Menu and user interface of SahysMod, a model for irrigation, drainage, soil salinity, and groundwater management in large project areas divided into polygons

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Abstract

The SahysMod (spatial agro-hydro-soil-salinity model) software can be used to assess the water and soil management in large irrigation projects. For that purpose the user can divide the area in polygons with different cropping, (geo)hydrological and pedological (soil and underground) characteristics. The model can be freely downloaded and applied. A manual exists explaining the principles of the model and the mathematics employed, but a menu with user interface has not yet been published. The present publication compensates this shortcoming.

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1. Introduction

SahysMod (spatial agro-hydro-soil-salinity model) 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 [Reference 1]. It is applicable to large irrigation projects as the area can be divided into polygons, each having more or less uniform characteristics, but these can be different between the polygons. The polygons are interconnected by a groundwater model

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

Within each polygon the principles of the SaltMod model are used [Reference 2].

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.

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

SahysMod has been used and tested extensively. A selection of reports and publications on the use of SahysMod exists [Reference 4].

2. General parts of the user interface

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



Figure 1. After opening the software, the introduction tab sheet is shown (blue square). Further there are tab sheets for the figure, the general input, the polygonal input, the seasonal input, the output, and the graphics (see the green line).

Clicking on the "Figure" tab sheet reveals a sheet as depicted in the following picture. It shows the hydrology, the irrigation canal system, ground water use, and three soil layers as used in each of the polygons, though specific characteristics may differ between the polygons.



Figure 2. The "Figure" tab sheet is opened (blue square). It gives a schematic overview of the physical elements used in the polygons of SahysMod. It shows the hydrology, the irrigation canal system, ground water use, and three soil layers as used in each of the polygons, though specific characteristics may differ between the polygons.

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

🚢 SahysMod, Sp	patial Agro-Hydro-Salinity Model	пх
File Edit		
Intro Figure	General input Polygonal input Seasonal input Output Graphics	
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Title2	In abvarzan co.	
Explanation	n	
of item		
	General data	
	Total number of polygons 124	
	Number to be added 0 Seas	on durations
	Number to be removed 0 Sea	ason 1 6
	Scale of polygonal map 1: 50000 Sea	ason 2 2
	Number of years 3 Sea	ison 3
	Number of seasons/year 3	· · · · ·
	Index for annual calculations	
	Output time step (years)	
	Accuracy level 2	•
	Restart Show symbols Save all/cal	culate Open input
Enter data, then us	e "Save data" and proceed to other data tabsheets, or use "Save/calculate" to save all d	ata and do calculations.

Figure 3. Overview of the general input tab sheet (blue square). It has been produced by clicking on the "Open input file" button (orange square), giving the general data of an existing input file, but this group can also be used for a new input file. The "Show symbols" button produces a list of all symbols used in this program, also in the "Figure" tab sheet depicted just before. When all the input data have been properly entered, the "Save all/calculations" button (green square) will make the program to save the data and start the calculations.

The next figure depicts the opening of the "Polygonal input" tab sheet.

3. The polygonal input menu

The next figure depicts the opening of the "Polygonal input" tab sheet.

SahysMod, Spatial Agro File Edit	-Hydro-Salinity Model					П	×
Intro Figure Genera	input Polygonal input	Seasonal input	Output	Graphics			
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Polygon	al data						
 Over 	all system geometry						
C Noda	al network relations						
C Inter	nal system properties						
C Hydr	aulic conductivity				Show net	work map	
C Hydr	aulic resistence						
C Tota	l porosity in soil strata						
C Effec	tive porosity soil strata	60	h				
C Lead	hing efficiency in strata	60	U I				
C India	es of agricultural practices						
C Subs	surface drainage system						
C Initia	I salinity rootzone						
C Initia	I salinity subsoil						
C Exter	rnal aquifer salinity						
C Critic	al depth capillary rise						
C Initia	I water level/pressure						
C Aquit	fer inflow/outflow condition	s	Cancel				
	Cancel group	(<u>C</u>) Show	v symbo.	ls Save	group (<u>S</u>)	Open	input
Select the data group to be e	dited. To save all data or perfo	orm calculations	use "Save/c	alculate" on the	General Input tal	bsheet	

Figure 4. The "Polygonal input" tab sheet (green square) reveals a table (rose colored) with items concerning the data that need to be known for each polygon. The selection in this figure is "overall system geometry" Clicking the "Go" button (blue square) will give the details of the geometry required. The "Show network map" button (orange square) will provide a picture of the polygonal network employed.

