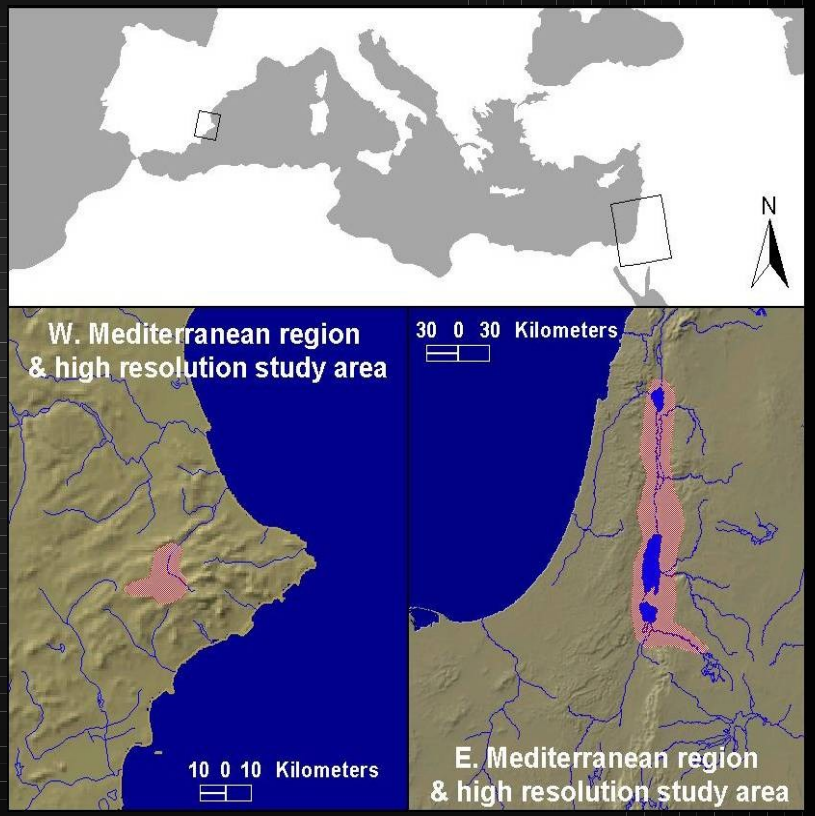
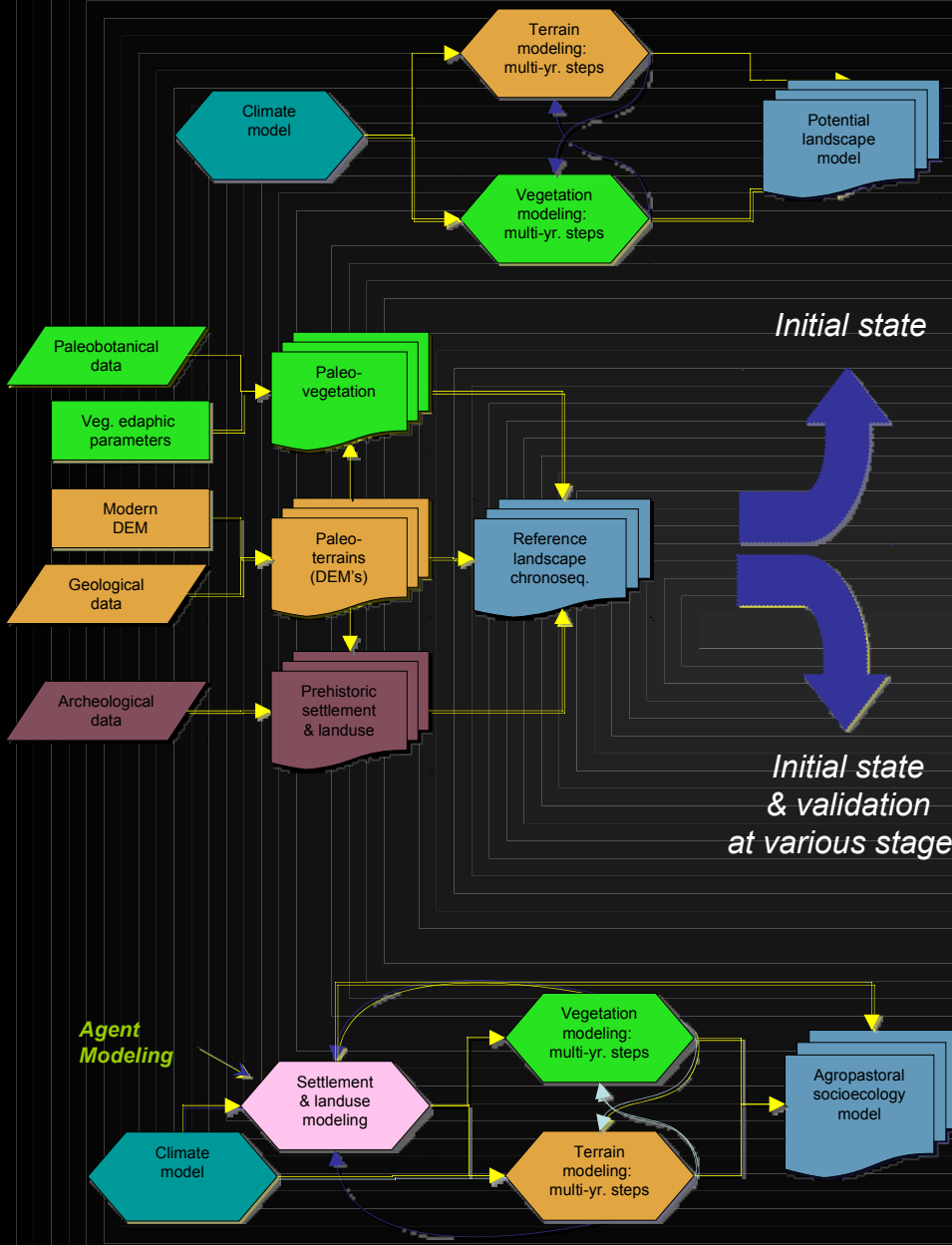
Mediterranean Landscape Dynamics Project

- 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



Modeling Ancient Human Impacts

- What affect, if any did ancient human landuse have on the environment?
  - Little direct archaeological evidence of human impacts on the environment
  - Even less direct evidence of the *processes* that created anthropogenic landscapes
- We must simulate ancient landuse through spatially explicit process-based models
  - Human processes (farming, herding, deforestation)
  - Natural processes (climate, vegetation, geological)

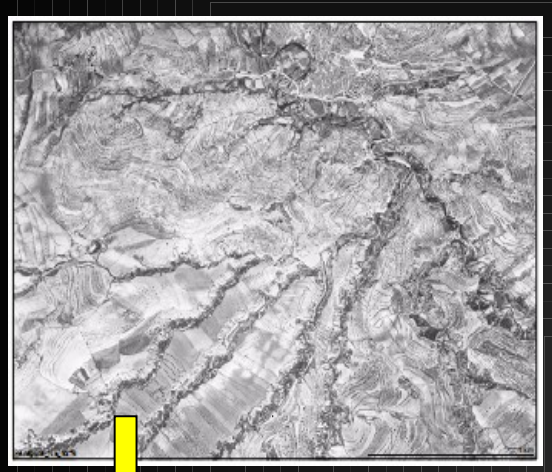


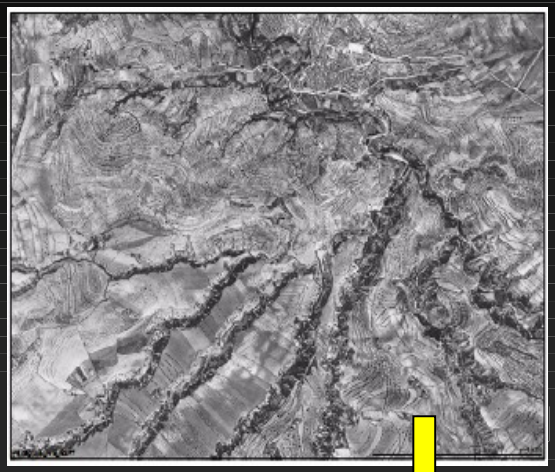
1. Potential landscape model (natural processes only—no human impacts!))

