"Morphostructural analysis of Tirana city center (Albania) under GIS and CAD technology"

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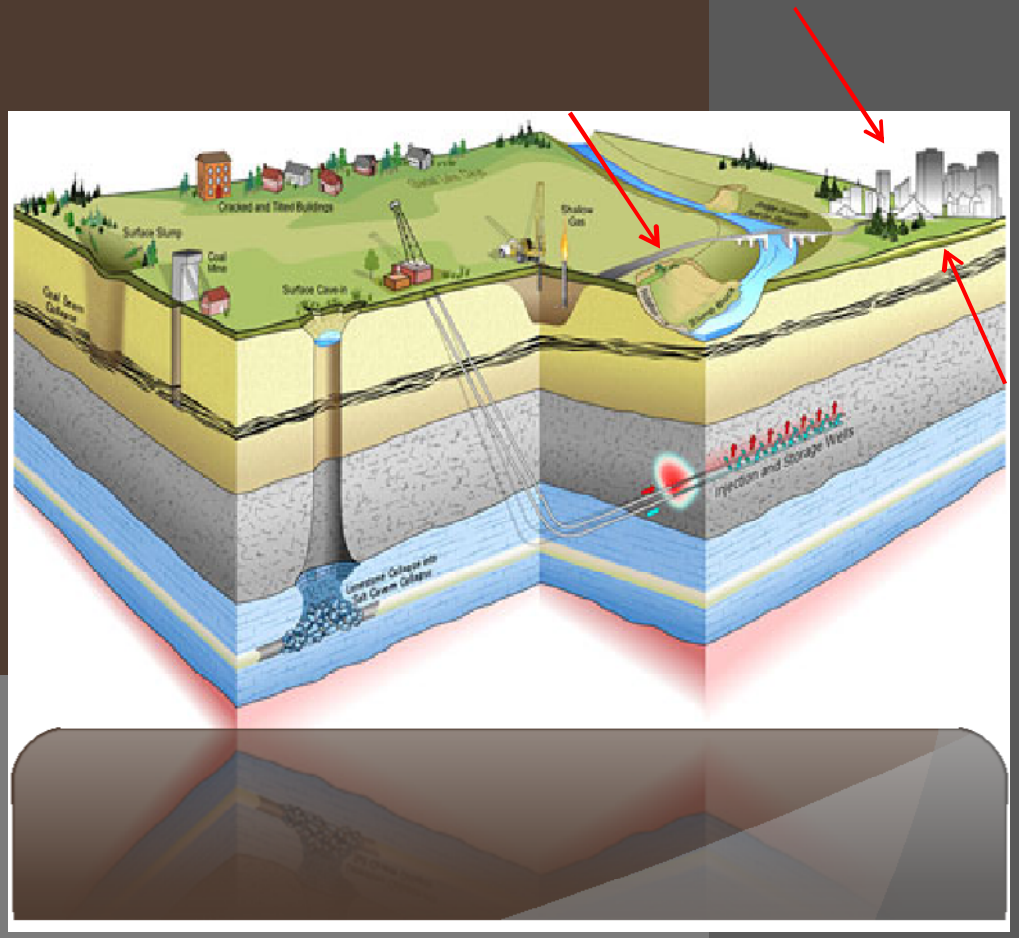
Urban areas: first approach

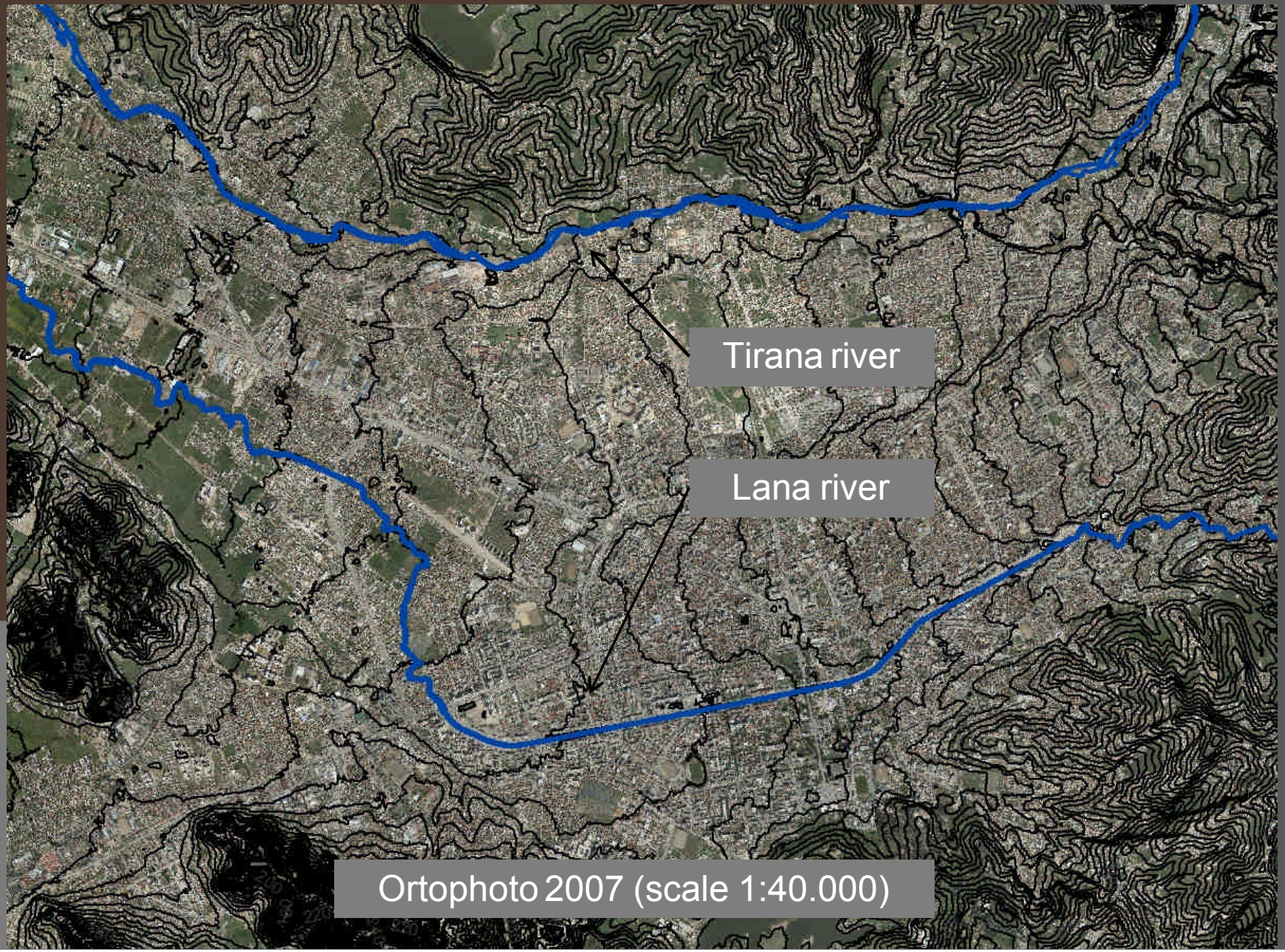
- Landscape forms and related geological processes in an urban area are heavily masked by a very intense "coverage" caused by buildings, infrastructure and underground utilities.



Object

- Reconstruct main recent and relict morphostructures despite the intense urban coverage of Tirana.

The study area is the city center with the available datas maximum density.



Data set

The data set provided by *Polytechnic University of Tirana* treated under GIS and CAD environments:

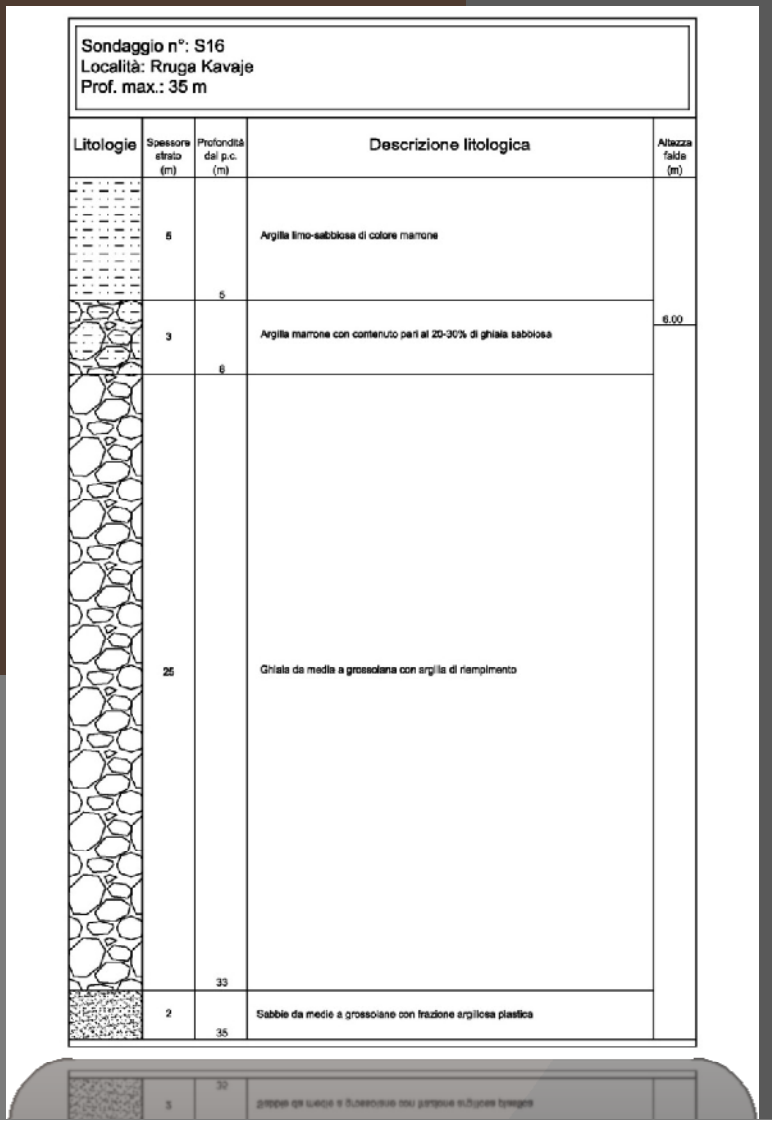
- 27 stratigraphy from continuous core surveys furnished with geotechnical parameters
- Digital Terrain Model acquired by laser scanner and filtered by infrastructure and buildings heights (year 2007)
- Orthophotos (year 2007)
- Historical topographic maps (1927-1937)

Study phases

1. Reconstruction of the geological subsurface model
2. Identification of surface forms in connection with the geological model proposed
3. Comparision

1. Subsurface model

- At first data from boreholes allowed the production of geological sections that have been used to reconstruct the geometric relationships between the lithotypes and to analyze these ones as depositional facies.

