Introduction to CLIK (CLimate Information ToolKit)

http://clik.apcc21.org

Yun-Young Lee

APCC APEC CLIMATE CENTER

Climate/weather related disasters

5. Jan. 13 — Flooding in the capital

Monsoon rails cause flooding in Jakarta, and residents flee on ma

Flood

Strong wind

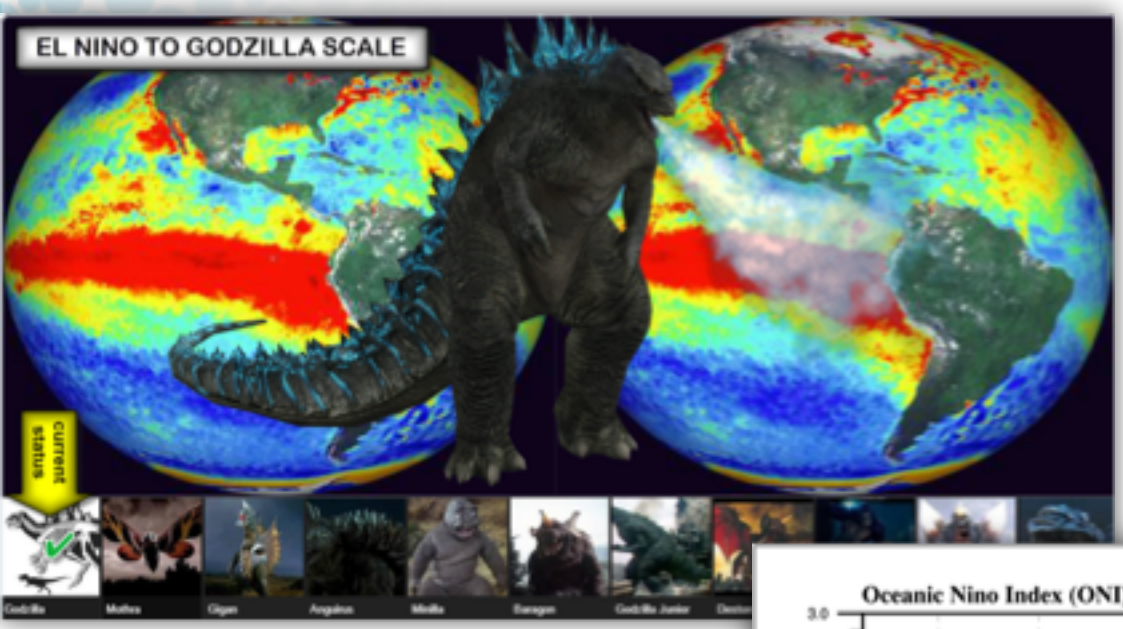
Indonesia landslide: 20 dead and dozens still missing

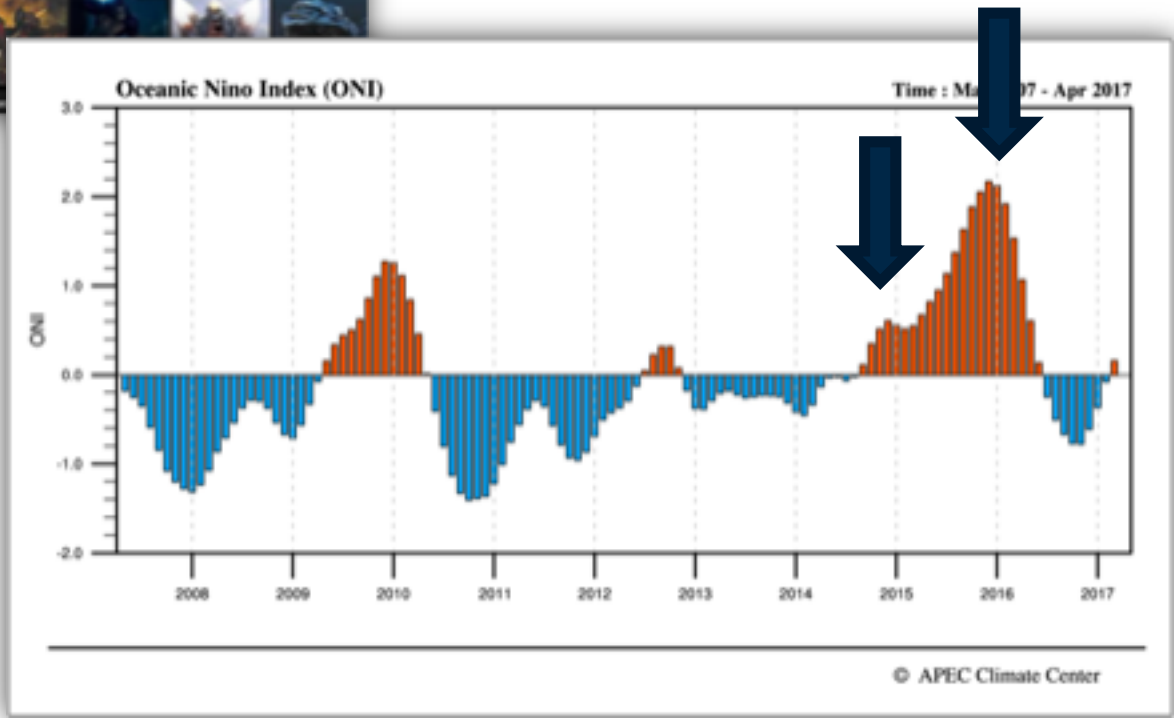
14 December 2014 | Asia

Landslide

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

2015/16 prolonged (Godzilla) El Nino





2015 Drought in Thailand :during prolonged El Nino

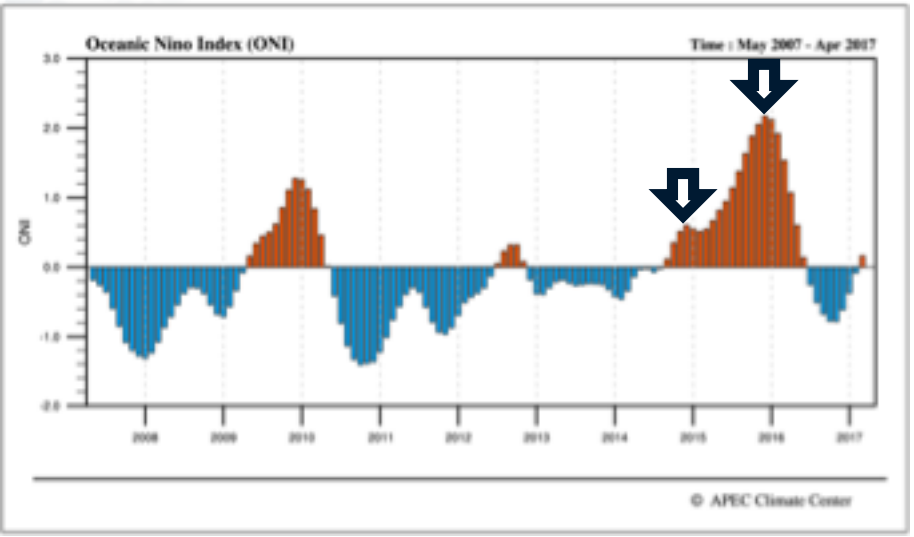
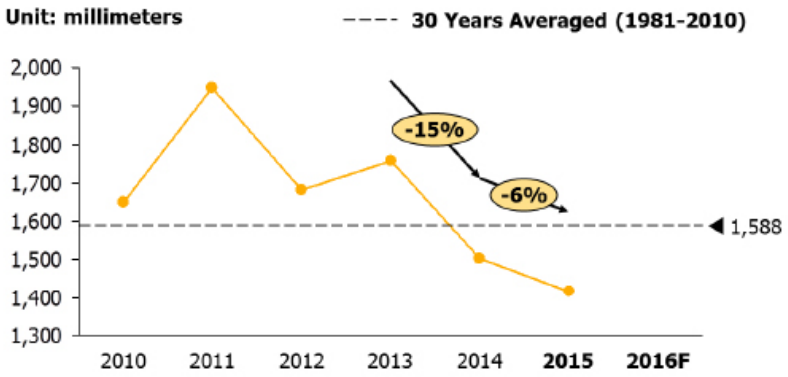
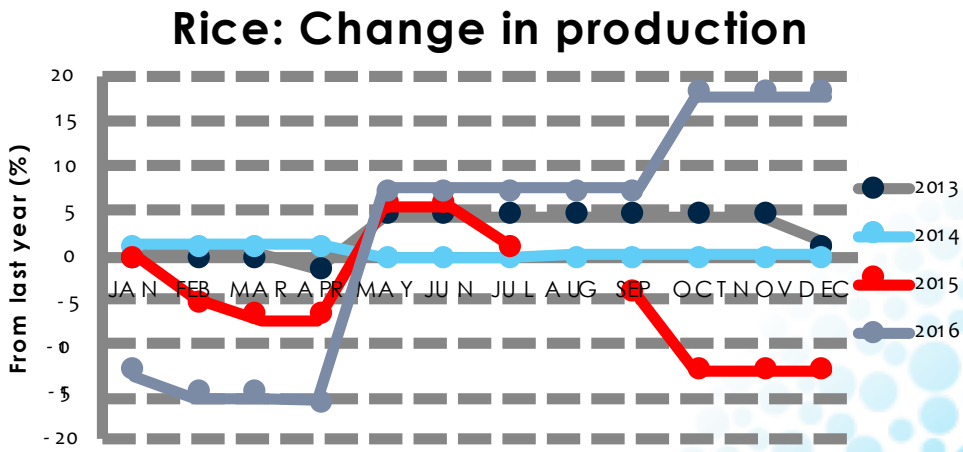


Figure 1: Cumulated rainfall in Thailand between 2010 and 2015

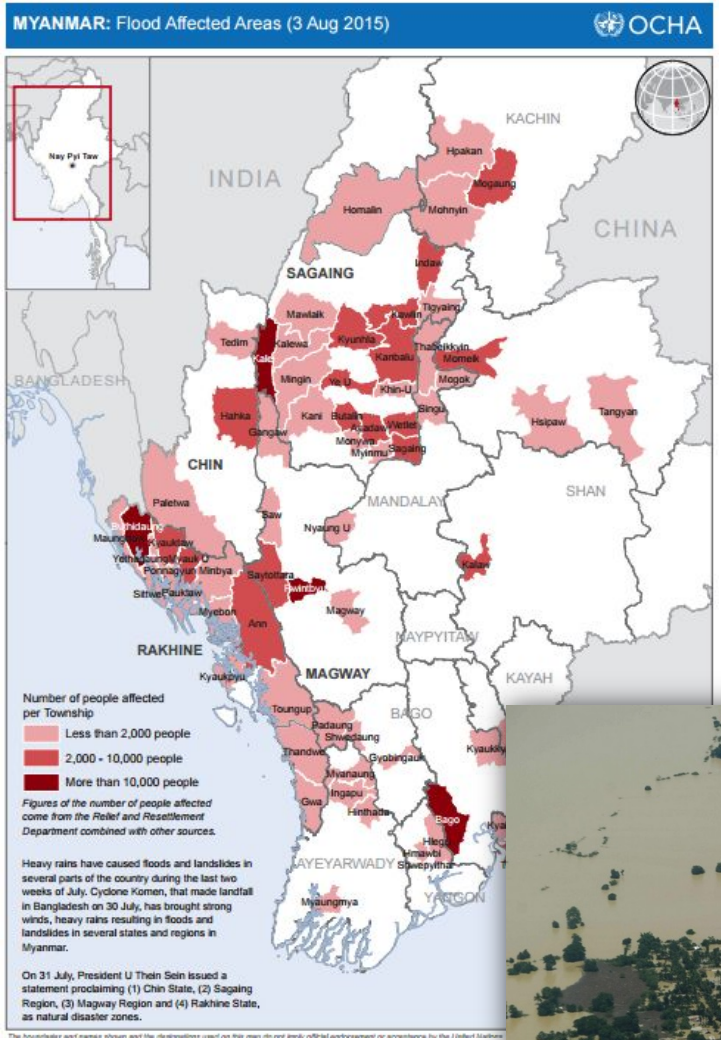


Source: EIC analysis based on data from Water Watch and Monitoring System, Royal Irrigation Department.



