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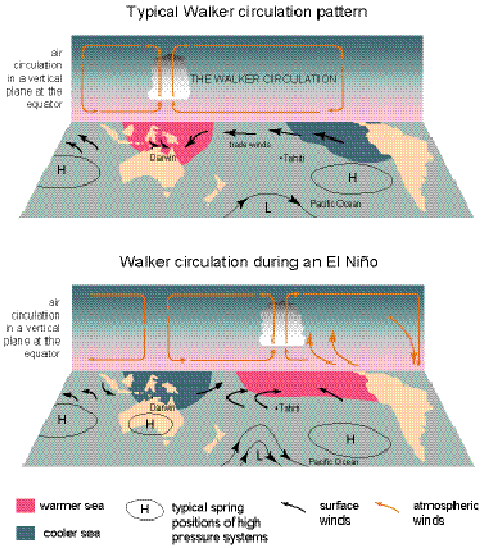
SEASONAL CLIMATE PREDICTION



David Walland

Australian Bureau of Meteorology

WMO RA-V Seminar on Climate Services

Honiara, Solomon Islands, 1-4 November 2011

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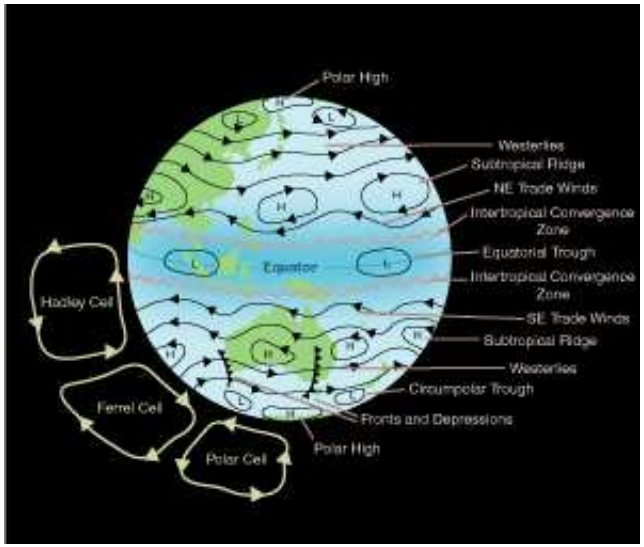
Overview

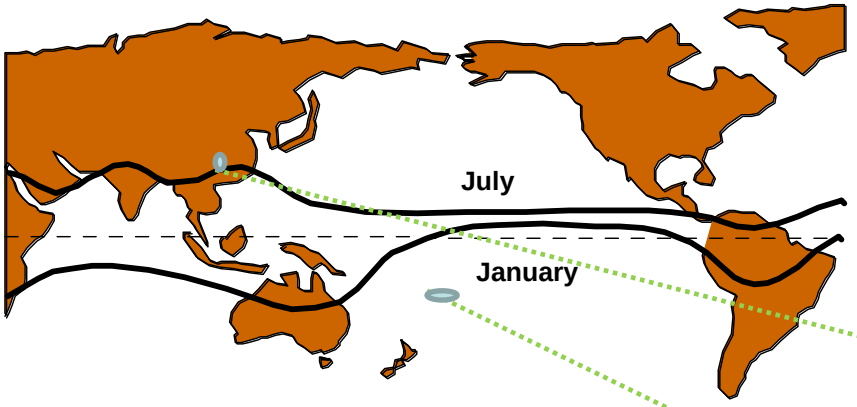
- Major climate Drivers in the region
- What gives predictability?
- Empirical versus Dynamical models
- Verification
- PI-CPP
- RCOFs

The Inter Tropical Convergence Zone (ITCZ)

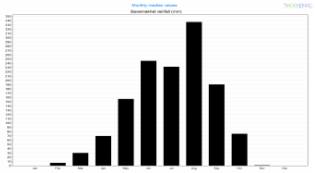
(also called the Equatorial trough)

* A zone of convergence of the trade winds
* Moves north and south with the seasons
* Associated with a peak in rainfall activity
* Sometimes ill defined
* Can have ragged edges or “spurs”

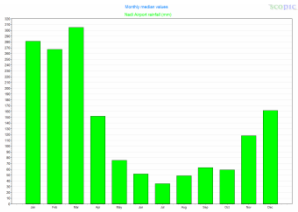




Average positions of the ITCZ during July and January



Savannakhet (Laos)



Nadi (Fiji)

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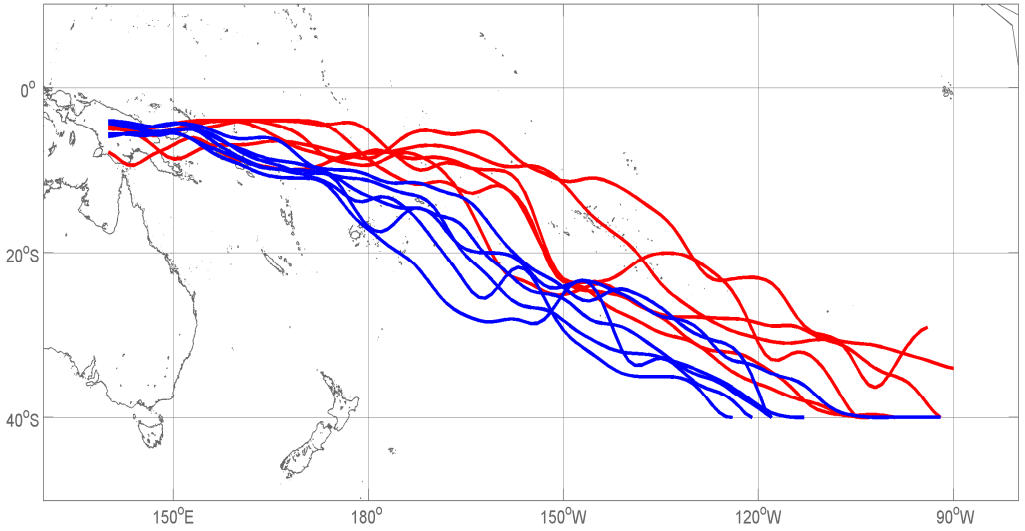
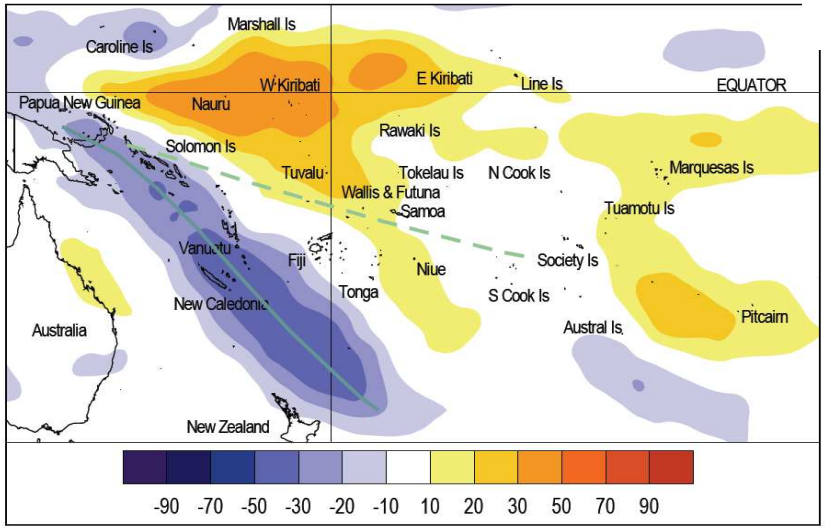
South Pacific Convergence Zone

