Rainsplash erosion characteristics induced by natural and simulated rainfall

David Zumr[1], Martin Neumann[1], Tomáš Laburda[1], Tomáš Dostál[1], Lisbeth L. Johannsen[2], Nives Balenovic[2], Andreas Klik[2], Peter Strauss[3], Zuzana Chládová[4], Tom Cochrane[5]

[1] Faculty of Civil Engineering, Czech Technical University in Prague, Prague, Czech Republic
[2] BOKU, University of Natural Resources and Life Sciences, Vienna, Austria
[3] Institute for Land & Water Management Research, Federal Agency for Water Management, Petzenkirchen, Austria
[4] Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic
[5] Dept. of Civil and Natural Resources Engineering, University of Canterbury, Christchurch, New Zealand

Project: Kinetic energy of rainfall as driving force of soil detachment and transport (**KERS**)

MAIN OBJECTIVES

Comparison of the natural and lab conditions

- Derivation/validation of KE – I relationship
- Determination of soil detachment as a function of the rainfall kinetic energy
- Soil surface changes

METHODOLOGY / TOOLS

- Disdrometers to monitor rainfall characteristics
- Splash cups for soil loss estimation
- Five monitoring sites in Austria, Czech Republic and New Zealand
- Experiments with rainfall simulator

SPLASH CUPS

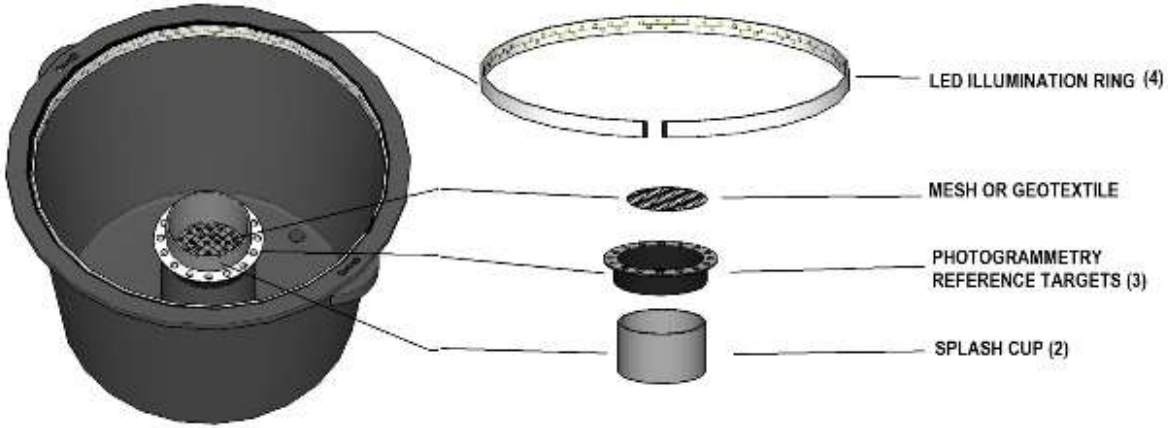
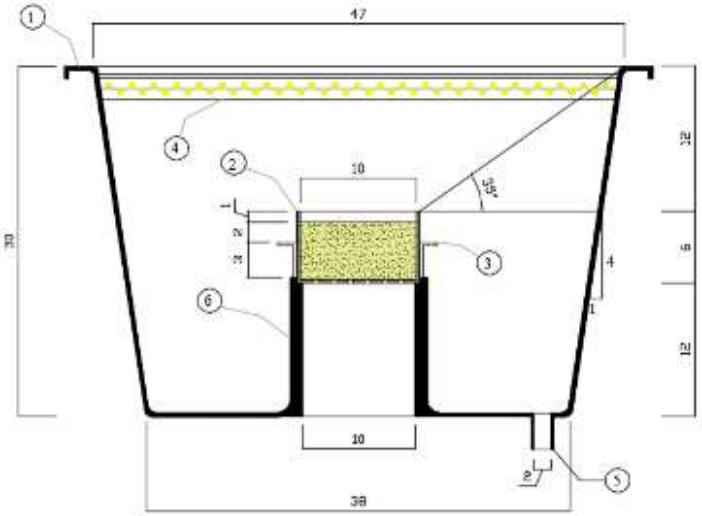
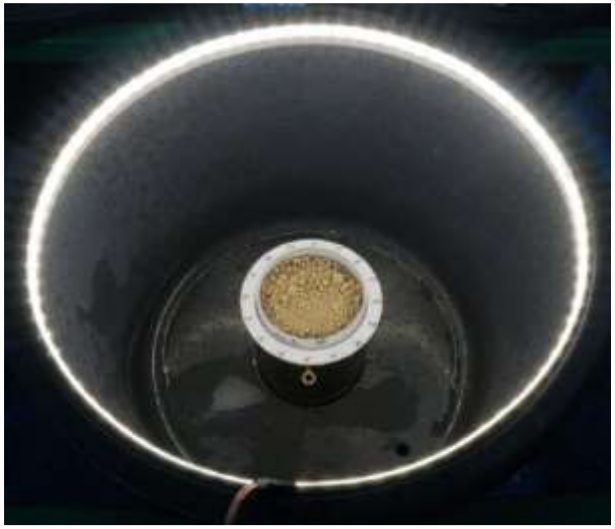


