COURSE: GROUNDWATER MODELLING USING MODFLOW

Session 8: Build a groundwater model

Objective:

The objective of this session is learning to define the active and inactive zone, , select the solver and import a DEM (raster).

Setting up model parameters

Open ModelMuse.exe and choose the option **Create New MODFLOW Model**. In the "Geo Reference and model Description" window change the length units to "meters" and time units to "seconds", after that click on "Next".

2 ModelMuse		- C	X
Geo Reference and Model Description			
Simulation starting date Projection type Length unit	Time unit		
1/ 1/2000	Second	6	•
Simulation starting time Projection			
00:00:00			
	<u>? H</u> elp	N	ext 🔸

Defining model grid properties

In the window, select the **No grid option** because the grid will be defined with shapefiles

28 Initial Grid	- 0	×
MODFLOW-NWT MODFLOW Version		
Specify initial grid (optional)		
10 Number of columns 100 Column width Layer group	o name Bottom elevation	
10 Number of rows 100 Row width Model_Top	0	
Upper Aqui	fer -10	
3 Number of layers Middle Aqui	ifer -20	
Grid origin: Upper left corner Lower Aquit	fer -30	
0 X 0 Grid angle (degrees)		
0 Y Vertical exaggeration		
0 Z		
<u>? H</u> elp	🗙 No grid 🛛 Fir	iish 🔸

To import the files, go to **File/ Import / Shapefile.** Open the file **activeZone.shp** located in:



Course_GroundwaterModellingMODFLOW\Week_8\Practice\Data

In the following window select **Set values of enclosed cells**, the number of formulas is zero and click **OK**.

🗱 Import Shapefile - C:\Users\Computer\Documents\Gidanas\Cursos\Course_GroundwaterModelli 🛛 🗙						
Options 1 Options 2 CSV (Optional) Data Coordi	Options 1 Options 2 CSV (Optional) Data Coordinate Conversion					
✓ Import shapes as objects	valuated at	Number of changes				
Set values of enclosed cells	Cells	Minimum X = 350000				
□ Set values of intersected cells C	Cell corners	Maximum X = 35320 Minimum Y = 854600				
□ Set values of cells by interpolation Maximum Y = 8549						
🗖 Import grid		<				
Import criterion True		Edit F()				
Import shapes as a single, multipart object						
Imported shapes should be visible but not selected	-					
Number of Z formulas C Zero C One Z-coordinate 0 Higher Z-coordinate Model_Top Lower Z-coordinate Lower_Aquifer_Bottom		Edit F() Edit F() Edit F()				
Number of shapes = 1	elp 🗸 OK	X Cancel				

To define the layers, go to **Model/ MODFLOW layer Groups**. These will be called **Upper Aquifer, Middle Aquifer** and **Lower Aquifer**. All of them will be of the type **Convertible**.



To discretize, click the **Upper Aquifer and Lower Aquifer**, which will have a discretization of 3 while the rest will have a value of 1. Click **OK**.



Select the **Show or hide object** option. For the shapefile **activeZone** select the options shown below.

🐉 Object Properties								-		×
Properties Data Sets MODFLOW Features Vertices Comments/Captions										
Evaluated at	oll come		Position	locked		Object inform	nation (not	edita	ble)	
Name activeZone_1 Image: Duplicate cells allowed Image: Duplicate cells allowed Image: Duplicate cells allowed Image: Duplicate cells allowed	0 50	Qua	adtree refine	ment		Object area 12999.999 Object area 10560000 Object orde	r. 19999964			
Color object line	_	Set of	bject line colo	or 🔤	_	1				
Set values of enclosed of Set values of intersected Set values of cells by intersected	cells d cells	Mi of	nimum fracti cell length	on	_					
Number of Z formulas	erpolatio	Two								
Z-coordinate	(Middl	e_Aquife	r_Bottom + L	.ower_	\quifer	Bottom) / 2.			Edit F	
Higher Z-coordinate	Model	_Тор						- 1	Edit F	()
Lower Z-coordinate	lower	Aquifer	Bottom						Edit F	()
						? Help	✓ OF		X Car	ncel

To activate the basin, go to Data Sets/Active and in the formula select True. Click OK.

