# Investigate human responses to Late-Holocene changes of fluvial landforms through Spatial Point Pattern Analysis (Po Plain, N Italy)

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# PhD Project

*Linking Environmental Archaeology to Geoheritage: a multifaceted approach to unravel and promote past fluvial landscapes*

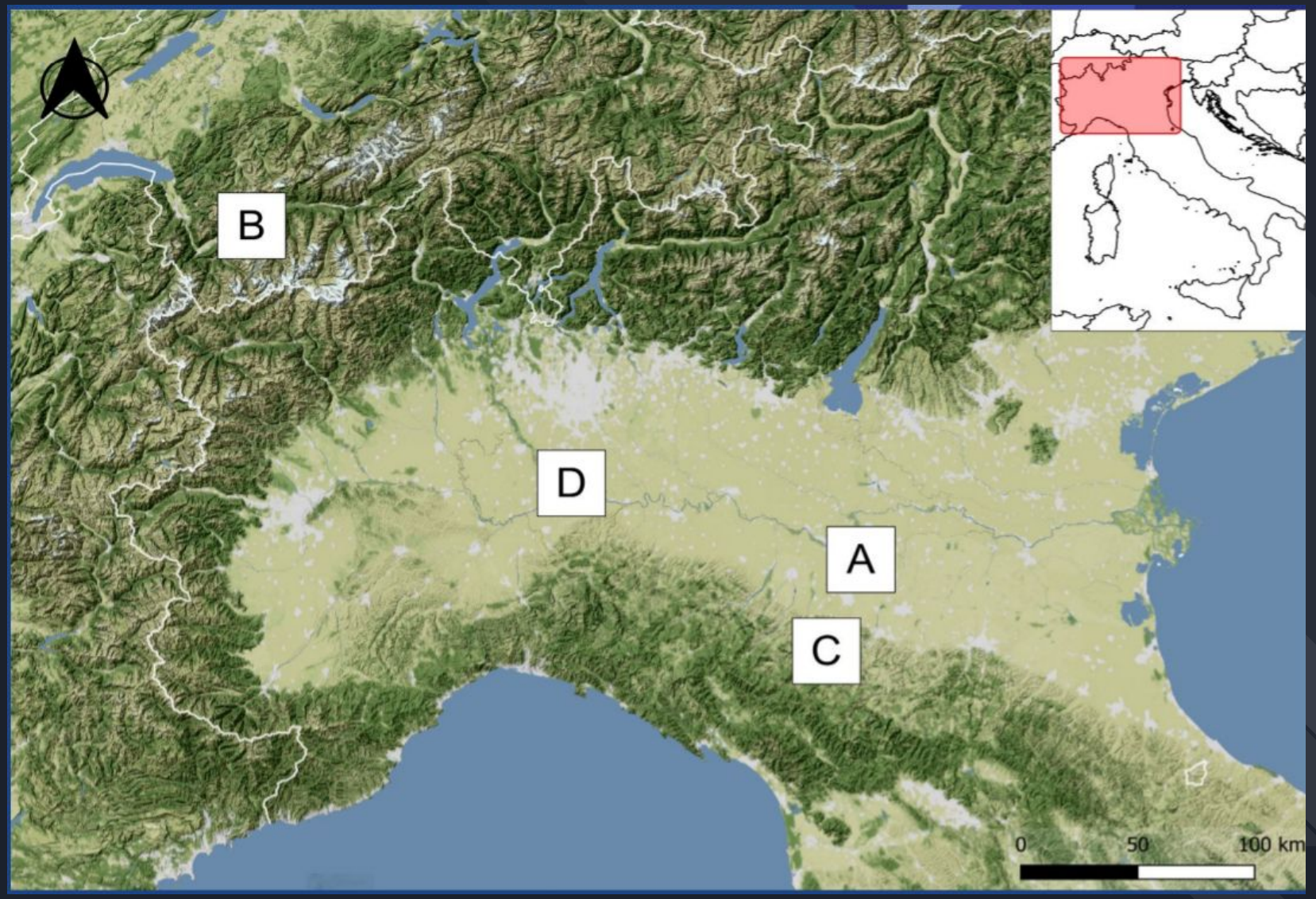
**Study Areas**

**A (Central Po Plain, Italy)**

B (*Upper Rhone Valley, Switzerland*)

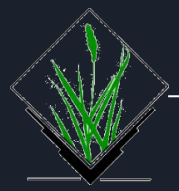
C (*Central Apennine valleys, Italy*)

