NSW GOVERNMENT | Office of Environment & Heritage

OEH Climate Research Team – delivering an integrative climate science program

Dr Kathleen Beyer, Senior Team Leader Climate Research, Climate & Atmospheric Science Branch, Science Division
Matt Riley, Director Climate & Atmospheric Science, Science Division

NSW Climate Change Policy Framework

Long-term objectives

Achieve net-zero emissions by 2050
NSW is more resilient to a changing climate

NSW Government Policy Directions

Take advantage of opportunities to grow new industries in NSW	Reduce risks and damage to public and private assets in NSW arising from climate change	Reduce climate change impacts on health and wellbeing	Manage impacts on natural resources, ecosystems and communities

Implementation

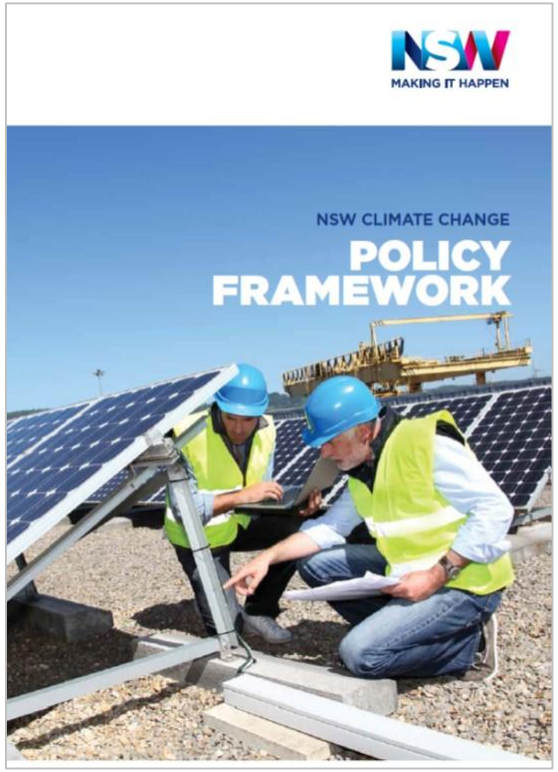
Investigate how to embed climate change emissions savings and adaptation in government decision making

Roles of NSW Government

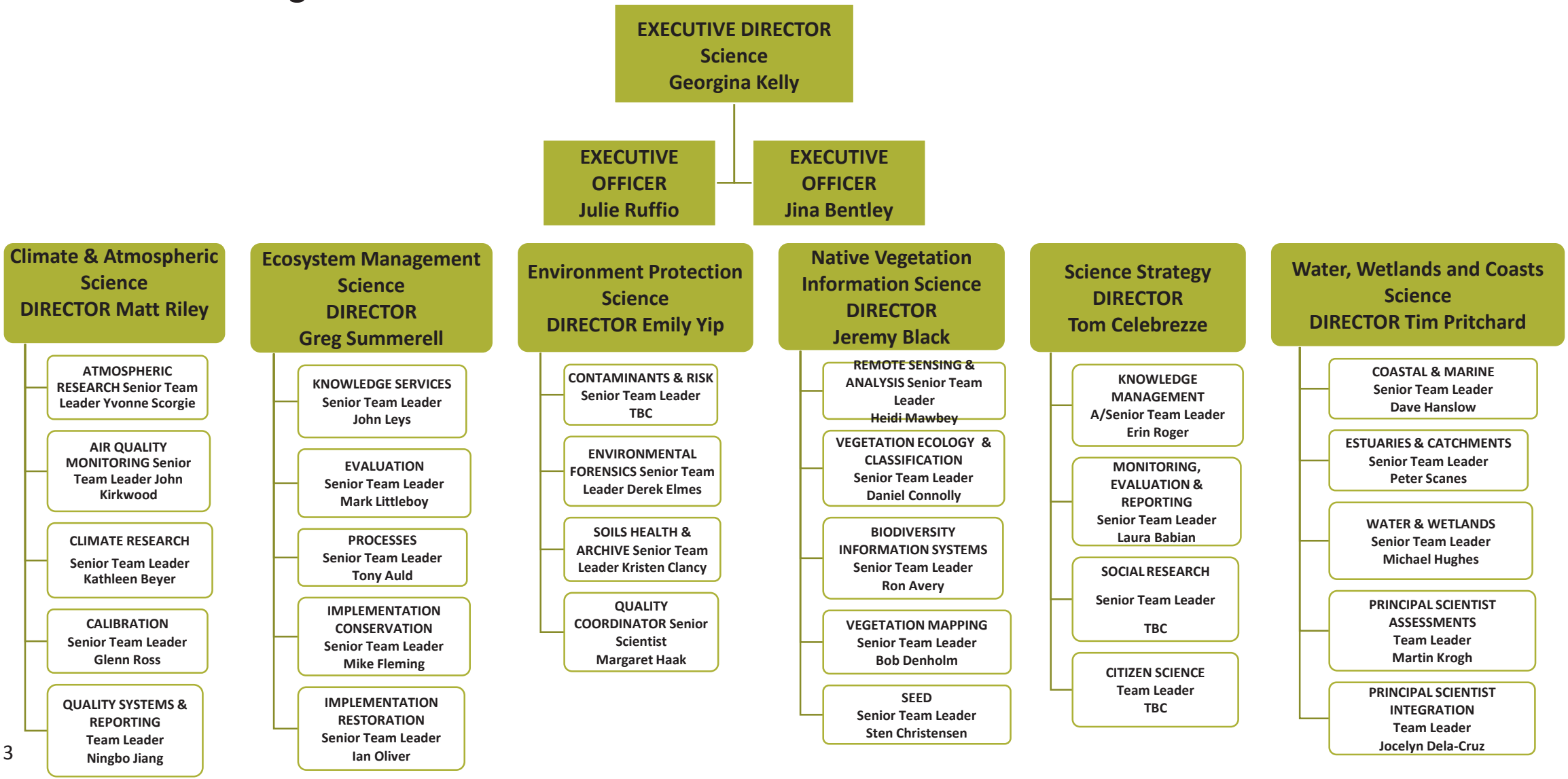
Government policy:
Implement policies to plan for climate risks and provide targeted support for households, communities and businesses that is fair, efficient and in the public interest

Government operations:
Assess and effectively manage climate change risk to government assets and services

Government advocacy:
Advocate for Commonwealth, COAG and international action to support effective adaptation

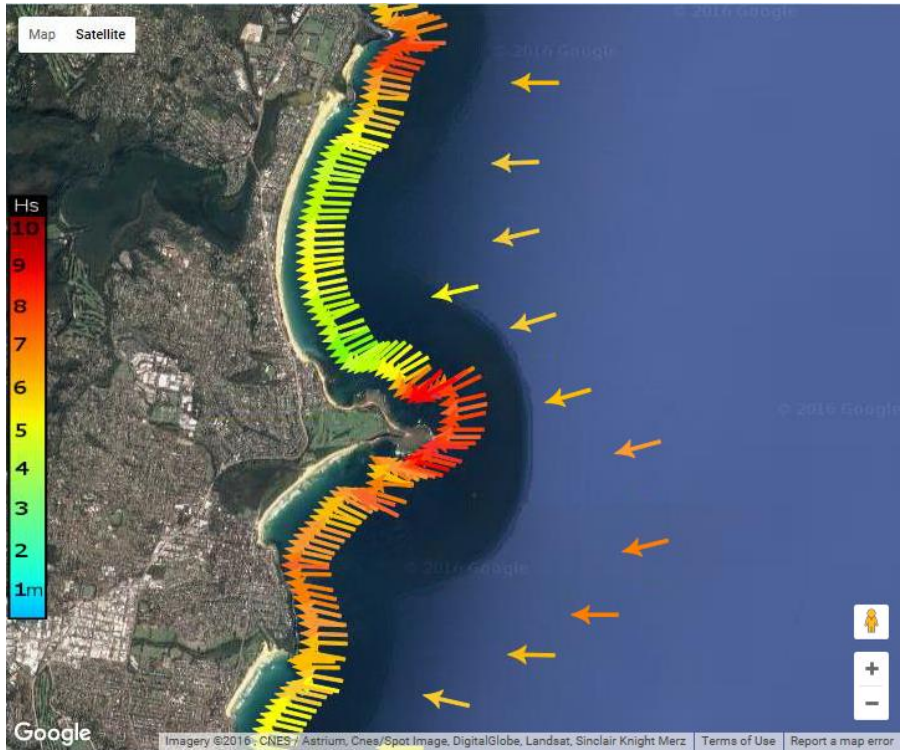


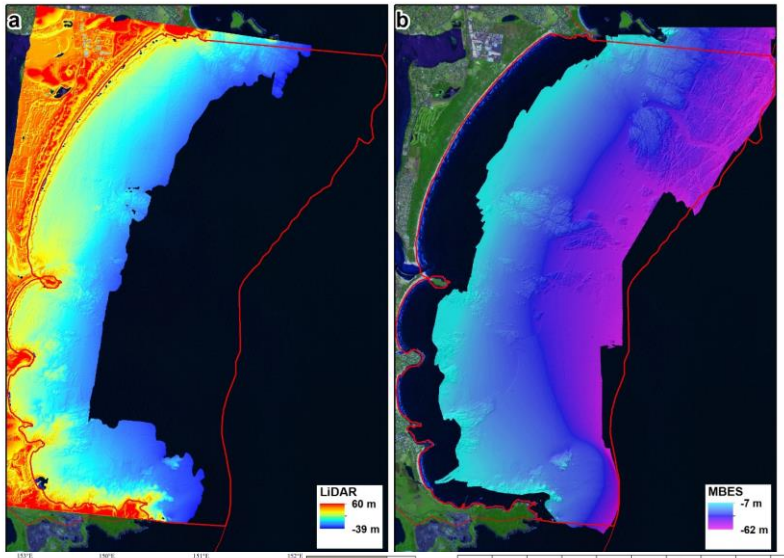
Science Division Organisational Structure