Source: USDA World Agricultural Production

2015 Myanmar Flood :the worst for decades



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, drough
Cambodia," said the Mekong Ri
Secretariat. "The current drough
March 2016 could be at least as
likely be getting worse in comin

Last year, according to the MRC
delayed until July. A similar dela
is due in May, until as late as Au
this year.

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

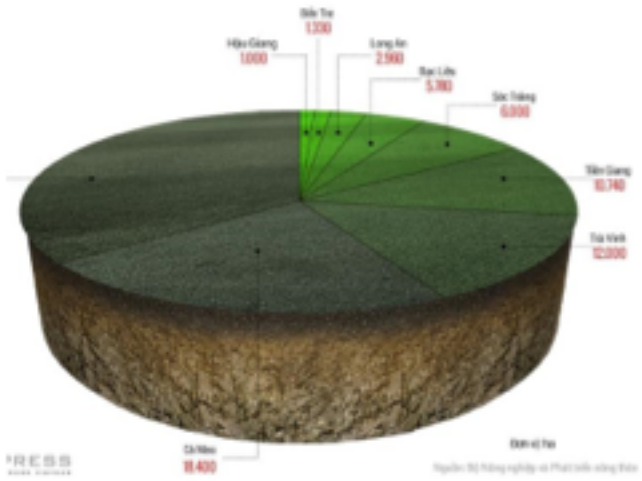
7 photos: Children are among hardest hit by El Nino-related drought in Cambodia

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

Image Credit: Hau Giang, Vietnam Image via Thoai / Shutterstock.com

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

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 Novemb
made front-page news around
the north, Sri Lanka to the wes
Southeast Asian "tiger" econo
miles of rainforest, plantations
Sumatra, Sulawesi, Irian Jaya,
Malaysia. Though official gove
acres (750,000 ha), environme
group WAHLI (the Indonesian
(1,714,000 ha) went up in smo
million ha (12.4 million acres)
alone in 1998 range from 445,
ha). Regardless of the extent
health problems and economic

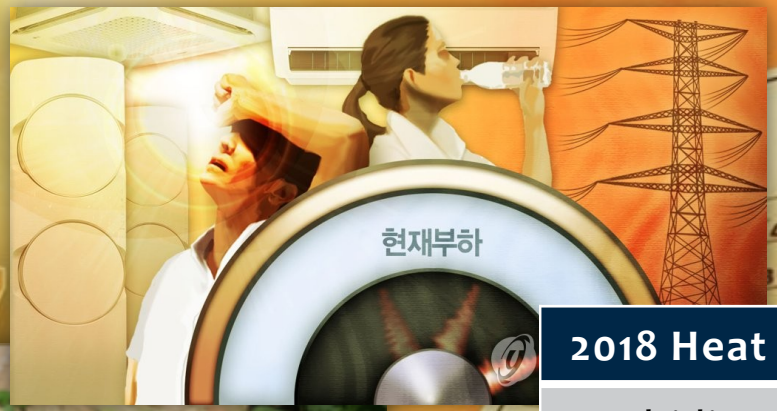
https://rainforests.mongab

https://www.google.co.kr/search?q=indonesia+wildfire+1997&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi9oOGUhqrcAhUJFogKHTaIBeEQ_AUICigB&biw=1745&bih=861#imgdii=DA3nBYrF9rmWdM:&imgrc=ELAMGJFKU97fPM:

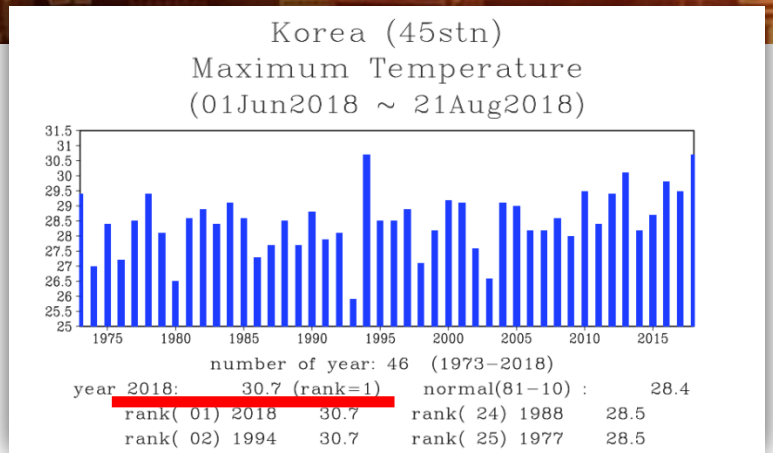
https://en.wikipedia.org/wiki/1997_Indonesian_forest_fires

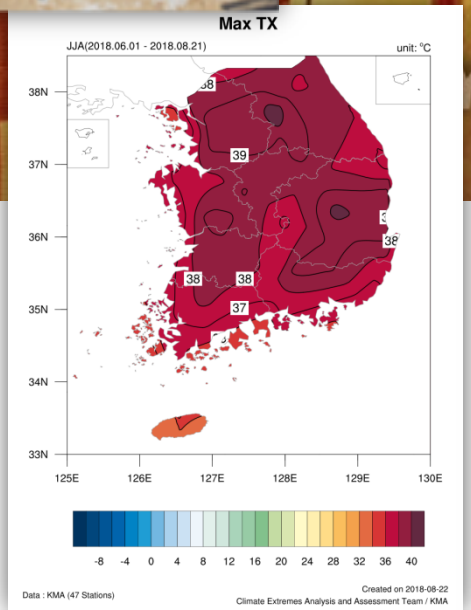
https://www.google.co.kr/search?q=indonesia+wildfire+1997&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi9oOGUhqrcAhUJFogKHTaIBeEQ_AUICigB&biw=1745&bih=861#imgrc=2OnzANCTqgpQcM:

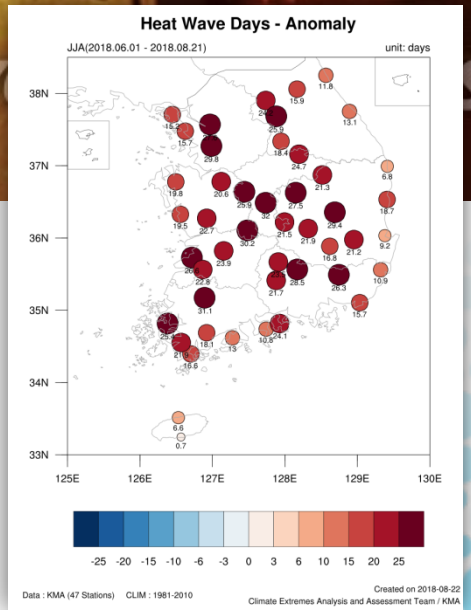
2018 Korea Heat Wave



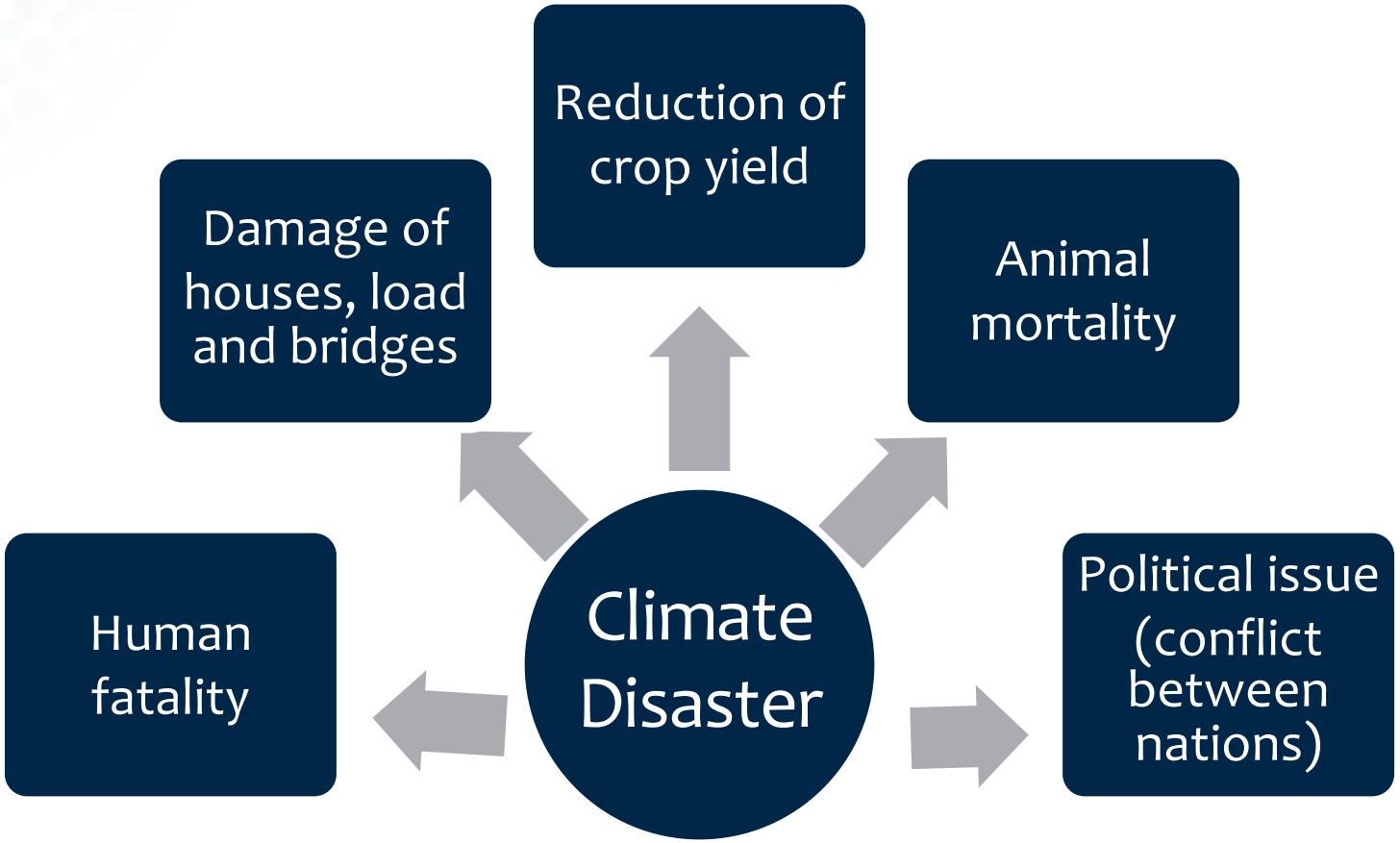
2018 Heat Wave related-	
Morbidity	4301
Fatality	48







Importance of "Accurate" prediction



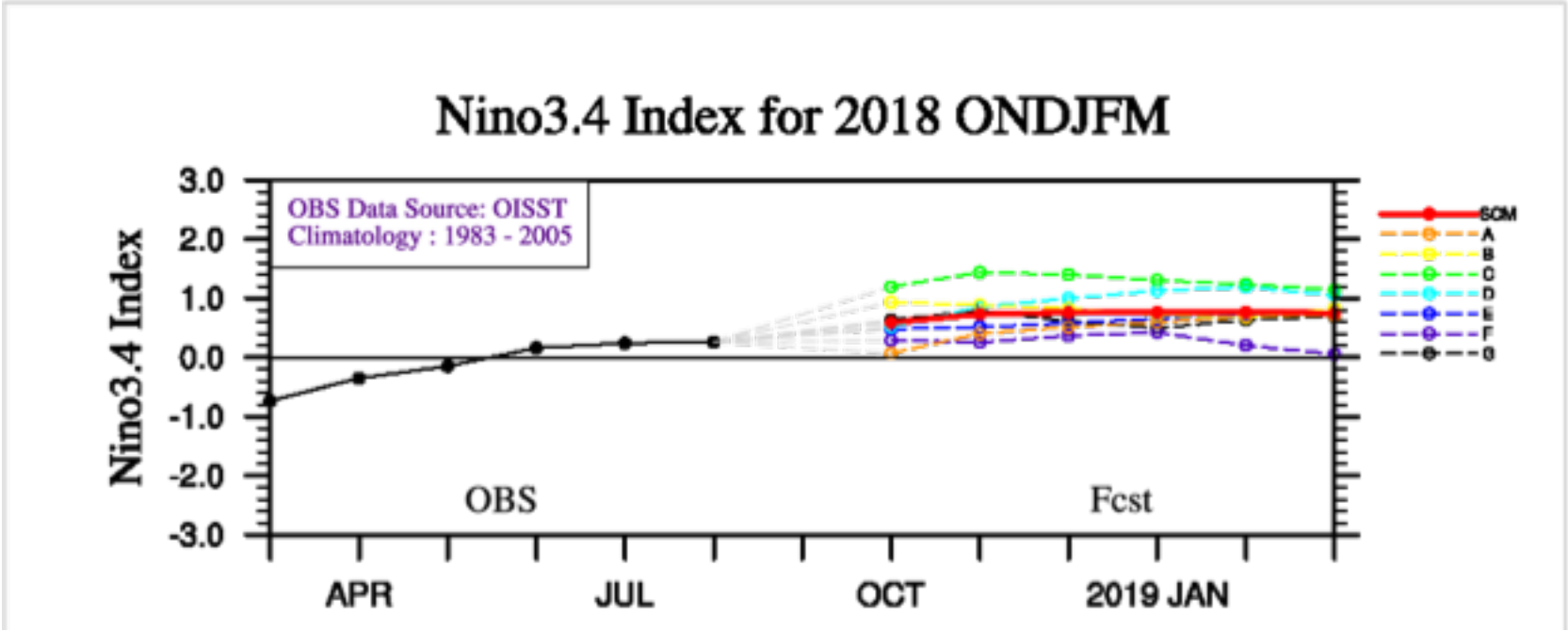
ACCURATE climate prediction optimized to our region (village) will make early warning possible and reduce economic and human losses.

