SaltModMY menu, description of the user interface of the free software for surface / groundwater and soil salinity assessment in irrigation projects.

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Abstract
SaltMod is a mathematical, numerical computer program for the simulation and prediction of the salinity of soil moisture, ground and drainage water, the depth of the water table, drain discharge and leaching of salts in irrigated agricultural lands under different geohydrologic conditions, varying water management options, including the (re)use of groundwater for irrigation by pumping from wells (conjunctive use), and several crop rotation schedules. It uses salt and water balances (budgets) in the soil. The model aims at sustainable land use and environmentally sound optimal water management for sustainability and can be used for the modeling of reclamation (remediation, rehabilitation, restoration) of saline soils. SaltMod can be freely downloaded and used. There exist a downloadable document with description of the mathematics used and a list of publications in which applications of SaltMod are reported. With the present description of the menu's in the user interface of the software, a missing link is repaired.

Contents

1. Introduction

SaltModMY is computer program for the prediction of the salinity of soil moisture, ground water and drainage water, the depth of the water table, and the drain discharge in irrigated agricultural lands, using different (geo)hydrologic conditions, varying water management options, including the use of ground water for irrigation, and several cropping rotation schedules.

The water management options include irrigation, drainage, and the use of subsurface drainage water from pipe drains, ditches or wells for irrigation.

The computer program was originally made in Fortran by R.J. Oosterbaan and Isabel Pedroso de Lima at ILRI, 1990. A user shell in TurboPascal was developed by H. Ramnandanlal, and improved by R.A.L. Kselik of ILRI, to facilitate the management of input and output data. Now, a Windows version is available, written in Delphi by Oosterbaan [Reference 1].

The program was designed keeping in mind a relative simplicity of operation to promote its use by field technicians and project planners. It aims at using input data that are generally available, or that can be estimated with reasonable accuracy, or that can be measured with relative ease.

SaltMod has been used and tested extensively. A selection of reports and publications on the use of SaltMod exists [Reference 2]. The lastest version is named SaltModMY, having a refined input menu.

The mathematics used in the software can be consulted in [Reference 3].

A combination of SaltMod with a polygonal groundwater model (SahysMod) is also available [Reference 4].

For the older Fortran version, a user menu was prepared, but the later versions lacked this. With the present paper, this omission is solved.

2. General parts of the user interface

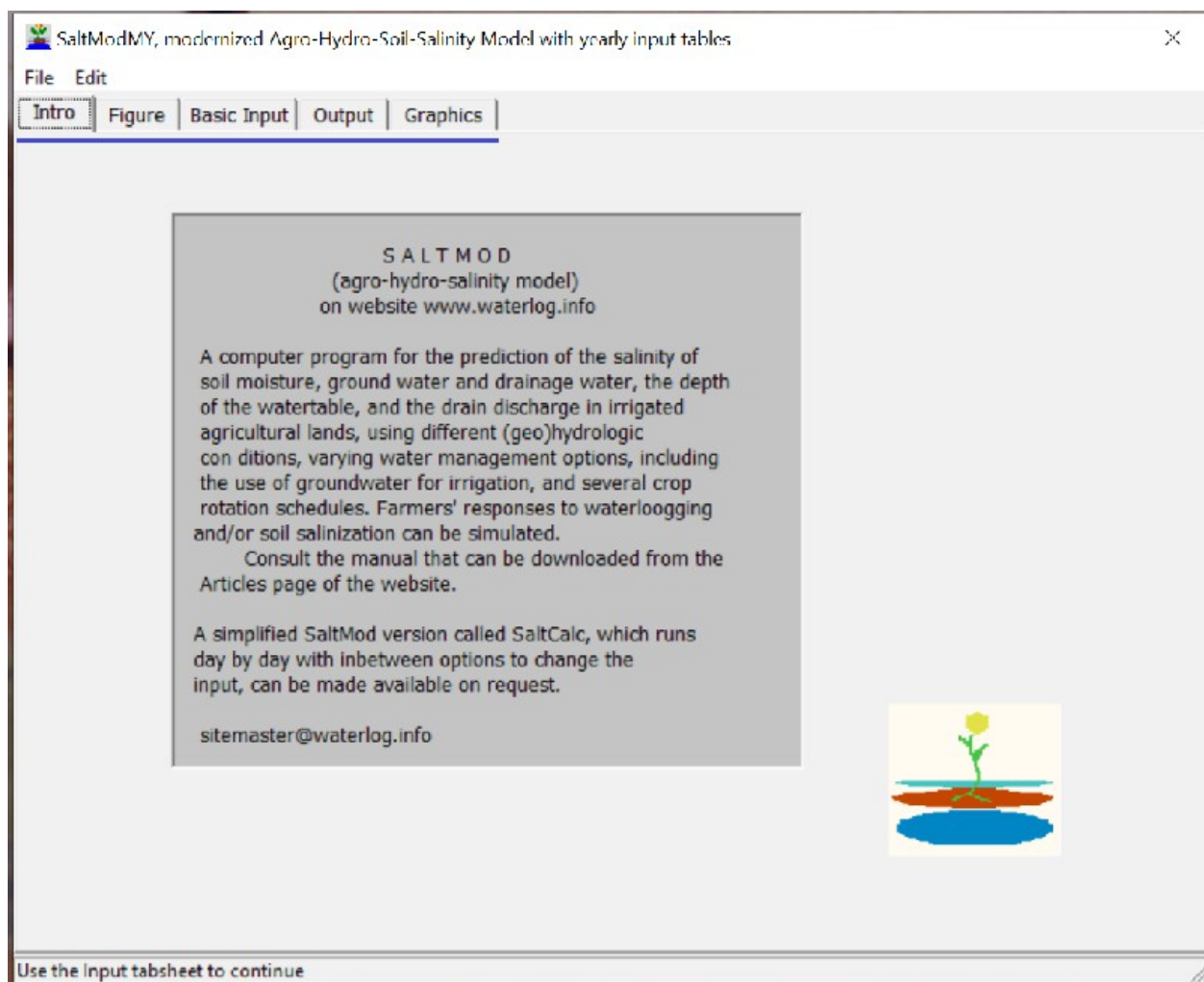The general part of SaltMod's user menu is shown in the next figure.

