

TRAVEL REPORT FORM

출장보고서

결 재	연구원	과장	부서장	원장
	12/05	12/05	12/05	12/05
협 조	이현주	이우섭	유진호	권원태

I. Travel Overview 출장개요

1. Traveler(s) 출장자

Department 소속	Position 직위(직급)	Name 성명	Note 비고
기후사업본부 기후분석과	연구원	이현주	

2. Travel Period 출장기간

- 출장기간 : 2019년11월19일-11/22일, 학회기간: 2019년11월20일-11월21일 (2일간)

3. Occasion and destination 행사 및 출장지

- 학회명 : 13th ASEAN Climate Outlook Forum (ASEANCOF-13)
- 장 소 : 방콕, 태국

II. Major Activities 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

○ 참가 회의명 : 13th ASEAN Climate Outlook Forum (ASEANCOF-13)

- ASEANCOF는 WMO가 공식적으로 후원하는 Regional Climate Outlook Forum (RCOF) 중 하나로, ASEAN (Association of Southeast Asian Nations)지역의 기후 전망을 위한 회의임.
- 이번 ASEANCOF는 WMO 장기예보 선도센터, Met Office (UKMO), Bureau of Meteorology (BOM) 등이 참석하여 기후예측 결과를 공유하였으며, 이 지역 각국 기상청 (Indonesia, Thailand, Vietnam, Malaysia, Philippines, Singapore, Myanmar, Cambodia, Laos, Brunei) 참석자들과 함께 겨울 몬순 시기의 기후 전망에 대한 전문가들의 의견을 공유하고 ASEAN지역 농업/식량 기후위험관리 프로젝트(De-RISK South East Asia)에 계절예측 정보 활용 사례를 공유하고 의견을 교환함.

○ 일자별 세부 일정 (붙임 1)

- 11월 20일 (1일차) : WMO LC-LRFMME 소개 및 ASEAN지역 2019/20 겨울 기후 전망 발표 (붙임 2)
 - 발표 제목 : Seasonal Climate Outlook for the 2019 Winter Monsoon Season from WMO LC-LRFMME
 - 발표 내용 : WMO LC-LRFMME 소개 및 MME 자료를 이용한 2019/20 DJF 기온, 강수 전망

- 11월 21일 (2일차) : Consensus Outlook 및 DeRisk 프로젝트 결과 공유

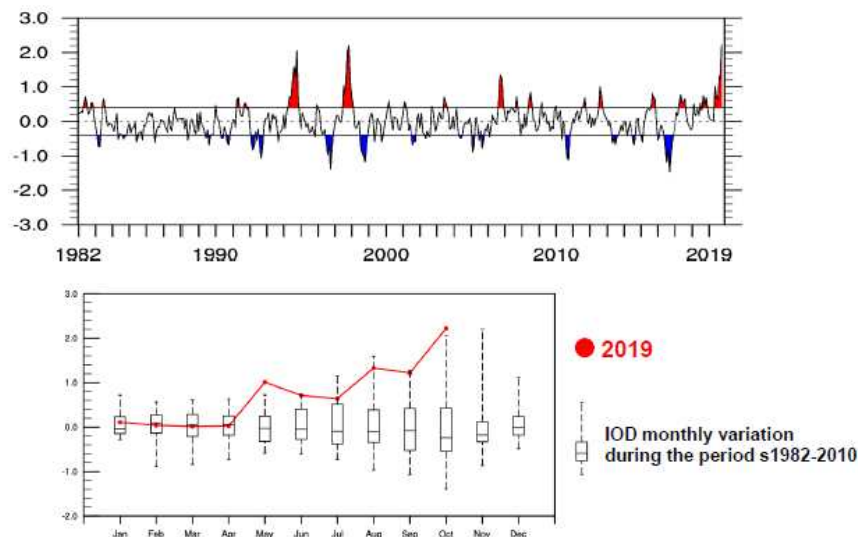
2. Relevance to APEC Climate Center's Activities 결론 및 소감

○ ENSO에 대한 감시 및 전망

- El Nino/Southern Oscillation (ENSO)는 ASEAN 지역 겨울철 강수와 기온의 경년변동에 영향을 미치는 중요한 요인 중 하나임. 현재 해수면 온도는 태평양 대부분의 지역에서 평년보다 약간 높은 상태이며, 2019년 7월 이후 ENSO Neutral 상태가 계속되고 있음. 이러한 ENSO Neutral 상태는 2019/2020 DJF 기간 동안 계속 유지 될 것으로 전망함.

○ IOD에 대한 감시 및 전망

- ASEAN 지역 겨울철에 영향을 미치는 또 다른 요인인 Indian Ocean Dipole (IOD)는 현재 강한 positive 상태(그림 1)이나 겨울철에는 그 강도가 많이 약해 질 것으로 전망함.



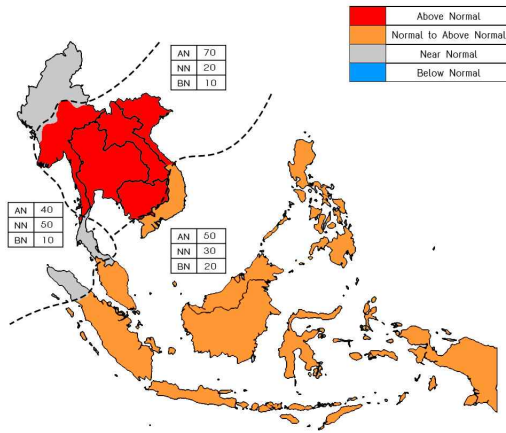
(그림 1) 2019년 Indian Ocean Dipole (IOD)

○ Monsoon 활동

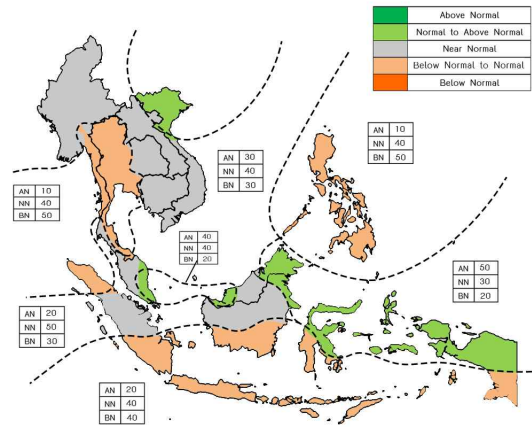
- Northeast 몬순 시작 시기의 Strong Positive Indian Ocean Dipole로 인해 남쪽지역에서의 몬순발달이 지연될 것으로 예측됨.

○ Consensus Outlook (붙임 3)

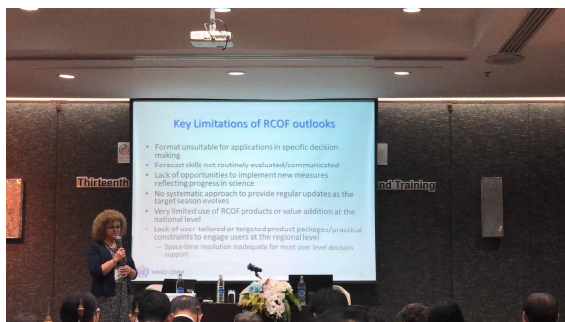
- 2019/20년 겨울 온도는 ASEAN의 많은 지역에서 above normal이 전망됨. 베트남 북부지역, 라오스, 캄보디아, 미얀마 남부지역은 약 70%의 above normal로 예측됨. 그러나 미얀마 동/남지역, 태국 북부지역, 수마트라 북부지역은 평년과 유사할 것으로 전망됨 (그림 2).
- 강수의 경우 다가오는 겨울철 Southeast지역의 Mainland와 적도지역 대부분은 평년과 유사할 것 예측된 반면, 베트남 북부지역, 말레이시아 동쪽지역, 술라웨시 섬의 동쪽지역, 파푸아의 북부지역은 약 40~50%의 확률로 above normal를 전망음. 미얀마 남부지역, 태국, 필리핀, 수마트라 남/북부지역, 자바, 보르네오 남부 지역 등은 약 40%의 Below Normal을 전망함 (그림 3).



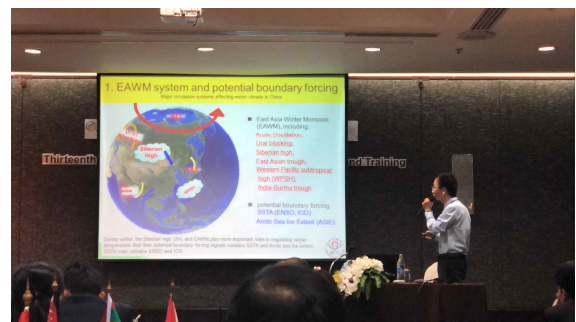
(그림 2) Consensus 2019/20 DJF temperature forecast



(그림 3) Consensus 2019/20 DJF precipitation forecast



(사진 1) 13th ASEANCOF 현장사진1



(사진 2) 13th ASEANCOF 현장사진2

- 이번 ASEANCOF에서는 현재 강한 IOD 상태와 겨울철 예측에 관한 논의가 주를 이루었으며, ASEAN 지역에서의 IOD 영향에 대한 연구가 미흡한 실정으로 향후 이에 대한 영향 연구의 필요성이 대두됨.
- 또한 브루나이 기상청의 발표에 따르면 2019년 여름철 하루 동안 계절평년을 넘는 강수가 발생하여 계절 예측에 어려움이 있음. 이에 계절 예측 전망시에도 Subseasonal scale의 예측 정보 활용 필요성이 대두됨. 향후 WMOLC-LRFMME와 APCC의 S2S 전망 결과를 지역기후포럼을 통해 공유할 수 있는 기회가 있으면 함.
- ASEAN지역 각 국의 기상청 담당자 및 De-RISK 프로젝트팀은 계절 예측결과의 신뢰성과 MME시 신뢰성을 바탕으로한 모델 선택에 관심이 많았으며, 특히 지역별로 세분화된 검증결과의 필요성이 언급됨. 이는 향후 공개예정인 WMO 장기예보선도센터의 임의영역 검증결과 표출 시스템이 많은 도움이 될 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

(붙임4) ASEANCOF-13참석자명단

THIRTEENTH ASEAN CLIMATE OUTLOOK FORUM (ASEANCOF-13)
BANGKOK, THAILAND, FROM 20 TO 21 NOVEMBER, 2019

DAY 3: COF-proper (Wednesday, 20 November 2019)		
Opening Ceremony		
Venue: Crystal I-II, 3 rd Floor		
08.00 – 08.30 hrs.	Registration	
Chair: TMD		
08.30 – 08.40 hrs.	Opening Address Deputy Director-General of Thai Meteorological Department	Miss Kornrawee Sitthchivapak Deputy DG for Operations
08.40 – 08.45 hrs.	Welcoming Remarks WMO	Ms Anahit Hovsepyan Scientific Officer, WMO
08.45 – 08.50 hrs.	Welcome Remarks ASMC	Dr Thea Turkington On behalf of ASMC
08.50 – 09.10 hrs.	Climate Services Information System Implementation	Ms Anahit Hovsepyan Scientific Officer, WMO
09.10 – 09.40 hrs.	Group photo Session followed by Coffee Break	Organizing Secretariat
09.40- 11.40 hrs.	Regional outlook (DJF 2019-20) from Global Producing Centres/International Climate Centres.	BoM CMA IRI JMA UKMO WMO LC
Chair: GPC 1		
11.40 – 12.30 hrs	National outlook (DJF 2019-20) from ASEAN National Meteorological and Hydrological (NMHSs).	Brunei Indonesia Lao PDR Malaysia Myanmar
12.30–13.30 hrs.	Lunch	Organizing Secretariat
Chair: GPC2		
13.30 – 14.10 hrs	National outlook (DJF 2019-20) from ASEAN National Meteorological and Hydrological (NMHSs) continued	Philippines Singapore Thailand Viet Nam
14.10 – 14.30 hrs	Summary/Open Discussions - Opportunity for others to share notable regional weather related events in Southeast Asia since June	Mr. Boonlert Archevarahuprok Expert on Research & Development for Meteorology
14.30 – 15.00 hrs	Updates from SEA RCC-Network	SEA-RCC Representatives
15.00 – 15.30 hrs	Coffee Break	Organizing Secretariat
Chair: TMD		
15.30 – 17.00 hrs	Draft review and outlook and consensus-building. - Invited participants only (GPCs, NMHS)	TMD

18.00 hrs.	Welcome Dinner	All participants
DAY 4: COF-proper (Thursday, 21 November 2019)		
8.30 – 9.00 hrs.	Presentation of Consensus Outlook and Review	Mr. Boonlert Archevarahuprok Expert on Research & Development for Meteorology
9.00 – 9.30 hrs.	Welcome and overview of DeRisk Project	DeRisk
9.30 – 10.00 hrs	The DeRisk project presentation and hands-on activity	University of Southern Queensland
10.00 -10.15 hrs.	Coffee Break	Organizing Secretariat
10.15 – 11.30 hrs	DeRisk project contin.	University of Southern Queensland
11.30 -12.30 hrs	Agricultural Climate Services Outlook	CIAT
12.30-13.00 hrs	Summary DeRisk	DeRisk
13.00 – 14.00 hrs.	Lunch	Organizing Secretariat
14.00 – 15.30 hrs.	Visit TMD Headquarters	TMD
15.30 – 16.00 hrs.	Coffee Break	Organizing Secretariat
16.00 – 17.00 hrs.	Depart from TMD Headquarters	
DAY 5 (Friday, 22 November, 2019)		
	Check-out the Century Park Hotel	All participants
	Depart from Bangkok	All participants



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

Seasonal Climate Outlook for the 2019 Winter Monsoon Season from WMO LC-LRFMME



Hyun-Ju Lee and WMO LC-LRFMME Team

● Global Producing Centres

What is WMO LC-LRFMME?

13 WMO-designated Global Producing Centres (GPCs) for long-range forecasts

- adhering to agreed procedures/ standards in delivery of global long-range forecasts (e.g. products, timeliness, verification/ validation info, system documentation)

Linkage is needed among GPCs and other organizations including NMHSs, RCCs and RCOFs to ensure wider and more effective use of LRF



WMO Global Producing Centres



- **Beijing:** China Meteorological Administration (CMA) / Beijing Climate Center (BCC)
- **CPTEC:** Center for Weather Forecasting and Climate Research / National Institute for Space Research (INPE), Brazil
- **ECMWF:** European Centre for Medium-Range Weather Forecasts
- **Exeter:** Met Office, United Kingdom
- **Melbourne:** Bureau of Meteorology (BOM), Australia
- **Montreal:** Meteorological Service of Canada (MSC)
- **Moscow:** Hydrometeorological Centre of Russia
- **Offenbach:** Deutscher Wetterdienst
Wetter und Klima aus einer Hand
- **Pretoria:** South African Weather Services (SAWS)
- **Seoul:** Korea Meteorological Administration (KMA)
- **Tokyo:** Japan Meteorological Agency (JMA) / Tokyo Climate Center (TCC)
- **Toulouse:** Météo-France
- **Washington:** Climate Prediction Center (CPC) / National Oceanic and Atmospheric Administration (NOAA), United States of America

What is WMO LC-LRFMME?



