

**Conefor 2.7.1 - Command line version 1.0.21 - (c) May 2013 UPM, Josep Torné & Santiago Saura (www.conefor.org) .**

conefor.exe --help

Shows the syntax for use of the command line version.

The majority of options and modes of use reflected below are similar to those of the standard graphical user interface (GUI) version of Conefor. More detailed specifications can be found in the standard user manual of the GUI version available for download at [www.conefor.org](http://www.conefor.org).

**Use:**

```
conefor.exe -nodeFile nfile -conFile cfile [-t dist|prob|adj [ all|notall ] ]
[-*] [ -confAdj value [ -CCP ] [ -LCP ] [ -IIC ] [ -BC ] [ -BCIIC ] [ -NC ]
[ -NL ] [ -H ] ] [ -confProb distance prob [ -F ] [ -AWF ] [ -PC ] [ -BCPC ] ]
[ onlyoverall ] [ -pcHeur all | value ] [ -add ] [ -removal [ maxValue value ] ]
[ -improvement [ maxValue value ] ] [ -change ] [ -double ] [ -simple ]
[ -noout ] [ -wcomp ] [ -wlinks ] [ -wprobdire ] [ -wprobmax ] [ -landArea area ]
[ -prefix pname ]
```

The arguments between brackets [] are optional

The arguments separated by | indicate that only one of them should be chosen; default values are noted below.

**-nodeFile nfile**

nfile specifies the path and file name for the node file. If only the name of the file is specified, it is understood that the file is located in the same folder as conefor.exe. The name of the file and path should not contain any spaces.

When the option -\* is used, nfile indicates the starting characters of all the node files to be processed in a single run (see below a detailed description of this option -\*).

**-conFile cfile**

cfile specifies the path and file name for the node file. If only the name of the file is specified, it is understood that the file is located in the same folder as conefor.exe. The name of the file and path should not contain any spaces.

When the option -\* is used, cfile indicates the starting characters of all the connection files to be processed in a single run (see below a detailed description of this option -\*).

**-t dist|prob|adj [ all|notall ]**

Indicates the type of connection file:

dist: The connection file is a distance file (default option)

prob: The connection file is a probability file

adj: The connection file is a link file

The next option indicates if the connections between every pair of nodes or just a part of them are reported in the connection file:

all: all the pairs of nodes are listed (only once) in the connections file

notall (default option): only some pairs of nodes are listed in the connections file. The nodes that are not included in the connections file are assumed to be fully unconnected in a direct way. This is the default and will be assumed if nothing is specified.

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When this option is specified, Conefor command line will process all the node and connection files that (1) are located in the same folder as conefor.exe (2) have a name starting with the text indicated by nfile (for the node files) and by cfile (for the connection files). Additionally, Conefor will automatically generate a prefix for writing the result files corresponding to each calculation (see more details below on the option -prefix name); such prefix is the part of the node file name after the characters specified by nfile (since all the calculations in this -\* mode correspond to node files with name starting with nfile).

To use this option there must be, within the same folder where conefor.exe is located, the same number of node files with name starting with nfile as the number of connection files with name starting with cfile. In addition, it is necessary that there are pairs of files (one node file and one connection file) with similar names, i.e. with exactly the same name after the characters corresponding to nfile and cfile (otherwise Conefor will report an error), apart from obviously corresponding to the same landscape/graph.

For example, if nfile is nodes\_ and cfile is distances\_, the following list of files (all located in the same folder as conefor.exe) is correct:

```
nodes_habitat1.txt
nodes_habitat2.txt
nodes_landscape_north.txt
distances_habitat1.txt
distances_habitat2.txt
distances_landscape_north.txt
```

If, in this example, nfile was nodes\_h and cfile was distances\_h, processing would be completed as well with no errors, although only two of the three pairs of files listed above would be processed.

