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HWRS 482

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The Challenge: Part 1

1.Read the paper that summarizes the stream flow packages in Modflow and look at the floPy documentation for the str package to understand how we have implemented this in our code. Write a short explanation for how the str package works and what assumptions it is making.

This package allows our model to simulate surface water flow and computes surface water levels. The str package uses the incoming flow from an initial stream reach as an initial discharge and then computes the outgoing flow by subtracting this value by the amount of seepage occurring in the system (this process creates a discharge for subsequent reaches). The model assumes that the incoming flow is available instantaneously, we input a value for the incoming flow, and it will be applied in our model. It computes the surface water levels using manning's equation. Manning's equation gives you discharge based on n (manning's roughness coefficient), A (cross sectional area of the stream), R (hydraulic radius, A/(w+2d), S (slope). Our code solves for the stream stage (surface water level) by first establishing variables, some of which we use in manning's equation.

Flow_into_the_1st_reach = 0	Initial amount of water discharged into our system
rough = 0	A value we can set (roughness coefficient)
Const = 86400	A value to convert our computation into m3/day
Slope = 0	A value we can set (slope of the stream bed)
width = 0	A value we can set (cross sectional width of the channel)
str_bott = 0	A value we can set (stream bottom)
sed_thick = 0	A value we can set (thickness of sediment in the riverbed)
str_top = str_bott+sed_thick	A function to find the depth

The model then uses all these variables and plugs them into an equation we wrote for stream stage.

Stream Stage = str_top + ((Flow_into_the_1st_reach*rough)/(const*width*(slope**0.5)))**0.6

2.The code is provided to produce the first set of 'correct' figures. Use these figures to describe the nature (direction/magnitude) of stream/aquifer exchange along the stream. Explain why the leakage changes magnitude or direction where these values change.

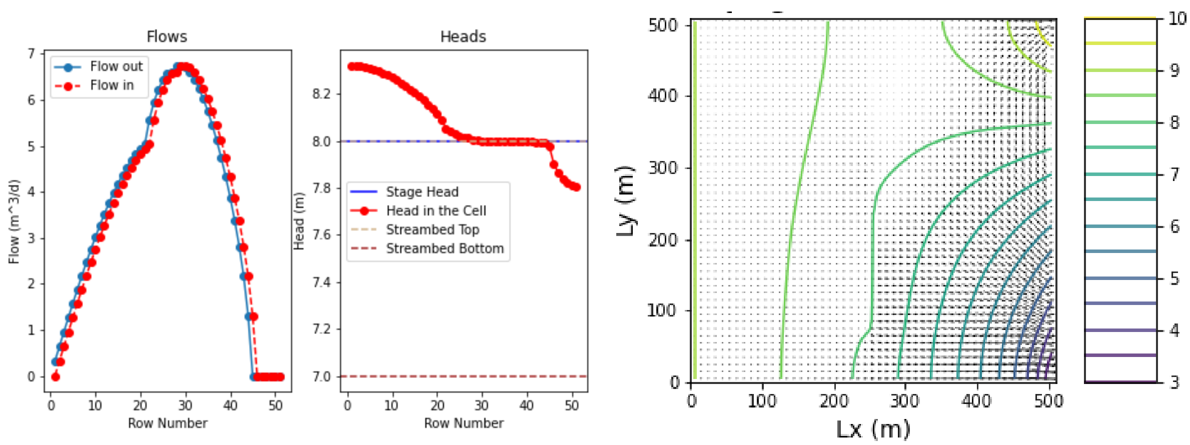

Figure 1. The plot on the left shows the flows going into each column in our domain. The plot in the middle shows the heads in each row of our domain, it also shows us the distance of the heads of the stream bottom and top. The plot on the right shows the head gradient and flow vectors in our domain.

From the left graph, it looks like water is flowing towards the bottom corner of the right boundary and there is little to no flow in the center top area. This center of the domain is where our stream is located. We can see from the plot on the right that the flow in the rows near the bottom right corner are higher coming in that going out. The magnitude is higher as more of the water is attracted to this area (down slope). Heads in the left of our domain are higher than the stage head, this reminds me of bank storage. There is a mound in the upper right corner as well and the flow going down gradient.

3.Use the head distribution to describe the movement of water across the boundaries and into/out of the stream.

The head distribution is higher in row zero and then decreases going down and then reaches a constant head from row 20-40 in our domain and this head is level with our stage head. Then the head decreases again until it reaches about 7.8 meters. We can compare this to the plot on the right, the counter at Lx of 200 m. The contour looks exactly like that of the plot in the middle. The plot in the middle has a higher head value due to the mound in the upper right corner of our domain.

