

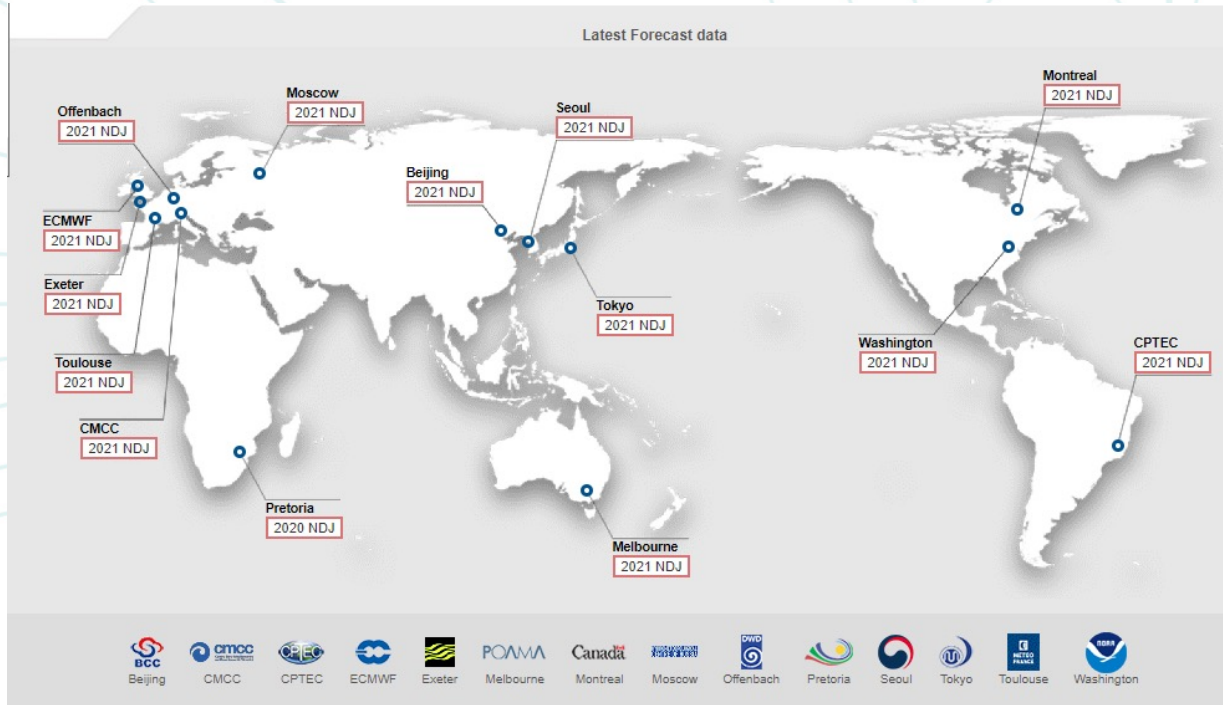
# Looking Forward – Seasonal and Intra-seasonal guidance for 2021/21

## i. Atmosphere

[Simon McGree, Bureau of  
Meteorology]

# WMO Lead Centre for LRF MME

- WMO LC MME official outlooks for PICOF
- Continue using outlooks and tailored products from RCC Network partners
- WMO LC MME based on 13 GPC LRF models.
- Many other national and research models in existence.
- Model skill varies significantly from model to model depending on a range of factors, such as model physics, initial conditions, length of hindcast, number of ensemble members etc.



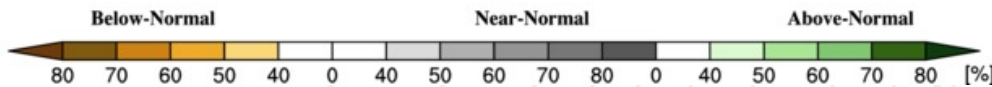
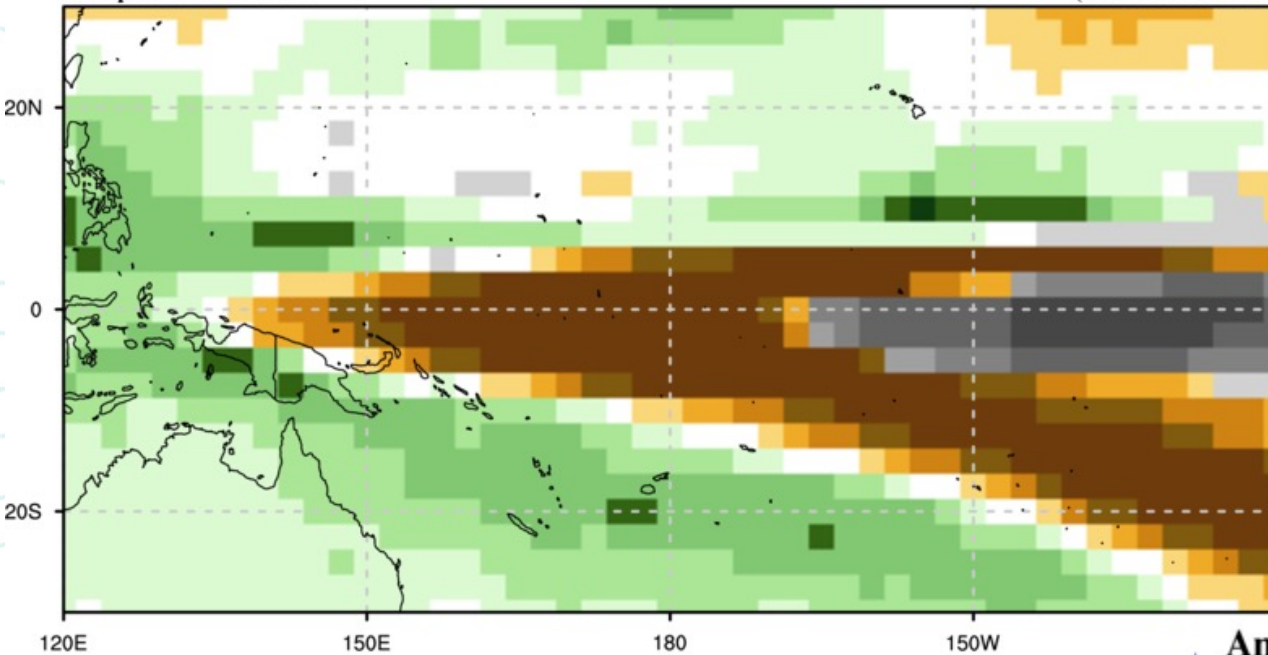
# WMO Lead Centre for LRF MME

## Probabilistic Multi-Model Ensemble Forecast

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

Precipitation : NDJ2021

(issued on Oct2021)



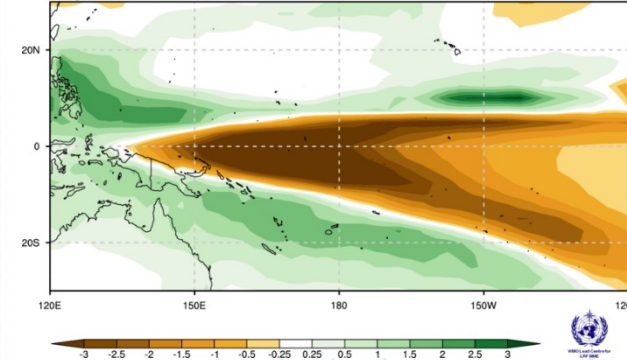
## Simple Composite Map

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

[Unit : mm]

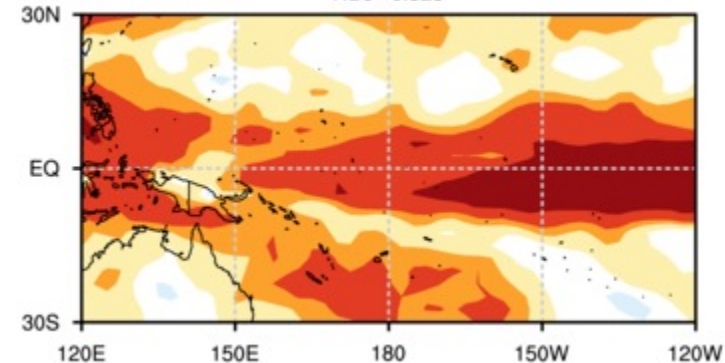
Precipitation : NDJ2021

(issued on Oct2021)



## Anomaly Correlation Coefficient (ACC)

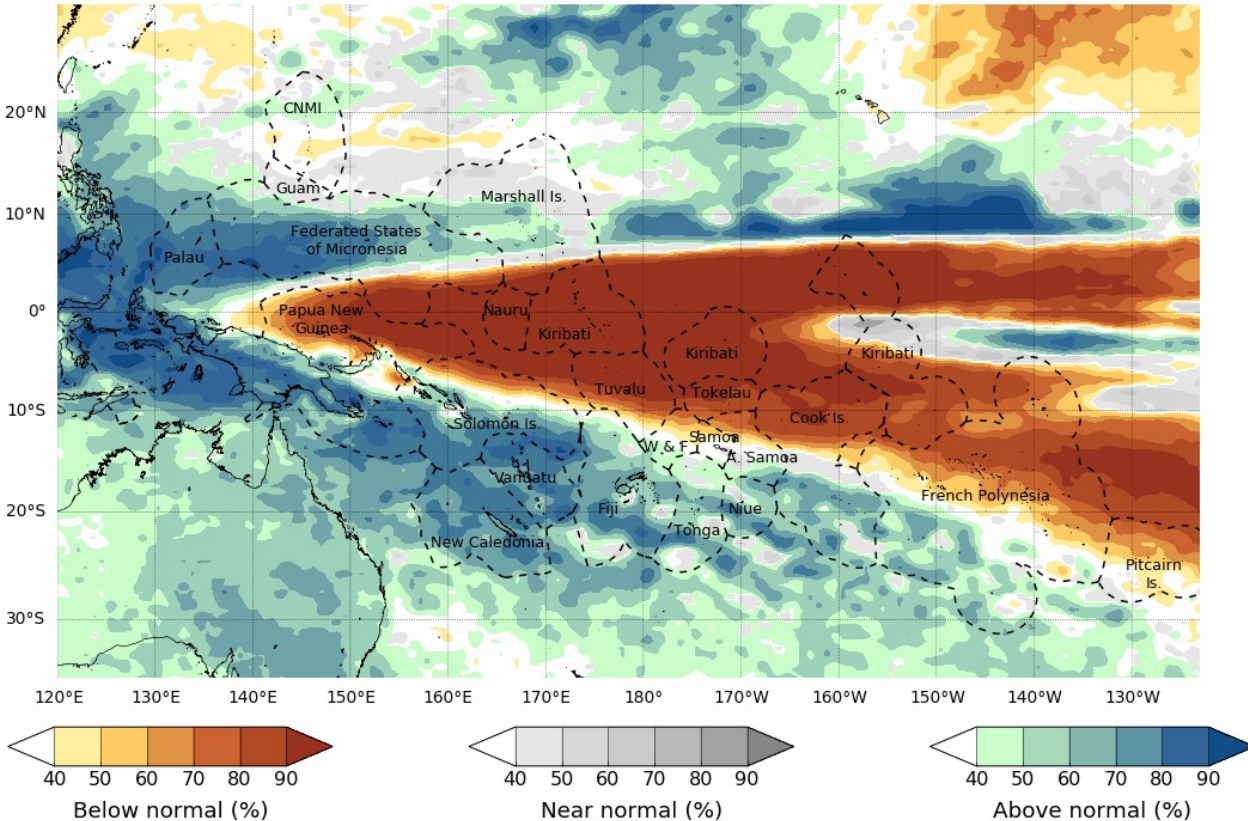
NDJ 0.525





# Melbourne GPC LRF ACCESS-S

Tercile rainfall probabilities for  
November 2021 to January 2022



© Commonwealth of Australia 2021, Australian Bureau of Meteorology

Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.marinerregions.org/>.

Model: ACCESS-S1

Base period: 1990-2012

Model run: 11/10/2021

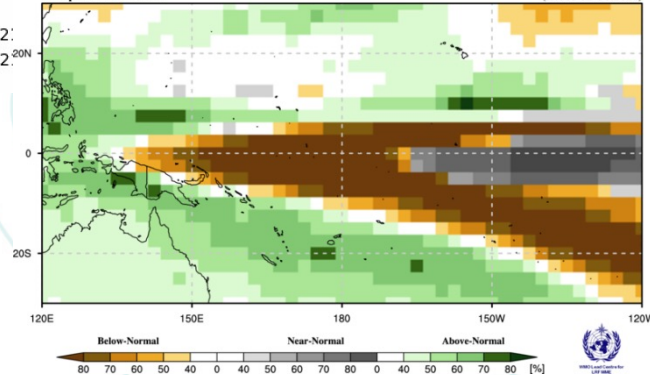
Issued: 14/10/2021

Probabilistic Multi-Model Ensemble Forecast

Beijing,CMCC,CNRM,ECMWF,Exeter,Melbourne,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington

Precipitation : NDJ2021

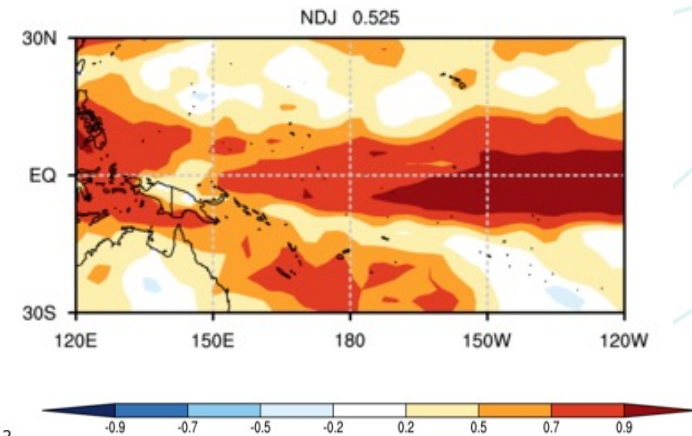
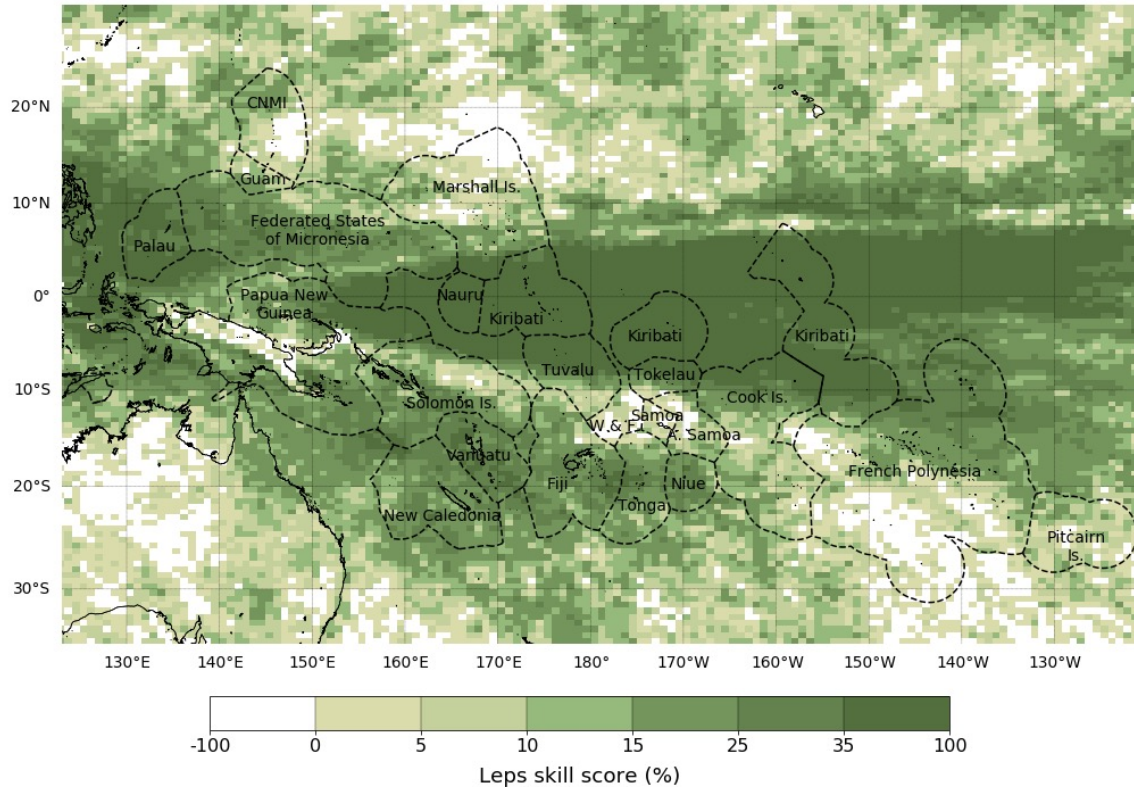
(issued on Oct2021)





# ACCESS-S skill Nov-Jan

NDJ rainfall Linear Error in Probability Space (LEPS) score.  
Period: Seasonal. Initialisation date: 9th October



Source: ACCESS-S1 and ERA5 Climate Reanalysis

© Commonwealth of Australia 2021, Australian Bureau of Meteorology

Disclaimer: Contains modified Copernicus Climate Change Service Information (2019). Neither the European Commission nor ECMWF is responsible for any use that may be made of the Copernicus Information or Data it contains.

Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.marinerregions.org/>.

Hindcast period: 1990-2012

Created: 06/05/2021

The X LEPS % score has been categorised as follows:

Very Low:  $X < 0.0$

Low:  $0 \leq X < 5$

Moderate  $5 \leq X < 10$

Good:  $10 \leq X < 15$

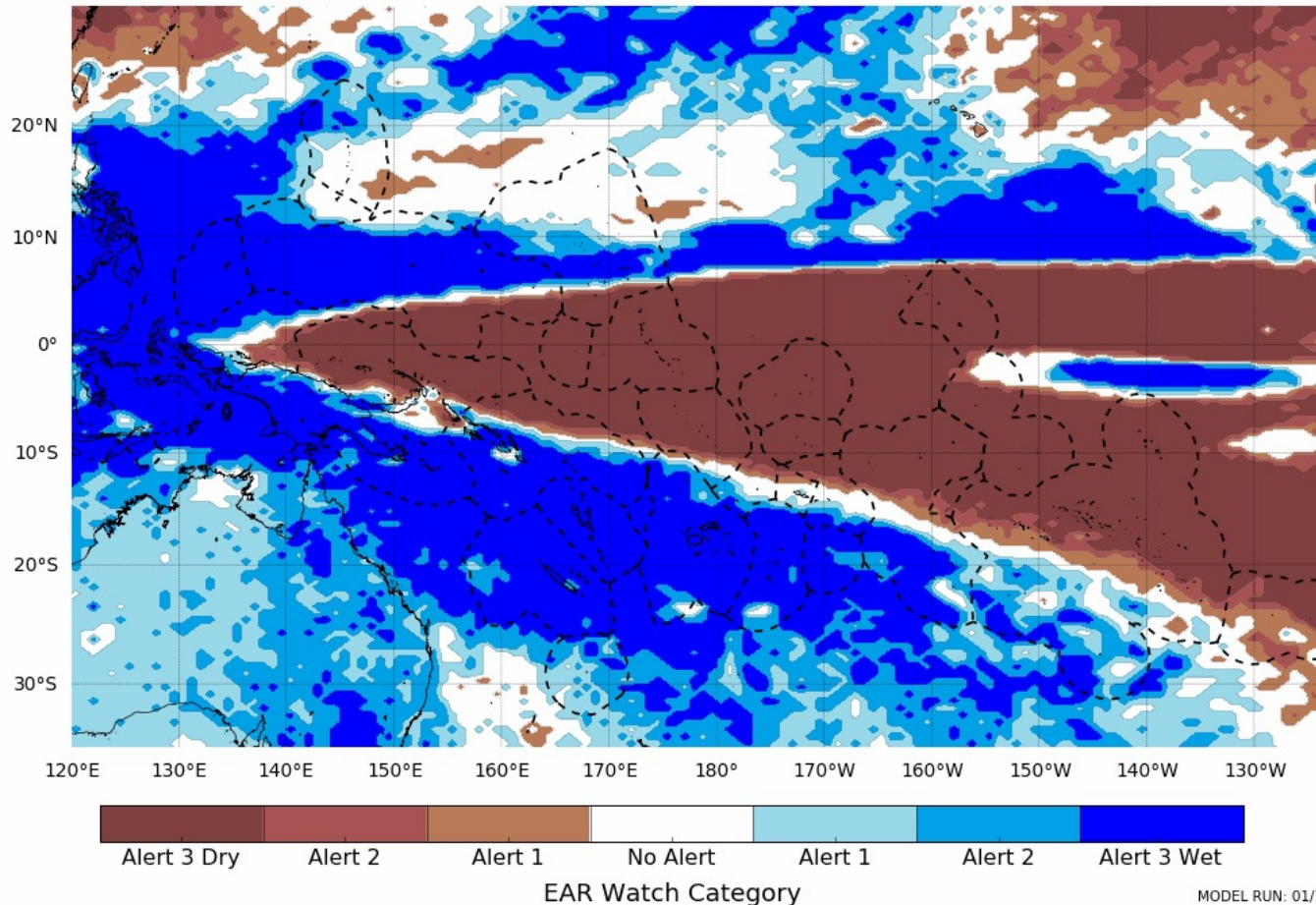
High:  $15 \leq X < 25$

Very High:  $25 \leq X < 35$

Exceptional:  $X \geq 35$

# Melbourne ACCESS-S prob+skill outlook

EAR Watch Categorical forecast for  
November 2021 to January 2022

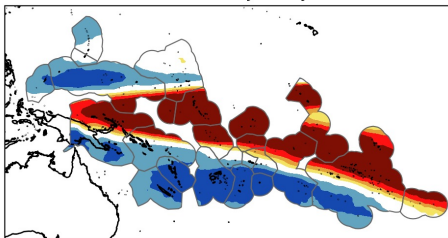




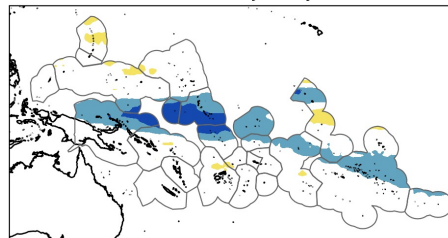
# NIWA Island Climate Update

- The ICU monthly and seasonal climate forecast products are based on the Copernicus Climate Change Service (C3S) Multi-Model Ensemble (MME)
- 8 models: ECMWF, UKMO, Météo-France, DWD, CMCC, NCEP, JMA, and ECCO: More than 470 ensemble members
- All climatologies are derived from the corresponding GCMs hindcasts (1993 – 2016)
- Hindcasts and forecast data processed at NIWA once per month

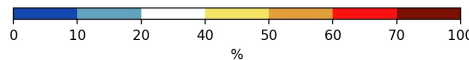
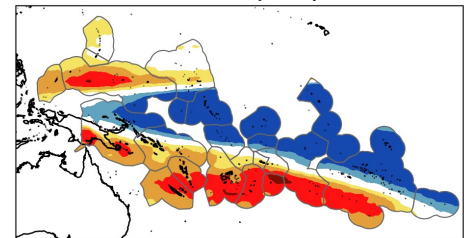
C3S MME, Prob(precipitation < lower tercile)  
November - January



C3S MME, Prob(lower tercile < precipitation < upper tercile)  
November - January



C3S MME, Prob(precipitation > upper tercile)  
November - January

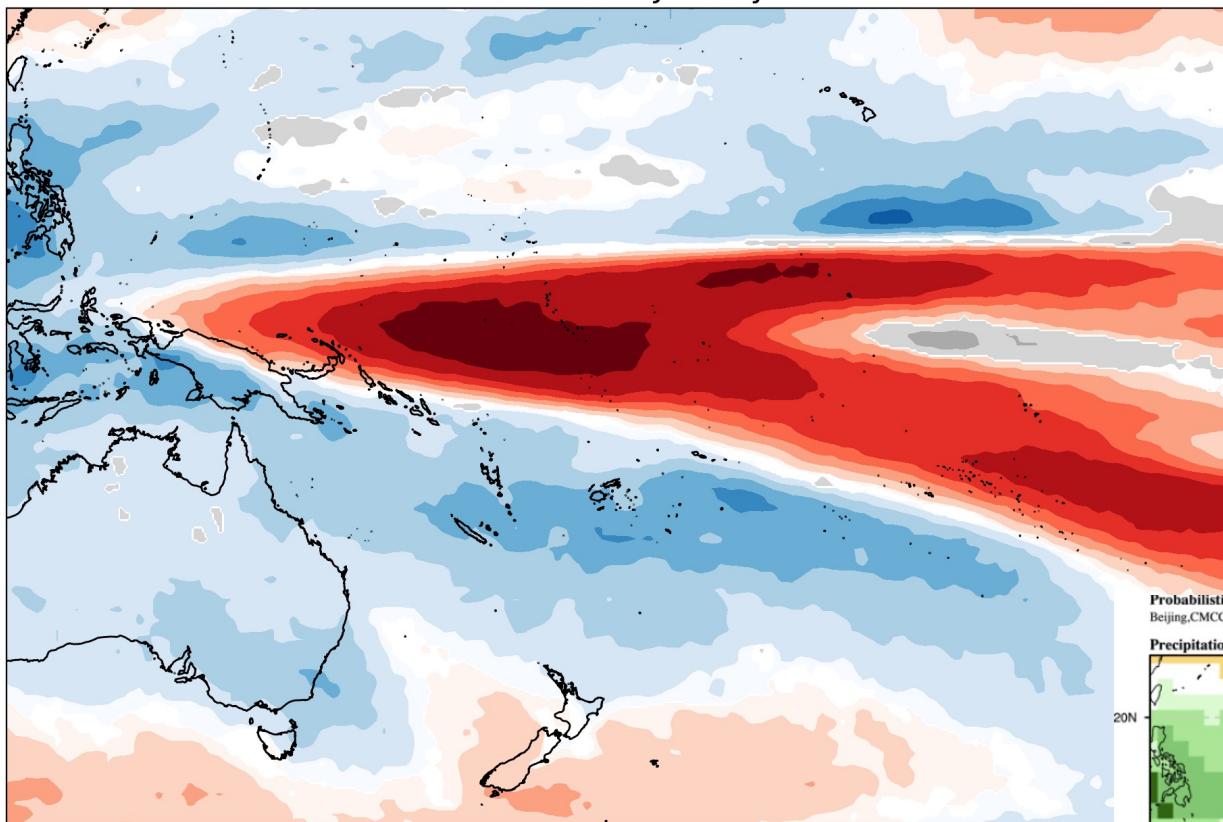


# NIWA ICU: most likely precipitation category over the coming seasons



C3S MME, Prob(most likely category of precipitation)  
November - January

- 8 models subset of WMO LC 14. Missing Melbourne, Seoul, Pretoria, Moscow, CPTec and Beijing
- WMO LC hindcast 1993-2009; C3S hindcast 1993-2016



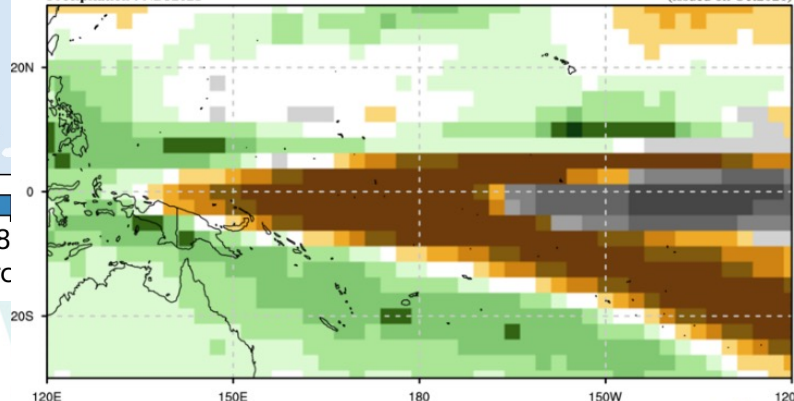
40 50 60 70 80 90 100  
below lower tercile (%)

40 50 60 70 8  
above upper terc

Probabilistic Multi-Model Ensemble Forecast  
Beijing,CMCC,CPTEC,ECMWF,Exeter,Melbourne,Montreal,Moscow,Offenbach,Seoul,Tokyo,Toulouse,Washington

Precipitation : NDJ2021

(issued on Oct2021)



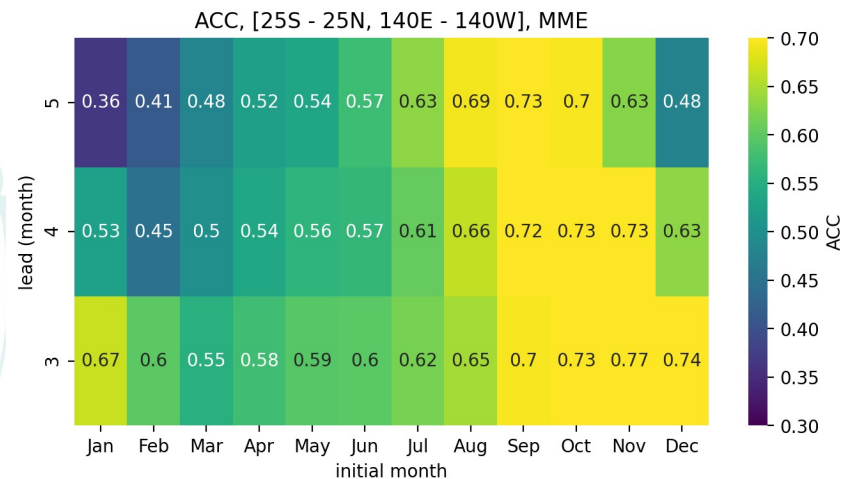
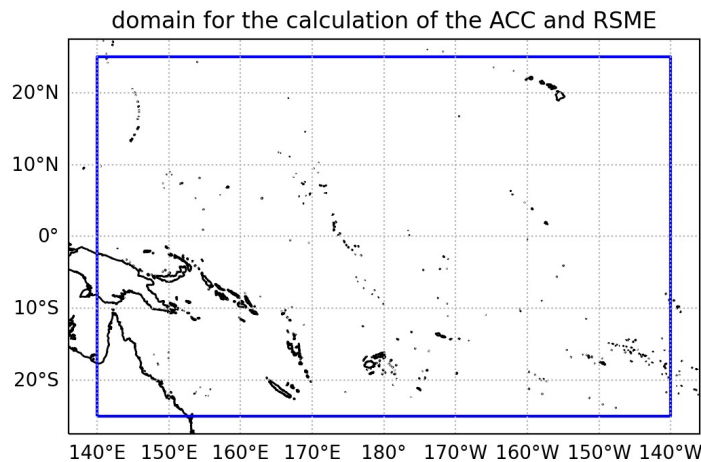
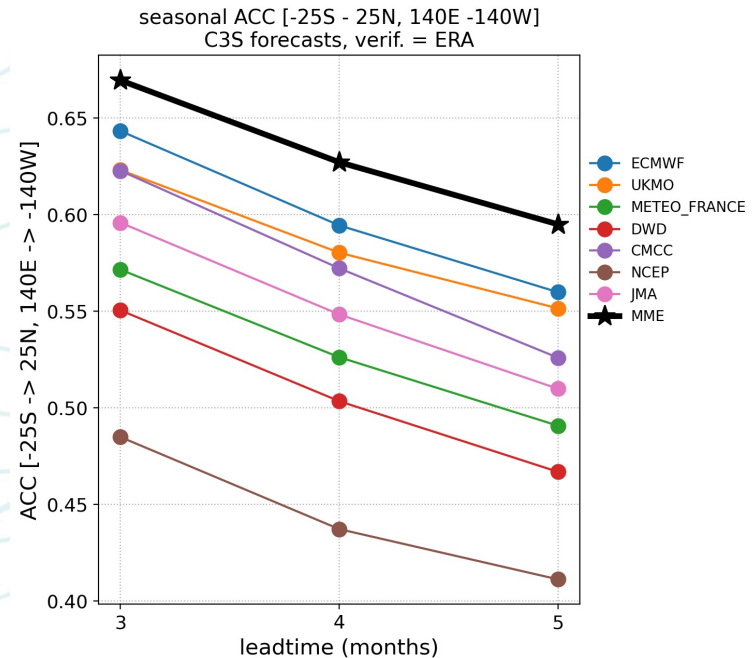
Below-Normal Near-Normal Above-Normal  
80 70 60 50 40 0 40 50 60 70 80 [%]



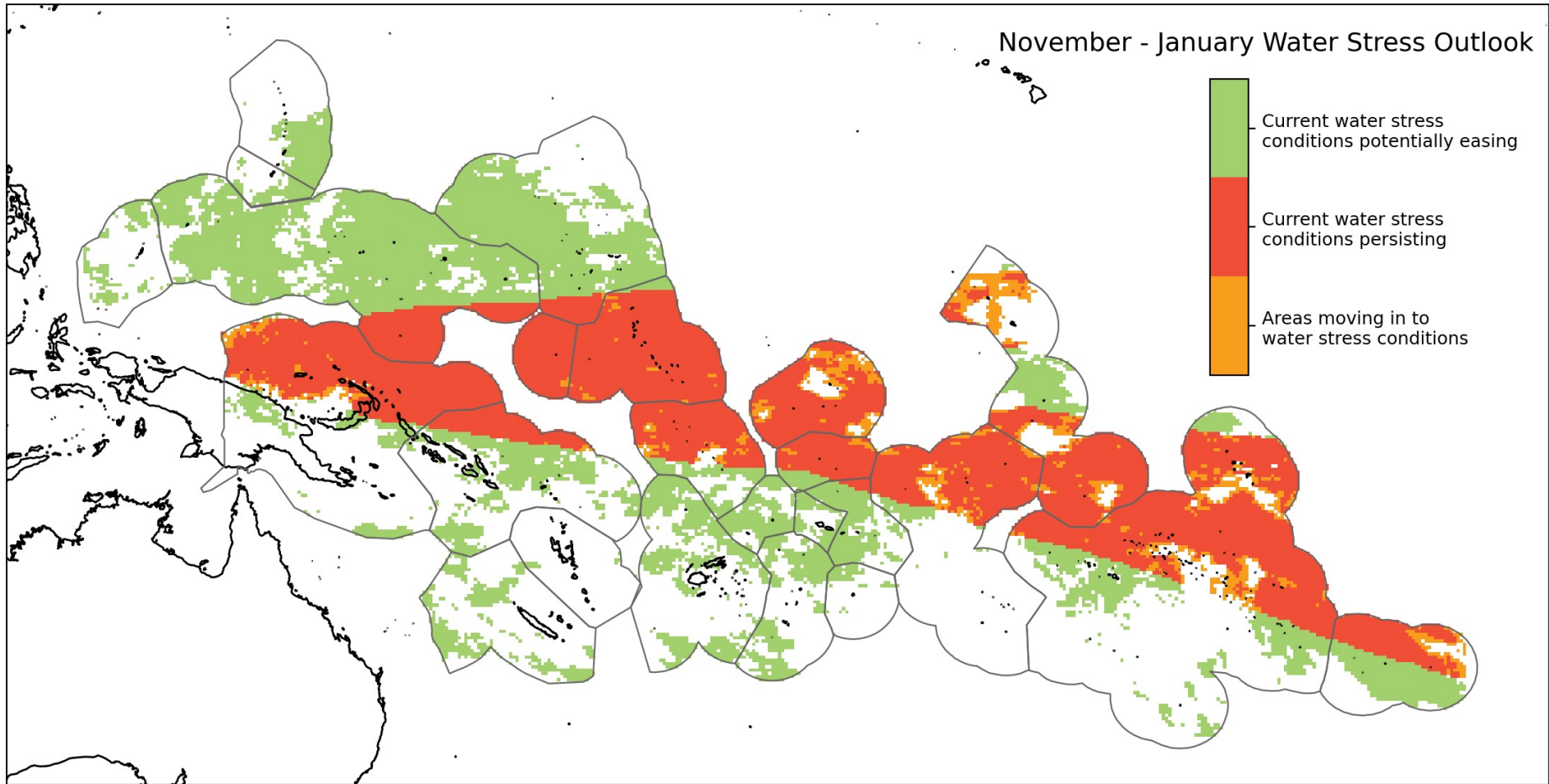


# NIWA Island Climate Update skill scores

- C3S MME vs ERA5 for monthly and seasonal precipitation
- MMEs outperform the best individual models
- Outlooks issued in September – December tend to have the best skill, as influenced by the peak of ENSO events



# ICU "Water Watch" – combines satellite rainfall monitoring with the forecast



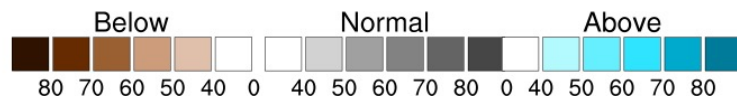
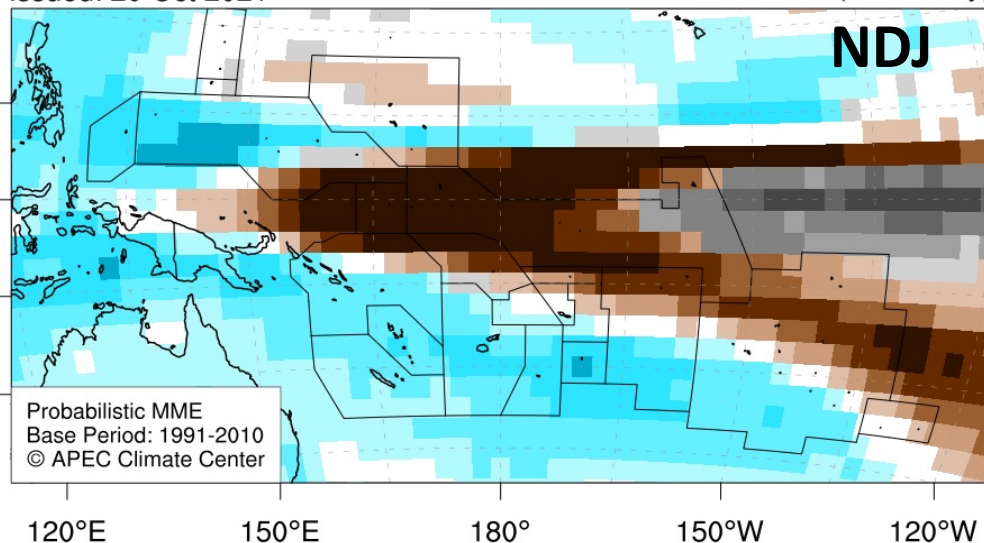


