Space-based Weather and Climate Extremes Monitoring (SWCEM) and Climate Risk and Early Warning Systems (CREWS) for Early Warning for All (EW4A)

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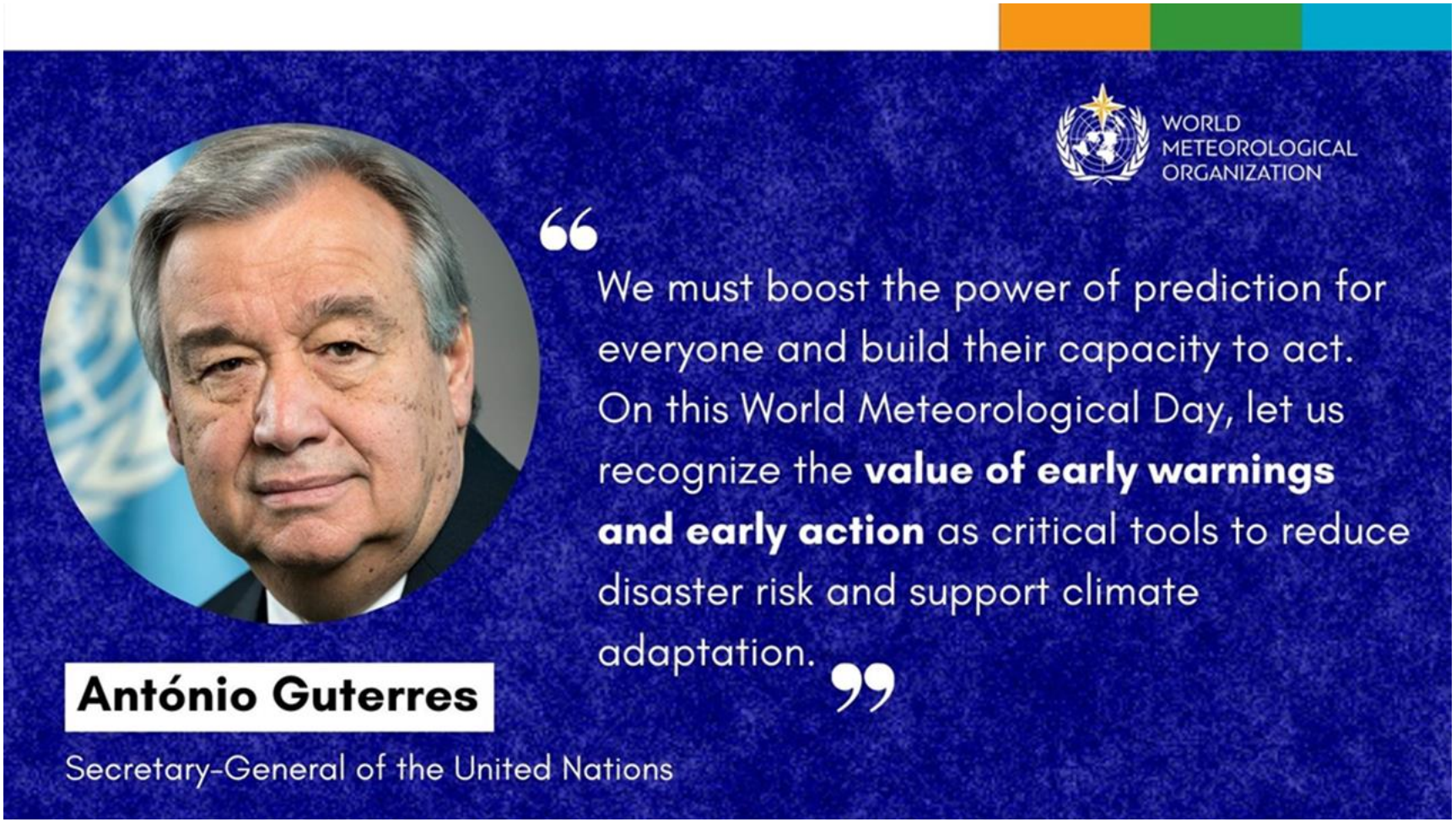
Early Warning and Early Action – EW2A

UN unveils ambitious target to adapt to climate change and more extreme weather



CREWS

- Developing and least developed countries are particularly vulnerable to the impact of climate extremes, including droughts, floods, and tropical cyclones.

- Recognizing the urgency of enhancing early warning systems to assist vulnerable countries with climate change adaptation, the Climate Risk and Early Warning Systems (CREWS) international initiative has been established at COP-21 in Paris in 2015.

CREWS

CREWS has already supported 73 countries through

- 9 country projects
- 7 regional projects
- 1 global project.

WORLD METEOROLOGICAL ORGANIZATION

WORLD BANK GROUP

GFDRR

UNDRR
UN Office for Disaster Risk Reduction

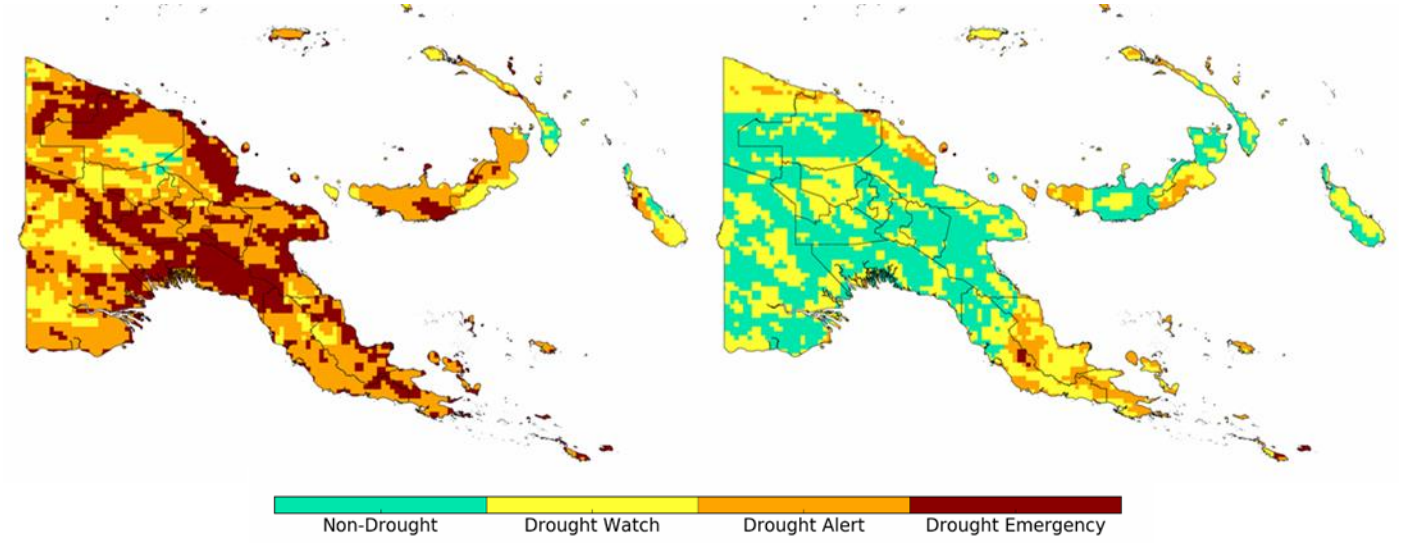
CREWS PNG

- In Papua New Guinea (PNG), severe drought caused by the strong El Niño in 2015-2016 affected about 40% of the population, with almost half a million people impacted by food shortages.

- To build resilience to impact of future droughts, Australian BoM, in partnership with the PNG NWS and the WMO, implemented CREWS project (2018 – 2022) developing
  - ✓ drought risk assessment, and
  - ✓ EWS for drought

CREWS PNG

The CREWS-PNG project developed drought monitoring and early warning system (EWS) for Papua New Guinea.



