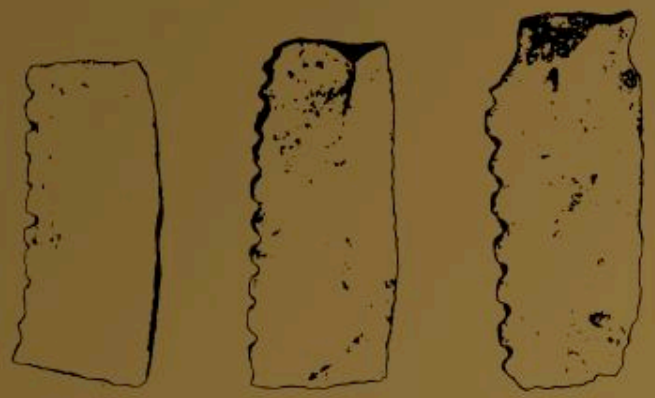
Alternative Futures of the Past

Modeling Neolithic Landuse and Its Consequences in the Ancient Mediterranean

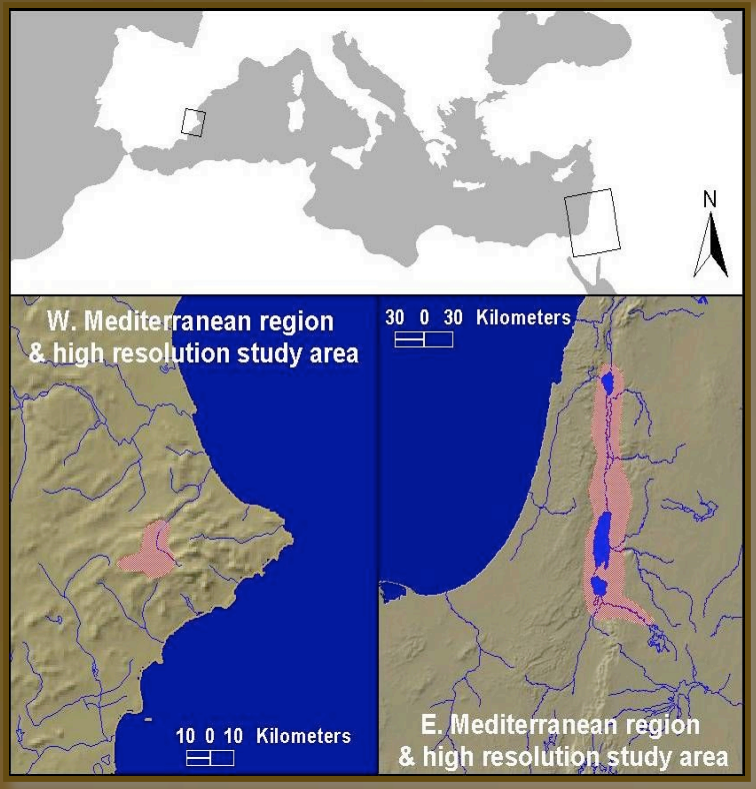


Isaac Ullah and Michael Barton

Mediterranean Landscape Dynamics Project

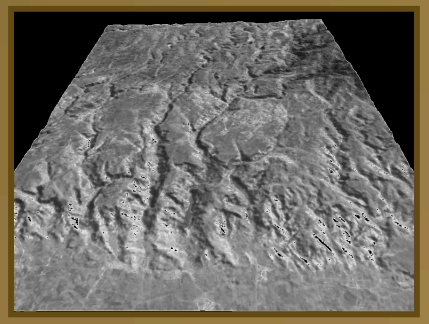
School of Human Evolution and Social Change

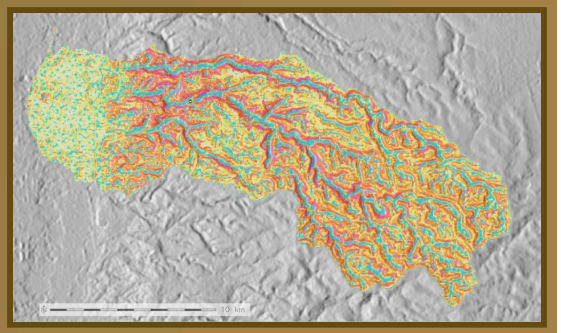
Background



- The Medland project aims to understand the long term effects of ancient landuse practices on the environment.
- GIS-based surface process simulation coupled with semi-dynamic stochastic landuse models (eventually with Agent-Based landuse model)

- Track the effects of landuse on landcover and subsequently on the spatial extent and severity of erosion and deposition through time



