ABOUT EARLY ACTION RAINFALL WATCH OUTLOOKS

Early Action Rainfall (EAR) Watch outlooks are weekly to seasonal predictions of extreme rainfall, defined as the chances of being in the top or bottom 20% of the rainfall distribution. The current EAR watch methodology was updated in 2022 utilising the recently updated ACCESS-S2 climate model and is a significant update to the EAR watch outlooks which were first created in 2013. The EAR watch was initially designed to address the poor uptake of the traditional tercile and chance of above median format outlooks in the Pacific Islands, while better meeting the needs of disaster management government and non-government organisations e.g. Red Cross.

The EAR Watch outlooks are usually presented in regional and national EAR Watch bulletins and are designed to inform Pacific Islands government and non-government disaster management and associated agencies of recent and upcoming periods of prolonged drier or wetter than normal conditions.

The EAR Watch bulletin and outlook production methodology are outcomes of work undertaken by the DFAT and MFAT funded Climate and Oceans Program in the Pacific delivered through the Australian Bureau of Meteorology (BoM), Australian Red Cross and the International Federation of Red Cross and Red Crescent Societies (IFRC) to better communicate seasonal outlooks to climate-vulnerable communities in the Pacific.

The EAR watch outlooks are produced using the 1st of the month model run and available on approximately the 3rd of the month, these can be updated more frequently upon request.

EAR Watch Outlooks background and advantages of the new methodology

EAR watch outlooks are presented as latitude/longitude maps of predictions for extreme rainfall, that is, the chances of being very dry or very wet for the coming fortnight, month, or season. The outlook is generated by the Australian ACCESS-S multi-week to seasonal prediction system. The outlooks are based on a quintile (5-category) prediction, made available in addition to the more traditional tercile and chance of above median outlooks.

Two major advantages in using quintile outlooks over the previous tercile EAR watch method is the ability to focus on the extreme ends of rainfall predictions which are often of most interest to stakeholders, and secondly the availability of a skill metric that can assess the retrospective forecast ability of the model between 1981-2018. Each EAR watch outlook map has an associated skill map to match the outlook period and time of the year.

EAR Watch Outlook maps

EAR Watch maps are available for each country for example Papua New Guinea below(Figure 1) and at a regional scale. Exclusive Economic Zones (EEZ) are shown in dashed lines, with provinces also marked by solid lines for some countries. The maps use the native ACCESS-S2 grid resolution of 60km, presented as a contoured map. Each outlook map contains the first and fifth quintile prediction together.

Without a bias in the climate system an outlook would record a 20% prediction for each quintile category; where there is shading on an outlook map there is a prediction of at least 30% probability in one of either the first or fifth quintile categories indicating an elevated risk of rainfall being either

lower or higher respectively. In the case where both the first and fifth categories record probabilities above 30%, the largest value will be the one presented on the map (in this case the probability value is most likely less than 50% indicating the model is not confident and the skill measure for the region and time of year is also likely very low or low).

