

GIS tools for water supply systems: an implementation using JGrassTools and gvSIG

Franceschi Silvia & Antonello Andrea

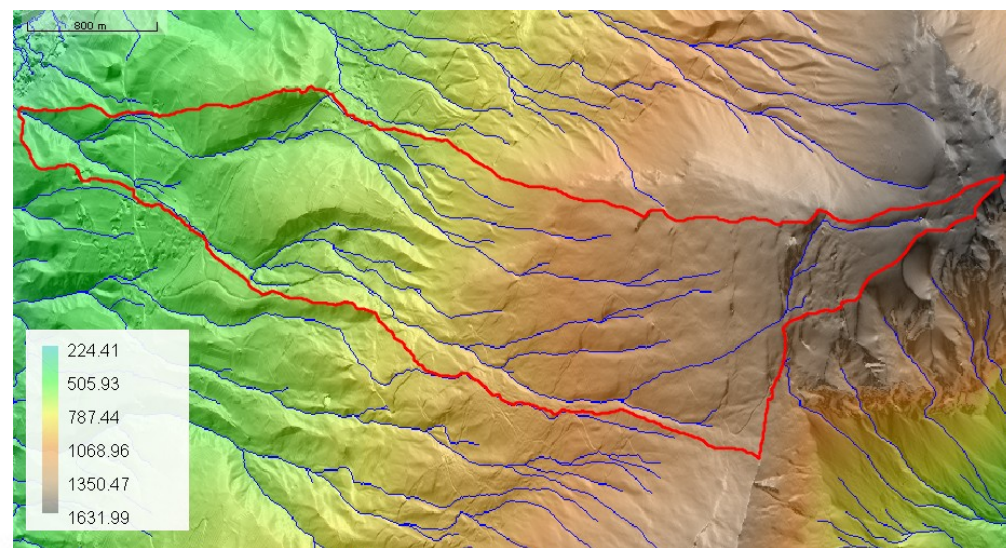
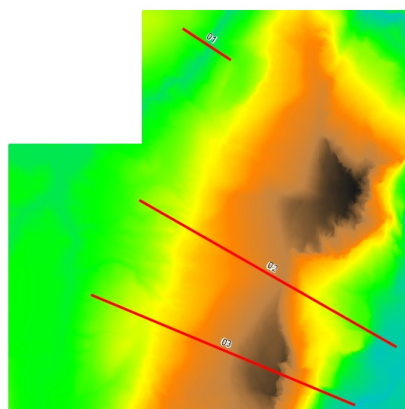
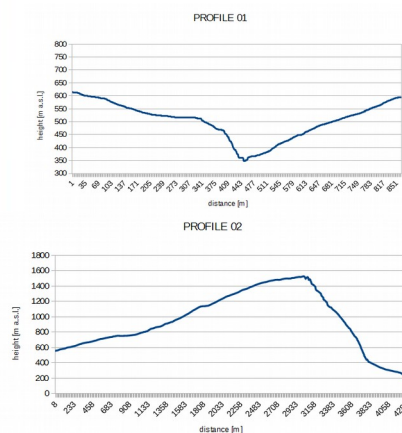
gvSIG conference - December 2015

WHO AM I?

- co-founder of HydroloGIS with Andrea Antonello
- environmental engineer specialized in hydrology, hydraulics and geomorphology
- PhD student of Science and Technology at the Free University of Bolzano (Italy)
- developed scientific models contained in the JGrassTools library in the field of:
 - hydrology
 - hydraulics
 - forestry
- OSGeo Charter Member

JGRASSTOOLS

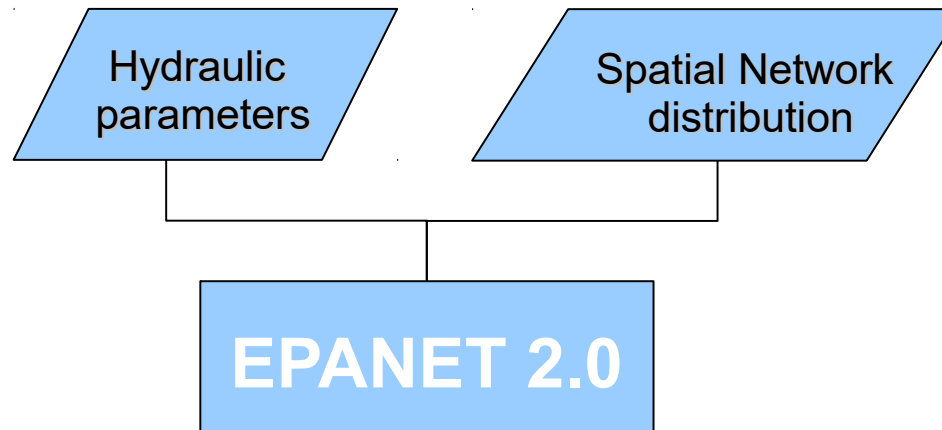
- geospatial Open Source library containing modules for:
 - vector and raster processing
 - geomorphology
 - forestry
 - mobile mapping connection
 - LiDAR data analysis