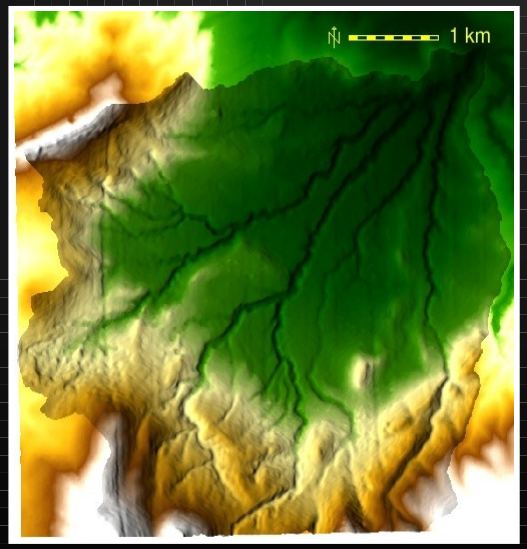
2. Reference landscape time series (Paleolandscape reconstruction, archaeological data, paleoenvironmental data)

3. Agropastoral socioecology model (Semi-Stochastic and Agent-based human landuse models coupled with natural process models)

Topography

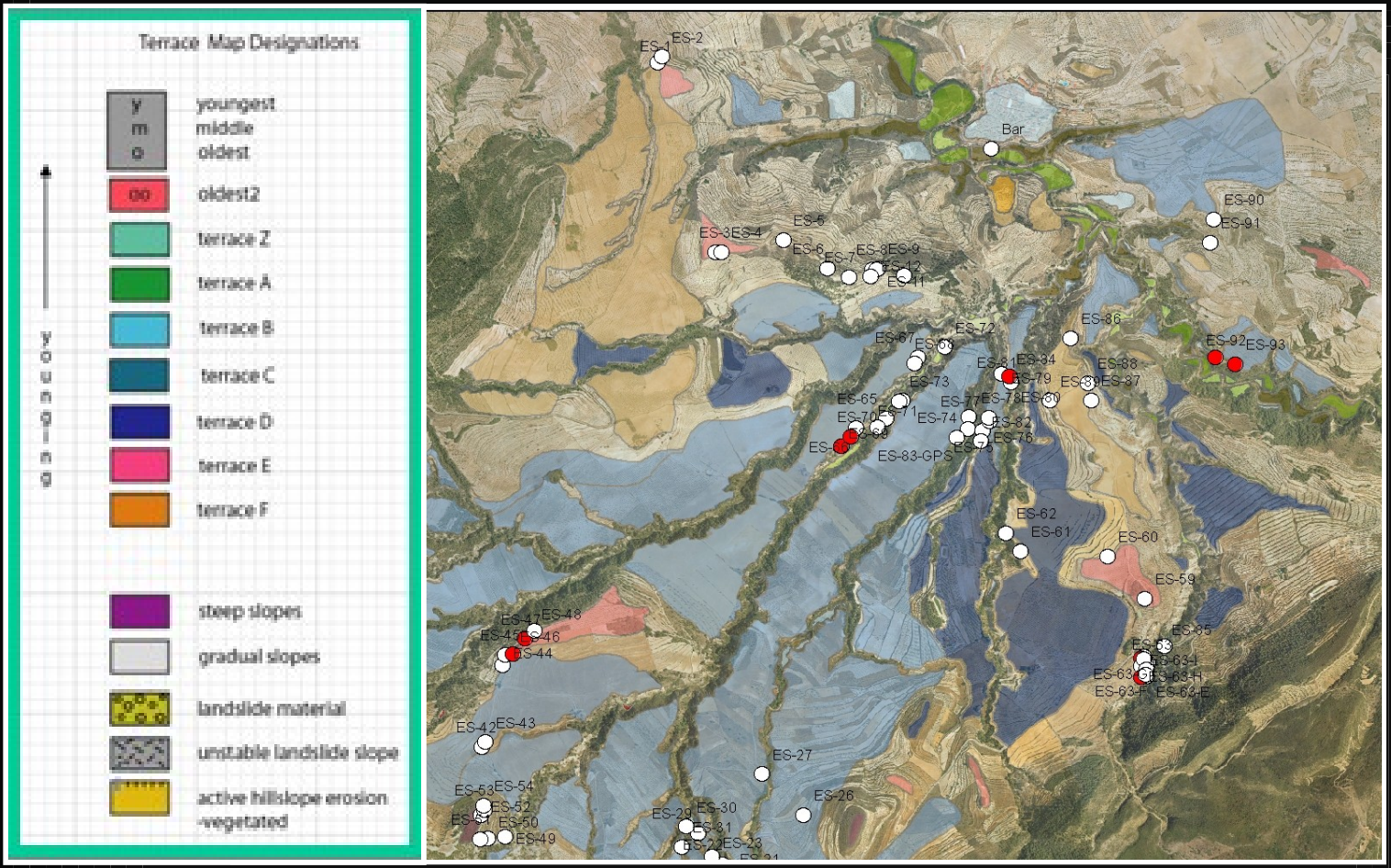




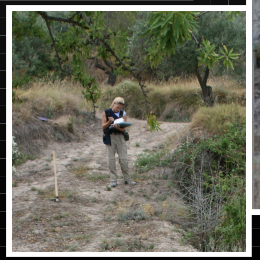


- Stereo aerial photos
- Point elevation extraction
- High-resolution (5m) DEM interpolation
- Study areas defined as watersheds using hydrologic modeling

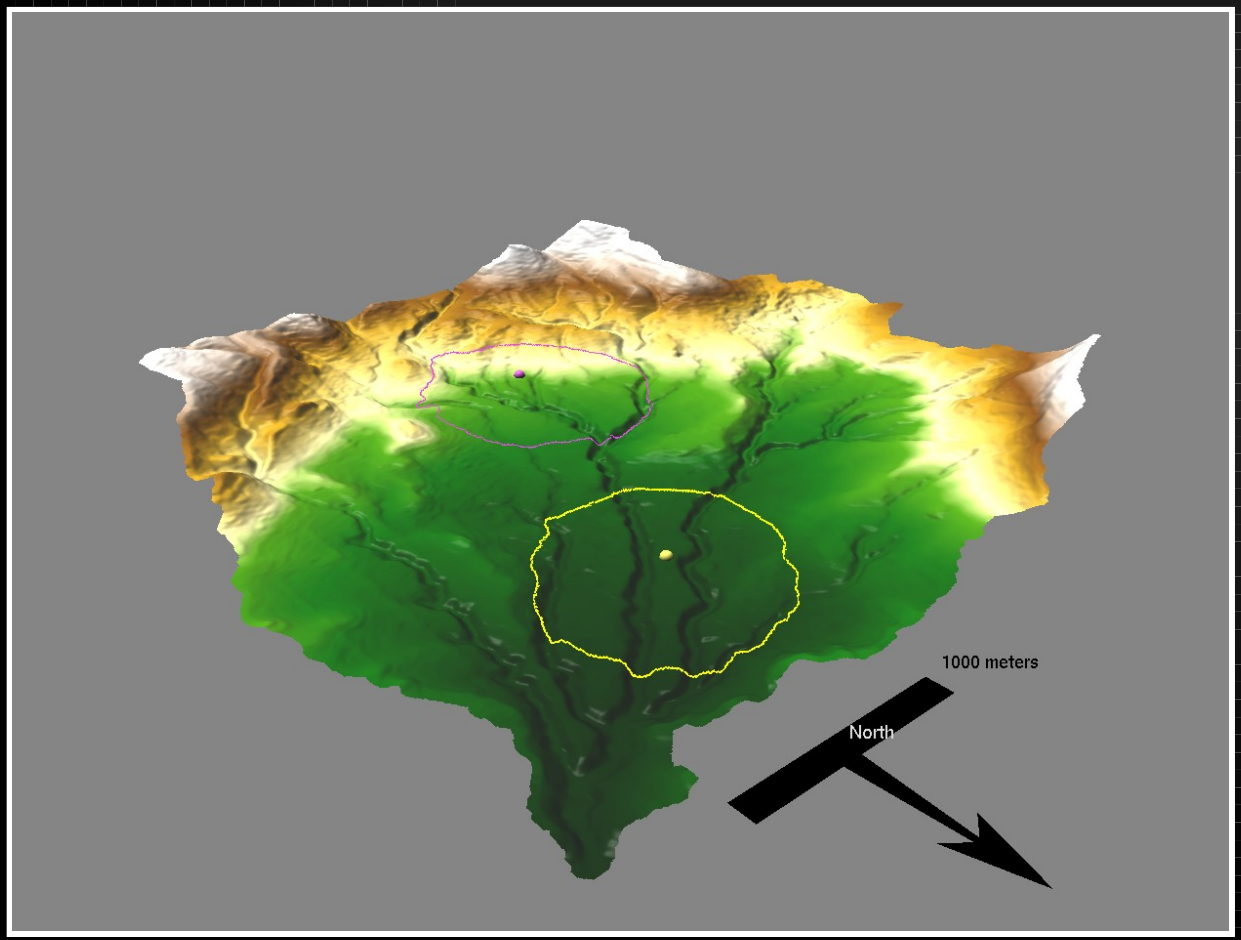
Terrace Mapping



- Geomorphic mapping
- Terrace sequence identification
- Field ground truthing
- OSL dating of sediments



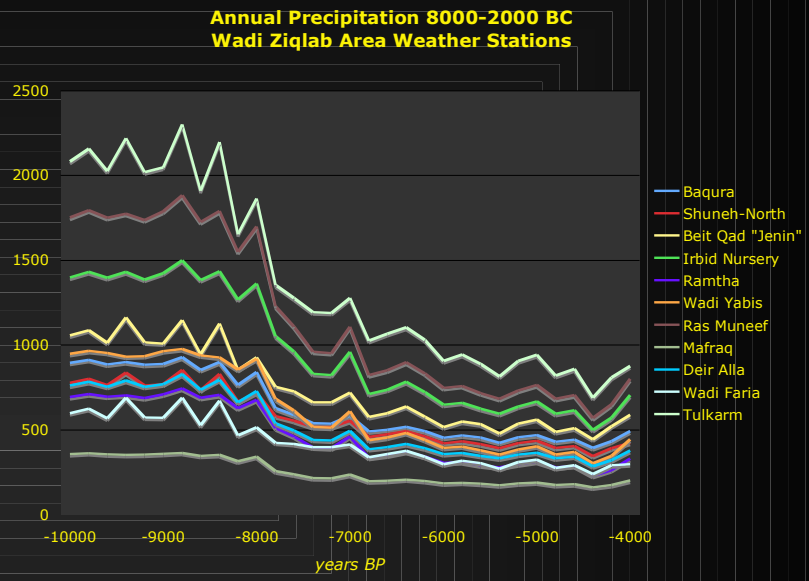
Topography: Paleolandscape reconstruction

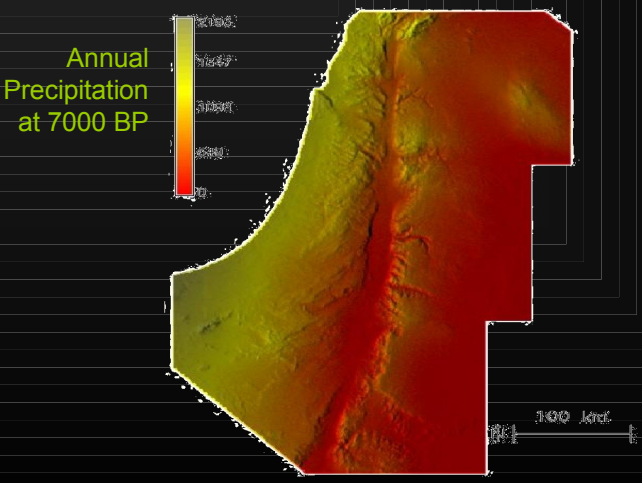


- Keep older surface remnants
- Remove all younger surfaces
- Interpolate elevations in removed areas from elevations of adjacent paleosurfaces

Paleoclimatological Modeling

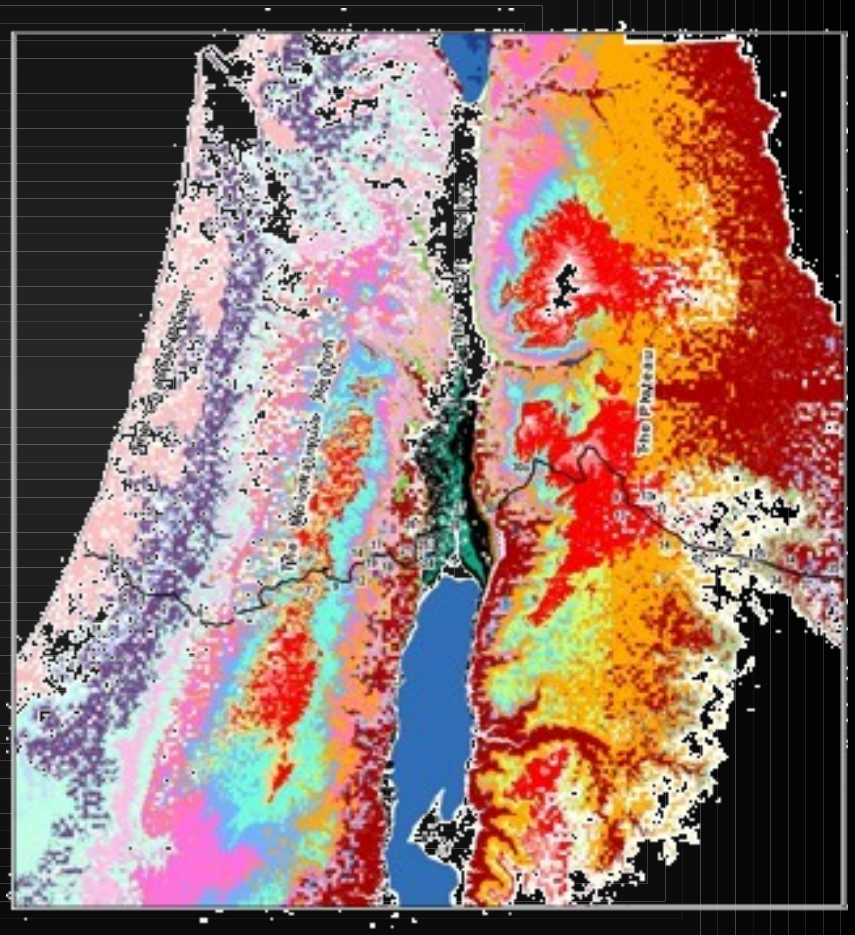
- Weather station data retrodicted for 14ky at 200 yr intervals to produce sequences for annual and monthly precipitation, temperature (mean, days>40°, days <0°), and storms.
- Monthly and annual climate sequence models interpolated to create paleoprecipitation surfaces using multiple regression (topograpy, distance from sea, latitude, etc)





