

An automatic detection method for the study of ancient land improvement in karst:

# LIMESTONE PAVEMENTS, STONES REMOVAL AND FARMING

É. Fovet

With the collaboration of D. Goguey, J Bénard, E. Chevigny & L. Saligny

TRAIL 2016

# Karstic landscape

limestone pavements, karen, lapiaz...

North Yorkshire, England (Wikipedia)



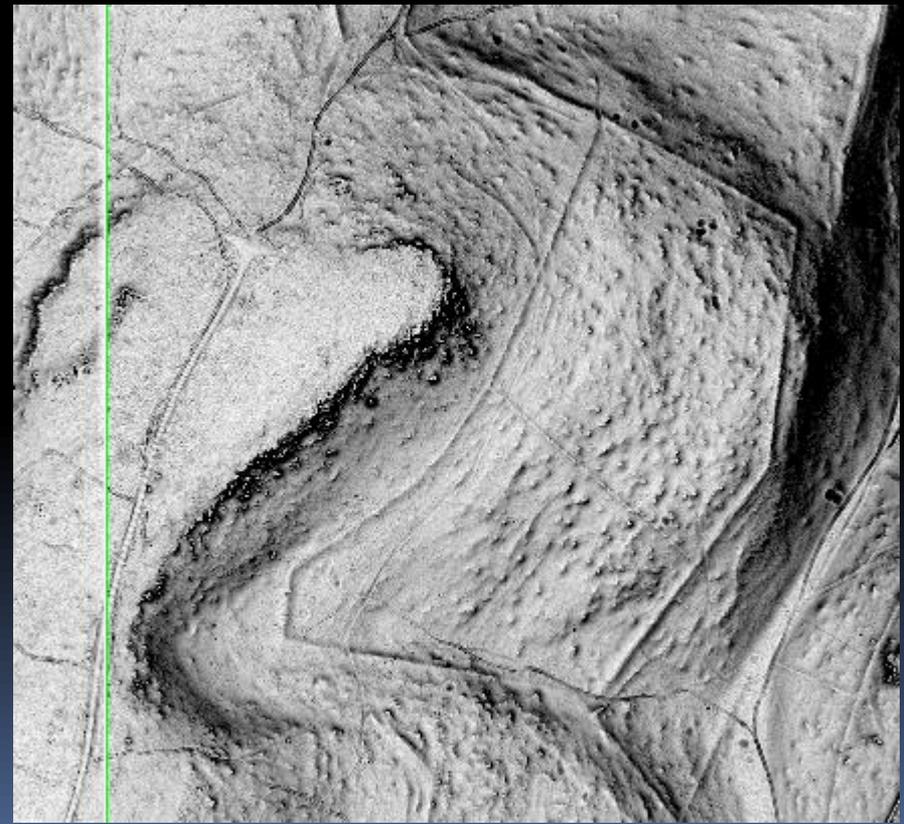
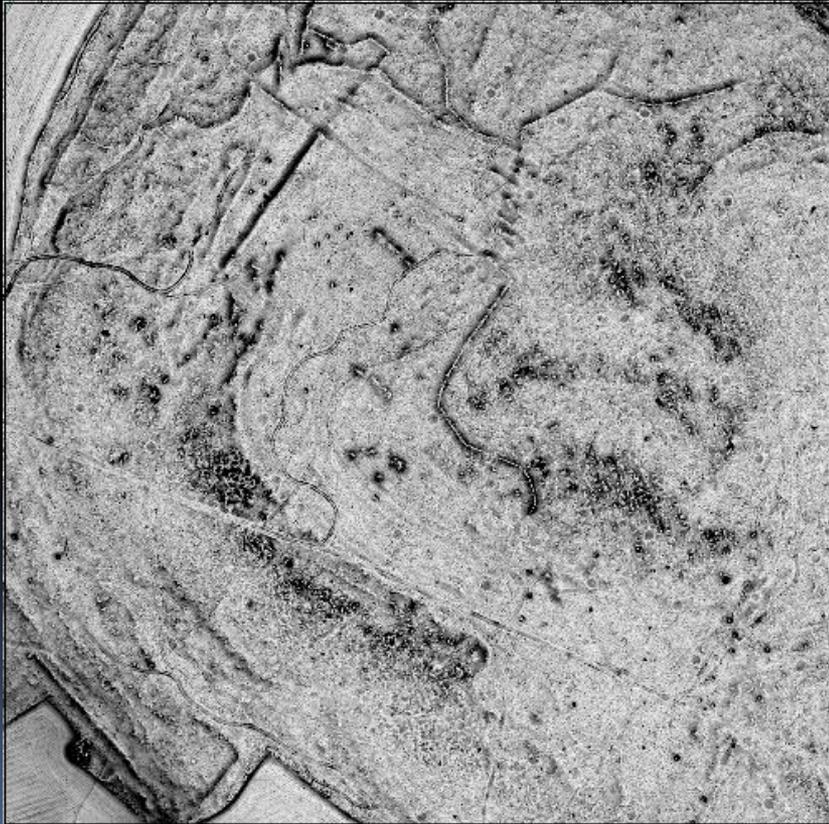
Châtillonnais, Burgundy, France  
(E. Fovet 2016)



Cantabria, Spain (Wikipedia)

