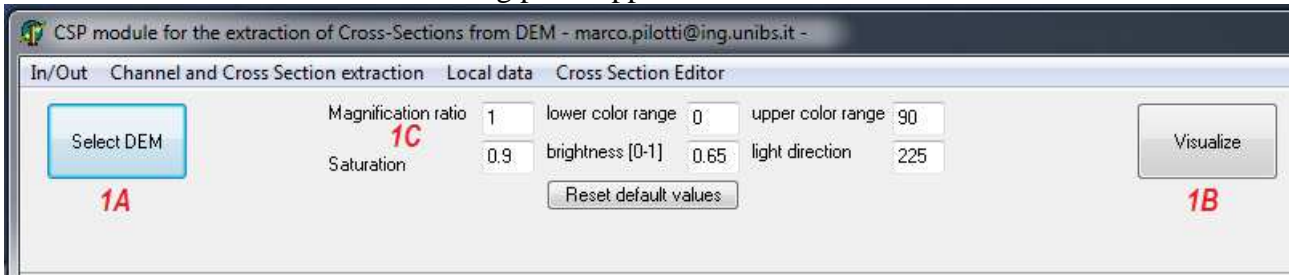# TUTORIAL 1

test case 1: *basin1.grd*
SELECTION OF THE CN END-POINTS BY COORDINATES

Run the CSP program by clicking on the *CSP.exe* icon.

Select command 1 above: the following panel appears

Using 1A, select the file *basin1.grd*. By pressing 1B, the basin is shown on the screen, according to the magnification ratio 1C.

The other numbers in the panel allow the user to control the palette of the DEM.
The dimension of the window where the DEM is shown, is given by the number of rows and colums of the DEM, scaled with the magnification ratio, that is a real number > 0. For instance, a 400x400 DEM with a 0.5 magnification ratio occupies a 200x200 dots window.

