Earth Systems and Climate Change Hub

National Environmental Science Programme

climate change **science brief**

Adding value to climate change projections through regional climate modelling

Global climate models are the primary tool for producing future climate change projections but can result in information at scales too coarse for some decision-making purposes, such as location-specific risk assessments and adaptation activities.

To produce finer scale and more local projections information, regional climate models can be used to apply information produced by global climate models to a specific area or region. But how do we know where and when regional climate models add value to the information provided by global climate models?

The Earth Systems and Climate Change Hub investigated the value of using downscaled regional, high resolution climate models to better understand Australia's future climate, and whether these downscaled projections provide more value than projections from the lower resolution global climate models.

Regional climate modelling

Global climate models, such as those used in the international 'Coupled Model Intercomparison Project' (CMIP), are the primary tool for producing future climate projections. However, they often use spatial resolutions that are too coarse to capture small-scale climate phenomena. Regional climate modelling (also called dynamical downscaling) can be used to better represent smaller scale climate phenomena and weather over local features such as complex topography or coastlines. They provide higher-resolution regional climate projections often better suited for decision making purposes.

The Coordinated Regional Downscaling Experiment (CORDEX) is a coordinated international initiative which produces high resolution regional climate projections. The Earth Systems and Climate Change (ESCC) Hub has supported simulations to the CORDEX-Australasia domain. The Hub has also supported the first evaluation of the CORDEX-Australasia ensemble to assess the resulting future projected changes to our climate.

ESCC Hub researchers found that CORDEX is able to simulate the current climate of Australia reasonably well. While the CORDEX-Australasia projections have more spatial detail than CMIP projections, they broadly agree with global models on the changes Australia can expect in the future; except with regards to northern Australia rainfall, where regional climate modelling suggest that a decrease in rainfall is more likely.

While downscaling climate projections to a higher resolution can provide more detailed spatial information, this does not automatically guarantee that the resulting regional climate projections will be of more value or more accurate than projections from coarser global climate models.

In addition, downscaling requires more computational time and power to reproduce the regional projections. It is therefore important to assess where and when it is beneficial to produce downscaled climate projections, and where and when global climate model projections are sufficient.

RIGHT: Regional climate modelling can help provide location-specific climate information, such as for the Gondwana Rainforests of Australia.

To address this need, ESCC Hub researchers investigated where dynamical downscaling provides more value than projections from global climate modelling for Australia.

Quantifying the benefits of downscaled projections

To quantify the added-value provided by downscaling, Hub researchers developed the 'Realised Added Value' (RAV) index. This index considers added-value to exist where the regional climate modelling has smaller errors evaluated against recent climate and they project a different future climate compared to global climate modelling. RAV for different climate variables and models can then be combined to provide an overall view of the value added through downscaling in the CORDEX-Australasia ensemble.

What we found

ESCC Hub researchers discovered that regional climate modelling added particular value in Australia over the Alps, Tasmania and near coastlines.

For example, added value of regional climate modelling was found in rainfall trends for the NSW Snowy Mountains, where regional climate models project enhanced drying in the cool season on the windward slopes and increased rainfall over peaks in summer.

These smaller scale projections were not captured in the coarser CMIP global climate models and match historical trends in the region.

In the Gondwana Rainforests of Australia World Heritage Area, where about 40% of the annual water for the rainforests comes from clouds and fog, any change in the height of the cloud base will change the water available to the rainforests and impact species that depend on that water supply.

Cloud base heights estimated from regional climate model experiments were found to improve the modelling of species distributions. This improved ecological modelling of the Gondwana Rainforests will be used to inform climate adaptation plans for these unique and important natural environments. However, a caution remains that regional models show significant disagreement in future rainfall changes in the region, similar to global models. This is because they are subject to the same 'large scale' uncertainties as global models, such as changes to large scale circulations (e.g. associated with El Niño).

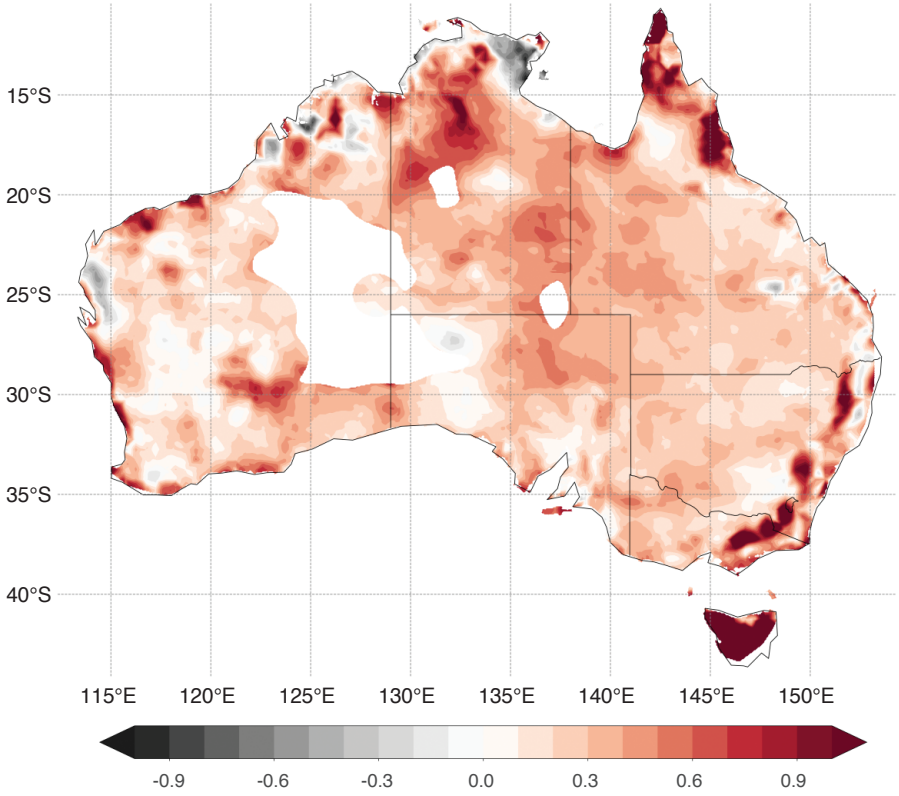

FIGURE 1 **Mean 'Realised Added Value' for a CORDEX-Australasia subset.** Red colours indicate where the downscaling is adding value to the global climate models.

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Climate information for decision makers

This ESCC Hub research allows decision makers to better understand when and how to use climate projections from global and/or regional climate modelling. This applies to decisions about the use of existing modelling as well as decisions about funding new modelling efforts. This in turn helps to ensure the most reliable and useful climate change information and data are used in impact assessments, adaptation and policy-relevant advice to stakeholders.

This research was led by ESCC Hub
Project 5.3: Regional climate change projections science and delivery

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The Earth Systems and Climate Change Hub is funded by the Australian Government's National Environmental Science Program