Soil loss monitoring of vineyards in the Gerecse Hills (Hungary), using UAV technology

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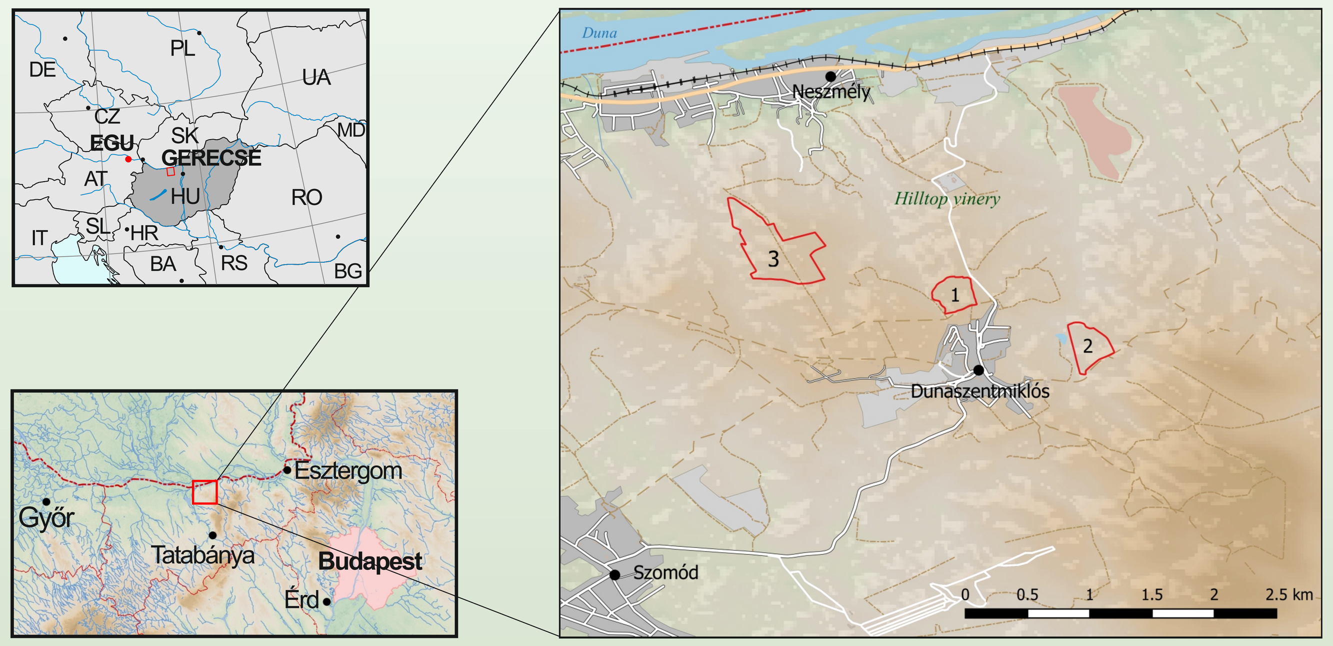


Figure 1. The overview maps show the wider and narrower surroundings of the study area. Numbers indicate the studied vineyards. 1: Előharaszt, 2: Keresztrét, 3: Göte-oldal/Korma föle

1. The studied area

The northern loess-covered part of the Gerecse belongs to the Neszmély Wine Region, and is highly affected by soil erosion. One of the largest vinery in the region recognized the problem and has already made efforts to cope with the natural degradation, but the exact measure of soil loss, is unknown. In this project three vineyards were selected in the vicinity of Dunaszentmiklós village (Figure 1). Previous studies identified the most erosion-sensitive locations using satellite images. In this case the satellite images were not enough punctual to specify the soil erosion among grapevines hence the high resolution UAV (*Unmanned Aerial Vehicle*) images seemed to be more efficient.

Picture 1-6. Some pictures from field trips, which sow the effect of the soil erosion in each fields in different seasons.

