Advanced SQL spatial analysis with OrbisGIS V3.0

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O P E N R S C E W O P P O R T U N I T I G I S

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Partners Contribution

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The University of Nottingham

Aalto University School of Science and Technology

irstv

Partner Collaboration

Universitat de Girona
Departament de Geografia

Outline

1 - Introduction to spatial SQL

2 - Compare the calculation of the watersheds using two different DEM

3 - Production of spatial indicators

4 - Assessing the impact of rail roads on runoff

Data for this lab

- Elevation contours : bt25m_al.shp

- Administratives boundaries : Limit_cities_UTM_31N.shp

- Roads / Rail network : bt25m_cl.shp

- Hydrographic network : rius.shp

- DEM from Girona : mde_resize_20.tif
  (resample with a resolution of 10m – Initial resolution = 2m)

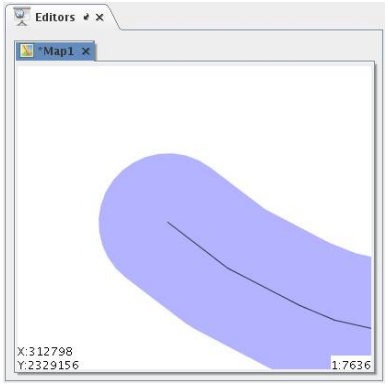
- Corine Land Cover : CLC_00_catalonia.shp *(2000)*
  CLC_06_catalonia.shp *(2006)*

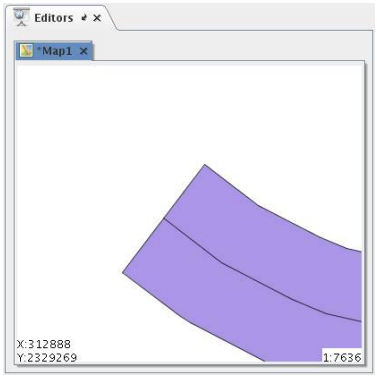
- Sub watershed : sub_watershed.shp

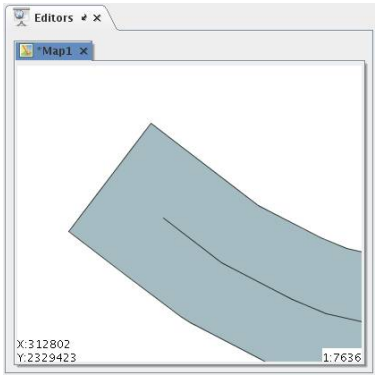
1 - Introduction to spatial SQL

Buffer

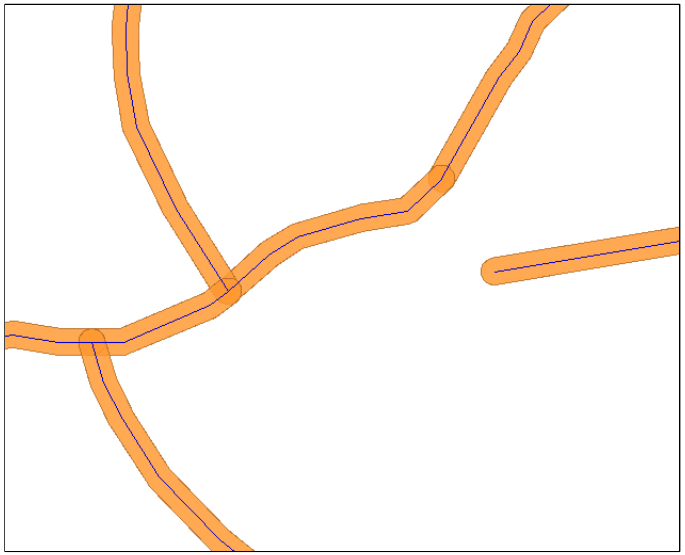
- Syntax
select ST_Buffer(the_geom, bufferSize[, 'butt'|'square'|'round']) from myTable;



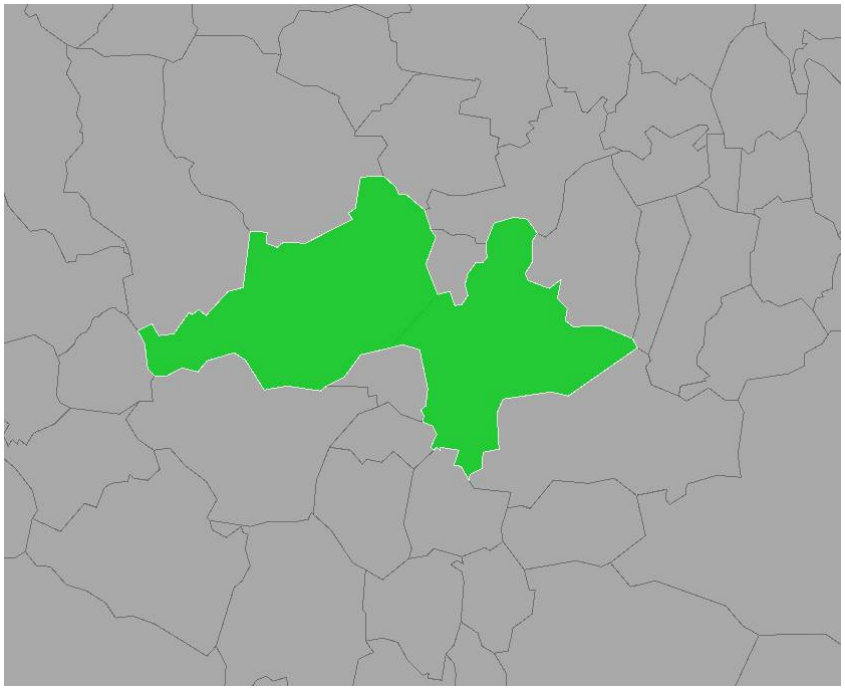




- Example
select ST_Buffer(the_geom, 30 ,'round') from rius;



1 - Introduction to spatial SQL



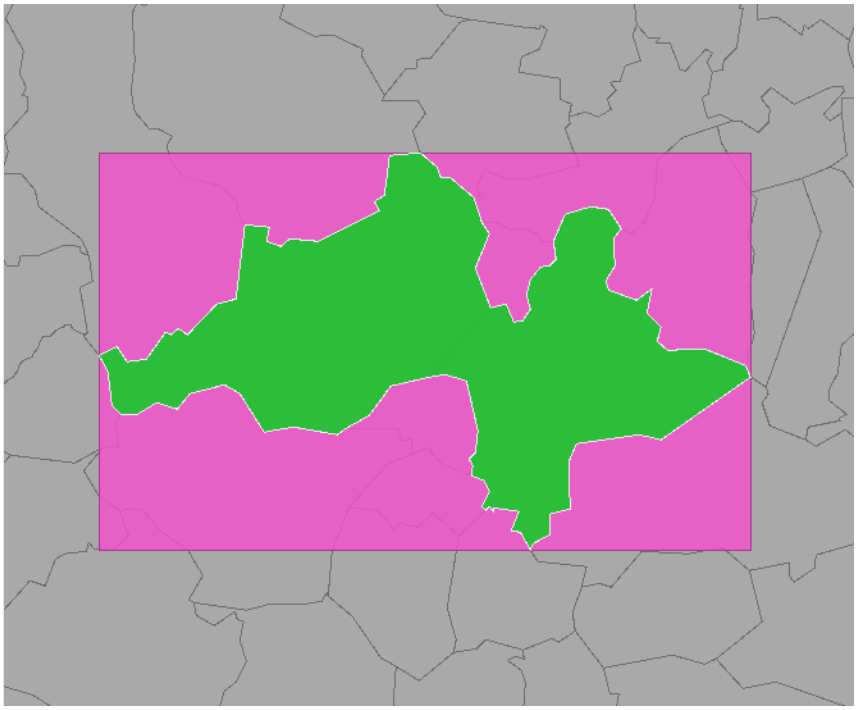
Union

Syntax : select ST_Union(the_geom) from myTable;

Example :

```
-- Selection of cities
create table stud_area as select the_geom from Limit_cities_UTM_31N where
NAME_4='Girona' or NAME_4='Sant Gregori';

-- Union of the two geometries
create table stud_area_union as select ST_Union(the_geom) as the_geom from stud_area;
```

1 - Introduction to spatial SQL



Envelope

- Syntax
select ST_Envelope (raster) as raster from mytif;
Or
select ST_Envelope (the_geom) from mytable;

- Example
create table study_area as select ST_Envelope (the_geom) as the_geom from stud_area_union;

1 - Introduction to spatial SQL

Intersection

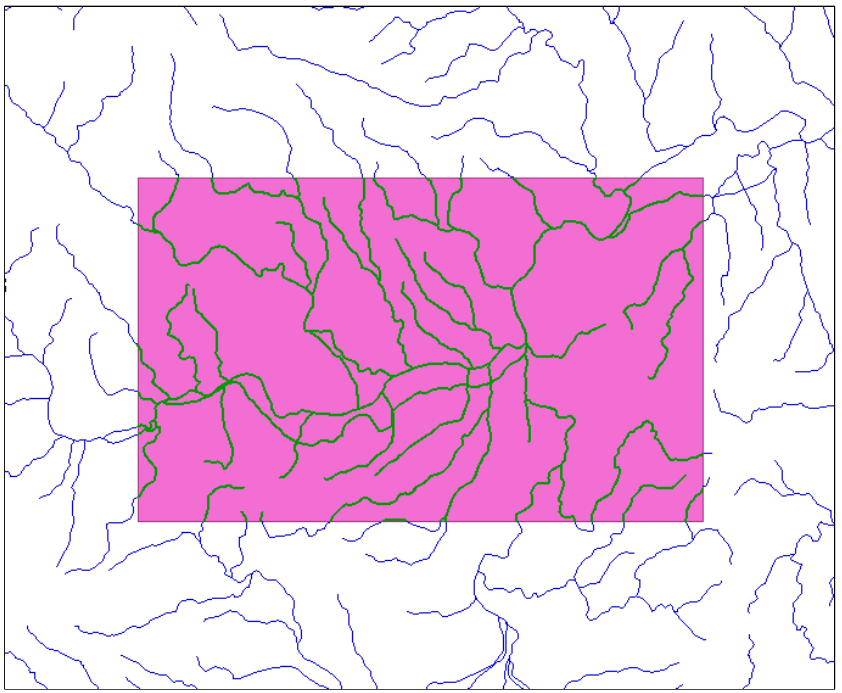
- Syntax : select ST_Intersection(the_geom1,the_geom2) from myTable;
  → *returns a geometry*

Intersects

- Syntax : select ST_Intersects(the_geom1,the_geom2) from myGeom;
  → *returns a boolean (does geometries intersects ? Yes or No)*

Example with both operations

create table hydro_intersect as select
ST_Intersection(a.the_geom,b.the_geom) as
the_geom, a.*{except the_geom} from rius a,
study_area b
where **ST_Intersects**(a.the_geom, b.the_geom);



2 - Compare the calculation of the watersheds using two different DEM

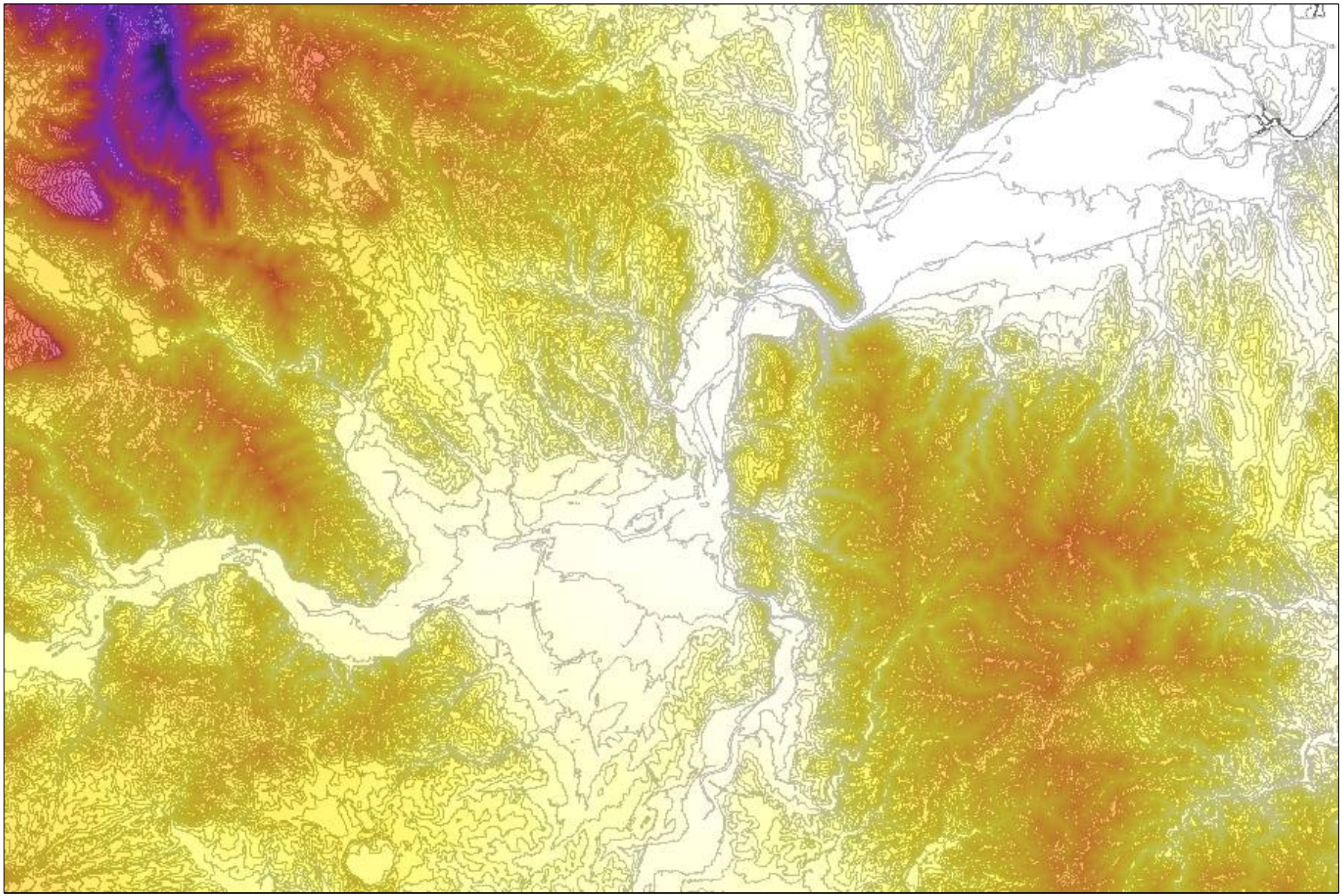
The objective of this first step

Compare the calculation of the watersheds from the DEM provided by the team of Girona and the one we produce from the contours.

