Modeling Impacts of Landuse Practices on Mediterranean Landscapes

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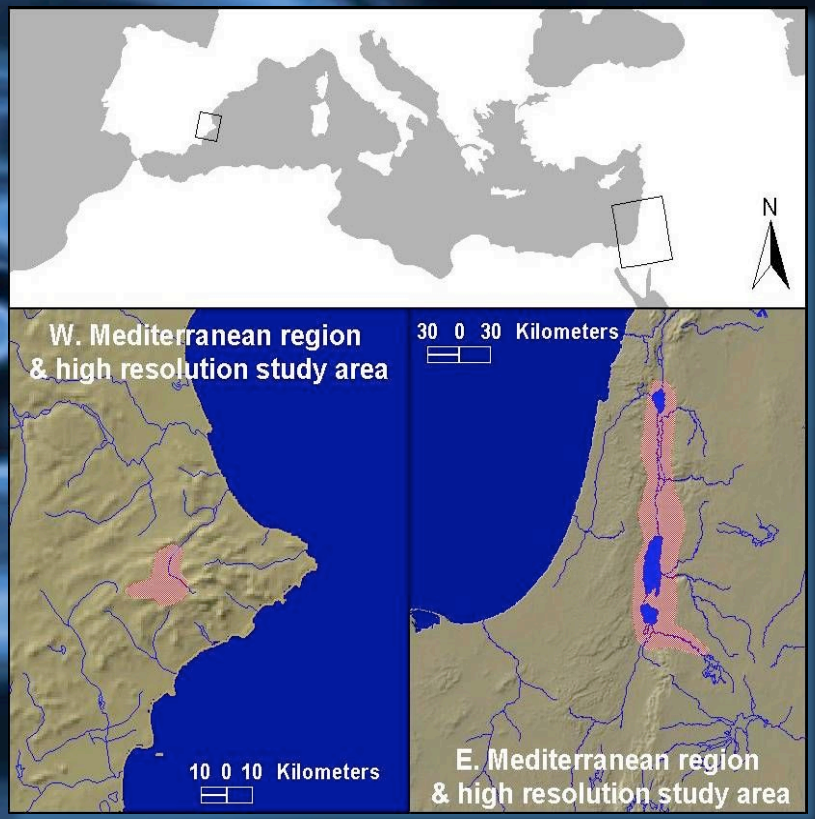
- Mediterranean Landscape Dynamics project
- NSF ERE Biocomplexity in the Environment Program, grant BCS-0410269
- Develop a modeling laboratory for the long-term recursive dynamics of agropastoral landuse and landscape change



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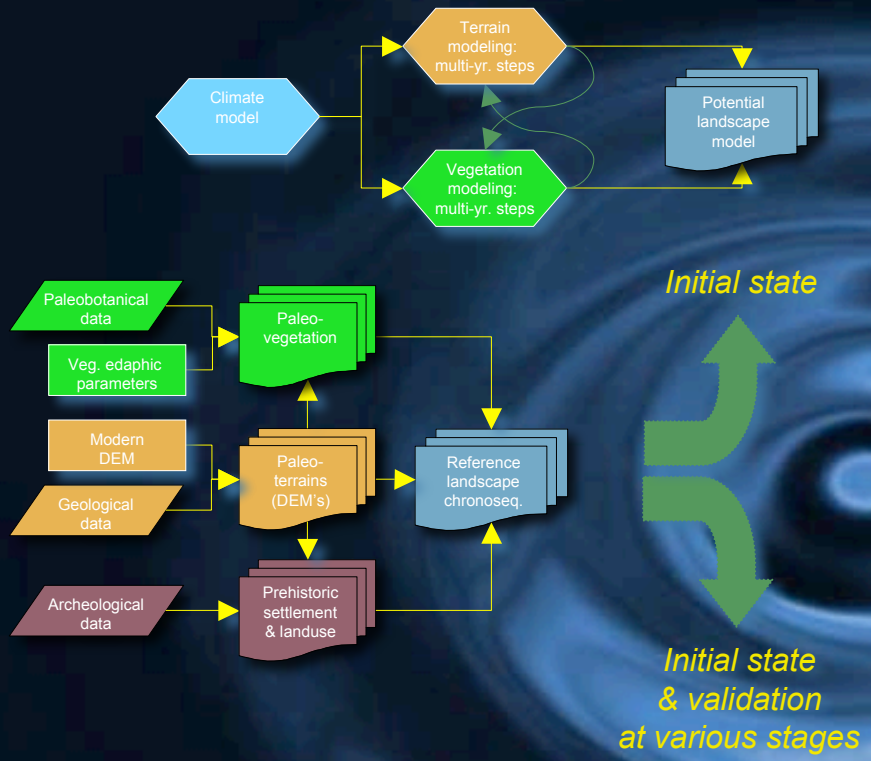
Modeling Laboratory