2. Soil erosion in the vinyards

The high resolution digital surface model (DSM) and the orthophoto of the area were produced by photogrammetric analysis of the collected images. The final resolution in which the soil loss was defined is 10 cm. Since the 24.07.2019, data have been collected in seasonal measurements. We used the USLE (Universal Soil Loss Equation) model [1] to determine the seasonal soil loss and its precise location. The focus was on the definition of the C (crop management) and the R (rainfall erosivity) factors because these change from season to season. The effect of the change of land cover as the summer turned into autumn was remarkable from the aspect of soil erosion. A similar change was observed in the weather impact: in this period more rain fell during the summer than in the autumn (Figure 2). According to the USLE model in the study area the rate of the soil loss was almost 10 times as high during the summer as in the autumn or winter.

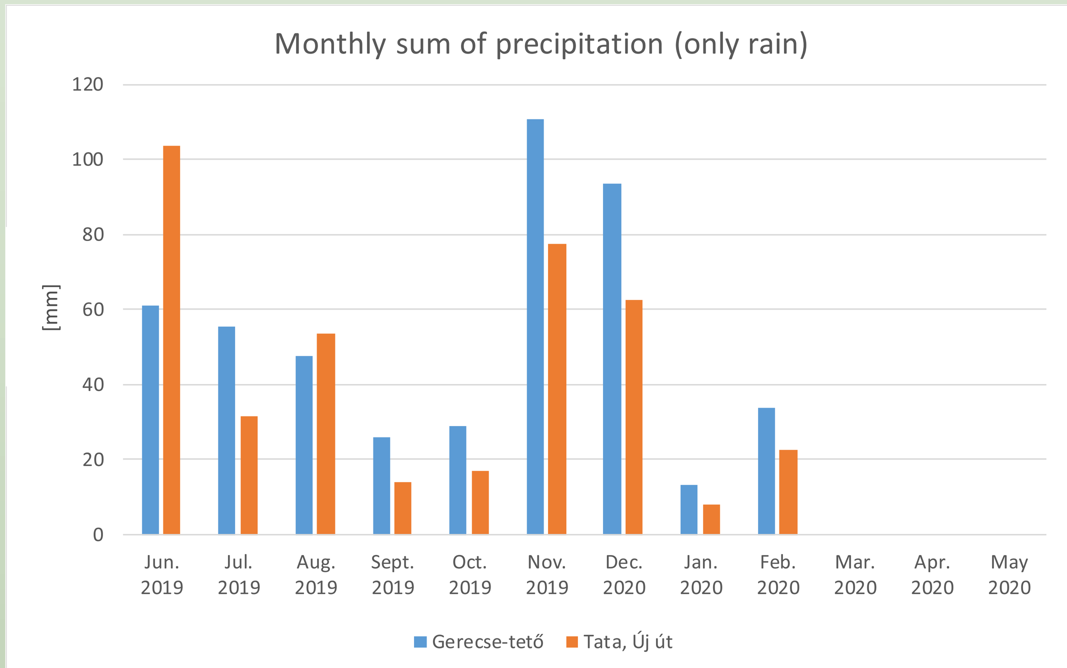
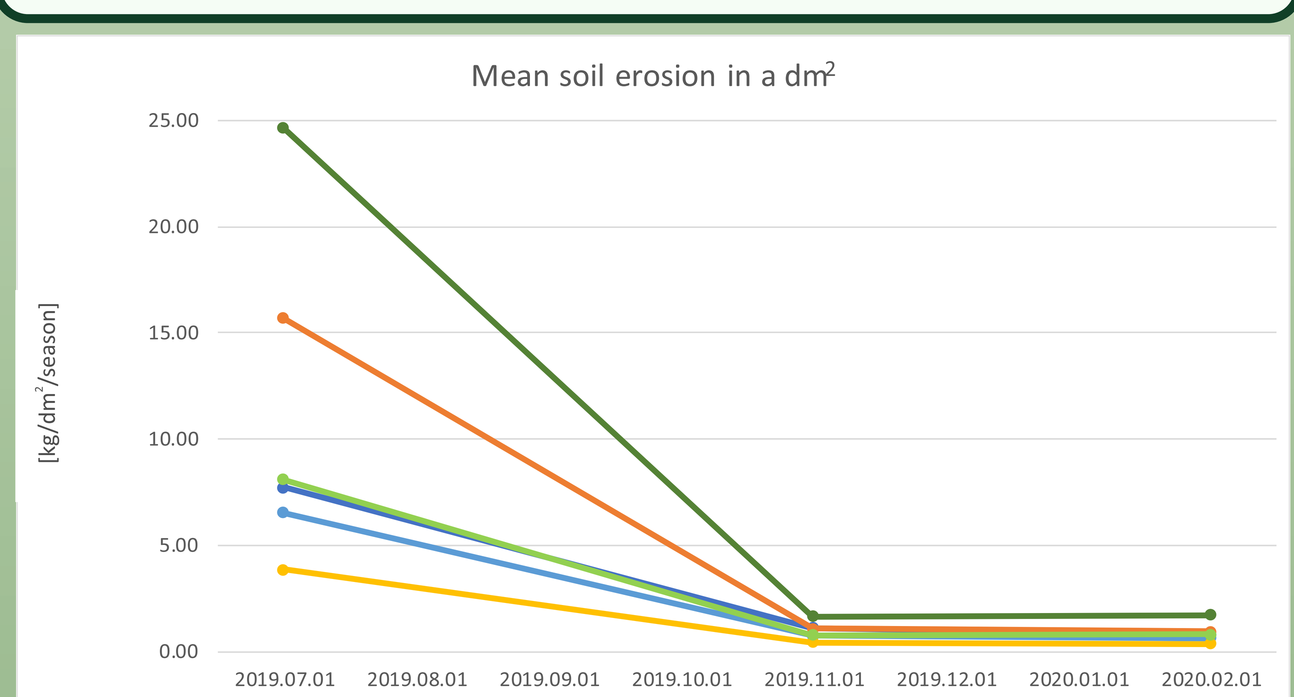


