



NIWA

Taihoru Nukurangi

Climate, Freshwater & Ocean Science

Tokelau Meteorological Service (TMS) training on National Climate Outlook Forums (NCOF)

Wednesday 2 April 2025
NIWA Auckland

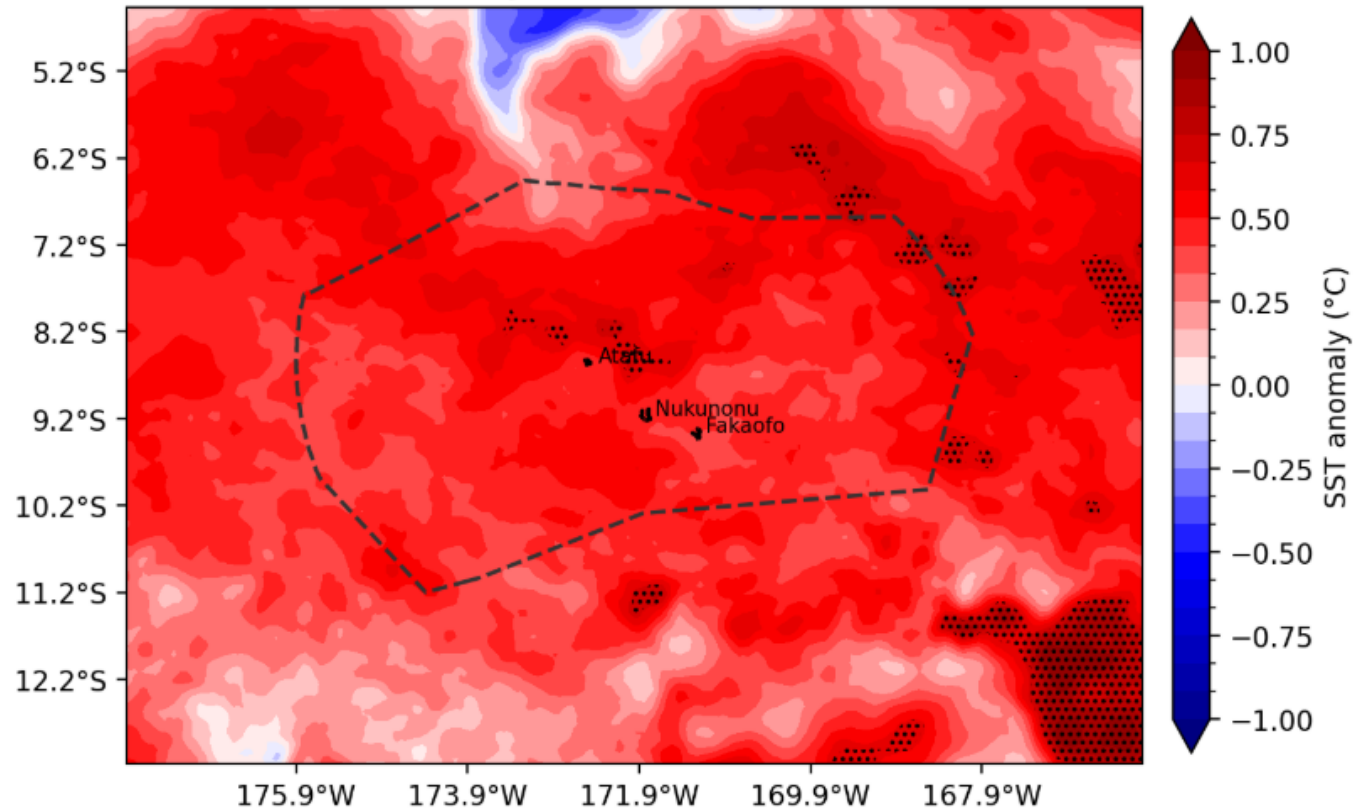
Dr. Nicolas Fauchereau
Principal Scientist, Climate & Analytics

Agenda

- **SST anomalies and Marine Heat Wave tracking**
- **SST anomalies and Marine Heat Wave forecasts**
- **Near realtime rainfall monitoring for Tokelau**
- **Monthly and seasonal rainfall forecasts**
- **Sub-seasonal rainfall forecasts**
- **Tide calendars**
- **In development / for discussion: wind, wave hourly forecasts**

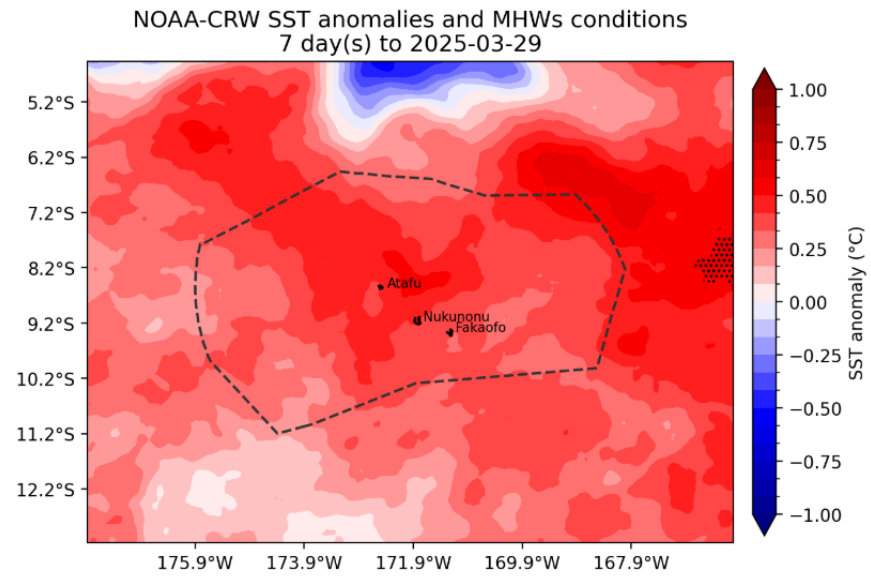
SST anomalies and Marine Heat Wave tracking

NOAA-CRW SST anomalies and MHWs conditions
1 day(s) to 2025-03-29

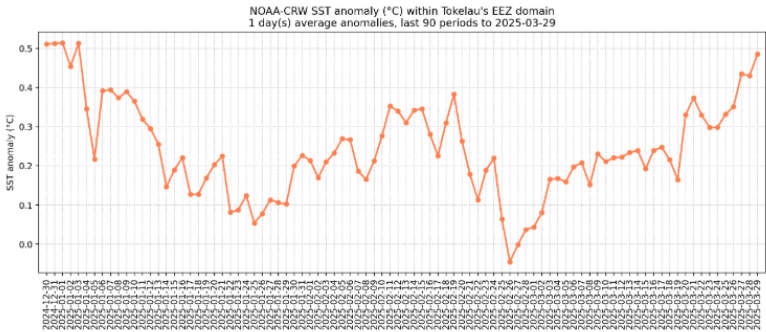


- SST anomalies expressed in °C
 - SST product is derived from Satellite
 - 5 km spatial resolution
 - Daily
 - Climatology is 1991 – 2020
-
- MHW = at least 5 consecutive days above the 90th percentile (for the 1 day product)
 - Grid points where MHW conditions are present are stippled

