Delivering improved climate change projections for NSW Councils

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Abstract

In the recently released document *NSW 2021*, the NSW Government has committed to "minimise the impacts of climate change in local communities". One action to deliver on this target is the completion of fine scale climate change projections for NSW, to be made publicly available to local councils and government by 2014. The NSW Office of Environment and Heritage is leading the NSW and ACT Regional Climate Modelling (NARCliM) project to provide a more robust picture of the likely regional impacts of climate change in NSW. It will be developed by the UNSW Climate Change Research Centre and project partners include Sydney Catchment Authority, ACT Government, Sydney Water Corporation, NSW Office of Water, Department of Primary Industries, Emergency Management NSW, Department of Transport and Hunter Water Corporation.

Dynamical downscaling of climate projections will be modelled at a resolution of 10km grid squares for the State of NSW and the ACT. A sub-project will be developed for the Sydney region providing modelling at a resolution of 2km grid squares. Ensuring accessibility and usability of this data will be paramount. This presentation will outline the project and open discussion on identifying how local government researchers can use the project outputs, as well as to identify specific data requirements for local government end-users.

Introduction

The Office of Environment and Heritage (OEH) is working with the Climate Change Research Centre at the University of NSW to develop a regional climate model. The NSW ACT Regional Climate Modelling (NARCliM) project will generate fine-scale climate projections for New South Wales and the Australian Capital Territory. The modelling component is being conducted by both OEH and Climate Change Research Centre staff. The project partners include Sydney Catchment Authority, ACT Government, Sydney Water Corporation, NSW Office of Water, Department of Primary Industries, Emergency Management NSW, Department of Transport and Hunter Water Corporation.

This is the first time that such fine-scale projections will be available for NSW and the ACT. These projections will be publicly available and provide valuable information at a local and regional scale to a wide range of sectors on climate change in NSW. It is envisaged that the projections will be used to guide local decision-making for the future, and provide critical information for managing climate change impacts on health and settlements, agriculture, fire weather extremes, flooding and services such as water and energy supplies. When completed, NARCliM will place NSW at the forefront of climate projections research both nationally and internationally.

Current climate projections in NSW

The NSW Government has developed a 'first cut' of climate projections for NSW through the NSW Climate Impact Profile (DECCW 2010). These projections are based on a small number

of dynamical global climate models (GCMs) that were selected because of their skill in modelling major climate variables for this region of the globe (Perkins et al. 2007). GCMs are based on physical processes (e.g. how solar radiation, the atmosphere, land and oceans interact to generate weather and climate) and evolve over time (hence 'dynamical').

GCM projections have a number of limitations which reduce their usefulness in predicting future climate at the regional level:

- Typically they have a resolution of between 100 and 400 kilometres. For instance, a single temperature or rainfall figure may be produced for an area 250 km x 250 km in size.
- GCMs do not factor in sub-continental scale topography such as the Great Dividing Range, which we know plays a very important role in determining regional climate here in NSW.
- GCMs do not capture important offshore processes such as the East Australian Current (EAC). The EAC is one reason climate differs on the eastern and western Australian coast.
- While GCMs are reasonably good at simulating temperature, there is less confidence in their projections of rainfall.

New climate projections – a regional climate model

One way of improving the resolution of global climate model projections is known as statistical downscaling. This method takes the existing climate – for instance actual observed time series of temperature and rainfall in a particular location – as its foundation, rather than the physical principles of climate drivers. It then uses statistical techniques to apply changes to the observed time series based on outputs from GCMs. One problem with this method is that it does not allow for any changes in the existing relationship between weather variables or climate drivers. This is an assumption that, given our understanding of climate drivers and the likely affect of climate change on them, is unlikely to hold true.

Using a dynamical regional climate model (RCM) overcomes many of the limitations of GCMs and statistical downscaling. The Weather Research and Forecasting (WRF) model is an RCM capable of providing high resolution projections of temperature, rainfall and a large number of other meteorological variables. It has a demonstrated ability to simulate temperature and rainfall in NSW (Evans and McCabe 2010). As its name suggests, WRF is also used for day to day weather forecasting which, among other things, requires it to provide a good representation of local topography and offshore processes such as the East Australian Current.