Largest and most persistent “spur” of the ITCZ
A band of low level convergence about 200 to 400 km wide stretching from Solomon Islands to Fiji, Samoa and Tonga weakening further to the south-east.
Associated with SST maxima, cloudiness and precipitation.
Present year round but most active in the SH summer



Mean Position of SPCZ during six active El Niño and La Niña Seasons



Moves north with the ITCZ in SH winter
It moves NE when SSTs are above average in the eastern Pacific it moves SW when SSTs are above average in the western Pacific

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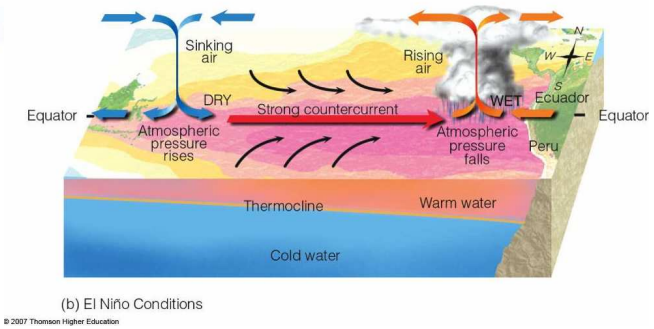
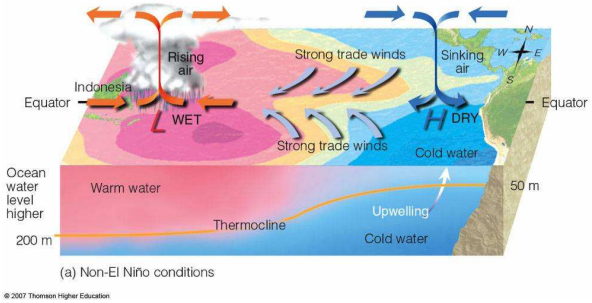
The Walker Circulation

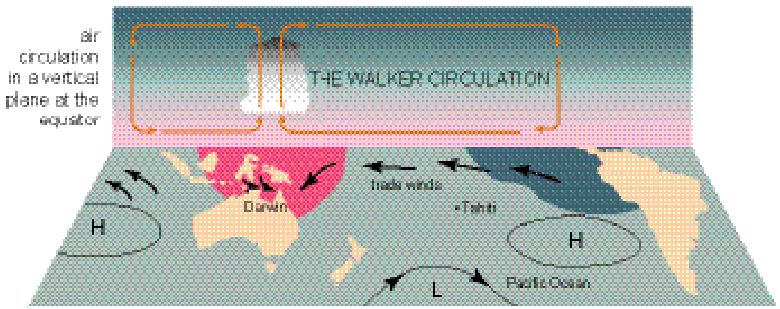
El Niño years



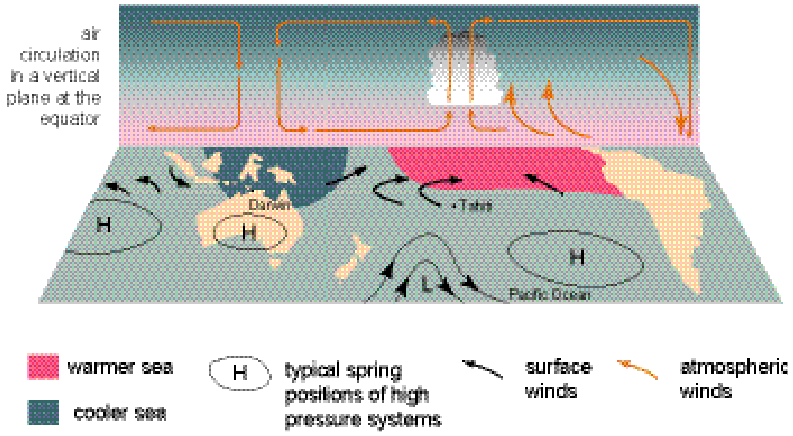
La Niña years



Typical Walker circulation pattern



Walker circulation during an El Niño



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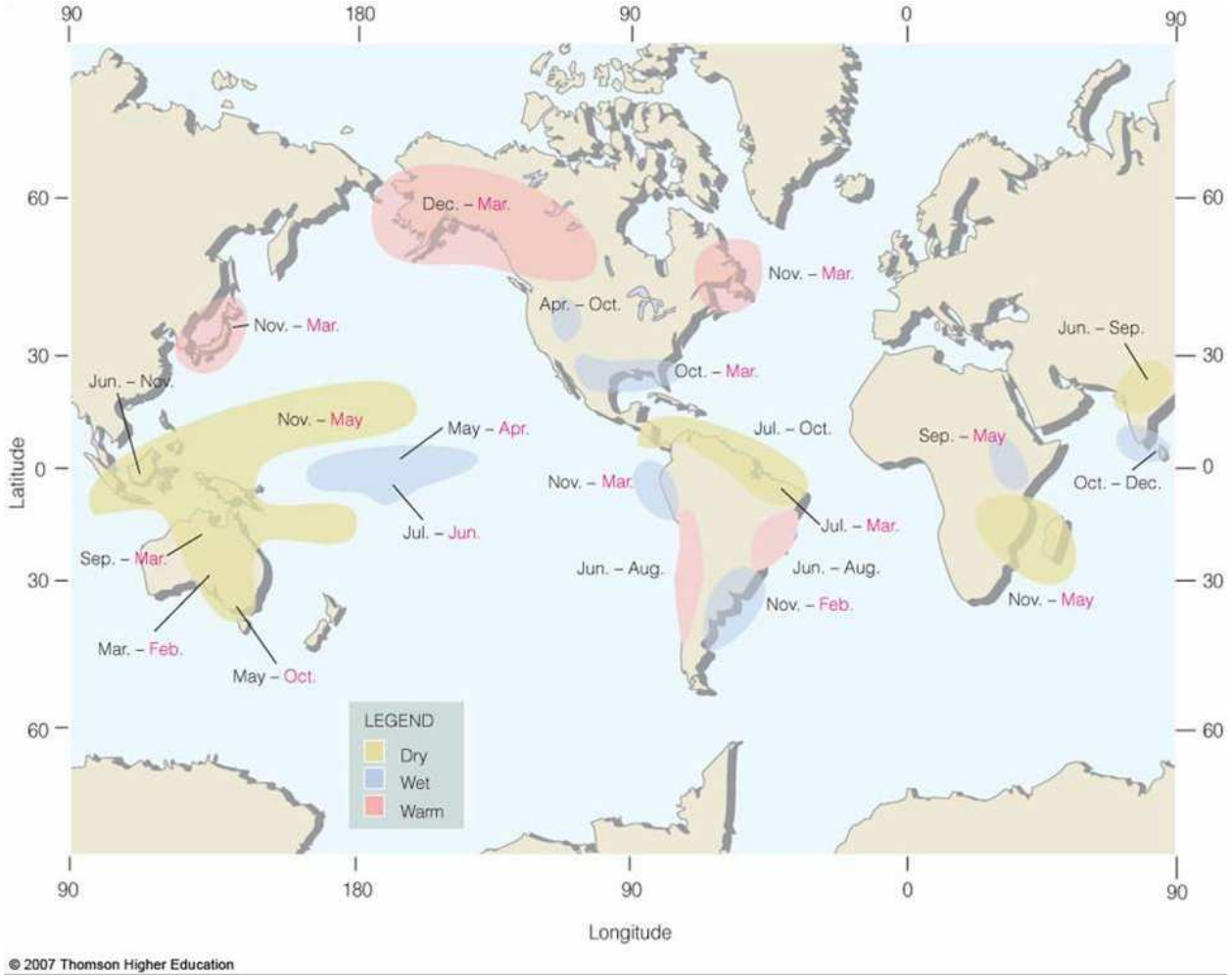
Typical impact of ENSO



