Our Changing Climate

SOUTHCOAST NATURAL RESOURCE MANAGEMENT

Australian Government

National Landcare Programme

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Our Changing Climate

Climate is always changing. It is the speed and scale of change that can present challenges. As a regional natural resource management (NRM) group, South Coast NRM has to consider how a rapidly changing climate will impact on the region's natural resources and how people, plants and animals might respond and adapt.

Under its Clean Energy Futures program, the Australian Government is funding South Coast NRM and its partners to add climate change planning to their regional strategies. The aim is to identify climate risks, potential adaptation responses and ways to reduce the vulnerability of natural resources and landscapes to climate change. This project has enabled South Coast NRM to develop a *Climate Adaptation Addendum to Southern Prospects 2011-16.*

To develop the addendum, South Coast NRM commissioned a series of background papers on climate change in each of the natural resource themes of adaptive capacity; *land, biodiversity, water, coastal and marine and cultural heritage*. Using these as a basis, the reference groups for each theme have developed priority goals and outcomes for the next few years.

The Australian Government has also funded each NRM region to develop guidelines for tree plantings so they can sequester carbon from the atmosphere and improve vegetation connectivity without impacting adversely on other natural resources.

South Coast NRM's reference groups developed criteria for deciding where carbon plantings are best located within the region. These maps and criteria can be viewed at: *www.climateactionfarming.com.au.*

How the South Coast Region's Climate is Changing

Most of the South Coast region is not warming as quickly as other WA NRM regions and this may present more time and opportunity for adaptation.

The region has a naturally variable climate and up until 2030 this natural variation may mask major climate change. This doesn't mean major climate change is not happening or likely to happen. So far, climate has changed more in some parts of the region than others.

Many of the western parts of the South Coast are becoming drier while central and eastern parts have had little change in rainfall. There have been changes in the distribution of rainfall in some parts of the region and this also has various impacts.

CSIRO and the Bureau of Meteorology have produced some projections for the whole south-west of Western Australia (Southern and South-Western Flatlands West) based on the latest global climate models which can be seen at: *www.climatechangeinaustralia.gov.au/en/*

These projections state:

† *A continuation of the trend of decreasing winter rainfall is projected with high confidence. Spring rainfall decreases are also projected with high confidence. Changes in other seasons are unclear.*

† *Temperatures have increased over the past century, with the rate of warming higher since 1960. Mean temperature increased between 1910 and 2013 by around 1.1 °C.*

† *For the near future (2030), the annually averaged warming across all emission scenarios is projected to be around 0.5 to 1.2 °C above the climate of 1986 - 2005.*

† *By late in the century (2090), for a high emission scenario (RCP8.5) the projected range of warming is 2.6 to 4.2 °C. Under an intermediate scenario (RCP4.5) the projected warming is 1.1 to 2.1 °C.*

They also project more extremely hot days and droughts. It is important to stress that these are projections not predictions. Although the models have been downscaled this does not increase accuracy.

Downscaling is useful when there are major mountains such as those in Tasmania but do not necessarily provide more information about the South Coast. The smaller the scale the more difficult it is to project climate.

There is always more uncertainty at local scale. You can read more about climate influences and uncertainties related to South Coast climate in the document, *The Changes in South Coast Climate* available at *www.climateactionfarming.com.au.*
The document also explains some of the climate

science that is helping to improve climate models and projections. The projections provide the best available information to help planning. Planning for uncertainty involves developing scenarios for different climate futures and analysing the risks.

Some of the scenarios for the South Coast are not negative in the short-term. For example, warming might increase the varieties of wine grapes that can be grown on the South Coast.

Temperatures in the main wine growing areas might be more like Margaret River. With the drying climate some farmers on the western part of the South Coast have been able to change to cropping enterprises, which have generally proved more profitable than livestock.

The South Coast is not projected to heat as much, or as rapidly, as the west coast and this will make it an ideal location for intensive industries such as free-range piggeries.

Longer term there is a lot more uncertainty. The biggest uncertainty is the level of greenhouse gases past 2030. Several levels have been used in climate models as Representative Concentration Pathways (RCPs) based on when, or if mitigation occurs.

The difference in the climate later in the century with different RCPs is very large. The best approach to use when dealing with uncertainty is risk management. This is a five-step process, which needs to be continually monitored and reviewed. An important goal for South Coast NRM is to increase the capacity for adaptation to climate change within the region. A first step is to understand the factors that can increase adaptive capacity. The Regional Capacity Reference Group is examining some of the socio-economic factors in adaptive capacity.

