

GIS-based platform for analysis and integration of hydrogeological data

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Joint International Workshop

**EU FP7 MARSOL and EU HORIZON 2020 FREEWAT projects and EU EIP MAR Solutions -
Managed Aquifer Recharge Strategies and Actions (AG128)**

Pisa - April 21st 2015

1.Introduction

GROUNDWATER

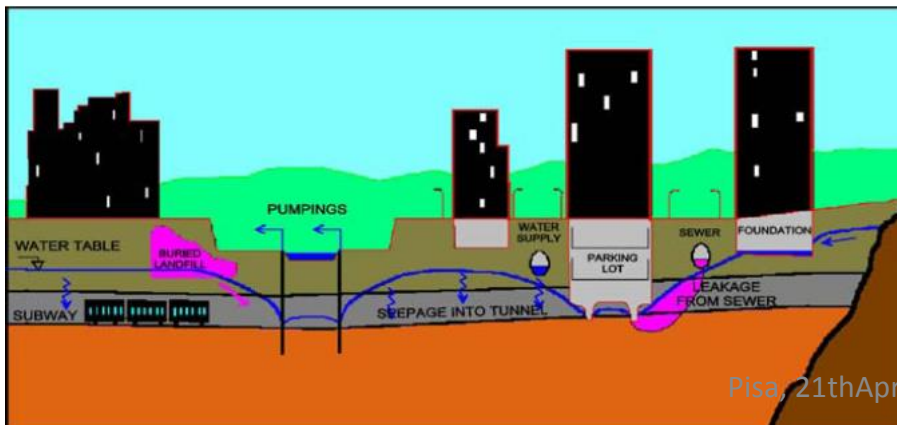
Important natural resource
of water supply

Many factors
(Irrigation,
industrialization,
urbanization...)

Deteriorate the
GROUNDWATER
quality and quantity

Sustainable
management of
GROUNDWATER

3D **hydrogeological models**
(Scenarios/ Planning)



2. Aim and Objective

AIM:

- Reliable **3D hydrogeological models** require the use of a **wide variety of information** (**geological, hydrogeological, geographical, hydrochemical, environmental, etc...**).
- Necessity of integrating in a coherent and consistent structure data from **different sources** gathered with different data access techniques(boreholes, pumping tests, etc) and **different formats** .
- Managing** different data **standard** and different **temporal** and **spatial extent**.
- Scarcity of comprehensive **tools** for the systematic **management** of **spatially and temporally** dependent data further complicates their **analysis and interpretation** necessary for **modeling**.

OBJECTIVE:

Development of a software platform that brings together a **geospatial database** and a set of **tools** that allow us to:

Harmonize, collect, storage, manage, analyze , interpret, pre and post-process hydrogeological data in a **GIS** environment.

Development

- Hydrogeological database HYDOR
- Geological analysis tools HEROS
- Hydrochemical analysis tools QUIMET
- Hydrogeological analysis tools HYYH
- Link to hydrogeological modeling ArcTransin

GIS-based
database

GIS-based
analysis
tools

GIS-based
tools



Q

H

3.1. Hydrogeological database HYDOR



Further information in Velasco, V. GIS-based hydrogeological platform for sedimentary media. PhD Thesis, 2013. Technical University of Catalonia (UPC)

Pisa, 21thApril

Collection/ management / harmonization / standardization spatial data 2D and 3D (point, lines, polygons, grids) and non-spatial data coming from different sources with different formats.



**GEOSPATIAL
DATABASE**

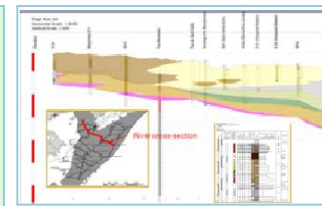
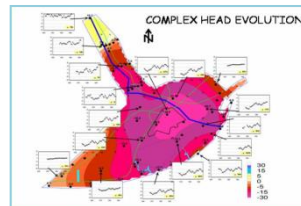
**Spatio-
temporal Data**

Hydrogeology, Geology, Hydrology, Geophysics, etc.



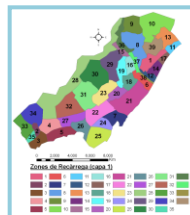
- Boreholes/Lithology
- Head Measurement
- Hydrochemistry
- ...

Interpreted data



- Cross-sections
- Geological Units and Hydrogeological Units (2D/3D)
- Piezometrics surfaces...

Calculations



- Recharge
- Hydraulic parameters (from textural data, hydraulic tests..)

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**Personal
Geodatabase
(ArcGIS;ESRI)**

Geological data

- Boreholes/Outcrop
- Petrology
- Chronology
- Paleontology
- GeolStructures and Units/Subunits
- HydroUnits
- Geotechnics
- Geophysics (e.g.diagraphie)



Hydrogeological

- Wells, springs
- Aquifers systems
- Measurements (head, well abstraction)
- Hydraulic tests
- Hydrogeological parameters (hydraulic conductivity, transmissivity..)

- Water management data

Hydrochemical data

- Physico-chemical parameters(organic, inorganic, iostopes..)
- Value and censored values
- Campaign /Projects details
- Laboratory
- Regulatory guidelines

Other data

- Hydrological data (lakes, rivers, water table monitoring, water use, etc)
- Hydrometeorology (Meteorological stations, measurements, etc)
- Enviromental (protected area, etc)
- Water management (River Basin district)
- Administration



POINT ID	Local Code	X	Y	Z	Local
INSPIRE PA4	42277	407416	5.35		
INSPIRE PA4	42281	407416	5.34		
INSPIRE PA4	42277	407416	5.42		
INSPIRE PA4	42281	407416	5.42		

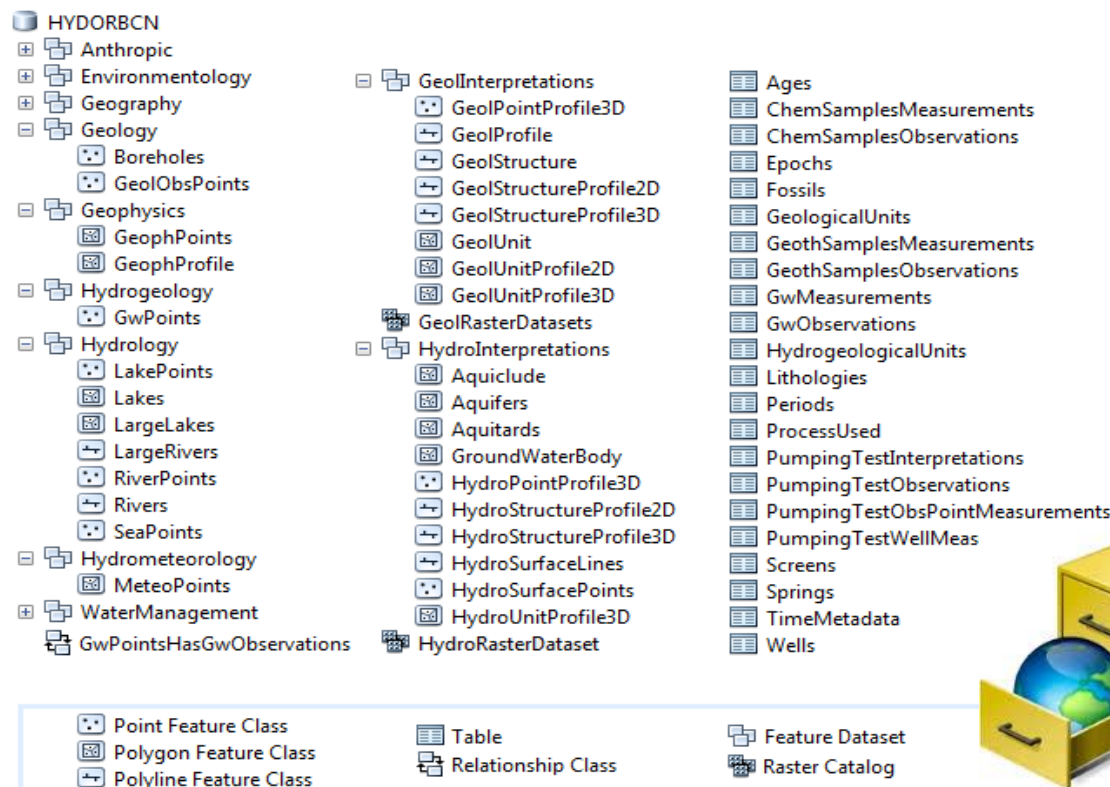
- INSPIRE Directive (2007/2/EC)
- Observation and Measurement (ISO19156)

- OGC WaterML2.0
- GeoSciML v3.1.
-

•Interpreted values are stored separately for further interpretations

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- Import/export through intermediate pre-established tables (excel, access..) or existing wizards (ArcGIS) following an entry protocol
- Export/import format: MS Excell, XML...
- Data control: pre coding permissible value lists (as dropdown lists) following standards and directives..
- Data retrieval facilities: ArcGIS, MSAccess...



GIS-based analysis tools

3.2. Geological analysis tools **HEROS**

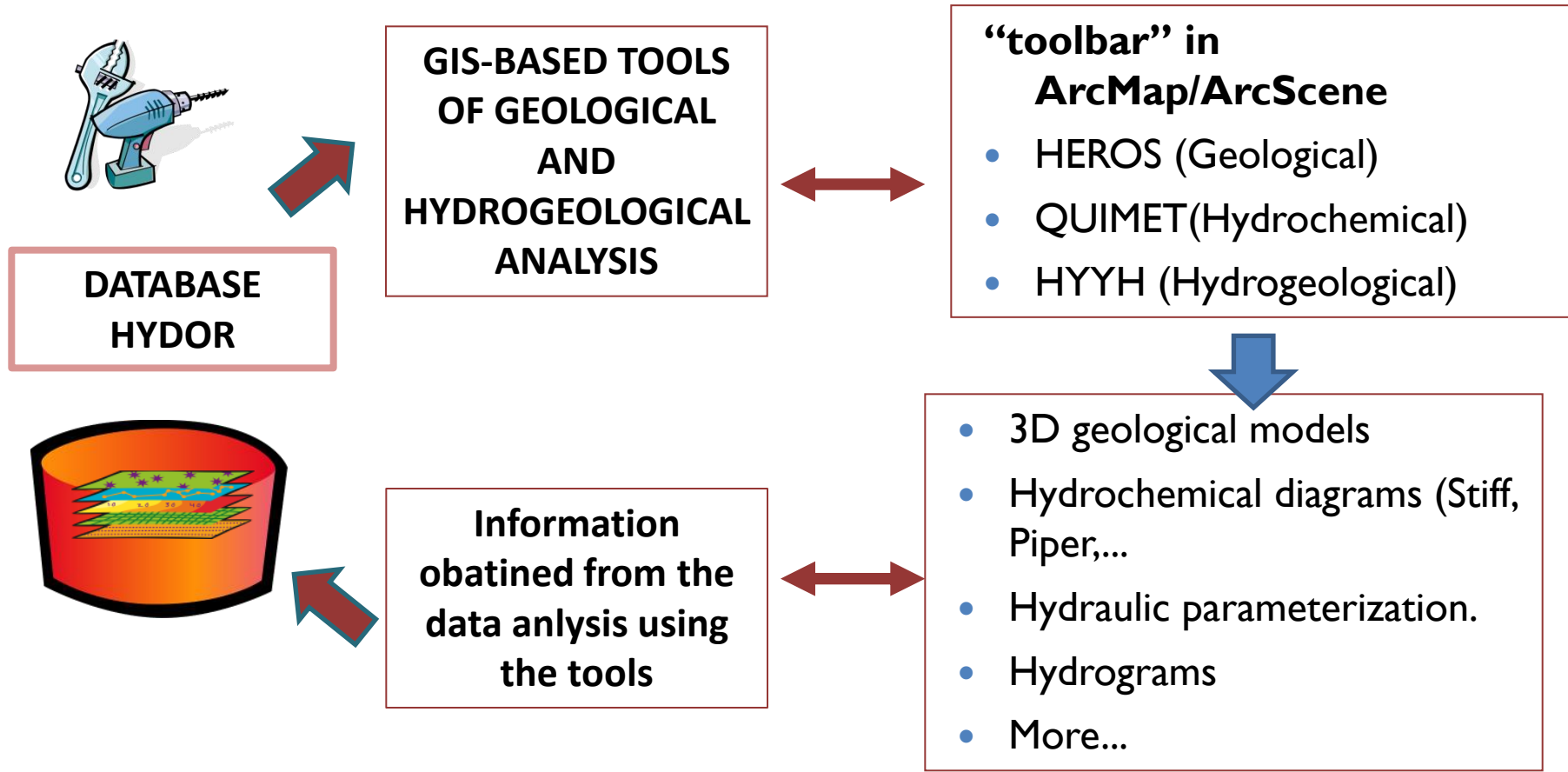
3.3. Hydrochemical analysis tools **QUIMET**

3.4. Hydrogeological analysis tools **HYYH**



3. GIS-BASED TOOLS

- This set of analysis tools was developed as an extension of the ArcMap/ArcScene environment (ArcGIS; ESRI).
- They were created with ArcObjects based on Component Object Model (COM), and programmed in Visual Basic using the Visual Studio (Microsoft) environment