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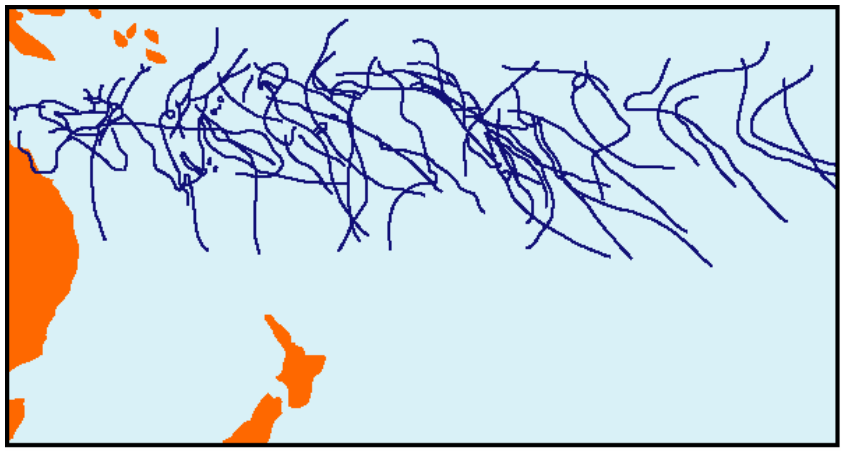
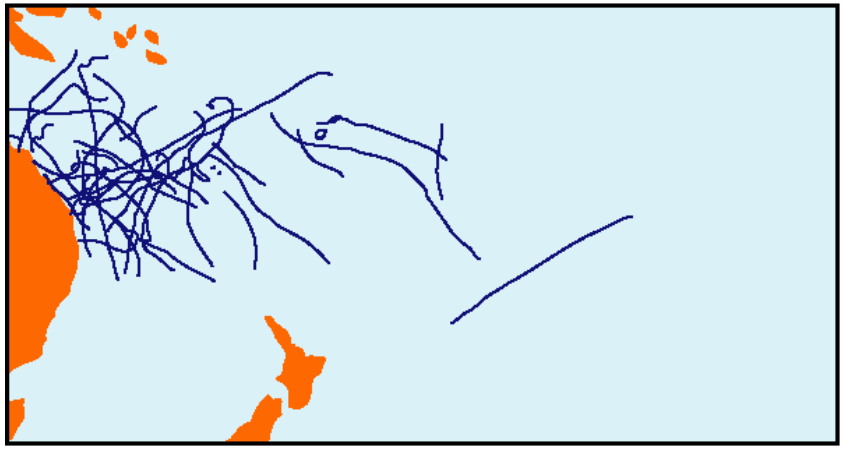
Paths of Tropical Cyclones

El Niño years



La Niña years



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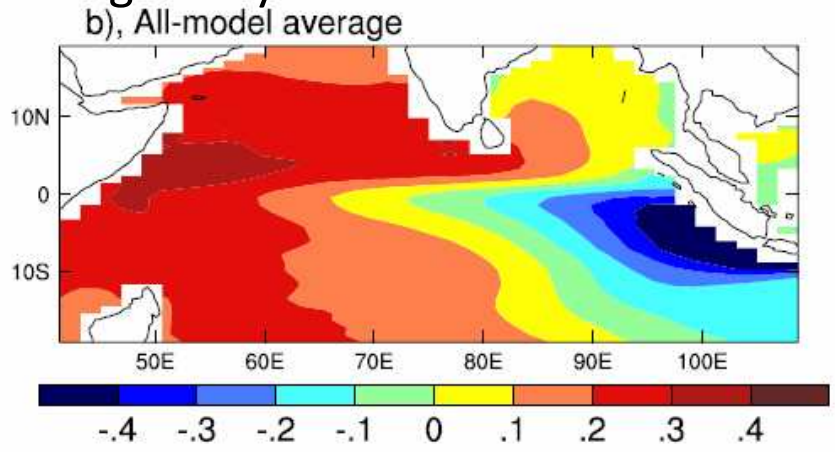
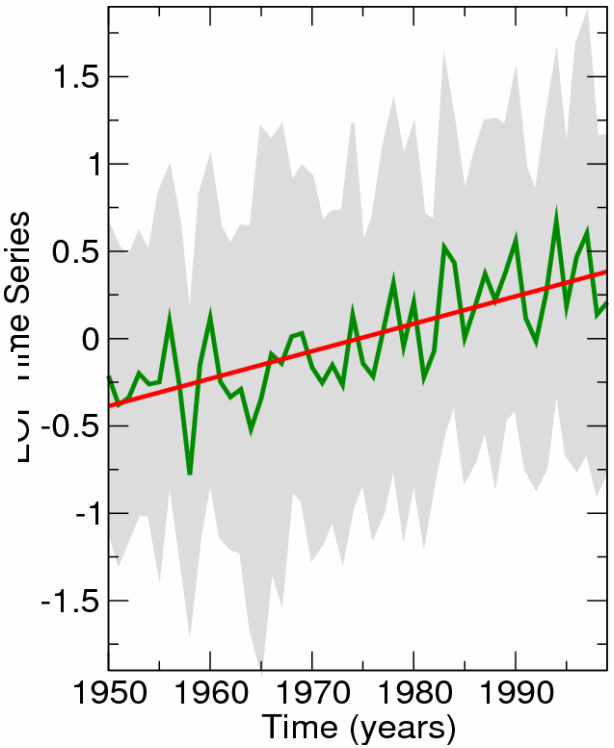
Indian Ocean Dipole (IOD)

The IOD is defined by an index that is the difference between SST in the western (50° -70° E, 10° S-10° N) and eastern (90° -110° E, 10° -0° S) tropical Indian Oceans. A positive IOD occurs when the western basin is warmer than average and the eastern basin is cool and hence the IOD index is positive.

