Catchment Management and Mining Impacts in Arid and Semi-Arid South America
European Commission FP6 Contract INCO-CT2006-032539

INSTITUTO SUPERIOR TÉCNICO

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Project Meeting 2
CAZALAC, La Serena
Chile 6-9 November 2007

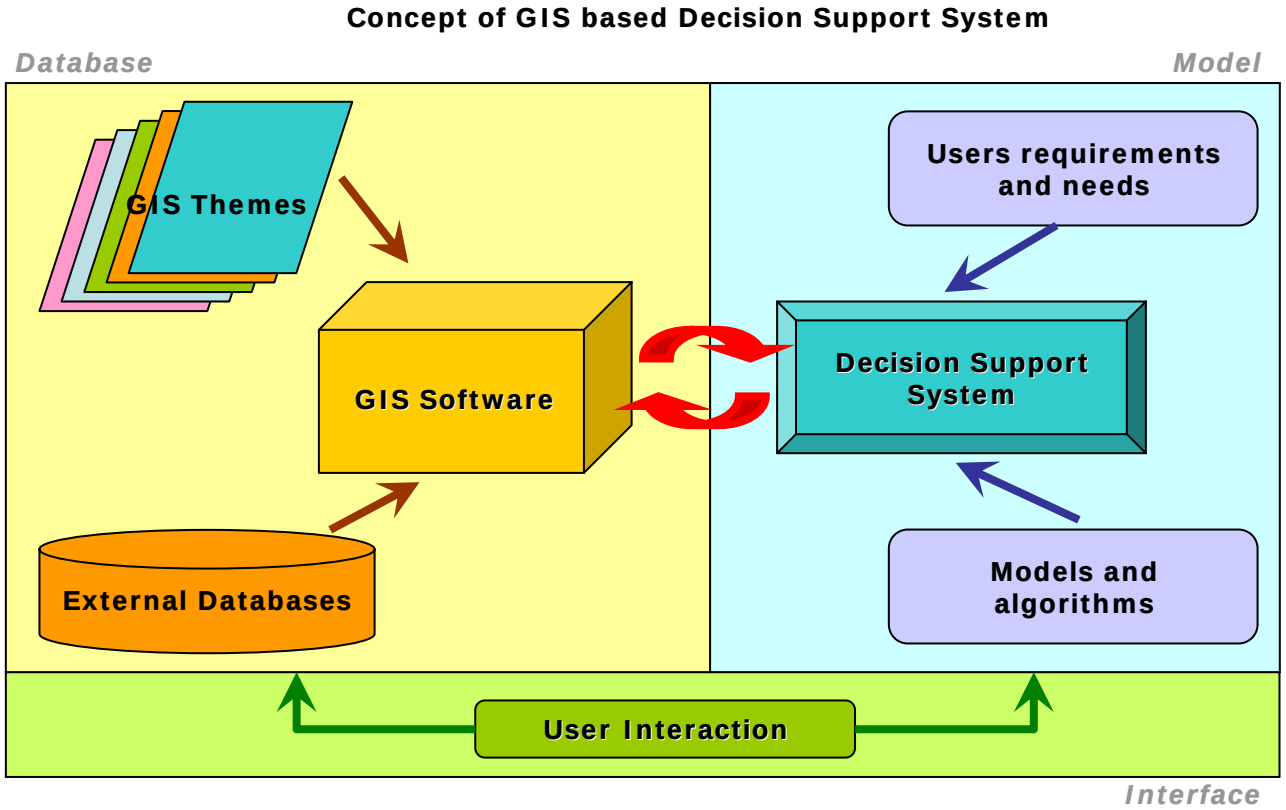
Present state of GIS/DSS for Case Studies

Present state of GIS/DSS for Case Studies - Introduction

WP 6 – is defined as Decision support tool

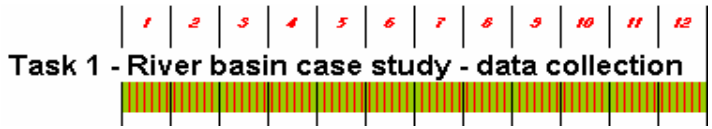
The objective is the development of decision support tools appropriate for river basin planning in arid and semi-arid catchments with mining impact.

Present state of GIS/DSS for Case Studies – GIS/DSS Conceptual Model



Present state of GIS/DSS for Case Studies – Tasks for Year 1

Workflow for implementation of the Spatial DSS for catchment management



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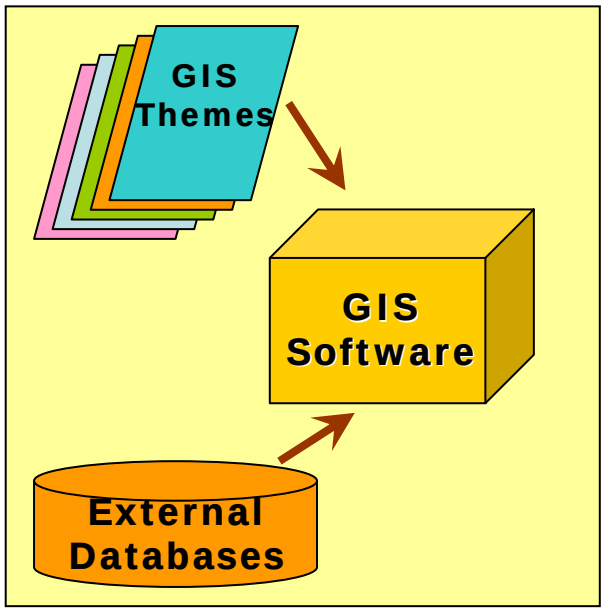


Present state of GIS/DSS for Case Studies – Workflow for WP6 (1Y)

I - Data Collection, pre-processing and pre-validation by local teams;

II - Building a Metadatabase

pre-evaluation and characterization of every information received;

Information about each file received is stored in a database.

III - Data modeling

Defining the database design and structure; building the template data model for each case study.

IV - Data processing

performing different types of data editing, data manipulation and data classification.

V – Database implementation

building the database; putting together different types and sources and information in a organized and standard structure.

Present state of GIS/DSS for Case Studies *I* – Data collection

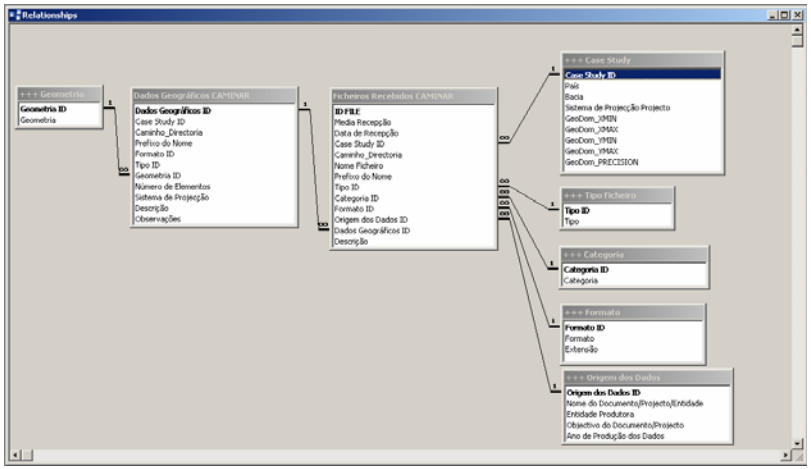
Extensive data compilation, from different sources, internal and external to the teams, that include pre-existing GIS layers in several formats, reports and articles, raw data in tables or lists, satellite images, photographs and general data, both in paper and digital media.

