▪ report

Creating and Using Digital Elevation Models

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By

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Revision History

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Document Acceptance

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Approved by			
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Types of 3 Dimensional Terrain Data

There are two main types of 3D data used in a GIS:

TIN – Triangulated Irregular Network.

Sometimes called a DTM (Digital terrain model) a TIN is made of a series of triangular polygons. The triangles are 3D dimensional in that each node will have a different x, y and z. Each triangle becomes one face of the terrain surface.

DEM – Digital Elevation Model.

A DEM is a raster or grid based terrain model. Each cell in the DEM will have a value representing the elevation of the area. Z values may also represent other data such as radio signal strength, population density, and rainfall or soil classification.

Generating a Grid in MapInfo

MapInfo has some 3D data support for Grid based datasets. In addition, the Vertical Mapper extension provides further functionality. It is possible to open and query a grid created in Vertical Mapper inside MapInfo, however Vertical Mapper's analytical tools are not available.

Data Sizes

Grid datasets are large! A fairly simple set of contour data may result in a large DEM file of several hundred megabytes or more. Be aware of the accuracy of the source datasets. Don't build a more detailed DEM than is required and expect that it may take several hours to process.

The processes below outline the steps to convert contour data into a surface and DTM using Vertical Mapper, running additional analysis over the DEM to produce a hill shade and aspect layer and then finally importing the layers into MapInfo's Native grid file format.

Convert Data To Points

Grids can be created from contours or other elevation data such as spot heights and break lines. If your contour data does not contain a zero contour, a coastline dataset may need to be added.

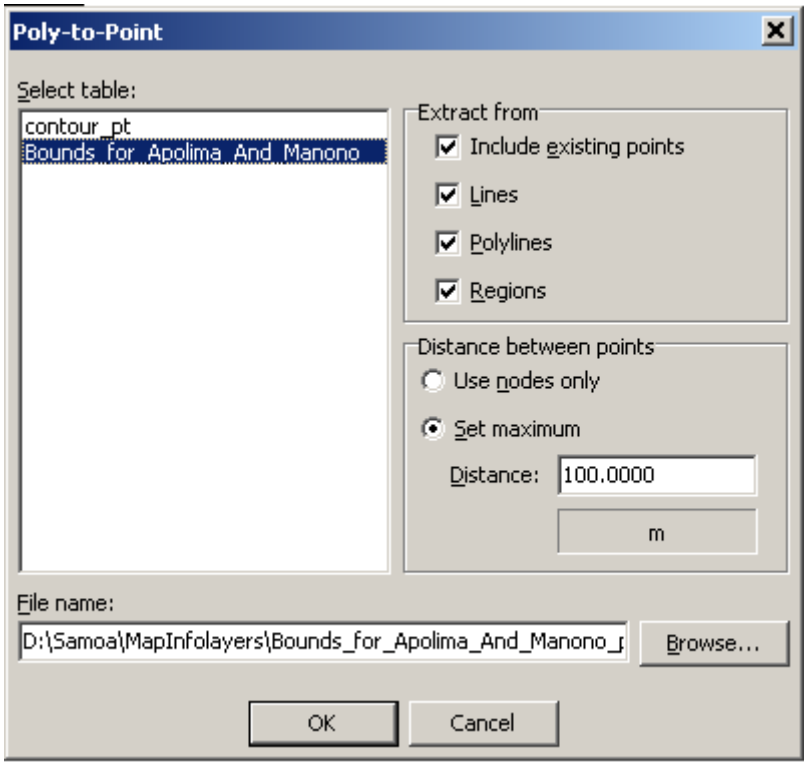
Vertical Mapper requires all input datasets to be points, contained in a single file. You will need to convert each layer to points and then combine these into single TAB file.

Typically, you will need to combine the following datasets:

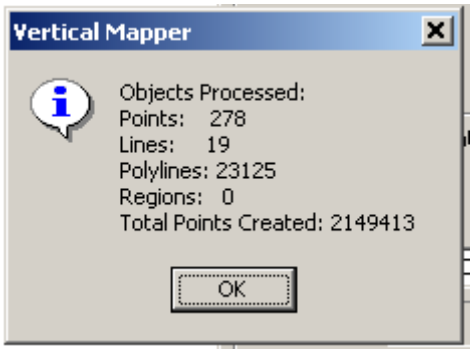
- Contour layer
- Spot heights
- Coastline (generally you will need to exclude any reefs etc).