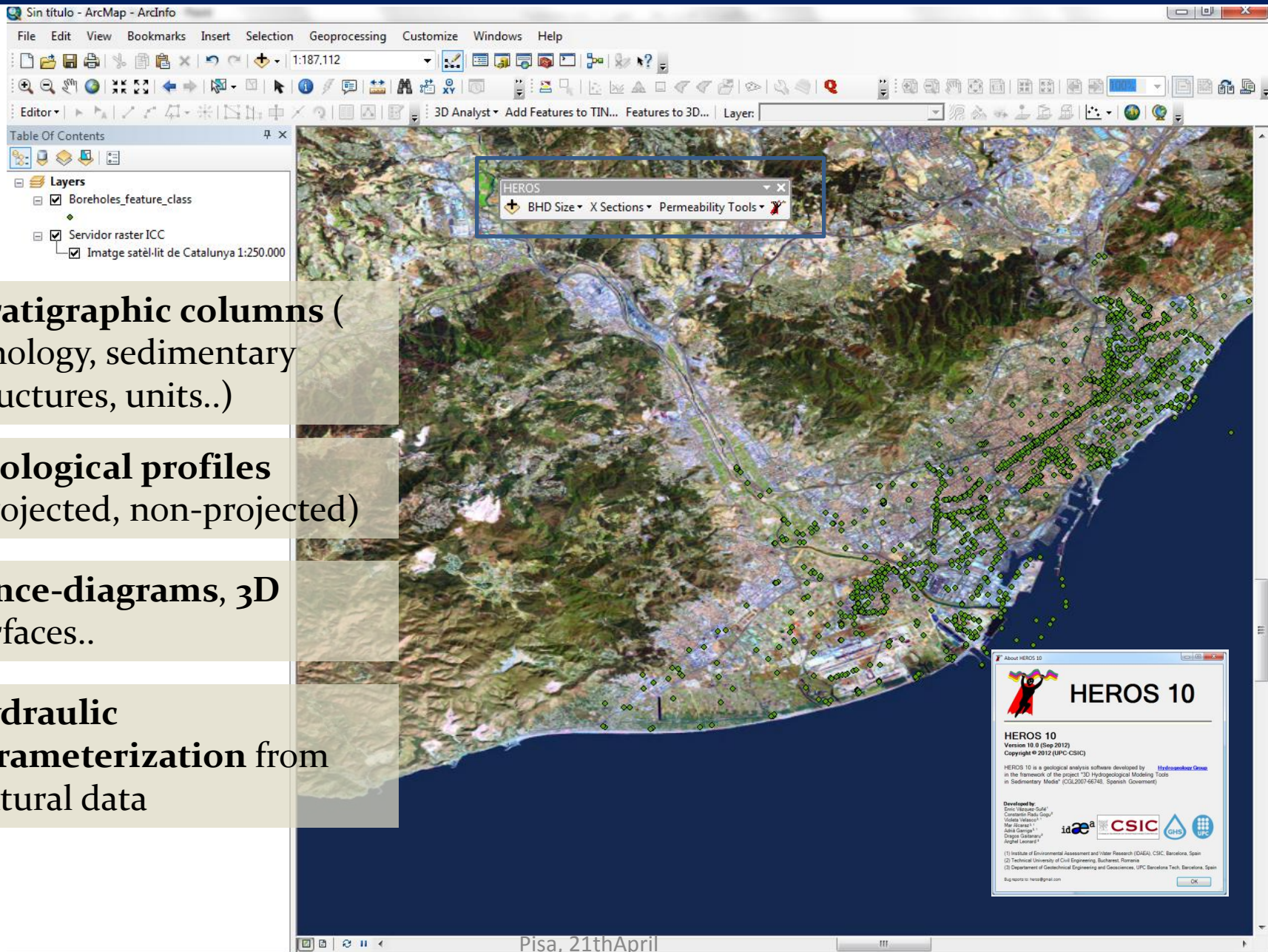


3.2. Geological analysis tools HEROS



Further information in Velasco, V., Gogu, R., Vázquez-Suñé, E., Garriga, A., Ramos, E., Riera, J., & Alcaraz, M. (2012). The use of GIS-based 3D geological tools to improve hydrogeological models of sedimentary media in an urban environment. *Environmental Earth Sciences*. Doi: 10.1007/s12665-012-1898-2.

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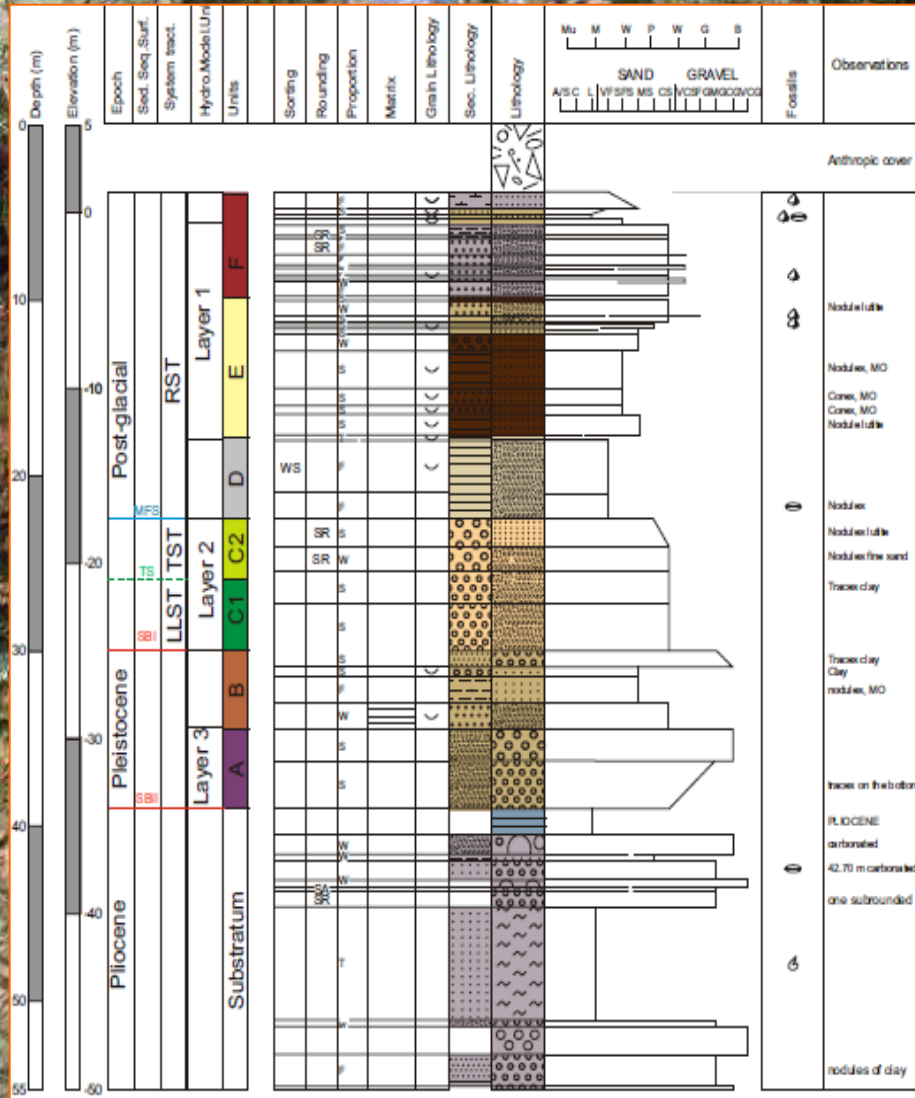
Stratigraphic columns (
lithology, sedimentary
structures, units..)

Geological profiles
(projected, non-projected)

**Fence-diagrams, 3D
surfaces..**

**Hydraulic
parameterization from
textural data**

Borehole diagram tools



HEROS 10.0
 BHD Size ▾ X Sections ▾ Permeability Tools ▾

OBTAINED INFORMATION

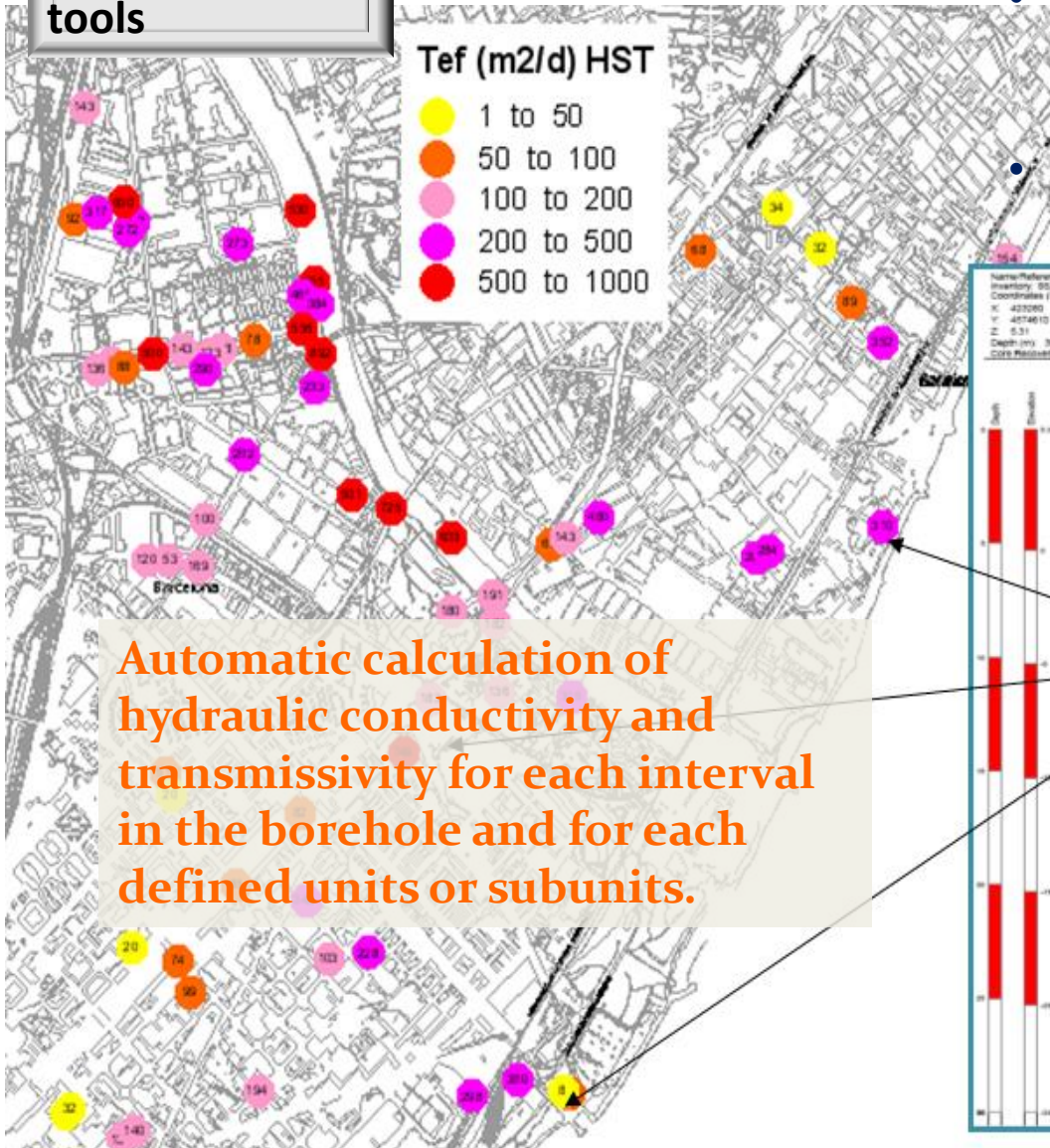
- Stratigraphic column (jpg, pdf..)
- Definition units/subunits



DATABASE HYDOR

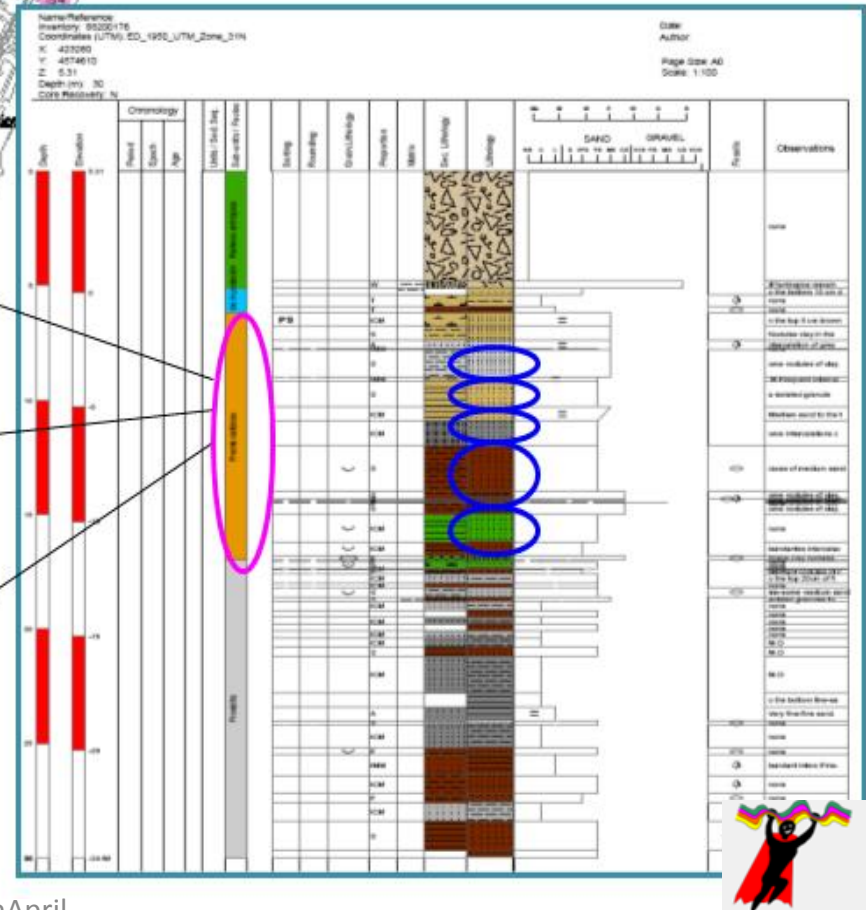
- 3 different detail level.
- Fossils/sedimentological structures..
- Age/Epoch/Period
- Depth/elevation
- Interpretation units/subunits
- In situ tests