Facts: until end of Oct/2007

4 478	files delivered
751	geographic layers or themes
25	different formats

Present state of GIS/DSS for Case Studies // – Metadatabase

MetaDatabase



Each file received is cataloged in the metadatabase. The metadatabase contains information about the data.

Each file is classified according to attributes such as:

Case study

Data of reception,

Media of delivery (FTP, CD, E-Mail, etc)

Name

Location on the computer

Type

Format

Category

and general description and/or observation

The objectives are:

- **Keeping track of information received;**
- **Rapidly accessing information;**
- **Evaluating gaps or duplications of information**

Present state of GIS/DSS for Case Studies *III* – Data Modeling

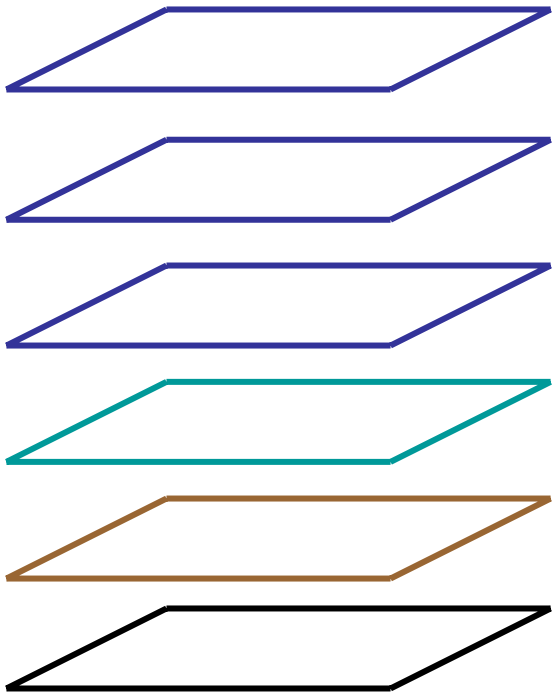
Definition: "Data modeling is a standard architecture that is used to organize, manage and access information in a database"

Basic goals of data modeling are:

- simplifying the process of projects implementation;
- to promote and support standards;
- to bring consistency and synergy between similar systems
- facilitate the transmission of both knowledge and technology, by the use of well documented processes.

Present state of GIS/DSS for Case Studies /// – Data Modeling

Data Model Based on Inventory



Point of interest in the hydrographic system

Line features in the hydrographic system

Surface features in the hydrographic system

Pumps

Dams

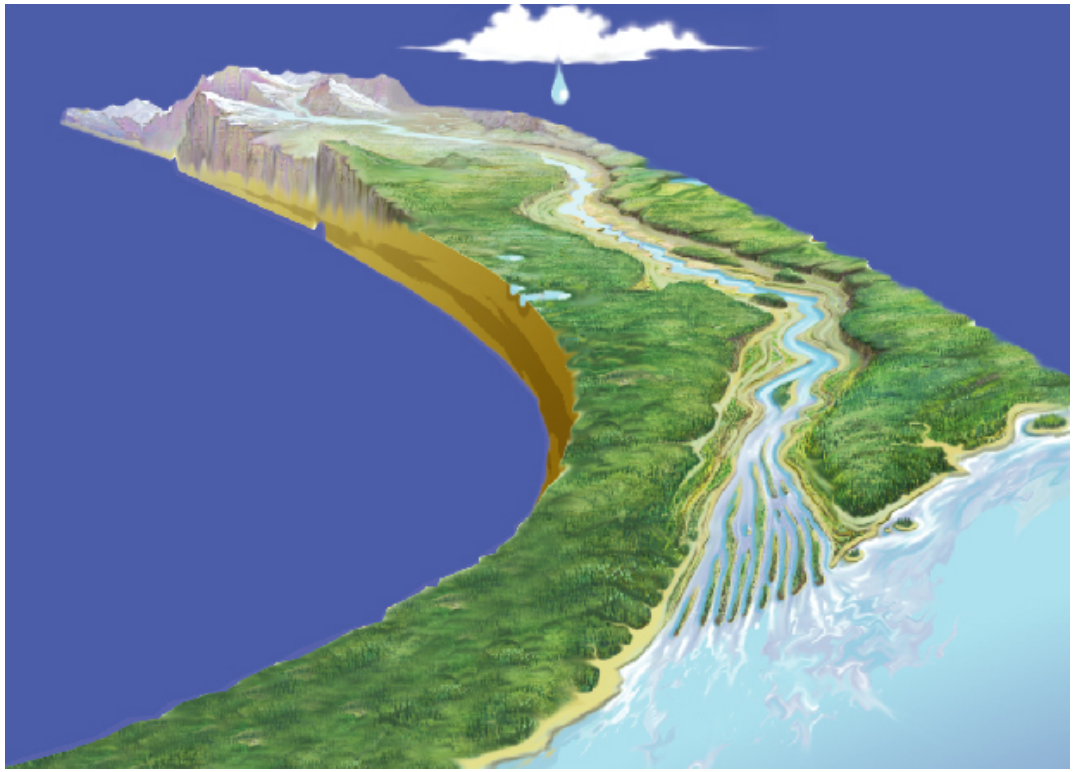
Bridges

Make an inventory of all features of a given type in the region

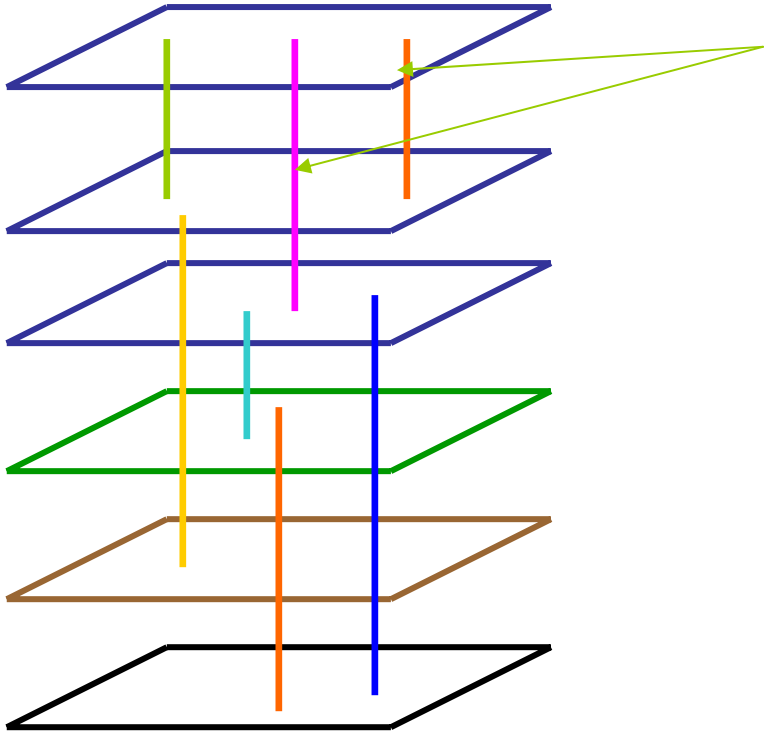
What is it?
Where is it?

