

Seasonal Rainfall Forecasting Day Introduction

**PREPARE Drought and Flood Early Warning for Pacific Islands
Training Workshop
Nadi, Fiji, 15-20 July 2024**

Dr. Katie Kowal

NOAA/CPC/International Desks

17 July 2024



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**How useful do you think
seasonal forecasts are?**

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Points of discussion - how can we complement existing seasonal climate tools?



Monthly to Seasonal Climate Outlooks

VANUATU CLIMATE UPDATE
Vanuatu Meteorology and Geo-Hazard Department

CLIMATE SUMMARY
Overall Vanuatu: Variable to locally heavy rain with moderate to strong winds.

5 MAINS IMPACTS, APTI/LEU, JARI, KAMBI, KOU, SOU

SOLOMON ISLANDS REGIONAL CLIMATE OUTLOOK
(November 2023 - January 2024)

CLIMATE SUMMARY MARCH 2024
Samoa Meteorological Division
Ministry of Natural Resources and Environment

Station	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Apia	100	120	150	180	200	220	240	260	280	300

Impact-based bulletins

VANUATU AoroMet Bulletin
Current ENSO Status: Neutral

July Climate Bulletin for Tourism
ENSO status is now in the Niño Weak, indicating a neutral ENSO state.

KIRIBATI OCEAN OUTLOOK
Issued: 04 April 2024

Summary
Sea surface temperature is likely to decrease at most of the Kiribati group.

Ocean, ENSO-focused Outlooks

Solomon Islands Ocean Bulletin
Issue date: 20 November 2023

Climate Summary
ENSO status continues to remain in the neutral phase.

Seasonal Climate Outlook for Samoa
May to July 2024

Early Action Rainfall Watches

Tuvalu Early Action Rainfall Watch (EAR Watch) for May to July 2024

The EAR Watch provides disaster managers with a tool summary of recent rainfall patterns, particularly drought and the rainfall outlook for the coming months.

Fiji Meteorological Service Early Action Rainfall Watch (EAR Watch) for May to July 2024

The EAR Watch provides disaster managers with a tool summary of recent rainfall patterns, particularly drought and the rainfall outlook for the coming months.

FJI CLIMATE OUTLOOK
JULY 2024; JULY TO SEPTEMBER 2024; OCTOBER TO DECEMBER 2024

Tuvalu Meteorological Service Work, Infrastructure, Development and Water EAR Watch for March to May 2024

The EAR Watch provides disaster managers with a tool summary of recent rainfall patterns, particularly drought and the rainfall outlook for the coming months.

Niue Southern Oscillation (ENSO) Outlook for May to July 2024

ENSO status is now in the Niño Weak, indicating a neutral ENSO state.

Tuvalu Ocean Outlook for May 2024
Samoa Meteorological Division

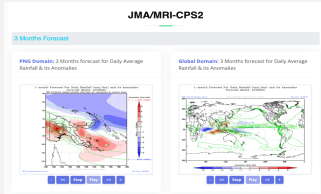
Summary
Sea surface temperature is likely to decrease at most of the Tuvalu group.

Vanuatu Ocean Outlook for May 2024
Samoa Meteorological Division

Summary
Sea surface temperature is likely to decrease at most of the Vanuatu group.



Points of discussion - how can we complement existing seasonal climate tools?

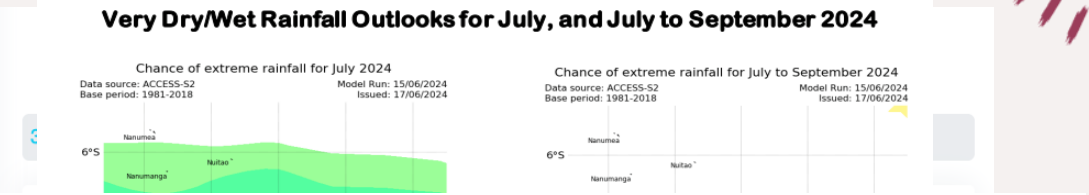
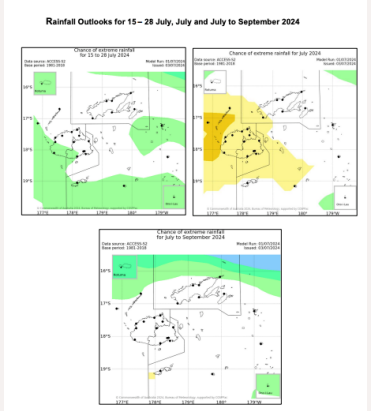


KIRIBATI CLIMATE OUTLOOK APRIL TO JUNE 2024

Issued: 5th April 2024

Summary

- The temperature in the tropical Pacific Ocean has been cooling since December 2023.
- The El Niño continues and anticipated to return to Neutral conditions by the end of April to May 2024.
- The Madden Julian Oscillation is expected to active (more rainfall) over the Pacific region including Kiribati in mid-April.
- Rainfall Outlook for April to June 2024 is likely to above normal for all islands of Kiribati.
- The forecast for air temperature from April to June 2024 is predicted to be above normal across the Kiribati Islands.



- Today's session goals
- (1) Improve understanding of existing regional seasonal forecasting products
 - (2) Support dialogue across islands on monitoring and forecast tools
 - (3) Share some NOAA CPC International Desk approaches to seasonal forecasts
 - (4) Collaborate to develop some seasonal forecasts using some common bias correction techniques during our practical session

location and season.