Figure 1. *After opening the software, the introduction tab sheet is shown. Further there tab sheets for the figure, the basic input, the output, and the graphics (see the blue line).*

Clicking on the "Figure" tab sheet reveals a sheet as depicted in the following picture. It shows two kinds of crop land, an irrigation canal system, a pump for ground water, and a subsurface drain.
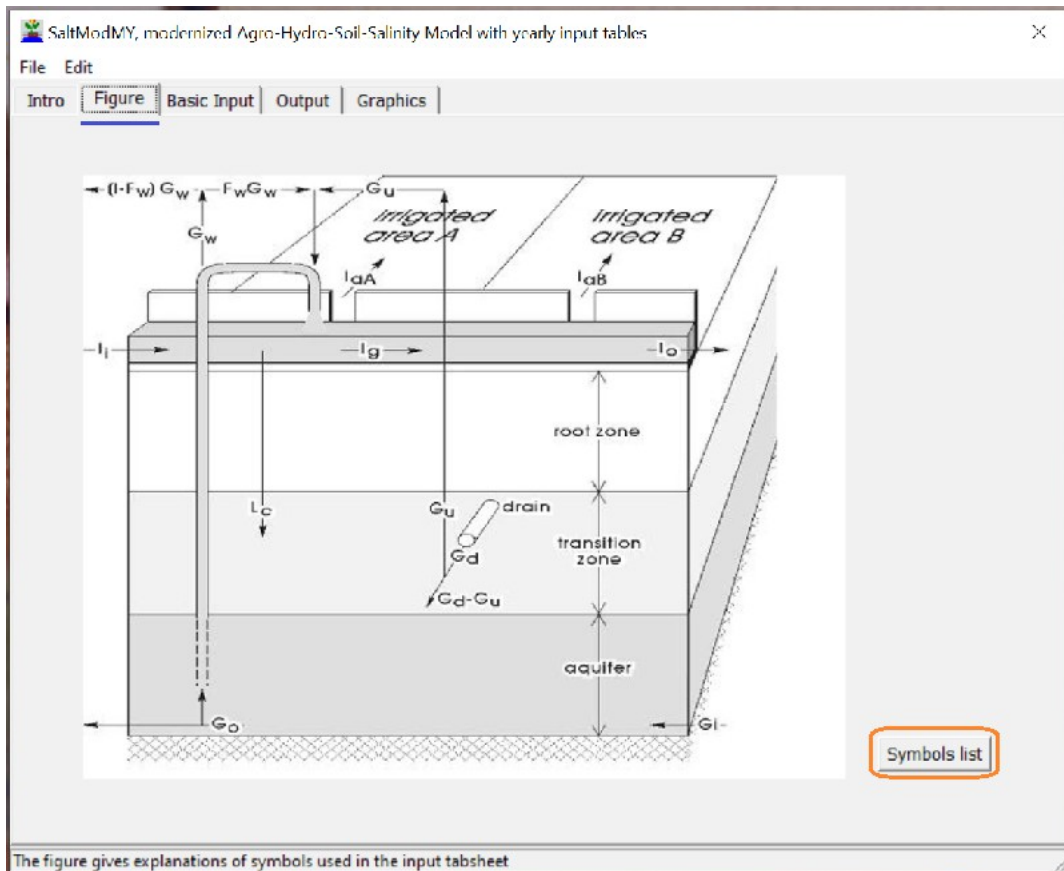

Figure 2. *The "Figure" tab sheet is opened (blue line). It gives a schematic overview of the physical elements used in SaltMod. The "Symbols" button (orange square) can be clicked to find information on the symbols used in the picture. There are two irrigated areas A and B that may have different cropping schedules. The land may also have an un-irrigated of fallow part (U), which is left out of this image.*

