Towards a Geographic Data Warehouse for Water Resources Management

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Introduction

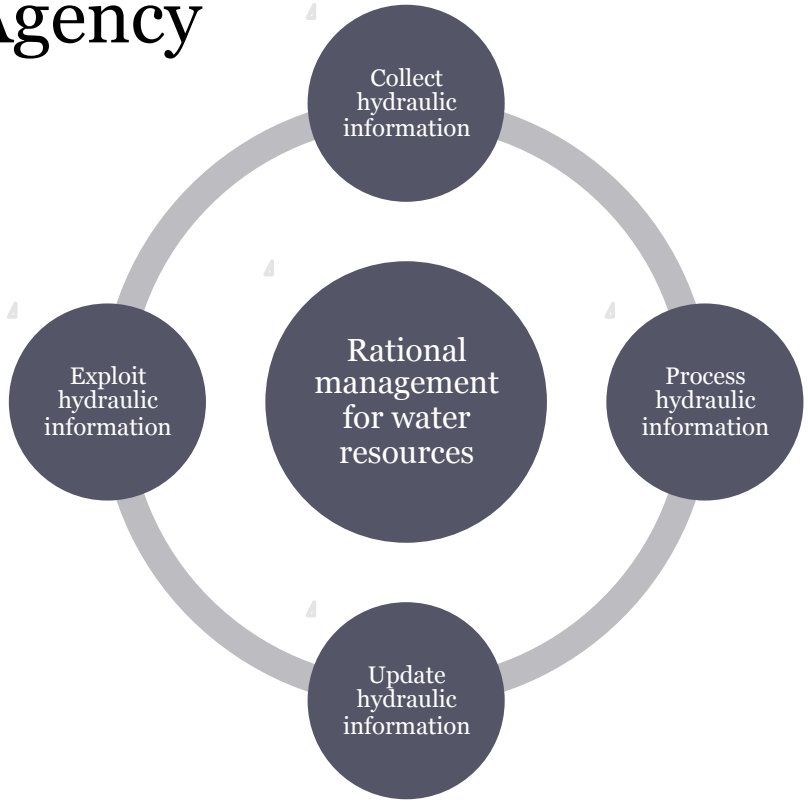
A large part of the data in all decisional systems is geo-spatial in its nature (location data). These data are generally not used efficiently.

Several research works around geographic data warehouses have identified some conceptual, logical and physical issues.

- Designing geographic data warehouses in real case studies involving different application domains can also be classified as an important works category.

- Particularly , we can mention the water resources domain which is crucial for the geopolitical stability of any country.

- In Algeria the management of water resources is the responsibility of the Hydraulic Resources National Agency



Our goal

- Improve the exploitation of hydraulic information by allowing an analytical process to support decision making.

Our mean

- To design and deploy a geographic data warehouse for water resources management.

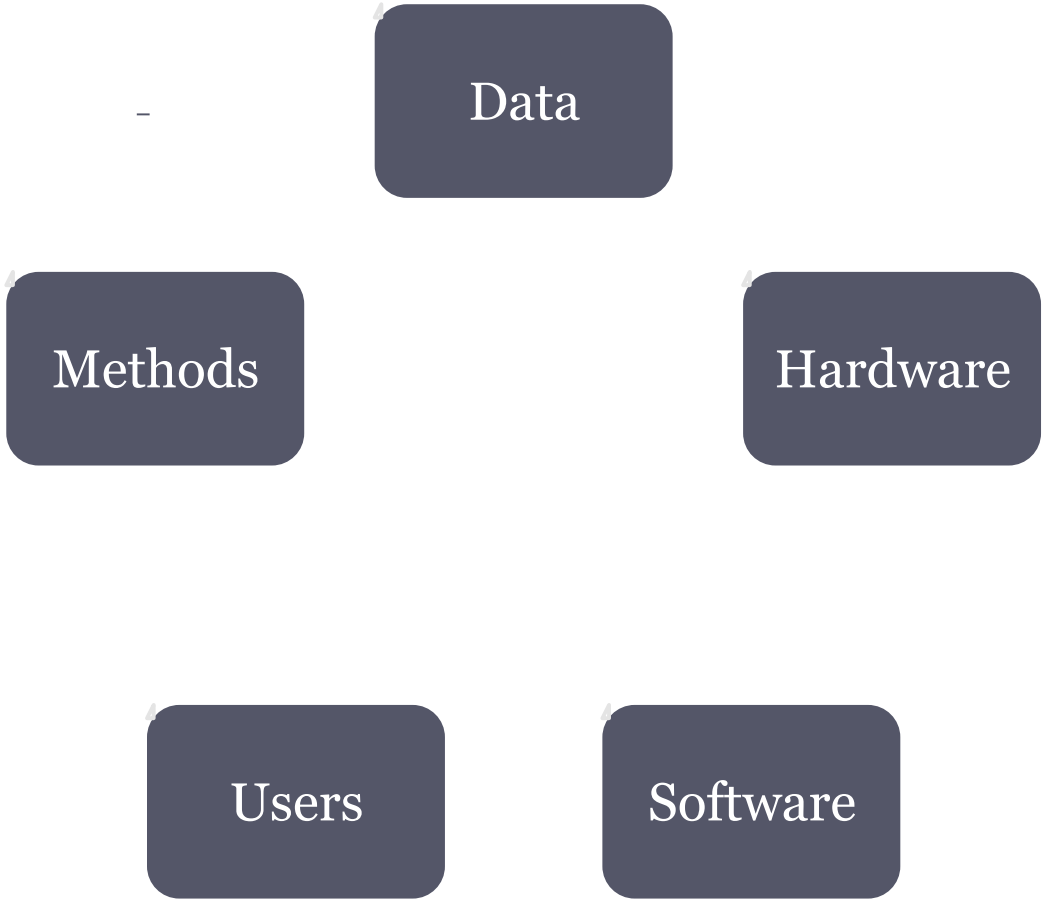
Outline

- GIS
- Data Warehouses
- Geographic Data Warehouses
- The spatial multidimensional model design
- Deployment of the solution
- Conclusion