# APCC MME Outlook

**Precipitation : *Wet* SubTr, *Dry* Eq. CP, *Normal* Eq. EP for NDJ**

Issued: 20 Oct 2021

Unit: % (Probability)



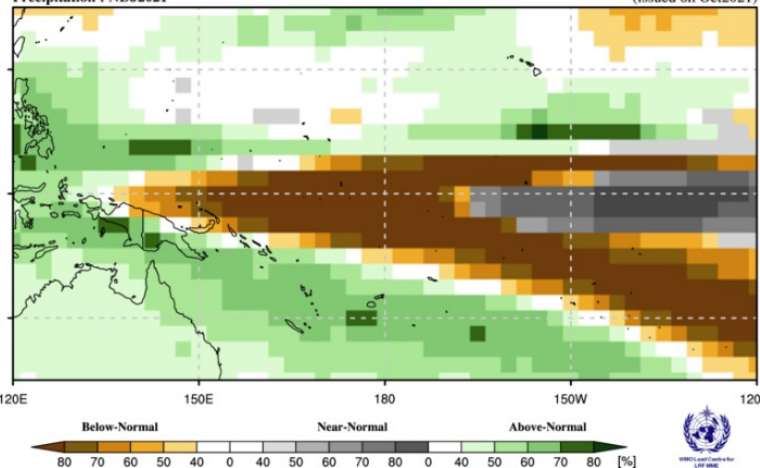
- ✓ APCC: APEC Climate Center
- ✓ BCC: Beijing Climate Center
- ✓ BOM: Bureau of Meteorology
- ✓ CMCC: Centro Euro-Mediterraneo sui Cambiamenti Climatici
- ✓ CWB: Central Weather Bureau
- ✓ HMC: Hydrometeorological Centre of Russia
- ✓ JMA: Japan Meteorological Agency
- ✓ KMA: Korea Meteorological Administration
- ✓ METFR: Météo-France
- ✓ MSC: Meteorological Service of Canada
- ✓ MGO: Voeikov Main Geophysical Observatory
- ✓ NASA: National Aeronautics and Space Administration
- ✓ NCEP: National Centers for Environmental Prediction
- ✓ PNU: Pusan National University
- ✓ UKMO: United Kingdom Met Office

## Probabilistic Multi-Model Ensemble Forecast

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

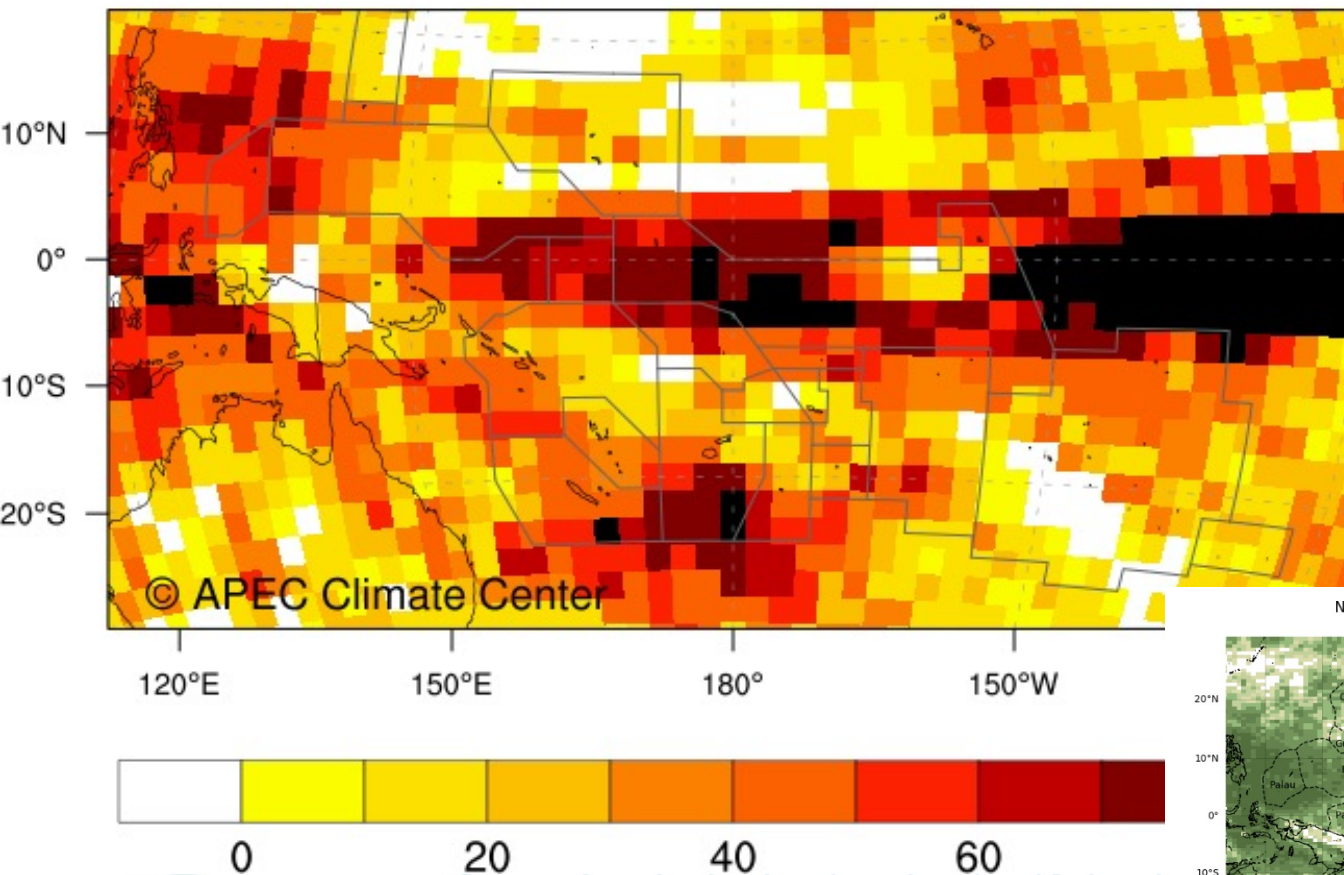
Precipitation : NDJ2021

(issued on Oct2021)

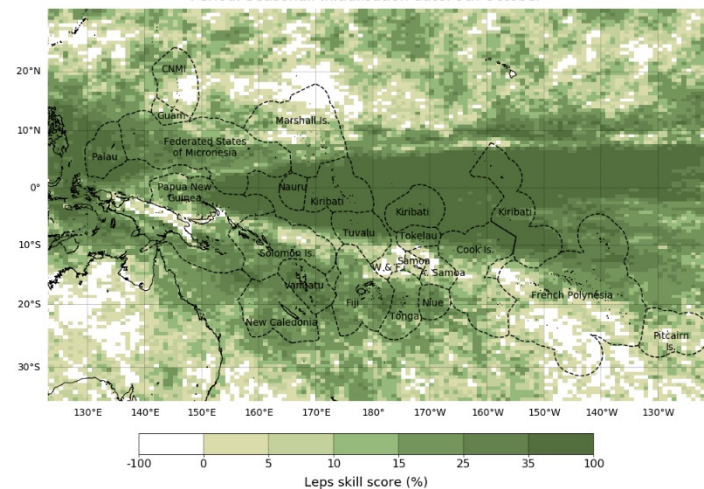


# APCC MME Outlook

## Heidke Skill Score (1991-2010)



NDJ rainfall Linear Error in Probability Space (LEPS) score.  
Period: Seasonal. Initialisation date: 9th October



Source: ACCESS-S1 and ERA5 Climate Reanalysis

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Disclaimer: Contains modified Copernicus Climate Change Service information (2019). Neither the European Commission nor ECMWF is responsible for any use that may be made of the Copernicus information or data it contains. Shapefile data extracted from Flanders Marine Institute (2019). Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (2000M), version 11. Available online at <http://www.marine-geo.org/>.

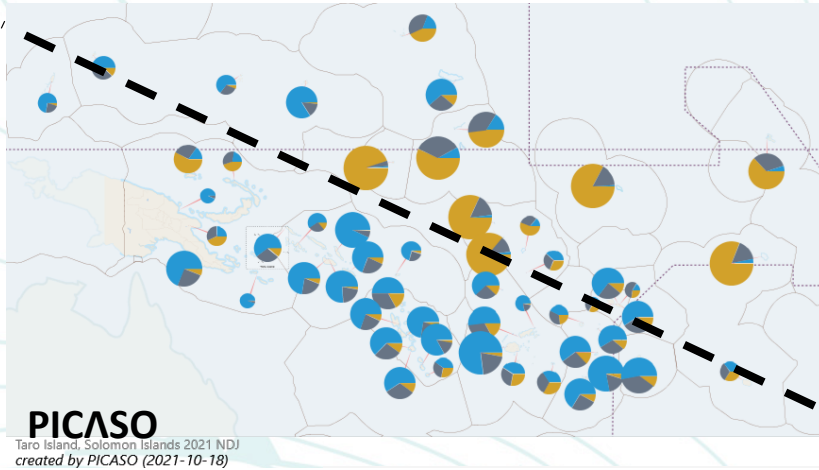
Hindcast period: 1990-2012

Created: 06/05/2021



# PICASO Regional/Local P Outlook

**Wet SubTr, Dry Eq. Pac.**



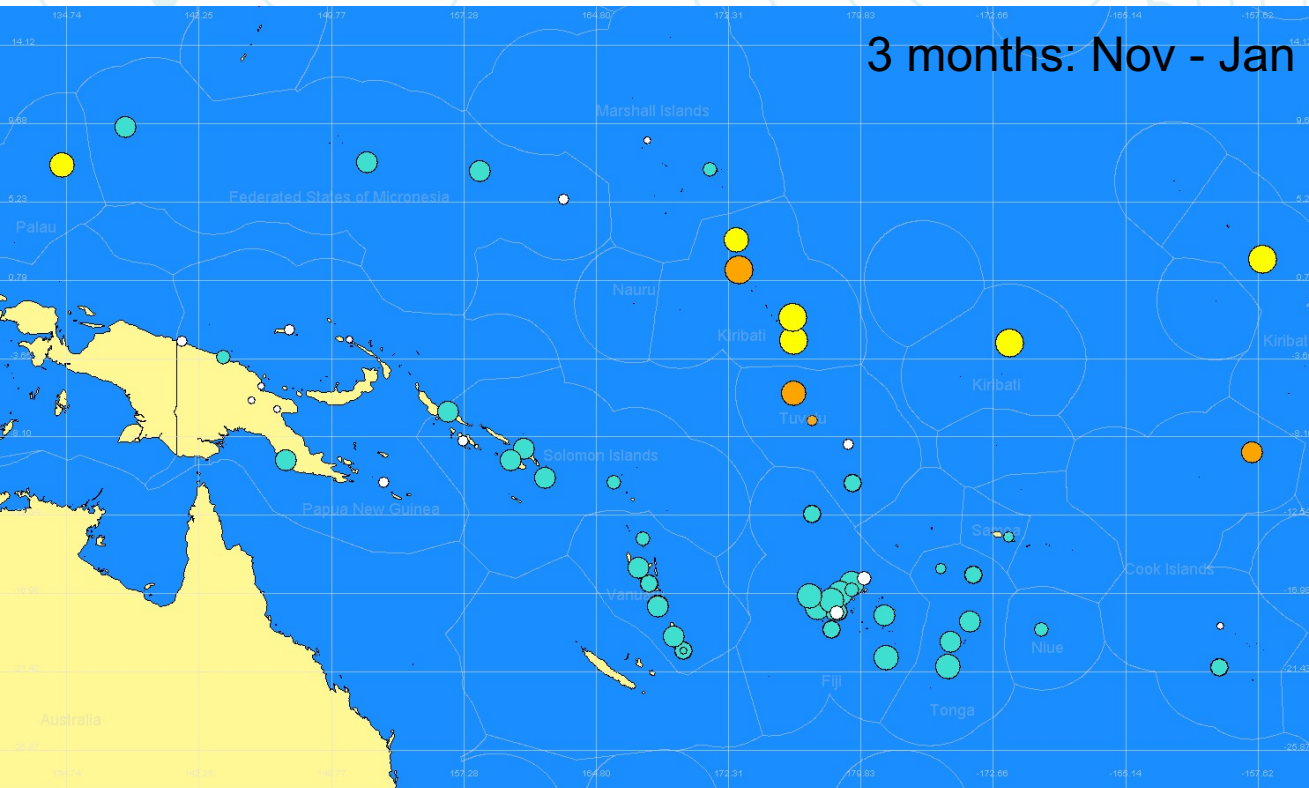
The Equatorial Pacific is expected to have drier than normal conditions (with high reliability) in the next season.

In particular, the probability of drier than normal condition is likely to be greater than 50% in Penrhyn, Kiritimati, Tarawa, Kanton, Nauru, Momote, Nanumea, Nui, Fanufuti.

