PAPUA NEW GUINEA

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Modelled Impacts of Taro Yields Under Different Climate Scenarios

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Motivation

1. Most of the population of PNG relies on subsistence agriculture for food security, with roots and tubers forming the staple of local diets **(Benny et al., 2022, Schmidt et all., 2009/2010 HIES).**

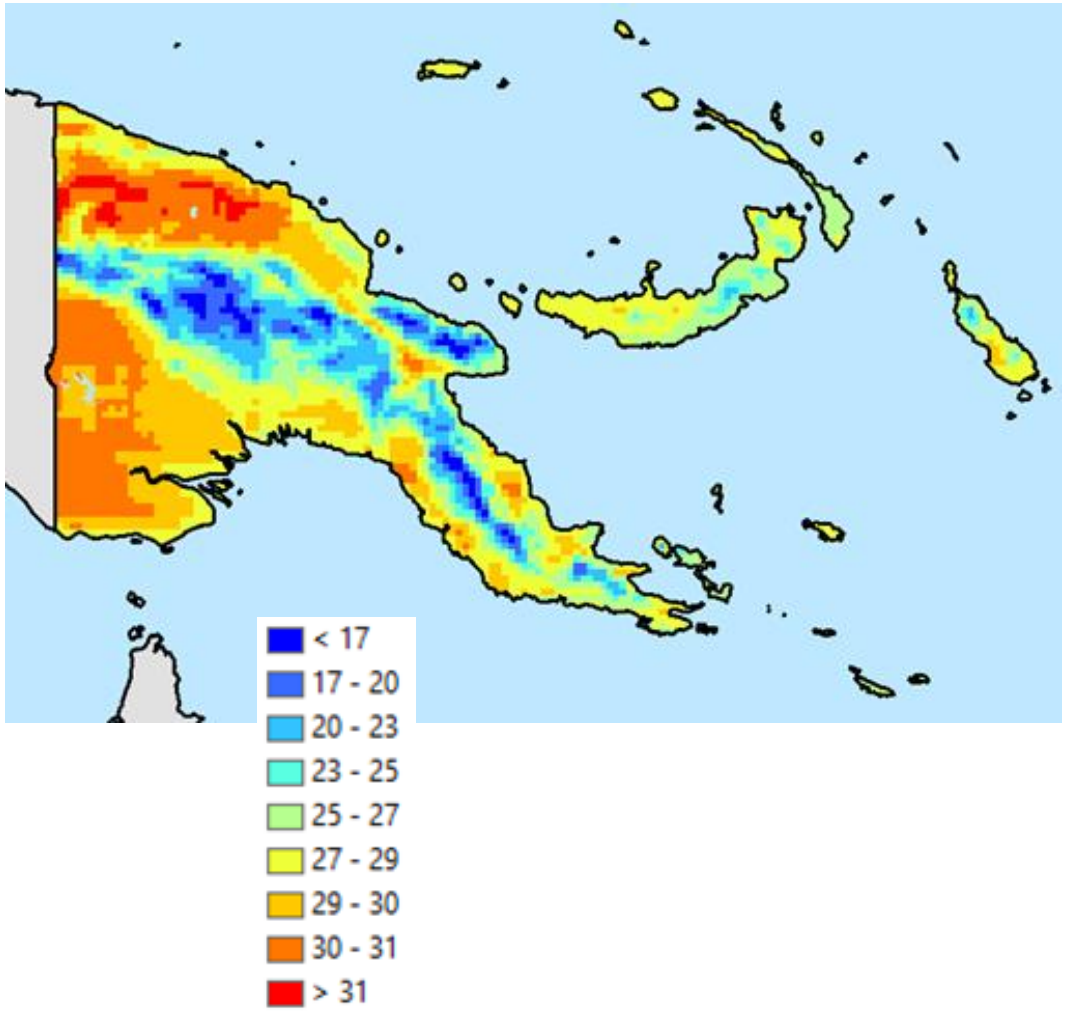
2. Despite the importance of taro to national food security, there is limited understanding of how climate change will affect taro yields in PNG. We found only one study which investigated these impacts **(Rosegrant et al., 2015)**, and that was done based on earlier climate models.

