Using terrain height maps in Vue d'Esprit

1. Introduction

If you use Vue, then you know that its terrain editor is extremely easy to use but is also very powerful. You may also know that producing terrains other than variations on the standard fractal mountain is problematic. For example, if what you want is a simple round hill with smooth sides, actually drawing this in the editor is not easy.

The purpose of this tutorial is to show how this can be done more reliably using terrain maps produced in a 2D drawing program such as Photoshop. With this you can produce terrains that can be defined as you want right from the start, and then modified in the terrain editor. You can also produce some bizarre and unusual terrains which don't really look like terrains at all!

1.1 What you will need

- Vue d'Esprit 4 (standard or Pro version)
- A 2D graphics package such as Photoshop – this will almost certainly work just as well with Paint Shop Pro or PhotoPaint, all you actually need is the ability to produce 8-bit greyscale pictures
- Some example terrain maps, included with this document, so you can see how it works

1.2 What are terrain height maps?

Vue has the ability to import greyscale images and use the brightness of each pixel to determine height in the terrain editor. In such an image, dark colours are low points in the terrain, while white are high; all shades of grey fall in between these two limits.

To see how easy this is, fire up Photoshop (from now on I'll refer to PS only but substitute your paint program where appropriate) and create a new greyscale image measuring 256 by 256 pixels. Create a black to white gradient and fill the image with the gradient with black on one edge and white on the other. It doesn't matter which way round it is. Save this image as a JPEG with 100% quality. You can find this image in the accompanying .zip file as image 'wedge-1.jpg'.

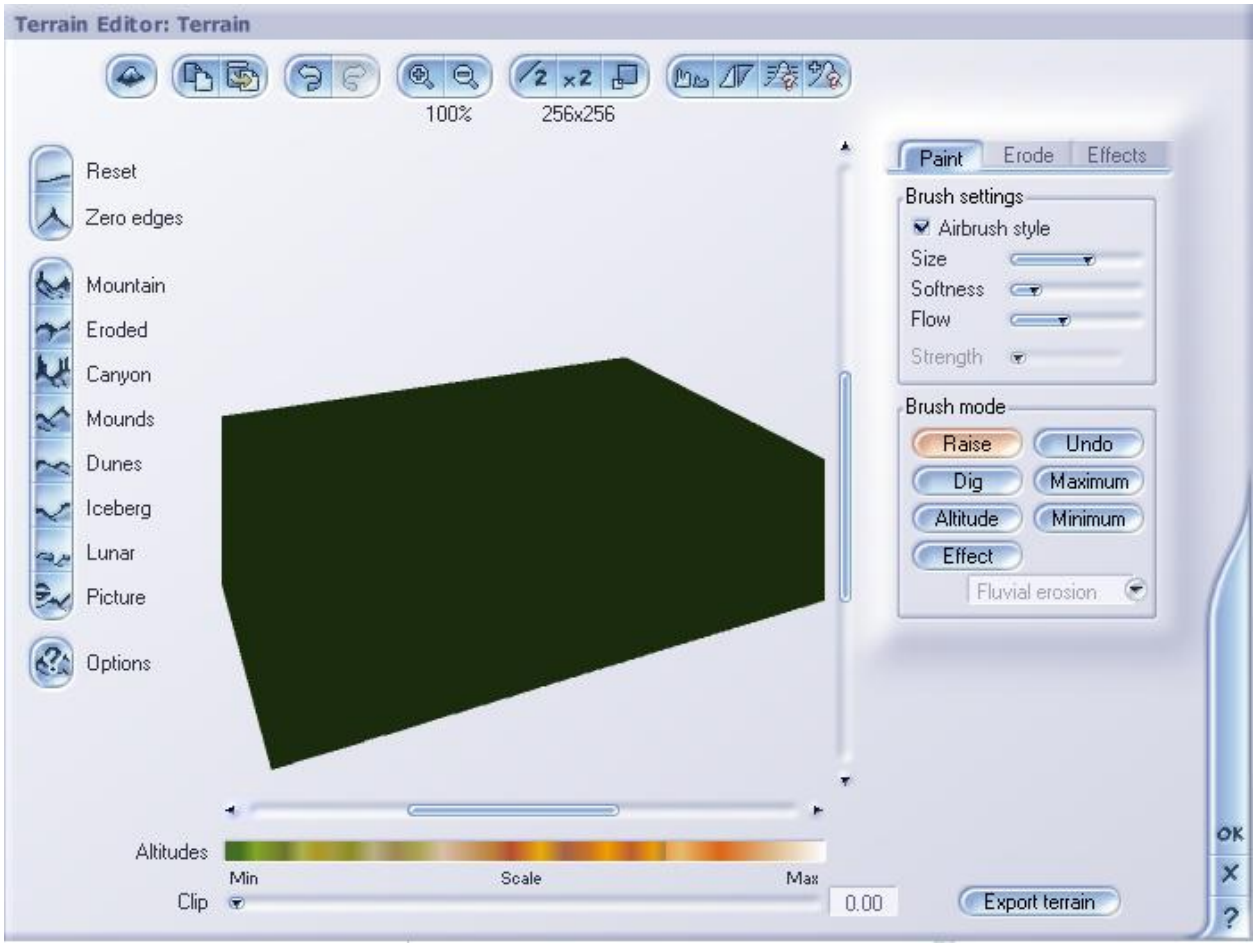
Now load Vue and create a new scene, then either:

- create a new terrain
- double-click the terrain in the viewport
- in the editor, make sure the resolution is 256 by 256 (it will be by default)
- click the Reset button (the top button in the vertical row on the left of the editor)

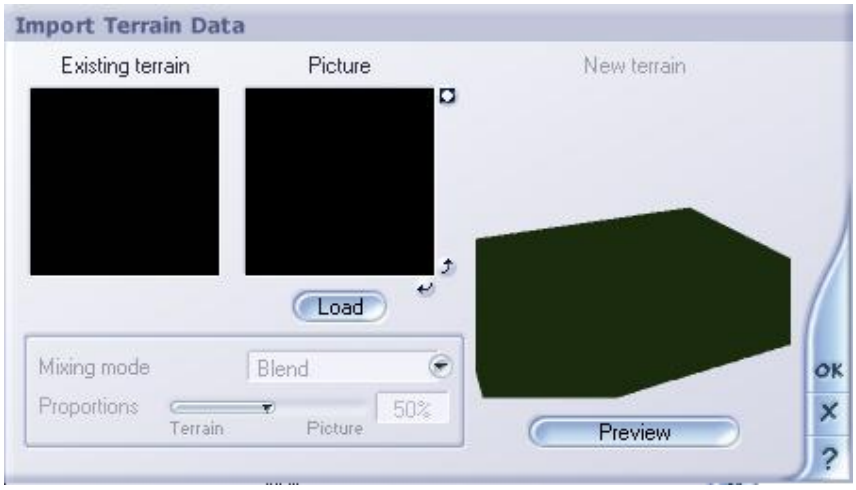
or:

- in the terrain button flyout, click the 'Terrain in editor' button
- when the dialog opens, ensure the resolution is 256 by 256 and de-select the 'Generate fractal terrain' option
- click OK

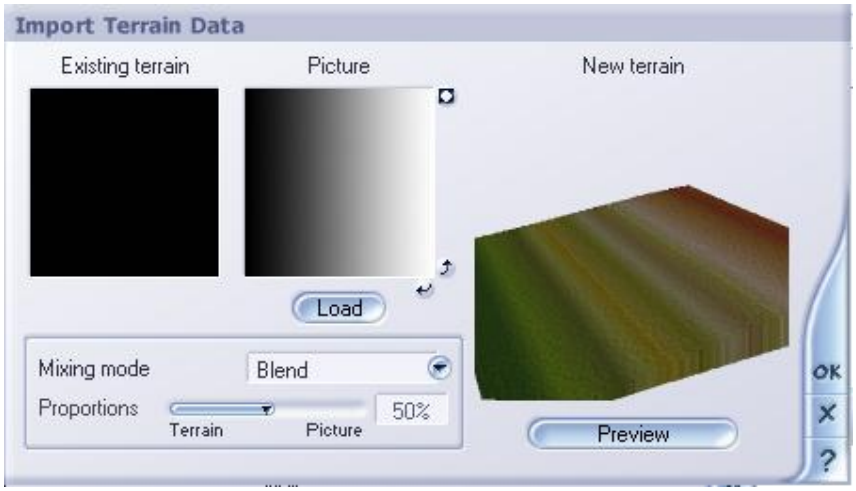
Either way, you should end up with a completely flat terrain coloured dark green in the editor:



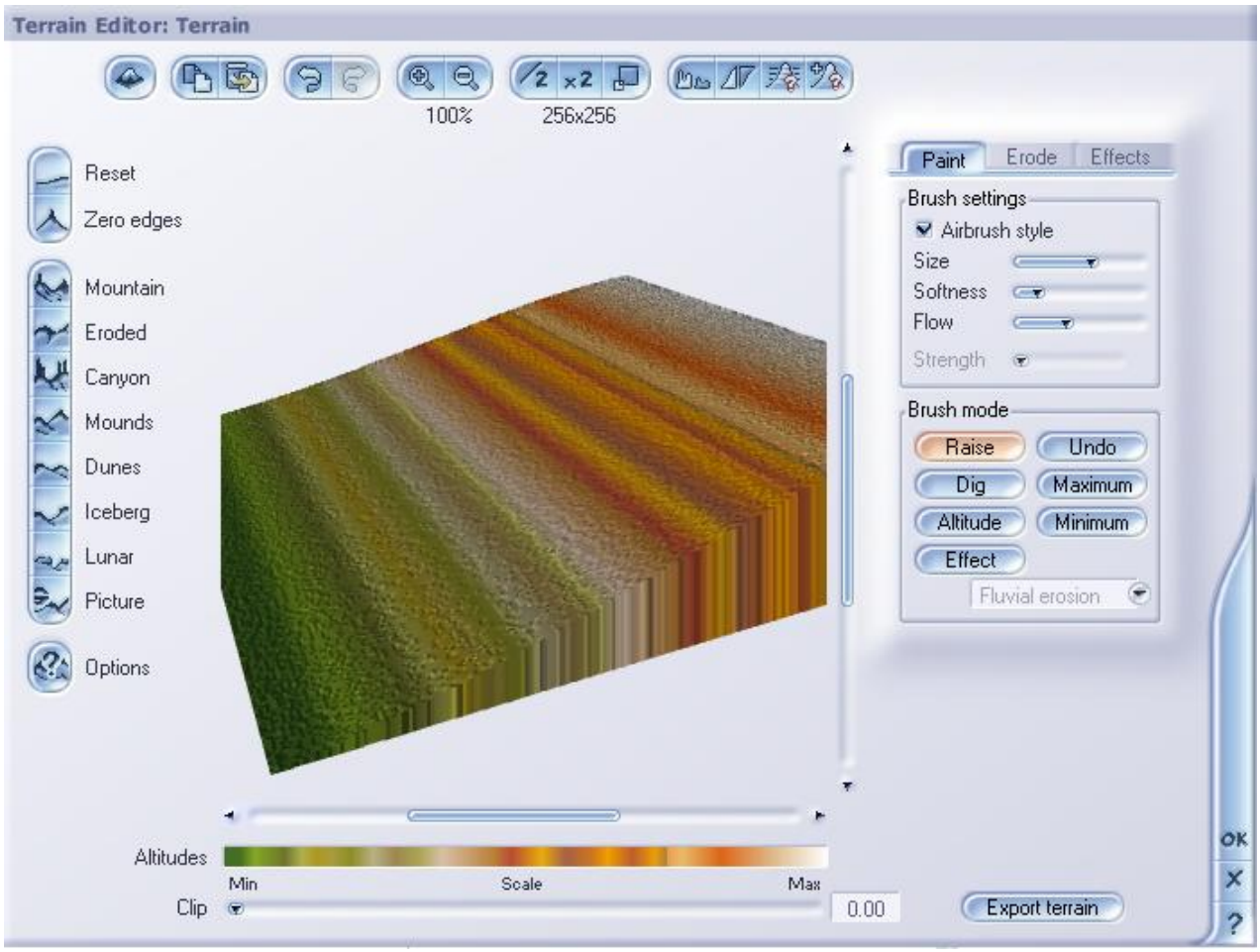
Now click the ‘Picture’ button (last but one on the vertical strip on the left of the editor). The following dialog appears:



You can see that the existing terrain is a plain black image, as it has no height yet, and the new image is the same as you haven’t loaded a terrain map. Click the ‘Load’ button and load your black and white gradient image (wedge-1.jpg in the .zip support file). This is a simple gradient ranging from pure black on one side to pure white on the other. Now you get the following effect:



There are a couple of things to note here. First, the new image is actually a blend of the existing one and the terrain map you loaded, the influence of each depending on the Proportions slider. Proportions of 0% just gives you the original image with no input from the map, and since the existing image is completely flat, in this case that would result in a flat terrain. On the other hand, 100% Proportions gives you the full effect of the loaded map with no input from the existing image. By default the Proportions value is set at 50%, so increase it to 100% and click OK. The result in the terrain editor is this:



I think you would agree that it would be impossible to achieve this by editing the terrain in the terrain editor.