1. Data collection & standardization

(6variables, GRIB1)

2. Producing seasonal forecast

Deterministic Forecast

- Simple Composite Mean
- Regular Multiple Regression
- Singular Value Decomposition
- Genetic Algorithm

Probabilistic Forecast

- Probabilistic MME

3. Producing verification data

Deterministic Verification

- ACC, RMSE, MSSS, GSS

Probabilistic Verification

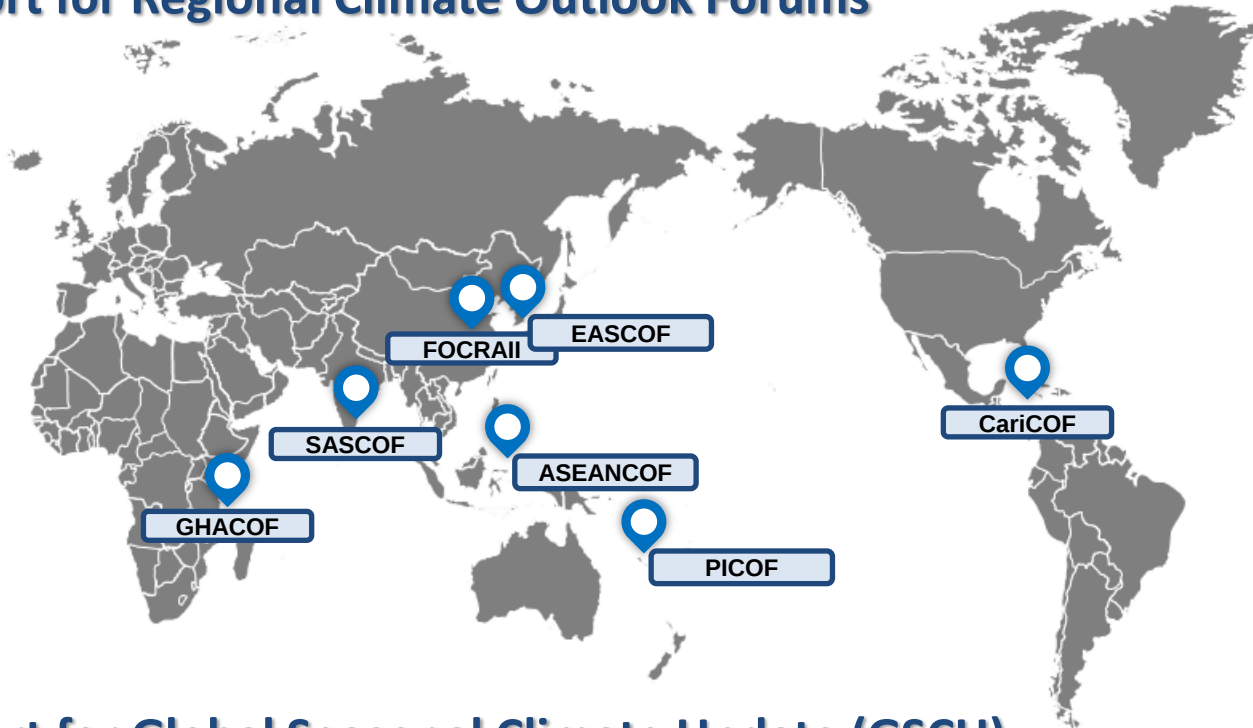
- Reliability Diagram
- ROC curve & ROC score
- BS and BSS

4. Dissemination

Display graphics on Website of WMO LC-LRFMME

Activities of WMO LC-LRFMME

❖ Support for Regional Climate Outlook Forums



In 2018,

ASEANCOF-11	10/28-11/2 (Kuala Lumpur, Malaysia)
EASCOF-6	11/7-11 (Seoul, South Korea)

In 2019,

PICOF-5	10/17-10/18 (Nouvelle-Calédonie)
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❖ Support for Global Seasonal Climate Update (GSCU)

- A new Initiative for [Consensus-Based Real Time Monitoring and Prediction](#) of Seasonal Climate of the World
- To provide the world community with [an expert consensus on the state of the global climate with an outlook](#) for the upcoming season along with information on robustness of the available forecast signals.
- To strengthen [international collaboration and information flow](#) between global, regional and national level operational climate monitoring and prediction centres
- For use by RCCs, RCOFs and NMHSs for [assistance in preparation of regional and national climate Updates](#)



Progress of WMO LC LRFMME in 2019

2019

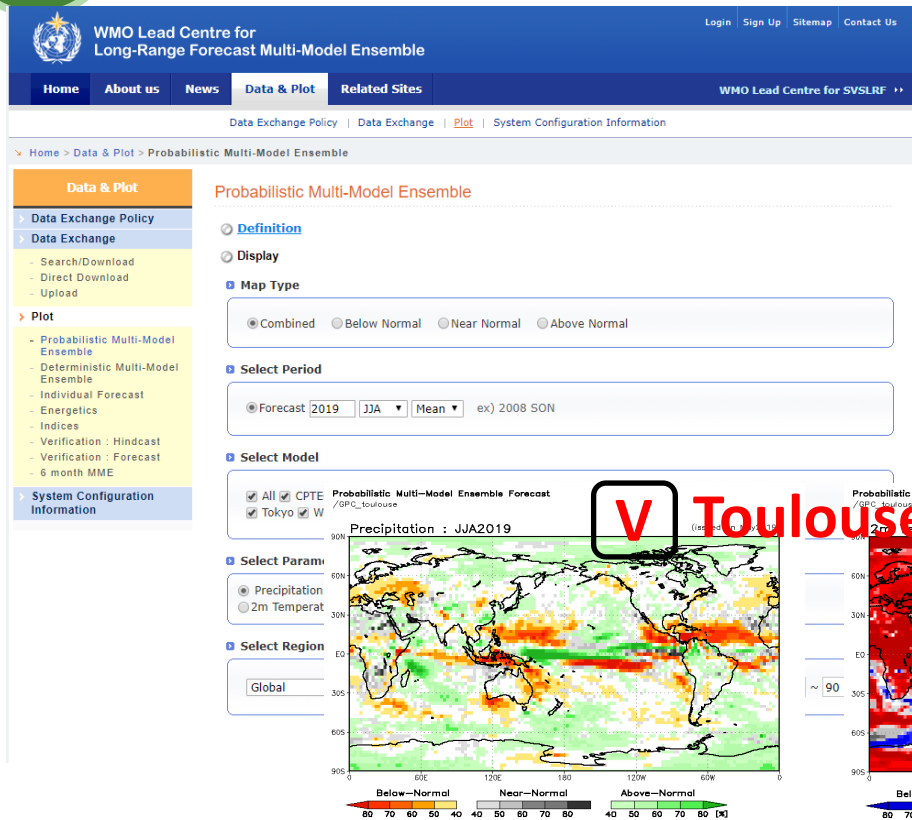
Toulouse
Participation in PMME

Mar

WMOLC-LRFMME
Renewal of website

Jun

» Main page of WMO LC-LRFMME website (www.wmolc.org)

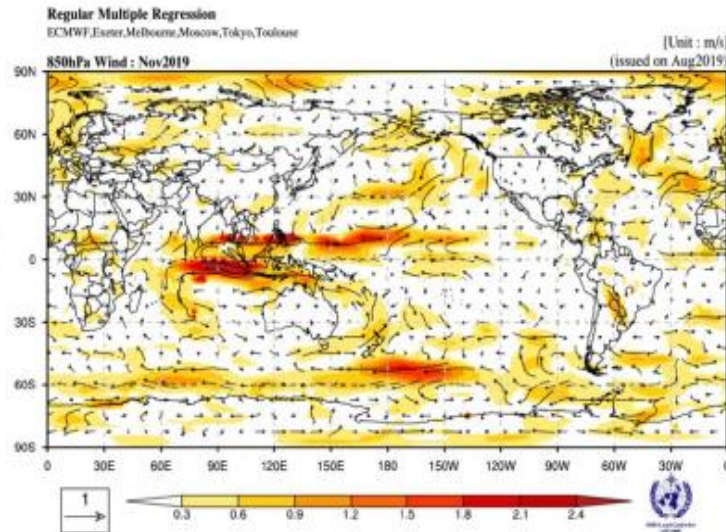


Plan of WMO LC LRFMME in 2020

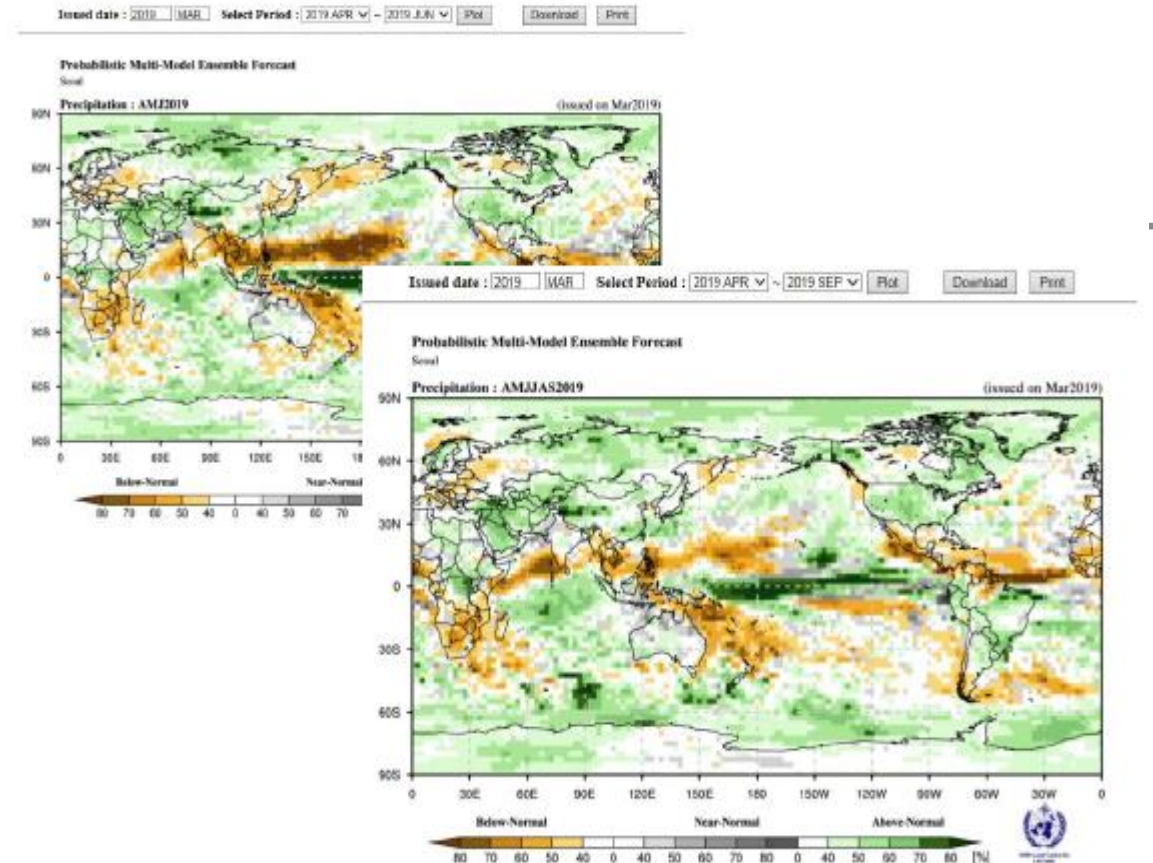
2020

Select Parameters

☒ All	☐ 500hPa QPH	☐ Mean Sea Level Pressure
☐ Precipitation	☐ 950hPa Temperature	☐ Sea Surface Temperature
☐ 7m Temperature		
☒ 850hPa Wind		



① Provision the variable for wind at 850 hPa



② Extension the forecast leadtime in PMME



Survey for Satisfaction Measurement via Website

https://www.wmolc.org/survey/ x +
wmolc.org/survey/Mgmt/survey

2019 Survey for satisfaction measurement (during 01 Sept.-30 Nov. 2019)

Thank you for using our WMO LC-LRFMME website. The LC-LRFMME is jointly organized and operated by the Korea Meteorological Administration (KMA) and NOAA/NCEP. It provides high-quality climate prediction products and develops advanced climate prediction technology, which is contributing to the reduction of the adverse impacts of abnormal climate.
As a part of our ongoing efforts to provide better services, we are conducting a simple survey on our website. In this regard, we would appreciate it if you can take a few moments to fill in the survey form below.

1. Are you a member of our WMO LC-LRFMME website? *

☐ Yes
☐ No

2. Which organisation do you belong to/which organisation are you involved in? (select all that apply) *

Maximum Choice: 4
The maximum number of choices is 4.

☐ WMO Global Producing Centres (GPCs) for Long Range Forecasts (LRF)
☐ National Hydrological and Meteorological Services (NHMS)
☐ WMO Regional Climate Centre (RCC)
☐ Regional Climate Outlook Forum (RCOF)
☐ Other :

3. How often do you visit our website? *

☐ more than 12 times a year (at least once a month)
☐ 4~12 times (at least once a season)
☐ 1~3 times (at least once a year)
☐ once in a while

4. What is your major purpose of using the forecast information from the WMO LC-LRFMME? *

☐ use as essential information for operational long range forecast
☐ use as reference information for operational long range forecast
☐ use for research data for long range forecast
☐ Other :

- **Why?**

To diagnose the current status of WMO LC-LRFMME and provide better services to the website user

- **When?**

1st September – 30th November 2019

- **To whom?**

All website users



LIKE

We hope that you give your cooperation!

<http://www.wmolc.org> ▼





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

Current Oceanic Condition

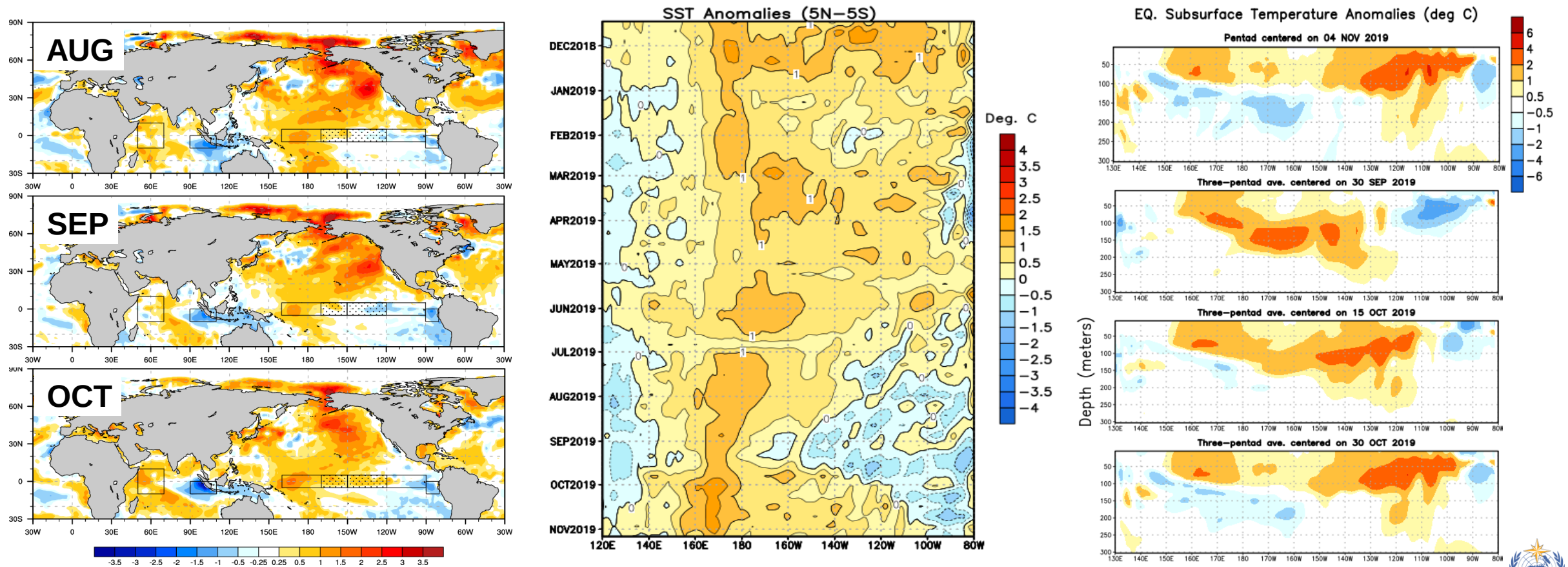
(Tropical Pacific Ocean & Indian Ocean)