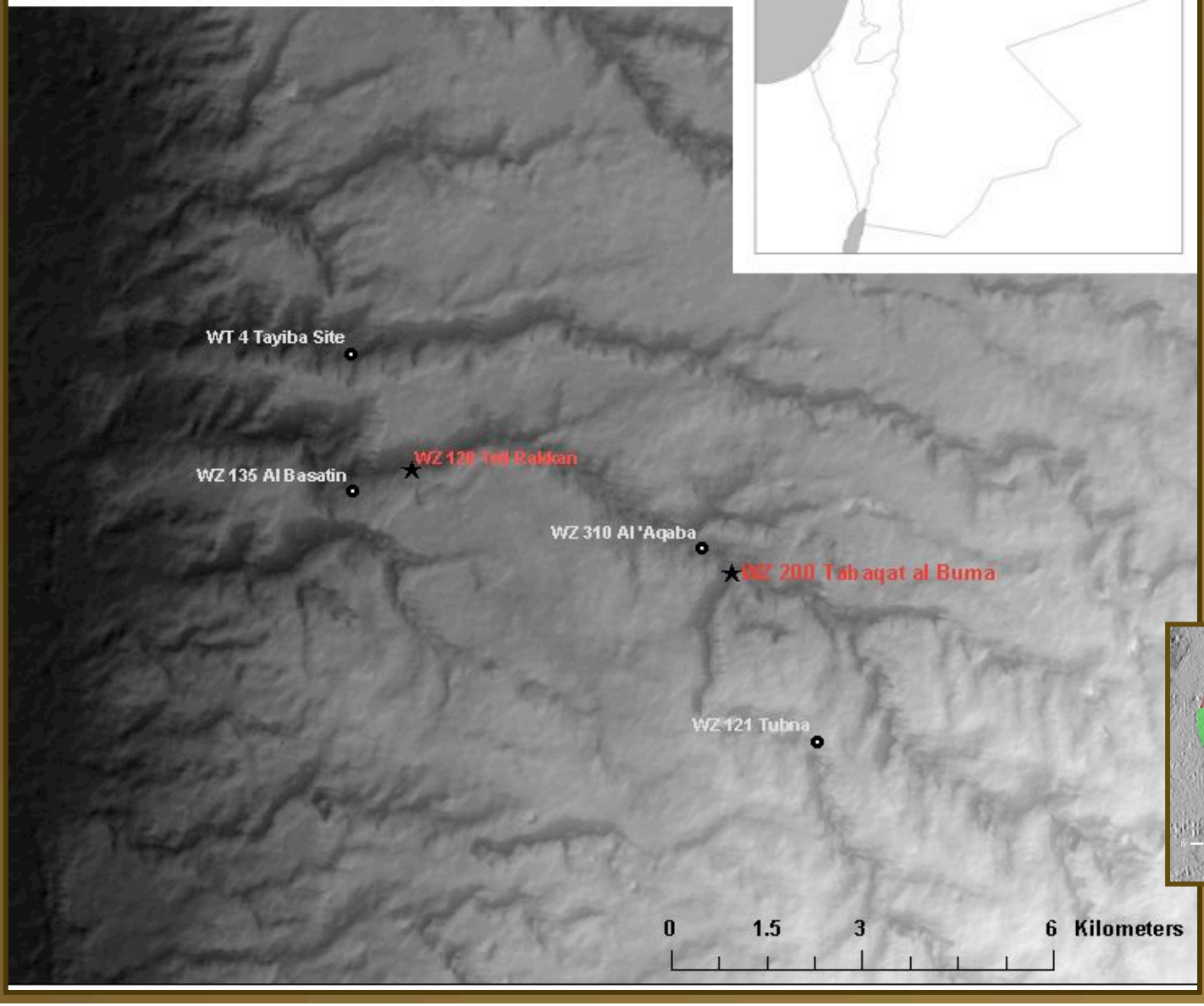


Study Methodology

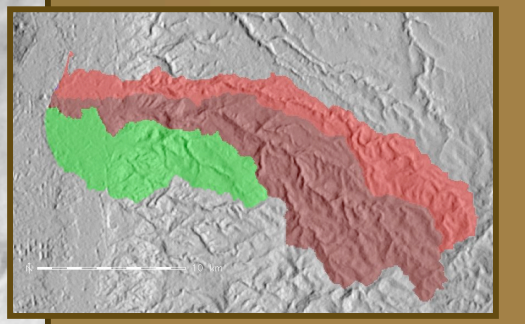
- Compare the effects of 50 years' simulated landuse between a medium-sized Middle/Late PPNB (~9-8 KYBP) village and a very small Late Neolithic (~7.5-7 KYBP) farmstead
- Four landuse scenarios: five year fallow slash and burn agriculture, intensive agriculture, and both of these types of agriculture with logistic herding in the surrounding catchment
- Model surface processes for each model plus control runs of with no landuse at all to provide a comparative baseline

Project Area

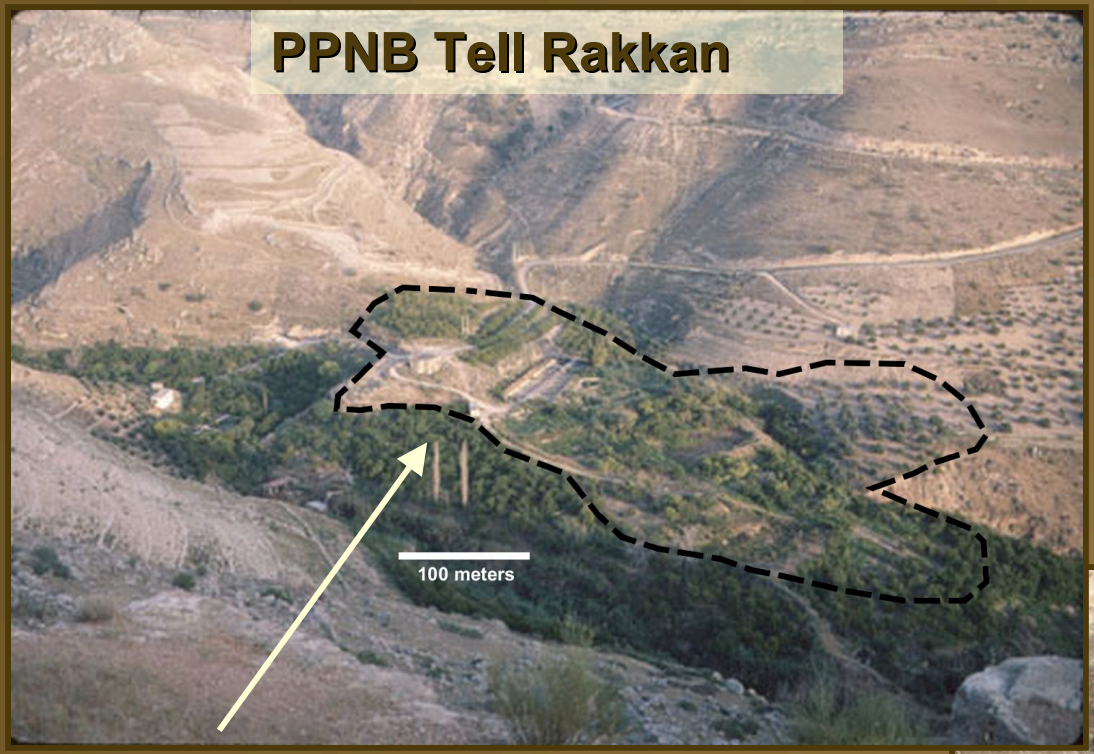
(Wadi Ziqlab, Northern Jordan)



Three watersheds

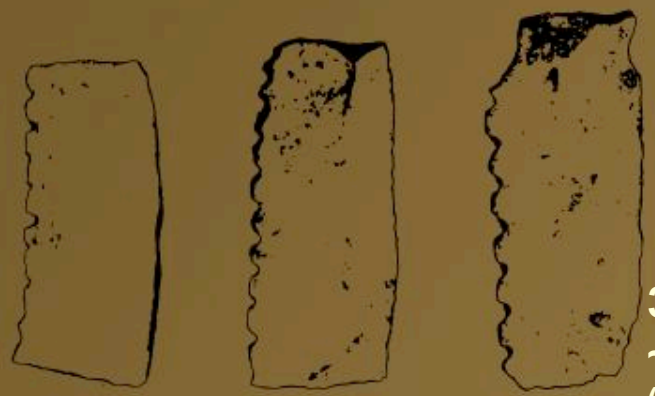


PPNB Tell Rakkan



~15 households (?)
~100 people
(limited excavations)