The following figure will demonstrate the geometry data, while the figure thereafter comes with the network picture.

In this manual it would be too much too show all the possible selections of polygonal data properties, so the view of the next two figures are considered representative for the remaining items.

🚢 SahysMod, Sp	oatial Agro-H	lydro-Salinit	y Model							×
File Edit										
Polygonal input										
File D	:\Werkmap	pen\WinMo	dels\Sahys	Mod grou	p\SahysMo	d17 A1(as 1	7 A, + GR	WT, LAST)\Sahy	Mod\GARM	MSAR\G
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	Move m	ouse ov	er synu	01 00	see exp	ranacion				
	Node nr.	X-coord.	Y-coord.	Bottom	K i/e	1				
	-	cm map	cm map	m level	index	^				1
	1	38	34	802	1			Show netw	ork map	
	2	34	34	807	1					
	3	30	34	827	1			Fill columns e	entirely	
	4	26	34	825	1			with the same	e value	
	5	58	30	743	1				ОК	
	6	54	30	742	1					-
	7	50	30	753	1					
	8	46	30	747	1					
	9	42	30	722	1					
	10	38	30	747	1					
	11	34	30	775	1					
	12	30	30	790	1					
	13	26	30	803	1					
	14	22	30	808	1					
	15	18	30	797	1	Y				
		Cano	el grou	np (<u>C</u>)	Show	symbols	Save	group (S)	Open i	nput
Use "Save group" t	o save the gi	oup data.								11

Figure 5. The geometry data filled in for each polygon. There X and Y coordinates, level of the bottom of the aquifer and the K index, which stands for the key of rotational type of agricultural land use, K = 0, 1, 2, 3 or 4. The explanation of the K index can be found clicking on the "Show symbols" button.

As this example concerns an existing input file, it cannot be seen how SahysMod helps to determine the polygonal network and the coordinates of its nodal points. Anyway, this will be discussed in the Appendix to this paper.

The next picture shows the polygonal network employed in this example.



Figure 6. Picture of map of the network of the polygons. There 89 numbered internal polygons (blue) and 35 external polygons defining the boundary conditions (purple numbers) making a total of 124 polygons. The map gives the possibility to "See a cross-section" over those polygons in a straight line wanted by the user. It is also possible to reduce the size of the network with the "Remove node numbers" button.

This map helps to visualize the node numbers mentioned in *figure 5*.

The coordinates of the node numbers are expressed in cm on the scale of the map defined in *figure 3* and shown on the top of this *figure 6*.



The Garmsar alluvial fan (Google Earth) overlain by the SahysMod nodal network (blue lines) and the surface level contour lines (black) made with the QuikGrid program.

When clicking on the "Seasonal input" tab sheet on obtains a picture as can be seen in *figure 7*.

4. The seasonal input menu

The seasonal input user interface looks as follows:



Figure 7. The SahysMod "Seasonal input" tab sheet (blue square) contains the seasonal data for each polygon. It can be seen that in this case the model uses three seasons in a year, as is also evident in figure 3..

There are 8 groups of data (green table) of which the "Irrigated area fractions" are being selected. Clicking on the "Go" button will produce the corresponding table as demonstrated in *figure 8* below.

File	D:\Werkm	appen\Wir	Models\Sal	hysMod g	roup\Sahys	Mod17_A1(as 17_	A, + GRWT, LAST)\SahysMod\GARM
Evaluation							
of symbol	Move m	ouse ov	er symb	ol to	see expl	lanation	
	7				-		
/	Node nr	Season	Lc	a	IaA	IaB	
	-	number	m/season	dS/m	m/season	m/season ^	Show network map
	85	1	0.02	1.61	0.65	-	
		2	0.017	1.68	0.15	0.38	Fill columns entirely
		3	0.04	1.765	-	0.9	with the same value
	86	1	0.02	1.61	0.65	-	ок
		2	0.017	1.68	0.15	0.38	
		3	0.04	1.765	-	0.9	
	87	1	0.02	1.61	0.65	-	" - " = n.a.
		2	0.017	1.68	0.15	0.38	Field irrig. data
		3	0.04	1.765	-	0.9	are only applicable
	88	1	0.02	1.61	0.65	-	concerned is greater
		2	0.017	1.68	0.15	0.38	than zero, see the
		3	0.04	1.765	-	0.9	area fractions data
	89	1	0.02	1.61	0.65	- Ų	

Figure 8. Table of irrigation data. There are two ways to find the meaning of the symbols used (blue arrows). In this picture the seasonal irrigation data are shown for polygons 85 to 88 because the scroll bar (orange square) has been moved down.

