Human-Environment Interactions in a Changing Environment:

A Computational Model of Agropastoral Practices and Landscapes in Neolithic Spain

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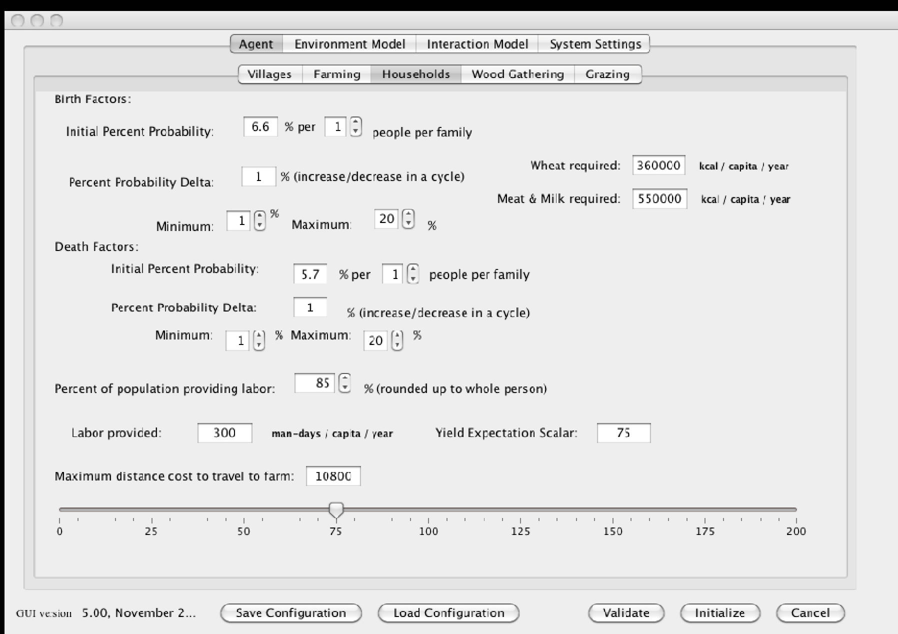
The MedLand Project

- Develop an understanding of long-term environmental effects of human environment interaction in the Mediterranean

- We have developed multiple landscape and human decision making simulations which can be used individually or together to understand components of socio-ecologic system dynamics.



Simulation GUI

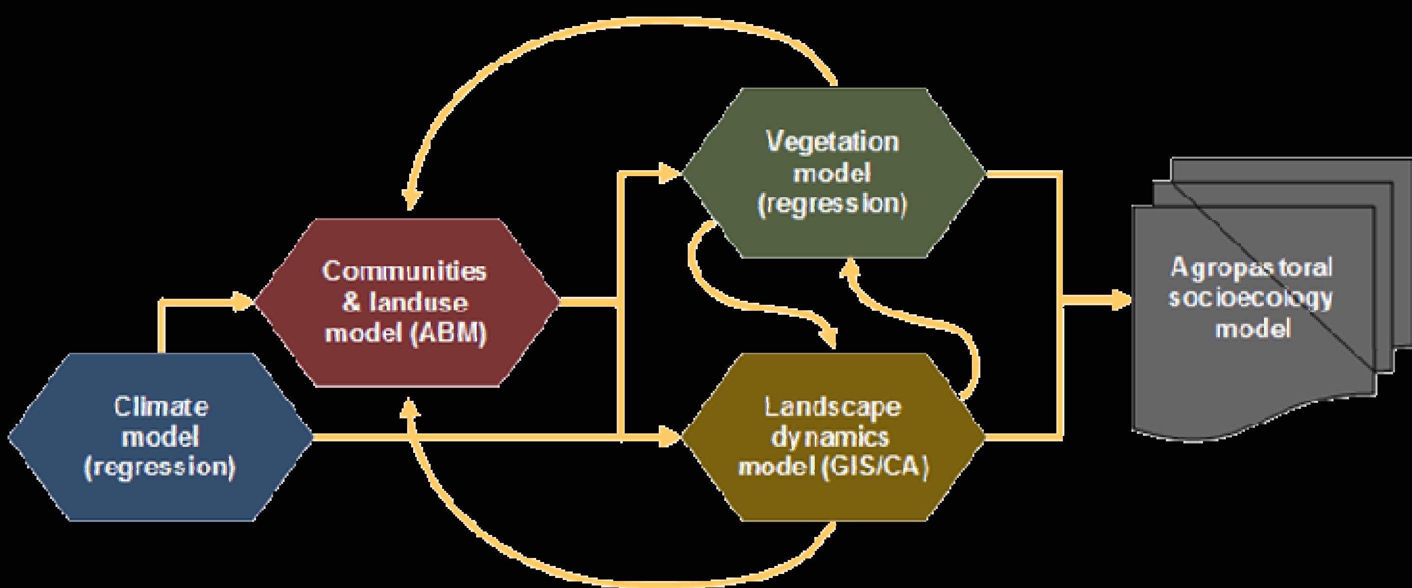
Simulation Viewer using NASA WorldWind

AP-SIM and LandDyn

- The agent-based model component of our model, AP-Sim, emulates villages that practice non-irrigated wheat and barley farming as well as site-tethered mixed sheep and goat herds.

- Households make annual economic decisions about how much land to farm and how much land will be needed to feed their herds.

- LandDyn, is composed of GRASS GIS scripts including a land assessment model, a vegetation succession model, a soil fertility model, a catchment model and a surface process model.

