

TRAVEL REPORT FORM

출장보고서

결 재	선임연구 원	팀장	부서장	원장
	02/20	02/20	02/20	02/21
협 조	민영미	이우섭	유진호	정홍상

I. Travel Overview 출장개요

1. Traveler(s) 출장자

Department 소속	Position 직위(직급)	Name 성명	Note 비고
기후예측본부	선임연구원	민영미	

2. Travel Period 출장기간

- 2018년 2월 5일 - 11일

3. Occasion and destination 행사 및 출장지

- 학회명: 2018 HEPEX (Hydrological Ensemble Prediction Experiment) Workshop
- 장소: 호주 멜버른대학

II. Major Activities 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

- 2018년 2월 호주에서 개최된 2018 HEPEX 학회 참석
 - 2004년 공식적으로 시작된 HEPEX는 앙상블 유량예측을 통한 홍수 및 수자원 관리를 목적으로 함
 - 2018년 HEPEX 워크샵의 주제는 'breaking the barriers'로 기초연설 및 초청발표 포함 총 40여개의 구두발표 및 40여개의 포스터 발표가 진행, 100여명 이상의 수자원 전문가들이 참석하였음
- 'APCC 계절예측정보 서비스에 대한 소개' 초청 발표 (2018 HEPEX로부터 참여 요청)
 - 2018년 2월 8일 Session 7 'Operational hydrometeorological forecasting services' 초청 발표
 - 발표제목: Current status of the operational multi-model ensemble prediction system and climate service at APCC
- 계절예측자료를 활용한 수자원 분야 (특히, 홍수 및 유량)의 연구 및 현업에 대한 현황 및 앙상블 유량예측의 현재 수준 (예측력) 파악
- 앙상블 예측기술의 응용분야 적용 (예, 수력전기 및 저수지)에 대한 과학적인 토론 및 앞으로의 방향에 대한 논의



(그림 1) 2018 HEPEX Workshop 참석자

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

- 다양한 수자원분야에서의 앙상블 예측기술의 적용, 유량예측 모델의 불확실성 및 예측력에 대한 전반적인 현황을 파악하는데 도움이 되었음
- 또한, 계절예측정보가 연구적인 측면과 현업적인 측면에서 수자원분야에서 어떻게 활용이 되고 있는지 확인할 수 있는 좋은 기회였으며 인적 네트워크 확장에 큰 도움이 되었음
- 현재 수자원 분야에서 활용하고 있는 계절예측정보는 대부분 ECMWF 자료였으며, APCC 계절예측 서비스에 대한 전반적인 소개에 대한 이번 초청 발표는 HEPEX 참석자들에게 많은 관심이 있었음
- 특히, 다중모델자료를 활용하는 MME 기술에 대한 관심이 높았으며 실제 수자원 분야에 적용을 위한 기술적인 부분에 대한 질문 및 논의가 추가적으로 있었음
- 마지막으로 실질적으로 수자원분야에서 APCC 계절예측정보를 활용하기 위해서는 자료 제공 시기가 다소 늦다는 의견이 있었으며 APCC 계절예측자료 활용성을 증대시키기 위해서는 충분히 고려해 볼 만한 사안이며 이를 위한 APCC의 추가적인 노력이 필요할 것으로 보임
- 이번 HEPEX 학회 참석 및 초청 발표를 통해 APCC 예측정보 활용성을 높이기 위해서는 여러 응용분야에 APCC 계절예측정보 서비스 및 활용방안을 지속적으로 소개하고 알리기 위한 끊임없는 노력이 필요할 것으로 보임

3. Suggestions and Remarks 건의사항

III.References (Presented and Collected Materials) 주요 수집자료

(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

- 2018 HEPEX 발표 프로그램 (첨부 1) 및 발표자료 (첨부 2) 첨부
- 구두발표에 대한 모든 발표문은 아래 홈페이지에서 공개될 예정임
(<https://hepex.irstea.fr/2018-hepex-workshop/programme/#support>)

Day 1 - 6 February 2018 (Tue)	
8.15 – 9.00:	Registration and coffee; put up posters
9.00 – 9.30:	Workshop open – Welcome from local organizers and HEPEX co-chairs
9.30 – 9.45:	Welcome to country
9.45 – 10.25:	Keynote - Hannah Cloke (University of Reading)
10.25 – 10.55:	Coffee break
Session 1 – Regional to Global Scale Forecasting	
10.55 – 11.15:	QiuHong Tang (Chinese Academy of Sciences) - A Hydrological Monitoring And Seasonal Forecast System Using Satellite And Climate Model Data Over China (Invited)
11.15 – 11.30:	Micha Werner (IHE-Delft/Deltares) - Are Global Models Skillful In Forecasting Floods, Drought, and Their Impacts In Data Scarce Areas?
11.30 – 11.45:	Louise Arnal (University of Reading/ECMWF) - Skilful Forecasts Of Seasonal Streamflow Over Europe?
11.45 – 12.00:	Calumn Baugh (ECMWF) - Using Global Ensemble Forecasts To Issue Flash Flood Warnings
12.00 – 12.15:	Andy Wood (NCAR) - Exploring The Application of Ensemble Prediction Methods Across Regional Forecasting Domains
12.15 – 12.35:	Florian Pappenberger (ECMWF) - Earth System Modelling @ECMWF - Implications For Hydrology And HEPEX (invited)
12.35 – 13.40:	Lunch break
Session 2 - Data assimilation for ensemble prediction	
13.40 – 14.00:	Hamid Moradkhani (Portland State University) - Data assimilation and post-processing in hydrological forecasting (Invited)
14.00 - 14.15:	Tomoki Ushiyama (ICHARM-PWRI/Kyoto University) - Comparison of Ensemble Flood Forecasts from Two Regional Ensemble Prediction Systems (EPS): Simple Downscaling of Global EPS and Regional Data Assimilation
14.15 – 14.30:	Dirk Schwanenberg (Kisters) - Inter-comparison experiment of data assimilation by neural networks and variational state estimation for different hydrological model structures
14.30 – 14.50:	Coffee break
Session 3 – Hydrological modelling for improved forecasts	
14.50 – 15.10:	François Anctil (Université Laval) - Impact of data assimilation on the usage of multiple models (Invited)
15.10 – 15.25:	Albrecht Weerts (Deltares/Hydrology and Quantitative Water Management group) - Improving hydrological modelling/predictions for the Rhine River in the framework of the IMPREX project
15.25 – 15.40:	David Zamora-Avila (Universidad Nacional de Colombia) - Functionality And Relevance Of Hydrological Models In Multi-Model And Multi-Forcing Ensembles From A Bayesian Perspective – A Study On The Magdalena-Cauca Macro-Basin, Colombia
15.40 – 16.00:	Discussion
16.00 – 17.30:	Poster Session 1 - 21 posters (with drinks)