A- Construct the DEM from contour lines

```
-- Remove layer if they exists
drop table if exists multipoints;
drop table if exists explode;
drop table if exists dem4;

-- Convert lines into multipoint and keep the altimetric attribute in the field called "altitude"
create table multipoints as select ST_ToMultiPoint(the_geom) as the_geom, Z as altitude
from bt25m_al;
-- Explode multipoint (convert to "simple" point)
create table explode as select st_explode(the_geom) from multipoints;
-- Create the DEM via interpolation process (where 50 is the resolution of one pixel)
create table dem_from_lines as select st_interpolate(the_geom, altitude, 50) from explode;

-- Optionnal : remove unused layers
drop table explode purge;
drop table multipoints purge;
```

2 - Compare the calculation of the watersheds using two different DEM



2 - Compare the calculation of the watersheds using two different DEM

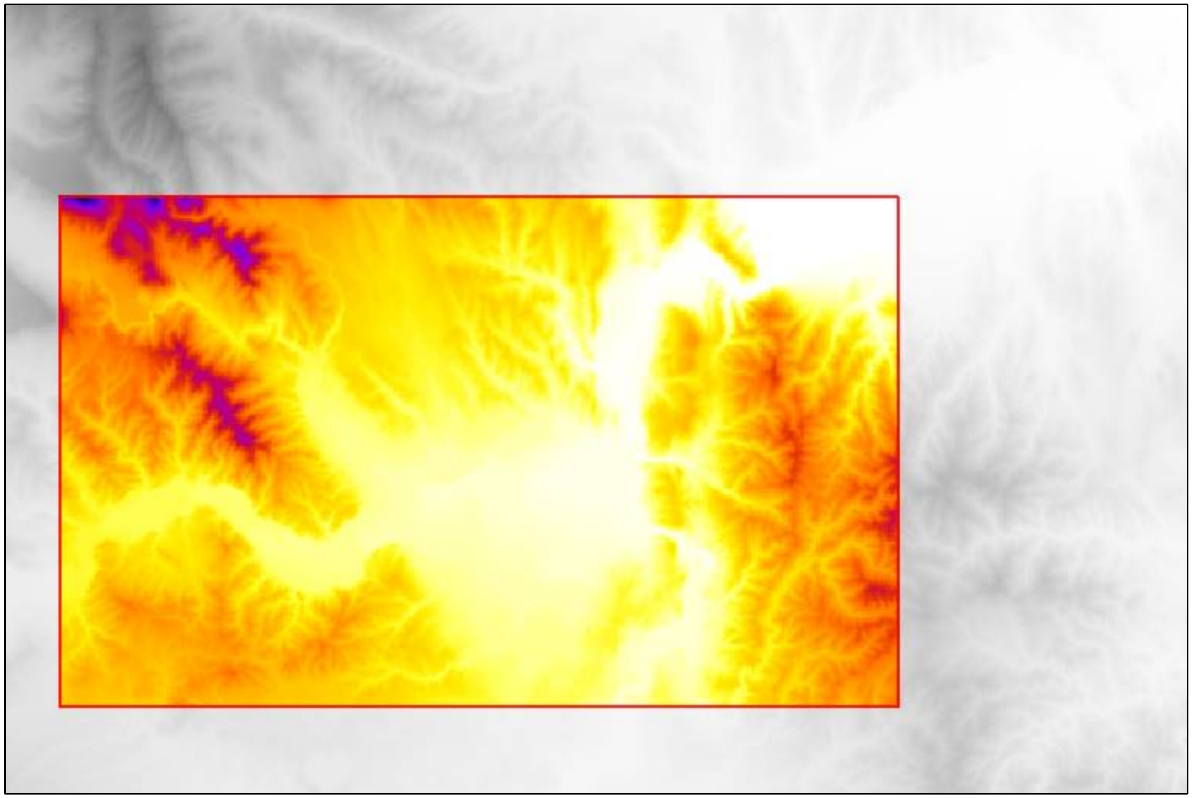
B- Crop DEM with study area

Use the ST_Croprаster function

Syntax : select ST_CropRaster(r.raster, f.the_geom) as raster from mytif r, fence f;

-- Crop layers

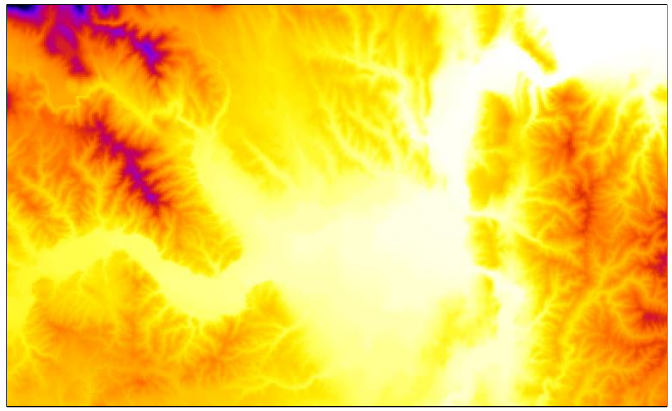
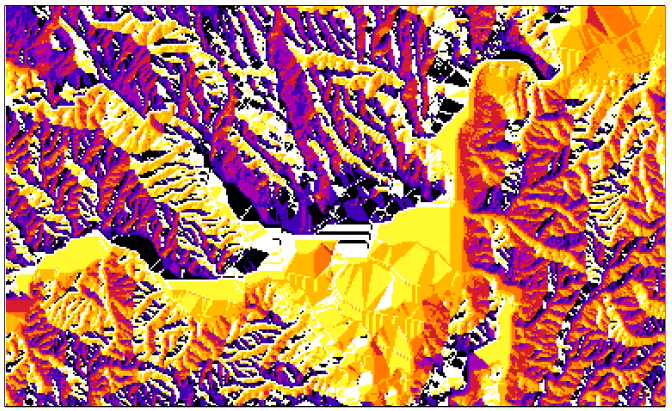
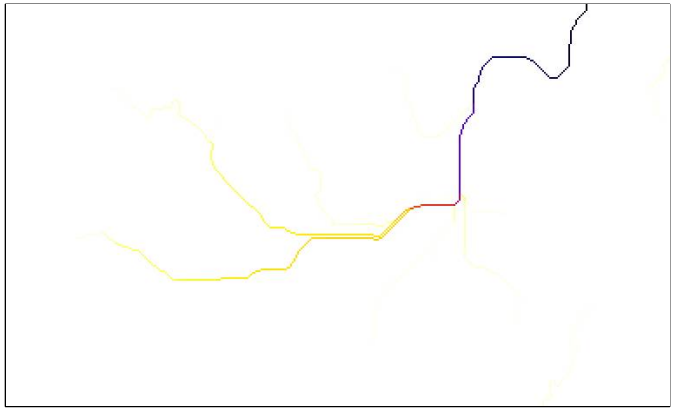
create table dem_study_area as select ST_CropRaster(r.raster, f.the_geom) as raster from dem_from_lines r, study_area f;



2 - Compare the calculation of the watersheds using two different DEM

C- Filter to fill sinks / Direction / Accumulation

```
-- Remove layer if they exists
drop table if exists filled;
drop table if exists dir;
drop table if exists acc;

-- Filter to fill sinks
create table filled as select ST_FillSinks(raster, 0.1) as raster from dem_study_area;

-- Compute the direction grid
create table dir as select ST_D8Direction(raster) as raster from filled;

-- Compute the accumulation grid
create table acc as select ST_D8Accumulation(raster) as raster from dir;
```