D (*Ticino River fluvial terraces, Italy*)



# Ph.D. Workflow

- GIS modelling
- Geopedological data
- Archaeological data
- Historical data






- Geomorphology → Mapping landscape feature derived from human-environment interaction during the Late-Holocene
- GeoSpatial Analysis → Assessing the role of alluvial geomorphology on Late-Holocene settlement strategies

- Geoheritage → Promoting the conservation and valorisation of landscape features through geocultural itineraries

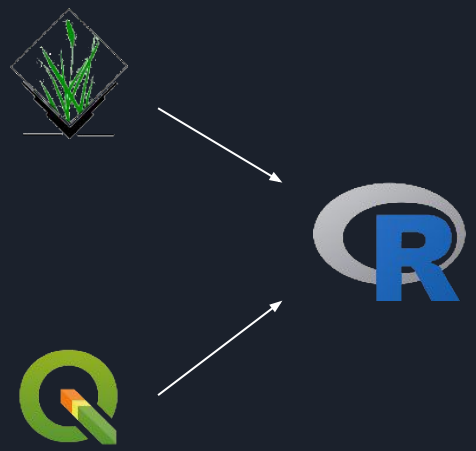
**DATA ACQUISITION** **PROCESSING** **RESULTS**

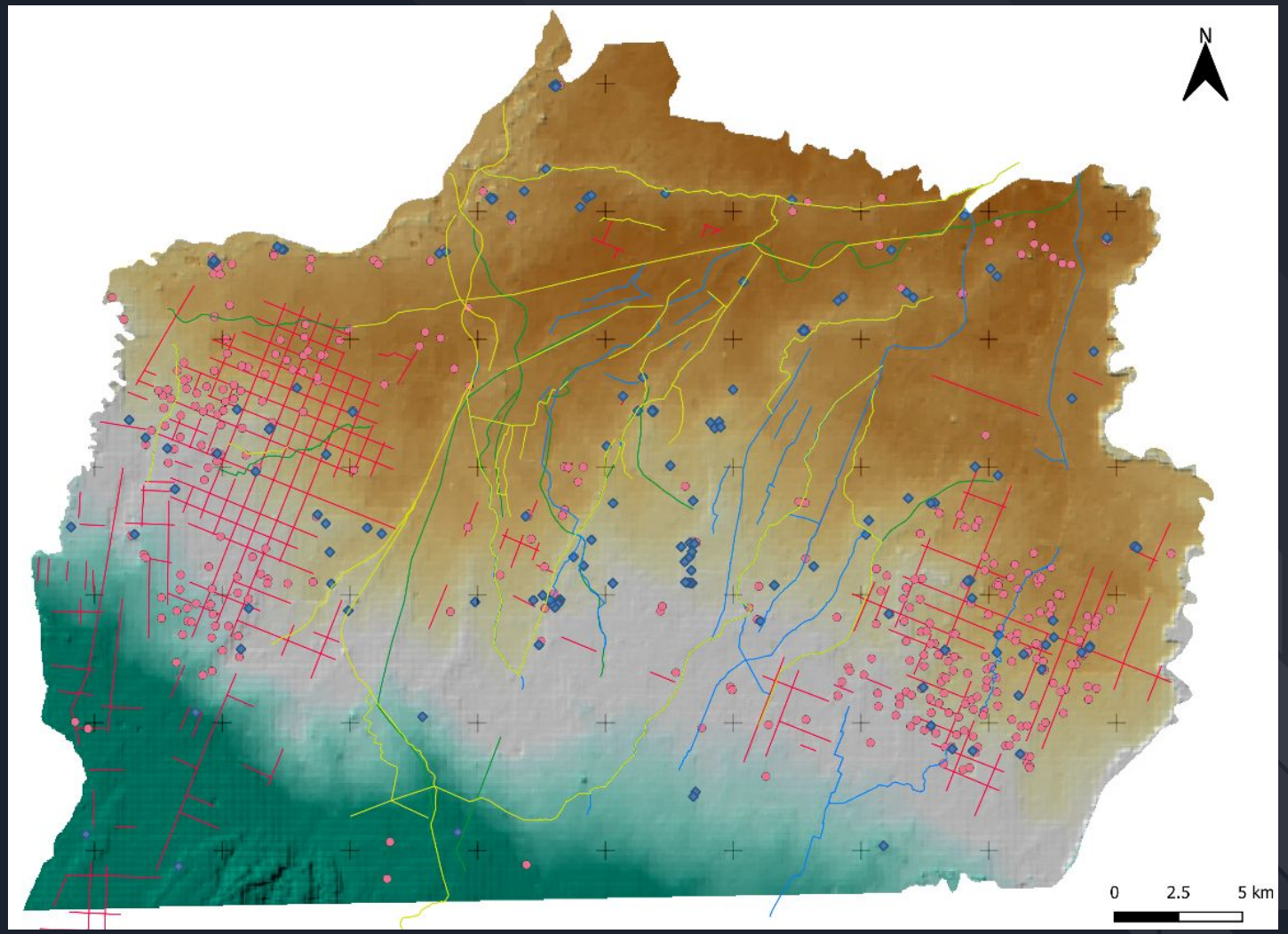
# Assessing the role of alluvial geomorphology for settlement strategies with Spatial Point Pattern Analysis