● Global Producing Centres

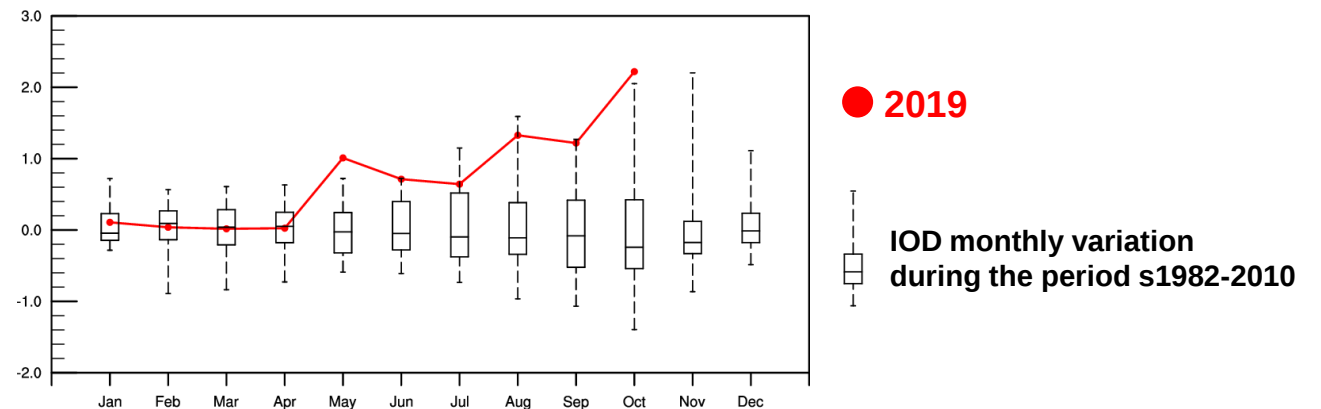
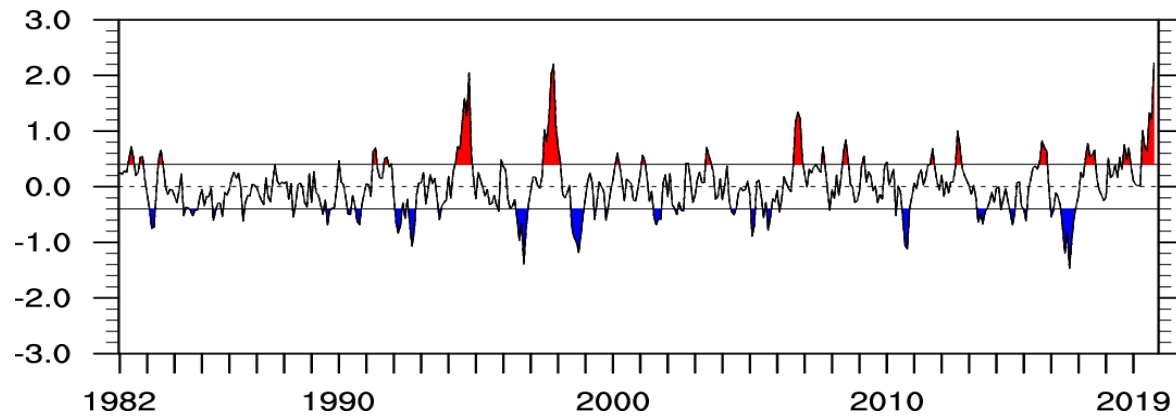
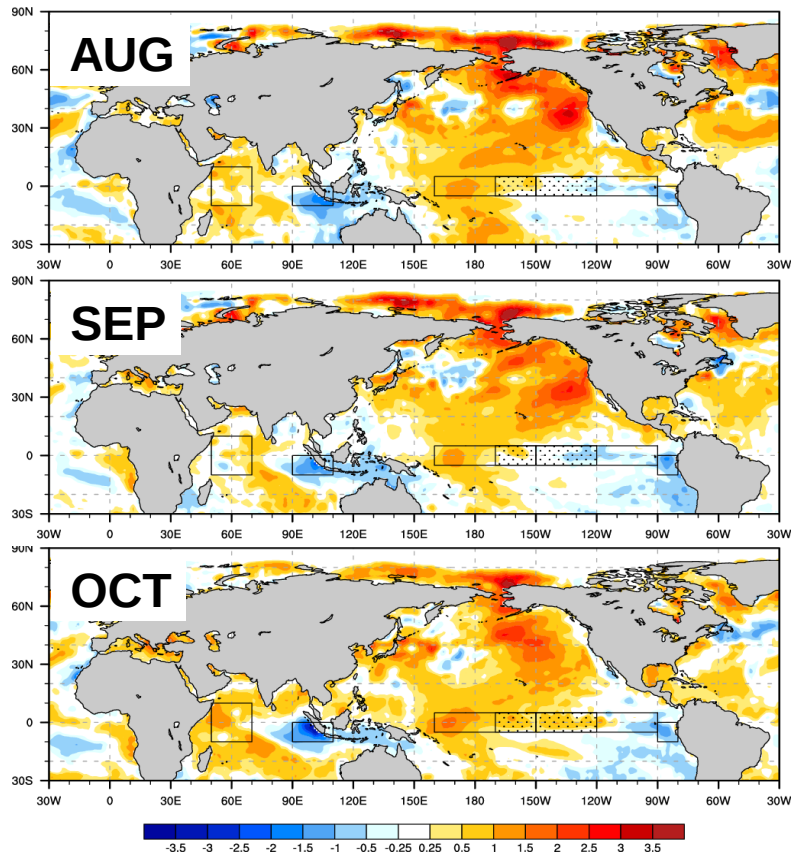
Recent Evolution of Equatorial Pacific Ocean SST

- Strong positive SST anomalies persisted in the Northeast Pacific and Arctic Oceans.
- Positive SST anomalies strengthened across the western to east-central Pacific Ocean, while negative SST anomalies remained in a small area of the eastern Pacific.
- Pacific Equatorial subsurface temperature anomalies have strengthened and expanded eastward.
- Negative subsurface temperature anomalies have strengthened at depth in the western and central Pacific Ocean.



Recent Evolution of Equatorial Indian Ocean SST

- In the western Indian Ocean, SST anomalies were warm, while in the eastern part, the SST anomalies were cold during October, featuring the positive IOD structure.
- The Indian Ocean Dipole (IOD) index is strong positive, ranking the historical high.





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

Seasonal Outlook for DJF 2019/20



● Global Producing Centres

Participating GPCs for DJF 2019/20 Prediction

			Initial Condition	Lead 1	Lead 2	Lead 3	Lead 4	Lead 5	Lead 6
	GPC	Institute	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	Beijing	BCC							
2	CPTEC	CPTEC		✓	✓	✓			
3	ECMWF	ECMWF		✓	✓	✓			
4	Exeter	UKMO		✓	✓	✓			
5	Melbourne	BoM		✓	✓	✓			
6	Montreal	MSC		✓	✓	✓			
7	Offenbach	DWD		✓	✓	✓			
8	Seoul	KMA		✓	✓	✓			
9	Toulouse	Met.France		✓	✓	✓			
10	Washington	NCEP		✓	✓	✓			
11	Moscow	HMC		✓	✓	✓			
12	Tokyo	TCC		✓	✓	✓			
13	Pretoria	SAWS		✓	✓	✓			

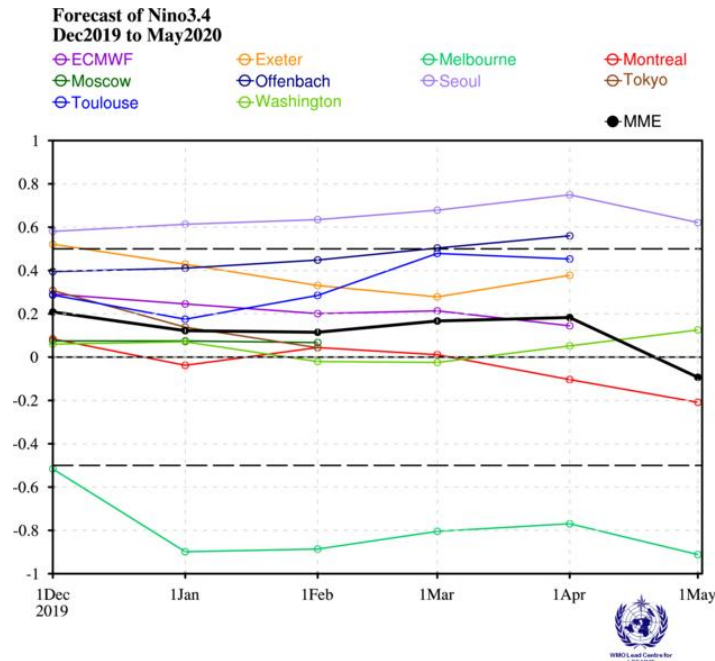
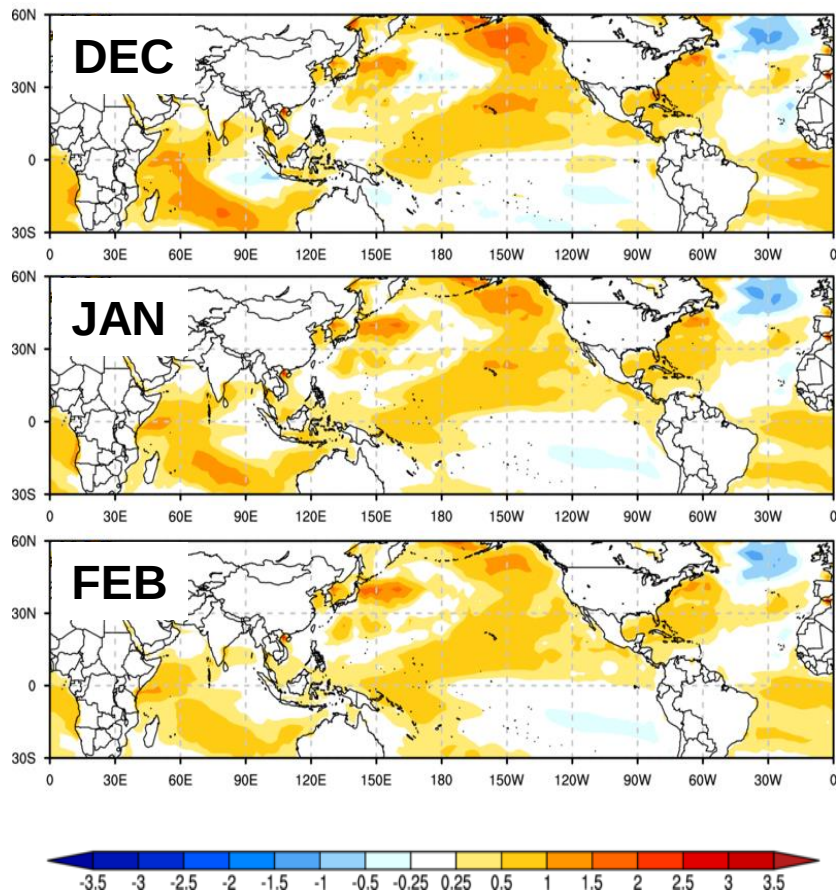
**Use 11GPCs
for PMME and DMME**

- Common Period : 1993-2009 (17years)
- Variable : 2m temperature, precipitation, mean sea level pressure, 850hPa temperature, 500hPa GPH, sea surface temperature (if available)



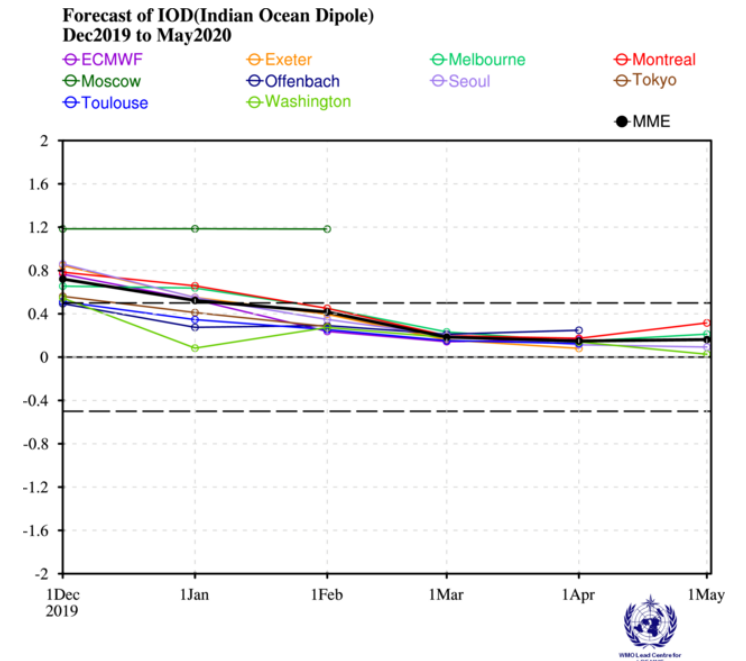
Surface Temperature prediction for DJF 2019/20

❖ NINO 3.4



- Warm SST anomalies are predicted in the western tropical Pacific during DJF.
- A majority of models predicted ENSO – neutral during DJF 2019/20.

