# Mapping fire risk on top of DEMs - visualising the 3rd dimension

## *Scenario*

In many areas of the world forest fires are a regular occurrence and a forest manager needs to be able to identify areas at risk. A GIS can be used to model complex landscapes and answer "what if" situations. Whilst a GIS can run complex models using many parameters the information it creates needs to be visualised in a meaningful way, especially if the end user is a person who has no technical knowledge about the subject.

Maps are typically displayed in 2 dimensions on a screen or sheet of paper, with elevation (the 3rd dimension) displayed as contours. A regular map user with interpret contour data with very little effort, whilst an occasional map user would likely misidentify contours and their meaning. GIS has the capability of turning elevation data into realistic 3 dimensional images, where the foreground can obscure the background. Such imagery is usually visually dramatic and immediately intuitive.

In this exercise you are a forest manager using a DEM and a fire risk map for a region in the USA. You will use this data to create a 3D image which will not only be visually dramatic but an image which you can fly through and use to get your point of view [*no pun intended!*] across to the general public.

## *Data used in exercise*

This exercise is supplied with several datasets and you will use these to create visualise your fire hazard layer. The supplied data are:

- DEM (30m resolution) – held as an ESRI float format raster file
- Fire risk layer – held as an ESRI ASCII format raster file
- Roads – a shape file

Each map layer is in UTM coordinates (for Zone 12 north, based on the WGS 1984 datum).

## *Setup*

This exercise comes with zipped data (raster, vector and symbol files), it is suggested that you unzip the data to a single location such as **C:\eLearning\Unit5\3DRisk**. The output you create can go into this directory.

## *1.1 Import the data*

Start up ArcMap and in ArcToolBox, under *conversion* and then *to raster*, use *float to raster* to import the **dem** raster grid. Use *ascii to raster* to import the **risk** grid, setting your new raster grid to be *float* (numbers with decimal places and a fractional part) rather than *integer* (whole numbers).

To document the coordinate system, head for the ArcToolBox, and under *data management*, select *projections and transformations*. Select the DEM that you just imported into ArcGIS. Next select *define projection* and under *coordinate system,* navigate through the *projected coordinate systems* folder to *UTM,* then to *WGS 1984*, then to *northern hemisphere*, then select **WGS_1984_UTM_Zone_12N**. You will need to repeat this for the **risk** grid that you imported.

Now, leave ArcMap for the moment and return to the *start* menu, the *ArcGIS* group of programs and select *ArcScene*. ArcScene is a specialist 3-dimensional visualisation module that forms part of the 3D analyst extension for ArcView. We will now explore its use.

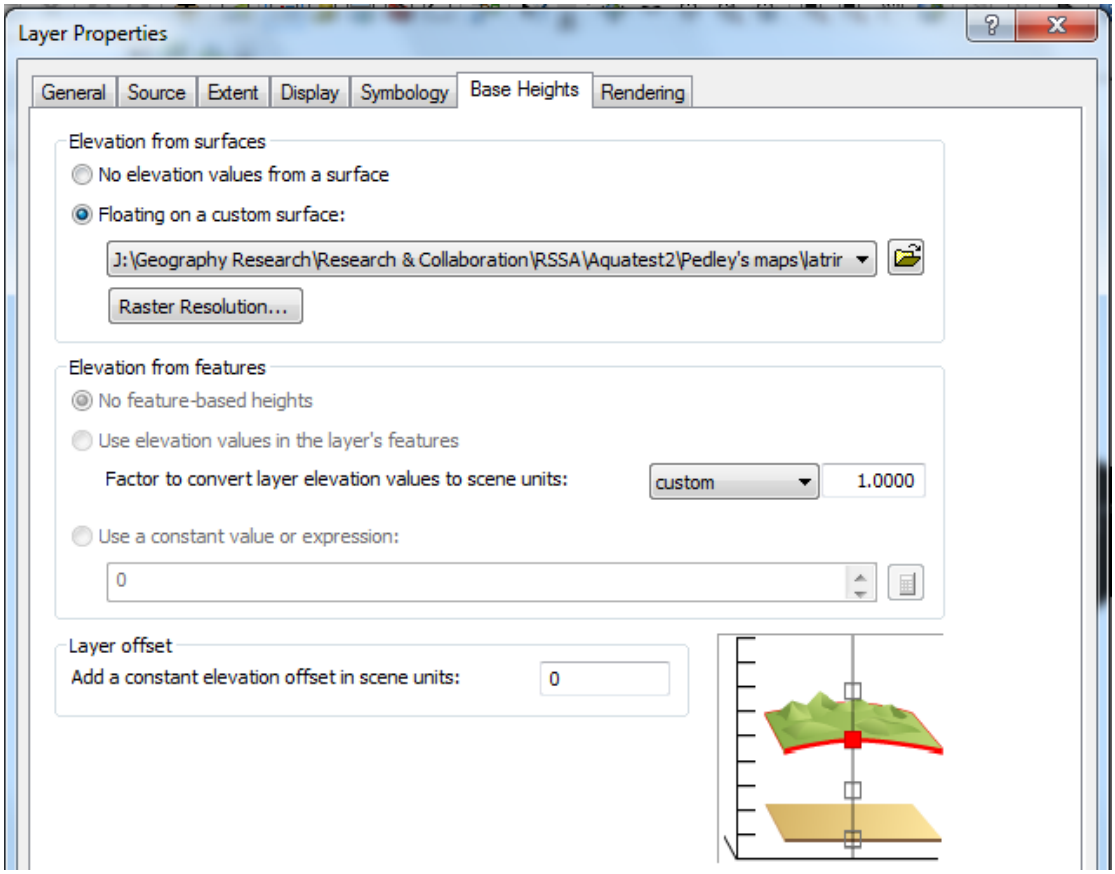
Using *add data* on the file menu (or the 'plus' tool on the toolbar), load up the shape file **roads**, the file **dem** and the file **risk.** At this stage, all of these files will appear as 'flat' parallelograms on screen.

