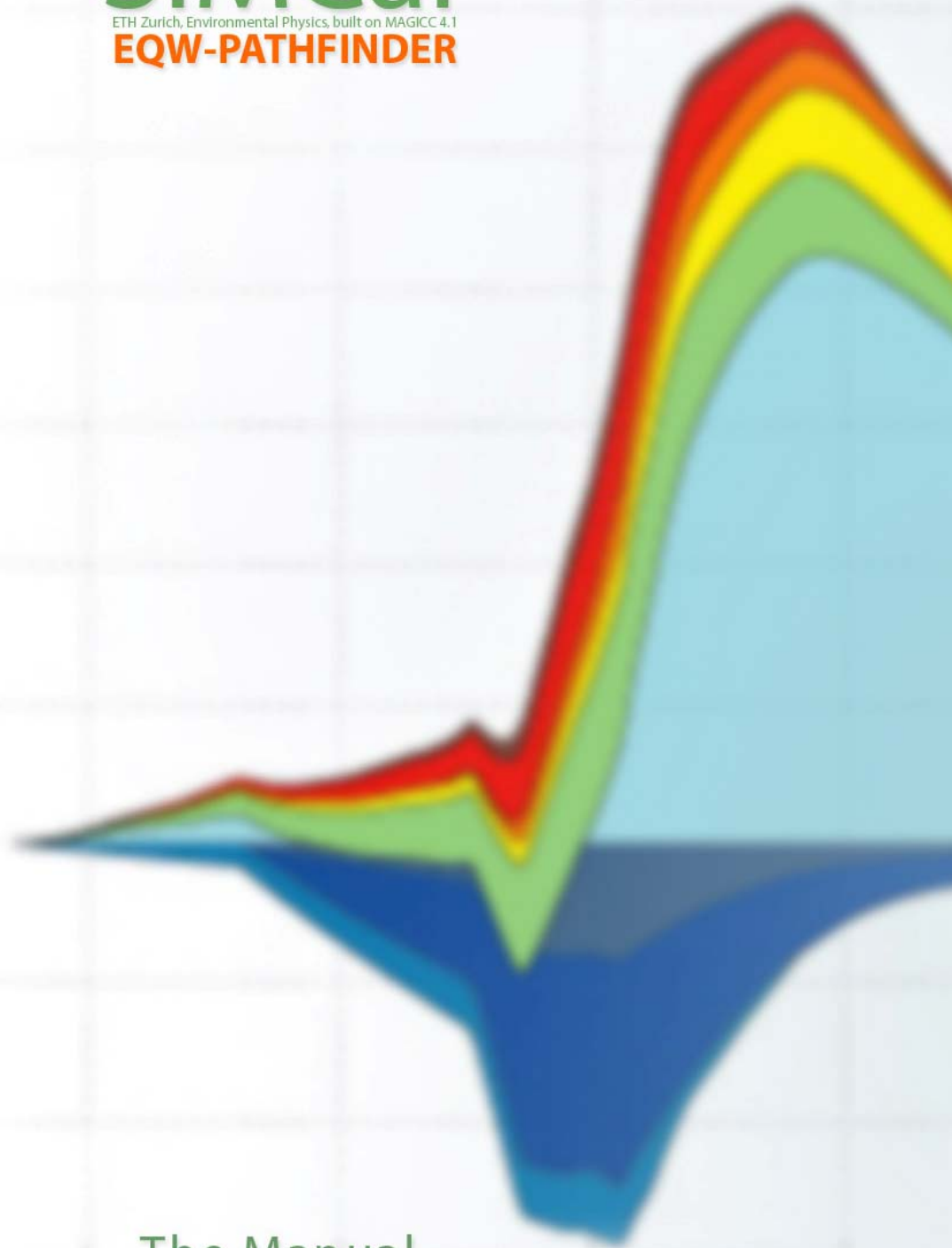


SiMCaP

ETH Zurich, Environmental Physics, built on MAGICC 4.1

EQW-PATHFINDER



The Manual

Malte Meinshausen, malte@simcap.org

- Did you ever want to create a greenhouse gas emissions pathway yourself?
- Have you been wondering how much emission reductions it takes up to 2050 to stabilize at 400 ppm CO₂ concentrations, or limiting warming to 2°C?
- And did you ask yourself how big of an influence a different climate sensitivity assumption might have?
- Or what might happen to the climate if we wait another ten years before bringing emissions down significantly?

SiMCaP's EQW-PATHFINDER might be the tool that you were looking for.

Concept of "Equal Quantile Walk" method:	Malte Meinshausen (ETHZ/NCAR), Bill Hare (PIK), Tom Wigley (NCAR), Detlef van Vuuren (MNP/RIVM), Michel den Elzen (MNP/RIVM) and Rob Swart (ETC/ACC)
SiMCaP's Manual, Scientific & GUI Programming:	Malte Meinshausen (ETHZ/NCAR)
Contact:	Malte Meinshausen Climate Analysis Section Climate and Global Dynamics Division National Center for Atmospheric Research P.O. Box 3000 Boulder, CO 80307-3000, USA tel: +1-303-497-1339 fax: +1-303-497-1333 Email: malte@simcap.org (or any of the other addresses given in this manual)

The manual for
SiMcaP's EQW-PATHFINDER
www.simcap.org

BETA 1.01

Malte Meinshausen
malte@simcap.org
Boulder, CO, 20 September 2005

SiMcaP's EQW-PATHFINDER is the accompanying software package for:

Meinshausen, M., Hare, B., Wigley, T.M.L., van Vuuren, D., den Elzen, M.G.J. and Swart, R.: 2005,
'Multi-gas emission pathways to meet climate targets', *Climatic Change*, pp.44. DOI:
10.1007/s10584-005-9013-2

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1. INTRODUCTION

The 'Simple Model for Climate Policy assessment' (SiMcaP) has been initiated in 2003. SiMcaP is in fact a suite of different components that grows slowly but steadily. The purpose of all modules is a common one: to assist policy makers and scientists alike when it comes to analyzing emission mitigation actions in order to avoid dangerous climate change.

