HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

CANDY Technical Issues & Handling

Description of Usage

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CANDY Version 2015

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Introduction

This document provides an overview of:

- the general system setup,
- preparing and running simulations with the CANDY interface,
- the usage of batch files for simulations without CANDY interface, and
- a checklist to avoid errors.

CANDY simulates the dynamics of carbon and nitrogen in the unsaturated (vadose) zone of agriculturally used soils. The model application should preferably be focused on sites with a rooting zone of up to 2 m. If required, simulation of water and nitrogen movement may be extended to deeper profiles. The soil profile is divided into homogeneous layers of 1 dm thickness each. The simulation proceeds in daily time steps. Starting from initial values for all state variables the model simulates the impact of management and climate on them. The following processes are included:

- climate conditions (access to database or generating climate data, correction of systematic errors of observed precipitation),
- soil water dynamics (potential and actual evapotranspiration, percolation through soil),
- soil temperature dynamics,
- turnover (mineralization and humification) of organic matter in soil,
- nitrogen dynamics (mineralization, immobilization, uptake, leaching, gaseous losses, symbiotic N fixation).

CANDY comprises a user interface (Figure 1) that is organizing the access to the data, the preparation of simulation tasks, and the simulation model itself. The data is kept in a database. A list of recently used databases (red box in Figure 1) is shown in the main window where you can quickly select the appropriate one. Each database may contain a number of folders representing meaningful subunits, e.g. different experiments or groups of fields or farms. Each folder contains a number of single farm fields or experimental plots whereby each of them is treated homogeneously over time. That means if fields have been divided in the past it is necessary to handle them as separate plots. In standard mode the plots are the smallest units for the process simulation. For site heterogeneities it is recommended to apply the GIS mode.

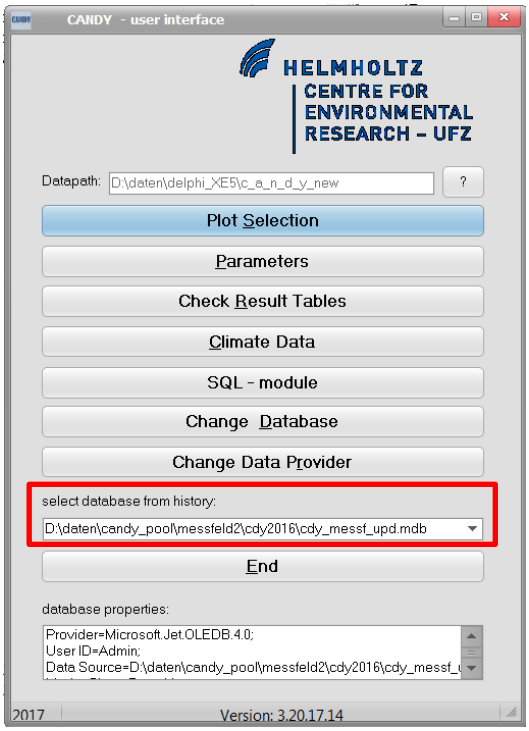


Figure 1: CANDY User interface - starting window

A simulation task consists of a site description and the scenario data. The site description includes climate data and parameters of the horizons in the soil profile.

The climate data (daily time steps) consist of:

- air temperature at 2 m height (°C)
- global radiation (J cm-²) or daily sunshine duration (h)
- precipitation (mm)

For each horizon the following parameters are used:

- depth of the horizon (dm)
- stone content (Vol. %)
- bulk density and particle density (g cm^{-3})
- soil moisture (Vol.%) at field capacity and wilting point
- soil texture: mass fraction (M.%) of clay, fine silt, and silt (the model also accepts the amount of particles < 6.3 µm as FAT parameter)
- saturated hydraulic conductivity (mm d^{-1})

- C_{org} concentration (%); if physical parameters are considered to be state variables, the value has to be consistent with the given soil physical parameters

The scenario data include the agricultural management and the description of initial conditions. These can be reconstructed from detailed observations. If no measurements are available, the model initialization can be based on information about former SOM reproduction. It may be helpful to apply the CCB model (see http://www.ufz.de/index.php?en=13999) to reconstruct carbon reproduction flux from crop rotation and average yields in history. Furthermore required are information about soil moisture (given as part of field capacity) and an indication of the nitrogen state at starting time. Alternatively it is recommended to include several years as 'pretreatment' for model spin up.

The model needs the description of the following farming activities (management) on each field:

- soil tillage: date, used device, tillage depth (cm), maximum regarded depth (dm)
- irrigation: date, applied water amount (mm)
- application of mineral N fertilizers: date, N amount (kg ha^{-1}), type of fertilizer, share of NH_4-N (%)
- organic amendments: date, type of organic matter, fresh matter amount (dt ha^{-1}), C amount (kg ha^{-1}) (Note: In case of slurry application, additional information about dry matter content, total nitrogen content, and mineral nitrogen content can be used by the model.)
- cropping: date of sowing and/or emergence and harvest, crop yield (dt ha^{-1}) and N uptake with main and side product (kg ha^{-1}), usage of the side product (removed or left on field) (Note: If by-products are not removed and data are available it is recommended to apply this as organic amendment instead of using the 'left on field' option.)
- ploughing: (see soil tillage)
- cutting of grassland and forage crops: date, yield (dt ha^{-1})
- grazed grassland:
    - start grazing: day, number of cattle units driven to the plot
    - stop grazing: day, number of cattle units removed from the plot

General system setup

You should have the candy.exe, borlndmm.dll, and an empty CANDY database (demo.mdb), which is based on a MS ACCESS database with the CANDY-specific tables and parameters. Copy all files to a directory where you have read and write access and start CANDY.exe. Starting CANDY the very first time you will see a window like this (Figure 2):

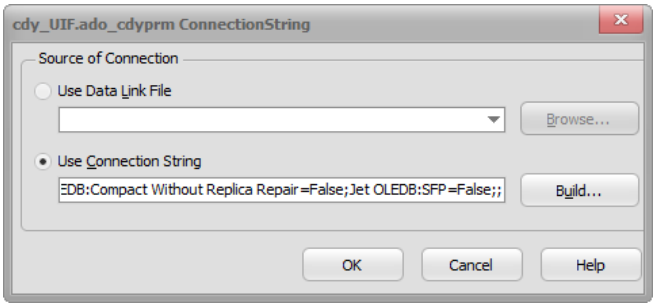


Figure 2: Building a data connection

Click on [Aufbauen/Build] to tell the model how it can connect to the database. Turn to the tab "Provider" and choose a DB-Provider (Figure 3). The selection of Microsoft jet 4.0 OLE Provider is recommended, but the Microsoft Office 12.0 Access Database […] Provider works as well.

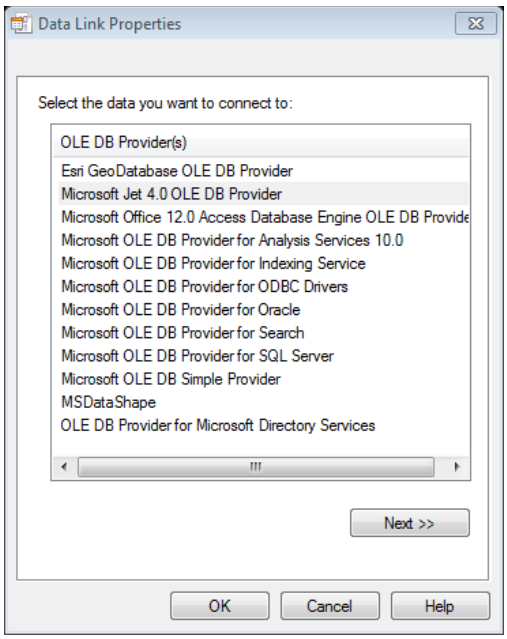


Figure 3: Select a data provider

Click on [weiter/next], which switches to the tab "Verbindung/Connection" and specify the filename (and path) of the CANDYAccess database that came together with the candy.exe by clicking on the […] button (Figure 4). It is strongly recommended to make a copy of the demo.mdb database and give it a new name that reminds you to the content (e.g. cdy_my_experiment.mdb).

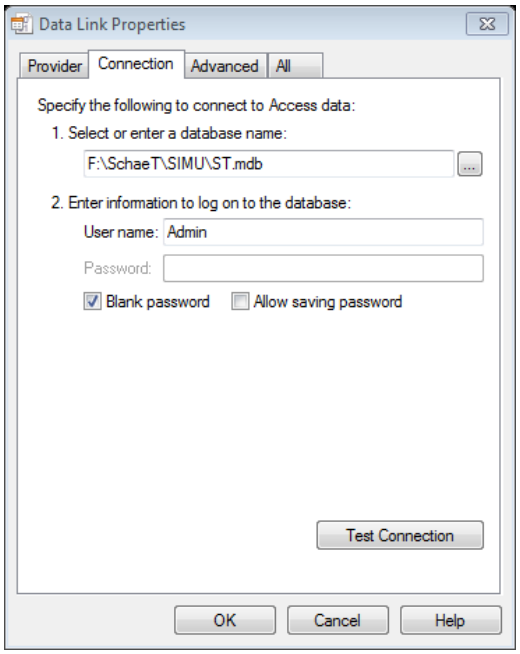


Figure 4: Select the required data base (.mdb)

After finishing this step click on [OK]. You may check the connection with [Test Connection/Verbindung testen]. The connection string is now built up (Figure 5). After clicking [OK] you should have a proper running CANDY showing its data connection in a list box.