- 3 interlinked modeling environments
  - Potential landscape model
  - Reference landscape chronosequence
  - Agropastoral socioecology model

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Surface Process Dynamics

- Landcover
- Topography
- Soils
- Climate
- Landuse

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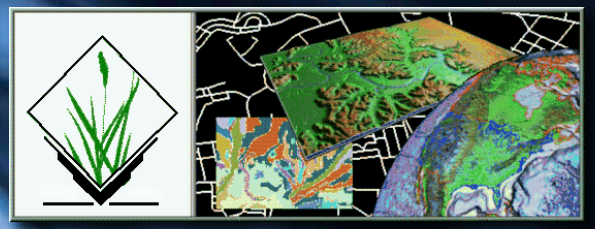
Modeling Overview

- Modeling environment built in GRASS
  - Geographic Resource Analysis Support System
- USPED
  - Unit Stream Power Erosion/ Deposition
  - $ED = d(T \times \cos a)/dx + d(T \times \sin a)/dy$
    - *ED* is net erosion or deposition of sediment
    - *a* is topographic aspect
    - *T* (sediment transport) is RUSLE value
    - $T = R \times K \times LS \times C \times P$
    - where …
      - R is the rainfall intensity factor,
      - K is the soil factor,
      - LS is the topographic (length-slope) factor,
      - C is the vegetation/landcover factor
      - P is the prevention practices factor.

