

## Reinforcement Learning Enabled Unmanned Aerial Vehicles in Pop-Up Cellular Networks

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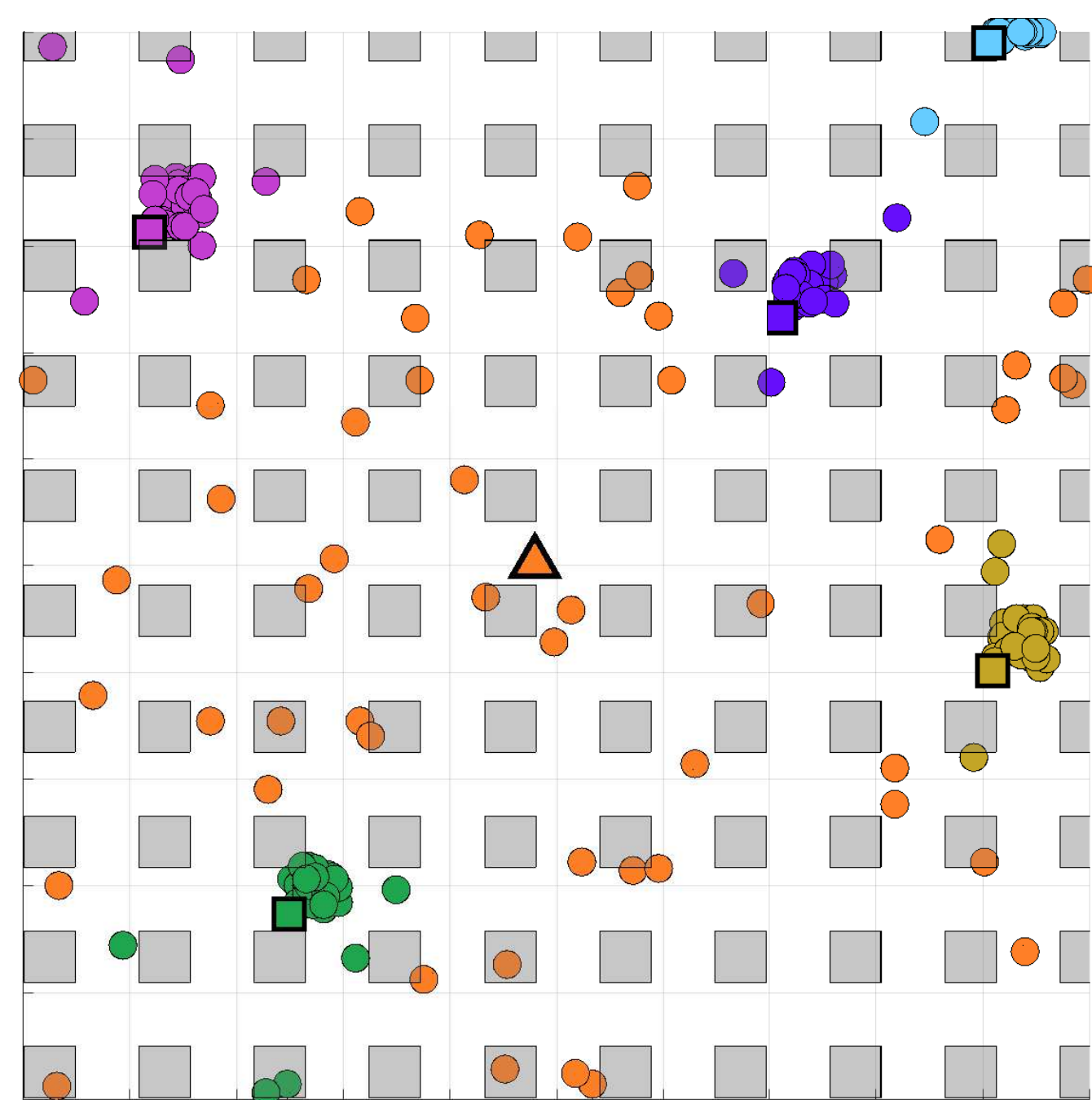
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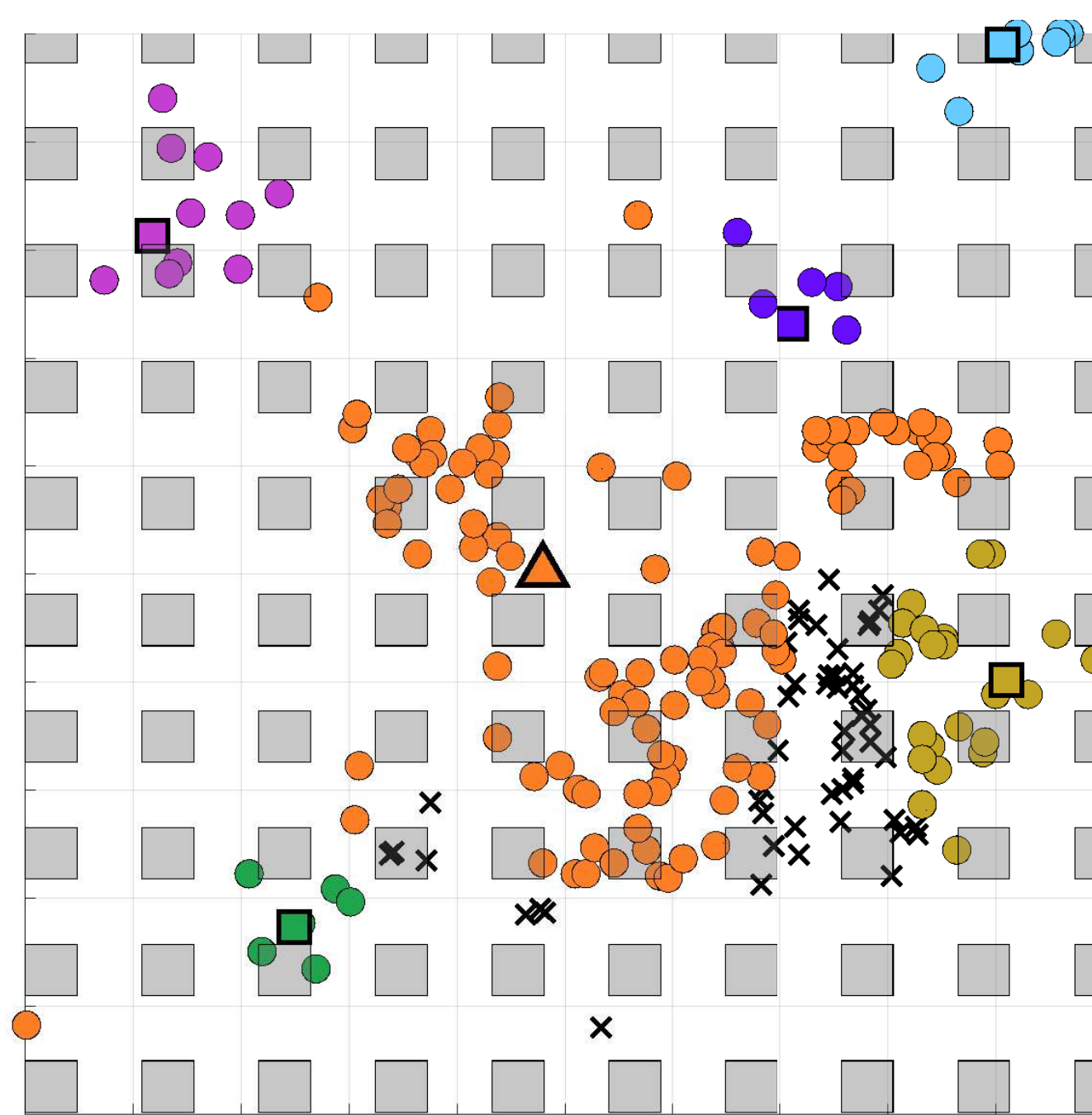
### Objective

