



INSTITUTO
SUPERIOR
TÉCNICO

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



CRM CENTRO DE
GEO-SISTEMAS

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

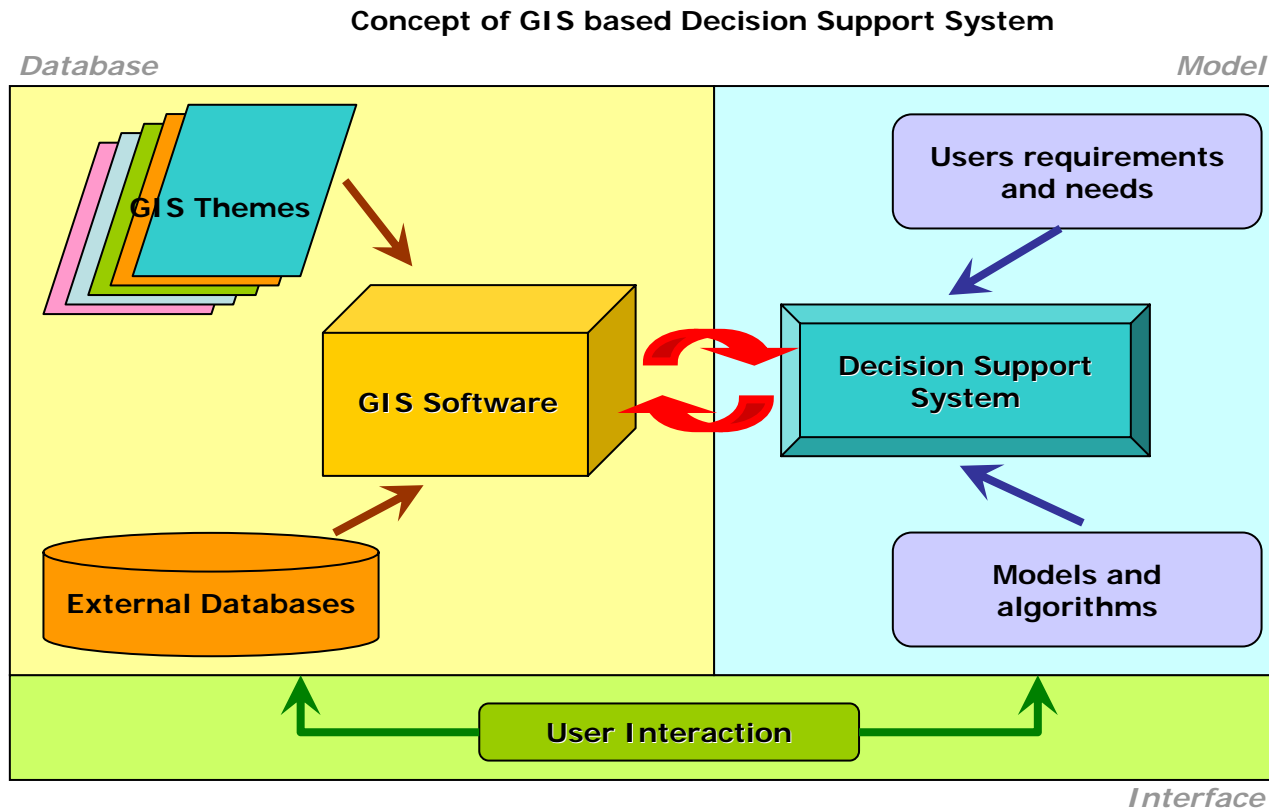
Present state of GIS/DSS for Case Studies

Present state of GIS/DSS for Case Studies - **Introduction**

WP 6 – is defined as Decision support tool

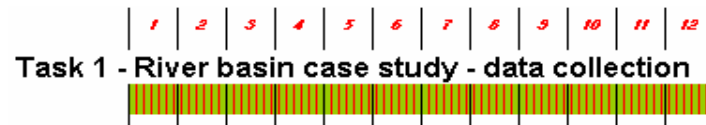
The objective is the development of decision support tools appropriate for river basin planning in arid and semi-arid catchments with mining impact.

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

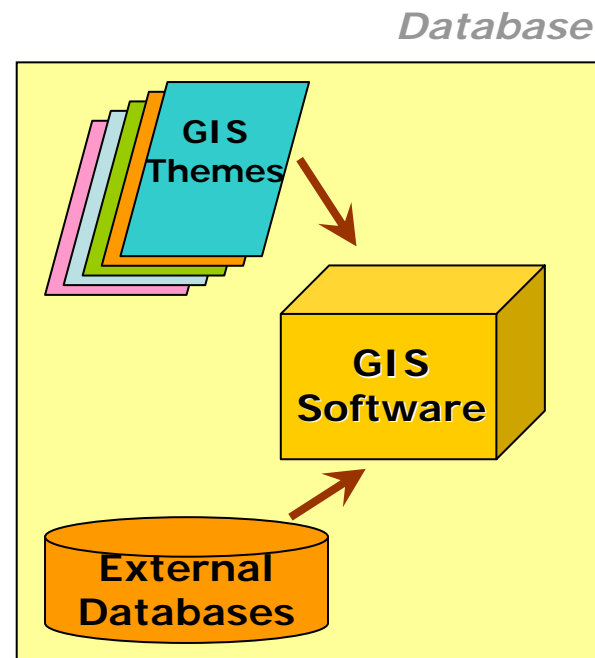


Present state of GIS/DSS for Case Studies – Tasks for Year 1

Workflow for implementation of the Spatial DSS for catchment management



FOCUSED IN THE:



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 / – Data collection

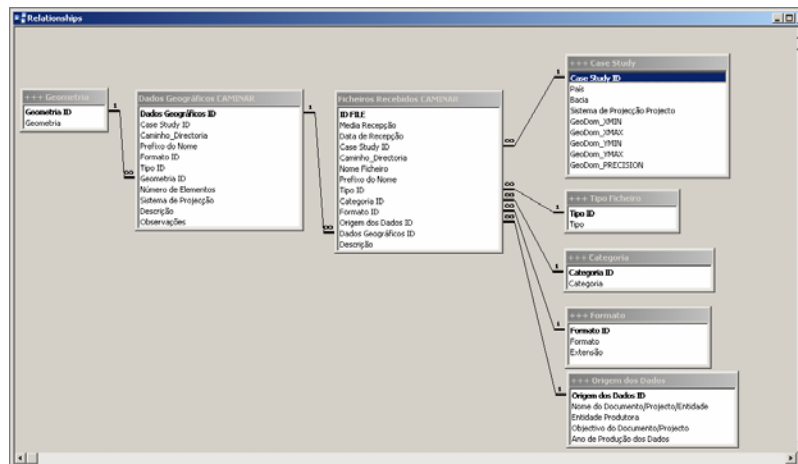
Extensive data compilation, from different sources, internal and external to the teams, that include pre-existing GIS layers in several formats, reports and articles, raw data in tables or lists, satellite images, photographs and general data, both in paper and digital media.

