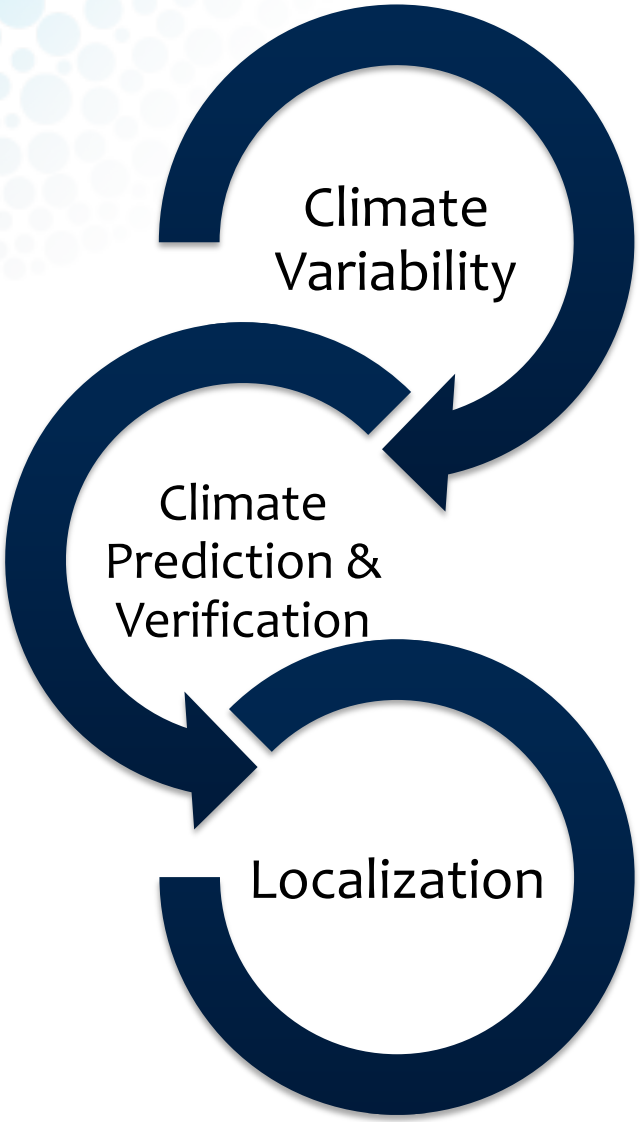
MME Seasonal Prediction & its Localization using CLIK



&

Clik
Climate Information Toolkit

Generating Seasonal Outlook

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

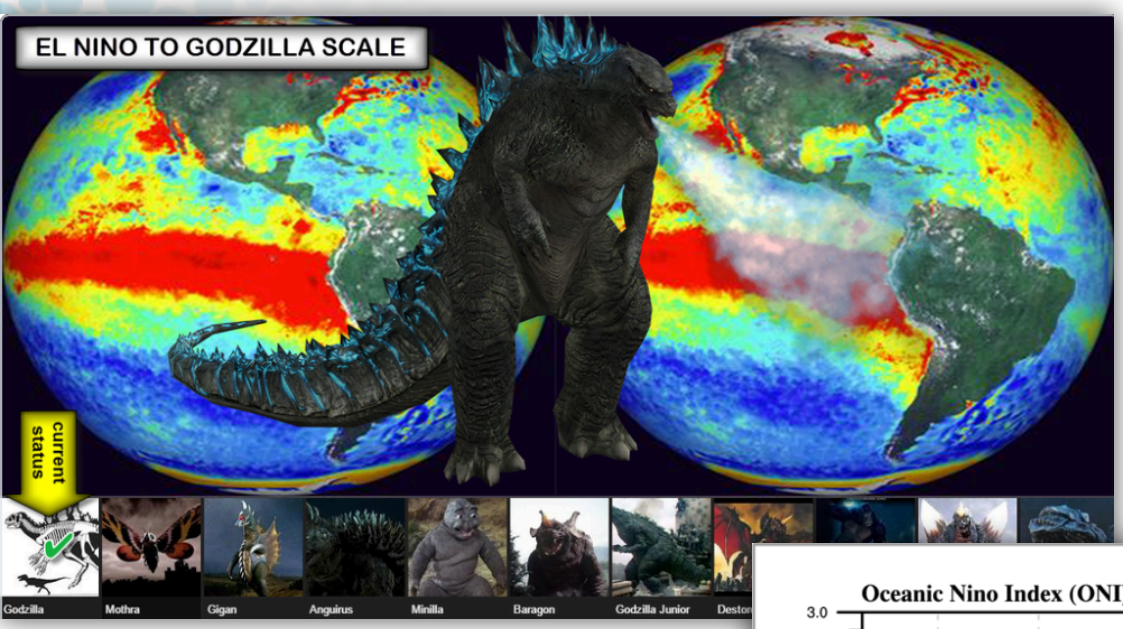
Indonesia landslide: 20 dead and dozens still missing

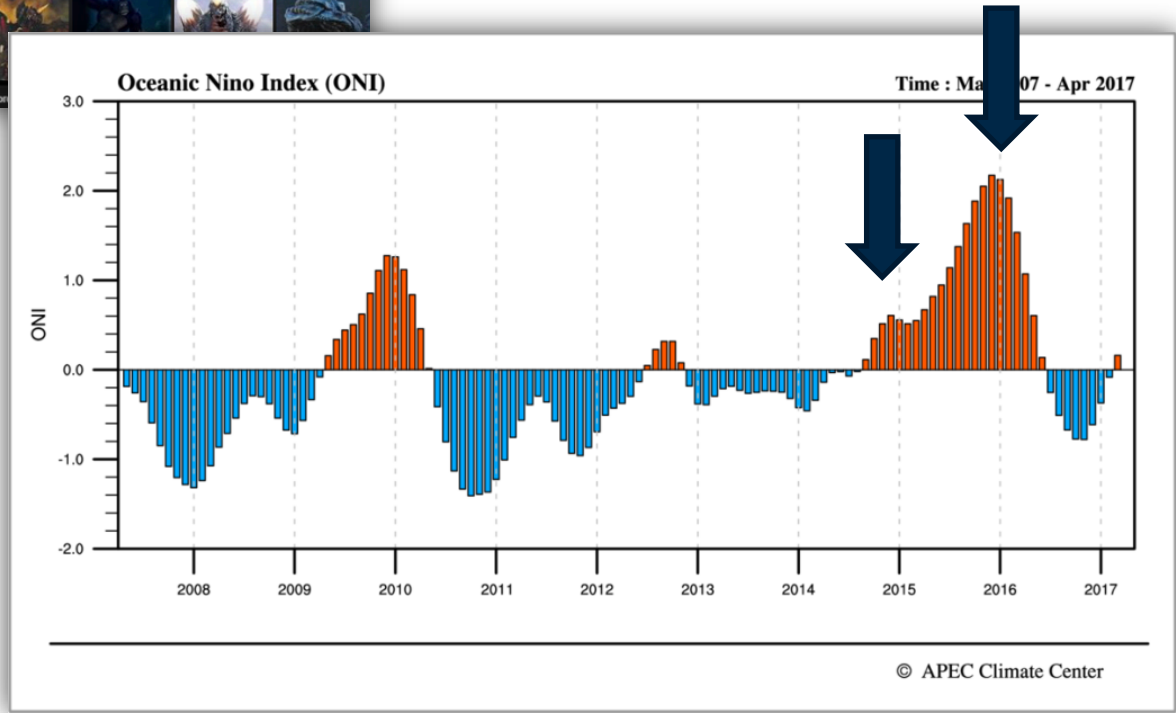
14 December 2014 | Asia

Landslide

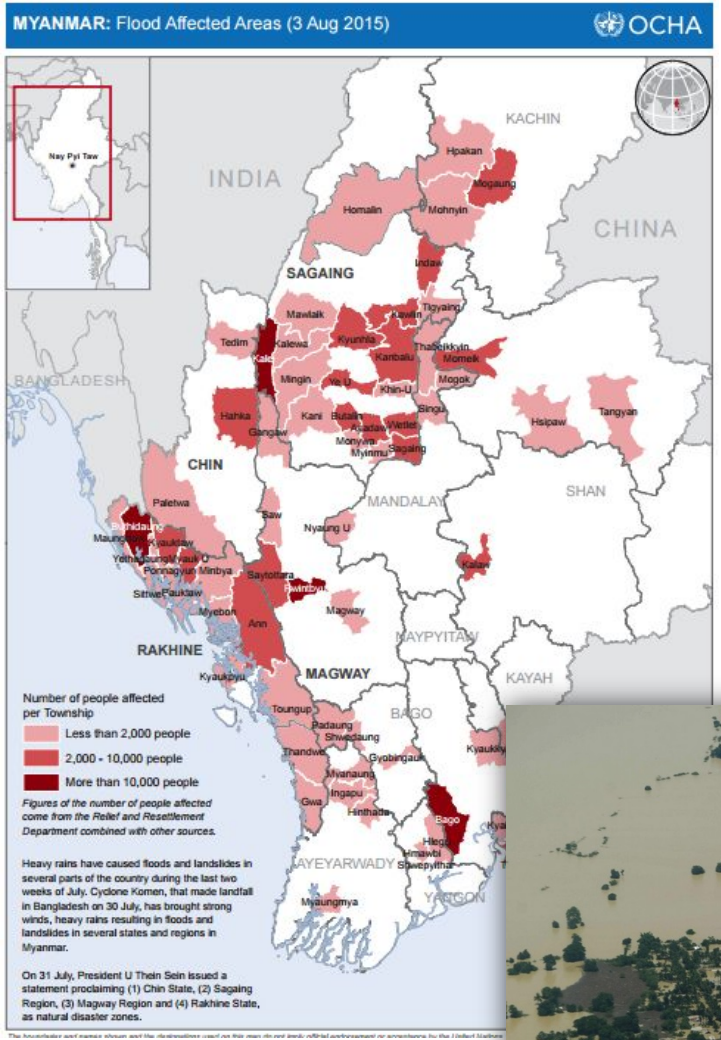
Rescuers, including local residents, are still hoping to find survivors

2015/16 prolonged (Godzilla) El Nino





2015 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

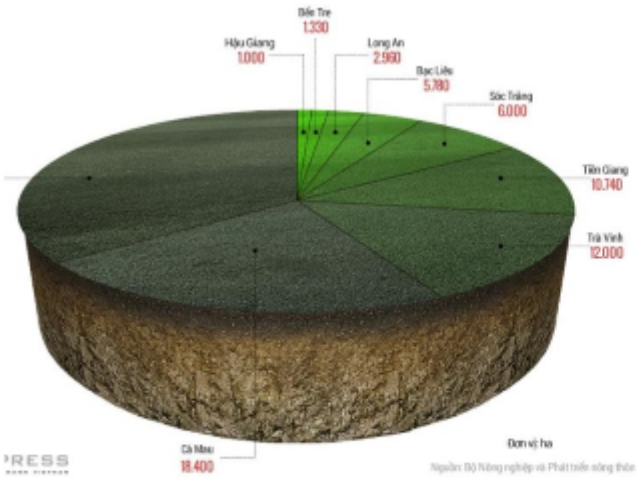
2015/16 Drought in Southeast Asia

Vietnam Consolidated Report on Drought and Saltwater Intrusion
Reporting period: Oct 2015 - Mar 2016