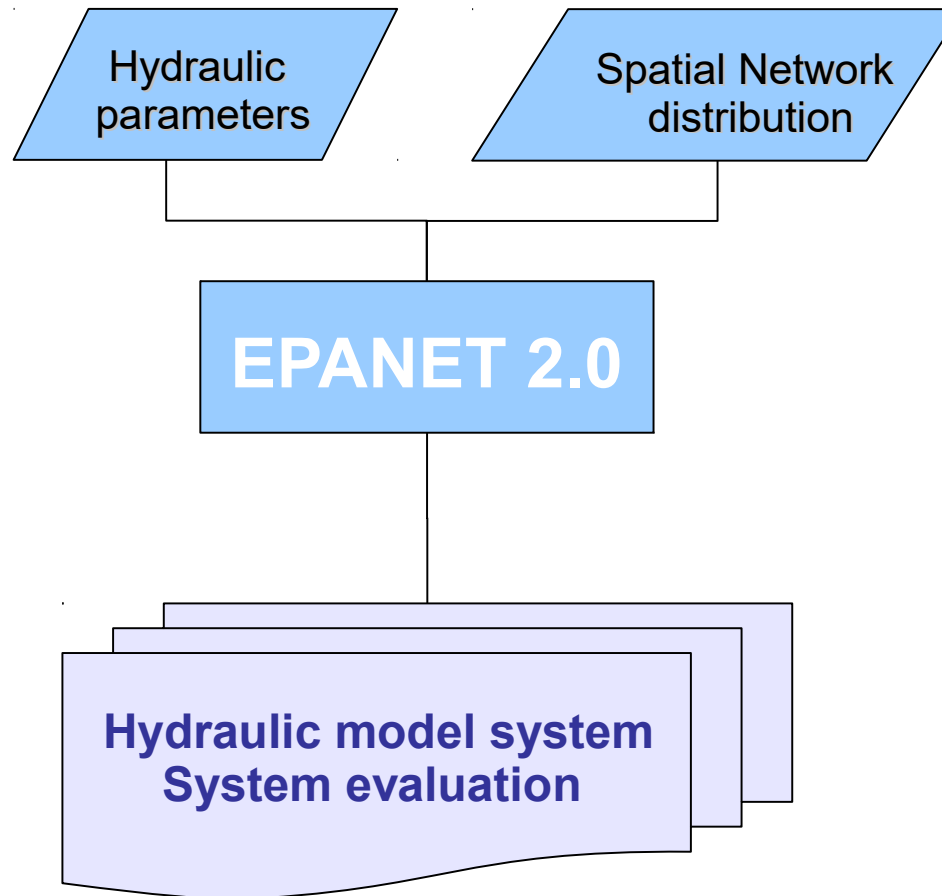
EPANET

- a powerful and well known software for water supply system management (analysis) and design
- developed by EPA (United States Environmental Protection Agency)
- predicts the dynamic hydraulic and water quality behavior within a drinking water distribution system operating over an extended period of time
- research tool for improving the understanding of the movement (flow and direction) of the water within a distribution systems

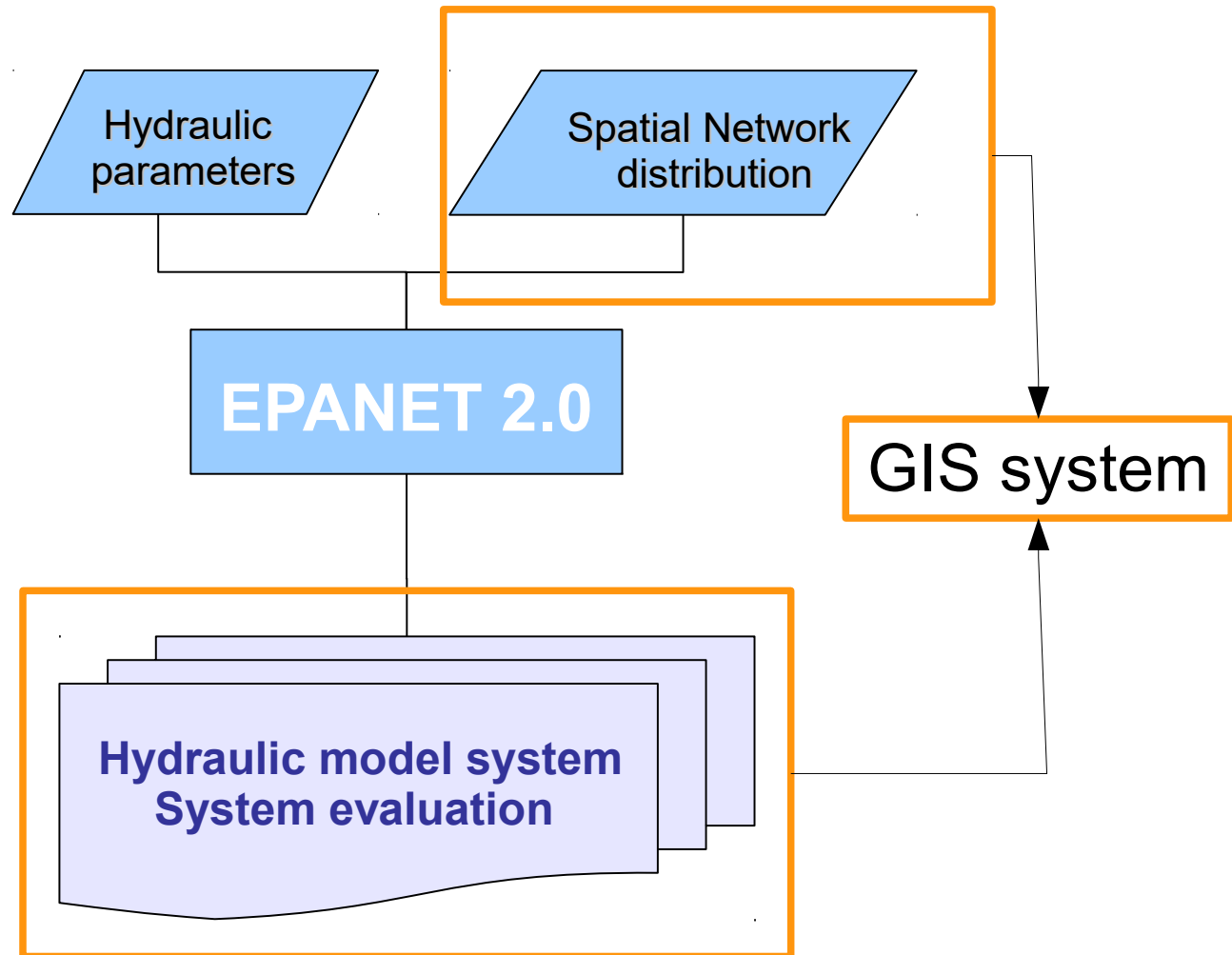
EPANET & GIS



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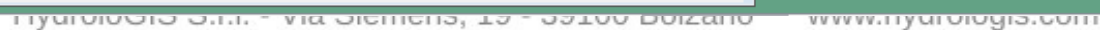
EPANET & GIS