In this paper it would be excessive to show the tables for all the seasonal data groups, and therefore we proceed to the "Output" tab sheet that is created when clicking on the "Save all/calculations" button, see *figure3*. This button should only be pressed after all the input data have been properly entered. Before SahysMod starts with the calculations, the data will be checked and saved. In case the data check detects one or more errors, a message will be given to correct these before the calculations can be done.

The output menu can make data groups, graphs and maps. This is explained in the section 5.

5. The output menu, tables, graphs and maps

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🚢 SahysMod, Spatial Agro-Hydro-Salinity Model
                                                              File Edit
Intro Figure Output Graphics
                                                                   ~
  SAHYSMOD: A predictive computation method for soil and groundwater,
  salinity and the watertable depth in agricultural lands using
  varying hydrologic conditions and watermanagement options.
  The first version of the ILRI working group:
  K.V.G.K. Rao, R.J. Oosterbaan, J. Boonstra, H. Ramnandanlal, and R.A.L. Kse
  was regularly updated by R.J. Oosterbaan
  and he brought it from DOS to Windows. Consult the manual.
                Name of output file: D:\Werkmappen\WinModels\SahysMod gr
   YEAR:
            0
   ***********
   Season: 1
               Duration: 6.0 months.
   ********
   Polygon: 1 X (cm): 38.000
                                  Y (cm): 34.000
                                Area (m2): 4000000.000
   Gnt = -2.12E+0
                                                     Gw = 7.40E-00
                                             -
   Dw = 7.70E+001 Hw = 8.30E+002 Hq =
                                              -
  <
                                                                 2
          Save group Go to input Show symbols Select data for graphs Open Group Open output
  See graph
The output file can be inspected. Use "Open output" to inspect any other output file or to see examples in any folder.
```

Figure 9. Overview of the top of the output file. The file can be further inspected using the scroll bars. The output file is quite big and its inspection is tedious. Therefore the possibility exists to inspect the output per group and see their graphs using the "Select data for graphs" button (blue square).

When the selection button has been clicked upon, the output groups appear in the next figure.



Figure 10. Overview of the selection options of groups of output data. In this example the "Average soil salinity per polygon" has been selected. To proceed with this selection, click the "Go" button.

When the "Go" button has been clicked, one will see a choice between inspection of all the polygonal data at a certain time, meaning at a certain season in a certain year, or all the time data of a certain polygon, See the following figure.

ro Figure Output Graphics	
 Output categories Polygonal characteristcs Detailed soil salinities rootzone Average soil salinity per polygon Underground salinities Irrigation and other salinities Salt storage at soil surface Groundwater flows in m/season Drain and well discharge Depth of the water table Percolation from the root zone Capillary rise into the rootzone Canal and field irrigation, bypass Irrigation efficiency/sufficiency Evaporation from unirrigated land Irrigated/unirrigated area fractions Frequency distribution soil salinity Groundwater flows in m3/season 	Mapping help Show network map Select type of data • • Time data per polygon • • Polygonal data per season • Cancel Node 1-89 50 Go •

Figure 11. After clicking the "Go" button in figure 10, a choice can be made either to inspect all the time data of a certain polygon, or all the polygonal data at a certain time, meaning at a certain season in a certain year. In this example the time data have been chosen (blue arrow), as well as polygon number 50 of the 89 polygons in total. To inspect this data group, the "Go" button (orange square) will have to be clicked upon.

Having clicked on the "Go" button the selected data group appears as visible in the next figure.

SahysN le Edit	Mod, Spat	ial Agro-I	tydro-Salinit;	Model								H		×
intro F	Figure	Output	Graphics											
Data POLY	_from_ GON_Nr	D:\Wei _50	kmappen	\WinMo	dels	\SahysMc	d gro	up\Sah	ysMod1	7_A1 (as 17_	A, +	GR	^
"Weig "(Avo	ghted C, ds/m	averaç m)"	e salin	ity of	the	rootzon	e in	the p	olygon	per	season			
Year	r Seas	on	AvC											
"			"											
0		1	6											
0		2	6											
0		3	6											
1		1	5.44											
1		2	5.26											
1		3	5.35											
2		1	4.91											
2		2	4.79											
2		3	4.95											
3		1	4.57											
3		2	4.49											
3		3	4.69											
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				_										
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See g	raph	Save g	roup Go	to input	Show	w symbols	Selec	t data fo	or graphs	Ope	n Group	Oper	out	put
e "Select	data for g	graphs" fo	r the graphic	s menu, o	use "O	pen output"	to retrie	ve an othe	r output fil	e.				

Figure 12. The average soil salinity data for polygon 50 over the time (three years with three season each) is presented here.

The group can be saved as a *.prn file (orange square) for further use, for example for import into a spreadsheet program like Excel (take care to import separated by space).

Also a graph of the data can be seen clicking on the "See graph" button. The result of this action is presented in the figure on the following page.



Figure 13. Graph of the average soil salinity (AvC) of polygon 50 with time. The color of the salinity in the first season of each year is yellow color, the second season (which is of larger duration) in green, while the third season (which is of shorter duration) is depicted in gray color. It appears the soil salinity is descending with time.

In *figure 11* a choice was seen either to inspect all the time data of a certain polygon, or the polygonal data at a certain time, meaning at a certain season in a certain year, and the first choice was made. Let us see what happens when the second choice is selected.

 Output categories Output categories	Mapping help Show network map Select type of data Time data per polygon Polygonal data per season Cancel Give year and season Year 3 Go Go
 Frequency distribution soil salinity Groundwater flows in m3/season 	Season 2 1 - 3

Figure 14. Instead of the choice "Time data per polygon" in figure 11, here the option "Polygonal data per season" is chosen (blue arrow) and the season selected is the second one (of three) in the second year (of three).

Clicking the "Go" button (orange square) produces the list of soil salinities as demonstrated in *figure 15*.

SahysMod, Spa	tial Agro-Hydro-Salinity Model	11	×
	Output I caushian I		
ntro Figure	Graphics		
Data_from: YEAR-2 SEDSON-2	_D:\Werkmappen\WinModels\SahysMod group\SahysMod17_A1(as 17	A, +	G ^
"Weighted	average salinity of the rootzone in the polygon per season		
"(AvC, ds/	m)"		
Polygon	AvC		
"	"		
1	4.64		
2	11.4		
3	13		
4	4.94		
5	5.22		
6	7.98		
7	7		
8	5.89		
9	4.74		
10	4.4		
11	4.27		
12	4.91		
13	5.11		
14	5.11		
15	21.5		
16	4.58		~
<			>
Hint: save gro	ups for use in spreadsheets		
See graph	Save group Go to input Show symbols Select data for graphs Open Group	Open	outpu
"Select data for	graphs" for the graphics menu, or use "Open output" to retrieve an other output file.		

Figure 15. List of average soil salinities (AvC) per polygon in season 2 of year 2 as determined in figure 14.

Clicking on the "See graph" button makes the graph visible as in *figure 16*.



Figure 16. Graph of the average soil salinity (AvC) of all the polygons (1 to 89) as selected in figures 14 and 15.

In some cases this graph is not clear, though here it is. In that case a cross-section over the polygonal map can be employed, see the announcement in light blue and the arrow in dark blue.

The map can be produced clicking the "See map" button (orange square). Also in this case, the mapping procedure can be carried out in different ways as explained in the figure on the next page.

Data_from:_D:\Werkmappen\WinModels\Sahy The sequence is from No. bigh. YEAR-2 SEASON-2 "Weighted average salinity of the rootz If a decide, enter the desired limits with the help of combo box below. "Advantage salinity of the rootz If a decide, enter the desired limits with the help of combo box below. "AvC, dS/m)" If a decide, enter the desired limits with the help of combo box below. Polygon AvC "	tro Figure	Output Graph	nics		Select clas	ss limits		-	X	
Polygon AvC 1 4.64 2 11.4 3 13 4 4.94 5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 C Cancel	Data_from YEAR-2 SEASON-2 "Weighted "(AvC, ds	:_D:\Werkma average sa /m)"	ppen\WinMo	odels\Sahy: the rootz(Automatic The se They can limits with If so de in the 3rd desired co Click "I	limits of classes are quence is from low be replaced by use the help of combol scided, enter the de column of the table lor codes in the 4th Ready" when done	shown. to high. preferred iox below. sired limits and the			<
1 4.64 2 11.4 3 13 4 4.94 5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	Polygon	AvC			Accept aut	tornatic limits 🚽]			r
2 11.4 3 13 4 4.94 5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58	1	4.64			Limit Nr.	Automatic			-	