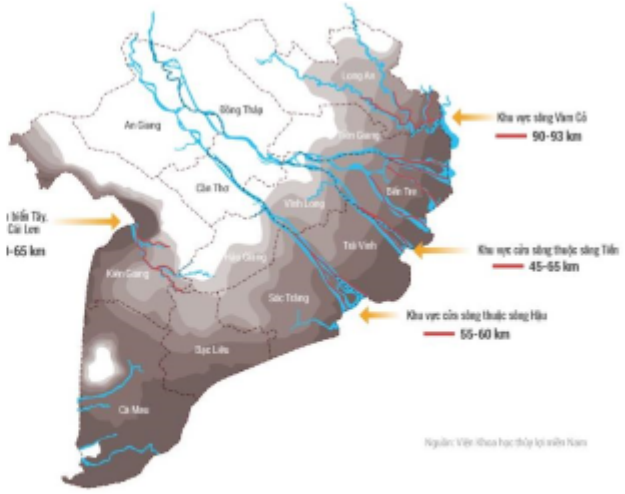
UNITED NATIONS VIET NAM

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)

2015 Drought in Thailand :during prolonged El Nino

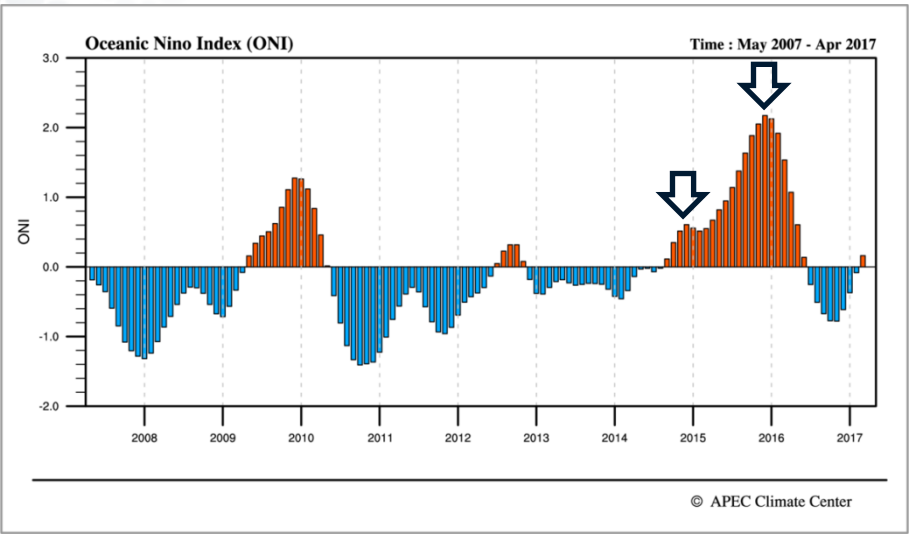
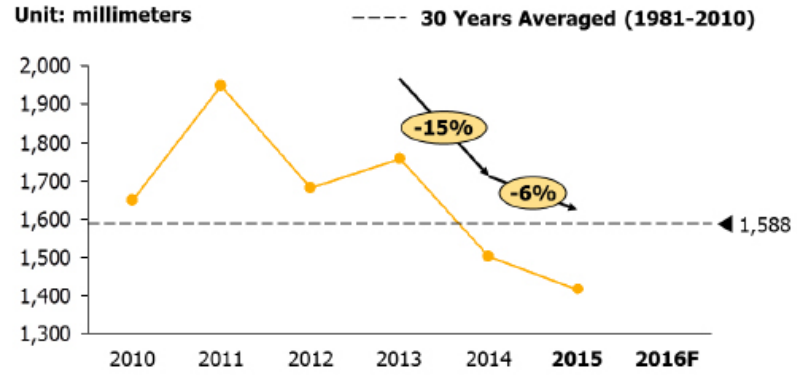
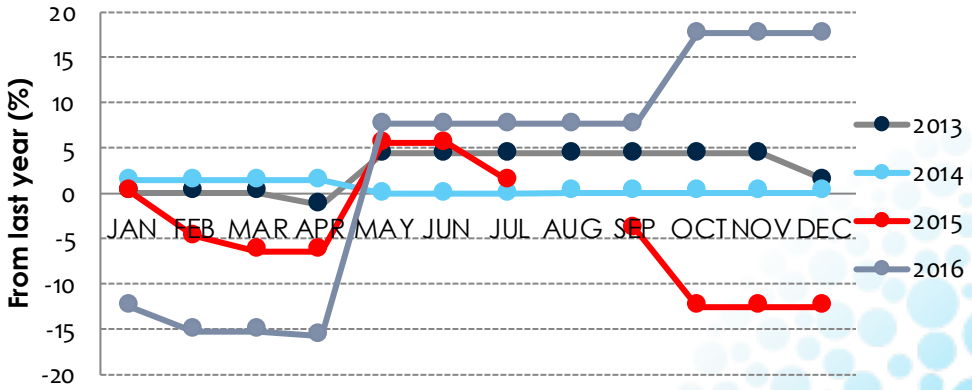


Figure 1: Cumulated rainfall in Thailand between 2010 and 2015



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

Rice: Change in production



Source: USDA World Agricultural Production

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

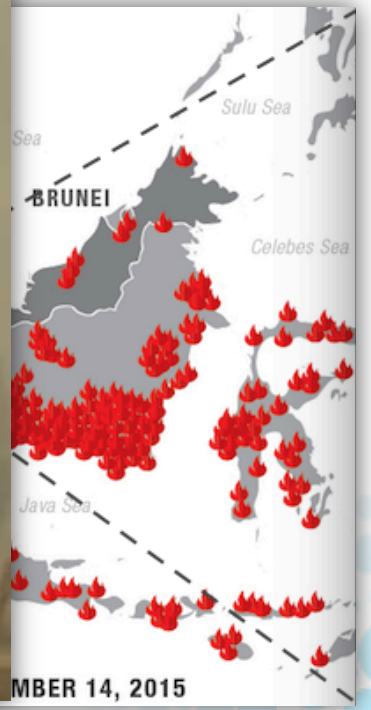
The Asian Forest Fires of 1997-1998

From October through Novemb
made front-page news around
the north, Sri Lanka to the wes
Southeast Asian "tiger" econor
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 o
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:

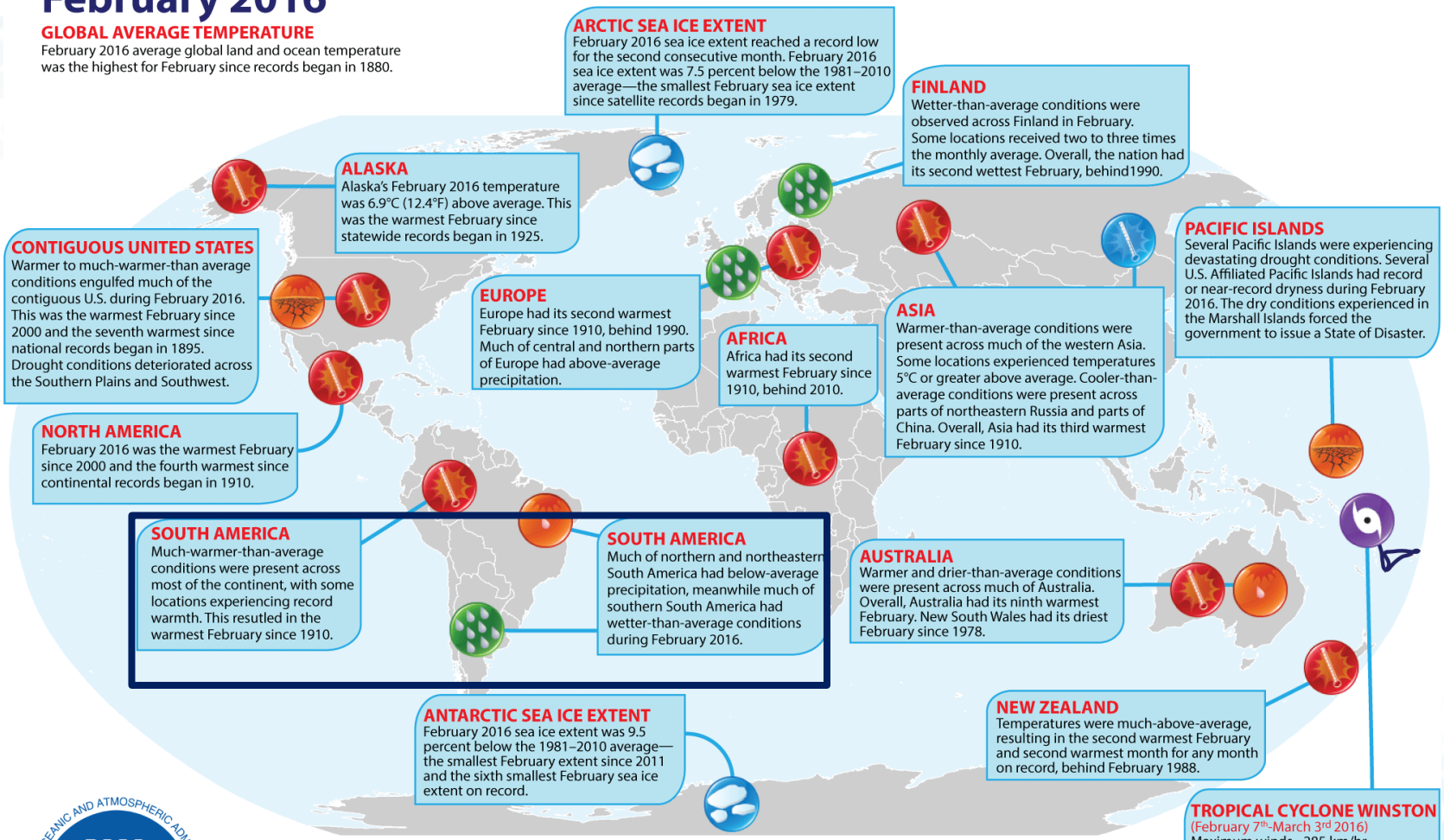
https://en.wikipedia.org/wiki/1997_Indonesian_forest_fires



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:

Feb 2016

Selected Significant Climate Anomalies and Events
February 2016



Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: http://www.ncdc.noaa.gov/sotc

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Climate disasters during El Nino

ENSO:

Peru is one of the countries that suffered most the effects of El Niño season, with several floods and landslides reported all over the country from north to south.