Methodology

Modelling

When generating projections of future climate, WRF and other RCMs require input information from outside the area of interest (e.g. NSW). This information is provided by global climate models, which are said to 'drive' the RCM at its boundaries. In order to minimise potential bias from any individual model, several GCMs (four in this case) are used to drive the regional model. Performing multiple model runs is also necessary to capture reliable information on extreme but rare weather events such as heatwaves, heavy rain and drought.

The project is limited to a twelve member GCM/RCM ensemble. This will be created by choosing four GCMs and downscaling each of these with three different RCMs. Three 20

year simulations will be performed with each GCM/RCM combination, for the present-day (1990-2010) and two future periods (2020-2040 and 2060-2080). For future projections the SRES A2 emission scenario will be used. All RCM simulations will be performed at 10km resolution over NSW/ACT. This high resolution domain will be embedded within a 50km resolution domain that covers the Australasia region.

A subproject is underway to provide a set of high resolution climate projections for the Sydney metropolitan region using a single GCM (CSIRO Mk 3.5) at a grid size of 2km. These projections will be form the basis of climate change impact analysis for the development of an Adaptation Strategy for Sydney – an action in the Metropolitan Plan for Sydney 2036. These projections will also be made available when complete - expected in 2012.

Outputs

A number of parameters will be generated from the NARCliM project such as surface evaporation and surface runoff (to list only a few). Data for all of these variables will be stored for each of the 12 RCM/GCM model runs. Projections for a number of key variables identified as being of particular interest such as: temperature, precipitation, surface pressure, humidity, wind speed, sea surface temperature and snow amount will be stored more frequently. These variables will stored at monthly, daily and 3-hourly time steps and more frequently when relevant (i.e. peak 10 minute wind gust).

End-user engagement

End-user engagement is a large component of the project. Ensuring model output accessibility and useability is critical. OEH is currently undertaking detailed consultation with end-users from a broad spectrum of business, government and research sectors, on the type of information they would like delivered. Of utmost importance to the success and value of the project is the means for the wider community to access both raw data and processed information. Establishment of data interrogation interfaces is a critical component of the program, with pilot prototypes in the early stages of development. Development of data inquiry, summary and visualisation tools will be driven by inputs from a user reference group. It is hoped the user reference group will play a major role early in setting scope, directions and priorities for tool development.

Web-based interfaces and interpretation tools, for final public release of post-processed products such as maps and summaries are also being investigated. There is close and ongoing collaboration with CSIRO and the Bureau of Meteorology in this development as they seek to revise and update their climate change information within a parallel timeframe. It is anticipated that OEH can benefit from existing successful climate modelling websites such as those developed by the California Energy Commission and the United Kingdom Climate Impacts Program.

OEH has existing relationships and initiatives with the NSW Local Government and Shires Associations (LGSA), various Regional Organisations of Councils (ROCs), and specific climate change initiatives across this sector, which will be useful in assisting local government practitioners understand and minimise the impacts of climate change as well as inform the development of this new climate data. For example, the Australia Centre for Excellence for local government can also provide valued insight into how we develop and deliver fine scale climate projections.

Summary

Research outcomes from the NARCliM project will represent the most comprehensive fine-scale climate projections over a large geographical extent to exist in Australia. Producing projections at this fine scale will provide much more reliable information about the impacts on rainfall (for example) in a particular area. Temperature and wind extremes will also be projected with much greater confidence than we have at present. Projections at such a fine scale will provide the detailed information fire and emergency management, water and energy management, agriculture, urban planning and biodiversity management need to adapt to a future climate.

Projections about our future climate form a critical part of adaptation planning. They take us a step beyond assuming that our climate will remain the same in the future, or that it will unpredictably fluctuate within the bounds of natural variability. They help us ask the question: given our understanding of climate drivers, and plausible future scenarios of greenhouse gas emissions, how will our climate system respond – 20 or 50 years down the track? Through the NARCliM project OEH aims to provide climate information that is accessible and useable by the target users, thus ensuring outputs will efficiently flow into policy and decision-making processes.

References

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