HWRS 582 – Groundwater modeling

HM11 – Effects of Pumping

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1. Based on your initial random ensemble, what is the most likely additional drawdown at the town well due to pumping the ag well? How confident are you in that response - explain/defend your answer.

The most likely drawdown in the entire domain is presented in Figure 1 (left). That drawdown is close to 1m, however, the standard deviation has almost the same or higher in magnitude (figure 1, right). That means a big uncertainty in the prediction. Probably, the town should take a position defining measurement of how certain they want to be such as 85%, 90%, 95%, etc. In other words, they have to define the risk they could tolerate but always having in mind that 0% risk is not possible.

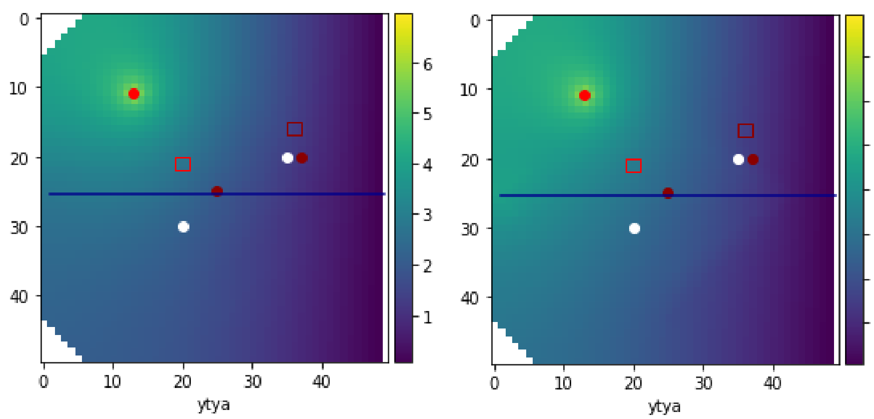

Figure 1. Left. Mean drawdown in the domain. Right: Standrad deviation of drawdown using 18 models (25 - 7 non-behavioral).

2. What is the likelihood that the reality (represented by the meager observed data) is best represented by an MOC?

The likelihood is very high. The accumulative likelihoods of the models of concern are 57.1%, therefore the town must be very concerned about the Ag pumping.

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Models with highest likelihoods

m001001330023042  L = 0.12 other model
m001001330113130  L = 0.095 model of concern
m001001330122221  L = 0.093 model of concern
m001001330202231  L = 0.08 model of concern
m001001330244131  L = 0.078 model of concern
m001001330244324  L = 0.069 model of concern
m001001330320413  L = 0.054 model of concern
m001001330324103  L = 0.046 other model
m001001330420212  L = 0.045 other model
m001001331013444  L = 0.044 other model

The total likelihood of the models of concern is  0.571
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Figure 2. Top 10 of the likelihood model.

3. What is the most likely loss in streamflow at the outflow end of the domain? Justify your answer.

The leakage in the river is almost invariant with the inclusion of the Ag. However, there is a high uncertainty under all the scenarios. That means the “true” data does not contain enough information to characterize the streamflow behavior. Therefore, more data should be collected in the river to infer the loss characterization. If we want to check the leakage at the end of the river, all the models and scenarios tell us that the exchange of water with the river is zero.