GIS

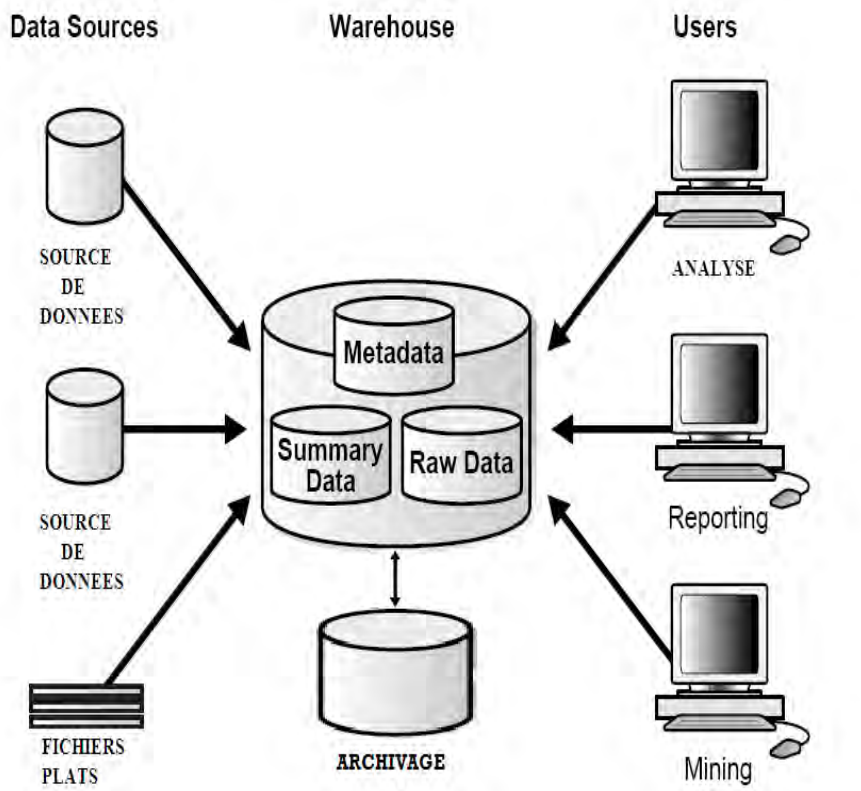
GIS can be seen as an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information

GIS components



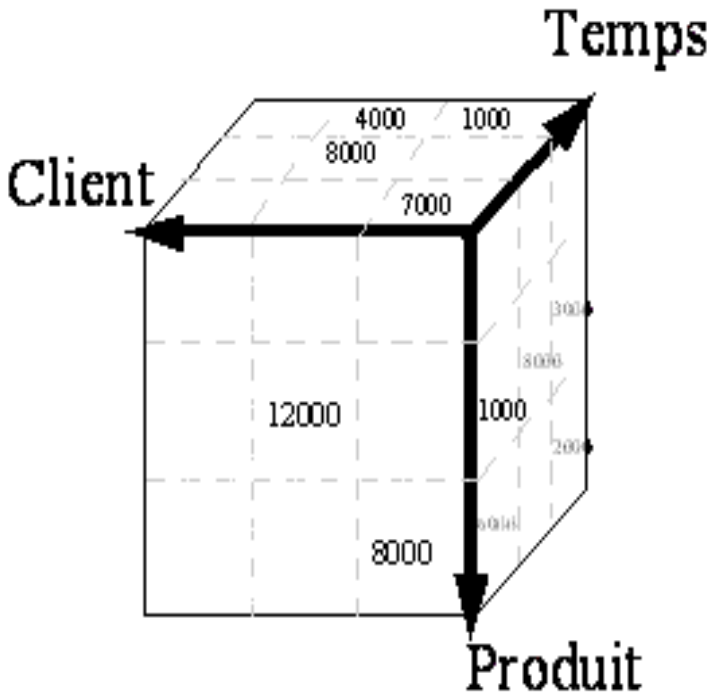
Data Warehouses

A data warehouse is a subject oriented, integrated, time variant, non volatile collection of data, in support of management's decision making process.

