

Effects of landscape change on soil erosion in the National Park Region of Saxon Switzerland

Introduction

Landscape change as the alteration of land use and land structure considerably affects the environment and its processes.

Land use and land use structure have changed significantly in the last century, mostly due to human impact. Consequently, processes affecting the environment have changed as well. Soil erosion as one of these processes is particularly affected by changes in land use structure. As soil erosion depends on surface runoff, which is regulated by the structure of land use, the effects of changes in slope length due to landscape change on erosion displacement can be significant.

Methods

There are various established methods to model soil erosion, although there is no appropriate method to determine historical displacements due to changes in land use structure. Therefore, a new method is proposed to examine historical developments of soil erosion depending on changes in land use structure.

By the example of the National Park Region of Saxon Switzerland (see figure 1), a timeframe of about 100 years was used to study the effects of landscape change on soil erosion. Historical maps were used for this to determine the changes in land use and land use structure.

Results

Agriculture has altogether withdrawn from steep slope positions since 1900. Thus, erosion displacement was reduced in this timeframe on average. However, when analyzed more precisely, erosion displacement has increased significantly due to changes in land use structure.

Besides the regional development, an analysis of the development of erosion by agricultural units has been carried out (see figure 5).

While the spatial distribution of soil erosion within the National Park Region did not change from 1900 to 1992 distinctively, it has changed within the agricultural units due to landscape change (see figures 2+3). Nearly 40 percent of the agricultural units had an increase in erosion displacement (see figure 4). In particular between 1940 and 1992, erosion displacement increased due to the aggregation of agricultural units and thus longer slopes.

Conclusions

Investigation and evaluation of changes in land use structure seems to be an appropriate method to analyze the historical development of soil erosion, in particular for larger areas.

The results confirm the strong dependence of erosion displacement on land use structure. Therefore, it is vital to include land use structure in erosion modeling. Otherwise the amount of erosion displacement will be underestimated.

Further work could lead to a decision tree based spatial planning tool for governmental institutions and NGOs for a sustainable development and to prevent hazardous anthropogenic changes in land use structure in the future.