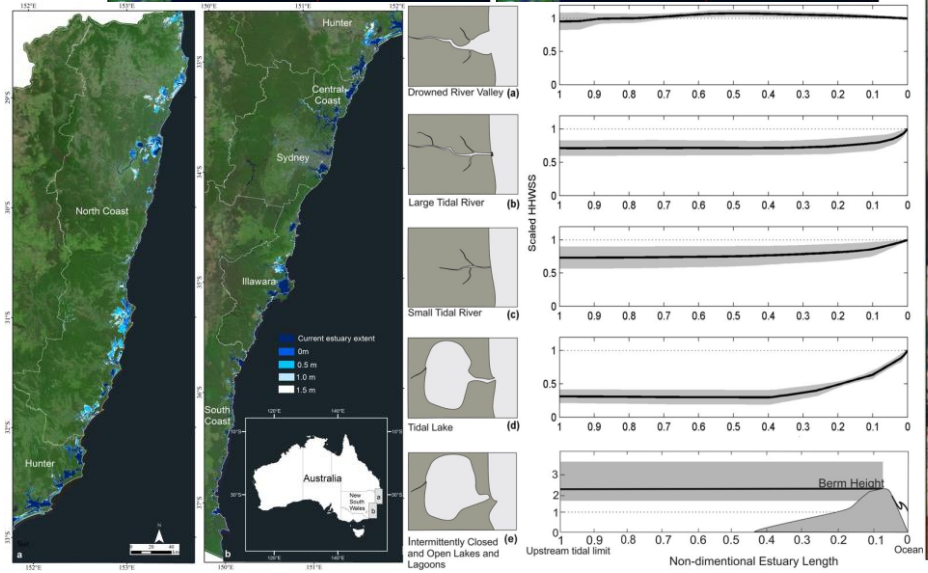


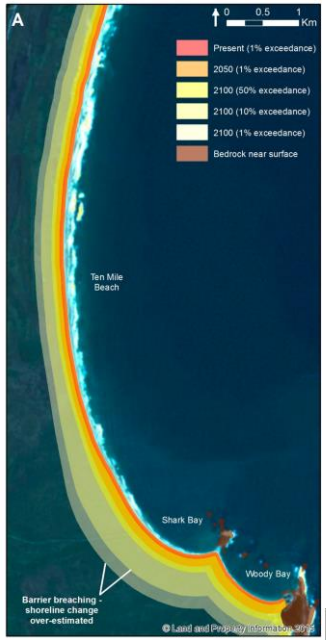
Coastal and Marine Science relevant to Risks and Extremes

- State-wide coastal seafloor mapping: Fundamental data collection to underpin coastal modelling
- NSW estuary inundation exposure
- NSW coastal erosion exposure
- State-wide wave modelling
- Wave Runup during extreme storms







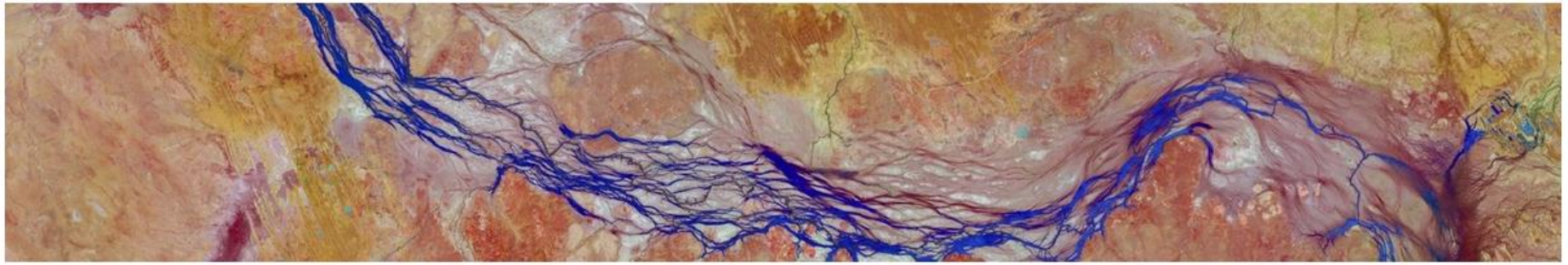


Native Vegetation Science

- Modelling to develop vegetation products
- Predictive modelling of vegetation structure
- Models for individual tree species (e.g. Koala trees)
- Improved woody extent modelling

JOINT Remote Sensing RESEARCH PROGRAM

HOME | ABOUT JRSRP | RESEARCH | PUBLICATIONS | CONTACT



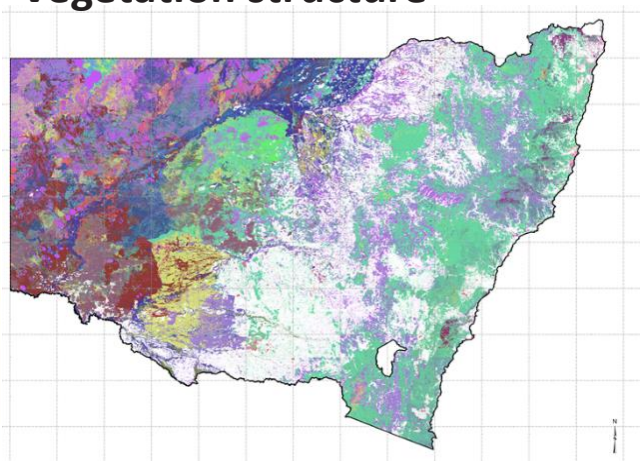
We are a collaborative program that combines research, research training expertise and infrastructure from the Remote Sensing Research Centre with remote sensing groups supporting the Queensland, New South Wales and Victorian governments.

We aim to increase Australia's capacity to conduct pure and applied remote sensing research to implement and assess effective environmental management policies at local, state and national scales.

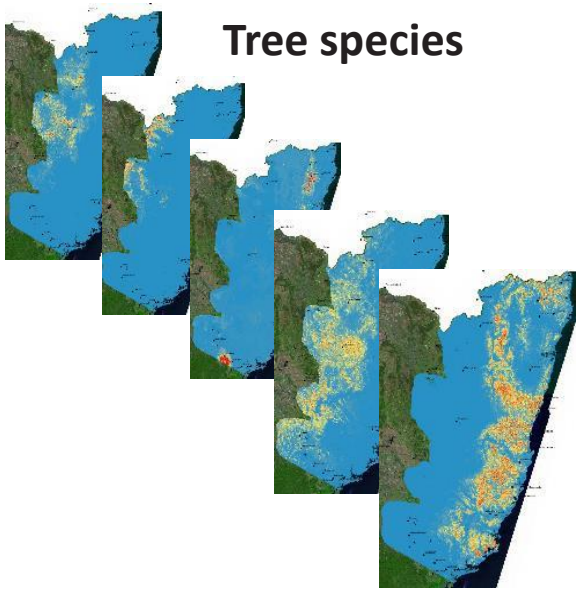
JRSRP Collaborative Partners:

- Remote Sensing Research Centre
- Queensland Department of Environment and Science
- New South Wales Office of Environment and Heritage
- Victoria Department of Environment Land Water and Planning
- University of New South Wales
- TERN
- University of New England

