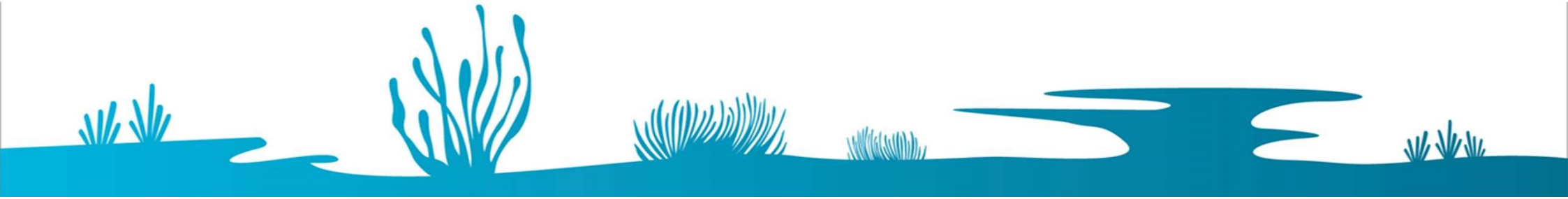
Climate and Oceans Support
Program in the Pacific

ACCESS-S Workshop

MODULE: Comparing SCOPIC and ACCESS-S predictions



Topics in this module

- The history of climate forecasting in the Pacific
- SCOPIC compared to ACCESS-S
- Climate change impacts on SCOPIC skill
- Detrending NINO3.4, how does this impact forecasts in 2021
- Comparing SCOPIC and ACCESS-S hindcast skill

Expected learning outcomes

- Understanding the history of seasonal prediction in the Pacific
- Understanding the advantages and disadvantages of SCOPIC and ACCESS-S

These outcomes are important for understanding why the Bureau is switching seasonal prediction from SCOPIC to ACCESS-S.

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History

Rainfall Outlook Probabilities for April - June 2000

Station Name	Dry (%)	33 % (mm)	Normal (%)	67 % (mm)	Wet (%)
Western Division					
Dobuilevu	14	422	35	591	51
Vatukoula	15	312	27	473	58
Rarawai	22	291	19	429	59
Penang	30	360	28	497	42
Lautoka	17	269	29	393	54
Nadi	21	254	34	367	45
Lomawai	13	246	42	349	45
Nacocolevu/Sigatoka	16	275	41	381	43
Olosara/Sigatoka	17	287	34	426	49
Yasawa-I-Rara	22	241	33	494	45
Central Division					
Navua	26	755	27	986	47
Suva	45	689	23	854	31
Nausori	35	634	32	820	33
Eastern Division					
Levuka	21	514	35	767	44
Lakeba	12	310	36	491	52
Matuku	48	353	22	457	30
Ono-I-Lau	16	254	36	420	48
Vunisea/Kadavu	7	488	55	605	38
Northern Division					
Korowiri/Labasa	6	350	54	455	40
Seaqaqa	13	332	40	512	47
Nabouwalu	11	479	39	639	50
Savusavu	16	427	25	629	59
Udu Point	42	402	32	546	26
Matei/Taveuni	15	519	30	691	55
Rotuma	41	741	32	899	27

- First seasonal outlook issued in a COSPPac partner country (Fiji Monthly Weather Summary) in April 2000
- Service in response to severe 1998 drought. BOM assistance begins in 1999.
- Statistical model based on statistical model schemes developed in Australia. Southern Oscillation Index values as Predictor. Rainfall (only) as predictand.

FMS Rainfall Prediction Model: *The FMS computerised model for rainfall prediction utilises combined historical monthly total rainfalls for selected sites in the various Divisions and the historical and current Southern Oscillation index values. It provides the probability of rainfall for the coming 3 months in three classes of below average, average and above average. The reliability of the model is high during the wet season (Nov-March) but decreases during the dry season (May-Sept) and during the transition months, April and October. The probabilities are given for selected individual sites in the four Divisions (Central, Western, Eastern, and Northern), and Rotuma.*

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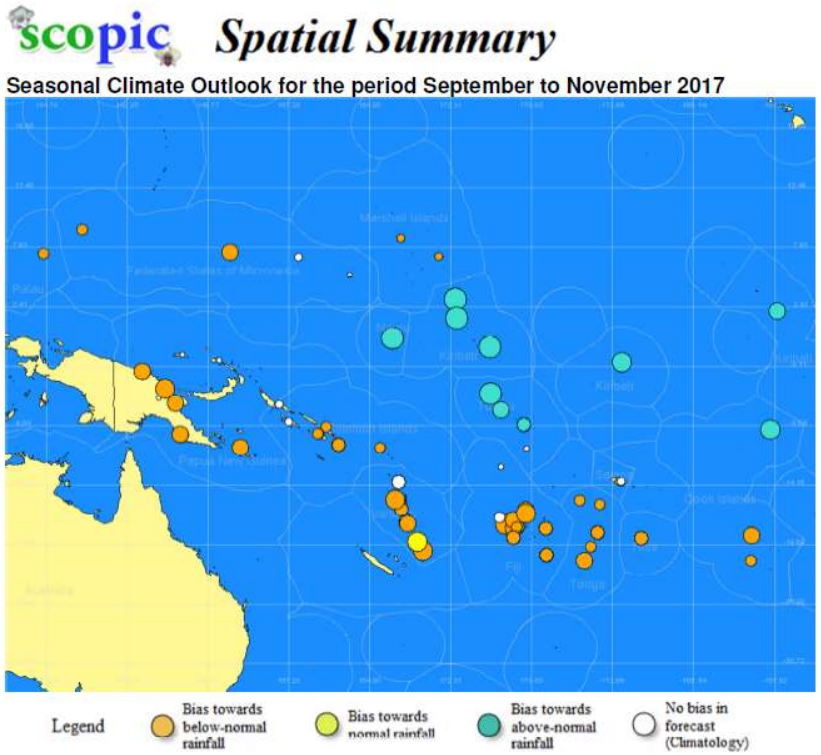
History



- DFAT funds Pacific Islands Climate Prediction Project from 2003. Based on FMS Rainfall Prediction Model success in Fiji. Can this be extended to other SW Pacific countries?
- SCOPIC gradually introduced in 10 SW Pacific countries (not Nauru)
- Additional Predictors added e.g. NINO34, SSTaEOFs
- Predictand options expanded to other variables e.g. maximum temperature (anything sensible to predict, point-based, ideally 30+ years of historical data)
- Hindcast training period set to use all predictand data as NMSs historical data not consistent in terms of length of record