Contact Tuvalu Meteorological Service for further information:
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website: tuvmet.tv, Facebook: <Tuvalu Meteorological Service>

VANUATU CLIMATE UPDATE
Vanuatu Meteorology and Geo-Hazard Department

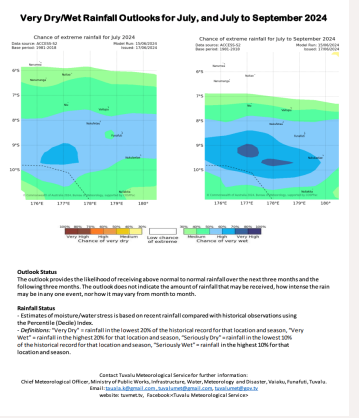
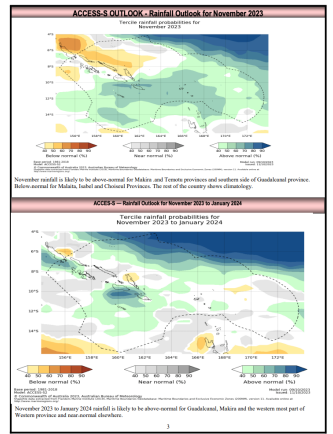
ENSO ANALYSIS

ENSO ANALYSIS
ENSO Cycle: Neutral
Phase: Neutral

3 MONTHS RAINFALL OUTLOOK: JULY TO SEPTEMBER 2024

ENSO ANALYSIS
ENSO Cycle: Neutral
Phase: Neutral

GENERAL LUNGLUK
Southern Oscillation Index: 30, 60, 90
Sea Surface Temperature (SST): 28.5, 27.5, 26.5, 25.5, 24.5, 23.5, 22.5, 21.5, 20.5, 19.5, 18.5, 17.5, 16.5, 15.5, 14.5, 13.5, 12.5, 11.5, 10.5, 9.5, 8.5, 7.5, 6.5, 5.5, 4.5, 3.5, 2.5, 1.5, 0.5, -0.5, -1.5, -2.5, -3.5, -4.5, -5.5, -6.5, -7.5, -8.5, -9.5, -10.5, -11.5, -12.5, -13.5, -14.5, -15.5, -16.5, -17.5, -18.5, -19.5, -20.5, -21.5, -22.5, -23.5, -24.5, -25.5, -26.5, -27.5, -28.5, -29.5, -30.5, -31.5, -32.5, -33.5, -34.5, -35.5, -36.5, -37.5, -38.5, -39.5, -40.5, -41.5, -42.5, -43.5, -44.5, -45.5, -46.5, -47.5, -48.5, -49.5, -50.5, -51.5, -52.5, -53.5, -54.5, -55.5, -56.5, -57.5, -58.5, -59.5, -60.5, -61.5, -62.5, -63.5, -64.5, -65.5, -66.5, -67.5, -68.5, -69.5, -70.5, -71.5, -72.5, -73.5, -74.5, -75.5, -76.5, -77.5, -78.5, -79.5, -80.5, -81.5, -82.5, -83.5, -84.5, -85.5, -86.5, -87.5, -88.5, -89.5, -90.5, -91.5, -92.5, -93.5, -94.5, -95.5, -96.5, -97.5, -98.5, -99.5, -100.5



EXCERPT FROM KIRIBATI MET SERVICE CLIMATE OUTLOOK - WATER STRESS, RAINFALL AND ENSO OUTLOOKS, FURTHER BASED PROBABILITIES AS RAINFALL EXTREMES CHANCES MONTHLY TO 3-MONTH MEAN, WITH ACCESS-S2?

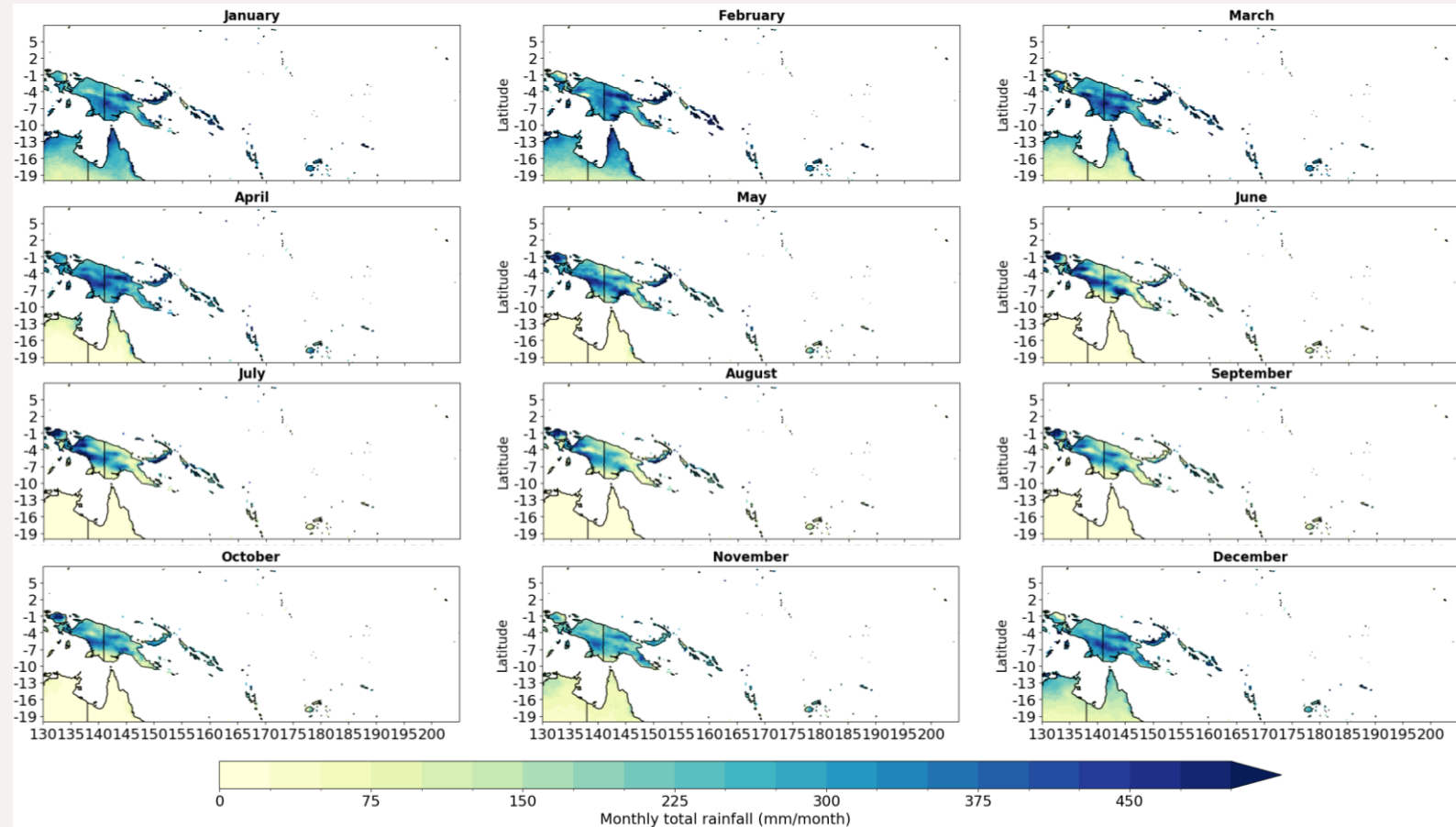
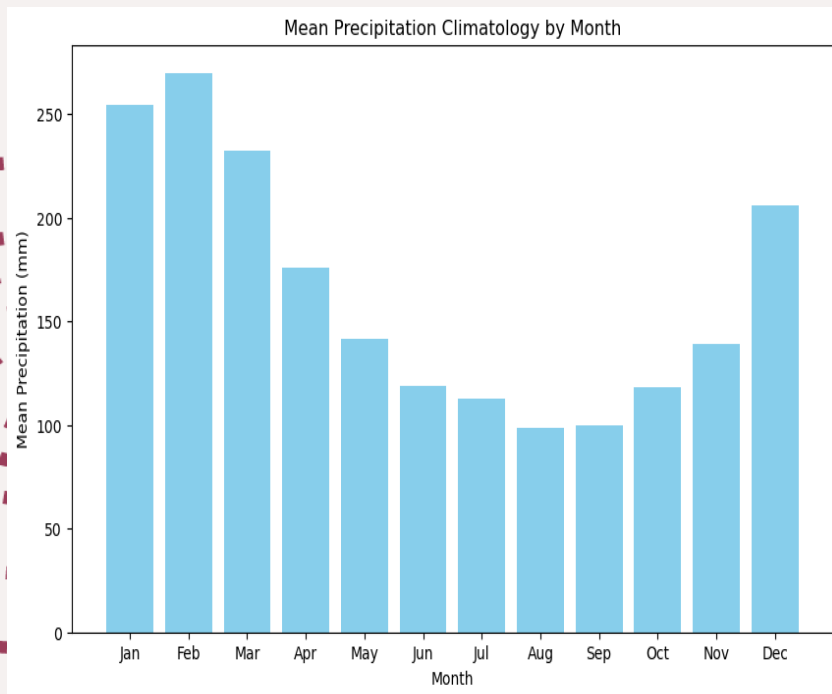
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What forecasting and/or monitoring products do you often use or like, e.g. NIWA, Australian BoM, CSIRO, your in house products, others?

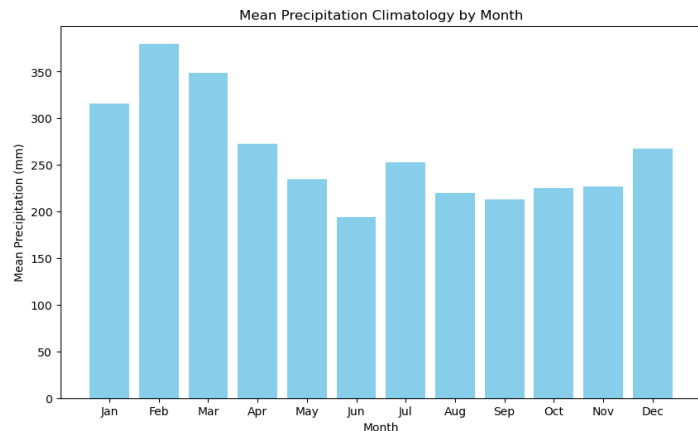
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Average Monthly Rainfall Climatology over the Pacific Islands

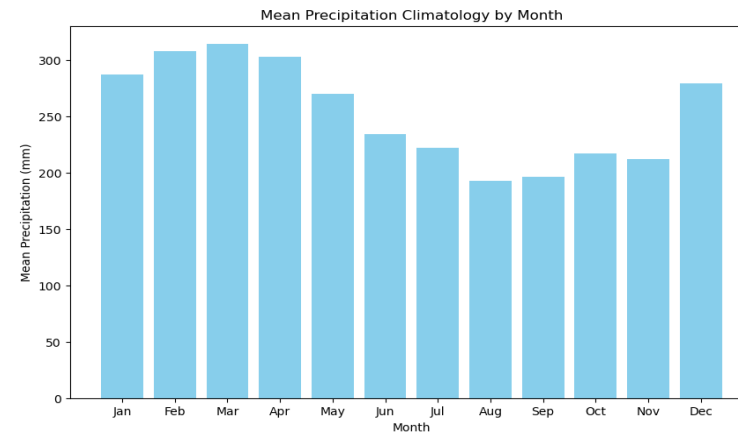


Average Pacific Islands
Climatology

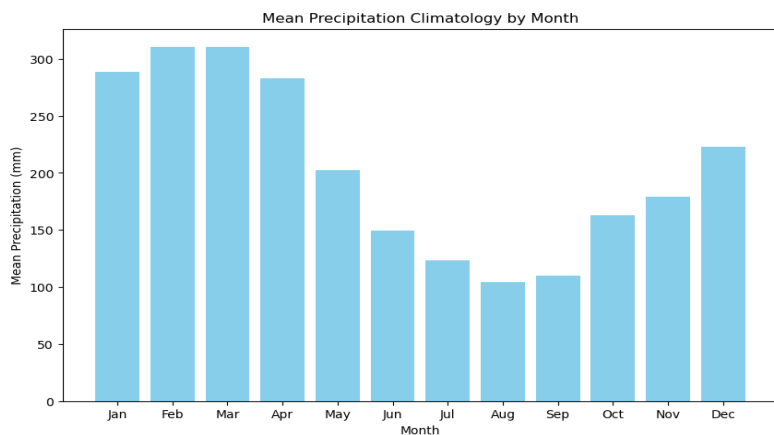
Monthly Rainfall Climatology over the Pacific Islands Comparison