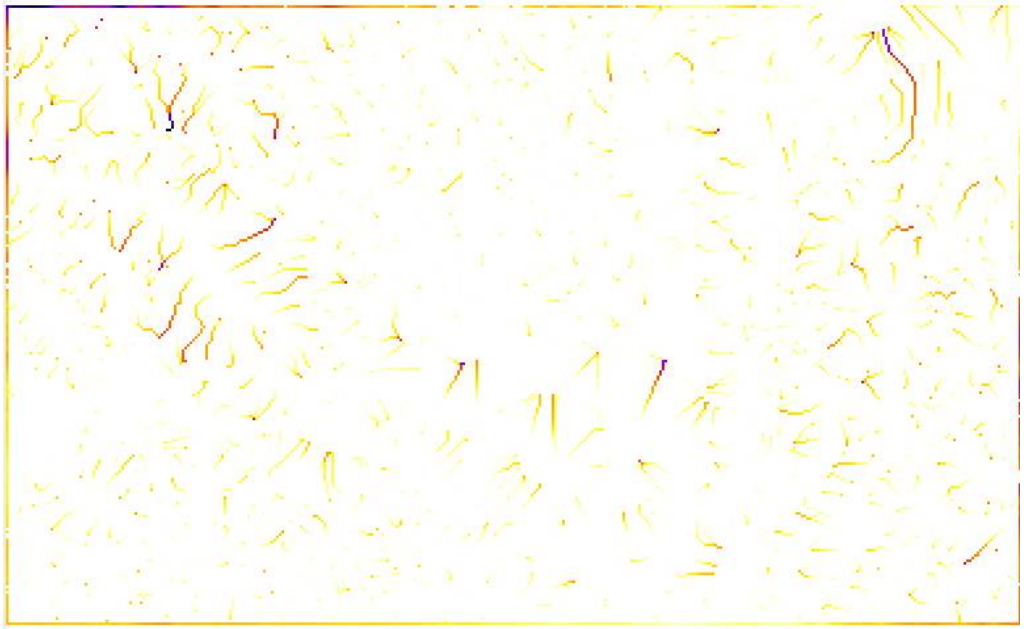




2 - Compare the calculation of the watersheds using two different DEM

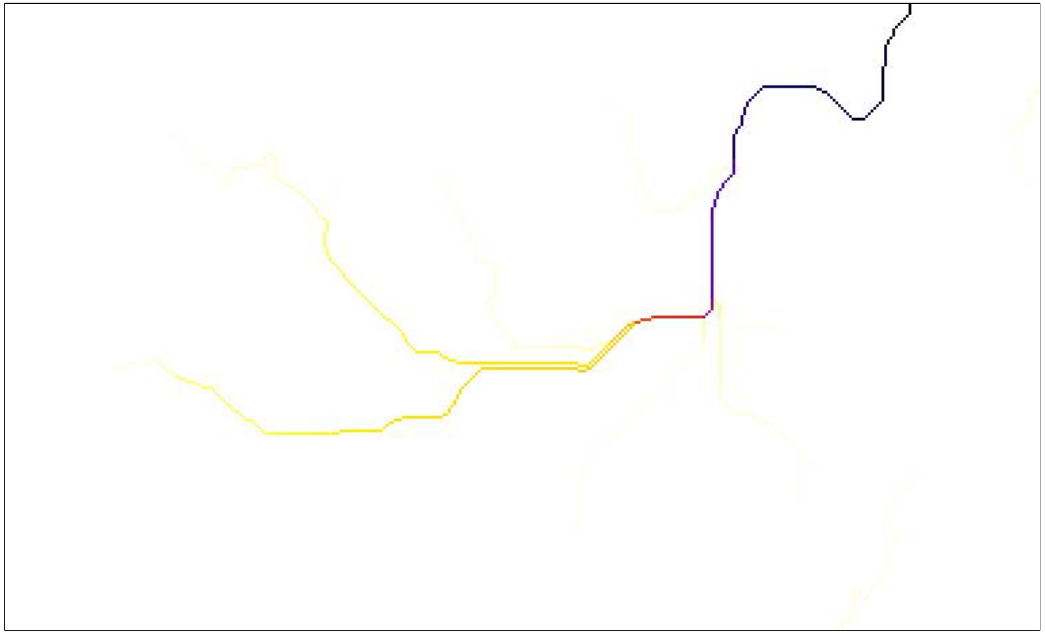
D – Compare the accumulation grid with / without Fillsinks operation

-- Create an accumulation grid without Fillsinks operation
Create table acc_no_fill as select st_D8accumulation(st_D8direction(raster)) from dem_study_area;

Accumulation without Fillsinks



Accumulation with Fillsinks



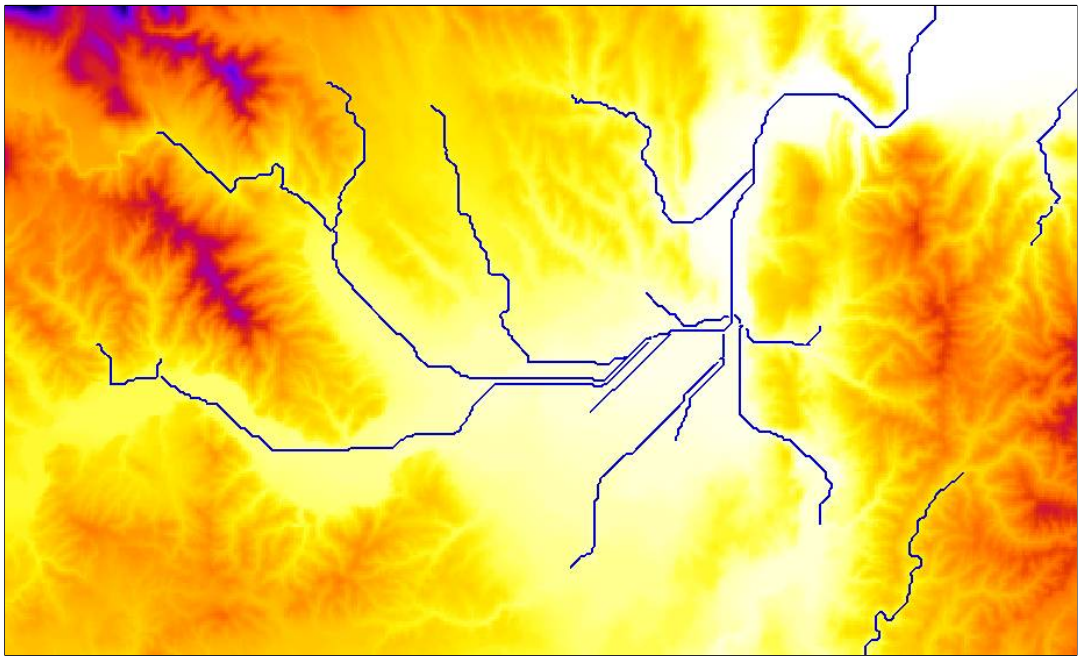
2 - Compare the calculation of the watersheds using two different DEM

E – Extraction of Drainage Network

-- We use the ordination of Strahler allowing prioritize the streams
create table strahler as select ST_D8StrahlerStreamOrder(d.raster, a.raster, 1500) from dir d, acc a;

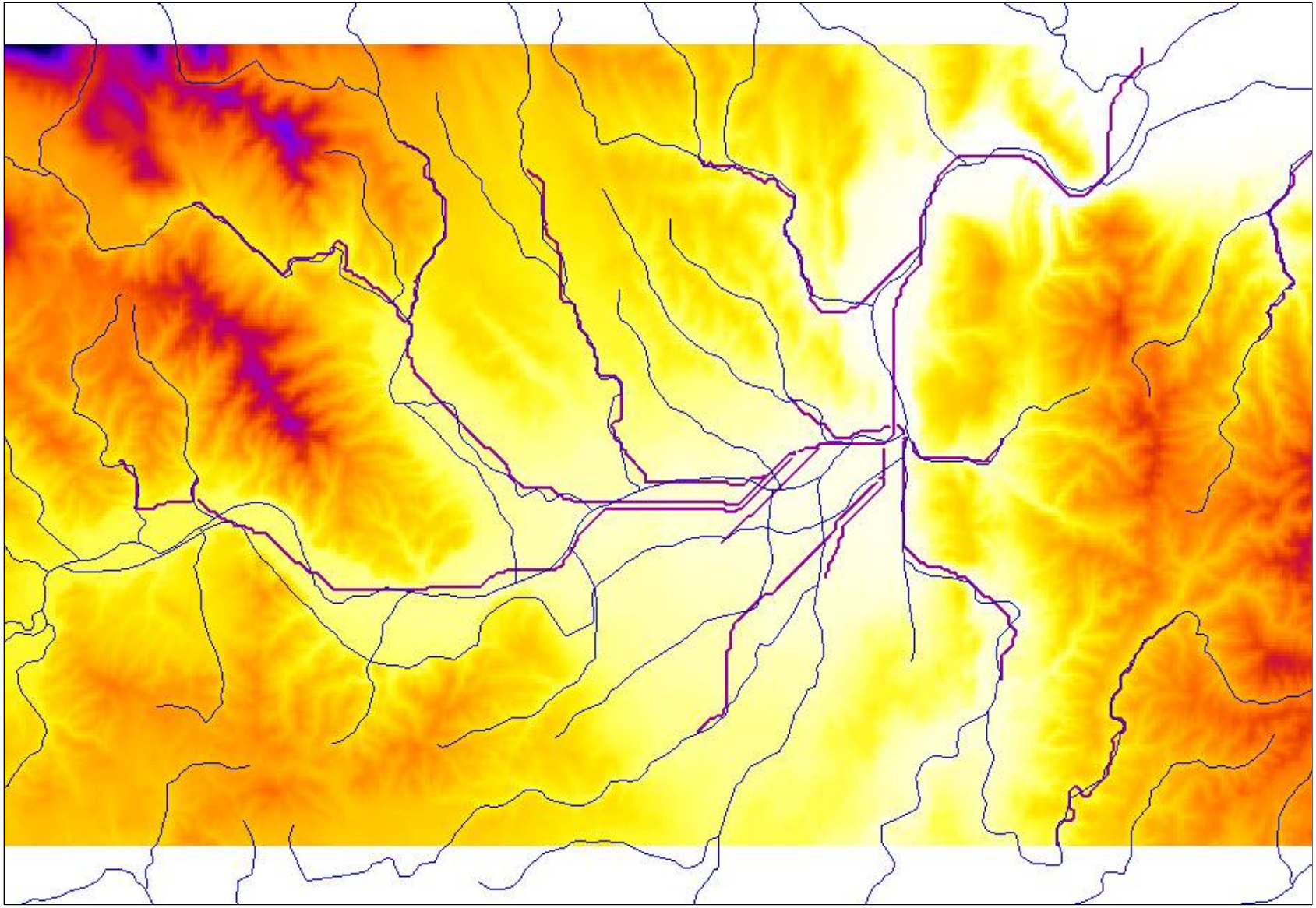
-- Vectorize the stream
create table allrivers as select ST_VectorizeLine() from strahler ;