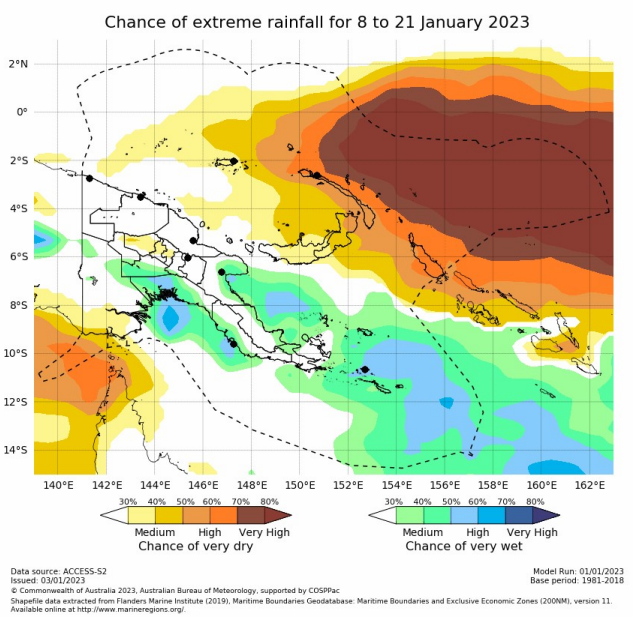

Figure 1. ACCESS-S2 EAR Watch outlook for Papua New Guinea

How to interpret the EAR Watch Outlooks

The key used on the map is presented in Figure 2, with the yellow/brown shadings indicating a prediction for a 'chance of very dry' where rainfall is predicted to be below the 20th percentile or much less than what is normal for the time of year being forecasted for. Conversely the green/blue shadings indicate a prediction for a 'chance of very wet' where rainfall is predicted to be above the 80th percentile or much more rainfall than is usual for the time of year.

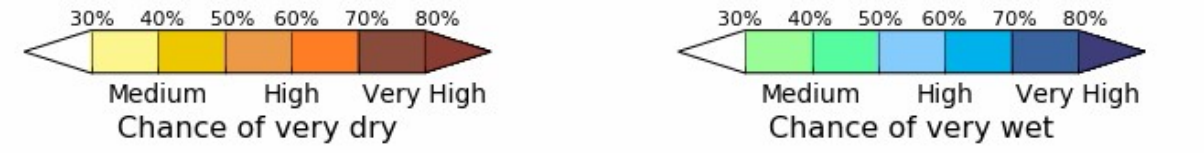

Figure 2. Key presented on EAR Watch outlook maps

The key presented here includes probabilities e.g. 30%, 40% etc. for both the chance of very dry and the chance of very wet. These probabilities represent the confidence of the model prediction, the yellow (green) shades with lower probabilities indicate the model favours a very dry (very wet) outcome but with less confidence in the outlook than the brown (dark blue) shades with much higher probabilities.

Details on probability calculation

Each EAR watch outlook map is a summary of 99 ACCESS-S model scenarios (let's round it up to 100). The target region in the Marshall Islands is represented by an open red circle (Figure 3). The predicted probability value for this location is 38%, based on the light yellow shading on our key. This means that 38 of the 100 model scenarios were associated with rainfall in the lowest quintile, which becomes the favoured category of the 5-category options. However, this leaves 62 times the model was run where the outlook for the selected location was in one of the other four quintile categories. Therefore the 'chance of very dry' conditions is the most likely outcome, however the model isn't as confident as a scenario where the red circle covers a region of dark brown shading. In this situation, 80 or more of the 100 scenarios would be associated with the very dry category.

