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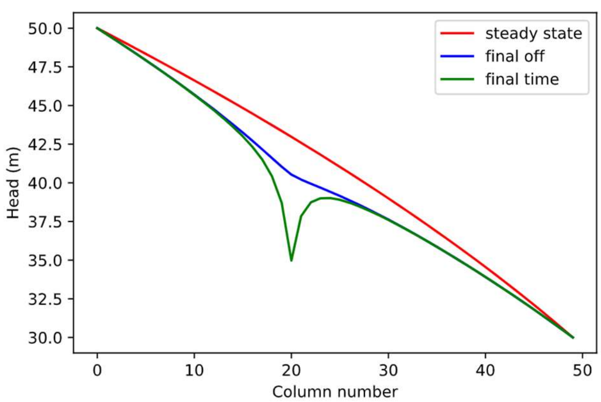
HWRS482

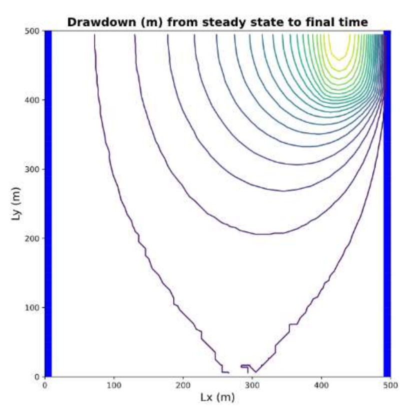
Transience

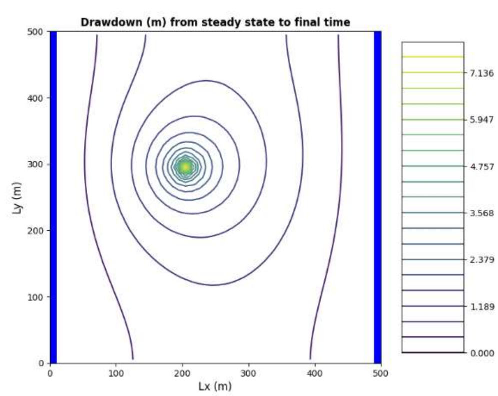
Without any input or output from the system, we would expect the gradient to be linear. To accommodate the input/output of the system, the amount of storage must change. In an unconfined system, that means that the elevation of the water table must change. Since the ends of the model are held in place by the constant head boundaries, this effect is going to curve the gradient more, farther away from those boundaries.



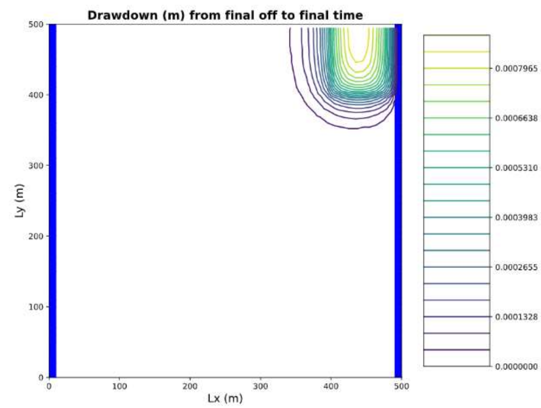
The system does not appear to have reached steady state. My intuition with the graphs is that the head where the pumping is occurring creates a transient state and that it reverses when the pumping ceases. It does not have time to reach a steady state before pumping is resumed.

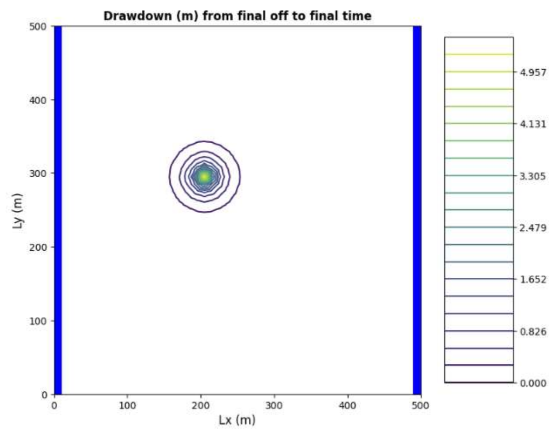
The well's zone of influence appears to influence pretty much the entire system.