The SiMcaP module 'EQW PATHFINDER' is a method to create multi-gas emission pathway to meet climate targets, like limiting global warming to 2°C. The method is described in detail in the paper "Multi-gas emission pathways to meet climate targets" by Malte Meinshausen, Bill Hare, Tom Wigley, Detlef van Vuuren, Michel den Elzen and Rob Swart (submitted to Climatic Change).

This quick manual is intended to guide the user through the graphical user interface of this bundled release of SiMcaP's EQW-PATHFINDER and SiMcaP's VIEWER. The expert user can as well look at and modify the source code although he has to do so primarily on his own without a manual.

2. GENERAL NOTES

- BETA-VERSION: SiMcaP's EQW-PATHFINDER software is distributed as beta-version. Thus, the user might find bugs, inconveniences, or insufficient comment lines in the software.
- BUG REPORTS WELCOMED: Please report bugs to oupsthereisabug@simcap.org
- NO SUPPORT: Unfortunately, we most likely don't have the resources to provide support. You can try though by sending a message to pleasehelpme@simcap.org. Please don't be disappointed, if we happen to be busy watering our plants or doing other stuff.
- COLLABORATIONS: If you plan a publication involving emissions pathways or other derivatives of this program, please inform us for a potential collaboration by sending an email to paperinpipeline@simcap.org.
- MAGICC INSIDE: This software is built on the simple climate model MAGICC 4.1, developed by Tom Wigley, Sarah Raper, Mike Hulme et al. Please see <http://www.cgd.ucar.edu/cas/wigley/magicc/> for updates, references and further information.
- GET UPDATES: if you want to be informed about new version releases, let us know by sending a (blank) email to keepmeupdated@simcap.org

3. LICENSE AGREEMENT

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Meinshausen, M., Hare, B., Wigley, T.M.L., van Vuuren, D., den Elzen, M.G.J. and Swart, R.: submitted, 'Multi-gas emission pathways to meet climate targets', *Climatic Change*, 50.



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4. INSTALLATION INSTRUCTIONS

A WORD ABOUT EFFICIENCY

You won't be pleased with the capabilities of this program if you have a low or medium performance machine. We know that the algorithms could be much faster, but we simply didn't invest the time yet. Still, SiMCaP's EQW PATHFINDER does some nice stuff, which might take slightly longer than using pencil and paper.

SYSTEM & SOFTWARE REQUIREMENTS

a) Standalone version (no MATLAB license required):

- Windows 2000/XP
- 512 MB RAM or higher
- 300 MB free hard disk space
- 1.6GhZ Pentium, equivalent or higher

b) Source-code version (MATLAB 7.01 or higher required):

- Windows 2000/XP
- 512 MB RAM or higher
- 200 MB free hard disk space
- 1.6GhZ Pentium, equivalent or higher
- MATLAB 7.01 or higher, including a couple of toolboxes, such as the statistics, spline, optimization toolboxes (and possibly others).

INSTALLATION STEPS, IF YOU DON'T HAVE MATLAB

Note: If you don't have MATLAB, no problem. You will be able to use the graphical user interface of SiMcaP's EQW-PATHFINDER and SiMcaP's VIEWER.

- 1) You will need two files for the installation process: MCRinstaller.exe and simcapeqw.exe. You can download these files from www.simcap.org > Models.
- 2) You first need to install the Matlab Component Runtime (MCRinstaller.exe) machine. Double click on MCRinstaller.exe. Follow the instructions on the screen.
- 3) Double click on simcapeqw.exe and unpack the archive to a folder of your choice, e.g. C:\simcapeqw\
- 4) Start SiMcaP by double clicking on simcap_eqw_start.exe, which is located in your SiMcaP folder, e.g. C:\simcapeqw\. Be patient: a black screen will appear for a minute or two during which another set of files is unpacked.
- 5) SiMcaP will now start. Future start-ups will be much quicker. Always start SiMcaP by double clicking on simcap_eqw_start.exe

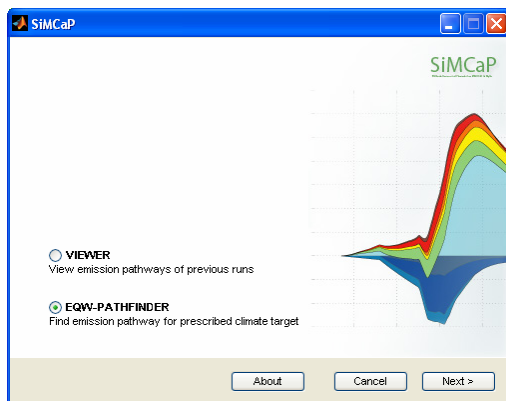
INSTALLATION STEPS, IF YOU DO HAVE MATLAB 7.01 OR HIGHER

Note: If you have MATLAB 7.01 or higher you will be able to use both, the graphical user interface as well as the command line version of SiMcaP's EQW-PATHFINDER. See Section "Expert Use of EQW-PATHFINDER".

- 1) You will need one file for the installation process: simcapeqw.exe. You can download this file from www.simcap.org > Models.
- 2) Double click on simcapeqw.exe and unpack it to a folder of your choice, e.g. C:\simcapeqw\
- 3) Start your MATLAB program and set the working directory to your SiMcaP folder, e.g. C:\simcapeqw\
- 4) Start SiMcaP by calling the function simcap_eqw_start.m.

