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HWRS 582

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HW 11 Discussion

1. Write a short explanation for how the str package works and what assumptions it is making.
    a. The STR package is an evolutionary step of the RIV package. The RIV package does not compute surface water elevation. That has to be defined manually. The STR package, however, computes the surface water elevation using Manning's equation. The flow in the most-upstream reach is defined by the user, and then discharge is computed for each downstream reach by calculating the gain or loss from seepage into/out of the bottom streambed layer. The STR package is configured to work in imperial units for some parameters, so being cognizant of that is important for accurate results.

2. Describe the nature (direction/magnitude) of stream/aquifer exchange along the stream. In particular, explain why the leakage changes magnitude or direction where these values change. (Additionally: 3. Use the head distribution to describe the movement of water across the boundaries and into/out of the stream.)
    a. `Streambed K = 0.01 m/day for the rows 0-19, 0.1 for rows 20-25, and 1 for the rest of the stream.`
    b. The simulation begins with flow into the first reach at 0. Figure 1 shows flow into each reach (row along the stream column) in red. From rows 0-19, flow out is slightly higher than flow in. The difference between the two lines is the amount of seepage from the groundwater that enters the stream. Figure 2 shows that between rows 0-19, the cell head is higher than the stage head, which, along with Figure 1, shows that this is a gaining stream. Figure 3 is a "Leaked to Aquifer" chart, so rows 0-19 being negative values makes since, since for this period, water isn't being leaked *to* the aquifer, but instead *from* the aquifer.
    c. For rows 20-25, the streambed K has increased by a factor of 10. This is why the rate of change of flow in Figure 1 increased so dramatically. Figures 1, 2, and 3 still show that the stream is gaining during these rows. After rows 25, the streambed K increases another tenfold. This changes the magnitude and direction of the vertical flow. With water able to now flow through the streambed so easily, the stream becomes a losing stream by row 30. That means water is now leaving the stream and seeping into the groundwater. This can be seen by the reversal in the red and blue lines in Figure 1, and the positive flux values in Figure 3. In Figure 2, "Head in the Cell" nearly matches "Stage Head" up until about row # 45, since the stream stage is being used to maintain the head in the cell.
    d. But by row #45, head drops below stream stage, and Figures 1 and 3 show that flow has now reached 0, which either means the stream and groundwater have become detached, or it might mean the stream dried out. I don't understand why the "Stage Head" in Figure 2 remains a constant 8.0 meters, which I interpret to mean that since

the streambed top is at 8.0 meters, there's just an infinitesimally small stream depth throughout the entire domain.