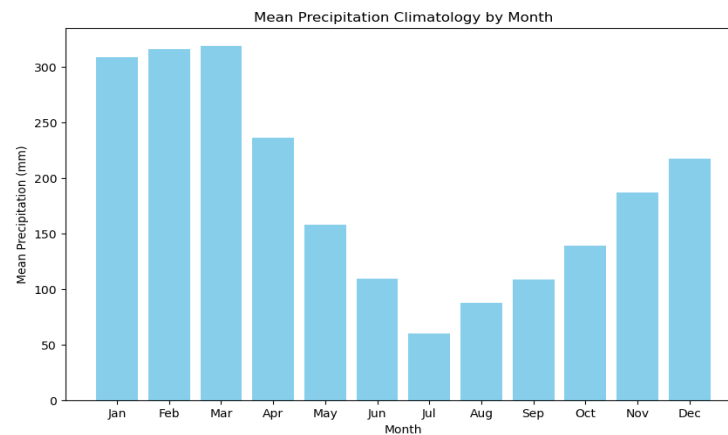
Solomon Islands Climatology



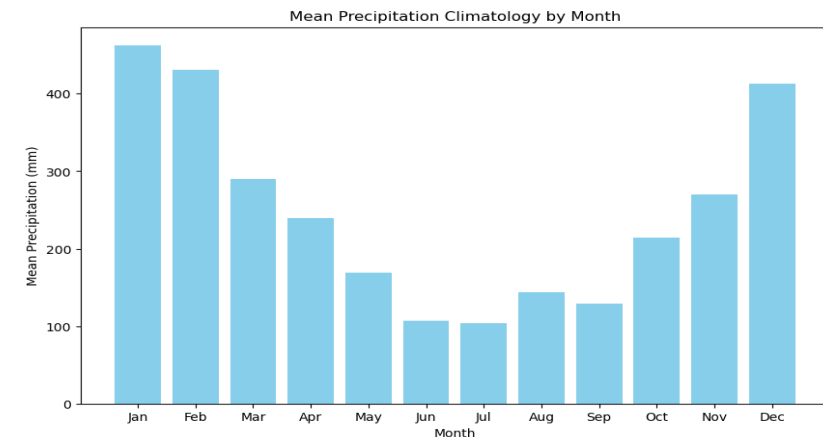
Papua New Guinea Climatology



Vanuatu Climatology



Fiji Climatology



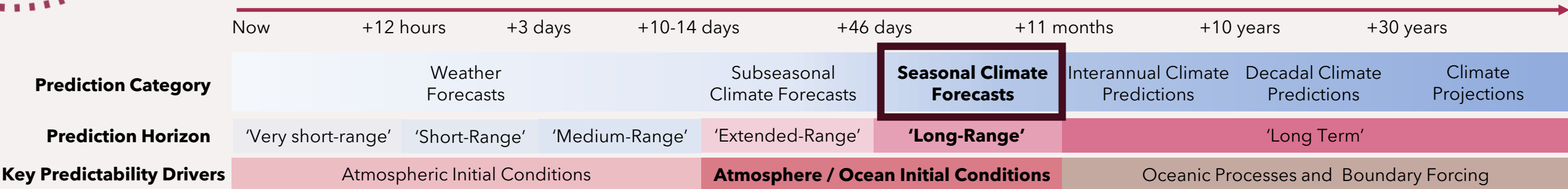
Samoa Climatology

Seasonal Climate Forecasting Approaches

Forecasting approaches are often referred to as 'statistical' or 'dynamical'

- **Statistical:** Pattern-based relationships using past observations
- **Dynamical:** Physically-based models (i.e. climate models, general circulation models - GCMs) to simulate the earth system using known physical relationships

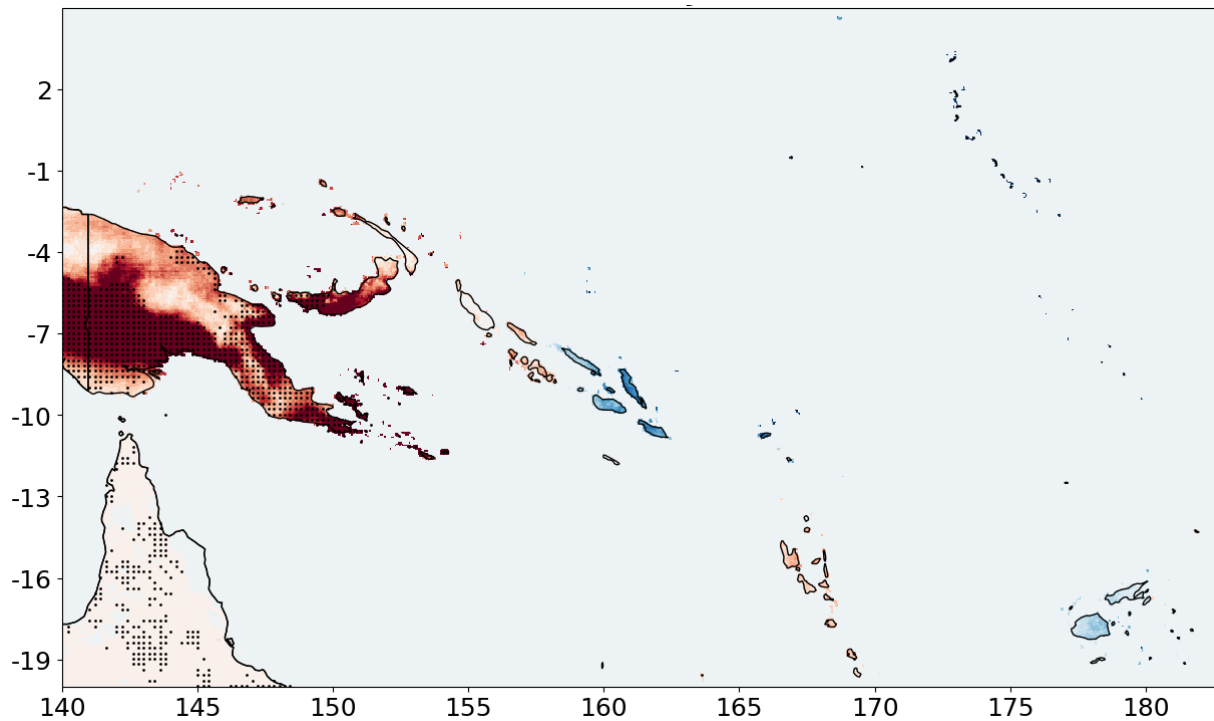
At the seasonal scale, atmospheric memory has weakened, and **we** begin to **rely more on oceanic memory** to find patterns and make predictions



