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research

Land-use history and trace metal concentration to assess the impact of agricultural management on soil

Genova, G.[1,2,*], Niedrist G.[2], Tasser, E.[2], Borruso, L.[1], Cesco S. [1], Mimmo, T.[1,3]

[1] Free University of Bolzano, Faculty of Science and Technology, Bolzano/Bozen, Italy
[2] Eurac Research, Institute for Alpine Environment, Bolzano/Bozen, Italy
[3] Competence Centre for Plant Health, Free University of Bolzano, Bolzano/Bozen, Italy

Young Soil Researchers Forum (YSRF)
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Introduction
Soils heavy metals and agricultural practices

- Soil: crucial role for mankind and ecosystems
- Copper: micronutrient, toxic at high concentrations
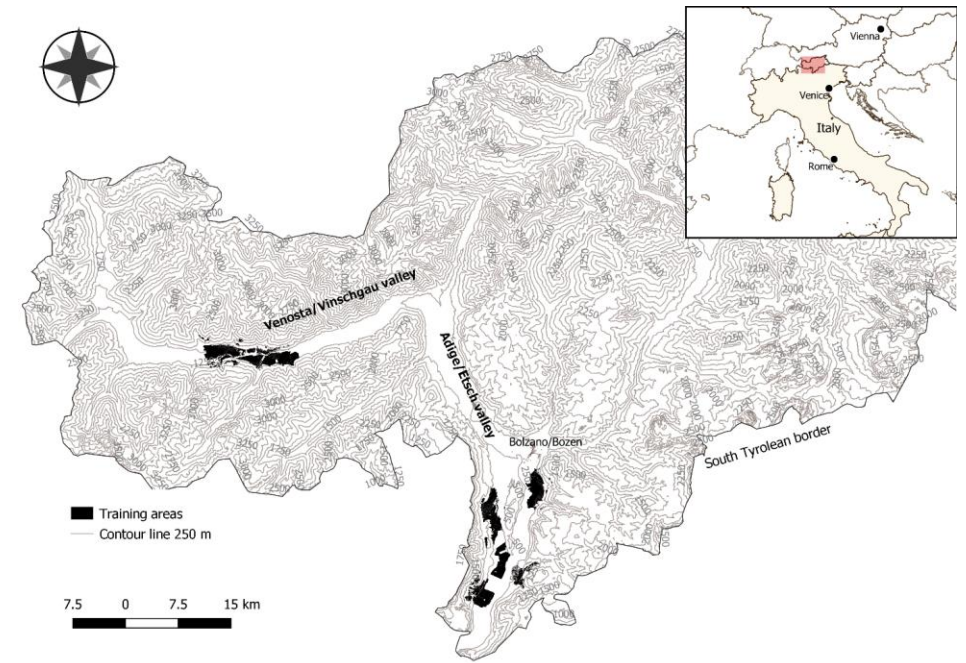- Accumulation over time in soils

Research questions

What link between Cu and land use history?

- Does land-use history affect soil heavy metal concentration?
- Can we quantify the heavy metal accumulation?
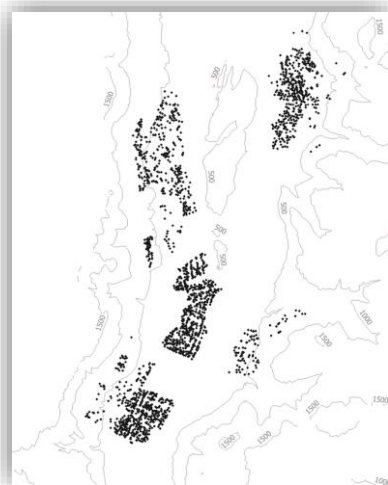- Can we predict land-use history from current soil data?

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Materials
Study area and data

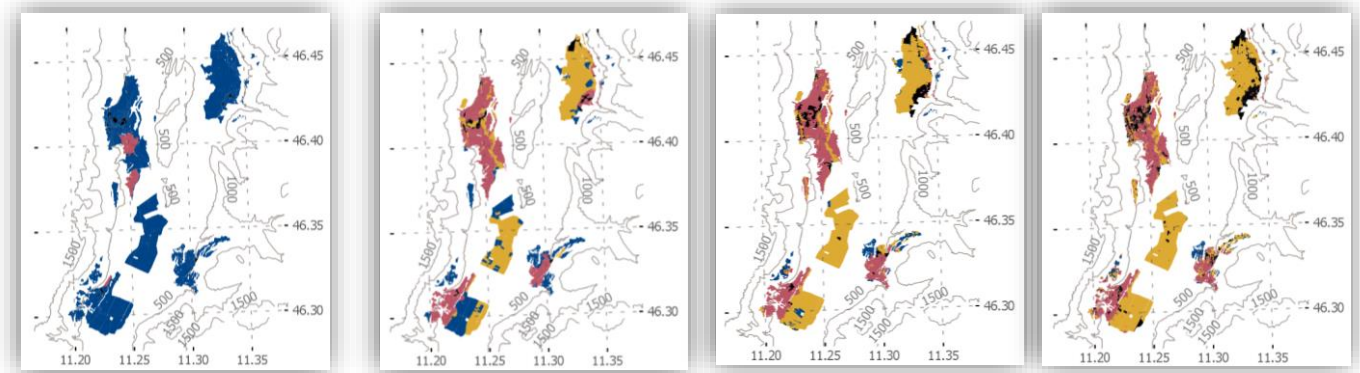Training areas
Contour line 250 m

7.5 0 7.5 15 km

Soil samples

5203 in training areas
44132 soil samples

Land use maps

1850   1950   1980   2010

■ Grasslands ■ Orchards ■ Vineyards

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Methods
Spatial overlay - Chronosequence - Machine learning model

