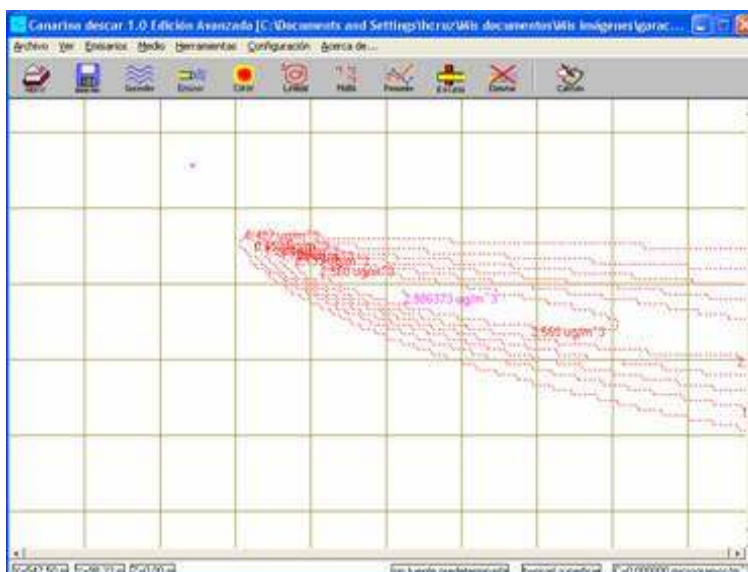




DESCAR software · water pollution modelling

DESCAR is a software for wastewater dispersion analysis. The program calculates the pollutant concentration in each point of the water considering each one of the pollutant sources and the conditions of the water. The system of simulation of processes of dispersion that DESCAR has, offers to the beginner and the expert programmer, a quick and practical system to evaluate the dispersion of pollutants in the water. The program is based on the operating system Microsoft WINDOWS where one works intensively with the mouse and the graphic windows. We can say, with a certain security that the software DESCAR is one of the best tools, to carry out numeric simulations of water pollution processes.



Water pollution map of the heavy metal concentrations (Hg) produced by continuous discharge in this region. The effluent flow rate is $0,15 \text{ m}^3/\text{s}$, the outfall angle is 180 (S) , the current velocity is $0,015 \text{ m/s}$ and the current angle is 90 (E) . The Buoyant Jet model has been used in the calculation. The fuchsia square represents a point source (position of the outfall pipe).

Solutions · DESCAR software:

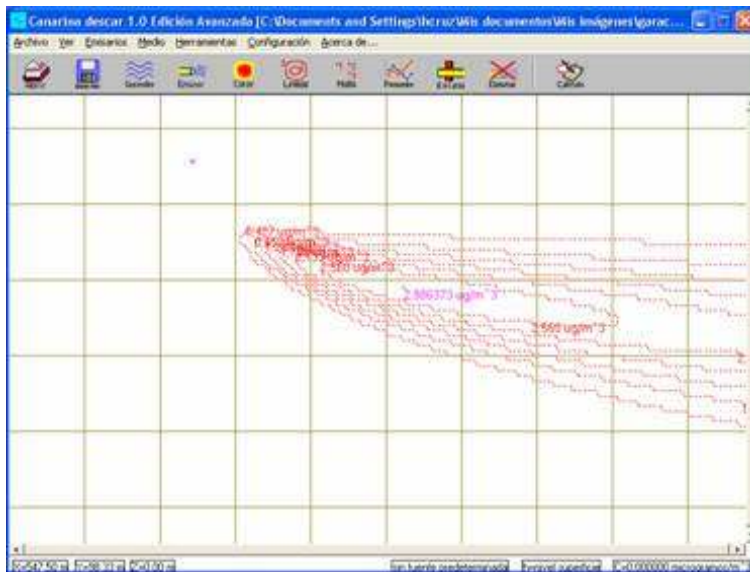
DESCAR Solutions:

It is ideal for environmental impact assessments, environmental consultancy services and environmental engineering.

With this application you will be able to import images and pictures (previously saved BMP files). These images will be background pictures and images for your program window. Many programs and computer applications (AutoCad, 3d Studio, ArcView,...) export BMP files. You will be able to load pictures and images generated by these programs.

This software can also be used for risk studies and safety in industries.

At the present time, numerous universities and study centers use this program for teaching and education.



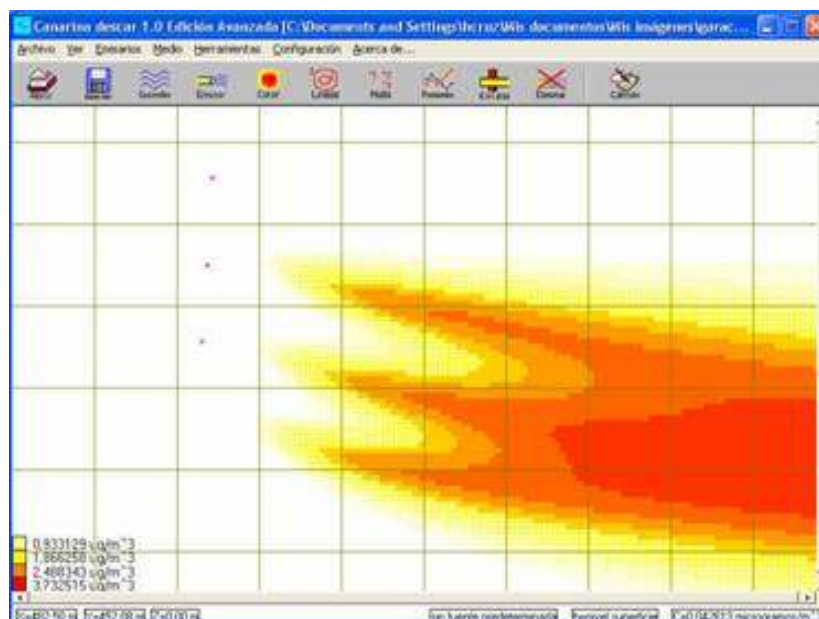
Water pollution map of the heavy metal concentrations (Hg) produced by continuous discharge in this region. The effluent flow rate is $0,15 \text{ m}^3/\text{s}$, the outfall angle is 180 (S) , the current velocity is $0,015 \text{ m/s}$ and the current angle is 90 (E) . The Buoyant Jet model has been used in the calculation. The fuchsia square represents a point source (position of the outfall pipe).

The application uses two different mathematical models: Buoyant jet model or Stratified model. The Buoyant model is ideal for industrial discharges located in the proximities of the coast and in rivers, (using little depth). This model is based on a time-independent Gaussian equation which simulates the pollutant dispersion in the water. The Stratified model takes into account the formation of the pycnocline in the sea. This model is ideal for sewage discharges in the sea (using a lot of depth).

DESCAR carries out temporal averages (daily, monthly or annual) so that you can calculate the concentration average in each point of the affected area.

It works in cartesian and geographical coordinates and the results can be exported in Microsoft EXCEL csv files. It is possible to import the DESCAR generated data in GIS systems, as ArcMap or ArcView.

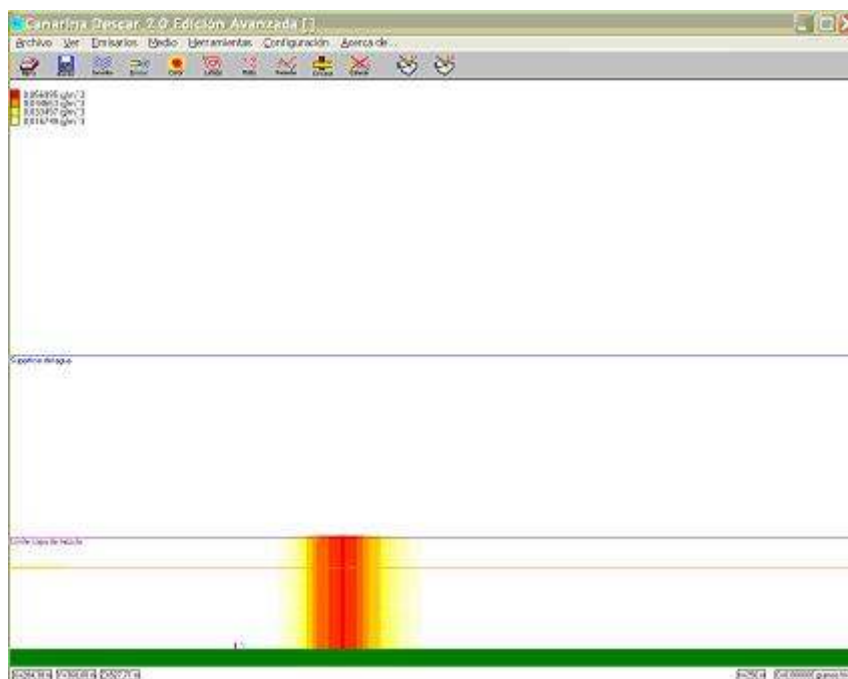
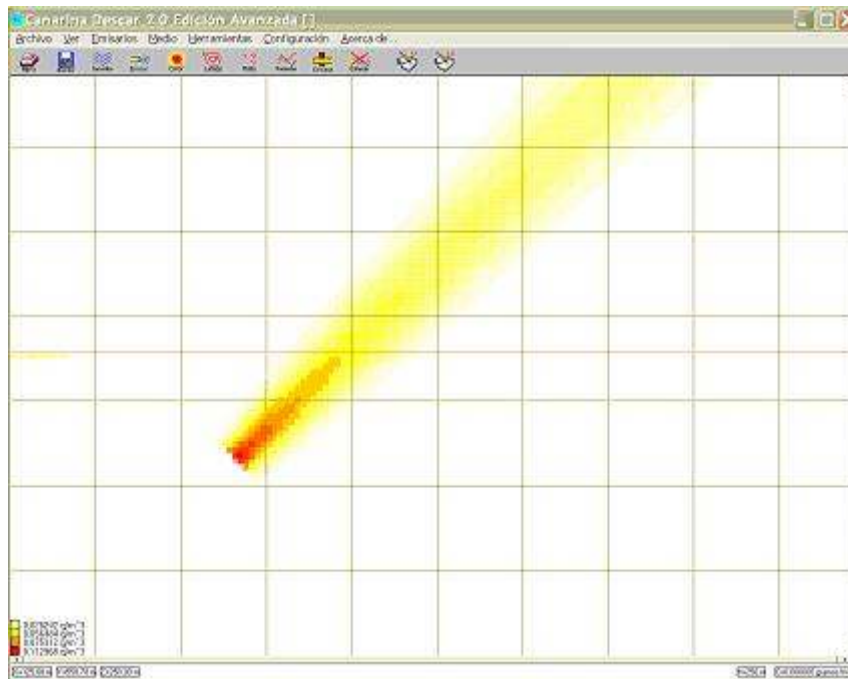
It is possible to obtain XY and XZ pollution maps.