🛃 Object Pro	perties								-		×
Properties	Data Sets	MODFLOW Fea	atures	Vertices	Comments/C	Caption	ns				
Requ	ired drology Active Horizontal_, Kx Ky Kz Modfleuu In	Anisotropy	Fo	rmula for "/ ue	Active" data se	et			E	Edit F()
Layer eleva using object	tions can on ts with Zero	ly be specified Z formulas.	Da	ta set com	ment		Associ PHAS MODF	ated mode T: MEDIA-a LOW BAS	data ictive IBO	a 9 UND	
Use PH	IAST-style in	terpolation			nterpolation ∊	direct Y	ion or m	c Mix			
Distance *	0	Value 1	0		Mixture formu	la					
Distance 2	2 1	Value 2	1							Edit F	()
						?	Help	🗸 ОК		🗙 Ca	ncel

Now for the characteristics of the zone represent the inactive zone, to import the files, go to **File/ Import / Shapefile**. Open the file **inactiveZone.shp** located in:



Course_GroundwaterModellingMODFLOW\Week_8\Practice\Data

Select the **Show or hide object** option. For the shapefile **inactiveZone**, go to **Data Sets/Active** and in the formula select **False**. Click **OK**.

😕 Object Properties				-		×
Properties Data Sets MODFLOW Fea	tures Vertices (Comments/Capti	ions			
E I Required	Formula for "Ad	tive" data set			Edit F()
⊟ IZ Hydrology	False					_
Horizontal Anisotropy						
- Kx	2					
□ Ky □ Kz						
Modflow_Initial_Head						
	Dete oot comm	ont	A	atad madal d	lata	
I	Data set comm	lent		T: MEDIA ac	iala tivo	
Layer elevations can only be specified			MODE	LOW BAS: I	BOUND	
using objects with zero 2 formulas.						
PHAST-style interpolation	1					
	Н	Interpolation dire	ction or m	ixture		
Use PHAST-style interpolation		ex cy	сz	C Mix		
Distance 1 D	0	lixturo formula				
Value 1		Inture formula				
Distance 2 1 Value 2	1				Edit F	()
					1. Carrowson	
		1	<u>? H</u> elp	🗸 ОК	🗙 Ca	ncel

All the model area has to be inactive, but the basin zone which is the only active area. Go to **Data / Edit data sets /Active** and in **Edit formula** write False. Click **Apply**

🔀 Data Sets	- 🗆 ×
Required Hydrology Active Horizontal_Anisotropy Kx Ky Kz Modflow_Initial_Head Modflow_Specified_Head Layer Definition	Basic Comment Name Active Type Orientation Boolean J Evaluated At Units Cells J Interpolation Anisotropy none J
	Default formula Edit formula False



To import the basin topography, go to **File/ Import/ Surfer grid file** and locate in Course_GroundwaterModellingMODFLOW\Week_8\Practice\Data, select the file **dem.**

🐉 Open a Surfe	r grid file		\times
Buscar en:	Data	 ✓ ✓ ✓ ✓ 	
Acceso rápido			
	dem	n	
Bibliotecas			
Este equipo			
In the second se			
	Nombre:	dem 💌 🔺	brir
	Tipo:	Surfer grid file (*.grd, *.dat)	celar

In Interpolator select Nearest Point and activate Set values of cells by interpolation. Click OK.

🔀 Import Surfer Grid File				-	-		×
Grid file extent							
	×	(Y		Z	^
Minimum	283077.42	22616811	8451349	9.01641681	1		
Maximum	392039.02	27916811	856268	1.99591681	234		
Number of Columns/Rows	3584		3662				
Delta X/Y	30 402233	36216518	30 4022	336155105			~
Data Set							
New data set							-
Interpolator Filter method Nearest Point Cuevest point in cell Set values of intersected cells Average of points in cell Set values of cells by interpolation Point closest to cell center Evaluated at Cell corners							
Convert X and Y coordinate	es from	No conve	ersion	✓ to No c	onve	rsion	-
		?	<u>H</u> elp	🗸 ОК		🗙 Can	cel

Then select **Data/ Edit data sets/Required / Layer definition.** Select the layer **Model_Top** and in Edit formula select the **dem**. Click **Apply.**

😕 Data Sets	- D >	< 🧏 Formula Editor	- 🗆
Required ⊕ Hydrology	Basic Comment	dem_Grd_Z	Double-click to insert in formula
Laver Definition Model_Top Loper_Acuter_Bottom	Model_Top		Data Sets User Defined Hoported from Sur
Middle_Aquifer_Bottom Lower_Aquifer_Bottom	Type Orientation Real 2D Top	dem. Grd_Z	^l <mark>dem_Grd_Z</mark> ⊪Functions
	Cells	Logical operators Operators	
	Interpolation Anisotropy	$ \begin{array}{ c c c c c c c c } \hline = & \leftrightarrow & \text{and} & \text{or} & 7 & 8 & 9 & () \\ \hline & & & & & & \\ & & & & & & \\ & & & &$	
	Default formula Edit formula dem_Grd_Z	>= <= True False 1 2 3 + -	
		Integer operators 0 E . " , mod div	
Add Delete	<u>? H</u> elp ✓ Apply <u>I C</u> lose		<
		© Eunction help ? Hel) V OK X Can