Heavy rains fall in the normally rainless **coastal regions**, leading to flooding and associated phenomena. At the same time, the **highlands** can suffer from **crippling droughts**. The 1997-1998 El Niño -- the worst in recent history -- affected an estimated 600,000 people, including hundreds of fatalities, 40,500 homes damaged or destroyed and the washing away of thousands of miles of roads and bridges.

http://goperu.about.com/od/healthandsafety/tp/Natural-Hazards-In-Peru.htm
http://floodlist.com/america/strong-el-nino-increased-preparedness-2015-2016-south-america

During 15/16 El Nino

The major impact in term of floods occurred between December 2015 and January 2016, especially in northern Argentina, southern Brazil, Paraguay and Uruguay with the Paraná, Paraguay and Uruguay Rivers inundation that caused more the 150,000 people from their homes.

Localized floods occurred in Guayaquil (25 January 2016), Cordoba (15 February 2016), Arequipa (22 February 2016), La Paz (24 February 2016), Rio de Janeiro (29 February 2016) and São Paulo (11 March 2016).

http://floodlist.com/america/strong-el-nino-increased-preparedness-2015-2016-south-america

During 15/16 El Nino

Heavy Rain in Central and Southern Peru – 1 Dead, 1 Missing

25 FEBRUARY, 2016 BY ALESSANDRO MASOERO IN AMERICAS, NEWS

Pachamama Radio
@PachamamaRadio

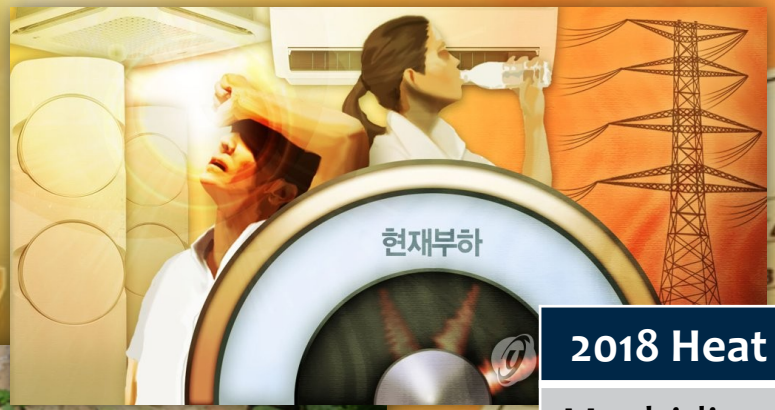
Follow

tinyurl.com/hvvrcyu Senamhi Puno declaró alerta naranja en la región

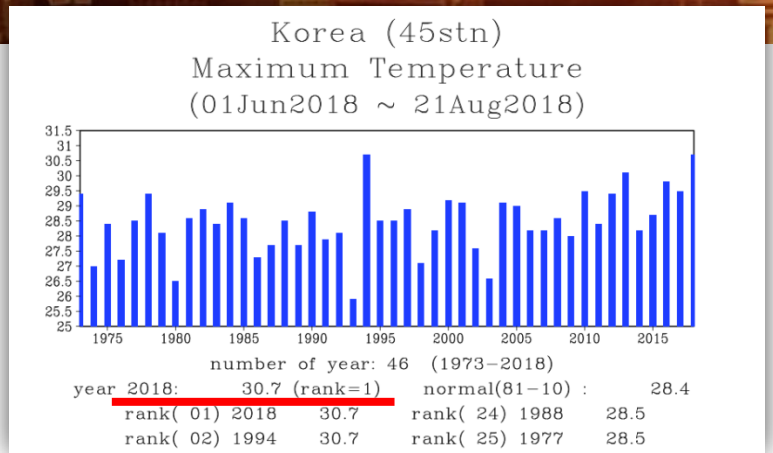
2:06 AM - 25 Feb 2016

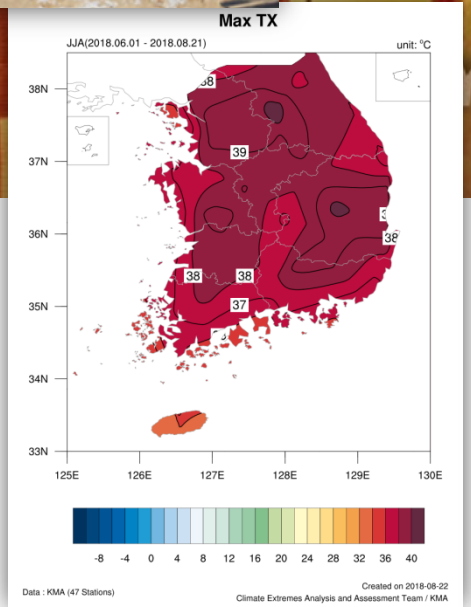
FOTOS. Lluvia de 10 horas y apagón afectaron la ciudad de Arequipa

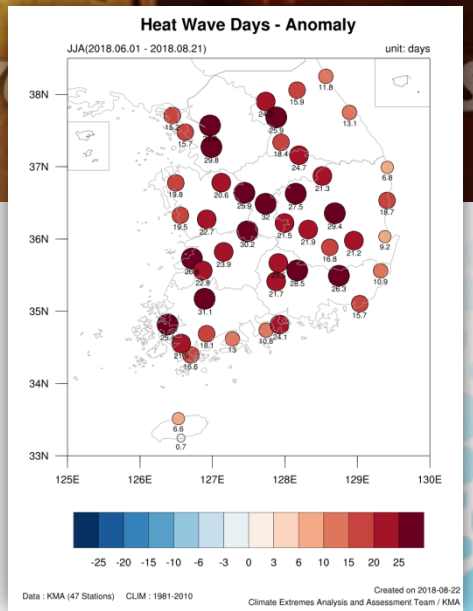
2018 Korea Heat Wave



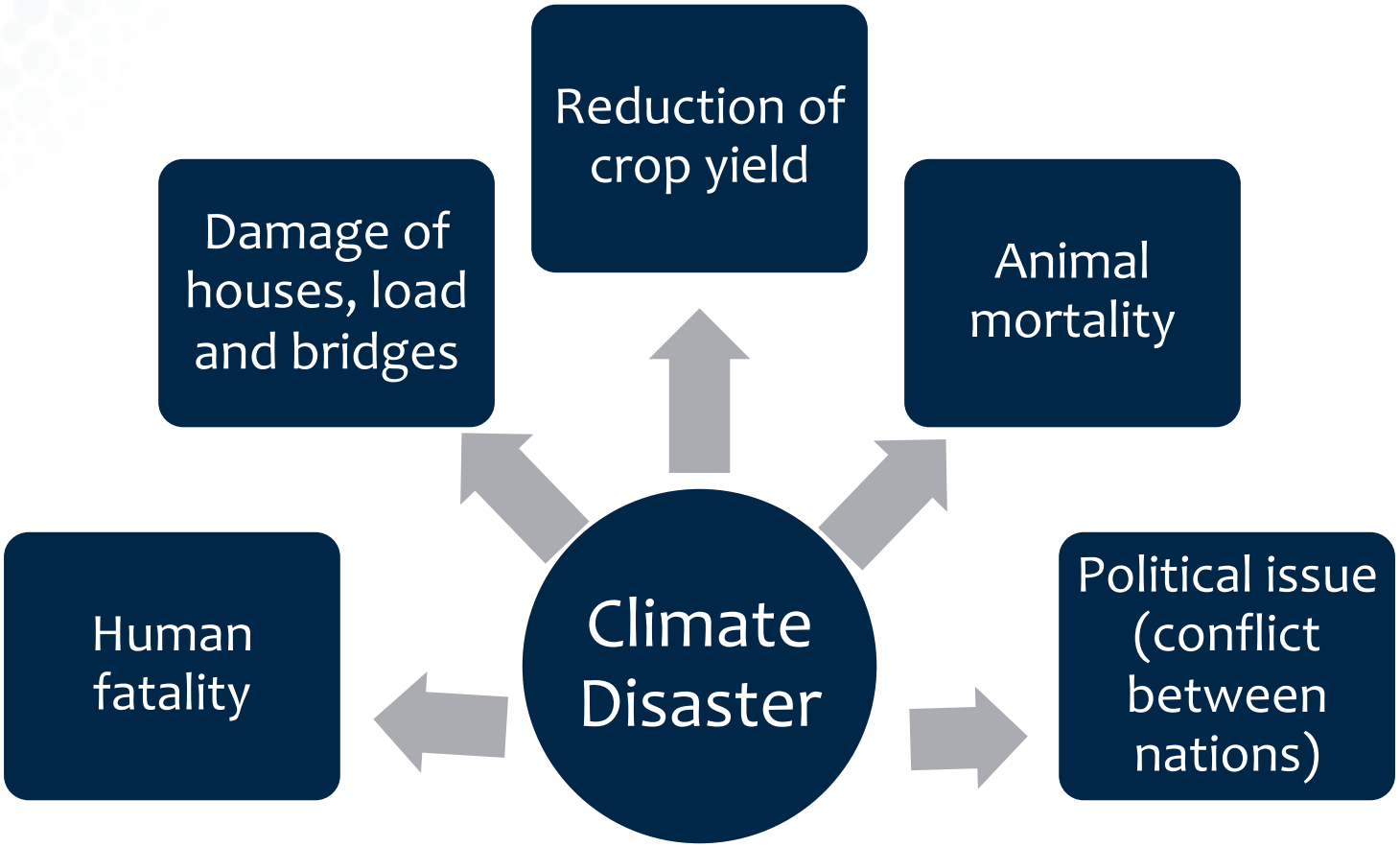
2018 Heat Wave related-	
Morbidity	4301
Fatality	48