Given the dependence of rural households on taro, improving the understanding of climate risks to this crop is critical for designing effective adaptation strategies and supporting food security planning

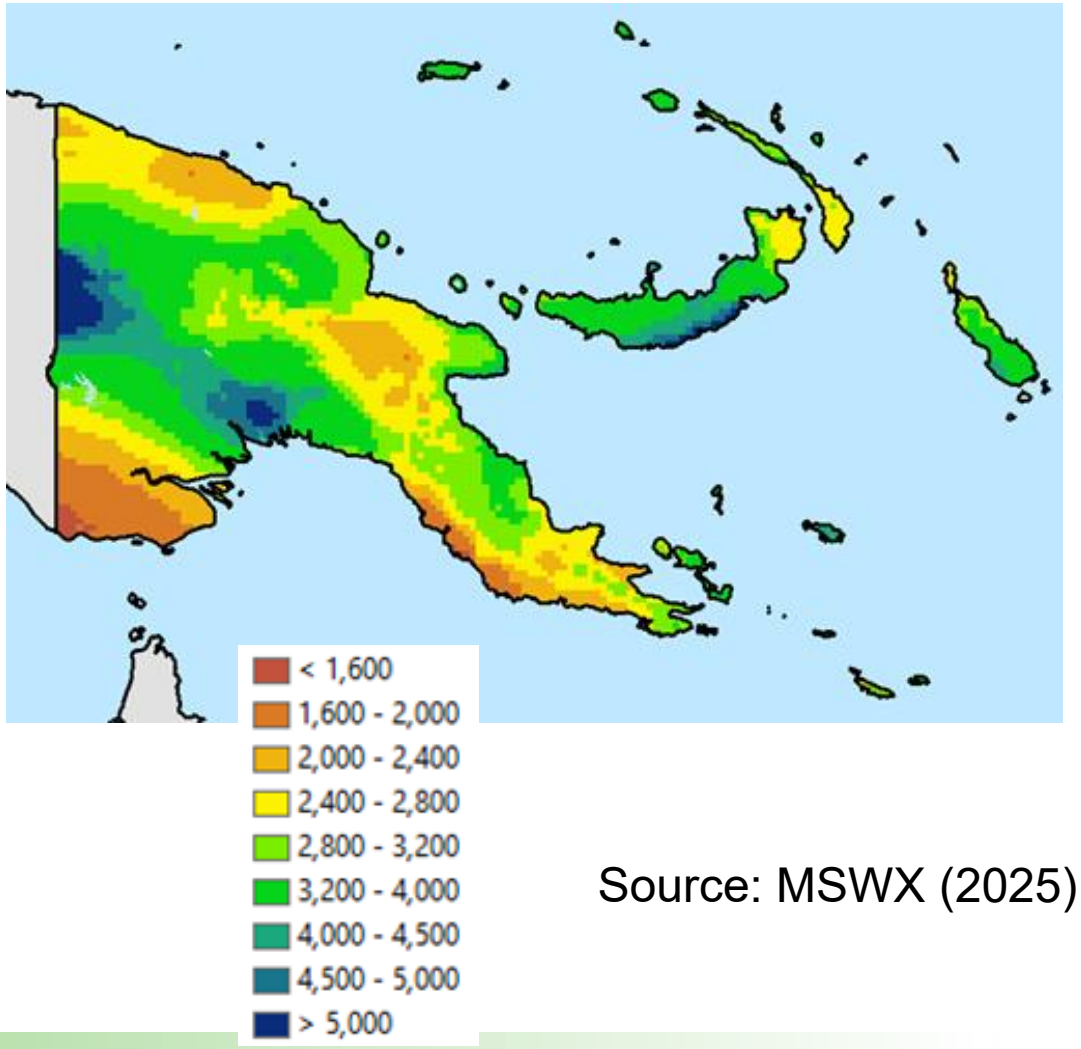
Historical averages and trends

Climate averages, 1990-2020, show influence of mountains and coasts