This procedure is only required if you copy the CANDY system on a new computer where it has not been used before. The following CANDY starts will always show the database that you have used the last time.

Technical preparations

There may be some adaptations required to make CANDY running properly

If you edit the data with the CANDY interface it is essential to use a decimal point as decimal symbol (!) because all data changes are made via SQL which is using the semicolon as list separator! Furthermore it is recommended to have a short date format as dd.mm.yyyy. These settings can be customized or checked at the MS-Windows Control Panel under "Region and language" (German: Systemsteuerung "Region und Sprache") and [Additional Settings/Weitere Einstellungen] (Figure 5).

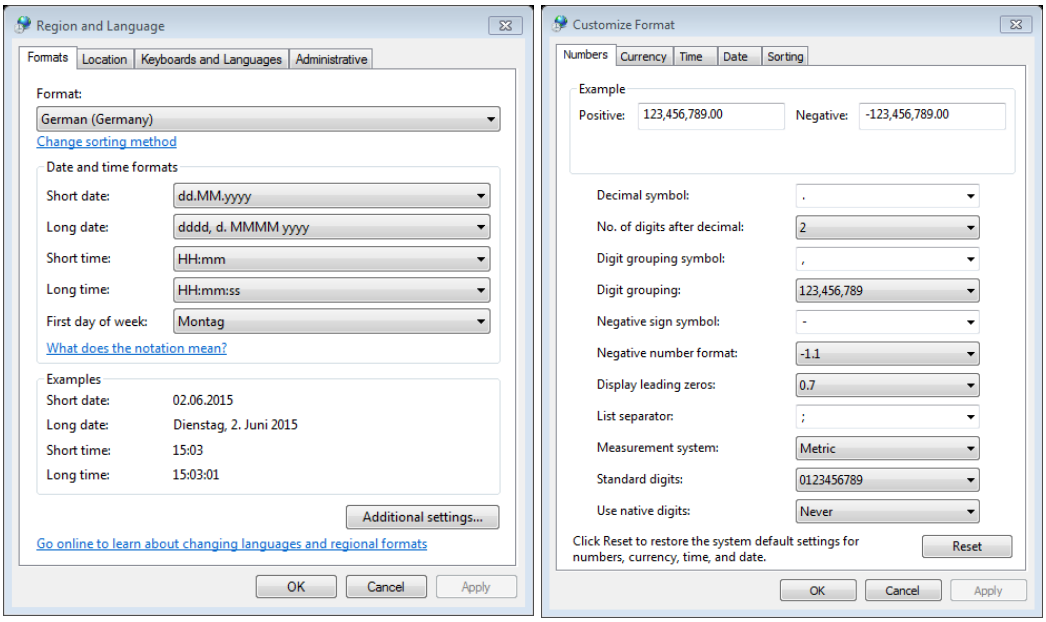


Figure 5: MS-Windows Control Panel "Region and Language" (left) to control the [short date/Datum (kurz)] entry and the [additional settings/Weitere Einstellungen] (right) to customize the [Decimal/Dezimaltrennzeichen] and [Digit grouping symbol/Symbol für Zifferngruppierung]

If required, the user may change the settings in the registry database of the windows system (Figure 6). Therefore you need to start the program regedit.exe that is localized in the windows folder. The information is stored under

➔ HKEY_CURRENT_USER/Software/candy

and

➔ HKEY_CURRENT_USER/Software/candy/switches

If changes are necessary users should proceed very carefully to avoid problems with the CANDY model.

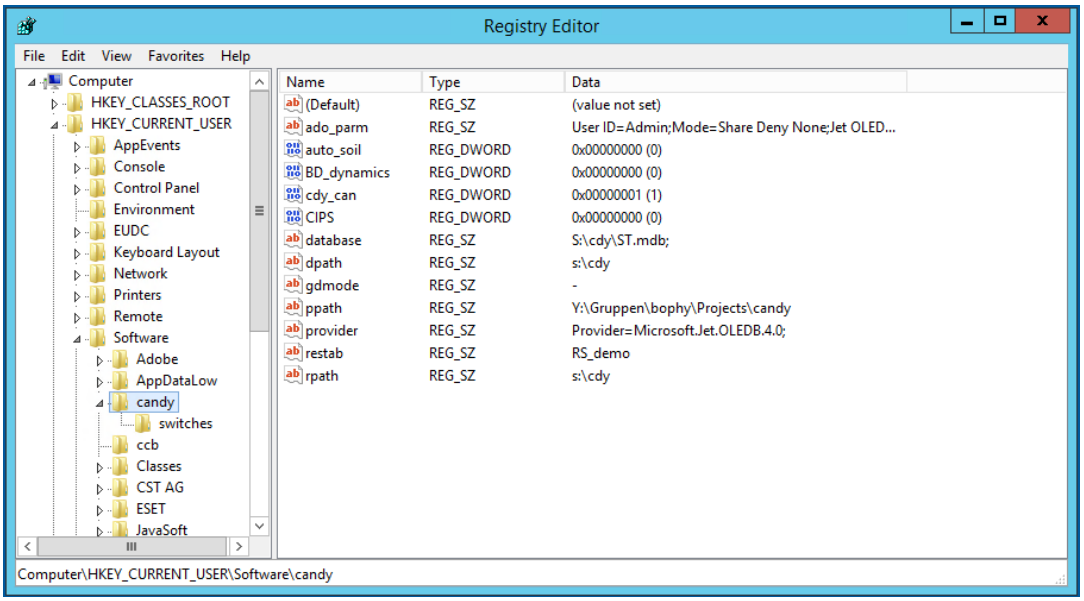


Figure 6: Registry Editor with the keys for the CANDY model

Preparing a simulation run

Any preparation should include at least following steps:

- provide and check soil data
- provide and check climate data
- create a field or a plot in order to define the simulation object (plot selection)
- provide and check farming activity data
- provide and check measurement data (optionally)

General functions on the database form

Creating a new folder and deleting folders

Right-click on the uppermost (database) symbol in the tree view and click on [create a new folder] in the context menu (Figure 7).

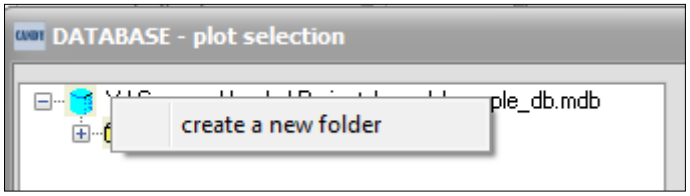


Figure 7: Creating a new folder

In the subsequent dialog you have to enter the name (5 characters) of the new CANDY folder (Figure 8) and click the [create] button. For details of the tree view structure see Figure 9.

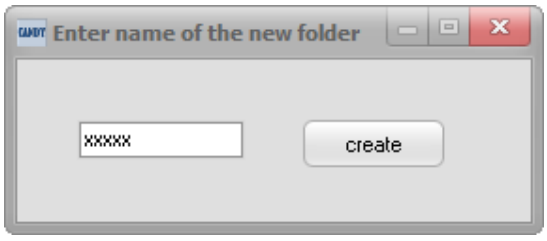


Figure 8: Enter name of the new folder

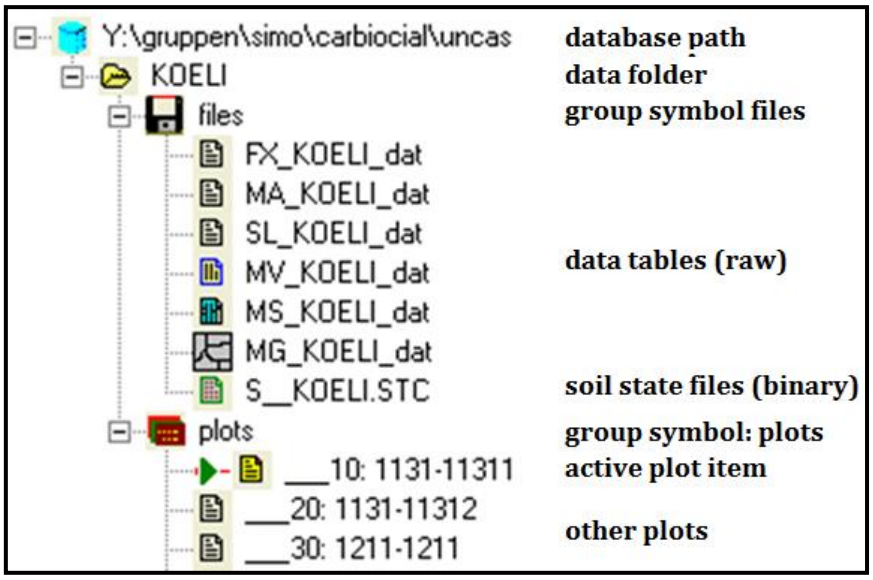


Figure 9: Tree structure overview

The context menu of a folder also includes a deleting option [delete folder]. There will be a warning that you are going to delete **all** plots in this folder.