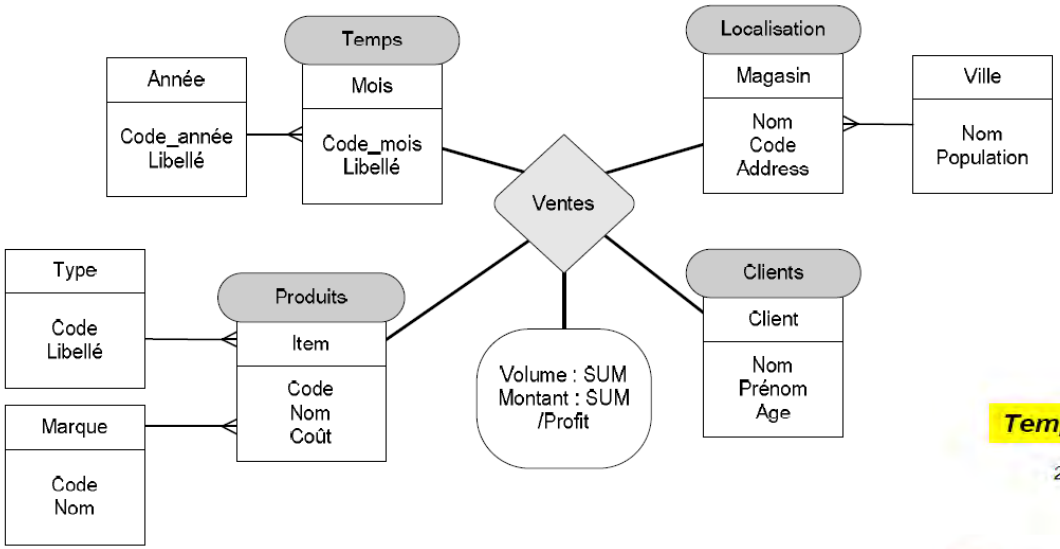


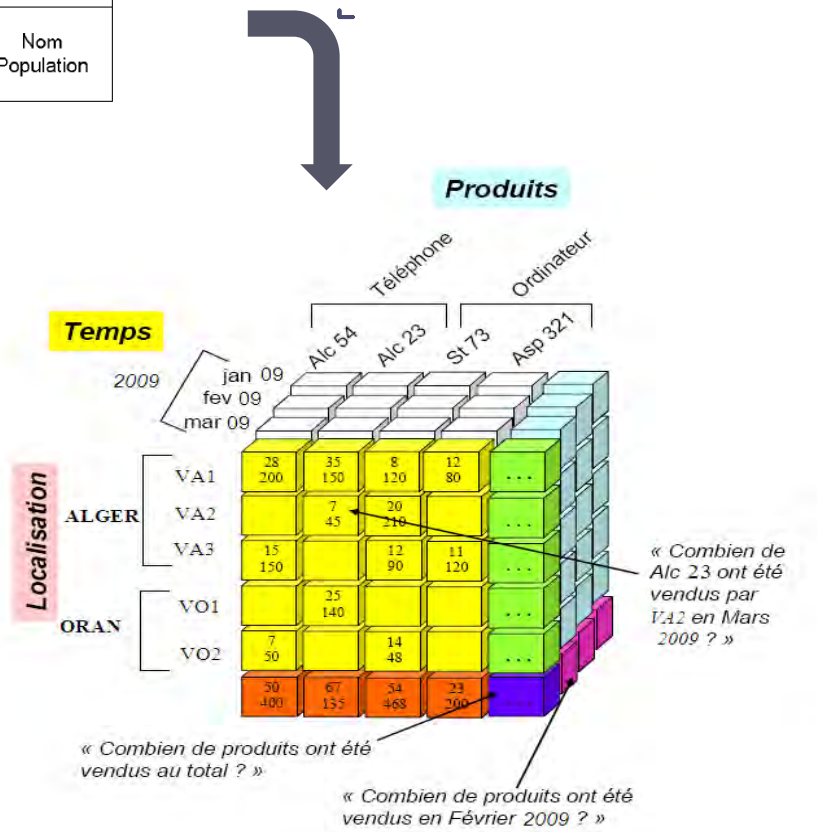
Data Model for Data Warehouses

The multidimensional model is based on two main concepts: *facts and dimensions* representing respectively the measures to be analyzed and the different axes of their analysis



Conceptual level, Logical level





Geographic Data Warehouses

The data managed by DBMSs have more often a spatial component that is mostly untapped. However to analyze the data and exploit their spatial component it is necessary to have new tools dedicated to spatial analysis to provide assistance to decision-making by users

Definition

A geographic data warehouse is a subject oriented, integrated, time variant, non volatile collection of spatial and not spatial data, in support of management's decision making process involving spatial referenced data.