After pressing 1B, the screen will look like in the following: the Watershed Visualizer panel and the Task List panel will appear on the screen.
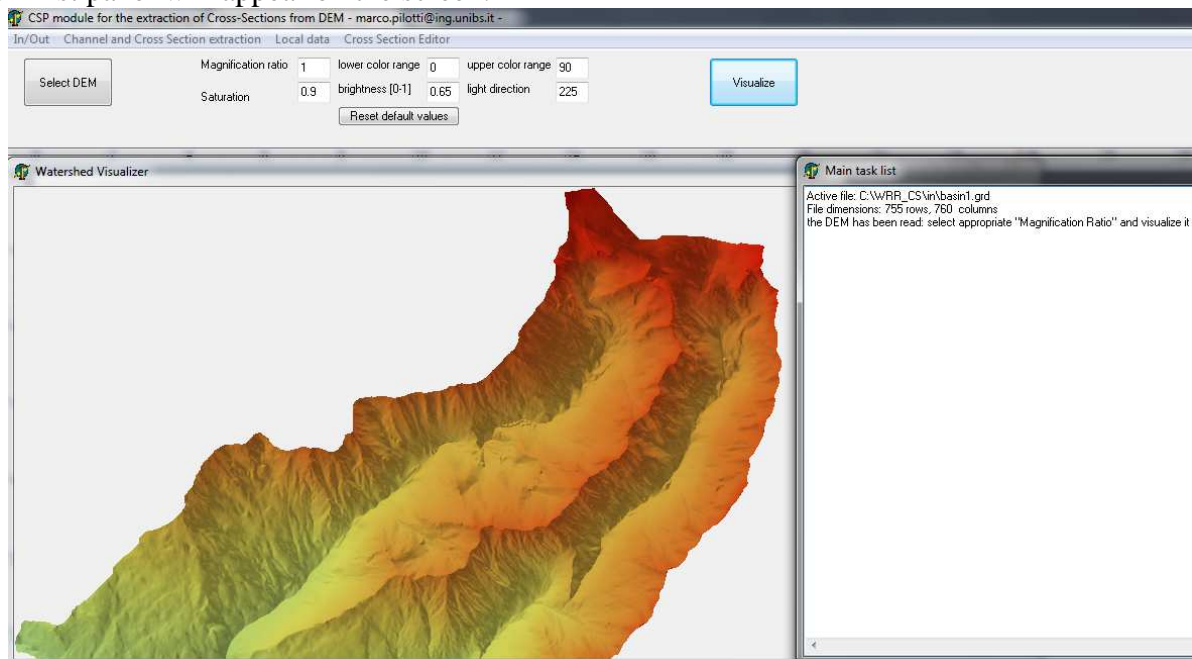
Note that in order to convey a 3D view of the basin relief, the program needs also the local orientation with respect to the north. This data set is computed by the program and saved in the /in/ directory during the CN extraction at the following point. Accordingly, the first time that a watershed is shown, this file is not present and the program shows the basin like in the left panel of figure below (where the aviolo.grd basin is shown). However, after computing the CN, the file can be shown again on the screen as in the right panel of figure below.
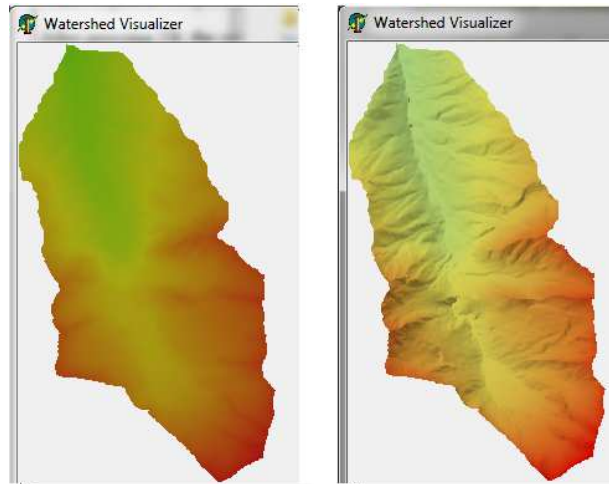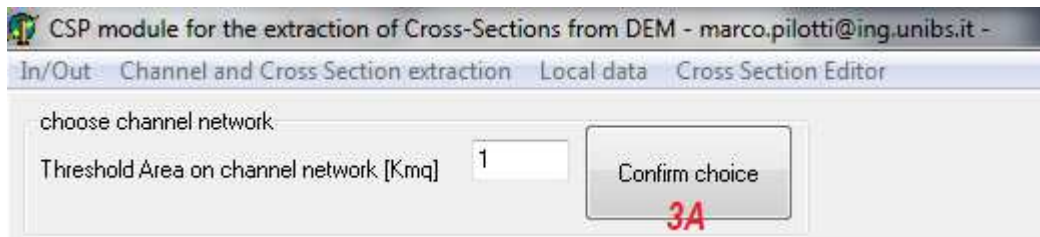
Select command 3 below.
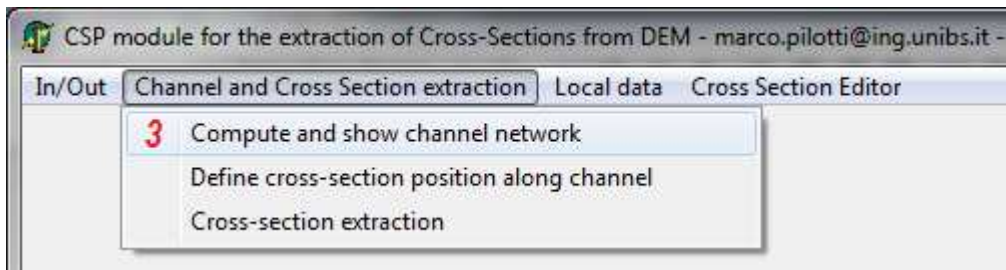
The program will automatically accomplish the tasks shown in the Main Task List panel, needed for the computation of the SFDN. This may take some dozens of seconds depending on the computer and on the DEM dimension.

the following panel is shown

Here the user can specify the constant area threshold (a real number $>=0$, in km^2) on the basis of which the CN will be filtered from the SFDN.

If one selects 0, the SFDN is shown on the screen, but this is very unconvenient for the following operations.