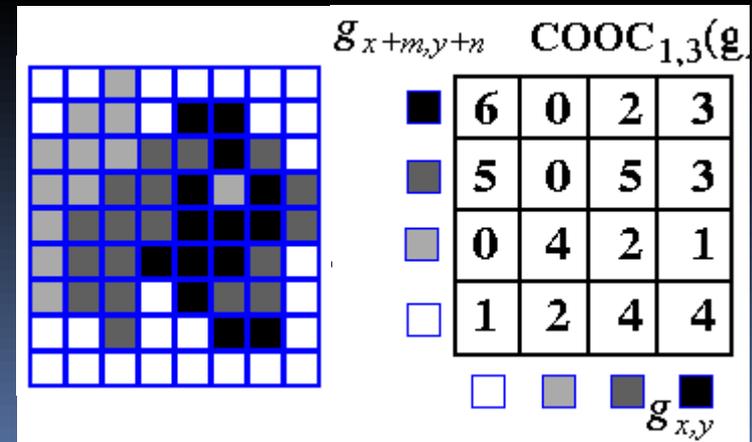
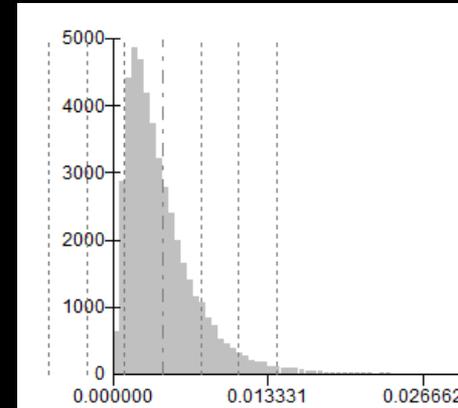


# Different types of surface landforms



# Digital approach to texture

- 1st order
  - Mean
  - Variance
  - Skewness
  - (...)
- 2<sup>nd</sup> order
  - Contrast
  - Orderliness
  - Statistic (e.g. Grey level linear dependence)