Enables better strategic decision making for agriculture, water management, and other climate-sensitive sectors.

Climate Information Services in PNG

	12-month period January to December 2020	9-month period April to December 2020	6-month period July to December 2020	3-month period October to December 2020
Goroka				
Madang				
Wewak				
Nadzab				
Vanimo				
Kavieng				
Momote				
Port Moresby				
Misima				

Rainfall status key	Drought	Drought Warning	Drought Watch	Status not available	Normal or wetter than normal	Very Wet

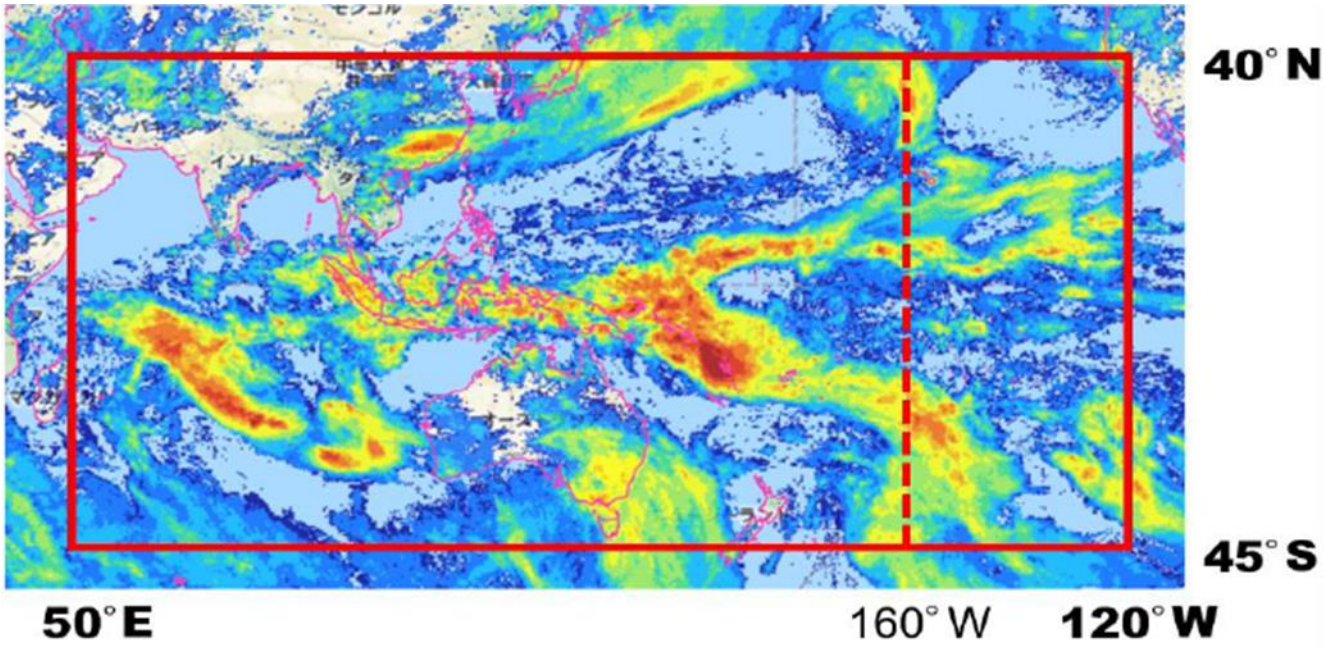
Rainfall observations: 13 weather and climate stations and 7 rain gauge stations; inadequate to accurately capture the complex spatial distribution and variability of rainfall across the country.

WMO SWCEM

- CREWS-PNG was implemented in partnership with the World Meteorological Organization's (WMO) Space-based Weather and Climate Extremes Monitoring (SWCEM).

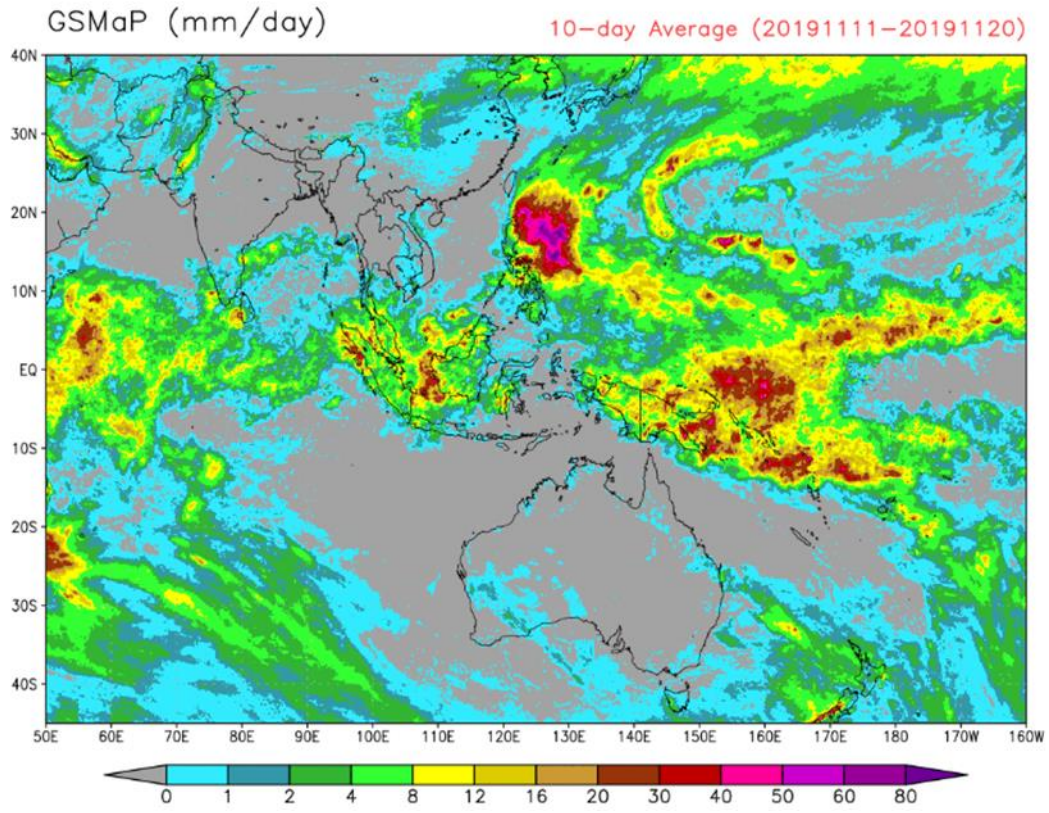
- WMO established the SWCEM flagship initiative, recognizing needs to better utilize and improve monitoring of weather and climate extremes from space to complement surface-based observations.

SWCEM Implementation in Asia-Pacific



SWCEM in Asia-Pacific - monitoring drought and heavy precipitation, implemented in geographical domain 40°N to 45°S; 50°E to 120°W.