Intelligent positioning of multiple UAVs in order to provide extra coverage whenever events happen in a city.

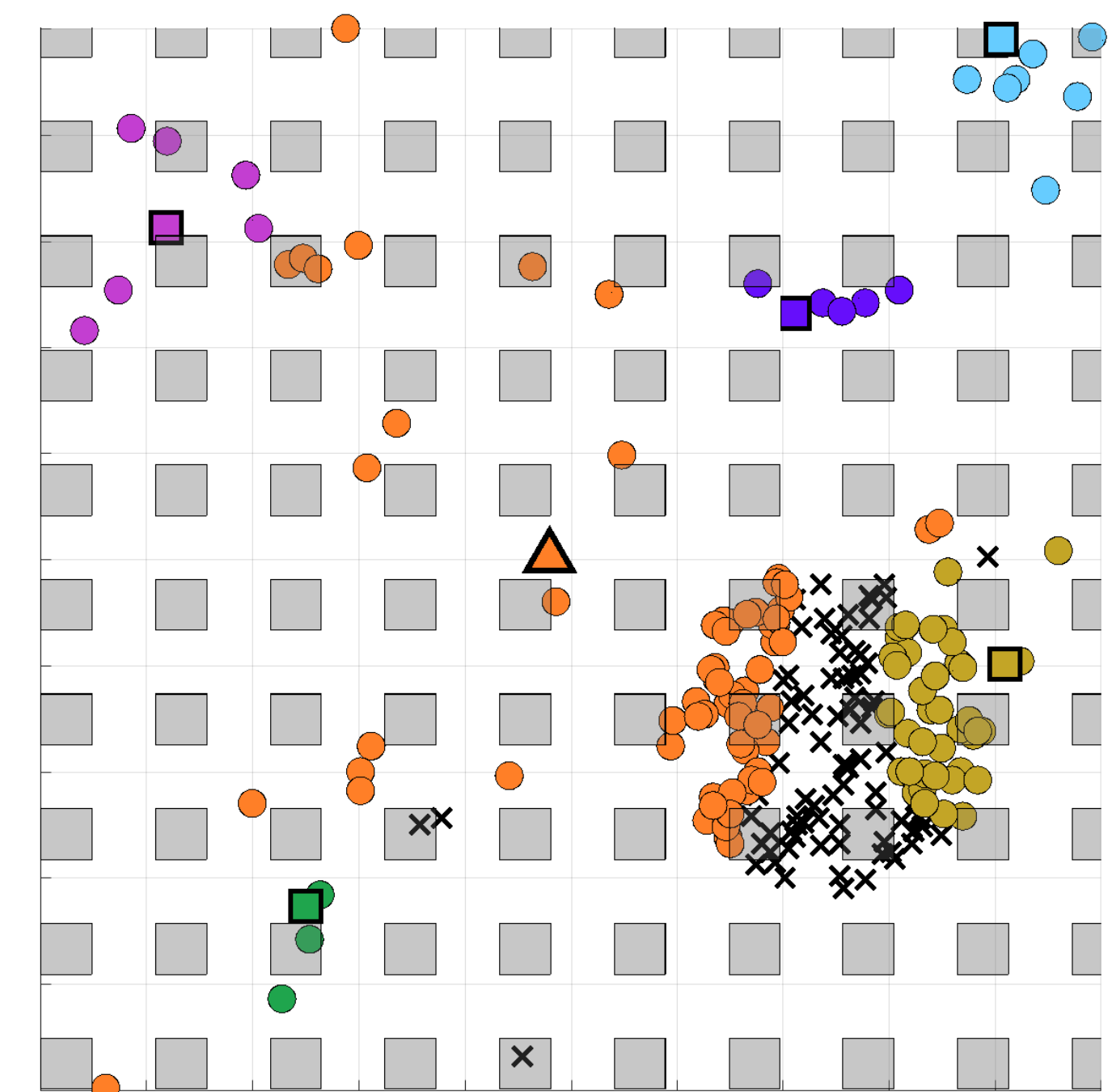
### Pop-Up Network Use Case



(a) Initial simulation scenario.

