Decoding WA's climate: regional models that help to understand our future

Locally relevant information

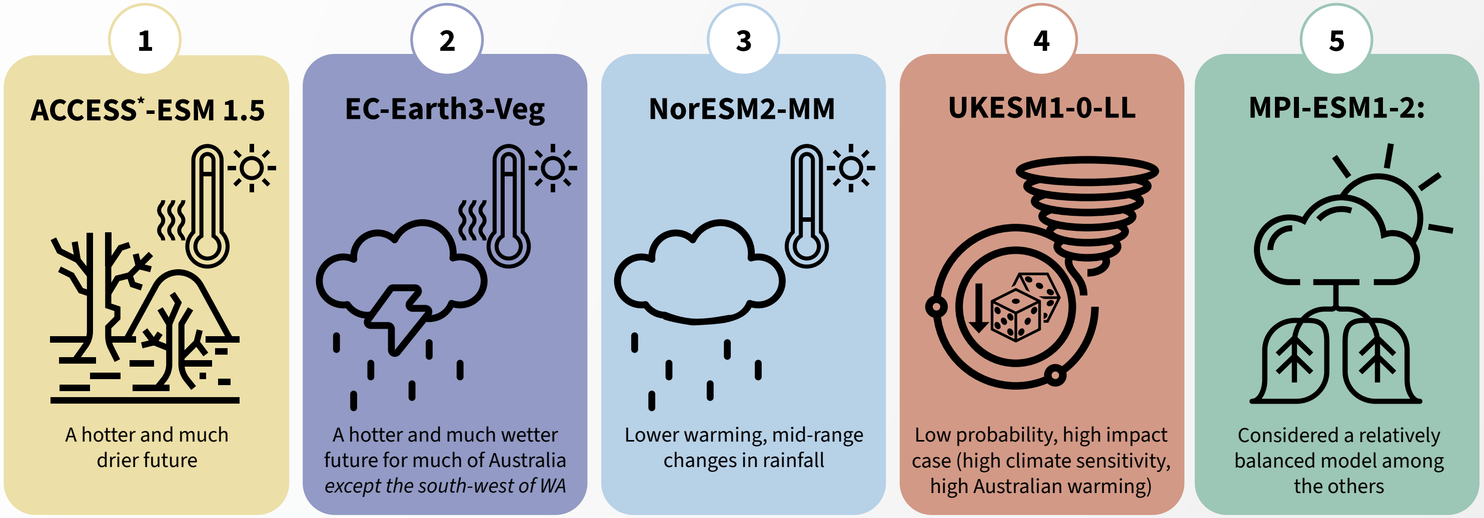
The Climate Science Initiative (CSI) is creating world-class regional climate projections using the latest available climate models adopted by the Intergovernmental Panel on Climate Change (IPCC).

The CSI combines carefully selected Global Climate Models (GCMs) and Regional Climate Models (RCMs), such as the Weather Research & Forecasting (WRF) model, to simulate possible future climates.

Global climate models used by CSI

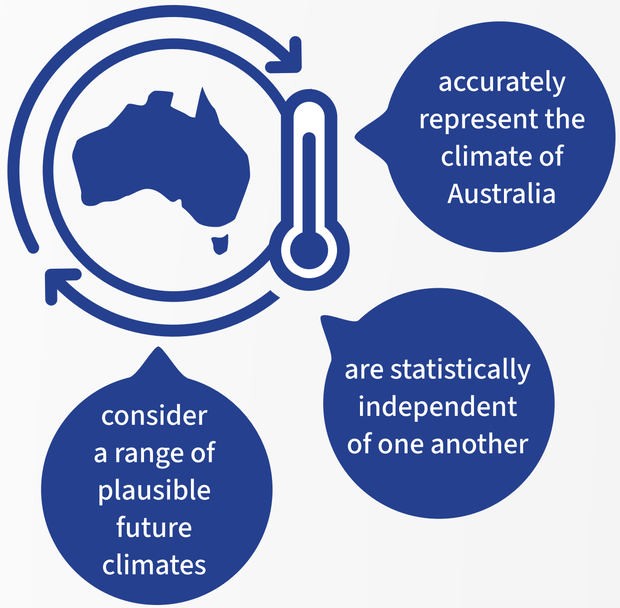
- All models have biases.
- Biases occur when models don't match past observations, for example, many GCMs underestimate extreme rainfall, or one model may be slightly too warm on average while another may be too cold.
- Selecting multiple GCMs helps to address these biases and provides a more suitable range of plausible future climates.

