Crop Monitoring as an E-agricultural tool in Developing Countries

Guide of BioMA platform for local wheat monitoring application in Morocco

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Contents

Help contents

1

This Guide is targeted to the users of the BioMA Software Framework.

In particular, it describes how to use the BioMA Spatial graphical user interface to configure, run, and view tested models (either static or dynamic) against spatial units or run a model which requires coupling spatial units at each time step.

The topics are organized as follows:

Topic	Contents
“Getting started with BioMA-Spatial” on page 5	How to install, launch and test BioMA-Spatial. Furthermore, it provides an overview of the user interface with links to the relevant sections.
“Using BioMA-Spatial to run model simulations” on page 15	• How to choose and configure a modelling solution • How to access the Model Parameters Editor • How to run a model simulation • How to access and use the Map Data Visualizer BioMA plugin to view the simulations results • How to analyze the results using the Simulation Result Visualizer

For an introduction to the BioMA Software Framework, see:

- BioMA Framework User Guide

Tip:

Aquick **BioMA Spatial Tutorial** is available in the **Web-based BioMA Portal**. You will find both the Tutorial and all the files you need to complete the lessons.

The **Documentation** page gives access to the User Guides of all BioMA components.

Getting started with BioMA-Spatial

2

What BioMA Spatial it is used for

BioMA Spatial is the Graphical User Interface developed within the BioMA Framework that allows configuring, running, and viewing instances of a Modeling Solution in a spatially and temporally distributed context.

BioMA Spatial includes several plugins, such as Map Visualizer, Model Parameters Editor (MPE), Graphic Data Display (GDD), and Model Component Explorer (MCE) that you can launch and use from within the application for further simulation's analysis. Furthermore, users can deploy other plugins to be used within BioMA Spatial.

In this topic:

Related topics:

Installing and launching BioMA-Spatial

Prerequisites

In order to install and run BioMA, the following prerequisites must be fulfilled:

Hardware prerequisites

- Operative system: Windows XP/Vista/7 (32 or 64 bit)
- 1 GB RAM minimum (recommended 2 GB)

Software prerequisites

The following software must be installed on your computer:

- **NET 3.5 Framework** - To install go to http://www.microsoft.com/net/. Follow the product’s documentation, if needed.
- **SQLServer Compact Edition** driver - It is required in order to use the SQLServer portable databases (if this is going to be your DB). To install the latest version, go to http://www.microsoft.com/Sqlserver/2005/en/us/compact-downloads.aspx#35.

Important note:

The driver to be installed depends on the database you are using: for instance, if you are going to use a Oracle database, visit the Oracle Web site and install the driver’s latest version. You might also use a SQLServer, or PostgreSQL database.

Regional Settings of your PC

Ensure that the Regional Settings of your PC are properly set:

1 Access the Windows **Control Panel**:

- **Windows 7** and previous versions: Click the **Start** button, then select **Control Panel**.
- **Windows 8**: Right-click in the lower left corner of the screen, then, in the Windows' **Quick Access Menu**, click **Control Panel** near the bottom.

2 In the Control Panel select **Clock, Language, and Region**, then, in the **Region and Language** window, click **Additional settings**.

3 Be sure that the **Decimal symbol** is set to “point” (**.**).

Installation procedure

To install BioMA Spatial, you must complete the following steps:

- Uninstall any older version of BioMA Spatial (see “Uninstall older versions of BioMA Spatial” here below)
- Download and install the application (see “Downloading and installing BioMA Spatial” on page 7)
- Deploy the package (or the packages) containing the modeling solution(s) to be run (see “Deploying the modelling solution package” on page 9)
- Deploy the regional settings that allow running the modeling solution(s) in a specific context (see “Deploying the regional settings” on page 9)

Uninstall older versions of BioMA Spatial

1 Access the Windows Control Panel and open the programs uninstall utility (**Control Panel > Programs > Uninstall a program**).

2 Select **BioMASpatial** and uninstall it.

3 Delete all the residual content from the BioMA Spatial installation folder.

Downloading and installing BioMA Spatial

To download the installation package:

1 In your browser, go to the FTP site: ftp://mars.jrc.ec.europa.eu/EAgri/

2 Save the **BiomaMorocco_2013** folder locally in your PC. The folder includes:

File name	Description
cgms.mdb	The database file that is needed for running the CGMS tool.
CgmsStatToolSetup_20120212.zip	The installation file for the CGMS Statistical Toolbox (CST). This tool was developed to facilitate national and sub-national crop yield forecasting.

File name	Description
Morocco_RegionalSettings.brs	The regional settings to be deployed (see "Deploying the regional settings" on page 9).
CropSystPackage.bpkg	The CropSyst modelling solution package to be deployed (see "Deploying the modelling solution package" on page 9).
indicatornames.txt	This file is required by the CGMS Statistical Toolbox (CST)
setup.exe	The BioMA Spatial installation file.
SetupBiomaSkeleton.msi	A setup file that is automatically created and used by the installation process.
WofostPackage.bpkg	The WOFOST modelling solution package to be deployed (see "Deploying the modelling solution package" on page 9).

To install and launch BioMA Spatial:

1. Run the **`setup.exe`** file that you find in the installation package that you downloaded on your PC. (Note that you can choose any directory on the PC as the installation directory. By default, the installation folder is:
   - On a 64-bit machine: `C:\Program Files(x86)\JRC\BioMASpatial`)
   - On a 32-bit bachine: `C:\Program Files\JRC\BioMASpatial`)

   The installation creates a shortcut to BioMA on the desktop, and in either the Windows **Start** menu (**Windows 7** and previous versions) or the Windows **Charm bar** (**Windows 8**: the bar pops up by dragging the mouse to the top right corner of the screen).
2. Launch BioMA Spatial. The **Home** page of BioMA is displayed.
3. Check the **Log** window, at the bottom-left of the **Home** page to verify that no errors were found during startup and the application was successfully initialized.

To troubleshoot access problems, if any:

If an error is displayed regarding missing grants on the installation folder (like "Access to the path X is denied"), you must change the security properties of the folder and its subfolders. To do that:

1. Go to the BioMA setup folder (e.g., `C:\Program Files (x86)\JRC\BiomaSpatial`), right-click it, and then select **Properties**.
2. Select the **Security** tab and click the **Edit** button.
3. Under **Group or user names**, select the current user or **Users**.

4 Allow to the user(s) the **Full control** permission, click **Apply**, then **Ok**.

Deploying the modelling solution package

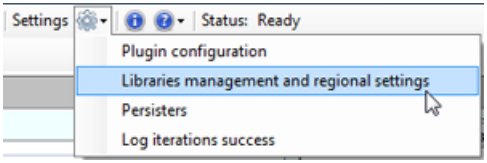
To use a modelling solution in BioMA Spatial, users must deploy a BioMA package file (.**bpkg** file).

A package contains one or more libraries (.**dll** or .**exe** files) and the .**xml** configuration files. These files are provided into a single ZIP file whose extension has been renamed to .**bpkg**.

Packages are used to collect all the files that are needed to deploy a modeling solution in BioMA Spatial.

To deploy the modelling solutions:

1 From the BioMA Spatial menu select **Settings > Libraries management and regional settings**.



2 In the window that opens, click the **Choose a package to deploy** button.

3 Browse to locate the .**bpkg** files that you downloaded, select one (e.g., **WofostPackage.bpkg**) and click **Open**.

4 Check **Deploy as modeling solution**, then click **Deploy**. BioMA Spatial will restart and will now include the modelling solution package you deployed.