The IOD can modulate rainfall in the region with IOD positive and negative years





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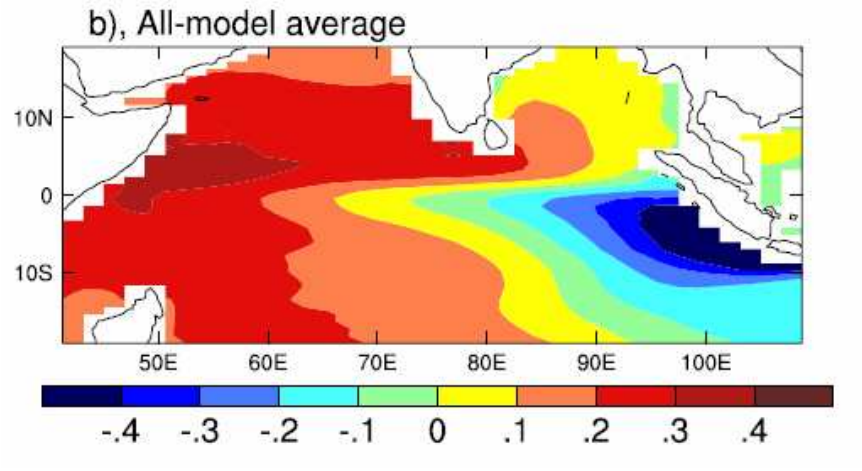
Indian Ocean Dipole (IOD)

A positive IOD brings heavy rain to East Africa and droughts to parts of Indonesia and parts of Australia. Usually, parts of East Asia including Japan suffer from dry hot conditions during a positive IOD event whereas Southeast Asia suffers from floods. Indian summer monsoon rainfall as a whole remains above normal during a positive IOD. Early onset of Monsoon



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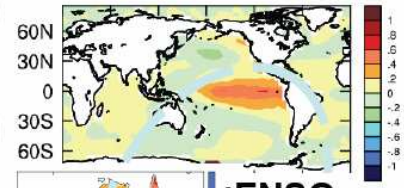
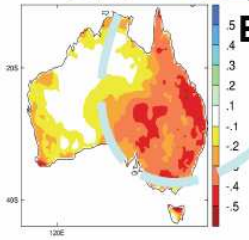
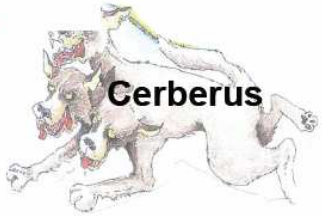
The three-headed dog of the Australian climate



All year

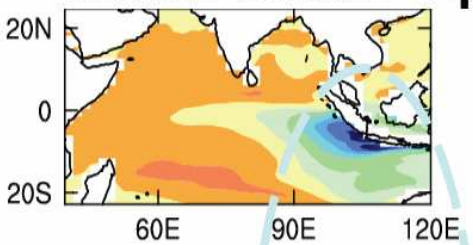
ENSO



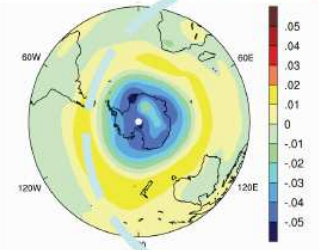


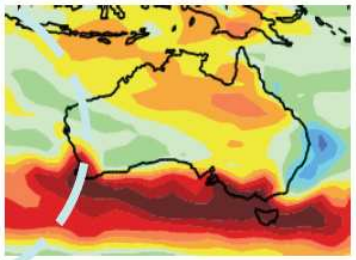
Cerberus

Indian Ocean Dipole: IOD

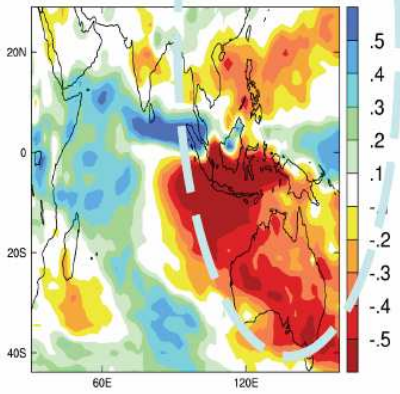


Southern Annular Mode: SAM





Winter



Winter & Spring

CSIRO. The Australian Drought

CSIRO

Source: Cai, W.J

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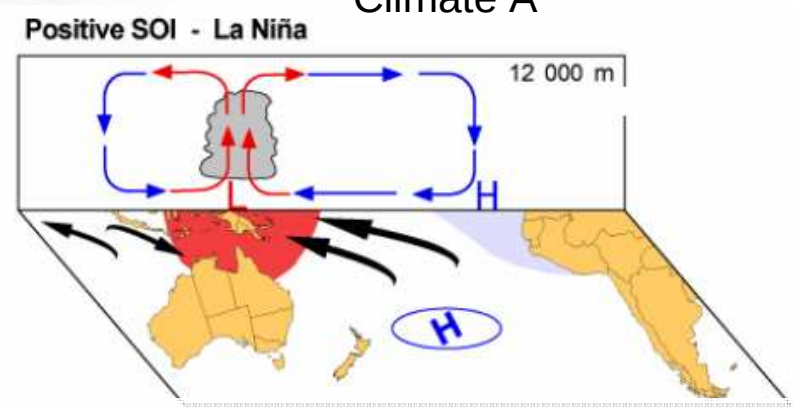
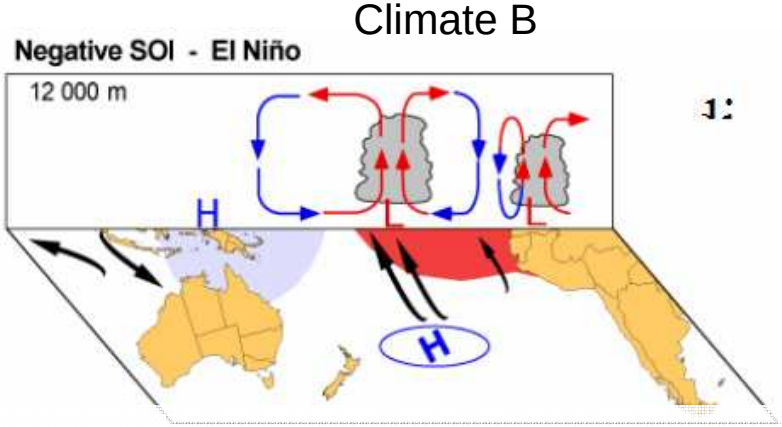
How is Climate Prediction Possible?

