USER GUIDE

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This document explains how to use Citymob for Roadmaps. The user will find all the steps to create mobility traces and generate simulations in the user manual. This manual is only for users.

1. Citymob for Roadmaps

Citymob for Roadmaps (C4R) is a mobility generator for vehicular networks. This means that it is a software which allows simulating traffic in different locations using real maps. Citymob for Roadmaps is a free software because its purpose is to be used by the scientist community. It is possible to access to the source code to validate algorithms. At the same time, users can adapt and fix the algorithms provided by the application.

2. License

The license of CityMob for Roadmaps is GNU General Public License version 3. This license is chosen because makes the distribution of the software easier. In addition this licence provides a copy of the source code with the binaries. Therefore the scientist community can validate the solution. Moreover, the license allows modify the source code, so the application can be improved by a third party.

The whole terms of use can be found in the C4R folder in a file called "license.txt". Also is possible to find a unofficial Spanish translation (does not legally state) in the file "licencia.txt". A disclaimer can be found in the about feature of the application and in the chapter as well.

> *Citymob for Roadmaps (C4R) is a software which uses SUMO to create*
> *mobility traces based on real maps extracted from OpenStreetMap.*
> *It is specially designed for VANET research.*
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Note that people who make modified versions of Citymob for Roadmaps are not obligated to grant this special exception for their modified versions; it is their choice whether to do so. The GNU General Public License gives permission to release a modified version without this exception; this exception also makes it possible to release a modified version which carries forward this exception.

3. Features

The user can find in Citymob for Roadmaps the next features:

- Highly portable system (tested for Windows and Linux).
- Generate mobility models using a powerful GUI.
- Work with real maps from OpenStreetMap.
- Vehicle routes defined by user.
- Vehicle random routes.
- Vehicle flows between 2 points.
- Attraction points.
- Vehicles movements defined by mobility models.
- Mobility models created with a comfortable wizard.
- Create mobility traces.
- Export mobility traces to ns-2 format.
- Export projects to SUMO format.
- Import files from different Citymob for Roadmaps projects.
- Visualize simulations.

Citymob for Roadmaps simulates the vehicles movements. To this task, users may utilize this system to generate random routes or create routes defined by them. In addition, it is possible to add attraction points. Finally, the software creates movement trace files and allows visualizing these movements.

4. System requirements

Component	Minimum requirements
Processsor	Pentium III, compatible with PC to 600 MHz
Hard disk	10 GB
RAM	1.5 GB
Screen resolution	1024x768
Platform	Windows or Linux
Java runtime version	Java 6 SE
SUMO version	0.11.1
Internet connection	56K connection

Table 1 *Minimum requirements to run Citymob for Roadmaps*

The minimum capacity of the hard disk could be greater for some tasks. In some circumstances, working with big maps and many vehicles, the trace file size could be greater than 10 GB, but it is unusual.

5. Installation

Windows install

1. Open in the CD.
2. Copy the C4R folder into the desired destination folder.

Linux install

To be able to run Citymob for Roadmaps on Linux you need to install the follow packages: Proj, GDAL, Xerces-c, Fox. If you have not yet installed them, it is recommended to install them from the distro repositories. If it is impossible to find them in the repositories they can be directly installed from the CD. The libraries can be found in the folder called **Libraries**.

1. Open a shell and enter into the SUMO folder.
2. tar xzf sumo-src-0.11.1.tar.gz
3. cd sumo-0.11.1
4. ./configure
5. make
6. cp –R ../../C4R <folder>

6. Running Citymob for Roadmaps

The first step is open the application and to familiarize oneself with the environment. The main window is divided in several areas. The names used for each division will be used along the document.
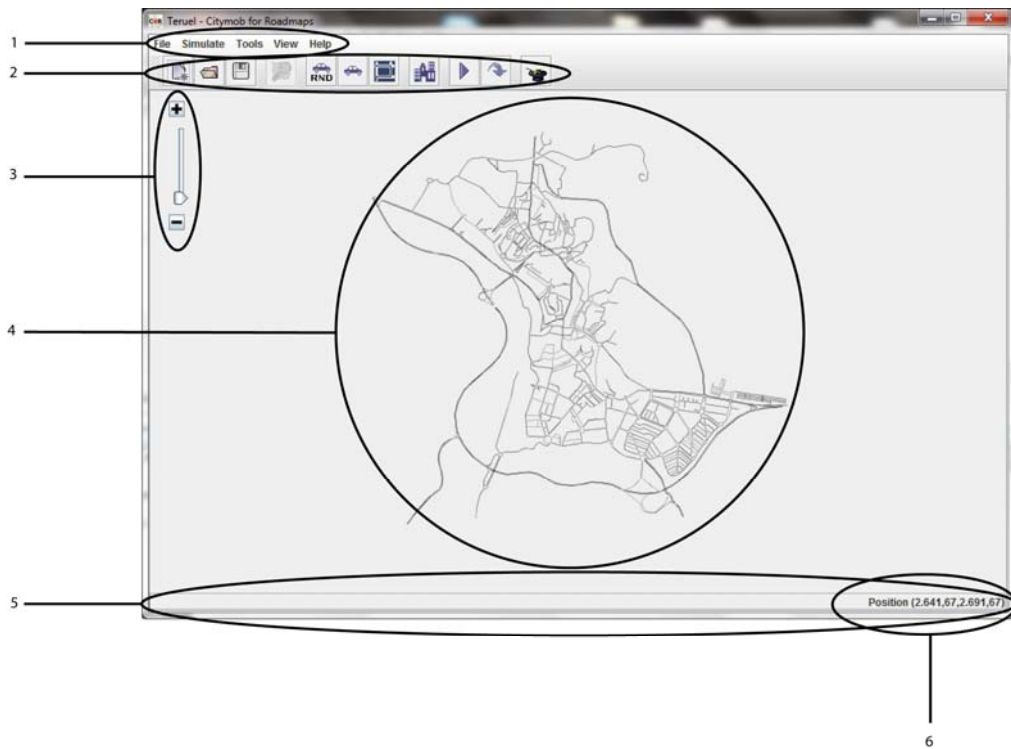

