

"Areas and distances" subroutine

Using the **"Areas and Distances"** subroutine of the program package **"IntErO"**, using the computer-graphic methods, the values of polygon areas and distances between the desired items are obtained. In order to get the area values, and lengths, i.e. the distances, mechanical instruments - planimeter and curvimeters - have so far been most frequently used, while the analytical methods for obtaining the results were used rarely. Apart from all the positive sides and the use value of the abovementioned methods, the use of computer-graphic models - in this case the use of the "IntErO" program, has significantly increased the work pace compared to the calculation of polygon areas by analytical methods, while the accuracy of the data obtained is higher than in cases where mechanical instruments - planimeter and curvimeter are used.

The principle of area calculation implies calculation of polygon area using a formula in the algorithm background of the "Areas and Distances" subroutine:

$$P = \left| \sum_{i=1}^n x_i y_{i-1} - x_{i-1} y_i \right|$$

where:

n - number of polygon vertices,
 x_i, y_i - polygon vertex coordinates ($x_0 = x_n; y_0 = y_n$)

Data obtained using the "Areas and Distances" subroutine, were compared to the data obtained with mechanical instruments, planimeter and curvimeter, analytically, by calculating the polygon areas as well as by microscopic comparison of the values obtained: classically, using the micrometer objective and ocular, as well as digitally.

The values of areas and lengths obtained by the "Areas and Distances" subroutine are identical to the results obtained analytically, while reading of coordinates, as well as subsequent calculation using the formula several dozens of times, depending on the number of vertices, is faster compared to the analytical method, which shows the advantages of using this CG method in terms of speed and efficiency of work.

In most cases, the "real" area cannot be measured by mechanical instruments. In work, measuring of a area that is not appropriate occurs due to deviation of mechanical instruments from the desired route. That is why very small deviations were noted in the results of the two said methods - computer-graphic and analytical - which points to the advantage of using the CG method with regard to the accuracy and correctness of the data obtained.

Deviation from the route can happen also during the application of this CG method. However, the track of movement along the route is clearly drawn so, where necessary, only a part of the route may be corrected, which was not the case with mechanical instruments. Depending on the needs of the research, the tolerance level should be set in order to reach a conclusion, empirically or in some other way, whether the route has been drawn in a satisfactory way.

Dry-out of maps is one of problems that occur in use of the abovementioned instruments. Where measuring with mechanical instruments on maps lasts for some time, maps are deformed, paper dry-out causes shrinking so measuring done at the beginning and at the end of the work do not match. In the computer-graphic method, the map is scanned and memorised in a digital form at the beginning of the work. The data on the size of the scanned area in digital form is the same at the beginning, in the course of and at the end of the work. This means that the dry-out that occurred as a problem in earlier procedures is avoided.

The program enables loading of an unlimited number of polygons i.e. lines, and each may have an arbitrary number of vertices (the number is limited only with the available memory space of the computer). However, the processing of elements should be done by common properties (the set of all isohypses, the network of watercourses with tributaries of the I and II order, etc.)

Another advantage of this CG method is that the very process of calculating the areas and distances is at the same time the process of drawing i.e. mapping. At the end of every area calculation we get the map of elements.

The part of the subroutine for calculation of areas and distances of the "IntErO" program operates in the following way: first, the desired items are uploaded from the computer hard disk into the **.PLT** (plotter) format. Practically all the programs for vector graphics support the conversion of the image into this format, for example, CorelDRAW and similar software. In this way, the digitalized map is converted into the format appropriate for uploading into the "IntErO".

In the course of the digitalisation it is necessary to mark a known length, distance, the so-called reference line, on the basis of which the program makes comparison and determines all lengths and areas¹.

It is important to note that in calculation of areas, it is important to close the polygon, i.e. to connect the start and end points of the polygon. Otherwise, just the value of the length of the line drawn will be shown.

Upon drawing of the items, the image drawn is exported into the .PLT format. By clicking the "Upload" button; a window pops up, where .PLT file is taken from the hard disk or some other database. Upon selection of the reference line, its known length needs to be entered, and after that, with selection of any line using the appropriate slider, its length will be automatically calculated, or the polygon area, as appropriate. The line selected is shown in yellow.

If appropriate option is turned on, the middle line calculation is obtained and its track on the screen is shown in red.

The data obtained in this way can be directly transferred into appropriate cells, i.e. they can be allocated to the corresponding input data. By right-clicking any of the cells with the length or area a menu pops up, enabling selection of which of the input data is attached to the value calculated, or the value obtained is copied into the Clipboard, as shown in the Image 8.

