A2 Benutzerdokumentation des SECONDO-Plugins für QGIS

Introduction

The SECONDO Plugin for QGIS is a novel extension for the desktop version of the open source geographical information system QGIS, which allows you to integrate and use the features of the SECONDO database system in the QGIS environment. SECONDO has being developed for more than 20 years at the Department of Mathematics and Computer Science of the University of Hagen, Germany, and allows you to store and handle different kinds of data types for experimental purposes. The storage and handling of spatial and spatio-temporal objects is also implemented in SECONDO.

Through the use of the SECONDO Plugin for QGIS you can access and query spatial, spatio-temporal and relational objects, create and delete databases, create new objects from QGIS and import objects from the database to QGIS for visualization and analysis. Furthermore, the integration of SECONDO with QGIS gives you the chance to set up a distributed collaboration environment, as SECONDO can be used as a central repository for collaborative QGIS projects. The spatial and spatio-temporal query capabilities of SECONDO can be used to extend the functions of QGIS to power up the analysis features of QGIS.

This user manual contains the main features and topics for the usage of the plugin within QGIS. If you are interested in the implementation details or want to collaborate with the project, please refer to the development documentation delivered together with the plugin and the SECONDO-API.

System requirements

The installation of the SECONDO Plugin for QGIS requires:

- QGIS 3 or higher (due to compatibility problems with PyQt, please check if your version uses PyQt5 or higher).
- Microsoft Windows 10.
- A running instance of the SECONDO server and a TCP connection to it. For test purposes you can try the Virtual Machine Appliance of SECONDO, downloadable from http://dna.fernuni-hagen.de/secondo/.

Installation in QGIS

The installation of the SECONDO Plugin for QGIS can be done using the plugin management environment of QGIS, which can be accessed through *Plugins -> Manage and Install Plugins...* in the menu bar of the application. The figure A2.1 shows the plugin management dialog of QGIS with the list of the plugins already installed.

The main folder and components of the plugin are delivered as a single ZIP file, which can be directly selected, unpacked and installed for execution in the QGIS environment using the plugin management dialog. Please notice, that QGIS plugins are always loaded during the startup of the application. Invalid plugins won't be loaded and cannot be activated afterwards by default. If you want to activate or reload a plugin, please install the external plugin *Plugin Reloader*.

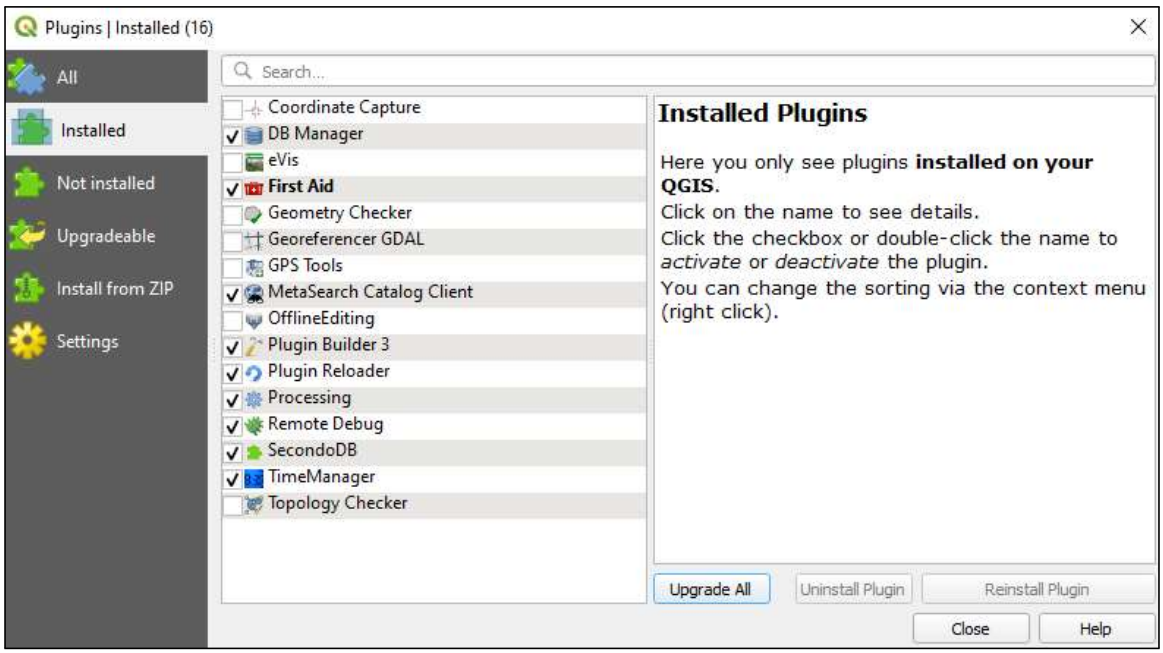

Figure A2.1: Plugin Management dialog in QGIS showing the installed plugins.