The five Global Climate Models used in the Climate Science Initiative



*ACCESS is an Australian-made climate model developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM)

These models have been carefully chosen to ensure they:



References

Peer-reviewed literature on the GCM selection process is published in Earth's Future.

Peer-reviewed literature on the RCM selection process is published in Geoscientific Model Development.

Making global climate models regionally relevant to WA through dynamical downscaling

The Climate Science Initiative (CSI) is creating regional climate projections for WA using dynamical downscaling, following international best practices and methods.

Downscaling for local insights

Dynamical downscaling converts low-resolution global climate models into higher-resolution data to better capture regional climate differences. It involves using regional climate models that simulate local climate processes, such as the influence of local topography and land use on regional climate, to refine and adapt the broader global climate data. This technique provides more accurate and localised climate information, which is useful for understanding regional climate impacts.

Global Climate Models | **Australasia Domain** | **Regional Climate Models**

Global Climate Models (GCMs)

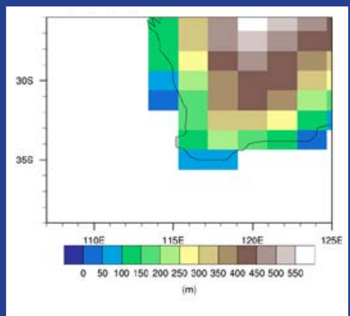
simulate the Earth's global climate system using numerical models. They help provide us with information about the future of our climate

Benefits of downscaling

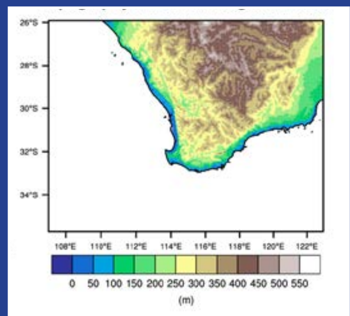
the local topography, which can influence the regional climate, is accurately accounted for

Regional Climate Models

use outputs from coarse resolution GCMs to provide simulations at higher resolutions typically ranging from 1 to 50 km



Topography in a GCM



Topography in a 4 km regional model

Downscaling in action

These images show how a better understanding of region-specific details can be captured through downscaling. Details like topography (e.g. coastlines) and land use can be shown, meaning projections are more useful for local planning and decision-making.

What are Shared Socioeconomic Pathways (SSPs)?

The five SSPs, developed by the Intergovernmental Panel on Climate Change (IPCC) for the 6th assessment report help model possible future climates. The SSPs refine the previous emissions scenarios called Representative Concentration Pathways (RCPs) which were used in the 5th assessment report.

Each SSP includes a socioeconomic narrative that describes broad trends such as population and economic growth, technological advances, patterns of consumption, etc. that could shape future society and influence future emissions and adaptive capacity. This guide provides a general overview of the SSPs. For more detailed information, refer to our fact sheet.

SSP & RCP equivalent	**SSP1-1.9 Sustainability** No equivalent RCP	☑ **SSP1-2.6 Sustainability** RCP2.6	☑* **SSP2-4.5 Middle of the road** RCP4.5	☑ **SSP3-7.0 Regional rivalry** No equivalent RCP	**SSP5-8.5 Fossil-fuelled development** RCP8.5
How the world might change in the future					
Emissions reduction	Very high and immediate	High and immediate	Moderate from 2040s	None	None
Energy sources	Renewables	Renewables and biofuels	Renewables and fossil fuels	Fossil fuels	Increase fossil fuels
Carbon dioxide removal	New technology	New technology	None	None	None
Global socioeconomic trends	Gradual move towards sustainability and environmental respect; increasing action towards Sustainable Development Goals (SDGs)	Gradual move towards sustainability and environmental respect; increasing action towards SDGs	As in the past; unevenly distributed; slow progress towards SDGs	Slow growth at the expense of the environment and increasingly unequal	Rapid growth at the expense of the environment; resource-intensive lifestyles and industries; dependence on technological solutions
What the future climate could look like					
Global warming by 2100	1.0 – 1.80°C	1.3 – 2.4°C	2.1 – 3.5°C	2.8 – 4.6°C	3.3 – 5.7°C
Resulting global warming levels (as a general guide only)**	Overshoots 1.5°C slightly around 2050 then returns and stabilises near 1.5°C by 2100	Reaches 2°C around 2050s and stabilises	Reaches 2°C around 2050s and 2.7°C by 2100	Reaches 2°C around 2050s and 3°C around 2070s. 4°C possible by 2100	Reaches 2°C around 2050s and 3°C around 2060s. 4°C by 2080s