Data Model Based on Behavior

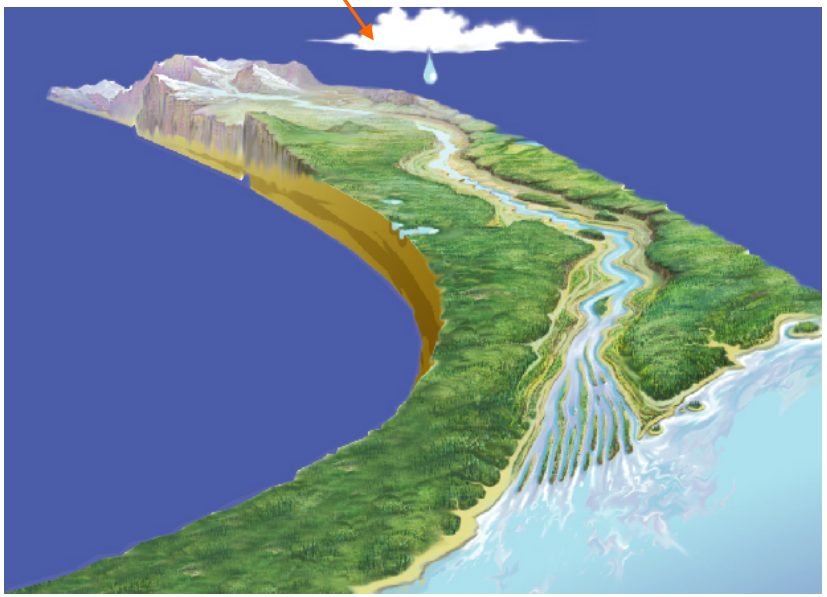
Follow a drop of water from where it falls on the land, to the stream, and all the way to the ocean.



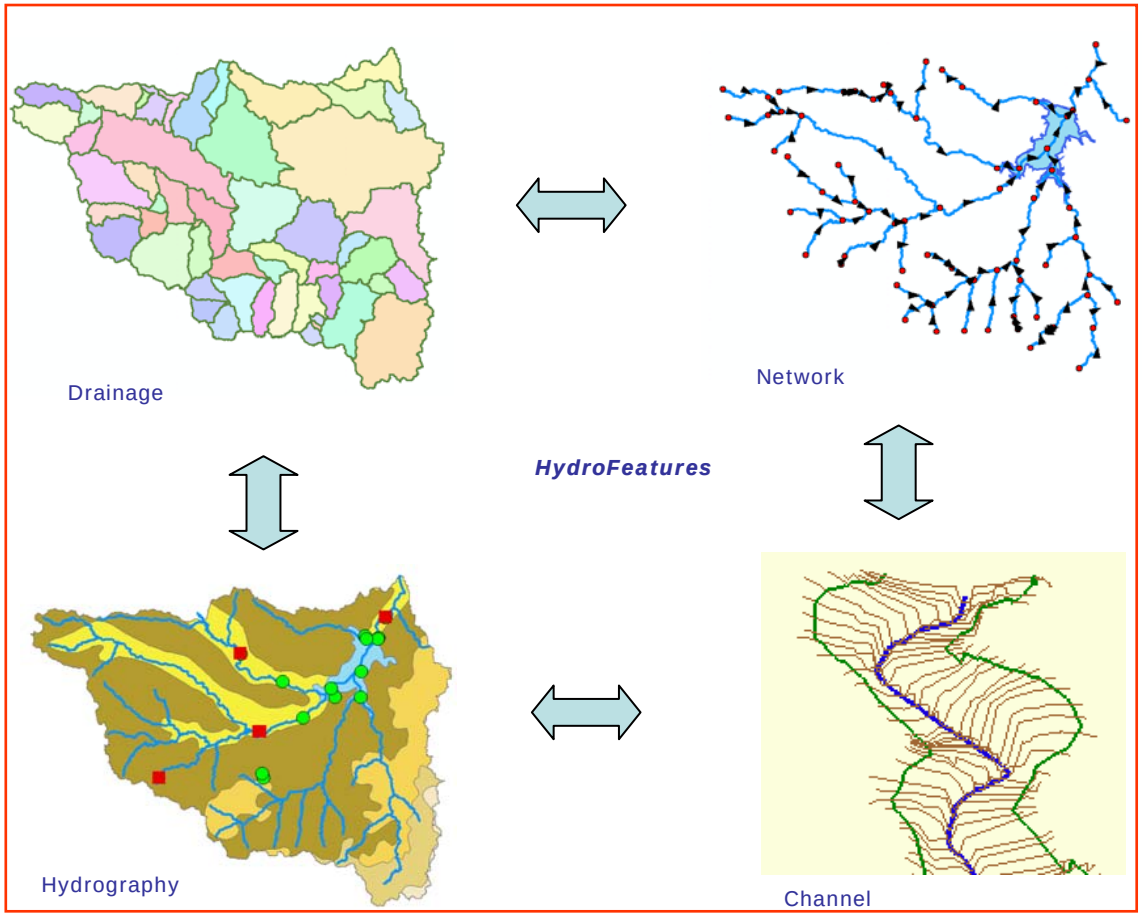
Integrating Data Inventory using a Behavioral Model



Relationships between
objects linked by tracing path
of water movement

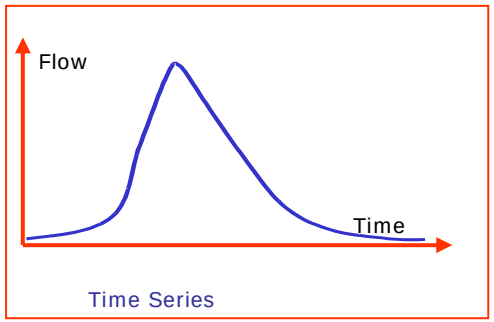


Present state of GIS/DSS for Case Studies *III*– Data Modeling



ArcHydro Data Model*

Behavioral view



**Developed jointly by the Center for Research in Water Resources of the University of Texas at Austin, and ESRI*

ArcHydro Data Model as a GEODATABASE Data Model

Geodatabase is a object-oriented data model that allow you to store both physical objects and behaviors in the same scheme.

A geodatabase can define general and arbitrary relationships between objects and features

A geodatabase can enforce the integrity of attributes through domains and validation rules

A geodatabase can present multiple versions so that many users can edit the same data.

A geodatabase can model topologically complex sets of features such as networks

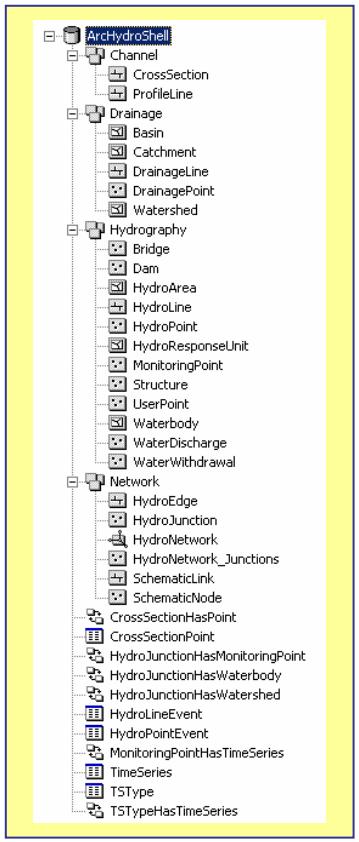
A geodatabase stores both geographic objects and non-geographic data in a commercial relational database.

