Shetran Easy Setup – Sediments and Snow

See video at: https://youtu.be/qyIjrUc3siQ

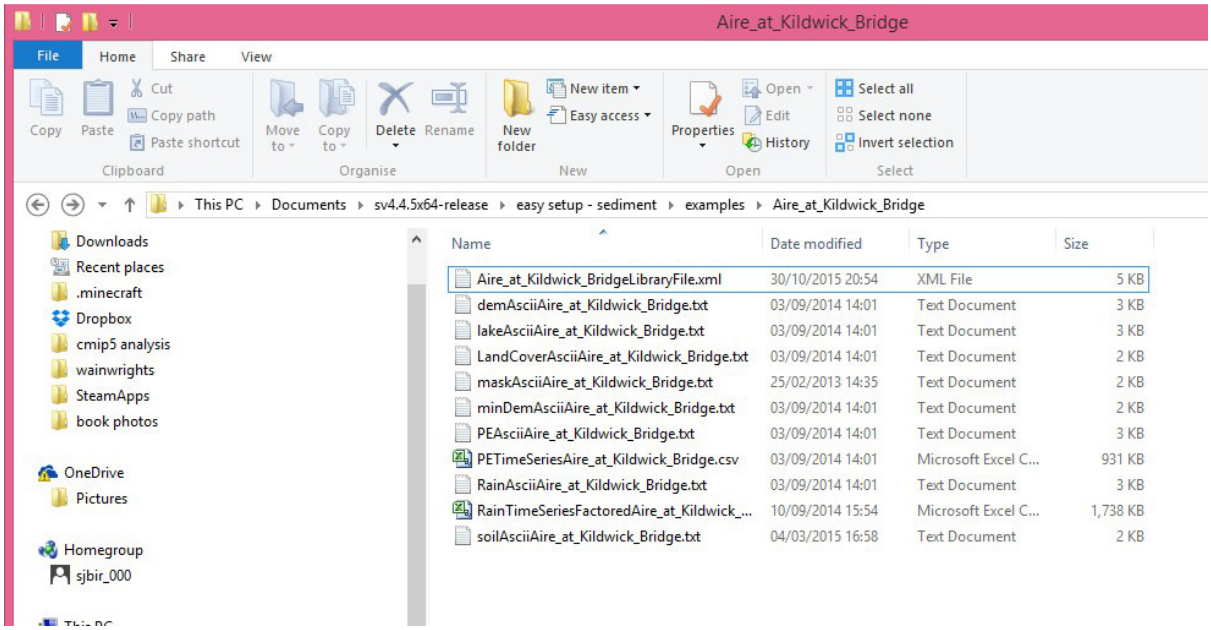
The normal Easy Setup uses run only a water flow simulation. However, there are four other components that can also be added. These are:

1. Sediment
2. Contaminant/solute transport
3. Snow
4. Banks

Easy setup has been produced for the **sediment** and **snow** components and these are considered here.

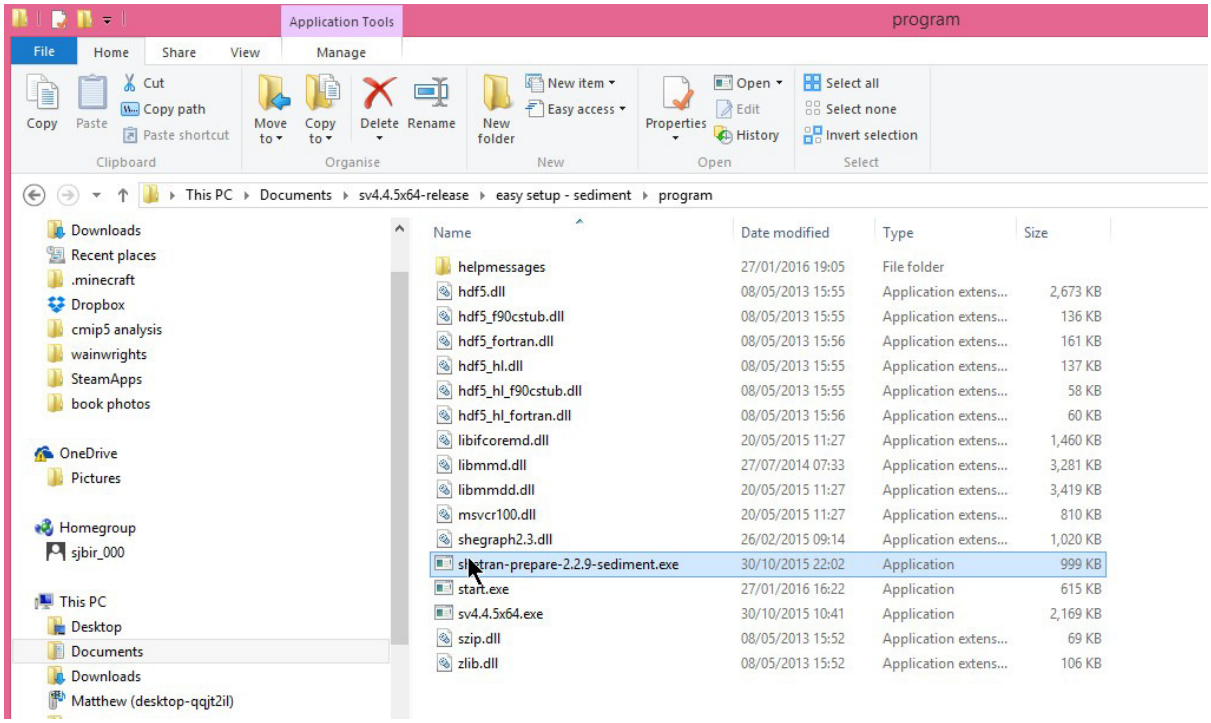
1. Sediment : Go to "easy setup - sediment\examples\Aire_at_Kildwick_Bridge"