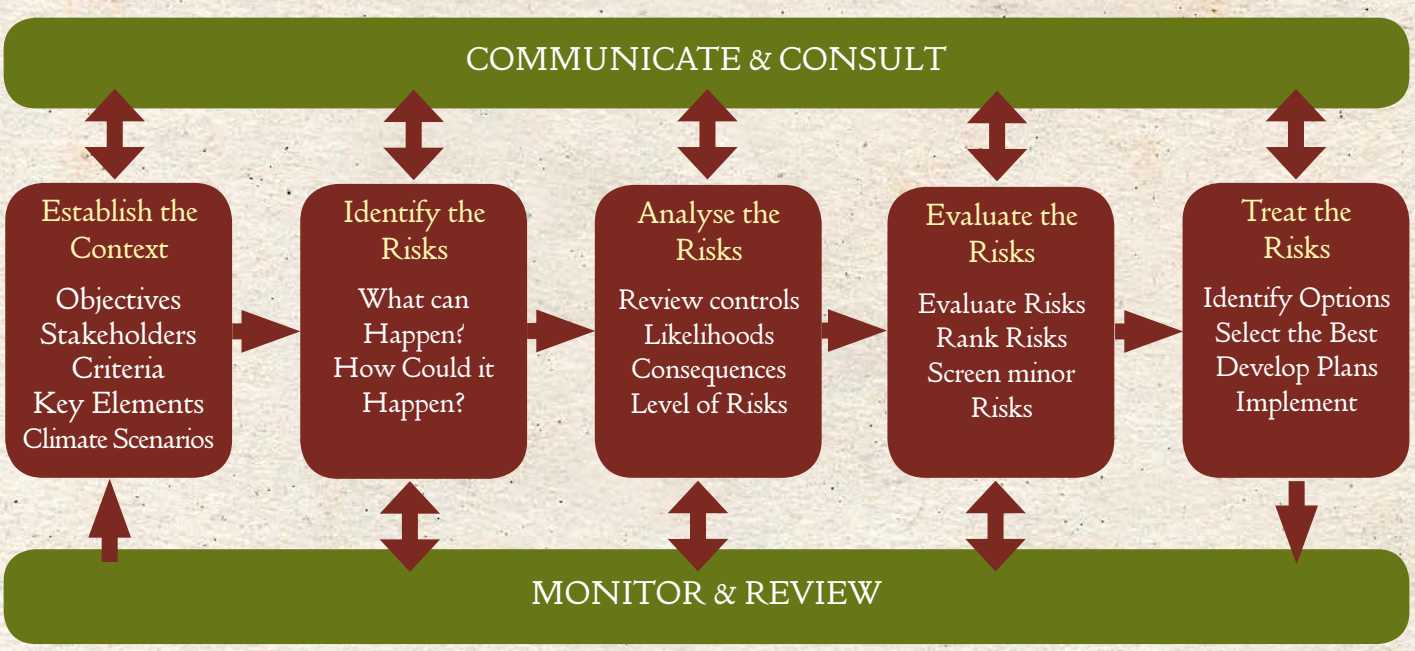
Uncertainty means natural resources need to be able to adapt quickly to sudden changes in climate. Each South Coast NRM themed reference group have had the common goal of needing to increase the resilience (or decrease the vulnerability) of each natural resource to climate change. This might mean more effort in increasing connectivity of vegetation or decreasing some of the specific threats which are likely to increase with projected climate changes.

The reference groups also found there was a need for more information on vulnerability and research on adaptation to climate threats.

Some examples where the changing climate is already having an adverse affect or is likely to soon, include; plant communities in the Stirling Range, species in wet refuges and freshwater creeks in the west of the region, water in farm dams, soil types prone to drying out quickly and low lying coastal areas, including estuaries.

The background papers on each theme provided current knowledge of the impacts of climate change and some of the gaps in knowledge. The impacts on each theme are summarised briefly here but more information is available in the *Climate Adaptation Addendum* and background papers.

Steps in Risk Management for Uncertain Climate Futures



Land

The South Coast region is diverse in climate and land use. Increasing variability in climate with a trend to warmer temperatures and lower rainfall in parts of the region will pose new challenges for agriculture and forestry.

