CLIK hands-on (PART I):

introduction and structure

(http://clik.apcc21.org)

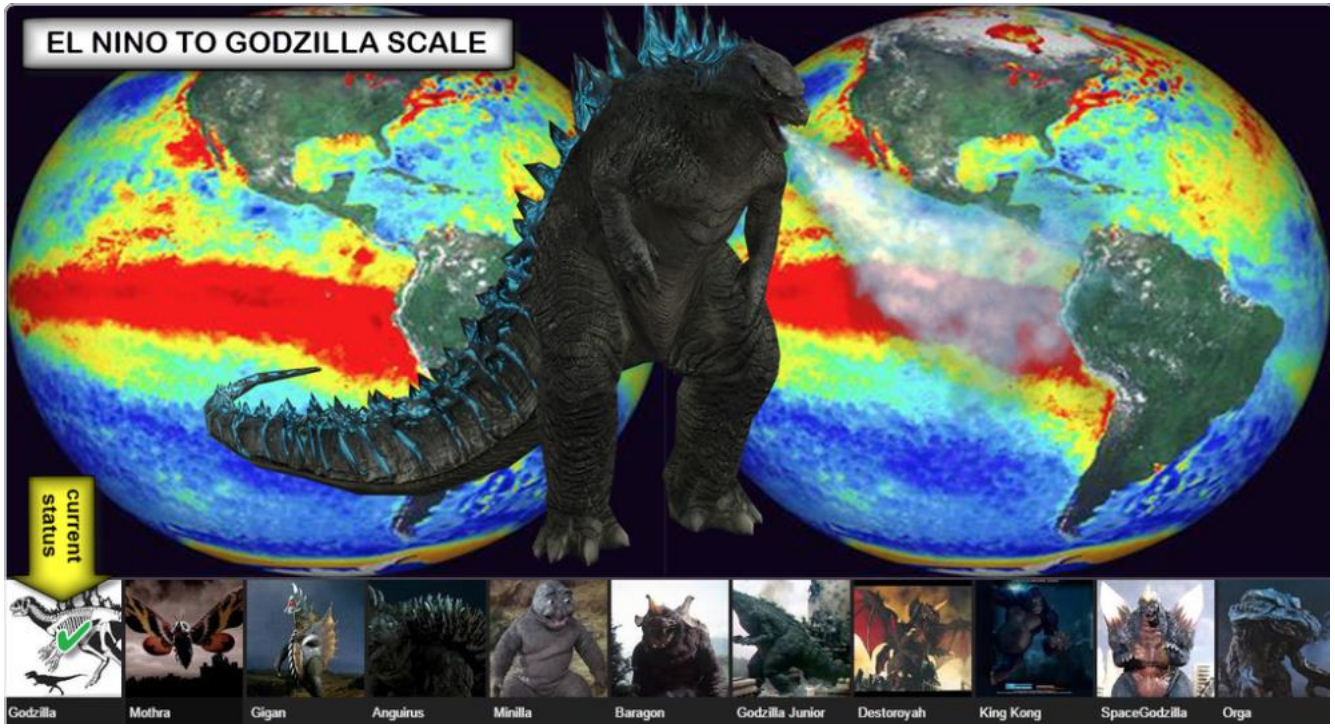
Yun-Young Lee

8 Sep 2016

APCC APEC CLIMATE CENTER

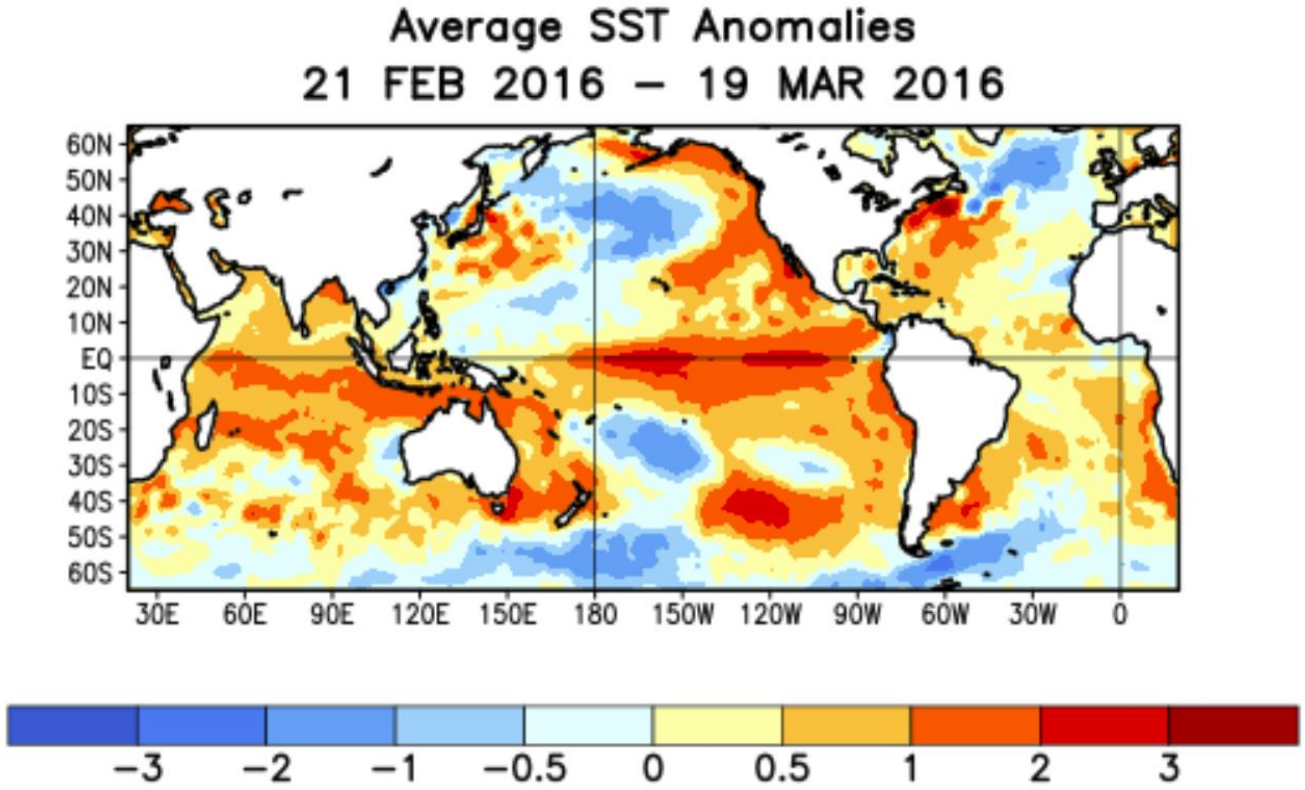
“Super” El Nino (15/16)

✓Why ENSO is important?



“Super” El Nino (15/16)

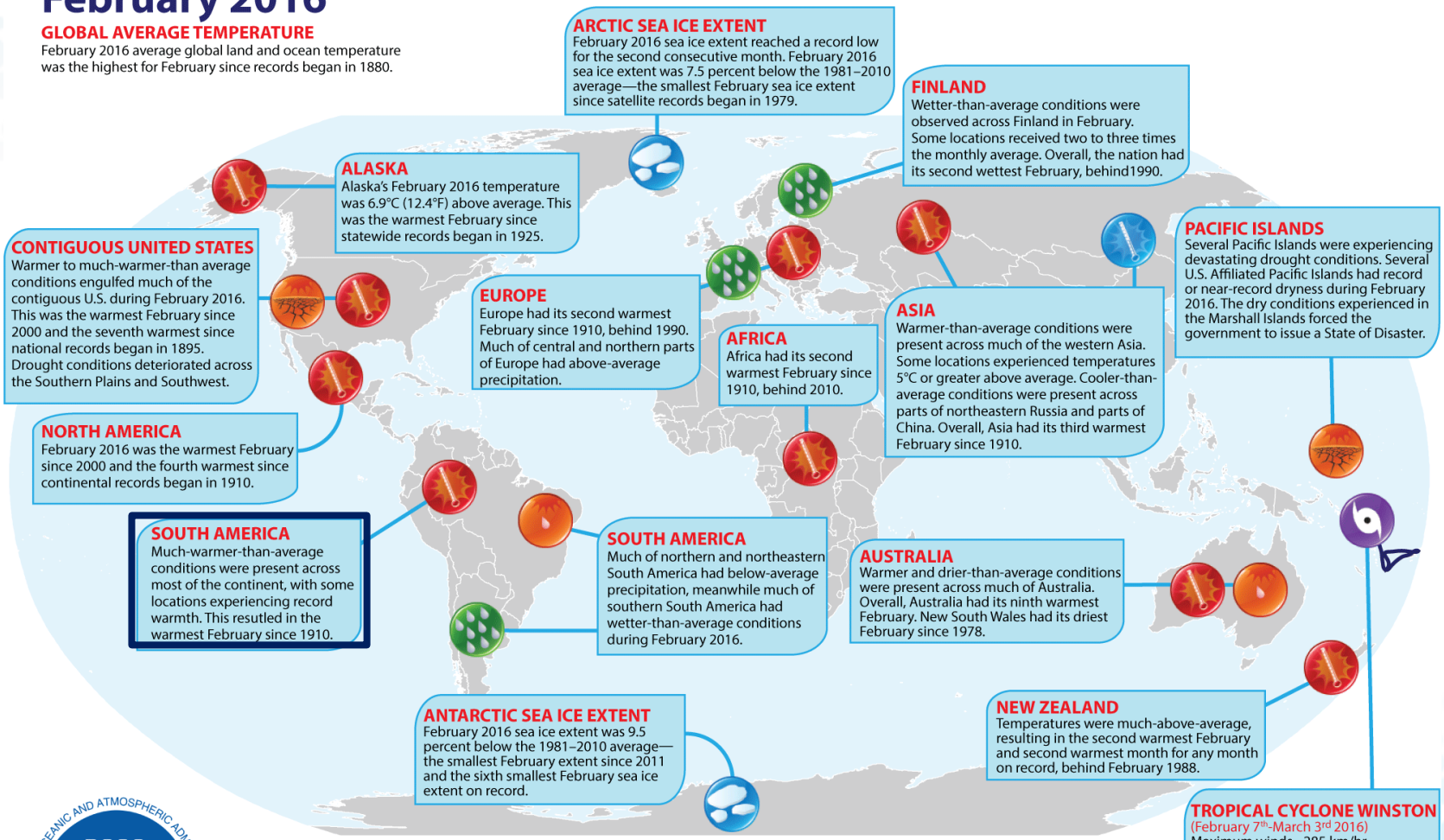
✓What happened in the world during 2015/16 El Nino season?



Extreme SST anomalies (up to 3 degrees) were recorded in the central Pacific, with values even higher than the records of the El Niño 1982-1983 and 1997-1998 seasons.

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

Importance of "Accurate" prediction

Preparedness in Peru:
The Emergency Decree authorised the funding and execution of structural and non-structural actions **to reduce risk and enhance preparedness for the 2015-2016 El Niño.**
A National Committee for the El Niño Phenomenon Risk Management was created, integrating the work of several government agencies or ministries including Internal Affairs, Agriculture, Education, Transportation, Health, Defence, Economy and Finance, Public Works and the National Disaster Manager Secretariat.

ACCURATE climate prediction optimized to your region (village) will make early warning possible and reduce economic and human losses in Peru & Chile.