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**

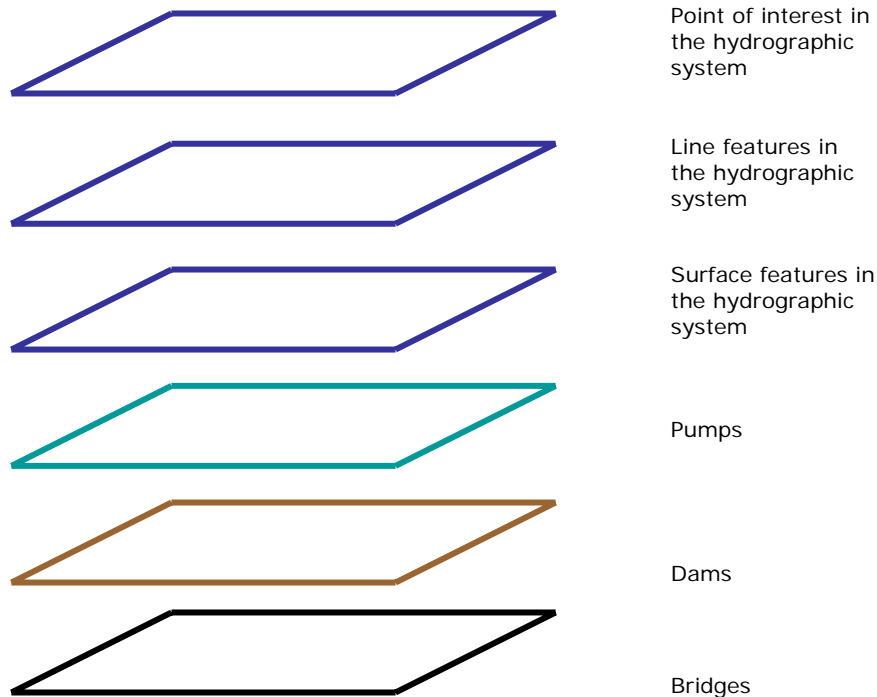
Definition: “Data modeling is a standard architecture that is used to organize, manage and access information in a database”