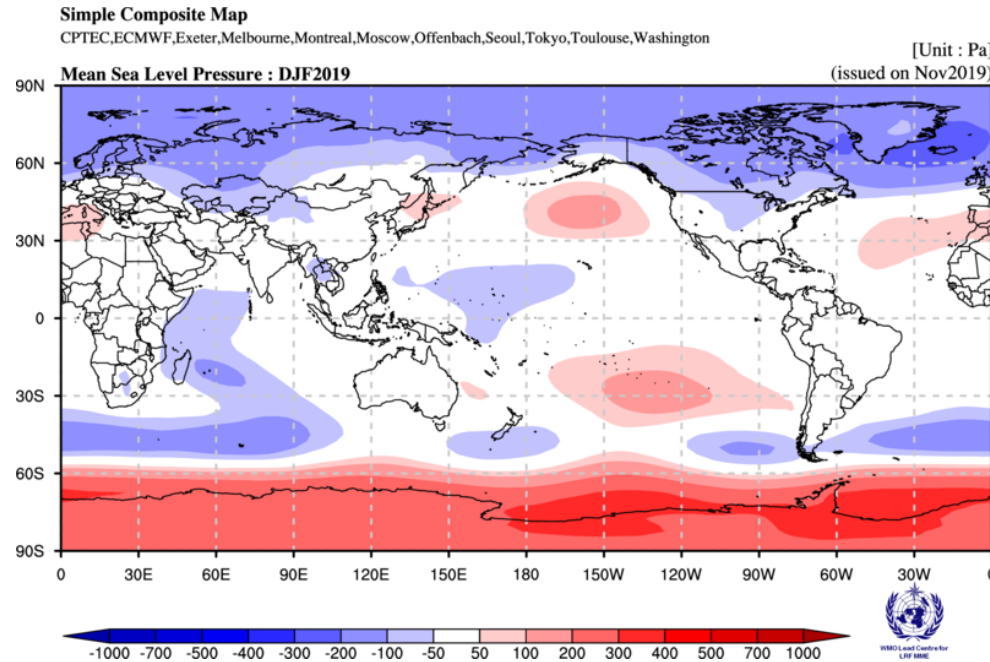
❖ IOD



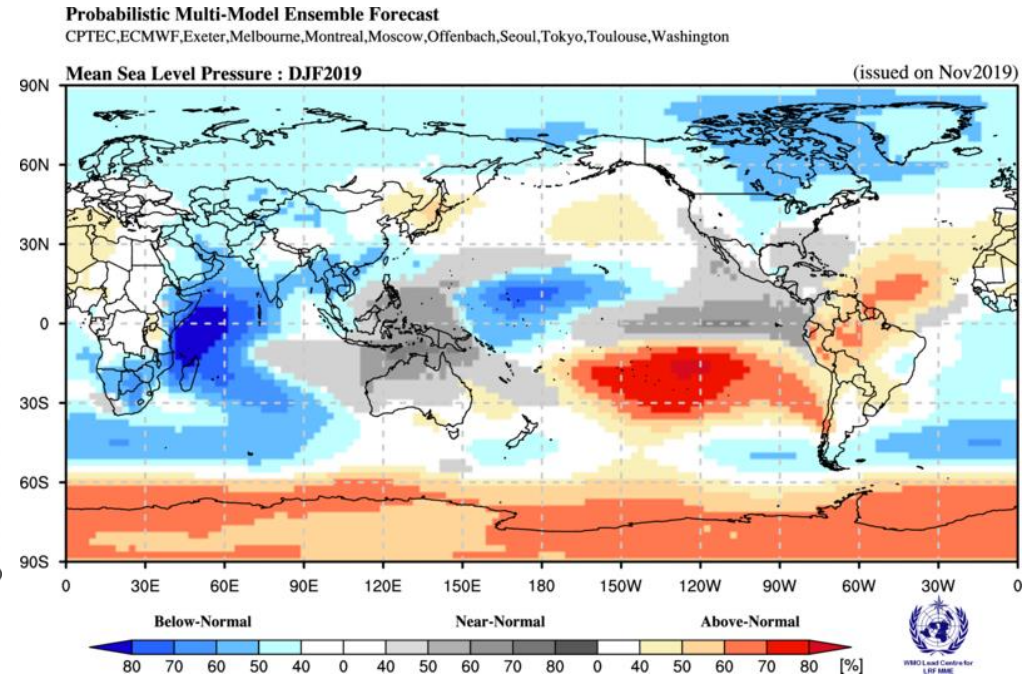
- The weak zonal gradient of SST in the Indian Ocean is predicted during DJF.
- Current positive IOD event will decay to neutral through spring 2020. But the weak positive IOD is predicted during DJF.

MME : Sea level pressure for DJF 2019/20

Deterministic MME

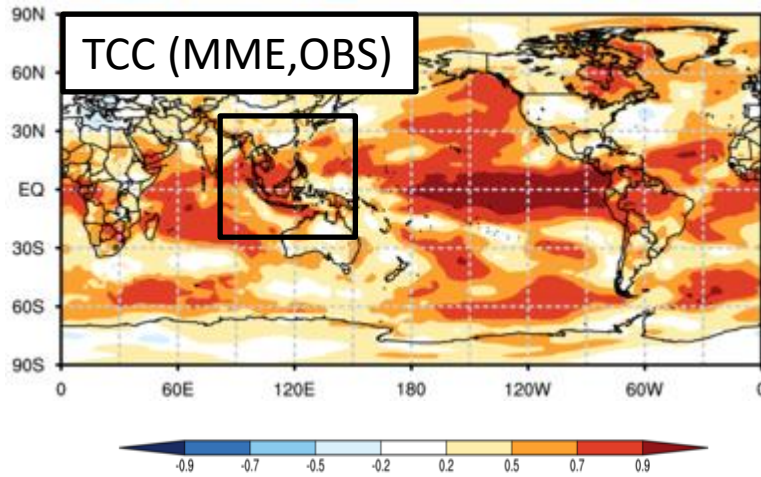


Probabilistic MME



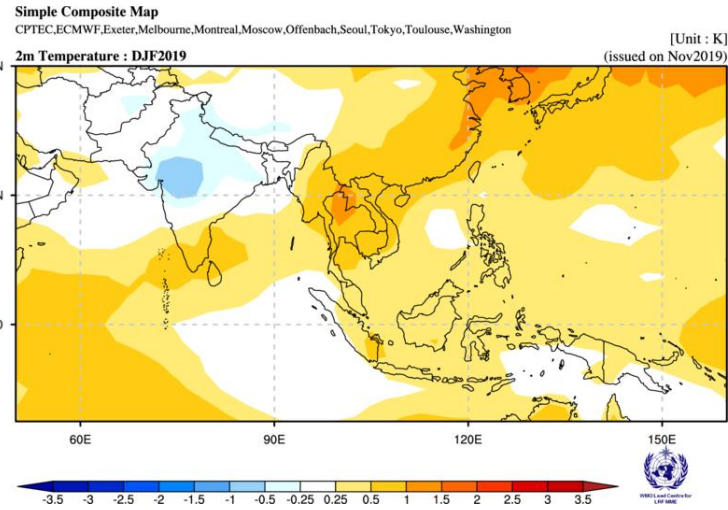
- Positive SLP anomalies are predicted over the western Indian Ocean and the northern part of Southeast Asia.
-> convective activity
- More than 50% models predict above normal SLP over the eastern tropical Indian Ocean and the southern part of Southeast Asia.

MME : 2m temperature for DJF 2019/20

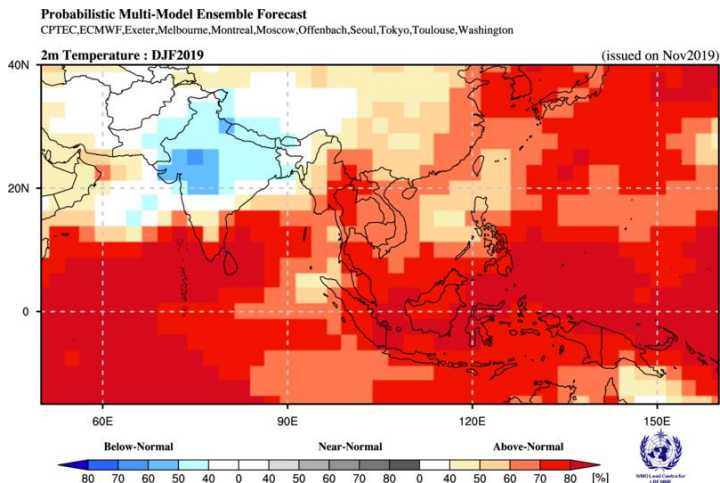


- The TCC (Temporal Correlation Coefficient) skills in the ASEAN region are quite good in DJF season.
- The ROC (Relative Operating Characteristics) skills are quite good for above/below normal during DJF season. But for Normal condition, the ROC skills are not reliable.
- The MME predicts warm temperature over the Southeastern Asia.

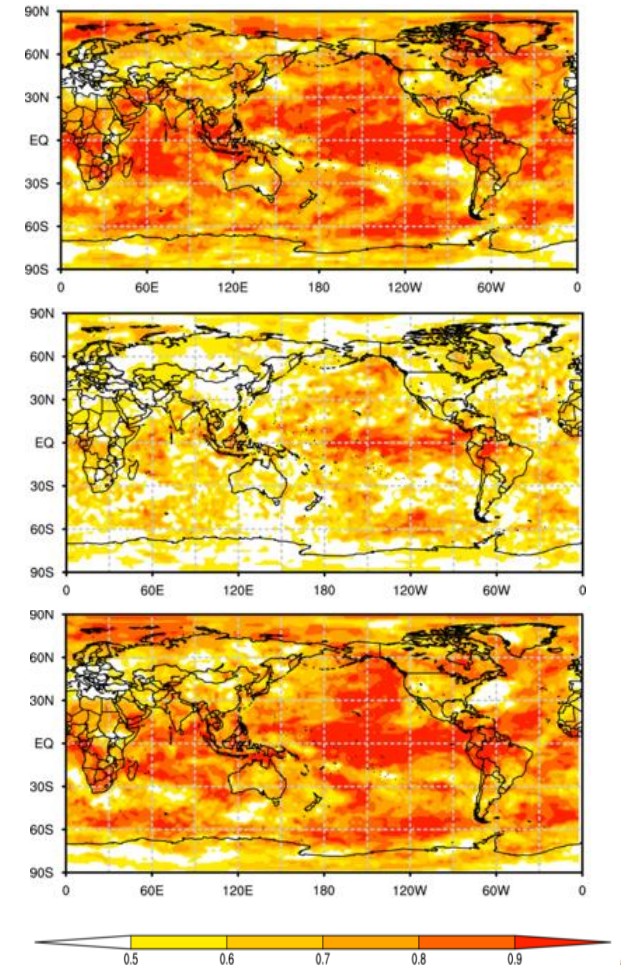
❖ Deterministic MME



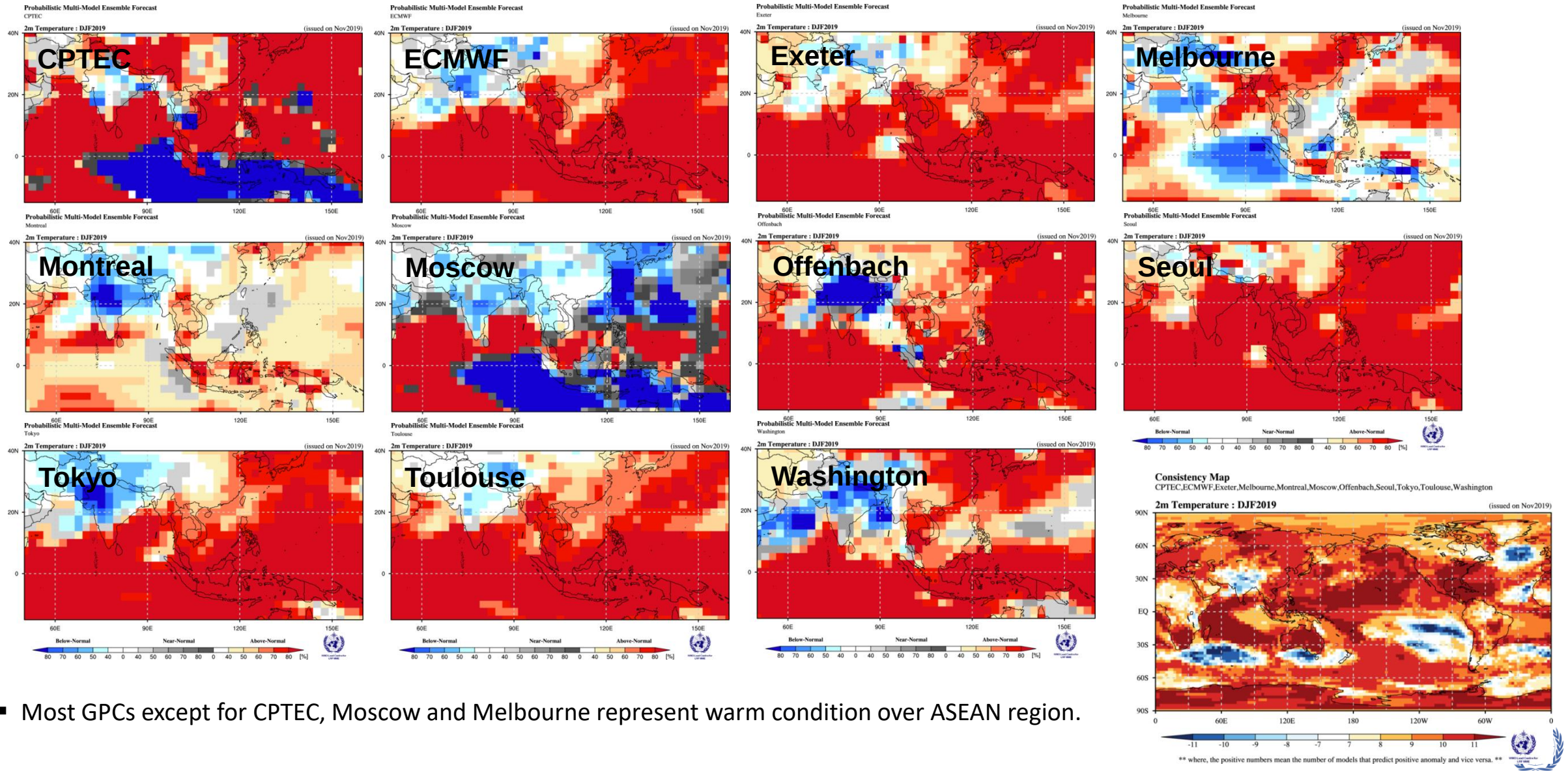
❖ Probabilistic MME



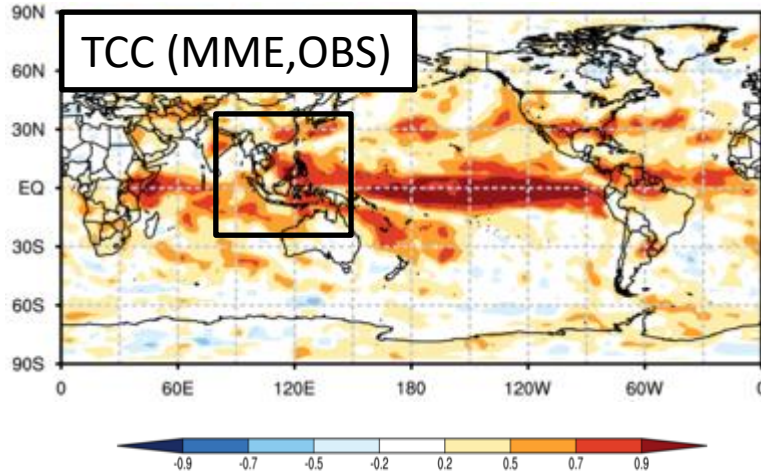
ROC Score



Individual forecast : 2m temperature for DJF 2019/20

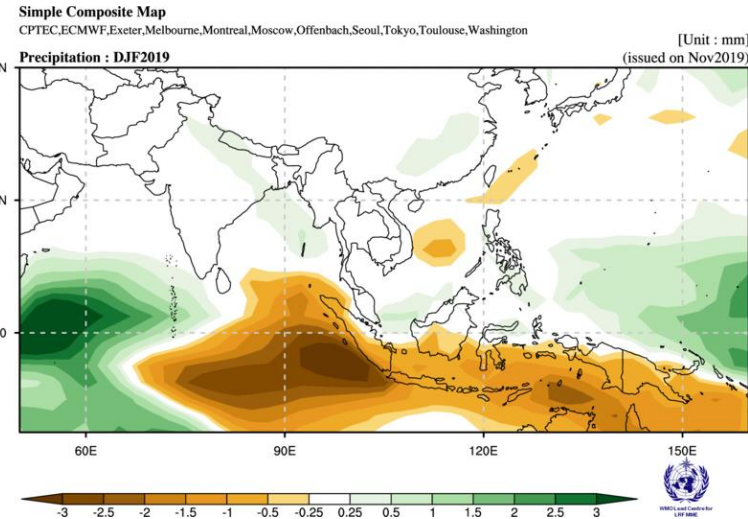


MME : Precipitation for DJF 2019/20

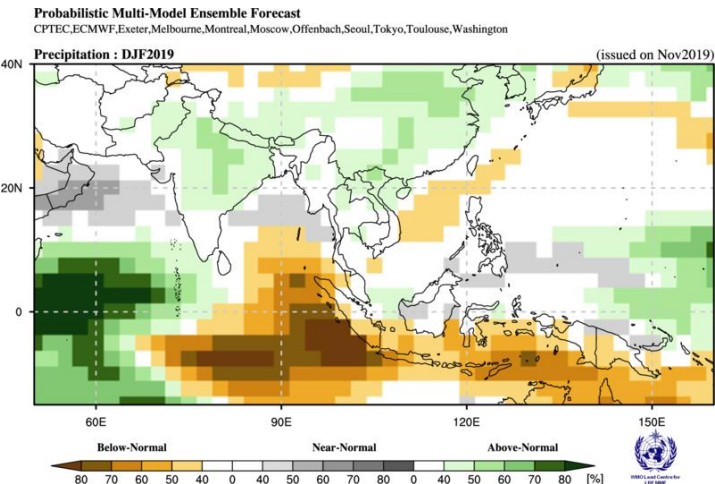


- TCC skills in the ASEAN region are relatively high compared to other regions but are low compared to those of temperature.
- Dry anomalies are predicted in western part of Borneo and in Java, while the MME predicts wet anomalies over the northern parts of Vietnam and Thailand.
- There are some uncertainties over Indonesia, Malaysia and Philippines.