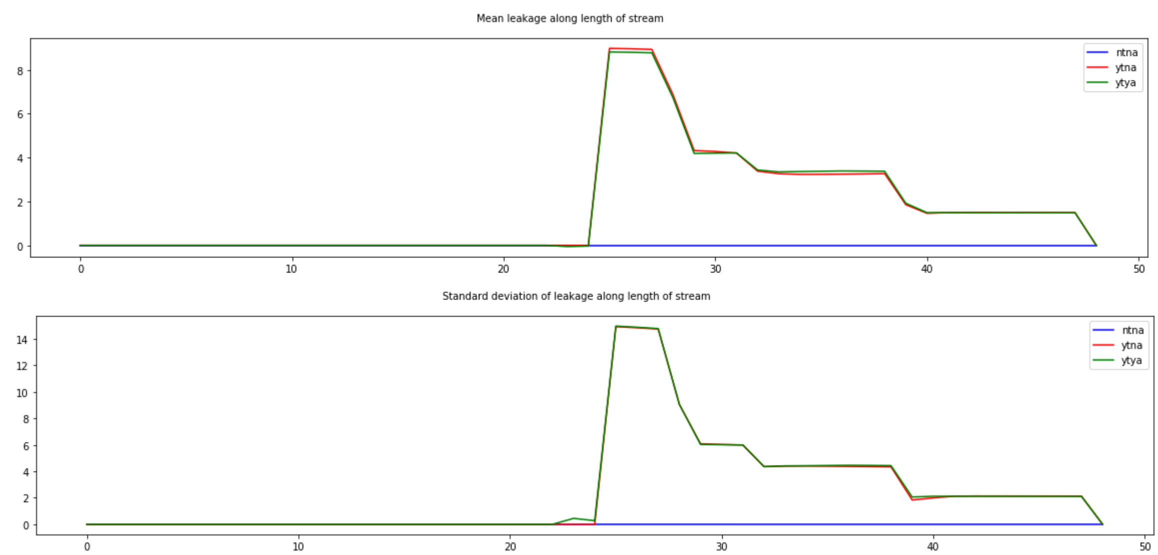


Figure 3. Mean and Standard Deviation of the Leakage across the river.

4. **Is it likely that either the town or ag well could be contaminated by the ag field? Justify your answer.**

The particle tracking tells us that there is approximately a 10% of chance that the town well would be contaminated with the farm. In the case of the Ag well there is a 60% that the farm contaminates its same source of water.

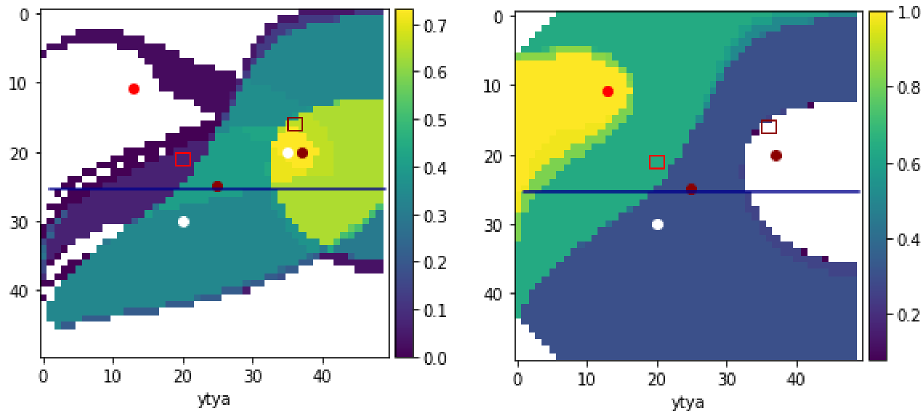


Figure 4. Particle tracking over all the models. Left: Town well. Right: Ag well.

5. **Make a set of plots based on ensemble 2 and discuss how each of your answers to the first four questions changed due to adding the MOC-inspired parameter sets.**

The drawdown and the standard deviation are almost the same after I added 10 MOCs in the ensemble (‘m001001330113130’). That means we did not add extra information to the system to decrease the uncertainty. In fact, I was waiting for a higher probability of having MOC, however, the number slightly decreased (ensemble 1=57.5%, ensemble 2=52.5%). That could be interpreted as the MOC used as pivot was located in a local minimum. Therefore, the region near to that had the same distribution of concern as the entire parameter space without adding more MOCs to the ensemble.