Figure 1 *Citymob for Roadmaps main window*

Main window areas:
1. Options menu.
2. Button panel.
3. Zoom slider.
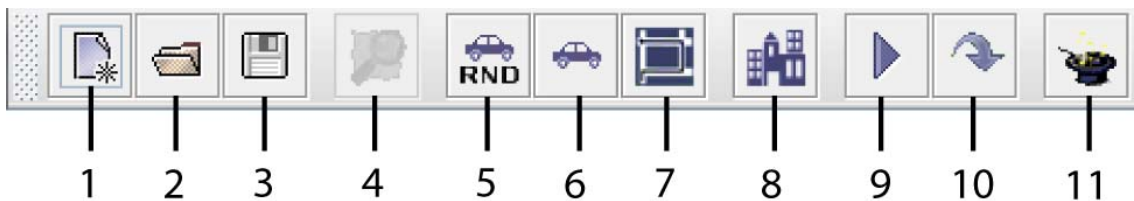4. Workspace.
5. State bar.
6. Cursor position.

Figure 2 *Citymob for Roadmaps toolbar*

Buttons name:
1. New projet.
2. Open project.
3. Save project.
4. Select map.
5. Add vehicles randomly.
6. Add vehicle.
7. Add route.
8. Add downtown.
9. Visualize simulation.
10. Create trace.
11. Wizard.

6.1 Check configuration

The first task before creating mobility traces is to check the application configuration. To do this task, follow the next steps:

1. Click **Tools** menu, and **Options.**
2. In Windows systems is necessary to indicate the SUMO folder in the **SUMO installation path** textbox. If the path does not appear, click the folder icon to search the SUMO path.
3. Check **OpenStreetMap API** textbox. It should be a text like: "http://api.openstreetmap.org/api/0.6/map?bbox=". This is the API used currently. If the API changes, the new one should be found in http://wiki.openstreetmap.org/wiki/API.
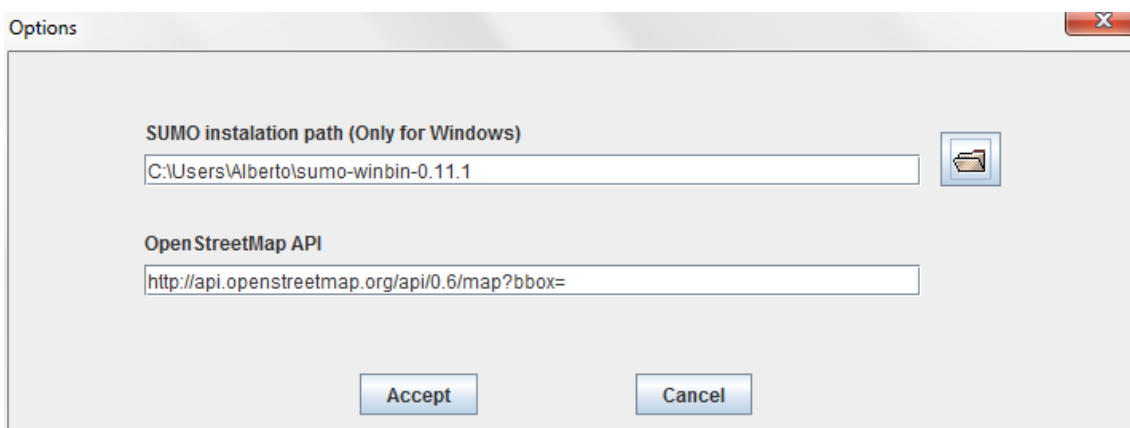4. Click **Accept.**

Figure 3 *Citymob for Roadmaps options dialog*

6.2 Create a new project

1. Click **New project** or **File** menu **New Project** option.
2. Select a folder.
3. Select a name for the project.
4. Click **Save**.

There is an error in SUMO v0.11.1 which prevents working with paths with spaces. It is highly recommended to avoid paths with spaces. This error is solved in 0.12.2 version but there are other different errors, so it is better keep working with the 0.11.1 version.

6.3 Open project

1. Click **Open project** button or **File** menu **Open project** option.
2. Look for C4R project.
3. Click **Open**.

6.4 Save project

1. Click **Save project** button or **File** menu **Save** option.

6.5 Import file

This option allows adding files from different projects. Even it is possible to add SUMO project files to the current C4R project. To do this task, follow the next steps:

1. Click **File** menu **Import** option.
2. Go to the file folder and select it.
3. Click **Open.**

6.6 Export file

This option allows exporting a C4R project to SUMO format. To do this task, follow the next steps:

1. Click **File** menu **Export** option.
2. Select the export folder.
3. Write a name for the exported project.
4. Click **Save**.

