Abstract  Adaptation to climate change in the water sector, especially changes in water management practices, will have a very significant impact on how future climate affects the water sector. The chapter starts out by describing the range of adaptive options that are available to water managers faced with changing circumstances. One classification distinguishes between “supply-side” and “demand-side” options. Another classification scheme proposed here distinguishes between 1) technological, 2) behavioural, 3) economic and 4) legal adaptive measures to manage and extend water resources. The chapter summarise these adaptive options. It assumes that the relative merits of one adaptive technique over another can be characterized in terms of the benefits and costs of the adaptation, across a spectrum of no effect (“no adaptation” or “wrong choice of adaptation”) to perfectly effective (“adaptation sufficient to eliminate all effects of climate change”) at an optimal level of cost effectiveness. There is also the issue of conflicting choices.

Assessment of impacts of climate change on water resources requires knowledge of future climate as well as methods capable of transforming this knowledge into likely biophysical and societal impacts. Current methods of impact assessment, however, are hampered by the unreliability of regional climate forecasts and by the incompatibility of these forecasts with the analytical tools needed to assess impacts at a scale that is useful for planning purposes. In particular, there is a mismatch between the temporal and spatial scales of available climate forecasts and the data required for impact assessment. Problems and methodologies that may cope with them are discussed. Two regions, New Zealand and the tropical Pacific, are used to illustrate application of the methods to assessment of water resources. The best adaptation strategies will depend on the impact potential of a given change in climate. This in turn will depend on the overall sensitivity of a particular water supply or demand unit to those aspects of climate that do change.
9.1 Introduction

The Earth is endowed with a huge quantity of water, but less than 3% of it is fresh water and three quarters of that is locked up in the planet’s ice caps and glaciers. The tiny amount of fresh water that remains is all that is available for human use, a fact that highlights the importance of managing the resource wisely. Global climate change, including changed variability, whether natural or anthropogenic, could modify the availability and spatial distribution of this scarce resource. Whatever the result we can be sure, as is already the case, the resource will unevenly distributed across continents and nations. For this reason, adapting to changes in water availability is more of a territorial than strictly global issue and most planning and investment decisions related to water resources will be made on a national or regional level. The problem is information on climate change is provided at a generalised global scale and even this is plagued with uncertainty. Thus, the important question arises: How do we plan for adaptation at the local scale to climate change at the global scale?

Over the past decade or so, and increasingly since the publication of the Second Assessment Report of the Intergovernmental Panel on Climate Change (Houghton et al. 1995), there have been many studies into climate change effects, but progress in the area of hydrology and water resources has been slow. Adaptation to climate change in the water sector, especially changes in water management practices, will have a very significant impact on how climate change affects the water sector. The best adaptation strategies will depend on the impact potential of a given change in climate. This in turn will depend on the overall sensitivity of a particular water supply or demand unit to those aspects of climate that do change. The chapter will address this and related themes.

9.2 Adaptation Options in the Water Sector

Adaptation to changing conditions in water availability and demand has always been at the centre of water management. Typically, it is assumed demand will grow and that the natural resource base is constant, except where land-use change occurs (Kundzewicz et al. 2007). Conventionally, it is also assumed that the future resource base will be similar to that of the future. Given the inevitability of climate change, this assumption is incorrect. Scenarios of future conditions vary and are not detailed. The IPCC (2007a) point to decreasing water availability in mid-latitudes semi-arid low latitudes and increased water availability in moist tropics and high latitudes. Annual average river runoff and water availability are projected to increase by 10–40% at high latitudes and in some wet tropical areas, and decrease by 10–30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water-stressed areas (IPCC 2007b).

Climate processes powered by solar energy drive the hydrological cycle that determines the global distribution of water resources. The key question for those