SWCEM Operational Products



JAXA and NOAA

Mean precipitation estimates

- hourly
- daily (00-23UTC)
- pentad (5-day)
- weekly (Monday– Sunday)
- 10-days
- monthly

Statistics:

- Climate normal
- 90th ~ 99th Percentiles
- Percentage of rainy days (>=1mm/day) in a month

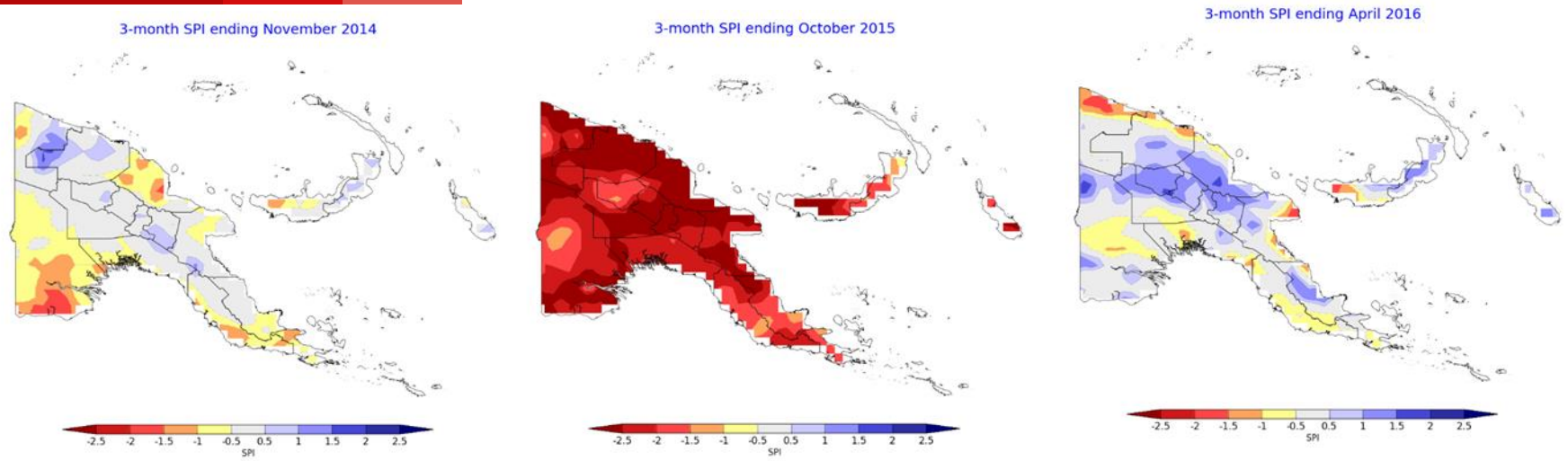
Indices: SPI, NDVI, VHI

Drought Detection over Papua New Guinea Using Satellite-Derived Products

- Study on how satellite-based products perform over PNG, focusing on the 2015-2016 drought event.
- Evaluated rainfall products (raw rainfall, % of normal, SPI) as well as some other remotely-sensed variables (VHI, NDVI, soil moisture, OLR).
- VHI, SPI were most valuable.

Chua, Z.-W.; Kuleshov, Y.; Watkins, A.B. Drought Detection over Papua New Guinea Using Satellite-Derived Products. *Remote Sensing*, 2020, 12, 3859. https://doi.org/10.3390/rs12233859

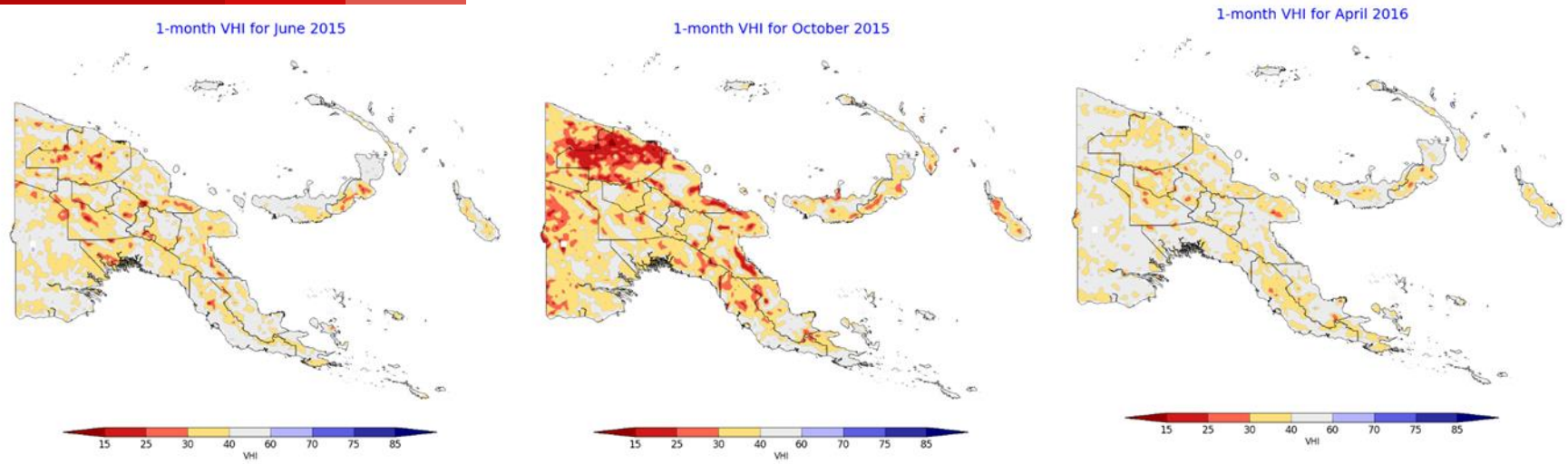
Drought Monitoring Using SWCEM Products: PNG



a b c

3-month SPI showing the progression of drought event in PNG: (a) November 2014 - initial signs of dry conditions towards the southeast of the mainland; (b) October 2015 - widespread severely dry conditions; (c) April 2016 - the easing of dry conditions.

Drought Monitoring Using SWCEM Products: PNG



a b c

1-month VHI values showing the progression of the 2015-2016 drought event in PNG: (a) June 2015 - the beginning of below-average vegetation health; (b) October 2015 - widespread areas of poor vegetation health; (c) April 2016 - easing of poor vegetation health.

Drought Detection over Papua New Guinea Using Satellite-Derived Products

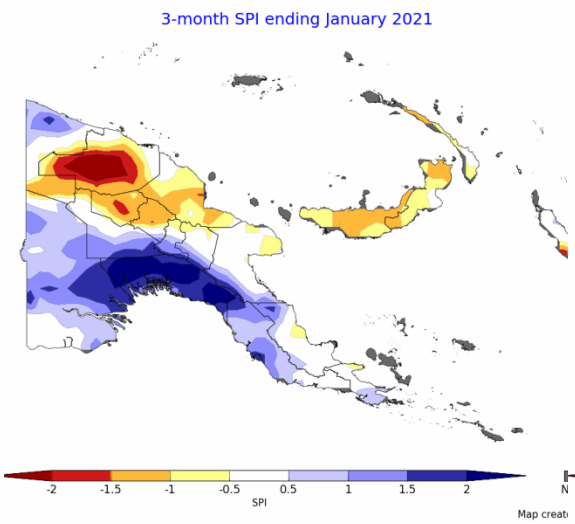
- Designed a Drought Early Warning System (EWS) based on SPI, VHI and rainfall forecast
- Could have provided 3-5 months of lead-time warning.

