Environmental Modeling

Exercise III: Fire in the Forest

Christian Autermann

Setup

As levels for the initial foreset percentage 20%, 40%, 60%, 80% and 100% were chosen. A simulation with 0% initial forest area would result in a single burned cell in every model. To simplify the comparison of the results of the different model, the unit to measure burned cells, empty ground and forest the percentage of the simulated area.

Results

Comparing the different levels beyond the bearings of the single models, it can be said, that a lesser amount of forest results in a smaller fraction of burned cells as the empty ground acts as barrier to prevent other forest cells from burning. As it can be seen in the following diagrams at a 20% forest coverage nearly no cells are burned as the probability that two forest cells are neighbors is quite small. With higher amount of forest cells the probability of two neighboring forest cells and the likelihood that a forest cell is burned is increased. The more area is initially covered by forest the longer the fire is alive. This results directly from the amount of burned cells as the fire spreads only at a distance of a single cell.

The correlation between the amount of neighboring forest cells and the amount of burned cells can also be seen in model 2 which uses a 8-cell neighborhood and shows a significant higher amount of burned cells on the significant levels. Considering a greater amount of neighbors results in greater probability to neighbor a burning cell.

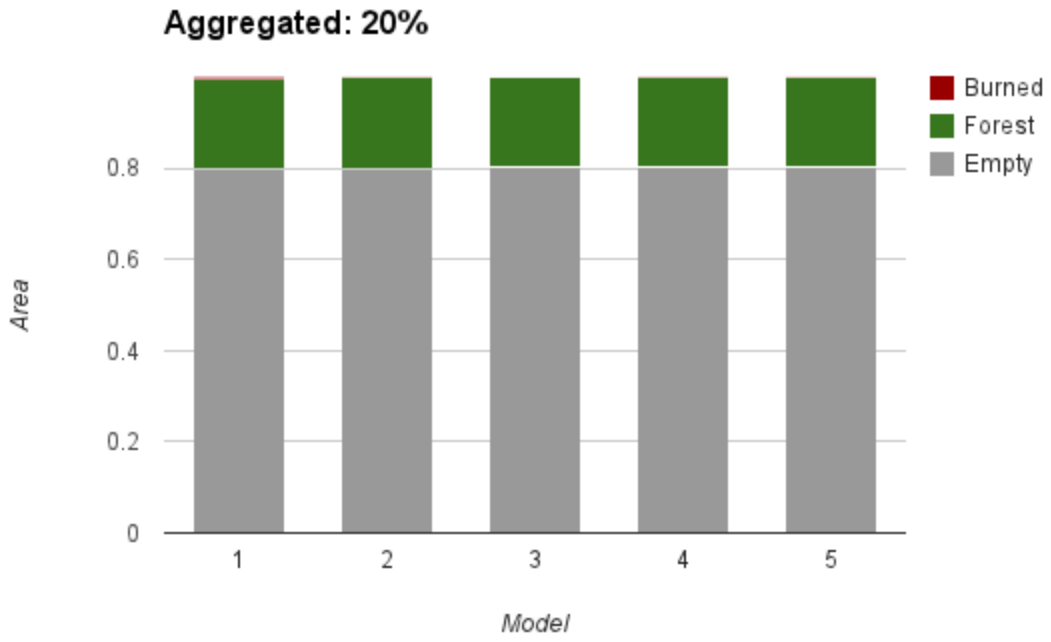
The iterations a cell needs to burn does not influence the amount of burned cells as the diagrams show. Model 3 does not show any significant differences to model 1 and even the runtime does not increase significantly as only the last iteration of the simulation is influenced by the extend time steps needed to burn a cell. Except this the simulations behave equally.