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 **III – Data Modeling**

Data Model Based on Inventory

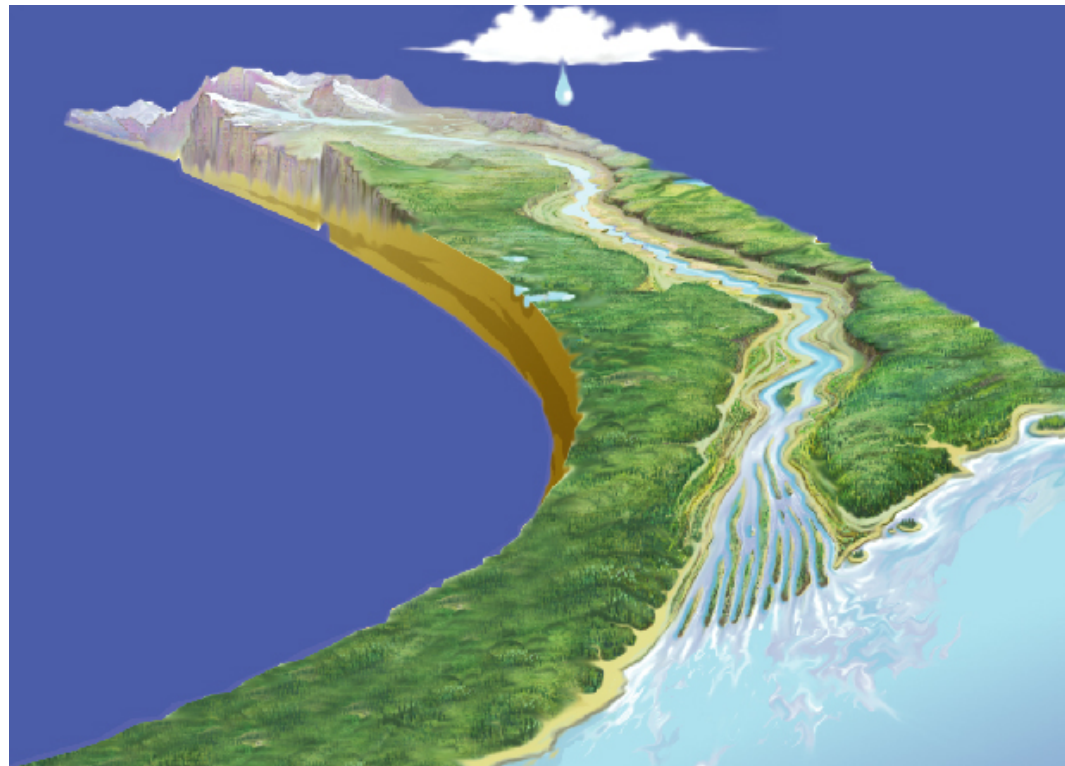


Make an inventory of all features of a given type in the region

**What is it?
Where is it?**

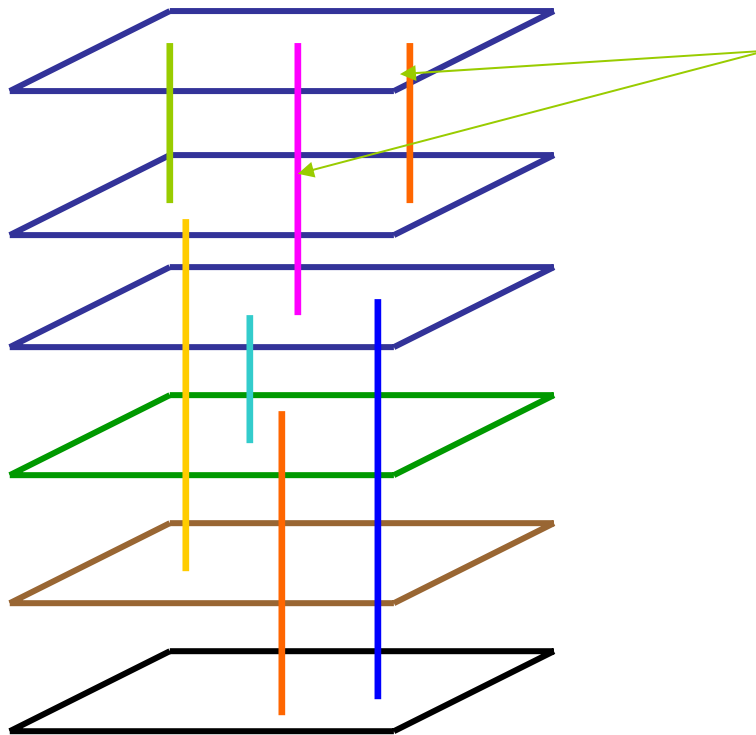
Data Model Based on Behavior

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

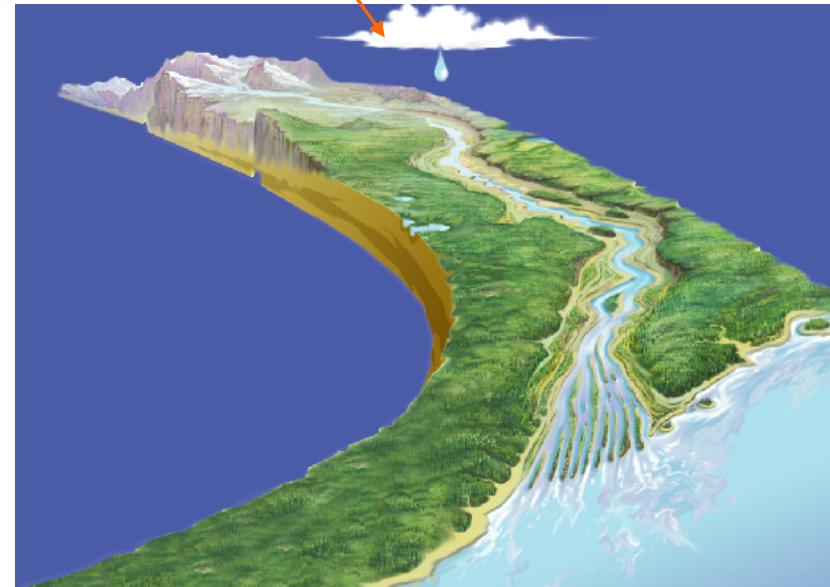


Present state of GIS/DSS for Case Studies **III – Data Modeling**

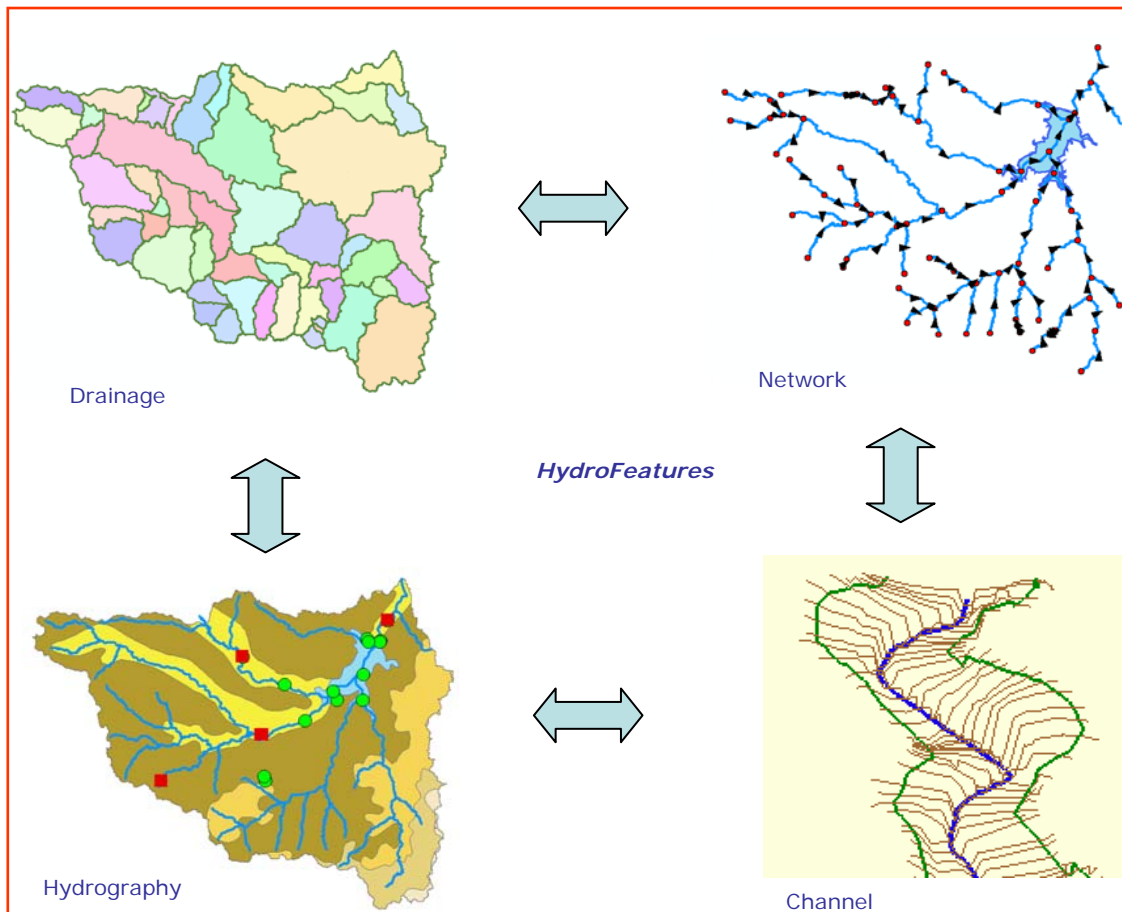
Integrating Data Inventory using a Behavioral Model