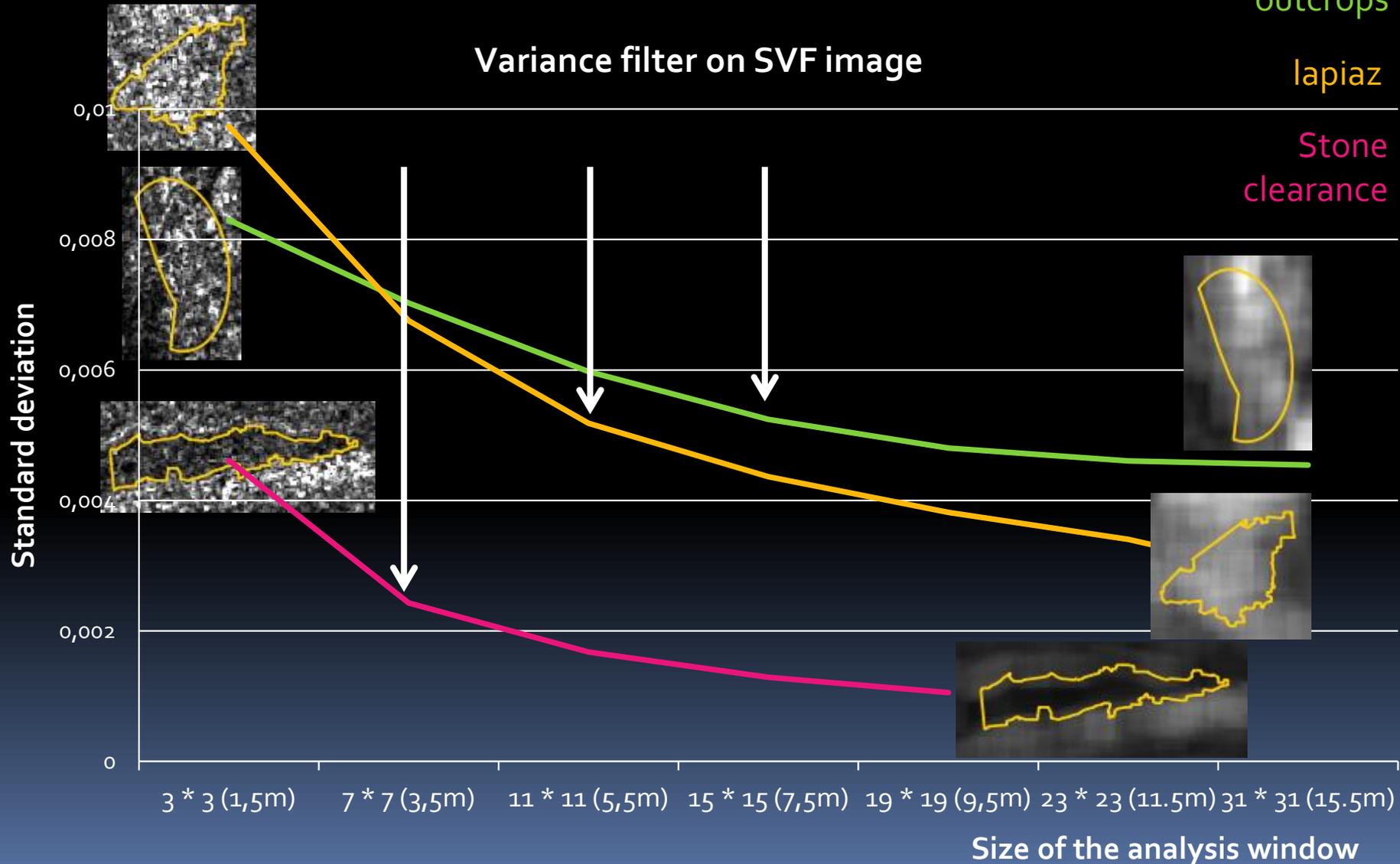


# Analysis window size

Rocky  
outcrops

lapiaz

Stone  
clearance

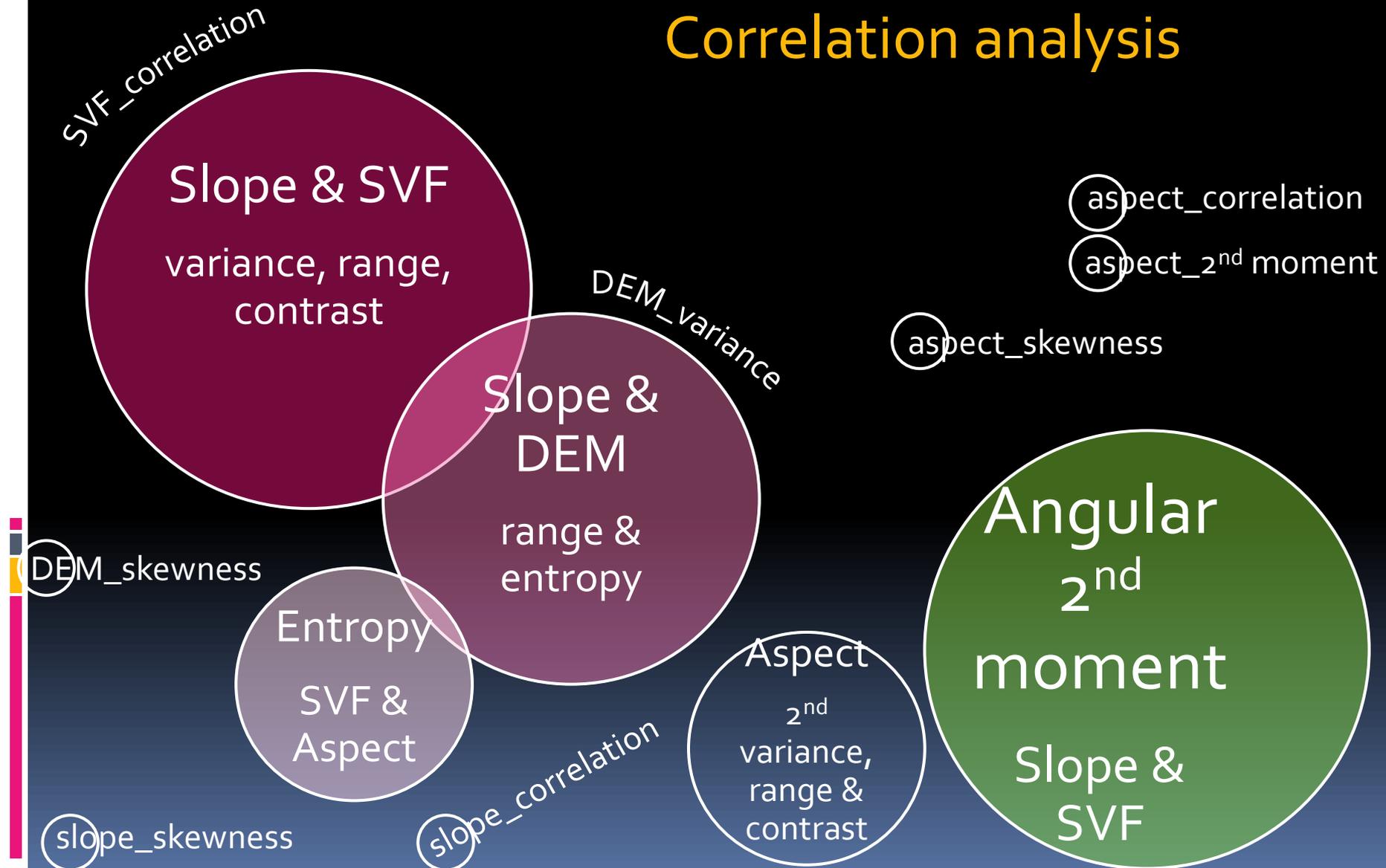


# Appropriate indices

- 1st order
  - Range
  - Variance
  - Skewness
  - Entropy
- 2<sup>nd</sup> order
  - Contrast
  - Angular second moment (orderliness)
  - Correlation (grey level linear dependence)
- DEM (altitude)
- Slope
- Aspect
- SkyView Factor (SVF)