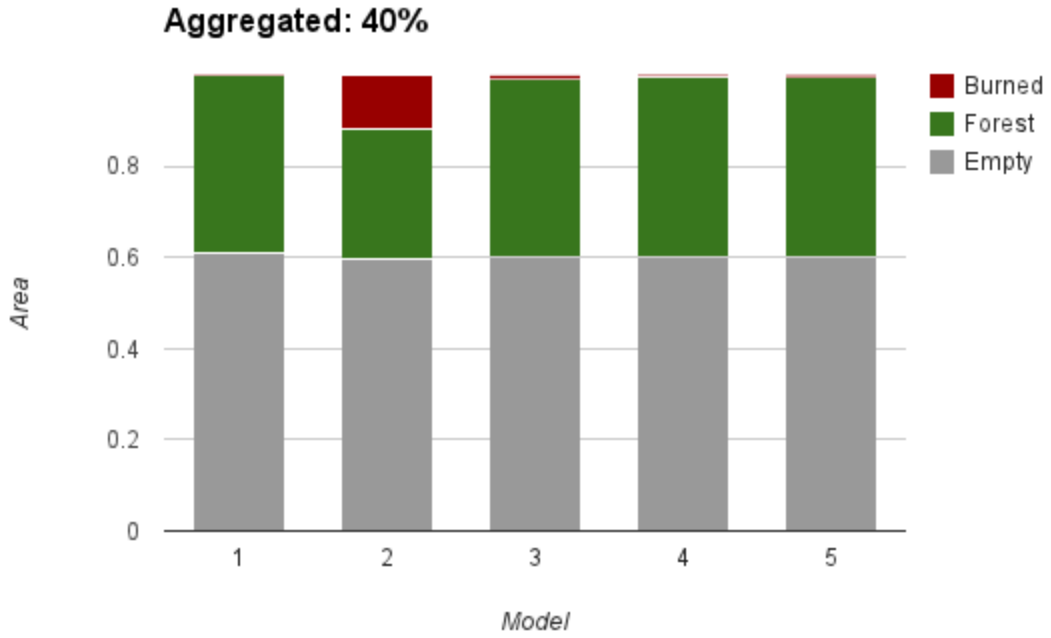
Raising the resolution of the observed area to 100 instead of 50 cells does not result in significant change in burning behavior but the time to is increased drastically (as it can seen for model 4). As the

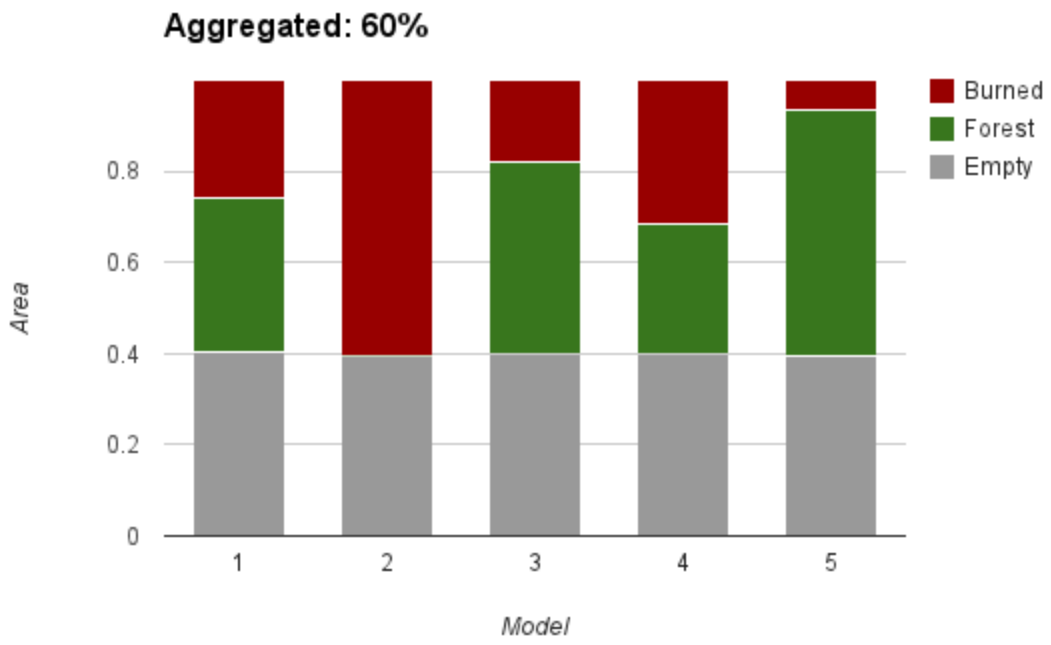
fire spreads only across a single cell the time to burn through a cell equivalent to the area in a space with a resolution of 50 cells is doubled.