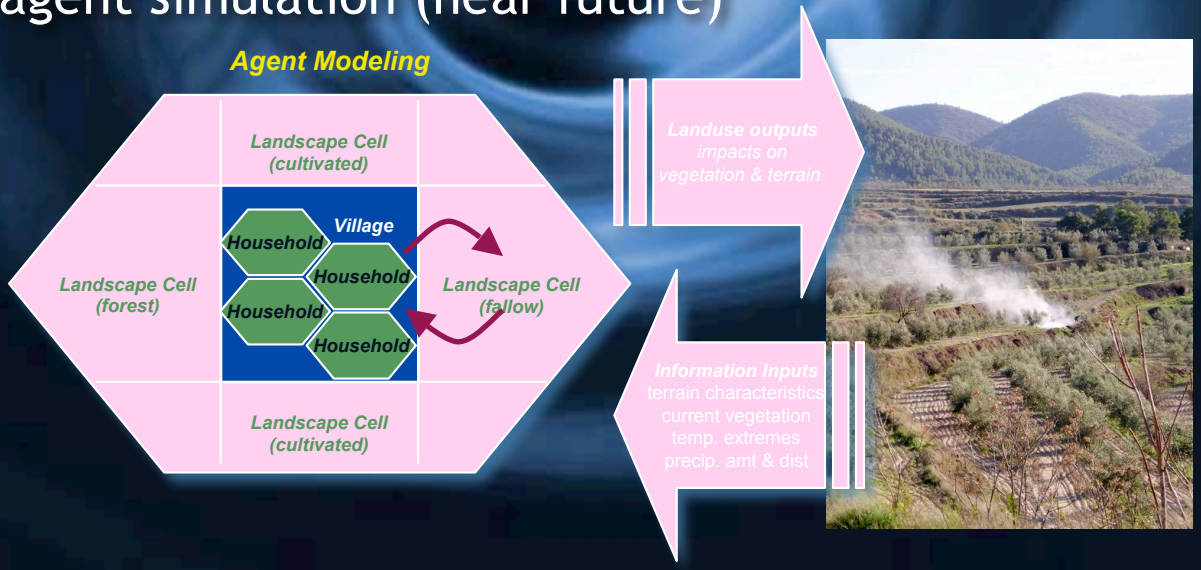


Modeling Inputs

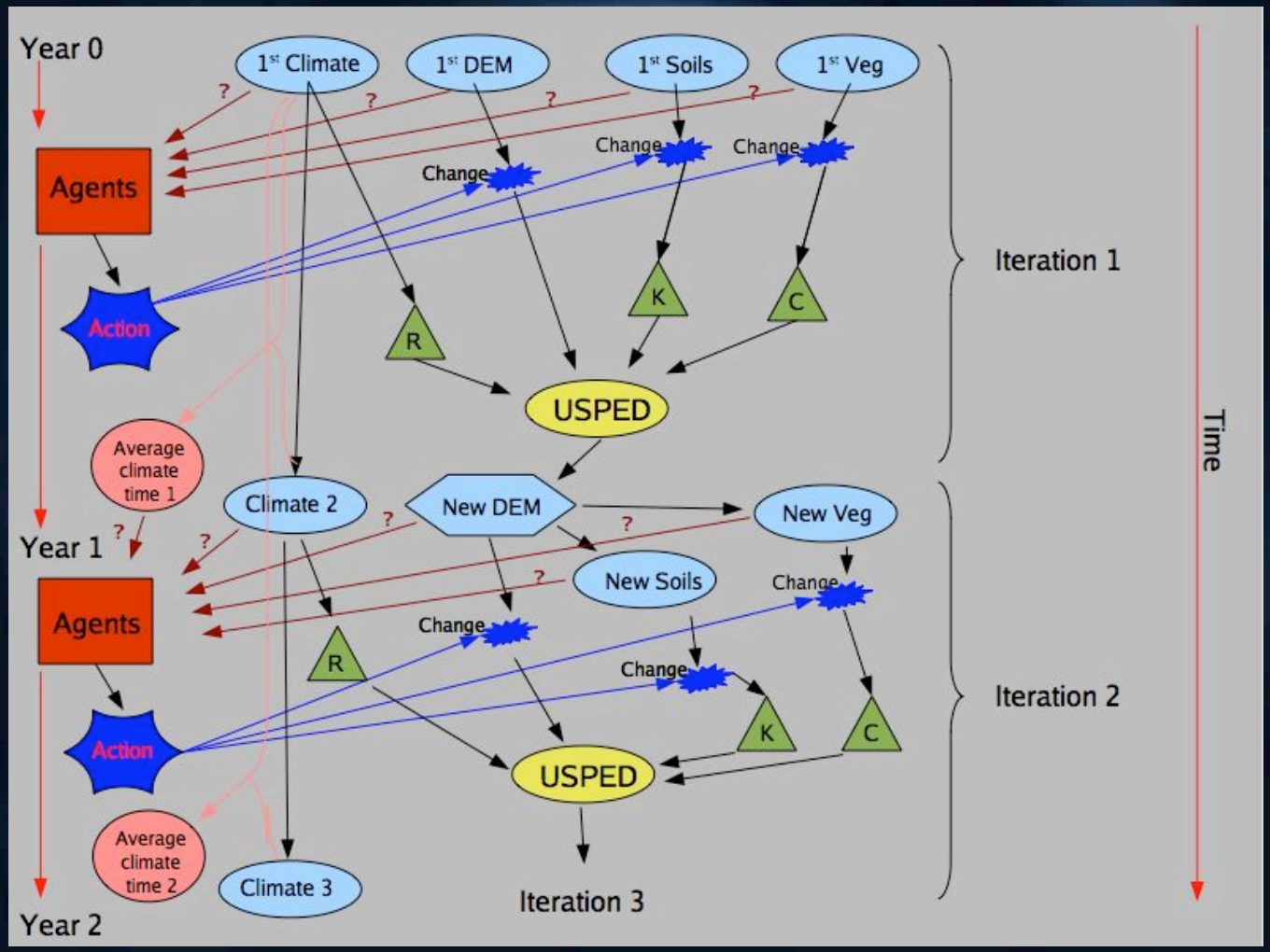
- Human landuse
- Topography
- Rainfall intensity (R-Factor)
- Landcover and erodability (C-Factor)
- Soil and erodability (K-Factor)

