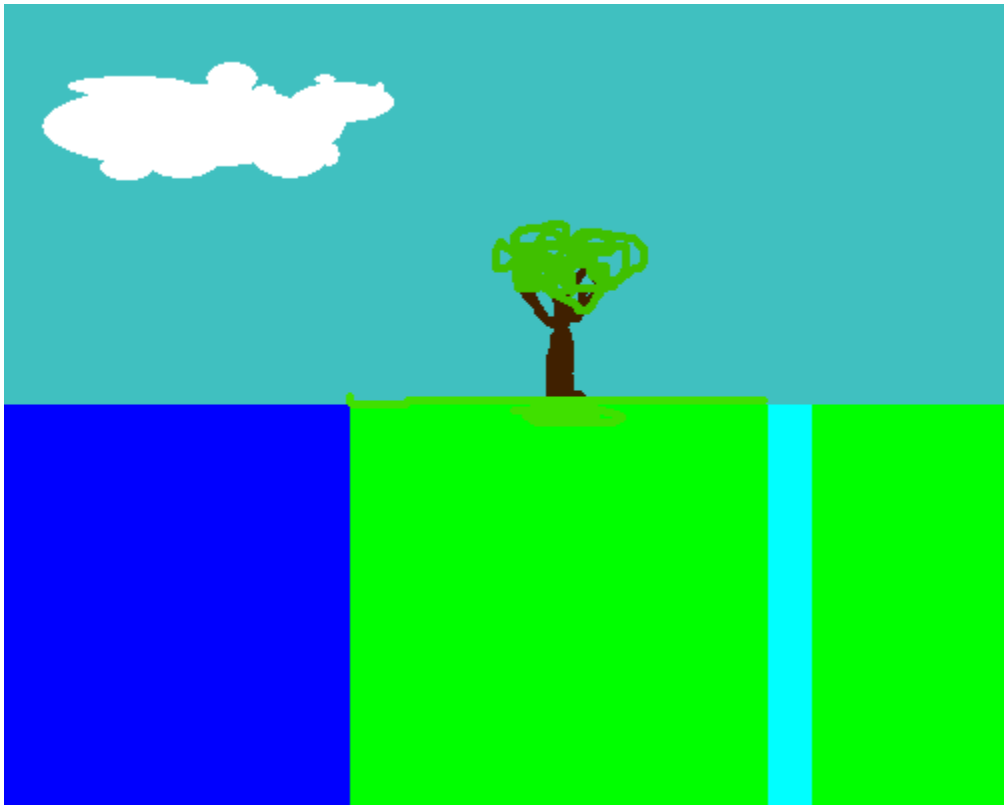
The GLOBOX program
A short manual
Version 1.0



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Reinout Heijungs & Anneke Wegener Sleeswijk, revision of 14 September 2010
See http://cml.leiden.edu/software/software-globox.html

The GLOBOX package and system requirement

To run the program, you need the following files:

- Globox.exe, a Windows executable
- GLOBACK2part1.xls, an excel file with data for individual countries and seas
- GLOBACK2part2.xls, an excel file with data for boundaries and flows between countries and seas
- substances.xls, an excel file with data on substance properties
- globox.bmp, a graphics file
- selection_of_countries.txt, a file that supports the calculation of characterisation factors for the most important countries
- readme.txt, a file with release notes
- The GLOBOX program - A short manual.pdf, this manual.

The system requirements are as follows:

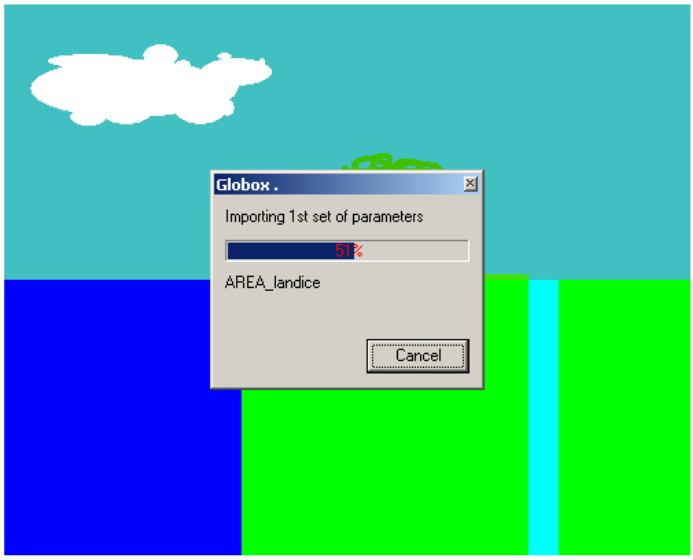
- Operating system Windows XP or later
- Microsoft Excel must be installed in order to import the environmental parameters and substance data
- Adobe Acrobat Reader must be installed in order to read this manual
- An internet browser must be installed