The default value of 1 km^2 will be used for this example. After confirming the choice (3A key), in a few seconds the following panel appears
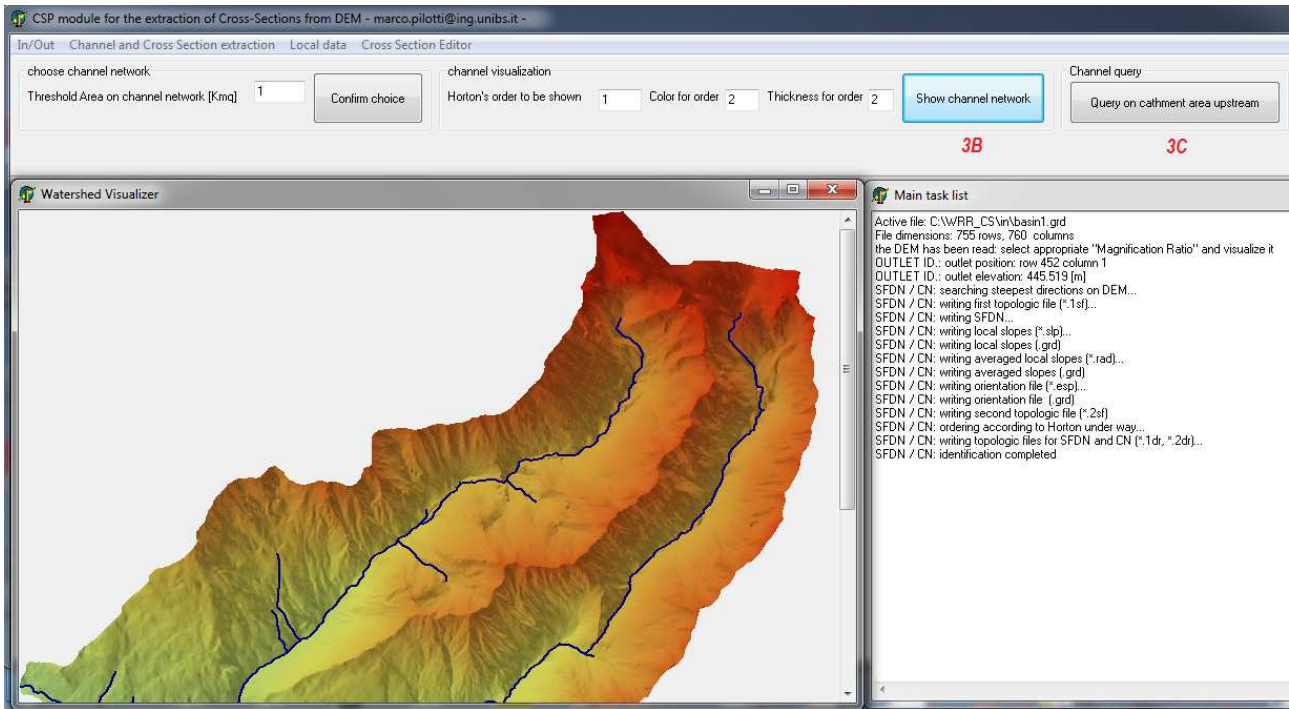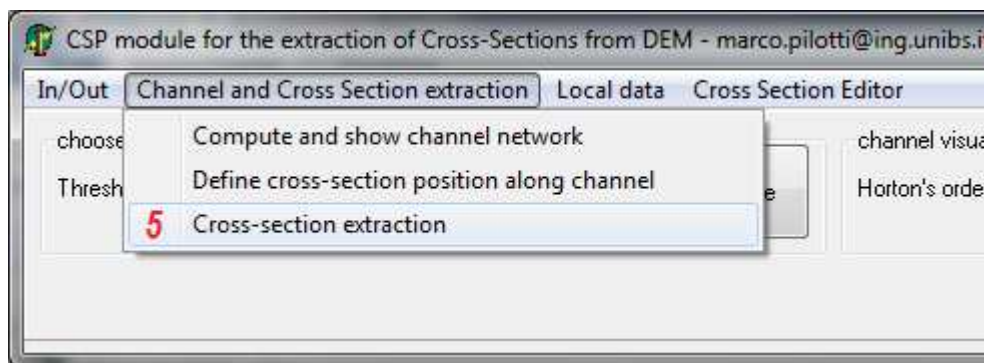
where the CN is shown.