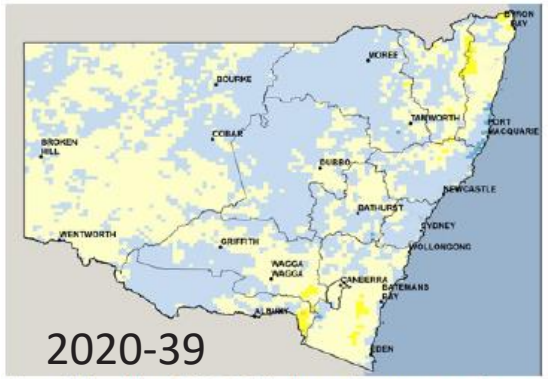
Vegetation structure



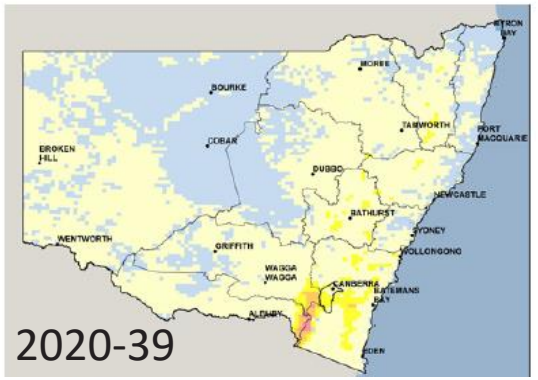
Tree species



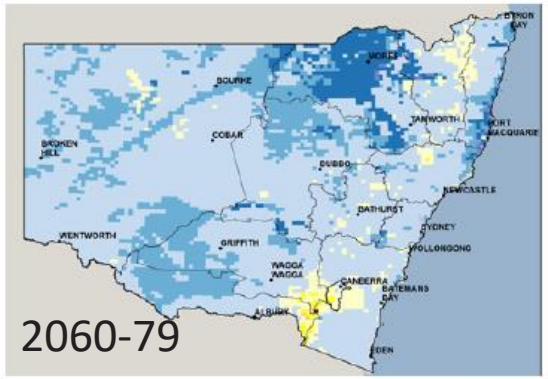
Hydrology and Landscape Modelling

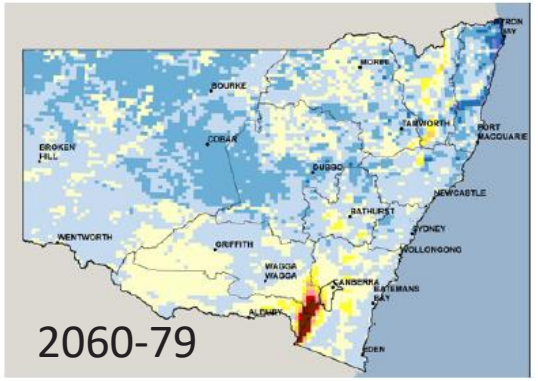


Surface Runoff

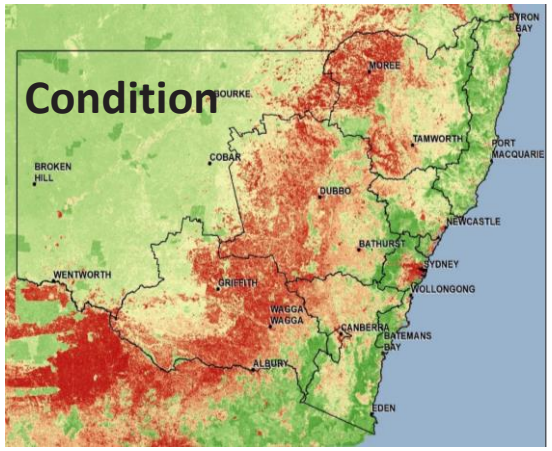


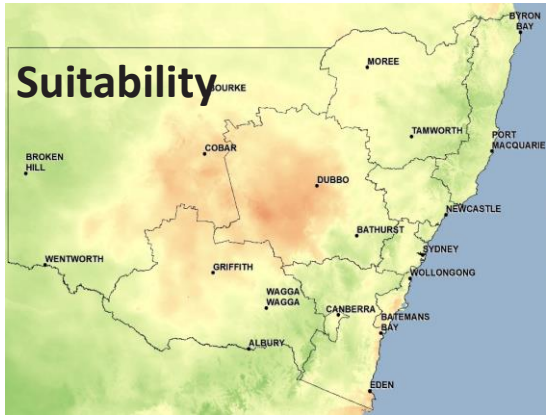
Recharge

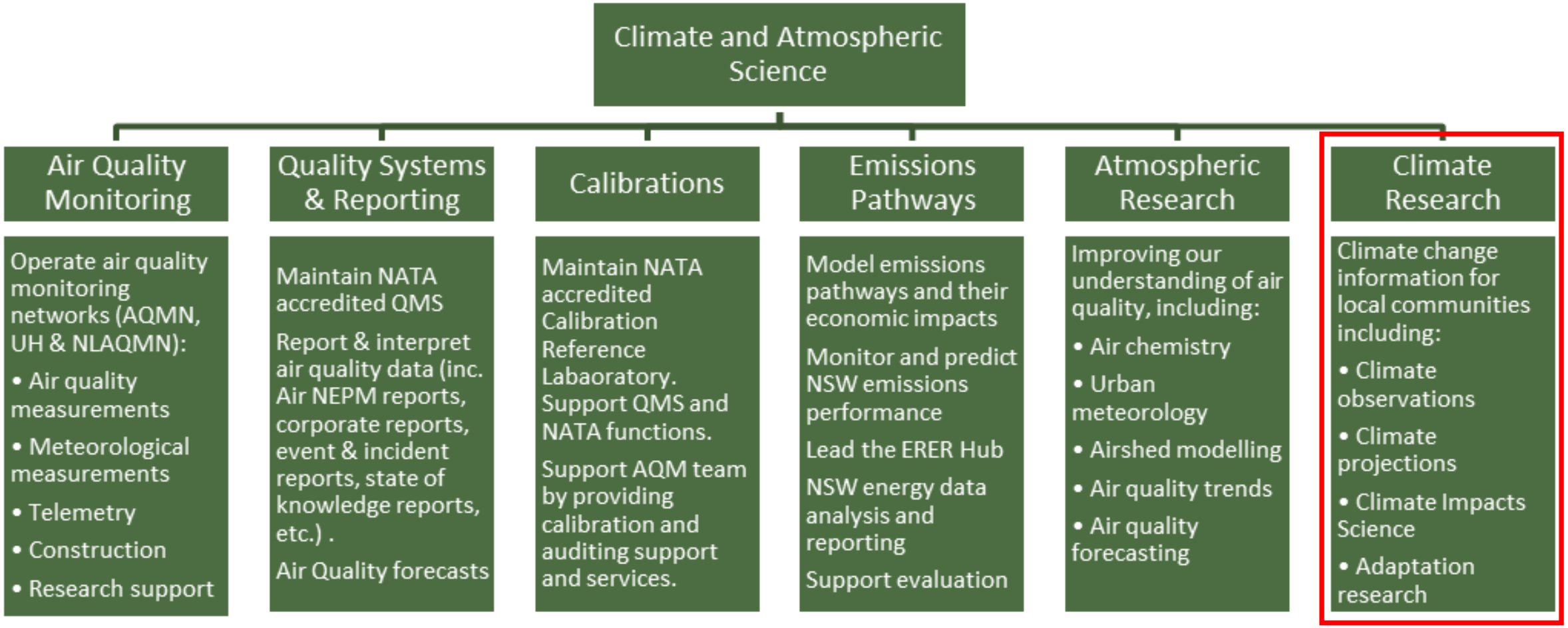




Soil Erosion







- 1 x Senior Team Leader: Kathleen Beyer
- 3 x Project Officers: Renee Dowse, Joseph Miller, Michael Colella, Daniela Marks
- 5 x Research Scientists; Stephanie Downes, Fei Ji, Nicholas Herold, Nidhi Nishant, Mia Gross
- 1 x Climate Data Specialist: Eugene Tam
- 1 x Science Communicator: Clare Watson

Climate Research Team - Portfolio includes:

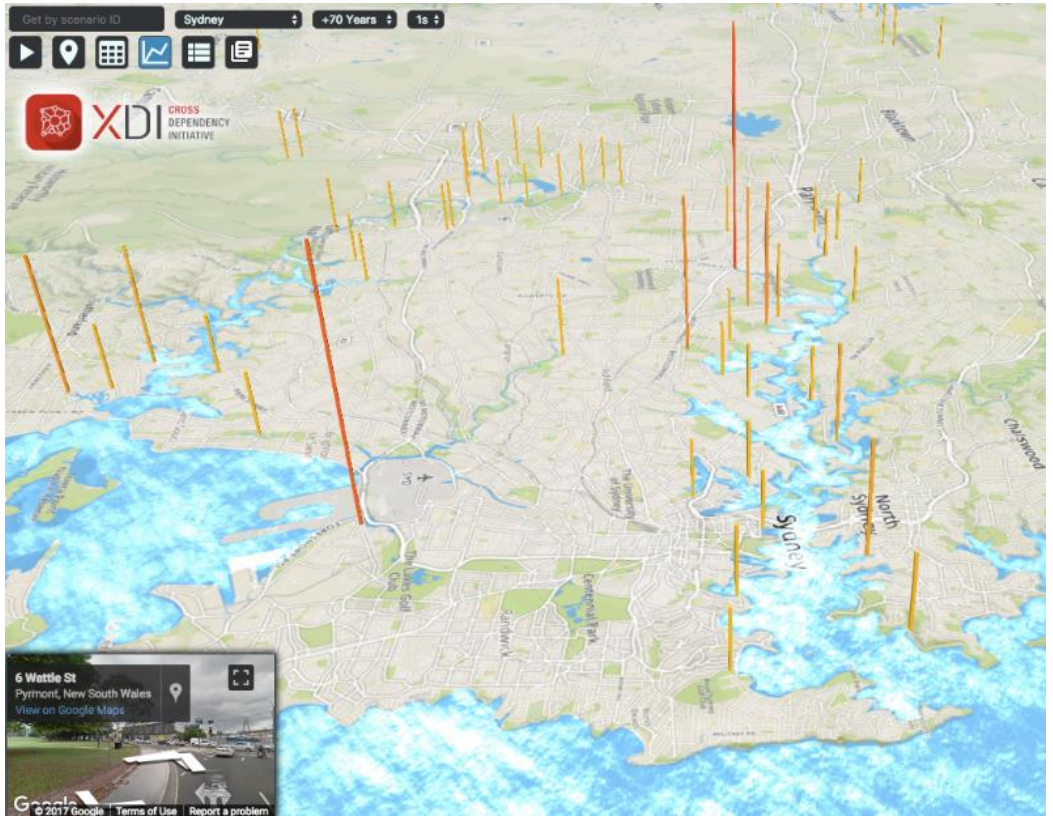
- Updating and Enhancing NARCliM 1.0
- Natural Hazards Research
- Climate Risks to Critical Infrastructure
- Human Health & Social Impacts Research
- Urban Heat & Green Cover Research
- Climate Change Impacts in the NSW Alpine Region
- Energy Efficiency Research
- Climate Impacts Research

Climate related risks to critical infrastructure

To identify the critical pathways and enablers for consideration of changes in climate into the design and risk management of assets, infrastructure and services in NSW.

Critical Infrastructure Sectors

- Energy
- Banking & Finance
- Communications
- Food & Grocery
- Transport
- Water
- Health
- Education
- Government



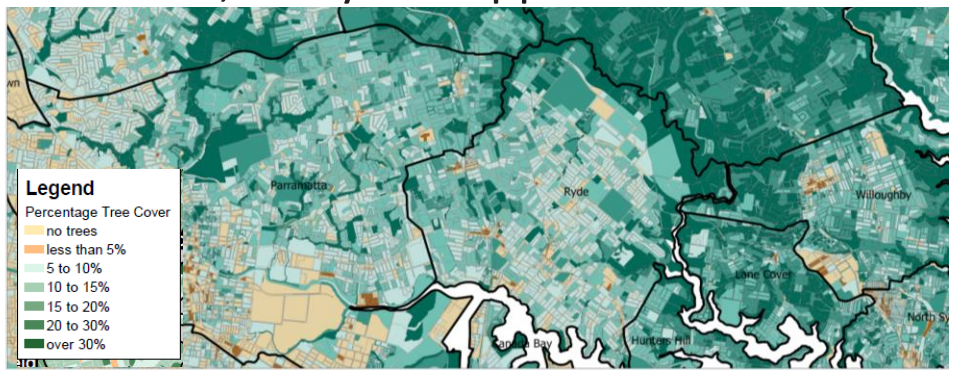
Human Health & Social Impacts Research (since 2017)

- Climate change, housing, and health: intersections between vulnerability, housing tenure, and adaptation responses to extreme heat
- Building climate resilience through policy-engaged mental health research
- Novel surveillance technologies to detect exotic mosquitoes in northern NSW
- Conceptual policy-response framework
- Climate change and allergy in NSW
- Health and Social Indicators of Environmental Exposures
- Food Security

University_
Planetary Health Platform

Urban Heat and Green Cover Research

- Best practice of the evaluation of Green Cover Strategies
- Multi-scale urban vegetation cover baseline for Sydney GMA
- Improve our understanding the relationships between surface temperatures and urban vegetation cover
- Supporting a consistent approach in evaluation research, analytical approaches and monitoring



Energy Efficiency Decision Making Node (since 2017)

Strategic research that supports the energy and resource efficiency program and policy design and to identify gas emissions reduction and energy saving opportunities.