3 13 4 4.94 5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	2	11.4								
4 4.94 5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	3	13			1	7.19				
5 5.22 6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	4	4.94			2	10.81				
6 7.98 7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	5	5.22			2	14.42				
7 7 8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58	6	7.98			3	14.43				
8 5.89 9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	7	7			4	18.06				
9 4.74 10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	8	5.89			5	21.68				
10 4.4 11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	9	4.74								
11 4.27 12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	10	4.4			6	25.31				
12 4.91 13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	11	4.27								
13 5.11 14 5.11 15 21.5 16 4.58 Cancel Ready	12	4.91								
14 5.11 15 21.5 16 4.58 Cancel Ready	13	5.11								
15 21.5 16 4.58 Cancel Ready	14	5.11								
Cancel Ready	15	21.5			1					
Cancel Ready	10	4.58			I	n . 1				Y
	<				Lancel	Ready				
Hint: save groups for use in spreadsheets	Hint: save gro	oups for use in sprea	dsheets							

Figure 17. This figure is like figure 15, but is has an insert to the right, indicating that the map will be made automatically with salinity class limits as given in the table.

In Appendix B it is explained how the map can be made manually with a determination of the number of classes, the class limits and the corresponding colors to be handled.

Clicking on the "Ready" button in the insert results in a map as illustrated in the next figure.



Figure 18. Map made automatically with the data demonstrated in the previous figure and concerning season 2 of year 2 as determined in figure 14.

The highest salinities (yellow) occur in the polygons with high polygonal number in the bottom line. Yet, salinities smaller than 7.2 dS/m (dark blue) are not present, meaning that the soil salinity in the area is generally quite high.

The button "See a cross-section" (orange square) helps to determine a sequence of polygons (for example diagonally 5, 17, 30, 44, 58, 72, 84) for which a graph can be made as visible in the selection table of figure 19.

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Ĩ.

≚ Select polygon	s —	X	Figure 19.
Select maximum first column by ty second column. The serial numbe of polygons you The graph will sh given by the seri	20 polygons from ping serial numb er ranges from 1 wish to select). N now the polygon al numbers.	m the list in the lers in the to N (the number N<21. s in the sequence	Table for the selection of polygon numbers in a cross-section over the area that must be included in the graph to be made.
1	^	Network map	
2	_		
3		See example	
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14		Cancel	
15	¥	0.000	
		Ready	

As a second and final example of a polygonal map, the net groundwater flow (incoming flow from neighbor polygons into the central polygon less outflow from the central polygon to neighbor polygons) is used in Figure 20.



Figure 20. Polygonal map of the net groundwater flow (Gnt, incoming flow through aquifer and transition zone from neighbor polygons into the central polygon less outflow through aquifer and transition zone from the central polygon to neighbor polygons).

Most polygons have negative Gnt value signifying that more water goes out than comes in owing to the polygonal recharge by rainfall and irrigation. Only polygon 77 (yellow) receives net inflow. It probably lies in a depressed area that should be apparent on the topographic map.

For a definition of the zones mentioned see *figure 2*.

7. Conclusions

The SahysMod model covers many aspects of land and water management of irrigation project. If the technicians of an irrigation project would set up SahysMod for their project area, they would have a good overview of the conditions. The model could also be updated any time that new or corrected data become available so that the value of the model would increase. Also, when project changes have been made, the might be incorporated in the model so that it keeps it value. Further when project changes are proposed, their consequences could be assessed and evaluated.

For more information on SahysMod, the list of publications in which the model is used can be consulted [reference 4]. The following publications could also be consulted:

- 1. Agro-hydro-soil-salinity characteristics of the irrigated Garmsar alluvial fan, Iran, described with the SahysMod model [*reference 5*].
- 2. Irrigation, groundwater, wells, drainage and soil salinity control in the alluvial fan of Garmsar, Iran assessments with the Sahysmod model [*reference 6*].