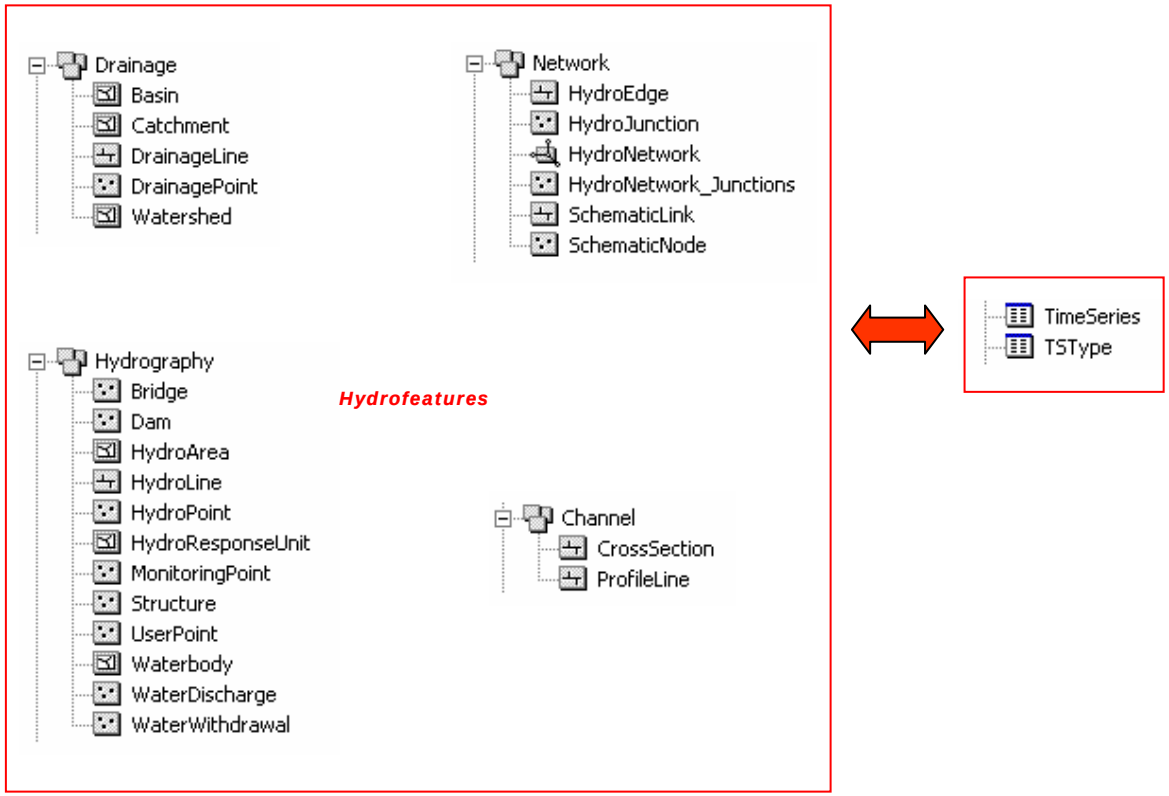
A uniform repository of data. All of your geographic and non-geographic data can be stored and centrally managed in one database file.

This means that we can use the advantage of improved performance of spatial analysis by use of topological rules as well as all the advantage of data management, retrieving and analysis associated with relational databases.

Present state of GIS/DSS for Case Studies *III* – Data Modeling

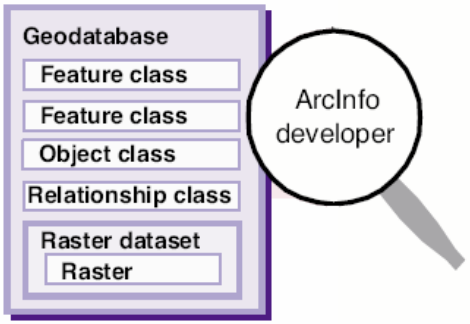
ArcHydro Data Model
Geodatabase view





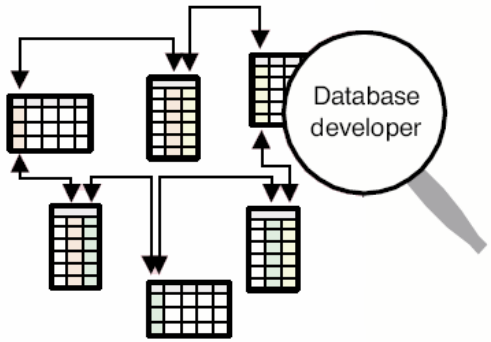
Present state of GIS/DSS for Case Studies /// – Data Modeling

Geodatabase



GIS applications

ArcInfo is a general-purpose GIS application with advanced editing and map display, spatial analysis, and topological processing. Through ArcInfo, features in your geodatabase act with full object awareness as expressed with domains, validation rules, and custom code. The developer uses the geodatabase data access objects in Visual Basic, Visual C++, or other COM-compliant development environments.



database applications

Database applications sometimes need to extract data from a geodatabase, but not to display or spatially process that data. An example would be to pull or join utility pole attributes from a geodatabase to a relational database so that an inventory can be taken. The database programmer can interact with the tables in a geodatabase through the native SQL interfaces. The developer should refrain from modifying any geographic shapes or geodatabase system tables.

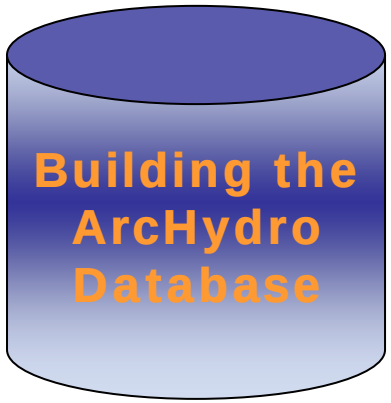
Present state of GIS/DSS for Case Studies *IV* – Data Processing

Data processing: performing different type of operations, edition and manipulation of data. Includes tasks such as:

- **Format conversion**
- **Projection system conversion**
- **Geometric correction**
- **Topologic correction**
- **Table reformatting**
- **Attributes normalization**
- **Data reclassification**
- **Generating new data**
- **Mixing different sources**

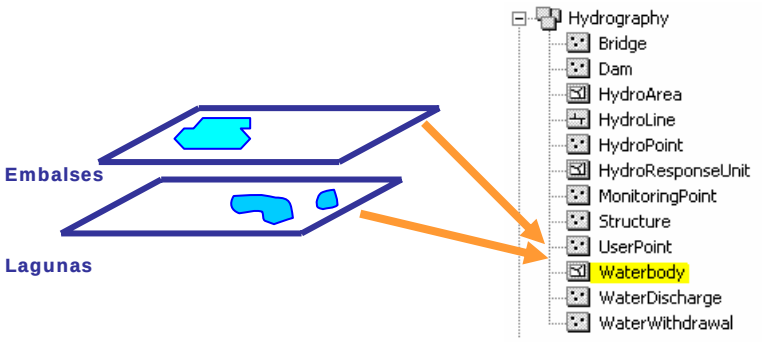
Present state of GIS/DSS for Case Studies *V* – Database Implementation

Database implementation: process through which data from different sources and formats is put together in a single, uniform database structure, according to a predefined data model and specifying the relations (geometric or alphanumeric) between the different hydro features.