Climate A



Climate B



Imagine you're a farmer in NE Australia and you want to know;

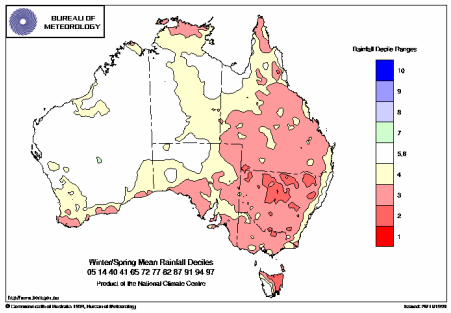
1) ***Precisely, how much rain will you receive during the coming season?***

   Don't know. . Science still cannot predict the weather over 3 months with accuracy.

2) ***Is the season likely to be wetter than average?***

   Very likely if Climate A – the La Niña.

   Very unlikely if Climate B – the El Niño



This is a very simple climate forecast

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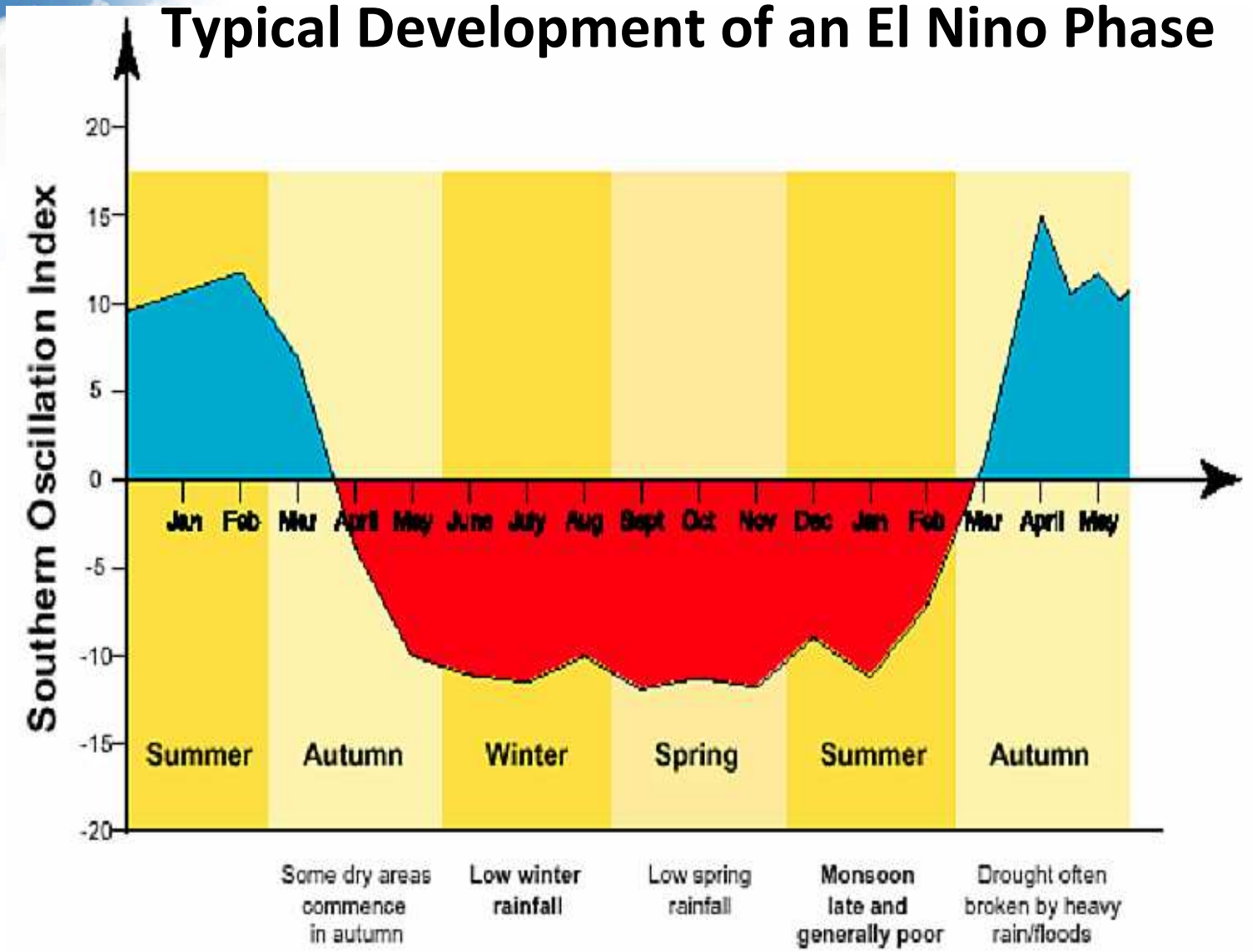
Typical Development of an El Nino Phase



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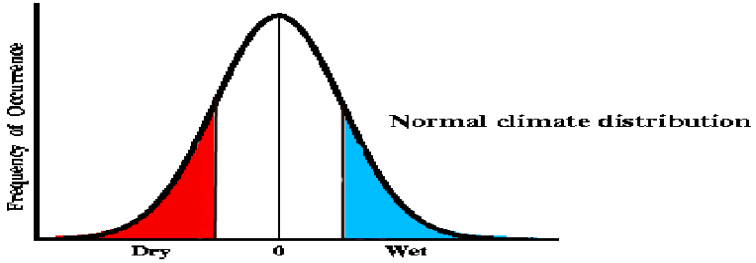
Empirical Climate Prediction

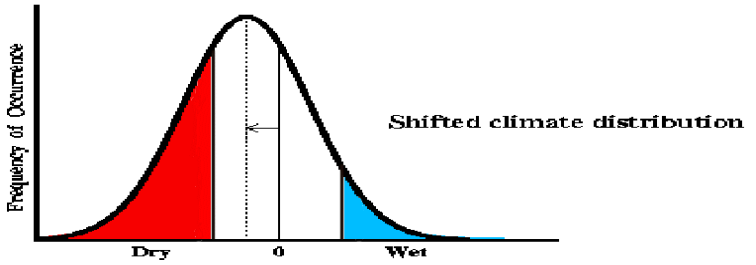
Statistical climate prediction is the process of estimating the change in the *probability distribution* of rainfall (or temperature) conditional on a climate forcing.

Use the past as a guide to the future.