1.3 How it works

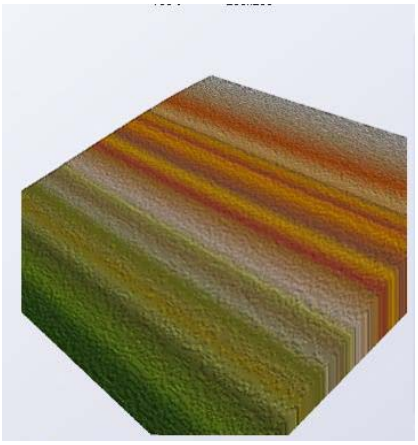
This section is important because you need to understand the results of importing a greyscale image in this way. Vue treats the terrain map as a map of altitudes. Black represents the lowest altitude whereas white is the highest. A greyscale image will therefore be mapped to a series of high and low points in the editor. The

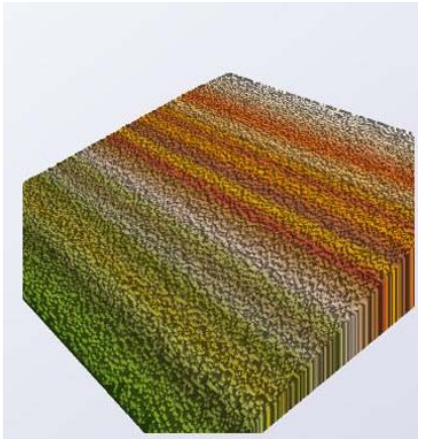
slope, or rate of change in altitude, will vary depending on the difference between adjacent pixels. In other words, if you have a height map with a black background and a white hard-edged circle on it, you can expect to see a very abrupt change in altitude (a vertical change in fact, so that the terrain would look like a circular tower on flat ground). You can try this out by loading tower-1.jpg from the support file.

However, it isn't quite as simple as that. What would happen if your map was plain black? You would expect to see a flat terrain with no height, but that's not quite correct. The terrain does have some volume, some thickness – you can dig holes in it in the editor. Of course, it's very thin. If the map is all white, you see a flat terrain at maximum height, which at first sight looks the same as that produced by the all black map. However, it has much more volume, as you can see if you dig into it in the editor. The surface of the terrain though is flat, the same as if the map was all black. It's elevated in the viewport, but when you move it down, it's just another plain flat terrain. The maps all-white.jpg and all-black.jpg (and all-grey.jpg) are in the archive if you want to try this out.

All this is probably what you would expect. But what if you create a map with a gradient as in section 1.2 above but instead of a black and white gradient you use two close shades of grey? You get the same sloping terrain as with the black-white gradient (try wedge-2.jpg from the archive to see this) rather than a much gentler slope, which is what I would have anticipated.

Well in fact, you don't get exactly the same effect. Look at the two images below, where the left terrain is created with a black-white gradient and the right with a grey-grey gradient:



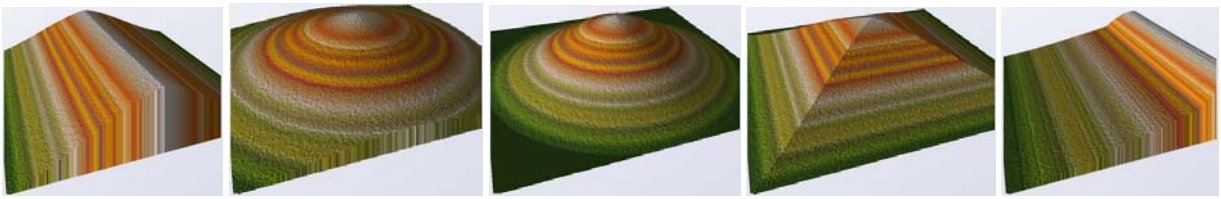


The difference is that the surface of the left hand terrain is much smoother than that on the right. What Vue seems to do is take the darkest pixel as the lowest point in the terrain and the brightest pixel as the highest point. These are then mapped to the maximum and minimum altitudes in the terrain editor. All other pixels are mapped to appropriate intermediate heights, but it seems that if there is little difference between the colour values (i.e. the brightest and darkest colours are very similar) there can't be a smooth interpolation and the terrain becomes coarse and lumpy. This is my just my guess from the images above but it seems to fit the facts. You can see this effect with the four maps in the archive named circular-ridge-1.jpg through circular-ridge-4.jpg which are the same map using different circular gradients. Each one produces the same shaped terrain but with different surface resolution.