6.7 Exit

Everytime the user wants to exit from the application or close the current Project, Citymob for Roadmaps ask for confirmation to the user. The user can choose amongst exit with save, exit without save and cancel exit actions.
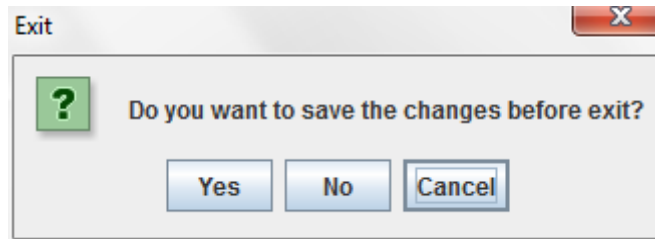

Figure 4 *Citymob for Roadmaps exit dialog*

Figure 4 shows the different options when the user tries to exit from the application. These options are explained as follows:
1. Yes: Saves the changes and closes the current project.
2. No: Closes the current project without save changes.
3. Cancel: Cancels close project action.

6.8 Load map

It is necessary to create a new project before to perform this task. It is possible to load a map using **Import** option or downloading it from OpenStreetMap.
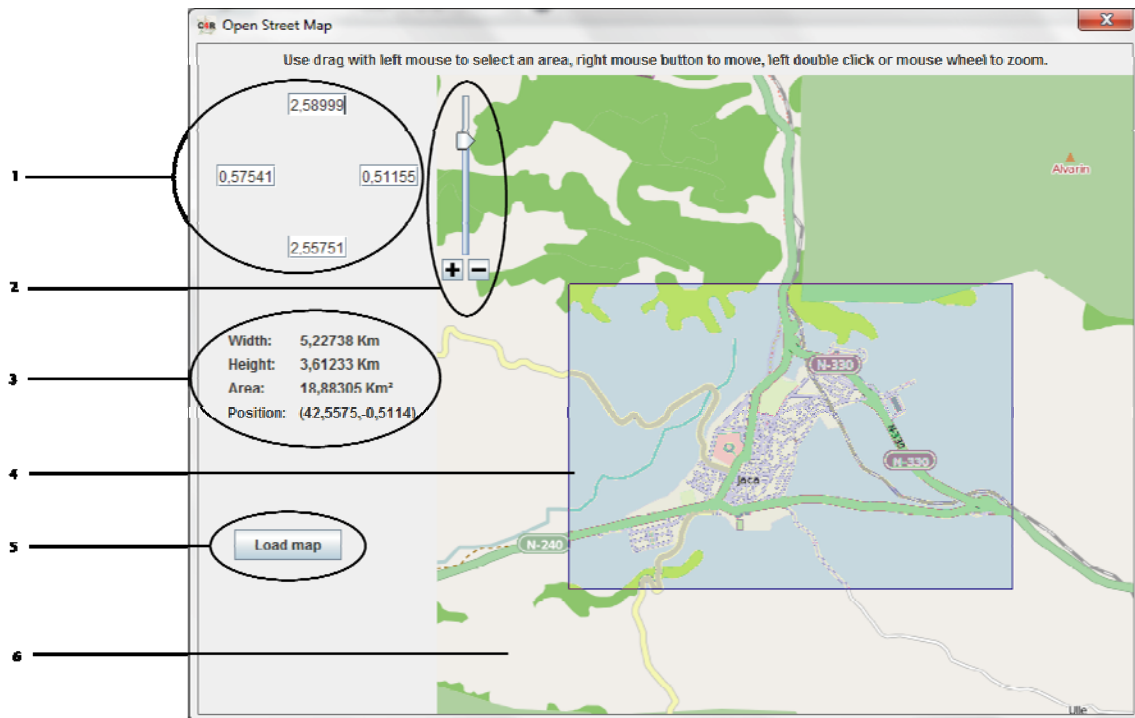

Figure 5 *Citymob for Roadmaps map downloading dialog*

1. Panel of coordinates.
2. Zoom slider.
3. Selection information.
4. Selection.
5. Load map button.
6. Map.

To download OpenStreetMap maps follow the next steps:

1. Click **Select map** button or **Tools** menu **Select map** option.
2. Move by the world map looking for the desired position. To move up, down, left, right, drag the cursor clicking the right button. To zoom in or zoom out use the zoom slider or the wheel mouse.
3. Once in the right position and the right zoom select an area. OpenStreetmap does not support download of big maps, so it is important to check out the zoom level. There are two ways to select a map area. The simplest one consists of dragging the cursor with the left mouse button clicked. During the selection the selected area will become blue. The other way consists of putting the longitudes and latitudes in the panel of coordinates. The textbox coincide with the geographical points. The textbox on the top is the North, the left one the West, the right one the East and the bottom one the South.
4. Click **Load map** to download the selection. A download dialog will be displayed with a button to cancel the operation. When the download is finished the map will be drown in the workspace.

6.9 Add randomly vehicles

1. Click **Add vehicles randomly** button or **Tools** menu **Add vehicles randomly** option.
2. Put the number of vehicles to generate.
3. Put the vehicles rate that will be created in the downtown (must be a number between 0 and 1).
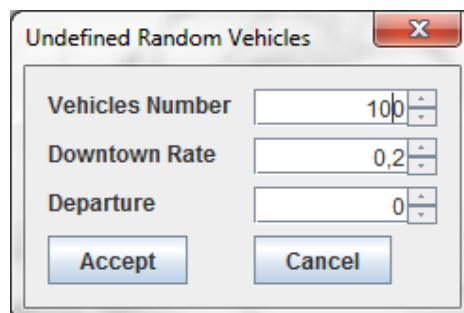4. Put the departure time of the vehicles in the simulation.