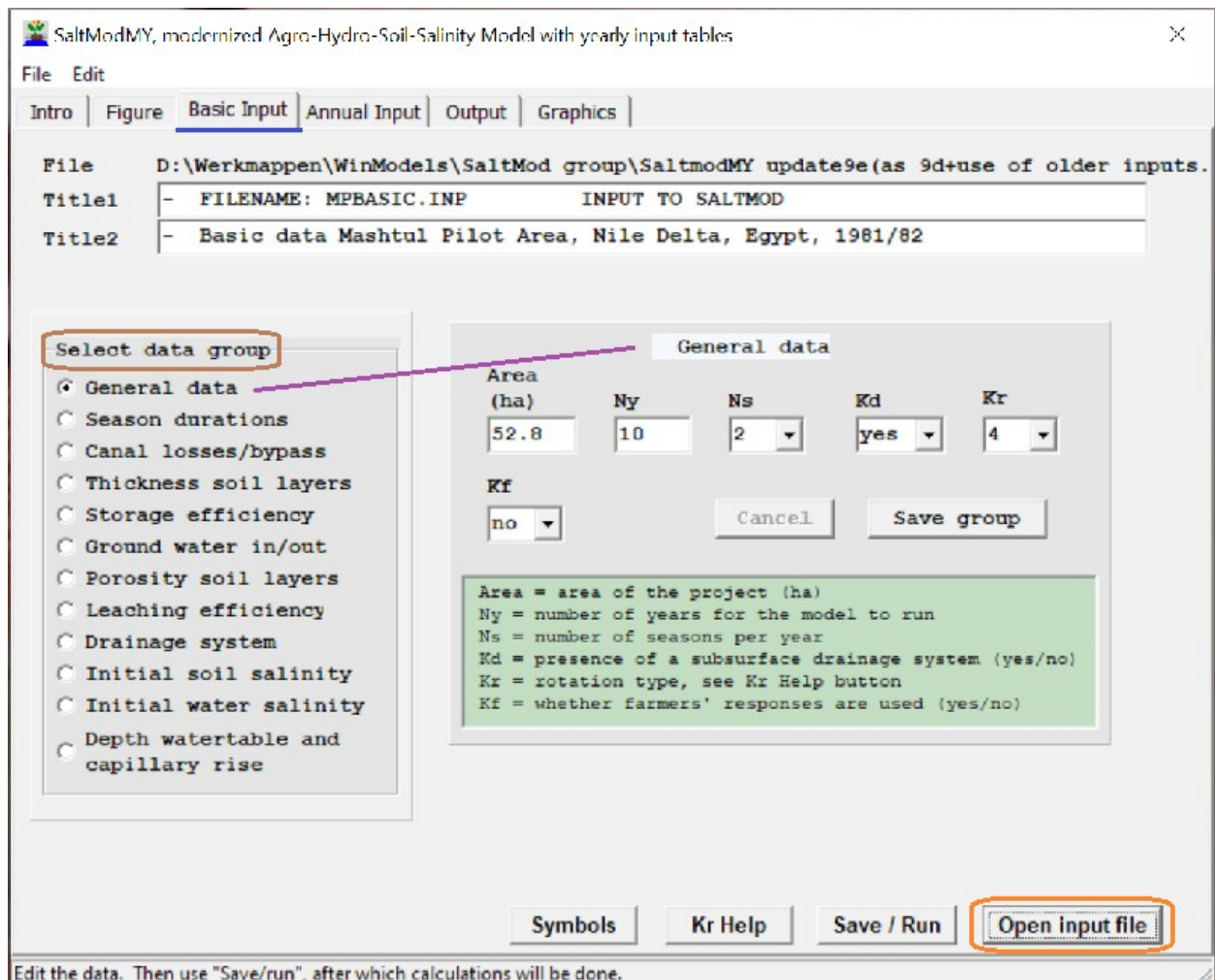The basic input tab sheet is presented in *figure 3*.

Figure 3. *Overview of the input tab sheet (blue). It has been produced by clicking on the "Open input file" button (orange square), giving the data of an existing input file, but this group can also be used for a new input file. There is a list of selectable data groups (brown square) of which the first ("General data") has been selected (purple line). This group gives the option to enter various elements of overall importance. The symbols use at each of the text blocks are explained in the green box.*

