

# Quality assessment of drainage networks extraction from a Digital Elevation Model (DEM)

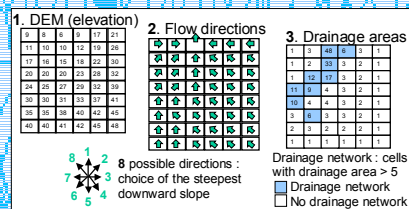
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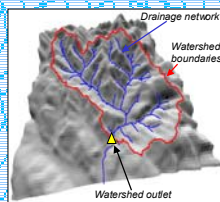
## Digital Elevation Model (DEM) interest for watershed management

Water resource integrated management requires a spatial knowledge of watersheds based on the structure given by drainage networks.

### Drainage networks extraction



### Information extracted from DEM

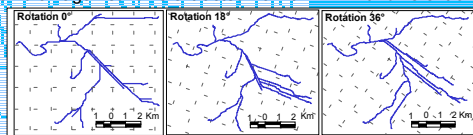


## Determining flow directions with the D8 procedure : advantages & weaknesses

Simple & robust method.

But the flow direction discretisation in 8 possible directions separated by 45° introduces a **bias on flow directions** ; this bias depends on the orientation of the numerical grid.

Illustrative example of this grid bias for an area of limited relief : differences between drainage networks extracted from a DEM with different orientations

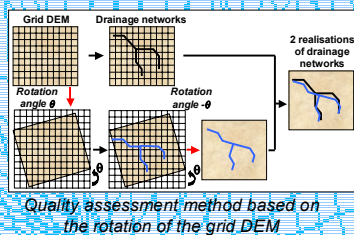


**Main aim :**  
to propose a method for evaluating the quality of drainage networks extracted from a grid DEM with the D8 procedure

## Quality assessment method : probabilistic measure of drainage networks

### Principe

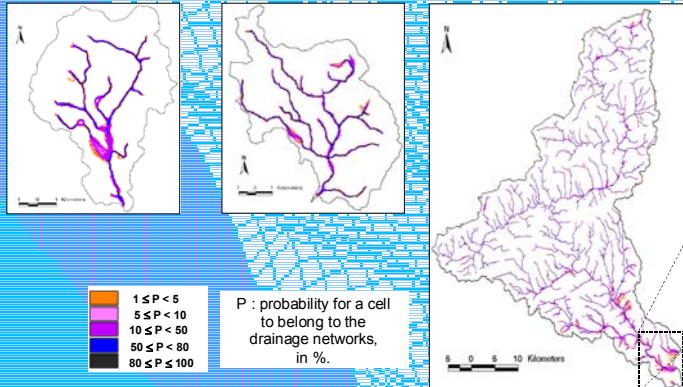
The grid DEM is rotated through **successive rotations** to extract drainage networks relative to different angles  $\theta$ . After inverse rotation (by  $-\theta$ ), those realisations of drainage networks are summed together to obtain a map giving the rate of occurrence of each cell belonging to the drainage network.



$\theta$  varies in  $[0^\circ - 90^\circ]$ , incremented by  $1^\circ$  ; consequently, the map gives us the **probability for a cell to belong to the drainage network**.

### Examples on 3 watersheds of the Hérault region

The Pallas watershed : 52 km<sup>2</sup> ; The Vène watershed : 66 km<sup>2</sup> ; The Orb watershed : 1550 km<sup>2</sup>



→ The critical areas of highest uncertainty for drainage networks extraction are those with very low relief and those with river confluence

## Application of the method : optimising a procedure to improve the drainage networks extraction

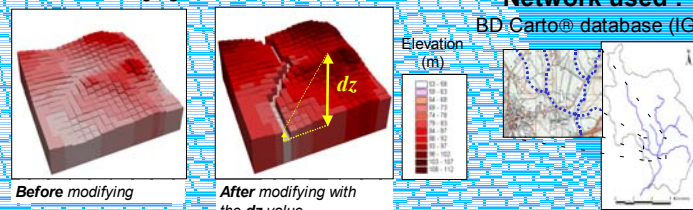
### Proposed solution

**DEM modification** integrating a reference drainage network

**Re-assignment** of the DEM elevations for the cells belonging to the reference network

### Network used :

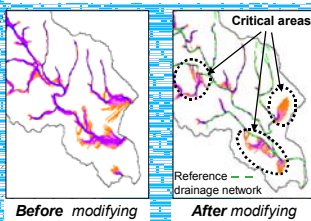
BD Carto® database (IGN)



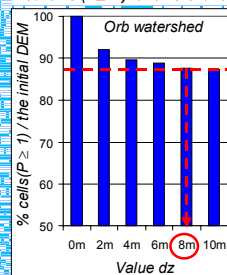
### Comparison of probabilistic measures to determine the optimal value dz

When dz increases, flow directions are more and more independent of the grid orientation, hence the extracted drainage networks are more stable

Probabilistic measure of drainage networks for the downstream area of the Orb watershed



Comparison of % of cells belonging to drainage networks (P ≥ 1) for different values dz :



The more stable the drainage network, the smaller the number of cells belonging to drainage networks for the 90° angles  $\theta$

→ The critical areas persistent whatever the dz value correspond to areas where rivers are not represented in the BD Carto® database.

→ The optimal dz value depends on the processed DEM & on the terrain within the watersheds : Pallas → 8m ; Vène → 4m ; Orb → 8m

## Conclusion

→ The quality assessment method proposed enables hydrological users to quantify and spatialise the quality of the drainage networks extracted from a grid DEM with the D8 procedure.

→ This approach represents a simple and efficient means of comparing different solutions developed to improve the extraction results, based on a modification of the DEM ; in this study, considering a reference drainage network.

### Glossary :

D8 : procedure for flow directions determination, with flow assigned to one of the 8 neighbours in the direction with the steepest downward slope.  
DEM : Digital Elevation Model - numerical description of relief.

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