



European
Commission



Optimizer for parameters calibration



User Guide

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CONTENTS

Help contents

1

This Guide is targeted to the users of the BioMA Software Framework. In particular, this Help describes how to use Optimizer for parameters calibration. Advanced users can extend the tool for objective functions and solvers. Optimizer can be used with each modelling solution made available in BioMA.

The topics are organized as follows:

Topic	Contents
"About Optimizer" on page 5	<ul style="list-style-type: none">• Introduction to what Optimizer can be used for and who are its main target users• Overview of what models calibration is and how it works
"Installing and using Optimizer" on page 11	<ul style="list-style-type: none">• Prerequisites and installation procedure• How to use Optimizer for parameters calibration

See also:

- BioMA Framework User Guide (<https://agri4cast.jrc.ec.europa.eu/DataPortal/Index.aspx?o=s>)

About Optimizer

2

What Optimizer can be used for

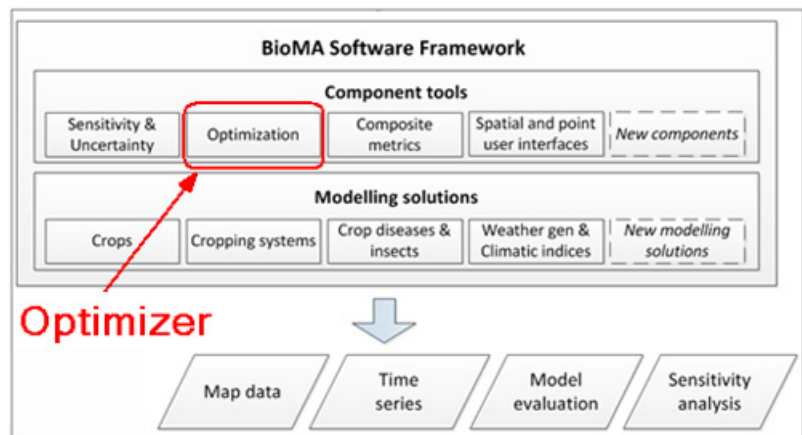
Optimizer is a BioMA framework component that allows calibrating models and it can be used with each modelling solution made available in BioMA.

The aim when working with models is to make the model describe the real world «as precisely as possible». This is what calibration is about.

In particular, Optimizer can be used for parameter calibration extensible for objective functions and solvers.

Optimizer can be used both as a BioMA plug-in and as a stand-alone application.

As an example, the following diagram shows the macro components of a BioMA deployment:



Main target users of Optimizer

- **Mathematicians** who use Optimizer to adapt/create new solvers or new objective functions.
- **Modelers** who create new modelling solutions.
- **Computer technicians** who develop selectors and/or Reference Data Readers.

What users can do

Optimizer allows you to use a solver of choice, an objective function of choice (e.g., minimizing simple and composite metrics), against a modeling solution of choice.

As an advanced user, you can extend the tool with news solvers and objective functions, which can be based on either simple or composite indices.

Furthermore, you can compose new metrics with the help of the IRENE component.

Related topics:

- “About models calibration” on page 7

About models calibration

The Optimizer library models the process of optimization, that is, it allows finding the minimum of an objective function value depending on a model output by varying the value of the model parameters.

In this process, three main entities are involved:

- A **Solver**, abstracting the task of exploring the parameters' space.
- An **Objective Function**, abstracting the task of calculating a cost function depending on some reference data and some estimated data.
- A **Model**, estimating data for a particular point in the parameters' space.

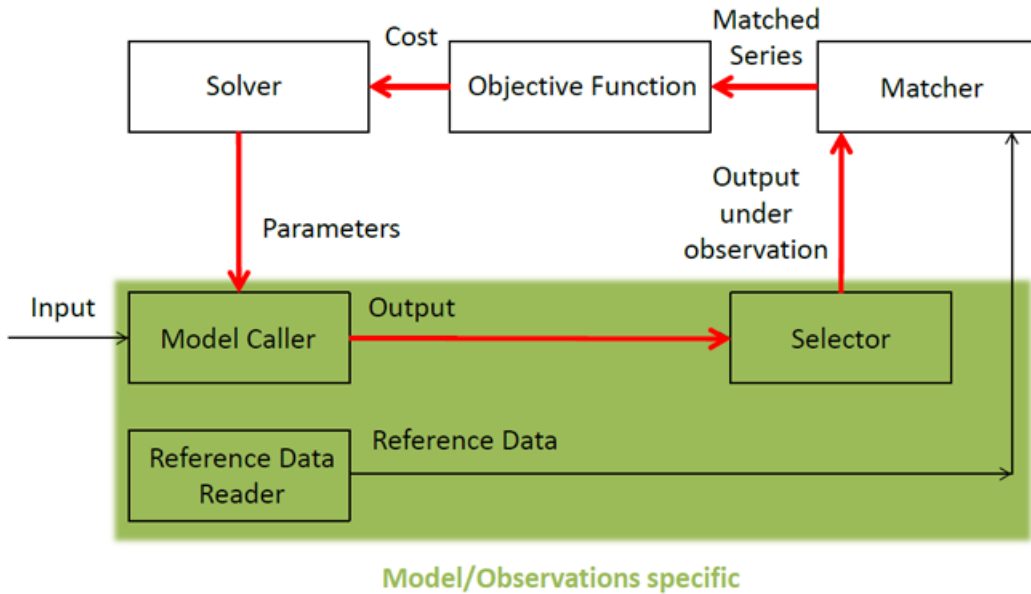
The Optimizer library is made available with sample Solvers, Objective Functions and Models to be optimized, but it can be extended with new solvers and objective functions. Models can be used by building a specific adapter.

Optimizer is distributed with a sample graphical user interface to manage the process of optimization. The implementation of the Model-View-Controller design pattern allows easily replacing the GUI with a custom one.

Optimizer can use the IRENE component that implements dedicated metrics for model evaluation and allows composing new metrics.

Calibration process workflow

The following schema illustrates the interaction between the optimization elements:



Schema description

Legenda:

Component	Description
Input	Parameters and input values determining the behaviour of the Model Caller
Model Caller	The component that calculates the output values that must be compared with the Reference Data
Output	The values calculated by the Model Caller
Selector	The component that further filters the Output values in order to meet the Reference Data formats
Output under observation	The outputs, calculated and filtered in the previous step
Reference Data Reader	The component that provides the values for the measured outputs (the Reference Data)
Reference Data	The measured values

Component	Description
Matcher	The component that correctly matches the outputs (calculated and filtered) with the measured values
Matched Series	The result of the Matcher's operation
Objective Function (Cost)	The cost function, that is, a number that summarizes the gap between the two data sets. The result (calculated number) is then passed to the Solver
Solver	The component that tracks the various values. It establishes how to change the parameters so as to find the minimum value in terms of difference between the two series (calculated and measured)
Parameters	The parameters that the Solvers selects if the minimum is not reached. These are sent to the Model Caller and the cycle is repeated until the Solver establishes the minimum for the Objective Function (or until the max. number of process iterations has been reached)

Workflow description

The schema describes the elements that are involved in the process of models' parameters calibration.

The parameters values, along with the input values, determine the behaviour of the **Model Caller**. This latter calculates the outputs values, which must be compared with the measured values of the homologous outputs matching the inputs that were used for outputs evaluation. The **Reference Data Reader** provides the values for the measured outputs.

The Model Caller's **Output** must be further filtered through the **Selector**, in order to meet the **Reference Data**'s format requirements. For example, you might have monthly-measured Reference Data and, at the same time, the Model Caller provides daily calculated outputs: in this case, the Selector's filtering process should consist in a monthly aggregation of the daily calculated data.

The **Matcher** component performs the next step, that is, it correctly matches the outputs (calculated and filtered in previous step) with the measured outputs. This step is not trivial as, considering the previous example, the data that refer to the calculated months must match the data relating to the respective measured months; alternatively, if you have measurements or evaluations that refer to different geographic areas, the data must match the same geographical areas and months. The

Matcher component carries out this matching, regardless of the key that identifies each record in the measured and calculated sets.