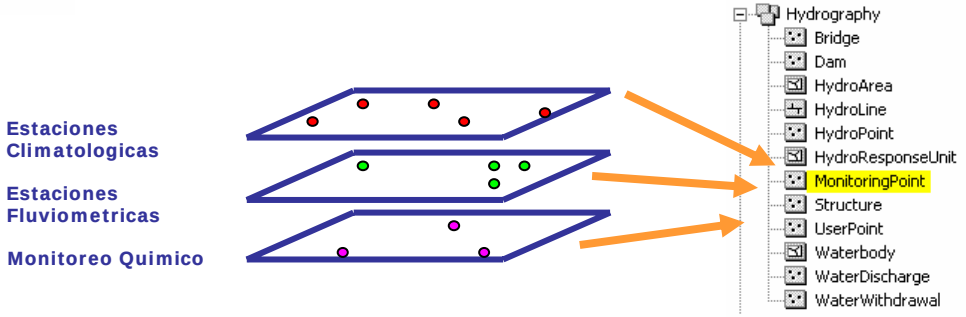
Present state of GIS/DSS for Case Studies *V* – Database Implementation

• Assigning the each element present in different files, the function it performs in the hydrologic system, according to the chosen data model



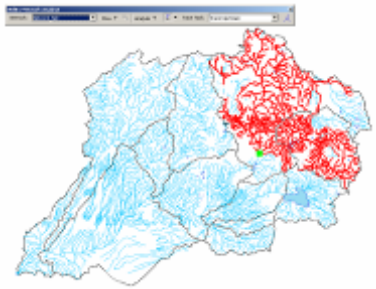
• example: a gauge station and a point of water collecting for chemical monitoring are both point along a stream associated with a time series (regular or irregular)

• example: A irrigation channel and a natural stream, are both lines along which water flows, so, they have the same basic function.

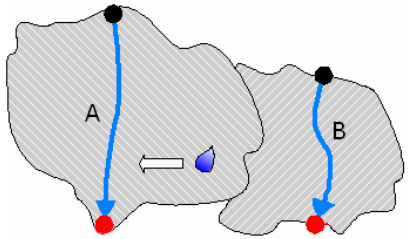


Present state of GIS/DSS for Case Studies *V* – Database Implementation

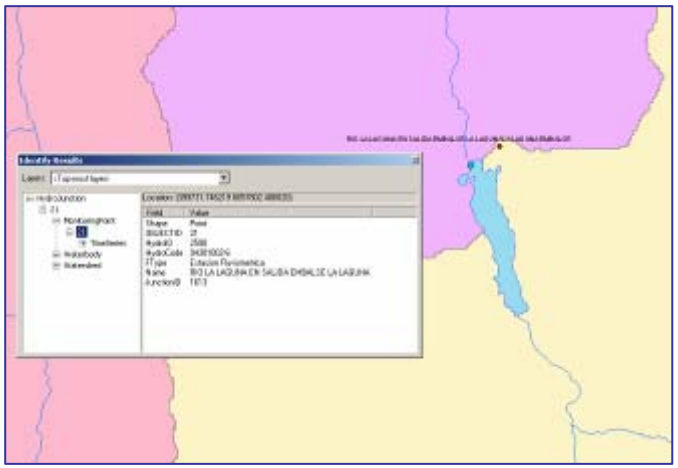
- **Building the relations between elements**



• example: assigning flow direction to the several elements in the system and adding NextDownStream Element information to each feature;



• example: building topologic relation such as “area flows to a point through lines”, etc.)



• example: associating values from a time series to the monitoring station were it was measured.

Present state of GIS/DSS for Case Studies – Next steps

Immediate task to perform for completion of WP6 objectives for 1Y

Continue data integration

special effort for time / HR allocation in processing time series

Data Refinement

normalization for definition, classes and data domains

ex: for geologic data, landuse, landcover, soil

it is necessary to uniform definitions

it is necessary to uniform classifications, possibly by applying more standard classification (ex: FAO classification for landuse or landcover)

Define strategies for data still non-existent

Present state of GIS/DSS for Case Studies – Next steps

Define a work procedure for

FINAL DATA VALIDATION

between IST team and local teams

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End of....

Present state of GIS/DSS for Case Studies

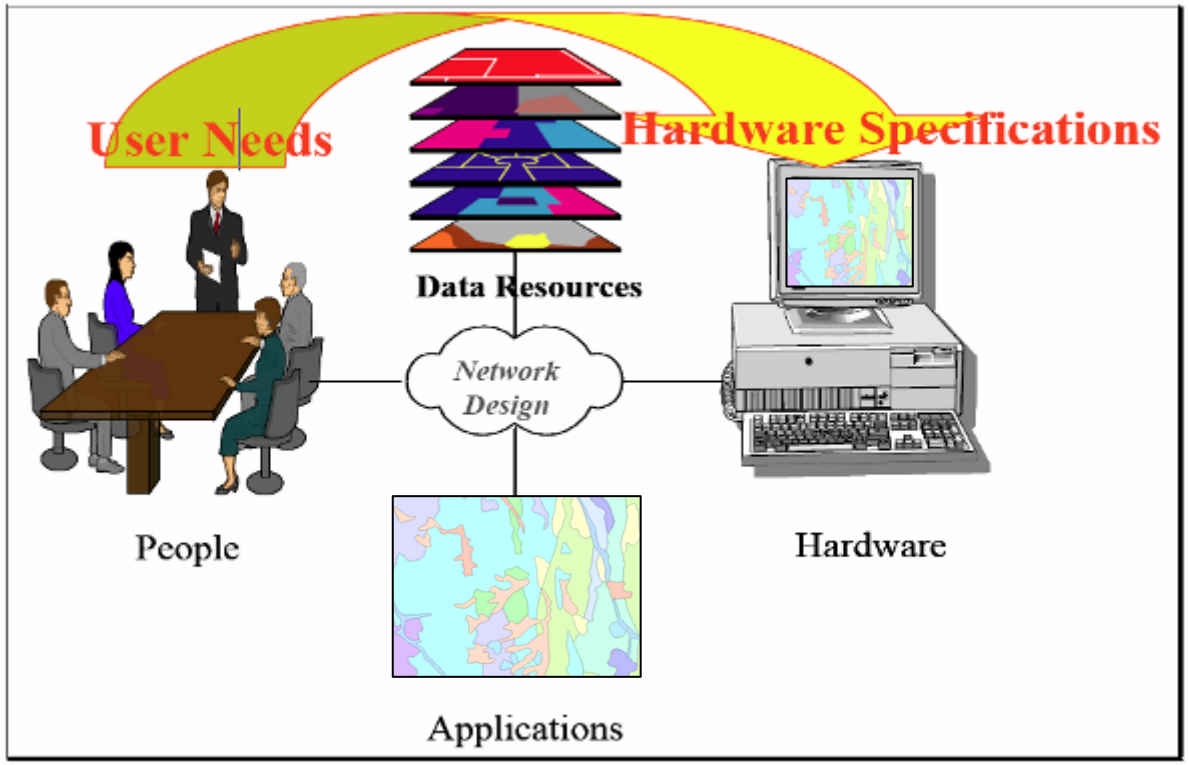
NEXT

GIS/DSS, future work – What GIS/DSS do we want?

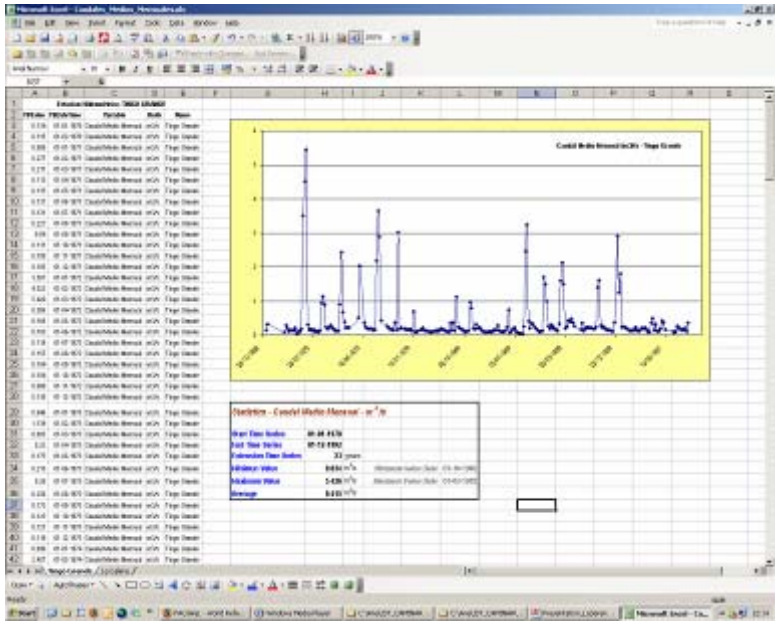
Building a Generic Spatial DSS

DSS Component		Spreadsheets	Database Managers	GIS
Database	DBMS	independent cell entries	linked database tables	linked spatial and non-spatial databases
	Database Tools	rudimentary sort and selection	comprehensive queries	spatial query
Models	Models	built in mathematical functions, statistical and management science tools	basic mathematical functions	basic summarization and network analysis models
	Model Building Tools	recorded or programmed macros	macro and database query languages	macro (script) languages, programming interfaces to other programming languages
User Interaction	Interface	tables, forms, charts	tables, forms, reports	multi-layer maps, plots