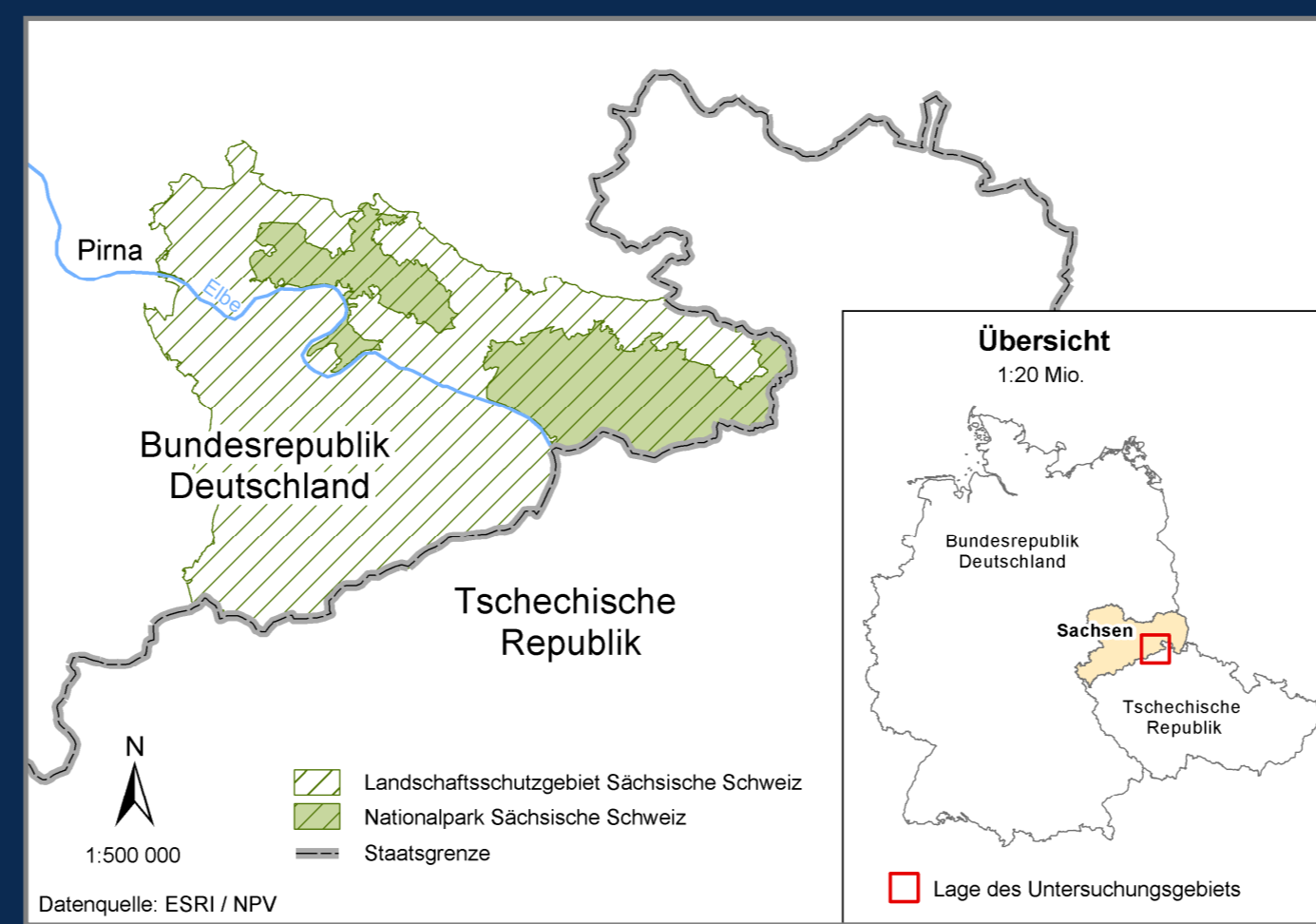


Figure 1: Study area

Erosion displacement based on agricultural units

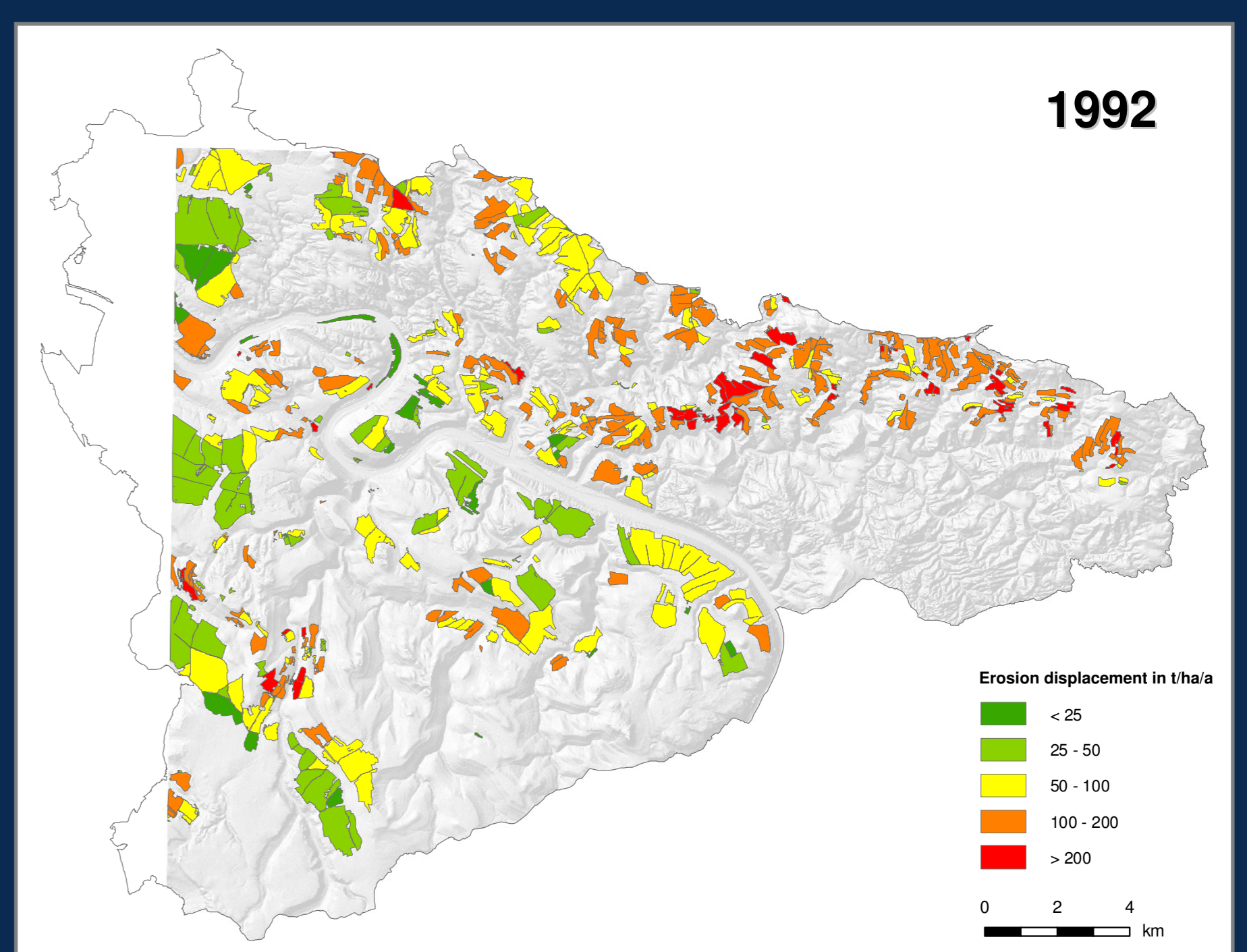
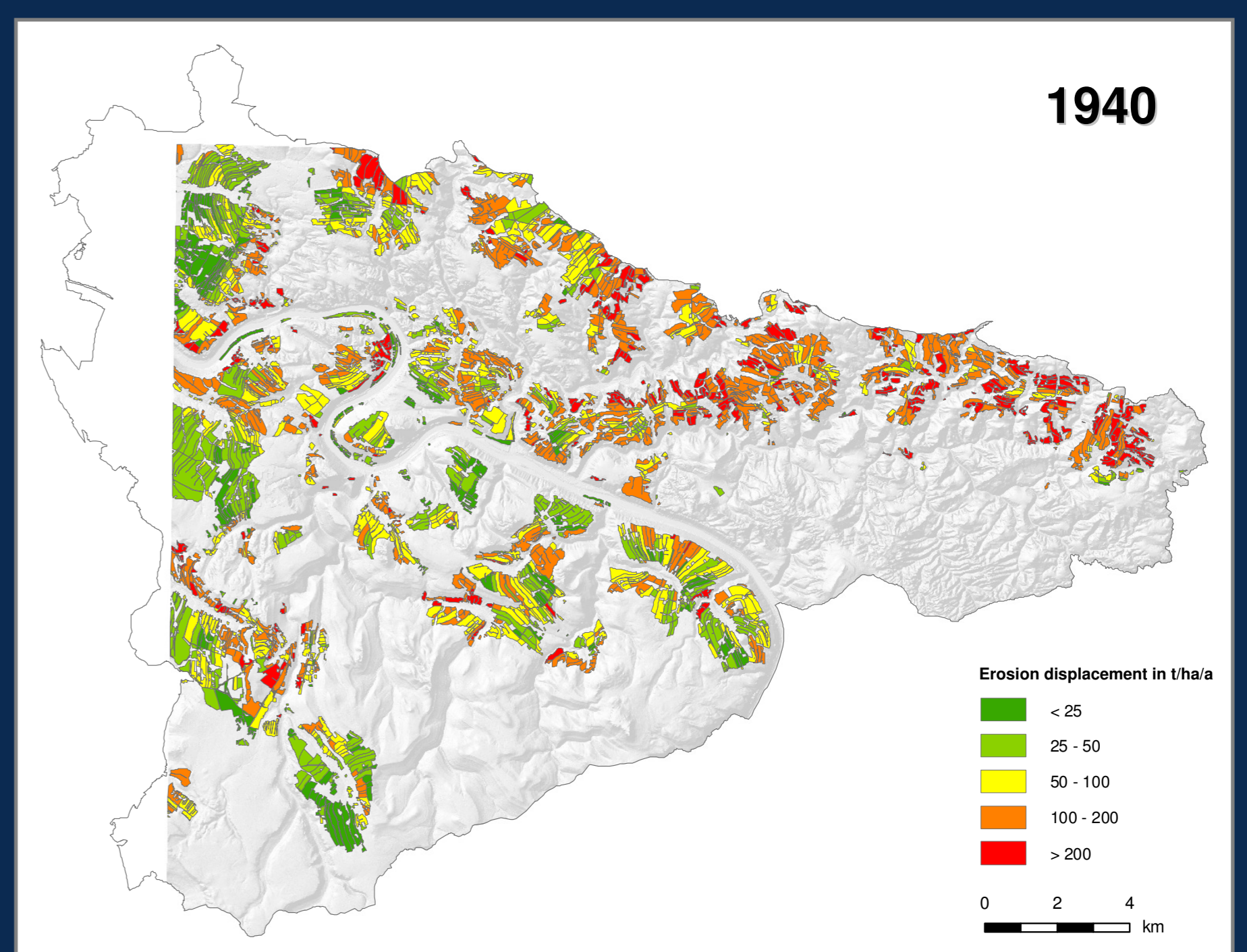
