

Building Farmer & Advisor Knowledge in Carbon Farming



The Carbon Farming Knowledge Project involves a series of workshops to increase the understanding of 30 independent agricultural advisers in south-east Australia on reducing greenhouse gas emissions, carbon in farming systems and the Emissions Reduction Fund – where farmers can earn credits for storing carbon or reducing greenhouse gas emissions on their properties. The project helps advisers prepare their clients for potential environmental, economic and social benefits of future carbon management policy.

Summary of Session 2: Climate Modelling 202

Summary of March 2015 workshop presentation by Roger Stone, University of Southern Queensland, and Director, International Centre for Applied Climate, Sciences, Toowoomba, Queensland.

Background

Australia has the highest level of year-to-year climate variability (see graph). Monitoring is showing this variability is increasing, particularly in the pastoral, wheat/sheep and high rainfall zones across the country.

Southern Australia's two most important climate drivers are the El Niño Southern Oscillation Index (ENSO) and the latitude of the Sub Tropical Ridge

(STR). There are also a number of other climate indicators that can be monitored to better understand the season ahead and what it might mean in terms of productivity.

Seasonal climate forecasting has no value unless it changes a management decision. For a farmer, this could be understanding climate forecasts to potentially examine stock rates before the climate event hits, prepare for drought, make decision on selling, agisting or buying fodder, and adjusting a cropping program.

'Lesser-known' Climate Influencers

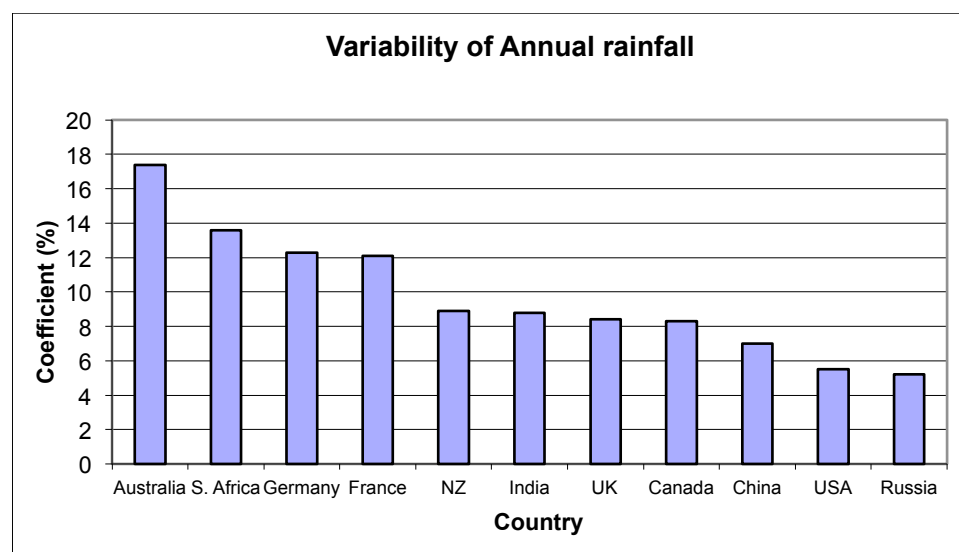
While many farmers may have heard of ENSO, STR, Indian Ocean Dipole and Southern Annular Mode (see Summary of Session 1) as key influencers of climate in southern Australia, there are a number of other indicators that scientists watch in developing climate forecasts.

Quasi Biennial Oscillation (QBO)

The QBO is an oscillation of the winds in the tropical atmosphere. The winds change between a west or east phase, altering flow of moisture over the continent. It has an average cycle of 28 to 29 months and can also be linked with the movement of the STR. It is an important feature for rainfall in Australia but does not attract the attention from the science community that perhaps it should, but there are exceptions.

El Niño Modoki (ENM)

The ENM is different to a 'conventional El Niño', which is characterised by strong warming in the eastern Pacific Ocean near the equator. ENM is a strong warming in the central tropical Pacific and cooling in the eastern and western tropical Pacific. It focuses on ocean temperatures and atmospheric conditions and is attracting interest from climate scientists because it is somewhat different to conventional El Niño.