Different parts of the South Coast will have different climatic responses to global warming. There will be interactions between increased carbon dioxide, rainfall and temperature.

For example, carbon dioxide could have production benefits in the short term before high temperature and variable rainfall changes impact. South Coast farmers have always had to adapt to a variable climate and will continue to do so but the scale of change may increase after 2030.

Some of the gaps identified in the *Climate Adaptation Addendum* include more climate information, better climate monitoring and more specific research and development applicable to particular South Coast areas and climates. The Land Reference Group set South Coast NRM and its partners a goal to protect the region's important agricultural land from the effects of climate change. Over the next few years they aim to do this by increasing knowledge and understanding of the risks and the capacity of people, organisations and agricultural plants and animals to adapt.

Another outcome of the land resource planning was a set of maps of where carbon plantings are best located so they do not conflict with high value agricultural land.

Understanding how agricultural animals will adapt to climate change will require further research over the coming years.

How Two South Coast Farmers are Adapting to Climate Change

Andrew Longmire farms north of Salmon Gums where the annual rainfall is approximately 330mm.

"We rely on summer rainfall for sub-soil moisture," Andrew said.

"We've been getting more summer rainfall since about 1992. Every year is different and there's no pattern to the rainfall, we just have to work with it," he said.

"We crop particular soil types depending on the season and use liquid fertiliser in dry years. The main adaptation in the district is direct drill and chemical fallow."

The biggest risk for Andrew are potential August/September heat events. He believes low rainfall farming will still be possible at Salmon Gums by using appropriate varieties with better tolerance to heat, dry seasons, frost and boron.

In contrast, in the high rainfall zone, farmers have so far benefited from climate change and been able to increase the proportion of cropping.

So for many, their current main income comes from cropping and as a result, their farms are more profitable.
There's a much smaller margin from prime lambs and beef than from wheat.

David Slade farms in the Kent catchment at Kendenup where the annual rainfall is approximately 600mm.

"We couldn't grow wheat 40 years ago, we're now getting Cranbrook to Tambellup weather. I have to accept the climate is changing but we don't know whether it's due to all the clearing in the south-west or due to the warming of the sea," David said.

The Slades' farm business has benefited from the drying climate by being able to put in a greater proportion of crop.

The Potential Impacts of Projected Climate Change

LAND USE	IMPACT SHORT TERM TO 2030	RESPONSE TO 2050 WITH NO GLOBAL MITIGATION OF GREENHOUSE GASSES
Cropping	• Varies with rainfall zone. • Increased variability in rainfall. • Overall reduction in grain yields but less than other regions. • Some higher rainfall areas become more suited to cropping. • Greatest impact on wheat & canola in hotter, drier northern parts of region. • Soil type important factor in yield responses. • Changes in distribution, abundance of pests & diseases.	• Major contraction of grain growing. • Movement of 300mm rainfall isohyet much further south & west.
Grazing	• Risk to water supplies, heat stress in livestock, declines in pasture production, loss of clover with false breaks. • Decreased groundcover.	• Temperature and low rainfall are both factors in very low productivity, high risk of soil erosion from livestock. • Heat stress very high risk.
Viticulture & other horticulture	• Temperature not a risk to 2030 & may be a benefit in some areas. • Some changes in distribution of plantings likely. • Water supplies at risk due to declining rainfall. • Increased water use efficiency with well-managed catchments will be important. • Changes in pests and diseases & smoke damage from increased fire are potential risks. Increased water catchment for farm dams & irrigation are a potential NRM risk.	• Temperature becomes a risk. • Dams may be unable to catch sufficient water even with well-managed catchments.
Forestry	• Plantations have already contracted from marginal rainfall zones. • Rainfall reduction & an increase in dry seasons is a risk to growth rates of plantations. • Length of time to harvest makes it difficult to be flexible to sudden shifts in climate. • CO_2 may increase production in some parts of the region in the short term. • Forestry has NRM benefits & risks, reducing salinity & inundation but also reducing streamflow.	• Higher temperatures will over-ride benefits of higher CO_2.
Intensive animal industries	• Risks to water supply & heat stress.	• Heat stress very high risk.

Biodiversity

The South Coast is part of the south-west biodiversity hot spot which means it has high biodiversity but also a high level of threat.

It is difficult for biologists to determine the impacts of climate change on threatened species and communities.

This is because of uncertainties about future climate and a lack of knowledge of capacity of species to adapt.