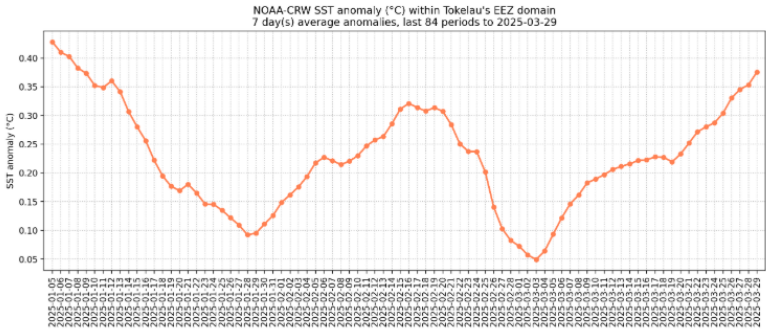
last 7 days



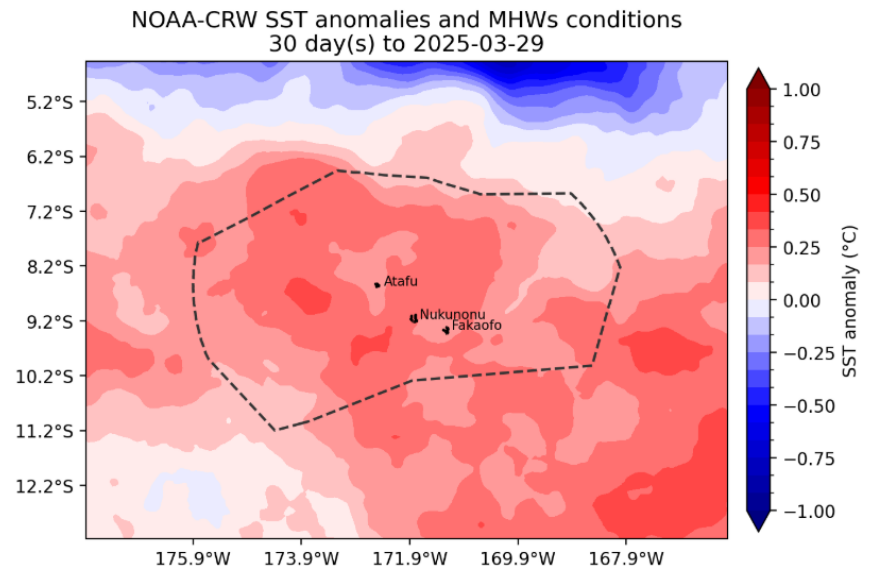
daily anomalies



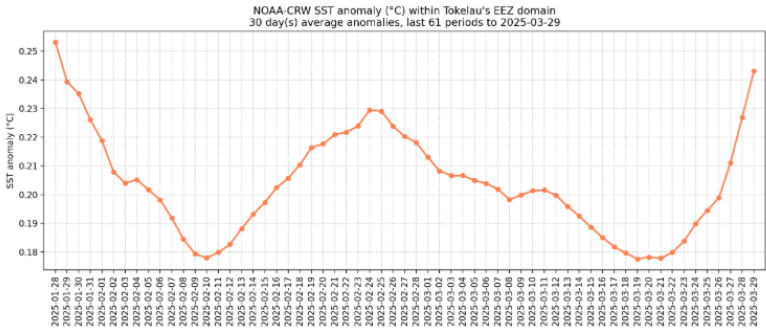
7 days anomalies



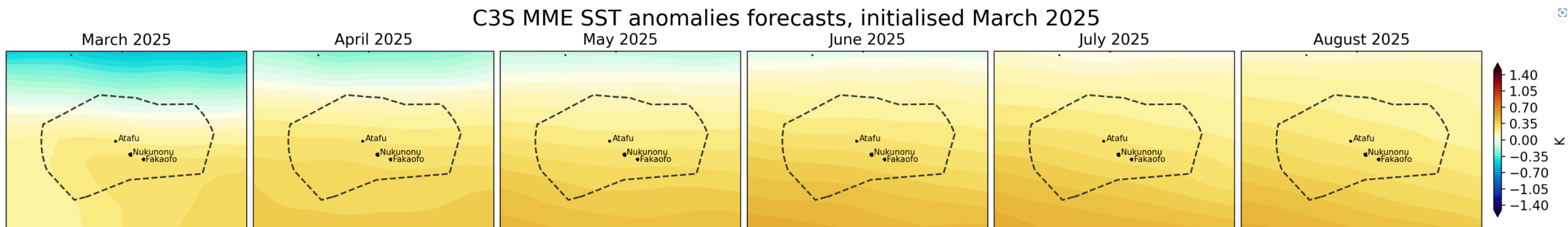
last 30 days



30 days anomalies

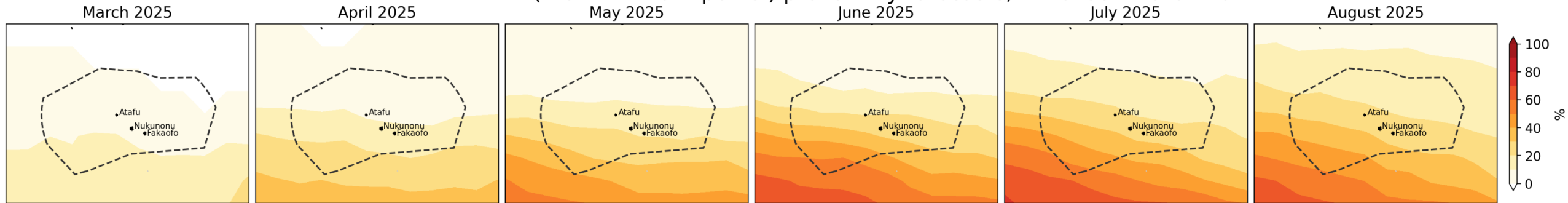


SST anomalies and Marine Heat Wave forecasts



- Monthly SST anomalies
- Start the month of initialisation (i.e. March 2025 = 1 month leadtime)
- Goes out 5 months in the future

C3S MME SST MHW (month > 90th pctl.) probability forecasts, initialised March 2025



- “Marine Heat Wave” forecast
- Not the same definition as for the daily monitoring product
- “MHW” for this product is defined as MONTHLY SSTs exceeding the MONTHLY 90th percentile (1993 – 2016 climatology)
- Expressed in terms of a probability: i.e. proportion of all the ensemble members in the C3S MME (500+ members) exceeding the corresponding GCM’s 90th climatological percentile
- By definition, a “climatological” forecast corresponds to a 10% chance of exceeding the 90th percentile

near realtime precipitation monitoring

1 day accumulation (mm)