8.30 – 9.00:
9.00 – 9.20:
9.20 – 9.35:
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15.10 – 15.25:
15.25 – 16.00:
16.00 – 17.30:
19.30:

Day 2 - 7 February 2018 (Wed)
Coffee; put up posters
Session 4 - Ensemble Weather Prediction
Céline Cattoën-Gilbert (NIWA) - Post-Processing Precipitation Forecasts From A High Resolution Convective-Permitting Weather Model For National Scale Short-Term Flow Forecasting In New Zealand (Invited)
Tom Pagano (Bureau of Meteorology) - Operational Weather Verification At The Australian Bureau Of Meteorology
Xing Yuan (Chinese Academy of Sciences) - Seasonal Predictability Of Atmospheric Moisture Transport Versus Precipitation: Exploring Precursor For Flood Early Warning Over Yangtze River By An Ensemble Approach
Keynote - Dasarath Jayasuriya (Jaya) (Bureau of Meteorology)
Group Photo and Coffee break
Session 5 - Seasonal streamflow forecasting
Louise Crochemore (SMHI) - Skill Sensitivity In Europe And Site-Specific Diagnostics Based On Catchment Characteristics (Invited)
Shaun Harrigan (CEH) - Improving Seasonal Prediction Of Uk Winter Streamflow
Bastian Klein (German Federal Institute of Hydrology) - Impact Of Hydrological Model Uncertainty On Predictability Of Seasonal Streamflow Forecasting In The River Rhine Basin
Daehyok Shin (DH) (Bureau of Meteorology) - The operational seasonal streamflow forecasting service for Australia: assessment and communication of forecast quality at the national scale
Lunch break
Session 6 - Floods: risk, forecasting and warning
Rebecca Emerton (University of Reading/ECMWF) - Complex Picture for Likelihood of ENSO-Driven Flood Hazard (Invited)
Maria-Helena Ramos (IRSTEA) - Contribution Of Ensemble Forecasting Approaches To Flash Flood Nowcasting At Gauged And Ungauged Catchments
Agathe Boronkay (Bureau of Meteorology) - The Use Of Radar-Based Rainfall Observations And Forecasts To Provide Enhanced Flood Forecasts And Warnings In Australia
Li Liu (Zhejiang University) - The Role Of Hydrological Ensemble Forecasts Of Flood And Its Components Over The Yarlung Zangbo River
Coffee break
Session 6 (continued) - Floods: risk, forecasting and warning
Schalk Jan van Andel (IHE-Delft) - Does Event-Based Verification Lead To Different Results From Equal-Interval Verification?
Vincent Boucher (Université Laval) - Confidence In Flood Warning System And The Value Of Ensemble Forecasts
Discussion
Poster Session 2 - 21 posters (with drinks)
Dinner

Day 3 - 8 February 2018 (Thu)
8.30 – 9.00: Coffee
Session 7 - Operational hydrometeorological forecasting services
9.00 – 9.20: Young-Mi Min (APCC) - Current Status Of The Operational Multi-Model Service Activities At the APEC Climate Center (Invited)
9.20 – 9.35: Narendra Tuteja (Bureau of Meteorology) - Opportunities and challenges in delivering Australian experience
9.35 – 9.50: Ilias Pechlivanidis (SMHI) - An Operational Pan-European Seasonal Hydro-Climatic Service
9.50 – 10.05: Charlie Pilling (UK Met Office) - Improving Operational Decision Making And Service Communication
10.05 – 10.45: Keynote - Matthew Bethune (Murray-Darling Basin Authority)
10.45 – 11.15: Coffee break
Session 8 – Subseasonal forecasting: bridging medium-term and seasonal timescales
11.15 – 11.35: Luis Samaniego (UFZ-Helmholtz Centre for Environmental Research) - Hindcast experiment (Invited)
11.35 – 11.50: Andrew Schepen (CSIRO) - Is it better to post-process seasonal rainfall and temperature forecasts?
11.50 – 12.05: Rachel Bazile (Université de Sherbrooke) - Comparison Of Several Ensemble Meteorological Forecasts In A Northern Climate
12.05 – 12.20: Fredrik Wetterhall (ECMWF) - Merging Of Extended- And Seasonal Range Forecasts
12.20 – 13.30: Lunch break
Session 9 - Applications of ensemble prediction: hydropower and reservoir operations
13.30 – 13.50: Samuel Monhart (ETH/WSL) - Hydrometeorological Ensemble Prediction Forecasts To Improve Hydropower Reservoir Operations (Invited)
13.50 – 14.05: Richard Arseneault (École de technologie supérieure/Rio Tinto Aluminium) - Sensitivity To Different Hydrological Forecasting Parameters
14.05 – 14.20: Hae Na Yoon (Seoul National University) - Adjustment of reservoir operating rules
14.20 – 14.35: Thomas Chubb (Snowy Hydro) - Use Of Artificial Neural Networks In Short-Term Forecasting
14.35 – 14.45: Coffee break
Session 9 (continued) - Applications of ensemble prediction: hydropower and reservoir operations
14.45 – 15.00: Olivier Vannier (Compagnie Nationale du Rhône) - A First Use Case Of Operational Hydropower Production On The Rhone River: Evaluation Of Several Post-Processing Methods
15.00 – 15.15: Nathalie Voisin (PNNL) - Sensitivity of power system operations to water availability meteorological forecasts
15.15 – 16.45: Plenary Discussion: What's next in hydrological ensemble prediction?
16.50 – 17.00: Workshop close