- the bindings to the original EPANET library are integrated as a module in the JGrassTools library
- a plugin in gvSIG is developed that supplies a graphical interface to prepare the data for EPANET in a GIS way
- this plugin provides all of EPANET → there is no need to install EPANET software itself, it comes automatically with the plugin

4 STEP SIMULATION RUN

1. generate new shape files: reservoirs, valves, pumps, pipes, tanks, junction
2. synchronize shape files attributes with other available geospatial data: DTM for elevation and pipes' 3D length evaluation
3. run EPANET simulation: hydraulic parameters definition and insertion of other information to be added for the simulation
4. open the EPANET result viewer: visualization of the results, spatial maps and charts with the evolution of local variables in space and time

The tools are available from the menu:
HydroloGIS → Epanet



1. CREATE PROJECT FILES

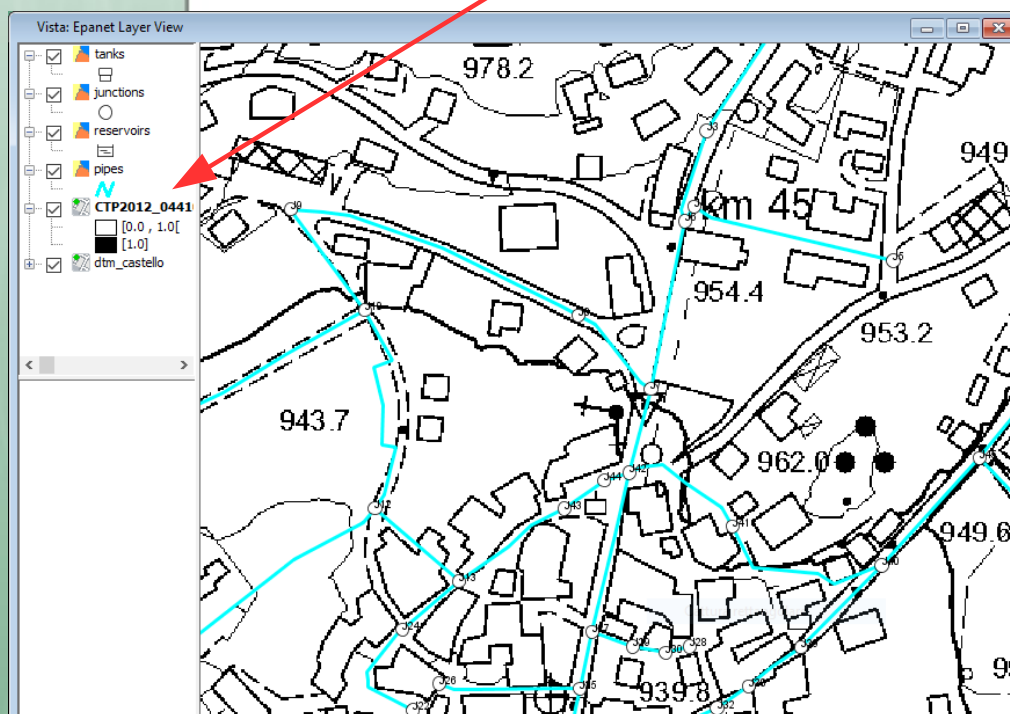
Select the folder and the projection of the project

The screenshot shows the gvSIG 2.2.0.2313 with JGrasTools interface. The 'Gestore di progetto' (Project Manager) window is open, showing the 'Epanet Layer View' as the selected view. The 'Vista' (View) window is also open, showing the 'Epanet Layer View' with a list of input files: reservoirs, valves, pumps, tanks, junctions, and pipes. The 'Choose a folder into which to create the project files' dialog is open, showing the 'epanet4' folder selected. The 'Select a projection' dialog is also open, showing the 'WGS84/UTMzone.32N' projection selected.

new view with all the possible input files for running EPANET with standard names and styles

2. SYNCHRONIZE ATTRIBUTES

GIS layers (orthophoto or technical maps) as background to draw/transform the main features of the aqueduct