- 3. The groundwater hydraulics of the Garmsar alluvial fan, Iran, assessed with the SahysMod model [*reference 7*].
- 4. Mapping facilities of the spatial agro-hydro-soil-salinity model SahysMod [reference 8].

7. References

Reference 1.

SahysMod (spatial agro-hydro-soil-salinity model) can be freely downloaded from: https://www.waterlog.info/sahysmod.htm

Reference 2.

SaltMod model software and computer program. Free download from: <u>https://www.waterlog.info/saltmod.htm</u>

Reference 3.

The principles and mathematics used in the SahysMod model can be consulted in: <u>https://www.waterlog.info/pdf/sahysmod.pdf</u>

Reference 4.

List of publications in which the use of SaltMod is reported. Download from: <u>https://www.waterlog.info/pdf/sahyslist.pdf</u>

Reference 5. <u>Agro-hydro-soil-salinity characteristics of the irrigated Garmsar alluvial fan, Iran, described with</u> <u>the SahysMod model</u>

Reference 6.

Irrigation, groundwater, wells, drainage and soil salinity control in the alluvial fan of Garmsar, Iran-assessments with the Sahysmod model

Reference 7. The groundwater hydraulics of the Garmsar alluvial fan, Iran, assessed with the SahysMod model

Reference 8.

Mapping facilities of the spatial agro-hydro-soil-salinity model SahysMod

8. Appendices

This section contains three appendices:

- Appendix A. SahysMod's aid in nodal network construction
- Appendix B. Manual selection of output item classes and map colors
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Appendix A. SahysMod's aid in nodal network construction

When starting a new input file, the "Input" tab sheet has a "First Aid" button that, when clicked on, shows the next advisory text:

🎽 Polygonal network help	-		×
When entering data for a new project, it w number of polygons to be added to the sta number of polygons desired. This includes necessary model details, and external poly conditions.	ill be require Indard five to Internal poly gons giving	d to speci o reach th ygons for the bound	fy the e total all dary
Use the "Example of network" button belo of the layout of a polygonal (nodal) netwo which 9 internal and 12 external. To creat ad 16 polygons to the standard 5.	w to obtain rk. It contain e such a net	a first impi is 21 node work one	ression es, of should
The other data on the General input tabsh An impression of data requirements can be to inspect an existing input file.	eet need als obtained us	o to be fil sing ''Ope	led in. n input''
After completion, use the "Save general in the data of the General input tabsheet. Pr two options: (1) to continue entering other polygonal da network has been prepared beforehand (2) to proceed with guidance on the prepa entering all other polgonal data.	put" button omptly one v Ita as the po I, or ration of the	which will will be fac lygonal (n network l	save ed with odal) before
The proceeds are furter supposed to be se exercise, one may try to reconstruct the ex	elf-explanato ample.	ry. For an	
,	(Exa	mple of n	etwok)

When, after completion of the general data (see figure 3), the "Save general input" button has been clicked, the following picture is shown:



An enlargement of the central block in the previous figure, with the "Network guidance required" option selected, is given in the next picture:

Nodal coordinates O Network map is available Network guidance required OK	After activating the "OK" button, one will see a block asking for the number or rows and columns, See left under in this table.
Number of horizontal (nodal) grid lines: rows 5 Number of vertical (nodal) grid lines: columns 5 OK	To make the examples not too complicated, only 5 rows and 5 columns are filled in. Clicking the "Example" button, the next figure appears.



From this figure on gets the impression how the horizontal and vertical grid lines are formed, how the horizontal X and the vertical Y coordinates are depicted and that there will be internal polygons, indicated by white nodal numbers, and external polygons, indicated by purple colored nodal numbers. The nodes are the centers of the polygons to be formed.

Further the following information will be asked sequentially:

Begin with lo	wermost grid lin	e Nr. 1		Y con Start	with smalles	ows as measured in c st Y value correspondin	n on the map. g to row 1.
Minimum: number of internal nodes +1	Row nr. 1 2 3 4 5	Nr. of Nodes 5 5 5 5 5 5 5	ОК		Row nr. 1 2 3 4 5	Y-coordinate 1 2 3 4 5	ОК
coordinates of o art with smalles	columns as meas st X value corres	sured in cm on ponding to colu	the map. Imn 1.	X Se	coordinate e example	of first node in eac	h row.

Each table follows after clicking the "OK" button of the previous table.

The table right under asks for the first X-coordinate per row.