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

APCC mission

- **Facilitating the share of high-cost climate data and information to minimize economic and human losses due to natural disasters**

- **Capacity building in climate prediction and sustainable social and economic applications of climate information**

CLIK (CLimate Information ToolKit) : online prediction tool

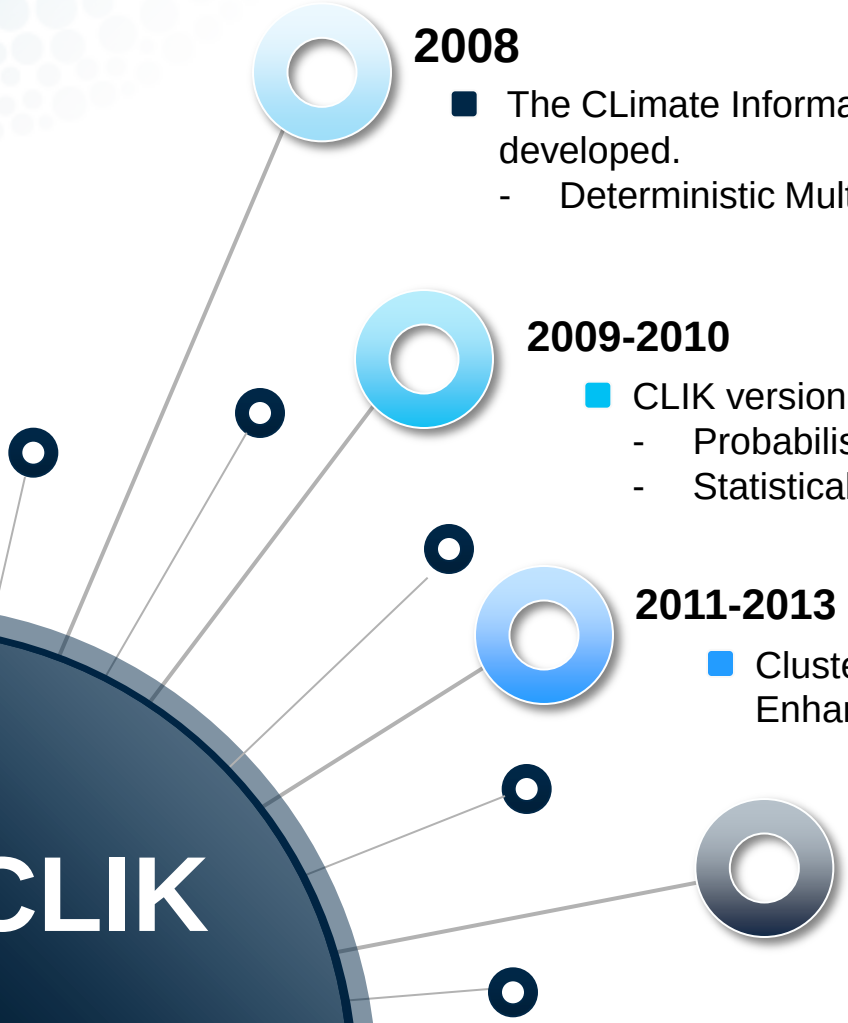
- For those who wants to play with model data
- To allow user manipulation of multi model prediction in producing his/her own forecast
- To provide statistical downscaling capability using multi model prediction

– Prediction : Diff. combinations

– Downscaling : model to station matching

➔**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

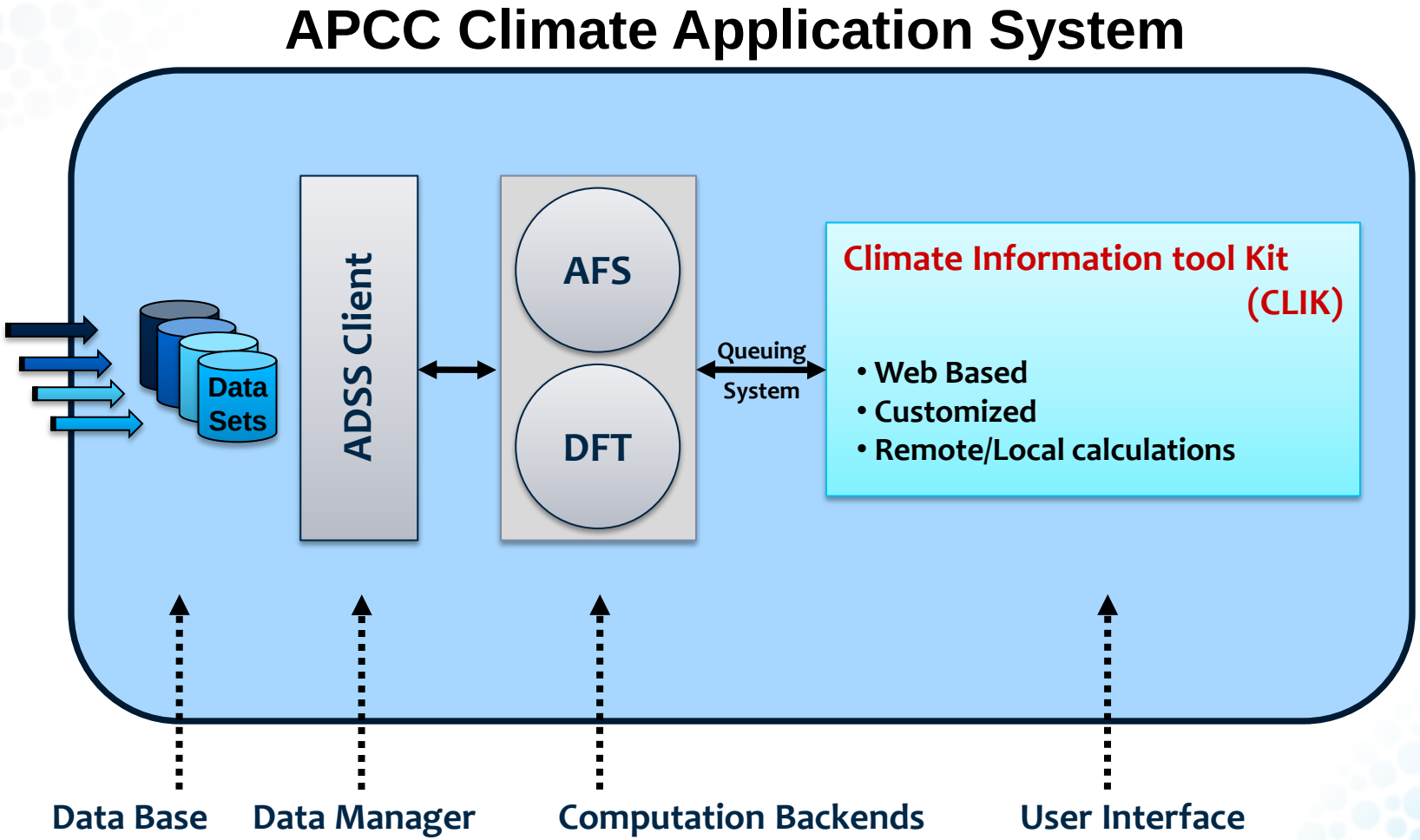
- CLIK v3.0 with New Web Framework (New CLIK)
  - Enhancement of User Interface & Performance
  - Database optimization, Lightweight Map, etc.

CLIK 3.0: Internals

- **The Customized Climate Information Service**
- **Be able to produce and utilize the climate information data by CLIK with only a computer and an internet connection.**
- **Based on Java and HTML with NCAR Command Language (NCL)**
- **Existing NCL, Fortran Code can be reused with Java Container**
- **Standard Web technology (HTML/JSP)**
- **CLIK 3.0 leverages on the robust functionality of previous product releases but at around 10 times the performance**

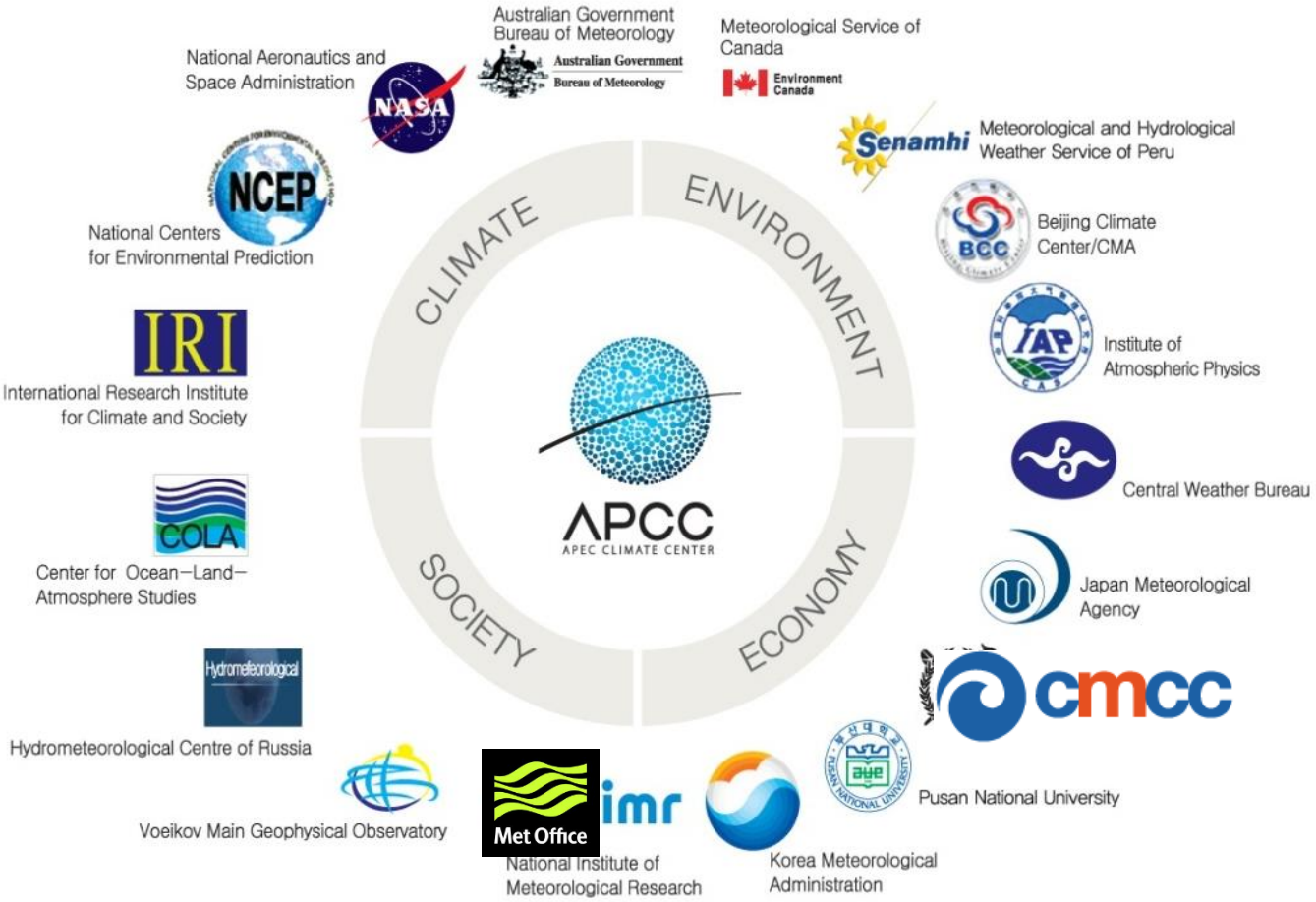
http://clik.apcc21.org
https://www.youtube.com/watch?v=5CNPoX1flXY