Each layer will need to be converted from Region, Polyline and Polygon to points and then combined. The coast layer will need an elevation value added to it (zero).

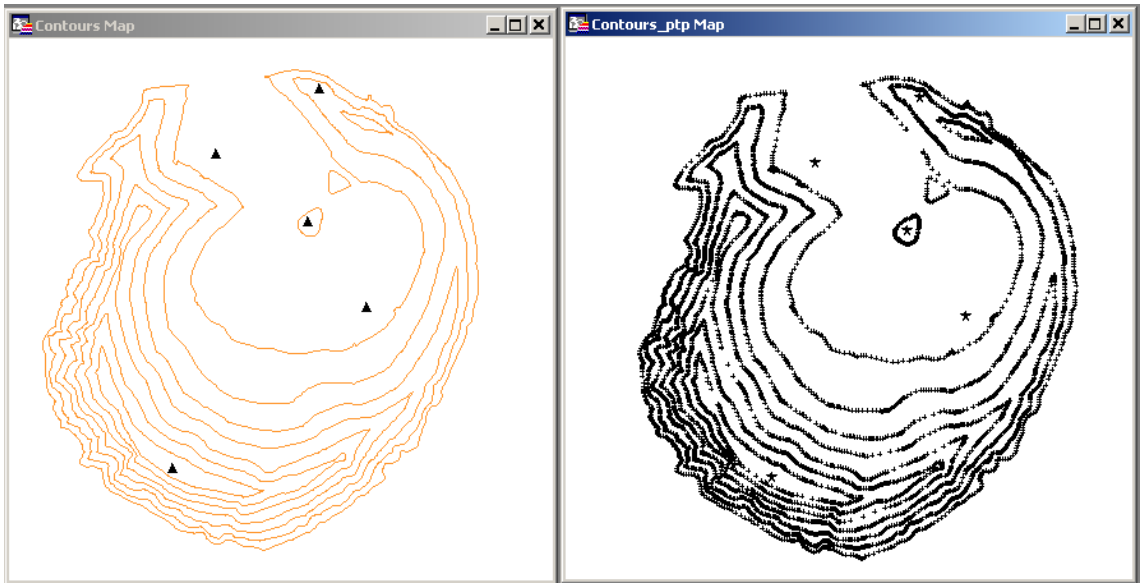
1. Select *Vertical Mapper*>*Create Grid*>*Poly-to-point…*
2. Select the layer you wish to convert. Generally you will want to include existing points, and all lines, polylines and regions in your dataset.
3. Specify the distance between points. Adding points between the nodes will generate a more detailed terrain especially where contours are straight.
4. Specify an output location.



Depending on the size of your dataset, this may take several minutes to process. Once completed, the following dialog will appear:



Below is an example of converted contour data before (left) and after (right).