-- Then filter the data keeping only streams of lower order than 6.
create table rivers_low_6 as select * from allrivers where gid < 6;



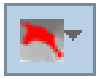
2 - Compare the calculation of the watersheds using two different DEM

Compare the result (purple) with hydrographic network of Catalonia (blue)



2 - Compare the calculation of the watersheds using two different DEM

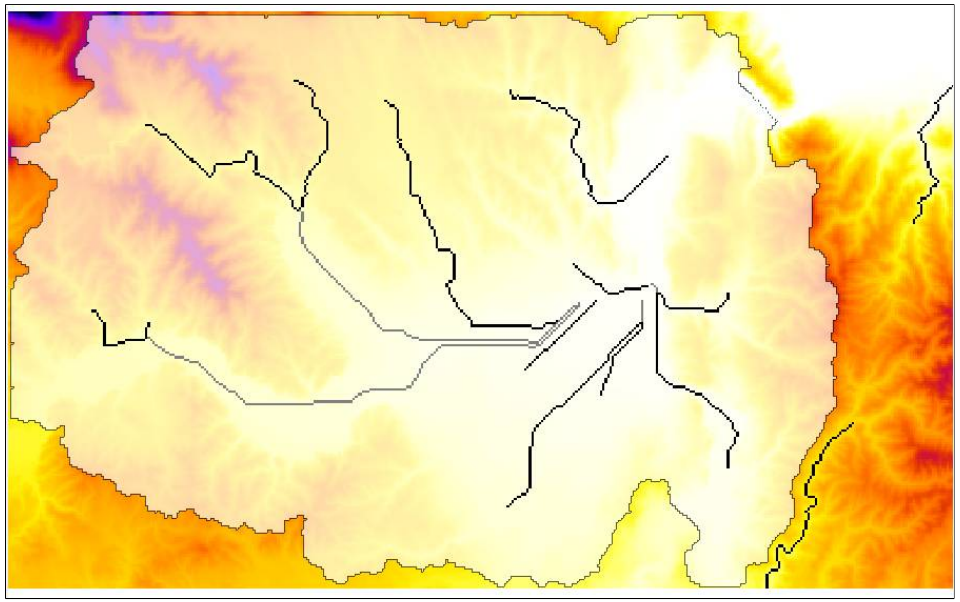
F – Extraction of watershed *(manual method)*

Point your mouse over the DEM "filled". Then, click on the outlet with this tool 

→ A new gdms layer is created, and added in the TOC

Then, you can convert this layer in vector, with this tool 

→ A new vector layer (called “wand”) is added in the TOC → your watershed



-- Save the result of the “Wand” operation in a layer

```
create table watershed_from_contours_lines
as select * from wand;
```

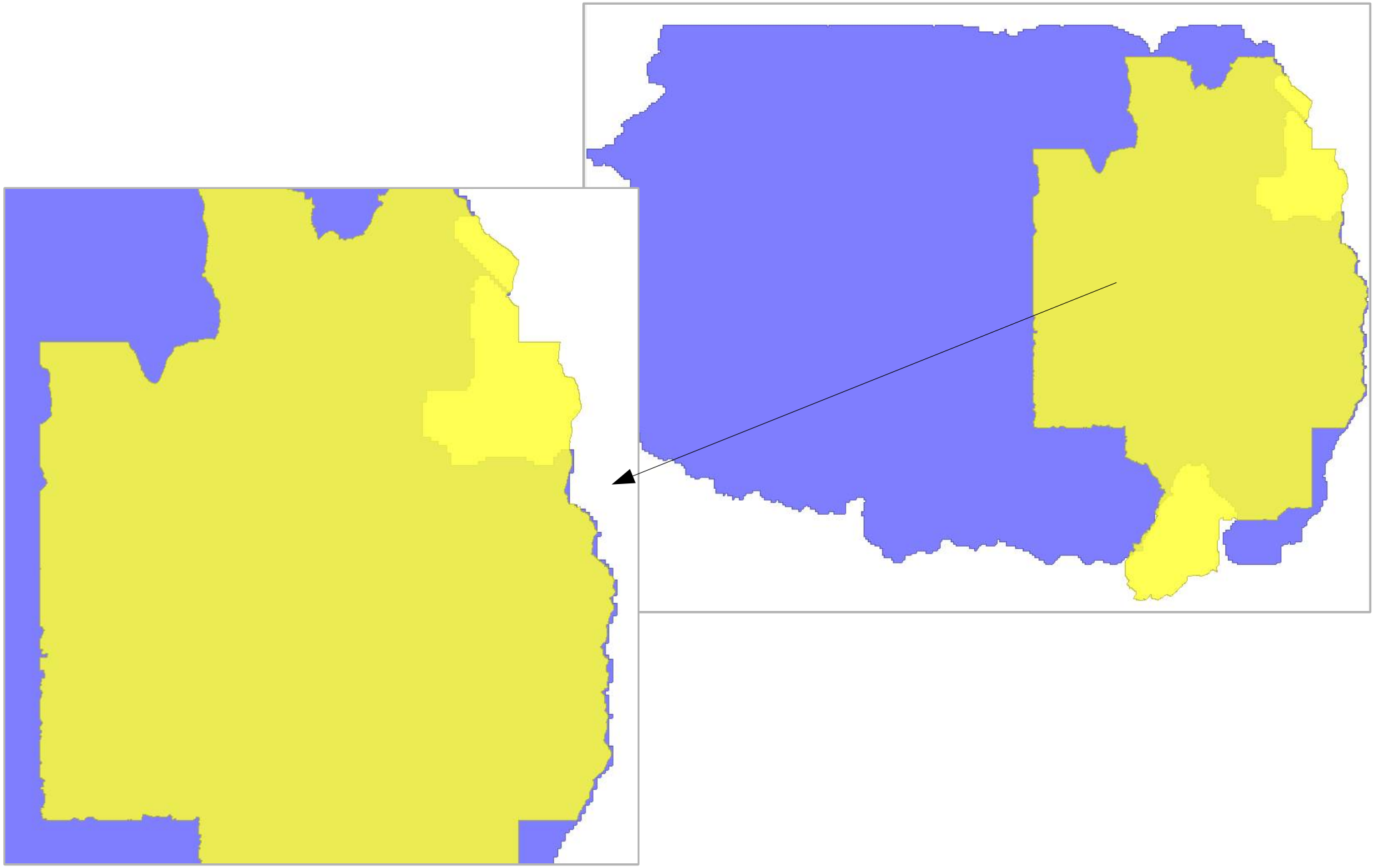
2 - Compare the calculation of the watersheds using two different DEM