The moral is that if you want smooth terrains use a map with the greatest possible difference between light and dark pixels, but if you want a coarser terrain use closer shades of grey. If you want the surface to be even smoother, try a 512 by 512 map which in theory increases the ability to interpolate altitudes – but note that you never quite get a completely smooth terrain, there's always some evidence of roughness and irregularity. One other point is that with very smooth, plain materials (such as the default material) there is some evidence of banding across the terrain when smooth gradients are used. This disappears if you use a rougher, more varied material such as the rock or landscape materials.

2. Different terrains

You aren't restricted to simple linear gradients. In the support file, you will find a variety of others including round hills and pyramids. These can produce effects like this:

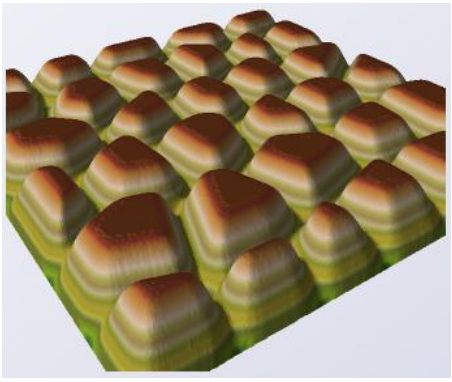


Nor do you have to use gradients at all. Any grayscale image can be used. It doesn't even have to be greyscale; if you use a colour image, Vue will convert it into a greyscale image when it is loaded, but the disadvantage is that you may not be able to visualise so easily what the 2D image will produce in the way of terrain. You could use text or a logo and output that as a terrain map – see the mac-x.jpg map in the archive. Do bear in mind though that the 'busier' or grainier the greyscale, the more roughened the terrain will be.

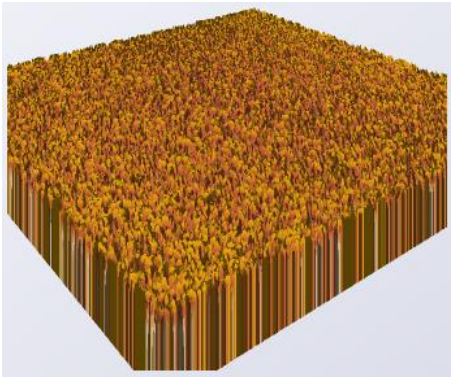
One of the things it is very difficult to do in the terrain editor is to produce a smooth, rolling plain for your scene. This is very easy to do with a terrain map. In PS, create a new 256 x256 greyscale document and run the 'Clouds' filter. This by itself can produce a nice smooth terrain, particularly if you reduce the blend Proportions; try clouds-1.jpg in the support file to see how it looks at 100% and 25% Proportions. We can do even better. In Photoshop, after using Clouds, run the Gaussian blur filter with about 5 pixels of blur (try different amounts to see what it's like). This reduces the contrast between neighbouring pixels and so produces a smoother terrain. Gentle-1.jpg and rolling-hills.jpg in the archive were both produced like this.

Alternatively, run Clouds and then Difference clouds. This will result in some very dramatic differences between parts of the map, so giving a wild, mountainous terrain. Clouds-1, -2, -3, and Dramatic-1 and -2 in the support file were produced in this manner.

Now try something different. Create a new image, and fill it with white. Then run Photoshop's Stained glass filter with a cell size of 24 and a border size of 4. The resulting terrain looks like this:



which is different to say the least! To get a softer, rounder approach try blurring the map first. Only the black border lines are blurred, the white background is unaffected, and this gives a rounded, softer appearance to the mounds. You can try all the PS filters like this, but some of them are more useful than others. Remember, you want an image without too many small dots of colour, or you will get a rough, gritty terrain (unless that's what you want, of course). As an example, the following terrain was produced by filling the map with white then running the Add noise filter (10% amount, Gaussian, monochromatic – see noise-1.jpg in the archive):



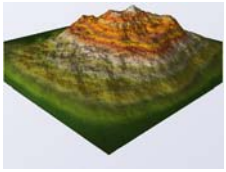
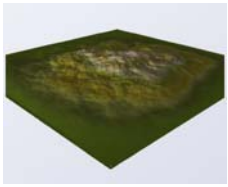
As you see, this produces a terrain with no slope but which is very rough-surfaced. This might well be what you want, but you can see the effect of having too much detail in your map. You can reduce the detail in a case like this by blurring the map with Gaussian blur; this still gives a bumpy map, but the bumps are bigger and fewer!