Creating a new plot and deleting plots

Right-click the *plots* symbol of the database to be extended, select the [add a new plot] option in the context menu. If you want to use data from another plot (even from another database) open the appropriate tableau and move the data (drag and drop) from one plot item on (of?) the tree view to another.

For deleting plots select the option [delete active plot] from the context menu (right-click on the *plots* symbol) to delete the activated plot (indicated by a yellow symbol in the tree view). Or use the [delete this plot] option by right clicking on the selected plot.

Editing tables of the user data

Activate the *files* symbol of the appropriate database and then the table that is to be changed. You may edit the data directly in the table view. To insert new records, move the pointer to the last record and press the [↓] key. The data is saved by leaving this record. To delete a record you have to press [CTRL]+[DEL] and confirm the deleting action. Deleting a record in your FX table means to remove a plot from the database, but without deleting the corresponding records in the other tables.

The MS table holds the simulation results. With a right click you can switch between the file mode (plain table) and evaluation mode (graphic display).

Definition of simulation objects

A simulation object is a plot or subplot that is considered homogenous in terms of climate, soil, and management. Different plots are aggregated in a database

consisting of (i) fixed data (FX_xxxxx_dat), (ii) management data (MA_xxxxx_dat), (iii) measurement data (MV_xxxxx_dat), (iv) results from manure/slurry analysis (SL_xxxxx_dat), and (v) data about the system state that can be used as initial values (S__xxxxx.stc [binary file]) (Figure 9).

After opening the Database with [Plot Selection] (**Fehler! Verweisquelle konnte nicht gefunden werden.**) you can edit the data on the sheets [Basic-Info], [Management], and [Experimental Values].

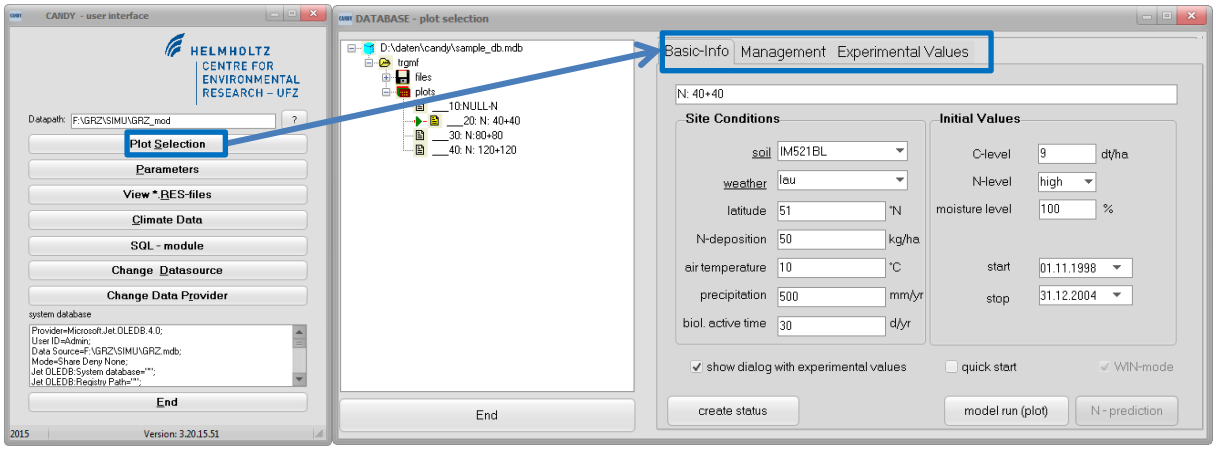


Figure 10: Plot and Basic-Info overview

Basic-Info

The [Basic-Info] sheet shows all data describing the plot and the simulation scenario, which includes the plot name and the panels **Site Conditions** and **Initial Values**.

Site Conditions

The description of site conditions is based on:

- soil: profile selection from popup (should be prepared in advance, see chapter Soil data)
- weather: climate station selection from popup (should be prepared in advance, see chapter Climate data)
- latitude: only required to transform sunshine duration into global radiation
- N-deposition: an annual average of solid, liquid, and gaseous N compounds
- air temperature: long-term annual average temperature
- precipitation: long-term annual rainfall
- biologic active time: if available it will be used to estimate the initial SOM pools

Initial Values

The panel **Initial Values** shows indicators of plot history together with the time frame of the planned simulation task.

-plot history

C-level: average annual input of reproducing carbon into SOM (Crep ≈ 8..12)

N-level: indicator of the intensity of previous N fertilization

Note: link to soil parameters *nin0* and *k_nin* (see chapter Soil data), which are useful for a quick start without evaluation of the N_{min} content. Nevertheless, it is recommended to add an appropriate N_{min} estimation to the [Experimental Values] (See chapter Experimental values), rather than this indicator.

moisture level: relative filling of usable field capacity at simulation start

Note: if information about the water content is available it could be added as initial value to the [Experimental Values] with model adaptation checked.

These data are used to determine specific initial values for the SOM pools, the mineral soil nitrogen, and soil moisture according to the farming intensity as a rough estimation. A better adaptation to real site conditions is possible if measurement data are available. The SOM initialization routine will try to use information about biologic active time (BAT). If not available, BAT will be calculated from soil texture, air temperature, and precipitation. These options have no impact on the result if the SOM pools will be adapted from measurement values.

-time frame

Start: simulation starting date; from this date climate and management data are required. Be aware of starting a simulation run before sowing or emergence of the crop.

Stop: simulation will finish at this date

If you want to use status file support you should as well press the [create status] button. The status calculation is based on the plot history data, the selected soil profile, and the BAT that will be calculated from soil texture, temperature, and precipitation. If you change these data you should create a new status record in any case.

Management data

Select the [Management] sheet to insert or edit the farming activities for the simulation scenario. Click on the [Insert Record] to edit and add a new record. Therefore, specify the date, select the farming action (upper drop down), and edit the details (subject and intensity). For a further specification of the intensity you may change the auto-filled content of the field at the bottom (green box).

To overwrite data, select the specific record in the table and change the information using the drop down menu on the lower part of the form.

To save and store the data, press the [insert] or [update] button. Furthermore records can be deleted with the [delete record] button and be printed with the [print] button.

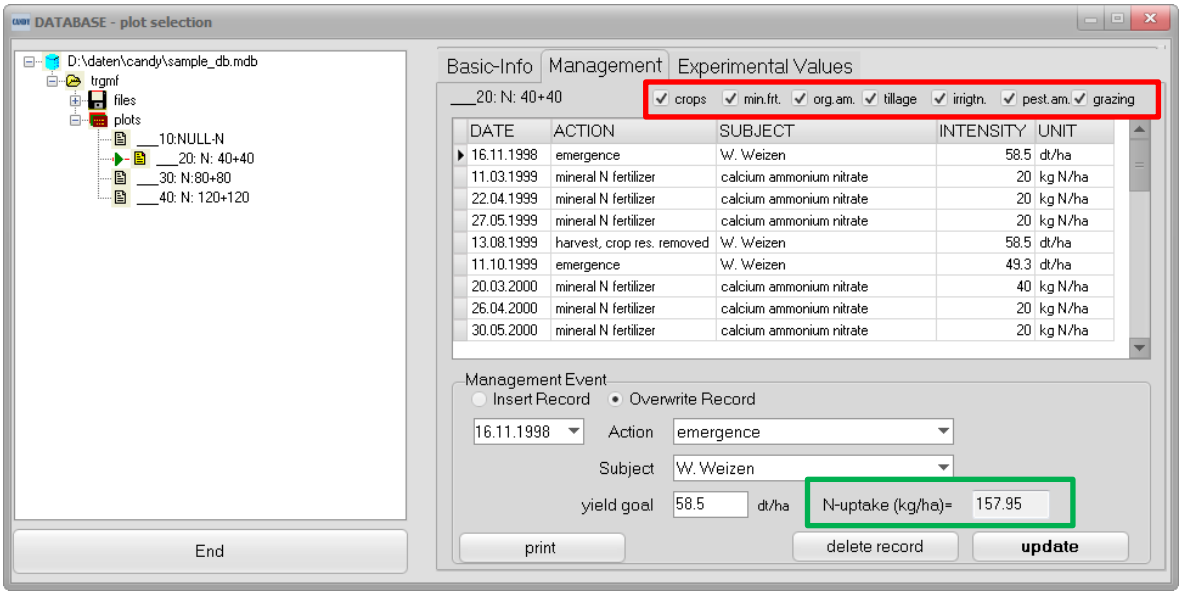


Figure 11: Editing management data

The check boxes in the upper part (red box) may be helpful to filter long data sets for a better overview. You can add or remove ticks to set which parameters should be displayed: crops, mineral fertilization (min.frt.), organic amendments (org.am.), tillage, irrigation (irrigtn.), pesticide application (pest.am.), grazing.

Experimental values

Select the [Experimental Values] sheet to edit your observation data. If you want the model to fit right through a data point, you should check the adaptation option [model adaptation] (ADAPT = Y, default = N). In this case internal model values will be overwritten with the observed value. Usually you won't check this option and CANDY stores the calculated values for an evaluation of the simulation results.

