## Section 2. Creating and Using GIS Datasets #

### 2.2 Precision and Accuracy, Scale and Resolution#

### 2.2.1 Precision and Accuracy

In incorporating any spatial data source it is crucially important to consider the issues of *precision* and *accuracy*.

"Precision implies that the degree of measurement of an attribute is refined; accuracy that the measurement taken is correct within the degree of precision indicated" (Richards and Ryan 1985: 20).

This can best be illustrated with respect to the example of a highly detailed topographical survey undertaken using a total-station survey instrument and based upon reference points taken from a 1:2500 scale base-map. This is an example of a potentially very **precise** method using potentially very **inaccurate** data. This is because the source data, i.e. the fixed point locations derived from the map, are not sufficiently accurate to justify the precision employed in the method. To summarise, accuracy relates to the correctness of a result, whereas precision is essentially a measure of the units used.

As an aside, such issues of precision and accuracy are of particular interest in the context of GPS, where the quoted accuracy of co-ordinates varies commonly from sub-centimetre to around ±50 or so metres. Although this varies according to where on the globe you are referring, one second is approximately equal to thirty metres, yet, in terms of decimal degrees, is represented by a value of 0.0002777778. Thus a typical GPS readout in decimal degrees of, say, 52.005N is only within about 500 metres - making the general GPS error rate of ±50 metres trivial!

There is a temptation to believe the apparent accuracy with which computer-based GIS report the co-ordinate locations of objects. This information is, however, only as good as the initial data source, and errors made at this stage can be perpetuated through the lifetime of the data set.

### 2.2.2 Scale and Resolution

Scale is the ratio of the distance measured on a map to that measured on the ground between the same two points. For example a quoted scale of 1:50,000 implies that a distance of 1 cm on the map translates to a distance of 50,000 cm (or 500 metres) on the ground. Often, the difference between large and small map scales is confused. The larger the ratio, the smaller the map scale. Therefore, a map of the world would have a very small scale, whereas a map of a town centre will have a large scale.

Resolution is the smallest distance that can be usefully distinguished on a map with a given scale, for example on a 1:10,000 scale map the smallest distinguishable distance is 0.5 mm which equates to a distance of 5 m on the ground. It is worth noting that the accuracy of a map cannot be 'better' than its resolution, but it can often be much 'worse'.

The larger the map scale, the higher the possible resolution. It is very important to be aware of the scale of a given spatial data source as the degree of simplification and reduction involved in the representation of spatial features tends to increase as scale decreases. As map scale decreases, resolution diminishes and feature boundaries must be smoothed, simplified, or not shown at all. This process is referred to as generalisation. To give an arbitrary example, a map of an area of rural

Greece produced at a scale of 1:5000 may show villages and towns as discrete areas, whereas at a scale of 1:500,000 they will be portrayed as little more than dots.

It should also be noted that the wider usability of any co-ordinate system is partly a function of the resolution in which it is quoted. For example, in the UK, the widely used six figure OSGB grid references are only valid within the hundred kilometre grid square for which they are quoted - they repeat in every other hundred kilometre grid square and they also only address to the nearest kilometre, even though the OSGB National Grid per se can support references to the nearest metre (or even sub-metre, if given as a decimal number).

In a GIS where spatial data sets from a range of sources are integrated and the spatial resolution of a given data set can be altered at will, it is vitally important to be aware of such issues and not to analyse spatial information at a scale greater than that of the data source (see DeMers 1997: 56 for discussion).

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