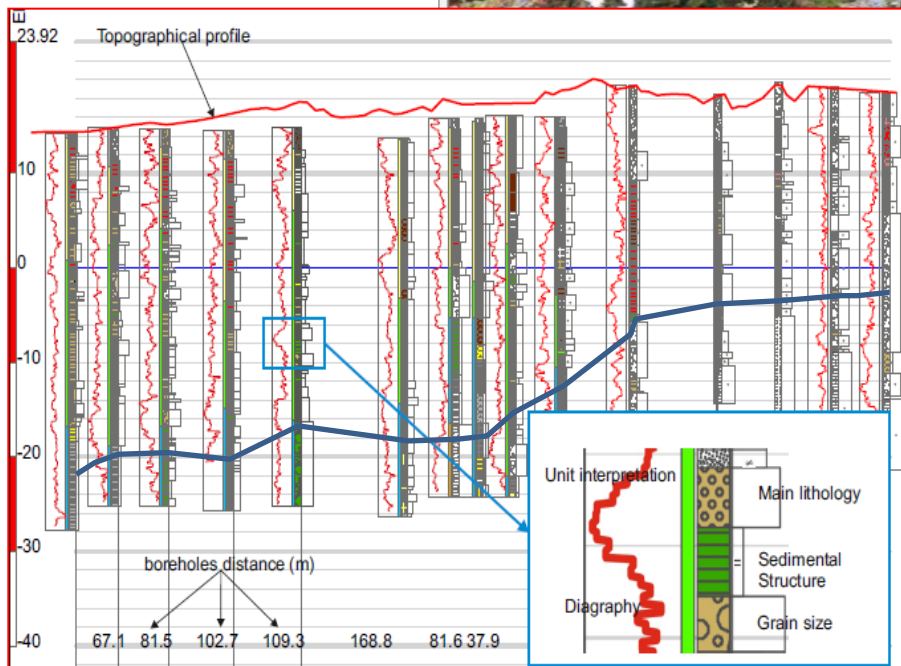
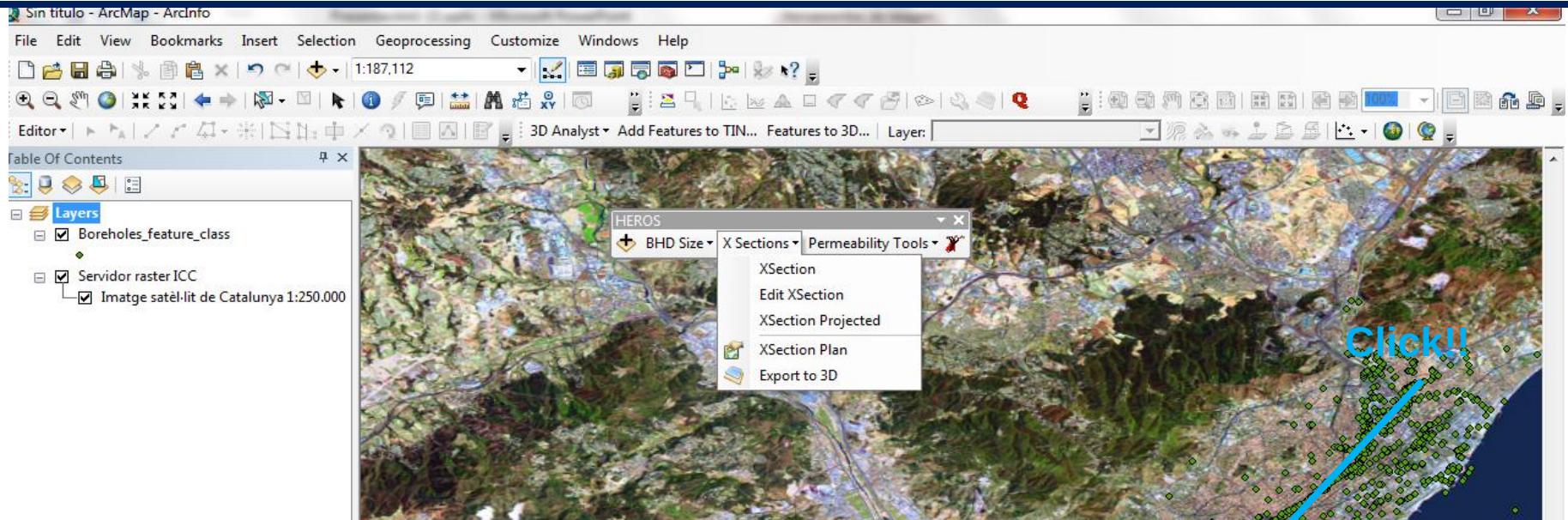
HG Parameters



OBTAINED INFORMATION

- Calculation and visualization of the spatial distribution of the hydraulic parameters.
- Initial parameterization of the hydrogeological model.





- Projected or not projected
- Diagraphies/units
- Previous interpretations profiles
- Geological map projected in topographical profile



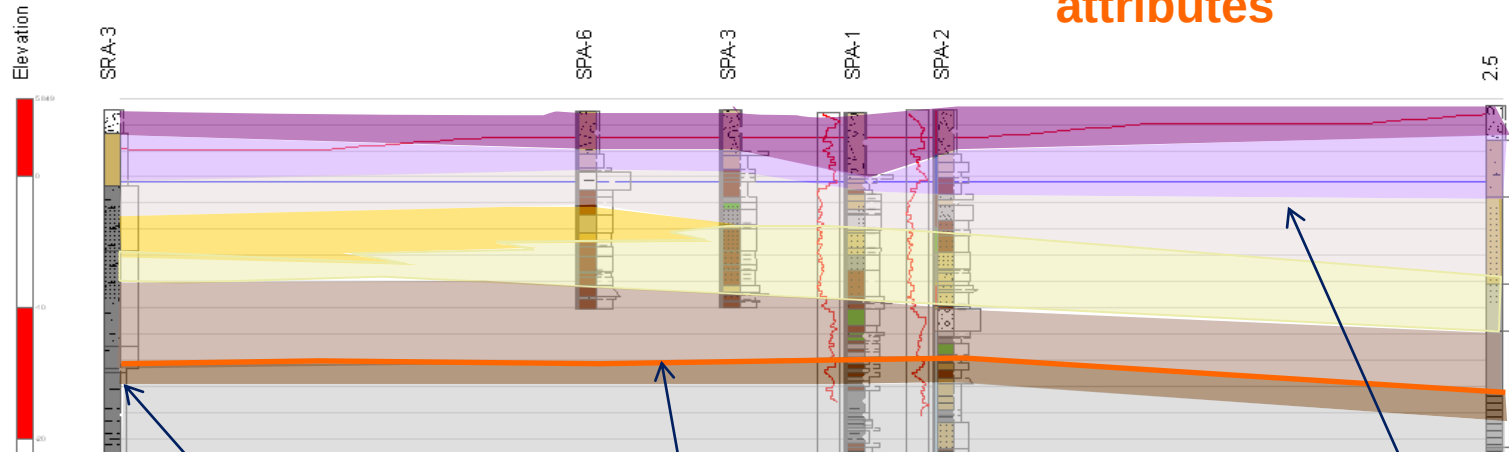
Xsection tools

Page Size: A2

Horizontal Scale: 1:478

Vertical Scale: 1:200

Correlation panel:
Export 3D points, lines
and polygons with its
attributes

**Información puntual**

Unit
Subunit
Depth
Kv
Kh
Porosity
Young_module

Acuitardo

Save

Close

Información lineal

Surface
TopUnit
BottomUnit
TopHC
BottomHC
Adnotation1
Adnotation2

Limite1
Acuifero Superior
Acuitardo

Save

Close

Información poligonal

Unit
Subunit
Thickness
Kv
Kh
Porosity
Observation_1
Observation_2

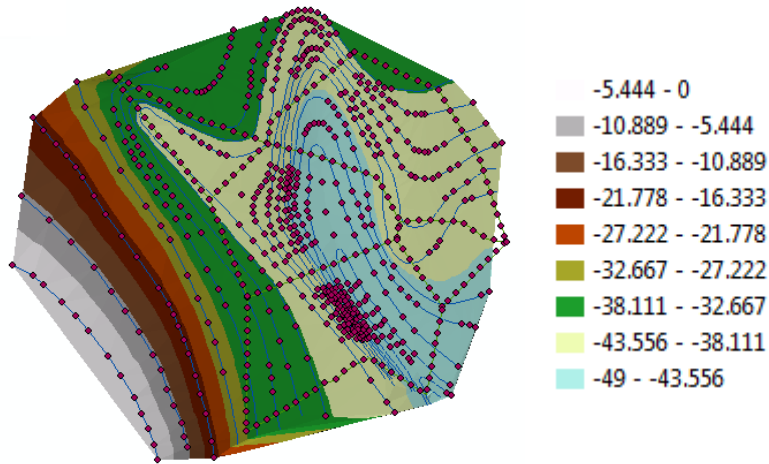
Acuifero Superficial

Save

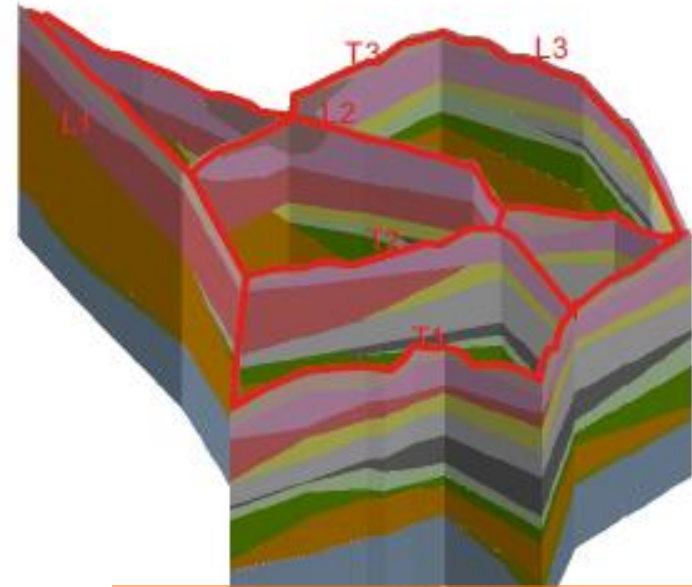
Close



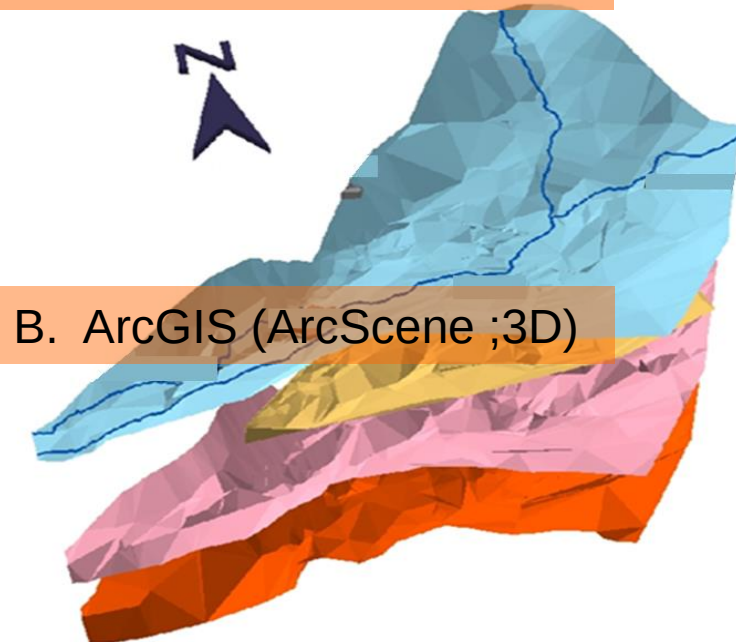
Xsection tools



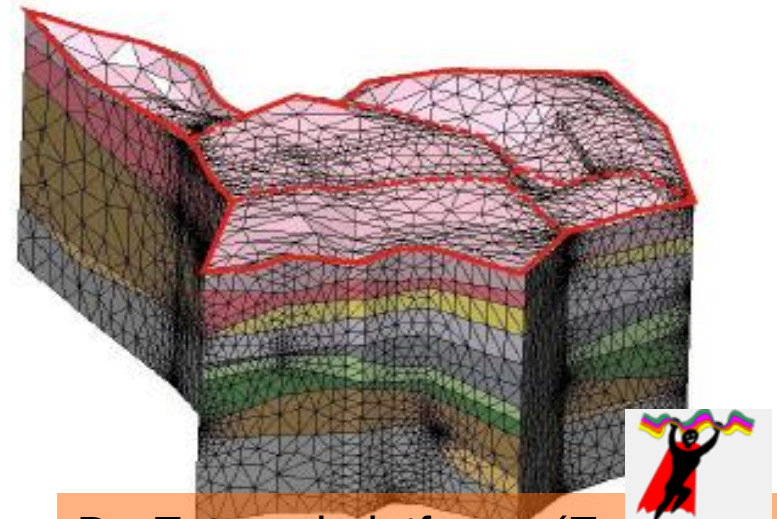
A. ArcMap (2D)



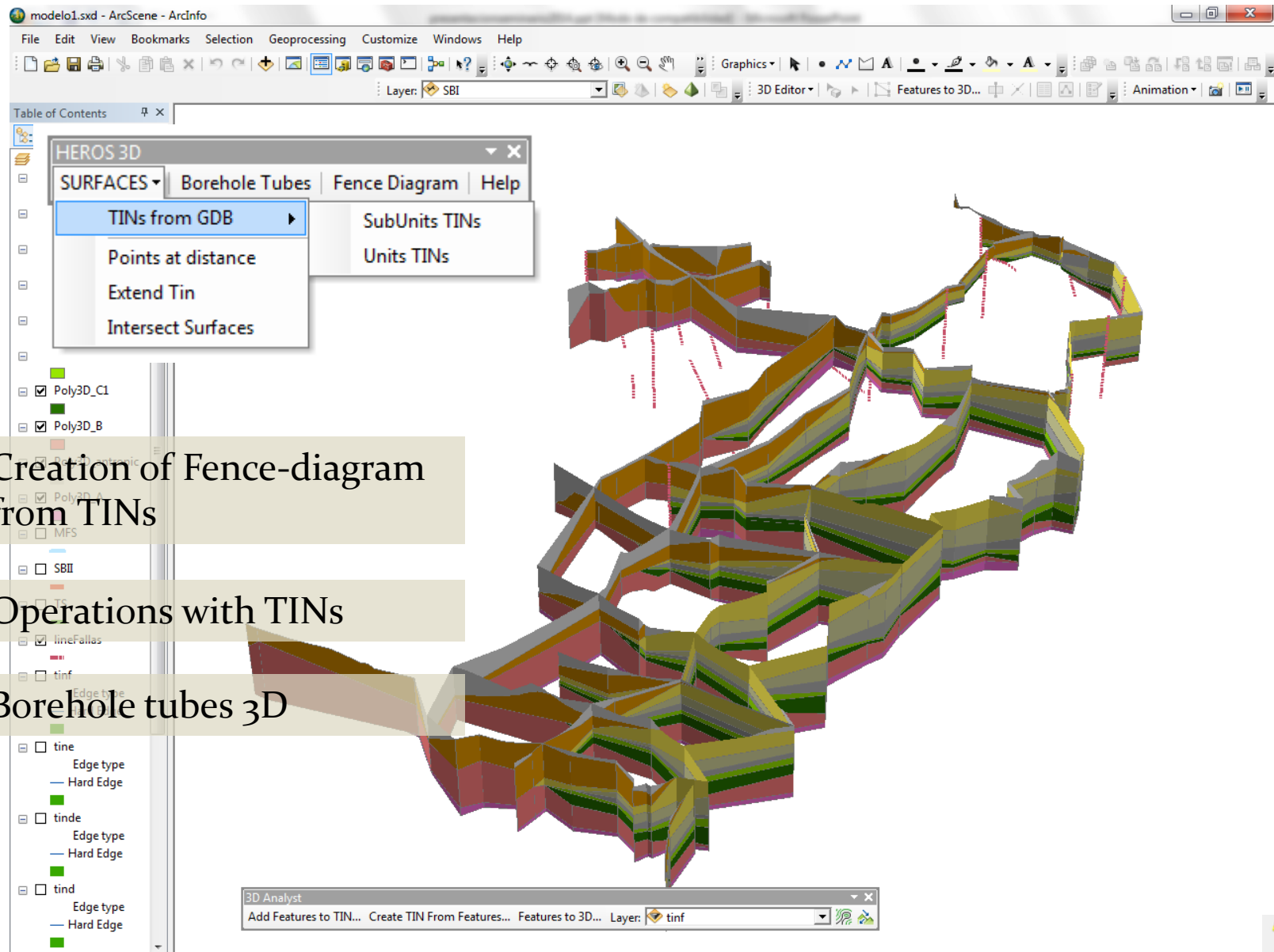
C. ArcGIS (ArcScene;3D)



