

문서번호 APCC-출장-16-1415(2016-12-20)

TRAVEL REPORT FORM

출장보고서

결 재	팀장	부서장	원장	
	12/15 이현록	12/18 유진호	12/20 정홍상	
협 조	팀장			
	12/16 이우섭			

I. Reporter 보고자

Department 소속	Position 직위(직급)	Name 성명	Travel Date 날짜	Note 비고
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기후예측본부 기후예측팀	선임연구원	이윤영	2016/12/5 ~ 9	

II. Major Activities 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

가. 개요

- 참가 회의명: Developers Meeting on the GFCS-Relevant Climate Data, Products and Tools
- 일시: 2016년 12월 6일 - 2016년 12월 8일 (3일 간)
- 장소: WMO Headquater, Geneva, Switzerland
- 회의목적 및 내용:
 - WMO HQ에서 개최된 해당 미팅은 15개국 CST(Climate Service Toolkit) 29명의 전문가와 WMO 사무국 22명이 참여 [붙임 1]
 - GFCS(Global Framework for Climate Services)를 구성하는 CSIS (Climate Service Information System) 구축의 일환으로 CST의 조속한 개발이 요구됨 [붙임 2]
 - WMO Global 및 Regional Center들이 보유하고 있는 가용자원 및 ECV(Essential Climate Variables)를 검토하고, CST 구성 잠재 후보군에 대한 현황 파악
 - 해당 가용자원인 데이터셋, 서비스, 툴 들의 통합 및 구축에 초점을 맞추어 CST Prototype 제작을 위한 분야별 Break-out discussion을 통해 Action Plan에 대한 의견 공유

나. 주요 업무 수행 사항

- APCC 소개와 CLIK MME 계절예측 및 상세화 예측에 대한 특징 발표 [붙임 3-1] (이윤영)
- CLIK 시스템 소개, CST 통합을 위한 준비현황 및 향후 발전방향 발표 [붙임 3-2] (이현록)
- CLIK 시스템 현장 온라인 시연 (이현록)

2. Relevance to APEC Climate Center's Activities 결론 및 소감

- Climate Data, Monitoring and Analysis, Prediction, 그리고 Projection에 최적화되어 세계 유수의 기관에서 만들어진 CST들의 현재 상황과 미래 개발 전략에 대해 배울 수 있었음
- 예측 분야에서 APCC의 CLIK에 대한 발표가 이루어졌으며, National Level에서 최적의 예측을 가능하게 하는 CLIK의 Customized MME System에 대한 관심이 높았음
- 2017년 3월 21일~24일 중국에서 개최 예정인 International CSIS Workshop인 “Climate Services Information System Operations and Coordination”에 대한 계획마련 그리고 CST Prototype Demonstration을 어떻게 구성할지에 대한 논의가 이루어졌음
- 해당 회의는 전체적으로 개발자 수준에서의 상세한 논의보다는 큰 그림에서 논의가 주를 이루었으며, 지속적인 관심과 CST Prototype 구현에 CLIK이 적극적으로 기여할 수 있는 방안 마련이 필요함. 해당 기여는 향후 APCC와 CLIK 인지도 제고에 많은 도움이 될 것으로 판단됨.

III. References 참고사항

(with attachment of any information or report in case of attendance of conferences, workshops and meetings) 학술대회, 워크숍, 회의 등 참석 시 관련 정보 및 문서 첨부

1. Presented and Collected Materials 주요 수집자료

- [붙임 4] 발표자료모음.zip
- [붙임 5] International CSIS Workshop - “Climate Services Information System Operations and Coordination” Concept Note

2. Suggestions and Remarks 건의사항



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WORLD METEOROLOGICAL ORGANIZATION



Developers Meeting on the GFCS-Relevant Climate Data, Products, and Tools

Geneva, Switzerland, December 6-8, 2016

CONCEPT NOTE

Background

WMO Commission for Climatology (CCI) supports the implementation of Global Framework for Climate Services (GFCS) with a particular focus on the Climate Services Information System¹ (CSIS), which is the core operational component of GFCS at the global, regional and national levels and constitutes a key contribution of WMO to the GFCS as articulated in Resolution 17 of the World Meteorological Congress at its sixteenth session (2011). For this purpose, CCI at its Sixteenth Session in 2014 has established a dedicated Implementation Coordination Team on CSIS (ICT-CSIS). CSIS is designed for producing and operationally delivering authoritative climate information data and products through appropriate operational mechanisms, data exchange, technical standards, authentication, communication and product delivery. Its functions include climate analysis and monitoring, assessment and attribution, prediction (monthly, seasonal, decadal) and projection (centennial scale) as well as tailoring the associated products to meet user requirements. Part of the CSIS is in place, but new infrastructure is needed to be further developed.

Towards this end, the World Meteorological Congress at its Seventeenth Session in 2015, through Resolution 60 (Cg-17), decided that the GFCS relevant data and products from the WMO World Data Centers (WDCs), Global Producing Centers of Long Range Forecasts (GPCLRFs), Regional Climate Centers (RCCs), Regional Climate Outlook Forums (RCOFs) and International Council of Scientific Unions World Data System (ICSU WDS), as well as from the framework of the Global Climate Observing System (GCOS) Essential Climate Variables (ECVs) (Atmospheric, Oceanic and Terrestrial), will constitute an essential contribution to the Framework and therefore should be made accessible among Members, in particular through the CSIS, on a free and unrestricted basis. In a further clarification of the scope of Resolution 60 (Cg-17), the WMO Executive Council at its Sixty-Eighth session in 2016 (EC-68) endorsed a recommendation, by the EC Task Team on Data Policy and Emerging Issues, that implementation of Resolution 60 initially focus on the GCOS ECVs, with initial data requirements to be specified in the forthcoming GCOS Implementation Plan, to be further supplemented through an on-going review by the Intergovernmental Board on Climate Services (IBCS) Expert Team on Specific Data Requirements (ET-SDR).

A related decision by EC-68, on data and products exchange for the implementation of the CSIS:

¹ Annex to the implementation plan of the Global Framework For Climate Services - Climate Services Information System Component (http://www.gfcs-climate.org/sites/default/files/Components/Climate%20Services%20Information%20System//GFCS-ANNEXES-CSIS-FINAL-14204_en.pdf)

- Requests the WDCs, GPCLRFs, RCCs, NMHSs and other associated entities within the CSIS to increase and harmonize the exchange between WMO members and partners of historical, current and forecast-related climate data and products called for by Resolution 60 (Cg-17), in support of CSIS implementation;
- Urges Members hosting the CSIS entities to actively facilitate sustained and ongoing exchange of data and products required for their respective operational functions; and
- Requests CCI, in close coordination with CBS and other relevant technical commissions, GCOS and the World Climate Research Programme (WCRP), to lead a review of the GFCS relevant data and products to be provided by the Global and Regional Climate Centers, with a view to increasing their access and availability, and present the results of the review along with recommendations to the sixty-ninth session of the Executive Council.

A key task, therefore, is to evaluate existing activities related to inventories of ECVs, currently led by the Joint CEOS_CGMS Working Group on Climate, and related monitoring, prediction and projection products, which should also take into account the above-mentioned centers and NMHSs. Based on this evaluation, it is recommended to design and implement a systems architecture dedicated for making available GFCS relevant data and products more easily accessible to WMO Members. In parallel, arrangements will be made for RCCs and NMHSs which have advanced in developing such products to support less advanced NMHSs and RCCs so that when the available GFCS relevant data and products are made more accessible through the CSIS there will be assistance available to help NMHSs wishing such assistance to access, interpret and add value to such data and products for country-level stakeholders, with an overall target of reaching 70 countries.

Additionally, this effort should include a compilation of tools for generating tailored data and products for decision-making, with a special focus on national requirements in developing countries. In this context, a Climate Services Toolkit (CST), conceived as a suite of guidance, data, software tools, training resources, and examples for enabling climate services at global, regional, and national levels, is considered to be a major enabling factor for CSIS implementation, particularly at the national levels.