We will now start to convert all of these files to a 3-dimensional perspective view.

## *1.2 Creating a 3D surface from a raster grid of elevation*

Let us start with our raster **dem** grid. Right-click on the name of this map layer, choose *properties*, and then click on the *base heights* tab.

Under *floating on a custom surface*, choose your **dem** raster:




The *layer offset* option is sometimes used to artificially raise or lower the 3D display relative to sea level (e.g. a negative number here would reduce the overall height of a scene for a high mountain plateau across all pixels).

## *1.3 Draping a raster surface over a DEM*

What if we wish to drape the values of another raster grid over our DEM? Right-click on the **risk** raster grid, choose *properties*, and then click on the *base heights* tab.

Under *floating on a custom surface*, and again choose your **dem** raster grid. Note that if you click on *raster resolution* here, if the two grids differ in their cell sizes and dimensions, you can adjust for this here. For now, leave the raster resolution settings as they are and click on *ok.* You should find that the fire risk map now appears as a 3-dimensional display.

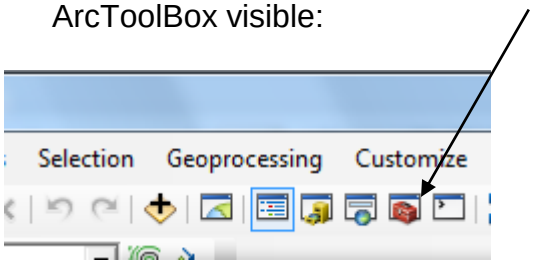
Using your knowledge of ArcView, you may wish to modify the way the fire risk is displayed.

## *1.4 Overlaying vector data on a 3D scene*

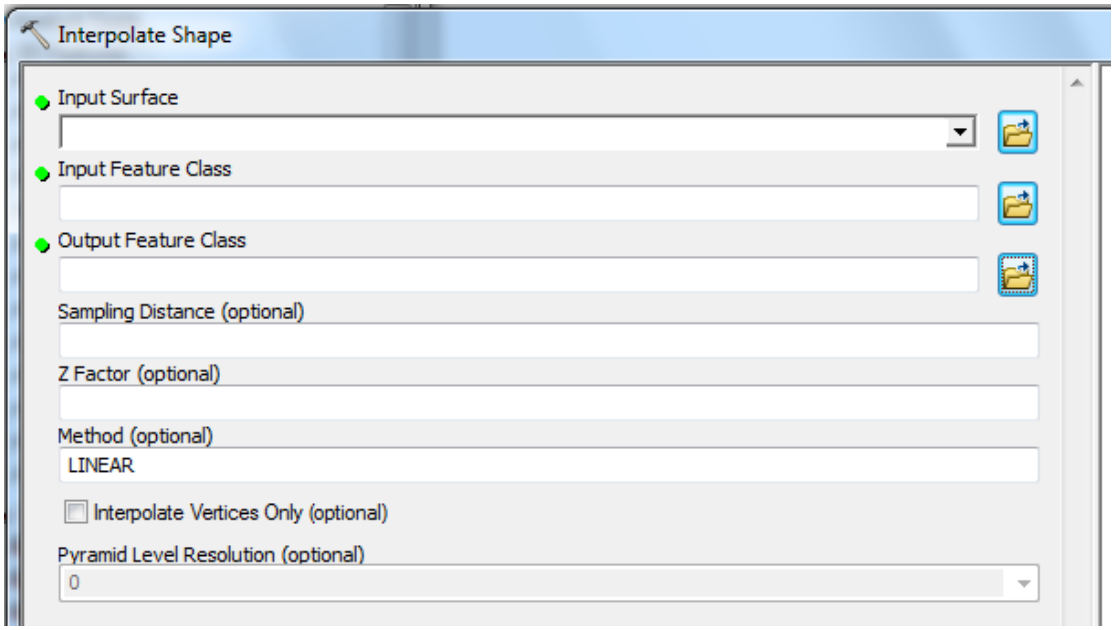
You should see that your roads remain 'stuck' underneath your DEM's surface. To have the roads properly represented over the surface of the DEM, we need to change their format from a conventional shape file to a specialist 3D vector file format. In this format, the co-ordinates along a road section are represented not only by X and Y co-ordinates, but also by Z co-ordinates, indicating the altitude of each road section.

