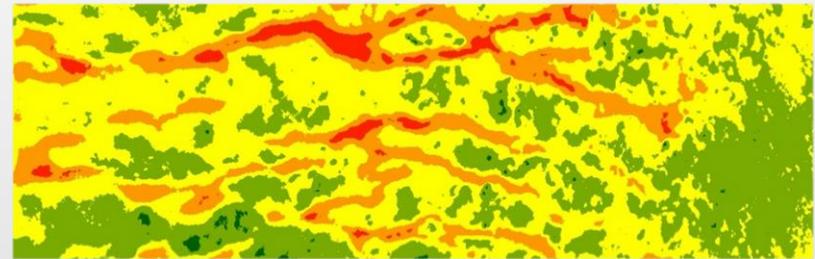


# PHOTOGRAMMETRICALLY MEASURED SHEET AND RILL EROSION ON STEEP SLOPES

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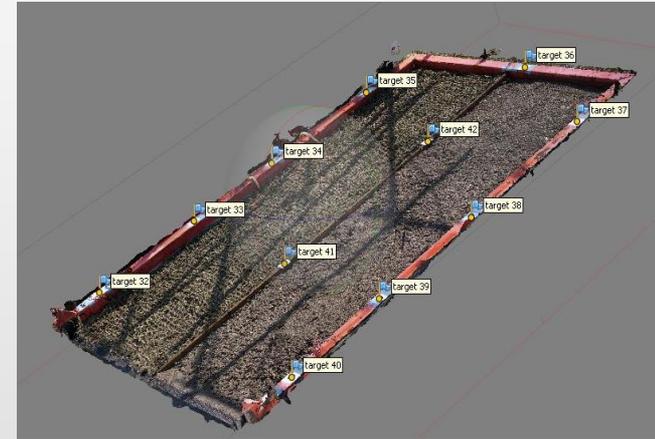
# Motivation

- Subject: Soil erosion on steep slopes along roads, watercourses and other linear structures.
- Goal:
  - 1) Asses commonly used technical protection (geotextiles, geomats and nets) against soil erosion and calculate its effectiveness.
  - 2) Monitor sheet and rill erosion using photogrammetry.**

According to results, create usefull methodology for projecting these erosion control technologies.

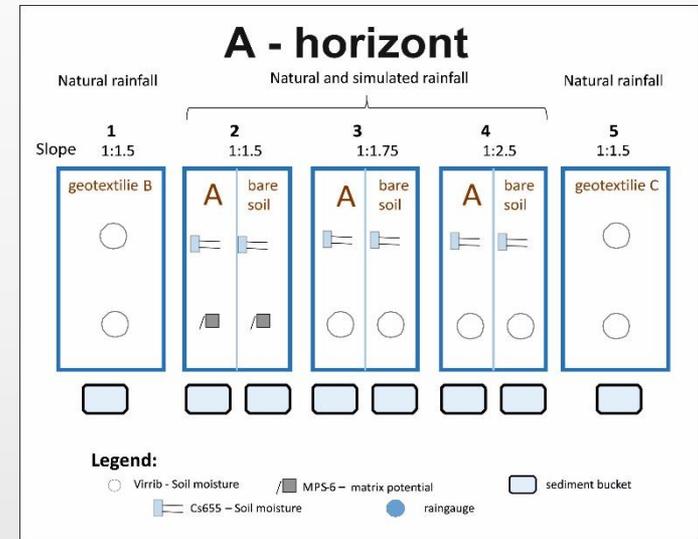
# Methodology

- „Field“ and laboratory experimental measurement with rainfall simulator.
- Comparison of bare soil and various technical protection in different conditions
- **Analysis of bare soil experimental plots**



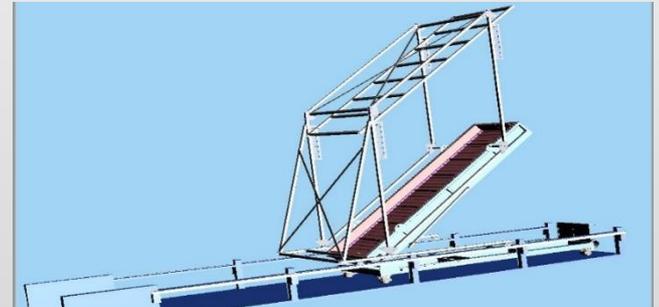
# Field rainfall simulator (Strix in Chomutov)

- Jet type outdoor simulator with stable metal construction
- Tarpaulin cover to avoid influence of wind
- 4 spraying nozzles (WSQ 40) 2,6 m above surface
- Water pressure: 0,75 bar
- Christiansen uniformity index: 71,3%
- 5 experimental plots— each with area of 2 x 4 m
  - 3 plots with simulated rainfall (different slopes 1:1,5, 1:1,75, 1:2,5)
  - 2 plots for longterm observation under natural rainfall
- Measuring consists of:
  - Soil loss and discharge
  - Soil moisture and rainfall intensity
  - Microtopography changes using photogrammetry method „Structure from Motion“



