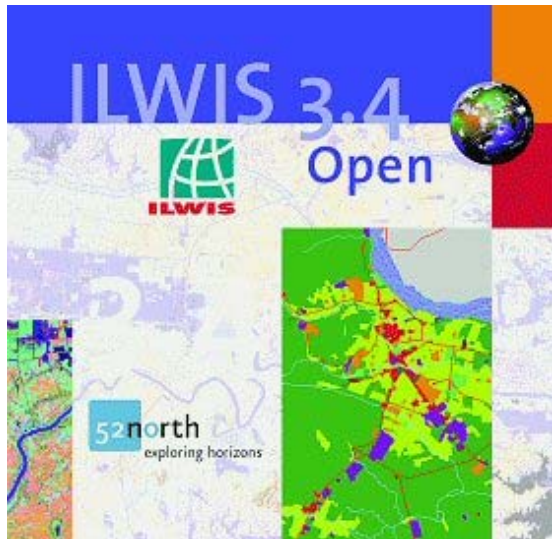


## DEM Hydro-processing in ILWIS

### 1- Introducing ILWIS

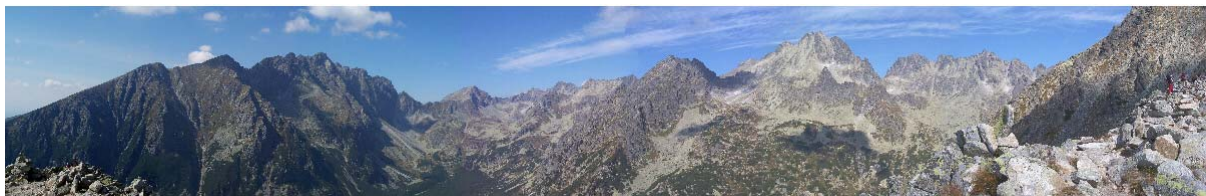


ILWIS is a remote sensing and GIS software which integrates image, vector and thematic data in one unique and powerful package on the desktop. ILWIS delivers a wide range of features including import/export, digitizing, editing, analysis and display of data, as well as production of quality maps. ILWIS software is renowned for its functionality, user-friendliness and low cost, and has established a wide user community over the years of its development. Even after its last commercial release in 2005, its user community has remained active, both within and outside ITC.

### 2- Introducing the Case Study

#### [2-1- Localization](#)

The Tatra Mountains:



The Tatra Mountains, constitute a mountain range which forms a natural border between Slovakia and Poland. They occupy an area of 750 km<sup>2</sup>, the major part (600km<sup>2</sup>) of which lies in Slovakia. The highest mountain is Gerlachovský štít at 2,655 m, located in Slovakia. The north-western peak of Rysy (2,499 m) is the highest Polish mountain.



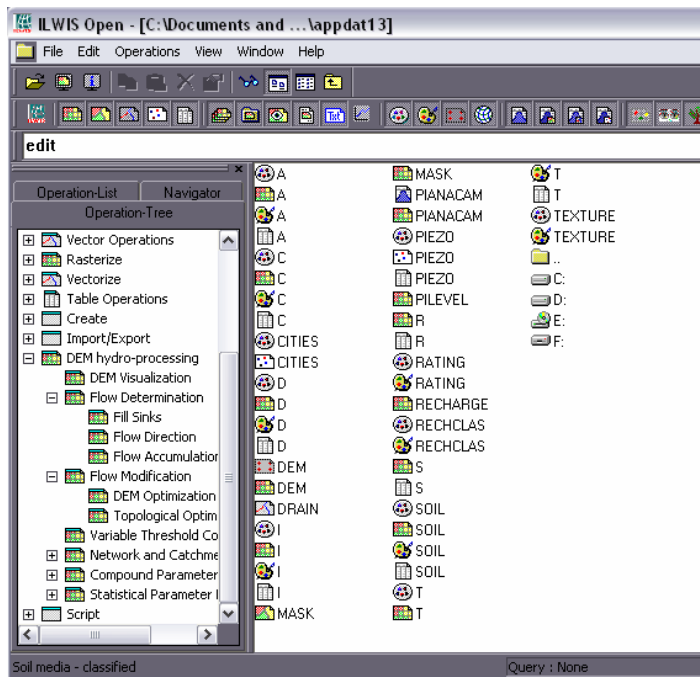
[2-2- The data](#)

DEM raster in TIF format containing the Tatra Mountains (south of Poland and north of Slovakia) taken from the KEO (Carpathians Environmental Outlook) datasets in UNEP/GRID-Warszawa and modified expressly for carrying out the demonstrations.