5. WELCOME TO SIMCAP

The following screenshots are intended to guide you through the graphical user interface of SiMcaP. When using this SiMcaP software, you have basically two choices:

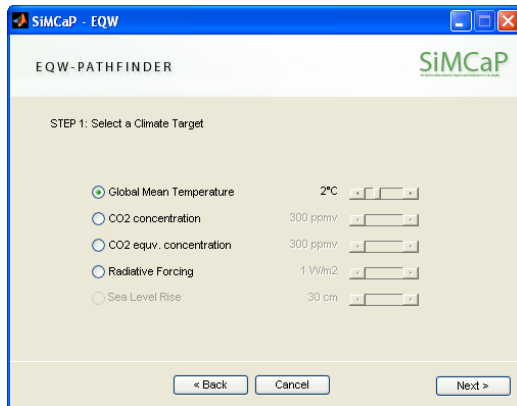


with section 7.

- a) EQW-PATHFINDER.
Design your own new emission pathway for a specified climate target. For this option, proceed with section 6 in this quick manual.
- b) VIEWER.
Browse EQW emission pathways that you have created previously. You can plot, save and compare emissions as well as look at some global mean climate effects associated with your emission scenario. For this option, proceed

6. SIMCAP'S EQW-PATHFINDER

STEP 1 OF EQW-PATHFINDER



Select your climate target, which shall be met by your new emission pathway. Hit "Next >".

STEP 2 OF EQW-PATHFINDER



Choose whether you want to create a PEAKING profile or a STABILIZATION profile. Specifically, the two choices are:

- a) PEAKING. The optimization routine within SiMCaP's EQW-PATHFINDER sets your specified climate target as an upper bound. Thus, SiMCaP attempts to find an emission pathway, which causes as much climate change as possible (yup), but never beyond your climate target.
- b) STABILIZATION. If you select this option, SiMCaP will be less concerned about whether your climate target is overshoot or not, but it attempts to create a best fit over time. Thus, the resulting temperatures, for example, might be a little above and below your climate target, e.g. 2°C, but the distance to 2°C is minimized. If you select STABILIZATION, you have an additional choice with the little slider bar on the right: You can choose, after which year SiMCaP shall be concerned about your stabilization target being met. See the following box "How to create a stabilization pathway" for more details.

TIP: HOW TO CREATE A STABILIZATION PATHWAY?

The best way to create a stabilization pathway is to separate the task into two chunks:

- 1) First, you design a peaking pathway that will match your ultimate stabilization pathway up to the year of maximum temperatures, concentrations or forcings.
- 2) Then, you take the optimized results of the peaking pathway up to that maximum and design a stabilization pathway for the years thereafter. The temperatures, concentrations and forcings can then either stay at maximum levels or decline to stabilize at lower levels (overshooting profiles).

Example: You want to create an emission pathway which leads to a peaking at 500ppm CO₂ equivalence before stabilizing at 450ppm CO₂-equivalence. Thus, what you do is:

First, design a peaking pathway with the climate target of 500ppm CO₂-equivalence.

- In STEP 1, you set the climate target to 500ppm CO₂-equivalence.
- In STEP 2, you choose "peaking pathway".
- In STEP 3, you choose an initial value for "Reduction Rate I", set its status to "free" and make your departure year choices.
- You follow the rest of the STEPs and let the optimization finish.

After the peaking pathway optimization successfully finished, you create your stabilization pathway.

- Start again at STEP 1, but this time you choose 450ppm CO₂-equivalence as your climate target.
- In STEP 2, you pick "Stabilization". Set the slider value to a year where you think the pathway is able to stabilize. If your peaking pathway peaks around 2100, and you want to stabilize at 50 ppm lower concentrations, then it would NOT be a good choice to set this slider value to 2100. You rather tell SiMcaP to be concerned about stabilization a little later, let's say from 2150 onwards.
- Now, if you click "Next >", you will be asked if you want to load configuration parameters of a previous peaking pathway. And yes, you do. Select the datahouse_*.mat file of your previously completed peaking pathway. This will now set the value of "Reduction Rate I" according to what SiMcaP's optimization found earlier for your peaking pathway.
- In STEP 3, you can set initial values of the start and slope of "Reduction Rate II". Leave the status of these parameters as "free", so that SiMcaP will vary them to best fit your stabilization target.
- In STEP 4, don't change any climate model parameters. They were already made consistent with your earlier choices in case you loaded the previous peaking pathway.

Click "Run" on STEP 5, sit back and enjoy.

STEP 3 OF EQW-PATHFINDER

The screenshot shows the 'EQW-PATHFINDER' window in 'STEP 3: Driver Path & Departure Years'. It features several input fields and checkboxes:

- 1. Driver Path:** OECD Departure Year: 2010 yr
- 2.** Red. rate I: free, Min: -10, Value: -2, Max: 0 %/yr
- 3.** Red. rate I: free
- 4.** Start R. II: 2020, 2040, 2400 yr
- 5.** Red. rate II: -10, -0.1, 0 %/yr
- 6.** REF Departure Year: 2010 yr; ASIA Departure Year: 2015 yr; ALM Departure Year: 2015 yr

Two line graphs are shown on the right. The top graph, labeled '7.', shows a red line representing the driver path for OECD fossil CO₂ emissions, starting at 1.0 in 2000 and decreasing to approximately 0.5 by 2100. The bottom graph, labeled '8.', shows a red line representing the driver path for other regions & gases, starting at 0.0 in 2000 and increasing to approximately 1.0 by 2100.

In this box, you can make selections in regard to the shape of the emission pathway.

- 1) Here you can tell SiMcaP how the driver path for emissions shall look like. This driver path will determine emissions for the other regions & gases.

Note: The details of what the EQW method actually does in order to get from the OECD fossil CO₂ driver path to the global emissions pathway are detailed in the accompanying paper "Multi-gas emissions pathways to meet climate targets". See as well Appendix A.