Meeting Purpose, Objectives, and Outcomes

A Developers Meeting on the GFCS-Relevant Climate Data, Products, and Tools, under the auspices of the CCI ICT-CSIS, will be held during December 6-8, 2016, at WMO Headquarters in Geneva, Switzerland. The meeting will use any available initial guidance provided by the IBCS ET-SDR on additional potential requirements from country-level GFCS implementation and from a review of data requirements in the GFCS priority areas. The meeting will review the GFCS-relevant data and products currently available from WMO global and regional centres, and from the ECV inventory. Drawing on this background, the meeting will focus on identification, compilation and integration of specific data sets, products, and tools relevant to GFCS development such as climate data management and mining, diagnostics, monitoring, predictions, projections, and tailoring of specific information including through the CST, with the Regional Climate Centers (RCCs), Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs) as the target users. The outputs of the meeting will be an action plan to seek contributions and commitments to populate a suitably consolidated CSIS data and products portal and CST, and a prototype CST for demonstration at the forthcoming International Workshop on the CSIS². The latter will be made available for deployment around the world, closely aligned to the needs and capacities of the target users including stakeholders of the GFCS priority areas. The meeting will discuss how to achieve the most effective access and improve usability of GFCS-relevant climate data available in the ECV inventory, GPCLRFs, RCCs, and WDCs for meteorology and climatology. The findings will guide the implementation planning of the International Workshop on the CSIS. In addition, the meeting will recommend documents from available WMO resources for accelerated climate

² Tentatively scheduled to be held in March 2017. This meeting will draw on the December Developers Meeting to engage the stakeholders whose input and cooperation is needed to initiate systematic sharing and access to GFCS-relevant data and products as decided in Resolutions 60 (Cg-17) and 7 (EC-67), and Decision 5.3/1(EC-68).

services implementation at the national, regional and global levels. Finally, the meeting will identify capacity development needs including those for successful launch of the toolkit using already available and to be developed materials and events.

The meeting will be by invitation only and plans to gather input and seek commitments from selected Subject Matter Experts (SMEs) and developers of climate data, products, and tools that will constitute initial CSIS data and products portal and CST core capabilities to be incorporated into a prototype for demonstration and use by selected countries. The meeting will develop a strategy to build and sustain collaborative relationships among SMEs/developers, WMO Technical Commissions, Intergovernmental Board on Climate Services (IBCS), WMO Secretariat, GFCS Office, RCCs, and other stakeholders representing - end-users from GFCS priority areas and countries. The collaborative relationship will have the overarching goal to accelerate timely and consistent integration of available data and tools into CST in coordination with stakeholders and users.

The meeting will:

1. Review currently available GFCS-relevant data and products from global and regional centres as well as research and operational organizations, existing ECV inventories and their operational availability and access;
2. Review and refine the CST contents and architecture as well as discuss the strategy to populate and maintain the CST and its elements through the WIS (registering products and tools in the WIS using WIS Metadata standards for search, discovery and retrieval);
3. Develop an action plan for populating the CST with datasets and tools required for climate services, based on the minimum functions defined for the CSIS, including criteria for their selection;
4. Address and provide recommendations on the CST governance issues: Define process for facilitating coherent and coordinated actions of the CST contributors of data, products, tools, and training resources;
5. Explore the software solutions and IT infrastructure required for the deployment of CST, including through relevant examples³;
6. Develop an outline for guidance on CST core capabilities, including through consolidation of the existing WMO guidance material;
7. Recommend training materials that will support capacity building and use of CST resources;
8. Identify metric for CST performance evaluation and develop criteria for quality assurance of the data and products;
9. Recommend strategy for deployment of CST core capabilities in close alignment with the needs and capacities of the concerned CSIS entities, including the elements of a User Forum for customer support and troubleshooting.

Expected meeting outputs:

- A CST prototype with demonstrated core capabilities using web portal for data and tools as well as stand-alone tool-set comprising software and data;
- Recommended actions for sustainable long-term development, maintenance and updating of the CST through institutional collaborations, expert engagement, infrastructural requirements for deployment of GFCS-relevant CST components;
- An active network of climate data and tool experts for CST demonstration for GFCS partners and priority countries;
- Action Plan for accelerated CST deployment in GFCS priority countries;
- Design of an International Workshop on CSIS, which will focus on establishing the institutional architecture and cooperative relationships needed to make available GFCS-relevant data and products systematically available through the CSIS.

³ A potential example is the approach taken by the Copernicus Climate Change Service (C3S).

Tentative Agenda

Day 1: Defining CSIS Requirements and CST Core Capabilities

AM:

- Purpose of the Meeting
 - o Guidance from WMO/GFCS constituent bodies
 - o CSIS Implementation Priorities
- Overview of selected resources
 - o GFCS requirements for data sets, products, and tools as pertained by sectoral applications, with a particular focus on the ECVs
 - o GFCS-relevant data and product availability and access with examples (e.g., C3S, IRI, GPCLRFs, RCCs, ECV inventory, etc.)
 - o CST concept and structure

PM:

- Potential CST Resources
 - o Presentations on highlights of individual CST resources covering Data Management and Data Rescue; Climate Analysis and Monitoring;

Day 2: Defining CST Development Process

AM:

- Potential CST Resources (contd.)
 - o Presentations on highlights of individual CST resources covering Climate Predictions; Climate Projections; Tailoring information to users
- Break-out sessions on categories of data, products and tools identified in the preceding session

PM:

- Break-out sessions (contd.) and reporting

Day 3: Identifying Steps for CST Deployment, CSIS implementation and Way Forward

AM:

- Defining the path for CST implementation
- Global infrastructure required for CSIS implementation

PM:

- Global infrastructure required for CSIS implementation (contd.)
- Planning for International CSIS Workshop (March 2017)
- Meeting Summary and Recommendations

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13.	Alexander Sterin	HCR, Russia	WDC for Meteorology, Obninsk	sterin@meteo.ru
14.	Pascal Lecomte	ESA Climate Office, Oxford, UK	Satellite Datasets for Climate	pascal.lecomte@esa.int
Climate Monitoring, Predictions, and Projection Products and Tools				
15.	John Kennedy	UK Met Office, UK	WMO National Climate Monitoring Products	john.kennedy@metoffice.gov.uk
16.	Wassila Thiaw	NOAA, USA	Climate Monitoring Tool, GPCLRF, US RCC	wassila.thiaw@noaa.gov
17.	Yun-Young Lee or Hyunrok Lee	APCC, South Korea	The Climate Information ToolKit version 1.0 (CLIK1.0) Climate Predictions and Climate Informatics and Application	yvalee@apcc21.org tank@apcc21.org
18.	TBD	ECMWF, UK	Copernicus Climate Change Service (C3S)	
19.	Caio Coelho	CPTEC, São Paulo, Brazil	LRF, EuroBrisa	caio.coelho@cptec.inpe.br
20.	Lisa Alexander	Univ. New South Wales, Sydney, Australia	ClimPACT, ETCCDI	l.alexander@unsw.edu.au
21.	David Hein	Met Office, UK	PRECIS (Regional Climate Change Projections)	david.hein@metoffice.gov.uk
22.	Valentina Khan	NEACC, Russia	GPCLRF, RCC, ET-RCC	valentina_khan2000@yahoo.com
23.	TBD	GPC Seoul, Korea	GPCLRF, LC-LRFMME	
24.	Andre Kamga	ACMAD, Niger	African RCC, CSIS	akamgaf@yahoo.com
User Interface Mechanisms				
25.	Chris Hewitt	UK Met Office, UK	User Interface Platform	chris.hewitt@metoffice.gov.uk
26.	Ned Gardiner	NOAA, USA	Climate Resilience Toolkit	David.Herring@noaa.gov
27.	Roger Stone	USG, Australia	OPACE 4 ; CAgM	Roger.Stone@usg.edu.au
28.	Mark Stafford Smith	CSIRO, Australia	Climate Risk and Information Services	Mark.Staffordsmith@csiro.au

