

## Spatial On Line Analytical Processing per Dati Ambientali

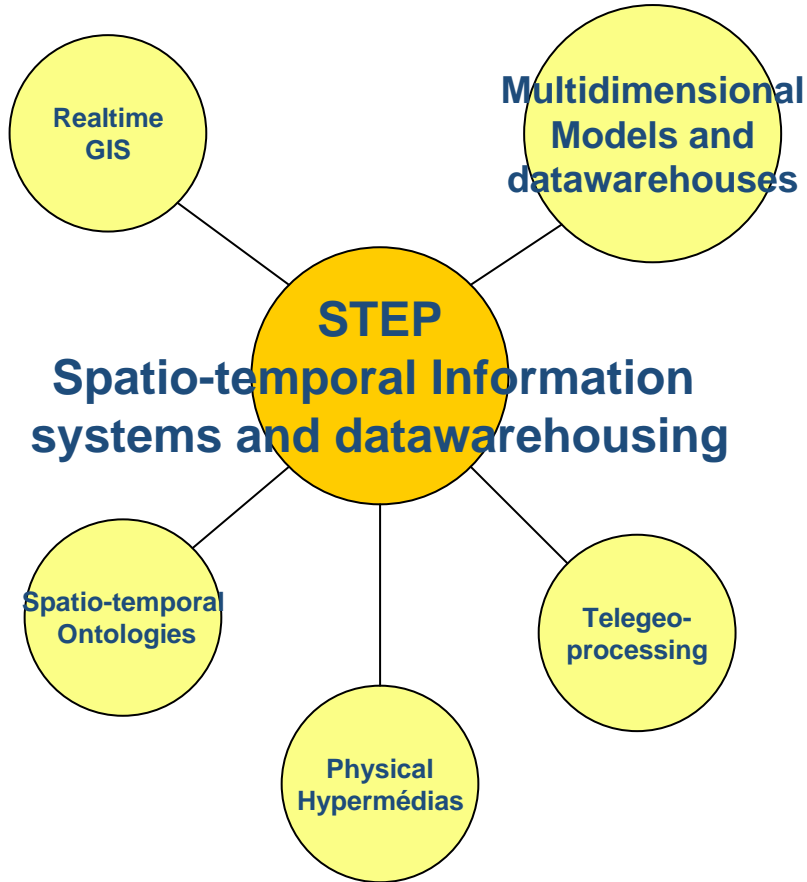
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*LIRIS, INSA Lyon, France*

## LIRIS / STEP

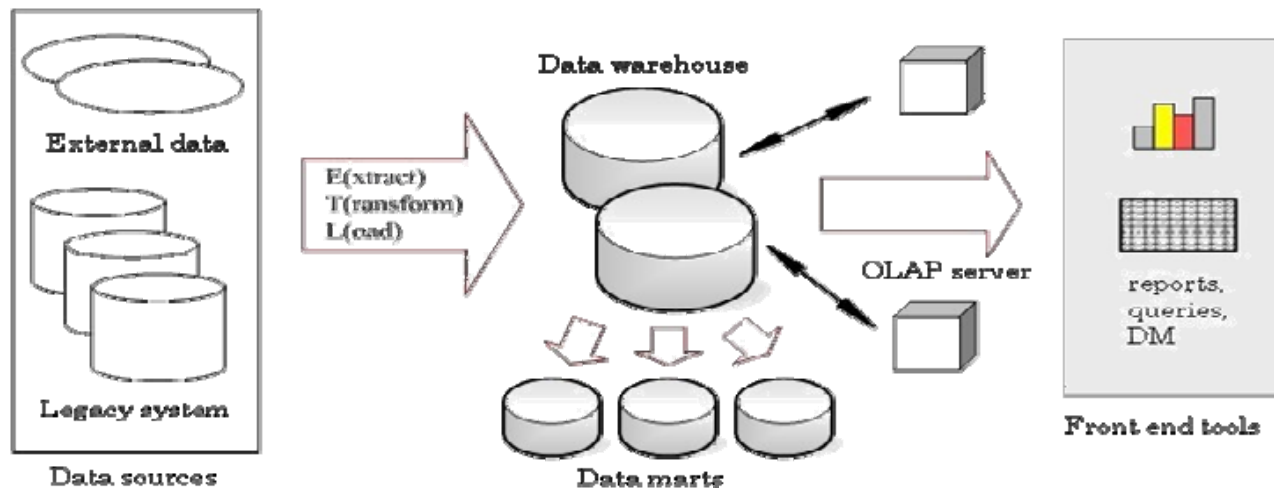
**Staff** : 21 full professors ; 54 associate professors ; 110 Ph.D. students ; 4 full time researchers ; 7 Post-docs (total ≈ 200)