Madden-Julian Oscillation

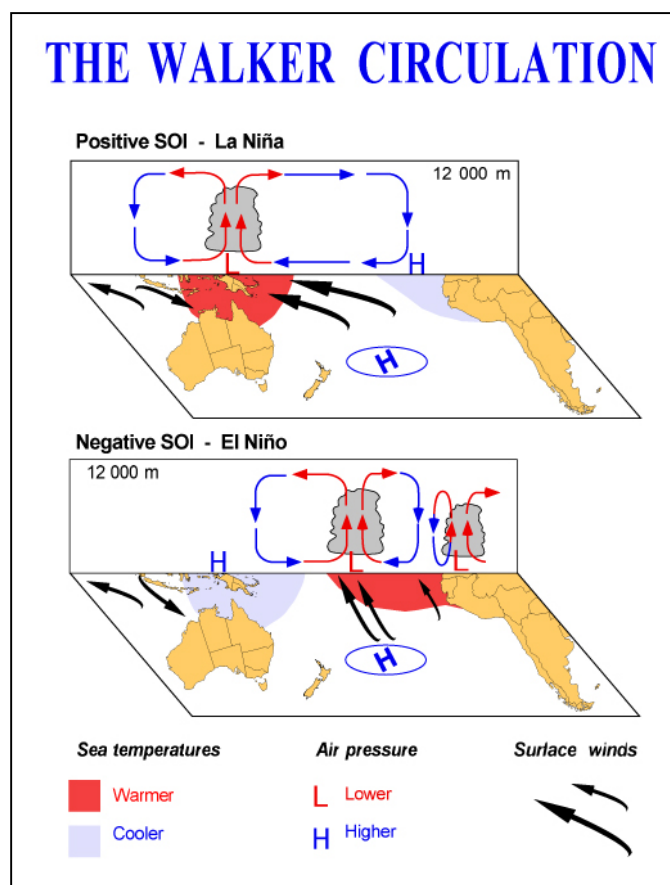
The Bureau of Meteorology describes the MJO as the major fluctuation in tropical weather on weekly to monthly timescales. It is an eastward moving 'pulse' of cloud and rainfall near the equator that usually recurs every 30 to 60 days.

The Walker Circulation

This climate phenomenon is not new to our understanding but remains very influential for Australian climate. The Walker Circulation is linked to the El Niño/La Niña (ENSO) system and refers to the atmospheric loop that circulates over the Pacific Ocean near the equator as part of ENSO. Normally, air flows east to west across the tropics at the surface of the ocean but at higher altitudes, it moves west to east as part of this circulation. The rising air in the west and sinking air in the east connects in a continuous loop that itself moves closer to and further away from Australia, associated with ENSO.

The atmospheric circulation in the loop is influenced by the sea surface temperature gradient across the equatorial Pacific Ocean. Like a hill on a road, the SST gradient describes the change in temperature across the ocean surface from one location to another. This is an east-west gradient. A stronger SST gradient produces stronger winds blowing across the equatorial Pacific. A weaker gradient means weaker winds.

During El Niño and La Niña events, pools of warm water pull the Walker Circulation of air across the Pacific. During El Niño, warm water, in effect, moves from the western Pacific to the east and as it moves, the rising air in the Walker Circulation model moves with it (see figure above right).



General Circulation Models (GCM)

A GCM is the most advanced type of modelling available to understand seasonal climate variability. Some can also help to understand how greenhouse gas concentrations will impact climate. They take into account four main components – the atmosphere, land surface and biosphere, oceans and polar ice. Data is computed in 30-minute time-intervals over a global grid for a series of months or years. Models simulate observed daily weather and average climate patterns to determine seasonal climate possibilities. The opportunity in using GCMs is that they can provide longer lead times for seasonal forecasting. This includes enhanced capability in, until now, poorer periods for seasonal forecasting such as from March to May, so farmers could gain an understanding of climate conditions in winter and beyond.

Useful resources

El Niño Modoki – www.jamstec.go.jp/frcgc/research/d1/iod/e/elmodoki/about_elnm.html

Madden-Julian Oscillation – www.bom.gov.au/climate/mjo/#tabs=MJO-phase

The Walker Circulation – www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy

Walker Circulation and Sea Surface Temperature Gradients – www.climate.gov/news-features/blogs/enso/what%E2%80%99s-hold-el-ni%C3%B1o

General Circulation Models - www.ipcc-data.org/guidelines/pages/gcm_guide.html

Building Farmer and Advisor Knowledge in Carbon Farming Project – www.carbonfarmingknowledge.com.au

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