Figure 2. Model of Splash Cup array and its parts

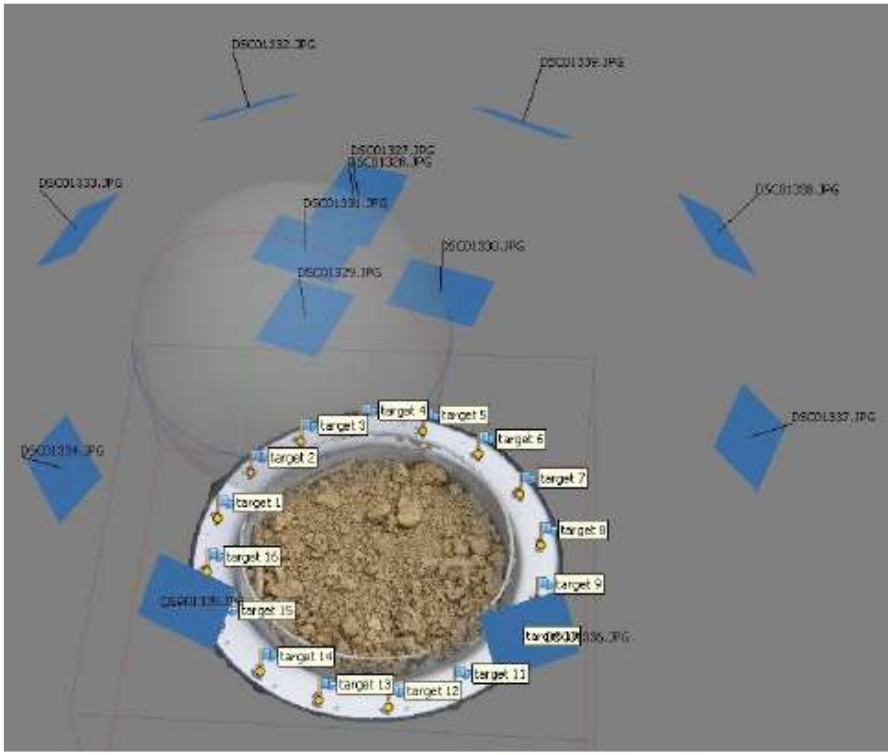




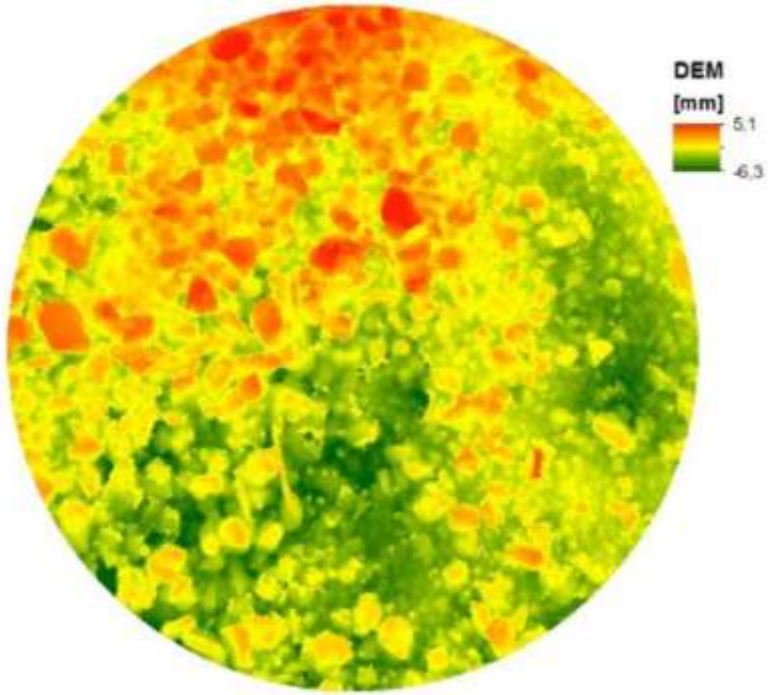
Agisoft PhotoScan

Camera Model	Resolution	Focal Length
ILCE-6000 (16 mm)	6000 x 4000	16 mm

Number of images:	13
Flying altitude:	26.2 cm
Ground resolution:	0.0467 mm/pix
Coverage area:	125 cm²



Positions of the photographs acquisition



Digital elevation model

Rainfall characteristics - Disdrometers

LPM (Thies Clima)

PWS100 (Campbell Sci)

Parsivel (OTT)

2D Videodistrometer

Monitoring sites

Sites instrumentation

Splash cups

Disdrometer

Meteorological station

HOAL, Petzenkirchen, Austria

Laboratory tests

Do different disdrometers provide similar results?

What is the difference between the simulated and natural rainfall?