4 axis :  
# 1 : Data, Documents and Knowledge  
# 2 : Image and Videos: Segmentation and Information Extraction  
# 3 : Virtual Reality  
**# 4 : Information and Communication Systems**

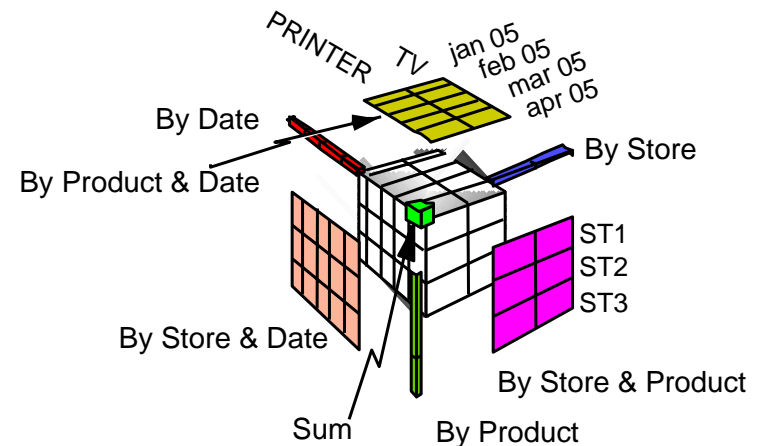


## Data warehousing and OLAP

“A data warehouse is a subject-oriented, integrated, time-variant, and nonvolatile collection of data in support of management’s decision-making process.” (Inmon)

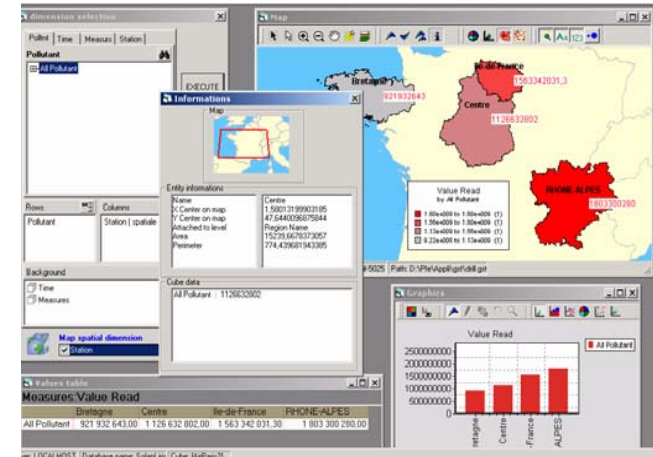


- gather and homogenize data
- guarantee the quality of data
- fast access to summarized data
- interactive navigation through data at different levels of detail



## SOLAP

- Motivation
  - 80% ~ of transactionnal data contains spatial information
  - Enhance decision making
    - visual information
    - discover relationships, correlation between phenomena

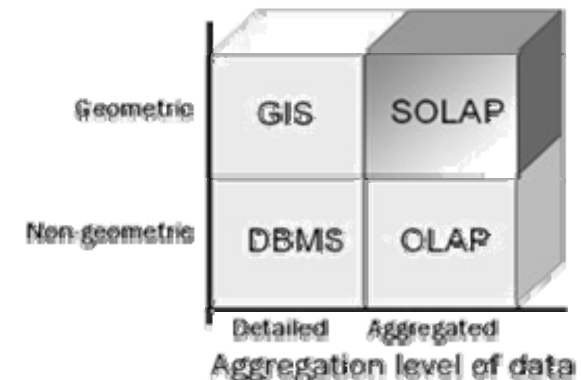


- Definition
  - "A **visual platform** built especially to support rapid and easy **spatio-temporal analysis** and exploration of data following a **multidimensional approach** comprised of aggregation levels available in **cartographic** displays as well as in tabular and diagram displays" [Bédard 97]

– SOLAP > GIS + OLAP

- Applications
  - Health (Supervisation of epidemics, environmental health...)
  - Road network management, physical planning
  - Environment (pollution, ...)
  - Population flow...