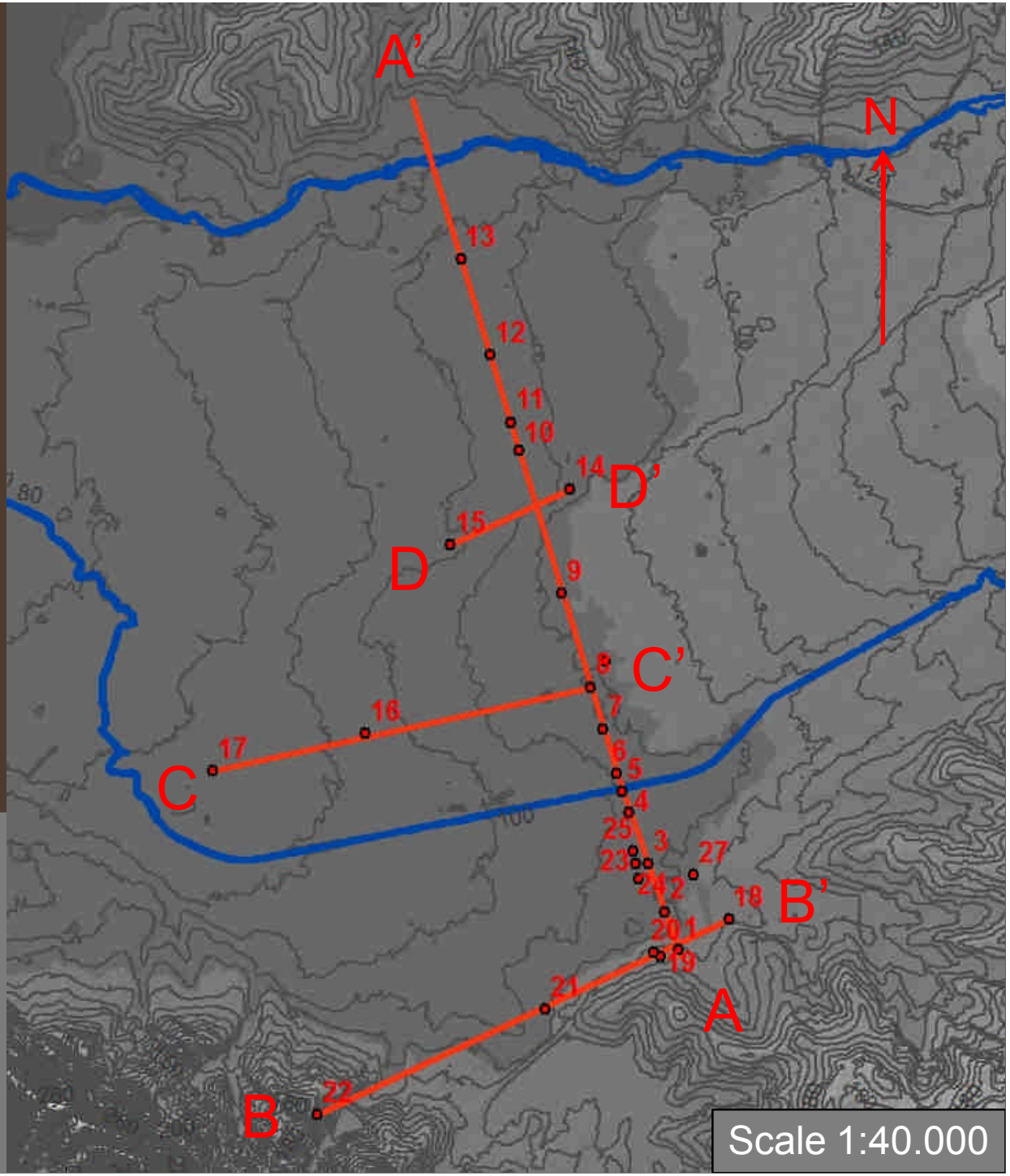


Sondaggio n°: S16
Località: Rruga Kavaje
Prof. max.: 35 m

Litologie	Spessore strato (m)	Profondità dal p.c. (m)	Descrizione litologica	Altezza falda (m)
	5	5	Argilla limo-sabbiosa di colore marrone	
	3	8	Argilla marrone con contenuto pari al 20-30% di ghiaia sabbiosa	6.00
	25	33	Ghiaia da media a grossolana con argilla di riempimento	
	2	35	Sabbie da medie a grossolane con frazione argillosa plastica	

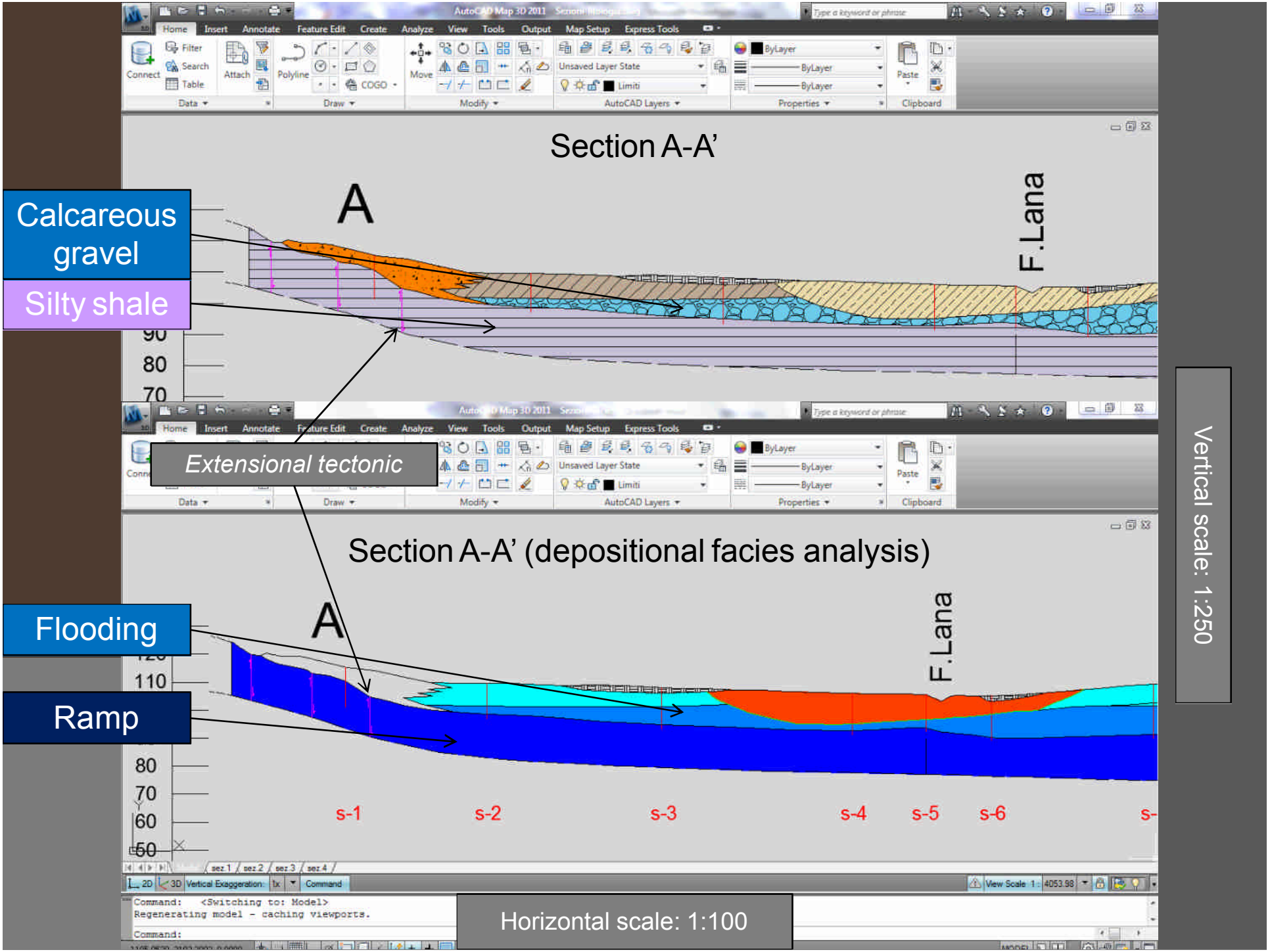
The sections follow 2 main directions:

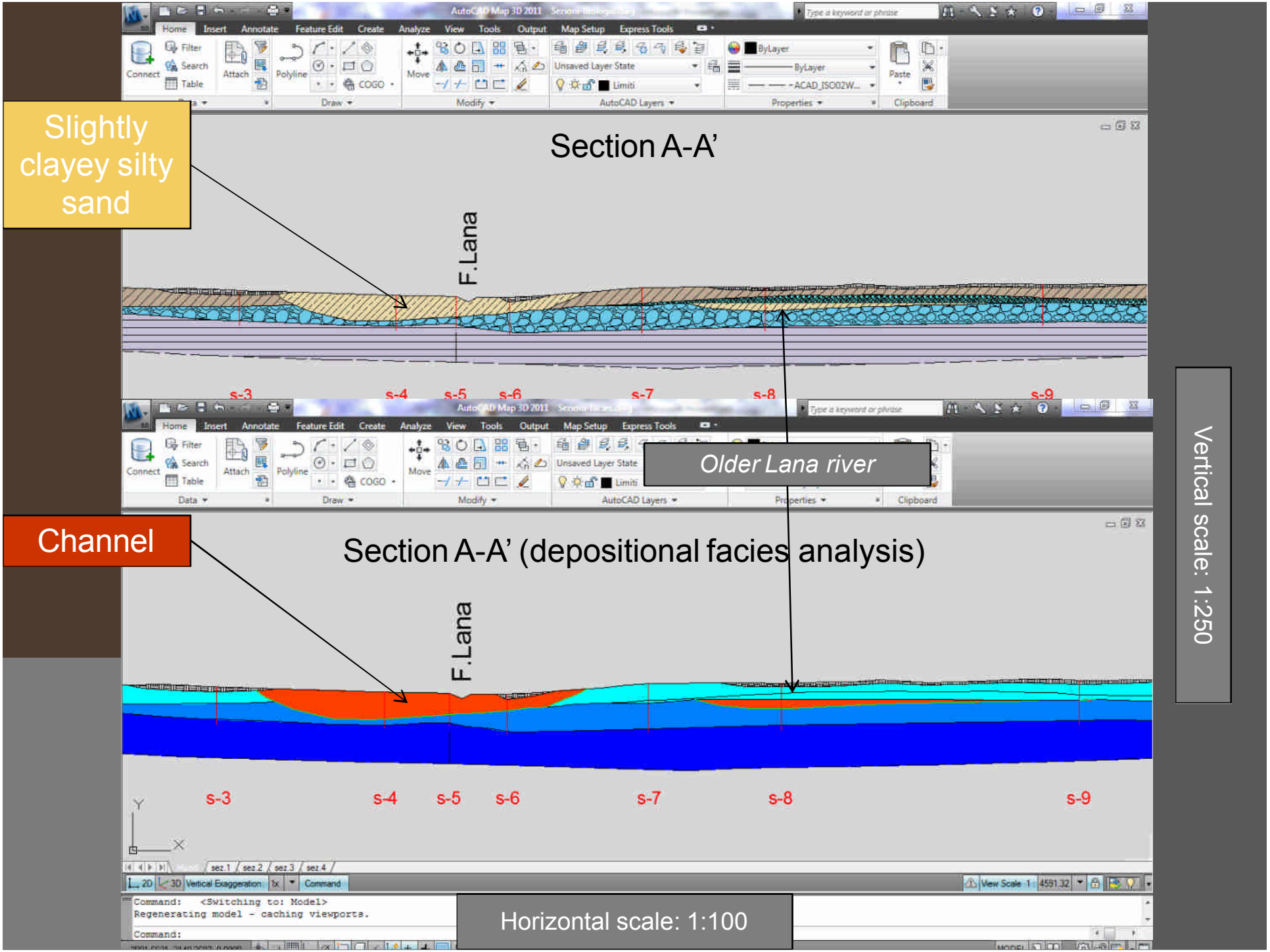
- One more or less N-S, normal to main rivers flow direction
- One approximately E-W, parallel to the main rivers flow direction