One more example of an input group will be given. It concerns the properties of the subsurface drainage system, illustrated in *figure 4*.
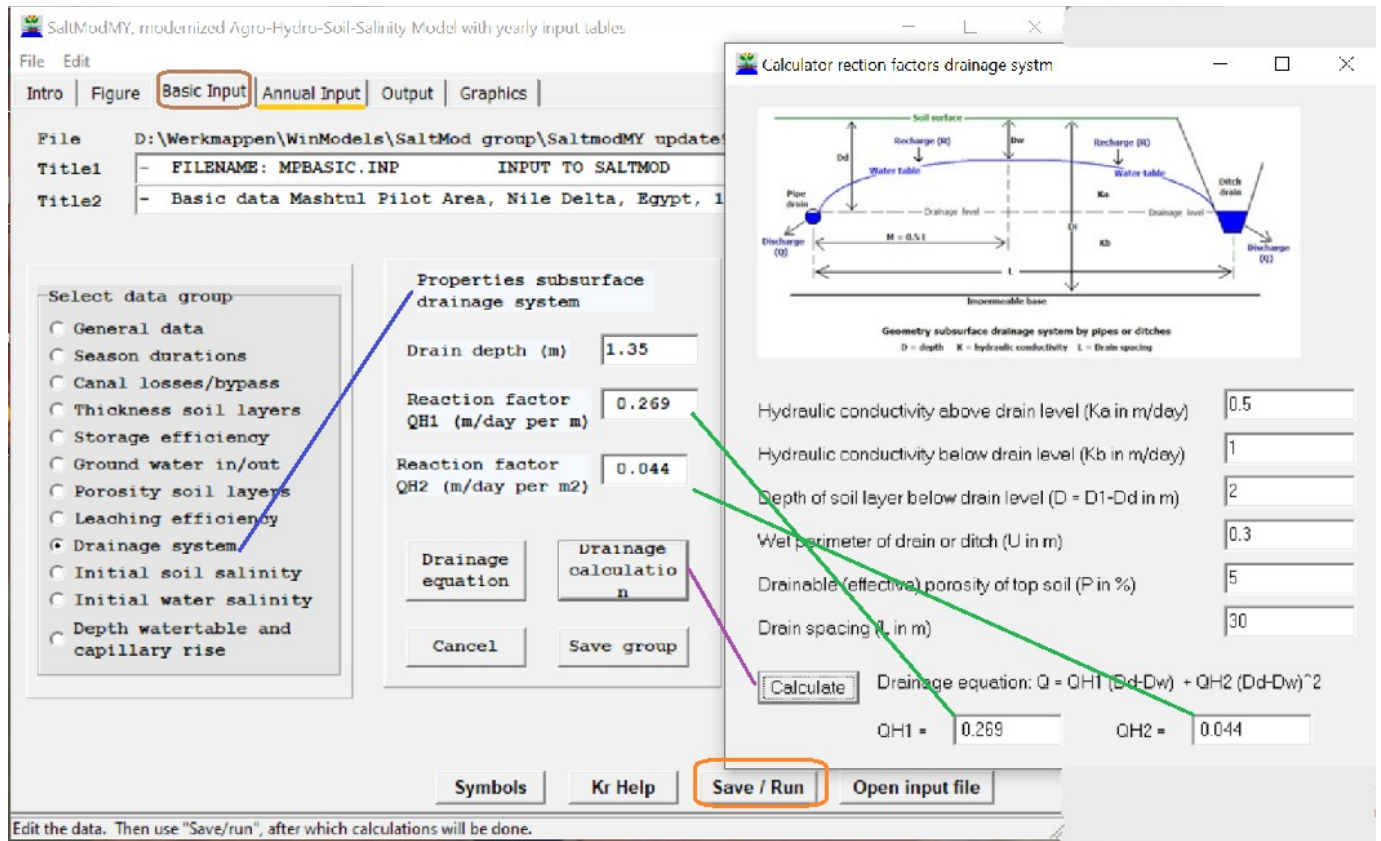
Figure 4. *The input group "Drainage system" is demonstrated (blue line). If desired, one can call the calculator of drainage capacity (reaction) factors of clicking on the "Drainage calculation" button (purple line). By filling in the characteristics of the drainage system (right hand side) and clicking the "Calculate" button, the capacity (reaction) factors QH1 and QH2 are determined and transposed to the Drainage system" group (green lines).*

Figure 4 also shows the "Annual input" tab sheet (yellow line, at the top) that needs to be completed before the calculations can be started clicking on the "Save / Run" button (orange square).