5 Repeat the same operation with the other package, **CropSystPackage.bpkg**).

Deploying the regional settings

By deploying regional settings the user can fill the application with all the files needed for running a modeling solution in a specific context, such as:

- A weather provider, or a soil provider, to get data for a specific region
- The Mapping files to connect to databases

- The BioMA configuration files (.bcf) that we have provided to quickly configure a simulation run
- The ShapeFiles and the configuration files, to be able to plot maps by using the Map Data Visualizer (MDV) tool for the specific region/ modeling solution(s)
- The crop masks definitions to be used in the location selector
- The Parameter files containing the modeling solution(s)' parameters for the specific context of the simulation
- The Agromanagement files containing the agromanagement rules for the simulation's specific context
- The portable databases containing data that are used for the simulation, as well as to provide tables to store the simulation results
- The BioMA settings files
- Other files needed by a modeling solution

To deploy the regional settings:

1. From the BioMA Spatial menu select **Settings > Libraries management and regional settings**.
2. At the bottom of the window that opens, click the **Add** (or **Change**) button. (If a regional settings set has already been deployed, this button is named **Change** and the name of the **Current regional settings** is displayed in this area.)

Attention:

When you change the regional settings, the current set will be deleted, and so any data file belonging to it. Make a back-up of your sensible data (if any) before proceeding.

3. Select the **.brs** file that you want to use as regional settings, that is, **Morocco_RegionalSettings.brs**, then click **Open**.
4. In the pop-up that displays informing you that the existing regional settings files will be deleted, click **Ok**, then wait for the unzip process to complete (this might require few minutes).
5. At the end, the message **Regional settings unzipped** will be displayed (this might include some potential warnings saying that some **dlls** are already loaded in BioMA and cannot be overwritten).
6. Click **Ok**. The application will be restarted.

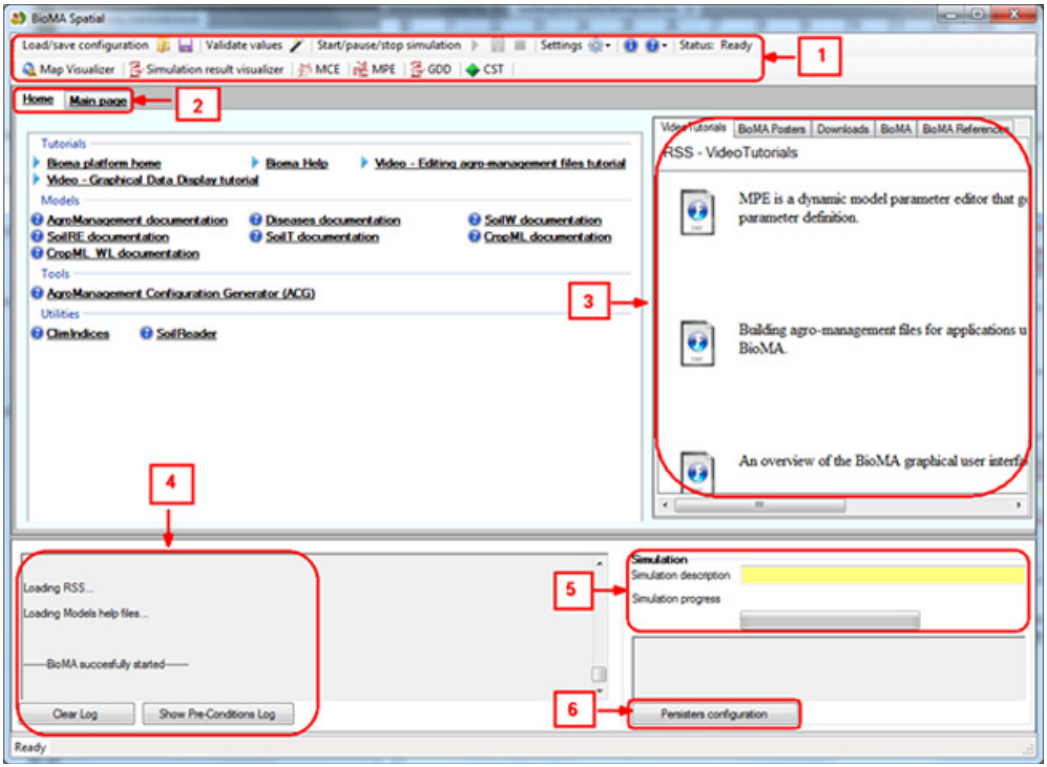
Related topics:

- “BioMA-Spatial workspace overview” on page 12
- “Using BioMA-Spatial to run model simulations” on page 17

BioMA-Spatial workspace overview

This section provides an overview of the BioMA-Spatial workspace:

Figure 1 Home page overview

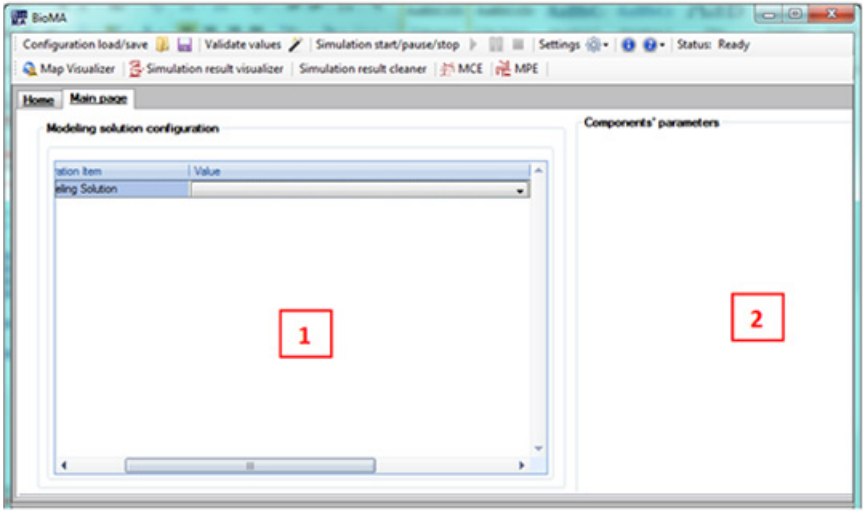


The table that follows provides a short description of all panes and commands. Links to sections of interest are also provided.

	Interface element/group	Description
1	**Main menu**	**Load/save configuration** - Allows saving a modeling solution configuration for a later reuse, and loading an available pre-saved configuration (*.BCF file), respectively. See "Saving and loading a configuration" on page 38. **Validate values** - Allows validating the configuration before running the simulation. **Start/pause/stop simulation** - Allows starting and managing the simulation. See "Running the model simulation" on page 37. **Settings** - The  button displays a popup menu including the following commands: • **Plugin configuration**: It allows registering or de-registering plugins. See "Deploying plugins" on page 45. • **Libraries management and regional settings**: It allows deploying new modeling solutions or components and installing the regional settings. • **Persisters**: Same as **Persisters configuration** button at the bottom of the window. See "Configuring the persisters" on page 34. • **Log iteration success** - This is a checkbox. If selected, a log file will be saved for each interaction. By default, is deselected because it might slow down the performance. • **About** and **Help** icons - These icons display the release information and all the available user guides, respectively.
1	**Tools buttons**	**Map visualizer** - It launches the Map and Data Visualizer tool. See "Using Map Visualizer to view the simulation results" on page 39. **Simulation result visualizer** - It opens the Result Visualizer window that allows exporting the result data to a CSV file. See "Using Map Visualizer to view the simulation results" on page 39. **MCE** - It launches the Model Component Explorer. Go to http://bioma.jrc.ec.europa.eu/mce/help to view the MCE Help. **MPE** - It launches the Model Parameter Editor. Go to http://bioma.jrc.ec.europa.eu/mpe/help to view the MPE Help. **GDD** - It launches the Graphic Display Data tool. Go to http://bioma.jrc.ec.europa.eu/gdd/help to view the GDD Help. **CST** - It launches the CGMS Statistical Toolbox that allows executing statistical analysis on the simulation results.