Water pollution map of the heavy metal concentrations (Hg) produced by three point sources in this region. Each effluent flow rate is $0,15 \text{ m}^3/\text{s}$, each outfall angle is 180 (S) , the current velocity is $0,015 \text{ m/s}$ and the current angle is 90 (E) . The Buoyant Jet model has been used in the calculation. The three cyan squares represent the three different point sources (outfall locations). The red colour represents high pollutant concentrations.

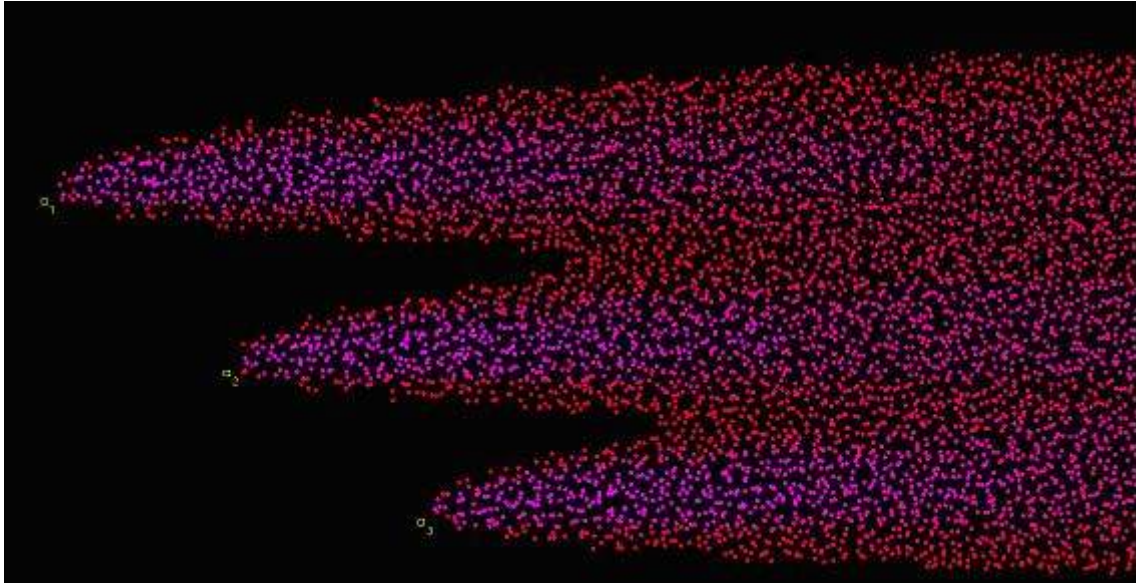
Calculation in both XY-plane (parallel to water surface) and XZ-plane (perpendicular to water surface). The cyan square represents a point source (position of the outfall pipe). The red colour represents high pollutant concentrations. The effluent flow rate is $0,15 \text{ m}^3/\text{s}$, the current velocity is $0,04 \text{ m/s}$ and the current angle is 45 (NE) . The Stratified

model has been used in the calculation. The fuchsia square represents the vertical discharge source (outfall locations). We have a three-dimensional image of the pollutant plume with these two computer screens.

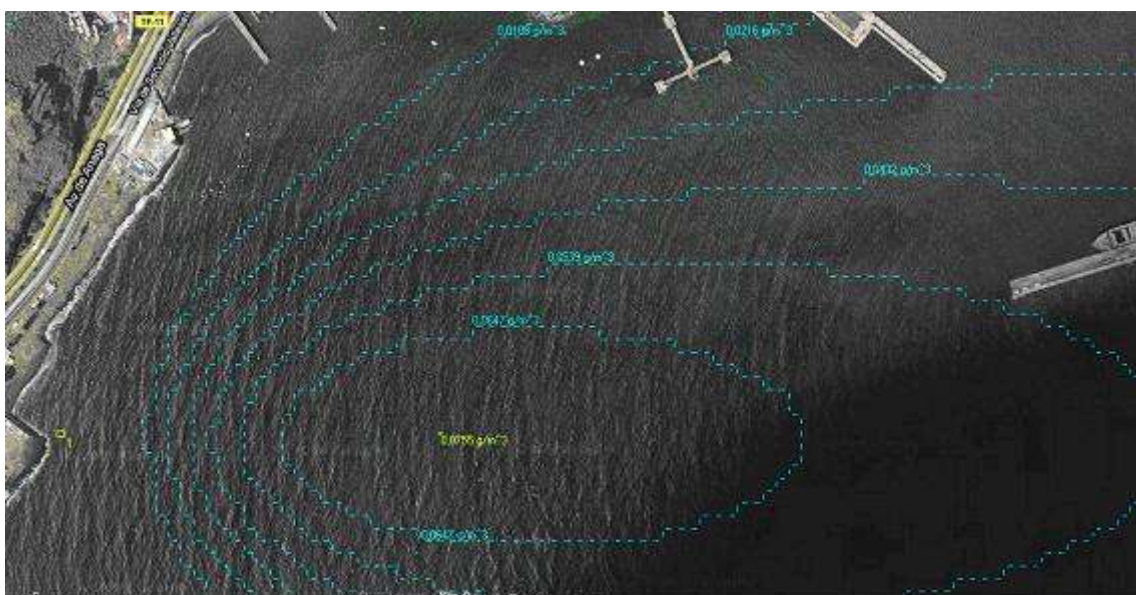


BOD pollution map produced by continuous discharge in this region. The stratified model has been used. Top: the orange horizontal line indicates us the position of the XZ-Plane.

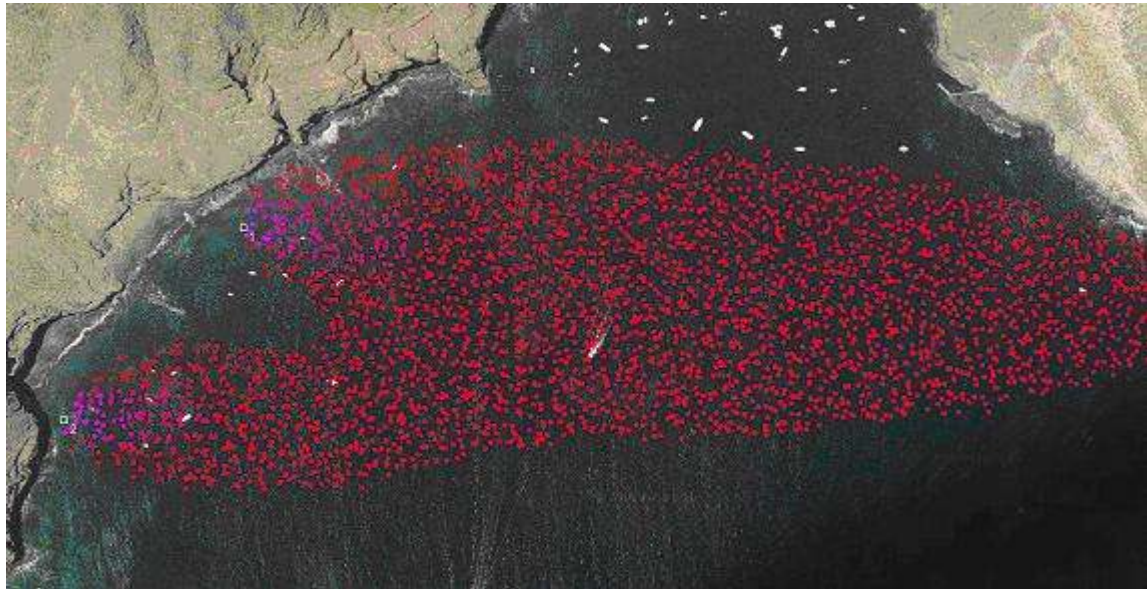
Bottom: the orange horizontal line indicates us the position of the XY-Plane and the blue horizontal line indicates us the position of the water surface plane. The fuchsia square represents a point source (position of the outfall pipe). The red colour represents high pollutant concentrations. The violet horizontal line (bottom) indicates us the position of the pycnocline (or thermocline) layer plane. We can see that there is no exchange of pollutants through the pycnocline layer.



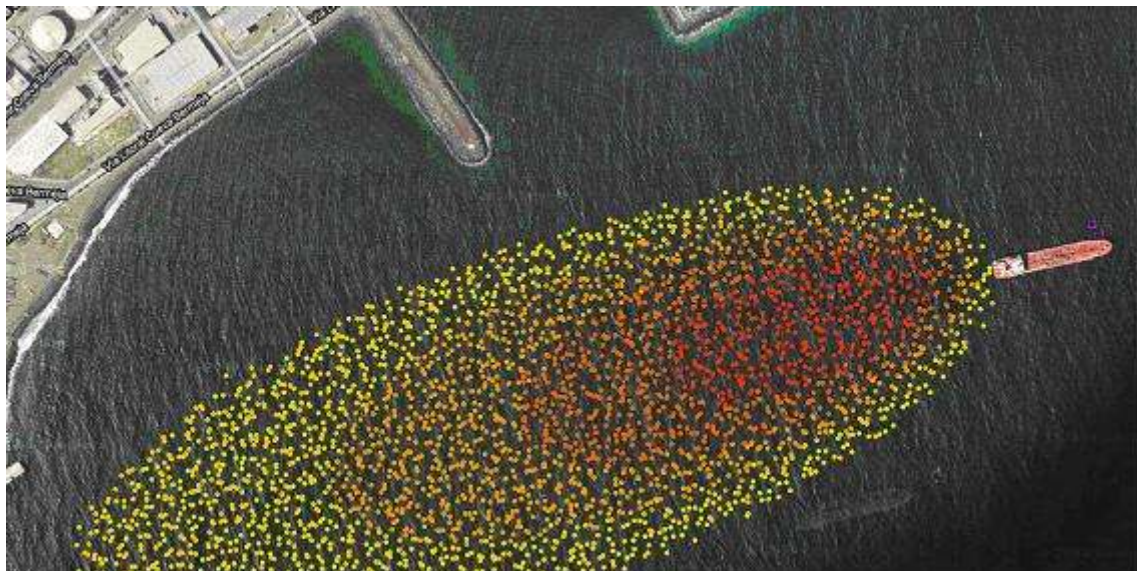
Three sources



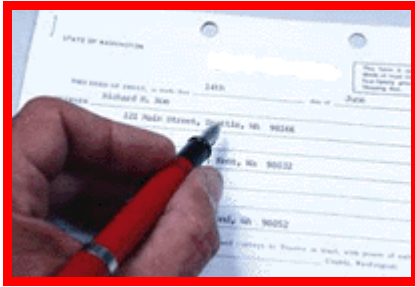
One source



Two sources



One source



Input data I

Outfall data:

An outfall is a pollutant point source. The outfall is small if we compare it with the size of the area in which we are simulating (point source). If you click this button, the next dialog box is shown:

Discharge data

Effluent velocity (m/s):	<input type="text" value="0,7"/>	Water depth at discharge location (m):	<input type="text" value="325"/>
Pollutant concentration (g/m ³):	<input type="text" value="350"/>	Discharge flow rate (m ³ /s):	<input type="text" value="0,017"/>
Discharge conditions		Discharge density (kg/m ³):	<input type="text" value="998,2"/>
<input checked="" type="radio"/> Vertical discharge		Pipe angle (deg, a 360):	<input type="text" value="90"/>
<input type="radio"/> Horizontal discharge (A-type)		Diffuser length (m):	<input type="text" value="1"/>
<input type="radio"/> Horizontal discharge (B-type)		1/190 (1/hours):	<input type="text" value="0"/>
Number of openings:			
<input type="radio"/> Single port			
<input checked="" type="radio"/> Multiport diffuser			
<input type="radio"/> Separated ports			
		<input type="button" value="Cancel"/>	<input type="button" value="OK"/>

Depending on the used model, some data of the dialog box can be modified: Buoyant jet model or Stratified model (see calculation models).

