

FREEWAT

Free and Open Source Software Tools for Water Resource Management

EU HORIZON 2020 Project

FREE and Open Source Software Tools for WATer Resource Management

FREEWAT User Manual

Volume 4

AkvaGIS (Hydrochemical Analysis Tools and Hydrogeological Analysis Tools)

by ***Alejandro Serrano[(1)] , Rotman Criollo[(1)], Violeta Velasco[(1)], Celia Riera[(1)] and Enric Vàzquez-Suñé[(1)]***

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This version is confidential, only for FREEWAT Project Partners



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 642224

FOREWORD

FREEWAT is an HORIZON 2020 project financed by the EU Commission under the call WATER INNOVATION: BOOSTING ITS VALUE FOR EUROPE. FREEWAT main result is an open source and public domain GIS-integrated modeling environment for the simulation of water quantity and quality in surface water and groundwater with an integrated water management and planning module. Specific objectives of the FREEWAT project are: to coordinate previous EU and national funded research to integrate existing software modules for water management in a single environment into the GIS-based FREEWAT platform and to support the FREEWAT application in an innovative participatory approach, gathering technical staff and relevant stakeholders in designing scenarios for the proper application of water policies.
The open source characteristics of the platform allow to consider this an initiative "ad includendum", as further research institutions, private developers etc. may contribute to the platform development. Capabilities integrated in FREEWAT are:

- a dedicated module for water management and planning;
- a whole module for calibration, uncertainty and sensitivity analysis;
- a module for solute transport in the unsaturated zone;
- a module for crop growth and rural water management;
- a module dedicated to time-series processing to support advanced model calibration;
- tools for dealing with groundwater quality issues;
- tools for the analysis, interpretation and visualization of hydrogeological data.

FREEWAT Development has received funding from the following projects:

1. Hydrological part has been developed starting from a former project, named SID&GRID, funded by Regione Toscana through EU POR-FSE 2007-2013 (sidgrid.isti.cnr.it).
2. Porting of SID&GRID under QGIS has been performed through funds provided by Regione Toscana to Scuola Superiore S.Anna - Project Evoluzione del sistema open source SID&GRID di elaborazione dei dati geografici vettoriali e raster per il porting negli ambienti QGIS e Spatialite in uso presso la Regione Toscana (CIG: ZA50E4058A)
3. Saturated zone solute transport simulation capability has been developed within the EU FP7-ENV-2013-WATER-INNO-DEMO MARSOL. MARSOL project receives funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement n. 619120 (www.marsol.eu)
4. The previous codes have been integrated into FREEWAT under development within EU H2020 project FREEWAT - Free and Open Source Software Tools for Water Resource Management. FREEWAT project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n. 642224 (www.freewat.eu)
This User Manual provides guidelines to properly install and use the FREEWAT plugin.

***Project Coordinator**:*
Rudy Rossetto, Istituto di Scienze della Vita – Scuola Superiore Sant'Anna, Via S. Cecilia 3, 56127 Pisa.
Capabilities of the FREEWAT platform were tested either by the developers group and by Project Partners. However, future applications of the platform may reveal errors and drawbacks not detected to date. Users are kindly requested to notify any error in both platform and User Manual. Please send this info to: rudy.rossetto@sssup.it

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***Text editing**:*
Giovanna De Filippis(2), Matteo Ghetta(2)

***Affiliation**:*
(1) Institute of Environmental Assessment and Water Research (IDÆA)
(2) Istituto di Scienze della Vita – Scuola Superiore Sant'Anna, Pisa (IT)

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Abstract

The main goal of this set of tools is to provide FREEWAT with different instruments to analyze and interpret the hydrochemical and other hydrogeological data. This set of tools (AkvaGIS) perfectly integrated in the platform FREEWAT can be divided into two modules:

1. Tools for the hydrochemical analysis and interpretation.
2. Hydrogeological analysis and interpretation tools.

The first module includes different instruments to improve the management, analysis, calculations and interpretations of hydrochemical data. The instruments for analysis cover a wide range of methodologies for querying, interpreting, and comparing groundwater quality data. They include, among others, ionic balance calculations, chemical time-series analysis, correlation of chemical parameters, and calculation of various common hydrogeochemical diagrams (Salinity, Schöeller-Berkaloff, Piper, and Stiff). Furthermore, it allow the generation of maps of the spatial distributions of parameters and diagrams and thematic maps for the parameters measured in the queried area and classified according to the threshold approach established by a given guideline, e.g. WFD. Moreover offer interoperability with external free codes (e.g. EASYQUIM, MIX or Statistical Tools) for performing further analysis such as calculations of mixing ratios or further statistical analysis. The second module is devoted to a better interpretation of the groundwater units, which in turn is crucial in modelling activities to define the conceptual model. It include tools to analyze and visualize different hydrogeological measurements. Thus, contour maps and further spatial operations and the depth or thickness of the hydrogeological units could be generated using customized queries. Likewise, thematic maps (e.g. piezometric maps, pumping rates) can be created for the selected points and for the selected period of time with another command included in this toolbar.

CHAPTER 1

Users Manual AkvaGIS

Toolbar

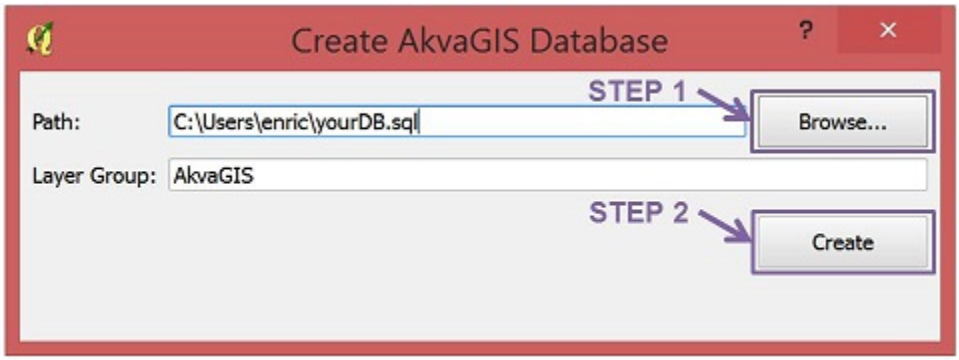


Database tools

Create AkvaGIS database

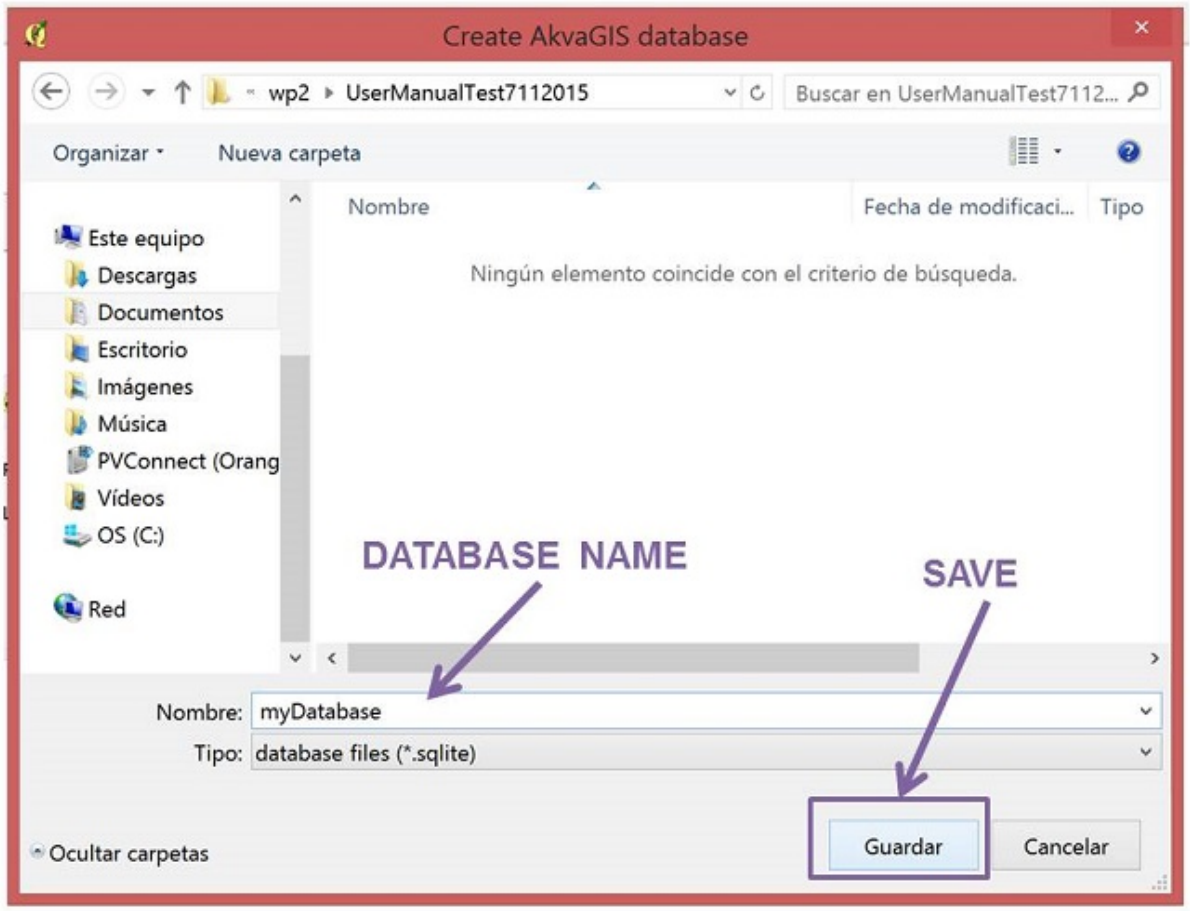


This command enable us to create a new AkvaGIS SpatiaLite database where the hydrochemical and the hydrogeological data will be introduced to be queried by AkvaGIS Analysis Tools.

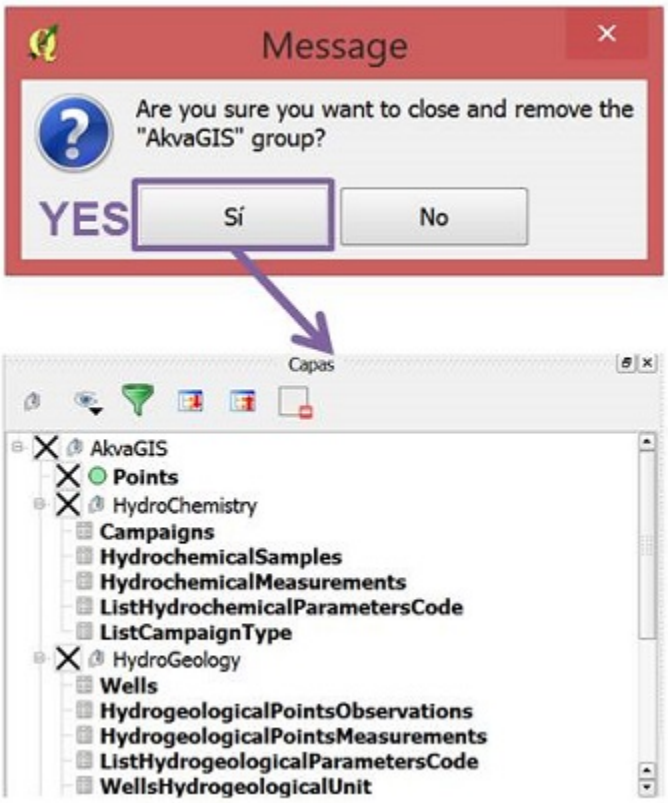


For further information about the AkvaGIS database, please read Chapter 4.

STEP 1 Select path in your computer where the database will be created.



STEP 2 Create new Database (empty) and it automatically will be loaded in QGIS.

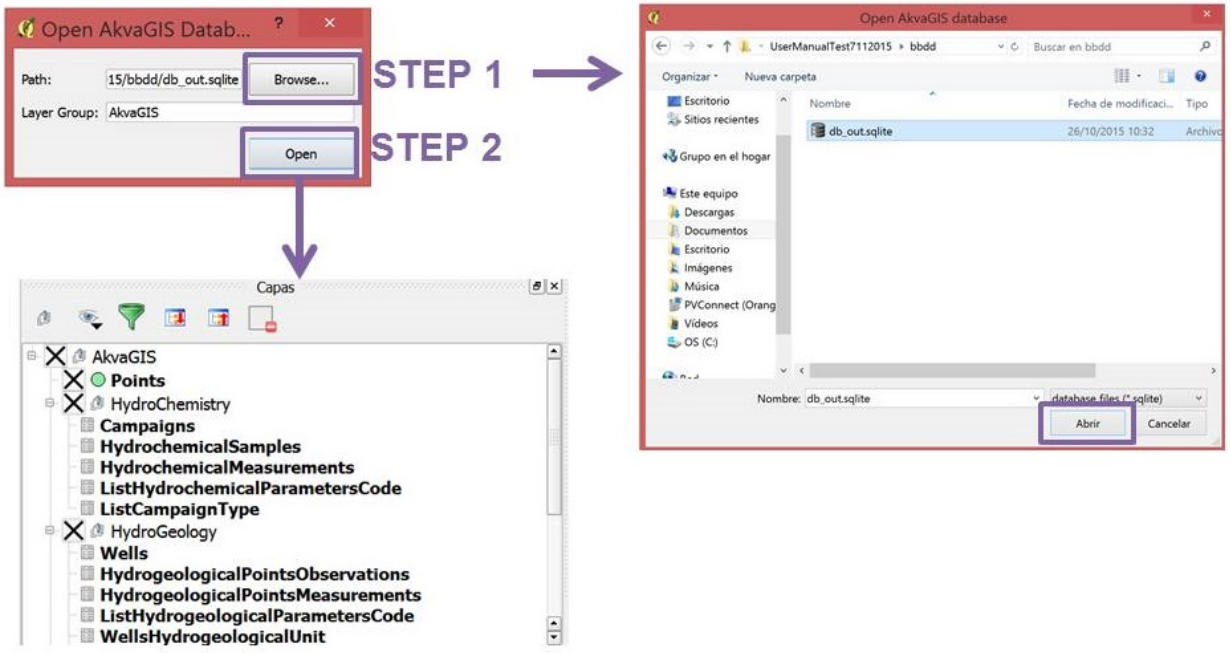


NOTE: For creating new geometric entities (e.g. Points) and entering data in the attribute tables the user can use the inbuilt utilities of QGIS (or SpatiaLite utilities). This database contains the required tables, geospatial entities as well as code lists to enable the user starting a new project from the scratch. Notice (see section 2.1) that the AkvaGIS toolbar include also a command composed by a GUI that facilitate the incorporation of hydrochemical data into the database.

Open AkvaGIS database

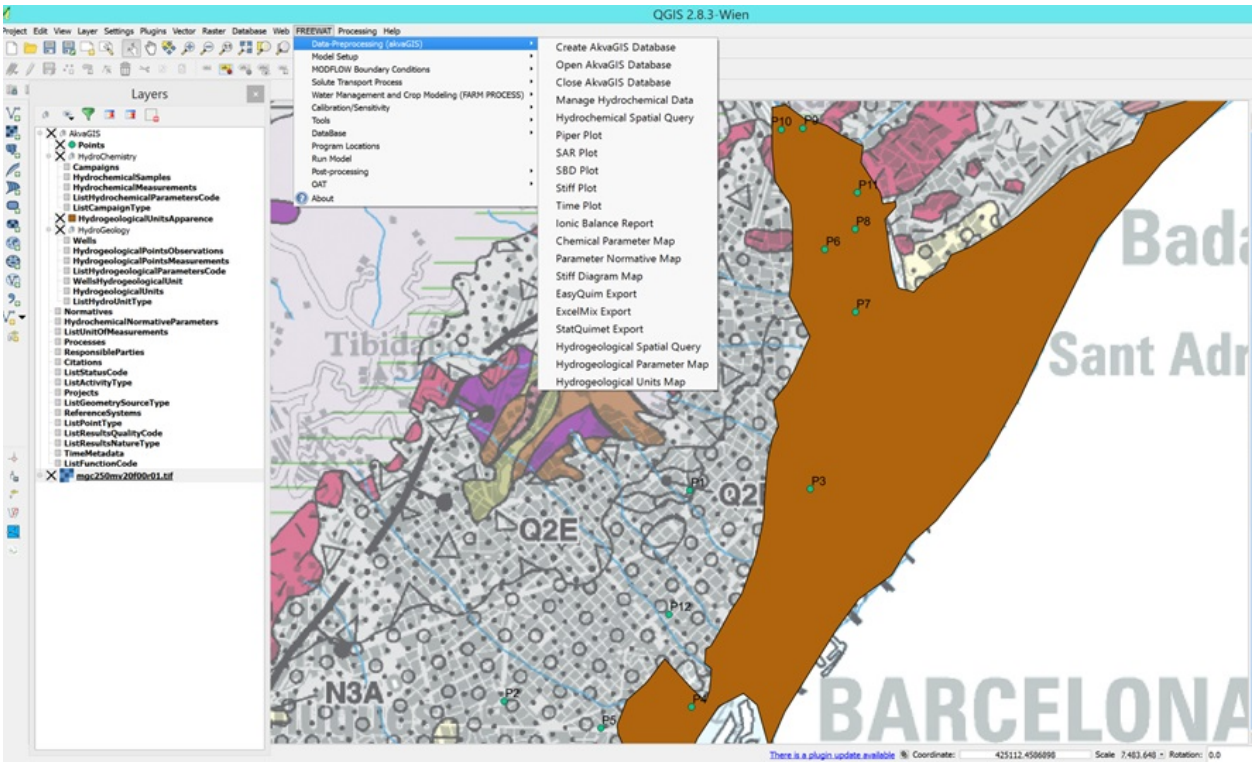


This command open an existing database.



STEP 1 Select path in your computer where the database is stored.

STEP 2 Automatically the main geometrical entities (Points and HydrogeologicalUnits) and the main attributes table will be shown in the Layers Panel.



The Points entities shown in the figure represent points where samples have been taken to be analysed or points where hydrogeological observations and measurements have been performed (for further information of the database, please see Chapter 4).

Close AkvaGIS database



Use this command to close and remove the opened database.



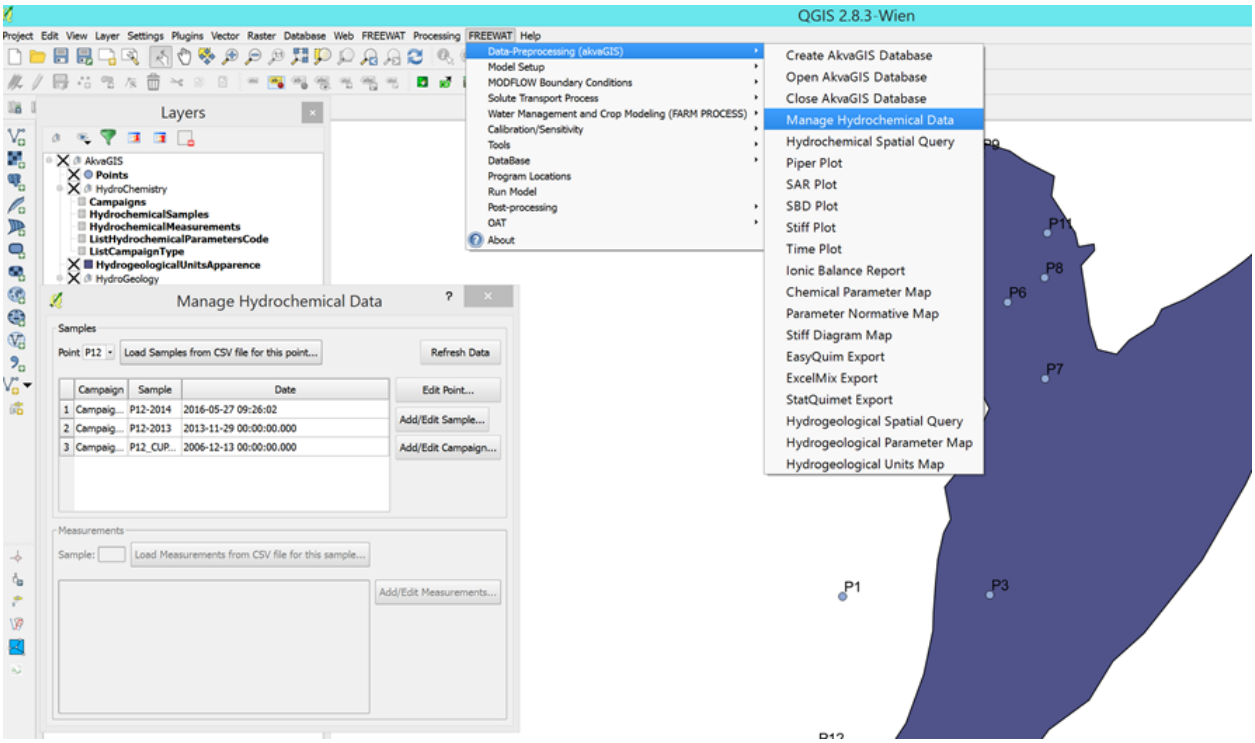
CHAPTER 2

Hydrochemical analysis tools

Manage Hydrochemical Data

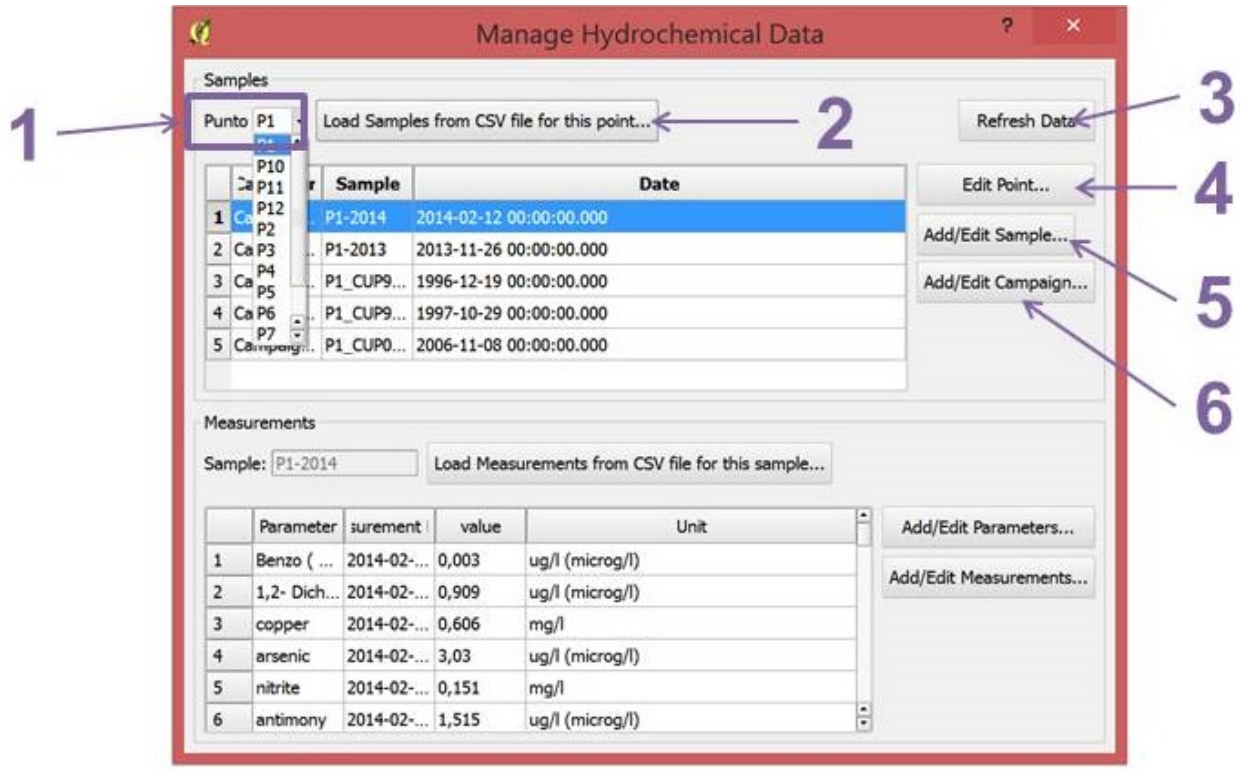


This utility enables e user canthe user to modify, insert and visualize hydrochemical data from existing points stored in the database.



STEP 1 Click on Manage Hydrochemical Data command and it opens automatically the management window GUI.

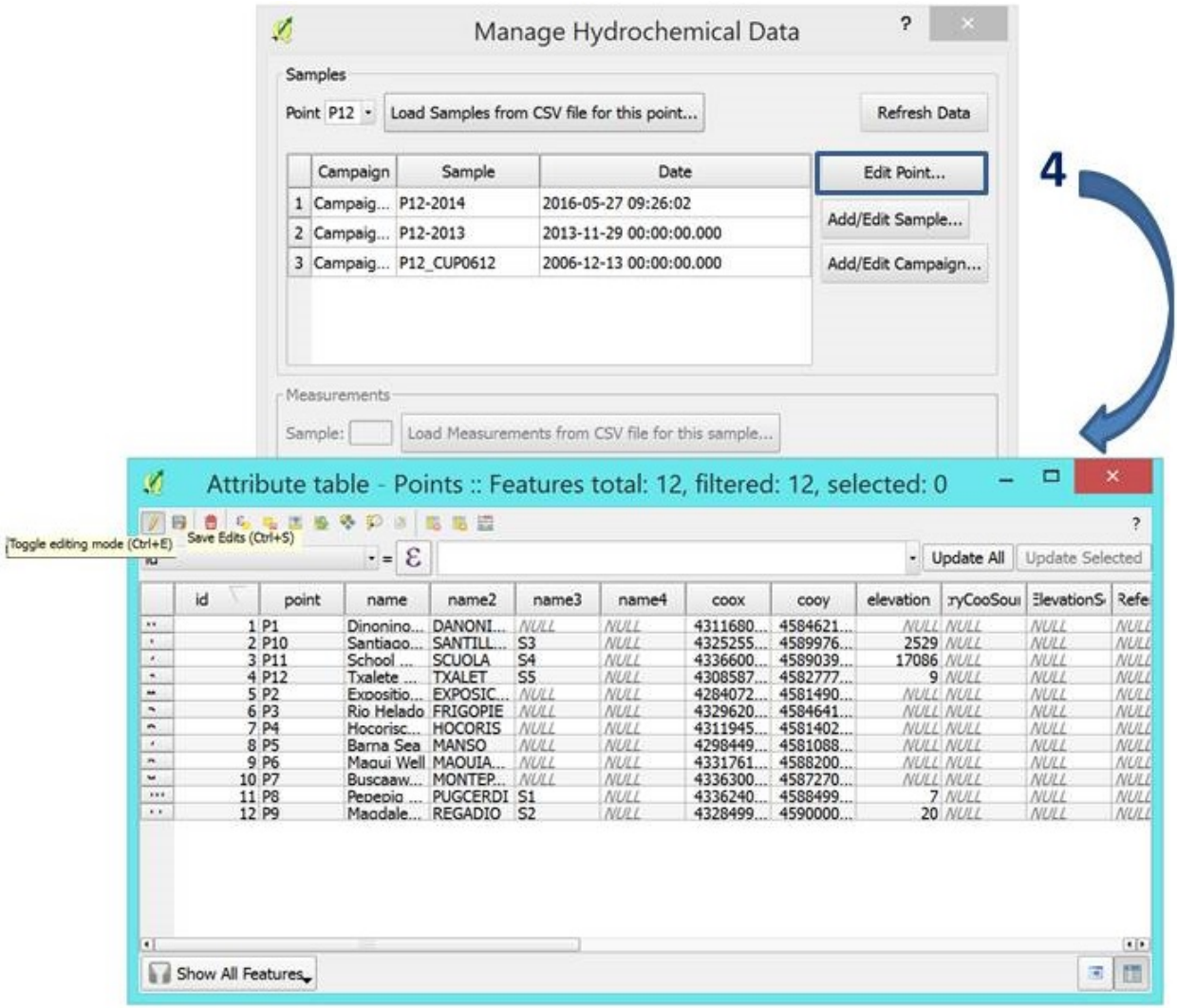
With this GUI, the user can: 1) edit the information of the sampling Points, 2) Add/edit Samples (one by one or massively using .csv files, 3) add/edit campaign, 4) add/edit Hydrochemical Measurements (one by one or massively for each selected sample using .cvs files). In the following paragraphs each of this utilities will be explained:



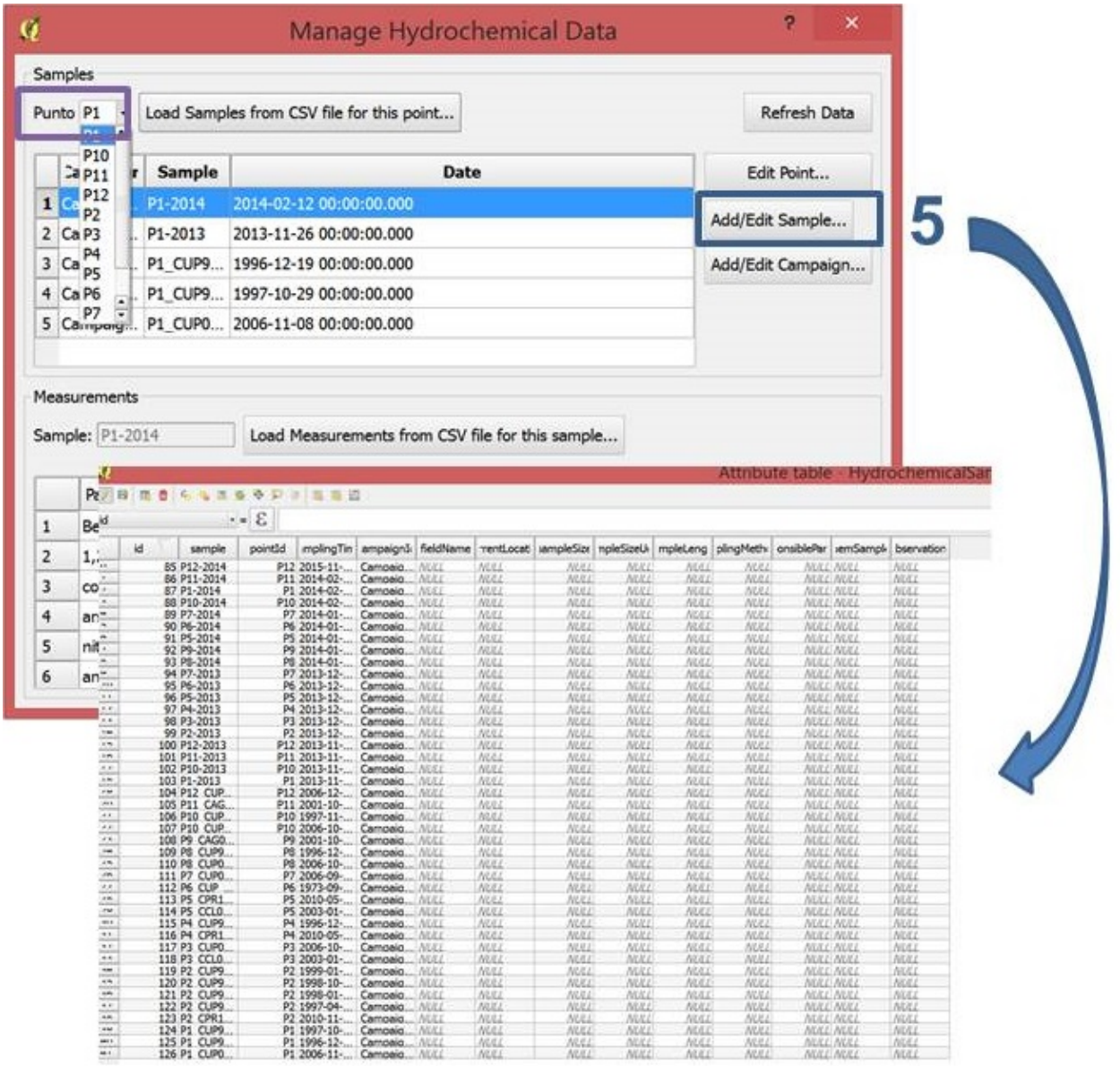
1. Click here for select the point that you want to modify/add a newsample/campaign/hydrochemical measurement.
2. here for adding samples to the selected point from CSV file.

   CVS File format: sample; samplingTime; campaignId; fieldname; currentLocation; sampleSize; sampleSizeUom; samleLenght; samplingMethodId; responsiblePartyId; otherChemSamplesDetails; observations. For further information about the contain of this table, please see Chapter 4.

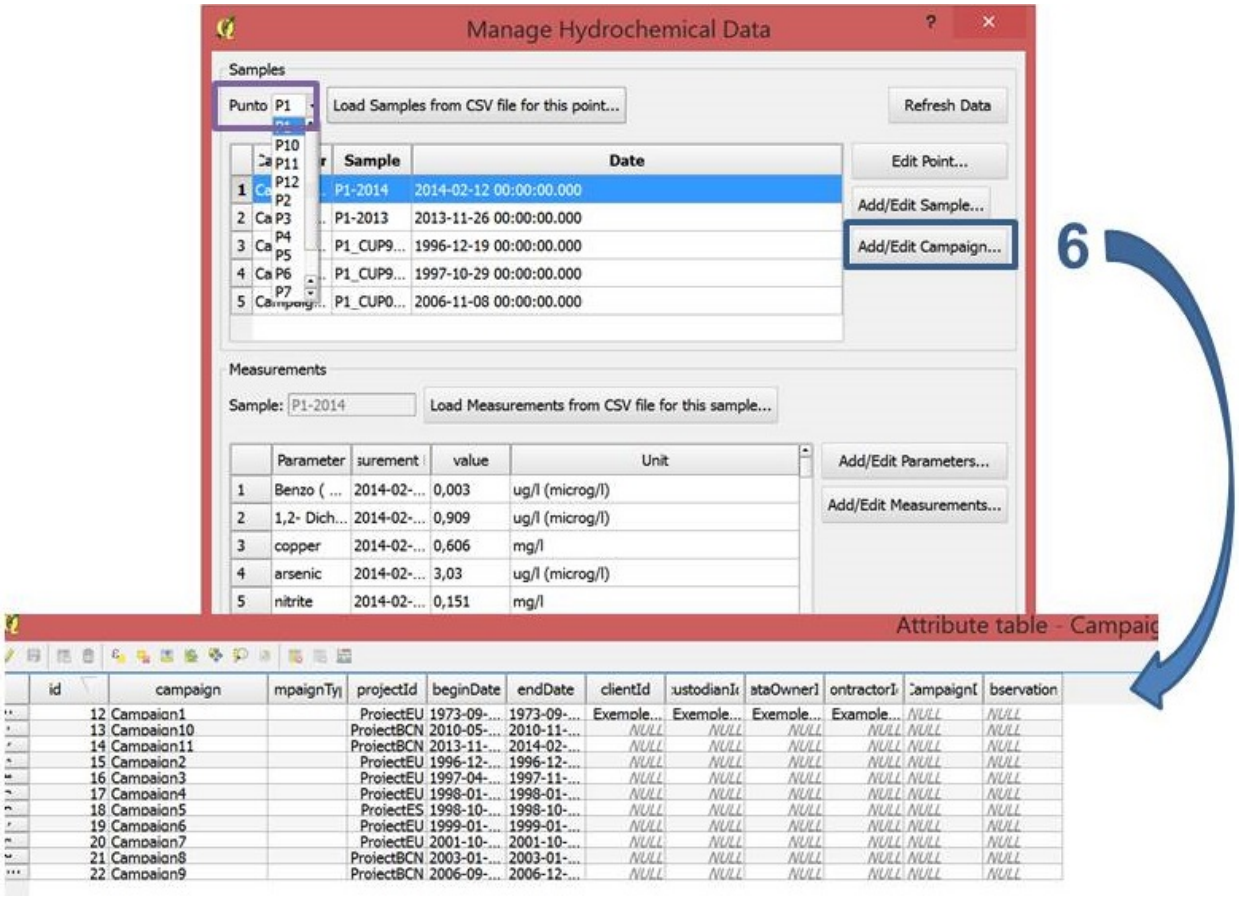
   Close AkvaGIS database.
3. Refresh Data button. This command enables us to visualize and update the editing or the new data included in the database. After **every** change in the database using this GUI, this command has to be used.



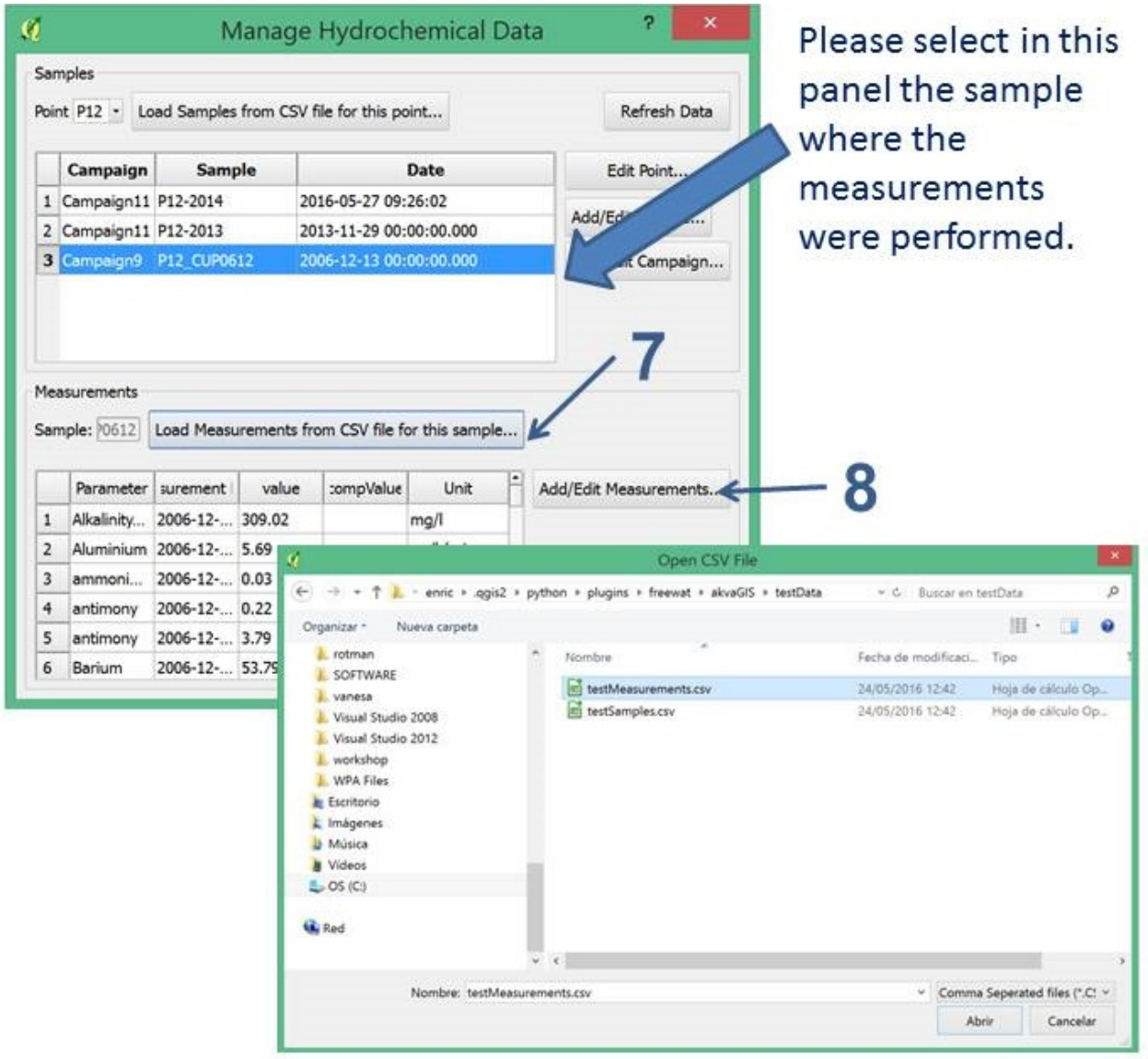
4. Click here for editing the information related to the Points of sampling. Please, notice that using this function the editing mode of QGIS will be automatically activated. After the required editions in the table, please use the command of save edits of QGIS.



5. Click here for adding/editing samples taken from the selected Points. Please, notice that using this function the editing mode of QGIS will be automatically activated. After the required editions in the table, please use the command of save edits of QGIS.



6. Click here for adding/ editing campaign information from the selected Points.



7. This command allows us to include into the database massively the different hydrochemical measurements performed for the selected sample for the selected point using a CVS file.

   CVS file format: hydrochemicalParameterCode; resultTime; value; compValue; responsiblePartyId; processId; citationId; otherChemMeasurementsDetails; observations. For further information about the contain of this table, please see Chapter 4.

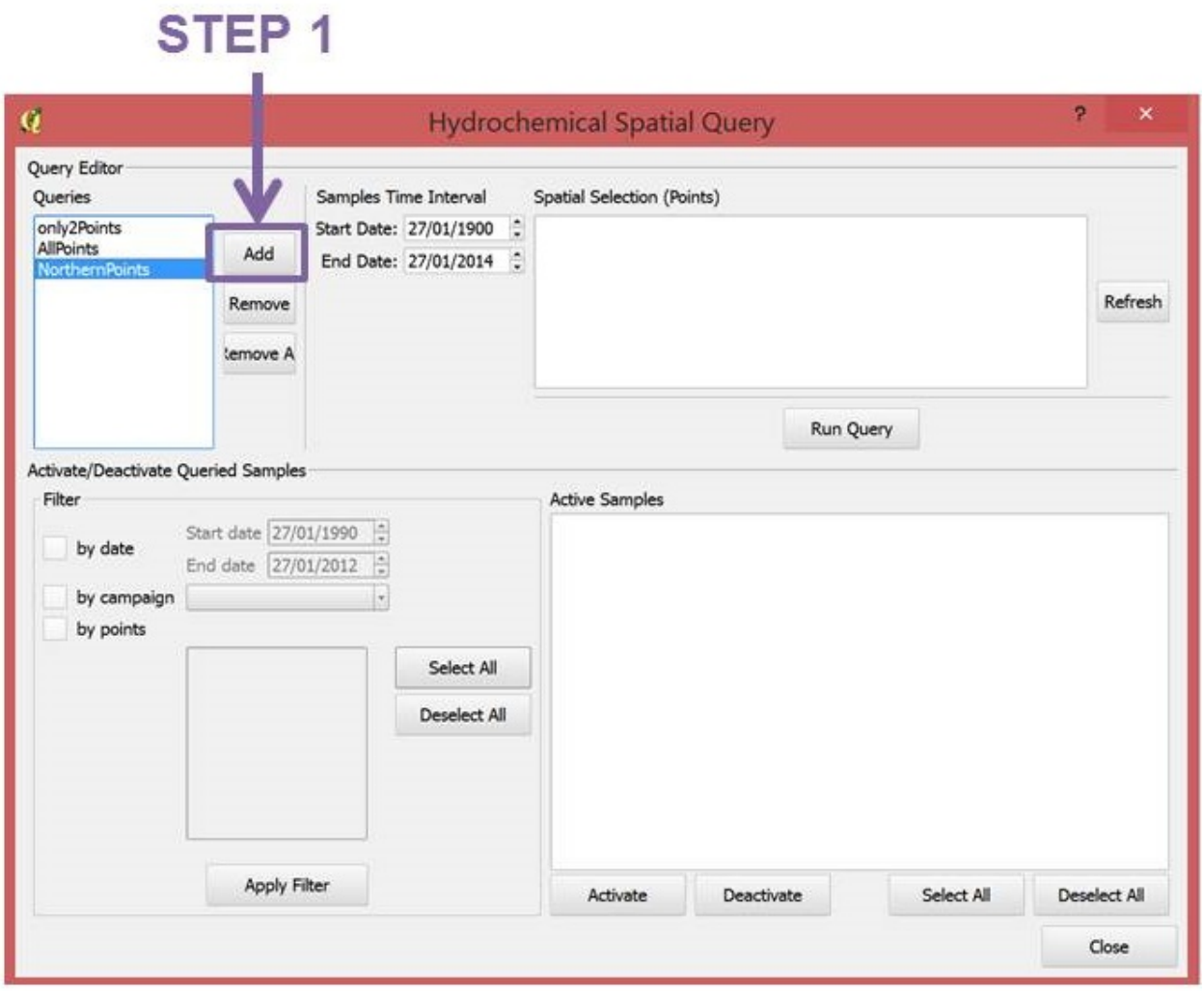
8. Click! here for adding/ editing measurements.