# Appropriate indices

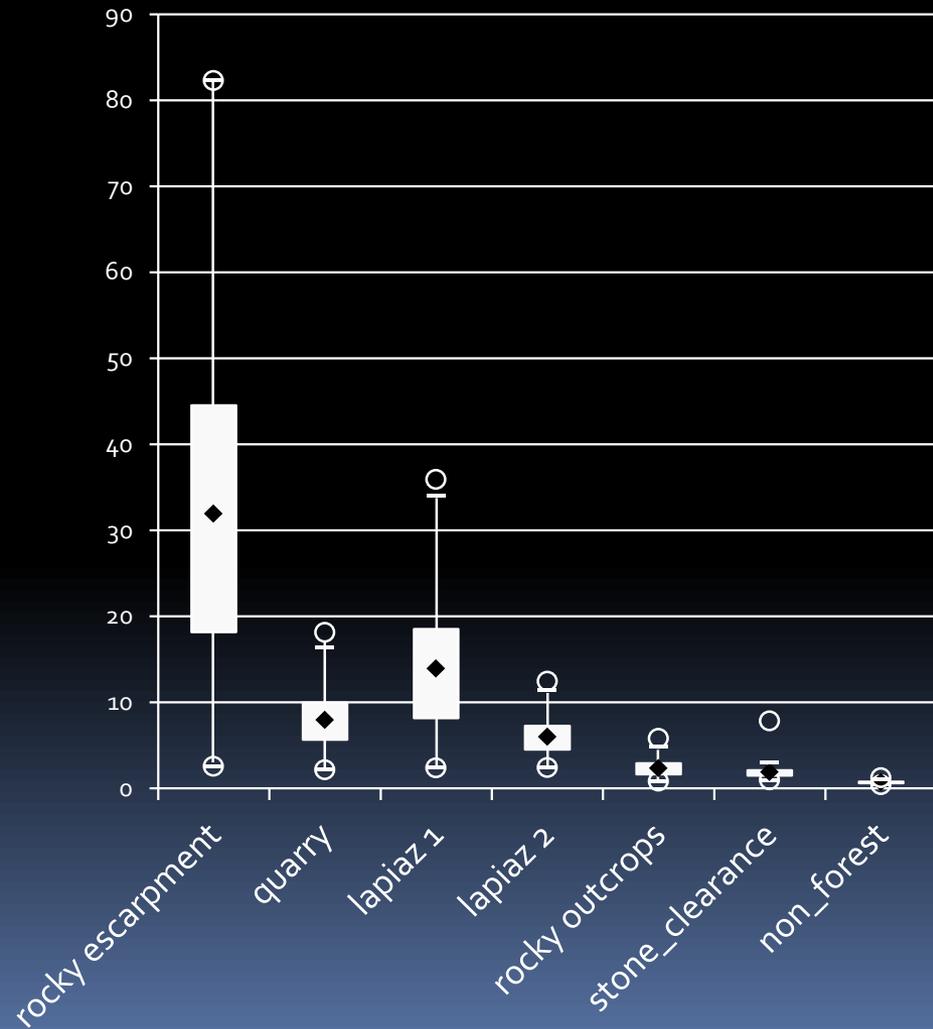
## Correlation analysis



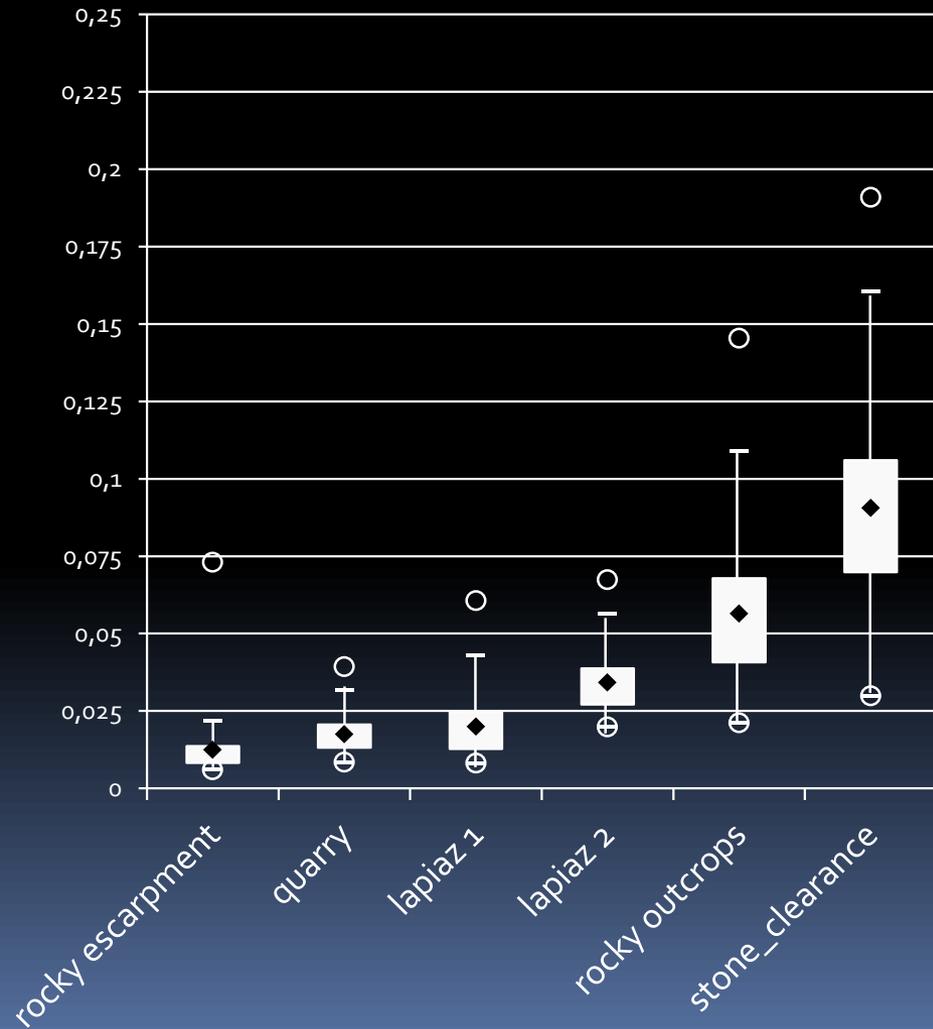
# Appropriate indices

## Samples analysis

### Contrast (SVF)



### Angular 2<sup>nd</sup> moment (SVF)



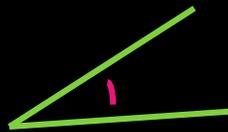
# Appropriate indices

SLOPE

SVF



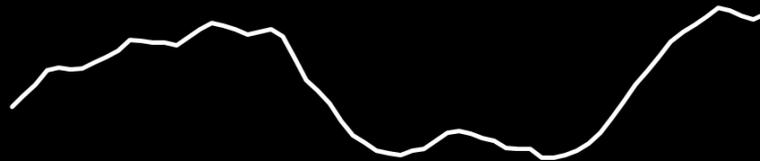
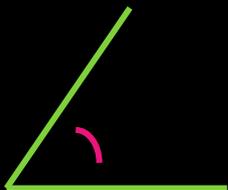
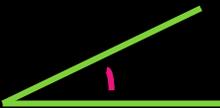
Stone clearance