Figure 6 *Random Vehicles dialog*

6.10 Add defined random vehicles

1. Click **Tools** menu, **Add defined vehicles randomly** option.
2. Select the **Start position**. It is possible to write the lane identification or clicking the lane in the workspace. If the user clicks the lane, the textbox is filled with the lane identification and the lane becomes blue with a red flag.
3. Perform the same operation than the step before for **End position**.
4. Write the vehicles number to generate.
5. Write the departure time for the vehicles of the simulation.
6. Click **Add vehicle** button.
7. To enter more vehicles is possible repeating the steps again. When all the vehicles were added Click **Close Panel**.
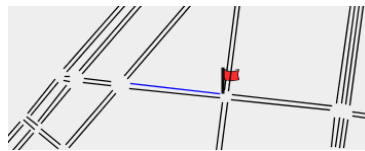

Figure 7 *Adding undefined random vehicles dialog*

Figure 8 *Detail of the selected lane*

6.11 Add vehicle type

1. Click **Tools** menu, **Add vehicle type** option.
2. Fill the table with data. The sigma parameter is a value between 0 and 1 to measure the driver imperfection.
3. To add more types just Click **Add.**
4. to remove types , select a row and Click **Remove.**
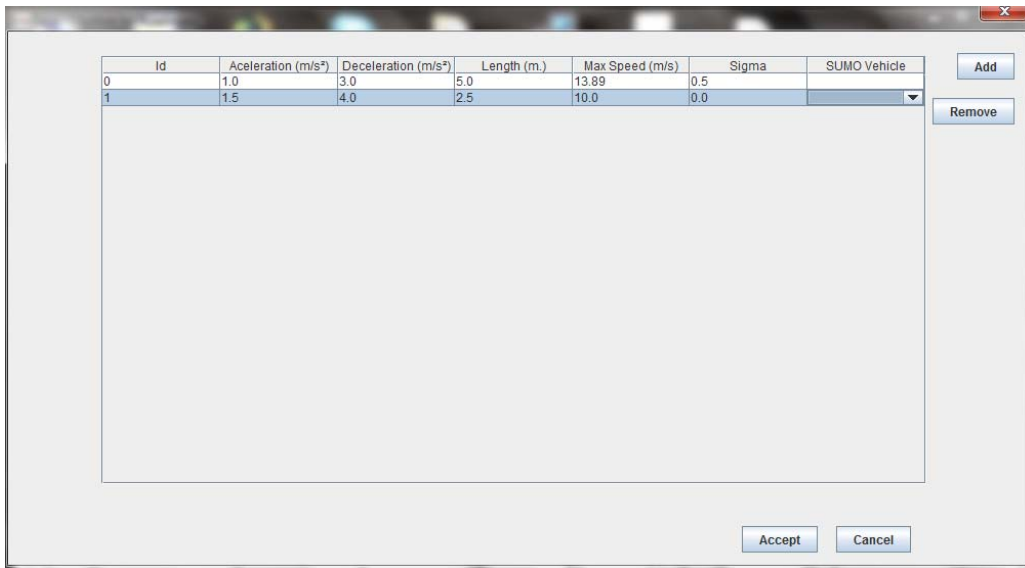5. Click **Accept** to exit.

Figure 9 *Vehicles type dialog*

6.12 Add route manually

1. Click **Add route** button or **Tools** menu **Add route** option.
2. Write a route identification.
3. Select a edge in the combobox and Click **Add.**
4. To remove an edge Click **Remove**. This button only removes the last edge to avoid inconsistencies.
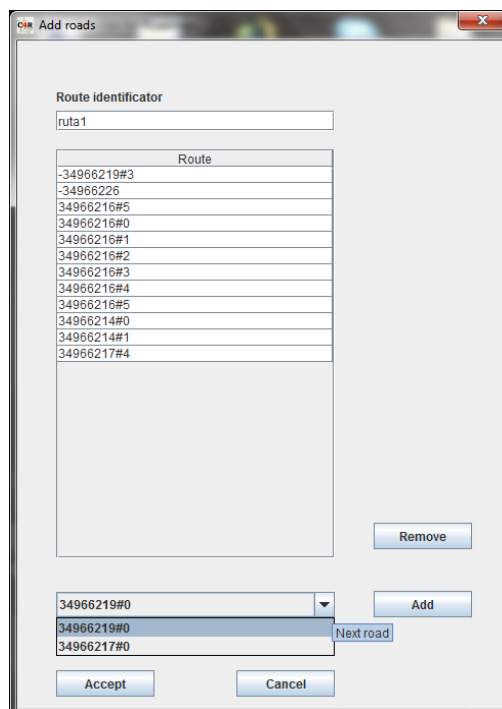5. Repeat the step 3 until reach the end of the route.
6. Click **Accept.**

Figure 10 *Add routes dialog*

6.13 Add vehicles manually

1. Click **Add vehicles** button or **Tools** button **Add vehicle** option.
2. Fill the fields of the table.
3. It is possible add more vehicles Clicking **Add**.
4. To remove a vehicle, select a row and Click **Remove.**
5. Click **Accept**.

