Appendix A: User guide for the Hillslope Model

Hillslope Hydrology Model

The accompanying CD-ROM contains the hillslope hydrology model produced during the Mawddach research project. This software is still under development and has not yet been released for general use.

The disc includes data files for four sub-catchments of the Mawddach river system:

- The Alltlwyd reach of the Afon Mawddach
- The Oernant reach of the Afon Gain
- The Pistyll Cain reach of the Afon Gain
- The Afon Gamlan at Cefn Cam.

Rainfall obtained from the MM5 meteorological model is included for two periods of flooding on the Mawddach:

- 1-4 February 2004
- 22-24 October 2005.

The accompanying notes describe the process of setting up and running a hillslope model of the Alltlwyd sub-catchment for the 1-4 February 2004 flood event. After carrying out this simulation, you may wish to experiment with models for the other sub-catchments and rainfall period.

Installation

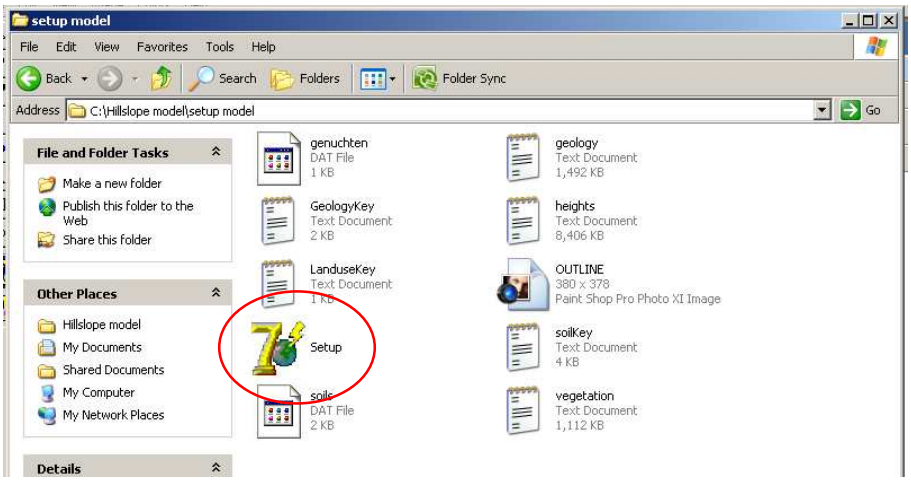
The CD-ROM disc contains the folder HILLSLOPE MODEL which should be copied to a suitable location on your computer. The root directory of the :C drive is recommended.

After use, the HILLSLOPE MODEL folder can simply be deleted – no changes will have been made to the computer configuration.

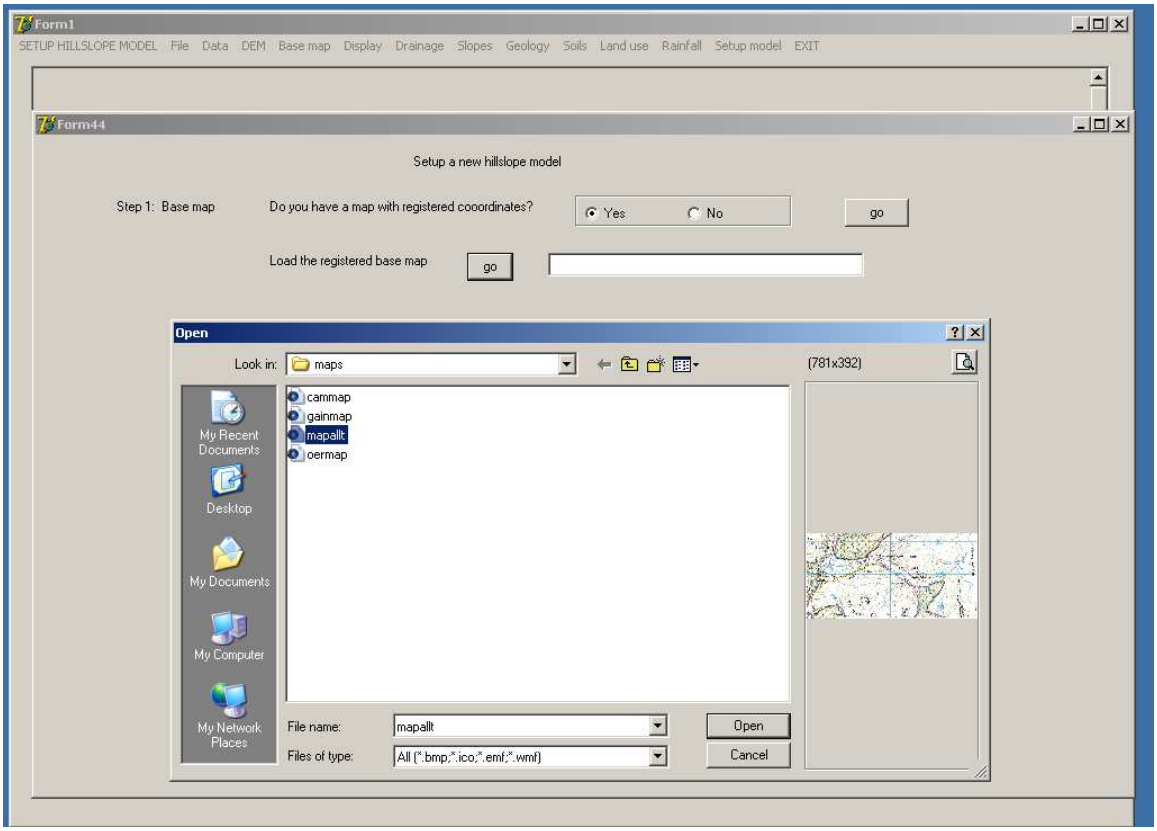
A minimum screen resolution of 1024 x 768 pixels is required to display the graphics.

Setup program

In this section, we will set up the PROJECT and INITIALISATION files which will be needed to run the Alltlwyd hillslope model.



Using the My Computer file manager, find the SETUP MODEL folder within the Hillslope Model folder.
Double-click the SETUP icon to start the program.



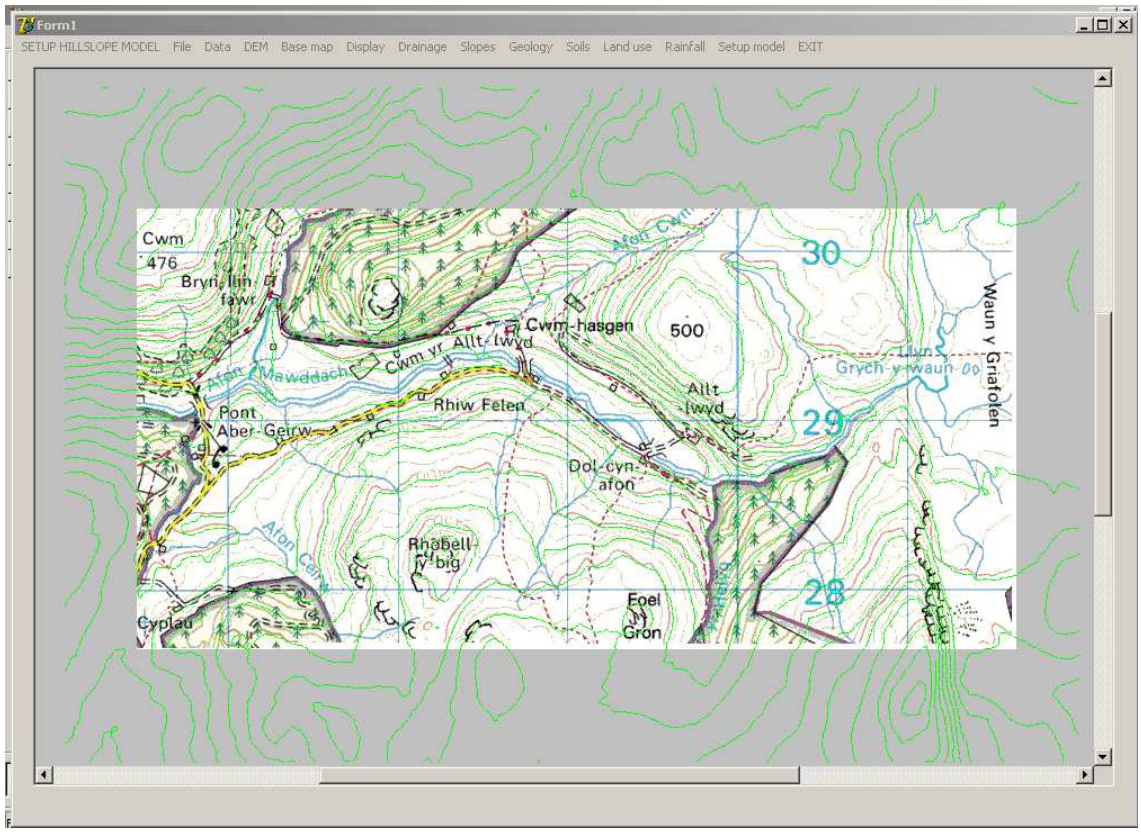
From the main menu, select the option SETUP HILLSLOPE MODEL. A dialog window will open which guides you through the steps of setting up the model.

At Step 1, select YES to indicate that you have a map file available. Click GO to load the map. You may need to navigate to the MAPS folder within HILLSLOPE MODEL.

Select the file **mapallt**, and click the OPEN button. An Ordnance survey base map for the Allt Lwyd valley will be loaded and displayed.

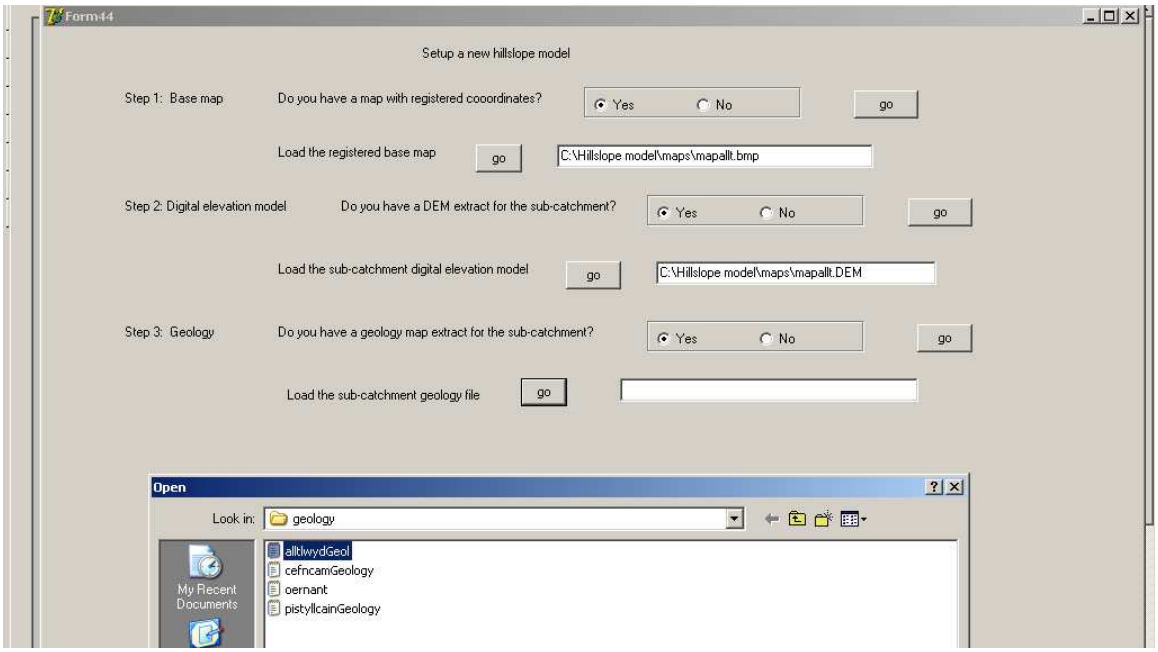
At Step 2, click YES to indicate that you have a sub-catchment digital elevation model available. Load the file **mapallt.DEM** from the MAPS folder.

