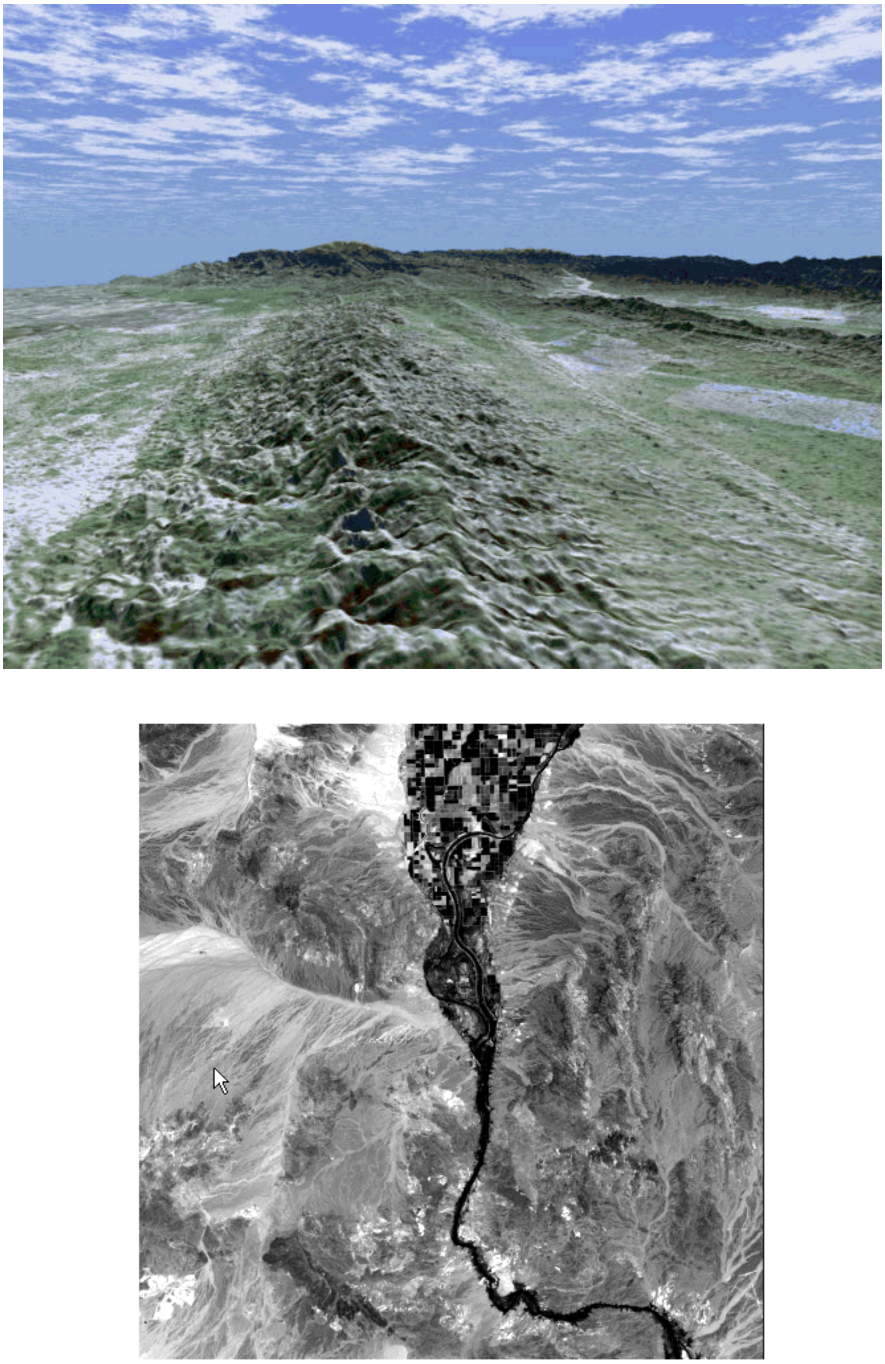

Figure 3.5 Examples of field-like phenomena. (A) Image of part of the lower Colorado River in the Southwestern USA. The lightness of the image at any point measures the amount of radiation captured by the satellite's imaging system. (*Derived from a public domain SPOT image, courtesy of Alexandria Digital Library, University of California, Santa Barbara.) (B) A simulated image derived from the Shuttle Radar Topography Mission, a new source of high-quality elevation data. The image shows the Carrizo Plain area of Southern California, USA, with a simulated sky and with land cover obtained from other satellite sources

than one recently created by cooling lava. Cliffs are places in fields where elevation changes suddenly, rather than smoothly. Population density is a kind of field, defined everywhere as the number of people per unit area, though the definition breaks down if the field is examined so closely that the individual people become visible. Fields can also be created from classifications of land, into categories of land use, or soil type. Such fields change suddenly at the boundaries between different classes. Other types of fields can be defined by continuous variation along lines, rather than across space. Traffic density, for example, can be defined everywhere on a road network, and flow volume can be defined everywhere on a river. Figure 3.5 shows some examples of field-like phenomena.

Here is a simple example illustrating the difference between the discrete object and field conceptualizations. Suppose you were hired for the summer to count the number of lakes in Minnesota, and promised that your answer would appear on every license plate issued by the state. The task sounds simple, and you were happy to get the job. But on the first day you started to run into difficulty. What about small ponds, do they count as lakes? What about wide stretches of rivers? What about swamps that dry up in the summer? What about a lake with a narrow section connecting two wider parts, is it one lake or two? Your biggest dilemma concerns the scale of mapping, since the number of lakes shown on a map clearly depends on the map's level of detail – a more detailed map almost certainly will show more lakes.

Your task clearly reflects a discrete object view of the phenomenon. The action of counting implies that lakes are discrete, two-dimensional objects littering an otherwise empty geographic landscape. In a field view, on the other hand, all points are either lake or non-lake. Moreover, we could refine the scale a little to take account of marginal cases; for example, we might define the scale shown in Table 3.2, which has five degrees of lakeness. The complexity of the view would depend on how closely we looked, of course, and so the scale of mapping would still be important. But all of the problems of defining a lake as an object would disappear (though there would still be problems in defining the levels of the scale). Instead of counting, our strategy would be to lay a grid over the map, and assign each grid cell a score on the lakeness scale. The size of the grid cell would determine how accurately the result approximated the value we could theoretically obtain by visiting every one of the infinite number

Figure 3.6 Lakes are difficult to conceptualize as discrete objects, because it is often difficult to tell where a lake begins and ends, or what distinguishes a wide river from a lake

Box 3.5 2.5 dimensions

Areas are two-dimensional objects, and volumes are three dimensional, but GIS users sometimes talk about ''2.5D''. Almost without exception the elevation of the Earth's surface has a single value at any location (exceptions include overhanging cliffs). So elevation is conveniently thought of as a field, a variable with a value everywhere in two dimensions, and a full 3D representation is only neces-sary in areas with an abundance of over-hanging cliffs, if these are important features. The idea of dealing with a three-dimensional phenomenon by treating it as a single-valued function of two horizontal variables gives rise to the term ''2.5D''. Figure 3.5b shows an example of an elevation surface.