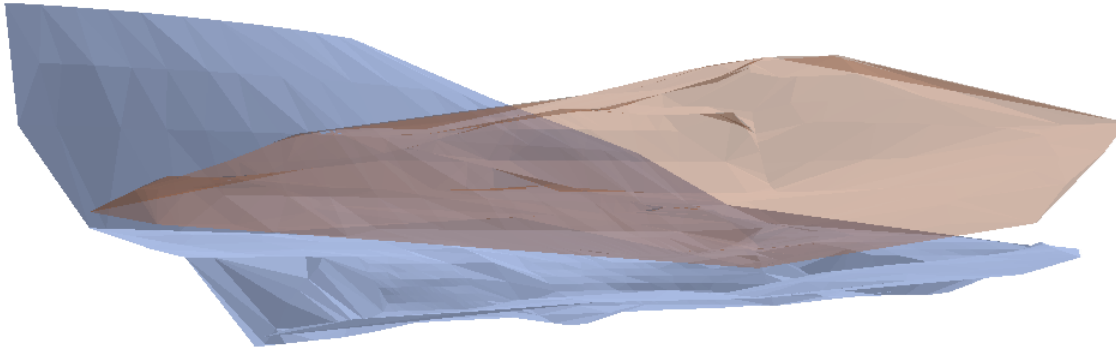
B. ArcGIS (ArcScene ;3D)



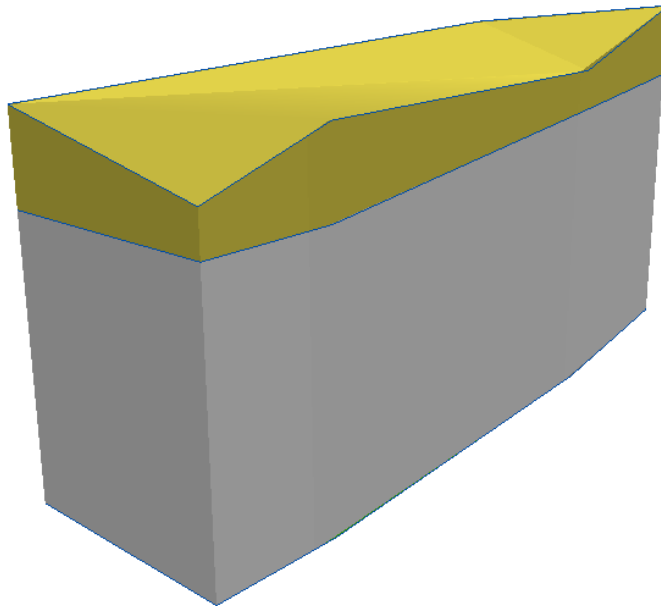
D. External platforms (Eg:GID)



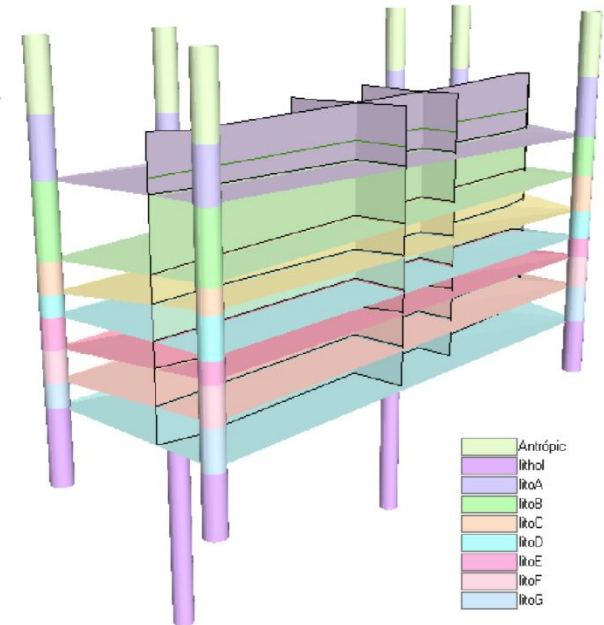
Operations with TINs



Multipatch from TINs



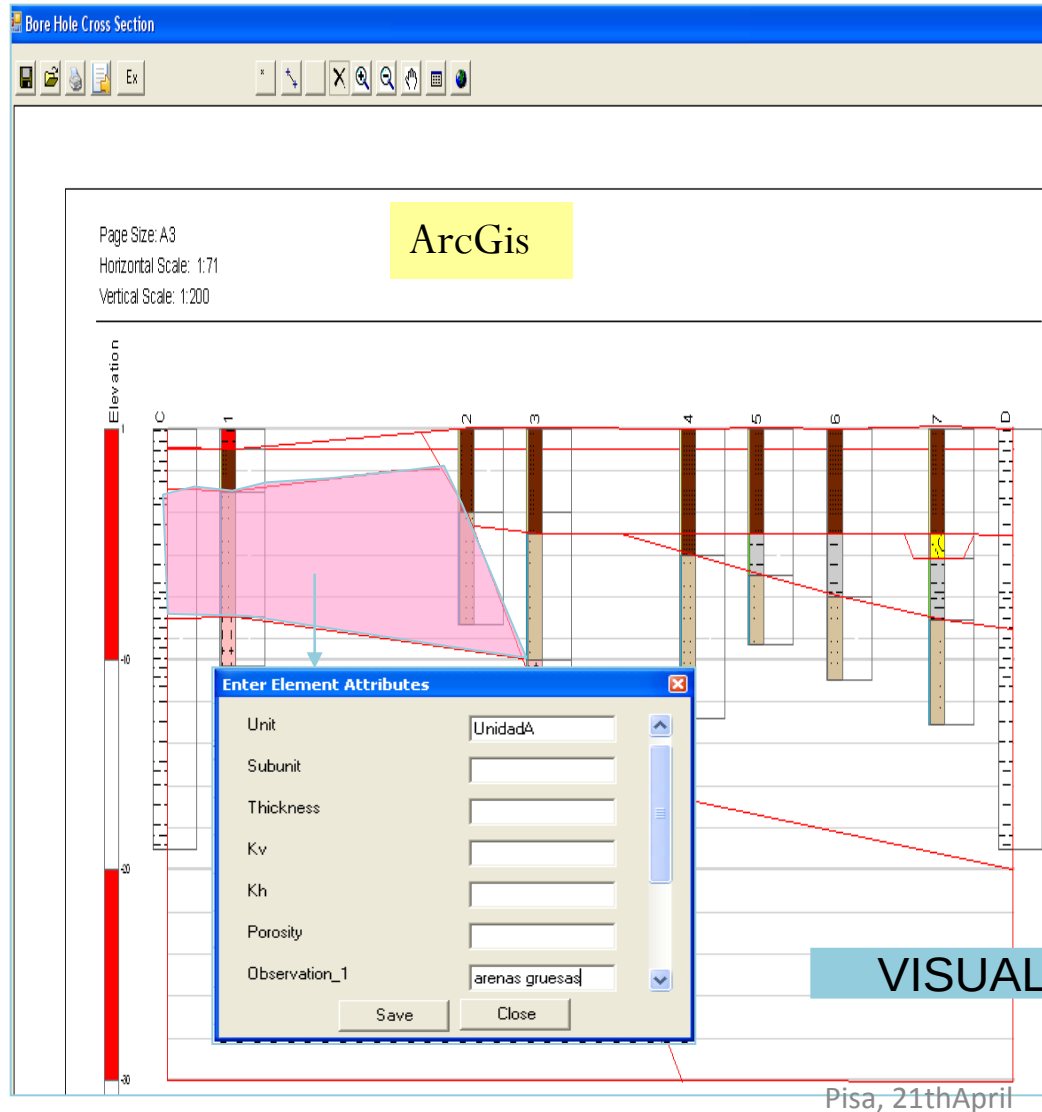
Borehole tubes 3D



Xsection tools

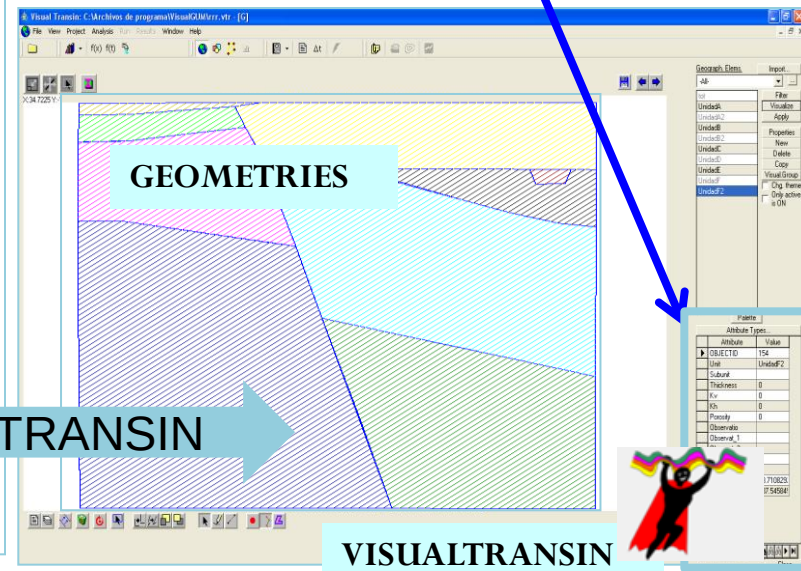
Export of 2D elements to other platforms

EXPORT OF THE OBTAINED INFORMATION



Attribute	Value
OBJECTID	147
Unit	UnidadA
Subunit	
Thickness	0
Kv	0
Kh	0
Porosity	0
Observatio	Arenasgrues
Observat_1	
Observat_2	
Observat_3	
Observat_4	
SHAPE_Leng	19.364502
SHAPE_Area	14.811348

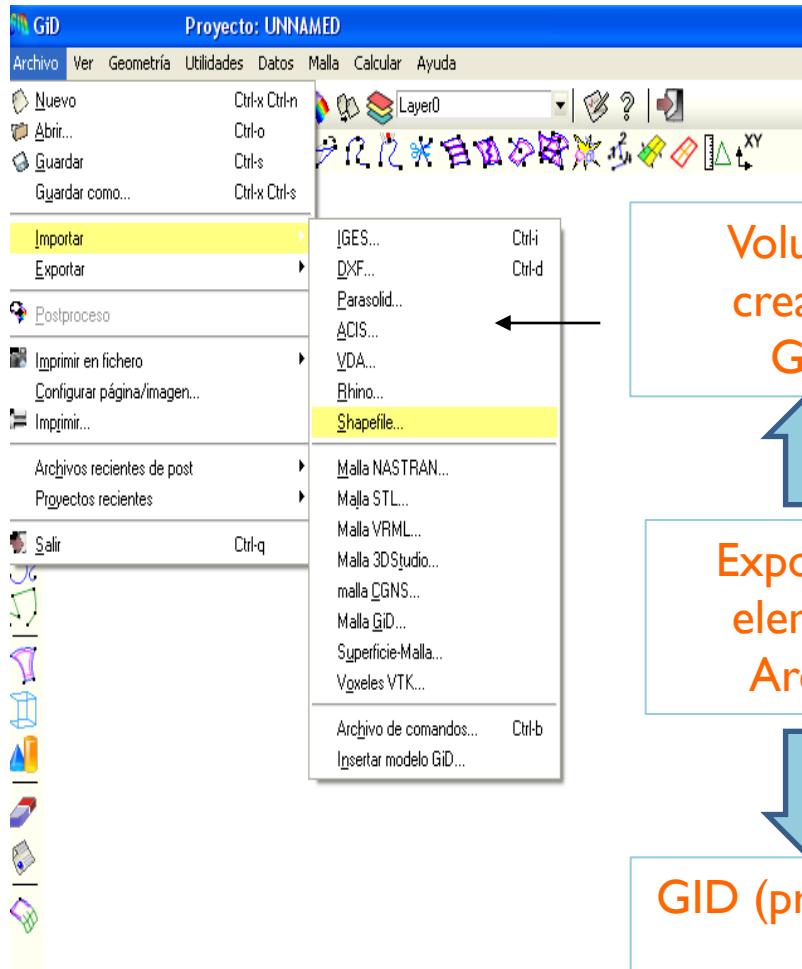
ATRIBUTTES



Xsection tools

Export of 3D elements to other platforms

EXPORT OF THE OBTAINED INFORMATION

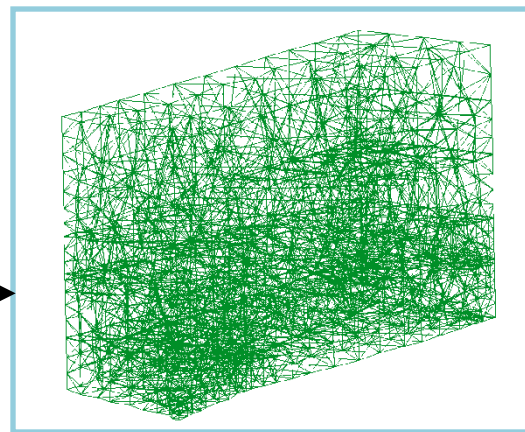
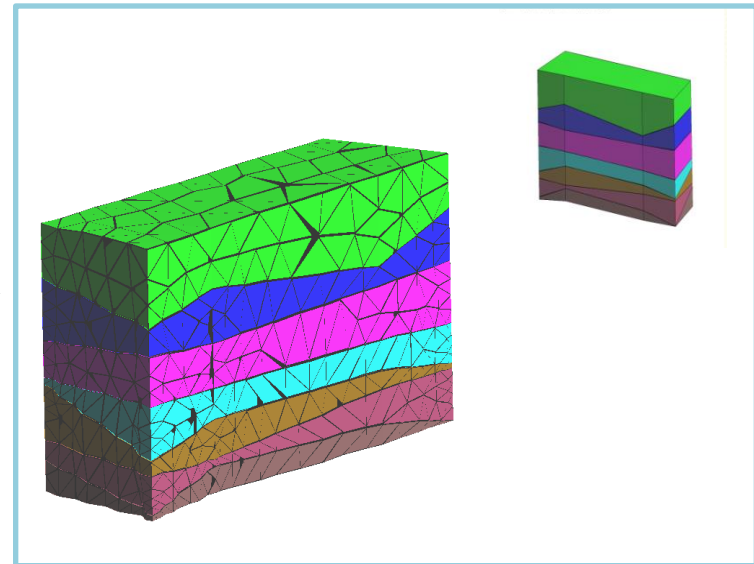