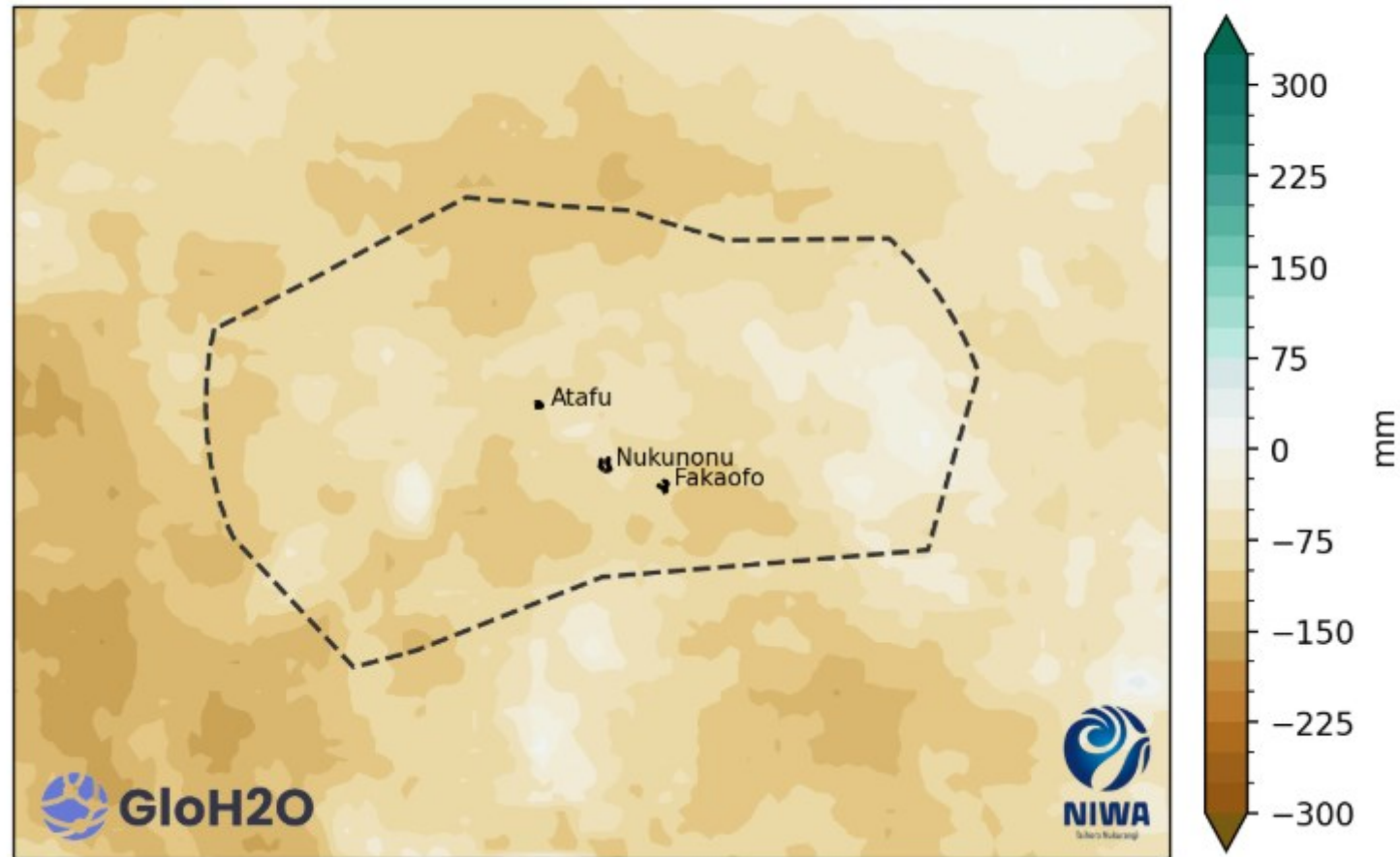
MSWEP 2.8.0 rainfall anomalies:
1 day(s) accumulation to 2025-03-29



Source: MSWEP 2.8.0 [<https://www.gloh2o.org/mswep/>]

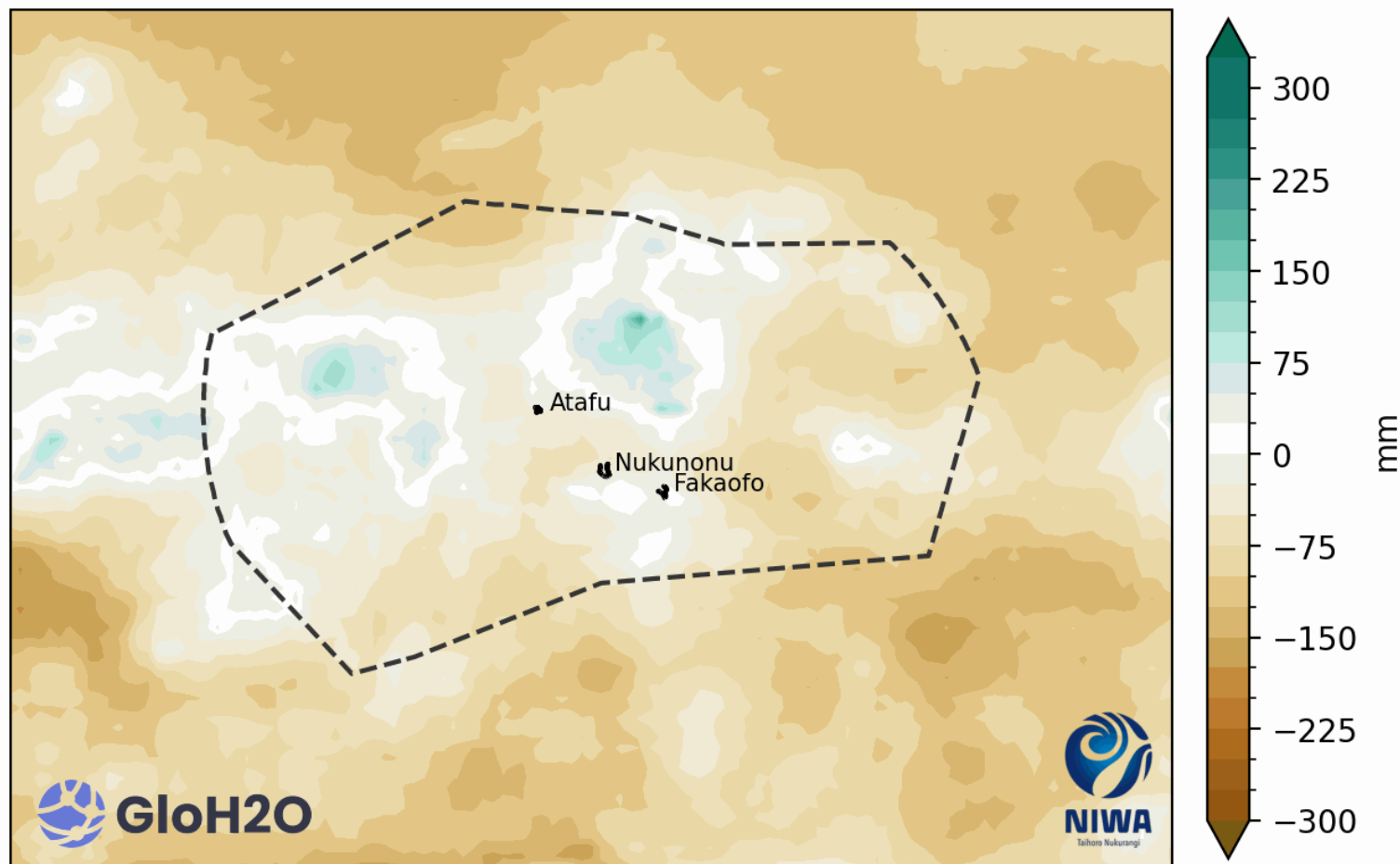
30 days accumulation (mm)