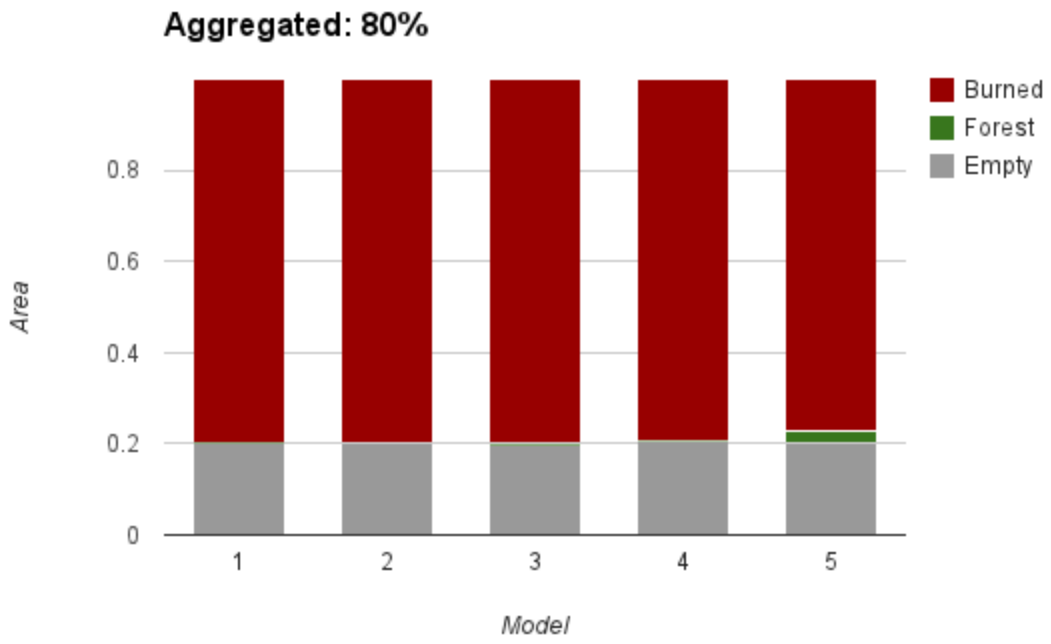
Reducing the probability that buring cell burns his neighbor of course results in a lesser amount of burned cells. Even with a initial forest coverage of 100% not all forest cells are burned. As the amount of burned cells directly correlates to the runtime of the model also the time to complete the simulation decreases.