Buoyant jet model: The necessary data in the Buoyant jet model is:

Effluent velocity u_a (m/s): The average velocity of the pollutant effluent. It can be around 1 m/s.

Pollutant concentration (g/m^3): The discharge concentration of the material of interest (pollutant or tracer) is defined as the excess concentration above any ambient concentration of that same material. $1g/m^3=1ppm$ in water.

Water depth at discharge location (m): The actual water depth at the submerged discharge location. For surface discharges it is the water depth at the channel entry location.

Discharge flow rate (m^3/s): The discharge flow rate and the discharge velocity are related through the port cross-sectional area. (Flow rate)=(area)x(discharge velocity).

Discharge density (kg/m^3): It is the density of the pollutant discharge.

Discharge conditions: There are three options: Vertical discharge, Horizontal discharge (A-type) and Horizontal discharge (B-type). In the vertical discharge, the discharge flow is perpendicular to the water surface. In the horizontal discharges (A and B), the discharge flow is parallel to the water surface. In the horizontal discharge case, we assume that the discharge vector is always perpendicular to current vector. That is to simplify the calculations. In the A-type, the flow vector points the South and the current vector points the East. In the B-type, the flow vector points the North and the current vector points the East.

Stratified model: The necessary data in the Stratified model is:

Pipe angle (0 to 360): It is the horizontal angle of discharge measured clockwise from the North (at the window top).

Diffuser length (m): The diffuser length is the distance from the first to the last port or nozzle.

1/T90 (1/horas): This coefficient considers the half life of the pollutant if this disappears by means of chemical reactions (non-conservative pollutant). This is the T90 for E.Coli. For towns with less than 10.000 inhabitants we can take a T90=2 hours ($1/T90=0,5 \text{ hours}^{-1}$) in the Mediterranean and T90=3 hours ($1/T90=0,33 \text{ hours}^{-1}$) in the Atlantic.

Ambient data:

Ambient conditions are defined by the hydrographic conditions in the vicinity of the discharge. This Menu lists: Current.

Current.- DESCAR analyses, as all mixing zone evaluations, are usually carried out under the assumption of steady-state ambient conditions. If you click this command, the next dialog box is shown:

Ambient conditions

Water density (kg/m³): 1025

Current velocity (m/s): 0,005

Current angle (0 to 360): 90

Coefficient of stratification (1/s²): 0,00005

Stratified model

Water is stratified

Water is not stratified

Cancel OK

Depending on the used model, some data of the dialog box can be modified: Buoyant jet model or Stratified model (see calculation models).

Buoyant jet model: The necessary data in the Buoyant jet model is:

Water density (kg/m³): It is the density of the ambient water.

Current velocity u_a (m/s): The average velocity of the water current. The admitted minimum velocity is 0,0001 m/s. A typical velocity can be of about 0,015 m/s.

Current angle (0 to 360): It is the horizontal angle of water current measured clockwise from the North (at the window top). For an outfall that is localized near the coast, the vector of the current is usually parallel to the coast.

Stratified model: The necessary data in the Stratified model is:

Coefficient of stratification (s^{-2}): Γ represents the stratification degree in the water

$$\Gamma = -(g/\rho_a)(d\rho_a/dh),$$

being g the gravity acceleration, $g=9,81\text{m/s}^2$, ρ_a the ambient water density and h the depth. A typical value can be $0,00005\text{ s}^{-2}$ (The density of the seawater increases 5 kg each 1000m).

Stratified model: There are two options: Water is stratified and Water is not stratified. The stratification process usually happens in summer.

Modifying data · as time progresses:

Some discharge data can vary with time (velocity of the current, pollutant concentration,...). Taking this into account, the program can do temporal averages in the calculation. In the DESCAR software, these data are allowed to vary with time.

Variables that can be modified as time progresses:

Current velocity (m/s)

Current angle (degrees)

Effluent velocity (m/s)

Pollutant concentration (g/m^3)

Discharge flow rate (m^3/s)

Variables that can not be modified as time progresses:

Buoyant Jet model / Stratified model

Water density (kg/m^3)

Stratification coefficient ($1/\text{s}^2$)

Water is stratified / Water is not stratified

Water depth at discharge location (m)

Discharge density (kg/m^3)

Pipe angle (degrees)

Diffuser length (m)

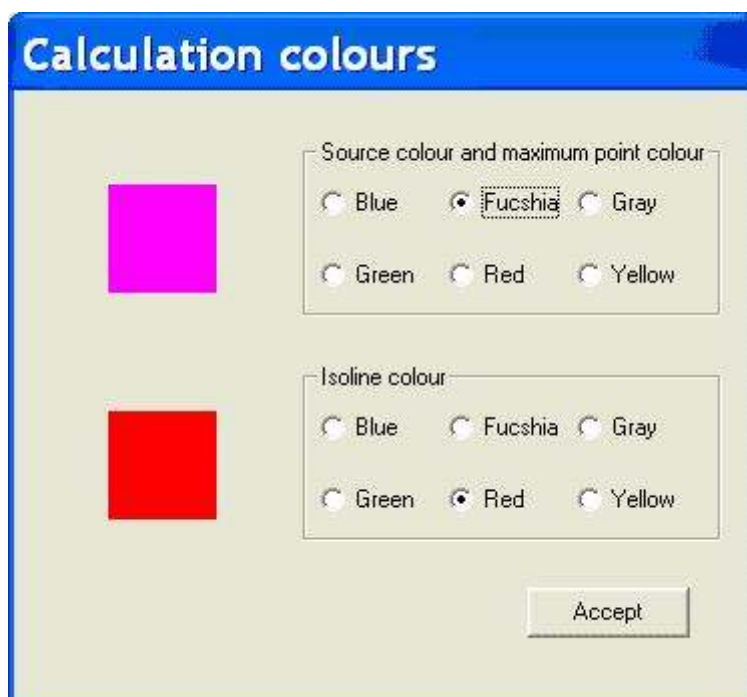
1/T90 (1/hours)

Discharge conditions

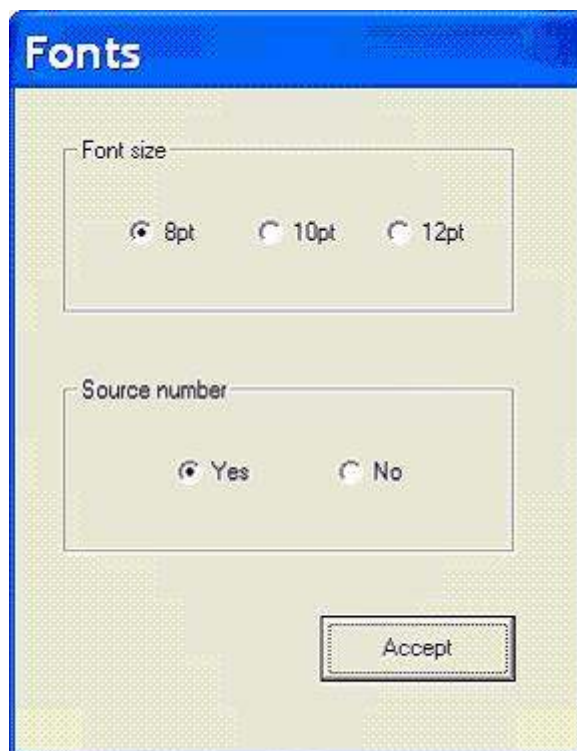
Number of openings

Commands · for obtained data:

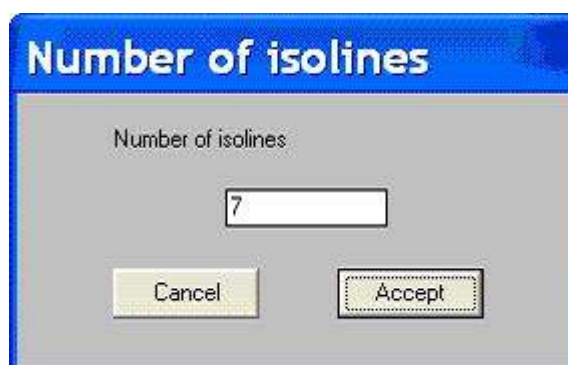
Calculation colours. - By means of this command, we will be able to change the colors of the isolines, of the maximum point and of the point sources.



Fonts. - This command is an auxiliary tool for making the maps of pollution. In this command we have two different options. We can choose: font size and source label (Yes/No).

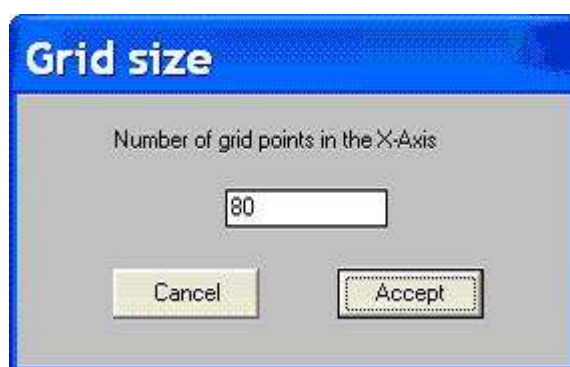


Number of isolines. - This command is an auxiliary tool for making the maps of pollution. We will decide the number of isolines in the screen that we will take to make the representation. In certain situations, it can be interesting to have a high number of isolines for a better visualization. We will use this command before using the calculation command because this parameter should be perfectly defined before running the simulation. If you click the Number of isolines button, the next program window is shown:



In this window we will be able to choose the number of isolines that we want to have in our computer screen. To calculate the lines, the program also considers to the maximum point as a line.