The following set of files will be however incorrect if nfile is nodes\_ and cfile is distances, since there are three node files with name starting with nfile but only two connection files with name starting with cfile:

```
nodes_habitat1.txt
nodes_habitat2.txt
nodes_landscape_north.txt
distances_habitat1.txt
distances_habitat2.txt
```

The following set of files is also incorrect (if nfile is nodes\_ and cfile is distances\_), since the names of the files nodes\_landscape\_north.txt and distances\_landscape\_N.txt do not match. Assuming that the content of both files is correct (i.e., they correspond to the same landscape/graph), the problem could be solved by renaming the connection file as distances\_landscape\_north.txt or by renaming the node file as nodes\_landscape\_N.txt:

```
nodes_habitat1.txt
nodes_habitat2.txt
nodes_landscape_north.txt
distances_habitat1.txt
distances_habitat2.txt
distances_landscape_N.txt
```

Note that the Conefor Inputs extensions for GIS (ArcGIS, QuantumGIS, Guidos) generate directly the node and connection (distance) files with names that already comply with the specifications above. Therefore, the node and connection files resulting from the Conefor Inputs extensions can be directly used with this option -\* (care just need to be taken not to have in the same folder other

files different from those that intend to be processed and that start with the same characters as those indicated by nfile and cfile).

**-confAdj value [ -CCP ] [ -LCP ] [ -IIC ] [ -BC ] [ -BCIIC ] [ -NC ] [ -NL ] [ -H ]**

value corresponds to the threshold distance (when the connection file is a distance file) or to the threshold probability (when the connection file is a probability file) used to determine the direct links between nodes for the indices based on a binary connection model (binary indices). If the connection file is a link file (-t adj) this value should not be specified.

Example: -confAdj 10000

After the distance/probability value, the binary indices to be computed need to be specified, one or more among those available in Conefor (CCP, LCP, IIC, BC, BCIIC, NC, NL, H):

-CCP: The CCP index will be calculated.

-LCP: The LCP index will be calculated.

-IIC: The IIC index will be calculated.

-BC: The BC index will be calculated.

-BCIIC: The BC(IIC) index will be calculated. IMPORTANT: to calculate this index it is necessary to select IIC as well. Otherwise Conefor will report an error message and calculations will not continue.

-NC: The NC index will be calculated.

-NL: The NL index will be calculated.

-H: The H index will be calculated.

**-confProb distance prob [ -F ] [ -AWF ] [ -PC ] [ -BCPC ]**

distance and prob correspond to the distance and probability values that will be used to compute the indices based on a probabilistic connection model (probabilistic indices) when the connection file is a distance file. This pair of values will determine the decay rate of a negative exponential function of distance (either Euclidean or effective) that will give the pij values (probabilities of direct dispersal) used by these probabilistic indices. If the connection file is a probability file (-t prob), these values should not be specified. If the connection file is a link file (-t adj) then it is not possible to calculate any probabilistic indices and this option should not be used.

Example: -confProb 10000 0.5

After the distance and probability values, the probabilistic indices to be computed need to be specified, one or more among those available in Conefor (F, AWF, PC, BCPC):

-F: The F index will be calculated.

-AWF: The AWF index will be calculated.

-PC: The PC index will be calculated.

-BCPC: The BCPC index will be calculated. IMPORTANT: to calculate this index it is necessary to select PC as well. Otherwise Conefor will report an error message and calculations will not continue.

### **onlyoverall**

Specifies that only the overall index values for the entire landscape will be calculated (for all indices that have been selected in the previous sections), and not the importance of each patch in maintaining connectivity of the network (percentage change in the index value after eliminating each patch). Runs specifying "onlyoverall" will finish much more quickly because calculations for the full network are much faster than are calculations for obtaining the importance values of each individual patch.

The results of the "overall indices" from multiple executions of Conefor command line made in the same folder will be recorded to a single text file called

"results\_all\_overall\_indices.txt". There will be one line of text for each index and execution. Additionally, the values of only the indices EC(IIC) and EC(PC) for all executions will be recorded in two separate files with names "results\_all\_EC(IIC).txt" and "results\_all\_EC(PC).txt", respectively. All these files are described in more detail in the last section of this manual.

#### **-pcHeur all | value**

Indicates that we want to set a minimum probability for the paths to be considered for the calculation of the PC index (this option will be rarely used, and is only for advanced use). In general it is NOT recommended to use this option. In the second example below, paths with a probability < 0.3 will not be analyzed.