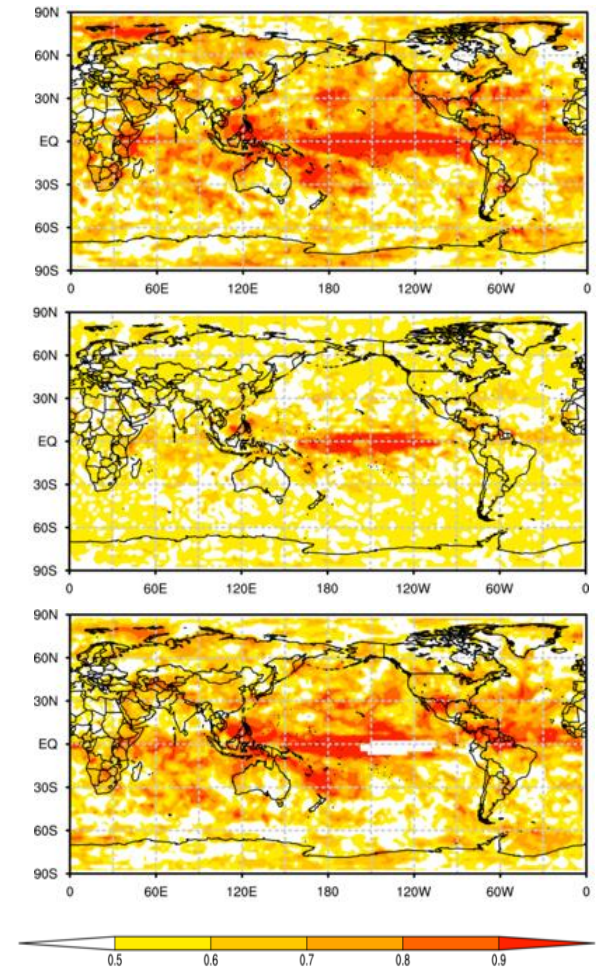
❖ Deterministic MME



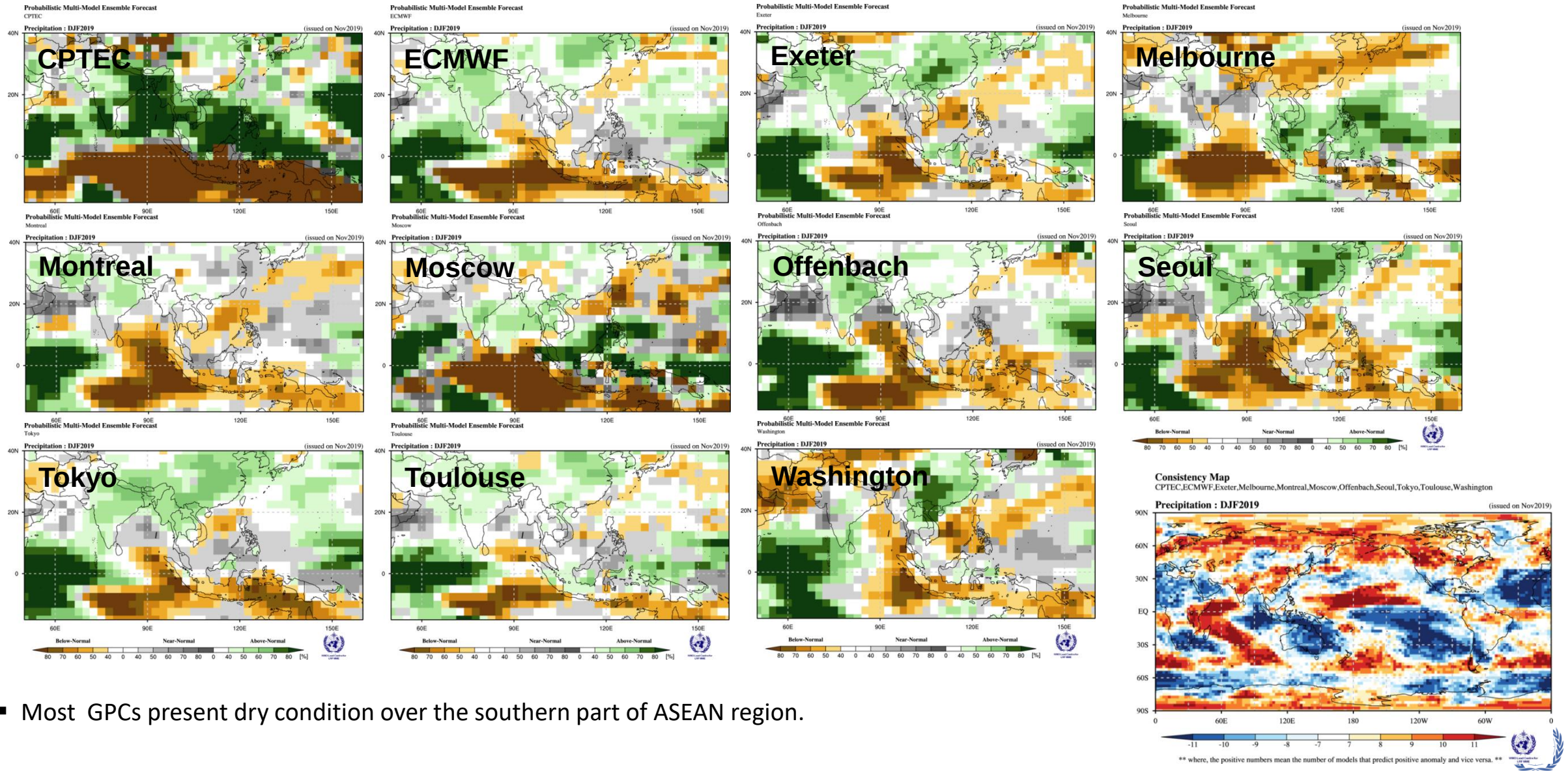
❖ Probabilistic MME



ROC Score



Individual forecast : Precipitation for DJF 2019/20



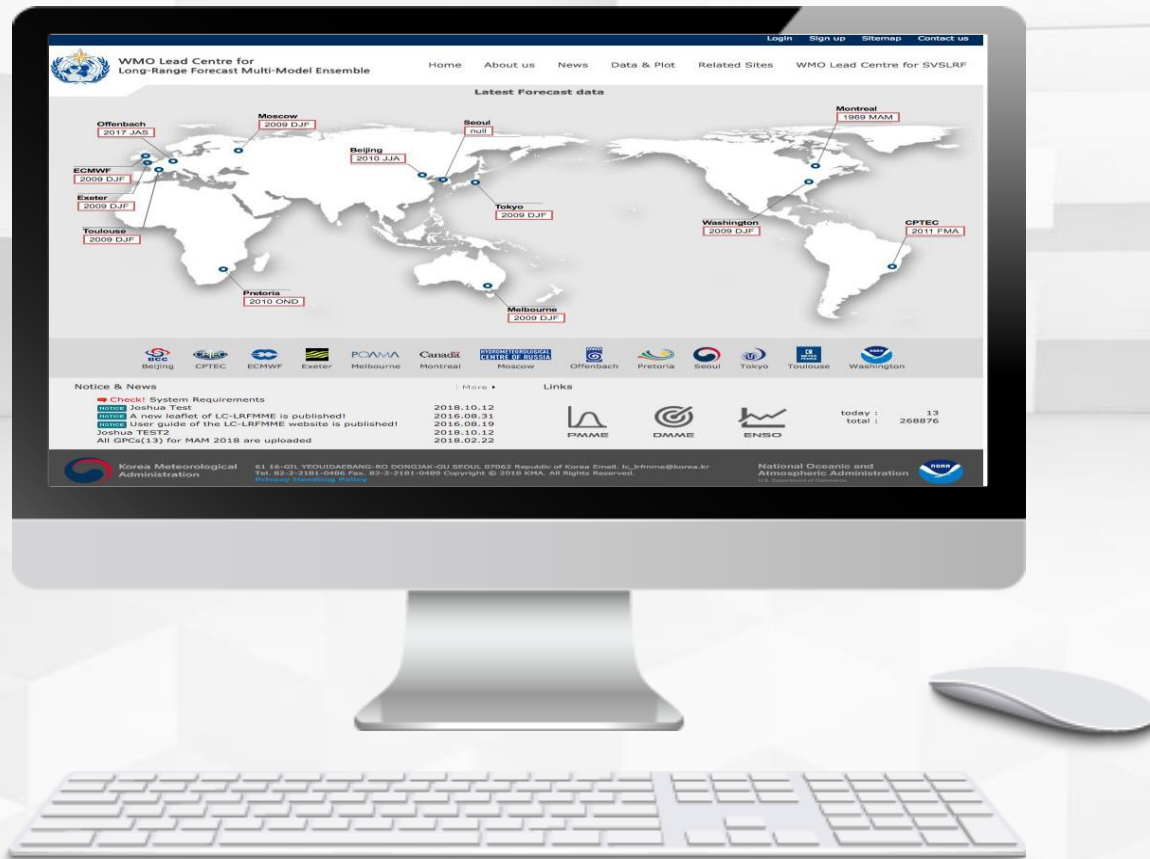
Summary for DJF 2019/20

- **Ocean**
 - **ENSO prediction**
 - Neutral ENSO is predicted during DJF.
 - **IOD prediction**
 - Weak Positive IOD is predicted during DJF.
- **Atmosphere :**
 - **2m Temperature**
 - Warmer than normal conditions are dominant over most ASEAN region.
 - **Precipitation**
 - Dry over Java and the western part of Sumatra.



Thank you

<http://www.wmolc.org>



**For more Information, Please
contact !**

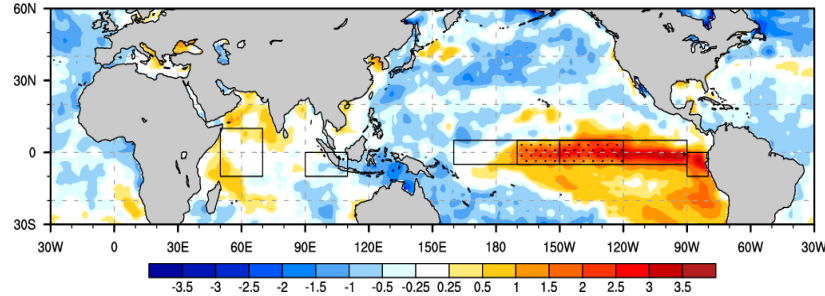


**Climate Prediction Division
Korea Meteorological
Administration**

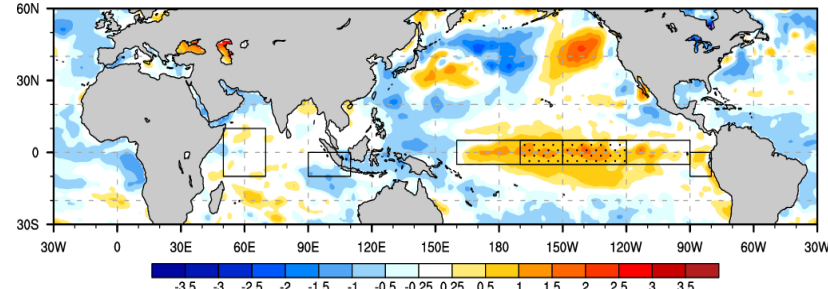
- 61, Yeouidaebang-ro 16-gil, Dongjak-gu, Seoul, 07062, Republic of KOREA
- Tel : +82-2-2181-0475
- Fax : +82-2-2181-0489
- E-mail : lc_lrfmme@korea.kr

Years of Positive IOD in OCT

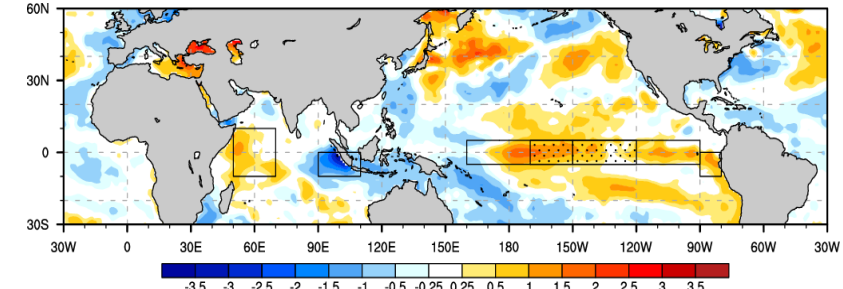
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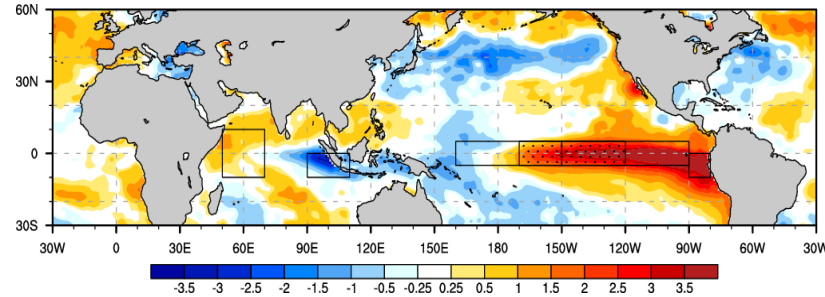
1991 (E)



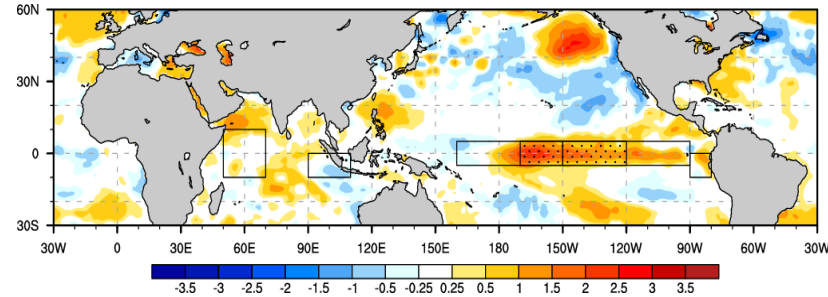
1994 (E)



