# A Spatial Simulation Approach to Model Grazing Dynamics on Vierkaser Pasture, Austria

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## Abstract

This poster examines the grass growth and the amount of cows grazing at Vierkaser pasture, Untersberg, Austria. Using geospatial data and ecosystem modeling, we simulate cow movement, grazing, and grass regrowth to identify the maximum sustainable number of cows before disrupting the ecosystem.

## Understanding Spatial Simulation

Spatial simulation integrates **spatial** and **temporal** dimensions to model dynamic systems. It uses methods like Agent-Based Models for individual behaviors and Cellular Automata for spatial interactions. Applications include urban planning, environmental management, and healthcare, providing insights into complex scenarios and supporting informed decision-making.

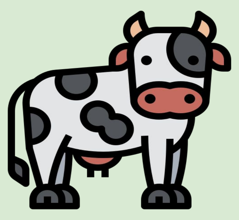
💡 **Agent-Based Modeling:** A simulation technique that models the behavior and interactions of autonomous agents to study complex systems

💡 **Cellular Automata:** A grid-based computational model where cells evolve over time according to simple local rules to simulate spatial and temporal dynamics

## Methodology

- Grid-based simulation using ABM for cow behavior and CA for grass growth.

- The pasture was represented by a 5-meter resolution grid, with biomass, location and regrowth rates.



- Movement prioritizing grazing spots with sufficient biomass.
- Each grazing action reduced biomass by 0.4 units. The simulation produced a map showing grazing.

## Results

The simulation identified a sustainable carrying capacity of around **17 cows**, with equilibrium achieved as **cows concentrated in high-biomass zones** (**Figure 6**). The first stage of the model starts with 50 cows (**Figure 1**), overgrazing led to **early mortality** (**Figure 2**), emphasizing the importance of balanced stocking rates and regrowth potential. It became evident which areas were **less favored by the cows for grazing** (**Figure 4**). After the 200th time it takes more cycles for one cow to not have enough biomass to survive as evidenced from **Figure 3 to 5**, after that the number of cows stabilized in 16, however the biomass always keeps increasing and decreasing over the cycles (**Figure 6)**. The numbers shown on **Chart 1** and **Chart 2** have a direct correspondence to the timings of each Figure.