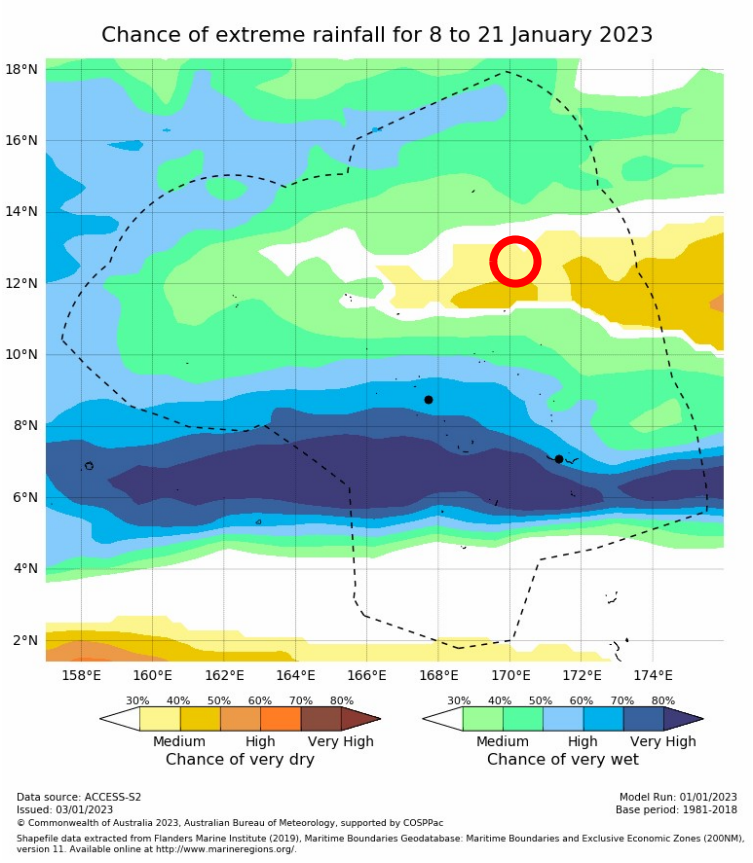

Figure 3. EAR Watch outlook for Marshall Islands

Note, where there is colour on the map, we are looking at the favoured quintile category. Where the map is showing white, the favoured quintile category is 'near normal' rainfall, that is, not extreme rainfall. The rainfall outlook in this case might be for wetter or drier than normal, but not "Very Dry" or "Very Wet" rainfall totals.

Interpreting the EAR Watch for Stakeholders

When interpreting an EAR watch map into written guidance, the general advice is to only present information where there is an extreme outlook (so not locations with white shading on the outlook map). If an island is located near two different colours, such as the highlighted region in Figure 4, either use wording which is conservative (the lowest probability) or summarise both options. For

example, if our island is close to a bright green 40-50% shading and a light blue shading (50-60%) as shown by the ○ use either of the sentences below.

- There is a medium chance of very wet for *location* over the coming *period*
- There is a medium to high chance of very wet for *location* over the coming *period*

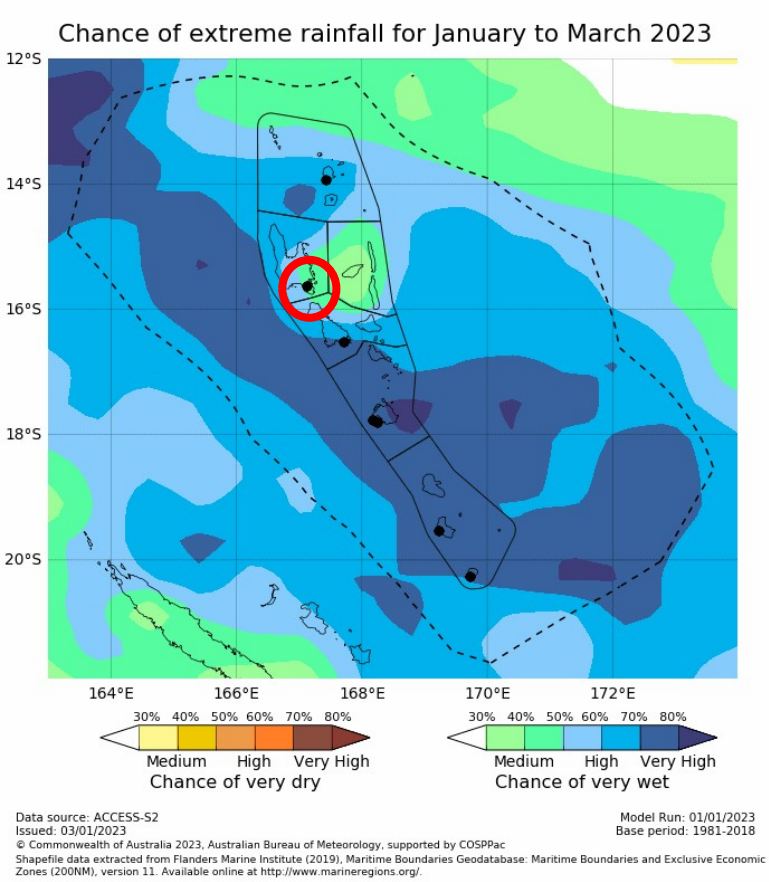

Figure 4. Vanuatu EAR Watch outlook

Verification for EAR Watch outlooks

A major advantage of quintile predictions is that each outlook has an associated hindcast (retrospective forecast) reflecting the location and time of year. Skill is also presented on a map which is updated each time the outlook is updated.