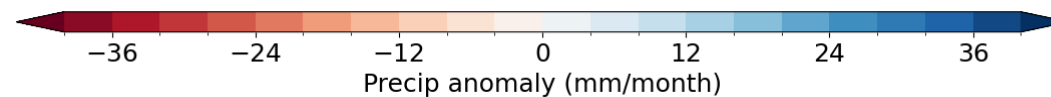
ENSO teleconnection patterns over the Pacific Islands - current period JAS



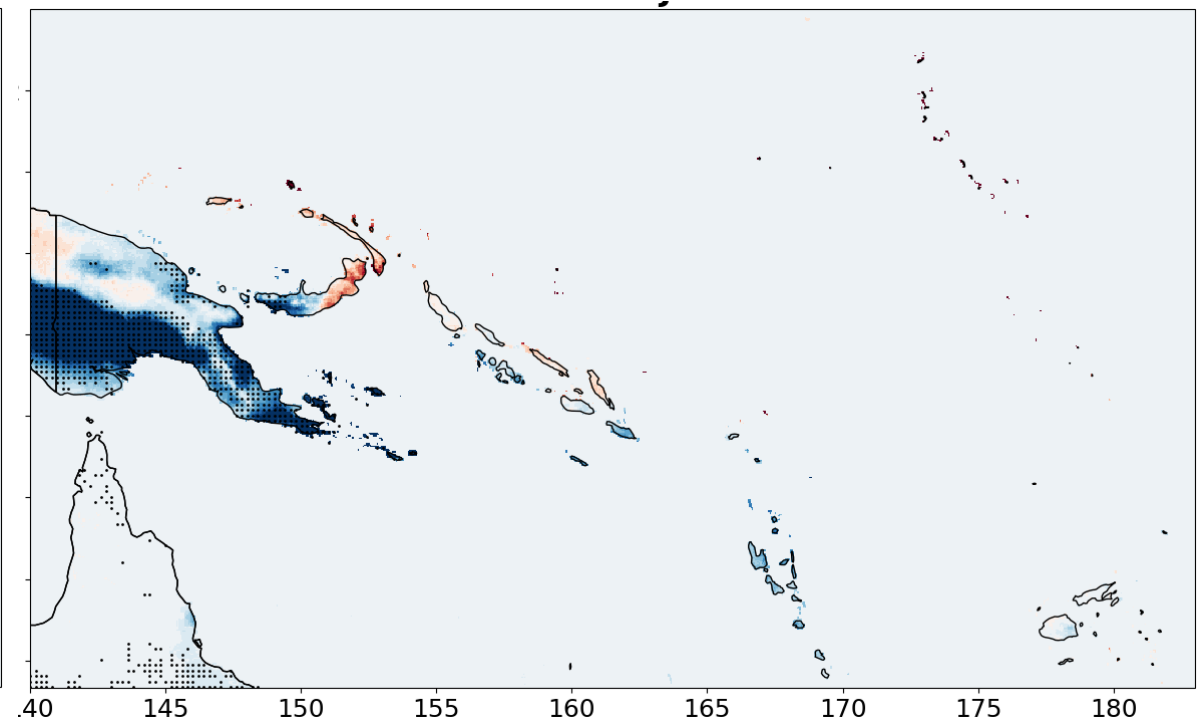
El Niño Composite for July-Sep



ONI > 0.5



La Niña Composite for July-Sep



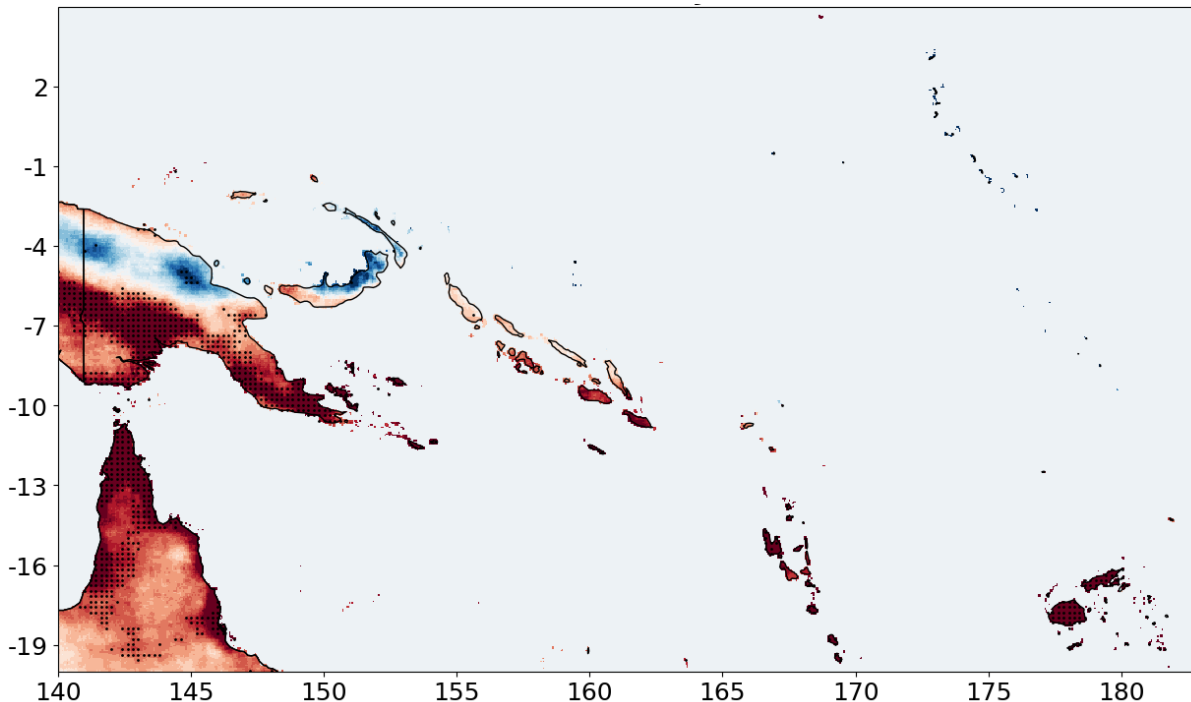
ONI < -0.5

Analysis curtesy of Bohar Singh

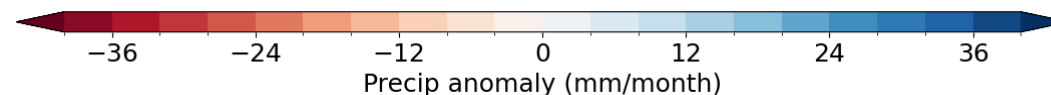
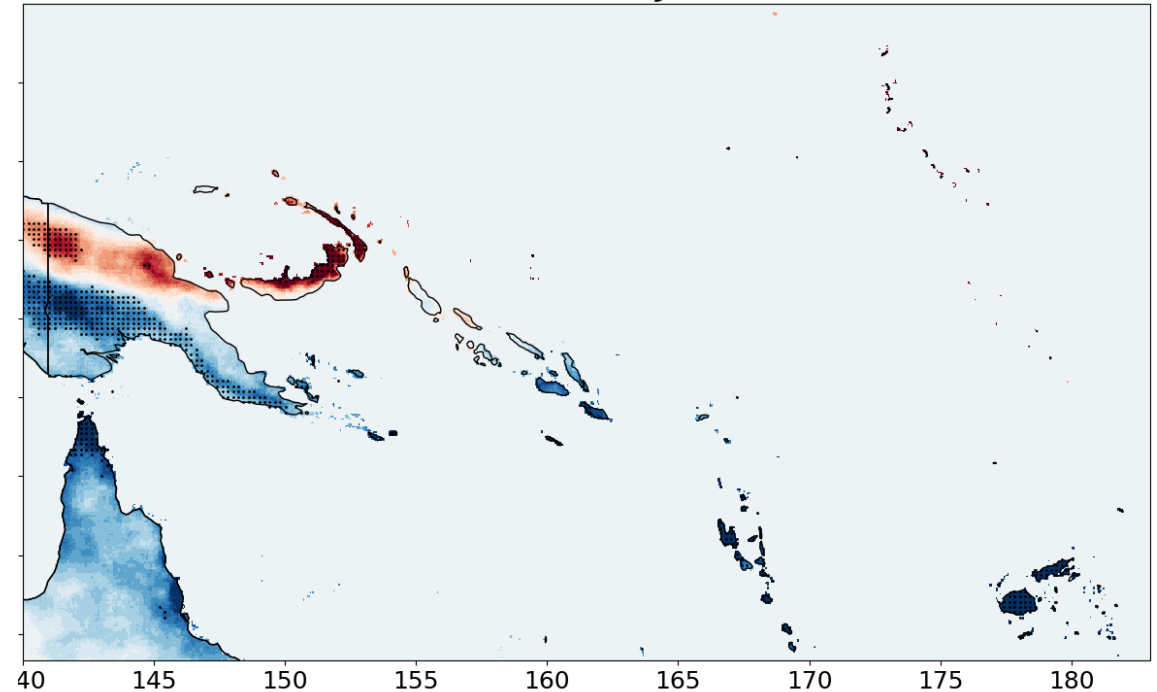
Composite analysis: Niño 3.4 (120°W, 180°W, 5°S, 5°N) with 3-month-mean Oceanic Niño Index (ONI), CHIRPS 5km rainfall¹ data

ENSO teleconnection patterns over the Pacific Islands - peak wet season period DJF