Cows: 50 / Time: 1

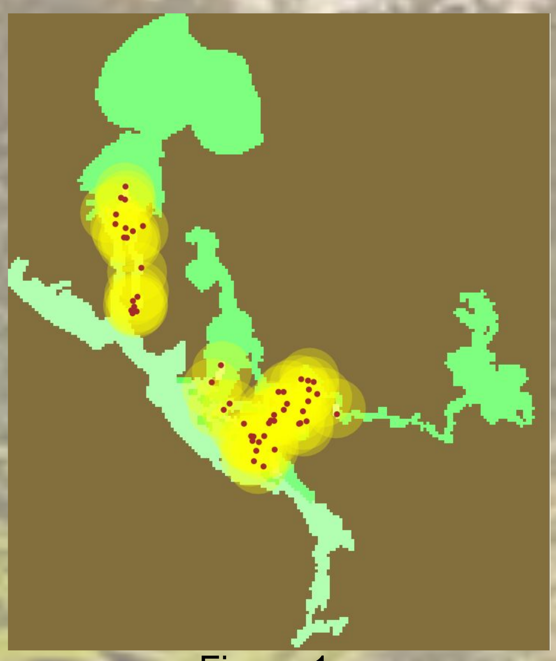


Figure 1

Cows: 36 / Time: 100

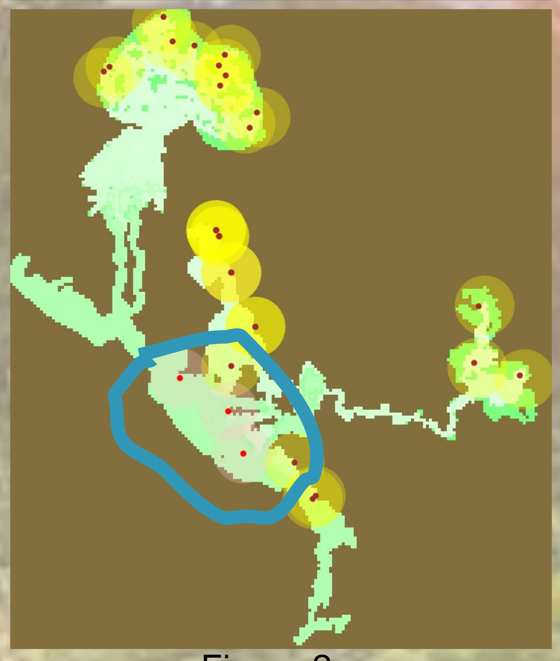


Figure 2

Cows: 25 / Time: 150

Figure 3

Cows: 21 / Time: 200

Figure 4

Cows: 17 / Time: 250

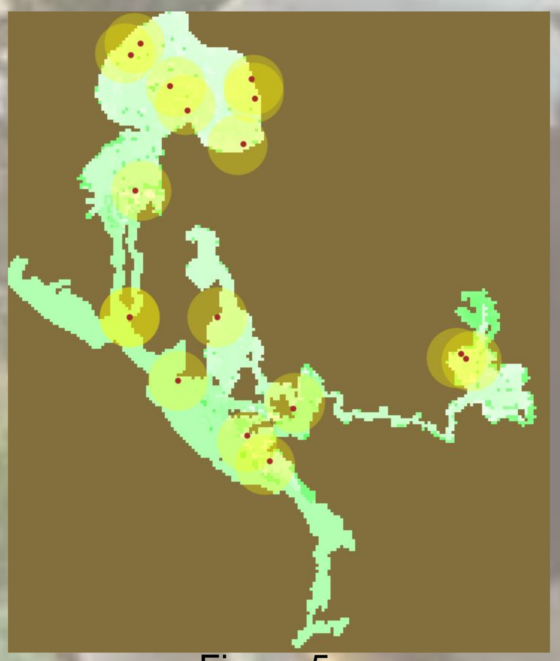


Figure 5

Cows: 16 / Time: 1000

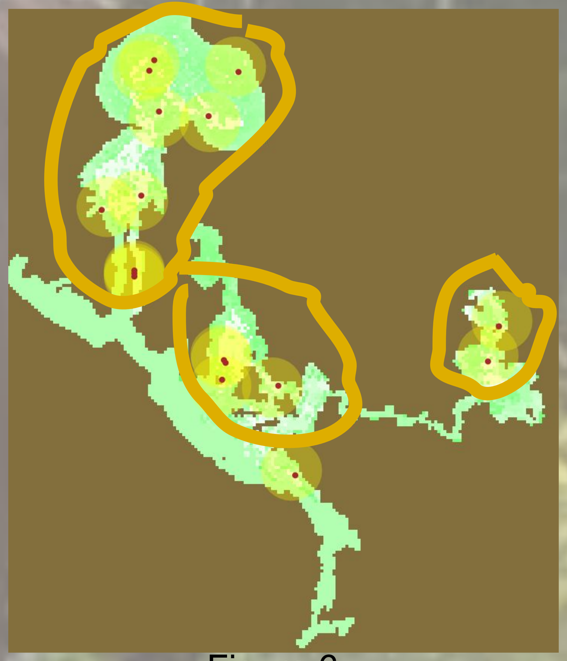


Figure 6


Chart 1

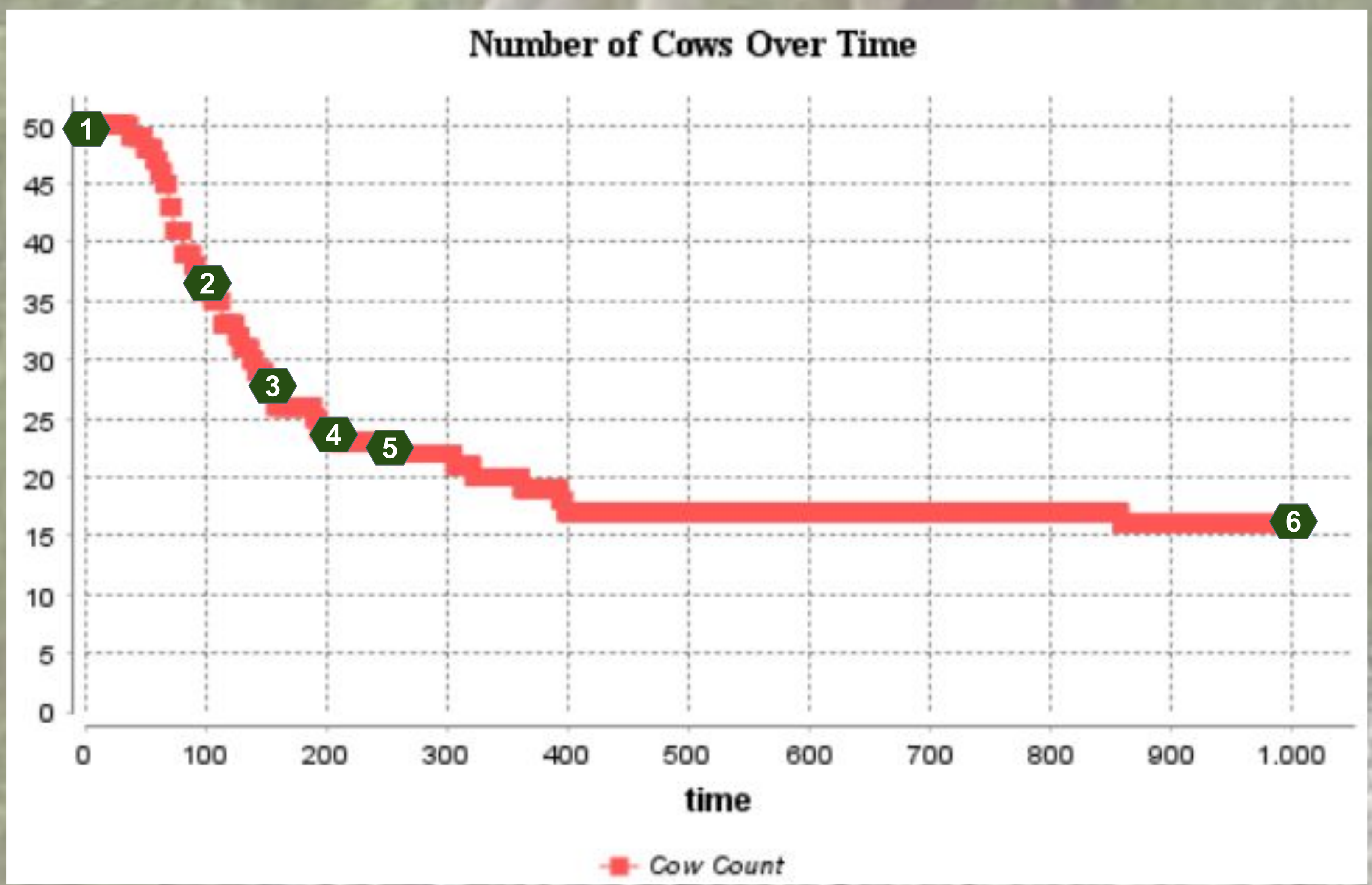



Chart 2

## Conclusion

The simulation highlights the importance of spatial modeling in understanding ecosystem dynamics. By illustrating the relationship between grazing, biomass regeneration, and cattle populations, it demonstrates how overgrazing leads to initial declines before stabilizing in high-biomass zones. This underscores the power of spatial models as tools for informed decision-making, enabling more sustainable and balanced resource management strategies.

https://unigis-salzburg.github.io/Opt_Spatial-Simulation/