UN SISTEMA DI ANALISI DEGLI IMPATTI DELL'AGRICOLTURA

SISTEM ZA ANALIZO VPLIVOV KMETIJSTVA

Technical document – The ORGANICS plugin

Versione/Verzija: N./ Št. 2.0 (final)

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Descrizione del progetto

Obiettivo principale del progetto GREVISLIN (progetto finanziato nell'ambito del Programma Interreg V-A Italia-Slovenia 2014-2020) è sviluppare un'area transfrontaliera coesa, integrata e sostenibile con una chiara strategia a lungo termine nella gestione delle infrastrutture verdi, rafforzare la sensibilità e le misure per uno sviluppo transfrontaliero sostenibile. La sfida è stabilire una pianificazione strategica transfrontaliera a lungo termine per sviluppare e tutelare le infrastrutture verdi, monitorare le acque e la biodiversità degli habitat, implementare attività pilota e investimenti per la creazione di infrastrutture verdi in aree NATURA 2000 e sensibilizzare i gruppi target sulla sostenibilità delle risorse idriche, delle aree protette e dei terreni forestali e agricoli.

BUDGET TOTALE: 2.940.032,53€

CONTRIBUTO FESR: 2.499.027,63€

DURATA: 39 mesi

INIZIO: 15.11.2018 - FINE: 14.02.2022

LEAD PARTNER:

Agenzia di sviluppo regionale del Nord Primorska S.r.l. Nova Gorica

PARTNER DI PROGETTO:

Comune di Ajdovščina; Comune di Nova Gorica; Istituto per l'Acqua Sloveno; Agenzia ambientale slovena (ARSO); Istituto agricolo forestale di Nova Gorica; Comune di Postojna; Autorità di bacino distrettuale delle Alpi Orientali; Regione Autonoma Friuli Venezia Giulia - Direzione Centrale ambiente ed energia - Servizio gestione risorse idriche; Agenzia Regionale per la Protezione dell'ambiente del Friuli Venezia Giulia; Consorzio di Bonifica della Venezia Giulia; Comune di Staranzano; Regione del Veneto; Agenzia Veneta per l'innovazione nel settore primario – Veneto Agricoltura

www.ita-slo.eu/grevislin

Opis projekta

Glavni splošni cilj projekta GREVISLIN (projekt, ki je financiran v okviru programa Interreg VA Italija-Slovenija 2014–2020) je razvijati trajnostno celostno kohezivno čezmejno območje z jasno dolgoročno strategijo na področju upravljanja zelene infrastrukture, krepiti ozaveščenost in ukrepe za trajnostni čezmejni razvoj. Skupni izziv je vzpostaviti dolgoročno čezmejno strateško načrtovanje razvoja in varstva zelene infrastrukture, dolgoročno spremljanje stanja voda in biotske raznovrstnosti habitatov, izvesti pilotne aktivnosti in naložbe vzpostavitve zelenih infrastruktur na območju NATURA 2000 ter povečevanje ozaveščenosti ciljnih skupin o pomenu trajnostnega upravljanja z vodami, zavarovanih območij ter gozdnih in kmetijskih površin.

VREDNOST PROJEKTA: 2.940.032,53€

PRISPEVEK ESRR: 2.499.027,63€

TRAJANJE: 39 mesecev

ZAČETEK: 15.11.2018 - KONEC: 14.02.2022

VODILNI PARTNER:

RRA severne Primorske d.o.o. Nova Gorica

PROJEKTNI PARTNERJI:

Občina Ajdovščina; Občina Nova Gorica; Inštitut za Vode Republike Slovenije; Agencija Republike Slovenije za okolje (ARSO); Občina Postojna; Urad za vodno območje Vzhodnih Alp; Avtonomna Dežela Furlanija – Julijska krajina - Centralna direkcija za okolje in energetiko - Služba za upravljanje z vodnimi viri; Deželna agencija za varstvo okolja Furlanije Julijske krajine; Konzorcij "Consorzio di Bonifica della Venezia Giulia"; Občina Staranzano; Dežela Benečija; Beneška agencija za inovacije v primarnem sektorju - Veneto Agricoltura

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TECHNICAL DOCUMENT

THE ORGANICS PLUGIN

Organics_v2.0

26/01/2022

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1. Introduction

The Organics plugin v.2.0 allows to simulate the concentration of a dissolved species in water (for example an organic compound) in surface water bodies. By providing as input the concentration measured at the entry point of a watercourse and the average speed of the water, the concentration of a substance at a certain distance from the entry point, along the profile of the watercourse, is simulated.