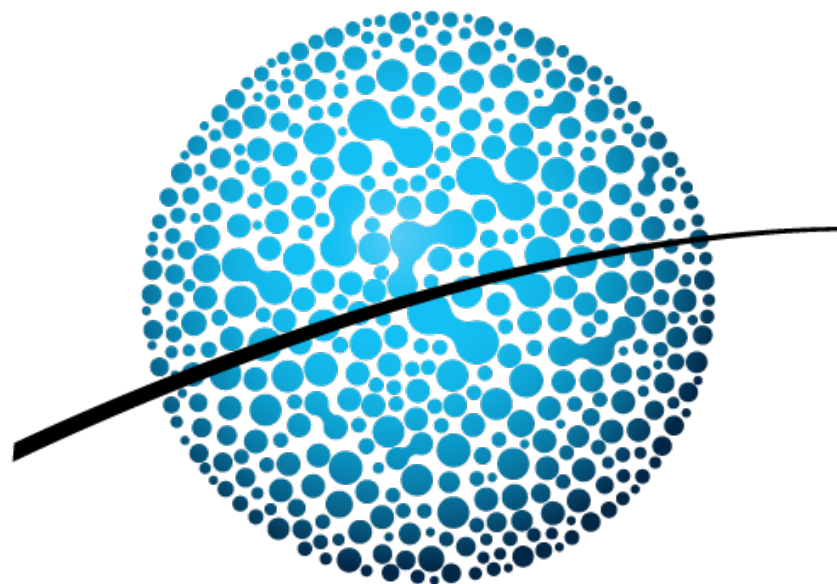
			Platform (CRISP)	
CCI Coordination				
29.	William Wright	Australia	CCI OPACE-1 Climate Data Management	w.wright@bom.gov.au
30.	Manola Brunet	Spain	CCI OPACE-2 Climate Monitoring and Assessment	manola.brunet@urv.cat
31.	Rodney Martinez	Ecuador New Zealand	CCI OPACE-4 User Interface for Climate Adaptation and Risk Management	r.martinez@ciifen.org
32.	Charlotte McBride	SAWS, South Africa	CCI OPACE-5, Capacity Development (especially QMS)	charlotte.mcbride@weathersa.co.za
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2.	Maxx Dilley	Director, CLPA	WCSP, GFCS, CCI	MDilley@wmo.int
3.	Filipe Lucio	Director, GFCSO	GFCS	FLucio@wmo.int
4.	David Carlson	Director, WCRP	WCRP	DCarlson@wmo.int
5.	Carolin Richter	Director, GCOS	GCOS	CRichter@wmo.int
6.	Peiliang Shi	Acting Director, OBS	OBS	PShi@wmo.int
7.	Xu Tang	Director, WDS	WDS	XTang@wmo.int
8.	Yinka Adebayo	Director, ETR	ETR	YAdebayo@wmo.int
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10.	Omar Baddour	OBS/WIS/DMA	International Data Rescue (I-DARE) Portal	OBaddour@wmo.int
11.	Anahit Hovsepyan	CLW/CLPA/WCAS	CSIS, CCI	ahovsepyan@wmo.int
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15.	Abdoulaye Harou	WDS/DPFS	GDPFS	aharou@wmo.int
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19.	Katiuscia Fara	WFP, Switzerland	GFCS Food Resilience area	katiuscia.fara@wfp.org
20.	Alasdair Hainsworth	WMO	GFCS DRR area	
21.	Claudio Caponi	CLW/HWR/CBHWR	GFCS Water area	ccaponi@wmo.int
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24.	Nirina Ravalitera	CLW	MCH - Meteorological, Climatological and Hydrological Database Management System	nravalitera@wmo.int
25.	Stephan Bojinski	WMO Secretariat	EUMETSAT, SAF, other tools	sbojinski@wmo.int

CLIK (CLimate Information ToolKit)

<http://clik.apcc21.org>

7 Dec 2016

Yun-Young Lee



APCC
APEC CLIMATE CENTER

Mission of APCC

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>



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 multi model prediction

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

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

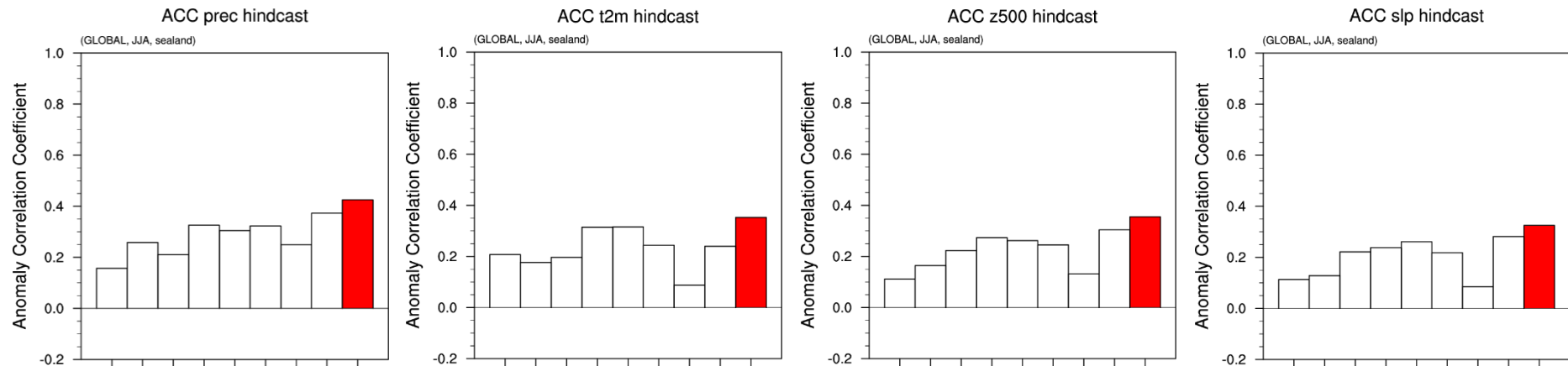
CLIK

Downscaling:
Simulated large scale
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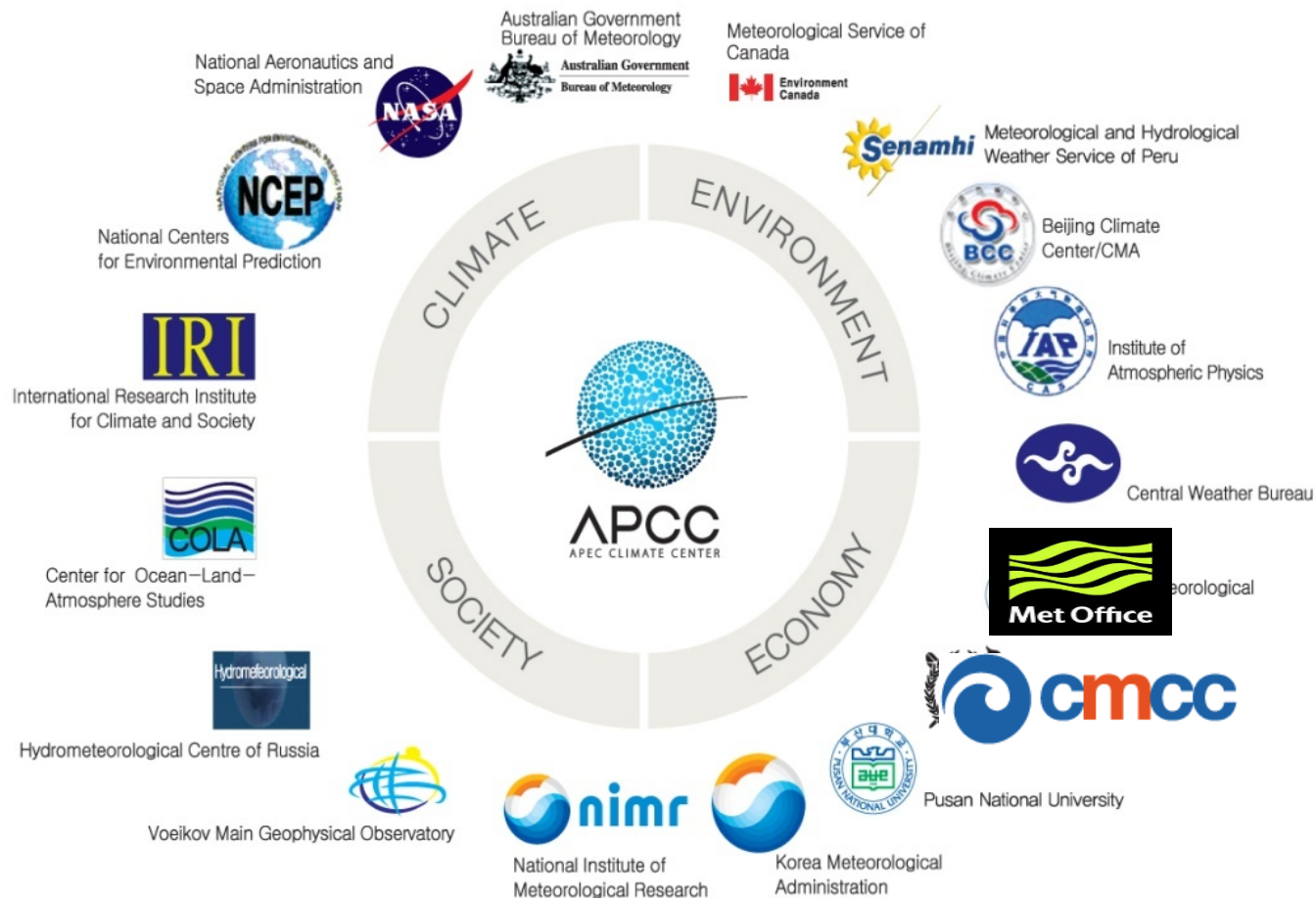
- To provide **statistical downscaling** capability using multi model prediction

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.



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 Meteorología e Hidrología	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

PREDICTION_methodology

Deterministic

Multi-Model
Ensemble
(MME)

Probabilistic

SCM

GAUS

Simple Composite Method:

Average of individual forecast
with equal weighting

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

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.