AIMS

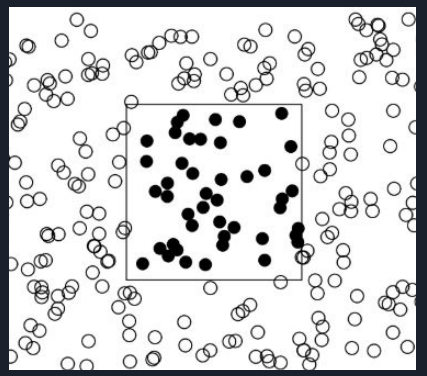
- estimating if the different water management strategies in the Roman and Medieval periods influenced the spatial distribution of sites

- evaluating the relative importance of agricultural suitability over flood risks in the two historical phases.





# Point Pattern Analysis (PPA)



$n(X \cap B)$

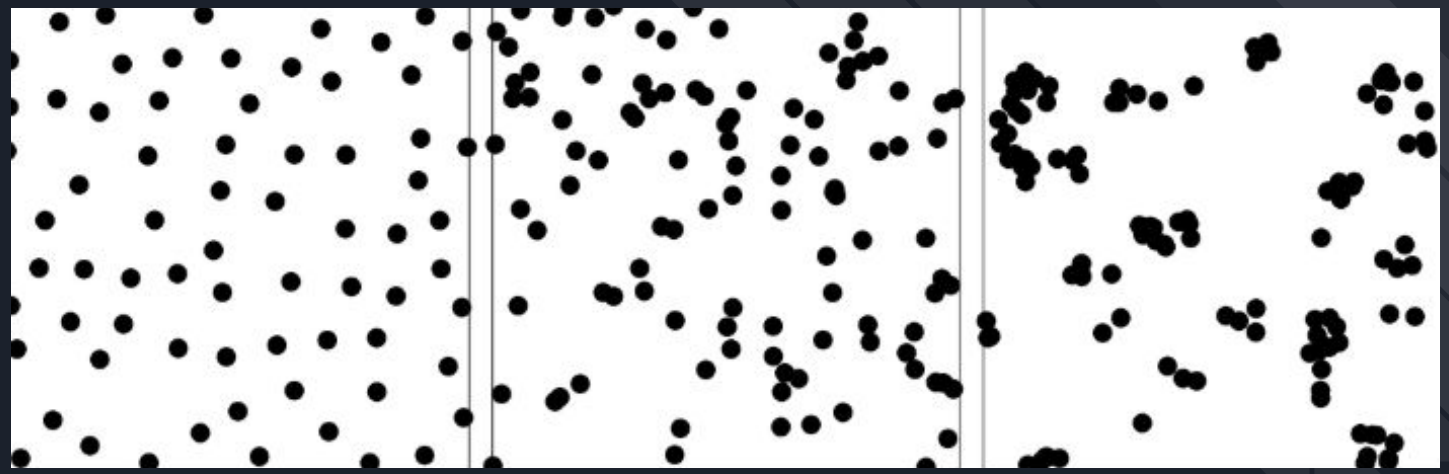
*n* = point pattern
X = point process (Poisson)
B = bounded region

Effects of point process intensity → first-order properties

- Intensity
  - constant within the region → (HPP)
  - spatially variable → (IPP)
    - spatial covariates