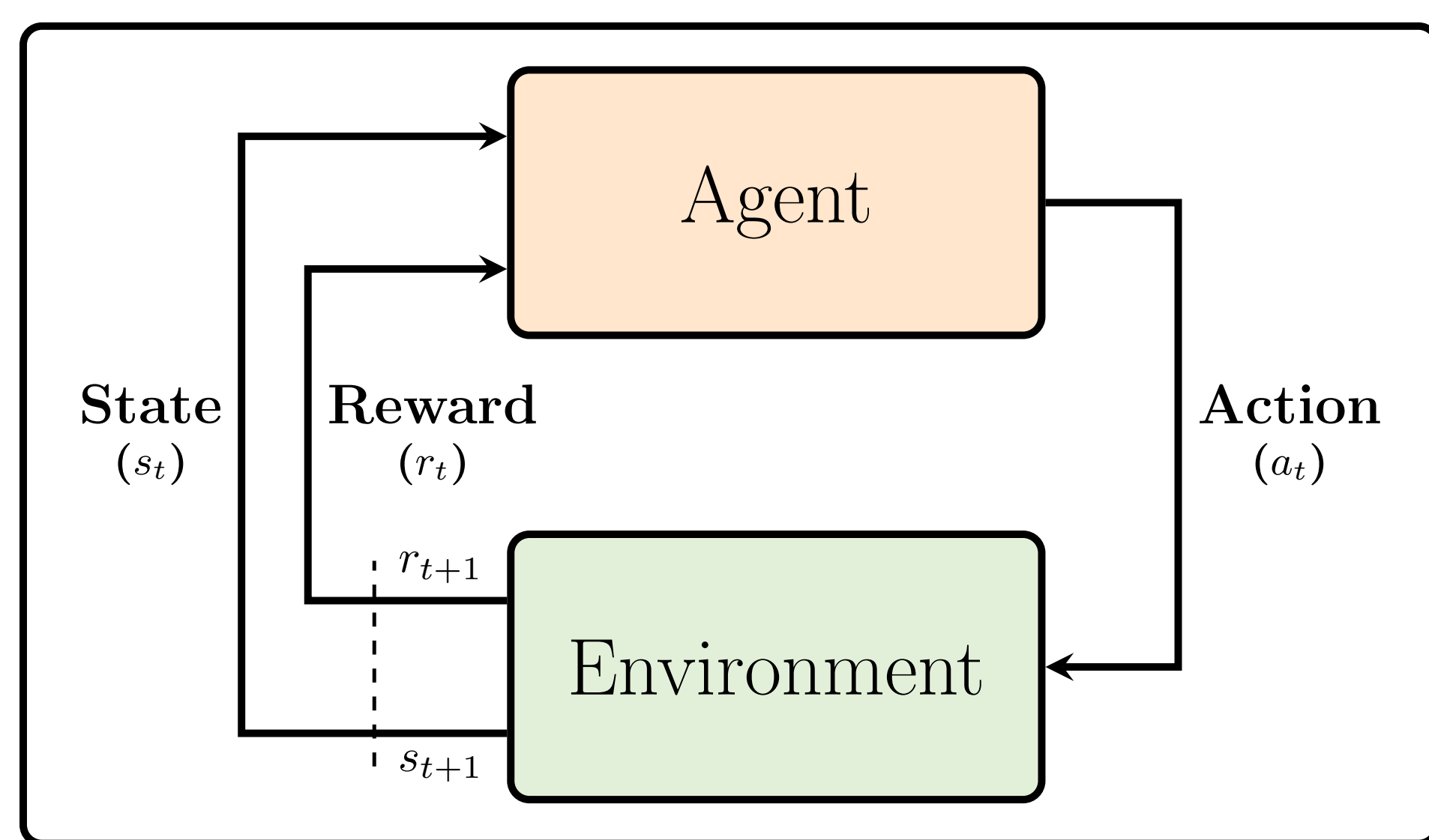


(b) Users moving to the event.



(c) Users at the event.

### Reinforcement Learning (RL)



### Simulation Parameters

- ▶ State: 3D Position of UAVs
- ▶ Actions: Move or not
- ▶ Reward: Number of users allocated
- ▶ Event happens in random locations
- ▶ 9 UAVs are deployed
- ▶ Q-Learning and SARSA with VFA