One can classify the CN on the basis of Horton's order (key 3B), and, more importantly, can query the drained area at different stations along the CN by pressing key 3C. After selecting 3C, the user can press the left mouse key at different position along the CN and the corresponding drained area is shown on the screen

Select command 5 below.

The following panel will be shown on the screen
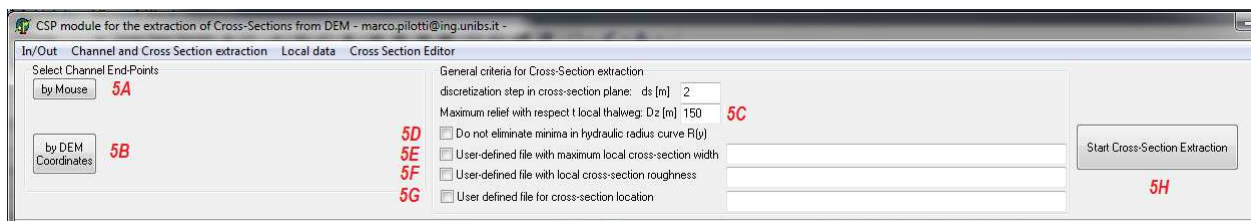
This panel allows the user to select the CN stretch along which the CS will be computed. To this purpose, the first upstream and last downstream end-points have to be specified. This can be done in three different ways:

1. by clicking on the corresponding stations with the mouse (option 5A; this is the simplest option to use and is discussed in detail in Tutorial 2);
2. by providing an ASCII file where the distance of the CSs from the outlet is given (option 5G, that will be presented in Tutorial 3).
3. Finally, by specifying the end-point UTM coordinates (option 5B), as discussed in the following

Let's consider option 5B, by clicking on the corresponding button.

here the East and North UTM coordinates of the end points have to be specified. The suggested coordinates for this test case are provided in the paper and in the *coordinates.doc* file, from which they can be pickup up by cut-and-paste.
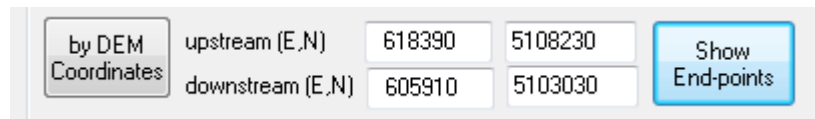
After clicking on the 5B1 button, the selected stretch of the CN is shown on the screen as a dotted red line between the two yellow-marked end-points.

The coordinates of the end-points can be obtained by using the Command 6, Local Data, Query xyz. The program uses a snap-to-point to find the station along the CN closest to the specified end-point. However, the search fails if the specified end-point is too far from the CN.
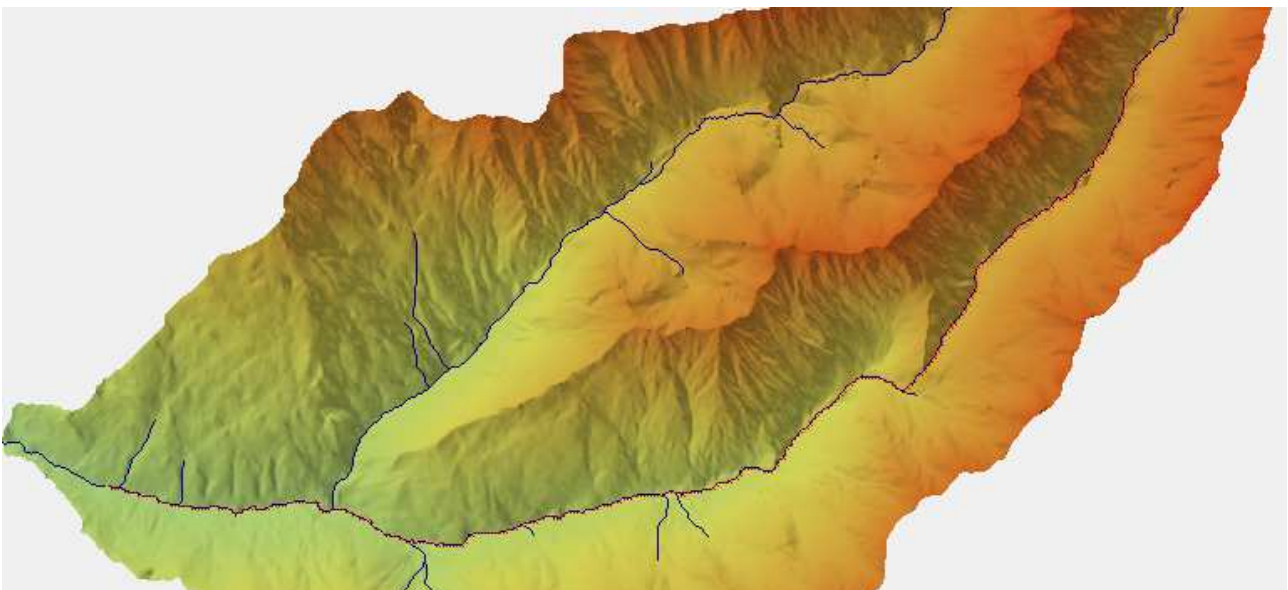
Now the user has to provide some criteria to guide the CS extraction, as discussed in the paper. One can control the lateral extent of the CS by providing a maximum elevation with respect to the local thalweg (value in 5C; by default it is set at 150 m above the local thalweg) and a user defined file