Figure 2. The monthly sum of precipitation (only rain) calculated from data of two meteorological stations (Gerecse-tető; Tata, Új út), which are close to the study area.

3. Model for grassing among the vines

The vinery do its best to prevent soil erosion. One of their effective method is to sow grass among the vines. In this study a hypothetic model was also created to prove the importance of their method in the scale of the erosion. The most significant difference between the results of the model and the reality was observed in the summertime. In Field 2 and Field 3 based on the hypothetic model the soil loss would be higher if they would not take care of sowing grass in the vineyard. In case of the Field 2 the soil erosion would be min. 2.5 and max. 4.07 times and for the Field 3 it would min. 2.12 and max. 3.05 times more (Figure 3).



	2019.07.24	2019.11.14	2020.02.19
Field 1	6.53	0.75	0.62
Field 1 Model	*7.73*	*1.10*	*0.80*
Field 2	3.85	0.42	0.37
Field 2 Model	*15.70*	*1.07*	*0.94*
Field 3	8.08	0.77	0.81
Field 3 Model	*24.65*	*1.64*	*1.73*

Figure 3. The diagram shows the seasonal soil loss and also its modeled value (if there would not be grassed among the vineyards)in each field. The table shows the calculated values in kg/dm²/season.

Soil erosion maps

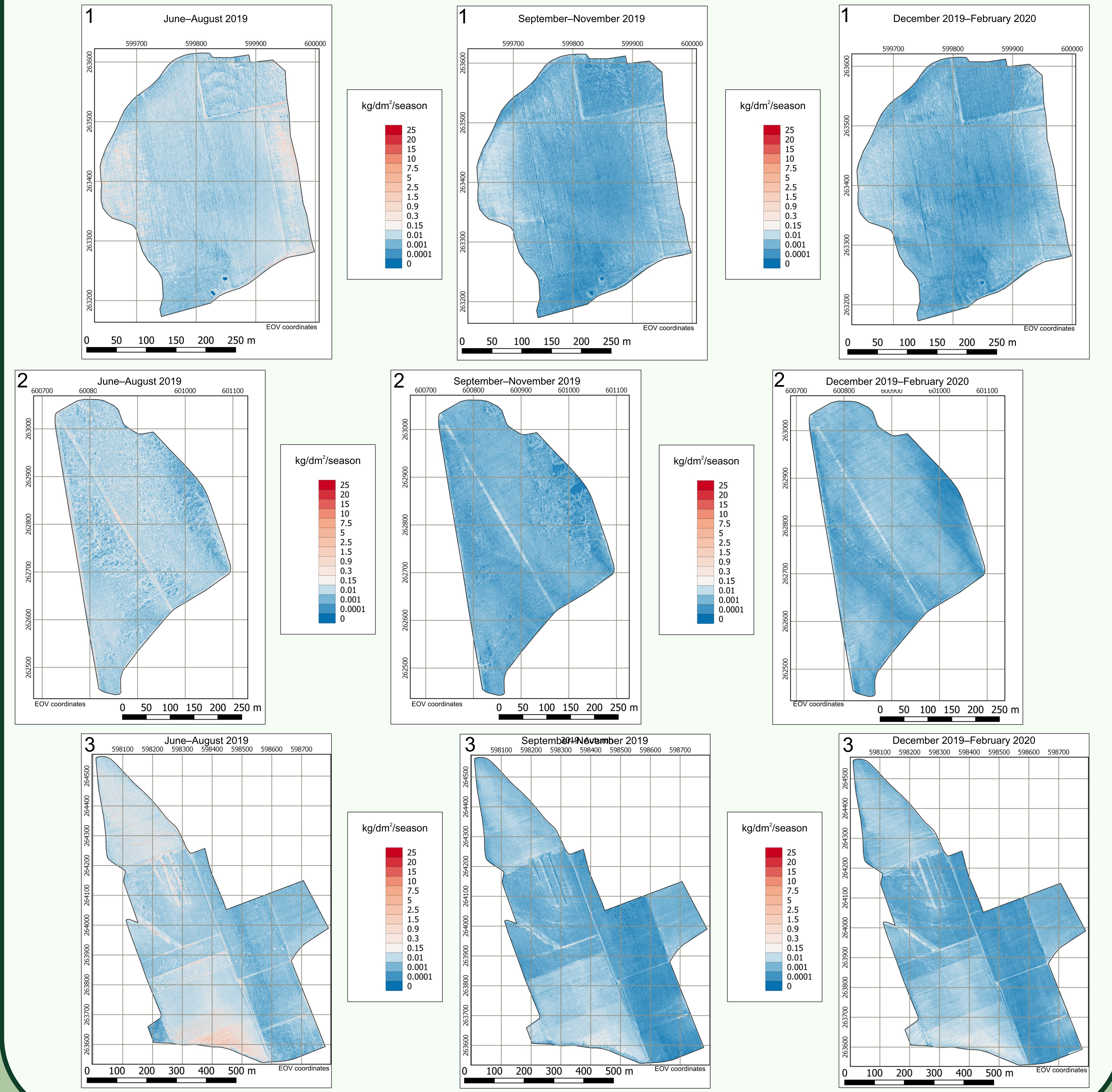


Figure 4. Maps show the soil loss in different seasons in each study field indicated by numbers.

Conclusion