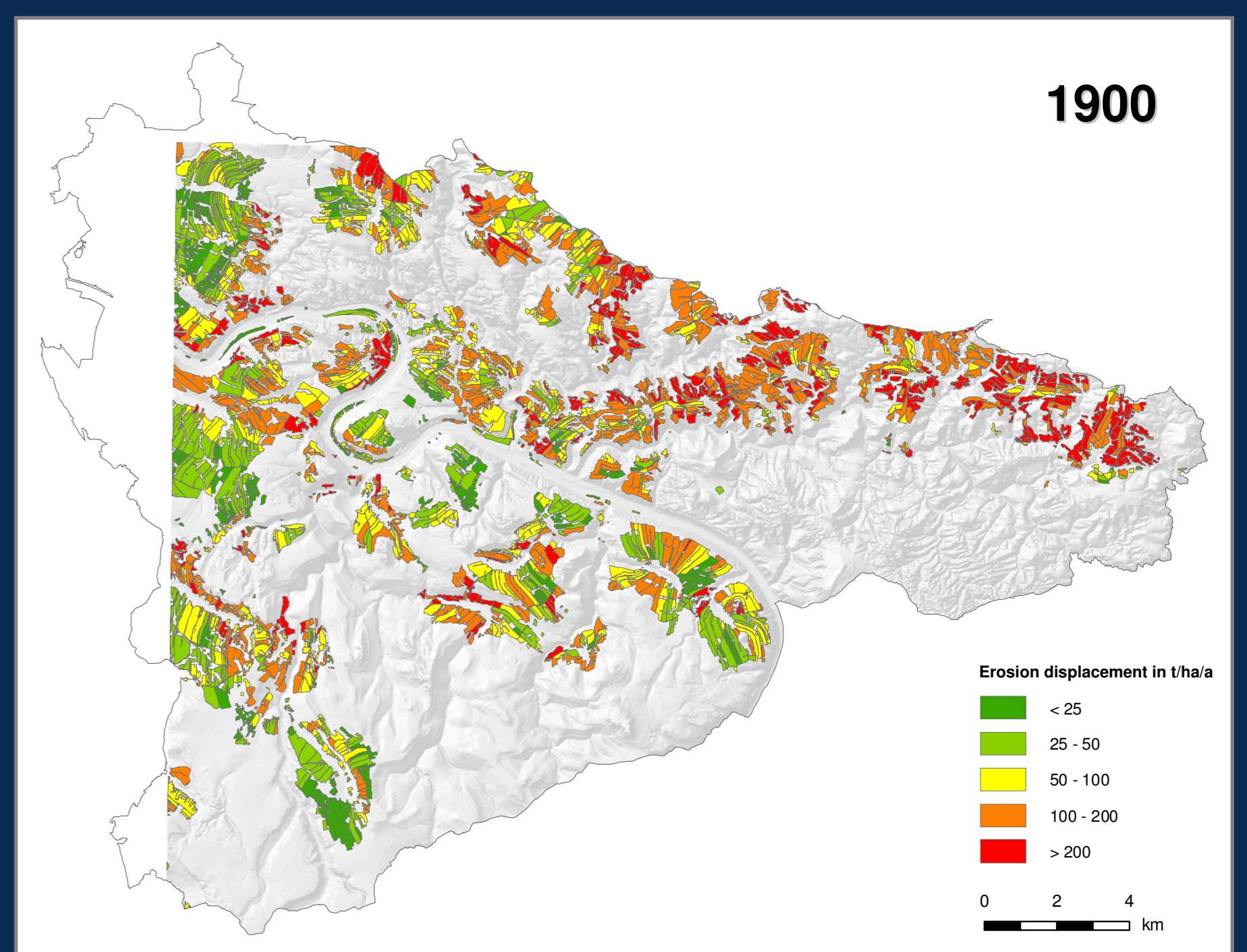
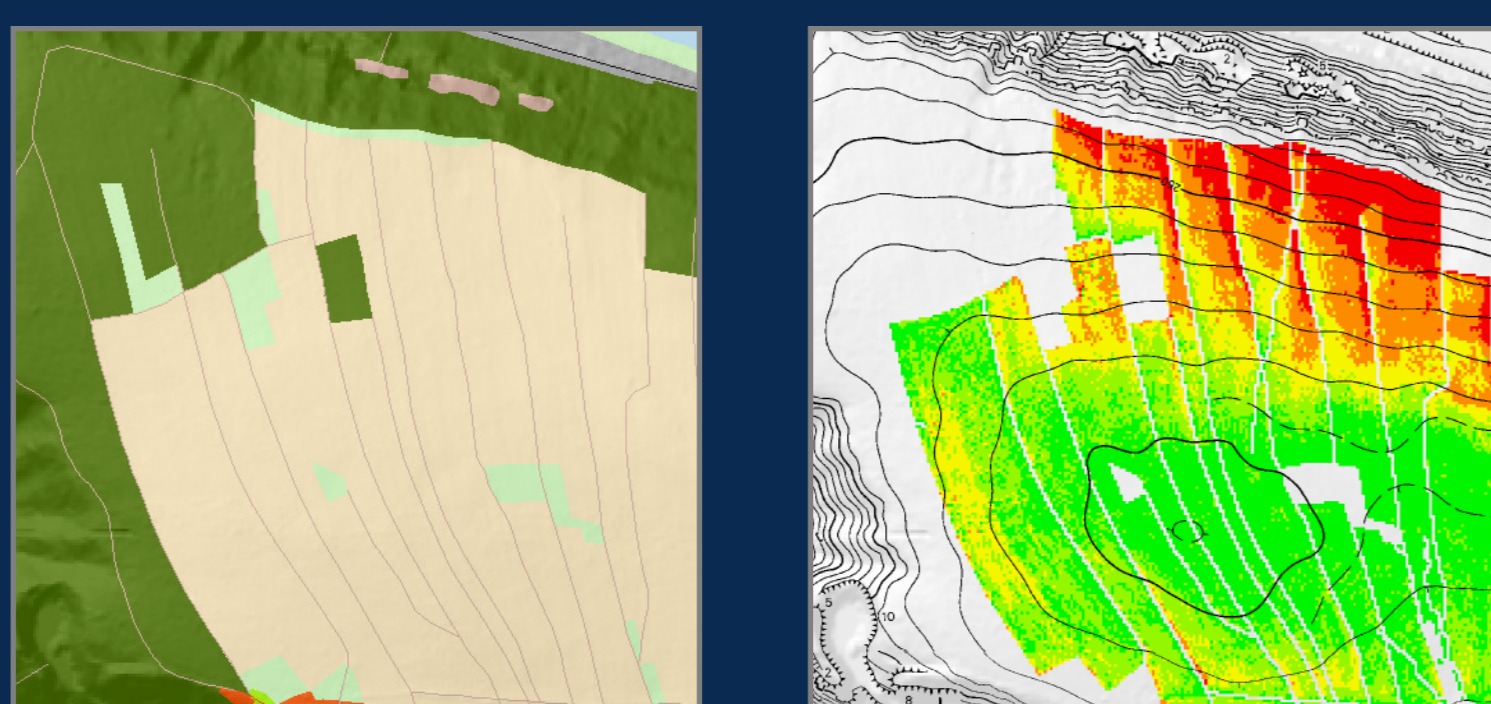