Examples: -pcHeur all, -pcHeur 0.3

#### **-add**

Indicates that there are nodes to add to the initial landscape

#### **-removal [maxValue value]**

When this option is selected, Conefor will calculate the importance of each individual link as the percentage decrease in the connectivity index value after the removal of that link.

Optionally, a maximum connection value (distance or probability, depending on the type of connection file used) can be specified to determine the links for which the importance will be calculated. This latter option is however only recommended for an advanced use of the software.

Examples: -removal, -removal maxValue 1000, -removal maxValue 0.2

#### **-improvement [maxValue value]**

When this option is selected, Conefor will calculate the impact on connectivity of the maximum possible improvement in the strength of each individual link (e.g. changing pij up to the maximum value pij=1 for the probabilistic connection indices, or adding a link between two patches if there was none for the binary connection indices).

Optionally, a maximum connection value (distance or probability, depending on the type of connection file used) can be specified to determine the links for which calculations will be performed. This latter option is however only recommended for an advanced use of the software.

Examples: -improvement, -improvement maxValue 1000, -improvement maxValue 0.2

#### **-change**

This option allows evaluating the impact on connectivity of a given change in the strength of each individual link between patches (see manual for Conefor 2.6 available at [www.conefor.org](http://www.conefor.org) for further details).

#### **-simple**

Single precision (float) is used to calculate the indices. Do not use when you want to obtain the importance values (deltas and fractions thereof) for links or patches. Single precision is in general recommended only if you are only interested in obtaining the 'overall index values'.

#### **-double**

Uses high precision (double) to calculate the indices. This is the default precision that is used in the calculations if neither is specified. The increased accuracy requires a greater use of RAM (which should not be a problem except in very large graphs) and a little more time to process (although the increase in processing time compared to the "simple" precision is usually very small). The "simple" precision can be enough when you want to only calculate the total value of PC or other indices ("overall index values"), whereas the "double" should be better used whenever you want to get the node or link importance values, including the three fractions of dPC or dIIC (intra, flux, connector).

**-noout**

The processing information is not shown on the screen but rather is saved in the file `execution_events.txt`.

**-wcomp**

Writes the component file, i.e. the file that indicates the component to which each of the nodes in the graph belongs. **IMPORTANT:** for this component file to be generated, the NC index must be selected for calculation (using `-NC`, see above). Otherwise Conefor will give an error message and processing will stop.

**-wlinks**

Writes the link file (see Conefor manual for details). For this link file to be generated, at least one binary index must be selected for calculation.

**-wprobdir**

Writes the file with the direct dispersal probabilities ( $p_{ij}$ ) among each pair of nodes. For this file to be generated, at least one probabilistic index must be selected for calculation.

**-wprobmax**

Writes the file with the maximum product probabilities ( $p^*_{ij}$ ) among each pair of nodes. For this file to be generated, the PC index must be selected for calculation.

**-landArea area**

Specifies the maximum landscape attribute (AL) that is used to calculate the overall value of indices like IIC or PC. This value is irrelevant and need not be specified for the purpose of prioritizing patches or links (percentage change in the value of a connectivity index after removal of a particular landscape element).

If you do not specify a value of "landArea" (or specify a value that does not make sense, for example, a value that is less than the sum of the attributes (area) of each of the nodes / patches), then the program gives only the PCnum or IICnum value (numerator of PC or IIC) in the output file of index values ("overall\_indices"). If you specify a value of "landArea", the output file will include both IICnum and PCnum and IIC and PC (where the latter two values are simply the result of dividing PCnum and IICnum by the squared value of "landArea"). The value of IICnum or PCnum allows you to immediately obtain the value of EC (Equivalent Connectivity, or Equivalent Connected Area in the particular case in which node attributes correspond to areas) for the analyzed landscape, since  $EC(IIC)$  and  $EC(PC)$  are simply the square root of IICnum and PCnum respectively. Hence, if you just want to obtain the value of  $EC(IIC)$  or  $EC(PC)$  it is not necessary to specify a value of "landArea".

**-prefix pname**

Adds a prefix in the name of all the result files that Conefor will save for a given run. It also adds a prefix in the first column of different summary files that Conefor generates for multiple executions in the same folder (see the last section of this manual). Using the option `-*` (see this option above) will automatically generate a different prefix for each execution (further details on this prefix with the option `-*` is given below).