MSWEP 2.8.0 rainfall anomalies:
30 day(s) accumulation to 2025-03-29



Source: MSWEP 2.8.0 [<https://www.gloh2o.org/mswep/>]

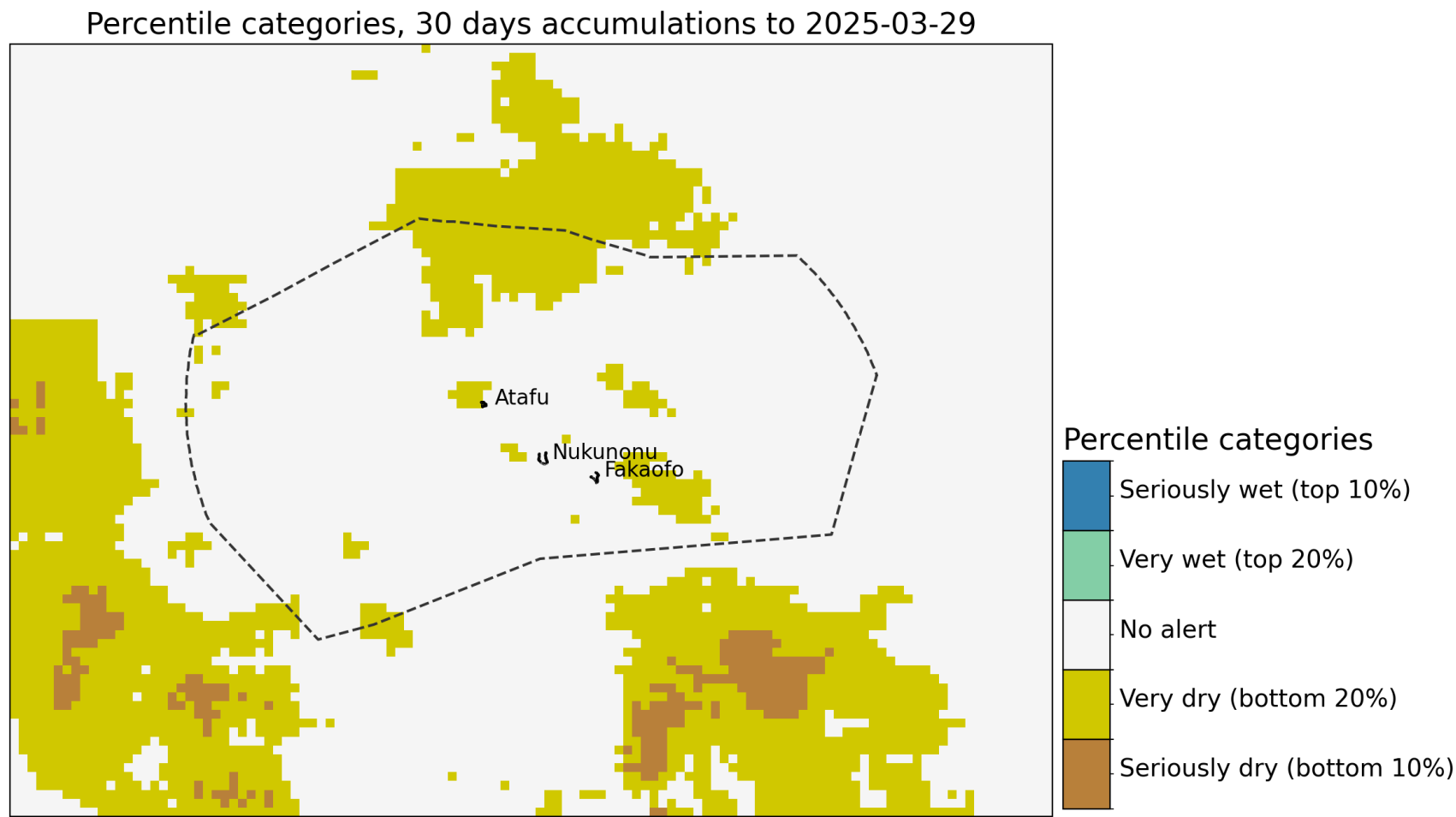
MSWEP 2.8.0 rainfall anomalies:
30 day(s) accumulation to 2024-12-29



Source: MSWEP 2.8.0 [<https://www.gloh2o.org/mswep/>]

Drought monitoring maps

Percentile categories, aligned with the “Early Action Rainfall” Watch



Drought monitoring

Percentile categories, aligned with the “**Early Action Rainfall**” Watch

Easy to interpret

Quick to produce, content easy to obtain, low demand on staff time, more likely to be issued

For disaster management sector but can be used by other sectors within DM management committee

Only considers rainfall variability BUT remember drought is a complex phenomena

- Other meteorological parameters such temperature, wind etc. (observations limited)
- Stream flow, dam levels, agricultural yield etc. (not easy to obtain in the Pacific)
- Socio-economic factors

EAR Watch information an indicator only, need to consider other factors (if available)

Example of an EAR Watch



Cook Islands Meteorological Service
Early Action Rainfall Watch

The Early Action Rainfall Watch provides sector managers with a brief summary of recent rainfall patterns, particularly drought and the rainfall outlook for the coming months.

Issued: 31/08/2021

Current El Niño-Southern Oscillation (ENSO) status: The Australian Bureau of Meteorology's ENSO Outlook is *Inactive*. Neither El Niño nor La Niña is present.

Status summary:
Penrhyn remains in Meteorological Drought for the 12-month, 6-month and 3-month timescales. Rarotonga is Very Wet at the 6-month and 3-month timescales.

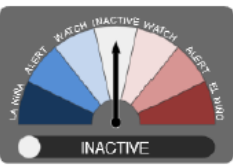
Outlook summary:
For September, High Chance Dry alerts are in place for all northern Cook Island stations (Penrhyn, Rakahanga, Manihiki, Pukapuka, Nassau and Suvarrow). The outlook is for the long term drought to continue this month. In the southern Cook Islands, there is a Medium Chance Wet alert for Palmerston, and a Low Chance Wet alert for Aitutaki, Manuae, Mitiaro, Mauke and Atiu.