The numerical code used to solve the problem is based on the analytical solution of an advection / diffusion / decay equation, in one-dimensional form, taken from [1]:

$$\frac{\partial C}{\partial t} + \frac{\partial v_x C}{\partial x} = E\frac{\partial^2 C}{\partial x^2} - kC$$

where:

C: concentration of the dissolved species in water for which we wish to simulate the evolution in space and time, $[C] = [M/L^3]$.

x [L] and t [T] are the space variable and time.

v_x is the input velocity, $[v_x] = [L/T]$.

E is the longitudinal dispersion coefficient, $[E] = [L^2/T]$.

k is the decay coefficient, $[k] = [T^{-1}]$.

1.2 Software development

The plugin was developed in Python3 [2] language, using the Qt5 [3] graphics libraries and the QGIS [4] API (Application Program Interface). The plugin can be used as an add-on to the QGIS desktop software, once it has been installed on your PC, version 3.4 or higher [5]. During the development some specific Python libraries were used, but each of them is already present in the official QGIS distribution. This choice allows the User to use the plugin without requiring further software updates.

2. How to install

2.1 Installation

Like all QGIS plugins, the installation of Organics, GIS desktop plugin QGIS version 3.4 or higher, simply consists in copying the software folder under the directory created during the QGIS installation, to save the User settings.

In particular, in Windows systems, this folder is generally found at the path:

C: \ Users \ USERNAME \ AppData \ Roaming \ QGIS \ QGIS3 \ profiles \ default \ python \ plugins \

where USERNAME is the username of the user who intends to add the plugin to his QGIS installation.

Once the folder has been copied, simply launch QGIS: the plugin will be found under the Plugin menu, as shown in Figure 1.

If the plugin does not appear, simply open the PluginManager, search for it in the list of installed plugins, and activate it (Figure 2).

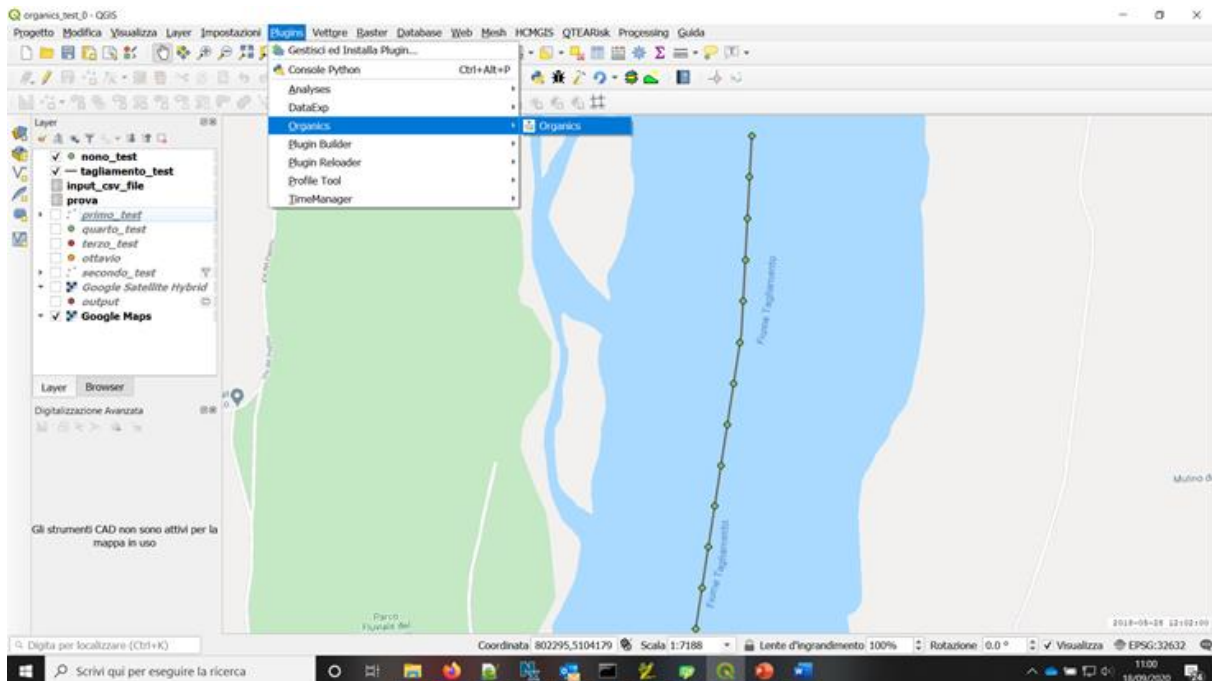The plugin is currently available with menus in Italian and English.