The change of the soil loss from June 2019 to February 2020 can be seen on the maps (Figure 4) which show the soil loss in kg/dm²/season. The Field 1 is a newly planted area therefore there is bare soil except from the vines. Because of this the rain has higher impact on the degradation of the soil. In the Filed 2 and Filed 3 the vinery sowed grass in between the rows of vines. The model represents that the grass decreases the effect of rain on the erosion. The seasonal change of the vegetation has also an effect on the erosion, but the seasonal change of rain intensity plays major role. The study is still an ongoing project for the spirng 2020 with that data we can determine the soil loss for a whole year.

References:

[1] Wischmeier, W. H., & Smith, D. D. (1978). Predicting rainfall erosion losses- a guide to conservation planning. USA: USDA, Science and Education Administration.
[2] Pásztor, L., Waltner, I., Centeri, C., Belényesi, M., & Takács, K. (2016). Soil erosion of Hungary assessed by spatially explicit modelling. Journal of Maps, 1-8. vinery.

Data Sources:

Precipitation data from the OMSZ Hungarian Meteorological Service and the K factor (soil erodibility) from Pásztor et. al. [2] MTA ATK TAKI.

Acknowledgement:

The project was supported by the ÚNKP-19-2 New National Excellence Program of the Ministry for Innovation and Technology (from part of T. Takáts), the Thematic Excellence Program, Industry and Digitization Subprogram, NRDI Office, project no. ED_18-1-2019-0030 (from part of G. Albert), and the Hilltop vinery.