Rocky outcrop



Lapiaz



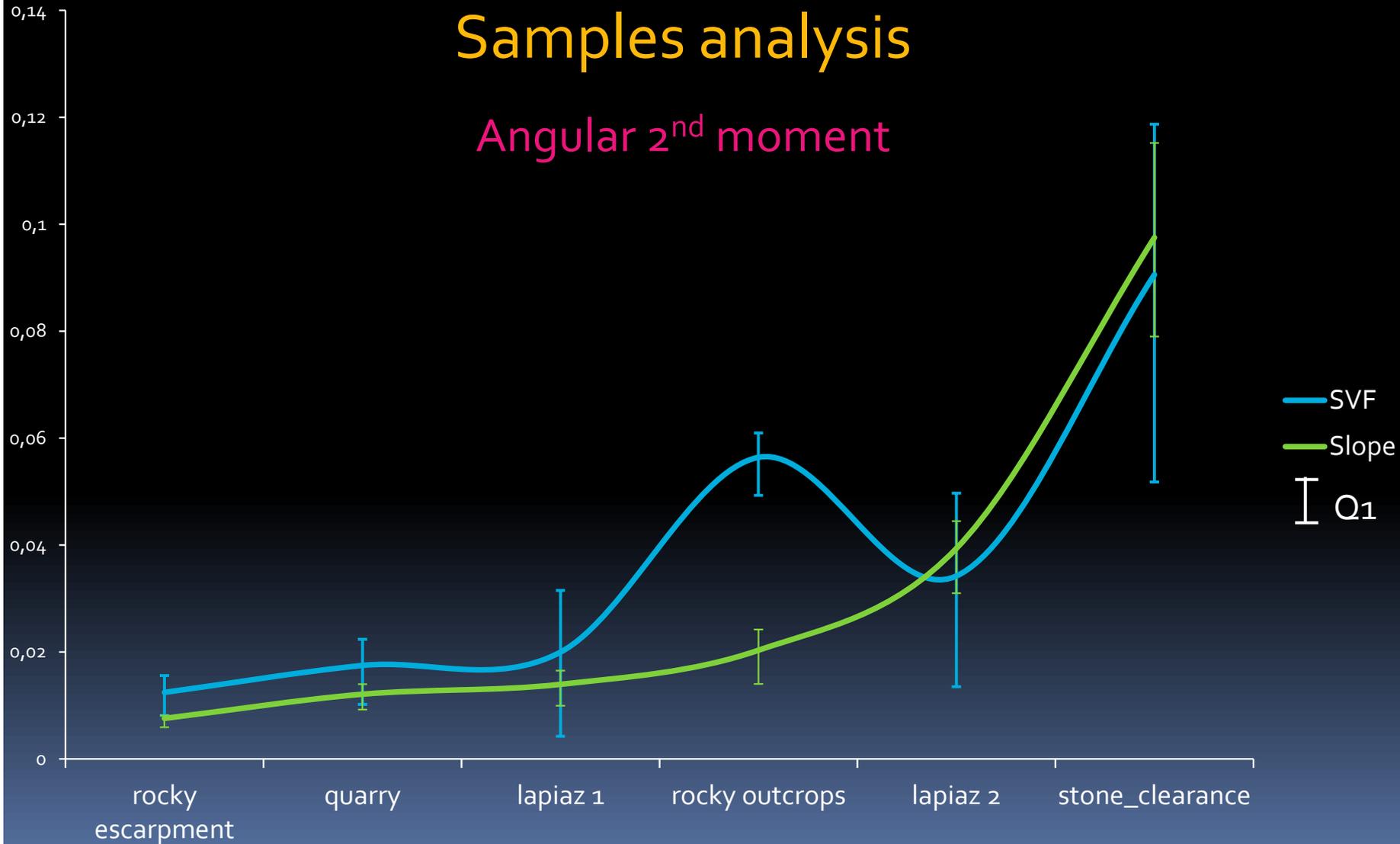
Quarry



# Appropriate indices

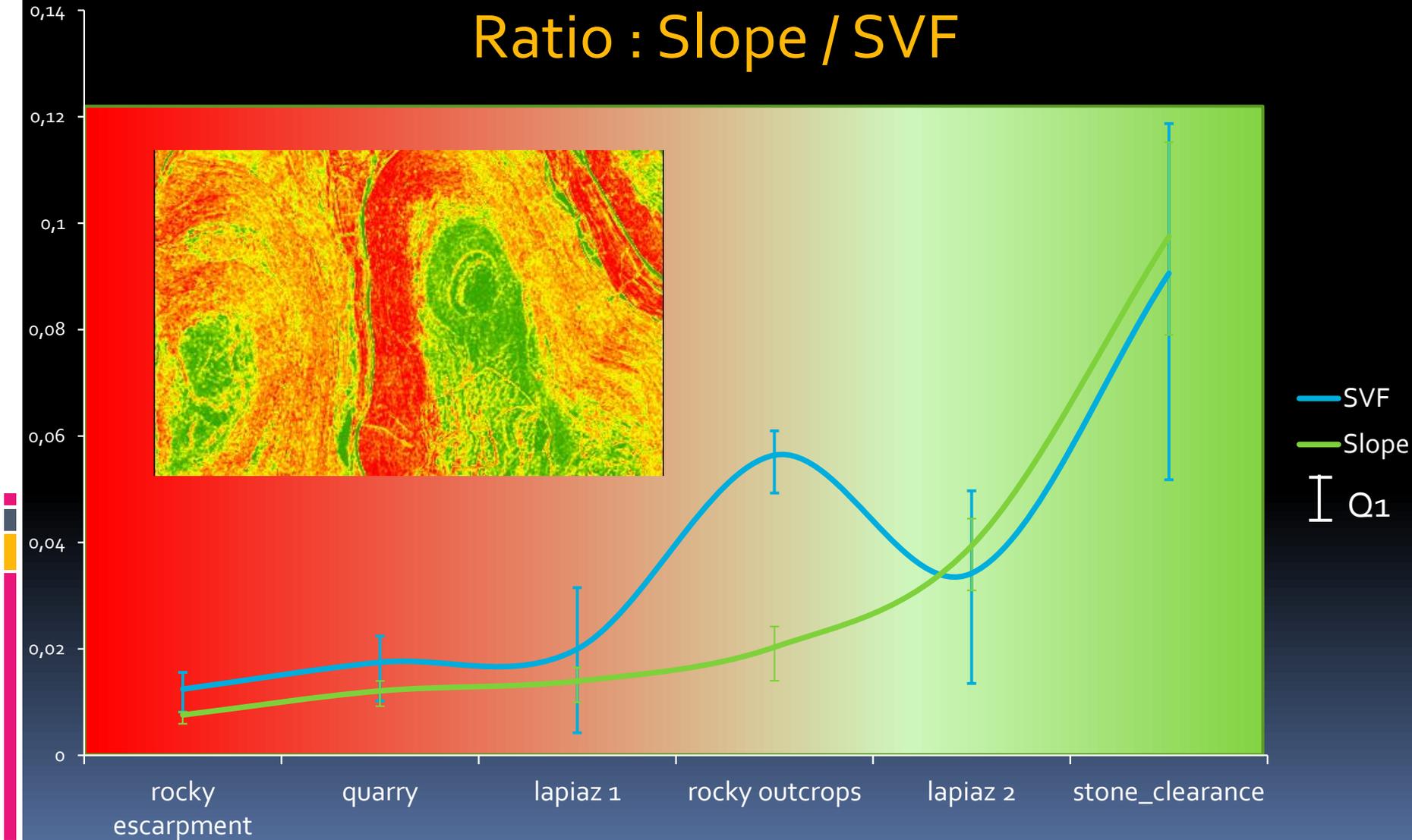
## Samples analysis

Angular 2<sup>nd</sup> moment