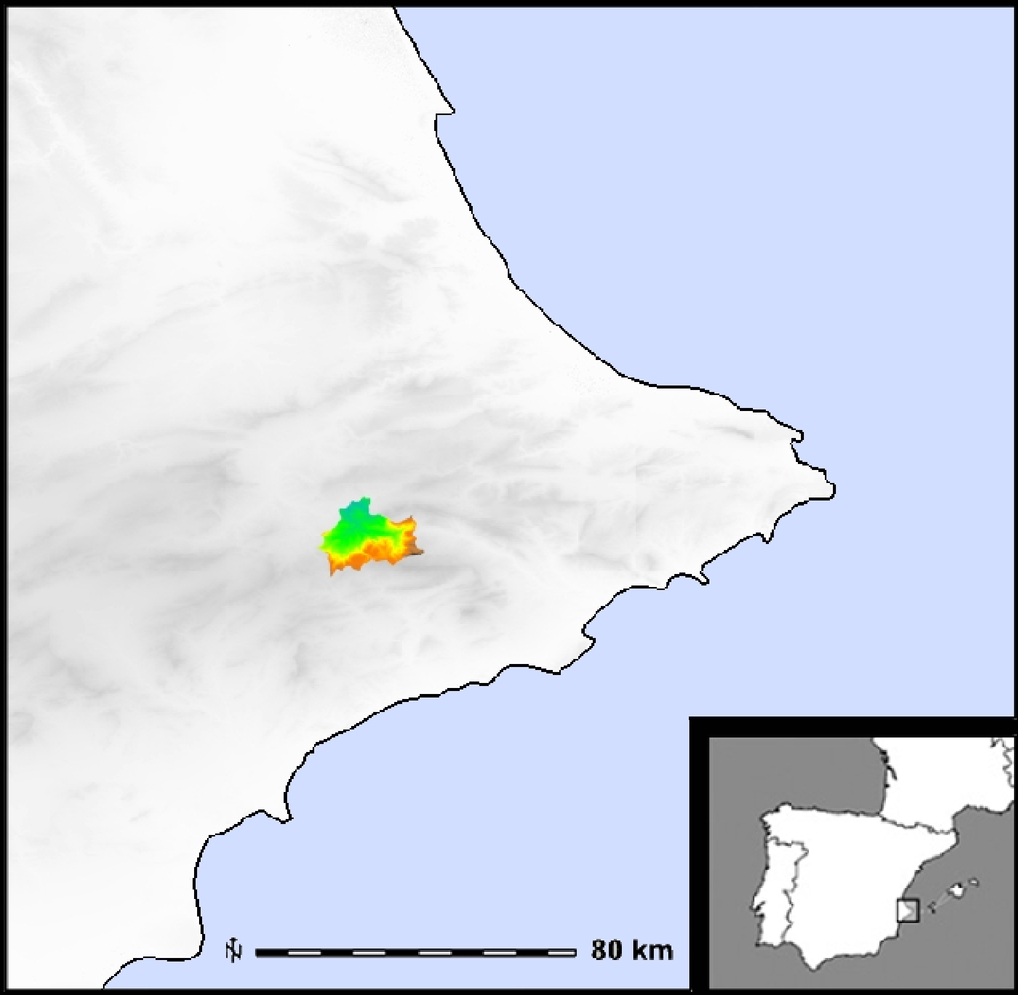


Experimental Study Area

During the Neolithic there is evidence of settlement re-organization and landuse

The Usual Suspects:

- Climatic Change
- Population Stress



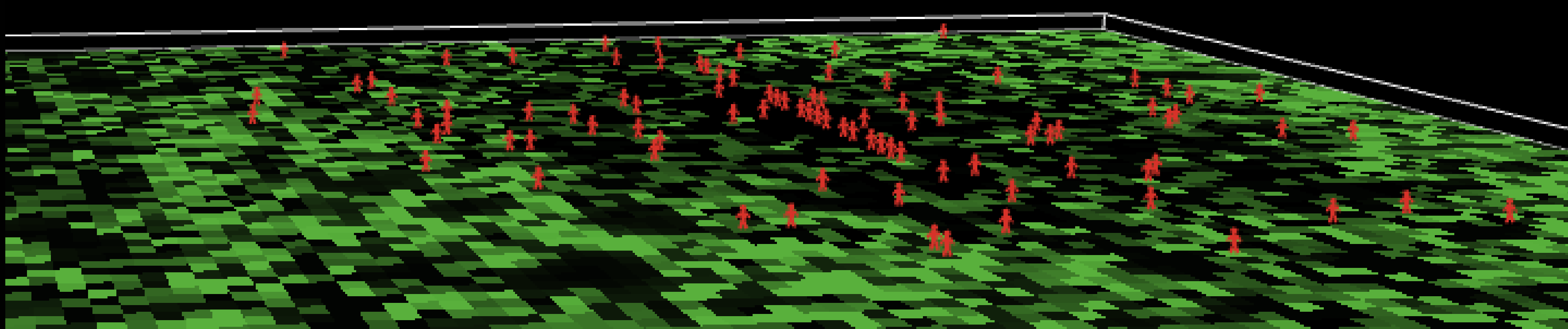
Penaguila Valley, Spain

Expectations

- High Population + Neolithic I Climate (Wetter) = Greatest Effect on Landscape
- Low Population + Neolithic IIb Climate (Drier) = Smallest Effect on Landscape

Population

- Prehistoric Population Rates are…?
- We use 6.6% as a birth rate for both simulations and vary the death rate as 5.2% and 5.7%
- Test two population growth rates: 0.05% and 0.1%
- Population Rates do vary in simulations from agropastoral returns



Neolithic Climate

Neolithic I: *Wetter* *More Storms*

Neolithic II: *Drier* *Fewer Storms*

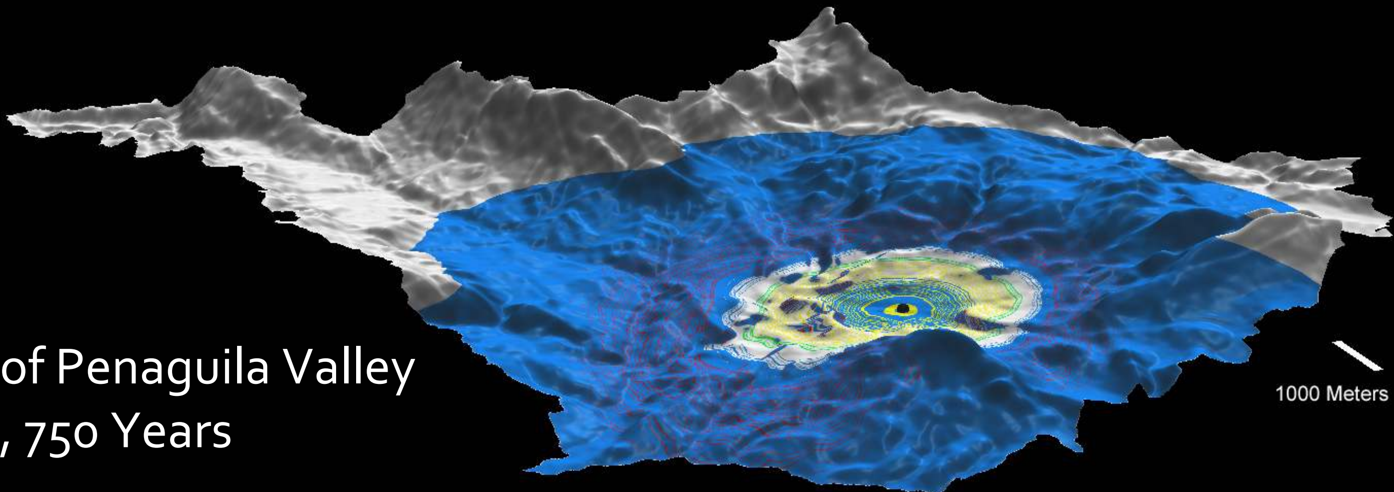
Neolithic I 7550-6450 BP				
	Annual mm	R-factor	Storm mm	Storm #
averages	515.2341261	4.537608	20.61391	24.98832
stdevs	21.77078577	0.061896	0.18702	0.854224