Mean daily maximum temperature, ^{0}C



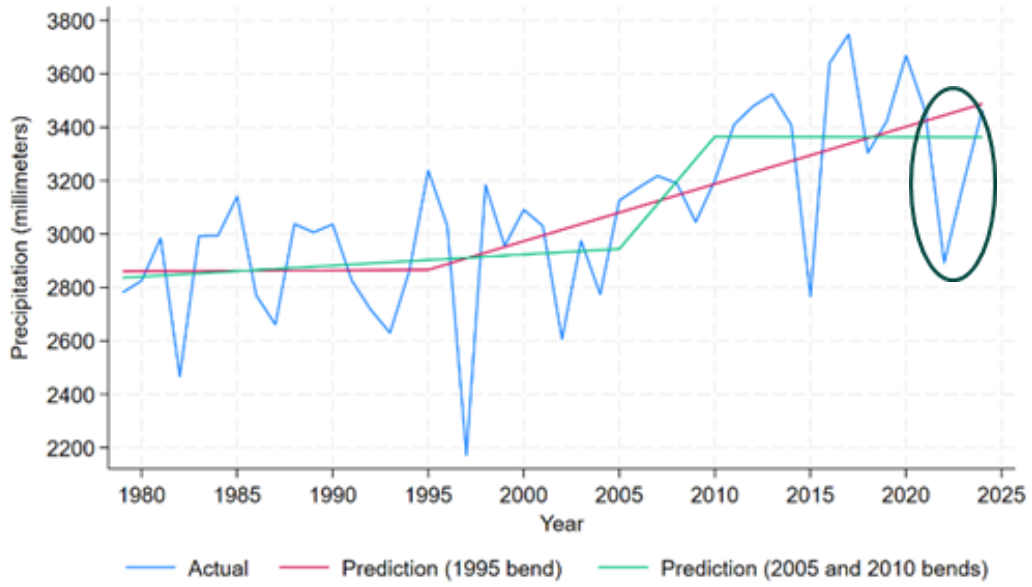
Annual precipitation, millimeters



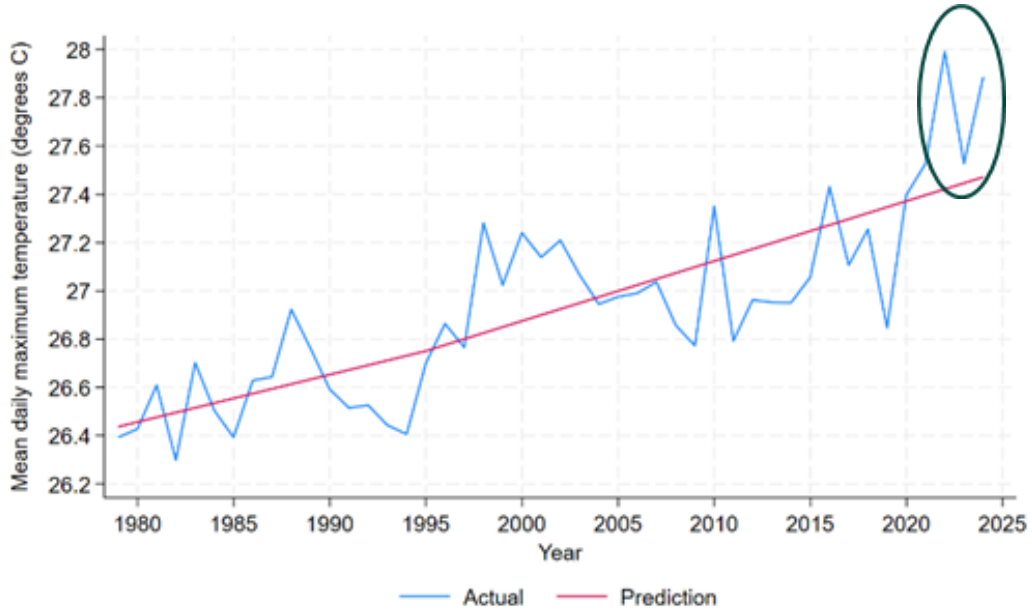
Source: MSWX (2025).

Annual climate variability and trends, PNG, 1979-2024, show large increases in rainfall and modest temperature rise