Relationships between objects linked by tracing path of water movement

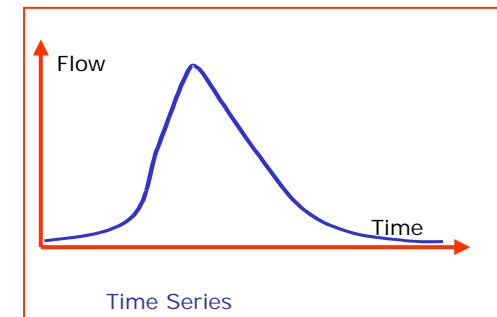


Present state of GIS/DSS for Case Studies **III- Data Modeling**



ArchHydro* Data Model

Behavioral view



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

ArchHydro 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

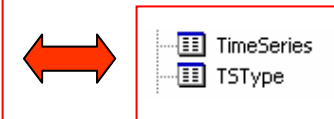
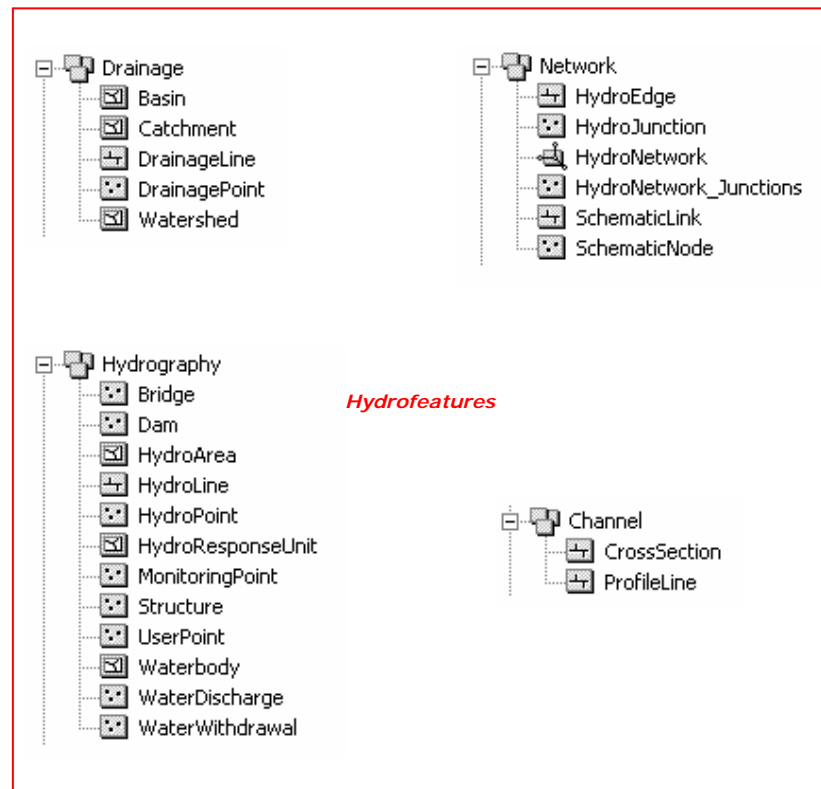
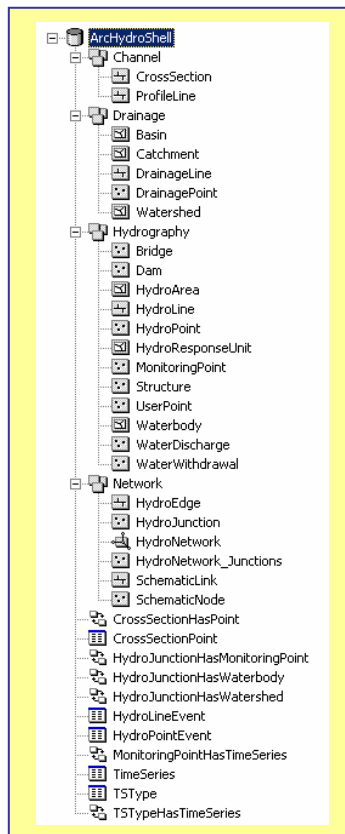
A geodatabase stores both geographic objects and non-geographic data in a commercial relational database.

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.

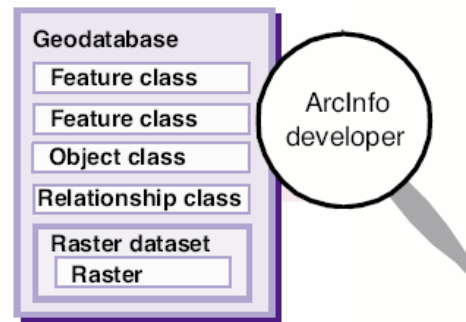
Present state of GIS/DSS for Case Studies **III – Data Modeling**

ArcHydro Data Model Geodatabase view



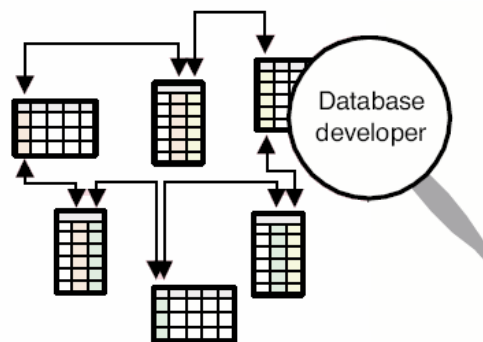
Present state of GIS/DSS for Case Studies **/// – Data Modeling**

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.

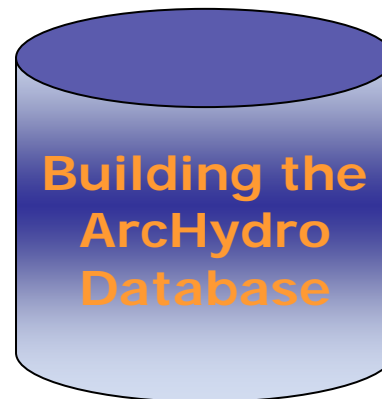
Present state of GIS/DSS for Case Studies **IV – Data Processing**

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

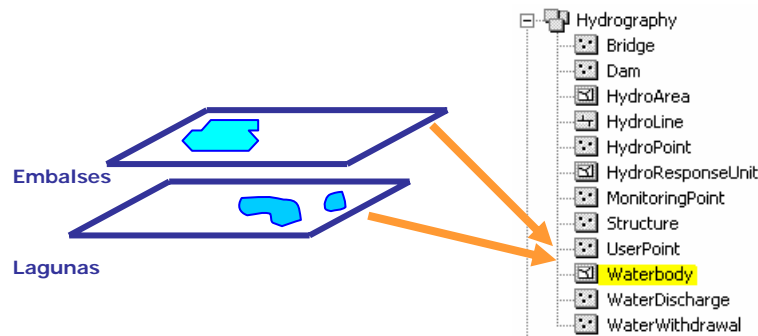
Present state of GIS/DSS for Case Studies **V – Database Implementation**

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**

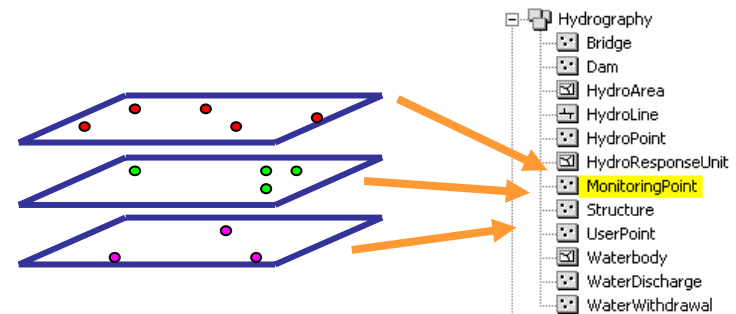
- Assigning the each element present in different files, the function it performs in the hydrologic system, according to the chosen data model



- *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)*

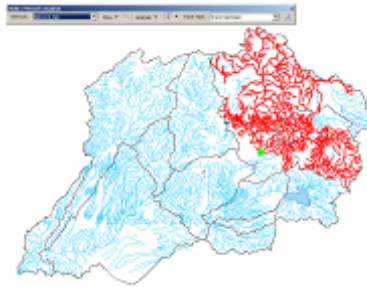
- *example: A irrigation channel and a natural stream, are both lines along which water flows, so, they have the same basic function.*