All files come in one single zip file. You must unzip this into one folder, e.g. C:\Program Files\Globox. You don't need to install anything, just unzipping is enough.

Before running GLOBOX, you should first make sure that your computer recognizes numbers with a decimal point, instead of a decimal comma. You can test this, for instance, by starting Excel, and typing "=1/2" into a cell. If the result is shown as "0.5" your system is installed correctly. If you see "0,5", you should open the Windows Control Panel. Go to Regional Settings, and change the Decimal Symbol into a point, and the Digit Grouping Symbol into a comma. Accept the settings, and close the Control Panel.

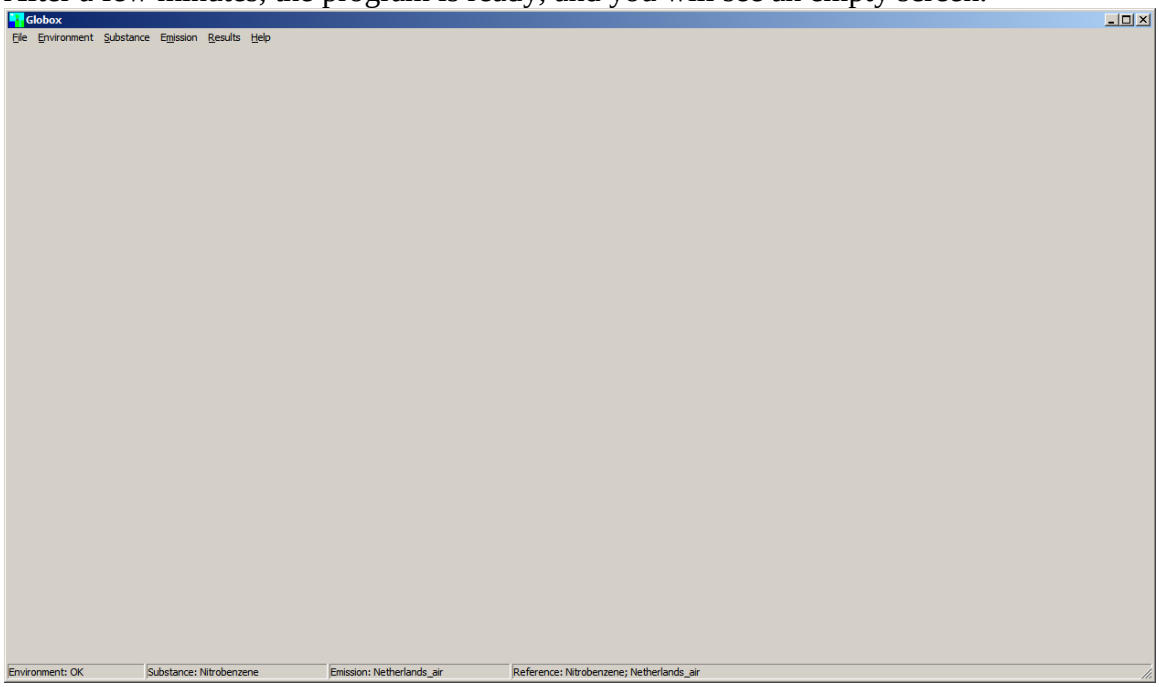
Starting GLOBOX
Before you start GLOBOX, make sure that your computer recognizes numbers with a decimal point, instead of a decimal comma. See above for instructions.

Now, start the program by double clicking Globox.exe.



You will see a welcome screen, and a progress indicator that tells you that the program is importing the data from the excel files.

After a few minutes, the program is ready, and you will see an empty screen.