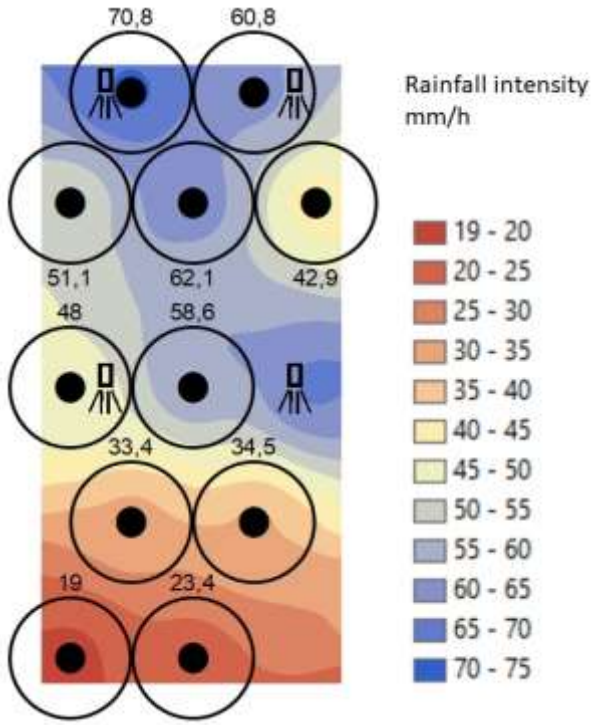
Rainfall simulator

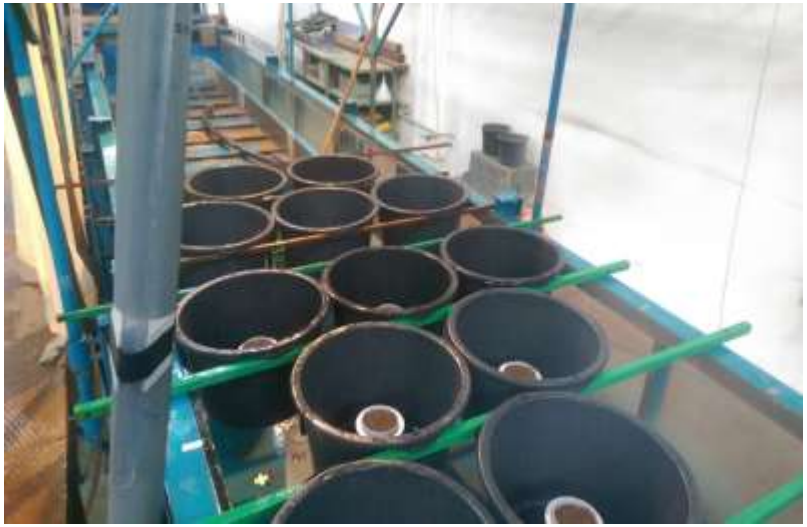
Laboratory rainfall simulator

Veejet nozzle

Laboratory tests

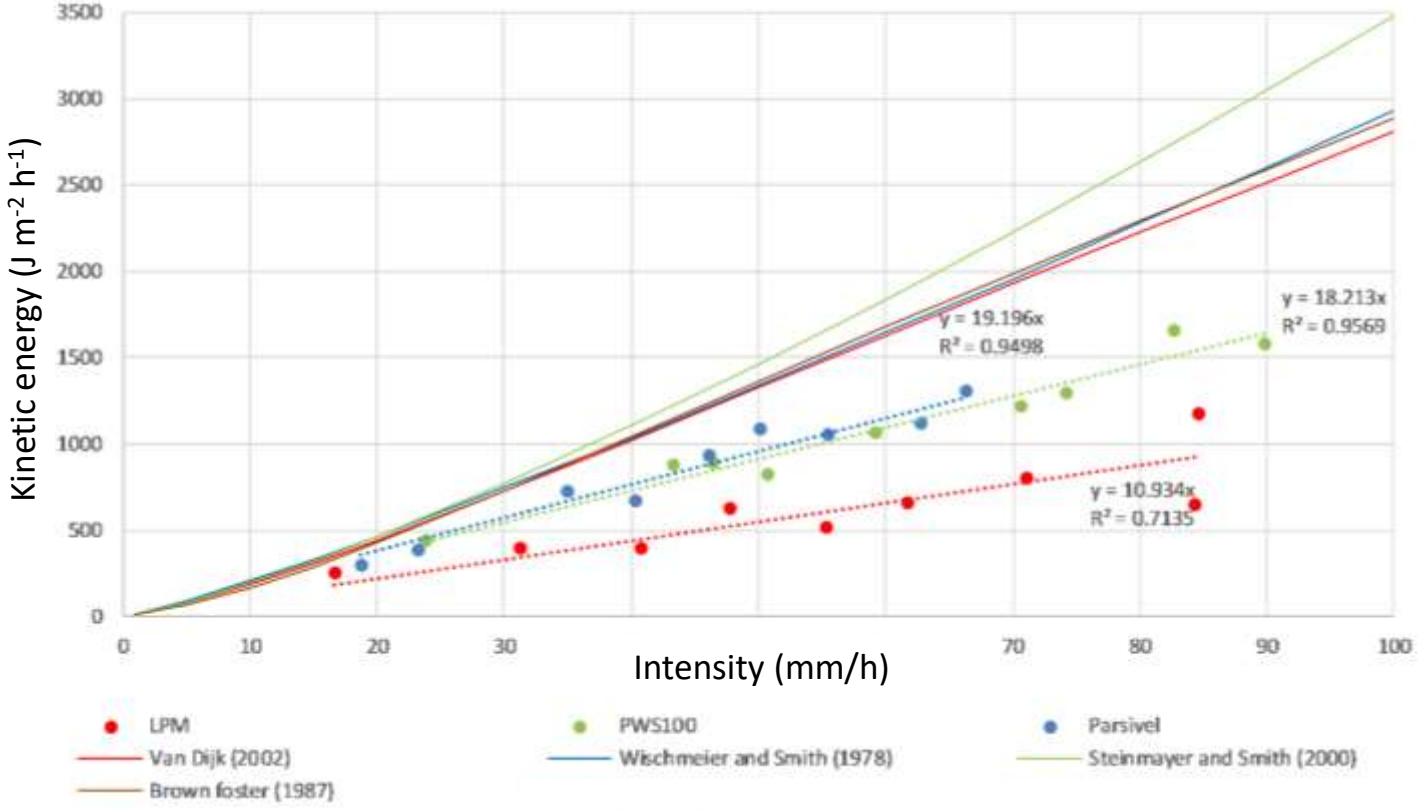
Monitoring rainfall KE and splash erosion under different rainfall intensity