To reduce the number of selectable properties you can filter the parameter type and select the corresponding parameters in the drop down field below.

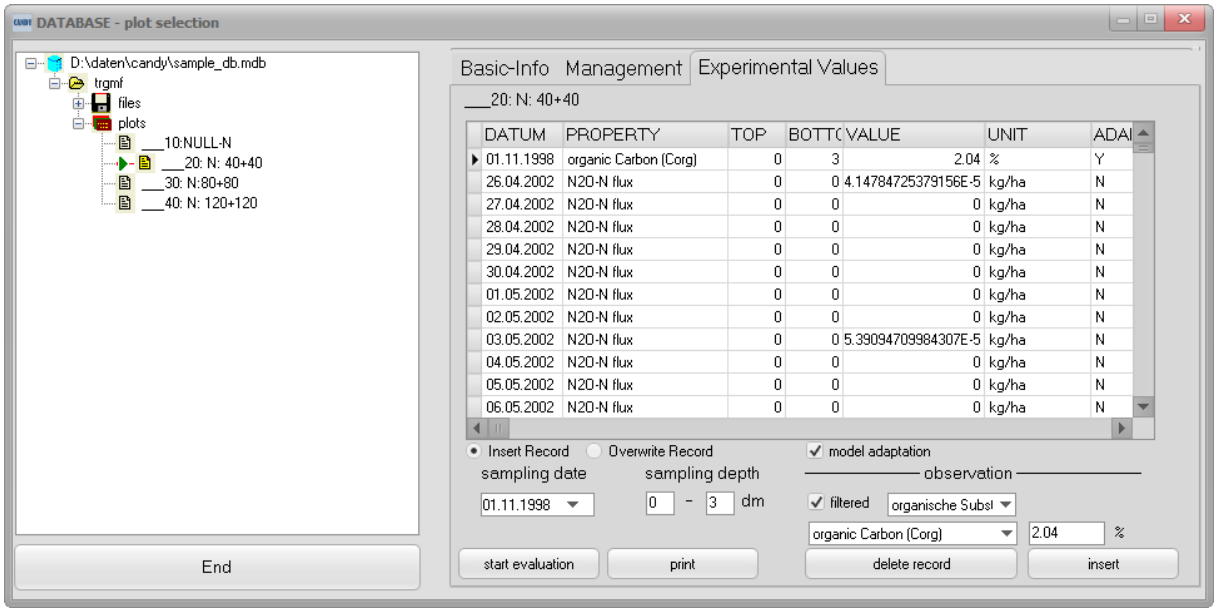


Figure 12: Editing measurement data

Soil data

There are two ways to access soil data. After starting CANDY, click on [Parameters] to open the sheet [Soil Profiles] with the profile and horizon description (Figure 13 A). Alternatively you can access this sheet by double clicking the [soil] label from the [Basic-Info] sheet in the Plot Selection window (Figure 13 B).

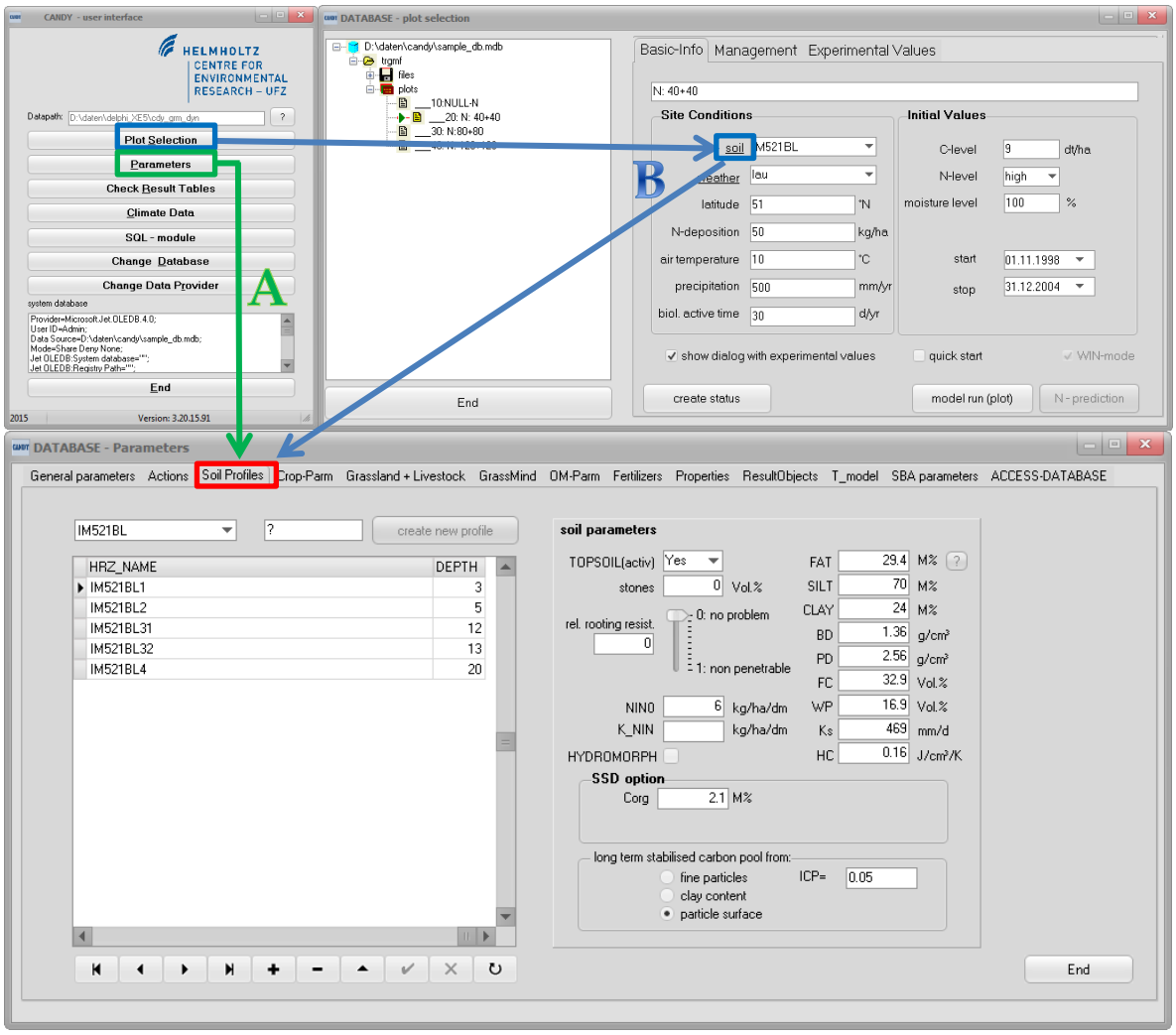


Figure 13: Soil Profile Sheet for editing soil data

You should describe the soil profile for the specific scenario. In order to create a new profile, replace the [?] with the name of the new profile and press the [create new profile] button. Then it is possible to edit the depth (lower boundary) and the soil parameters of each horizon. The cursor has to be moved to an empty line ([↓] key) or click the [+] button in order to insert a new horizon record.

The parameters of each horizon are listed on the right hand side of the sheet. Soil texture is mainly characterized by the FAT value that represents the particles < 6.3 µm (clay + fine silt). If available, the values for clay (particles ≤ 2 µm) and silt (particles ≥ 2 µm and ≤ 63 µm) should be added. FAT will be calculated internally based on clay and silt content by clicking the [?] button while the FAT field is active.

Other parameters are:

TOPSOIL (active):	Yes (1) = tillage horizon, modelling of OM-turnover, No (0) = otherwise
rel. root resist:	modifier (0..1) to adapt default root development to the specific soil conditions
stones:	stone concentration [Vol. %]
HYDROMORPH:	if checked horizon is permanent saturated with water
NIN0:	standard value (level 2) of nitrate N (kg ha^{-1}) in a 1 dm soil layer.
K_NIN:	describes the changing of NIN0 amount per level
FAT:	soil particles < 6.3 µm
CLAY:	soil particles ≤ 2 µm
SILT:	soil particles ≥ 2 µm and ≤ 63 µm
BD:	bulk density (g cm^{-3})
PD:	particle density (g cm^{-3})
FC:	water content at field capacity (Vol. %); usually at pF 1.8
WP:	water content at permanent wilting point (Vol. %); at pF 4.2
Ks:	saturated hydraulic conductivity (mm d^{-1})
HC:	heat capacity of soil substrate (default: 0.16)
C_{org}:	organic carbon [M. %] should be only filled if using the SSD option and the impact of SOM on soil physics should be simulated.

Furthermore, the description of a topsoil horizon includes a selection of the model type that will be used for the calculation of long-term stabilized carbon (LTSC). The available options are:

- Fine particles: LTSC := FAT * ICP; selecting this option you have to specify the parameter value for ICP. Its usual range is 0.04...0.06.
- Clay content : LTSC := f(clay); see Rühlmann (2002) (see CANDY Manual)
- Particle surface: following Puhlmann et al. (2006) and Kuka (2005); LTSC is associated with the surface area of micropores, indicated by WP (recommended option) (see CANDY Manual: chapter Soil organic matter turnover).