Land use history maps

Soil samples

Soil analysis	Land use 1850	Land use 1950	Land use 1980	Land use 2010
Cu, Zn, … chemical/physical	Grassland	Vineyard	Vineyard	Orchard

Methods
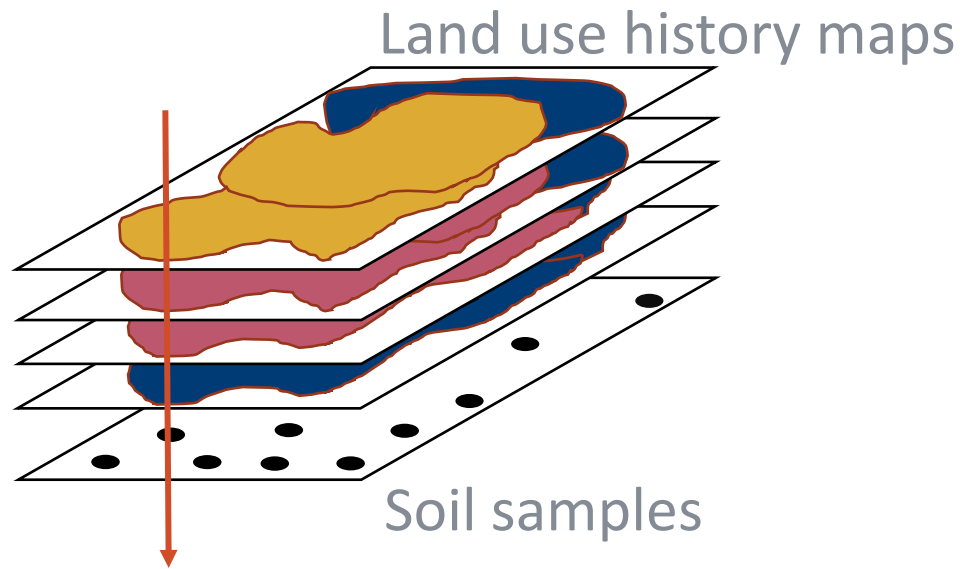## Spatial overlay - Chronosequence - Machine learning model

Land use history maps

Soil samples
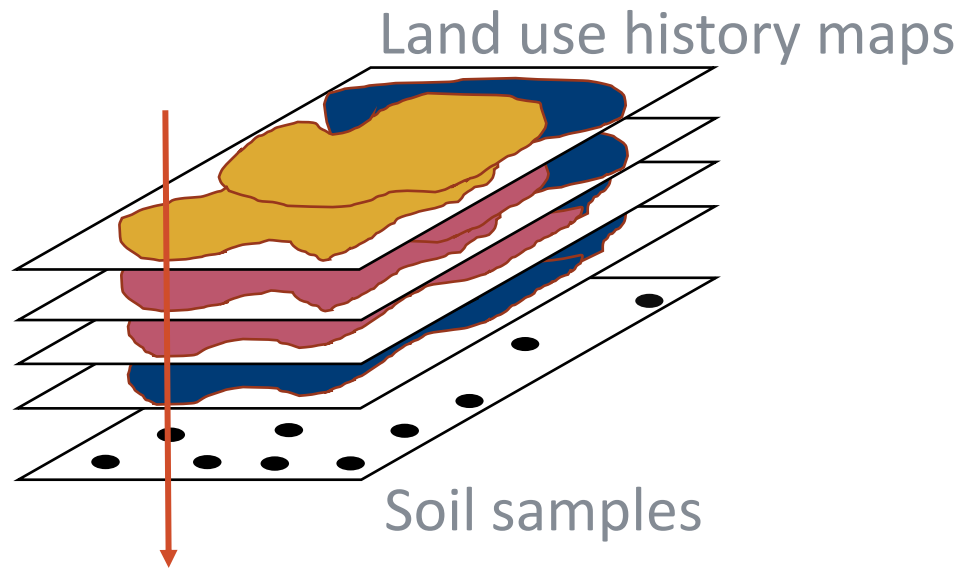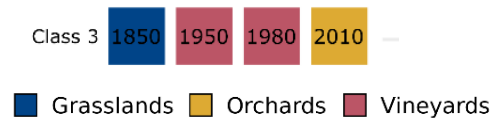
- Chronosequence classes: metal **accumulation**

| Class 3 | 1850 | 1950 | 1980 | 2010 |

■ Grasslands   ■ Orchards   ■ Vineyards

Soil analysis	Land use 1850	Land use 1950	Land use 1980	Land use 2010
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Spatial overlay - Chronosequence - Machine learning model
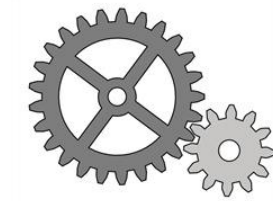
Land use history maps

Soil samples

Soil analysis	Land use 1850	Land use 1950	Land use 1980	Land use 2010
Cu, Zn, ... chemical/physical	Grassland	Vineyard	Vineyard	Orchard