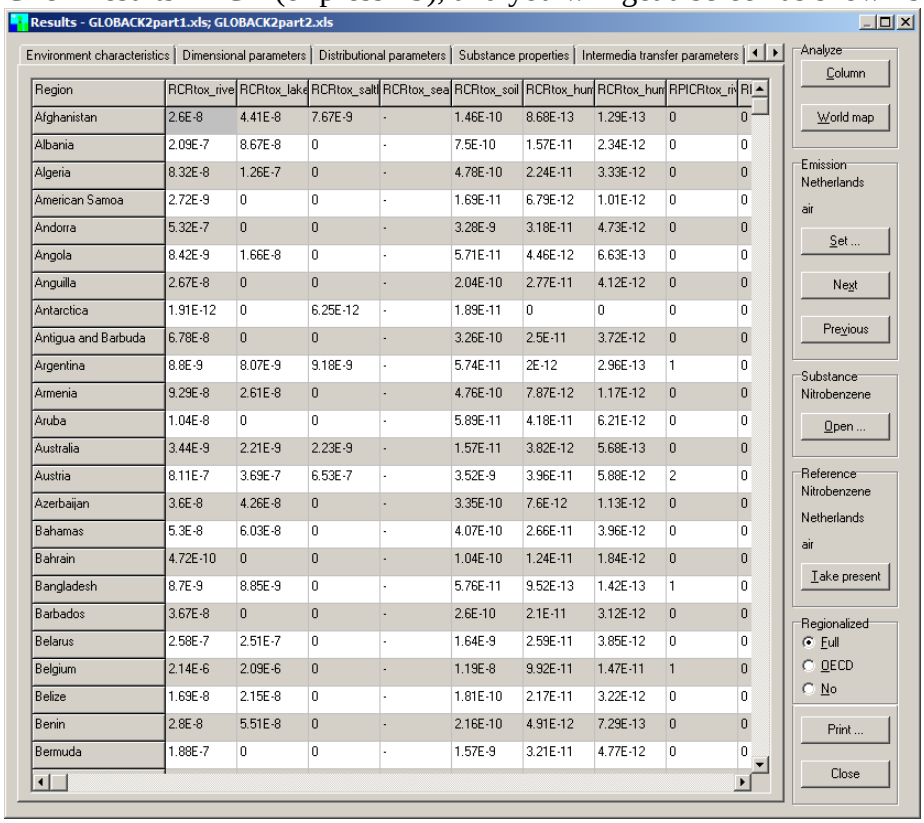


The program has now imported all parameters for all countries and seas, and the substance data for one substance (nitrobenzene). Moreover, it has calculated the results for this substance, and the emission of nitrobenzene to the air compartments of the Netherlands as the reference emission.

The program is now ready to calculate more substances, or emissions to other compartments in other countries.

Displaying results

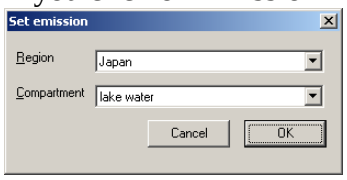
Click Results - RCR (or press F9), and you will get a screen as shown below.