Day 4 - 9 February 2018 (Fri)	
8.00 – 18.00:	Field trip to BoM National Forecast Centre and Melbourne Water Infrastructure (TBC)

Presenting Author	#	ID	Co-authors
Anctil, François	3	HW01	Mabrouk AbazaF
Anctil, François	2	HW04	Antoine Thiboultl
Arnal, Louise	1	HW37	Jess NeumannLoi
Bennett, James	1	HW10	QJ WangDavid R
Bretreger, David	1	HW13	In-Young YeoNat
Crochemore, Louise	2	HW17	M. LindskogT. Lai
Dasgupta, Antara	1	HW18	Stefania Grimaldi
Emerton, Rebecca Elizabeth	2	HW20	Ervin ZsoterHann
Fakhruddin, Bapon	1	HW21	Mudasser Khan
Frost, Andrew	1	HW22	Chantal Donnelly
Hapuarachchi, Prasantha	1	HW23	X.S. Zhang A. Kak
Hegdahl, Trine Jahr	1	HW25	Trine Jahr Hegda
Hou, Jiawei	1	HW26	Albert I.J.M. Van
Li, Wentao	1	HW28	Qingyun Duan
Li, Yuan	1	HW29	Valentijn Pauwels
Marshall, Lucy	1	HW31	Sahani PathirajaL
Meucci, Alberto	1	HW32	Ian R Young
Monhart, Samuel	2	HW35	Konrad BognerCh
Pauwels, Valentijn	1	HW39	Gabriëlle J.M. De
Peredo-Ramirez, Daniela	1	HW41	Claire VrignaudM
Perraud, Jean-Michel	1	HW42	Robert J. Bridgarl
Ramos, Maria-Helena	1	HW44	Fredrik Wetterhal
Robertson, David	1	HW46	Rowan Barling
Schepen, Andrew	2	HW49	Andy WoodJame
Schwanenberg, Dirk	1	HW50	Enrique Cano Sch
Schwanenberg, Dirk	2	HW51	Rodolfo Alvaradc
Seo, Seung Beom	1	HW52	Kim, Young-OhKi
Shrestha, Durga Lal	1	HW54	David Robertson.
Smith, Adam	1	HW55	Jeff PerkinsJustin
Song, Yong	1	HW56	David RobertsonC
Tangdamrongsub, Natthachet	1	HW58	Shin-Chan HanIn
Tsanis, Ioannis	1	HW59	Grillakis M.G.Tsar
van Osnabrugge, Bart	1	HW64	Albrecht WeertsR
Velasco-Forero, Carlos	1	HW66	Alan Seed
Vuillaume, Jean-François	1	HW68	Dai Yamazaki
Wang, QJ	1	HW69	Ming LiJames Bei
Weerts, Albrecht	2	HW71	Daniel TwigtTom
Wood, Andy	2	HW75	Elizabeth A. Clark
Wood, Andy	3	HW82	Andrew W. Wooc
Ye, Aizhong	1	HW77	Jingwen HouQing
Zhang, Xuejun	1	HW84	QiuHong Tang
Zsoter, Ervin	1	HW81	Hannah ClokeElis