- Chronosequence classes: metal **accumulation**

- Machine learning classifier: predict **land use history** from **soil data**

Model
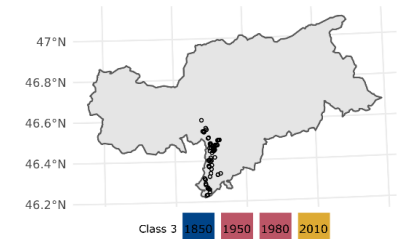
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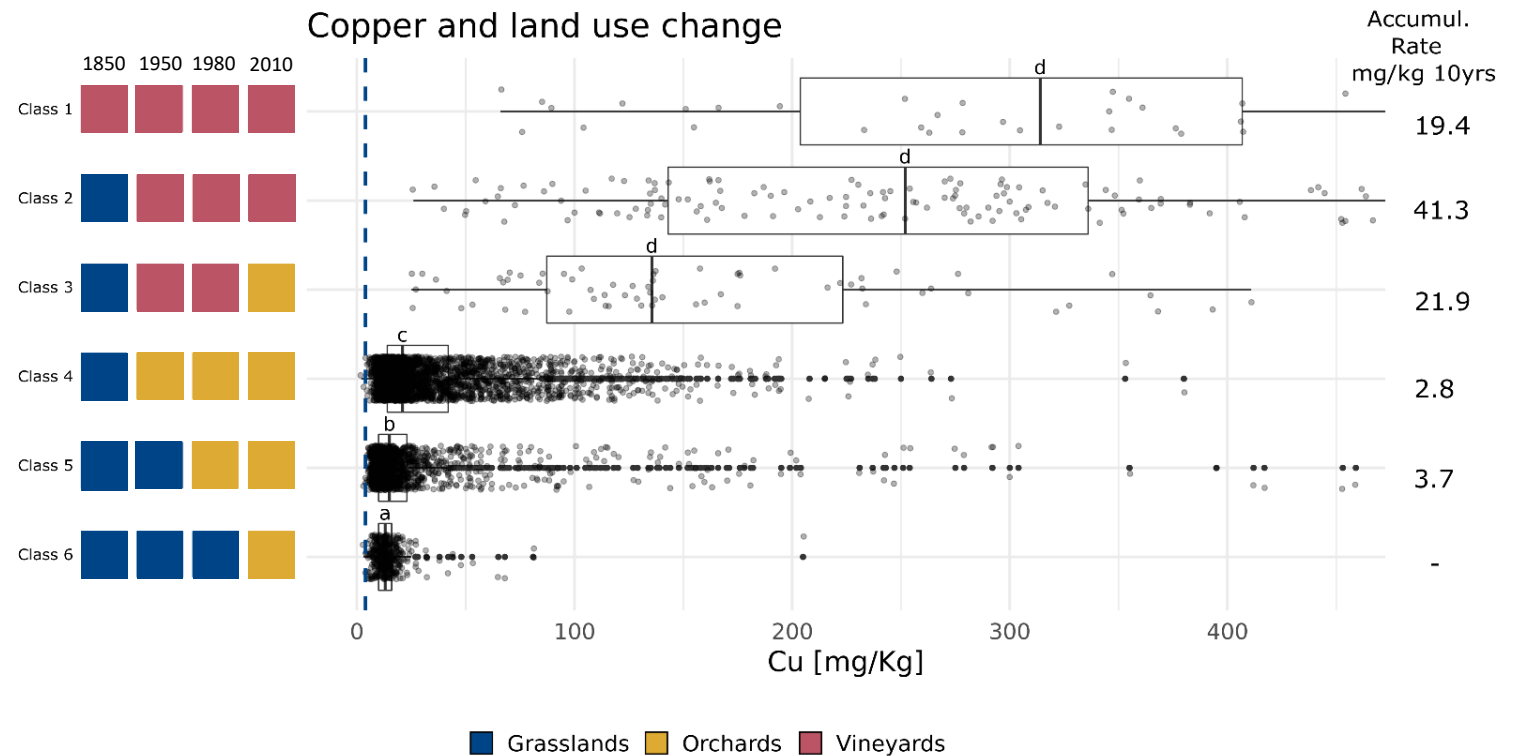
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Land use history
General patterns