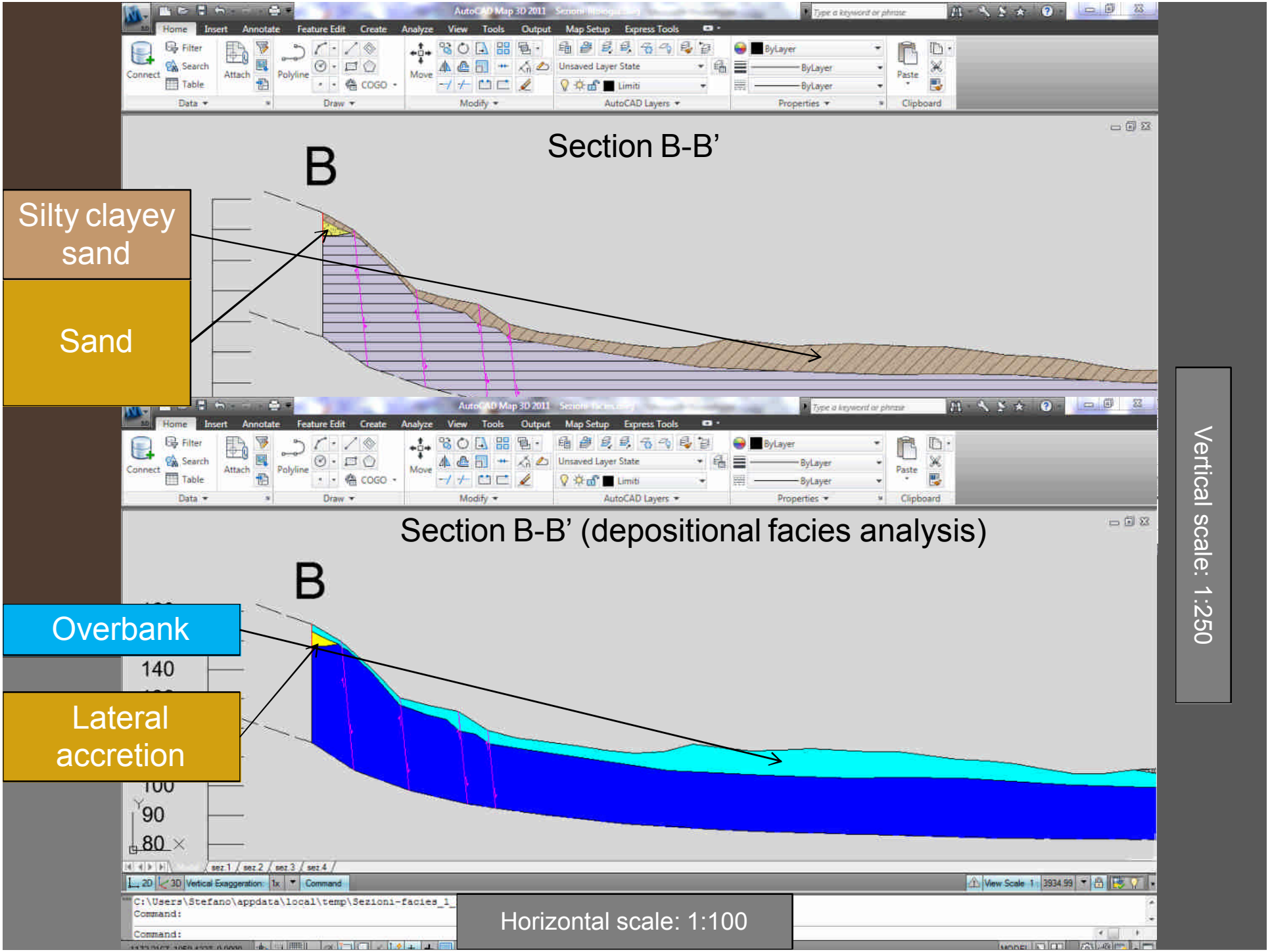


Were thus identified 2 depositional systems with related facies:

- Marine depositional system:
  - Ramp facies
- Continental fluvial depositional system:
  - Flooding facies
  - Channel facies
  - Lateral accretion facies
  - Overbank facies

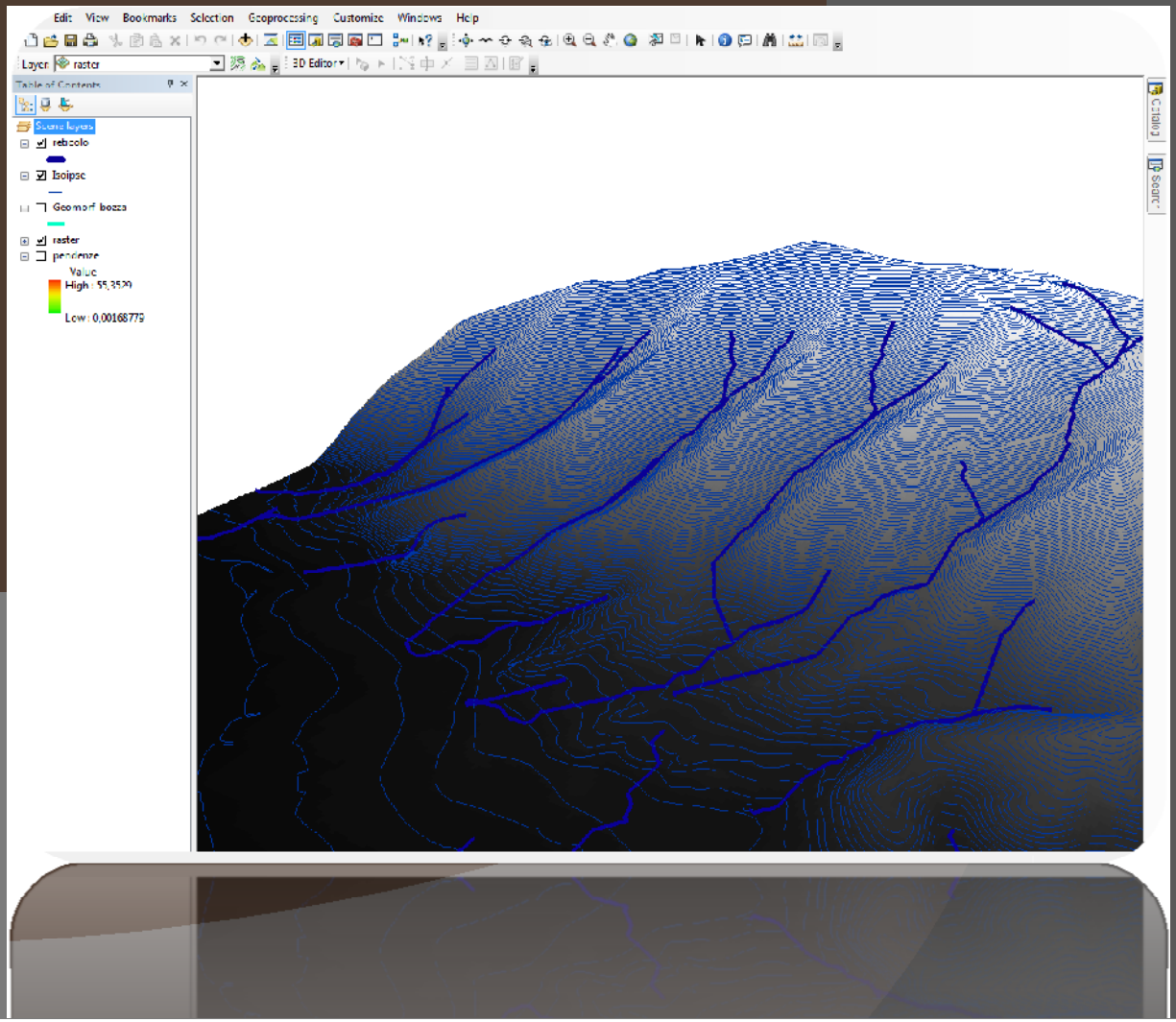

Section A-A’
A
F.Lana
Calcareous gravel
Silty shale
Extensional tectonic
Section A-A’ (depositional facies analysis)
A
F.Lana
Flooding
Ramp
s-1
s-2
s-3
s-4
s-5
s-6
Vertical scale: 1:250
Horizontal scale: 1:100