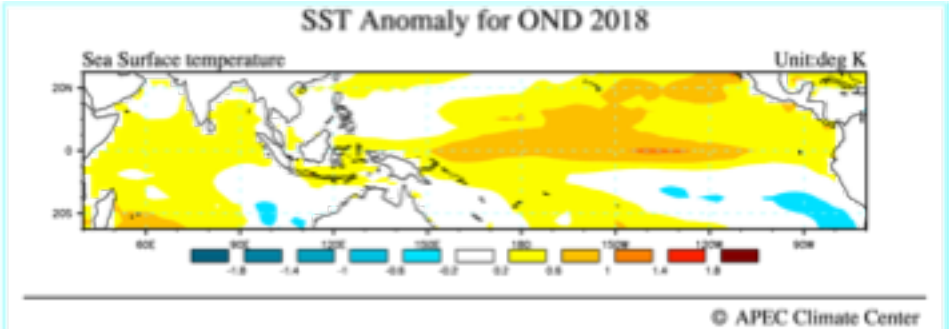
18/19 ENSO Outlook

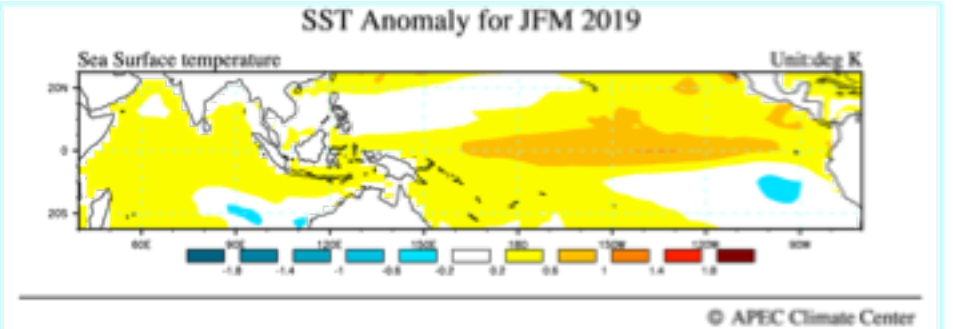
By APCC

Weak El Niño (CP-type)

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







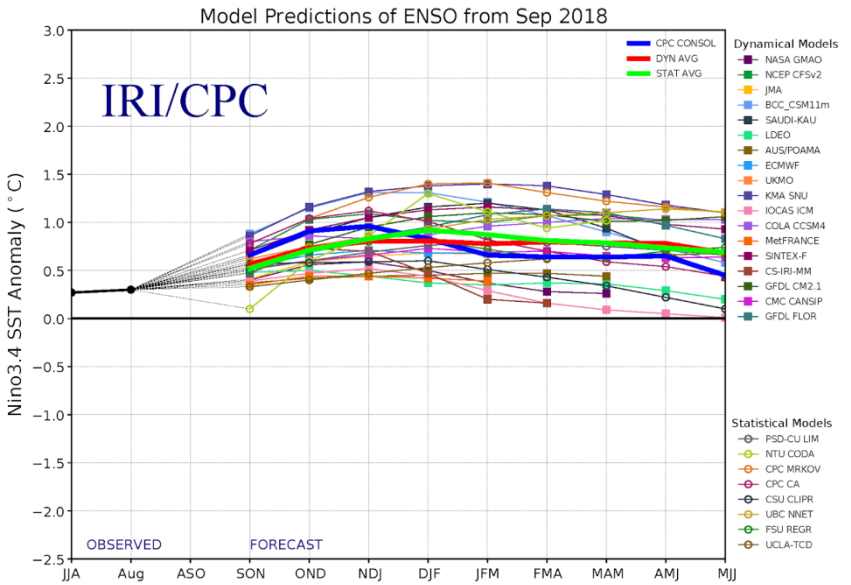
18/19 ENSO Outlook

By NOAA (USAPI)

El Niño WATCH

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

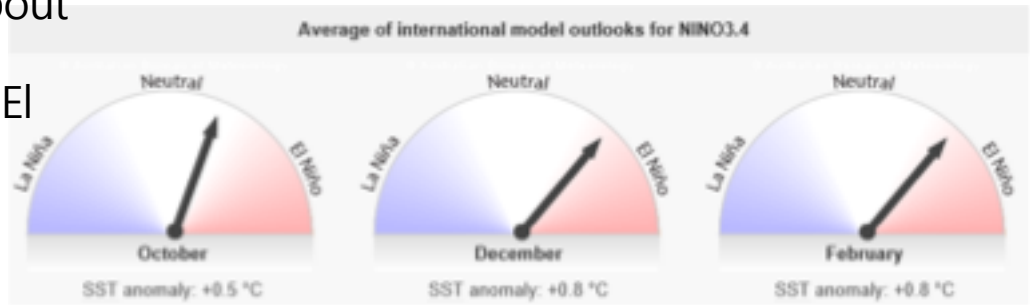
Probabilities for El Niño peak from NDJ - MAM (>70%) with about a 65% chance prior (SON).

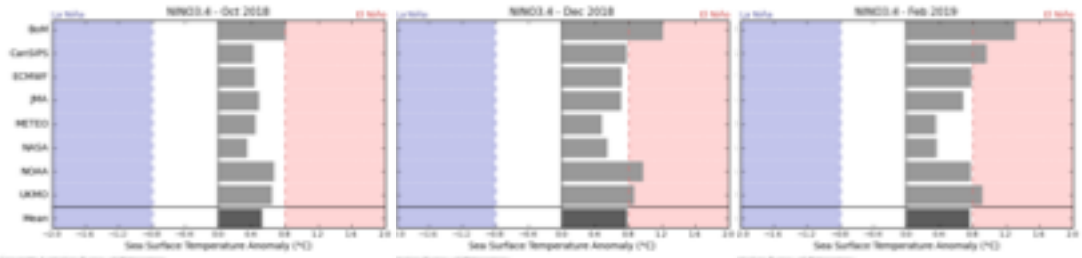


By BOM

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

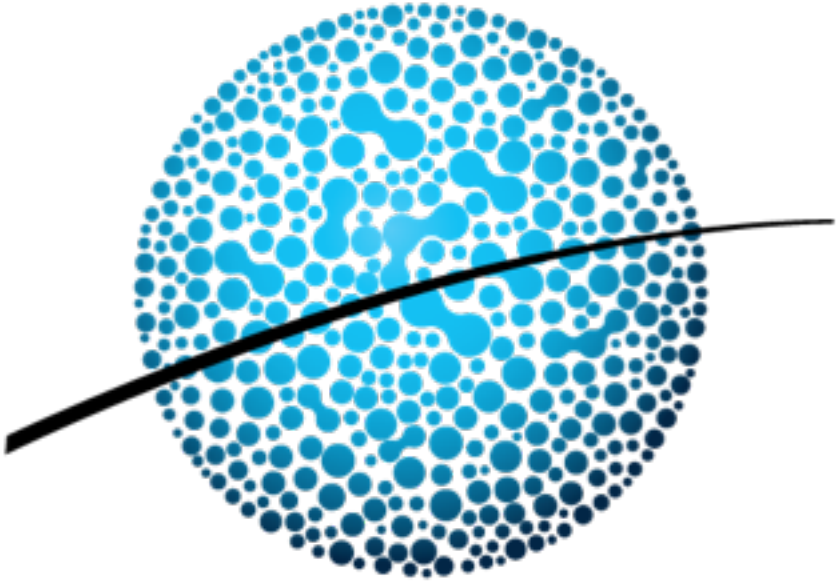
History: for half of El Niño WATCH years, El Niño has developed!





