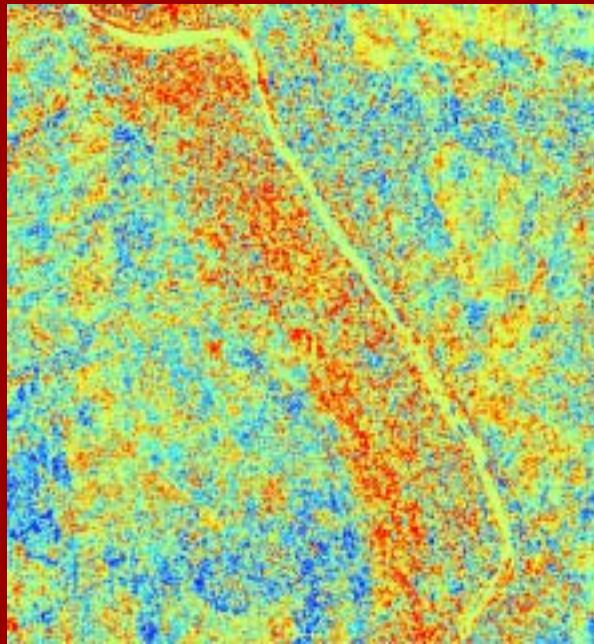


Linking patterns of vegetation change with underlying processes in Northern Kruger



Shaun Levick & Kevin Rogers

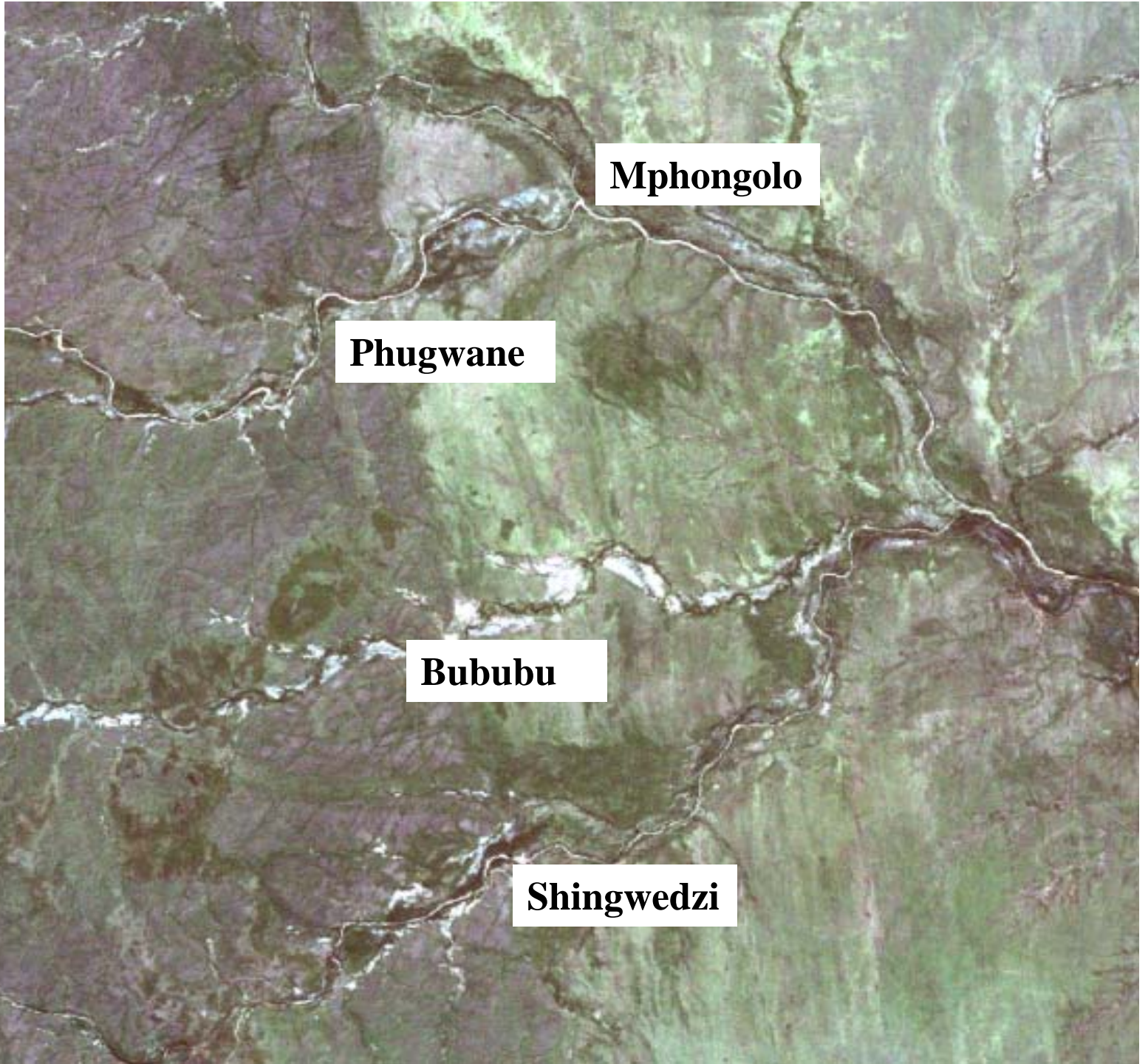


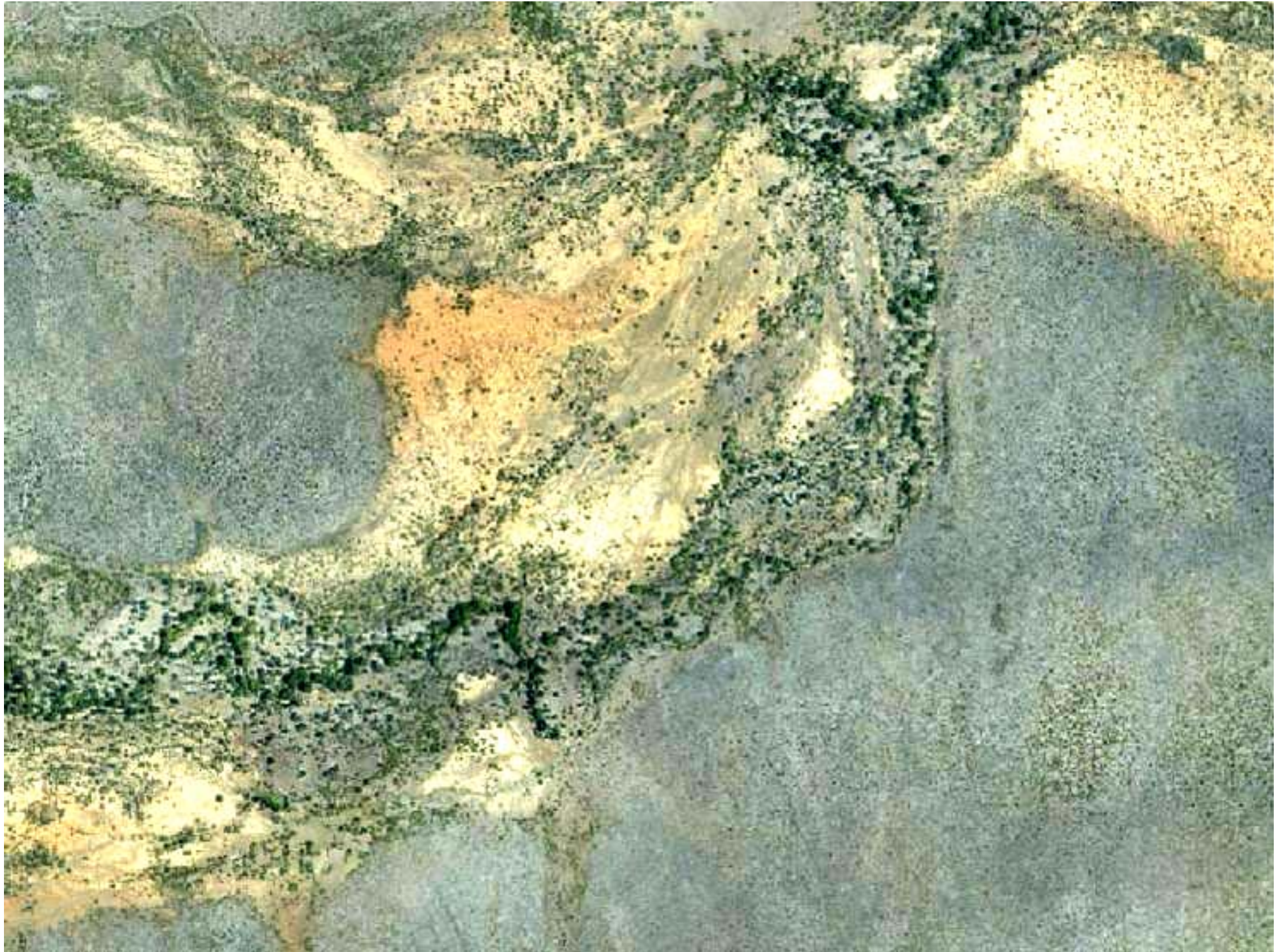
Vegetation dynamics in Savannas

- Focus on the drivers of change
 - Rainfall, fire, elephant
- Focus on broad scale patterns
 - Patterns of vegetation change at different scales has not received much attention
 - Spatial component has largely been ignored
 - Patterns of change at finer scales are still poorly understood
- Needs to be addressed

Pattern and Process

- Key principle of the hierarchical patch dynamics paradigm
 - Pattern affects process, process affects pattern
 - Exploring the spatial patterns at different scales can provide insight to the underlying processes
- Understanding the spatial and temporal heterogeneity of a system at multiple scales is fundamental to its successful management
 - Heterogeneity paradigm adopted by KNP management