El Niño Composite for Dec-Feb



La Niña Composite for Dec-Feb

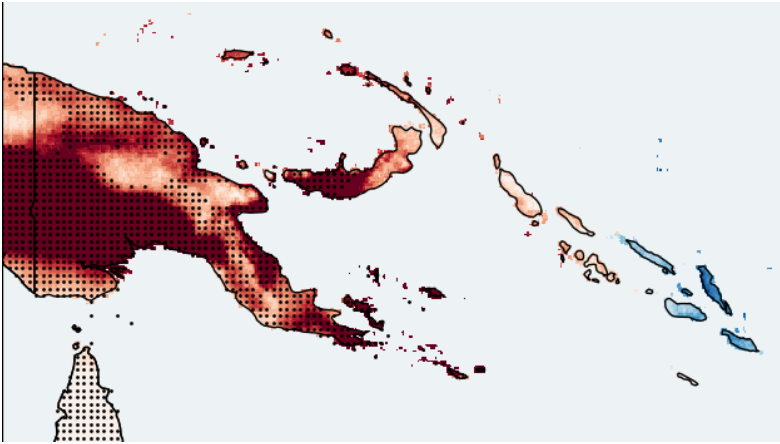


Analysis courtesy of Bohar Singh

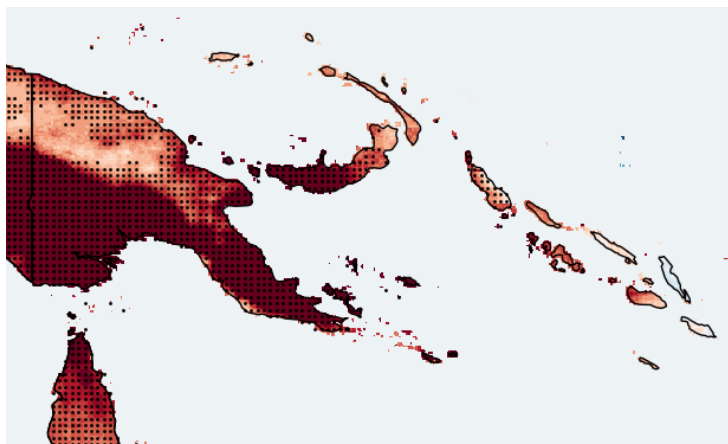
Composite analysis run using Niño 3.4 region (120°W, 180°W, 5°S, 5°N) with 3-month-mean Oceanic Niño Index (ONI), CHIRPS 5km rainfall data

El Niño composites across the wet season

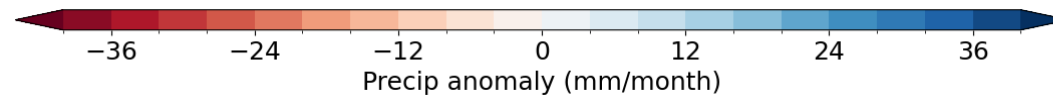
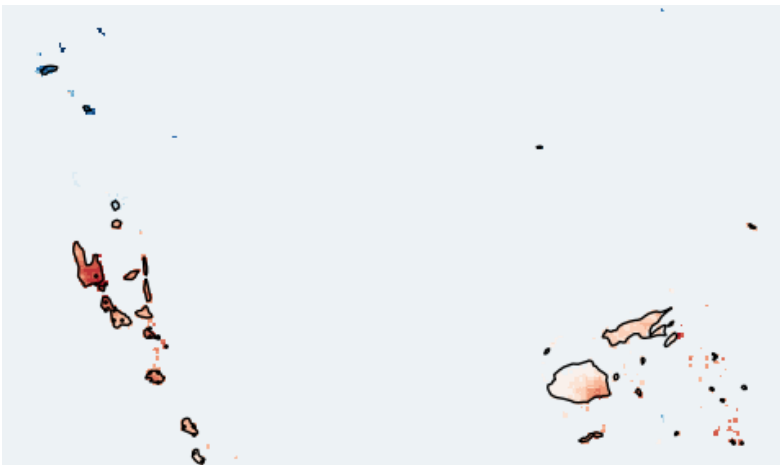
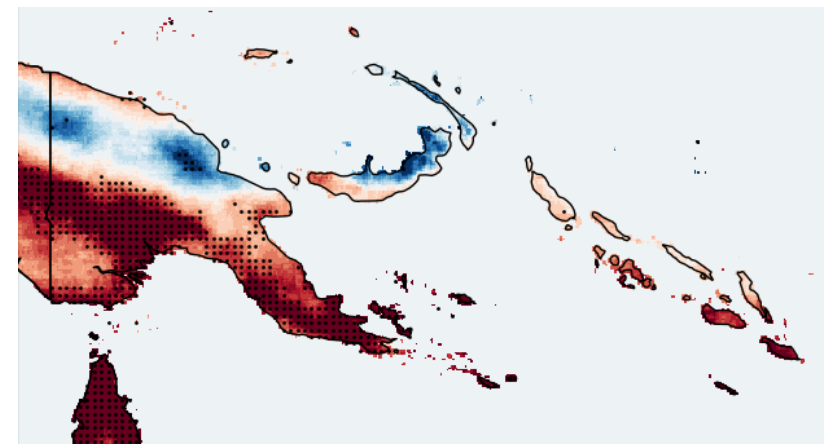
ASO