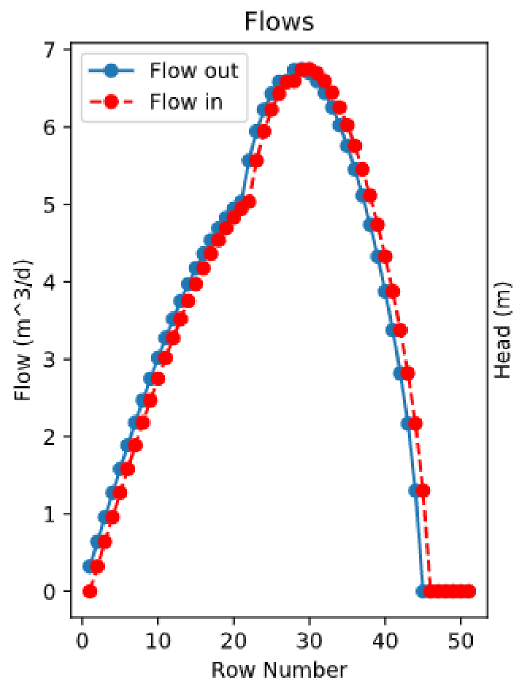

Figure 1: Flow in stream by row number

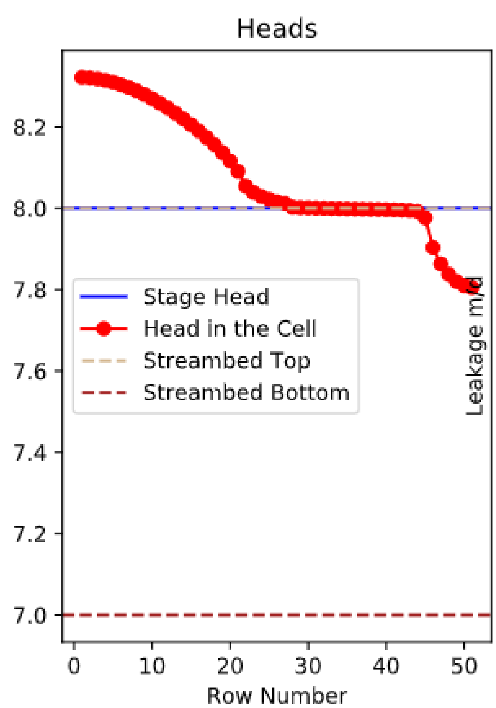

Figure 2: Head by row number

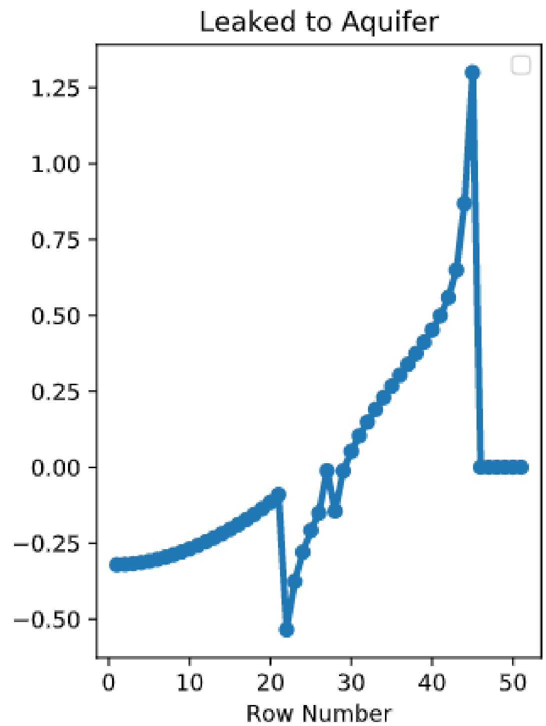

Figure 3: Flow leaked to (or if negative, leaked from) aquifer

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.

    a. Quick observation: Changing “stage_above_datum” from 9 to 20 does not change any results.

    b. In Figure 4, K for rows 21:25 was changed from .1 to .001 f^2 / day, and K for rows 26-50 was changed from 1 ft^2 / day to .01 ft^2/day. The right-most chart would not plot. Once again, stage head does not change, which makes me very skeptical of these results. Something interesting is that the vertex of the flow curve matches up with the inflection point of the head curve, which if I remember my Calculus correctly, it could mean that head is a second-order derivative of flow, or perhaps the other way around.

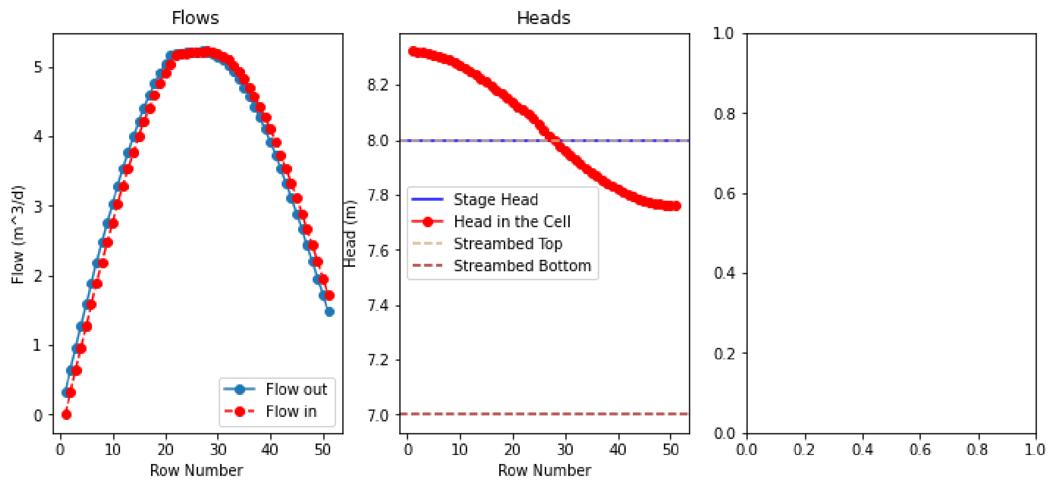

Figure 4: Effects of changing Rows 21-25 K to .001 and Rows 26-50 K to .01

c. Figure 5 is the set of charts when Flow_into_the_1st_reach was changed from 0 to 100, and K was kept at a constant 0.01 for the entire length of the stream. The head chart did not change at all. The flow chart had the exact same shape. The only thing that changed was the y-axis increased by 100. This again makes me thing that there's either something wrong with the code, or I don't understand what it's actually portraying.

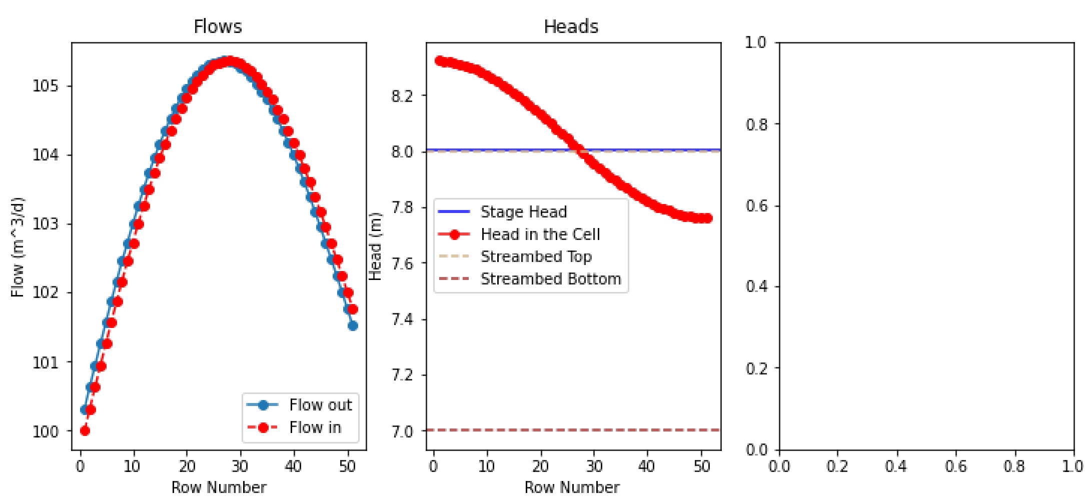

Figure 5: When flow_into_the_1st_reach is increased from 0 to 100, and K is a constant 0.01 through the stream.