Hydrochemical Spatial Query



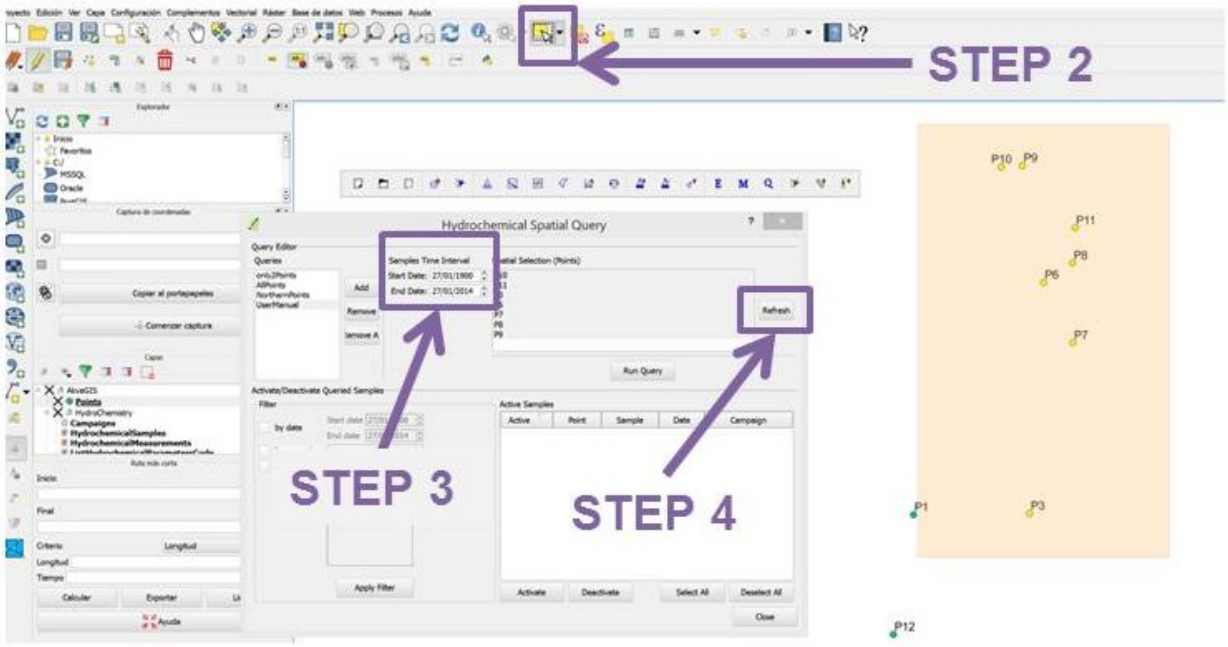
This command enable us to create a query for the selected point or set of points on the screen that represents sampling sites (Points). Thereafter, the user select other query criteria such us period of time of sampling or campaigns.

The Hydrochemical Spatial Query created by the user can be stored in the database to the other hydrochemical tools (e.g. piper, stiff, ionic mass balance, etc.) included in akvaGIS toolbar.



STEP 1 Add a newQuery.

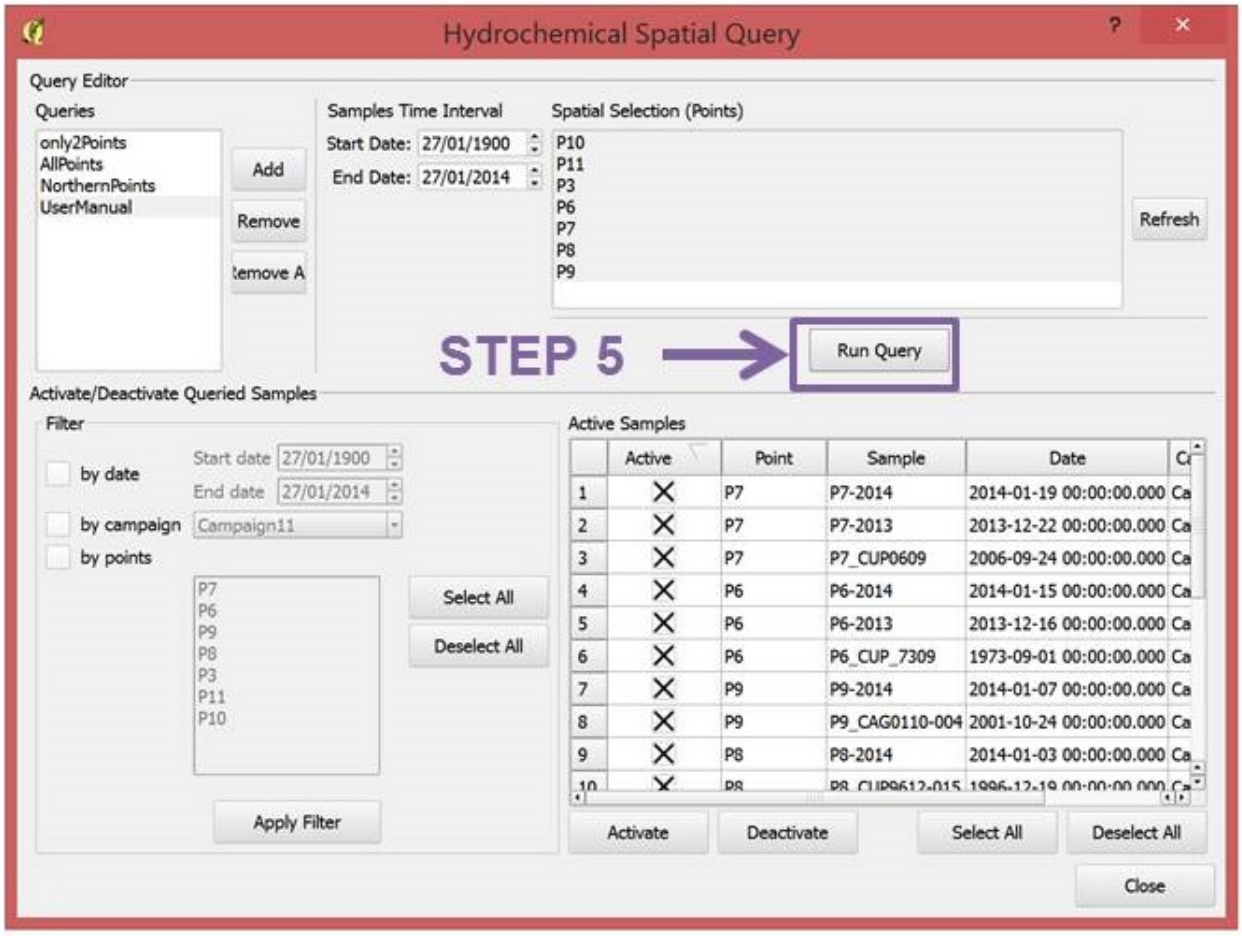
Use this command to create and add to the database a new query of the selected sampling points (spatial selection) for the desired time interval. Also campaign can be used as a query criteria. Thus, hydrochemical tools can be applied to the queries stored in the database or it can be used in future analysis. Using the command Remove, the selected Query can be deleted from the database and using Remove All, all the queries stored in the database will be deleted.



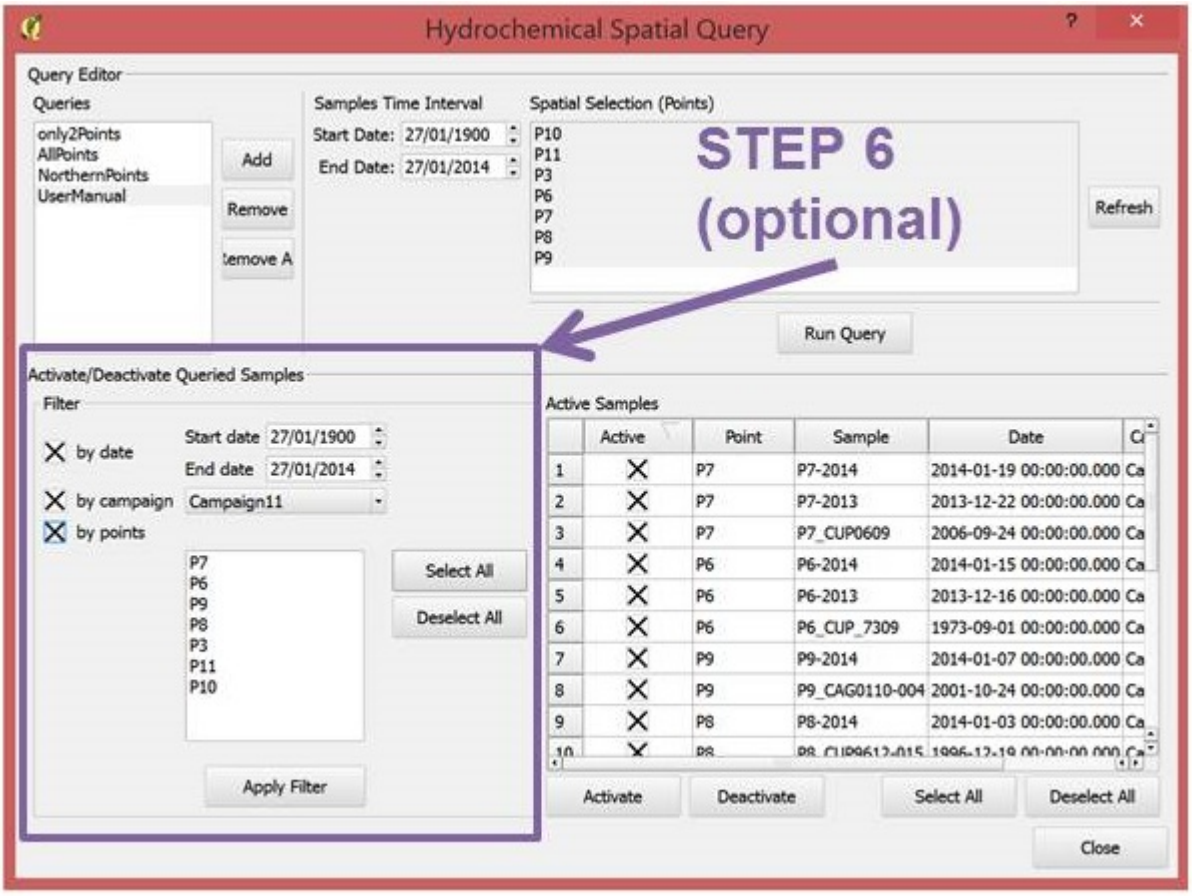
STEP 2 Select (using inbuilt tools of QGIS) the points to be included in the query on the screen.

STEP 3 Select the desired time interval to be queried.

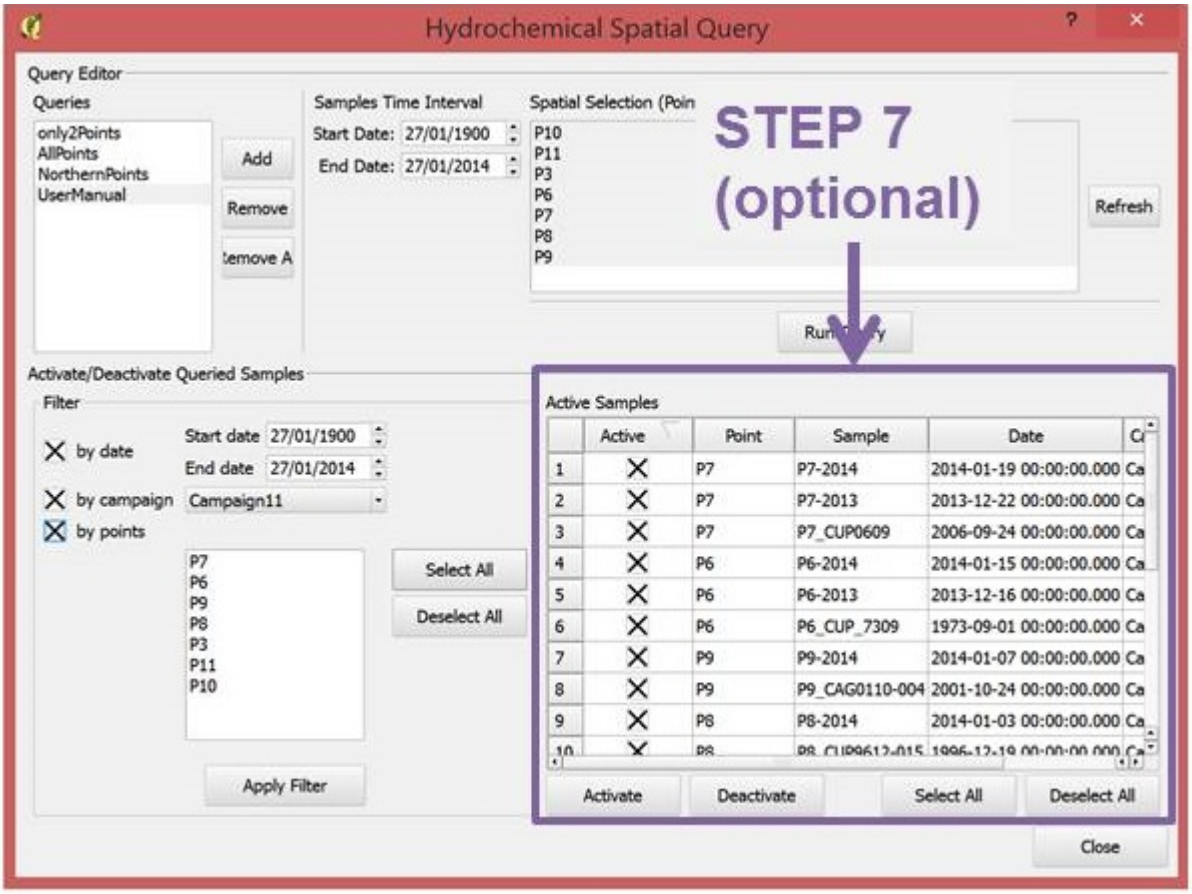
STEP 4 Refresh for visualize the new query.



STEP 5 Run Query.



STEP 6 (optional) Filter chosen any available query criteria (by date, by campaign or by points).



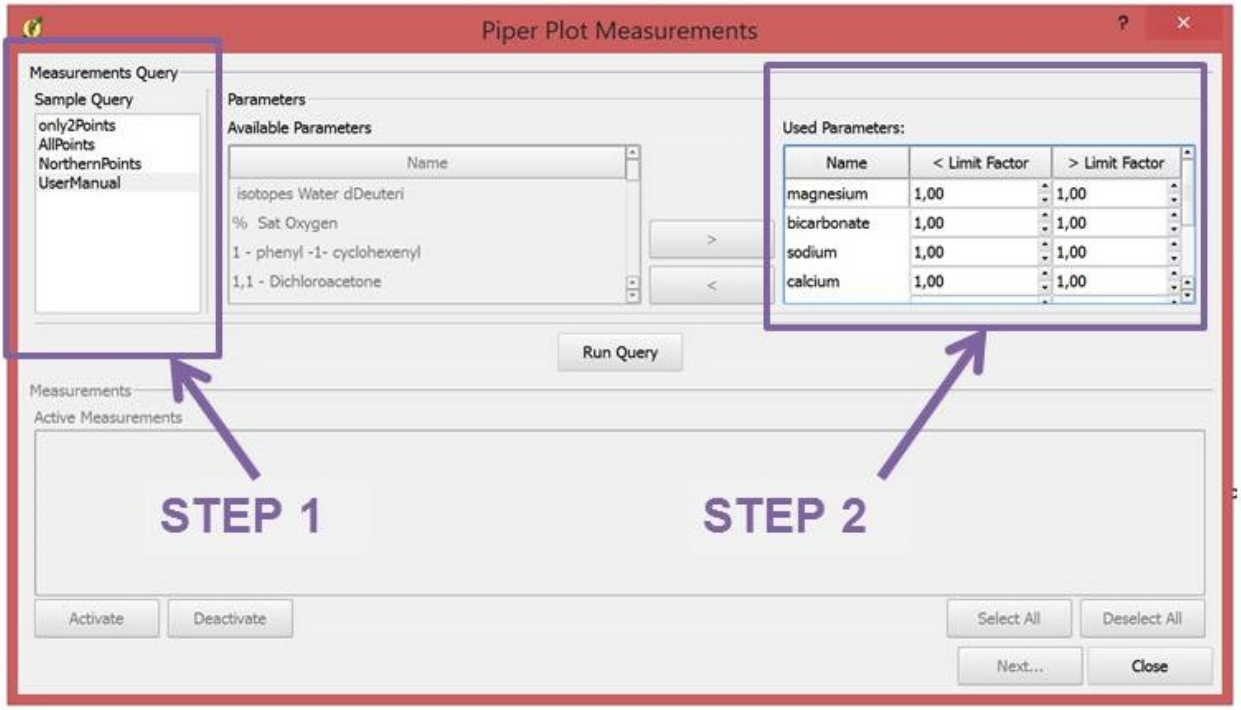
STEP 7 (optional) Activate/Deactivate the desired samples to be included in the query. For activate/deactivate please, select the row (also select all/deselect all).

Finally, click in close button to close the query form.

Piper Plot

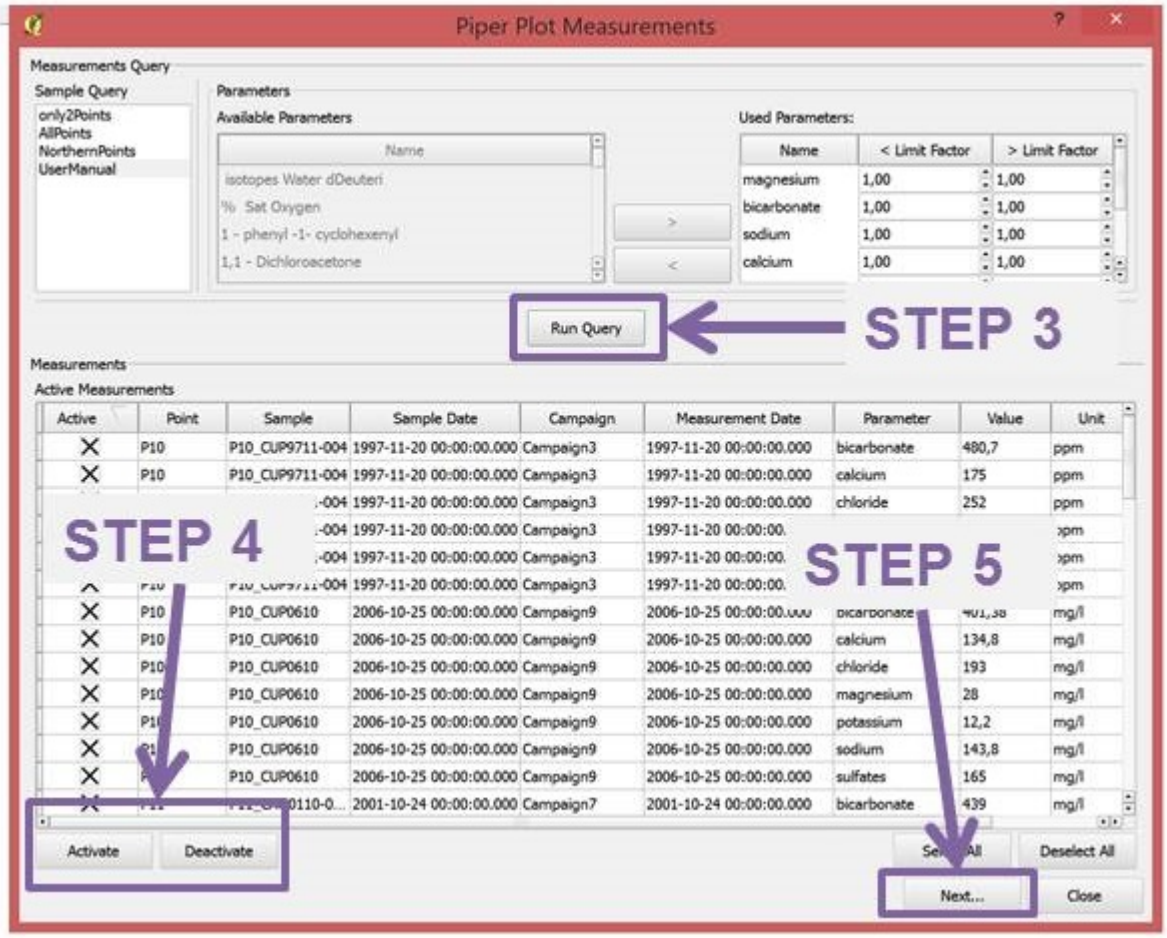


Use this command to create automatically Piper Plots for the selected query created previously with the Hydrochemical Spatial Query tool (section 2.2). This diagram will be created only if the measurements required for the creation of this diagram are available.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

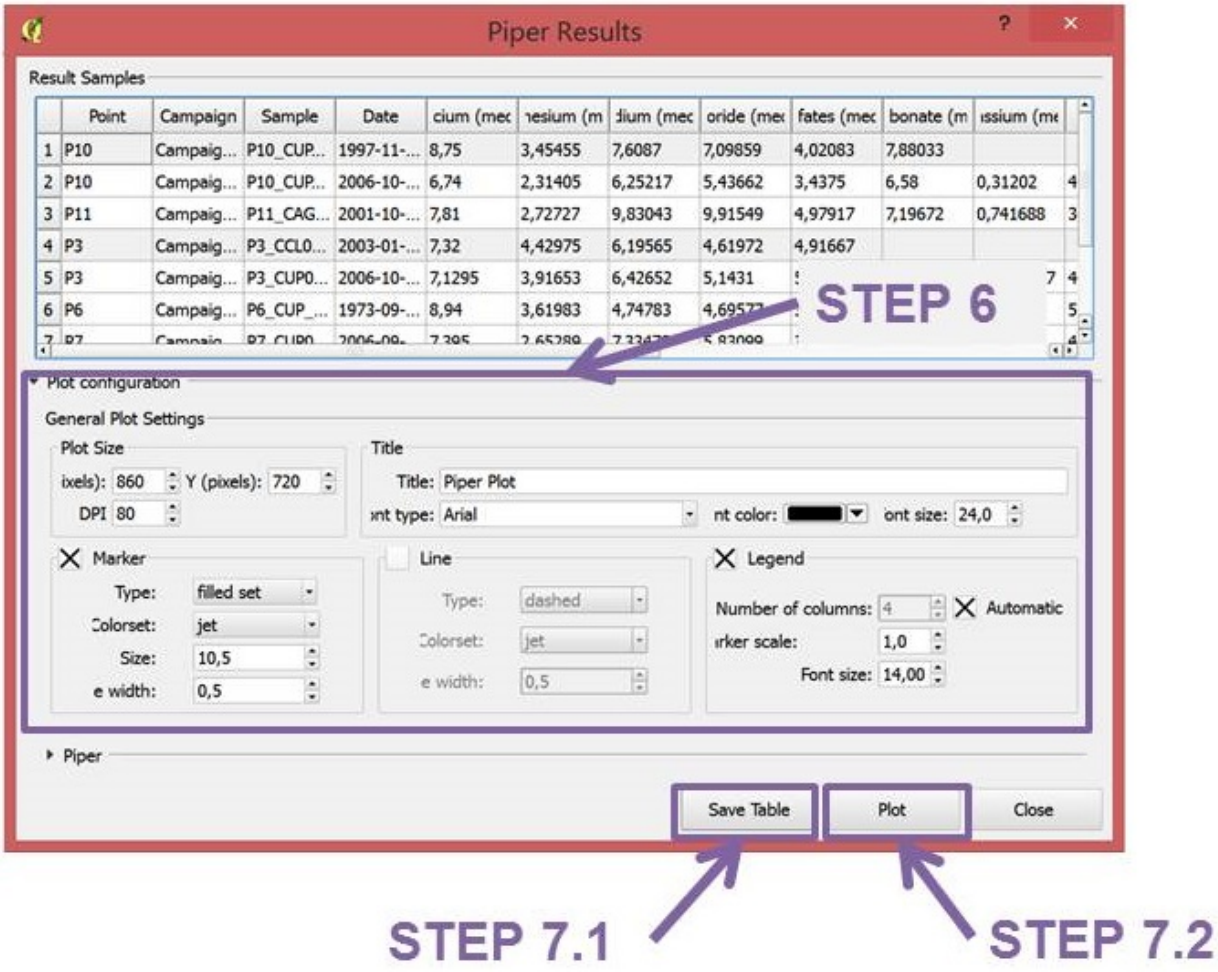
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



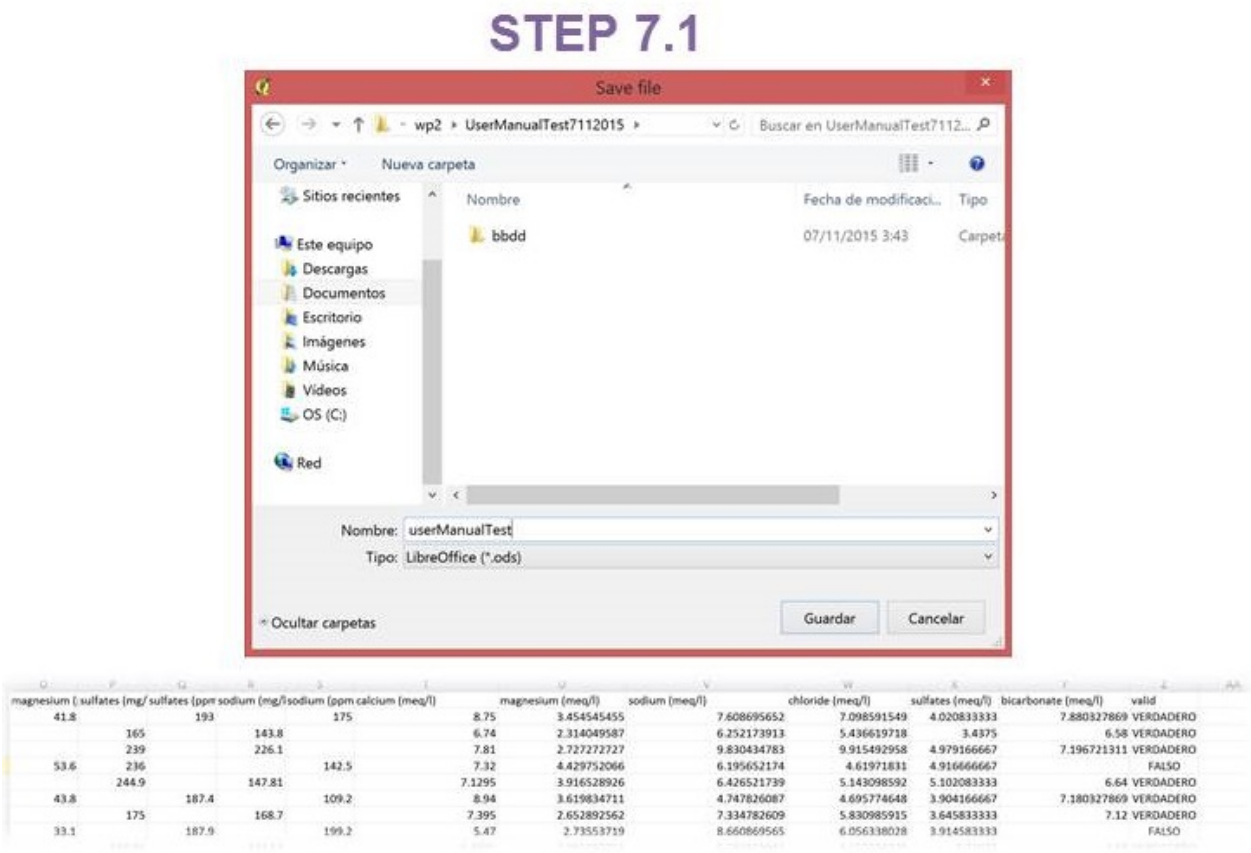
STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the selected measurements.

STEP 5 Click Next.

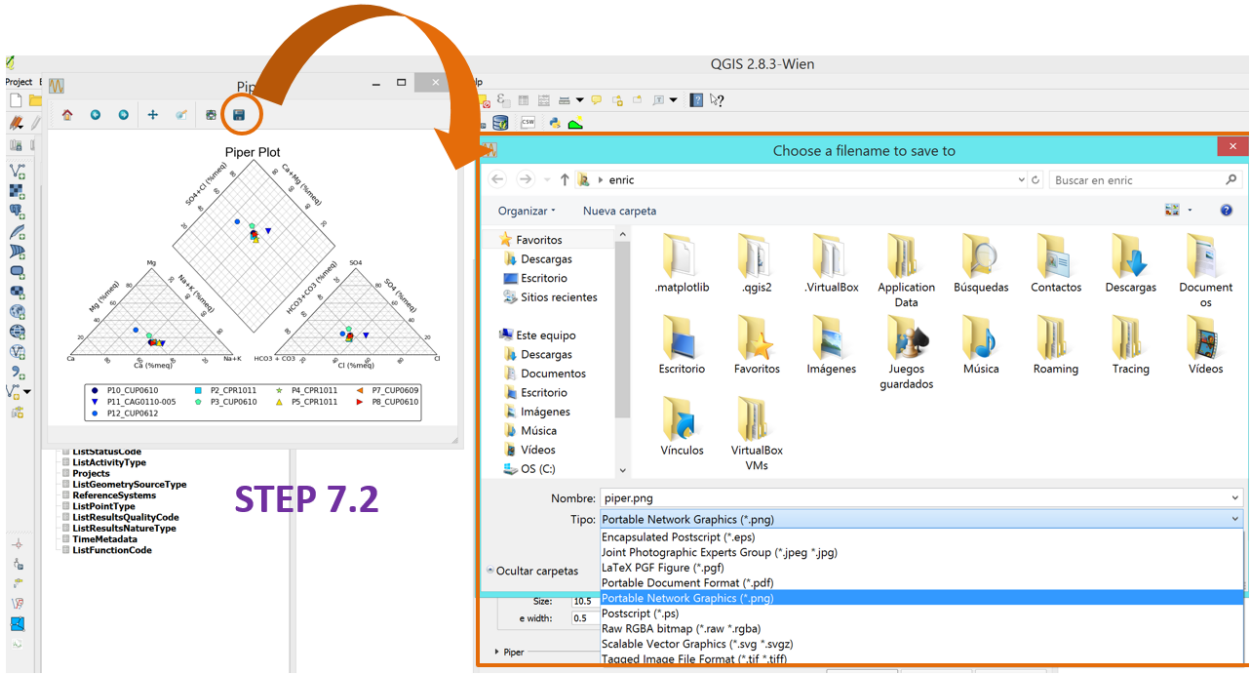


STEP 6 Plot configuration.Choose the plot size, title, markerstyle, legend, etc.



magnesium (	sulfates (mg/	sulfates (ppm	sodium (mg/l	sodium (ppm	calcium (meq/l)	magnesium (meq/l)	sodium (meq/l)	chloride (meq/l)	sulfates (meq/l)	bicarbonate (meq/l)	valid
41.8		193		175	8.75	3.454545455		7.608695652	7.098591549	4.020833333	7.880327869 VERDADERO
	165		143.8		6.74	2.314049587		6.252173913	5.436619718	3.4375	6.58 VERDADERO
	239		226.1		7.81	2.727272727		9.830434783	9.915492958	4.979166667	7.196721311 VERDADERO
53.6	236			142.5	7.32	4.429752066		6.195652174	4.61971831	4.916666667	FALSO
	244.9		147.81		7.1295	3.916528926		6.426521739	5.143098592	5.102083333	6.64 VERDADERO
43.8		187.4		109.2	8.94	3.619834711		4.747826087	4.695774648	3.904166667	7.180327869 VERDADERO
	175		168.7		7.395	2.652892562		7.334782609	5.830985915	3.645833333	7.12 VERDADERO
33.1		187.9		199.2	5.47	2.733553719		8.660869565	6.056338028	3.914583333	FALSO

STEP 7.1 Save Piper query results in different formats (e.g. csv, ods, etc.).

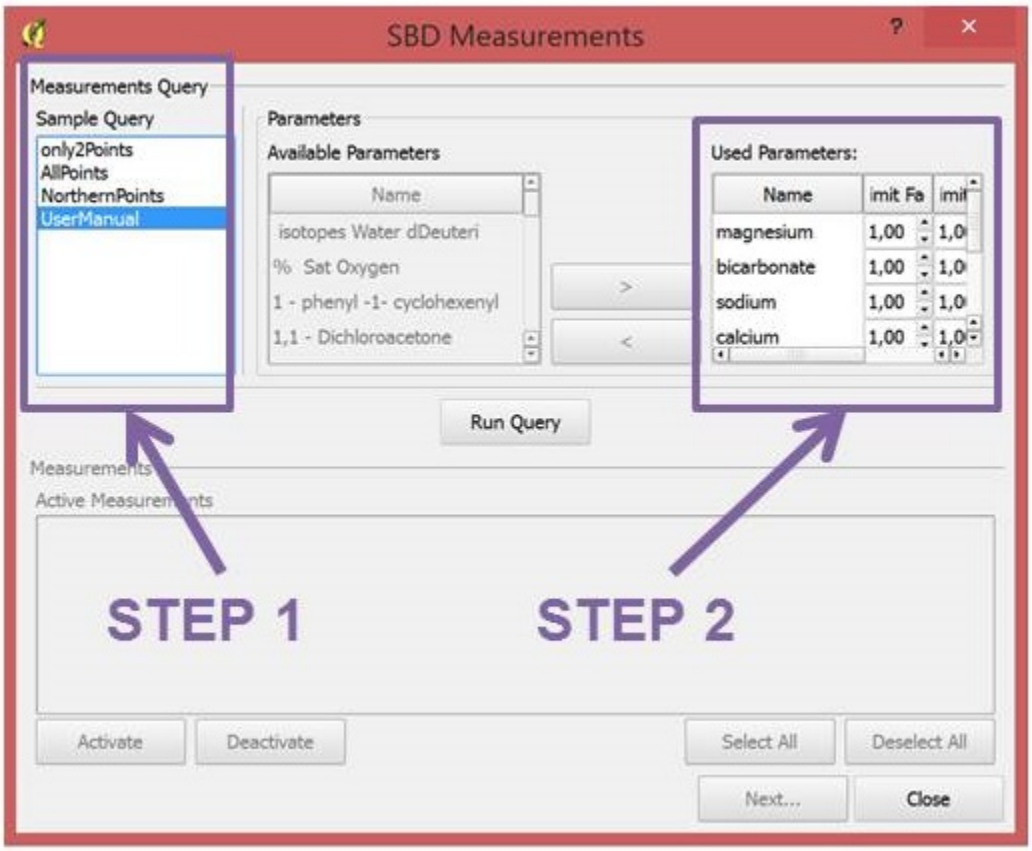


STEP 7.2 Plot Piper diagram automatically. The plot GUI, enable the user to save the plot in different formats, ro pan axes, to zoom, to configure subplots and to save the plot in dfferent formats such as .pdf, .png, .tiff, .svg, etc.

SAR plot

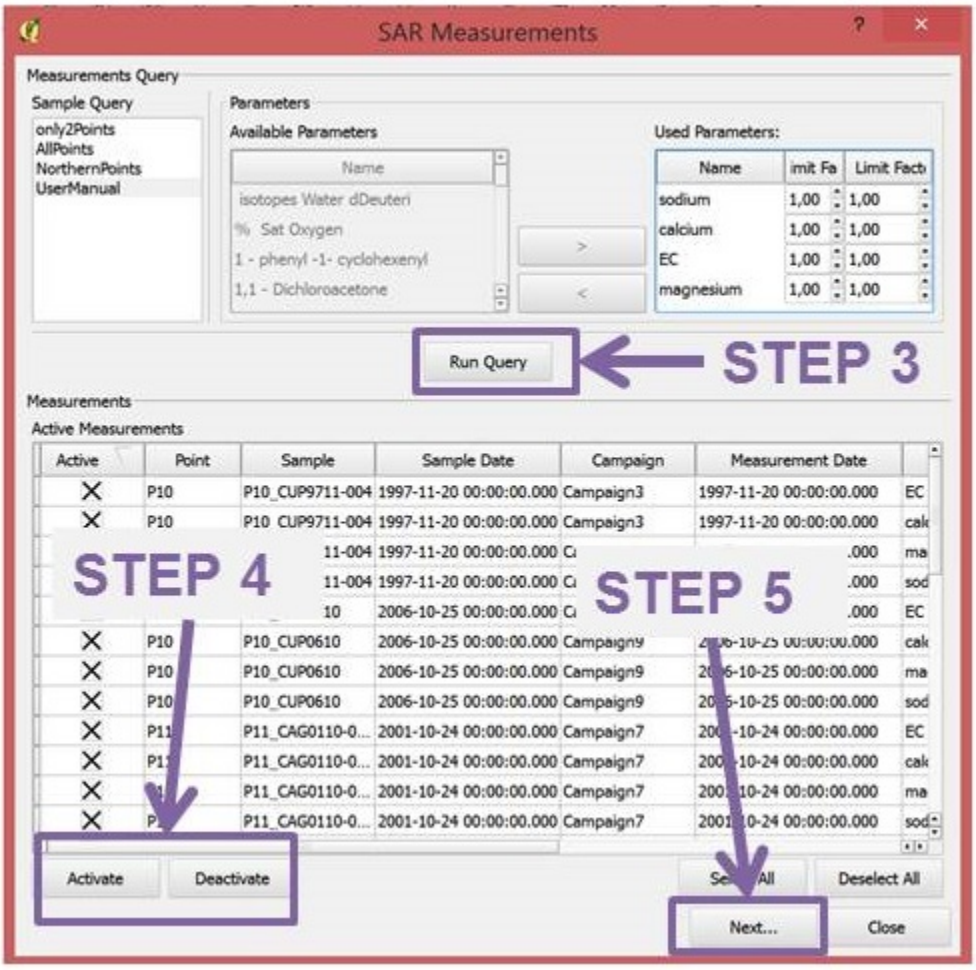


Use this command to create automatically Salinity Diagrams of the selected query created previously with the Hydrochemical Spatial Query tool (section 2.2). This diagram will be created only if the measurements required for the creation of this diagram are available.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

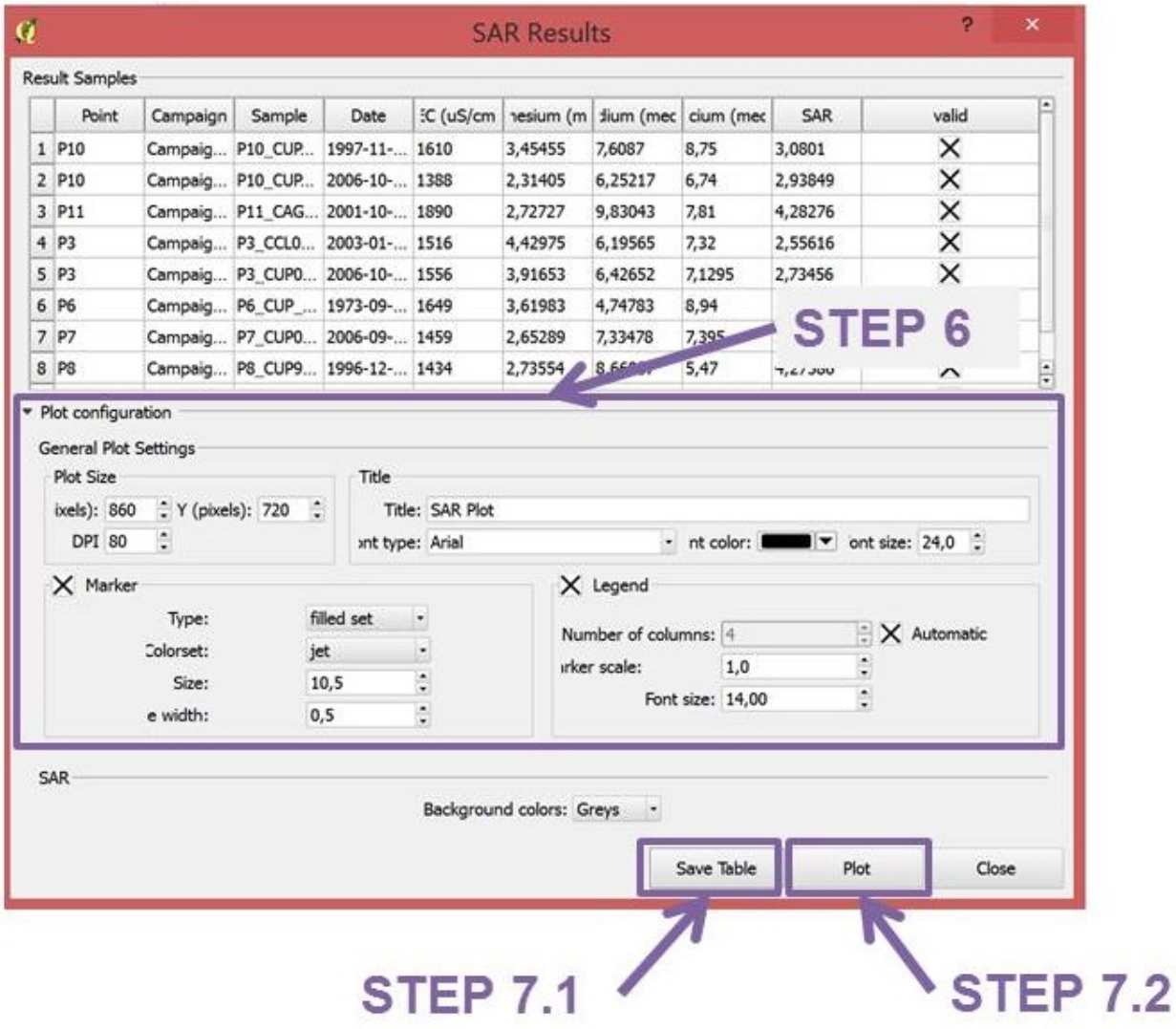
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



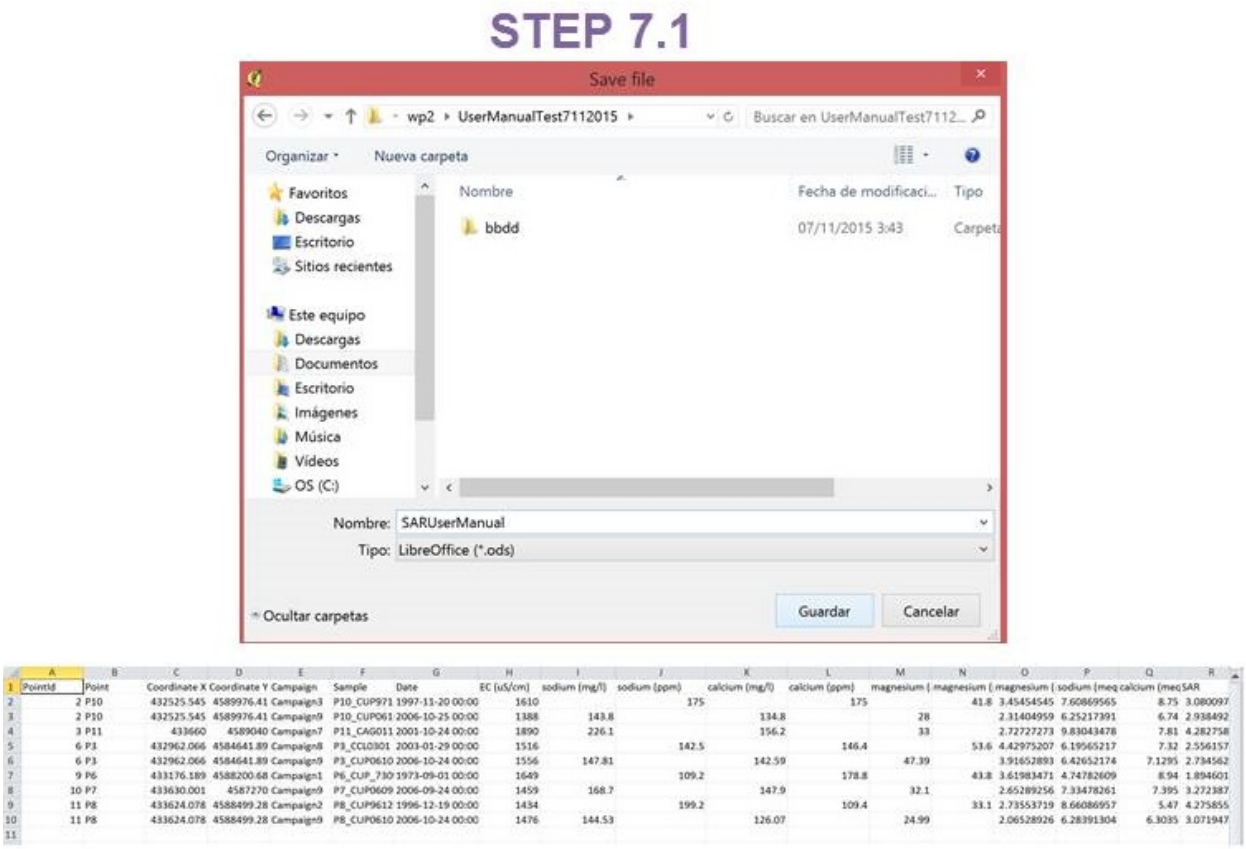
STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.