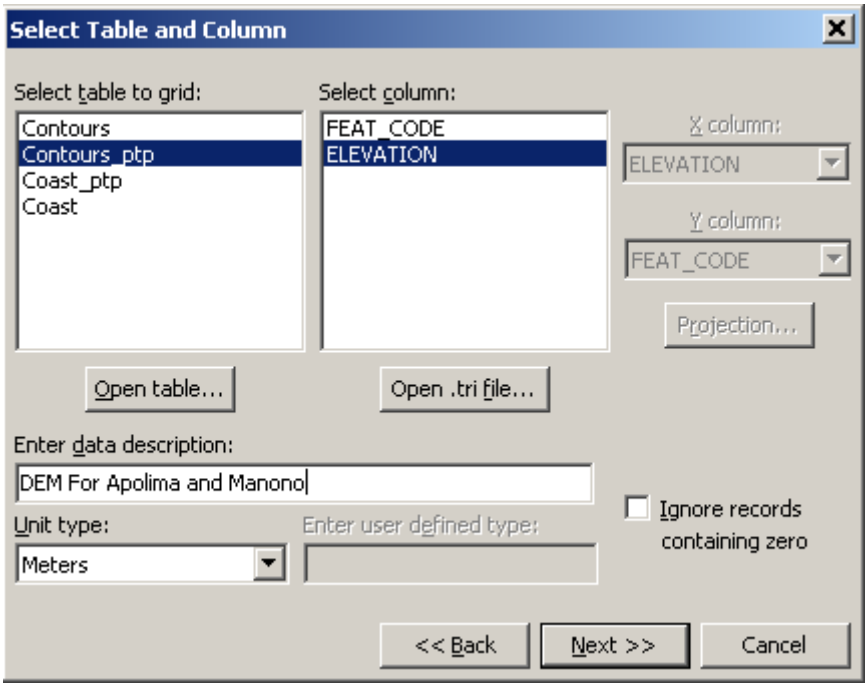
Combine Point Layers

Once each layer is converted to points you will need to combine each point layer together. You can do this using a copy and paste or by appending records to you table.

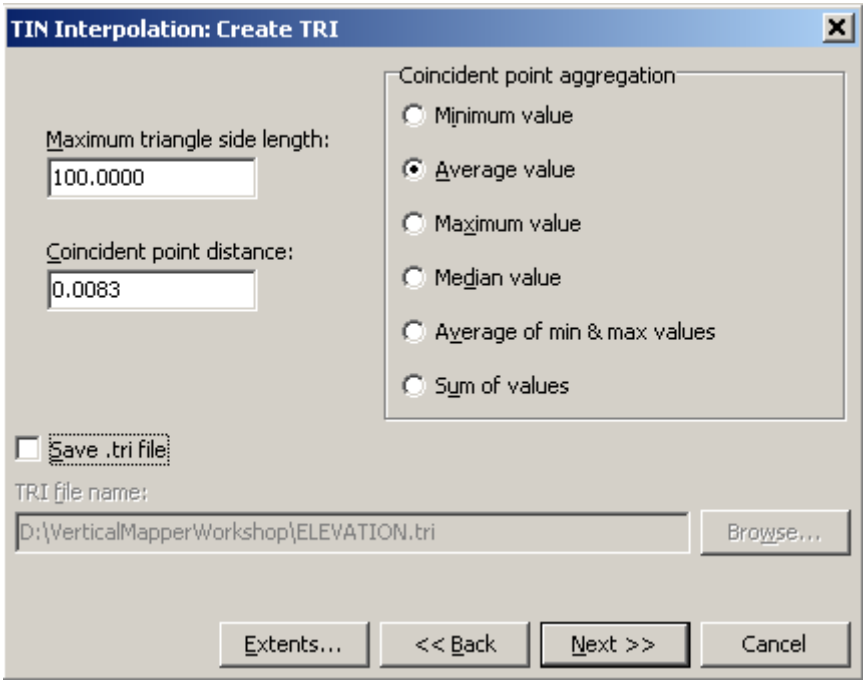
Create TIN Model

Once all the input points are prepared, you are ready to begin generating your grid model.

1. Select *Vertical Mapper*>*Create Grid*>*Interpolation…*
2. For elevation data, select *Triangulation with smoothing* and click *Next*.
3. Select your point table and specify its elevation column. Enter a data description and specify the units for height. Click *Next*.



4. Enter the details for your TRI file. Again, for elevation data use the average value. You may wish to reduce your maximum triangle size by reducing the side length. This will reduce the number of sliver polygons where data from points far apart is joined in the TIN model. More details on this can be found in the Vertical Mapper online help file. The coincident point distance can be left at its default value. Click *Next*. It may take several minutes to process to the next step.

