DISPER software · air pollution modeling

DISPER is a software for air pollution dispersion analysis. The program calculates the pollutant concentration in each point of the air considering each one of the pollutant sources and the conditions of the atmosphere. The system of simulation of processes of dispersion that DISPER has, offers to the beginner and the expert programmer, a quick and practical system to evaluate the dispersion of pollutants in the air. 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 DISPER is one of the best tools, to carry out numeric simulations of air pollution processes.

Air pollution map (XZ-Plane) produced by continuous discharge in this region. The fucshia lines represents three different stacks (position of three different point sources) in a XZ-Plane. The red colour represents high pollutant concentrations. The green colour represents the ground and the surface topography.

DEMO software DISPER Download
Solutions · DISPER software:

- 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) and Google maps. 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.

Map of Nitrogen oxides (NOx) produced by an industrial stack. The wind angle is 90 degrees (E), the wind velocity is 5 m/s and the pollutant flow rate is 1g/s. The fuchsia square represents the point source (position of the stack).
Air pollution map (isolines) near the coast. With DISPER software you will be able to import and export images (previously saved BMP files).

Air pollution picture (isolines). With DISPER software you will be able to import and export pictures (previously saved BMP files).
3D representations. Point source.

It works with Google maps. Point source.
Area source.

Line source. Roads.
Advantages · air pollution modelling

- Without considering the experience that the user possesses in programming languages or in the use of simulation tools, in few minutes he will be able to have the first results. You don't need a course to use the software.
- With this application you will be able to export your simulation results (BMP files). These images will contain the background picture (map) and your simulation results. Many programs and computer applications (AutoCad, 3d Studio, ArcView, MS Power Point, MS Word,... ) can import your saved BMP files. You can work with Google maps.
- DISPER 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 generated data in GIS systems, as ArcMap or ArcView.
- DISPER works with two different models: Briggs model (used by ISCST from EPA, EE.UU.) and the European environmental agency model.
- It is possible to obtain XY and XZ pollution maps.
- You can work with odor units.

Air pollution map of the carbon monoxide concentrations (CO) produced by a road (300 vehicles per hour) in this region. The wind angle is 90 degrees (E) and the wind velocity is 5 m/s. The fucshia squares represent the road.
Input data I · air emission modeling

Source data:

The Point source Menu lists the possible pollutant sources: the point source, line source and area source.

Point source:

Point source - This is a pollutant point source. The stack size 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:

![Point source data dialog box]

The necessary data is:

- **Physical stack height (m)**: This is the physical stack height in meters.
- **Stack gas exit velocity \(v_s\) (m/s)**: This is the stack gas exit velocity. It can be around 15 m/s.
- **Stack gas exit temperature \((K)\)**: 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. \(1\text{g/m}^3=1\text{ppm}\) in air.
- **Stack inside diameter (m)**: This is the stack inside diameter.
- **Pollutant emission rate (g/s)**: This is the pollutant emission rate.
**Decay coefficient (1/s)** This coefficient considers the half life of the pollutant if this disappears by means of chemical reactions (non-conservative pollutant).

**Estimate flow rate** With this button, you can estimate the pollutant flow rate if it is unknown. If you know the rate, you don't need to use this command. You can write it directly in the point source window. If you click this button, the next dialog box is shown:

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**Area input data:**

**Area source** - This is a pollutant area source. The area width is small if we compare it with the size of the area in which we are simulating (area source). If you click this button, the next dialog box is shown:
Here, only some data can be modified. The necessary data is:

**Pollutant emission rate (g/m$^2$ s)**: This is the pollutant emission rate per unit area and second.

**Decay coefficient (1/s)**: This coefficient considers the half life of the pollutant if this disappears by means of chemical reactions (non-conservative pollutant).

**Line source:**

**Line source** - This is a pollutant line source. The line width is small if we compare it with the size of the area in which we are simulating (line source). If you click this button, the next dialog box is shown:

**Pollutant emission rate (g/m s)**: This is the pollutant emission rate.
Decay coefficient (1/s): This coefficient considers the half life of the pollutant if this disappears by means of chemical reactions (non-conservative pollutant).