The use of the reloader is highly encouraged if you are experiencing connection problems or the SECONDO Plugin becomes unstable. In many cases, a reload of the plugin helps to recover a stable session within the plugin.

Make sure that the checkbox *Show also experimental plugins* is set before you try to install the SECONDO Plugin for QGIS. To install the components of the plugin, select the option *Install from ZIP* on the left side of the dialog and navigate in the *ZIP file* address line to the location of the ZIP file containing the components of the plugin. Once located, press the button *Install Plugin* below the file address according to figure A2.2.

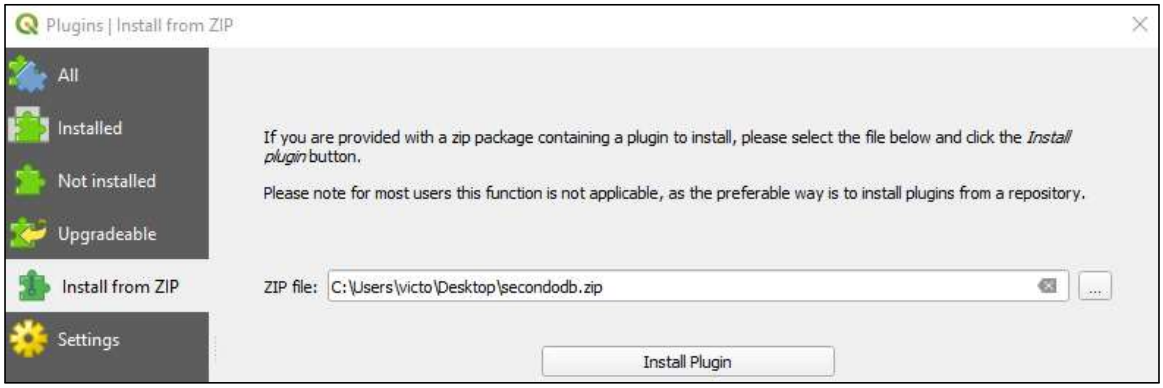

Figure A2.2: Installing the SECONDO Plugin using the ZIP file in QGIS.

After the installation, a new icon will appear in the plugin toolbar, as depicted in the figure A2.3. A menu entry under *Plugins -> SecondoDB* will be added as well.

Initialization of the SECONDO Plugin in QGIS

The main window of the SECONDO Plugin for QGIS can be called by clicking the icon in the plugin toolbar or by clicking the menu entry under *Plugins -> SecondoDB*. This initializes a

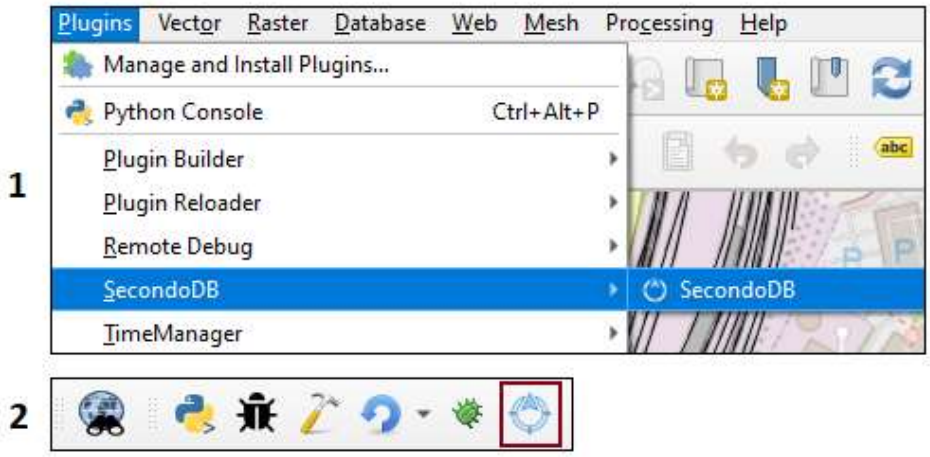

Figure A2.3: Accessing the SECONDO Plugin for QGIS: 1. through the menu bar and 2. through the tool bar.

single instance of the plugin, which will be active for the whole QGIS session. Please notice, that only this single instance can exist under a QGIS session. This means, that only one connection to the SECONDO server can be managed under the current QGIS session and no there is no possibility to perform parallel queries or to call further objects during import/export processes. This behavior will be further explained in section A2.

Connection to the SECONDO-Server

To connect to the running instance of the SECONDO server go to *Server Connection -> Connect to Secondo Server* in the menu of the plugin. This will open a connection dialog where you can enter the host IP-address (or name, in case you set the host name in your OS environment) and the port. If you set and saved the connection parameters previously in the settings dialog, the plugin loads the saved parameters every new session. For further information about the settings please refer to section A2 of this manual.