Grid size. - The grid size is an important parameter in the configuration of the system. We will decide the number of calculation points in the grid that we will take to make the simulation. As we increase the number of points, the computer will take much more time in carrying out the calculation but the result will be much more exact. If you click the Grid size command, the next program window is shown:



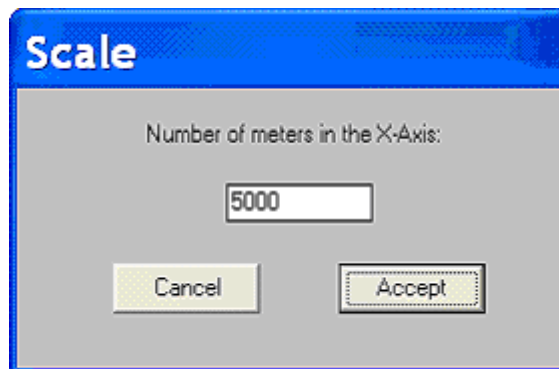
In this window we will be able to choose the number of grid points (calculation points) that we want to have in the X-Axis. The number of points to calculate will increase quadratically with the number of grid points along the X-Axis N , that is to say, it will increase as N^2 .

Import pictures · DESCAR software:

Picture size. - The displayed image size will depend on the size that had when it was saved. If it is necessary, modify the picture size before loading the image (for example, you can use windows Paint, Adobe Photoshop,...). You will be able to load BMP maps generated by AutoCad.

Scale command. - Bitmaps and scanned maps must be loaded into memory and then adapted to the program scale (we will make use of the Scale command). The X-Axis width (meters) in the program window can be easily changed to be able to compare both images (simulation results and background maps). Then, the X-Axis width (in meters) of the imported map and the X-Axis width (in meters) of the program window match together. The imported images are not stored physically in the simulation process. Terrain

elevations (represented on the imported map) don't interact in the simulation process. We haven't the possibility to zoom an imported map with the Zoom command. This command only acts in the calculation process. If it is necessary, zoom the map before loading the image.



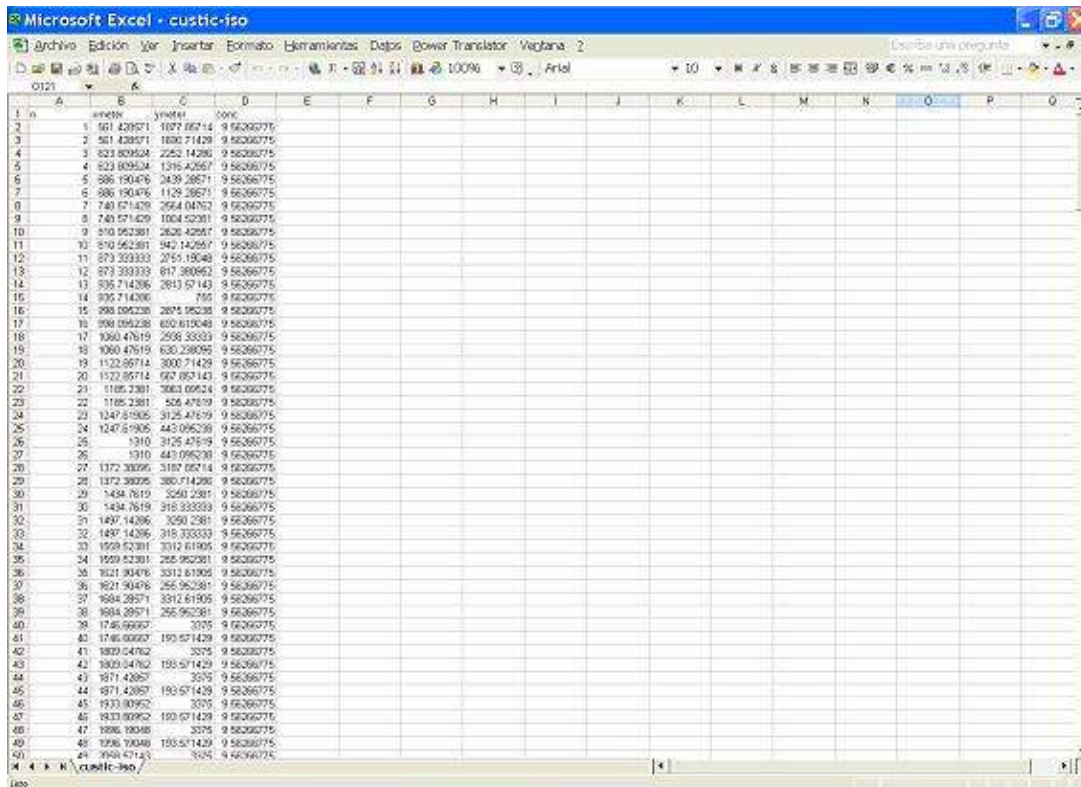
Zoom command. - We have the possibility to zoom a part of the program window with the Zoom command. However, we won't be able to enlarge background pictures with this command. If it is necessary, zoom the map before loading the background image. This command only acts in the calculation process. This way, we can place a point source in a side of the computer screen and we can calculate the concentrations in another different detailed region.



Export results · DESCAR software:

With the Export Picture command you will be able to export images and pictures (BMP files). These images will contain the background picture and the simulation results. Many programs, computer applications and word processors (AutoCad, 3d Studio, ArcView, MS Word,...) import BMP files. You will be able to load images generated by DESCAR.

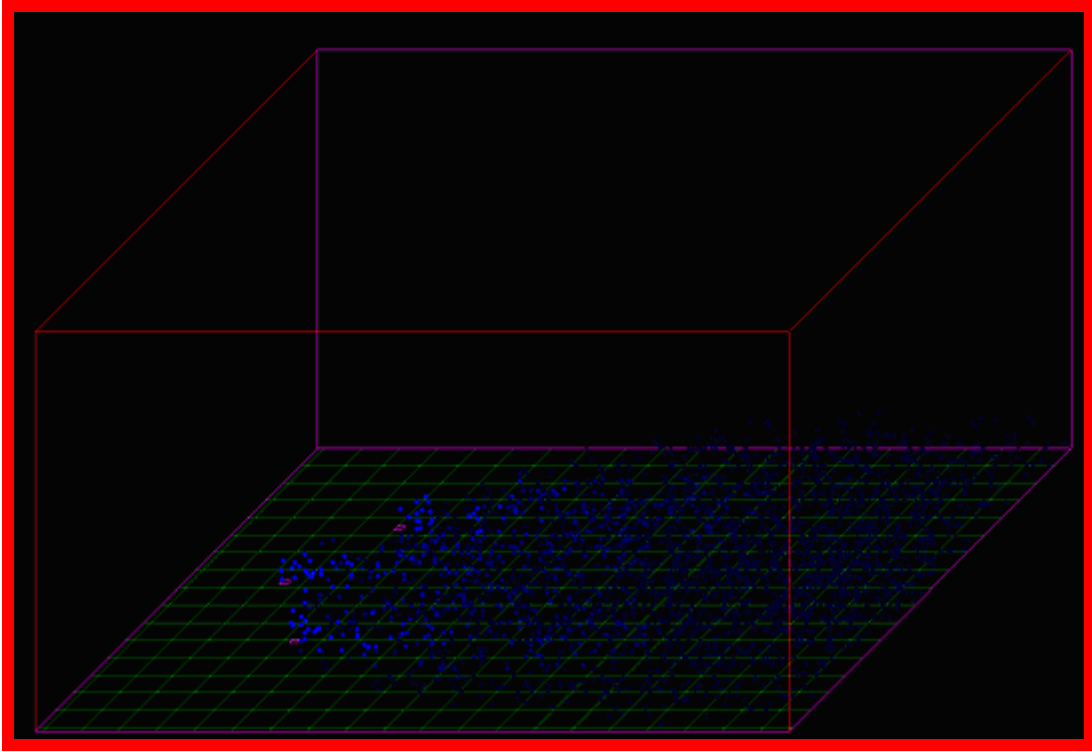
Export isolines , sources, maximum point, concentration values in geographical and cartesian coordinates commands. - These commands are to export data to EXCEL CSV files. After that, you can import the files with Microsoft EXCEL, Arcview and other graphical programs.



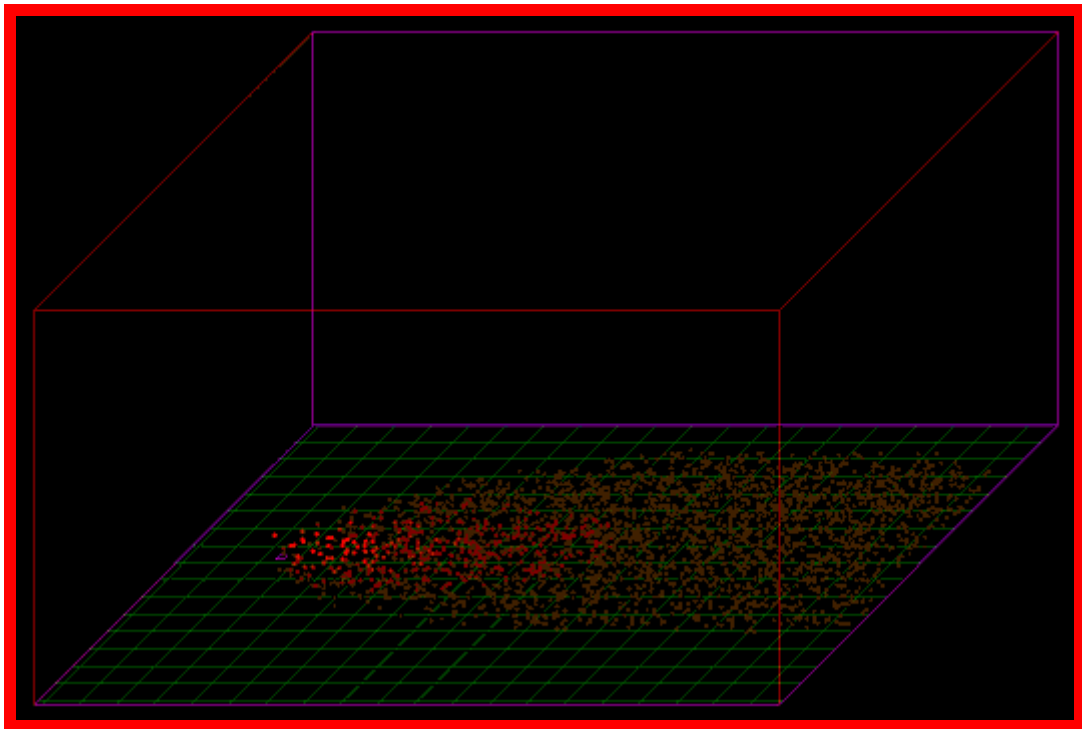
n	X	Y	concentration
1	561.428571	1072.05714	9.58266775
2	561.428571	1030.71429	9.58266775
3	623.809524	2252.14286	9.58266775
4	623.809524	1376.42857	9.58266775
5	686.190476	2439.28571	9.58266775
6	686.190476	1129.28571	9.58266775
7	748.571429	2564.04762	9.58266775
8	748.571429	1004.52381	9.58266775
9	810.952381	2626.42857	9.58266775
10	810.952381	942.428571	9.58266775
11	873.333333	2751.19048	9.58266775
12	873.333333	617.380952	9.58266775
13	935.714286	2813.57143	9.58266775
14	935.714286	755	9.58266775
15	998.095238	2874.95238	9.58266775
16	998.095238	630.619048	9.58266775
17	1060.47619	2936.33333	9.58266775
18	1060.47619	630.280952	9.58266775
19	1122.85714	3000.71429	9.58266775
20	1122.85714	602.657143	9.58266775
21	1185.2381	3063.09524	9.58266775
22	1185.2381	626.47619	9.58266775
23	1247.61905	3125.47619	9.58266775
24	1247.61905	443.095238	9.58266775
25	1310	3125.47619	9.58266775
26	1310	443.095238	9.58266775
27	1372.38095	3187.85714	9.58266775
28	1372.38095	380.714286	9.58266775
29	1434.7619	3250.2381	9.58266775
30	1434.7619	318.333333	9.58266775
31	1497.14286	3290.2381	9.58266775
32	1497.14286	318.333333	9.58266775
33	1559.52381	3312.61905	9.58266775
34	1559.52381	288.952381	9.58266775
35	1621.90476	3312.61905	9.58266775
36	1621.90476	256.952381	9.58266775
37	1684.28571	3312.61905	9.58266775
38	1684.28571	256.952381	9.58266775
39	1746.66667	3375	9.58266775
40	1746.66667	3375	9.58266775
41	1809.04762	193.571429	9.58266775
42	1809.04762	3375	9.58266775
43	1871.42857	193.571429	9.58266775
44	1871.42857	3375	9.58266775
45	1933.80952	193.571429	9.58266775
46	1933.80952	3375	9.58266775
47	1996.19048	193.571429	9.58266775
48	1996.19048	3375	9.58266775
49	2058.57143	193.571429	9.58266775
50	2058.57143	3375	9.58266775