For September to November 2021, High Chance Dry alerts are in place for all northern Cook Island stations (Penrhyn, Rakahanga, Manihiki, Pukapuka, Nassau and Suvarrow). This suggests the long term drought may continue in the coming months. For the southern Cook Islands, there is a High Chance Wet alert for Aitutaki, a Medium Chance Wet alert for Palmerston and Manuae, and a Low Chance Wet alert for Atiu, Mitiaro and Mauke. See table/maps below for additional information. See status table below for potential impacts.

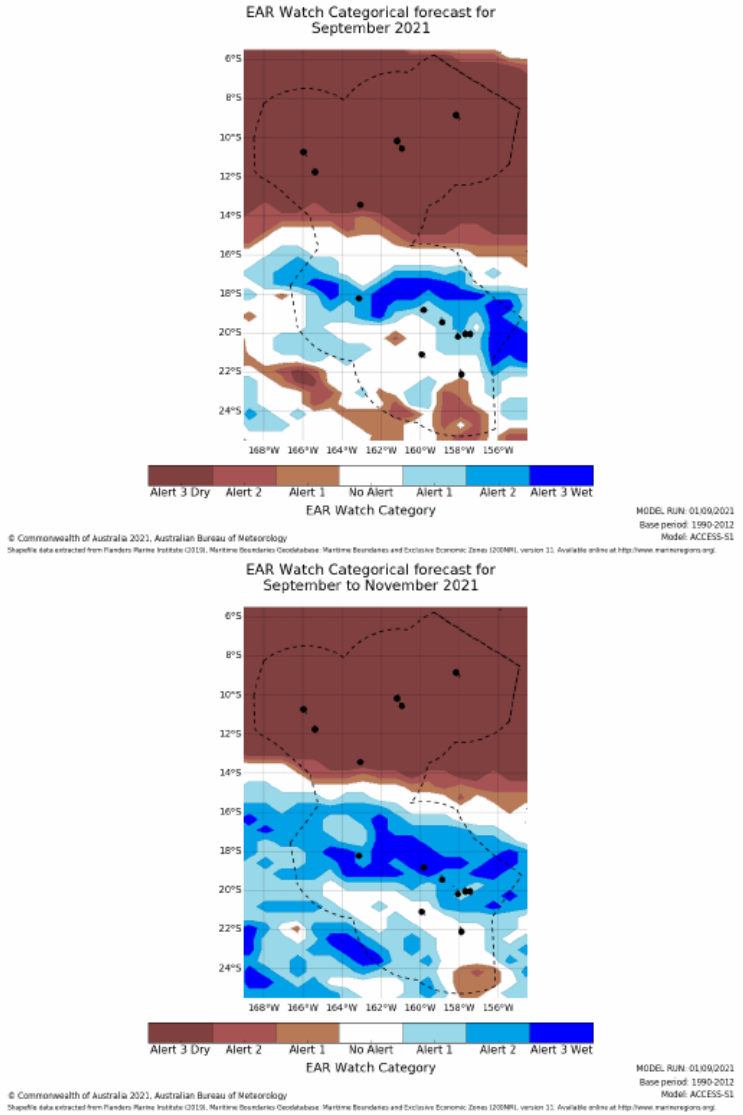
Rainfall status at the end of August 2021, Outlook to November 2021

Northern Cook Islands						
	Rainfall Status				Rainfall Outlook	
	Past 12 months	Past 6 months	Past 3 months	Past month	Next month Sep. 2021	Next 3 months to Nov. 2021
Penrhyn						
Rakahanga						
Manihiki						
Pukapuka						
Nassau						
Suvarrow						
Southern Cook Islands						
	Rainfall Status				Rainfall Outlook	
	Past 12 months	Past 6 months	Past 3 months	Past month	Next month Sep. 2021	Next 3 months to Nov. 2021
Palmerston						
Aitutaki						
Manuae						
Mitiaro						
Atiu						
Mauke						
Rarotonga						
Mangaia						

Rainfall status key	Meteorological Drought		Drought Warning	Drought Watch	No Alert	Very Wet	
Outlook Key	High Chance Dry	Medium Chance Dry	Low Chance Dry	No Alert	Low Chance Wet	Medium Chance Wet	High Chance Wet