	Interface element/group	Description
2	**Tabs**	**Home** - The tab that is displayed at the application startup. **Main page** - It allows selecting and configuring the modeling solution (see “Main page overview” on page 14)
3	**Right pane**	This pane includes several tabs that allows viewing or downloading reference documentation. The pane is dynamic: it gets updated whenever an authorized user changes a document.
4	**Log window**	This pane allows checking if the current operation (starting the application, launching a simulation, and so forth) has been successfully completed. Furthermore, it lists detected errors, if any. The **Clear log** button allows clearing the log window, whereas the **Show pre-conditions log** allows checking at runtime that the values are within the proper ranges; by clicking this button a dedicated log window is displayed.
5	**Simulation descrption** **Simulation progress**	It allows naming the simulation and viewing its progress when launched.
6	**Persisters configuration**	It allows configuring the persisters, that is defining how to save the simulation results (either in a Database or a textual file). See “Configuring the persisters” on page 34.

Figure 2 Main page overview



The table that follows provides a short description of all panes and commands. Links to sections of interest are also provided.

	Interface element/group	Description
1	**Modeling solution configuration**	This is the configuration editor that allows choosing the modeling solution to run and set its configuration. See “Choosing the modeling solution” on page 16. The grid shows the following columns: • **Iterate** - If selected, it allows the iteration on multiple values of the item (if possible). For example, you might iterate on multiple years or locations. See, “Iterating over multiple item values” on page 23. • **Configuration item** - This column shows the name of the item to be set in the **Value** column. • **Value** - By clicking a field in this column, a dropdown list is made available from which you can choose the desired value. Furthermore, in some cases, an ellipsis button  is displayed in the third column: click it to display a popup that helps you in your selection. (See “Using the Location selector” on page 26). • **Value Hints and Definitions** - This column shows the value constraints (if any). If you don’t see this column drag the scrollbar at the bottom of the panel.
2	**Component’s parameters**	This panel shows the model’s parameters, grouped by the component of the model which they belong to. It allows viewing and editing the parameters. Besides of showing the name of the components, two buttons are displayed: **Show** and **View parameters** that allow displaying the values and launching the Model Parameter Editor, respectively. (See “Editing the model’s parameters” on page 32 for further information).

See also:

- “Choosing and configuring the modeling solution” on page 16

Using BioMA-Spatial to run model simulations

3

To get you started with BioMA-Spatial, in the following you find the step-by-step procedures for running a modeling solution.

The topic has been organized into the following sections:

Choosing and configuring the modeling solution

In this guide we will choose, configure, and run the WOFOST modeling solution.

WOFOST (WOrld FOod STudies) is a simulation model for the quantitative analysis of the growth and production of annual field crops. It simulates crop growth with time steps of one day.

WOFOST is a mechanistic model that explains crop growth on the basis of the underlying processes, such as photosynthesis, respiration and how these processes are influenced by environmental conditions.

Tip:

To configure the CropSystmodelling solution, which has been provided with the installation package, you can mainly use the same procedure that is described in the following.

The only differences are due to specific parameters that refer to that modelling solution. For information on the modelling solutions and their components, please refer to the Modelling Solutions Documentation in the BioMA Portal.

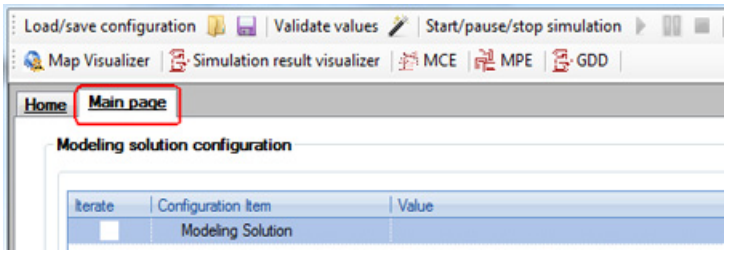
In this section:

Choosing the modeling solution

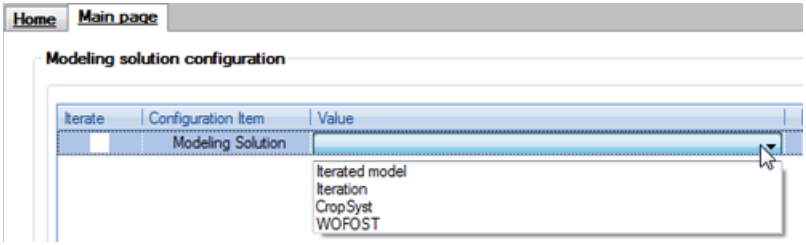
To select the modeling solution to run:

1 Launch BioMA Spatial either from your desktop or from the **Start** menu in your Windows application bar.

2 In the BioMA window, select the **Main page** tab:



3 In the **Modeling solution configuration** panel, double-click the **Value** column next to **Modeling Solution** to display the drop-down list:



4 Choose the **WOFOST** modeling solution from the list. The list includes:

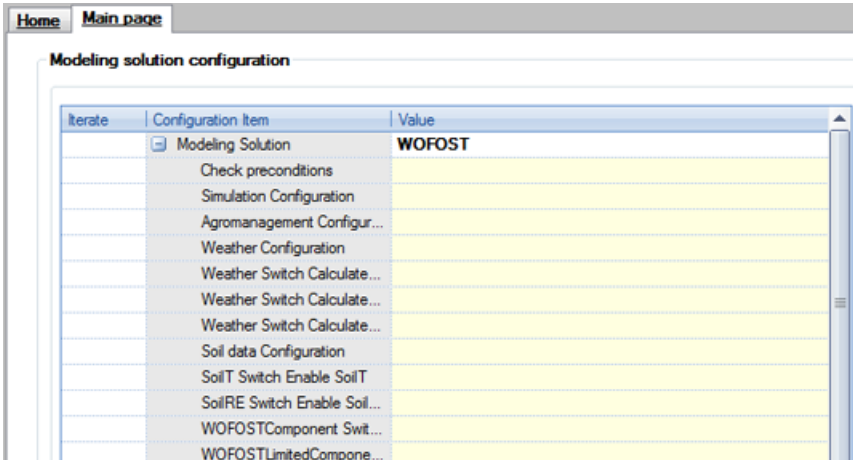
- The modeling solutions that have been provided with the BioMA Spatial installation package (**CropSyst** and **WOFOST**)
- **Iterated model** and **Iteration**, which are auxiliary values that can be ignored from the user.
- Any other modeling solution that was deployed in your BioMA platform.

Configuring the modelling solution

Once you have selected the modeling solution to run, you must configure the model with the input data sources and specify the output format.

To configure the model:

1 After selecting **WOFOST** as the **Modeling solution**, the configuration items are shown, which are specific for that modeling solution:



2 Configure the modeling solution by selecting a **Value** for each **Configuration Item**, as described in the table that follows. (Click the yellow field in the **Value** column, then select the proper item from the dropdown list).

Table 1 WOFOST model configuration items

Configuration Item	Possible values and description
Check preconditions	Set this value to **Enable**, to automatically perform a check before running the simulation.
Simulation configuration	Please, before configuring this item, set the **Weather Configuration** (that is, the data source to use) so as to make available the years to select. (See below for instructions). The **Simulation configuration** item allows setting the time frame and the location to run the simulation for. Select the proper value from the dropdown list, then set the sub-values. The following shows an example where **Daily step with start year** has been selected as the main item: • **Start Year** - 2006 • **Start Year Doy** - 1 • **Number of Years** - 2 • **Location ID** - 30048. This is the location you will run the simulation for. Furthermore, this item allows accessing the **Location selector** tool. For futher information, see “Using the Location selector” on page 31.