MME PREDICTION: product

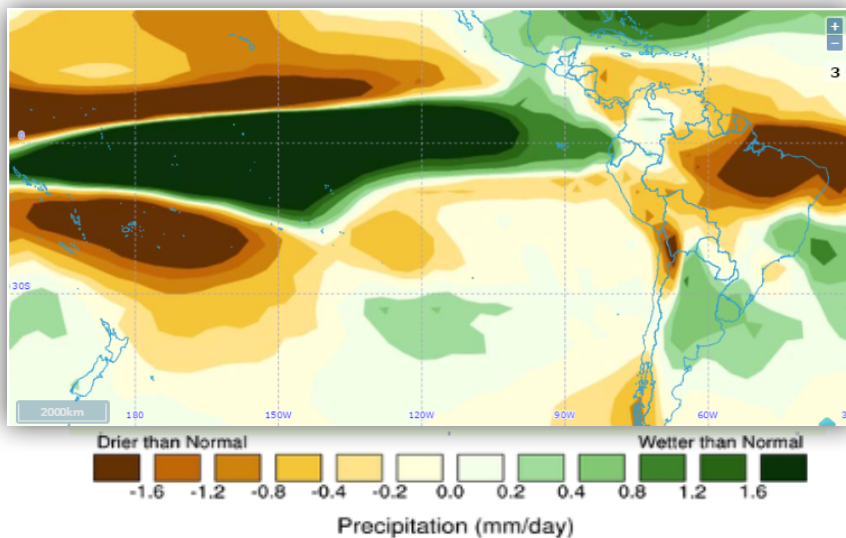
Lead Month
☒ 3Month

When
Year Season

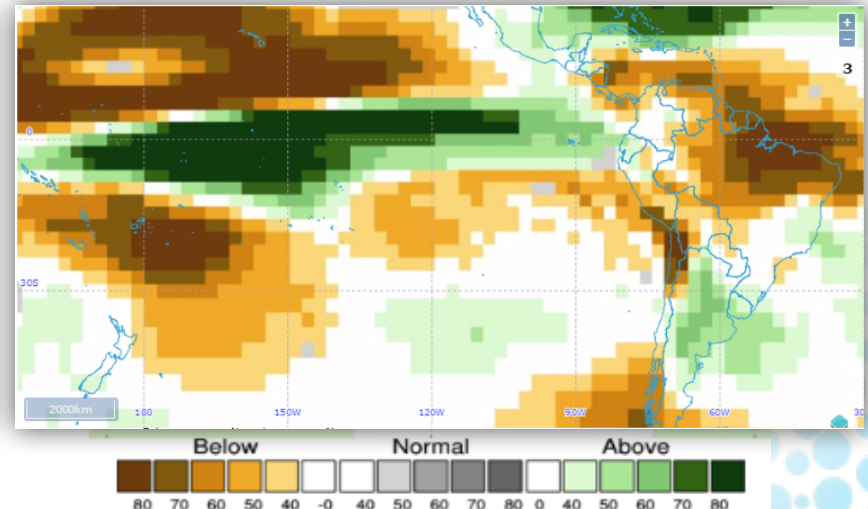
Variables
☒ PREC ☐ T850

Model
☒ ALL
☒ APCC ☒ CMCC ☒ COLA ☒ CWB ☒ HMC
☒ IRIF ☒ IRI_CA ☒ MGO ☒ MSC
☒ NASA ☒ NCEP ☒ PNU ☒ POAMA

DMME (SCM)



PMME (GAUS)



MME PREDICTION: skill score

Lead Month
☒ 3Month

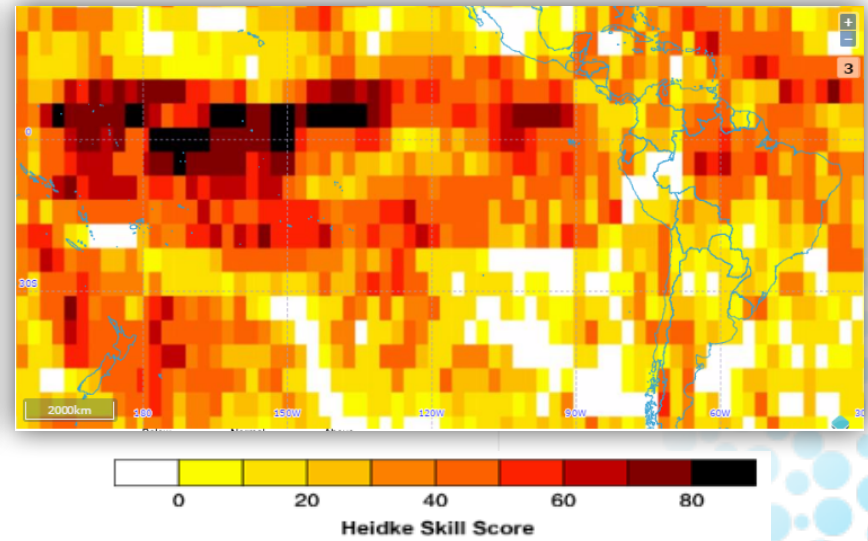
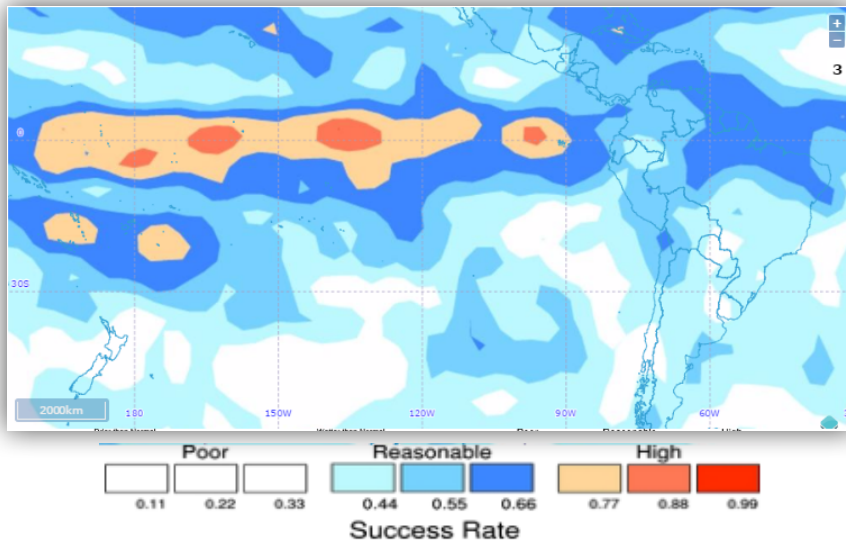
When
Year Season

Variables
☒ PREC ☐ T850

Model
☒ ALL
☒ APCC ☒ CMCC ☒ COLA ☒ CWB ☒ HMC
☒ IRIF ☒ IRI_CA ☒ MGO ☒ MSC
☒ NASA ☒ NCEP ☒ PNU ☒ POAMA

DMME (SCM) → Success rate

PMME (GAUS) → HSS



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

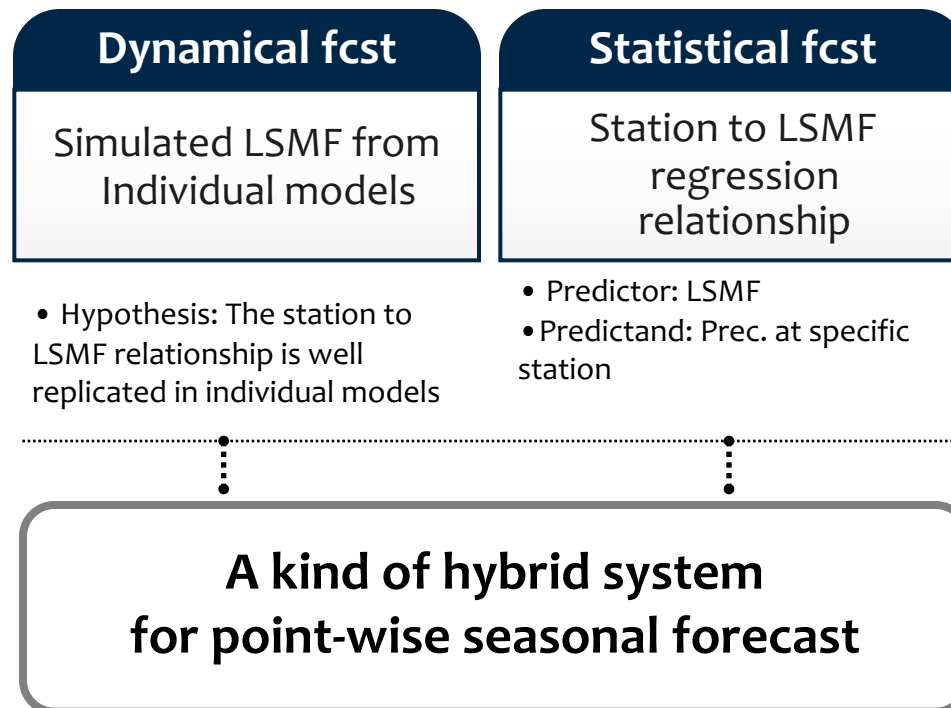
Downscaling:
Simulated large scale
pattern to station
matching

- To provide **statistical downscaling** capability using multi model 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. ($Y = a \cdot X + b$) By utilizing the simulated LSMF (X, predictor), CLIK estimates seasonal mean precipitation/temperature (Y, predictand) at specific station.