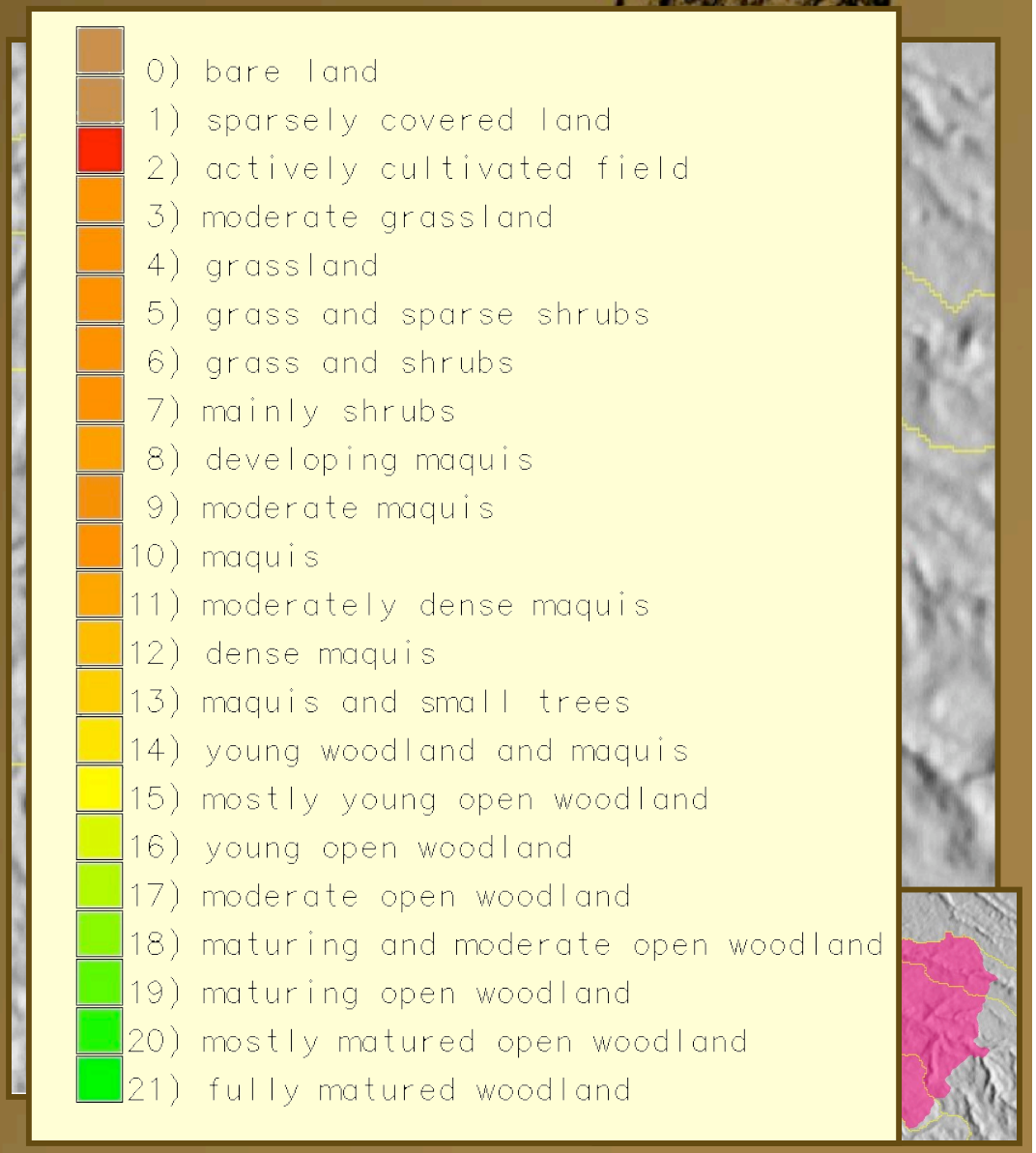
LN Tabqat al-Bûma



3 households
~20 people
(fully excavated)

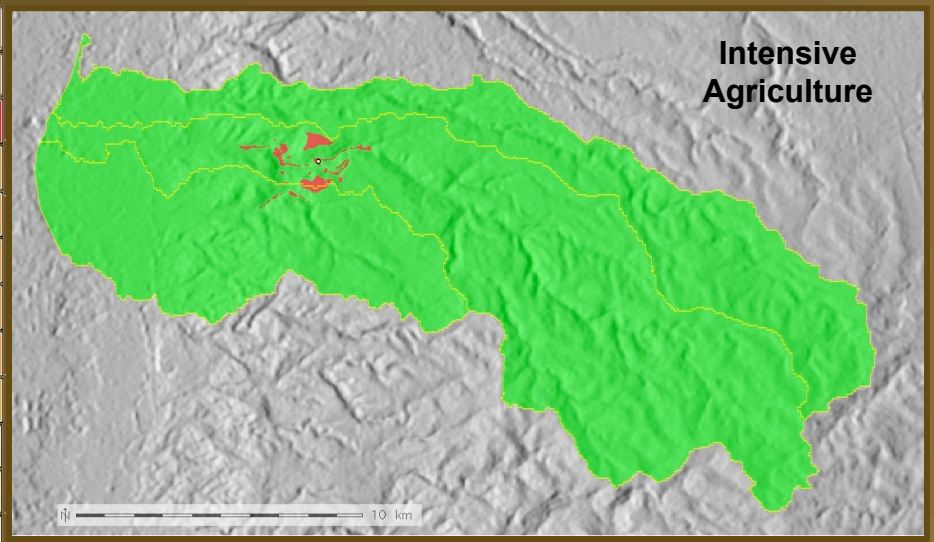
Landuse Simulation

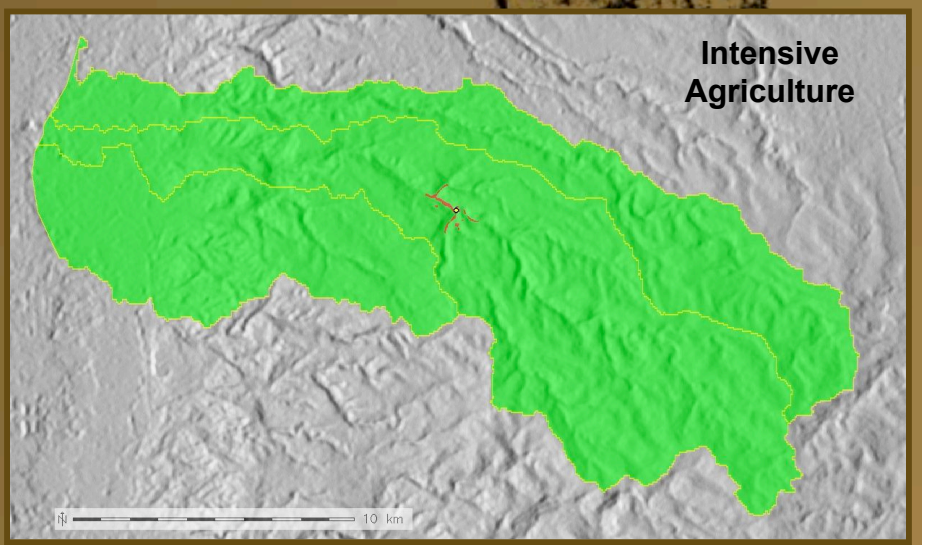
- Agricultural and pastoral catchments defined through ethnoarchaeologically-derived size estimates and cost-surface models
- Grazing and fallow agricultural landuse utilize stochastic resampling of required percent of catchment with succesional vegetative regrowth
- Track landcover diversity/degradation through time