Correlation → second-order properties

- Spatial interaction of events (X,Y,...)
  - aggregation
  - segregation

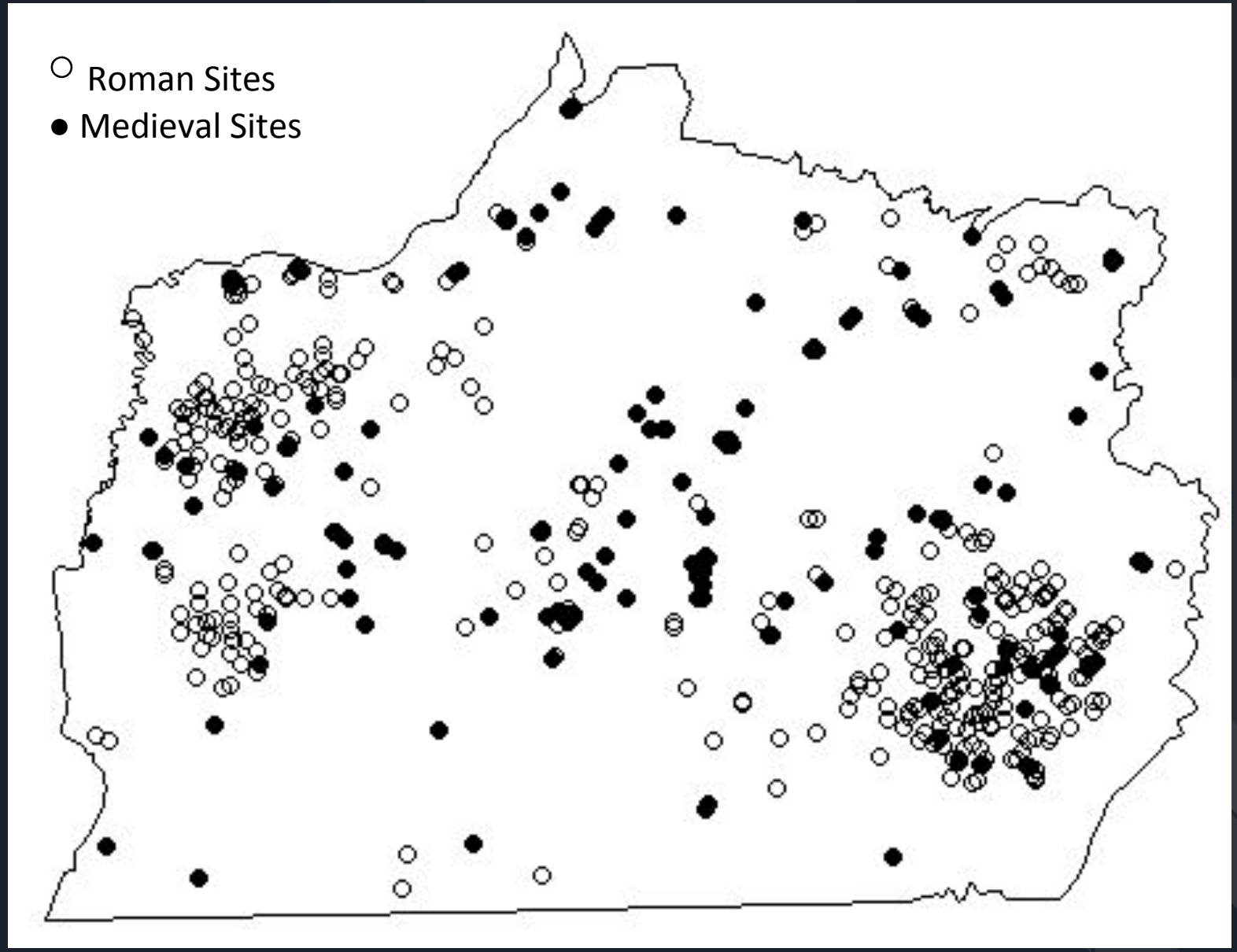



**Regular** *Repulsion* **CSR** *Attraction* **Clustered**

## Null hypotheses:

- *Ha*: At large-scale, the density of Roman/Medieval sites is uniform

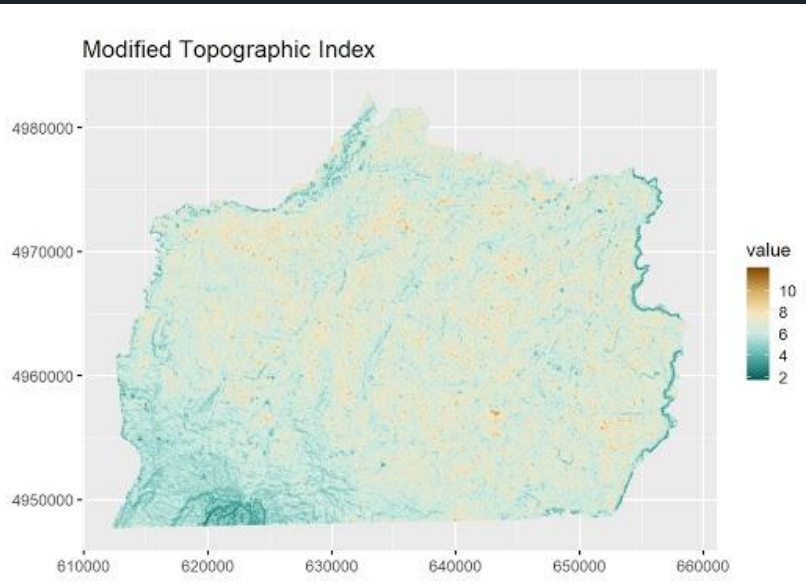