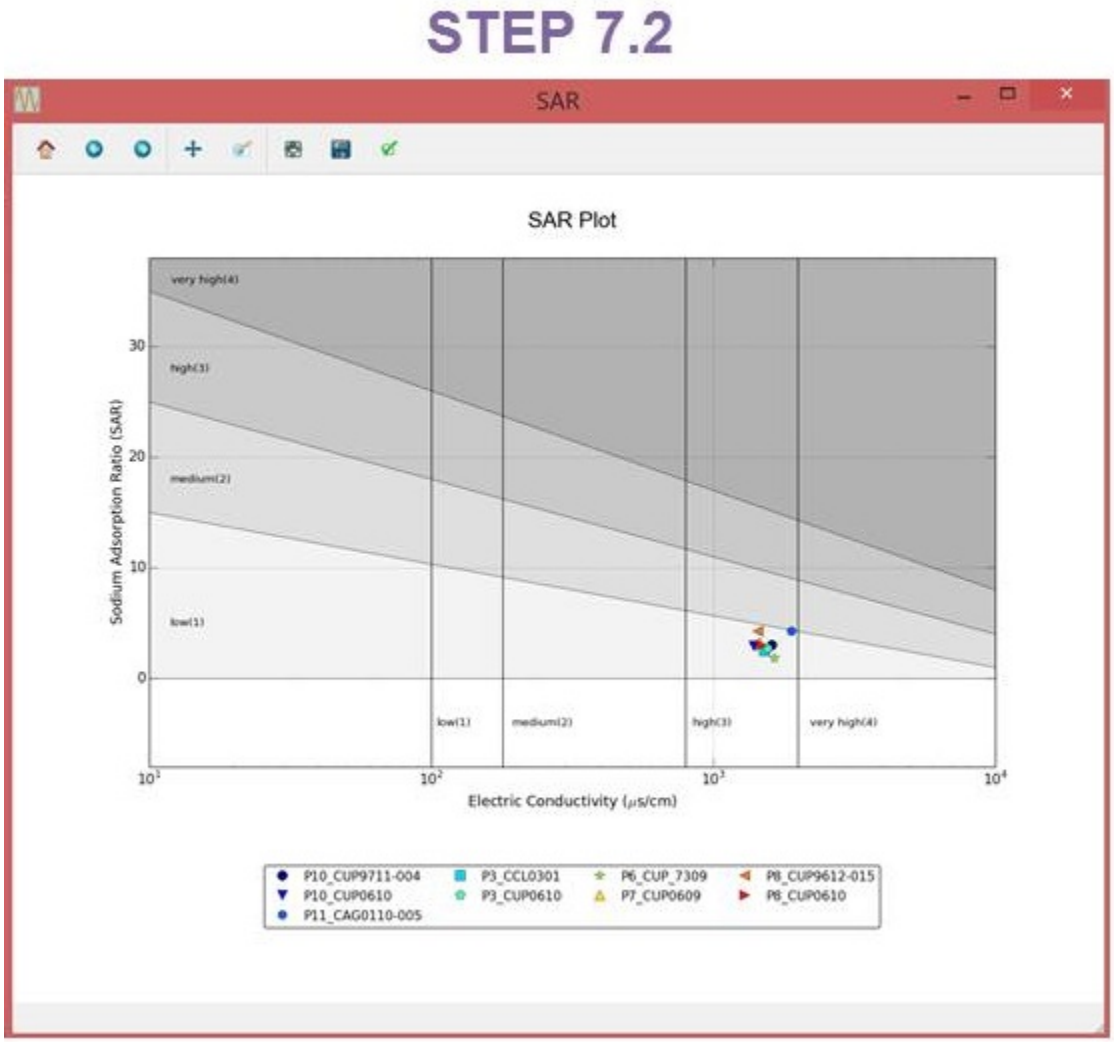


STEP 6 Plot configuration. Choose the plot size, title, markerstyle, legend, background colours, etc.



	PointId	Point	Coordinate X	Coordinate Y	Campaign	Sample	Date	EC (uS/cm)	sodium (mg/l)	sodium (ppm)	calcium (mg/l)	calcium (ppm)	magnesium (	magnesium (	magnesium (	sodium (meq	calcium (meq	SAR
2	2	P10	432525.545	4589976.41	Campaign3	P10_CUP971	1997-11-20 00:00	1610		175		175		41.8	3.45454545	7.60869565	8.75	3.080097
3	2	P10	432525.545	4589976.41	Campaign9	P10_CUP061	2006-10-25 00:00	1388	143.8		134.8		28		2.31404959	6.25217391	6.74	2.938492
4	3	P11	433660	4589040	Campaign7	P11_CAG011	2001-10-24 00:00	1890	226.1		156.2		33		2.72727273	9.83043478	7.81	4.282758
5	6	P3	432962.066	4584641.89	Campaign8	P3_CCL0301	2003-01-29 00:00	1516		142.5		146.4		53.6	4.42975207	6.19565217	7.32	2.556157
6	6	P3	432962.066	4584641.89	Campaign9	P3_CUP0610	2006-10-24 00:00	1556	147.81		142.59		47.39		3.91652893	6.42652174	7.1295	2.734562
7	9	P6	433176.189	4588200.68	Campaign1	P6_CUP_730	1973-09-01 00:00	1649		109.2		178.8		43.8	3.61983471	4.74782609	8.94	1.894601
8	10	P7	433630.001	4587270	Campaign9	P7_CUP0609	2006-09-24 00:00	1459	168.7		147.9		32.1		2.65289256	7.33478261	7.395	3.272387
9	11	P8	433624.078	4588499.28	Campaign2	P8_CUP9612	1996-12-19 00:00	1434		199.2		109.4		33.1	2.73553719	8.66086957	5.47	4.275855
10	11	P8	433624.078	4588499.28	Campaign9	P8_CUP0610	2006-10-24 00:00	1476	144.53		126.07		24.99		2.06528926	6.28391304	6.3035	3.071947
11																		

STEP 7.1 Save SAR query results in different formats.

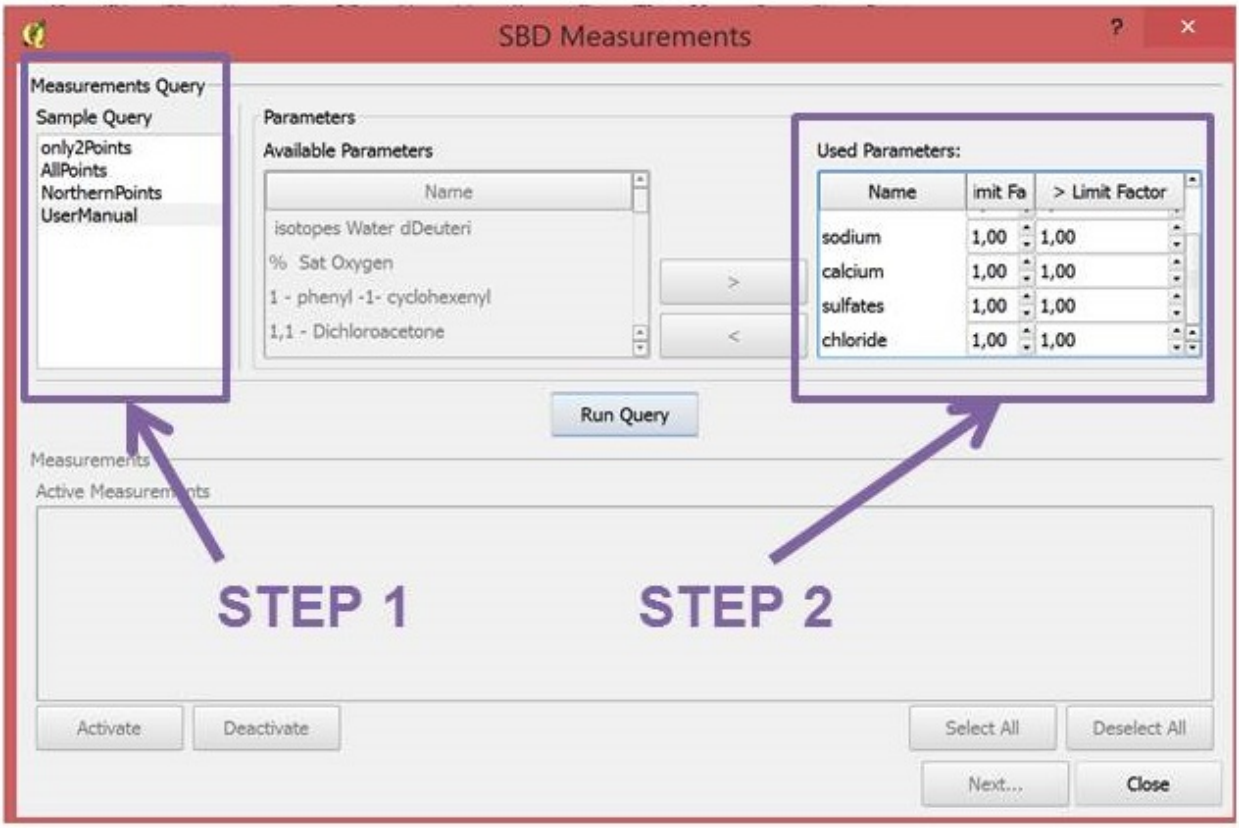


STEP 7.2 Plot SAR diagram automatically. The plot GUI, enable the user to save the plot in different formats, ro pan axes, to zoom, to configure subplots and to save the plot in dfferent formats such as .pdf, .png, .tiff, .svg, etc.

SBD Plot

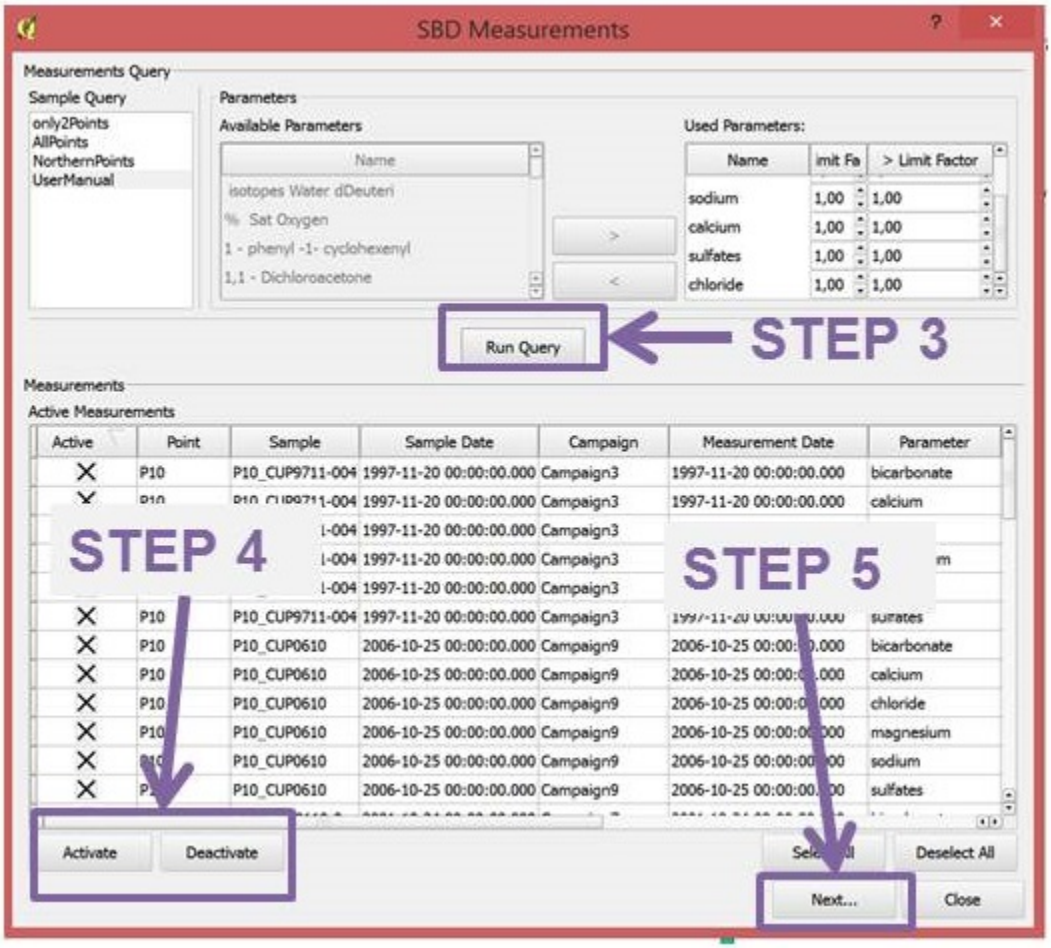


Use this command to create automatically Shöeller-Berkaloff diagrams of the selected query created previously with the Hydrochemical Spatial Query tool (section 2.2). This diagram will be created only if the measurements required for the creation of this diagram are available.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

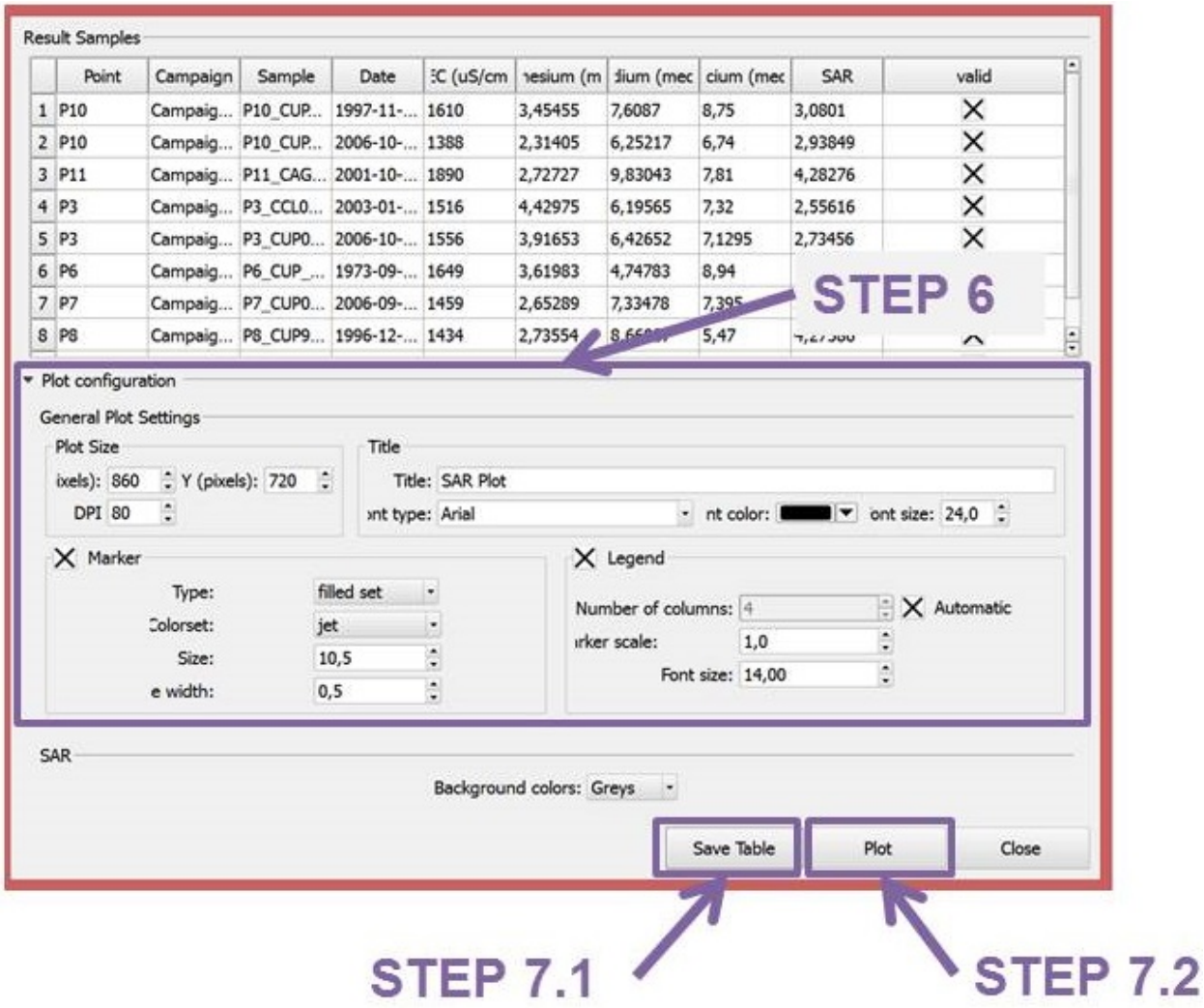
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



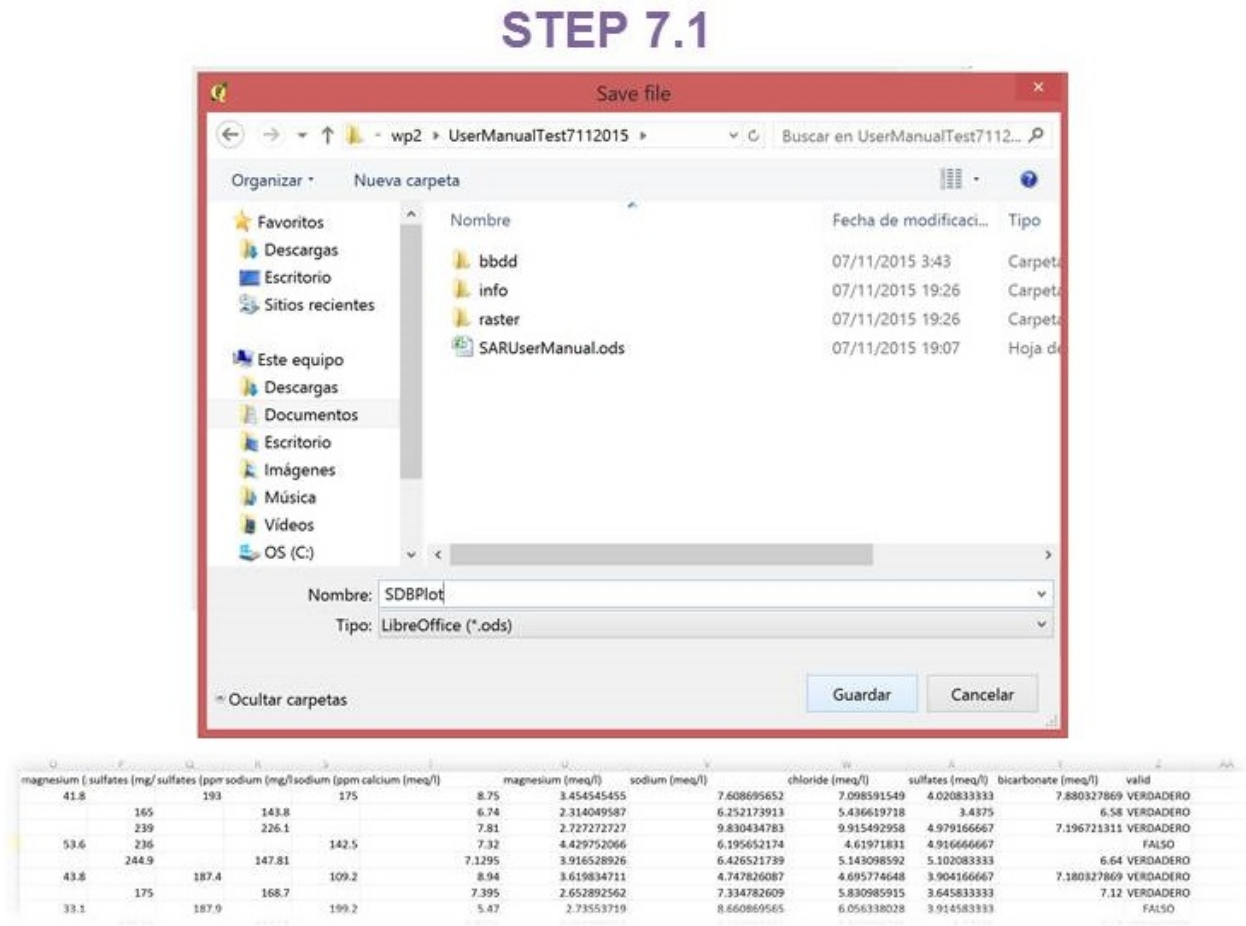
STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the desired measurements.

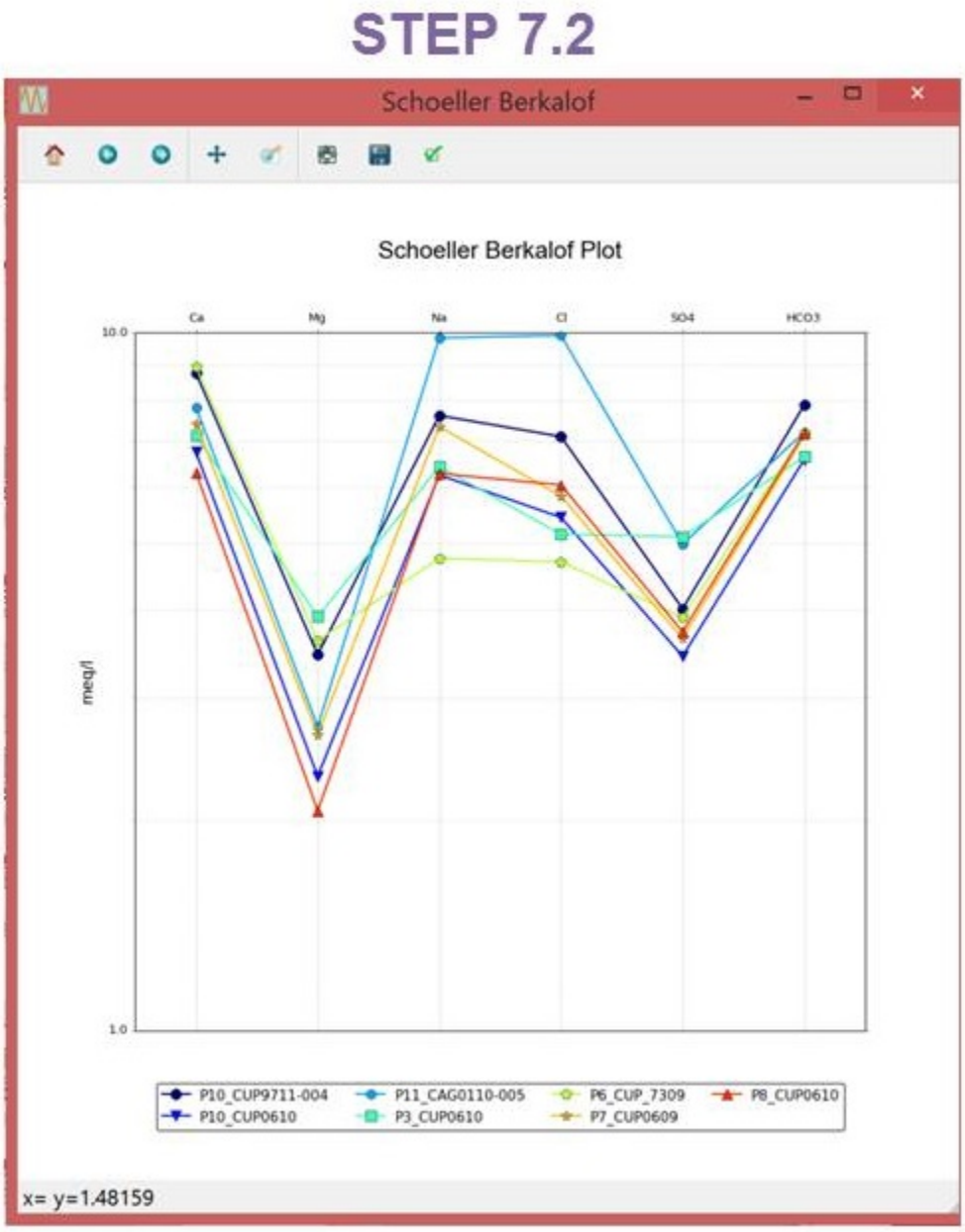
STEP 5 Click Next.



STEP 6 Plot configuration.Choose the plot size, title, marker style, legend, background colours, etc.



STEP 7.1 Save Shöeller-Berkaloff query results in different formats.



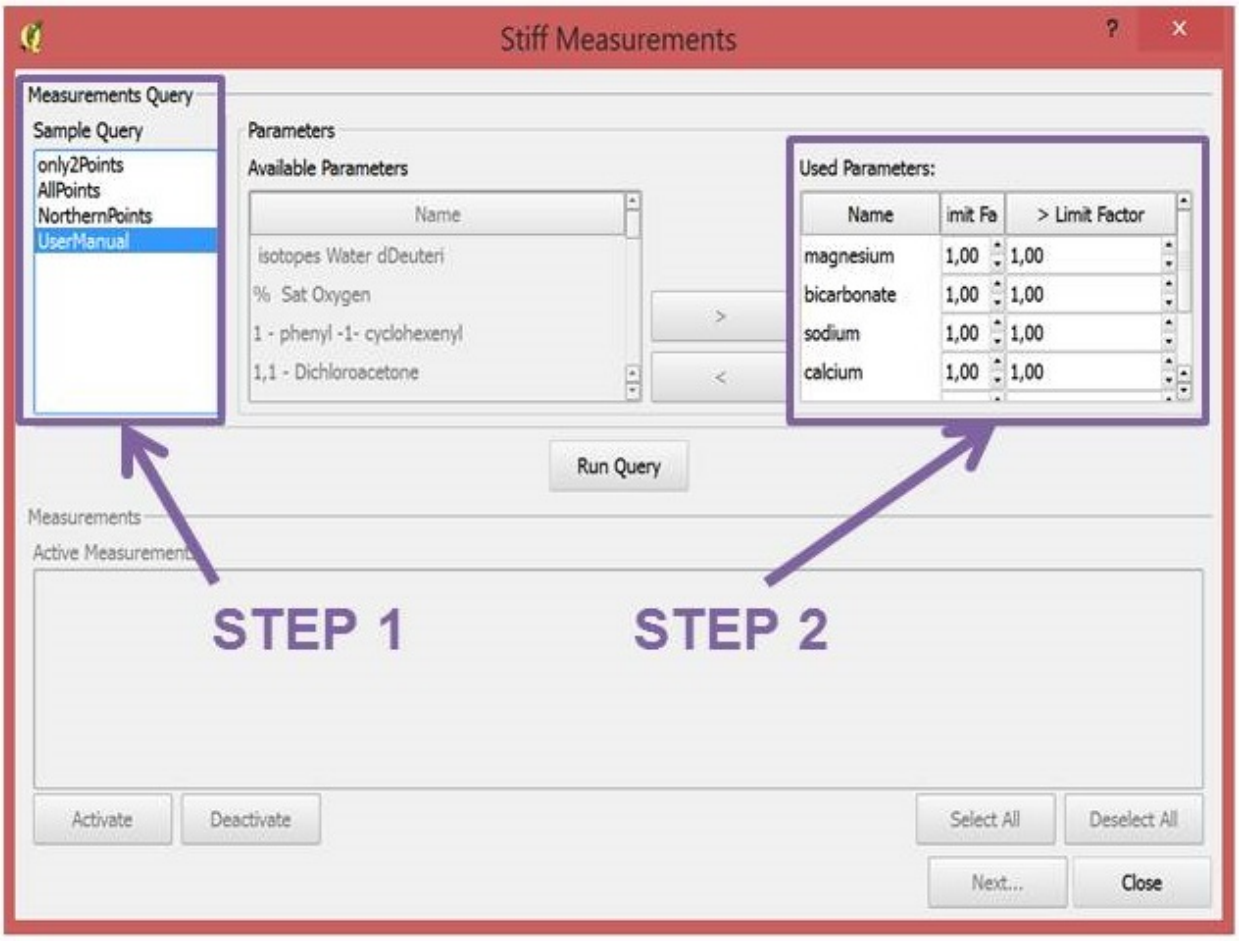
STEP 7.2 Plot Shoeller-Berkaloff diagrams automatically. The plot GUI, enable the user to save the plot in different formats, ro pan axes, to zoom, to configure subplots and to save the plot in different formats such as .pdf, .png, .tiff, .svg, etc.

Stiff Plot



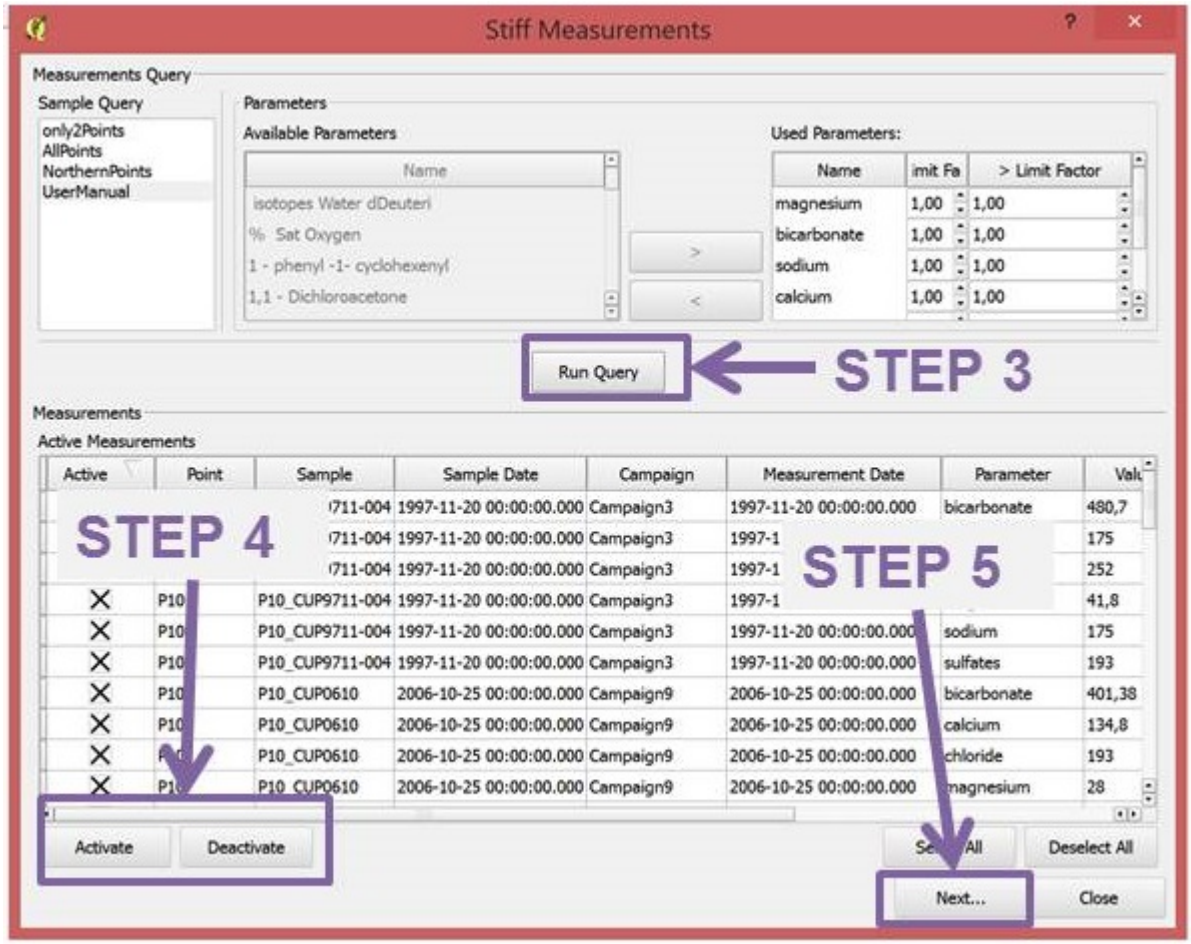
Use this command to create automatically Stiff plots of the selected query created previously with the Hydrochemical Spatial Query tool (section 2.2). This diagram will be created only if the measurements required for the creation of this diagram are available.

For obtaining stiff maps, use command Stiff Diagram Map in section 2.11.



STEP 1 Choose the Query created previously with the tool shown in section 3.1.

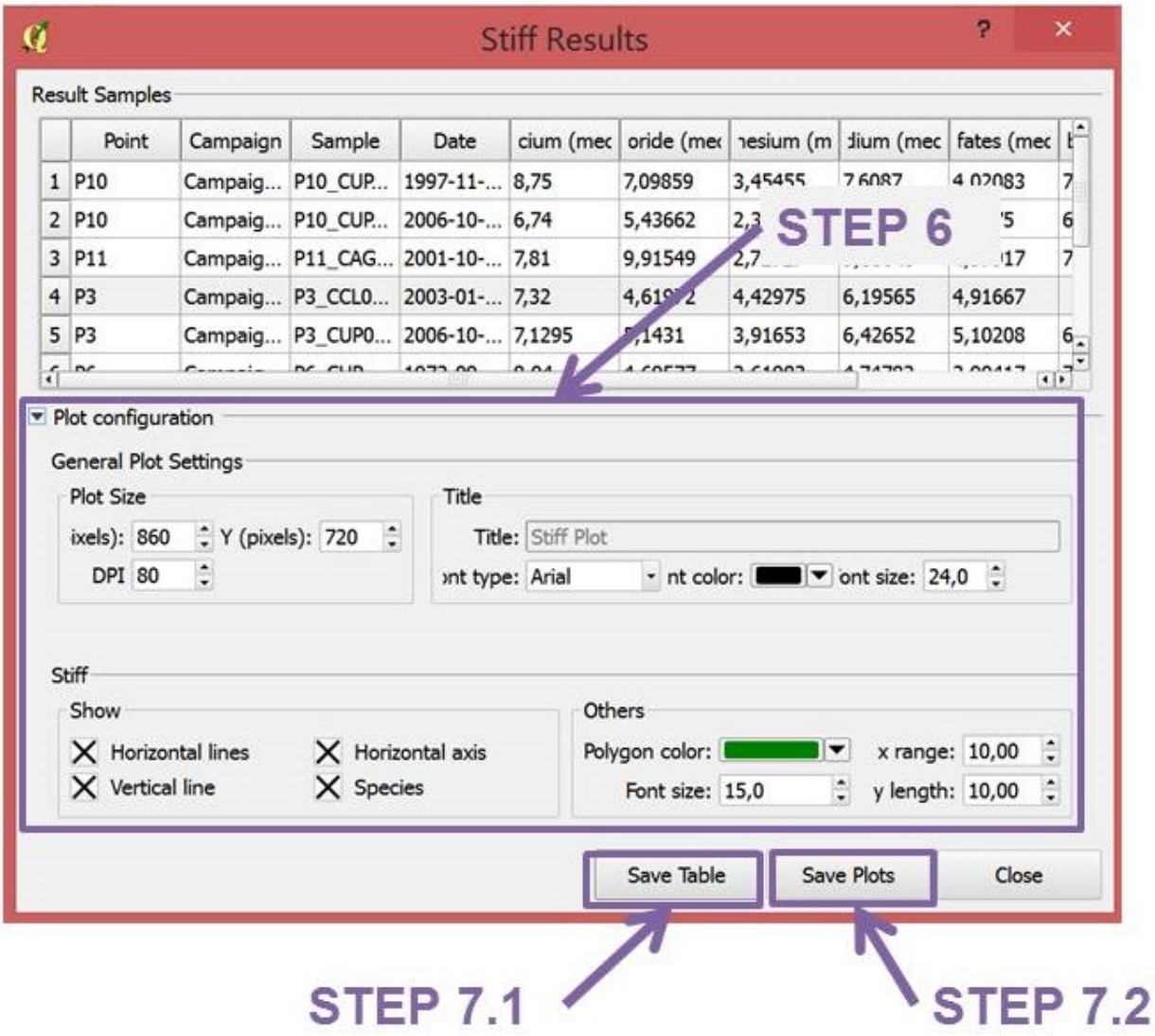
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



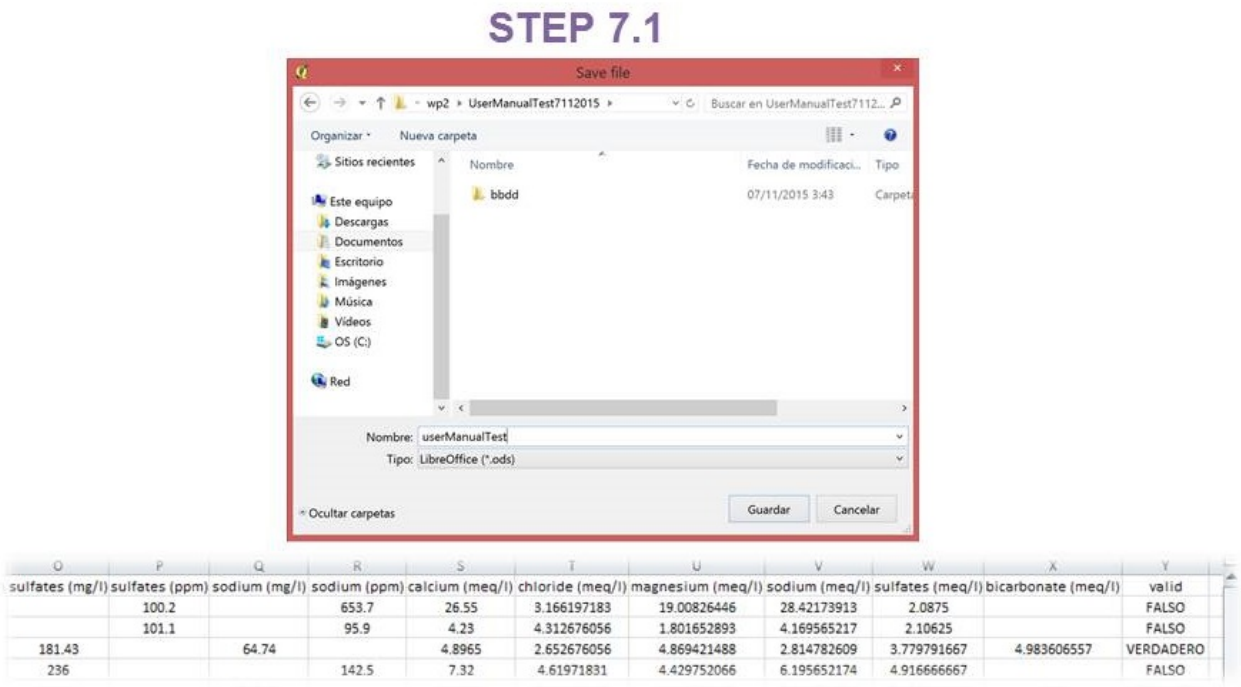
STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.

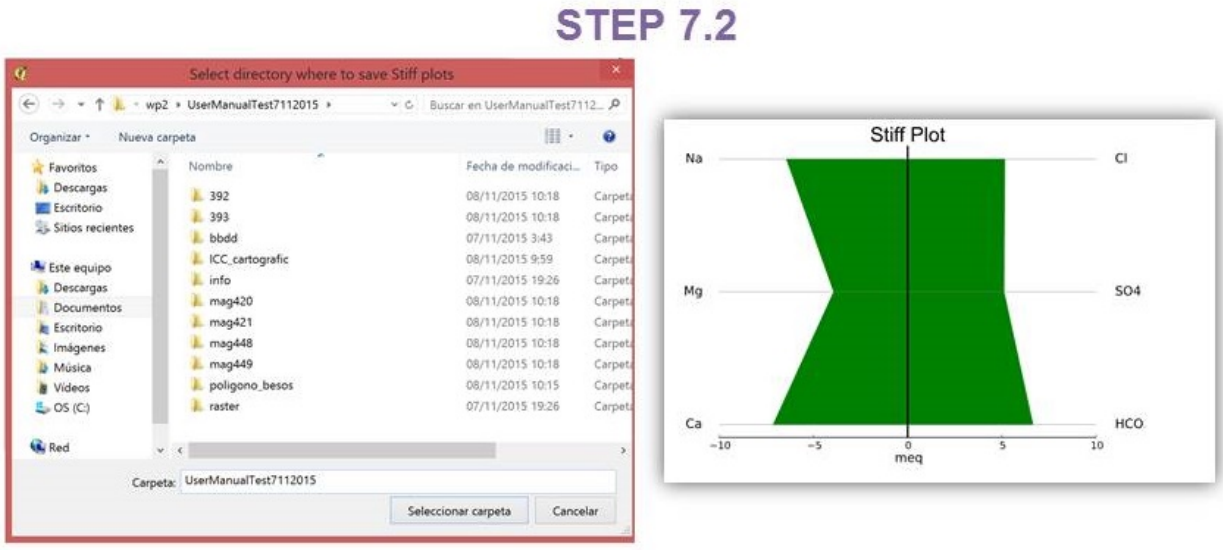


STEP 6 Plot configuration. Choose the plot size, title, Polygon colour, etc.



sulfates (mg/l)	sulfates (ppm)	sodium (mg/l)	sodium (ppm)	calcium (meq/l)	chloride (meq/l)	magnesium (meq/l)	sodium (meq/l)	sulfates (meq/l)	bicarbonate (meq/l)	valid
	100.2		653.7	26.55	3.166197183	19.00826446	28.42173913	2.0875		FALSO
	101.1		95.9	4.23	4.312676056	1.801652893	4.169565217	2.10625		FALSO
181.43		64.74		4.8965	2.652676056	4.869421488	2.814782609	3.779791667	4.983606557	VERDADERO
236			142.5	7.32	4.61971831	4.429752066	6.195652174	4.916666667		FALSO

STEP 7.1 Save Stiff query results in different formats.

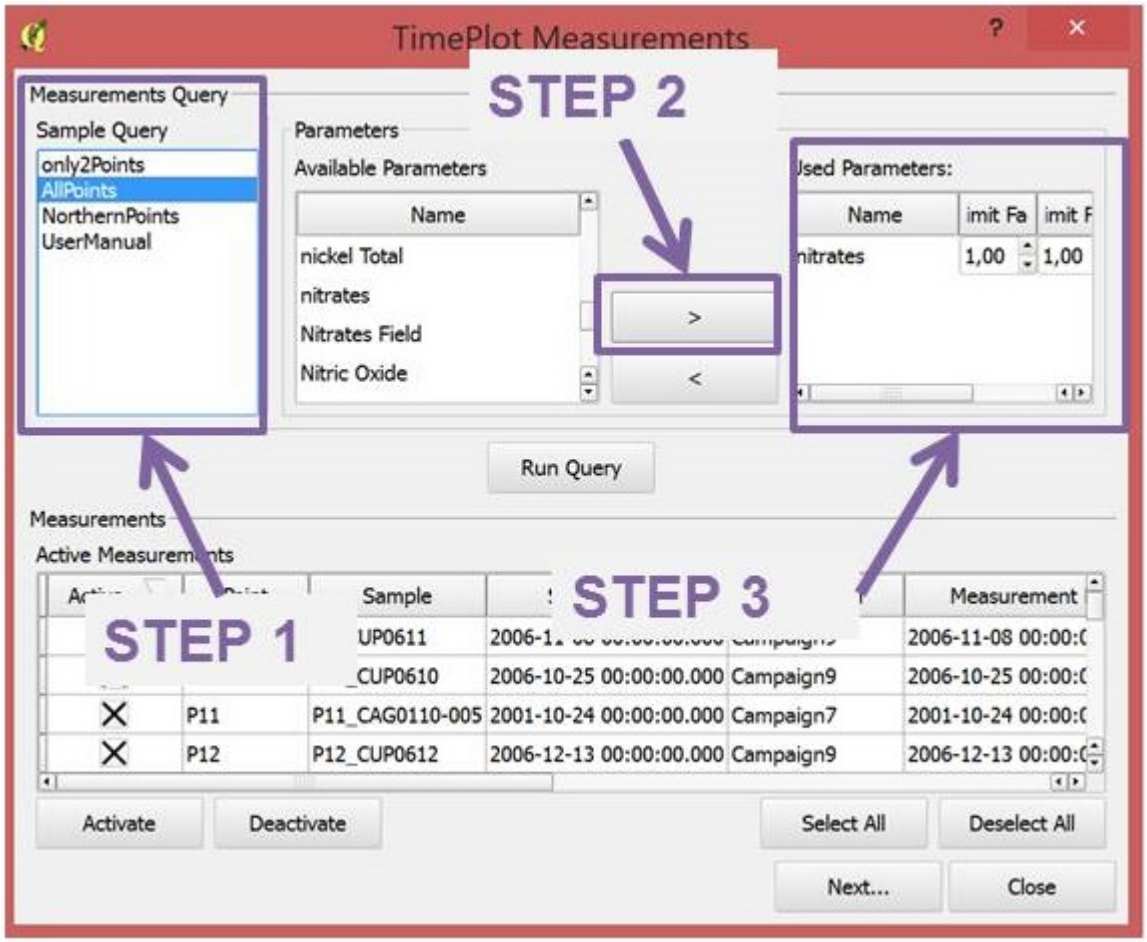


STEP 7.2 Save Plots. This button creates *svg* files with the stiff diagram for each point selected during the query.