Figure 1. The QGIS *Organics* plugin in the main bar.

Alternatively, the plugin can be installed directly through the PluginManager using the *Install from ZIP* function.
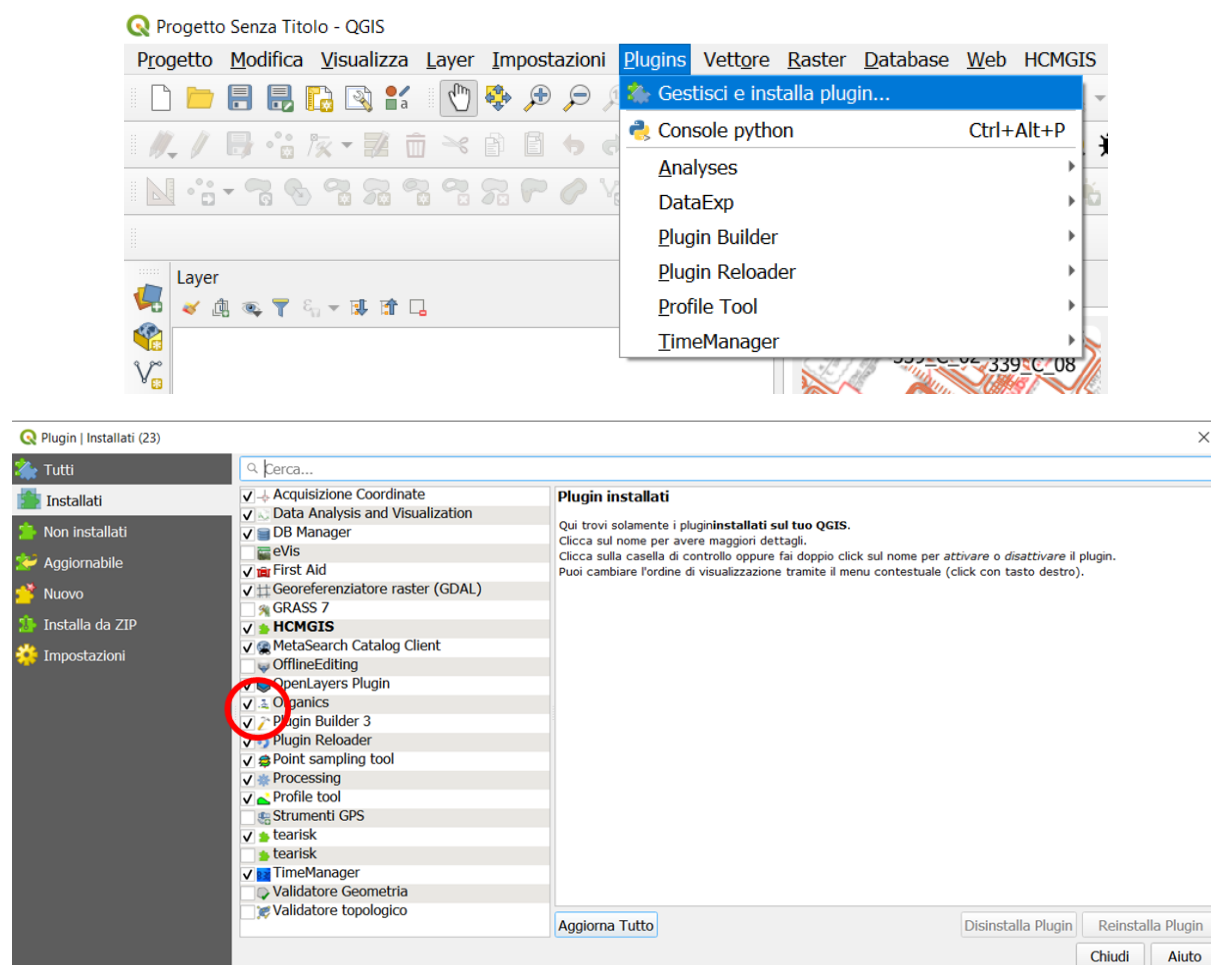