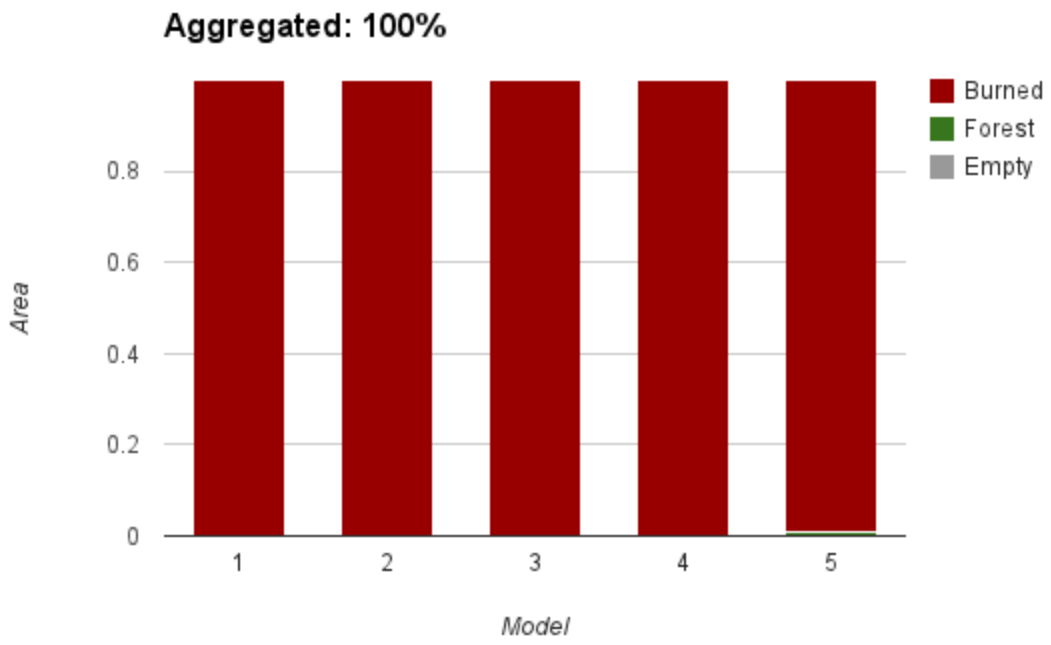
Coverage


Aggregated: 20%
Burned
Forest
Empty
Area
0
0.2
0.4
0.6
0.8
1
2
3
4
5
Model

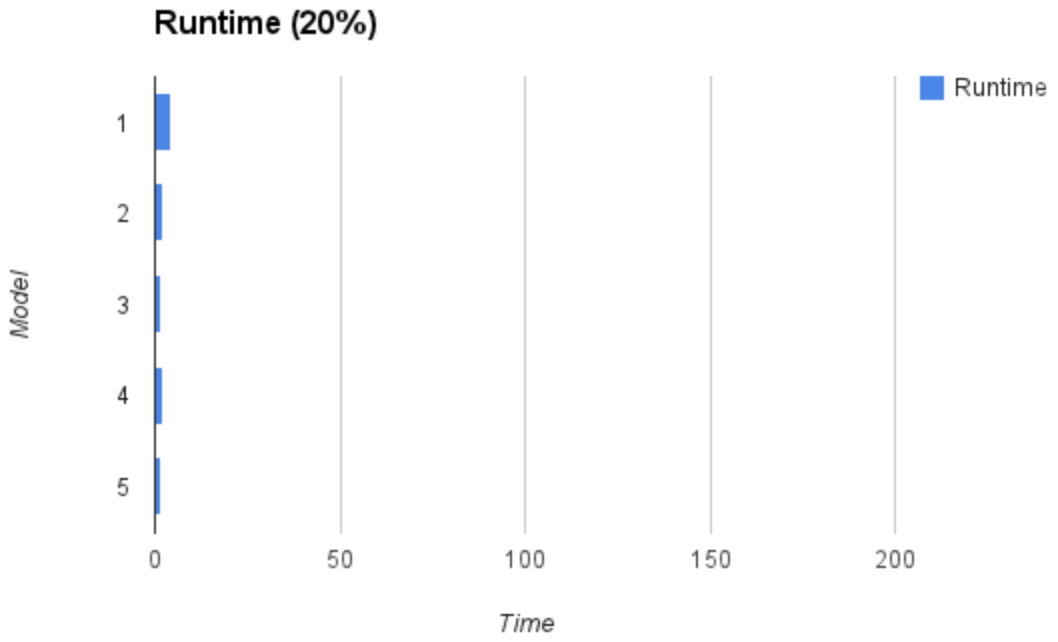

Aggregated: 40%
Burned
Forest
Empty
Area
0
0.2
0.4
0.6
0.8
1
2
3
4
5
Model

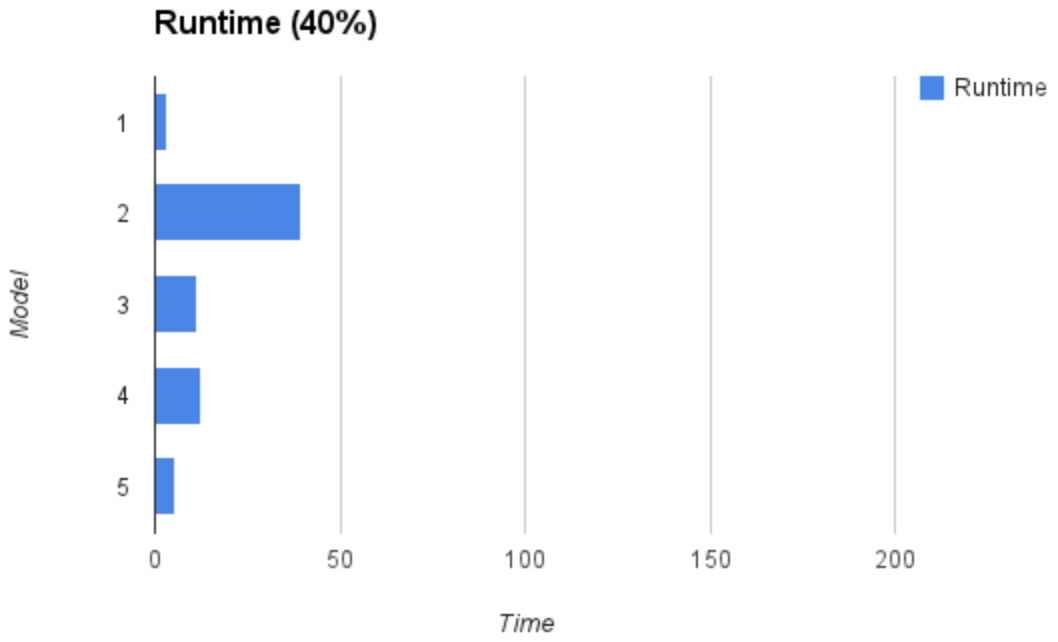

Aggregated: 60%
Burned
Forest