F – Extraction of watershed *(manual method)*

To compare with the “Girona's DEM” we must first :

```
-- Filter to fill sinks
create table filled_girona as select ST_FillSinks(raster, 0.1) as raster from mde_resize_20;
-- Compute the direction grid
create table dir_girona as select ST_D8Direction(raster) as raster from filled_girona;
-- Compute the accumulation grid
create table acc as select ST_D8Accumulation(raster) as raster from dir_girona;
-- Compute the Strahler layer
create table strahler_girona as select ST_D8StrahlerStreamOrder(d.raster, a.raster, 1500) from
dir_girona d, acc_girona a;


-- Save the result of the “Wand” operation in a layer
create table watershed_from_dem_girona as select * from wand;
```

2 - Compare the calculation of the watersheds using two different DEM

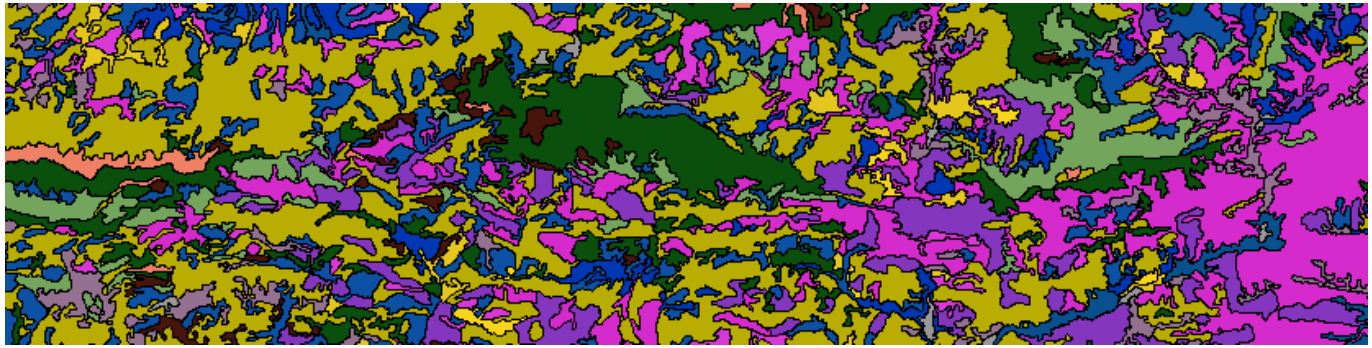


3 - Production of spatial indicators

The objective of this second step

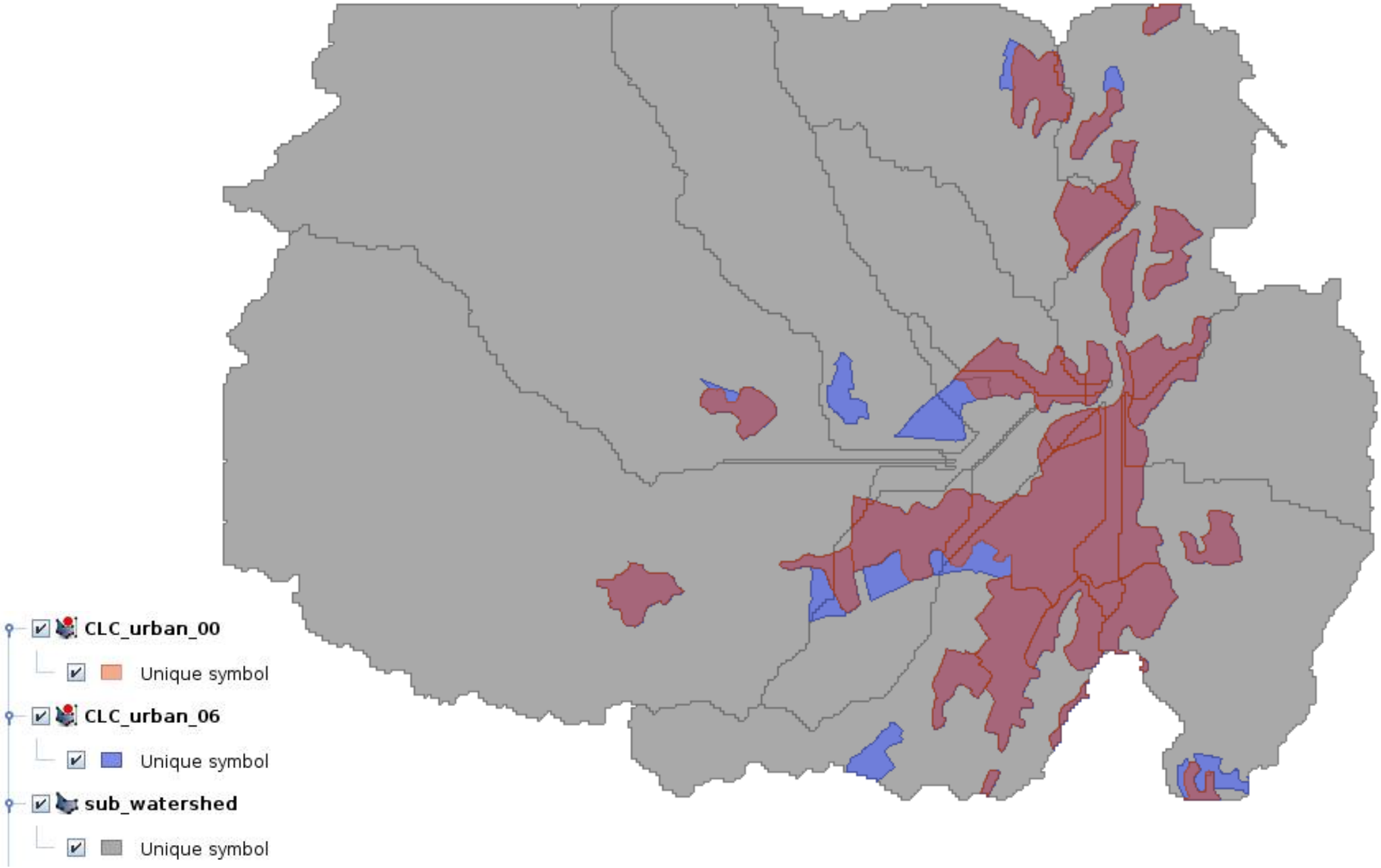
→ Compute the building area density for each sub-watershed, between 2000 and 2006

A- Extract the area (code between 100 & 199) from Corine Land Cover



```
-- For 2000
create table CLC_urban_00 as select ST_Intersection(a.the_geom,b.the_geom) as
the_geom, a.*{except the_geom}, b.id as id_wtshd from CLC_00_catalonia a, sub_watershed
b where ST_Intersects(a.the_geom, b.the_geom) and cod00>100 and cod00<199;

-- For 2000
create table CLC_urban_06 as select ST_Intersection(a.the_geom,b.the_geom) as
the_geom, a.*{except the_geom}, b.id as id_wtshd from CLC_06_catalonia a, sub_watershed
b where ST_Intersects(a.the_geom, b.the_geom) and cod06>100 and cod06<199;
```

3 - Production of spatial indicators



3 - Production of spatial indicators

B- Union of CLC geometries, in each sub-watershed

```
-- For 2000
create table CLC_urban_00_wtshd as select ST_Union(the_geom) as the_geom, id_wtshd
from CLC_urban_00 group by id_wtshd;
-- For 2006
create table CLC_urban_06_wtshd as select ST_Union(the_geom) as the_geom, id_wtshd
from CLC_urban_06 group by id_wtshd;
```