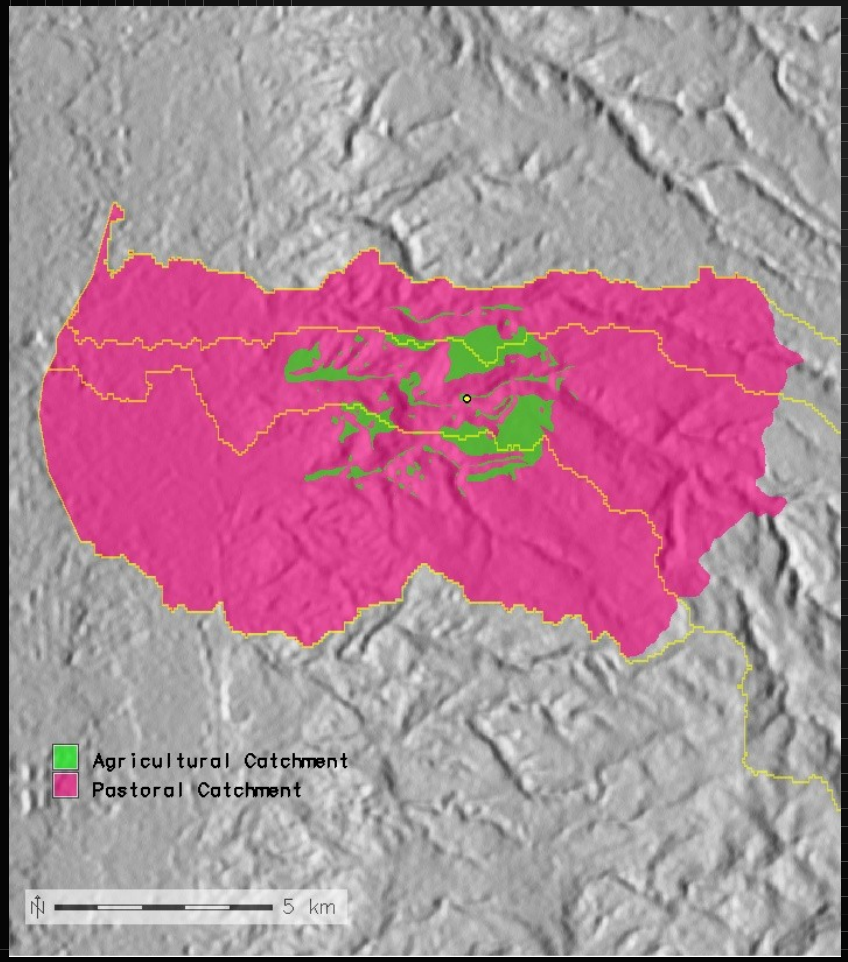
Landcover Modeling

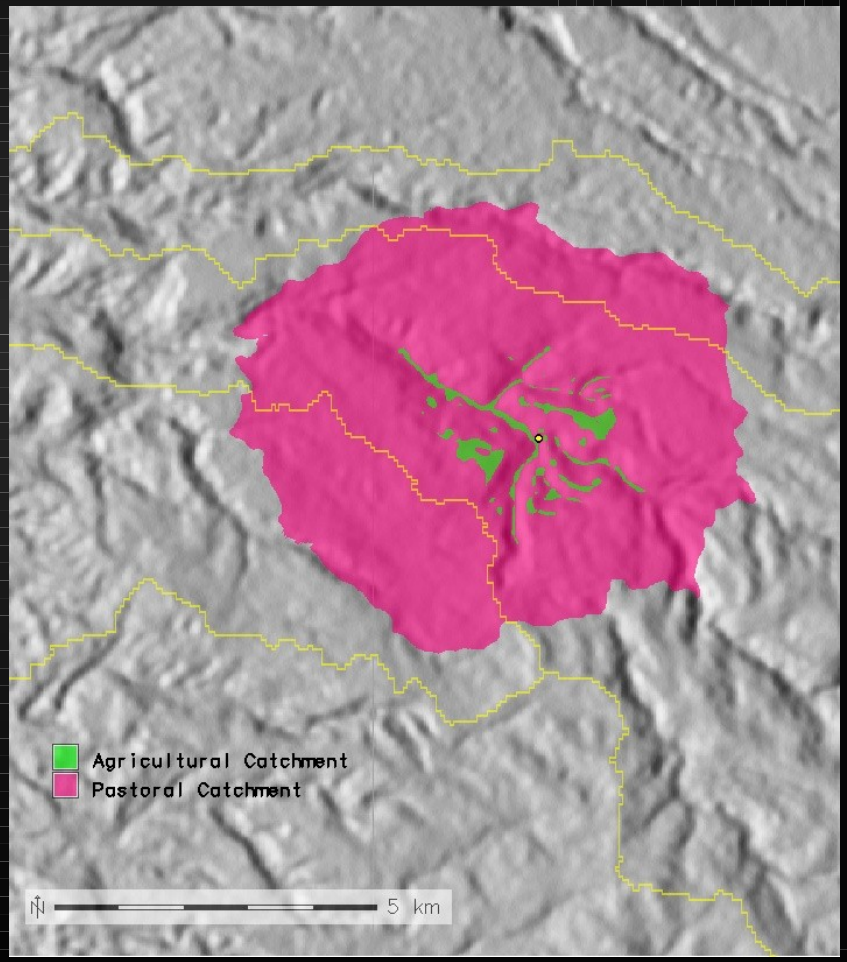
- Potential natural vegetation model based on phytogeography (climatic/topographic variables)
- Human Landuse affects natural vegetation by reduction (grazing, burning) or replacement (farming)
- Vegetation regrowth models incorporate successional dynamics