DESCAR results exported to EXCEL CSV files. It is shown X-coordinate Y-coordinate and concentration

3D · water pollution modeling



3D representations. Point source.



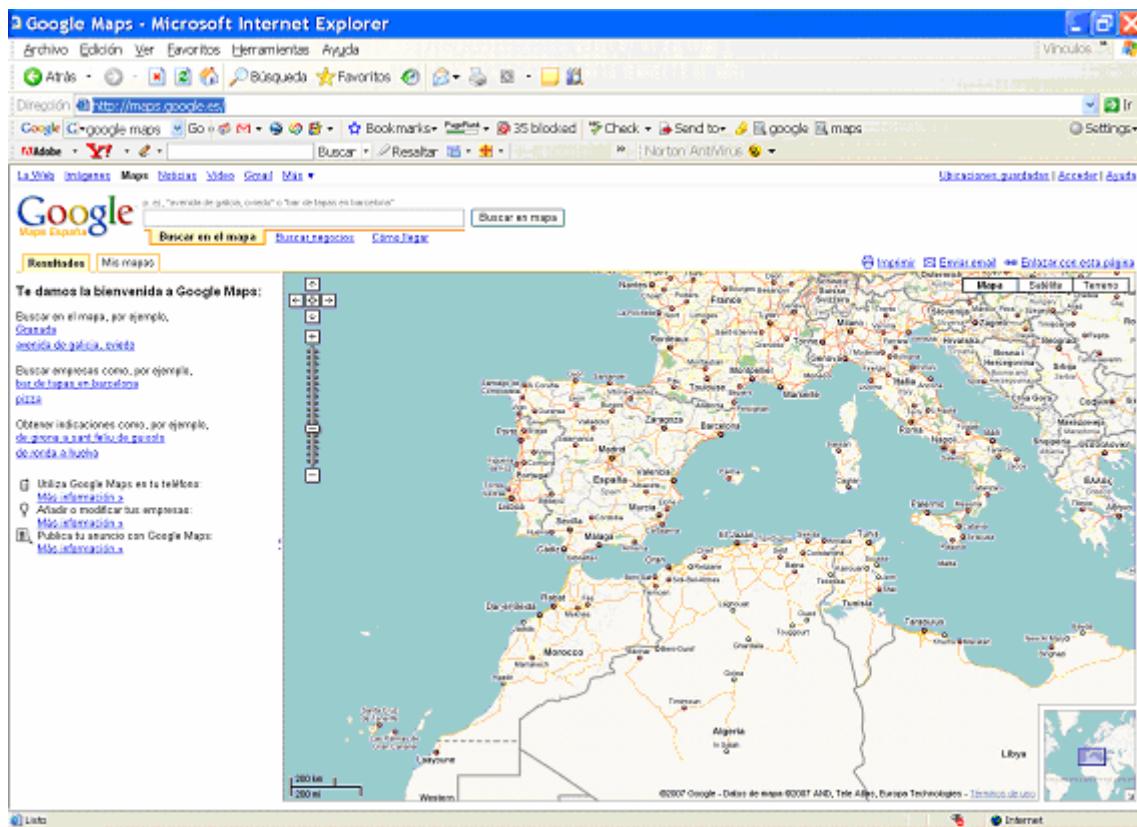
3D representations. Point source.



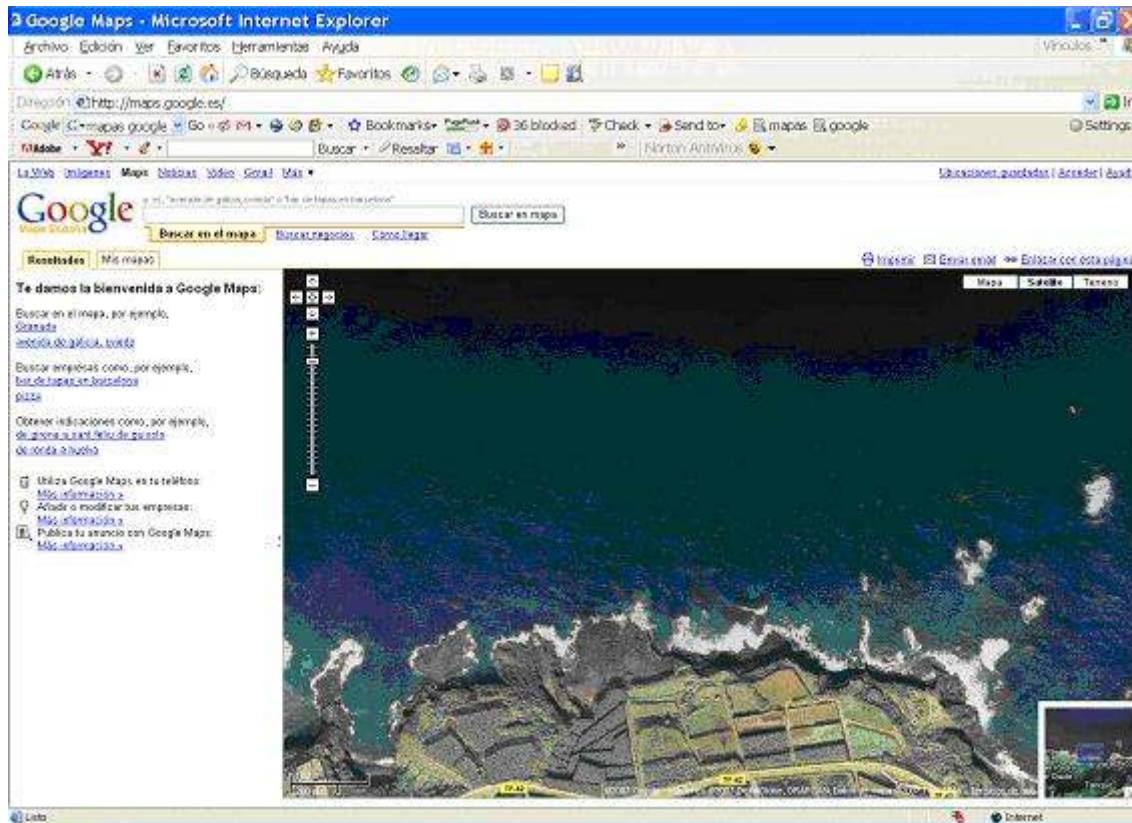
Working with Google maps

1. Firstly you can navigate to Google maps web.

<http://maps.google.com/>

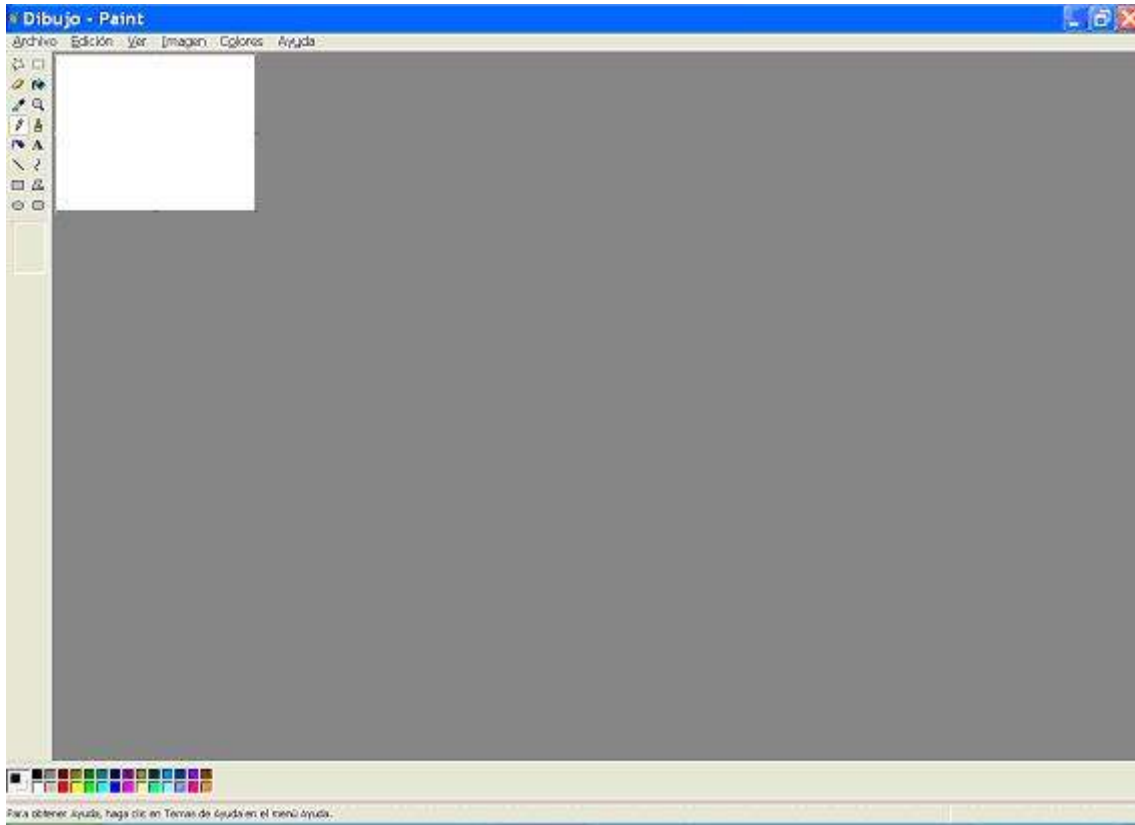


2. Using the screen arrows move to the map area that you want to watch. For example, we can watch *Garachico coast in Tenerife North*.