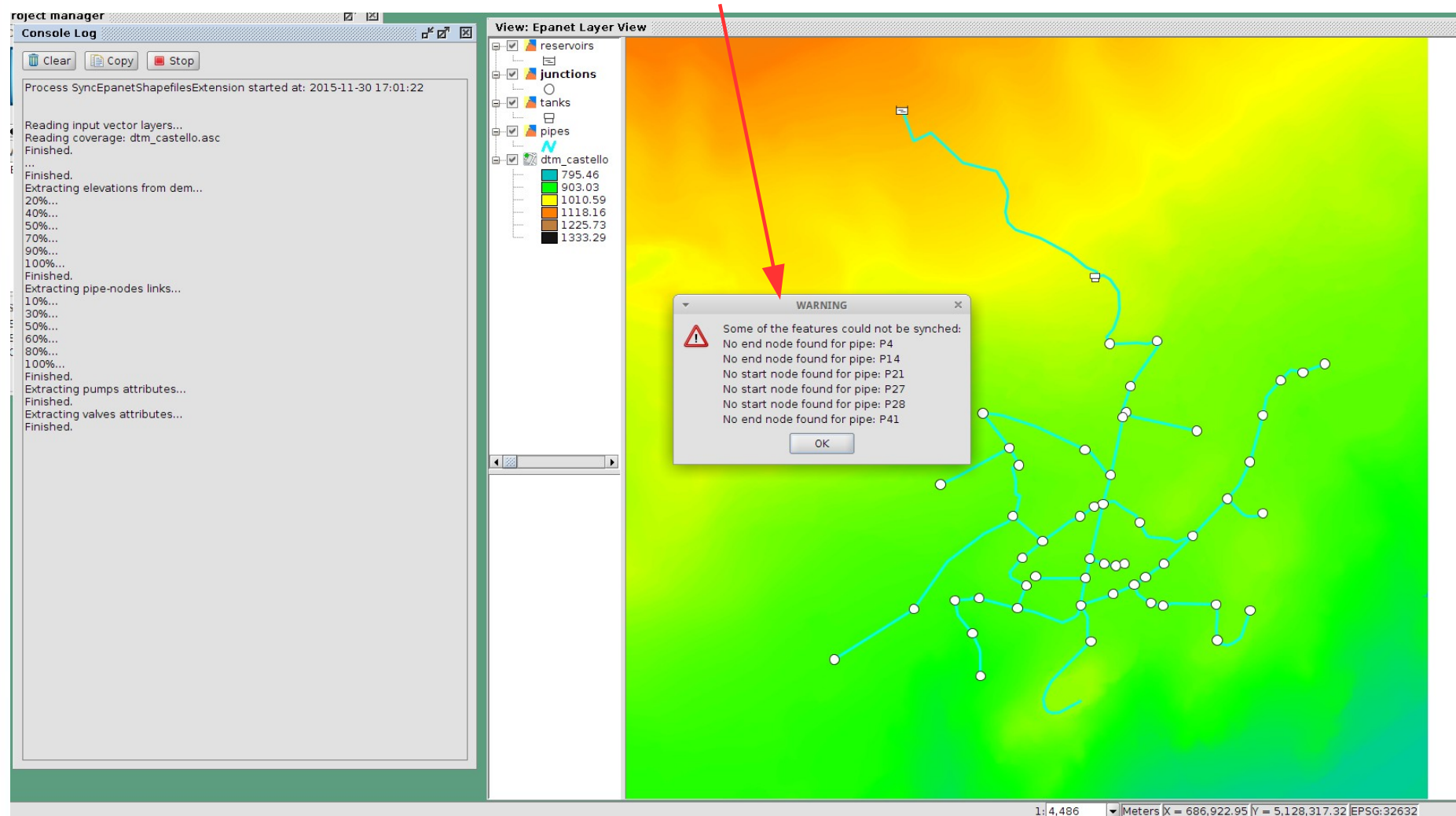


DTM for elevation and pipes' 3D length evaluation



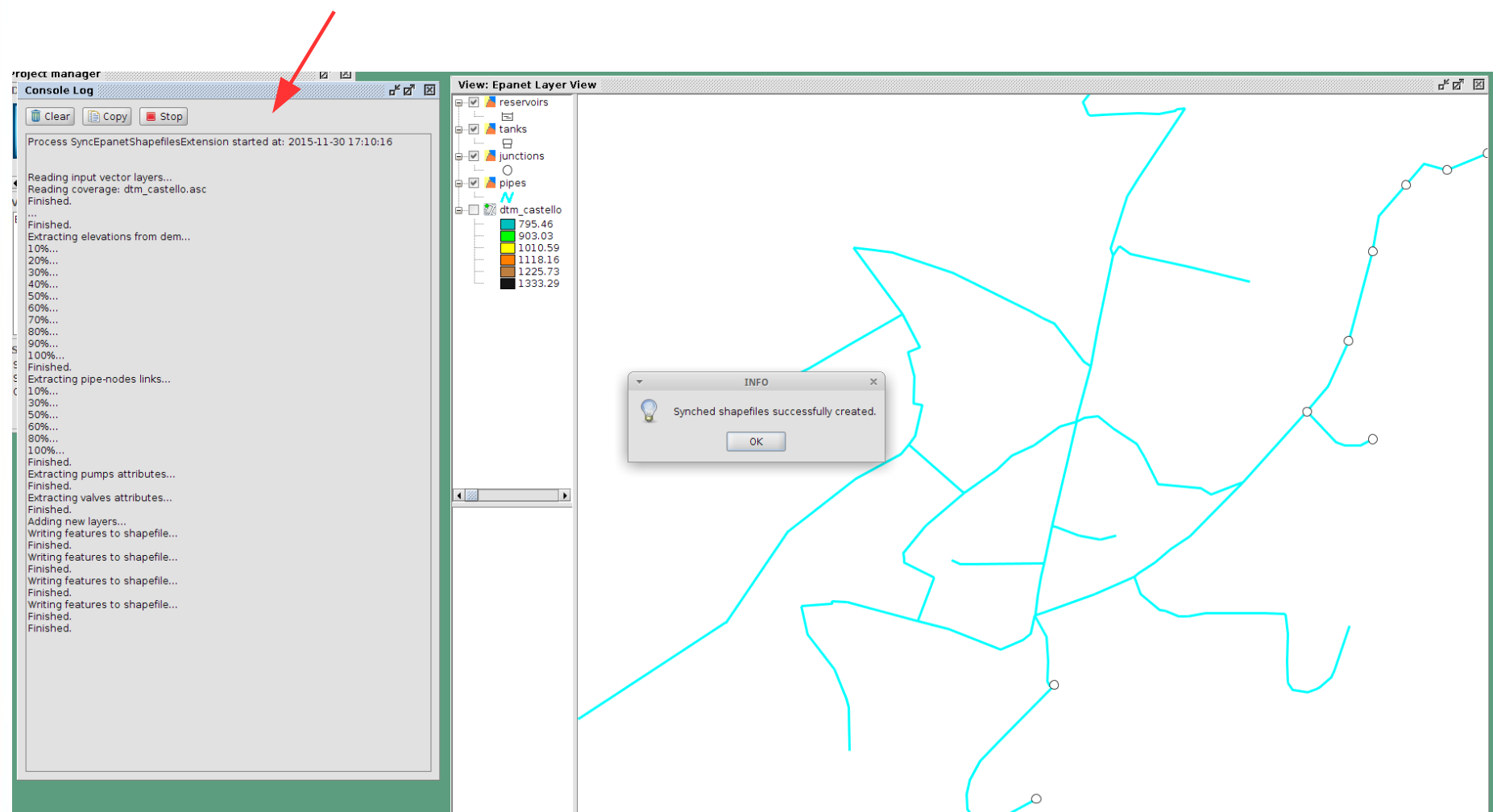
2. SYNCHRONIZE ATTRIBUTES

Warnings and errors messages from the EPANET code are highlighted in a pop-up dialog.