Human Landuse Modeling

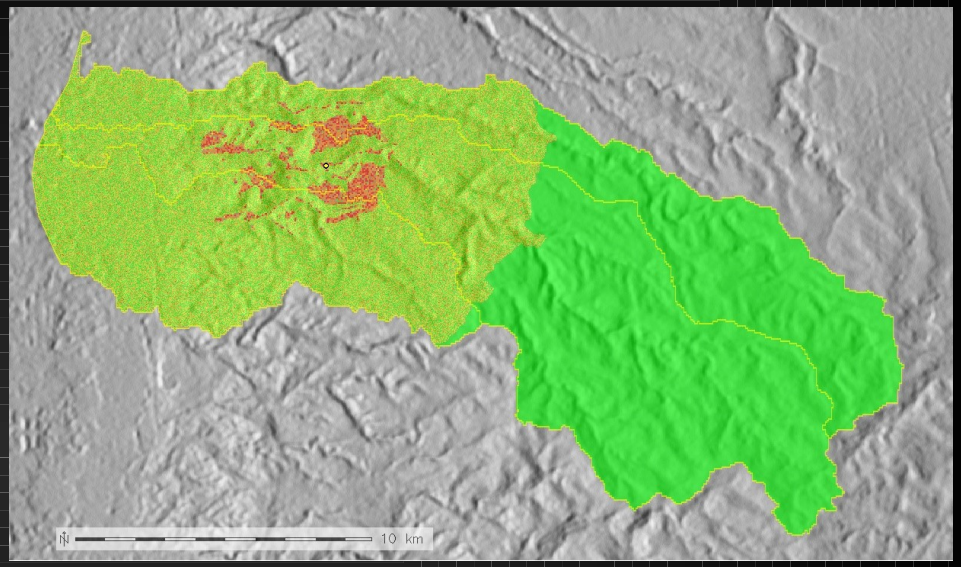
Catchment modeling

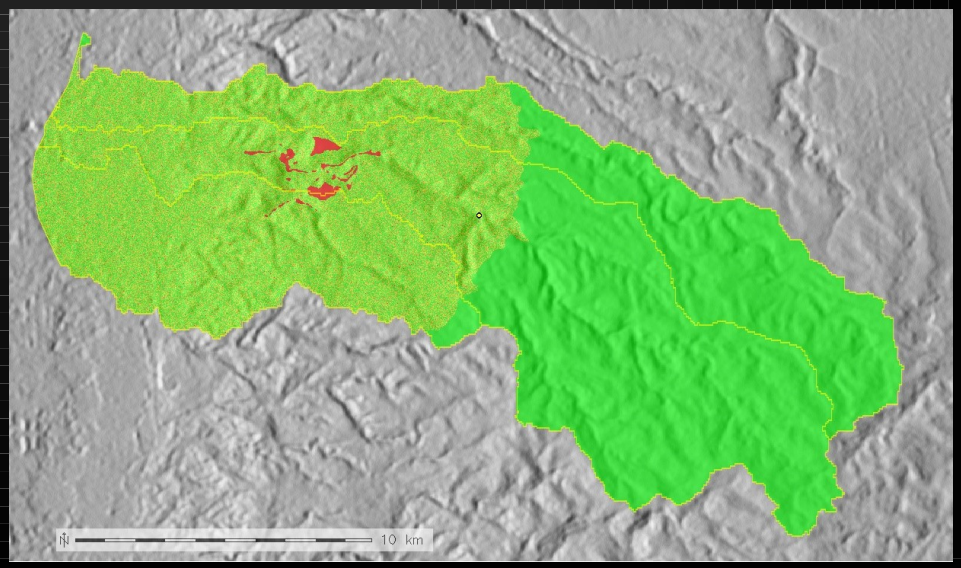




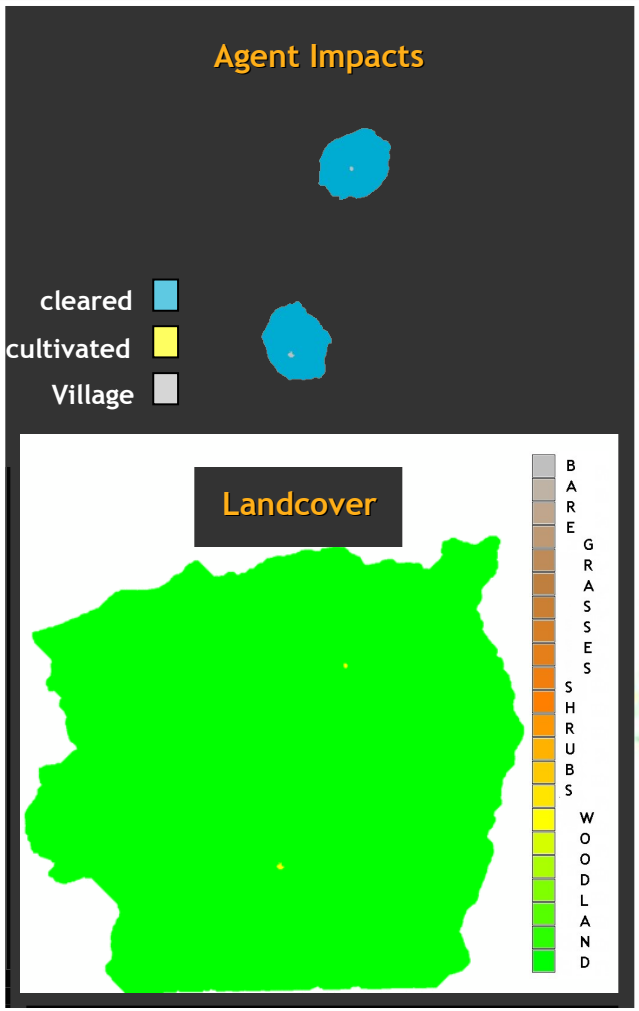
Stochastic Landuse models

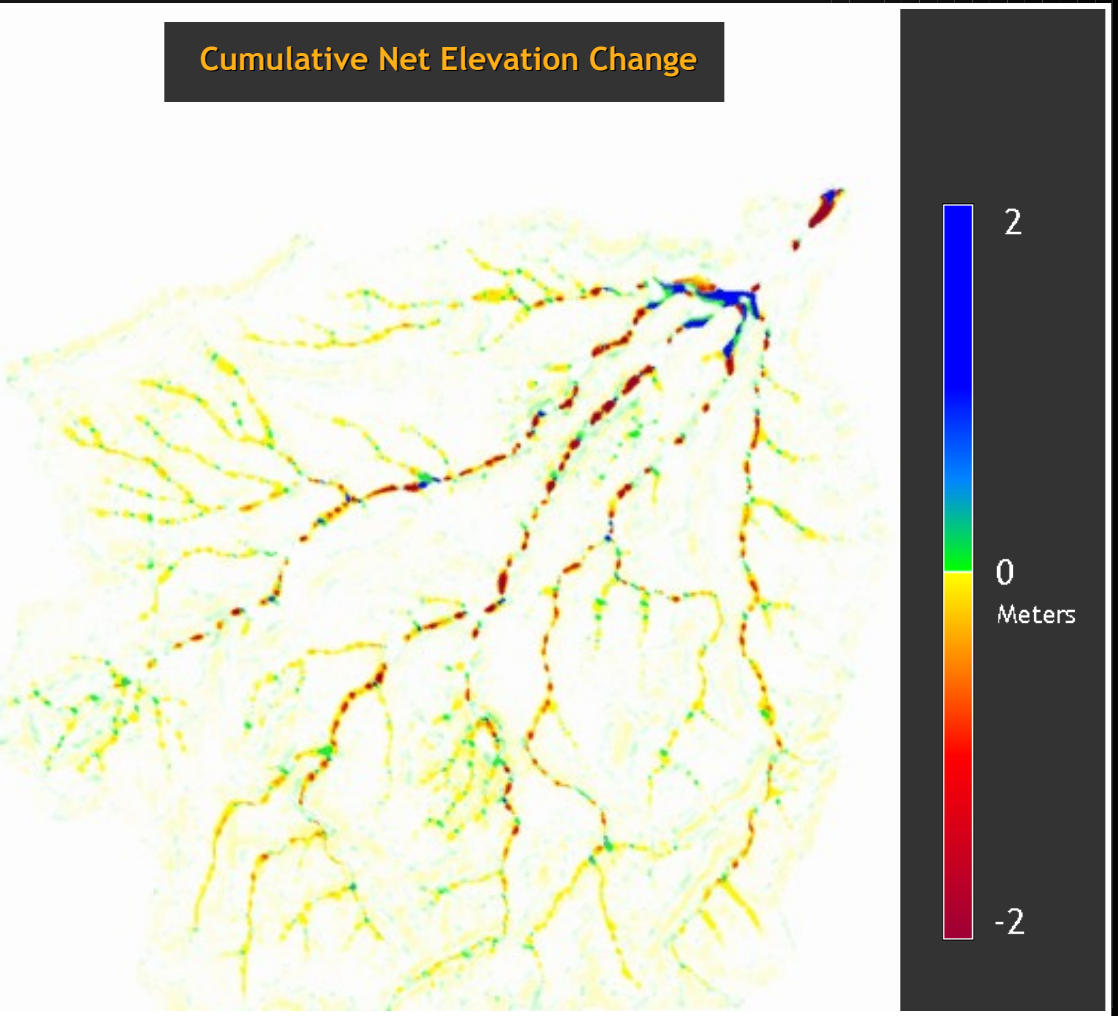
0) bare land
1) sparsely covered land
2) actively cultivated field
3) moderate grassland
4) grassland
5) grass and sparse shrubs
6) grass and shrubs
7) mainly shrubs
8) developing maquis
9) moderate maquis
10) maquis
11) moderately dense maquis
12) dense maquis
13) maquis and small trees
14) young woodland and maquis
15) mostly young open woodland
16) young open woodland
17) moderate open woodland
18) maturing and moderate open woodland
19) maturing open woodland
20) mostly matured open woodland
21) fully matured woodland



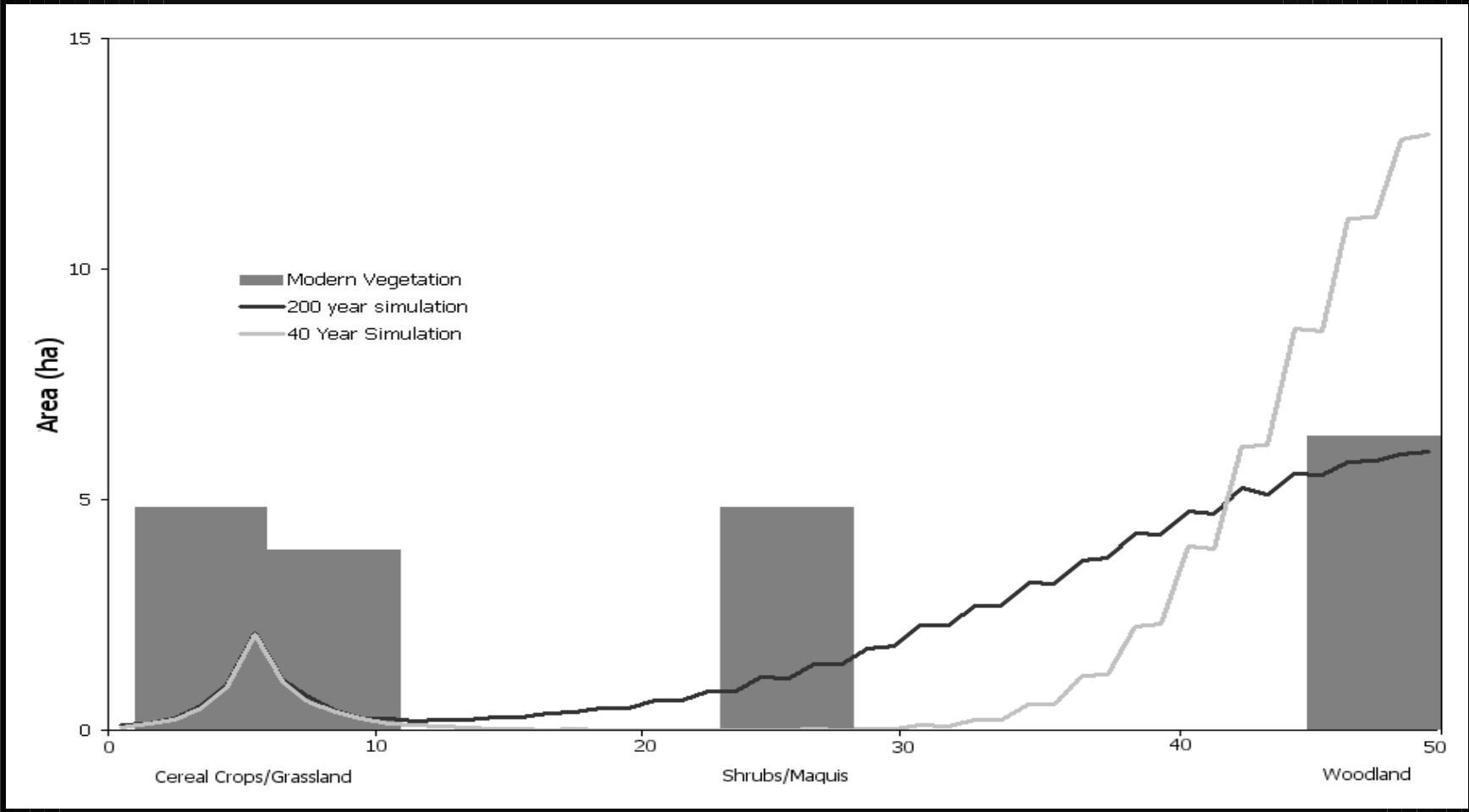


Multi-agent Simulation





Resultant Vegetation Profiles



Grass **Shrubs/Maquis** **Woodland**

Erosion/Deposition Modeling

Options | Output

-r Calcuate for predominantly rill erosion instead of sheet erosion

-n Output a map of the net erosion deposition as well

-k Keep all intermediate files as well

-z Keep region zoomed to output maps

Input elevation map (DEM):

Prefix for all output maps:

usped

Rainfall (R factor) map prefixes (leave off years):

Soil erodability index (K factor) map or constant:

0.32

Landcover index (C factor) map prefixes (leave off years):

Band-pass filter neighborhood size:

3

Band-pass filter threshold value, sigma (meters):

0.10

Neighborhood smoothing method:

median

Iteration Time Step (integer years):

200

Maximum Time Step (oldest year):