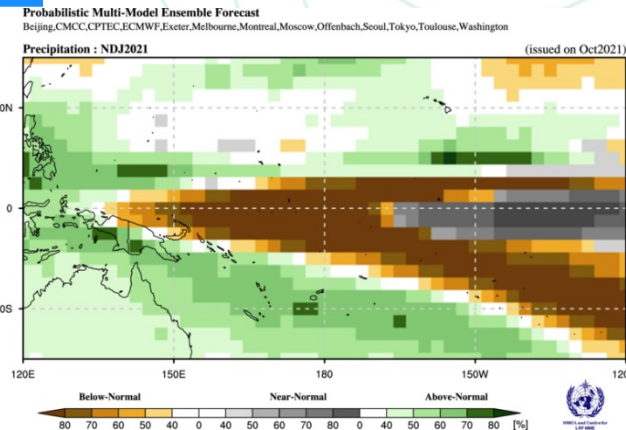
While, the most subtropical islands will experience wetter than normal conditions.

	Cook Islands		Marshall Islands						
<input checked="" type="checkbox"/> Penrhyn	<div><div>81%</div><div>16%</div></div>	<input checked="" type="checkbox"/> Kwajalein Bucholz Aaf	<div><div>43%</div><div>38%</div><div>19%</div></div>	<input checked="" type="checkbox"/> Port Moresby	<div><div>25%</div><div>69%</div></div>	<input checked="" type="checkbox"/> Honiara Henderson	<div><div>21%</div><div>76%</div></div>	<input checked="" type="checkbox"/> Sola (Vanua Lava)	<div><div>17%</div><div>33%</div><div>50%</div></div>
<input checked="" type="checkbox"/> Rarotonga	<div><div>34%</div><div>31%</div><div>35%</div></div>	<input checked="" type="checkbox"/> Majuro	<div><div>11%</div><div>28%</div><div>61%</div></div>	<input checked="" type="checkbox"/> Momote	<div><div>58%</div><div>27%</div><div>15%</div></div>	<input checked="" type="checkbox"/> Kira Kira	<div><div>7%</div><div>24%</div><div>69%</div></div>	<input checked="" type="checkbox"/> Pekoa Airport (Santo)	<div><div>7%</div><div>24%</div><div>69%</div></div>
	Fiji		Micronesia	<input checked="" type="checkbox"/> Nadzab	<div><div>43%</div><div>32%</div><div>25%</div></div>	<input checked="" type="checkbox"/> Santa Cruz	<div><div>23%</div><div>72%</div></div>	<input checked="" type="checkbox"/> Lamap (Malekula)	<div><div>22%</div><div>73%</div></div>
<input checked="" type="checkbox"/> Rotuma	<div><div>12%</div><div>26%</div><div>62%</div></div>	<input checked="" type="checkbox"/> Chuuk WSO AP	<div><div>6%</div><div>29%</div><div>65%</div></div>	<input checked="" type="checkbox"/> Kavieng	<div><div>45%</div><div>33%</div><div>22%</div></div>		Tonga	<input checked="" type="checkbox"/> Bauerfield (Efate)	<div><div>10%</div><div>27%</div><div>63%</div></div>
<input checked="" type="checkbox"/> Udu Point	<div><div>19%</div><div>78%</div></div>	<input checked="" type="checkbox"/> Pohnpei	<div><div>14%</div><div>84%</div></div>	<input checked="" type="checkbox"/> Misima	<div><div>94%</div></div>	<input checked="" type="checkbox"/> Niuafoou	<div><div>23%</div><div>34%</div><div>43%</div></div>	<input checked="" type="checkbox"/> Port Vila	<div><div>10%</div><div>31%</div><div>59%</div></div>
<input checked="" type="checkbox"/> Nabouwalu	<div><div>17%</div><div>31%</div><div>52%</div></div>	<input checked="" type="checkbox"/> Yap Island WSO Airport	<div><div>12%</div><div>35%</div><div>53%</div></div>		Samoa	<input checked="" type="checkbox"/> KeppelMata'aho Airport	<div><div>11%</div><div>30%</div><div>59%</div></div>	<input checked="" type="checkbox"/> White Grass Airport	<div><div>14%</div><div>83%</div></div>
<input checked="" type="checkbox"/> Nadi Airport	<div><div>20%</div><div>77%</div></div>		Nauru	<input checked="" type="checkbox"/> Afiamalu	<div><div>12%</div><div>29%</div><div>59%</div></div>	<input checked="" type="checkbox"/> Lupepau'u	<div><div>13%</div><div>27%</div><div>60%</div></div>	<input checked="" type="checkbox"/> Aneityum	<div><div>28%</div><div>32%</div><div>40%</div></div>
<input checked="" type="checkbox"/> Suva	<div><div>28%</div><div>31%</div><div>41%</div></div>	<input checked="" type="checkbox"/> Nauru	<div><div>95%</div></div>	<input checked="" type="checkbox"/> Laulii	<div><div>27%</div><div>57%</div><div>16%</div></div>	<input checked="" type="checkbox"/> Haapai	<div><div>17%</div><div>78%</div></div>		
<input checked="" type="checkbox"/> Ono I Lau	<div><div>33%</div><div>33%</div><div>34%</div></div>		Niue	<input checked="" type="checkbox"/> Faleolo	<div><div>33%</div><div>32%</div><div>35%</div></div>	<input checked="" type="checkbox"/> Nuku'alofa	<div><div>8%</div><div>26%</div><div>66%</div></div>		
	Kiribati	<input checked="" type="checkbox"/> Hanan Airport	<div><div>10%</div><div>37%</div><div>53%</div></div>	<input checked="" type="checkbox"/> Apia	<div><div>11%</div><div>24%</div><div>65%</div></div>		Tuvalu		
<input checked="" type="checkbox"/> Kiritimati	<div><div>63%</div><div>32%</div><div>5%</div></div>		Palau		Solomon Islands	<input checked="" type="checkbox"/> Nanumea	<div><div>82%</div><div>16%</div></div>		
<input checked="" type="checkbox"/> Butaritari	<div><div>48%</div><div>36%</div><div>16%</div></div>	<input checked="" type="checkbox"/> Koror	<div><div>23%</div><div>72%</div></div>	<input checked="" type="checkbox"/> Taro Island	<div><div>11%</div><div>29%</div><div>60%</div></div>	<input checked="" type="checkbox"/> Nui	<div><div>86%</div><div>12%</div></div>		
<input checked="" type="checkbox"/> Tarawa	<div><div>57%</div><div>35%</div><div>8%</div></div>		Papua New Guinea	<input checked="" type="checkbox"/> Munda	<div><div>14%</div><div>27%</div><div>59%</div></div>	<input checked="" type="checkbox"/> Funafuti	<div><div>56%</div><div>30%</div><div>14%</div></div>		
<input checked="" type="checkbox"/> Kanton	<div><div>83%</div><div>16%</div></div>	<input checked="" type="checkbox"/> Madang	<div><div>93%</div></div>	<input checked="" type="checkbox"/> Auki	<div><div>93%</div></div>	<input checked="" type="checkbox"/> Niulakita	<div><div>31%</div><div>31%</div><div>38%</div></div>		
				<input checked="" type="checkbox"/> Honiara	<div><div>21%</div><div>73%</div></div>		Vanuatu		

# SPREP SCOPIC (statistical model)



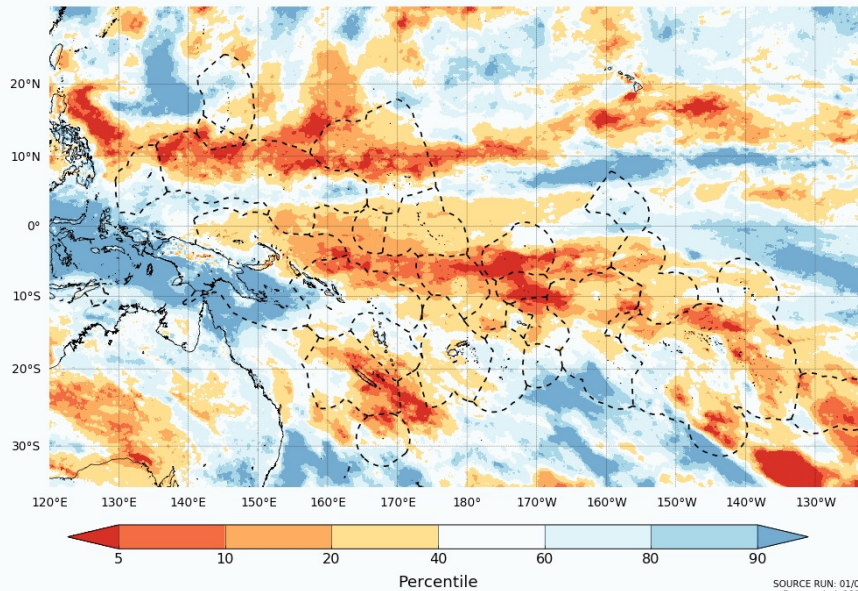
- SCOPIC using August + September NINO3.4 SSTa as predictor
- Not taking into account October ENSO conditions or ENSO forecast





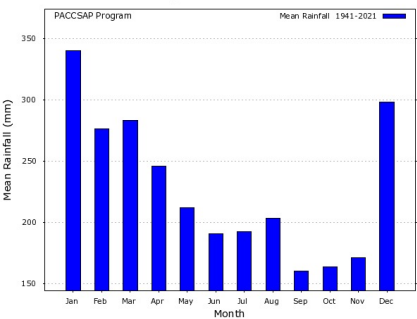
# Areas of greatest concern

3-month Percentile to end of September 2021

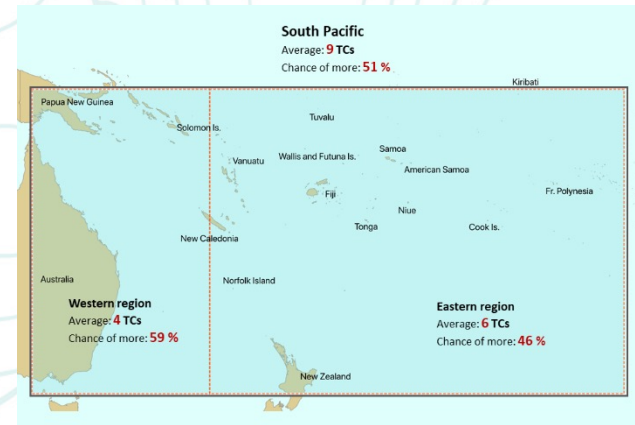
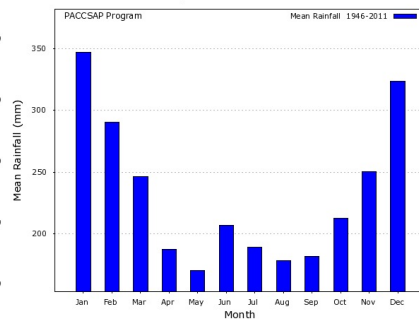


Supported by Climate and Oceans Support Program in the Pacific  
© Commonwealth of Australia 2021, Australian Bureau of Meteorology  
Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.maritimeresources.org/>

Monthly mean rainfall - Nanumea



Monthly mean rainfall - Nukunono

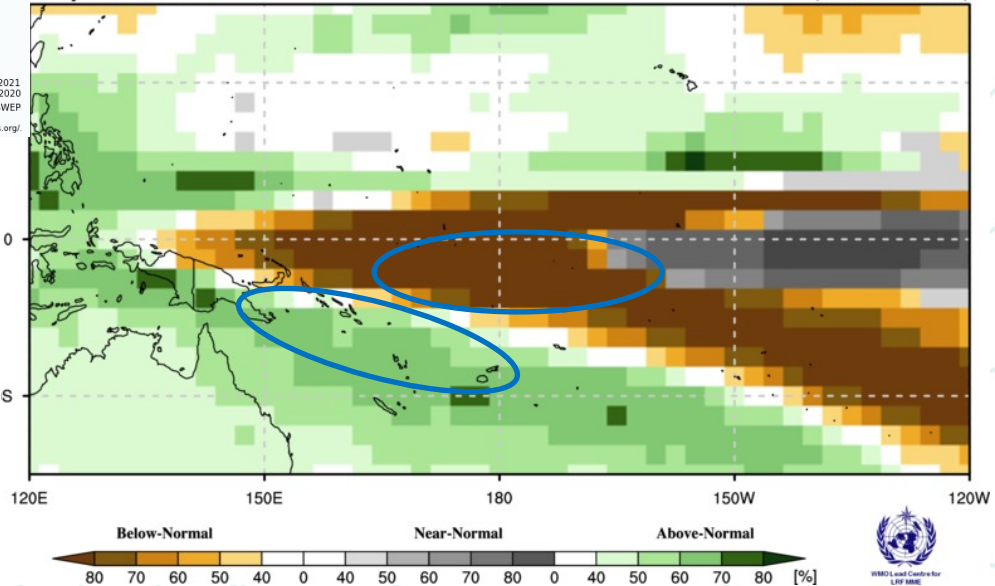


## Probabilistic Multi-Model Ensemble Forecast

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

## Precipitation : NDJ2021

(issued on Oct2021)



# Rainfall Outlook Feb-Apr 2022

- WMO LC MME has a limited number of dynamical models available (Beijing, Montreal, Seoul, Washington)
- APCC MME
- SCOPIC
- Warning! Skill not great for this period, but useful early indication of likely conditions. Obtain updates as they become available.



