# Shetran GUI User guide

**General**

There are three main stages to this program. First data is input into the Front-End and an XML file is produced. Secondly, using the data from the XML file the standard Shetran input files are produced. Thirdly, a standard Shetran simulation is run. There is an optional 4th stage when the Shetran output (e.g. lise-shegraph.h5) file can be viewed in the free software HDFView (http://www.hdfgroup.org/hdf-java-html/hdfview/).

All the map data (DEM,Mask,vegetation and soil) needs to be in ASCII format that comes directly from ArcView (or QGIS). This needs 6 header lines and then the data. Part of an example file can be seen in Figure 1. The ASCII files also need to be the correct cell size (e.g. in the data set in Figure 1 this is 80m) for use in Shetran. i.e if you have a DEM with a finer resolution (e.g.10m) this cannot be altered in SHETRAN it needs to be modified in ArcView.

**Data requirements:**

**Essential data**

| Data type | Restrictions | Example data available |
|---|---|---|
| DEM | ≤ 50 by 50 | Yes |
| Mask | Same dimensions as DEM | Yes |
| Precipitation | | Yes |
| Potential Evaporation | | Yes |

Example data is available in the install folder (e.g. c:\program files\shetran\shetran). Example data for precipitation (input_test_prd.txt) is 1 year of hourly data and for potential evaporation (input_test_epd.txt) 1 year of 24 hour data.

**Optional data**

| Data type | Restrictions | Example data available |
|---|---|---|
| Vegetation map | Same dimensions as DEM<br>Maximum category number ≤ 9 | Yes |
| Soil categories map | Same dimensions as DEM<br>Maximum category number ≤ 9 | Yes |
| Discharge data | | Yes |

**Acceptable ranges for parameters (Checks are made in the Front-End):**

| Parameter | Minimum value | Maximum Value | Other restrictions |
|---|---|---|---|
| Canopy storage capacity(mm) | ≥0 | | |
| Leaf area index | ≥0 | | |
| Maximum rooting depth(m)* | ≥0 | ≤20 | |
| AE/PE ratio at field capacity | ≥0 | | |
| Number of layers for each soil category | 1 | 3 | |
| Soil depth at bottom of layer(m) | ≥0.3 | ≤20 | > layer above and < layer below |
| Saturated water content | ≥0.05 | ≤1 | |
| Residual water content | ≥0 | ≤0.8 | < saturated water content |
| Saturated conductivity (m/day) | >0 | | |
| Van genuchten-alpha ($cm^{-1}$) | >0 | | |
| Van genuchten-n | ≥1.2 | | |
| Strickler overland flow roughness coefficient ($m^{1/3}$ $s^{-1}$) | >0 | | |
| Initial water table depth (m below ground) | ≥0 | | |
| Precipitation data – Timestep (hr) | >0 | ≤24 | |
| Potential evaporation data – Timestep (hr) | >0 | | |
| Grid square accumulated before river is produced | ≥2.0 | ≤100 | |
| Drop from grid elevation to channel depth elevation (m) | ≥2.0 | ≤100 | |

*No checks are made that the rooting depth is less than the soil depth. If a rooting depth greater than the soil depth is input then Shetran will not crash but the roots below the bottom of the soil will not transpire and so the simulated evaporation will be less than expected.

# FAQ

**Why is there a 50 by 50 limit on the SHETRAN Grid sizes?**

The problem with a larger grid size is: a) The time to do a simulation (the run time) becomes considerably longer, b) There are more likely to be numerical instabilities.

What I generally recommend is running with larger grid squares (i.e. change from 100m by 100m to 200m by 200m) rather than using a version of SHETRAN that accepts more grid squares.

I can provide versions of SHETRAN that do not have this restriction for experienced users. But these only run using the standard version of SHETRAN **not** the GUI version.

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**I use a comma (rather than a full stop) as a decimal mark, this seems to cause problems?**

Unfortunately the Shetran GUI and Standard version have been set-up to run with a full stop as a decimal mark. The main restriction is that the DEM, Mask, Soil and Veg maps that are in ASCII format need "." rather than "," as the decimal mark. Using Find and Replace in a text editor will sort out this problem

If there are still problems then the settings on the machine will need changing temporarily. In the **Control Panel**, select **Regional and Language options** and **Regional Options tab** and select English (United Kingdom).