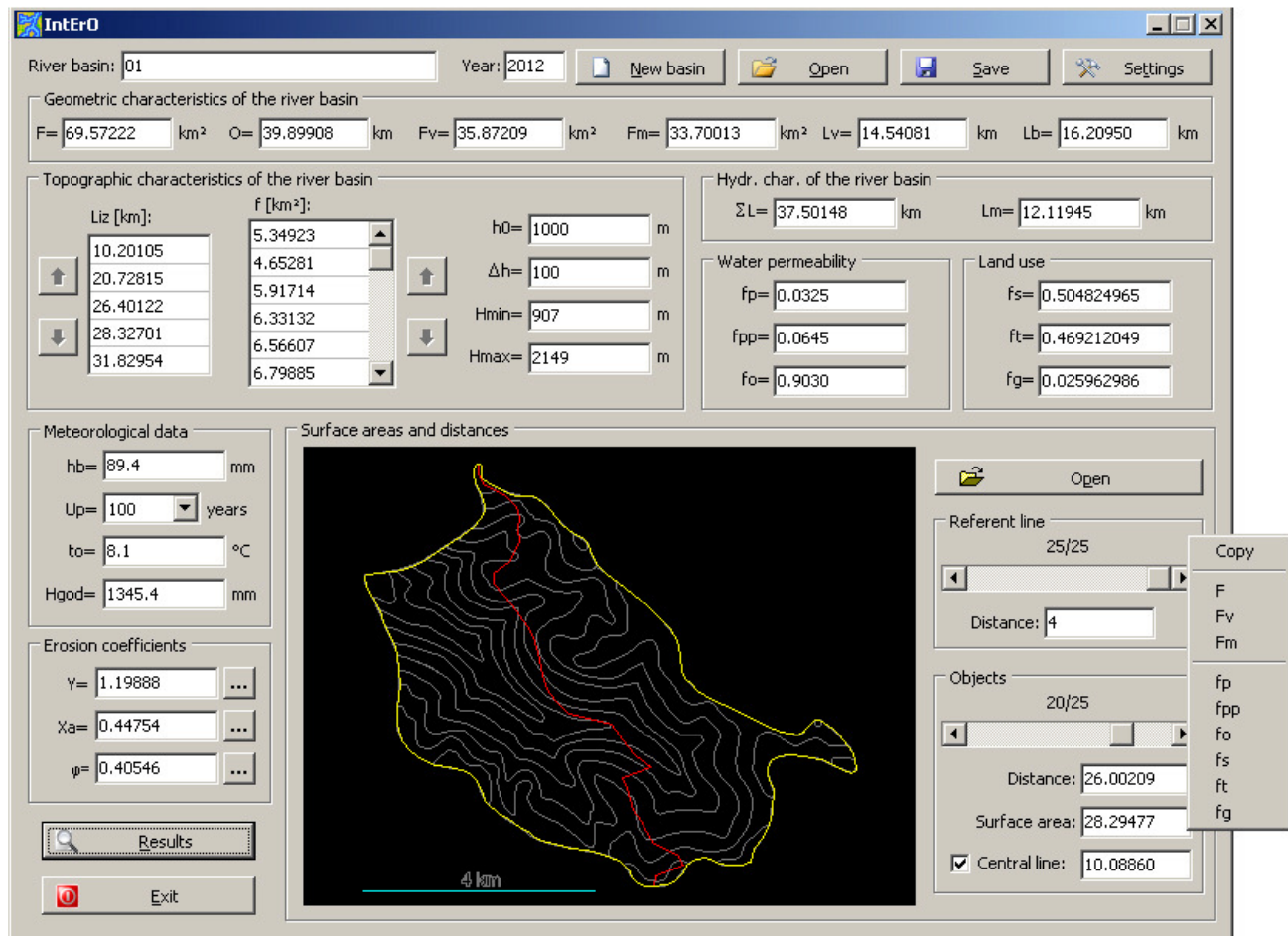


Image 8: Transfer of results obtained

Exit from the "IntErO" program is done by pressing the button "Finish".

Finally, as with the *.sli database, the setting up of the *.plt database for river basins calculated, the monitoring of the changes in the process of outflow and soil erosion intensity in river basins is significantly easier and faster.

¹ In measuring under the microscope, the entering of the preparation is followed by introduction of the micrometer under the same magnifying conditions. It is followed by importing the scanned/microscoped item into the CorelDRAW program: File/Import. Once the item is shown on the screen, the polygons and lines are drawn by a pencil: Freehand icon in the CorelDRAW program.