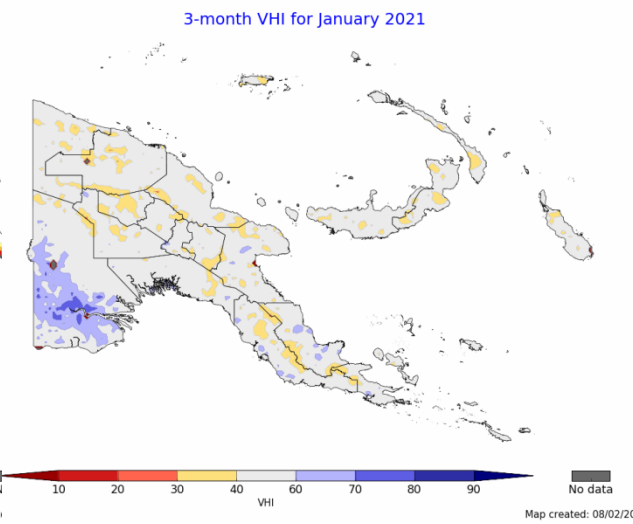
Bhardwaj, J.; Kuleshov, Y.; Chua, Z.-W.; Watkins, A.B.; Choy, S.; Sun, Q. Building Capacity for a User-Centred Integrated Early Warning System for Drought in Papua New Guinea. *Remote Sensing*. 2021, 13, 3307. https://doi.org/10.3390/rs13163307

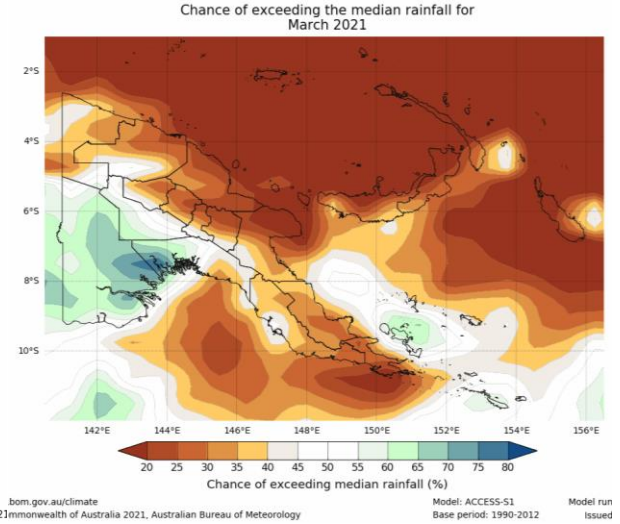
CREWS PNG: Drought EWS

Monitoring Inputs

Forecasting Inputs



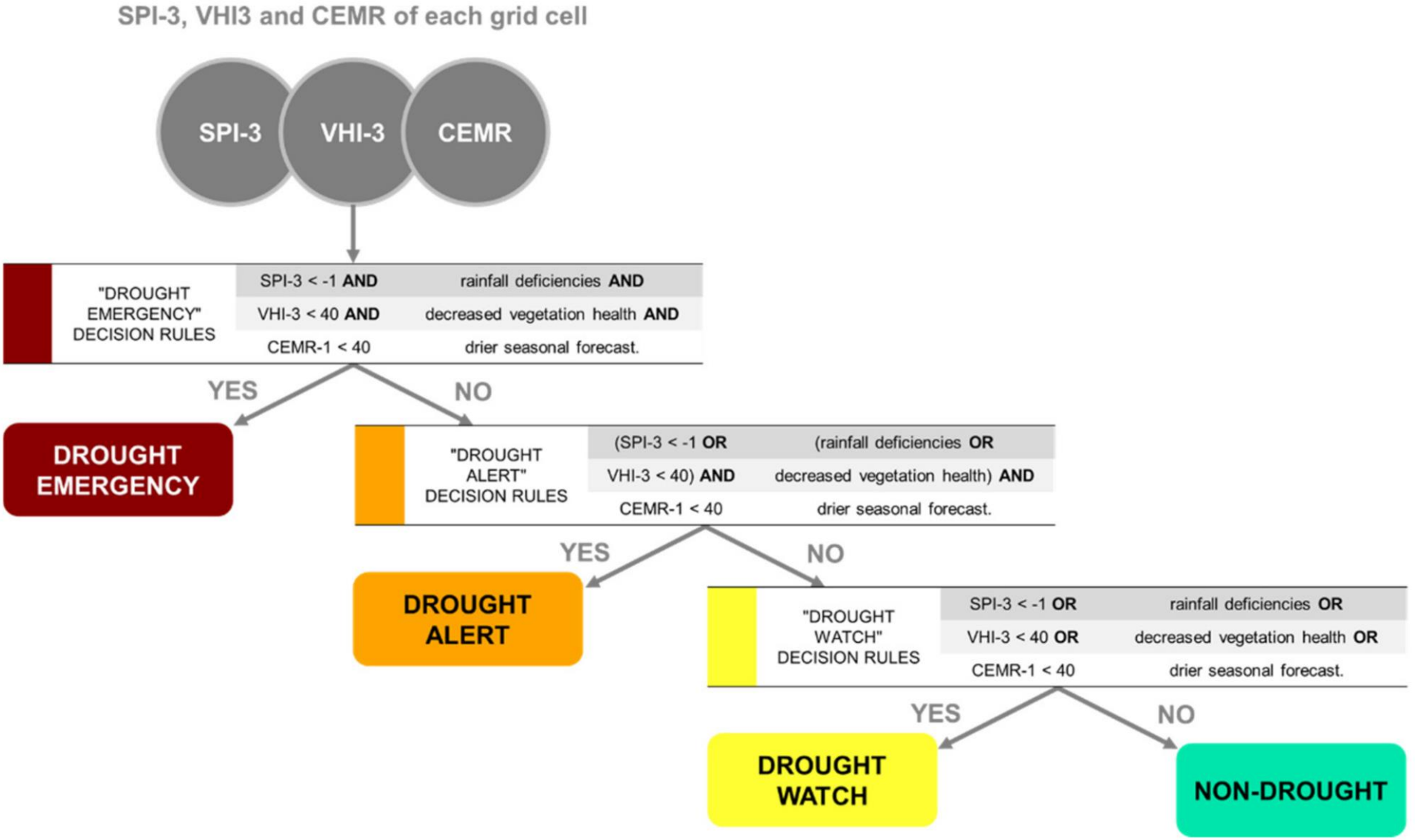




SWCEM: SPI **SWCEM: VHI** **WMO GPC LRFs: Rain**

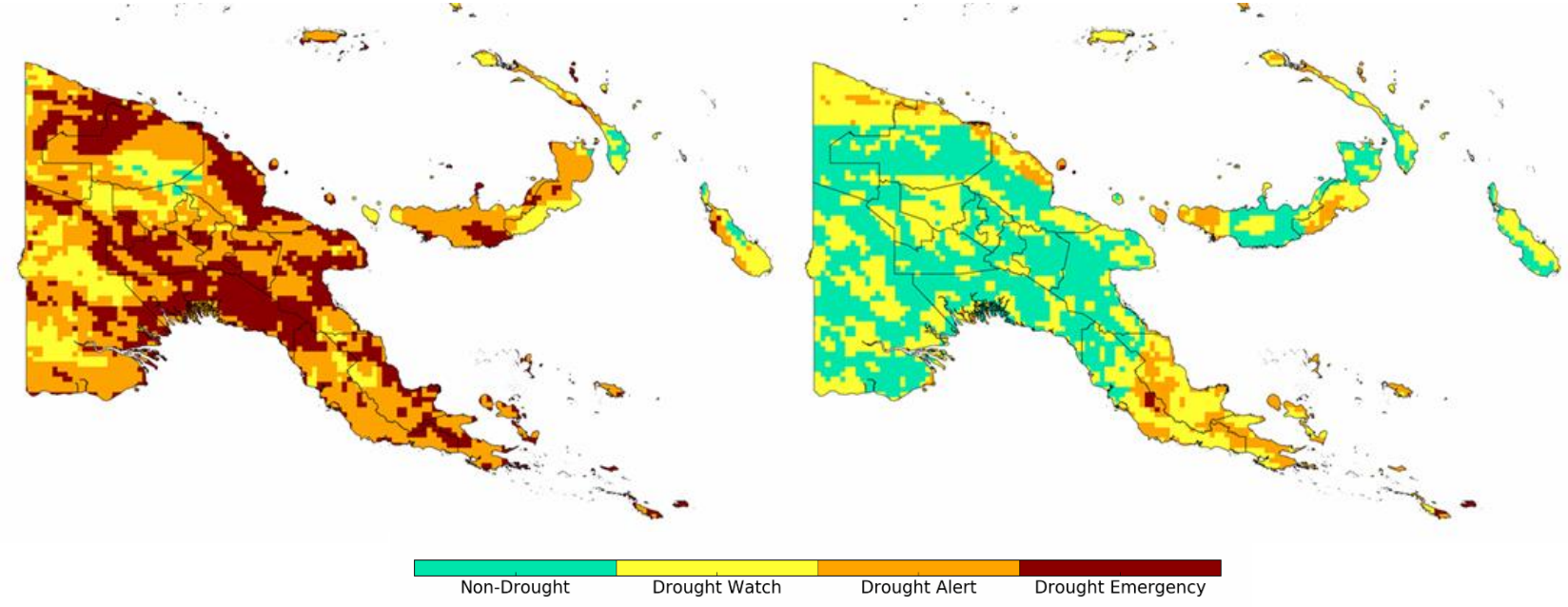
Drought EWS: SWCEM satellite-derived products - monitoring component and ACCESS-S S2S products – forecasting component

CREWS PNG: Drought EWS



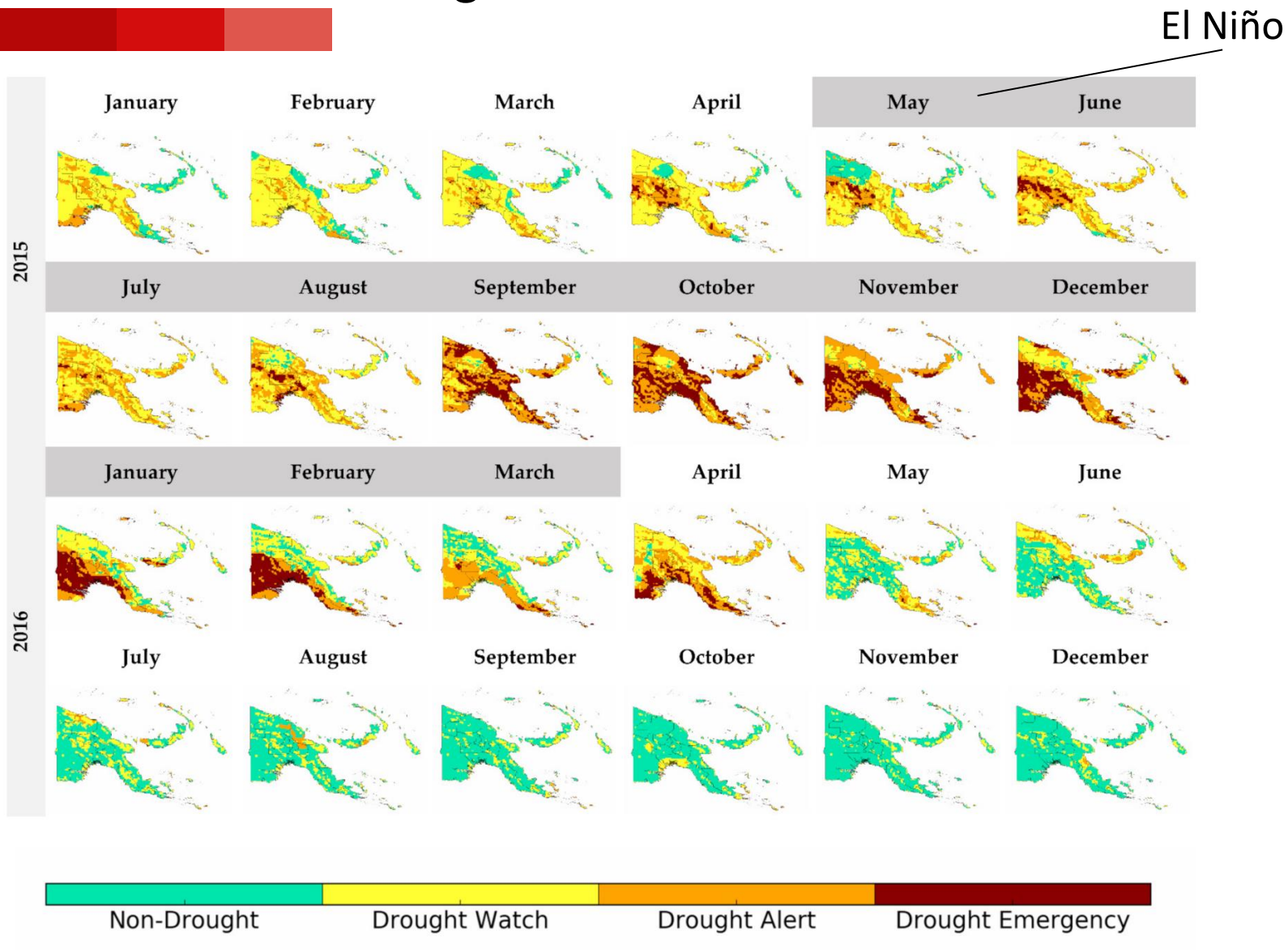
CREWS PNG: Drought EWS

The CREWS project developed drought EWS for PNG. It generates maps of staged drought early warning - Watch, Alert and Drought Emergency.