Annual precipitation, millimeters



Mean daily maximum temperature, ^{0}C

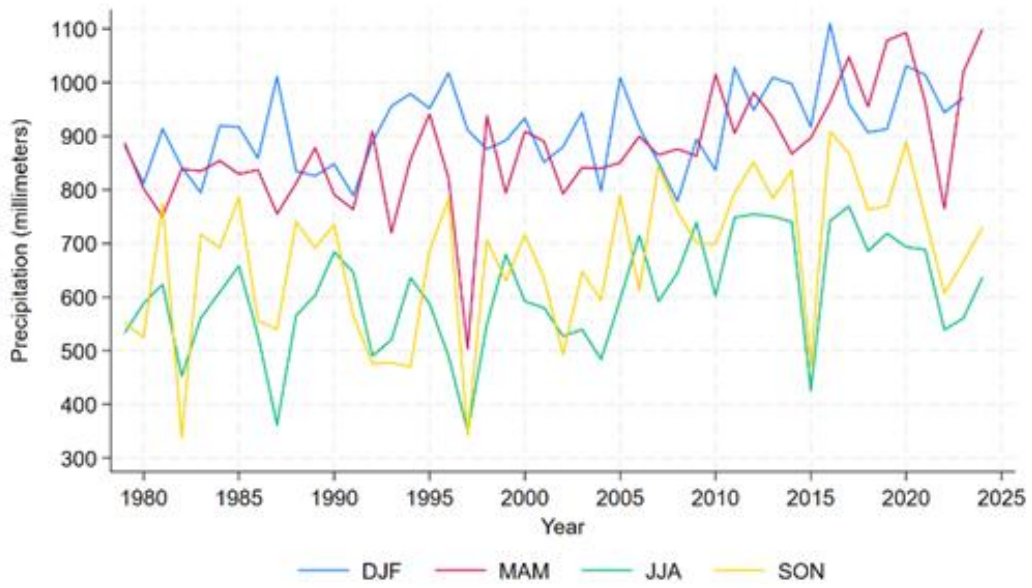


1) Depending on how we compute the trend, precipitation has risen 400-600 millimeters since 1995.
2) Anomaly noted 2020-2024 due in part to La Nina and El Nino. Unclear if is will return to previous trajectory.

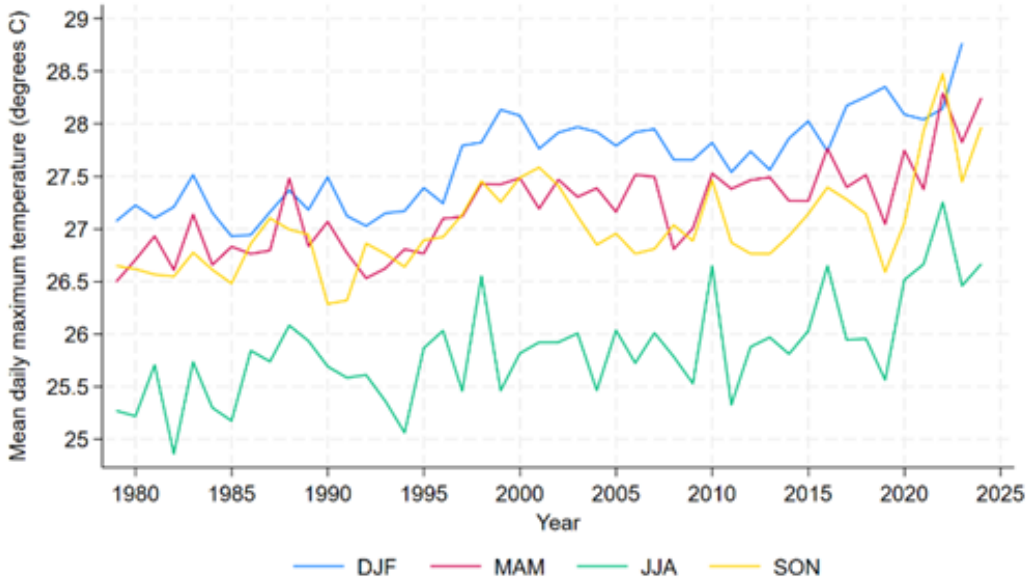
Source: MSWX (2025).

Precipitation and temperature by season, 1979-2024, shows the length of some droughts and seasonality and variability