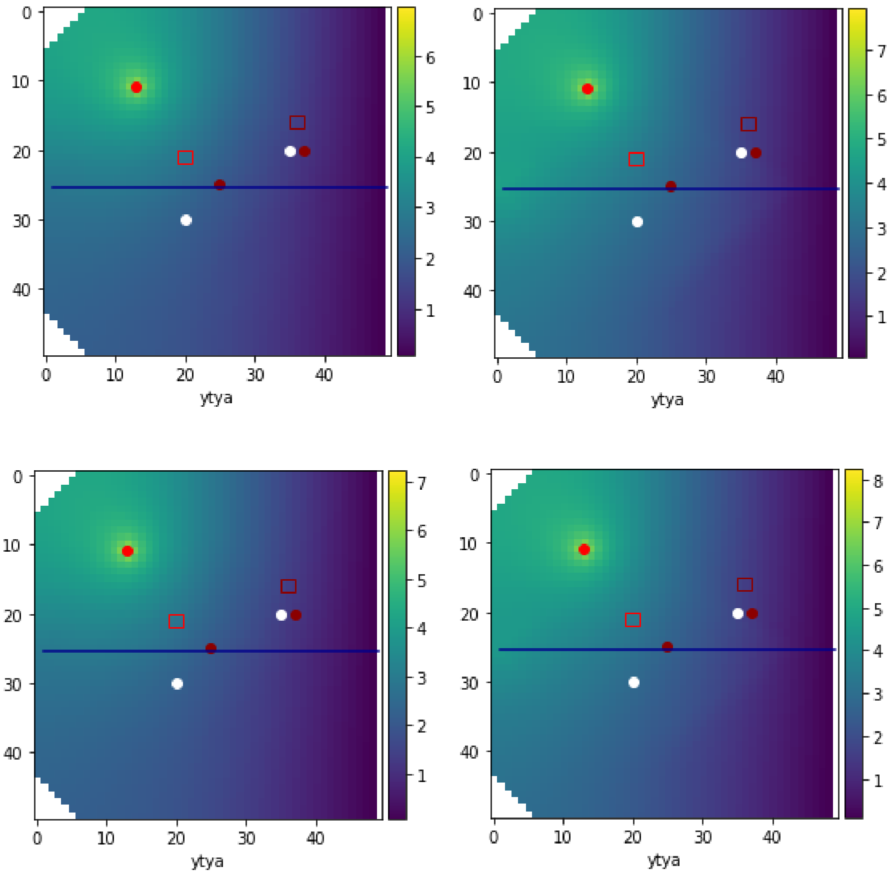


Figure 5. Left. Mean drawdown in the domain. Right: Standard deviation of drawdown. Upper: random parameter set. Down: 10 MOC model added.

In the case of the leakage, the change in shape was little, however, the mean value increased almost 50%. Moreover, adding the 10 MOCs the standard deviation, the results show that even in “ntna” there is some losing water from the river. Anyway, the change between “ytna” and “ytya” is slight.