The further step consists in calculating a “cost function”, which summarizes the “gap” between the calculated and the measured sets. This “cost function” (**Objective Function**) is a number that summarizes the gap concept between the two sets. Its possible implementations are the mean-square error (or, e.g., the modelling efficiency), and other error measurements between the two numerical series.

The calculated number is then passed to the **Solver**, which is responsible for tracking the various values as these are assumed by the **Objective Function**. The solver “establishes” how to change the parameters in order to minimize the Objective Function, so as to find the best minimum value of the difference between the measured and the calculated series.

The **Solver** “establishes” whether or not the function has been minimized; if it has not, based on its own implemented algorithm, selects which new parameters values must be set for the **Model Caller**. Then, the cycle keeps iterating itself until the Solver establishes that the minimum for the **Objective Function** has been reached (that is, “convergence has been reached”), or until a stop condition occurs, that is, the maximum number of process iterations has been reached. This means that convergence has not been reached and the minimum value for the Objective Function was not found.

Relative topics:

- “Using Optimizer for models calibration” on page 16

Installing and using Optimizer

3

This topic is organized into the following sections:

- “Installing Optimizer” on page 12
- “Workspace overview” on page 13
- “Using Optimizer for models calibration” on page 16

Installing Optimizer

Prerequisites

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

Hardware prerequisites

- Operative system: Windows XP/Vista/7 (32 or 64 bit)

Software prerequisites

The following software must be installed on your computer:

- **NET 4.5 Framework** - To install it, go to <http://www.microsoft.com/net/>. Follow the product's documentation, if needed.

Regional Settings of your PC

Ensure that the Regional Settings of your PC are set as follows:

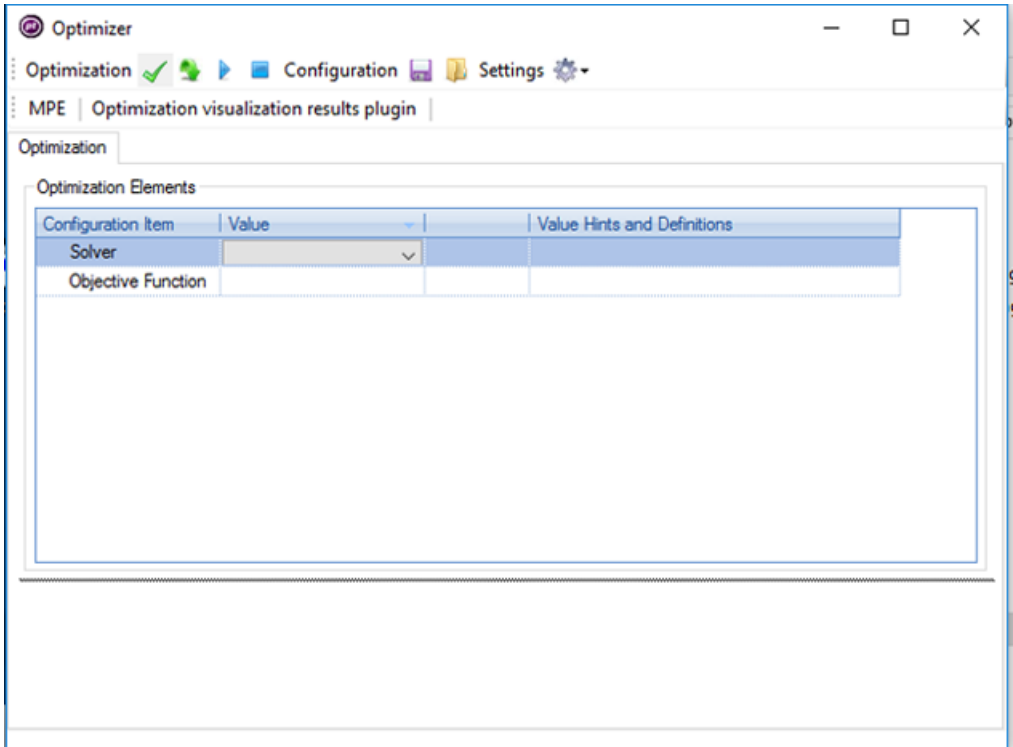
- 1 Access the Windows Control Panel (**Start > Control Panel > Clock, Language, and Region > Region and Language**).
- 2 In the **Region and Language** window, click **Additional settings**.
- 3 Be sure that the **Decimal symbol** is set to "point" (.).

Launching the application








- In the Optimizer installation folder, double-click the .exe file to launch the application.

Workspace overview

The following screenshot shows the main screen that is displayed after launching Optimizer (where no elements have yet been selected):



The following table describes the main workspace items:

Workspace item	Description
<p>Menu bar</p>	<p>Optimization - The buttons allow to:</p> <ul style="list-style-type: none"> •  Validate - It allows validating the selected values before starting the optimization. •  Reset - It allows canceling the current configuration without exiting the program. •  Start optimization - It allows launching the optimization process. •  Abort optimization - It allows canceling the optimization process. <p>(See “Launching the optimization” on page 36)</p> <p>Configuration - The buttons allow to:</p> <ul style="list-style-type: none"> •  Save configuration - It allows saving the current configuration for a future reuse. •  Load configuration - It allows loading an existing configuration. (See “Saving or loading a configuration” on page 32) <p>Settings  - It includes the following options:</p> <ul style="list-style-type: none"> • Deploy assembly - It allows adding a new modeling solution to be used (calibrated) in Optimizer. (For further information, see the BioMA Spatial User Guide) • Plugin configuration - It allows registering a new plugin in Optimizer. For further information, see “Registering a new plugin” on page 39. • Save results - If selected, the Result Persisters tab will be displayed, which allows configuring the persisters to save the results in a persistence form (that is, a database or a textual file). See “Configuring the persisters” on page 37. • Matching information log - If selected, the Optimizer Matching Log window is displayed, which allows viewing the computations performed by Optimizer, including the values of objective functions and parameters throughout the calibration steps.

Workspace item	Description
Optimization visualization results plugin	It launches the plugin that allows inspecting the behaviour of the used simplexes. See “Analyzing the optimization results” on page 41.
Optimization tab	It allows configuring the main elements based on which to run the optimization.
Optimization Elements	<p>Solver - It allows selecting from the dropdown list a mathematical method to be used to explore the parameters. For further information, see “Configuring the Solver” on page 17.</p> <p>Objective function - It allows selecting from the dropdown list a mathematical function. For further information, see “Configuring the Objective Function” on page 20.</p>

Related topics:

- “Using Optimizer for models calibration” on page 16

Using Optimizer for models calibration

To configure Optimizer for calibration you must select and configure the optimization elements, meaning:

- The **Solver**, that is the mathematical method that will be used to explore your parameters. A sample solver is provided with the tool.
- The **Objective Function**, that is a mathematical function, which is generally created either with IRENE (and then used in Optimizer through an adapter), or a newly created one.
- The **Modelling Solution**, that is a models composition, as it is extensively described in the **BioMA Spatial User Guide** here: <https://agri4cast.jrc.ec.europa.eu/DataPortal/Index.aspx?o=s>. You will then select the modelling solution parameters that you want to put under optimization.

For further information, see also “Calibration process workflow” on page 7.