3. Blending terrains

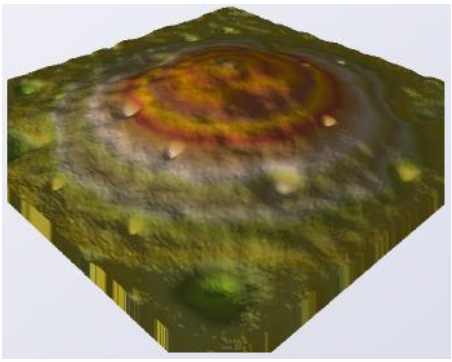
This brings us on to the subject of the mixing modes for terrains, which we have ignored so far. Firstly, exit the terrain editor and then go back in again (this is just to reset the editor). Create a terrain as in section 1.2 above, using the wedge-1.jpg map in the archive. You get a fairly gentle, smooth slope. DON'T rotate the terrain or do anything to it in any way. Now, what if you want this slope to be steeper and higher? You can't alter the height map – it's already as black and white as it can be. In the terrain editor, click the Picture button again. The height map of your existing terrain (the wedge) can now be seen in the 'Existing terrain' box, while the 'Picture' box is just black. Load wedge-1.jpg again. There's no immediate change, and even if you turn up Proportions to 100%, nothing happens. Now choose 'Add' from the Mixing mode menu and turn Proportions to 100%. Now you have a much higher, steeper slope. Vue has added the heights of one terrain to those of another. This is why I said not to rotate the terrain in the editor. If you do, the rotated map will be added to the new map and the black and white pixels may cancel one another out, giving a flat terrain (try it).

The most useful mode is 'Blend' which is the default. To see what it can do, create a new terrain but this time let Vue create its own random, fractal terrain. Now click Picture and load pyramid-1.jpg from the archive. I can't tell you what you'll get, because it depends on what sort of random terrain Vue generated, but play with the Proportions and see the different effects. You can blend any terrain with any map like this; one of the terrains doesn't have to be flat. There are other mixing modes as well, multiply is quite good at giving flat-topped, mesa-like terrains.

The other useful point to mention is that if the loaded height map is uniformly flat then blending your existing terrain with such a map will reduce the effect of the original terrain. For instance, if you have a mountainous terrain, blending that with an all-black map will reduce the height and slope of the mountain. Uniformly reducing the height of a terrain is difficult in the editor, but this technique makes it easy. You can find a black terrain map in the archive (all-black.jpg). For example:

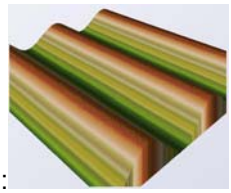
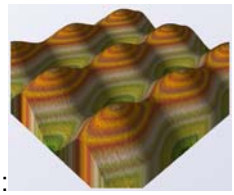
This terrain:  gives this when blended with all-black (proportions 66%): 

Now try this. Create a new blank terrain in Vue, then click Picture and load the map round-1.jpg from the archive. Set Proportions to about 75% to get a nice round hill. Now click Picture again and load the map noise-2.jpg and turn Proportions down to about 8% to give an irregular but fairly smooth surface. Now click Picture yet again and load spots-1.jpg, and turn Proportions to about 10%. This adds some soft-edged round holes into the terrain. The final result is:



You'll need to experiment with the Proportions slider to get the effect you want. You can keep on blending as much as you like.