Select the layer **Upper_Aquifer_Bottom** and in Edit formula write **Model_Top-37.5**. Click **Apply.**

📆 Data Sets	- 🗆 ×
Required Hydrology Layer Definition Model_Top Upper_Aquifer_Bottom Middle_Aquifer_Bottom Lower_Aquifer_Bottom User Defined	Basic Comment Name Upper_Aquifer_Bottom Type Orientation Real DDTop Cells Cells Interpolation Anisotropy none I Default formula Edit formula Model_Top - 37.5
Add Delete	? Help ✓ Apply <u>I C</u> lose

Select the layer **Middle_Aquifer_Bottom** and in Edit formula write **Model_Top-45**. Click **Apply.**

😕 Data Sets	- 🗆 ×
Required Hydrology Layer Definition Model_Top Upper_Aquifer_Bottom Middle_Aquifer_Bottom Lower_Aquifer_Bottom User Defined	Basic Comment Name Middle_Aquifer_Bottom Type Orientation Real v 2D Top v Evaluated At Units Cells 1 Interpolation Anisotropy none 1 Default formula Edit formula Model_Top - 45.
Add Delete	? Help ✓ Apply I Close

For Lower_Aquifer_Bottom, in Edit formula write Model_Top-200. Click Apply.

🤔 Data Sets		-		\times
Required Hydrology Layer Definition Model_Top Upper_Aquifer_Bottom Middle_Aquifer_Bottom User Defined	Basic Comment Name Lower_Aquifer_Bottom Type Orientation Real 2D Top Evaluated At Units Cells Interpolation			
Add Delete	Default formula Model_Top - 200.	Edit form	nula	se

Then go **Required/ Hydrology/ Modflow_Inital_Head**, in Default Formula write **Model_Top-10**.

🥦 Data Sets	- 🗆 ×
	Basic Comment Name Modflow_Initial_Head Type Orientation Real ✓ SD ✓ Evaluated At Units Cells ✓ Interpolation Anisotropy none ✓
	Default formula
Add Delete	? <u>H</u> elp ✓ Apply <u>I C</u> lose

To de define the hydraulic conductivity, select Kx and write 0.0001, then select Kz and write Kx/2.

🐌 Data Sets	-	- 🗆 X	🧾 Data Sets		- 🗆 ×
Required Active Act	Basic Comment Name Kx Type Oriental Real 3D Evaluated At Units Cells Interpolation none 1 Default formula Edit 0.0001 Interpolation	tion v ppy formula	Required Hydrology Horizontal_Anisotropy Kx Ky Modflow_Initial_Head Modflow_Specified_Head User Definition	Basic Comment Name	Orientation 3D Units Anisotropy 1 Edit formula
Add Delete	? <u>H</u> elp ✓ Apply	<u>i</u> <u>C</u> lose	Add Delete	? Help	Apply

Then go View/ Vertical exaggeration and write 5. Click OK.

🥦 Vertical Exagge	ration		-	\times
Vertical exaggeration:		5		
Default	? <u>H</u> elp	-	ок	🗙 Can

The result should look like the image:



To visualize the initial head, go to Data visualization > Color Grid > Data set or boundary condition. Select **Modflow_Initial_Head** and log transform. Click **Apply.**

🐉 Data Visualization		– 🗆 X				
Color Grid	Selection Filters Legend					
Contour Data	Data set or boundary condition	Time				
MODPATH End Points	Modflow_Initial_Head	• • • •				
MODPATH Time Series	Data set comment (read only)					
SFR Stream Links						
STR Stream Links SWR Reach Connections	When changing data sets:					
SWR Observations	Update limits and legend (default)					
Vectors (SUTRA models)	C Retain limits and legend (animations)					
01033 0001013	Color scheme					
	Rainbow	Edit custom color schemes				
		Cycles				
		1				
	Color adjustment					
	0.60 I	Log transform				
	րուստուսուսու					
	? <u>H</u> elp	✓ Apply ▲ Apply				

The result should look like the image, go to File/ Save as Model 1.gpt.