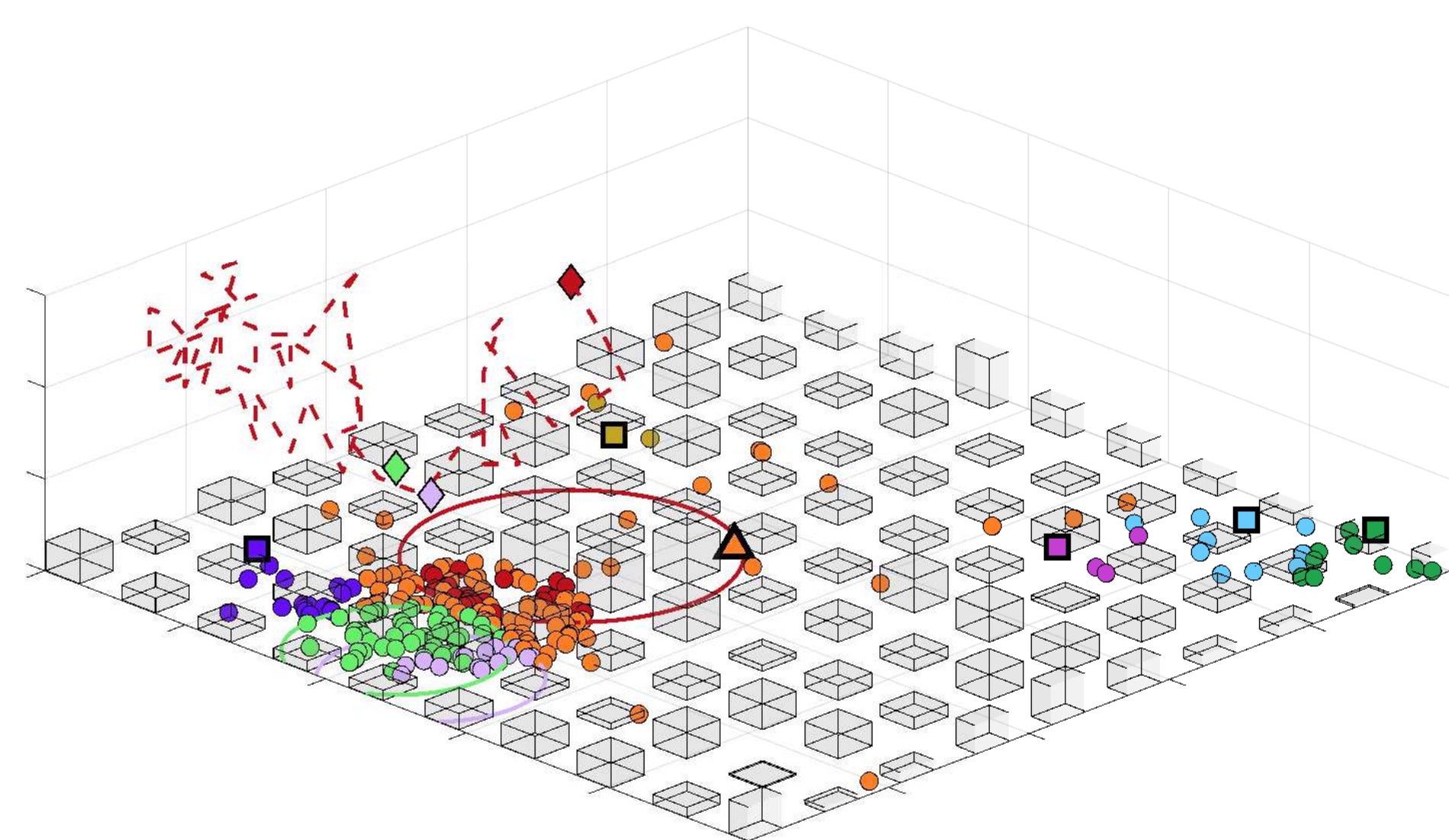
### Problems with Conventional RL

- ▶ Rely on look-up tables
- ▶ Time to fill the table
- ▶ Memory
- ▶ Generalization