Time Plot



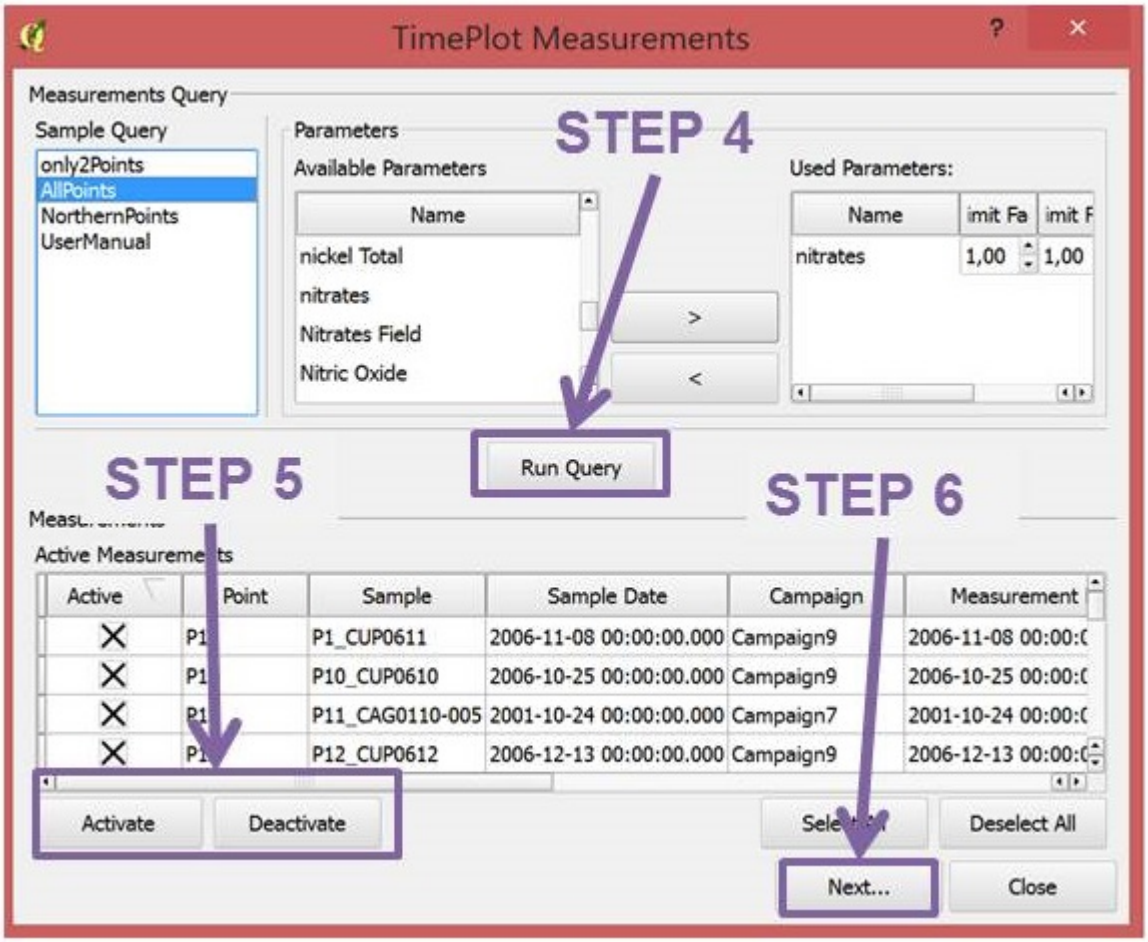
Use this command to create time plots of the selected query (created previously with the Hydrochemical Spatial Query tool, section 2.2) for the selected parameters.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

STEP 2 Choose the parameter to be queried for the analysis.

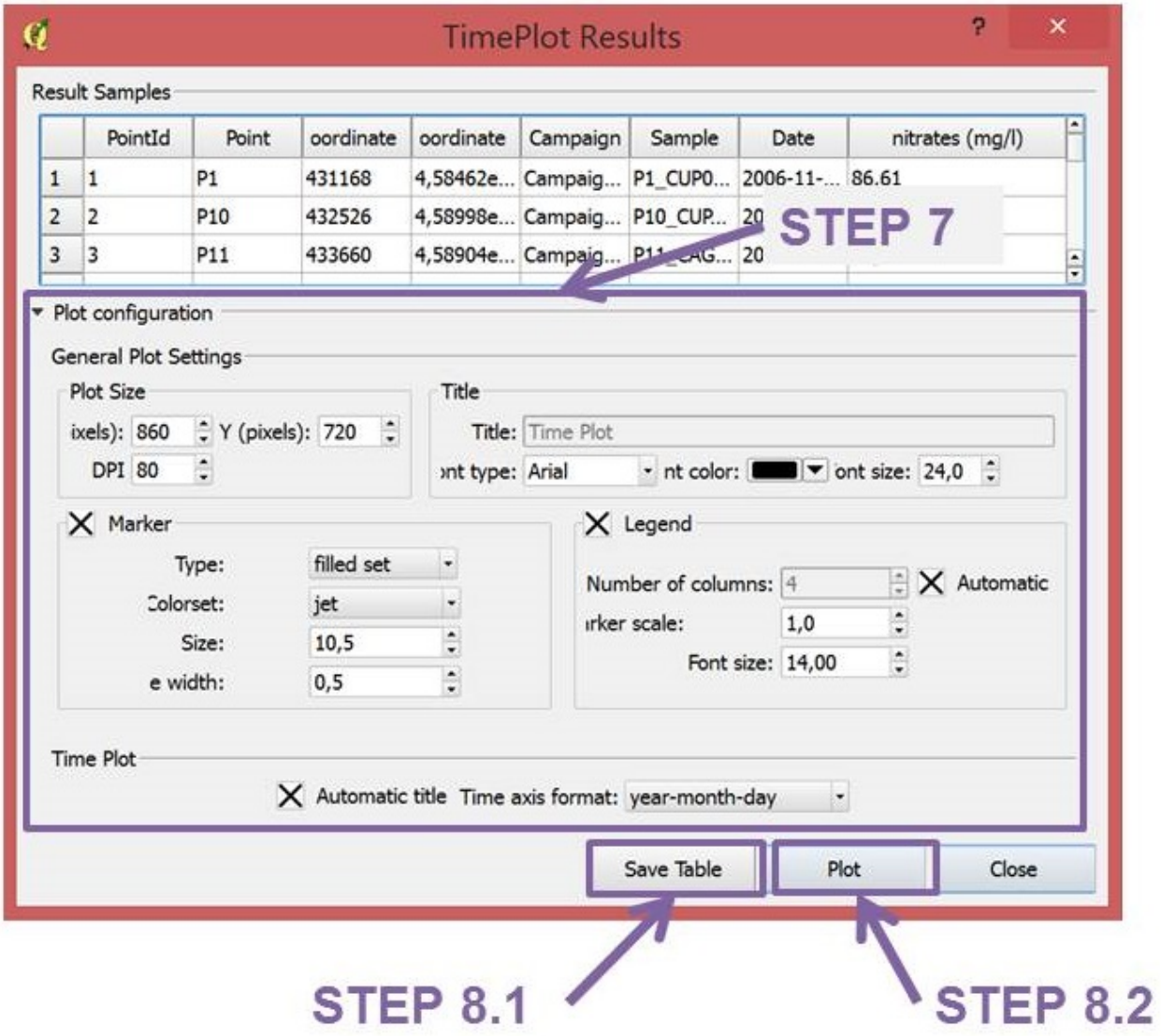
STEP 3 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



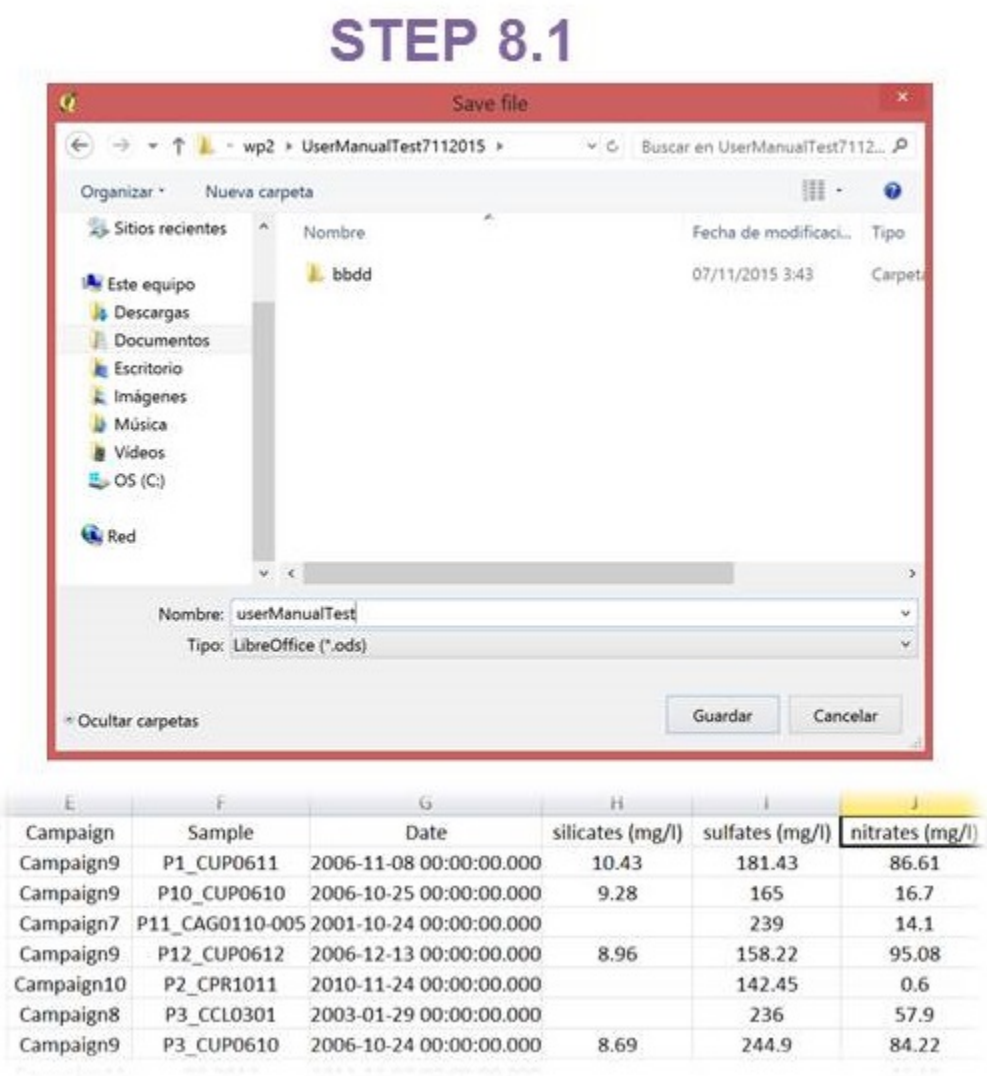
STEP 4 Run Query.

STEP 5 Use this commands to activate or deactivated the desired measurements.

STEP 6 Click Next.

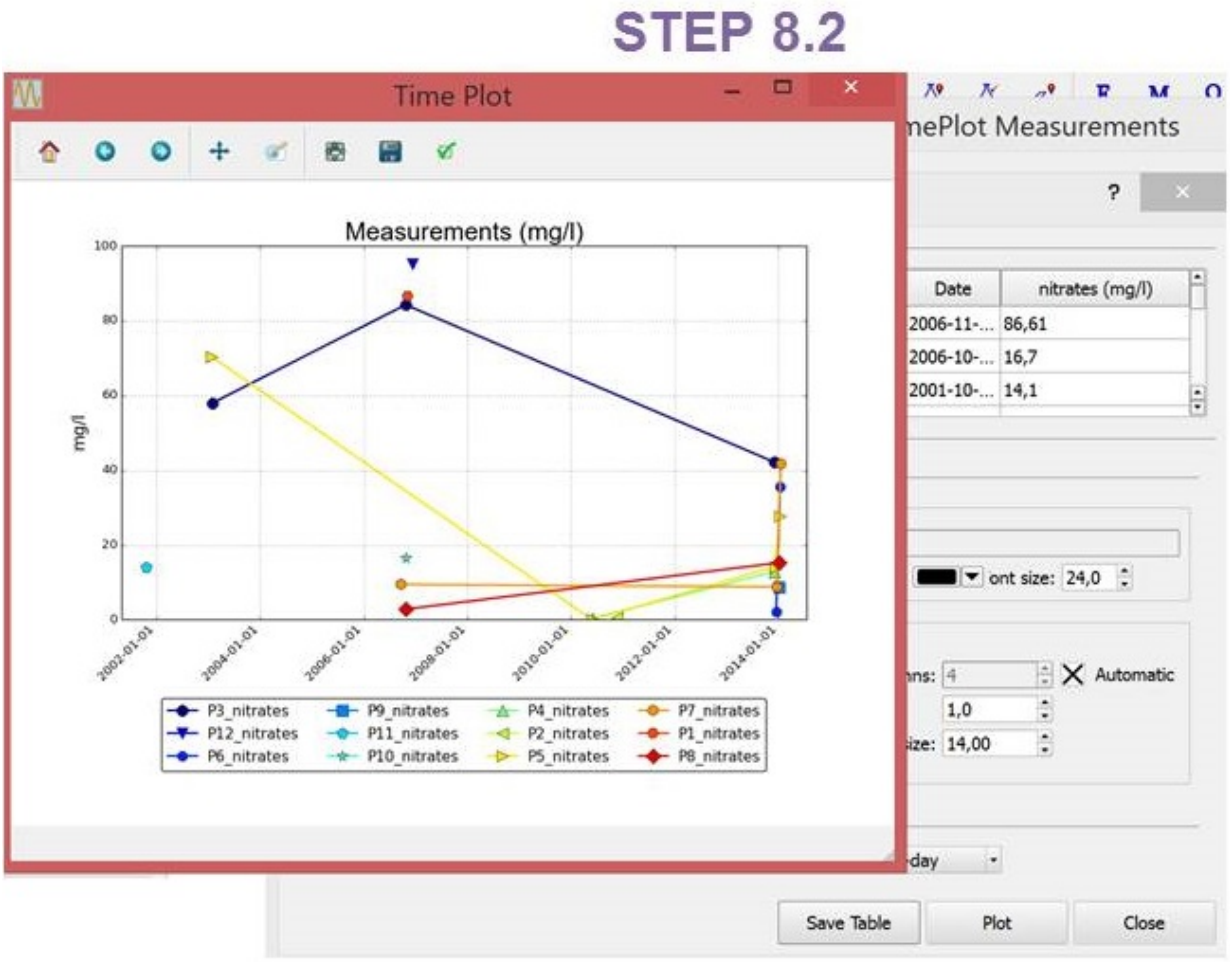


STEP 7 Plot configuration. Choose the plot size, title, markers, time axis format, etc.



Campaign	Sample	Date	silicates (mg/l)	sulfates (mg/l)	nitrates (mg/l)
Campaign9	P1_CUP0611	2006-11-08 00:00:00.000	10.43	181.43	86.61
Campaign9	P10_CUP0610	2006-10-25 00:00:00.000	9.28	165	16.7
Campaign7	P11_CAG0110-005	2001-10-24 00:00:00.000		239	14.1
Campaign9	P12_CUP0612	2006-12-13 00:00:00.000	8.96	158.22	95.08
Campaign10	P2_CPR1011	2010-11-24 00:00:00.000		142.45	0.6
Campaign8	P3_CCL0301	2003-01-29 00:00:00.000		236	57.9
Campaign9	P3_CUP0610	2006-10-24 00:00:00.000	8.69	244.9	84.22

STEP 8.1 Save query results in different formats.

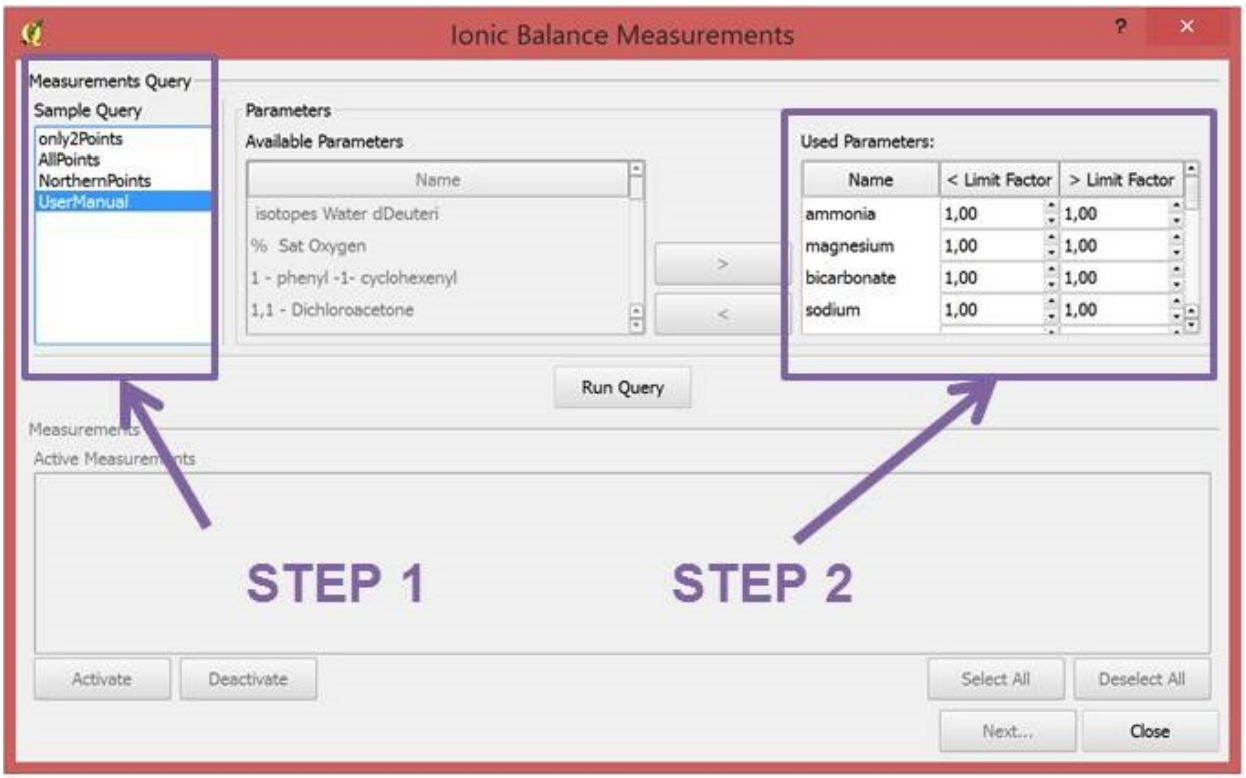


STEP 8.2 This button creates automatically time plots. Here, the user can edit the plot and save it. The plot GUI, enable the user to save the plot in different formats, to pan axes, to zoom, to configure subplots and to save the plot in dfferent formats such as .pdf, .png, .tiff, .svg, etc.

Ionic Balance Report

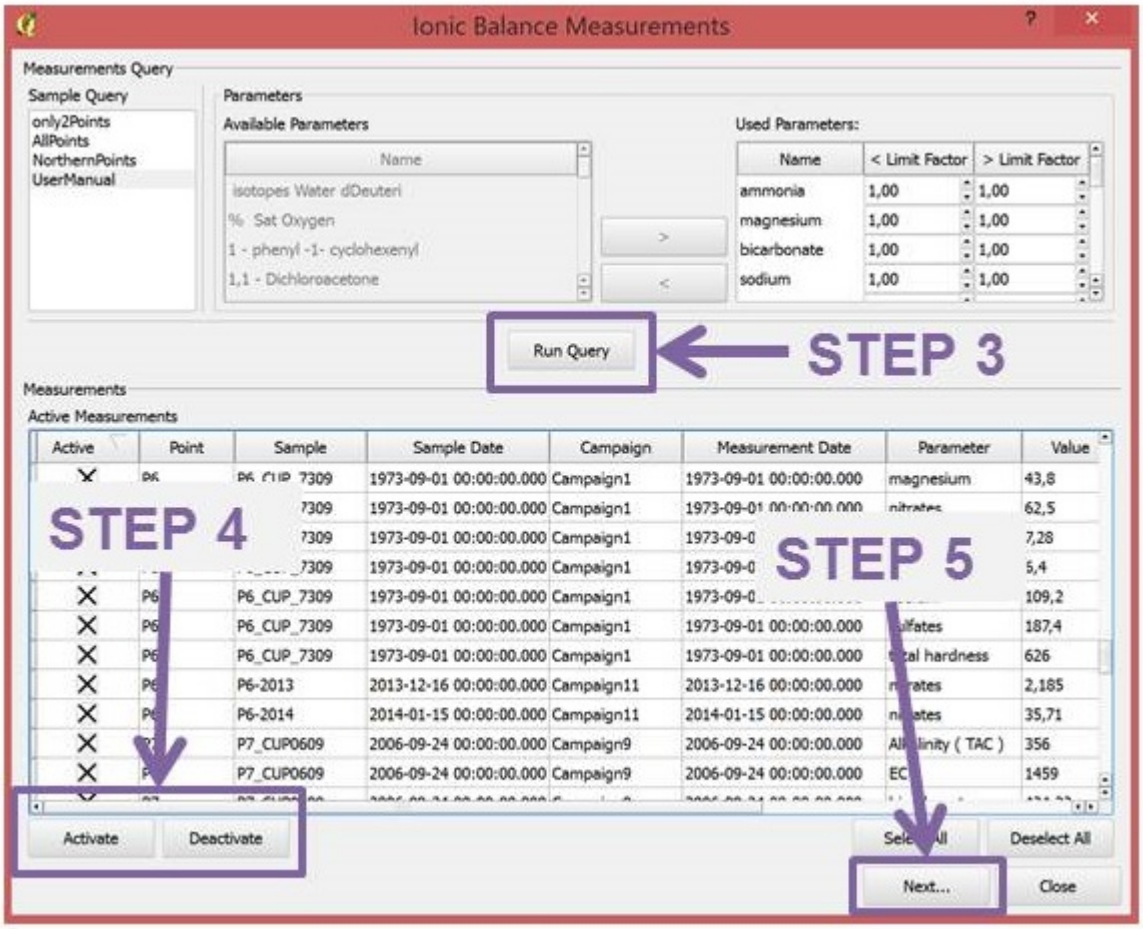


This command was created to calculate ionic balance Report. To date automatically converts all units to meq/l and automatically select the majors ions of the selected sample.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

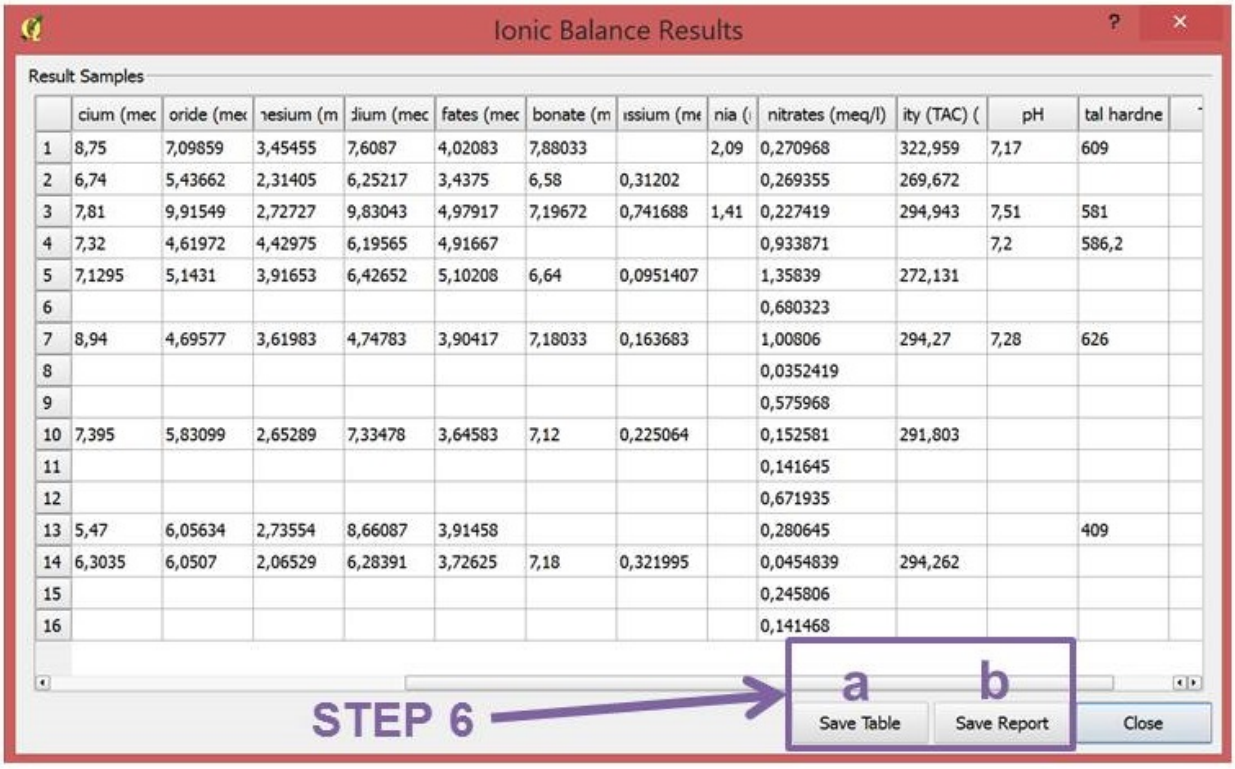
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.



	cium (mec	oride (mec	ıesium (m	dium (mec	fates (mec	bonate (m	ıssium (me	nia (i	nitrates (meq/l)	ity (TAC) (	pH	tal hardne
1	8,75	7,09859	3,45455	7,6087	4,02083	7,88033		2,09	0,270968	322,959	7,17	609
2	6,74	5,43662	2,31405	6,25217	3,4375	6,58	0,31202		0,269355	269,672		
3	7,81	9,91549	2,72727	9,83043	4,97917	7,19672	0,741688	1,41	0,227419	294,943	7,51	581
4	7,32	4,61972	4,42975	6,19565	4,91667				0,933871		7,2	586,2
5	7,1295	5,1431	3,91653	6,42652	5,10208	6,64	0,0951407		1,35839	272,131		
6									0,680323			
7	8,94	4,69577	3,61983	4,74783	3,90417	7,18033	0,163683		1,00806	294,27	7,28	626
8									0,0352419			
9									0,575968			
10	7,395	5,83099	2,65289	7,33478	3,64583	7,12	0,225064		0,152581	291,803		
11									0,141645			
12									0,671935			
13	5,47	6,05634	2,73554	8,66087	3,91458				0,280645			409
14	6,3035	6,0507	2,06529	6,28391	3,72625	7,18	0,321995		0,0454839	294,262		
15									0,245806			
16									0,141468			

STEP 6 Save query results in different formats with all information related (a) or ionic balance report in ods format (b). It is useful to analyze in detail data stored in the user database necessary to ionic balance calculations and its results.

a

Point	Coordinate X	Coordinate Y	Campaign	Sample	Date	sodium (mg/l)	sodium (ppm)	chloride (mg/l)	magnesium (r	magnesium (p	sulfates (mg/l)	ammonia (mg	pH (u. ph)	pH (°C)	total hardnes	total hardnes	nitrates (mg/l)	calcium (m
P10	432525,5449	4589976,413	Campaign9	P10_CUP06	2006-10-25	143,8		193	28		165			7,21			16,7	13
P11	433660,0001	4589040	Campaign7	P11_CAG01	2001-10-24	226,1		352	33		239	1,41	7,51		581		14,1	15
P12	430858,7211	4582777,016	Campaign9	P12_CUP06	2006-12-13	82,96		139,89	49,72		158,22			7,49			95,08	129
P2	428407,2487	4581490,897	Campaign10	P2_CPR101	2010-11-24	146,33		206,41	28,01		142,45		7,59				0,6	130
P3	432962,0663	4584641,892	Campaign8	P3_CCL0301	2003-01-29		142,5	164		53,6	236		7,2			586,2	57,9	
P3	432962,0663	4584641,892	Campaign9	P3_CUP0619	2006-10-24	147,81		182,58	47,39		244,9			7,47			84,22	142
P3	432962,0663	4584641,892	Campaign11	P3-2013	2013-12-03												42,18	
P4	431194,5767	4581402,259	Campaign10	P4_CPR101	2010-05-30	165		201,22	28,48		145,55		7,69				0,36	122
P4	431194,5767	4581402,259	Campaign11	P4-2013	2013-12-04												12,86	
P5	429844,9611	4581088,809	Campaign8	P5_CCL0301	2003-01-28		152,1	305		68,6	438,8		7,2			800,7	70,3	
P5	429844,9611	4581088,809	Campaign10	P5_CPR101	2010-05-30	156,07		183,01	26,18		139,14		7,42				0,0001	117
P5	429844,9611	4581088,809	Campaign11	P5-2013	2013-12-08												14,15	
P5	429844,9611	4581088,809	Campaign11	P5-2014	2014-01-11												27,77	
P6	433176,1889	4588200,677	Campaign11	P6-2013	2013-12-16												2,185	
P6	433176,1889	4588200,677	Campaign11	P6-2014	2014-01-15												35,71	
P7	433630,0011	4587270	Campaign9	P7_CUP060	2006-09-24	168,7		207	32,1		175			7,34			9,46	14
P7	433630,0011	4587270	Campaign11	P7-2013	2013-12-22												8,782	
P7	433630,0011	4587270	Campaign11	P7-2014	2014-01-19												41,66	
P8	433624,0783	4588499,284	Campaign9	P8_CUP061	2006-10-24	144,53		214,8	24,99		178,86			7,64			2,82	126
P8	433624,0783	4588499,284	Campaign11	P8-2014	2014-01-03												15,24	
P9	432849,9987	4590000	Campaign11	P9-2014	2014-01-07												8,771	

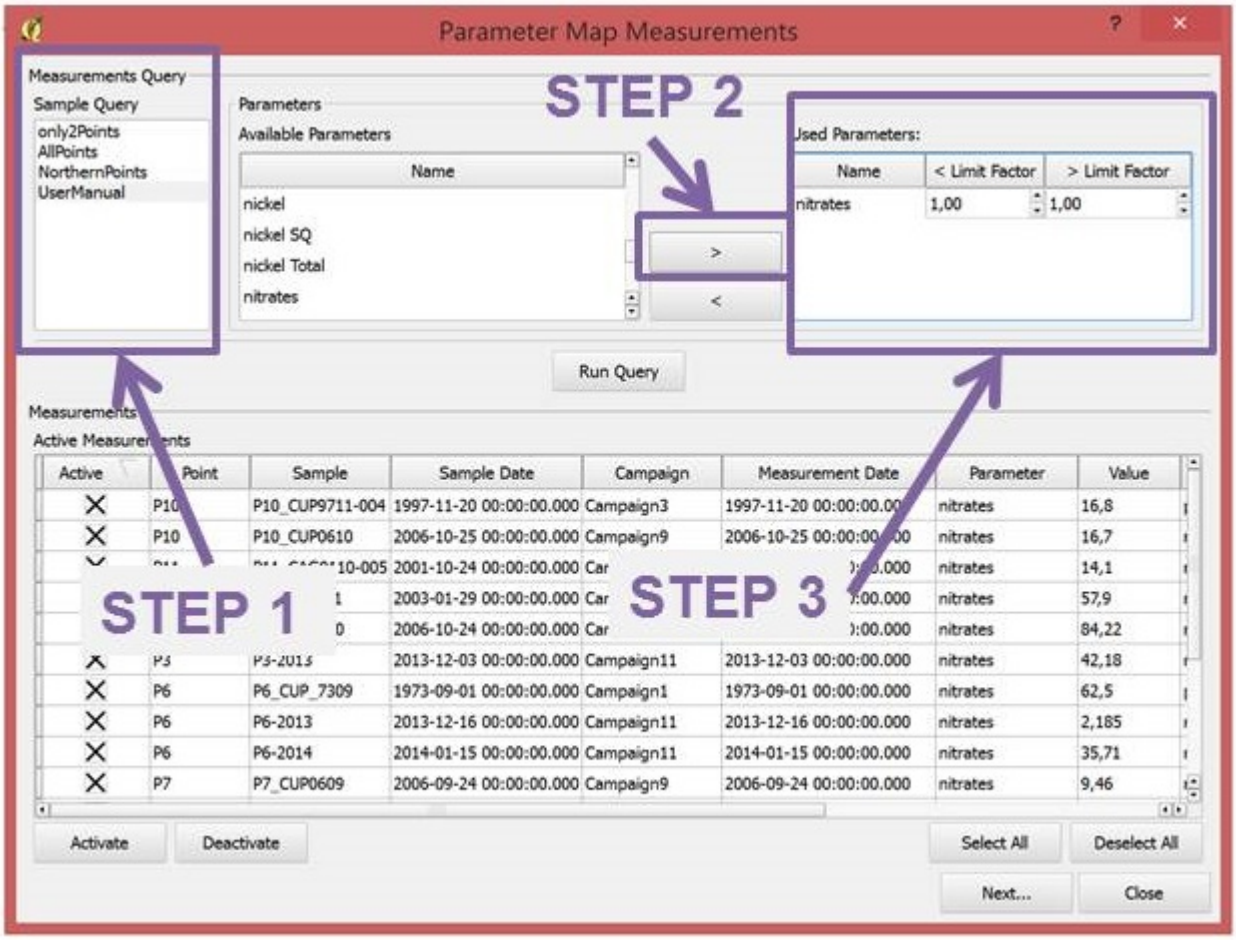
b

Cations Weight Percentage					Anions Weight Percentage				Cations meq Percentage				Anions meq Percentage				Ionic Balance
Total(meq/l)	Ca(mg/l %)	Mg(mg/l %)	Na(mg/l %)	K(mg/l %)	Cl(mg/l %)	SO4(mg/l %)	HCO3(mg/l %)	NO3(mg/l %)	Ca(meq/l %)	Mg(meq/l %)	Na(meq/l %)	K(meq/l %)	Cl(meq/l %)	SO4(meq/l %)	HCO3(meq/l %)	NO3(meq/l %)	Error(%)
15,72347456	0,422835634	0,08782936	0,451066499	0,038268507	0,248685703	0,212606948	0,51718895	0,0215184	0,431546595	0,148163237	0,40031222	0,019977948	0,345764525	0,218622162	0,418482567	0,017130745	-0,67150496
22,31880029	0,351564258	0,074274139	0,508890389	0,065271213	0,337132459	0,228905277	0,420457811	0,013504454	0,369977435	0,129197102	0,465690019	0,035135444	0,444266396	0,223092935	0,322451082	0,010189587	-5,56967555
14,95068964	0,491149104	0,188062637	0,313790756	0,006997504	0,181630507	0,205429829	0,489489606	0,123450058	0,455426687	0,288238684	0,253015673	0,003189856	0,263570676	0,220474779	0,413380788	0,102573756	-4,75802577
15,90535851	0,400453529	0,085833359	0,448411118	0,065301995	0,263483067	0,18183791	0,553913121	0,000765902	0,414697511	0,146919701	0,403792116	0,034590671	0,36556021	0,186585441	0,447245911	0,000608438	-0,94307689
18,24356902	0,417528037	0,138766068	0,432813095	0,0108928	0,199162249	0,267142265	0,441826472	0,091869014	0,405830218	0,222939307	0,365814814	0,005415661	0,281912963	0,279664759	0,363963871	0,074458408	-3,77466576
15,54020156	0,368184695	0,085837427	0,497302511	0,048675367	0,263376963	0,190510471	0,545641361	0,000471204	0,380592155	0,146661262	0,447009663	0,02573692	0,36474231	0,195125633	0,439758416	0,000373641	3,219322865
14,64806124	0,369269521	0,08243073	0,491404282	0,056895466	0,252640118	0,192078826	0,555280918	0,000000138	0,383884274	0,141641537	0,444219843	0,030254345	0,351938129	0,197893083	0,450168678	1,1011E-07	4,193197142
16,74939989	0,413706294	0,08979021	0,471888112	0,024615385	0,250672092	0,211920851	0,525951222	0,011455836	0,419985778	0,150666281	0,416565839	0,012782103	0,348131035	0,21766949	0,425089857	0,009109615	4,996569797
17,0024381	0,40907911	0,081088974	0,468979168	0,040852748	0,257411979	0,214342209	0,524866381	0,003379431	0,420943404	0,137918599	0,4196354	0,021502597	0,35587274	0,219159745	0,422292377	0,002675138	-12,6824426

Chemical Parameter Plot



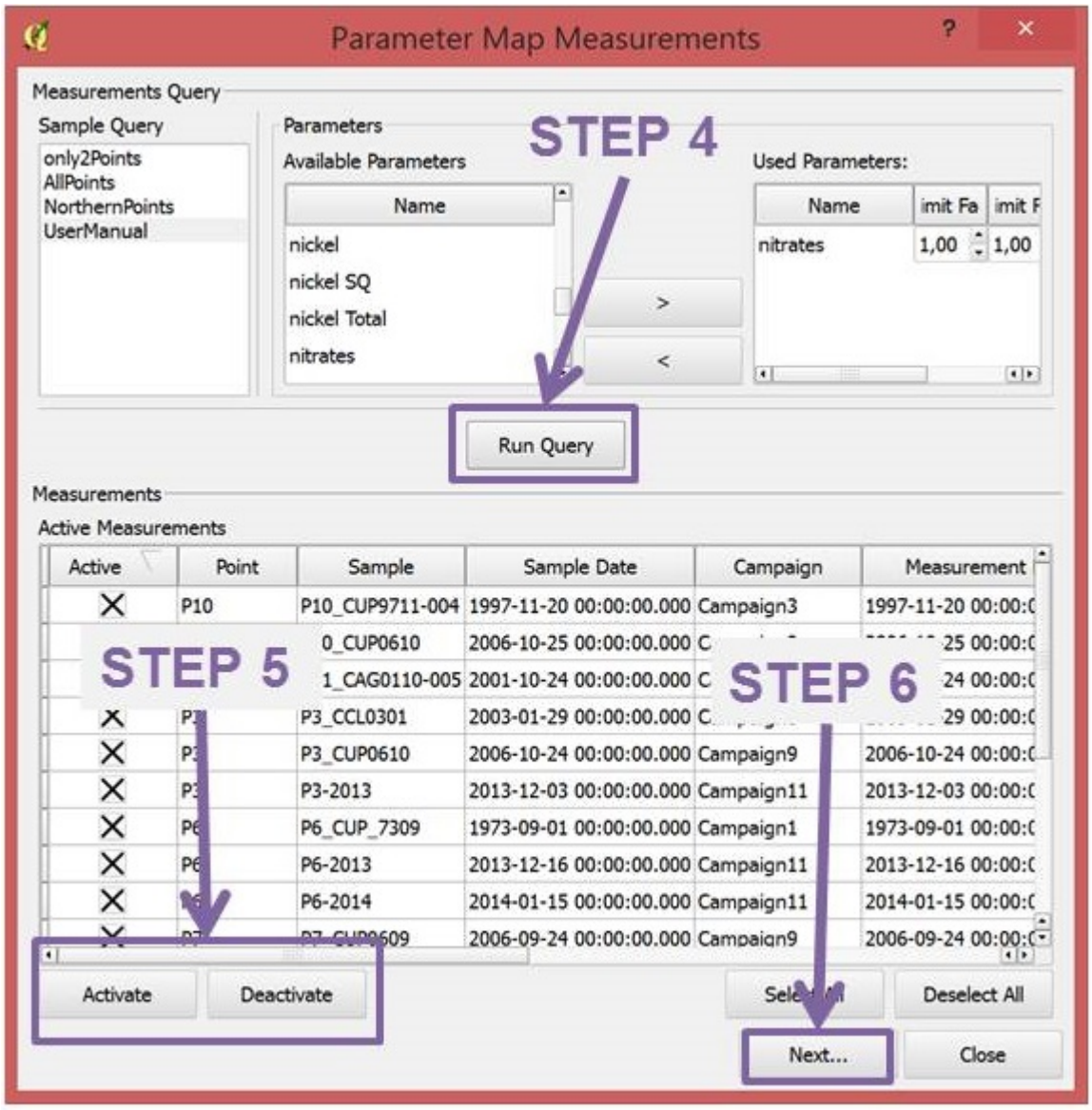
Use this command to obtain the minimum, maximum and average for each selected parameter, for the selected query and to represent these values in a map.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

STEP 2 Choose the parameter to be queried for the analysis.

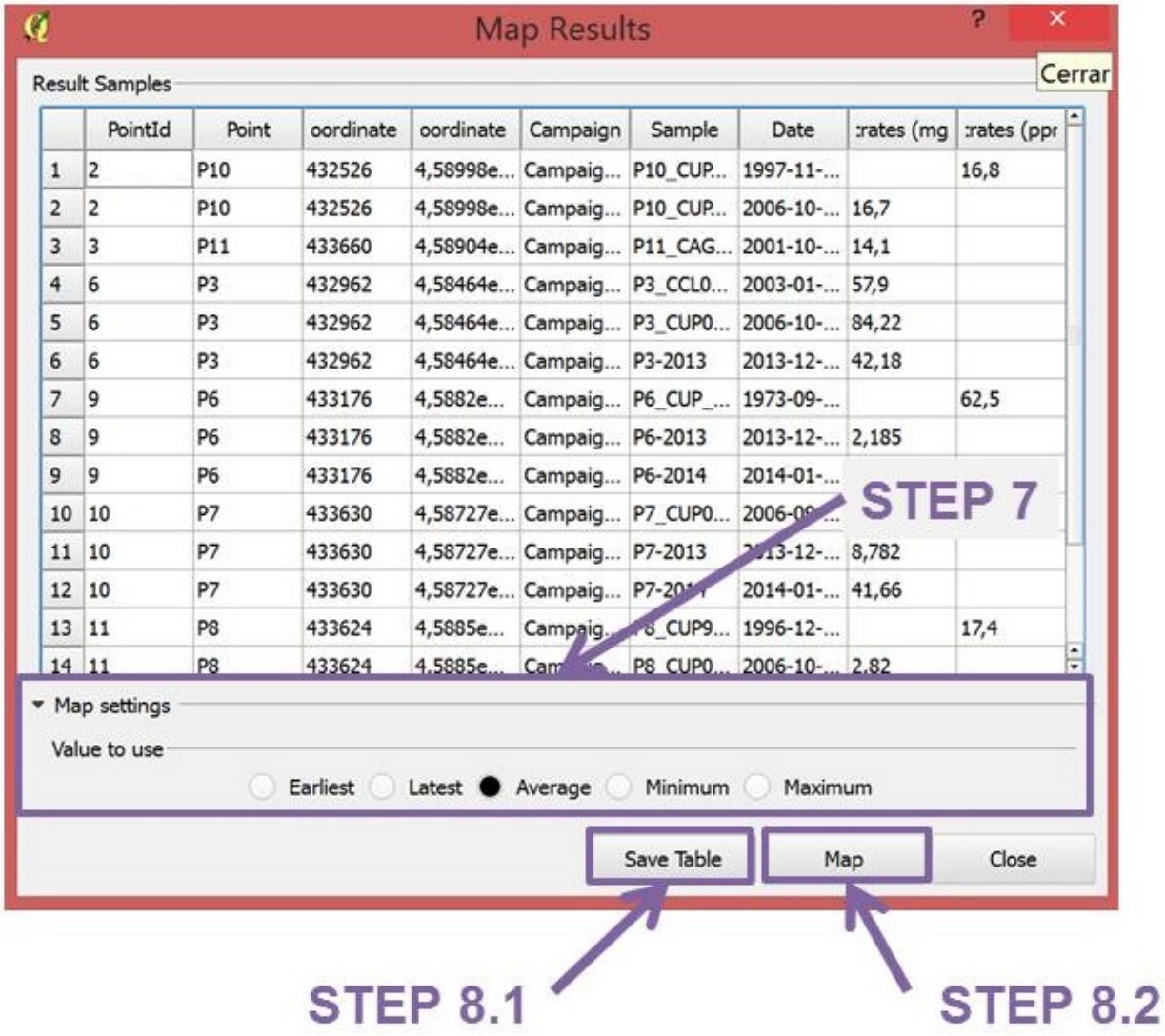
STEP 3 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



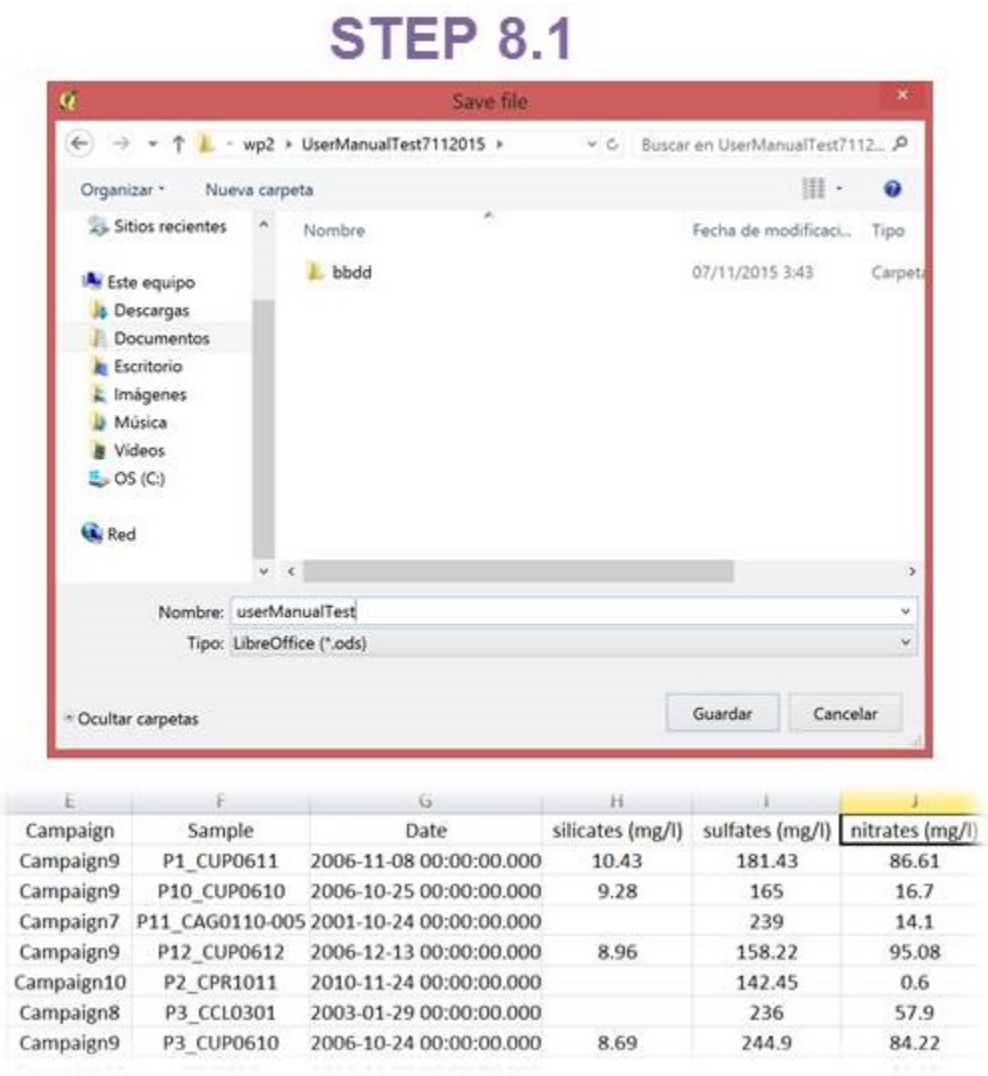
STEP 4 Run Query.