Neolithic II-b 5650-4250 BP				
	Annual mm	R-factor	Storm mm	Storm #
averages	436.2173316	4.454338	19.16122	22.78008
stdevs	22.73606926	0.017223	0.87561	1.090053

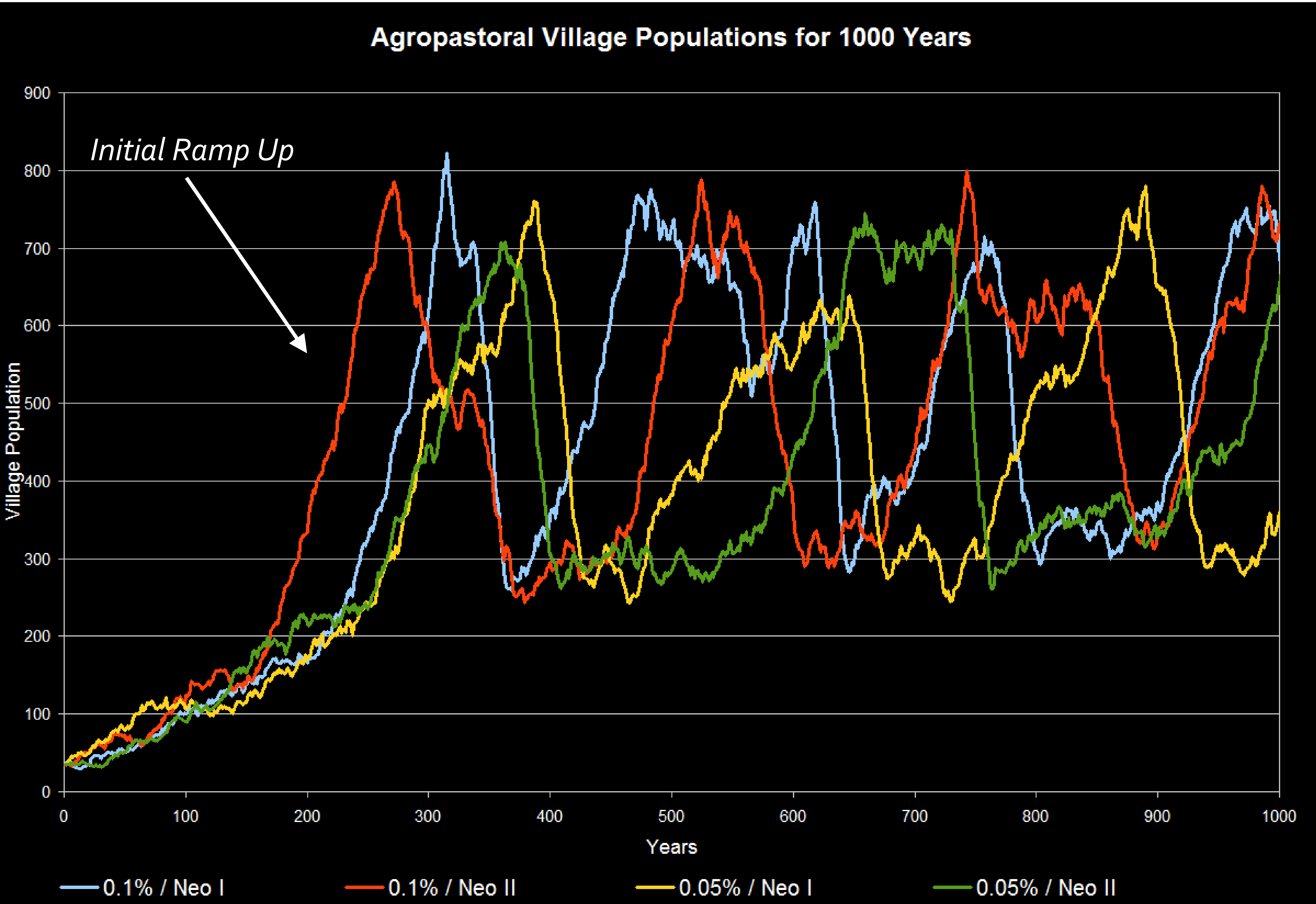
How do climate and population interact and result in stress on the landscape that may necessitate change in land-use strategies?

4 Parameter Sets:

- High Population Rate, Low Rainfall
- Low Population Rate, Low Rainfall
- High Population Rate, High Rainfall
- Low Population Rate, High Rainfall