You can even blend a terrain with itself. Normally this wouldn't produce any effect if the Blend mixing mode is selected, but there are an additional couple of options. Create a terrain using the pipes-1.jpg map in the archive; leave Proportions at 50% and click OK. Then blend the resulting terrain with pipes-1.jpg again, but this time, use one of the tiny arrows next to the Picture box in the 'Import terrain data' dialog to rotate the map through 90^{o}, either clockwise or anti-clockwise. This cause the two maps to cross one another at right angles:

Initial pipes-1 map:  blended with itself, rotated in the import dialog: 

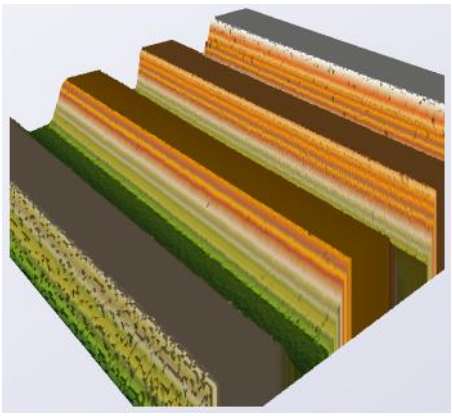
Obviously, this effect is strongest when the map has some directional line in it rather than if perfectly circular or a random pattern.

In addition to rotating an imported map you can also invert it by clicking the tiny white circle in a black square on the top right of the Picture box. Try the lightning-1.jpg map, and invert it once loaded to convert a narrow river into a tall thin mountain.

4. Altitude filters and Functions

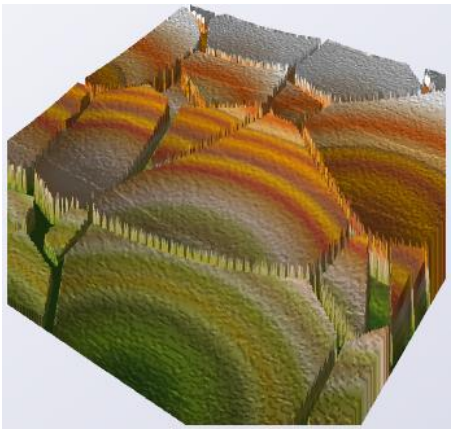
One of the best uses of a terrain map is that for the first time you can get a real handle on what the altitude filters do. If you have experimented with these, you know they produce striking effects but that what effect you get isn't always predictable. This is because the filter is acting upon what is usually a random fractal terrain. By using a defined terrain map, you can begin to see what the filter really does.

Once again, create the terrain from section 1.2, using wedge-1.jpg from the archive, and then click the Filter Altitudes button in the top toolbar of the terrain editor (it's the last button but one on the right). When the dialog opens, double-click the filter profile, which by default is a simple diagonal line, and from the next dialog choose Terrain Profiles. Finally, choose the Bands profile and click OK, then click OK again:



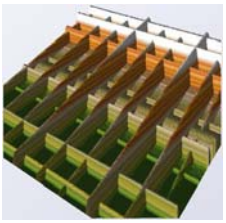
Whether you want this appearance or not is up to you! This is a very simple demonstration, but by using a terrain the shape of which is defined and consistent, we can see what the various altitude filters will do. Try the other filters and see what you get.

You can do the same with the Functions (the last button on the top horizontal row). Create a new terrain with wedge-1 again, then click the Functions button, double-click the image for the function (not the filter box on the right) and from the Basic collection choose Drought. Click OK twice to get back to the editor and this is what you get:

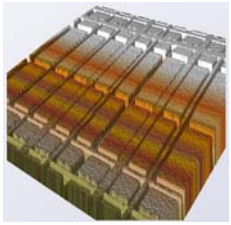


The function can also have a filter applied to it. Apply the Squares function to wedge-1, which gives the image below on the left. In the same dialog box which applies the function you can also apply the Round Dip filter to the function, to get the middle image below; and then you can apply a filter to the whole terrain using the Altitude filter button to get the rightmost image:

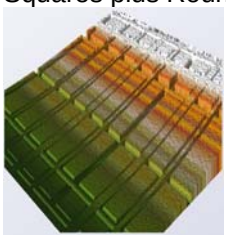
Squares function



Squares plus Round Dip filter



Squares plus Round Dip filter, filtered with Wild Dig



5. And finally

You can see that using terrain maps to produce terrains in Vue can produce much more consistent terrains, rather than relying on hit-and-miss editing in the terrain editor. You can still use all the functions of the editor to alter the terrain, but the underlying shape is much more under your control. You can even produce some truly bizarre appearances and even 'terrains' which look more like buildings, as you can see in the archive file.

There are 67 terrain maps in the accompanying archive file, some of which are variations of one another and some of which are quite unique. You are free to use these as you wish, for both commercial and non-commercial renders.

Any comments or questions on this tutorial (especially if you spot a mistake), please email me on Steve@microbion.co.uk. The latest version of this tutorial and support file can be found at http://www.microbion.co.uk.

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