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

CLIK

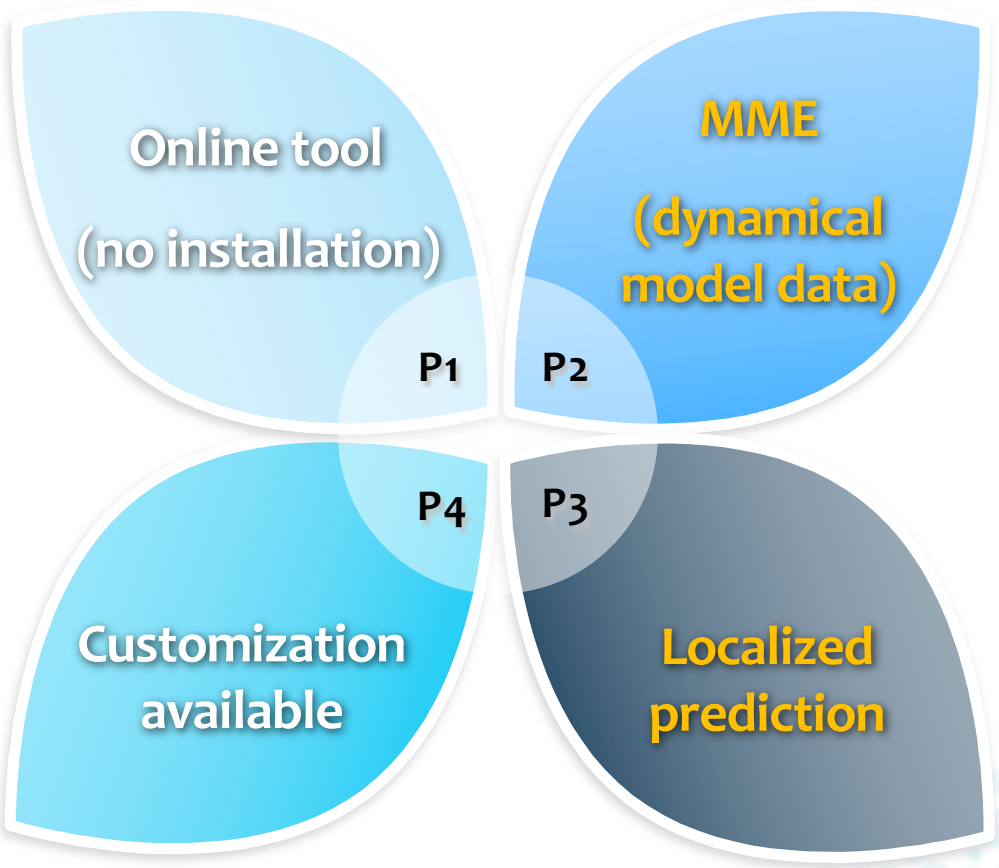
CLimate Information ToolKit

http://clik.apcc21.org

Climate Information Toolkit

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

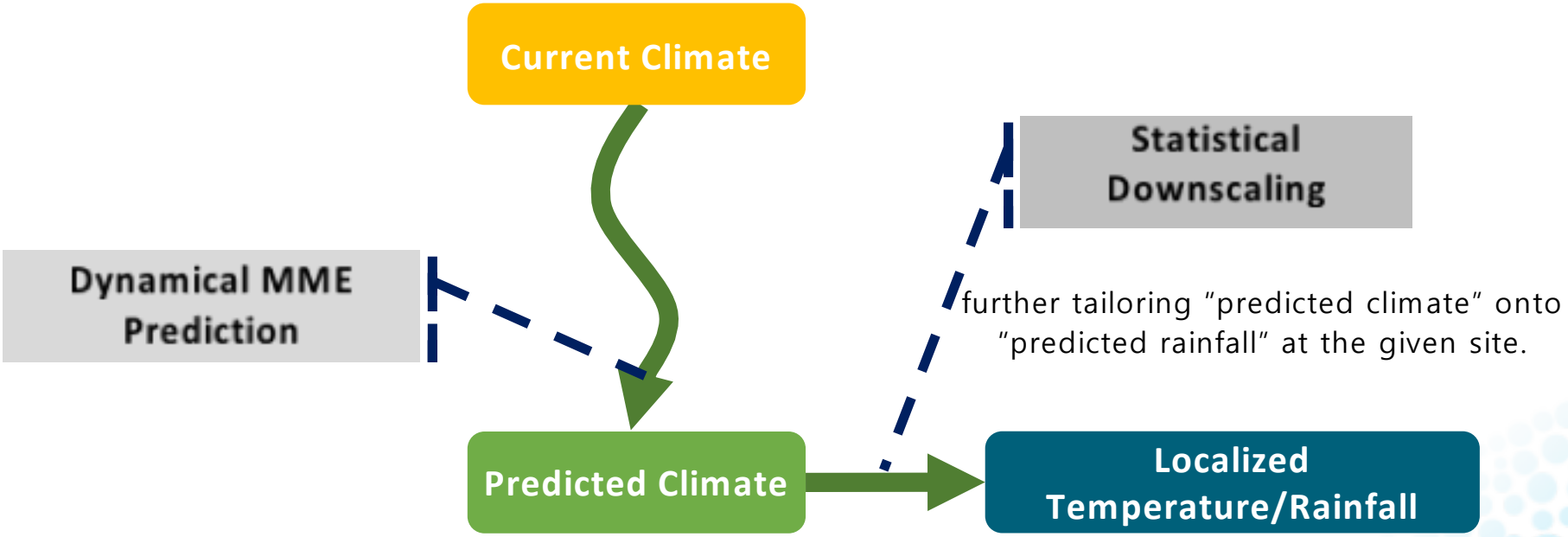
1. Limitation of manpower and computing resources
2. Desire for utilizing **dynamical forecast data**
3. Direct benefit on **regional community**
4. Thirsty for Capacity building: Interests in learning science and technology and high satisfaction when participating in the model developing process



➔ 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

Clik
Climate Information Toolkit



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

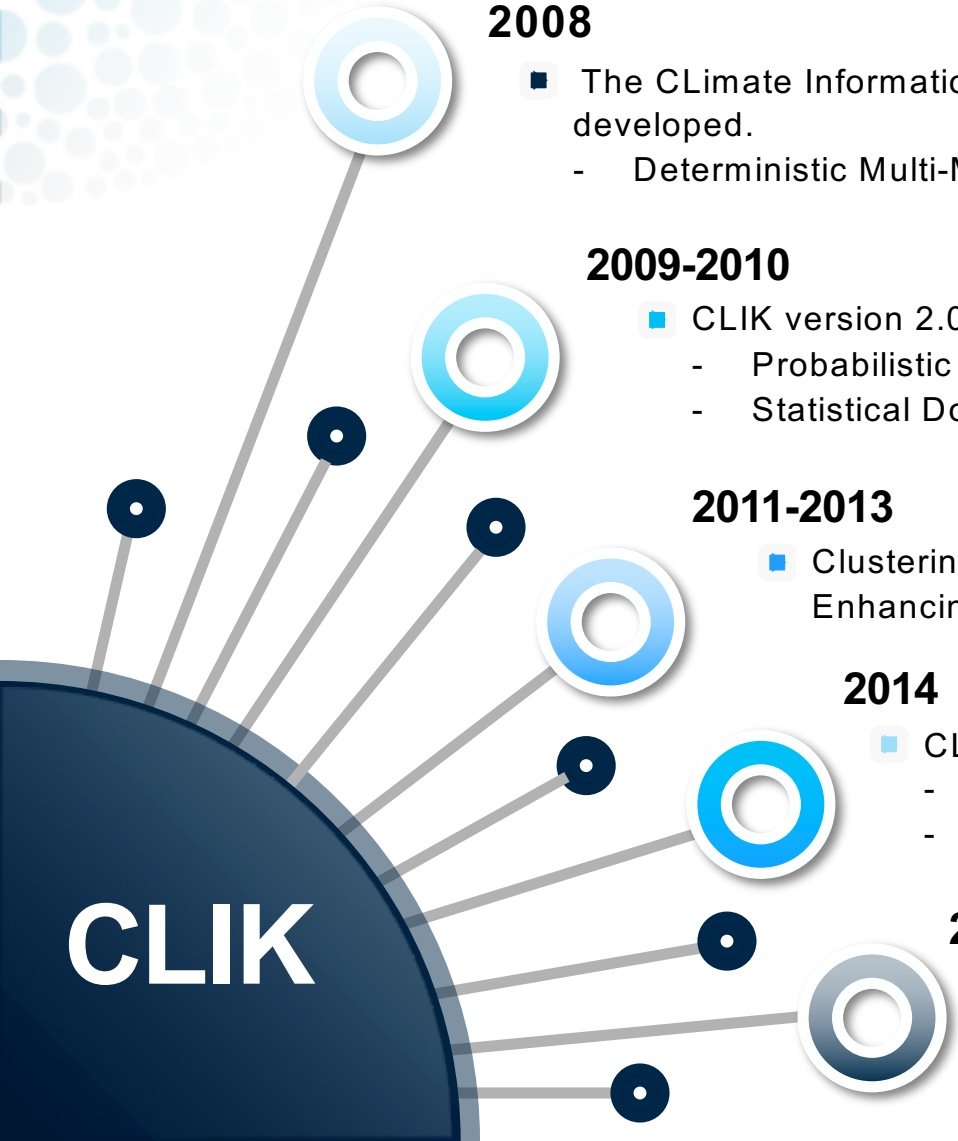
Downscaling:
Simulated large scale pattern to station matching

- 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

With only a computer and an internet connection

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with different model combination

CLIK

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Why MME?

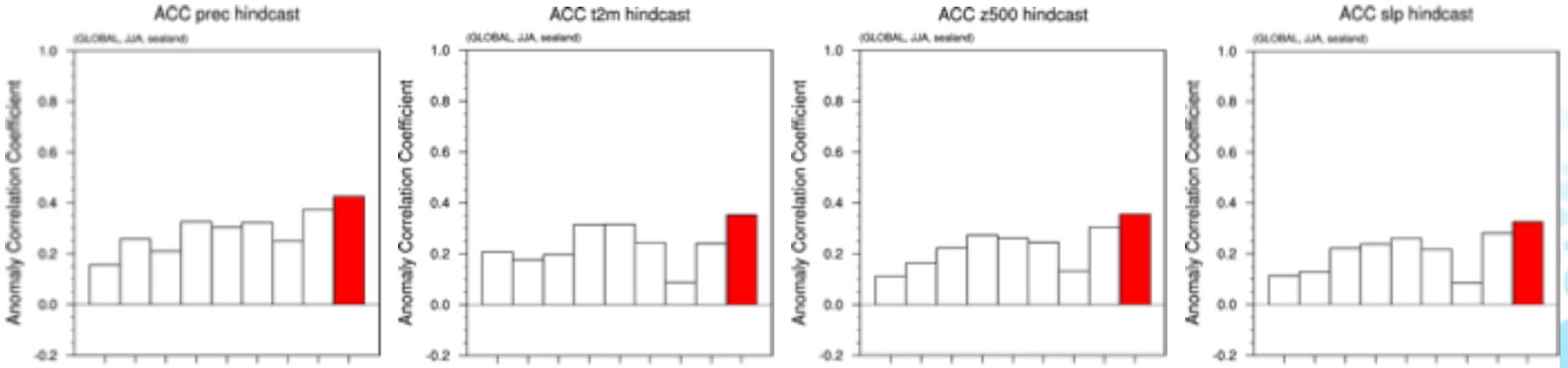
- Climate predictions have huge ***uncertainty!***

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

Multi-model Ensemble (MME)

Deterministic

SCM

Simple Composite Method:
Average of individual forecast with equal weighting

$$P = \frac{1}{M}\sum_i F_i'$$

Probabilistic

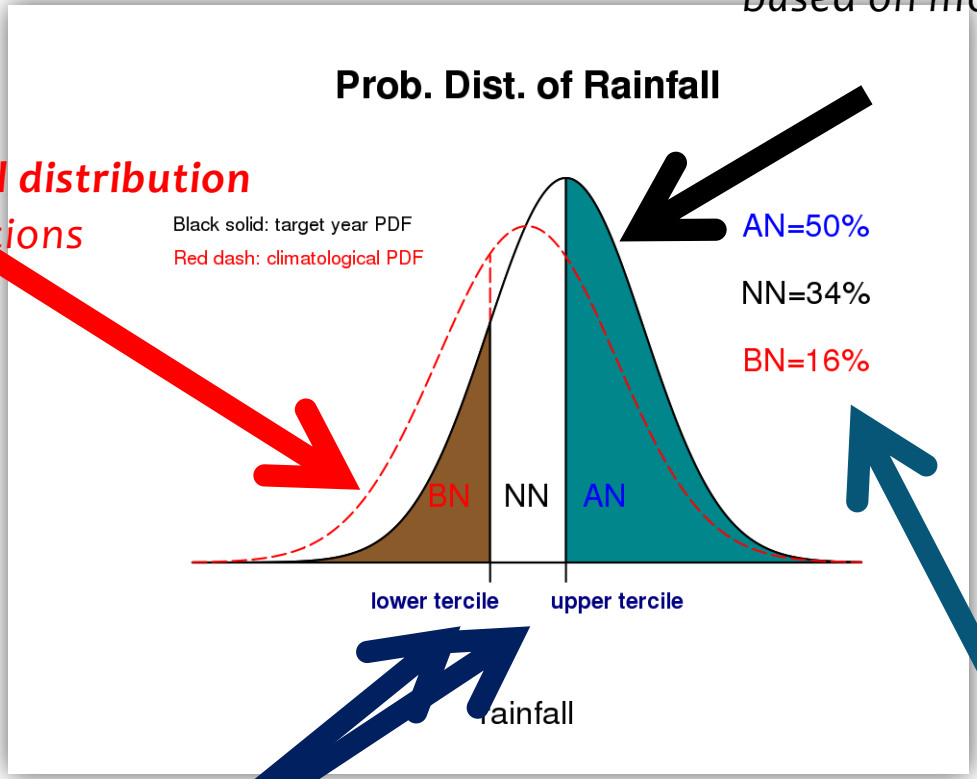
GAUS

A parametric Gaussian fitting method for the estimation of tercile-based categorical probabilities; forecast probability of each category is estimated as a portion of the forecast PDF(Probability Density Function) with respect to the historical one.