Landuse Modeling

- Model components
  - Growing agricultural catchments
  - Shifting and non-shifting cultivation
  - Grazing catchment
  - USPED calculation
  - Iterated to simulate cumulative change
- Multi-agent simulation (near future)



Landuse Modeling



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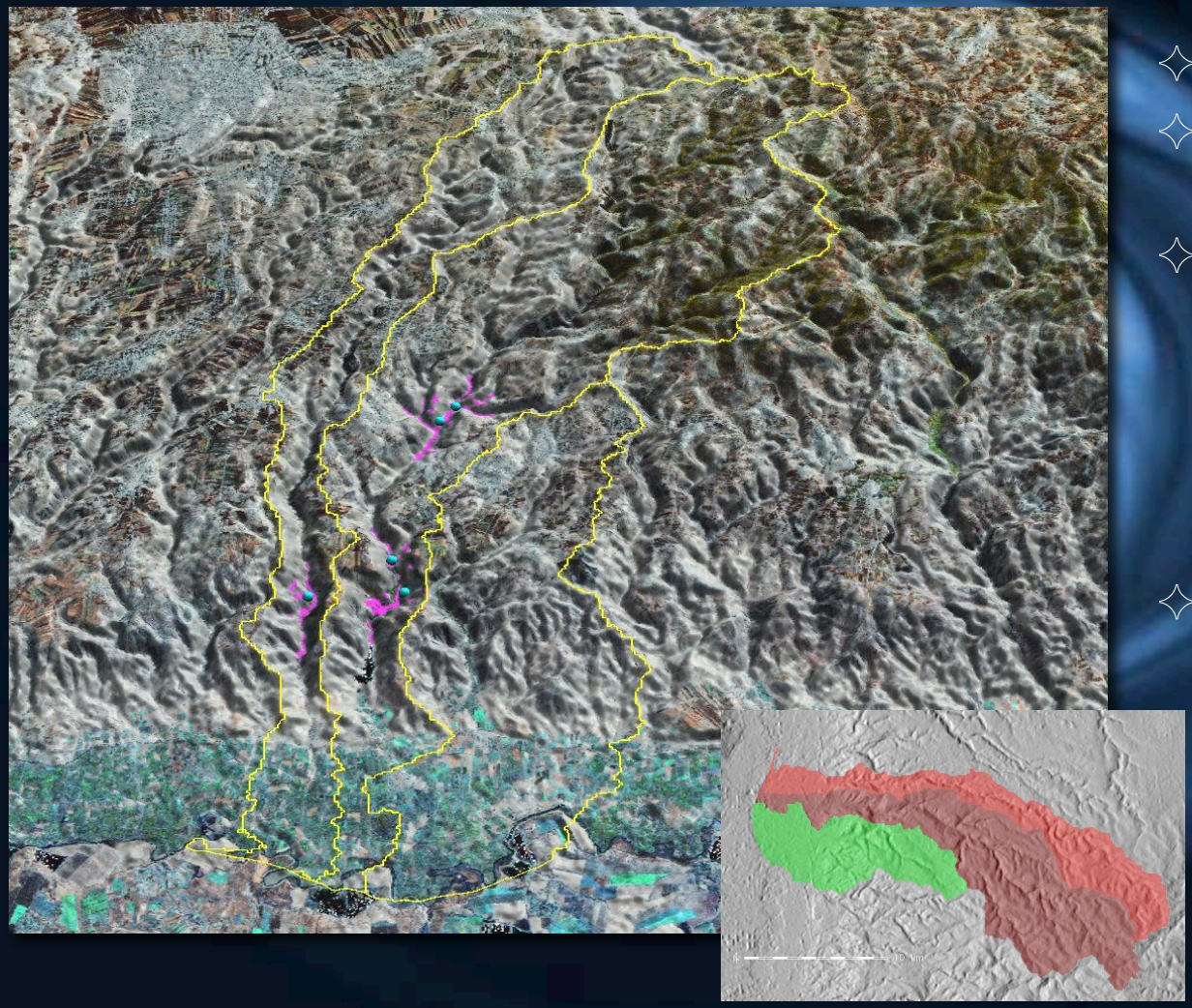
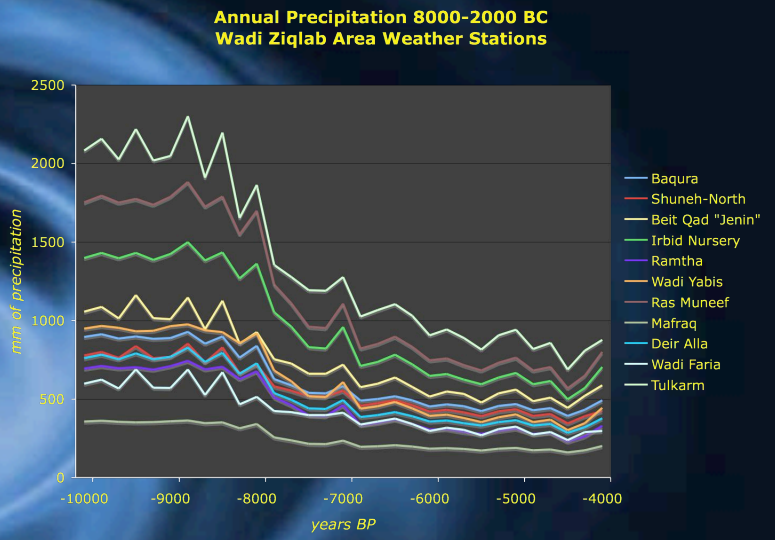
Topography