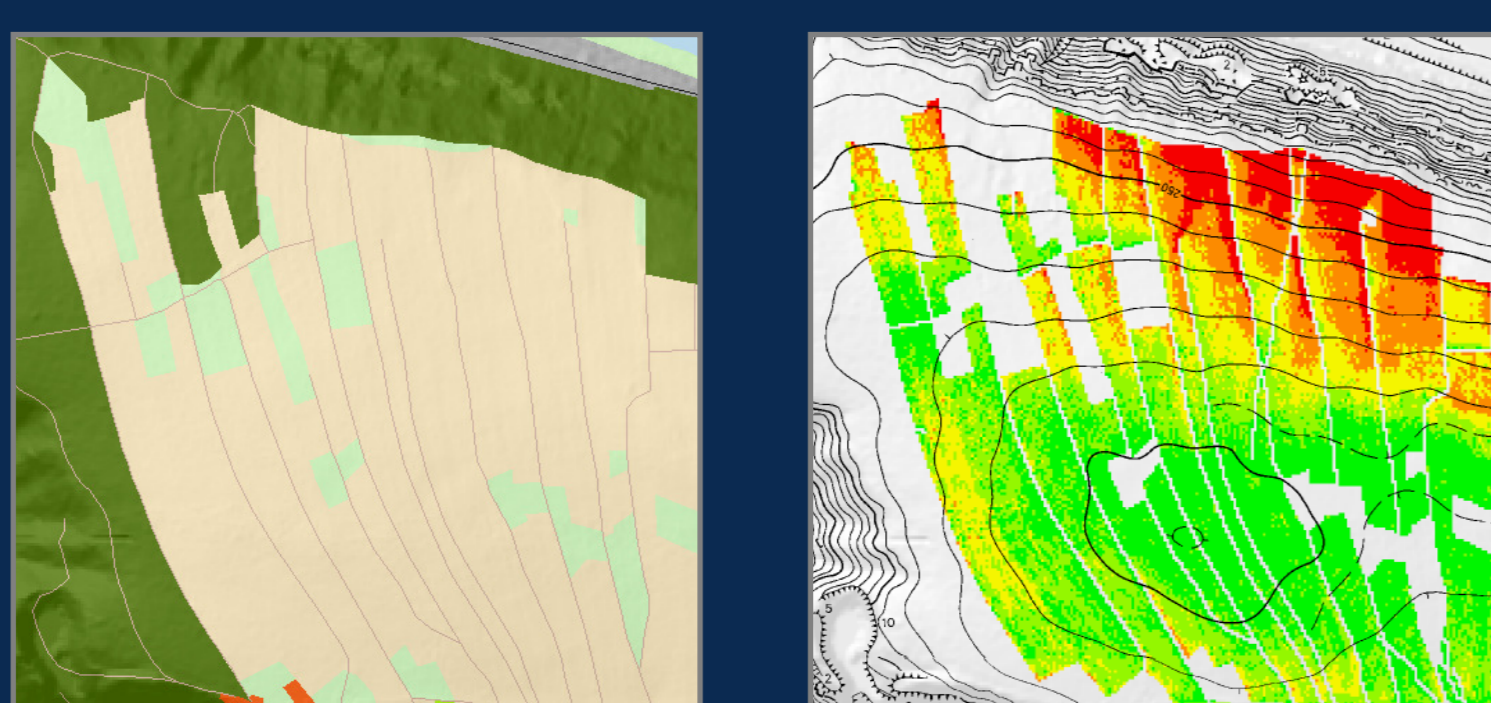
Figure 5: Erosion displacement based on agricultural units from 1900 to 1992