- 2) The OECD Departure Year. Determine after which year emissions in OECD countries shall leave the median path of all the 54 SRES & post-SRES scenarios.
- 3) Determine the reduction rate I. Set the emission reduction rate to your preferred value in the "Value" box, e.g. to -2%/yr. If you want SiMcaP to optimize this parameter in order to match your climate target, set its status to 'free' and determine the bounds within which SiMcaP is allowed to search ('Min' and 'Max').
- 4) Determine the year in which the emission reduction rate changes to rate II (only available in the stabilization option). Set the initial value for the optimization in the 'Value' box, determine the minimal and maximal years and change its status depending on whether you want SiMcaP to look for a better value.
- 5) Determine the reduction rate II and its optimization choices.
- 6) Determine the departure years for the other non-OECD SRES world regions: REF (Eastern Europe & Russia), ASIA (tricky abbreviation), and ALM (Africa and Latin America).

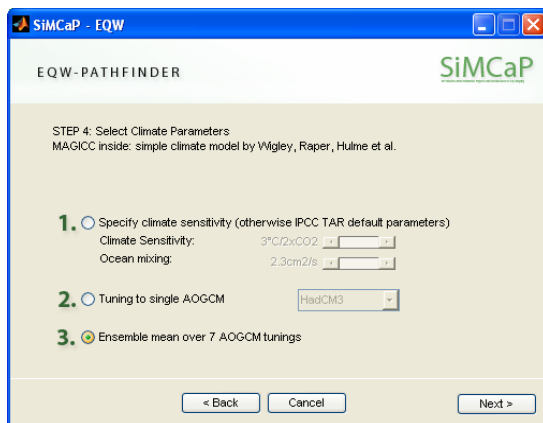
Note: If you choose these departure years to be different from the OECD one, SiMcaP will calculate hypothetical OECD fossil CO₂ emissions paths with your departure year choices. The corresponding "quantile path" is then derived and applied to the region-specific emission distributions. That's basically it, but you might want to have a look at the source code ('simcap_eqw_target_flesh.m') or accompanying paper, in case you are really interested.

- 7) The upper preview box shows relative emissions of your driver path (OECD fossil CO₂ in this version).

- 8) The lower preview box depicts the derivative of your driver path, i.e. the emission reduction rates. Note that these preview boxes do neither show the non-OECD emissions, nor the smoothing, which is applied when the emissions pathways are finally generated.

NOTE: If you don't set the status of any of the driver path parameters to be "free", SiMcaP will create an emission scenario without performing iterations. Thus, your climate target will not be met (or only by chance). This is obviously the fastest way to create new emission pathways

STEP 4 OF EQW-PATHFINDER

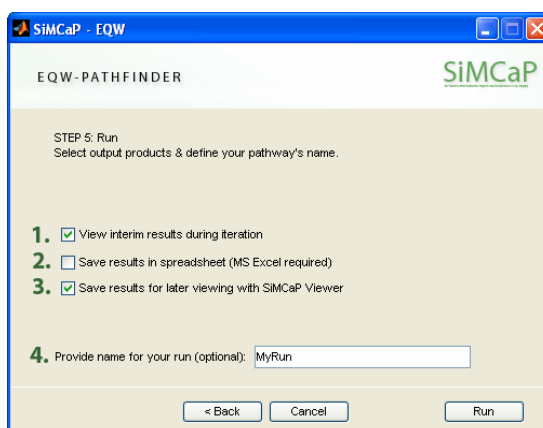


Choose, in which modus you want to run the inbuilt simple climate model (MAGICC 4.1 by Tom Wigley, Sarah Raper, Mike Hulme et al.). Your options are:

- 1) Specify the climate sensitivity and ocean mixing. For all other parameters, MAGICC is run with its default IPCC TAR parameters.
- 2) Use parameters that were derived to tune MAGICC to a specific AOGCM (the big models). See Table 9.A1 in IPCC WGI (2001) for details.

- 3) Run MAGICC seven times, each time tuned to one of the TAR AOGCMs and then average the results.

STEP 5 OF EQW-PATHFINDER



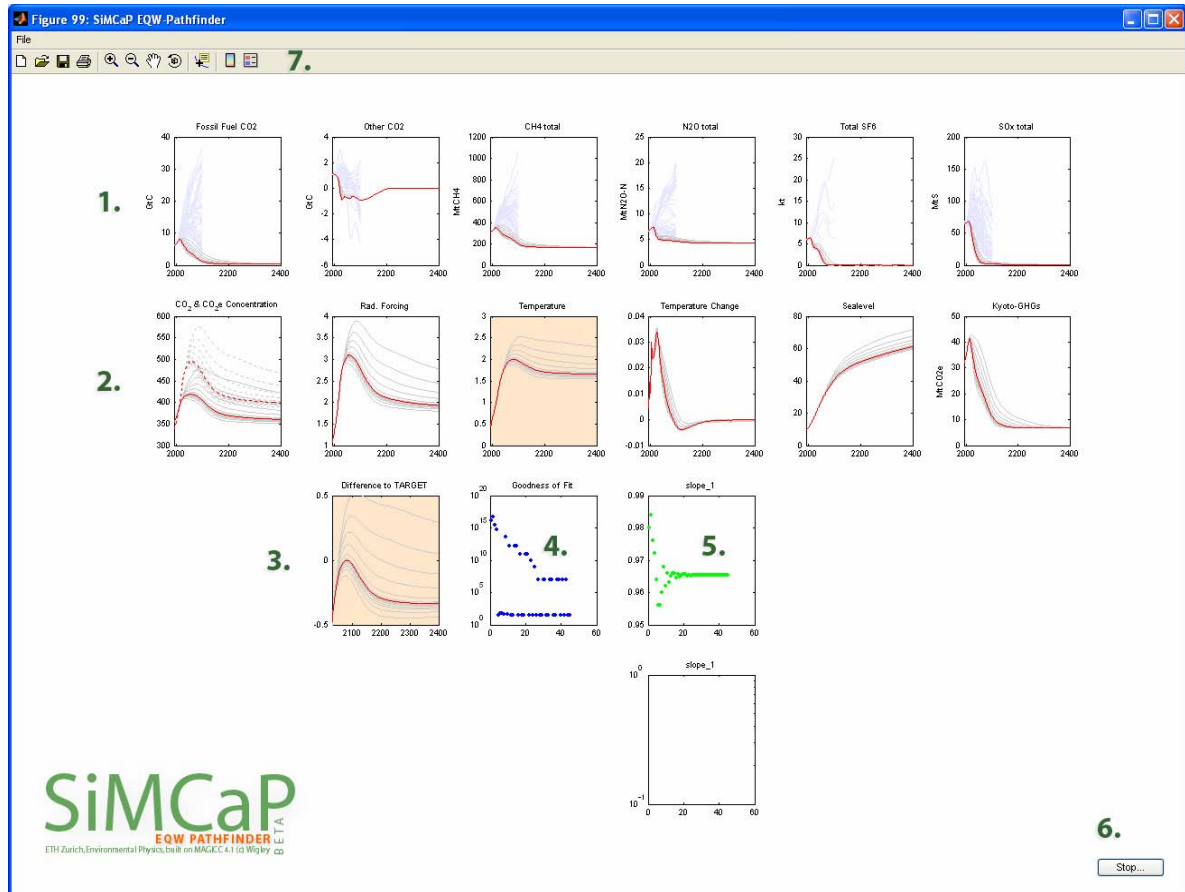
Choose the name of your emission pathway and the output.