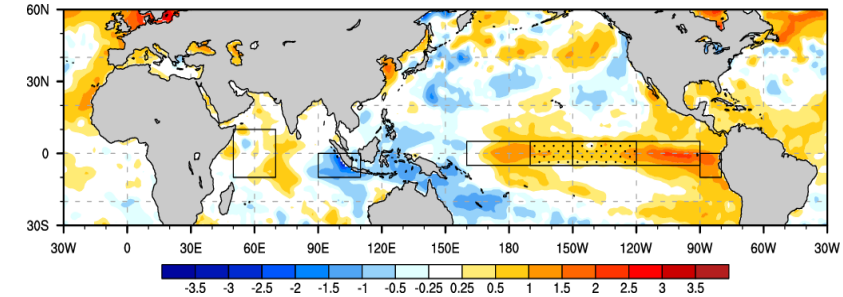
1997 (E)



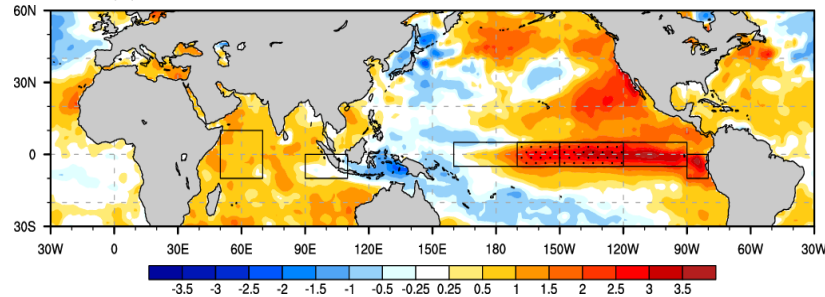
2002 (E)



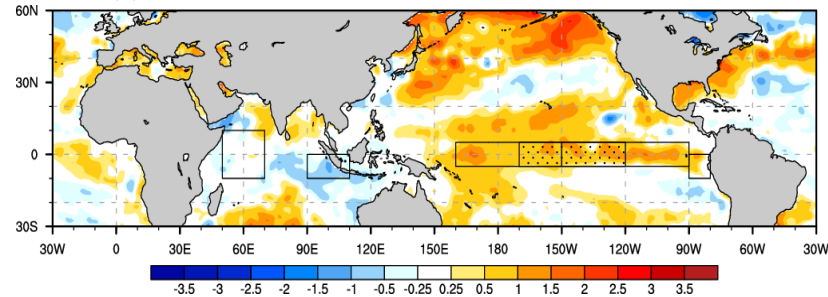
2006 (E)



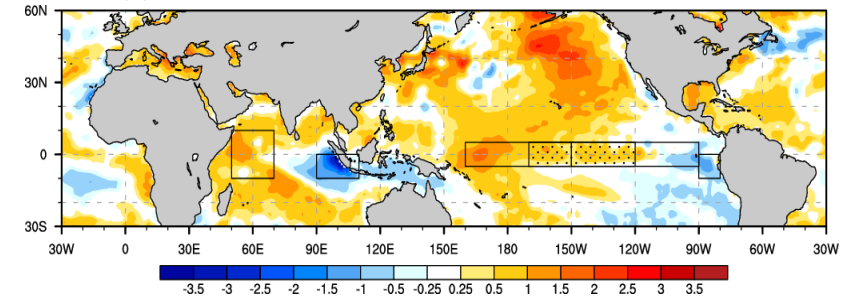
2015 (E)



2018 (E)



2019 (N)

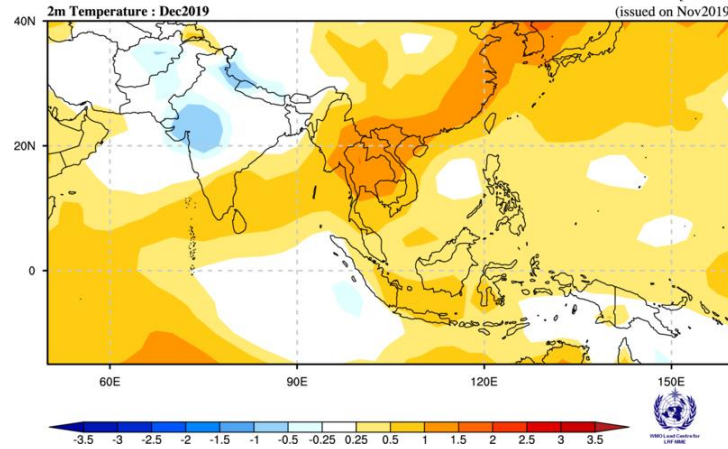


MME : T2m for DJF 2019/20

Simple Composite Map

CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington

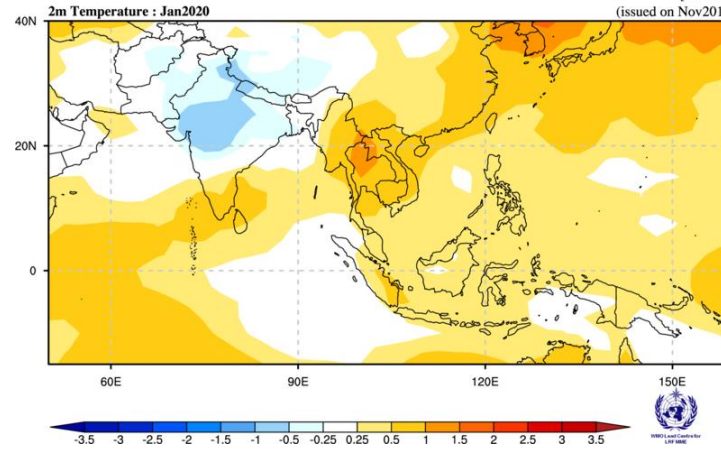
[Unit : K]



Simple Composite Map

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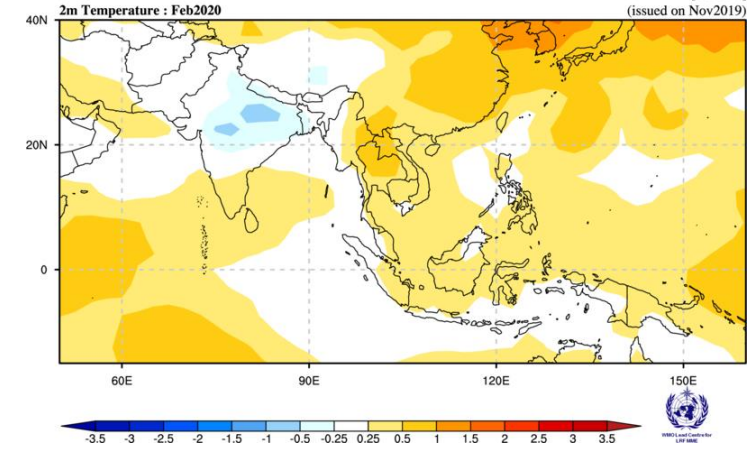
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Simple Composite Map

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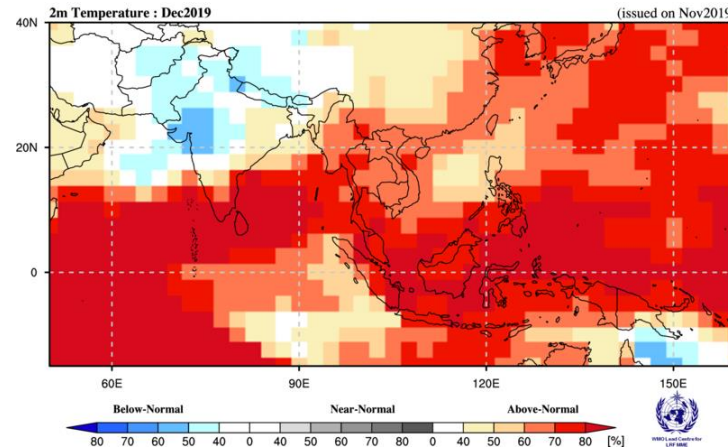
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Probabilistic Multi-Model Ensemble Forecast

CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington

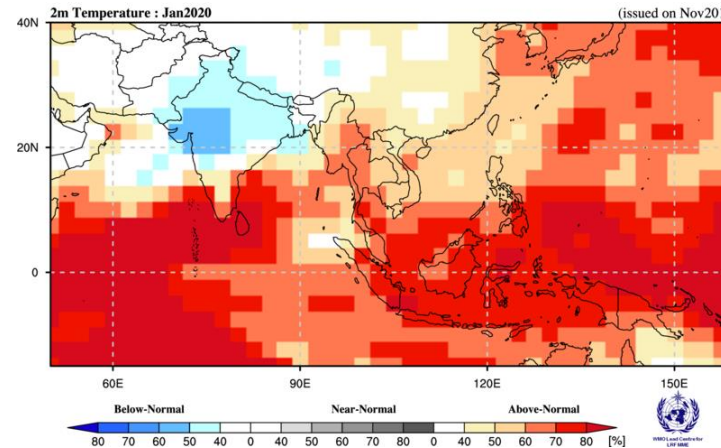
(issued on Nov2019)



Probabilistic Multi-Model Ensemble Forecast

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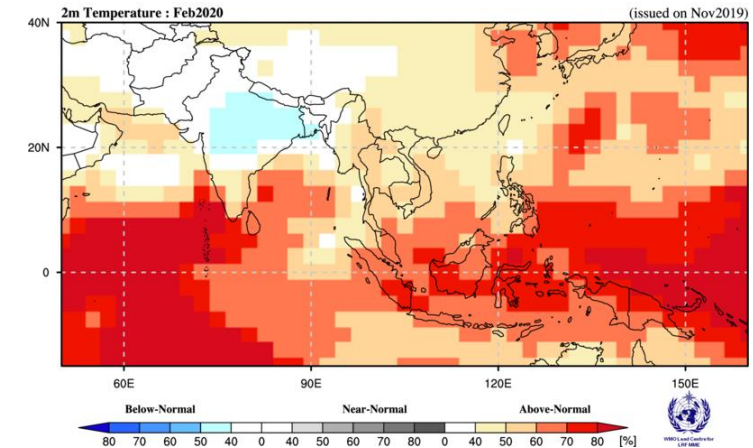
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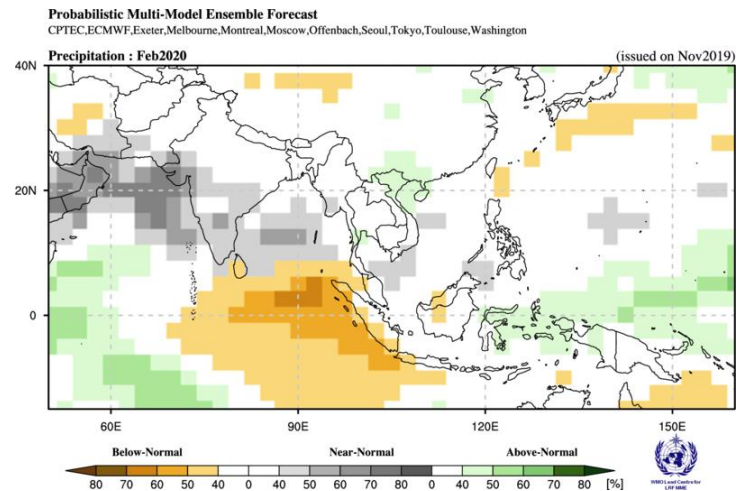
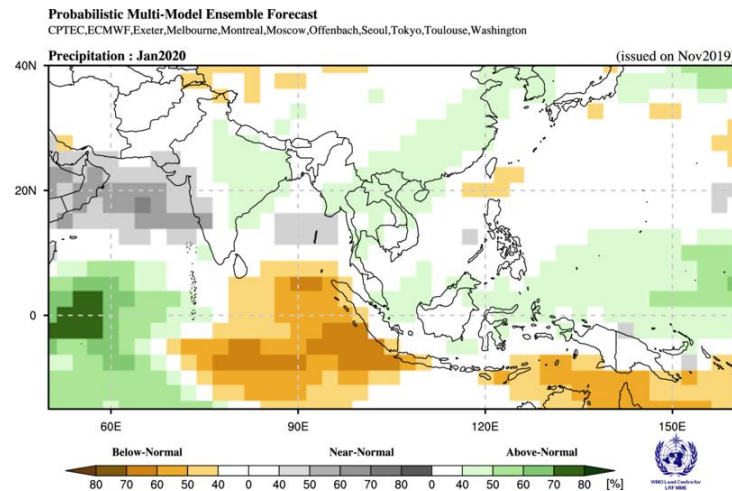
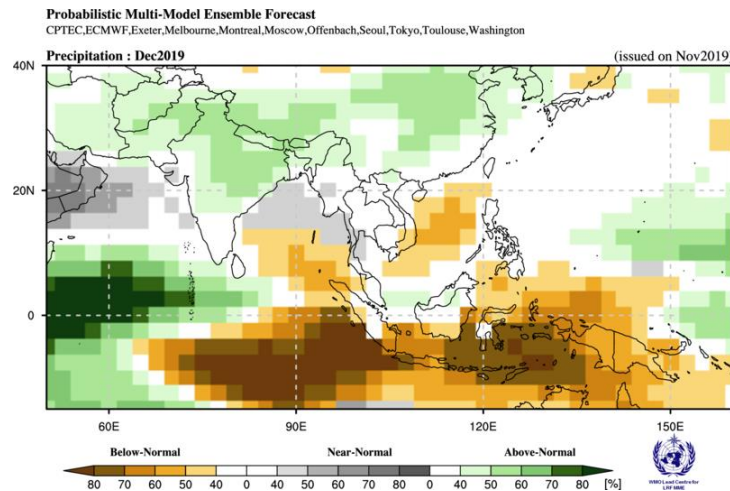
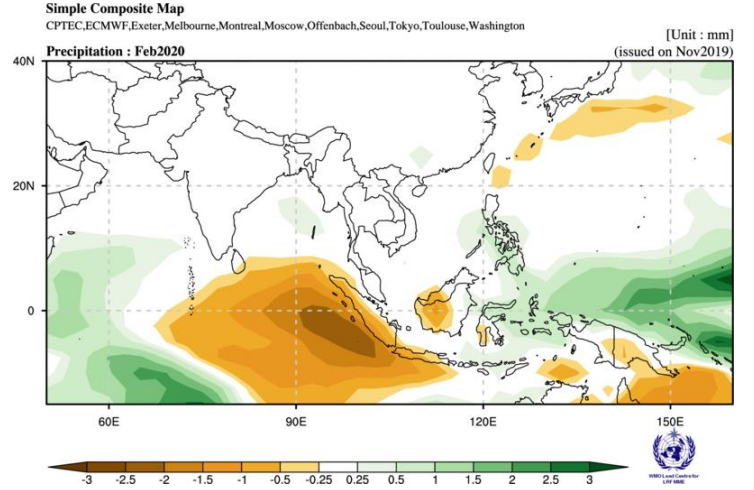
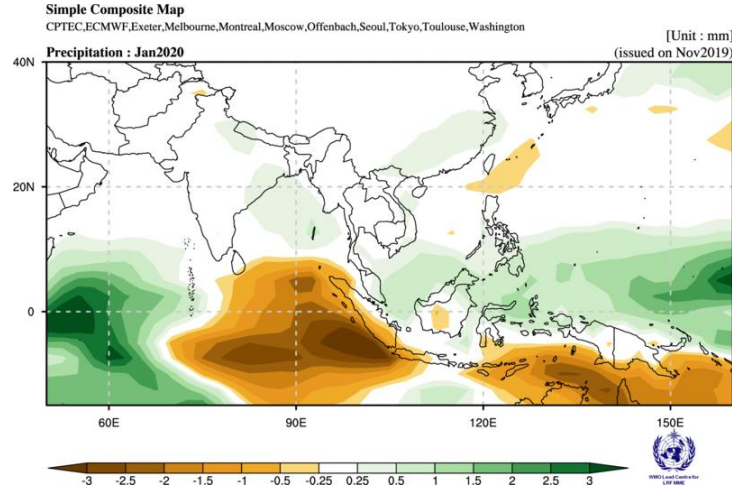
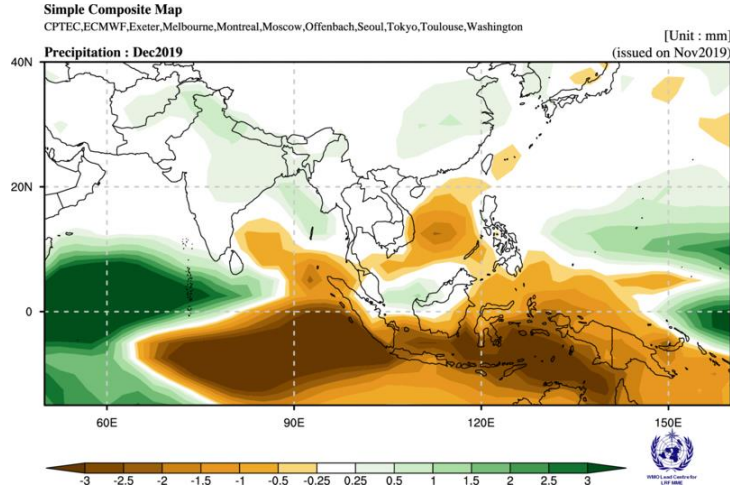
Probabilistic Multi-Model Ensemble Forecast