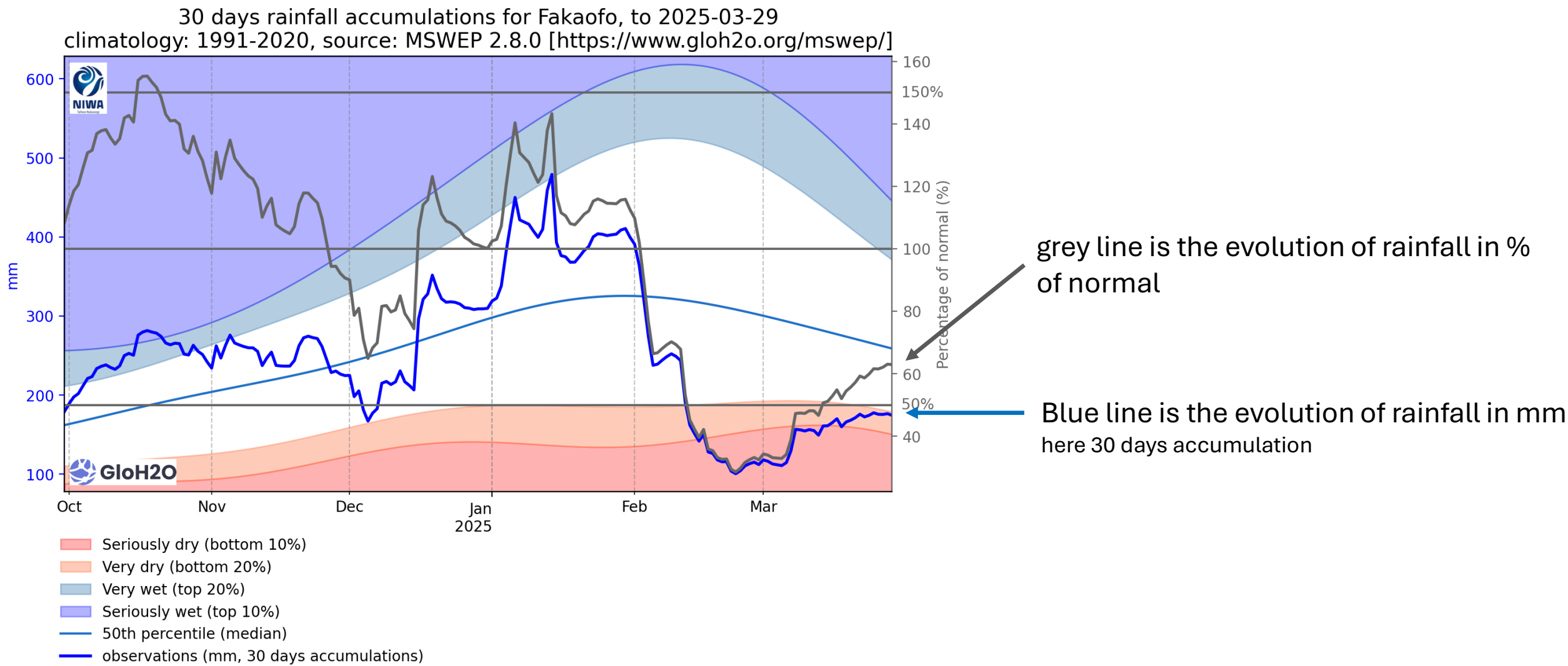


ACCESS-S Rainfall Outlooks for September, and September to November 2021



Drought monitoring time-series

Percentile categories, aligned with the “Early Action Rainfall” Watch



Monthly and seasonal rainfall forecasts

Terciles probabilities

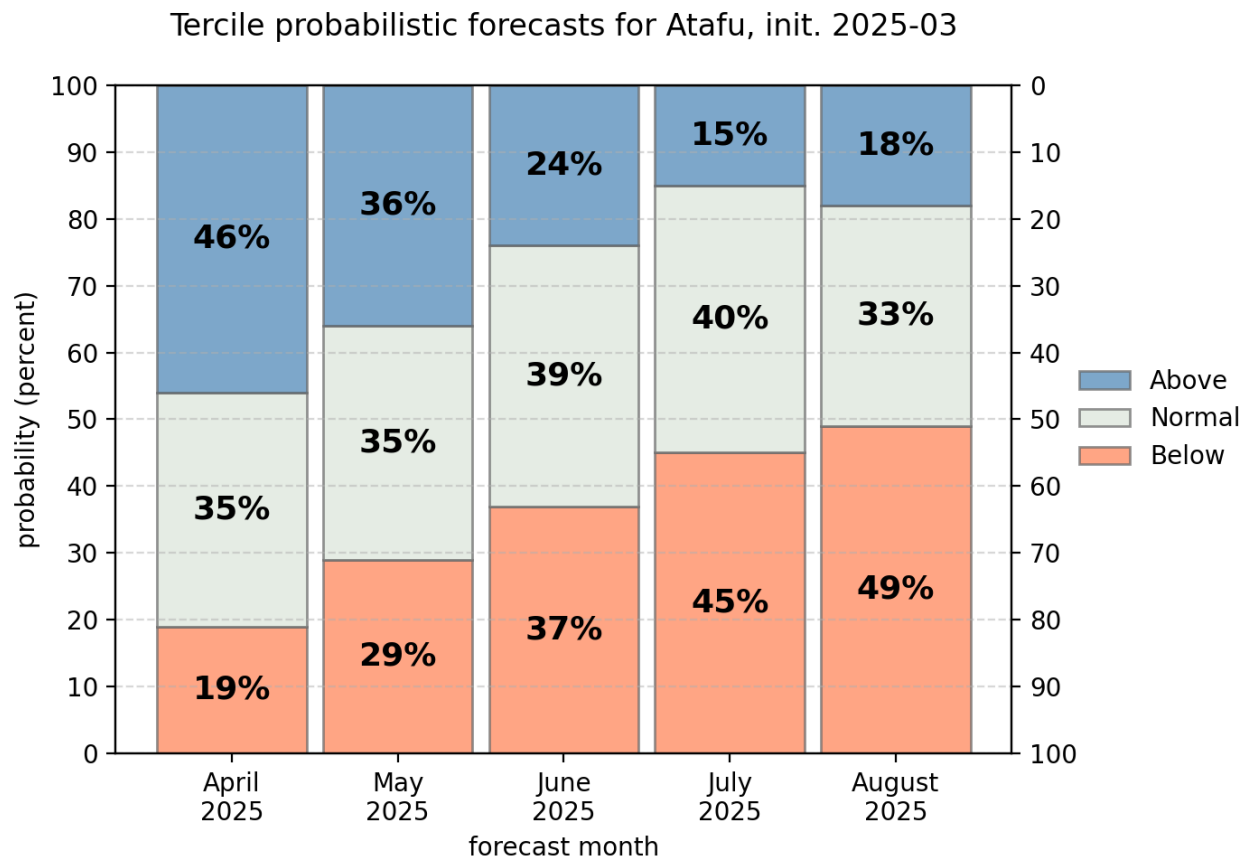
Example: How are the tercile probabilities for Atafu calculated ?

https://nicolasfauchereau.github.io/Tokelau_NCOF/#monthly-terciles-probabilities

46% of the ensemble members (i.e. **230 out of 500**)
fell above the climatological 66th percentile

The remaining members (**175**, i.e. **35 %**) fell in-between

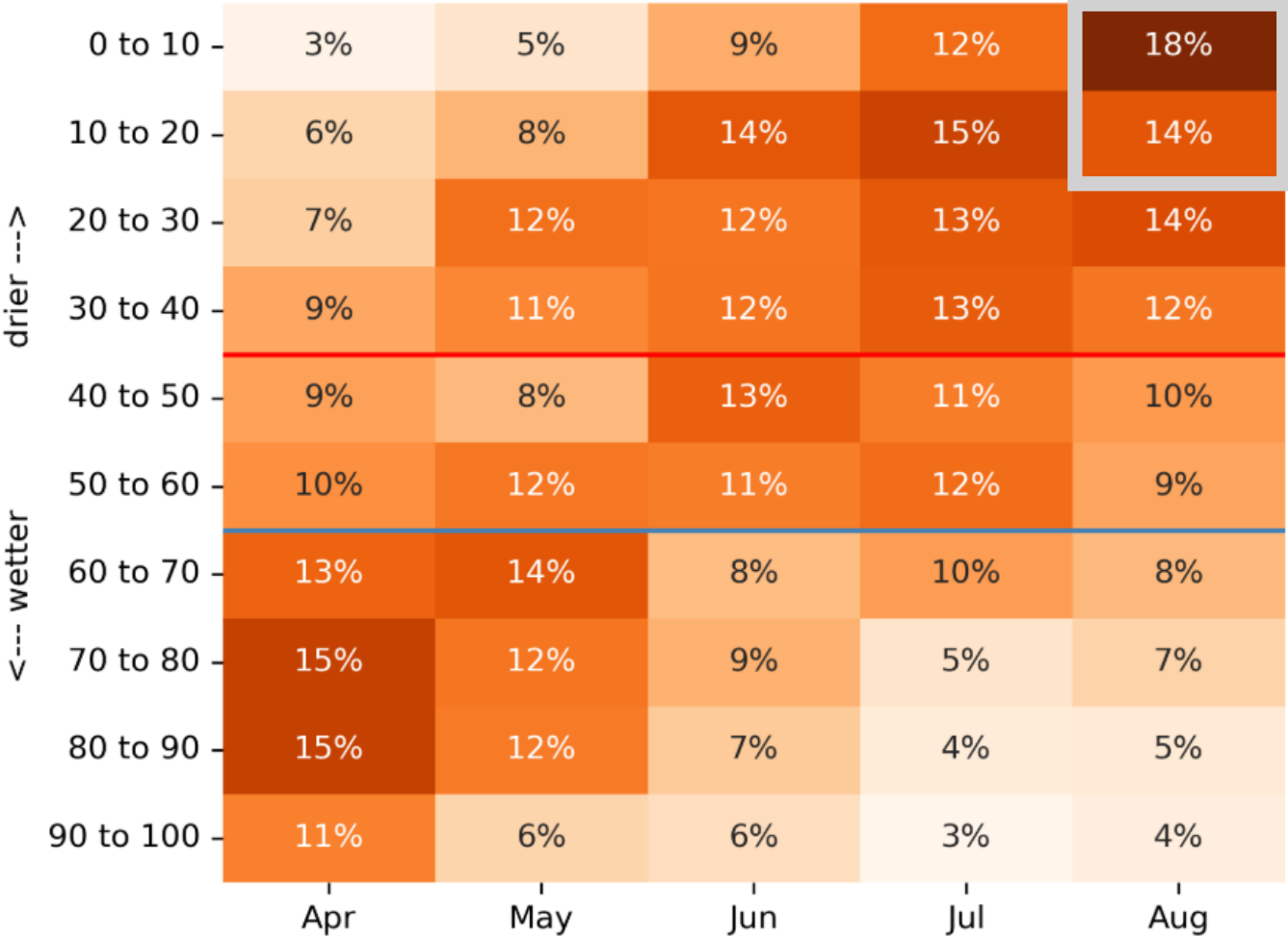
19% of the ensemble members (e.g, **95 out of 500**) fell
below the climatological 33th percentile