There is also uncertainty as to how species will interact with one another in their responses and how all the other threatening processes will interact with climate change.

Uncertainty means that ecologists and natural resource managers will have to use different approaches to those used in the past.

Biologists have estimated 80 per cent of threatened fauna and 95 per cent of threatened flora of the South Coast region as extremely or highly vulnerable to climate change.

Some threats can increase with particular changes in climate. For example, fungal pathogens such as *Phytophthora dieback* could increase if summer rainfall increases and fire frequency is likely to increase with hotter days or more summer thunderstorms.

The table below outlines some of the threatening processes and the potential impact of projected climate change.

South Coast NRM and its partners aim to build resilience into ecosystems to increase their ability to adapt.

They recognise they will need to do this in conjunction with more targeted management of species, communities and ecosystems that may be particularly vulnerable to climate change.

Ways to do this include reducing threats, managing existing vegetation, increasing connectivity and identifying climate refuges.

Research is going to be critical to managing risks to biodiversity. South Coast NRM aims to encourage research into climate impacts and determining which species and ecosystems are particularly vulnerable.

Threatening Processes & Potential Impact of Projected Climate Change

PRIMARY THREATENING PROCESS	IMPACT OF CLIMATE CHANGE
Fire regimes	Changes in distribution, potential for increased spread, increased vulnerability of some species. Heat & drought stress may increase vulnerability to pathogens.
Predation	Increased risk due to rapid dispersal.
Altered hydrology	Reduced water availability for aquatic species, variable effects on salinity & water-logging depending on rainfall & landscape. Potential for increased sedimentation.
Fragmentation	Reduction of species ability to disperse to climatically suitable areas.
Small population size	Decreased genetic variability of small populations.
Weeds	Increased risk of invasive species with changes in rainfall & temperature & particularly woody weeds with higher carbon dioxide.

Water

Water demand is increasing with population growth, particularly in the west of the region and supply is reducing and likely to reduce further with the drying climate.

Many Albany residents are unaware of how few water resources are currently available for human consumption. Denmark has experienced water shortages in the last few years.

The Department of Water is investigating potential new water supplies for Albany and other coastal towns and the Water Corporation is introducing water efficiency programs and examining climate independent options, such as desalination.

The South Coast is highly dependent on groundwater for human consumption and there needs to be better understanding of the impact of climate change on supplies. Over-abstraction is a major threat.

Water for agriculture is going to decrease with projections of further drying and low inflow to farm dams is a particular threat for livestock, viticulture and horticultural industries.