Dimensions in GDW

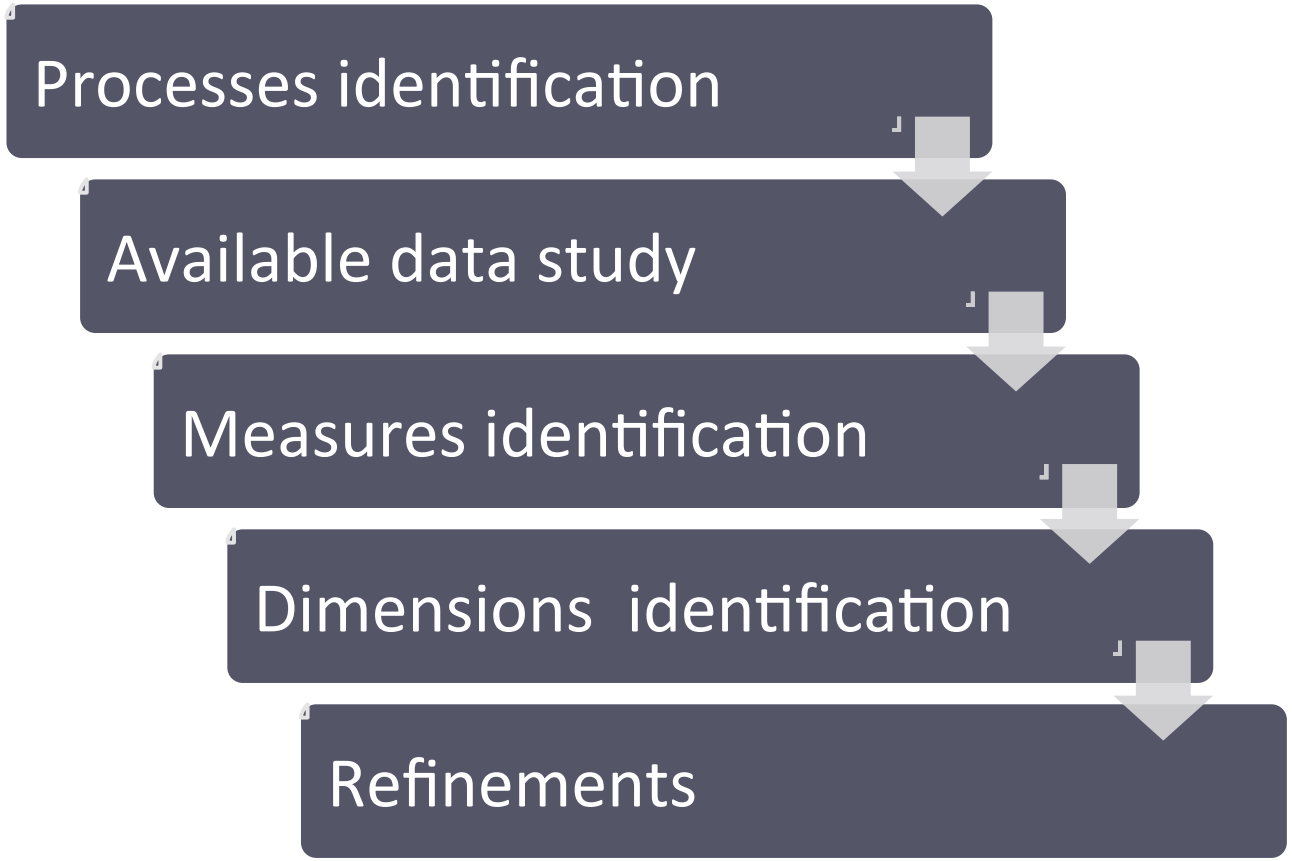
- *Non-geometric spatial dimension*
- *Geometric-to-non-geometric spatial dimension*
- *Fully geometric spatial dimension*

Spatial measures

Spatial measures can be seen as :

- A metric resulting from a set of spatial operators
- A collection of spatial objects

The spatial multidimensional model design



Processes identification

- Stations monitoring
- Water treatment
- Rainfall monitoring
- Gauging
- Flood monitoring