Decile probabilities

Atafu

Atafu monthly decile probabilities (C3S MME)



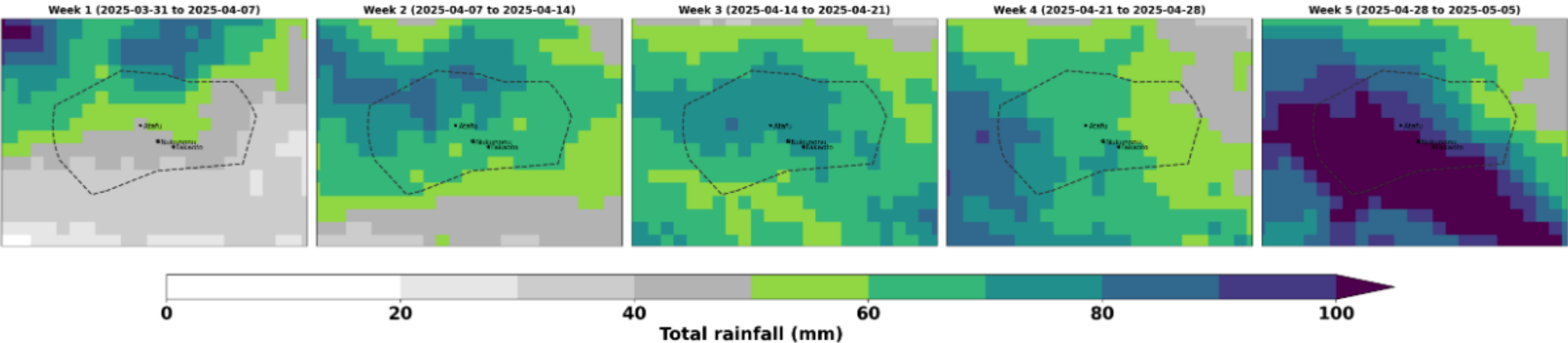
i.e. there’s a 32% chance that rainfall will be below the 20th percentile in August