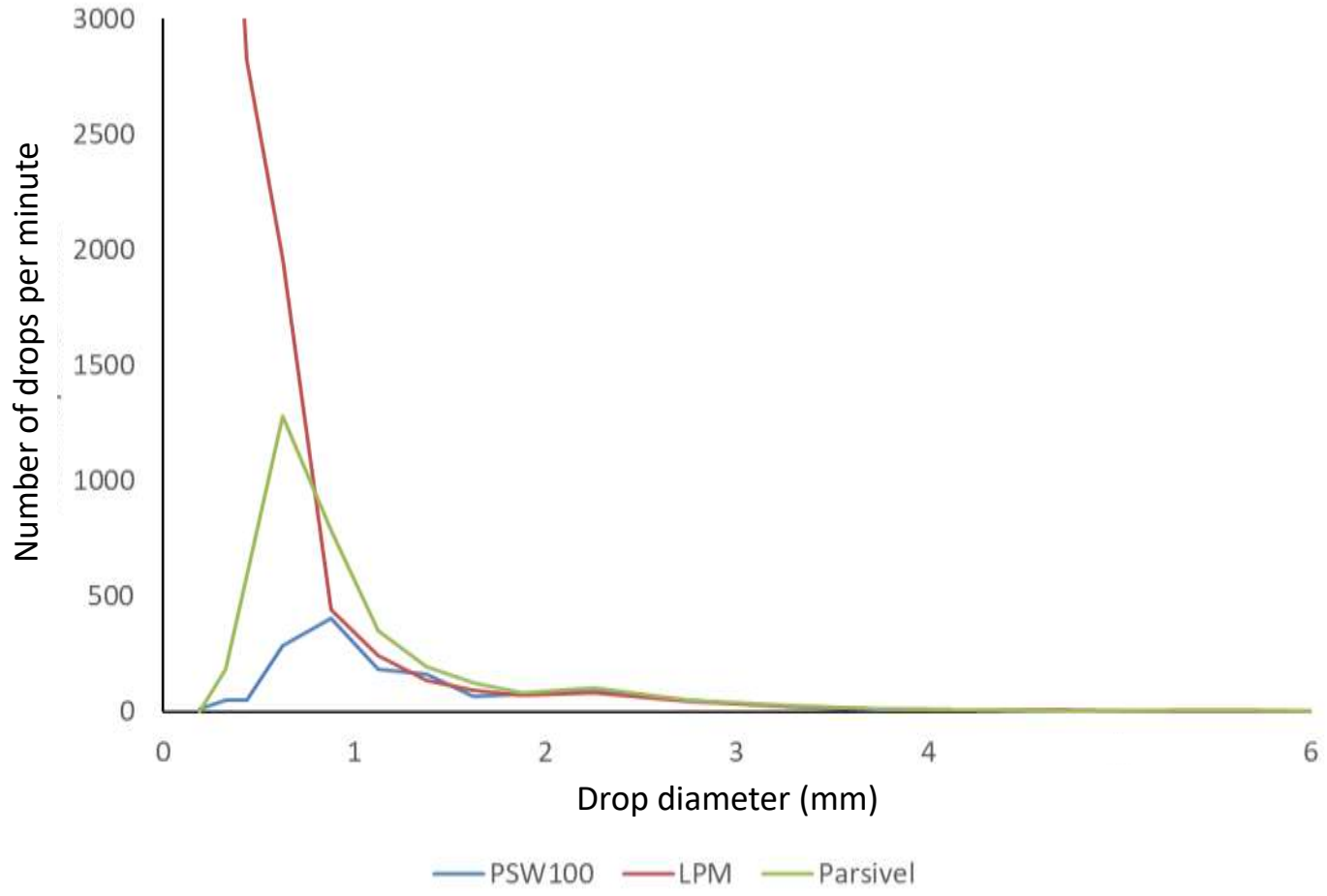
Results: KE-I of simulated rainfall

1. Simulated rainfall



Results – comparison of disdrometers

1. Simulated rainfall



Results – comparison of disdrometers

2. Natural rainfall

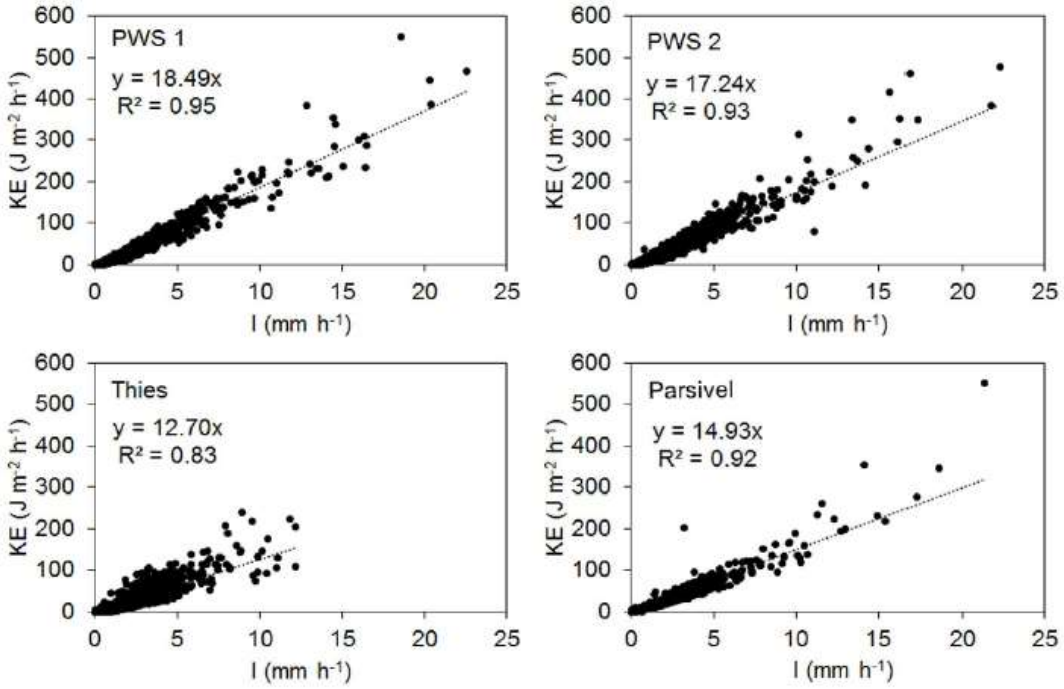


Figure 8. Kinetic energy versus rainfall intensity for all rainy minutes of the selected events with linear regression for each disdrometer.

(Johannsen et al., in prep.)