CLIK: process diagram



AFS: Automated Forecast System
DFT: Downscaling Forecast Tool

APCC: data collection



- Collection of Dynamic ensemble seasonal prediction data from NMHS and research institutes
  (16 operations/institutions from 10 countries)

List of available models

DATA SOURCES

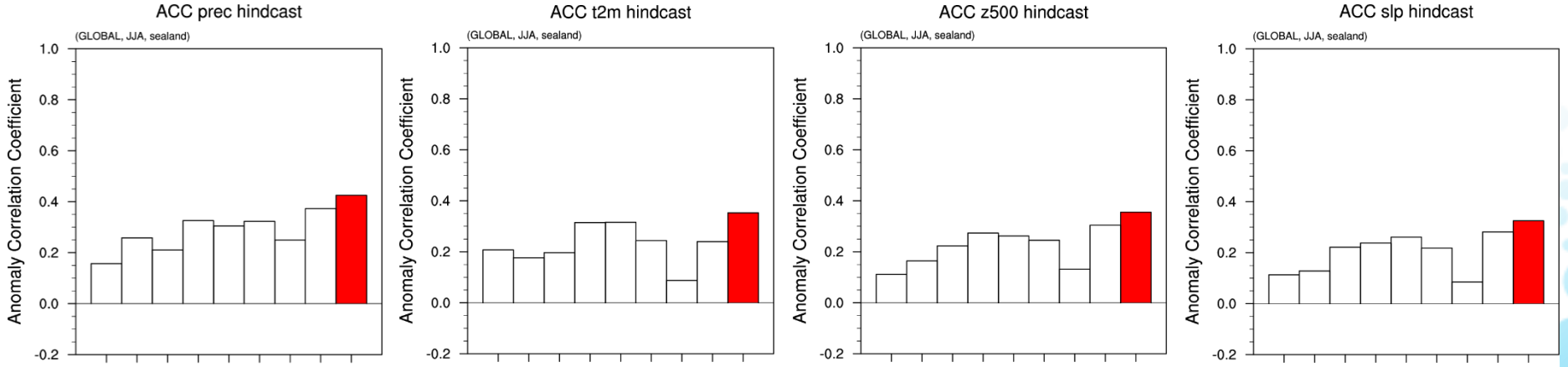
Nation	Organization	Acronym
Australia	Bureau of Meteorology	BoM
Canada	Meteorological Service of Canada	MSC
China	National Climate Center, CMA	NCC
	Institute of Atmospheric Physics	IAP
Chinese Taipei	Central Weather Bureau	CWB
Italy	Centro Euro-Mediterraneo sui Cambiamenti Climatici	CMCC
Japan	Japan Meteorological Agency	JMA
Korea	Korea Meteorological Administration	KMA
	Pusan National University	PNU
	National Institute of Meteorological Research	NIMR
Peru	Servicio Nacional de Meteorologia e Hidrologia	SENAMHI
Russia	Hydrometeorological Research Centre of Russian Federation	HMC
	Voeikov Main Geophysical Observatory	MGO
UK	Met Office	Met Office
USA	International Research Institute for Climate & Society	IRI
	Center for Ocean-Land-Atmosphere Studies	COLA
	National Centers for Environmental Prediction, NOAA	NCEP
	National Aeronautics and Space Administration	NASA

Why MME?

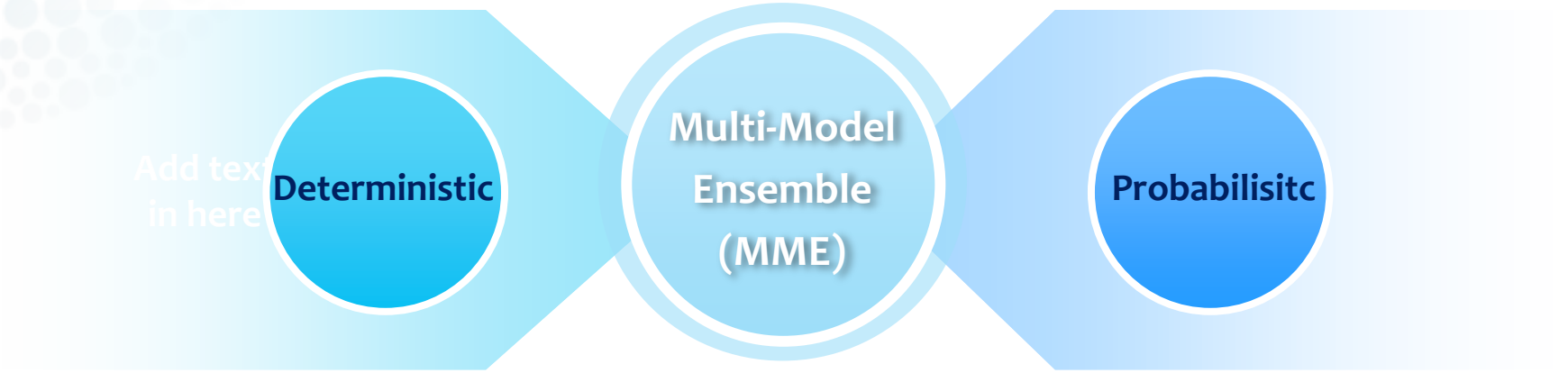
- Climate predictions have ***uncertainty*** coming from two major sources,
  - Initial conditions uncertainty (errors in obs. system or estimates)
  - Model formulation uncertainty (errors due to discrete representation of temporally and spatially continuous real world)

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

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



PREDICTION_methodology



SCM

Simple Composite Method:
Average of individual forecast with equal weighting

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

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.

Probabilistic MME Scheme(GAUS)

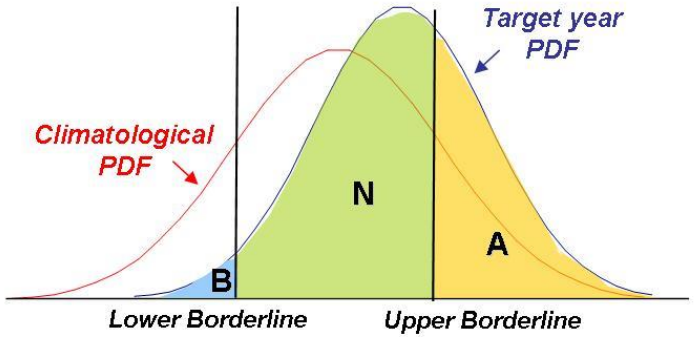
A parametric Gaussian fitting method for the estimation of tercile-based categorical probabilities; forecast probability of each category is estimated as a portion of the forecast PDF(Probability Density Function) with respect to the historical one.