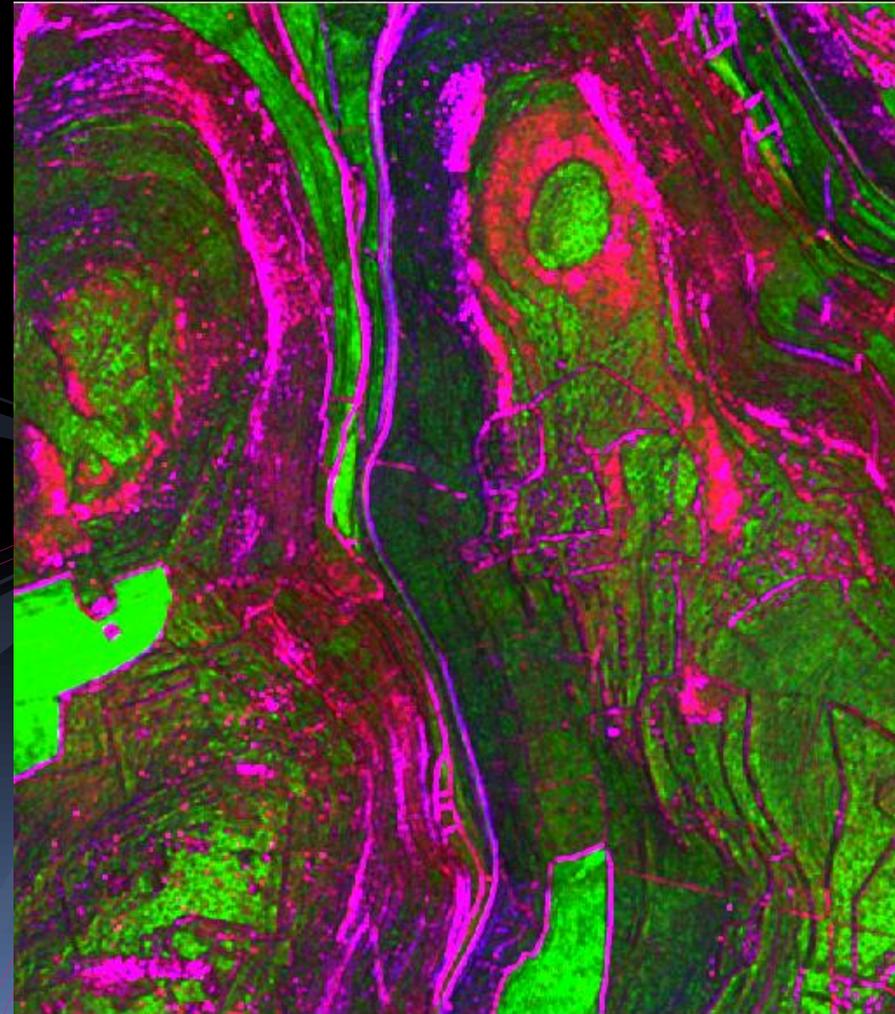


# Appropriate indices

Ratio : Slope / SVF



# Image-segments delineation and classification



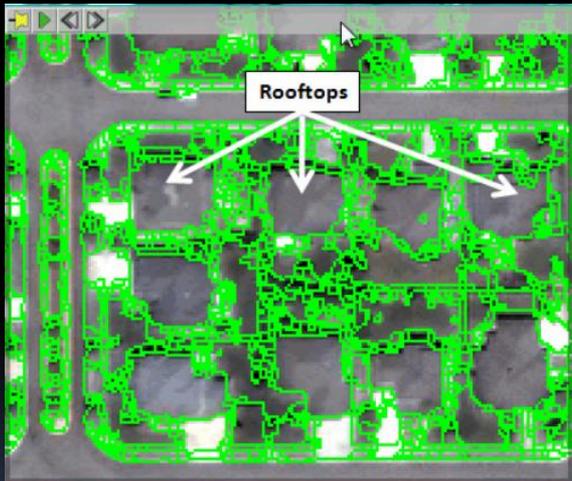