Spatial DSS – System requirements

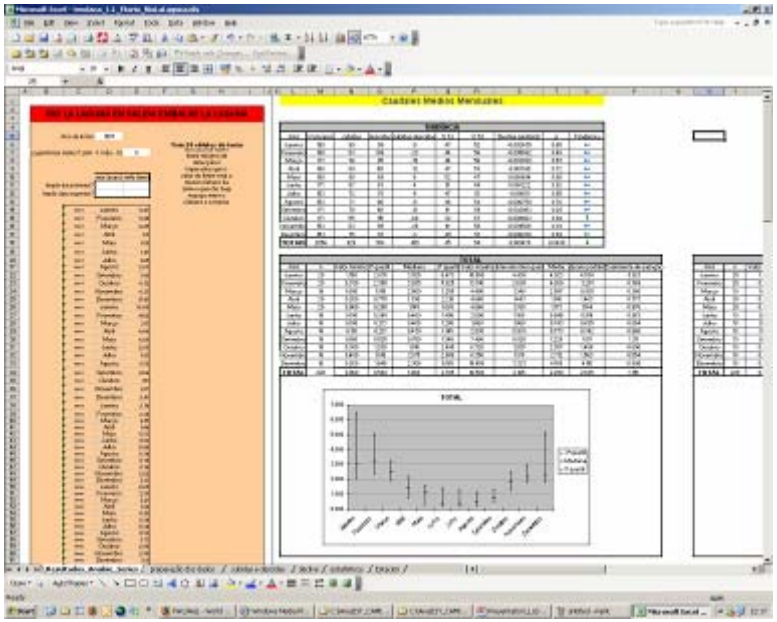


Present state of GIS/DSS for Case Studies – Examples / Applications



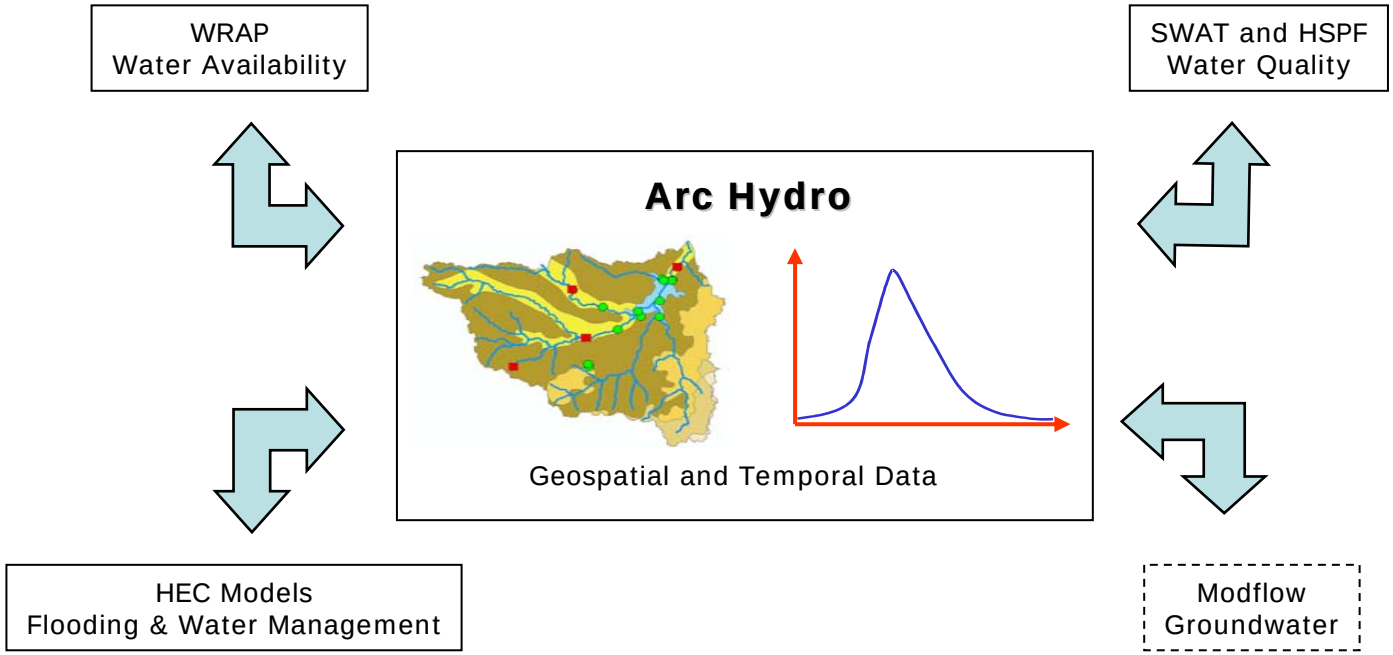
Accessing data via external application:

- examples: accessing information stored in the ArcHydro Database using MsExcel



Present state of GIS/DSS for Case Studies – Examples/Applications

Documented integration of Watershed Management/Analysis Models and ArcHydro



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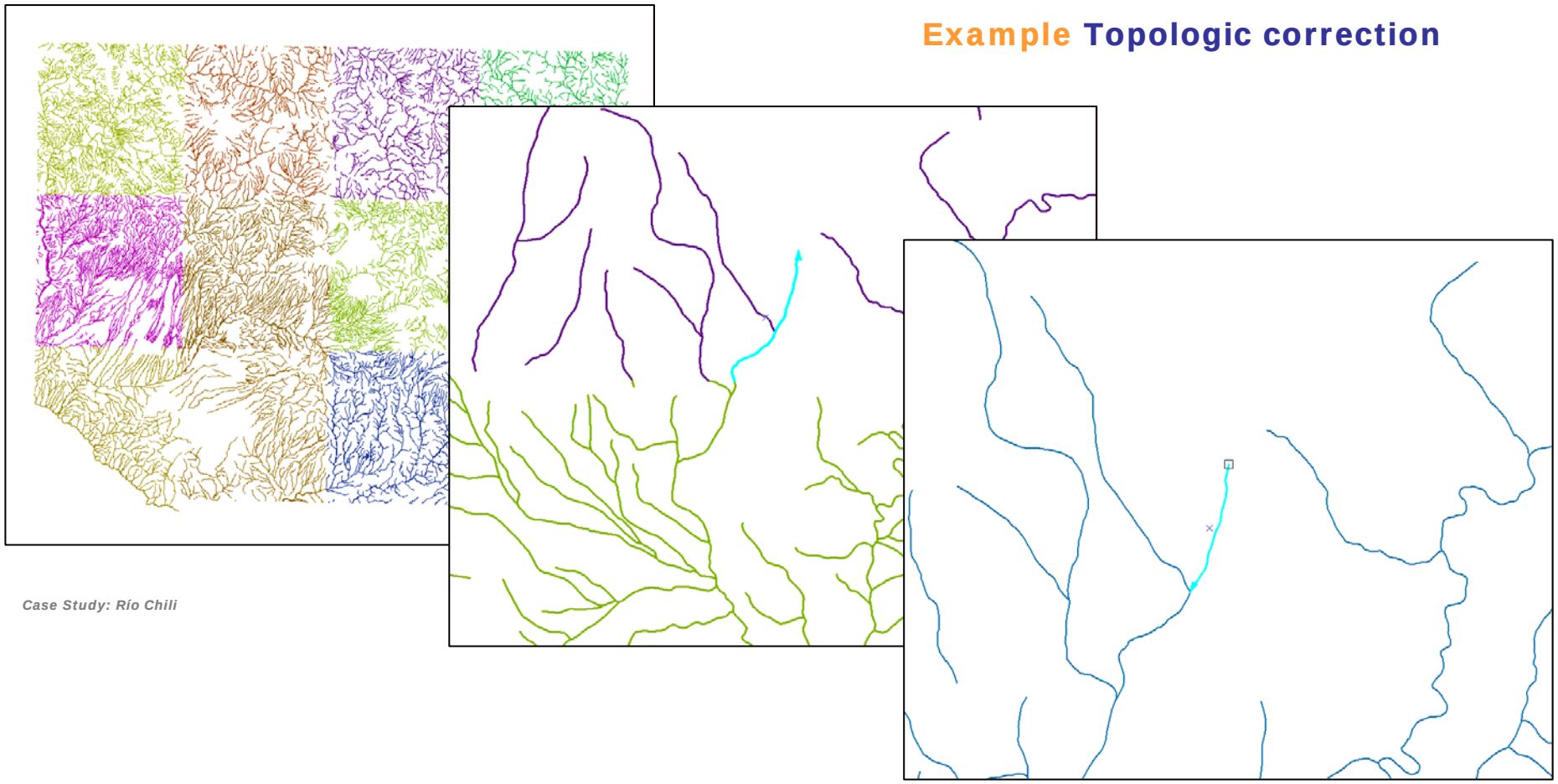
Present state of GIS/DSS for Case Studies

Present state of GIS/DSS for Case Studies *IV* – Data Processing

Example Topologic correction

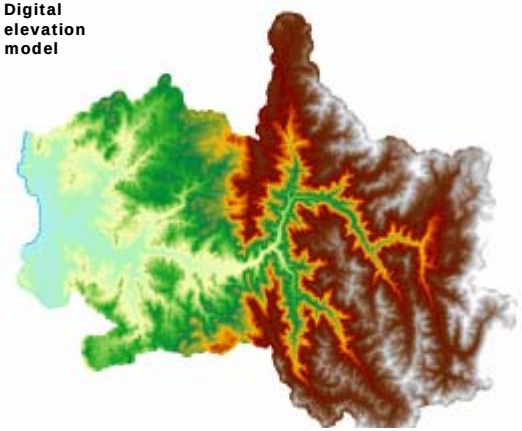


Case Study: Río Chili

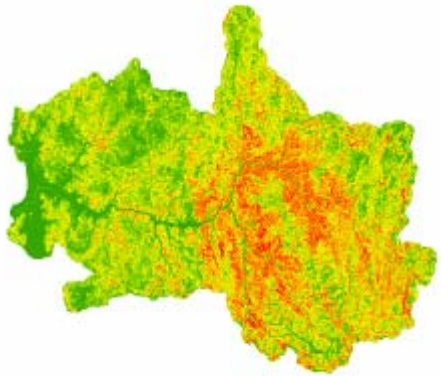
Present state of GIS/DSS for Case Studies *IV* – Data Processing