Estimate flow rate: With this button, you can estimate the pollutant flow rate if it is unknown. If you know the rate, you don't need to use this command. You can write it directly in the point source window. If you click this button, the next dialog box is shown:

![Line flow rate dialog box](image)

Ambient data · DISPER software:

Ambient conditions are defined by the land and atmospheric conditions in the vicinity of the pollutant emission. This Menu lists: Meteorology and Topographic lines.

Meteorology. · DISPER 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:
The necessary data in the Meteorology command is:

**Pasquill stability**: Classification scheme that describes the degree of atmospheric turbulence. Categories range from extremely unstable (A=1) to extremely stable (F=6). Unstable conditions promote the rapid dispersion of atmospheric contaminants and result in lower air concentrations compared with stable conditions.

**Wind speed at reference anemometer height (m/s)**: The measurement of wind speeds is usually done using a cup anemometer. The cup anemometer has a vertical axis. The number of revolutions per minute is registered electronically.

**Wind angle (0 to 360 degrees)**: It is the horizontal angle of wind measured clockwise from the North (at the window top).

**Ambient temperature (K)**: The temperature of the medium surrounding an object. This is the air temperature at stack location.

**Mixing height (m)**: Mixing Height is used by meteorologists to quantify the vertical height of mixing in the atmosphere. It is the height at which vertical mixing takes place. There is a smaller volume which the pollutant can be dispersed. There is a seasonal variation of mixing height. For Summer daylight hours maximum mixing height can be a few thousand feet where as for Winter it can be a few hundred feet. It is lowest at night and increases during the day.

**Anemometer height (m)**: This is the ambient temperature at stack location.

**RURAL/URBAN option**: This is the RURAL/URBAN terrain options.

**Obtain K value**: With this button, you can estimate the Pasquill stability category if it is unknown. If you know the K value, you don't need to use this command. You can write it directly in the Meteorology window. If you click this button, the next dialog box is shown:
**Topographic lines.** - This command is to draw topographical lines. If you click this command, the next dialog box is shown:

![Topographic line dialog box]

**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 DISPER software, these data are allowed to vary with time.

**Variables that can be modified as time progresses:**

- Stack gas exit velocity (m/s)
- Stack gas exit temperature (K)
- Pollutant emission rate (g/s)
- K Pasquill stability category
Wind speed (m/s)
Wind angle (degrees)
Ambient temperature (K)
Mixing height (m)

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 noise 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 noise 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 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 · DISPER 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 · DISPER 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 DISPER.

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.
In the center of the program window, we will draw and we will calculate the different polluting processes. We can draw using two different planes: parallel to the ground surface (XY) and perpendicular to the ground surface (XZ). There is a grid in the XY-plane. The coordinate origin is on the left bottom corner (X=0, Y=0) in XY-planes (parallel to the ground surface). In addition, the coordinate origin is on the left bottom corner (X=0, Z=0) in XZ-planes (perpendicular to the ground surface).

**XY-Planes (parallel to ground surface):**

In such a case, the program window is a XY-plane (parallel to the ground surface). A pollutant point source (stack) is represented by a small square. In the Status bar at the bottom, we have X,Y and Z coordinate values in meters and data on our environmental system. Point the mouse where you want in the program window and the X,Y and Z values will be shown in the status bar at the bottom. If you select XY-Plane, a grid appears. On the left bottom corner, two different text boxes appear: The position of the XY-plane with respect to the ground surface (XY-plane height) and the pollutant concentration value (micrograms per cubic meter, ug/m³). Point the mouse where you want in the program window and the concentration value will be shown in the text box. The pollutant concentrations will be calculated in a parallel plane to the ground surface (XY-Plane). The plane height will be determined by the user (zᵢ).
All the points of the XY-plane will be at a z_r height. The z_r value is chosen by the user before the calculation. We will be able to make many calculations considering different plane heights. The different plane heights will be determined by the user (z_r values). In this way, the physical form of the pollutant plume can be studied.