Annual precipitation, millimeters



Mean daily maximum temperature, ^{0}C

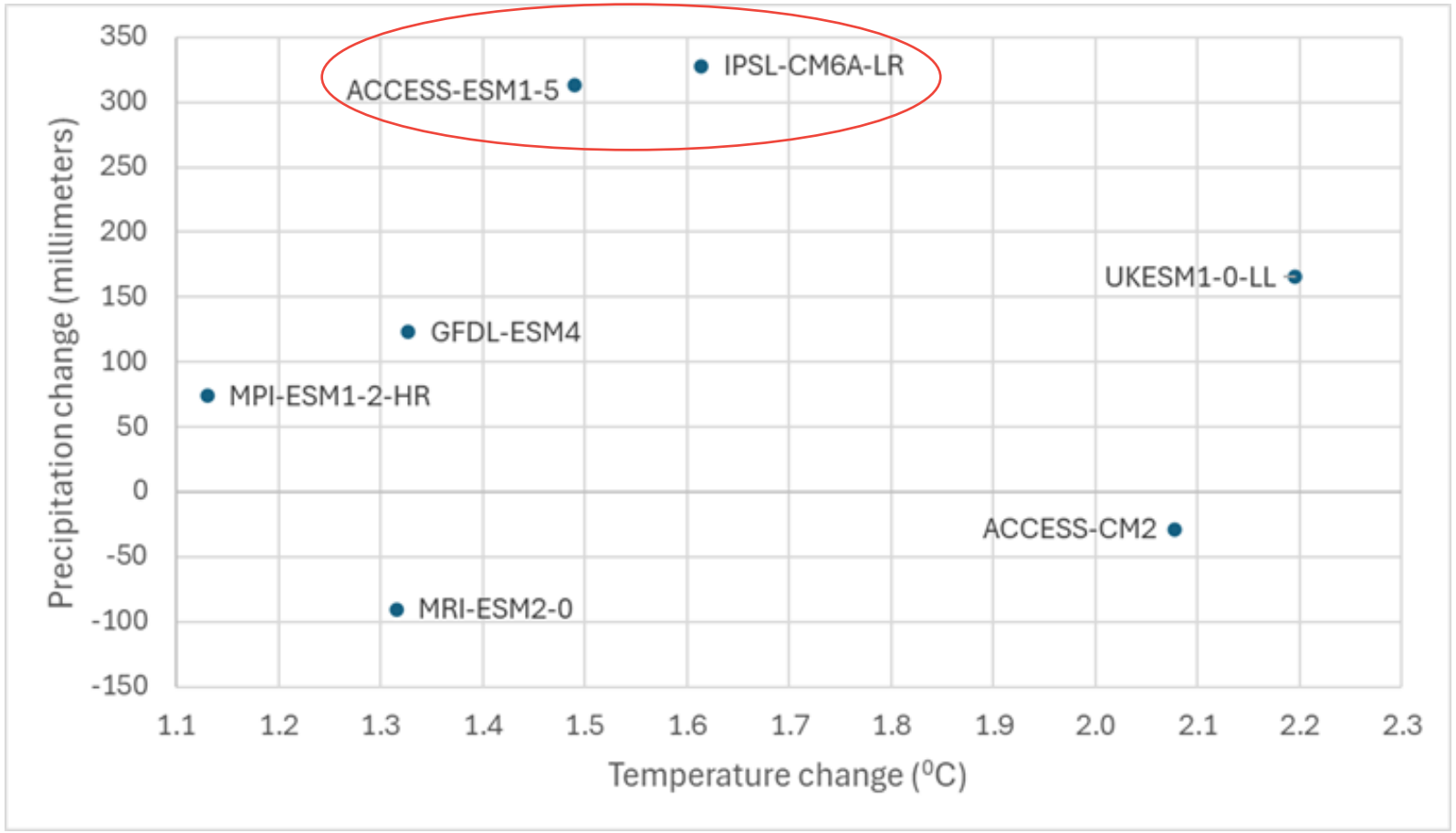


1) "DJF" means December through February. "MAM" means March through May. "JJA" means June through August. And "SON" means September through December.
2) Can see significant droughts in 1997, 2015, and 2022 (led by MAM)
3) Less variability noted in DJF

Source: MSWX (2025).

Climate projections into the future

Change in precipitation and temperature in key climate models in PNG, 2000-2050

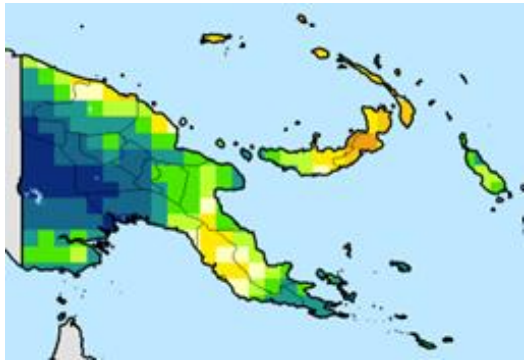


1) 5 models part of CMIP effort to downscale IPCC climate models (GFDL, IPSL, MPI, MRI, and UK).
2) Comparing with 2 models from CSIRO.
3) Best models reflecting rise in PNG precipitation are IPSL and ACCESS-ESM1-5.

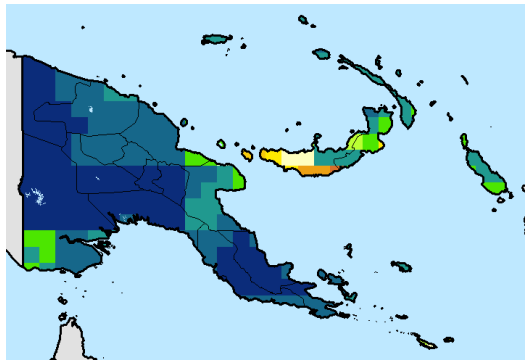
Source: NASA (2021).