Region	RCRtox_rive	RCRtox_lake	RCRtox_salt	RCRtox_sea	RCRtox_soil	RCRtox_hun	RCRtox_hun	RPICRtox_ri	RI
Afghanistan	2.6E-8	4.41E-8	7.67E-9	-	1.46E-10	8.68E-13	1.29E-13	0	0
Albania	2.09E-7	8.67E-8	0	-	7.5E-10	1.57E-11	2.34E-12	0	0
Algeria	8.32E-8	1.26E-7	0	-	4.78E-10	2.24E-11	3.33E-12	0	0
American Samoa	2.72E-9	0	0	-	1.69E-11	6.79E-12	1.01E-12	0	0
Andorra	5.32E-7	0	0	-	3.28E-9	3.18E-11	4.73E-12	0	0
Angola	8.42E-9	1.66E-8	0	-	5.71E-11	4.46E-12	6.63E-13	0	0
Anguilla	2.67E-8	0	0	-	2.04E-10	2.77E-11	4.12E-12	0	0
Antarctica	1.91E-12	0	6.25E-12	-	1.89E-11	0	0	0	0
Antigua and Barbuda	6.78E-8	0	0	-	3.26E-10	2.5E-11	3.72E-12	0	0
Argentina	8.8E-9	8.07E-9	9.18E-9	-	5.74E-11	2E-12	2.96E-13	1	0
Armenia	9.29E-8	2.61E-8	0	-	4.76E-10	7.87E-12	1.17E-12	0	0
Aruba	1.04E-8	0	0	-	5.89E-11	4.18E-11	6.21E-12	0	0
Australia	3.44E-9	2.21E-9	2.23E-9	-	1.57E-11	3.82E-12	5.68E-13	0	0
Austria	8.11E-7	3.69E-7	6.53E-7	-	3.52E-9	3.96E-11	5.88E-12	2	0
Azerbaijan	3.6E-8	4.26E-8	0	-	3.35E-10	7.6E-12	1.13E-12	0	0
Bahamas	5.3E-8	6.03E-8	0	-	4.07E-10	2.66E-11	3.96E-12	0	0
Bahrain	4.72E-10	0	0	-	1.04E-10	1.24E-11	1.84E-12	0	0
Bangladesh	8.7E-9	8.85E-9	0	-	5.76E-11	9.52E-13	1.42E-13	1	0
Barbados	3.67E-8	0	0	-	2.6E-10	2.1E-11	3.12E-12	0	0
Belarus	2.58E-7	2.51E-7	0	-	1.64E-9	2.59E-11	3.85E-12	0	0
Belgium	2.14E-6	2.09E-6	0	-	1.19E-8	9.92E-11	1.47E-11	1	0
Belize	1.69E-8	2.15E-8	0	-	1.81E-10	2.17E-11	3.22E-12	0	0
Benin	2.8E-8	5.51E-8	0	-	2.16E-10	4.91E-12	7.29E-13	0	0
Bermuda	1.88E-7	0	0	-	1.57E-9	3.21E-11	4.77E-12	0	0

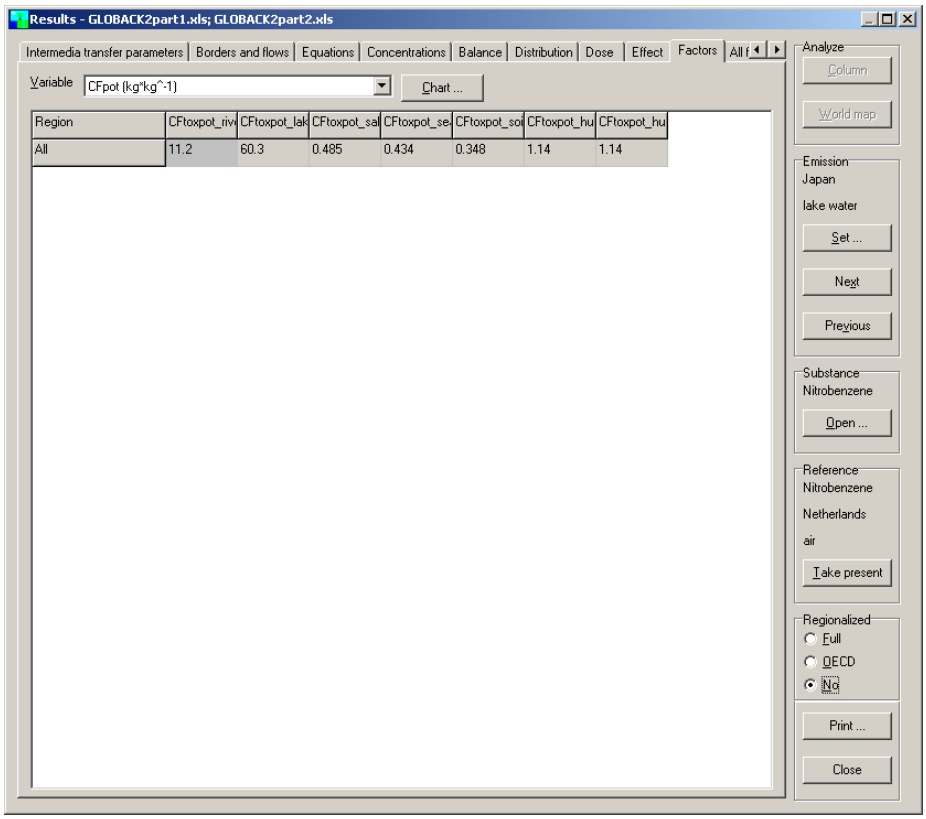
This page shows the risk characterisation ratios (RCRs) for all countries and seas (from Afghanistan to the Southern Ocean) for the RCR in rivers, lakes, saltlakes, etc. As indicated at the right side, this is for an emission to air in the Netherlands, or the substance nitrobenzene, with the reference also as Netherlands and air.