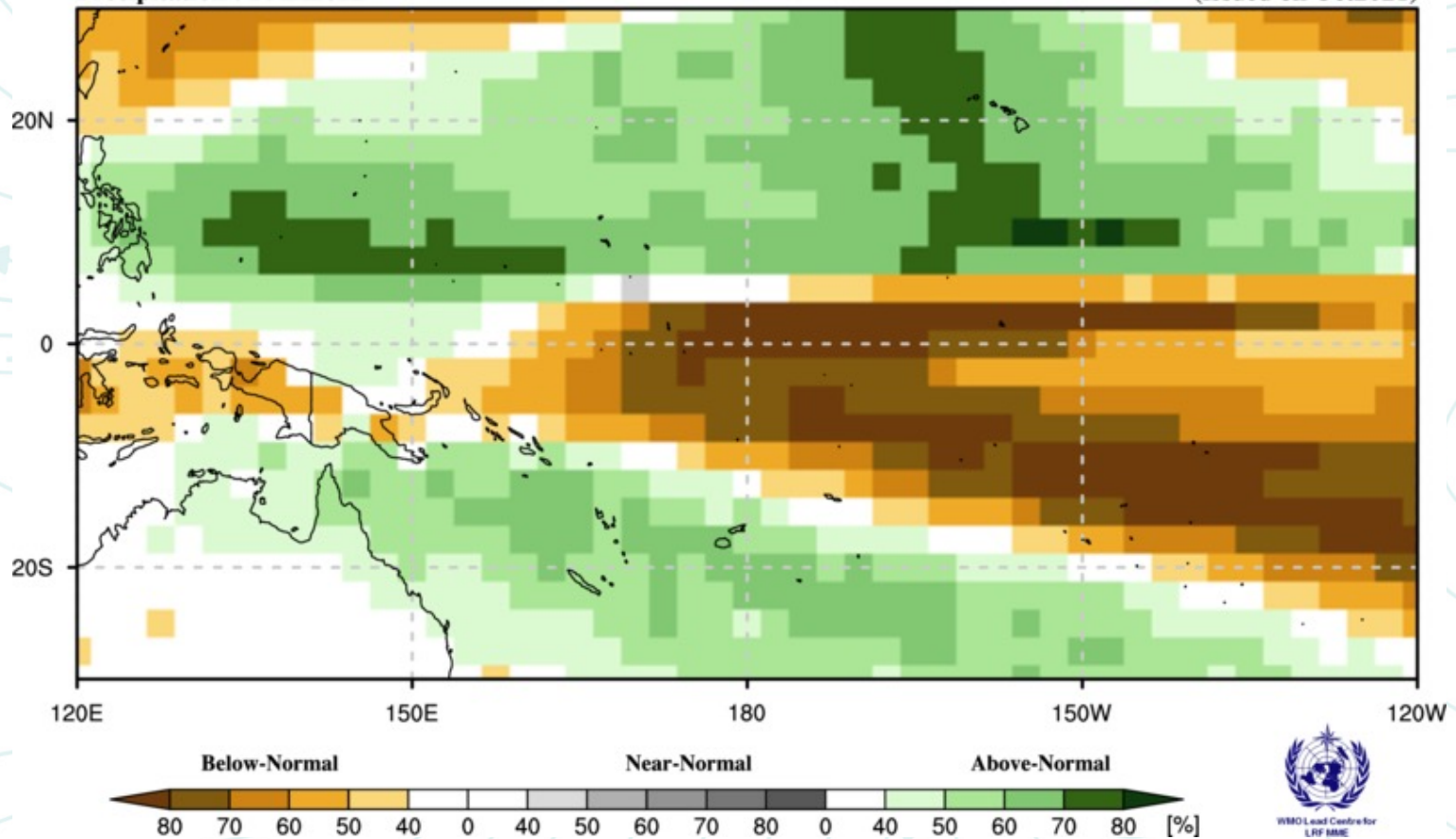
# WMO Lead Centre for LRF MME

## Probabilistic Multi-Model Ensemble Forecast

Beijing, Montreal, Seoul, Washington

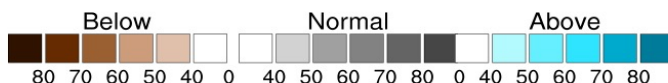
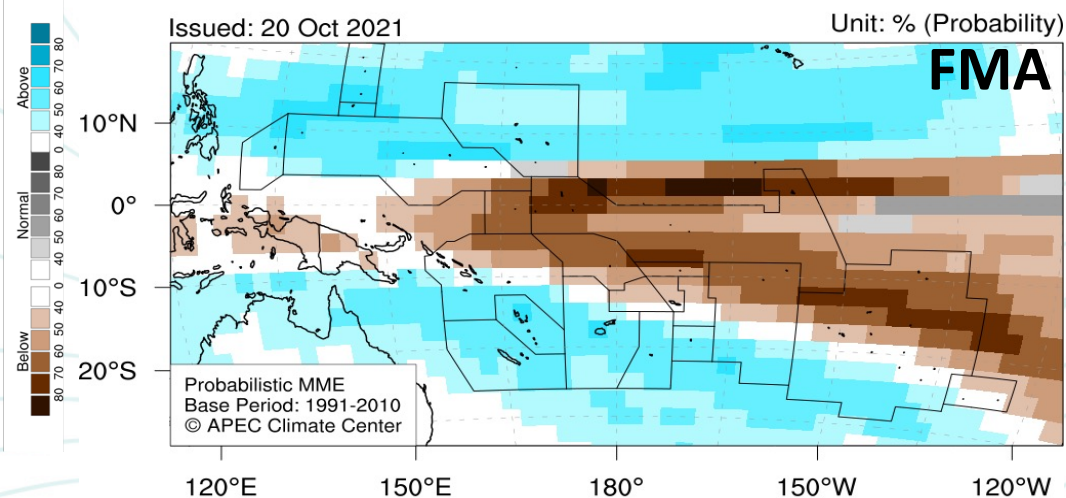
Precipitation : FMA2022

(issued on Oct2021)



# APCC MME Outlook

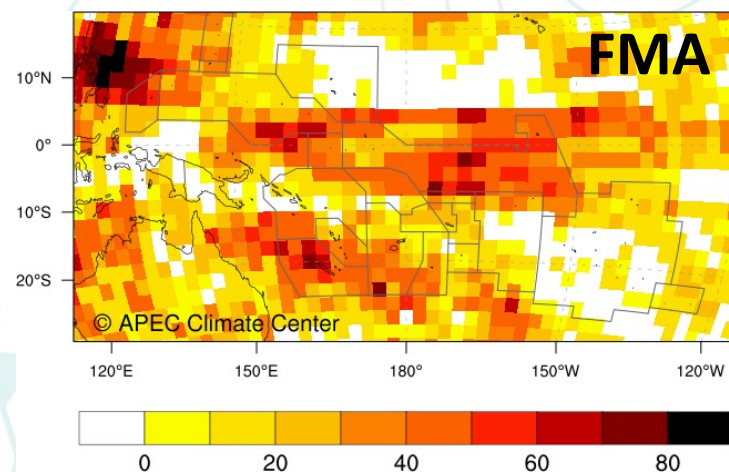
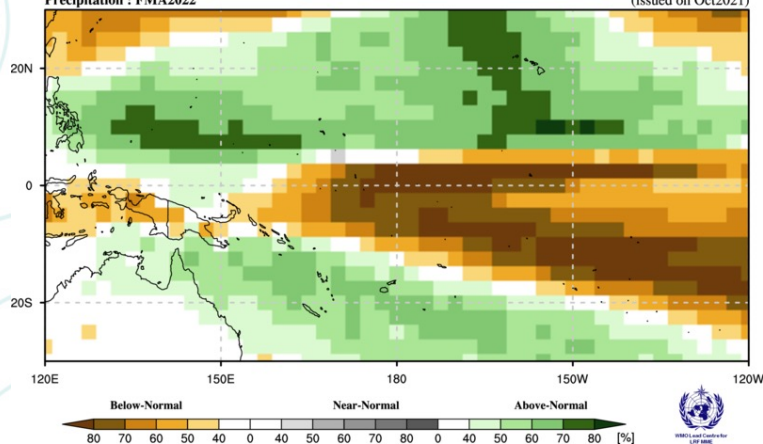
Precipitation for February-April 2022



Probabilistic Multi-Model Ensemble Forecast  
Beijing, Montreal, Seoul, Washington

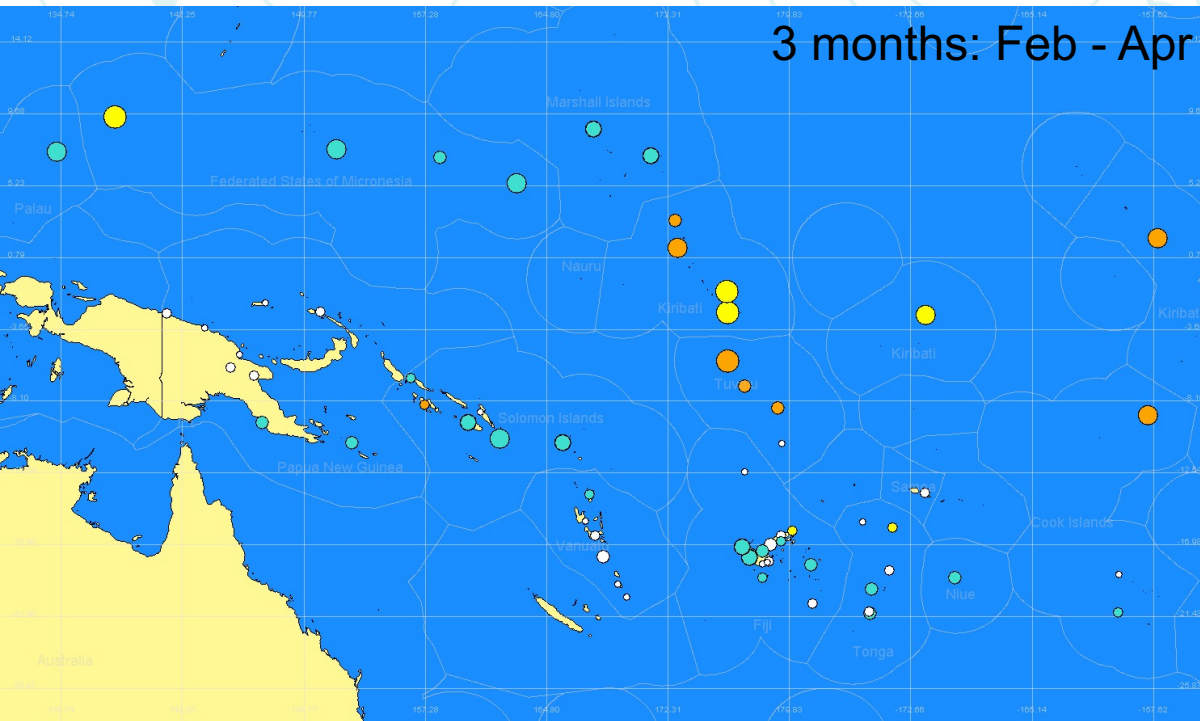
Precipitation : FMA2022

(issued on Oct2021)