Sub-seasonal forecasts

Weekly rainfall amount in mm



NOAA/GEFS total weekly rainfall (mm) for Tokelau

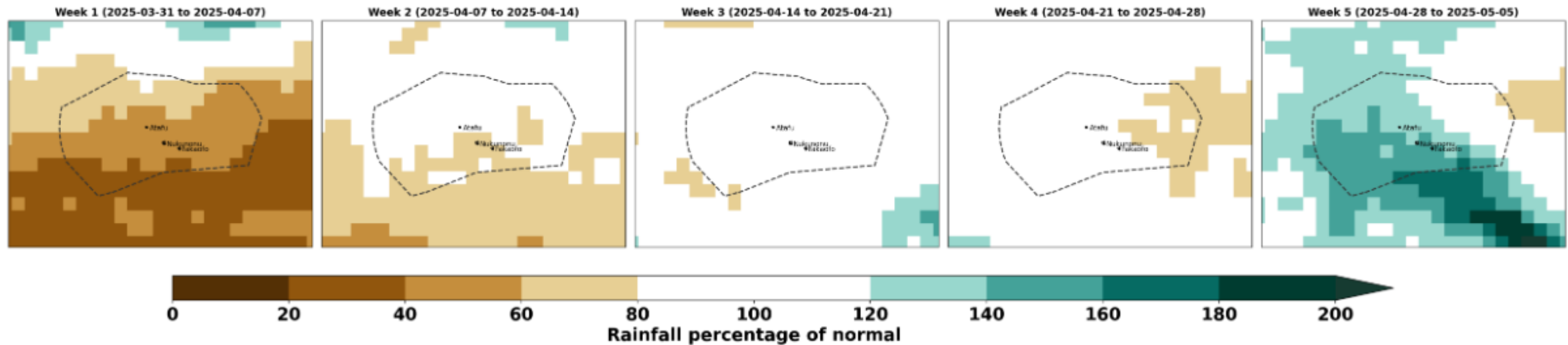


Forecast initialisation: 2025-03-31

Weekly rainfall anomalies in percentage of normal



NOAA/GEFS weekly rainfall percentage of normal for Tokelau

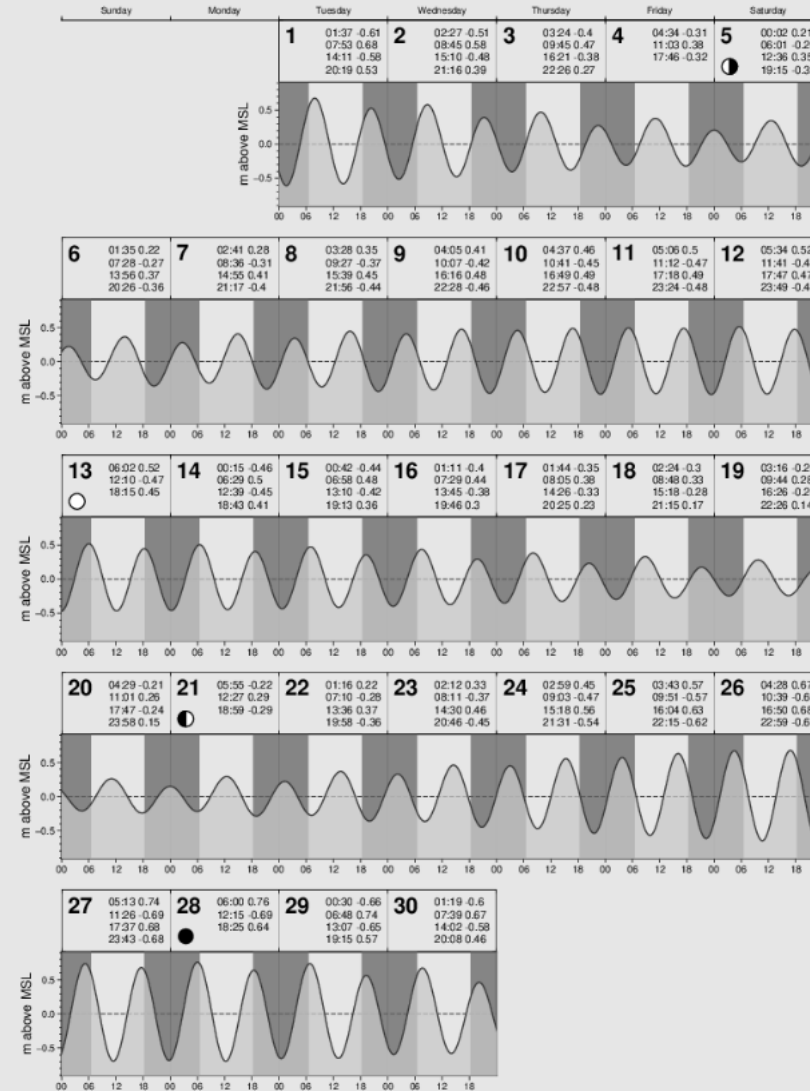


Climatology: 2000-2020 | Forecast initialisation: 2025-03-31

Tide calendars

Fakaofu tide predictions

April 2025



© NIWA Tokelau Meteorological service 2024. Times are in local time. Source: FES tide model. The above calendar is not an official tide table. NIWA-TMS accepts no liability for direct or indirect damages that may arise from the use of this calendar.



Open weather and marine forecasts

<https://open-meteo.com/>

<https://open-meteo.com/en/docs>



Weather Forecast API

Seamless integration of high-resolution weather models with up 16 days forecast

Location and Time

Location:

Latitude 52.52	Longitude 13.41	Timezone Not set (GMT+0) <input type="button" value="v"/>	<input type="button" value="🔍 Search"/>	<input type="button" value="+"/>
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Time:

<https://open-meteo.com/en/docs>



Weather Forecast API

Seamless integration of high-resolution weather models with up 16 days forecast

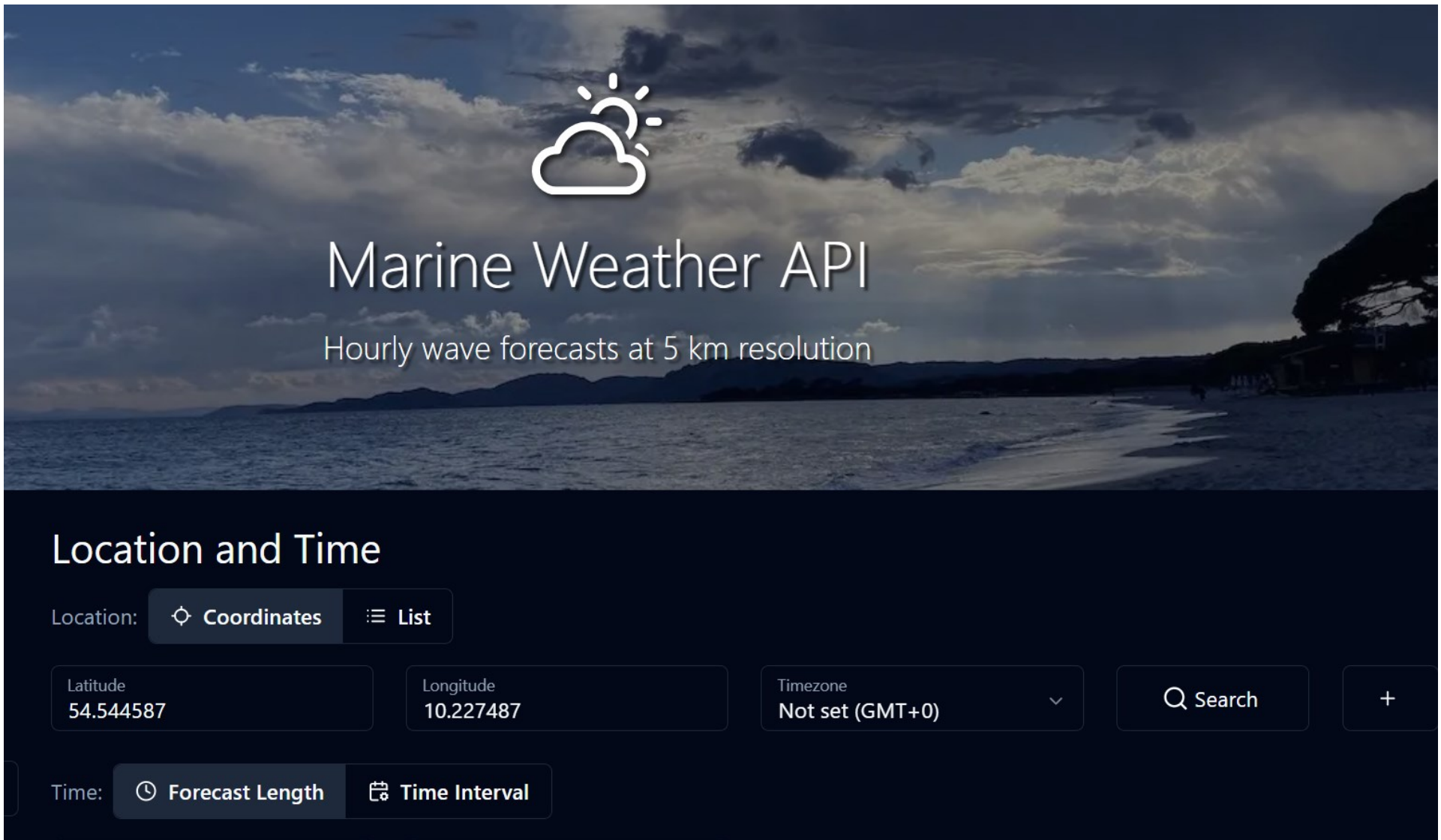
Location and Time

Location: ☒ Coordinates ☐ List


Latitude Longitude Timezone

Time: ☒ Forecast Length ☐ Time Interval

<https://open-meteo.com/en/docs/marine-weather-api>



The image shows the web interface for the Marine Weather API. At the top, there is a header with a sun and cloud icon, the title "Marine Weather API", and the subtitle "Hourly wave forecasts at 5 km resolution". Below this is a section titled "Location and Time" which contains several input fields and buttons. The "Location" section has two tabs: "Coordinates" (selected) and "List". Under "Coordinates", there are input fields for "Latitude" (54.544587) and "Longitude" (10.227487). To the right of these is a "Timezone" dropdown menu set to "Not set (GMT+0)". Further right is a "Search" button with a magnifying glass icon and a "+" button. The "Time" section has two tabs: "Forecast Length" (selected) and "Time Interval".



Marine Weather API


Hourly wave forecasts at 5 km resolution

Location and Time

Location: ☒ Coordinates ☐ List

Latitude:

Longitude:

Timezone: 

Time: ☒ Forecast Length ☐ Time Interval

Fakafetai !