If you click on Emission - Set, you can select another emission, say lakes in Japan.



Clicking OK will now recalculate the RCRs.

Besides RCRs for the different region, other types of results may be of interest. For instance, the tabsheet Factors, when the option Regionalized has been set to No, gives the characterisation factors for potential toxicity to rivers, lakes, etc, in the example for an emission of nitrobenzene to Japanese lakes, with nitrobenzene to Dutch air as the reference:



The tabsheets give access to:

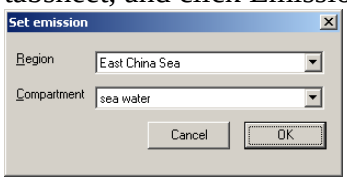
- Intermediate transfer parameters (DIFF and ADV, within each region)
- Borders and flows (WINDSPEED and ADV, between regions)
- Equations (AREA, DIFF, etc. in the way they appear in the full balance matrix equation)
- Concentrations (in air, lakes, fish, etc.)
- Balance (an overview of what goes into and out of a certain box)
- Distribution (a graphical overview of where the chemical ends up in the environment)
- Dose (a graphical overview of how the chemical enters the human body)
- Effect (RCR and the precentages)
- Factors (the characterisation factors, potential or actual)
- All factors (a rapid way to compute the characterisation factors for emissions to all compartments in all regions)
- Check (some diagnostics)

Calculating characterisation factors

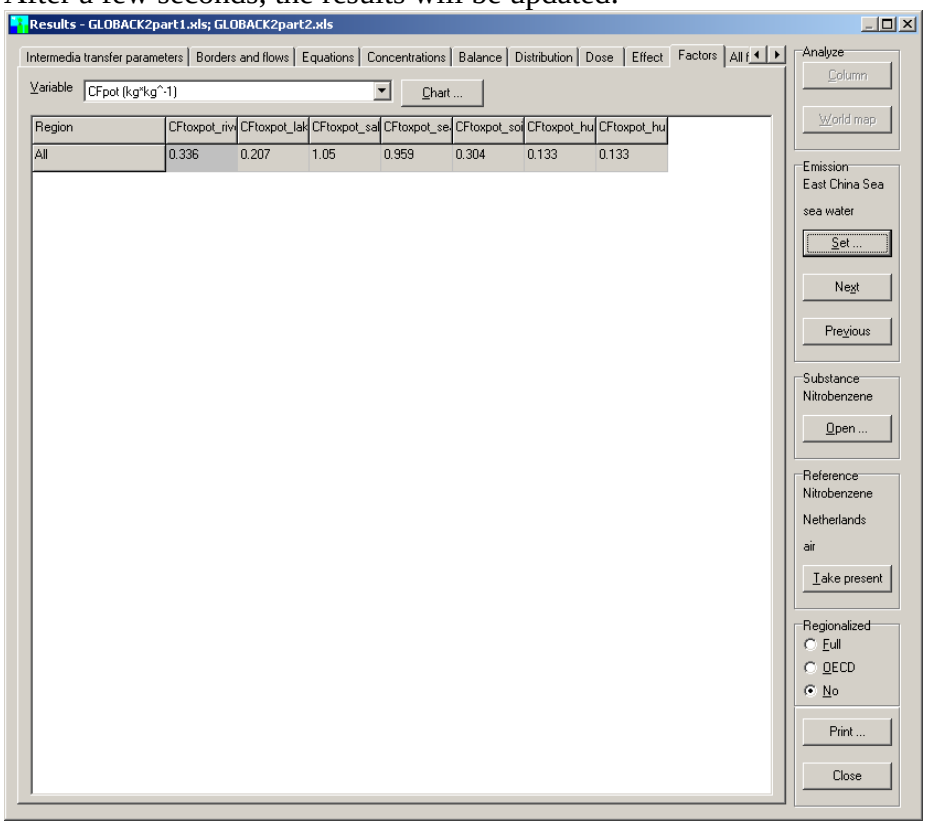
There are two ways of calculating characterisation factors for a specific substance:

- select the region and the compartment of emission, and run the calculation
- run an automatic calculation to create a table for all regions and compartments.