Research inludes:

- Energy Efficiency Decision Making in the NSW Transport Sector [consumer behaviour]
- Developing an Evidence-Based BASIX Compliance Plan to Improve Energy Efficiency and Productivity of Residential Buildings
- Sustainable social housing – providing access to energy efficiency technologies
- Multiple impacts of energy efficiency

NSW GOVERNMENT | Office of Environment & Heritage

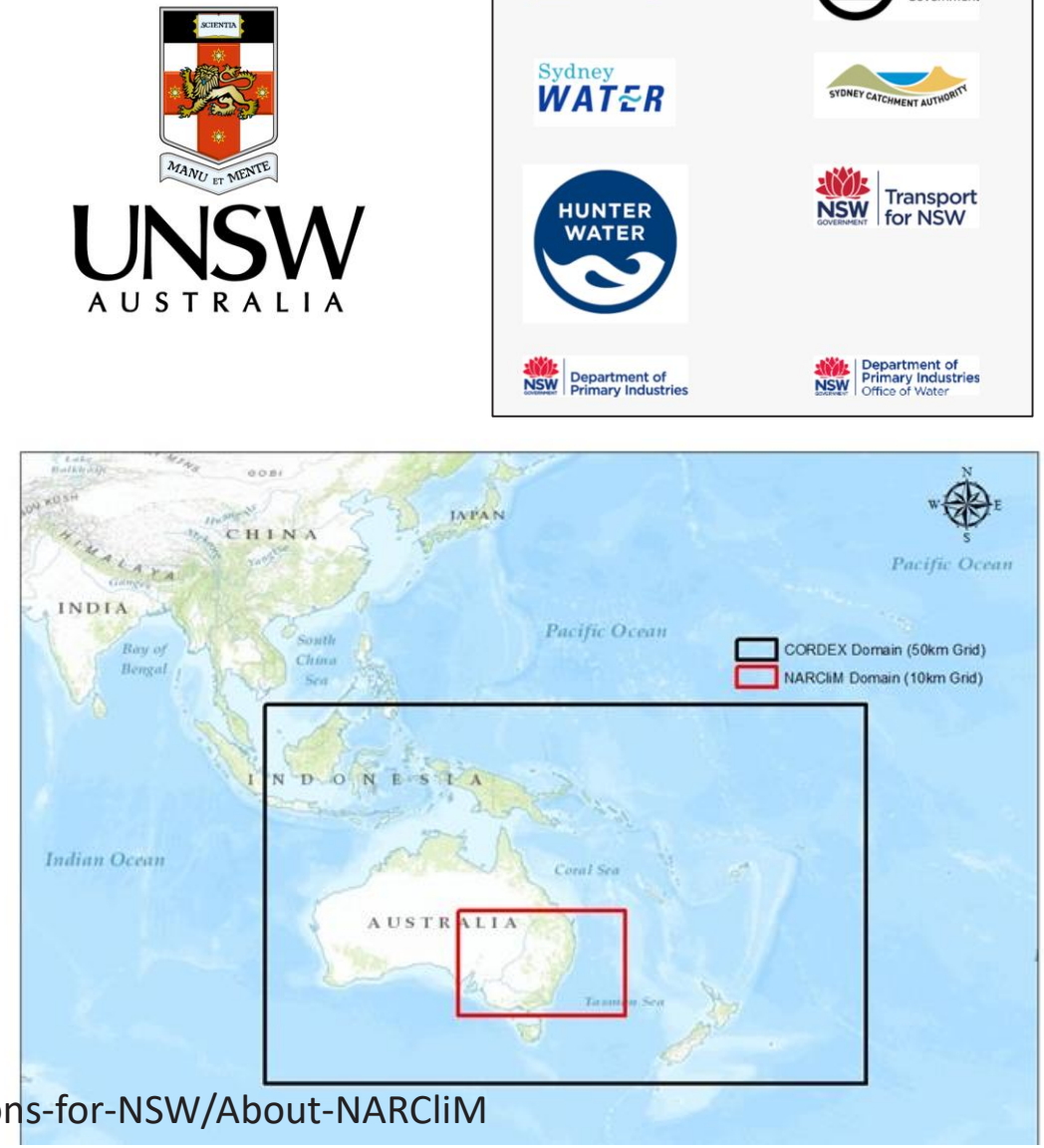
NARCliM – Designing updated climate projections

Dr Stephanie Downes & Dr Fei Ji

Climate Research, Climate and Atmospheric Science, OEH Science Division

What is NSW/ACT Regional Climate Modelling (NARCliM)?

- 10 km dynamically downscaled projections
- 12 regional climate models
- 3 x 20-yr periods: 1990-2009, 2020-2039, 2060-2079
- 1 x Business As Usual climate emission scenario
- Also:
  - 1950-2009 NCEP-reanalysis (3 RCMs)
  - 2km Sydney (1 model) [Argueso et al. 2015]
- Total data (raw & post processed): 0.5 PB



http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARCliM

Methods behind NARCliM: Selection of GCMs

1) Performance

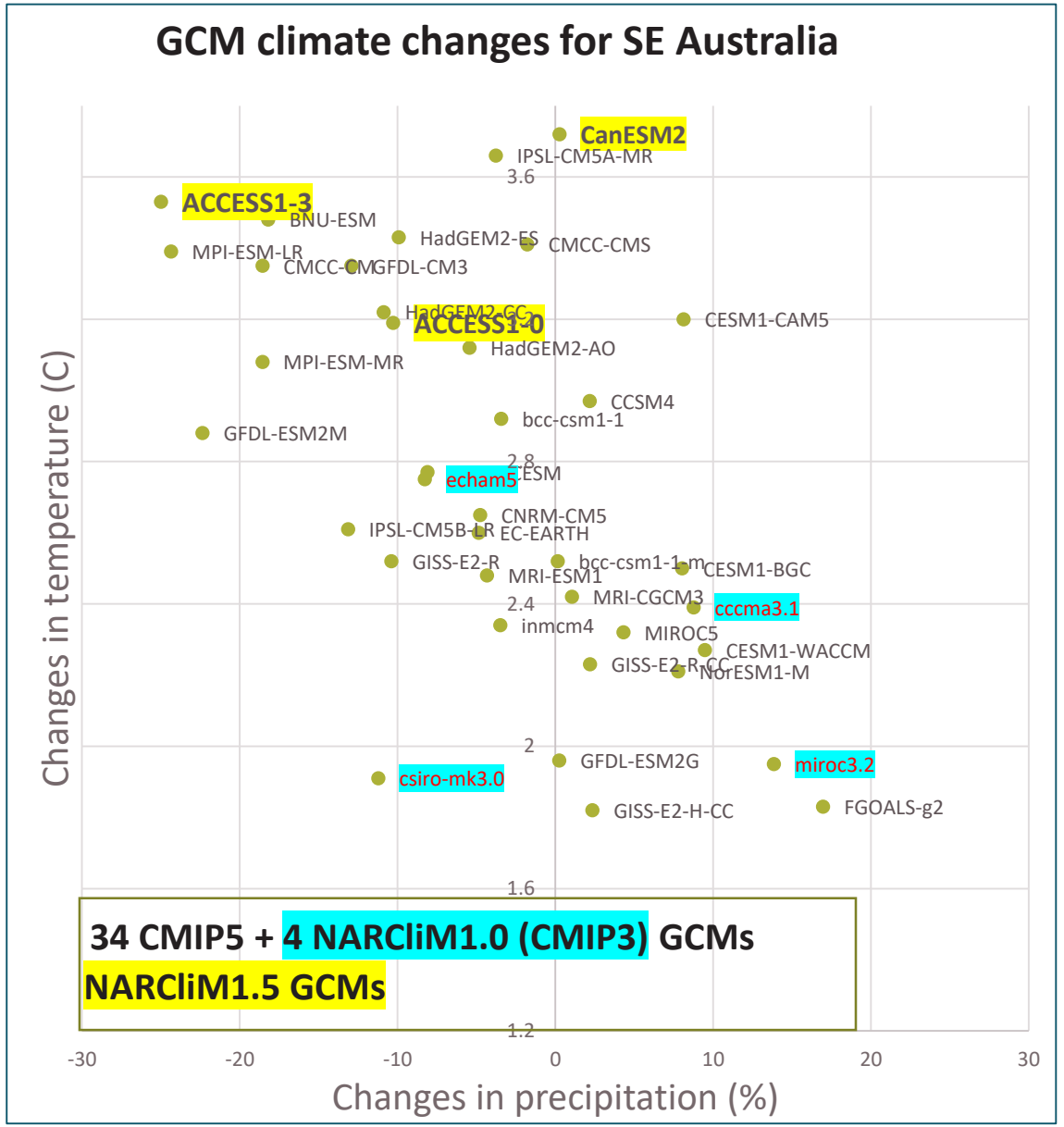
- review of literature assessing GCM performance
- Some GCMs excluded as in too few studies or poor performance across multiple studies

2) Independence

- GCMs ranked on the basis of having different imperfections when simulating recent Australian climate

3) Spanning uncertainty in climate changes simulated over 21st century

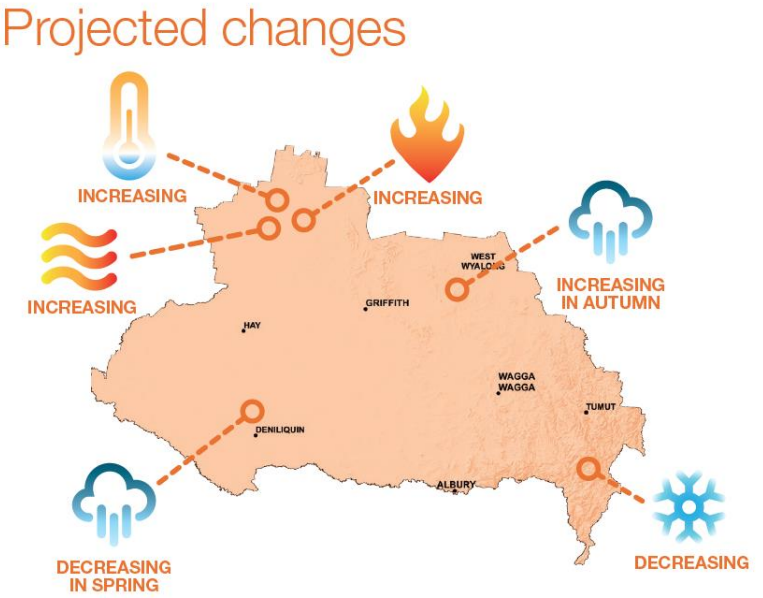
- Changes in annual average temperature & rainfall
- Changes in climate for NARCliM domain land area

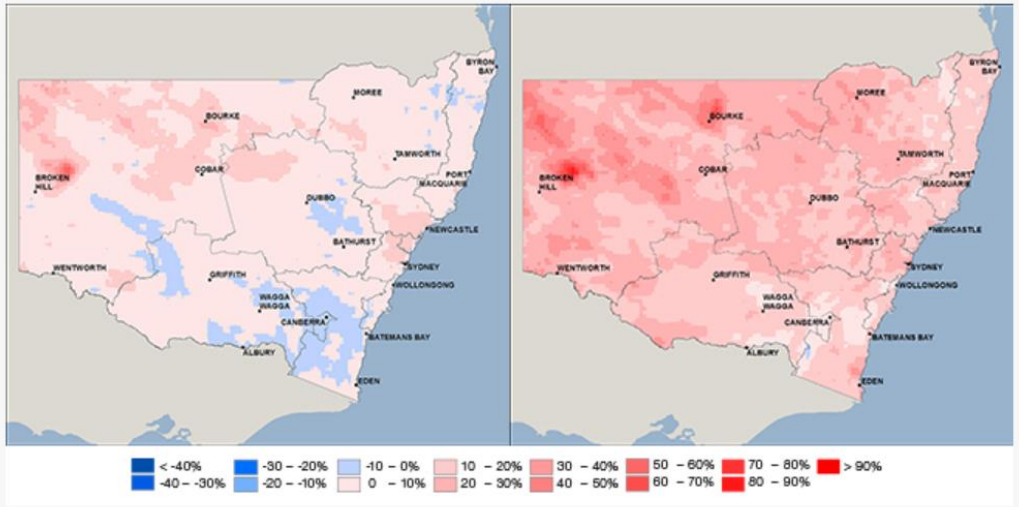


How was NARCliM delivered?