The digital elevation model data will be loaded, and contours will be plotted to check the positioning of the DEM in relation to the base map.

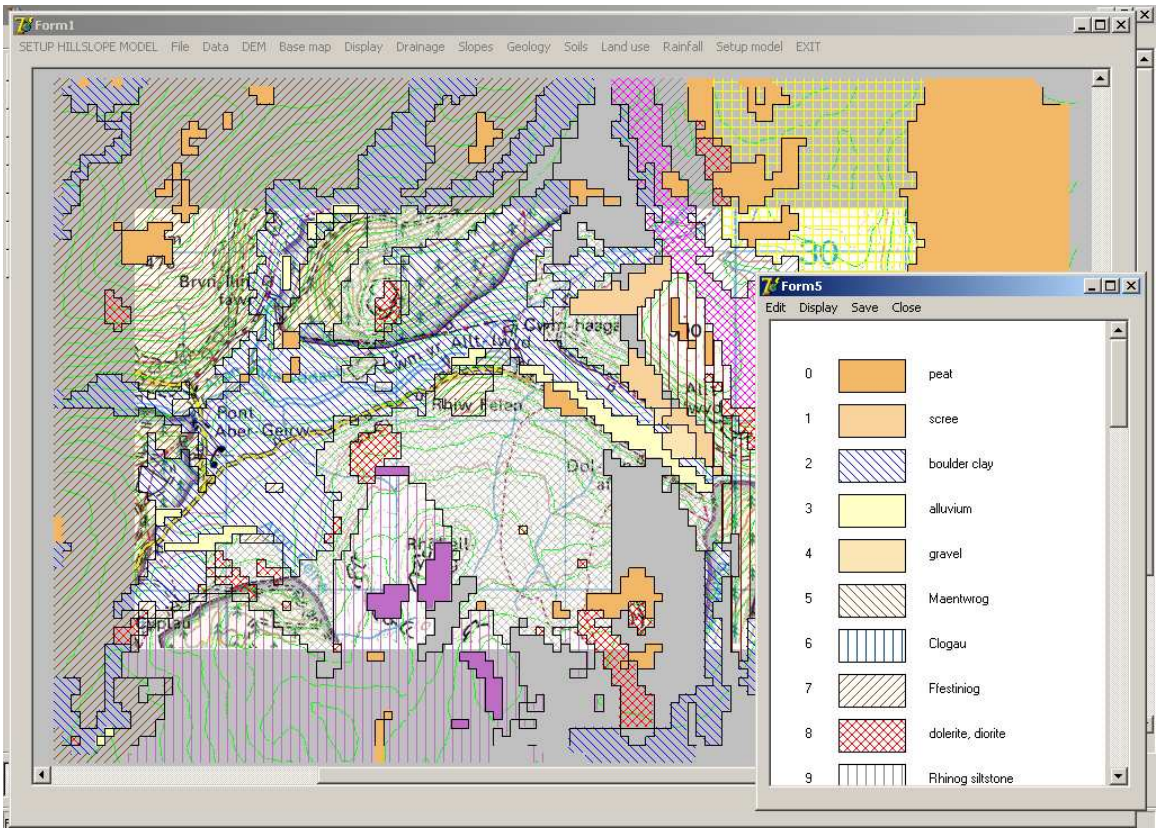


At Step 3, click YES to indicate that you have a geology data file available.

Select the file **alltlwydGeol** from the GEOLOGY sub-folder.

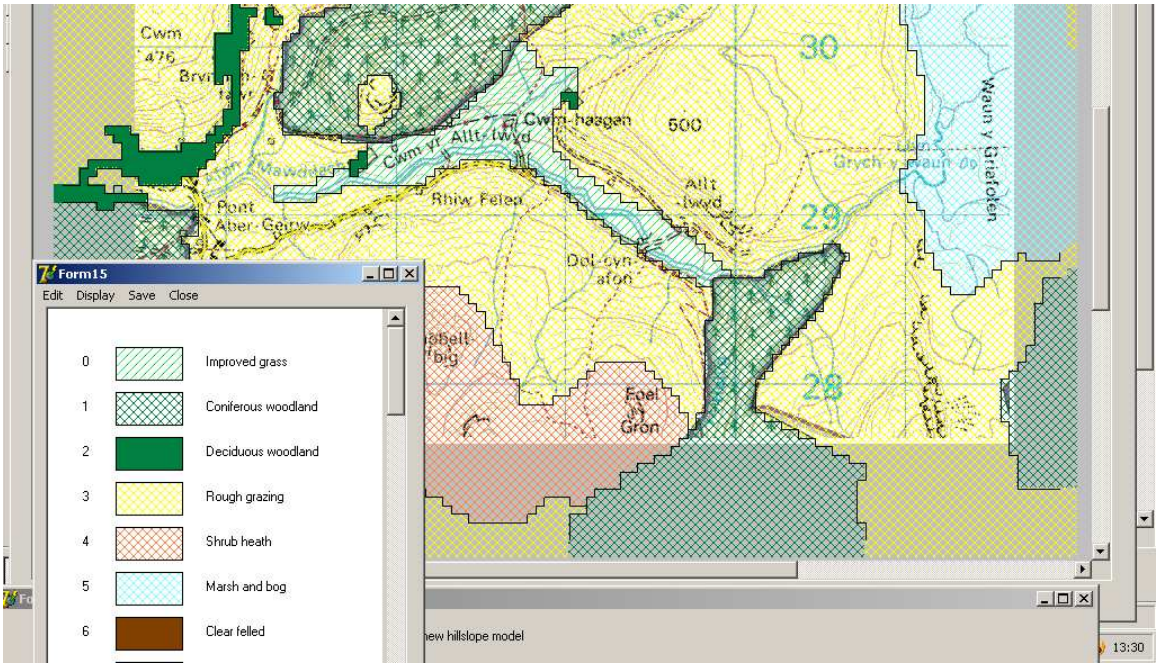


A digitised geological map will be loaded and displayed:



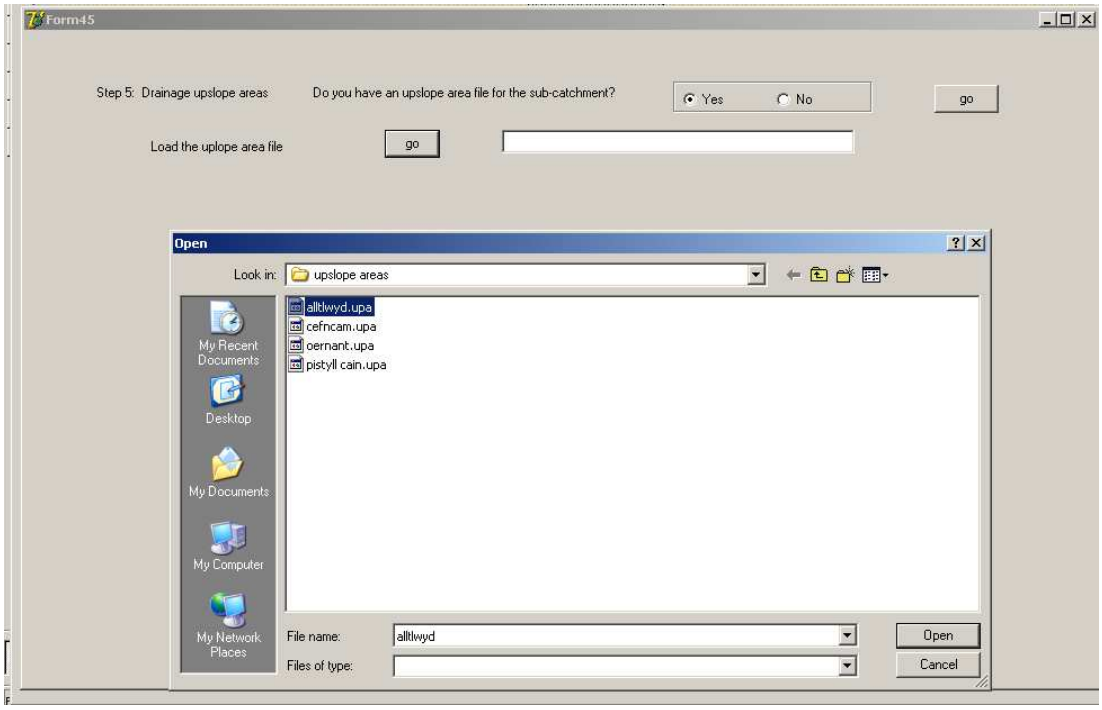
At Step 4, click YES to indicate that you have a land use data file available.

Select the file **alltlwydLanduse** from the LANDUSE sub-folder.