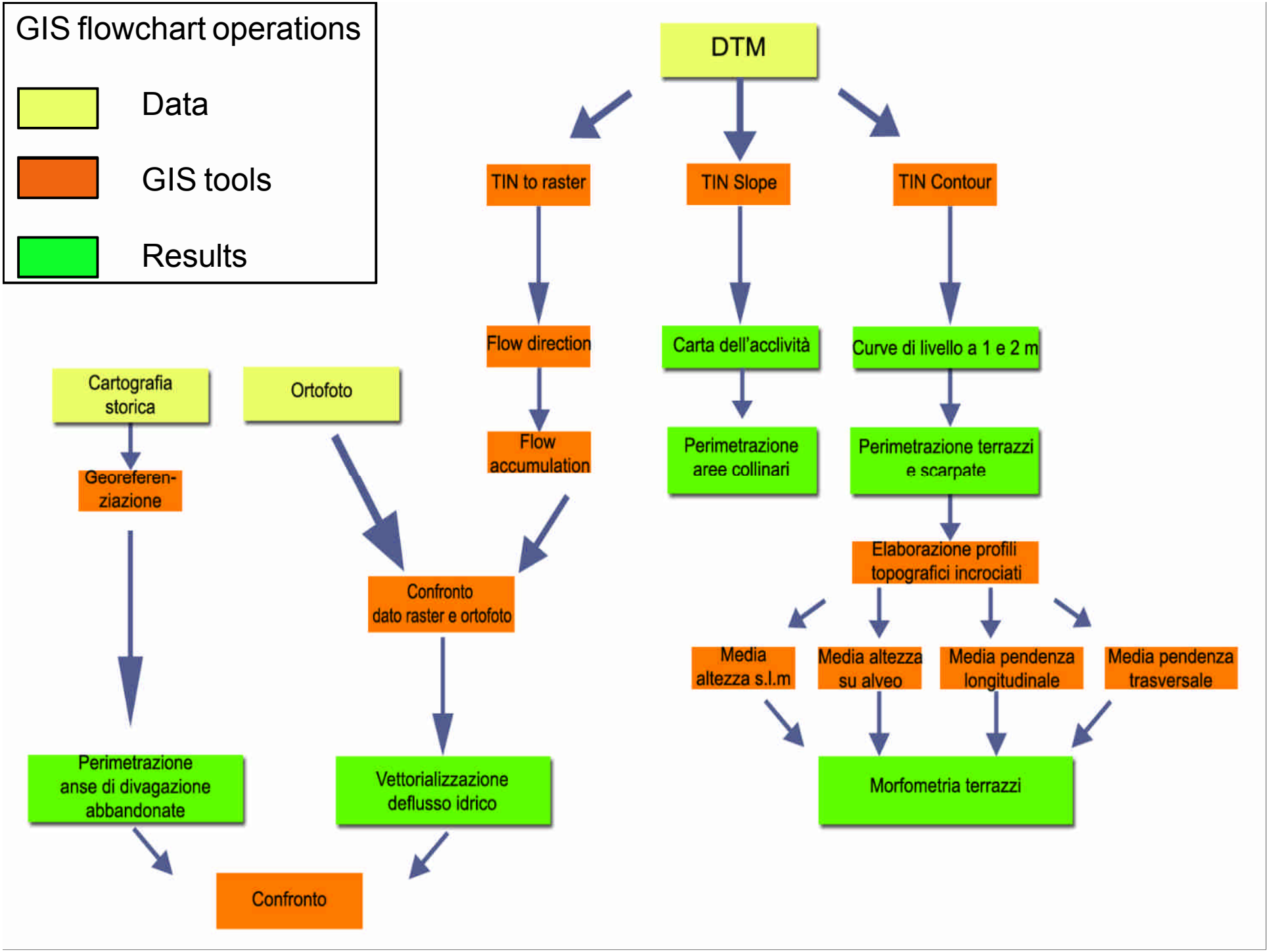

Slightly clayey silty sand
Section A-A'
F.Lana
s-3
s-4
s-5
s-6
s-7
s-8
s-9
Older Lana river
Channel
Section A-A' (depositional facies analysis)
F.Lana
s-3
s-4
s-5
s-6
s-7
s-8
s-9
Vertical scale: 1:250
Horizontal scale: 1:100


Section B-B’
B
Silty clayey sand
Sand
Section B-B’ (depositional facies analysis)
B
Overbank
Lateral accretion
140
90
80
Vertical scale: 1:250
Horizontal scale: 1:100

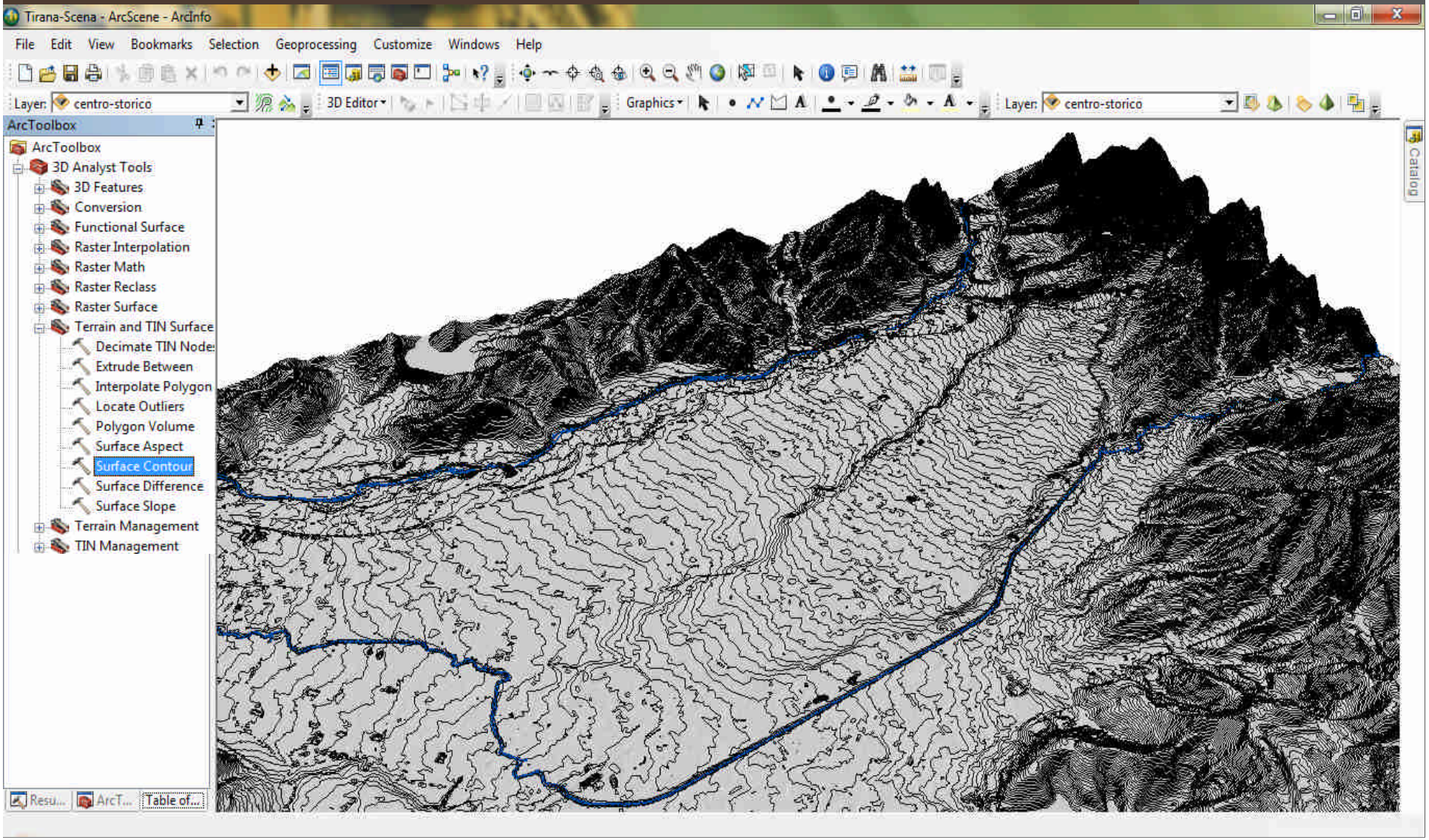
2. Surface morphostructures

- In this phase the DTM was used under ESRI ArcGIS 10© environment to highlight the surface morphostructures.

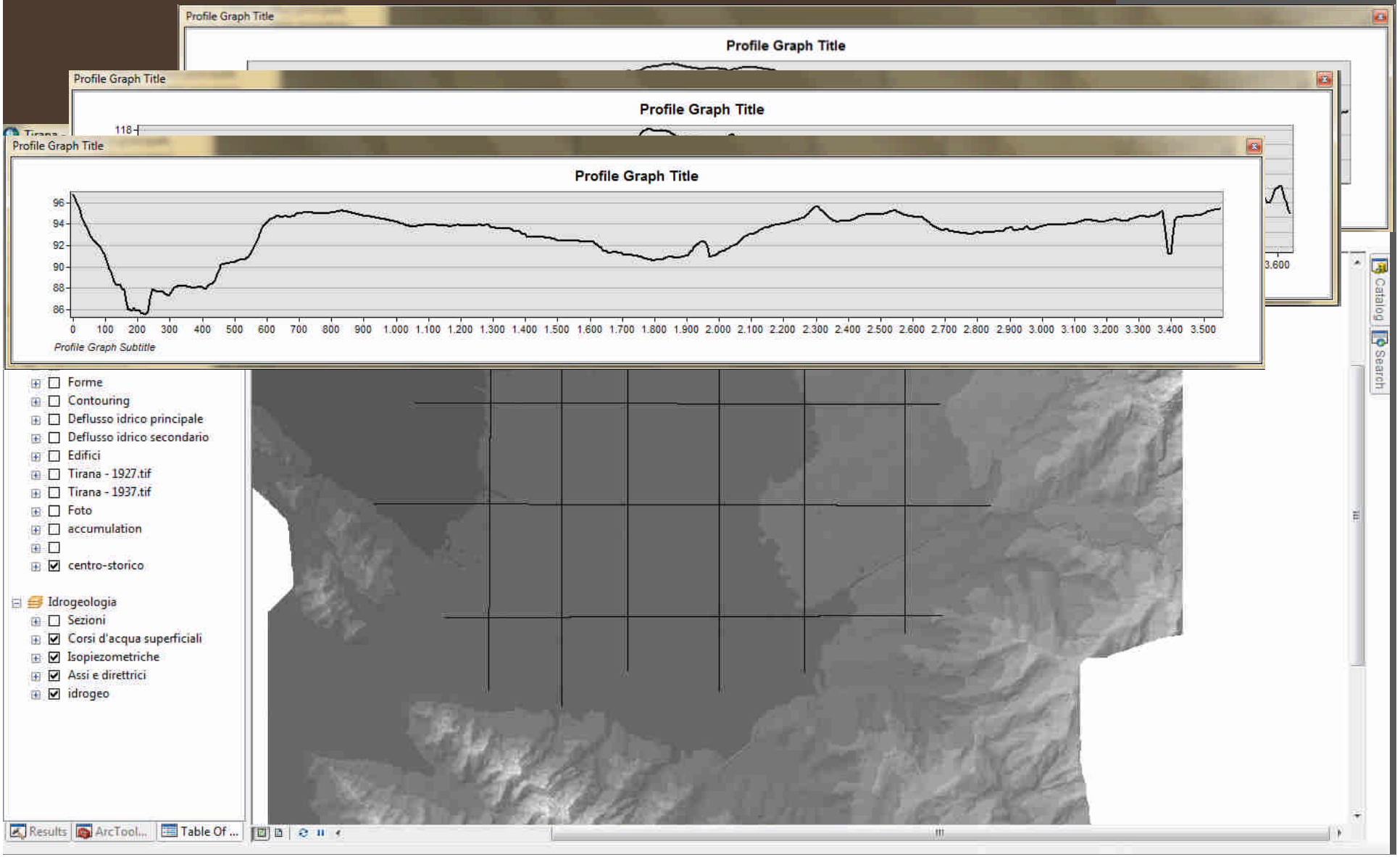



GIS flowchart operations
Data
GIS tools
Results
DTM
TIN to raster
TIN Slope
TIN Contour
Flow direction
Carta dell'acclività
Curve di livello a 1 e 2 m
Cartografia storica
Ortofoto
Flow accumulation
Perimetrazione aree collinari
Perimetrazione terrazzi e scarpate
Georeferen-ziazione
Elaborazione profili topografici incrociati
Confronto dato raster e ortofoto
Media altezza s.l.m
Media altezza su alveo
Media pendenza longitudinale
Media pendenza trasversale
Perimetrazione anse di divagazione abbandonate
Vettorializzazione deflusso idrico
Morfometria terrazzi
Confronto

- *3D Analyst Tools -> Terrain and TIN Surface ->* **Surface contour:** first of all a detailed contouring was done (with metric gradient).