Table 1 WOFOST model configuration items

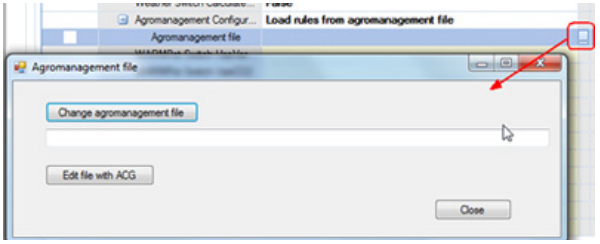
Configuration Item	Possible values and description
Agromanagement Configuration	The agromanagement file defines the chronology of the agromanagement practices, including sowing date and harvesting date. • From the dropdown list, select **Load rules from agromanagement file** to select the agromanagement file to use. • The **Agromangement file** item is displayed. Click the ellipsis button to display the following popup:  • Click **Change agromanagement file**, then, in the BioMA installation folder, browse to the **ParameterFiles** folder and select the **XML** file you want to use.
Weather configuration	The dropdown list includes the source database from which weather input data are taken:
	Morocco weather: Select this item to run the simulation using the real weather saved in a remote portable database. The following item will be enabled:
	• **Connection** - It allows selecting the provider and the source database. Double-click the row, then select **SQLServer CE DB** from the dropdown list to locate the weather data source. See “Establishing the Internet connection to the database:” on page 29 for detailed instructions on how to proceed.
The **Configuration items** that follow are the modelling solution’s switches, that is, the options that the modeller can set to enable (**True**) or disable (**False**) an optional component or to change the internal behaviour of a component.	
Weather Switch Calculate evapotranspiration	Set it to **True** to calculate the value of the daily evapotranspiration. If it is set to **False**, the model uses the evapotranspiration read from the weather source.
Weather switch Calculate VPD	Set it to **True** to calculate the value of the daily vapour pressure deficit. If it is set to **False**, the model uses the VPD read from the weather source.

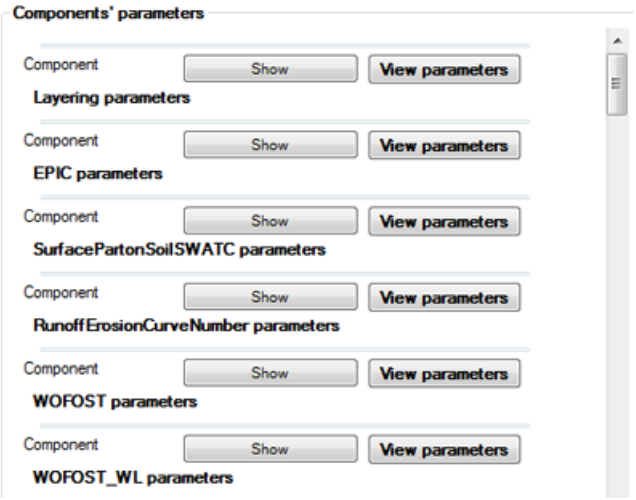
Table 1 WOFOST model configuration items

Configuration Item	Possible values and description
Weather switch Calculate Humidity	Set it to **True** to calculate the value of the daily maximum and minimum relative humidity. If set to **False**, the model uses the humidity read by the weather source.
Soil data configuration	This component provides the soil data to the other components. The dropdown allows connecting to a data source to get a set of soil data for a specific location. Select **Read soil data from DB**, the following field is displayed: • **Connection** - Being a remote database, it requires an Internet connection. Double-click the row, then select **SQLServer CE DB** from the dropdown list to locate the database you want to connect to. See “Establishing the Internet connection to the database:” on page 29 for detailed instructions on how to proceed.
SoilT Switch Enable SoilT	Set it to **True** to include the soil temperature optional component in the modelling solution. If this component is included, the modeller must configure its parameters before running the simulation.
SoilRE Switch Enable SoilRE	Set it to **True** to include the soil runoff and erosion optional component in the modelling solution. If this component is included, the modeller must configure its parameters before running the simulation.
WOFOSTComponent Switch UsePhotoPeriod	Set it to **True**. This switch allows users to activate or deactivate the simulation of the impact of daylength on development rate, via a modulation effect on thermal time accumulation rate. This option is useful in case of species/ varieties sensitive to photoperiod.
WOFOSTLimitedComponent Switch Enable water limitation	Set it to **True**. The WOFOST Limited Component calculates the water limited crop simulation by using the soil water content calculated by the soil water component.
LeafWetnessComponent Switch Select leaf wetness strategy	This switch allows setting the strategy to be used for calculated the leaf wetness, which is a requisite to calculate the plant disease. From the dropdown list, select **CART**. (For further information, on these strategies, please refer to the LeafWetness documentation).
DiseaseProgress Switch Enable disease component	Set it to to **True** to include the disease damage optional component in the modelling solution. If this component is included, the modeller must configure its parameters before running the simulation.

Table 1 WOFOST model configuration items

Configuration Item	Possible values and description
DiseaseImpactsOnPlants Switch Enable disease impacts on plant	Set it to **True** to include the disease impact on plants optional component in the modelling solution. If this component is included, the modeller must configure its parameters before running the simulation.
Iteration values	You can iterate the simulation over more configuration item's values (in particular, for the Simulation Configuration's **Location ID** and **Year** items). Here are displayed the items you enabled the iteration for. (For further information, see "Iterating over multiple item values" on page 27).

3 Once you are finished with the model configuration, in the **Components' parameters** panel at the right of the window, the parameters are displayed:



The parameters of the model are grouped by the component of the model which they belong to. In this example, the **Components' parameters** panel includes several **Components**:

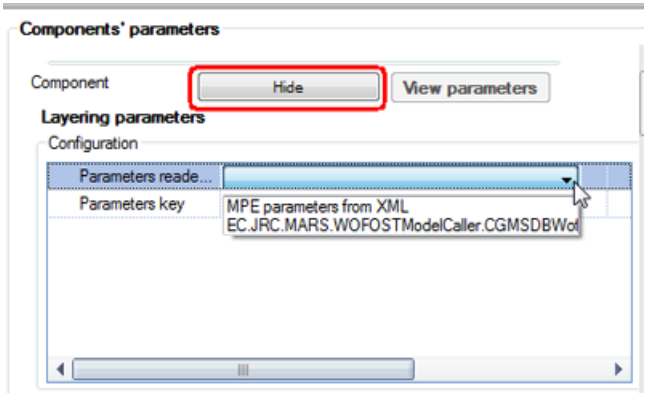
Component parameters	Description
Layering	These components calculate the soil moisture content.
EPIC	

Component parameters	Description
SurfacePartonSoilSWATC	This component calculates the soil temperature starting both from the weather data and the soil composition parameters.
RunoffErosionCurveNumber	This component calculates the soil runoff erosion.
WOFOST	This component performs the crop growth simulation in potential conditions.
WOFOST_WL	This component performs the crop growth simulation in water limited conditions.
ContextResistance	These components are used to simulate the crop disease infection.
DiseaseSimulation	
LinearCO2BasedModelC	This component is used to simulate the impact of disease on the simulated crop's properties.

Note:

These components depend on the modelling solution that has been loaded. Components could change if, for example, either a different soil module or configuration is embedded in the modelling solution.

4 Click the **Show** button next to the first **Component** to display the relevant parameters. The button changes to **Hide** and the configuration parameters are displayed:



5 From the **Parameters reader** dropdown list, select **MPE parameters from XML**. The **XML file** field will be displayed.

6 Browse to locate your BioMA Spatial installation folder, locate the **ParemeterFiles** folder, then select **`UNIMI.SoilW_Layering.xml`** as the **XML file**.

