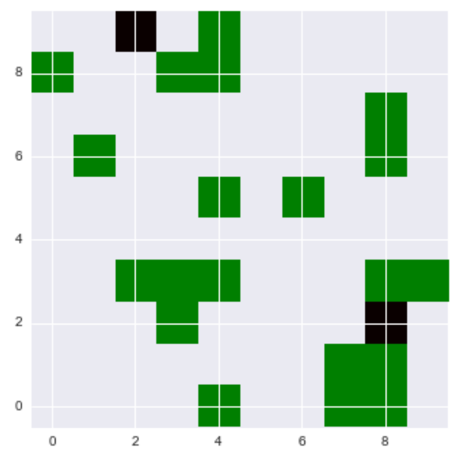
4 Results

This agent based model tests three optimization scenarios to see which one is the better way to operate. The first one, the control - consists of random movement of the tractor fleets. This can represent a scenario guided by decisions not correlated to factors being measured such as social capital present in the village to execute the operations. The second the tractors move towards area of high current demand, and the third consists of areas of high quality silt (though it may not currently have high demand) so that farmers gain the most benefit - and potentially results in the highest future demand.

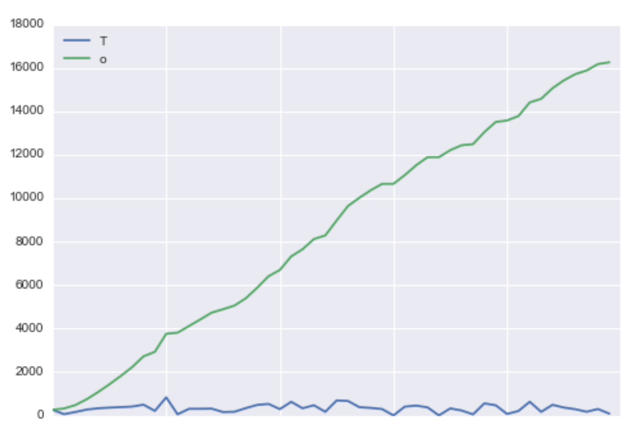
4.1 Visualizing Basic Outputs

Figure 1 shows the illustration of the space. The villages (green) and tractors (black) are initialized randomly during each run.

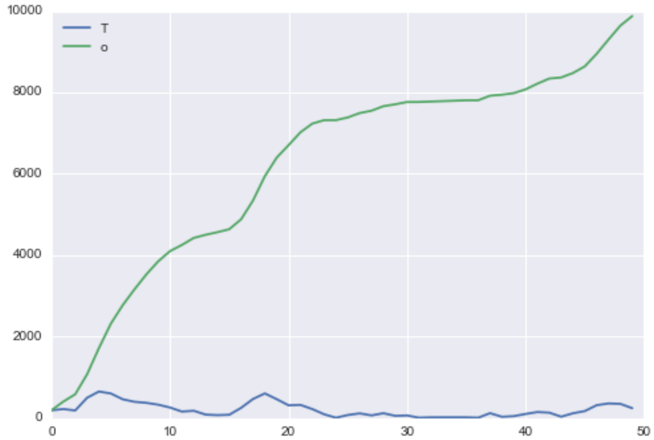


Single run results.

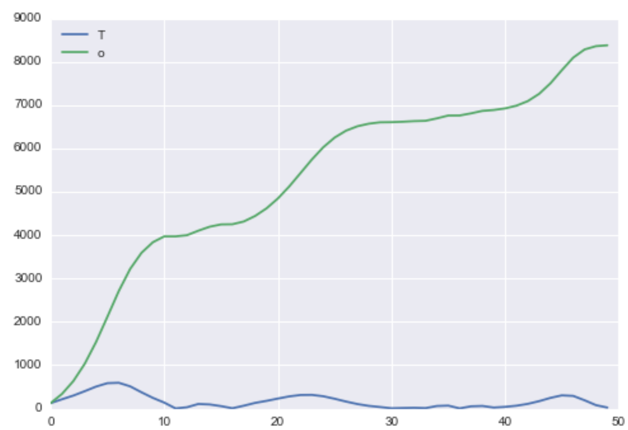
Case 1: Random movement. The tractors move around randomly and apply silt at a fairly uniform rate during the first 50 iterations at points where they happen to come across a village.



Case 2: Optimizing current demand. Tractors move to locations of high demand and stay there applying silt until the demand goes under a threshold. They then move to find another close by area of high demand. S curve adoptions can be seen. A clear drawback is also visible as the tractors pinpoint local optima and saturation of silt demand can be seen, as well as large amounts of time in which they try to find other local optima.



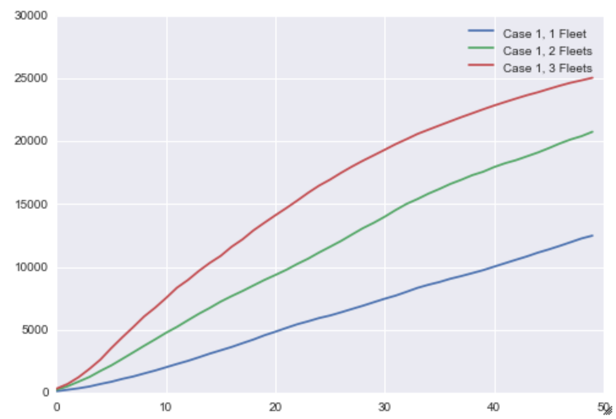
Case 3: Optimizing for silt quality. The result here is rather similar to case 2. Again tractors seem to get stuck in areas of high silt quality even if the total demand of that area is not significant.