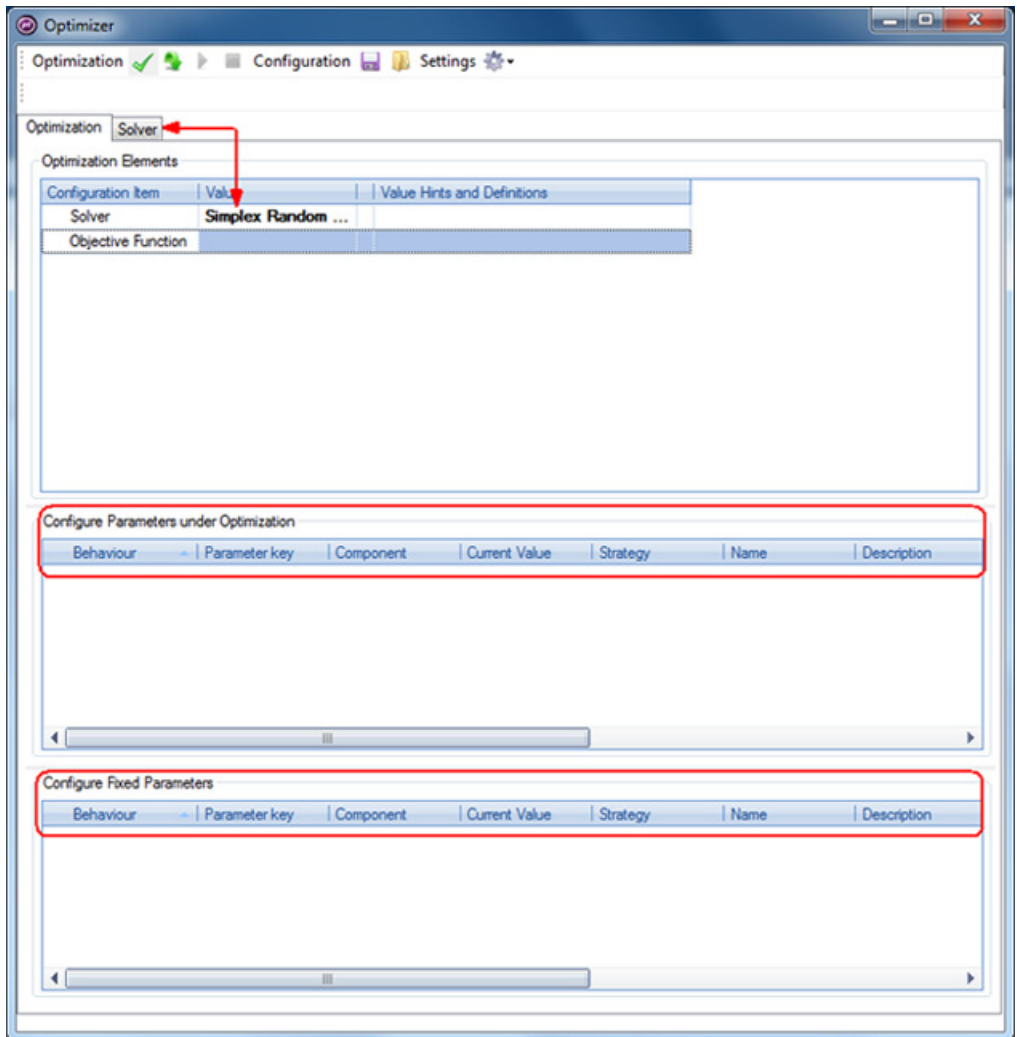
For detailed instructions:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Configuring the Reference Data Reader” on page 33
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Configuring the Solver

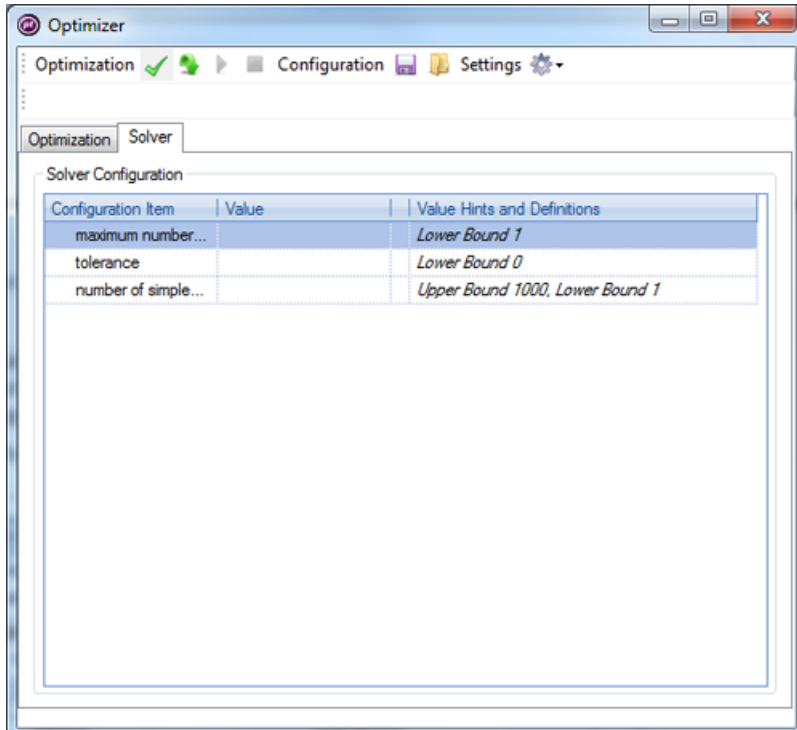
To configure the Solver:

- 1 From the **Solver** dropdown list that is displayed when clicking the **Value** column, select the mathematical method you want to use for calibration. After the selection, the window changes as follows:



Note that the **Solver** tab is displayed and, in the lower part of the window, the panes for parameters configuration are displayed.

- 2 Select the **Solver** tab:



- 3 Set each solver's **Configuration Item** by entering a **Value** in the text box. Values must be within the allowed range, as it is specified by the **Lower** and **Upper Bounds**.

Note that the available items depend on the solver you selected:

- **Maximum number of runs** - It allows specifying the maximum number of iterations that will be executed in the optimization process.
- **Tolerance** - The maximum allowed error for the point to be considered as the function local minimum.

- **Number of simplexes** - It only refers to specific solvers. It allows running more simplexes at once.
For example, when the optimization problem is complex and includes various local minima, by running more than one simplex you can explore a greater region of the parameters' hyperspace. This results in reducing the probability to find only a local minimum and increasing the probability to find the global minimum.

Related topics:

- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Configuring the Reference Data Reader” on page 33
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Configuring the Objective Function



What is this?

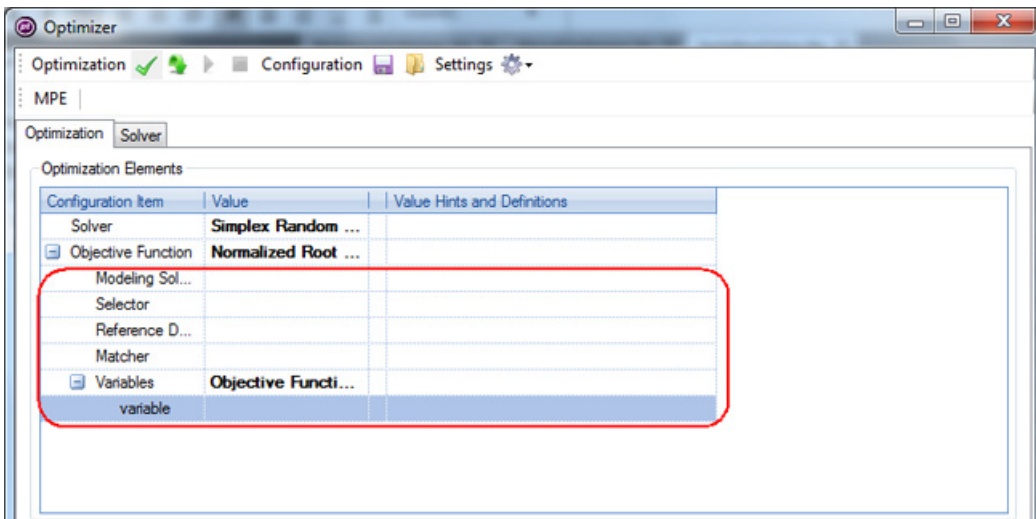
The component of the calibration process that measures the difference between the output data and the Reference Data, the touchstone that we want the model to reproduce with the calibrated parameters' values.

You can have as many Objective Functions as you want, as well as to deploy your own in Optimizer.

To configure the Objective Function:

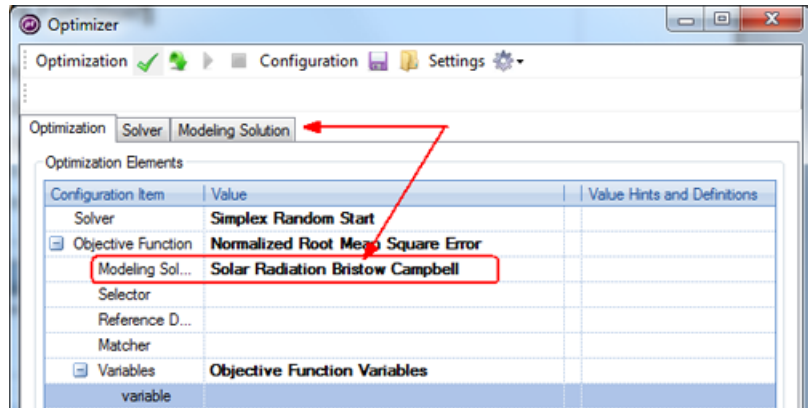
- 1 Go to the **Optimization** tab.
- 2 From the **Objective Function** dropdown list that is displayed when clicking the **Value** column, select the mathematical function that you want to use.