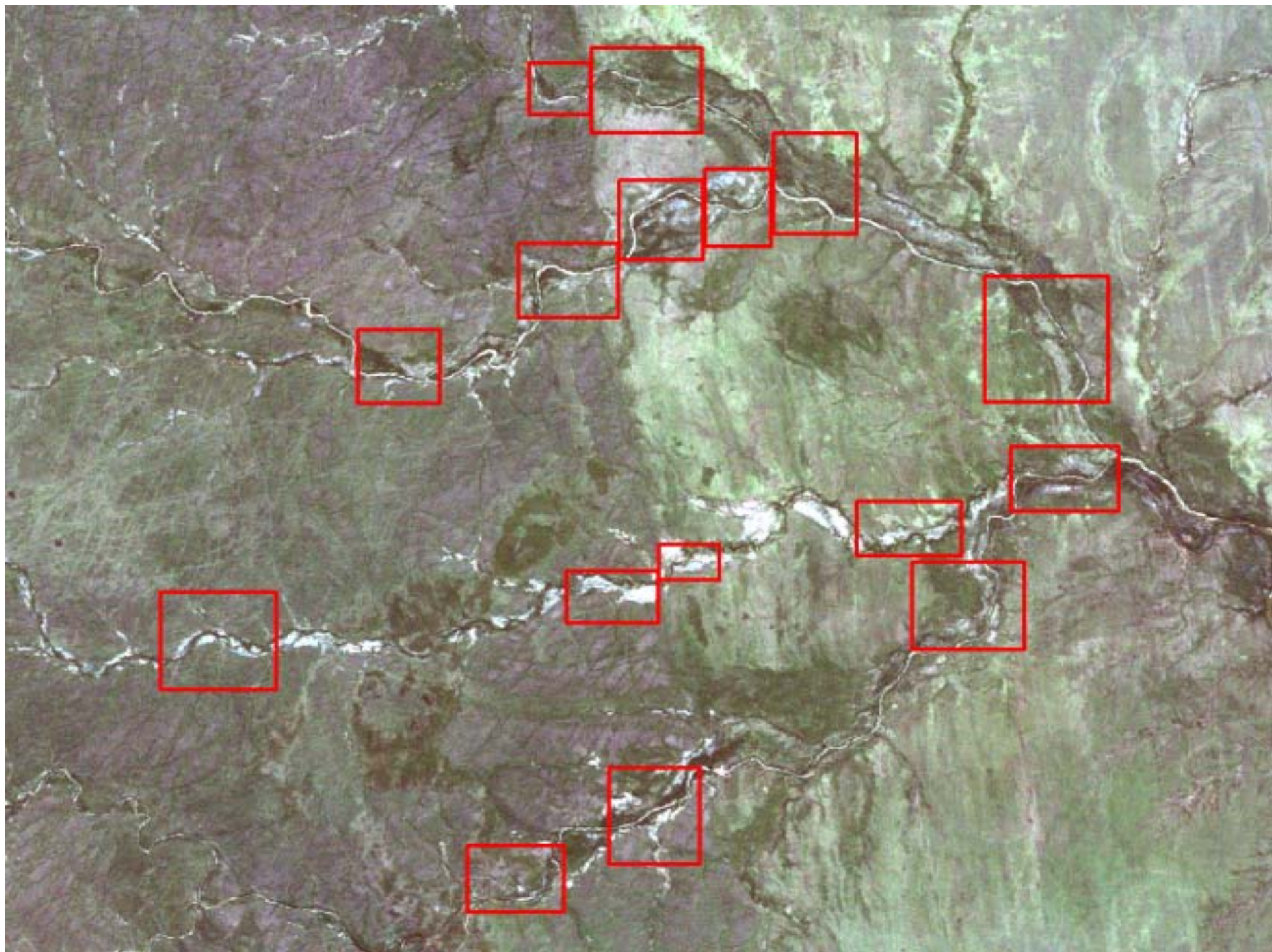






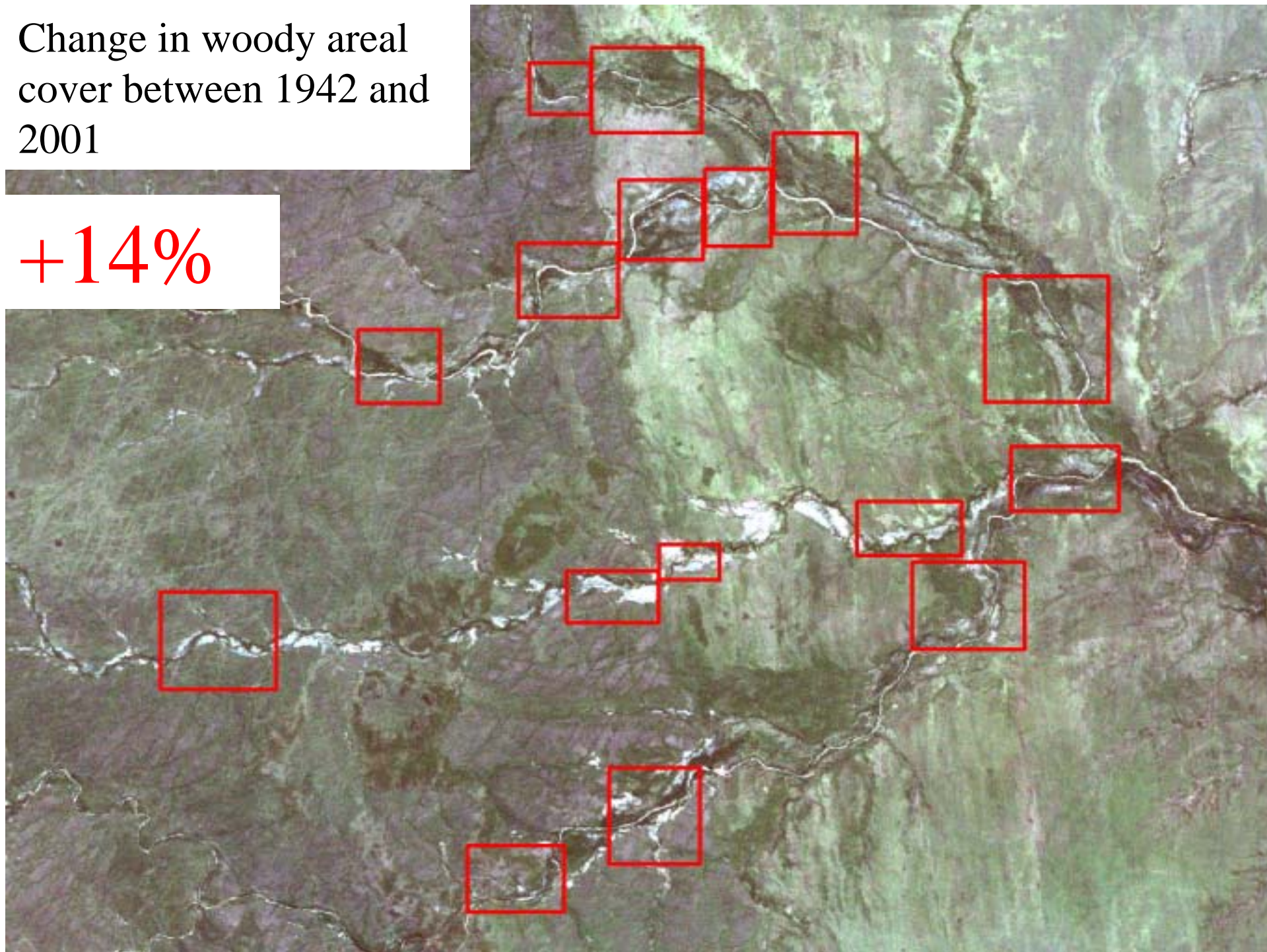
Patterns of change in vegetation cover in the Shingwedzi Catchment

- Aerial photography record
 - 1942, 1962, 1971, 1977, 1989, 2001
- 16 sites
 - 4 on each river
 - Upland, riparian, range of substrates
- Object-based image analysis
 - eCognition
 - Multi-scale segmentation
 - Fuzzy logic membership functions