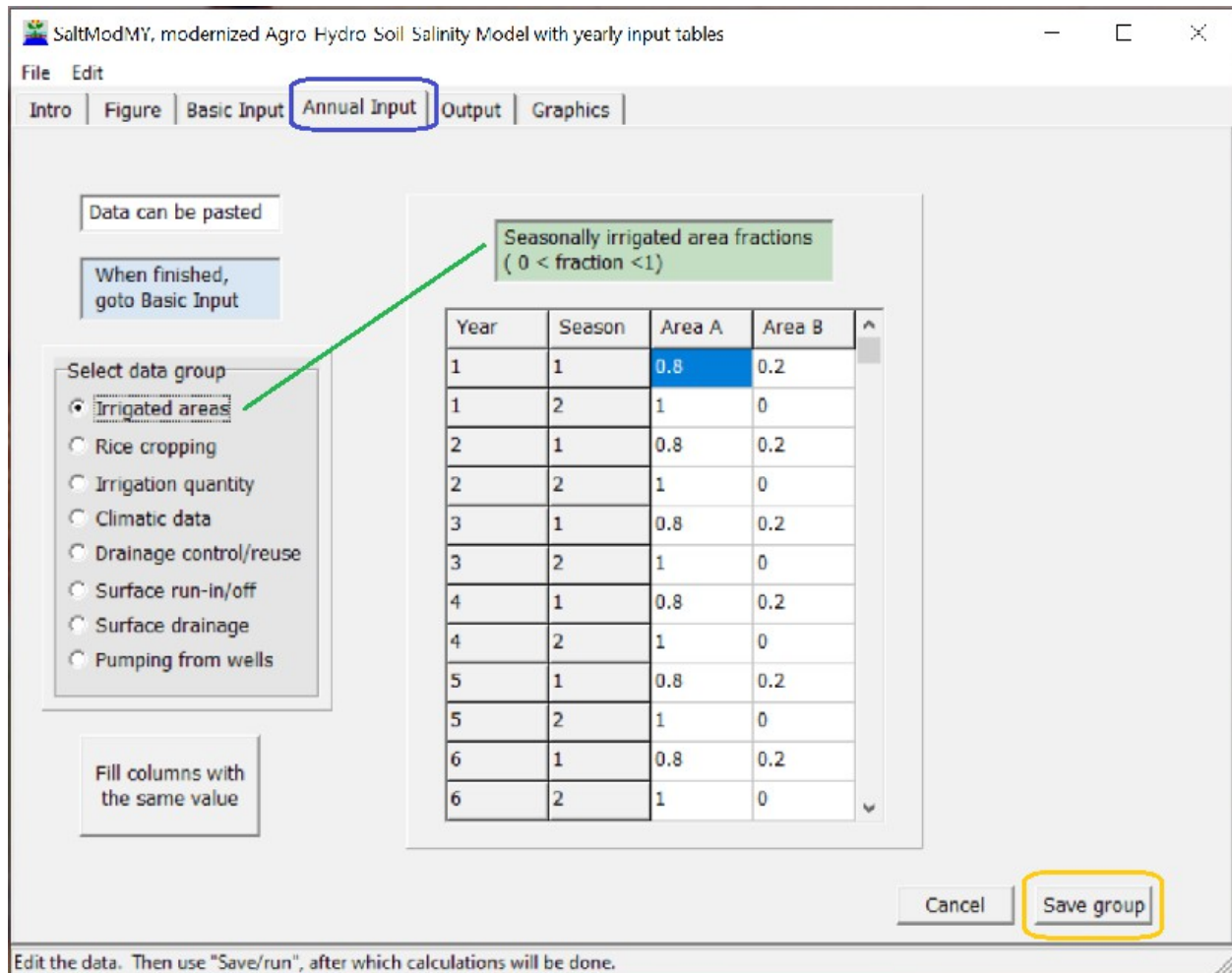The "Annual input" tab sheet can be viewed in the next figure.

Figure 5. *Picture of the "Annual input" tab sheet. The annual groups are given in the gray table on the left. Here the "Irrigated areas" group has been selected (green line). Data are to be entered for all years the model is to be run (see* figure 3*) and for all seasons within the year. In this case the year is divided into two seasons (see* figure 3*), while the number of seasons can range from 1 to 4 (see* figure 3*). In this example the irrigated areas are the same in all the years, but they differ per season. The data can be pasted from a spreadsheet like Excel. When the work is done, the data can be saved using the "Save group" button indicated by the orange square.*

When all the annual data groups have been completed, one may go to the "Basic input" tab sheet to perform the calculations (see the "Save / Run" button in *figure 4*, indicated by an orange square).

4. The output menu

After performing the calculations, the SaltMod program will show the output menu (*figure 6*).
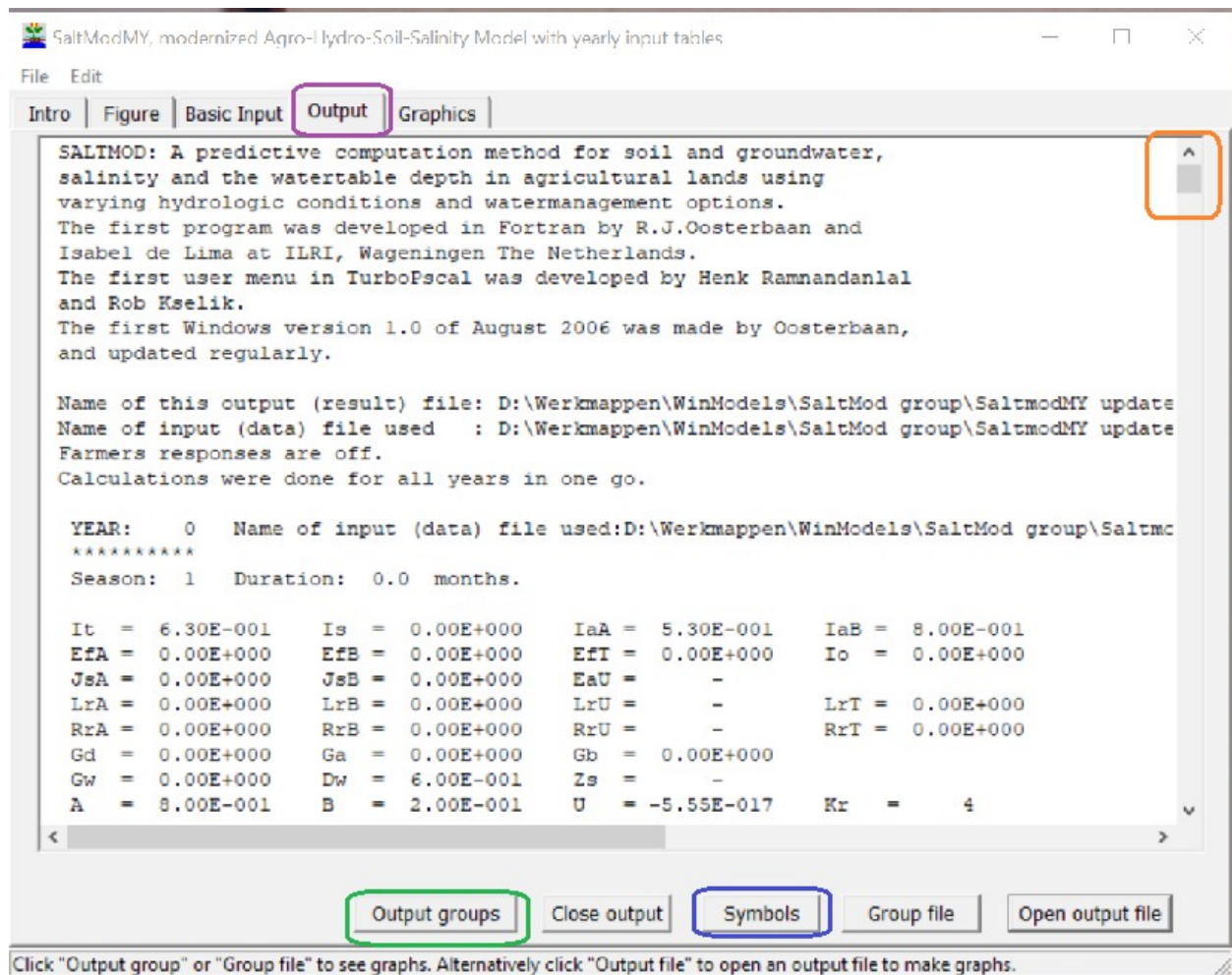