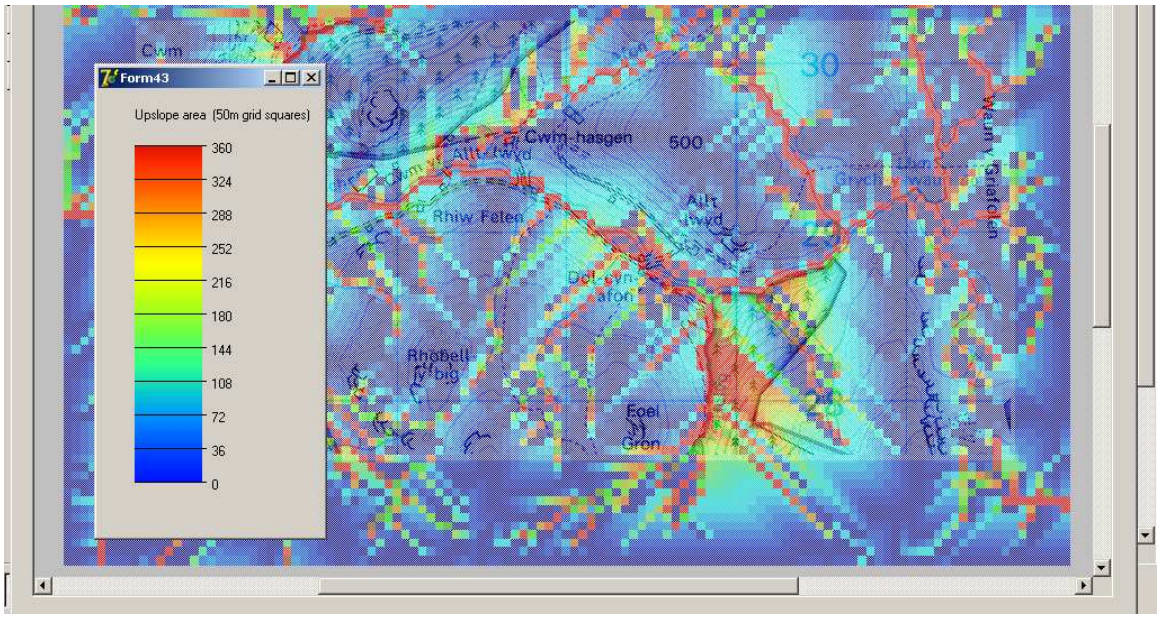


Click the CONTINUE button to move to the next screen.

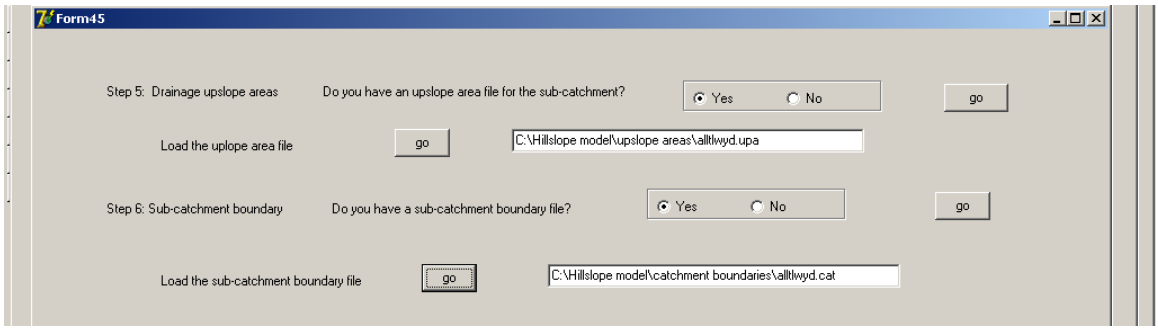
At Step 5, click YES to indicate that you have a file of upslope contributing drainage areas computed for the sub-catchment. Select the file **alltlwyd.upa** from the UPSLOPE AREAS folder.



An overlay of upslope areas will be added to the base map:

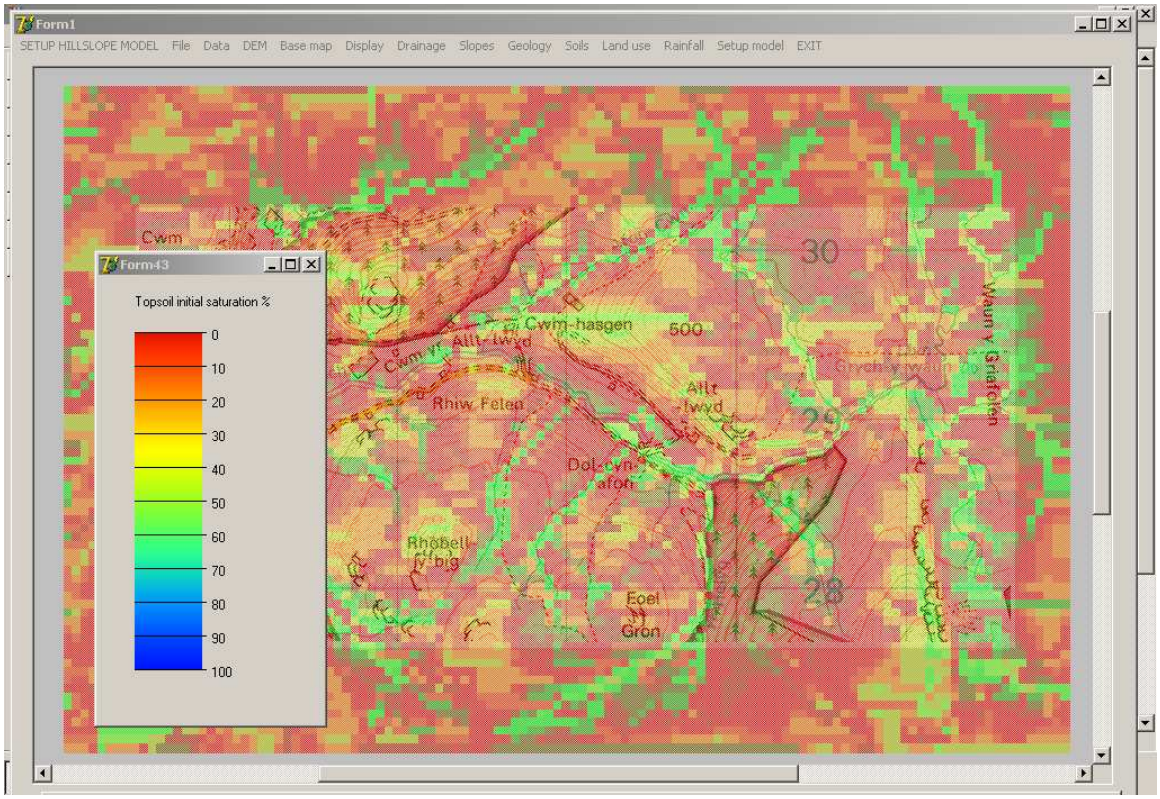


At Step 6, click YES to indicate that you have a catchment boundary file, then select the file **alltlwyd.cat** from the CATCHMENT BOUNDARIES folder.



The extent of the sub-catchment will be displayed on the base map.

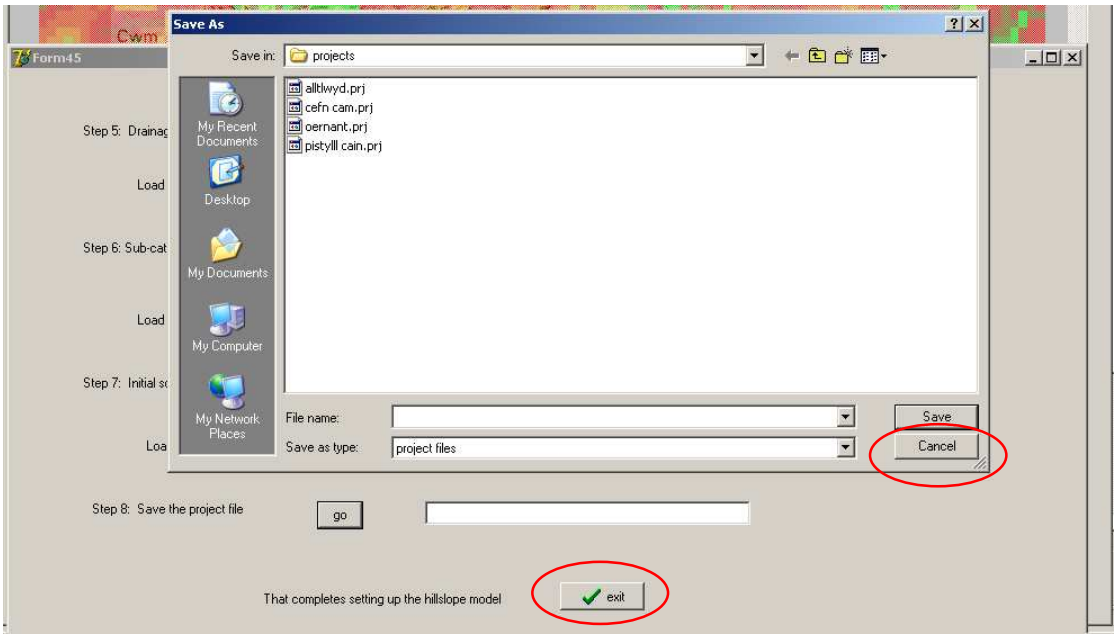
At Step 7, click YES to indicate that you have prepared a file of initial saturation data, and select the file **alltlwyd** from the SOIL SATURATION folder.



Values for initial soil saturation will be displayed.

This completes the preparation of catchment data, and at Step 8 you will be asked to save a project file.

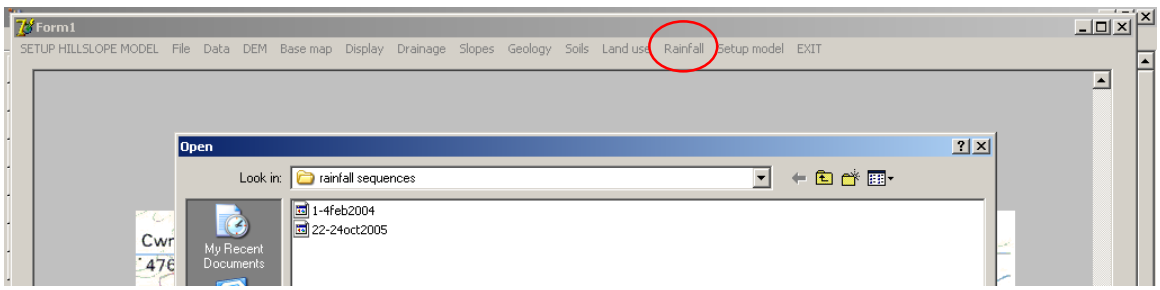
Project files have already been produced for the four example catchments, and are stored in the PROJECTS folder. You may click CANCEL to close the Save window, then click END to exit from the setup procedure.