Volumen
creation
GID

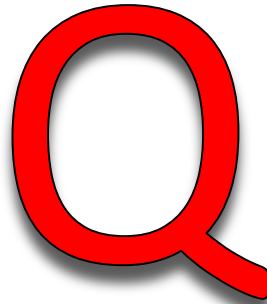
Export 3D
elements
ArcGIS

GID (pre-process)
+
Modelization
CODEBRIGHT

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3.3. Hydrochemical analysis tools QUIMET



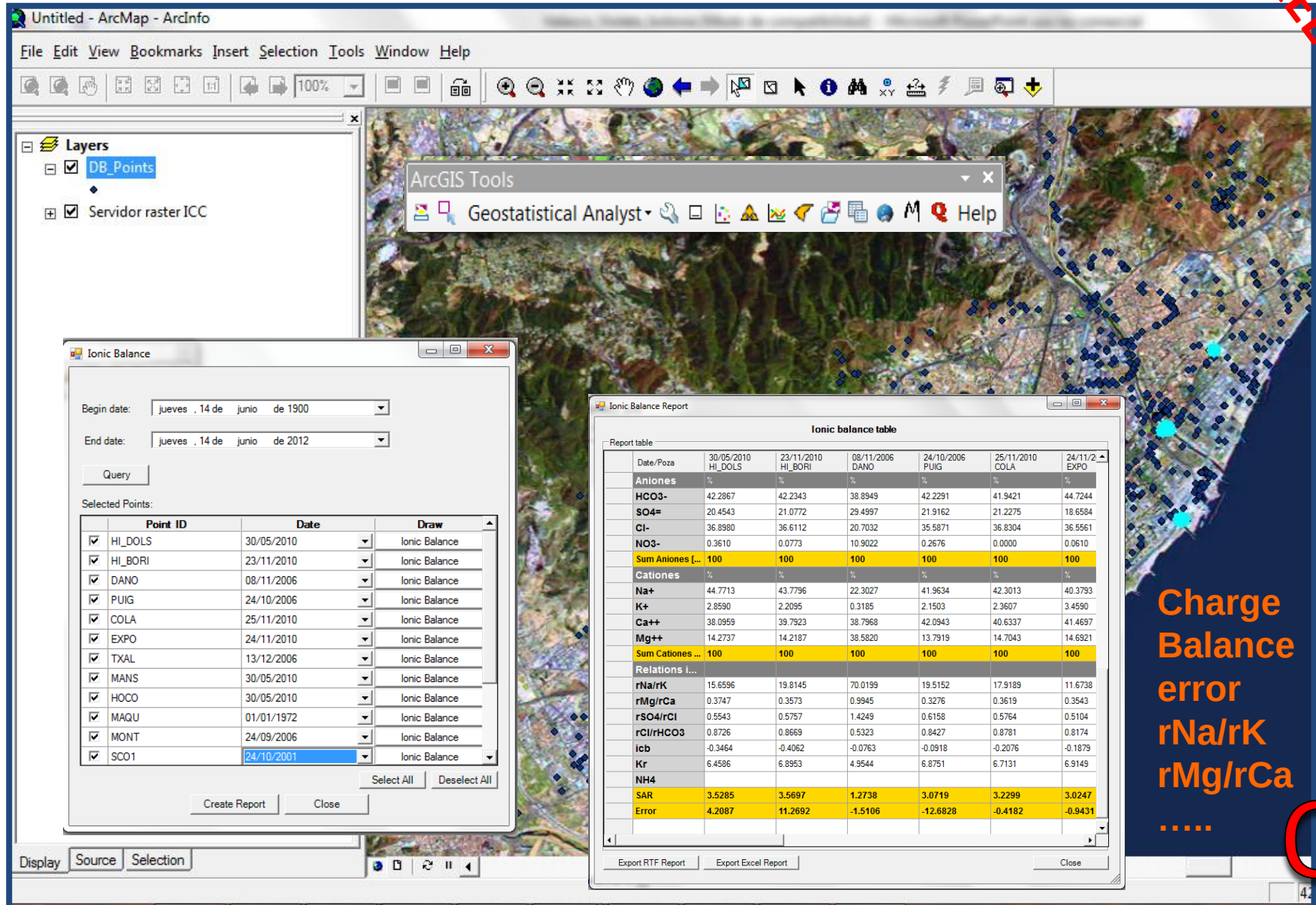
FREEWAT

Further information in Velasco V, Tubau I, Vázquez-Suñe E, Gogu, R, Gaitanaru, D, Alcaraz, M, Serrano-Juan A, Fernández-García D, Garrido T, Fraile J, Sanchez-Vila, X. GIS-based hydrogeochemical analysis tools (QUIMET). Computers & Geosciences. Volume 70, September 2014, Pages 164-180

Funded by ACA (Catalan Water Agency)

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FREEWAT



Untitled - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Tools Window Help

Layers

- ☒ DB_Points
- ☒ Servidor raster ICC

ArcGIS Tools

Geostatistical Analyst Help

Ionic Balance

Begin date: jueves , 14 de junio de 1900

End date: jueves , 14 de junio de 2012

Query

Selected Points:

Point ID	Date	Draw
☒ HI_DOLS	30/05/2010	Ionic Balance
☒ HI_BORI	23/11/2010	Ionic Balance
☒ DANO	08/11/2006	Ionic Balance
☒ PUIG	24/10/2006	Ionic Balance
☒ COLA	25/11/2010	Ionic Balance
☒ EXPO	24/11/2010	Ionic Balance
☒ TXAL	13/12/2006	Ionic Balance
☒ MANS	30/05/2010	Ionic Balance
☒ HOCO	30/05/2010	Ionic Balance
☒ MAQU	01/01/1972	Ionic Balance
☒ MONT	24/09/2006	Ionic Balance
☒ SCO1	24/10/2001	Ionic Balance

Create Report Close

Ionic Balance Report

Ionic balance table

Date/Posa	30/05/2010 HI_DOLS	23/11/2010 HI_BORI	08/11/2006 DANO	24/10/2006 PUIG	25/11/2010 COLA	24/11/2010 EXPO
Aniones	%	%	%	%	%	%
HCO3-	42.2867	42.2343	38.8949	42.2291	41.9421	44.7244
SO4=	20.4543	21.0772	29.4997	21.9162	21.2275	18.6584
Cl-	36.8980	36.6112	20.7032	35.5871	36.8304	36.5561
NO3-	0.3610	0.0773	10.9022	0.2676	0.0000	0.0610
Sum Aniones [...]	100	100	100	100	100	100
Cationes	%	%	%	%	%	%
Na+	44.7713	43.7796	22.3027	41.9634	42.3013	40.3793
K+	2.8590	2.2095	0.3185	2.1503	2.3607	3.4590
Ca++	38.0959	39.7923	38.7968	42.0943	40.6337	41.4697
Mg++	14.2737	14.2187	38.5820	13.7919	14.7043	14.6921
Sum Cationes [...]	100	100	100	100	100	100
Relations [...]						
rNa/rK	15.6596	19.8145	70.0199	19.5152	17.9189	11.6738
rMg/rCa	0.3747	0.3573	0.9945	0.3276	0.3619	0.3543
rSO4/rCl	0.5543	0.5757	1.4249	0.6158	0.5764	0.5104
rCl/rHCO3	0.8726	0.8669	0.5323	0.8427	0.8781	0.8174
icb	-0.3464	-0.4062	-0.0763	-0.0918	-0.2076	-0.1879
Kr	6.4586	6.8953	4.9544	6.8751	6.7131	6.9149
NH4						
SAR	3.5285	3.5697	1.2738	3.0719	3.2299	3.0247
Error	4.2087	11.2692	-1.5106	-12.6828	-0.4182	-0.9431

Export RTF Report Export Excel Report Close

Display Source Selection

Charge Balance error
rNa/rK
rMg/rCa
.....

Q

HQ data analysis tools

Query

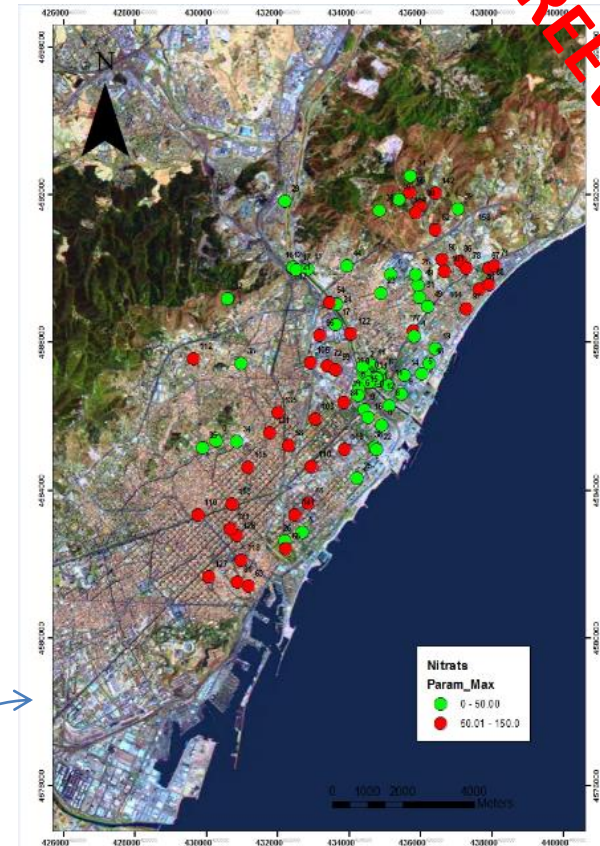
Time Query
Choose your time interval

Begin date: End date:

Parameter Query
Choose parameters:

Query Results

	Id_Well	Campaign	Sample	Date	Param	Value
☒	L9SB06	Mostreig Químic General ...	L9SB06_CUP0611	23/11/2006	Ferro	912.86
☒	L9SB08	Mostreig Químic General ...	L9SB08_CUP0611	09/11/2006	Ferro	1359.81
☒	L9SB12	Mostreig Químic General ...	L9SB12_CUP0610	31/10/2006	Ferro	128.76

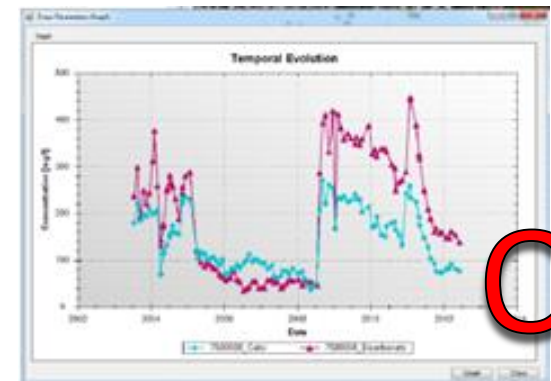


Query Report

Area: Delta del Besòs

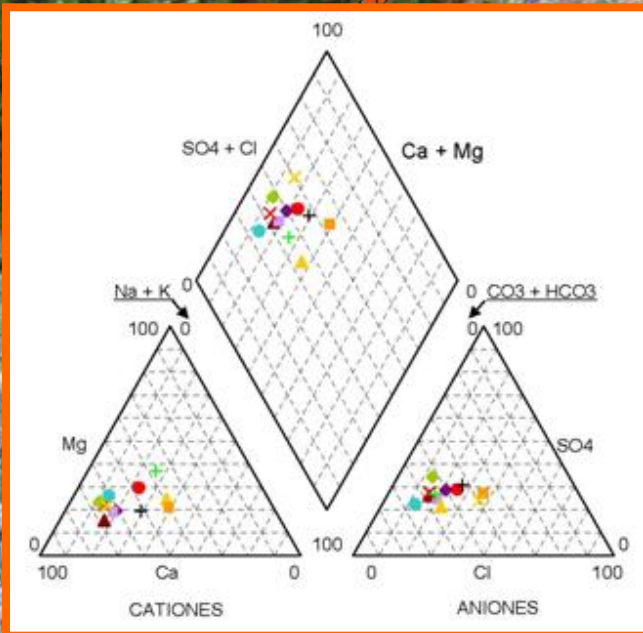
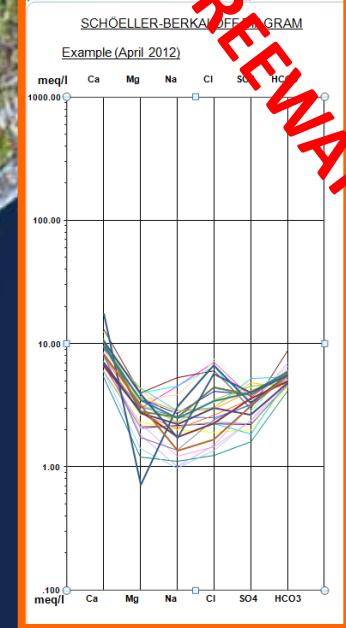
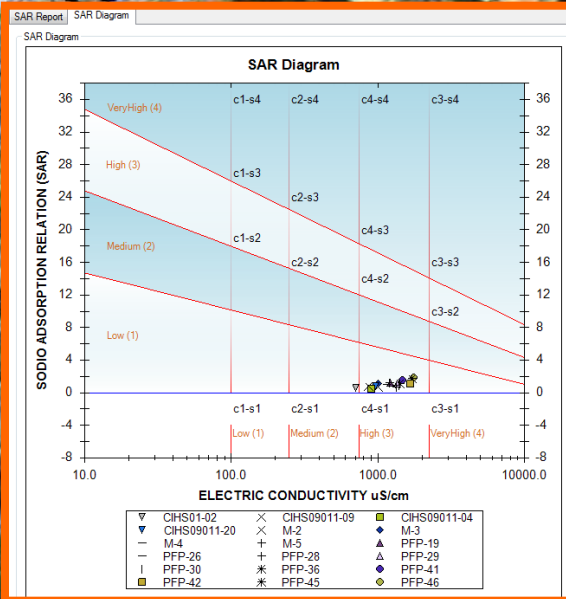
Date: 15/02/2012 14:23:26