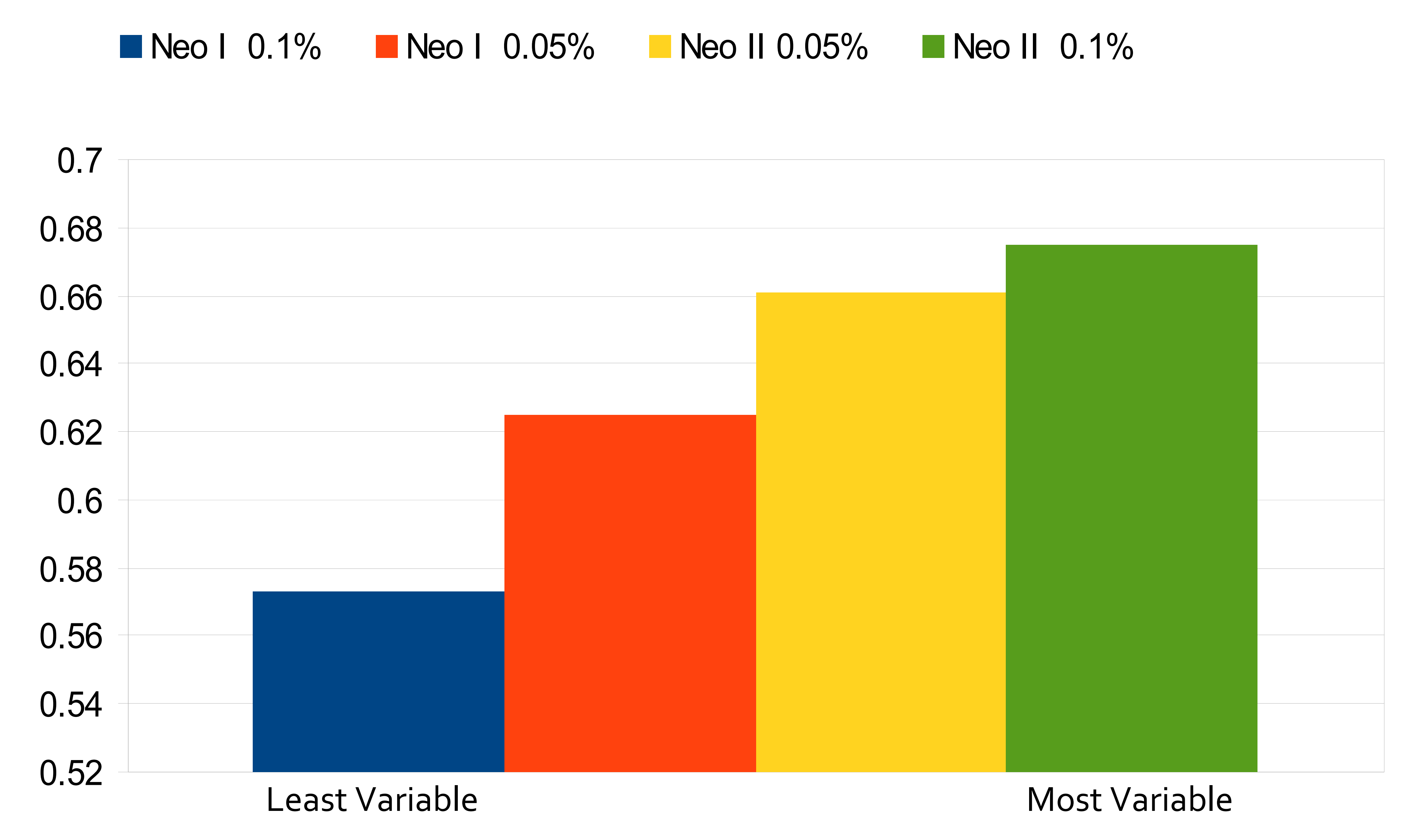


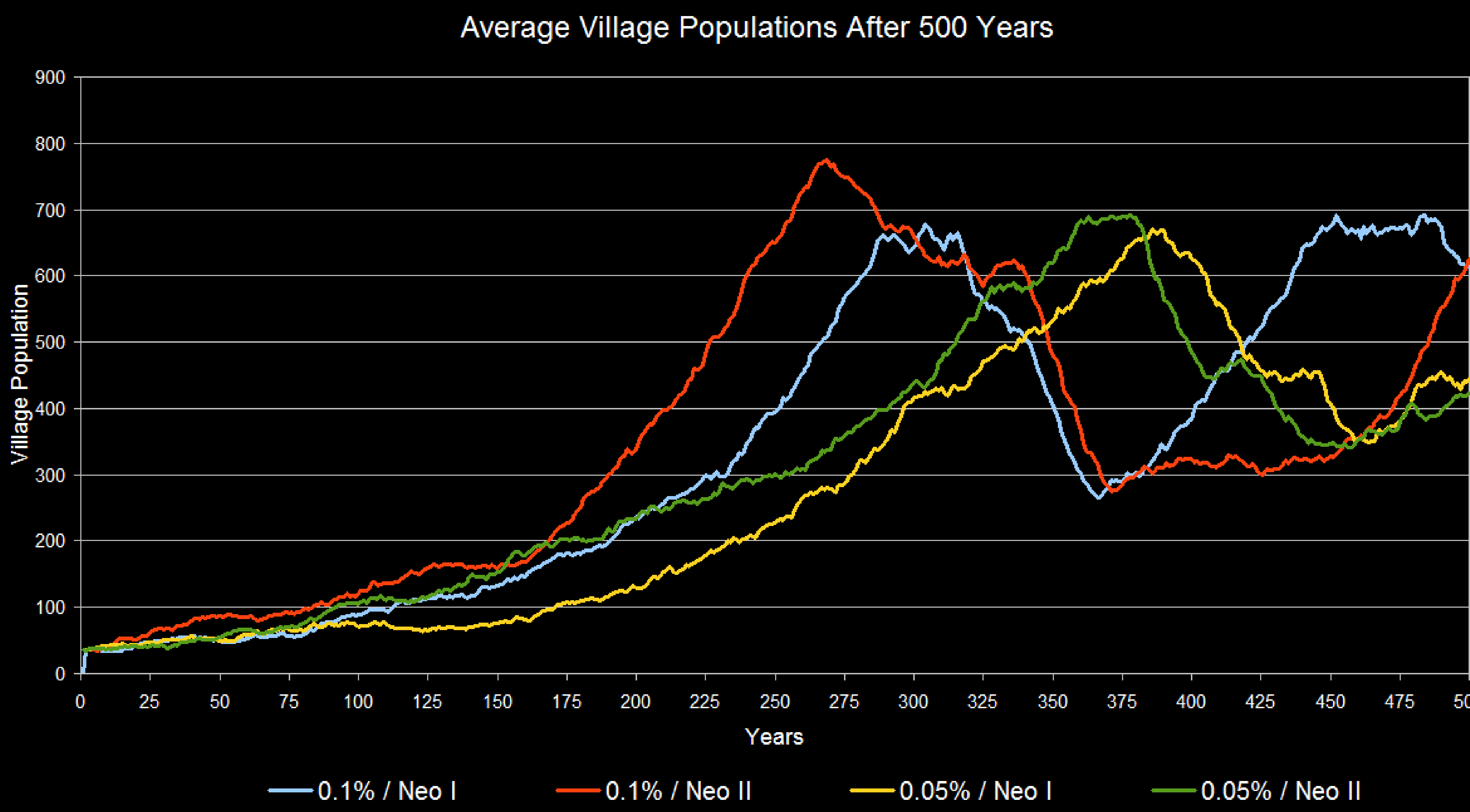
Modeled Area of Penaguila Valley
Agent Impacts, 750 Years