CLIK downscaling

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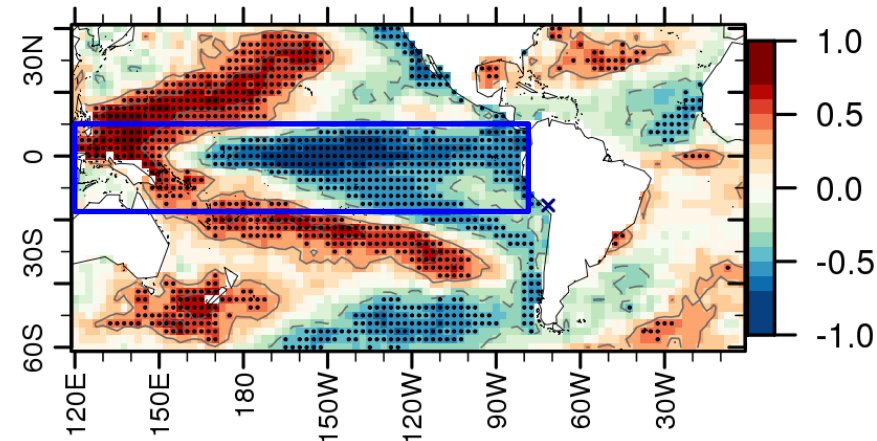
The screenshot shows the CLIK Climate Information Toolkit interface. The top navigation bar includes 'Prediction', 'Downscale', and 'My Page' tabs, with 'Downscale' currently selected. The 'Set-up Downscaling' section contains several configuration panels:

- Prediction Season:** Year (2016), Season (JFM).
- Variable:** Radio buttons for PREC, T850, Z500, SLP, U850, U200, and SST. The 'SST' option is selected and highlighted with a red box.
- Models:** Checkboxes for APCC, MSC, NASA, NCEP, PNU, and POAMA. All are checked.
- Predictand:** Radio buttons for Precipitation and Temperature. 'Precipitation' is selected.
- Training Period:** Form (1998) to To (2009).
- Method:** Radio button for Linear Regression, which is selected.
- Advanced Options:** Significance Level (5%) and Minimum Pattern Score (0.3%).

The 'Downscaling Region' panel on the right shows a map of the Indian Ocean with a purple rectangular region of interest. A red pin marks a specific location with coordinates: Lat: -3.447155 to 27.742381, Lon: -224.384251 to -82.976126, and Area: 21878747.19 sq.mi. The map includes a 5000km scale bar and a 'Previous' button at the bottom.

**Empirical relationship:
LSMP ~ local station rainfall**

**sibayo [FMA]
NNR2 sst**



CLIK downscaling: results

Details

PREDICTAND		PREDICTOR	
YEAR/SEASON	2016 /6	Training Period	1982 /2004
PREDICTAND	PREC	VARIABLE	PREC
DATASET	Aphrodite data interpolated to Monsoon Asia Region	MODELS	☉ NCEP
REGION	11 Stations	REGION	Lat : -10 ~ 10, Lon : 60 ~ 10
SIGNIFICANCE LEVEL			5%
MINIMUM PATTERN SCORE			0.3
☒ List up hopeful & good result stations only			

Selected Stations

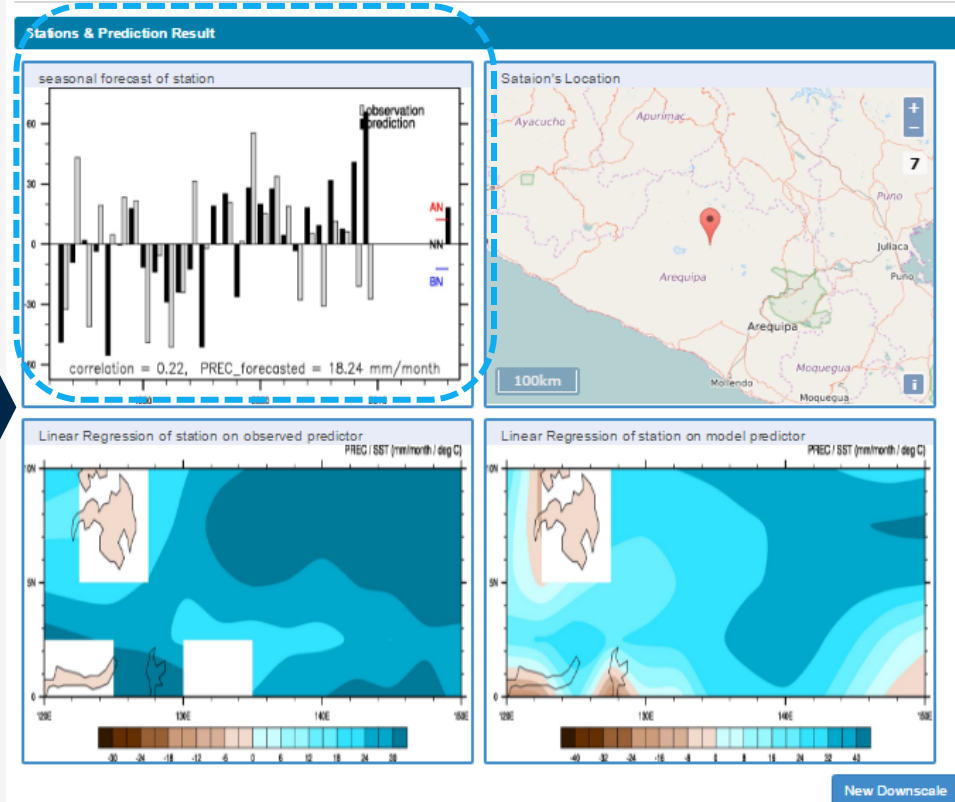
Station ID	Result	Name	Data period for PREC	Data period for TSS	Correlation
97014000	Good	Mapanglet/manado, Indonesia	1961/1 ~ 2004/12		0.308431
97014001	Good	Amurang	1961/1 ~ 2004/12		0.308376
97014002	Good	Talisel	1961/1 ~ 2004/12		0.306781
97026001	Hopeful	Noancan	1961/1 ~ 2004/12		0.287869
97026002	Good	Modayak	1961/1 ~ 2004/12		0.295097
97028000	Hopeful	Tolitoli, Indonesia	1961/1 ~ 2004/12		0.416711

Historical station time series &
Historical downscaled time series
(hindcast) for individual models

Correlation coefficient skill

Deterministic forecast with tercile range
from historical observation

No integration (no merging) of models

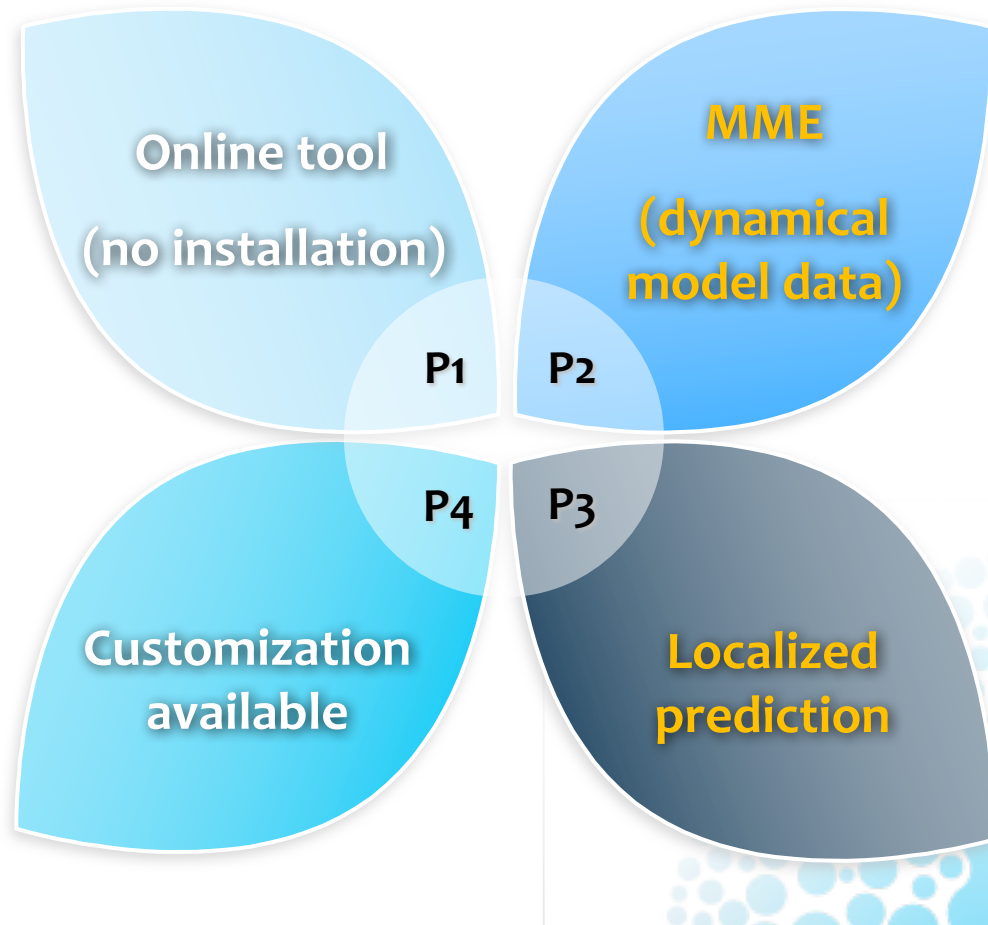


Target Users

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

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 from participating in the model developing process





Thank you.
감사합니다.