- *Hb*: At small-scale, the distribution of Medieval and Roman sites are spatially independent

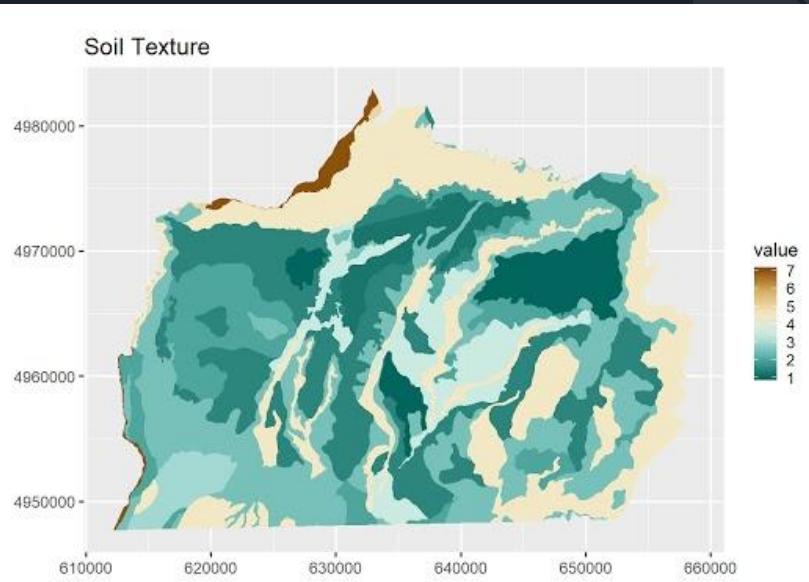


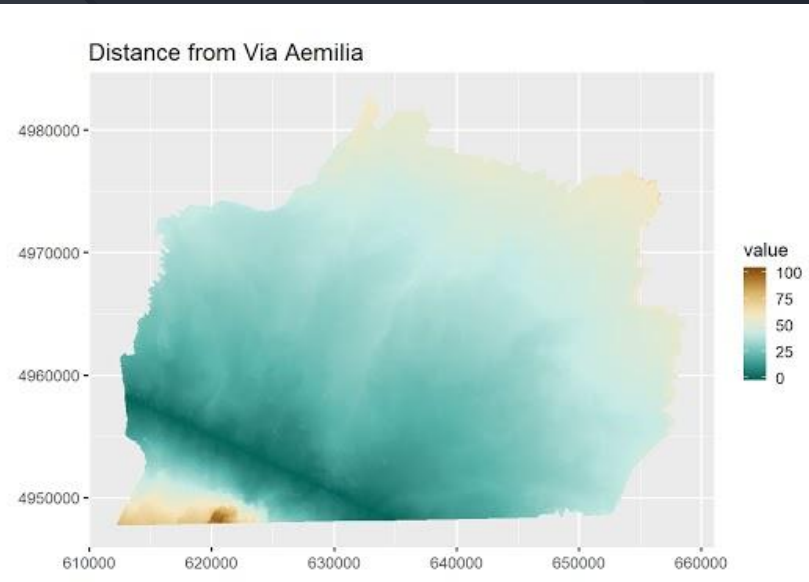
# Spatial Covariates

- Flood hazard □ Modified Topographic Index (MTI)
- Agriculture suitability □ Soil texture (Soil)
- Distance from *via Aemilia* □ VAE