[2-3- The analysis](#)

DEM hydro-processing in ILWIS:

Operation-Tree > DEM hydro-processing

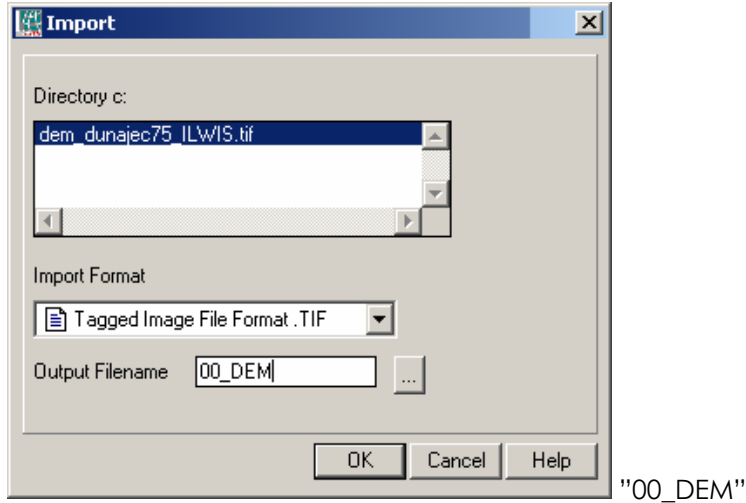


Importing raster .TIF map to ILWIS



Import raster maps of a number of different formats (indicated by the name of the option) to the ILWIS raster format. For each map, an .MPR and an .MP# file are created. Furthermore, a domain, a representation, a georeference, a coordinate system and an attribute table may be created.

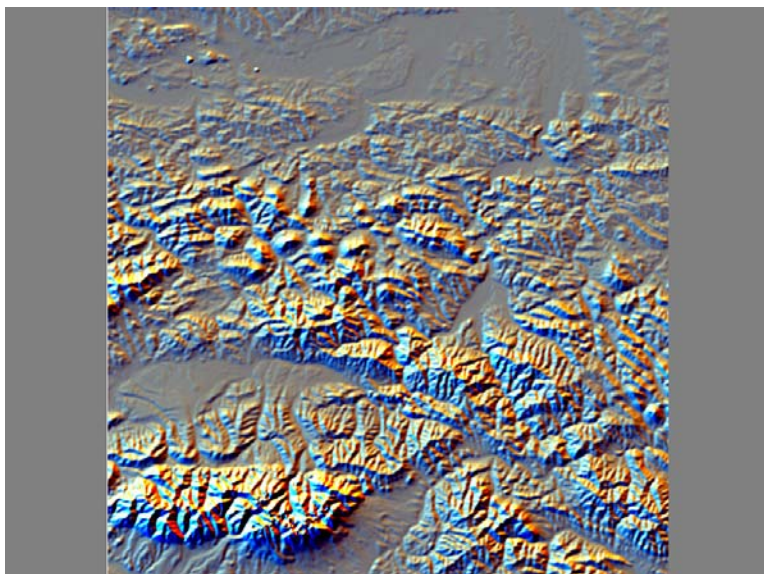
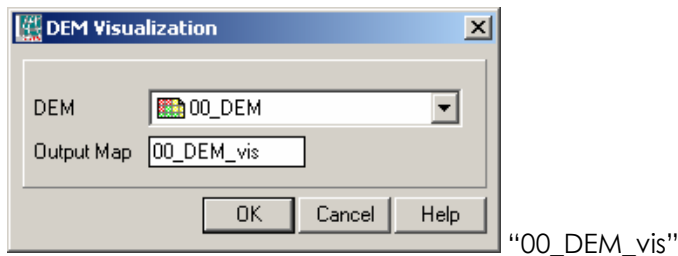
Operation-Tree > Import/Export > **Import Map**



### Visualizing DEM

The DEM Visualization script creates a color composite for you a DEM. First, three shadow maps are created by the script, using three different shadow filters. The combination of them in a color composite gives a very good impression of the relief in your area.

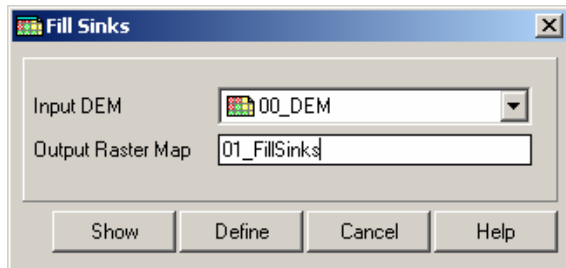
Operation-Tree > DEM Hydro-processing > **DEM Visualization**



Filling local depressions in the DEM

Before using the Flow Direction operation, you may wish to clean up your Digital Elevation Model (DEM), so that local depressions (sinks) are removed from your DEM.