World Meteorological Organization



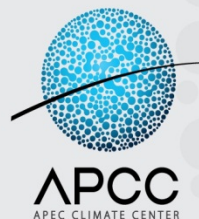
DEVELOPERS MEETING ON THE
GFCS-RELEVANT CLIMATE DATA, PRODUCTS,
AND TOOLS FOR IMPLEMENTATION OF THE CLIMATE SERVICES INFORMATION SYSTEM

Geneva, Switzerland, 6-8 December 2016

CLimate Information toolKit



Wednesday, 7 December 2016



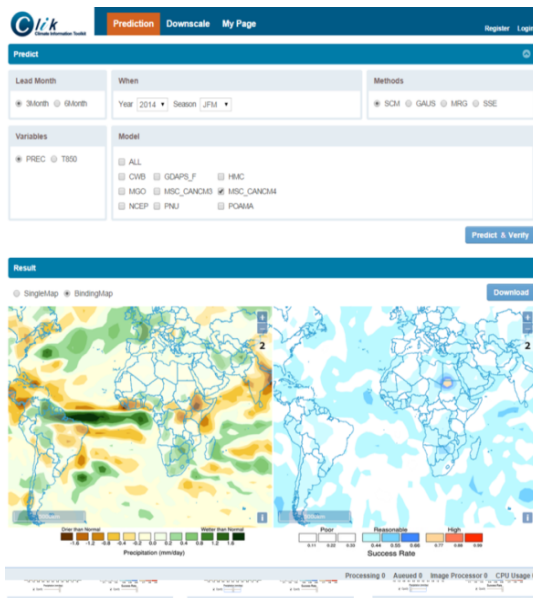
Hyunrok Lee
tank@apcc21.org

Information Service Team
Climate Prediction Department
APEC Climate Center

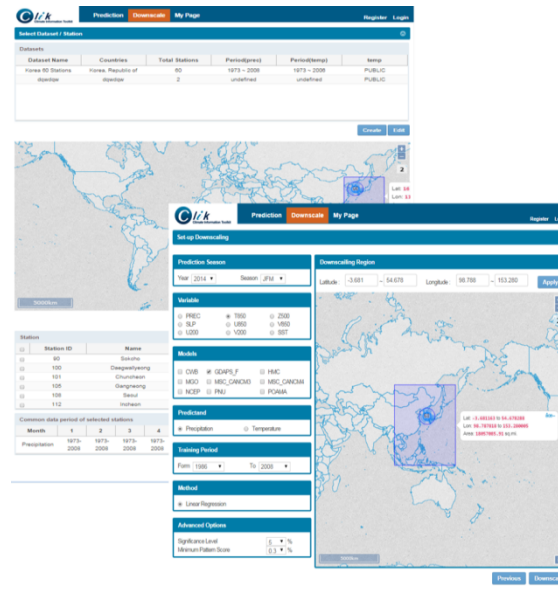
<http://clik.apcc21.org>

✓ **CLimate Information toolKit (CLIK) :**

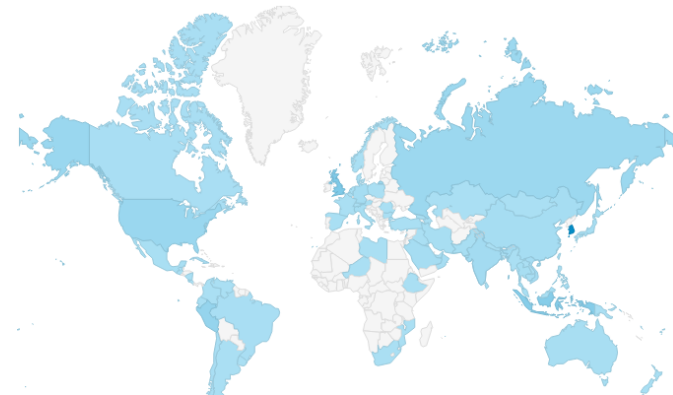
- **[Online]** Web based Climate Prediction Toolkit
- **[Customized]** Produce customized Prediction/Verification to freely select climate models, variables, areas, and analysis techniques
- **[MME]** Produce the state-of-art Multi-Model Ensemble climate prediction
- **[Lightweight]** Precomputation, Optimizing map & image size



MME Prediction



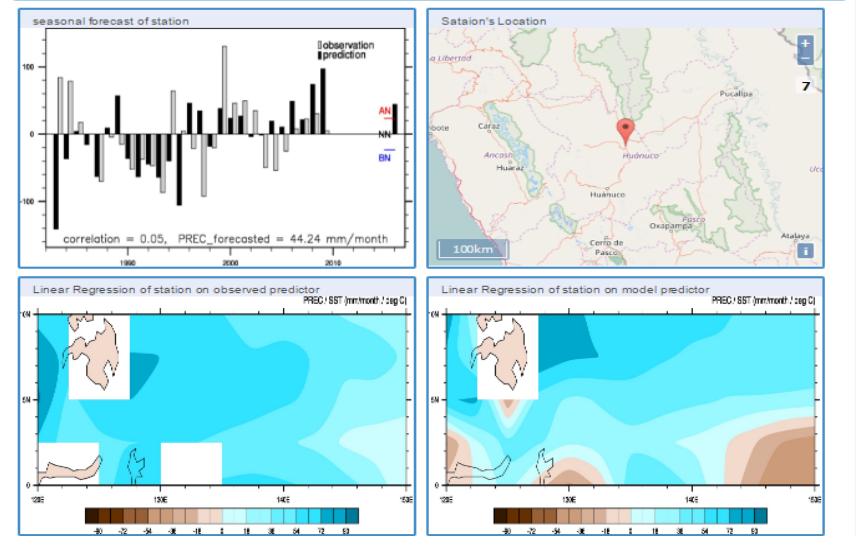
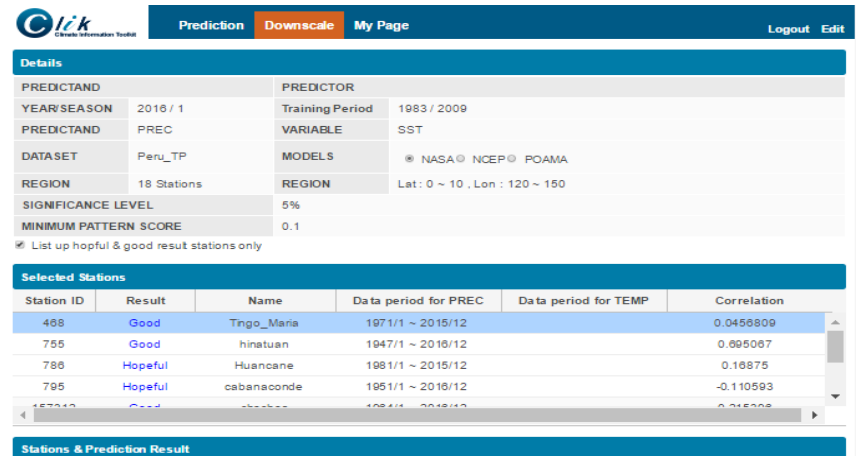
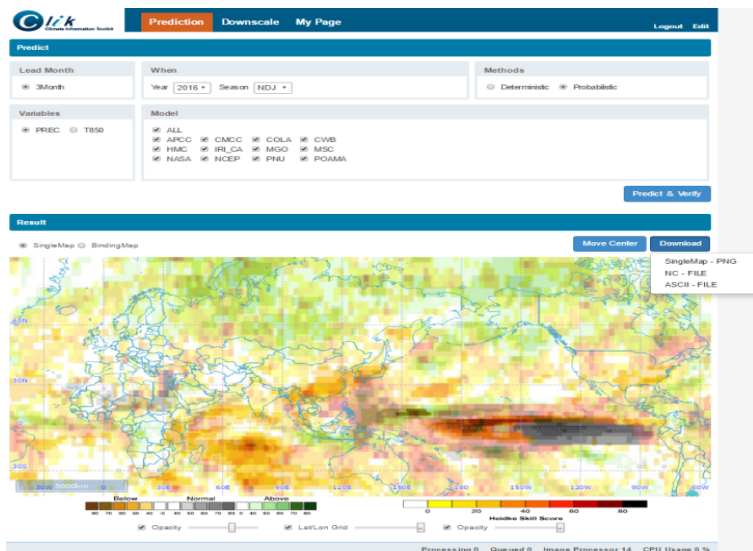
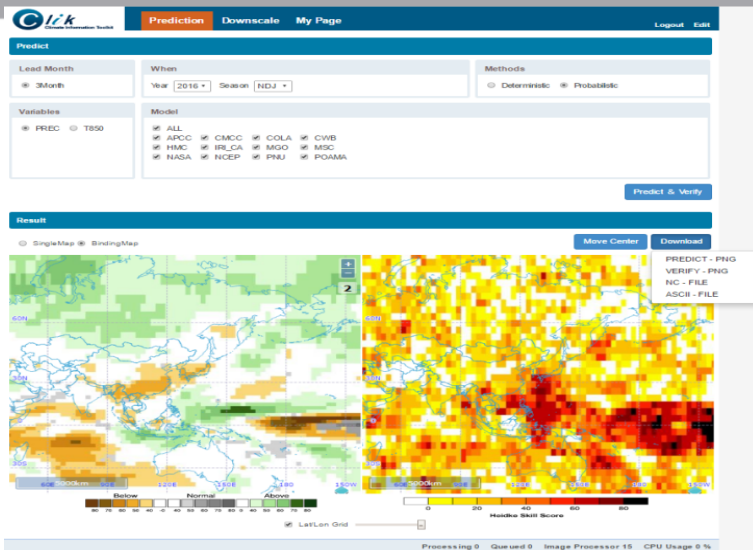
Downscale