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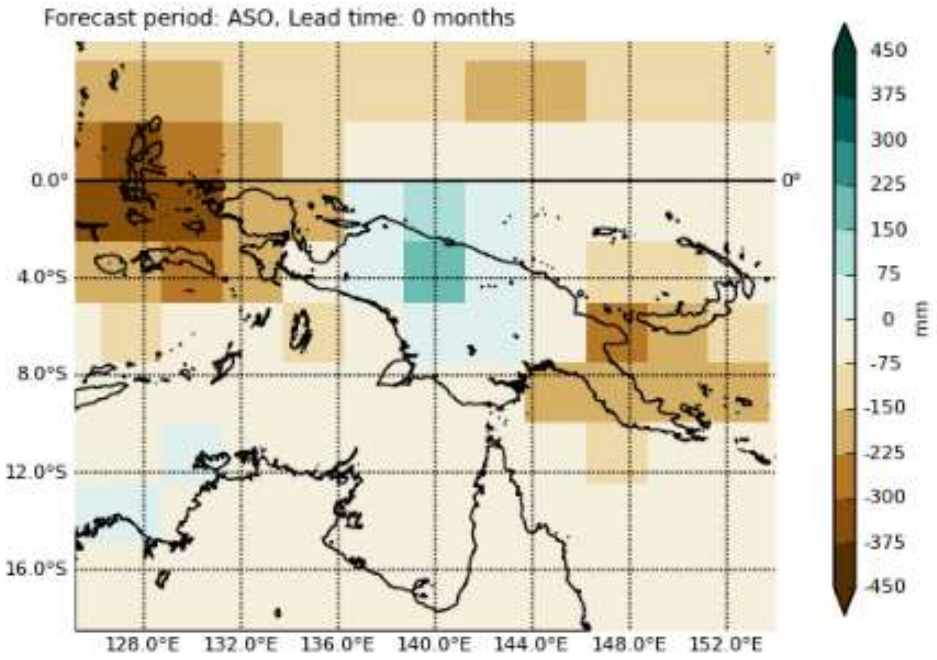
History



- POAMA dynamical predictions introduced during PASAP from 2009. Expanded/improved under PACCSAP program. Support continues under COSPPac.
- Outlooks available for multiple parameters (NINO indices, rain, SST, MSLP, sea level)
- Complete Pacific region covered, resolution 250 km x 250 km
- Monthly timescale for some parameters
- Rainfall downscaled to 'SCOPIC' station locations
- SST and sea level outlooks presented via BOM website and Ocean Portal
- Skill about the same as SCOPIC
- Issues with resolution. Large islands covered by one grid. POAMA didn't recognise topography.

SCOPIC

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Advantages

- Seasonal predictions with high skill possible for locations where there are long historical records and a strong relationship with ENSO
- Locally generated within a NMS. Uses local meteorological records therefore a good sense of ownership

Disadvantages

- Model driven by oceanic component of ENSO, there are other climate drivers
- Sub-seasonal predictions possible e.g. 1 and 2 month outlooks but not recommended as generally low skill. Gap between 7-day weather forecasts and seasonal outlooks
- Point-based
- Needs long, reliable near continuous historical data. Not possible for stations with short records.
- Model can only be run once a month. Mid-month updates not available during strong ENSO event.
- Uses complex statistics
- **Assumes the future will be similar to the past (assumes no climate change)**
- Skill unlikely to improve much with further development

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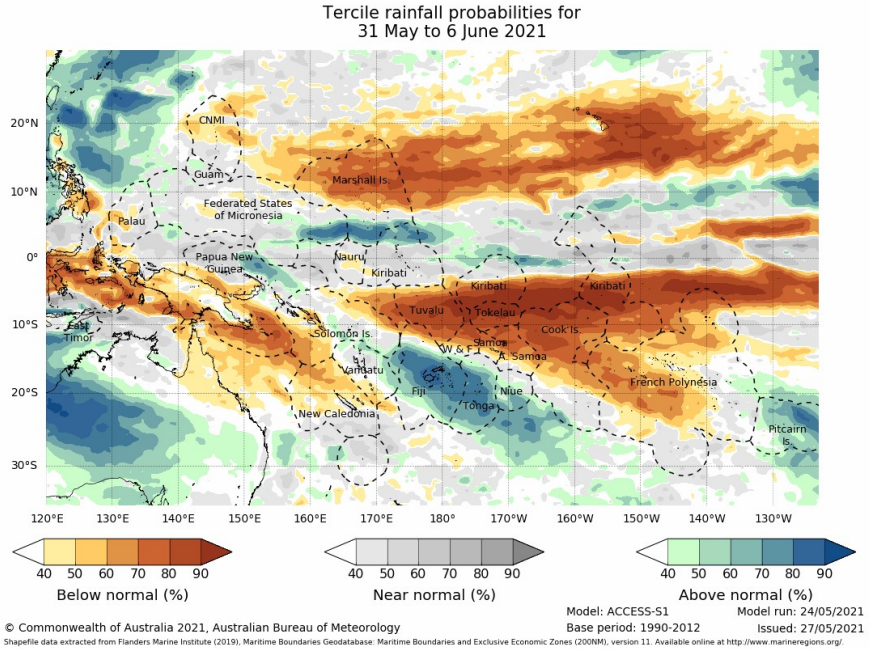
ACCESS-S

Advantages

- BOM is a Global Producing Centre for Long-Range Forecasts so required to make ACCESS-S outlooks available globally for as long as ACCESS-S is used in Australia
- One of the best global models. Built on UKMO GC2 model and improved further
- Sub-seasonal (week to month) predictions available, high skill at short lead times.
- Higher resolution 60 km x 60 km (atmosphere horizontal)
  25 km x 25 km (ocean horizontal)
- Grid-based forecasts. Covers the entire globe
- Doesn't need reliable historical station data but useful if calibration/downscaling required (grid based data e.g. ERA-5 or station data)
- Model is run daily. Pacific ACCESS-S outlooks issued twice a week. Forecast skill generally improves through the month.
- Doesn't assume the future will be similar to the past (allows for climate change)
- Further development possible. Skill and product options will improve with time. ACCESS-S2 to be released in 2021 (will have longer hindcast period, 23 to 38 years).
- Large number of parameters can be predicted e.g. rain, tmax, tmin, SST, SSH, TCs etc.