Tercile Probabilistic Forecast

Target year/season distribution
based on model ensembles

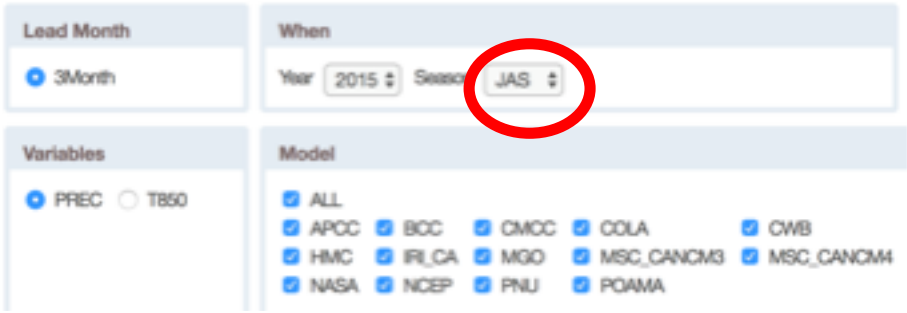
Climatological distribution
from observations



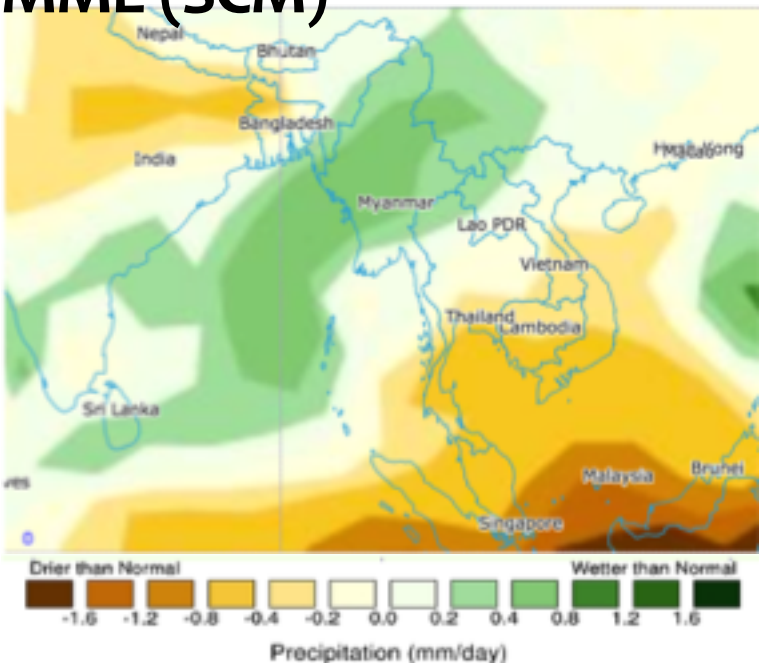
LT & UT
(thresholds to separate area under curve into 1/3)

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

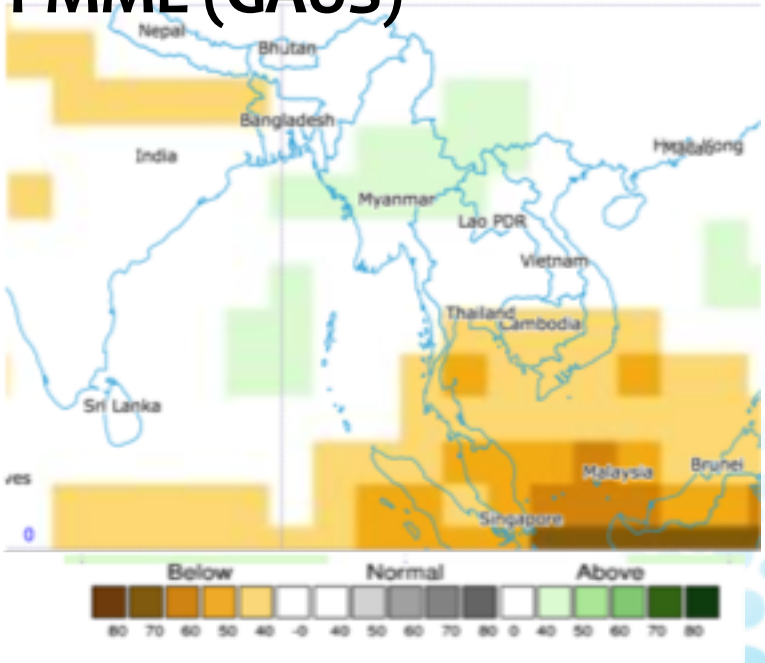
PREDICTION_product



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 ~ 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*

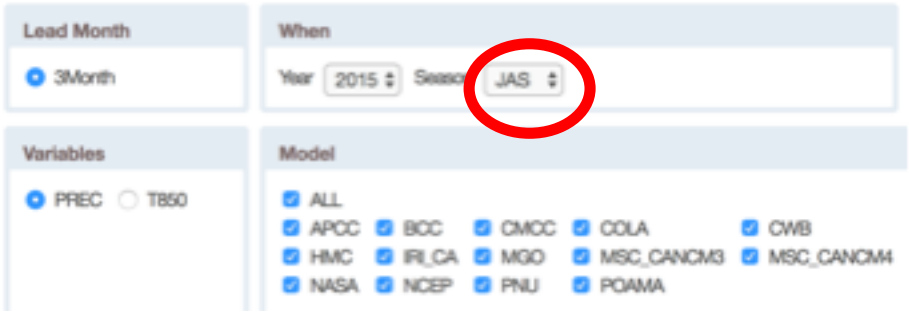
F \ O	Yes	No
Yes	Hit (H)	False Alarm (F)
No	Miss (M)	Correct Rejection (C)

*HSS = (score – **score by chance**)*

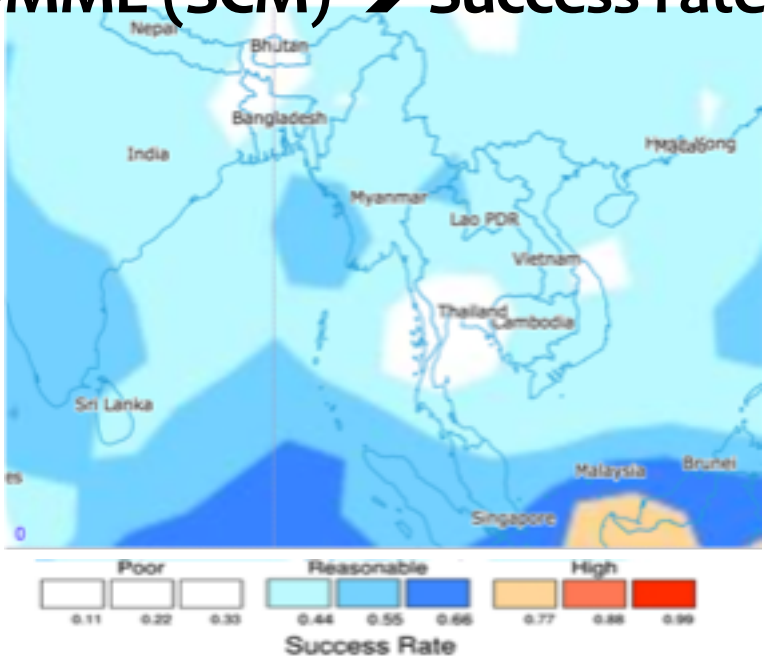
*/(perfect score – **score by chance**)*