Due to small sample sizes when dealing with a 5-category outlook, the relative operating characteristic (ROC) accuracy metric is most suitable. This is presented as the area under a ROC curve at each point on the map. ROC scores are calculated for each of the first and fifth quintiles and presented separately, it is possible for skill to be different at the same location between the different quintile categories.

Before computing the ROC score the ROC curve is calculated. A ROC curve is defined as a measure of the times the model chose the correct quintile category together with the times the model chose the incorrect category. ROC scores are generated from the area under these ROC curves, where the

greater area under the curve indicates a higher number of times the correct category was selected together with a lower false positive rate of selection.

A perfect ROC score is 100%, and outlooks with little skill will obtain a score below 50%, as shown in Figure 5. For example, in a 38-year ACCESS-S2 hindcast, to achieve a perfect score, the model would have correctly made a very dry prediction (first quintile) for February each time. The ROC skill scores presented on the maps represent the average skill over the hindcast period, 1981-2018, depending on how well ACCESS-S predicts the climate of a location

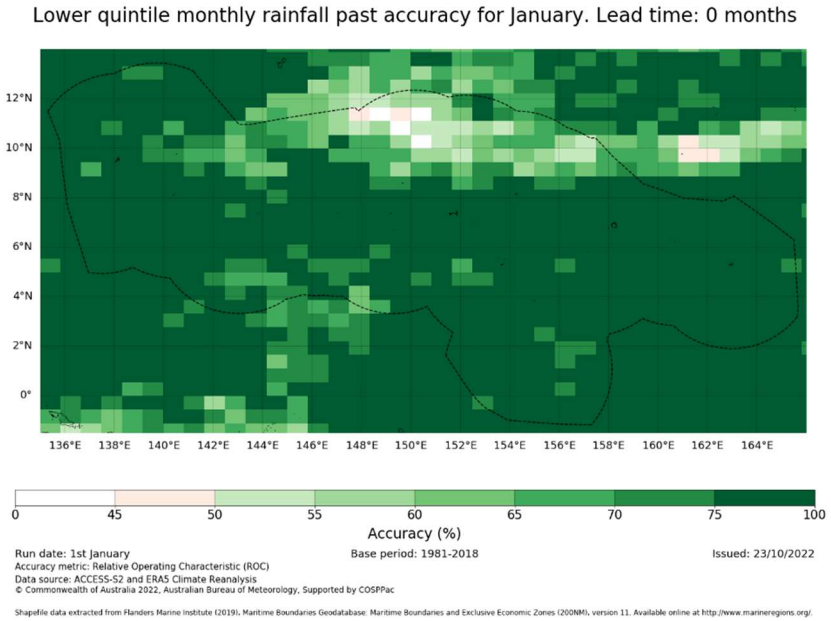

Figure 5. Relative Operating Characteristic score skill map for the Federated States of Micronesia.

Interpreting ROC scores

When interpreting skill maps it is useful to consider the immediate grid squares surrounding your location of interest, the skill maps are intended as a guide only to model performance, and real-time skill may not match past performance exactly for each grid.

The ROC score interpretation is summarised in Table 1. For ROC scores between 0 and 50% skill is 'very low', and between 50-60% skill is considered 'low'. These skill scores indicate the outlooks have little to no skill. ROC scores between 60-70% show moderate skill, where the model performs better than guessing. High skill is associated with ROC scores over 70% where skill for that location and time of year is relatively good.

ROC score value	Interpretation
0 – 50 %	Very Low
50 – 60 %	Low
60 – 70 %	Moderate
70 % +	High

Table 1. Relative Operating Characteristic (ROC) score interpretation guide