After entering the connections parameters click the *Connect* button in the dialog. During the connection process a message will be shown in the status bar of the plugin. If the connection was established, the toolbar of the plugin will be activated together with the main elements of the navigation tree pane at the left side of the window, as shown in figure A2.4.

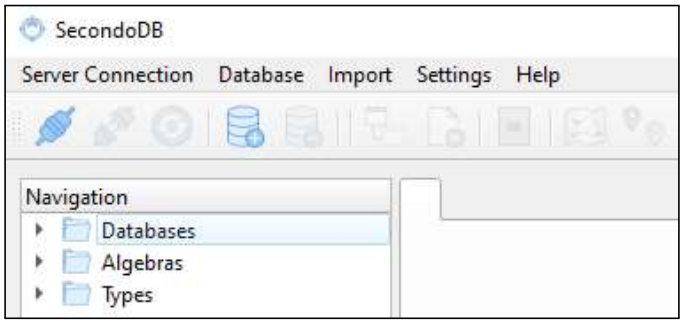

Figure A2.4: Status of the navigation tree and available options in the toolbar after connection.

If you want to disconnect from the SECONDO server, go to *Server Connection -> Disconnect.*

Navigation and object handling

Right after connecting to the running instance of the SECONDO server, you will notice that some elements will be loaded in the navigation tree pane (with the title *Navigation* at the left side of the window). In the current release of the plugin three main folders are offered at the first level of the tree: *Databases*, *Algebras* and *Types*, which corresponds to the objects at server level of the current instance of the SECONDO server. For better performance, you can deactivate the loading of the last two folders *Algebras* and *Types* in the settings if you don't need them regularly.

The *Databases* folder contains the available databases on the SECONDO server. The icon of the database shows the currently opened database: If the database is open, its icon will be shown green colored, otherwise light blue. To open a database, just double-click on the desired database or alternatively select the database on the tree and click on *Connect to Database* on the toolbar. The same function is available in the menu under *Database -> Connect to Database*. After opening the database, the available and supported objects will be shown under the database name, as shown in figure A2.5.

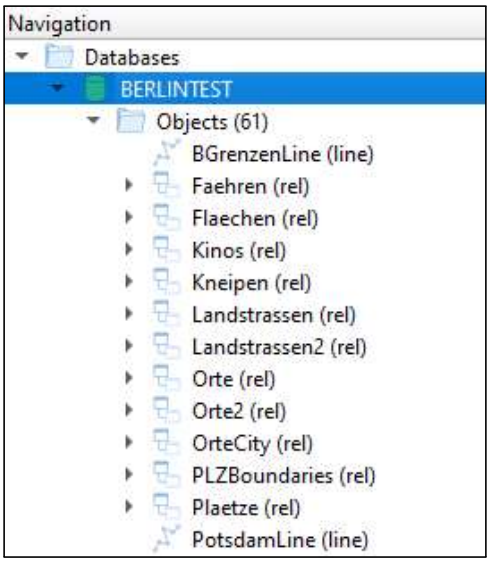

Figure A2.5: Available objects of the database BERLINTEST shown in the navigation tree of the plugin.

Currently only the following SECONDO object's type are supported and will be displayed within the database item:

- **Relations** (rel)
- The spatial objects **point**, **points**, **line** and **region**.
- The spatio-temporal objects **moving point** (mpoint) and **moving region** (mregion).

To close the currently opened database, click on *Disconnect from Database* on the toolbar. Please notice, that only a single database can be opened at a time. The currently opened database won't close by double-clicking another database, so close first the database first in order to open a new one.

After opening an available database on the navigation tree, you can see the supported objects contained in it. Some meta data related to the object will be displayed in the tree as well:

- The name of the object (for example „Flaechen“)
- The icon and the name of the data type (for example „rel“ or „line“)

To display the data of an object, double-click the object's name in the tree. This will launch the specific view interface with the data viewer for the corresponding object type.

You can delete available objects in the database using the function *Delete Selected Object* on the tool bar. You will be prompted to confirm the deletion before the object is actually deleted from the database.

Displaying data with the Data Viewer

The view interface displays the data of the called object. The upper part of the interface shows the name and the type of the object. The lower part shows the data viewer control, which displays the data contained in the object using a table or a tree view. The selection of the data viewer's type depends of the kind of object: relations, points, lines and moving objects are displayed in a table, regions are displayed in a tree view. The data viewer for an object of the type relation is shown in figure A2.6 as an example.