2. SYNCHRONIZE ATTRIBUTES

Progress state and general information are displayed in a dedicated Console



3. RUN EPANET SIMULATION

Simplified wizards help the user to fill in the main hydraulics parameters

Define options parameters

UNITS	LPS
HEADLOSS	D-W
QUALITY	NONE
VISCOSITY	1.0
DIFFUSIVITY	1.0
SPECIFIC GRAVITY	1.0
TRIALS	40
ACCURACY	0.001
UNBALANCED	CONTINUE 10
PATTERN	1
TOLERANCE	0.01
EMITTER EXPONENT	0.5
DEMAND MULTIPLIER	1

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Additional files and folders

Extra files folder ...

Demand file ...

Control file ...

Rules file ...

Inp file ...

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The results are stored in a local database (sqlite)

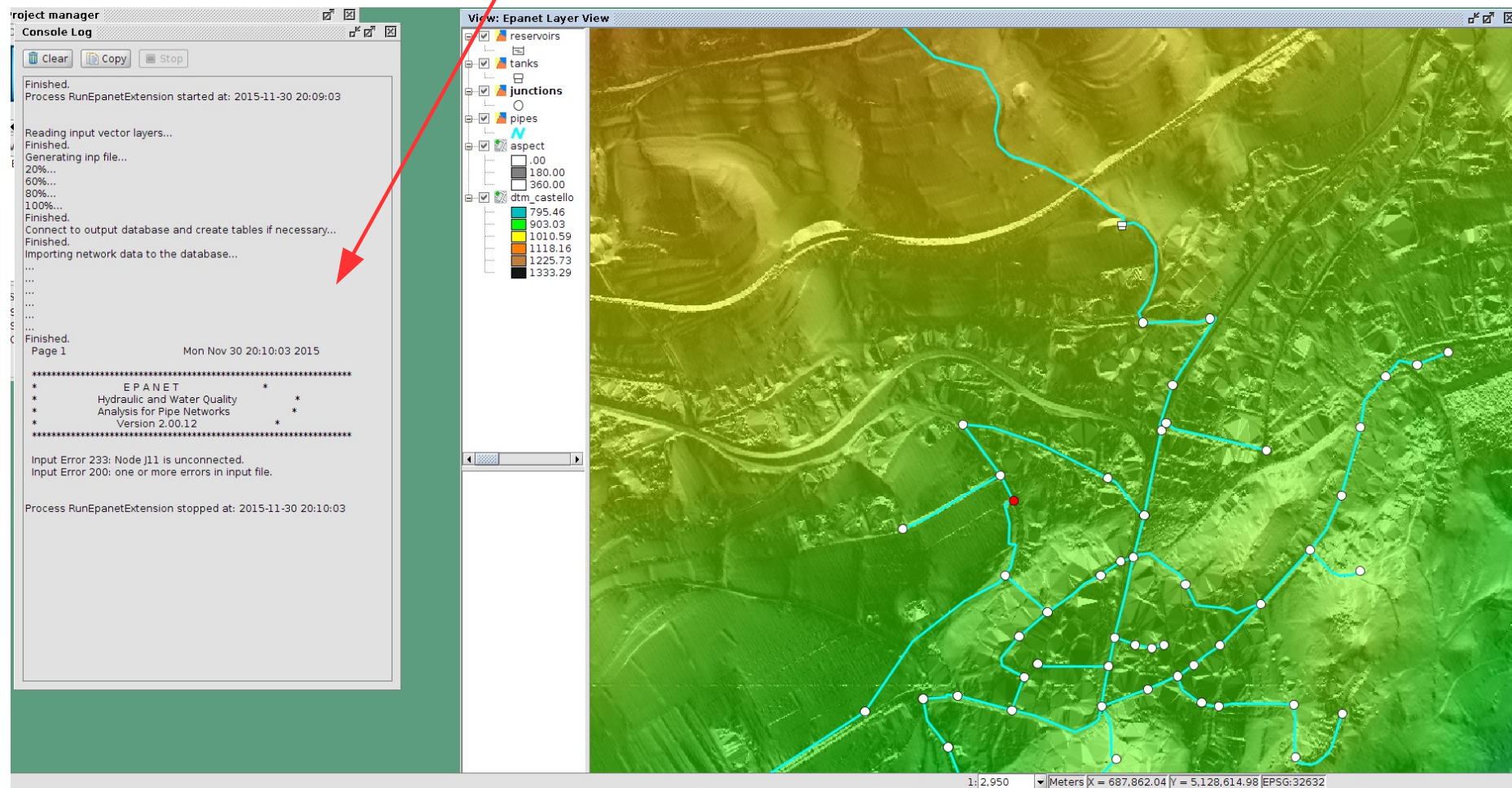
Output database

Output sqlite db ...