Normal climate distribution – probability of wet/dry = long term average



Conditional climate distribution, for example "El Niño" conditions



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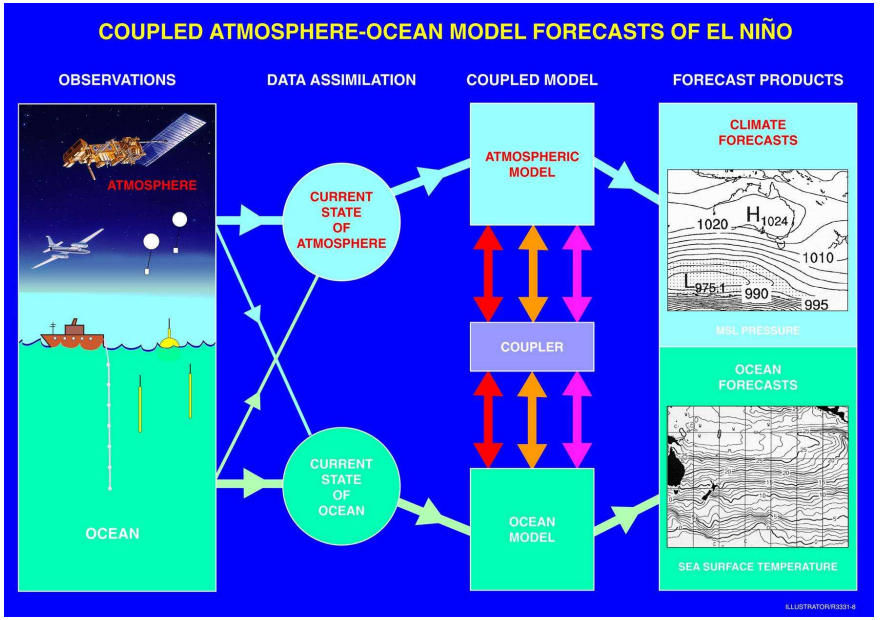
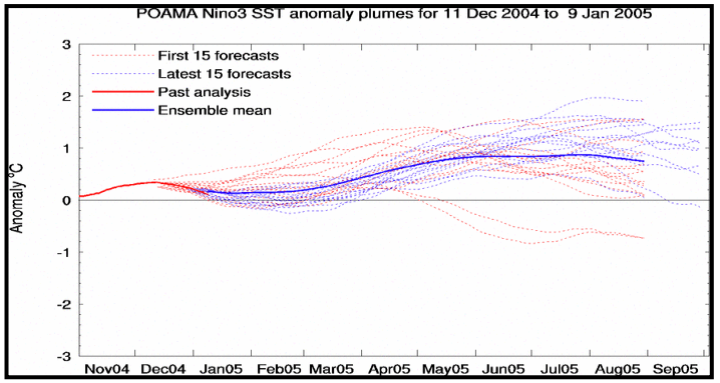
Dynamical – Coupled Model - Seasonal Prediction

- Use physical equations to project the climate forwards in time.
- Models do not know about the past; hence they can predict new situations, cope with climate change etc.
- Forecast are still probabilistic, however.
- Require very expensive super computers.v





Current Forecast for El Niño

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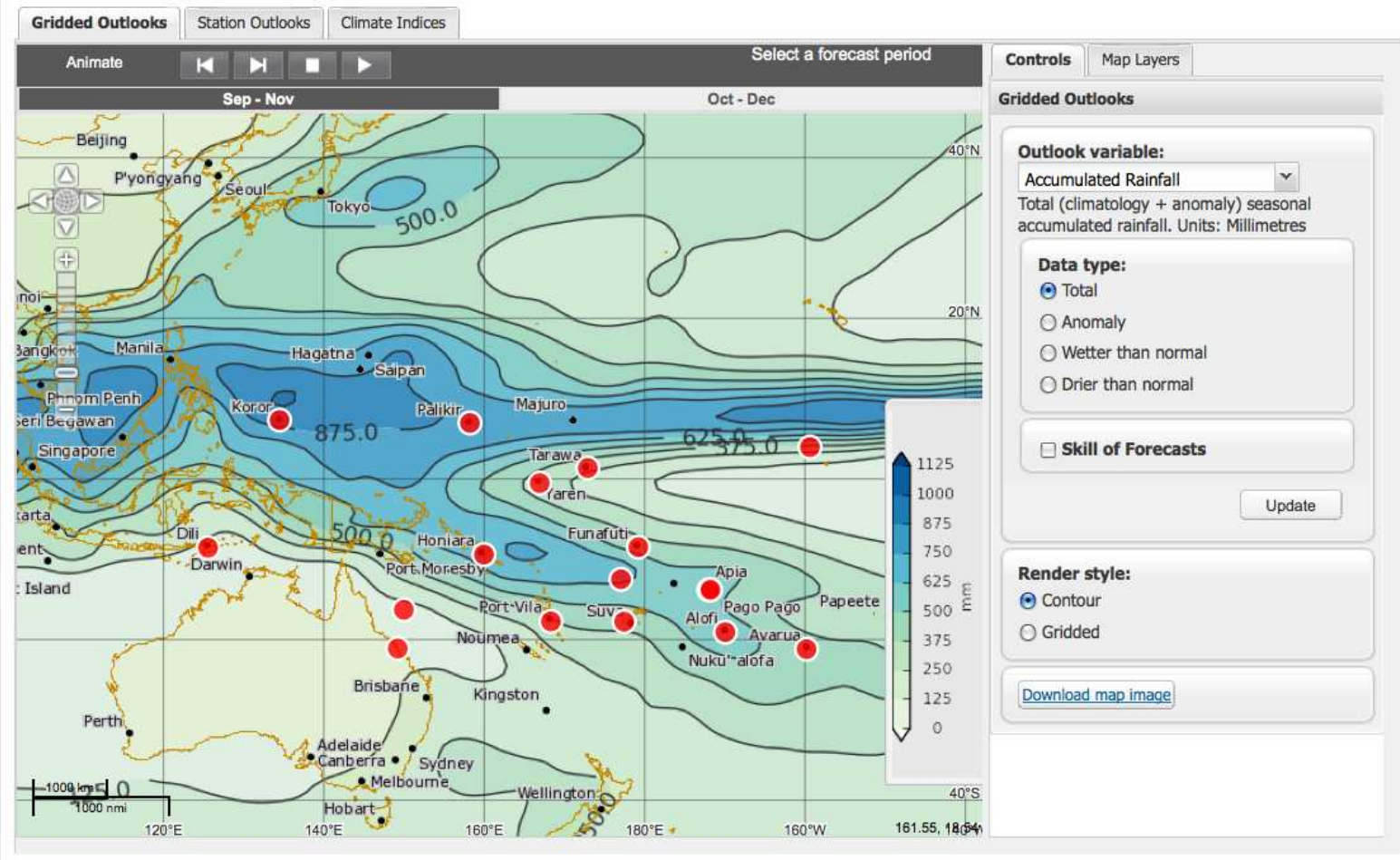
Rainfall