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

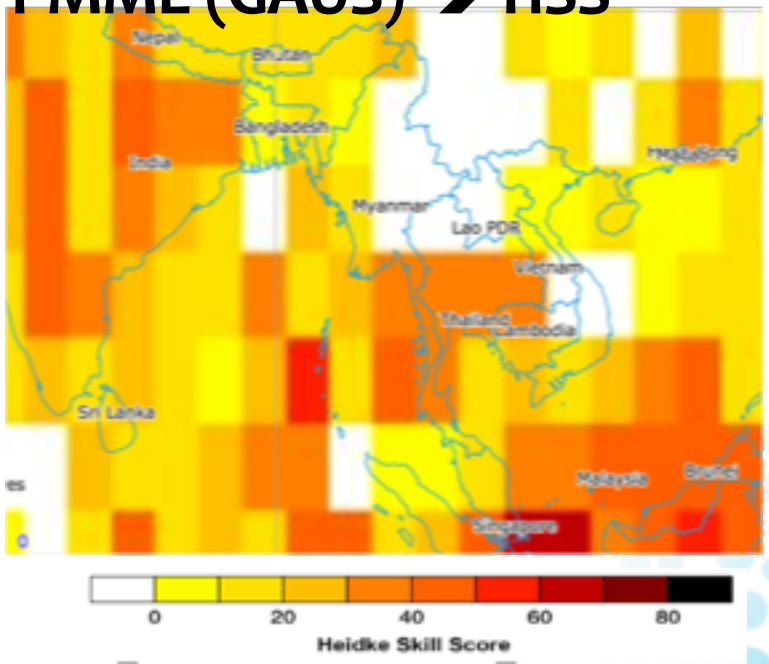
PREDICTION_product



DMME (SCM) ➔ Success rate

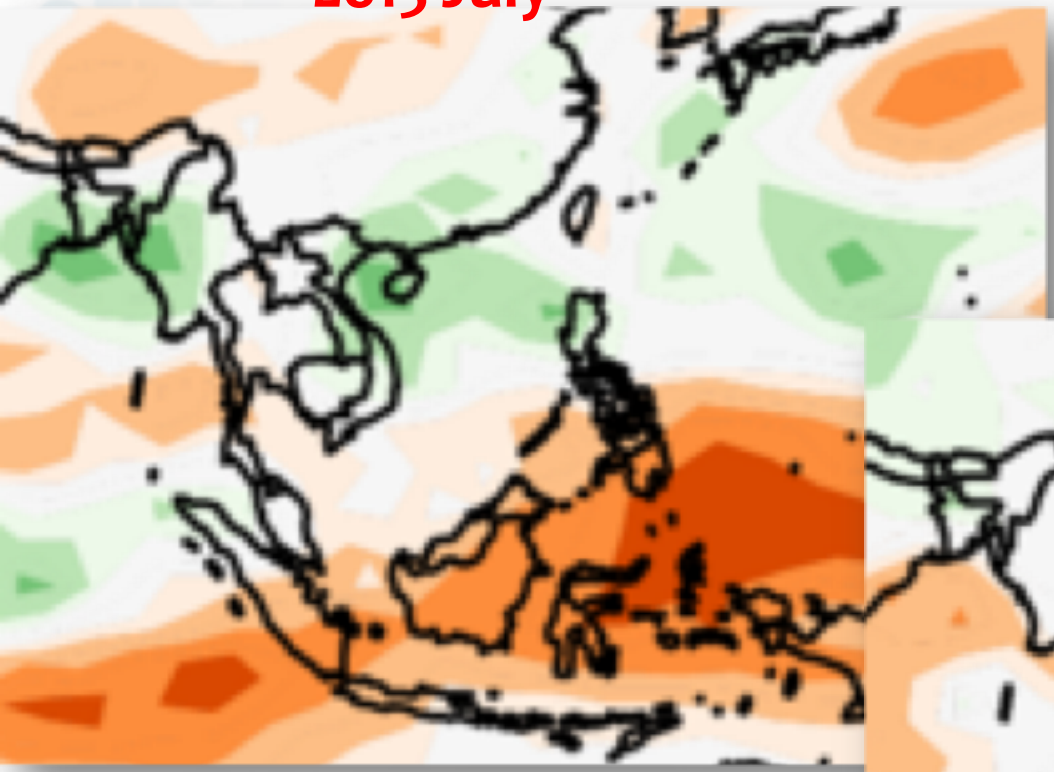


PMME (GAUS) ➔ HSS

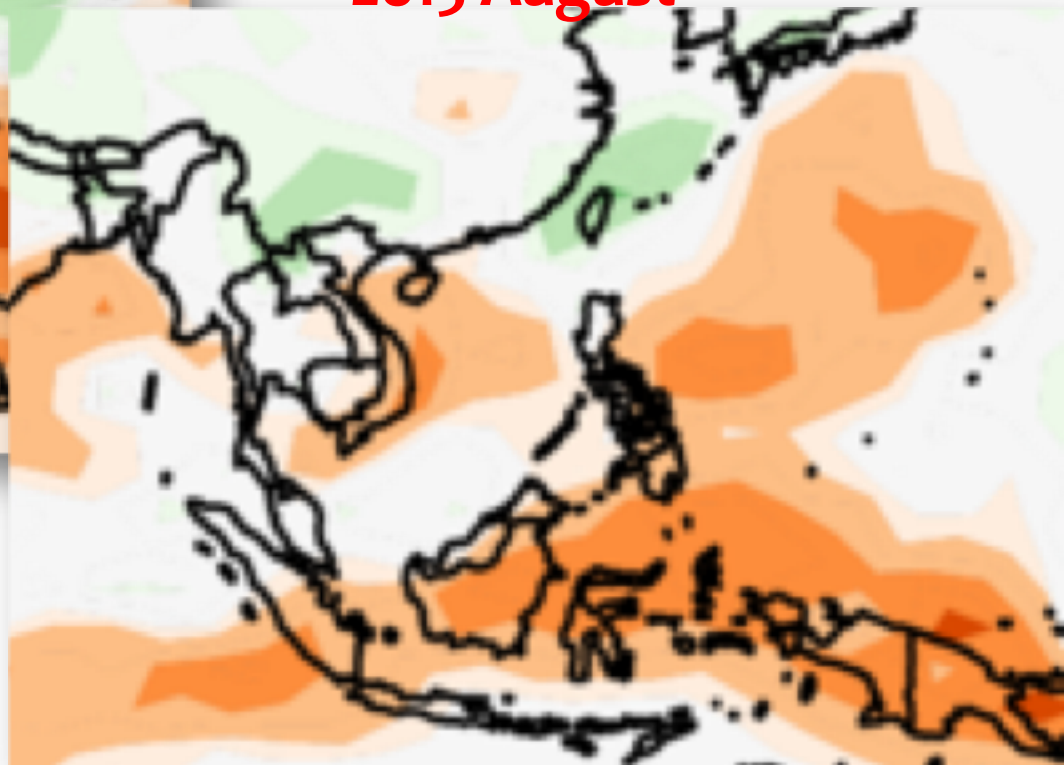


2015 JA Flood

2015 July



2015 August



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Downscaling:
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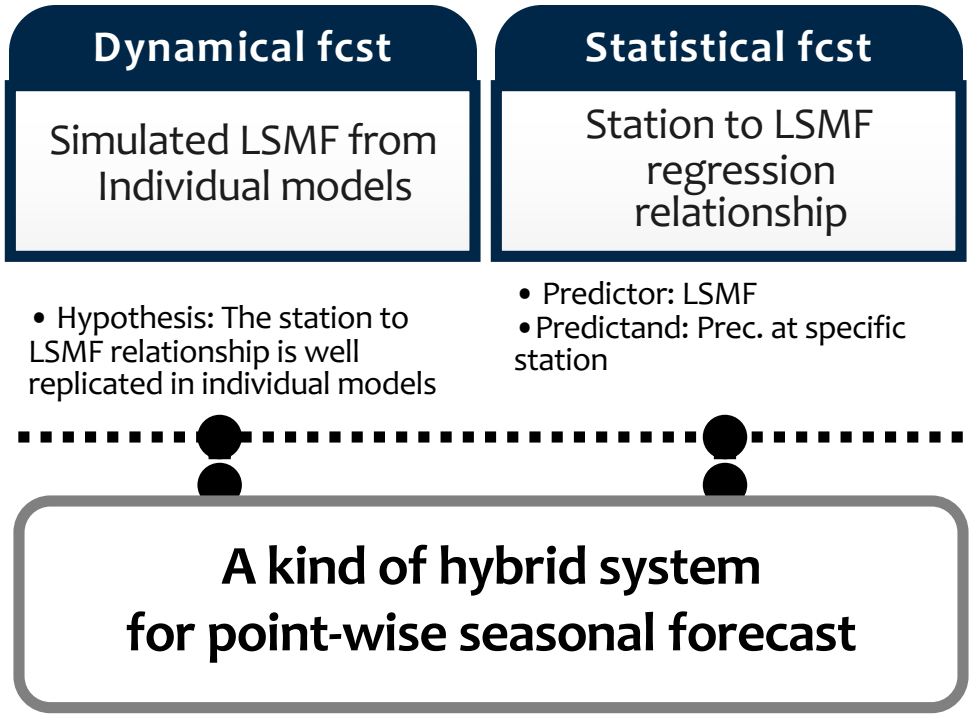
CLIK downscaling

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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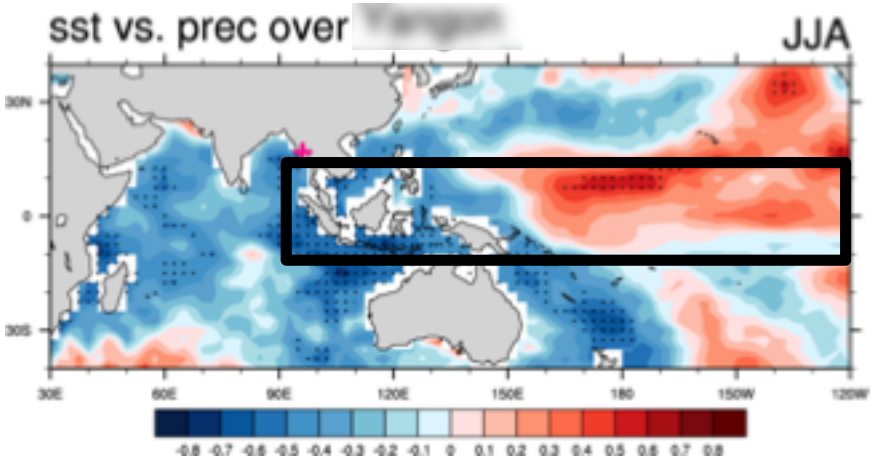
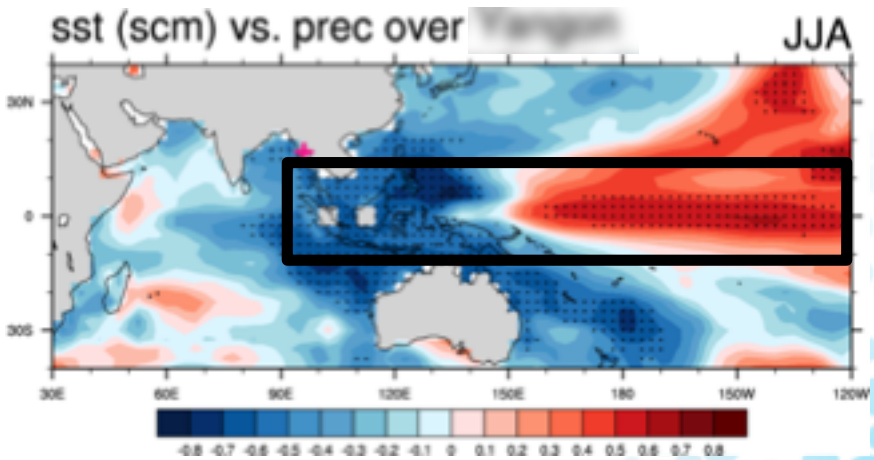
Empirical relationship: LSMP (OBS) ~ local station rainfall

LSMP (MME) → Local station rainfall





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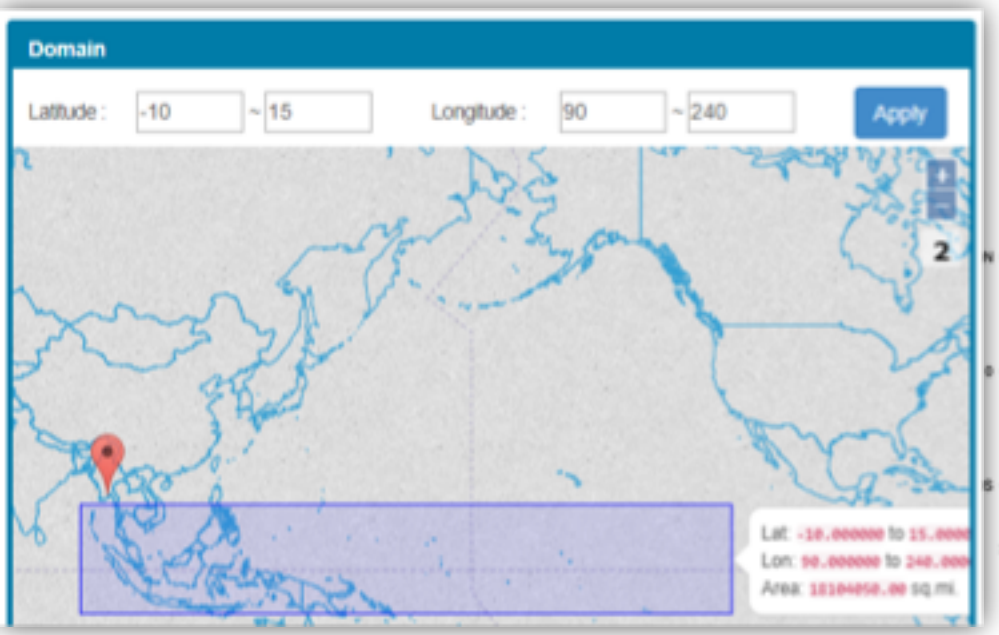
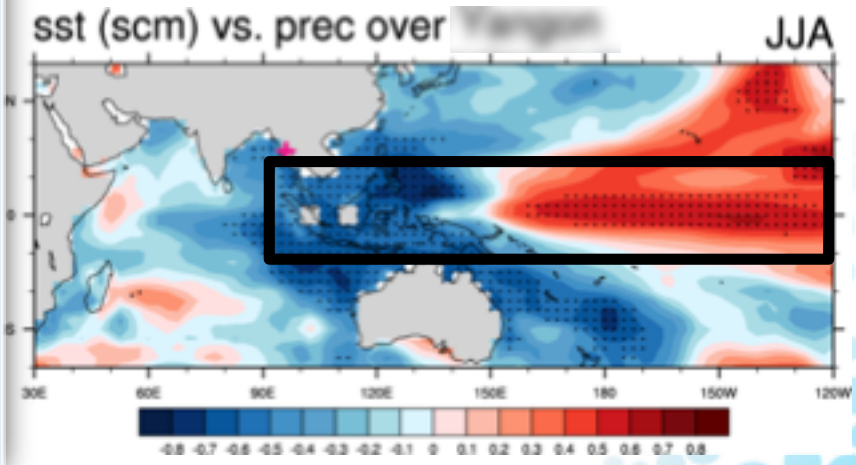
LSMP (MME) → Local station rainfall