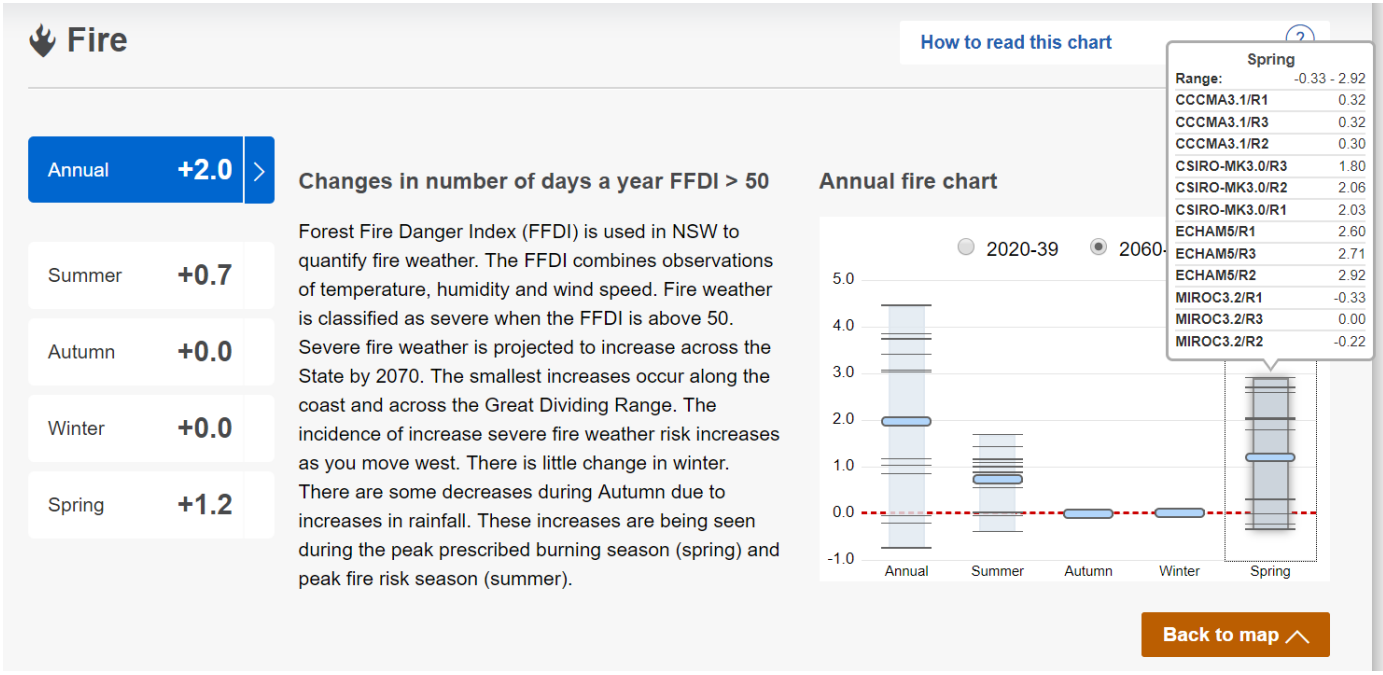
AdaptNSW

AdaptNSW: Maps, information and data
https://climatechange.environment.nsw.gov.au/

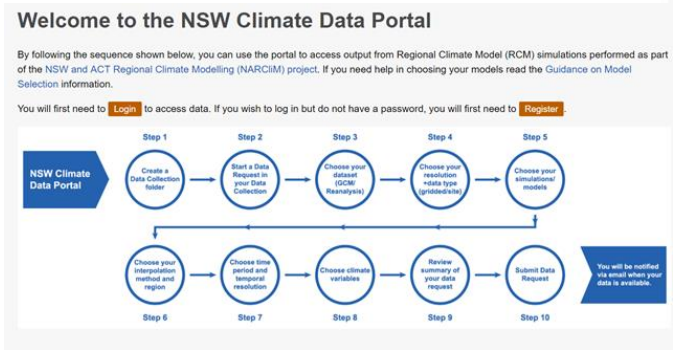


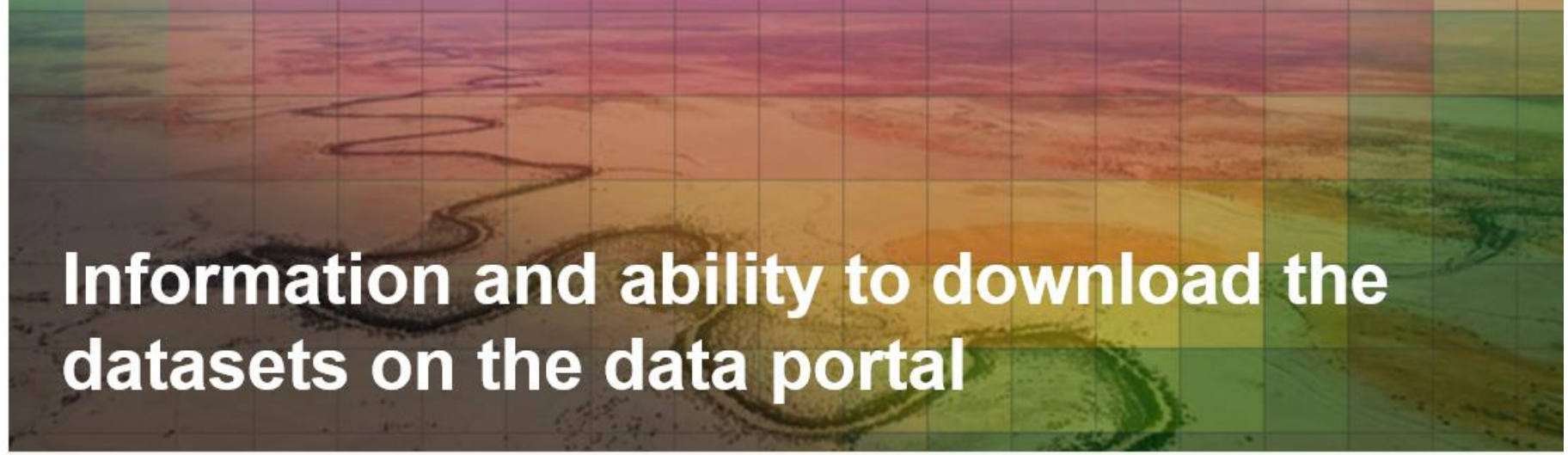


Percent change in annual rainfall erosivity for near (left) and far (right) futures



- Climate projections for NSW
  - Interactive map
  + Climate projections for your region
  - Need some help on where to start?
  + About NARCliM
- Download datasets
  - Guidance on NARCliM Models
  - What can you download
  - About the Software
  - Terms and Conditions





Data available from the Climate Data Portal

Users of the Climate Data Portal are able to construct and submit data requests to extract Regional Climate Model (RCM) data for the simulations, locations, time periods and climate variables that are of interest to them. Additional Information is provided for the data sets.

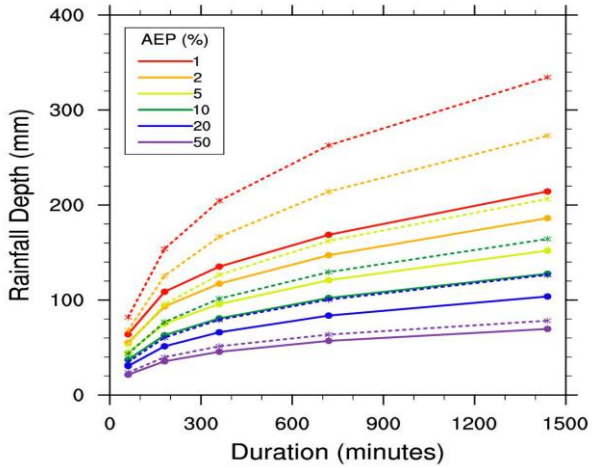
Please contact us if you need further advice on how to use the Climate Data Portal or the data available from it.

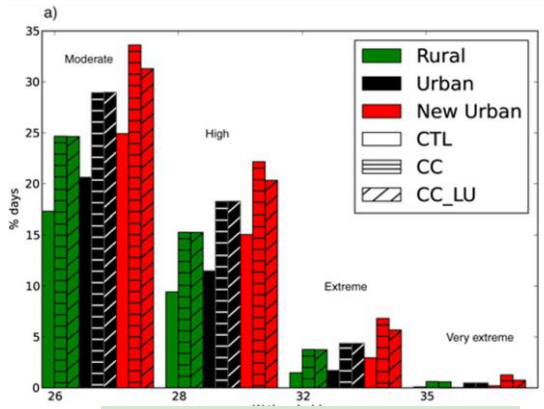
Domain and resolution

All of the data available from the Climate Data Portal is available over two domains and at two resolutions. The NARCliM domain covers southeast Australia at a horizontal resolution of ~10 kilometres. The Coordinated Regional Climate Downscaling Experiment (CORDEX) domain covers Australia and surrounds at a resolution of ~50 kilometres (See About NARCliM).