**XZ-Planes (perpendicular to ground surface):**

In such a case, the program window is a XZ-plane (perpendicular to the ground surface). A pollutant point source (stack) is represented by a small square. In the Status bar at the bottom, we have X,Y and Z coordinate values in meters and data on our environmental system. Point the mouse where you want in the program window and the X,Y and Z values will be shown in the status bar at the bottom. On the left bottom corner, a text box appears: the pollutant concentration value (micrograms per cubic meter, ug/m$^3$). Point the mouse where you want in the program window and the concentration value will be shown in the text box. The pollutant concentrations will be calculated in a perpendicular plane to the ground surface (XZ-Plane). The plane height will be determined by the user (y_r).
All the points of the XZ-Plane will be to a y_r height. The y_r value is chosen by the user before the calculation. We will be able to make many calculations considering different plane heights. The different plane heights will be determined by the user (y_r values). In this way, the physical form of the pollutant plume can be studied.

Example 1:
Both XY-Calculation and XZ-Calculation have been used in our simulation. In this way, the physical form of the pollutant plume can be obtained. Calculation in both XY-plane (parallel to ground surface) and XZ-plane (perpendicular to ground surface). The fucshia square represents a point source (stack). The red colour represents high pollutant concentrations. Pollution map of Nitrogen oxides (NOx) produced by en industrial stack. The wind angle is 45 degrees (NE), the wind velocity is 5 m/s and the pollutant flow rate is 1g/s. The fucshia square represents the point source (position of the stack). We have a three-dimensional image of the pollutant plume with these two computer screens.
Example 2:

Both XY-Calculation and XZ-Calculation have been used in our simulation. In this way, the physical form of the pollutant plume can be obtained. Calculation in both XY-plane (parallel to ground surface) and XZ-plane (perpendicular to ground surface). The fucshia squares represent three point sources (stacks). The red colour represents high pollutant...
concentrations. Pollution map of Nitrogen oxides (NOx) produced by an industrial stack. The wind angle is 0 degrees (N), the wind velocity is 5 m/s and the pollutant flow rate is 1g/s. The fuschia squares represent the point sources (position of the stacks). We have a three-dimensional image of the pollutant plume with these two computer screens.
3D · air dispersión modeling

3D representations. Point source.

3D representations. Line source.
Working with Google maps · environmental

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

4. Open the windows PAINT program (\textit{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 retangle. 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 m -7m = 68m. However, the correct value in the original Google scale is 100 m. The correcting ratio is

$$P = \frac{100}{68} = \frac{\text{real value}}{\text{our value}}.$$

$$P=100/68=1.47$$

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

**METHOD A:**
We go now to Canarina program $$\rightarrow$$ GIS $$\rightarrow$$ 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 m -10m = 100 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,

(correct X-Axis width)=Px(X-Axis width)

(correct X-Axis width)=1.47x1000=1470m

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 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 m -10m = 100 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 · GIS · air dispersion models

**Calculation models.** - This option is to decide the mathematical model that will be used in the calculation. We can choose between two different models: Briggs model and the European environmental agency model, Technical report No 11 – Guidance Report on preliminary assessment under EC air quality directives –(96/62/EC)1 – European Environmental Agency, EEA.

**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.
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.

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 to different points in the map. After introducing the distance data, you can click consecutively both points, and the scale will be automatically calculated.

Odor units · DISPER software

Odor concentration:

The measurement of odor concentration is the most widespread method to quantify odors. It is standardized in CEN EN 13725:2003. The method is based on dilution of an odor sample to the odor threshold, at which the odor can just barely be perceived by 50 % of the test panel. The numerical value of the odor concentration is equal to the dilution factor that is necessary to reach the odor threshold. Its unit is the European Odor Unit, OU_E. Therefore, the odor concentration at the odor threshold is 1 OU_E by definition.