*Grass 7*



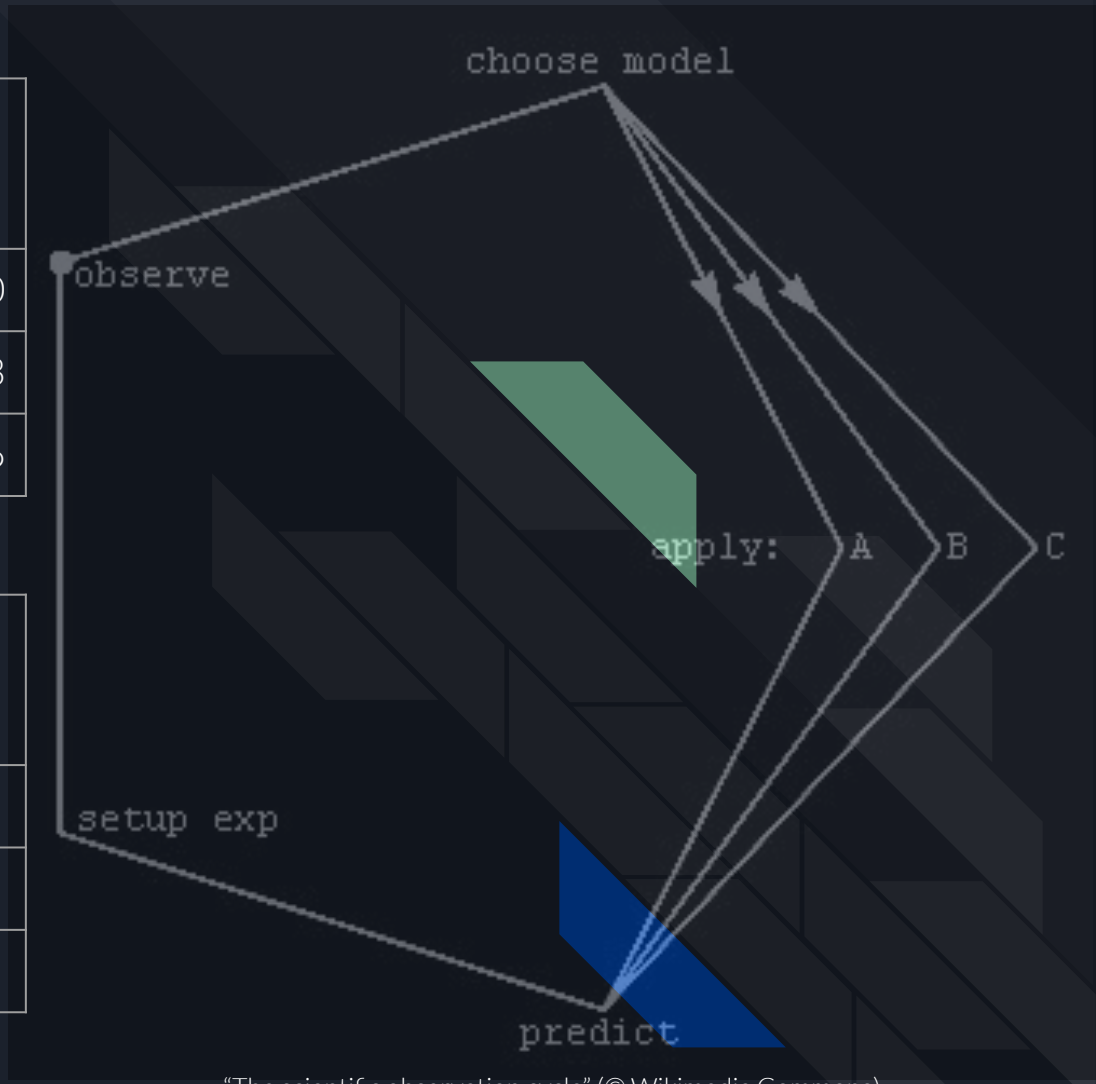




- Model 0, Model 1, Model 2 have been created for Roman (R) and Medieval (M) sites.