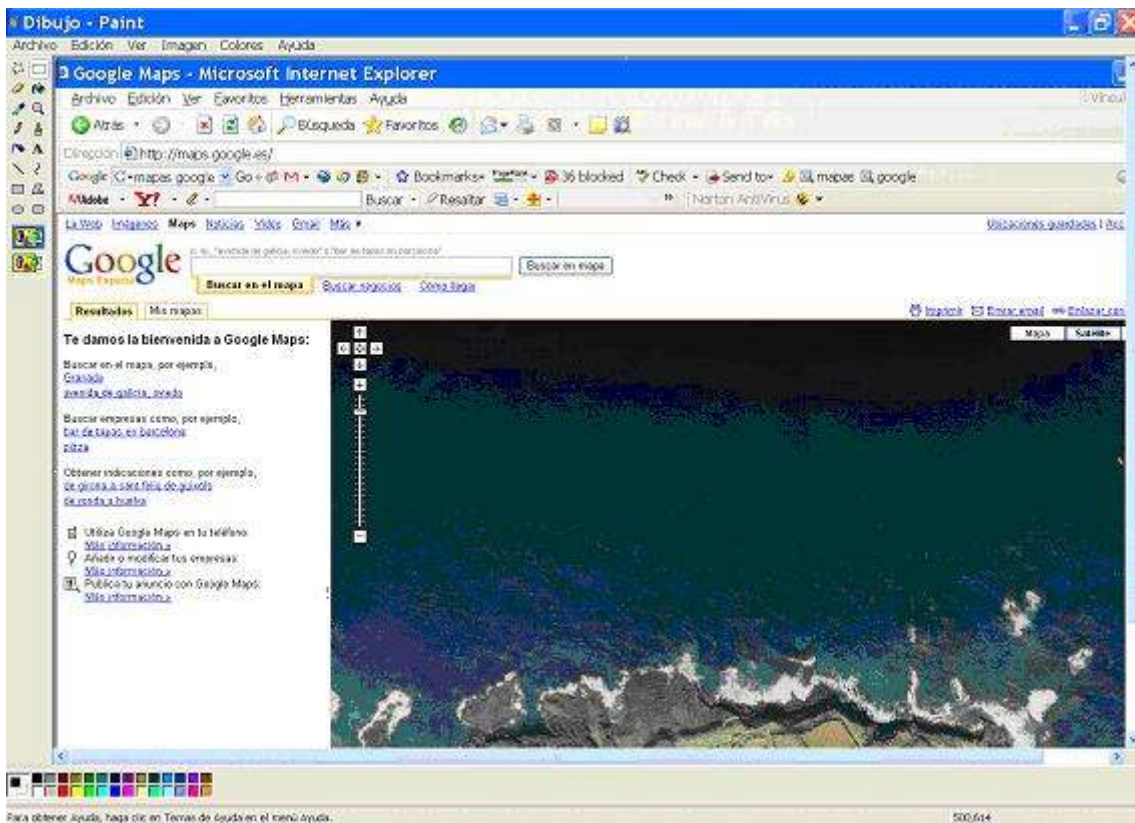


3. For the image capture, it is possible to use in the keyboard *Ctrl+Alt+PrtSc*). In the keyboard you can push at the same time (*Ctrl+Alt+PrtSc*). In that way, the screen image is copied by the computer memory.

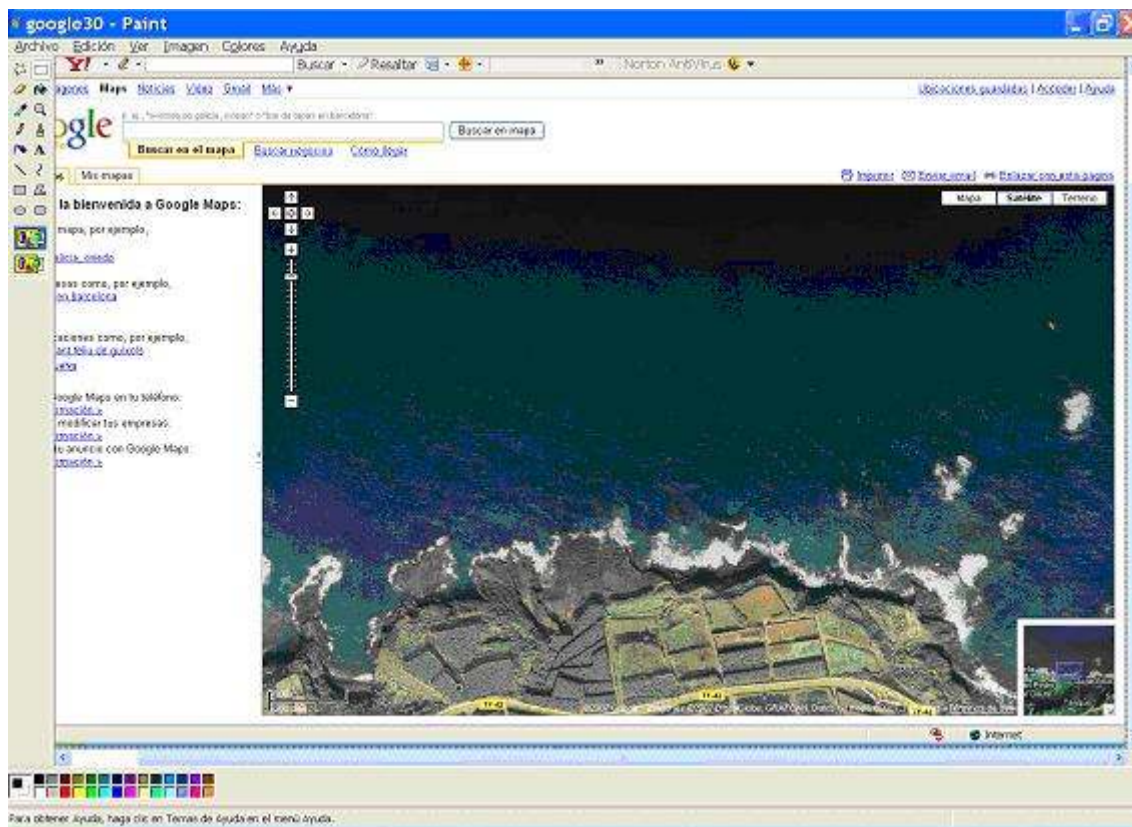
4. Open the windows PAINT program (*Windows >> Start>> Programs>> Accessories >> PAINT*).



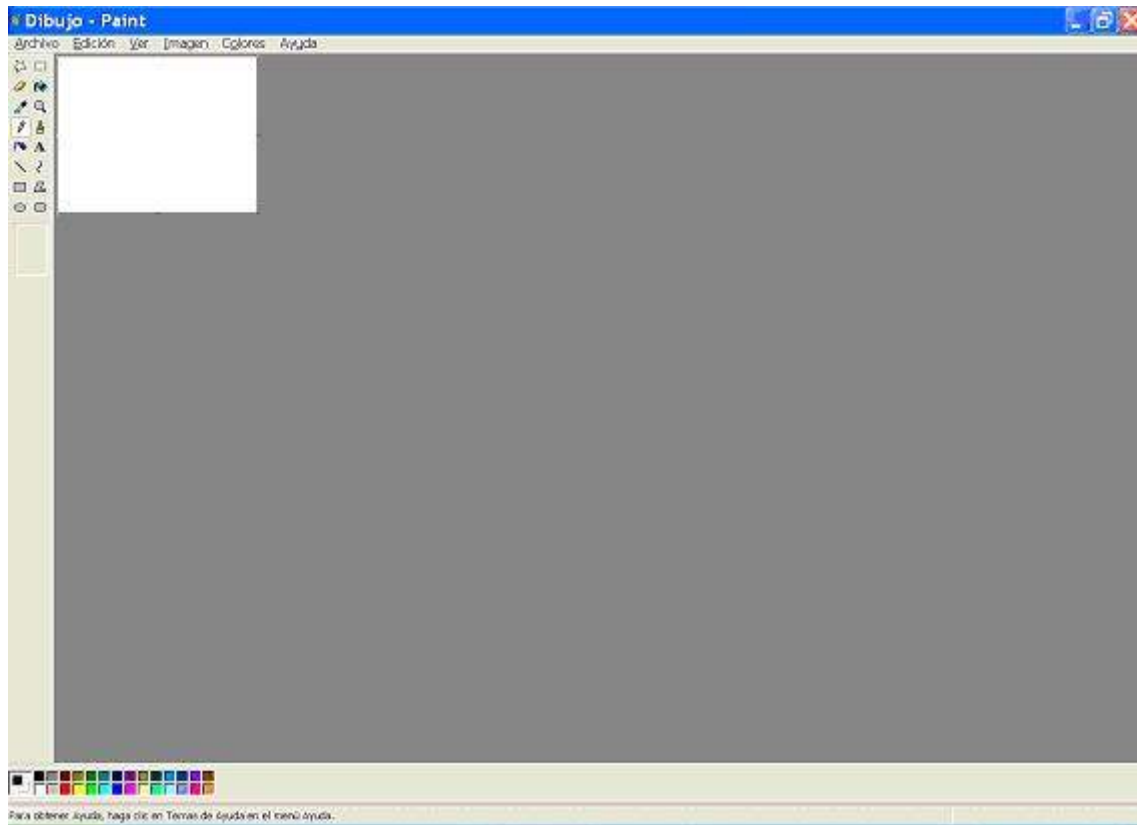
5. To paste the image that has been previously copied in the computer memory, you can use the commands (*Edit >> Paste* in the *PAINT program*) or (*Ctrl+V*). You can watch now the copied image from the Google maps web page.