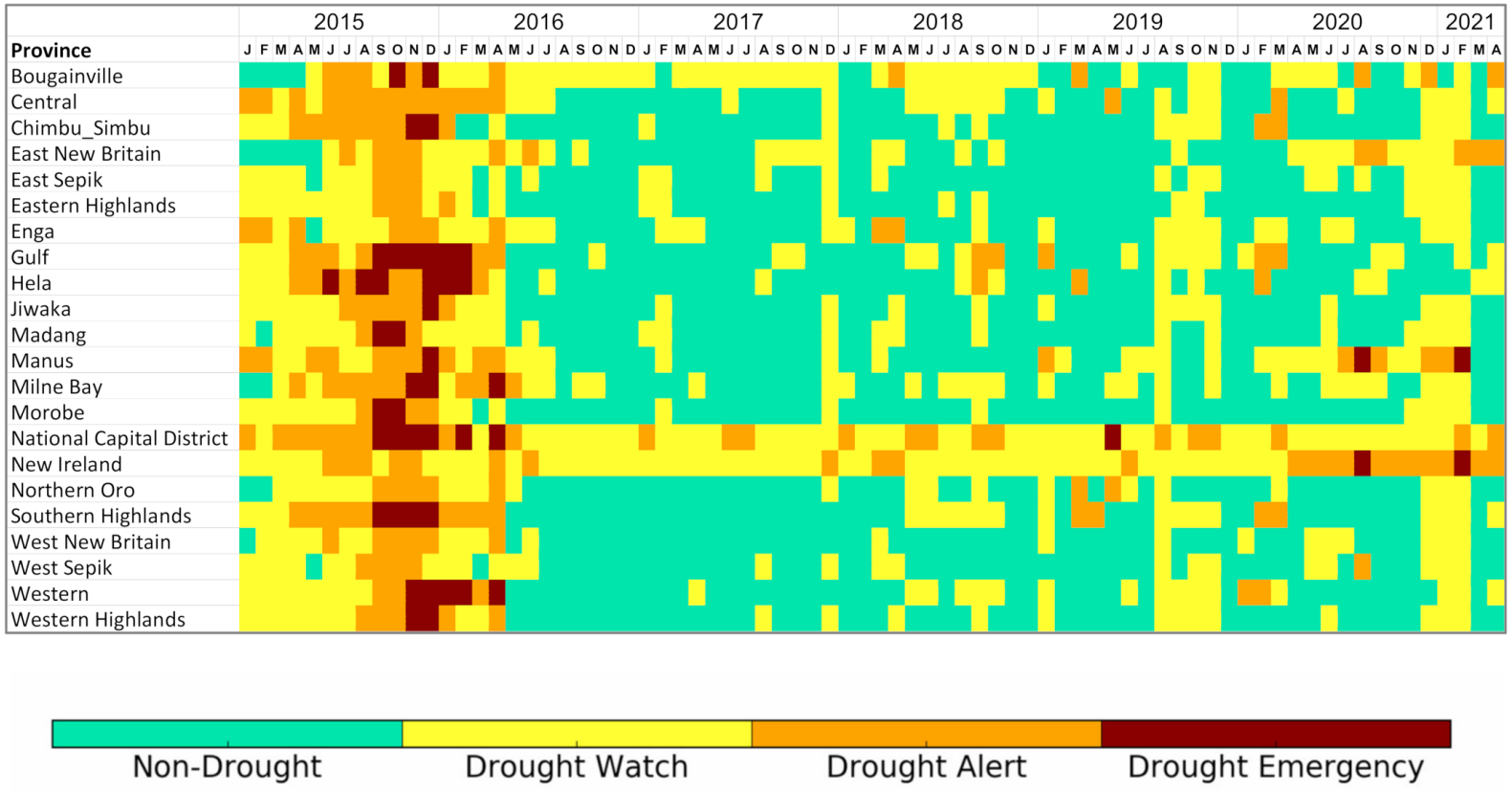


Maps of drought early warning for PNG for September 2015 and May 2016.

CREWS PNG: Drought EWS

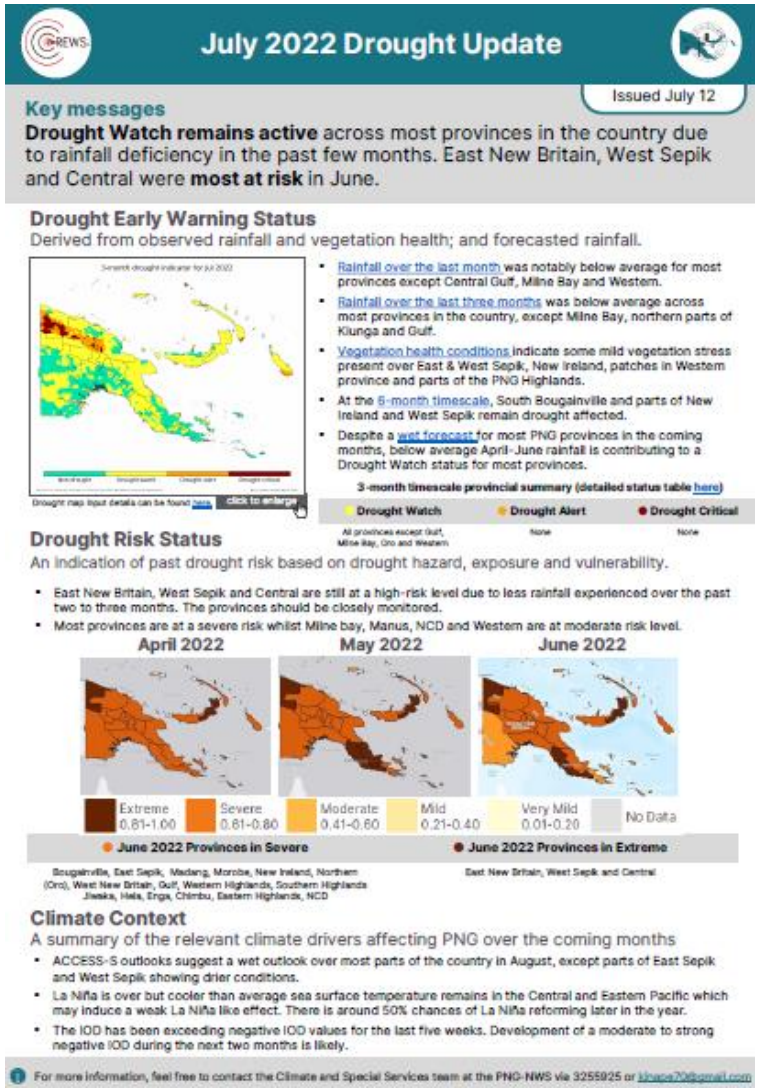


CREWS PNG: Drought EWS



Drought early warnings for 22 provinces in PNG for 2015-2021.

CREWS PNG Operational Product: Drought Update



July 2022 Drought Update

Issued July 12

Key messages

Drought Watch remains active across most provinces in the country due to rainfall deficiency in the past few months. East New Britain, West Sepik and Central were **most at risk** in June.

Drought Early Warning Status

Derived from observed rainfall and vegetation health; and forecasted rainfall.

- Rainfall over the last month was notably below average for most provinces except Central Gulf, Milne Bay and Western.
- Rainfall over the last three months was below average across most provinces in the country, except Milne Bay, northern parts of Klunga and Gulf.
- Vegetation health conditions indicate some mild vegetation stress present over East & West Sepik, New Ireland, patches in Western province and parts of the PNG Highlands.
- At the 6-month timescale, South Bougainville and parts of New Ireland and West Sepik remain drought affected.
- Despite a wet forecast for most PNG provinces in the coming months, below average April-June rainfall is contributing to a Drought Watch status for most provinces.

3-month timescale provincial summary (detailed status table here)

Drought Watch	Drought Alert	Drought Critical
All provinces except Gulf, Milne Bay, Oro and Western	None	None

Drought Risk Status

An indication of past drought risk based on drought hazard, exposure and vulnerability.

- East New Britain, West Sepik and Central are still at a high-risk level due to less rainfall experienced over the past two to three months. The provinces should be closely monitored.
- Most provinces are at a severe risk whilst Milne bay, Manus, NCD and Western are at moderate risk level.

April 2022 | May 2022 | June 2022

Extreme 0.81-1.00 | Severe 0.61-0.80 | Moderate 0.41-0.60 | Mild 0.21-0.40 | Very Mild 0.01-0.20 | No Data

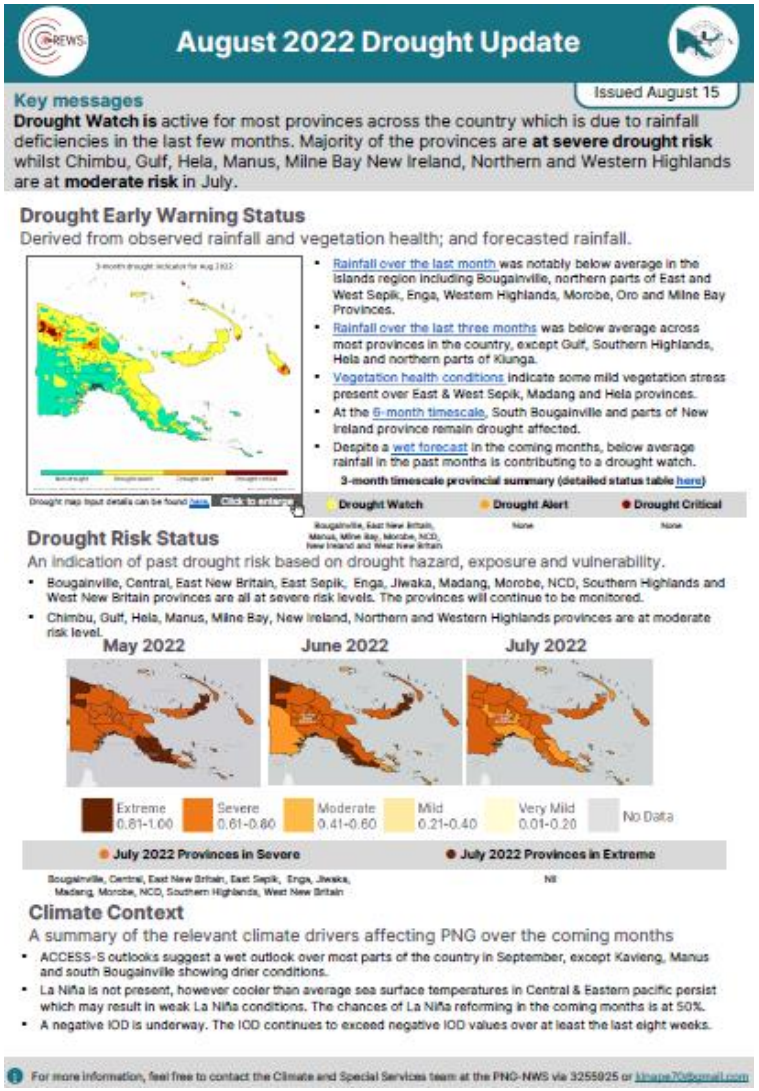
June 2022 Provinces in Severe	June 2022 Provinces in Extreme
Bougainville, East Sepik, Madang, Morobe, New Ireland, Northern (Oro), West New Britain, Gulf, Western Highlands, Southern Highlands Jiwaka, Hela, Enga, Chimbu, Eastern Highlands, NCD	East New Britain, West Sepik and Central