The first option is fast, but does not provide a table of factors. Go to the Results - Factors tabsheet, and click Emission - Set. Select the region and compartment, and click OK.



After a few seconds, the results will be updated:

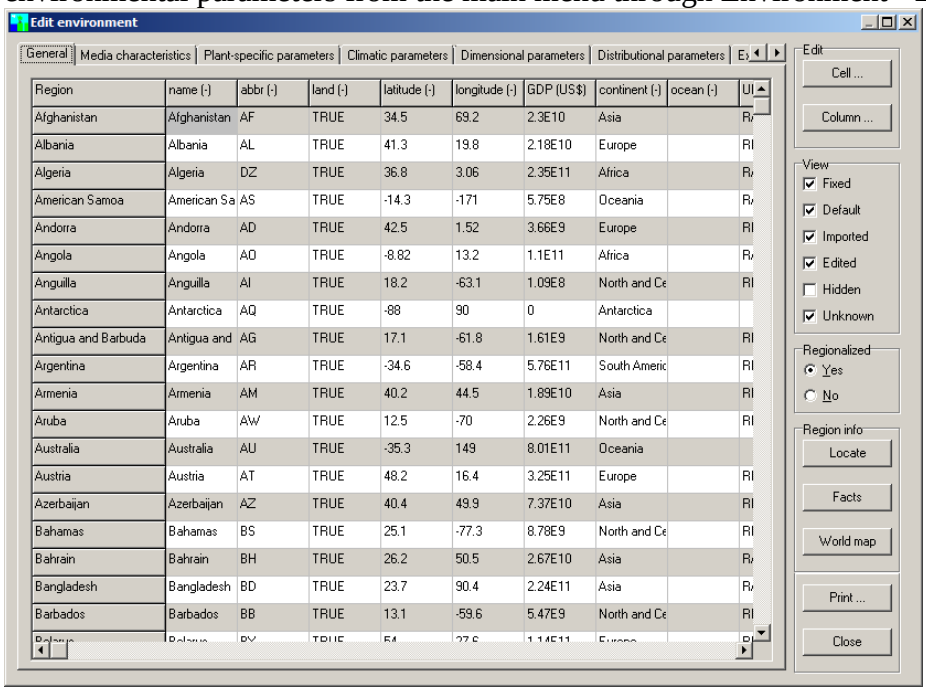


We can read that the characterisation factor for potential toxicity to lake ecosystems is 0.207, for an emission of nitrobenzene to sea water of the East Chinese Sea, with nitrobenzene to Dutch air as a reference.

The second method takes more time, but it generates an entire table of characterisation factors. Go to the Results - All factors tabsheet. Click the Start button, and you will get the possibility to select the regions and compartments for which you want characterisation factors. After several minutes, you will get this table.

Environmental parameters

On startup, many parameters are imported from the excel files from GLOBACK. In addition, for a number of parameters default values are used. You can inspect all environmental parameters from the main menu through Environment - Edit.



Region	name (-)	abbr (-)	land (-)	latitude (-)	longitude (-)	GDP (US$)	continent (-)	ocean (-)
Afghanistan	Afghanistan	AF	TRUE	34.5	69.2	2.3E10	Asia	
Albania	Albania	AL	TRUE	41.3	19.8	2.18E10	Europe	
Algeria	Algeria	DZ	TRUE	36.8	3.06	2.35E11	Africa	
American Samoa	American Sa	AS	TRUE	-14.3	-171	5.75E8	Oceania	
Andorra	Andorra	AD	TRUE	42.5	1.52	3.66E9	Europe	
Angola	Angola	AO	TRUE	-8.82	13.2	1.1E11	Africa	
Anguilla	Anguilla	AI	TRUE	18.2	-63.1	1.09E8	North and Ce	
Antarctica	Antarctica	AQ	TRUE	-88	90	0	Antarctica	
Antigua and Barbuda	Antigua and	AG	TRUE	17.1	-61.8	1.61E9	North and Ce	
Argentina	Argentina	AR	TRUE	-34.6	-58.4	5.76E11	South Americ	
Armenia	Armenia	AM	TRUE	40.2	44.5	1.89E10	Asia	
Aruba	Aruba	AW	TRUE	12.5	-70	2.26E9	North and Ce	
Australia	Australia	AU	TRUE	-35.3	149	8.01E11	Oceania	
Austria	Austria	AT	TRUE	48.2	16.4	3.25E11	Europe	
Azerbaijan	Azerbaijan	AZ	TRUE	40.4	49.9	7.37E10	Asia	
Bahamas	Bahamas	BS	TRUE	25.1	-77.3	8.78E9	North and Ce	
Bahrain	Bahrain	BH	TRUE	26.2	50.5	2.67E10	Asia	
Bangladesh	Bangladesh	BD	TRUE	23.7	90.4	2.24E11	Asia	
Barbados	Barbados	BB	TRUE	13.1	-59.6	5.47E9	North and Ce	