Title

On The Incidence Of Meteorological And Hydrological Processors: Effect Of Resolution And Reliability
A Data Assimilation Scheme To Foster Model Cooperation Within A Hydrological Multimodel Ensemble
The 2013/14 Thames Basin Floods: Do Improved Meteorological Forecasts Lead To More Skilful Hydrological
Long-range Streamflow Forecasts in Drylands
Assimilating P-Band Microwave Soil Moisture Observations To Improve Root Zone Soil Moisture Estimates
How Much Can Continental Hydrological Forecasting Services Be Benefited From High-Resolution
Diagnostic Assessment Of Localized Flood Flow Behaviour
Glofas-Seasonal: An Operational Seasonal Global Hydro-Meteorological Forecasting System
Medium Range Ensemble Flood Forecasting In Waikato River Basin, New Zealand
Evaluation Of Fine-Scale Ensemble Seasonal Soil Moisture And Evapotranspiration Forecasts For The
Developing ensemble 7-day streamflow forecasting service for Australia
Can Improved Meteorological Forecasts Improve The Flood Forecasts? A Case Study Of Selected European
Potential For Enhanced Flow Forecasting Through Satellite-Based River Gauging
A Comparison Of Statistical Post-Processing Methods For Short- To Medium-Range Precipitation
Soil Moisture Assimilation For Ensemble Streamflow Prediction
Advancing Our Understanding Of Data Assimilation For Hydrologic Predictions In Changing Catchments
Wind And Wave Climate: Design Sea State From Ensemble Forecasts
Hydrometeorological Ensemble Predictions In Switzerland: The Influence Of Pre- And Post-Processing
Estimation Of The Observation Bias For Remotely Sensed Soil Moisture Using A Bias-Aware Kalman Filter
Assessment of the 2016 flood event on the Seine and Loire river basins using ensemble forecasts
A Software Ecosystem For End-To-End Hydrological Ensemble Modelling Workflows
Does HEPEX Need A New Cutting Edge?
How can ensemble streamflow forecasts inform decisions on the management of environmental flows?
The HEPEX Seasonal Streamflow Forecast Intercomparison Project
Data Assimilation In Application To Data Validation Of Meteorological And Hydrological Data
HEPEX Data Assimilation Inter-Comparison Experiment
Improvement Of Drought Outlook Using A Bayesian Inference Approach
Schaafe Shuffle: Does It Work For All Forecasts?
Development Of A Pilot Forecast Service For Extended Lead Time Flood Forecasts For The Hawke's Bay
A Gibbs Sampler Bayesian Joint Probability Model
Assimilation Of Grace Water Storage And Smos/Smmap Soil Moisture Retrievals Into CABLE Using Particle
Assessment Of The Probabilistic Forecasting Of The European Flood Awareness System
GENRE: A Method To Extend Gridded Precipitation Climatology Datasets In Near Real-Time For Hydrological
Seamless Rainfall: A Multi-Scale Ensemble Rainfall Forecast Generator
Global Ensemble Data Assimilation For Hydrological Forecasts
Stochastic Updating For Ensemble Hydrological Forecasting
RWsOS: clustered multi-hazard early warning in the Netherlands
Improving ensemble forecasts in Watersheds with seasonal snowpack through data assimilation and
Watershed-Oriented Climate Forecast Products For Hydrologic Forecasters And Water Managers
The Contribution Of Ensemble Streamflow Forecast To Water Resources Optimization Scheduling
Operational Drought Forecasting And Skill Assessment Over China
The Impact Of Land Data Assimilation On Global River Discharge Simulations



Current Status of the Operational Multi-Model Ensemble Prediction System and Climate Service Activities at APEC Climate Center

(Feb. 8, 2018)

Young-Mi Min, Sangmyong Oh, Hyun-Ju Lee, Woo-Seop Lee
APEC Climate Center

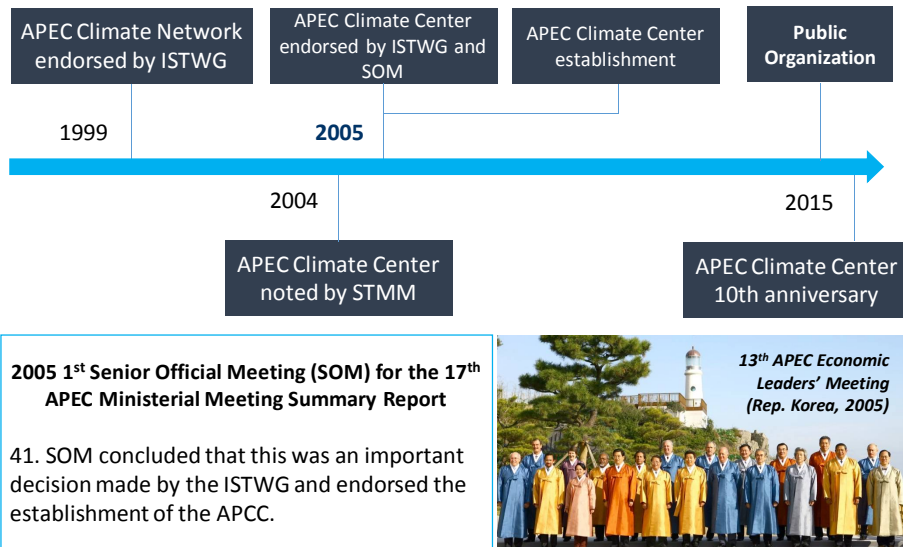
2018 HEPEX Workshop, 6-8 Feb. 2018, Melbourne, Australia

Overview of the APEC Climate Center

Asia-Pacific Economic Cooperation (APEC) Climate Center (APCC) is a leading climate information service provider in the Asia-Pacific region. We provide seasonal climate forecasts and other climate information products and services, conduct research and development activities, and organize capacity building initiatives for scientists from developing economies.



History of the APEC Climate Center



Mission of the APEC Climate Center

To enhance the socio-economic well-being of member economies by utilizing up-to-date scientific knowledge and applying innovative climate prediction techniques.



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.