WellId	Campaign	Sample	SampleDate	Param	Value	Units
POLO	UPC2000	POLO_C UP0610	23/10/2006	Cloroform_CHCl3	9.65	microg/l
TXAL	UPC2000	TXAL_CU P0612	13/12/2006	Cloroform_CHCl3	5.75	microg/l
DANO	UPC2000	DANO_C UP0611	08/11/2006	Tetracloroetile	296.38	microg/l
POLO	UPC2000	POLO_C UP0610	23/10/2006	Tetracloroetile	0.17	microg/l
TXAL	UPC2000	TXAL_CU P0612	13/12/2006	Tetracloroetile	115.83	microg/l
DANO	UPC2000	DANO_C UP0611	08/11/2006	Tricloroetile	18.35	microg/l
POLO	UPC2000	POLO_C UP0610	23/10/2006	Tricloroetile	0.5	microg/l
TXAL	UPC2000	TXAL_CU P0612	13/12/2006	Tricloroetile	3.77	microg/l



FREWAT

HQ diagrams tools



Traditional numerical and graphical analysis techniques (Piper, Stiff, Schöeller- Berkaloff salinity.) to which the spatial component is added

Regulatory parameter analysis tools

Query

Time Query
Choose your time interval
Begin date: sábado, 17 de febrero de 1990 End date: viernes, 17 de febrero de 2012 Submit

Parameter Query
Choose parameters:
Substancias del GRUP 4
Tetracloroetileno
Tricloroetileno
Substancias del GRUP 3
Etilbenzene
Bromoform
Clorobenzeno
Cloroformo_CHCl3 Submit

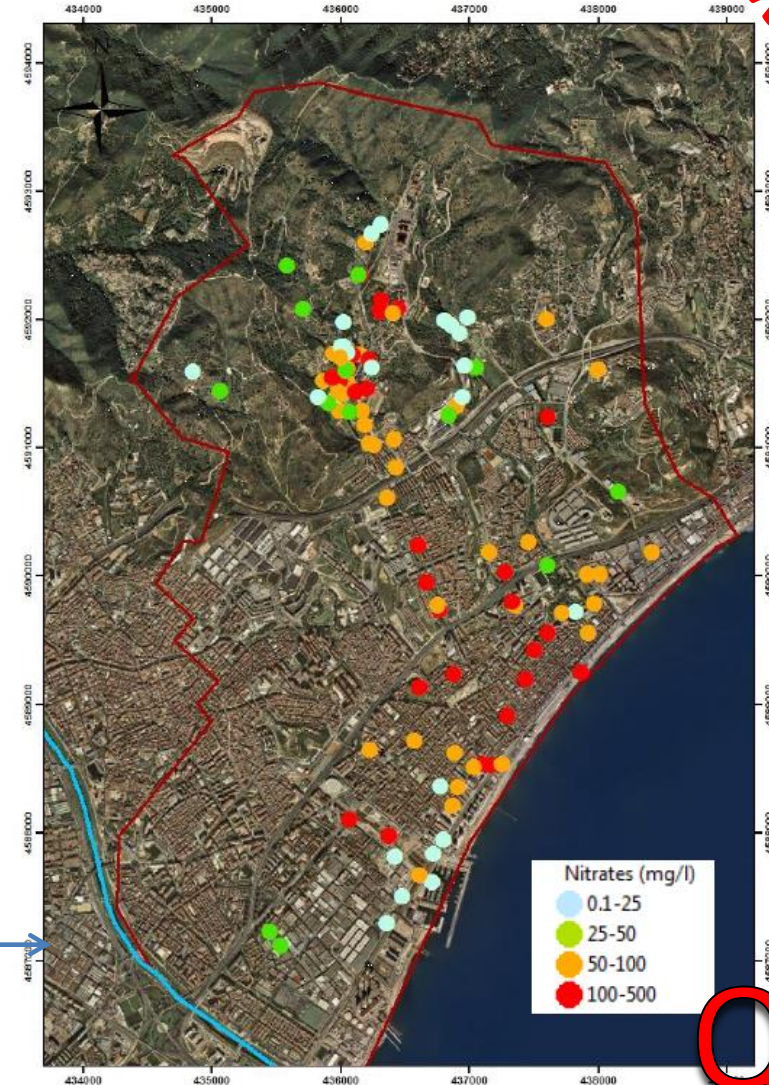
Query Results
Select All Deselect All

	Id_Well	Campaign	Sample	Date	Param	Value
☒	DANO		DANO_CUP0611	08/11/2006	Cloroformo_CHCl3	30.5
☒	FRIG		FRIG_CUP0610	24/10/2006	Cloroformo_CHCl3	10.45
☒	MONT		MONT_CUP0609	24/09/2006	Cloroformo_CHCl3	1

Create RTF Report Create Map Close

Classification according to the threshold by a given normative!

FREWAT



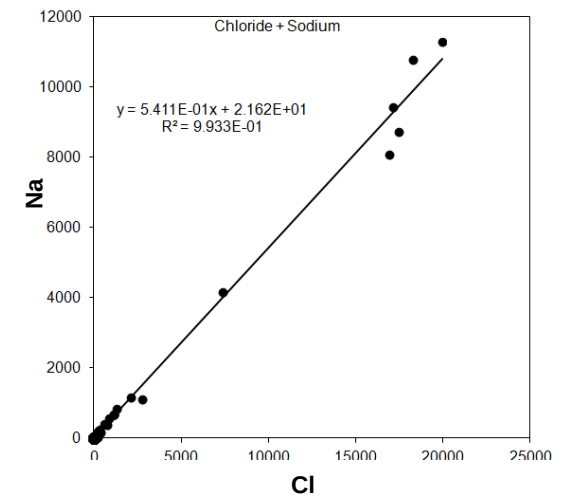
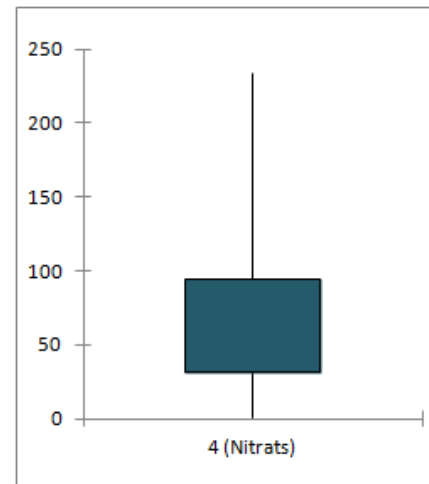
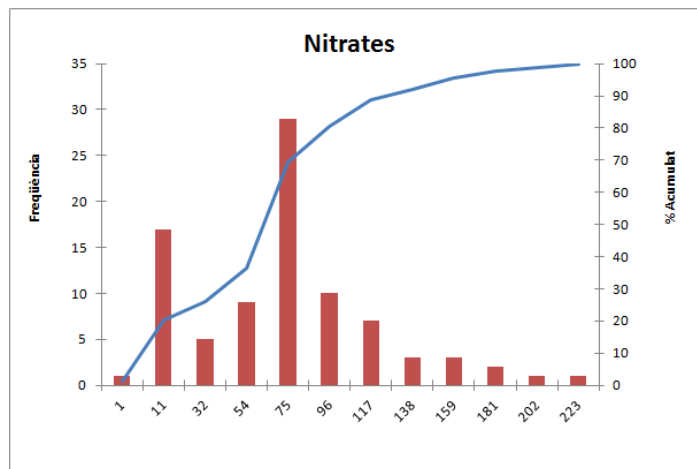
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Q

Statistical analysis tools

Statistical Quimet

Interrogate the DataBase.



	Bicarbonates	Sulphates	Chloride	Nitrates	Sodium	Potassium	Calcium	Magnesium	EC
Bicarbonates	1.00000	0.21223	0.07690	-0.17897	0.19657	-0.26039	0.54644	0.48271	0.60713
Sulphates		1.00000	0.39872	-0.08756	0.42554	-0.15540	0.14330	0.51732	0.62286
Chloride			1.00000	-0.25059	0.82033	0.38120	-0.26940	0.22479	0.56979
Nitrates				1.00000	-0.05234	0.07870	0.04569	0.26612	0.09407
Sodium			0.82033		1.00000	0.46856	-0.33454	0.19027	0.73103
Potassium						1.00000	-0.71424	-0.06363	-0.01571
Calcium							1.00000	0.22225	0.21567
Magnesium								1.00000	0.52914
EC	0.60713	0.62286			0.73103				1.00000

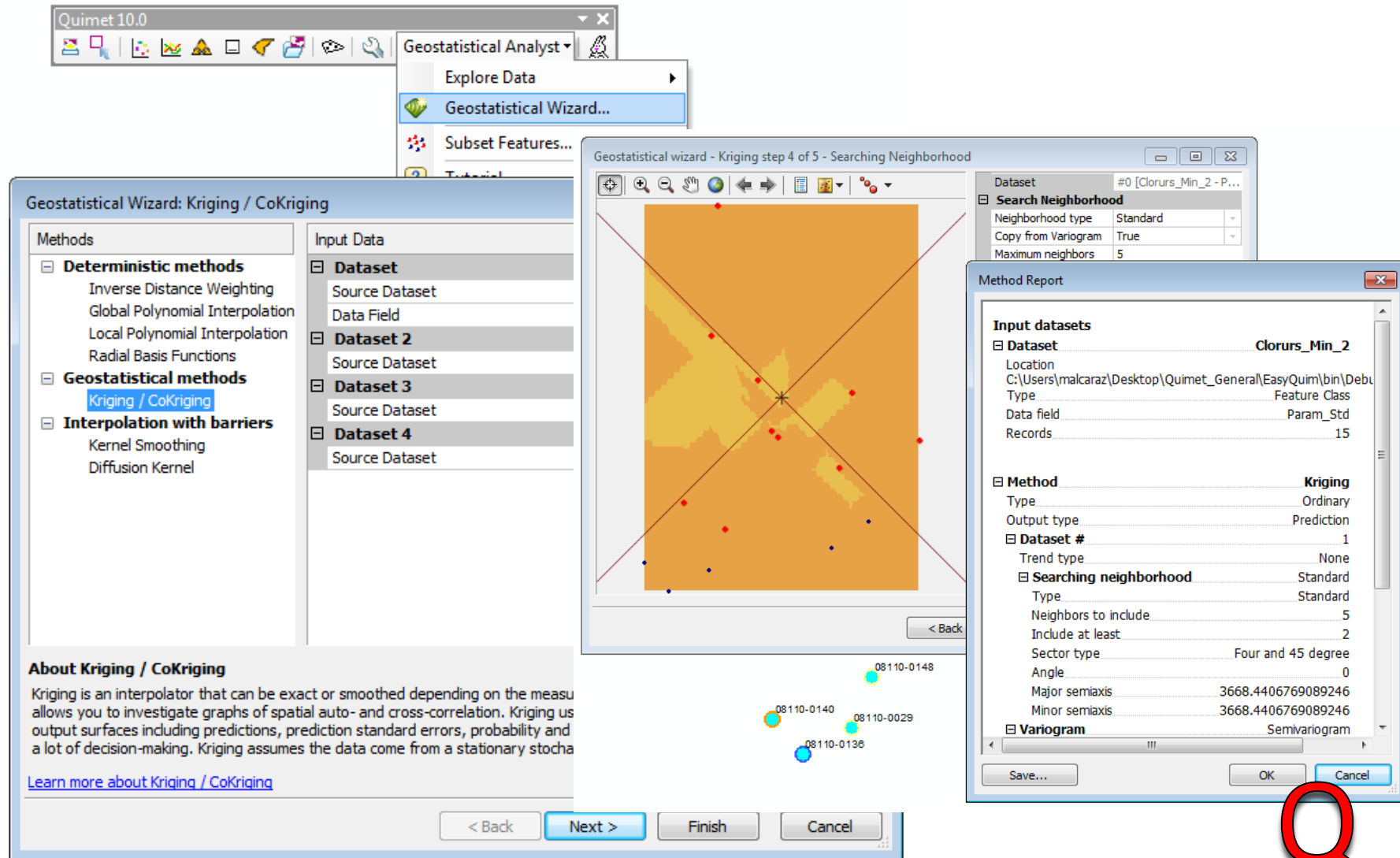
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Q

Spatio-temporal
Query



Geostatistical Analysis tools
(ArcGIS)



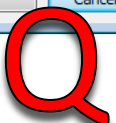
The screenshot displays the Quimet 10.0 Geostatistical Wizard interface, specifically the 'Kriging / CoKriging' step. The main window is titled 'Geostatistical Wizard: Kriging / CoKriging' and shows a list of methods on the left, including 'Deterministic methods', 'Geostatistical methods' (with 'Kriging / CoKriging' selected), and 'Interpolation with barriers'. The 'Input Data' section on the right lists four datasets: 'Dataset', 'Dataset 2', 'Dataset 3', and 'Dataset 4', each with a 'Source Dataset' field.

A secondary window, 'Geostatistical wizard - Kriging step 4 of 5 - Searching Neighborhood', is open, showing a map of the study area with a grid and a search neighborhood defined by a red circle. The 'Dataset' is set to '#0 [Clorurs_Min_2 - P...]' and the 'Search Neighborhood' parameters are configured: 'Neighborhood type' is 'Standard', 'Copy from Variogram' is 'True', and 'Maximum neighbors' is '5'.