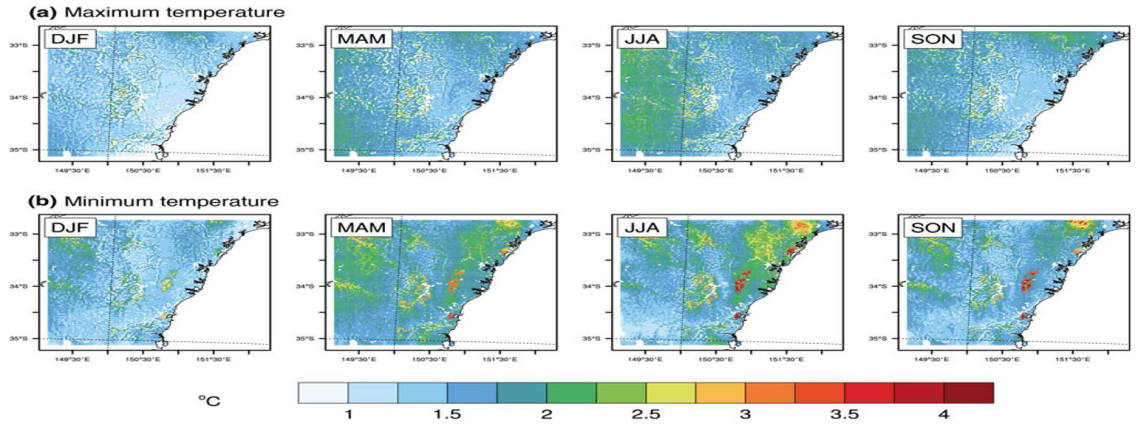
Climate Researchers using NARCliM

IFD curves



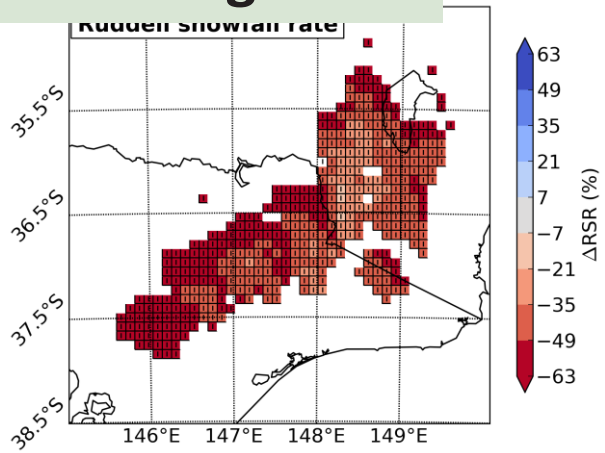


Urban land use & heat

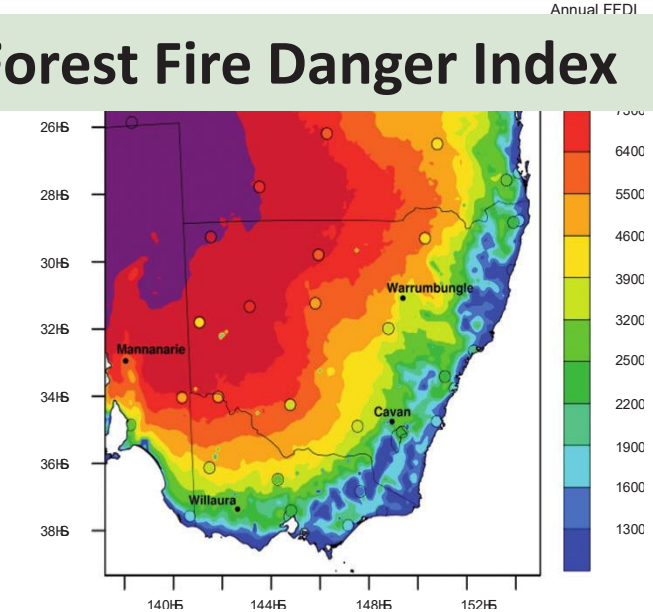


Seasonal temperature

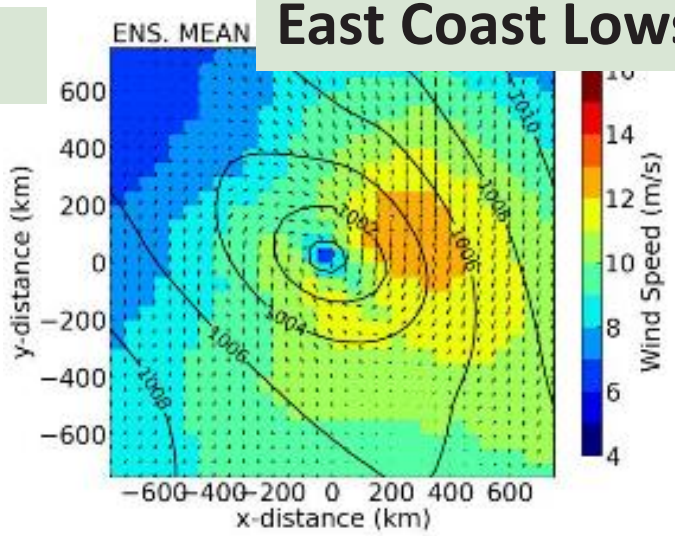
Snowfall changes



Forest Fire Danger Index



East Coast Lows



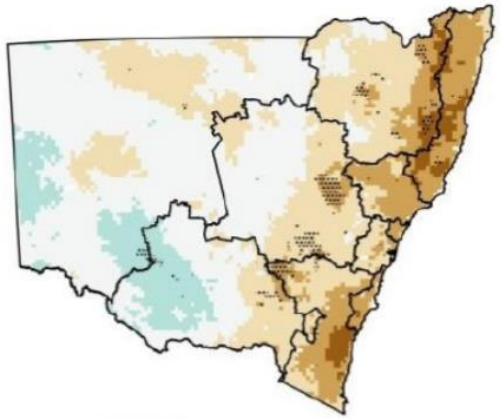
NARCliM 1.0 and 1.5 variables outputted

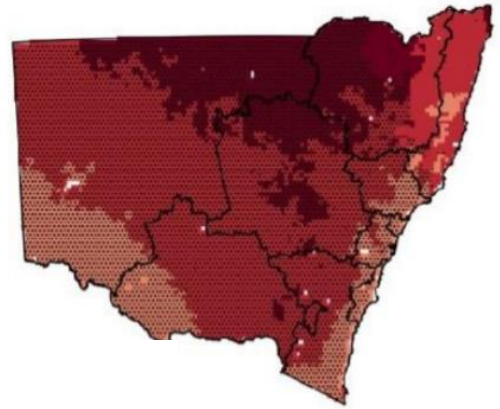
- **Precipitation**
- Convective precipitation
- Non-convective precipitation
- **2-meter temperature**
- 2-meter specific humidity
- **Surface pressure**
- **10-metre wind speed**
- **10-meter U, V wind**
- Albedo
- **Surface Evaporation**
- Upward latent heat flux at surface
- Upward sensible heat flux at surface
- Near surface relative humidity
- Downward LW surface radiation
- Downward SW surface radiation
- Surface emissivity
- Total soil moisture content
- **Potential evapotranspiration**
- Upwelling Surface Longwave Radiation
- Sea surface temperature
- Daily max 10-meter wind speed

*NOTE: Variables in **bold** font are those of most interest to stakeholders*

OEH Climate Research team upcoming analyses NARCliM1.5

- Technical Working Group – beta testing of simulations by UNSW, Sydney Water, Water NSW, DPE, DPI, CSIRO
- Rainfall extremes
- Comparison with non-climate datasets (e.g., health records)
- Mapping natural hazard indices (EHF, FFDI, drought indices)
- Comparisons of reanalysis forcing for regional climate models
- Model projections for major NSW catchments





Projecting changes to NSW climate extremes over the 21st century

Nicholas Herold
Climate Research, Climate and Atmospheric Science, OEH Science Division

2009 East Australian dust storm
(credit: John Byrne)

2017 flooding in Lismore
(credit: Dave Hunt)

2007 beaching of the Pasha bulker
(credit: Tim J Keegan)

Our motivation

Climate extremes affect environment, infrastructure and people.

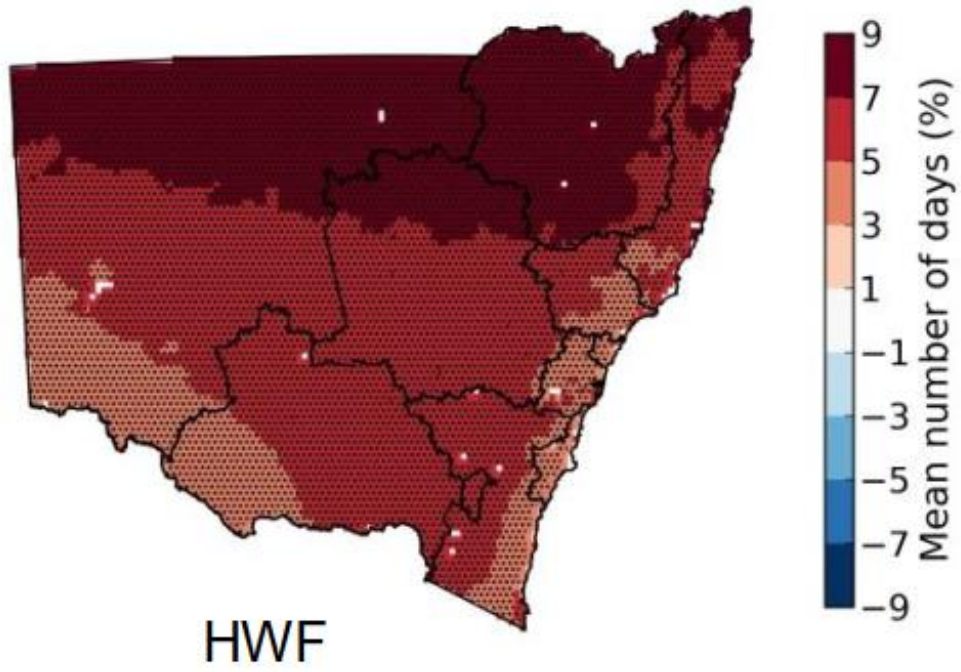
2014 Drought in northwestern NSW
(credit: Nathan Edwards)

2013 Firefighters resting on the Central Coast
(credit: PHIL HEARNE)

2018 Beachgoers at Bondi Beach.
(credit: AAP)

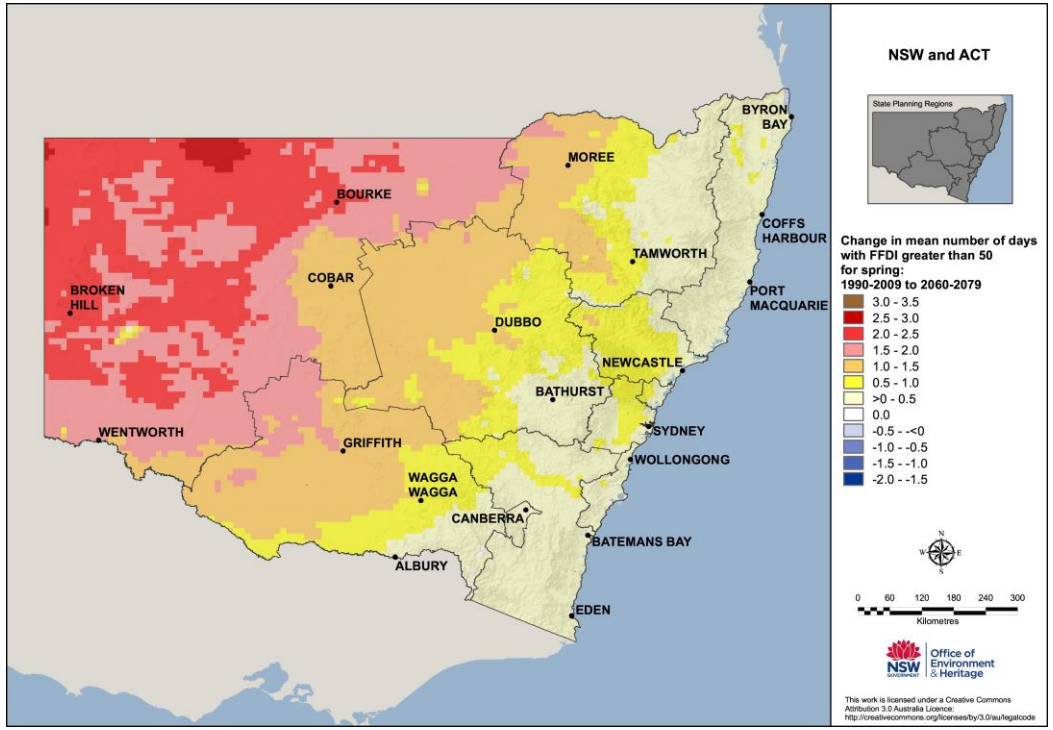
Climate extremes will change

Increase in late 21st century heatwave frequency



Argueso et al. (2015)