After making your selection, more parameters are displayed:



- 3 From the **Modelling Solution** dropdown list, under **Value**, select the solution you want to optimize.

Note that the **Modelling Solution** tab is displayed. (For further information, see “Configuring the Modelling Solution” on page 23):



- 4 Choose a **Selector** from the dropdown list.
The **Selector** is used to make the model outputs consistent with the Reference Data. For example, if the **Reference Data** consist in monthly data and the model's outputs in daily data, in order to compare them the Selector converts the model outputs into monthly data, as well.
- 5 Select a **Reference Data Reader** from the dropdown list. The **Reference Data** tab will be displayed. (For further information, see "Configuring the Reference Data Reader" on page 33).
- 6 Select a **Matcher** from the dropdown list.
This component is in charge of correctly matching the model's outputs with the measured outputs (Reference Data).
The dropdown list includes two possible options:
 - a. **Stochastic Matcher** - This matcher is used when calibrating a model that produces an output having the meaning of a random variable (e.g., a model producing the average daily values for the wind speed in a given region).
In cases like these, matching the corresponding elements of the observed and estimated series (as the Equality Matcher does) does not make sense: this is because the behavior to be reproduced with the stochastic model is, precisely, random. What must be reproduced by the model once calibrated, are some stylized characteristics of the underlying distribution. So the stochastic matching is to be used, by ordering both the reference data and the simulated data in descending order, then calculating the gap on

the ordered datasets. This way, the calibrated model will reproduce a values distribution rather than a time series.

- b. **Equality Matcher** - This matcher couples all the records of both datasets (observed data and simulated data) based on the data key. (E.g., if the Reference Data are based on Year, Location, and Day, the model's data must be coupled with the same data keys).

This matcher allows minimizing the distance, the key being equal, between the two datasets. In other words, you reproduce the same trend.

- 7 Set the objective function's **Variables** as required.

The Variables are the outputs that can be taken into consideration for the optimization. The Objective Function treats equally every couple of observed/estimated series (in this case, calculating the mean squared error). So, the **Variables** item allows to chose the model output on which to perform the calibration.

See also:

- “Configuring the Solver” on page 17
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Configuring the Reference Data Reader” on page 33
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Configuring the Modelling Solution

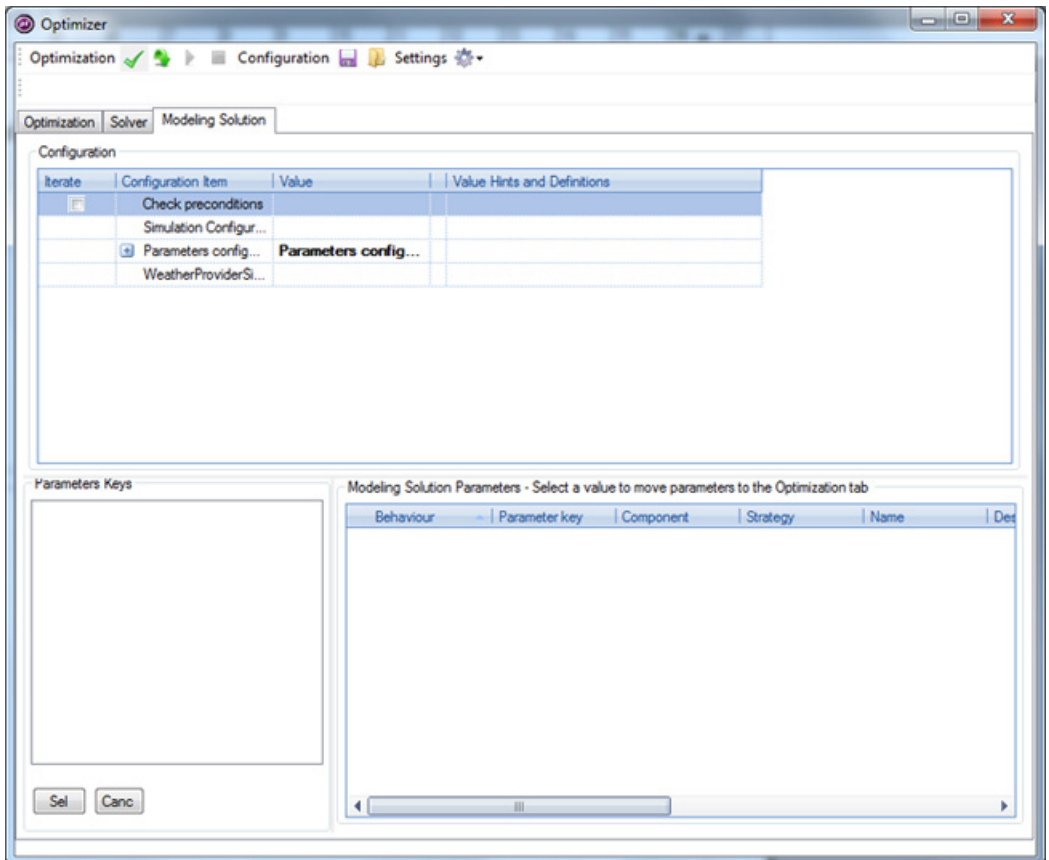


What is this?

In the example that follows, we use the **BristowCampbell Solar Radiation** modelling solution that allows calculating the solar radiation in relation to the temperature range, assuming a relationship between the range of daily temperatures and the transmissivity of the atmosphere. This relation is governed by a parameter that has to be calibrated.

To configure the Modelling Solution:

- 1 After selecting the **Modelling Solution** in the **Optimization** tab (see “Configuring the Objective Function” on page 20, Step 3), select the **Modelling Solution** tab that is made available:



- 2 Set the **Configuration Items** by selecting an option from the dropdown list in the **Value** column.



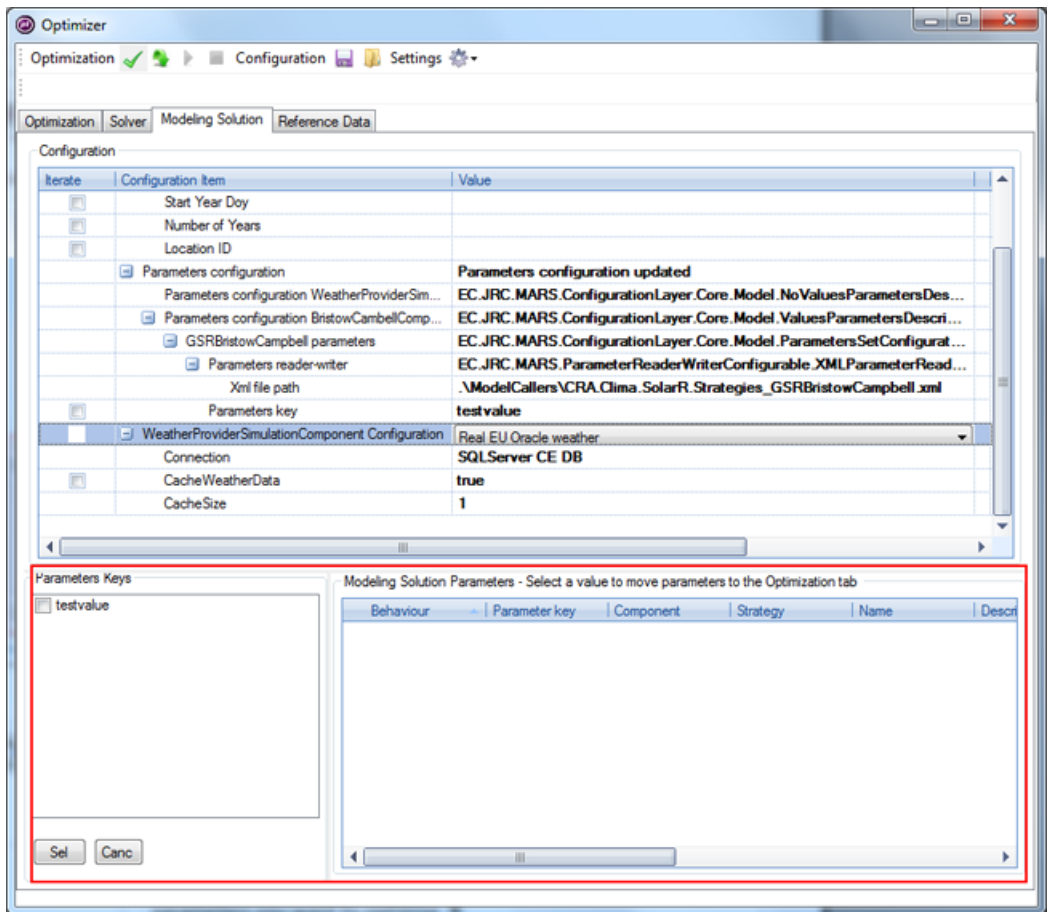
Tip:

For further information on how to configure Modelling Solutions, go to the Web-based BioMA Spatial User Guide, then navigate to the chapter “Using BioMA Spatial to run models simulations”.

- 3 The configuration items vary according with the selected Modelling Solution. However, the following item is commonly displayed:

Configuration Item	Possible values and description
WeatherProviderSimulationComponent Configuration	The source database from which weather input data are taken: Remote connection to MARS weather database: It allows running the simulation using the remote weather dataset.
	Real EU Oracle weather: It allows running the simulation using the real weather saved in a remote portable database.
	<ul style="list-style-type: none"> • Connection - Double-click the row, and select from the dropdown list the database you want to connect to in order to retrieve the weather data.
	<ul style="list-style-type: none"> • Cache weather - Temporary memory for the weather source. Double-click the field and set it to True.
	<ul style="list-style-type: none"> • Cache size - The dimension of the Cache weather.

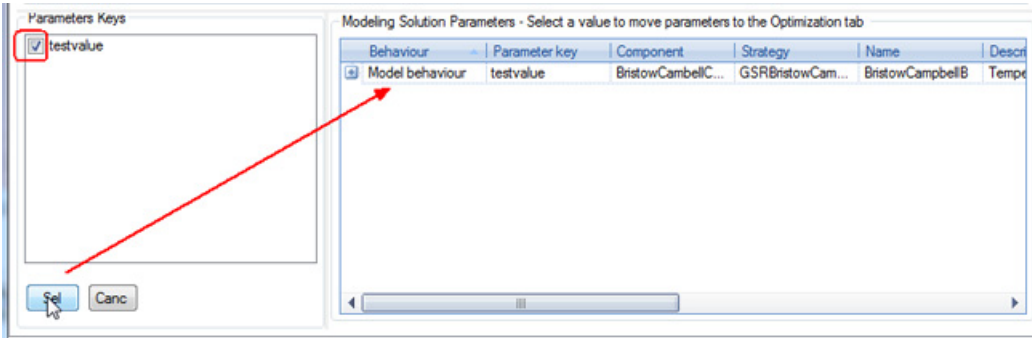
When finished with the items configuration, the **Parameter Keys** at the lower-left of the window lists the set(s) of parameters that you can put under optimization:



Tip:

For further information on how Parameters Keys are defined, please refer to the Model Parameters Editor User Guide.

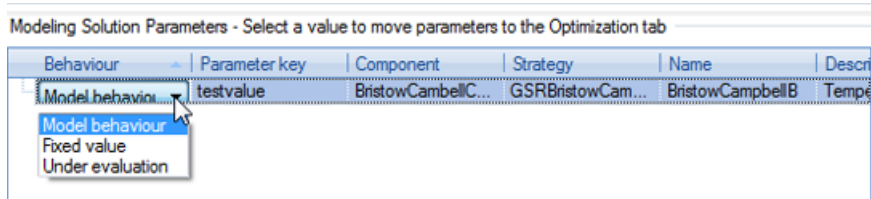
- 4 In the **Parameters Keys**, select the checkbox corresponding to the set of parameters that you want to optimize and then click the **Sel** button.



Note:

If you load an existing configuration whose parameters have already been optimized, these will not be displayed in the **Modelling Solution Parameters** pane. Rather, the parameters will be directly displayed in the Optimization tab. See “Configuring the Modelling Solution parameters” on page 27.

- 5 The **Modelling Solution Parameters** pane displays the selected **Parameter key(s)**. Click the **Model behavior** field to open the dropdown list:



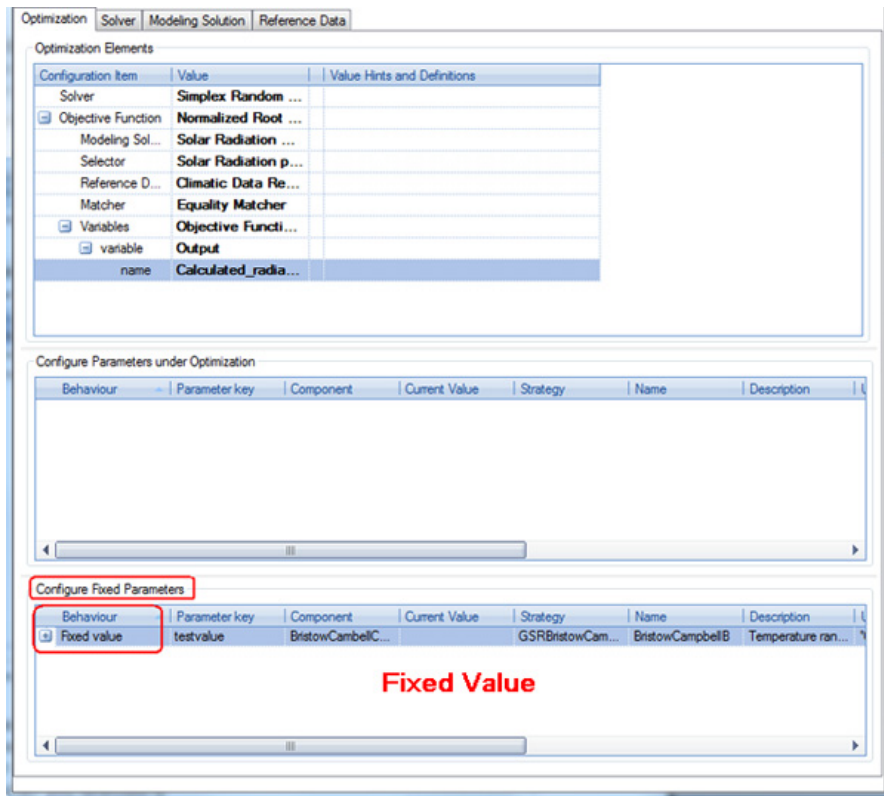
- 6 Select an option to set the parameters behaviour during the calibration process. The available options are:
 - **Model behavior** - This is the default value. The parameters will not be changed during the calibration process, that is, the model will manage the parameters as they are.
 - **Fixed value** - During the calibration process the parameters will keep a fixed value, which is configurable in the **Optimization** tab (see “Configuring the Modelling Solution parameters” on page 27).
 - **Under evaluation** - During the calibration process the parameters will be managed and changed by the **Solver**, according with the selections you made in the **Optimization** tab.

If either the **Fixed value** or the **Under evaluation** option is selected, the parameter set is moved to the **Optimization** tab where you can configure it. For detailed instructions, see the following section.