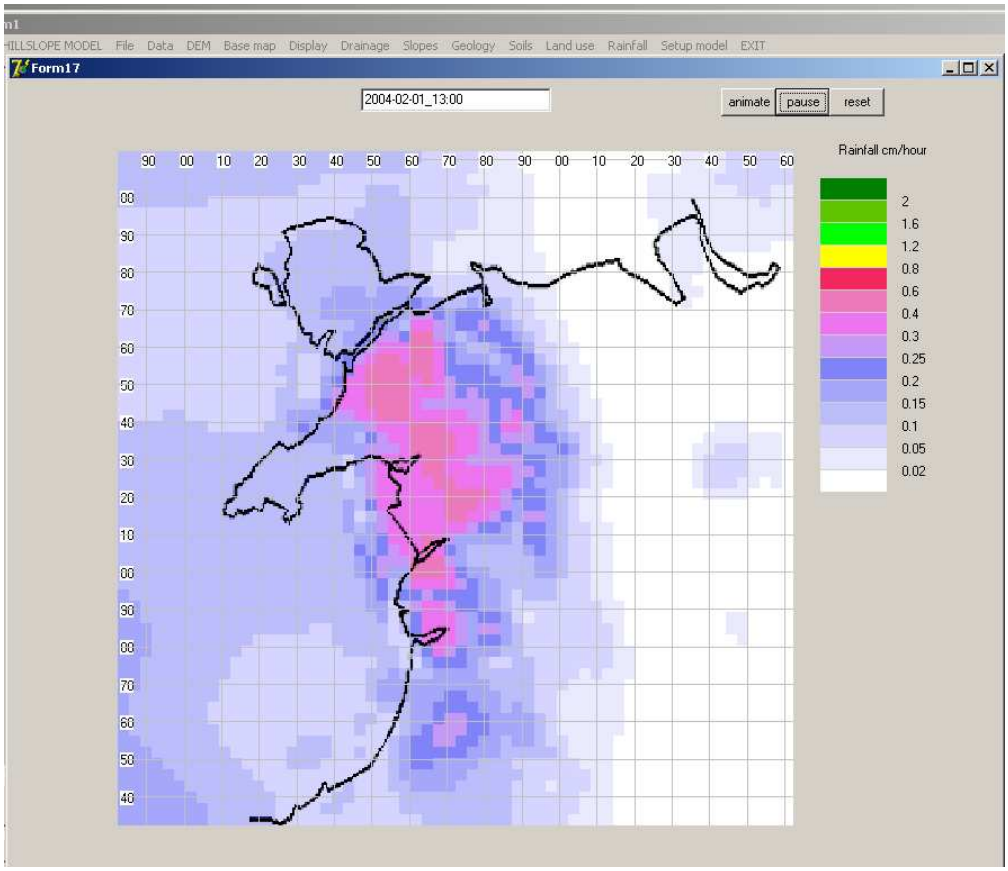
Now that the ground surface characteristics of the sub-catchment have been defined, the next process is to define a rainfall sequence for the hillslope hydrology simulation.

Click the main menu option **Rainfall / Load regional rainfall sequence**.

Select the file **1-4Feb2004**



An animation of the rainfall sequence can be run on a map of North Wales:

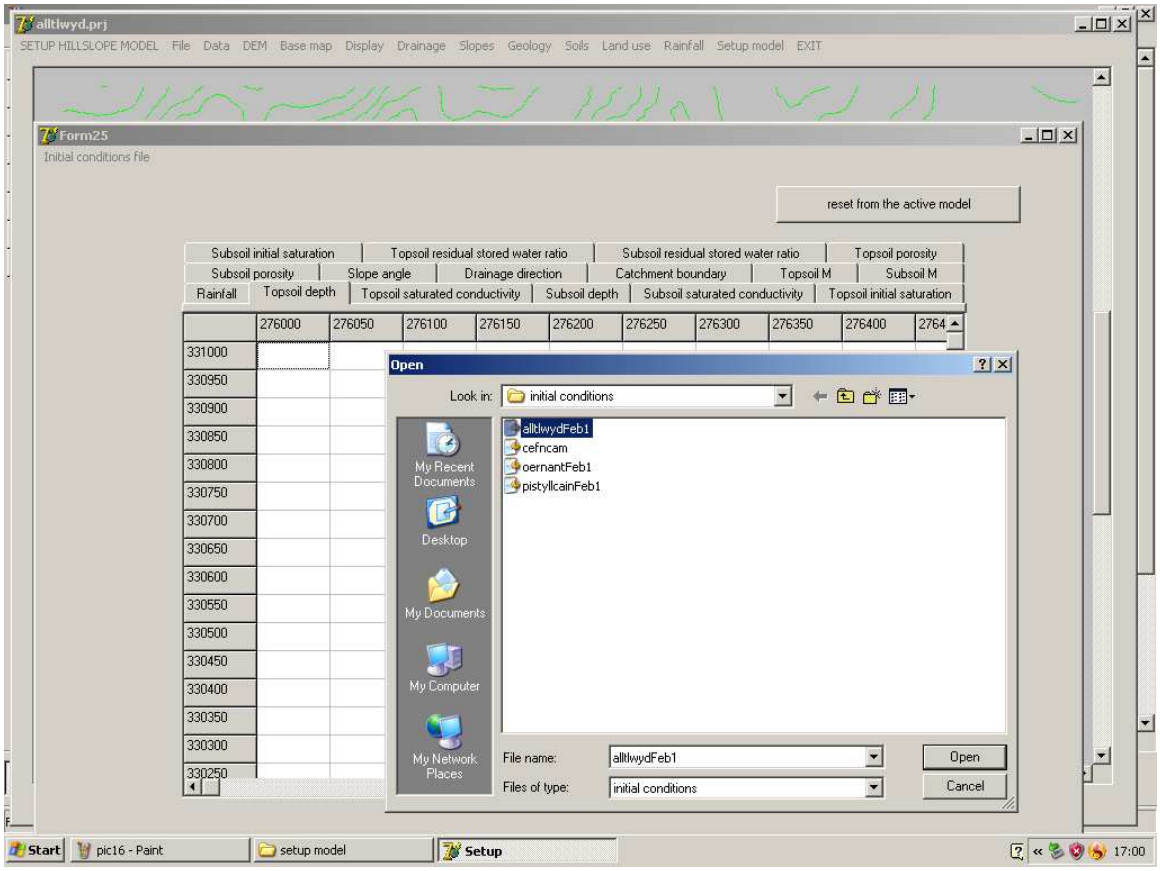


Close the rainfall display window after viewing the sequence.

The final stage in preparing the model is to set up an INITIALISATION file which combines the catchment surface characteristics with the rainfall sequence data.

Select the **Setup model** option from the main menu.

A grid will be displayed. Click **Initial conditions file** / **Load**, then select the file **alltlwydFeb1** from the INITIAL CONDITIONS folder:



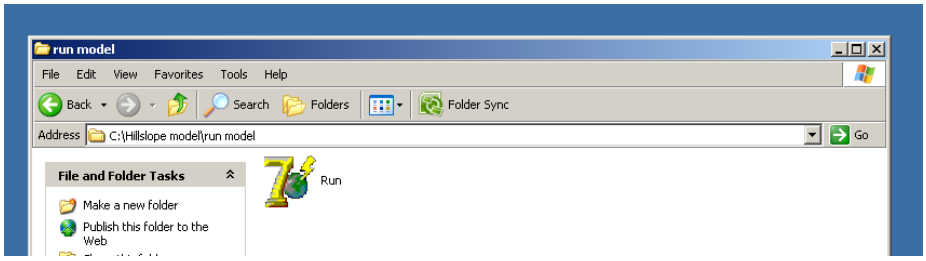
A previously saved initialisation file will be loaded, and parameters for each sub-catchment grid square are displayed.

Initialisation files have already been prepared for the February 2004 storm over the four sub-catchments, so there is no need to re-save any data at this stage

When first setting up a hillslope model, the initialisation file is created from this screen by clicking the **reset from active model** button with each tab selected in turn. Data from previous pages will be transferred to the grids and may then be saved.

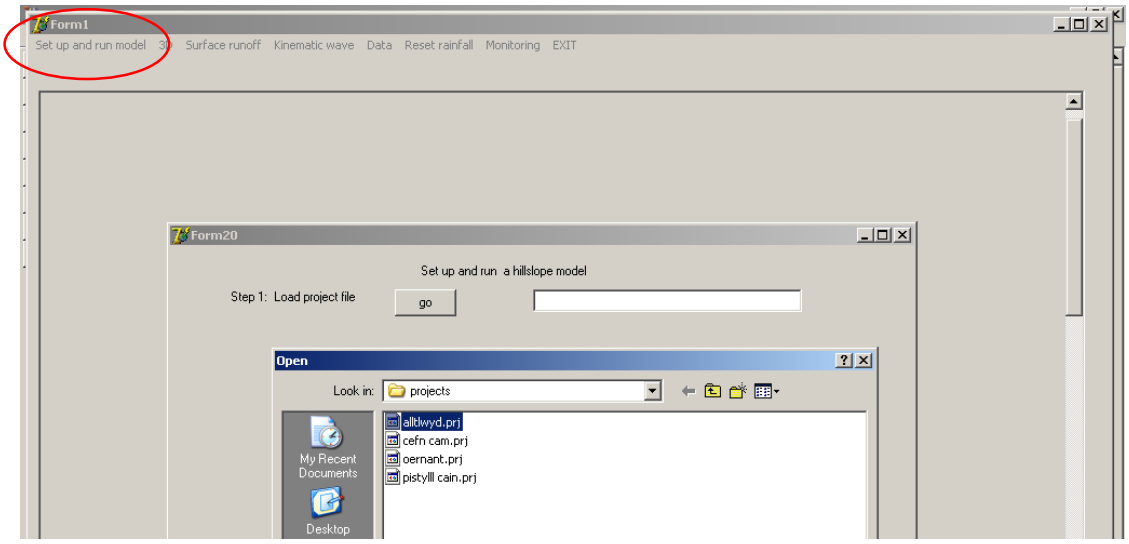
Running the model

Go to the RUN sub-folder in the HILLSLOPE directory. The model may be run by double-clicking the Run icon:



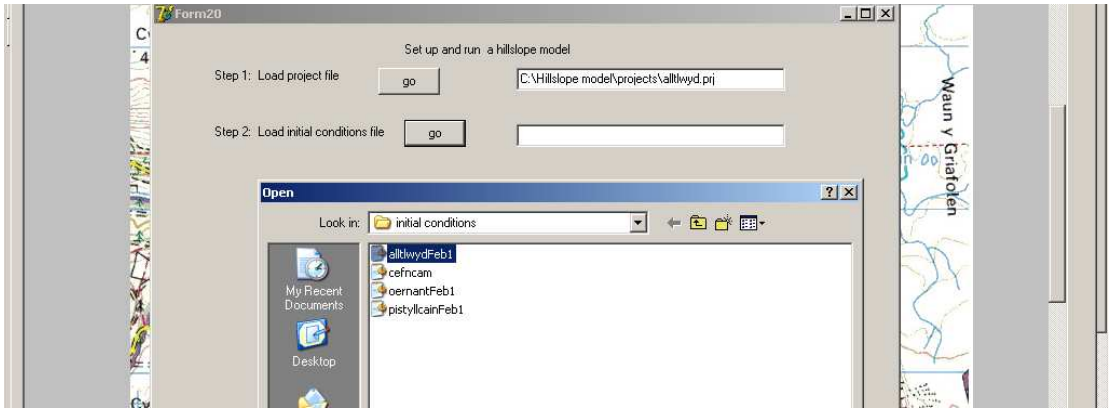
Select the option **Set up and run model** from the main menu.

A dialog window appears.