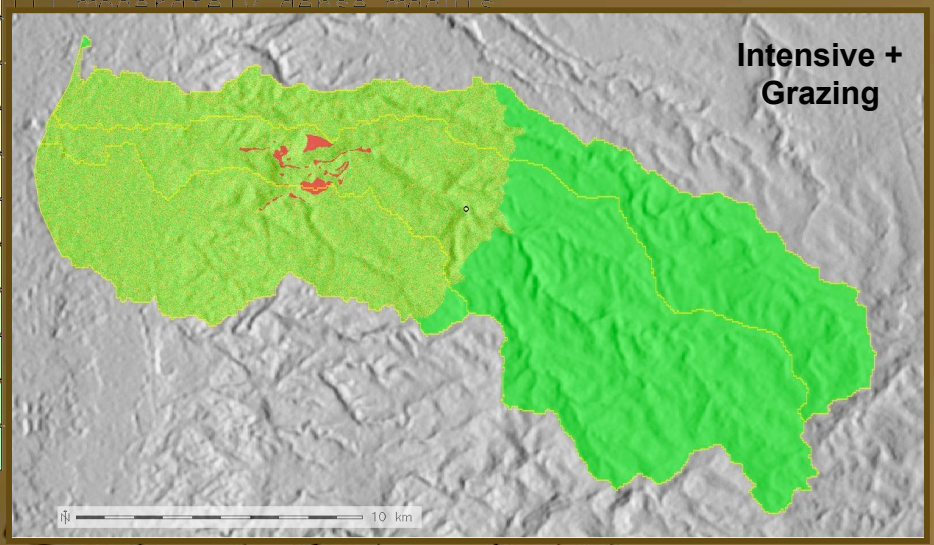


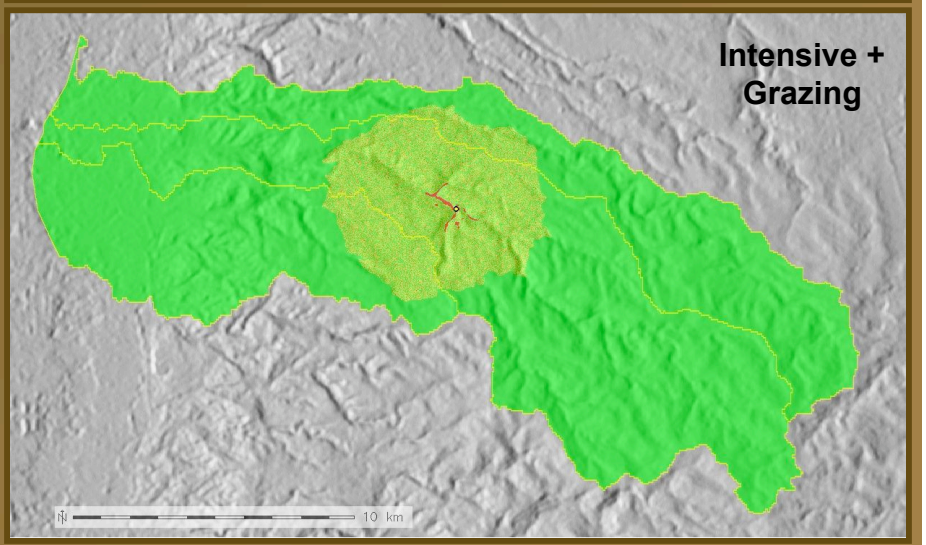
Tell Rakkan

Tabaqat al-Buma



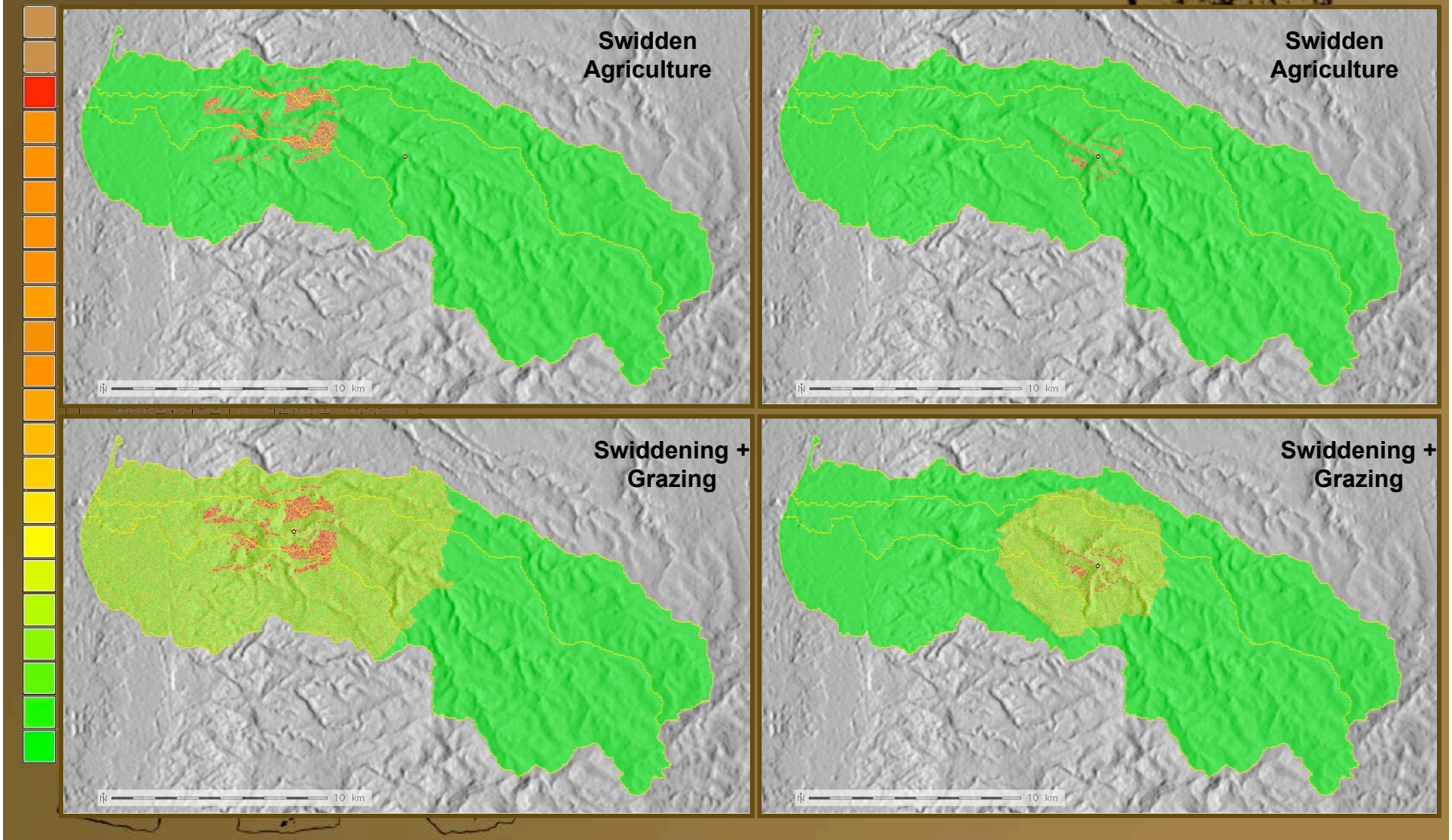




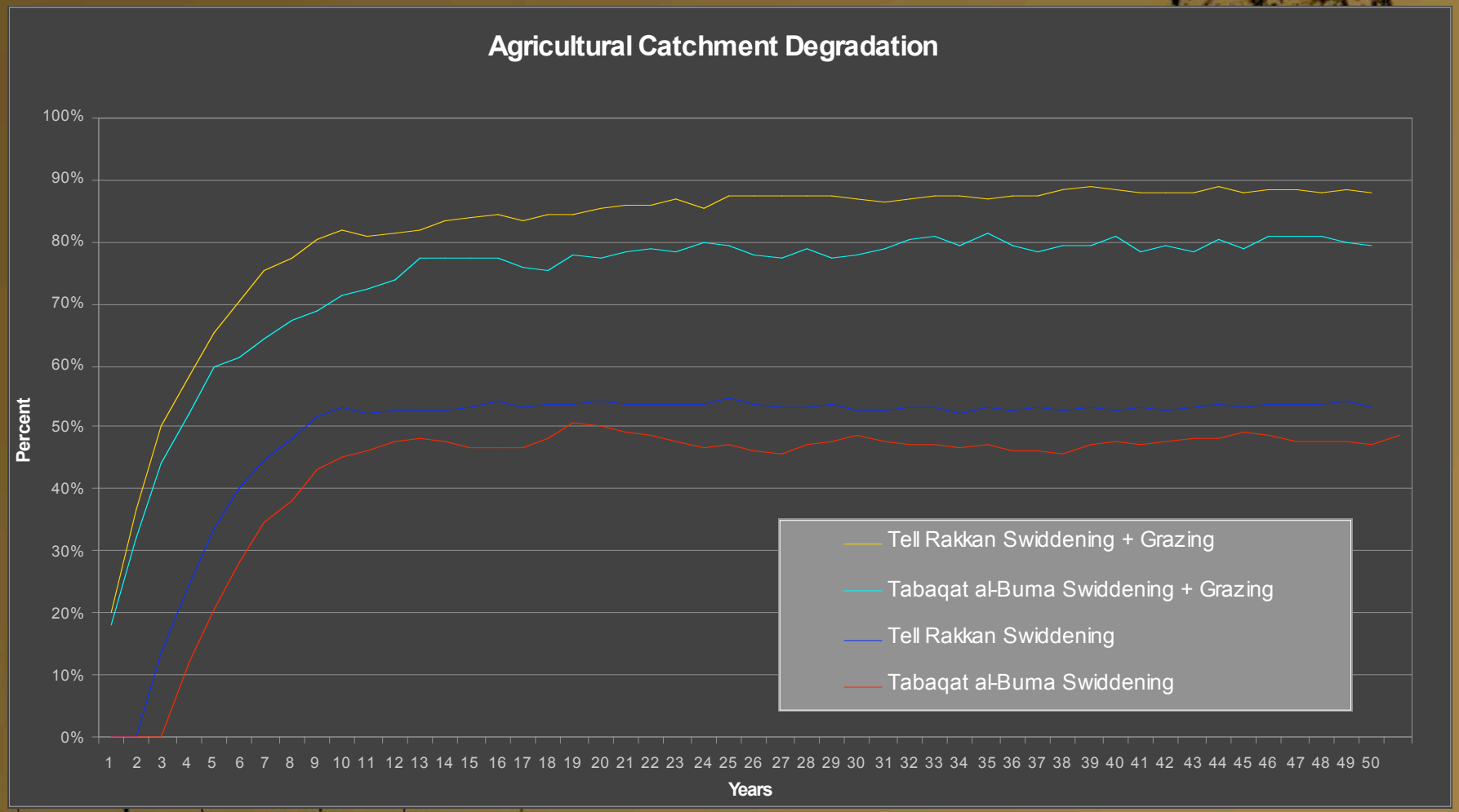


Tell Rakkan

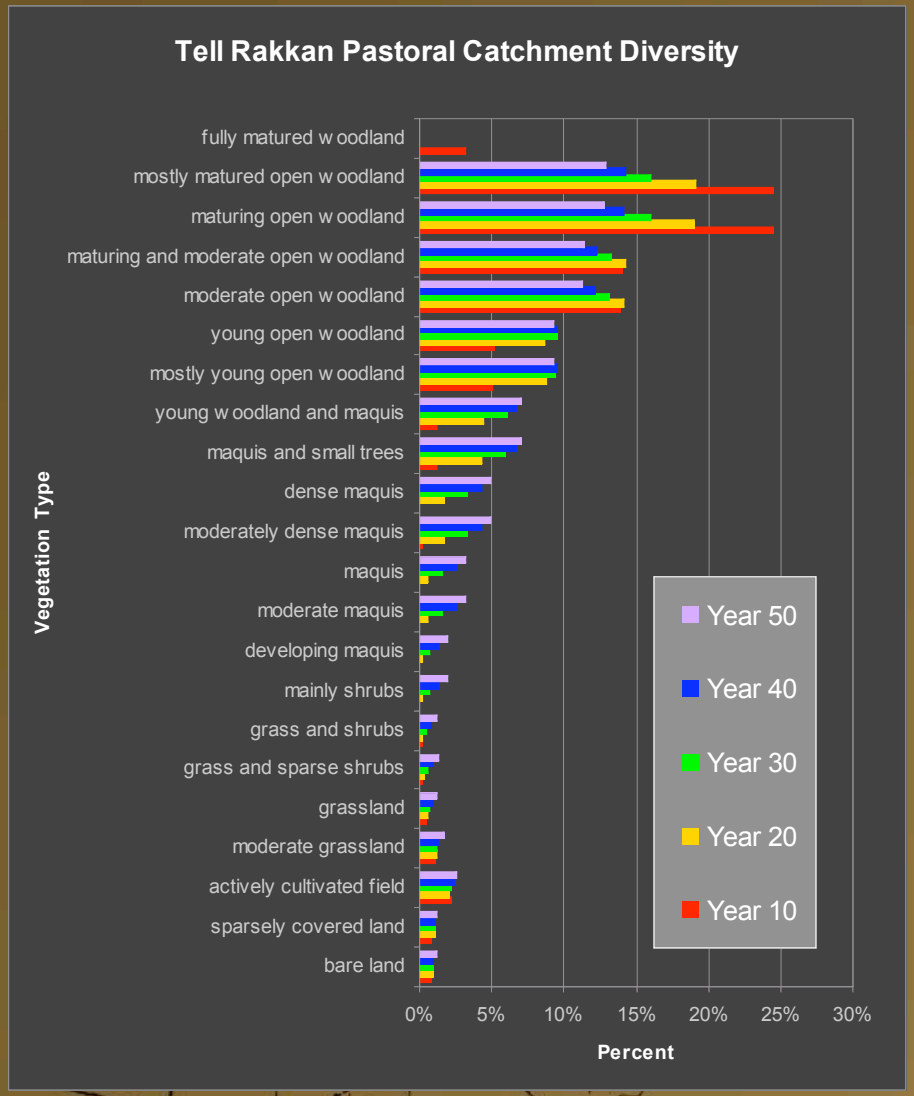
Tabaqat al-Buma

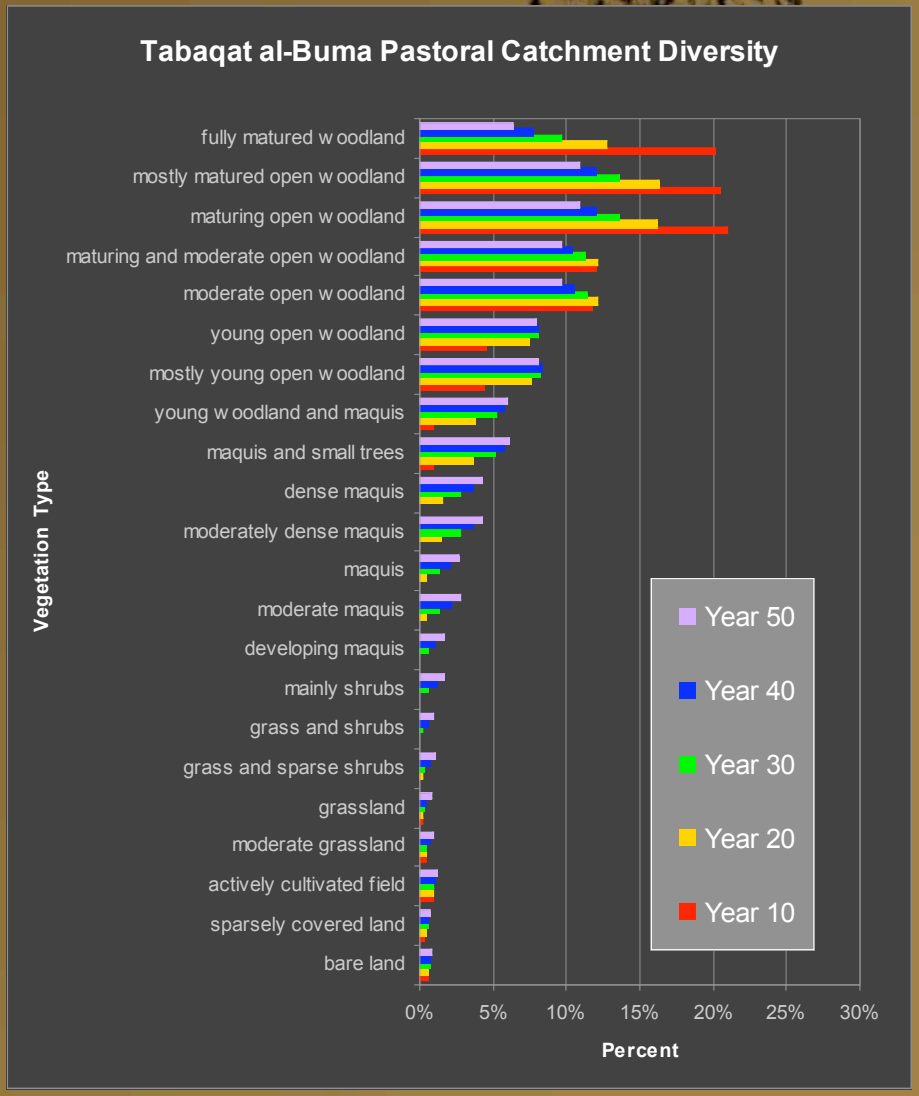