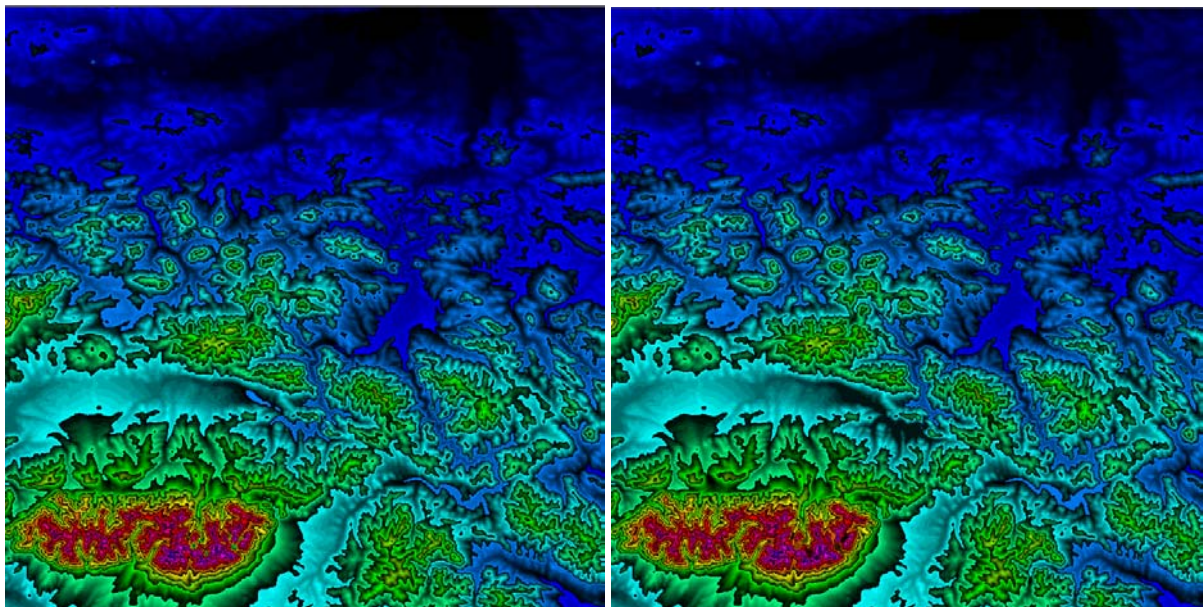
Operation-Tree > DEM Hydro-processing > Flow Determination > **Fill Sinks**



"01\_FillSinks"

Comparing initial DEM with sinks-filled DEM

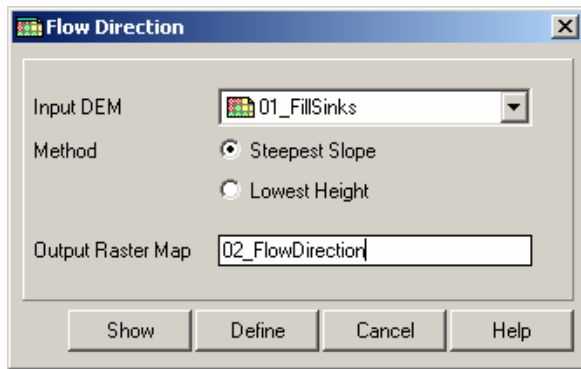
Open "00\_DEM" and "01\_FillSinks" and choose "CLRSTP12" representation



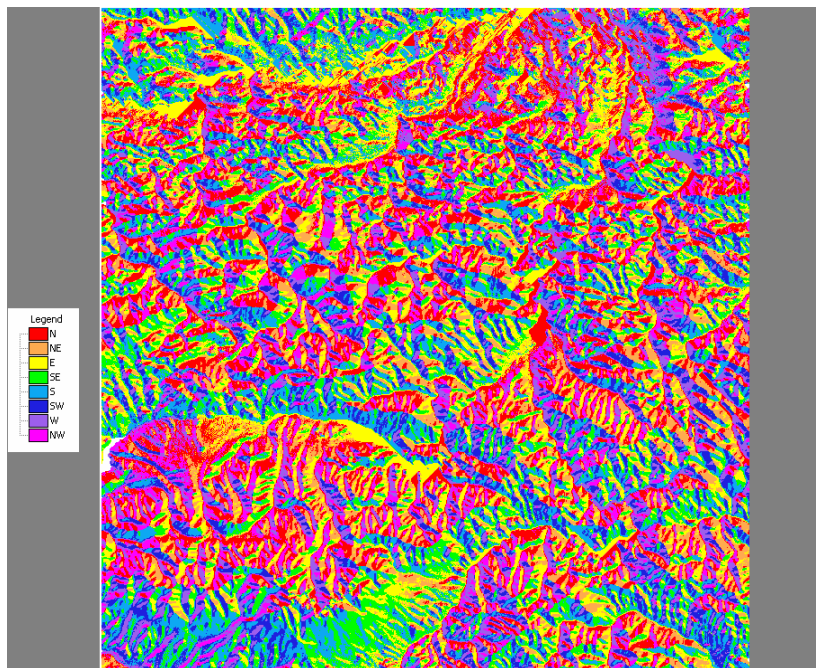
Calculating Flow Direction

In a (sink-free) Digital Elevation Model (DEM), the Flow direction operation determines into which neighbouring pixel any water in a central pixel will flow naturally.