- Intensification
- Increasing orchards
- Stable vineyards

Cu accumulates

- High accumulation in the oldest vineyards
- Orchards accumulating less

Copper and land use change

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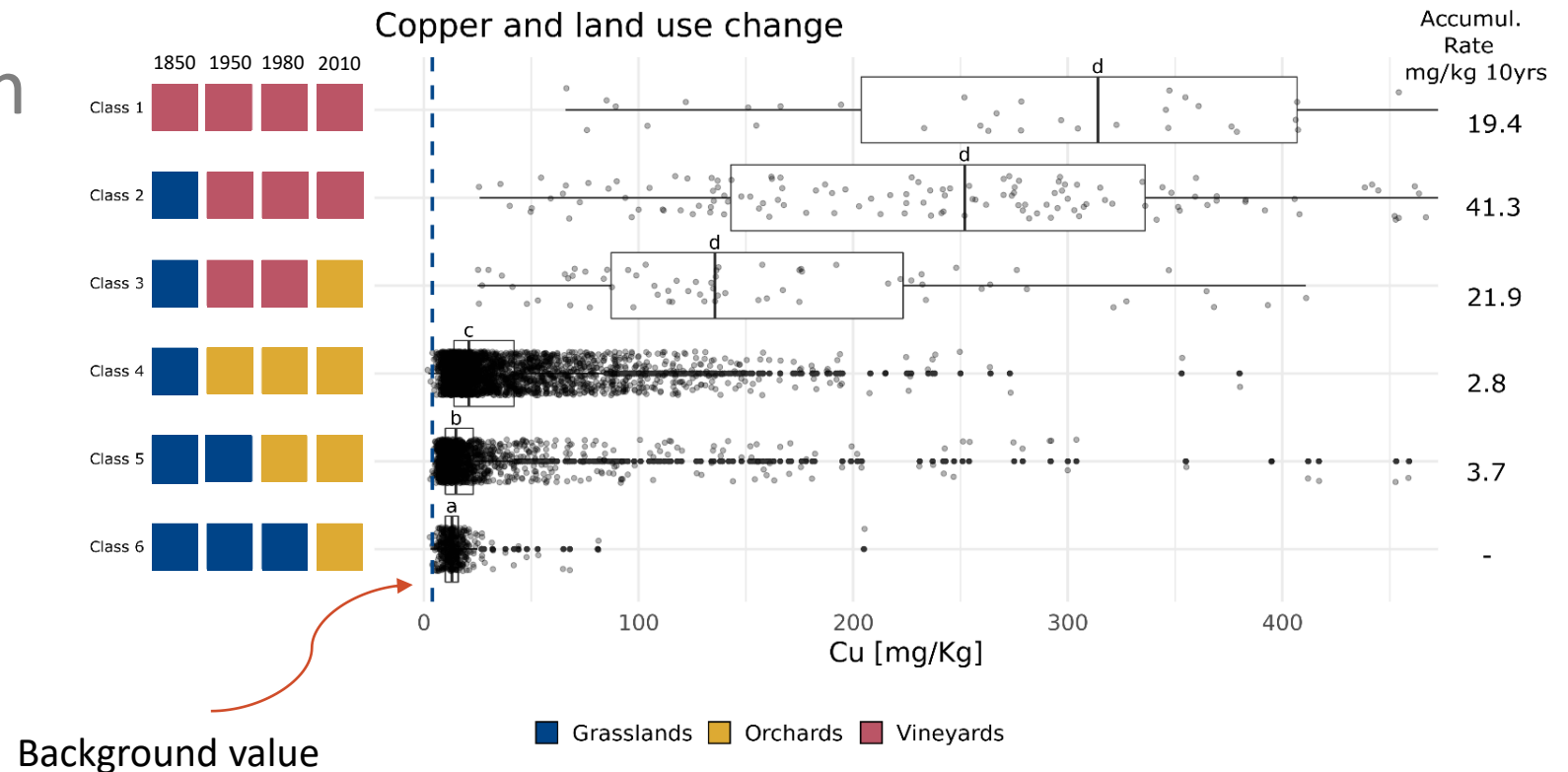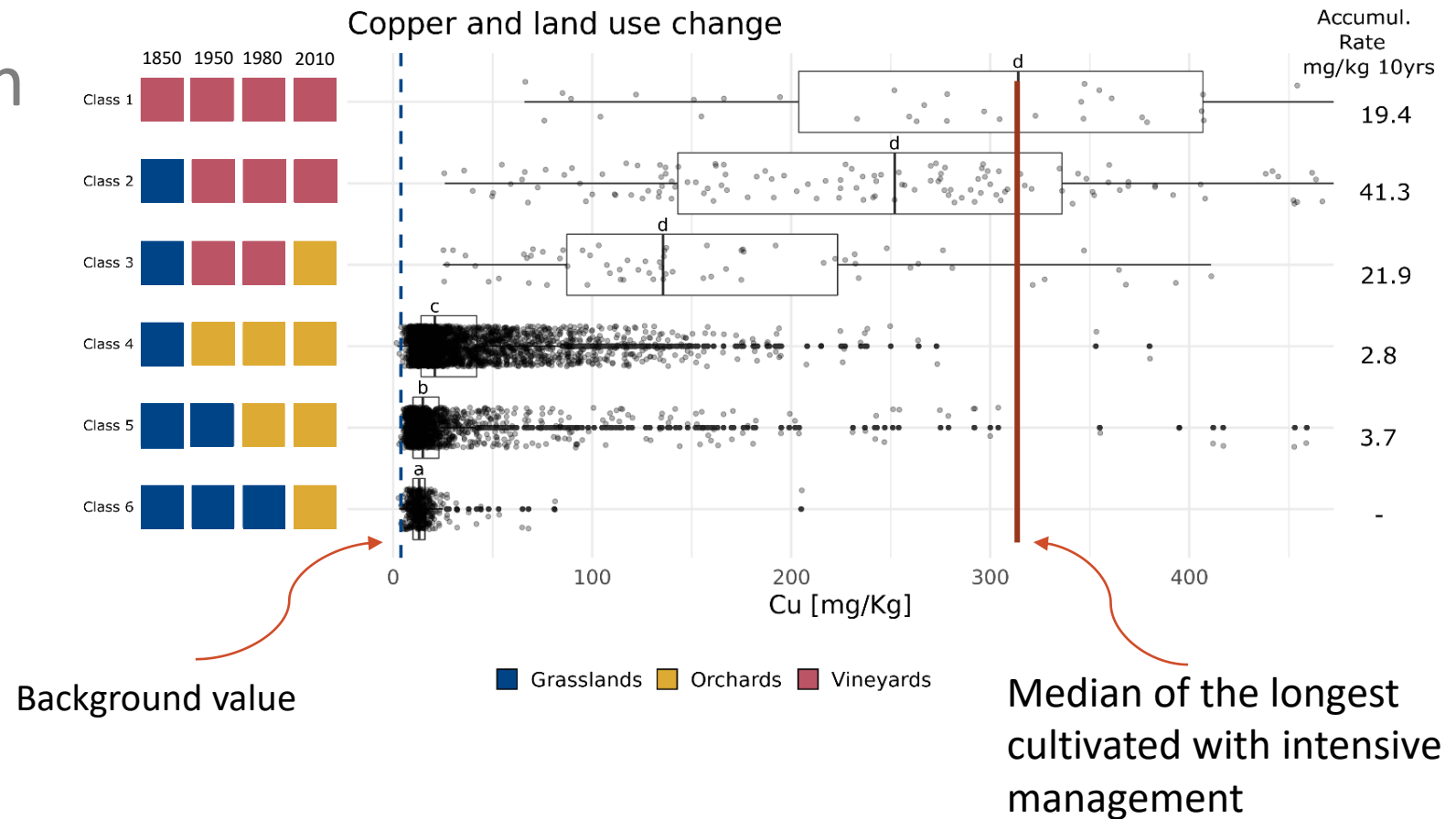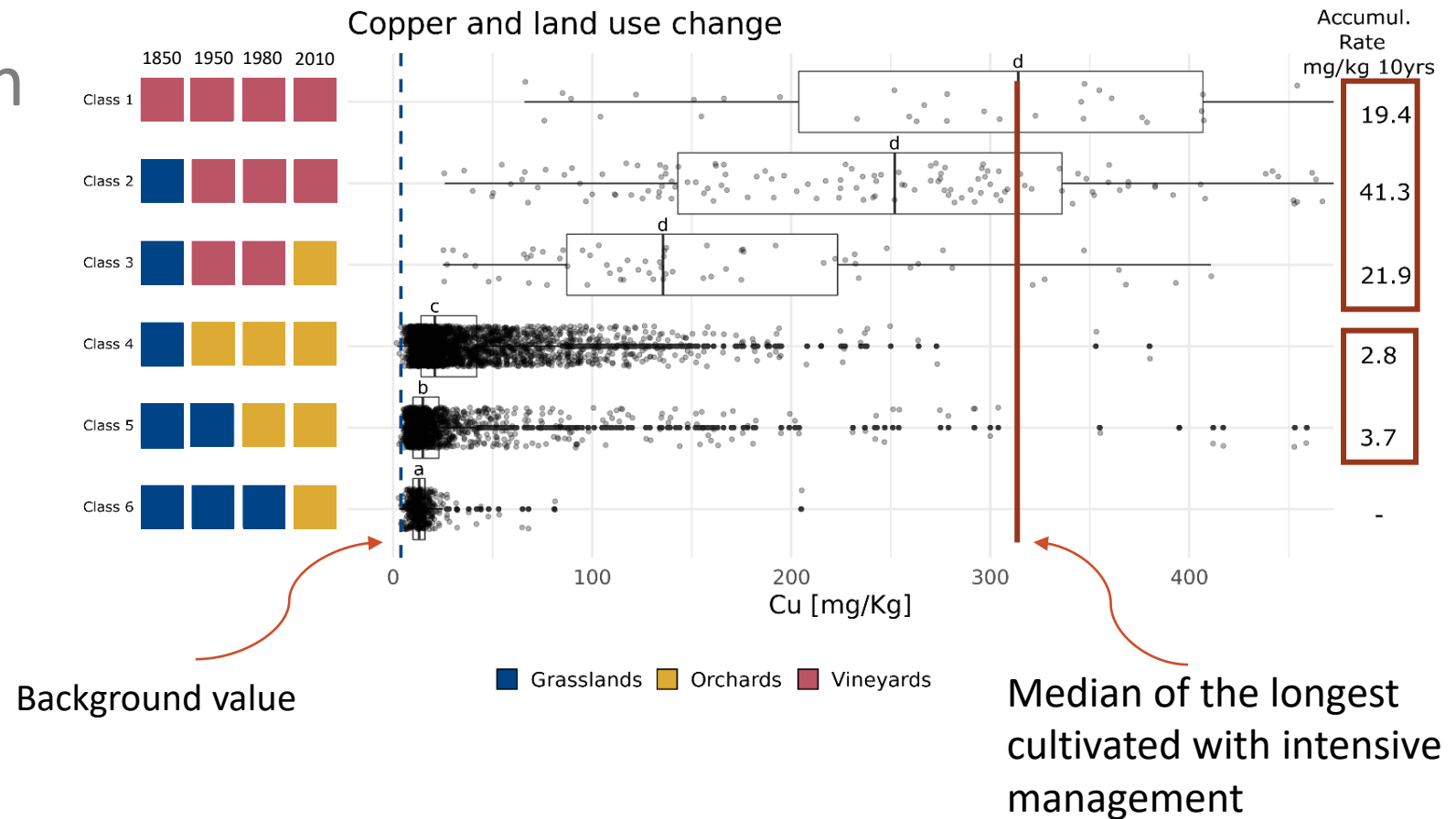
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Background value