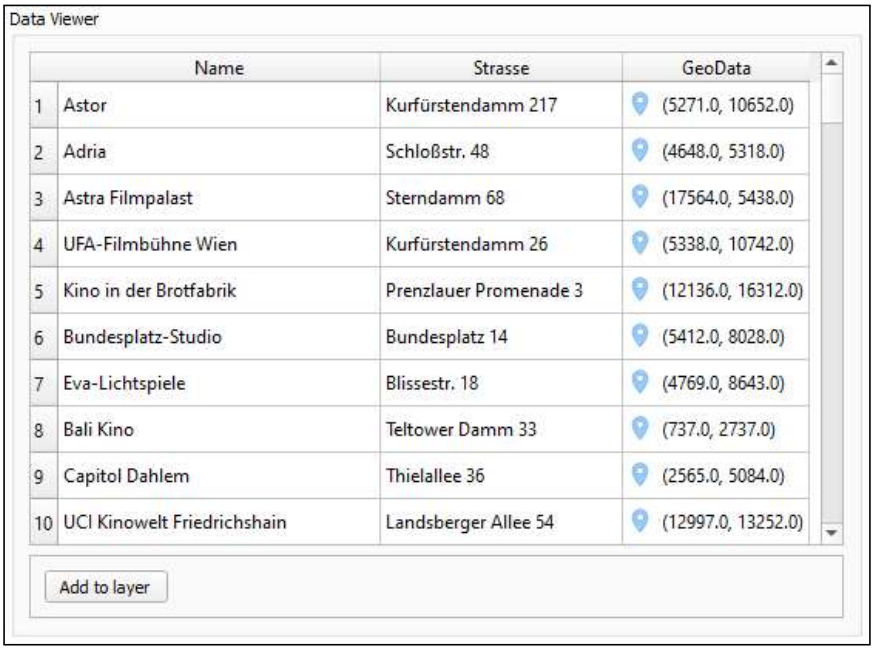

Figure A2.6: Data viewer displaying the data of the relation Kinos of the BERLINTEST database.

Within the data viewer you can scroll and search for the relevant entries. The import of objects from SECONDO into QGIS requires for some object types the previous selection of the relevant entries. his behavior will be further explained in the section A2.

Database creation and deletion

To create a new database, click on *Add New Database* on the toolbar or in the main menu under *Database -> Add New Database*. In the creation dialog enter a name and click on *Add*, as shown in figure A2.7. If the database was created successfully, a message will be displayed in the status bar. In case of an error, an error message will be displayed there as well. New databases can only be created on server mode, i.e. you have to close any opened database before creation.

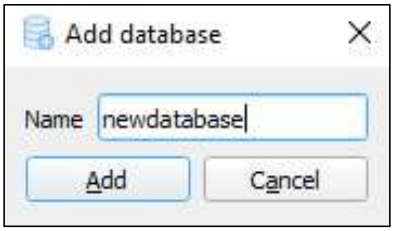

Figure A2.7: Add a new database in the SECONDO server.

Importing objects from SECONDO into QGIS

You can export spatial, spatio-temporal and relation objects to the QGIS environment using the function *Add to layer* of the data viewer. Single objects (like spatial and spatio-temporal objects) can be directly imported without a previous selection on the data viewer. To import entries of a relation, you have to select previously the relevant entries in the control. You can select all entries at once by clicking the upper left corner of the data viewer. After selection, click on *Add to layer*.

Depending of the object type, different options will be available for the import. Every import creates a new vector layer in QGIS with the content of the import. The current release doesn't support the import into existent layers yet, mainly because the definition of the attributes or the geometry between the imported object and the layer could be different. Make sure that you give a valid, not yet existent name to the layer.

If you are importing a line or a relation with a line geometry, you can check the option *Add as a single polyline*. This option joins the single segments of the line to a polyline geometry, improving the performance and look of the visualization. Nevertheless this option is not checked as default. You can set this parameter according to your own needs.

If you are importing a moving point, you can select between two import options, as shown in figure A2.8. Importing the moving point as a moving point layer means, that the layer will contain the single frames of the animation sorted using a time stamp. This kind of import allows you to animate the imported geometry using the plugin TimeManager. Please be aware that importing the moving point as a moving point layer requires some processing time, as well as the processing within the plugin TimeManager. This topic will be further discussed in the next section.

You can import the moving point as a trajectory line as well, which corresponds to a line geometry showing the trajectory of the moving point along the duration of the motion. This is useful if you want to plot trajectories as static geometries.