Example Generating New Data

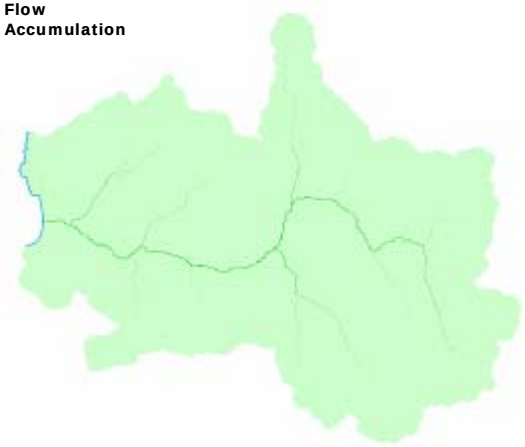
Digital elevation model



Slope



Flow Accumulation



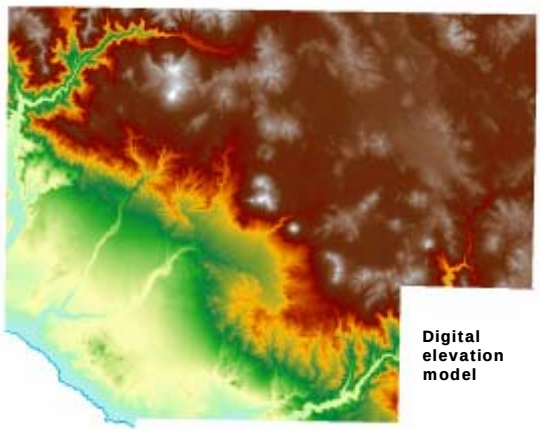
Drainage Areas and Main drainage lines

Watersheds And Longest Flow Paths

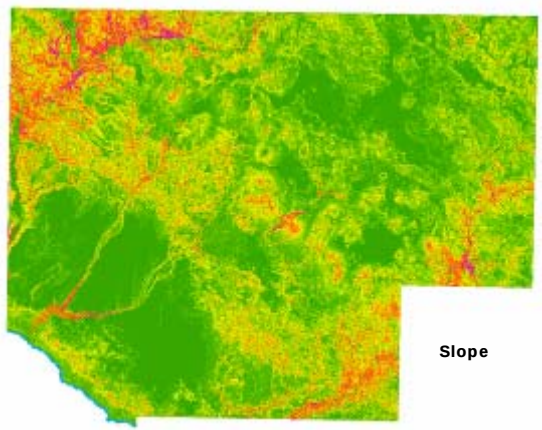
Case Study: Río Elqui

Present state of GIS/DSS for Case Studies *IV* – Data Processing

Example Generating New Data

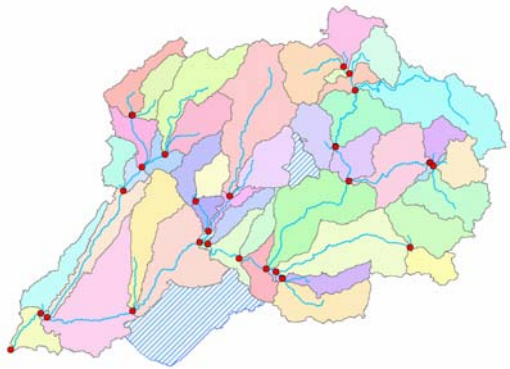


Digital elevation model



Slope

Flow Accumulation



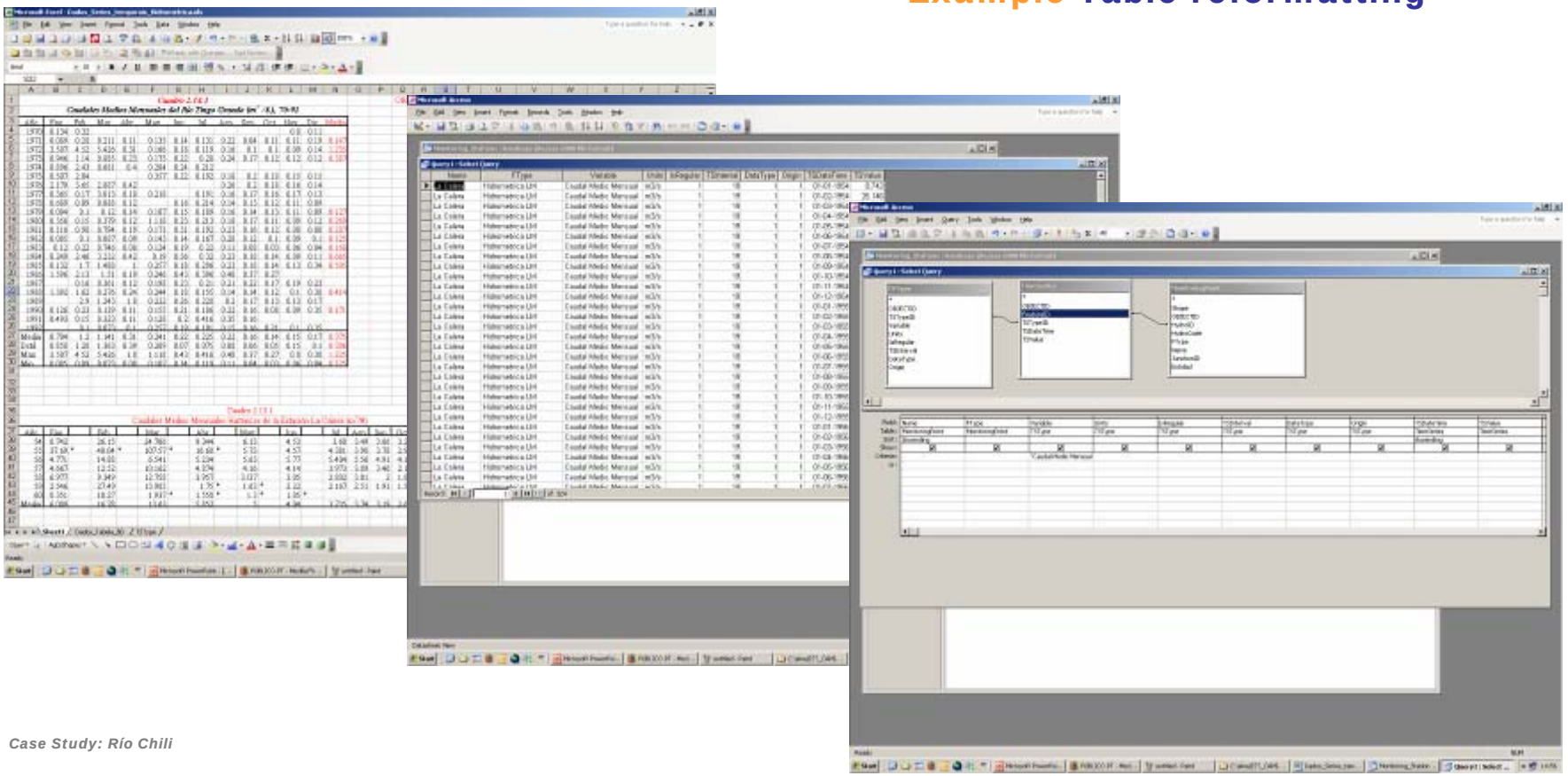
Drainage Areas and Main drainage lines

Watersheds and Longest Flow Paths

Case Study: Río Chili

Present state of GIS/DSS for Case Studies *IV* – Data Processing

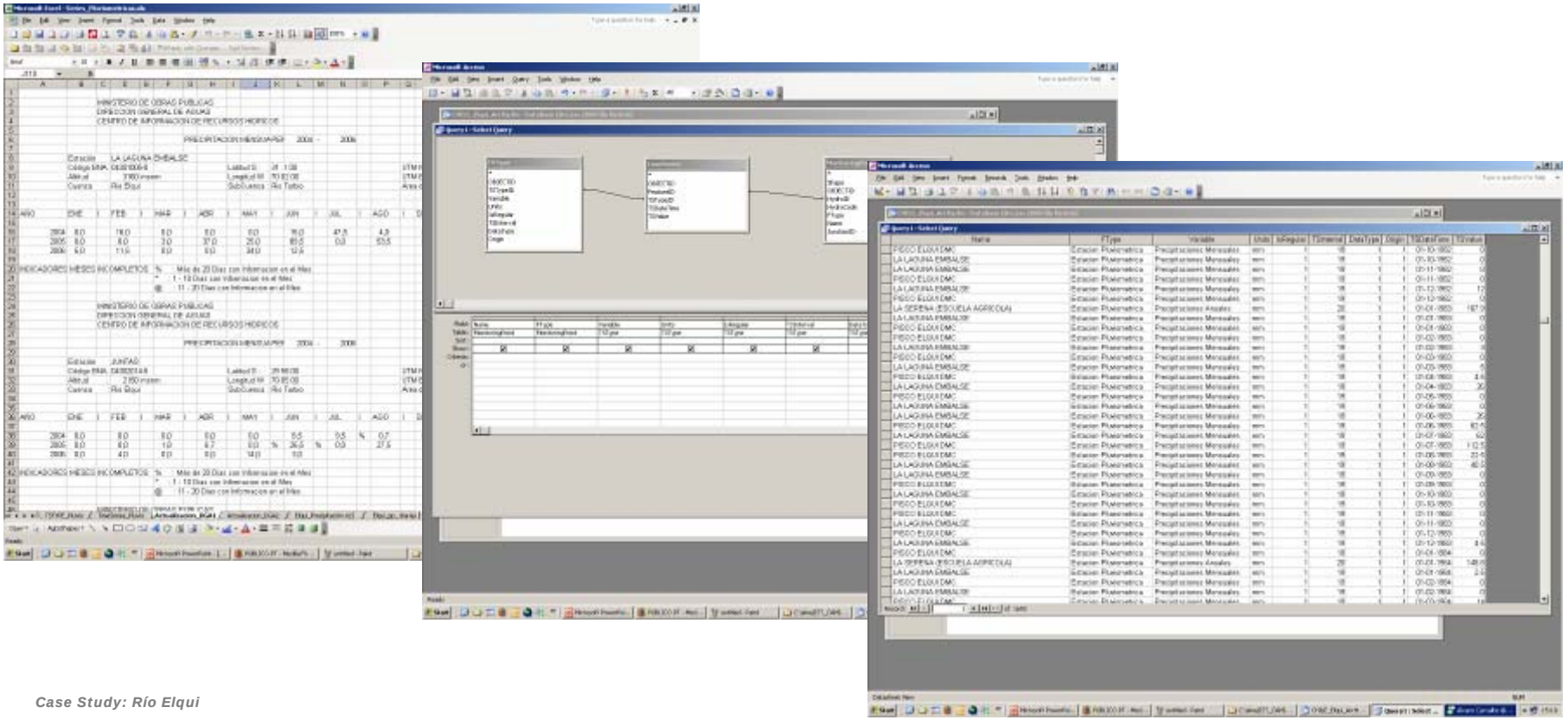
Example Table reformatting



Case Study: Río Chili

Present state of GIS/DSS for Case Studies *IV* – Data Processing

Example Table reformatting



Case Study: Río Elqui

Present state of GIS/DSS for Case Studies *IV* – Data Processing

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