Estaciones Climatologicas
 Estaciones Fluviometricas
 Monitoreo Quimico

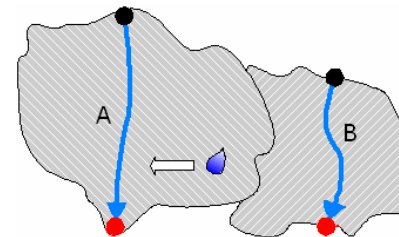


Present state of GIS/DSS for Case Studies **V – Database Implementation**

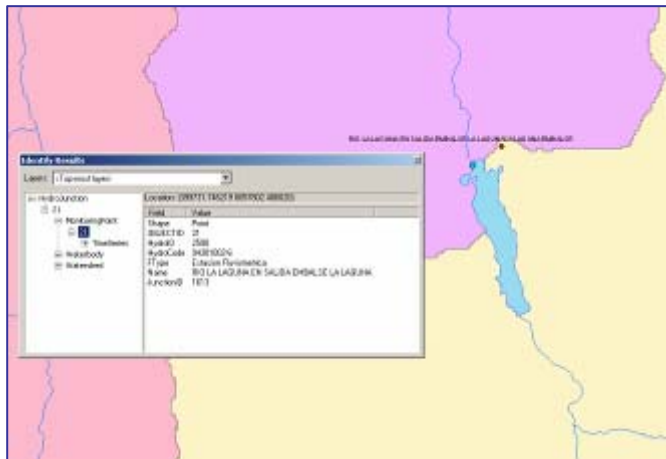
- **Building the relations between elements**



- **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



INSTITUTO
SUPERIOR
TÉCNICO

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



CRM CENTRO DE
GEO-SISTEMAS

End of....

Present state of GIS/DSS for Case Studies

NEXT

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

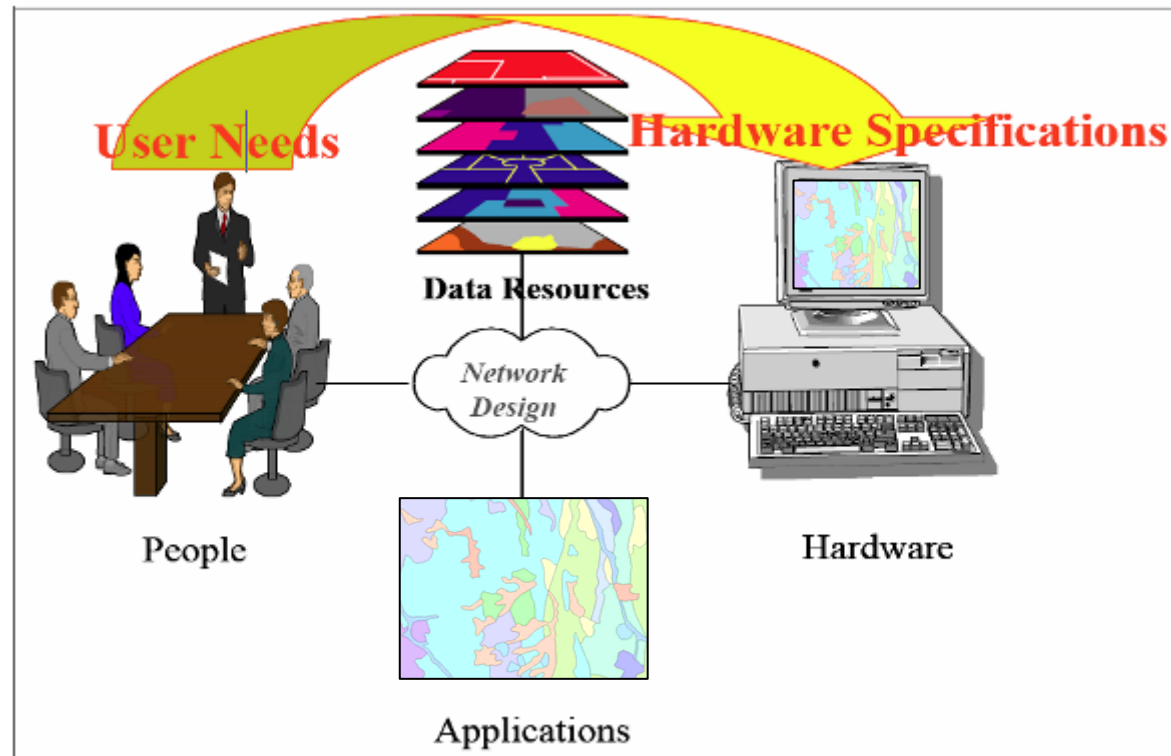
Present state of GIS/DSS for Case Studies – What GIS/DSS?

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

Present state of GIS/DSS for Case Studies – What GIS/DSS?

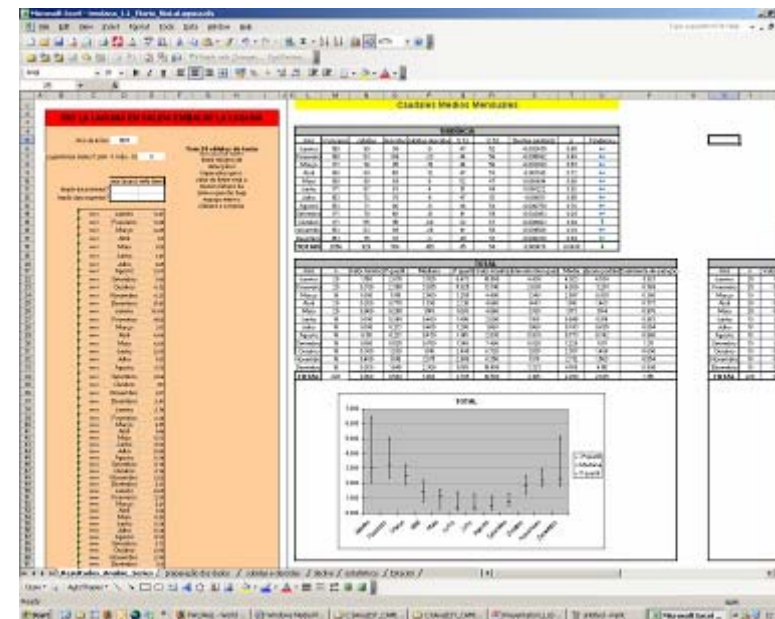
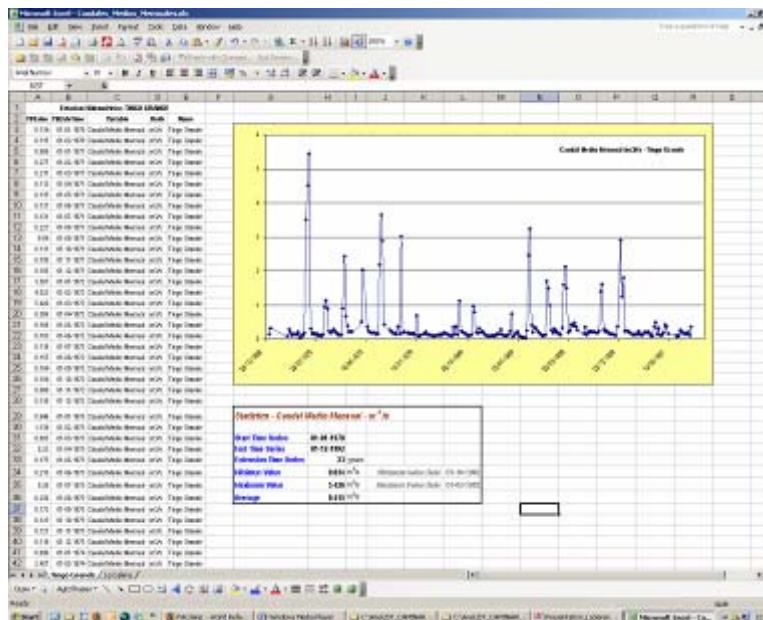
Spatial DSS – System requirements