Swidden Model Results

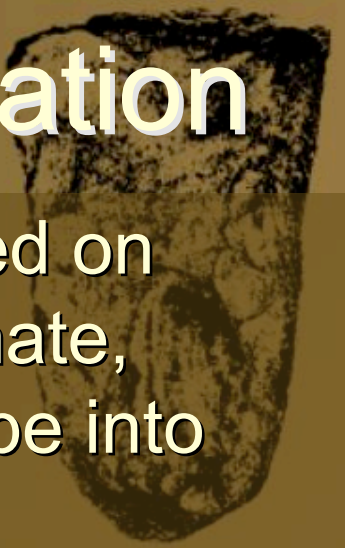


Pastoral Catchment Results



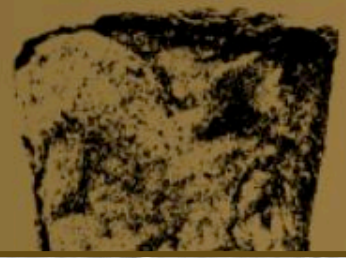


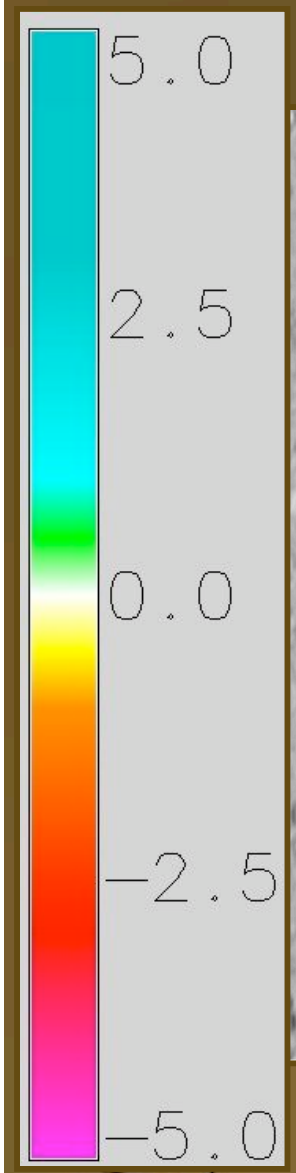
Surface Process Simulation

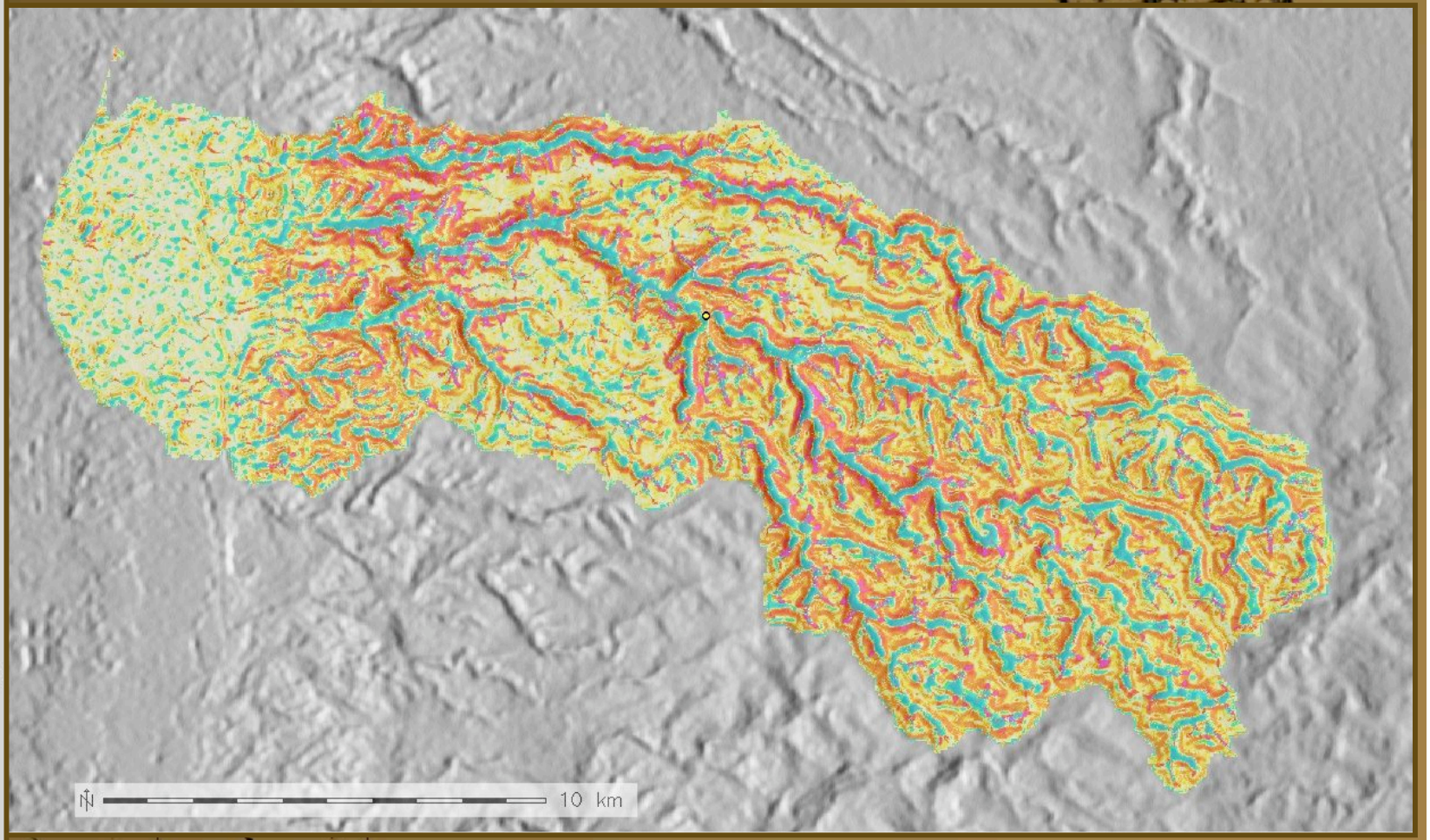


- Dynamic cellular automata model based on USPED equations that take yearly climate, yearly landcover, soil type, and flow type into account
- Use precipitation maps for the PPNB and LN retrodicted from modern weather station data
- Use landcover maps produced by our other simulation
- Tracks soil production, soil depth, bedrock elevations, erosion/deposition, and surface elevation at each pixel