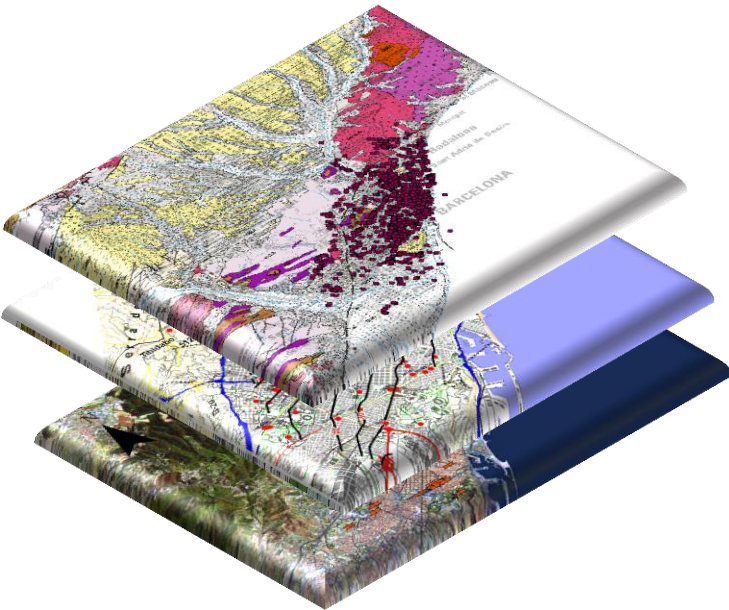
A third window, 'Method Report', is also open, displaying the results of the Kriging process. It includes the 'Input datasets' (Dataset: Clorurs_Min_2, Location: C:\Users\malcaraz\Desktop\Quimet_General\EasyQuim\bin\Debu, Type: Feature Class, Data field: Param_Std, Records: 15) and the 'Method' details (Type: Ordinary, Output type: Prediction, Dataset #: 1, Trend type: None, Searching neighborhood: Standard, Type: Standard, Neighbors to include: 5, Include at least: 2, Sector type: Four and 45 degree, Angle: 0, Major semiaxis: 3668.4406769089246, Minor semiaxis: 3668.4406769089246). The 'Variogram' section shows 'Semivariogram'.

At the bottom of the main window, there is a section titled 'About Kriging / CoKriging' which states: 'Kriging is an interpolator that can be exact or smoothed depending on the measure you use. It allows you to investigate graphs of spatial auto- and cross-correlation. Kriging outputs surfaces including predictions, prediction standard errors, probability and a lot of decision-making. Kriging assumes the data come from a stationary stochastic process.' Below this text is a link: 'Learn more about Kriging / CoKriging'.

The bottom of the interface features navigation buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.



GIS tools



Link with External Platforms

- Integration and interaction with other information.
- Geostatistic calculations.
-

Query

Time Query
Choose your time interval
Begin date: lunes, 01 de enero de 1900 End date: miércoles, 12 de marzo de 2014 Submit

Easy-Quim Analysis
Generate Easy-Quim Excel Report: Easy Quim Analysis

Parameter Query
Choose parameters:
Bacterias aerobias a 22C
Bacterias aerobias a 37C
Bor
Cadmi
CE
Clostridis sulfid-reductors
Coliformes fecals

Mix Wells Selection
Select Wells for Mix Excel Report: Mix Selection

Query Results
Select All Deselect All

	Id_Well	Sample	Date	Mix Sample
☒	PIUL	PIUL_CUP9710...	28/10/1997	
☒	PIUL	PIUL_CUP9805...	05/05/1998	
☒	PIUL	PIUL_CUP9807...	07/07/1998	
☒	PIUL	PIUL_CUP9901...	26/01/1999	

Source Well

EASY_QUIM v5.0 (2012)
by Enric Vázquez-Suñe^{1,2}, Alejandro Serrano-Juan¹
www.h2ogeo.upc.edu

MIX v1.0 (2012)
By E. Vázquez-Suñe, J. Carrera and A. Serrano-Juan
www.h2ogeo.upc.edu

3.4. Hydrogeological analysis tools HYHY



3.4. Hydrogeological analysis tools HYYH

FREEWAT

The screenshot displays the ArcMap interface with the HYYH 10.0 toolbar. The 'Well Test Query' tool is highlighted with a red box. An orange circle around the HYYH 10.0 logo points to the 'ChooseSU' dialog box, which is open and shows a list of subunits: 'shallower_aquifer', 'mean_aquifer', and 'lower_aquifer'. The 'Layers' panel on the left shows 'DB_Borehole' and 'Servidor raster ICC' loaded. The main map area shows a topographic view with blue dots representing boreholes. In the bottom left, there is an inset map titled 'Aquifer thickness [m]' showing a color-coded map of aquifer thickness with a scale bar from 0 to 12 km. The text 'García-Gil et al., 2013' is written in red at the bottom of the inset map.

ChooseSU

Choose Subunit

- shallower_aquifer
- mean_aquifer
- lower_aquifer

OK Cancel

Aquifer thickness [m]

High : 20.5

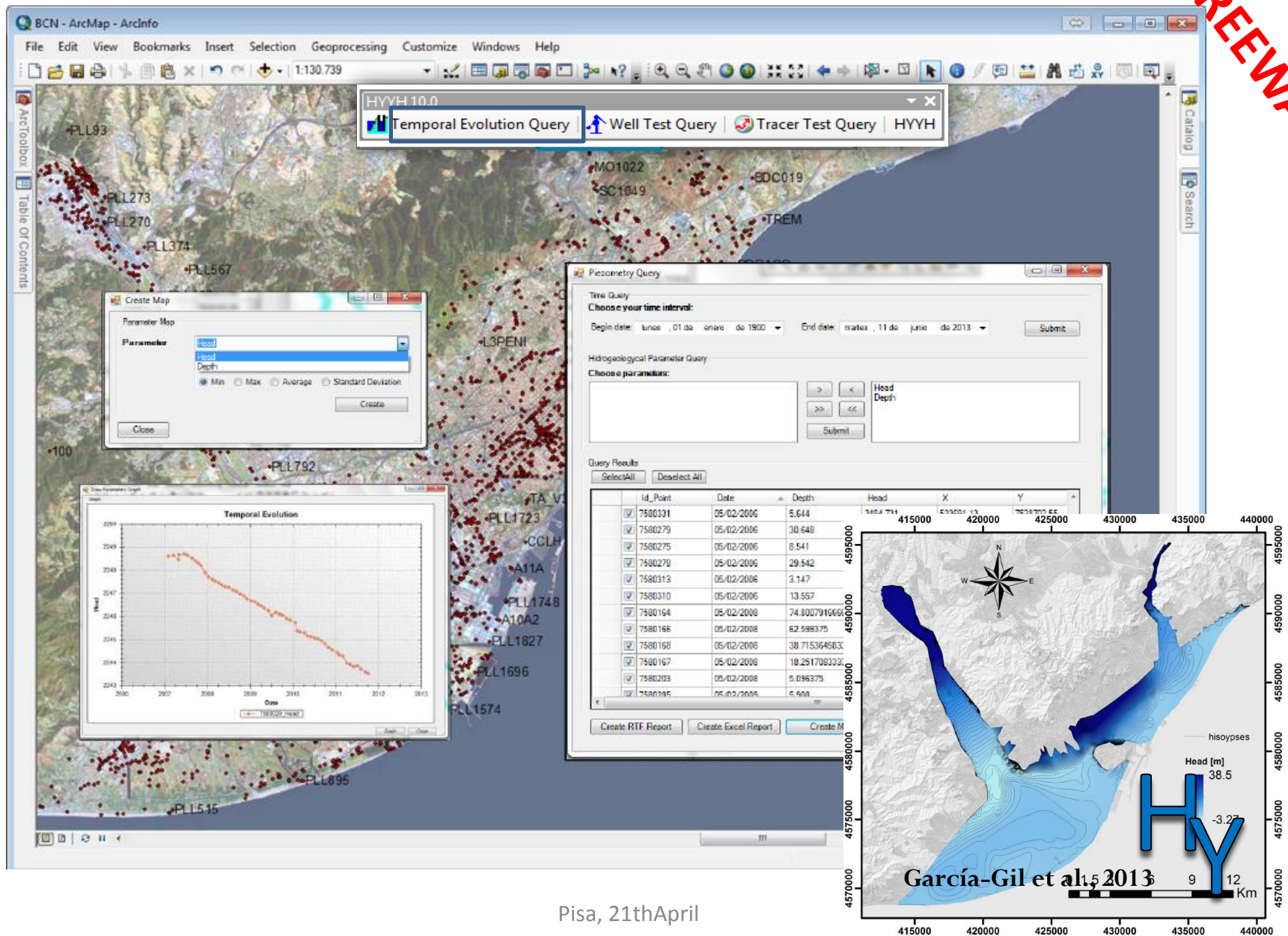
Low : 0.8

0 1.5 3 6 9 12 Km

García-Gil et al., 2013

HYY

FREEMAT



3.4. Hydrogeological analysis tools HHYH

ejemplo HHYH - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:129,503

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Layers

- D:\Usuari\Mis docum...
- Hydrogeological
- D:\Usuari\Mis docum...
- DB_Points
- ✓ Servidor raster ICC

HHYH 10.0

Temporal Evolution Query Well Test Query Tracer Test Query HHYH

2

Time Query

Choose your time interval

fecha ini: lunes , 01 de enero de 1900 fecha fin: martes , 11 de marzo de 2014 Submit

Parameter Query

Choose parameters:

Slug

3

4

Query Results

Select All Deselect All

	Id Point	Test Type	Id Test	Transmissivity	Storativity	Interpretation Method
✓	7580016	Bombeo Puntual	ENSBOMVBLE_B-03	14.1 m²/día		Theis
✓	7580016	Bombeo Puntual	ENSBOMVBLE_B-03	19.44 m²/día		Agotamiento
✓	7580016	Bombeo Puntual	ENSBOMVBLE_B-03	25.1 m²/día	0.000303	Cooper & Jacob III
✓	7580016	Bombeo Puntual	ENSBOMVBLE_B-03	26.2 m²/día		Theis & Jacob
✓	7580016	Bombeo Puntual	ENSBOMVBLE_B-03	27.9 m²/día	0.000227	Theis
✓	7580017	Bombeo Puntual	ENSBOMVBLE_B-05	10.5 m²/día		Theis Corregido
✓	7580017	Bombeo Puntual	ENSBOMVBLE_B-05	11.16 m²/día		Agotamiento
✓	7580017	Bombeo Puntual	ENSBOMVBLE_B-05	14.8 m²/día		Theis & Jacob
✓	7580017	Bombeo Puntual	ENSBOMVBLE_B-05	14.8 m²/día		Theis Corregido

Variables Map Report Rep Close

HHYH

P1 PUMP TOOL - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

BHD Size X Sections Permeability Tools Load Objects... HHYH 3D Analyst Create TIN From Features... Layer:

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Layers

- d:\Usuari\mis docum...
- Transmissivity_10
 - AverT
 - 5-366
 - 366-731
 - 731-1827.66
- D:\Usuari\Escritorio\pi...
- Hydrogeological_E

HHYH 10.0

Temporal Evolution Query Well Test Query Tracer Test Query HHYH

Parameter Map

Choose parameters

☐ Minimum ☐ Maximum ☒ Average ☒ Standard Deviation

Close Create

Query

Time Query

Choose your time interval

fecha ini: lunes, 01 de enero de 1900 fecha fin: miércoles, 12 de marzo de 2014 Submit

Parameter Query

Choose parameters:

Bombeo Puntual Slug Submit

Query Results

Select All Deselect All

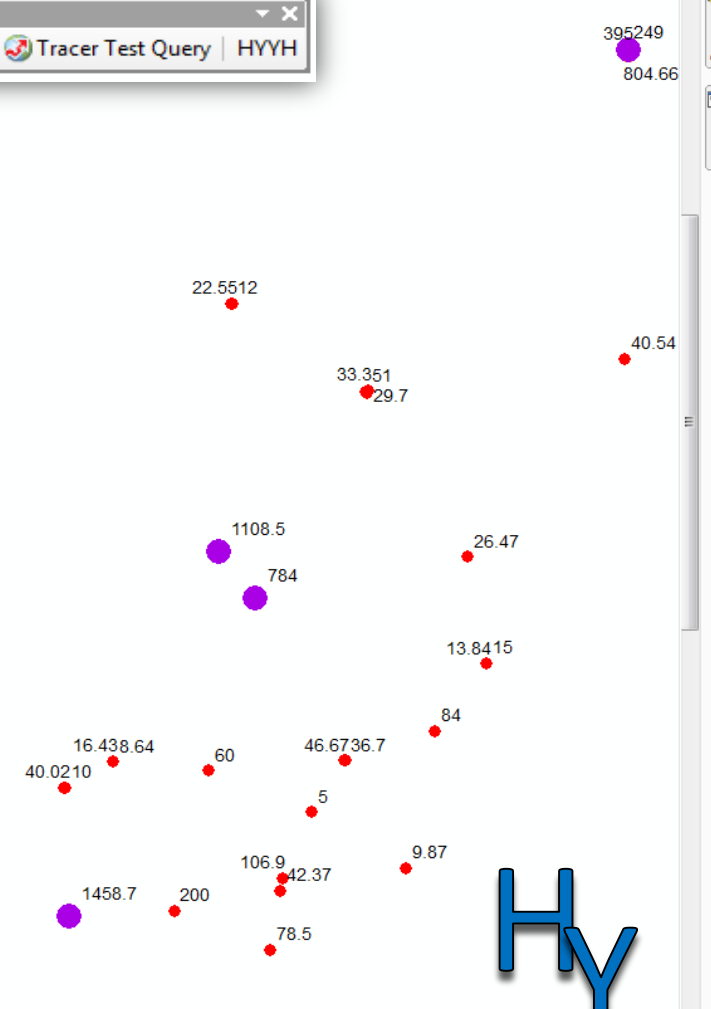
	Id Point	Test Type	Id Test	Transmissivity	Storativity	Interpretation Method
☒	7580014	Bombeo Puntual	ENSBOMCTE_B...	18 m ² /día		Theis
☒	7580014	Bombeo Puntual	ENSBOMCTE_B...	21.7 m ² /día		Theis & Jacob
☒	7580014	Bombeo Puntual	ENSBOMCTE_B...	25.3 m ² /día	0.00209	Cooper & Jacob
☒	7580014	Bombeo Puntual	ENSBOMCTE_B...	27.37 m ² /día		Agotamiento
☒	7580014	Bombeo Puntual	ENSBOMCTE_B...	28.4 m ² /día	0.00214	Theis
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	36.8 m ² /día		Theis & Jacob
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	38 m ² /día		Theis
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	39.7 m ² /día	0.000808	Cooper & Jacob
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	39.7 m ² /día	0.000815	Cooper & Jacob
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	39.7 m ² /día	0.000839	Theis
☒	7580015	Bombeo Puntual	ENSBOMVBLE_...	46.22 m ² /día		Agotamiento

Variables Map Export Excel Report Close

Consulta de los valores medios de transmisividad (m³/día)

Pisa, 21th April

533954.414 7531846.723 Unknown Units




3.4. Hydrogeological analysis tools HYYH idæa



P1 PUMP TOOL - ArcMap - ArcInfo

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

BHD Size X Sections Permeability Tools Load Objects...