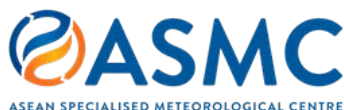
CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington

(issued on Nov2019)



MME : Precipitation for DJF 2019/20





Thirteenth Session of the ASEAN Climate Outlook Forum (ASEANCOF-13)

**November 2019, Thai Meteorological Department
in collaboration with Centre for Climate Research Singapore (CCRS),
Meteorological Service Singapore**

Consensus Bulletin for December-January-February (DJF) 2019-2020 Season

INTRODUCTION

The ASEAN Climate Outlook Forum (ASEANCOF) is an avenue to collaboratively develop consensus-based seasonal climate outlooks and related information on a regional scale for southeast Asia.

The forum outlook and its activities contribute significantly to one of the key roles of the ASEAN Specialised Meteorological Centre (ASMC), which is to conduct climate and seasonal prediction for ASEAN region through pooling the expertise of ASEAN National Meteorological Services.

The Thirteenth ASEANCOF (ASEANCOF-13) was organised by the Thai Meteorological Department in collaboration with the Meteorological Service Singapore as host of the ASEAN Specialised Meteorological Centre. Representatives from National Meteorological and Hydrological Services (NMHSs) of ASEAN Member States created a consensus forecast for the winter 2019-2020 in the ASEAN region. The consensus for December-January-February (DJF) 2019-2020 outlooks was achieved through the Thirteenth ASEAN Climate Outlook Forum and Training in Bangkok, Thailand from 18 to 21 November 2019. The consensus was made based on presentations and discussions on current conditions and predictions for the Southeast Asia region. In particular, the forum took into account the significant influence of the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) on the climate over Southeast Asia.

CONDITIONS AND OUTLOOK

Recent analysis of sea surface temperature (SST) anomalies over the equatorial Pacific indicate a slightly above average SST across most of the Pacific Ocean. The ENSO neutral conditions have been present since July 2019. The international climate outlooks predict ENSO neutral conditions are likely to continue during DJF 2019-2020. The present positive Indian Ocean Dipole (IOD) is expected to weaken in DJF 2019-2020. The Northeast monsoon for the southern half of the region is expected to be delayed due to the strong positive IOD at the start of the season.

Taking into consideration the national level forecasts, the present state of the climate, and the forecasts available from GPCs and other global centres, the forum agreed on the following consensus-based outlook for DJF 2019-2020 for the Southeast Asia region:

RAINFALL

For the upcoming Northern Hemisphere winter season (December-January-February), near-normal conditions are expected over most parts of Mainland Southeast Asia, and parts of the equatorial region. However, there are a slightly probability enhanced of wetter than normal conditions over northern Vietnam, the eastern part of Malaysia, Sabah, the eastern part of Celebes, Moluccas and northern of Papua. There is slightly probability of drier than normal conditions over the southern part of Myanmar, parts of Thailand (the northern, central, eastern and south-eastern of region), Philippines, northern and southern Sumatra, Java, the western part of Celebes, Bali, Nusa Tenggara, the southern part of Borneo and the southern part of Papua.

TEMPERATURE

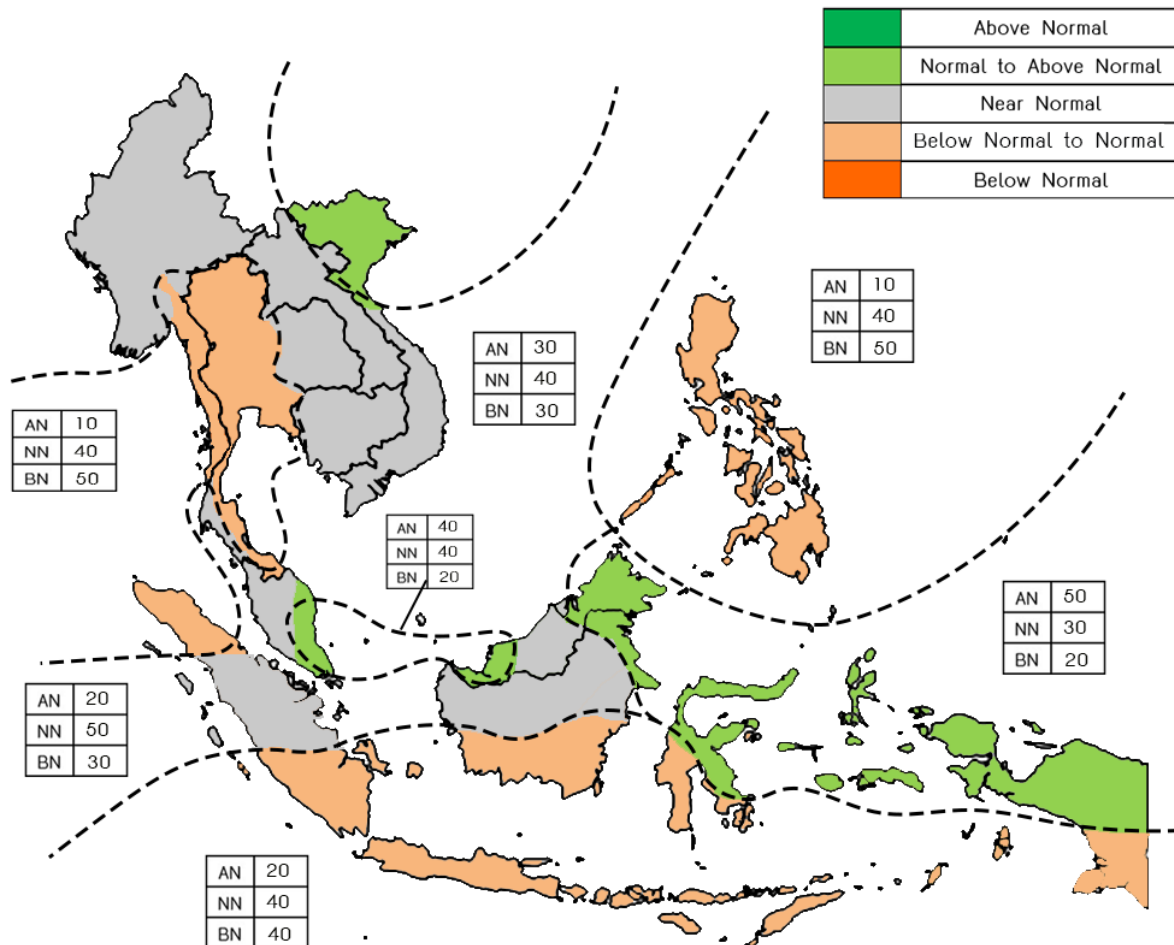
Above normal temperatures are expected for most of Southeast Asia, apart from eastern and southern Myanmar, northern Thailand and northern Sumatra, where near normal temperatures are expected. For the regions with above normal temperature, the highest probability is over northern Vietnam, Lao PDR, Cambodia, upper Thailand and southern Myanmar,

Refer to **Annex A** for reference on what is meant by “above, near, or below normal” in the outlook. For more information on the Northern Hemisphere summer monsoon outlook and further updates on the national scale, the relevant NMSs should be consulted (see **Annex B**).

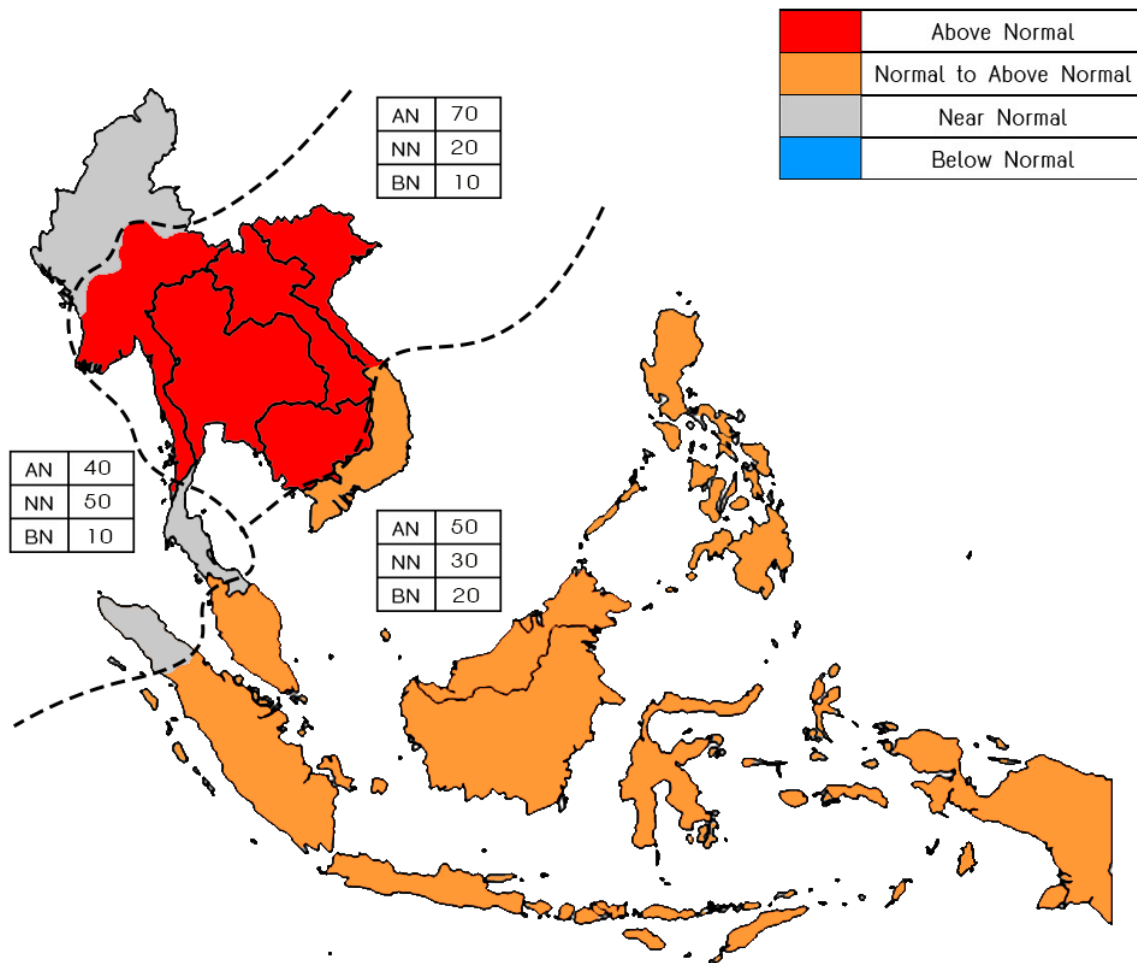
CONSENSUS MAPS FOR DJF 2019-2020

The following maps provide the probabilistic outlooks for DJF 2019-2020 season in terms of tercile categories of “Above Normal” (AN: upper tercile), “Near Normal (NN: middle tercile) and “Below Normal” (BN: lower tercile).

PROBABILISTIC RAINFALL OUTLOOK



PROBABILISTIC TEMPERATURE OUTLOOK



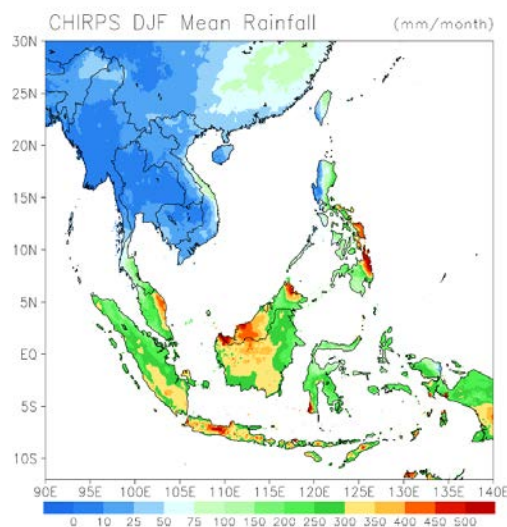
ACKNOWLEDGEMENTS

The Forum would like to convey its appreciation to the National Meteorological Services of the ASEAN Member States for sharing their national-level forecasts, the Global Producing Centres and other participating international climate modelling centres for their products and expertise made available for this Climate Outlook Forum.

ANNEX A: RAINFALL AND TEMPERATURE TERCILE CLIMATOLOGIES

The following figures are rainfall and temperature mean and tercile boundary climatologies to reference against the consensus outlook. Only a single source of data for each variable is provided (CHIRPS for rainfall, and GHCN, CRU-UEA for temperature). For more representative climatologies, reference should be made also against observational datasets known to better characterize local patterns (e.g. quality-controlled station data from the respective National Meteorological Services).