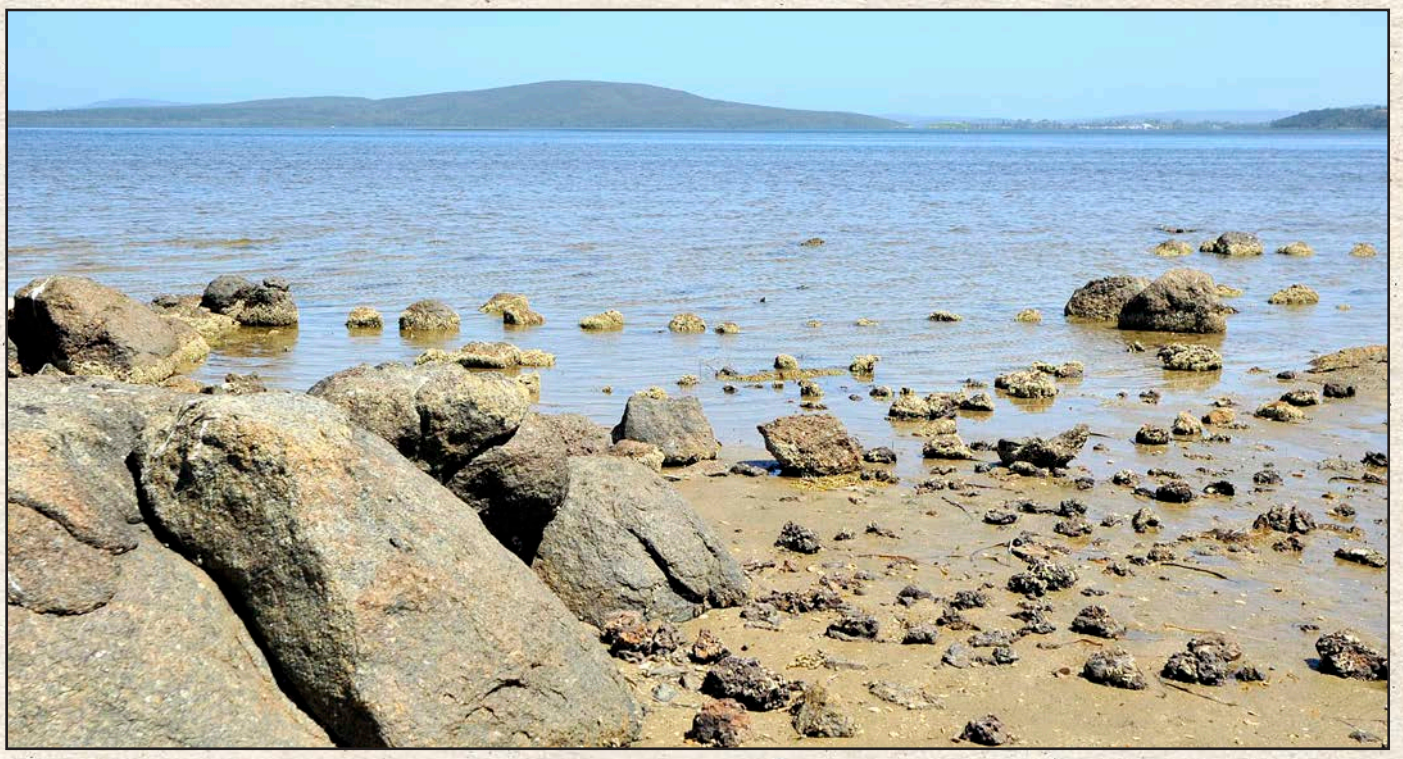
Climate change is already reducing surface water in rivers, creeks and wetlands in the west of the region. In some cases this will temporarily improve the condition by reducing the inundation caused by clearance of native vegetation but in areas where there are fresh water rivers and wetlands in good condition, the drying climate will be a major threat.

The threat from climate change will need to be managed with other threats such as increased population, changes in land use, increased water abstraction, sedimentation and salinization.

Estuaries are likely to have more saltwater inundation and less rainfall from catchments. This is already occurring in the Wilson Inlet. This will change the freshwater/saltwater ratio and cause changes in sea grasses, fish and other estuarine species.

South Coast NRM has an overarching goal of maintaining or improving waterways and ensuring water for the environment as well as people's needs. As in the case of biodiversity the aim is to increase the resilience of waterways.

There is a need for a better understanding of the impacts of climate change on water assets and to improve community understanding of the impacts of climate change on potable water supplies, waterways and estuaries.



Estuaries such as Oyster Harbour are likely to have more saltwater inundation and less rainfall from catchments.

Coastal & Marine

The impact of climate change on the coastal and marine environment will depend on how much and how quickly sea levels and temperatures rise.

The South Coast region has approximately 1000km of coastline, including many estuaries. About 70 per cent of coastal vegetation is in conservation parks or reserves. The coastal vegetation is in relatively good condition and forms an important wildlife corridor.

The coastal reserves, Two Peoples Bay Nature Reserve, Cape Arid and Fitzgerald River national parks, are refuges for threatened flora and fauna species. The coastal wetland systems of Lake Warden and Lake Gore are wetland sites of international importance (Ramsar sites) for migratory and resident birds.

Offshore islands are important habitat and breeding sites. Some are also used to translocate threatened species. In the short-term the South Coast is at less risk from storm surges and sea-level rise than many other coastal areas in Australia. Nevertheless some sea level rise could cause increased saline inundation of estuaries and coastal wetlands which are also under stress from reduced rainfall.

As the ocean warms some species are likely to move south from the Indian Ocean and there may be changes in the Leeuwin Current. CSIRO and the Bureau of Meteorology have projected sea level rise based on projected ocean expansion and ice melt. Under the highest emission scenario, structures in 2070 would need to be half a metre higher in Albany than in 2016.

Some of the region's offshore islands are used to translocate threatened species.

There is still some uncertainty about how much sea levels will rise, depending on how rapidly the Antarctic ice sheets melt. The community is carrying out valuable research and monitoring projects on the coastal and marine environment including fisheries monitoring with the Department of Fisheries and school research projects.

The Coastal and Marine Reference Group identified the management of the coastal zone and marine assets and ecosystems, based on their vulnerability to climate change, as a major goal.