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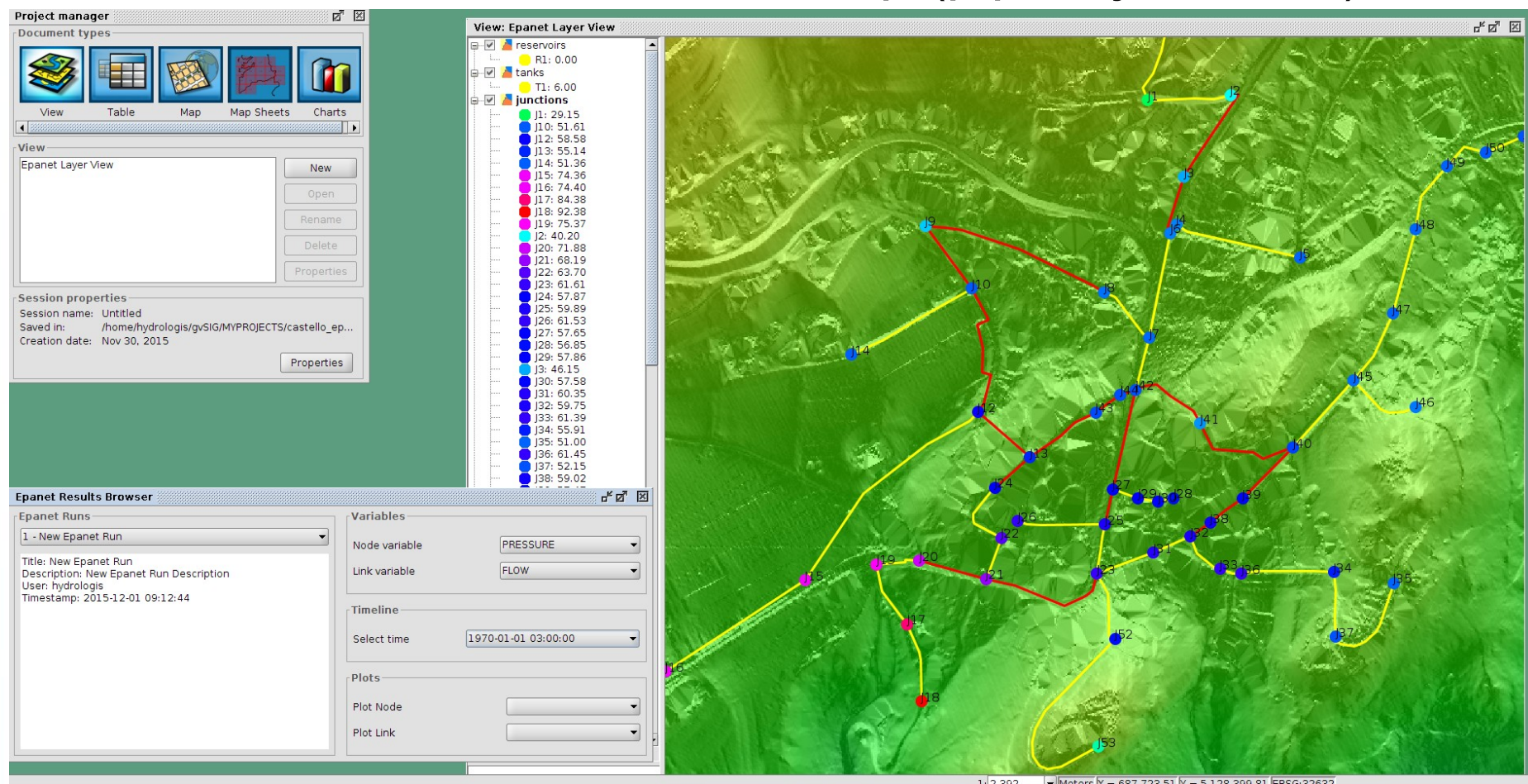
3. RUN EPANET SIMULATION

Progress state and log messages from EPANET code are displayed in a dedicated Console



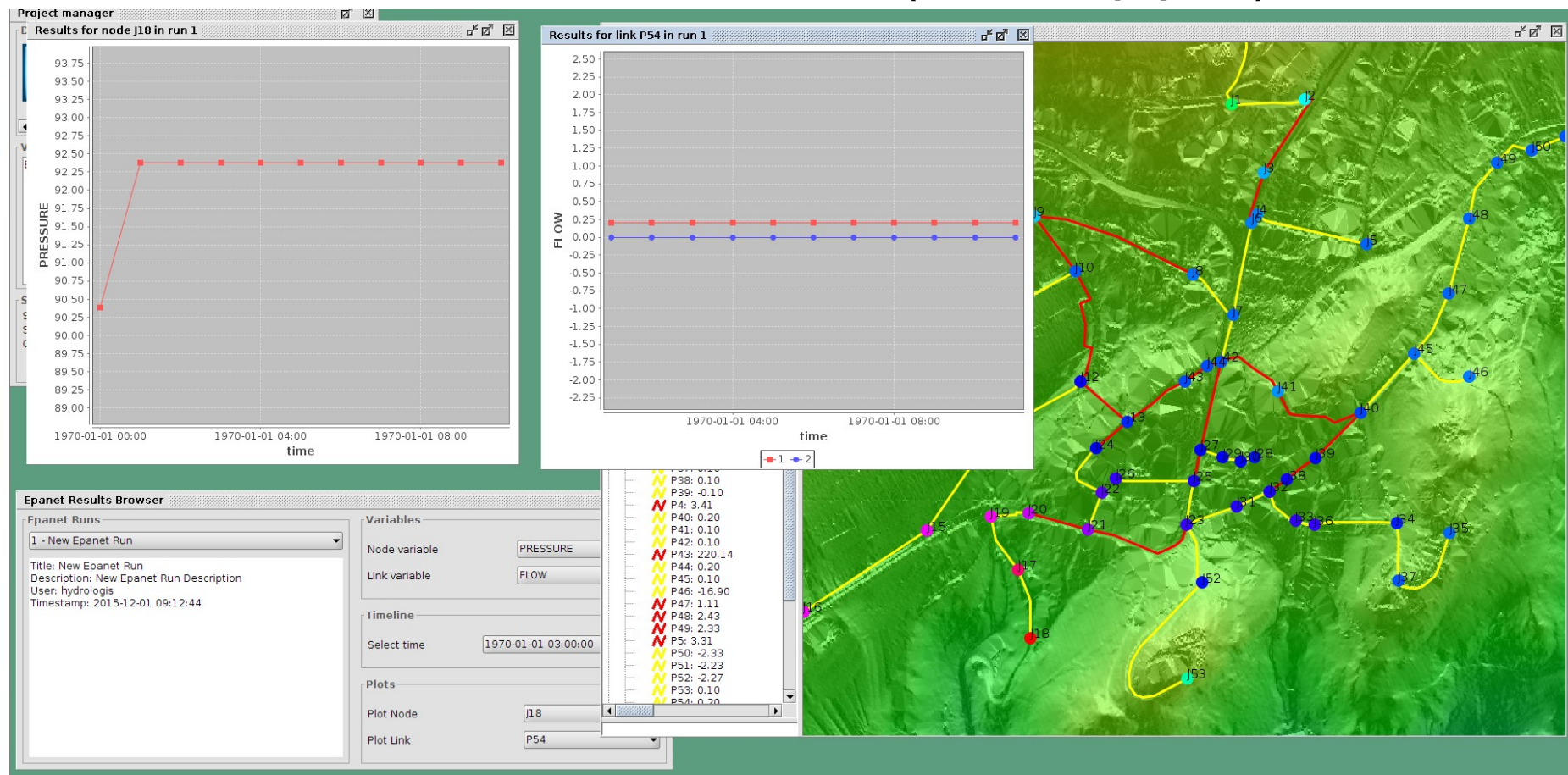
4. VISUALIZATION OF RESULTS

- selection of the timestep, variable and elements to visualize
- visualization of results on the map (pipes, junctions)