Forecast probability

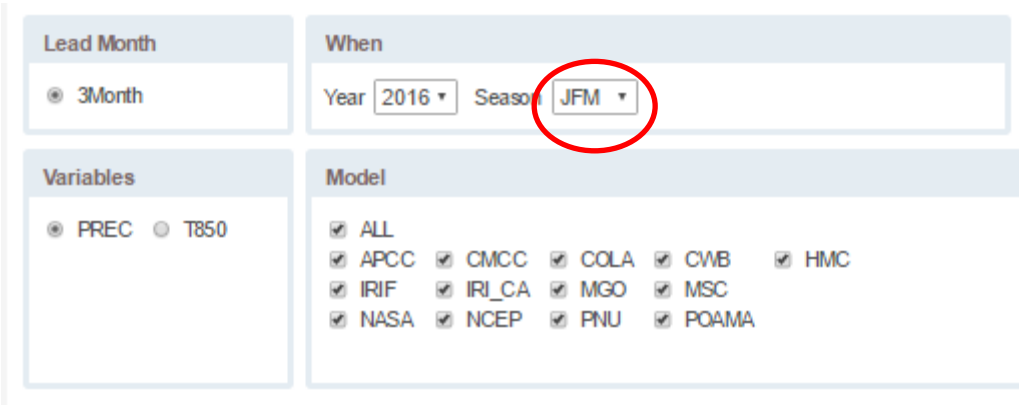
A Probability of Above-normal

N Probability of Near-normal

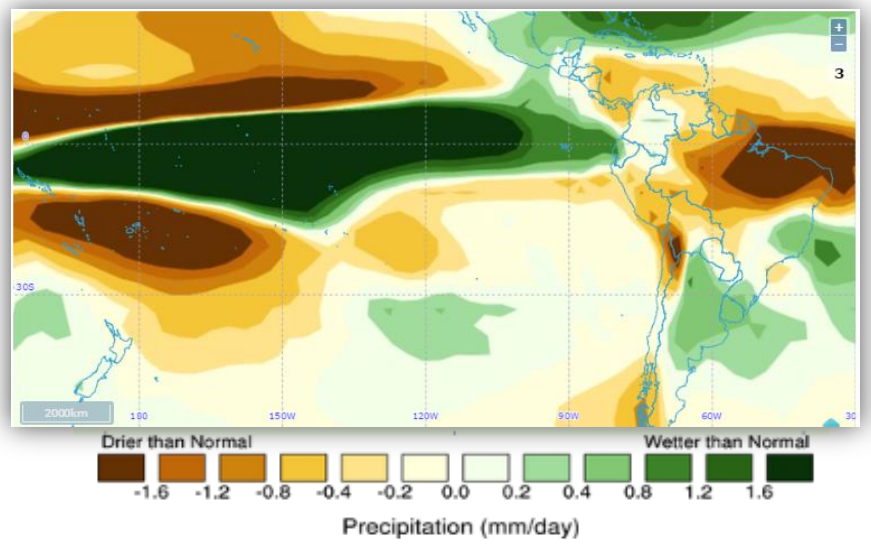
B Probability of Below-normal



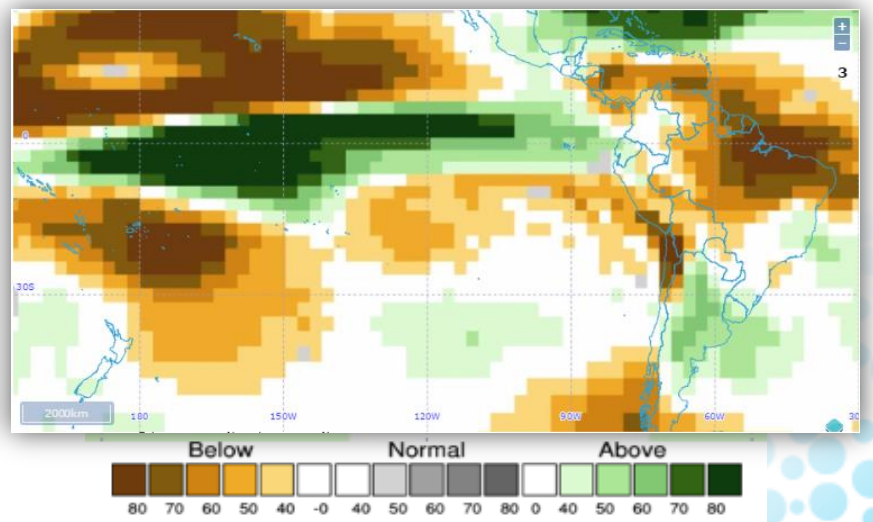
PREDICTION_product



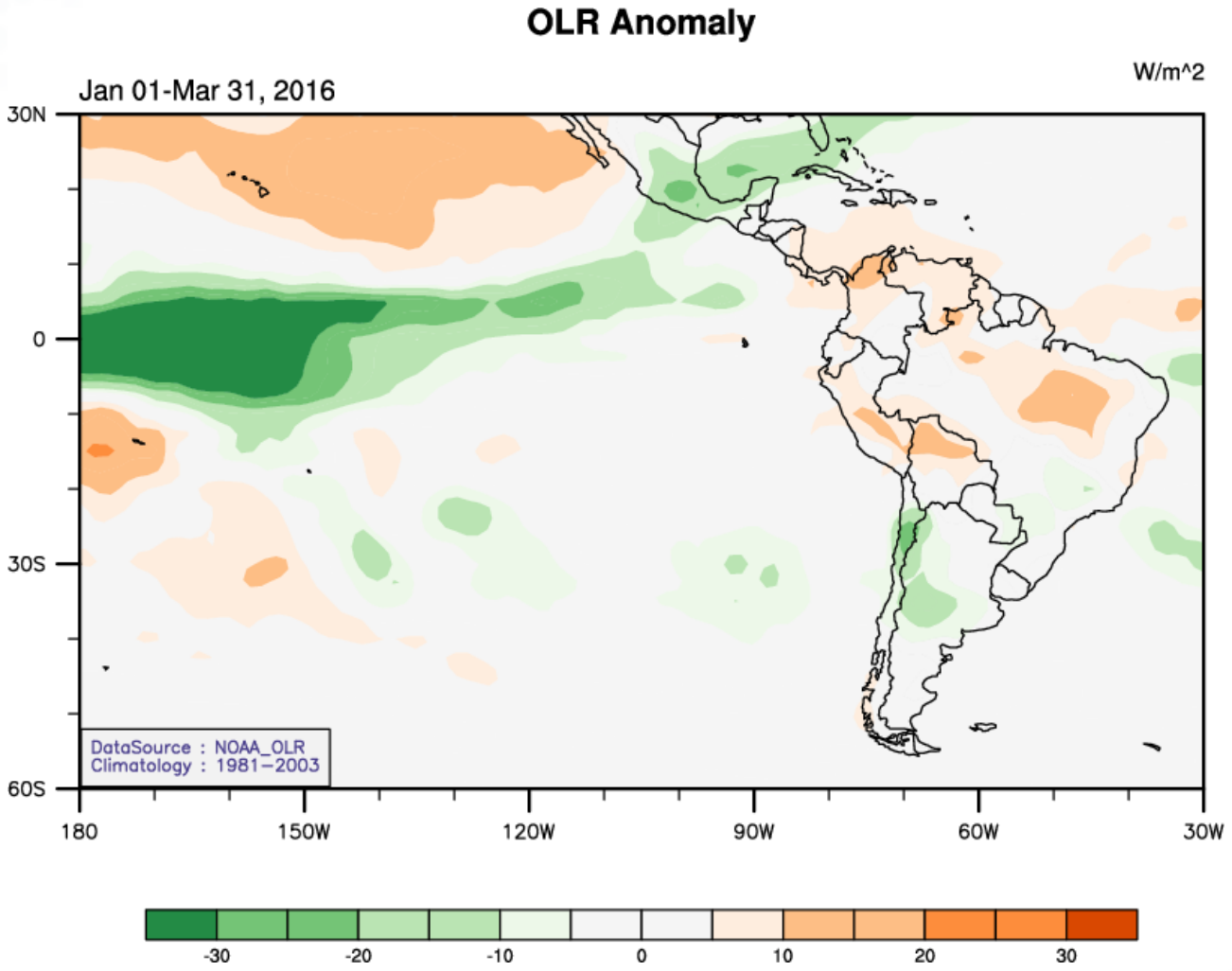
DMME (SCM)



PMME (GAUS)



JFM!


OLR Anomaly
W/m^2
Jan 01-Mar 31, 2016
30N
0
30S
60S
180
150W
120W
90W
60W
30W
DataSource : NOAA_OLR
Climatology : 1981–2003
-30
-20
-10
0
10
20
30

PREDICTION_skill_score

Success Rate

the fraction or percentage of success among a number of attempts. CLIK provides a simple success rate as the hindcast skill 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)

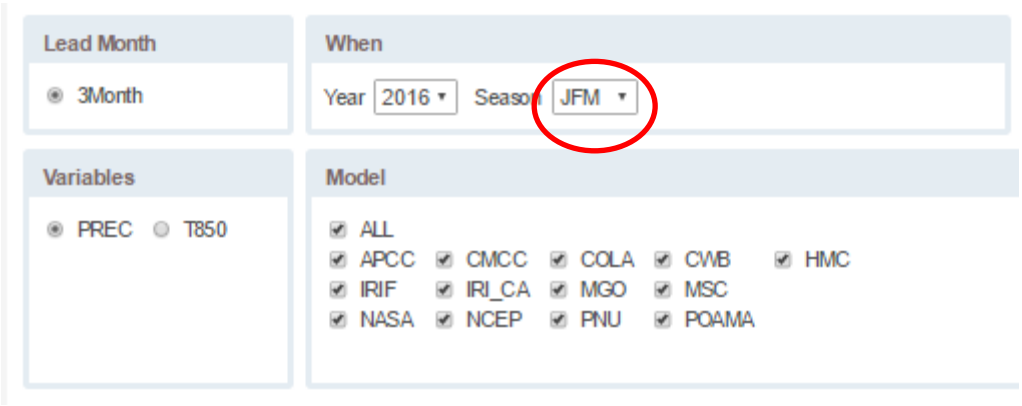
measuring the fractional improvement of the forecast over the standard forecast

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

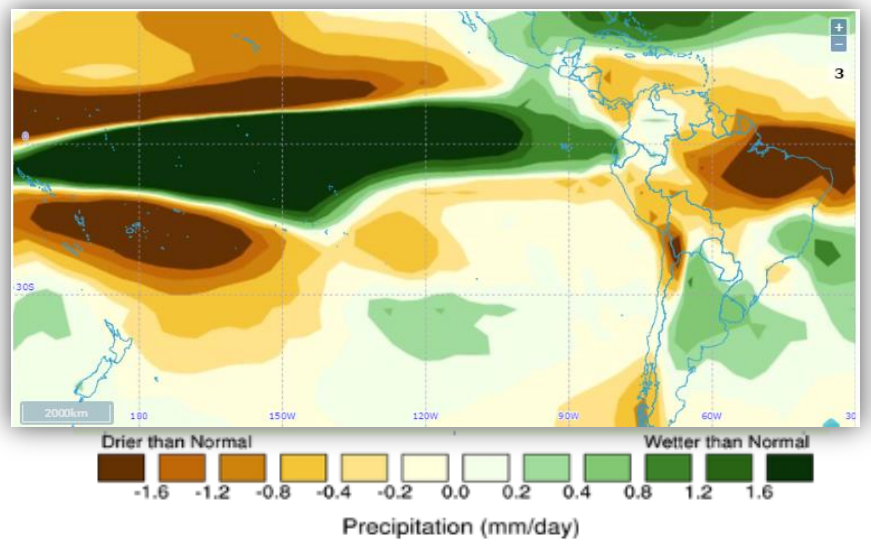
HSS = (score – score by chance)
/(perfect score – score by chance)

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

PREDICTION_product



DMME (SCM)



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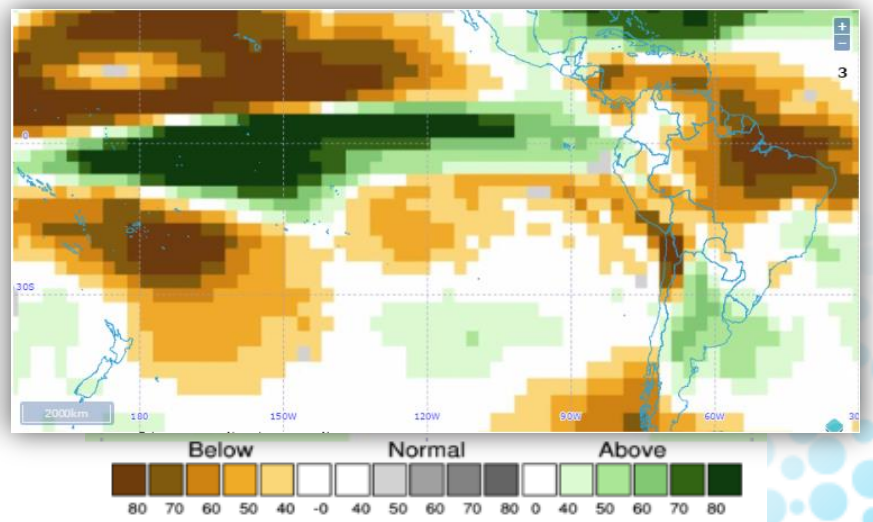
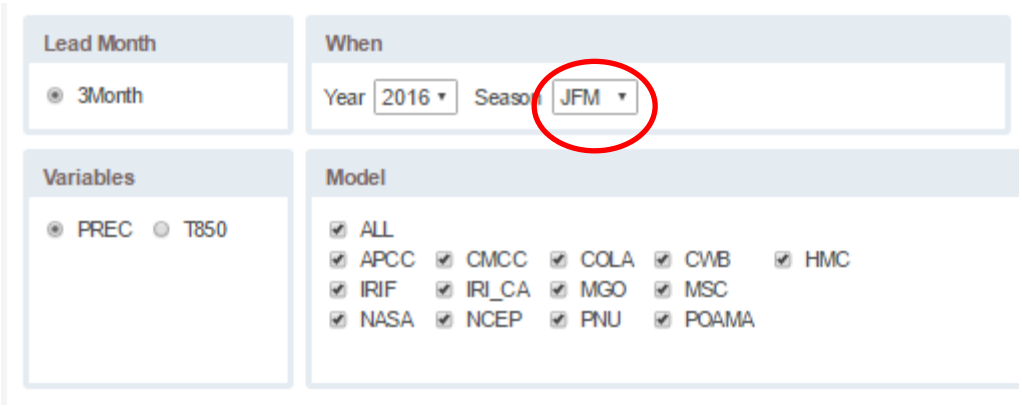
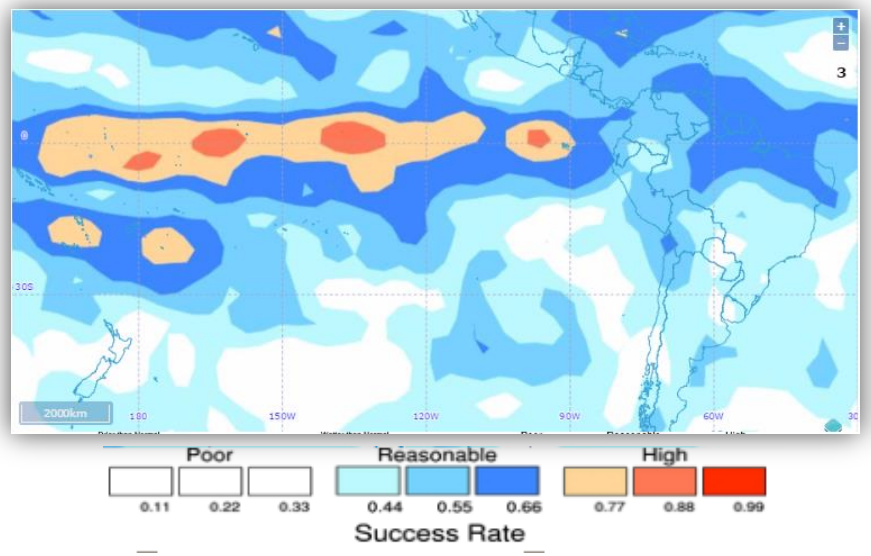