7 Repeat the same for the other **Components**, but specify the following as the **XML file**:

Component	Parameters reader
EPIC parameters	**XML file**: CropML_WOFOST_EvapCropSyst.xml
SurfacePartonSoilSWATC parameters	**XML file**: UNIMI.SoilT.Strategies.Composite_SurfacePartonSoilSWATC.xml
RunoffErosionCurveNumber parameters	**XML file**: UNIMI.SoilRE.Strategies.Composite_RunoffErosionCurveNumber.xml
WOFOST parameters	**XML file**: Parametri WOFOST.xml
WOFOST_WL parameters	**XML file**: Parametri WOFOST.xml
ContextResistance parameters	**XML file:** JRC.MARS.Diseases.Airborne.DiseaseProgress.Resistance_ContextResistance.xml
DiseaseSimulation parameters	**XML file:** JRC.MARS.Diseases.Airborne.DiseaseProgress.Strategies_DiseaseSimulation.xml
LinearCO2BasedModelC parameters	**XML file**: JRC.MARS.Diseases.Airborne.ImpactsOnPlants.Strategies_LinearCO2BasedModelC.xml

In all cases, the **Parameters key** field will be automatically filled.

Note that the files proposed here are suitable for the simulation run within the E-AGRI project, but can be edited or replaced according to the need of the modeller.

Note:

The **View parameters** button allows displaying the **Models Parameter Editor (MPE)** for you to view and edit the parameters before launching the simulation.

MPE can be used as a BioMA plugin, or as a standalone tool to load specific parameters definitions as XML files, which were created using the **Domain Class Coder (DCC)** application. (Access the **DCC Help** here http://bioma.jrc.ec.europa.eu/dcc/help)

To launch **MPE**, click the  button on the Spatial toolbar. For information on how to use it, refer to the integrated **Help** that you can access by clicking **> MPE User Guide** from the MPE menu bar.

When finished, validate your configuration:

1 In the BioMA-Spatial toolbar, click **Validate values**  to validate the configuration. There are two possible scenarios:

- If everything is OK you will see the green **Validation succeeded** message.
- If errors are detected, a popup is displayed with a description (missing/wrong field values) along with the **Error during validation** message.

2 Correct the errors, if any, and repeat the validation.

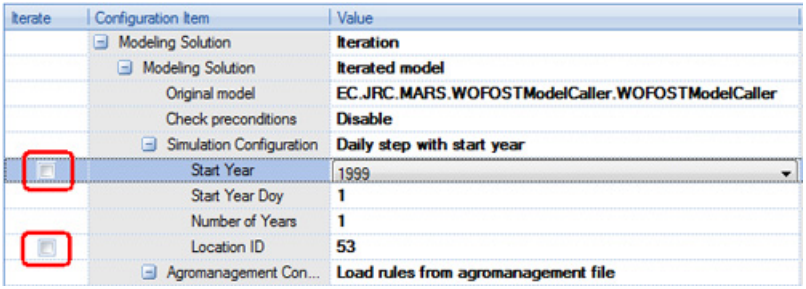
See also:

- “Iterating over multiple item values” on page 27
- “Using the Location selector” on page 31

Iterating over multiple item values

You can iterate the simulation over more configuration item's values (if the option is available). In particular, this function is available for years and locations.

The following shows an example where a specific year for the simulation has been choosen:



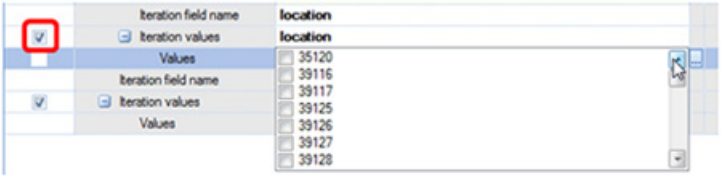
Note:

For the sake of this guide, we have choosen a specific year. However, users can choose other ranges of dates (start and end date, or start and number of years, and so forth) accordingly to their needs.

In this example, we want to iterate over more **Locations**:

1 Select the **Iterate** checkbox in the left most column next to the **Location ID** Simulation Configuration's item.

As a result, the **Iteration field name** item will be displayed showing the selected configuration item (**location**).



2 Click next to **Values**, in the **Value** column, to display the dropdown list that allows selecting multiple values. The list includes the available values for the selected model.

3 Select the desired location IDs from the list. To see which geographical locations are associated with the IDs, click the ellipsis button in the third column and use the **Location selector**.

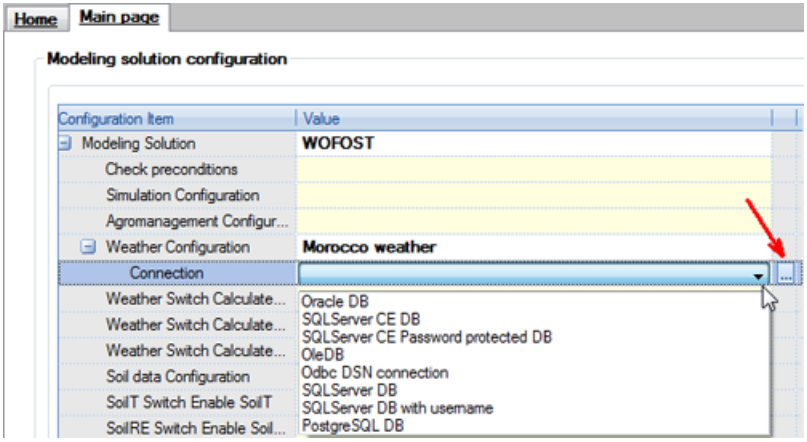
See also:

- “Using the Location selector” on page 31

Establishing the Internet connection to the database:

To estabilish the connection:

1 After selecting a remote database as the **Weather Configuration**, click the **Value** column next to **Connection**. A dropdown list is displayed:

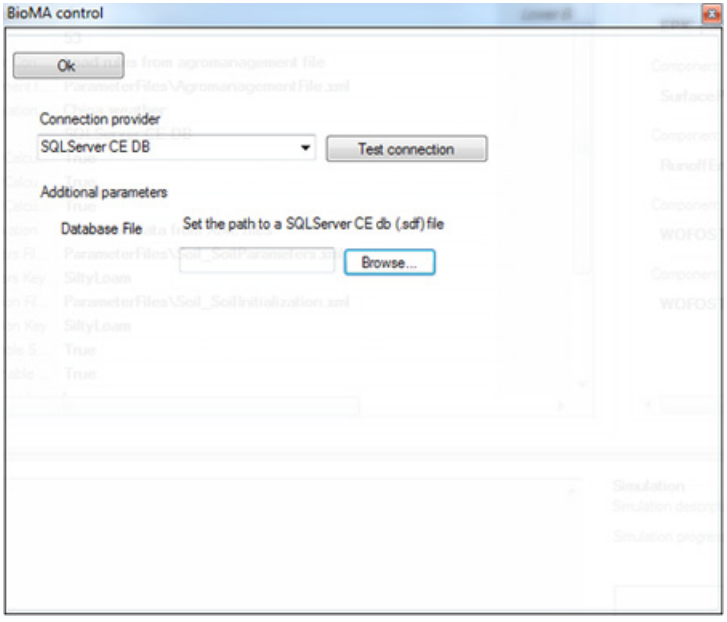


Note that in the third column, an ellipsis button is also displayed (as indicated by the arrow).

2 Select from the dropdown list the kind of database you want to connect to:

- **Oracle DB**: Connects to a database Oracle.
- **SQLServer CE DB**: Connects to a SQLServer CE portable DB.
- **SQLServer CE Password protected DB**: Connects to a password-protected SQLServer CE portable DB. The password to access the data is a mandatory field of the configuration.
- **SSQLServer DB**: Connects to a SQLServer database using the Windows account as the access credential.
- **SSQLServer DB with user name**: Connects to a SQLServer database with a User/Password account.
- **SPostgreSQL DB**: Connects to a PostgreSQL database Select one of the database types (e.g., SQLServer CE DB).