Land use structure Erosion displacement

1900



1940



1992

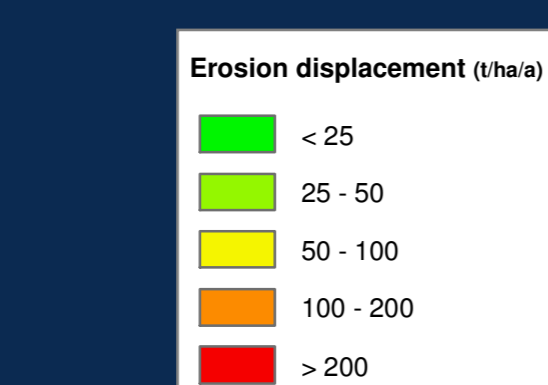
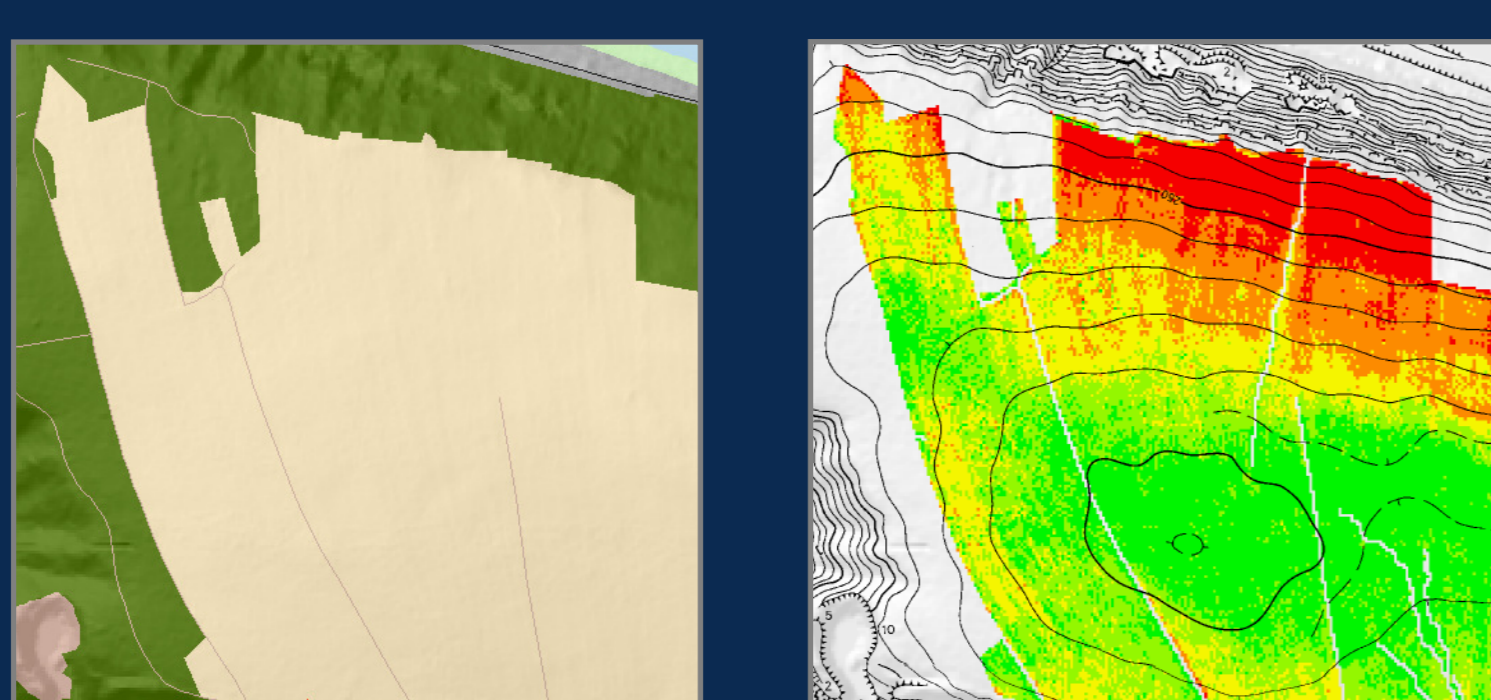


