12

World climate, soils and vegetation

'There was … an instant in the distant past when the living things, the rocks, the air and the oceans merged to form the new entity, Gaia.'

James Lovelock, *The Ages of Gaia*, 1989

Although it is possible to study climatic phenomena in isolation (Chapter 9), an understanding of the development of soils (Chapter 10) and vegetation (Chapter 11) necessitates an appreciation of the interrelationships between all three (Figure 12.1a). This chapter attempts to show how the integration and interaction of climate, soils and vegetation give the world its major ecosystems, or biomes, and how these have often been modified, in part or almost totally, by human activity (Figure 12.1b).

Soils can be grouped, at the simplest of levels, under zonal, azonal and intrazonal (page 273) with each group, in turn, being subdivided (zonal Figure 12.2, azonal page 273, and intrazonal page 274). Likewise, the major vegetation and fauna groupings (biomes) were listed on page 306 and their generalised global locations and distributions shown in Figure 11.38. In a similar way, geographers seek – despite the difficulties and limitations – to classify different world climates (Framework 7, page 167).

Classification of climates

By studying the weather – the atmospheric conditions prevailing at a given time or times in a specific place or area – it is possible to make generalisations about the climate of that place or area, i.e. the average, or 'normal' conditions over a period of time (usually 35 years). Any area may experience short-term departures from its 'normal' climate, especially if the 35-year mean coincided with an unusually wet/dry or hot/cold period, but, at the same time, it may have long-term similarities with regions in other parts of the world.

In seeking a sense of order, the geographer tries to group together those parts of the world that have similar measurable climatic characteristics (temperature, rainfall distribution, winds, etc.) and to identify and to explain similarities and differences in spatial and temporal distributions and patterns. Areas may then be compared on a global scale – bearing in mind the problems resulting from short-term and long-term climatic change – to help to identify and to explain distributions of soil, vegetation and crops.

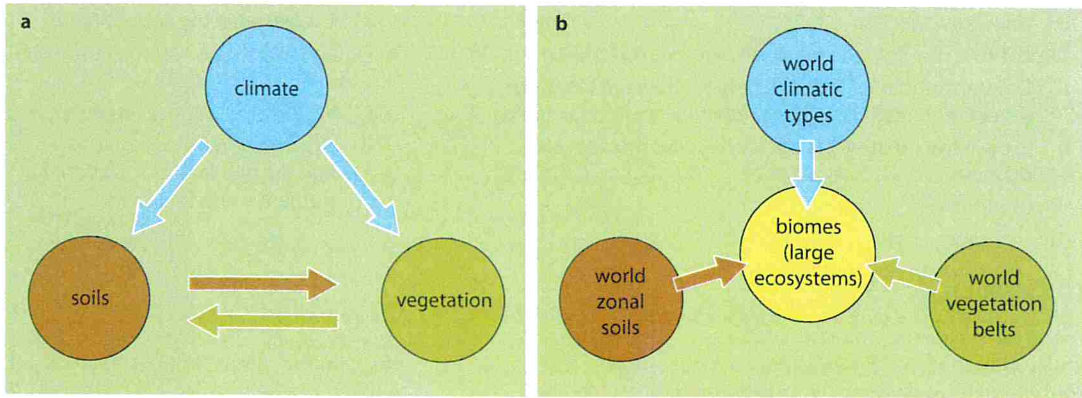
Bases for classification

The early Greeks divided the world into three zones based upon a simple temperature description: torrid (tropical), temperate, and frigid (polar); they ignored precipitation.

In 1918, **Köppen** advanced the first modern classification of climate. To support his claim that natural vegetation boundaries were determined by climate, he selected as his basis what he considered were appropriate temperature and seasonal precipitation values. His resultant classification is still used today, although a modification by **Trewartha**, with 23 climatic regions, has become more widely accepted.

Figure 12.1

Relationship between climate, vegetation and soils



Thornthwaite, in the 1930s and 1940s, suggested and later modified a classification with a more quantitative basis. He introduced the term 'effectiveness of precipitation' (his P/E index – page 178) which he obtained by dividing the mean monthly precipitation of a place by its mean monthly evapotranspiration, and taking the sum of the 12 months. The difficulty was, and still is, in obtaining accurate evapotranspiration figures. (How can you measure transpiration loss from a forest?) This classification resulted in 32 climatic regions.

In Britain, in the 1930s, **Miller** proposed a relatively simple classification based on five latitudinal temperature zones which he determined by using just three temperature figures: 21°C (the limit for growth of coconut palms); 10°C (the minimum for tree growth); and 6°C (the minimum for grasses and cereals). He then subdivided these zones longitudinally according to seasonal distributions of precipitation. The advantages of this classification include its ease of use and convenience; and its close relationship to vegetation zones and also, as these are a response on a global scale to climate and vegetation, to zonal soils.

All classifications have weaknesses: none is perfect.

- They do not show transition zones between climates, and often the division lines are purely arbitrary.
- They do not allow for mesoscale variation (the Lake District and London do *not* have exactly the same climate) or microscale (local) variation.
- They can be criticised for being either too simplistic (Miller) or too complex (Thornthwaite).
- They ignore human influence and climatic change, both in the long term and the short term.
- Most tend to be based upon temperature and precipitation figures, and neglect recent studies in heat and water budgets, air-mass movement and the transfer of energy.
- All suffer from the fact that some areas still lack the necessary climatic data to enable them to be categorised accurately.

However, climatic classifications such as those named above are rarely used today. Instead, as we saw in Chapter 11, the relationship between climate, vegetation and soils can best be described and understood at this level through the study of ecosystems, especially the largest of the ecosystems: the **biomes** (Figure 12.1b). Figure 12.2 lists eight of the more important biomes and shows, simplistically, the links between climate, vegetation and soils. These links are described in more detail and explained in the remainder of this chapter, using knowledge and understanding gained from Chapters 9, 10 and 11.

Climate type		Text reference number	Climatic characteristics	Biome (based on NPP)	Soil (zonal type)
arctic		8	very cold all year	tundra	tundra
cold		7	cold all year	coniferous forest (taiga)	podsols
cool temperate	western margin	6	rain all year, winter maximum	temperate deciduous forest	brown earths
	continental	5	summer rainfall maximum	temperate grassland	chernozems prairie chestnut
warm temperate	western margins: Mediterranean	4	winter rain	Mediterranean	Mediterranean
	eastern margins: monsoon	4A	some rain all year, summer maximum	tropical deciduous forest	
tropical	desert	3	little rain	desert (xerophytes)	desert
	continental	2	summer rain	tropical grassland (savanna)	ferruginous
	monsoon	1B		jungle	
	tropical eastern margins	1A	rain all year	rainforest	ferralitic
	equatorial	1			

Figure 12.2

World biomes: the relationship between climate, vegetation and soils at the global scale