Identified measures

- Number of stations
- Number of running stations
- Number of station off

Stations monitoring

- Pollution ratio
- Pollution min
- Pollution max

Water treatment

- Cumulative rainfall

Rainfall monitoring

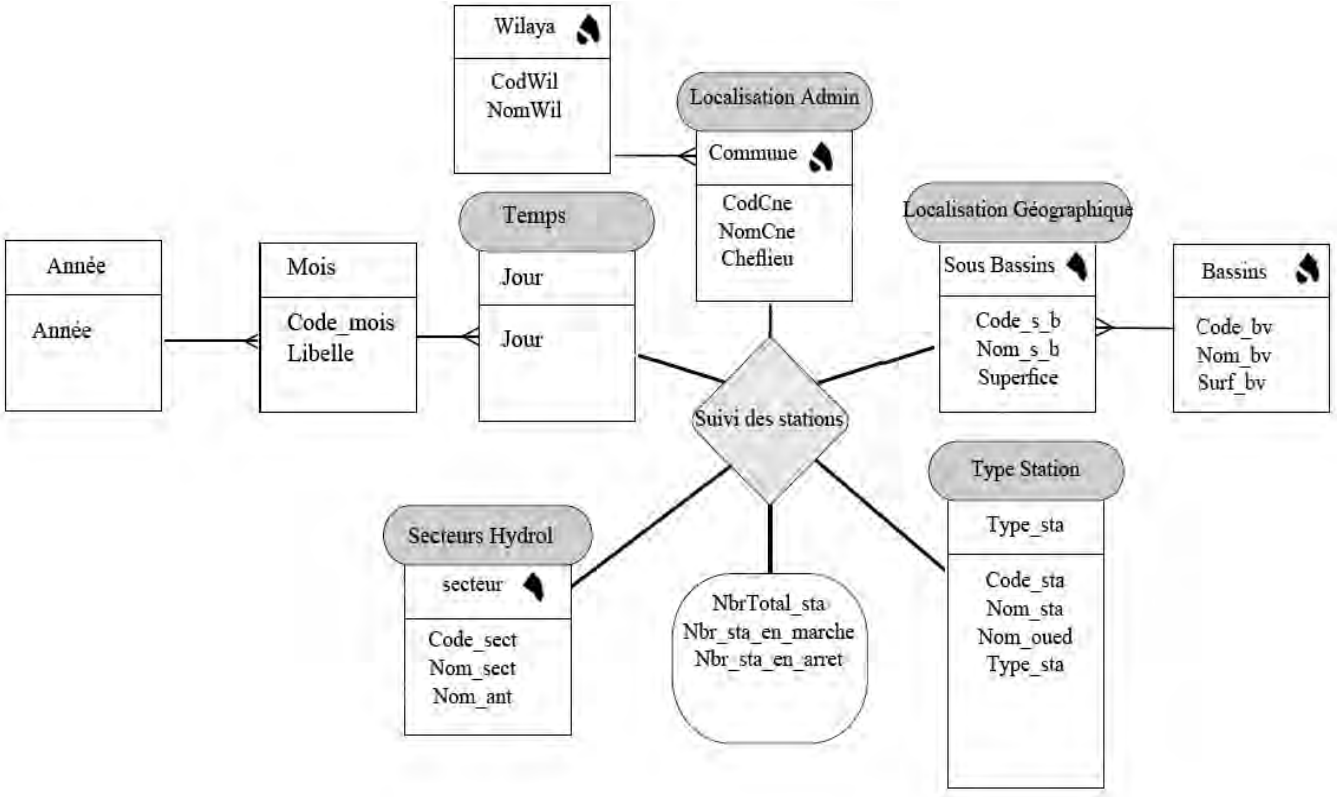
- Number of gauging

Gauging

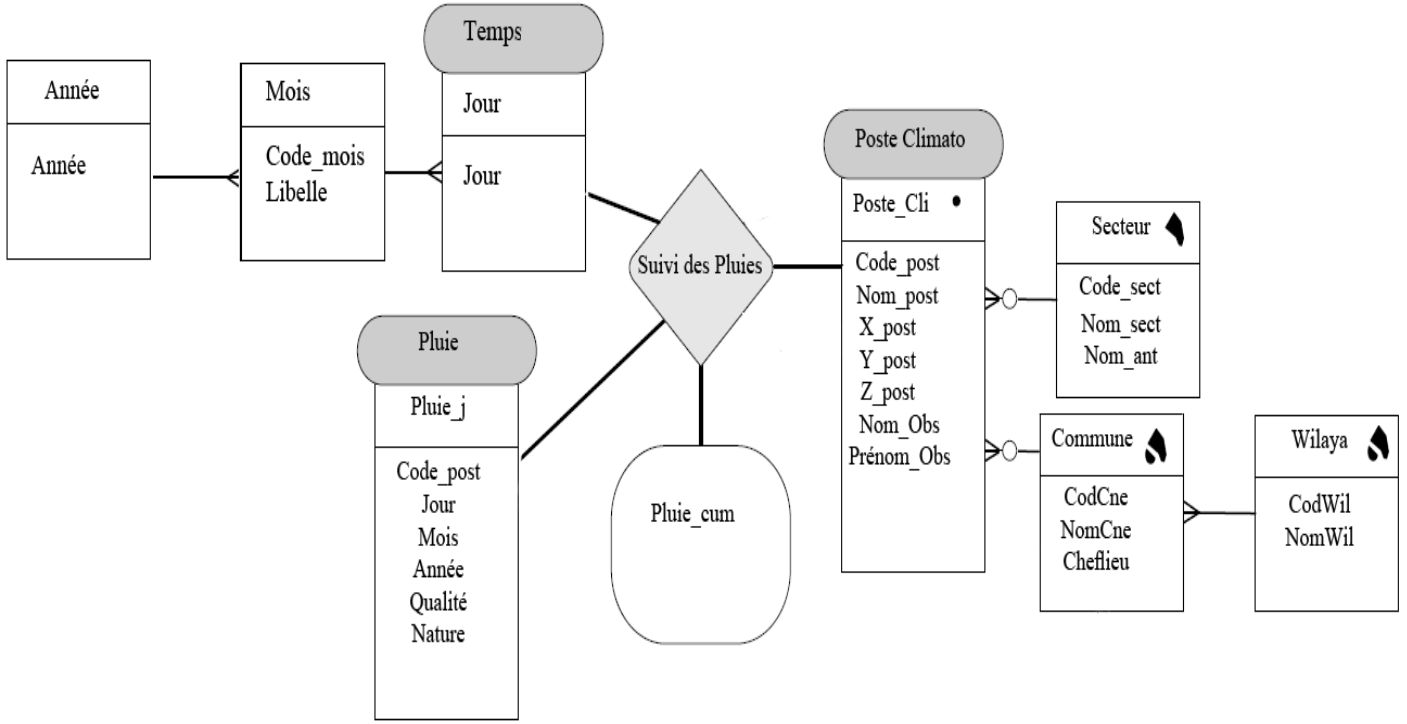
- Number of floods

Flood monitoring

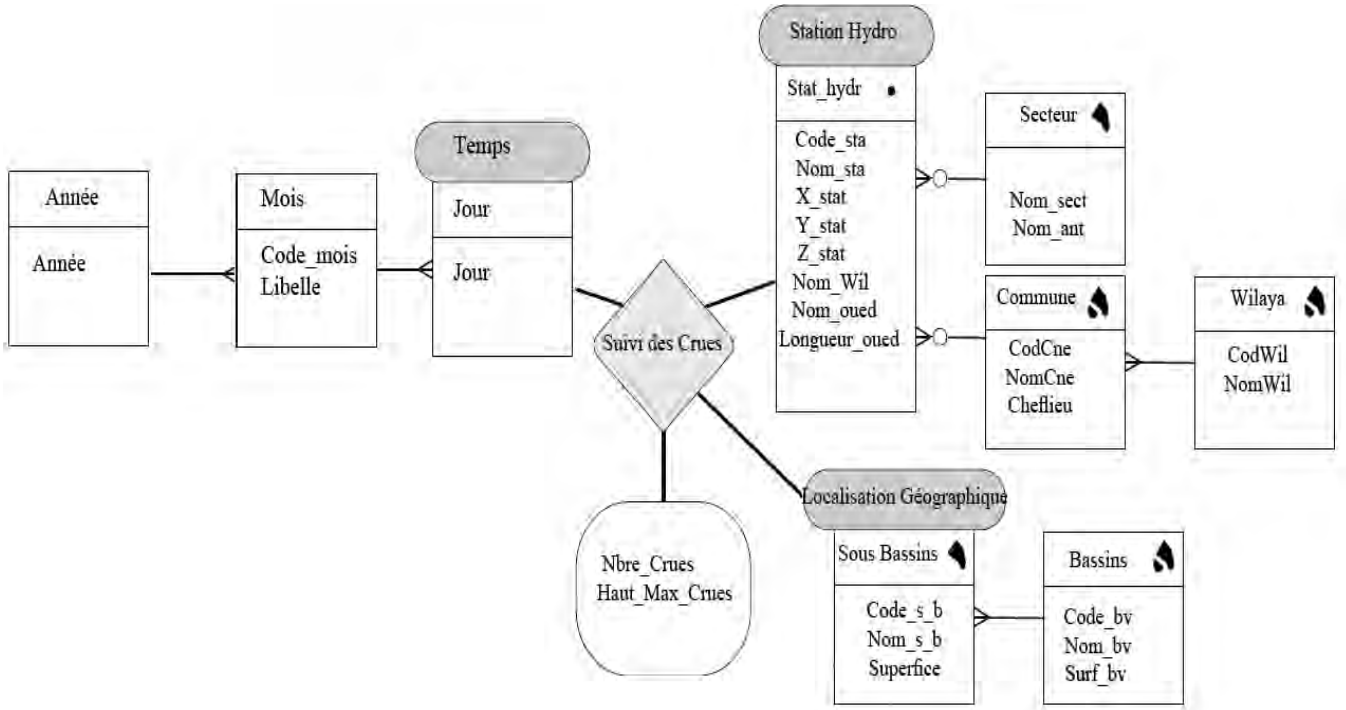
Stations Management Data mart