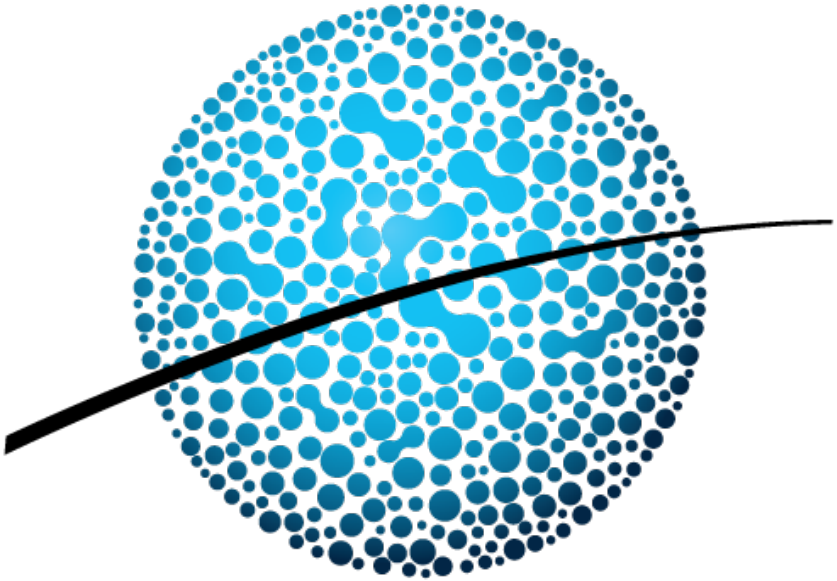
Importance of “Accurate” prediction



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

High-end climate information service center

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



APCC

APEC CLIMATE CENTER

http://apcc21.org

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

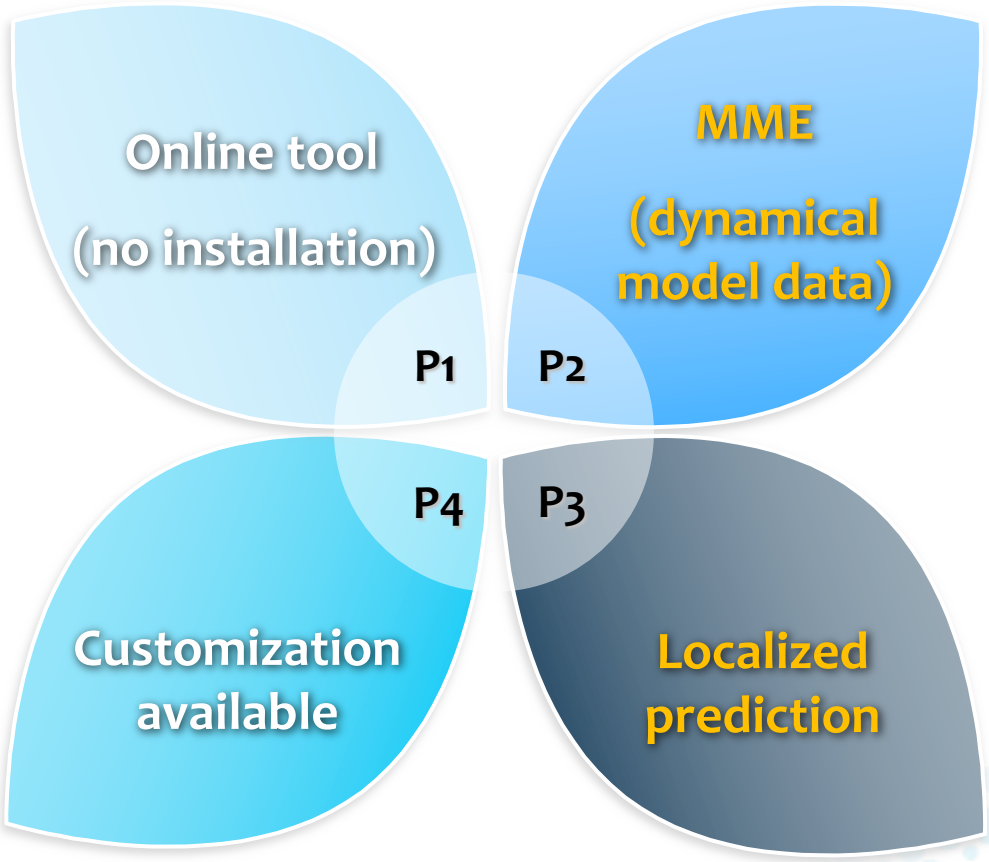
CLimate Information ToolKit

http://clik.apcc21.org

Climate Information Toolkit

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

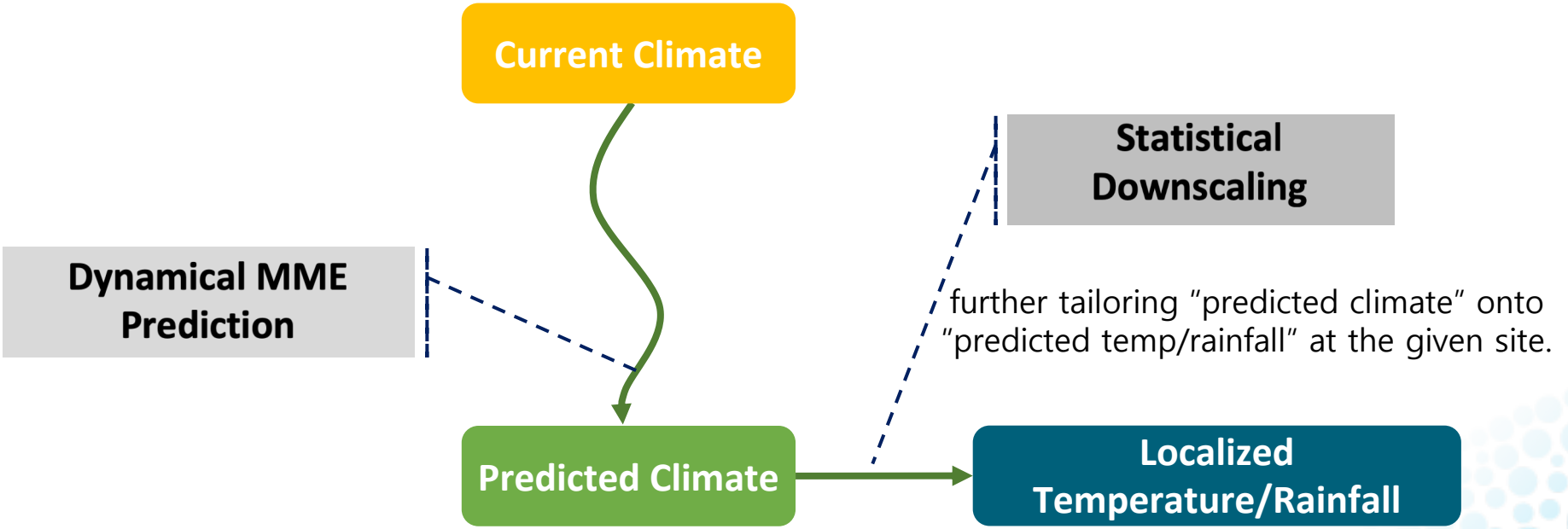
1. Limitation of manpower and computing resources
2. Desire for utilizing **dynamical forecast data**
3. Direct benefit on **regional community**
4. Thirsty for Capacity building: Interests in learning science and technology and high satisfaction when participating in the model developing process



➔ 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

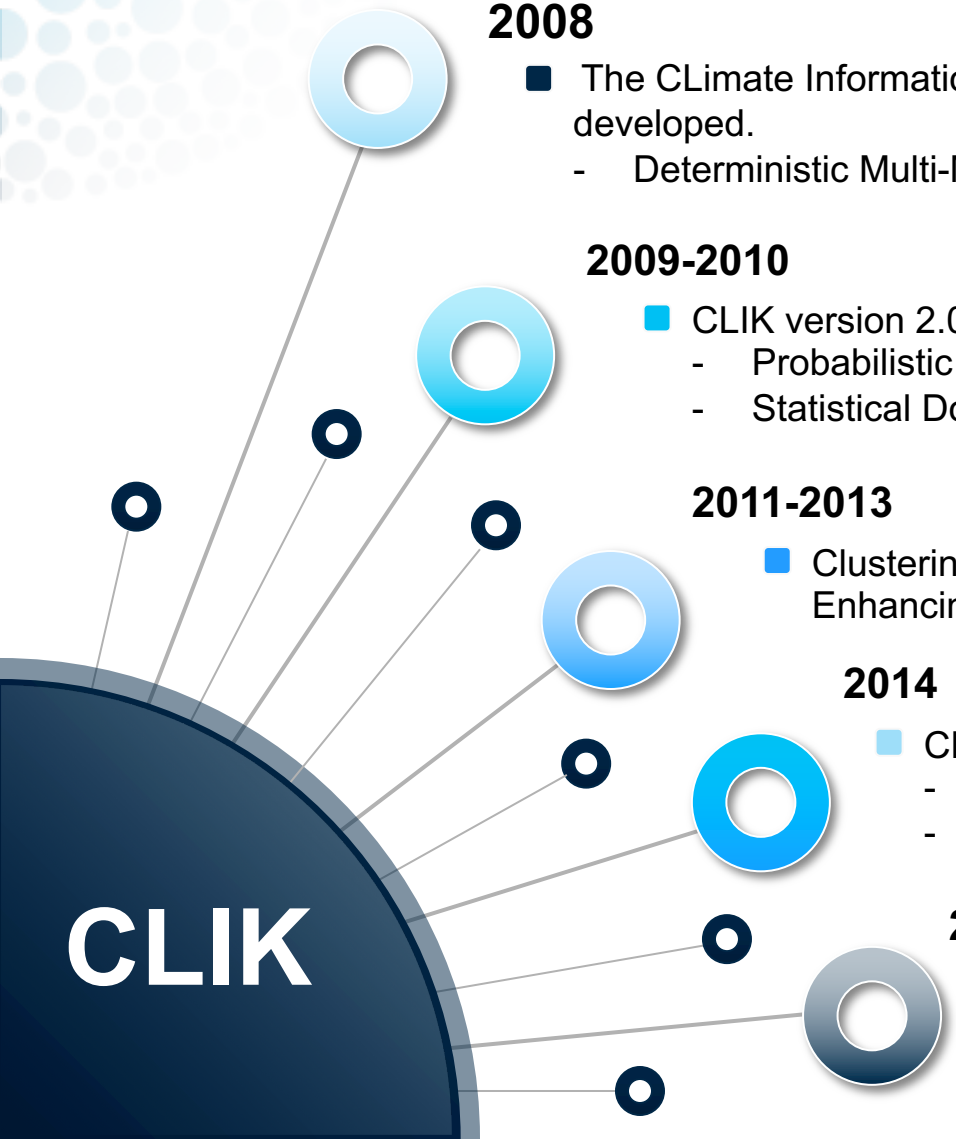
Downscaling:
Simulated large scale pattern to station matching

▸ To provide statistical downscaling capability using **Individual models & 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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Why MME?