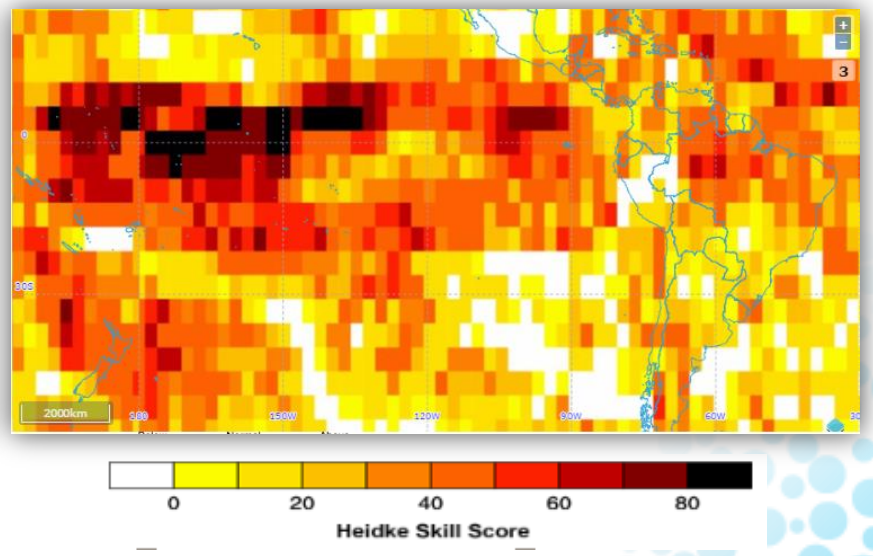
PREDICTION_skill_score



DMME (SCM) ➔ Success rate



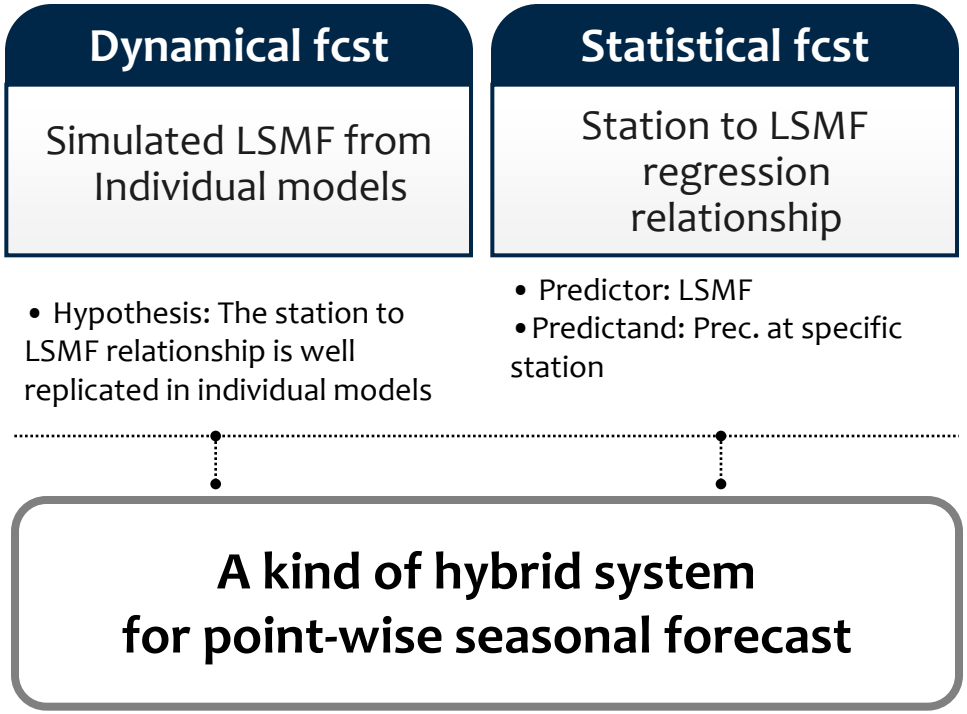
PMME (GAUS) ➔ HSS



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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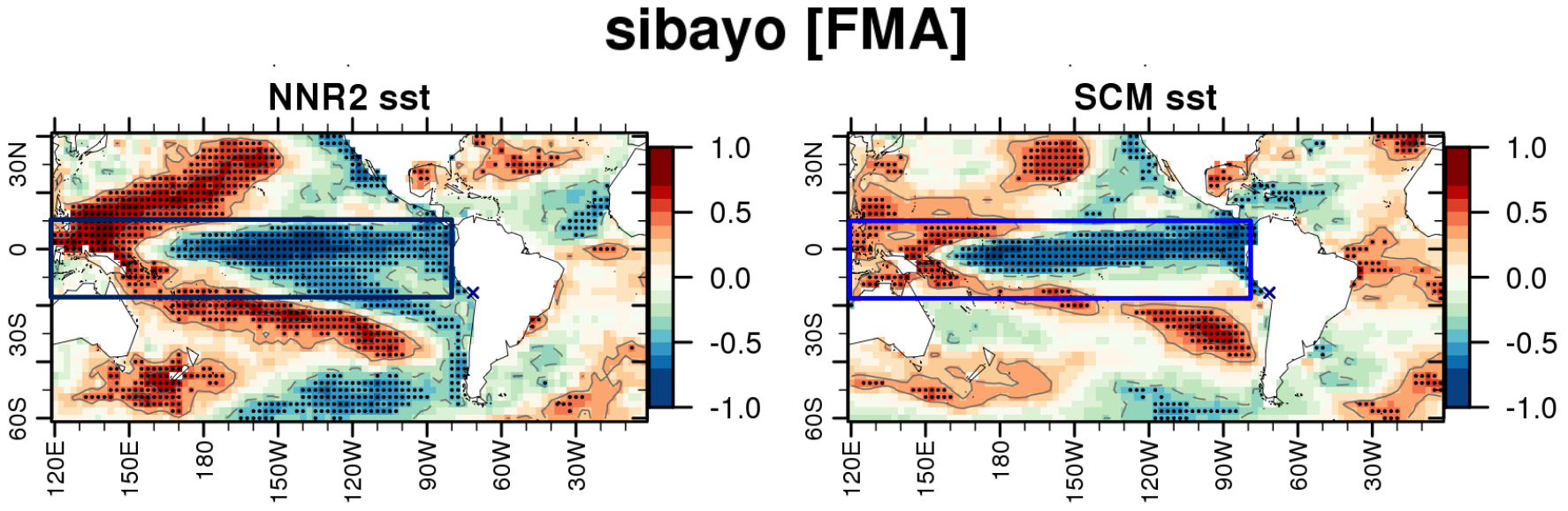
Empirical relationship: LSMP ~ local station rainfall

LSMP (model) → Local station rainfall



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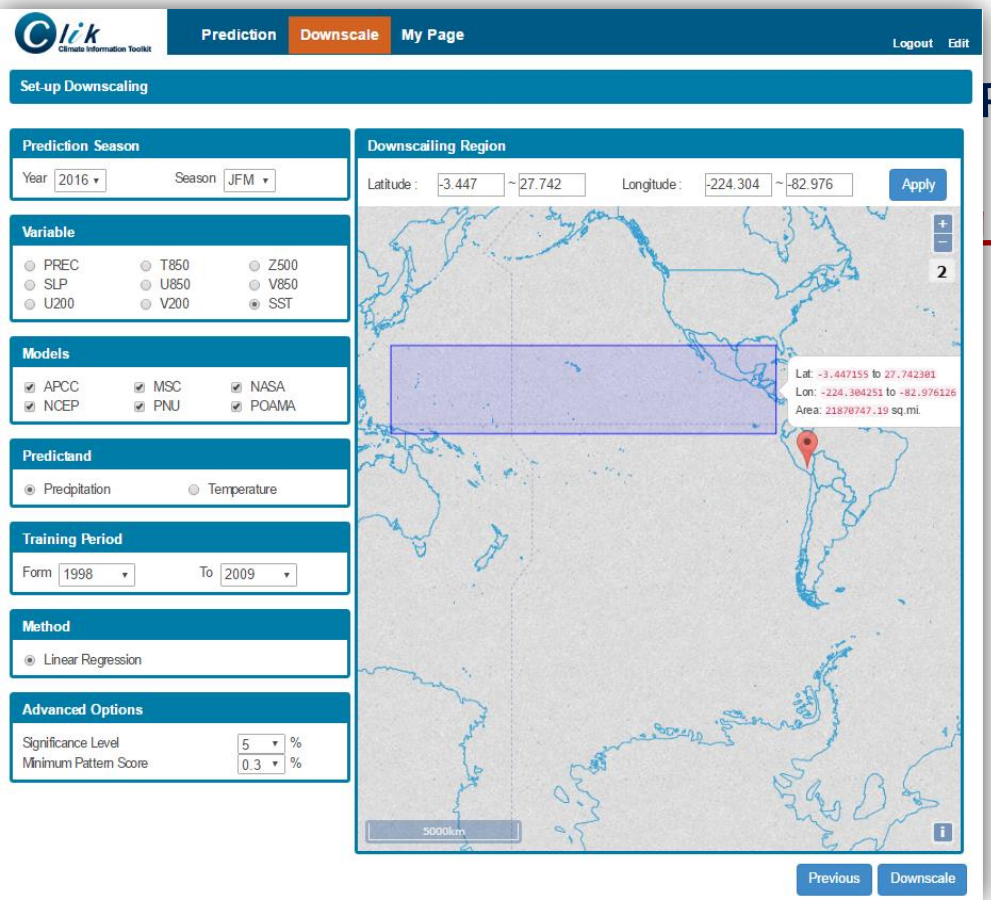
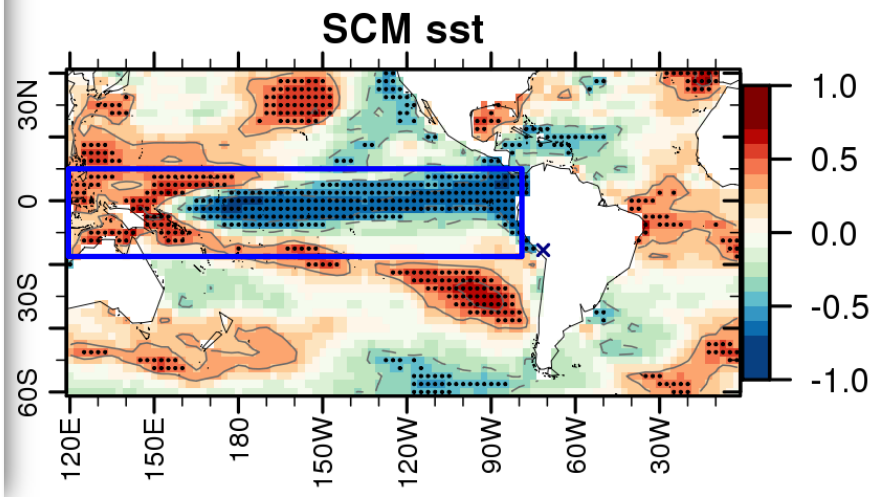


P ~ local station rainfall

Local station rainfall

[FMA]