- 1) Click this box, if you want to watch the iteration process in a big graph, which details emissions, climate effects, and optimization developments (see STEP 6 of EQW-PATHFINDER). In case you keep your computer busy over night, you might want to deselect this option as it will slow down the iteration process a bit.

- 2) Save a detailed version of all computed climate effects in an MS Excel file. This is basically the output of MAGICC for the final iteration.
- 3) Check this third box, if you want use SiMcaP's VIEWER to plot and save emissions and climate effects of your emission pathway. In other words, a

datahouse_*.mat file will be created, which can be very useful for later analysis (recommended option).

STEP 6 OF EQW-PATHFINDER



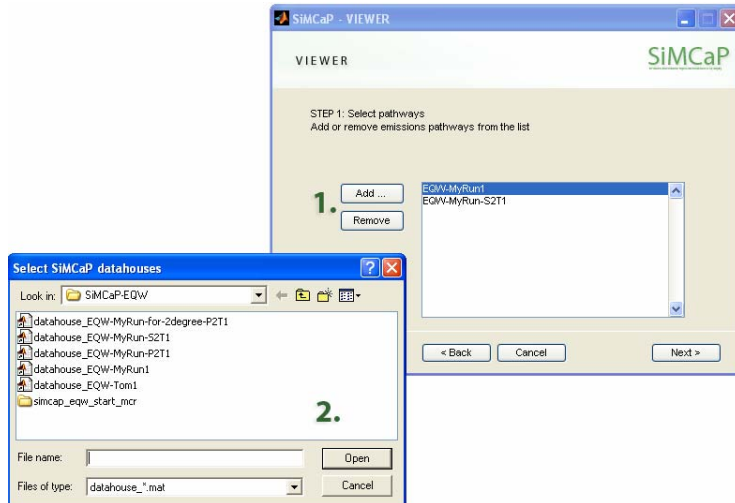
Watch the creation of your emissions pathway unfolding. This window will be shown, if you ticked the first box in the previous STEP 4.

- 1) The top row provides a selection of emissions (from left to right: fossil CO₂, landuse CO₂, methane, nitrous oxide, SF₆, and sulphate aerosols) with your emissions pathway shown in red. The thin grey lines up to year 2100 are the underlying 54 SRES & post-SRES scenarios. Emissions of ozone precursors and other fluorinated gases are not shown in the default setting.
- 2) The second row depicts some climate effects (from left to right: CO₂ concentrations (solid) and CO₂ equivalence concentrations (dashed), radiative forcing, global mean temperatures, the rate of temperature change, and sea level. The last box on the right shows the GWP-weighted sum of the greenhouse gas emissions without landuse CO₂ emissions (Kyoto-gases).
- 3) The third and fourth rows show some of the optimization indicators. The first graph is an excerpt of the red box in the second row showing the years over which the optimization is performed (minimization of mean-squared errors). The red box signals which climate target indicator you selected, in this case global-mean temperatures.

- 4) This box shows the goodness of fit criteria (y-axis) for each iteration step (x-axis). Ideally, these blue dots should come down over time (after around 10-20 iterations).
- 5) To the right of the goodness of fit box, there are up to three boxes which show the values for the "free" emission pathways parameters. Ideally, these green dots should converge over time.
- 6) At some point, when SiMCaP thinks it doesn't get better, the iteration process will be halted automatically. In the default setting, the termination criteria are pretty strict, so that you might judge before the automatic termination of the full iteration, that the latest iteration is "good enough". If you hit the "Stop..." button, SiMCaP will perform another two iterations to wind up and save your results (and if you hit the stop button a couple of times, you will be informed about this a couple of times).
- 7) After the iteration is halted (either automatically or by you), the toolbar & menu bar might provide useful. Not only can you save the figure in all kinds of graphic formats, you can as well click into the graphs using the 'data cursor', if you desire to do so. A little box will then inform you about the numerical values of the plotted lines. The real way to analyze your emission pathway is however to start your SiMCaP's VIEWER.