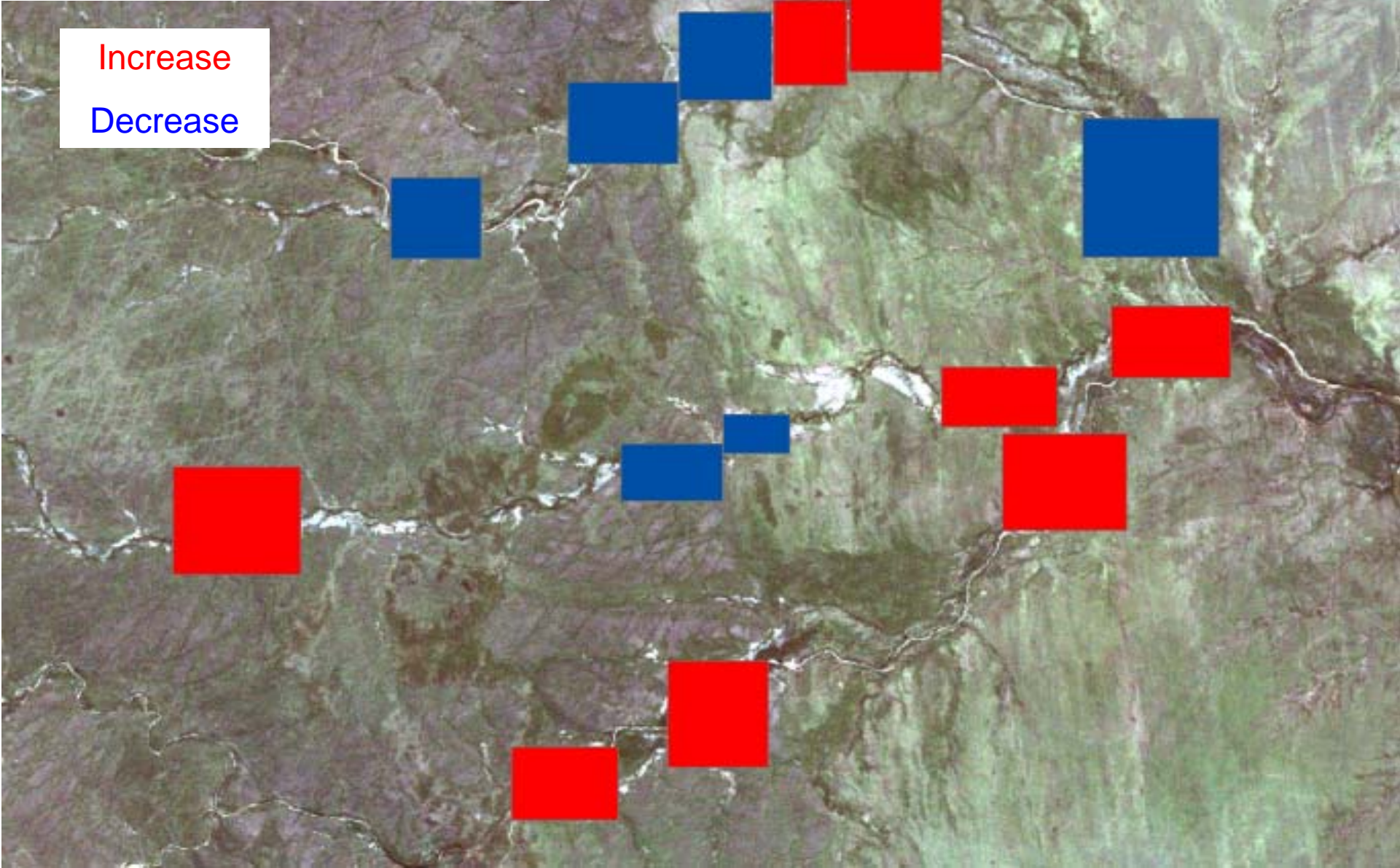


Change in woody area
cover between 1942 and
2001

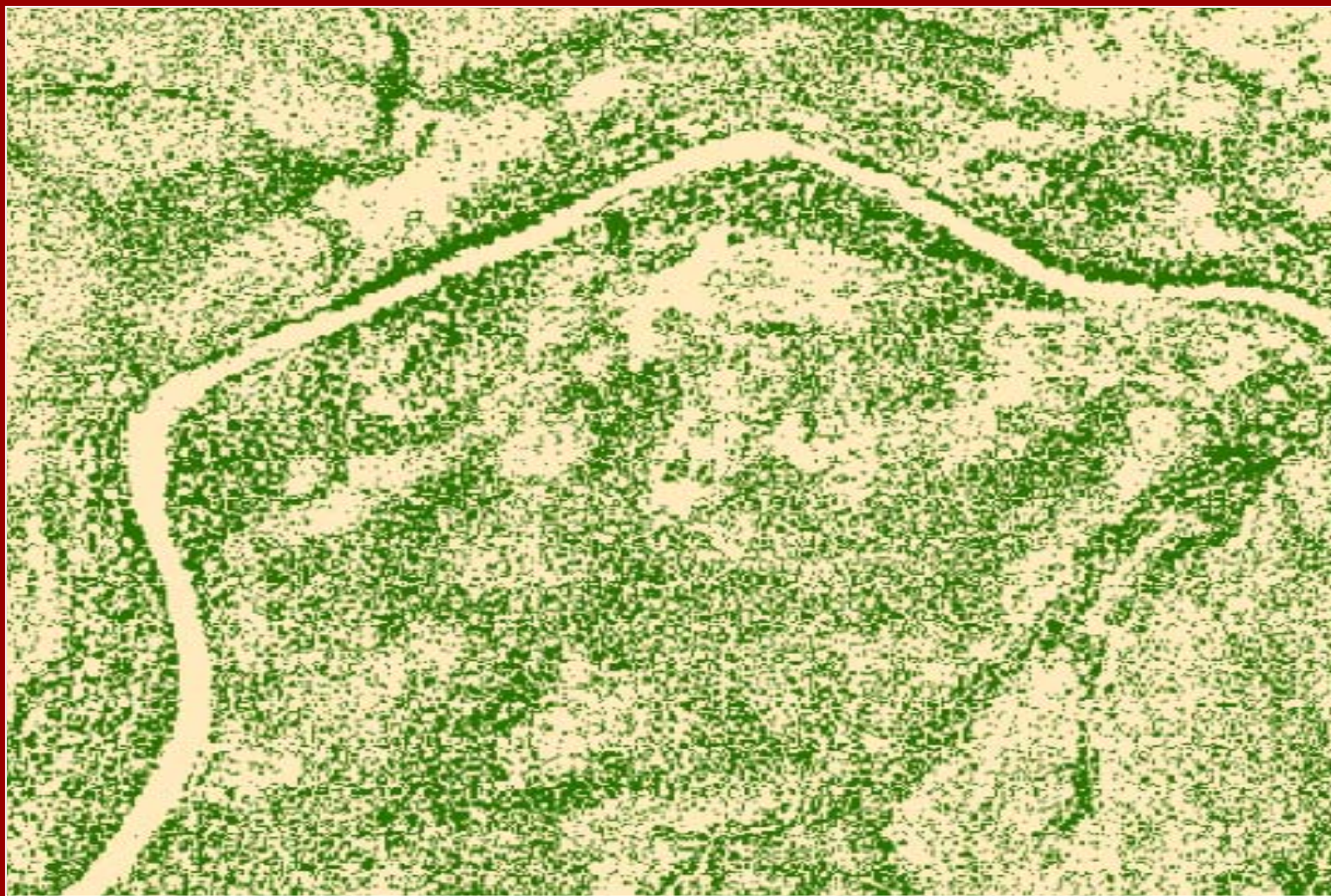
+14%



Change in woody areal cover between 1942 and 2001



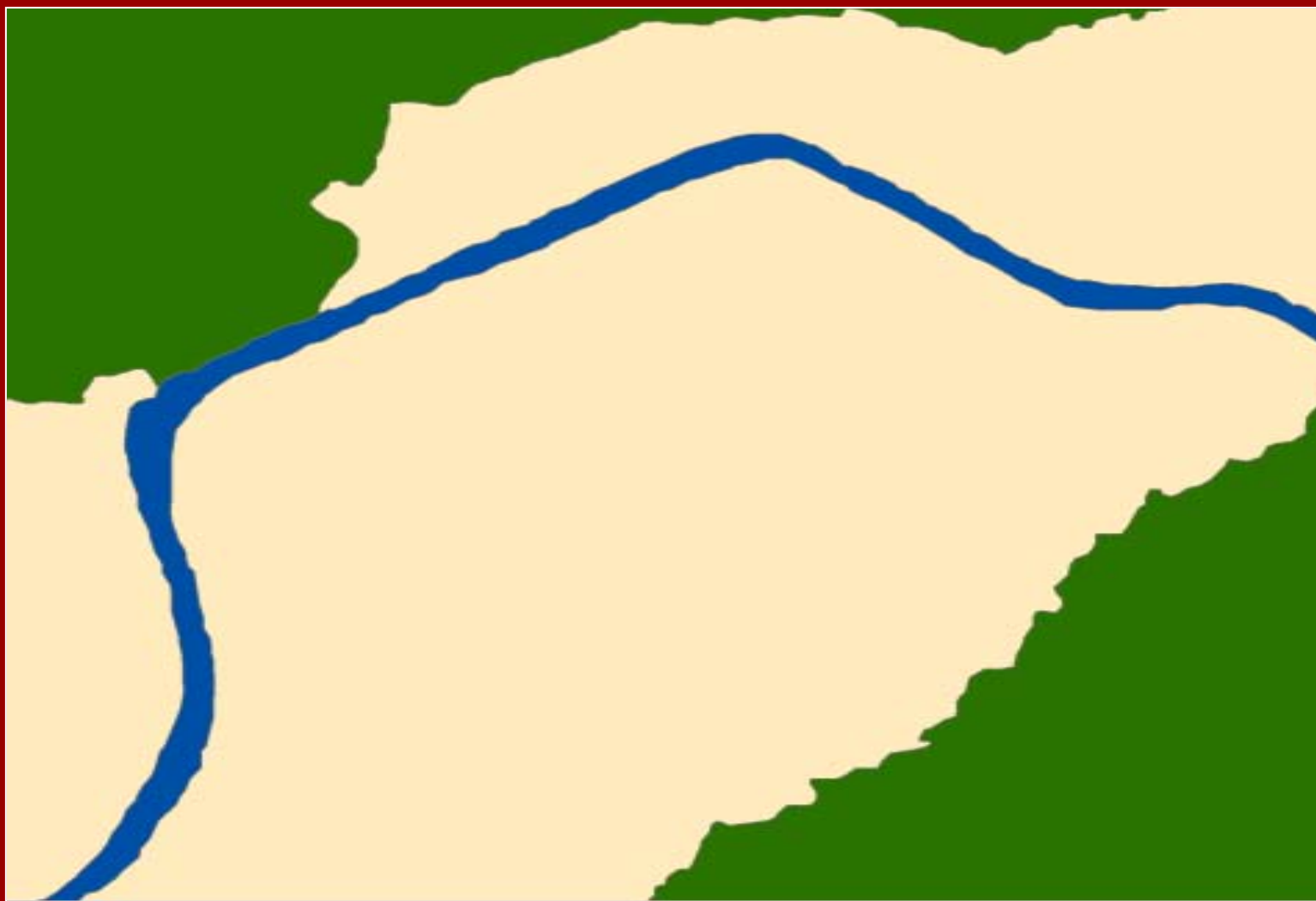
- 7 %



Change in woody areal cover between 1942 and 2001

-17%

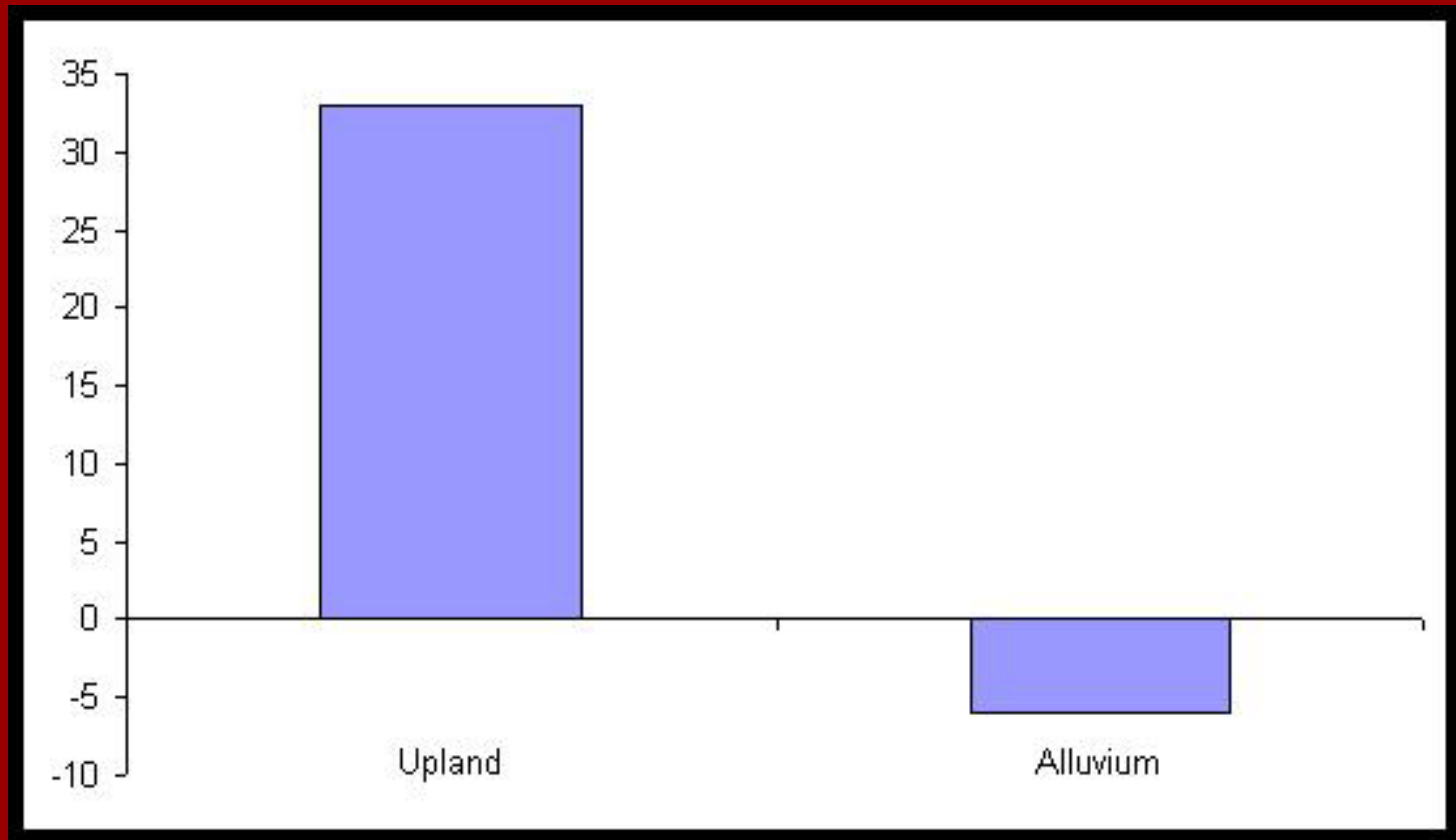
+46%

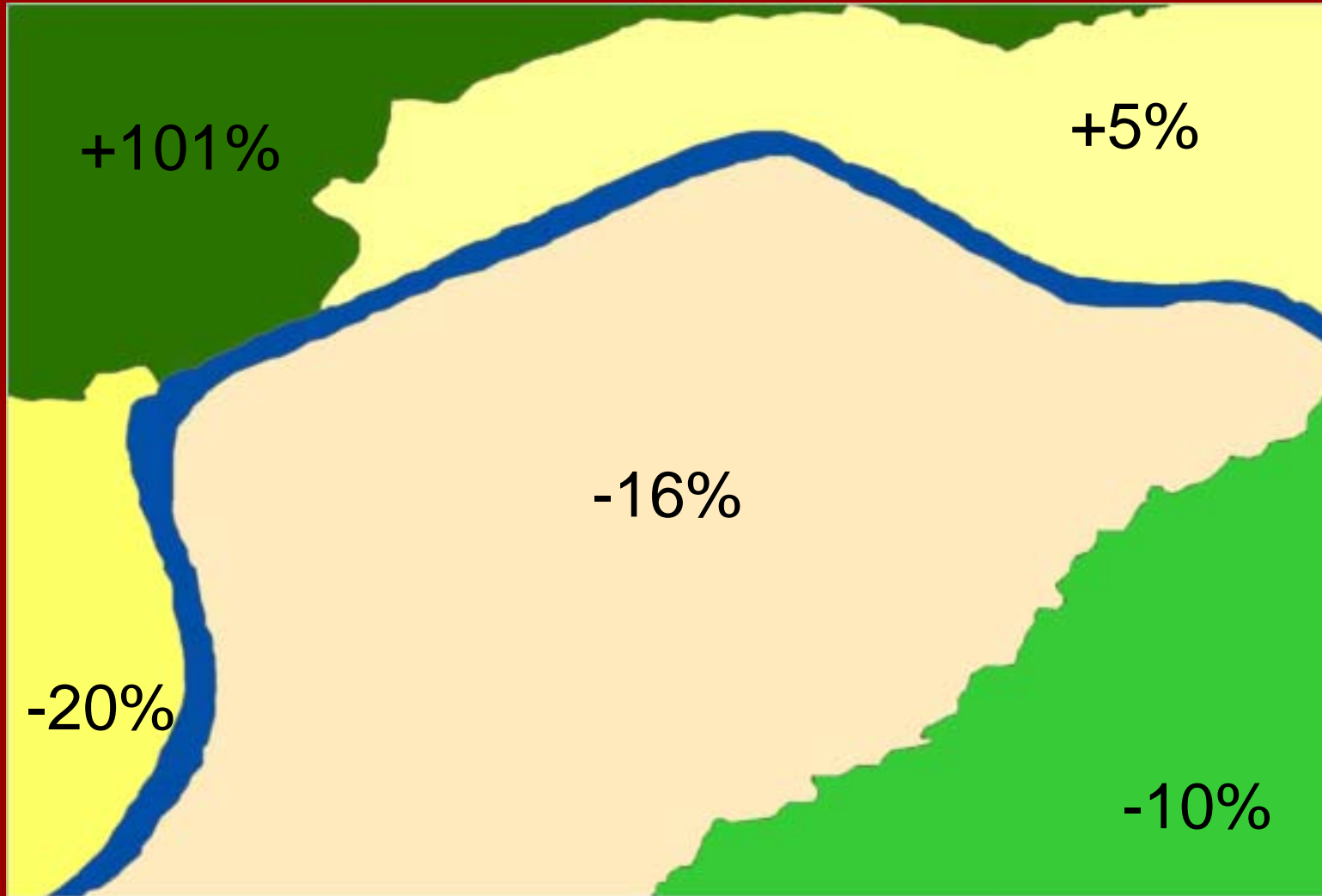


Change in woody areal cover between 1942 and 2001

Percentage change of woody cover on different landscape positions

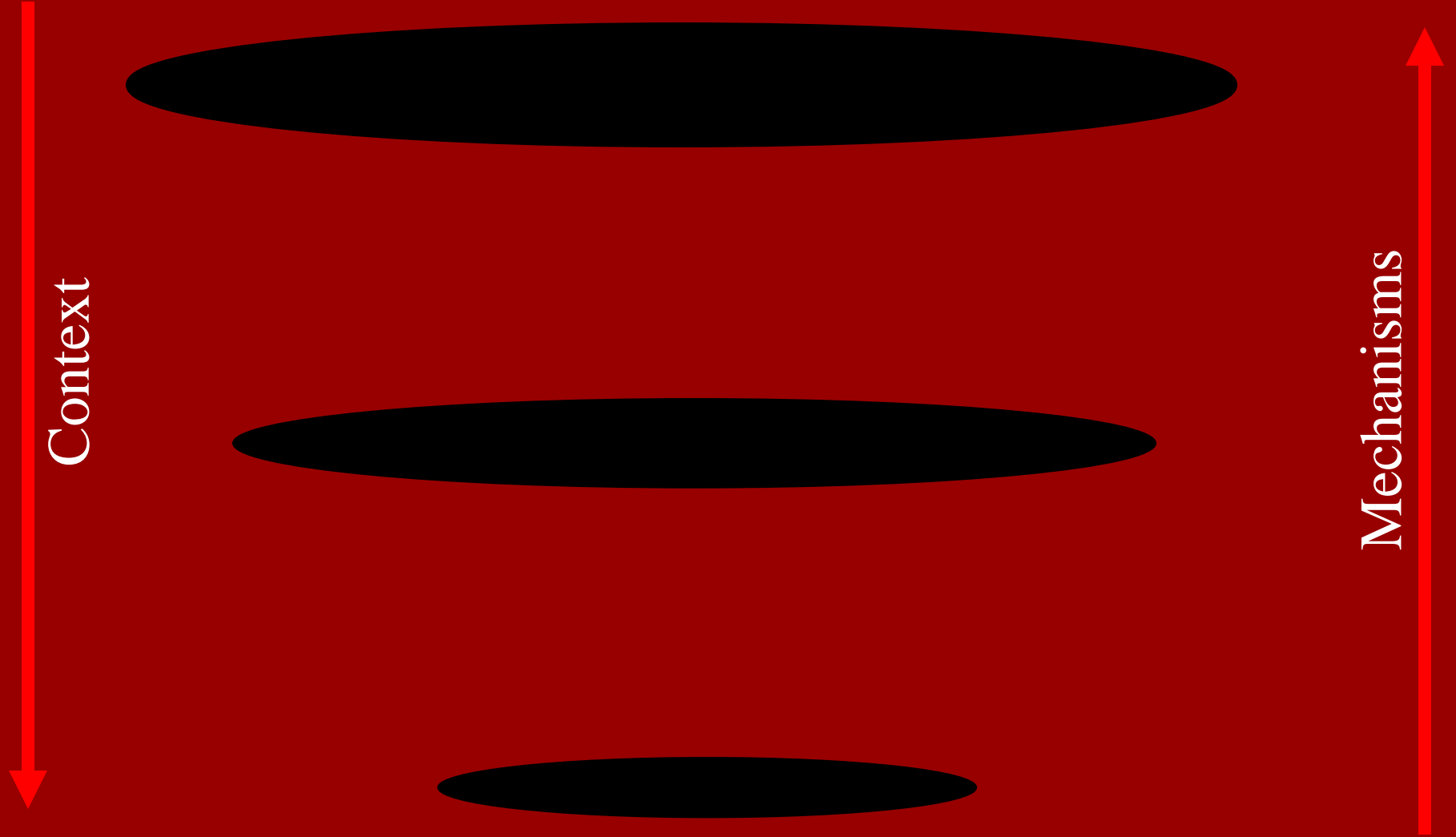