Figure 6. *The general output file of SaltMod. It show the output data for all years and all seasons, that can be inspected using the scroll bar (orange square). The symbols used in the output file defined in the "Symbols"list (blue square). The overview of the output data this way is troublesome. Therefore the output data can be more clearly interpreted using "Output groups" (green square).*

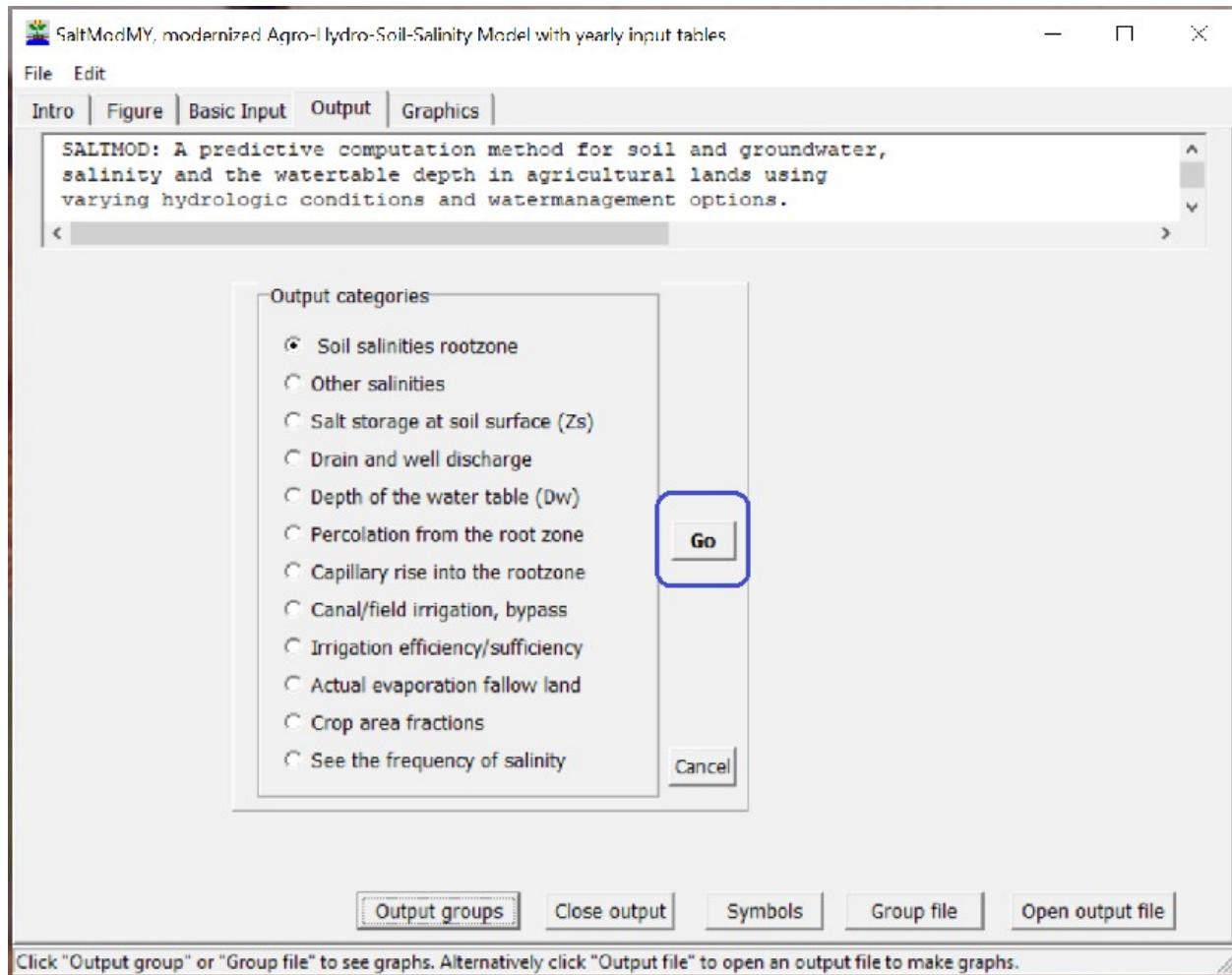The "Output groups" menu is illustrated in figure 7.