We can convert our roads shape file to this specialist 3D format as follows:

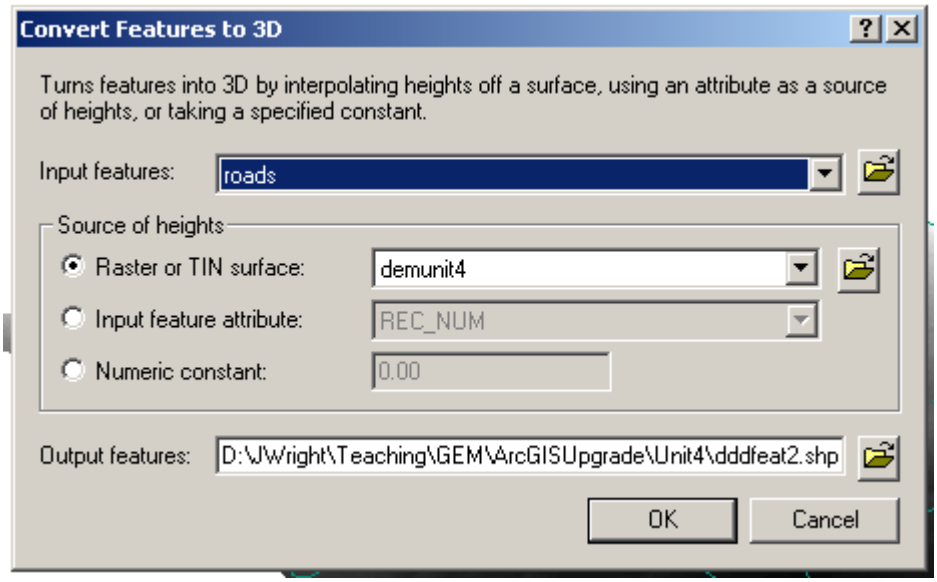
- Within ArcScene, click on the ArcToolBox button to make the ArcToolBox visible:




- Within the ArcToolBox, click on the *3D Analyst tools* group of tools and then select *functional surface* and then *interpolate shape*.




- Select **roads** as your *input feature class* and under *input surface*, choose your **dem** as the source for the heights. Under *output feature class*, choose an appropriate location for the resultant 3D shape file.

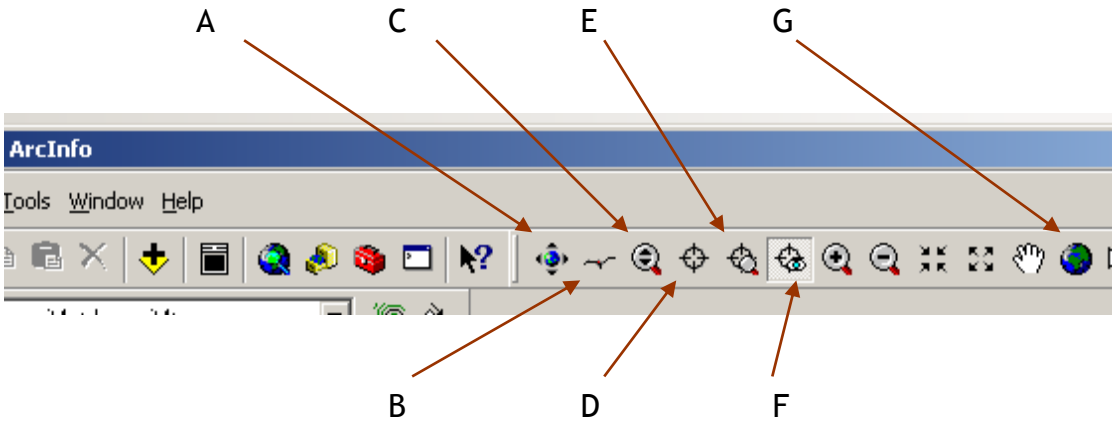



You should now find that your roads appear on top of the DEM surface.