3 Click the ellipsis button on the third column to display a popup window whose contents depend on the database you selected. In the following example, the **SQLServer CE DB** database has been selected:



4 Here you can configure the connection to a specific database. In this case, click the **Browse** button, and then select the **WeatherMorocco.sdf** portable database file that contains the weather data.

5 Click the **Test connection** button to ensure that everything is working.

See also:

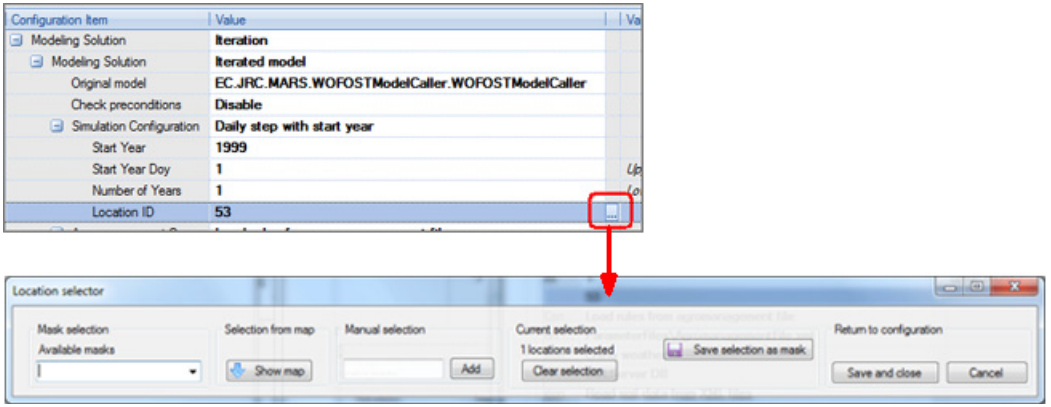
- “Iterating over multiple item values” on page 27
- “Using the Location selector” on page 31

Using the Location selector

When configuring the Modelling Solution, the **Location ID** Configuration item allows selecting the location(s) you want to run the simulation for.

1 Set a **Value** for the **Simulation Configuration** Configuration item, then do one of the following:

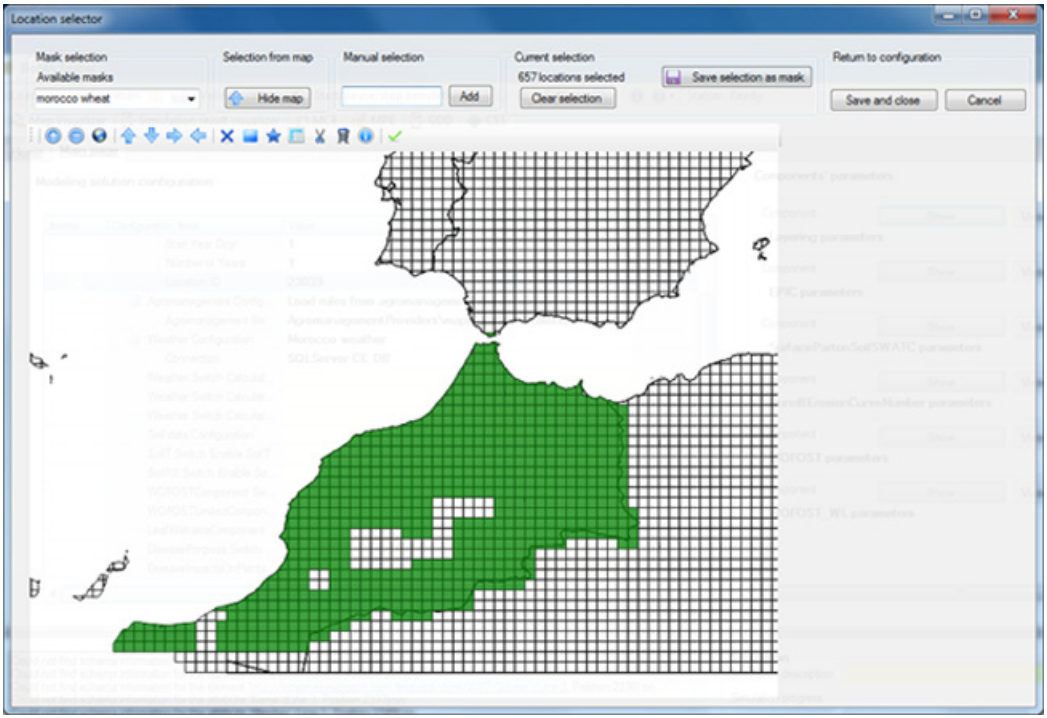
- Select a **Location ID** from the dropdown list in the **Value** column. The dropdown listsi the available IDs according to your selections.
- Click the ellipsis button to select the geographical locations on a map, as shown below:



2 The **Location Selector** window that is displayed allows to view and select the locations by doing one of the following:

- In the **Mask selection** area, select a locations set from the **Available mask** dropdown list.
- In the **Manual selection** text box, enter a grid code for a specific locations set and then click **Add**.

3 Click the **Show map** button to display a map showing, in green, the locations set you selected:



Note that the button's name changes to **Hide map** and a toolbar is displayed, which allows you to further manage your selection(s):

Buttons	Function
	**Zoom** buttons - Allow magnifying, reducing, and viewing the whole map, respectively.
	**Move** buttons - Allow moving the map up, down, right, and left, respectively.
	**Select** buttons - Allow selecting a single grid, a group of grids (based on a rectangle, and a group of grids based on a polygon, respectively. Drag to select the cells.
	**Add selected items from query** - It allows opening the selection form. (For further information on how to fill the selection form, please refer to "Using Map Data Visualizer to view the simulation results" on page 39).
	**Deselect** buttons - Allow deselecting specific or all selected grids, respectively. To deselect a specific set of grids, drag to highlight the desired area, and then double-click it.
	**Inspect values** button - Allows displaying information on the selection (e.g., the grid code). Click the button and then click the selection you want to see the information about.
	**Save and close** button - Allows saving the current selections and closing the form.

 The buttons are toggle: to quit a function, click the button again.

4 When you are done with selection, there are two possible scenarios:

- Click **Save selection as mask** if you want to save a newly created locations set. You will be prompted to enter a name for the set.
- Click **Save and close** to save the settings and return to the model configuration. (Click **Cancel** to return to the model configuration without saving the selection.)

In the **Location** Configuration item, the ID of the selected location will be displayed.

Configuring the persisters

The persister must be configured before starting the simulation.

The persisters are the BioMA tools which are used to save the simulation results in a persistence form (that is, a database or a textual file).

The following persisters are deployed by default in the BioMA installation:

- **XML persister** - Saves the simulation results in XML format (to be read by the **Simulation result visualizer** plugin).
- **DB persister** - Saves the simulation results in a database.
- **Persister for GDD** - Saves the simulation results so as to be able to open it with the Graphic Data Display (GDD) tool.
- **Save to Access and aggregate for CST** - Saves the simulation results into an Access database, then launches the data aggregation that is required for the CST (CGMS Statistical Toolbox) functioning.