Empty
Area
0
0.2
0.4
0.6
0.8
1
2
3
4
5
Model

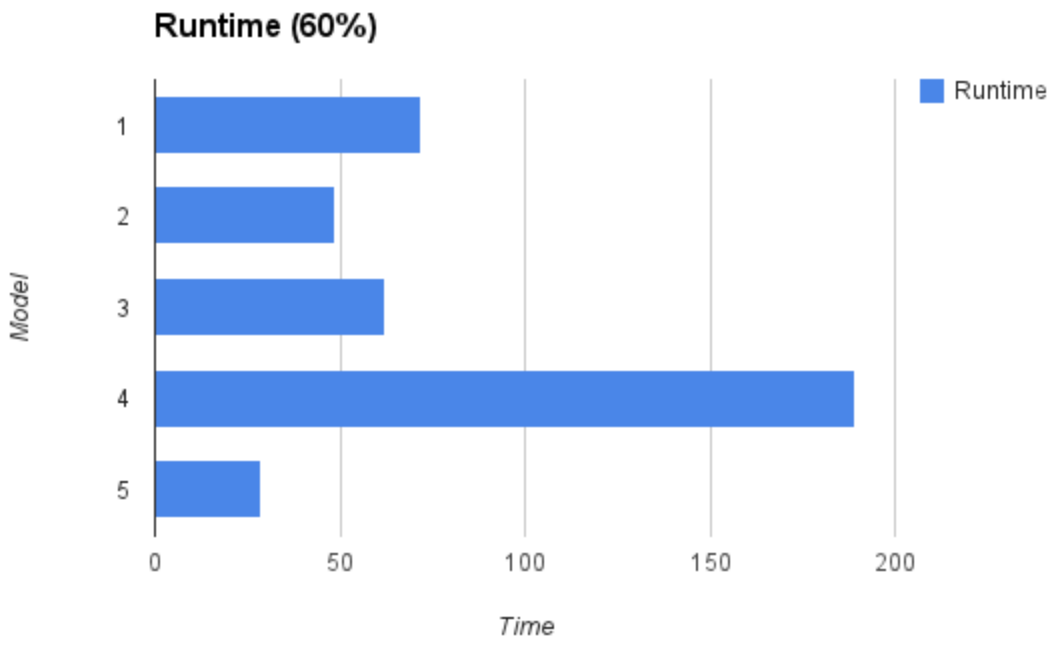

Aggregated: 80%
Burned
Forest
Empty
Area
0
0.2
0.4
0.6
0.8
1
2
3
4
5
Model

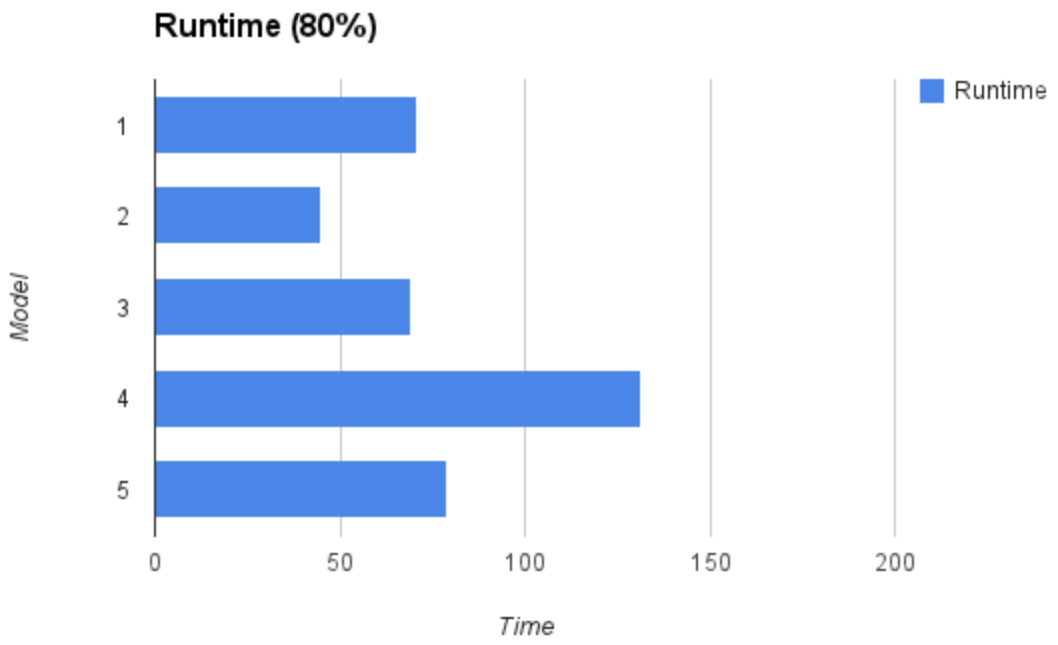

Aggregated: 100%
Burned
Forest
Empty
0.8
0.6
0.4
0.2
0
Area
1
2
3
4
5
Model

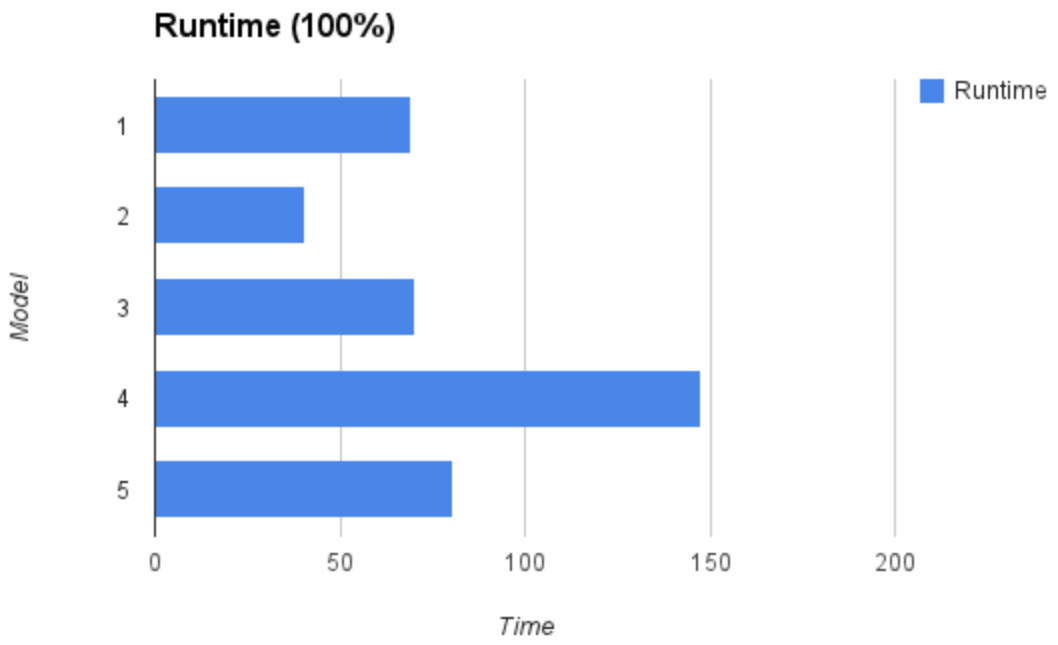
Runtimes


Runtime (20%)
Runtime
1
2
3
4
5
Model
0
50
100
150
200
Time


Runtime (40%)
Runtime
1
2
3
4
5
Model
0
50
100
150
200
Time


Runtime (60%)
Runtime
1
2
3
4
5
Model
0
50
100
150
200
Time


Runtime (80%)
Runtime
1
2
3
4
5
Model
0
50
100
150
200
Time


Runtime (100%)
Runtime
Model
1
2
3
4
5
0
50
100
150
200
Time