the downscaling function, enhancing performance, and supporting multiplatform use have been added in the updated version CLIK 2.0 based on user feedback. The product is continuously being improved as APCC responds to the climate information needs of APEC member economies and users worldwide.

Product Description

CLIK aids users in retrieving and using climate prediction data and information available from APCC data servers in a user-friendly manner. Climate forecasters, disaster managers, water resource managers, researchers, and other users anywhere in the world can use this service to generate customized climate predictions on seasonal to inter-annual timescales for their region of interest. The tool has an immense potential to contribute to early warning and management of climate-related disasters and resource management, particu

The data processing engines p
and visualization. The web inte
developers but resulted in hear
have designed and developed
more useful to developing cour

CLIK 3.0 leverages on the robu

User Manual

[PDF](#)

[Contact Information](#)

If you have any questions or feedback regarding APCC CLIK, please contact the Climate Informatics and Application Team (clik@apcc21.org)

[Data Sources](#)

Please refer to [\[DATA SOURCES\]](#)

[Terms of Data Use](#)

Please refer to [\[TERMS OF DATA USE\]](#)

✓ User can see the information of the CLIK background, product description, user manual and so forth.

CLIK - “MME”



MME

Downscale

My Page

Logout Edit

Predict

Lead Month

3Month

Year/Season

Year Season

Methods

Deterministic Probabilistic

Variables

PREC T850

Models

- ALL
- APCC CMCC CWB
- MSC NASA NCEP
- PNU POAMA

✓ User can produce the **customized MME seasonal forecast**, then view the result figure map and download corresponding data.

Predict & Verify

Result

Prediction only Prediction & Verification

Move Center Download



CLIK - “Downscale”



MME **Downscale** My Page

Logout Edit

Select Dataset / Station

Datasets

Dataset Name	Countries	Total Stations	Period(prec)	Period(temp)	Public
MCDW(Monthly Climatic Data for th...	The World	6463	1998 ~ 2014	1998 ~ 2014	PUBLIC
Test_2018KMA		0	N/A	N/A	dolkong400
Korea 60 Stations	Korea, Republic of	60	1973 ~ 2008	1973 ~ 2006	PUBLIC
Traning_2017	Myanmar	2	1982 ~ 2016	N/A	dolkong400
Man Dam		0	N/A	N/A	dolkong400
GHCN	GHCN	3707	1950 ~ 2009	N/A	PUBLIC

Create

Edit

Remove

✓ User can upload their own station data and make a **downscaled forecast**

+
-
2

CLIK - "My Page"



My Page

Jobs

System Status

Last Updated At : 18:14:48 (auto refresh at about every 60 seconds)

Auto Refresh

10 records per page

Search:

JOB ID	TYPE	STATE	DESCRIPTION	CREATED	UPDATED	RESULT DATA
6904	Downscale	fail	-	2018-07-27 13:39:24	2018-07-27 13:39:49	
6903	MME	fail	-	2018-07-27 13:33:56	2018-07-27 13:38:57	
6902	MME	fail	-	2018-07-27 13:31:05	2018-07-27 13:32:05	
6901	MME	fail	-	2018-07-27 13:29:31	2018-07-27 13:30:27	
6784	Downscale	success	양근	2018-05-29 10:29:12	2018-05-29 10:29:42	download
6783	Downscale	success	양근	2018-05-29 10:28:47	2018-05-29 10:29:24	download
6549	Downscale	fail	Kuala_Lumpur	2018-03-07 15:33:24	2018-03-07 15:33:33	
6548	Downscale	fail	-	2018-03-07 15:33:18	2018-03-07 15:33:24	
6543	Downscale	fail	-	2018-03-07 15:33:04	2018-03-07 15:33:04	
6542	Downscale	fail	-	2018-03-07 15:15:17	2018-03-07 15:15:29	

✓ Users can find the **list of jobs they requested**, identify the status of jobs, and download result data of successful jobs.

Registration

Climate Information ToolKit

<http://clik.apcc21.org>