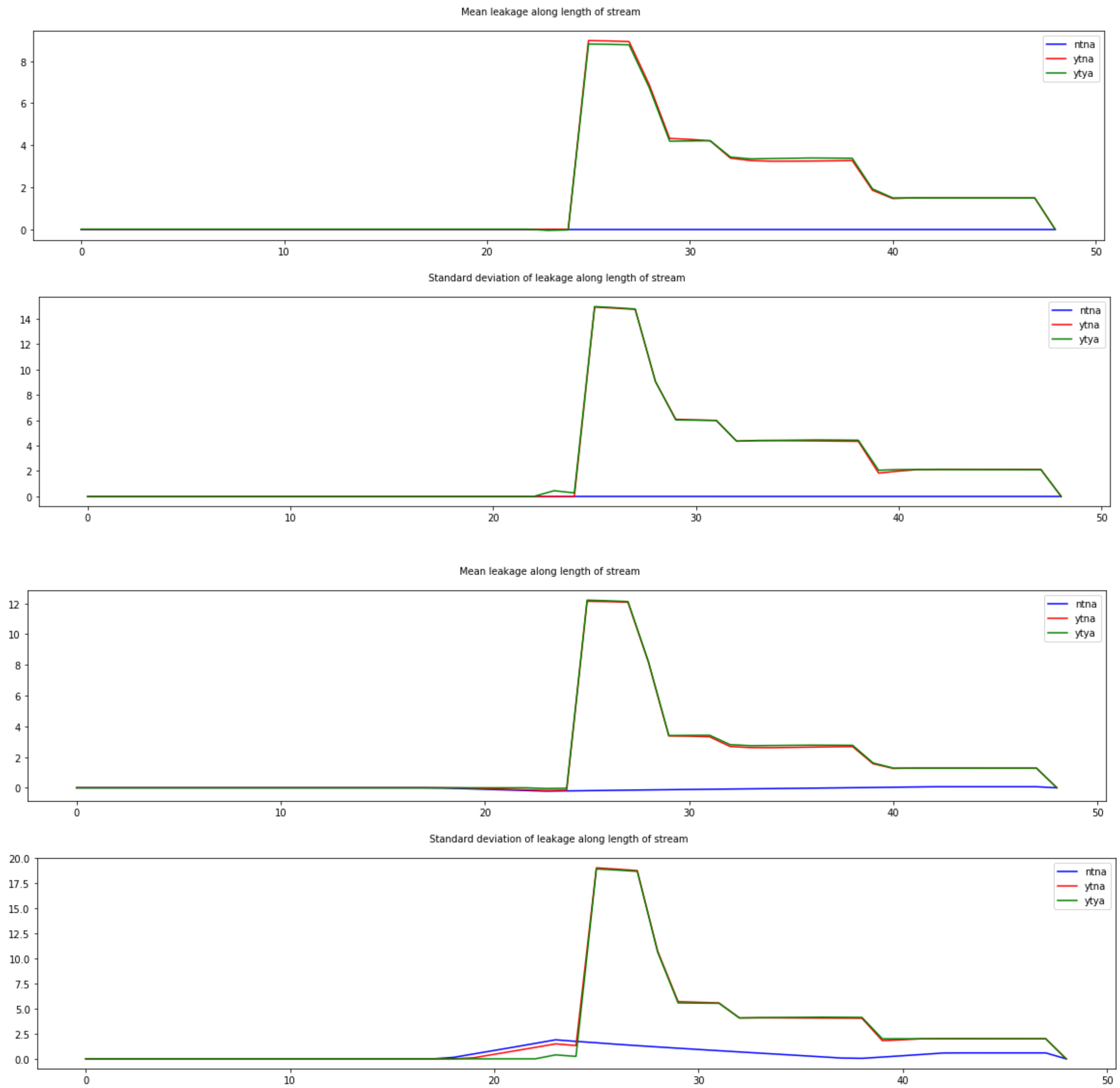
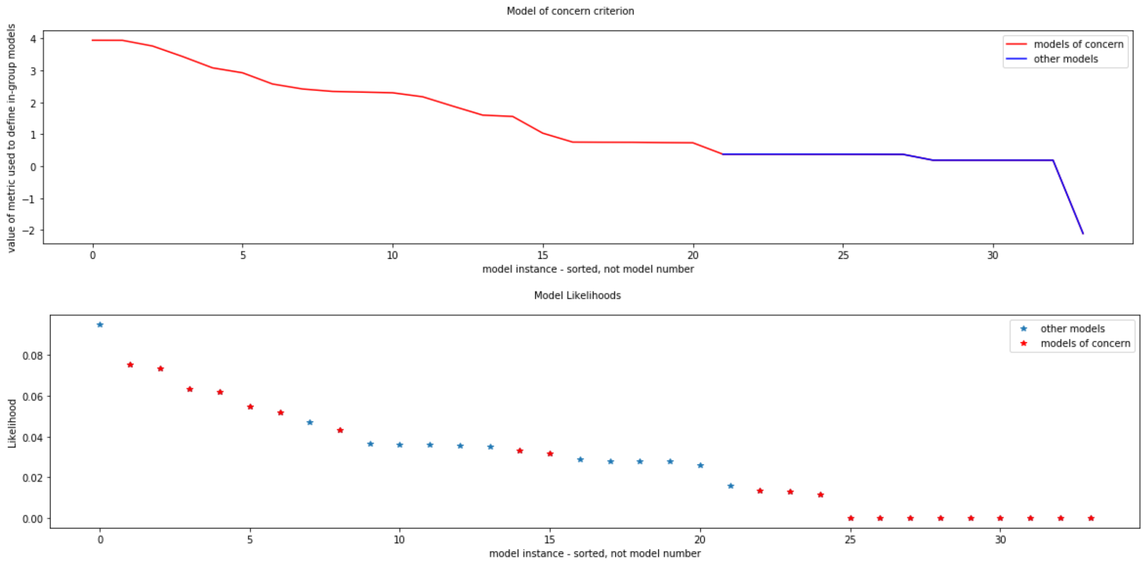


Figure 6. Upper two: Mean and standard deviation in ensemble 1. Lower two: Mean and standard deviation in ensemble 2.

Finally, the particle tracking shows almost the same result in both ensembles. In summary, the inclusion of 10 MOC using as pivot the model “m001001330113130” did not change the conclusions, however, there are other parameter sets that are MOCs for the town and they should be explored.

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Models with highest likelihoods

m001001330010320  L = 0.094 other model
m001001330023042  L = 0.075 model of concern
m001001330113130  L = 0.073 model of concern
m001001330122221  L = 0.063 model of concern
m001001330202110  L = 0.061 model of concern
m001001330202231  L = 0.054 model of concern
m001001330244131  L = 0.051 model of concern
m001001330244324  L = 0.047 other model
m001001330311134  L = 0.043 model of concern
m001001330313130  L = 0.036 other model

The total likelihood of the models of concern is  0.525
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Figure 7. MOC in the ensemble 2.