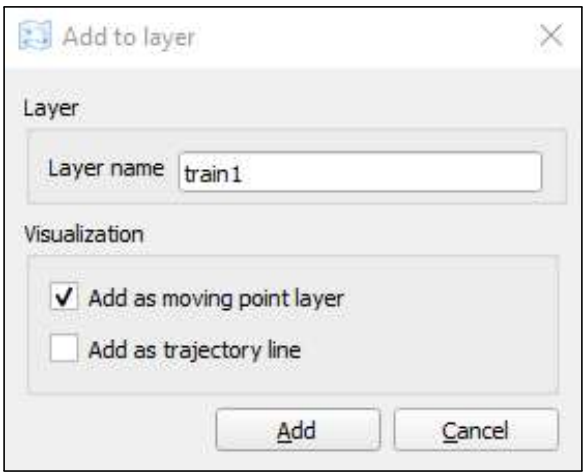

Figure A2.8: Add to layer dialog for a moving point.

Animation of moving objects with the TimeManager plugin

The current release of the SECONDO Plugin for QGIS doesn't offer an animation and control interface for motion on its own. For this purpose, you can use the plugin TimeManager, which you can install using the Plugin Management function of QGIS.

To animate a moving object, you have to import it as a moving object layer as described in the section A2. This will generate a series of points or regions depicting the trajectory of the geometry in every single time frame. Notice that every frame corresponds to one feature of the newly created vector layer, as depicted in figure A2.9.

train1 :: Features Total: 2400, Filtered: 2400, Selected: 0

	fid	Name	Timestamp	X	Y
1	1	train1	2003-11-20 06:03:00.000000	13506.0	11159.0
2	2	train1	2003-11-20 06:03:01.000000	13502.773275125748	11151.901205276645
3	3	train1	2003-11-20 06:03:02.000000	13499.546550251494	11144.802410553288
4	4	train1	2003-11-20 06:03:03.000000	13496.319825377243	11137.703615829932
5	5	train1	2003-11-20 06:03:04.000000	13493.093100502989	11130.604821106577
6	6	train1	2003-11-20 06:03:05.000000	13489.866375628737	11123.50602638322
7	7	train1	2003-11-20 06:03:06.000000	13486.639650754485	11116.407231659865
8	8	train1	2003-11-20 06:03:07.000000	13483.412925880231	11109.30843693651
9	9	train1	2003-11-20 06:03:08.000000	13480.18620100598	11102.209642213154
10	10	train1	2003-11-20 06:03:09.000000	13476.959476131726	11095.110847489797
11	11	train1	2003-11-20 06:03:10.000000	13473.732751257474	11088.012052766442
12	12	train1	2003-11-20 06:03:11.000000	13470.50602638322	11080.913258043087

Show All Features

Figure A2.9: List of features representing the single frames generated for a moving point in QGIS.

TimeManager requires you to first save the scratch vector layer as a permanent layer in order to use it for the animation. For this purpose, right-click the corresponding scratch layer with the

moving object and select the option *Make Permanent...*. This will show the dialog *Save Scratch Layer* where you can specify a file name and location. This will make the layer permanent, making it permanently usable for the current and for other QGIS projects.

To assign and configure the layer for animation, click on *Settings* in the TimeManager pane. This will open the *Time Manager Settings* dialog, where you can add a new layer to be synchronized for animation. Click on *Add Layer* in the dialog.

In the *Select Layer and Column(s)* dialog select the corresponding layer. As start time, define the column *Timestamp* of the selected layer, which contains the time stamps of every generated frame of the moving point. This parameters are shown in figure A2.10.

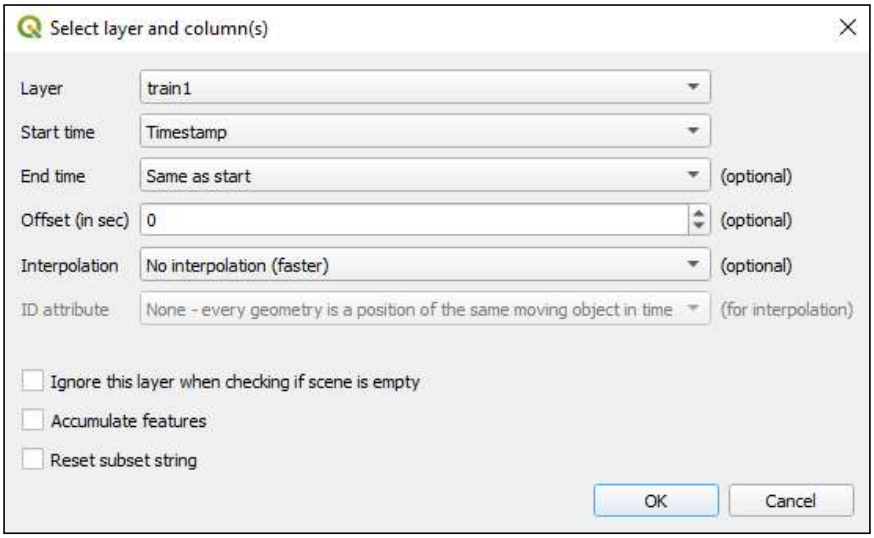

Figure A2.10: Layer selection and parameter setting in TimeManager.