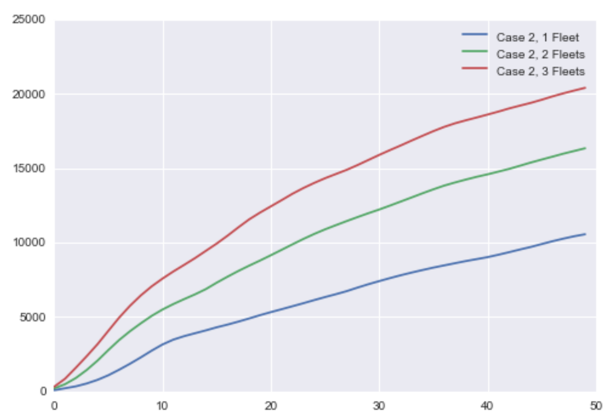


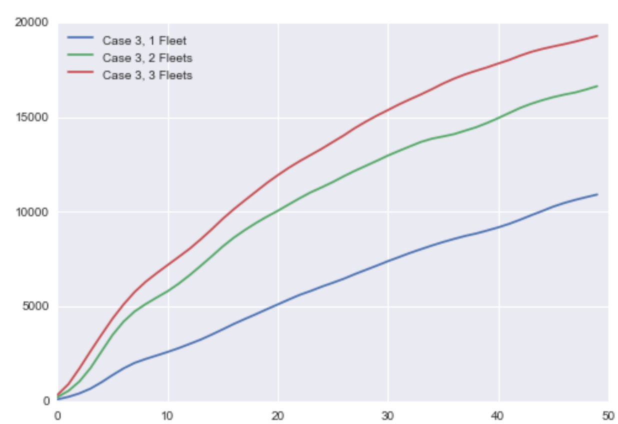
Multiple run averages, sensitivity on number of fleets and comparison between cases.

Comparing between single runs of different scenarios is difficult due to the random initialization of the space. Due to the random elements present – some initializations have more total acres, some have denser village placement, some have ideal tractor initialization scenarios etc. This shows a limitation of random generation. In retrospect I should have generated a single spatial arrangement that most closely represented on the ground realities and then used that as the base. However, deciding on a single arrangement randomly was not seemed suitable as different initial arrangements seem to favor different optimization scenarios. Hence, multiple runs (25) were averaged so that a comparison could be made between the scenarios.

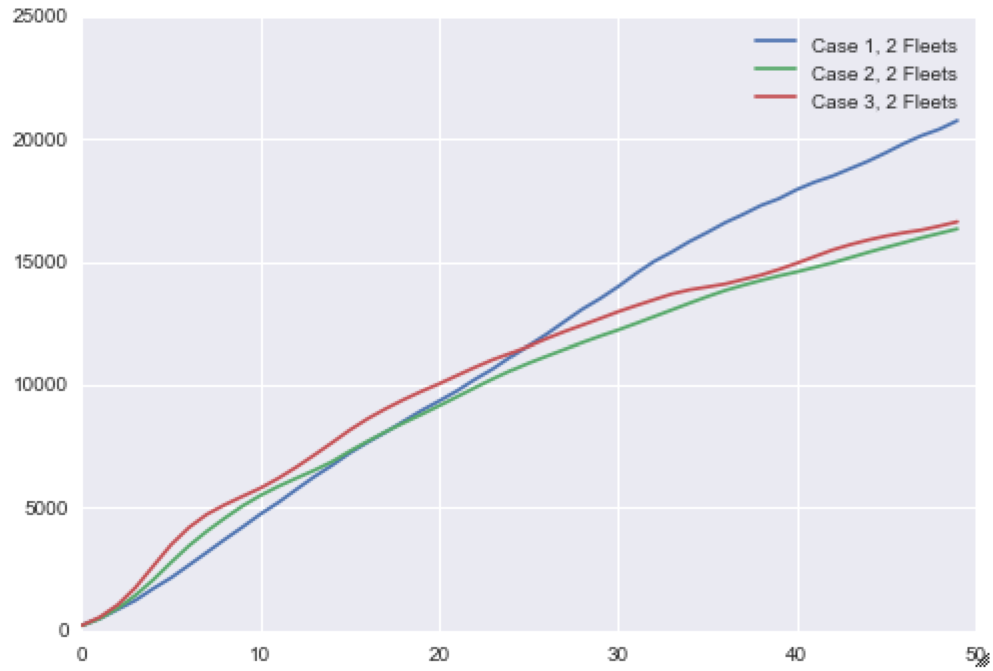
More tractor fleets results in increased adoption rates for all scenarios. Here blue represents 1 tractor, green two tractors and red three tractors. For the random movement case the benefit seems to be almost linear, where as in the other two cases there seems to be some sort of depreciating returns for each tractor – especially in the silt optimization scenario. It is possible that all tractors congregate close to the same villages with high silt.







Comparing within scenarios we see that optimization is beneficial in the beginning – but then loses its effect. All three scenarios seem to perform equally well.



Conclusion:

The result was rather counter intuitive. I expected any sort of optimization to have a huge effect on the rate of adoption. However, perhaps given the large scale of the space and the density of the villages and the large amount of acres, it seems as if optimization or focus on building local demand is a constraining factor in large scale silt application.

I also feel that averaging over several initializations also averaged out the uniqueness of each optimization technique. It should be noted that the tractors were instructed to randomize movement if demand went under 50 acres, increasing this, or sweeping over the minimum required acres could be an interesting next step.

There are some further limitations in this model.

1. While each village does follow the typical 'S' curve adoption rates, I could not implement nearby village demand being effected by adoption by their neighbors.
2. Once silt is applied on a field, there is no need to apply more silt for 5 years. However, after this time the farmer is very likely to apply silt again. This would require keeping track of cohorts in the model, making to rather complicated. A possible solution is to just analyze the first 5 years. 5 years is a suitable time period to guide decisions of an enterprise (still pretty long term).