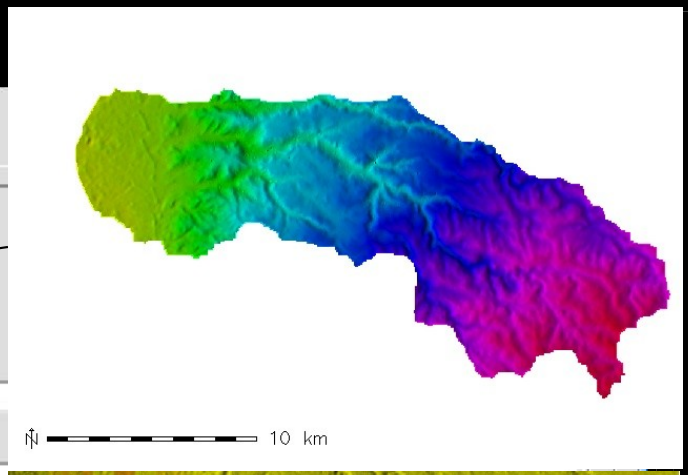
14000

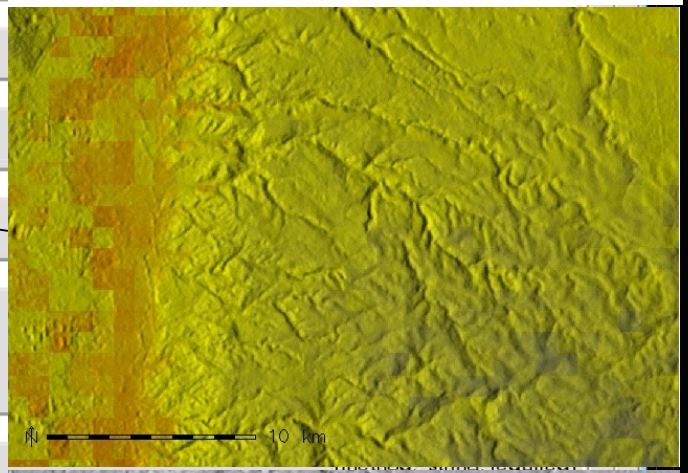
Minimum Time Step (youngest year):

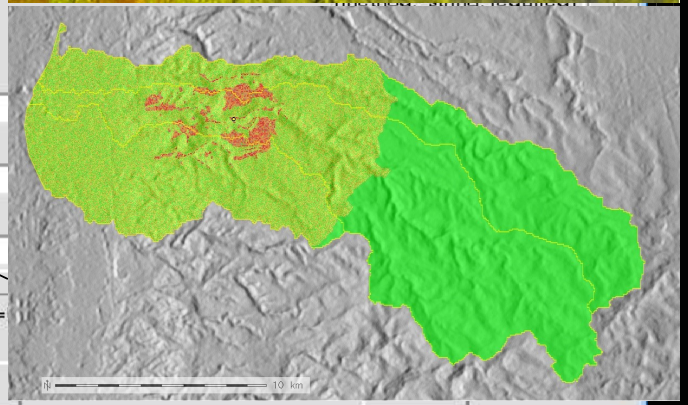
0

r.usped.itr.devl prefx=usped K=0.32 nbhood=3 sigma=0.10 method=median number=200 maxyrs=14000 minyrs=