- The contour lines along with several height profiles (obtained using *3D Analyst Toolbar -> Interpolate Line*) allowed the identification of plain areas and scarps related to river terraces of the main waterways.



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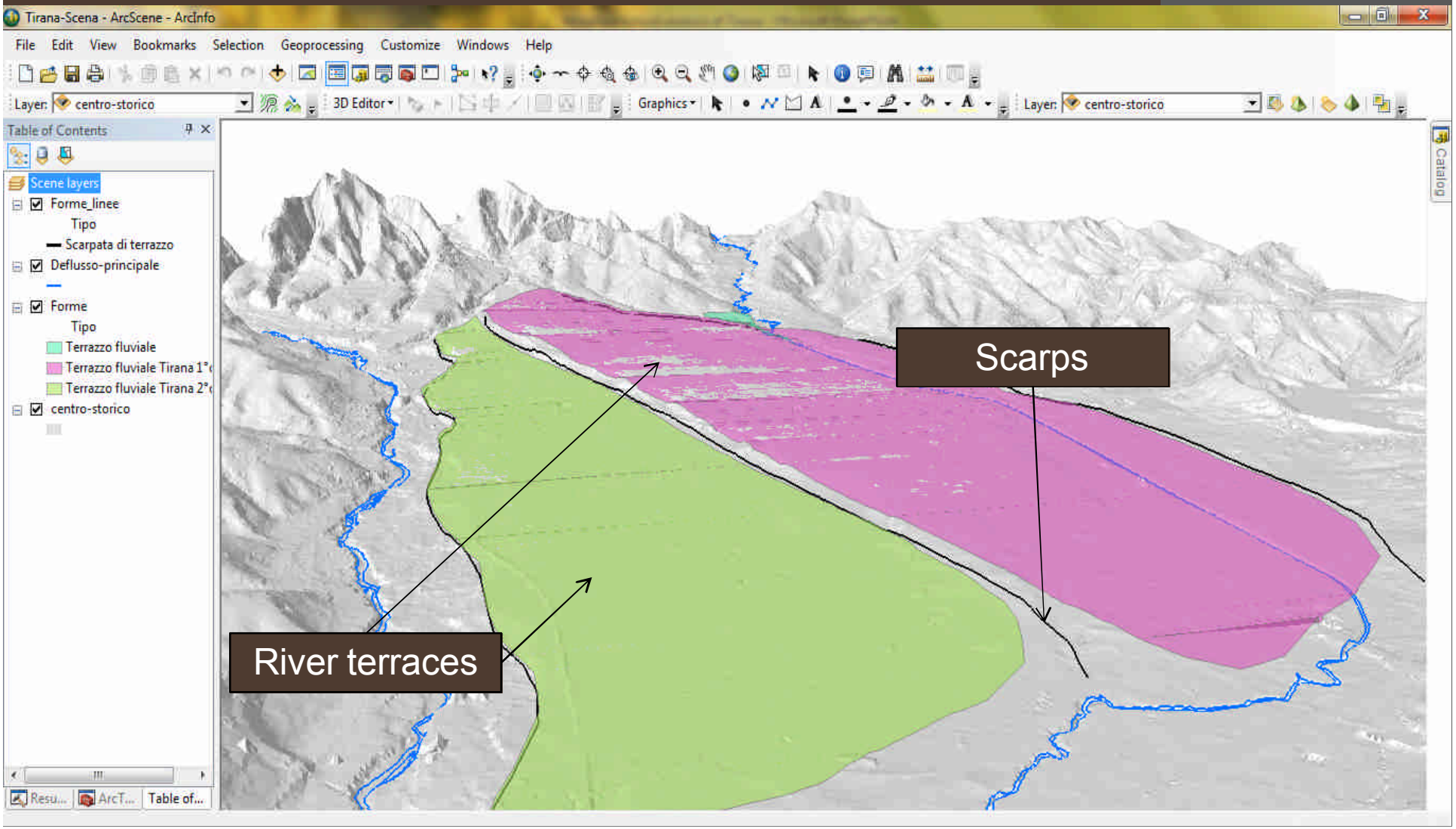
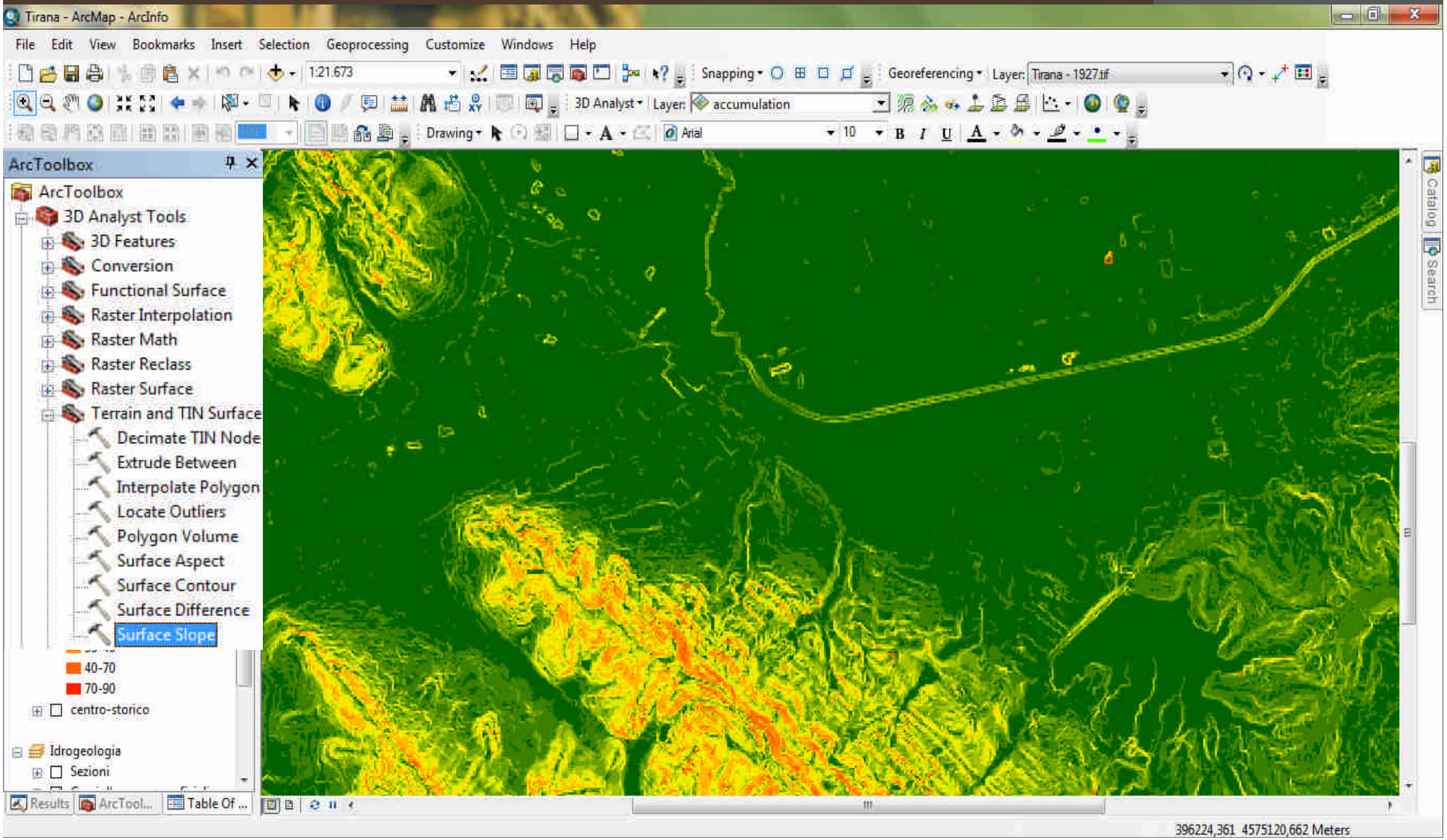
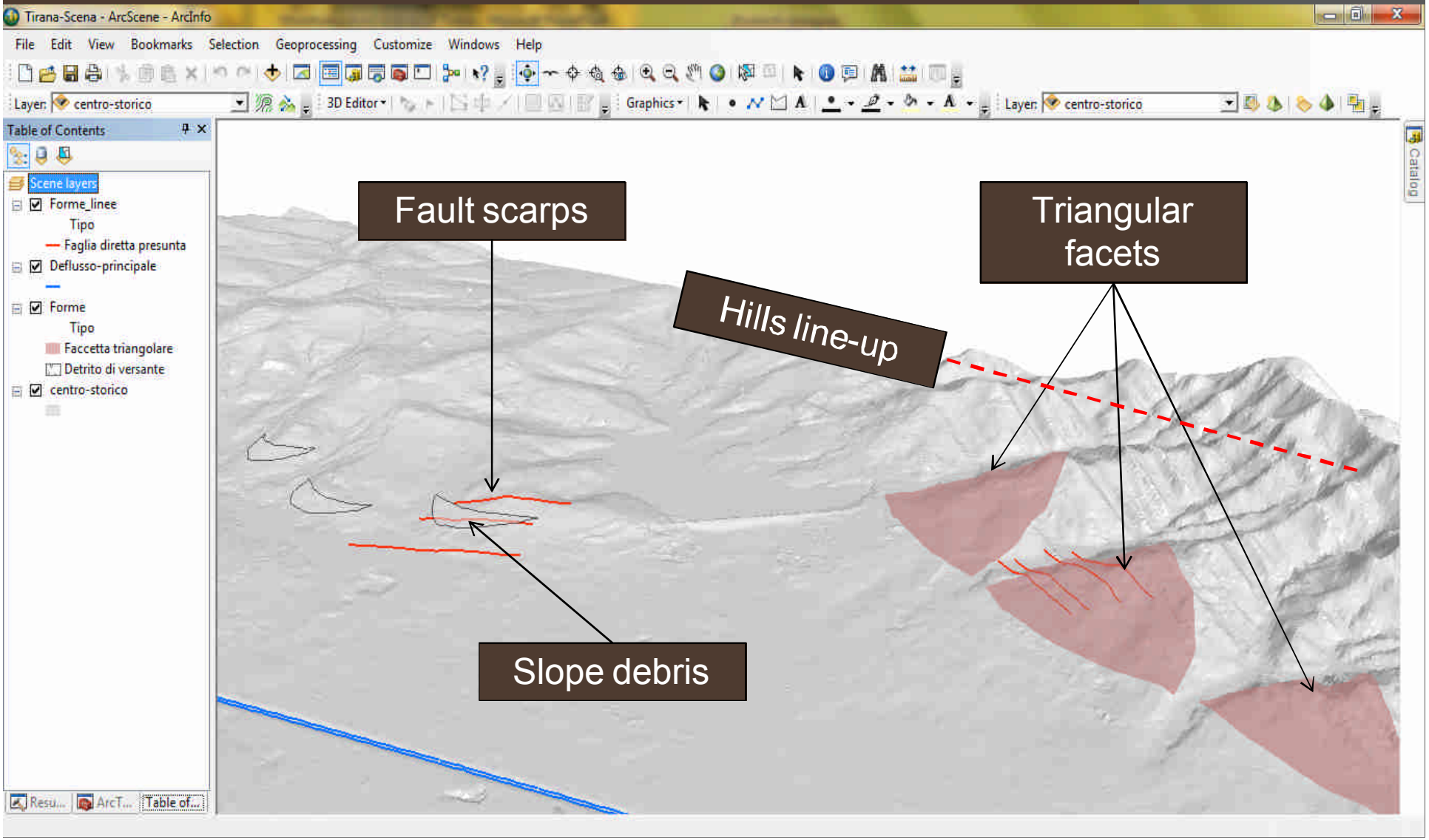