Click *OK* to add the layer. Back in the *Time Manager Settings* dialog, set the *Animation options* located in the lower part of the dialog. A frame show time between 30 and 60 milliseconds should provide a smooth animation of the geometry. Click *OK* to start the processing towards the synchronization of the layer. This can take from a few second to a minute depending the number of layers and geometries to be synchronized. During this time, QGIS will be completely unresponsive.

To start the animation, click on the *play* button in the Time Manager pane. You can configure the start frame and the size for displaying. In order to avoid a distorted visualization of the object, try to set the time frame size to a value near to the configured FPS for the generation of the frames in the SECONDO Plugin. Otherwise, the animation will show several frames at the same time and the motion won't be smooth. The animation controls of TimeManager are shown in figure A2.11.

Importing features from QGIS to SECONDO

The current release of the plugin supports the import of features from vector layers for some common used, 2-dimensional geometries of QGIS into SECONDO. For this purpose, the plugin collects the features of the currently active layer of the project and handles them as entries of a relation. This means, that QGIS features will be always imported into SECONDO as relations using the defined attributes of the layer.

Figure A2.11: Animation controls of the TimeManager plugin.

You can import some selected features of the active layer, or even all features of it. To import features, click on *Import from QGIS layer* or *Import from Selected Features in Active QGIS-layer*. The first option will automatically select all features of the active layer. The second option allows you to select the features using the selection functionalities of QGIS, as depicted in figure A2.12. Please select the features before you start the import from selected features function.

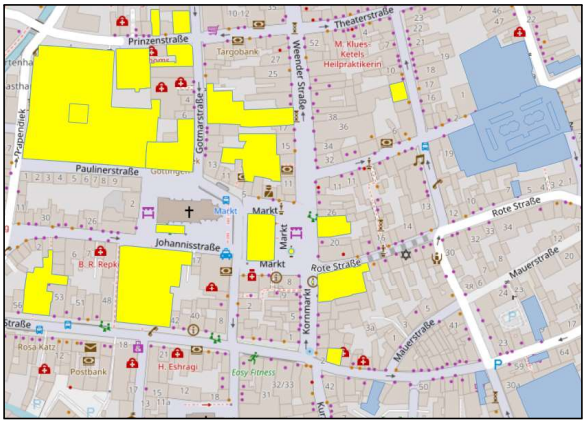

Figure A2.12: Selection of some features in the active layer in QGIS (background map and geometries courtesy of OpenStreetMap©).

The import dialog will show the features in a table control together with the main properties of the layer. This corresponds to the layers name, the geometry, the WKB type of the geometry and the number of selected features. You can select the attributes for the creation of the relation in SECONDO using the list control in the lower part of the dialog. If you don't want to export the geometries of the features, uncheck the option *Import geometry* of the dialog. Please make sure that the name of the new relation doesn't exist in the database yet, otherwise the plugin will reject the import. To start the import process, click on *Import*. The import dialog is shown in figure A2.13.

The import to SECONDO will be performed in a separate thread in background. During this time, the plugin will be closed until the import process is completed. The progress of the import will be displayed on the upper part of the QGIS canvas, as shown in figure A2.14.

After the import, the newly created relation object will be shown under the corresponding database. You can access the object by double-clicking the name in the navigation tree.