STEP 5 Use this commands to activate or deactivated the desired measurements.

STEP 6 Click Next.

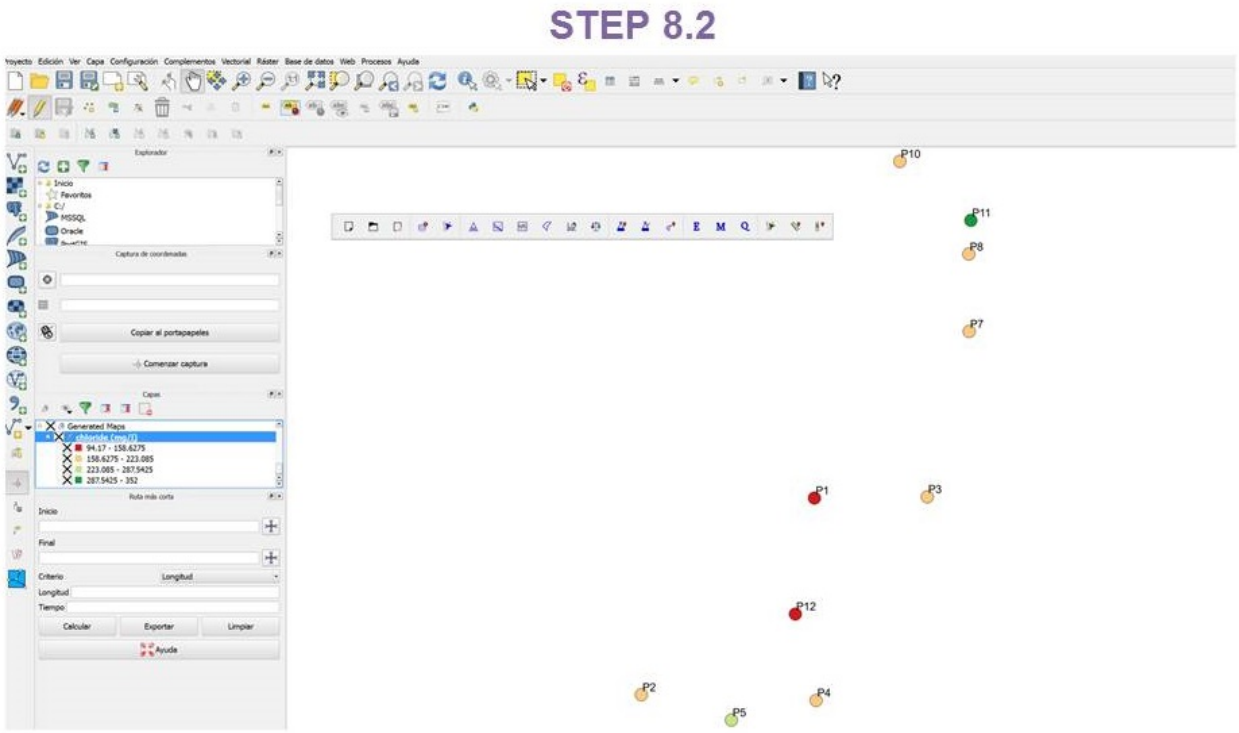


STEP 7 Map settings. Select the value to use in the map. Statistical calculations can be used to be represented in the maps such as average value, mean, minimum, etc.



Campaign	Sample	Date	silicates (mg/l)	sulfates (mg/l)	nitrates (mg/l)
Campaign9	P1_CUP0611	2006-11-08 00:00:00.000	10.43	181.43	86.61
Campaign9	P10_CUP0610	2006-10-25 00:00:00.000	9.28	165	16.7
Campaign7	P11_CAG0110-005	2001-10-24 00:00:00.000		239	14.1
Campaign9	P12_CUP0612	2006-12-13 00:00:00.000	8.96	158.22	95.08
Campaign10	P2_CPR1011	2010-11-24 00:00:00.000		142.45	0.6
Campaign8	P3_CCL0301	2003-01-29 00:00:00.000		236	57.9
Campaign9	P3_CUP0610	2006-10-24 00:00:00.000	8.69	244.9	84.22

STEP 8.1 Save query results in different formats.

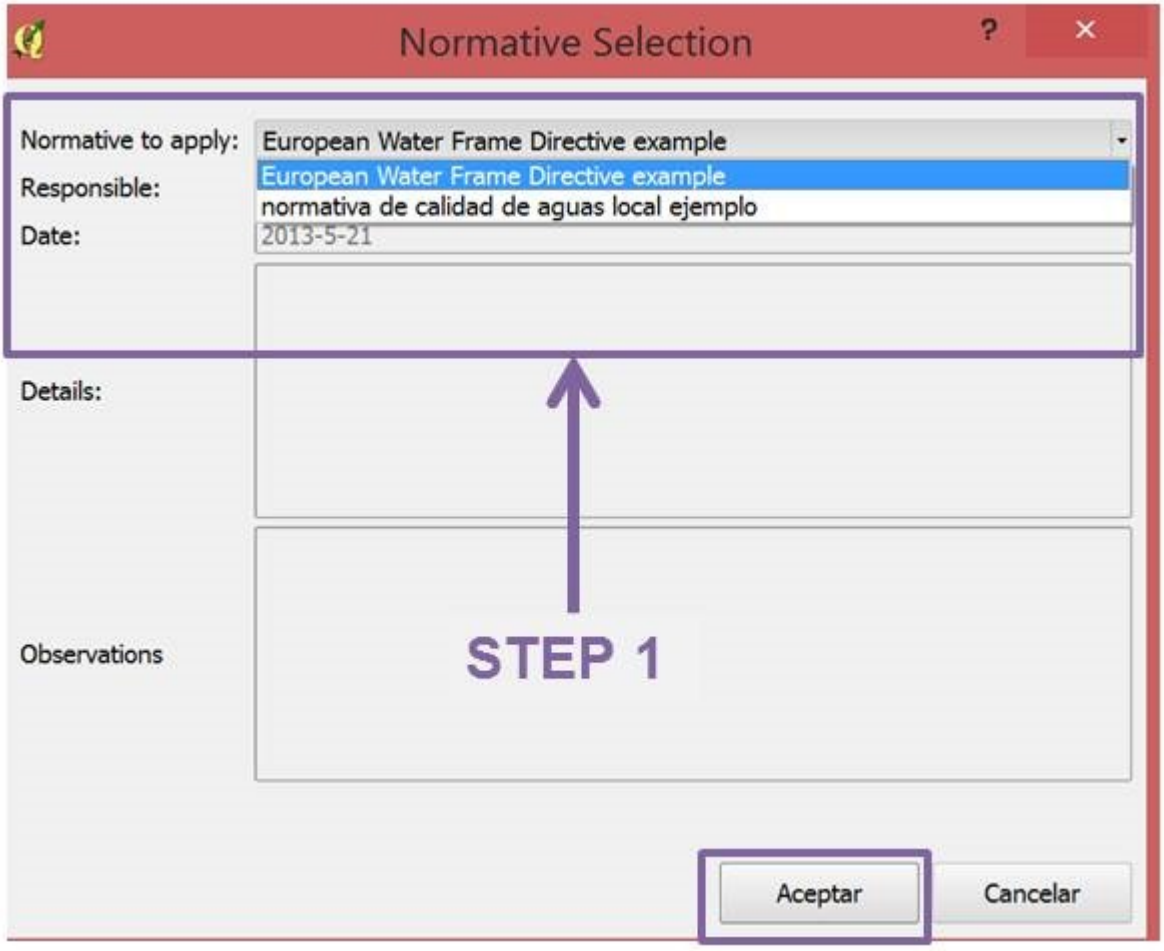


STEP 8.2 This button creates automatically the map with the selected values.

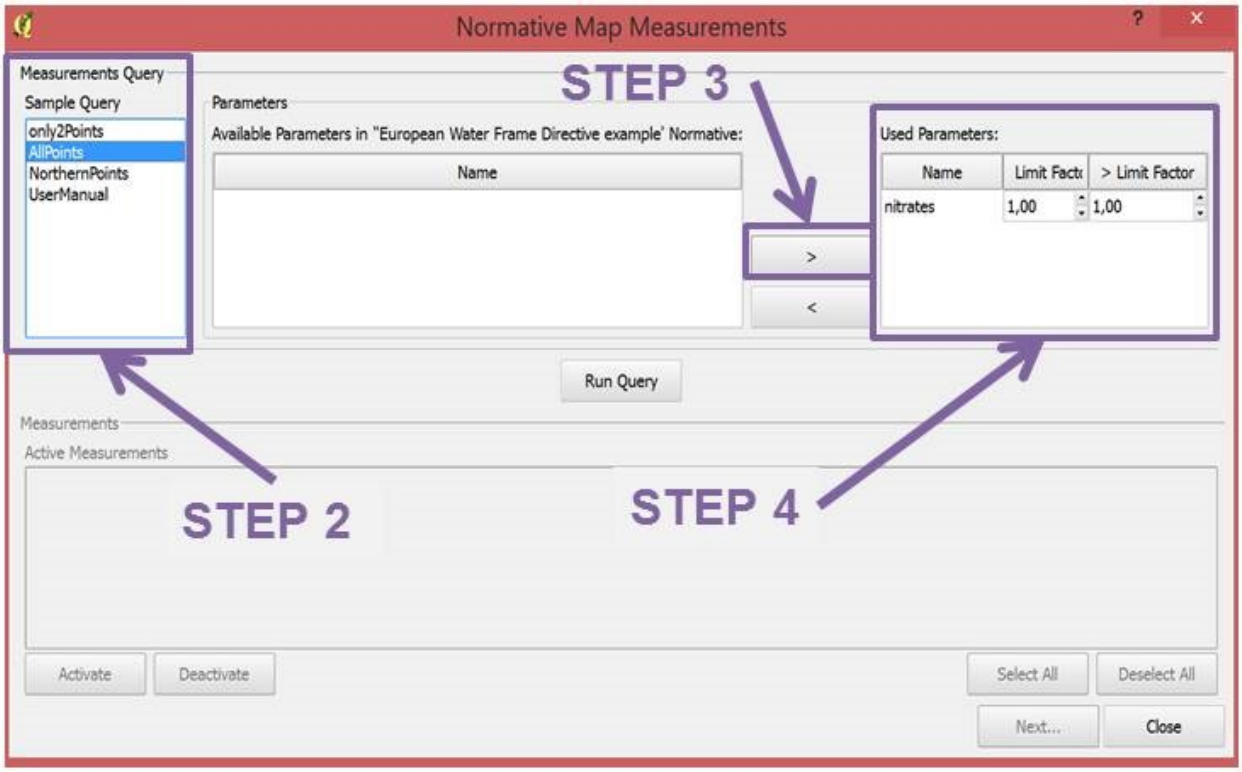
Parameter Normative Map



This command enables the user to obtain thematic maps for the queried parameters, classified according to the threshold approach established by a given guideline (e.g. Water Framework Directive).



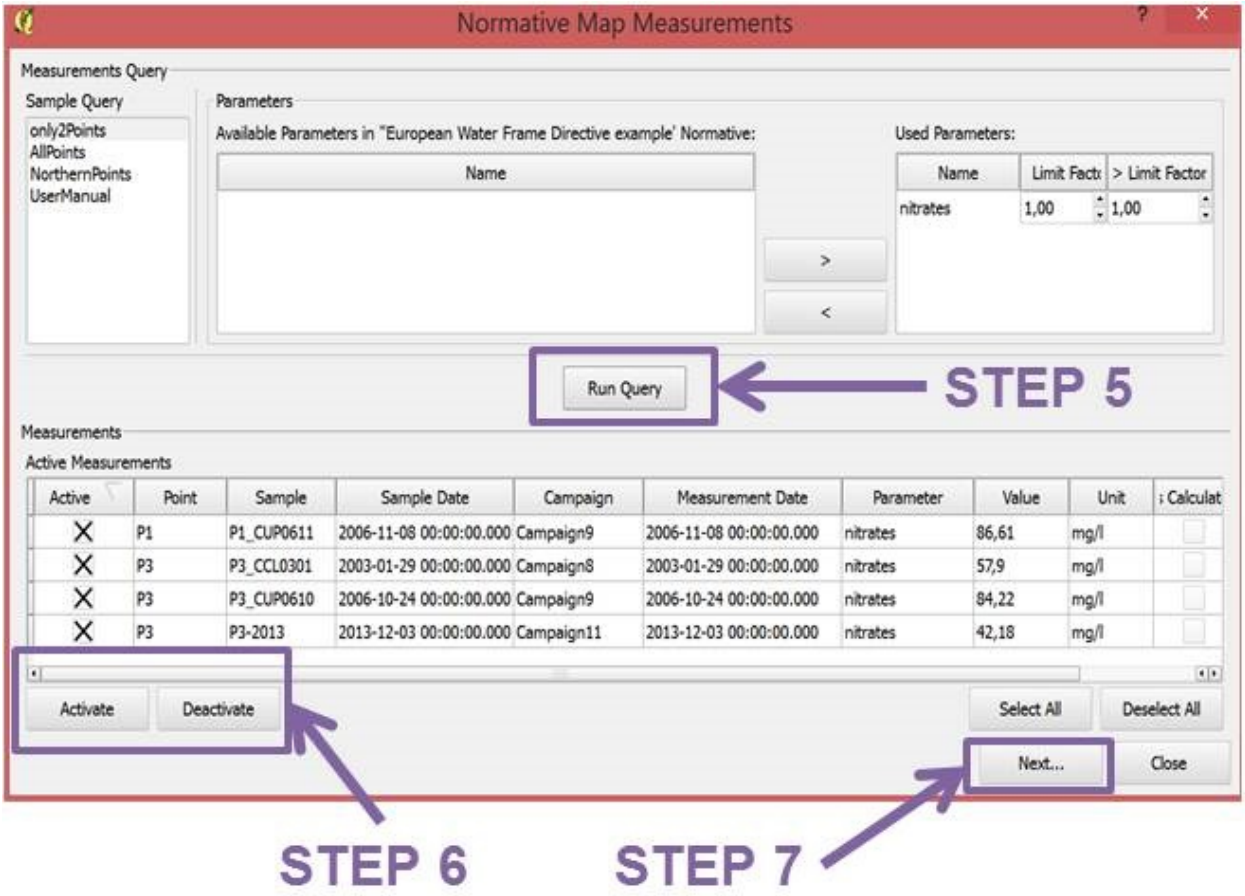
STEP 1 Choose the Normative to be applied (The different normatives and the threshold values must to be entered in the database, in the tables *Normatives* and *Normatives Parameters*) and click accept. For further information about the contain of this table, please see the Chapter 4.



STEP 2 Choose the Query created previously with the tool shown in section 2.2.

STEP 3 Choose the parameter to be queried for the analysis.

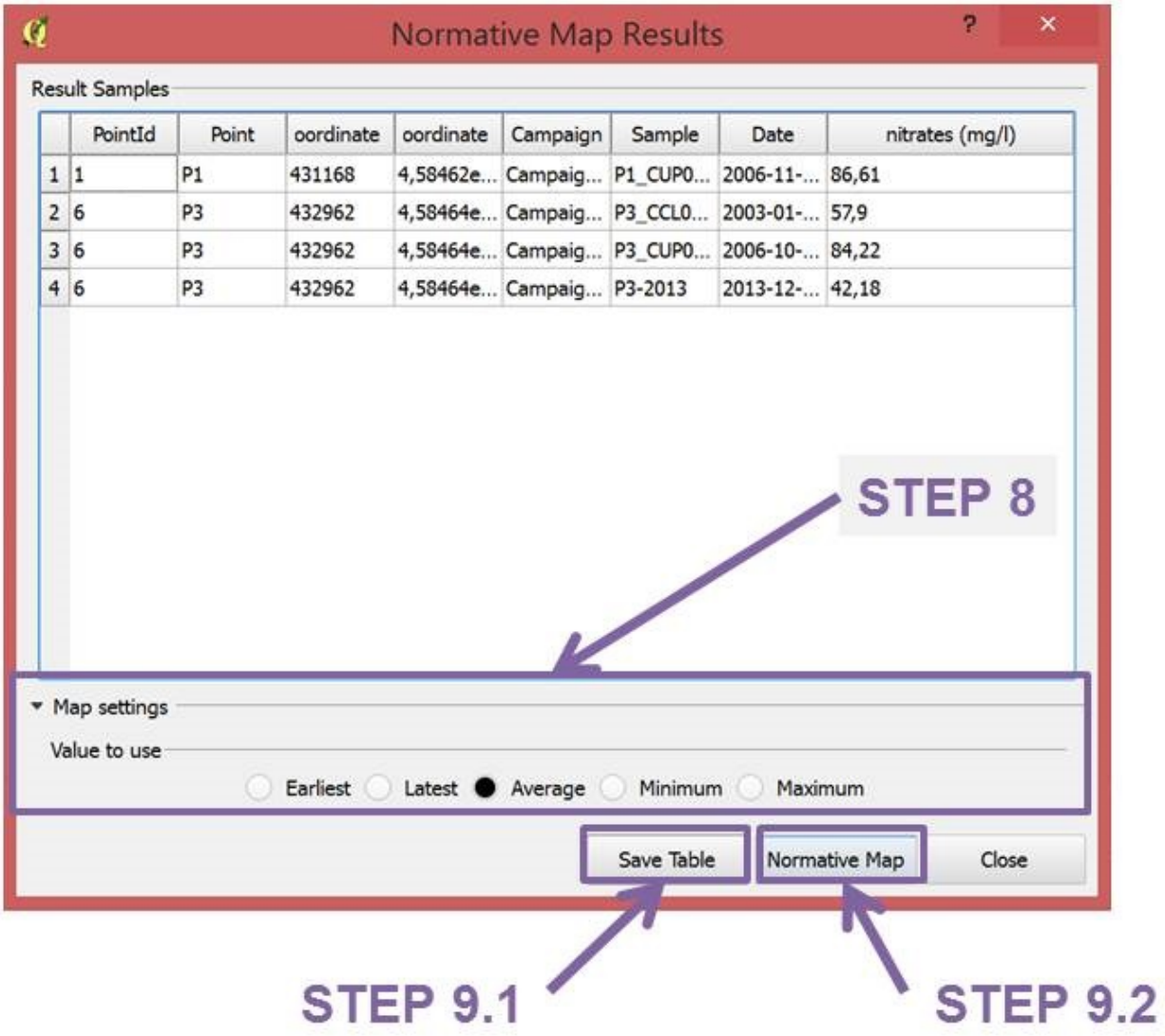
STEP 4 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



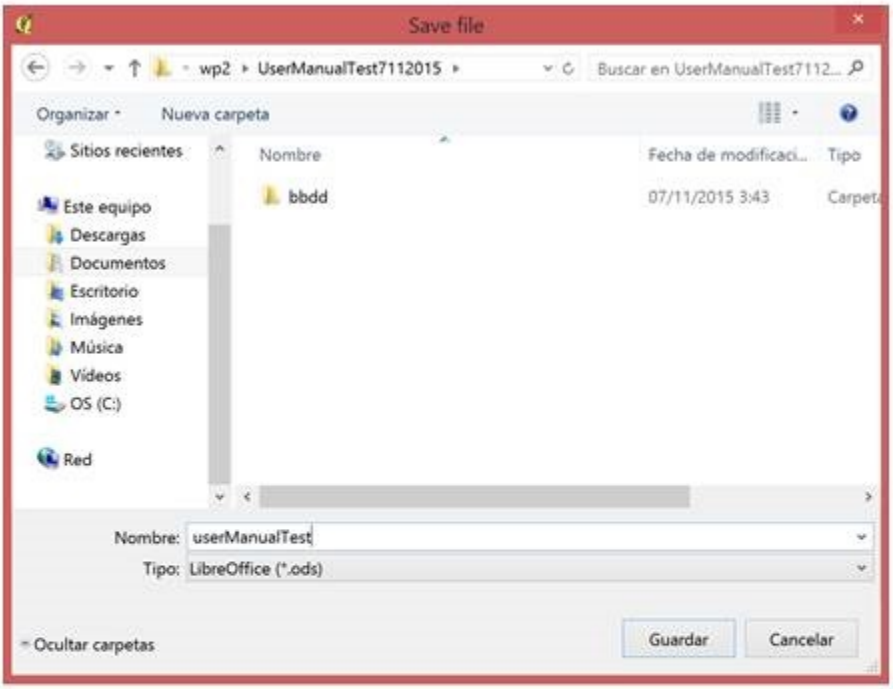
STEP 5 Run Query.

STEP 6 Use this commands to activate or deactivated the desired measurements.

STEP 7 Click Next.

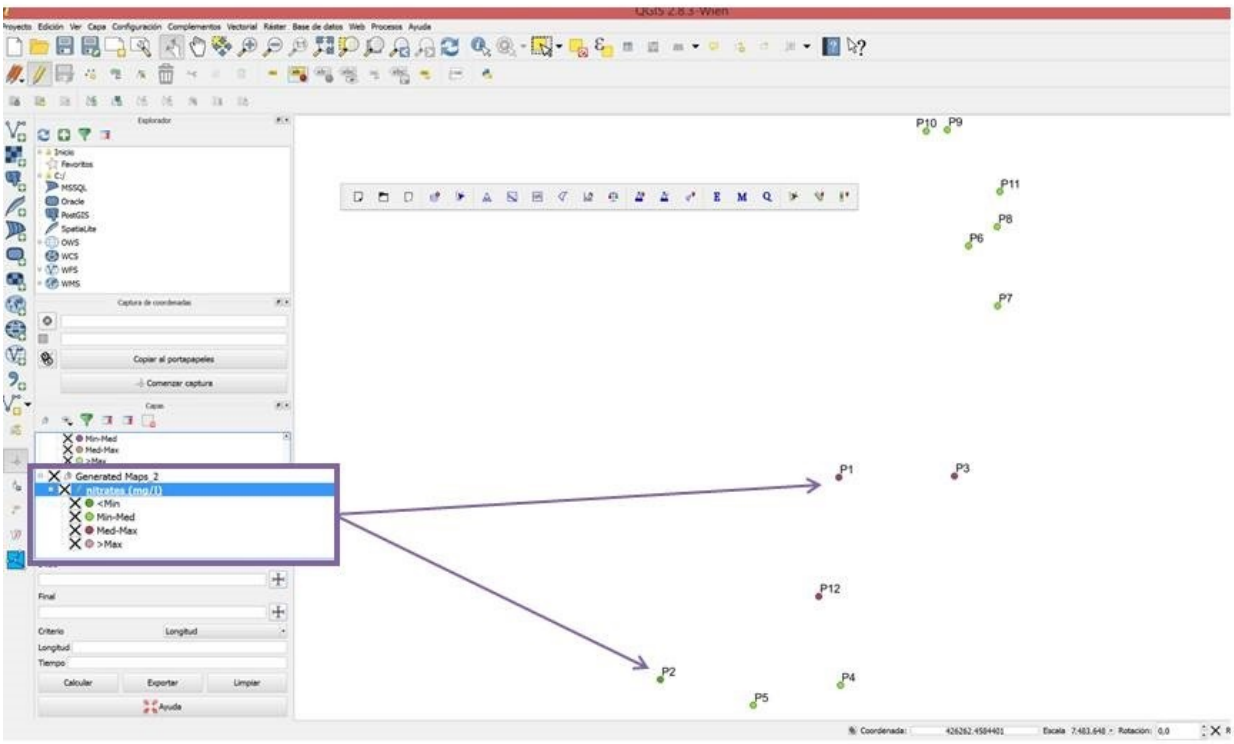


STEP 8 Map settings. Select the value to use in the map. Statistical calculations can be used to be represented in the maps such as average value, mean, minimum, etc.



E	F	G	H	I	J
Campaign	Sample	Date	silicates (mg/l)	sulfates (mg/l)	nitrates (mg/l)
Campaign9	P1_CUP0611	2006-11-08 00:00:00.000	10.43	181.43	86.61
Campaign9	P10_CUP0610	2006-10-25 00:00:00.000	9.28	165	16.7
Campaign7	P11_CAG0110-005	2001-10-24 00:00:00.000		239	14.1
Campaign9	P12_CUP0612	2006-12-13 00:00:00.000	8.96	158.22	95.08
Campaign10	P2_CPR1011	2010-11-24 00:00:00.000		142.45	0.6
Campaign8	P3_CCL0301	2003-01-29 00:00:00.000		236	57.9
Campaign9	P3_CUP0610	2006-10-24 00:00:00.000	8.69	244.9	84.22

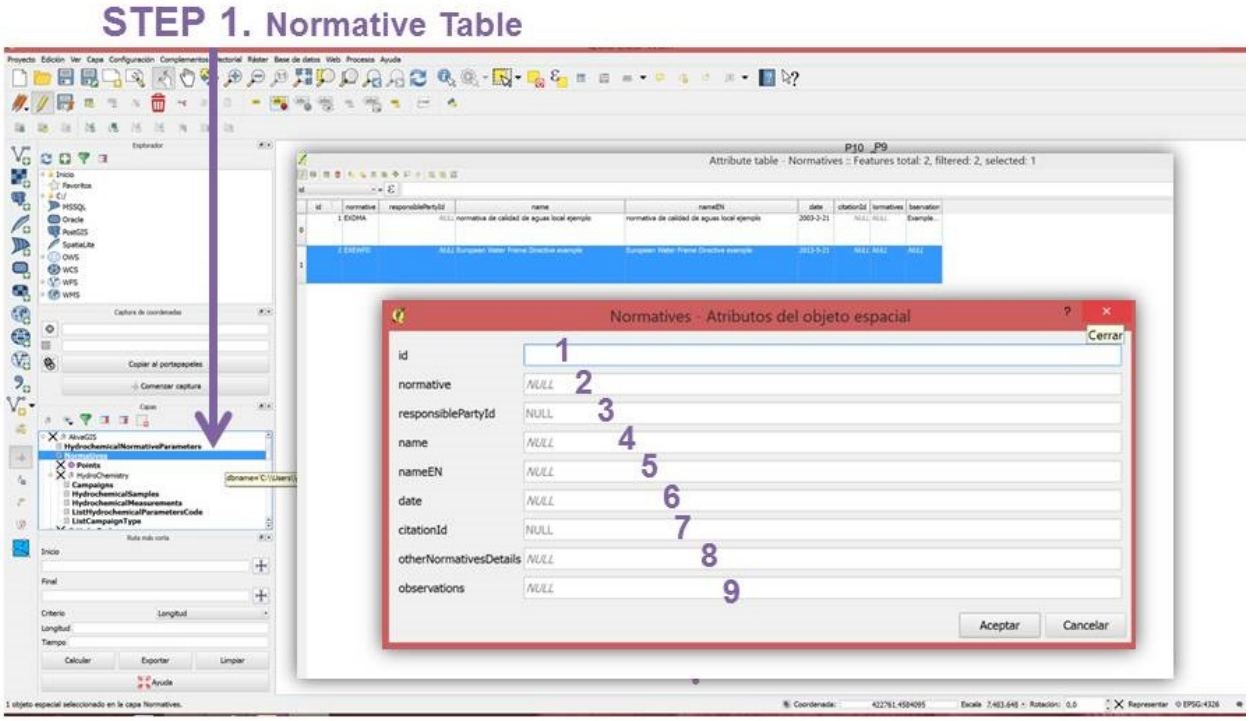
STEP 9.1 Save query results in different formats.



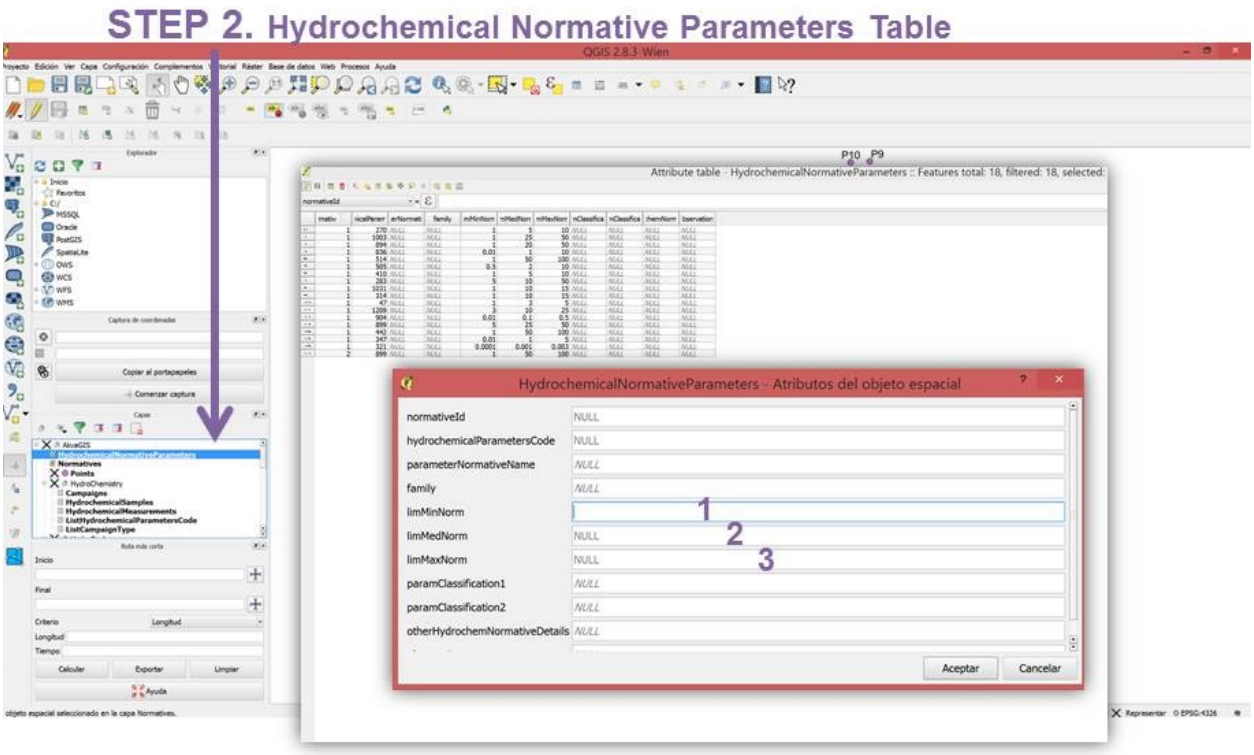
STEP 9.2 This button creates automatically the map with the selected parameter.

How to edit / add new normatives and its limit values?

STEP1 Edit or add a new normative if is not included in the table *Normatives*. Select and open attribute table. Here, some information has to be added:



1. Id number.
2. Short name of the normative.
3. Responsible entity of this normative. In case this entity is not in the list, add a new entity in the *Responsible Party Table*.
4. Long name of the normative in native language (recommended).
5. Long name of the normative in English (recommended).
6. Date of the normative (recommended).
7. Citation of the document where the normative is described. In case the citation is not in the list, add a new citation in the table *Citation* (from the TOC) (recommended).
8. Other normatives details (recommended).
9. Observations (recommended).

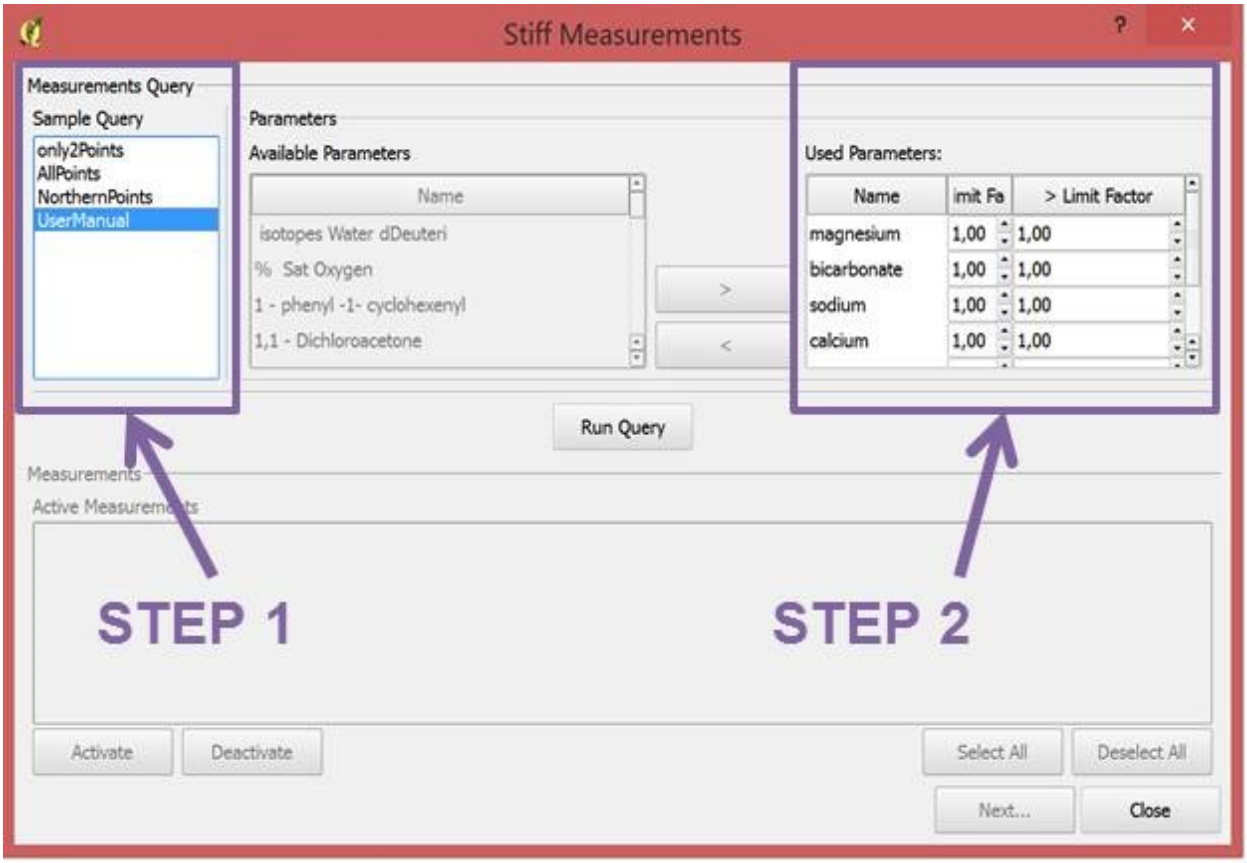


STEP 2 Add/editing threshold values for each parameter for each normative. The user can introduce 3 limits: Minimum (a), Medium (b) and Maximum (c) in *Hydrochemical Normative Parameter* table.

Stiff Diagram map

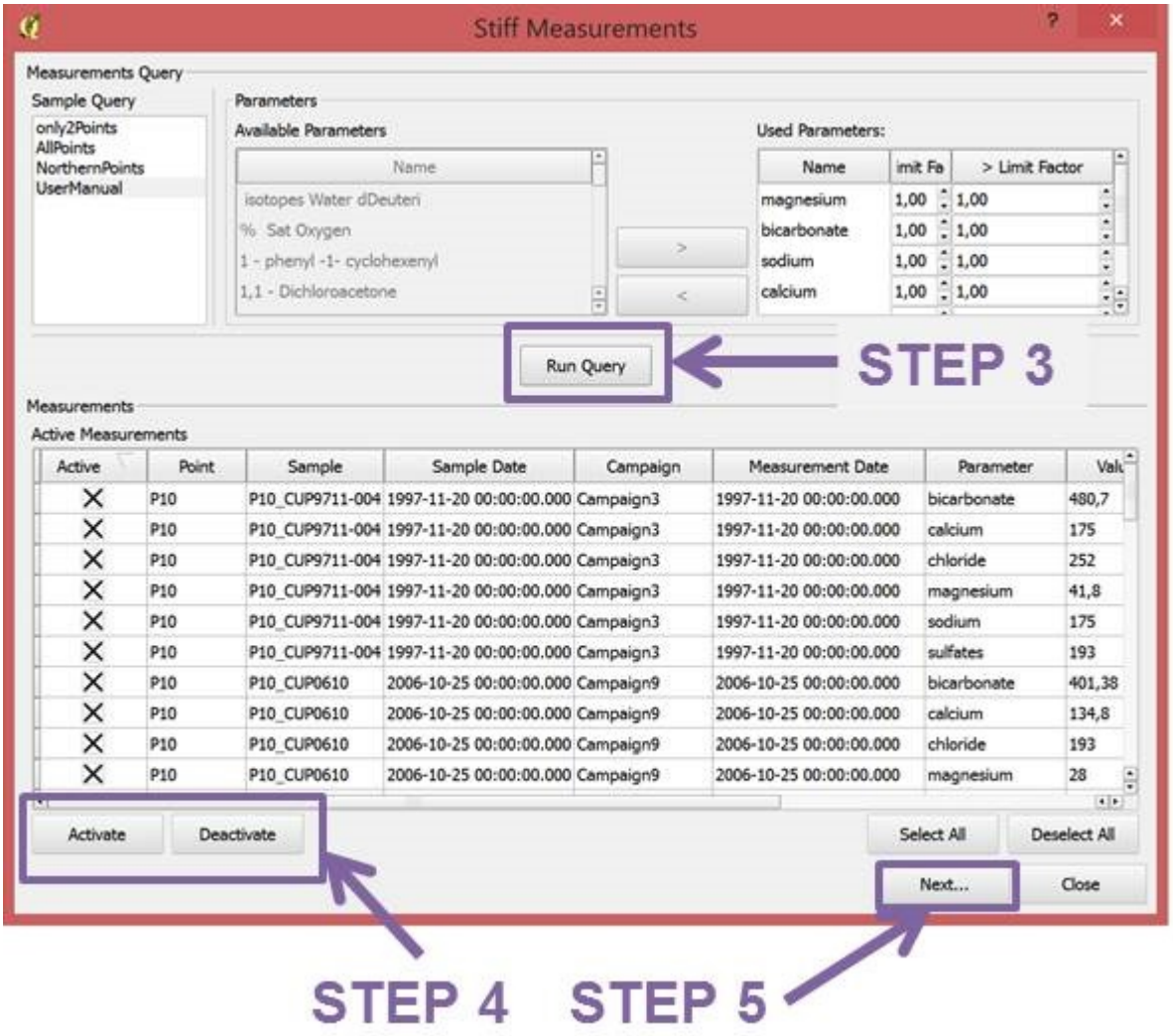


Use this command to create the Stiff diagram map for the selected query created previously with the tool shown in section 2.2. For obtaining single stiff diagrams, use command Stiff Plot Tool in section 2.11. This diagram will be created only if the measurements required for the creation of this diagram are avalaible.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

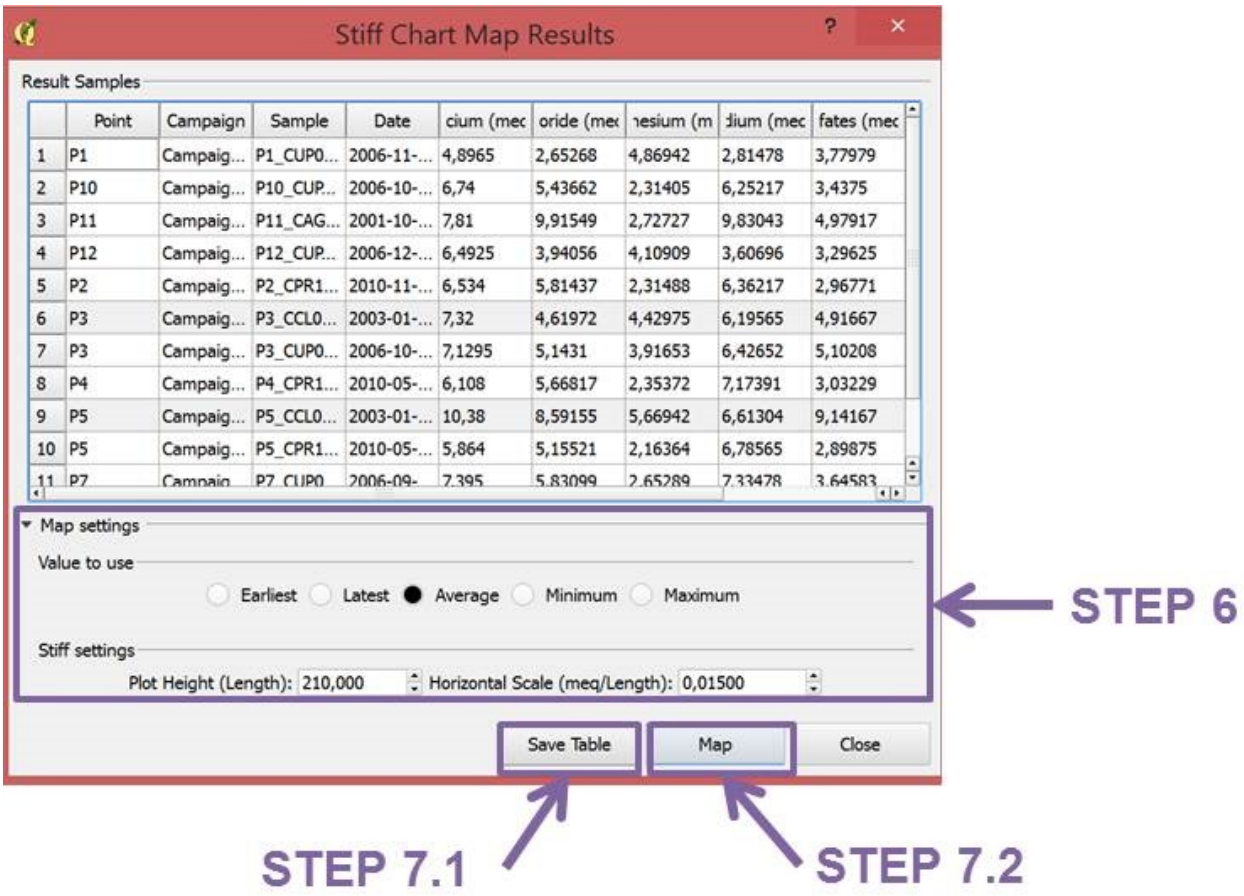
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



STEP 3 Run Query.