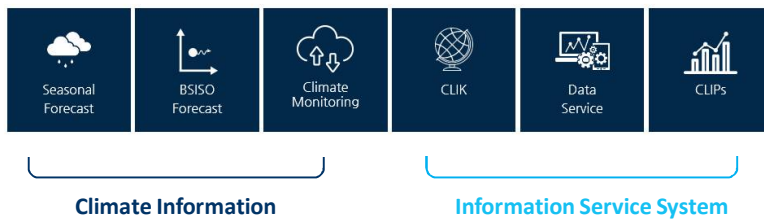


International Cooperation

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

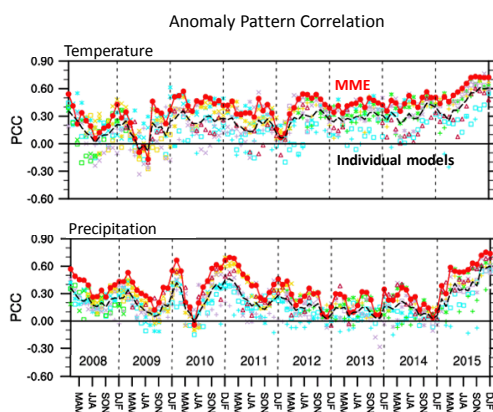
Climate Prediction & Information Service

✓ <http://www.apcc21.org>



Multi-Model Ensemble

- Producing skillful real-time climate predictions and developing a value-added reliable climate prediction system based on a **Multi-Model Ensemble (MME)** technique.



Min et al. (2017), *Climate Dynamics*

Operational Institute/Organization



International Research Institute
for Climate and Society



Government of Canada
Gouvernement du Canada

WMO Lead Centre for
Long-Range Forecast Multi-Model Ensemble

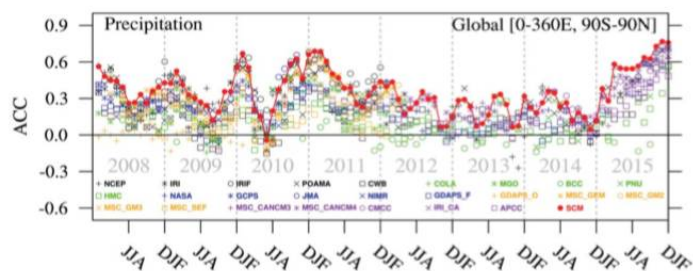
Why MME is better?

$$R_{MM} = \frac{\langle R \rangle}{\sqrt{V(\langle y \rangle)}} = \frac{\langle R \rangle}{\sqrt{\langle r \rangle}}$$

Average skill of all models

Inter-dependency among models

- Error cancellation
- Wider Prob. distribution

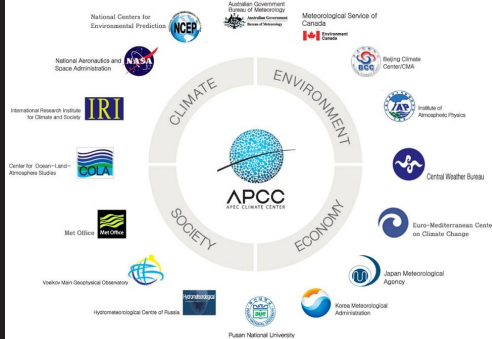


Not always but mostly similar to best performing model (changing)

APCC MME Prediction System

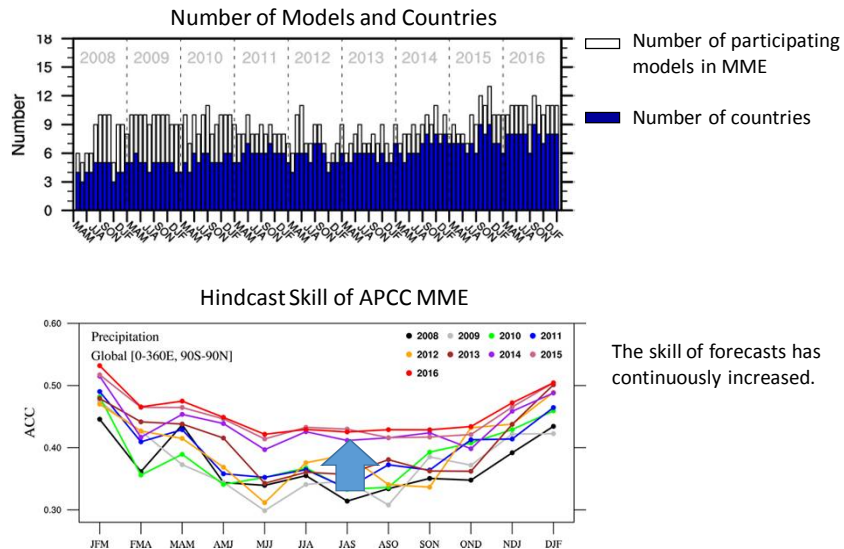
- The world's largest MME system based on international cooperation to generate monthly rolling 3-month and 6-month MME climate outlooks.

Multi-institutional Cooperation

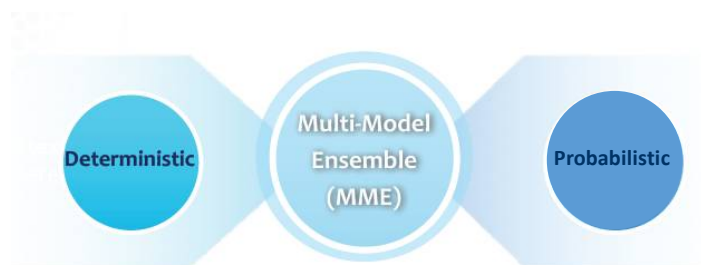


Economy	Organization/Institute
Australia	Bureau of Meteorology (BoM)
Canada	Meteorological Service of Canada (MSC)
China	Beijing Climate Center (BCC) Institute of Atmospheric Physics of China (IAP)
Chinese Taipei	Central Weather Bureau of Chinese Taipei (CWB)
Italy	Euro-Mediterranean Center on Climate Change (CMCC)
Japan	Japan Meteorological Agency (JMA)
Korea	Korea Meteorological Administration (KMA) Pusan National University (PNU)
Peru	Servicio Nacional de Meteorología e Hidrología (SENAMHI)
Russia	Hydrometeorological Centre of Russia (HMC) Main Geophysical Observatory of Russia (MGO)
UK	Met Office
USA	Center for Ocean-Land-Atmosphere Studies (COLA) International Research Institute for Climate and Society (IRI) National Aeronautics and Space Administration (NASA) National Center for Environmental Prediction (NCEP) / National Ocean and Atmospheric Administration (NOAA)