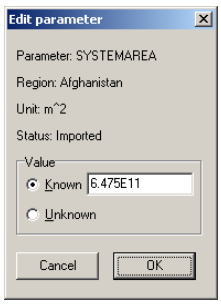
The data is organized along a number of tabsheets:

- General (name, land or sea, etc.)
- Media characteristics (properties of the different compartments)
- Plant-specific parameters (properties of vegetation)
- Climatic parameters (windspeed, etc.)
- Dimensional parameters (areas, depths, etc.)
- Distributional parameters (sedimentation, etc.)
- Exposure data (food patterns, body weight, etc.)
- Borders and flows (border length, river flows, etc.)
- Intramedium exchange parameters (flows within a region)
- Check (some diagnostics)

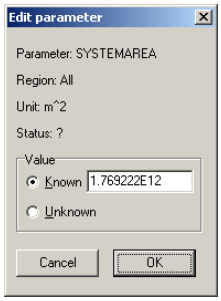
For most of these, the option Regionalized toggles between the regionalized parameters and the overall parameters. Moreover, the option to view fixed, default, hidden, etc. parameters refers to the way data are defined in Globox:

- Fixed (not changeable)
- Default (set by the program)
- Imported (read from the excel file)
- Edited (changed by the user)
- Hidden (not relevant)
- Unknown (no value assigned)

It is possible to edit parameters by clicking Edit - Cell.

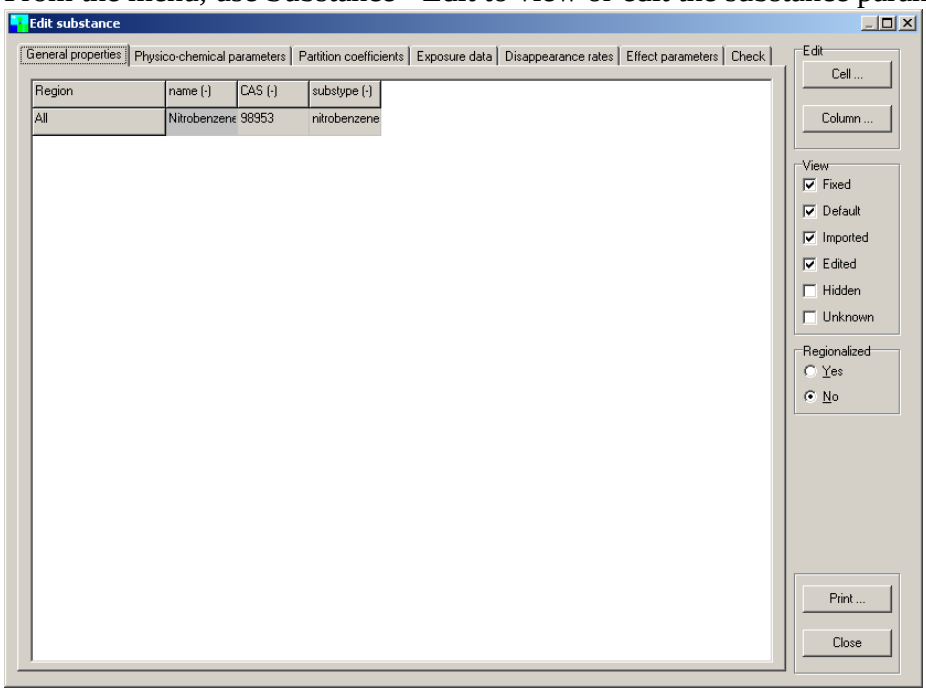


It is also possible to change the value for all regions (so in an entire column) by clicking Edit - Column.