Fig. 2: Land use structure 1900-1992

Fig. 3: Erosion displacement 1900-1992

Development 1900-1992

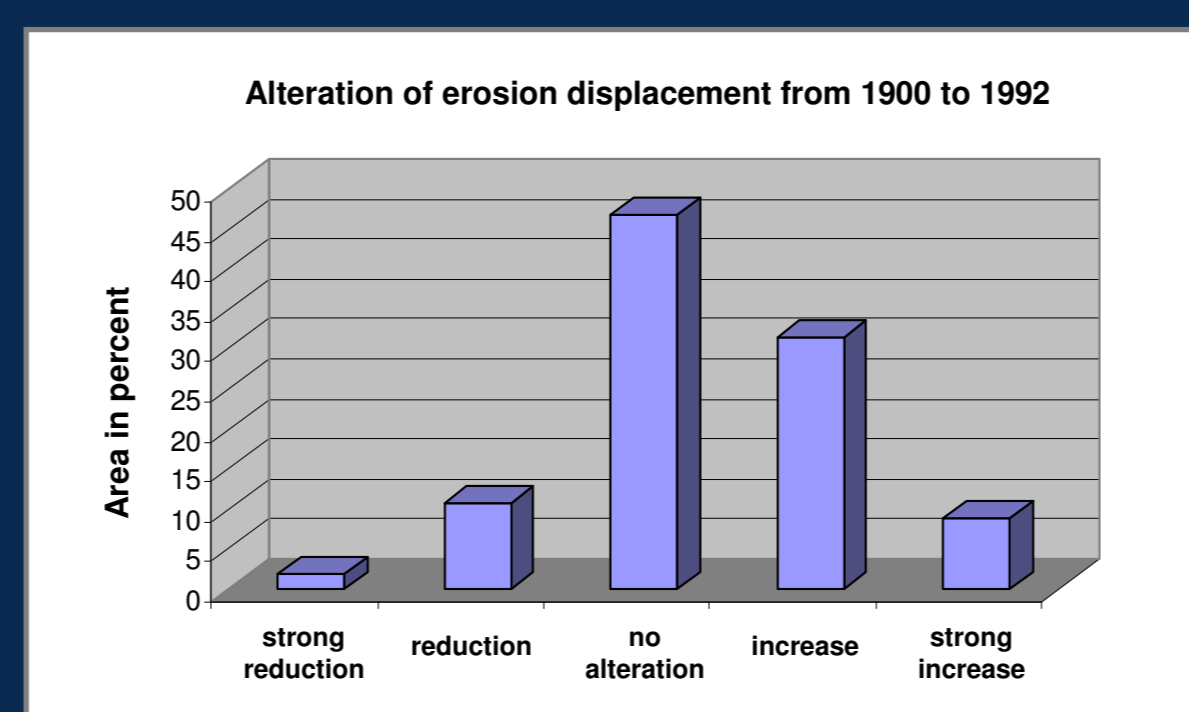
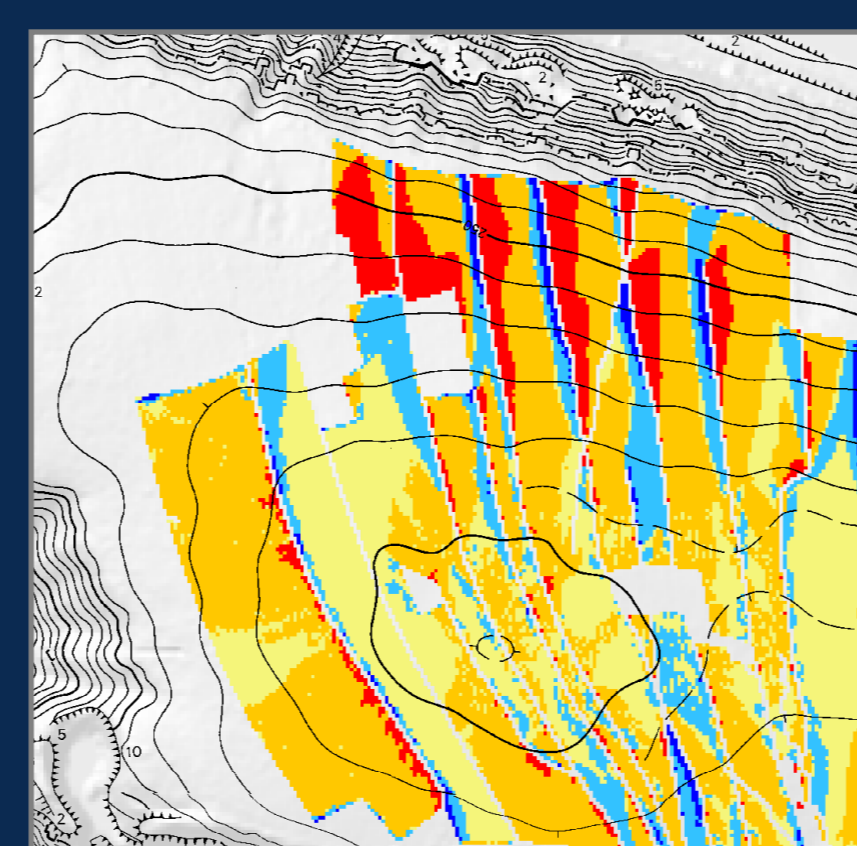


Figure 4: Alteration of erosion displacement in the National Park Region of Saxon Switzerland 1900-1992

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