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Layers

D:\Usuari\Mis documentos\ArcGIS\HydroC

Hydrogeological_Elements

DB_Points

HYYH 10.0

Temporal Evolution Query Well Test Query **Tracer Test Query** HYYH

Export to MJ-Pumpit

Parameter Query

Choose Test Type:

Slug Bombeo Puntual

> < >> << Submit

Query Results

Select All Deselect All

	Test	Test Type	Test Begin	Test End	Observation Points	Interpretation
☒	BANK	Bombeo Puntual	21/01/1997 11:30	21/01/1997 15:00	4	☒
☒	CINESA	Bombeo Puntual	08/01/1997 11:00	08/01/1997 13:30	2	☐
☒	COBEGA	Bombeo Puntual	24/01/1997 9:45	24/01/1997 13:50	1	☒
☒	MAGORIA	Bombeo Puntual	19/12/1996 12:30	19/12/1996 14:29	1	☒
☒	MANS1	Bombeo Puntual	18/08/2006 12:00	24/08/2006 13:33	2	☒
☒	MANS2	Bombeo Puntual	09/10/2006 14:00	10/10/2006 14:00	2	☒
☒	MANSO	Bombeo Puntual	16/12/1996 8:40	16/12/1996 15:33	1	☒
☒	MANSO	Bombeo Puntual	16/12/1996 8:40	16/12/1996 15:35	1	☒
☒	QUIRON	Bombeo Puntual	23/12/1996 10:00	23/12/1996 15:56	1	☐
☒	VAQUERS	Bombeo Puntual	23/01/1997 9:30	23/01/1997 10:28	3	☒
☒	QUIRON2	Bombeo Puntual	15/02/2001 9:00	18/02/2001 18:00	2	☐

Export! Close

MJ-PUMPIT v2.0 (2013)

Pumping Test Automatic Calibration

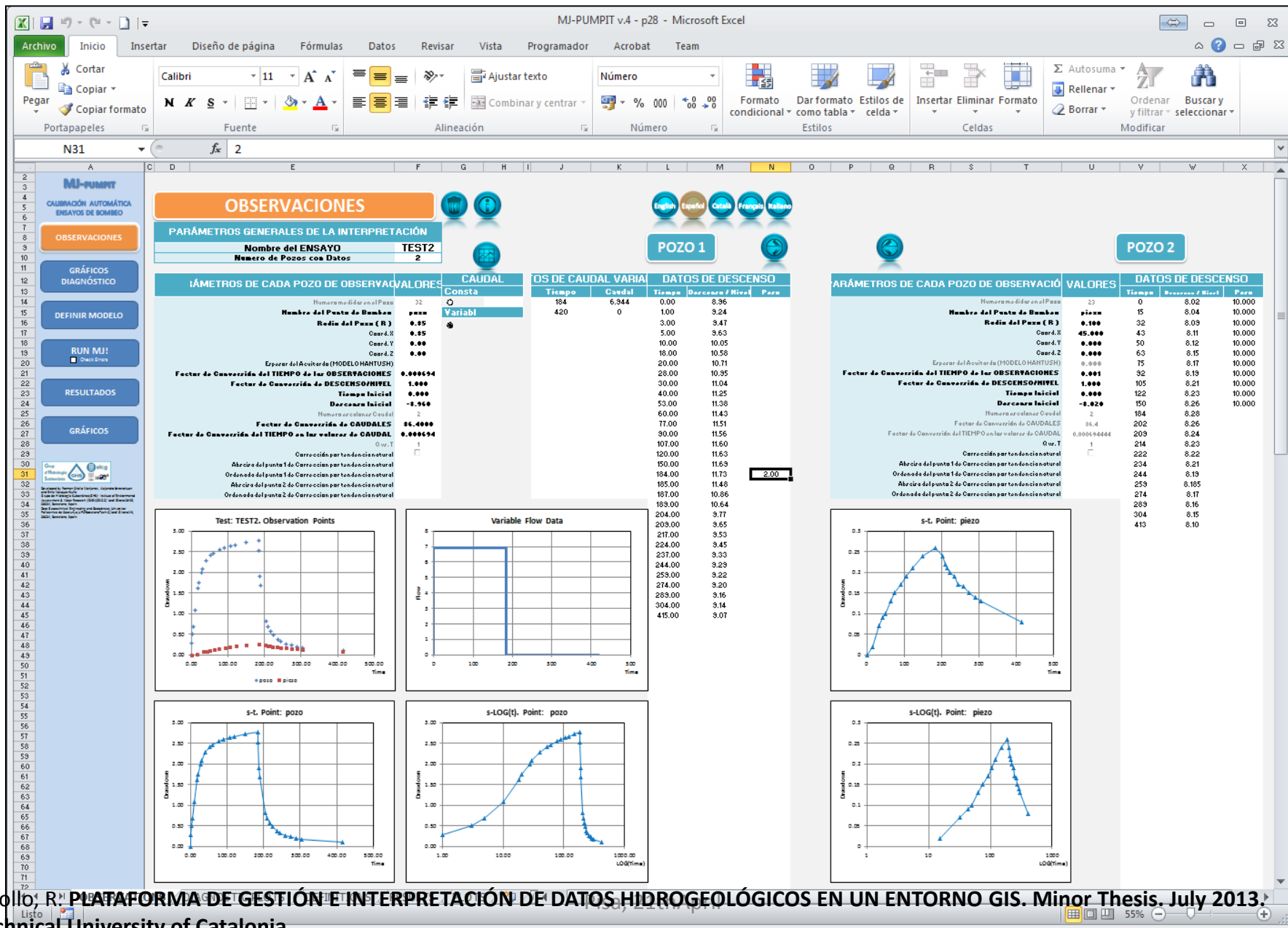
Input and output pumping test data for Maria_J_V software (Pumping Test Automatic Calibration, 1997) by José Alberto Carbonell, Alfredo Pérez Aparicio, Jesús Carrera Ramírez

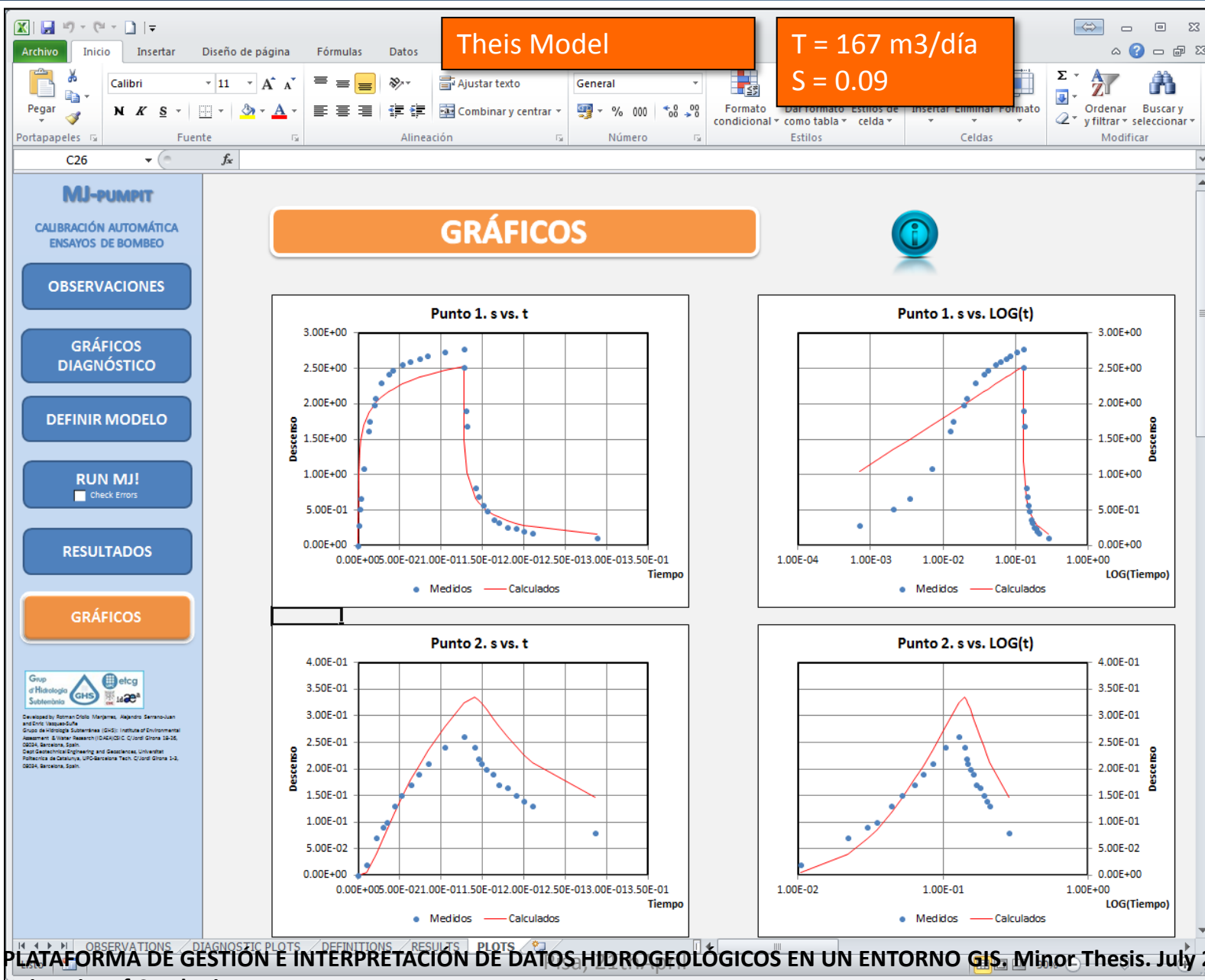
Rolman A. Criollo Manjarez, Alejandro Serrano-Juan, Enric Vazquez-Suñe

www.htages.upc.edu

528169.604 7523286.464 Unknown Units

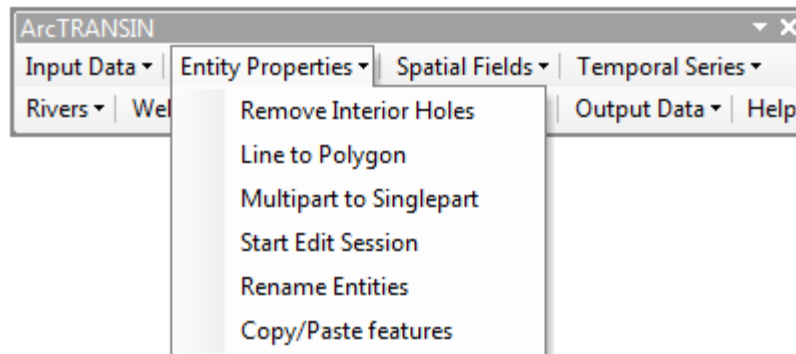
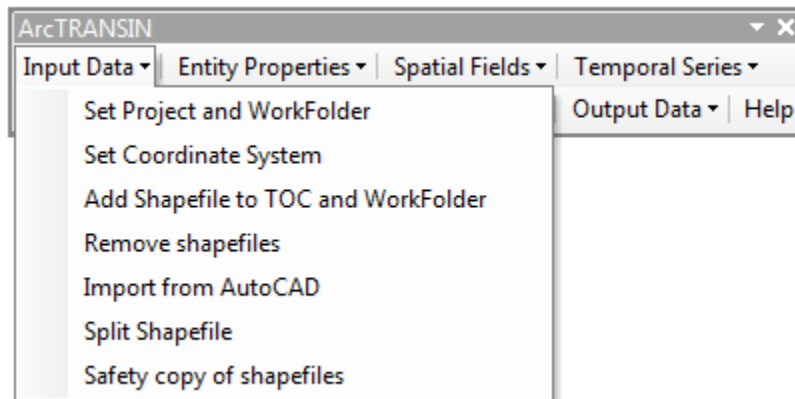
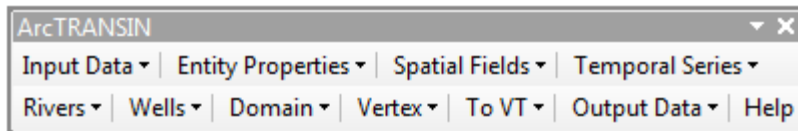
HYY





3.5. Link to hydrogeological modeling ArcTransin

3.5. Link to hydrogeological modeling ArcTransin



Attributes of geologia_SimplifyPolygon300

FID	Shape *	Entity	Handle	Layer	LyrFrzn	LyrI
0	Polygon	Insert	3B08	0	0	
1	Polygon	Insert	3B1A	0	0	
2	Polygon	Insert	3B20	0	0	

Record: 1 Show: All Selected



Maria del Mar Garcia Alcaraz

Pisa, 21thApril

- This GIS-based software platform offers a **user friendly GIS environment** that arranges all the available hydrogeological data into a coherent structure and provides support for its proper management, analysis, interpretation, pre and post-processing for modelling.
- The **geospatial database HYDOR** allows us to store and integrate data for the majority of geological and hydrogeological studies.
- The **introduction of data is facilitated** by alternative utilities such as intermediate tables, inherent GIS wizards and assisting menus following a pre-established entry protocol.
- Despite the large amount of data that can be stored, their **consultation is simple** by using the GIS-tools (HEROS, QUIMET and HYYH).

- **Some of these functionalities will be implemented in FREEWAT platform!!!**
- **The interpreted data and calculations** can be easily stored and consulted in the same platform. Thus, each model study does not have to start from scratch.
- This software platform offers **interoperability** with external software for subsequent analyses of hydrogeological data such as hydrochemical packages like MJPUMPIT, MIX and EASYQUIM, pre-processor package such as GID and Hydrogeological modelling software such as Visual Transin.

Thank you for your attention!