Figure 7. *After clicking on the "Output groups" button in figure 6, one will see the selection menu for various output groups. Here the group "Soil salinities root zone" is selected and it will be shown after clicking the "Go" button (blue square).*

The result after selecting the "Soil salinities root zone" group and clicking the "Go" button is presented in the next figure.
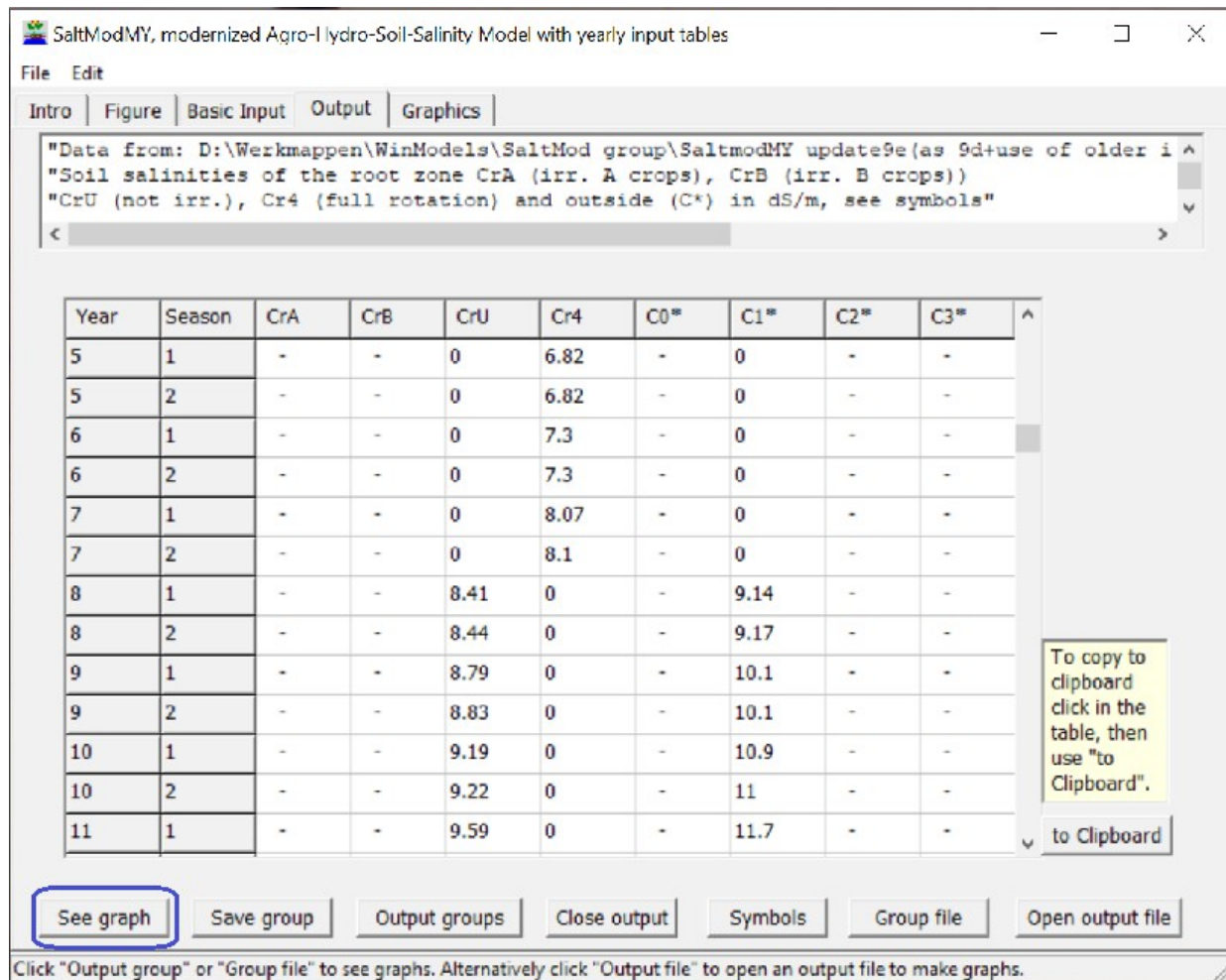
5. The graphics menu

Figure 8. *Picture of the output group "Soil salinities root zone" Initially the crops are in full rotation and the corresponding soil salinity is given by the symbol Cr4. In yea 8 a change happens due to the salinization of the soil when it reaches an ECe value over 8 dSm. SaltMod has a built-in farmers' response function that can be activated by the user. In this case the farmers have decided to leave part of the crop land fallow and use the irrigation water thus save in the remaining area to help the leaching of the excess salts. The salt concentration in the fallow land is called CrU, while in the remaining part it is called C1**