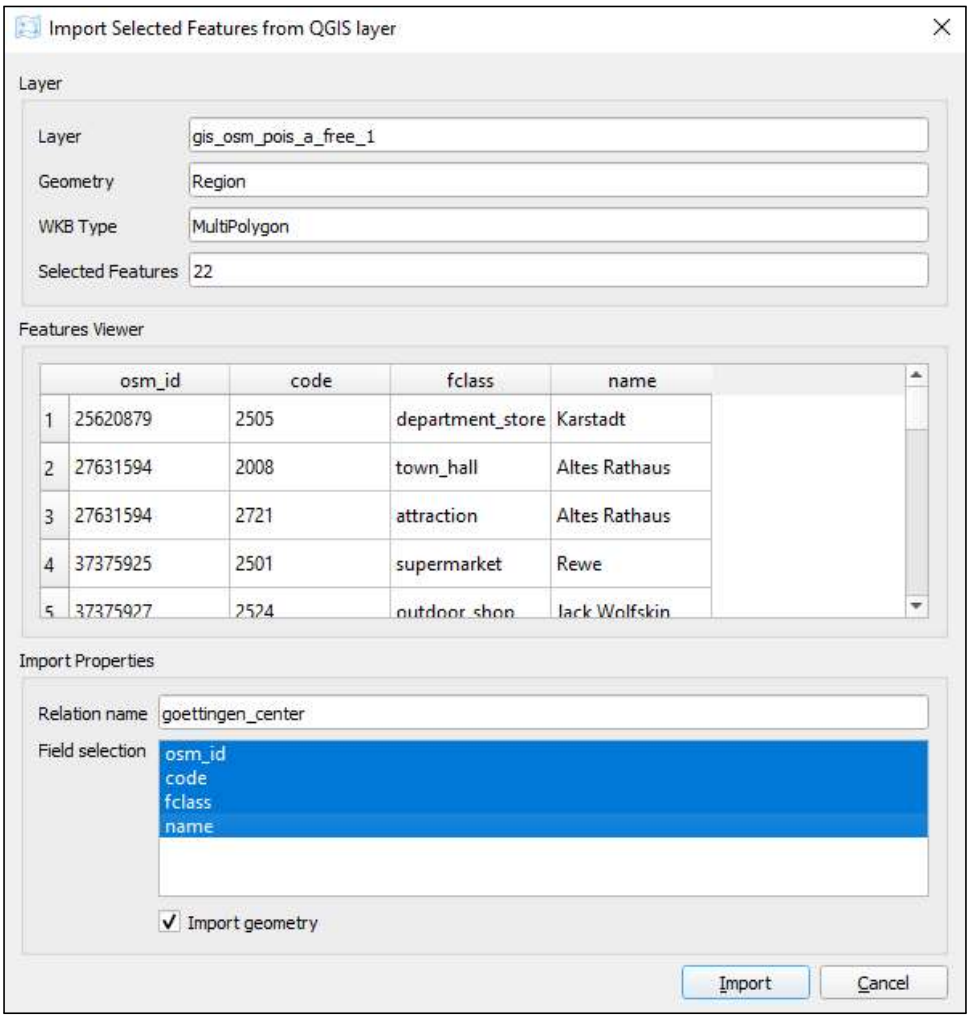

Figure A2.13: Import dialog for selected features from QGIS into SECONDO.

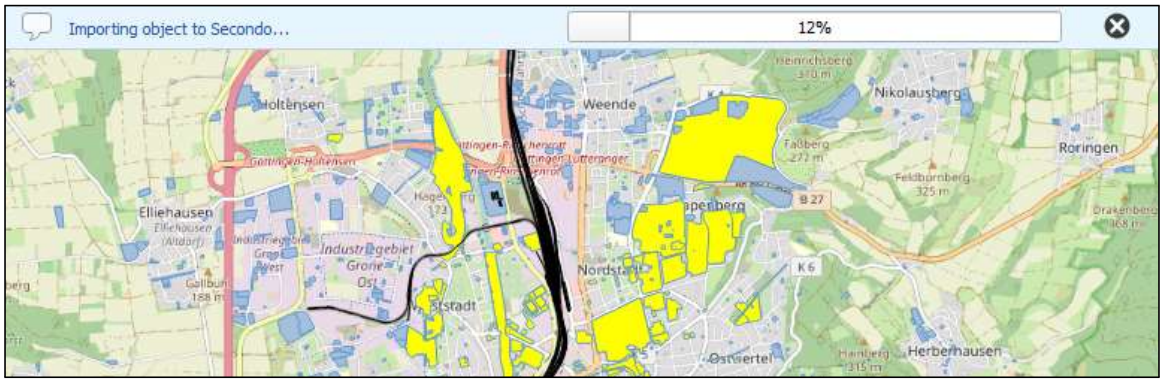

Figure A2.14: Progress bar during the import of an object to SECONDO (background map and geometries courtesy of OpenStreetMap©).

Executing queries in SECONDO

The current release of the plugin includes a simple query editor that allows you to perform queries to retrieve data from the database. To start the editor, click on *Execute Query* on the tool bar. The database must be opened before you start the query editor. This feature works in the same way that the console input of other user interfaces of SECONDO, like the JavaGUI. Currently only queries in executable language are supported. You can't perform queries other than to retrieve data (the operators let, derive, create, etc. are currently not supported). The editor is shown in figure A2.15.