These files are exactly the same as normal easy setup files for the same catchment.



2. Sediment : Go to "easy setup - sediment\program"

These executables are very similar to the normal easy setup files. The difference is "shetran-prepare-2.2.9.exe" is replaced by "shetran-prepare-2.2.9-sediment.exe"



3. Sediment : Double Click on “start.exe” and select “Aire_at_Kildwick_Bridge.xml" from the “easy setup - sediment\examples\Aire_at_Kildwick_Bridge” folder

This executable first runs “shetran-prepare-2.2.9-sediment.exe” then the standard version of Shetran “sv4.4.5x64.exe”. It produces slightly different Shetran input files compared to the normal easy setup (I will come to these in section 4). Then using these files it runs both the Shetran water flow and sediment transport components. The simulation outputs are then produced.

4. Sediment : Go to folder “Easy setup - sediment\examples\Aire_at_Kildwick_Bridge”

Loads of input and output files can now be seen.

Four input files are different/new from before. These are:

rundata_Aire_at_Kildwick_Bridge.txt
input_Aire_at_Kildwick_Bridge_frd.txt
input_Aire_at_Kildwick_Bridge_syd.txt - **NEW**
input_Aire_at_Kildwick_Bridge_visualisation_plan.txt

In the **rundata_Aire_at_Kildwick_Bridge.txt** file these line are different:

17: sediment yield input
input_Aire_at_Kildwick_Bridge_syd.txt

24: sediment yield print
output_Aire_at_Kildwick_Bridge_spr.txt

So it reads the new syd file and writes to the spr file. The spr file gives details of any errors in the sediment component.

In the **input_Aire_at_Kildwick_Bridge_frd.txt** these lines are different

```
:FR24 - COMPONENT EXECUTION CONTROL PARAMETERS (SM,BK,SY,CM)
    F     F     T     F
```