OND

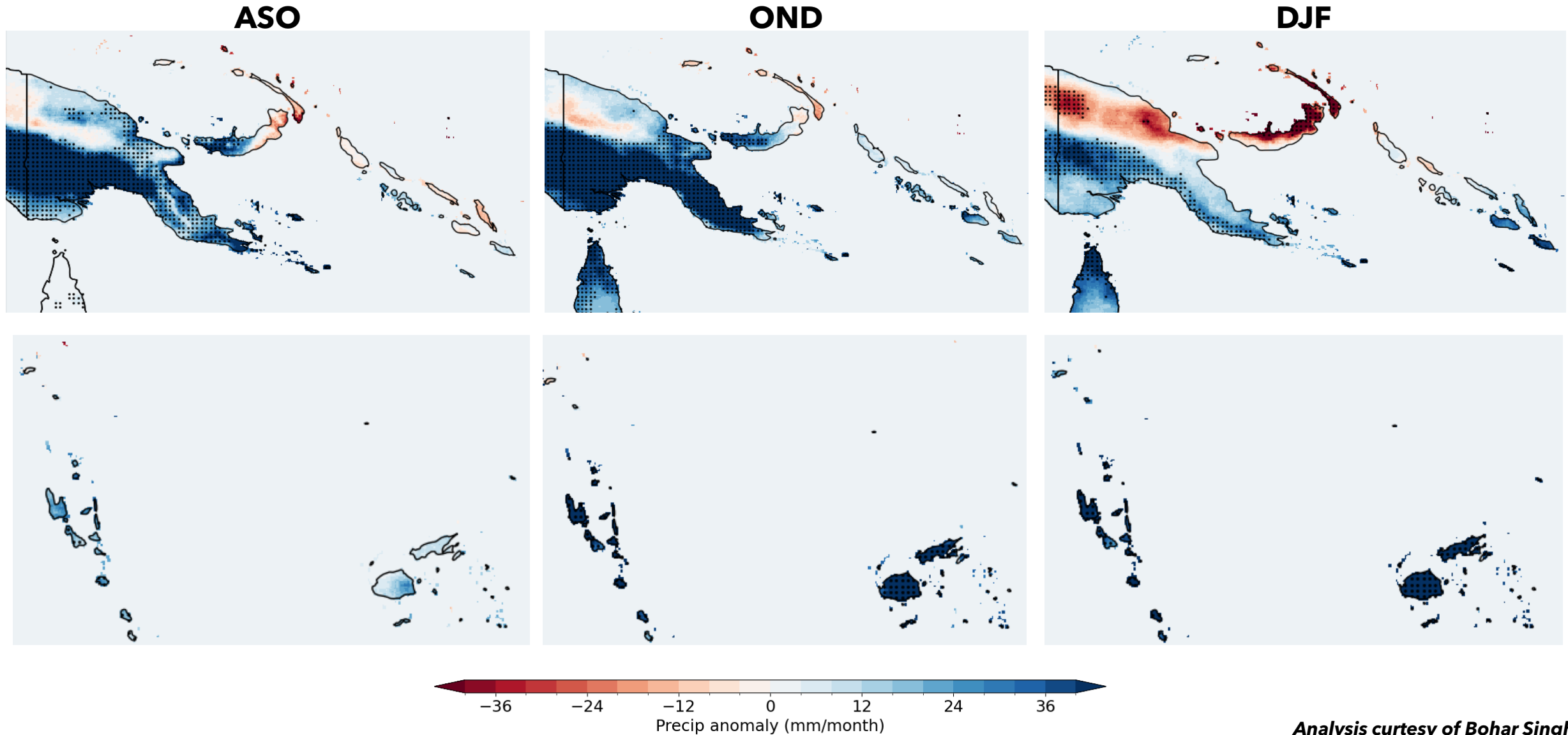


DJF



Analysis courtesy of Bohar Singh

La Niña composites across the wet season

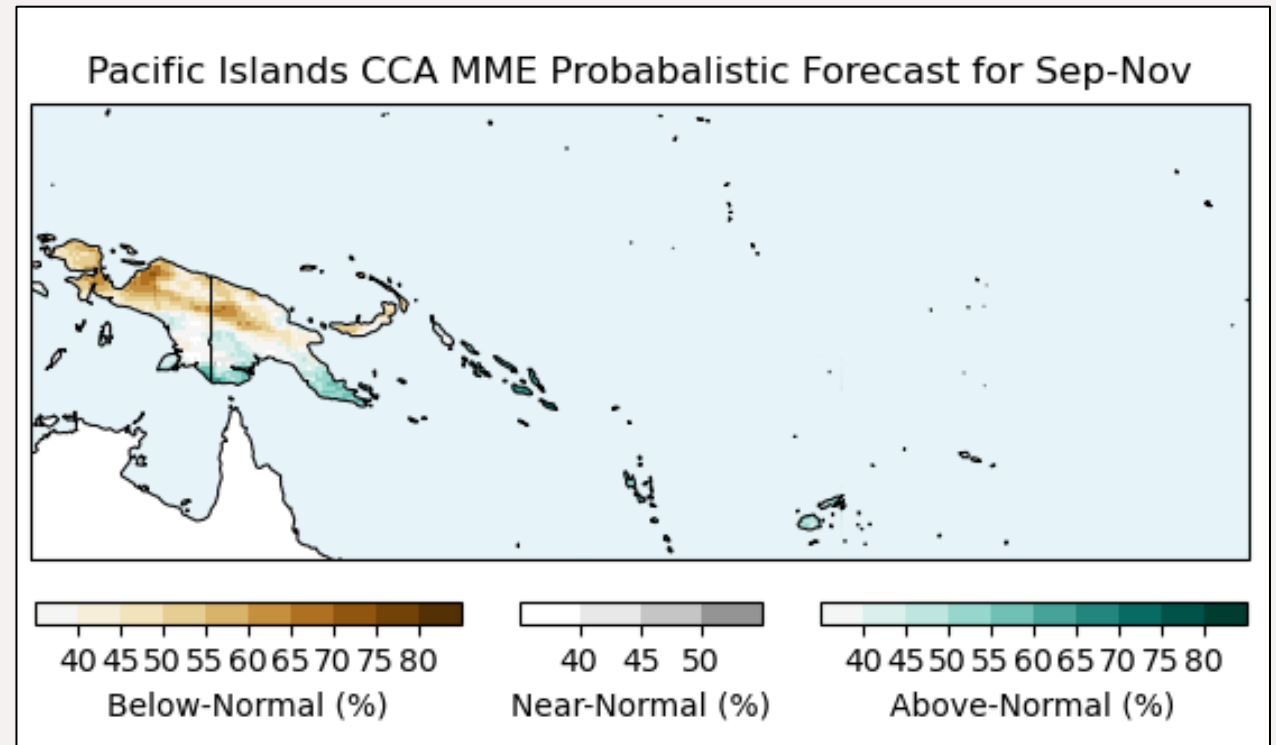


Analysis curtesy of Bohar Singh

All models are wrong, *but some are useful*

Earth system is complex and chaotic, no model will have a perfect representation of future conditions
We can **improve** the **usefulness of a prediction** by

- (1) **Choosing a more attainable forecast type** for a model (e.g. tercile-based probabilities)
- (2) **Combining forecast models** to aggregate different assumptions about the earth system
- (3) **Bias-correction and calibration of** our raw model outputs using statistical relationships



Several techniques can correct raw forecasts, to be discussed in following sessions today

- **Logistic Regression (LR)** - probability of a binary outcome (probability of above or below normal) based on one or more predictor variables, applied separately for each tercile
- **Extended Logistic Regression (ELR)** - nonlinear ensemble calibration that extends Logistic Regression and is applied across all terciles simultaneously
- **Probabilistic Output Extreme Learning Machine (POELM)** - nonlinear advanced machine learning approach (neural network with a single hidden layer)
- **Extended Probability Output Extreme Learning Machine (EPOELM)** - combines ELR and POELM approaches, useful for non-exceedance forecasts for any threshold value after fitting
- **Canonical Correlation Analysis (CCA)** - spatial pattern matching using linear correlations