Figure 2. How to start the *Organics* plugin.

At the date the *Organics* plugin folder can be downloaded from the following sources:

a) Online GREVISLIN project repository at
https://drive.google.com/file/d/1rLwfLeVQg706zDuJTw5R90NULKudUQ__/view?usp=sharing;

b) Online QGIS plugins repositoty at https://pligins.qgis.org/plugins/ (coming soon);

c) Writing to Prof. Rudy Rossetto (rudy.rossetto@santannapisa.it) and Dr. Nico Dalla Libera (nico.dallalibera@distrettoalpiorientali.it).

2.2   How to use the Organics plugin

To use the plugin you must first prepare the input files required by the code. An example of these files to conduct a first test are provided as an attachment, in the template_files folder of the plugin.

The required files are as follows:

•   a * .csv file In particular, the file must contain data relating to (at least) one concentration measurement, specifying:

•   date and time of the measurement, in YYYY-MM-DD format HH: MM: SS;

•   flow velocity in the water course, in m/s;

•   initial concentration at the point of entry (here there is no specific request on the units of measurement of the concentration expressed therein, remembering however that they will then be the same as those found in the output). If you have a dataset consisting of more than one measure, for each of them, on consecutive lines, all the above information must be reported. This approach allows you to simulate the temporal variation of the inputs at the entry point.

•   a linear ESRI Shapefile that represents the watercourse. The file can consist of one or more line segments. It is important that the line is digitized in the direction of flow. Furthermore, it will be the User's responsibility to ensure that, in the case of several lines, the topology is respected (the lines must be connected).

Once these files have been prepared, the first operation is to load the vector layer of the line into the QGIS view. By clicking on Organics in the Plugin menu, the main window opens: this is divided into four sections:

1) Run;

2) Plot Results;

3) Help;

4) About.

2.2.1 Run

By entering this section, the User enter the input data, as described below (Figure 5):

a) the *.csv file contains the speed and concentration measurements at the starting point and the time at which these were acquired. Once you have loaded the file, the drop-down menus below will be automatically updated. Through these menus the User must select the name of the fields in the *.csv file that contain the required information (date of measurement, speed and concentration values).

b) linear shapefile representing the watercourse. Definition of the length of the segments in which to "divide " the line: the results of the simulated concentration will be provided to a series of points representing the extremes of these segments.

c) the values of the degradation coefficients (1/s) and longitudinal dispersion (m^2/s).

d) the length of the Time Step: the solution will be returned over a time interval (expressed in minutes from the start of the simulation) discretized according to this time step.

e) the name of the output file (shapefile) and the directory where the file will be saved. If this field is left blank, the output will be saved as a temporary layer (memory layer) in QGIS.