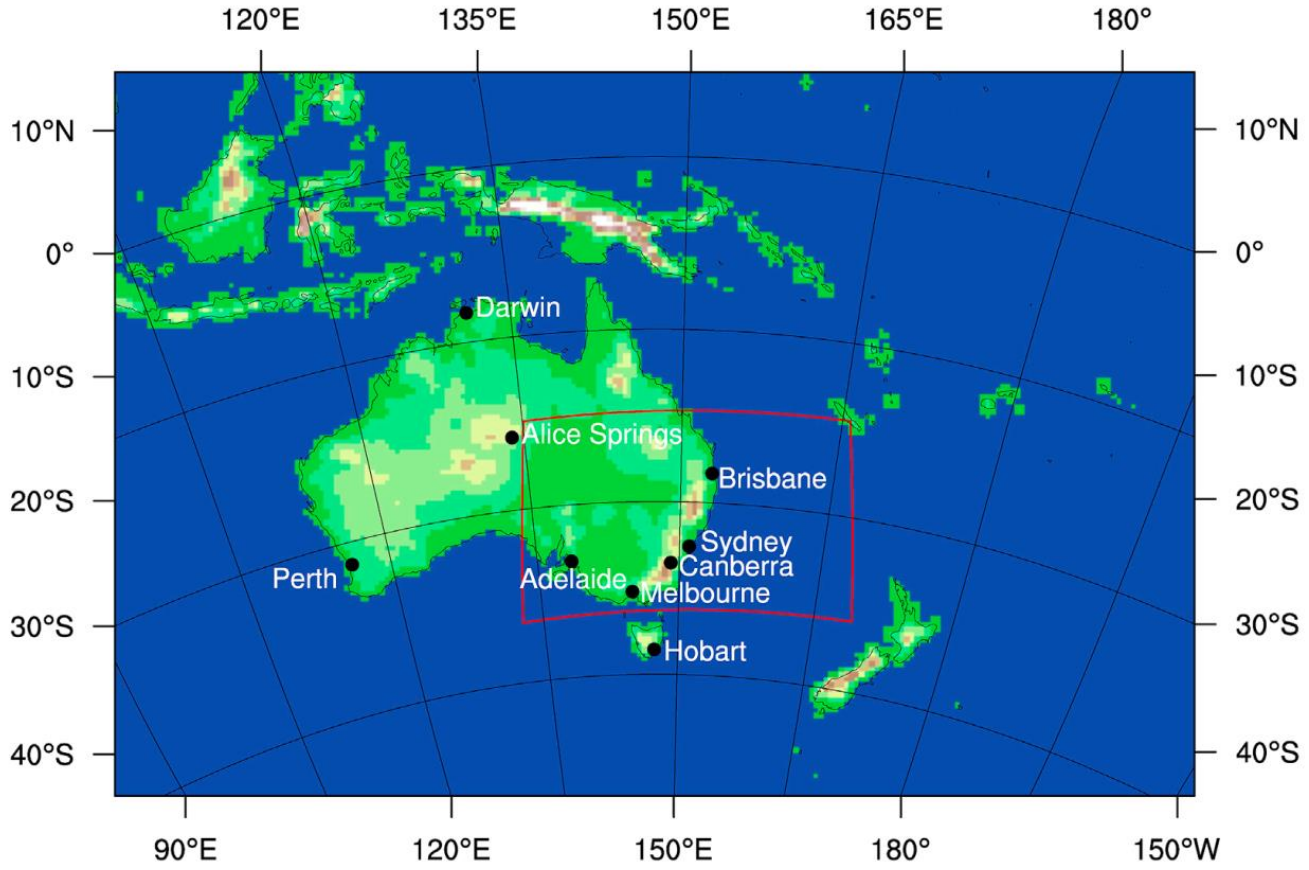
Increase in late 21st century bushfire conditions



AdaptNSW website

Climate extremes to assess*

- Heatwaves
- Bushfire
- Extreme precipitation
- Drought
- Extreme wind
- Flood
- Hail
- Lightning
- Dust
- Air pollution



NARCliM regional climate model domains

*a tentative list.

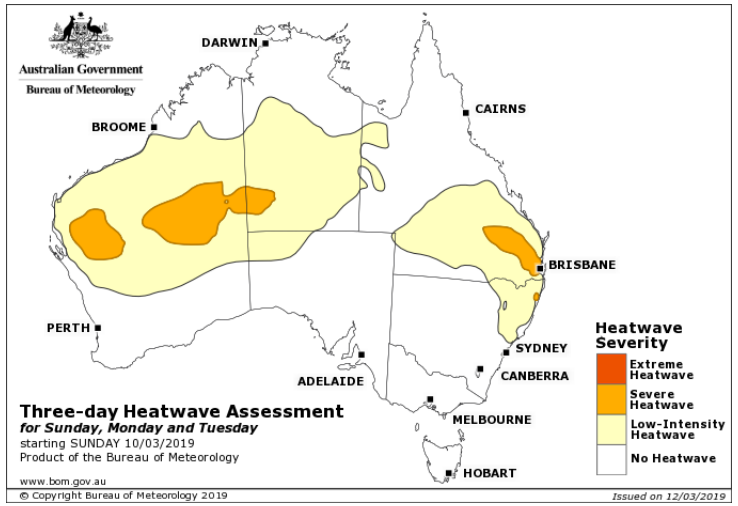
Heatwaves

Used by the BOM

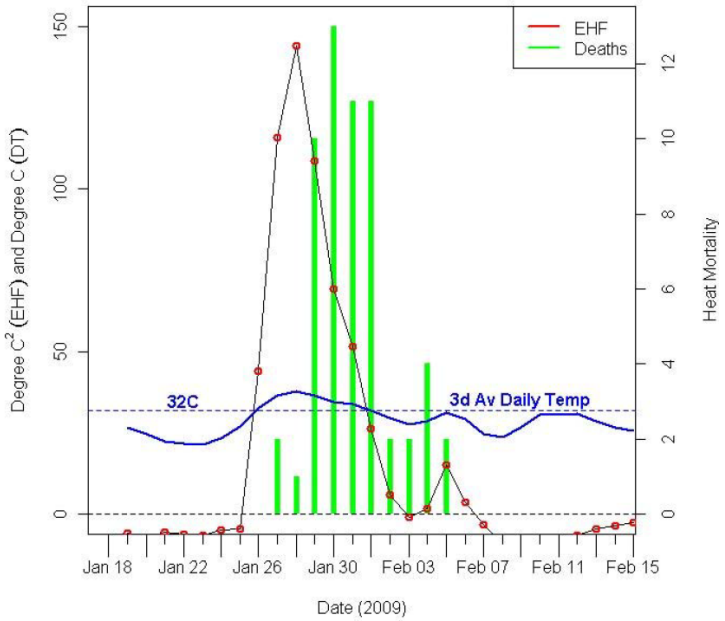
- **Excess Heat Factor** (EHF)

  = F(daily T)

- Looking to incorporate **humidity**: apparent temperature, wet bulb [globe] temperature.
- Extreme temperature metrics for sectors such as **infrastructure** and **agriculture**.



BOM provides heatwave forecasts using the EHF



EHF correlates well with heat-related mortality (Nairn and Fawcett, 2013)

Bushfires

Used by RFS

- **Forest Fire Danger Index** (FFDI)

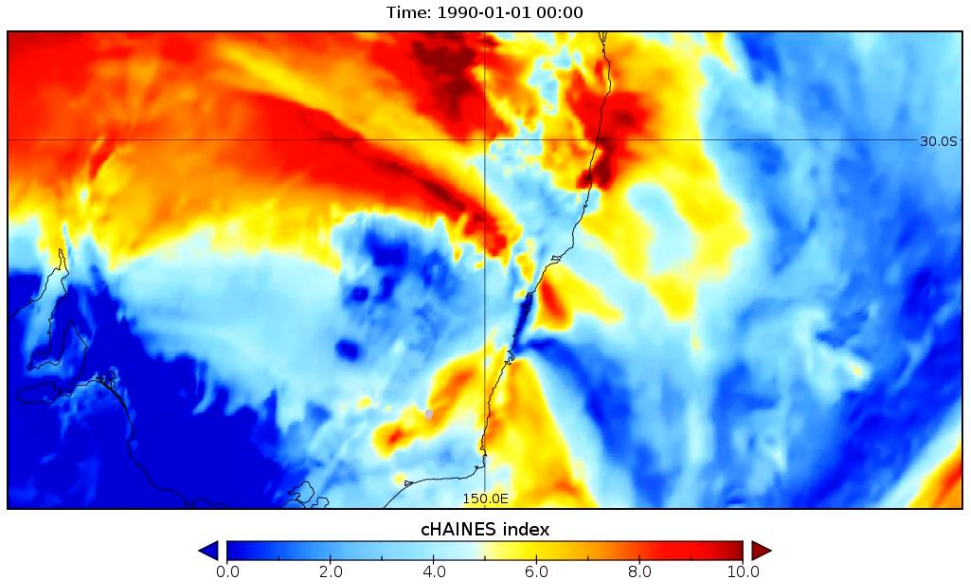
  = F(RH, T, D, U)

- **cHaines** index

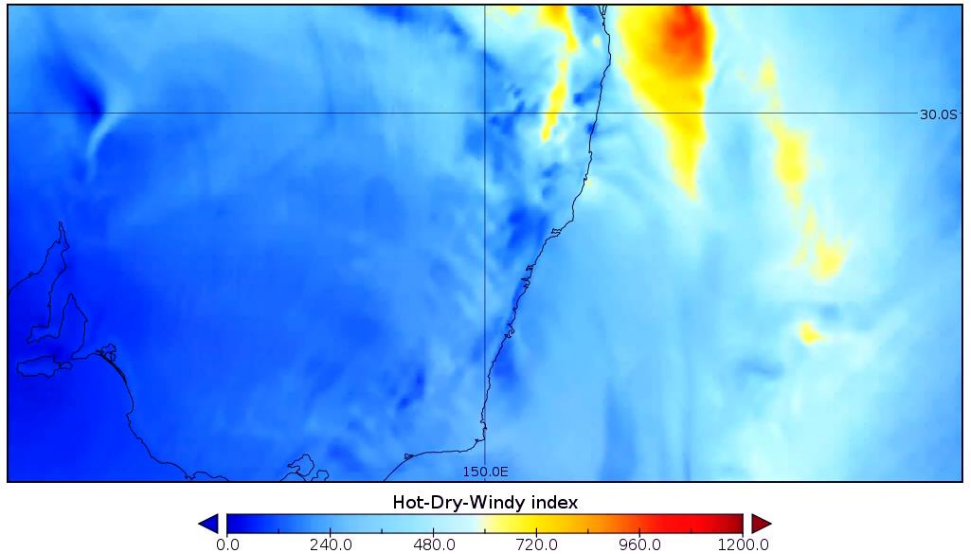
  = F(T, DP)