Operation-Tree > DEM Hydro-processing > Flow Determination > **Flow Direction**



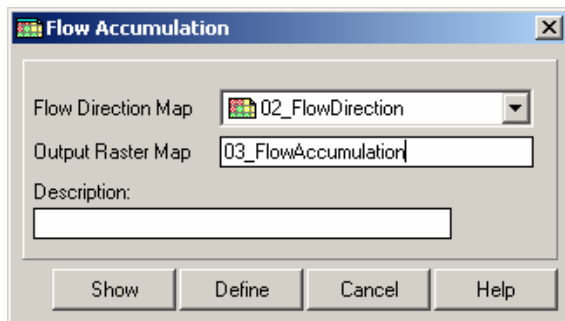
"02\_FlowDirection"



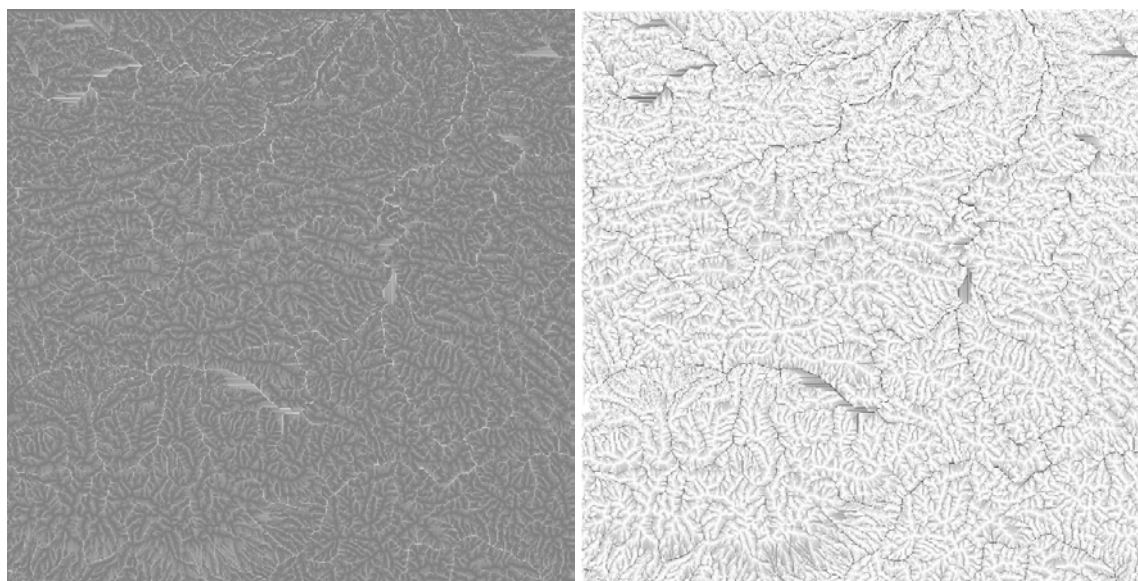
### Calculating Flow Accumulation

The Flow accumulation operation performs a cumulative count of the number of pixels that naturally drain into outlets. The operation can be used to find the drainage pattern of a terrain.

Operation-Tree > DEM Hydro-processing > Flow Determination > **Flow Accumulation**



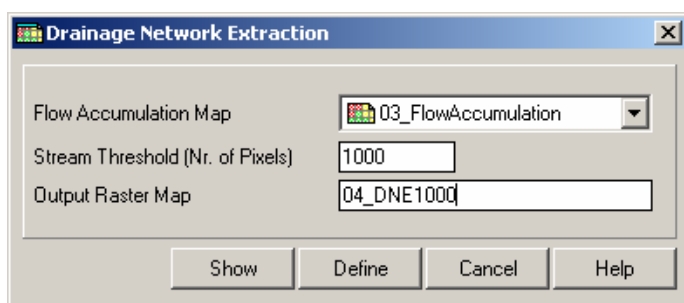
"03\_FlowAccumulation"



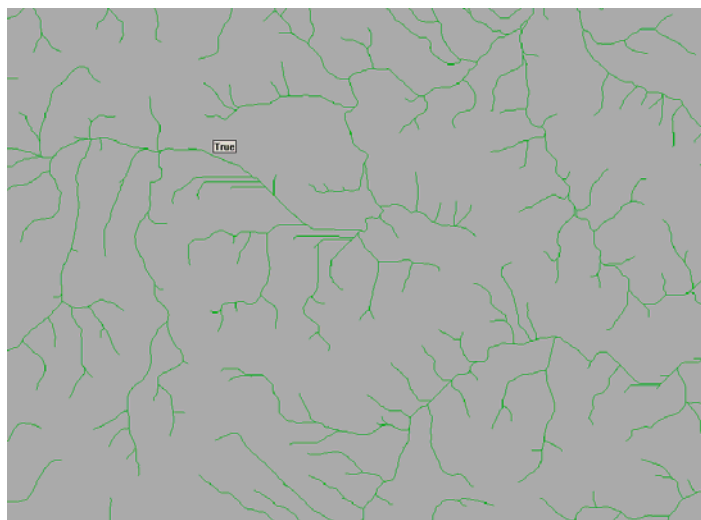
### Calculating the Drainage Network

The Drainage Network Extraction operation extracts a basic drainage network (boolean raster map). The output raster map will show the basic drainage as pixels with value True, while other pixels have value False.