Cu accumulates

- High accumulation in the oldest vineyards
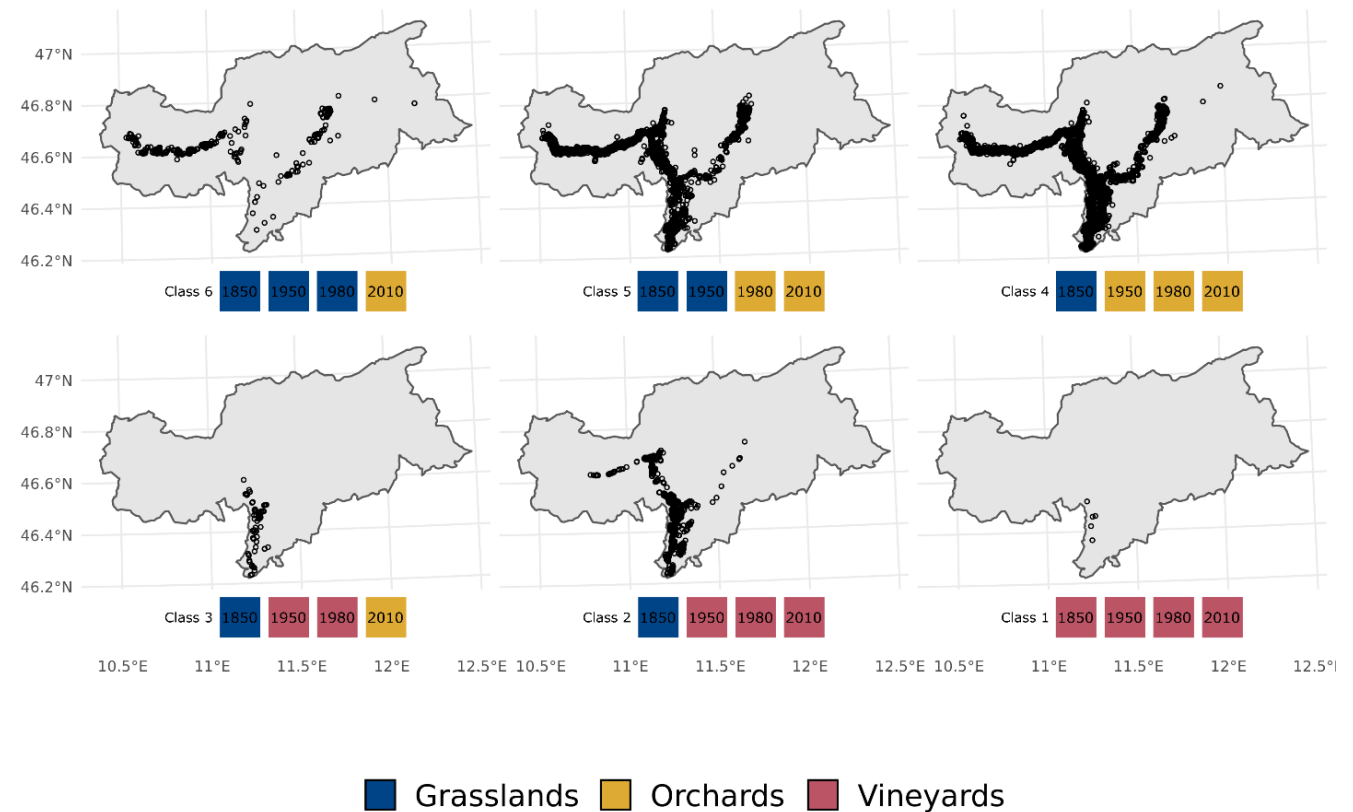- Orchards accumulating less

Copper and land use change

Background value

Median of the longest cultivated with intensive management

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Cu accumulates

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Copper and land use change

Background value

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Land use history classifier
Spatial distribution of chronosequence classes

- Good land use history prediction (Accuracy: **0.72**)