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

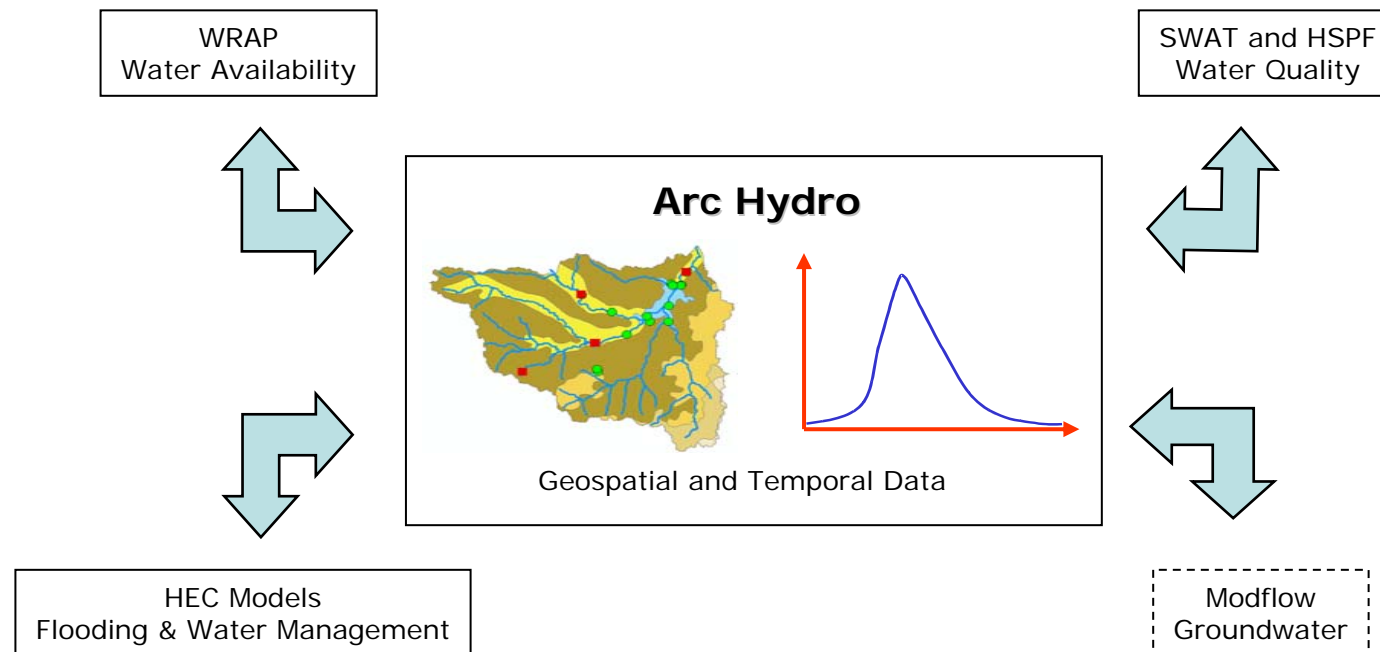
Accessing data via external application:

- **examples:** accessing information stored in the ArchHydro Database using MsExcel



