1 Introduction

1.1 Rationale & Motivation

There is much discussion in the scientific literature and concern in the wider community about changing water availability associated with the enhanced greenhouse effect. That is not surprising – water is essential for life on earth.

What will happen to water availability in the future? Will it remain the same or will it change?

If models predict declining precipitation should dryland agricultural industries begin relocation to suitable regions where the models predict increasing precipitation?

Are the current urban water supplies sufficient to meet the expected demand or do we need to plan for increased storage or perhaps construct desalinisation plants?

These are profound and important questions facing governments, communities and individuals world-wide.

Water-based planning has traditionally been based on estimating water supply using historic precipitation (as well as evaporation and runoff) records combined with projections of population and irrigation needs to forecast future demand.

The central challenge faced by individuals, communities and governments world-wide is that the historic precipitation (as well as evaporation and runoff) patterns may not stay the same because of the enhanced greenhouse effect.

Climate models are now being used to try and forecast how regional water availability might change in the future. For example, in their fourth assessment report published in 2007, the IPCC (www.ipcc.ch) presented projections of precipitation out to 2100. Those projections were based on averaging the output from different climate models.

In principle only one particular precipitation pattern will happen in future. In that context, it is not immediately obvious why the best estimate of that particular pattern should be the average of the projections made by 20 different climate models. In fact it is not immediately obvious what the best projection would be (McWilliams 2007). For example, some models simulate the historic precipitation (1900-2000) of a particular region, say Australia, better than others. If a model makes a better estimate during the historic period, then intuitively, it seems more likely that it might make a better projection into the future (Whetton et al. 2007, Pitman & Perkins 2008). This is an area of active and ongoing research.

The obvious question arises: how accurate are existing models in simulating the precipitation in different regions over the last 100 years? There is vast literature on this topic in thousands of individual reports and scientific papers. However, most papers only deal with a single model, or when they deal with several, they present averages so it is very difficult, if not impossible, to see how the simulations and projections vary from one model to the next, or from one model run to the next.

What is needed is a simple "Atlas" with maps from all the different model runs showing water balance simulations for the last 100 years alongside projections for the next 100 years. That was the rationale and motivation for this research.

1.2 Atlas Contents

Output data for the climate model simulations were available from the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset. The same database was used to prepare the 2007 IPCC 4th Assessment Report. Hence, the maps and tables presented here can be considered as the "detail" that underpins the water balance summaries presented in the IPCC 4th Assessment report.

We used the above-noted data to compile maps for the globe and for Australia showing precipitation, evaporation and their difference (i.e., runoff) for the historic period (1970-1999) and for the future (2070-2099). Each set of maps is accompanied by tables that summarise the precipitation, evaporation and their difference, by continent, and then by latitude that is further split into land and ocean components. The tables also summarise the differences between simulations of historic (1970-1999) and future (2070-2099) precipitation, evaporation and their difference.

For Australia we prepared plots comparing the model simulations of continental precipitation with the official Bureau of Meteorology observations for the historic period (1900-2007, see section 3.2). This allows a rapid visual assessment of how well the model performed.