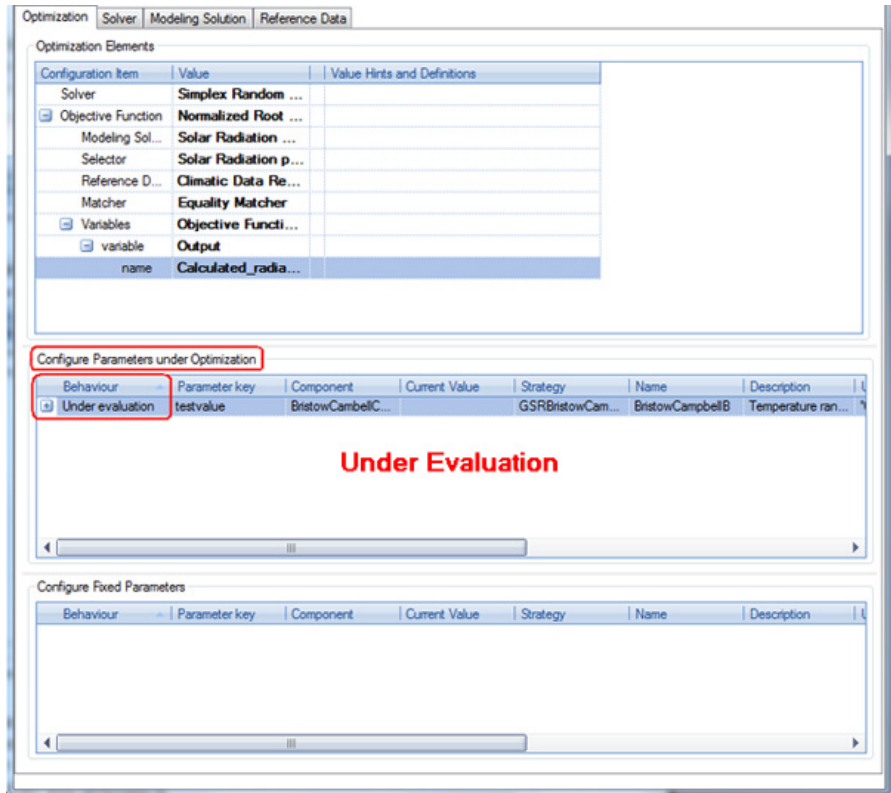
Configuring the Modelling Solution parameters

After selecting the parameters that you want to put under optimization, you can configure them.

- 1 Go to the **Optimization** tab.
- 2 There are two possible scenarios:
 - a. If in the **Modelling Solution** tab you selected the **Fixed value** option, the parameter(s) is moved to the **Optimization** tab, under **Configure Fixed Parameters**:

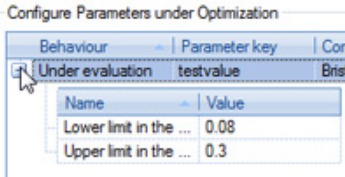
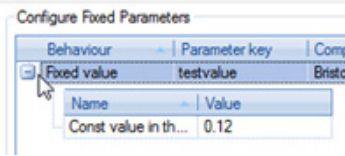


- b. If in the **Modelling Solution** tab you selected the **Under evaluation** option, the parameter(s) is moved to the **Optimization** tab, under **Configure Parameters under Optimization**:



3 To configure the parameters, use the following table as a reference:

Configuration item	Description
Behaviour	<p>The behaviour option that you selected when configuring the Modelling Solution. (See “Configuring the Modelling Solution” on page 23).</p> <p>Depending on your selection, by clicking the plus (+) sign next to the selected Behaviour, a dropdown opens that includes some configurable options:</p>

Configuration item	Description
	<p>Parameters under Optimization:</p>  <p>As previously described, the Under evaluation option specifies that the parameters will be managed and changed by the Solver. The Lower and the Upper limits in the parameters evaluation values determine the bounds between which the Solver will vary the parameters in search of the minimum.</p> <p>Fixed Parameters:</p>  <p>As previously described, the Fixed value option specifies a constant value that will not vary during the optimization process.</p>
Parameter Key	The set of parameters that you selected when configuring the Modelling Solution. (See “Configuring the Modelling Solution” on page 23).
Component	The component of the model which originates the parameters definition.
Current Value	The parameter's current value.
Strategy	The subcomponent which originates the parameters definition.
Name	The parameter's name.
Description	The parameter's description.
Units	The unit of measure that is used for the parameter value.
Default	The default value of the parameter.
Upper Bound	The upper allowed value for the parameter.
Lower Bound	The lower allowed value for the parameter.

Related topics:


- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Configuring the Reference Data Reader” on page 33
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Saving or loading a configuration


Once your configuration is completed, you can save it for a future reuse.

You can load a saved configuration in case you need to recalibrate a model, or if you want to execute the optimization process using a different solver or a different objective function.

To save a configuration:

- 1 In the Optimizer menu bar, click  (**Save configuration**).
- 2 In the **Save a configuration file window**, specify the folder and the name for the .OCF file.
- 3 Click **Save** to return to Optimizer.

To load a saved configuration:

- 1 In the Optimizer menu bar, click  (**Load configuration**).
- 2 In the **Open a Optimizer configuration file**, select the .OCF file you want to open.
- 3 Click **Open** to return to Optimizer where the selected configuration will be displayed.

Related topics:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
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Configuring the Reference Data Reader

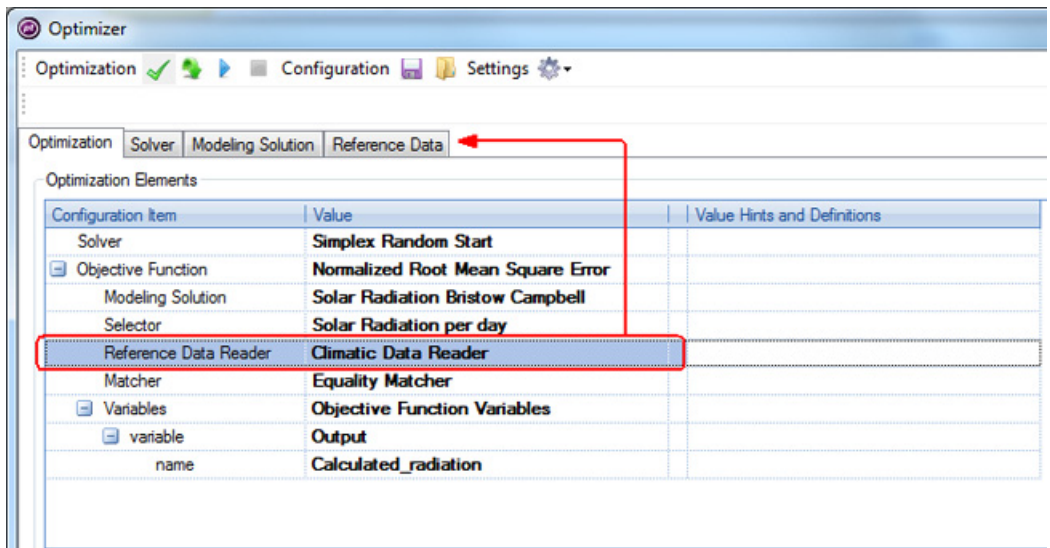
The aim when working with models is to make the model describe the real world «as precisely as possible». This is what calibration is about.

Reference data (that is, the observed data) are the touchstone that, at the end, we want the model to reproduce using the calibrated parameters' values.

If, for example, the aim of a model is to evaluate the solar radiation, the Reference Data could be composed by the solar radiation measures based on different locations, for several years. These data must be read from a database, which is called **Reference Data Reader**.

To configure the Reference Data Reader:

The **Reference Data** tab that allows configuring the reader, is displayed when you select an **Objective Function** in the **Optimization** tab (see “Configuring the Objective Function” on page 20):



- 1 Select the **Reference Data** tab. The following is displayed:

Configuration Item	Value	Value Hints and Definitions
<input checked="" type="checkbox"/> Weather source	Real EU Oracle weather	
Connection	SQLServer CE DB	
CacheWeath...	false	
CacheSize	0	
Location	77088	
Location label	Location ID	
Year	2001	
Year label	Start Year	

2 Configure the items using the following as a reference:

Configuration Item	Possible values and description
Weather source	The source database from which input data are taken: Remote connection to MARS weather database: It allows connecting to the remote weather dataset.
	Real EU Oracle weather: It allows connecting to the real weather data saved in a remote portable database.
	After making a selection, the following configuration items are displayed, which you must set:
	<ul style="list-style-type: none"> • Connection - Being a remote database, it requires an Internet connection. Double-click the Value column to open the dropdown list, then select the database you want to connect to. • Cache weather - Temporary memory for the weather source. Double-click the Value column to open the dropdown list, then select False. • Cache size - The dimension of the Cache weather.
Location / Location label	The Location item allows selecting the ID of the location you want to simulate. Double-click the Value column to open the dropdown list with the available locations. These depend on the weather source you have chosen.
	The Location label item allows selecting the identification label, which depends on the selected modelling solution.