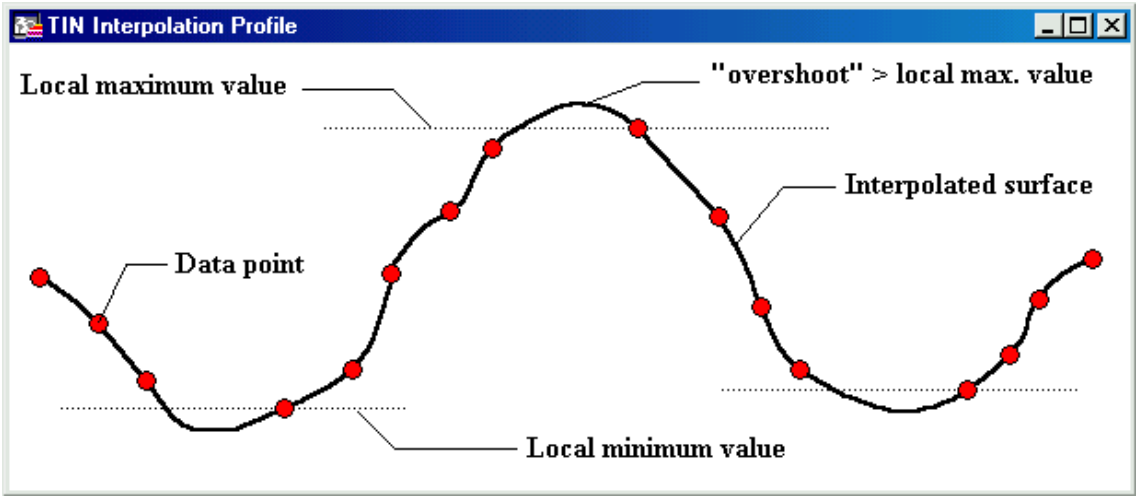


Vertical Mapper has now created the TIN file. You now need to covert the TIN to a grid file so it can be used inside Vertical Mapper and MapInfo.

Create Grid

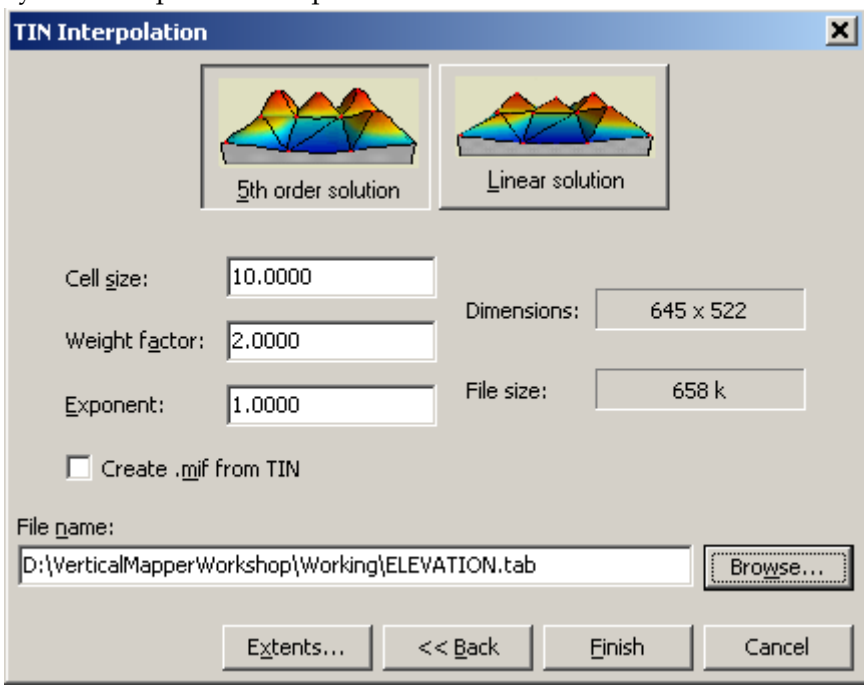
Vertical Mapper can create two types of grid file:

- Fifth order solution – (see below) flat areas and steep terrain is smoothed and rounded.



- Linear solution – straight lines are used to connect points together.

1. Specify a methodology (either 5th order or Linear)
2. Enter a *Cell size*. Note the effect changing the grid cell size has on the dimensions and particularly the file size. Halving the grid size produces a file four times larger.
3. Tick the box to create a .mif file of your TIN. This allows you to view your TIN file as a wire frame within MapInfo. Vertical Mapper will save this as a MID/MIF file that you can import into MapInfo.