Percentage change in woody aerial cover
(1942 – 2001)





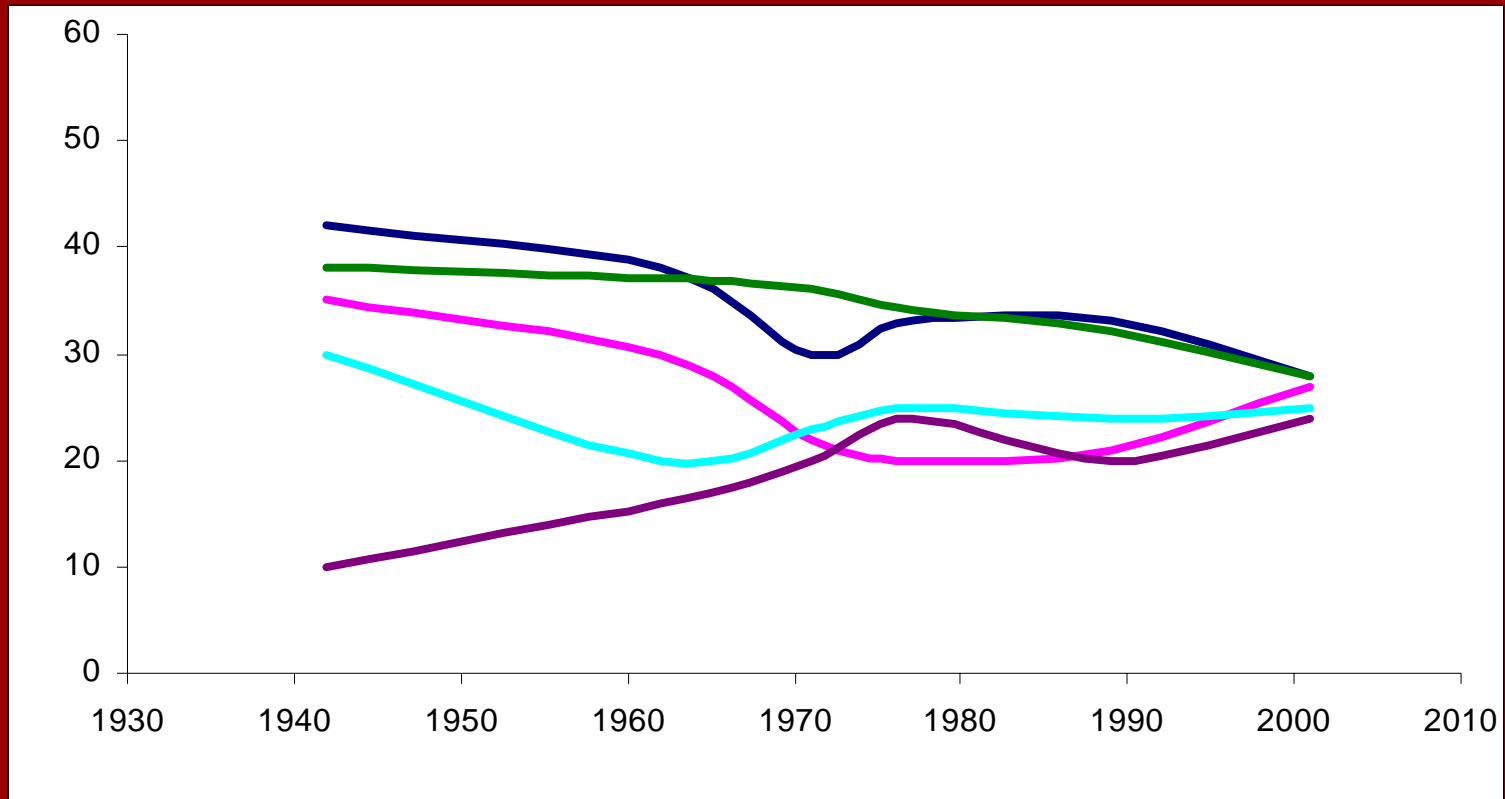
Change in woody areal cover between 1942 and 2001

Hierarchical Patch Dynamics Approach



Temporal trend in percentage woody cover per patch

Percentage areal cover of woody vegetation

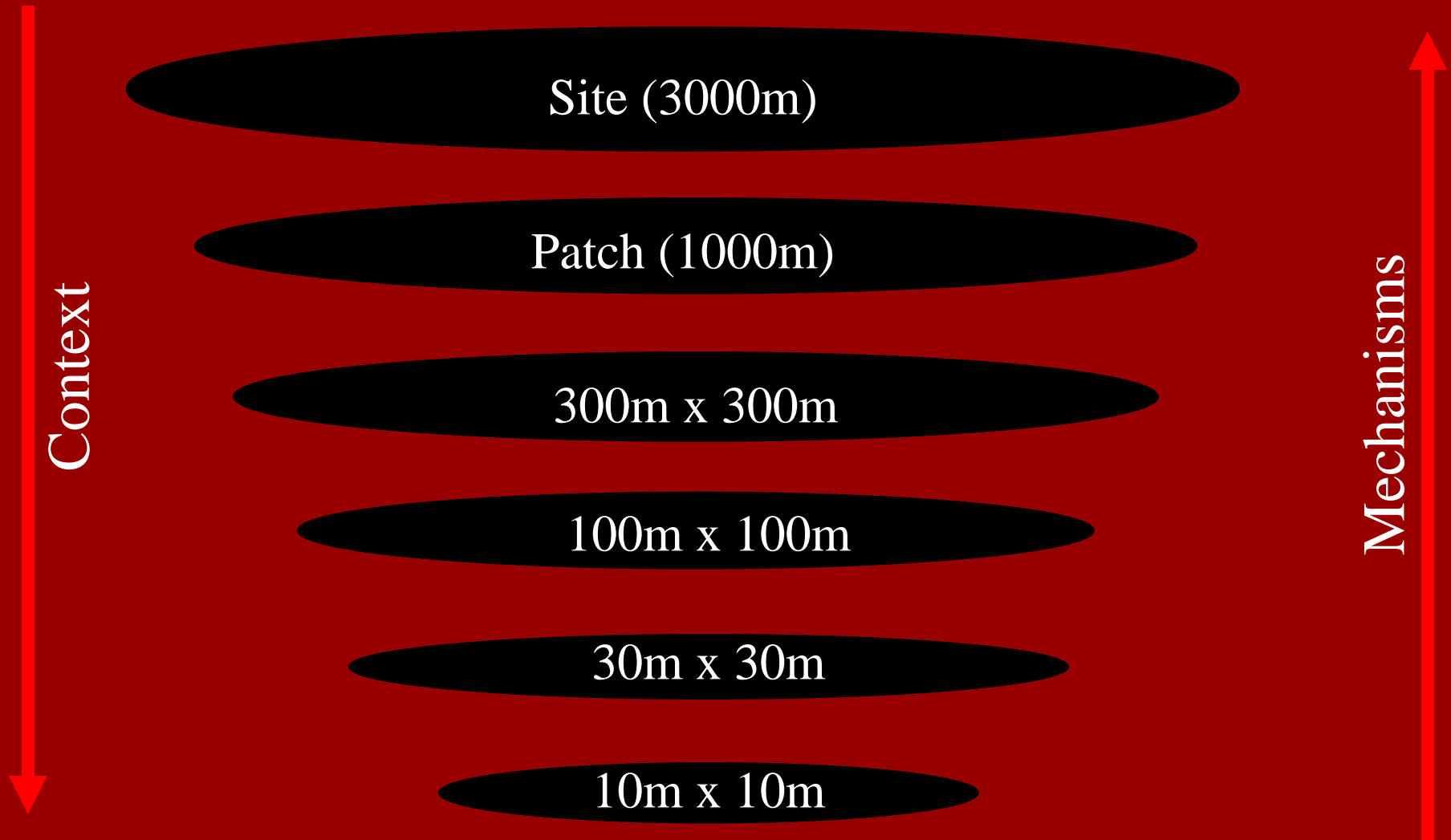


Heterogeneity \longrightarrow Homogeneity

Linking patterns with processes

- Explore the relationship between change over time with environmental and management variables
- Ordination
 - CCA
 - Manual forward selection of environmental variables ($p < 0.05$)