7. SIMCAP'S VIEWER

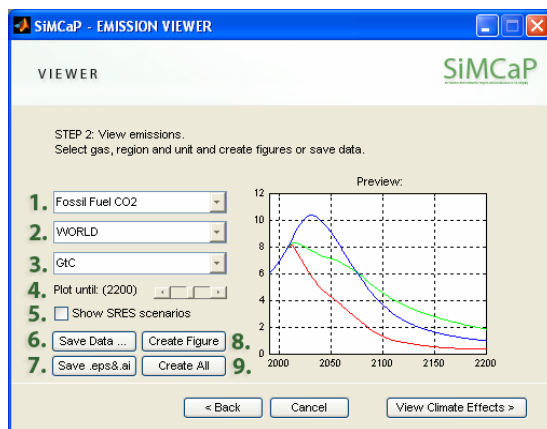
STEP 1 OF SIMCAP'S VIEWER



First, you have to select a previously created emission pathway or rather its datahouse_*.mat file, where * stands for the name of your emission pathway. Click "Add.." (1), make your selection (2) and proceed by clicking on "next >".

STEP 2 OF SIMCAP'S VIEWER

This is SiMcaP's emission viewer. You can now have a detailed look at all the different gases' emissions



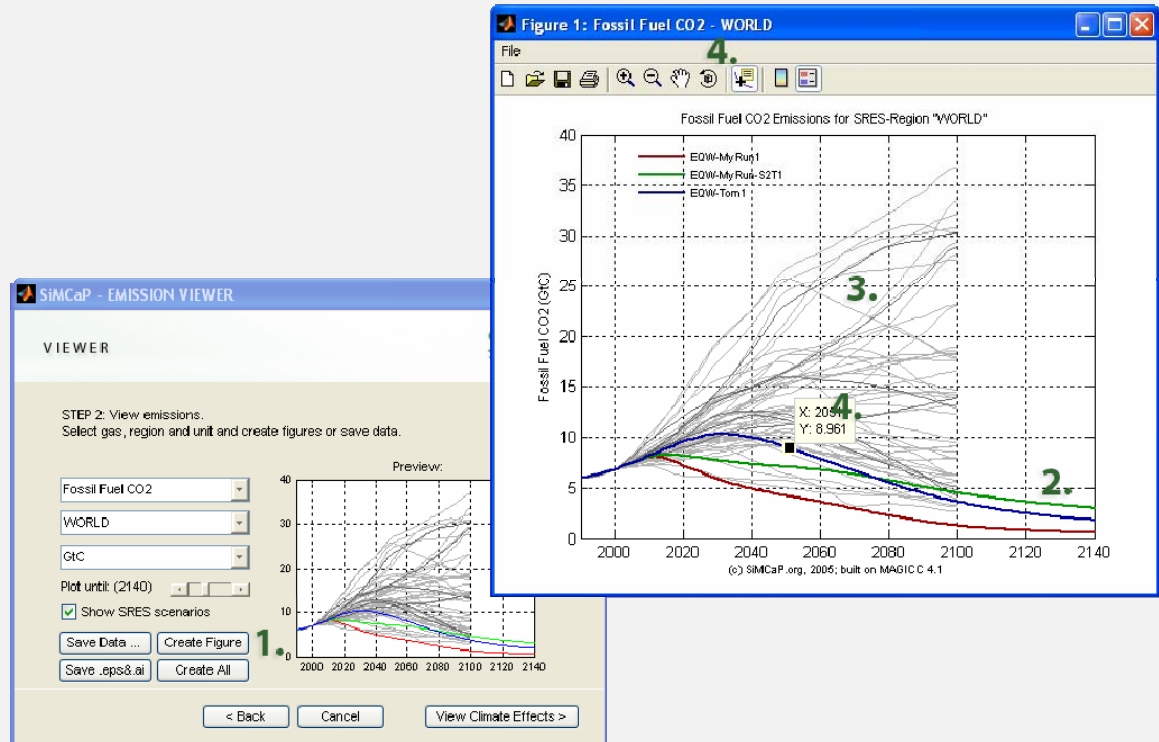
- 1) Select a gas of your choice from the whole set of emissions, namely fossil CO₂, landuse CO₂, methane, nitrous oxide, sulphate aerosols, some ozone precursors and the most important fluorinated gases.
- 2) Select the region. EQW pathways come with regional information for the four standard SRES world regions, which are the countries that belonged to OECD in 1990 (OECD), Easter Europe and Russia (REF), Asia (ASIA) and Africa &

Latin America (ALM).

- 3) You can choose the units. Either as absolute emissions or percapita emissions. To calculate the percapita emissions, the median population trajectory as given by Lutz et al. (Nature 412, p. 543-545, 2001) is assumed. Furthermore, for the greenhouse gases, you can choose between 'native' units and CO₂ equivalent emissions. IPCC Global Warming Potentials (1996) are used for the conversion.

- 4) You can specify the time horizon of your graph. Normally, the EQW emission pathways are created up to 2400, but you might be interested only in the next couple of decades.
- 5) Check this box, if you want to compare your emission pathways to the underlying set of 54 SRES & post-SRES scenarios.
- 6) If you click on "Save Data..." you can save the data of your plot as either MS Excel or ASCII file. The file will be put in your SiMcaP folder, e.g. C:\simcapeqw\.
- 7) Hit the "Save .eps&.ai" button, if you want to save the previewed figure as Adobe Illustrator (.ai) and Encapsulated Post-Script file (.eps). The files will be dumped in your SiMcaP folder.
- 8) Click "Create Figure" to see a larger version of your previewed figure (see Box below).
- 9) Click "Create All", if you want to create a series of overview figures, one for fossil CO₂, one for landuse CO₂ and one for each of the 14 other gases. Each overview graph will contain five boxes with emissions for the five standard SRES regions WORLD, OECD, REF, ASIA and ALM. An Adobe Illustrator file (.ai) will be saved in your SiMcaP folder for each figure.

TIP: How to create, save, plot and rotate figures.