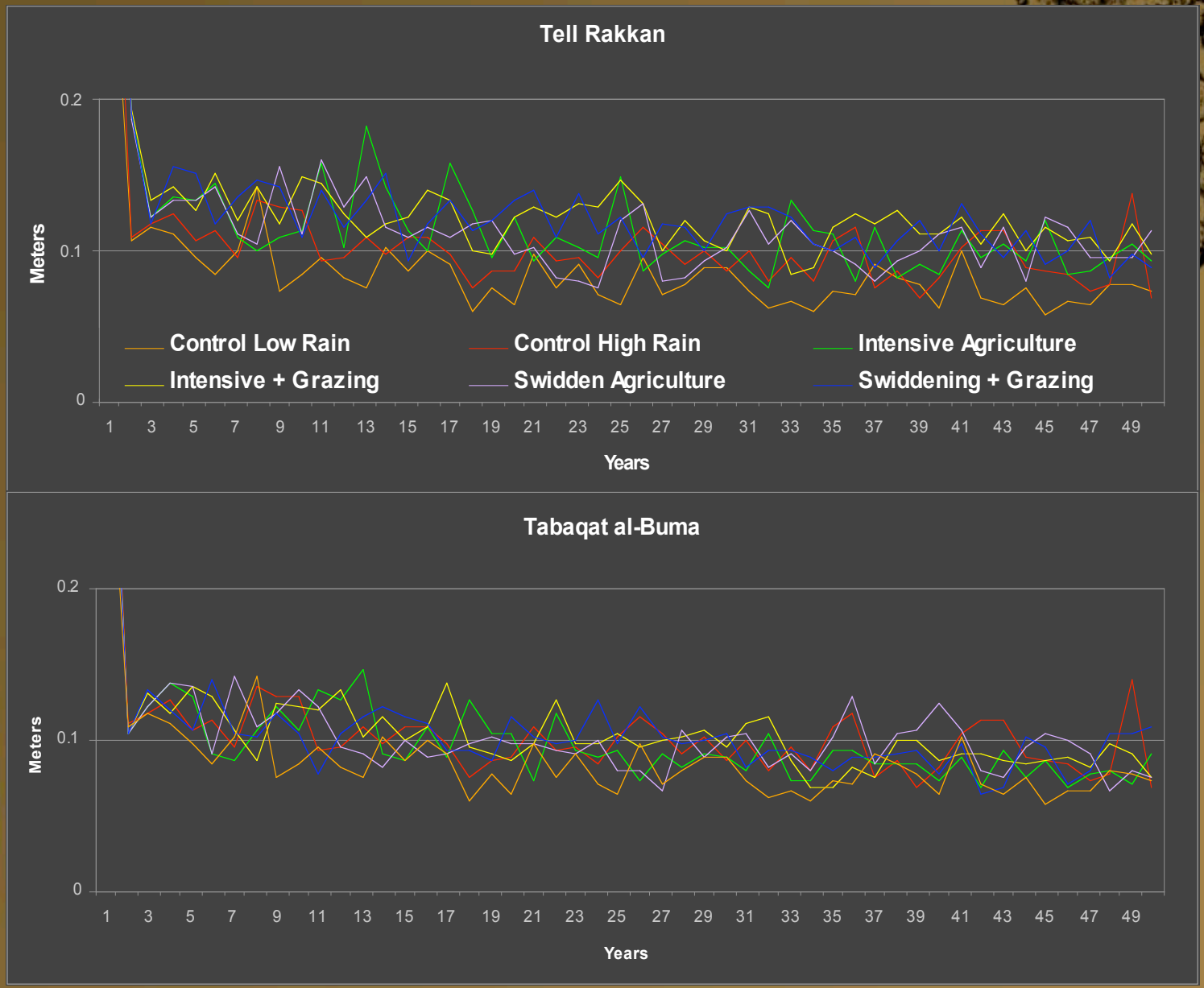
Model Results





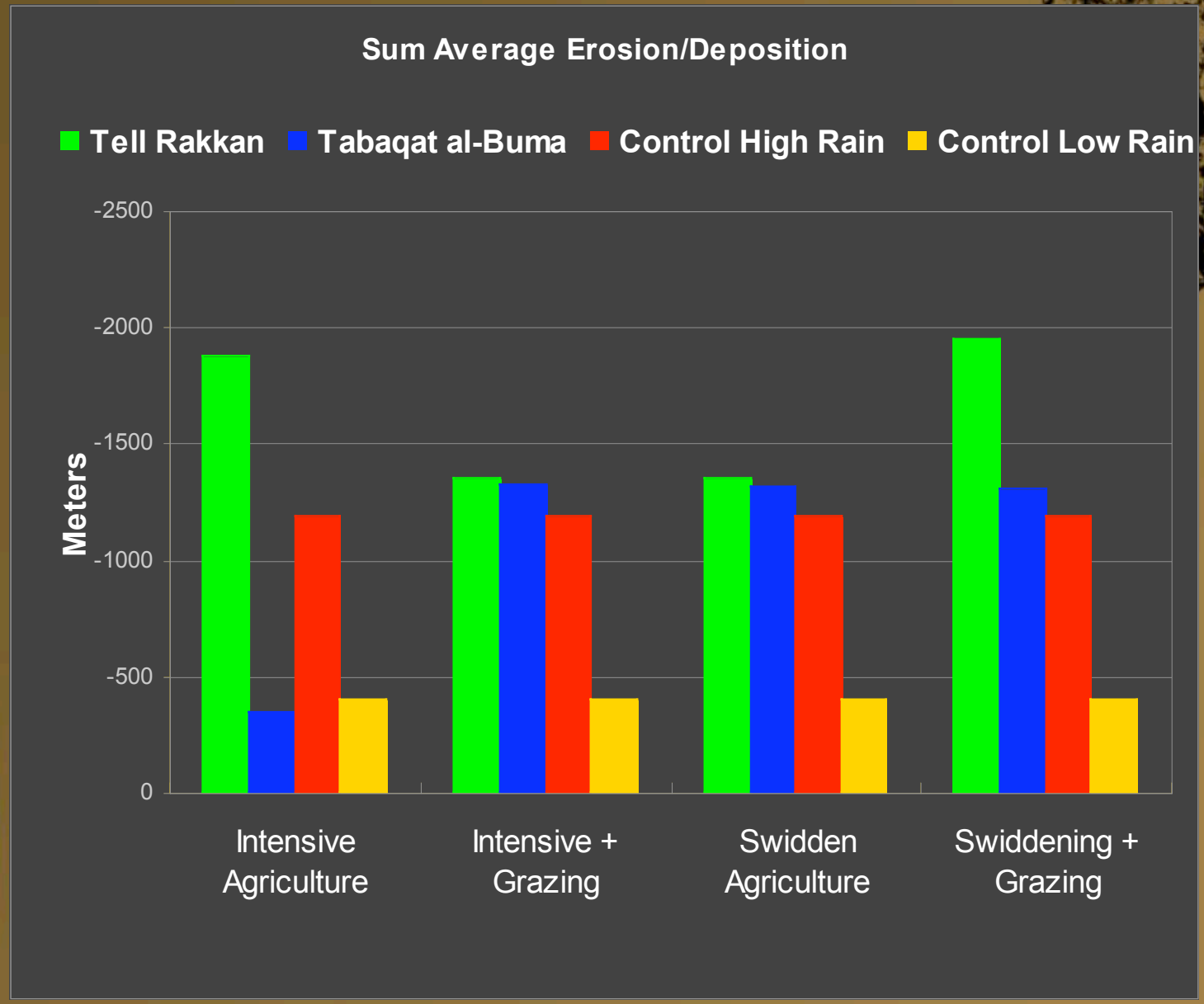


Average Deposition

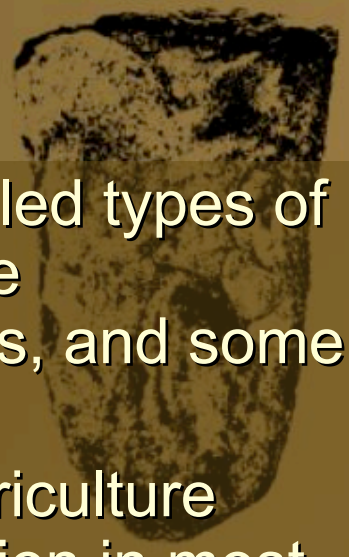


Average Erosion

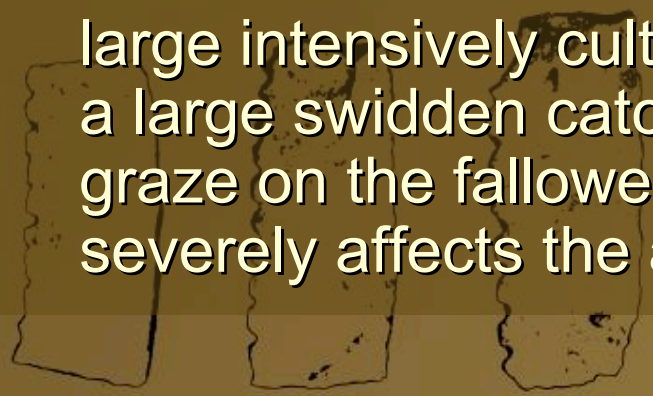
Surface Processes Summary



Conclusions

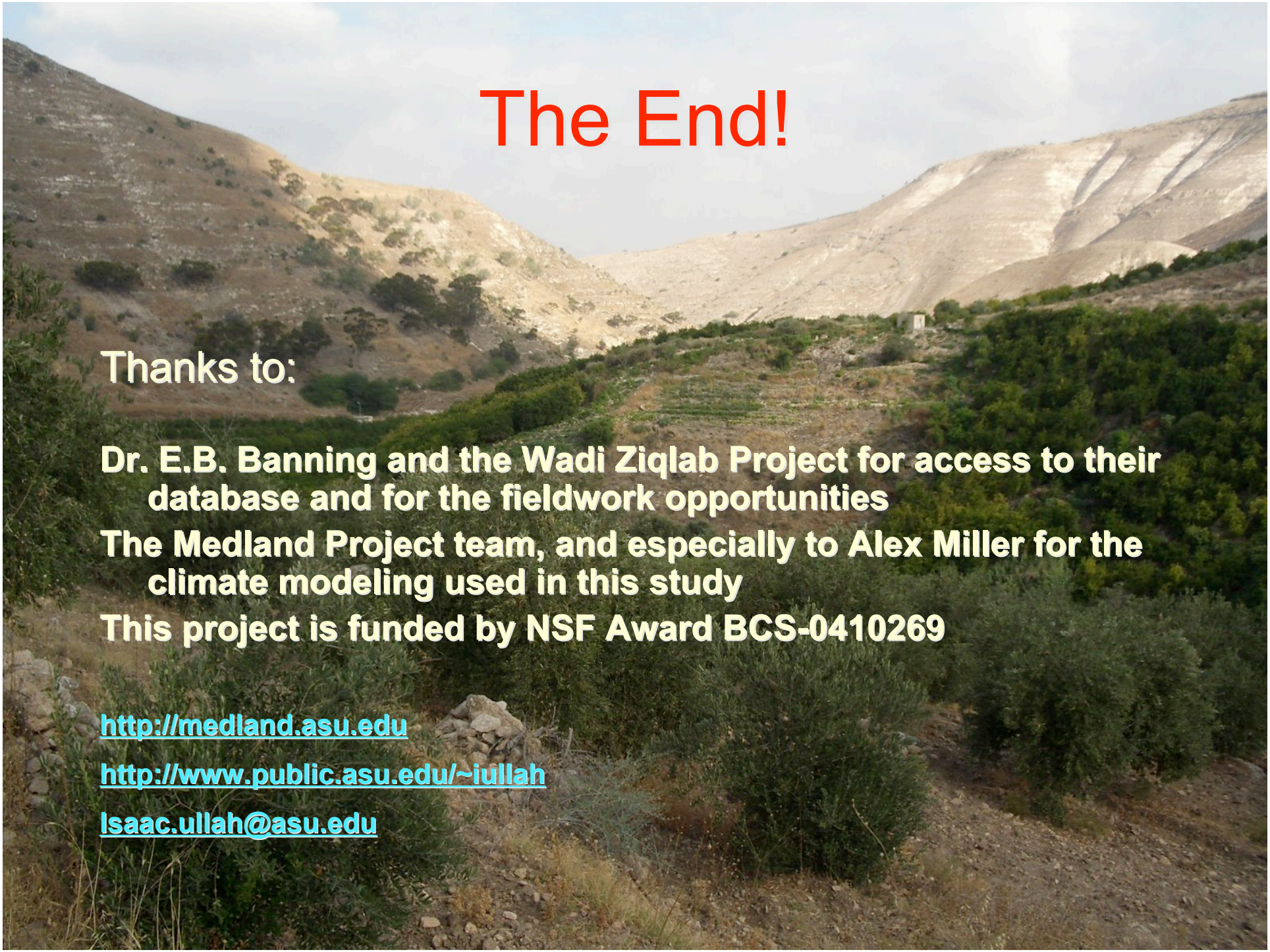


- We have demonstrated that while all the modeled types of ancient landuse practices had an impact on the environment, some had less impact than others, and some had other, unexpected results.
- Specifically, the addition of herd keeping to agriculture significantly increases environmental degradation in most cases, but in certain cases may actually help depress erosion by increasing the diversity of vegetation in the entire catchment.
- Also, it seems that a small intensively cultivated catchment has less effect than a small swidden catchment, but that a large intensively cultivated catchment has more effect than a large swidden catchment, and allowing herd animals to graze on the fallowed portions of the swidden catchment severely affects the ability of those areas to recover.



Conclusions

- It seems that the larger catchment of Tell Rakkan coupled with the wetter climate of the PPNB could have created intensive localized environmental degradation under some landuse scenarios, and it seems that the change from villages to dispersed small farmsteads across the PPNB-Late Neolithic transition would have been a viable mitigating response to those conditions, and could be seen as a way for people to remain in a degraded area without drastically changing their economy.
- Finally, it seems that this type of computer-based modeling not only offers an intriguing new way to assess the validity of various archaeologically based landuse models for prehistoric sites, but also allows us to gain insights into aspects of that ancient human landuse that are not readily apparent from the archaeological record.



The End!

Thanks to:

Dr. E.B. Banning and the Wadi Ziqlab Project for access to their database and for the fieldwork opportunities

The Medland Project team, and especially to Alex Miller for the climate modeling used in this study

This project is funded by NSF Award BCS-0410269

http://medland.asu.edu

http://www.public.asu.edu/~iullah

Isaac.ullah@asu.edu