Climate data

The module climate data provides the possibility to edit or verify the climate data. Of course you could as well use other tools to compile the data. The table view of the selected climate data file supports also pasting of data from other sources. This has to be done separately for each column. Click on [Climate Data] to open the window with the climate data (Figure 14).

DataTable

Here you can fill in your climate data.

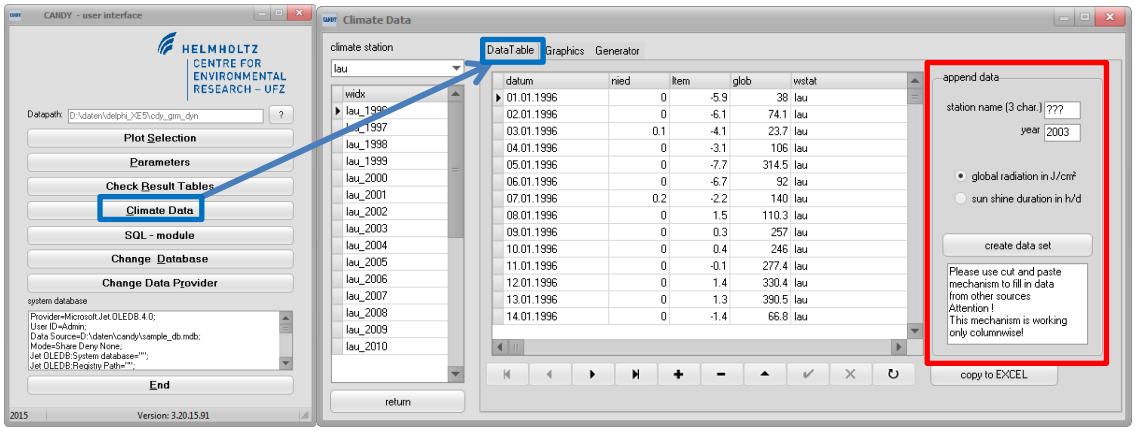


Figure 14: Editing climate data

Copy the data to the clipboard as usual and click the right mouse button on the first (upper) cell where you want to start the pasting. Click on the *paste* command of the appearing context menu.

For the whole time interval of the simulation scenario the climate data have to be provided in daily time steps without any gaps. Practice shows that temperature and radiation data can also be used from distant stations, but precipitation data should be used from a local data set. The available data can be checked selecting a climate station and the appropriate year. Users who don't want to edit the data directly in the ACCESS database can append a new dataset using the elements on the right panel (Figure 14, red box). You may use the copy and paste function (right click on empty field) to fill the data grid. The option [copy to EXCEL] may be helpful to use the climate data in another task.

For larger datasets it may be possible that the climate data contain for several years sunshine duration and for other years global radiation. In this case it is necessary to replace the GLOB values with -999 as symbol for missing value. CANDY will check during the program start if records with sunshine duration are found where GLOB is not indicated as "missing" and ask if it should replace these values automatically.

Graphics

This sheet can be used to empirically check your weather data within your data set (Figure 15). For each relevant element (temperature, precipitation, sunshine duration, and global radiation) a plot can be generated for every year and controlled for patterns of natural occurring conditions and/or appearing uncertainties, e.g. data gaps. Furthermore precipitation and global radiation data can be plotted as either observed data or corrected and generated data, respectively.

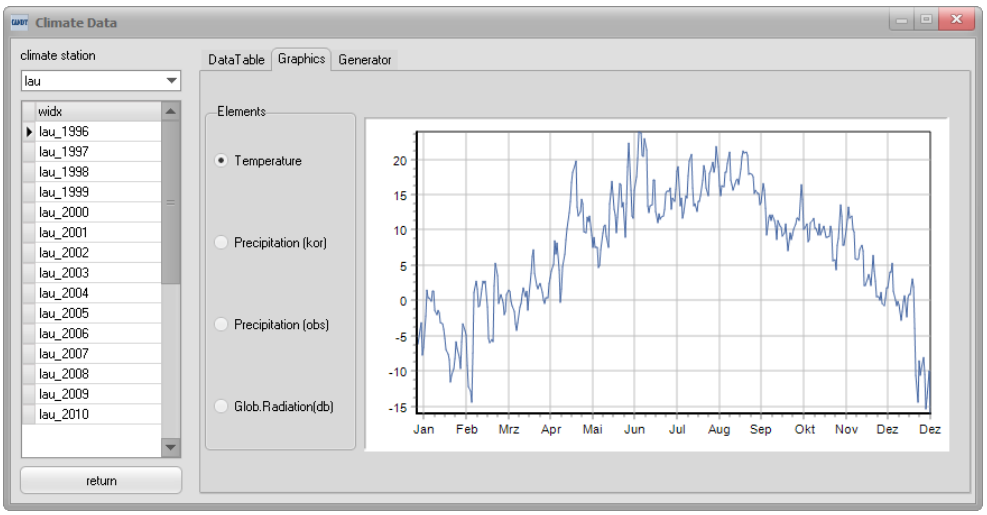


Figure 15: Graphical overview for a selected year within the given data set

Climate generator

The climate generator is an option that may be helpful to provide long term data series. From a number of available annual data sets the monthly statistical parameters of temperature, rainfall, and global radiation can be identified. These parameters are stored in a file and can be used during simulation runs to generate randomly weather data.

Parameter environment

Any simulation result is based on the parameters used. As a first step the user should verify that the available parameters are fitting the special purpose. It may be possible to extend the parameters provided with CANDY database (add new crops or fertilizers) or to adapt single parameter values (e.g. the C/N ratio of straw) according to local peculiarities. It is strongly recommended to look at the description of model algorithms before changing the parameter set. Sensitivity analyses may help to find the most important parameters to be adapted to local conditions.

Simulation runs

Single simulation run

This paragraph explains how to start single model runs. In the [Basic-Info] sheet of the Plot Selection module you will find the [model run (plot)] button (blue box) to start the simulation model (Figure 16 A). The system creates a batch file to document the simulation run (last_candy_run.bat). This batch file can be modified by experienced users in order to run the model without using the interface program (see chapter Batch file settings).

Before starting the actual simulation you have to decide about the use of measurement data. The dialog in Figure 16 provides the opportunity to select records from either existing observations [existing data] or generating new data sets [new data]. All records compiled within this dialog will be moved from the CDY_MVDAT table into the CDY_MSDAT table (used during simulation) where model results will be stored. The dialog is only activated if the appropriate option is checked (red box).

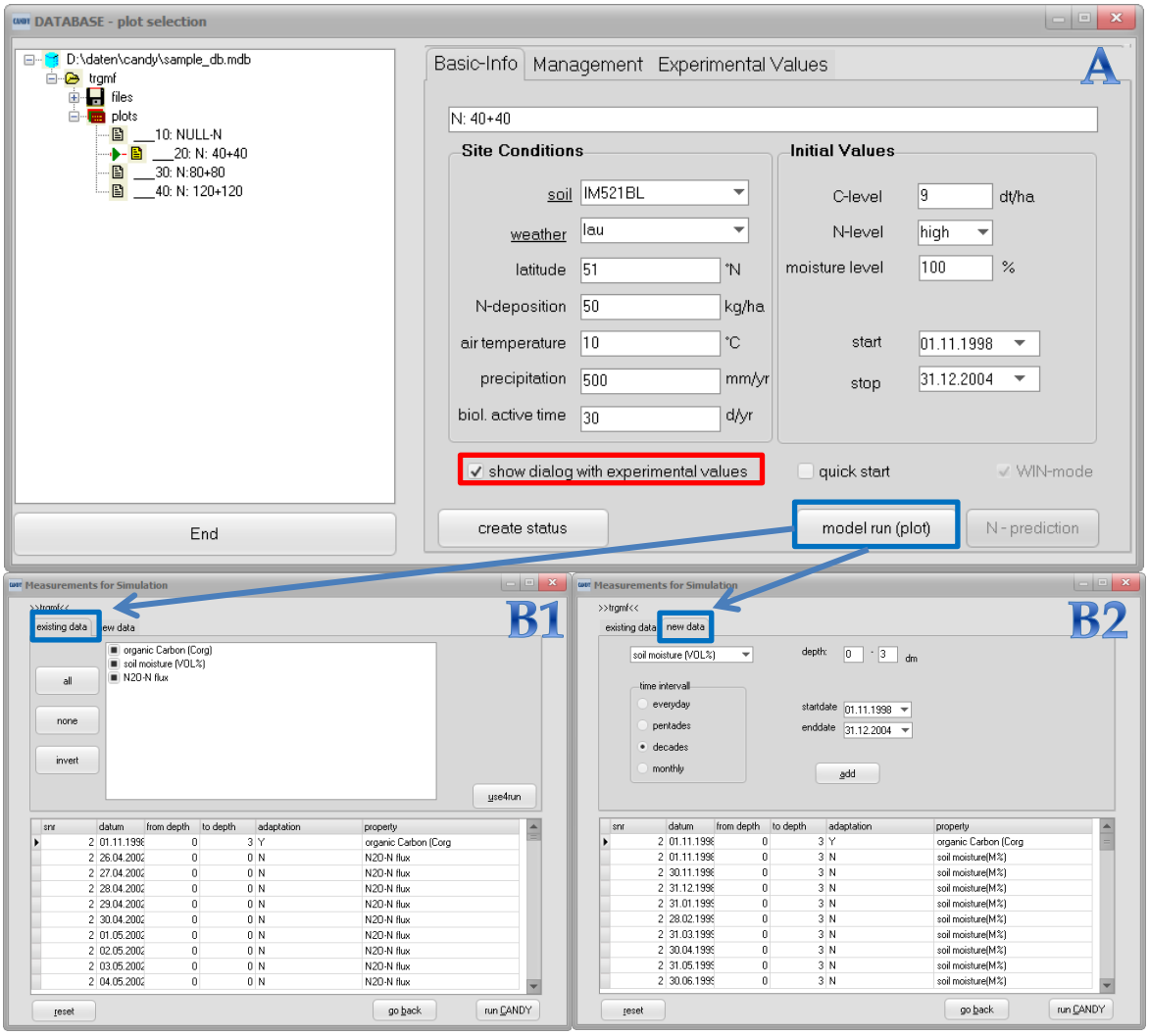


Figure 16: Dialog for model run (A) with measurement data dialog for existing data (B1) and new data (B2)