Climate Context

A summary of the relevant climate drivers affecting PNG over the coming months

- ACCESS-S outlooks suggest a wet outlook over most parts of the country in August, except parts of East Sepik and West Sepik showing drier conditions.
- La Niña is over but cooler than average sea surface temperature remains in the Central and Eastern Pacific which may induce a weak La Niña like effect. There is around 50% chances of La Niña reforming later in the year.
- The IOD has been exceeding negative IOD values for the last five weeks. Development of a moderate to strong negative IOD during the next two months is likely.

For more information, feel free to contact the Climate and Special Services team at the PNG-NWS via 3255925 or klnape70@gmail.com



August 2022 Drought Update

Issued August 15

Key messages

Drought Watch is active for most provinces across the country which is due to rainfall deficiencies in the last few months. Majority of the provinces are **at severe drought risk** whilst Chimbu, Gulf, Hela, Manus, Milne Bay New Ireland, Northern and Western Highlands are at **moderate risk** in July.

Drought Early Warning Status

Derived from observed rainfall and vegetation health; and forecasted rainfall.

- Rainfall over the last month was notably below average in the islands region including Bougainville, northern parts of East and West Sepik, Enga, Western Highlands, Morobe, Oro and Milne Bay Provinces.
- Rainfall over the last three months was below average across most provinces in the country, except Gulf, Southern Highlands, Hela and northern parts of Klunga.
- Vegetation health conditions indicate some mild vegetation stress present over East & West Sepik, Madang and Hela provinces.
- At the 6-month timescale, South Bougainville and parts of New Ireland province remain drought affected.
- Despite a wet forecast in the coming months, below average rainfall in the past months is contributing to a drought watch.

3-month timescale provincial summary (detailed status table here)

Drought Watch	Drought Alert	Drought Critical
Bougainville, East New Britain, Manus, Milne Bay, Morobe, NCD, New Ireland and West New Britain	None	None

Drought Risk Status

An indication of past drought risk based on drought hazard, exposure and vulnerability.

- Bougainville, Central, East New Britain, East Sepik, Enga, Jiwaka, Madang, Morobe, NCD, Southern Highlands and West New Britain provinces are all at severe risk levels. The provinces will continue to be monitored.
- Chimbu, Gulf, Hela, Manus, Milne Bay, New Ireland, Northern and Western Highlands provinces are at moderate risk level.

May 2022 | June 2022 | July 2022

Extreme 0.81-1.00 | Severe 0.61-0.80 | Moderate 0.41-0.60 | Mild 0.21-0.40 | Very Mild 0.01-0.20 | No Data

July 2022 Provinces in Severe	July 2022 Provinces in Extreme
Bougainville, Central, East New Britain, East Sepik, Enga, Jiwaka, Madang, Morobe, NCD, Southern Highlands, West New Britain	Nil

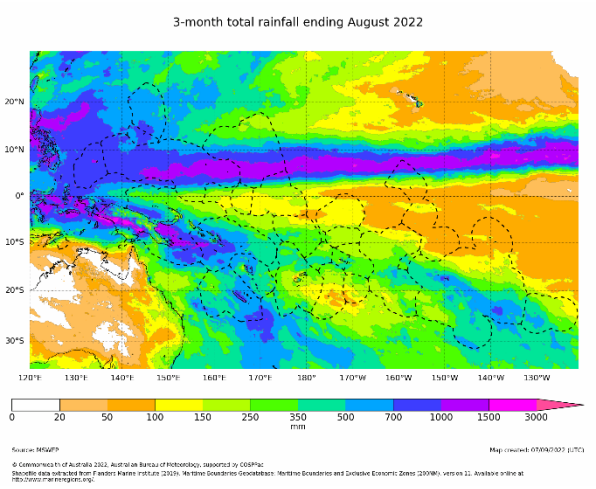
Climate Context

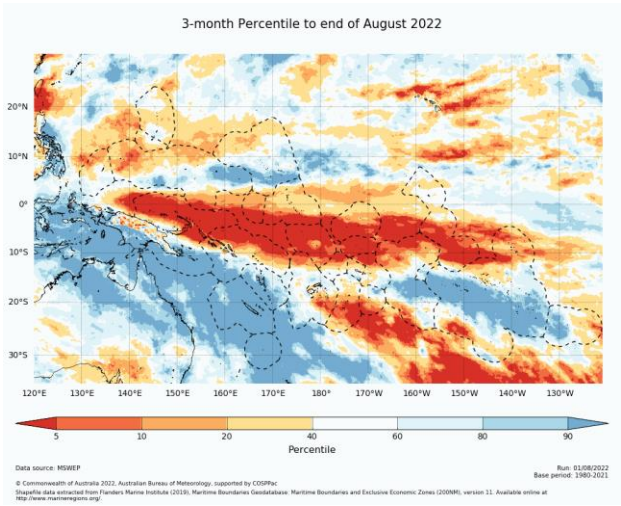
A summary of the relevant climate drivers affecting PNG over the coming months

- ACCESS-S outlooks suggest a wet outlook over most parts of the country in September, except Kavieng, Manus and south Bougainville showing drier conditions.
- La Niña is not present, however cooler than average sea surface temperatures in Central & Eastern pacific persist which may result in weak La Niña conditions. The chances of La Niña reforming in the coming months is at 50%.
- A negative IOD is underway. The IOD continues to exceed negative IOD values over at least the last eight weeks.