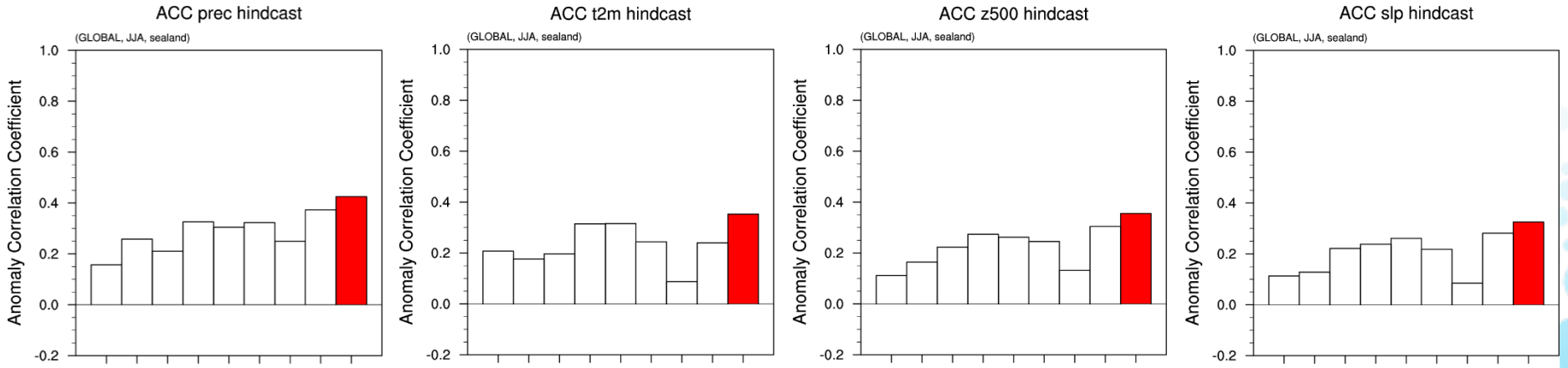
- Climate predictions have huge ***uncertainty!***

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

Continuous variable forecast

SCM

Simple Composite Method:
Average of individual forecast with equal weighting

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

Probabilistic

Tercile category forecast

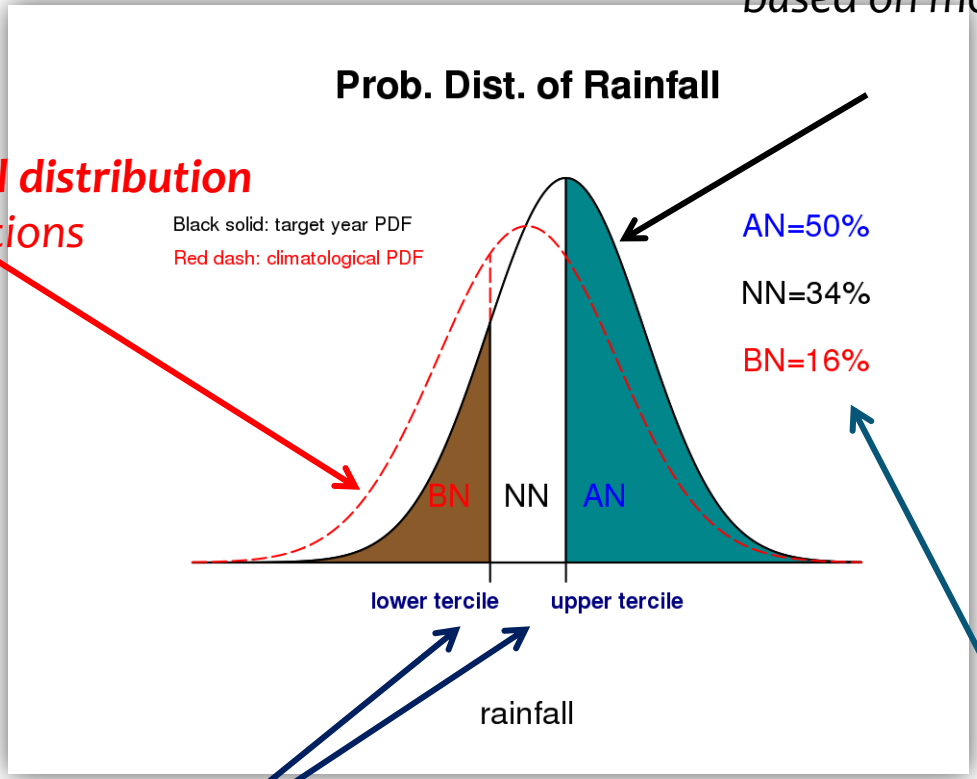
GAUS

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

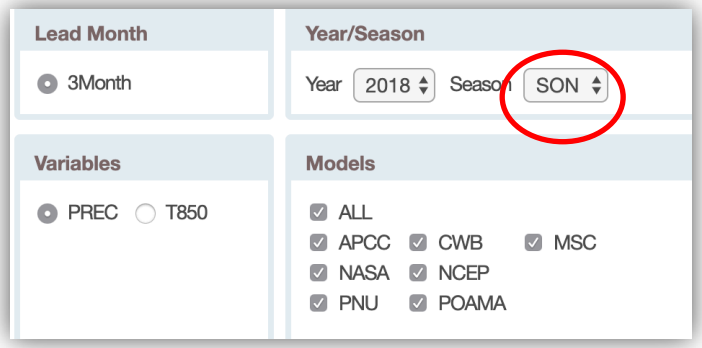
Climatological distribution
from observations

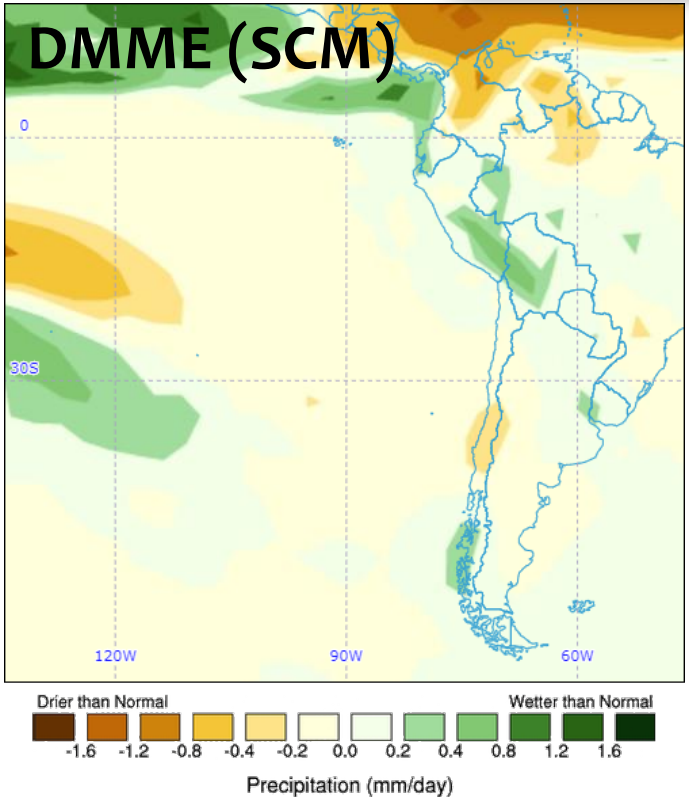


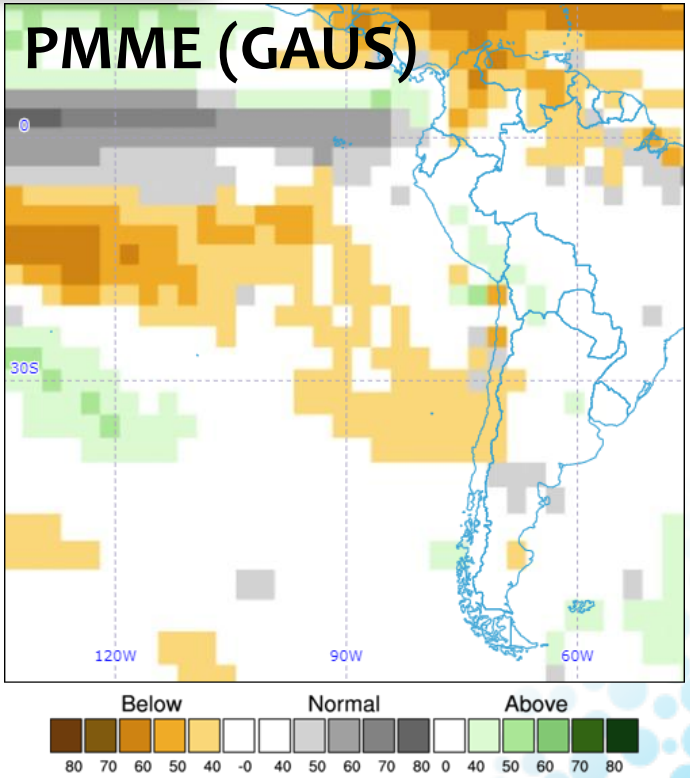
LT & UT
(thresholds to separate area under curve into 1/3)

Probability of AN/NN/BN condition
= percent of brown/white/green are a under curve

MME PREDICTION







MME_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**)*

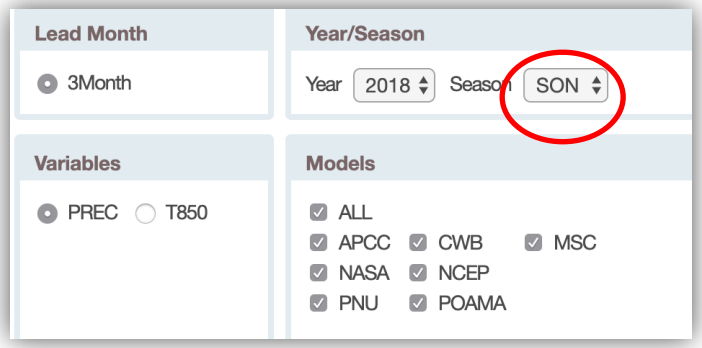
*/(perfect score – **score by chance**)*