The name of the prefix (pname) cannot contain any space.

It is necessary to use this prefix option (explicitly setting a pname or using `-*`) when working with multiple processes / files in one folder. A different prefix name must be specified for each execution of the command line (either using pname or `-*`) to prevent output result files (e.g. node importance file) for different executions being overwritten and thus causing loss of previous results, and to allow determination of the execution corresponding to the values

in each line of the summary result files that are generated by Conefor (see last section of this manual for these summary files).

There are, however, several options in Conefor command line that allow to have to "manually" specify a different prefix name for each execution, or at least facilitate or simplify that process:

- When the option `-*` is selected, Conefor will automatically generate a different prefix for each pair of node and connection files to be processed, which would make probably unnecessary to use the `-prefix pname` option. Specifically, when using `-*`, the name of the prefix will be equal to the text characters that appear in the node file name after those characters corresponding to `nfile` (since the characters in `nfile` are common for all the node files to be processed with the option `-*`, these characters are not used in the prefix that will differentiate the different executions). If we want the prefix to also include the value of distance/probability used for calculating the connectivity indices, it is possible to do so by using the `-prefix` option with `pname` the text `"_b_"` and/or `"_p_"`, as will be described below. This (using `"_b_"` and/or `"_p_"`) will only be necessary if different distance/probability values are used in different executions using the same node and connection files (otherwise the results of the last execution for that pair of node and connection files will overwrite the result files for previous executions for that same pair of files). If the option `-prefix pname` (including `"_b_"` and/or `"_p_"` as describe next) in combination with option `-*`, the name of the prefix used by Conefor will correspond to the characters specified in `pname` followed by the automatic prefix name that is generated by option `-*` (which corresponds to the characters appearing in the node file name after the common characters specified by `nfile`).

- If in the prefix name (`pname`) the characters `"_b_"` appear, Conefor will automatically include in the final prefix the value of the distance or probability used in the option `confAdj` (for the binary connectivity indices), by replacing the character `"+"` by that distance or probability value. If for example, the specified prefix name (`pname`) is `"distance_b+_habitat1"`, and several executions have been performed with distance threshold values for the binary connectivity indices of 1000, 5000 and 10000 meters, the results of these three executions will be written using the following prefix names: `distance_b_1000_habitat1`, `distance_b_5000_habitat1` and `distance_b_10000_habitat1`.

- If in the prefix name (`pname`) the characters `"_p_"` appear, Conefor will automatically include in the final prefix the distance and probability values used in the option `confProb` (for the probabilistic connectivity indices), by replacing the character `"+"` by that distance and probability values. If for example, the specified prefix name (`pname`) is `"distance_p+_habitat1"`, and several executions have been performed with a distance value for the probabilistic connectivity indices of 200, 400 and 800 meters corresponding to a probability value of 0.5, the results of these three executions will be written using the following prefix names: `distance_p_200_0.5_habitat1`, `distance_p_400_0.5_habitat1` and `distance_p_800_0.5_habitat1`.

- If in the same execution both binary and probabilistic indices are calculated, both options (`"_b_"` y `"_p_"`) can be used simultaneously; it is enough to include the characters `"_b+_p_"` (with no spaces) in the prefix name. The final prefix will include the distance and probability values corresponding to both the binary and probabilistic indices (and these distances and probabilities can be different for the binary and probabilistic indices). For example, if the specified prefix name (`pname`) is `"distance_b+_p+_habitat1"`, and a distance threshold of 300 meters has been set for the binary indices, and a distance of 700 meters corresponding to a probability of 0.4 has been set for the probabilistic indices, the results of this execution will be saved with the prefix `"distance_b_300_p_700_0.4_habitat1"`.