Operation-Tree > DEM Hydro-processing > Network and Catchment Extraction > **Drainage Network Extraction**



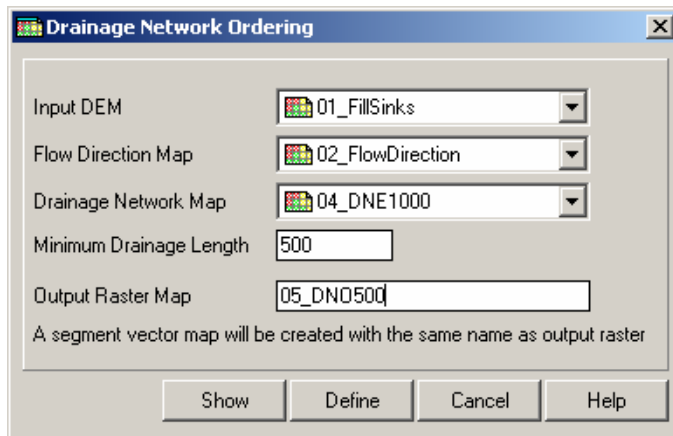
"04\_DNE1000"



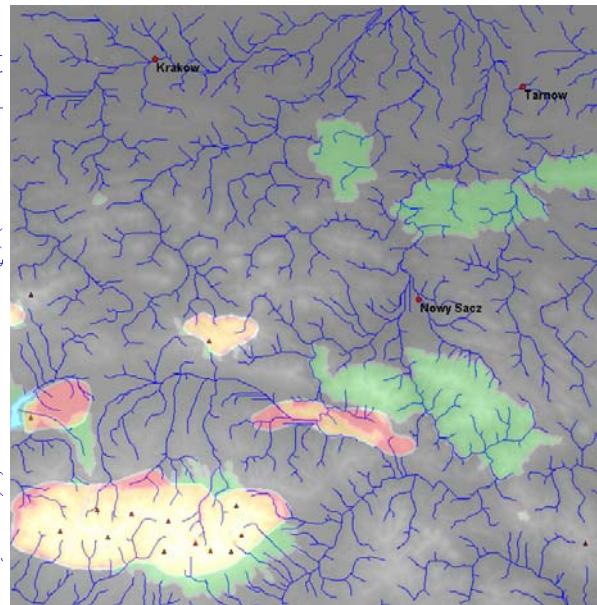
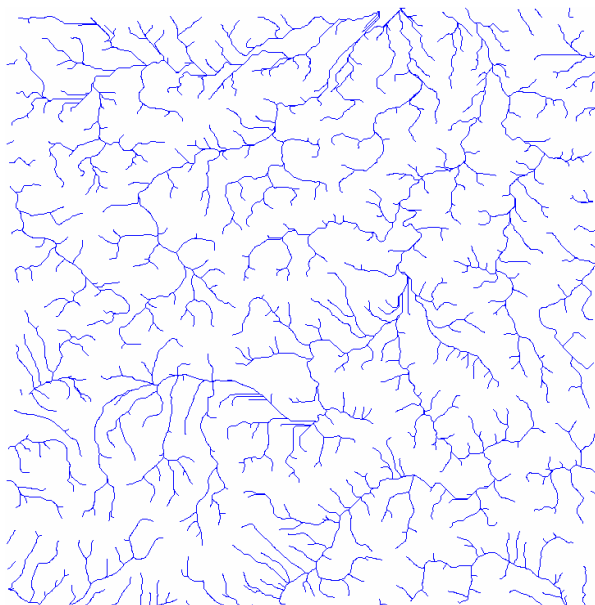
### Ordering the Drainage Network

The Drainage network ordering operation examines all drainage lines in the drainage network map, finds the nodes where two or more streams meet, and assigns a unique ID to each stream in between these nodes, as well as to the streams that only have a single node.

Operation-Tree > DEM Hydro-processing > Network and Catchment Extraction > **Drainage Network Ordering**



"05\_DNO500"



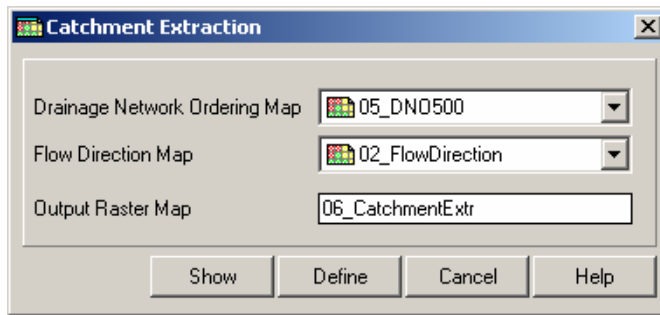
Composition:

DEM+DrainageNet+Lake(Blue)+Peaks+PriorityAreas(Red)+ProtectedAreas(Green)+Cities

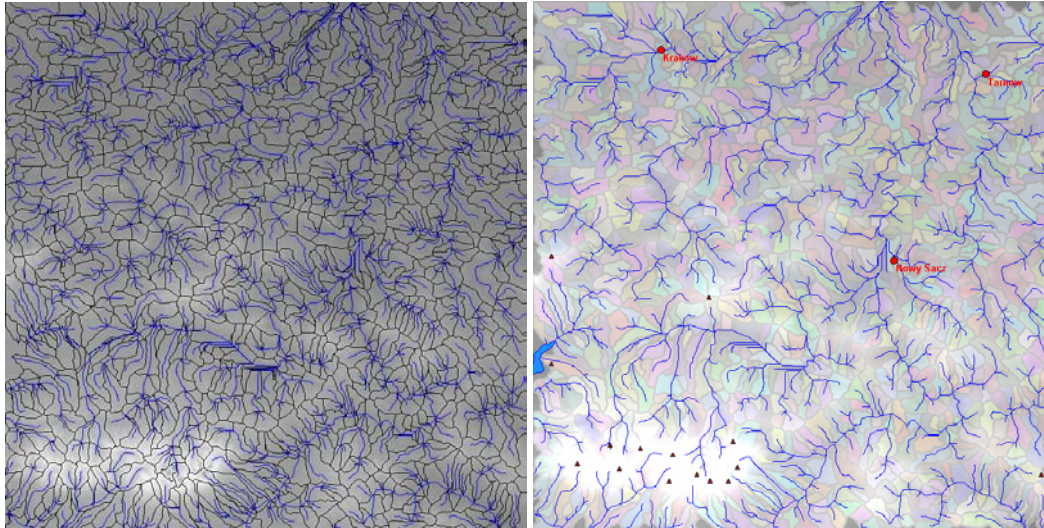
### Calculating the Catchment Areas

The Catchment extraction operation constructs catchments; a catchment will be calculated for each stream found in the output map of the Drainage network ordering operation. The operation uses a Flow direction map to determine the flow path of each stream.

Operation-Tree > DEM Hydro-processing > Network and Catchment Extraction > **Catchment Extraction**



"06\_CatchmentExtr"



Compositions:

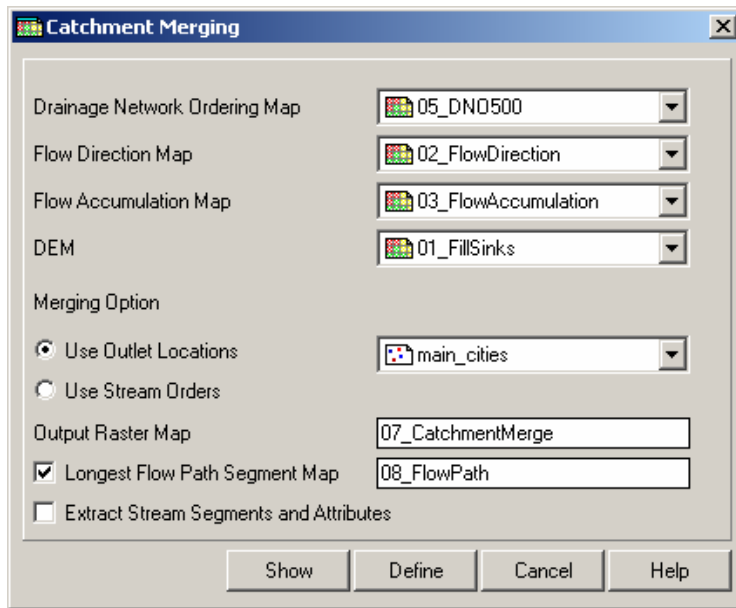
DEM+DrainageNetwork+CatchmentAreas

DEM+DrainageNetwork+Lake(Blue)+CatchmentAreas+Peaks+Cities

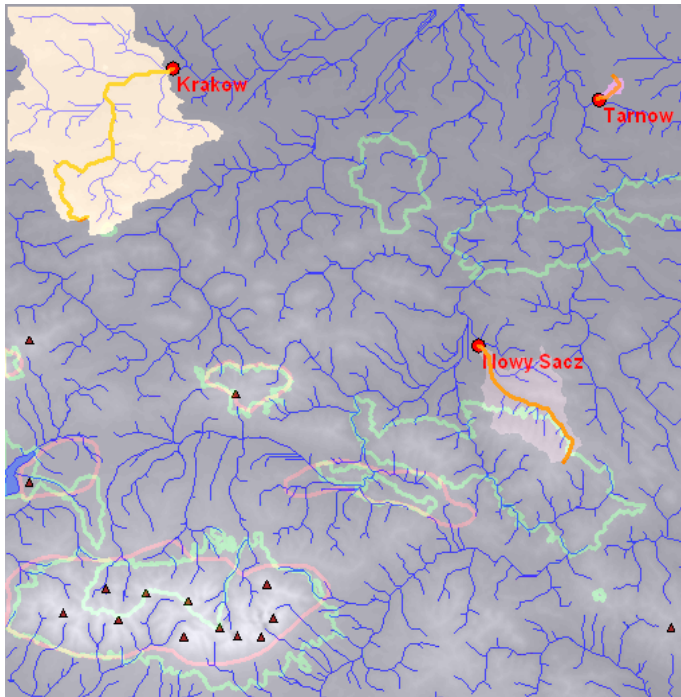
### Calculating the Catchment Merges

The Catchment merge operation is able to merge adjacent catchments, as found by the Catchment extraction operation. In fact, new catchments will be created on the basis of the Drainage network ordering map and its attribute table.