6.14 Add downtowns

1. Click **Add downtowns** button or **Tools** menu **Add downtown** option. When this feature is enabled the cursor changes.
2. Drag the cursor on the map to create downtowns.
3. Fill the dialog with identification for the downtown and the attraction rate. The rate is a value between 0 and 1.
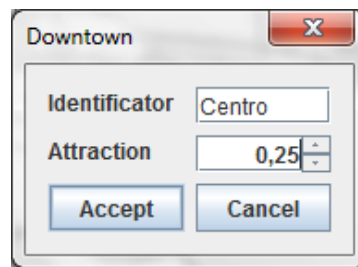4. Click **Accept**.

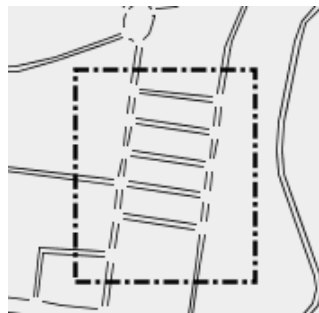**Figure 11** *Downtown dialog*

Figure 12 *Appearance of a downtown in C4R*

The appearance of a downtown in the workspace is shown in the *Figure 39*. The user should be very careful choosing the lanes of the downtown because are made up for all the lanes in the downtown rectangle. These lanes include those which are not entirely included in the rectangle.

6.15 Select mobility model

1. Click **Tools** menu **Add mobility model** option.
2. Select a model from the list.
3. Depending on the selected model the options will change. Anyway, just write the right values in the textboxes.
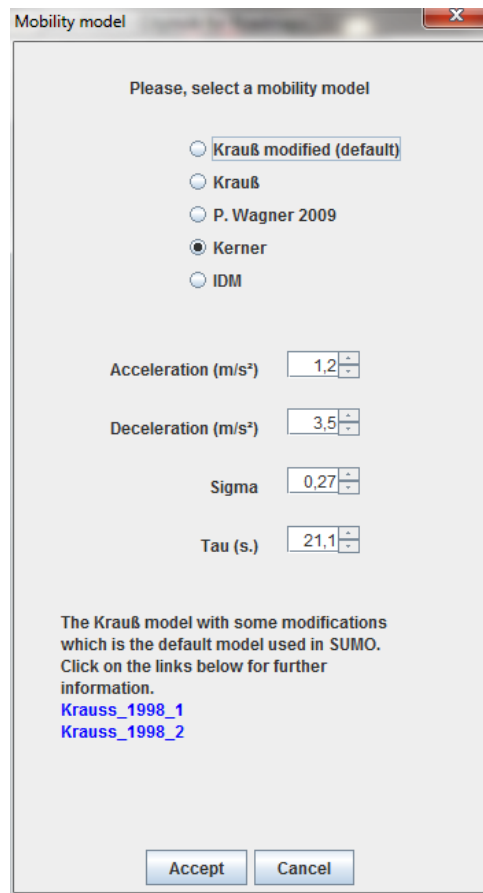4. Click **Accept**.

Figure 13 *Mobility model dialog*

6.16 Views

There are several options in **View** menu. The procedures to handle the data in the view are the same in all the views, so it is possible to apply them to all the views.

1. Select **View** menu and the option desired.
2. To remove a row, select the row to be deleted and Click **Remove**.
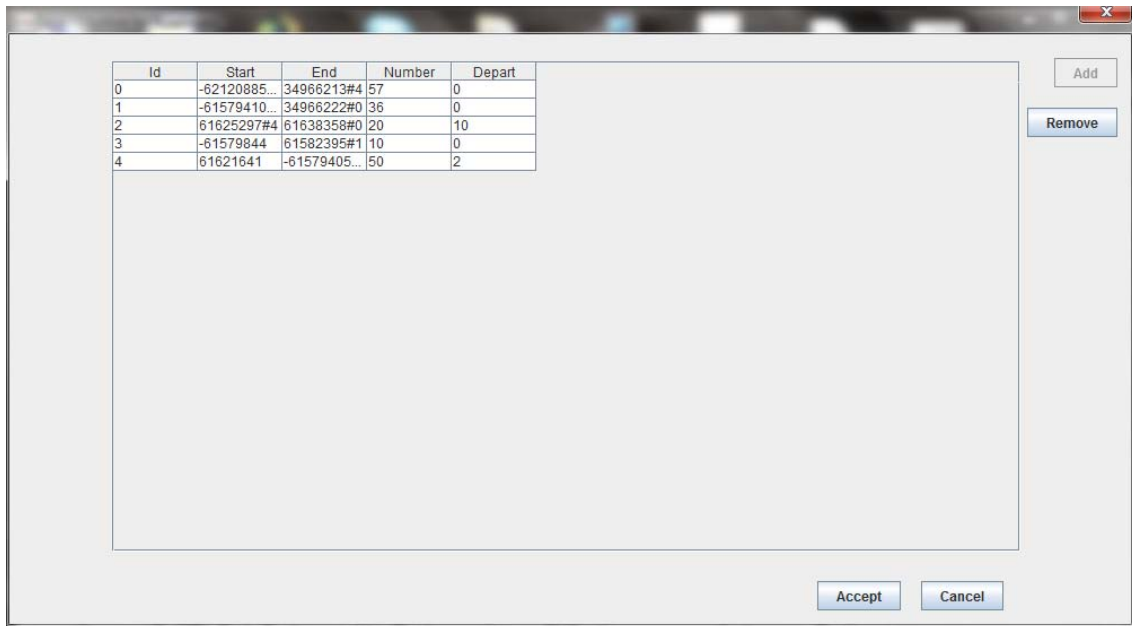3. Click **Accept**.