Results – comparison of disdrometers

2. Natural rainfall

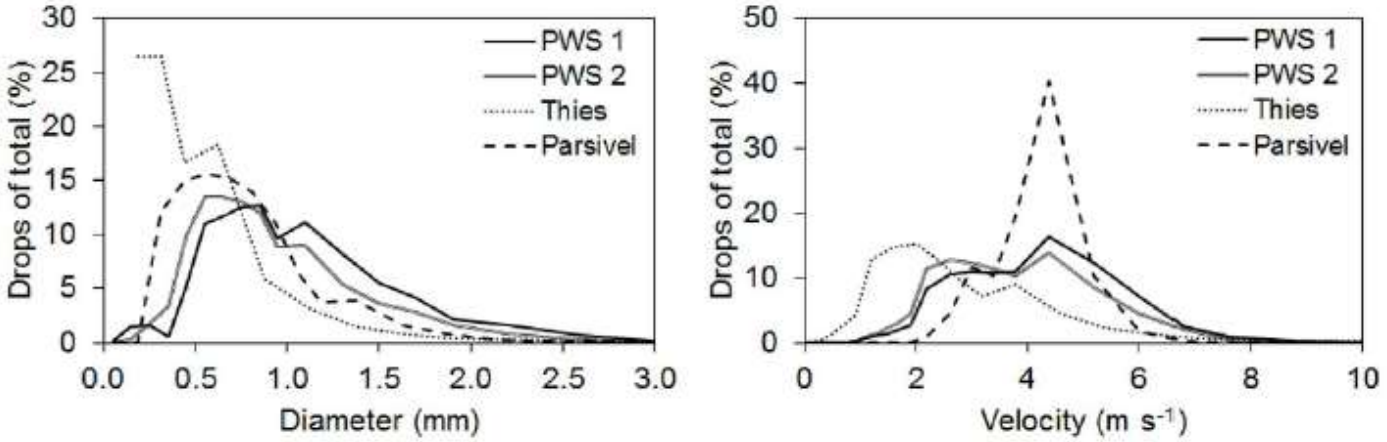
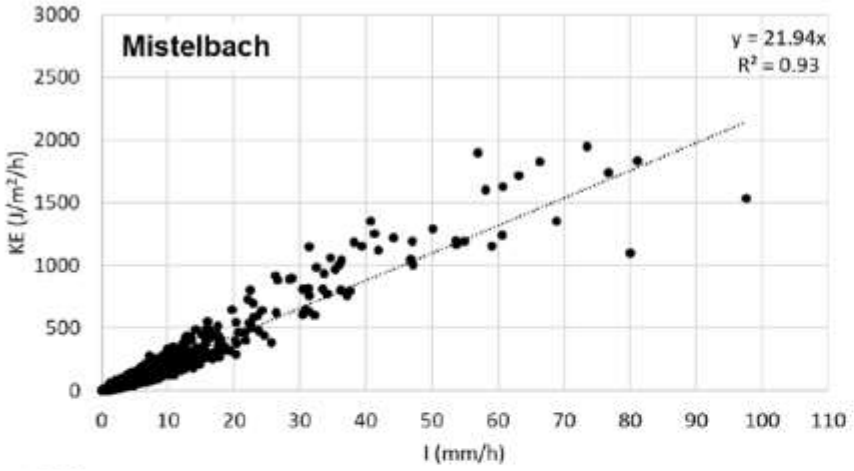
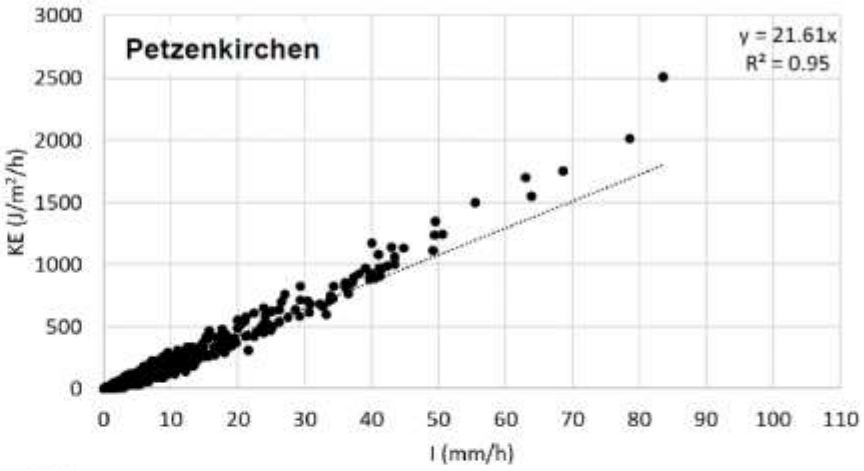


Figure 4. Mean drop size and velocity distribution of the selected events analysed. Each drop size and velocity class is shown as the percentage of drops within this class out of the total number of drops.

(Johannsen et al., in prep.)

Natural vs Simulated Rainfall

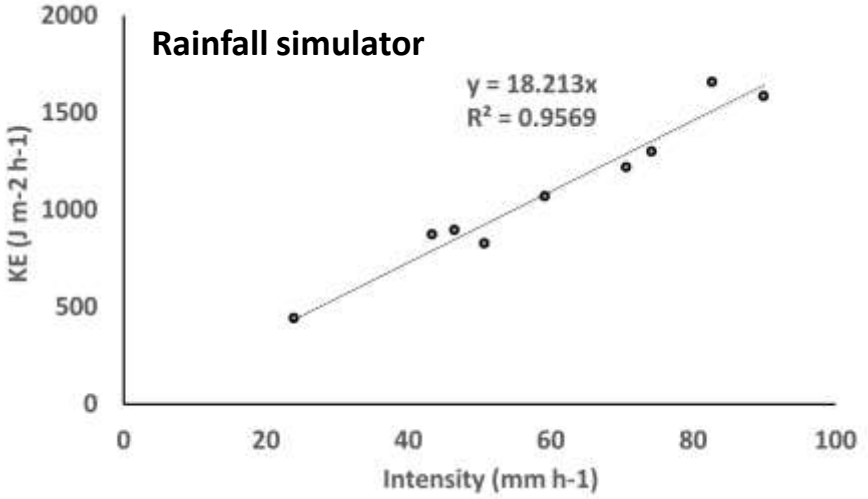




Simulated rainfall has:

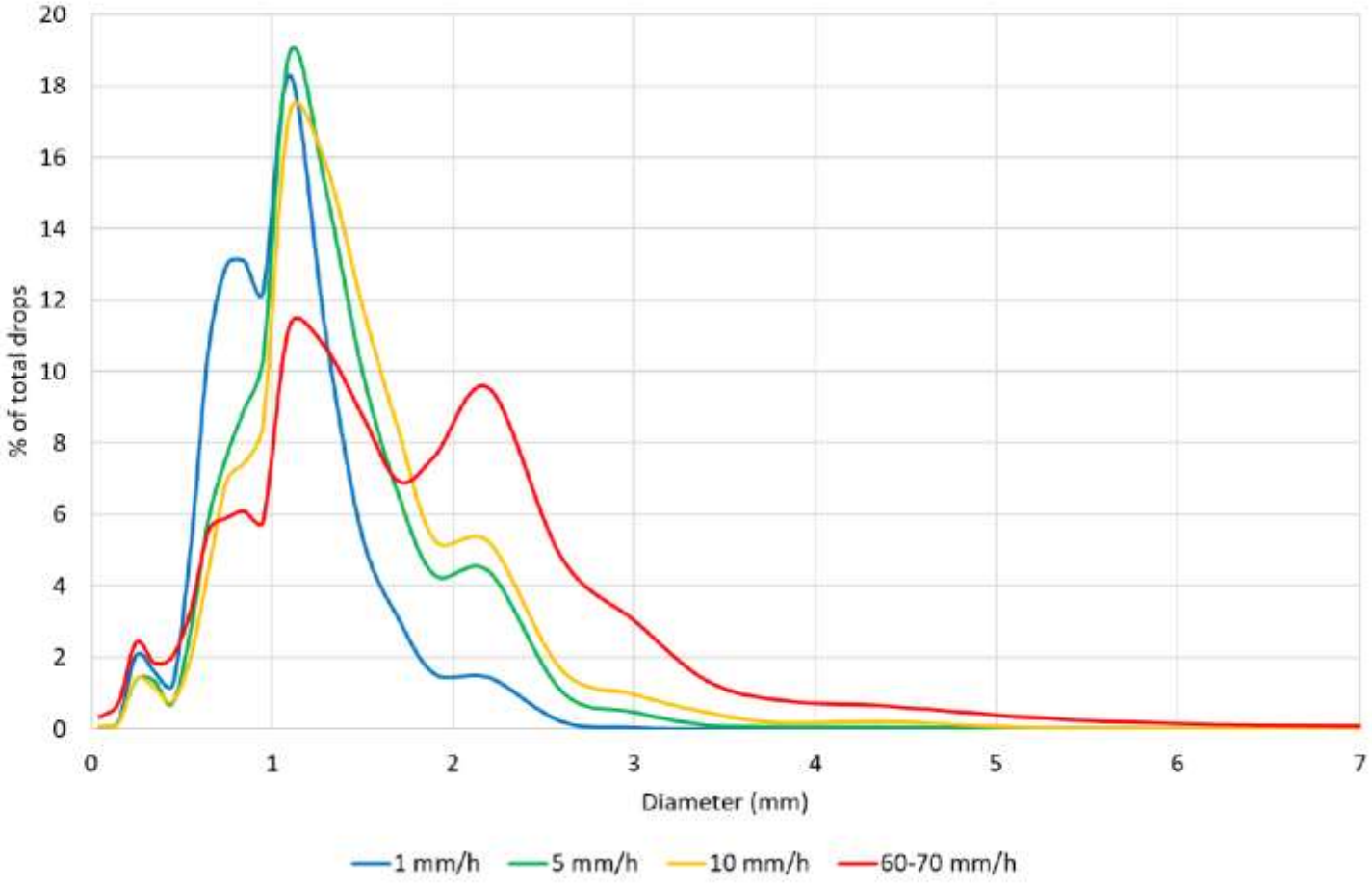
17 % lower KE than measured in situ

36 - 48 % lower KE compared to the published relationships



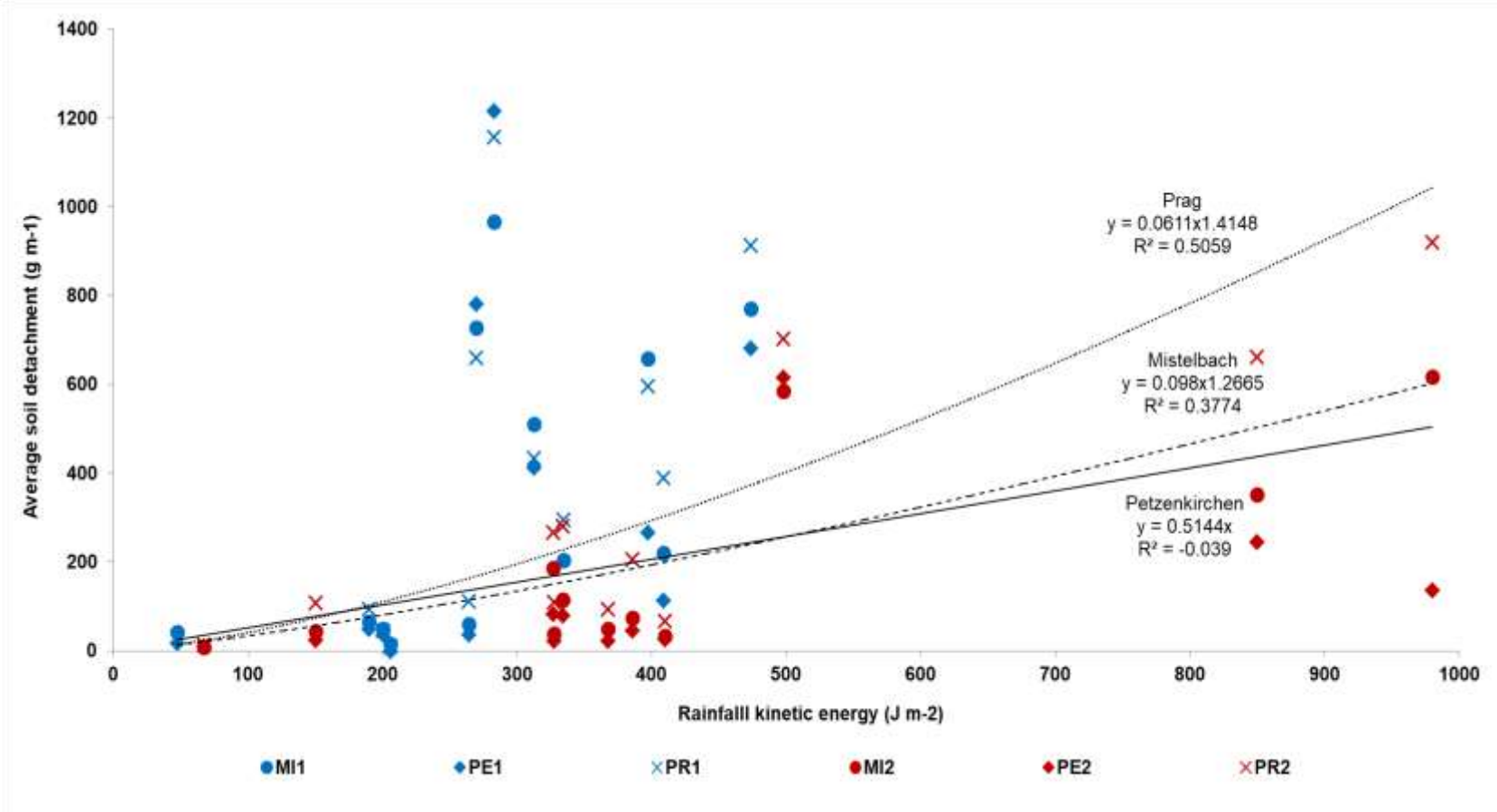
Drop size distribution at different intensities