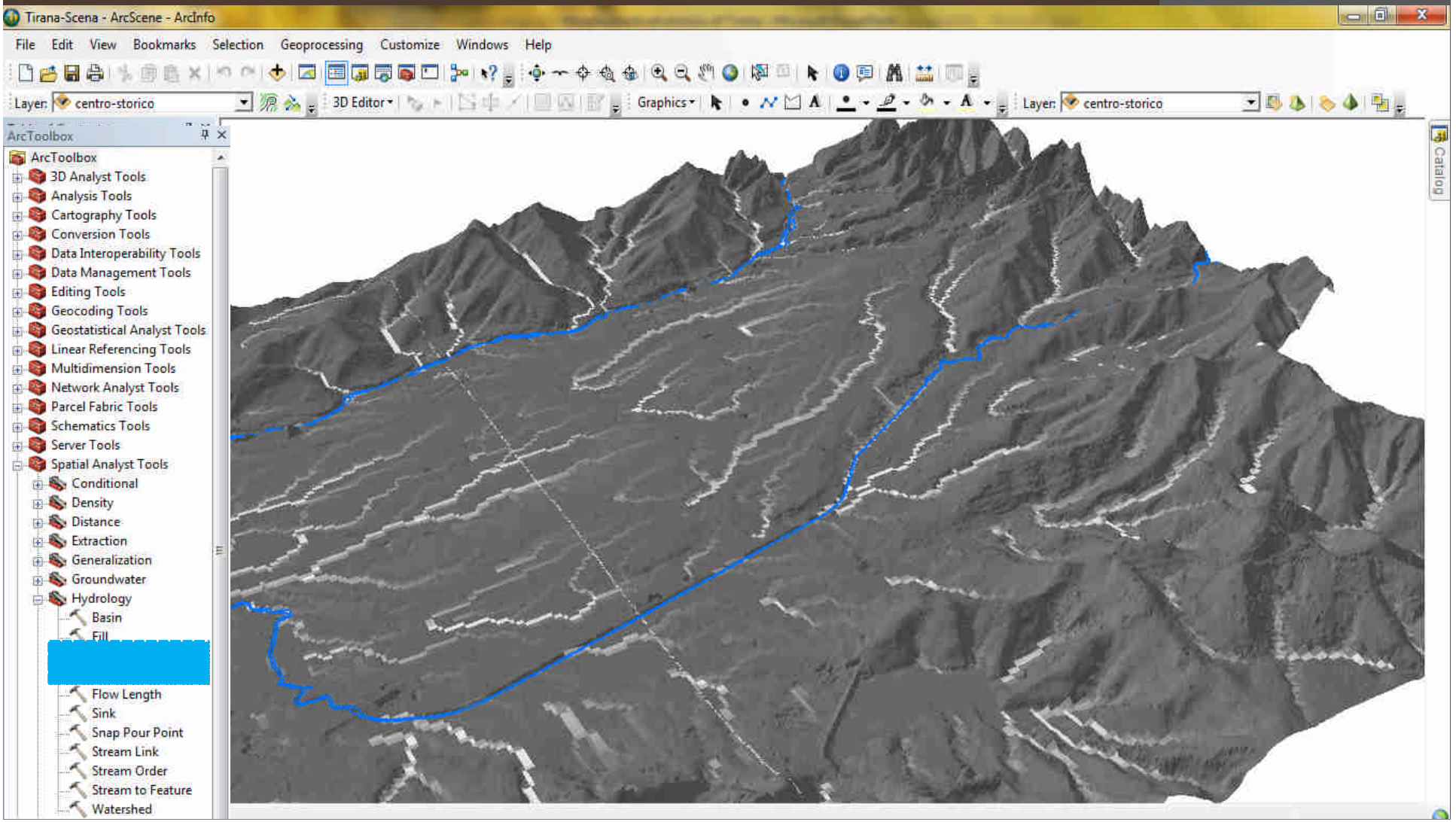
- *3D Analyst Tools -> Terrain and TIN Surface ->* **Surface slope:** a steepness map was generated to outline the hills basis.



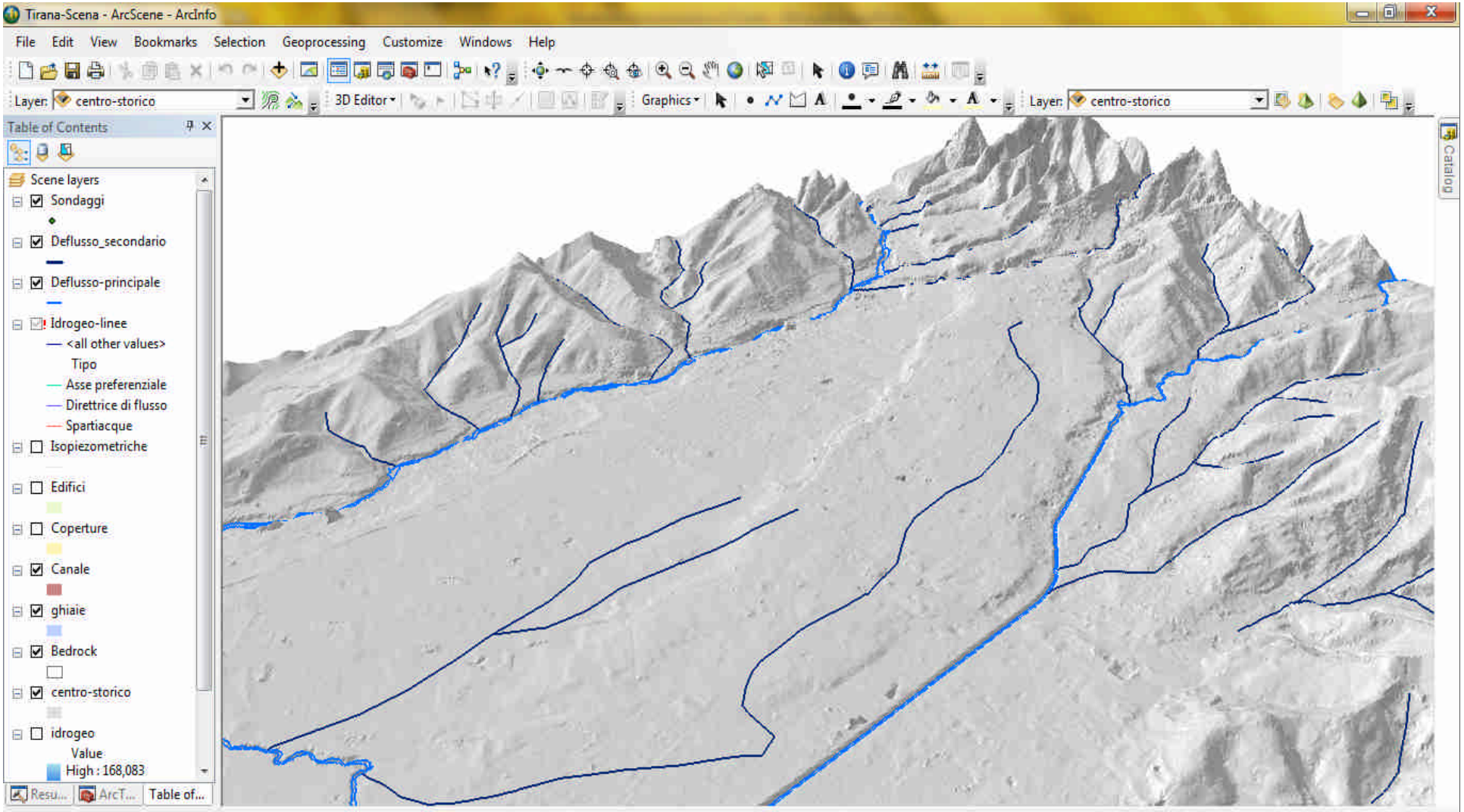
- This map together with the contour lines allowed the identification of some tectonic evidences at the hill basis such as triangular facets, hills line-up, fault scarps, etc.



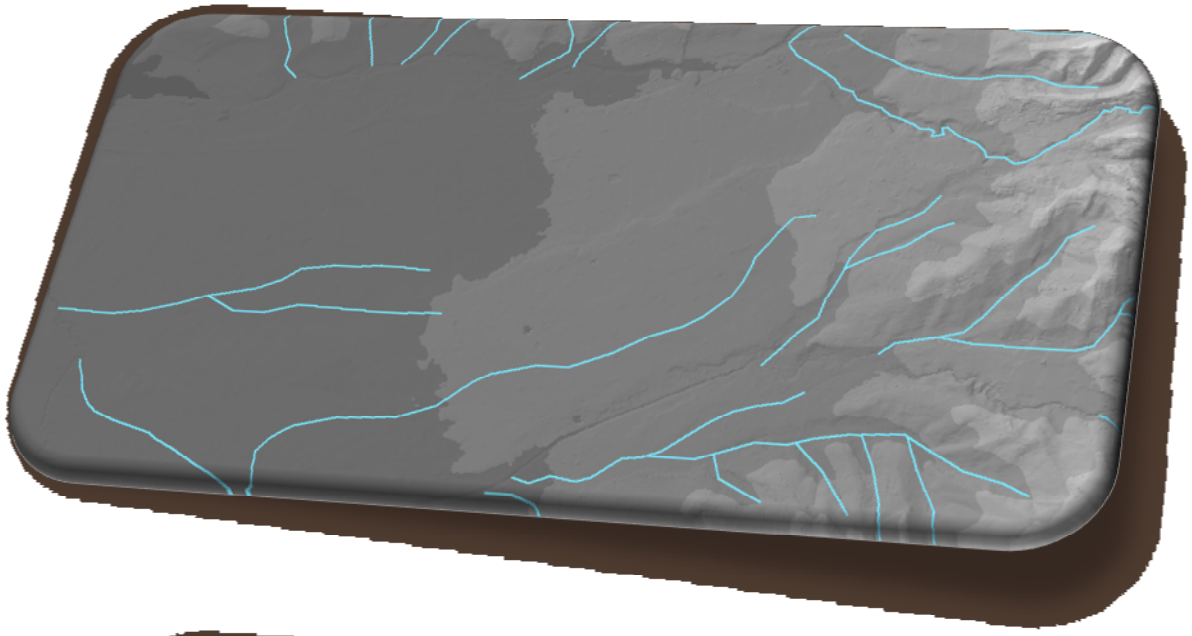
- *Spatial Analyst Tools -> Hydrology ->* **Flow direction and Flow accumulation:** these tools have been applied to highlight the trend of surface water runoff.