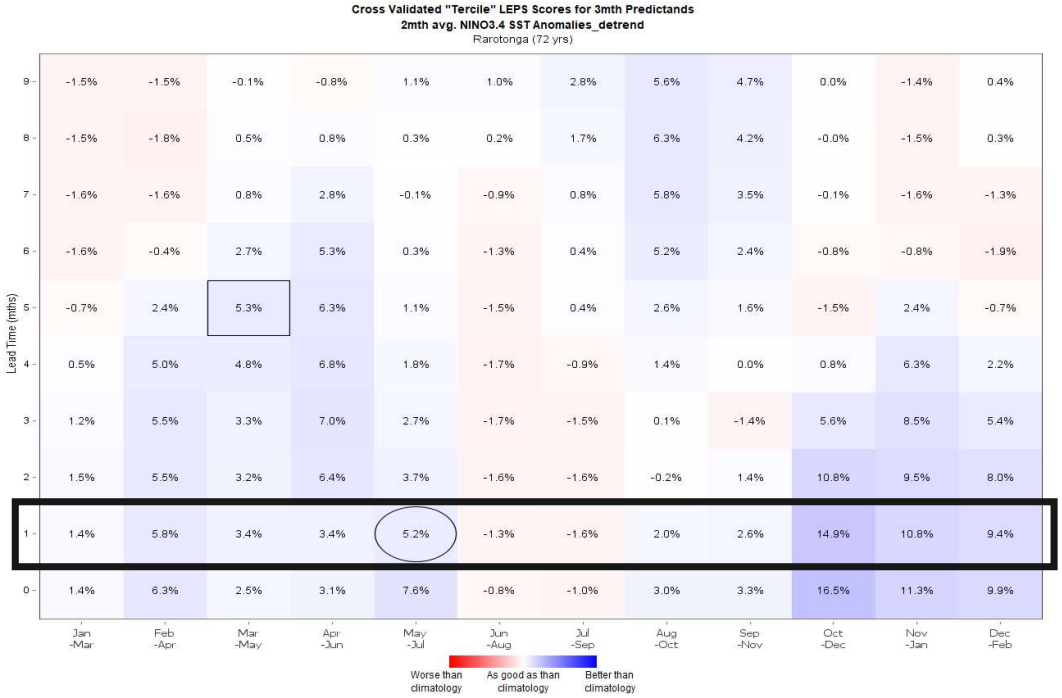
Disadvantages

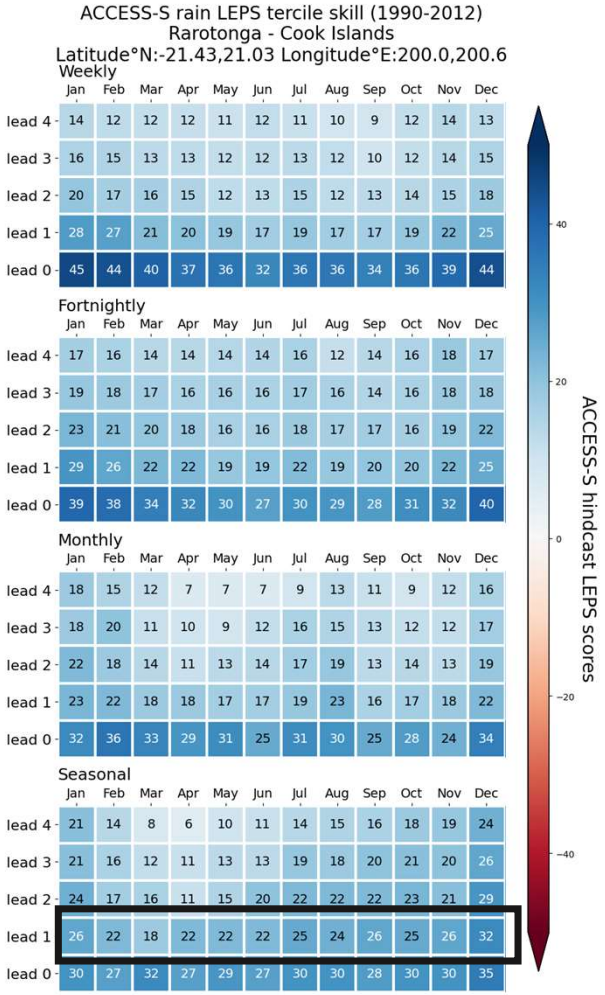
- Outlooks not produced in the COSPPac countries but NMSs can relay BOM issued outlooks to their stakeholders via their website. Doesn't use local meteorological records but see point 6 under advantages
- Expensive! Requires a super-computer. Fortunately the Australian Government pays the development bill ($$ millions for hardware and staff time). COSPPac pays for product development and skill assessment for the Pacific region



SCOPIC skill compared with ACCESS-S

Rarotonga rainfall





Note: Different periods used to generate skill will impact results (ACCESS-S1 23 years, SCOPIC 72 years).

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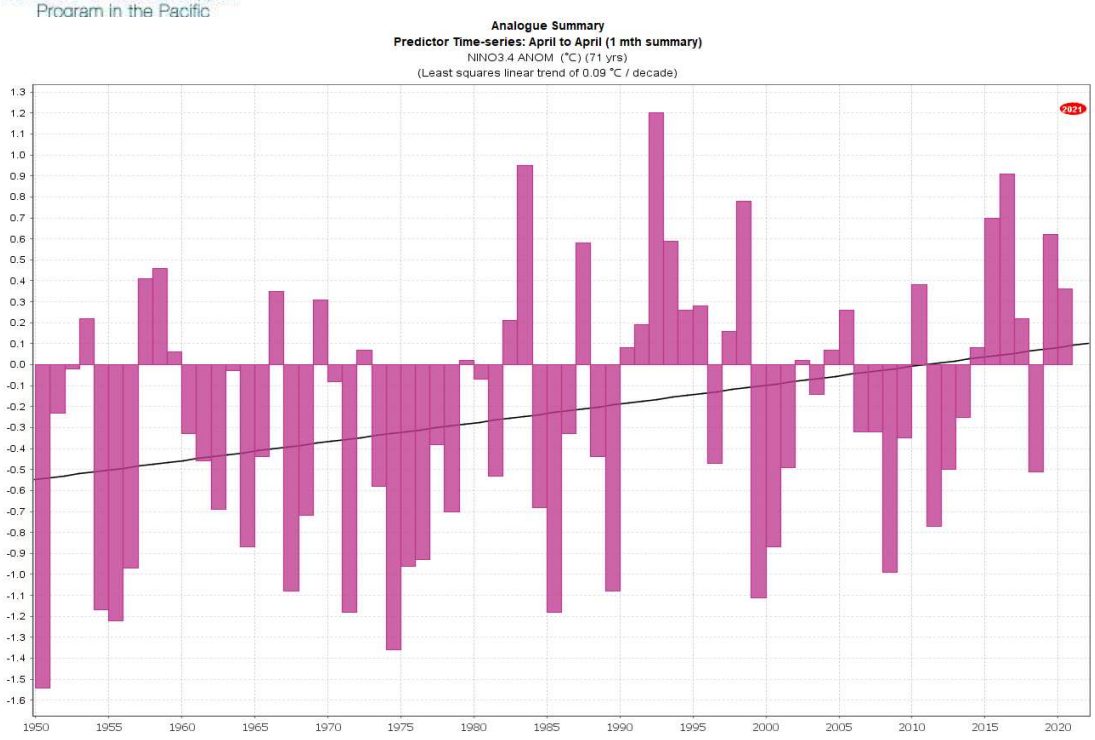
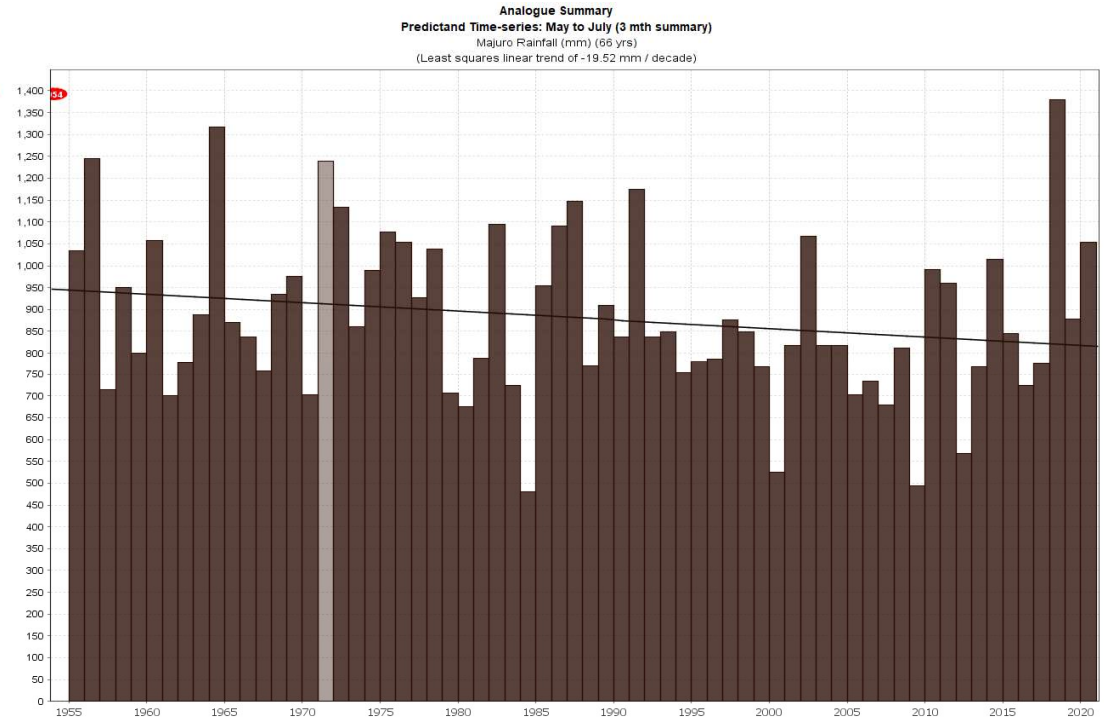
SCOPIC and climate change