# SPREP SCOPIC (statistical model)

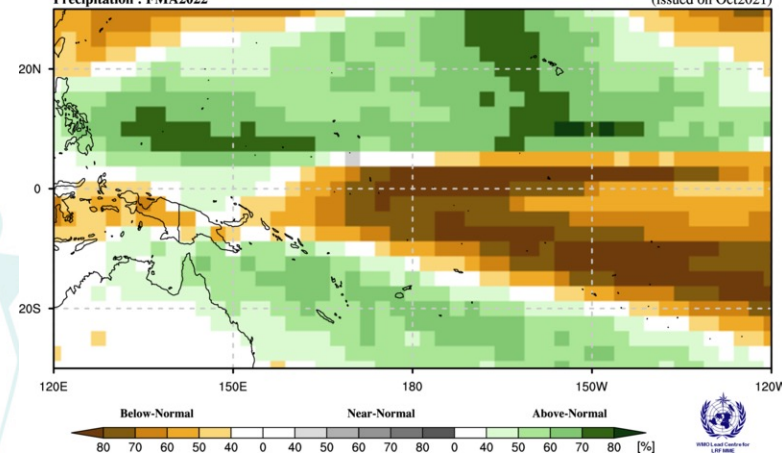


## Probabilistic Multi-Model Ensemble Forecast

Beijing, Montreal, Seoul, Washington

Precipitation : FMA2022

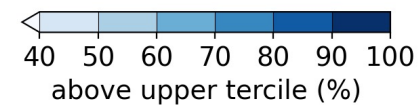
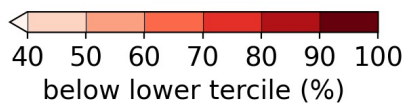
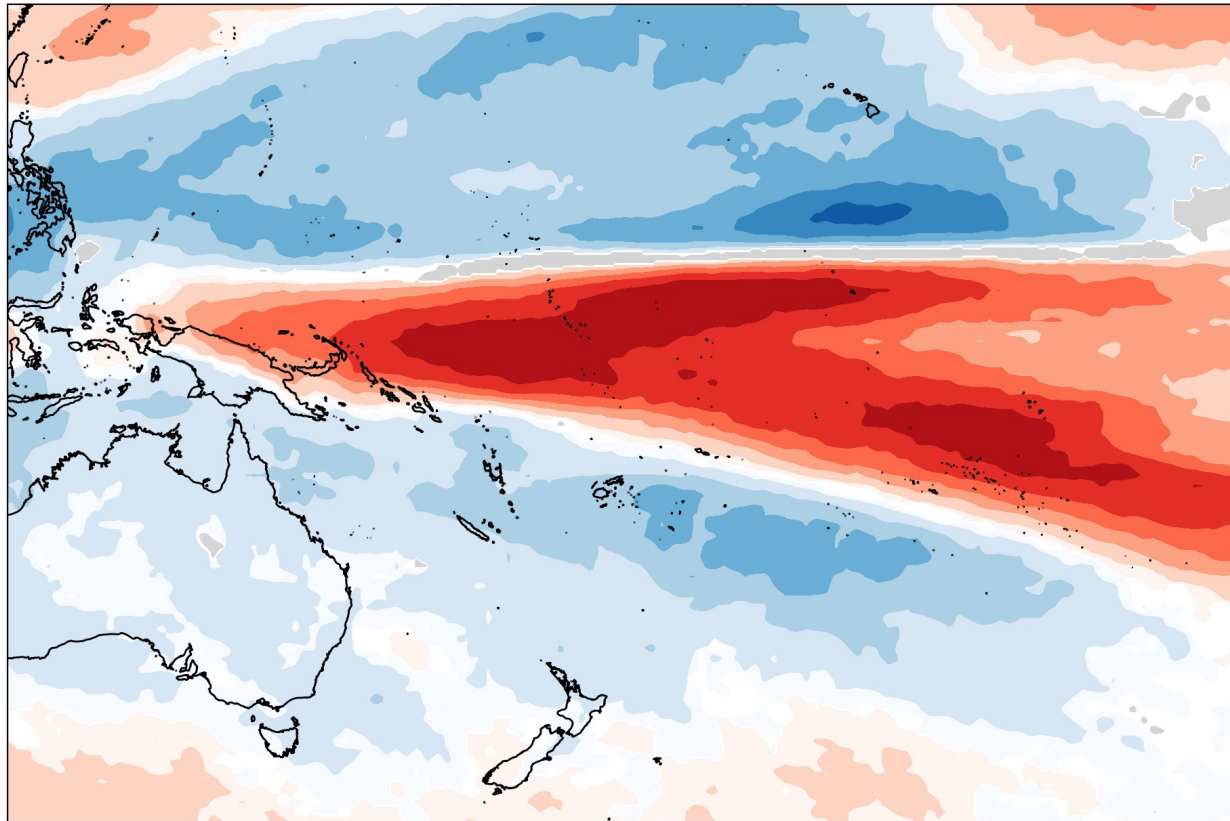
(issued on Oct2021)



# NIWA ICU: most likely precipitation category over the coming seasons



C3S MME, Prob(most likely category of precipitation)  
January - March





The background of the slide is a light blue map featuring contour lines and wind vectors. The contour lines are thin, light blue lines that curve across the map, representing lines of equal value. The wind vectors are represented by small, light blue arrows of varying lengths, indicating the direction and relative strength of the wind. The overall pattern suggests a meteorological or oceanographic context.

# Air Temperature, MSLP and Wind Outlooks Nov-Jan 2022

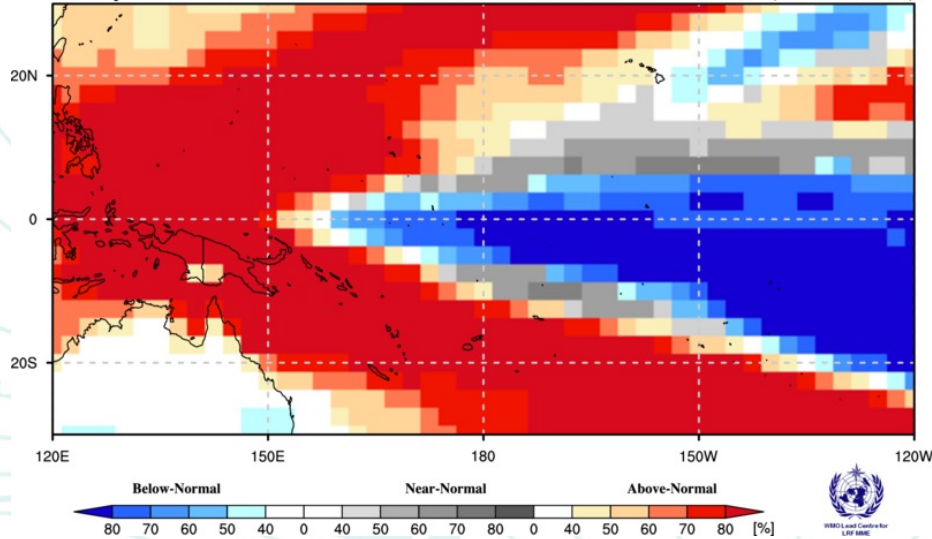
# WMO LC Centre LRF MME

## Probabilistic Multi-Model Ensemble Forecast

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

2m Temperature : NDJ2021

(issued on Oct2021)

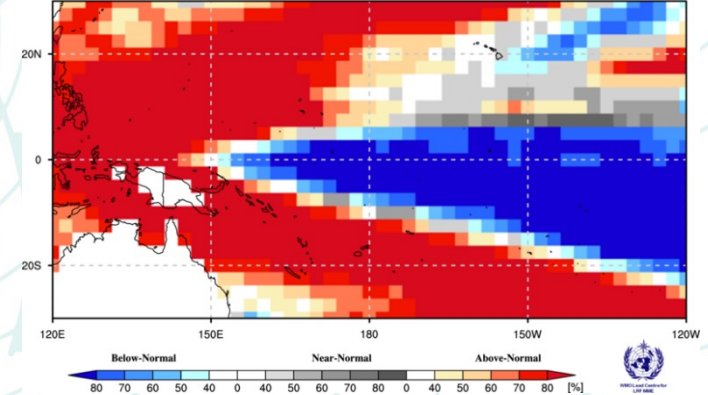


## Probabilistic Multi-Model Ensemble Forecast

Beijing, CMCC, ECMWF, Exeter, Melbourne, Montreal, Moscow, Offenbach, Seoul, Tokyo, Toulouse, Washington

Sea Surface Temperature : NDJ2021

(issued on Oct2021)

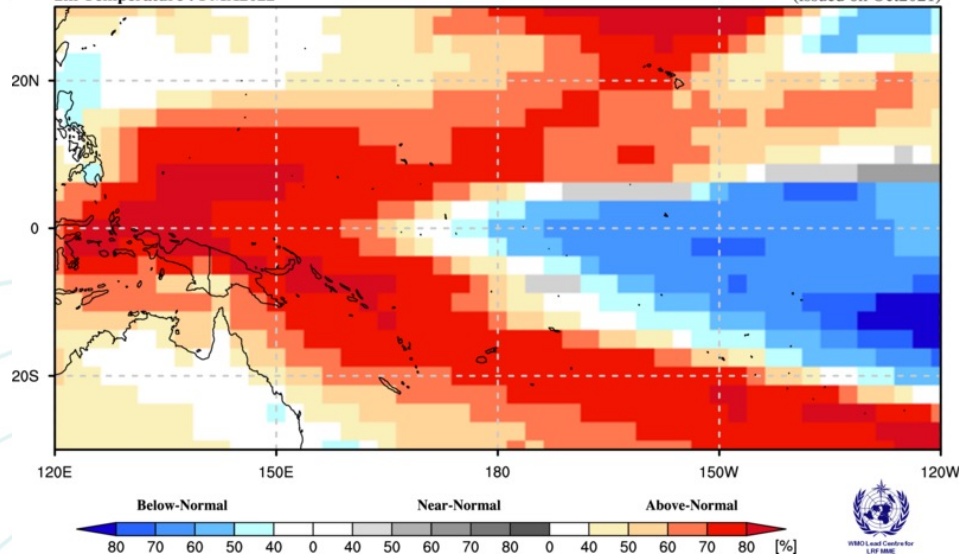


## Probabilistic Multi-Model Ensemble Forecast

Beijing, Montreal, Seoul, Washington

2m Temperature : FMA2022

(issued on Oct2021)

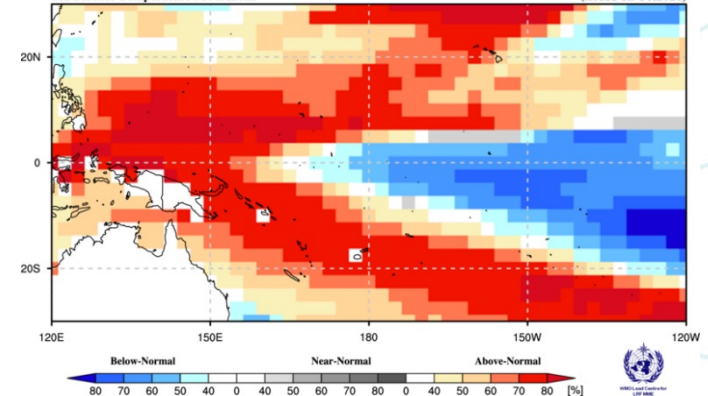


## Probabilistic Multi-Model Ensemble Forecast

Beijing, Montreal, Seoul, Washington

Sea Surface Temperature : FMA2022

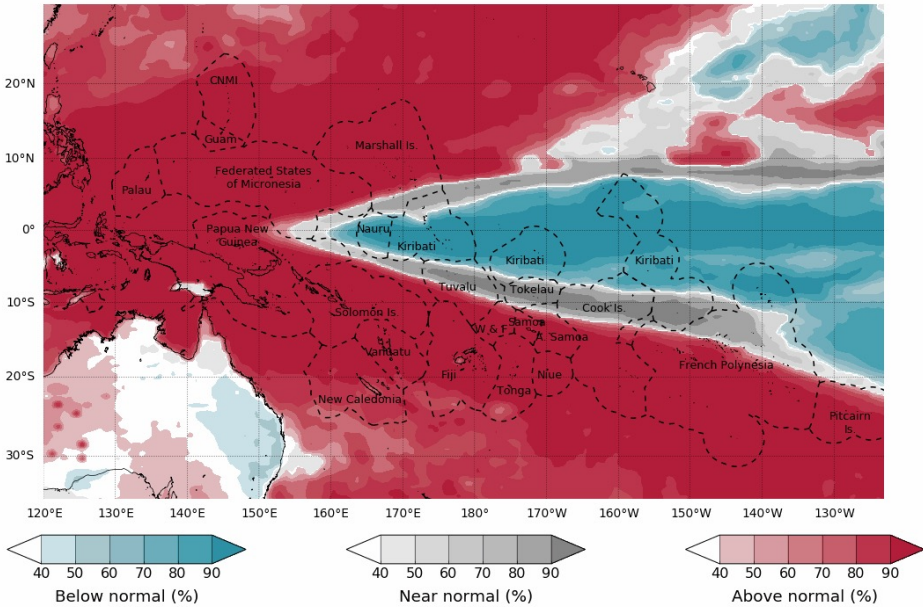
(issued on Oct2021)





# Melbourne ACCESS-S

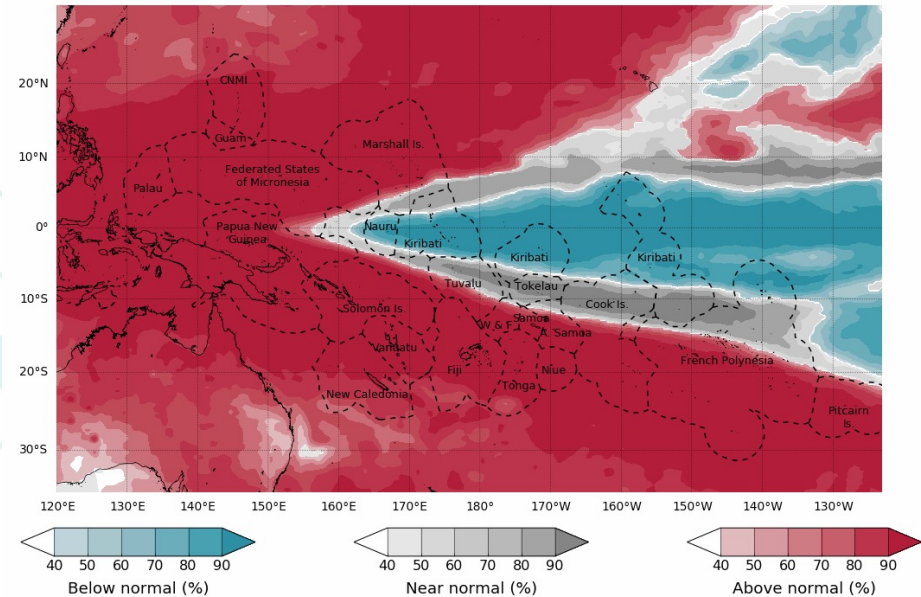
Tercile maximum temperature probabilities for  
November 2021 to January 2022



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Model: ACCESS-S1 Model run: 11/10/2021  
Base period: 1990-2012 Issued: 14/10/2021  
Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.marinerregions.org/>.