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

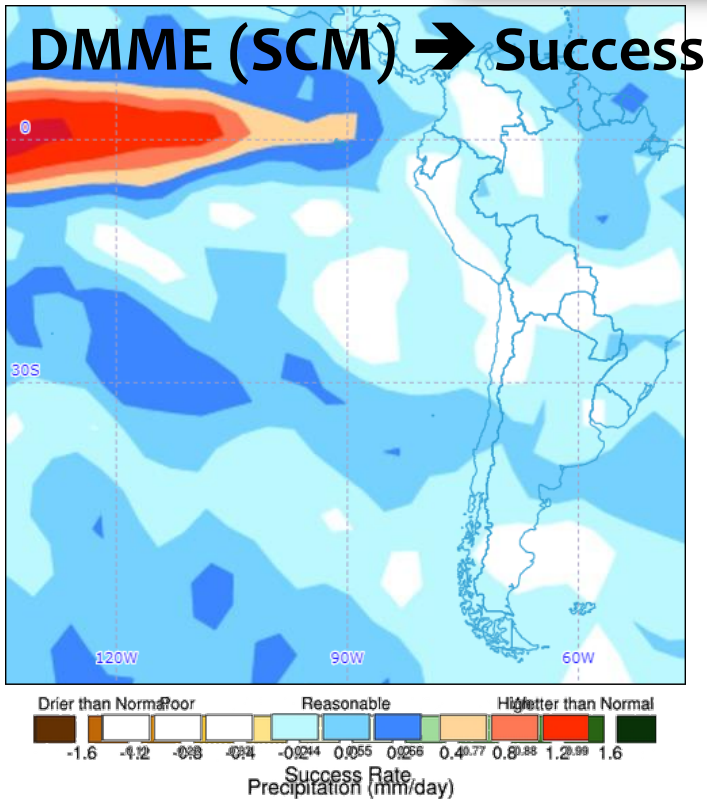
$/\{1 - [(h+f)(h+m)+(f+c)(m+c)]/n^2\}$

>0 : better than random forecast

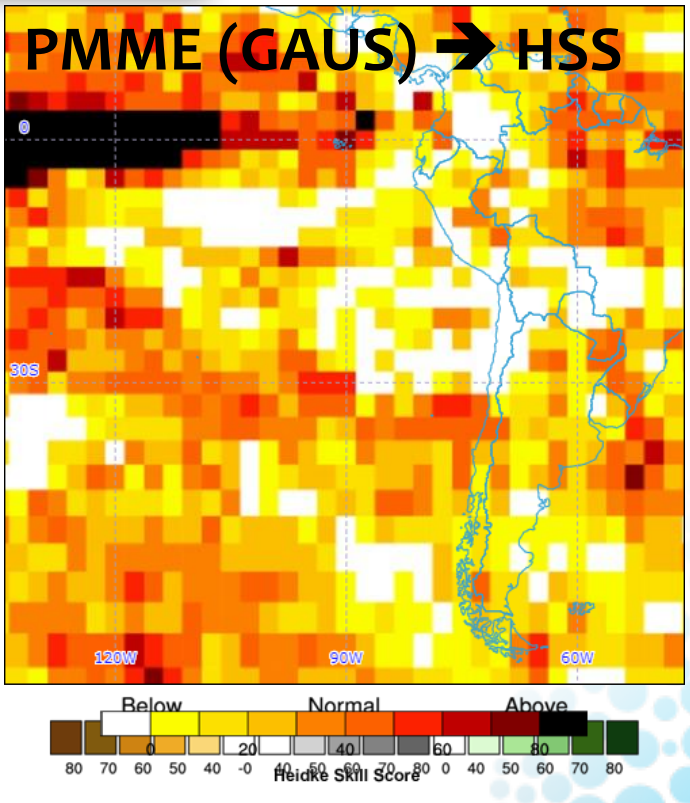
MME_verification_score



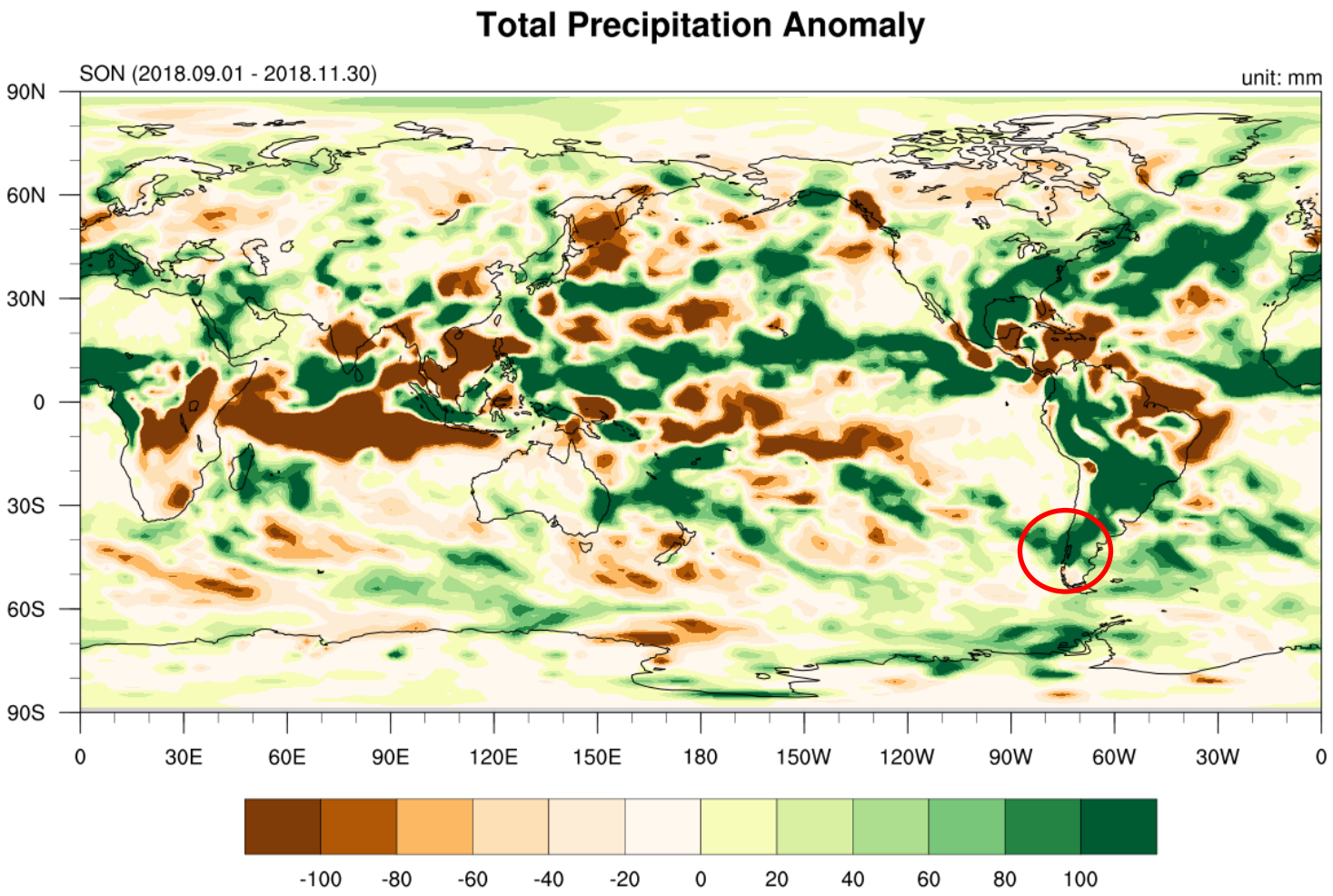
DMME (SCM) ➔ Success rate



PMME (GAUS) ➔ HSS



2018 SON


Total Precipitation Anomaly
SON (2018.09.01 - 2018.11.30)
unit: mm
90N
60N
30N
0
30S
60S
90S
0
30E
60E
90E
120E
150E
180
150W
120W
90W
60W
30W
0
-100
-80
-60
-40
-20
0
20
40
60
80
100
Data : NCEP RA1
Level : surface
CLIM : NCEP(1981-2010)
Created on 2018.12.04
Climate Extremes Analysis and Assessment Team / KMA

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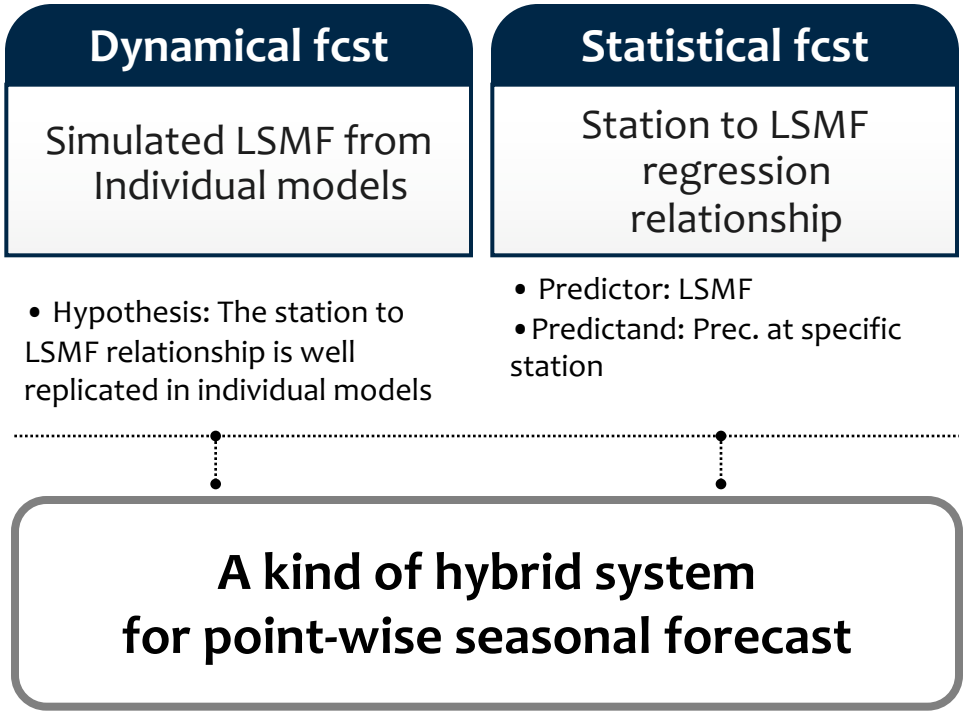
CLIK downscaling

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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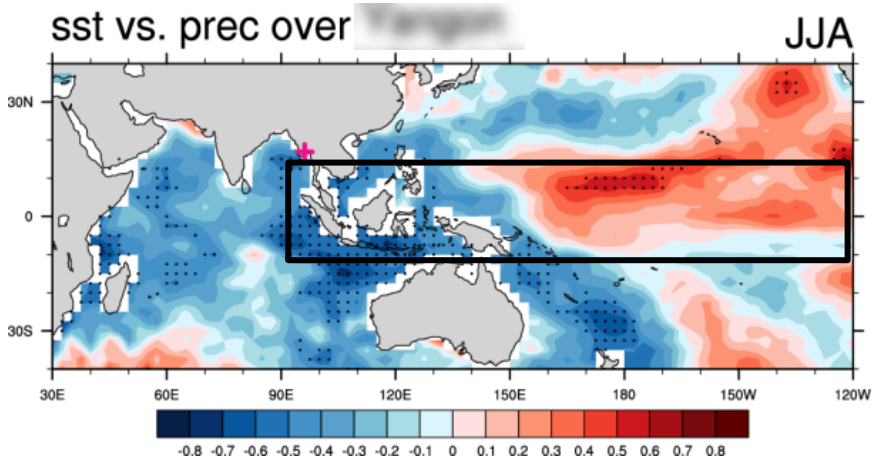
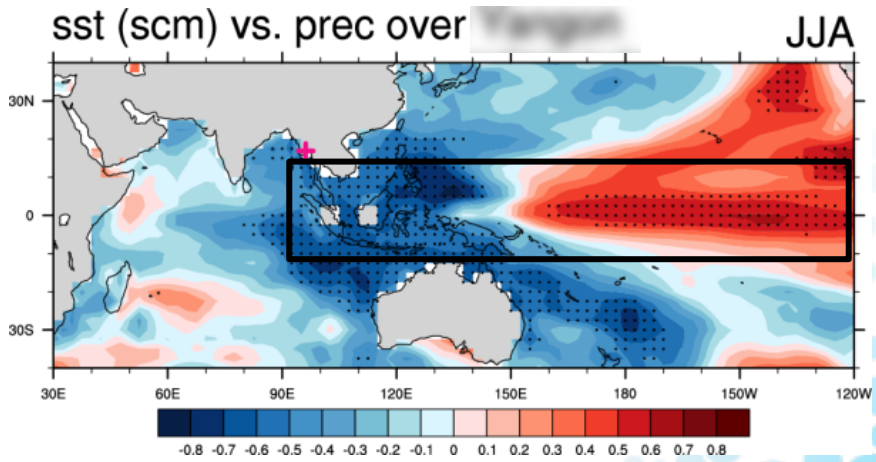
Empirical relationship: LSMP (OBS) ~ local station rainfall