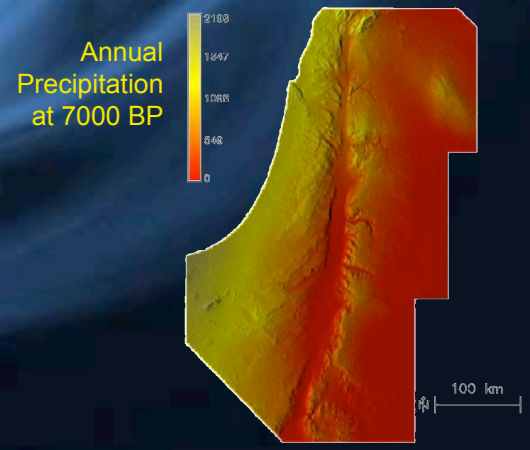


- Terra ASTER DEM
- Re-interpolated to 15m resolution
- Ultra-high resolution topography from aerial photograph stereo pairs (near future)
- Study areas defined as watersheds using hydrologic modeling

Rainfall Intensity

- 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)
- Transformation to R-Factor surface





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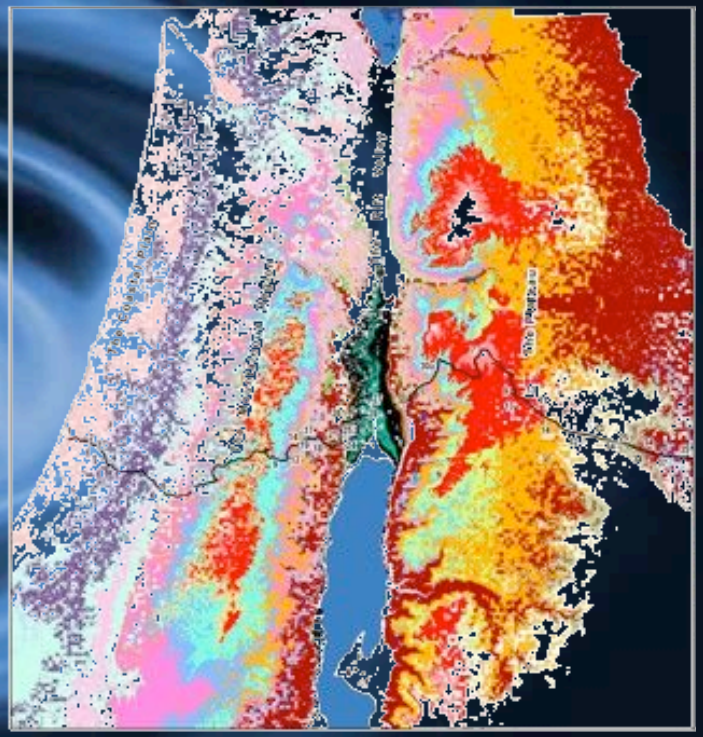
Landcover

- Simple estimate of paleovegetation
- Community models based on climate and topography (near future)
- Patch models incorporating successional dynamics (eventually)
- Using NDVI regression to scale vegetation to C-Factor



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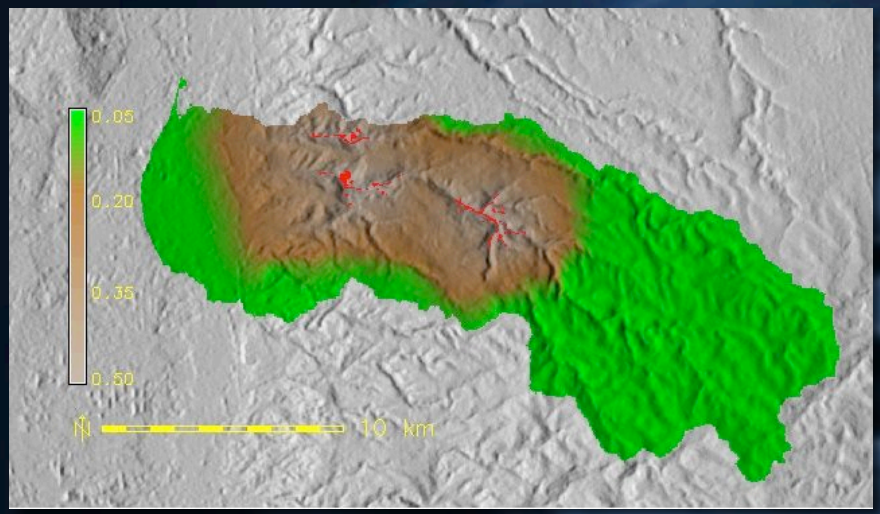
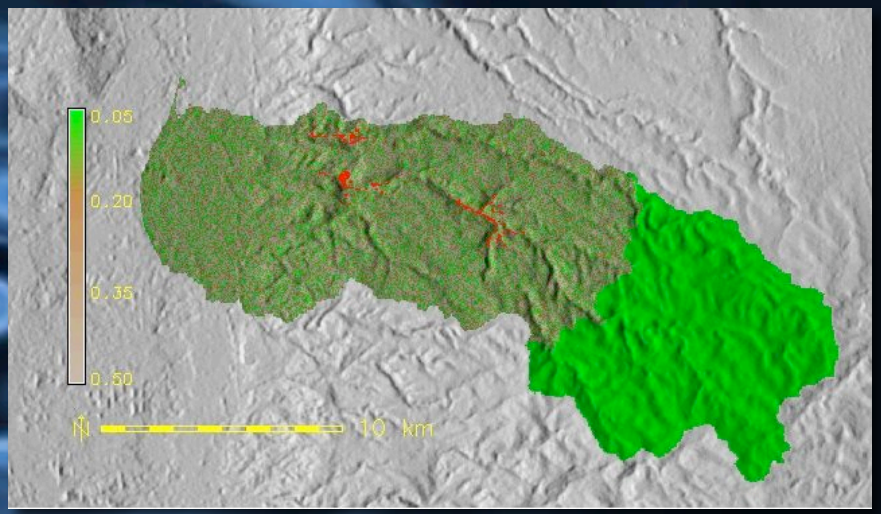
Soil