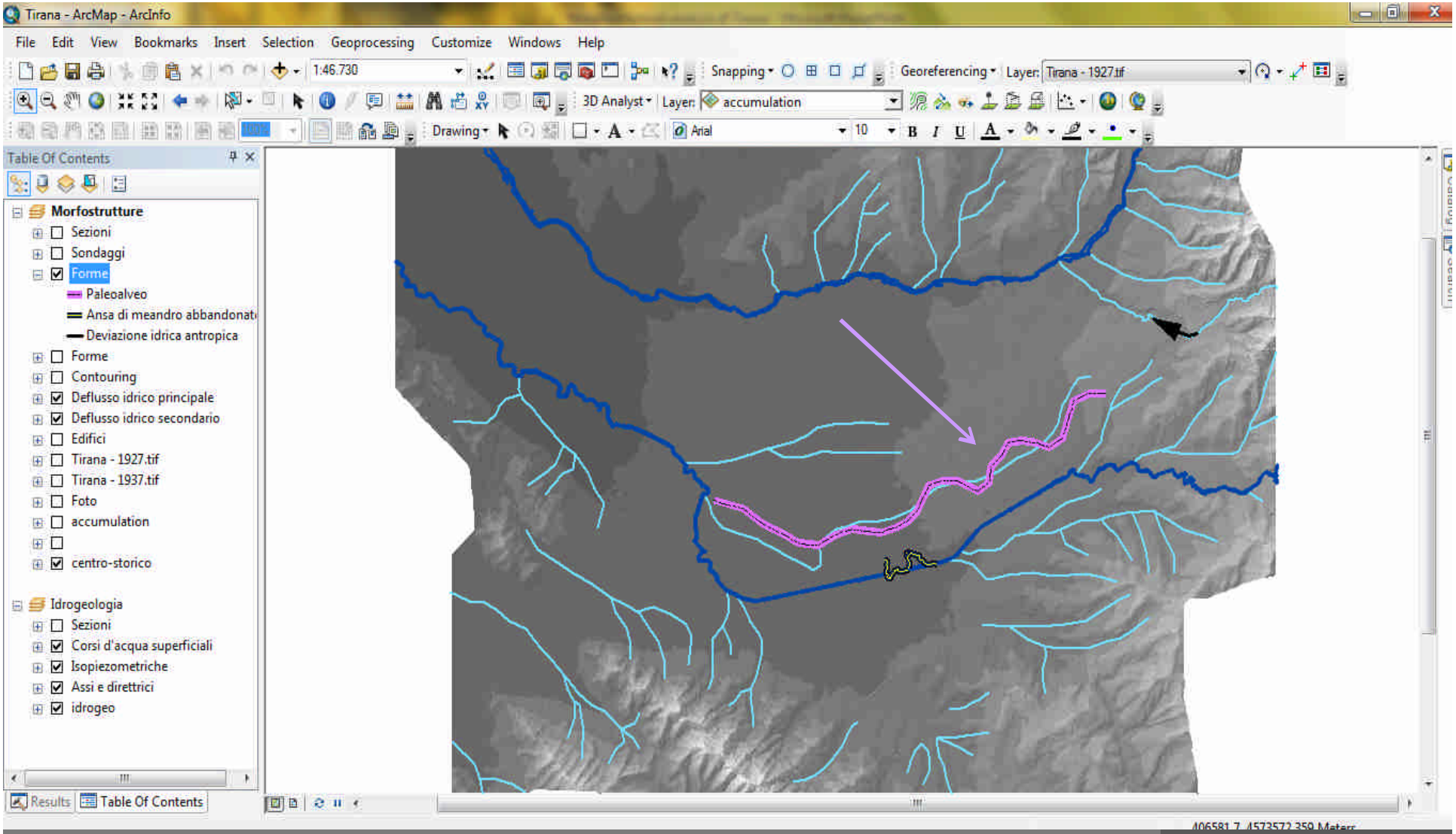
- Flow accumulation map
- Ortophotos (2007)
- Actual urban secondary waterflow



- Actual urban secondary waterflow



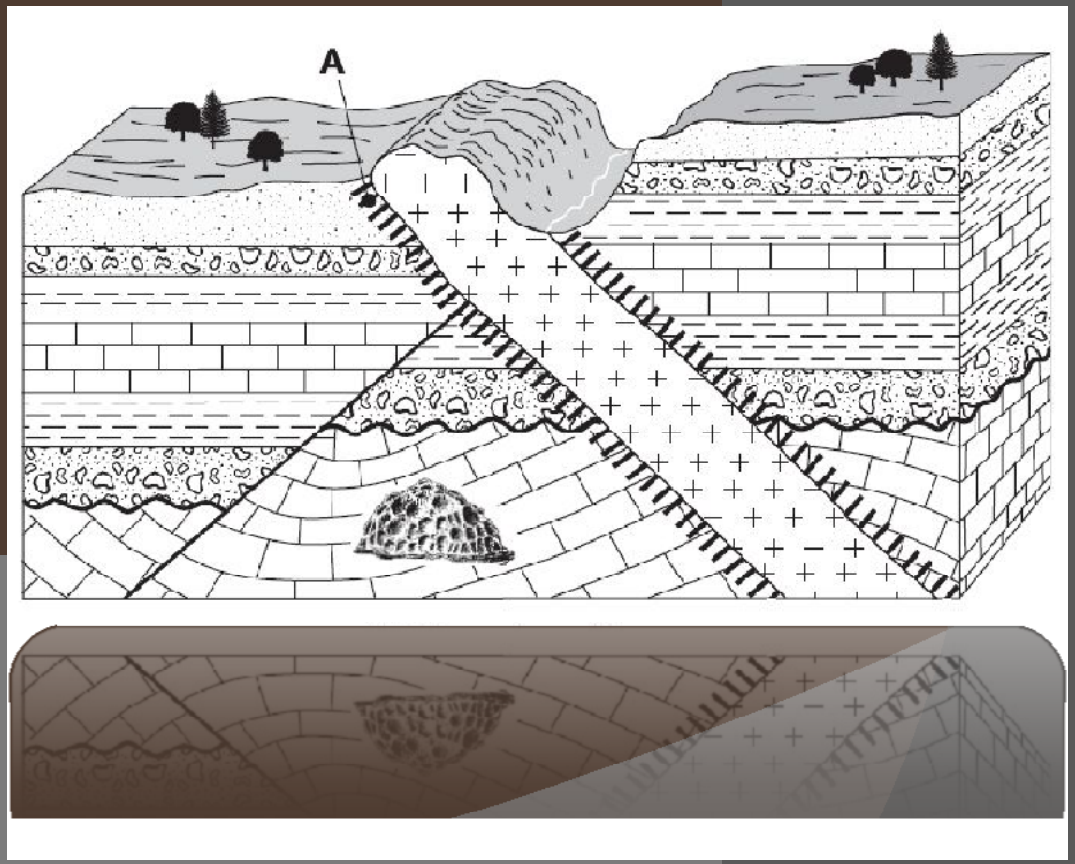
- Actual secondary urban waterflow
- Hystorical maps (1927-37)
- Older Lana river course