with the maximum local width (5E). Let us click on the 5E button and let us select the *basin1_a.wdt* file

*The *.wdt files are ASCII files with couples (distance from upstream end-point, local CS width). The data are in meters. For instance the basin1_a.wdt file*

0   300
25000   300

specifies a constant CS width of 300 m. Note that the station can exceed the actual length of the selected CN, as in this case where the actual length of the selected CN is 17000 m. In order to tune the CS width in a more refined way, additional lines can be added as in the basin1_b.wdt file, whose first 5 lines are shown in the following

0   400
383   400
390   300
1470   300
1480   400

The program calculates the local CS width by linear interpolation as a function of the distance from upstream.

Finally, we need the local roughness coefficient, that is used to compute the local stage-discharge relationship. By clicking on the 5F button let us select the *basin1.stk* file

*The local roughness coefficient is given by the Gauckler-Strickler coefficient ($m^{1/3}s^{-1}$) and is supposed constant within each CS. The *.stk files are ASCII files with couples (distance from upstream end-point, local CS Gauckler-Strickler coefficient). For instance the basin1.stk contains the two lines*

0   15
25000   25

according to which the Gauckler-Strickler coefficient will vary linearly between 15 and 25 with distance from the upstream end-point. More detailed description are obviously possible as mentioned above for the local CS width.