Hierarchical Patch Dynamics Approach



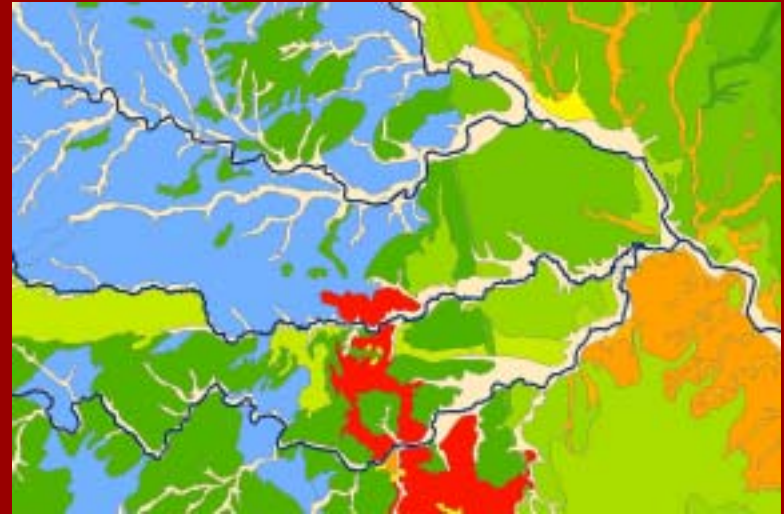
Geometric series

Substrate

Geology



Soil



History

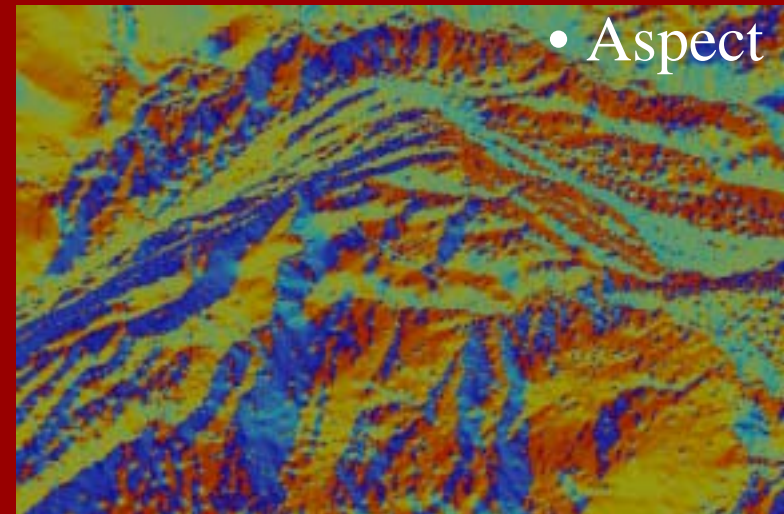
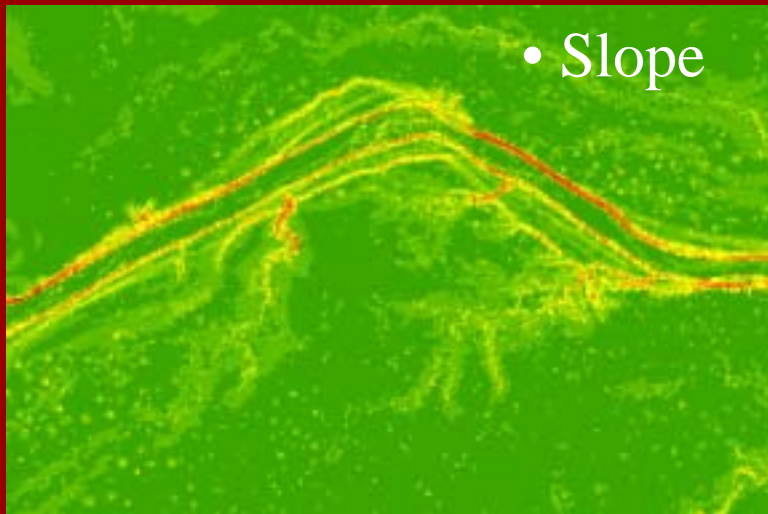
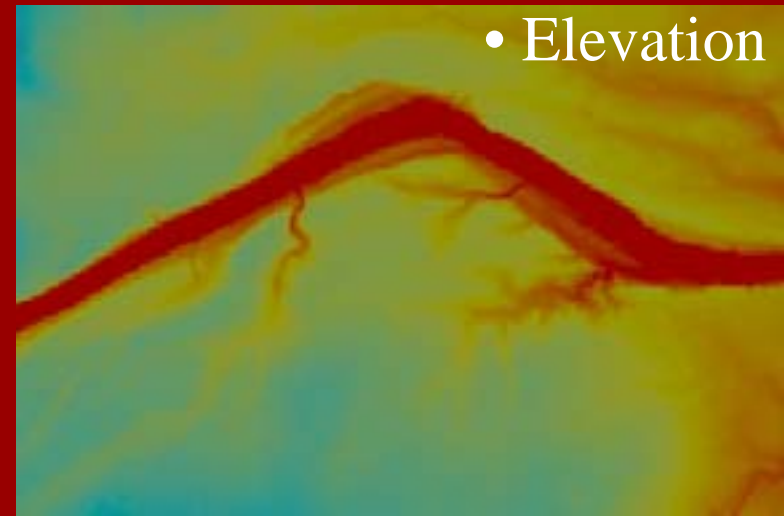
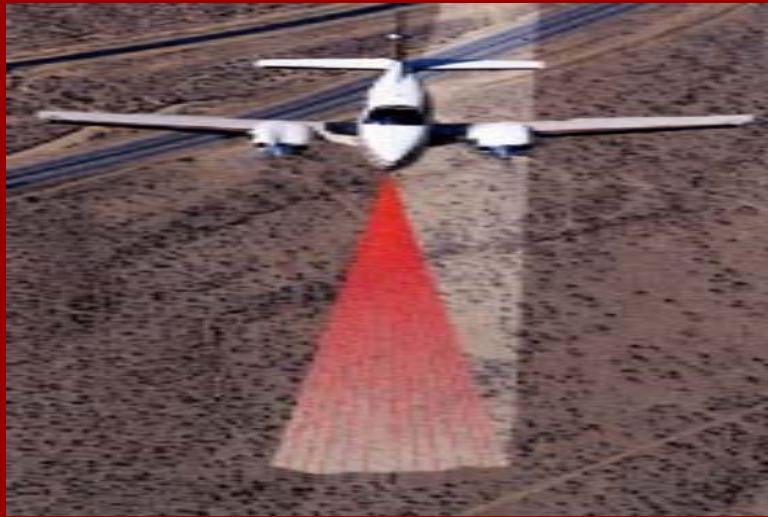
Rainfall