Once the simulation is launched (Run) the code will divide the line in points. The result will be a point layer in which the simulated concentration values at different times will be saved for each point (Figure 6). This layer can be used to visualize the results using the tools present in QGIS: for example it can be themed with color scales depending on the level of concentration.

It is then possible to obtain animations to visualize the evolution of the concentration in the various points, by applying the TimeManager plugin (plugin, downloadable from the QGIS PluginManager).

A version in text format (*.csv) of the output file will also be saved in the previously defined destination folder. This file can be used by the User to conduct further analyses externally to the plugin and/or from QGIS.
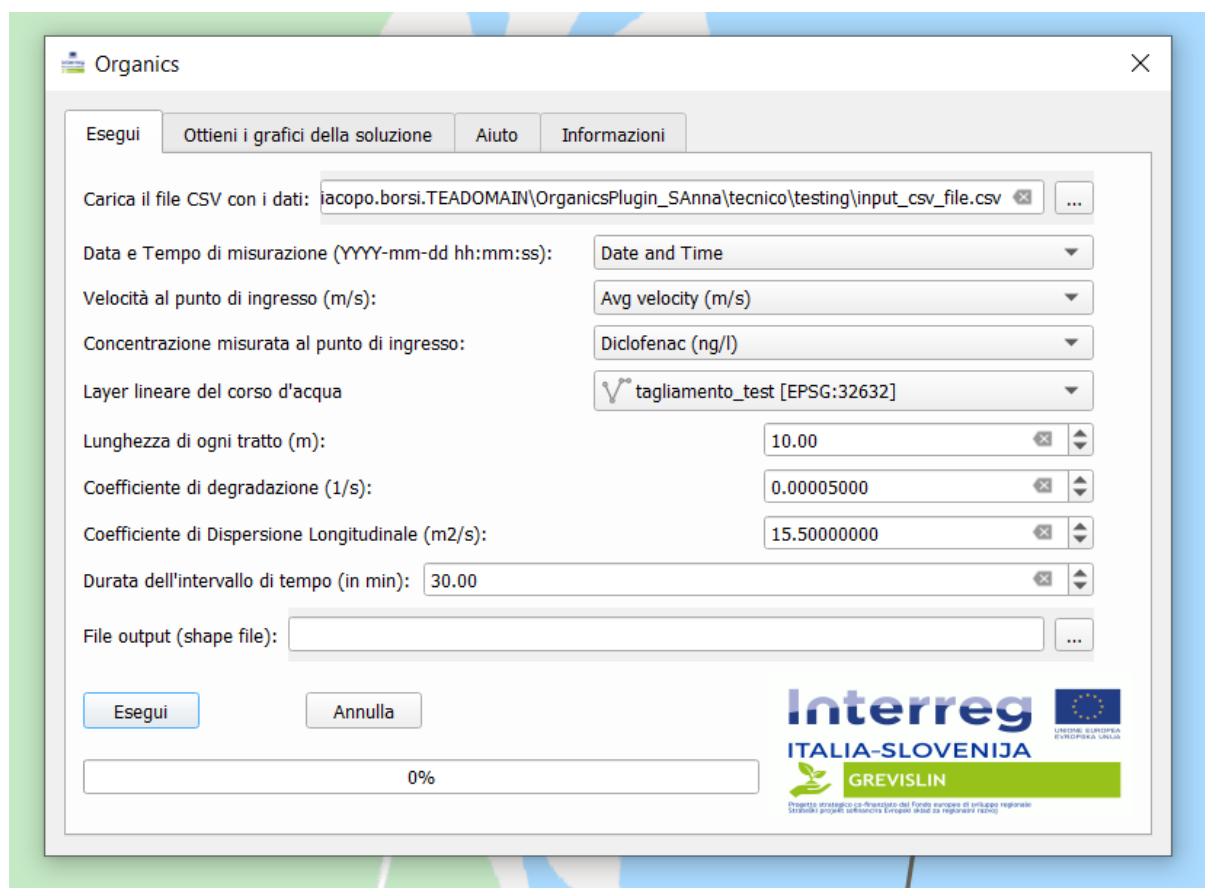

Figure 5. Main plugin window.