They found that South Coast NRM and its partners need baseline data on the current state of coastal and marine ecosystems with monitoring over time, more knowledge of climate impacts, and identification of coastal and marine assets at risk. They also set outcomes for integrated planning and better information sharing.

Albany Senior High School Research & Monitoring

The marine science students with their teachers, Tracy and Duncan Brothers, have been studying fish, seagrass and invertebrates in Princess Royal and Oyster Harbours for the past 14 years.

The students have worked with Fisheries WA, Edith Cowan University and the Department of Water. South Coast Natural Resource Management and Coastwest support their research program.

A major part of the program is the monthly sampling of commercially and recreationally important fish species using the same techniques as the Fisheries Department.

Students also conduct their own research projects and develop sampling techniques to study the local marine environment and have been monitoring salinity and temperature as well as other changes. "Long term data sets are very important in seeing changes," Tracy Brothers said.

Cultural Heritage

Cultural heritage includes the values of particular places and associated objects, traditions and spiritual connections.

It includes both and non-Indigenous people have for particular places and their associated objects, traditions, landscapes, building and spiritual connections. There is an overlap between natural and cultural heritage.

The South Coast has many important Aboriginal sites including the Oyster Harbour, Kalgan River and Wilson Inlet fish traps and weirs, as well as burial sites, lizard traps, grinding stones and grooves and historical and camping sites.

A number of these sites, including gnamma holes (man-made holes in rock for collecting water), are located at the Quaranup Peninsular.

Others, such as the region's fish traps, are particularly vulnerable to rising sea-levels. Some sites are only known to custodians and much knowledge is being lost with the passing of Traditional Owners and Elders.

Aboriginal cultural values are strongly connected to Country and natural landscape as well as registered sites. In the past, rivers, estuaries and inlets were important cultural sites for ceremonies and gatherings and although many have been highly modified since settlement, climate change is likely to impact them further.

Many of the South Coast's rivers and estuaries remain important fishing places for Aboriginal people. It is important to identify current and potential Aboriginal and non-Indigenous cultural sites at risk of climate change impacts.

The South West Land and Sea Council has a range of heritage protection strategies and South Coast NRM is increasingly involving Aboriginal people in its cultural heritage planning.

Likely Impacts of Climate Change on Cultural Heritage

CHANGING CLIMATE IMPACTS	NON-INDIGENOUS CULTURAL HERITAGE	ABORIGINAL CULTURAL HERITAGE
Sea level rise: coastal inundation, saltwater intrusion into freshwater systems including groundwater.	Historic buildings & monuments in low-lying areas risk of flooding. Coastal environment that detract from cultural aesthetic & use values.	Estuaries, rivers, wetlands that link to cultural values. Aboriginal fish traps in estuaries & foreshore middens. Inundation of sites on the coast & on estuary & river foreshores.
Increased temperatures: evaporation of water bodies, temperature of waterways & water bodies.	Water quality in rivers, wetlands and estuaries that detract from cultural aesthetic & use values.	Water quality in rivers, wetlands & estuaries that detract from cultural aesthetic & use values.
Increased bushfires from temperature increases, higher evapotranspiration, less rainfall and at different times of the year, less soil moisture.	Damage to historic buildings & monuments. Impacts environmental values linked to cultural values.	Damage to scar trees, man-made structures, burial sites, middens. Impacts environmental values linked to cultural values. Availability & continuity of bush tucker & medicinal flora & fauna.
Increased drought: less rainfall at different times of year, variable across years, reduced runoff into rivers, storage dams and groundwater.	Impacts environmental values linked to cultural values.	Higher temperatures will override benefits of higher CO_2.

Useful Online Resources

South Coast NRM Regional Mapping For Climate Change: southcoastnrm.com.au /our-projects/regional-mapping-for-climate-change

Climate Action Farming: www.climateactionfarming.com.au

Climate Change in Australia: www.climatechangeinaustralia.gov.au/en/

Australian Climate Influences: www.bom.gov.au/climate/about/

Department of Environment Climate Change: www.environment.gov.au/climate-change

CSIRO Tools to Assist NRM Groups: http://adaptnrm.csiro.au

CSIRO Climate Research: www.csiro.au/en/Research/Environment/Atmosphere-and-climate

Carbon Dioxide Levels, Cape Grim Tasmania: www.csiro.au/greenhouse-gases/

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