0 37.5 75 150 Meters

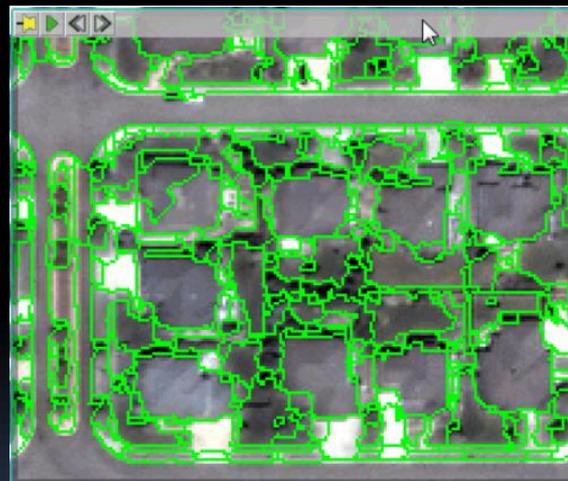


# Region growing method

## Principle:



segmentation

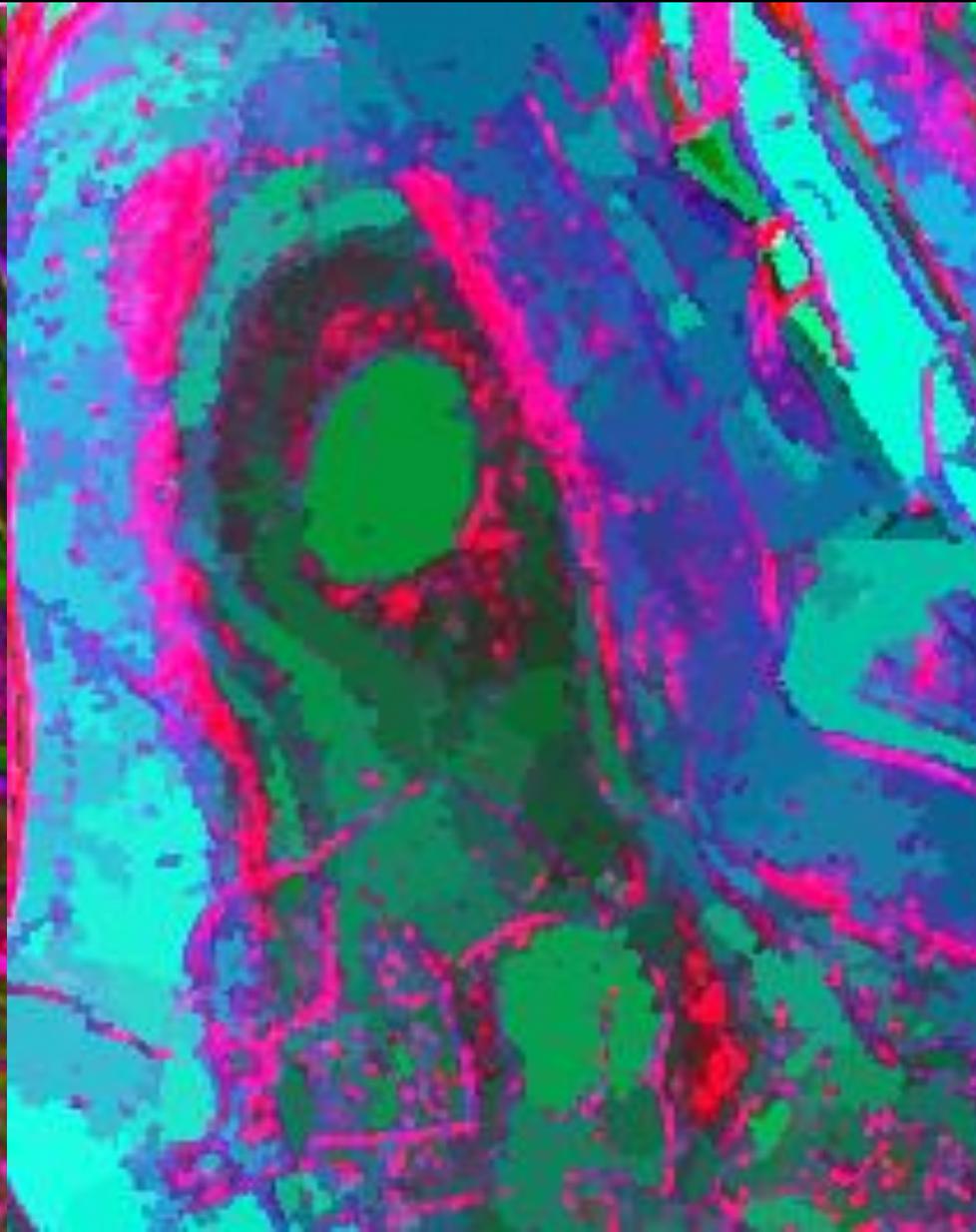
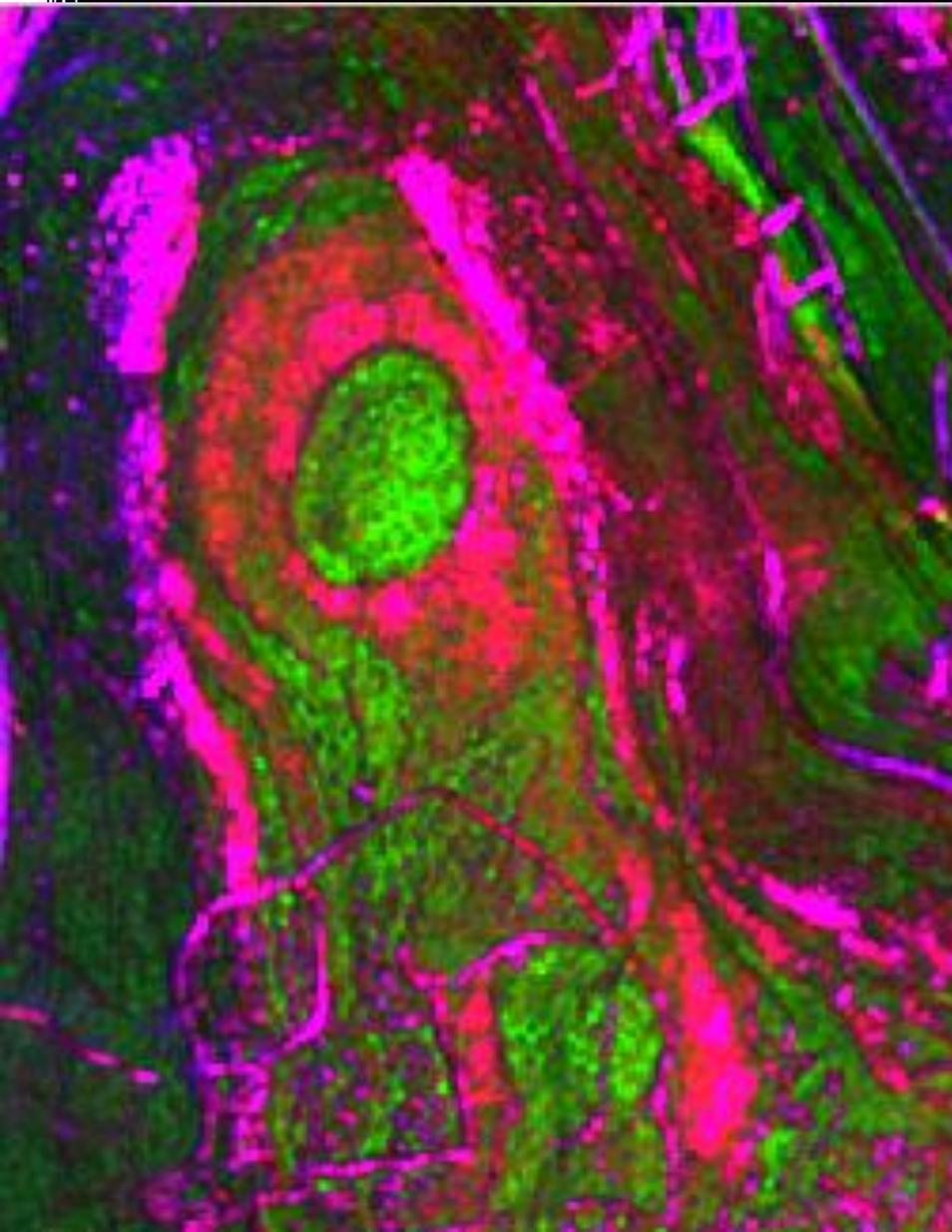