Grasslands   Orchards   Vineyards

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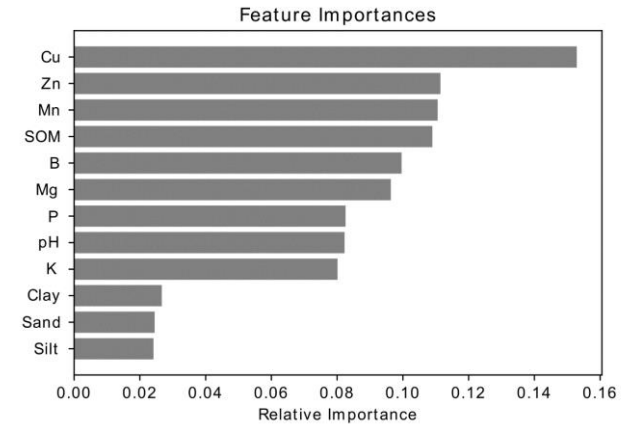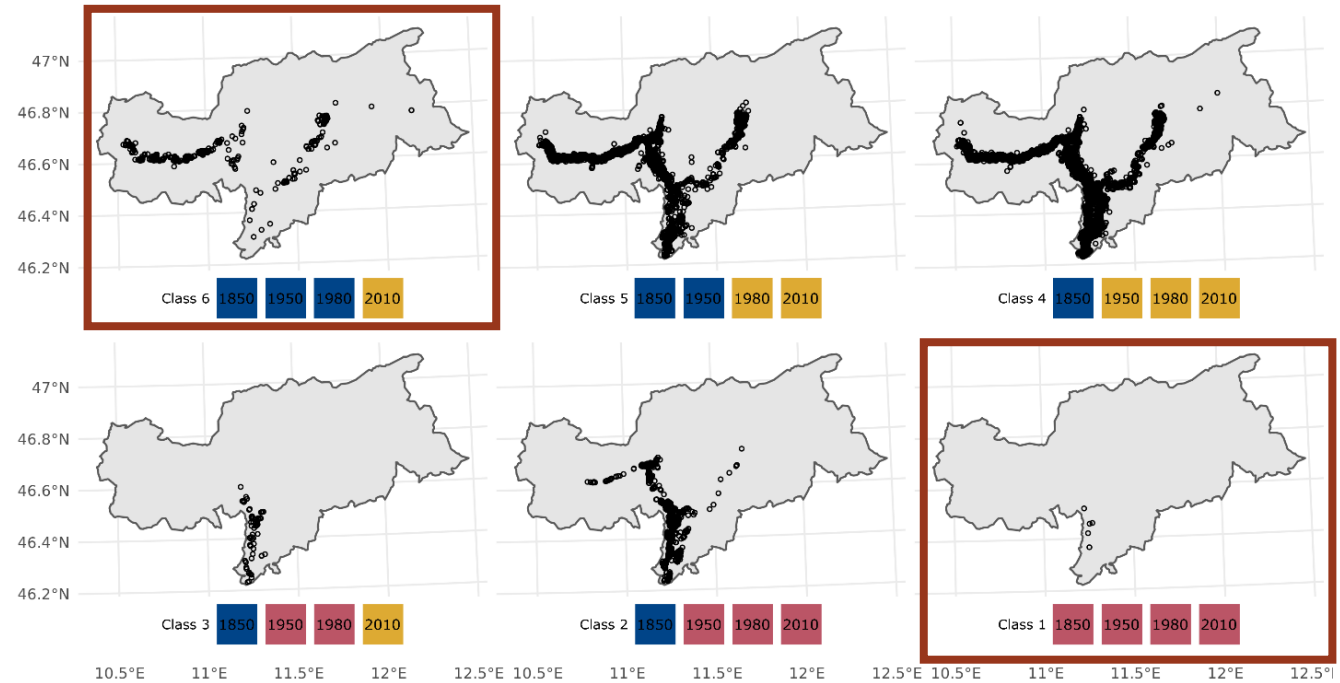
Land use history classifier
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Land use history classifier
Spatial distribution of chronosequence classes

Feature Importances
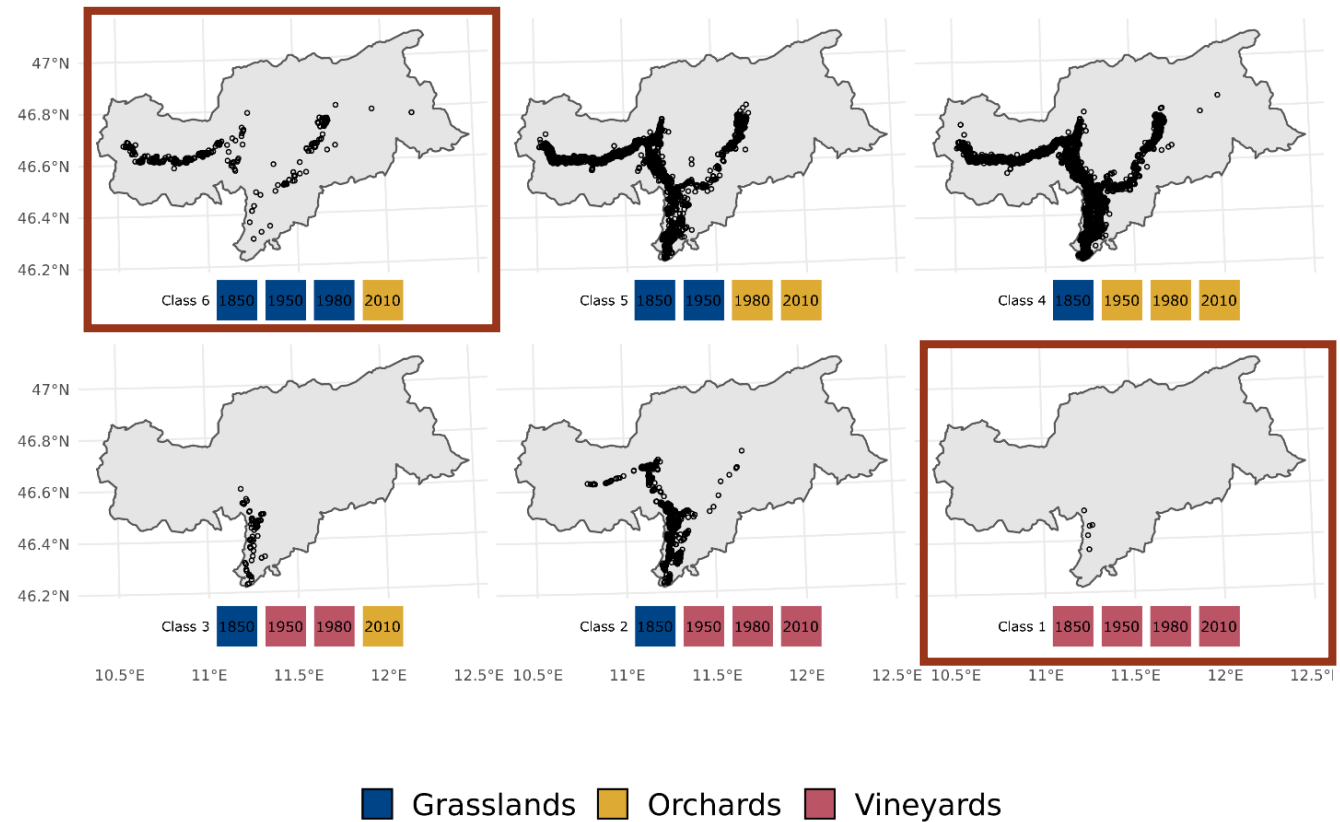
- Good land use history prediction (Accuracy: **0.72**)
- Cu, Zn, Mn, SOM important for the model