2.2.2 Plot Results

Directly from the plugin, it is possible to create a graph of the solution obtained. Opening the *Plot Results* section, you have a number of options for producing solution plots (Figure 7). The User must choose the output layer to be processed. The display operations can therefore be performed at any time, even after the execution of the model, by selecting this file from the drop-down menu. However, in order for the desired layer to appear in the menu, it is necessary that it is loaded in the QGIS Legend.

The options for creating the graphs are:

• **Select a position** (such as distance from the entry point): to display the concentration trend in a point defined by the User at a certain distance from the starting point, as a function of time (Figure 8);

• **Use the selected position on the layer**: this option allows to view the same result as above, but in this case the position is provided by selecting, on the map using the classic selection tools, one or more points of the output layer (Figure 9);

• **Select a time**: to obtain the concentration at a given instant, as a function of the distance from the inlet (Figure 10). The times series to be selected corresponds to the discretization obtained with the time step chosen in input by the User.

Charts are displayed on a window that opens independently of the plugin window. It contains some commands to further customize the graph and to save the graph itself in image format (for example in * .png format).
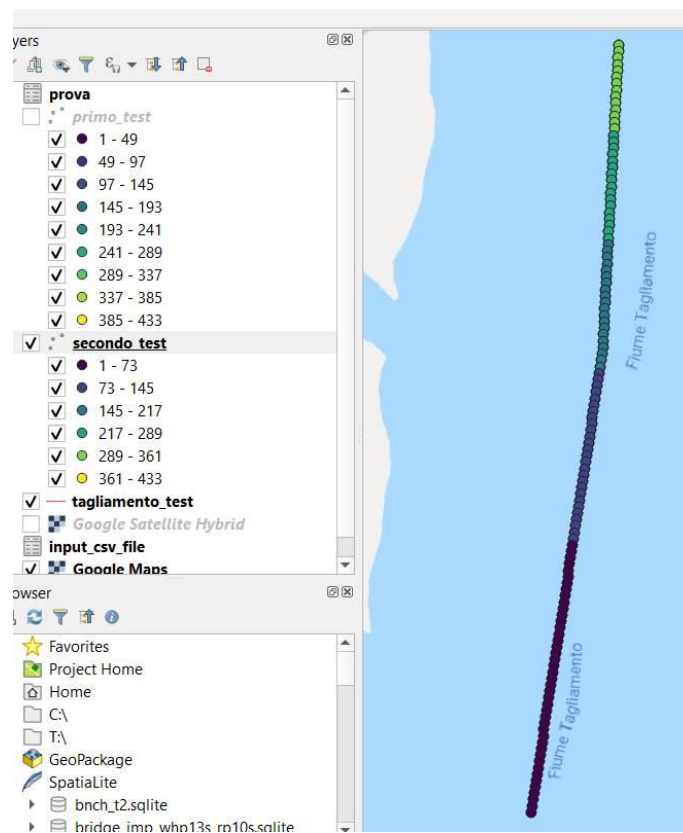
Figure 6. Output file: space discretisation of the linear shapefile.
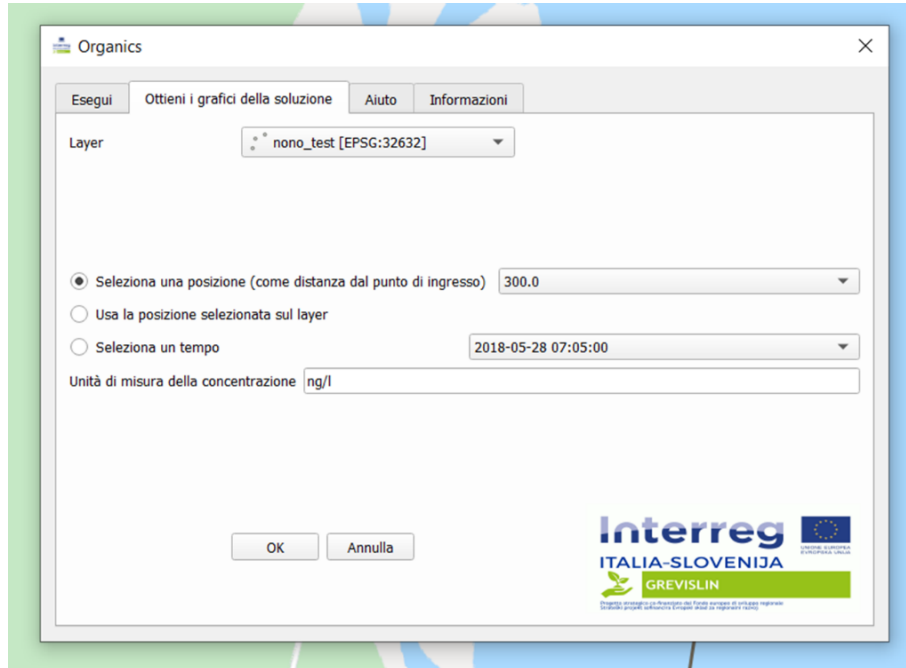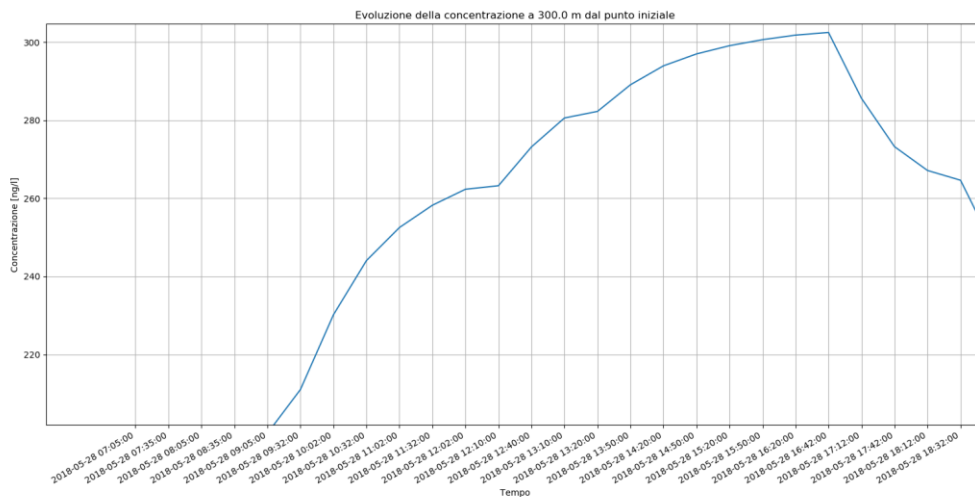