Fire return period

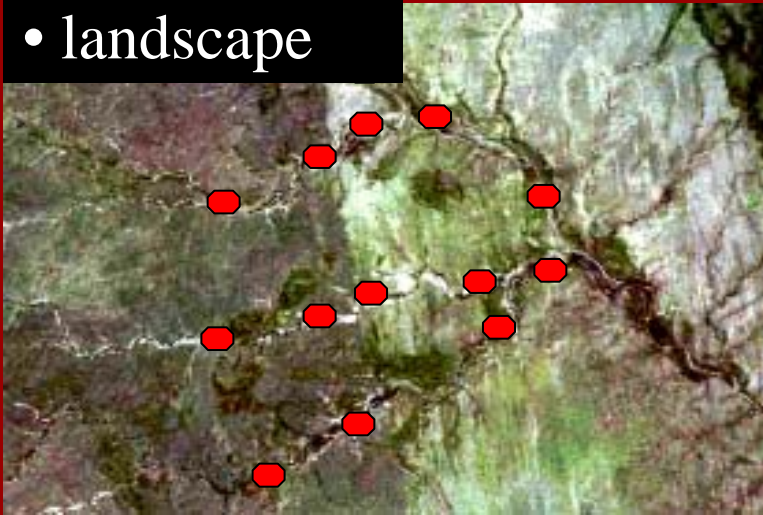


Topography

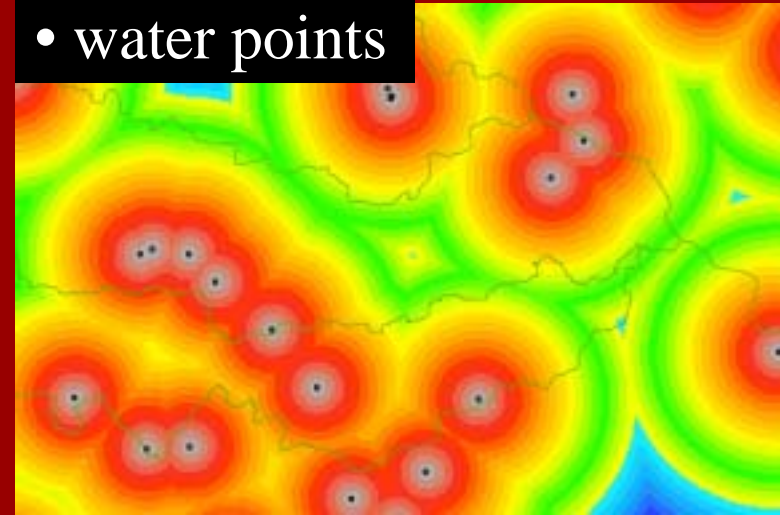


Spatial context

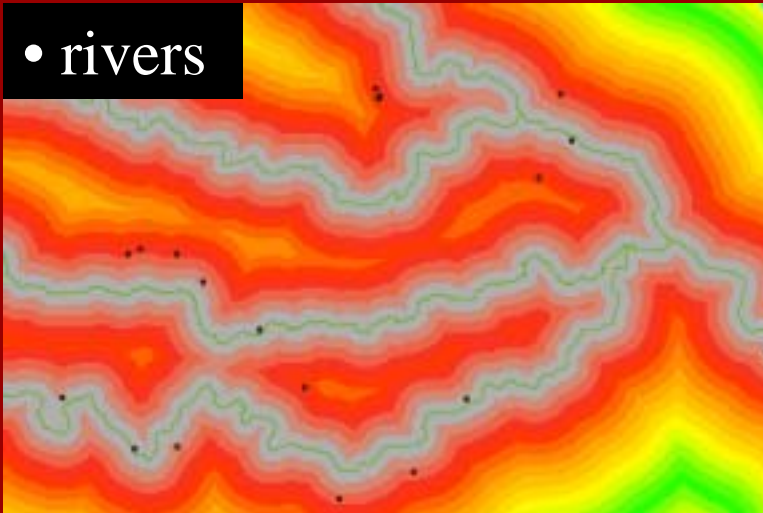
- landscape



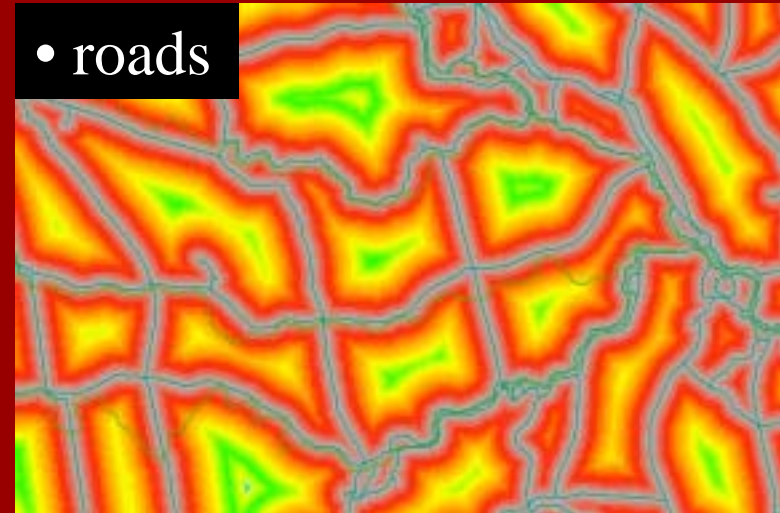
- water points



- rivers

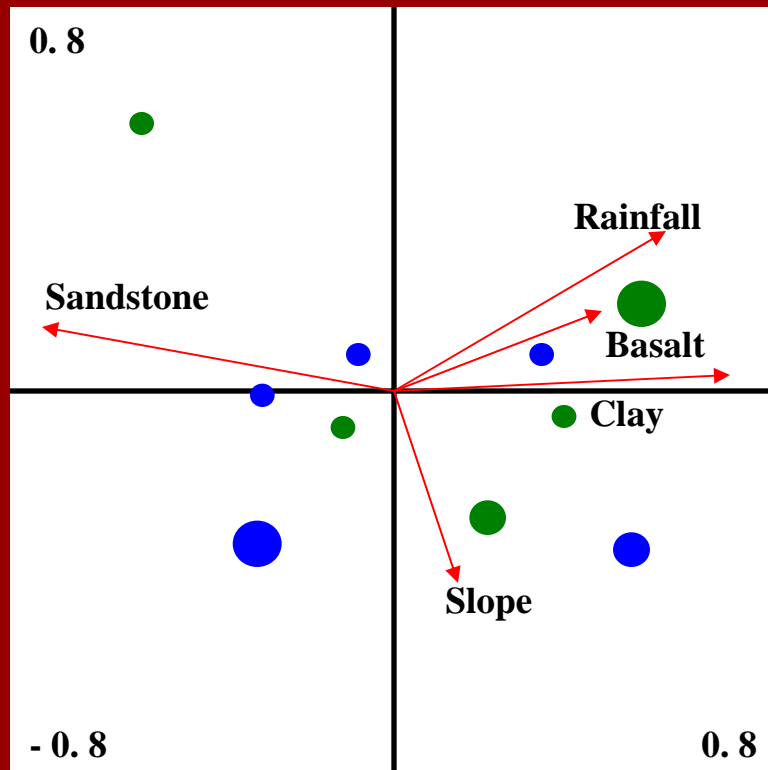


- roads

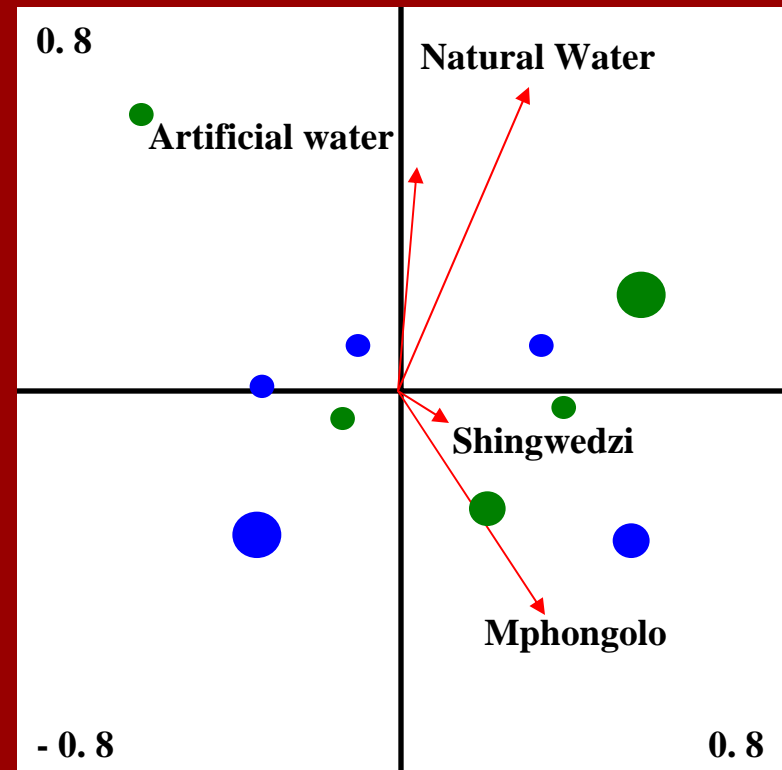


3000m X 3000m

Substrate, history, topography



Spatial context



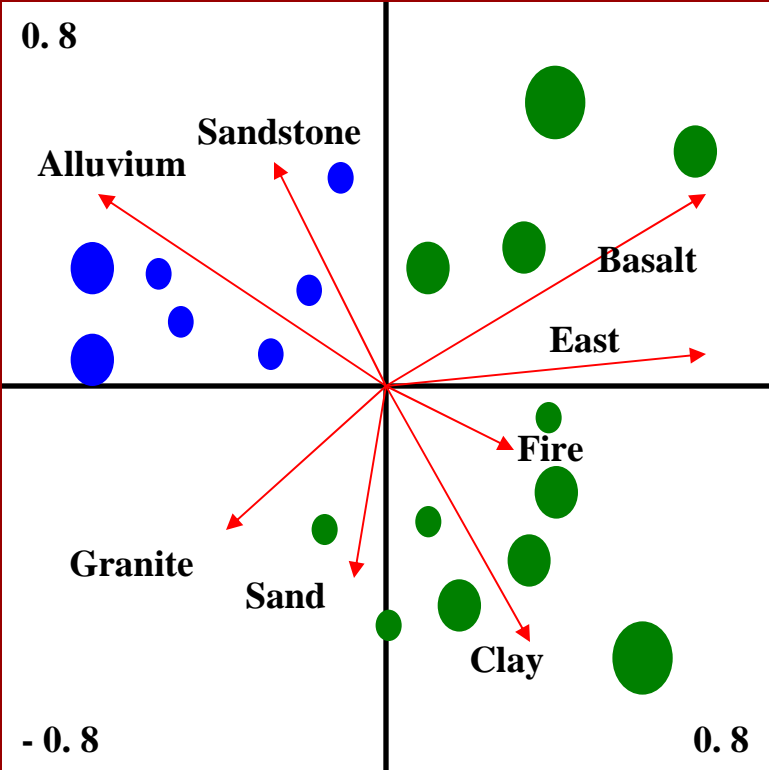
Increase

Decrease

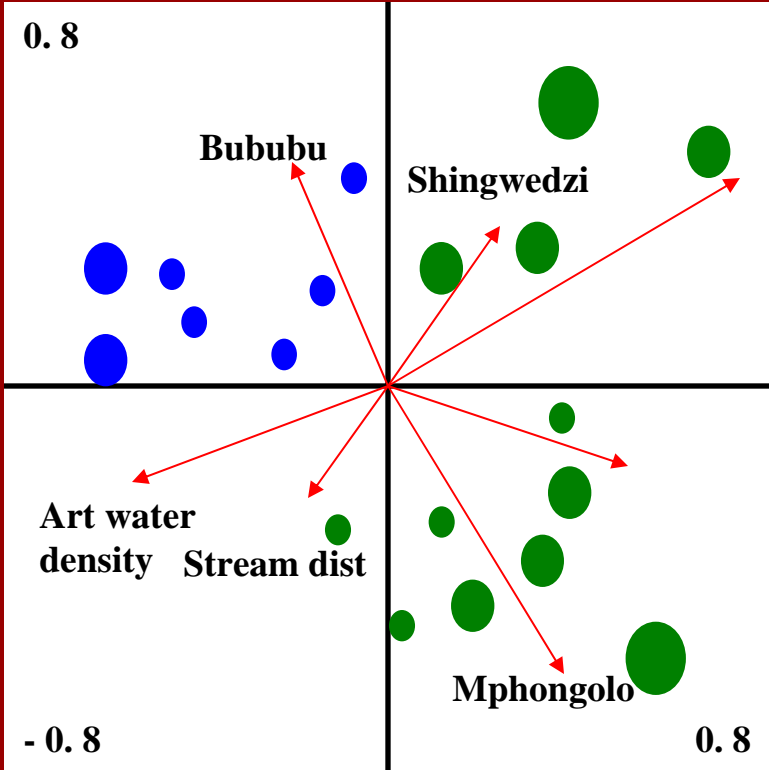
Size of dot represents magnitude of change

300m X 300m

Substrate, history, topography



Spatial context

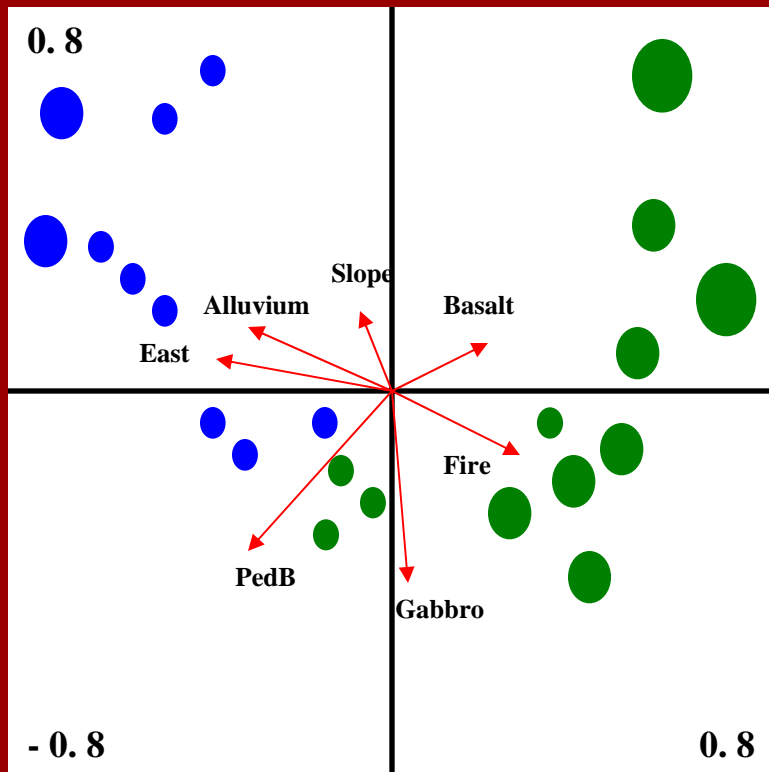


Increase
Decrease

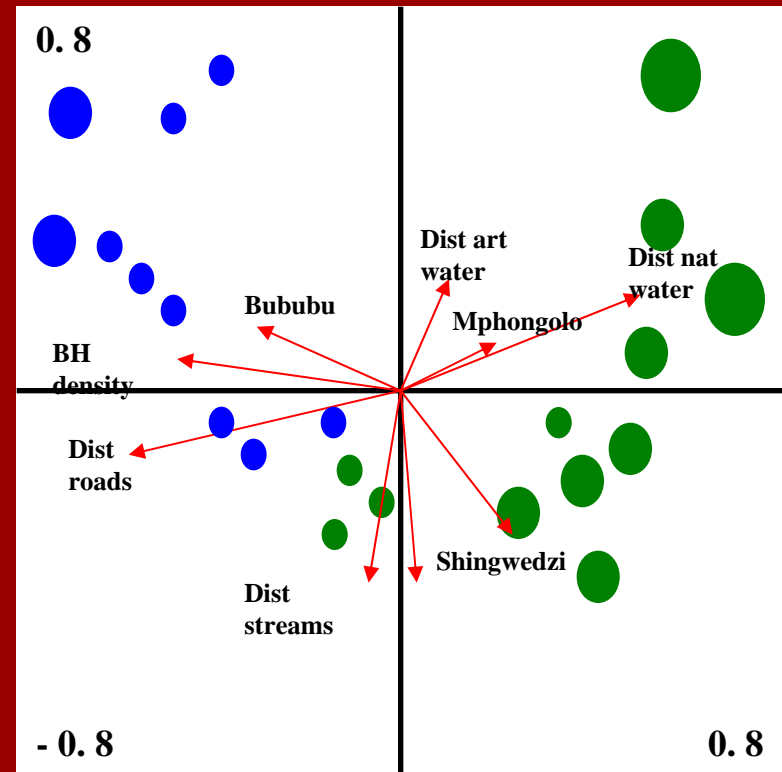
Size of dot represents magnitude of change