- Ideally no or little trend in the predictor and predictand time-series. NINO34 anomalies show a warming trend of +0.09°C/decade, statistically significant at the 95% level. Some rainfall records show significant changes e.g. near subtropics and eastern FSM and RMI area. Strong positive trends in air temperature across the Pacific (don't use SCOPIC to predict temperature!)

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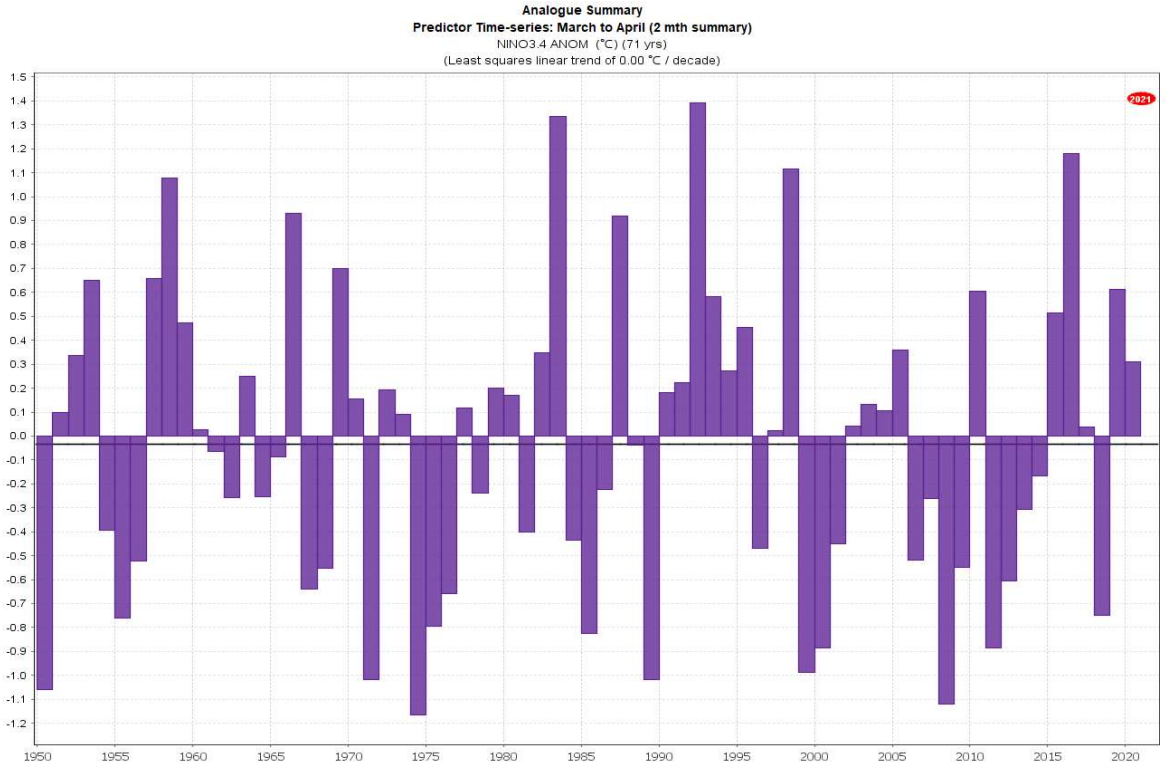
Is climate change negatively impacting SCOPIC predictions?



- Need to compare predictions with and without trends in the predictor and predictand time-series
- Previously saw NINO34 time-series with trend. Need to remove this trend on a monthly basis but we need to keep the year-to-year variability
- Calculate simple linear trends for 12 months
- Use linear de-trending method. Jan 1950 doesn't change but Jan_1951_detrend=Jan_1951-1*0.00534
- New de-trended NINO34 shown

0.005354 is the trend for January
Jan 1951 = 1, Jan 1952 = 2 etc.