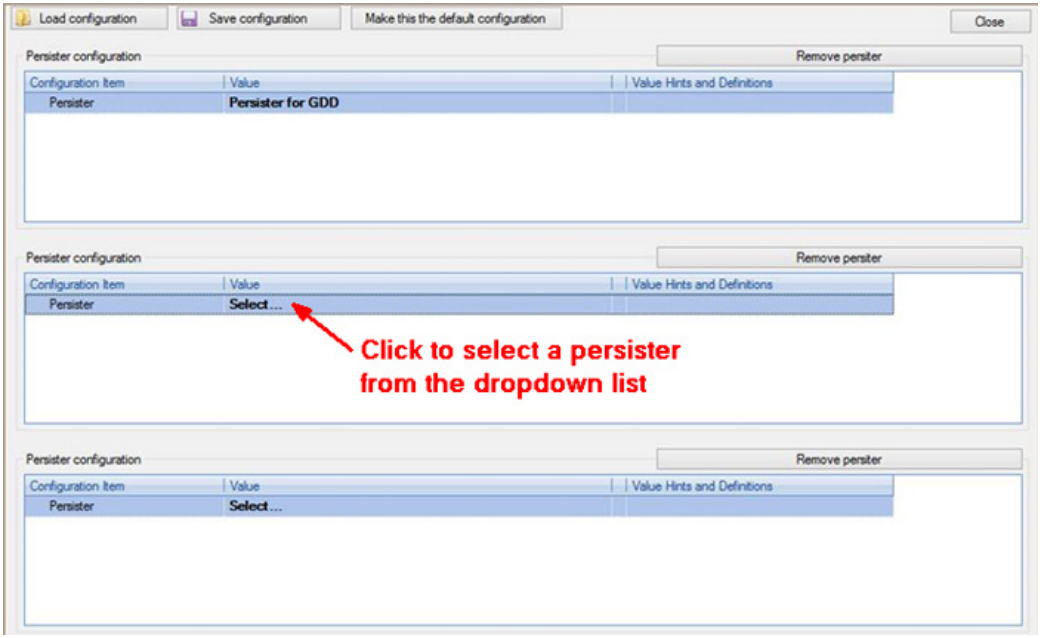
However, the user can create and deploy its own persister(s).

To configure the persisters:

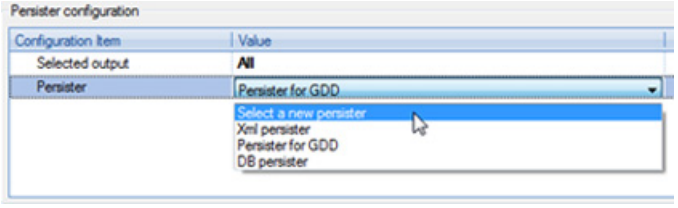
1 Do one of the following:

- In the BioMA main menu, click the **Settings**  button and then select **Persisters** from the dropdown menu.
- In the **Simulation** panel, at the bottom-right of the BioMA window, click **Persisters configuration**.

The **Persisters configuration** window is displayed that allows you to set up to four persisters at the same time:



2 Click **Select...** to display the dropdown list, then choose how you want to save your simulation results:



You might use the default configurations or deploy your own persisters. You can configure up to four persisters.

3 Depending on your selection, specific configuration items are displayed for you to set, as it is described in the following:

- If you select **XML persister**:

Configuration Item	Description
Directory	Specify the folder where to save the file(s).
File name prefix	Specify the file prefix.

- If you select **Persister for GDD**, you will be able to retrieve the configuration file from the **Graphic Data Display** application (for further information, go to http://bioma.jrc.ec.europa.eu/GDD/help/ to access the **GDD Help**).
- If you select **DB persister**:

Configuration Item	Description
Mapping file path	The XML file that allows matching the columns of the table coming from the model and the columns of the database tables.
Connection	Select the database type. After the selection of the database type, configure the connection to the specific database. For information on how to do it, see “Establishing the Internet connection to the database:” on page 30.
Save rules	Select how to save the data. You can use this setting to filter the number of records that will be saved in the database.

- If you select **Save to Access and aggregate for CST**, the configuration items for connecting to the Access database will be automatically displayed. Do not change these items.

See also:

- “Choosing and configuring the modeling solution” on page 18
- “Configuring the persisters” on page 34
- “Running the model simulation” on page 37

Running the model simulation

Prerequisites:

- You have chosen, configured, and successfully validated the modeling solution to run (by clicking on **Validate values**). See “Choosing and configuring the modeling solution” on page 18.
- You have configured the persisters, that is, you have specified how the simulation results will be saved. See “Configuring the persisters” on page 34.

To run the simulation:

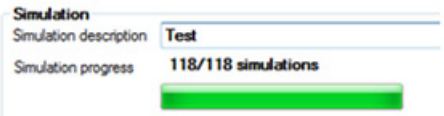
1 In the **Simulation** area at the bottom-right of the BioMA window, enter a **Simulation description**.

2 In the BioMA main menu, click 

to launch the simulation.

Note that during the simulation, two activities are carried on:

- The messages from the modeling solution code (e.g., errors, progress status) are shown in the **Log** window at the top-left.
- In the **Simulation** area the **Simulation progress** is shown:



3 Ensure that the **End of the simulation** message is displayed in the **Log** window and no errors are detected.

4 Analyze the results of the simulation by using one of the BioMA plugins, that is **Map Visualizer** or **Simulation Result Visualizer**.

Related topics:

- “Using Map Data Visualizer to view the simulation results” on page 39
- “Using Simulation Result Visualizer to view the simulation results” on page 41

Saving and loading a configuration

Saving a configuration

When you are finished with the model configuration (see “Choosing and configuring the modeling solution” on page 18), it is possible to save the configuration into a file, so as to avoid rebuilding it many times.

To save the configuration:

1 In the main menu, click the save button 

.

2 In the **Save a configuration file** window that is displayed, enter a **File name**.

3 Click **Save**. The file will be saved as a BioMA configuration file (*.BCF file) that you will be able to re-load, as it is described in the section below.

Note: By default the file will be saved in the **BiomaConfigFiles** folder, but you can choose another directory.

Loading a pre-saved configuration

It is possible to open and run a configuration that was previously saved.

To load a configuration:

1 Click the load button 

.

2 In the **Open a Bioma configuration file (.bcf)** window that is displayed, select the desired file. The available files depend on your BioMA installation.

3 Click **Open** to return to the BioMA **Main page** where the selected model configuration will be displayed.

Related topics:

- “Using Map Data Visualizer to view the simulation results” on page 39
- “Using Simulation Result Visualizer to view the simulation results” on page 41

Using Map Data Visualizer to view the simulation results

After running a simulation, you can use the **Map Data Visualizer (MDV)** BioMA plugin to view the results.

MDV allows inspecting and visually analyzing the outputs of simulations through graphs and maps, as well as displaying values for specific areas as time series.

MDV can be used in two ways: as a **BioMA-Spatial plugin**, or as a **standalone component**. However, the functioning is exactly the same.

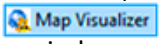
To access the MDV Help:

MDV has its own User Guide, which you can access by selecting  **(Help) > User Guide** from the tool's menu bar.

Alternatively, to access the Web-based version of the Help click here.

Using Map Data Visualizer as a BioMA plugin

To launch MDV:

1. After running the simulation (see "Running the model simulation" on page 37), click the 

button in the BioMA toolbar. The **Map Data Visualizer** window pops up.
2. Select a **Work Set** from the dropdown list. This defines the database to query and the typology of data.
3. The MDV features allows you to:
   - Change the legend to apply to the map
   - Change the colors of the map
   - Customize the map layout by adding information
   - Save the legend settings for a later re-use
   - Export the map to different file formats
   - Use the controls to navigate, inspect, and zoom the map
   - Draw a graph of specific geographical elements
4. For detailed instructions on how to use each feature, from the menu toolbar of MDV, select  (**Help) > User Guide**.