To establish the odor concentration, an olfactometer is used which employs a panel of test persons. A diluted odorous mixture and an odor-free gas (as a reference) are
presented from sniffing ports to a group of panelists. In comparing the gases emitted from each port, the panelists are asked to report the presence of odor. The gas-diluting ratio is then decreased by a factor of 1.4 or two (i.e. the concentration is increased accordingly). The panelists are asked to repeat their judgment. This continues for a number of dilution levels. The responses of the panelists over a range of dilution settings are used to calculate the concentration of the odor in terms of European Odor Units (OUe/m³).

The test persons must fulfill certain requirements, for example regarding their sensitivity of odor perception. The main panel calibration gas to verify this requirement used is n-Butanol.

You have the option to consider a null vertical momentum in point sources. This is useful if you have a landfill (area source with no vertical momentum) small in comparison with the working area. You can treat it as a point source.

**Estimate odor**.- With this module you can estimate the odor in simple cases. You can introduce the another odor flux quantity, if you want.
Flare stacks · DISPER software

Flare stacks:

Calculations with gas stacks:
You need to calculate the flare height and add the flare height to the stack height. For example, if the stack is 35m height and the flare height is 5m, you can introduce an stack height equal to 40m as input data.
To calculate the flare height $L$, you can use the next equation

$$L=0.006 \, Q^{(0.478)}$$

being $Q$ the heat power. The heat power can be calculated from the flux (g/s) of methane (for example) or another gas. We can also help you to determine this value, depending the gas you are using.

Software · characteristics

- System requirements: Windows 95, 98, 2000, XP, Vista or 7
- CD-ROM drive
- RAM Memory: 16MB or higher
Testimonials

“What a great tool...every environmental group should have this software”

Alan Pryor, environmental engineer and consultant, California, USA

"Canarina provides the ideal modeling tools to supplement human judgment in environmental studies. Very convenient and highly recommended"

Eng. Lam KAJUBI, President/CEO
Air Water Earth Inc. and Pollution Control Equipment, LLC, Uganda

"This software is a powerful tool to evaluate the environmental impact of air pollution emissions . . . it is possible to know the affected areas very easily. . . it's a great program and every industrial complex should have this tool"

Julio Mario Dequelli, environmental consultant, Argentina

“I use Canarina software often. It's a very good program for this price"

Irena Taraskeviciene, environmental consultant, Lithuania

"The software is user-friendly and simple yet gives an output result with reasonably high accuracy to allow judgment to be made"

Mr. Hung, environmental consultant, Malaysia
Clients

- National Institute of Science & Technology - Japan
- International Atomic Energy Agency - Austria
- Bureau Veritas - Holanda
- ARPA - Agenzia Regionale per la Protezione dell'Ambiente - Italia
- Environment Agency - UK
- ExxonMobil Corp.
- Royal Dutch Shell
- British Petroleum
- Total S.A.
- Chevron
- Saudi Aramco
- ConocoPhillips
- Samsung
- General Electric Co.
- Daimler AG
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- AT&T Inc.
- Arcelor Mittal
- Pemex
- Siemens AG
- StatoilHydro ASA
Petróleo Brasileiro S.A.
E.ON AG
Valero Energy Corporation
LG Group
National Iranian Oil Company
SK Group
BASF AG
Electricité de France S.A.
Matsushita Electric Industrial Co., Ltd.
France Télécom
ThyssenKrupp AG
OAO Gazprom
Repsol YPF, S.A.
Toshiba Corp.
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Kuwait Petroleum Corporation
Marathon Oil Corporation
Petroleum Nasional Berhad
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United Technologies Corp.
OAO LUKOIL
The Dow Chemical Company
Indian Oil Corporation
European Aeronautic Defence and Space Company EADS N.V.
PTT Public Company Limited
ENEL S.p.A
Veolia Environnement SA
Nippon Oil Corporation
Order and pricing · DISPER software

Software order and pricing information

Price: DISPER Software.........................................................590 Euros

Licence: You have not to pay a monthly (or annual) subscription to use the software. See, the Legal Notice http://www.canarina.com/legalnotice.htm

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.

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

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

Canarina Environmental Software

3. We will contact you soon for the payment method

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

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2. Payment by WESTERN UNION

3. Payment by credit card (PAYPAL)

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).
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