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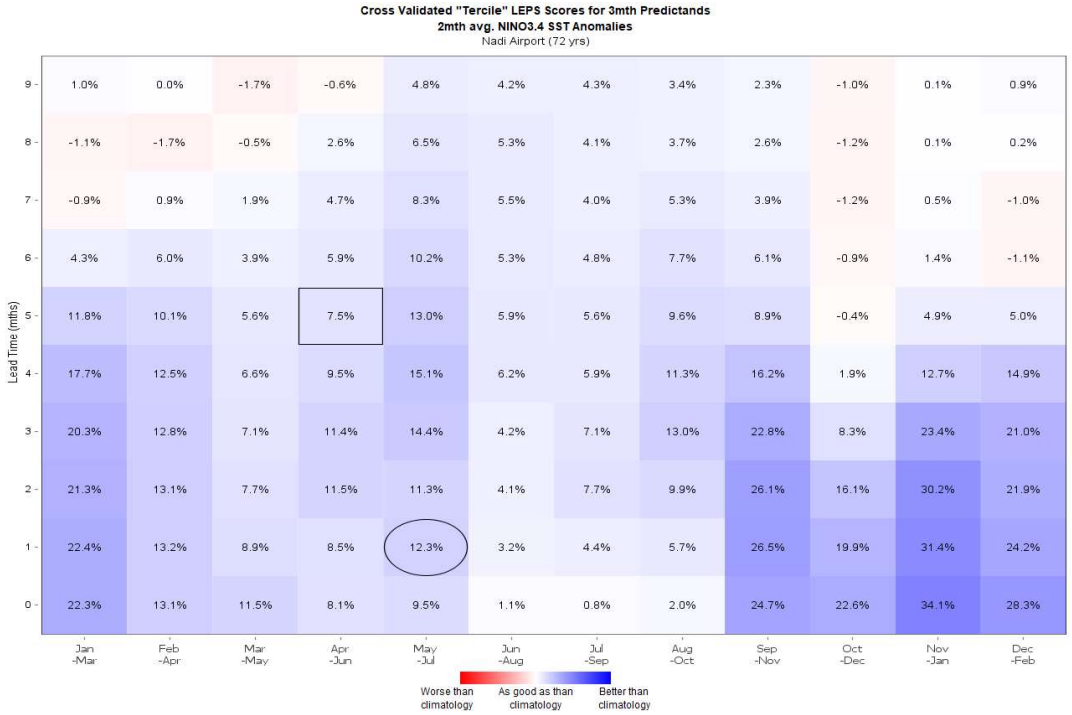
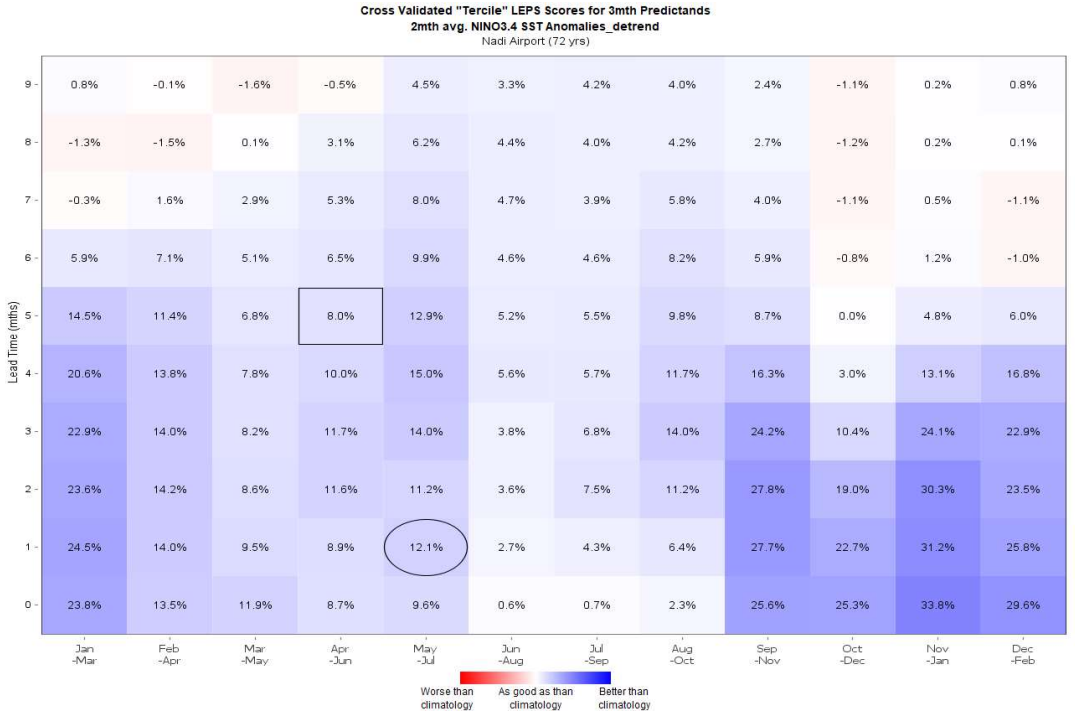
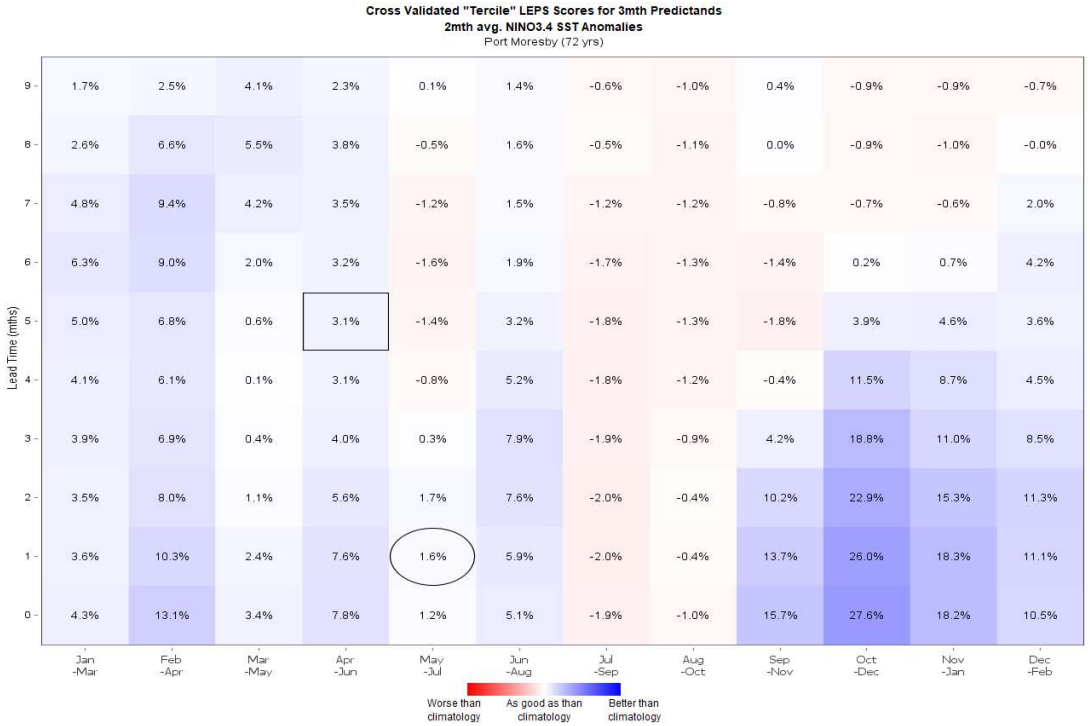
Impact of hindcast skill? Nadi Airport rainfall. Trend (left) de-trend (right)