30m X 30m

Substrate, history, topography



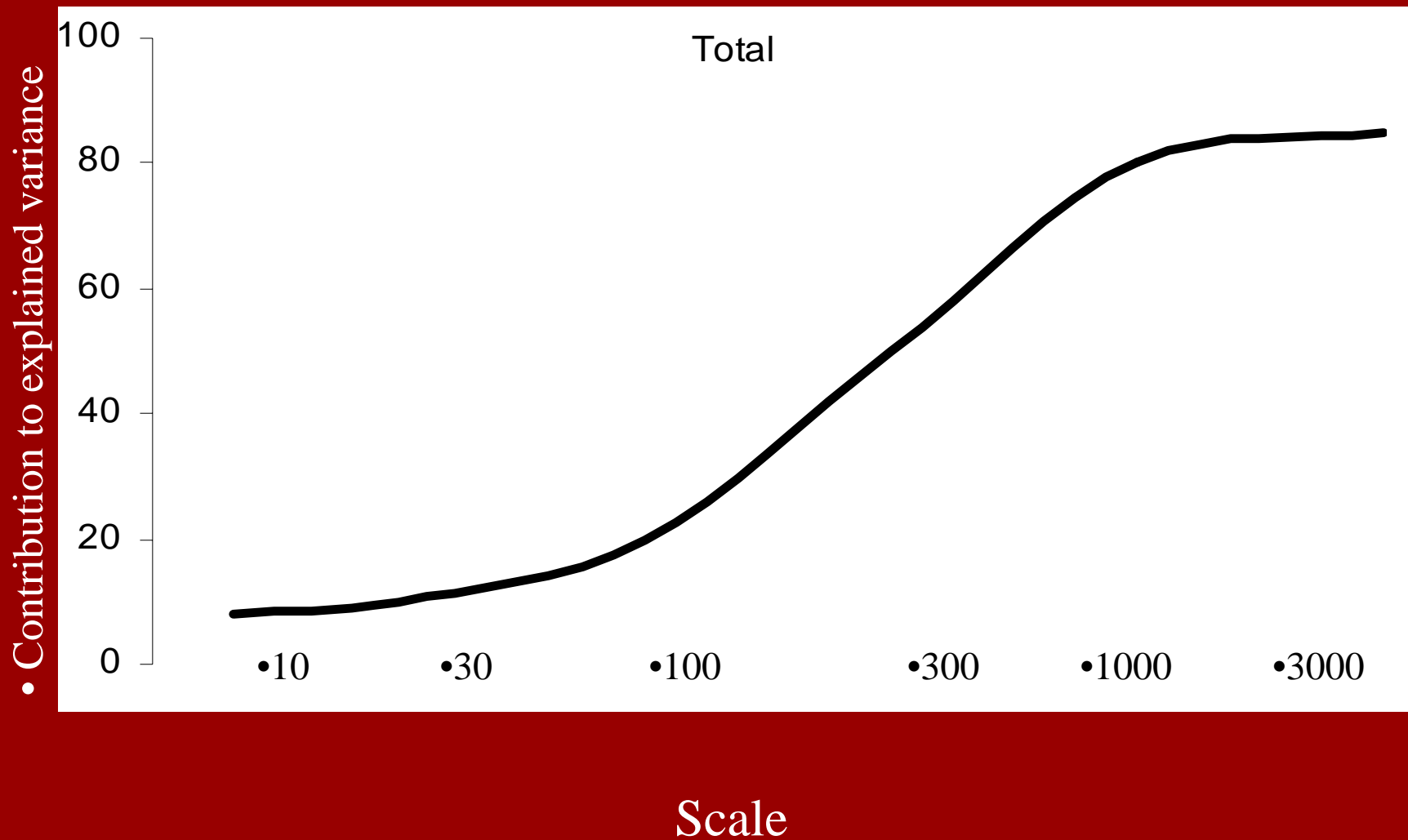
Spatial context



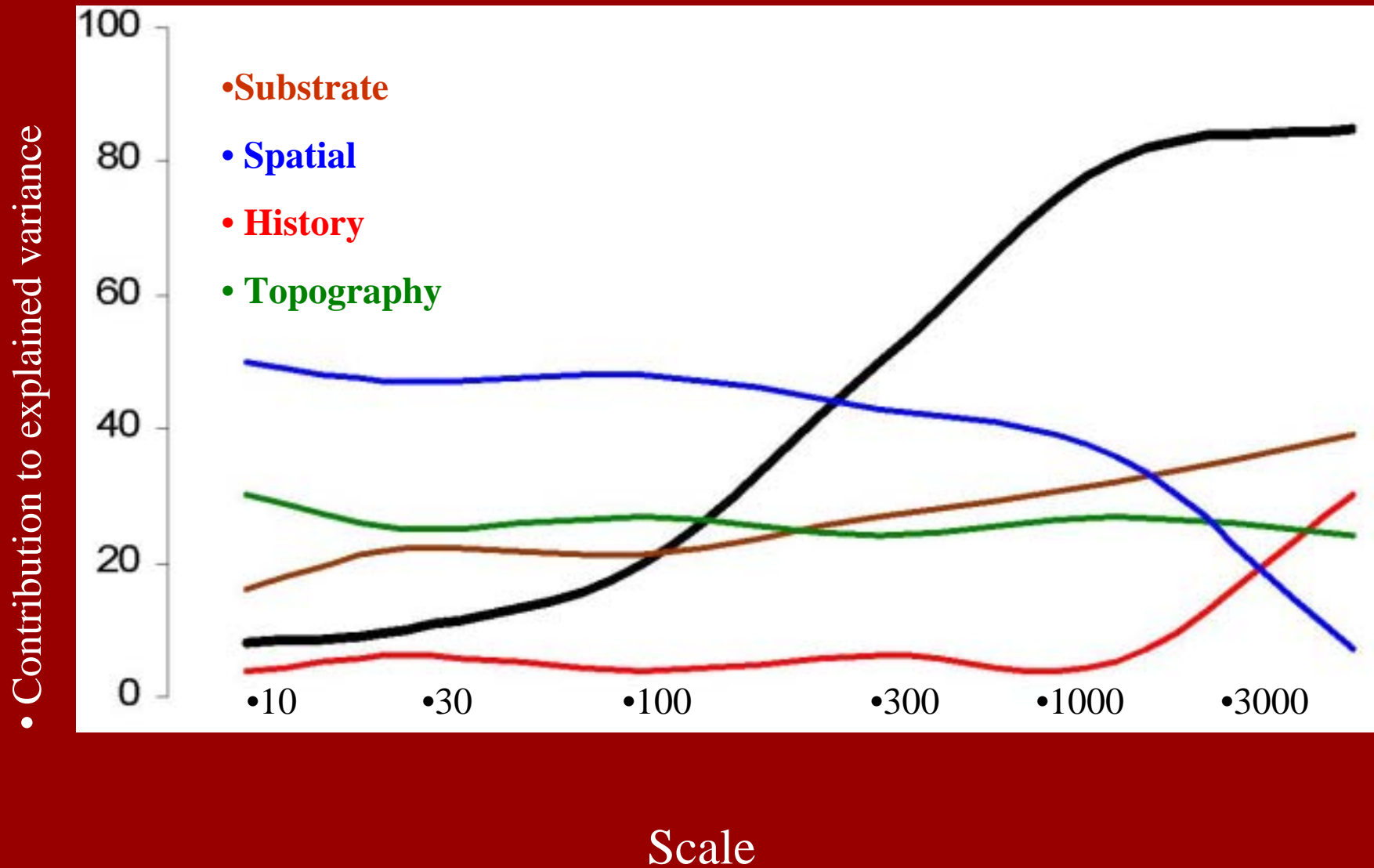
Increase
Decrease

Size of dot represents
magnitude of change

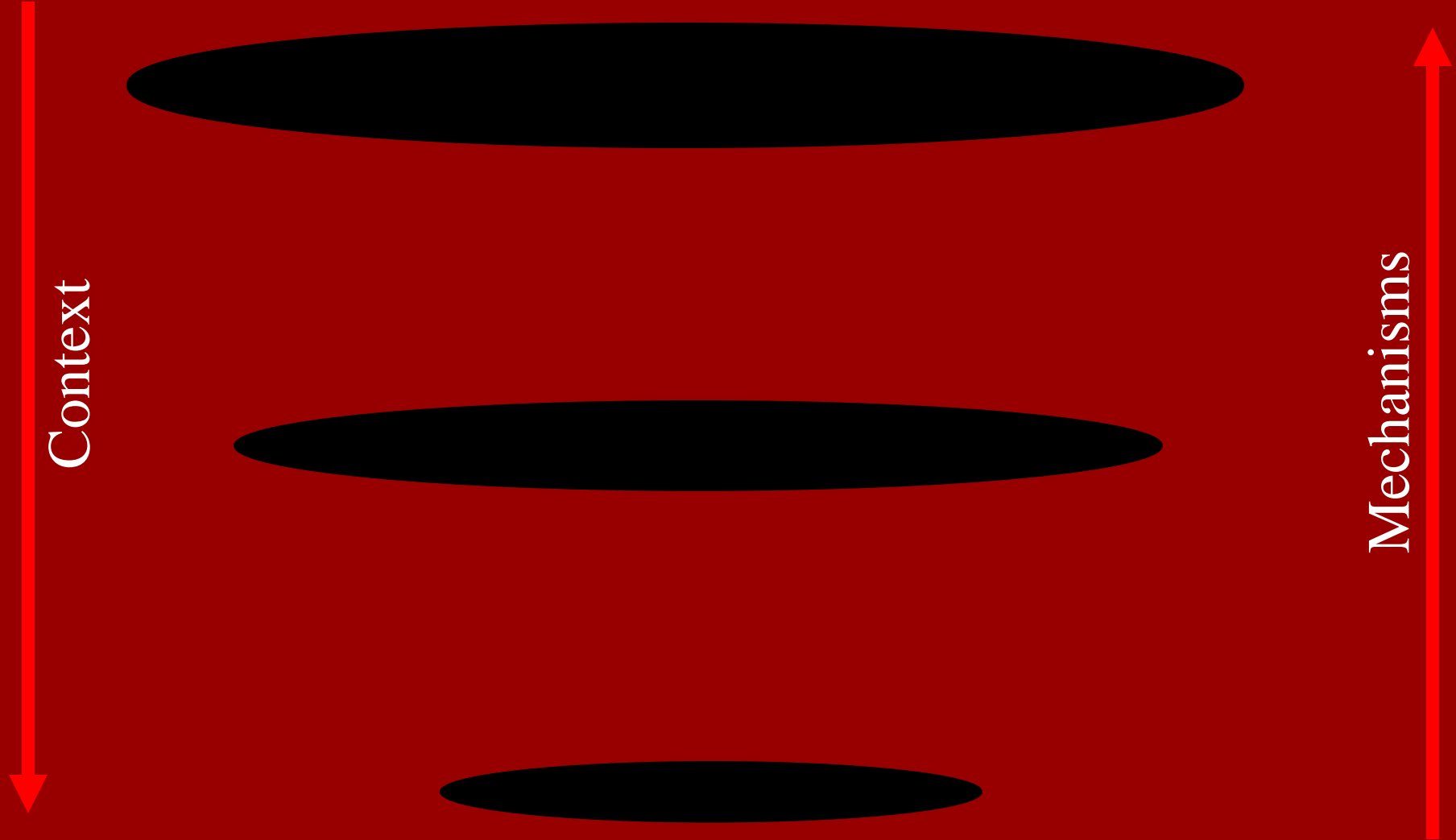
Contribution of environmental variable groups to explained variation



