4.1 Introduction

Temperate East Asia comprises a major portion of the Earth's largest continent. The region is bordered by the planet's highest mountains and largest ocean and its climate and ecosystems are uniquely dominated by the East Asian monsoon. Moreover, East Asia is the homeland of some of the world's oldest, most populous, most advanced and most rapidly evolving human civilisations. It is therefore not surprising that this region plays a major role in global processes, nor that human activities have powerfully influenced these processes on both regional and planetary scales. The overarching story of the region is of massive human-induced changes in every aspect of the environment and their consequences for natural resources, the global environment, and human welfare. The major conclusion is that the region's past, present, and future may be understood and predicted only in the context of a comprehensive integrated framework that includes the physical, chemical, biological and human components of the system. Given the central role of the monsoon in the region, such a framework may best be termed the General Monsoon System.

4.1.1 Characteristics of the Region

The East Asia region includes China, the Democratic Peoples Republic of Korea, Japan, Mongolia, the Republic of Korea, and the Asian part of Russia. About 25 million km² in area, it is located in the north-eastern part of the Eurasian continent, the world's largest continent, and includes the northwestern borders of the Pacific, the world's largest ocean. The region includes the world's largest plateau, the Tibetan Plateau, with a mean elevation of more than 4000 m, and the world's highest peak (Mt. Qomolanma (Everest), 8848 m) (Fig. 4.1).

Fig. 4.1. The region
Mainly due to strong land-ocean thermal contrast and the dynamic and thermal effects of the Tibetan Plateau, East Asia has a well-developed monsoon climate system, which releases huge amounts of latent heat from monsoon rainfall and plays an important role in the global energy and water balances. The surface monsoon flow patterns in winter and summer over the region are distinctly different (Fig. 4.2). In winter the region is dominated by a dry-cloud continental air mass, while it is dominated by a warm and humid air mass in summer. The monsoon system is characterised not only by this strong seasonal change, but also by high inter-annual and inter-decadal variability that have profound impacts on economic development and human life in the region.

Diversity in climate, terrestrial ecosystems, peoples and culture is a major feature of the region. For example, East Asia encompasses examples of nearly all the major terrestrial ecosystems recognised on the planet, ranging from cold deserts to humid rainforests and from permafrost to rich coastal forest areas. The terrestrial ecosystems of East Asia comprise a large portion of the global biomass and constitute a huge evapotranspiration source in the global hydrological cycle. They also serve as a major carbon sink in the global biogeochemical cycle.

East Asia is one of the most populated areas of the planet, with a current human population of more than 1.5 billion. The large population and continuing demand for rapid economic growth result in ever-increasing industrialisation and intensive use of land and biotic resources. The human activities producing a rapid increase of anthropogenic emission of greenhouse gases and sulphate aerosols, deforestation, and desertification constitute the major driving force causing environmental changes in East Asia. Urbanisation is another significant feature of anthropogenic regional changes. Most of the world’s cities with a population of more than 5 million are located in East Asia and other parts of Asia. Thus, the natural geographic features and socio-economic conditions in East Asia make it a priority region for global change studies.

4.1.2 Central Questions

This synthesis attempts to answer the following questions in relation to regional aspects of global changes in East Asia:

- What environmental changes have taken place in the region?
- What are the driving forces for such changes, natural or anthropogenic?
- What will be the future changes on the decadal time scale?
- What will be the impacts of such changes on the region, including water resources, agriculture and human health, etc?
- How should human society adapt to such changes and impacts?
- What role does East Asia play in earth system dynamics, in terms of the global hydrological and biogeochemical cycles?

4.1.3 Principal Findings

The major specific regional findings of this study are summarised below.

4.1.3.1 Climate

There has been a nearly 1 °C warming over the past century in most parts of east Asia, including Japan, with the exception of an area of cooling in eastern half of southern China. This cooling is perhaps related to anthropogenic aerosols. The warming has occurred primarily in the winter season and has been greatest in the last 20 years. Temperatures in other seasons also show a slight increase. No significant trend of precipitation is apparent in regionally averaged temperatures, but such a trend is evident in the humidity index, which takes account of both precipitation and evaporation in relation to temperature changes.