Configuration Item	Possible values and description
Year / Year label	<p>The Year item allows selecting the ID of the year(s) you want to run the simulation for. Double-click the Value column to open the dropdown list including the available years. These depend on the weather source you have chosen.</p> <p>The Year label item allows selecting the identification label for the year, which depends on the selected modelling solution.</p>

Related topics:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Launching the optimization” on page 36
- “Configuring the persisters” on page 37
- “Registering a new plugin” on page 39
- “Analyzing the optimization results” on page 41

Launching the optimization

When you are finished with the configurations, do the following to start the optimization process:

- 1 In the Optimizer menu bar, click  (**Validate**). A popup will be displayed listing the configuration errors, if any, or confirming the correct configuration.
- 2 Correct any error, then click  (**Start optimization**) to launch the process.



Note:

The **Start optimization** and **Abort optimization** buttons are enabled after you complete your configuration.

- 3 If needed, click  (**Abort optimization**) to cancel the process.

Once the optimization process has been completed, a pane will be displayed listing the results for your review. You can save these results for a future reuse.

To save the optimization results, do one or both of the following:

- Save the results in a persistent format (database or .TXT file). See “Configuring the persisters” on page 37.
- Click the **MPE** button at the top-left of the window to launch the Model Parameters Editor component and save the results as MPE files. (For information on how to use MPE, please refer to the Model Parameters Editor User Guide).

Related topics:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
- “Configuring the Reference Data Reader” on page 33
- “Configuring the persisters” on page 37
- “Registering a new plugin” on page 39
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Configuring the persisters

To save the optimization results for a future reuse, you must configure the persisters, that is, how these results will be saved.

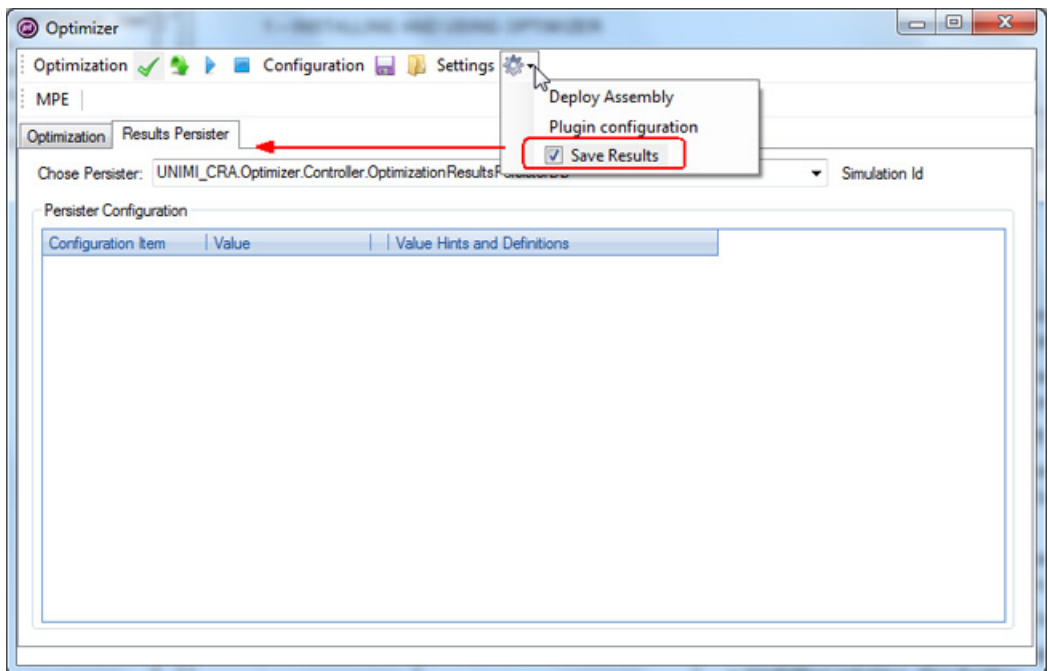


Note:

A default persister (database file) is provided with the application. However, it is possible to configure other persisters (i.e., other database files or new textual files). For this purpose a specific interface must be created.

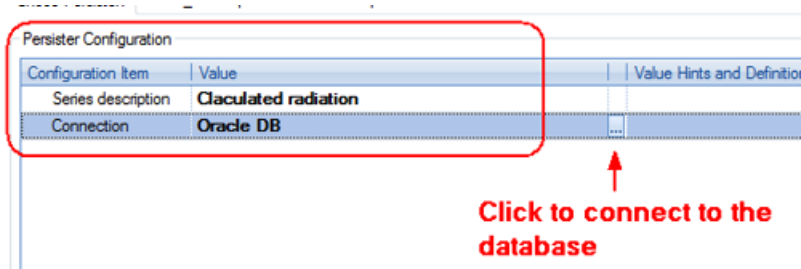
To configure the persisters:


- 1 In the Optimizer menu bar, click **Settings**.
- 2 From the menu, select the **Save Results** checkbox, then click the **Results Persister** tab that is made available:



- 3 From the **Choose Persister** dropdown list, select the persister, that is, the database in which the calibration results will be saved.

- 4 In the **Parameter Configuration** area, set the configuration items that are displayed after the persister's selection:
 - As the **Value** for the **Series description** item, enter the name of the dataset you want to save.
 - In **Value** column next to **Connection**, click to display the dropdown list and then choose **Oracle DB**.



- 5 Click the  button next to the selected database.
- 6 In the window that is displayed, set the parameters to connect to the database, then click **OK**.


Related topics:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
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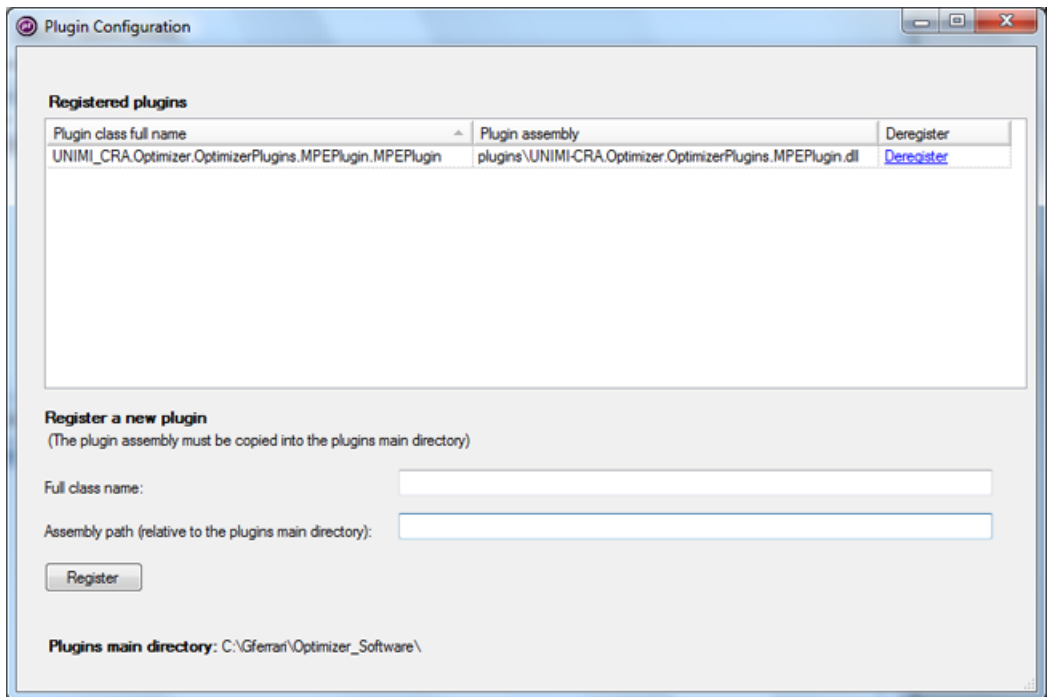
Registering a new plugin

Optimizer can be extended by adding new plugins. To do this, you must register your plugin(s).