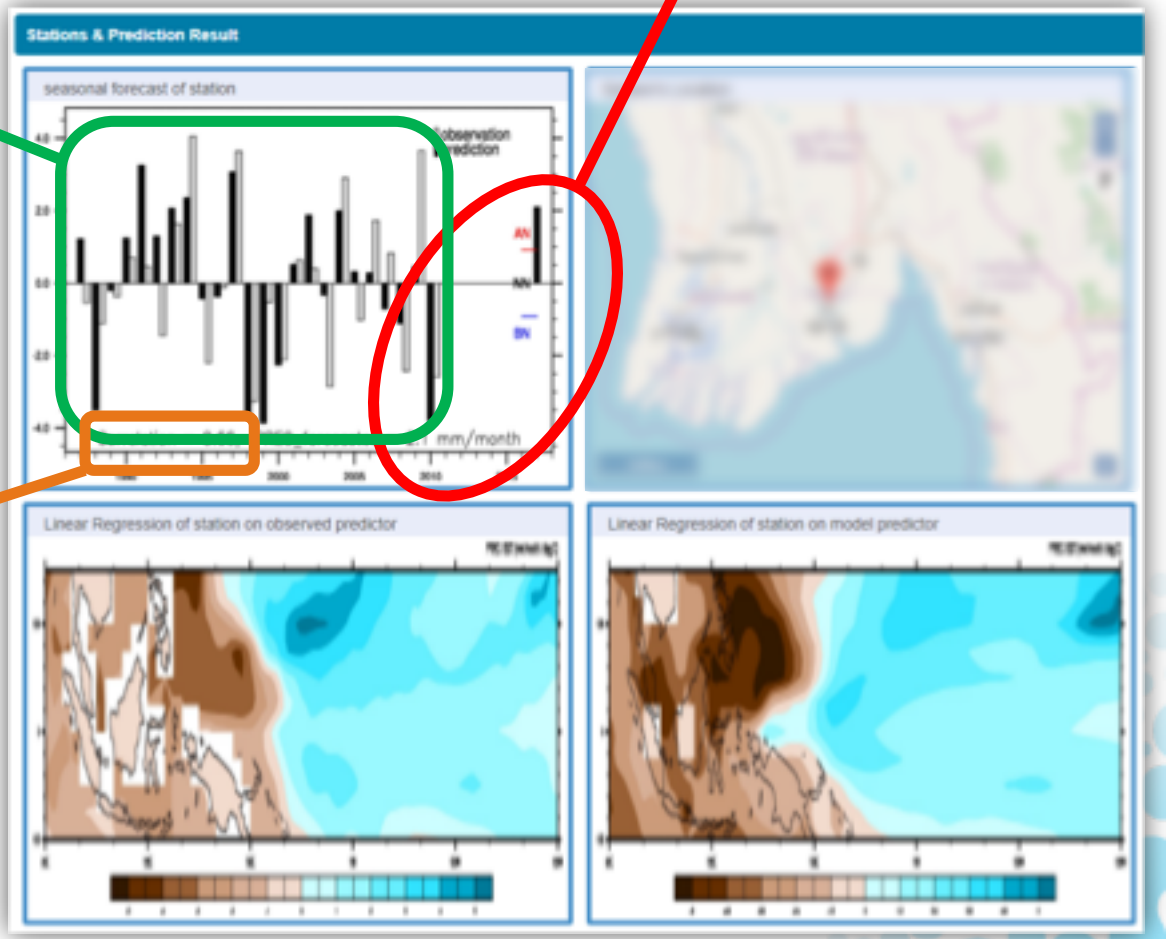




Downscaled forecast at a given site

Deterministic forecast with **tercile range** for target year/season

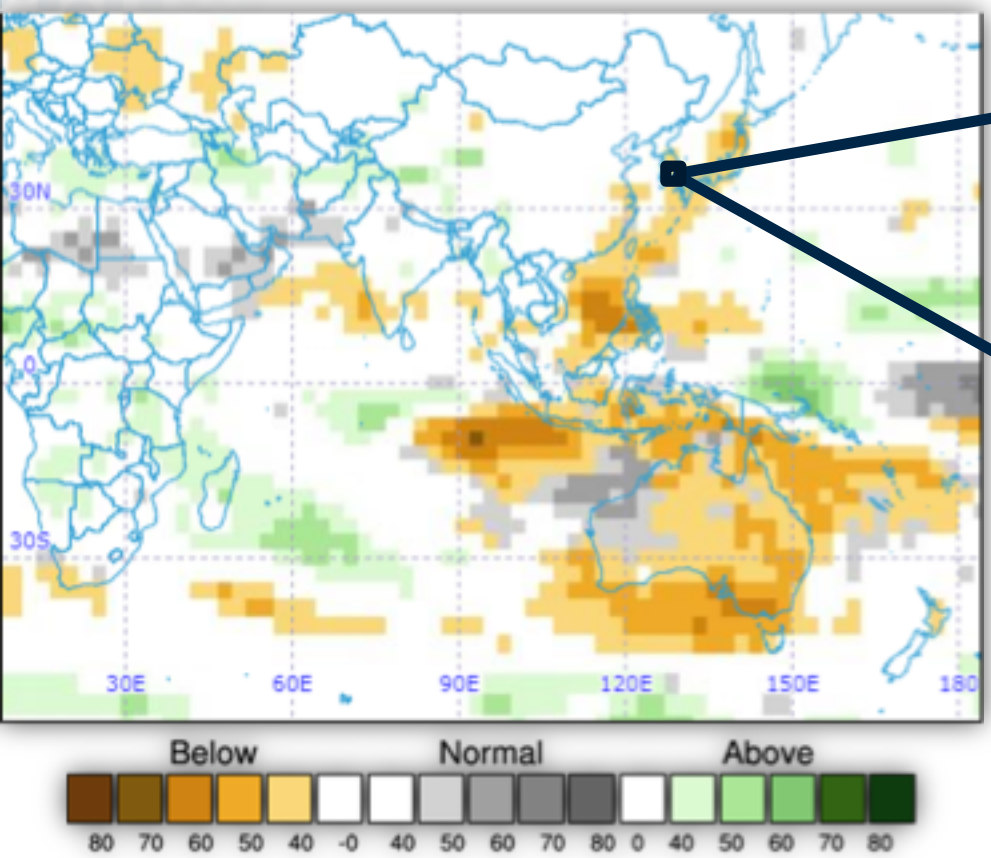
Historical time series: obs & downscaled from MME

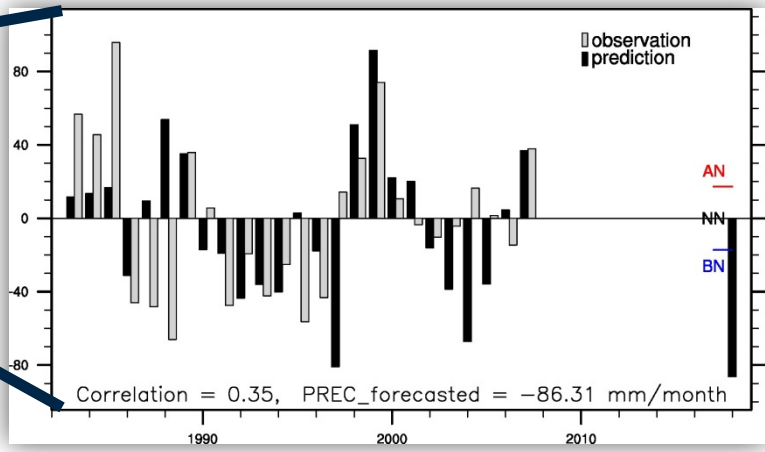


Temporal Correlation Coefficient (**TCC**) **skill**

2018 SON Rainfall forecast (Busan, KOREA)

PMME (dynamical, grid) & Downscaled (pointwise)

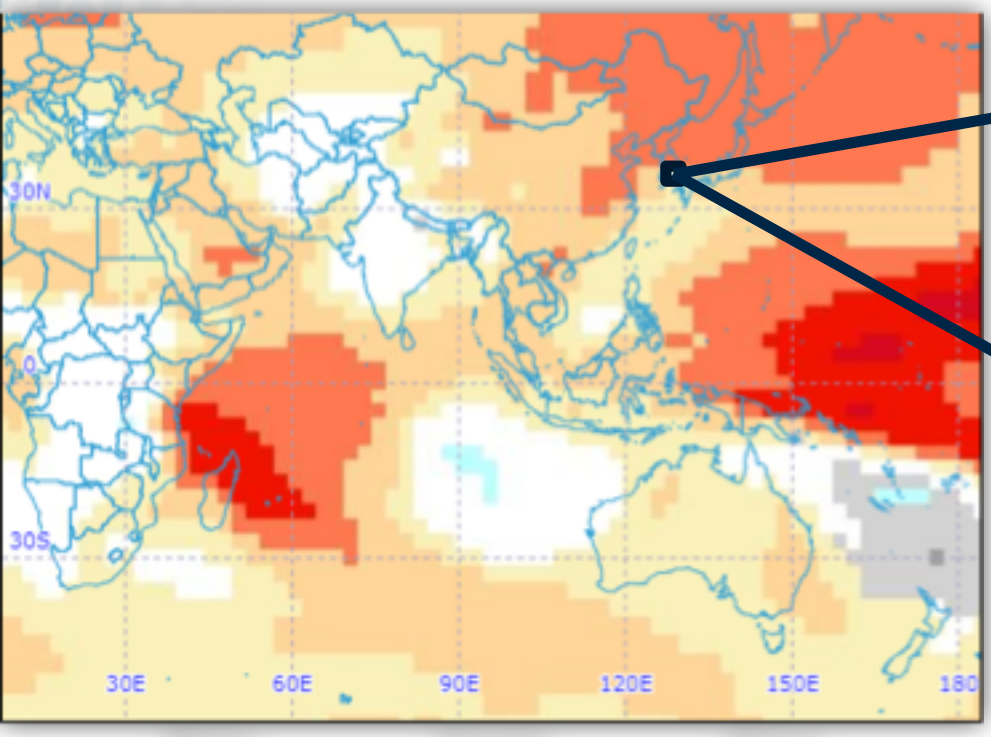


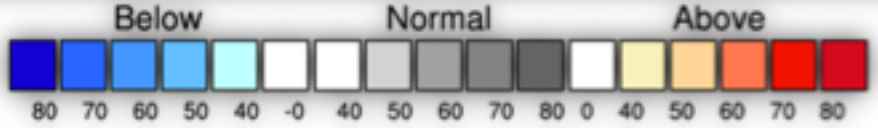


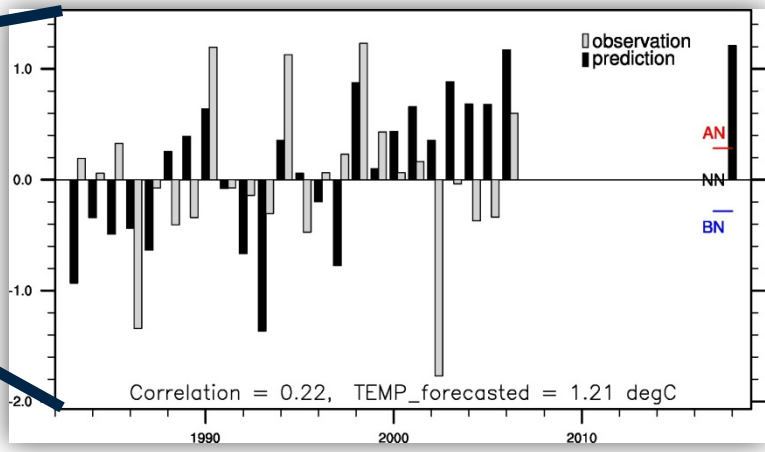
Lead Month: 3, Year: 2018, Season: 9, Methods: GAUS
Model: APCC,CMCC,CWB,MSC,NASA,NCEP,PNU,POAMA
created by CLIK(2018-8-22)

2018 SON Temp. forecast (Busan, KOREA)

PMME (dynamical, grid) & Downscaled (pointwise)



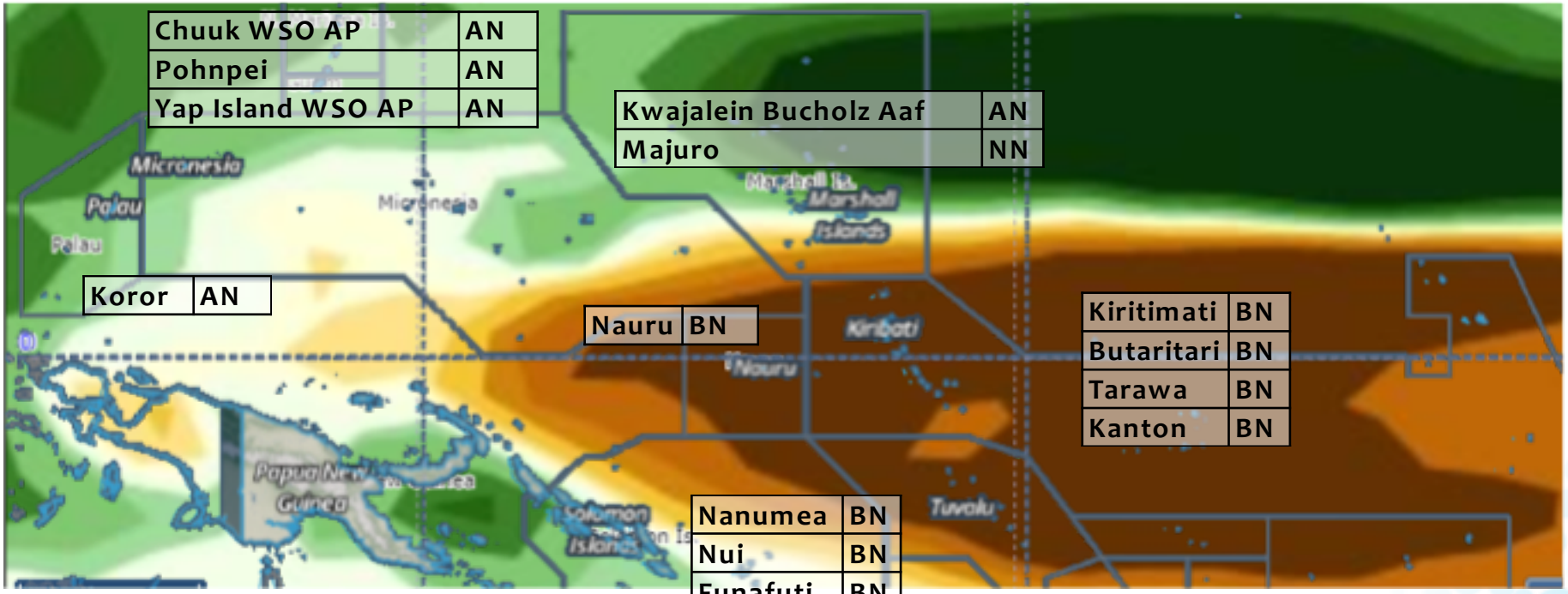




Lead Month: 3, Year: 2018, Season: 9, Methods: GAUS
Model: APCC,CMCC,CWB,MSC,NASA,NCEP,PNU,POAMA
created by CLIK(2018-8-22)