Operation-Tree > DEM Hydro-processing > Network and Catchment Extraction > **Catchment Merge**



"07\_CatchmentMerge"



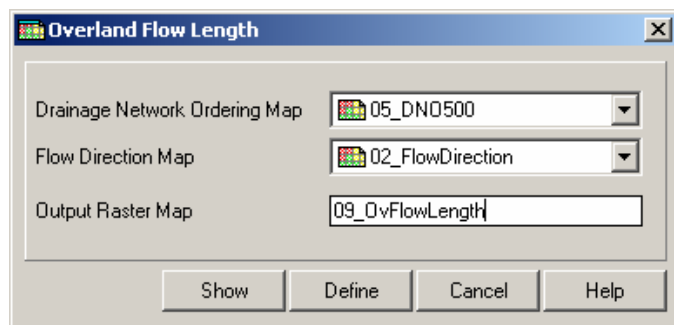
Composition:

DEM+DrainageNet+Lake+CatchMerge+FlowPath+Peaks+PriorityAreas+ProtectedAreas+Cities

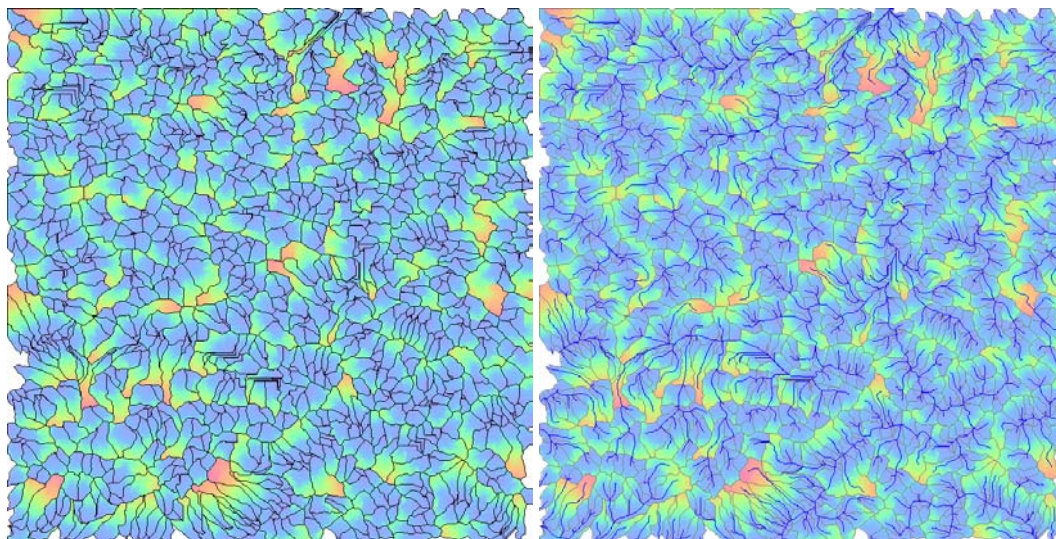
### Calculating the Overland Flow Length

The Overland Flow Length operation calculates for each pixel the overland distance towards the 'nearest' drainage according to the flow paths available in the Flow Direction map.

Operation-Tree > DEM Hydro-processing > Compound Parameter Extraction > **Overland Flow Length**



"09\_OvFlowLength"