Substance parameters

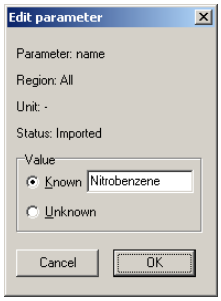
From the menu, use Substance - Edit to view or edit the substance parameters.



There are tabsheets for:

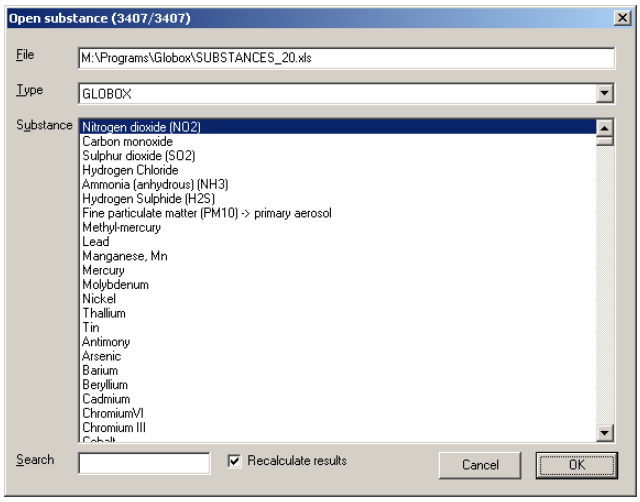
- General (name, CAS, etc.)
- Physico-chemical parameters (molecular weight, Kow, etc.)
- Partition coefficients (Henry constant, etc.)
- Exposure data (BCFs, etc.)
- Disappearance rates (DT50s, etc.)
- Effect parameters (such 1/HC50)
- Check (some diagnostics)

Like for the environmental parameters, you can change the data by clicking Edit.



The options for fixed, default, etc. are also like described above.

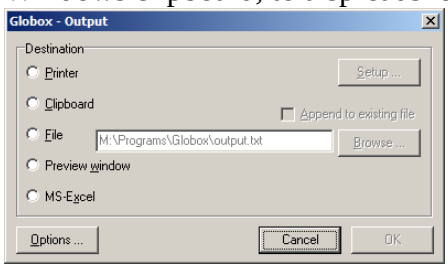
Data on substance properties and substance toxicity data for 3402 substances, collected in the context of the USES-LCA 2.0 model (Van Zelm *et al.*, 2009), are included in the GLOBOX package (with special thanks to Mark Huijbregts and Rosalie van Zelm, Radboud University, Nijmegen, The Netherlands). The menu Substance - Open will bring a new window, from which a substance can be selected.



Use the Search field to type the first few letters of a substance name.

Miscellaneous topics

Almost all screens have a button Print. This will send the result to the printer, to the Windows clipboard, to a spreadsheet, or to a file.



GLOBOX can be terminated by the menu command File – Exit. Upon closing GLOBOX, you may wish to restore the decimal symbol to a comma.

Changes in parameters (environment, substance) can be made in calculations, but such changes are not stored in the Excel files. Permanent changes should be made in the Excel files.

Please consult the webpage http://cml.leiden.edu/software/software-globox.html for more information (documentation, updates, contact information, etc.).

References

GLOBOX model:
Wegener Sleeswijk A, Heijungs R (2010) GLOBOX: a spatially differentiated global fate, intake and effect model for toxicity assessment in LCA. *Sci Total Environ* **408**: 2817-2832

USES-LCA 2.0 model:
Van Zelm R, Huijbregts MAJ, Van de Meent D (2009) USES-LCA 2.0 – a Global Nested Multi-Media Fate, Exposure, and Effects model. *Int J LCA* **14**: 282–284

USES-LCA 2.0 substance data:
Radboud University > Faculty of Science > Homepage Environmental Science > Research > Life Cycle Assessment > Multimedia Toxic Pollutants, at: http://www.ru.nl/environmentalscience/research/life_cycle/multimedia_toxic/