Contribution of environmental variable groups to explained variation



Hierarchical Patch Dynamics Approach



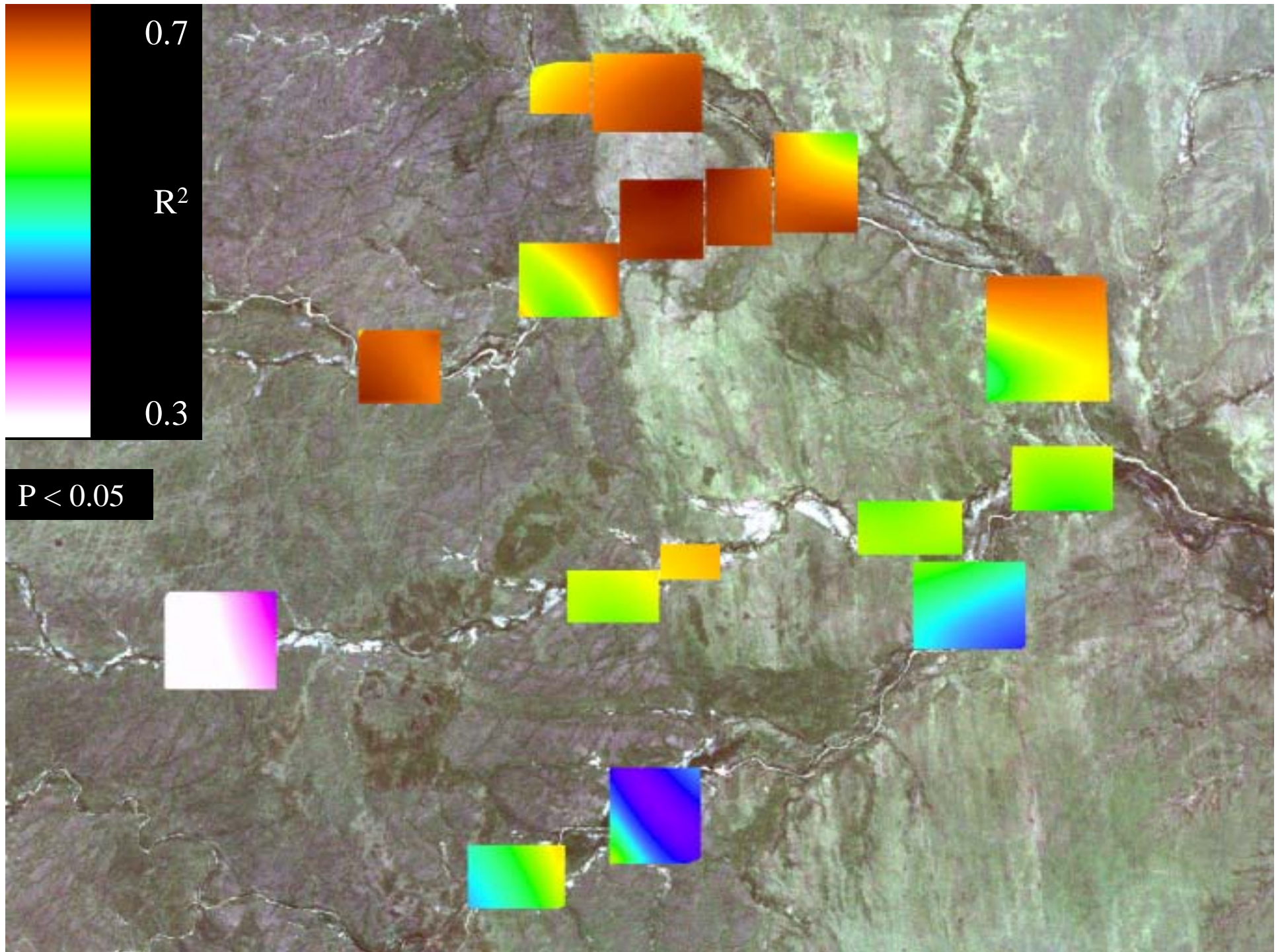
Context conscious understanding

- Most models are global in nature
- Landscape are heterogeneous
 - Relationships between dependant and independent variables are unlikely to be stationary in space
- Geographically weighted regression (GWR)
 - GWR 3.0
 - Charlton, Brunsdon, Fotheringham
 - Deals with spatial non-stationarity

$R^2 = 0.55$

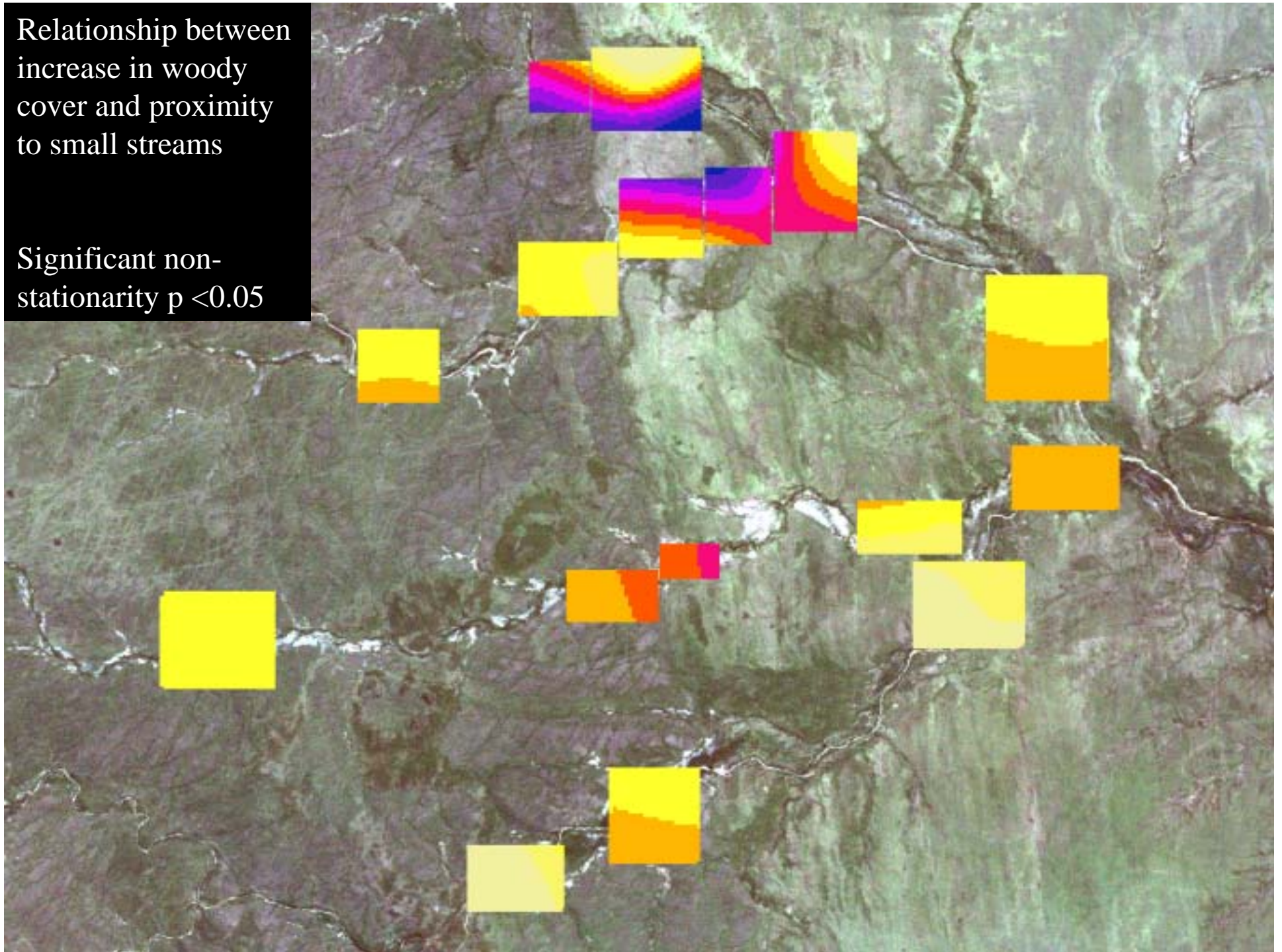
$P < 0.05$





Relationship between
increase in woody
cover and proximity
to small streams

Significant non-
stationarity $p < 0.05$



Decrease in woody cover

Scale



- Sandstone
- Lowlands – Alluvium
 - Slightly more in granite setting
- High density of water points
- Close to water points

Increase in woody cover

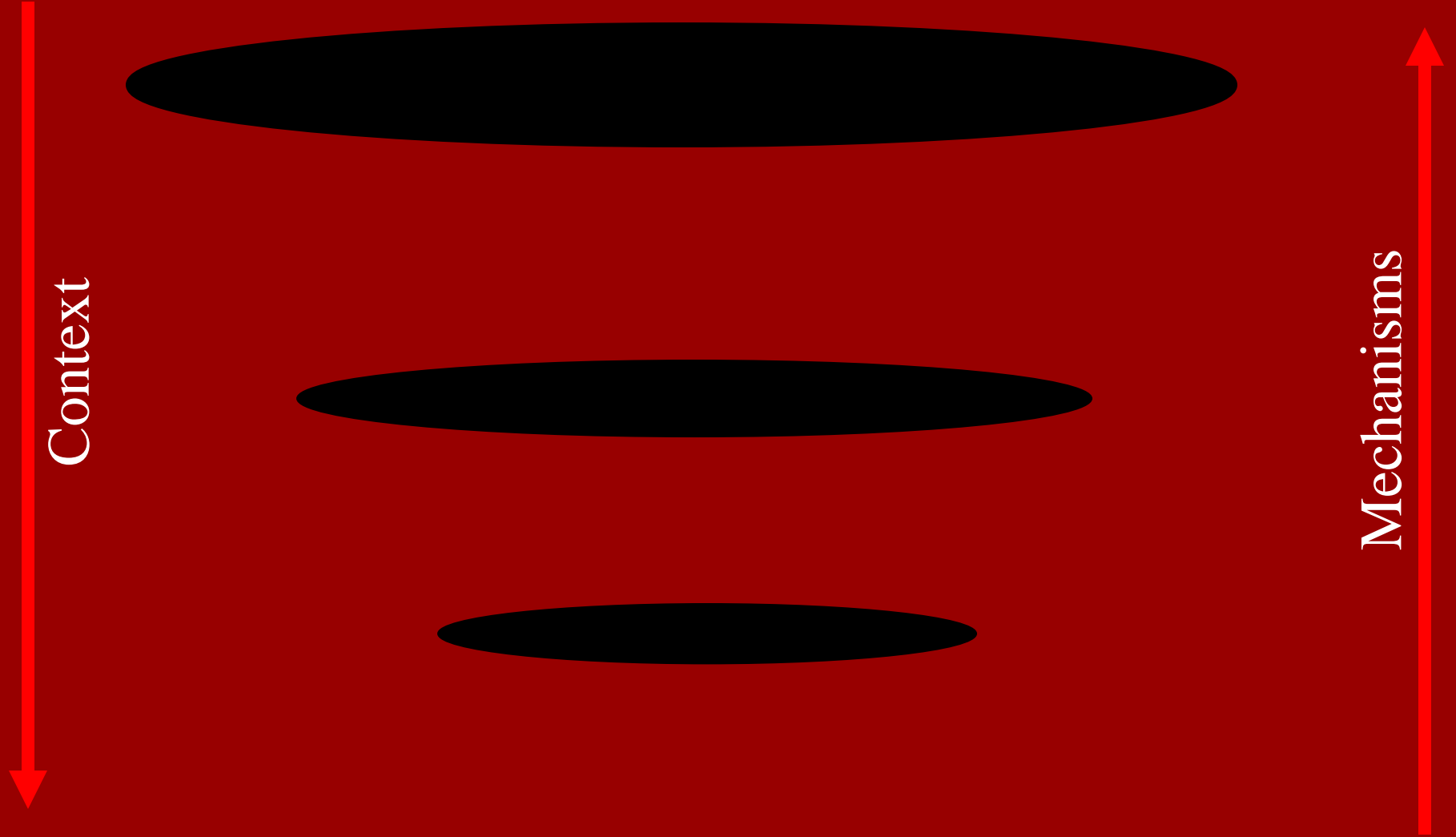
Scale



- Basalt, Gabbro
- Rainfall
- Uplands – Clay
- Away from water points
- North east aspect
- Low fire frequency
 - Granite
- High fire frequency
 - Basalt
- Close to streams
 - Basalt
- Close to roads
 - Tar



Hierarchical Patch Dynamics Approach



Key Issues

- Different patches in the landscape change differently over time
 - Scale of analysis strongly effects observed patterns of change
 - Managers need to be cognisant of this when setting conservation objectives
- Change is not randomly distributed through the landscape
 - Associated with environmental variables
 - Different variables at different scales
- Exploring these associations can help elucidate the underlying drivers of change
 - Spatially explicit analysis provides a tool for exploring effects of management practices on the landscape

Understanding the Future



Context



Mechanisms

Heterogeneity / Context Conscious

Acknowledgements

- Andrew Mellon Foundation