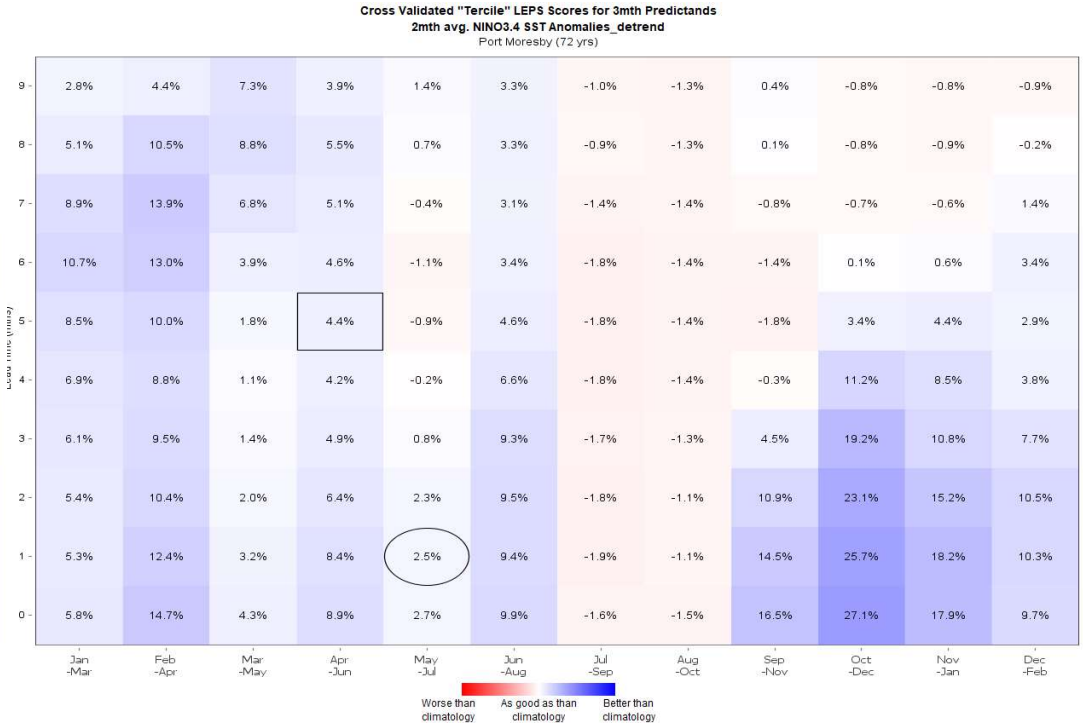




Climate and Oceans Support Program in the Pacific

Impact of hindcast skill? Port Moresby rainfall. Trend (left) de-trend (right)





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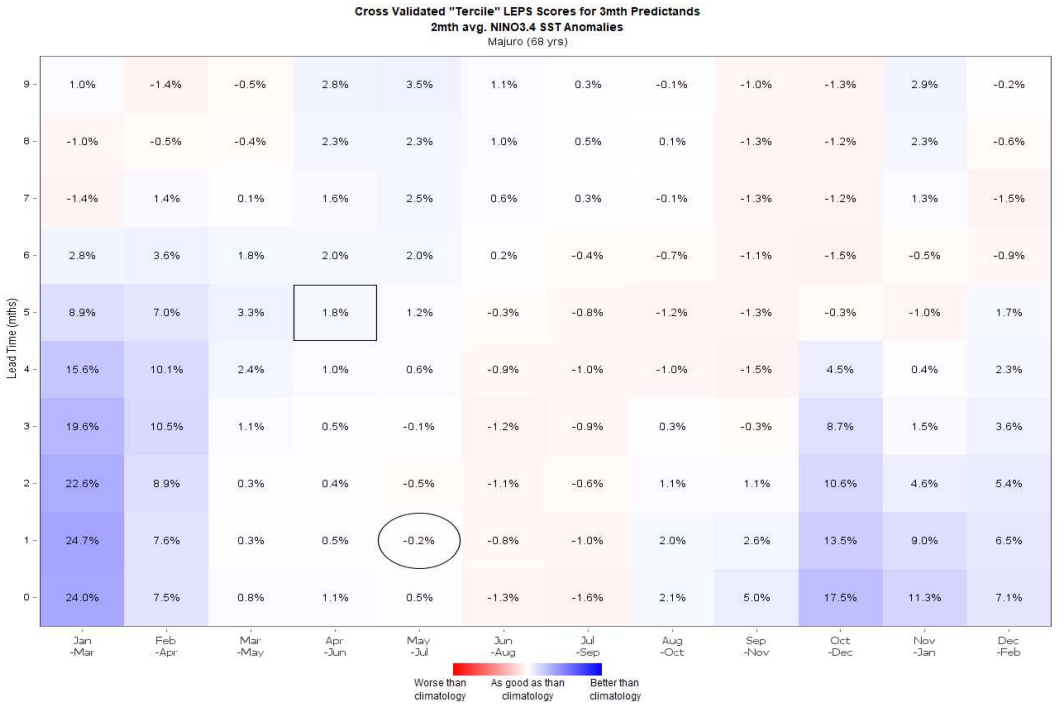
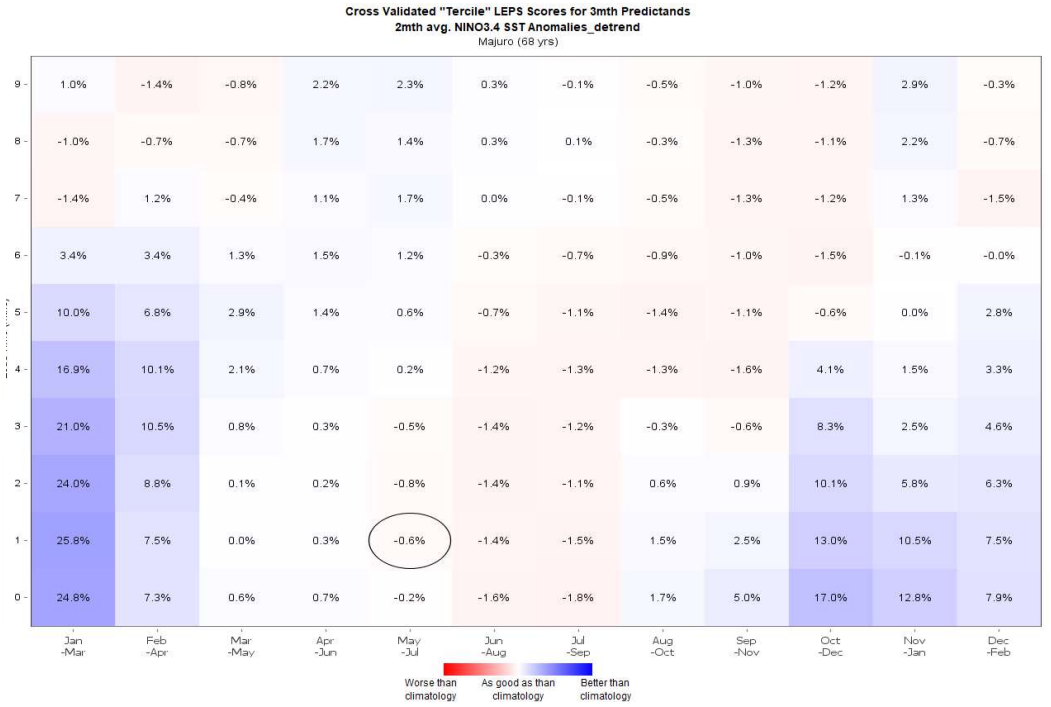
Impact of hindcast skill? Majuro rainfall. Trend (left) de-trend (right)