Now, by clicking the 5H button, the CS extraction process starts. The list of CS is shown on the Task panel, as in the Figure below where the name of the last 100 created files is shown
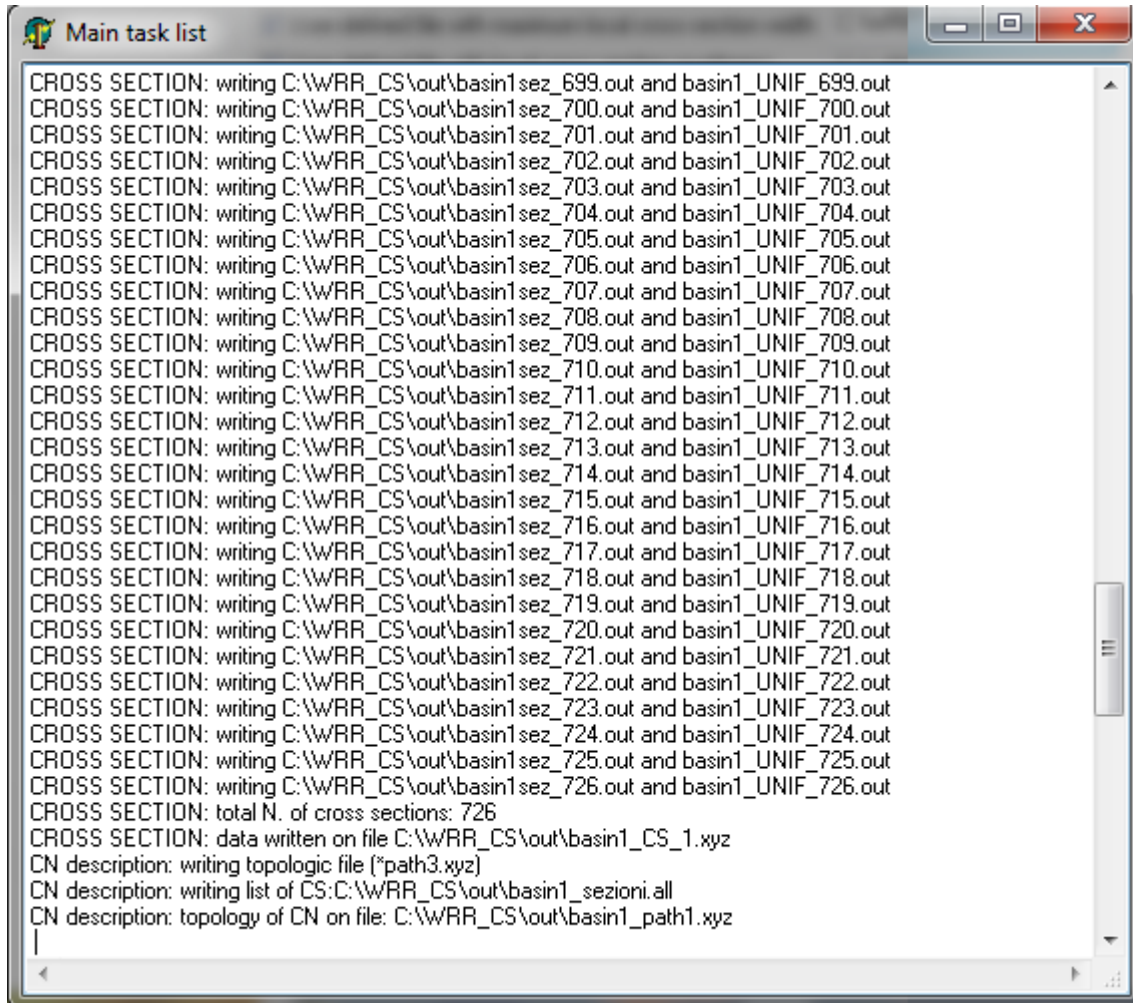
In this case 726 CS are created. On the watershed visualizer two black lines mark the envelope of the CSs outer end-points.

As one can see, for each CS, two ASCII files with extension .out are created in the \out\ directory. In addition, other ASCII files are created that provide a comprehensive description of the CS geometry and of the selected stretch of the CN. The content and format of these files is explained at the end of the user's guide.