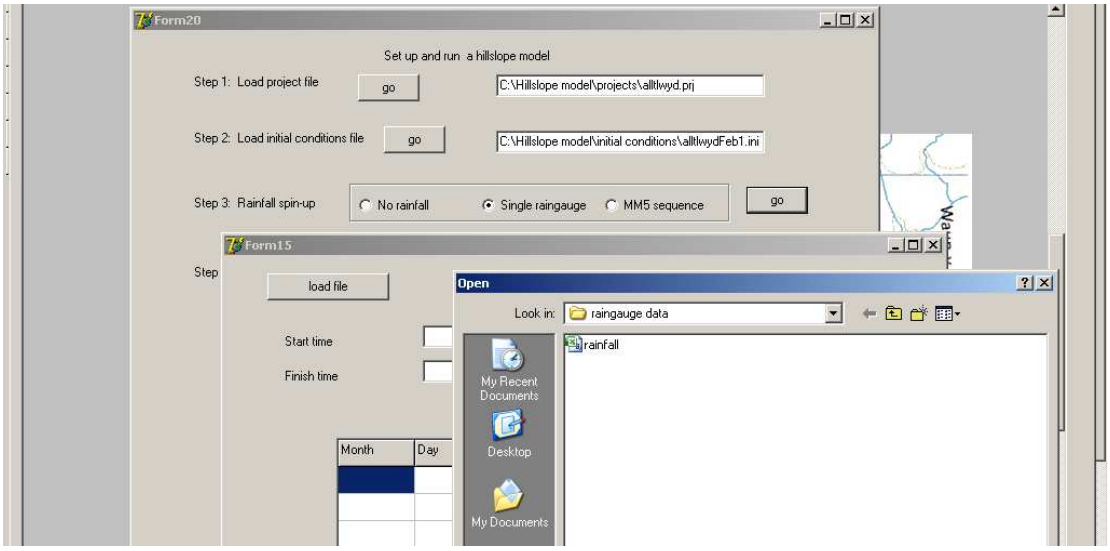


At Step 1, click GO and select the project file **alltlwyd.prj** from the PROJECTS sub-folder.

At Step 2, click GO and select the initialisation file **alltlwydFeb1.ini** from the INITIAL CONDITIONS sub-folder:



When the model is run, it is necessary to provide a spin-up period during which the soil moisture levels and water flows stabilise prior to the storm simulation. Step 3 provides options for spin-up:

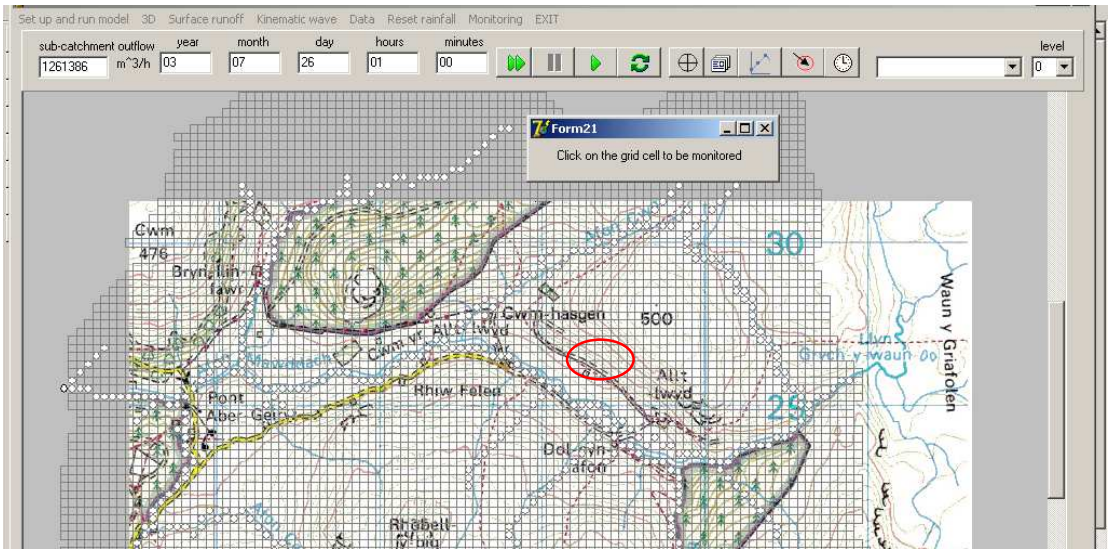


We will select the option to spin-up using data for a single raingauge. Select **Single raingauge** and click GO. A window opens to display a rainfall sequence.

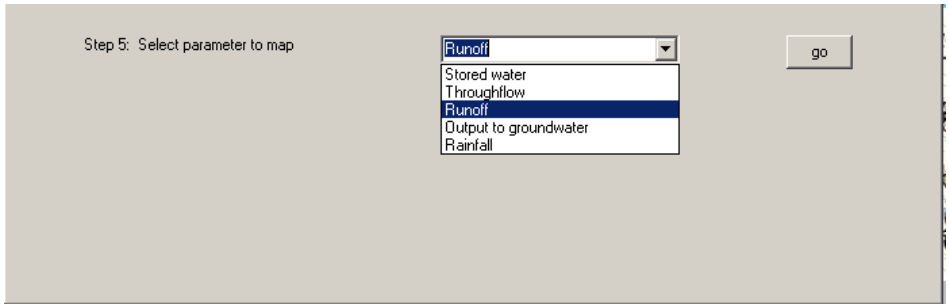
Click **load file**, then select the file **rainfall** from the RAINGAUGE DATA sub-folder.

At Step 4, a grid cell can be selected for water flow monitoring during the hillslope simulation. Click YES and GO. The Base map will be displayed with a grid overlay.

Click on a grid square on the hillside between Cwm-hasgen and Allt Lwyd.

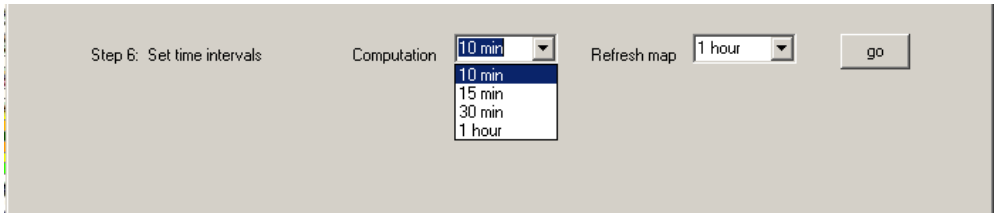


At Step 5, you may choose a parameter to map during the simulation. Select **Runoff**.



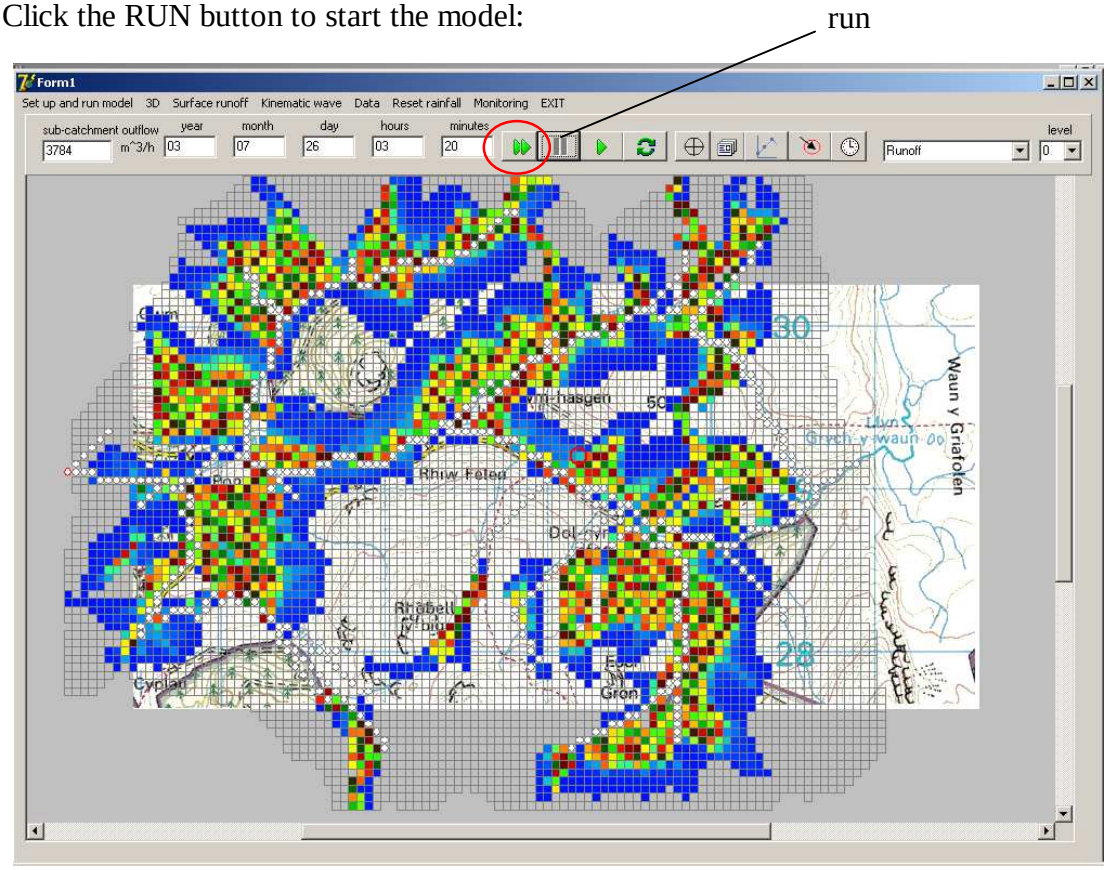
At Step 6, intervals are set for the calculation time step and the map refresh rate.

Select a **10min** calculation interval and a **1 hour** map refresh interval.



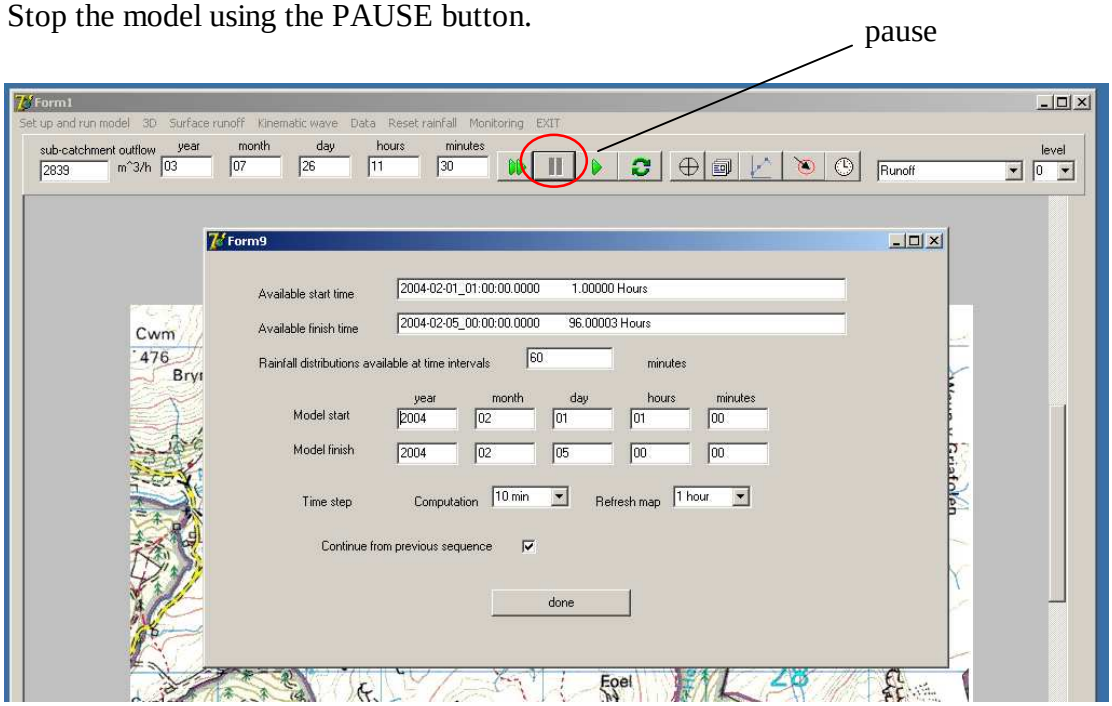
Click the button commence model spin-up.

Click the RUN button to start the model:



Allow the model to run for several days until the pattern of surface runoff has stabilised to a low level, shown by darker blue colours on the map display.

Stop the model using the PAUSE button.



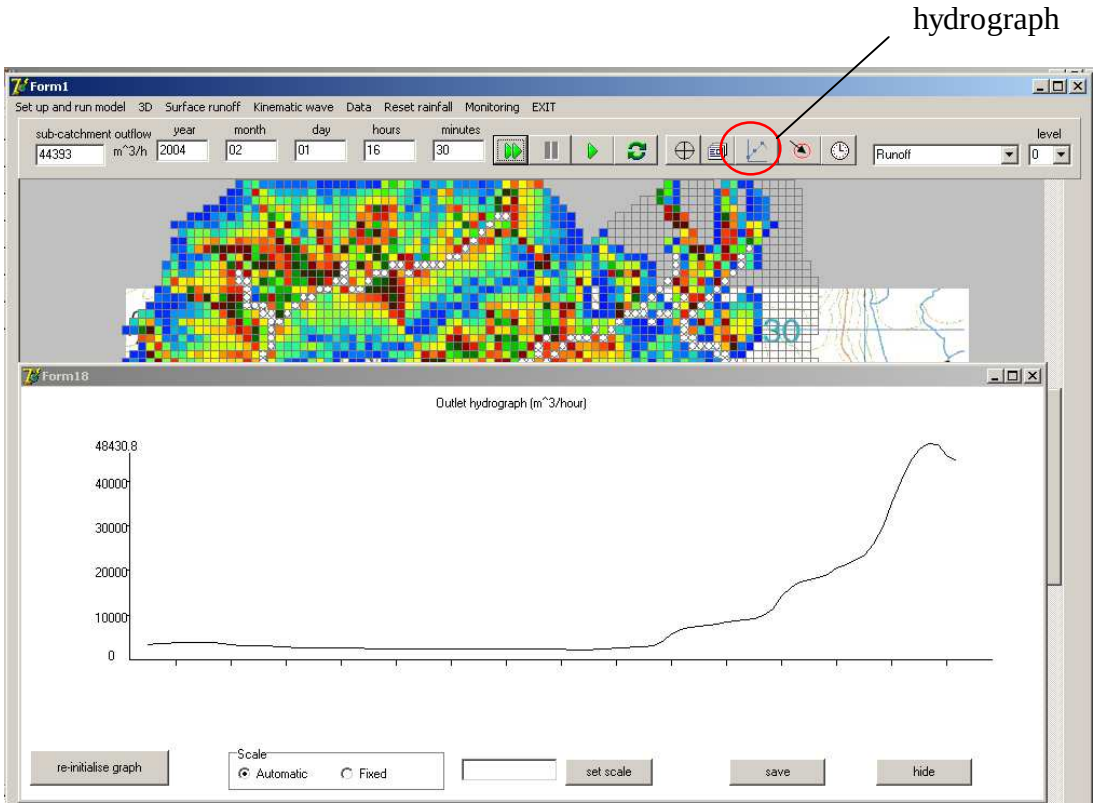
Select the main menu option **Reset rainfall / MM5**. A window opens to confirm the rainfall sequence contained in the initialisation file. Click DONE to continue.

The model can now be run for the February 2004 flood event. Run the model.

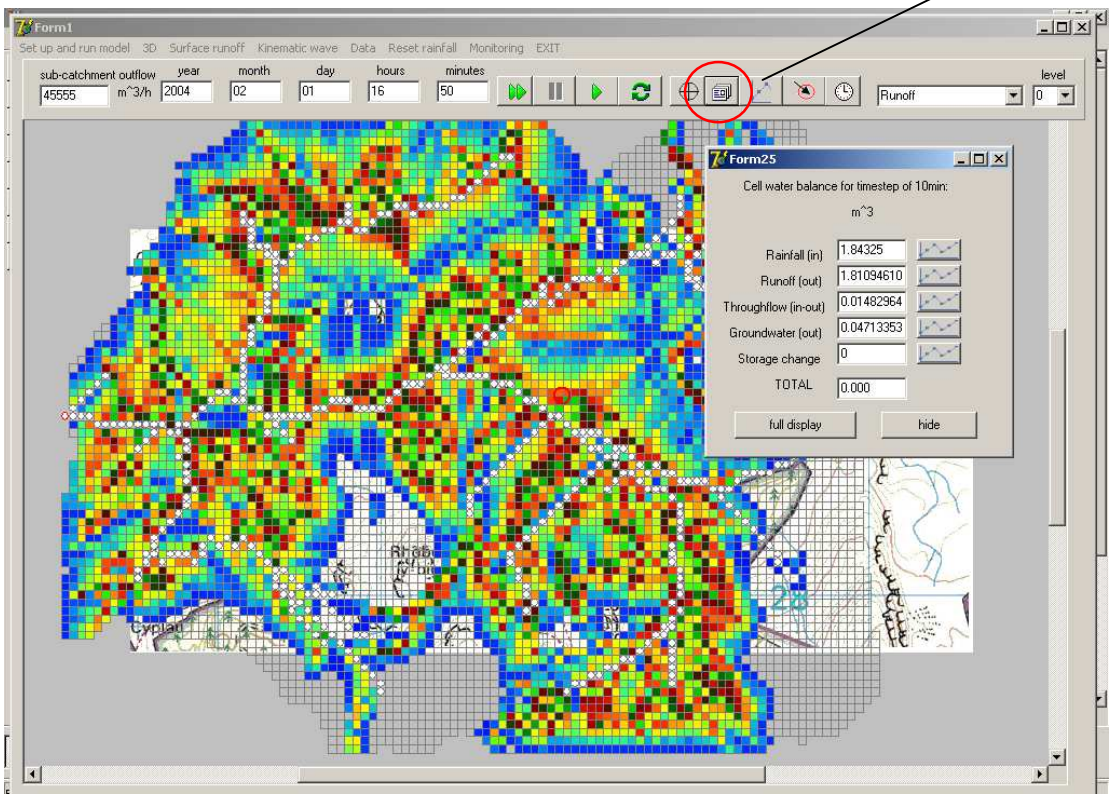
Various display options are available during and after the run:

A hydrograph for the subcatchment contribution at the outlet point can be plotted.

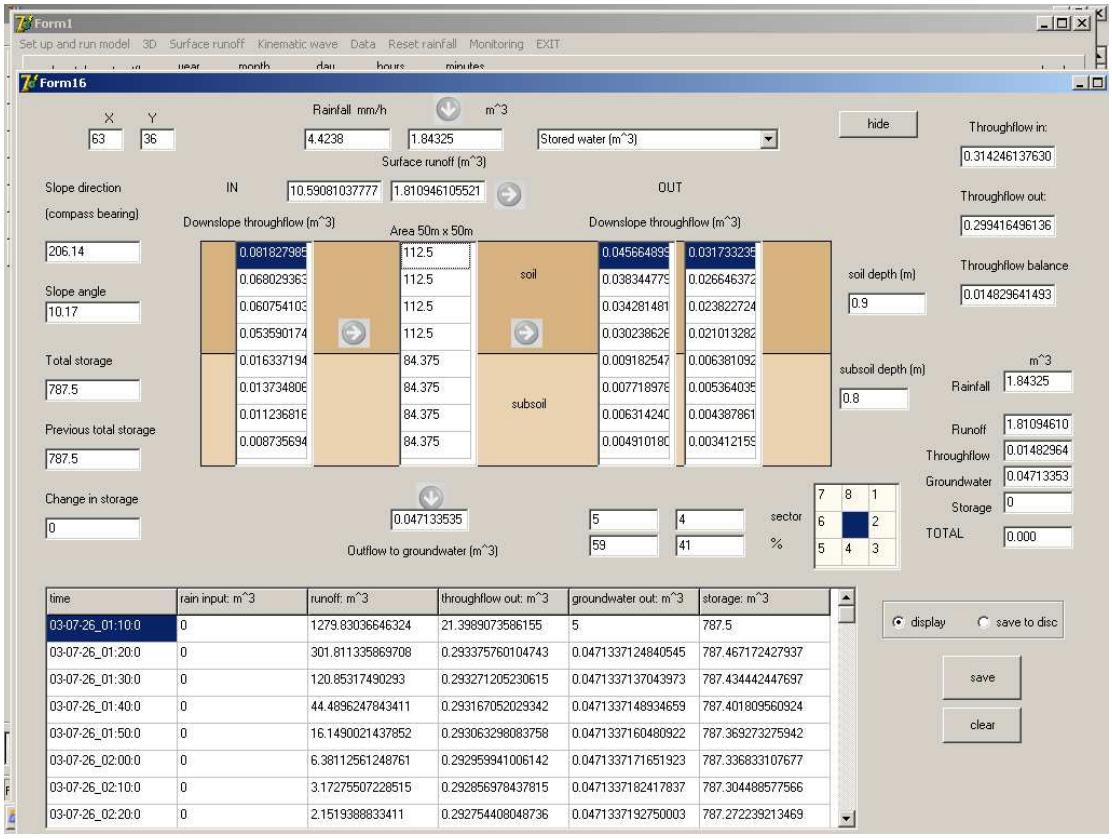
Click the hydrograph button to open a display window:



The selected grid square can be monitored by clicking the display button:



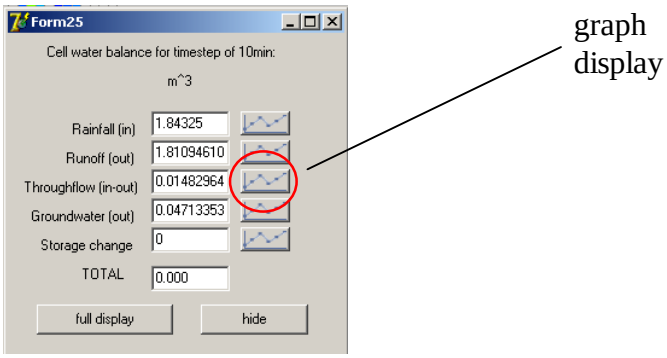
The initial display summarises the water balance for the grid square. A fully detailed analysis of the hillslope calculations is available by clicking the **full display** button.