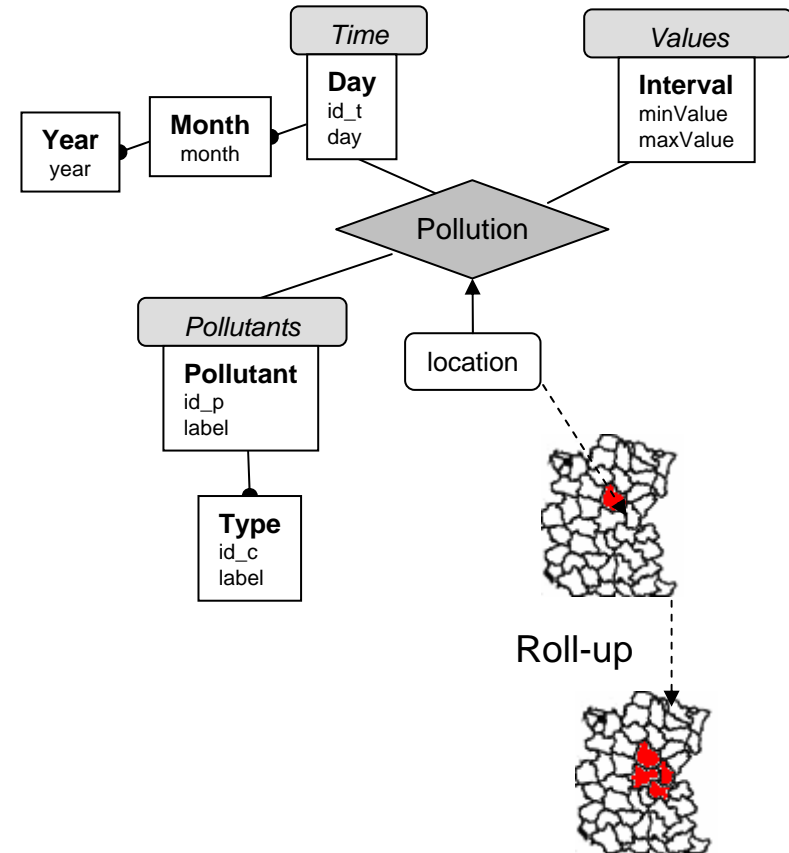
Nature of data





## Spatial measure

- Definition/usage
  - “Where did FERRO exceeded 0.5 in dec. 2000 ?”
- Some issues
  - Computation of hypercube:
    - pre-aggregation with un-classical and time-consuming aggregation operators [Stefanovic 00]
  - Visualization:
    - (multiple) cartographic cells into crosstabs (visual abstraction/data abstraction)
  - Modelization:
    - integration of the descriptive and metric attributes of the spatial measure that can be useful to the decision process



## Formal models

- Model for spatial dimension and/or spatial measure
  - provide a symmetric treatment of measure and dimension
  - allow the definition of spatial dimension and/or spatial measure taking in account all spatial, metric and descriptive attributes : towards a geographic measure and a geographic dimension
  - define an aggregation mode in order to perform aggregation on geographic complex measure
- Integration of the continuous nature of spatio-temporal data
  - Recuperation of hidden and missing data
  - Analysis at very low level of detail
  - simulate spatio-temporal continuity during navigation thanks to on-the-fly interpolation of the data

# Prototype



GéOlap

- Fonctionnalités
  - Frame to select measures and dimensions
  - Multi-modal synchronized
    - tabular, diagram, cartographic
  - OLAP operators available on each mode