- Example from Mistelbach data
- Clear shift in DSD towards larger drops at higher intensities

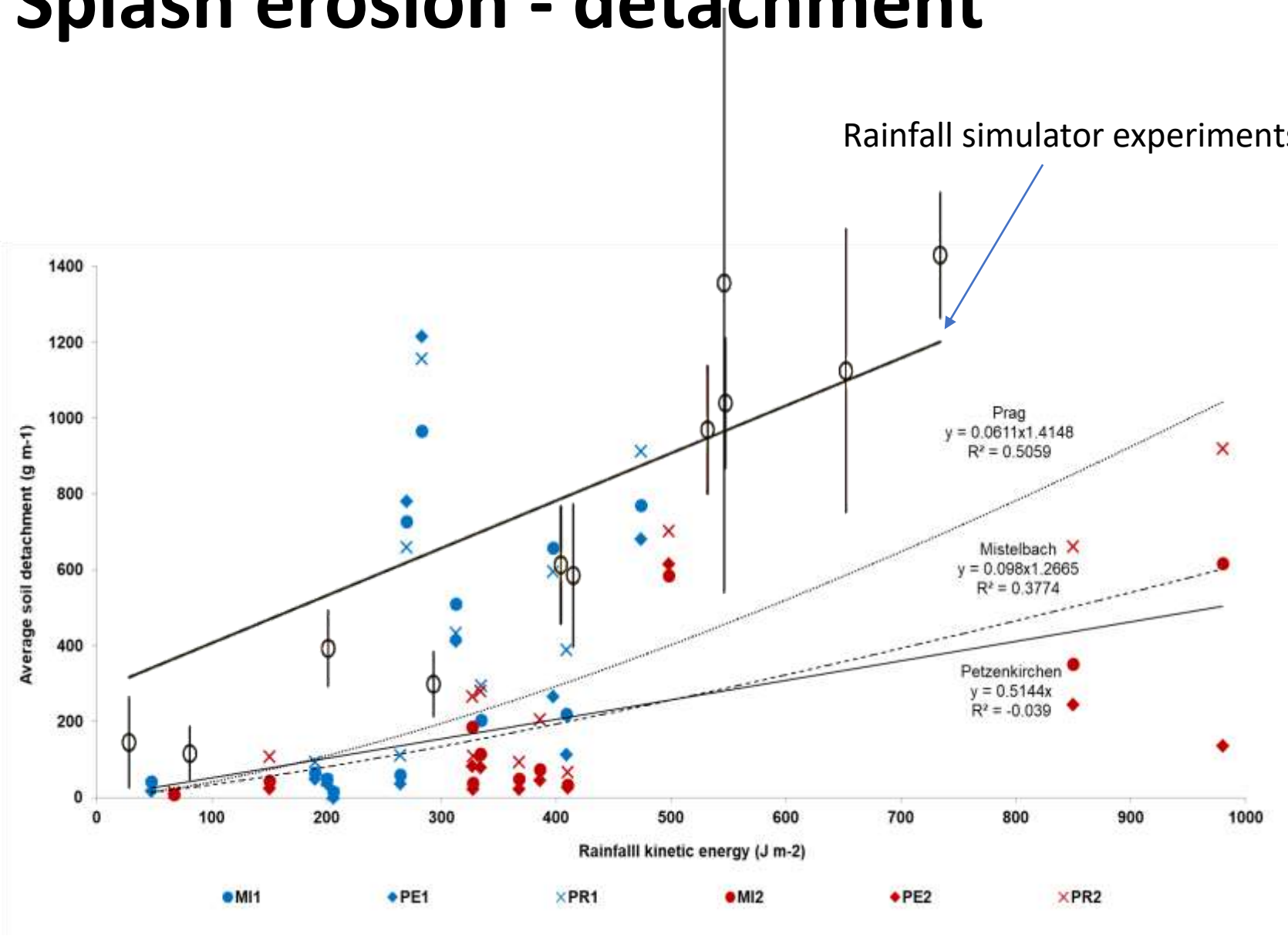


Splash erosion - detachment

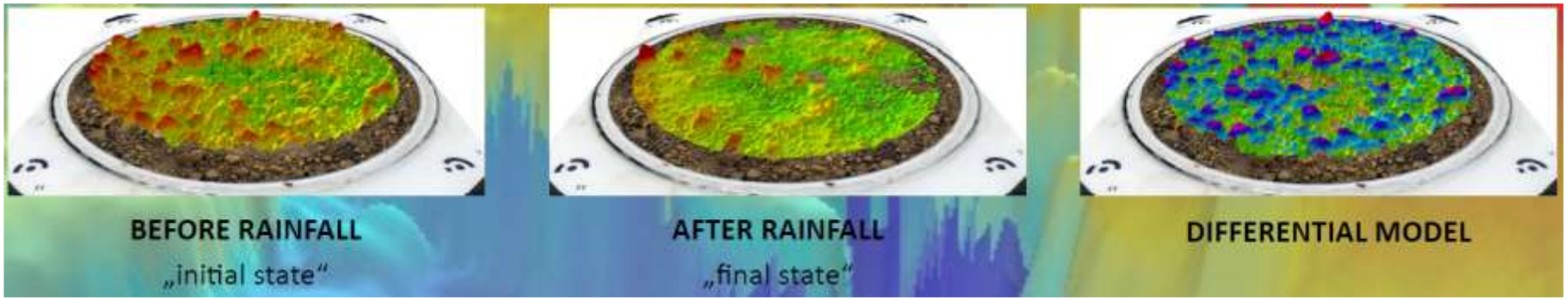
Field data – natural rainfall



Splash erosion - detachment