4. VISUALIZATION OF RESULTS

- selection of the timestep, variable and elements to visualize
- visualization of results on charts (nodes, pipes)



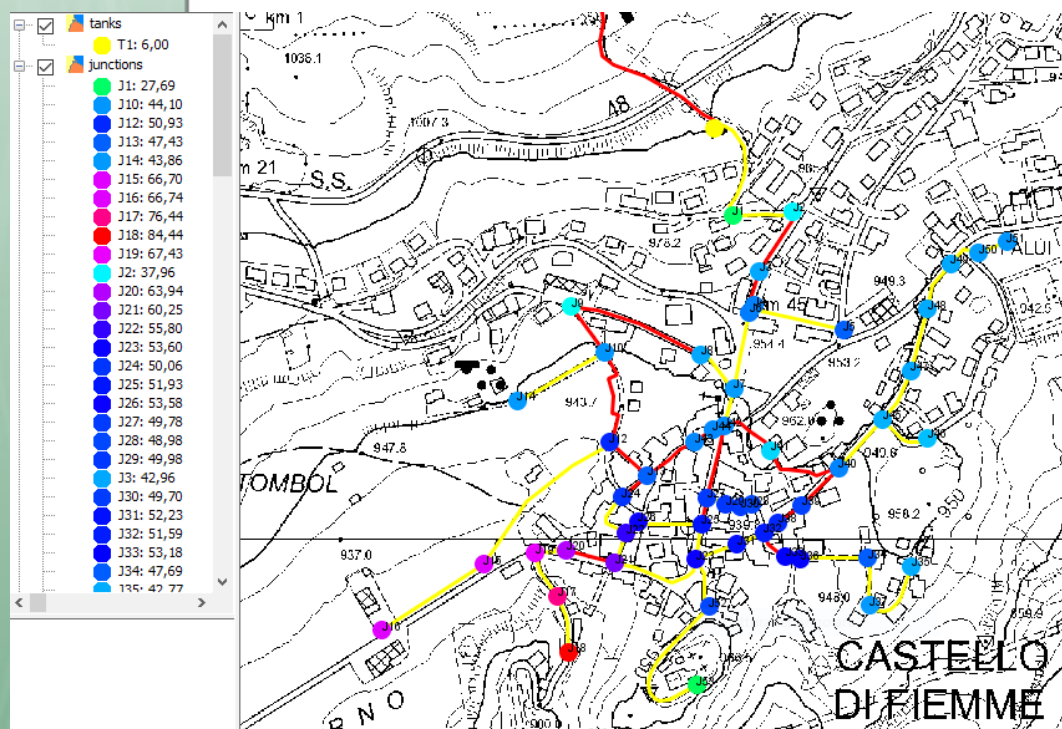
EPANET & gvSIG

can help assess alternative management strategies for improving the performance of the system by:

- altering source utilization within multiple source systems
- altering pumping and tank filling/emptying schedules
- targeted pipe cleaning and replacement
- pre-localization of leakages

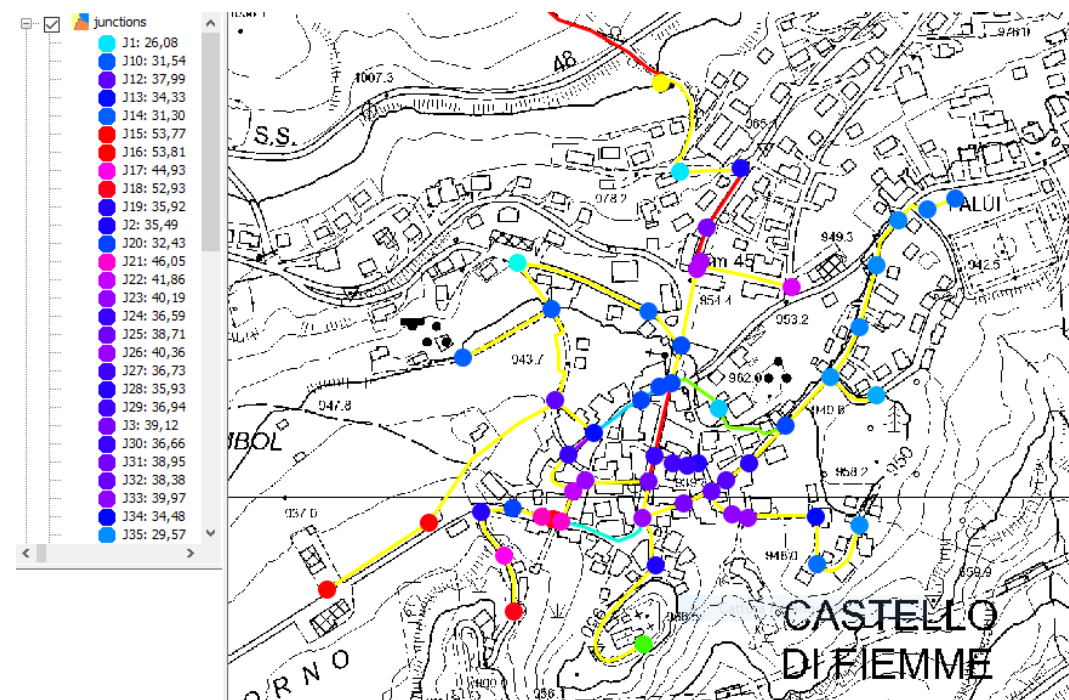
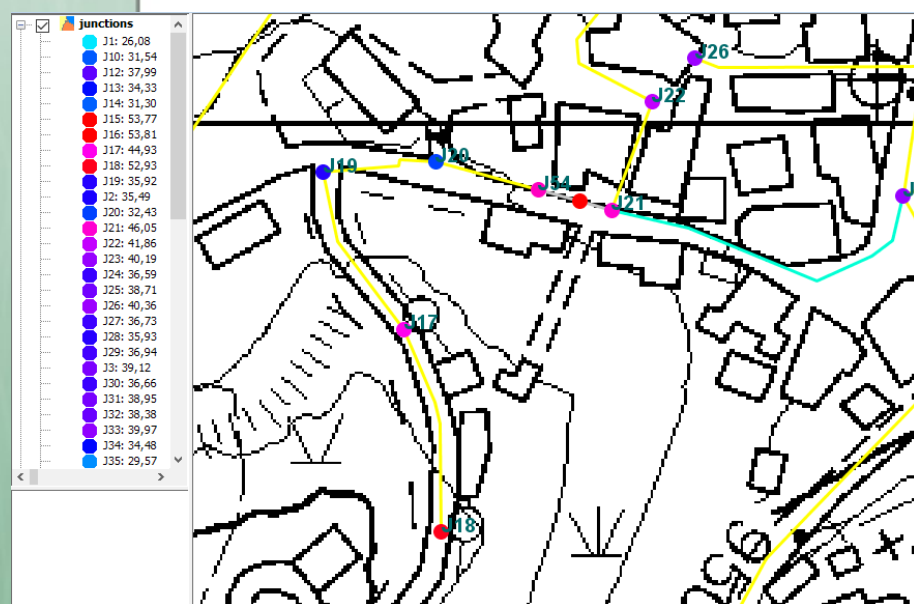
EPANET & gvSIG