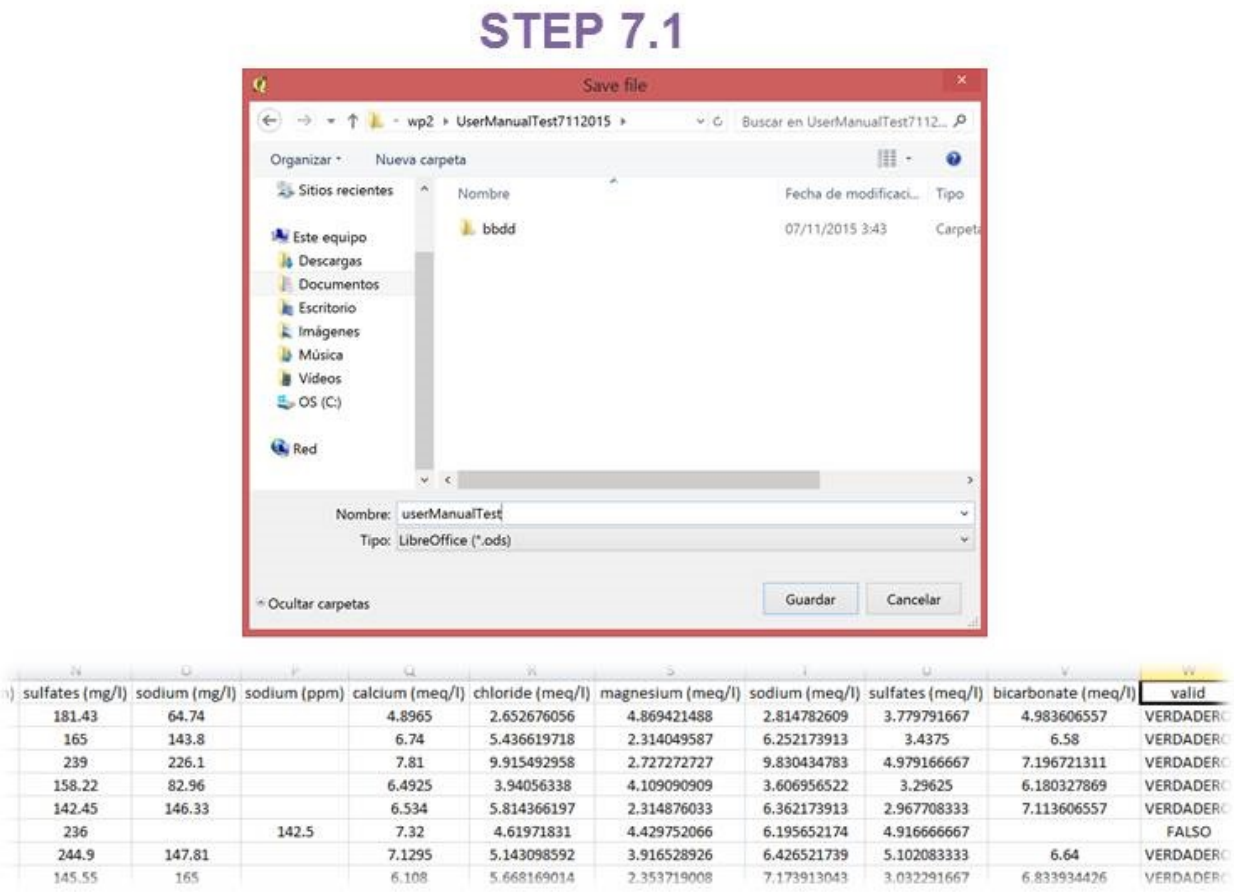
STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.



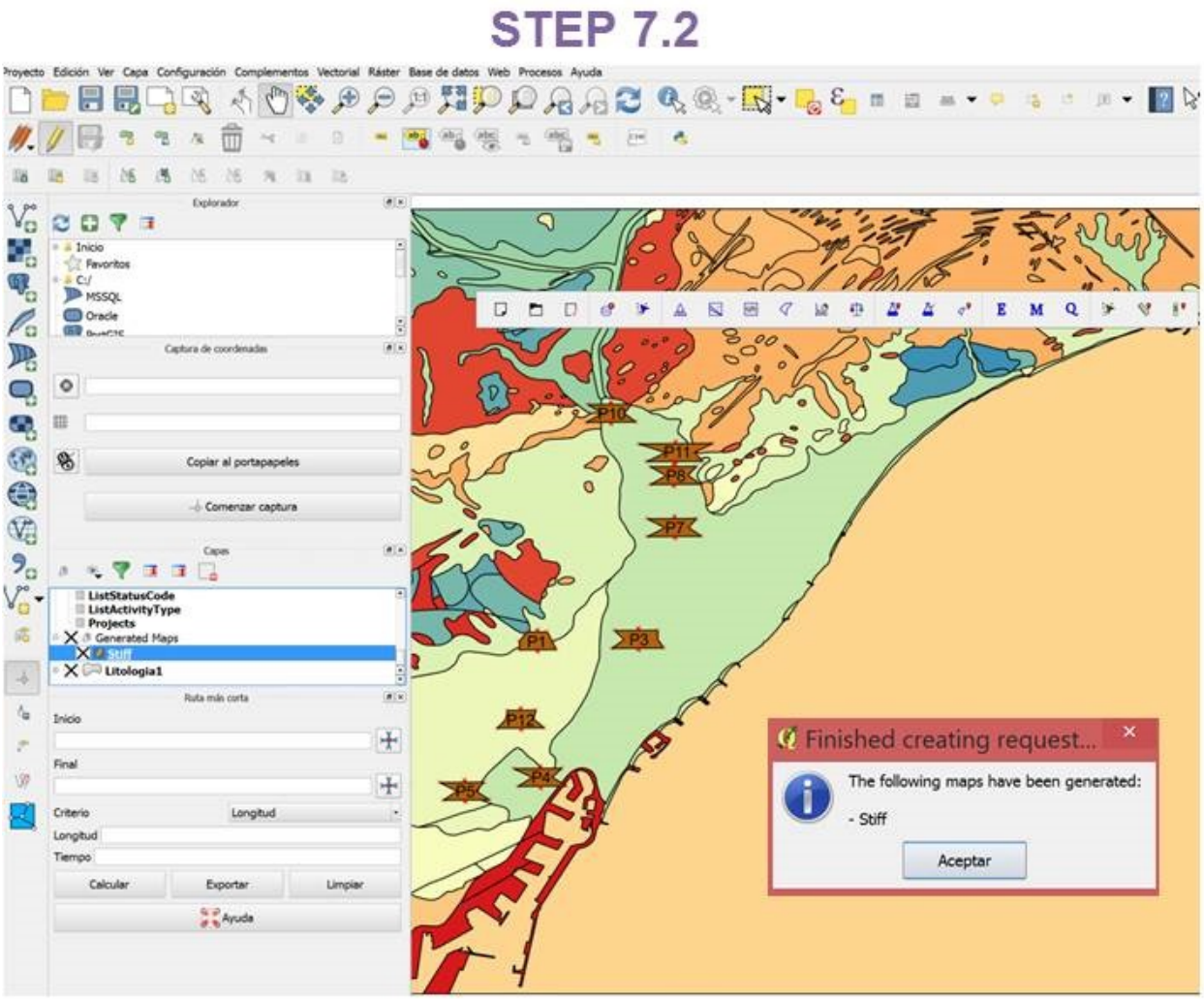
STEP 6 Map settings. Select the value to use in the map. Statistical calculations can be used to be represented in the maps such as average value, mean, minimum, etc.

Stiff settings. Choose the plot height and the horizontal scale. To plot settings such as stiff colour see layer properties.



sulfates (mg/l)	sodium (mg/l)	sodium (ppm)	calcium (meq/l)	chloride (meq/l)	magnesium (meq/l)	sodium (meq/l)	sulfates (meq/l)	bicarbonate (meq/l)	valid
181.43	64.74		4.8965	2.652676056	4.869421488	2.814782609	3.779791667	4.983606557	VERDADERO
165	143.8		6.74	5.436619718	2.314049587	6.252173913	3.4375	6.58	VERDADERO
239	226.1		7.81	9.915492958	2.727272727	9.830434783	4.979166667	7.196721311	VERDADERO
158.22	82.96		6.4925	3.94056338	4.109090909	3.606956522	3.29625	6.180327869	VERDADERO
142.45	146.33		6.534	5.814366197	2.314876033	6.362173913	2.967708333	7.113606557	VERDADERO
236		142.5	7.32	4.61971831	4.429752066	6.195652174	4.916666667		FALSO
244.9	147.81		7.1295	5.143098592	3.916528926	6.426521739	5.102083333	6.64	VERDADERO
145.55	165		6.108	5.668169014	2.353719008	7.173913043	3.032291667	6.833934426	VERDADERO

STEP 7.1 Save Stiff query results in different formats such as .ods.



STEP 7.2 Plot Stiff diagram automatically. The resulting layer will be automatically loaded into the bottom of the Layer Panel.

Export Tools



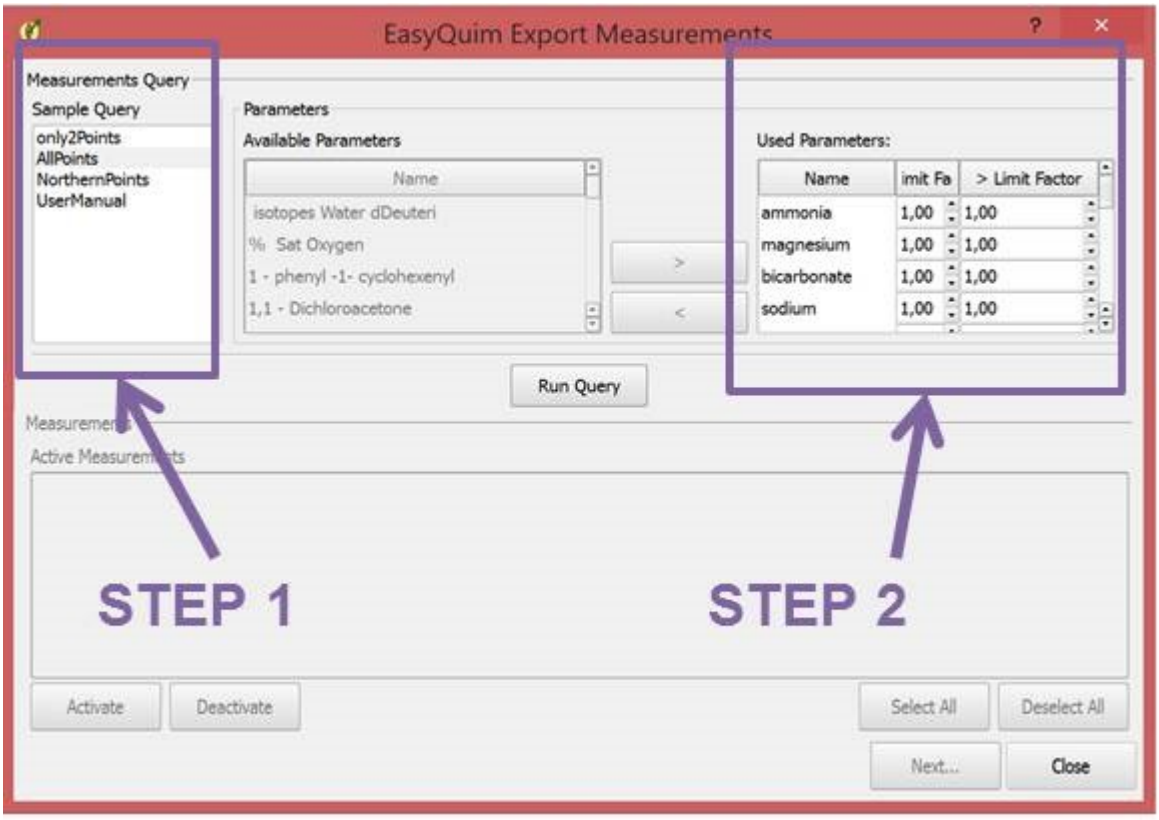
This set of tools enables us to use different query criteria to be exported to external formats (e.g. ods, xls or csz files). In addition allow us to export the query data to further external platforms (e.g. Easy_Quim, MIX or Statistical Tools).

For more information see: http://h2ogeo.upc.edu/en/investigation-hydrogeology/software

Export Major Ions

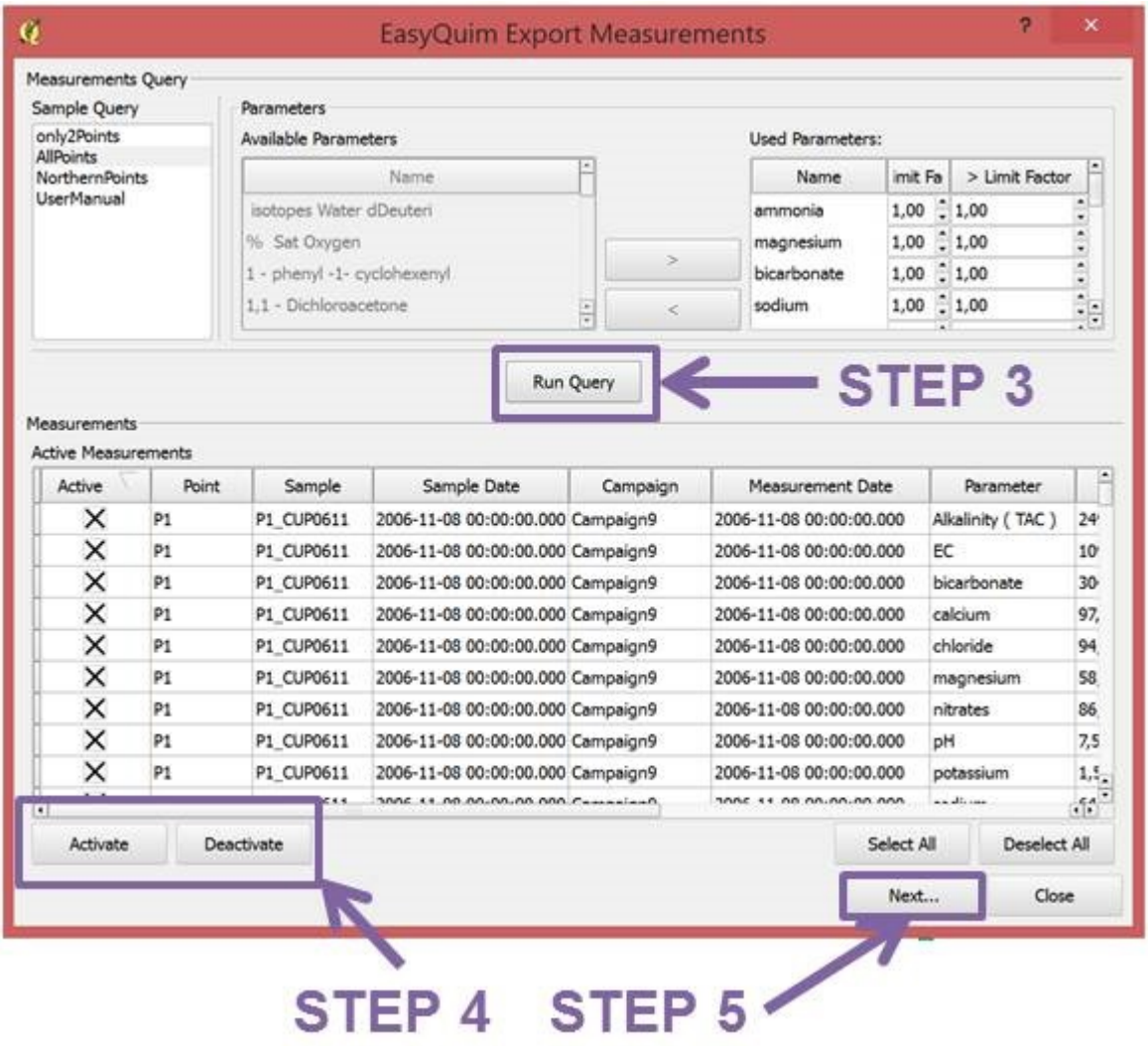


This tool provides a query form that enables the user to automatically query the common major ions of the selected sample query.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

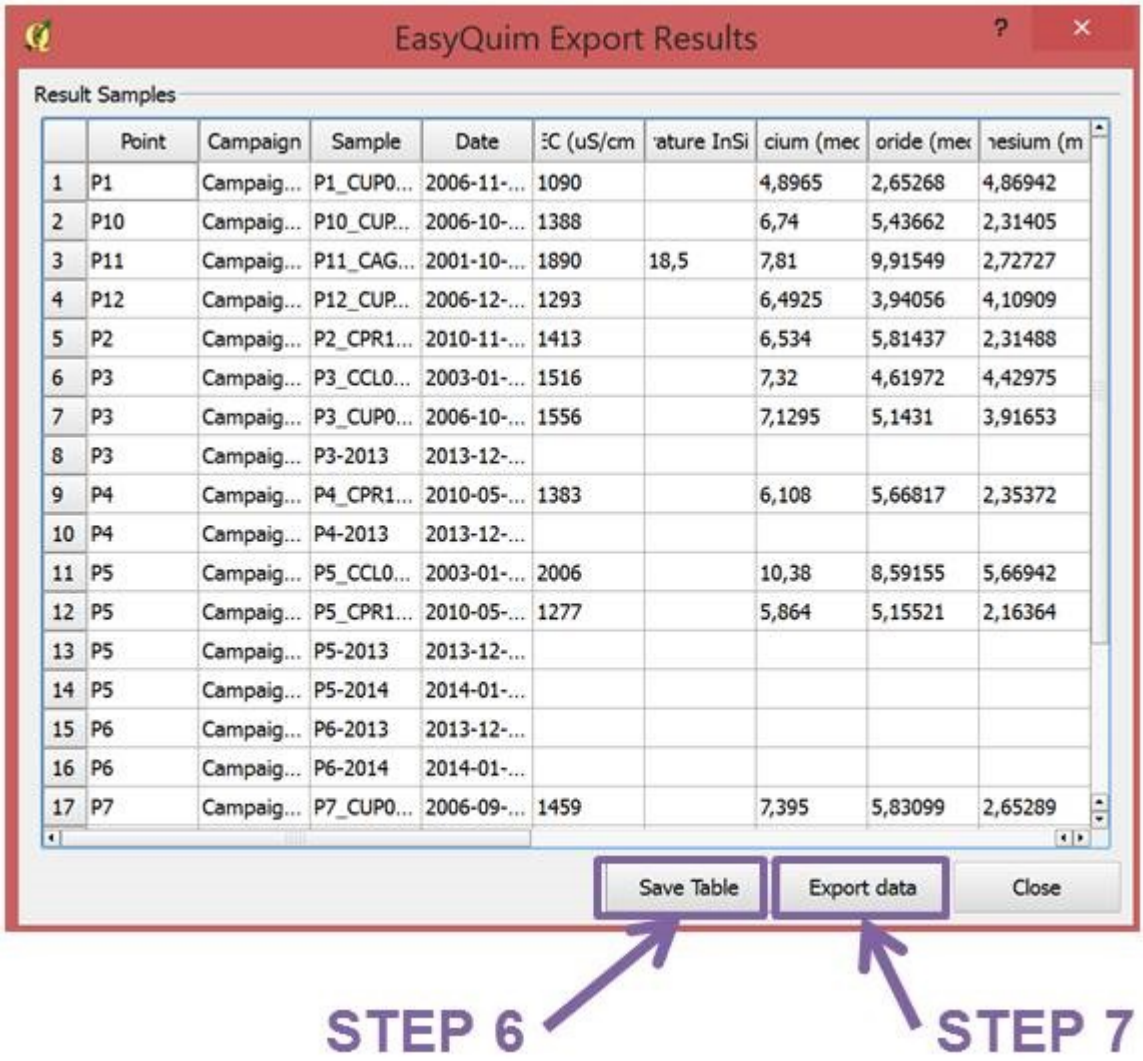
STEP 2 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



STEP 3 Run Query.

STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.



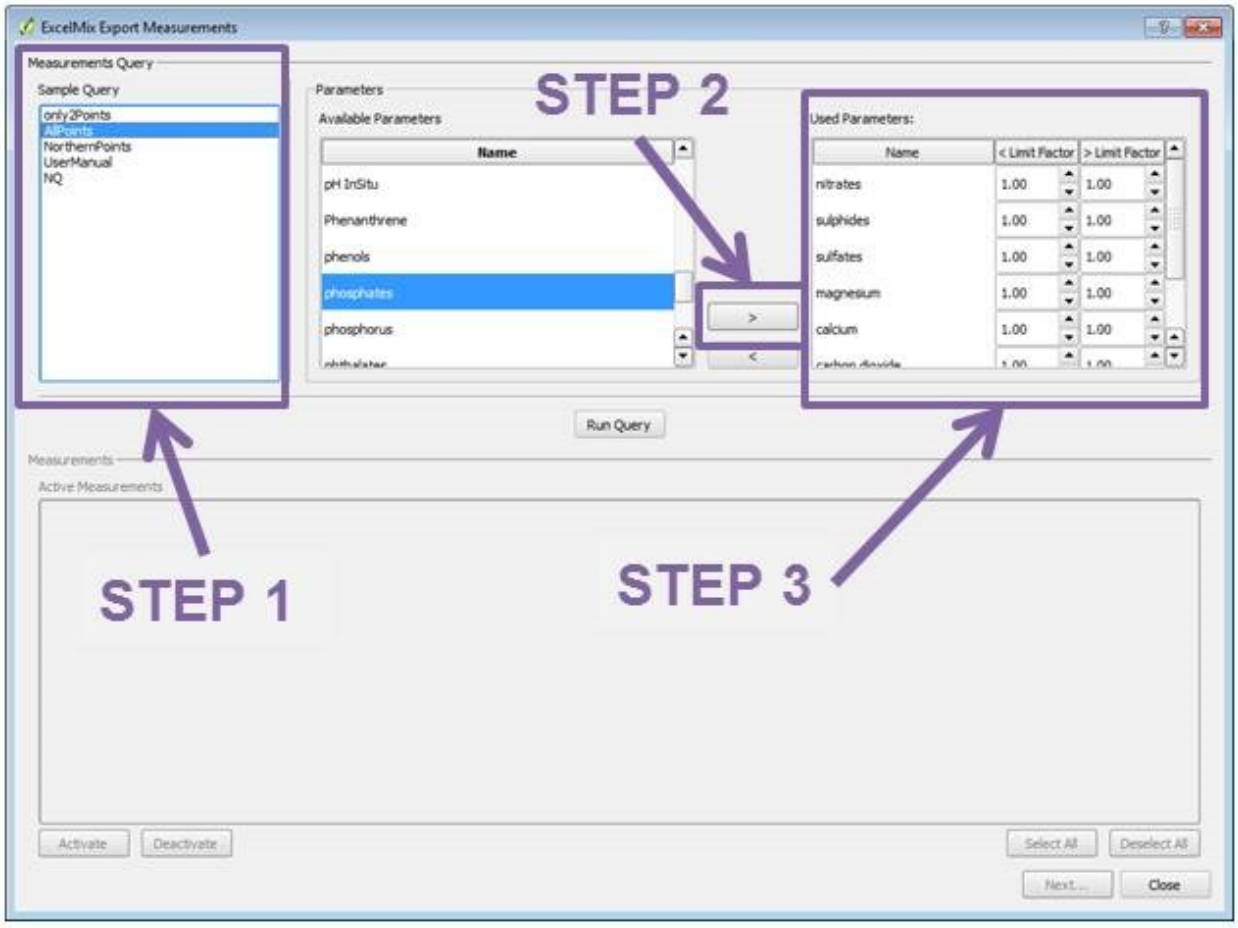
STEP 6 Save table where the selected parameters for the selected points are shown.

STEP 7 Export query results to different formats (.xls, .csv, .ods) including the query of the major ions for the selected Query (i.e. for the selected points in the desired intervals). The resulting spreadsheet follows the required format of EasyQuim.

Export to Mixing



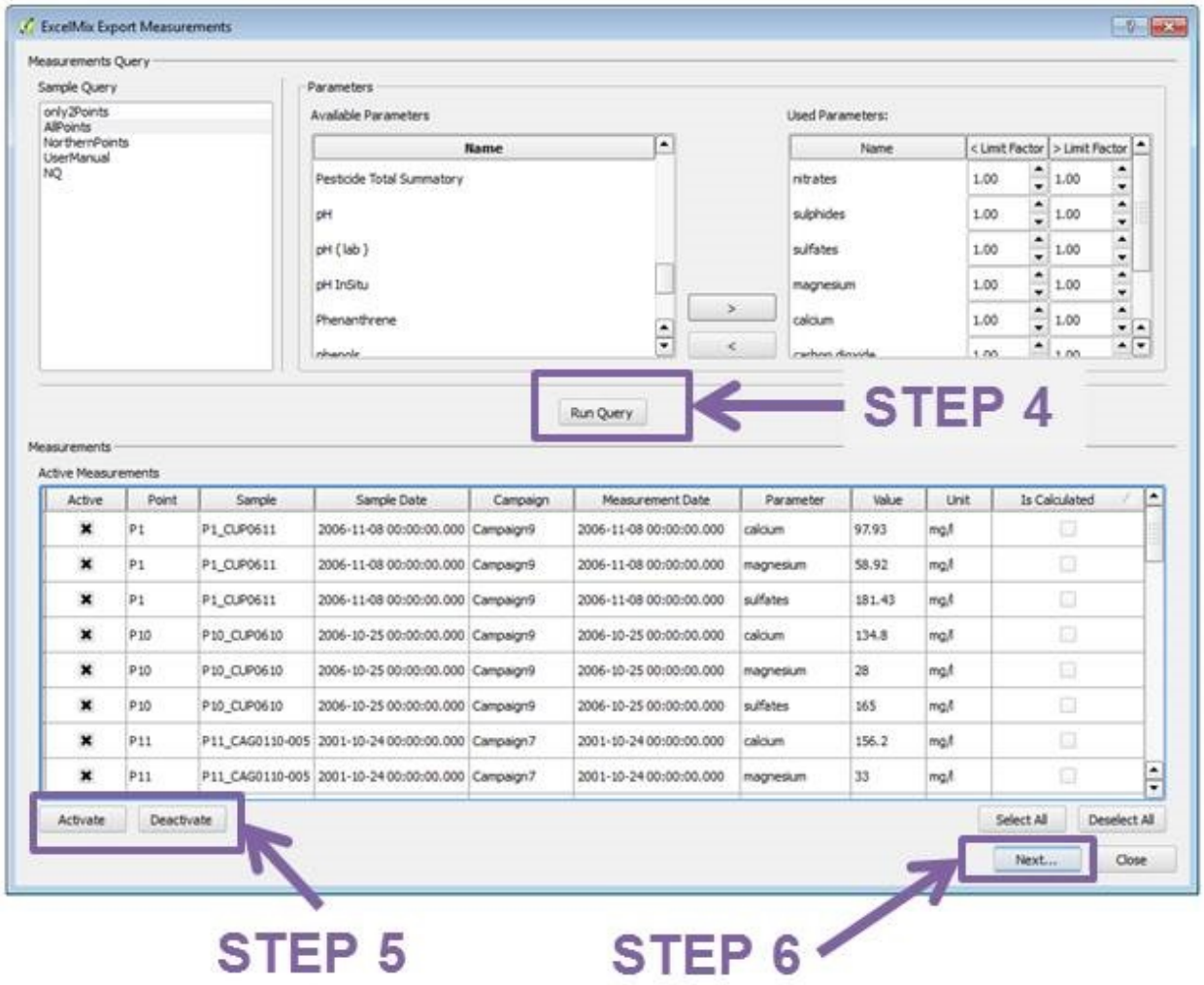
This tool provides a query form that enables the user to apply different query criteria oriented to evaluate the mixing ratios of the samples. As result, a classification of the samples in end members(that is, samples that represents the extreme composition of a mixing) or in samples members can be obtained for the selected parameters.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

STEP 2 Choose the parameter to be queried for the analysis.

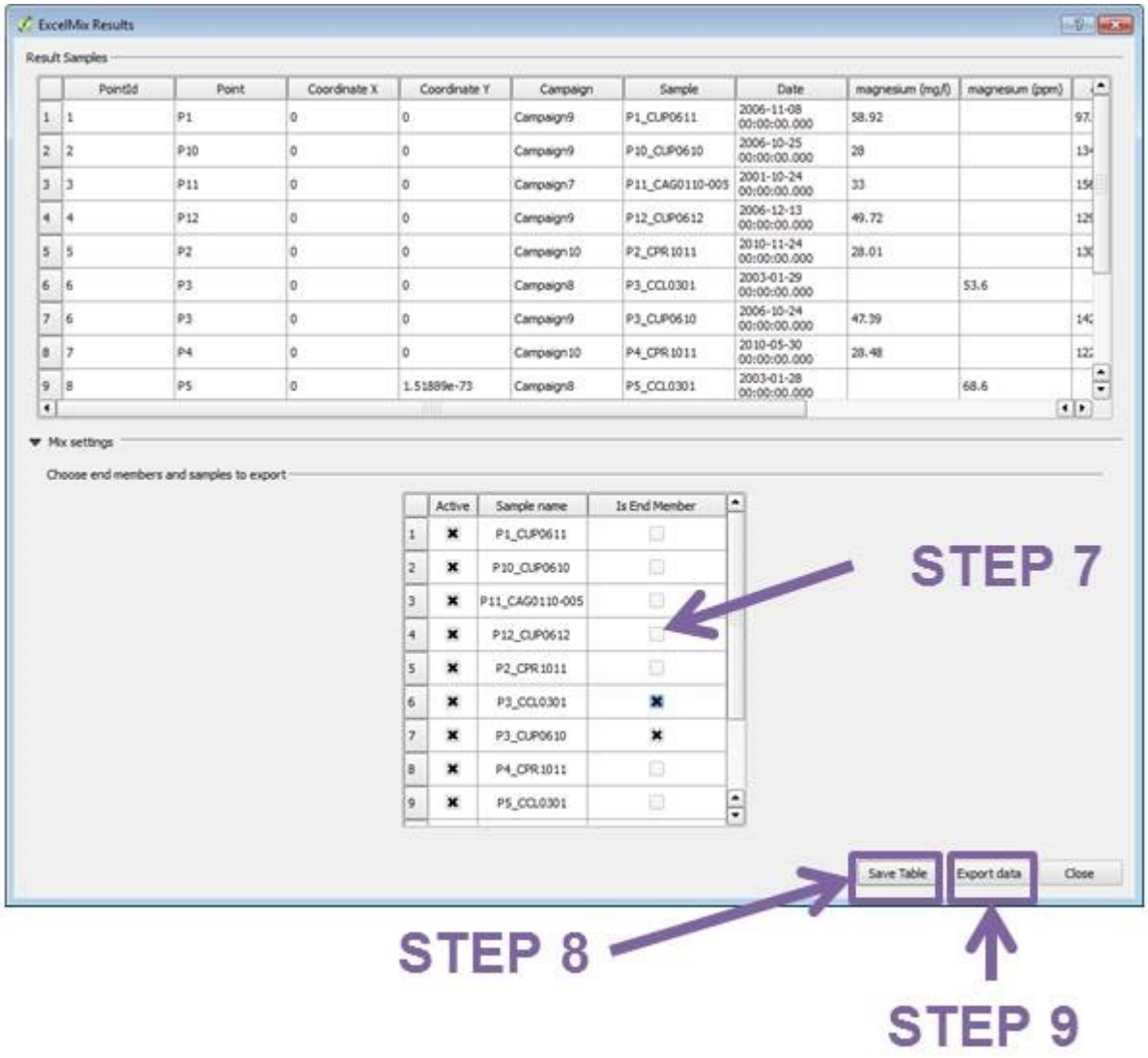
STEP 3 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



STEP 4 Run Query.

STEP 5 Use this commands to activate or deactivated the desired measurements.

STEP 6 Click Next.



STEP 7 Select the end member. If the sample is not selected, it is considered as sample. Here the user select if the sample is a mixing of the recharge sources or an end member (unique recharge source sample).

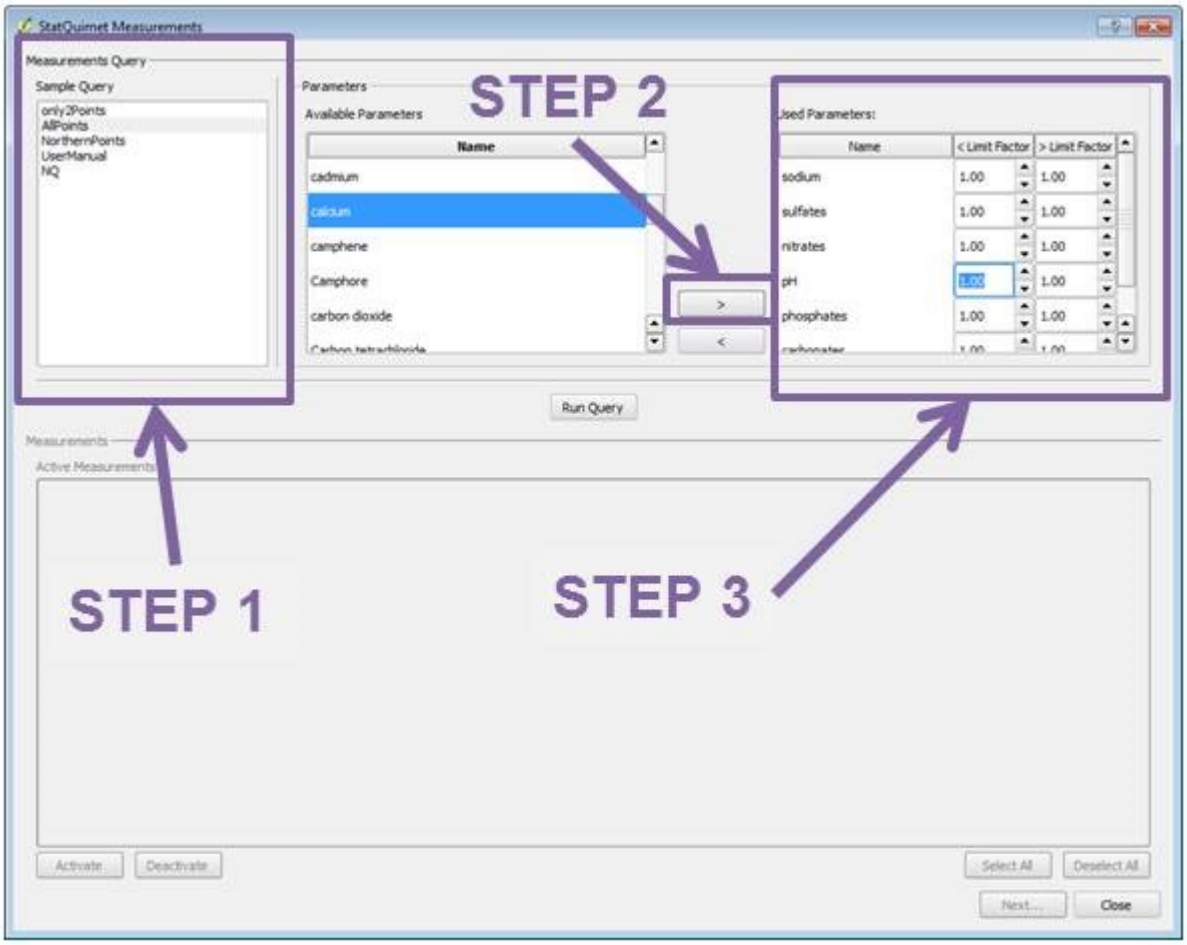
STEP 8 Save table where the selected parameters for the selected points are shown.

STEP 9 Export query results to different portable format (e.g. .xls, .csv,.ods) including the query of end members and sample members. The resulting spreadsheet follows the required format of Mix.

Export to Statistical Analysis



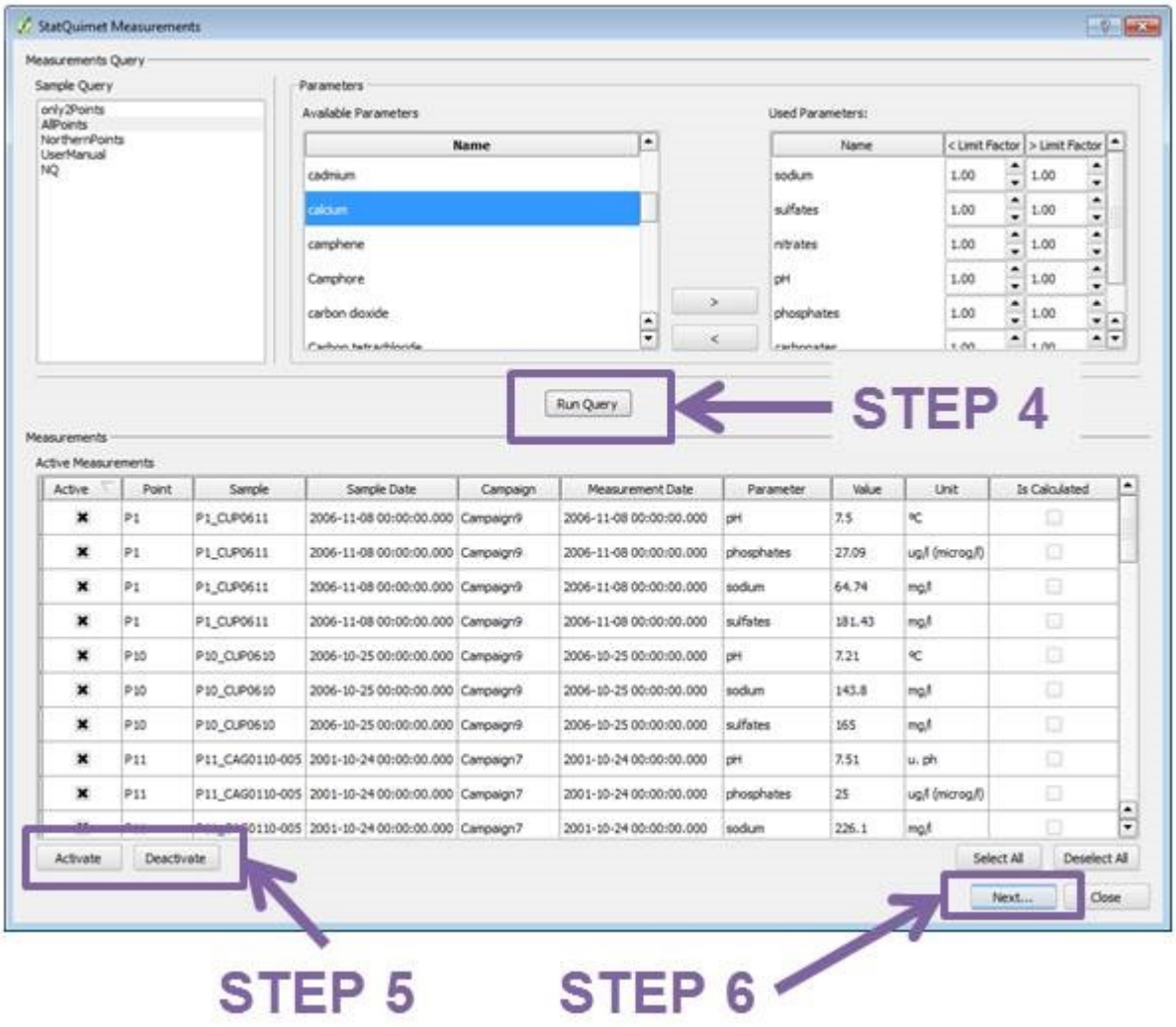
This tool enables us to obtain for the selected query sample and for the selected parameters different portable reports for further analysis (e.g. further statistical analysis). The statistical analysis performed with the related external platform could provide additional statistical anlysis to the statistical analysis already provided with the different instruments included in AkvaGIS.



STEP 1 Choose the Query created previously with the tool shown in section 2.2.

STEP 2 Choose the parameter to be queried for the analysis.

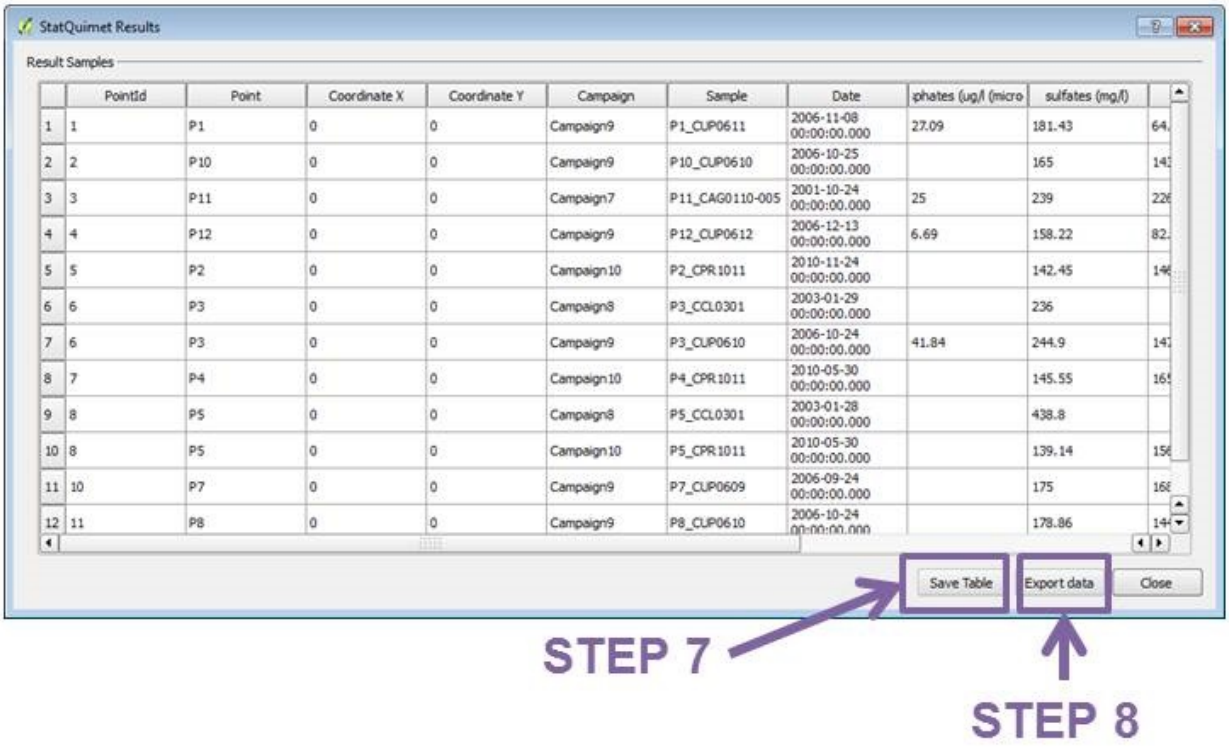
STEP 3 Choose the limit factor to be applied to the censored values. With this tool the user has the option to substitute the censored values (which are the concentration of some elements reported as less than or greater than) by this factor times the detection limits.



STEP 4 Run Query.

STEP 5 Use this commands to activate or deactivated the desired measurements.

STEP 6 Click Next.



STEP 7 Save table where the selected parameters for the selected points are shown.

STEP 8 Two tables will be exported:

DATA_W file with all samples measurements including incompleted samples (samples without measurements for each of the selected parameters).

DATA file which contain only samples with measurements for each of the selected parameter. This query can be used for the further statistical analysis using external platforms as Statistical Tools.