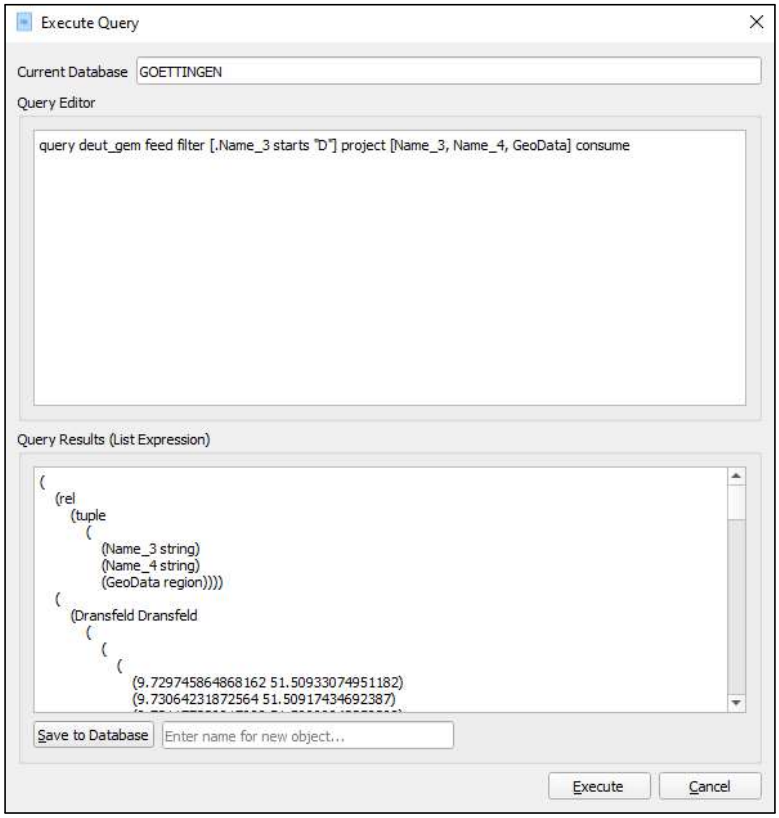

Figure A2.15: Query execution in the plugin using the query editor.

The results will be presented using the nested list representation of the SECONDO objects. You can save the results to the database using the function *Save to Database* in the lower part of the dialog. Please be aware, that the query will be executed again before being saved in SECONDO.

Creation of empty relations

The current release of the plugin allows you to create simple relations using some of the data types available in SECONDO. This is still an experimental feature and is being used to demonstrate the possibilities of the graphical user interface to perform some common tasks in SECONDO, which are normally performed using the traditional text console.

To create a relation, click on *Create New Relation* on the tool bar. The right pane of the plugin will offer an interface to input the parameters needed for the creation. Enter a name for your relation, and add some attributes selecting the available types from the combo box at the right side. You can edit the names of the attributes or delete them. After entering the parameters,

click on *Create* as shown in figure A2.16.

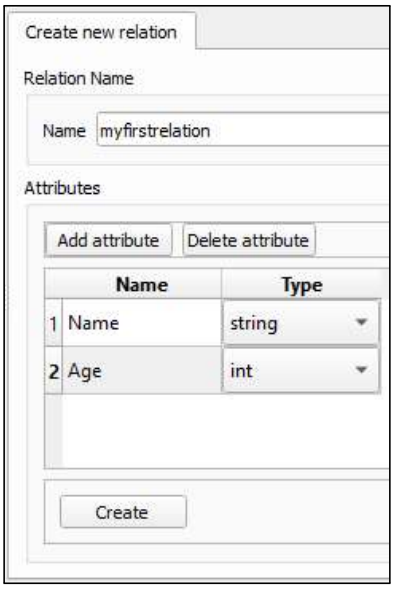

Figure A2.16: Creating a new empty relation in SECONDO

Settings

Some parameters of the plugin can be set to be reused in every new session of QGIS. To access the settings, go to *Settings -> Settings...* in the menu bar. The available options are shown in figure A2.17. As of today, you can set the connection parameters (host and port), the start-up options for loading the algebra and type definition objects when connecting to the SECONDO server and the frames per second rate (FPS) for the generation of the single frames of moving objects. Please be aware, that loading the algebras and type definitions increases the starting up of the plugin after connecting to the server in a couple of seconds.

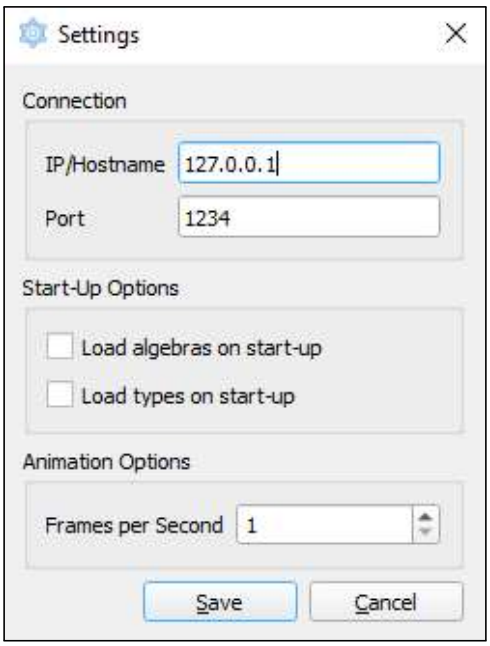

Figure A2.17: Settings dialog of the SECONDO plugin for QGIS.