4.Choose two things to explore (e.g. impact of streambed K or inflow into the river or recharge rate). Produce a plot for each to compare to the base plots and use the plots to explain the impact of the hydrologic change.

Inflow Into River

0 m^3/day **70 m^3/day** **500m^3/day**

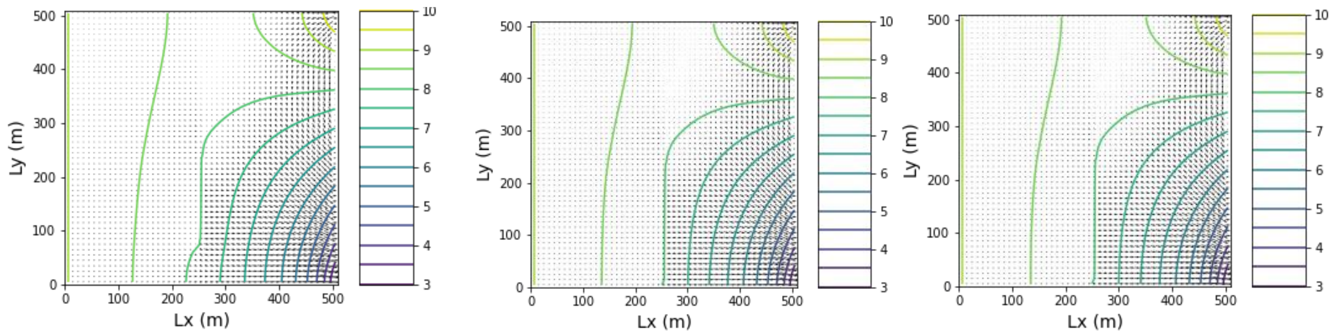

Figure 2. These are the plots of our head gradient and flow vectors for an inflow of 0, 70, and 500 m^3.

We can see the initial plot where our inflow was zero and then we change it to 70 and we can see that the nick from the initial has disappeared. This means that the entire head along this contour has reached the head level of the stage head. When I increased the value to 500, I did not see any differences from the plots. This leads me to believe that we won't see any significant change unless we hike up this value by several times. I tried it with 100,000 and the lone contour on the left crossed the stream.

Streambed K Value

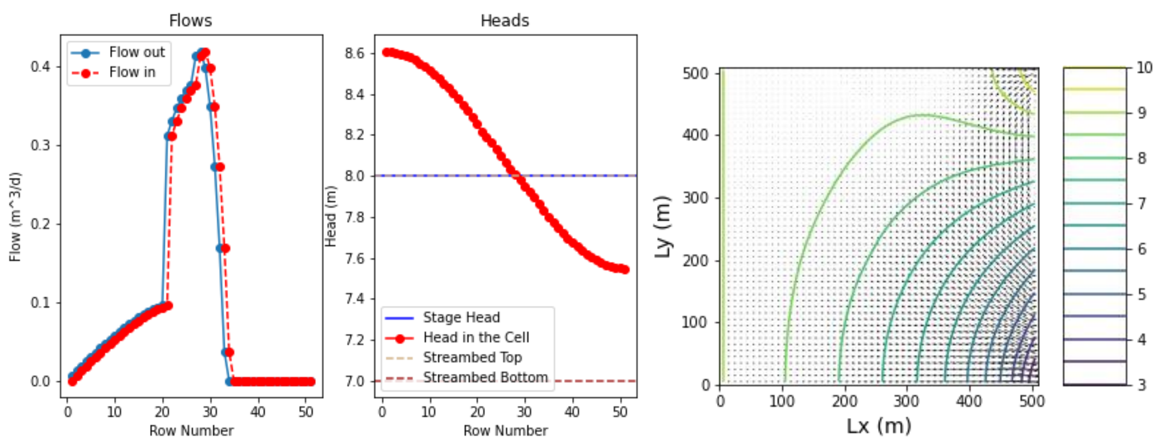

Figure 3. The plot on the left shows the flows going into each column in our domain. The plot in the middle shows the heads in each row of our domain, it also shows us the distance of the heads of the stream bottom and top. The plot on the right shows the head gradient and flow vectors in our domain. These figures are produced with a streambed k of 0.01 f/day, and inflow of 0.

When I manipulated the k value for the stream bed there was an entire shift in my contours. This model returned to the inflow value of 0. When I compare it with the inflow value of 0 with a k value of 1 in figure (1) it is apparent the k value is very important. The lower k value means that there is less opportunity for leakage. This allows for a more uniform head gradient, although it is skewed, we can tell from the head plot in the center that it is a lot linear now. This allows us to also measure a head value under our stream like we could do before, due to the leakage (due to the higher k value).