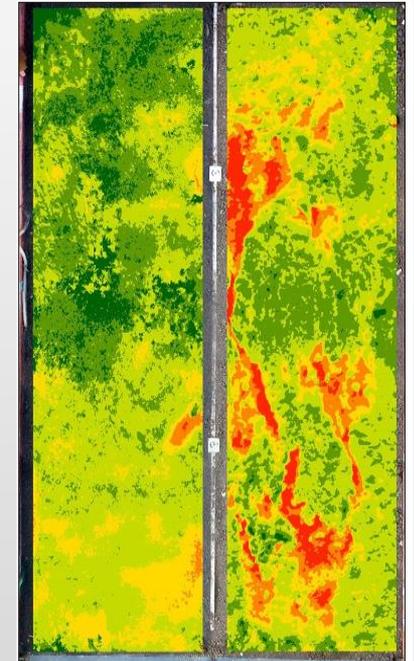
# Laboratory rainfall simulator (CTU in Prague)

- Reconstruction of laboratory rainfall simulator at CTU in Prague
- Two spraying systems
  - swing plane nozzles (V jet type)
  - intermittent spraying system (WSQ jet type)
- Soil sample (plot) up to 1 x 5 m
- Variable height of nozzles with the maximum of 2,6 m
- Precipitation intensity from 10 to 200 mm/h
- Variable slope from 0 to 40°
- Adjustable soil temperature from -15 °C to +60 °
- Constructed in 2018



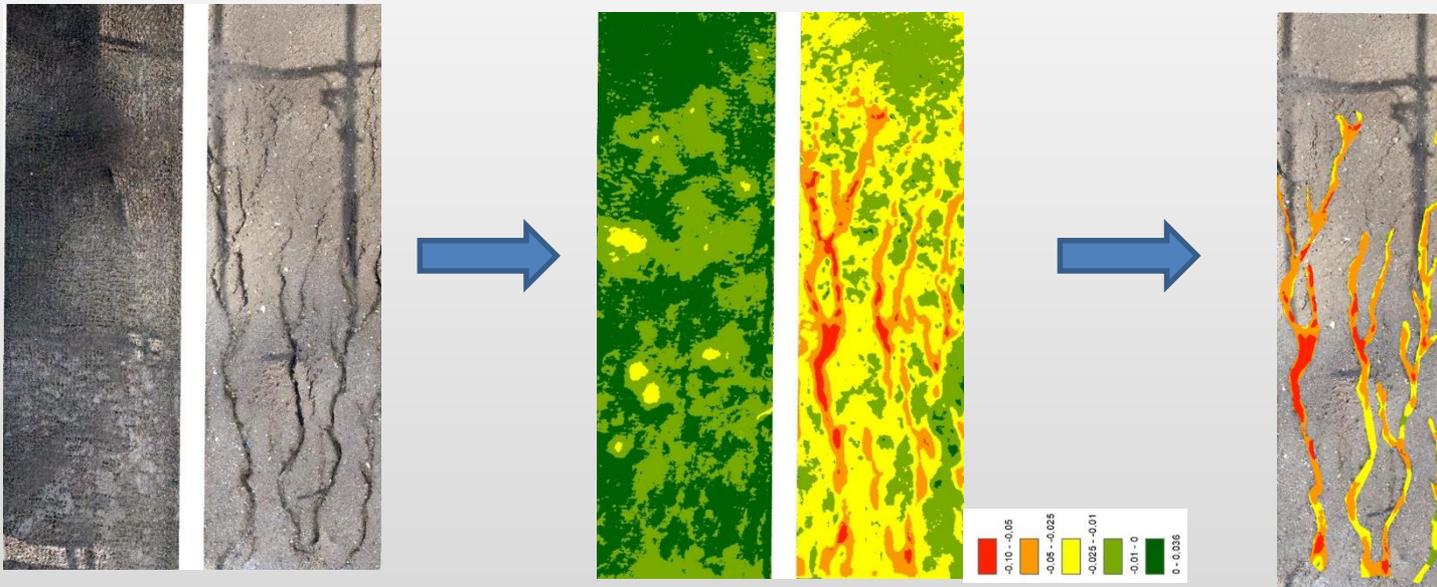
# Photogrammetry

- Soil surface to 3D data (Digital Elevation Models) using photogrammetry method „Structure from Motion“
- Detecting surface parameters and its changes
- Equipment:
  - Sony NEX-5N + lens 12 mm
  - 11 reference targets
- Processing photos in Agisoft PhotoScan
- Processing of DEM in ArcGIS, Matlab