Change in precipitation (millimeters) in key climate models, circa 2000-2050, gridded

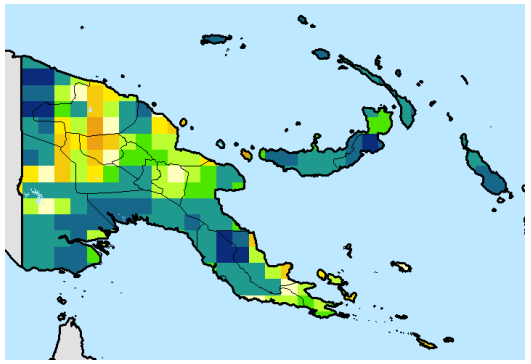
GFDL-ESM4



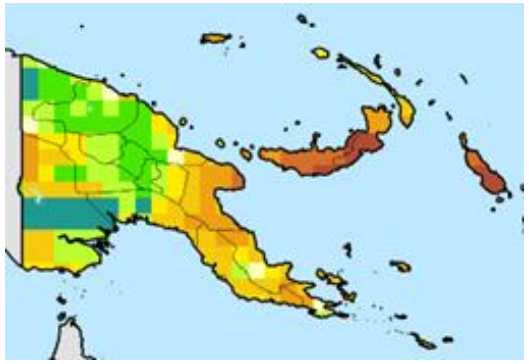
IPSL-CM6A-LR



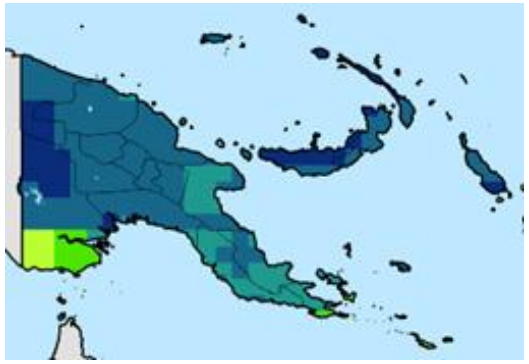
MPI-ESM1-2-HR



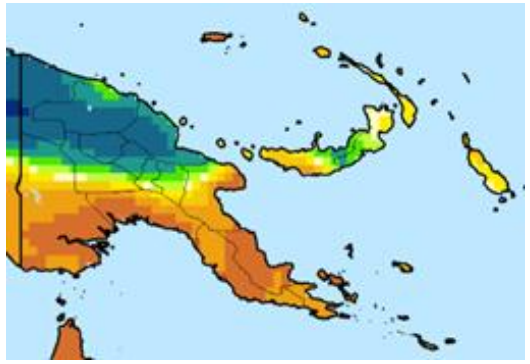
MRI-ESM2-0



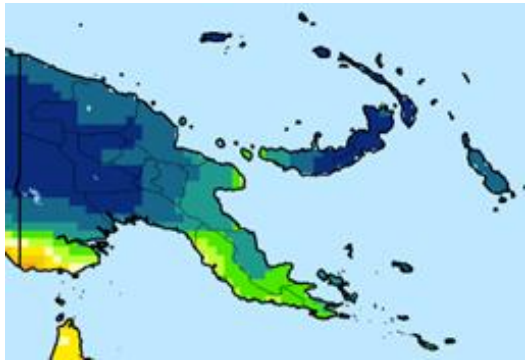
UKESM1-0-LL



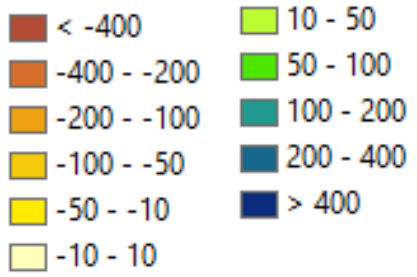
ACCESS-CM2



ACCESS-ESM1-5

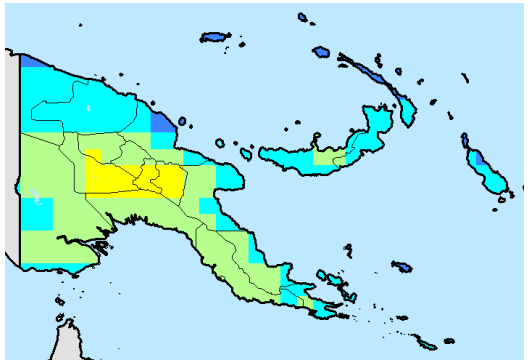


Source: NASA (2021) and ISIMIP (2021).