Figure 14 *An example of view in Citymob for Roadmaps*

6.17 Create trace

This option creates a movement trace of the vehicles. The trace is generated in the same project path selected by the user. The trace is generated in SUMO and ns-2 format. To create traces follow the next steps:

1. Click **Create trace** button or **Simulate** menu **Create trace** option.
2. Write the simulation end time.
3. Write the number of traces to create.

Depending on the map size and number of vehicles, the process could take many minutes or even hours. Anyway, it is possible to cancel the process anytime.
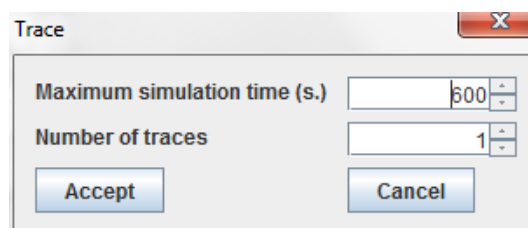
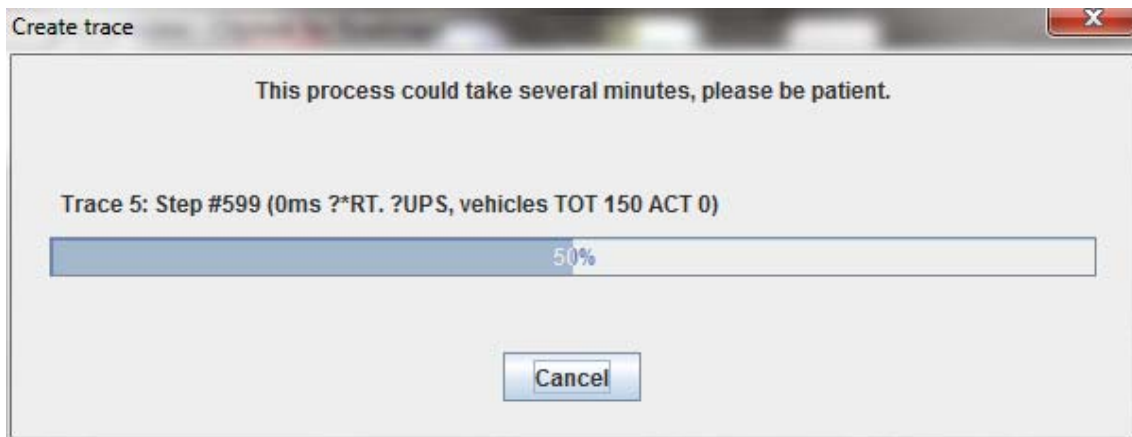

Figure 15 *Create trace dialog*

Figure 16 *Citymob for Roadmaps create trace dialog*

6.18 Visualize trace

1.   Click **Visualize trace** button **Simulate** menu **Visualize trace** option. Then the application will open SUMO. The user can visualize the map loaded and the vehicles in movement.
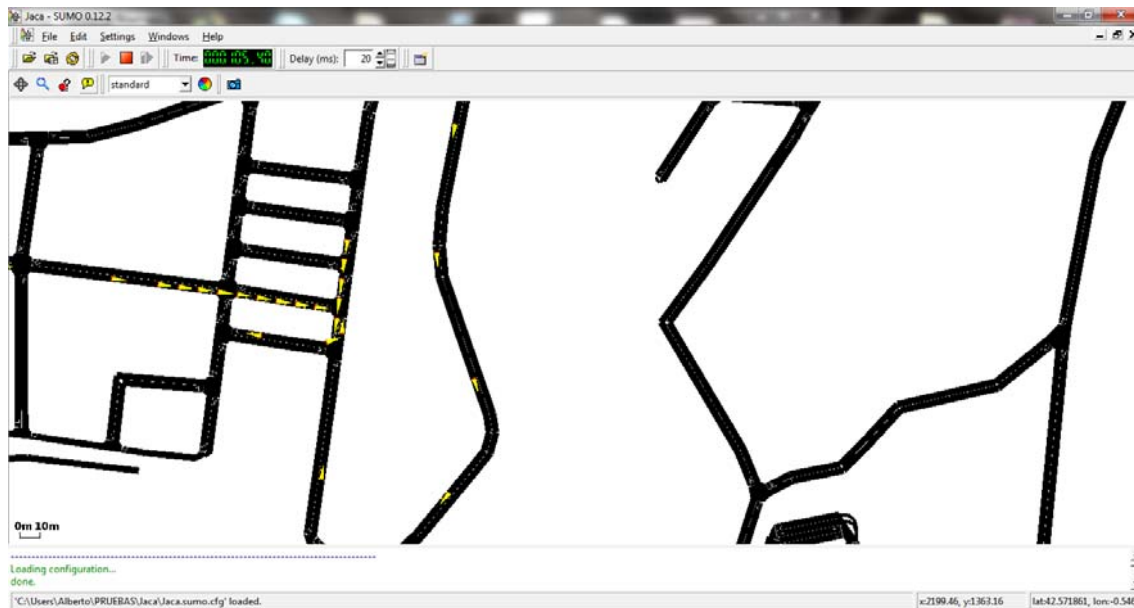

Figure 17 *Trace visualization using SUMO*

6.19 Wizard

In addition to all the features previously presented, Citymob for Roadmaps allows creating mobility traces following a wizard. Thus the traces can be created in few minutes. The objective is that the user can create mobility traces without being an expert. The steps of the wizard will be described in this user manual.