Accumulated Rainfall over 3 months

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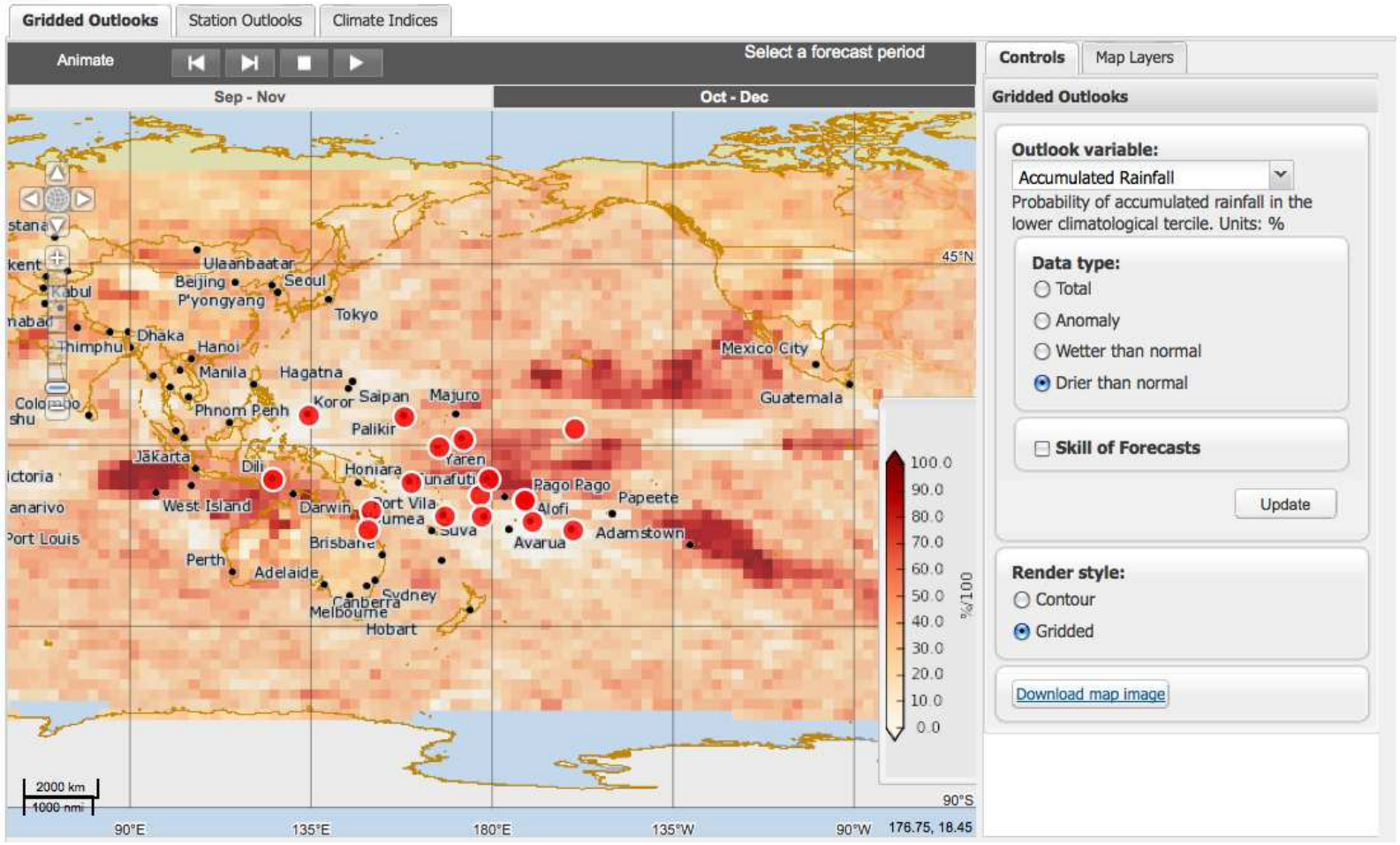
Rainfall - Tercile Probability



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Verification

What is forecast verification?

If we take the term *forecast* to mean a prediction of the *future state* (of a variable) then the *forecast verification* is the process of assessing the quality of a forecast.

The forecast is compared, or *verified,* against a corresponding observation of what actually occurred. The verification can be qualitative or quantitative. In either case it gives information about the nature of the forecast errors.

Why verify?

A forecast is like an experiment. We make a hypothesis that a certain outcome will occur. The experiment is not compete until we know the outcome. In the same way a forecast experiment is not complete until we know if the forecast was successful. Based on past performance we can build confidence in the utility of a forecasting tool.

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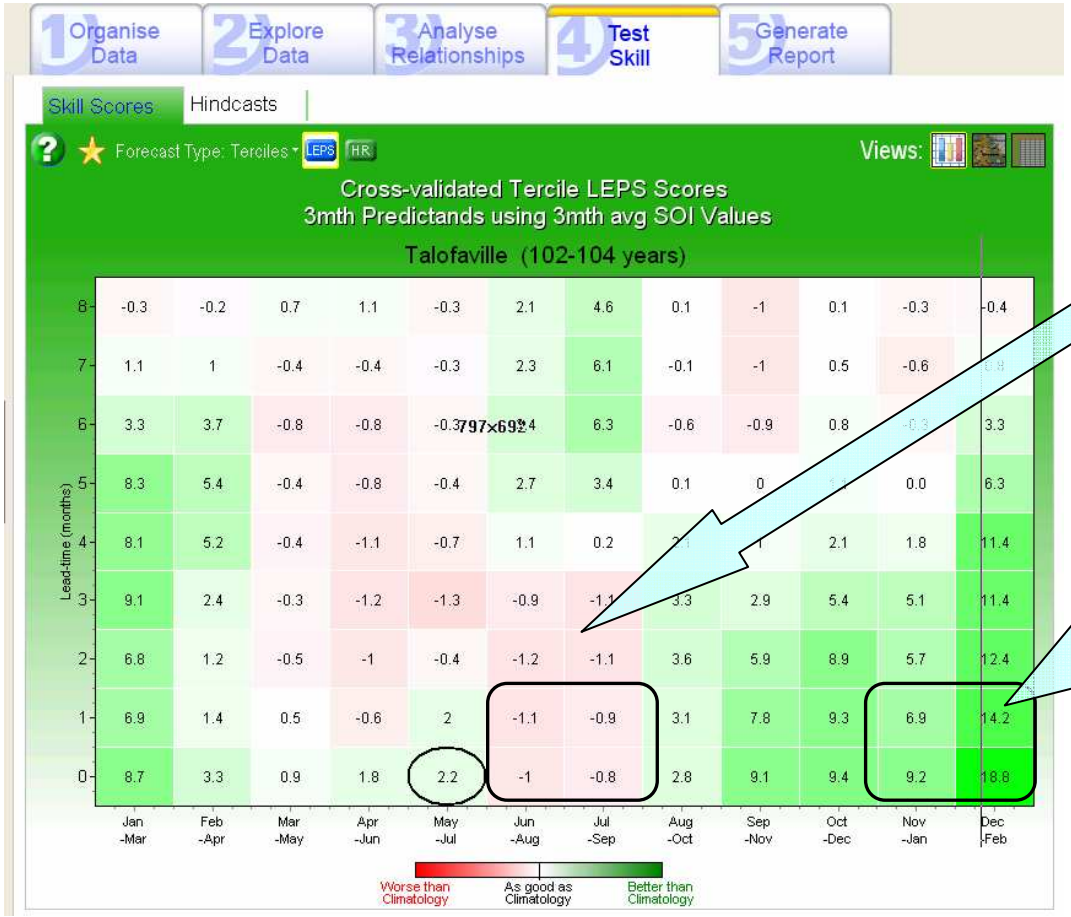
What is Skill (not same as accuracy)?

Measures how much better a forecast is than some benchmark (e.g. climatology) . Often use LEPS.