Performance of APCC MME



Deterministic MME Method



SCM

Simple Composite Method:
Average of individual forecast with equal weighting

SPM

Step-wise pattern Projection Method:
Calibrated MME estimated as corrected single-model prediction (Kug et al. 2008)

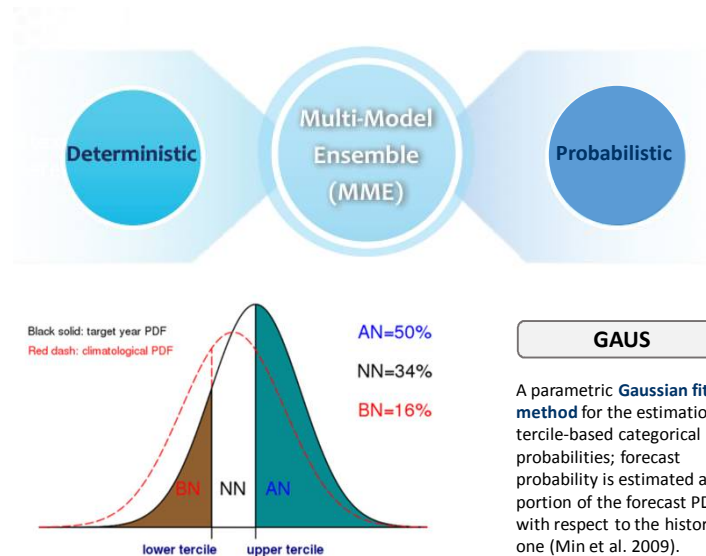
MRG

Multiple Regression Method:
Empirically weighted MME with coefficients computed using multiple linear regression (Yun et al. 2003)

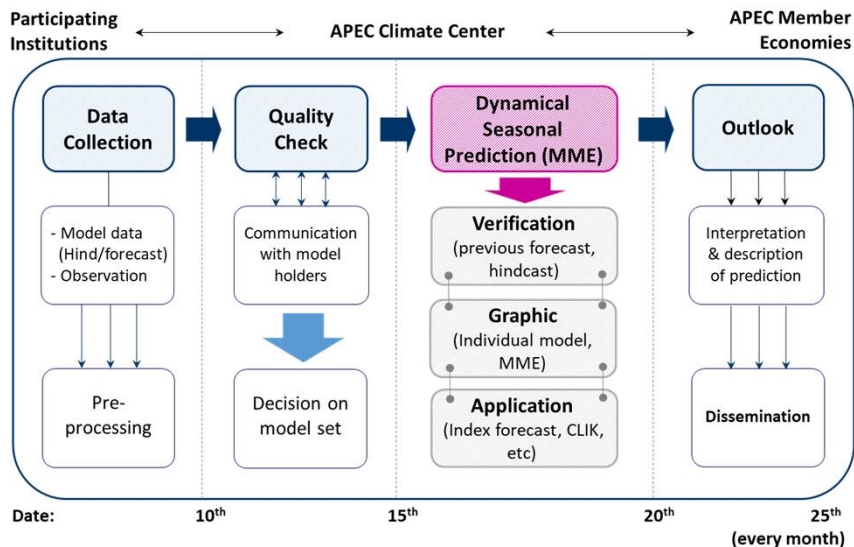
SSE

Synthetic Superensemble Method:
MRG with the EOF-filtered dataset to minimizing the residual error variance (Yun et al. 2005)