Countries using CLIK (1 Jan. ~ 3 Dec. 2016)

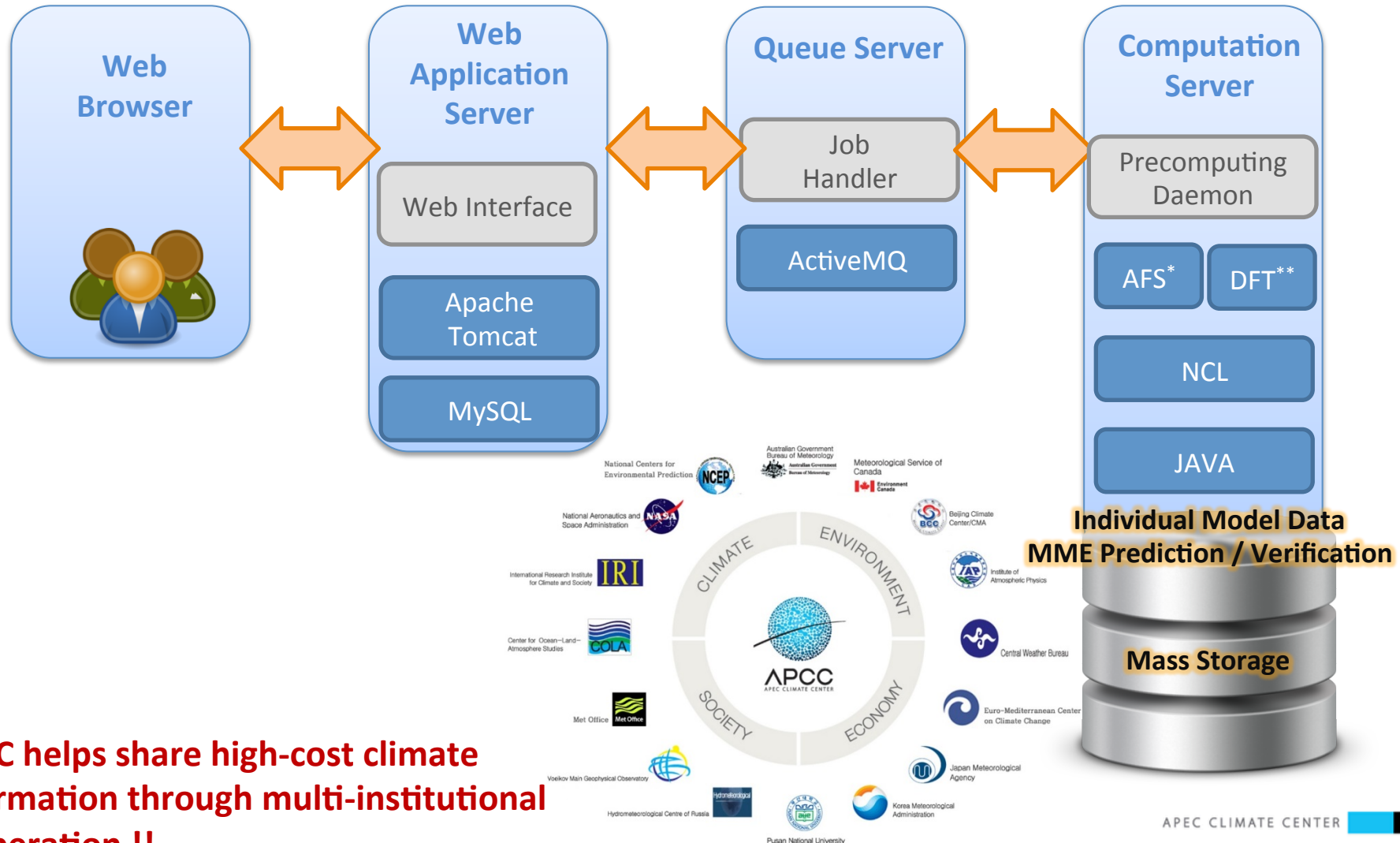
Web User Interface

APCC



CLIK Internals

APCC



APCC helps share high-cost climate information through multi-institutional cooperation !!

* AFS : Automated Forecast System, **DFT: Downscale Forecast Tool

APEC CLIMATE CENTER

APCC

Nationally tailored information on seasonal climate prediction and improve climate services.



APCC-Tonga Agricultural decision support system



APCC-PNU Hospital
Heat wave & fever



- [illegible]

APEC CLIMATE CENTER



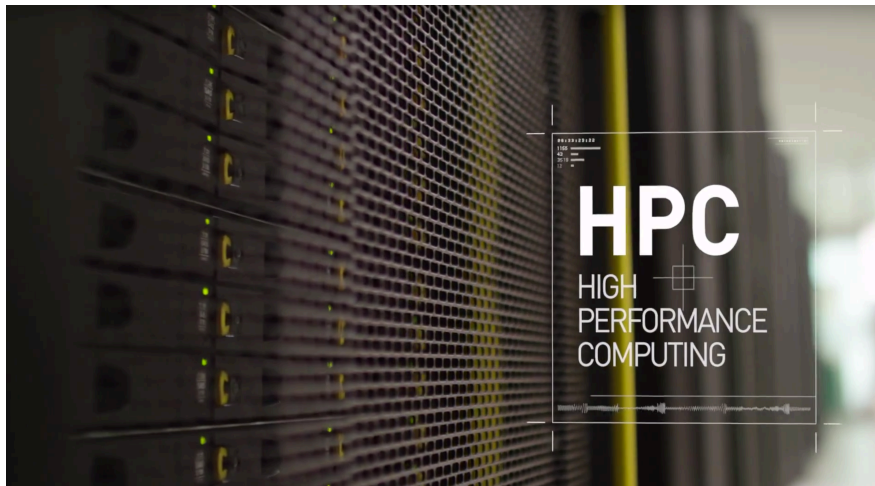
For CST Integration

- Readiness for sharing
 - Storing presented data in the mass storage at APCC
 - Periodically receive Individual Model Data and precompute MME Data
 - Well organized computation backend at APCC
 - AFS (Automated Forecast System)
 - Produce DMME, PMME Prediction with Verification (SR, HSS)
 - DFT (Downscale Forecast Tool)
 - Produce Statistical Downscaling Prediction
 - Continuous CLIK Training Workshop and plan to develop tutorial based on the user & usability survey