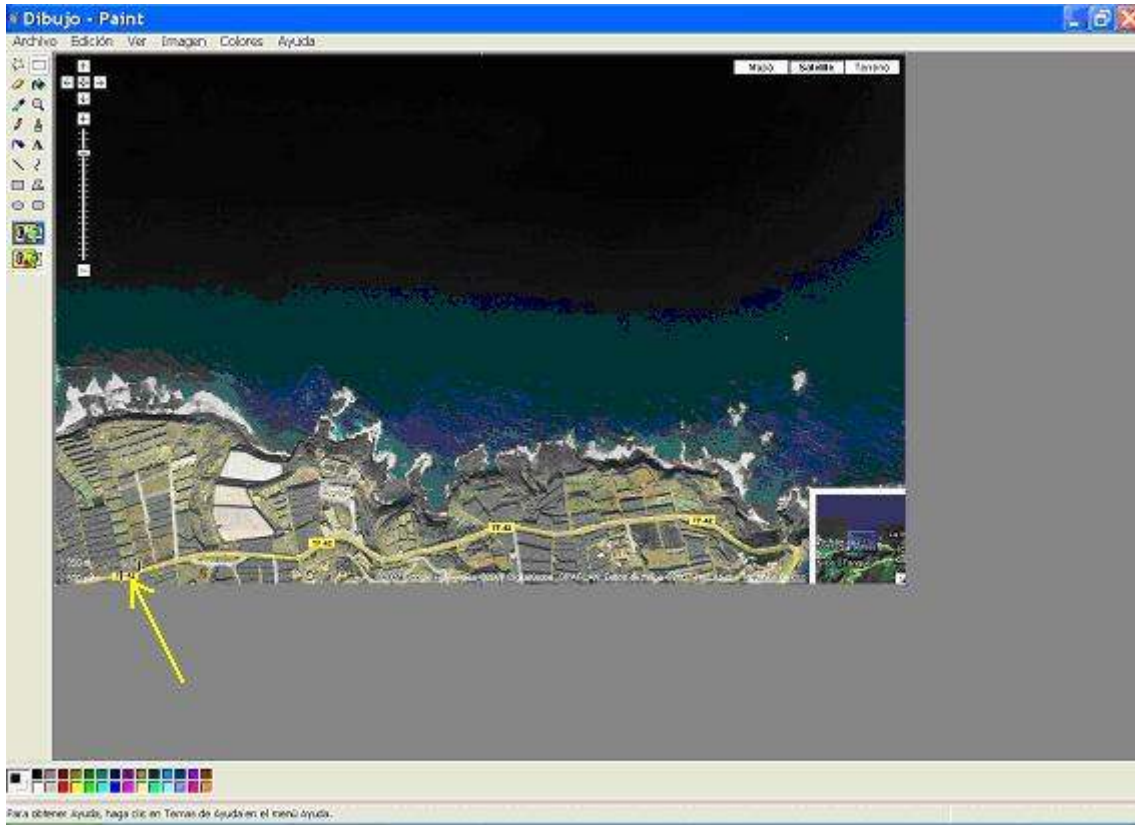
6. It is obvious that you don't want to watch the navigator bars that appears in the screen. Use the arrows of the PAINT program to center the image, that you are interested for, in your computer screen. In the toolbar of PAINT, you can use the icon SELECT (it is on top of the toolbar and at the right in the last picture). Drag the mouse arrow selecting the screen area that you are interested for. For our case, it is the rectangle where the picture of the terrain appears.



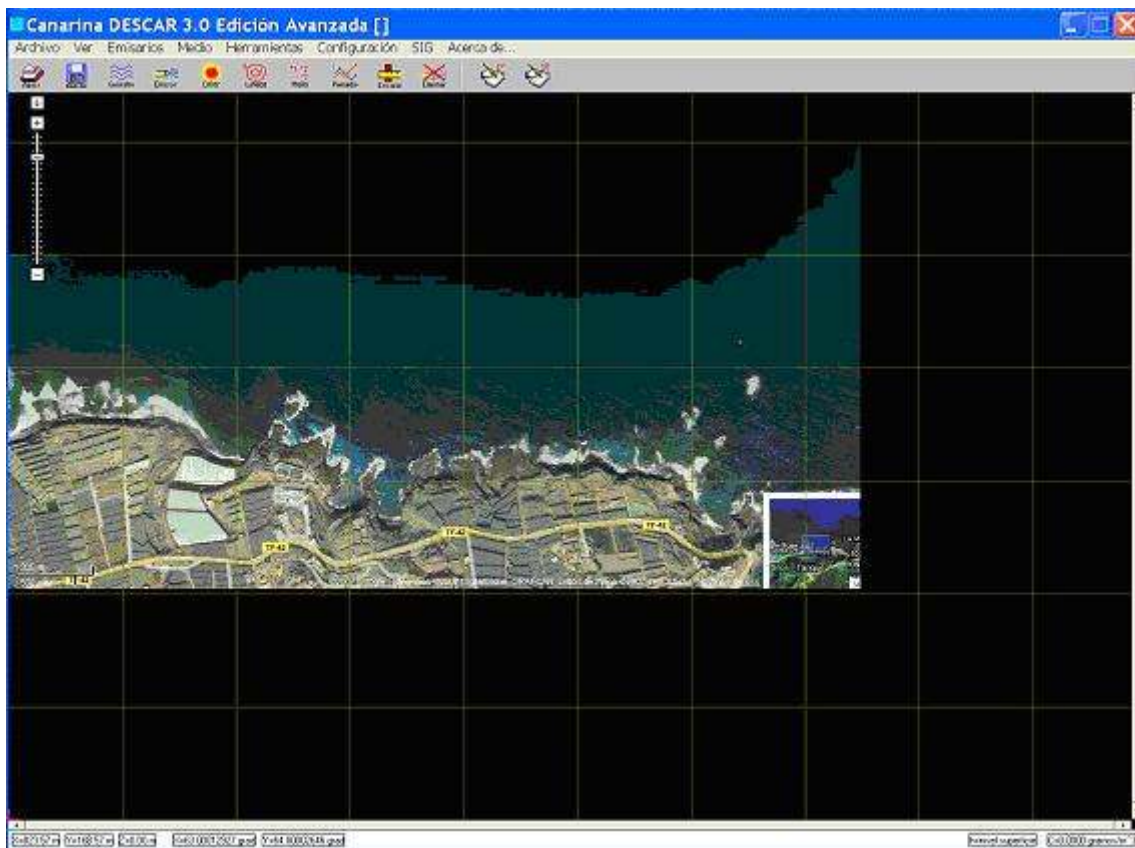
7. Copy now the selected area by the rectangle in the last image using (*Ctrl+C*) or the command (*PAINT Edit>>Copy*) in the PAINT program. Then, you can use the command (*File>>New*) in the PAINT to have a new and clear screen



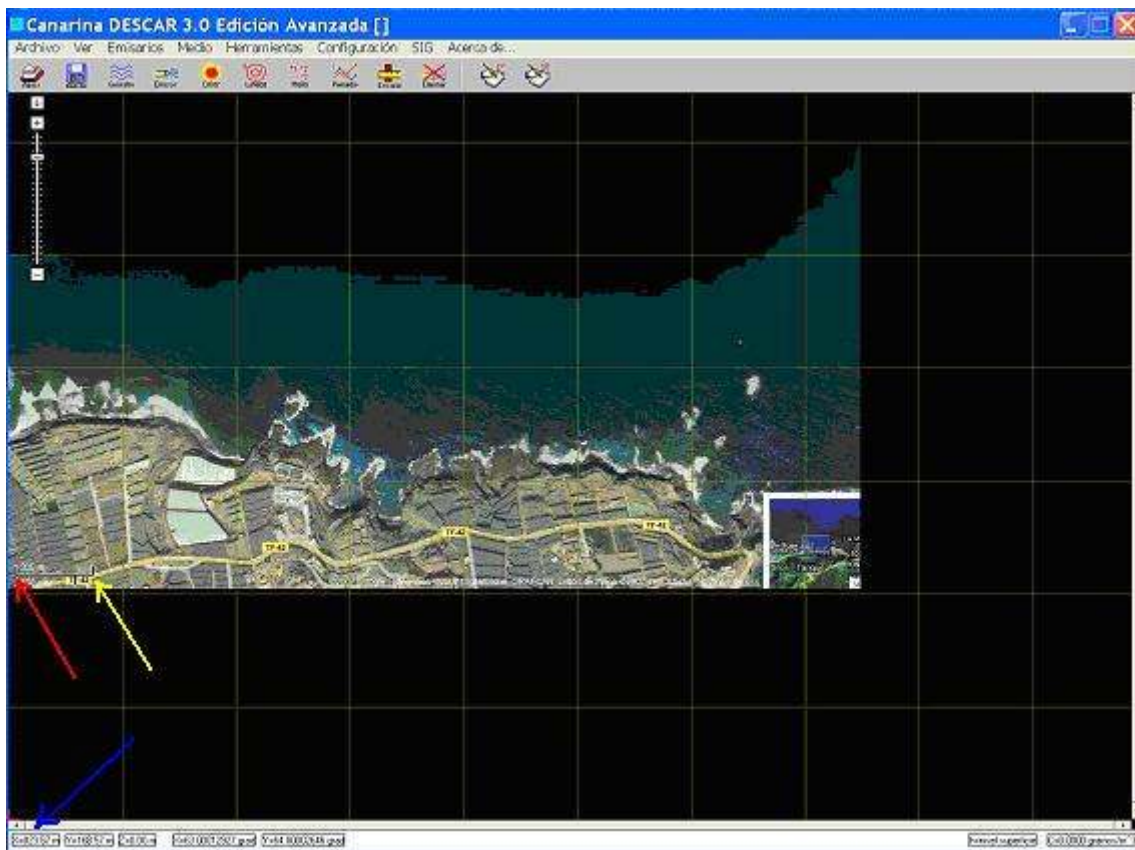
8. Use (*Ctrl+V*) command in the keyboard, or (*Edit>>Copy*) in the PAINT program to paste the selected rectangle. The copy of the image appears now in the PAINT screen. The scale of the map imported from Google maps appears now in our screen (marked by a yellow arrow). This will be of great interest in a near future. It is important to have this scale in the image that you have selected.



9. Save the file using BMP format using the commands of the PAINT program (*File*>> *Save as. . .*). Then, you can open the previously saved BMP file using the Canarina program.



10. To work in the correct scale, we need to check the scale bar width in the Google map. The Google scale bar is between the red and yellow arrows (in the next picture). The Google bar width is in meters. When we put the mouse pointer in the point of the red arrow we can see the X-Coordinate value in the box marked by a blue arrow. If we put now the mouse pointer in the point of the yellow arrow, we will obtain a new value for the X-coordinate. The difference between both values in meters must be the same that the original Google bar width in meters to be in the correct scale.