1. Click **Wizard** button or **About** menu **Wizard** option. It will be displayed a welcome screen.
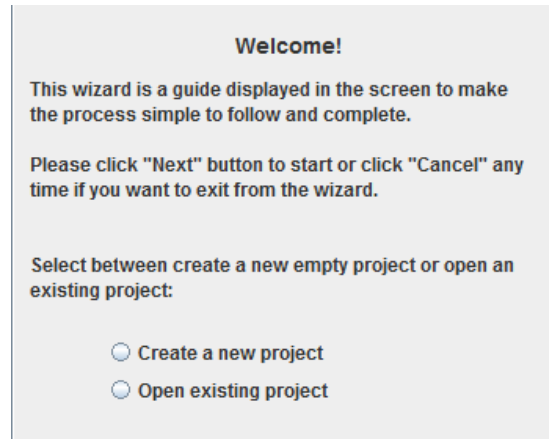
2. Click **Next** to continue.

Figure 18 *Wizard screen asking for a new Project.*

3. Choose between **Create new Project** or **Open existing project**. After that click **Next**.

   3.1 If **Create new Project** is chosen then follow the procedure described in section 6.2 and select a between download a map or import it.

       3.1.1   If download map is selected then the download map will be displayed. The procedure to download a map is described in section 6.8.

       3.1.2   If import option is selected, just select the path of the map.

   3.2 If **Open existing project** is selected, follow the procedure described in section 6.3.
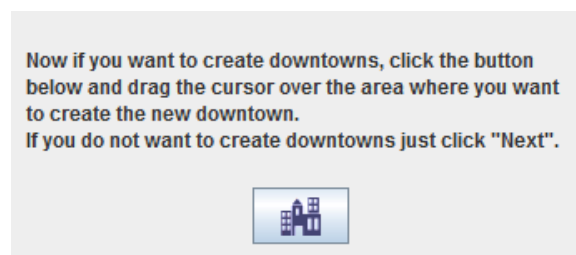

Figure 19 *Wizard screen to create downtowns.*

4. Create downtowns. This procedure is described in section 6.14.

This panel allows you to add random vehicles in the network. The vehicles will be deployed in the whole network according to the existing downtowns weight.

There are three parameters. The first one "Vehicles number" is the number of random vehicles that will be deployed. The second parameter "Downtown Rate" is the rate of vehicles that will be deployed in the downtown. This parameter must be between 0 and 1. 0 means that the vehicles will be deployed uniformily in the whole network and 1 means that all the vehicles will be deployed in the different downtowns. Finally, the third parameter is the random vehicles departure time in the simulation.

If you do not want to add random vehicles just click "Next".

Vehicles Number	0
Downtown Rate	0,2
Departure (s.)	0

Figure 20 *Wizard screen to create random vehicles.*

5. Add vehicles randomly in the same way than in section 6.9.

Please, select a mobility model

○ Krauß modified (default)
○ Krauß
○ P. Wagner 2009
● Kerner
○ IDM

Acceleration (m/s²)	1,2
Deceleration (m/s²)	3,5
Tau (s.)	0,27
k (Vehicles/Km)	21,1

The Krauß model with some modifications which is the default model used in SUMO. Click on the links below for further information.
Krauss_1998_1
Krauss_1998_2

Figure 21 *Wizard screen to add mobility models.*

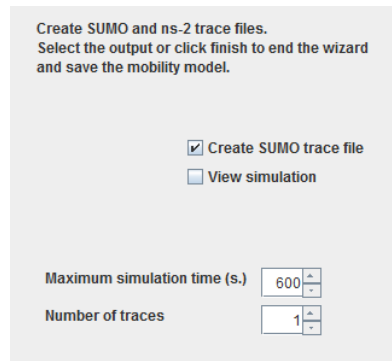6. Define mobility models as in section 6.15.

Figure 22 *Wizard screen asking for output format.*

7. Select the output format. It is possible choose between create an output trace and visualize the simulation using SUMO. After that click **Finish** to end.

The researchers usually perform several simulations to validate their work. For this reason is possible to create several traces with the same configuration. This feature makes the research task easier avoiding the user click create trace option many times.