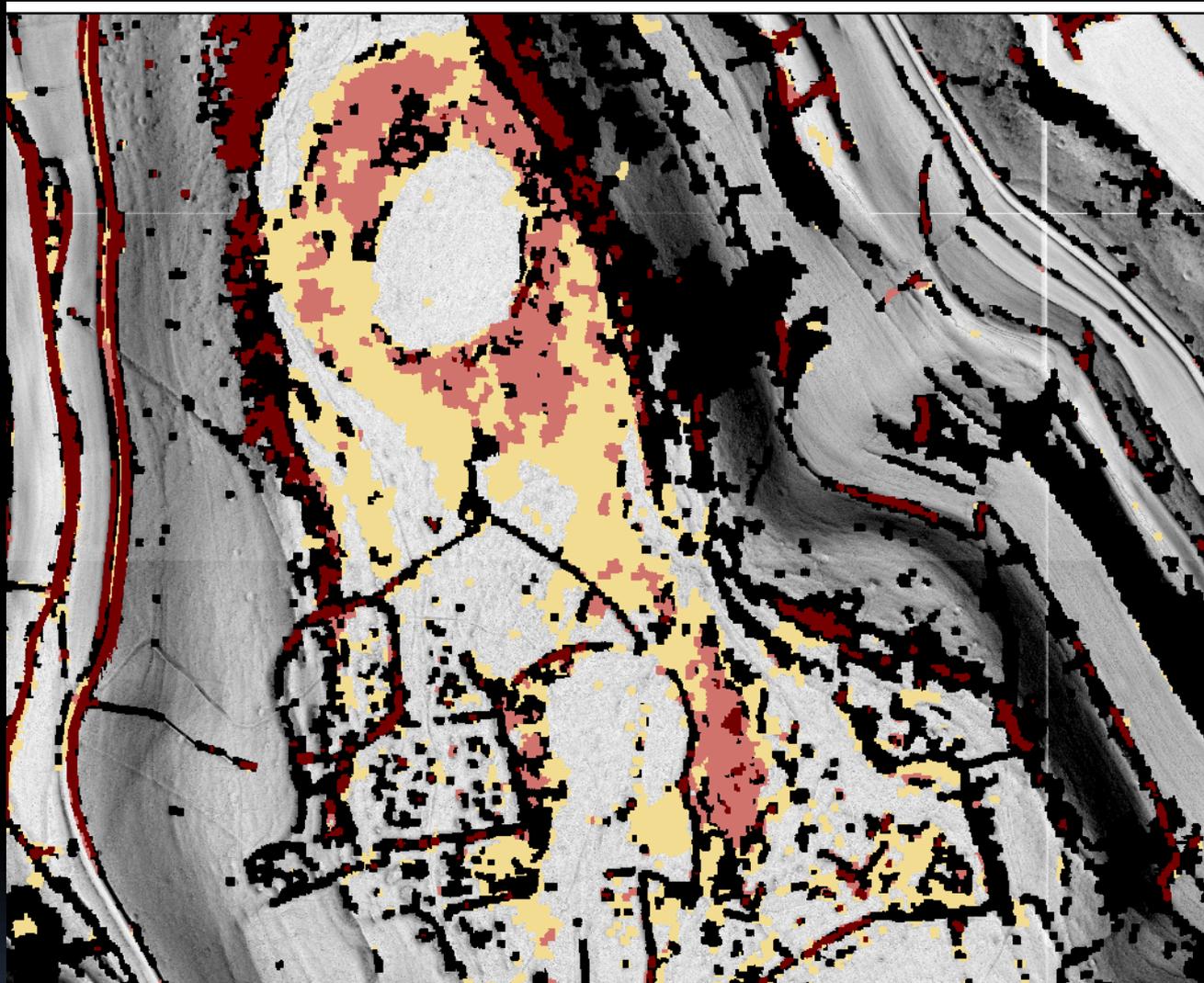
merging



classification

# Region growing method





**classe**

-  rocky escarpement / deep lapiaz
-  lapiaz
-  probable (shallow) lapiaz
-  undetermined

0 75 150 300 Meters