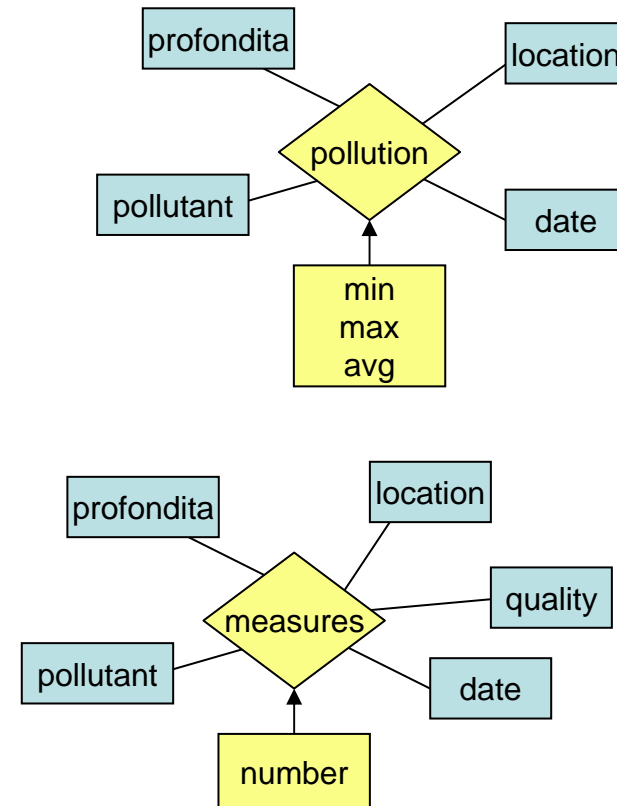
The screenshot displays the GéOlap interface with several components:

- dimension selection:** A tree view under 'Pollutant' showing categories like 'premiere polluants', 'Benzene', 'Dioxyde d azote', etc.
- Values table:** A table showing 'Measures: Value Read' for 'COTES-D'ARMOR', 'FINISTERE', and 'ILLE-ET-VILAINE' across months like 'Février' and 'Mars'.
- Graphics:** Three pie charts representing 'Value Read' for 'COTES-D'ARMOR', 'FINISTERE', and 'ILLE-ET-VILAINE'.
- Map (top):** A map of Brittany with regions highlighted in red and labeled with values like 187728486, 187730779, 187801869, 281890535, and 187801869.
- Map (bottom):** A map of France with regions highlighted in red and labeled with values like 34901710, 58635285, 22963480, 41117984, 14369199, 38479771, and 15648815.
- Actions menu:** A context menu with options: Drill Down, Drill Up, Actions, Expand, Collapse, Isolate, Eliminate, Properties.

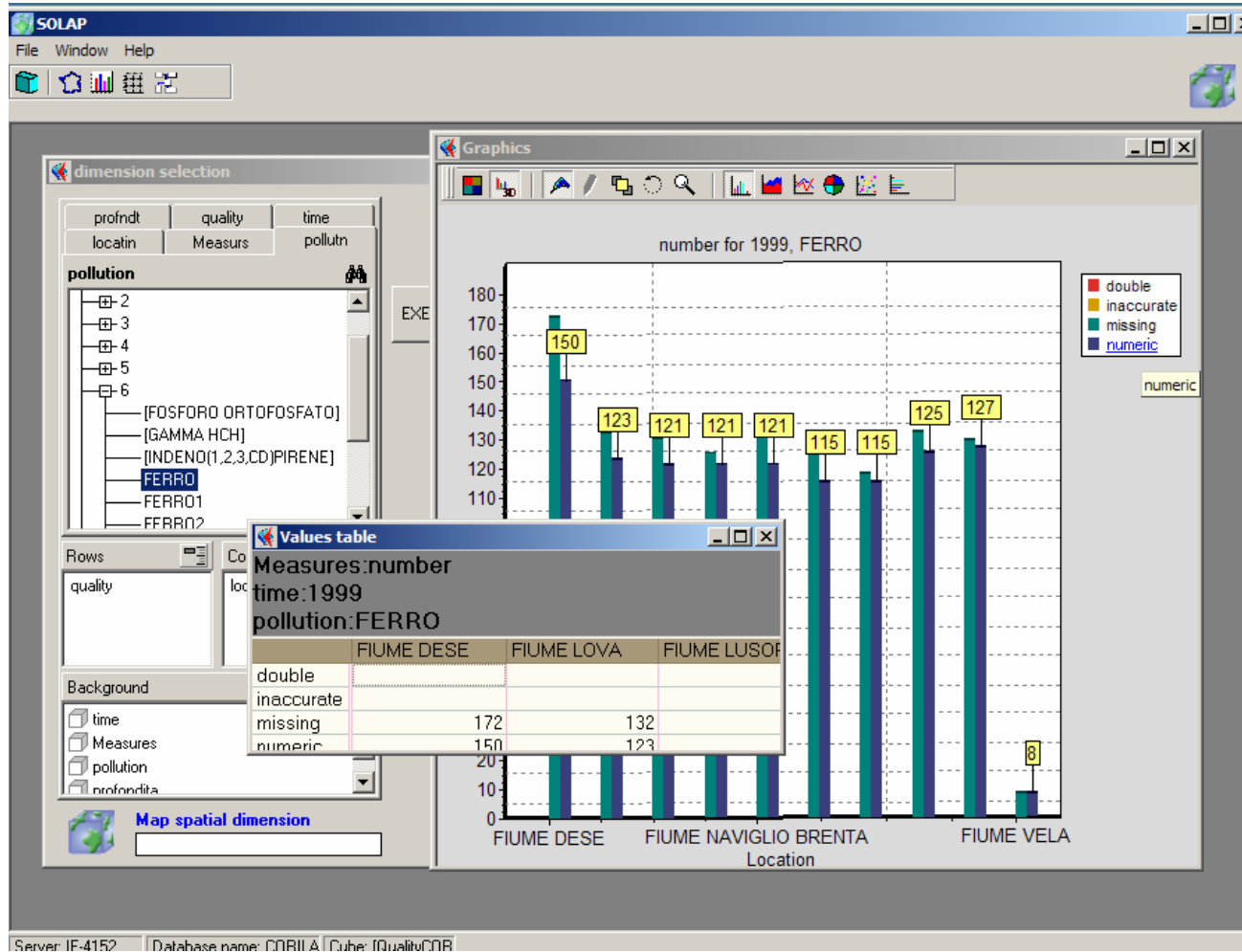
- 8 data files
  - Drain1, Drain2, ... Drain8 in excel and csv format
    - columns :
      - location : **10** locations (FIUME OSELLINO, FIUME DESE...)
      - date : **2826** timestamps (3 years, 28 months, 207 days)
      - pollutants : **100** pollutants
    - pollution values : **294425**
- Problems
  - Heterogeneity (types and values)
  - Multiple inputs
  - Missing data (sparsity)
  - Redundant data