☑ = Climate Science Initiative (CSI) data available and *available in Tranche 2

The diagram is adapted from the National Environmental Science Program's Climate Systems Hub 'What are SSPs?' diagram, which is funded by the Australian Government.

**Descriptions are based on averages within the range provided

Who are the users of Climate Science Initiative data?

- Climate Science Initiative (CSI) data will be used to inform a variety of resources and can benefit different users.
- Categorising end users by how they use climate science information, which often corresponds with their experience of it, provides a basis for identifying and providing climate information to different users according to their unique needs.
- Each user of the CSI has different climate information needs. For example, expert users may use the data in its 'raw form' for analysis and research.
- Users may move between user types as their climate needs, interests or literacy change.

User	Passenger	Deckhand	Skilled sailor	Deep diver
Level of experience with climate science information	Beginner ●○○○	Capable ●●○○	Intermediate ●●●○	Advanced ●●●●
What is the information used for?	• General interest • Lifestyle decisions • Information concerning themselves and/or immediate community • Climate adaptation	• Government policy decisions • Business/investment decisions • Risk assessments at portfolio/agency (high level/first pass) • Climate adaptation	• Risk assessments • Decision-making, e.g. policy making, asset locations, investments • State and regional planning • Climate adaptation • Insurance	• Second-pass and quantitative risk assessments • Research • Technical or asset-level assessments • Insurance • Development of models and experiments
Description and example roles	Individuals and community groups who are interested in climate change science and climate change projections but don't have any technical knowledge. **Example roles** • General public • Teachers and school students • Community groups • Some policy officers	People or groups who have a low or general understanding of climate change science and climate change projections and are interested in how climate change may affect them, their business, community, or investments. **Example roles** • Land managers • Government policy officers • Local government	People and practitioners who understand climate change science and climate change projections, and use data directly and indirectly for their work. **Example roles** • State government risk officers • Planning officers • Consultants • Team members working with 'deep divers'/advanced users of climate science information	Climate scientists and technical users who use models and projections for their work, and have a background in climate science. **Example roles** • Climate scientists or modellers • Researchers and academics • Technical consultants • Climate risk specialists

Reference: Skelton et al. (2019) inspired the figurative grouping of users by how closely they interact with climate science information.
[Who is 'the user' of climate services? Unpacking the use of national climate scenarios in Switzerland beyond sectors, numeracy and research-practice binary (doi.org/10.1016/j.cliser.2019.100113)]

The rules of climate modeling

How to appropriately use data from the Climate Science Initiative (CSI)

- Climate projections help us understand the future climate
- Although climate projections are a reliable source of future climate information, there are inherent uncertainties
- Uncertainty is present because:
  - our climate is highly variable and responds to natural processes such as El Niño and La Niña events
  - there are complex interactions taking place in the physical world that the climate models may not capture
  - we don't know what socioeconomic, technological and climate policy choices will happen in the future.
- To use the outputs of climate models effectively, it is crucial to understand their appropriate application, including the lessons to the right:

1 Don't rely on the results from a single model

Using an array of different model results is recommended to assess different plausible future climates. Considering the results from different models is important for risk assessments.

2 Consider multiple climate scenarios

Users should consider a range of projections by considering different emissions scenarios (e.g. SSP1-2.6 and SSP3-7.0) when conducting climate risk assessments or planning.

3 Models can't predict the future

Remember that climate projections are not predictions. They capture a range of plausible future climates which are within the bounds of possibility. However, because of uncertainty, climate projections do not say what might happen in the future. The reality may be better, worse, or different from projections.

4 Unpredictable events

Models have their limitations such as predicting sudden occurrences as rapid sea-level rise, or the impacts of compound and cascading events (where multiple risks interact or one event triggers a subsequent crisis). These events are possible so consider whether your system or asset would be at risk.