C- Calculate the area of building area in each sub-watershed

```
-- For 2000
create table wtshd_urban_00 as select a.*, ST_Area(b.the_geom) as area_urban from
sub_watershed a, CLC_urban_00_wtshd b where a.id=b.id_wtshd;
-- For 2006
create table wtshd_urban_06 as select a.*, ST_Area(b.the_geom) as area_urban from
sub_watershed a, CLC_urban_06_wtshd b where a.id=b.id_wtshd;
```

D- Calculate the density (%) of building area in each sub-watershed

```
-- For 2000
alter table wtshd_urban_00 add column density_urb numeric;
update wtshd_urban_00 set density_urb=((area_urban/ST_Area(the_geom))*100);
-- For 2006
alter table wtshd_urban_06 add column density_urb numeric;
update wtshd_urban_06 set density_urb=((area_urban/ST_Area(the_geom))*100);
```

3 - Production of spatial indicators

E- Evaluate the evolution between 2006 and 2000

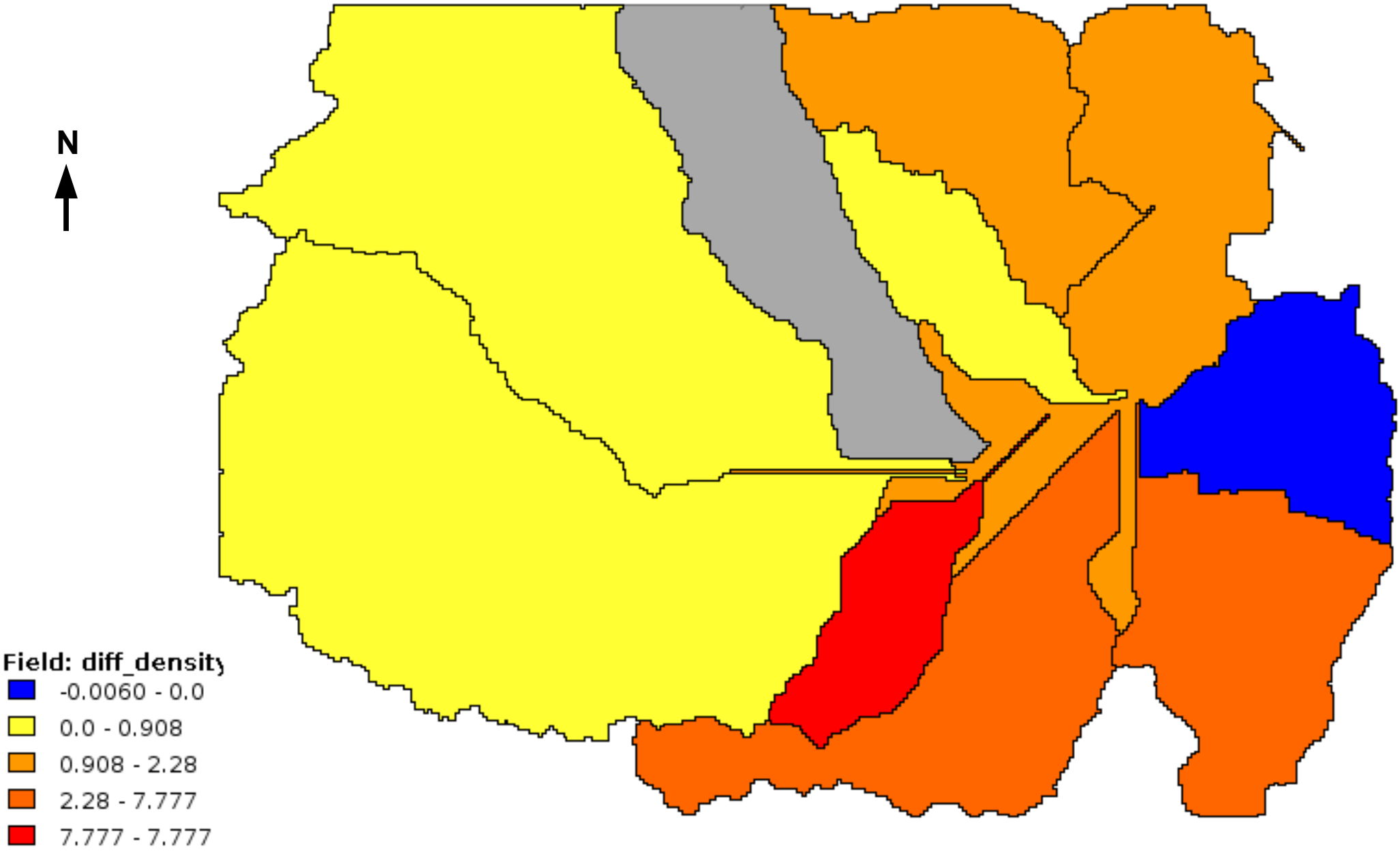
```
-- Compute a new layer with the difference of urban area
create table CLC_urban as select a.*{except density_urb}, (b.area_urban - a.area_urban) as
diff_area from wtshd_urban_00 a, wtshd_urban_06 b where a.id=b.id;

-- Add a new field called “diff_density”
alter table CLC_urban add column diff_density numeric;
-- Update this field
update CLC_urban set diff_density=((diff_area/ST_Area(the_geom))*100);
```

F- Let's make a thematic map !

Thematic analysis :
- Interval classification
- Field : diff_density
- Method : Equivalences
- Nb of classes : 5
- Blue for negative value

The evolution of building area between 2000 and 2006

Density (%) of area per sub-watershed



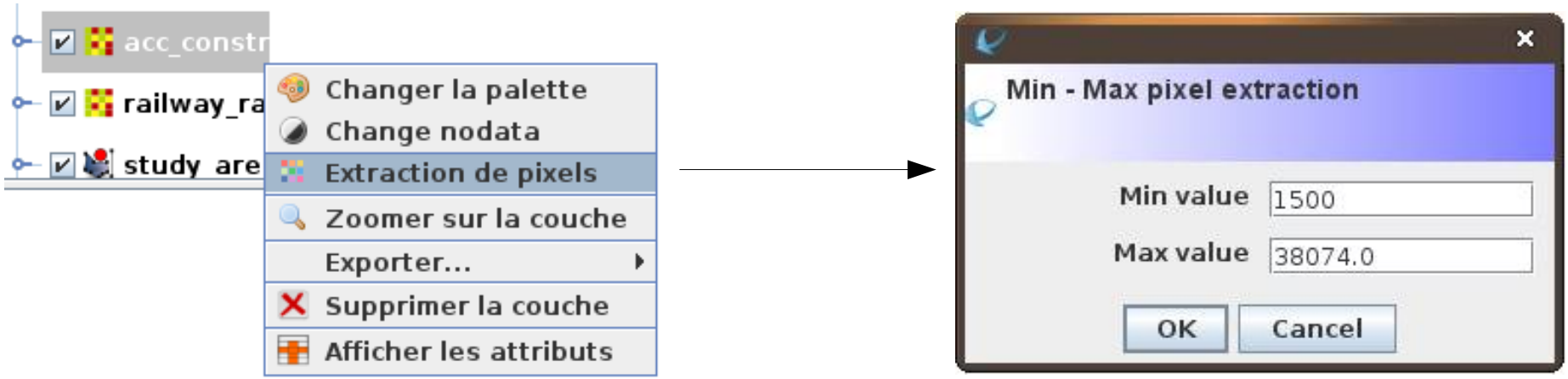
4- Assessing the impact of rail roads on runoff

-- Select rail roads in the layer from ICC
create table railway as select * from bt25m_cl where CAS like '%FER%';

-- Rasterize railways *(where intersects study area)*
create table railway_raster as select ST_RasterizeLine(the_geom, raster, 1) as raster from railway , dem_study_area;

-- Compute the Constrained Accumulation between two raster layers
create table acc_constr as select st_D8ConstrainedAccumulation(d.raster,c.raster) as raster from dir d, railway_raster c;

Then, filter in order to extract hydrological network where value are upper than 1500