4. Click *Finish*. The processing of the TIN may take several hours for a 10m grid for all of Samoa.

Using the resizer

The resizer allows the re-specifying of the cell size of the grid. This will not make your grid more accurate, and generally increasing the grid size using the resizer does not improve its accuracy. However, you can use the resizer to create a less detailed file. This might be useful if a PC is having trouble displaying a large existing grid.

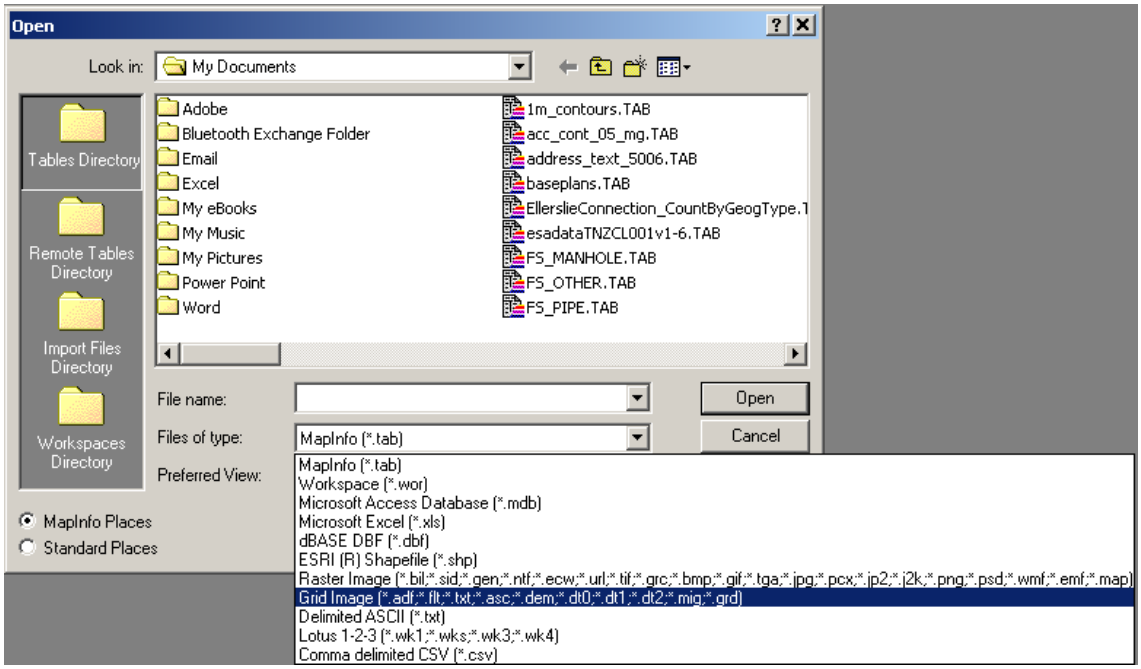
Grid Trim

Typically when the grid is created, a series of sliver polygons (narrow spiked triangles) will form across ocean areas. To tidy the grid you can trim it using a polygon object. Only the part of the grid inside the trimmed object will remain. In the case of Samoa, where you may want to retain the grid from within several islands, you will first need to combine all the relevant coastline polygons. To use grid trim:

Select the *grid trim* icon  from the Vertical Mapper tool bar. Click on the polygon you wish to trim with.

Opening your file in MapInfo

Once you have created your grid in Vertical Mapper you can open it on any MapInfo desktop even if it does not have Vertical Mapper installed. To open your grid file use *File>Open* and select *Files of type: Grid Image*. Vertical Mapper will have created a .grd file.



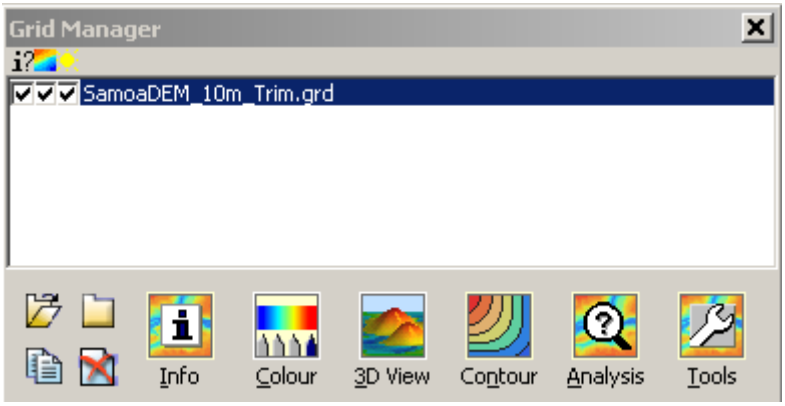
Once the file is opened in MapInfo you will be able to query the grid using the MapInfo Info tool.