Clik
Climate Information Toolkit

CLIK

CLimate Information ToolKit

http://clik.apcc21.org

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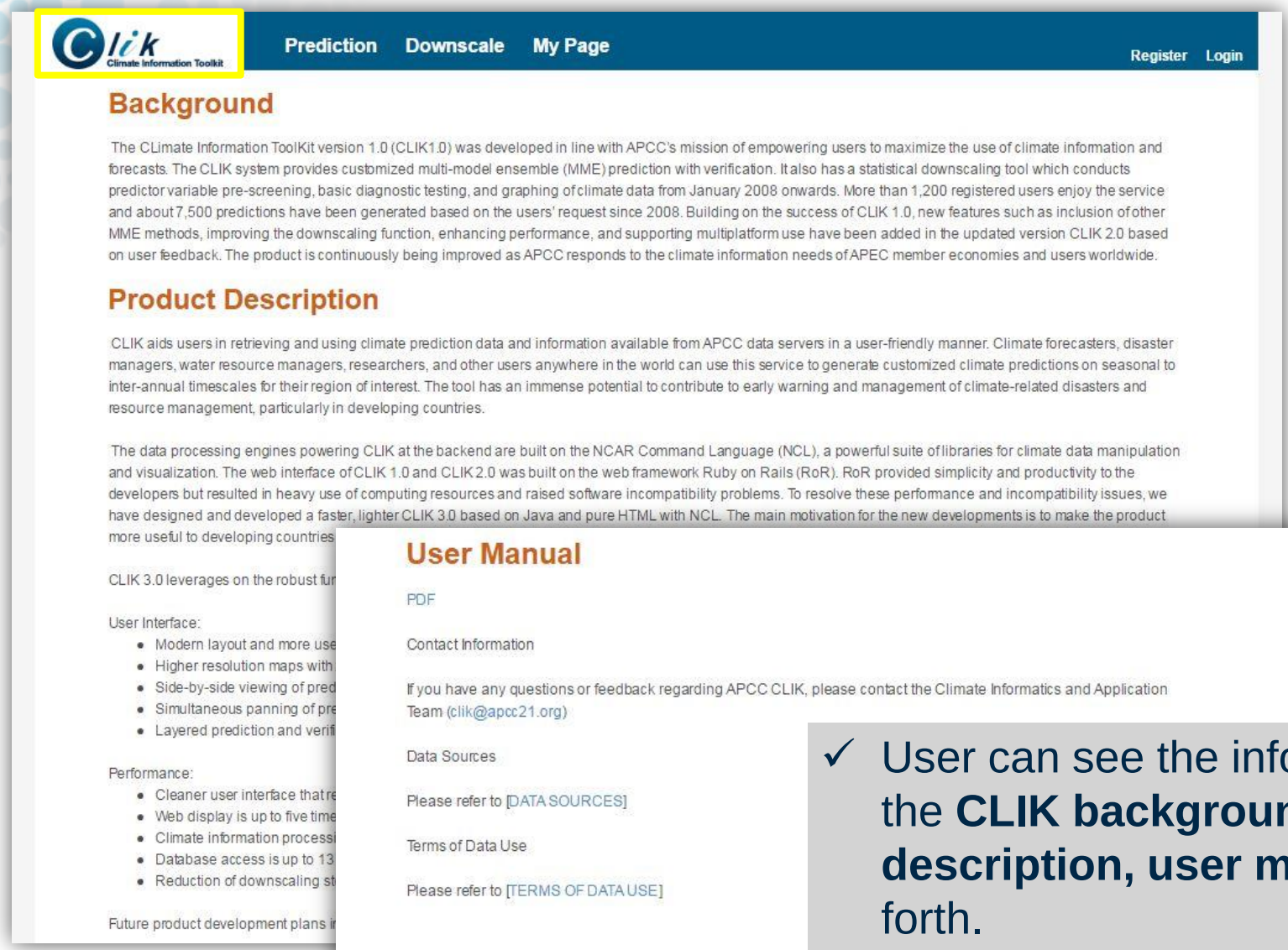
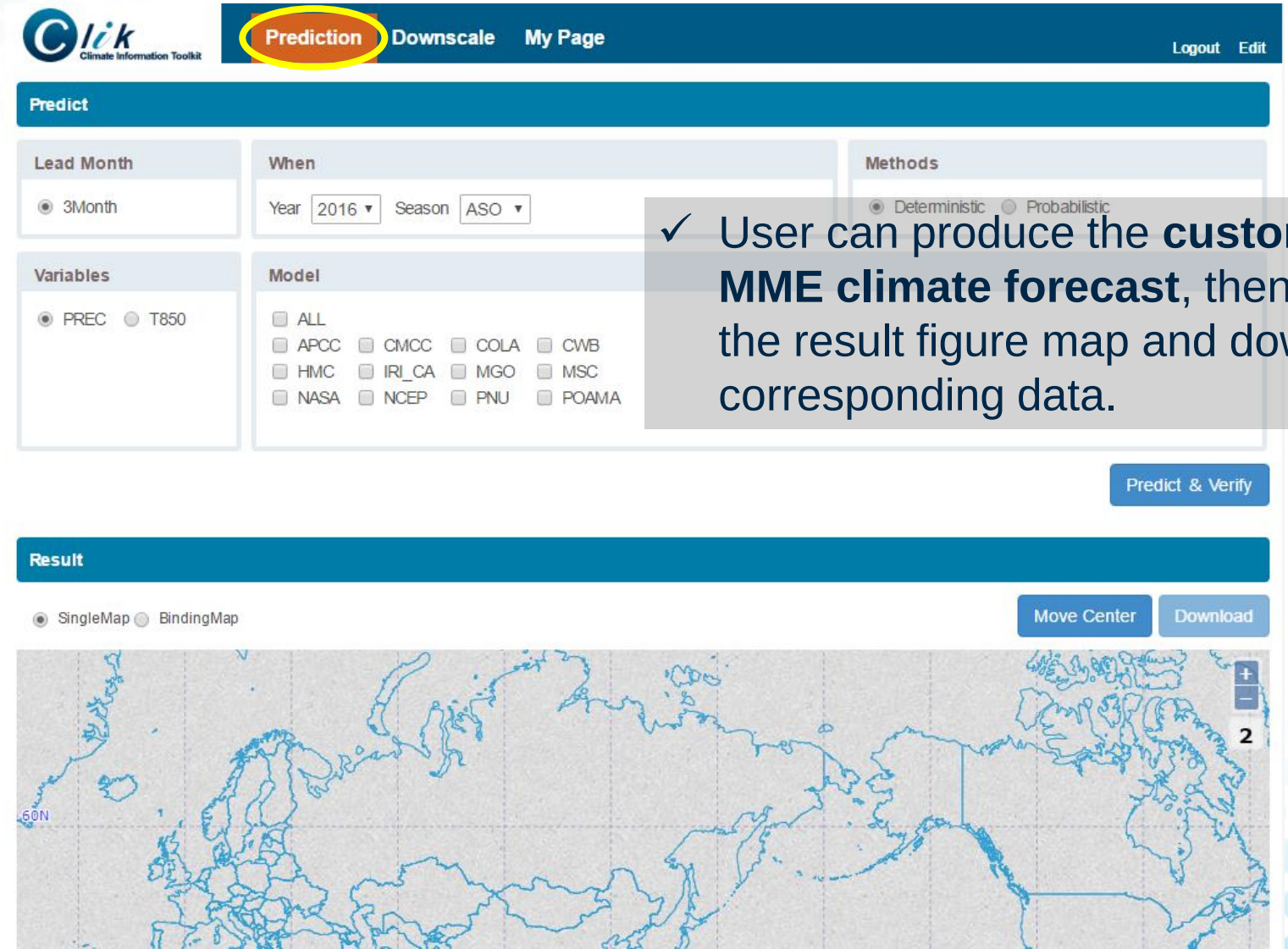
CLIK - main page



✓ User can see the information about the **CLIK background, product description, user man**ual and so forth.

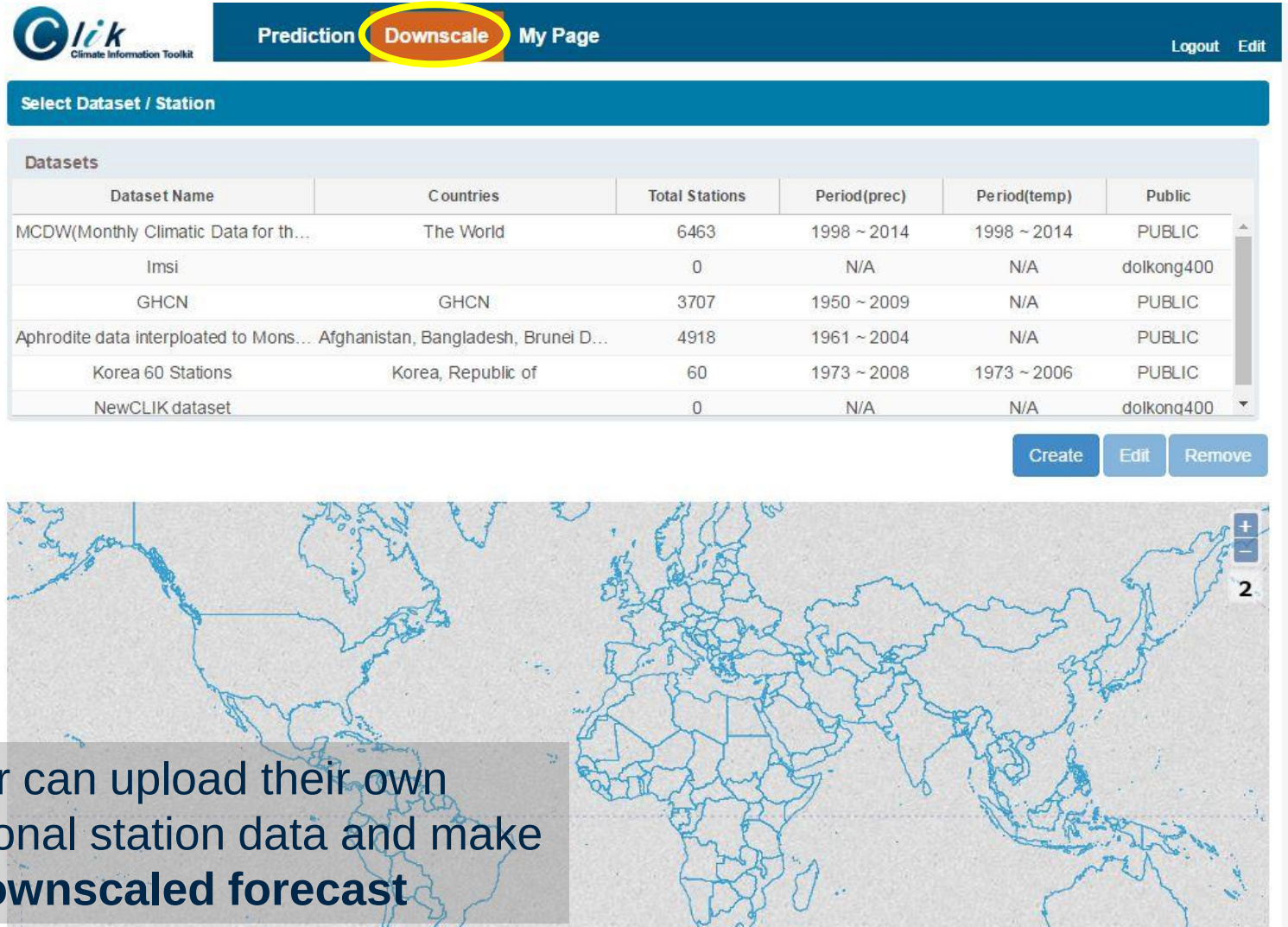
http://clik.apcc21.org

CLIK - "Prediction"