Figure 7. Post-processing section.

Figure 8. Graph of the solution at a selected point, as a function of time.
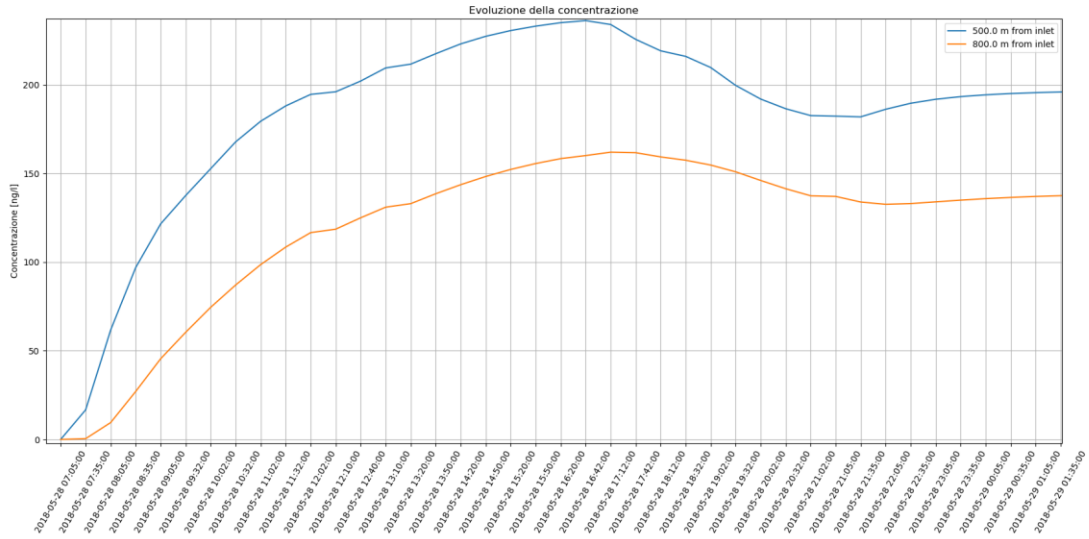
Figure 9. Graph of the solution at a selected point, as a function of time. Two points selected.
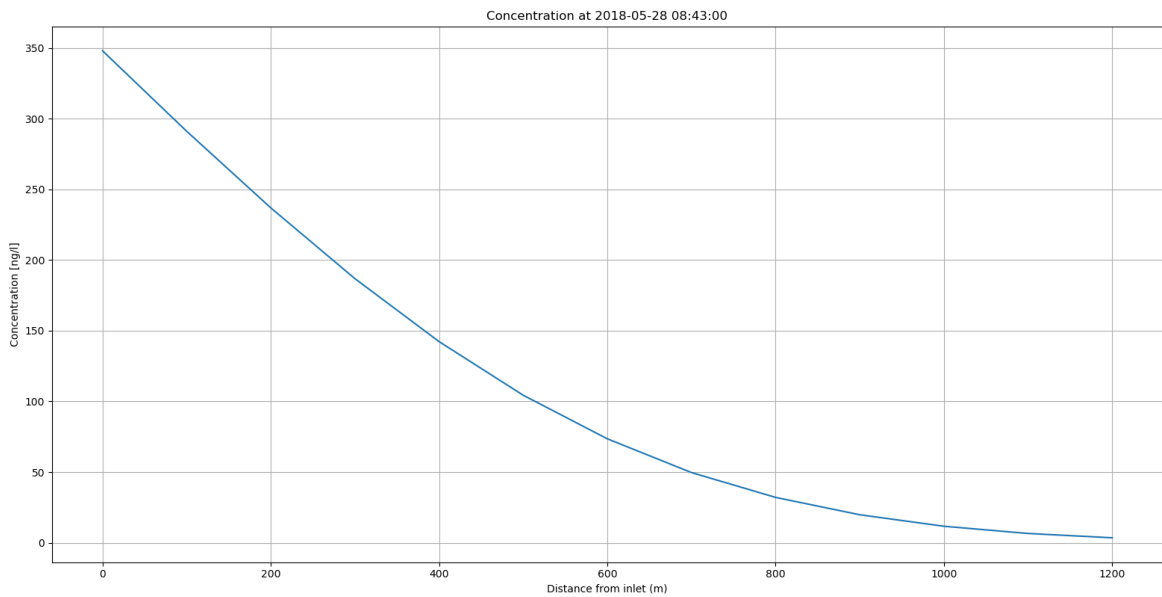

Figure 10. Graph of the solution at a selected time, as a function of the distance form the inlet.

2.3 Help and About

In the Help section, the user can find a summary of the required inputs.

The About section contains information on the funding that supported this development.

References

[1] Benedini M. and Tsakiris G., 2013. Water Quality Modelling for Rivers and Streams, in: Water Science and Technology Library, Vol. 70, Springer Verlag, Berlin, Germany.

[2] Python 3: https://www.python.org/download/releases/3.0/

[3] Qt5 Library: https://www.qt.io/

[4] QGIS Python API: https://qgis.org/pyqgis/3.10/

[5] QGIS: https://qgis.org

Electronic attachments

For using the plugin, two .zip archives are available:

- organics.zip: the plugin folder, in compressed format;

- template_files: contains the models of the input files (.csv and .shp) needed by the plugin.