1. Introduction

Climate variability and change pose serious challenges to the sustainable development of Pacific island countries and East Timor. Economic activities, such as agriculture and tourism, as well as individual livelihoods can be affected in negative ways.

In 2008, the Australian Government launched the International Climate Change Adaptation Initiative to meet high-priority adaptation needs of vulnerable countries in the Asia-Pacific region, especially Pacific island countries and East Timor. The Pacific Climate Change Science Program (PCCSP) was a key activity of the Initiative that conducted research to support decision making in the 15 partner countries. This work is undertaken by Australia's Bureau of Meteorology (BoM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in collaboration with the partner countries. The PCCSP ran from 2009 to 2011 and the *Pacific Climate Futures* web-tool was launched, along with the *Climate Change in the Pacific: Scientific Assessment and New Research* report, in November 2011.

Following completion of the PCCSP, the Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) program commenced to build on the work of the PCCSP. The *Pacific Climate Futures* web tool was further developed under PACCSAP and version 2 of the tool was released in April 2014. This was updated to version 2.1 in 2017 (for details of the enhancements, please see Section 1.1).

The purpose of this *User Guide* is to provide guidance in using the *Pacific Climate Futures* Version 2.1 web-tool for the generation of national climate projections and the selection of climate models for specific impact/risk assessments.

Pacific Climate Futures Version 2.1 is a free web-based climate impacts decision-support tool. It provides national and some sub-national climate projections for East Timor and 14 Pacific countries: Cook Islands (two sub-regions), Federated States of Micronesia (two sub-regions), Fiji, Kiribati (three sub-regions), Marshall Islands (two sub-regions), Nauru, Niue, Palau, Papua New Guinea (two sub-regions), Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Built on CSIRO's Representative Climate Futures Framework (Clarke *et al.* 2011; Whetton *et al.* 2012), it includes projections from the global climate modelling experiments (CMIP5) that informed the IPCC's Fifth Assessment Report as well as those used for the earlier Fourth Assessment Report (CMIP3). The CMIP3 results derive from up to 18 global climate models (GCMs). These can be explored for three future time periods (2030, 2055 or 2090) and three emissions scenarios (low-B1, medium-A1B and high-A2). The CMIP5 results are from up to 43 GCMs, six of which were downscaled using CCAM. These projections can be explored for up to 13 time periods (2030, 2035, 2040...2085, 2090) and four new emissions scenarios (very-low-RCP2.6, low-RCP4.5, medium-RCP6.0 and very-high-RCP8.5).

The *Pacific Climate Futures* web-tool has been designed to provide information and guidance in the generation of national climate projections and facilitate the generation of data for detailed impact and risk assessments.

Pacific Climate Futures has three levels of detail:

Basic interface

This interface provides a summary of the projected changes in annual temperature and rainfall and is accessible for everyone.

Intermediate interface

This level provides access to a step-by-step guided interface to generate climate projections tailored to an impact assessment. The interface uses information entered by the user to recommend which models to use to represent the 'best', 'worst' and 'maximum consensus' cases. To obtain access to Intermediate level, you must successfully complete the short online training and quiz. To do this, simply click on "Log In" and follow the prompts. Allow approximately one hour to work through the training material and a further 30 minutes to complete the quiz (you can pause and resume as many times as you like).

Advanced interface

This level provides more flexibility to the user along with access to the full set of climate variables and additional options for exporting data for use in risk assessments. Access is only available to registered users who have completed the necessary face-to-face training.

Projections are classified by the combined changes in two variables, with the data presented (for Advanced users) in an easy to understand colour-coded matrix (see below). The resultant classifications provide a clear visual display of the spread and clustering of the projections. This provides model consensus information for each classification and makes it easy for users to identify those that are of most importance to their impact assessment.

Users can then identify the 'Best' and 'Worst' cases in terms of likely impacts. It is also possible to identify a 'Maximum Consensus' case. For example, consider a study into the possible impacts of climate change on the incidence of mosquito-borne diseases. Using the example shown here, the worst case is likely to be the projection with the greatest increase in rainfall and temperature, i.e. 'Much Hotter – Wetter'. The best case may be regarded as the 'Hotter – Drier' projection, while the maximum consensus projection is "Hotter – Little Change'. Thus users can apply the information from Pacific Climate Futures through a risk management approach to deal with the spread in the results (sometimes referred to as model uncertainty).

In general, climate projections are derived from (global) climate model simulations. Climate models are mathematical representations of the Earth's climate system, based on well established laws of physics. Importantly, *Pacific Climate Futures* is underpinned by the most extensive, independently peer reviewed climate model evaluation ever undertaken in the Pacific (Australian Bureau of Meteorology and CSIRO 2011; 2014). This research assessed and identified the most reliable and appropriate GCMs and downscaled (DS) simulations for the Pacific region, excluded models that do not perform well and identified those that should be used with caution in some countries. Where relevant, the *Pacific Climate Futures* tool brings this information to the attention of users who can select appropriate results at the click of a button.

A key feature of *Pacific Climate Futures* is the Representative Model Wizard. This identifies a suitable subset of models that can be used to represent the selected projections, *e.g.* one model to represent a 'worst' case, one to represent a 'best' case and one to represent the 'maximum consensus' case. This reduces the effort involved in data management and analysis.

In the following chapters of this *User Guide* the basic, intermediate and advanced features of *Pacific Climate Futures* will be explained in detail, providing screenshots and guidance on how to generate “climate futures” at different levels of detail for the 15 partner countries.