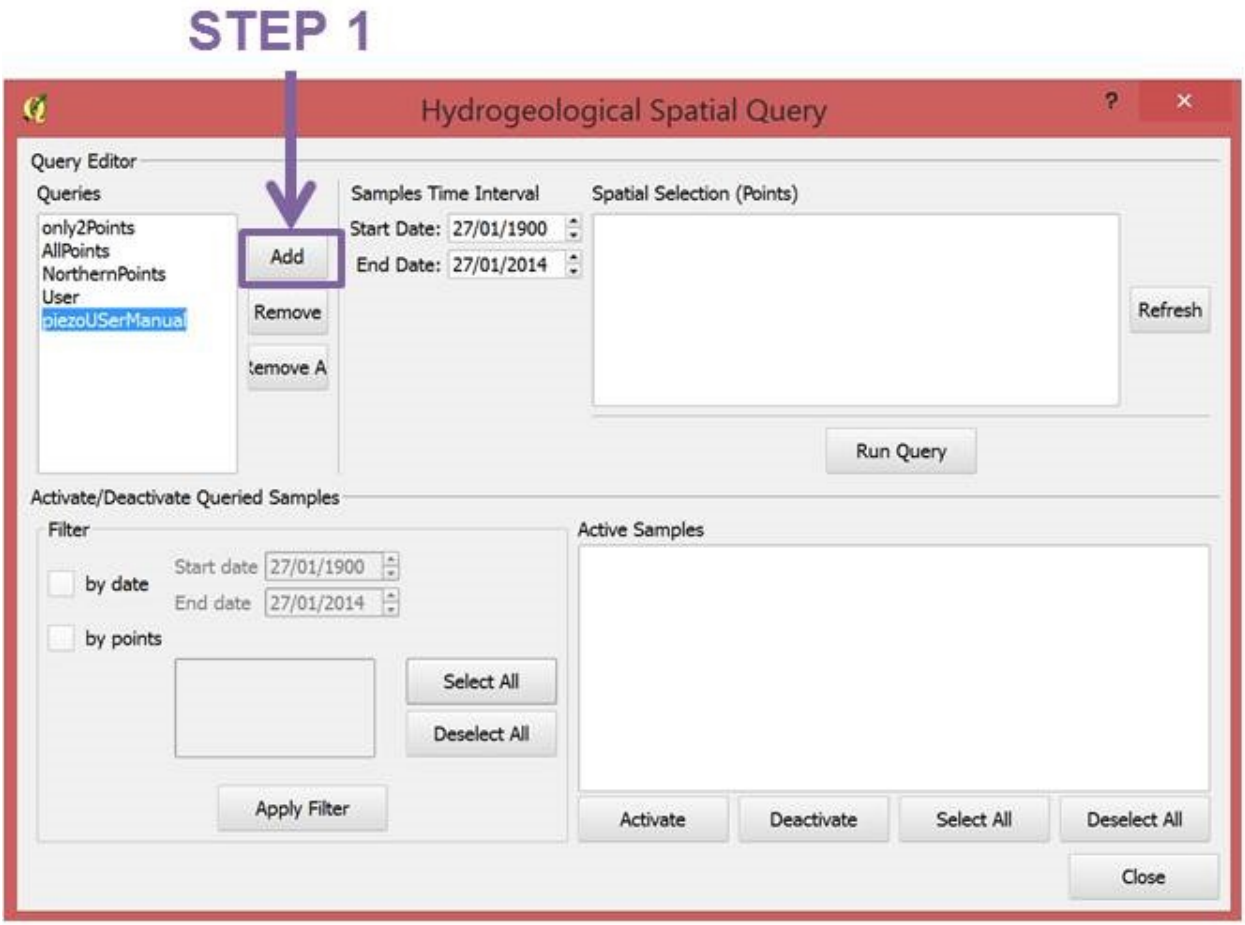
CHAPTER 3

Hydrogeological analysis tools

Hydrogeological Spatial Query



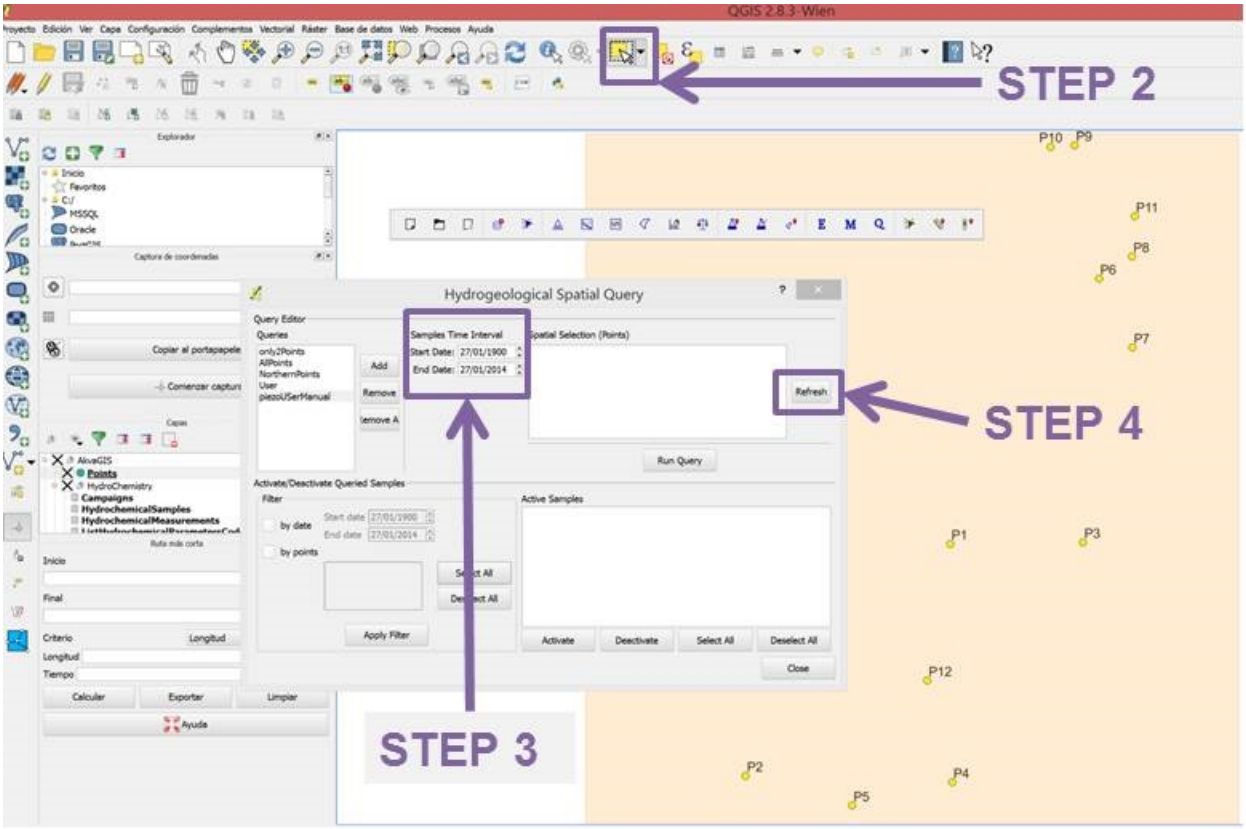
This tool enable us to query the hydrogeological measurements (e.g. head, wells abstractions, etc.) performed in wells, piezometers, springs, etc. This query only act only for those points where hydrogeological observations and measurements have been done. Please, see AckvaGIS database report.



STEP 1 Use this command to create and add to the database queries of the selected points (spatial selection) for the desired time interval. Also campaign can be used as a query criteria. Thus, hydrogeological tools can be applied to the queries stored in the database or it can be used in future analysis.

Add a new query and rename newQuery.

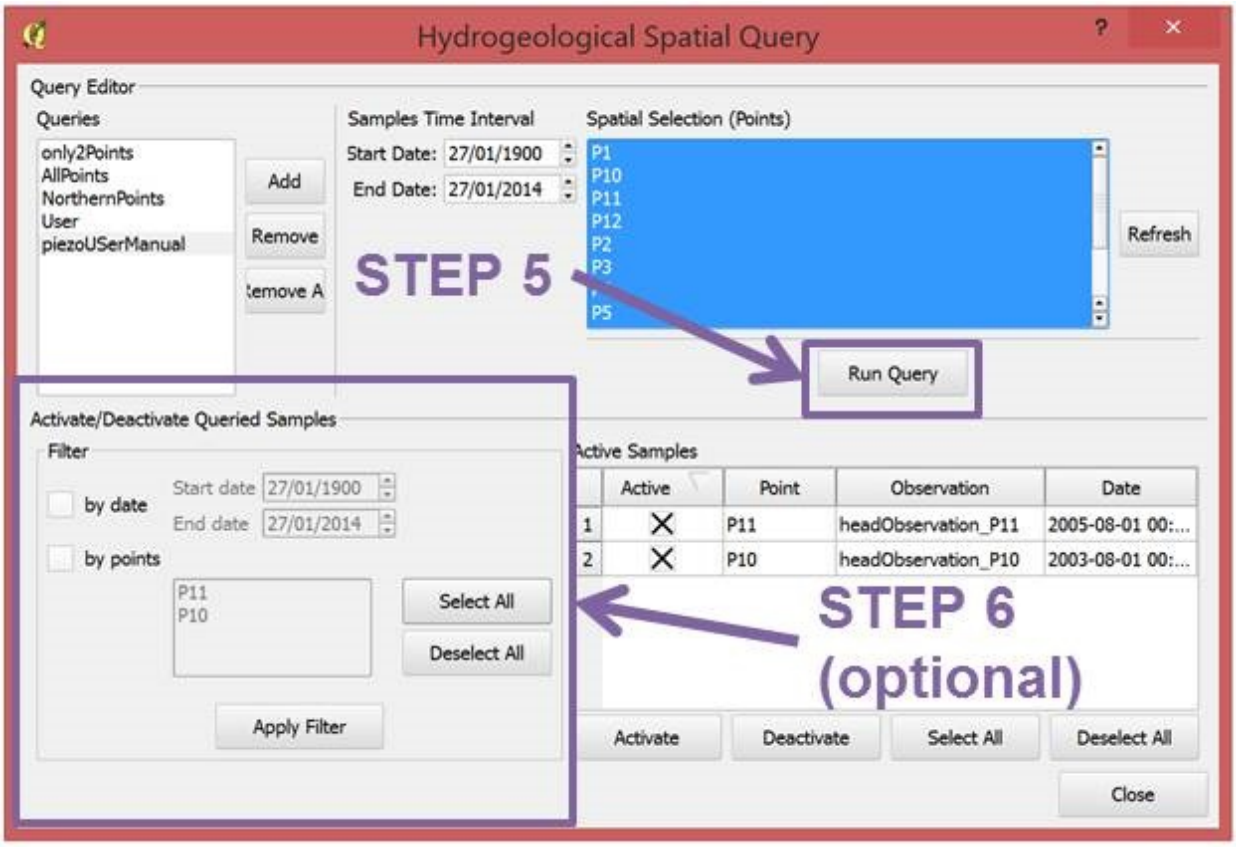
NOTE: Use the command Remove for deleting the selected query from the database or use the command remove all for removing all the queries from the database.



STEP 2 Select (using inbuilt tools of QGIS) the points to be included in the query.

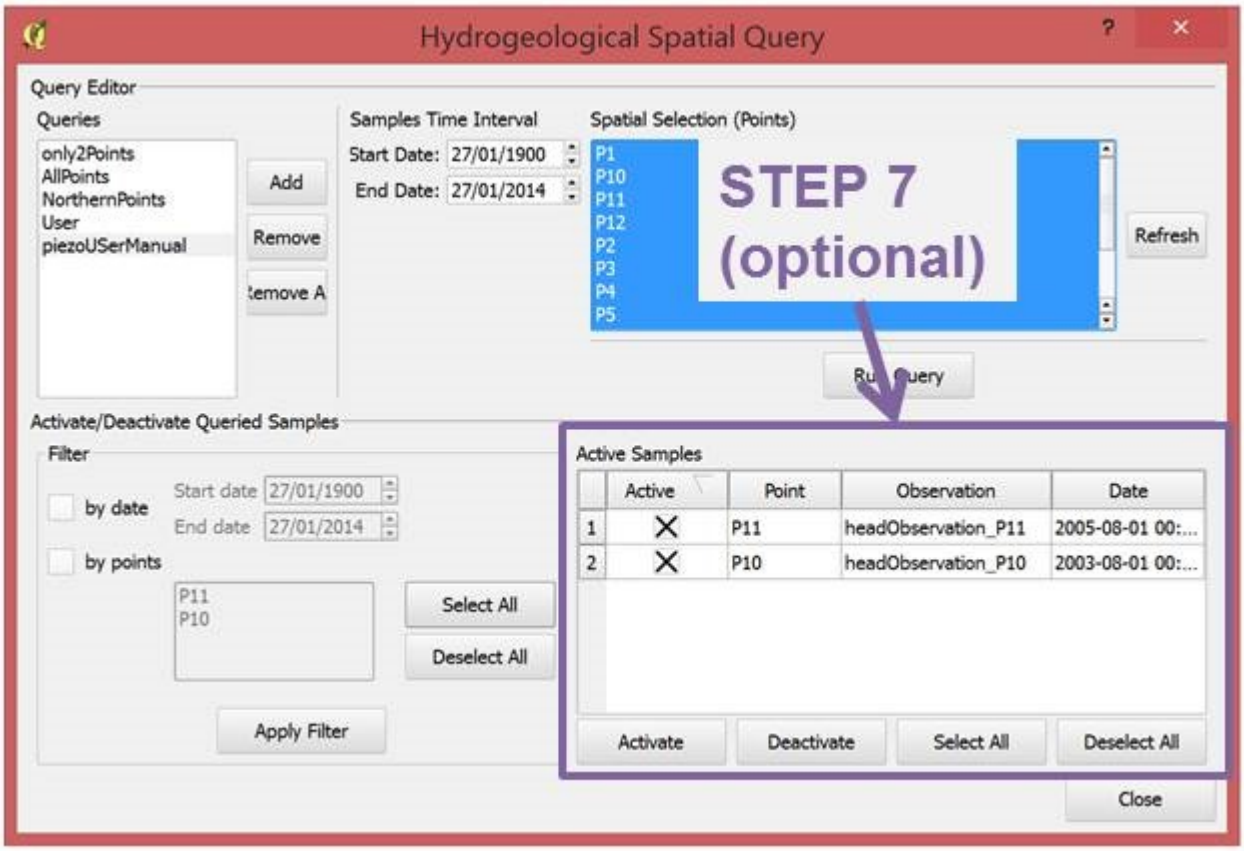
STEP 3 Select the desired time interval to be queried.

STEP 4 Refresh for visualize the new query.



STEP 5 Run Query.

STEP 6 (optional) Filter chosen any available query criteria (by date or by points).



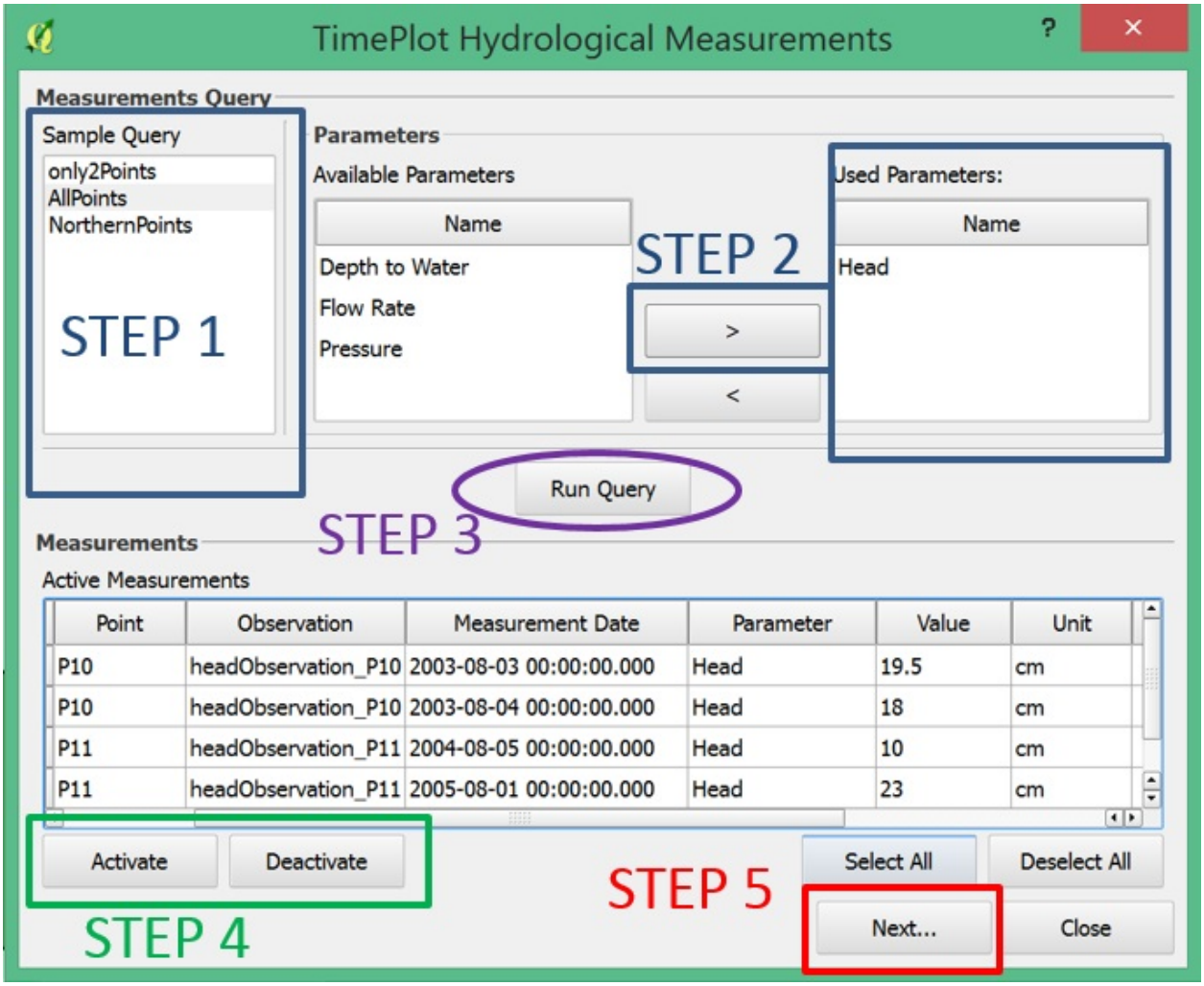
STEP 7 (optional) Activate/Deactivate the desired samples to be included in the query. For activate/deactivate please, select the row (also select all/deselect all).

Finally, click in close button to close the query form.

Time Plot



Use this command to create time plots of the selected query (created previously with the Hydrogeological Spatial Query tool, section 3.1) for the selected parameters.



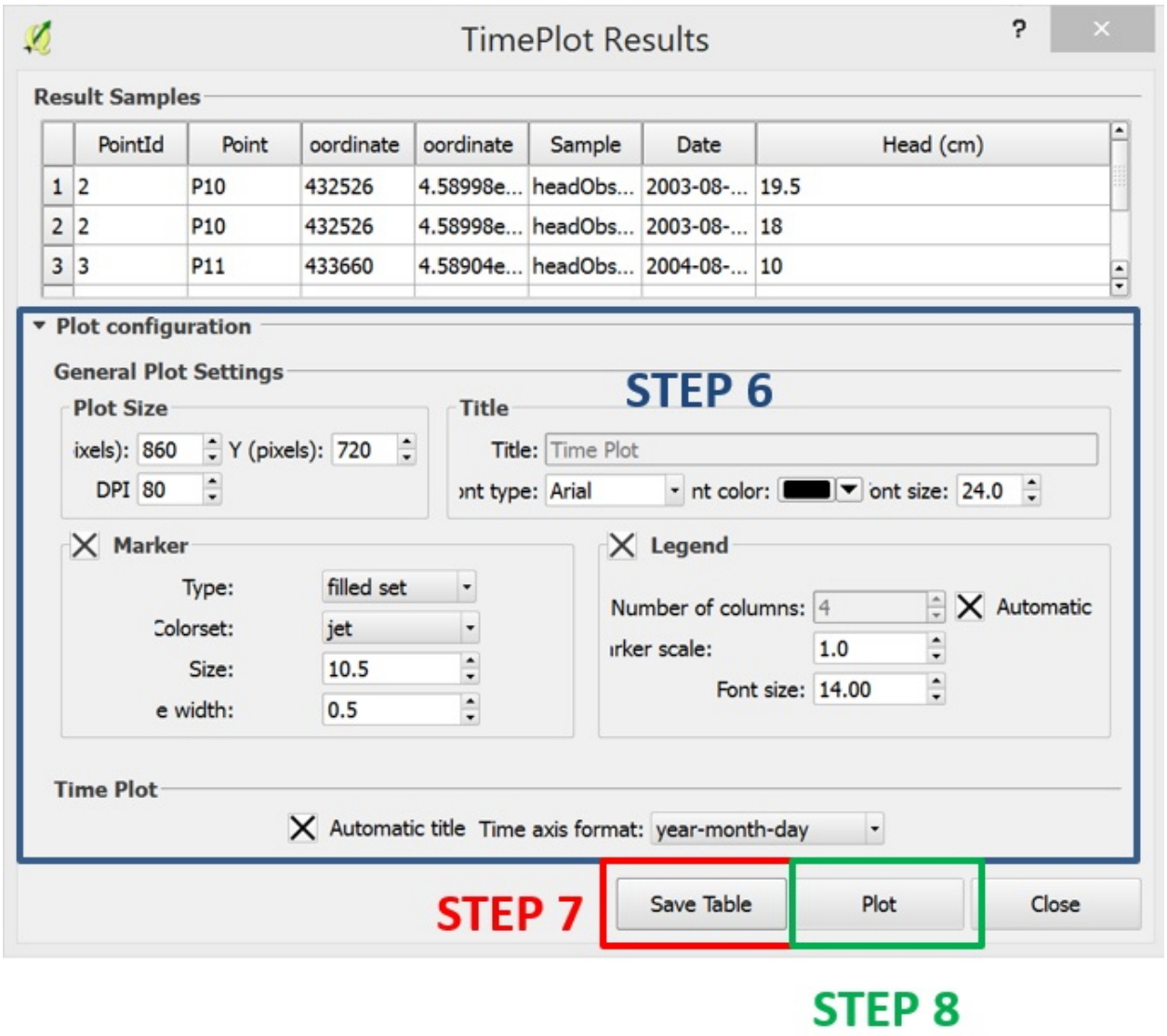
STEP 1 Choose the Query created previously with the Hydrogeological Spatial Query tool, section 3.1.

STEP 2 Choose the parameter to be queried for the analysis (e.g. head).

STEP 3 Run Query.

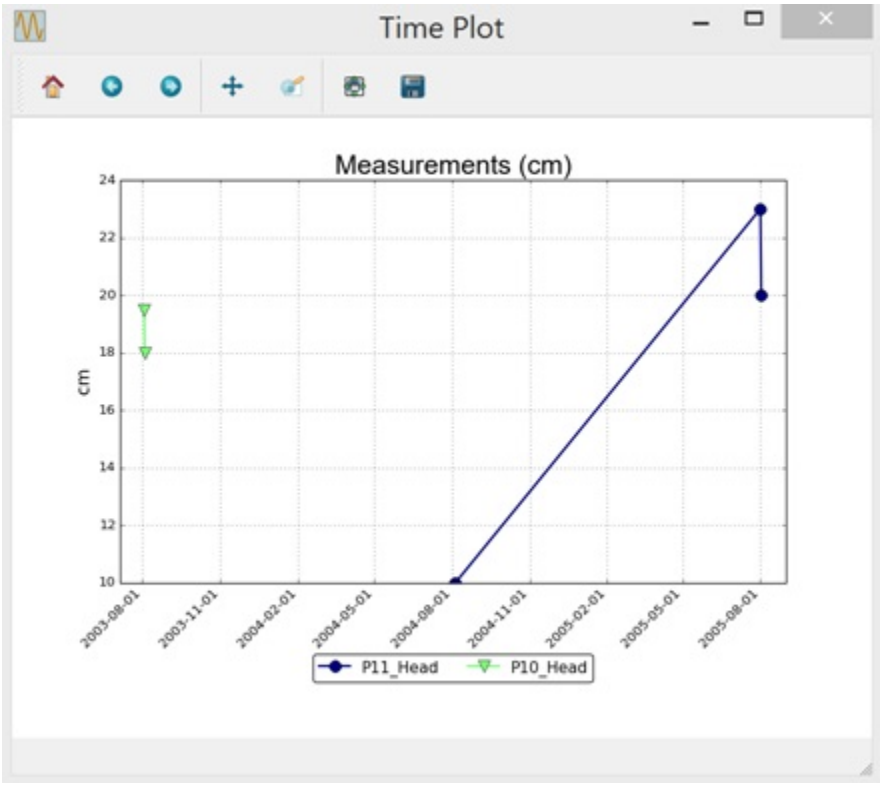
STEP 4 Use this commands to activate or deactivated the desired measurements.

STEP 5 Click Next.



STEP 6 Plot configuration. Choose the plot size, title, markers, time axis format, etc.

STEP 7 Save query results in different formats (.ods, .csv..).

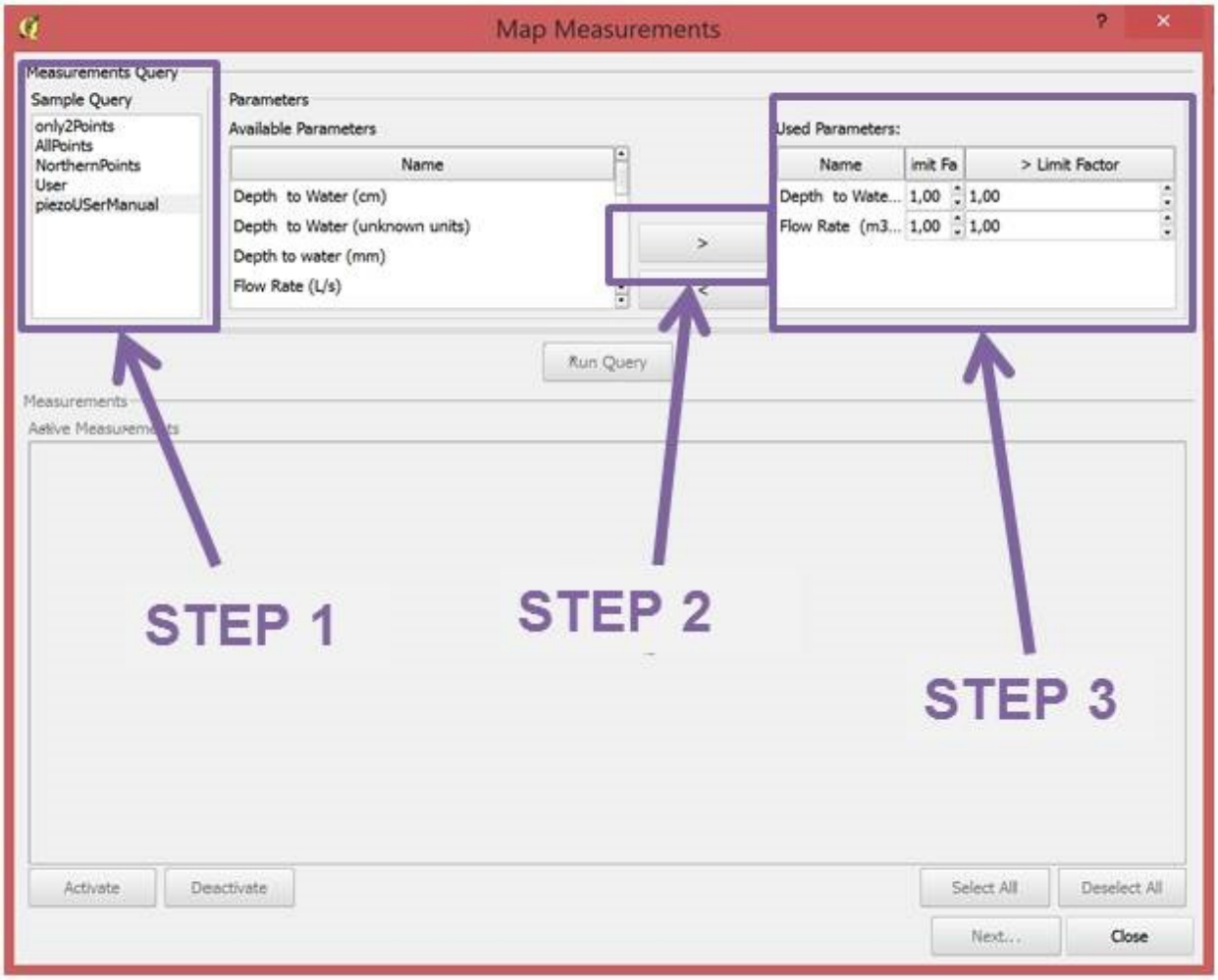


STEP 8 This button creates automatically time plots. The plot GUI, enable the user to save the plot in different formats, to pan axes, to zoom, to configure subplots and to save the plot in different formats such as .pdf, .png, .tiff, .svg, etc.

Hydrogeological Parameter Map



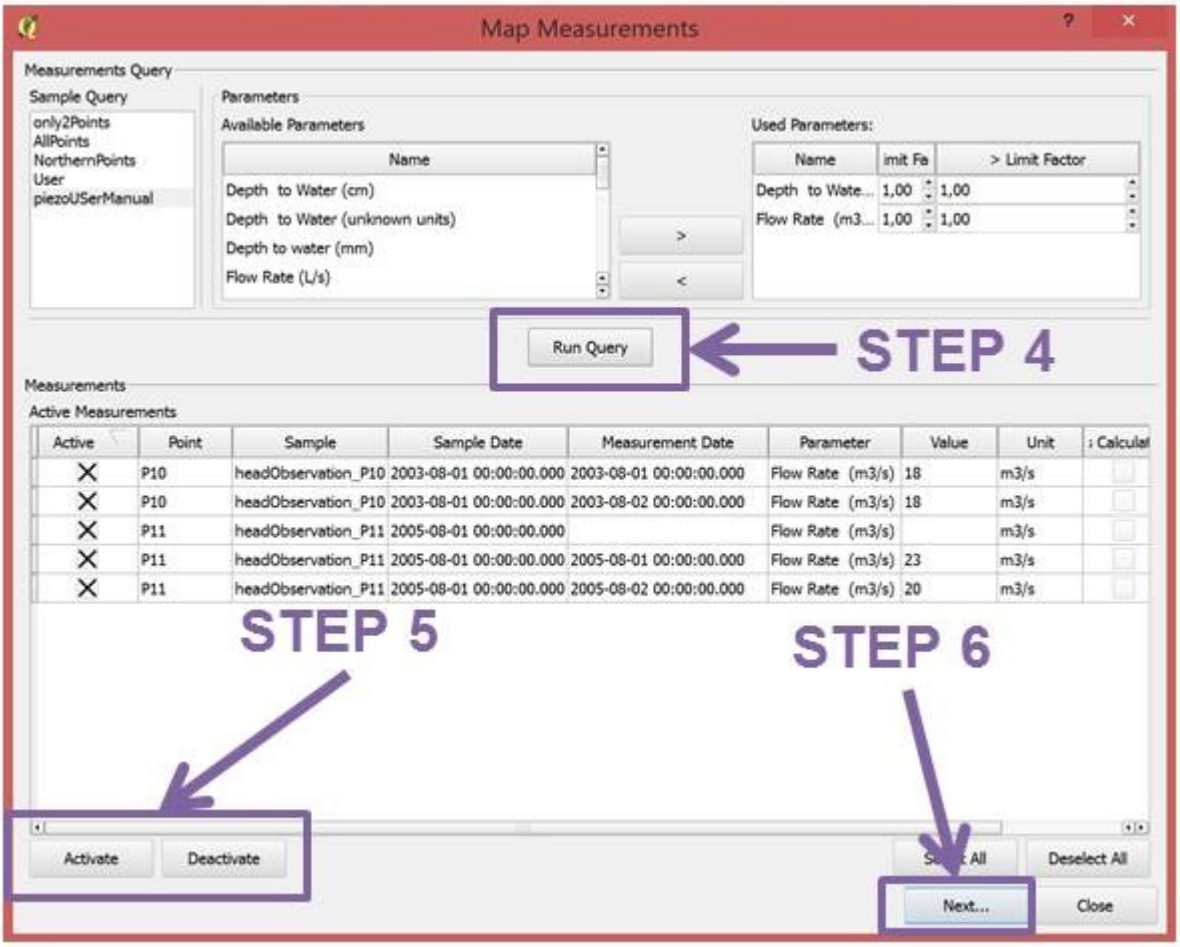
Use this command to create parameter plots of the selected query (created previously with the Hydrogeological Spatial Query tool, section 3.1) for the selected parameters.



STEP 1 Choose the Query created previously with the tool shown in section 3.1.

STEP 2 Choose the parameter to be queried for the analysis.

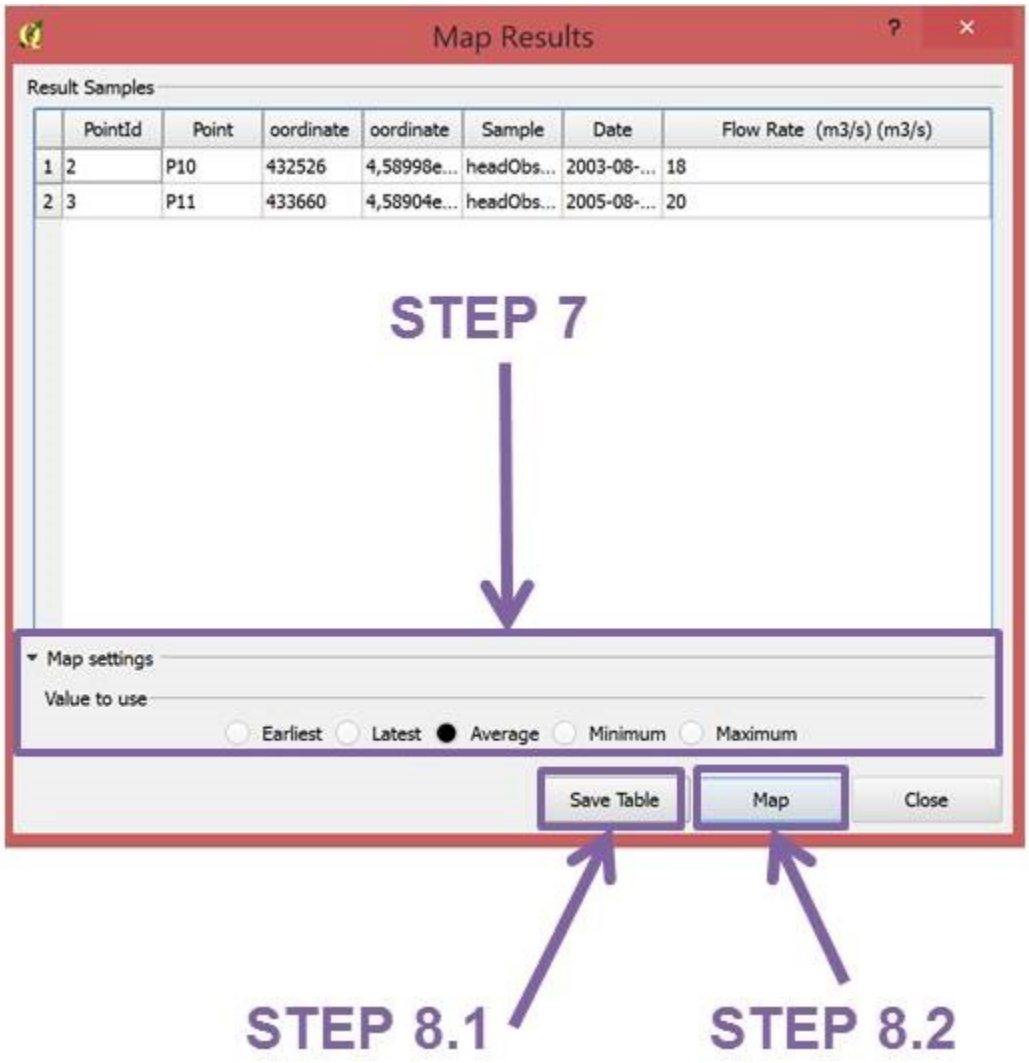
STEP 3 Choose the limit factor to be applied to the censored values.



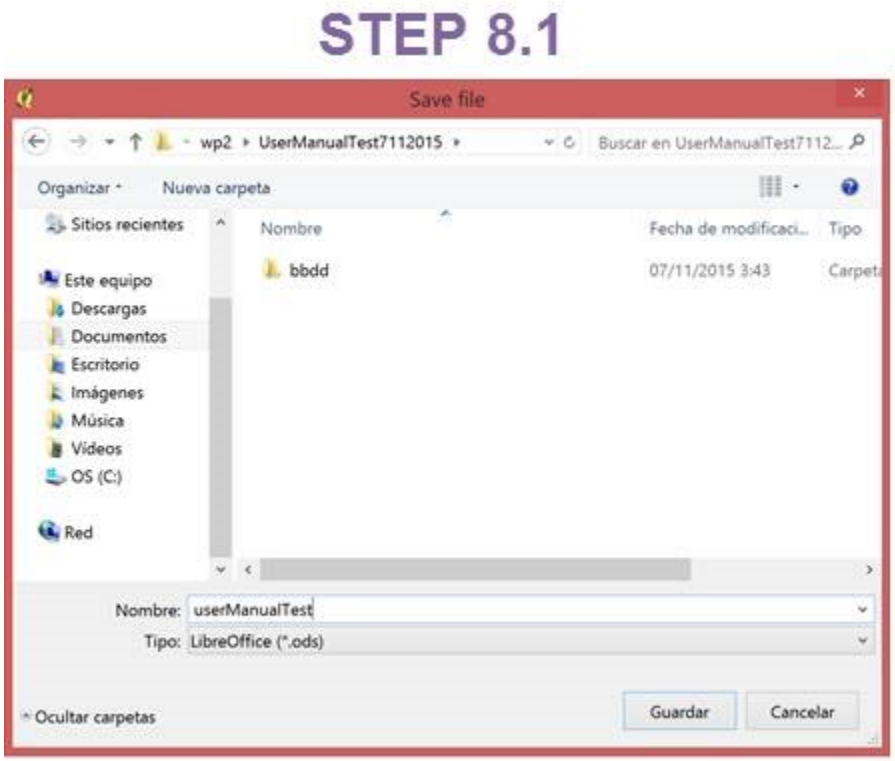
STEP 4 Run Query.

STEP 5 Use this commands to activate or deactivated the desired measurements.

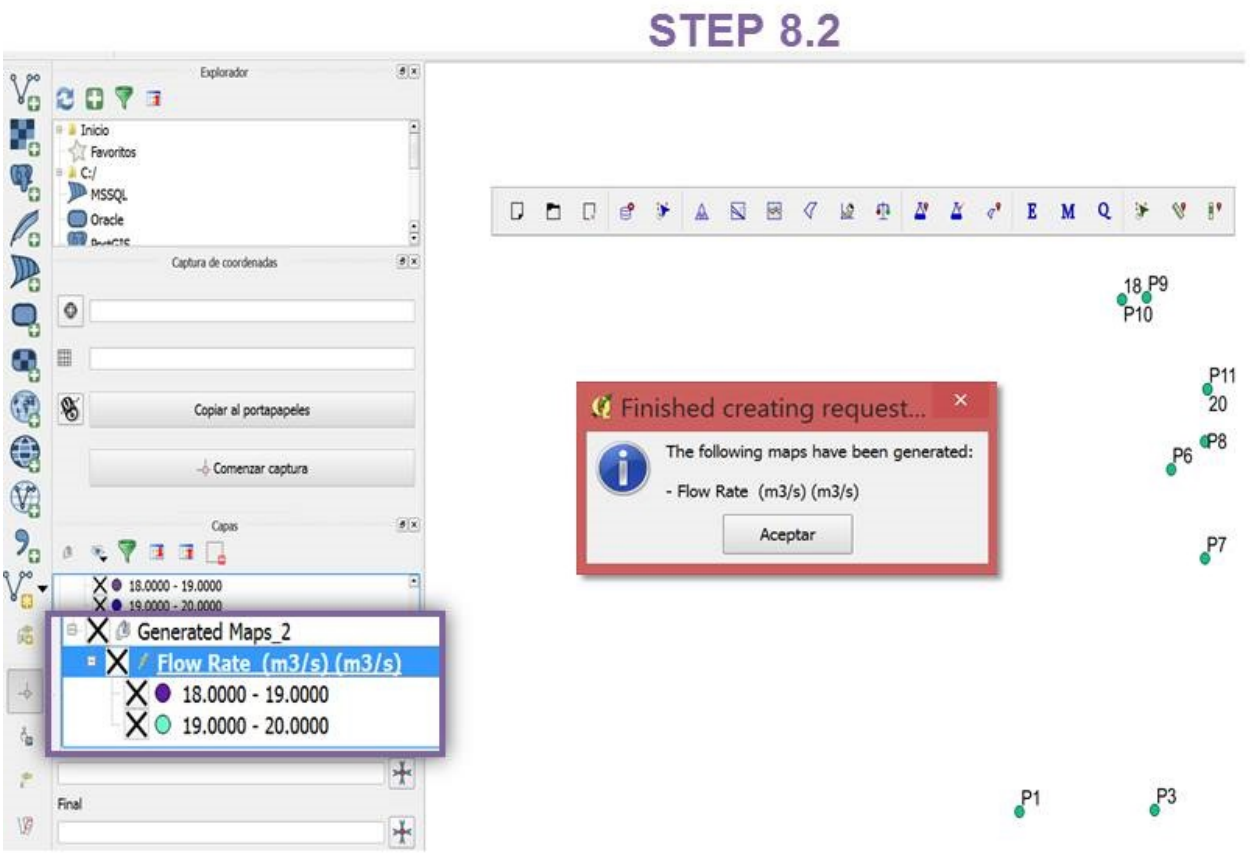
STEP 6 Click Next.



STEP 7 Map settings. Select the value to use in the map (earliest, latest, average, etc.)



STEP 8.1 Save query results in different formats.

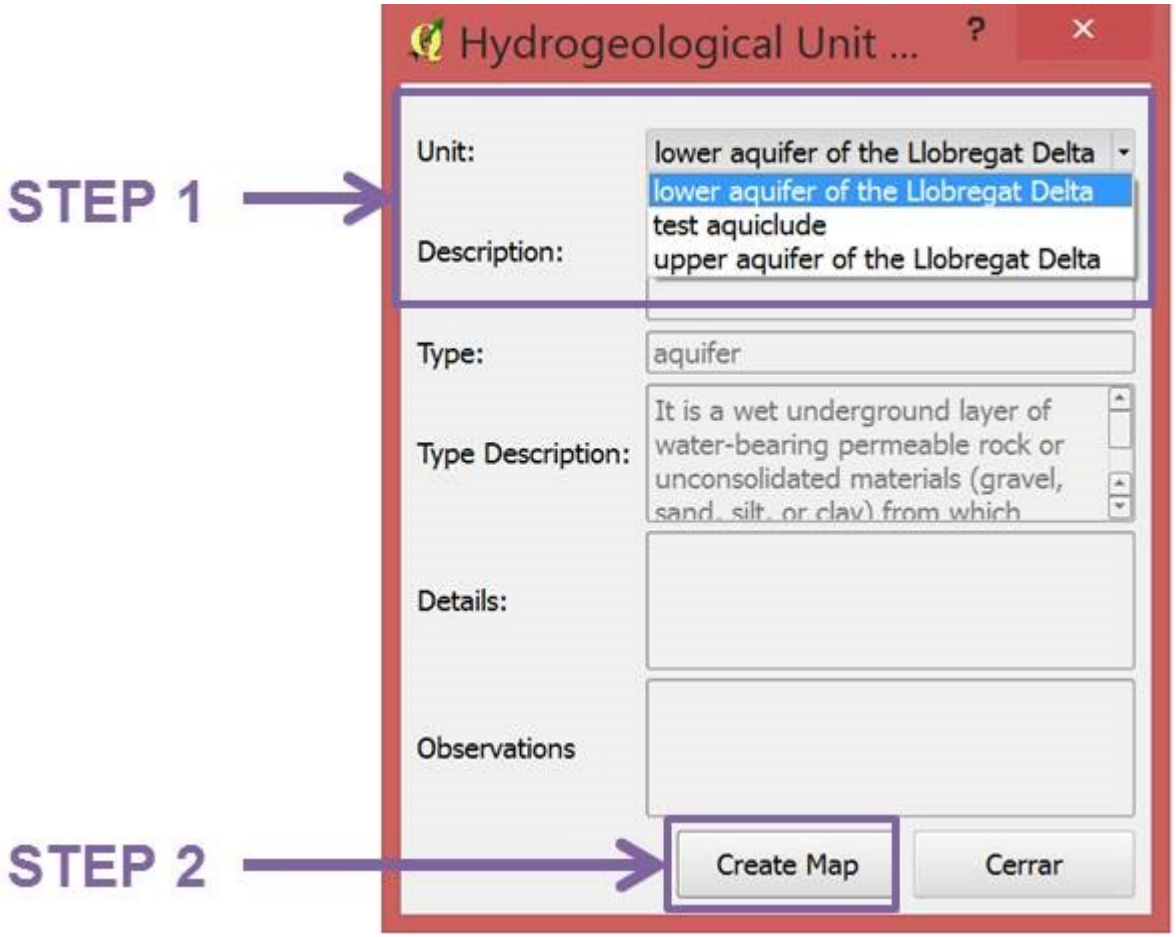


STEP 8.2 This button creates automatically parameter map.