Using A DEM

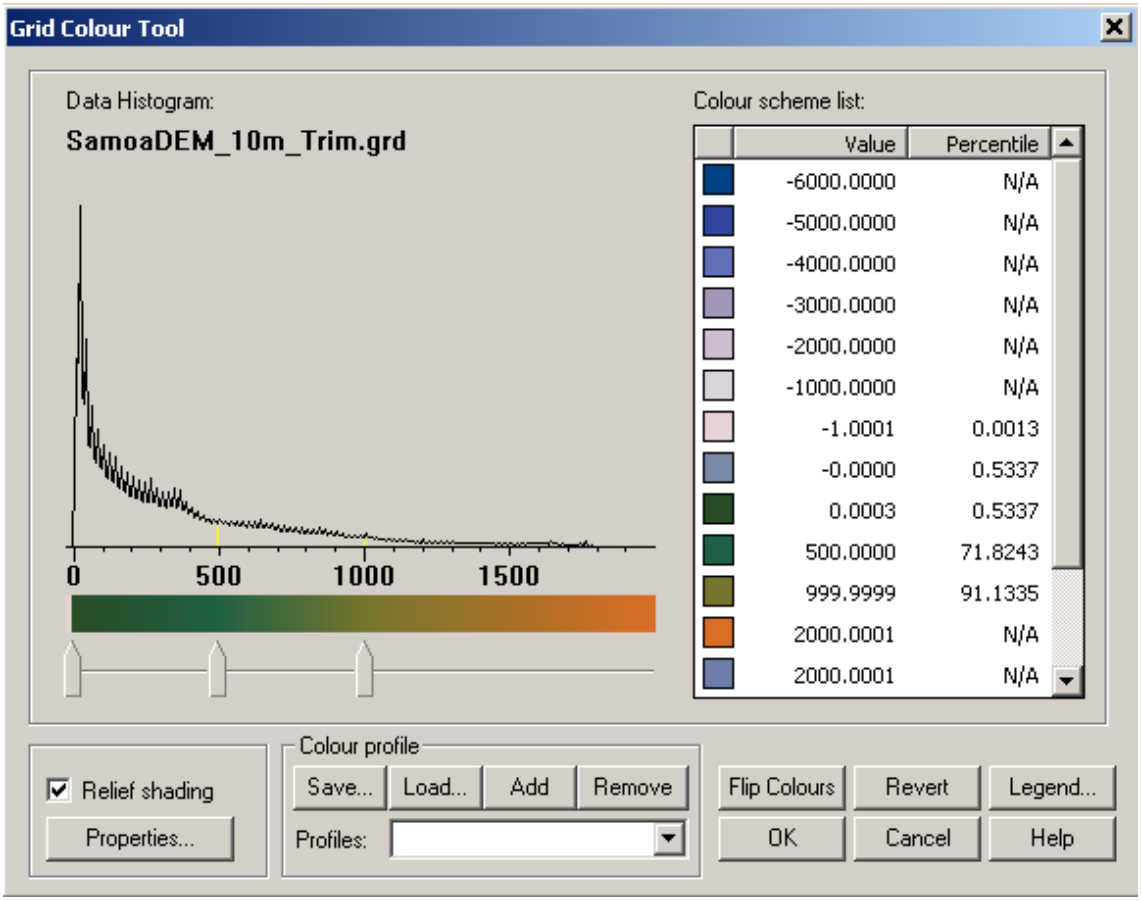
This section will describe how the grid can be used within Vertical Mapper and MapInfo.