LSMP (Model) → Local station rainfall





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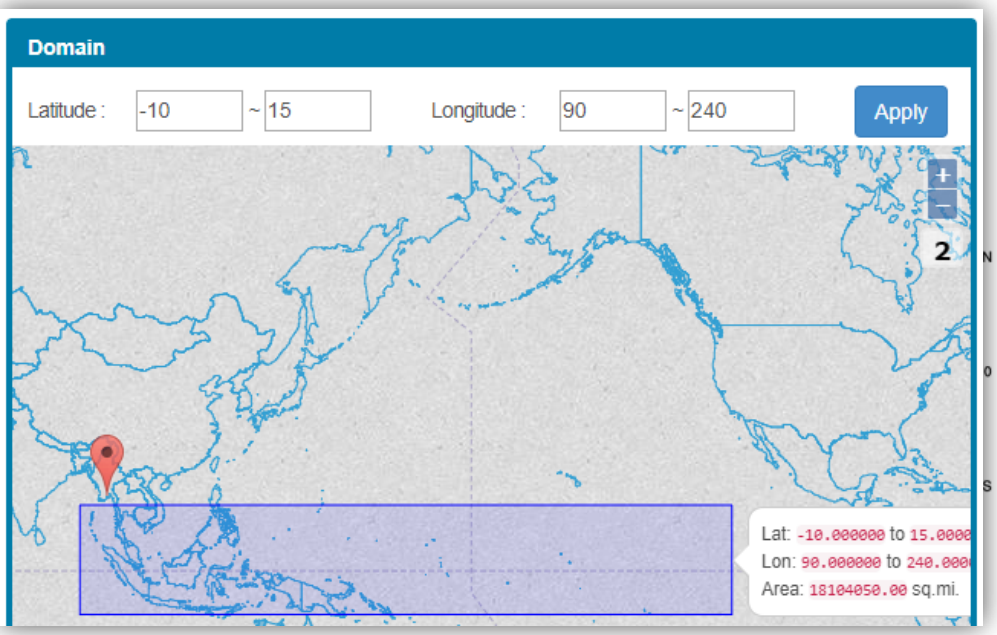
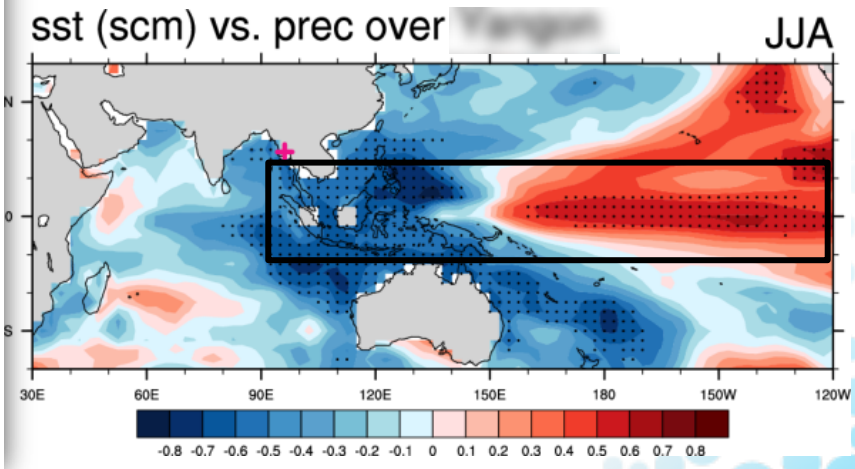
CLIK downscaling is mainly based on station to Large Scale Meteorological Field (LSMF) relationship. (Y = a*X + b) By utilizing the simulated LSMF (X, predictor), CLIK estimates seasonal mean precipitation/temperature (Y, predictand) at specific station.

Empirical relationship: LSMP (OBS) ~ local station rainfall

LSMP (Model) → Local station rainfall

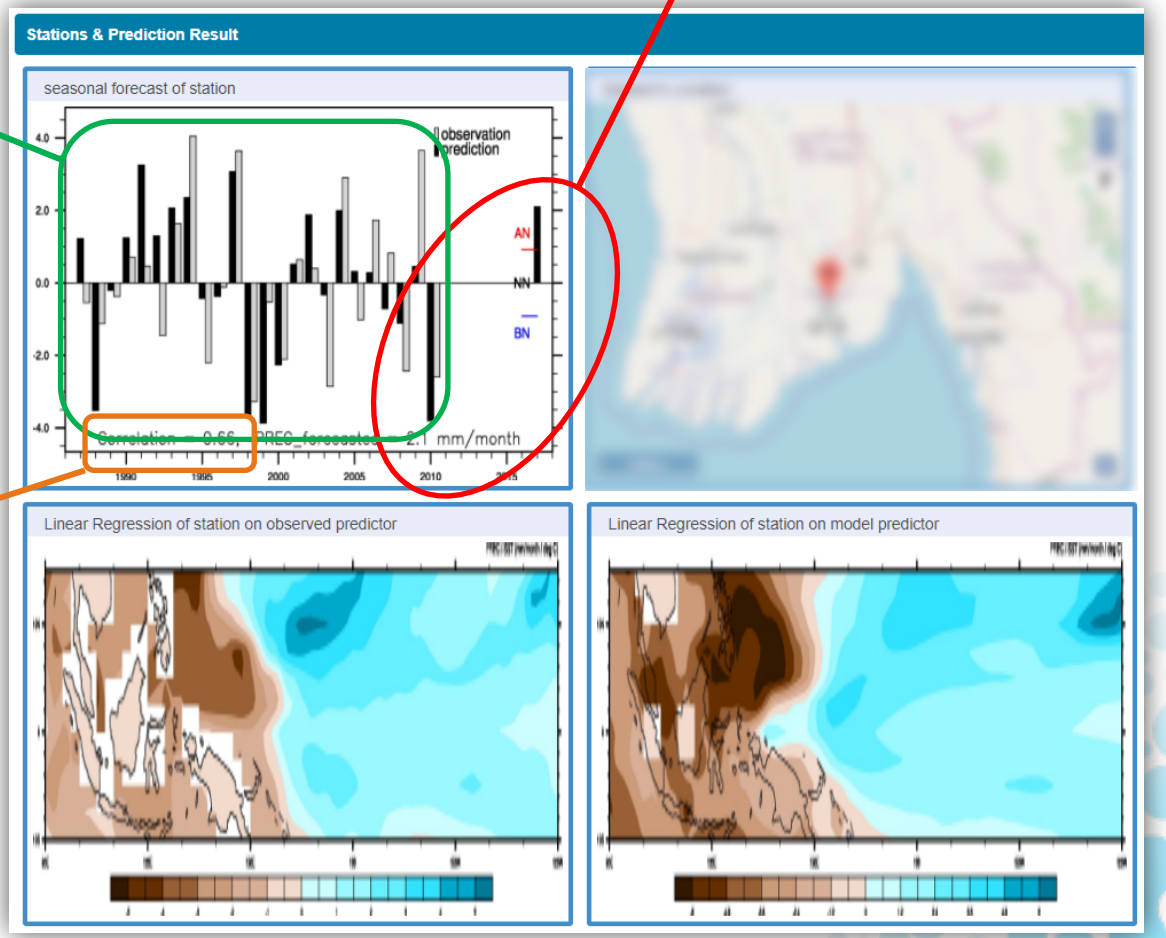




Downscaled forecast at a given site

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

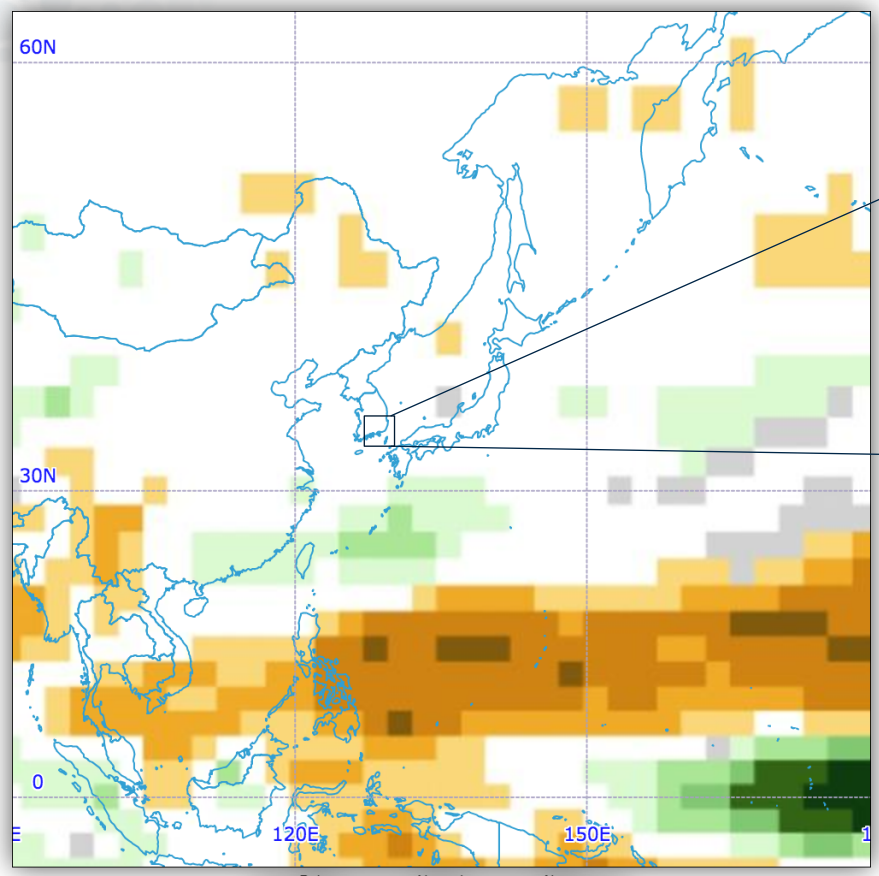
Historical time series: obs & downscaled from model

