Starlivia Kaska

HWRS 482

Dr. Laura Condon

February 1, 2022

HW2 Challenge/ Discussion/ Glossary

**Challenge Questions:**

**Conceptual Model:**

Answer:

Each cell was 100m x 100m. In our dis. File our z bottom was 0 and z top was 10. You have to know which way your axis are oriented. The grid we were shown was actually a 2 dimension block, 2500m X 2500m with a thickness of 10m.

**Cross Section:**

Hydraulic Head Gradient = dH/dL

15-10 / 0-2500

dH/dL = -0.002

**Graphs for Steady State = q plots:**

If you use the harmonic average it becomes more like it should look like. Steady state means constant flux. When you are looking at a different k (heterogeneous) then the q here has to be determined using the harmonic mean.

**Show the steady state head contour in plan view for the homogeneous and heterogeneous (zones in series) condition. Use this plot to defend a contention that flow is 1D. Then, drawing on your first assignment, use the results to explain WHY the equivalent hydraulic conductivity, Keq, is closer to the lower of the two K values.**

From our homogeneous and heterogeneous head figures we can tell flow is 1D because we see smooth columns (there aren’t any blurring of the columns or the grid cells). The equivalent hydraulic conductivity is closer to the lower of the two k values as that is a function of the equation, we use to get the equivalent hydraulic conductivity.

Answer: Equal gradients throughout for a homogeneous. The reason why we know that flow is in one dimension is that there is no flow in y and z direction and we can see this because we do not have a gradient in the y and z axis. The Overall K is closer to the lower K value because of the harmonic average. It gets skewed towards the lower value. We need to use a harmonic mean and not the arithmetic mean.

You need a head gradient to have flow.

**Build a model based on a homogeneous domain with a square region of lower K in the middle of the domain. What can you learn based on your explanation of what controls the effective K for a 1D flow system now that you are applying it to a 2D system? What do you think the Keq of this entire system would be compared to the high and low K values? Explain why it is much more difficult to develop a direct solution for this 2D system than it was for a 1D system (including the zones placed in series).**

What we can learn from our explanation of what controls the effective K for a 1D flow system now is that we can determine whether a flow is 1D or 2D. From what we see in this example is that the grid cells get distorted when flow is 2D. I would expect the K value for the entire system to be closer to the higher value, as there are more values in the grid with it. It is more difficult to develop a direct solution for this 2D system due to the lack of uniformity. For example, in the 1D system we could use the flux equation for an entire column, where in the 2D system we would have to change variables for the cells in the column. It takes more time to derive.

Answer: Assume every cell is isotropic. Water is seeing everything the same. The K would be closer to the lower k value due to the harmonic mean. There is less flow through the square and more in the other areas, but the low k has a disproportionate effect because the flow is still there. Some of the cells would have to have a higher head gradient as the water has to flow through lesser cells. It is difficult to derive the K value for the system because you have different variables, with movement in x and y, this leads to partial differentials. You have to take in to account movement in the y direction (equivalent to realizing you need to use partial differential equations)

**For steady state conditions, there are equivalent Type I and Type II boundary conditions. What would the Type II boundary condition be that would result in the same equipotential for the first model? What is the value of the constant flux? What about the second model? What are the values of the constant flux on the left and right boundaries? What is fundamentally different about the equivalent Type II boundary for the third model compared to the first two?**

The type II boundary that would result in the same equipotential for the first model are the constant head boundaries. The value for the constant flux was .0021 for the first model. In the second model the constant flux on the left and the right boundaries was 0.0024. The fundamental difference between the type II boundaries of the first two compared to the third model is that the head values are not constant along each column. This makes a slight distortion in the heads graph at both ends of the grid (the constant head boundaries).

Answer from Class Thursday: Type II is constant flux; you could set each of the cells with the corresponding q’s to get the same equipotential for the first model. Type I is constant head.

**Glossary Questions:**

**What is MODFLOW? What is a MODFLOW package (provide at least 2 examples)? What are the inputs to a MODFLOW model?**

MODFLOW is a hydrology model. A MODFLOW package is an added on attribute for the MODFLOW model. Two examples of a MODFLOW package are, the Well Package, and the River Package. The inputs to a MODLFLOW model are files.

<https://www.usgs.gov/mission-areas/water-resources/science/modflow-and-related-programs>

Answer from Class Thursday:

**What is the relationship between head gradients and hydraulic conductivity in steady state systems?**

In a steady state system, the relationship between head gradients and hydraulic conductivity is the flux. You need the head gradient and the hydraulic conductivity to find q.

Answer from Class Thursday:

**What is a model node? A model cell? Use a simple diagram to show the relationship between heads defined at nodes and properties defined in cells.**

A model node a sensor that is parallel to the y axis of your system? It measures the a certain value at the center of a cell. A model cell is an area in the model grid. The cell contains information like the head value at certain points and the hydraulic conductivity of the cell.



|  |
| --- |
|  |
|  |
|  |
|  |
|  |
|  |
|  |
|  |



**What is the difference between Type I and Type II boundary conditions and under what conditions might you use each? Provide at least 2 examples for locations where we might use Type I or Type II boundaries to represent a feature in the real world.**

I am assuming that the difference between type II and type II is that the head boundaries are constant in one and not constant in the other. A location where you would use a type 2 boundary (constant head boundaries) is in a lab environment, or in a controlled environment where you can control the head boundaries. Where you would use the type 1 boundary would be used in situations where heads are variable, maybe in the field.

Answer from Class Thursday: