HWRS 582 – Groundwater modeling

HM12 – Stakeholder

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1. Describe, in words, three scenarios that best represent the interests of your stakeholder group. These can be some combination of design parameters (if relevant) such as which crop to grow or where to place the ag well and field and predictions of interest (if relevant) such as change in flow in the river or source of water for the town well.

The town is concerned that if a new agricultural development is added, it will affect the town well's water levels, river flow rate, or water quality in both the well and in the stream. There are three possible scenarios for which the town will determine a MOC - each have several parameters that can be changed.

MOC with highest drawdown

Under this scenario the town is concerned with the greatest drawdown at the town well (coordinates 37, 20). The MOC is influenced by the proposed ag_well such that if any model produces a drawdown greater than 0.5, then that model is listed as an MOC.

MOC with the greatest difference in streamflow

The river in the model could provide some economic benefit to the town as a recreational resource. Because the town is located downstream, as the council members, we are concerned with flow in the area closer to the town (coordinate 25, 38).

MOC with particles in the town well

We are concerned that the well may be contaminated by irrigated crops. As council members, we demand that the other stakeholders find models that show us 0.01 particles are captured by anything other than recharge. We want to be guaranteed our water is safe!

2. For each of the scenarios, show all of the lines in the code that you would have to change (and how to change them) to represent that scenario.

We have identified the MOCs name that match with each of the previous scenarios:

A. MOC with the highest drawdown (m001001330240033)
B. MOC with the highest decrement in the river in a specific location (m001001332033404, m001001334000443, m001001334134333)
C. MOC with particles in the capture zone of the town well. Baseline model shows that 20% of the model suggests pollution in the capture zone.

In the case A and B, we can explore 10 models close to the original to see the behavior of them. For that we should change the following parts of the code.

Analysis notebook.

```
start = time.time()

stakeholder='town'
stage='Baseline'
prefix = stakeholder
```

```
define_mocs = True
if stakeholder=='town':
    moc_time_sequence =       [2]
    moc_basis_sequence =      [4]
    moc_comparison_sequence = [0]
    moc_limit_sequence =      [0.5]
    moc_column_sequence =     [37]
    moc_row_sequence =        [20]
```

Analysis notebook.

```
# The following models will be included for all ensemble methods EXCEPT modelgentype = -1
addname=['m001001330240033']
#addname =np.loadtxt('filename.csv', dtype=str)

#print(addname)
# addname.append('m001001330010233')

modelgentype=1     # choose how to generate the ensemble of model names
```

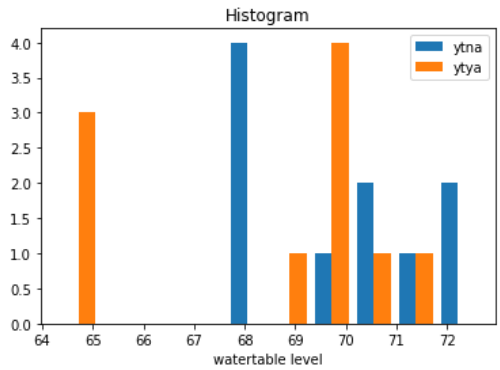
3. Run this ensemble for each of your scenarios and report on the results - what does the ensemble indicate about the interests of your stakeholder group.

Scenario with the highest drawdown:

```
Models with highest likelihoods

m001001330143333  L = 0.206 model of concern
m001001330200013  L = 0.175 model of concern
m001001330200043  L = 0.175 model of concern
m001001330222013  L = 0.175 model of concern
m001001330240033  L = 0.086 other model
m001001330242033  L = 0.084 other model
m001001332042003  L = 0.079 model of concern
m001001332200423  L = 0.015 other model
m001001333031342  L = 0.0 other model
m001001334243023  L = 0.0 other model

The total likelihood of the models of concern is  0.813
```



That shows that in the neighborhood of the model m001001330240033 there are more models that are MOC (60% of them)

Scenario with the highest decrement in river flow:

```
Models with highest likelihoods

m001001330103404  L = 0.091 model of concern
m001001330200343  L = 0.09 other model
m001001331032132  L = 0.078 model of concern
m001001331113430  L = 0.058 model of concern
m001001331134431  L = 0.049 model of concern
m001001331203232  L = 0.049 model of concern
m001001332003333  L = 0.049 model of concern
m001001332032133  L = 0.044 other model
m001001332033404  L = 0.043 other model
m001001332033433  L = 0.043 other model

The total likelihood of the models of concern is  0.556
```

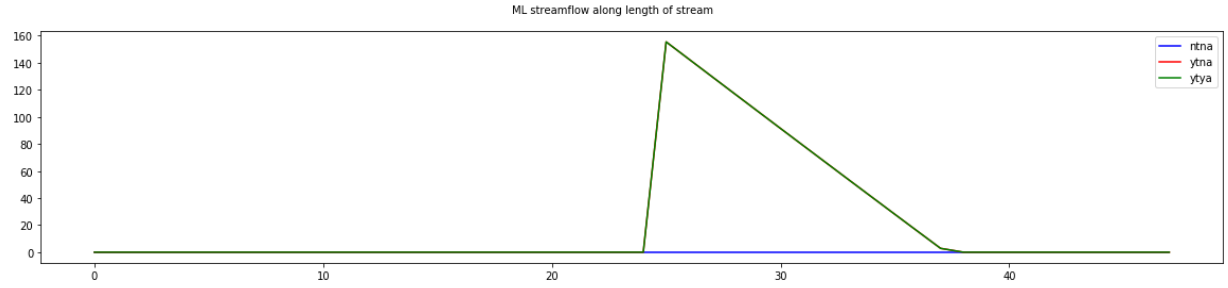


Figure 1. Flow across the river in different scenarios

That shows that consternation about a dry river is not unrealistic, because the 30% of the models close to (m001001332033404, m001001334000443, m001001334134333) are now MOC when we check the ensemble only in that region.

4. Identify one of the scenarios, develop a utility curve and show the threshold for MOC definition. Describe how you would augment the ensemble with 10 additional models and explain your rationale. Then generate the 10 additional models. Create a .csv file with the filenames and save it as, for example, town_added_models.csv.

Scenario with the highest drawdown:

The definition of MOC for the town well is defined by the change of the pump when the water table is below 70.37m. Before that the loss in the utility is for the increment in electrical cost, which is constant for each depletion in the water table. To augment the sensibility of the ensemble in that region we took the model with lower level in the water table and we explored 10 models close to that. Those models were added to the original 25 models.

Utility function		
Water table	**Utility**	**Description**
80.00	1.00	Top screen
70.86	0.95	ytna
70.37	0.95	Change of pump
70.36	0.75	
65.50	0.73	
65.01	0.73	Change in infraestructure
65.00	0.43	
60.50	0.41	
60.00	0.00	New well

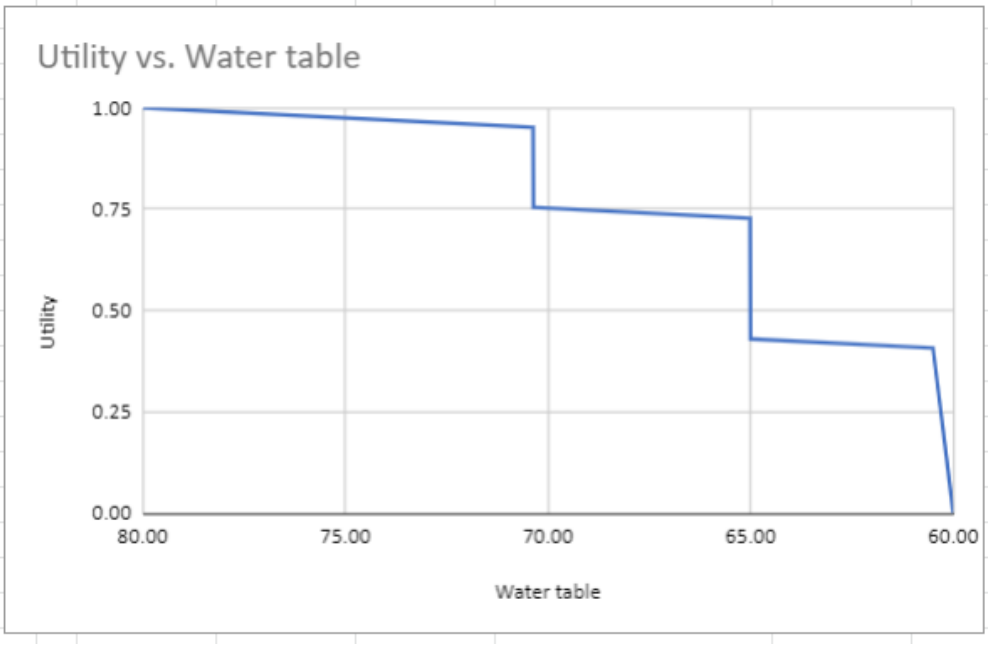


Figure 2. Utility function of the town well.

The results show that MOC concentrates 76% of the likelihood similar to the baseline.

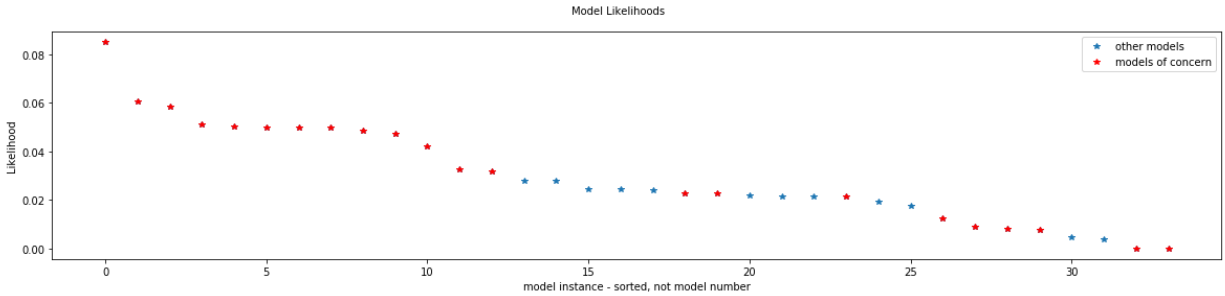


Figure 3. Distribution of model likelihood in baseline.

5. Discuss how adding the models did or did not change the interpretation of your stakeholder regarding their likely support for / opposition to the proposed ag development.

The changes between the baseline(left) and augmented (right) is almost imperceptible in the water table and fraction of particles. That means that the added models follow the distribution of the output space, therefore the overall behavior is the same. Figure 6 presents exactly that situation, the likelihood changed for all but the relative importance is almost the same.

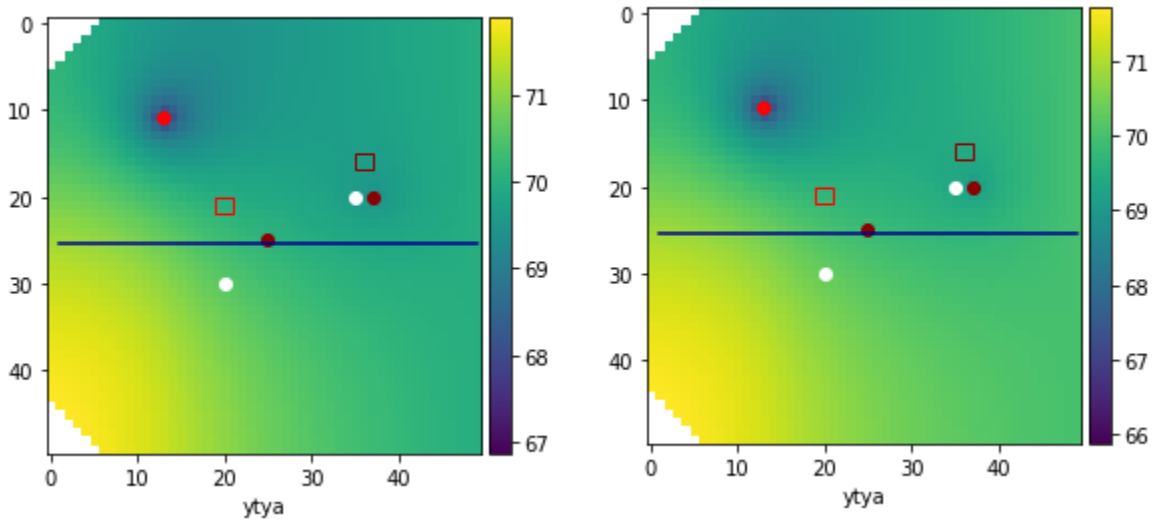


Figure 4. Water table for baseline (left) and right (augmentation)

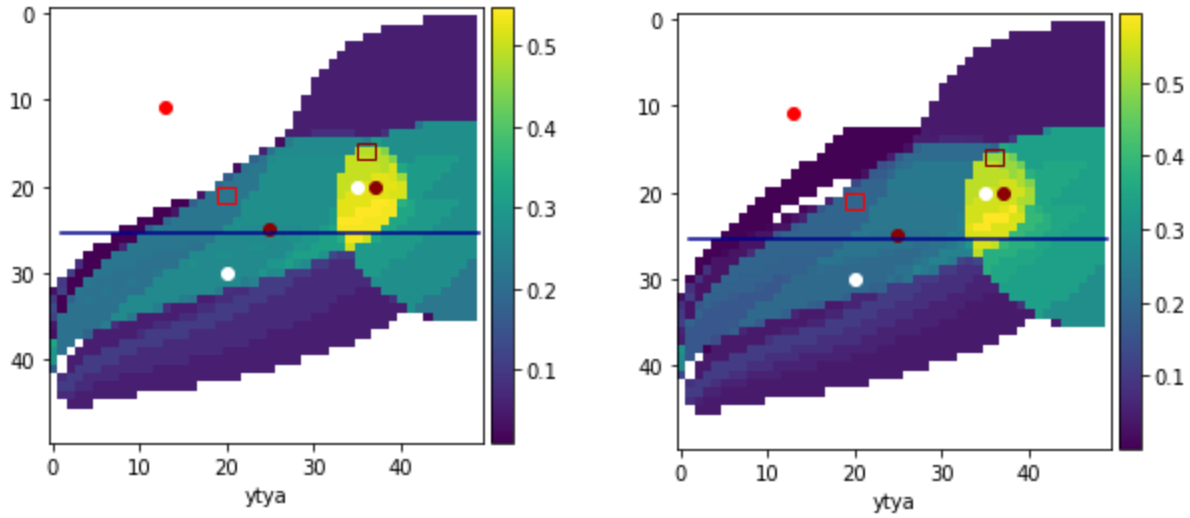


Figure 5. Fraction of particles for baseline (left) and right (augmentation)

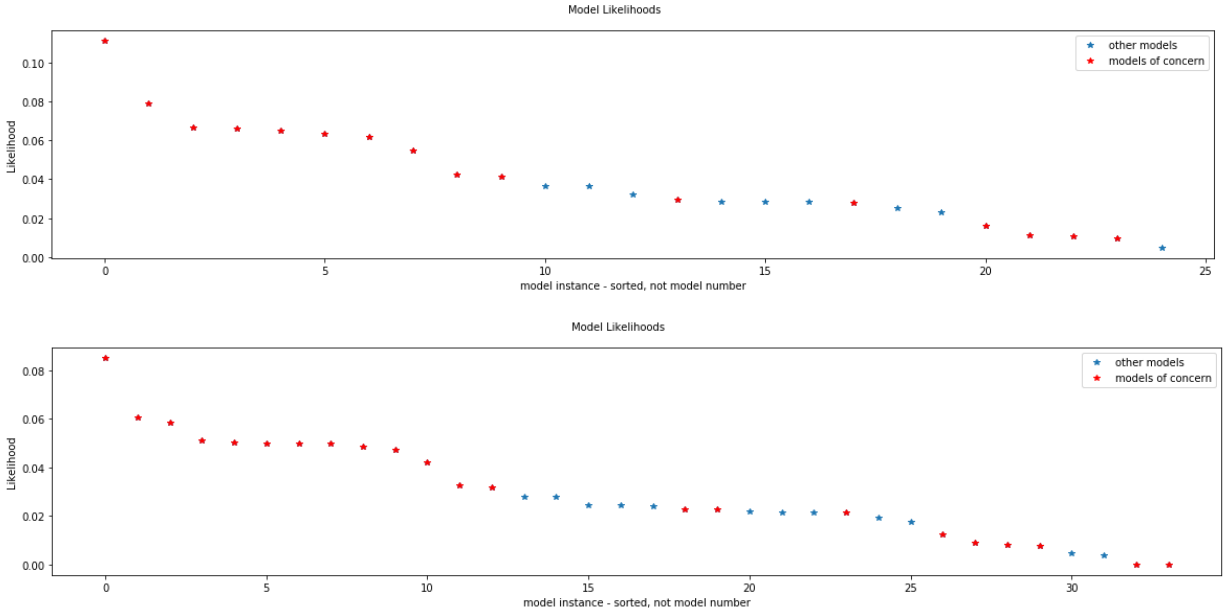


Figure 6. Comparison of model likelihood distribution. (top: 25 models), (bottom: Augmented)