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**How is it best to view the river channel and elevations that are produced by the program?**

The free software HDFView (http://www.hdfgroup.org/hdf-java-html/hdfview/) needs to be installed. Once installed double click on the output_catchmentname_shegraph.h5 file (e.g. output_lise_shegraph.h5) and it will open in HDFView. Double click on "Catchment_Maps" and double click on "SV4_elevation". The river channel network can now also be viewed in the GUI

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**How are the positions of the river channels and their elevations calculated?**

The position of the channel links is calculated from the DEM by analysing the number of upstream grid squares that flow into a particular grid square. When these reach a certain number (the default is 20) a river channel is produced. The channel elevations are based on the 2 adjacent grid squares. The elevations are then modified so that there is always a downward flow path. Details of the method can be found in the following paper:

Birkinshaw, S. J. (2010) Technical Note: Automatic river network generation for a physically-based river catchment model, Hydrol. Earth Syst. Sci., 14, 1767-1771

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**In Lise example the data is 23 by 32. In the frd file in the "input" folder the data has been modified to 25 by 34, Why is this?**

For numerical reasons the Shetran code requires that in the frd input file the entire catchment is surrounded by blank elements. So an extra column is added to the left and right of the catchment and an extra row to the top and bottom.

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**In HDFView sometimes the water flow values and the sediment transport values are negative and sometimes positive. Why is this?**

For water flow in Shetran: any flow in a northerly or easterly direction is +ve and any flow in a Southerly or westerly direction is -ve.

For sediment transport in Shetran: any flow out of a grid square is +ve and into a grid square is -ve.

This is consistent in the code and in the output.

The result is that if the flow into a grid square is from the south (i.e in a northerly direction) it is positive for water flow but it is into the grid square so negative for sediment transport. Similarly if the flow from a grid square is from the west (i.e an easterly direction) it is positive for water flow but it is into the grid square so negative for sediment transport.

In the output_catchmnetname_discharge_sim_hourly.txt file the discharge is always set to be positive.

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**The data is not displaying correctly in HDFView**.

On the "data selection" page you select the dimensions for Height, Width and Depth. If the dimension for height is greater than for width you have a choice of "reshape" which is the default or "transpose". Select "Transpose"

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**In the Shetran GUI how do I view a simulation I have carried out previously?**

In the Front-End go to **File | Open** and select the project file name that you specified previously (e.g lise.xml).

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**The simulated water discharge at the outlet at the start of the simulation is bad.**

Shetran as with other hydrological models needs a run-in period. This is so that the water stored in the catchment reaches an equilibrium. The deeper the soil the longer the run-in period needed. In the GUI one way round this is to have a run-in of say a year with the precipitation and evaporation data repeated in this first year and then only compare the measured and simulated discharge after one years simulation.

In the standard version of Shetran the VSI file is normally used - see the user guide for more details.

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```
ncols 23
nrows 32
xllcorner 724581.3455
yllcorner 9742444.756
cellsize 80
NODATA_value -9999
-9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -
9999 -9999 -9999 -9999 -9999
-9999 1680 1766.358 1816.239 1868.035 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999
-9999 -9999 -9999 -9999 -9999 -9999
-9999 1781.698 1780.171 1809.461 1860.54 1903.851 1946.618 1991.715 2045.857 2093.538 -9999 -9999 -9999 -
9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999
-9999 1817.787 1867.599 1828.057 1857.411 1943.774 2008.037 2032.258 2037.915 2065.756 2107.549 2152.852
2197.18 2263.567 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999 -9999
-9999 1861.126 1927.323 1915.684 1947.049 1995.333 2060.783 2113.351 2119.139 2118.944 2135.092 2193.651
2245.324 2265.62 2310.469 2363.547 2425.153 2478.54 -9999 -9999 -9999 -9999 -9999
```

**Figure 1 – 6 Header lines and first 5 lines of data in a DEM ASCII file (from lise-dem.asc)**