- Simple constant currently
- Using remote sensing to calculate K-Factor (near future)
- Dynamically modeling changing soil thickness and erodability (near future)

Surface Process Models



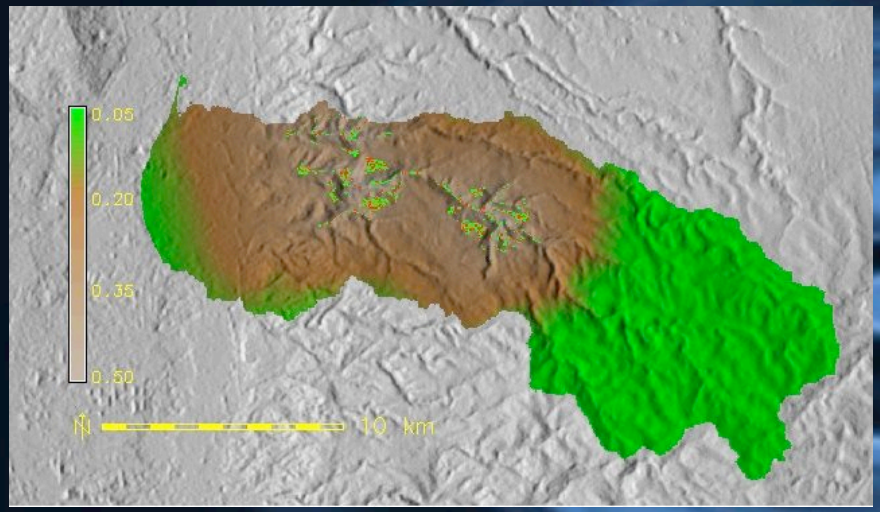
site-tethered grazing



extensive forest grazing

- Intensive horiculture (red culivated)

Surface Process Models



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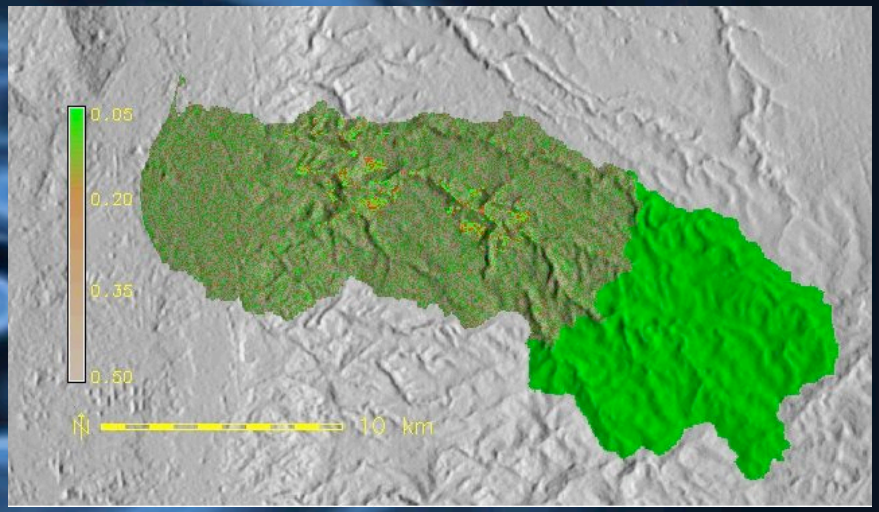

extensive forest grazing

- Shifting cultivation (red cultivated, brown fallowed, green forest)