Left under in figure 8 the option "See graph" is visible (blue square). Activating this option, one can see an image as the next figure.
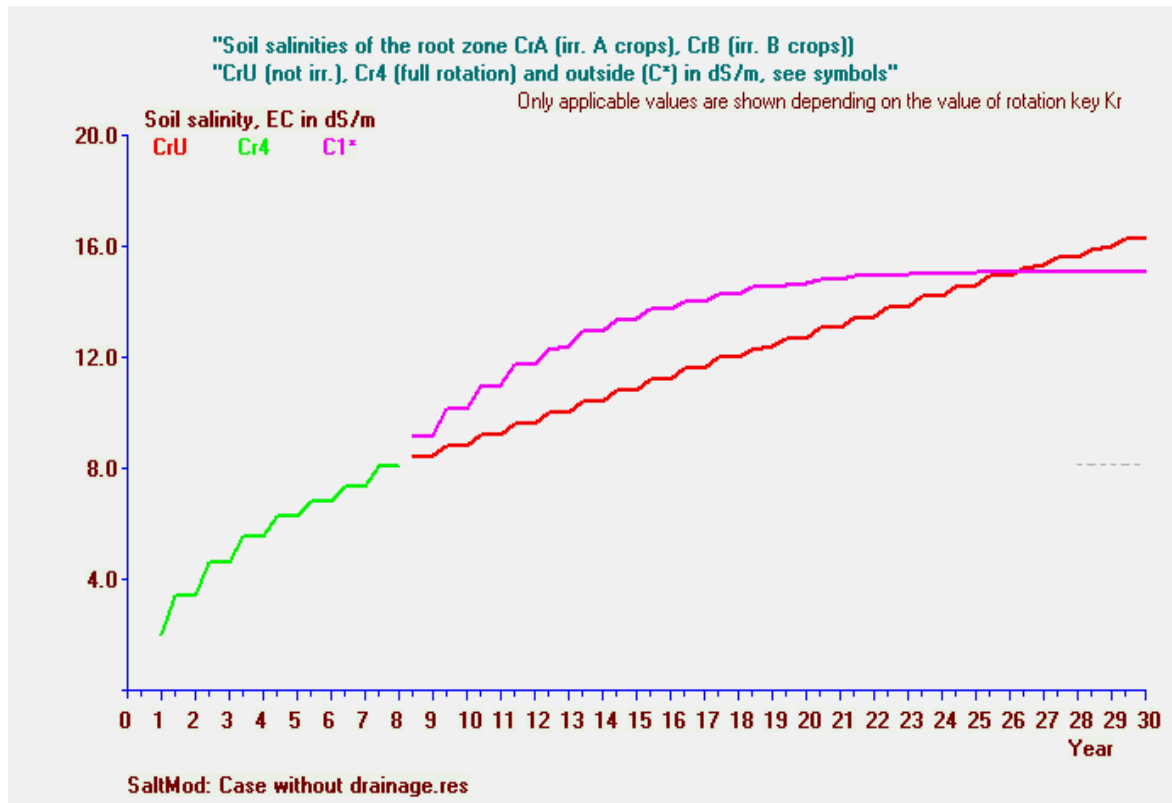
Figure 9. *Graphics of the soil salinity output data as shown in* figure 8. *Initially the soil salinity rises (green curve). After year 8, there is a split. As the soil salinity is getting to high for sound cropping, the farmers start abandoning part of the cultivated area. The fallow part helps to control the salinity in the irrigated land, as the soil becomes dry here and it sucks up water from te underground by capillary rise. As a result the salinity in the uncultivated land continues to rise (red line), while in the irrigated land it reaches an equilibrium (purple curve).*

In the graph of *figure 9*, the salinity of the root zone in the fully cropped land is called Cr4 (4 stand for crop rotation type 4) land, while in the abandoned land it is called CrU (U stands for un-irrigated) and in the part of the land that remains cultivated, the symbol used is C1* (* stands for outside U).

The interactions indicated before can be checked using the different output group options (for example the depth of the water table and the crop area fractions) shown in figure 7. This the mutual influence of the various factors involved can be elaborated.

6. Conclusions

The present user manual is not 100% completer because there are many more possibilities than explained before. However, the main parts of the user interface have been dealt with.

It is the intention of the user menu to make access to and operation of the model facilities as clearly and simple as possible. After all, the main purpose of SaltMod is that situations in irrigation projects all around the world are assessable not only by scientists but also by project technicians.

7. References

Reference 1.
SaltMod model software and computer program. Free download from:
https://www.waterlog.info/saltmod.htm

Reference 2.
List of publications in which the use of SaltMod is reported. Free download from:
https://www.waterlog.info/pdf/SaltModlist.rtf

Reference 3.
The mathematics used in the SaltMod model can be consulted in:
https://www.waterlog.info/pdf/saltmod.pdf

Reference 4.
SahysMod, a combination of SaltMod with a groundwater model. It divides the project area into polygons. Free download from: https://www.waterlog.info/sahysmod.htm