In order to explore the computed CSs, select command 7 above: the CS visualizer panel appears
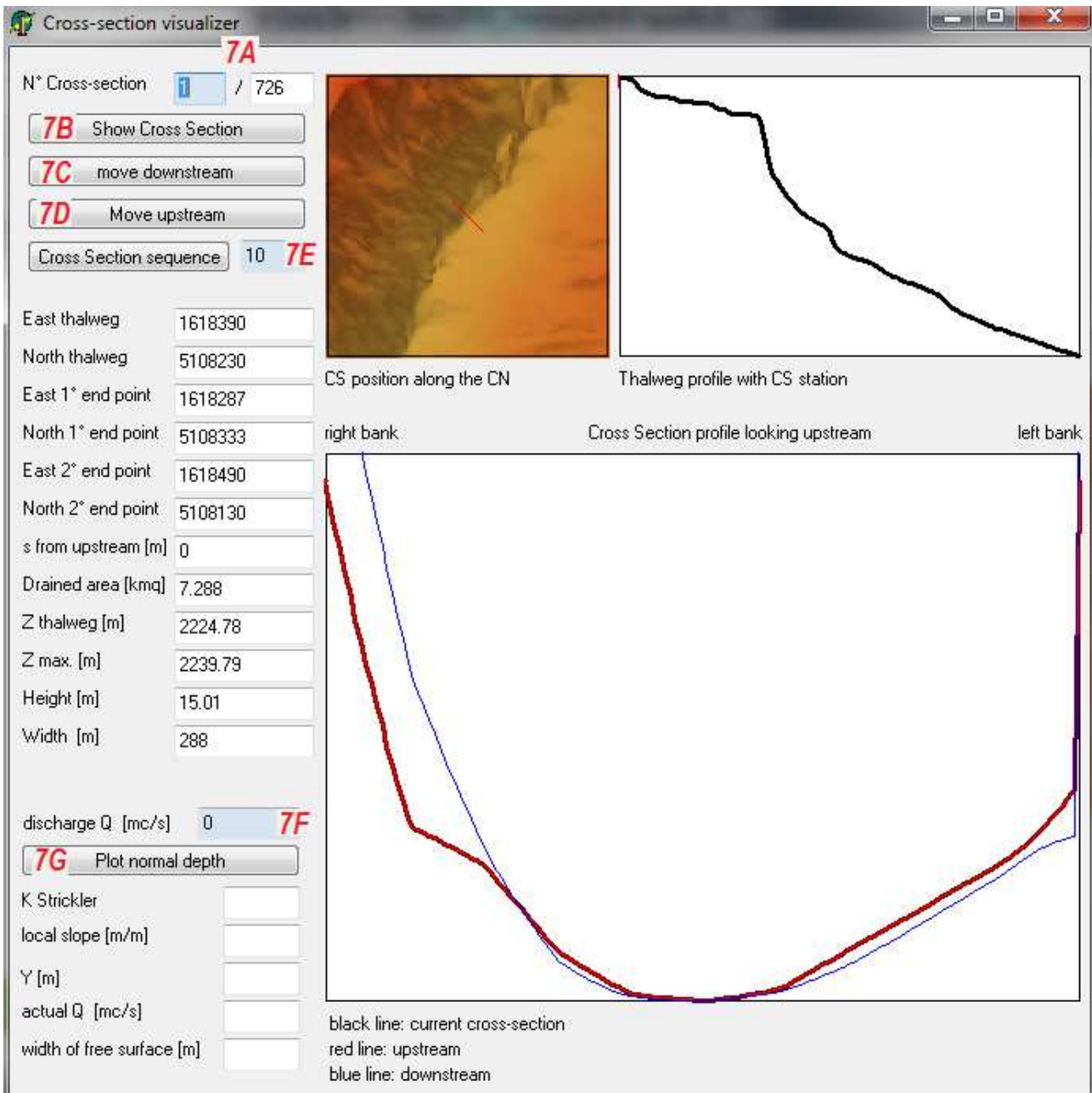
In this panel the CS whose number is in 7A is shown, along with its planimetric position with respect to the valley and the thalweg vertical profile. Values that can be changed by the user (7A,7E and 7F) are shown against a pale blue background.

The user can browse the CSs both sequentially (press 7C or 7D) or with a direct access, by specifying the CS number in 7A and then by clicking 7B. A sequence of n CS in the neighborhood of the current CS can be shown by changing the number in 7E and by clicking the corresponding button. It is possible to specify the discharge in 7F (in m³/s) and show the corresponding normal depth plotted on the CS, as shown below

North 1° end point	5108333
East 2° end point	1618490
North 2° end point	5108130
s from upstream [m]	0
Drained area [kmq]	7.288
Z thalweg [m]	2224.78
Z max. [m]	2239.79
Height [m]	15.01
Width [m]	288

discharge Q [mc/s]	8000

Plot normal depth

K Strickler	15.00
local slope [m/m]	0.00920
Y [m]	8.7
actual Q [mc/s]	8193.11
width of free surface [m]	268.7

right bank   Cross Section profile looking upstream   left bank

black line: current cross-section
red line: upstream
blue line: downstream

As observed in the papers, the CSs obtained by using the *basin1_a.wdt* file show many flaws. A better CSs description is obtained by using the *basin1_b.wdt* file, where the CS width is better modulated as a function of the distance s from the watershed outlet.
To this purpose it is suggested to Quit the program and Run it again with this second file.