Grasslands Orchards Vineyards

Conclusions and final remarks

- Combining heavy metal analysis with land use history is a valuable approach to understand spatio-temporal patterns in agricultural ecosystems

- Chronosequences highlight heavy metals are accumulating with current-recent land use practices

- Stakeholder decision making needed to prevent heavy metals available fraction increase
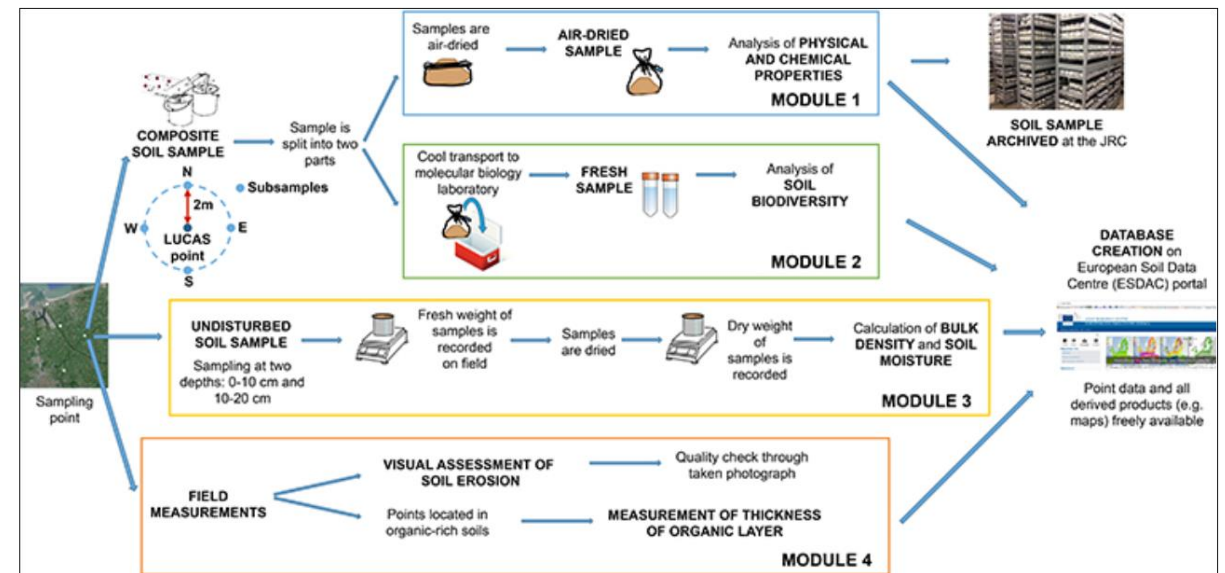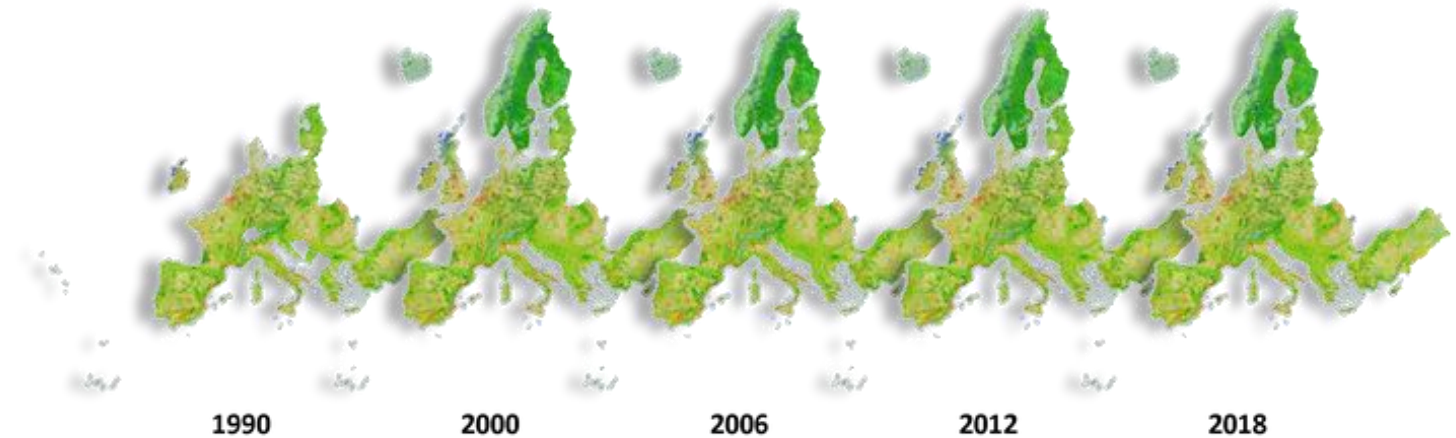
Outlook
Working at the EU scale

Corine Land Cover

1990   2000   2006   2012   2018

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LUCAS
Land Use and Coverage Area frame Survey

Thank you for your attention

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