Colour Ramps And Relief Shading

To get a more natural colour scheme you may wish to adjust the colours using Vertical Mapper:

1. Open the Vertical Mapper *Grid Manager* by clicking on 
2. The following dialog will display. Select your grid and click the *Colour* button.
3. 

4. Load colour profiles by pressing the load button. These are usually stored under *C:\Programe Files\MapInfo\Professional\vm\Colour Profiles*. You will also find a PDF file *Catalogue1.PDF* that outlines the different colour options.
5. Turn on relief shading to further highlight the changes in terrain.
6. Under properties specify the sun angle to 345 degrees (North West).
7. Click *Ok*.



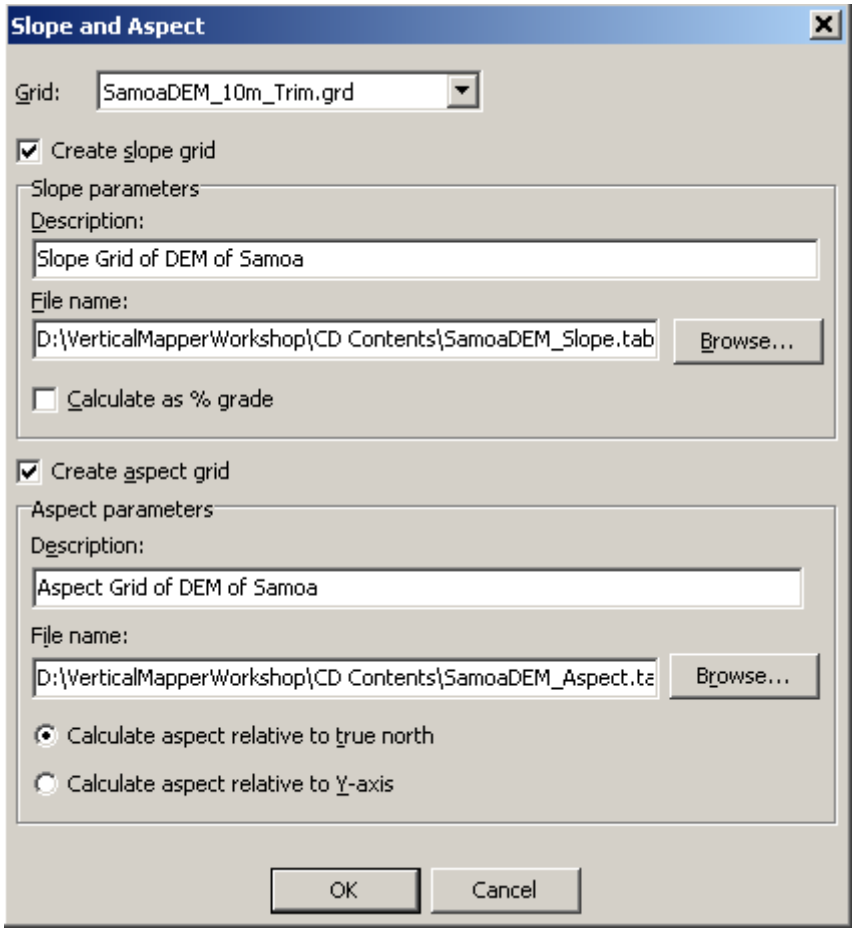
Creating Slope And Aspect

Creating a slope and aspect for the DEM data will allow further analysis of the terrain.

Click on the *Analysis* button in the *grid manager.*

Select *Create Slope and Aspect* from the menu.

The dialog below will appear. Select the relevant grid types and file locations and click *Ok*.



As with the DEM itself you can now alter the colour profile for the aspect and slope grids. These grids can also be opened and queried with MapInfo.

Analysing Grids Using Vertical Mapper

With these three grids you can perform a number of different analytical functions.

 The Vertical Mapper *Line Info* tool allows you to query the grid statistics of any line object. This is useful for calculating the slope of a proposed road etc.

 The cross section tool produces a cross-section graph for a polyline drawn with the tool.

You can analyse a table of points, lines or polygons using the tools under analysis. These tools will add columns to your tables to contain height, slope and aspect data from the grid surface.

Analysing Grids In MapInfo

Simple analysis is possible using the MapInfo *info* tool to query the values for grids.