

# Pollution Modelling

## Height Data in Environmental Protection

*Peter Fallon, Air Quality Team Leader for Birmingham City Council, explores how height data is a valuable source of information for those involved in environmental protection. Complex tasks including: noise mapping, air quality evaluation and assessing land for potential contamination are all issues covered within this article and provide an insight into how rapid evaluation is a great deal easier in 3D.*

Geographic Information Systems (GIS) attempt to reconcile two domains, the real world and that world as 'modelled' by the GIS. To produce a modelled domain that is as close as possible to the real world domain, accurate information is required.

When considering what use height data may be to those working in environmental protection, consideration should first be given to what is meant by 'height' data. Digital Terrain Models (DTM) are available, but are not all the same in terms of resolution and accuracy. The resolution required will be dependent on the task in hand and the scale being used. For example, mapping a large geographic area where showing the basic contours is all that is required, a high resolution DTM would be inappropriate due to increased processing time required to produce outputs. Conversely, lack of detail can give rise to outputs that are not representative of the real world.

The Environmental Protection Unit of Birmingham City Council obtained a DTM for an area covering some 815km<sup>2</sup> and building height data for in excess of one million buildings. This data was used in the Birmingham Updated Noise Map project that updated the original noise maps produced in 1998. However, the data is used in other environmental analysis some of which are detailed below.

### Noise mapping

Noise mapping is a complex task and requires detailed information. Data sets required include; road network, traffic flows, modal (type of vehicle) split and emission or imission values for each specific vehicle type. The road network had to be spatially accurate (or at least align with OS MasterMap) and for those parts of the network, the height data for bridges and embankments had to be extracted. As

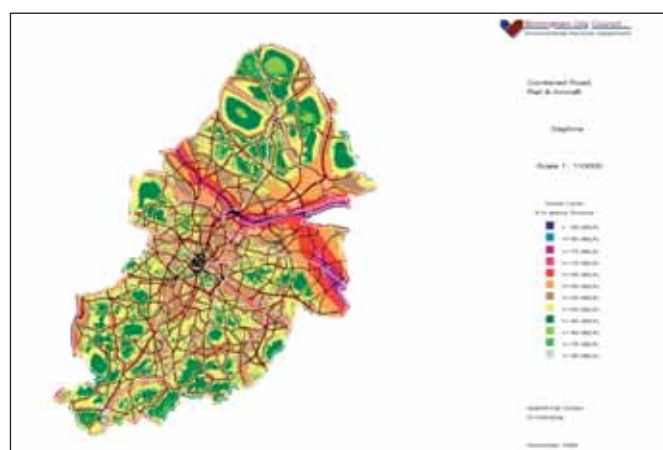


Figure 1. Birmingham Noise Map 1998

the noise map is calculated at a specified height, the building height data can be used to ensure that only residential buildings of the correct height are assessed for noise level, for example only one floor of a tower block. It should also be noted that the buildings themselves form barriers and may be reflective or sound adsorbing, and thus having a major impact on the outputs of the noise model.

### Air quality

Air quality assessments are somewhat more complicated in that large areas need to be modelled, and that to keep model run times sensible certain generalisations need to be applied such as the type of surface – water or land, etc. Building heights are not usually taken into account at this scale, but are more important when modelling individual streets. When modelling air quality over a large geographic area assumptions are usually made with regard to topography that can lead to over-estimation of pollution concentrations. This is in part due to the complex nature of the chemistry taking place and the difficulty in determining accurate weather scenarios.

The area of Birmingham shown in Figure 2 has an elevated section of motorway running through it. Draping Cities Revealed aerial photography over the Cities Revealed LiDAR generated DTM produced the image below. The buildings are OS MasterMap with Cities Revealed Building Height data applied both as a base value and a height value for each building polygon.



Figure 2. Representation of an area of Birmingham.

To highlight the route of the motorway, the appropriate feature has been added to produce Figure 3. The height difference between the housing and the motorway varies but is approximately 30 metres.



Figure 3. Representation of an area of Birmingham. Motorway highlighted

Air quality model results based on crude topography produced the map shown as Figure 4. The output would predict that elevated concentrations of this pollutant (nitrogen dioxide) might be found in the residential area. Actual measured values were significantly lower than those predicted, because of the differences in calculation height and the actual heights concerned.



Figure 4. Representation of an area of Birmingham. Air pollution model result.

### Contaminated Land

Local councils are required to assess land for potential contamination based on a number of variables such as past land use, historic mapping, sites surveys and local knowledge. For land contamination to be problematic three keys have to be connected—the source, pathway and the receptor. Basically remove any one of these keys and the contamination issue is discharged. The role of terrain and height data in this task is one of assessing pathways between source and receptor. Consider a contaminated site leaching liquids into the surrounding ground with residential properties nearby, in simple terms if those properties are on higher ground the chances of a pathway existing are much reduced.

High quality terrain data is also used to identify sites with ambiguous boundaries. Certain types of site such as landfills, may not have a clearly defined boundary. The LiDAR derived data makes identifying those edges much easier. The light blue area in Figure 5 is where a landfill site was thought to have existed based on local knowledge and historic maps. However, the raised area circled in black identified a much larger area of potential contamination.

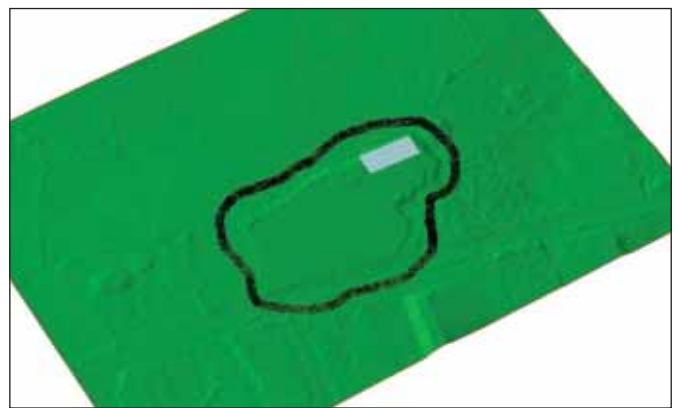


Figure 5. Known landfill Vs actual landfill boundary

### General uses

There are many more uses for this type of data than can be covered here, but in addition to those mentioned above, there are obvious uses such as planning and development or emergency planning where rapid evaluation of an area is much easier in 3D, an example of which is shown in Figure 6.



Figure 6. 3D representation of Gravelly Hill Birmingham

*Please note that the views expressed within this article are those of the author and not of Birmingham City Council.*