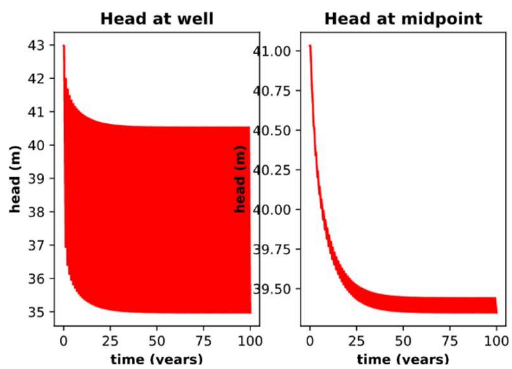




When we look at the influence of the well from the finall off-time to the final time, the zone of influence seems to only be around the well (the area adjacent to the well in the chart on the right). The chart on the left shows some loss due to ET. It is not significant here and it may not have been intended to be included within the model.

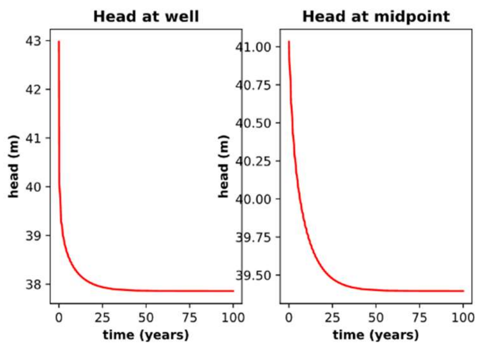




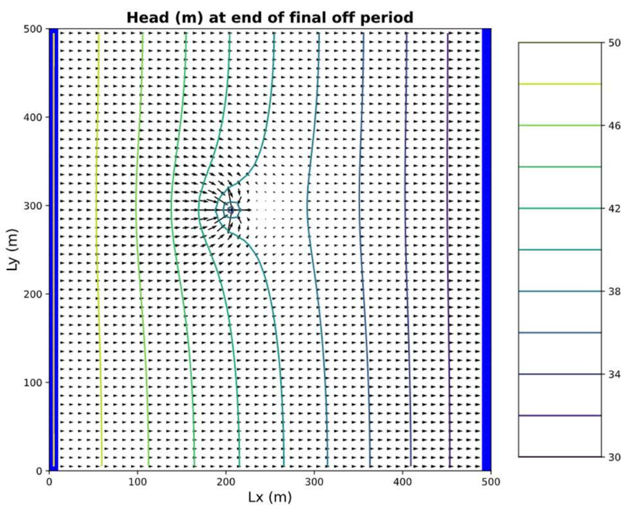


Just eyeballing it, it looks like this system reaches (more or less) a steady state after around 50 years of pumping. At least if we ignore the massive oscillation occurring every year. A more precise estimate of when this system reaches steady state could be acquired through creating an annual moving average and finding when the slope of that average over time comes to near 0. Taking only the maximum or minimum values and finding a line that way may also serve this purpose.

Because 500 cubic meters of water were only being pumped during one quarter of the year, my initial thought was to have a constant pumping rate of one quarter the initial pumping rate. It turns out that recharge completely cancelled any effect on head that that had on the system. Half of the initial pumping rate seems to come close to matching the average values for head. I am not sure why it seems to work out this way. The pumping rate of 250 cubic meters seems to work as a good approximation for both the head at the well and the head at the midpoint. Since the transient forces causing transience in this model are mainly coming from the well, what generates a “steady state condition at the well is also likely to do so farther from the well.



The two sources of water captured by the well that I can think of are the water from the left boundary and the recharge occurring within the capture-zone. It's worth noting here that there are two capture zones. Water found within the first will be pumped out. A larger capture zone may or may not because water within that area is only feeling the pull from the well for one quarter of the year. It could be drawn towards the well and then be drawn down-gradient away from the well when the pumping stops.



The difference between this capture zone and the ones from previous models is that this one changes in its extent through time both in the period before it reaches a steady state and in the period when the pumping has been turned off. I would expect the capture zone to expand and contract every year even after it can be simplified as a steady state system.