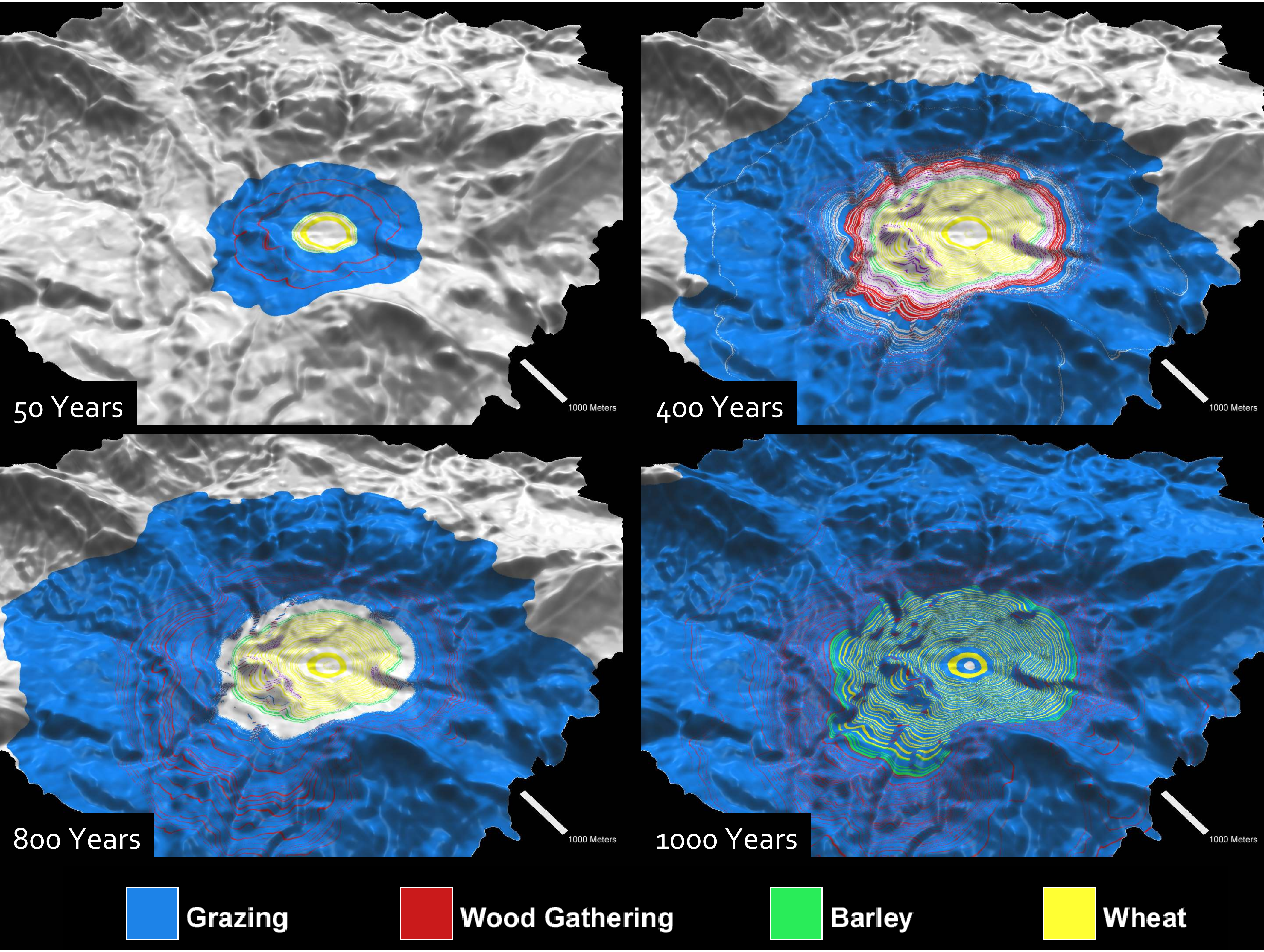
Village Populations Begin With 36 People and reach a maximum size of 800 people