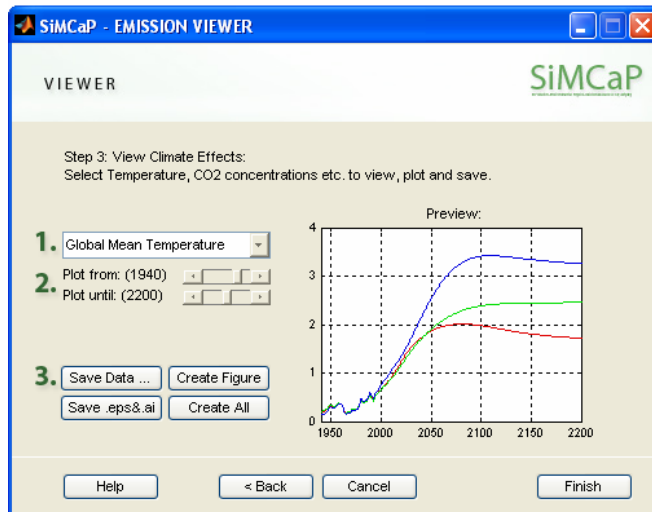
Click “Create Figure” after you defined gas, region and unit (1). A new window pops up, which shows your selected EQW pathways (2) as thick colored lines. In this example, the “Show SRES scenarios” box is selected, so the underlying scenario pool of 54 SRES & post-SRES scenarios is shown as well as grey lines (3).

From the toolbar you can select such useful choices as a “data cursor” (4). Activate the data cursor and click on any line. A little window will then tell you the numerical value of the year and emission level you selected.

In addition, the toolbar allows you to save the figure in a number of different graphic formats, print it, zoom in, or rotate it (with the latter option being probably the most useless one).

STEP 3 OF SIMCAP'S VIEWER

SiMcaP's Climate Viewer allows you to plot and save the climate effects of your created emission pathways.



- 1) Choose between global mean temperature data, temperature change, sea level rise, CO₂ concentrations, radiative forcing and CO₂ equivalence concentrations.
- 2) Set the ranges for which years you want to plot the data.
- 3) The four options "Save Data...", "Create Figure", "Save .eps&.ai" and "Create All" are more or less equivalent to the previous STEP's options (see above).

Note: Differences in climate effects might not only be caused by differences in emissions, but also by different climate model settings. Example: You can create two 450ppm CO₂ stabilization pathways, but if you choose different climate sensitivities during the creation process (see STEP 4 of EQW-PATHFINDER), different global mean temperatures will show up here.

Tip 1: If you want to compare your created EQW pathways on an equal footing, i.e. with the same climate model settings, you might want to run MAGICC with your EQW pathways. A user-friendly MAGICC version can be downloaded from <http://www.cgd.ucar.edu/cas/wigley/magicc/>. The necessary emission files to run MAGICC with your pathways were saved in your SiMcaP folder (e.g. C:\simcapeqw\) when you ran SiMcaP's EQW-PATHFINDER. The name of the files is EQW-*.gas, where * is your pathway's name.

Tip 2: If you are interested in more climate effects, e.g. the thermal expansion component of the sea level rise or the methane concentrations, you might want to select option 2 on STEP 5. This will save an Excel file, where you can find all the different MAGICC outputs, which are as well stored in the file MAG.OUT. You have to use a little bit of imagination to relate the abbreviations to the indicator that you are looking for...

8. EXPERT USE OF EQW-PATHFINDER

If you are lucky and have a license of MATLAB 7.0.1 or higher, you can run the SiMcaP program directly in MATLAB. This allows you to change the source code, explore additional settings and create bunches of new emission pathways with one run. However, you are assumed to be an expert user, so there is not much documentation for you, we're afraid. Only three hints:

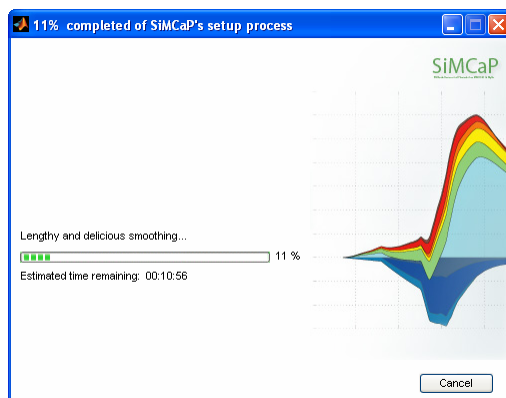
Hint # 1: There are two ways how to start the SiMcaP program when you run it in MATLAB.

- a) You can call the file `simcap_eqw_start.m`. This will start the graphical user interface just the same way as if you would run the standalone version.
- b) You will have additional options, if you start SiMcaP by setting your preferences in `simcap_eqw_preferences.m` and then calling `simcap_eqw_target.m`. There are some comment lines and examples in the file `simcap_eqw_preferences.m`, which might help you a little in regard to what you can do.

Hint # 2: If you happen to be really interested in the method and interested in exploring it to its limits, you can as well fiddle around with the `simcap_eqw_target_flesh.m` file. By setting some options differently and with a couple of extra lines of code, you can quite easily create your personalized EQW-PATHFINDER version. For example, you might want to avoid the constraints posed by the three free parameters for the driver path. Thus, you can create an EQW-PATHFINDER version that allows you to insert a time series of global CO₂ emission data as driver path. This will be useful, if you want to amend your specific CO₂-only emission pathway and turn it into a multi-gas pathway.

Hint #3: You might want to use a different pool of underlying emissions scenarios, such as adding EMF-21 scenarios. In this release, 40 SRES and 14 post-SRES scenarios and their emission characteristics are used to create the EQW pathways. What you will have to do is to standardize your additional scenarios in the same format as the SRES scenarios are standardized in the file

`sres.mat`. Then you have to fiddle around with some lines in the file `simcap_eqw_freq_cooker.m` to make it work. Next, delete the existing `freq.mat` file (or rather create a backup in a different folder). If you now start `simcap_eqw_start.m`, `simcap_eqw_start.exe` or `simcap_eqw_target.m` again, you will be asked to allow the creation of a new `freq.mat` file. This will take approximately 10 to 20 minutes depending on your computer.