## Drain Project

- Migrate the files to SQL Server
  - add one table for the pollutants and turn column pollutant to foreign key
  - add one attribute to qualify the pollution value
  
- Build 2 multidimensionnal cubes
  - **CubeCorila** : with selected "clean" data
    - 26527 numeric pollution values
    - litteral values for "profondita"
  
  - **CubeAudit**
    - all pollution values (294425)
    - quality measure (numeric, double, inaccurate, missing)



# Drain Project



# Drain Project

**SOLAP**

File Window Help

dimension selection

profndt quality  
locatin Measurs

**location**

- All location
- FIUME DESE
- FIUME LOVA
- FIUME LUSORE
- FIUME MONTALBANO
- FIUME NAVIGLIO BREN
- FIUME OSELLINO
- FIUME SILONE
- FIUME TAGLIO NUOVIS
- FIUME TREZZE
- FIUME VELA

Rows: location, profondita  
Columns: pollution

Background: Measures, quality, time

Map spatial dimension

**Values table**

Measures: Avg  
quality: numeric

		[PCDD/F TOT#]	MANGANESE	MANGANESE1	MANGANESE2
FIUME NAVIGLIO BRENTA	Fondo		62,12	16,73	
	Metà		39,00	11,57	
	Superficie	0,17	51,85	17,12	
	Superficie/APP		34,40	11,00	
FIUME OSELLINO	Fondo		84,12	35,98	
	Metà		67,00	34,50	
	Superficie	0,41	64,94	37,83	
FIUME SILONE					
FIUME TAGLIO NUOVISSIMO					
FIUME TREZZE					
FIUME TREZZE					
FIUME TREZZE					
FIUME TREZZE					

**Graphics**

Avg for Fondo, numeric

Legend:

- [PCDD/F TOT#]
- MANGANESE
- MANGANESE1
- MANGANESE2
- MERCURIO
- MERCURIO1
- MERCURIO2
- NAFTALENE
- NICHEL
- NICHEL1
- NICHEL2
- PIOMBO
- PIOMBO1
- PIOMBO2
- PIRENE
- PROPAZINA
- RAME
- RAME1
- RAME2

Server: IF-4152 Database name: CORILA Cube: [QualityCOR]

## On going works

- Spatial visualization of the laguna for the drain data
- Web version of GéOlap
- SOLAP operators