For taking your existing data into account, select the desired parameters and press [use4run] (Figure 16 B1). For new data, choose the appropriate parameter from the drop-down list, specify the soil depth in dm (only for properties that require this input) as well as the output frequency (everyday, pentades, decades or monthly), select the start and the stop date, and click [add] (Figure 16 B2). Please be aware that some properties make only sense with the proper setting of model switches.

The dialog with the compilation of the control data with an opportunity to edit model switches and result recording option appears after clicking on [run CANDY] (Figure 16 B1 and B2). To omit the Measurement data dialog you have to check the quick start option before clicking on the [model run (plot)] button on the [Basic-Info] sheet.

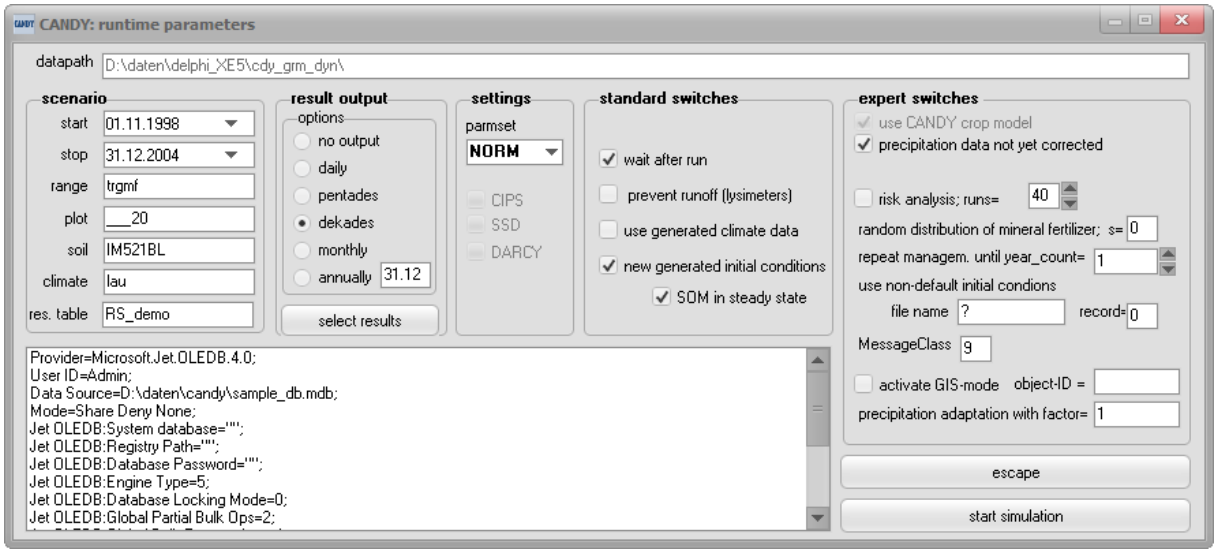


Figure 17: Dialog for runtime parameter environmental settings to start a simulation run

Scenario

In left panel of the window is a summary of the scenario that will be simulated. Changes are still possible.

Result output

You may select the results that you want to be recorded as well as the selected output frequency on panel **result output** (Figure 18). The recording frequency of result records (additional to measurements that have been selected in a previous dialog) may be chosen between different time intervals. For annual recording the date may be specified (e.g. hydrologic year ends at 31.10.). If any result output is selected it is possible to edit the table name (RS_*) and the single elements of the result record clicking on [select results]. The set of selected results is kept within the database and can be used for following simulation runs without further activity. It is possible to store and re-load a specified list if you have to use different compilations of results and want to switch between them.

The names of the result tables have to start with RS_. From the user interface you may start a special viewer for these tables with an option to export data into an

EXCEL sheet. The name of the result table can be changed by the user. CANDY provides the last given name as default. One result table may contain result sets of different plots (see database description). Only results of the current simulated plot will be rewritten.

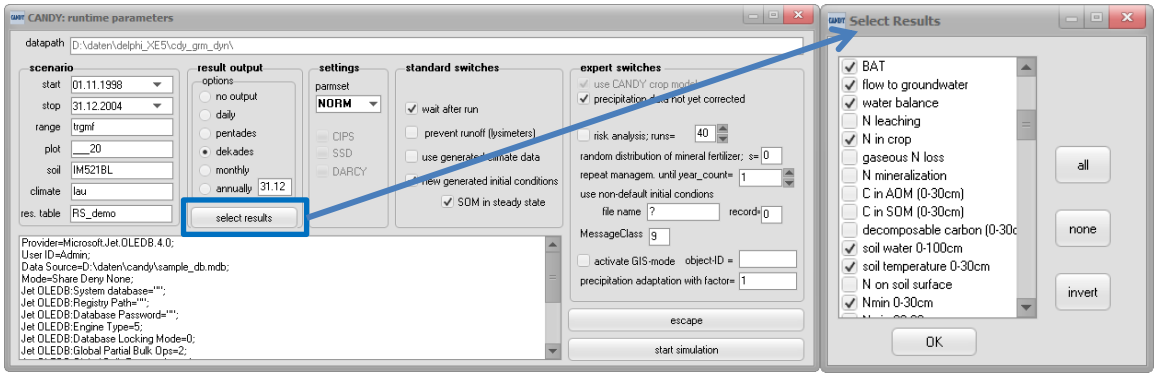


Figure 18: Selecting output results

Settings

The drop down selection controls the record of CDYAPARM that is used for the simulation run. Usually the standard selection of NORM (normal) will be appropriate. Furthermore, special submodels like Soil Structure Dynamics (SSD), Carbon In Pore Space (CIPS), and DARCY for water dynamics may be switched on – if the CANDY version is enabled for this option.

Standard switches

wait after run: model window stays on screen after finishing the simulation

prevent runoff: no surface runoff occurs, water surplus stays on top

generated climate: climate data will be generated during simulation; to use this option, the preparation of a generator file (*.per) in the climate module is required

new initial cond.: model initialization from basic data (FXDAT) and not from a status record

SOM in steady state: assuming the scenario represents also the past management, the initialization of SOM will be based on the farming activity during the scenario and not on the Crep value in the basic data (C-level in **Initial Values**)

Expert switches

precipitation data not yet corrected (default): the model compensates the systematic errors of precipitation measurements

risk analysis: here you can specify the number of repeated model runs with random climate data from the weather generator

repeat management: use this option if you want to repeat a crop rotation for N succeeding years

non-default initial conditions: you may read the initial condition from any status file (*.stc). Specify the file name and the record number that should be used

message class: a higher message class will suppress less interesting messages

GIS-mode: to be checked if the model is used in GIS mode

precipitation adaptation factor: all precipitation data will be increased by this factor

Clicking [start simulation] will start the model. The simulation protocol is written into the ASCII file CANDYMSG.msg

You may stop [wait] and continue [go on] the simulation at any time. If the model run is stopped you can go on for certain time steps [step] to watch the model behavior at these dates. You may as well cancel [end] the simulation and return to the initial window.

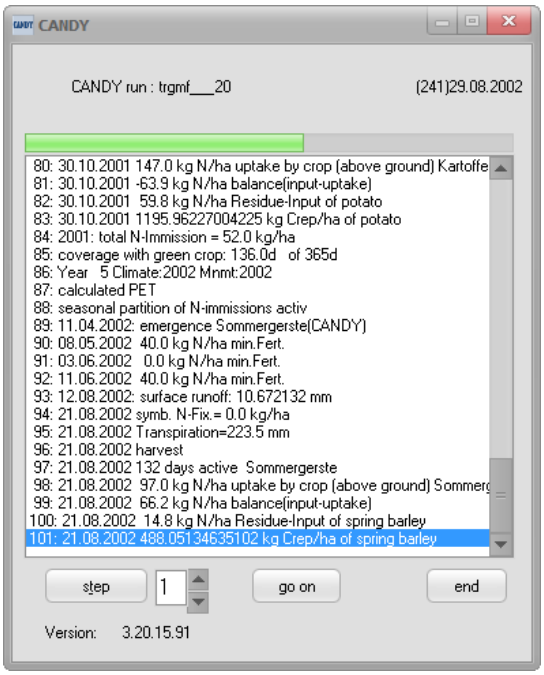


Figure 19: CANDY protocol of the simulation run

Group simulation

If you want to bundle your simulations for a number of plots in a given folder, you can activate *group simulation* from the context menu of the folder (right click, Figure 20A) in the tree view. There will be a list of all plots shown, where you can make a selection for the simulation run. All selected results are recorded in the given (RS_) table. Special parameters or switches can be set in the parms field (Figure 20B). Switches relate to the batch file setting (see chapter Batch File Settings).

