Spatial datasets make it possible to build operational models of the real world based upon the field and object conceptions discussed in Section 2.2.6 and the use of coordinate geometry to represent the object classes described in Section 2.2.3. These include: discrete sets of point locations; ordered sets of points (open sets forming composite lines or *polylines*, and closed, non-crossing sets, forming *simple polygons*); and a variety of representations of continuously varying phenomena, sometimes described as surfaces or fields. The latter are frequently represented as a continuous grid of square cells, each containing a value indicating the (estimated) average height or strength of the field in that cell. In most of the literature and within software packages the points/ lines/ areas model is described as vector data, whilst the grid model is described as raster (or image) data.

Longley *et al.* (2010) provide a summary of spatial data models used in GIS and example applications (Table 4-1). The distinctions are not as clear-cut as they may appear, however. For example, vector data may be converted (or transformed) into a raster representation, and vice versa. Transformation in most cases will result in a loss of information (e.g. resolution, topological structure) and thus such transformations may not be reversible. For example, suppose we have a raster map containing a number of distinct zones (groups of adjacent cells) representing soil type. To convert this map to vector form you will need to specify the target vector form you wish to end up with (polygon in this example) and then apply a conversion operation that will locate the boundaries of the zones and replace these with a complex jagged set of polygons following the outline of the grid form. These polygons may then be automatically or selectively smoothed to provide a simplified and more acceptable vector representation of the data. Reversing this process, by taking the smoothed vector map and generating a raster output, will generally result in a slightly different output file from the one we started with, for various reasons including: the degree of boundary detection and simplification undertaken during vectorization; the precise nature of the boundary detection and conversion algorithms applied both when vectorising and rasterizing; and the way in which special cases are handled, e.g. edges of the map, “open zones”, isolated cells or cells with missing values.

Table 4-1 Geographic data models

Data model	Example application
Computer-aided design (CAD)	Automated engineering design and drafting
Graphical (non-topological)	Simple mapping
Image	Image processing and simple grid analysis
Raster/grid	Spatial analysis and modeling, especially in environmental and natural resource applications
Vector/Geo-relational topological	Many operations on vector geometric features in cartography, socio-economic and resource analysis, and modeling
Network	Network analysis in transportation, hydrology and utilities
Triangulated irregular network (TIN)	Surface/terrain visualization
Object	Many operations on all types of entities (raster/vector/TIN etc.) in all types of application