# Schwarz’s Bayesian Information Criterion (BIC)

| Model R | Selected Covariates | Discarded Covariates | BIC | df | Weights Model 0-1 | Weights Model 0-2 |
|---|---|---|---|---|---|---|
| 0 | - | - | 12105.69240972 | 0 | 0.2120797 | 0.201900 |
| 1 | Soil | MTI | 12103.06753956 | 1 | 0.7879203 | 0.750103 |
| 2 | VAE | | 12108.56572157 | 1 | - | 0.047996 |

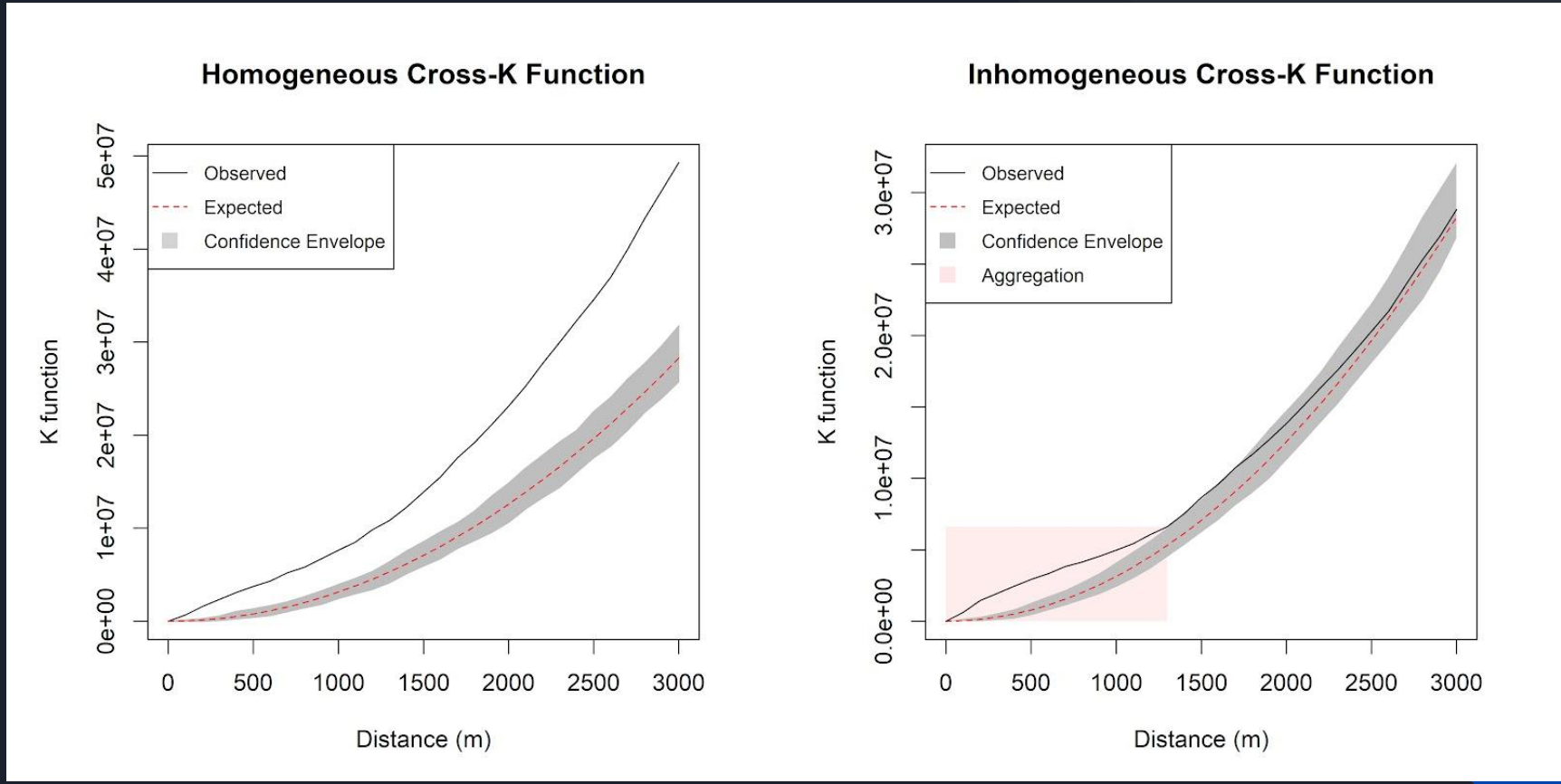
| Model M | Selected Covariates | Discarded Covariates | BIC | df | Weights Model 0-1 | Weights Model 0-2 |
|---|---|---|---|---|---|---|
| 0 | - | - | 5389.107074615 | 0 | 0 | 0 |
| 1 | MTI, Soil | - | 5328.237281848 | 2 | 1 | 1 |
| 2 | VAE | | 5384.960433685 | 1 | - | 0 |




“The scientific observation cycle” (© Wikimedia Commons)

# Assessing the spatial interaction of Medieval and Roman sites using cross-K function

The inhomogeneous cross-K function shows a significant deviation of the observed values from the confidence envelope between 0 and 1.2 km.