In the example (the blue figure above) the first X-coordinate in the first row, pertaining to Node 1, is 1. The first X-coordinate in the second row, pertaining to Node 6, is 0. The first X-coordinate in the third row, pertaining to Node 13, is 1. The first X-coordinate in the fourth row, pertaining to Node 18, is 2. Lastly, the first X-coordinate in the fifth row, pertaining to Node 21, is 3.

The table right under is more simple, all first nodes have the same X-coordinate begin 1.

After the last "OK" click, the following picture appears, showing the polygonal network that has been created with the data previously provided.



This picture shows the polygonal network that has been created with the data previously provided.

The message on top announces that the levels of the aquifer bottom in each polygon must be completed (see for example *figure 5*).

Hereafter the SahysMod aid will help to complete all the other polygonal data as appears in figure 4.

Appendix B. Manual selection of output item classes and map colors

In figure 17 the classification and coloring of the map of the output item selected was indicated as automatic.

However, it is also possible to follow the preferences of the user as clarified in the illustration hereunder.

Select clas	s limits limits of classes	s are shown.	1			×	Instead of the automatic procedure demonstrated in figure 17, the user can prefer
They can I limits with t If so de in the 3rd o desired co Click "F	preferred limits	user preferred bo box below. e desired limits able and the e 4th. lone.	imits -	The desire may be en last colum	ed color con Intered in the In of the tab	des e ble	the "Make user preferred limits" option (blue arrow). can also define the amount of class limits (green arrow), define the limits themselves (third column) as well the
Limit Nr.	Automatic	Preference 4	Color code	_	4		<i>colors desired (see for example the purple arrow).</i>
2	n.a.	6	2		5		In the automatic procedure
3	n.a.	8	1		6 7		(figure 17) the number of
4	n.a.	12	11		8		classes is one less and the cl
5	n.a.	16	10		9		umus are aijjereni.
6	n.a.	20	6 K		10		When activating the "Ready
7	n.a.	24	5		11		button, the polygonal map of
Cancel	Ready				12 13 14		the average soil salinity according to these specifications will be reveale see the picture placed on the next page.



This figure is like figure 17, but via a manual specification procedure (previous figure) the map looks quite different, even though it relates to the same soil salinity, the same season and the same year.

A map with soil salinity contours has been made with the free Quikgrid program and the result is seen in the following image.



Contour lines of soil salinity with the same data as in the foregoing illustration. The map is made with the free Quikgrid program.

<u>Appendix C. Relations between topographic level. soil salinity, depth of water</u> <u>table, capillary rise, and hydraulic conductivity</u>

The figures in the table hereunder and on the next page cover the aspects of topography (level of the soil surface), average soil salinity, depth of the water table, capillary rise, and aquifer hydraulic conductivity. To interpret the relations between these magnitudes more easily, the corresponding print outs of these items (see *figure 12* for the "Save group" instruction) have been imported in an Excel work sheet (here the separation instruction has to be provided and in continuation the space instruction has to be given) and a graph was made with the topographic level of the soil surface on the horizontal X=axis and values of adjusted magnitude values on the Y-axis (see the very last figure below),



The last graph is reproduced hereunder in a somewhat enlarged format for better visibility.



Legend: soil salinity in dS/m, cap. rise = capillary rise in cm/day, DWT = depth of the water table in units of 10 m, hydr. cond = hydraulic conductivity of the aquifer in units m/3 per day. The units have to be adjusted so that the can be plotted against the same Y-axis.

The conclusions that can be drawn are:

- 1. The capillary rise (purple) only occurs in the lower lying polygons with a level below 820 m.
- 2. Like the capillary rise, the soil salinity (dark blue) is highest in the lower lying polygons, especially those with a level below 820 m.
- 3. The soil salinity is correlated with the capillary rise.
- 4. In the higher lying polygons the soil salinity becomes more or less constant, around 5dS/m, which is tolerable by most crops.
- 5. Both the depth of the water table (orange) and the hydraulic conductivity of the aquifer (green) increase in the direction of the higher lying polygons. These three magnitudes are correlated, but the hydraulic conductivity has a large scatter in the higher lying polygons.