DJF Mean Rainfall



DJF Mean Temperature

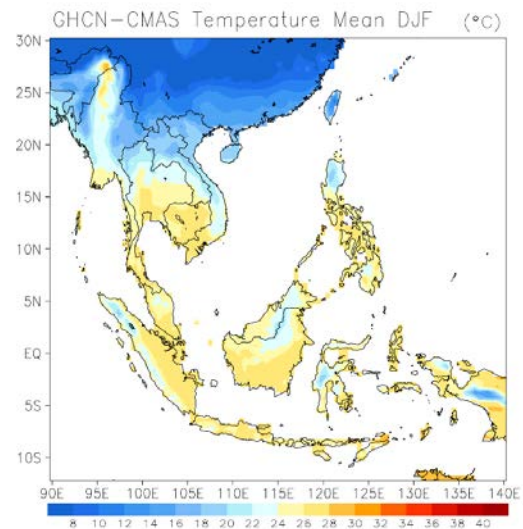
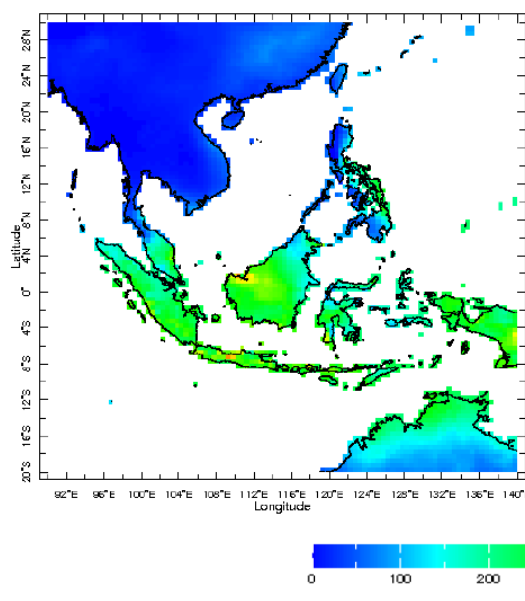
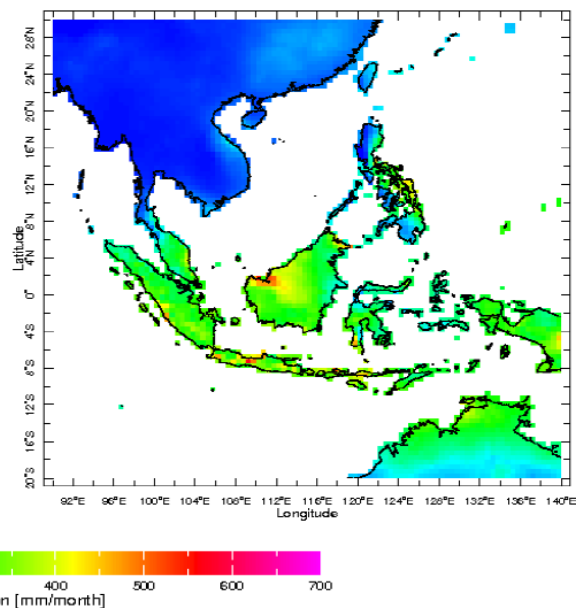


Figure A1: Rainfall mean climatology in mm/month (left, CHIRPS) and the temperature mean climatology (right, GHCN-CAMS) for DJF from 1981-2010

DJF Lower Tercile Rainfall ("Below Normal")



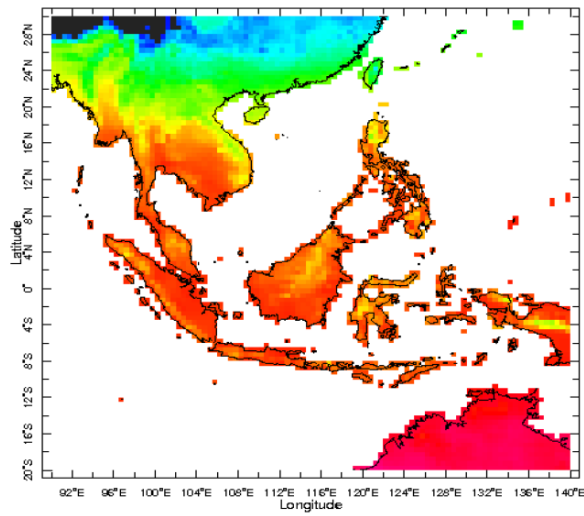
DJF Upper Tercile Rainfall ("Above Normal")



Annex A: Rainfall and Temperature Tercile Climatologies

Figure A2: Rainfall climatologies of the lower tercile boundary (left) and the upper tercile boundary (right) for DJF from 1981-2010 from TS3p22 (CRU, UEA) in mm/month

DJF Lower Tercile Temperature ("Below Normal")



DJF Upper Tercile Temperature ("Above Normal")

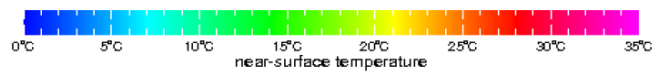
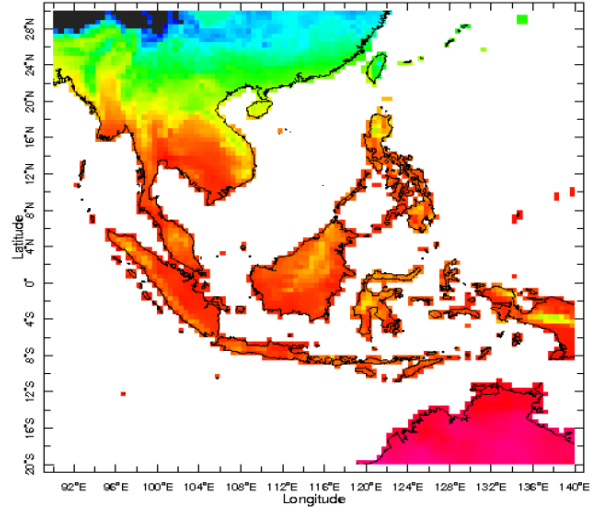


Figure A3: Temperature climatologies of the lower tercile boundary (left) and the upper tercile boundary (right) for DJF from 1981-2010 from (CRU, UEA)

ANNEX B: NATIONAL METEOROLOGICAL SERVICES' CONTACT INFORMATION

- Brunei Darussalam Meteorological Department (BDMD)

<http://www.met.gov.bn/weather>

- Department of Meteorology, Cambodia

<http://www.cambodiameteo.com/map?menu=3&lang=en>

- Badan Meteorologi, Klimatologi dan Geofisika, Indonesia (BMKG)

<http://www.bmkg.go.id>

- Department of Meteorology and Hydrology (DMH), Lao PDR

<http://dmhlao.etllao.com/>

- Malaysian Meteorological Department (MMD)

<http://www.met.gov.my/>

- Department of Meteorology and Hydrology (DMH), Myanmar

<http://www.dmh.gov.mm/>

**- Philippines Atmospheric, Geophysical and Astronomical Services Administration
(PAGASA)**

<http://www.pagasa.dost.gov.ph/>

- Meteorological Service Singapore Government (MSS)

<http://www.weather.gov.sg/home/>

- Thai Meteorological Department (TMD)

<http://www.tmd.go.th/en/>

- National Center for Hydro-Meteorological Forecasting (NCHMF), Vietnam

<http://www.khituongvietnam.gov.vn/kttvsite/>

ANNEX C: REVIEW OF JJA 2019 CONSENSUS OUTLOOK

SUMMARY

The rainfall and temperature outlooks were representative of the actual conditions over most parts of the Southeast Asia. Much of the region experienced above-normal temperature and below-normal conditions in some places. Near-to-below normal rainfall was observed in most parts of Southeast Asia, with a few regions recording normal to above-normal rainfall. Notable events include both droughts and floods, as well as strong wind.

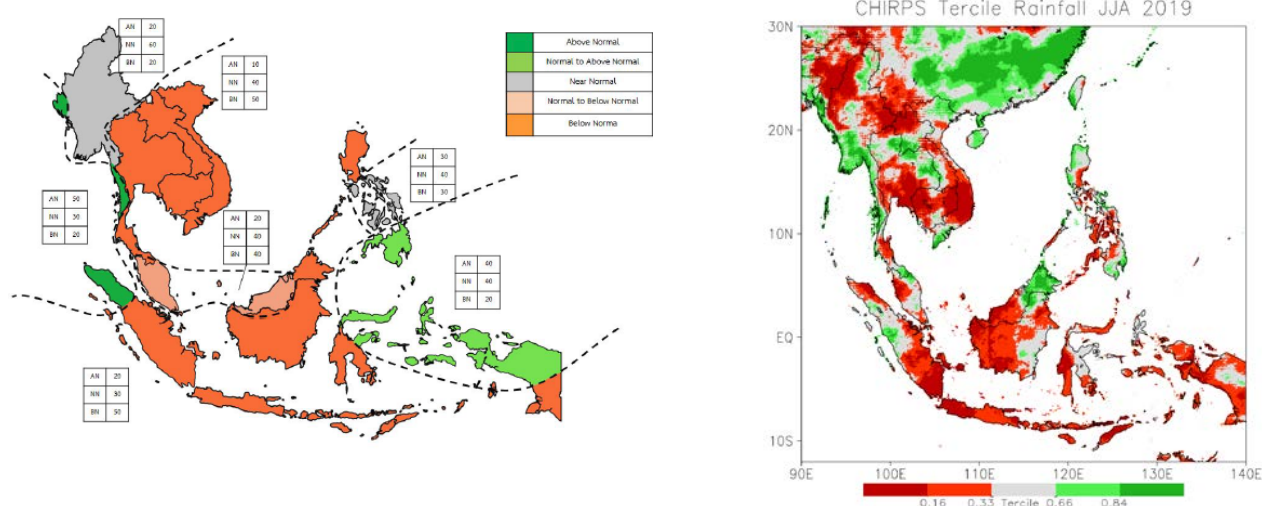
Sea surface temperature anomalies (SSTA) in the tropical Pacific Ocean have been presented to be near-average since July 2019, prior to which a borderline of weak El Niño to ENSO-neutral conditions were observed. The Indian Ocean reflected a dipole mode, which was the western tropic Indian Ocean presented above-average and the south eastern presented below-average SSTA. Based on the conditions, the Dipole Mode Index (DMI) was presented as a positive IOD and the below-normal rainfall conditions were expected over the southern and eastern Maritime Continent.

JJA 2019 RAINFALL OUTLOOK

For the upcoming Northern Hemisphere summer monsoon season (June-July-August), below normal conditions are expected over most parts of the Southeast Asia. However, there is a slightly enhanced probability of wetter than normal conditions over western and southern Myanmar and parts of Sumatra, Northern Celebe, Molluccas, and Papua islands of Indonesia).

As was seen using the CHIRPS data, much of outlooks were in good agreement with the CHIRPS gridded product in Figure 1 including Lao PDR, Central and Eastern Thailand, Central and Southern Thailand, Indonesia (North Sumatra, Java, Borneo, Central Celebs), Lao PDR, parts of Malaysia (Peninsular Malaysia and Sarawak), parts of Myanmar (Western and Southern Myanmar) and part of Philippines (Mindanao). A few regions received more rainfall than predicted by the dominant tercile category, including the eastern side of the northern and north-eastern region of Thailand, parts of Myanmar (Bago and Yakin), part of southern Vietnam, part of Philippines (Luzon) as well as Sabah. Drier than expected conditions occurred in Myanmar (Northern, Central and Western) and parts of Philippines (Maluku and Papua). The occurrence of below-normal rainfall over northern Mainland Southeast Asia and Indonesia may be associated with the weak/borderline El Niño and positive IOD phenomena.

Annex C: Review of JJA 2019 Consensus Outlook



Much of the outlook was in good agreement with the CHIRPS gridded product in **Figure 1** including parts of Indonesia, Myanmar, Lao PDR, and Thailand. In particular, central Lao PDR and upper Thailand, received above-normal rainfall. Near-normal conditions were observed over most of Borneo, northern Vietnam, and northern Myanmar which reflected the outlook. However, the Philippines, southern Vietnam, and southern Thailand experienced near-to above-normal rainfall using CHIRPS, contrary to the below normal prediction.

Figure 1: JJA 2019 Rainfall outlook (left) with observed rainfall from CHIRPS (right; Funk et al., 2014)

JJA 2019 TEMPERATURE OUTLOOK

Above normal temperatures are expected over much of central and eastern Southeast Asia, including parts of Peninsular Malaysia, Singapore, central and western Indonesia. Normal to above normal temperature are expected elsewhere, including Philippines, Moluccas and Papua islands of Indonesia.

The Southeast Asia region experienced above-normal temperature as showed in the GHCN-CAMS data and generally consistent the JJA 2019 Temperature outlook (**Figure 2**). The gridded product observed above-normal temperatures over most of the ASEAN regions, except for southern Vietnam, parts of southern Lao PDR, eastern Cambodia, Sabah, parts of southern Indonesia and parts of Philippines that experienced below-normal conditions, while Maluku Islands and parts of Celebes experienced near-normal conditions.

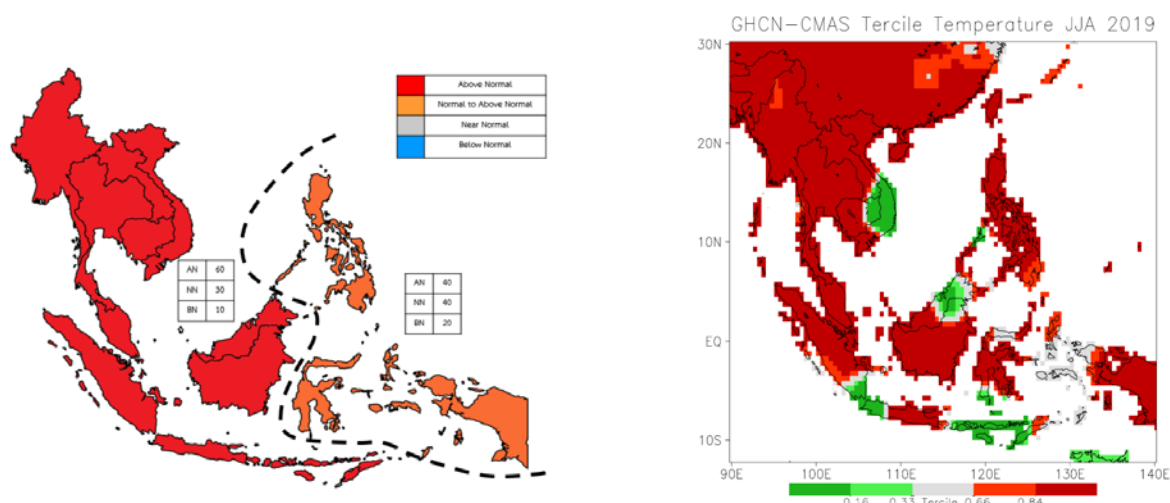


Figure 2: JJA 2019 Temperature outlook (left) and observed temperature from GHCN-CAMS (right; Fan, Y., and H. van den Dool., 2008)

SIGNIFICANT EVENTS

Notable events that occurred during JJA 2019 in Southeast Asia include long dry season in Indonesia caused drought in Java, Bali and Nusa Tenggara which affected thousands hectares of rice field. Meanwhile, in August, heavy rainfall with flooding occurred in Myanmar and new highest daily rainfall records were established. Also, the tropical storm “Podul” hit Thailand during late August brought torrential rain and prolong flooding in the northern and north-eastern region of Thailand. Besides, the northern state of Malaysia was affected by strong wind due to Typhoon “Lekima” in August.

REFERENCES

- CHIRPS: Funk, C. C, Peterson, P. J., Landsfeld, M. F., Pedreros, D. H., Verdin, J. P., Rowland, J. D., Romero, B. E., Husak, G. J. Michaelsen, J. C., and Verdin, A. P. (2014) A quasi-global precipitation time series for drought monitoring: U. S. Geological Survey Data Series 832, 4 p., dx.doi.org/10.3133/ds832.
- GHCN-CAMS: Fan Y., H. van den Dool (2004), Climate Prediction Center global monthly soil moisture data set at 0.5° resolution for 1948 to present, J. Geophys. Res., 109, D10102, [doi:10.1029/2003JD004345](https://doi.org/10.1029/2003JD004345).
- GHCN-CAMS: Fan, Y., and H. van den Dool (2008), A global monthly land surface air temperature analysis for 1948-present, J. Geophys. Res., 113, D01103, [doi:10.1029/2007JD008470](https://doi.org/10.1029/2007JD008470).