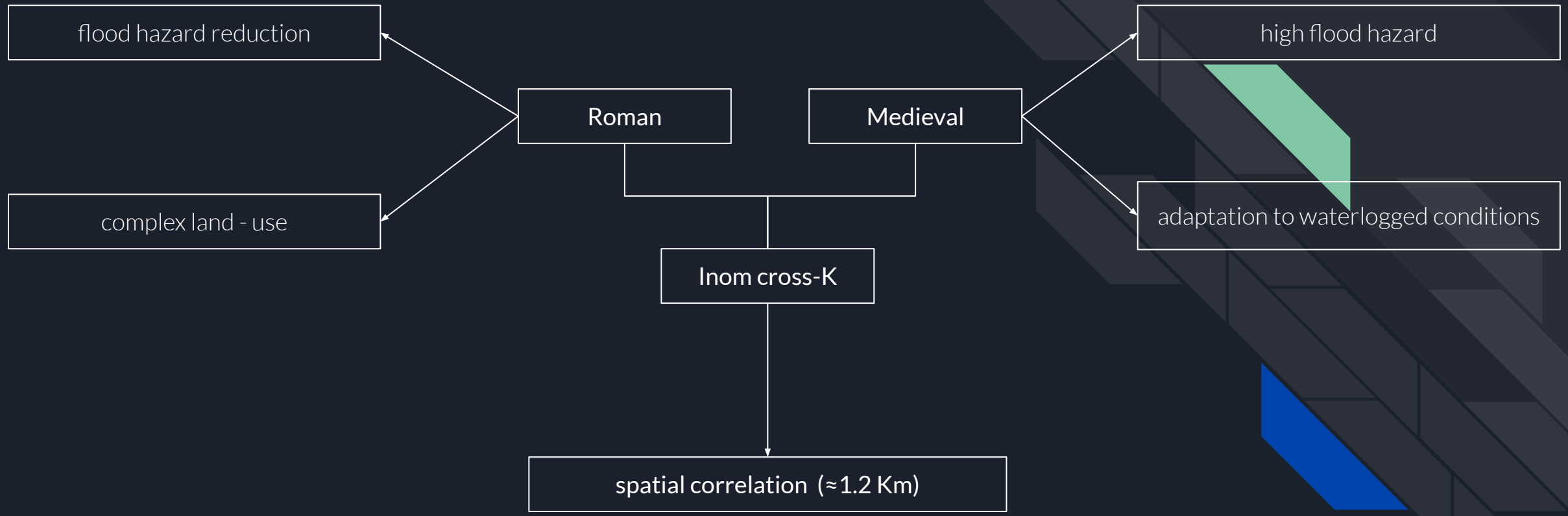



*Hb* hypothesis can be rejected !!!

The distinct Roman and Medieval settlement strategies do not explain the proximity of Medieval and Roman sites when sites are closer than 1.2 km.

# Conclusion

Social and cultural dynamics played a crucial role in responding to alluvial geomorphological environmental challenges in different times.



# Publications: results & data

## Research paper


Brandolini, Filippo; Carrer, Francesco, *"Terra, Silva et Paludes*. Assessing the Role of Alluvial Geomorphology for Late-Holocene Settlement Strategies (Po Plain – N Italy) Through Point Pattern Analysis" https://doi.org/10.1080/14614103.2020.1740866

## Dataset

HARVARD Dataverse

Brandolini, Filippo, 2020, "Late-Holocene human resilience in a fluvial environment: a geoarchaeological database for the Central Po Plain (N Italy)", https://doi.org/10.7910/DVN/JSYZ3H, Harvard Dataverse, V3

## Data paper

Journal of open archaeology data — ubiquity press open access

Brandolini, Filippo, 2020, "Late-Holocene human resilience in a fluvial environment: a geoarchaeological database for the Central Po Plain (N Italy)", Journal of Open Archaeology Data, *in press*

# *THANK YOU FOR YOUR ATTENTION !*