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

Documented integration of Watershed Management/Analysis Models and ArcHydro





INSTITUTO
SUPERIOR
TÉCNICO

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



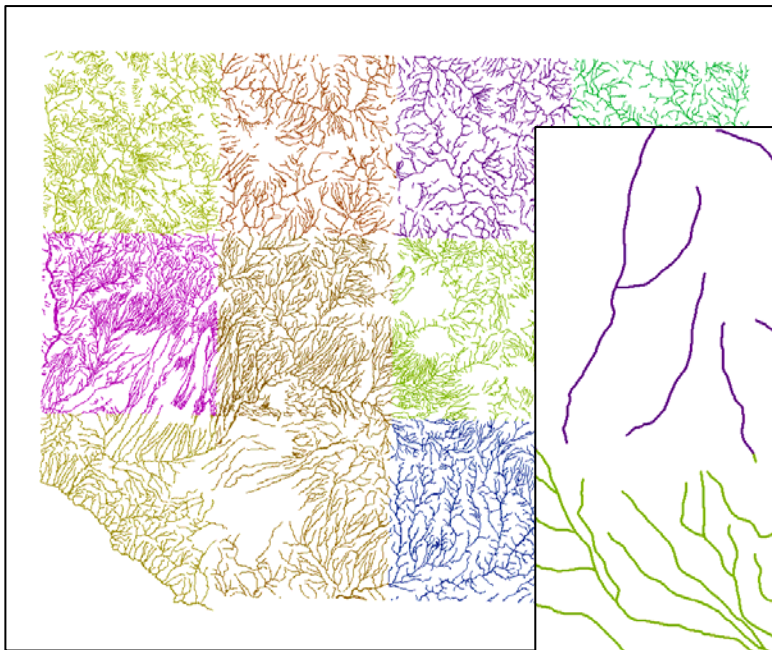
CRM CENTRO DE
GEO-SISTEMAS

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

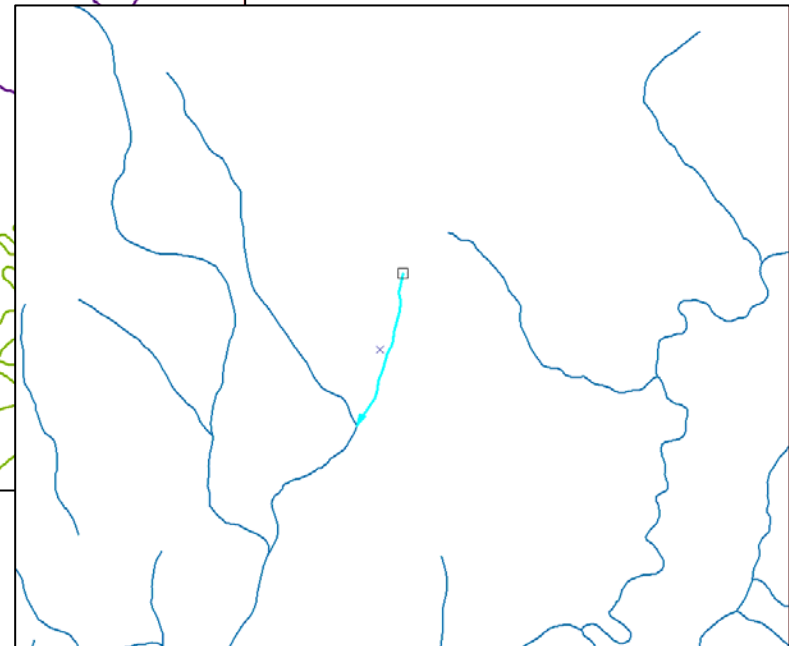
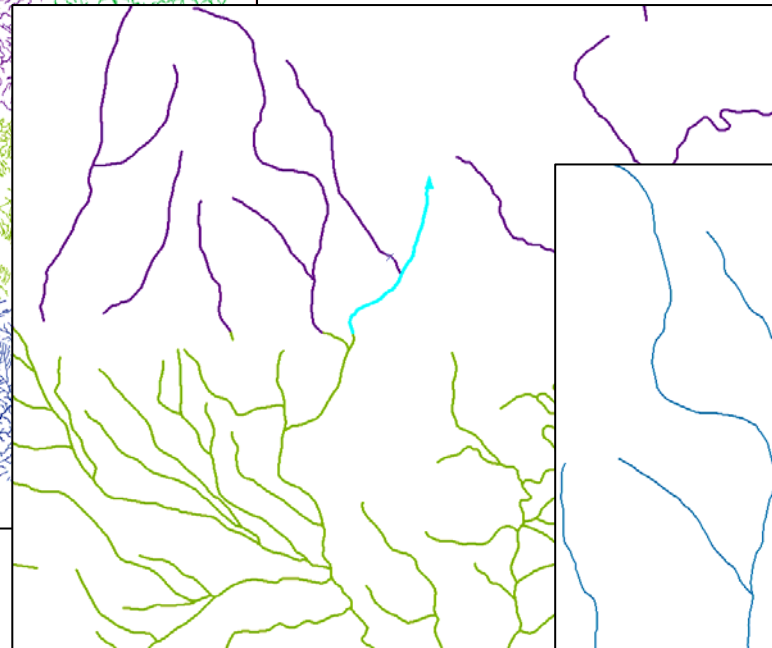
Present state of GIS/DSS for Case Studies

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

Example Topologic correction



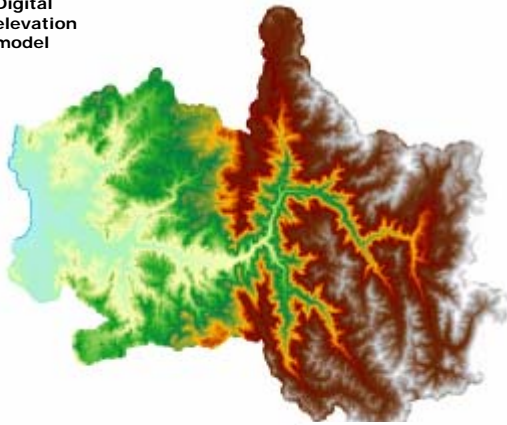
Case Study: Rio Chili



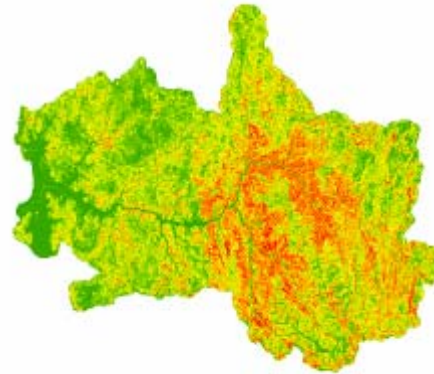
Present state of GIS/DSS for Case Studies **IV – Data Processing**

Example Generating New Data

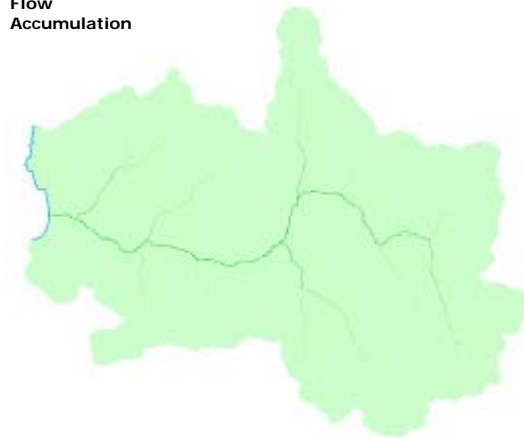
Digital elevation model



Slope



Flow Accumulation



Drainage Areas and Main drainage lines

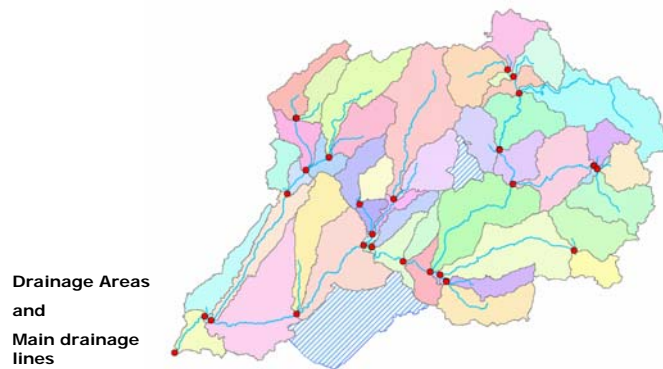
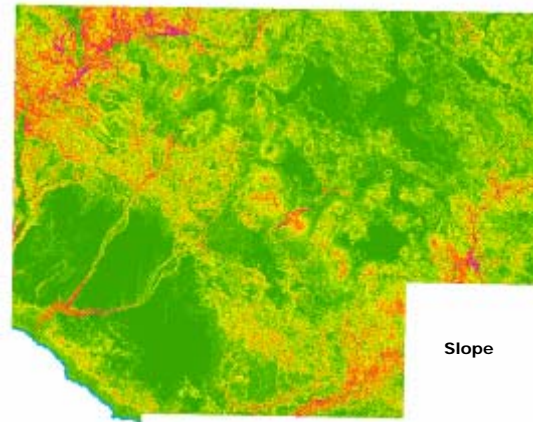
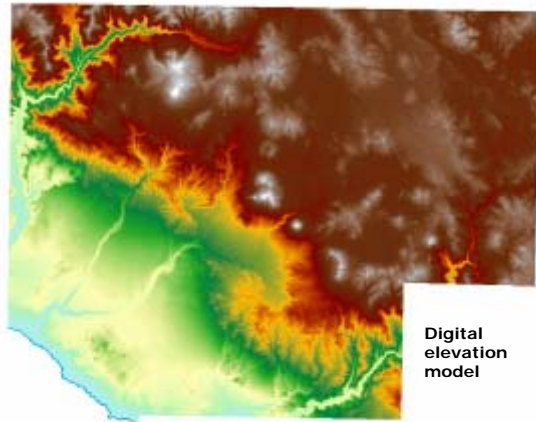