To register a plugin in Optimizer:

- 1 Copy your plugin's software libraries into the **Plugins** directory of the Optimizer installation folder.
- 2 From the Optimizer menu bar, click the  **Settings** button and select **Plugin configuration**.

The following is displayed:



The plugins that have already been registered are listed in the upper part of the window.

- 3 Enter the **Full class name** in the text box.
This is the name that will be displayed in the list of the **Registered plugins**.

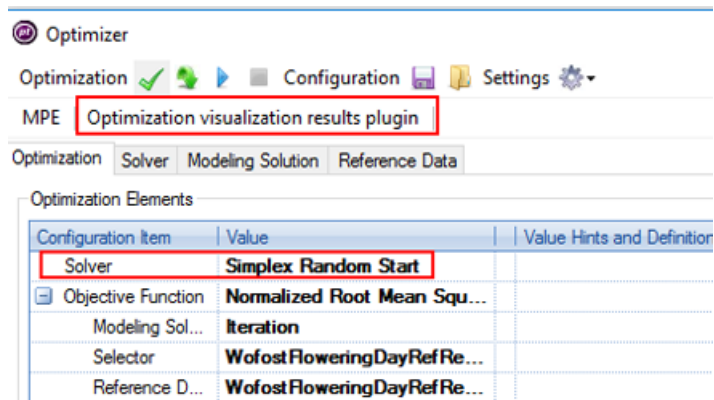
- 4 Enter the **Assembly path** in the text box.
This indicates where the plugin is located. It is composed by: the **Plugins** directory within the Optimizer installation folder, and the plugin's **Full class name**.
- 5 Click **Register**.
- 6 To remove a plugin from the **Plugins** folder, click **Deregister** in the **Registered plugins** area.

Related topics:

- “Configuring the Solver” on page 17
- “Configuring the Objective Function” on page 20
- “Configuring the Modelling Solution” on page 23
- “Saving or loading a configuration” on page 32
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Analyzing the optimization results

After running the optimization, besides of the optimized values of the parameters (which is the calibration process main output), the user can also inspect the behaviour of the simplex by launching the **Optimization visualization results plugin** that is highlighted below:



Note:

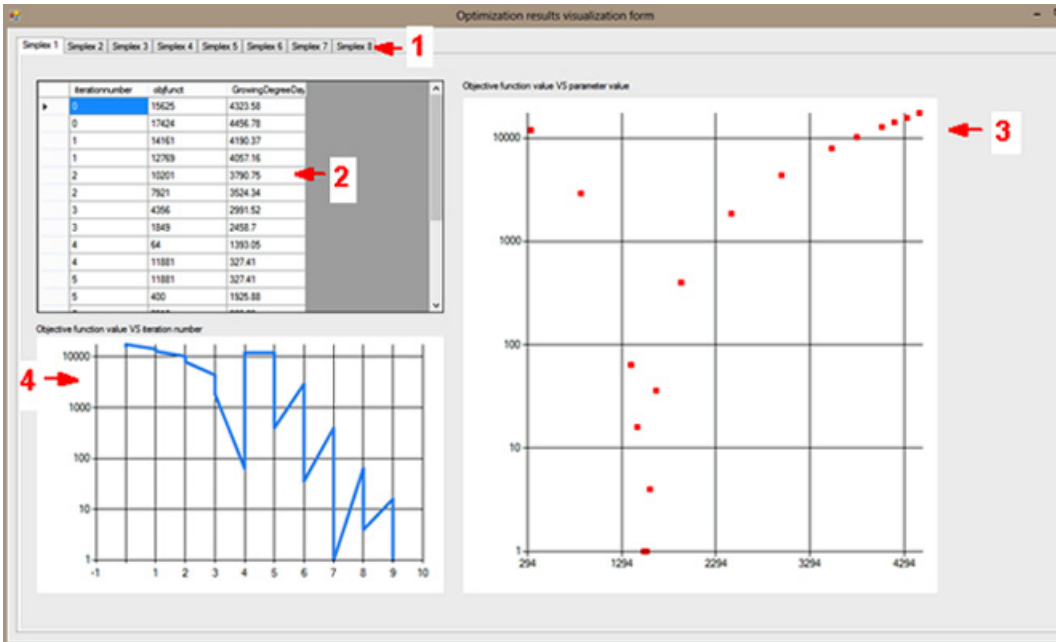


This plugin is only available if the **Simplex Random Start** has been selected as the **Solver**.

Using the plugin, the user can analyze how the Simplex *moves* into the parameters space and visually verify how the convergence was reached, or explain why the convergence was not reached.

After clicking **Optimization visualization results plugin**, the following form opens:

3 – INSTALLING AND USING OPTIMIZER

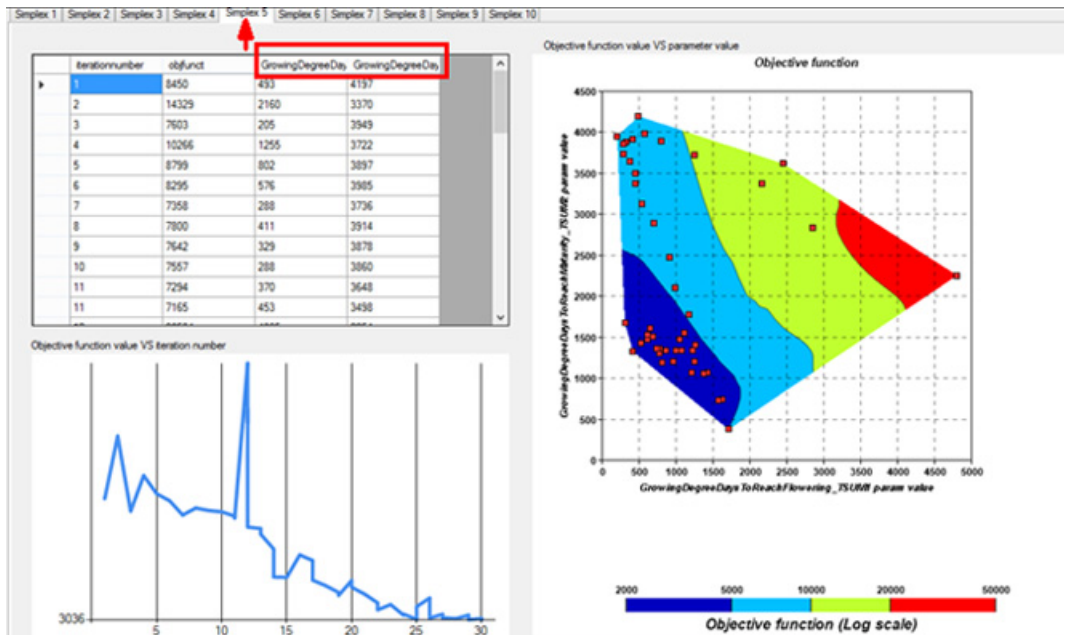


Legenda

Area	Description
1 - Tabs 1 to 8	In this area, a tab is displayed for each launched Simplex (in our example, there are 8).
2 - Values of the launched simplexes	<p>IterationNumber - The number of iterations of the Simplex.</p> <p>objfunct - It shows the values of the objective function.</p> <p>GrowingDegreeDay - The parameter under optimization.</p>
3 - Objective function value vs. parameter value	<p>The chart shows the objective function versus the parameter(s) values tested by the simplex (ideally it should move toward the zero for the optimum value of the parameter).</p> <p>The chart shows the path of the simplex in the parameter mono dimensional space (red dots). On the Y axis the objective function value, on the X axis the parameter value.</p>

Area	Description
<p>4 - Objective function value vs. iteration number</p>	<p>The chart in the lower part shows the trend of the objective function versus the iteration number (ideally it should move toward the zero).</p> <p>The chart shows the magnitude of the objective function for the several iterations of the calibration process.</p>

The figure below shows the tab **Simplex 5** where two parameters are under optimization:



In this case, the right chart shows the parameters **bidimensional** space (red dots).

The chart shows the path of the Simplex in the parameters bidimensional space (red dots). The colors represent the objective function magnitude in logarithmic scale.

The bottom chart shows the magnitude of the objective function for the several iterations of the calibration process.

In case of more than two parameters under optimization, the user must select the two to be used to display the chart.

See also:

- “Using Optimizer for models calibration” on page 16