## 1.5 Navigating within your 3D view:

We are now in a position to navigate around within our 3D view. The key tools for doing this are explained below:

A. If you select this tool and hold down the left mouse button, you can rotate your scene from left to right.
B. This is the most complex tool on the menu – the 'fly-through' tool. Select it and your mouse icon will change to a standing bird. Click the left button once, and you can rotate your scene – note that the mouse icon changes to a flying bird, indicating that you are now in 'fly-through' mode. Click the left mouse button again, and you will gradually move towards the centre of the scene. Click the left mouse button again, and the speed with which you approach the scene will increase. You can continue to increase your speed further with more clicks on the left mouse button. To reduce your speed, use the right mouse button. Enough right mouse button clicks will return you to the 'standing bird' icon and take you out of 'fly-through' mode.
C. If you select this tool and hold down the left mouse button, pushing the mouse towards the computer will zoom you in, whilst pushing the mouse away from the computer will zoom you out
D. Selecting this tool enables you to click on a point somewhere on the DEM's surface and make this the centre point of your scene.
E. If you select this button, you can identify a 'target' on the DEM's surface, which you can subsequently zoom in on.
F. Clicking this button enables you to zoom in on the 'target' identified with button E.
G. The remaining tools are equivalent to their ArcMap equivalents. However, remember that this tool is very useful, as it returns you to your original perspective view, if you get a bit lost!




Try experimenting with the tools A to F, remembering to use tool G to return you to your original view when necessary.

## 1.6 Saving a view for use in a Word document

Once you have a satisfactory scene that works well, you can save the view's parameters for subsequent use in a special form of map document (an .SXD file) via *file….save*.

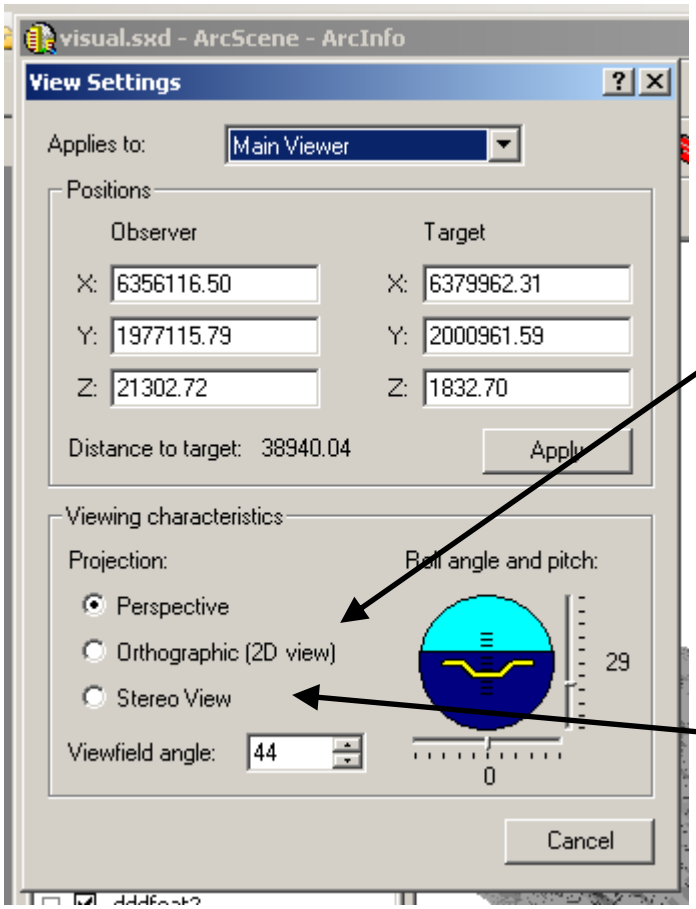
If you produce a view that works particularly well, you can save this for subsequent use in a Word document or elsewhere as follows:

- On the *file* menu, choose *export scene*, and then *2D…*
- You can then save your view in several of the common graphics file formats, such as .JPG
- This can subsequently be imported from within Word by going to the *insert* menu in Word, choosing *picture* and then *from file*.

## 1.7 Exploring ArcScene

You may wish to explore further areas of ArcScene's functionality. Here are some suggestions for further areas to explore:

- If you click on the *view* menu and choose *view settings*, you can see some of the other ways in which ArcScene displays data




Orthographic displays data in a conventional 'plan view'

Stereo view creates a scene which – if viewed with '3D glasses' (i.e. glasses with a red panel over one eye and a blue panel over the other eye) – provide a truly 3D perspective view.

- Under the 3D Analyst button, if you choose *convert*, and then *raster to TIN*, you can convert our **dem** file to a TIN. You can then explore some of the ways in which TINs are displayed in ArcScene.
- How might you add hillshading to your 3D scene to improve its realism?