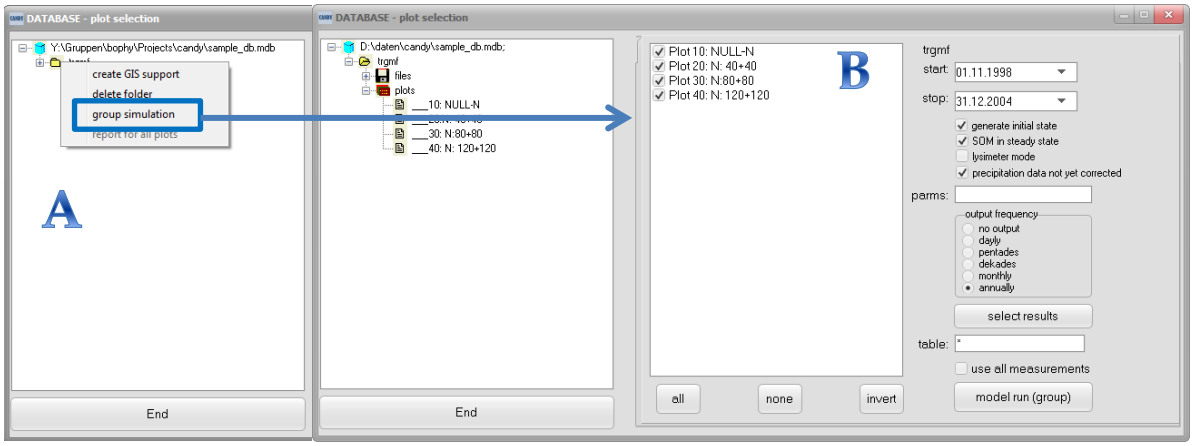


Figure 20: Preparation of group simulation runs

Result evaluation

All messages about the model activities are stored in a message file (CANDYMSG.msg). For each simulated date listed in the CDY_MSDAT table the respective model value is stored as *s_wert*. Further, depending on the settings, you will find a user defined table with result recordings (RS_*). Start the RS_-table viewer from the user interface to work with this model output. To use this facility all result table names have to start with 'RS_'. Activate the record set and the plot number that you want to analyze. Then you may select the variable of your interest. You will see a numerical and a graphical representation as well as the average value of this result variable.

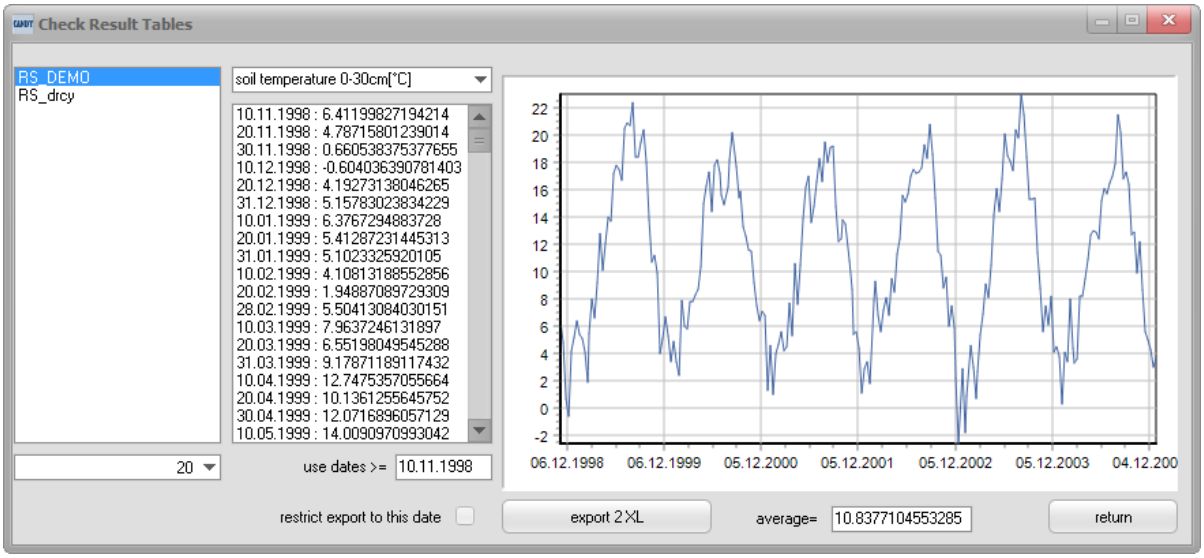


Figure 21: Result overview

Click on [export2XL] to move the whole result data set (all variables) into an EXCEL spreadsheet. Be patient until export is finished! To reduce time it may be useful to select an appropriate starting date.

Another tool for model assessment is the usage of the evaluation module that can be activated directly after a simulation run (launch evaluation mode?) or can be started from the context menu of the MS_xxxxx_dat item in the files group.

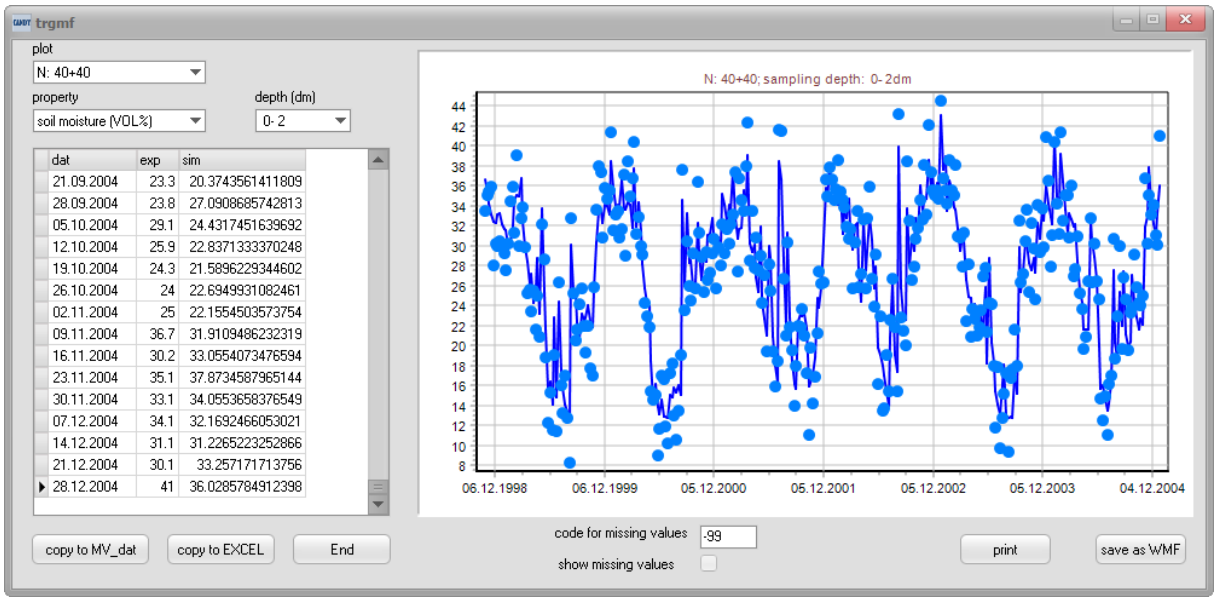


Figure 22: Comparing measurement and simulation results with the evaluation module

In the evaluation module the user has to select plot, property, and depth. Measurement values (dots) and simulation results (line) are shown as table and graphic. Data may be moved into an EXCEL sheet and simulation results can be permanently saved to the CDY_MVDAT table.

Soil state recording

If you did not activate the option for new generated initial conditions, the system will initialize from a valid record in the status file (S___*.stc). During simulation a new status record is written after each year and additionally at the end of the simulation scenario.