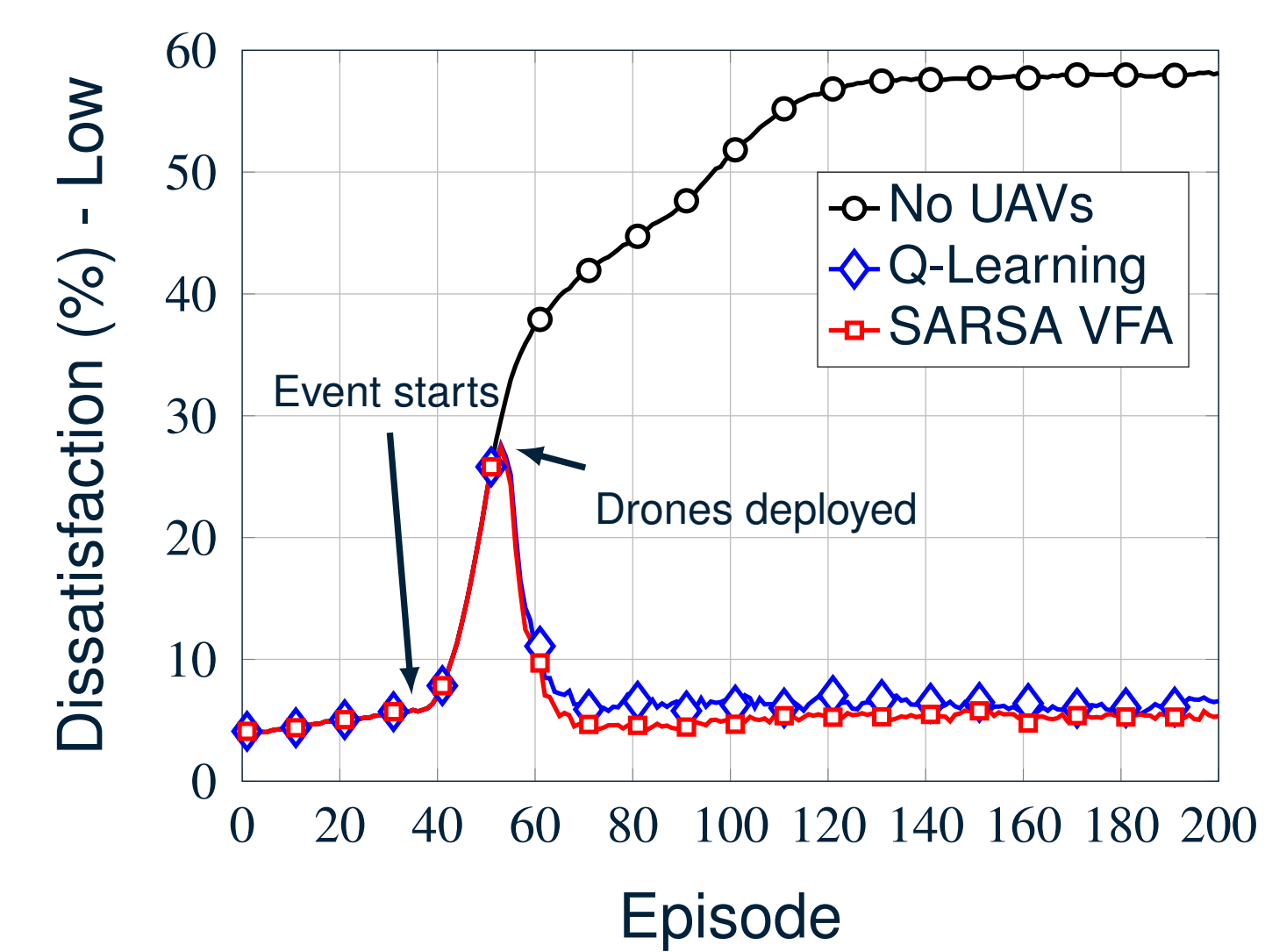
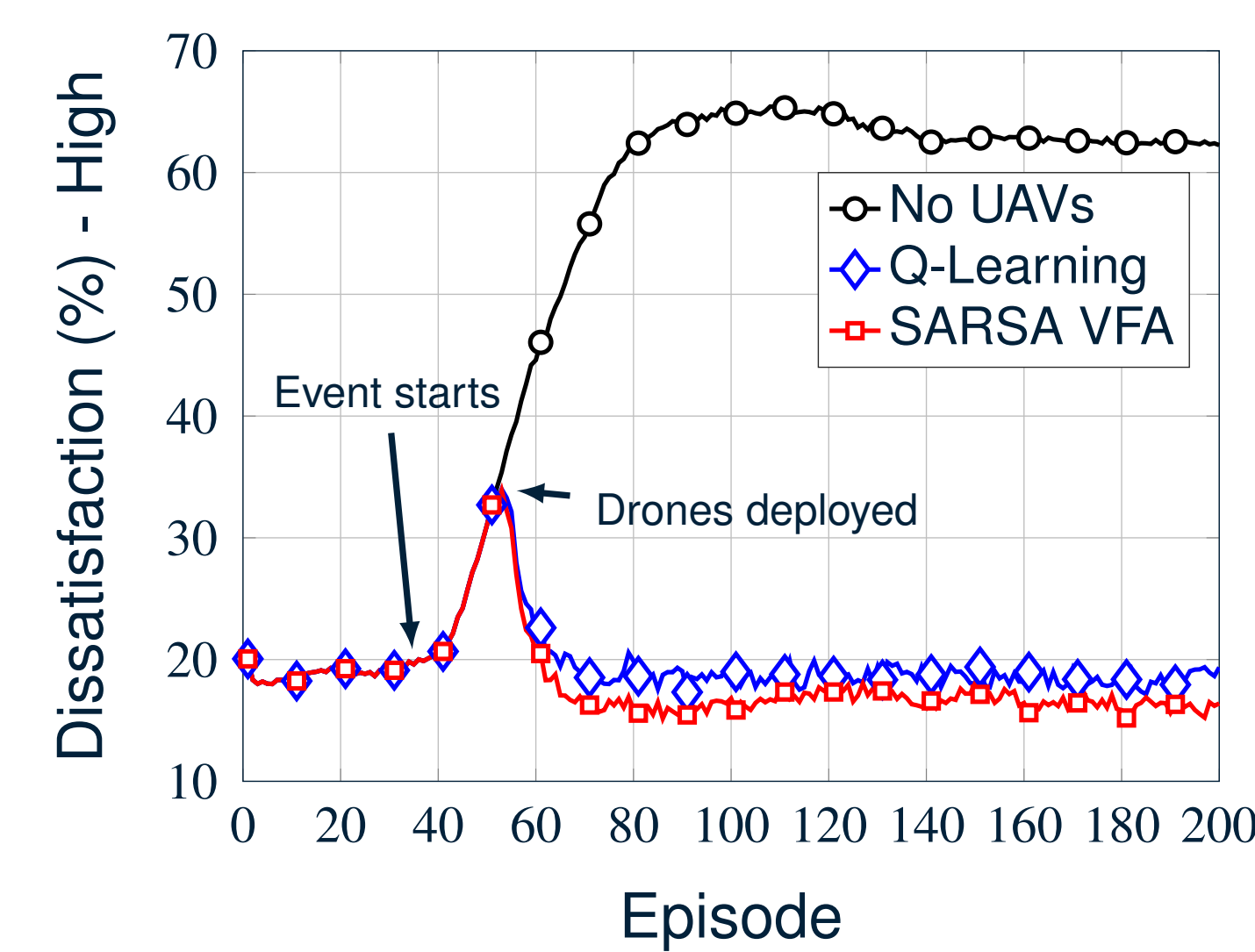
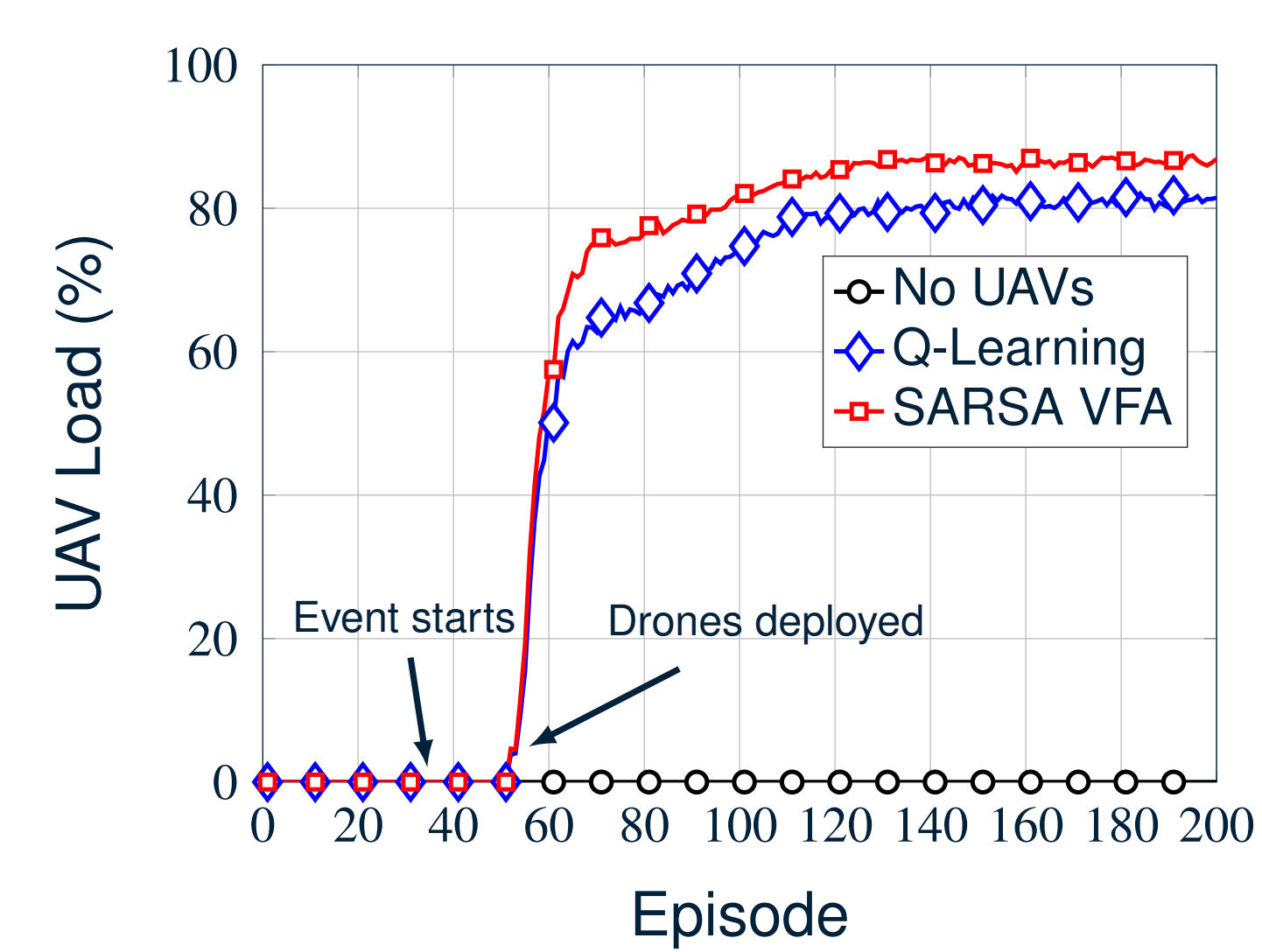
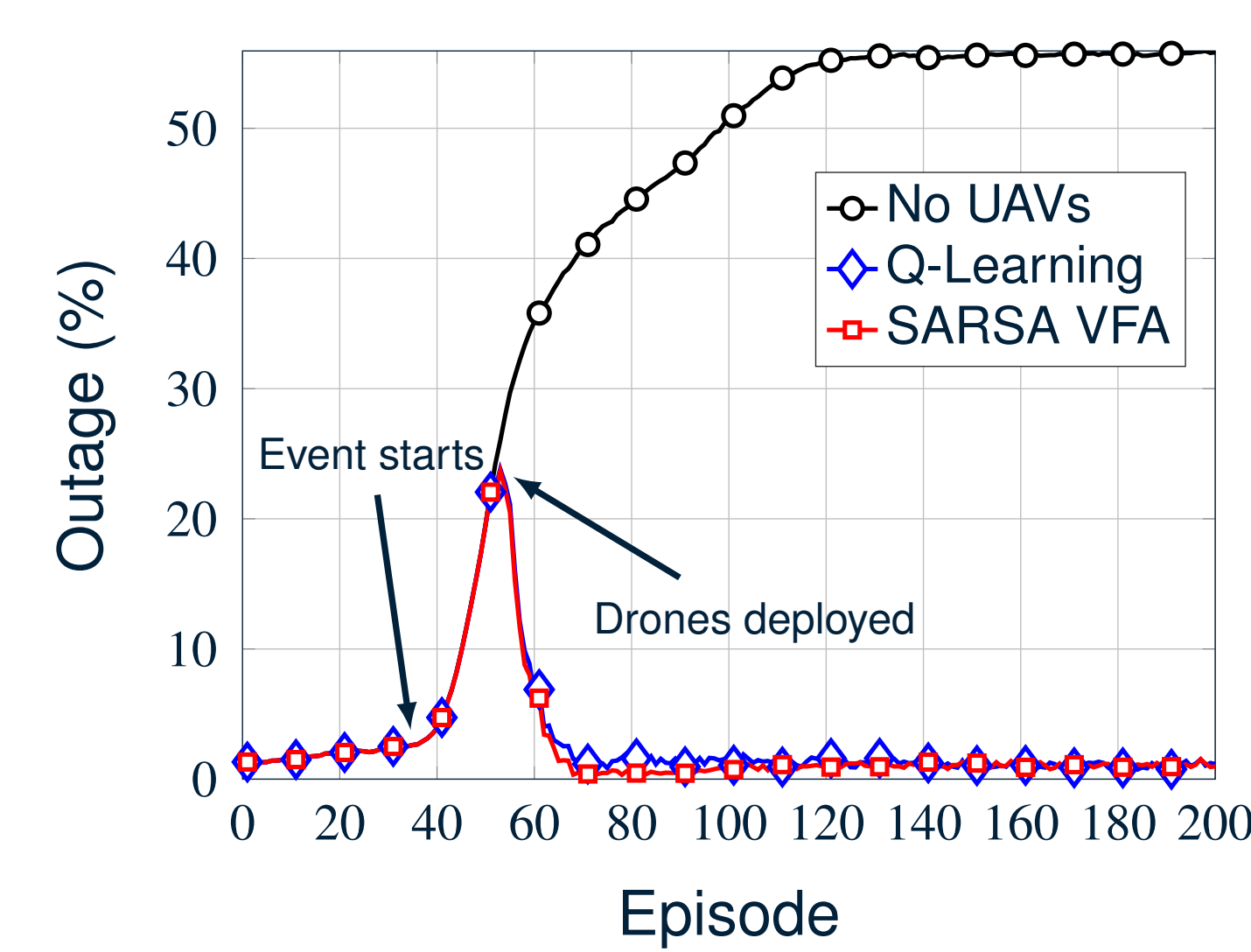
### Value Function Approximation (VFA)

- ▶ Generalize from previous states
- ▶ RL + Supervised Learning
- ▶ Estimate table by a function
- ▶ Linear, Neural Networks

### Simulation Scenario



### Results



### Conclusions

- ▶ UAVs are able to find users out of coverage
- ▶ UAVs are capable of tracking user mobility
- ▶ UAVs can provide extra coverage wherever and whenever needed
- ▶ Mitigates number of users in outage and dissatisfaction