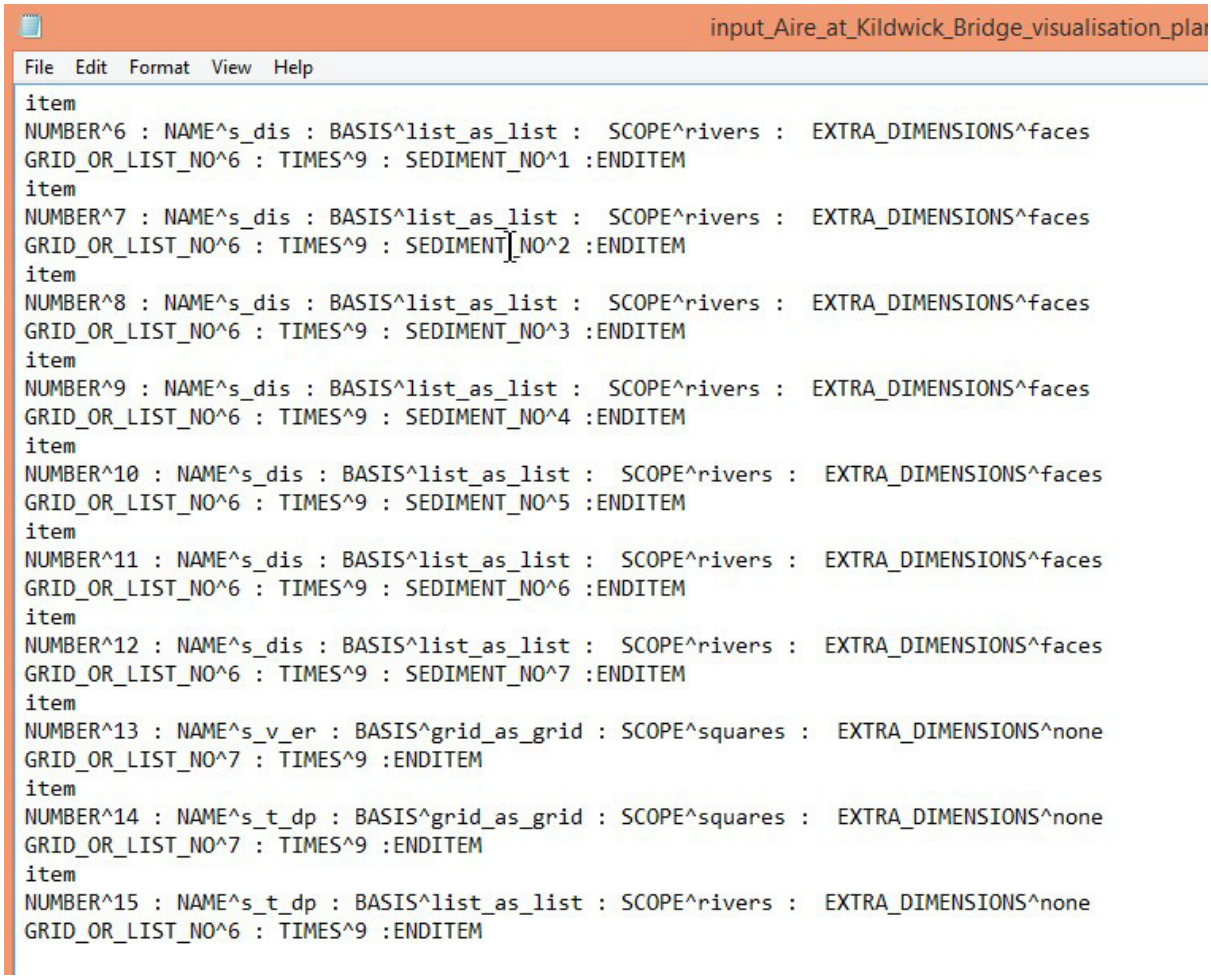
So the sediment component (SY) is now switched on (T for true)

The NEW **input_Aire_at_Kildwick_Bridge_syd.txt** file contains all the parameters needed to run the sediment component

If any parameters need to be changed the best are often GKR, GKF and BKB. See the user guide for details (http://research.ncl.ac.uk/shetran/SHETRAN%20V4%20User%20Guide.pdf)

```
:SY22 - GKR(s),GKF(s),RHOSO(s),FPCLAY(s),BKB(s) for s=1 to NS : Soil properties
      2.5   1.0D-5   1.537D3   0.26    0.0
      2.5   1.0D-5   1.537D3   0.26    0.0
      2.5   1.0D-5   1.537D3   0.26    0.0
      2.5   1.0D-5   1.537D3   0.26    0.0
```

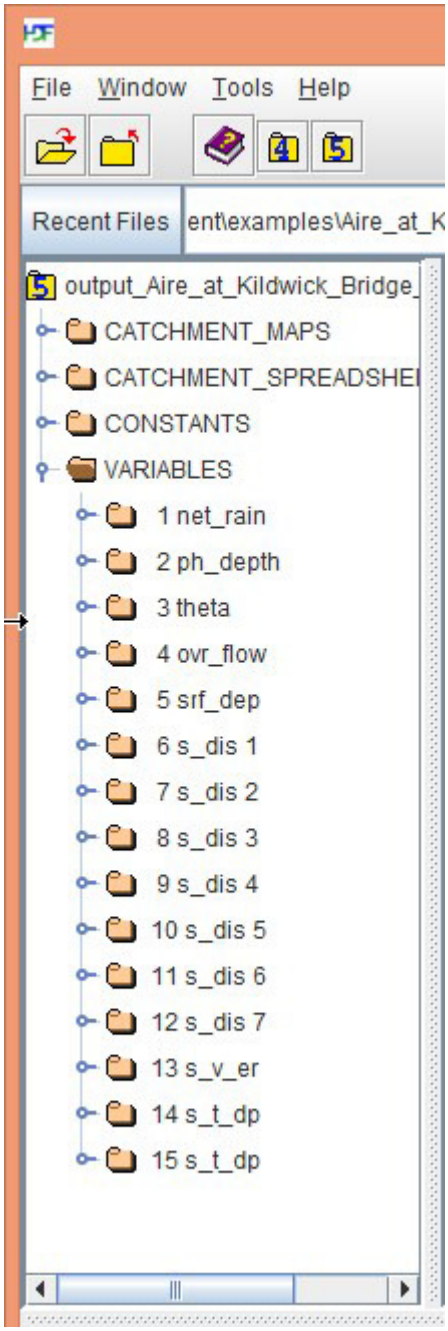
In **input_Aire_at_Kildwick_Bridge_visualisation_plan.txt** the following line have been added:



S_dis is the Sediment discharge rate (kg/s). Results are produced for each of the 7 sediment sizes
S_v_er is the rate of ground surface erosion (mm/day)
S_t_dp is the total depth of sediment (mm)

Two output files are different/new from before. These are:

output_Aire_at_Kildwick_Bridge_shegraph.h5
output_Aire_at_Kildwick_Bridge_spr.txt
The additional output in **output_Aire_at_Kildwick_Bridge_shegraph.h5** can be seen below in types 6-15



In **output_Aire_at_Kildwick_Bridge_spr.txt** any errors in the sediment component are produced.

5. Snow : Go to "easy setup - snow\examples \Aire_at_Kildwick_Bridge"

The files are the same as basic Easy Setup except for three files:

Aire_at_Kildwick_BridgeLibraryFile_snow.xml
MaxTempTimeSeriesAire_at_Kildwick_Bridge.csv – **NEW**
MaxTempTimeSeriesAire_at_Kildwick_Bridge.csv - **NEW**

The temperature time series data must have the same spatial distribution and timestep as the potential evaporation data

Changes to the **Aire_at_Kildwick_BridgeLibraryFile_snow.xml** are the addition of three extra lines:

```
<MaxTempTimeSeriesData>MaxTempTimeSeriesAire_at_Kildwick_Bridge.csv<
/MaxTempTimeSeriesData> Maximum Temperature time series for snow
melt. spatial distribution is the same as for PE.
<MinTempTimeSeriesData>MinTempTimeSeriesAire_at_Kildwick_Bridge.csv<
/MinTempTimeSeriesData> Minimum Temperature time series for snow
melt. spatial distribution is the same as for PE. Average
temperature for snow melt caculated from the mean of min and max.
```

And

```
<SnowmeltDegreeDayFactor>0.0002</SnowmeltDegreeDayFactor> Units  =
mm s-1 C-1
```

6. Snow : Go to "easy setup - snow\program"

These executables are very similar to the normal easy setup files. The difference is "shetran-prepare-2.2.9.exe" is replaced by "shetran-prepare-2.2.9-snow.exe"

7. Snow : Double Click on "start.exe" and select "Aire_at_Kildwick_Bridge.xml" from the "easy setup - snow\examples\Aire_at_Kildwick_Bridge" folder

This executable first runs "shetran-prepare-2.2.9-snow.exe" then the standard version of Shetran "sv4.4.5x64.exe". It produces slightly different Shetran input files compared to the normal easy setup (I will come to these in section 8). Then using these files it runs both the Shetran water flow and snow components. The simulation outputs are then produced.

8. Snow : Go to the folder "Easy setup - snow\examples\Aire_at_Kildwick_Bridge"

Loads of input and output files can now be seen.

Four input files are different/new from before. These are:

rundata_Aire_at_Kildwick_Bridge.txt
input_Aire_at_Kildwick_Bridge_frd.txt
input_Aire_at_Kildwick_Bridge_smd.txt - **NEW**
input_Aire_at_Kildwick_Bridge_visualisation_plan.txt

In the **rundata_Aire_at_Kildwick_Bridge.txt** file these line are different:

15: snowmelt
input_Aire_at_Kildwick_Bridge_smd.txt

45: maximum air temperature
MaxTempTimeSeriesAire_at_Kildwick_Bridge.csv
46: minimum air temperature
MinTempTimeSeriesAire_at_Kildwick_Bridge.csv

So it reads the new smd file and the two new temperature files

In the **input_Aire_at_Kildwick_Bridge_frd.txt** these lines are different

:FR24 - COMPONENT EXECUTION CONTROL PARAMETERS (SM,BK,SY,CM)
T F F F

So the snow component (SM) is now switched on (T for true)

The NEW **input_Aire_at_Kildwick_Bridge_smd.txt** file contains all the parameters needed to run the snow component . The degree day factor method is used here. There is a full energy budget version available

In **input_Aire_at_Kildwick_Bridge_visualisation_plan.txt** the following line have been added so the snow depth is now produced in the HDF5 (h5) file:

item
NUMBER^6 : NAME^snow_dep : BASIS^grid_as_grid : SCOPE^squares : EXTRA_DIMENSIONS^none
GRID_OR_LIST_NO^7 : TIMES^8 : ENDITEM

Considering the output files, **output_Aire_at_Kildwick_Bridge_shegraph.h5** is different as the new variable Snow_dep is now produced (type 6). The output discharges and mass balances will now all be different from the basic setup which does not consider the snow. For example in the mass balance output (**output_Aire_at_Kildwick_Bridge_mb.txt)** there is a column for snow storage which is now sometimes not zero.