- problems are highlighted in the results
- test new design solutions: Pressure Reducing Valve



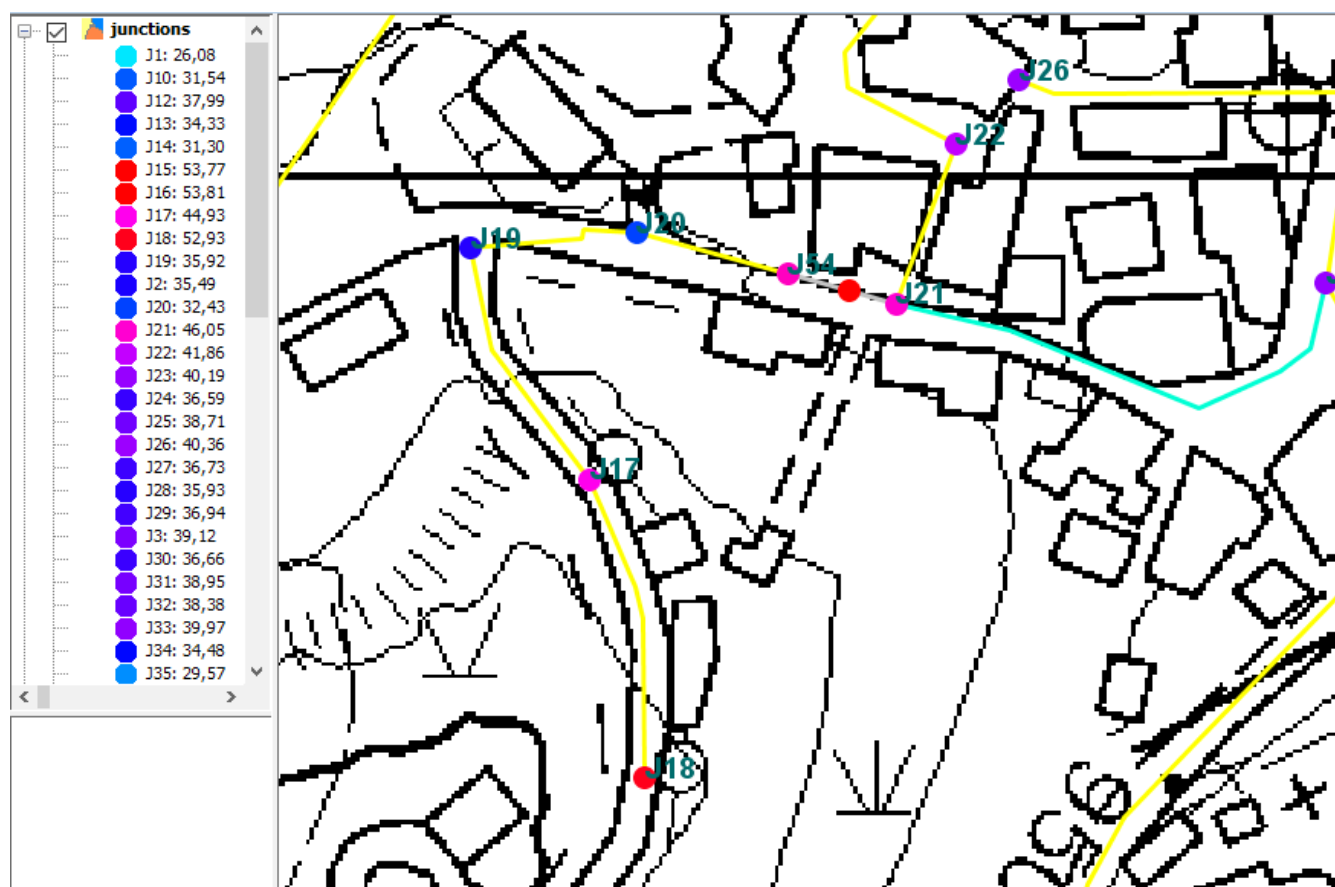
EPANET & gvSIG

- problems are highlighted in the results
- test new design solutions: Pressure Reducing Valve



EPANET & gvSIG

- problems are highlighted in the results
- test new design solutions: change volume of tank



FUTURE PLANS

- finalize the implementation and testing of Epanet in gvSIG in different areas and scenarios
- integrate the support for simulation of the water quality in Epanet
- integrate a new model for design and verification of systems for collecting rain water and sewage in urban environments

THANKS FOR THE ATTENTION!

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