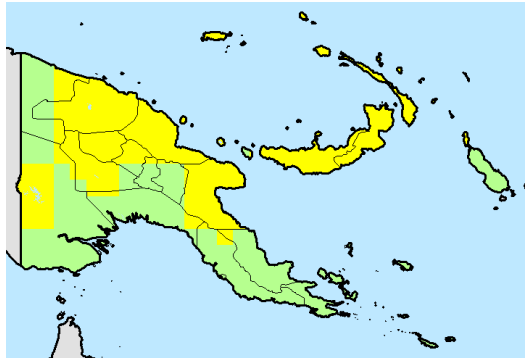


Change in temperature (^{0}C) in key climate models, circa 2000-2050, gridded

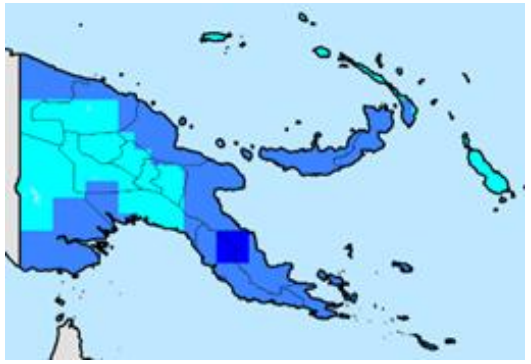
GFDL-ESM4



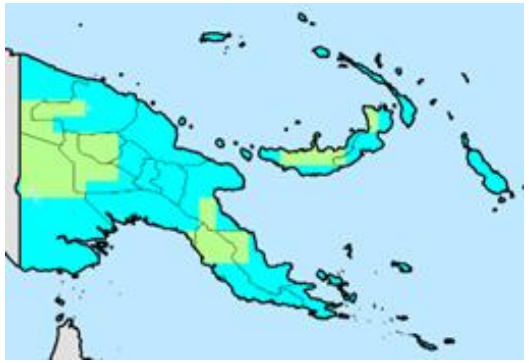
IPSL-CM6A-LR



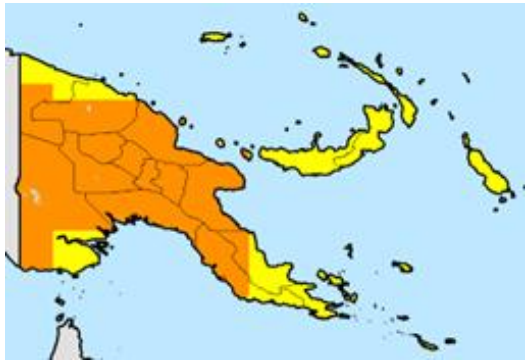
MPI-ESM1-2-HR



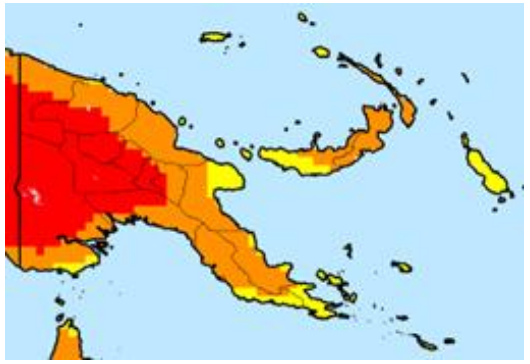
MRI-ESM2-0



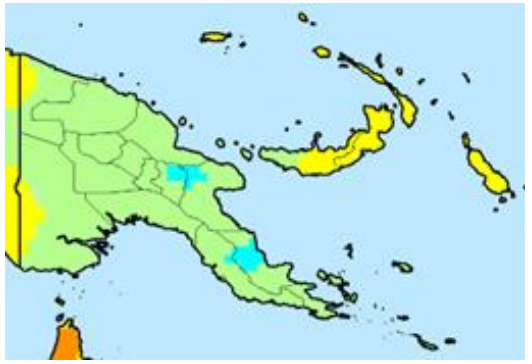
UKESM1-0-LL



ACCESS-CM2



ACCESS-ESM1-5



Source: NASA (2021) and ISIMIP (2021).

< 0.7
0.7 - 1
1 - 1.3
1.3 - 1.6
1.6 - 1.9
1.9 - 2.2
> 2.2

Taro yield change from climate change

How does the DSSAT crop model work?