Population Variation

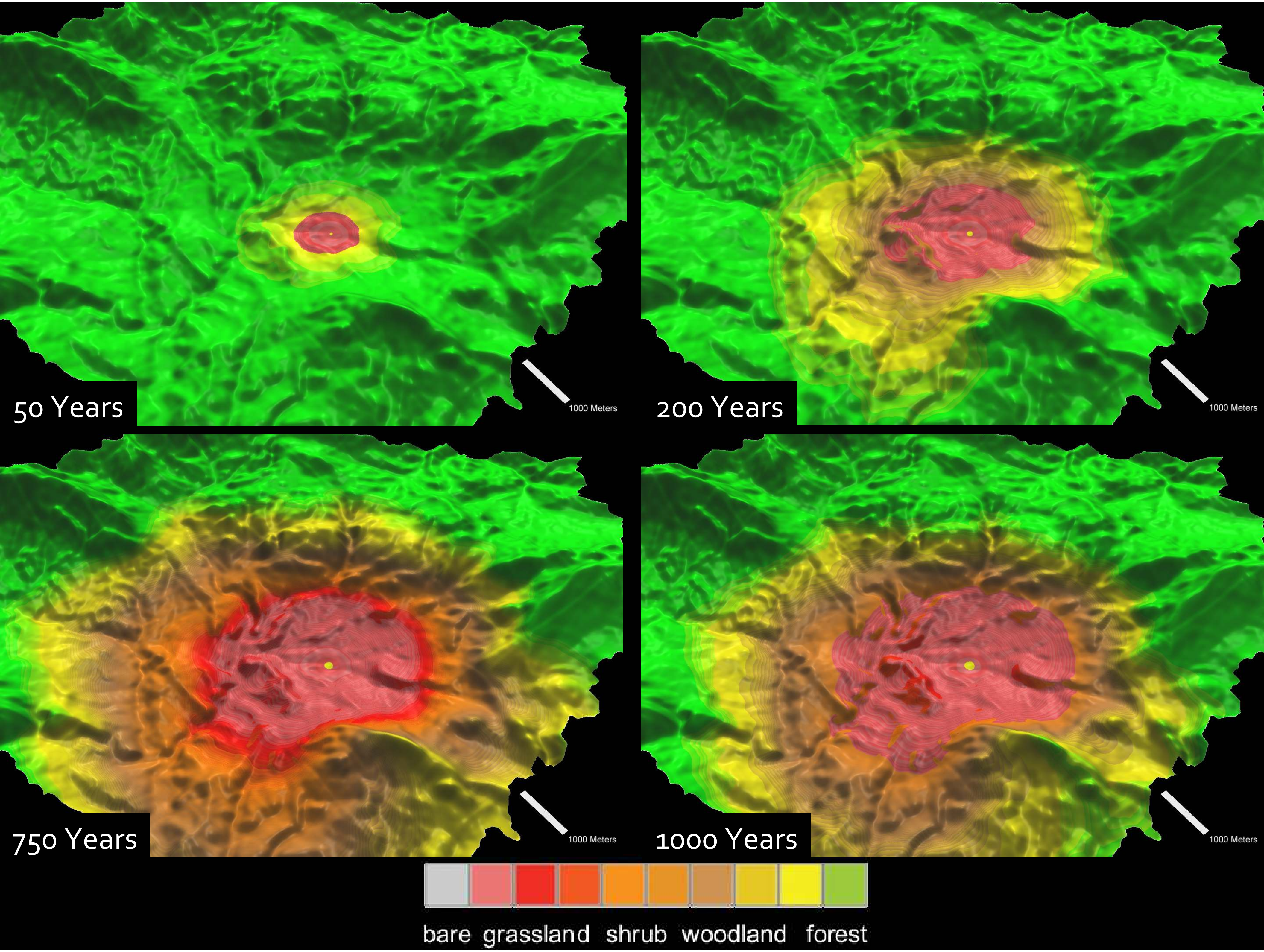


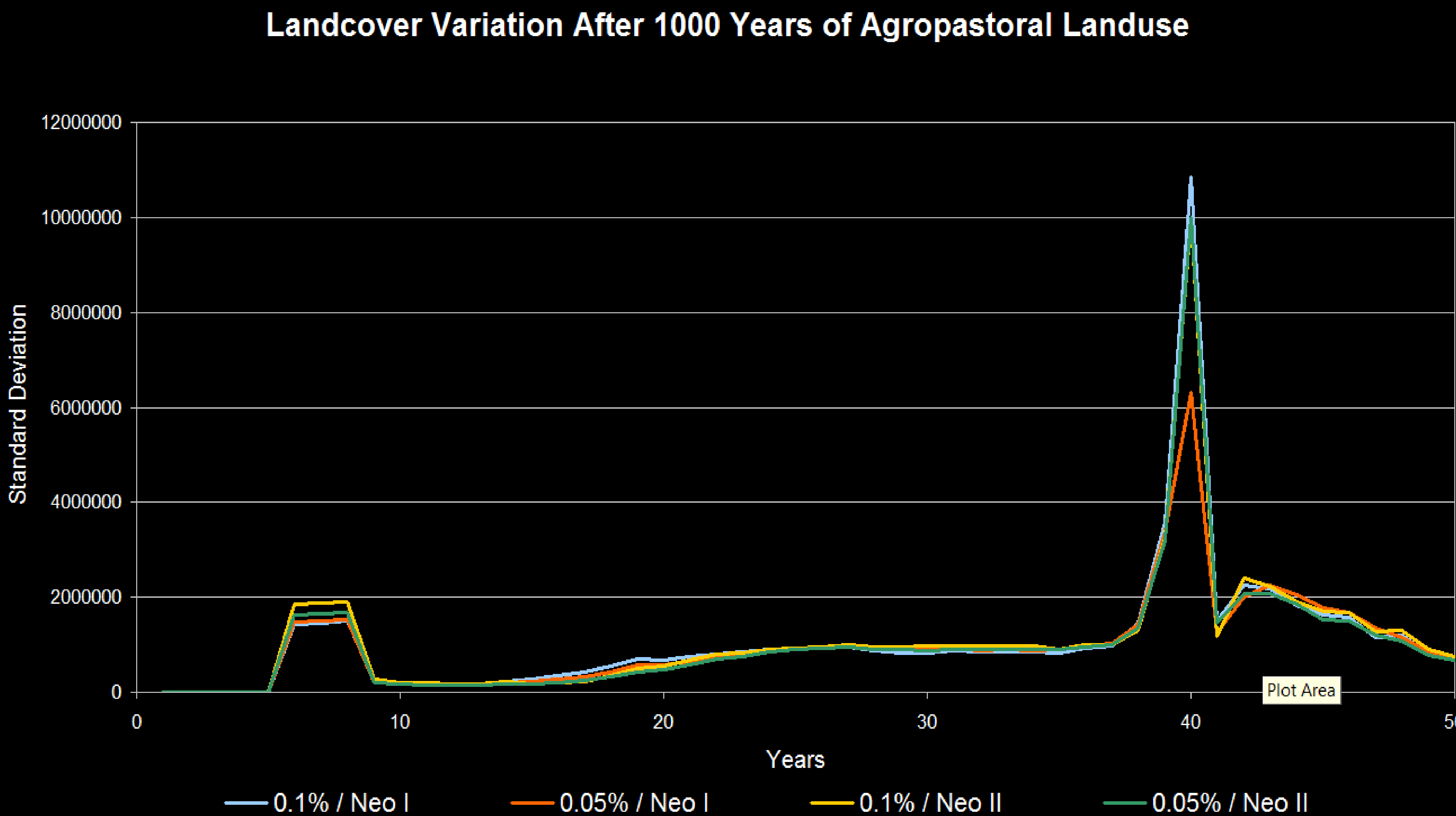


High Population Rate and Drier Climate Results In An Earlier Ramp Up Period



50 Years
1000 Meters
400 Years
1000 Meters
800 Years
1000 Meters
1000 Years
1000 Meters
Grazing
Wood Gathering
Barley
Wheat