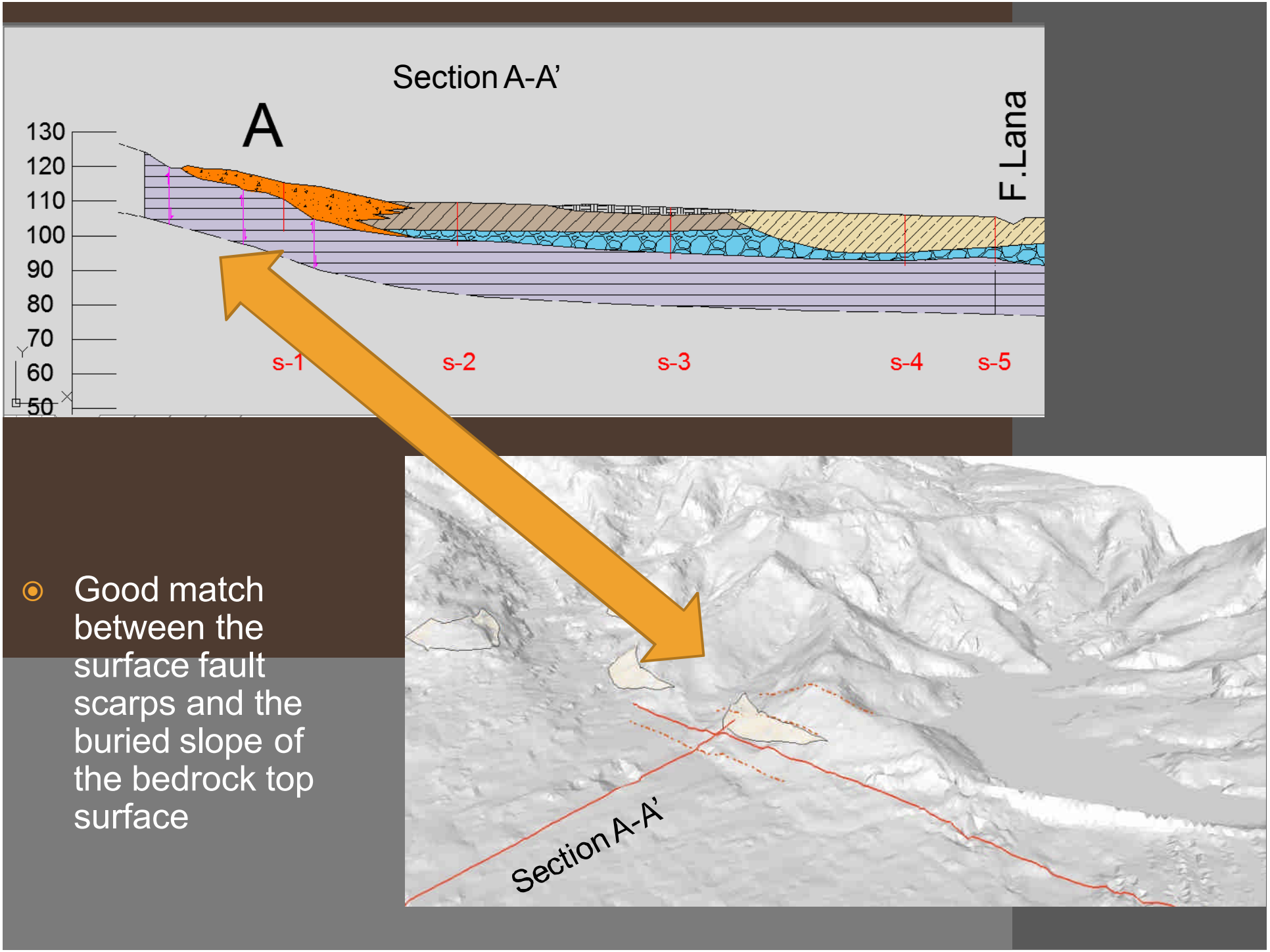


- Older Lana river course

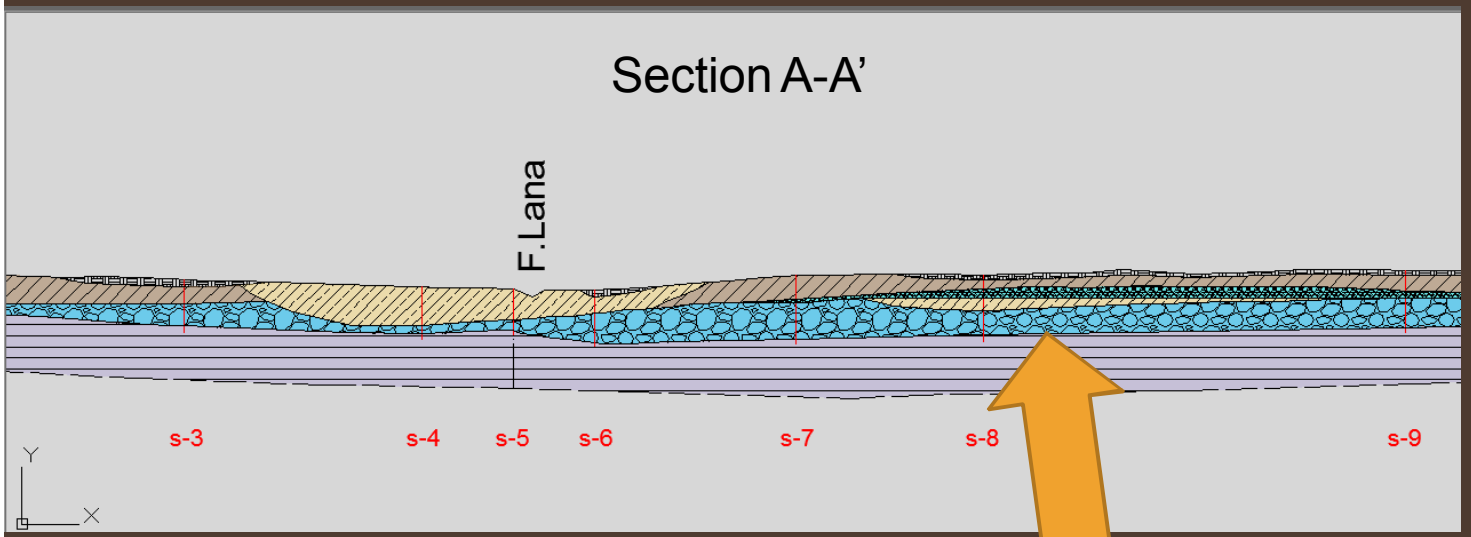
3. Comparison

In the last phase of the study a comparision between surface and buried morphostructures was done.

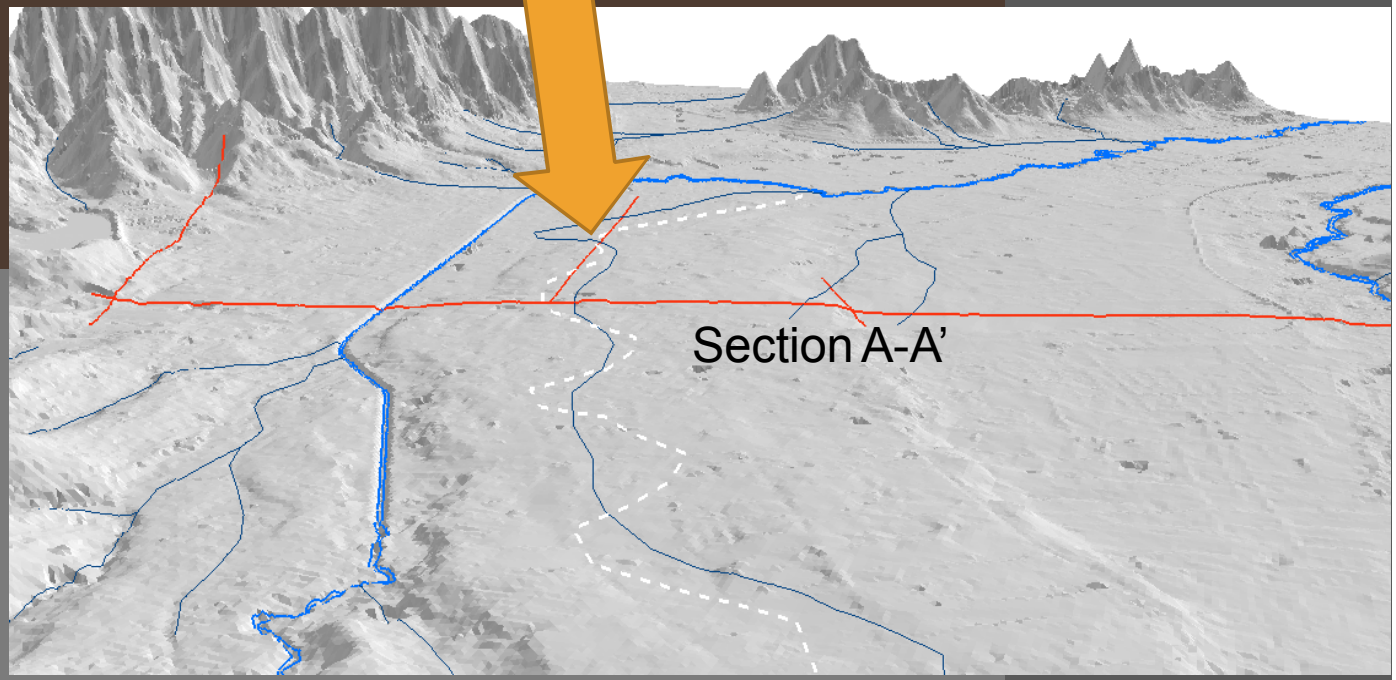


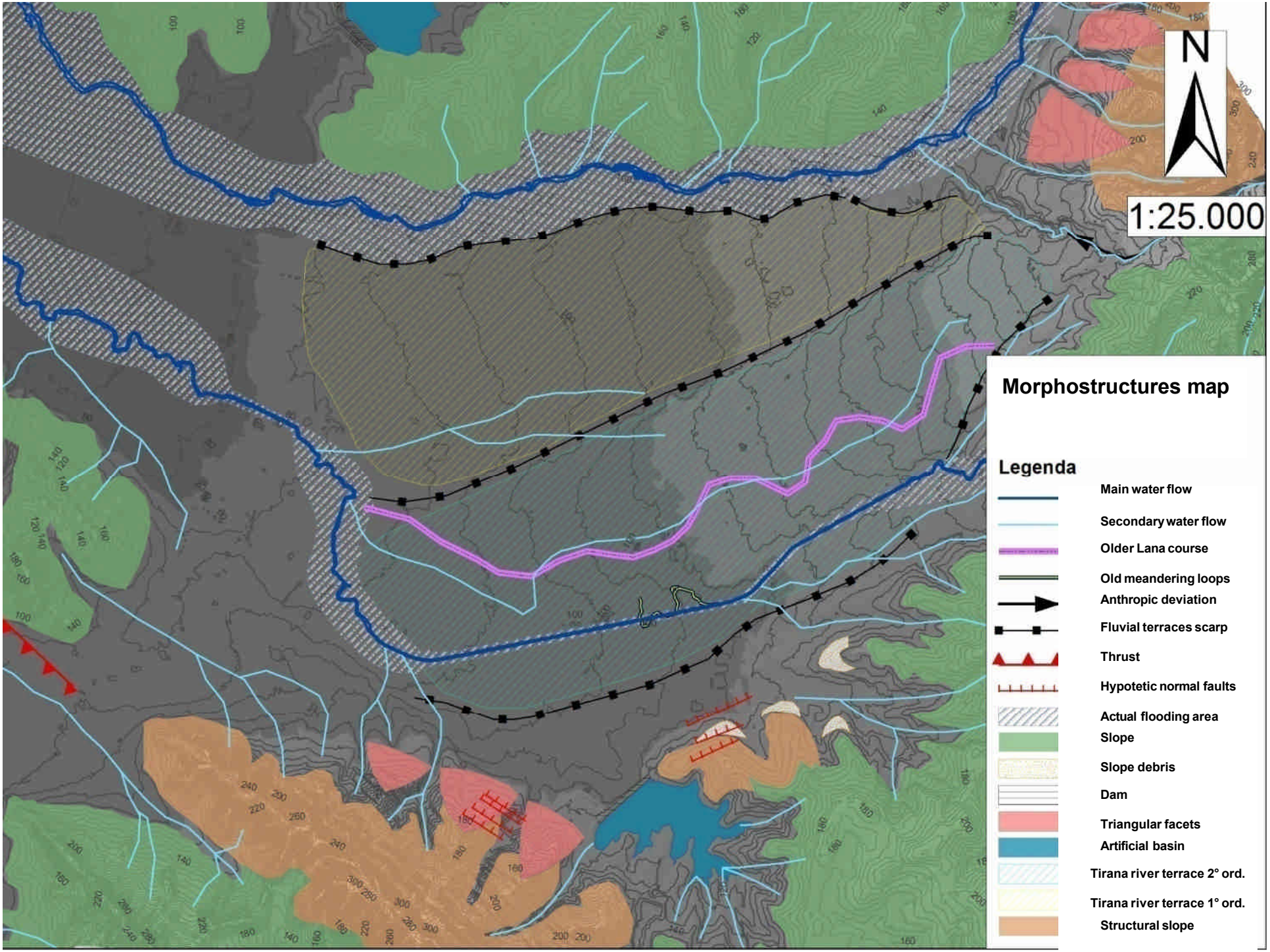


- Good match between the surface fault scarps and the buried slope of the bedrock top surface



- Good match between the surface trend and the buried channels of the older Lana course.




N
1:25.000
Morphostructures map
Legenda
Main water flow
Secondary water flow
Older Lana course
Old meandering loops
Anthropic deviation
Fluvial terraces scarp
Thrust
Hypotetic normal faults
Actual flooding area
Slope
Slope debris
Dam
Triangular facets
Artificial basin
Tirana river terrace 2° ord.
Tirana river terrace 1° ord.
Structural slope

Conclusions

- In spite of a small amount of data and the intense urban coverage of Tirana, in this study we recognized the depositional, erosive, tectonic landscape forms and the related processes that represent the geological background of Tirana urban area.

  This was made under GIS and CAD environment that helped, with 3d image analysis tools, to figure out all the morphological elements of study area.

- **References:**

CHIRICO S., DAJA S., NARDI G., STRATI B. (2011) - *Reconstrucion of a geological underground model in the center of Tirana (Albany) (Geology degree thesis - University of Naples "Federico II")*

- 3d volume interpolation
- Sequence stratigraphy
- Hydrogeological model
- Seismic noise acquisition

GRAZIE PER L'ATTENZIONE

FALEMINDERIT PËR VËMENDJEN