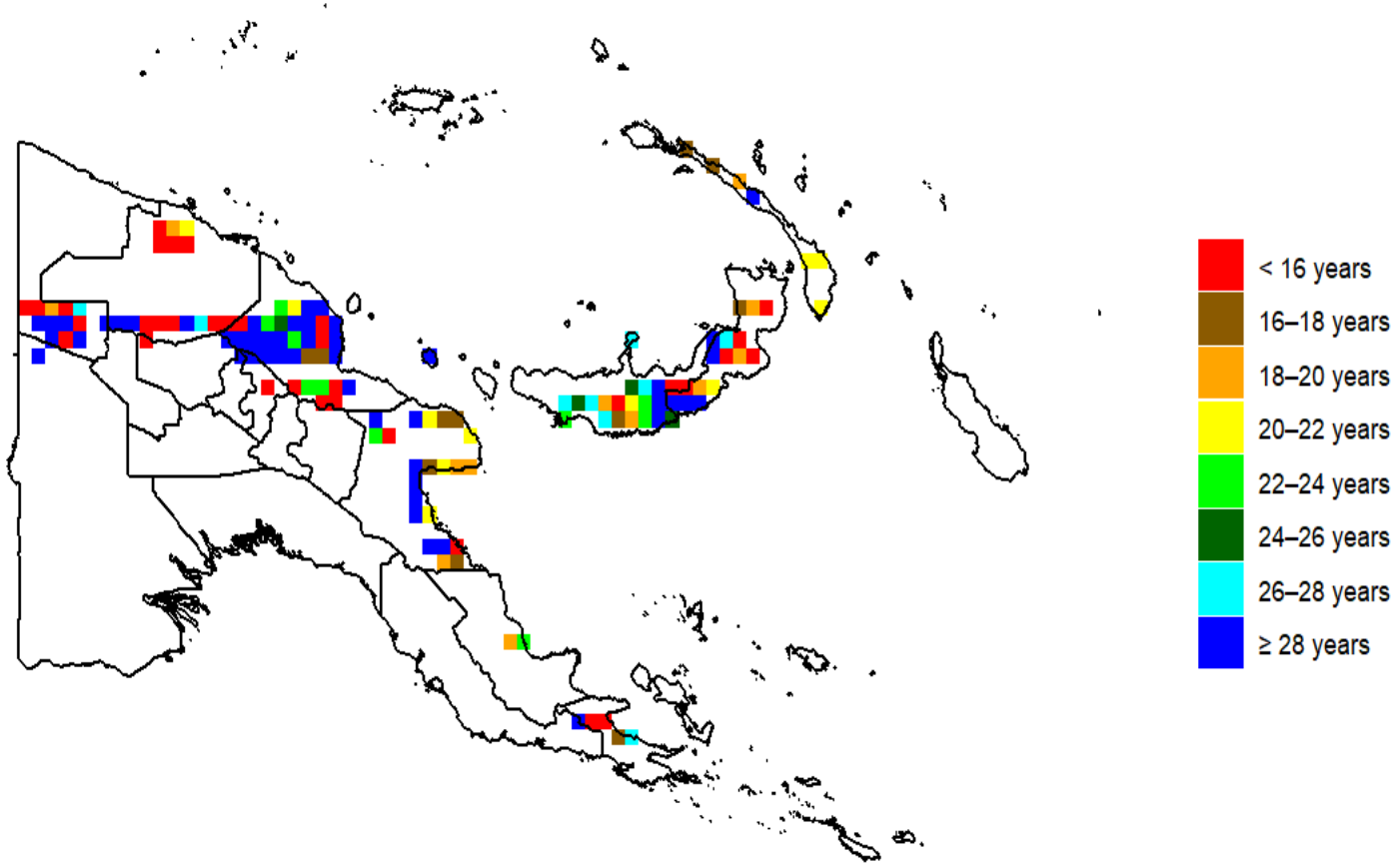
- It “grows” the crop in daily time steps
- You must tell it information about the soil and farm management
- You give it monthly statistics on rainfall, daily minimum and maximum temperatures, and solar radiation and it simulates daily weather
- We run it at least 20 times (because of the weather simulation)
- It keeps track of soil nutrients, soil moisture, and plant growth
- We run it for the starting climate of 2005 and for each of the future climates for 2050
- We compare yields between the two years

Percent change in taro yield from climate change by region, 2020-2050

Unit of analysis	IPSL	Median	Minimum	Maximum
Nation	1.1%	1.5%	-9.3%	7.5%
Highlands	5.8%	2.8%	-5.2%	5.8%
Islands	2.1%	2.1%	-8.7%	2.5%
Momase	0.9%	1.4%	-9.6%	9.8%
Southern	-2.1%	-2.9%	-8.2%	-0.1%

Source: Authors.

Frequency in 2050 of a 1-in-20-year low-yield event from 2020



Summary

- The IPSL model leads to the greatest projected reduction in taro yield (6.4%), with Southern region projected to have greater than 10% yield reduction. Across the 5 climate models, the median is 1.6% loss to 4.4% gain.
- Because of uncertainty across climate models and different impacts across regions, and potentially increasing climate variability, we recommend a range of options to help farmers.
- Examples:
  - Developing and testing crop varieties that would offer better yields whether the future is wetter or drier,
  - Varieties that are less sensitive to temperature extremes.
  - Farming techniques to protect crops during adverse climate events.

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