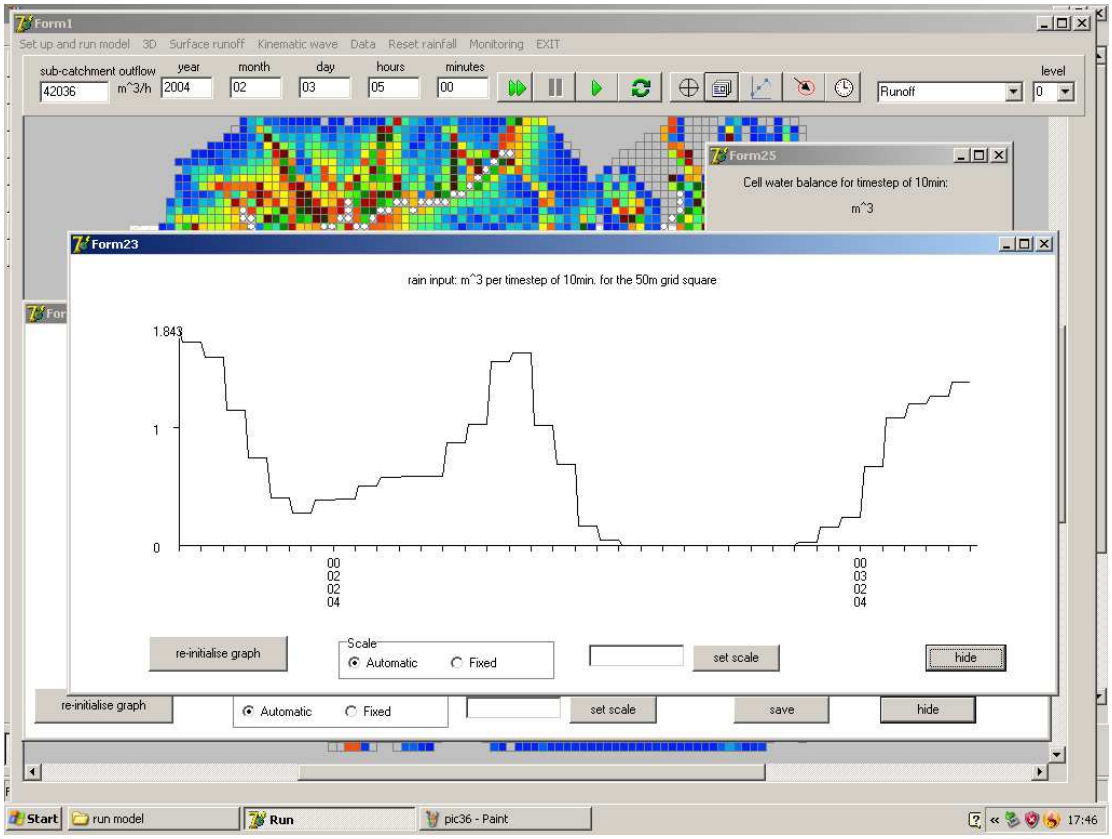


Close the display screen to return to the sub-catchment map.

The parameter displayed as a map overlay can be selected from a drop down menu at the top right of the screen. Available options include throughflow and loss to groundwater storage.

Graphs may be plotted for parameters monitored at the selected grid square. Click the graph icon to the right of the parameter:




Form1
Set up and run model 3D Surface runoff Kinematic wave Data Reset rainfall Monitoring EXIT
sub-catchment outflow
42036
m^3/h
year
2004
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Runoff
Form25
Cell water balance for timestep of 10min:
m^3
Form23
rain input: m^3 per timestep of 10min. for the 50m grid square
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re-initialise graph
Scale
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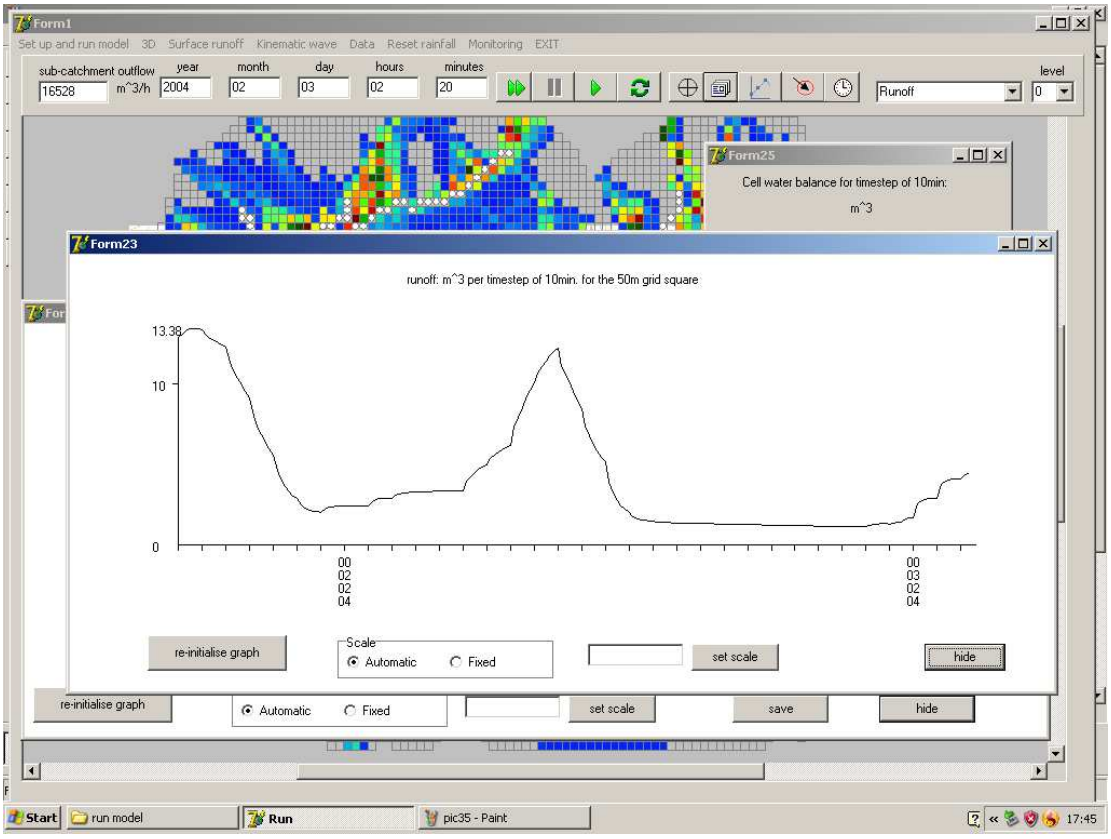
17:46


Form1
Set up and run model 3D Surface runoff Kinematic wave Data Reset rainfall Monitoring EXIT
sub-catchment outflow
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month
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Cell water balance for timestep of 10min:
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Start
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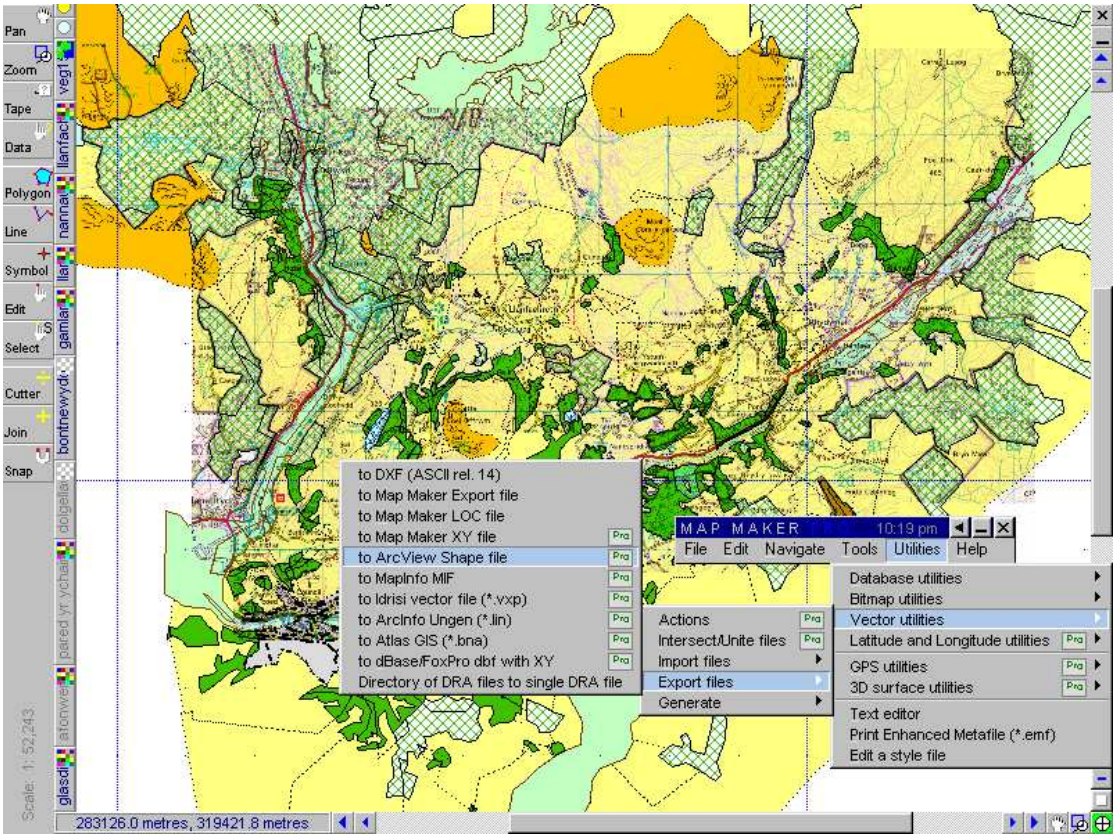
Run
pic35 - Paint
17:45

Preparing gridded geology and vegetation data

Geology and vegetation map data is prepared for use in the hillslope model by means of the software packages **Mapmaker** and **SagaGIS**.