6.20 About

The About feature shows information about the application. To open the dialog, follow the next steps:

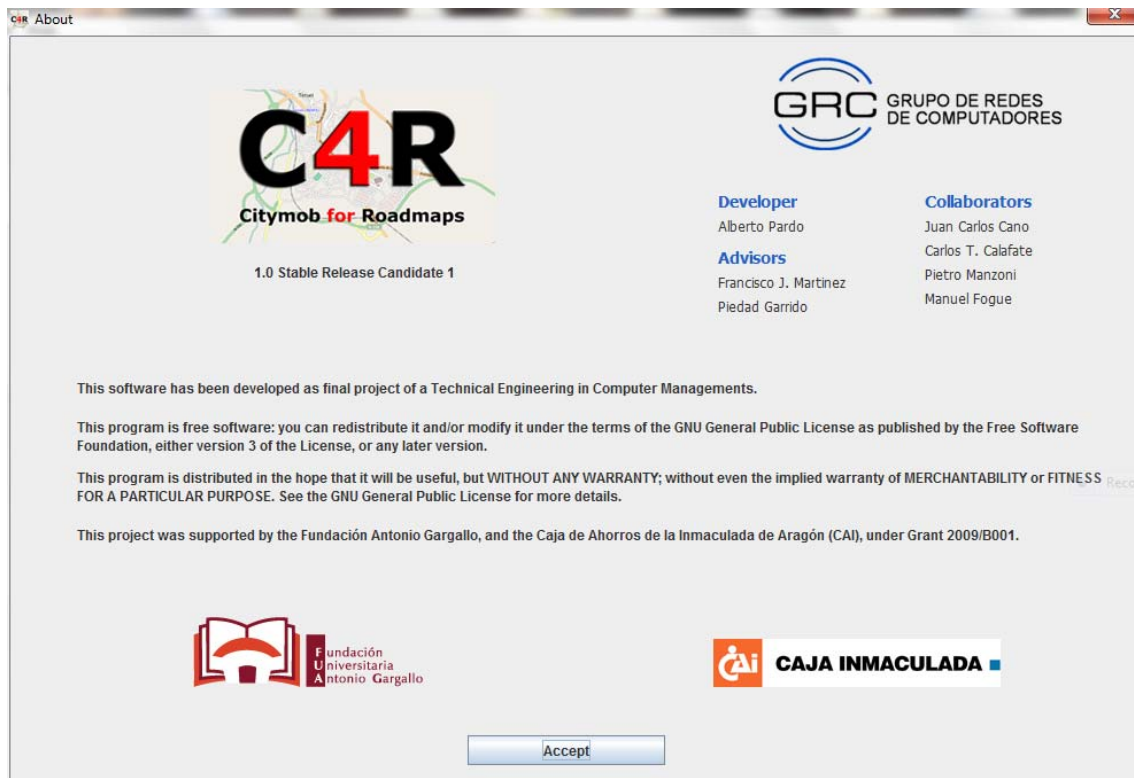1. Click **Help** menu **About** option.

Figure 23 *About dialog from Citymob for roadmaps*

From this dialog is possible to obtain the following information:

- C4R version.
- Disclaimer.
- Collaborating organizations.
- People who have collaborated in the development of the application.

Moreover, it is possible to access to the different organizations web pages by clicking the logo.

7. Troubleshooting

7.1 Configuration problems

Problem

The application shows an error message when starts. The message contents the text: "Cannot find configuration file c4r.cfg Please check if the file exists".

Or

The application shows an error message when starts. The message contents the text: "The configuration file c4r.cfg could not be correct". Please go to menu "Tools" option "options" to configure correctly".

Solution

The Citymob for Roadmaps configuration file was not created or it is corrupt. To solve this problem follow the next steps:

1. Click **Tools** menu **Options** option.
2. In Windows systems is needed to check **SUMO installation path** textbox. If the SUMO path does not exist then click in the folder button to look for the SUMO installation path.
3. Check out the **OpenStreetMap API** textbox. It should be a text like: http://api.openstreetmap.org/api/0.6/map?bbox=". This is the current API of OpenStreetMap. If the API changes, it is possible to find the new one in http://wiki.openstreetmap.org/wiki/API.
4. Click **Accept.**

Problem

When the application tries to download a map or when tries to create a trace, the application shows a message with the text "Cannot run program "(path)": CreateProcess error=2, the system cannot find the specified file".

Or

When the application tries to visualize a trace shows a error message with the text: "An error ocurred while attemping to read from the file (file name)".

Solution

These incidents have the same source. First check out the SUMO installed version. If the version is different of 0.11.1 there is not warranty about the application work. Therefore install the 0.11.1 version to solve the problem. If the SUMO version is right follow the next steps:

1. Click **Tools** menu **Options** option.
2. In Windows systems is needed to check **SUMO installation path** textbox. If the SUMO path does not exist then click in the folder button to look for the SUMO installation path.
3. Click **Accept**.

Problem

Downloading a map the application shows and error with a text which looks like an Internet Address.

Solution

1. Click **Tools** menu, **Options** option.
2. Check the text of the **OpenStreetMap API** textbox. The text should be like: "http://api.openstreetmap.org/api/0.6/map?bbox=". This is the current API. If the API changes, it is posible to find the new one in http://wiki.openstreetmap.org/wiki/API.
3. Click **Accept**.

7.2 Map problems

Problem

When the map download dialog is opened, the window shows a cross mosaic instead of world map.

Solution

There is no Internet connection. Fix the connectivity problems to solve it.

Problem

When the user downloads a map appears a message with the text "Connection refused: connect".

Solution

The message error means that OpenStreetMap servers are unavaiable. There is further informations about the server status in www.openstreetmap.org. Usually this happens when the servers are closed to maintenance.

7.3 Other problems

Problem

The application shows a message error with the text "Impossible convert the map to SUMO format. Further information in <path>".

Solution

This error happens when any SUMO process cannot be executed successfully. The first step is check the SUMO version is 0.11.1. Different versions could not be compatible. The second step is check that the project path has not spaces. To solve it create a new project is a path without spaces.