Watersheds And Longest Flow Paths



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

Example Generating New Data



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

Example Table reformatting

The screenshot displays a workflow for data processing in Microsoft Access. On the left, an Excel spreadsheet shows a table with columns for 'Año', 'Ene', 'Feb', 'Mar', 'Abr', 'May', 'Jun', 'Jul', 'Ago', 'Sep', 'Oct', 'Nov', 'Dic', 'Total', 'Desv. Est.', and 'Desv. Exp.'. The data represents monthly and annual values for various years from 1974 to 2004. In the center, the Microsoft Access 'Queries - Select Query' window shows a table with columns: 'Año', 'Tipo', 'Variable', 'Unidad', 'Abogador', 'Estratema', 'Ente Tipo', 'Eje', 'Unidad de Medida', 'Origen', 'Fecha de Inicio', and 'Fecha de Fin'. The table lists data sources for 'La Colina' and 'Hidrobrisa LHM' across various years and variables. On the right, another 'Queries - Select Query' window shows a diagram of a query structure with fields like 'Año', 'Variable', 'Unidad', 'Abogador', 'Estratema', 'Ente Tipo', 'Eje', 'Unidad de Medida', 'Origen', 'Fecha de Inicio', and 'Fecha de Fin' mapped to a table structure. At the bottom, a preview of the resulting table is shown with columns: 'Año', 'Variable', 'Unidad', 'Abogador', 'Estratema', 'Ente Tipo', 'Eje', 'Unidad de Medida', 'Origen', 'Fecha de Inicio', 'Fecha de Fin', 'Origen de Datos', and 'Origen de Datos'. The table contains data for 'Hidrobrisa LHM' and 'La Colina' for the years 1974-2004.

Case Study: Río Chill

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

Example Table reformatting

The screenshot displays a workflow for data processing. On the left, a Microsoft Excel spreadsheet shows a table with columns for months (ENE, FEB, MAR, ABR, MAY, JUN, JUL, AGO) and rows for various hydrological data points. The data includes values for precipitation (PRECIPITACION) and other metrics. The right side shows a Microsoft Access database interface with a 'Query1 - Select Query' window. This window displays a table with columns: 'Name', 'Type', 'Precipitation', 'Date', 'Status', 'Frequency', 'Date Type', 'Date', 'Start Date', and 'End Date'. The table lists various catchment areas like 'LA LAGUNA EMBAJALDE' and 'LA SERENA - ESCUELA AGRICOLA' with their respective precipitation data and dates.

Case Study: Rio Elqui

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

Case Study: Rio Elqui

The screenshot displays the ArcMap interface with the following components:

- Layers Panel:** Lists layers including 'panos_cultivos_elqui_v0', 'superficie_riego_elqui231205_V0', 'superficie_riego_elqui231205_V1', and 'Zonas_Riego_v0'.
- Identify Results (Top Left):** Shows data for 'panos_cultivos_elqui_v0' with a selected feature ID '1034-19'. The table below contains its attributes.
- Identify Results (Bottom Left):** Shows data for 'superficie_riego_elqui231205_V0' with a selected feature 'PAPAYO'. The table below contains its attributes.
- Identify Results (Middle):** Shows data for 'superficie_riego_elqui231205_V1' with a selected feature 'PAPAYO'. The table below contains its attributes.
- Map:** Displays a spatial map with various colored polygons representing agricultural plots and irrigation areas.

Field	Value
OBJECTID	30
Shape	Polygon
ROLPREID	1034-19
SUPERF_ROL	5.8
NOMBPREID	PC 8 ALTOVALSOL
PROPIETARI	CARMONA AMENABAR LUIS
PRODUCTOR	CARMONA AMENABAR LUIS
COMUNA	LA SERENA
DIREPOST	CASILLA 159
COMUPOST	LA SERENA
FONDPROD	226171
LOCALFONO	LA SERENA
FAX-PRODU	0
LOCALFAX	0
FOLIO	484
Shape_Length	863.386592
Shape_Area	43293.200453

Field	Value
OBJECTID	160
Shape	Polygon
ID	160
ESPEDE1	PAPAYO
ESPEDE2	CHIRIMOYO
ESPEDE3	-
ESPEDE4	-
ESPEDE5	-
HA_ESP1	3
HA_ESP2	1
HA_ESP3	0
HA_ESP4	0
HA_ESP5	0
HA_CULTIV	4
RIEGO	SURCO
COMUNA	La Serena
ZR	ZR 9
FUENTE	CIREN
Shape_Length	863.386792
Shape_Area_m2	43293.207767
Shape_Area_ha	4.329321
FOLIO	484
ROLPREID	1034-19
SUPERF_ROL	5.8
NOMBPREID	PC 8 ALTOVALSOL
PROPIETARI	CARMONA AMENABAR LUIS
PRODUCTOR	CARMONA AMENABAR LUIS
COMUNA	LA SERENA
DIREPOST	CASILLA 159
COMUPOST	LA SERENA
FONDPROD	226171
LOCALFONO	LA SERENA
FAX-PRODU	0
LOCALFAX	0
Origen_Datos_2	FTP1\SIG\economic activities\panos_cultivos_elqui.dta

Field	Value
OBJECTID	160
Shape	Polygon
ID	160
ESPEDE1	PAPAYO
ESPEDE2	CHIRIMOYO
ESPEDE3	-
ESPEDE4	-
ESPEDE5	-
HA_ESP1	3
HA_ESP2	1
HA_ESP3	0
HA_ESP4	0
HA_ESP5	0
HA_CULTIV	4
RIEGO	SURCO
COMUNA	La Serena
ZR	ZR 9
FUENTE	CIREN
Shape_Length	863.386792
Shape_Area_m2	43293.207767
Shape_Area_ha	4.329321
FOLIO	484
ROLPREID	1034-19
SUPERF_ROL	5.8
NOMBPREID	PC 8 ALTOVALSOL
PROPIETARI	CARMONA AMENABAR LUIS
PRODUCTOR	CARMONA AMENABAR LUIS
COMUNA	LA SERENA
DIREPOST	CASILLA 159
COMUPOST	LA SERENA
FONDPROD	226171
LOCALFONO	LA SERENA
FAX-PRODU	0
LOCALFAX	0
Origen_Datos_2	FTP1\SIG\economic activities\panos_cultivos_elqui.dta