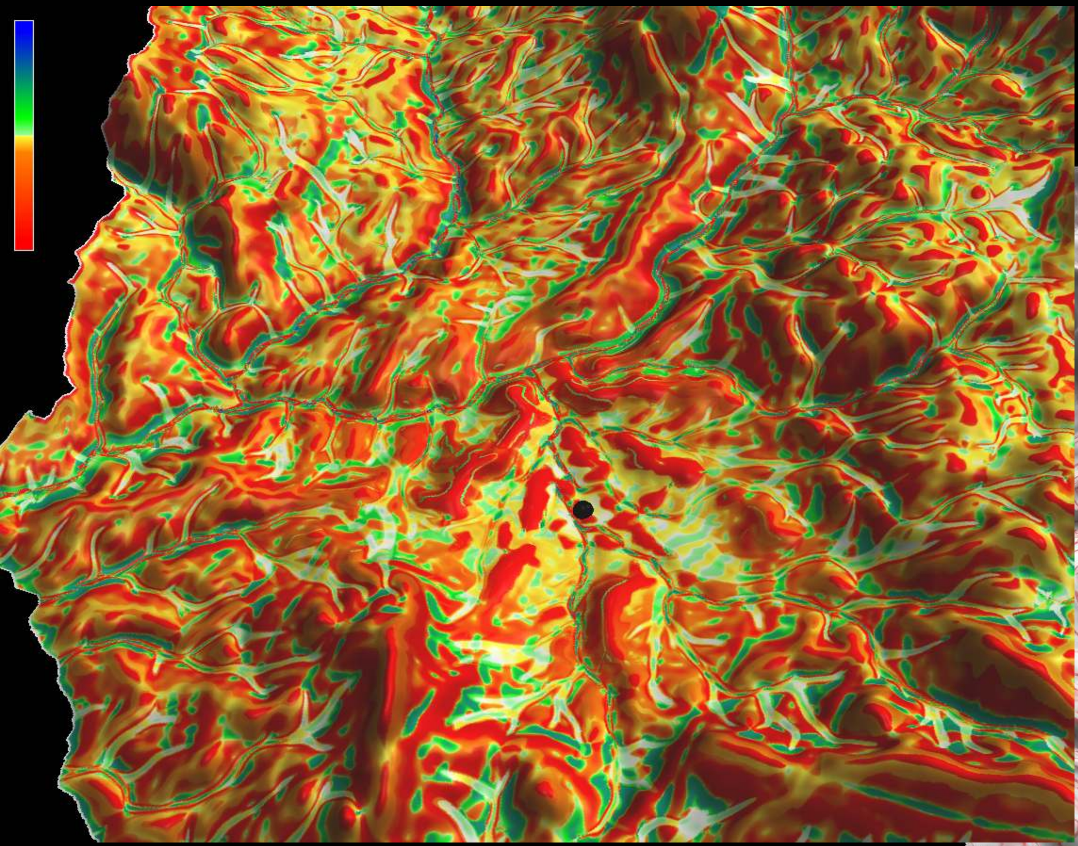

50 Years
1000 Meters
200 Years
1000 Meters
750 Years
1000 Meters
1000 Years
1000 Meters
bare grassland shrub woodland forest



Low Population and Wetter Climate is Less Variable

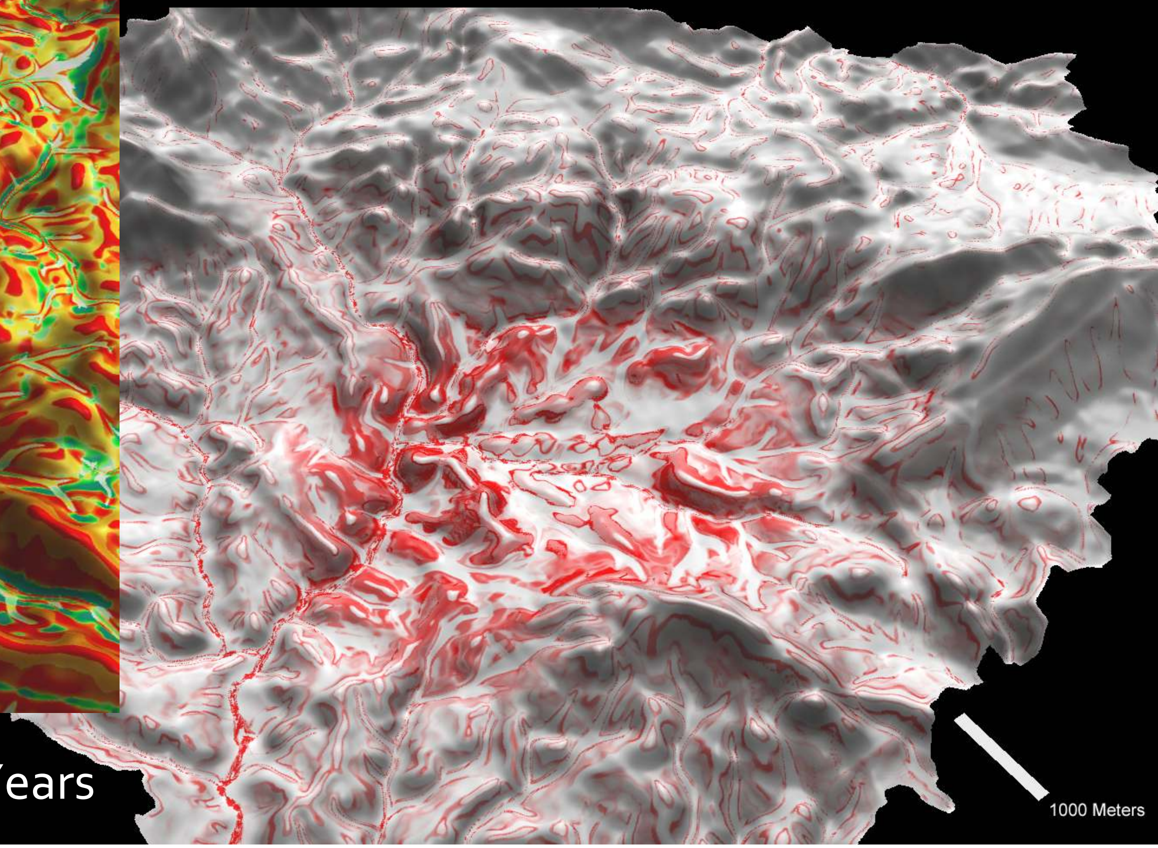
Erosion & Deposition

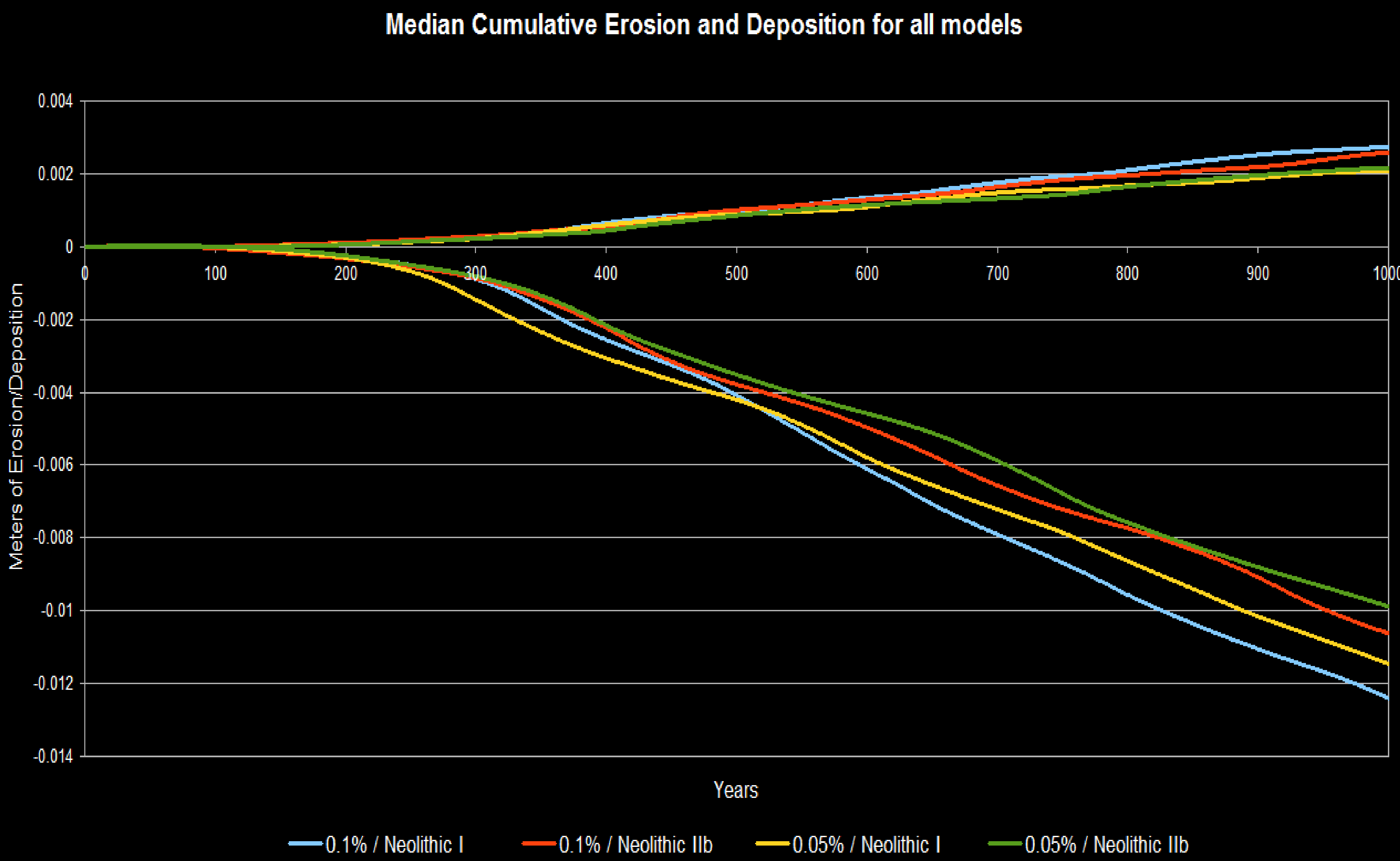
- We compare control models of E & D to our simulations to determine the human contribution
- Which is the larger factor, Climate or Humans?