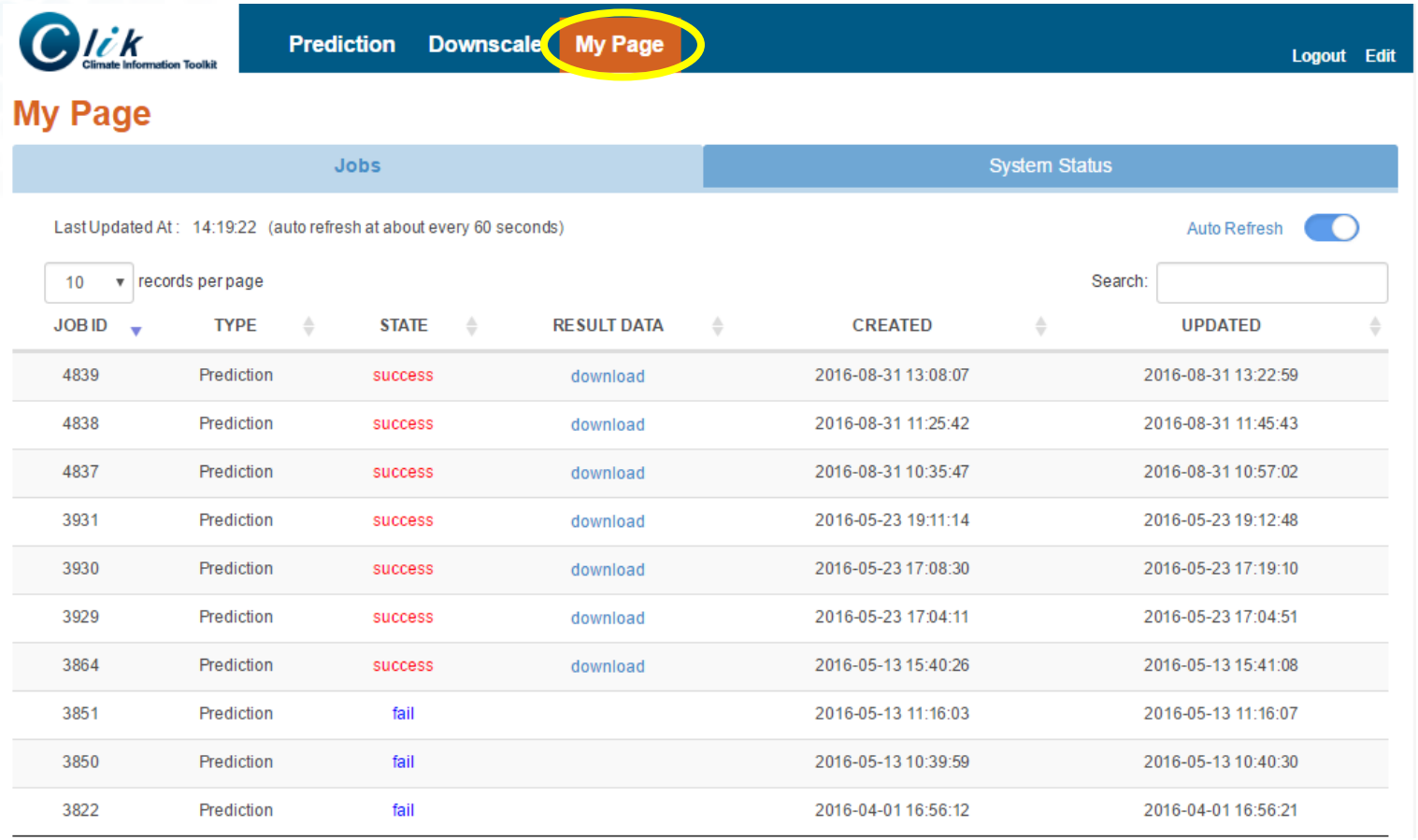
✓ User can produce the **customized MME climate forecast**, then view the result figure map and download corresponding data.

CLIK - "Downscale"



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

CLIK - "My Page"