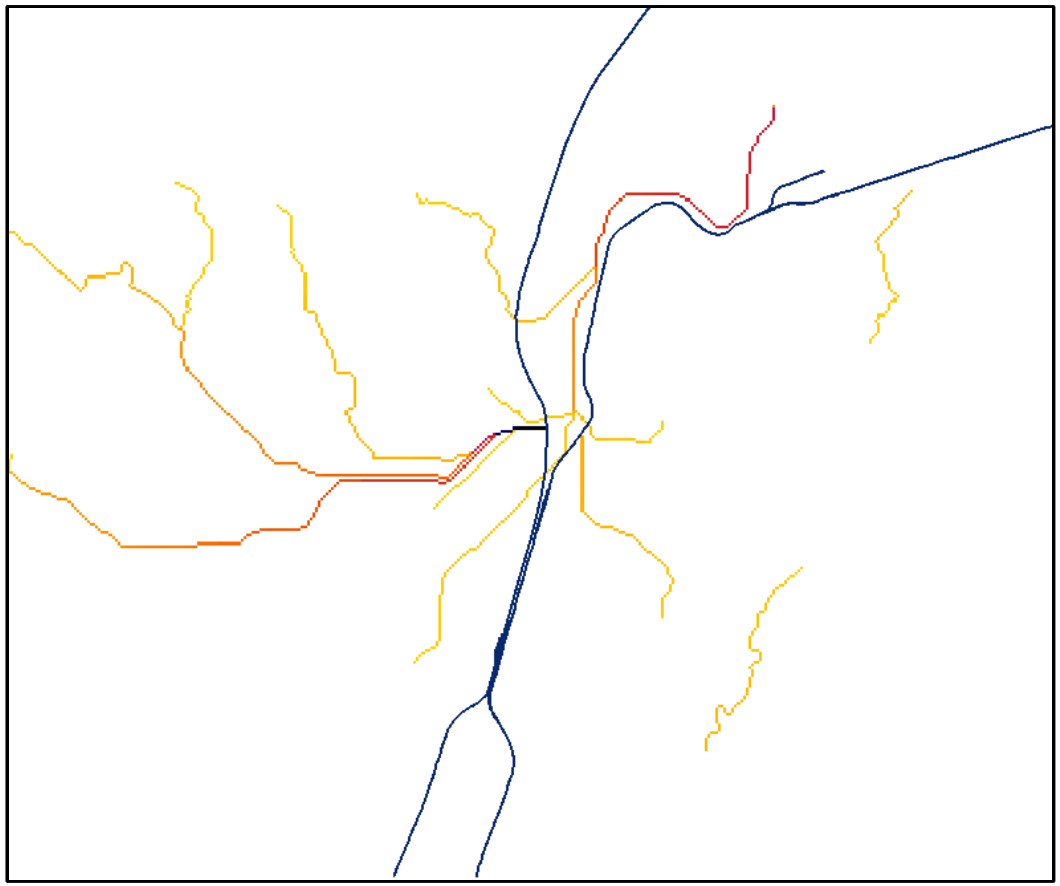


→ *A new gdms layer is added in the TOC*

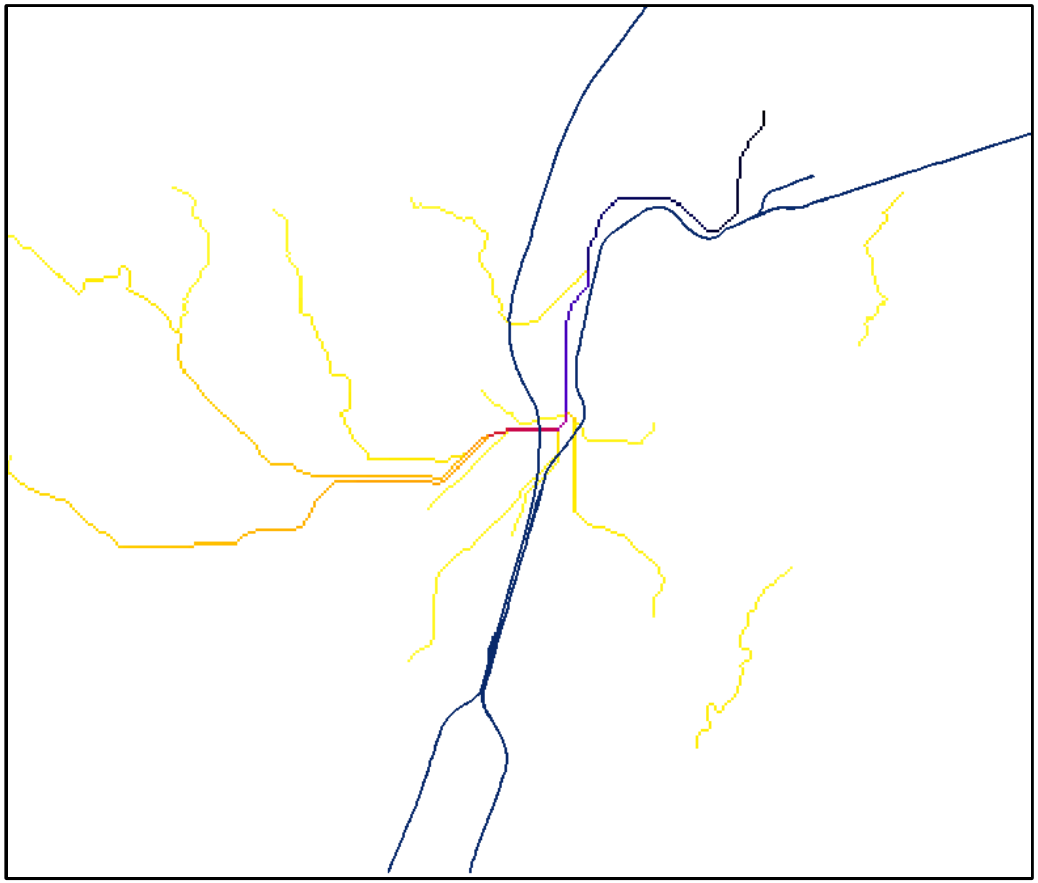
4- Assessing the impact of rail roads on runoff

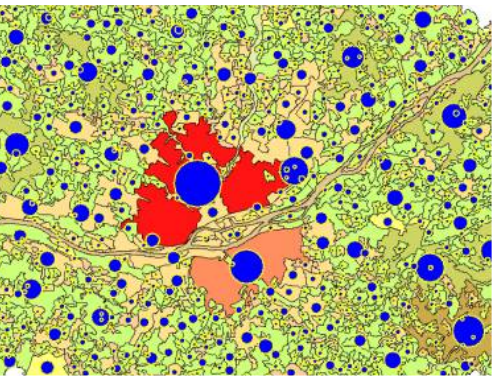
Do the same with “acc” layer (without constraint) and compare both results

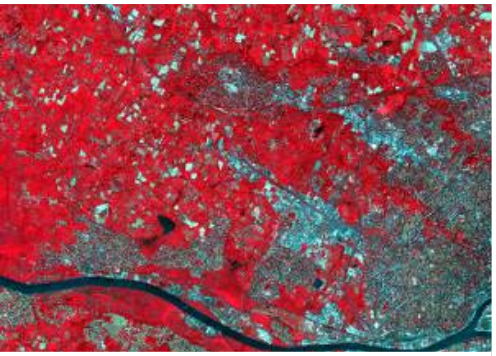
With constraint

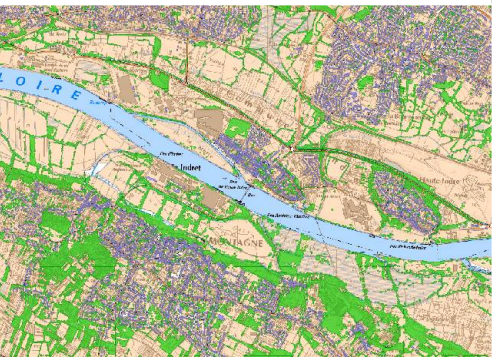


Without constraint









Any questions