## RESULT SUMMARY FILES FOR MULTIPLE EXECUTIONS GENERATED BY THE CONEFOR COMMAND LINE VERSION

### - Overall index values for the entire landscape

As long as (1) a prefix name has been specified in a given execution of Conefor command line (either through `-prefix pname` or through `-*`) and (2) all the files required for executing the Conefor command line (`conefor.exe`, node files, and connection files) are all located in the same folder, the results of the overall index values will be written in a single file with name `"results_all_overall_indices.txt"`. This file contains the results of all the multiple Conefor executions performed in that folder. This file will have one line for each execution and index selected for calculation within the same execution, and will have the following five columns:

- Name of the prefix (as specified either through `-prefix pname`, through `-*`, or through the combination of both). If no prefix is specified in a given execution, no results for that execution will be saved in this file `"results_all_overall_indices.txt"`.
- Distance value (either in `-confAdj` or `-confProb`).
- For the probabilistic indices, probability value that has been specified (`-confProb`) corresponding to the previous distance. For binary indices, this column will shown a value of 0.
- Name of the calculated index (the overall value of which will be presented in next column).
- Value of the calculated index.

Additionally two more result files will be written, one of them containing only the values of the index EC(IIC) only if IIC has been selected for calculation), and another one containing the values of the index EC(PC) (only if PC has been selected for calculation). The name of these files is `"results_all_EC(IIC).txt"` (for the index EC(IIC)) and `"results_all_EC(PC).txt"` (for the index EC(PC)), and in fact they just contain a part of the information already included in the file `"results_all_overall_indices.txt"` for all selected indices. The results of these two indices are saved separately because EC(IIC) and EC(PC) are those most frequently used when the overall connectivity in the entire landscape is to be assessed.

As above, these two file will have one line for each execution and index selected for calculation within the same execution.

The file `"results_all_EC(IIC).txt"` will have the following three columns:

- Name of the prefix (as specified either through `-prefix pname`, through `-*`, or through the combination of both). If no prefix has been specified the results will also be included in the file but writing "NA" in this column.
- Value of the EC(IIC) index.

The file `"results_all_EC(PC).txt"` will have the following four columns:

- Name of the prefix (as specified either through `-prefix pname`, through `-*`, or through the combination of both). If no prefix has been specified the results will also be included in the file but writing "NA" in this column.
- Distance value (specified through `-confProb`).
- Probability value that has been specified (`-confProb`) corresponding to the previous distance
- Value of the EC(PC) index.

For example, if four Conefor command line executions have been performed with prefix names "Habitat1", "Habitat2", "Habitat3" and "Habitat4", calculating in two first executions ("Habitat1", "Habitat2") the indices NC and IIC for a distance value of 500 meters, and in the two latter executions ("Habitat3", "Habitat4") calculating the indices F and PC for a distance value of 600 meters corresponding to a probability of 0.37 (without specifying in either case the value of AL (landArea)), the information written in the file

"results\_all\_overall\_indices.txt" will be the following (the index values written here are arbitrary):

Habitat1	500	0	NC	4
Habitat1	500	0	IICnum	234.5
Habitat1	500	0	EC(IIC)	15.31
Habitat2	500	0	NC	7
Habitat2	500	0	IICnum	493.3
Habitat2	500	0	EC(IIC)	22.21
Habitat3	600	0.37	F	156.7
Habitat3	600	0.37	PCnum	198.4
Habitat3	600	0.37	EC(PC)	14.09
Habitat4	600	0.37	F	136.2
Habitat4	600	0.37	PCnum	138.3
Habitat4	600	0.37	EC(PC)	11.76

And the information written in the file "results\_all\_EC(IIC).txt" would be the following:

Habitat1	500	15.31
Habitat2	500	22.21

And the information written in the file "results\_all\_EC(PC).txt" would be the following:

Habitat3	600	0.37	14.09
Habitat4	600	0.37	11.76

The results of all Conefor command line executions performed in the same folder will be saved in the same files "results\_all\_overall\_indices.txt", "results\_all\_EC(IIC).txt" y "results\_all\_EC(PC).txt". When a new Conefor execution is performed in a given folder, if the file "results\_all\_overall\_indices.txt" already exists in that folder, one or more new lines (depending on the number of indices selected for calculation) are added in that same folder. If the file "results\_all\_overall\_indices.txt" does not previously exist in that folder, a new file with that name will be created and the lines with the obtained results will be written in it. If we want that after a certain point (after a certain number of executions) the results are saved in a new file different from the one containing the results for the previous executions, it is enough to change the name of the file "results\_all\_overall\_indices.txt" that so far contained the results of the previous executions (or just move that file to a different folder). The same applies to summary files "results\_all\_EC(IIC).txt" and "results\_all\_EC(PC).txt" containing the values of the EC(IIC) and EC(PC) respectively.