Low skill – not much different from a benchmark

High skill – much better than a benchmark

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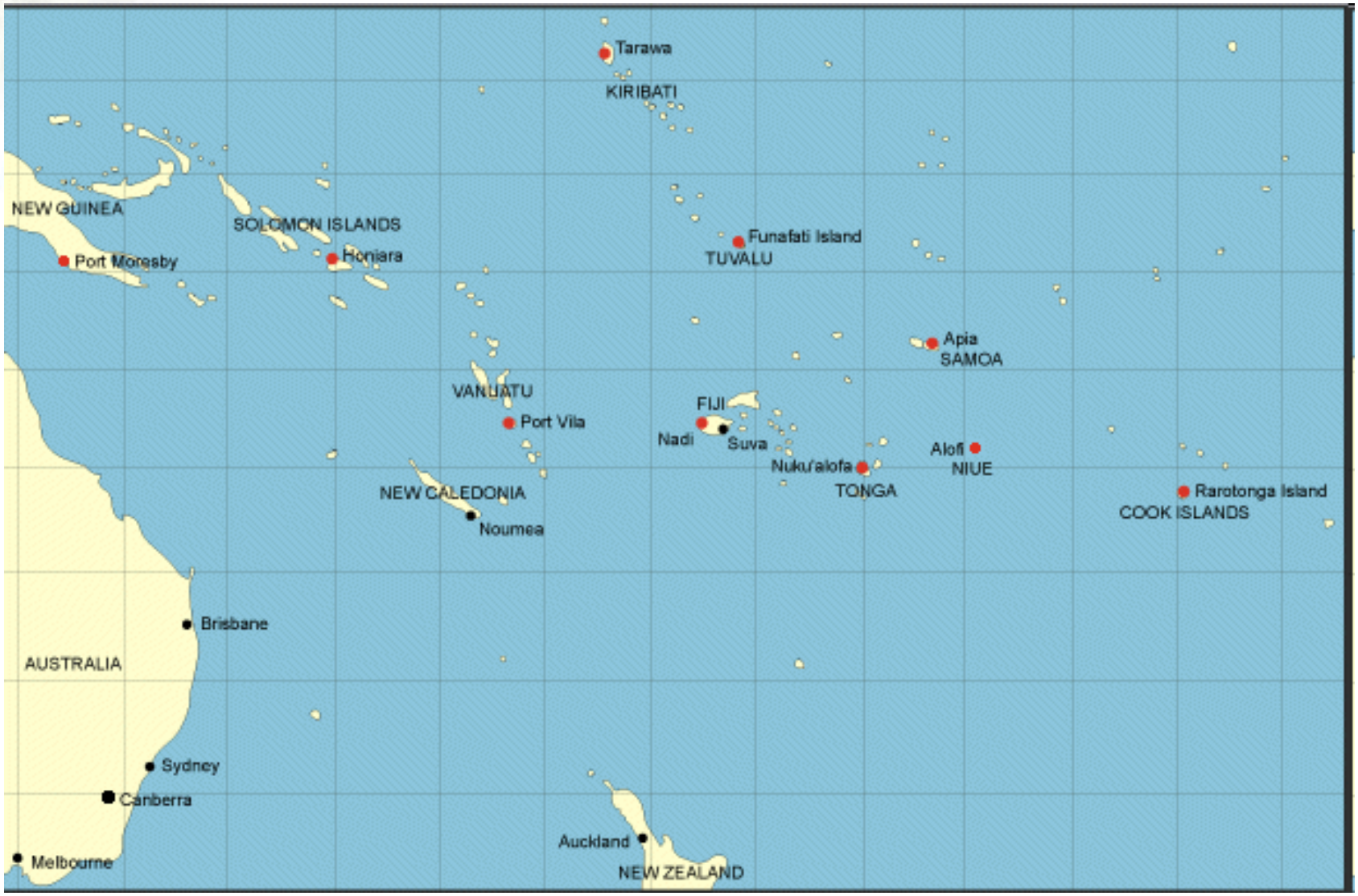
Pacific Island Climate Prediction Project



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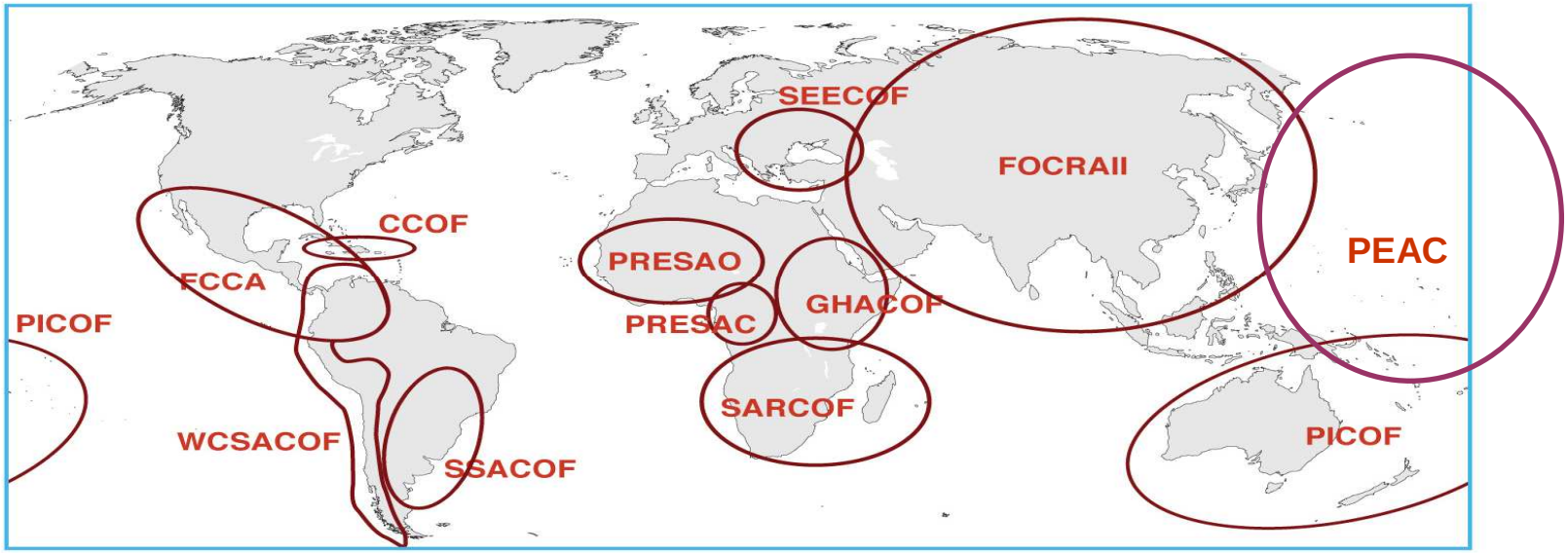
Climate Outlook Forums

- Island Climate Update
- Pacific Climate Outlook forum
- Pacific ENSO Applications Centre meeting



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Thank you

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Bureau of Meteorology

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