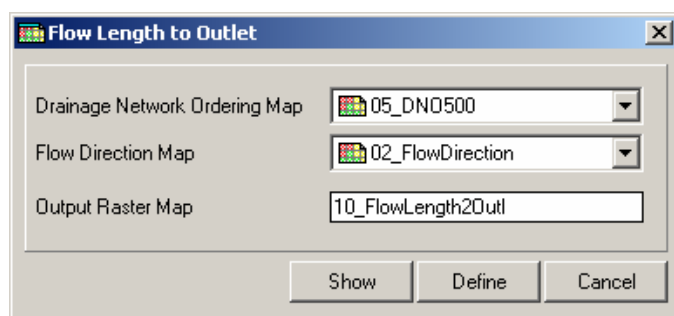


Composition: OvFlowLength+CatchmentAreas+DrainageNetwork

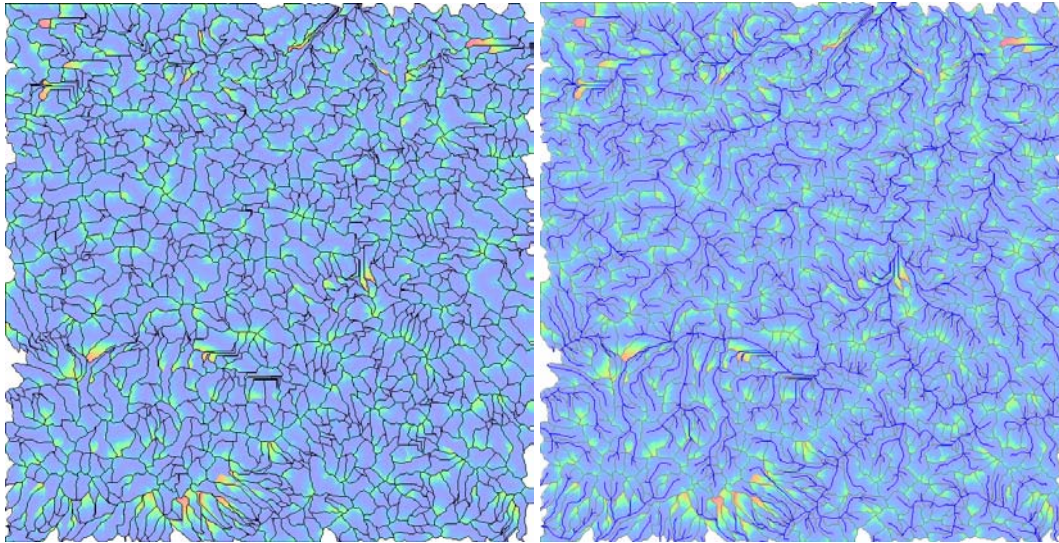
### Flow Length to Outlet

The *Overland Flow Length* operation calculates the distance between every pixel and the outlet of the catchment area. This operation, just like *Overland Flow Length*, requires a *Drainage Network Ordering* and a *Flow Direction Map*.

Operation-Tree > DEM Hydro-processing > Network and Catchment Extraction > **Flow Length to Outlet**



"10\_FlowLength2Outl"

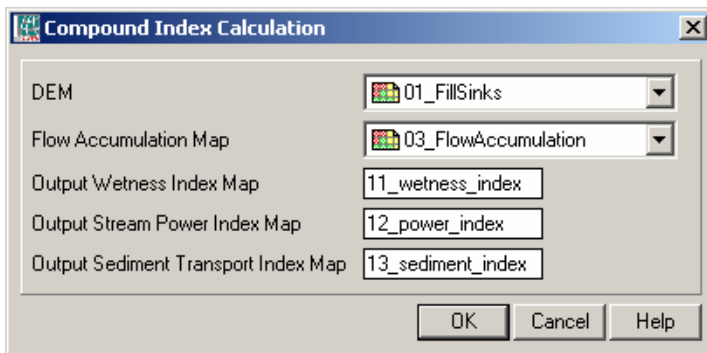


Composition: FlowLenthtoOutlet+CatchmentAreas+DrainageNetwork

### Compound Index Calculation

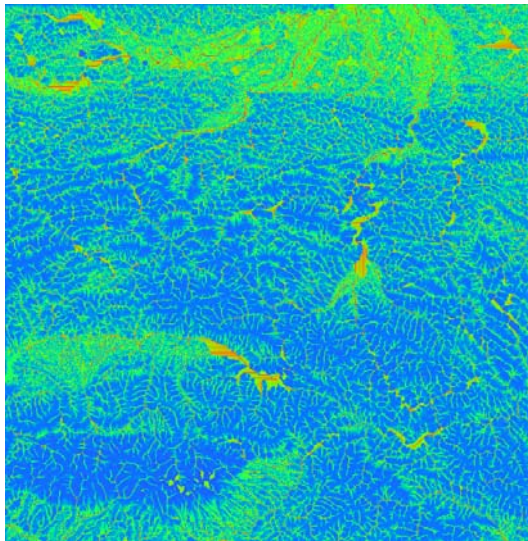
*In Compound Index Calculation, a number of scripts (routines) are given here to calculate a number of maps that are relevant with respect to watershed management, soil erosion and conservation type of studies.*

Operation-Tree > DEM Hydro-processing > Compound Parameter Extraction > **Compound Index Calculation**



"11\_wetness\_index"

"12\_power\_index" "13\_sediment\_index"



Wetness index

**The wetness index** sets catchment area in relation to the slope gradient. This is basically the famous:  $w = \ln(A_s/\tan(\beta))$  (Beven and Kirkby, 1993).

An idea of the spatial distribution and zones of saturation or variable sources for runoff generation is obtained.



Power index (values over 10% in black)

**The stream power index** is the product of catchment area and slope and could be used to identify suitable locations for soil conservation measures to reduce the effect of concentrated surface runoff.



Sediment index (values over 10% in black)

**The sediment transport index** accounts for the effect of topography on erosion. The two-dimensional catchment area is used instead of the one-dimensional slope length factor as in the Universal Soil Loss Equation.