Note: If you delete your 130MB `freq.mat` file, any new start of `simcap_eqw_target.m`, `simcap_eqw_start.exe` or `simcap_eqw_start.m` will result in the creation of a new `freq.mat` file, provided that the necessary emission information about the underlying scenario pool is available. Thus, if you don't delete the three files `sres.mat`, `sresf.mat` and `postsres.mat`, then a new `freq.mat` file will be created based on the emission characteristics of 54 SRES & post-SRES

scenarios.

If you change (bits of the) code, and make it work, we would like to ask you to make it public, acknowledge the original authors, and send us a version (newsimcapeqwversion@simcap.org) so that we can offer it on www.simcap.org (see License Agreement). When you explore the source code, you might find some of the little bugs that we hid there. Tell us, which ones you found by sending an email to ifoundabug@simcap.org. Thanks.

9. UNINSTALL

Uninstalling is easy. Uninstall SiMcaP simply by deleting the whole folder in which you placed it. In addition, you might or might not want to uninstall the MATLAB Component Runtime machine. Do so by going to "START > Control Panels > Add or Remove Programs" and then click on "remove" next to the MATLAB Component Runtime entry.

10. ACKNOWLEDGEMENTS

As this software release would not have happened without all the work that went into the accompanying paper "Multi-gas emission pathways to meet climate targets", the co-authors of the paper are warmly thanked, namely Bill Hare, Tom Wigley, Detlef van Vuuren, Michel den Elzen and Rob Swart. Without the MAGICC software that is designed by Tom Wigley, Sarah Raper and the others, this SiMcaP project would have never learned to fly. Thus, warm thanks in this direction. Furthermore, the Swiss Federal Institute of Technology (ETH Zurich, Switzerland), RIVM (Bilthoven, Netherlands) and NCAR (Boulder, CO, USA) provided valuable support in terms of salaries, office space and infrastructure. A big thank goes to all past and future users that are brave enough to install this software on their machines and help by providing valuable feedback.

11. APPENDIX A

The following Figure provides you with an overview of how the EQW emissions pathways are generated. It is Figure 1 in the accompanying paper, which you might want to consult if you are looking for more detail: Meinshausen, M., Hare, B., Wigley, T.M.L., van Vuuren, D., den Elzen, M.G.J. and Swart, R.: 2005, 'Multi-gas emission pathways to meet climate targets', *Climatic Change*, pp.44.

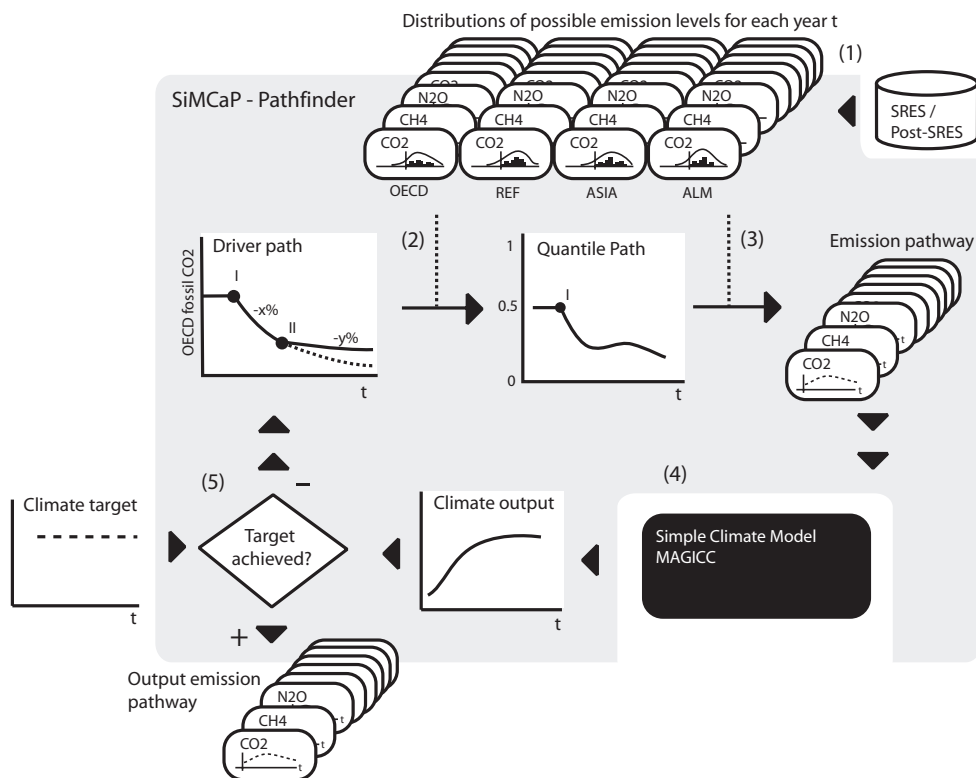


Figure 1 - The EQW method as implemented in SiMCaP's 'pathfinder' module. (1) The 'distributions of possible emission levels' are distilled from a pool of existing scenarios for the 4 SRES world regions OECD, REF, ASIA and ALM. (2) The common quantile path of the new emissions pathway is derived by using a driver emission path, such as the one for fossil CO₂ emissions in OECD countries. The driver path is here defined by sections of constant emission reductions ('-x/y%') and years at which the reduction rates change ('I' and 'II'). (3) A global emissions pathway is obtained by assuming that - in the default case - the quantile path that corresponds to the driver path applies to all gases and regions. (4) Using the simple climate model MAGICC, the climate implications of the emissions pathway are computed. (5) Within SiMCaP's iterative optimization procedure, the quantile paths are optimized until the climate outputs and the prescribed climate target match sufficiently well.