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

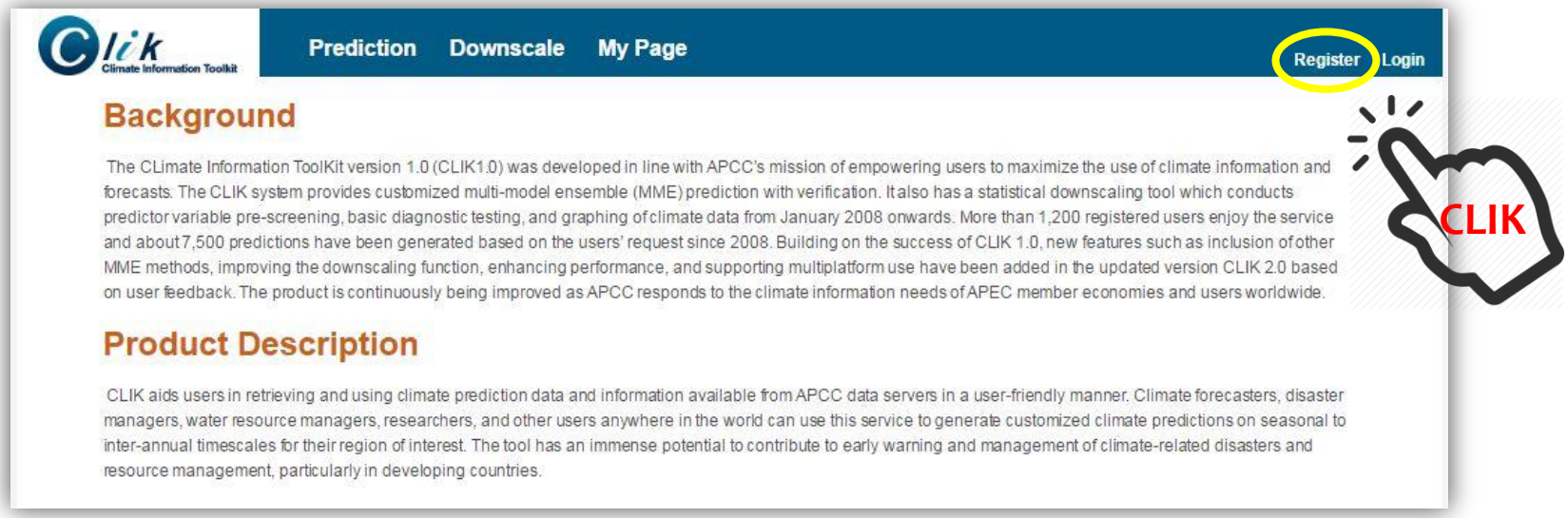
Clik
Climate Information Toolkit

CLIK

http://clik.apcc21.org

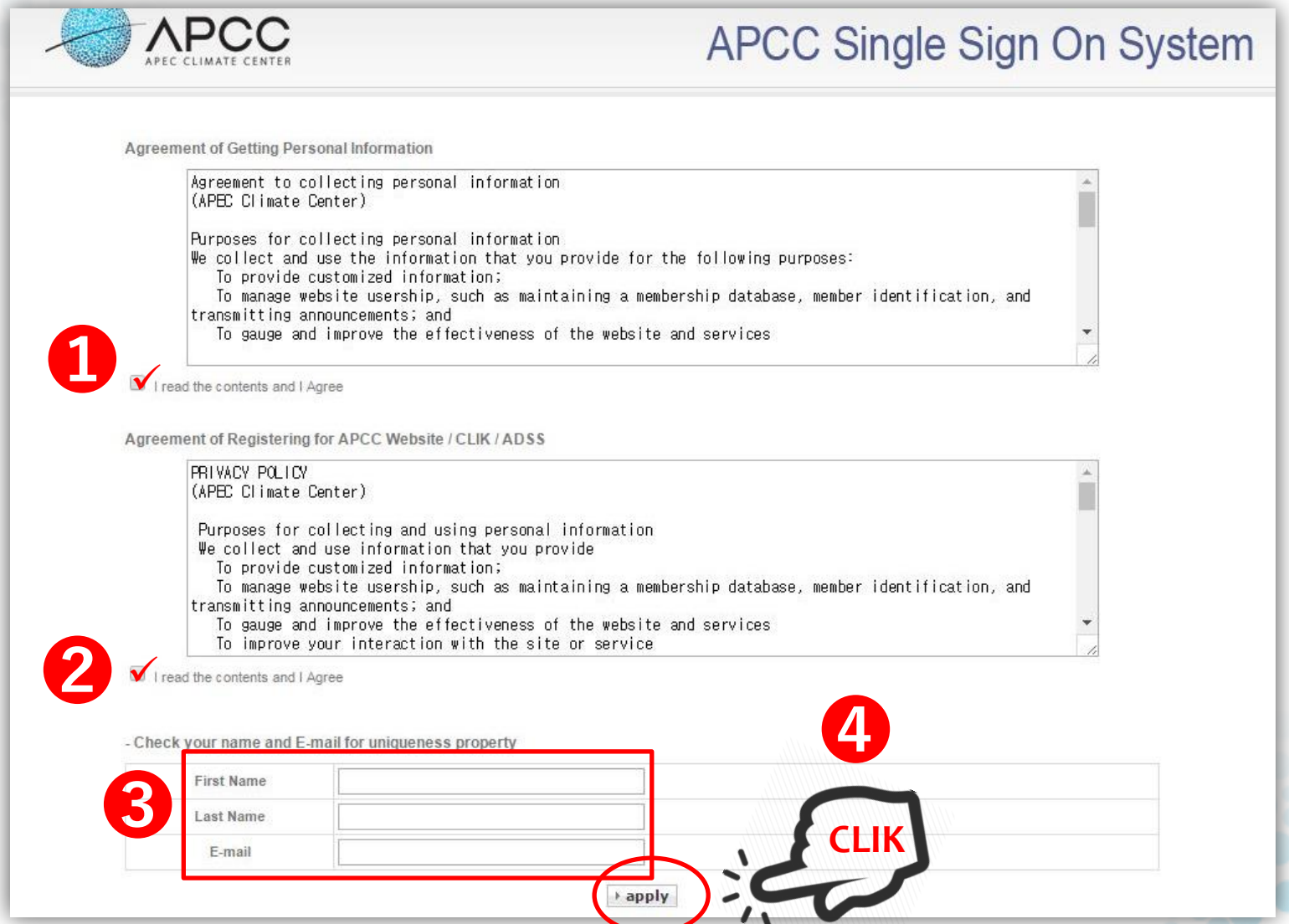
CLIK - Getting Started

- **Creating your account**



CLIK - Getting Started

- **Creating your account**



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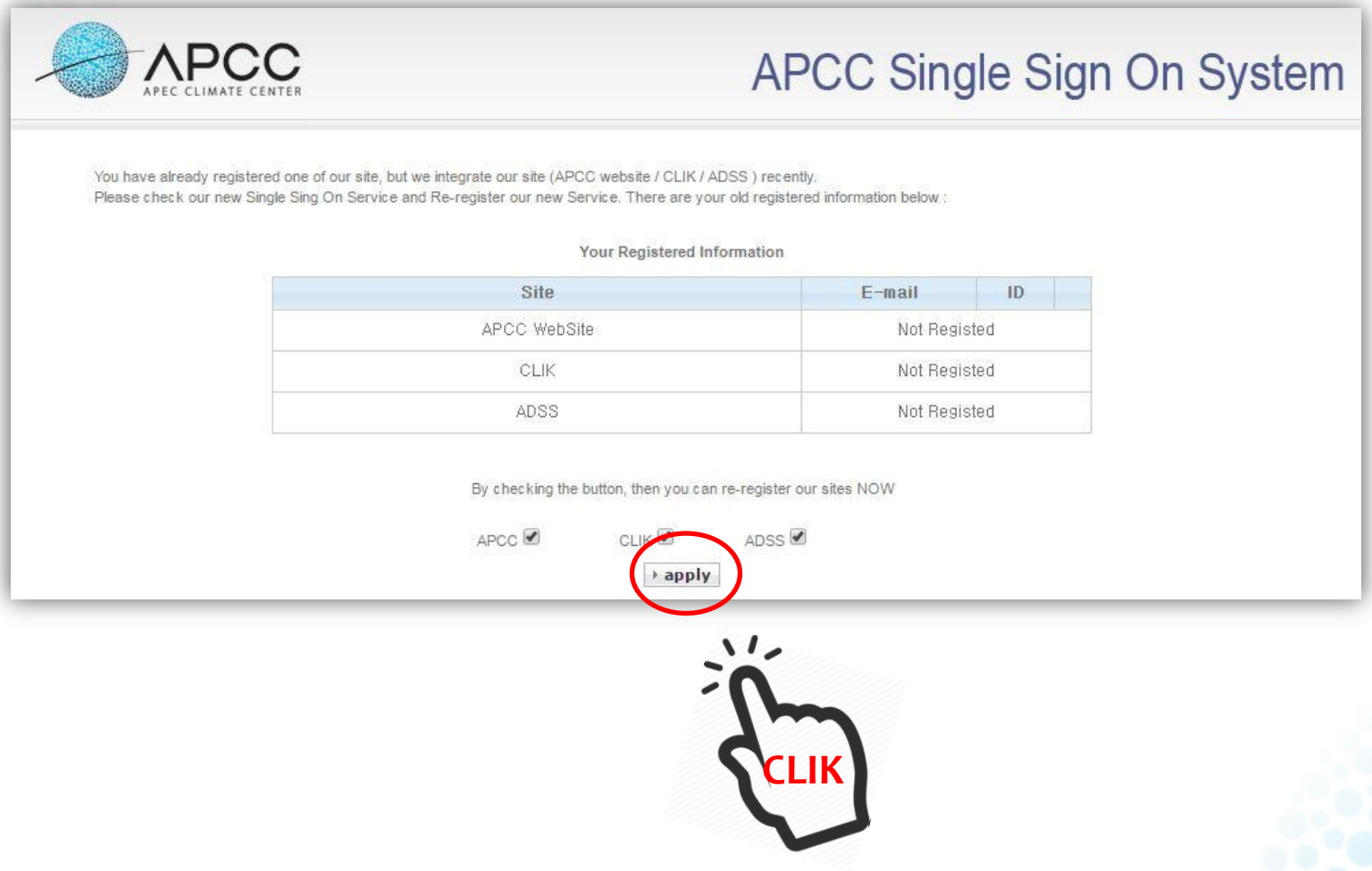
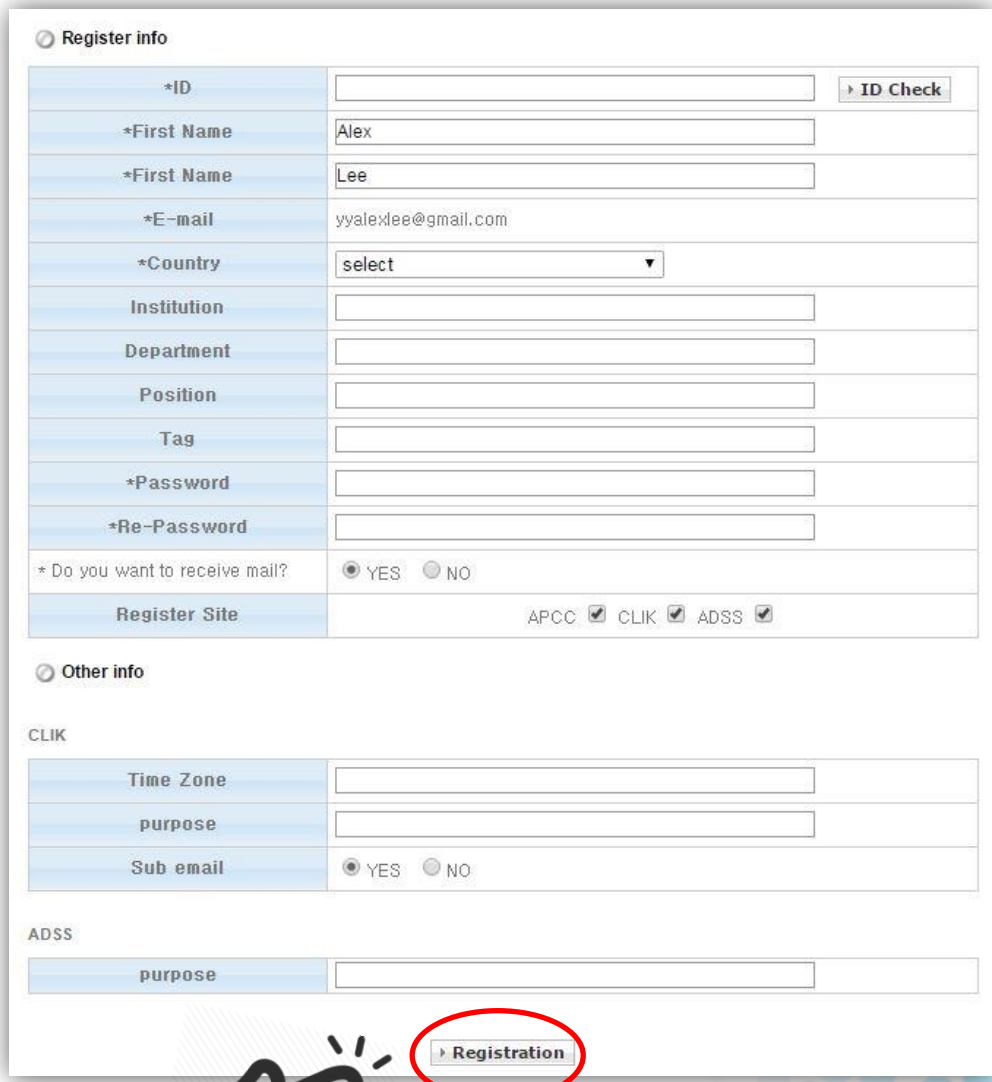


CLIK - Getting Started

- **Creating your account**

✓ Please fill in the blanks!



CLIK - Getting Started

- **Creating your account**

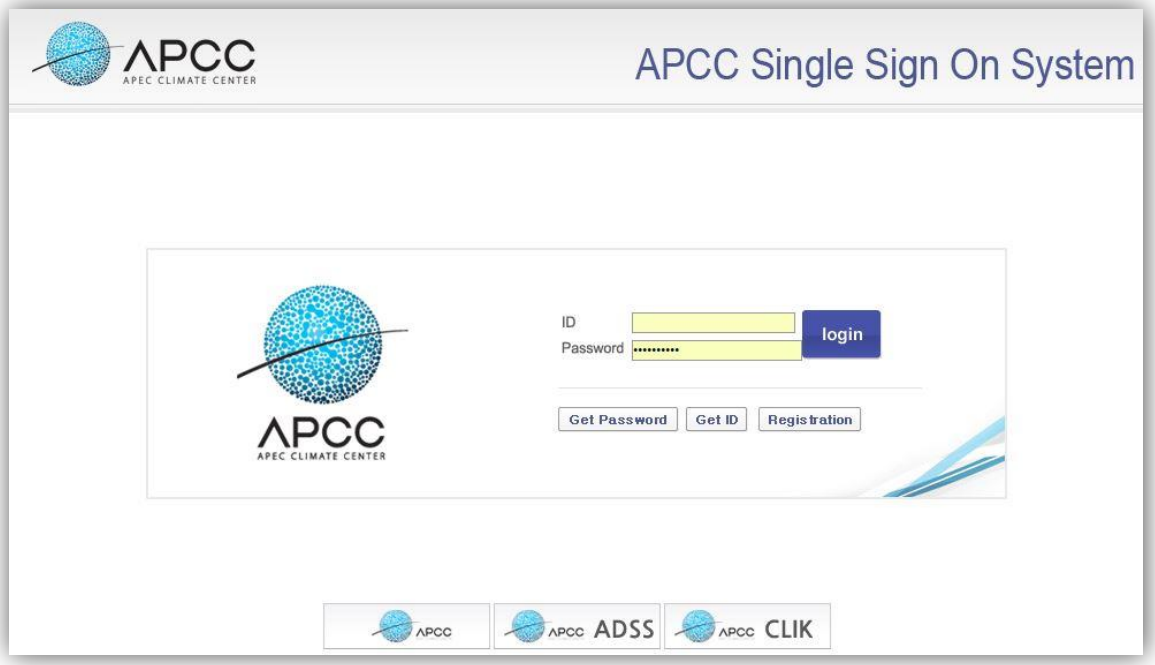
CLIK - Getting Started

- **Creating your account**

✓ Please ***activate your account*** by clicking the LINK in the e-mail sent you.

CLIK - Getting Started

- **Creating your account**



✓ Please **log in** with your ID and password.
✓ Finally, you guys are **READY** to use the CLIK system!


Thank you.

CLIK:

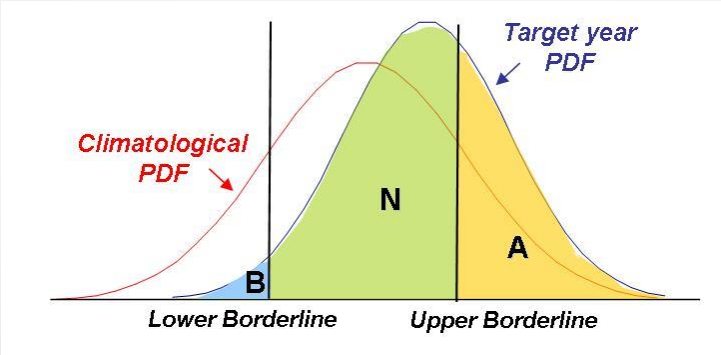
- **Aids users in retrieving and utilizing climate prediction data and information available from APCC data servers in a user friendly manner through web-based format**
- **Provides the customized multi-model ensemble (MME) prediction and the statistical downscaling tool which performs ancillary tasks of predictor variable prescreening, basic diagnostic testing, and graphing of climate data**

Probabilistic MME Scheme(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.

Forecast probability

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



Skill Scores: Success Rate (SCM)

Success Rate

is the fraction or percentage of success among a number of number of attempts. CLIK provides a simple success rate as the hindcast skill score.

- **~0.33 : Poor skill region**
- **0.33~0.66 : Reasonable skill region**
- **0.66~ : High skill region**

Skill Scores: Success Rate (SCM)

The verification metric is success rate.

Divided the prediction into 3 categories normal, above normal and below normal. The observations are also similarly divided.

If model and observations are in the same category then the forecast is counted a success. Otherwise it is a failure. For example,

- Model predicted above normal and observations was normal – failure
- Model predicted above normal and observations was below normal – failure
- Model predicted above normal and observations was above normal – success

Because the forecast is divided into 3 equal category, and there is equal chance to be in each category then there is 33.3% chance that a forecast can be any of normal, above or below normal. That is why the forecast has some skill if the success rate is above 33.3%(0.33).

Skill Scores: Heidke Skill Score (GAUS)

- HSS (Heidke Skill Score)

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)

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