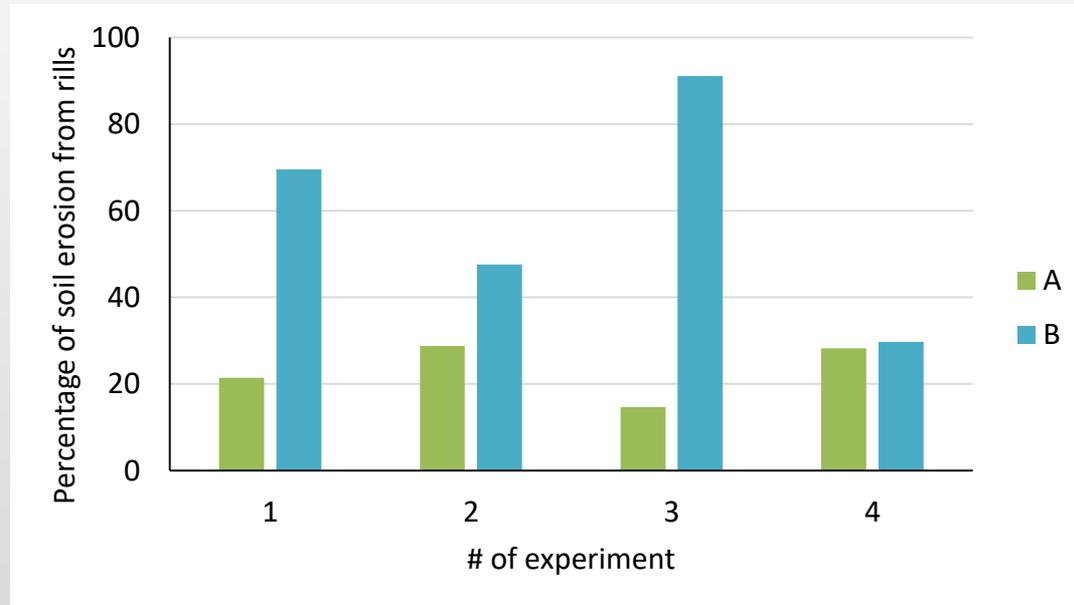
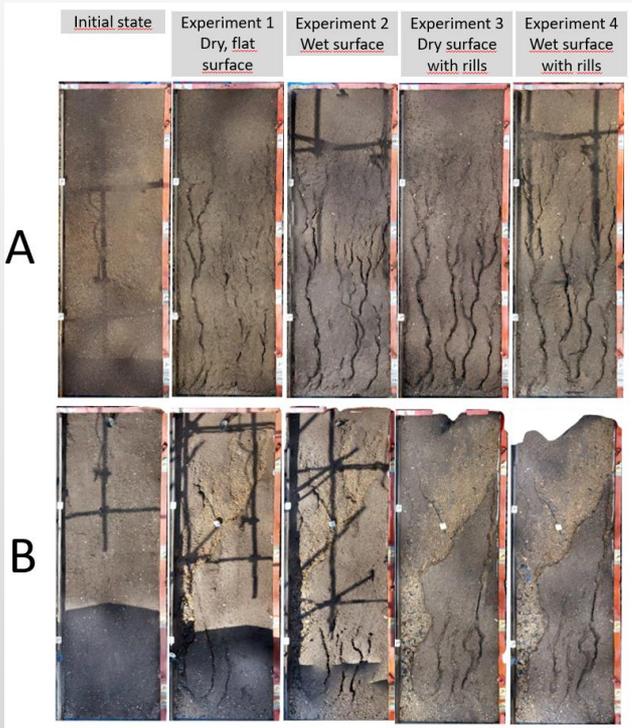
# Results

- Following figures show example of results from photogrammetry analysis of surface changes. Left plots with protection geotextiles shows on DoD (digital elevation model of difference) very low detected difference before and after simulated rainfall. Right plots without any protection are eroded by large rills. These rills accounted variable from 28 % to 74 % of the soil loss, while the remainder is the soil loss from sheer erosion.



# Results

- Explanation of variable soil erosion from rills – orthophotos shows different creation of rills on the same plots with the same soil and slope.
- It depends on soil conditions and local morphology how the rill is formed.



# Conclusion

- Rainfall simulation is a useful technique for measuring the effect of artificial slopes protection measures
- High reduction of the net soil loss from the experimental plots due to the protection measures, as the rills do not develop on the covered plots.
- Development of the rills can be observed on the untreated plots (bare soil surface). The rills propagate especially during the repeated simulation under the wet initial conditions. The soil loss from rills is variable approx. From 28 % to 74 % of the total soil loss.

## **OUTLOOK**

- Evaluation of the effect of the surface cover on soil water regime.
- Assessment of the impact and suitability of individual measures .
- Effect of the soil temperature on the rills development in laboratory conditions.

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