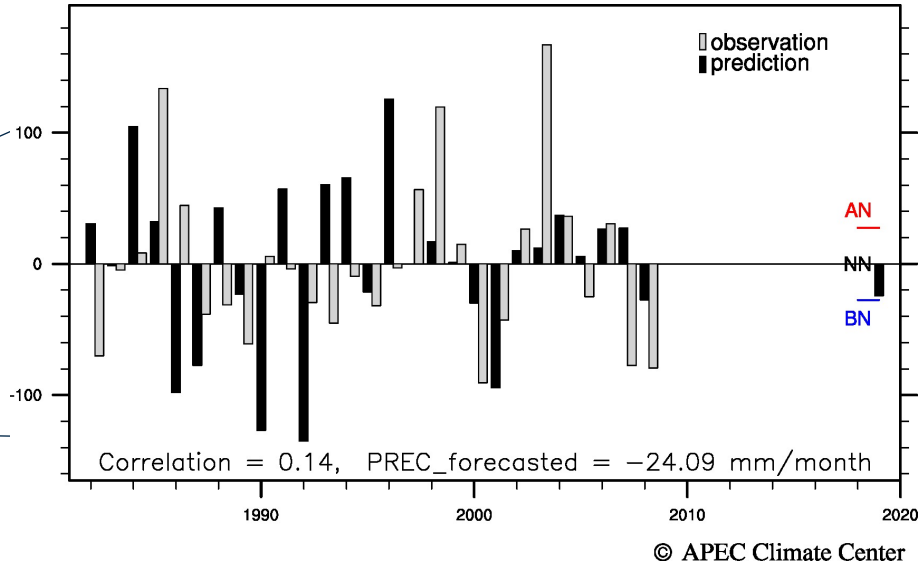


Temporal Correlation Coefficient (**TCC**) **skill**

2019 AMJ Rainfall forecast (Busan, KOREA)

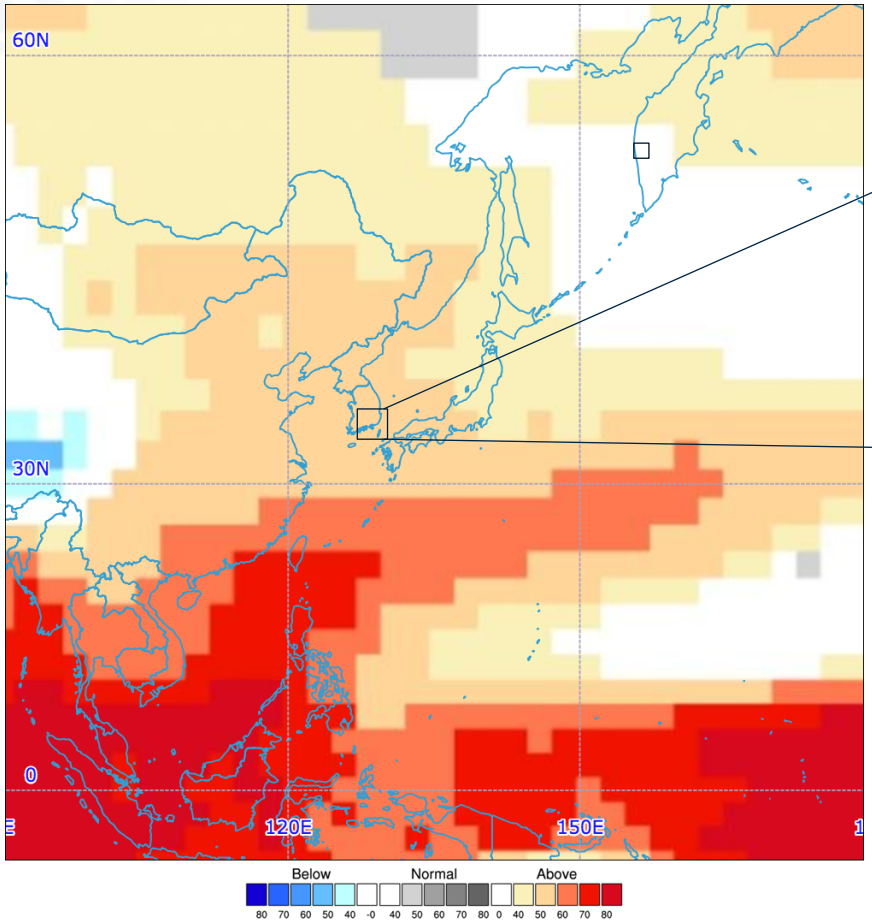
PMME (dynamical, grid) & Downscaled (pointwise, NCEP)

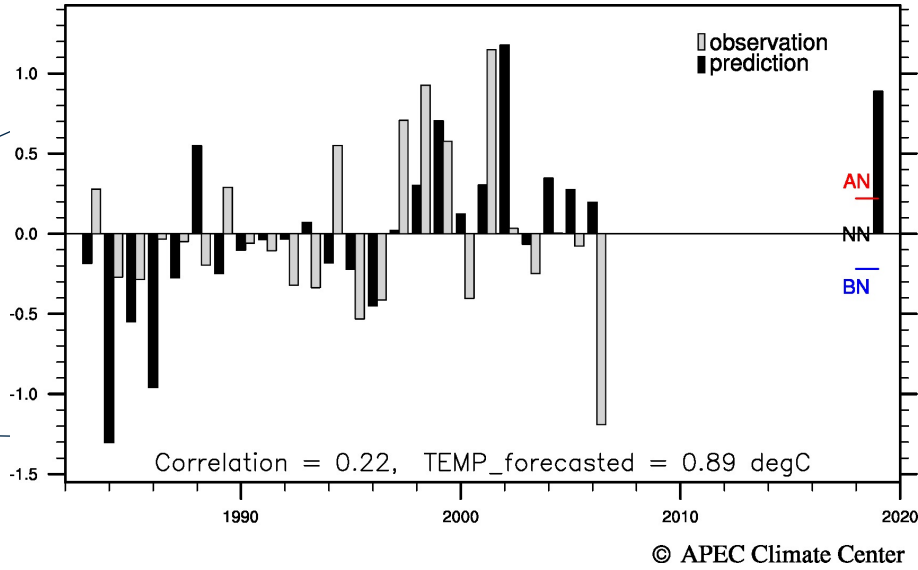




2019 AMJ Temp. forecast (Busan, KOREA)

PMME (dynamical, grid) & Downscaled (pointwise, SCM)





Busan 2019 AMJ mean temp.	17.87 degC
Normal (median)	17.27 degC
	+ 0.6 degC

Clik
Climate Information Toolkit

CLIK

CLimate Information ToolKit

http://clik.apcc21.org

http://clik.apcc21.org

CLIK - main page

Clik Climate Information Toolkit

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 heav
have designed and developed
more useful to developing cou

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.

APEC Climate Center
12, Centum 7-ro, Haeundae-gu Busan 612-020 Korea. Tel : 82-51-745-3900 Fax : 82-51-745-3949

http://clik.apcc21.org

CLIK - "MME"

Clik Climate Information Toolkit

MME | Downscale | My Page | Logout | Edit

Predict

Lead Month
- (•) 3Month

Year/Season
Year 2018 Season OND

Methods
- (•) Deterministic
- ( ) Probabilistic

Variables
- (•) PREC
- ( ) T850

Models
- [ ] ALL
- [ ] APCC [ ] CMCC [ ] CWB
- [ ] MSC [ ] NASA [ ] NCEP
- [ ] PNU [ ] POAMA

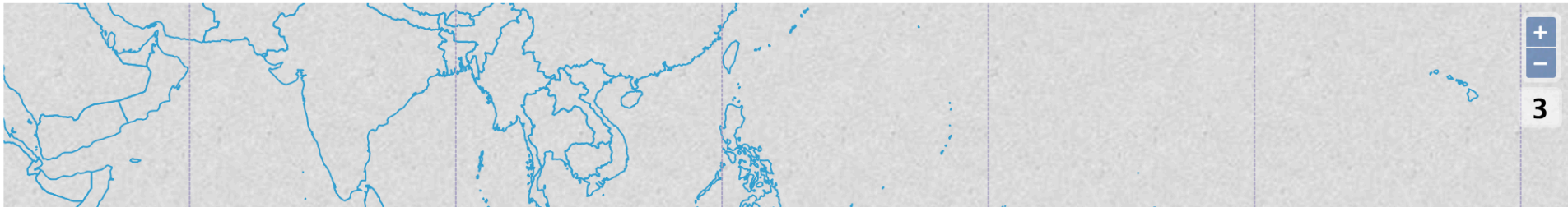
✓ User can produce the **customized MME seasonal forecast**, then view the result figure map and download corresponding data.

Predict & Verify

Result

- (•) Prediction only
- ( ) Prediction & Verification

Move Center | Download



http://clik.apcc21.org

CLIK - "Downscale"

Clik Climate Information Toolkit

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**

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.

Clik
Climate Information Toolkit

Registration

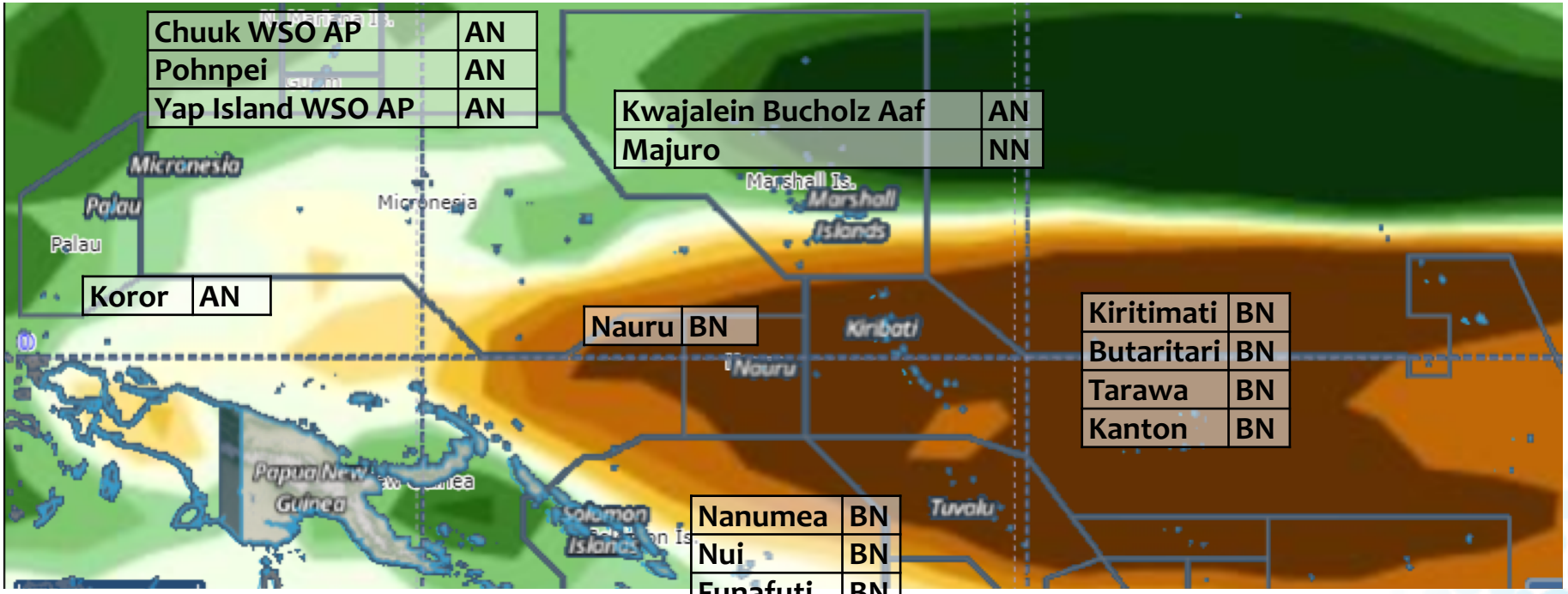
CLimate **I**nformation Tool**K**it

http://clik.apcc21.org


Thank you.

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