Probabilistic MME Method

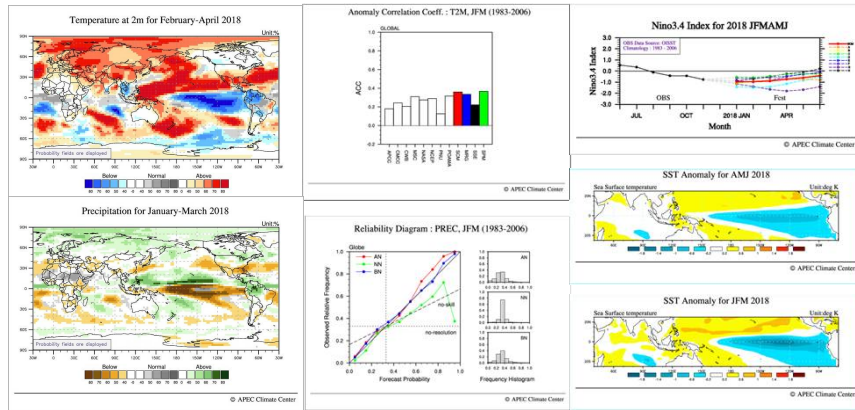


Operation Schedule



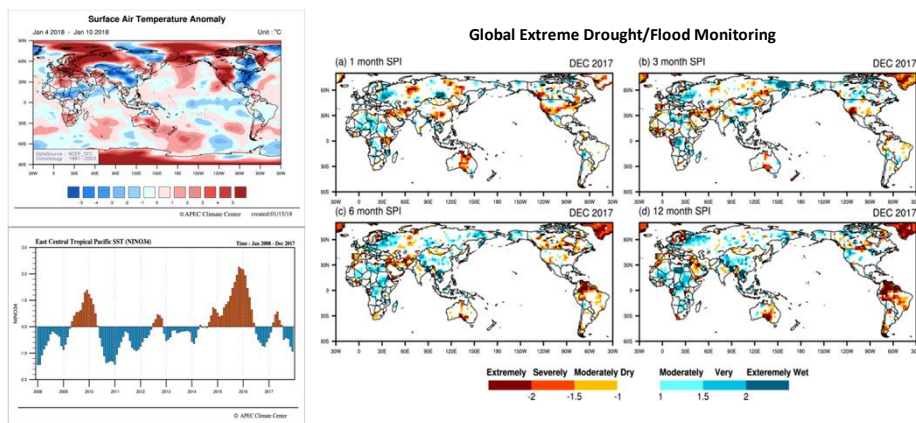
Seasonal Forecast Products

- Monthly & Seasonal mean forecast of Tsfc, Prec, T850, Z500, SLP, SST, UV (deterministic & probabilistic)
- Verification results (hindcast, realtime forecast)
- ENSO Outlook



Climate Monitoring Products

- Current Conditions
 - Climate Highlight: Weekly/monthly/seasonal T/OLR/P/SST/UV/Z
 - Climate Indices: Pacific, Indian & Atlantic SST, Atmos. and Monsoon indices
 - Global droughts: SPI for the last 1-, 3-, 6-, and 9-month periods



Climate Prediction & Information Service

✓ <http://www.apcc21.org>



Information Service System

ADSS

APCC Data Service System

<http://adss.apcc21.org>

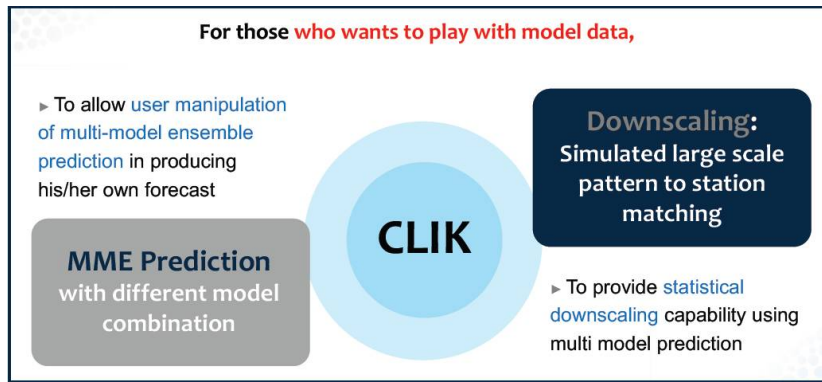
✓ Disseminate up-to-date climate data and forecast information

Data Set	Areal Coverage	Grid Size	Time Step	Source	Requirement
APCC-MME(6-MON)	Global	2.5×2.5(degree)	Monthly	APCC	Login
APCC-MME(3-MON)	Global	2.5×2.5(degree)	Monthly	APCC	Login
INDIVIDUAL-MODEL(6-MON)	Global	2.5×2.5(degree)	Monthly	APCC	Login
INDIVIDUAL-MODEL(3-MON)	Global	2.5×2.5(degree)	Monthly	APCC	Login
CORDEX-SEA25	Regional	25km	Daily	APCC	
CORDEX-SEA50	Regional	50km	Daily	APCC	
Clipped CMIP5	National level (22 Countries)	Depending on GCMs	Daily	ESGF	
IRI_DATA_LIBRARY	Global	2.5×2.5(degree)	Various	IRI	
NCEP	Global	2.5×2.5(degree)	Daily	NOAA	
NCEP-SFC	Global	2.5×2.5(degree)	Daily	NOAA	
NOAA-OLR	Global	2.5×2.5(degree)	Daily	NOAA	
TMI	Global	2.5×2.5(degree)	Daily	REMSS	
QUICKSCAT	Global	0.25×0.25(degree)	Daily	REMSS	
GPCP	Global	1.0×1.0(degree)	Daily	NASA	
GHCN	Global	5.0×5.0(degree)	Monthly	NOAA	
UD	Global	0.5×0.5(degree)	Monthly	University of Delaware	

CLIK CLimate Information toolKit

<http://clik.apcc21.org>

- ✓ On-line tool to generate customized & localized seasonal forecast

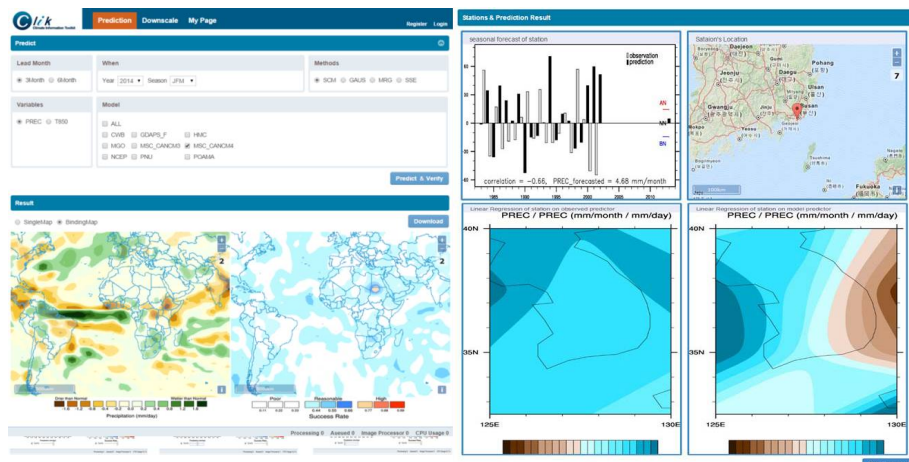


CLIK CLimate Information toolKit

<http://clik.apcc21.org>

(Customized MME prediction)