See also:

- "Choosing and configuring the modeling solution" on page 18

Using Simulation Result Visualizer to view the simulation results

After running a simulation, you can use one of the BioMA plugins to analyze the results. In this section, is described how to view the results graphically.

The **Simulation Result Visualizer** allows viewing the result of a simulation in a table for analysis purposes.

You can then export the table in a comma-separated values file (CSV) that can be opened in Microsoft Excel (see “Exporting the results to a CSV file” on page 44).

In this section:

Related topics:

- “Using Map Data Visualizer to view the simulation results” on page 39

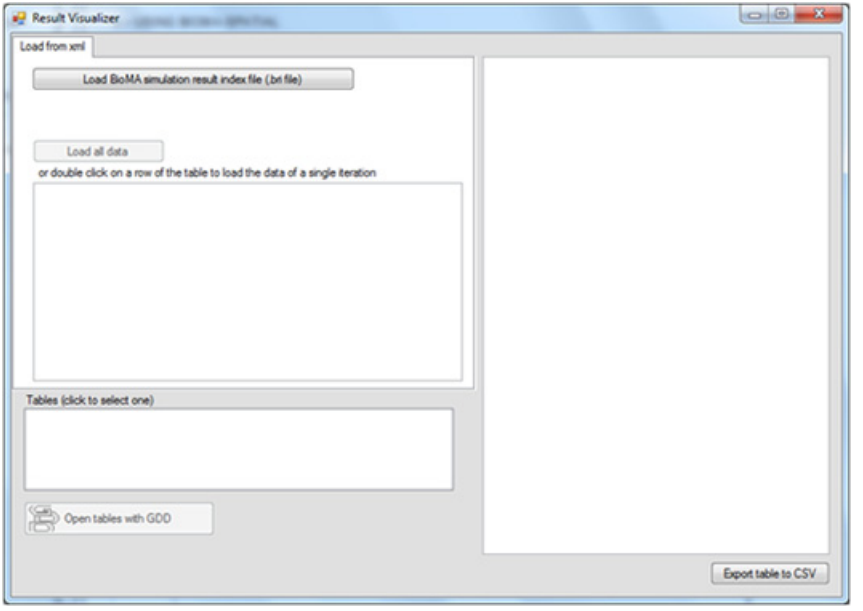
Launching the Simulation Result Visualizer from BioMA Spatial

Prerequisite:

You have configured the **XML persister**, which allows saving the simulation results in XML format to be read by the **Simulation Result Visualizer**. See “Configuring the persisters” on page 34 for further information.

Procedure

1 After running the simulation (see “Running the model simulation” on page 37), click the **Simulation result visualizer** button in the BioMA toolbar. The **Result Visualizer** window is displayed:



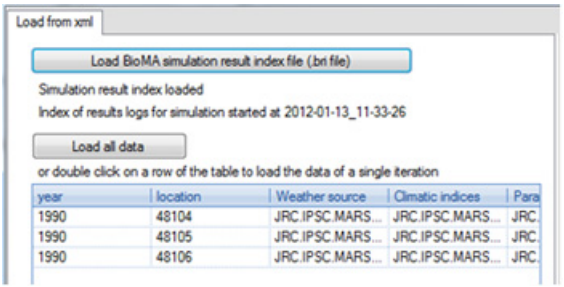
2 Click the **Load BioMA simulation result index file (.bri file)** button.

3 In the window that is displayed, select the simulation result file you want to analyze. Note that:

- The simulation results are stored in the [*BioMA installation directory*]/`ResultLogs` directory as files with `.bri` extension (`BioMA Result Index` files).

- The name of the file contains: the name of the model, the simulation ID and the date/hour when the simulation was started. **Example**: The file `ResultIndex_Model_WOFOSTModelCaller_SimId_17_starttime_2013-11-10_12-29-34_log.bri` is the simulation result of a WOFOST model, simulation ID 17, started at 12:29, 10/11/2013.

4 Click **Open**. As a result, the table on the left will be filled with the identifier of each iteration (on **year** and **location** columns) of the simulation:



5 Do one of the following:

- Double click on a row to show the result of a specific iteration.
- Click the **Load all data** button to load all the results.

The results are shown in the table on the right of the window.

6 You can now:

- Export the result file into a CSV file, as described below.
- Open the tables with the Graphic Data Viewer (GDD) plugin by clicking the button **Open tables with GDD** at the bottom-left. Go to http://bioma.jrc.ec.europa.eu/gdd/help to access the **GDD Help**.

Tip:

If the model output is stored in more than one data set (corresponding to a database table), select the table in the **Tables** pane at the bottom-left of the window. Note that, by default, the first one is selected.

Exporting the results to a CSV file

Do the following:

1 If the simulation has been executed on many locations/years, there are two possible scenarios:

- To export the results of each location/year in a different file, click on **Export table to CSV** to export the content of that specific table.
- To export the whole simulation result in a single file, click **Load all data** and than **Export table to CSV**.

2 In the window **Save a CSV file** that is displayed, enter a name for the file and click **Save**.

By default, the file will be saved into the `ResultLog` folder of your BioMA installation directory.

Related topics:

- "Launching the Simulation Result Visualizer from BioMA Spatial" on page 42

See also:

- "Choosing and configuring the modeling solution" on page 18
- "Configuring the persisters" on page 34
- "Running the model simulation" on page 37
- "Using Map Data Visualizer to view the simulation results" on page 39

Deploying plugins

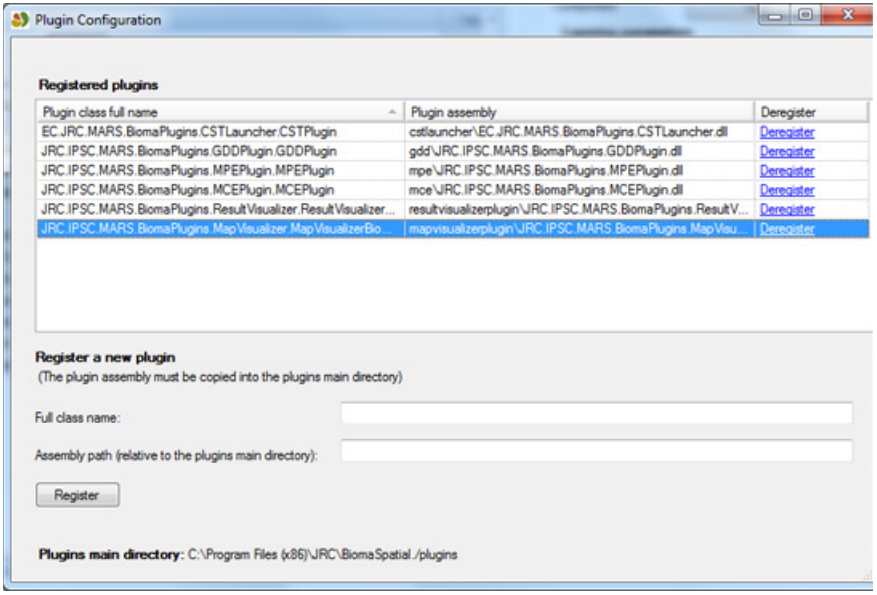
The BioMA graphical user interfaces can be extended by loading plug-ins.

To deploy a plugin:

1 Copy your plugin's software libraries into the `plugins` directory of the BioMA Spatial installation folder.

2 Click the  **Settings** button in the BioMA Spatial toolbar.

3 From the dropdown list, select **Plugin configuration**. The following is displayed:



The **Registered plugins** list includes all plugins already registered and functioning in BioMA Spatial, such as, **MPE**, **MCE**, and so forth.

4 To add the new plugin, enter its **Full class name** and the **Plugin assembly** path.

5 Click the **Register** button at the bottom of the window.

To de-register a plugin, click **Deregister** in the **Registered plugins** grid.