**- Sum of the importance values (deltas) for each individual node (node importances) or link (link importances) for the indices IIC and PC**

The results for each individual node (node importances) or link (link importances) in either of the three variants: removal, improvement or change) will not be saved in a single joint summary file for multiple executions. They will be saved in an individual node importances or link importances file for each execution as long as a different prefix has been set in each execution, or they will be saved overwriting the node or link importance file from previous executions when no prefix has been specified.

Conefor command line will write however a summary of the results for the nodes and/or link importance values only for the indices IIC and PC and their fractions (intra, flux, connector). This summary consists in the sum of the dIIC or dPC values for all nodes in the graph, as well as the sum of their fractions (dIICintra, dIICflux, dIICconnector, dPCintra, dPCflux, dPCconnector). These results will be automatically saved in files with names



"node\_importances\_sum\_IIC.txt" (for the index IIC) and  
"node\_importances\_sum\_PC.txt" (for the index PC).

The file "node\_importances\_sum\_IIC.txt" will only be generated if the IIC index has been selected for calculation. This file will have the following six columns, and one line for each execution of the Conefor command line in which IIC has been selected for calculation:

- Prefix: name of the prefix (specified either through -prefix pname, through -, or through a combination of both). If no prefix has been specified the results will also be included in the file but writing "NA" in this column.
- Distance or probability: value of the distance threshold (if the connection file is a distance file) or of the probability threshold (if the connection file is a probability file) used for calculating the binary connectivity indices. This value was specified with option "-confAdj value". If the connection file is a link file (-t adj), then the value 0 will be written in this column.
- Sum\_dIIC: sum of the dIIC values for all nodes.
- Sum\_dIICintra: sum of the dIICintra values for all nodes.
- Sum\_dIICflux: sum of the dIICflux values for all nodes.
- Sum\_dIICconnector: sum of the dIICconnector values for all nodes.

The file "node\_importances\_sum\_PC.txt" will only be generated if the PC index has been selected for calculation. This file will have the following seven columns, and one line for each execution of the Conefor command line in which PC has been selected for calculation:

- Prefix: name of the prefix (specified either through -prefix pname, through -, or through a combination of both). If no prefix has been specified the results will also be included in the file but writing "NA" in this column.
- Distance: value of the distance used for calculating the probabilistic connectivity indices, as specified with option "-confProb distance prob". If the connection file is a probability file (-t prob), then the value 0 will be written in this column.
- Probability: value of the probability (corresponding to the previous distance value) used for calculating the probabilistic indices, as specified with option "-confProb distance prob". If the connection file is a probability file (-t prob), then the value 0 will be written in this column.
- Sum\_dPC: sum of the dPC values for all nodes.
- Sum\_dPCintra: sum of the dPCintra values for all nodes.
- Sum\_dPCflux: sum of the dPCflux values for all nodes.
- Sum\_dPCconnector: sum of the dPCconnector values for all nodes.

When some modality of the "link importance" analysis is selected (removal, improvement, change), Conefor will write for IIC and PC a summary file analogous to those just described, but having a single column for the sum of dIIC or the sum of dPC for all nodes (sum\_dIIC or sum\_dPC), and not one column for each of the three separate fractions. This is because, by definition, links can only contribute to connectivity through the connector fraction. This means that in the link importance analysis, sum\_dIIC = sum\_dIICconnector and sum\_dPC = sum\_dPCconnector. These summary files will be named as

"link\_importances\_removal\_sum\_IIC.txt" and "link\_importances\_removal\_sum\_PC" (for the link removal modality), "link\_importances\_improvement\_sum\_IIC.txt" and "link\_importances\_improvement\_sum\_PC" (for the link improvement modality), and "link\_importances\_change\_sum\_IIC.txt" and "link\_importances\_change\_sum\_PC" (for the link change modality). All these files will have three columns for the IIC index (prefix, distance or probability, sum\_dIIC) and four columns for the PC index (prefix, distance, probability, sum\_dPC). The rest is the same as described above for the files summarizing the results of the node importance analysis.