The viewer for this file will be activated if you click on a S___-file item:

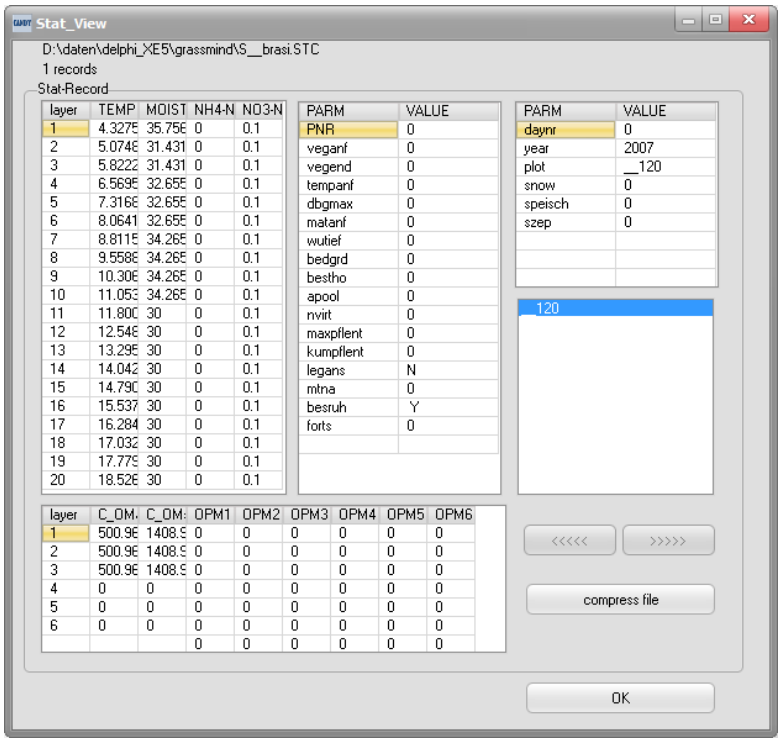


Figure 23: Checking soil state records

Batch file settings

Description

CANDY simulation can be performed without opening the graphical user interface using batch file calls. Therefore some specific parameter settings in the batch file are required. Some settings are mandatory (A, E, S, D, P, and W).

The general call is: <Data path>\Candy.exe <parameters> <switches>

Parameters

attribute	**meaning**
A=	start date (A=dd.mm.yyyy) (same as *startdat* in CDY_FXDAT)
E=	end date (E=dd.mm.yyyy) (same as *stopdat* in CDY_FXDAT)
P=	name of soil profile (link to *standort* in CDY_FXDAT)
D=	data folder name (link to *fname* in CDY_FXDAT)
O=	object id for GIS simulations
S=	plot index as 5 digit string (from *snr* and *utlg* in CDY_FXDAT and "_" for free digits): "___snrutlg"
W=	short name of the climate station (sss) (link to *wetter* in CDY_FXDAT)
R=	result table name (will eventually be created)
OF=	output frequency for simulation results
X=	Name of text file for result output
PDB=	database path
DP=	data path
LTEM=	average air temperature
RF=	factor to change precipitation
LT=	longitude
DS=	standard deviation of randomized N fertilizer application
PSET=	selection of general parameters
UNIT=	selection of global climate dataset
ST=	state record
Z=	number of years the simulation will repeat
ZOF=	offset (years) for cyclic simulation
RAnn	risc analysis with *nn* replications of the scenario

Remarks

Be aware of correct using, there should be no space before the equal sign "=".

S=_snru with snr=plot number and u=subplot (UTLG); e.g.: __123: snr=12, utlg=3

W=INKUB for the simulation of incubation experiments

OF=possible options are 1 (daily), 5 (pentades), 10 (decades), 30 (monthly);
default: annual

Also be aware of setting spaces between each attribute.

Model switches

All switches have +/- options; if a switch is not used in the model call at all, the default setting will be active anyway.

attribute	Meaning
Z+	generated climate data, default Z- (real climate data)
S+	generates initial conditions from fixed data (C_rep), no status file necessary (S__xxxxx.STC), default S- optional SS (generation of SOM pools in steady state)
W-	no stop after simulation run, default W+
GO	simulation starts immediately (usually combined with W-)
G+	simulations in GIS mode, default G-
P-	no graphical results during simulation, default P+
K-	precipitation data will be taken as given and won't be corrected
L+	lysimeter mode
P+	presentation mode

An example of a batch-file setting is given in Figure 24, where a master batch-file (Figure 24 A) defines the command "call ???.bat" to initiate a model run, which is described with its settings in the slave batch-file (Figure 24 B). The name of the slave batch equals the name within the master batch-file. The term "call" therefore assures that the start of the model call in the next row is initiated. The terms "%1" (Figure 24 B, green box) and "%2" (Figure 24 B, orange box) in the slave batch-file work as a placeholder, which automatically call a certain attribute that is described within the first stake (Figure 24 A, green box) and the second stake (Figure 24 A, orange box) of the master batch-file. This might be used for different states of the system, e.g. when different soil profiles, climate situations, plot index' or any other variable condition will be addressed.

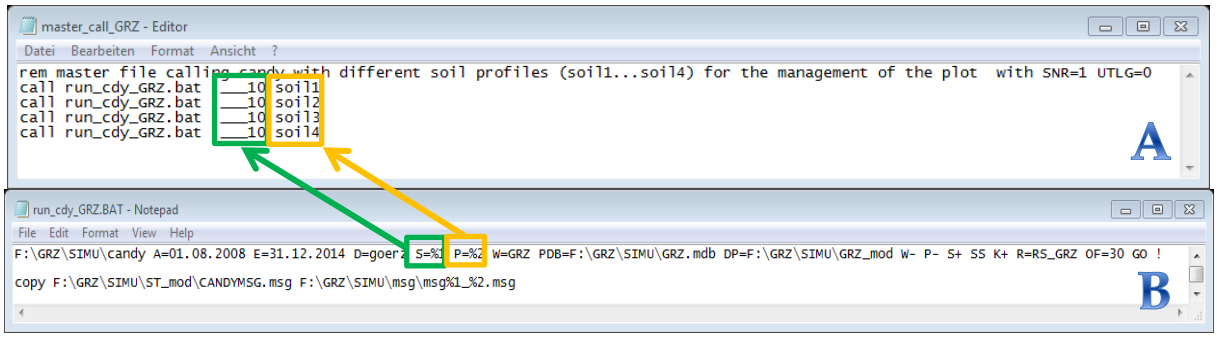


Figure 24: An example for running the model via batch calls from master (A) and slave (B). Latter is using parameters for the plot index (%1) and soil profile name (%2). The message file is stored in a separate directory after each model call

CANDY error handling

A number of typical errors will be recognized by the model during a simulation run. Normally the model stops showing a message box with some hint to identified problem and terminate after quitting this box. In some cases this hint is only showing the last reason for the model to give up. It is well possible that the real cause for the termination is not directly shown - so use your common sense to find the solution for this problem.

There are applications where this stop and wait for a button click may not be appropriate. It is possible to avoid this waiting behaviour inserting a text value in the CANDY registry with the name "wait_on_error" and the value "no". In this case the model will terminate immediately without any error hint.

Checklist to avoid errors

- Do you use '.' as decimal separator? (Figure 25)

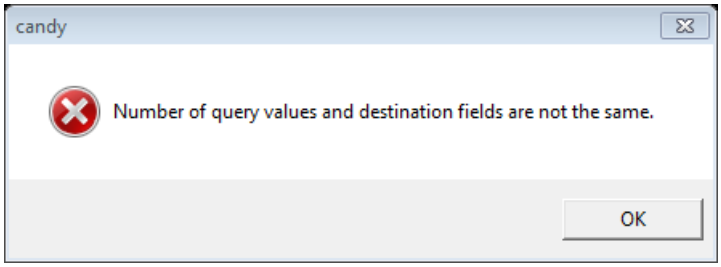


Figure 25: Error message possibly caused by wrong decimal separator

- Is a name of the data source correct?
- Is the date format set to [dd.mm.yyyy]?
- Are all required parameters for modelling in the database?
- Do you have gaps in your climate, soil or management data?
- Is the order of actions in your management data correct? (Figure 26)

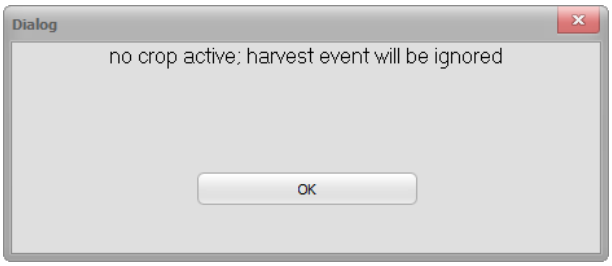
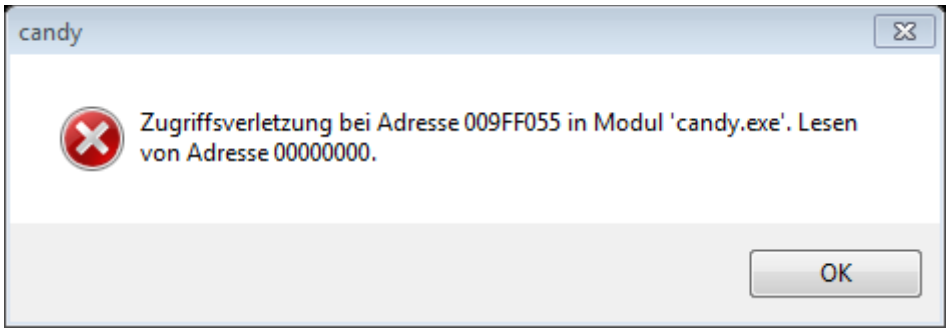


Figure 26: Message caused by starting the simulation between sowing and harvesting

- Are climate data sets complete for the current simulation run?
- Check availability of climate data.