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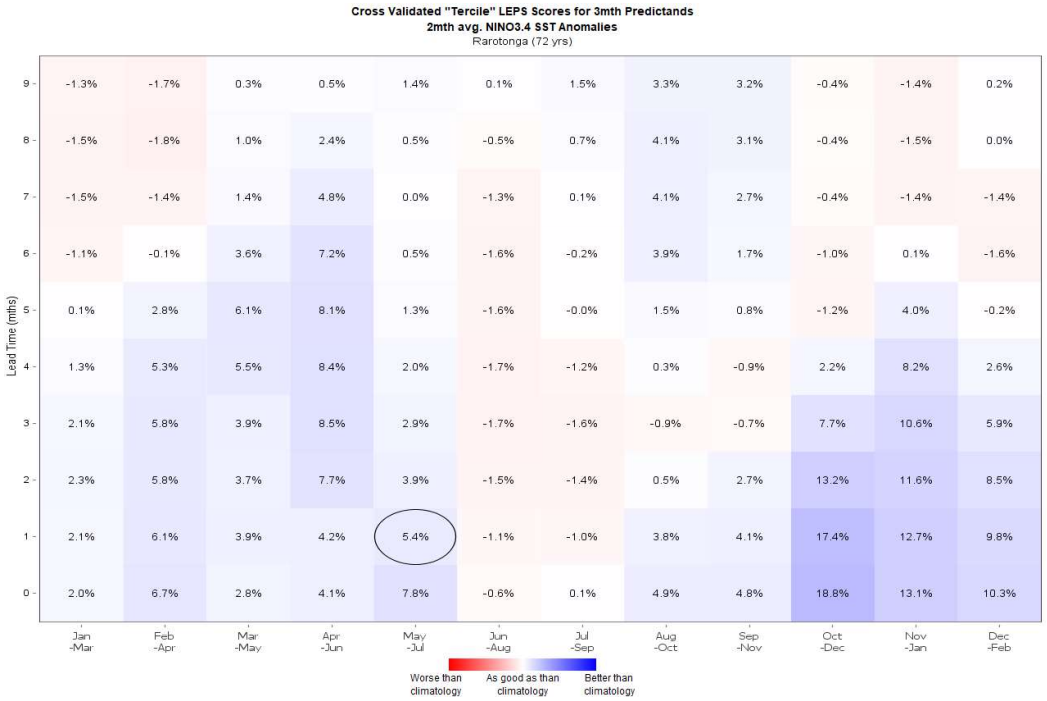
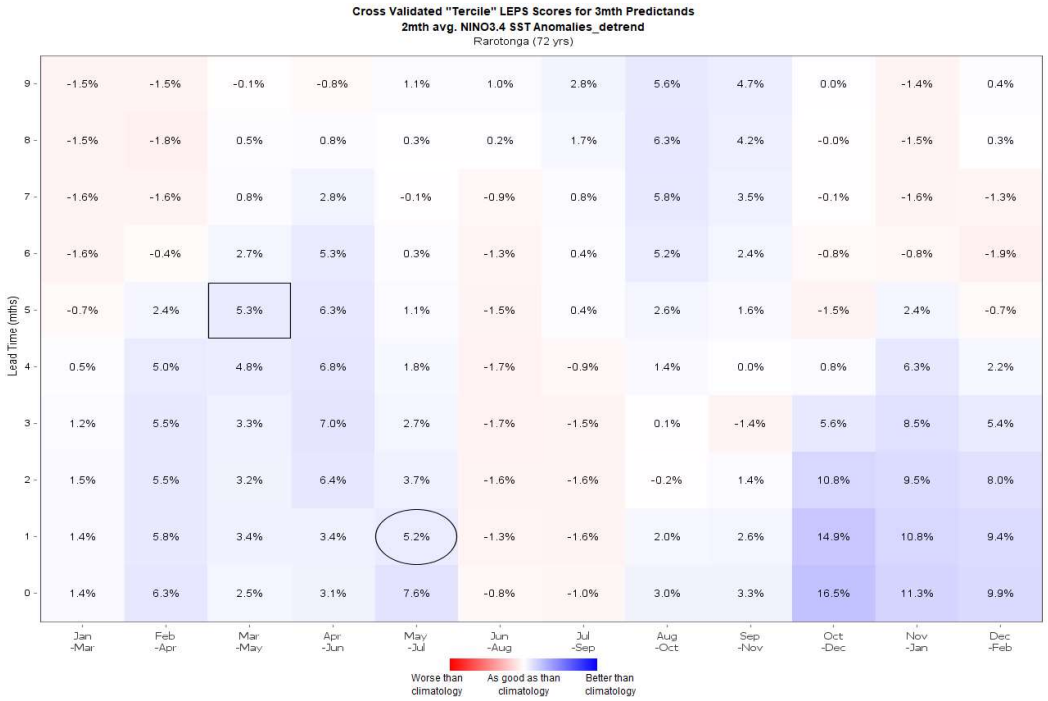
Impact of hindcast skill? Rarotonga rainfall. Trend (left) de-trend (right)





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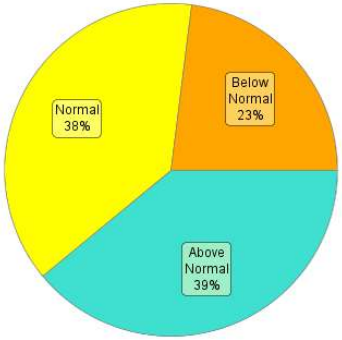
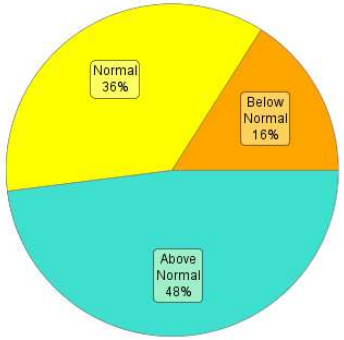
Impact on forecast? Trend (left) de-trend (right)

Outlook for May to July 2021 Predictands (3mth)
using 2mth avg. February to March 2021 NINO3.4 SST Anomalies (1mths lead)
Predictor Values: (-0.91)

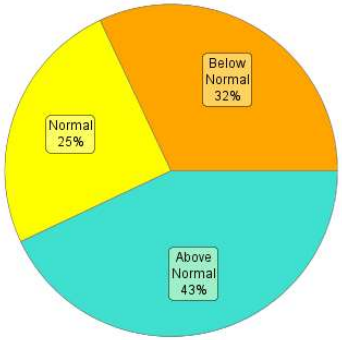
Port Moresby (72 yrs)
33%ile: 84.4mm 67%ile: 154.9mm
LEPS=1.6% Hit-rate=29.9%



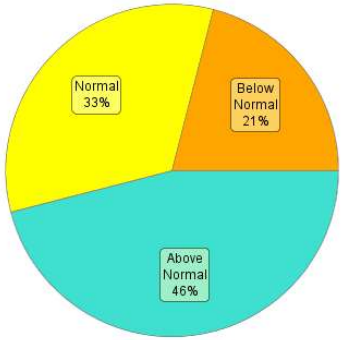
Nadi Airport (72 yrs)
33%ile: 140.5mm 67%ile: 243.6mm
LEPS=12.3% Hit-rate=50.7%



Majuro (68 yrs)
33%ile: 784.7mm 67%ile: 951.1mm
LEPS=-0.2% Hit-rate=43.9%

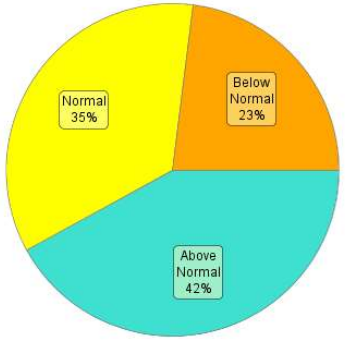


Rarotonga (72 yrs)
33%ile: 292.3mm 67%ile: 399.3mm
LEPS=5.4% Hit-rate=32.4%

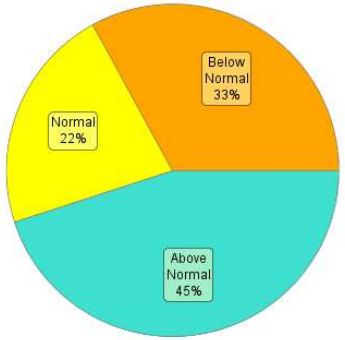


Outlook for May to July 2021 Predictands (3mth)
using 2mth avg. February to March 2021 NINO3.4 SST Anomalies_detrend (1mths lead)
Predictor Values: (-1.00)