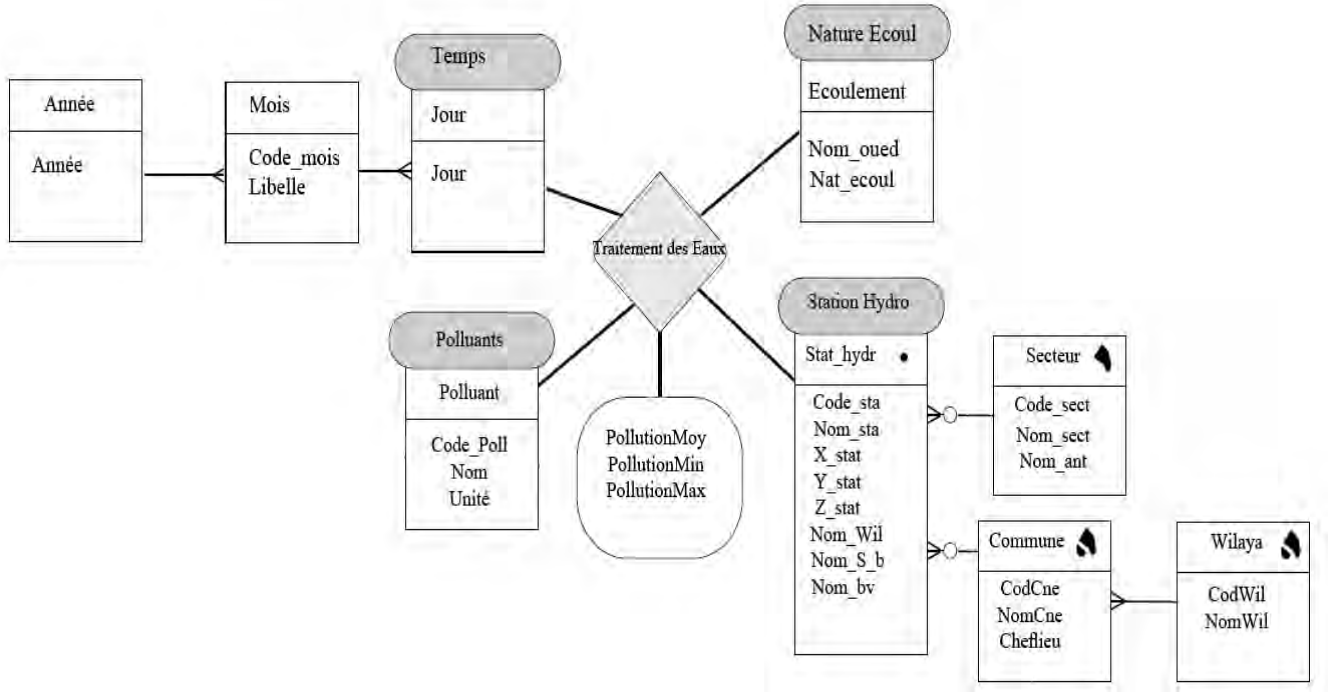
Rainfall Monitoring Data mart



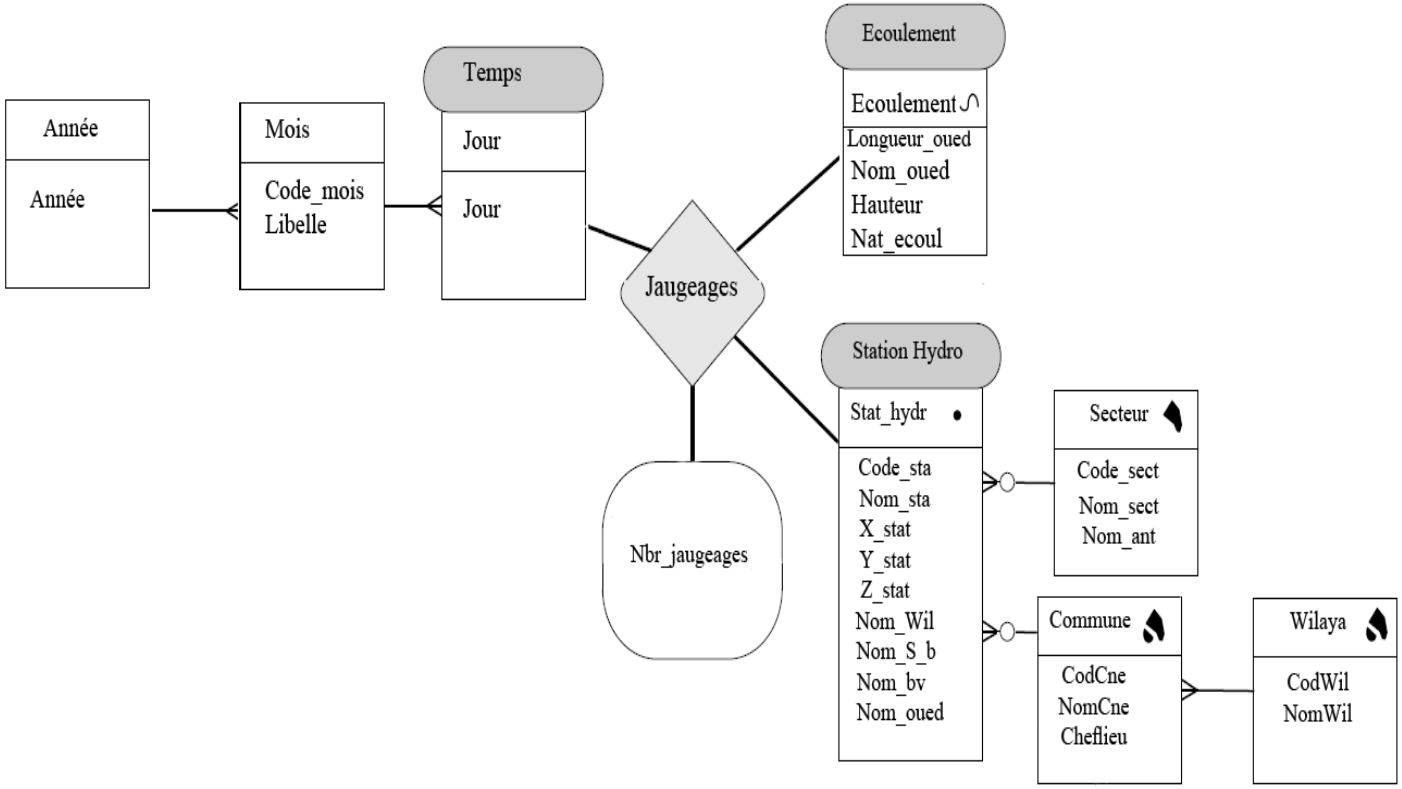
Flood Monitoring Data mart



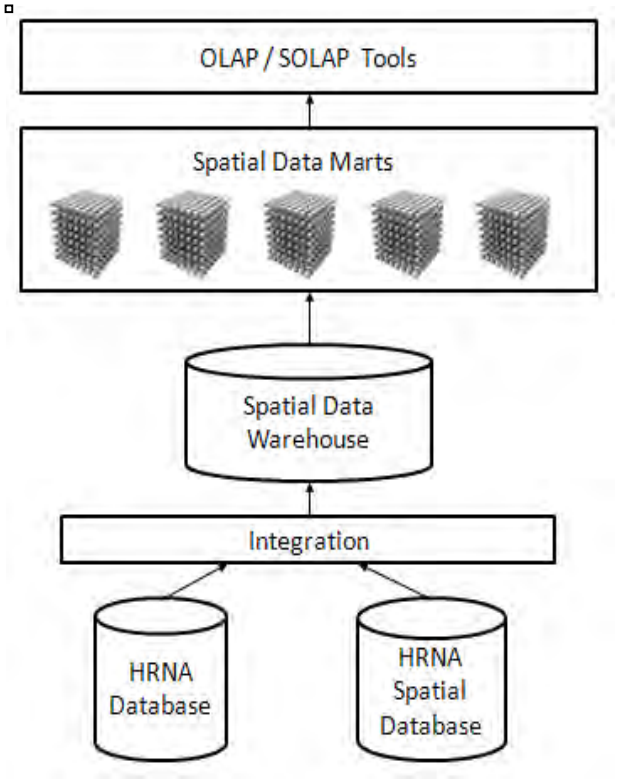
Water treatment Data mart



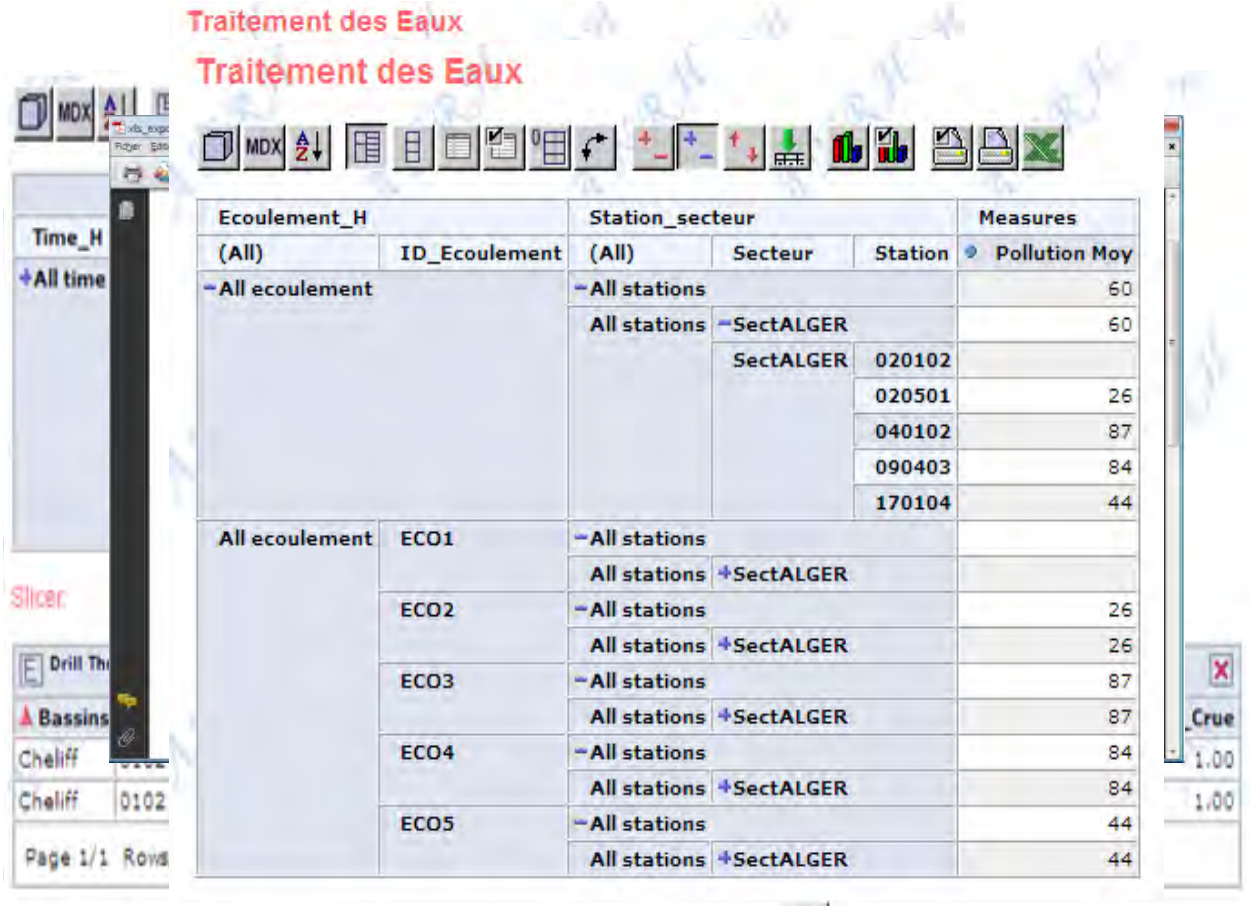
Gauging Data mart



Architecture of the solution



Some interfaces



Ecoulement_H		Station_secteur			Measures
(All)	ID_Ecoulement	(All)	Secteur	Station	Pollution Moy
−All ecoulement		−All stations			60
		All stations	−SectALGER		60
			SectALGER	020102	
				020501	26
				040102	87
				090403	84
				170104	44
All ecoulement	ECO1	−All stations			
		All stations	+SectALGER		
	ECO2	−All stations			26
		All stations	+SectALGER		26
	ECO3	−All stations			87
		All stations	+SectALGER		87
	ECO4	−All stations			84
		All stations	+SectALGER		84
	ECO5	−All stations			44
		All stations	+SectALGER		44

Conclusion

- We have designed a multidimensional model that highlights measures, spatial and non-spatial dimensions, which are relevant in the decision process related to the Hydraulic Resources National Agency.
- The first version of the restitution layer permits the use of OLAP operators to analyse measures through different axes.

Future works

- To enrich the restitution layer by allowing SOLAP manipulations.

- Exploration of spatial data mining opportunities, to improve the usefulness of the geographic data warehouse.

Thanks…