Cumulative Erosion and Deposition, 1000 Years

Erosion Variation, 1000 Years





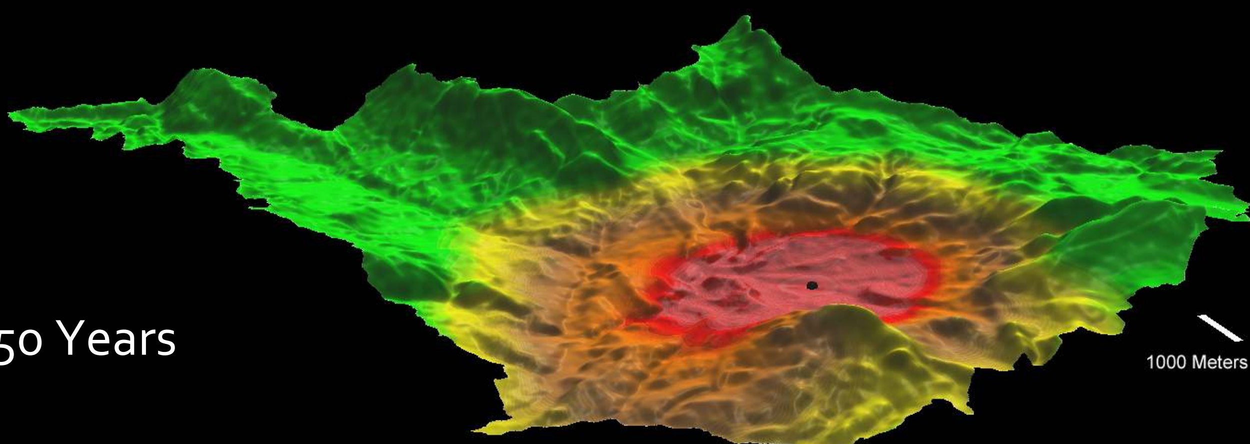
-Little Difference In Deposition

-A Wetter Environment Results in the Most Erosion, Population Is Still A Factor

Preliminary Conclusions

- None of the Parameter Combinations we used are inherently unstable and must lead to a re-organization of landuse
- The combination of a High Population Rate and Neolithic I climate results in the most variable population and the most erosion
- Village Populations reach a maximum size that is not well understood
- It is unclear why a high population rate and drier climate results in a faster ramp up period
- Importance of climate underscores the importance of adding climatic variation during simulations

Landcover, 750 Years



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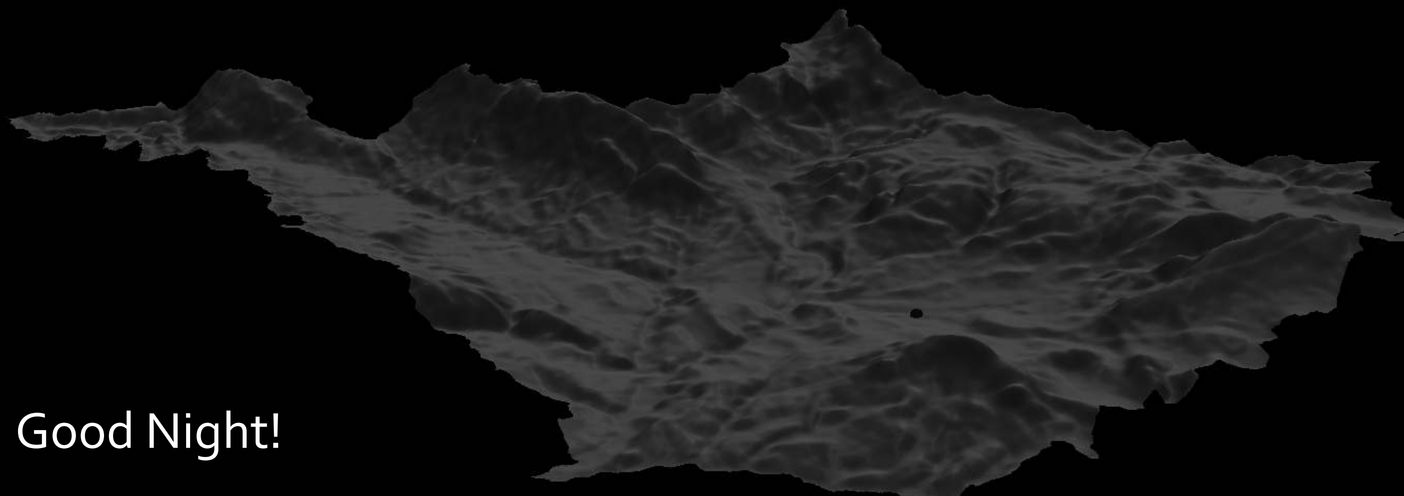

Good Night!