Future Directions of CLIK

✓ Tailored, Customized “Information” for YOU

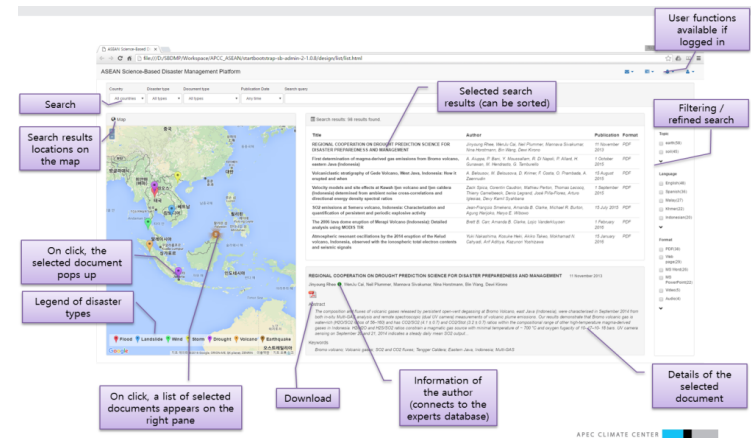
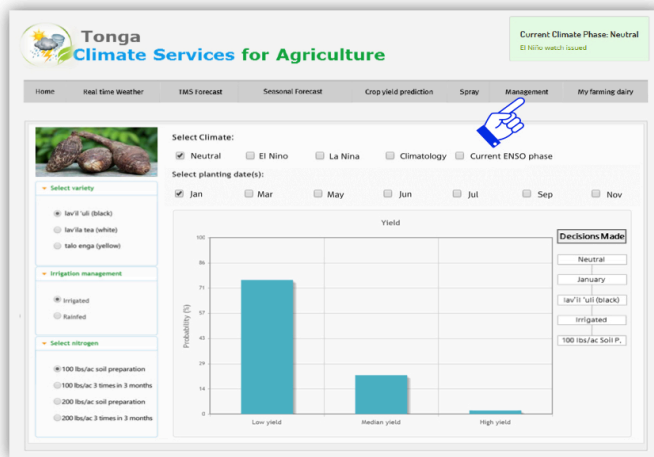
- [Method]
 - Provide additional methods on MME prediction and verification feature
 - Enhance computing mechanism through in-house HPC



Category	Specification
Computing Performance	3.47GHz X 1,248cores, 17.322 TF, 6 login nodes, 2 license manager, 1 master node, 8 hosting servers
Storage	3 PB, 15ea NAS gateway, storage SAN
Network	40Gbps QDR IB interconnector non-blocking 구성 (8 edge + 6 core), Individual NIS/ILO network

Future Directions of CLIK

- **[Augmentation]**
 - Interdisciplinary research result from APCC to be gradually applying
 - Agriculture, Disaster Management, Health, and Water Resource Management



- **[Localization]**
 - Develop and Improve region-specific statistical downscaling prediction
- **[Training]**
 - Enhance Training Workshop and Tutorial program

Other efforts for climate services

✓ Climate Data Clipping tool & Research on Enhancing its method



- <http://clips.apcc21.org>

Objectives

Climate and climate application data not only have numerous file formats, but also require enormous time and resources to process. Researchers and policy makers need user-friendly file formats and data extraction services to conveniently utilize climate data. The average user tends to have difficulty dealing with climate data because a single climate data set includes time information, geological information, and various factor values. Due to these various factors, expertise in data extraction is required. Therefore, the APCC Climate Center (APCC) Climate Information & Application Team has developed the Climate Information Processing System (CLIPS), which enables the average user to conveniently extract the specific data necessary for their research.

Material

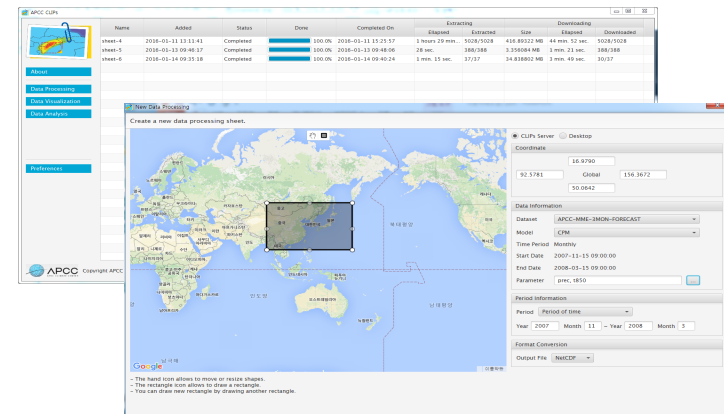
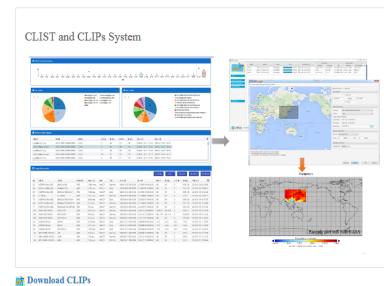
1.49 million climate change scenario, climate forecast MME data, climate change scenario, NOAA Station observation data, and NASA satellite data all from 1950 to 2020, are collected and available on CLIPS. The collected data were formatted with NetCDF, GRIB, HDF, TXT, and various different formats relative to the characteristics of each dataset and institution.

To provide standardized data, all the data are reformatted with NetCDF (widely used in climate research) and the numerous attributes and units of the data have been converted into standardized units. Additionally, the team has built the database with the extracted temperature, precipitation, wind data and global climate factors.

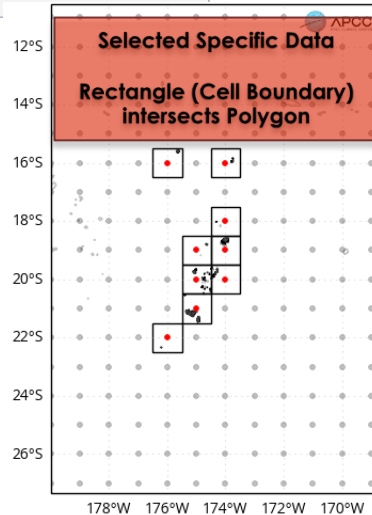
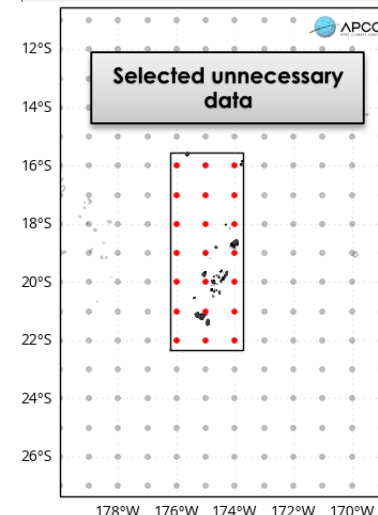
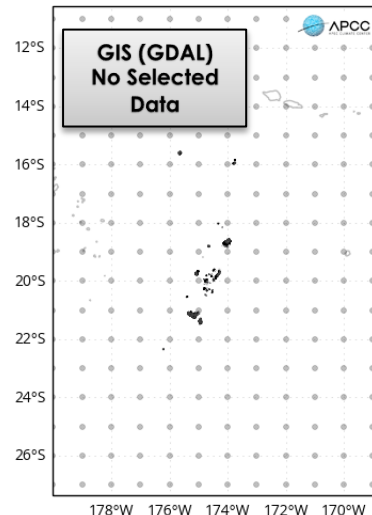
In order to process large amounts of climate data, the system has two distinct functions, CLIST (CLimate Information Standardization Toolkit) and CLIPs (CLimate Information Processing system) that collect and standardize data, then makes this data available to users. CLIST transforms various file formats into standardized file formats while CLIPs enables users to search for specific locations or values with the installed application on their PCs. Then the combination of these two systems conveys the search results to the users. Finally, for those users residing in those places that lack high-speed Internet infrastructure, APCC has applied compression technology to CLIPs so that they can easily access this service.

Results

APCC CLIPs provides functions that empower researchers that are unfamiliar with processing mass data, to effortlessly extract necessary data for specific regions including climate index and time-scale information. This service helps researchers reduce time spent on data processing and renders it unnecessary to budget for high-end hardware and software. This service is expected to be widely used in Korea as well as developing countries that lack appropriate IT infrastructures.

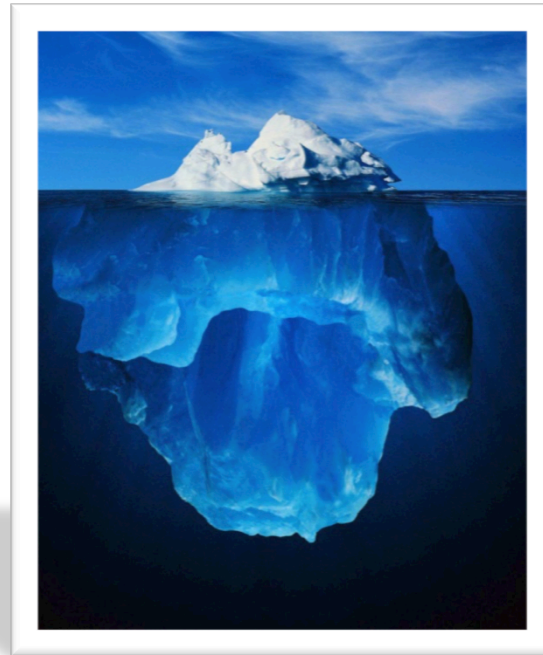


CMIP5
Spatial Res.
1.0 deg
Resampling
Data



Thank You !!

APCC



**For question and feedback, please contact
the Information Service Team at**

clik@apcc21.org