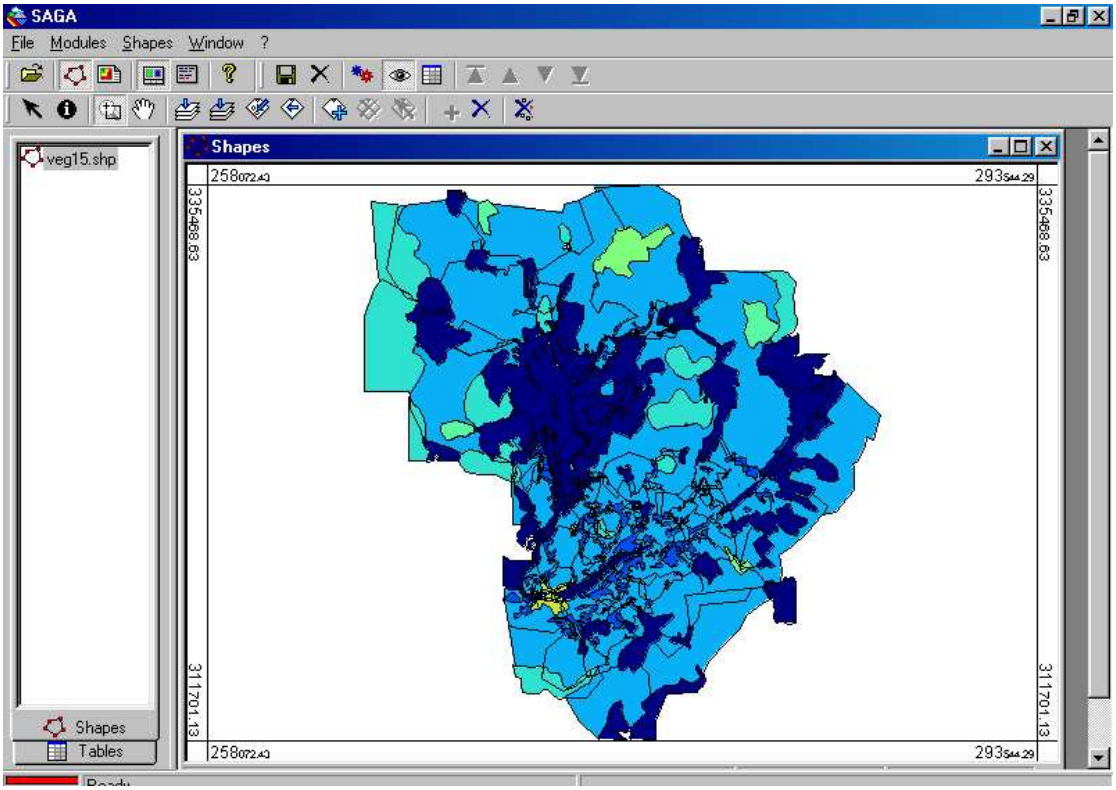
The map is traced from a scanned map image and saved as an Arcview shapefile using Mapmaker.



The Mawddach vegetation map, plotted as vector shapes in Mapmaker and ready for export in Arc View format

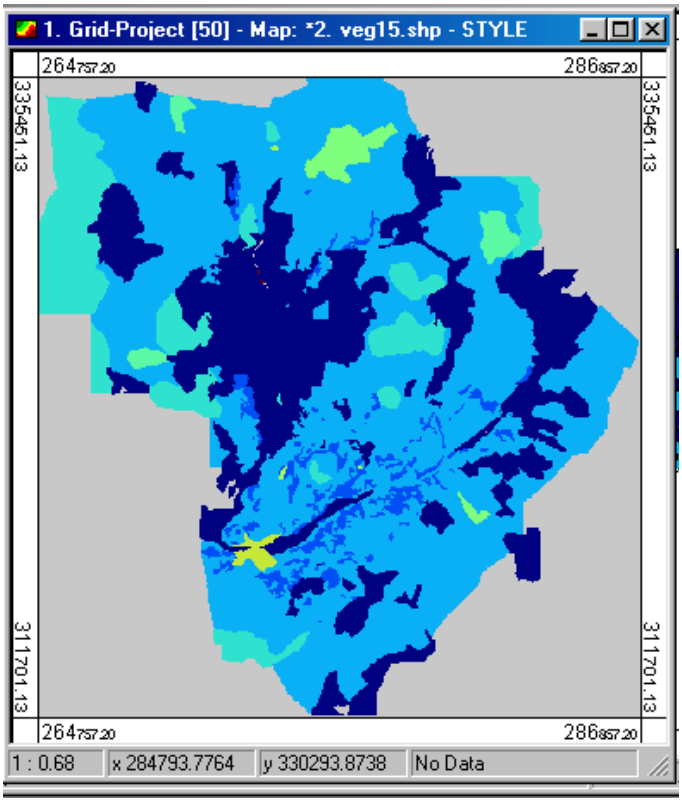
Shapes are assigned styles in Mapmaker, corresponding to geological formations or vegetation classes within the model. The style data is retained by saving a database file along with the shape file.

The shape file and its accompanying database table are loaded in the SagaGIS program.



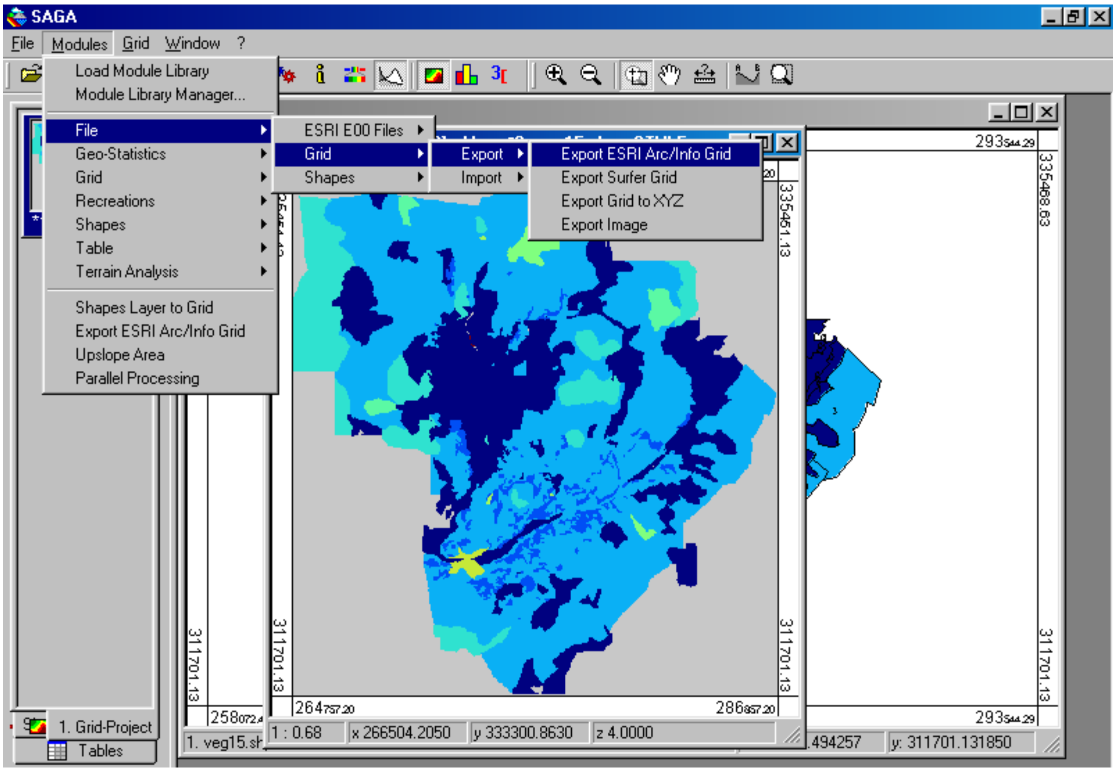
Vector shape data for the Mawddach vegetation map displayed in SagaGIS

The vector shape data is now converted to 50m gridded data using the gridding function with SagaGIS:

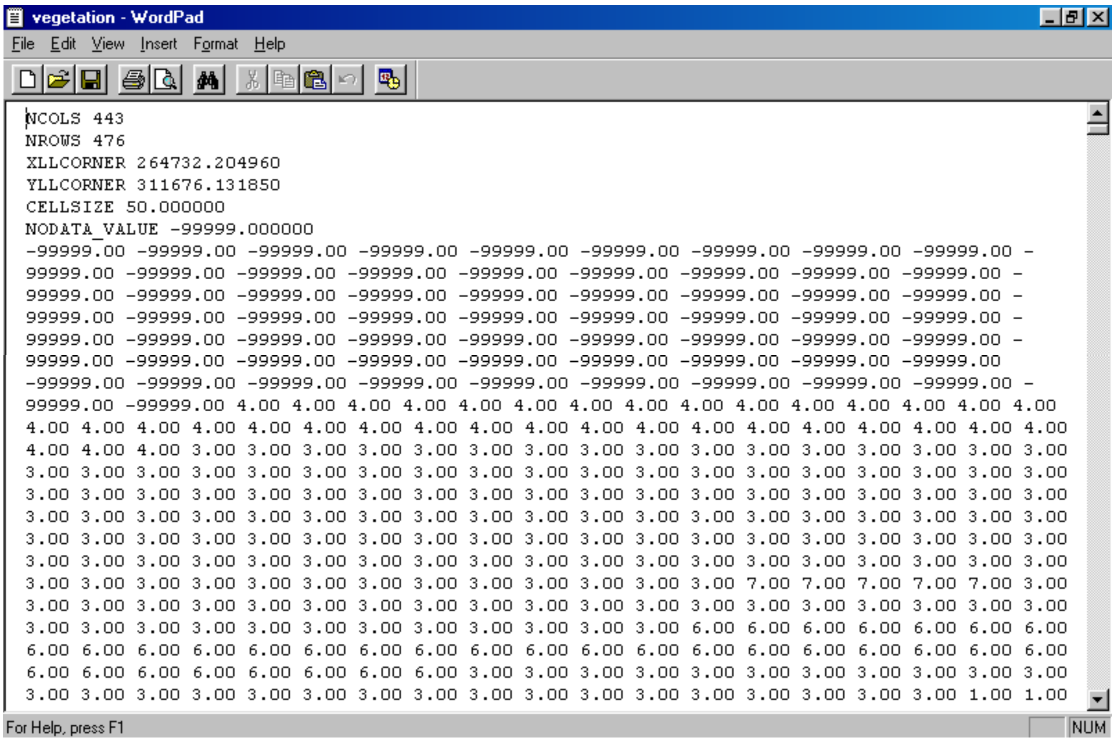


Map digitised on a 50m grid using the vector shape data represented in figure 42 above.

The final stage of the conversion process is to create an ArcInfo Grid file which can be read directly by the hillslope model.



Gridded data ready for export in Arc Info format to the hillslope model

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YLLCORNER 311676.131850
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3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00 1.00 1.00
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Example of the Arc Info file format. Header information specifies the location and grid dimensions. Values represent codes for the vegetation class of each 50m cell, with –99999 indicating cells outside the map area with no vegetation data.