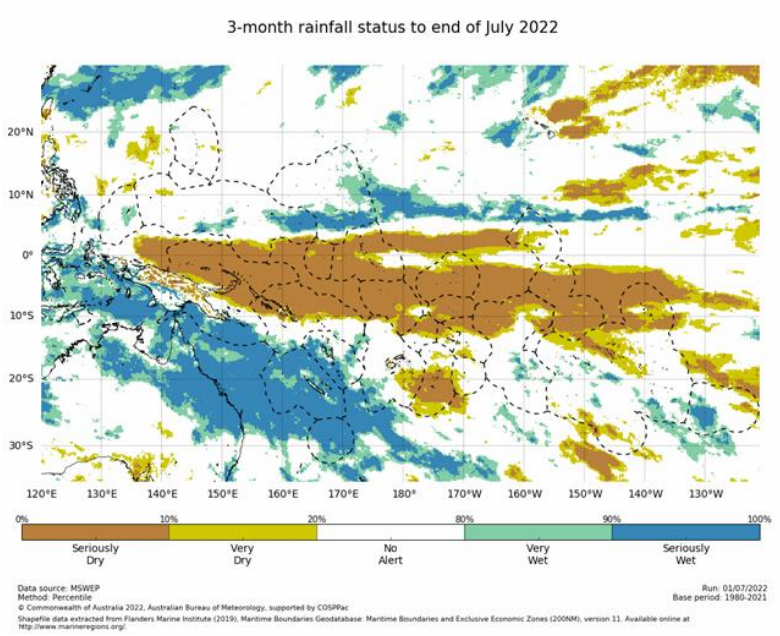
For more information, feel free to contact the Climate and Special Services team at the PNG-NWS via 3255925 or klnape70@gmail.com

Climate and Ocean Support Program in the Pacific (COSPPac) EAR Watch monitoring



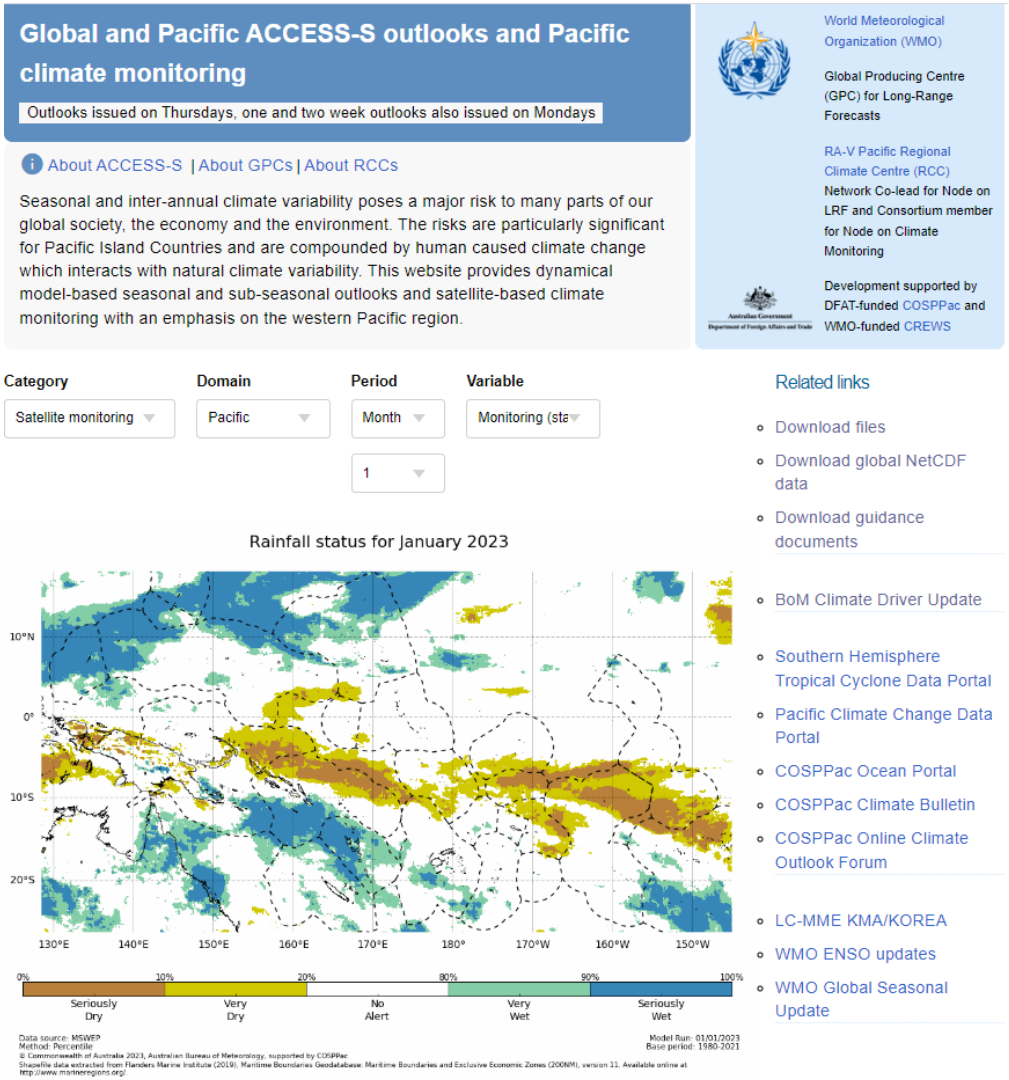


- Provide blended satellite data for monitoring rainfall over Pacific countries every month.



Global and Pacific ACCESS-S outlooks and Pacific climate monitoring portal

- http://www.bom.gov.au/climate/pacific/outlooks/



Recommendations

Assisting Most Vulnerable Countries with Climate Change Adaptation

Climate Risk and Early Warning Systems (CREWS) International Initiative helps SIDS and LDCs with climate change adaptation.

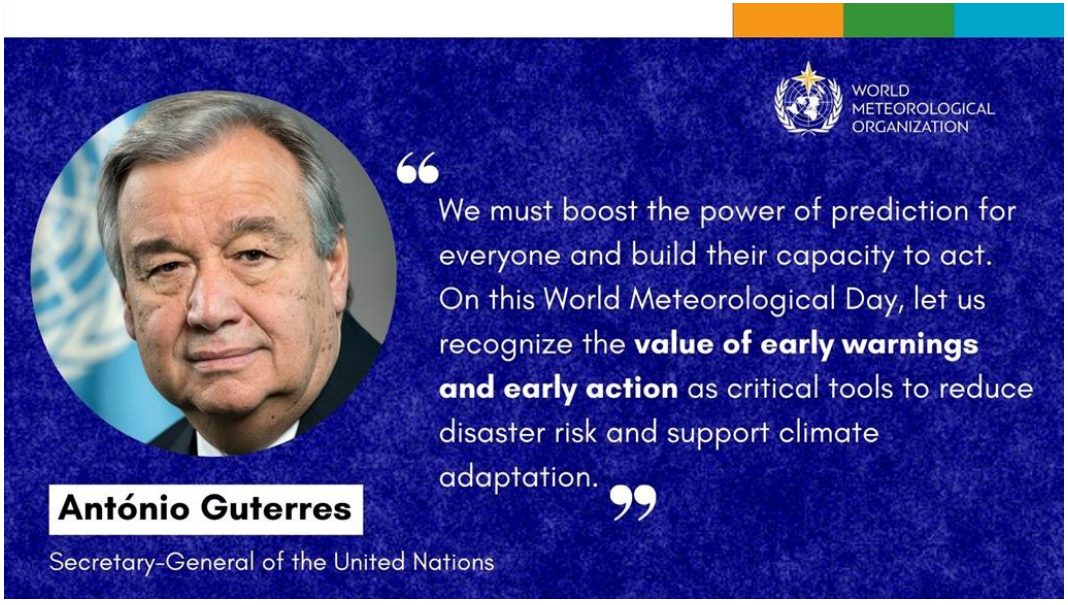
Strengthening Observing System

Space-based observations provide valuable information on a global scale and complement surface-based observations (this is particularly important for SIDS and LDCs).

Incorporate SWCEM satellite precipitation estimates and derived products to enhance drought monitoring and EWS

Early Warning and Early Action – EW4A

UN unveils ambitious target to adapt to climate change and more extreme weather



CREWS and WMO SWCEM are important contributors to the UN initiative EW4A:

"Early warning systems must protect everyone within five years".

We invite countries in the Indo-Pacific Region to work with us on developing Early Warning Systems to help protect populations from climate hazards and build resilience.