2018 MJJ Rainfall forecast (Pacific Islands)

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



Chuuk WSO AP	AN
Pohnpei	AN
Yap Island WSO AP	AN

Kwajalein Bucholz Aaf	AN
Majuro	NN

Koror	AN

Nauru	BN

Kiritimati	BN
Butaritari	BN
Tarawa	BN
Kanton	BN

Nanumea	BN
Nui	BN
Funafuti	BN
Niulakita	AN

Clik
Climate Information Toolkit

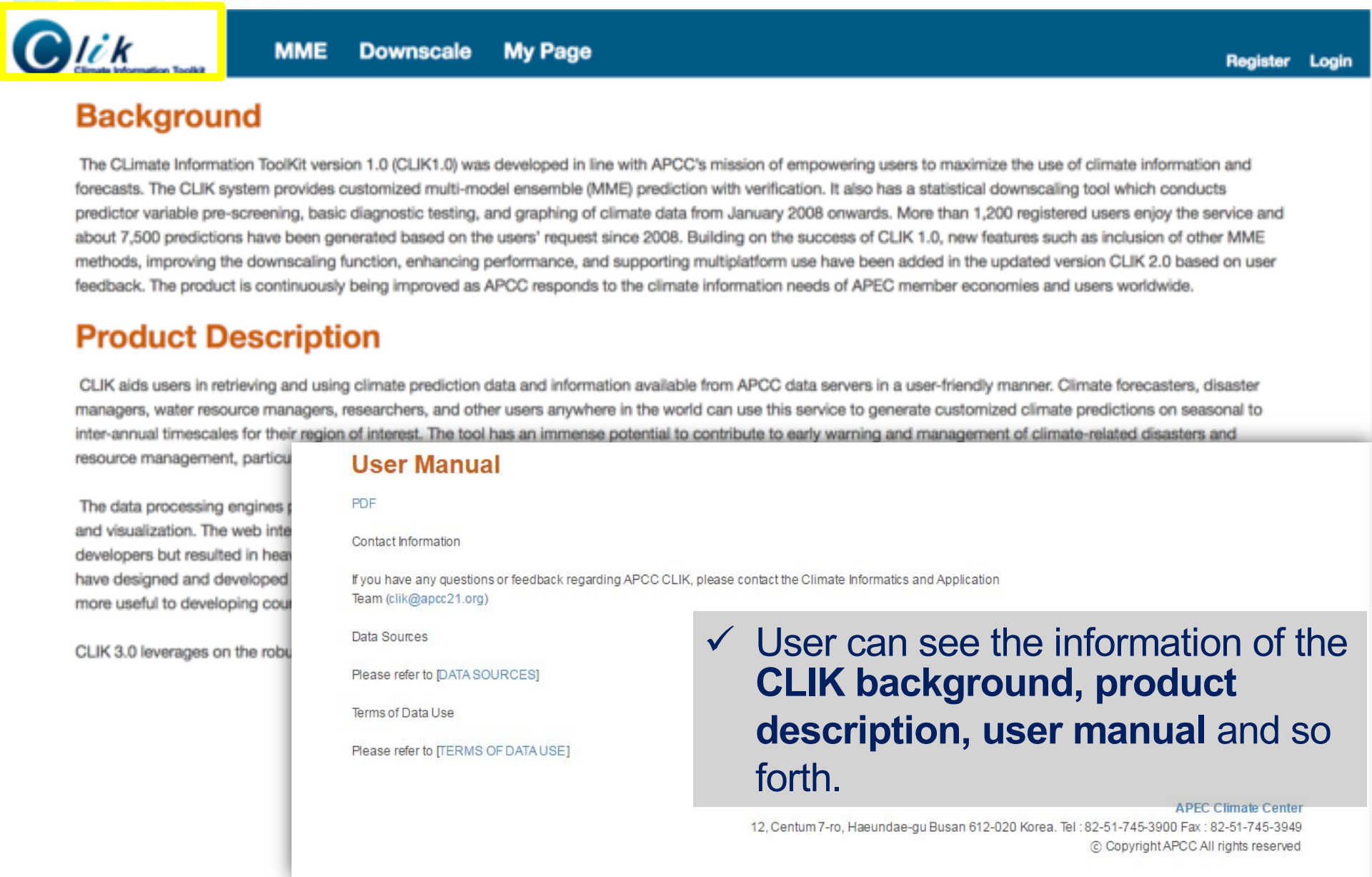
CLIK

CLimate Information ToolKit

http://clik.apcc21.org

http://clik.apcc21.org

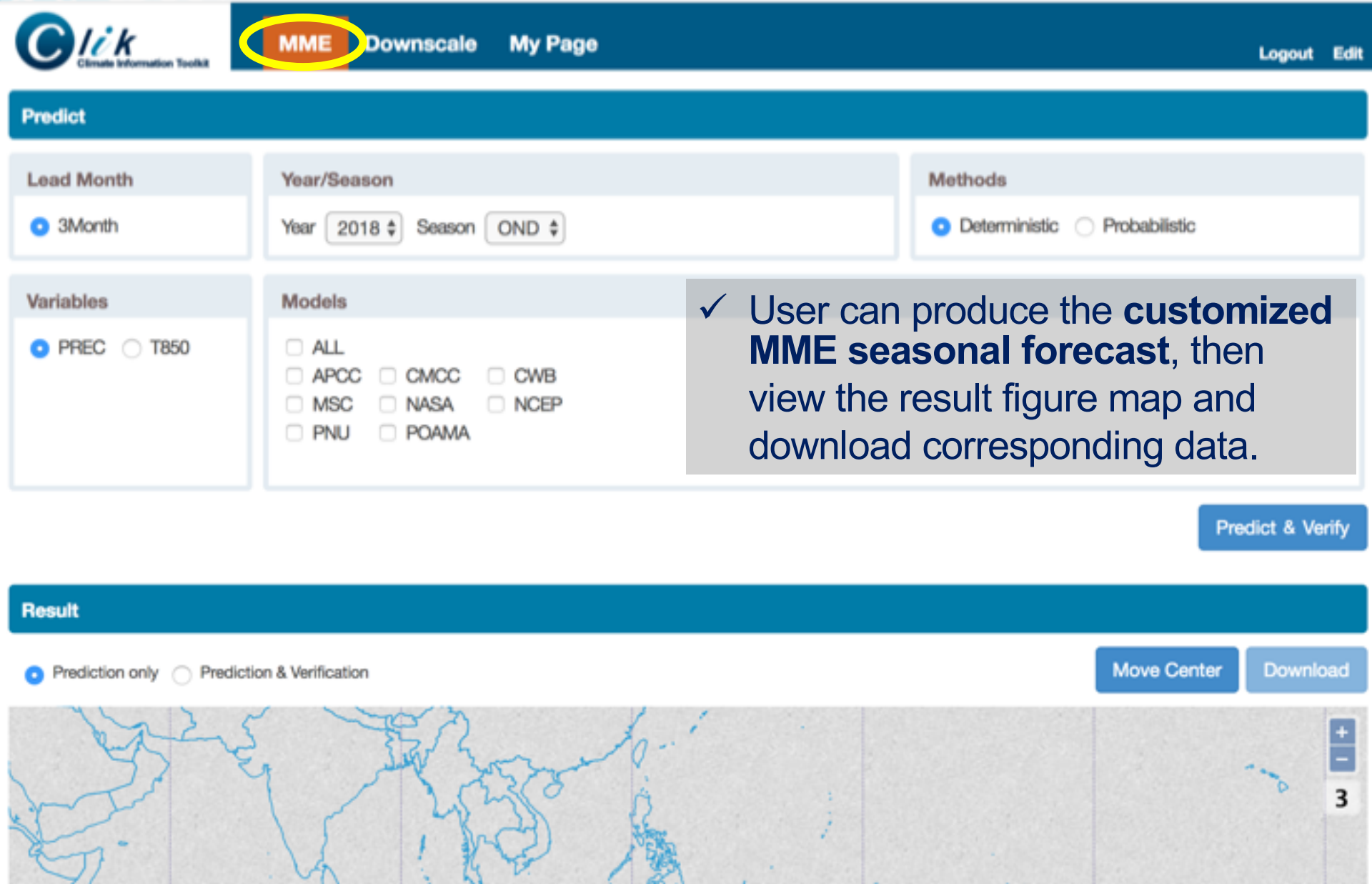
CLIK - main page



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

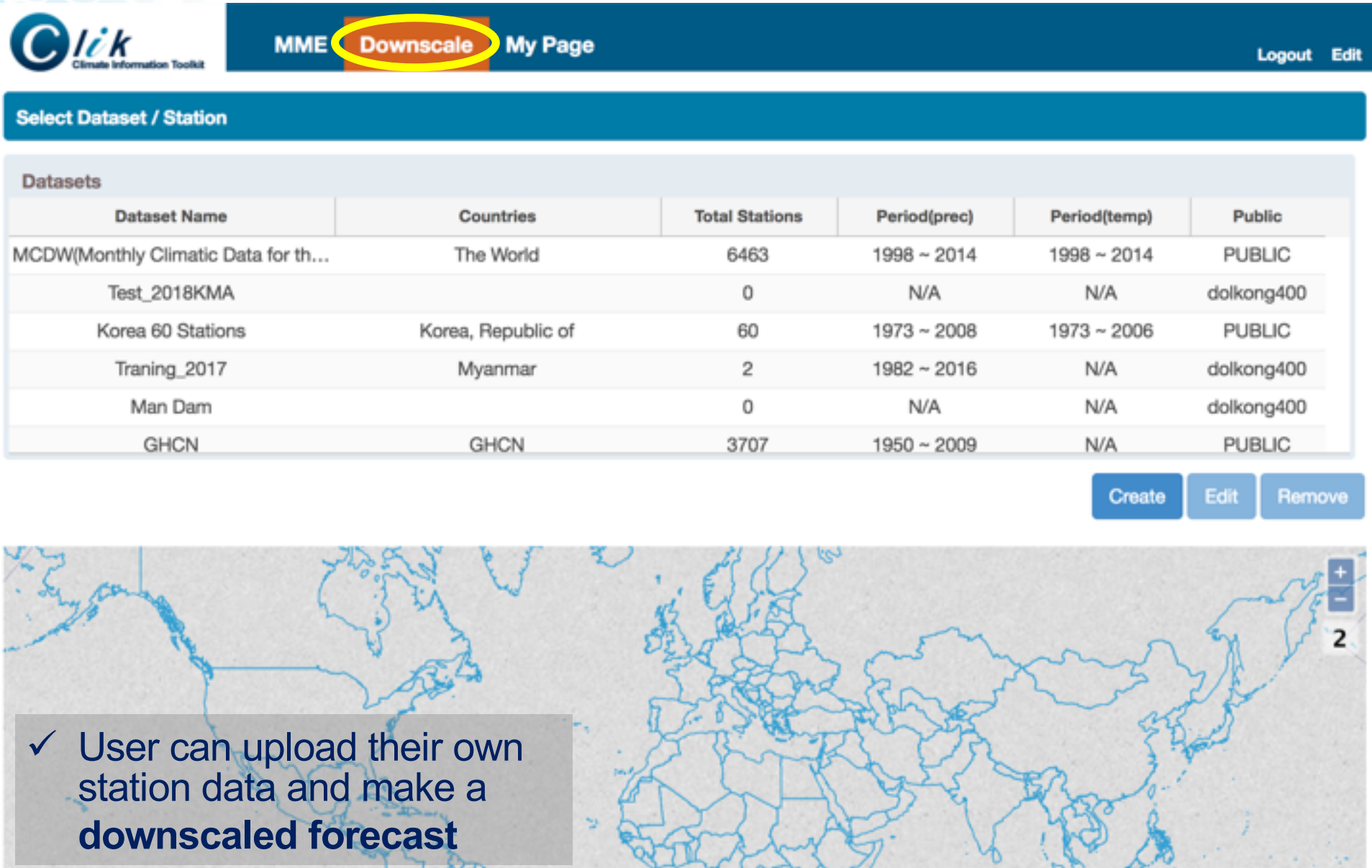
http://clik.apcc21.org

CLIK - "MME"



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

CLIK - "Downscale"



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

http://clik.apcc21.org

CLIK - "My Page"

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

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Registration

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http://clik.apcc21.org