(Downscaled prediction)

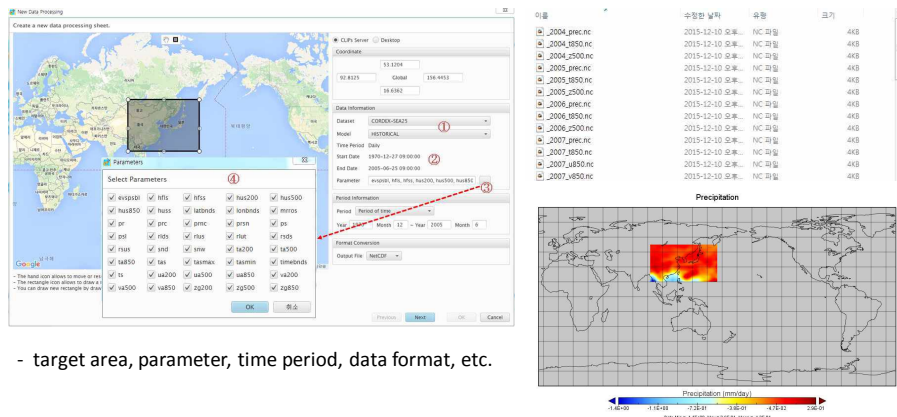


CLIPs

Climate Information Process System

<http://clips.apcc21.org>

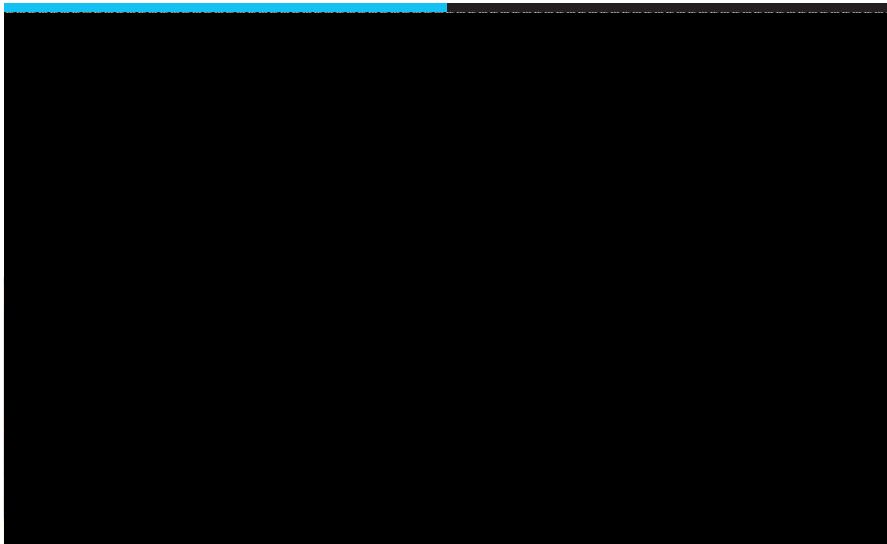
- ✓ Utilize big climate data that has been processed into one standard user-friendly file format, reducing the time spent on data processing and eliminating the need for costly high-end hardware and software



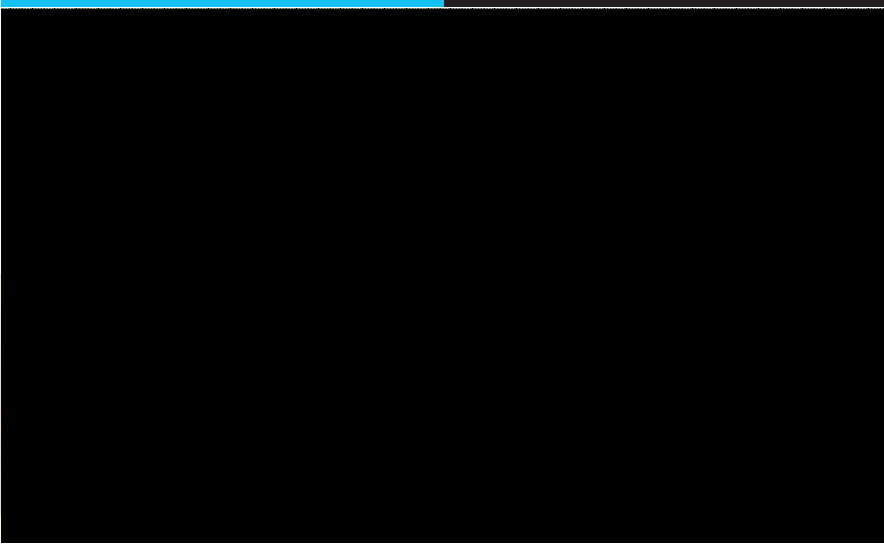
- target area, parameter, time period, data format, etc.

APCC Activities

Interdisciplinary Research



Interdisciplinary Research



Summary

- APEC Climate Center (APCC) is a leading operational center providing seasonal forecast based on the **Multi-Model Ensemble** (MME) prediction system.
- MME seasonal prediction is one of the **most reliable** seasonal forecast information at present.
- APCC focuses on producing and sharing valuable and reliable high quality climate prediction information applying that information to sectors through **interdisciplinary research** and **building capacity** in both climate prediction and application.