Run | Help | Clear

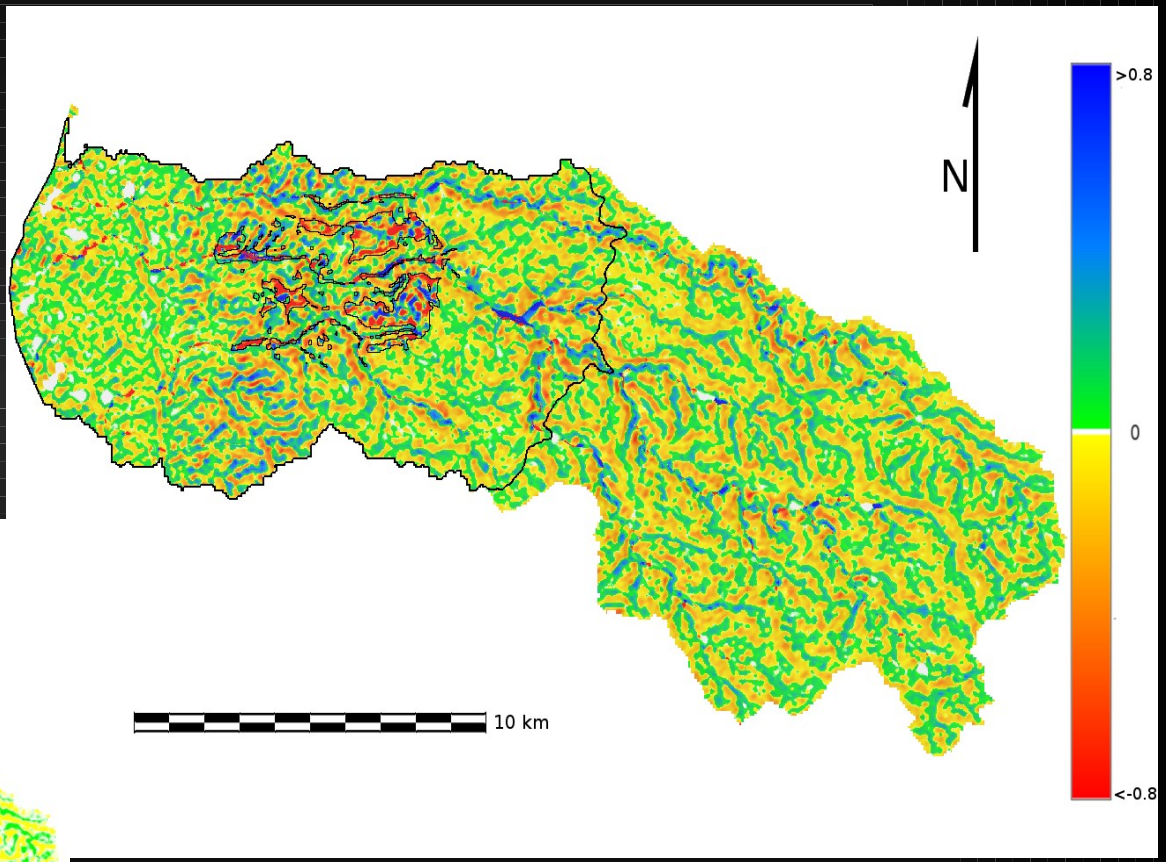


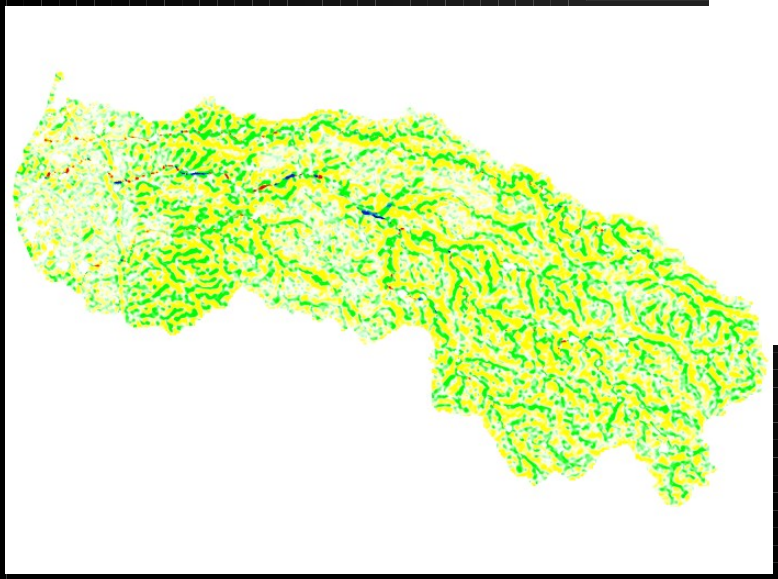




Model the effect of the resulting landcover on erosion

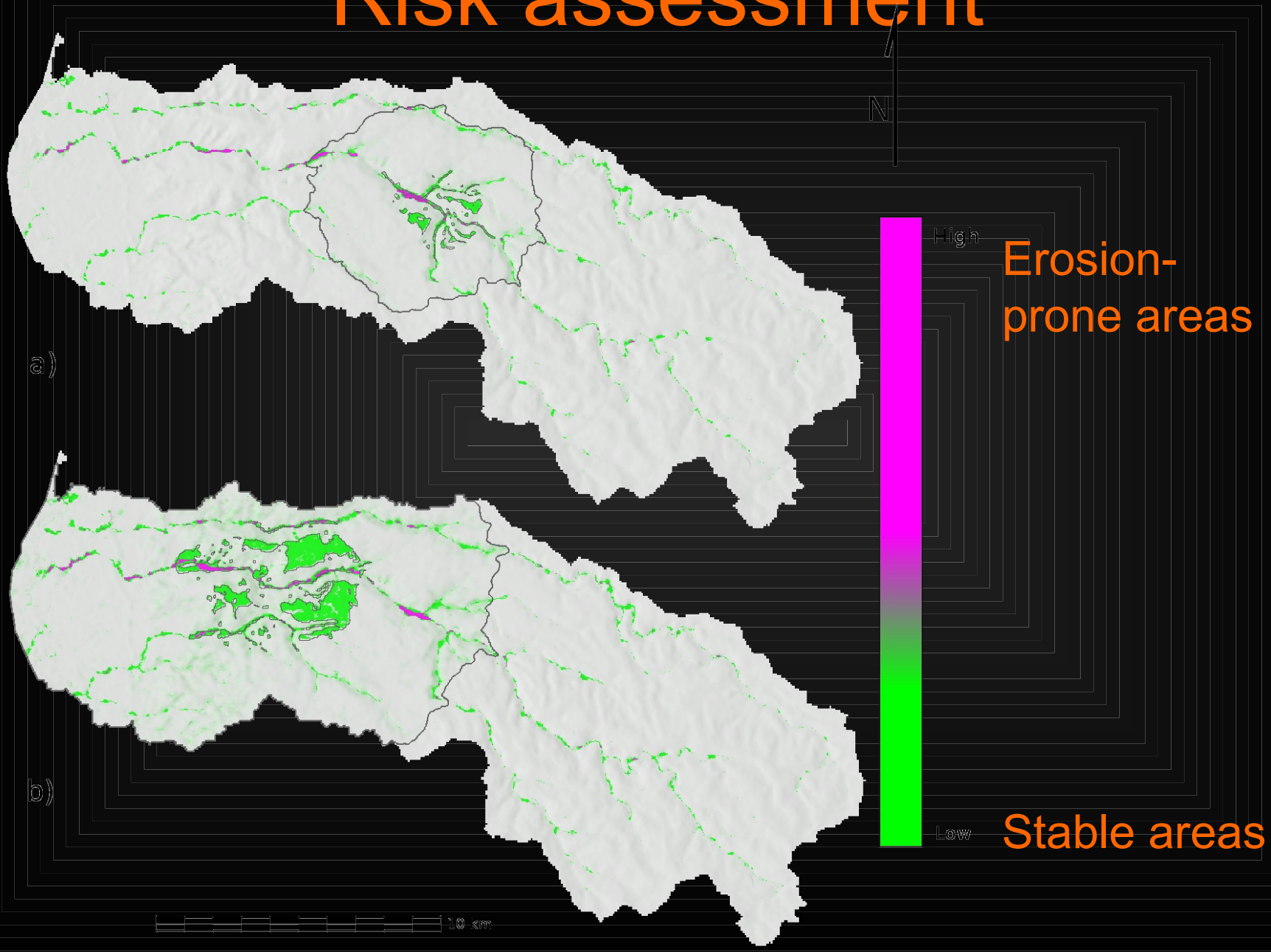
40 years of fallow agriculture with grazing





Control Model (no landuse)

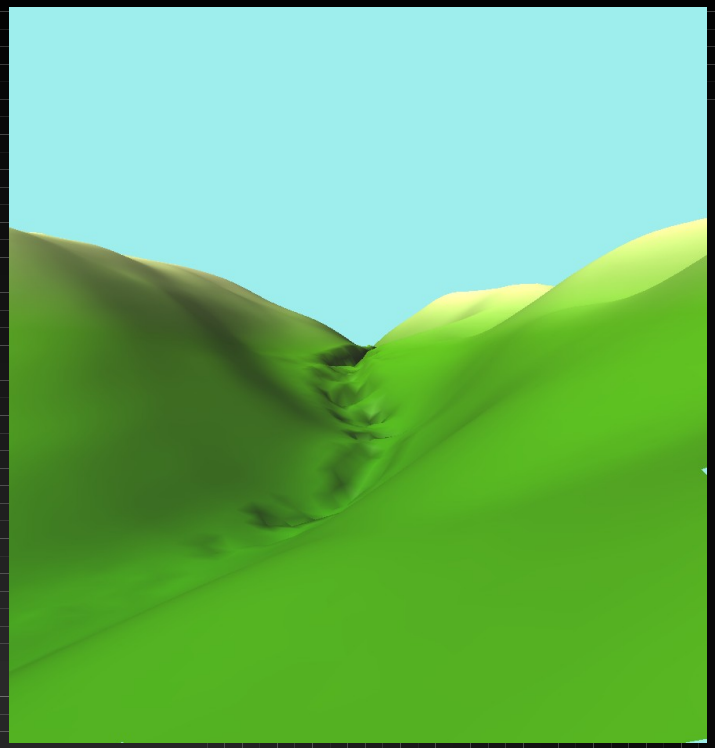
Risk assessment



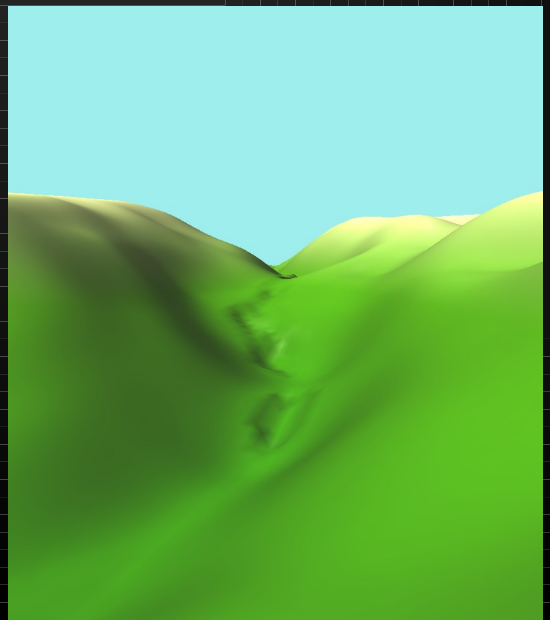
Erosion-prone areas

Stable areas

3-D results with human landuse



Reality Check. There IS a deep canyon in this location!!!



Control model (no human landuse)