When we put the mouse pointer in the point of red arrow, it is found 7 m in the X-Coordinate box (marked with a blue arrow). If we do the same with the yellow arrow, we obtain 75 m in the box marked with a blue arrow. Then, and in our actual scale, the bar width have $75\text{ m} - 7\text{ m} = 68\text{ m}$. However, the correct value in the original Google scale is 100 m. The correcting ratio is

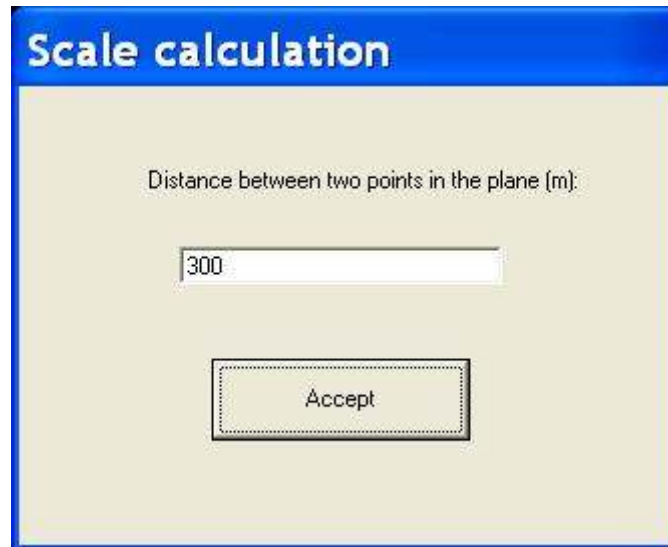
$$P = 100/68 = (\text{real value})/ (\text{our value}).$$

$$P=100/68=1.47$$

11. To work in the correct scale, we have two methods:

METHOD A:

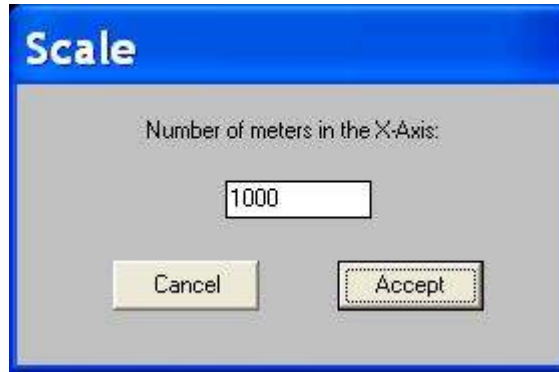
We go now to *Canarina program*>> *GIS* >> *Scale calculation* in the program and we get



We replace the 300m value that appears in the last picture by 100m (the original Google bar width in meters) and 'click' *ACCEPT*. Then we click firstly in the left extreme of the original Google scale bar and secondly, we click again in the right extreme of the original Google scale bar (both points in the screen were marked with red and yellow arrows in the last step 10). The imported Google map is now in the correct scale and we can check it. When we put the mouse pointer in the red arrow, we get an X-Coordinate value equal to 10 m (in the box marked with a blue arrow). We can also get 110 m for the position marked with the point of the yellow arrow. The difference is now $110\text{ m} - 10\text{ m} = 100\text{ m}$. Such a value coincides with the original value of the Google map bar. So, the program scale is correct now.

METHOD B:

We go now to *Canarina program*>> *Tools* >> *Scale* in the program and we get



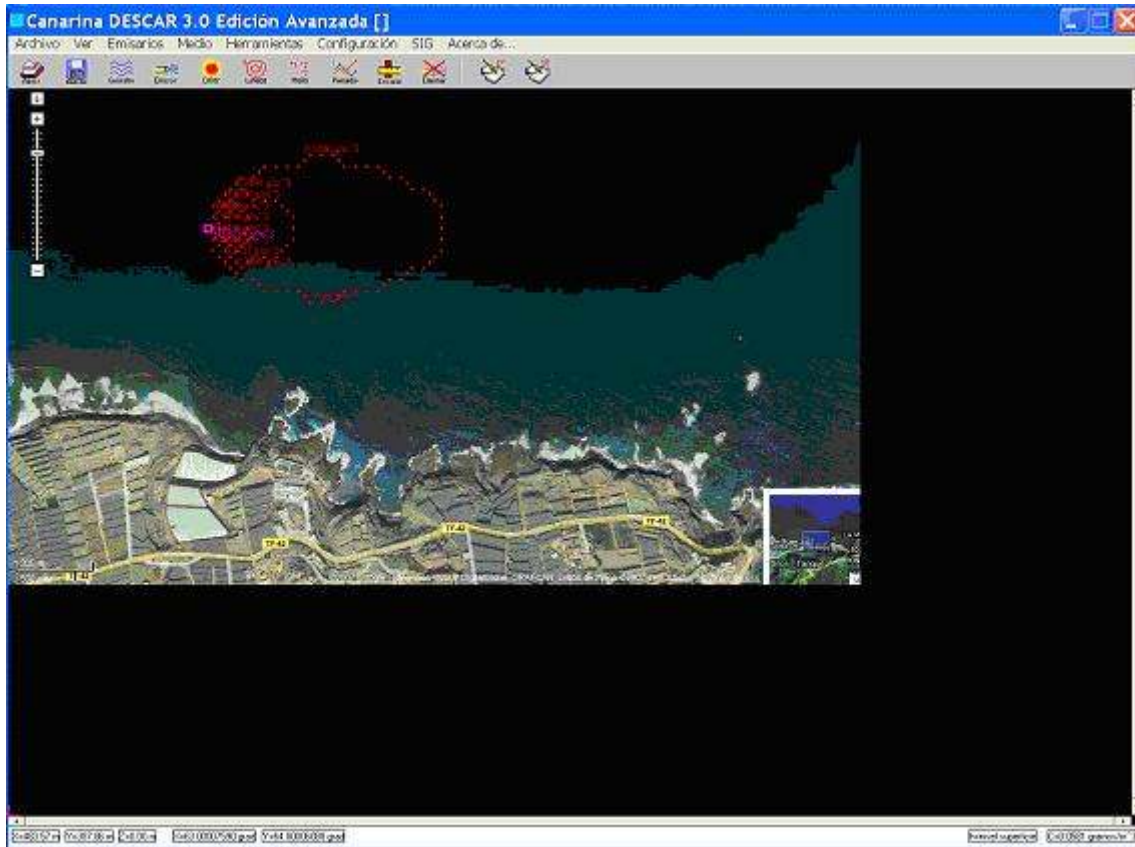
Now we multiply (our actual X-Axis width) by P to get the correct X-axis width,

$(\text{correct X-Axis width}) = P \times (\text{X-Axis width})$

$(\text{correct X-Axis width}) = 1.47 \times 1000 = 1470 \text{m}$

And we introduce the new X-Axis width and click *ACCEPT* in the last window. The imported Google map is now in the correct scale and we can check it. When we put the mouse pointer in the red arrow, we get an X-Coordinate value equal to 10 m (in the box market with a blue arrow). We can also get 110 m for the position market with the point of the yellow arrow. The difference is now $110 \text{ m} - 10 \text{ m} = 100 \text{ m}$. Such a value coincides with the original value of the Google map bar. So, the program scale is correct now.

12. Now we introduce a pollutant source and we make the simulation. The result can be exported to a BMP file using the Canarina software.



13. We can repeat the 6-7-8 steps 'in order to eliminate not necessary parts in the picture. At the end we have a clean image with both the Google map and the simulation process results.





Models and GIS

Calculation models.- The application uses two different mathematical models: Buoyant jet model or Stratified model. The Buoyant model is ideal for pollutant discharges located in the proximities of the coast and in rivers, (using little depth). This model is based on a time-independent Gaussian equation which simulates the pollutant dispersion in the water. The Stratified model takes into account the formation of the pycnocline in the sea. This model is ideal for outfall discharges in the sea (using a lot of depth). The program calculates the pollutant concentration in each point of the water considering each one of the pollutant sources and the conditions of the water.

GIS. - In this option it can be found all necessary to work with geographical information system. Coordinates of the origin: With this command we can choose the value for the origin of coordinates. It is initially in the left bottom corner of the program window. It is possible to work with geographic and Cartesian coordinates.

Origin coordinates

Cartesian coordinates

X: Y:

Geographic coordinates

X: Y:

Reference points. - With this command we can decide the coordinate values of a point, that we previously know, in the map in order to have a referenced system. It is possible to work with geographical and Cartesian coordinates. After that, it will be possible to export the results to a GIS system.

Reference point

Cartesian coordinates

X: Y:

Geographic coordinates

X: Y:

Radius of curvature. - By means of this command, you can choose a value for the Earth radius. This radius can be slightly modified to adjust the reference system with the available data. The program considers the Earth as a perfect sphere with an exact radius. We know that this is not exactly true. This option is to correct this kind of effects.



Scale calculation. - With this command it is possible to estimate the map scale that corresponds to a background image, that has trees previously imported by the user. It is necessary to know the distance between two different points in the map. After introducing the distance data, you can click consecutively both points, and the scale will be automatically calculated.

Software · characteristics

- System requirements: Windows 95, 98, 2000, XP, Vista or higher
- CD-ROM drive
- RAM Memory: 16MB or higher



Order and pricing · DESCAR software

Software order and pricing information

Price: DESCAR Software.....590 Euros

Licence: The software licence is for life. Once you buy the software, you will be able to use it at any time and forever.

Software update policy: Habitually we make good offers for the software upgrade (50 euros).

Refund policy: Refunds are not granted. Before buying, you will have to consult all the doubts on the software. Send us an email for further information.

To Order DESCAR Software: To place an order for DESCAR software, choose from the following

1. Complete the order form :

DESCAR Order form: (Please complete all items that apply)

First Name: _____

Last Name: _____

Title: _____

Company/Affiliation: _____

Fiscal Identity Number(*): _____

Address: _____

City/State/Region: _____

Country: _____

Zip/Mail Code: _____

E-mail: _____ Telephone: _____

(*) or analogous

2. Email the completed form to: info@canarina.com

Canarina Algoritmos Numericos, S.L.

3. We will contact you soon for the payment method

Payment methods: After you send us the completed form, please choose from the following:

1. Payment by international wire transfer

2. Payment by WESTERN UNION

We will contact you soon.

Shipping and handling expenses: Shipping and handling expenses are included in our posted prices. Orders will be sent first class by Postal Express (Spain).

Estimated Delivery Date:

	Europe	East Europe	North America	Asia	Africa
Estimated Delivery Date (Business days)	7 days	15 days	15 days	15 days	15 days

Canarina Environmental Software



Canarina Algoritmos Numéricos, S.L.
38300 LA OROTAVA, Canary Islands
Santa Cruz de Tenerife, SPAIN
www.canarina.com

Tel. +34 922 323 046 - 646 702 416
e-mail: info@canarina.com