- **Hot-Dry-Windy** index

  = F(T, Q, U)



cHaines index

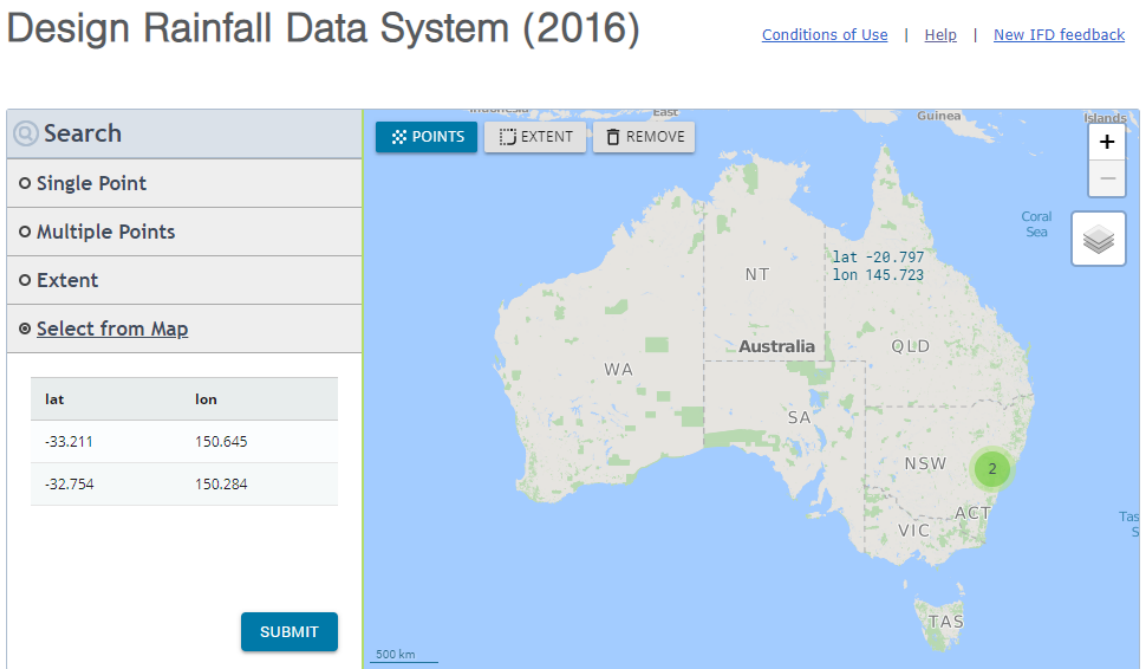


Hot-Dry-Windy index

Extreme precipitation

- Maximum one-day precipitation, number of days greater than 20 mm.
- Focus on return periods and Intensity-Duration-Frequency curves

Used for engineering, flood, etc.



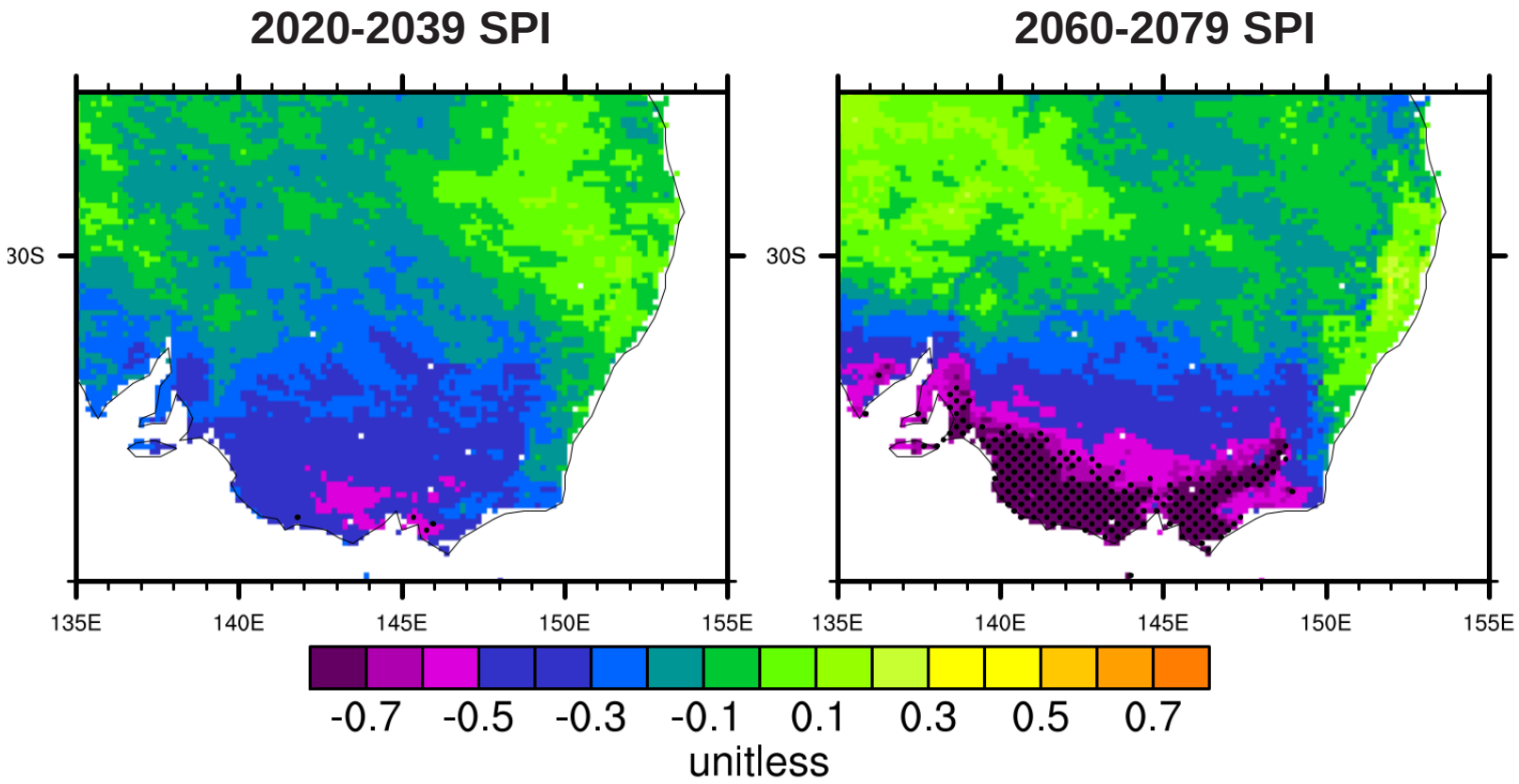
The ARR2016 provides “design rainfalls”

http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016

Drought

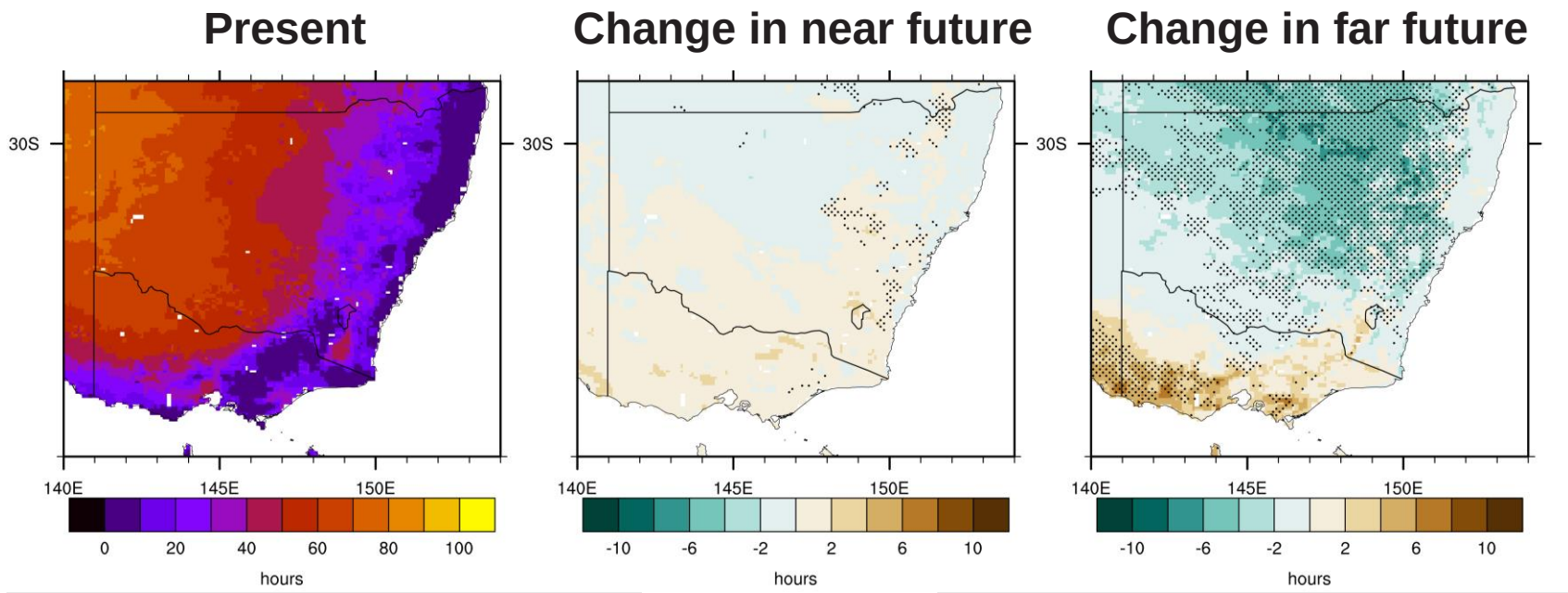
Recommended by WMO to be used by all met services

- Standardised-Precipitation-Index (SPI) and its variants for meteorological drought.
- Different sector definitions.



Dust

- Dust indices based on known climatological relationships.
- Dust targets using an empirical dust-precipitation relationship (Leys et al., 2018).



hours of dust

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