Tercile minimum temperature probabilities for  
November 2021 to January 2022

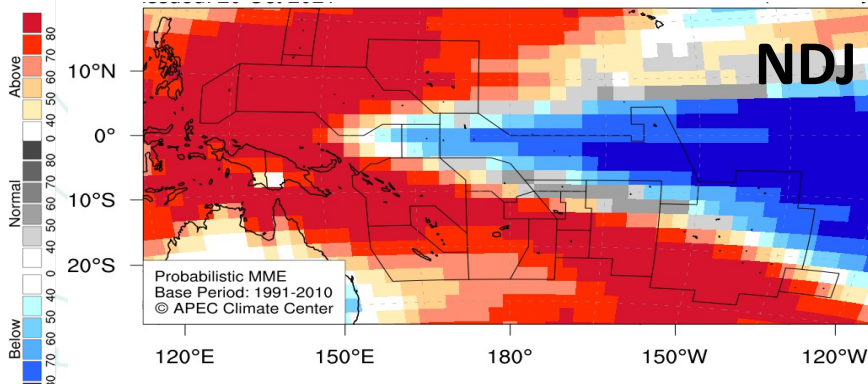


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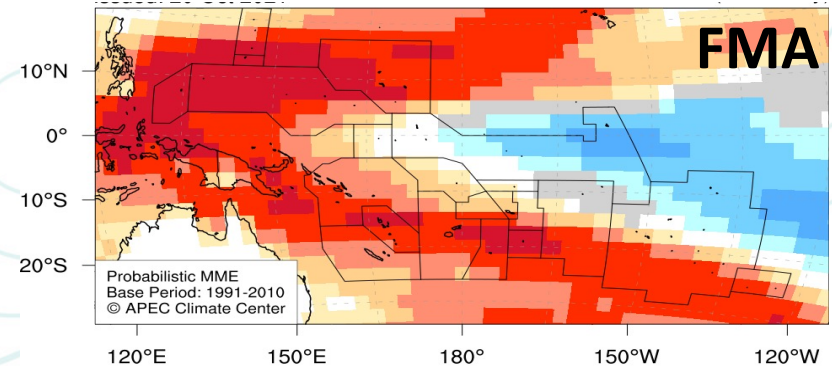
Model: ACCESS-S1 Model run: 11/10/2021  
Base period: 1990-2012 Issued: 14/10/2021  
Shapefile data extracted from Flanders Marine Institute (2019), Maritime Boundaries Geodatabase: Maritime Boundaries and Exclusive Economic Zones (200NM), version 11. Available online at <http://www.marinerregions.org/>.

# APCC MME Regional T Outlook

**Temperature: *Warm* WP - SubTr, *Cool* EP**

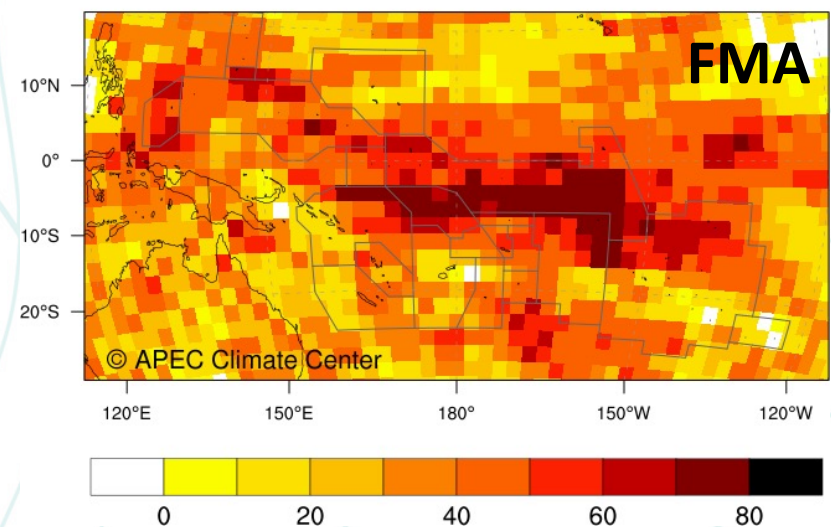
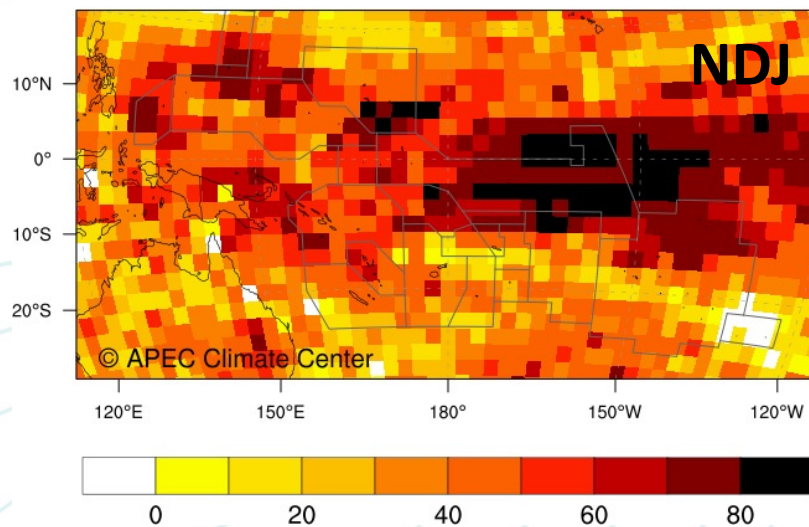


**Temperature: *Warm* WP - SubTr, *Slightly Cool* EP**



Hotter than normal conditions are expected in many of the islands located along the ITCZ/SPC axis in the next two seasons, particularly during NDJ. On the hand, the eastern Pacific is expected to be within the cooler than normal condition.

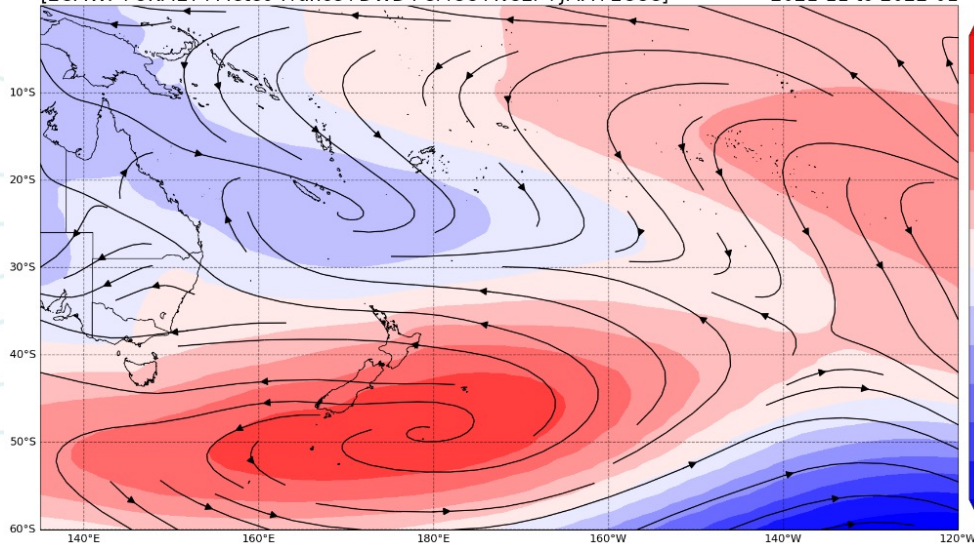
**Heidke Skill Score (1991-2010)**





# MSLP and Air flow

C3S Mean Sea Level Pressure (hPa) & Air Flow Anomalies  
[ECMWF+UKMET+Météo-France+DWD+CMCC+NCEP+JMA+ECCC] 2021-11 to 2022-01



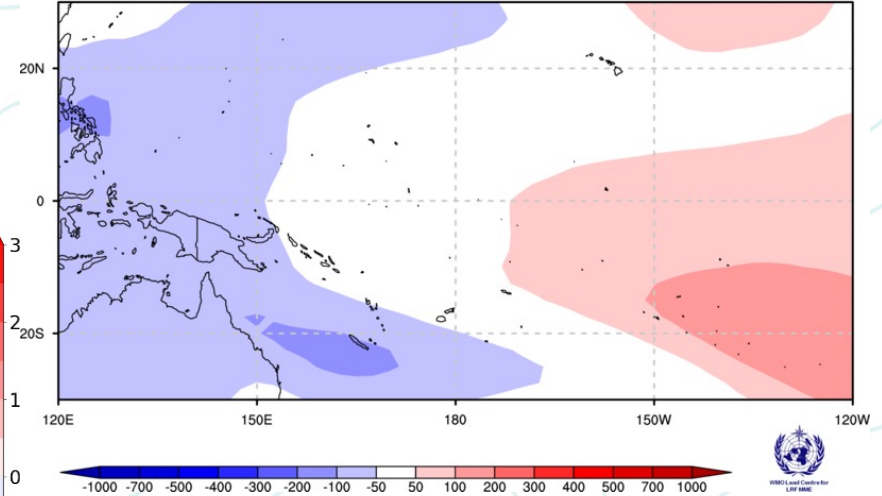
Simple Composite Map

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

[Unit : Pa]

Mean Sea Level Pressure : NDJ2021

(issued on Oct2021)



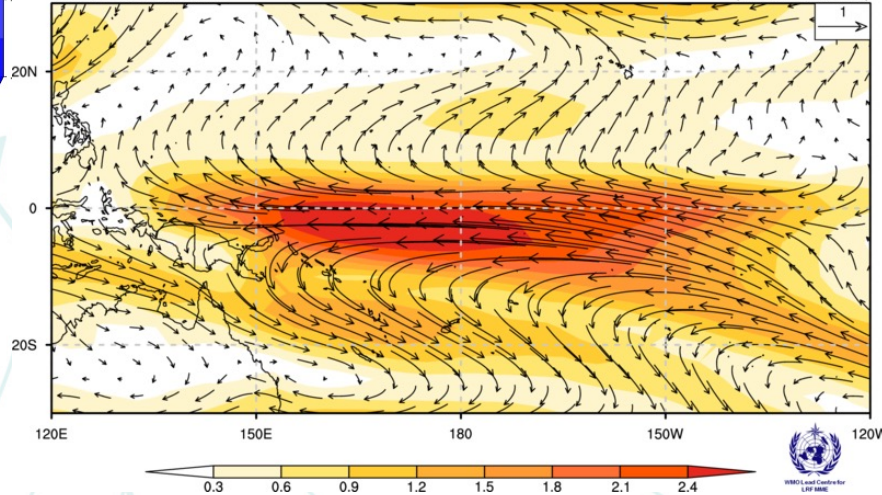
Simple Composite Map

Beijing,ECMWF,Exeter,Melbourne,Montreal,Moscow,Tokyo,Toulouse

[Unit : m/s]

850hPa Wind : NDJ2021

(issued on Oct2021)



# Summary paragraphs

- The transition from neutral to a La Niña-like ENSO state is evident in the rainfall, air temperature and wind seasonal outlooks for November 2021 to January 2022 and February to April 2022. The outlooks are largely consistent with conditions experienced over the same period in the past when a La Niña-like ENSO state has been present.
- Drier than normal conditions are favoured for island groups near and west of the Dateline that are located close to the equator (excluding the area west of New Guinea). The expanse of drier than normal conditions extends northeast and southeast from the dateline towards the subtropics (Fig X). Islands in this region that have experienced low rainfall during or since the last La Niña event are likely to continue to experience these conditions. Forecast confidence for this region is high. Wetter than normal conditions are favoured for islands located between Palau and the central Marshall Islands in the north Pacific and southeast PNG to southernmost French Polynesia in the South Pacific. Forecast confidence for this region is moderate to high. A similar pattern is favoured for February to April 2020 with minor differences. Consistent with signs of a La Nina event maturity and declining, the chances of drier than normal conditions ease near and west of the dateline. The chances of wetter than normal conditions also ease in the South Pacific but become stronger and are more extensive in the north Pacific.
- Associated with ocean surface temperature patterns, warmer than normal air temperatures are expected for many island groups, particularly in the western equatorial Pacific, extending northeast and southeast towards the subtropics (Fig. 2). Cooler than normal air temperatures are more likely closer to and off the equator near and east of the Dateline. The air temperature outlook pattern for February to April 2022 period is similar but less emphatic.
- Wind outlooks show a stronger than normal easterly air flow along the equator over November to January with a larger than normal flow of warm and moist air into the northern and southern hemisphere in the western Pacific. This pattern is consistent with the warmer and wetter outlook presented above.