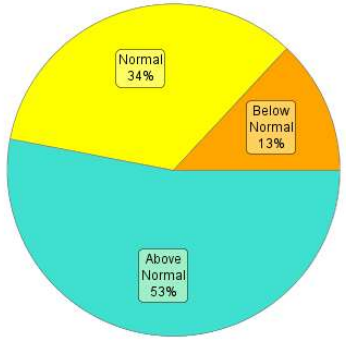
Port Moresby (72 yrs)
33%ile: 88.2mm 67%ile: 159.0mm
LEPS=3.3% Hit-rate=35.8%



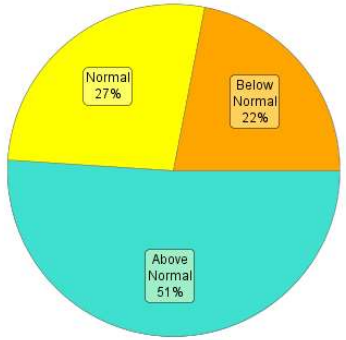
Majuro (68 yrs)
33%ile: 784.7mm 67%ile: 951.1mm
LEPS=-0.6% Hit-rate=43.9%



Nadi Airport (72 yrs)
33%ile: 140.4mm 67%ile: 244.4mm
LEPS=12.2% Hit-rate=43.7%



Rarotonga (72 yrs)
33%ile: 303.0mm 67%ile: 390.3mm
LEPS=4.8% Hit-rate=38.0%



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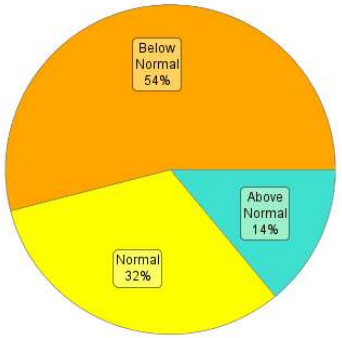
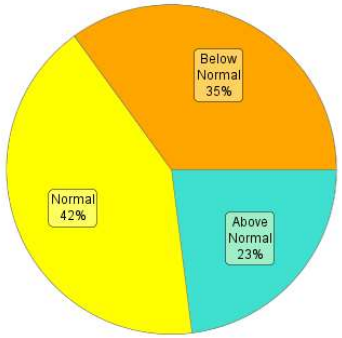
Impact on forecast? Trend (left) de-trend (right)

Outlook for May to July 2021 Predictands (3mth)
using 2mth avg. February to March 2021 NINO3.4 SST Anomalies (1mths lead)
Predictor Values: (-0.91)

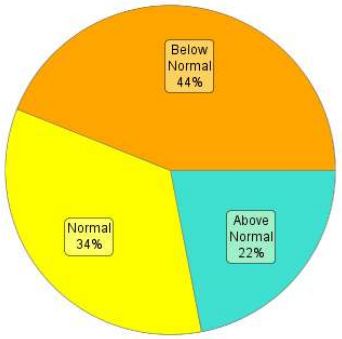
Penrhyn (72 yrs)
33%ile: 290.0mm 67%ile: 486.4mm
LEPS=16.0% Hit-rate=50.0%



Kiritimati (72 yrs)
33%ile: 125.0mm 67%ile: 250.8mm
LEPS=1.4% Hit-rate=38.0%

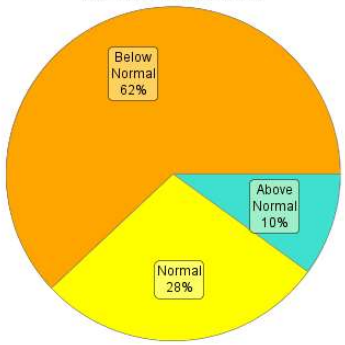


Tarawa (72 yrs)
33%ile: 328.9mm 67%ile: 510.5mm
LEPS=4.8% Hit-rate=40.8%

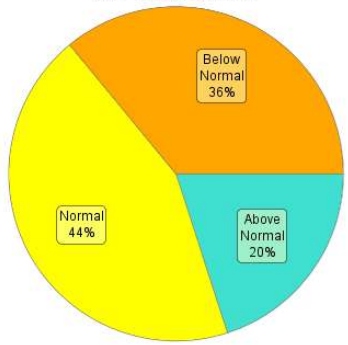


Outlook for May to July 2021 Predictands (3mth)
using 2mth avg. February to March 2021 NINO3.4 SST Anomalies_detrend (1mths lead)
Predictor Values: (-1.00)

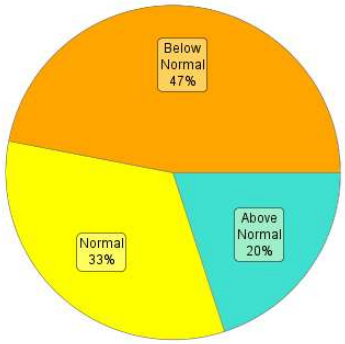
Penrhyn (72 yrs)
33%ile: 290.0mm 67%ile: 486.4mm
LEPS=18.0% Hit-rate=44.3%



Kiritimati (72 yrs)
33%ile: 125.0mm 67%ile: 250.8mm
LEPS=1.6% Hit-rate=36.6%



Tarawa (72 yrs)
33%ile: 328.9mm 67%ile: 510.5mm
LEPS=4.3% Hit-rate=45.1%



Comparing SCOPIC and ACCESS-S summary

Impact on skill and near-real time forecasts

- 'With climate change' hindcast skill marginally reduced for some seasons and predictions (including lagged predictions)

Predictions for May to July 2021 show:

- Regions expected to be wetter than normal during La Niña have lower AN % in the 'with climate change prediction'
- Regions expected to be drier than normal during La Niña have lower BN % in the 'with climate change prediction

- Overall, ACCESS-S offers NMSs outlooks with high skill at multiple lead times, more frequent outlooks, higher resolution, outlooks that cover the entire country, calibrated outlooks and outlooks that fill the gap between weather forecasts and seasonal outlooks.

Discussion questions

- Positive trend in the NINO34 time-series has minor negative impact on SCOPIC hindcast skill
- 'El Niño-like' shift in near-real time outlook probabilities but impact is marginal

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Questions?

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Questions for you?

1. There is an aspect to the climate change analysis that I haven't presented. Can you spot the limitation in my analysis? Clue see slide 6.
2. In theory you could use a de-trended NINO3.4 time-series (adjust backward in time) to deal with the Climate Change problem. Advantages of this?
3. Question 2. Limitations?
4. Regarding historical datasets. What other limitations are there to using station rainfall for climate prediction?
5. What communication with stakeholders difficulties might you face in changing from SCOPIC to ACCESS-S?