Hydrogeological Units Maps

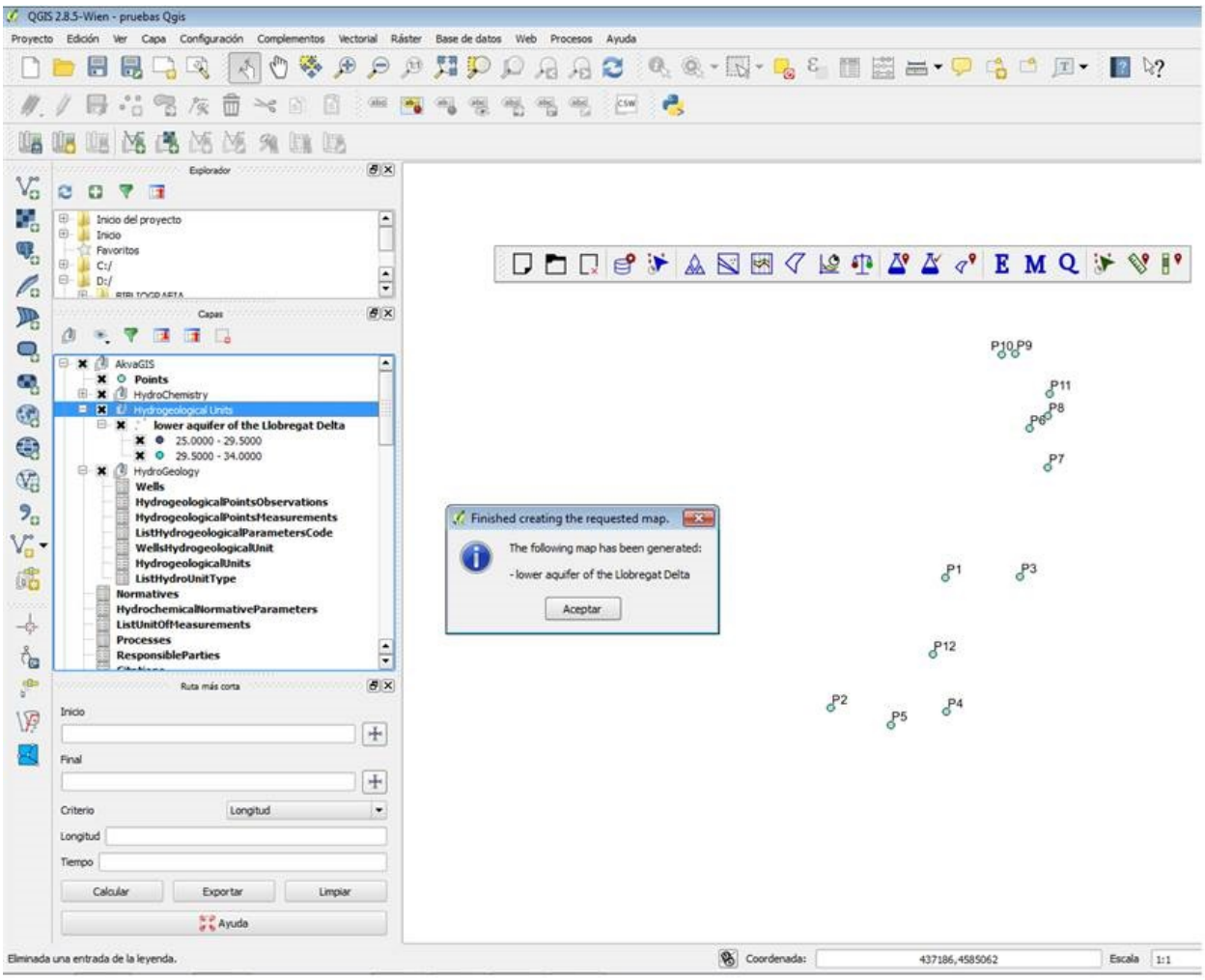


This command enables the user to create maps of top/bottom hydrogeological units defined in the wells.



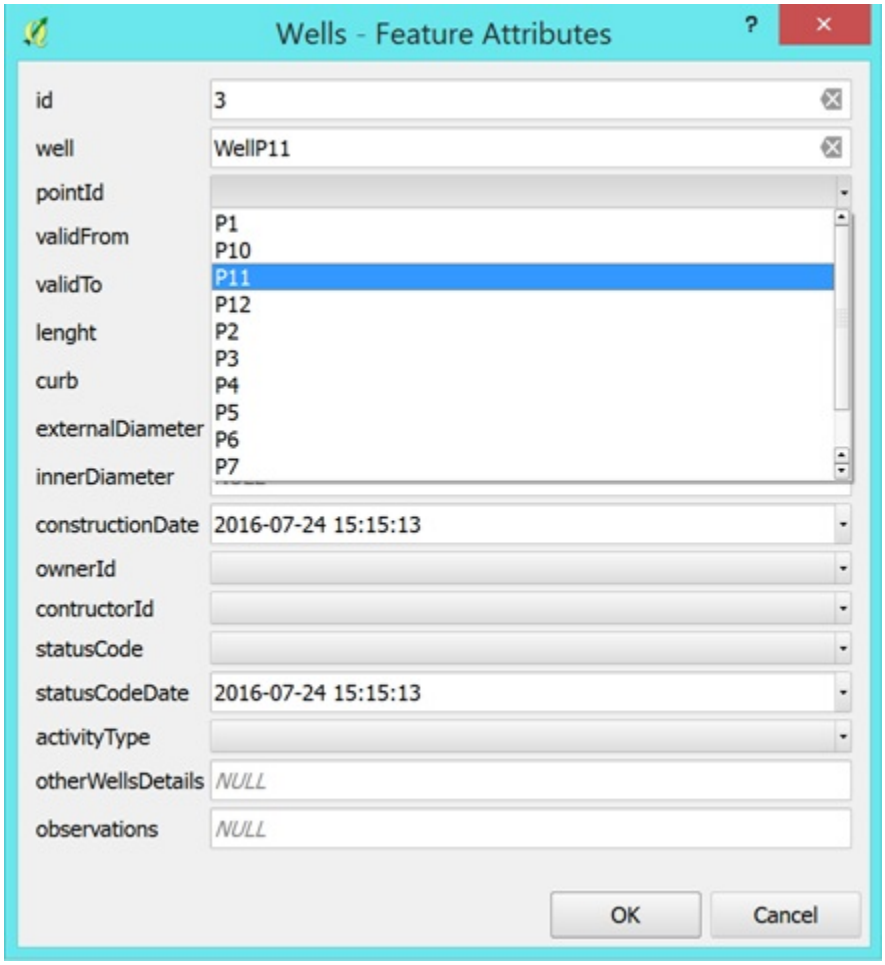
STEP 1 Choose the hydrogeological unit that you want to query.

STEP 2 Create map for selected hydrogeological unit.



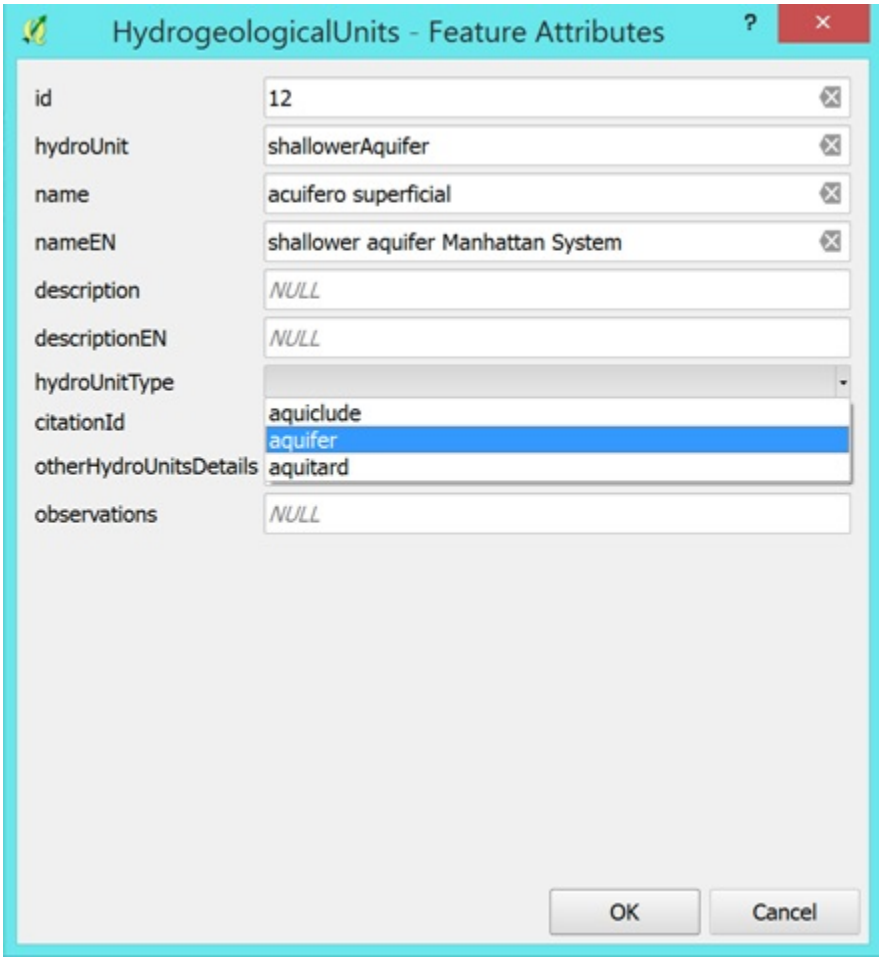
How to edit/add the top/bottom of a hydrogeological units?

STEP1 Introduce the general characteristic of the well that provide the information of the limits of the hydrogeological Unit (i.e. Top/bottom length of the Hydrogeological Unit). For further information about the database, please see AckvaGIS database report. Select and open *Well* attribute table. Here, some information has to be added:



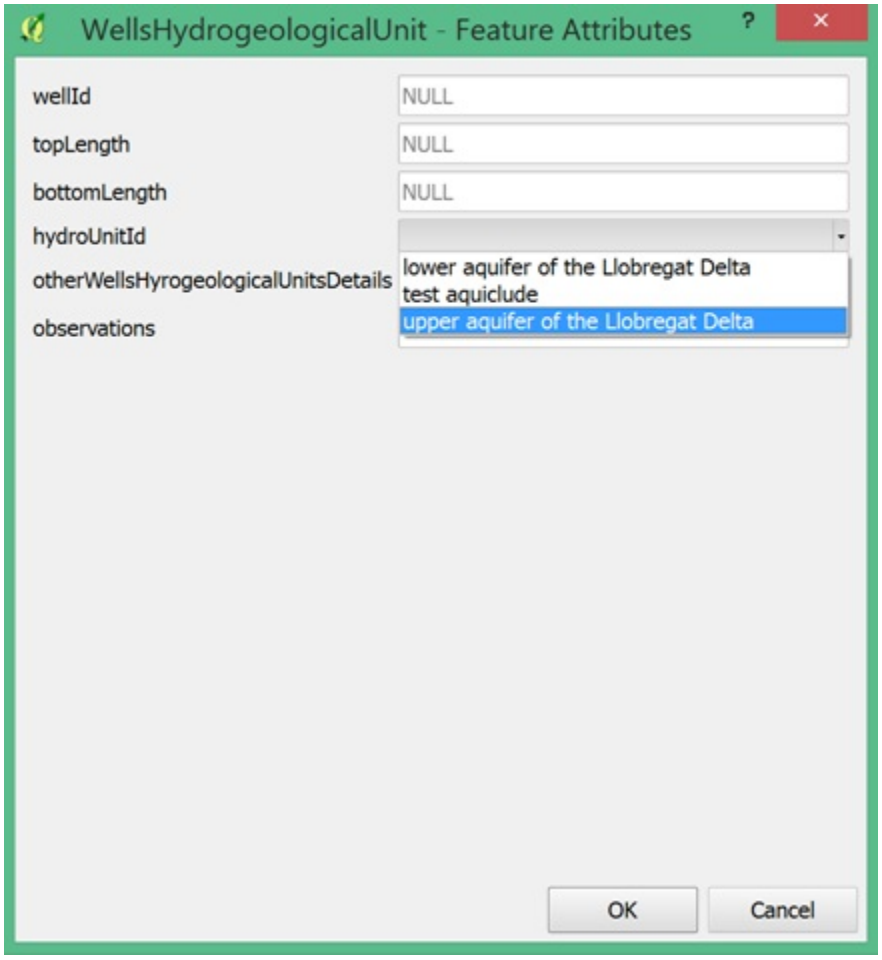
1. Id number. Unique identifier for each well
2. Name well.
3. idPoint (from table *Points*)
4. Properties of the well such as length, inner and external Diameter (recommended)
5. Construction Details (constructor, date of construction, etc. (recommended)

STEP 2 Edit or add a new hydrogeological Unit if is not included in the table *HydrogeologicaUnits*. Select and open the attribute table. Here, some information has to be added:



1. Id number.
2. Short name of the Hydrogeological Unit (unique)
3. Name (full name of the aquifer in local language) and nameEN (full name of the aquifer in English) (recommended)
4. Description of the hydrogeological Unit in native language and in English (recommended)
5. Type of hydrogeological Unit (Aquifer, Acuiclude, Aquitard). Further information about the hydrogeological units according to their classification in aquifers, aquicludes and aquitards will be introduced in further attributes tables (See chapter 4; Tables *Aquifers*, *Aquitards*, *Aquiclude* and *Aquifer System*). It is recommended to complete these tables as much as possible, even when they are not required for the use of the presented instruments
6. Citation of the document where the normative is described. In case the citation is not in the list, add a new citation in the table *Citation* (from the TOC) (recommended)
7. Other details (recommended)
8. Observations (recommended)

STEP 3 Complete the required fields of the table *WellsHydrogeologicalUnits*. Select and open the attribute table. Here, some information has to be added:



1. IdWell. Unique identifier of wells where the hydrogeological Units were observed
2. Top/bottomLenght. Top and the bottom of the depth described (in meters)
3. HydrogeologicalUnitsId. Hydrogeological Unit defined along the well
4. Description of the hydrogeological Unit in native language and in English (recommended)
5. Other details (recommended)
6. Observations (recommended)

CHAPTER 4

Database documentation

- "*" Primary Key
- "**" Foreign Key
- Tables used in the Pre-processing tools (IDAEA - CSIC)

Documentation of the project

The first step in the introduction of the data into AkvaDatabase is to describe the different documents, projects, campaigns or entities that provide the information. For entering the data in the AkvaDatabase, the user can use the utilities of Spatialite database or the utilities of QGIS.

Citations

In this table we introduce the information about the source of data. The source of data can be technical report, scientific papers, files, other databases, etc. This table acts as a library of terms, if the reference of the source of information (document, paper, etc.) that have been already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each citation	Integer; YES
citation	Citation is a human readable title and the publication date. e.g. Velasco2015Also citationId for technical reports, names of databases, etc. E.g. GA2378297459EU	Text; 50; NO
title	Title of the report/paper/database etc	Text; 255; NO
alternateTitle	Short name or other language name by which the cited information is known. Example: "DCW" as an alternative title for "Digital Chart of the World"	Text; 50; NO
description	Short description of the source of data in local language	Text; 255; NO
descriptionEN	Short description of the source of data in English	Text; 255; NO
presentationFormCode**	mode in which the resource is represented	Integer; YES
citedResponsiblePartyId**	name and position information for an individual or organization that is responsible for the resource	Integer; YES
citationSearch	Document's location where it can be available and/or who can facilitate it). E.g. file path in your computer	Text; 255; NO
citationDate	Date of edition/publication/revision of the document source of the data, date of the last change of the database, date of the technical report	Date
otherCitationDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database.	Text; 255; NO

ResponsibleParties

This is the description of the organisation responsible for the establishment, management, maintenance and distribution of the resource. This description shall include the name of the organisation and a contact e-mail address. This table acts as a library, if the entity is already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each responsable party	INTEGER; YES
responsibleParty	Unique name for each entity (laboratory, company, employees, etc.). E.g. For Technical University of Catalonia, ResponsiblePartyId can be UPC	Text; 50; YES
individualName	name of the responsible personsurname, given name, title separated by a delimiter	Text; 255; NO
organisationName	name of the responsible organization	Text; 255; NO
positionName	role or position of the responsible person	Text; 255; NO
deliveryPoint	address line for the location (as described in ISO 11180, Annex A)	Text; 255; NO
city	city of the location	Text; 255; NO
administrativeArea	state, province of the location	Text; 255; NO
postalCode	ZIP or other postal code	Text; 255; NO
Country	country	Text; 255; NO
electronicMailAddress	address of the electronic mailbox of the responsible organization or individual	Text; 255; NO
Phone	telephone numbers at which the organization or individual may be contacted	Text; 255; NO
onlineResource	on-line information that can be used to contact the individual or organization	Text; 255; NO
Linkage	location (address) for on-line access using a Uniform Resource Locator address or similar addressing scheme such as http://www.statkart.no/isotc211URL (IETF RFC1738 IETF RFC 2056)	Text; 255; NO
Protocol	connection protocol to be used	Text; 255; NO
applicationProfile	name of an application profile that can be used with the online resource	Text; 255; NO
onlineResourceName	name of the online resource	Text; 255; NO
Description	detailed text description of what the online resource is/does	Text; 255; NO
functionCode**	Code for function performed by the online resource. From the table ListFunction-Codes	INTEGER; NO
hoursOfService	time period (including time zone) when individuals can contact the organization or individua	Text; 255; NO
contactInstructions	supplemental instructions on how or when to contact the individual or organization	Text; 255; NO
otherResponsiblePartyDetails	Additional data	Text; 255; NO
Observations	Observations of the person that introduce the data into the database	Text; 255; NO

Projects

This table allows the user to introduce information about the project that provides the information. This table acts as a library, if the project is already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Project's Unique identifier	INTEGER; YES
project	Project's Unique identifier name. E.g. PANACEA	Text; 50; NO
name	Project's full Name	Text; 200; NO
description	Short description of the project in local language	Text; 255; NO
descriptionEN	Short description of the project in English	Text; 255; NO
citationId**	Reference of the document that contains the agreement, proposal, etc.	INTEGER; NO
principalInvestigatorId**	Key party responsible for gathering information and conducting research of this project.	INTEGER; NO
parentProject	The parent Project. A large investigation project may have several sub projects.	Text; 255; NO
otherProjectDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Campaigns

This table contains details about the campaign (e.g. hydrochemical campaign) performed to obtain the data. This table acts as a library, if the campaign is already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each field campaign	INTEGER; YES
campaign	Name of the Unique identifier for each field campaign. E.g.Campaign01	Text; 50; NO
campaignType**	Type of a campaign must be one of the item listed in ListCampaignType	INTEGER; NO
projectId**	Unique identifier for each project related with the field campaign	INTEGER; NO
beginDate/endDate	Start/End date of the campaign	Date; NO
clientId**	Party to which investigation is carried out	INTEGER; NO
custodianId**	Party responsible to maintain data related to the campaign	INTEGER; NO
dataOwnerId**	Responsible party that owns the data related to the campaign.	INTEGER; NO
contractorId**	Party that carries out the survey	INTEGER; NO
otherCampaignDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Geography/general data

These tables contain information about the location of the points of interest (i.e. of the observed feature such as wells, springs, sea...)

Points

This is a geometric feature (point) that represents points where hydrogeological observations have been done.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	unique identifier for each point with information	INTEGER; YES
point	Name of the unique identifier for each point with information	Text; 50; YES
beginLifespanVersion	Specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set (INSPIRE)	Date
endLifespanVersion	Specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set. If the endLifespanVersion is null, this indicates that the object is the current representation of the feature(INSPIRE)	Date
name	Place name of the point (popular name of the point, e.g. Well of the Major, Spring of the butterflies?)	Text; 100; NO
name2/name3/name4	Point's name in different databases or references. Note that the same point can provide different information of different nature and origin and can be termed with different names in different reports	Text; 100; NO
description	Text providing description of object	Text; 255; NO
cooX	Coordinate X	Double; YES
cooY	Coordinate Y	Double; YES
elevation	Elevation (Z) in meters	Double; NO
geometryCooSourceType**	Type of CooX, CooY (e.g. BoreholeO&M, cartographicalO&M) ListGeometrySourceType	INTEGER; NO
geometryElevationSourceType**	Type of source of the geometry of Elevation (e.g. BoreholeO&M, CartographicalO&M) ListGeometrySourceType	INTEGER; NO
elevationReferenceSystemId**	reference System of the Elevation	INTEGER; NO
cooReferenceSystemId**	reference System of the coordinators X, Y	INTEGER; NO
sourceReferenceSystemId**	spatial reference system used by the source data	INTEGER; NO
nameCitation/name2Citation/name3Citation/name4Citation**	Reference of the name indicated in Nam1-4Point. Here introduce the reference of the report/database were the information point were obtained	INTEGER; NO
adressPoint	Adress of the point of interest (e.g. Palm Beach, 92, Cuenca)	Text; 255; NO
accessPoint	Description of the access to the point (e.g. easy access, it is in the middle of the street, talk to the owner, its unknown) . In any case the information has to be accompanied with the date	Text; 255; NO
pointType**	Type of point (spring, seep, swallowHole, well, seepoint, lakepoint)	INTEGER; NO
otherPointDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

ReferenceSystems

This package contains the identification of the spatial and temporal reference system(s) used in a dataset.This table act as a library, if the reference system code already exist in this you do not need to fill this table.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each reference system	INTEGER; YES
referenceSystem	Refer to ISO 19111 when coordinate system is not given through reference system identifier	Text; 255; YES
name	name of the reference system used in the local language	Text; 255; NO
nameEN	name of the reference system used in English	Text; 255; NO
domainOfValidity	range which is valid for the reference system	Text; 255; NO
OtherReferenceSystemDetails	additional details	Text; 255; NO
observation	Observations of the person that introduce the data into the database	Text; 255; NO

Hydrogeological objects

HydrogeologicalUnits

The INSPIRE hydrogeological data model considers 3 areas: Hydrogeological Units (e.g. Aquifers, Aquitards and aquiclude). Hydrogeological Systems and man-made and natural objects wich interact with those systems. The HydrogeologicalUnits stores the conceptual description and attributes of the hydrogeological units identified. A hydrogeological unit is a part of the terrain with distinct parameters for water storage and conduction. There are 3 main subclasses of hydrogeological units: Aquifer, Aquitard and Aquiclude. This table act as a library, if the Hydrogeological Unit has been already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each hydrogeological unit	INTEGER; YES
hydrogeologicalUnit	Name of the Unique identifier for each hydrogeological unit (e.g.UpperAquiferLlobregat)	Text, 50; NO
name	Name of the hydrogeological Unit in the local language	Text; 255; NO
nameEN	Name of the hydrogeological Unit in English.	Text; 255; NO
description	Short description of the hydrogeological Unit in local language	Text; 255; NO
descriptionEN	Short description of the hydrogeological Unit in English	Text; 255; NO
hydroUnitType**	Type of hydrogeological unit (aquifer, aquitar or aquiclude)	INTEGER; NO
citationId**	Document containing information about this Hydrogeological Units	INTEGER; NO
otherHydroUnitsDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

HydrogeologicalUnitsApparence

The hydrogeological units have different spatial representations in 2D.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each hydrogeological unit apparence	INTEGER; YES
hydrogeologicalUnitId**	Unique identifier for each hydrogeological unit	INTEGER; YES
approximateDepth	Approximate depth (mean value) of the hydrogeological unit	Double
approximateThickness	Approximate thickness (mean value) of the hydrogeological unit	Double
beginLifespanVersion	Stores the date that the new object was created	Date; NO
endLifespanVersion	The date that the next version of the object was created. If the endLifespanVersion is null, this indicates that the object is the current representation of the feature	Date; NO
sourceReferenceSystemId**	spatial reference system used by the source data	INTEGER; NO
referenceSystemId**	reference System of the Aquifer	INTEGER; NO
geometrySourceType**	The type of source for the geometry of a hydrogeological feature.	INTEGER; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Aquifers

This table store the properties of the Hydrogeological Units defined as Aquifers. An Aquifer is a wet underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted by a groundwater well. (INSPIRE).

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique Identifier for each aquifer	INTEGER; YES
aquifer	name for each Unique Identifier ofeach aquifer	Text; 50: NO
hydrogeologicalUnitId**	name of Unique Identifier for each aquifer defined in the table HydrogeologicalUnit E.g. e.g. UpperAquiferLlobregat	INTEGER; YES
name	Aquifer's name in the local language	Text; 255; NO
nameEN	Aquifer's name in English	Text; 255; NO
aquiferType**	Water in an Aquifer is, or is not, under pressure. Based on those unconfined, confined, artesian, or subartesian types are distinguished. Further information in INSPIRE data specifications	INTEGER; NO
mediaType**	The classification of the medium in which the groundwater flow occurs	INTEGER; NO
isExploited	Indicates if groundwater from aquifer is exploited by wells or intakes	boolean
isMainInSystem	Indicates if aquifer is the main useful aquifer in the aquifer system	boolean
permeabilityCoefficient	The volume of an incompressible fluid that will flow in unit time through a unit cube of a porous substance across which a unit pressure difference is maintained. The parameter represents the hydraulic conductivity of a rock container. Describes the ease with which water can move through pore spaces or fractures. It depends on the intrinsic permeability of the material and on the degree of saturation. NOTE: Because of their high porosity and permeability, sand and gravel have higher hydraulic conductivity than clay or unfractured granite aquifers.NOTE OF THE AUTHORS: This should be a mean value. The aquifers media is heterogeneous	Double; NO
permeabilityCoefficientUomCode**	Unit of measurement of permeability coefficient	INTEGER; NO
storativityCoefficient	The ability of an aquifer to store water. NOTE OF THE AUTHORS: This should be a mean value. The aquifers media is heterogeneous	Double;NO
vulnerabilityPollution	An index value or interval of values determining the potential degree of aquifer risk arising from the geological structure, hydrogeological conditions and the existence of real or potential source of contamination. A single value should be used if it is determined directly from the DRASTIC method. If attribute data comes from another data source which is expressed by categorized items, for example: low, moderate or high, interval should be used expressed by lowest and highest value of category. EXAMPLE: Moderate means interval from 101 to 140.(INSPIRE)	Text; 255; NO
hydroGeochRockType**	The rock type with respect to the soluble rock components and their hydrogeochemical influence of groundwater. Defines the prevailing geochemical character of natural groundwater within the Aquifer. Further information in http://inspire.ec.europa.eu/codeList/HydroGeochemicalRockType	INTEGER; NO
aquiferSystemId**	The AquiferSystem of which the Aquifer is a part	INTEGER; NO
otherAquiferDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Aquitards

This table store the properties of the Hydrogeological Units defined as Aquitards. It does not yield water freely to wells, but may transmit appreciable water to or from adjacent aquifers and, where sufficiently thick, may constitute an important ground-water storage unit. Aquitards are characterized by values of leakance that may range from relatively low to relatively high. A really extensive aquitard of relatively low leakance may function regionally as boundaries of aquifer flow systems (INSPIRE).

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique Identifier for each aquitard	INTEGER; YES
aquitard	name of the unique identifier for each aquitard	Text; 50: NO
hydrogeologicalUnitId**	Unique Identifier for each aquitard defined in HydrogeologicalUnits	INTEGER; YES
name	Aquitard's name in the local language	Text; 255; NO
nameEN	Aquitard's name in English	Text; 255; NO
IdHydroGeochRockType**	The rock type with respect to the soluble rock components and their hydrogeochemical influence of groundwater. Defines the prevailing geochemical character of natural groundwater within the Aquifer. NOTE OF THE AUTHORS: This should be a mean value. The aquifers media is heterogeneous	INTEGER; NO
approximatepermeabilityCoefficient	The volume of an incompressible fluid that will flow in unit time through a unit cube of a porous substance across which a unit pressure difference is maintained. The parameter represents the hydraulic conductivity of a rock container. Describes the ease with which water can move through pore spaces or fractures. It depends on the intrinsic permeability of the material and on the degree of saturation. NOTE: Because of their high porosity and permeability, sand and gravel have higher hydraulic conductivity than clay or unfractured granite aquifers	Double; NO
permeabilityCoefficientUomCode**	Unit of measurement of permeability coefficient	INTEGER; NO
approximatestorativityCoefficient	The ability of an aquifer to store water. NOTE OF THE AUTHORS: This should be a mean value. The aquifers media is heterogeneous	Double; NO
aquiferSystemId**	The AquiferSystem of which the Aquitard is a part	INTEGER; NO
Observations	Additional data	Text; 255 ;NO
ObsInput	Observations of the person that introduce the data into the database	Text; 255; NO

Aquicludes

This table store the properties of the Hydrogeological Units defined as Aquiclude. It is a formation which, although porous and capable of absorbing water slowly, will not transmit water fast enough to furnish an appreciable supply for a well or spring. Aquicludes are characterized by very low values of "leakage" (the ratio of vertical Hydraulic Conductivity to thickness), so that they transmit only minor inter-aquifer flow and also have very low rates of yield from compressible storage. Therefore, they constitute boundaries of aquifer flow systems (INSPIRE).

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique Identifier for each aquiclude	INTEGER; YES
hydrogeologicalUnitId**	Unique Identifier for each aquiclude defined in the table defined in HydrogeologicalUnits	INTEGER; YES
name	Aquiclude's name in the local language	Text; 255; NO
nameEN	Aquiclude's name in English	Text; 255; NO
hydroGeochRockType**	The rock type with respect to the soluble rock components and their hydrogeochemical influence of groundwater. Defines the prevailing geochemical character of natural groundwater within the Aquifer	INTEGER; NO
aquiferSystemId**	The AquiferSystem of which the Aquitard is a part	INTEGER; NO
otherAquicludeDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

AquiferSystems

A collection of aquifers and aquitards, which together constitute the environment of groundwater - "communicating vessels", that are filled or can be filled with water. Attributes of Aquifer System and its components determine the feasibility of water collection, its movement, as well as the impact on its chemical state. NOTE: The Aquifer System components and their attributes (including geometry) are relatively stable over time except in special cases.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique Identifier for each aquifer system	INTEGER; YES
aquiferSystem	name of Unique Identifier for each aquifer system	Text; 50: NO
name	AqufferSystem's name in the local language	Text; 255; NO
nameEN	AquiferSystem's name in English	Text; 255; NO
isLayered	Indicates if the AquiferSystem consists of more than one layer.	boolean
otherAquiferSystemDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255 ;NO

Wells

This table store the main attributes of the wells.

NAME OF THE FIELD	DESCRIPTION	FORMAT
id*	Unique identifier for each well	INTEGER; YES
pointId**	Unique identifier for each point with information.	INTEGER; YES
well	name of the Unique identifier for each well	Text; 50: YES
validFrom	The date the well started being used	Date
validTo	The date the well ceased being used. If this field is not fullfiled means that the well it is still active	Date
lenght	The distance along the well. This will be determined by the data provider (ie, "length"" can have different sources like drillers measurement loggers measurement survey)"	Double; NO
curb	Distance from land to well curb (meters)	Double; NO
externalDiameter	Approximate Externe diameter (in mm)	Double; NO
innerDiameter	Approximate Interne diameter (in mm)	Double; NO
constructionDate	Date of Construction	Date; NO
ownerId**	Responsible party that owns the well	INTEGER; NO
contructorId**	Party that carries out the development of the Well	INTEGER; NO
statusCode**	Values describing the status of man-made hydrogeological objects	INTEGER; NO
statusCodeDate	When was the last observation of the WellStatus	Data; NO
activityType**	The type of activity carried out by the well.	INTEGER; NO
otherWellsDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

WellsHydrogeologicalUnit

This table store the definition of the boundaries of the different hydrogeological units identified for each well.

NAME OF THE FIELD	DESCRIPTION	FORMAT
wellId**	Unique identifier of wells where the hydrogeological units were observed	INTEGER; YES
top/bottomLength	Top and the bottom of the depth described (in meters)	Double; YES
hydrogeologicalUnitId**	HydroUnits defined/identified along the well (defined in the table HydrogeologicalUnits)	INTEGER; YES
otherWellsHyrogeologicalUnitsDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Screens

In this table the main characteristics of the screens of the wells can be introduced. This table acts as a library, if the screen is already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique identifier for the screen installed in the wells/piezometers	INTEGER; YES
screen	name of the unique identifier for the screen installed in the wells/piezometers	Text; 50; NO
responsiblePartyId**	Model Entity	INTEGER; NO
screenType**	ScreenType from the ListScreenType(e.g. Slotted Plastic Pipe, continuous-slot screen)	INTEGER; NO
description	Short description in the local language of the screen	Text; 255; NO
descriptionEN	Short description of the screen in English	Text; 255; NO
OtherScreenDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

WellScreens

This table has been designed to contain the screen type and the intervals screened. It also establishes (for each screened interval) the link of the well to the hydrogeological unit that is screened. Thus, a well can be screened in diverse hydrogeological units whereas a hydrogeological unit can be screened by different wells.

NAME OF THE FIELD	DESCRIPTION	FORMAT
wellId**	Unique identifier for each well	INTEGER; YES
screenId**	Unique identifier for the screen installed in the wells	INTEGER; YES
topLenght	Length of the top of the Screen (in meters)	Double; NO
bottomLenght	Length of the bottom of the Screen (in meters).	Double; NO
screenExtentCode**	Extent of the screen in the hydrogeological unit (partial, entire, etc.)	INTEGER; YES
instalationDate	Date of installation	Date;NO
hydrogeologicalUnitsId**	Hydrogeological unit that is screened	INTEGER; YES
otherWellScreensDetails	Additional data	Text; 255; NO
Observations	Observations of the person that introduce the data into the database	Text; 255; NO

Springs

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique identifier for spring	INTEGER; YES
pointId**	Unique identifier for each point	INTEGER; YES
springType**	SpringType	Text; 50; NO
persistenceCode	The degree of persistence of water flow.E.g . Intermittent, seasonal, perennial, notSpecified ephemeral, ... http://inspire.ec.europa.eu/codeList/WaterPersistenceValue	INTEGER; NO
approximateQuantityOfFlow	An approximate value defining the water yield in a natural hydrogeological object	Double; NO
approximateQuantityOfFlowUom-Code	Units of measurements of the quantity of flow	INTEGER; NO
description	Short description in the local language of the spring	Text; 255; NO
waterPersistenceCode descriptionEN	Short description of the spring in English	Text; 255; NO
OtherSpringDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Hydrogeological observations and measurements

The HydrogeologicalPointsObservations and HydrogeologicalPointsMeasurements tables were designed to manage hydrogeological data observed at a given groundwater point such as time series of head measurements, or rate and volume of abstraction or recharge .The aforementioned tables related to the temporal measurements (TimeMetadata) and to the process used to carry out the observation (Processes) are linked to these tables. A code list of hydrogeological measurements with its corresponding units (ListHydrogeologicalParametersCode) was also developed.

HydrogeologicalPointsObservations

This table store information of the hydrogeological data observed at a given groundwater point (e.g. well abstraction, water level, etc.).

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique identifier for each observations/measurements performed for each groundwater point defined	INTEGER; YES
pointId**	Unique identifier for each point with groundwater information (based on O&M:FeatureOfInterest)	INTEGER; YES
hydrogeologicalParametersCode**	This property is used to describe the phenomenon that is being observed (including the uom) (based on O&M: observed property)	INTEGER; YES
qualifier	Define potentially influential conditions occurring whilst the measurement was taking place (after WTDF). E.g. pumping ocurring	Text; 50; NO
processId**	Unique identifier for each process used to carry out the observation (based on O&M:Procedure)	INTEGER; NO
phenomenomTime	This may be the time when the observation procedure was performed on a real-world feature (based on O&M:phenomenomTime)	Data
timeMetadataId**	Unique identifier for each characteristic time-series	INTEGER; NO
beginDate	Start time period, defining the start and end times of the time series (after WaterML 2.0)	Date/Hour
endDate	End time period, defining the start and end times of the time series (after WaterML 2.0)	Date/Hour
citationId**	Reference of the source of information	INTEGER; NO
responsiblePartyId**	Unique identifier for the person/entity in charge of the measurement	INTEGER; NO
resultsQualityCode**	This is used to describe the overall quality of a time series. Time series often require per point quality information, which is provided by the specific time-series types that are used	INTEGER; NO
resultsNatureType**	Nature of the results (e.g. simulated)	INTEGER; NO
otherObservationsDetails	Additional data	Text; 255; NO
Observations	Observations of the person that introduce the data into the database	Text; 255; NO

HydrogeologicalPointsMeasurements

This table store the information related to the hydrogeological data observed at a given groundwater point such as time series of head measurements, or rate and volume of abstraction or recharge.

NAME OF THE FIELD	DESCRIPTION	FORMAT
hydroPointObsId**	Unique identifier for each observations/measurements performed for each groundwater point defined	INTEGER; YES
resultTime	The attribute resultTime describes the time when the result became available, typically when the procedure associated with the observation was completed For some observations this is identical to the phenomenonTime (based on O&M:resultTime)	Date/hour; YES
value	The value is a Record that indicates the value of the property of interest for the observation. (based on O&M:values)	Double; YES
qualifier	Property of the value. E.g. > , <?	Text; 10; NO
otherHydroMeasurementsDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

TimeMetadata

This table contains details of the time series obtained in the observation point.

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique identifier for each characteristic time-series. Describe the time-serie	INTEGER; YES
accuracy	This property allows for a quantitative assertion of the estimated accuracy of the measurement value (e.g. Standard Deviation)	Double; NO
spacing	The spacing property of the time series is used to specify the time between points	Double; NO
interpolationType**	One of the core characteristics of measurement time series is the nature of the relationship between the time instant and the recorded value. This relationship is determined by the procedure that was used in making the estimate that the value represents. WaterML2.0 defines a number of types of time series. (e.g. Continuous, Average in preceding interval, ...)	INTEGER; NO
nilReasonCode**	This property describes the reason that a point has been identified as null. This provides context for interpreting null points (e.g. missing, withheld etc.). Further information in WML2.0.	INTEGER; NO
otherTimeMetadataDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Processes

It has the role of describing generic procedures that are common in practice and can be referenced from many observations that were made in the same or similar way. It has name, unique identifier, documentation, responsibleParty to inform the user about the nature of the procedure and the authority that maintains the record.

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique Identifier for each type of process used	INTEGER; YES
name	Name of the process used for performing the measurement, the sampling, etc. in the local language	Text; 50; NO
nameEN	Name of the process used for performing the measurement in English	Text; 50; NO
description	Short description of the process in the local language	Text; 255; NO
descriptionEN	Short description of the process in English	Text; 255; NO
responsiblePartyId**	Responsible party to the user about the nature of the procedure and the authority that maintains the record	INTEGER; NO
processParameterCode**	Generic process parameter	INTEGER; NO
processType**	Process Used type	INTEGER; NO
citationId**	Documentation of the process used	INTEGER; NO
otherProcessDetails	Additional data	Text; 255; NO
oservations	Observations of the person that introduce the data into the database	Text; 255; NO

Hydrochemical observations and measurements

The hydrogeochemical data from each sampling point are stratified within the database in accordance with the sampling point, campaign, sampling date, name and lenght (in HydrochemicalSamples). Thereafter, each sample is stratified in accordance with sampling data analysis, parameter, value and measurement units (in HydrochemicalMeasurement). The different observed properties (physico-chemical parameters) are included in a codelist termed ListHydroChemical-Parameters.

HydrochemicalSamples

This table store the main properties of the samples to be analysed.

NAME OF THE FIELD	DESCRIPTION	FORMAT
pointId**	Unique identifier for each point where the sample has been taken (pointId from Points). In the O&M:The sampledFeature is the feature the SamplingFeature was sampled from, providing the ultimate context for the observation. An example of sampledFeature would be the river segment a specimen was taken from.In the O&M schema also the FoI is modelled as a SF_Specimen; the location pertaining to the measurement is provided by the attribute samplingLocation	INTEGER; NO
samplingTime	Date of sample collection	Date; YES
Id	Unique identifier for each sample. In the O&M standard it is correspond with Specimen. A specimen is a feature sampled from a feature of interest to enable ex-situ observation, such as in a laboratory	INTEGER; YES
sample	Unique name/identifier for each sample	Text; 50; YES
campaignId**	Unique identifier for the campaign in which the sample was taken. CampaignId from campaigns; campaignId	TINTEGER; NO
fieldName	Name of the sample in the field before to send to the lab	Text; 30; NO
currentLocation	If present, the attribute currentLocation: Location shall describe the location of a physical specimen. This may be a storage location, such as a shelf in a warehouse or in a laboratory	Text; 50; NO
sampleSize	Size of the sample. Measure shall describe a physical extent of the specimen. This may be volume	Double; NO
sampleSizeUom	Unit of measurement (vol) of the sample Size	Text; 50; NO
sampleLenght	Lenght/Depth where sample was obtained (m)	Double; NO
samplingMethodId	The attribute samplingMethodId shall describe the method used to obtain the specimen	INTEGER; NO
samplingTime	The time the sample was taken. (based on O&M scheme)	Data
responsablePartyId**	Person /entity responsible of the sample collection	TINTEGER; NO
otherChemSampleDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

HydrochemicalMeasurements

This table store the measurement of the aforementioned samples.

NAME OF THE FIELD	DESCRIPTION	FORMAT
sampleId**	Unique identifier for each sample defined in HydrochemicalSamples	TINTEGER; YES
hydrochemicalParametersCode **	Unique Identify for each parameter from ListHydroChemicalParameters; field:parameterId	TINTEGER; NO
resultTime	Provides the time the results of the laboratory analysis were made available. If the measurement was done in situ, resultTime is equal to samplingTime (table HydrochemicalSamples)	Date; NO
value	Result, numeric value	Doble; NO
compValue	censored values (which are the concentrations of some elements reported as non-detected?, or as less-than? or greater-than?)	Text; 50; NO
responsablePartyId**	Laboratory from ResponsibleParties where the sample was analyzed. If the measurement was done in situ, here the author of such measurement	INTEGER; NO
processId**	Procedure of the analysis	INTEGER; NO
citationId**	Citation to the laboratory report. From the table Citations	TINTEGER; NO
otherChemMeasurementDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

Normatives

This table store information of the different regulatory guideline. This table acts as a library, if the normative/guideline details are already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
Id*	Unique identifier for each normative, directive, etc.	INTEGER; YES
responsiblePartyId**	Entity/Agency/ organism that has developed (or applied) the normative	INTEGER; NO
name	Name of regulations, guidelines, etc. in the local language	Text; 50; NO
nameEN	Name of regulations, guidelines, etc. in English	Text; 50; YES
date	Date of regulations, guidelines, etc.	Date; NO
citationId	Documentation of the normative	INTEGER; NO
otherNormativeDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

HydrochemicalNormativeParameters

This table acts as a library, if the normative/guideline details for a given parameter are already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
normativeId**	Unique identifier for each normative, directive, etc.	INTEGER; YES
hydrochemicalParametersCode **	Unique Identify for each parameter from ListHydroChemicalParameters; field:parameterId (the uom is included into the code)	INTEGER; YES
parameterNormativeName	Unique Identifier/name for each parameter defined by the normative/guideline (e.g. Nitrate)	Text; 50; NO
family	Classification of the different parameters following users defined normative/criteria for its subsequent classification according to the threshold approach established by a given guideline/normative	Text; 255; NO
limMinNorm	Threshold value 1 for a given paramater for a given normative	Double; YES
limMedNorm	Threshold value2 (> than limMinNorm) for a given paramater for a given normative	Double; YES
limMaxNorm	Threshold value 3 (> que LimMedNorm) for a given paramater for a given normative	Double; NO
paramClassification1/ paramClassification2	Classification parameter1-2 by the normative	Text; 50; NO
otherhydrocheNormativeDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

HydrochemicalLaboratoryParameters

This table acts as a library, if the parameters nomenclature and its properties for a given laboratory/entity is already included, you do not need to add a new term.

NAME OF THE FIELD	DESCRIPTION	FORMAT
hydrochemicalParametersCode **	Unique Identify for each parameter from ListHydroChemicalParameters; field:parameterId	INTEGER; YES
laboratoryId**	Laboratory entity in charge of collecting data in lab or the entity that provide the information	INTEGER; YES
laboratoryParameter	Parameter used by the entity in charge of providing/analysing hydrochemical data	Text; 30; NO
uomCode	Units of measurements of the laboratoryParameter	INTEGER; YES
detectionLimit	Parameter detection limit	Double; NO
processId**	Procedure of the analysis	INTEGER; YES
paramClassification1/ paramClassification2	Classification parameter1-2 by the entity	Text; 50; NO
citationId**	Citation of the document that contain the details of the analysis methodology, nomenclature, etc of the parameter (e.g. protocol established by the laboratory). *Dropdown* list from DB_References	INTEGER; YES
otherHydrochemicalLaboratoryDetails	Additional data	Text; 255; NO
observations	Observations of the person that introduce the data into the database	Text; 255; NO

References

This data model was generated taken into account different International Standards and on-going projects. These include data specification of the following:

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- INSPIRE, 2013. Infrastructure for Spatial Information in Europe. D.2.8.11.4. Data specification on Geology-Draft Technical Guidelines.
- INSPIRE, 2011. Infrastructure for Spatial Information in Europe. D2.9_V1.0. Guidelines for the use of Observations&Measurements and Sensor Web Enablements-related standards in INSPIRE AnnexII and III data specification development.
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- Sen, M., Duffy, T., 2005. GeoSciML: Development of a generic GeoScience Markup Language, Computers & Geosciences. DOI: 10.1016/j.cageo.2004.12.003
- 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
- Velasco, V, 2013. GIS-based hydrogeological platform for sedimentary media. PhD Thesis. Technical University of Barcelona (Spain).
- Velasco, V., Tubau, I., Vázquez-Suñé, E., Gogu, R., Gaitanaru, D., Alcaraz, M., Serrano-Juan, A., Fernández-Garcia, D., Garrido, T., Fraile, J., Sanchez-Vila, X, 2014.GIS-based hydrogeochemical analysis tools (QUIMET)2014. Computers & Geosciences. DOI: 10.1016/j.cageo.2014.04.013