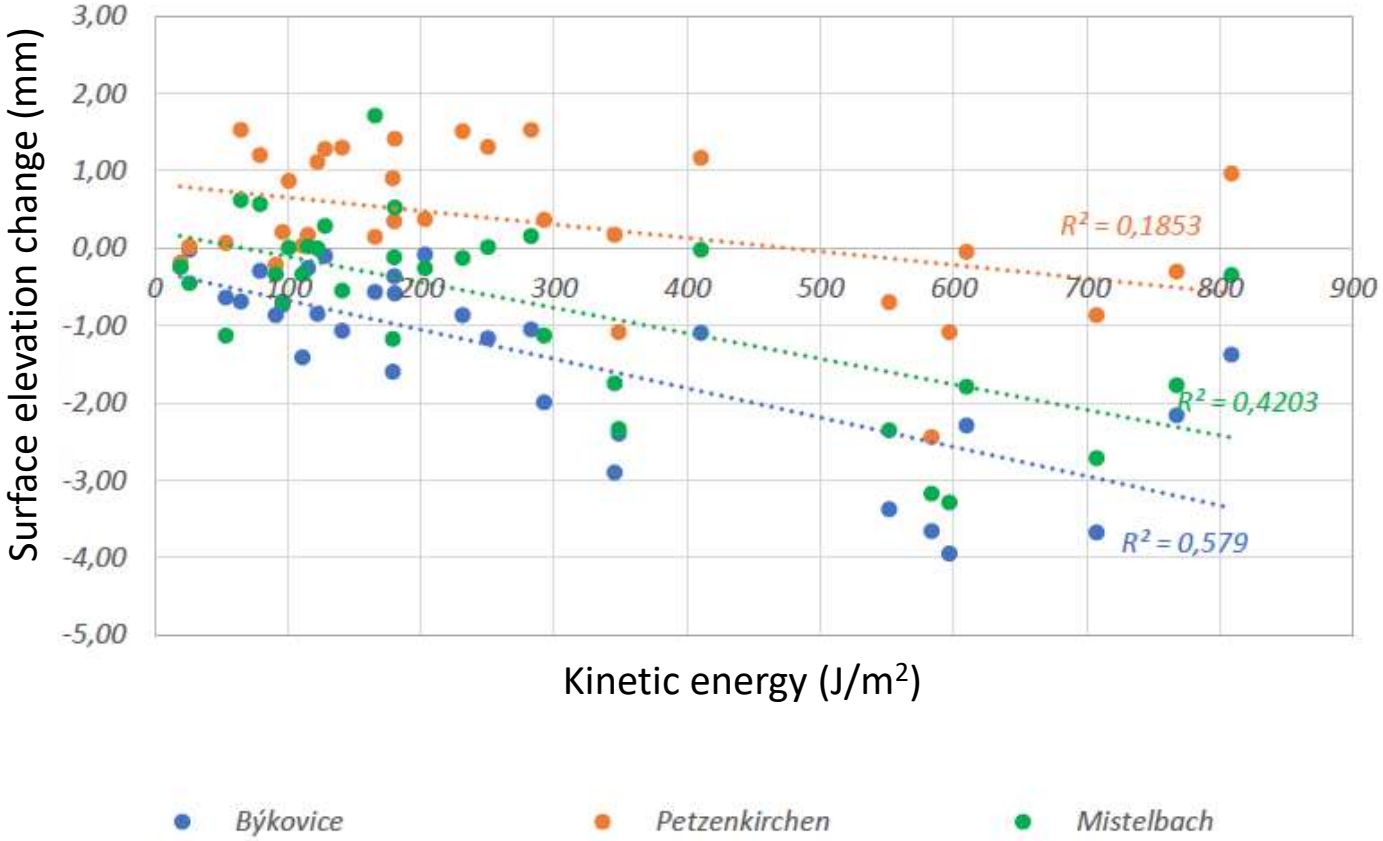
Splash erosion – surface change



SOIL CONSOLIDATION – change of the average DEM elevation

SURFACE ROUGNESS – change of the DEM standard deviation

Soil consolidation



BEFORE RAINFALL

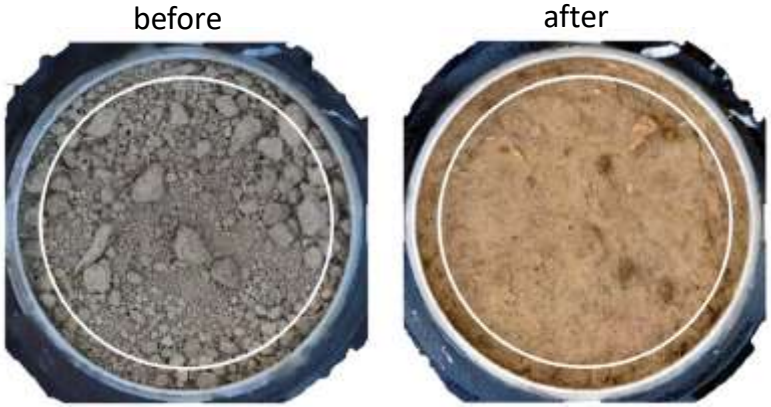
AFTER RAINFALL

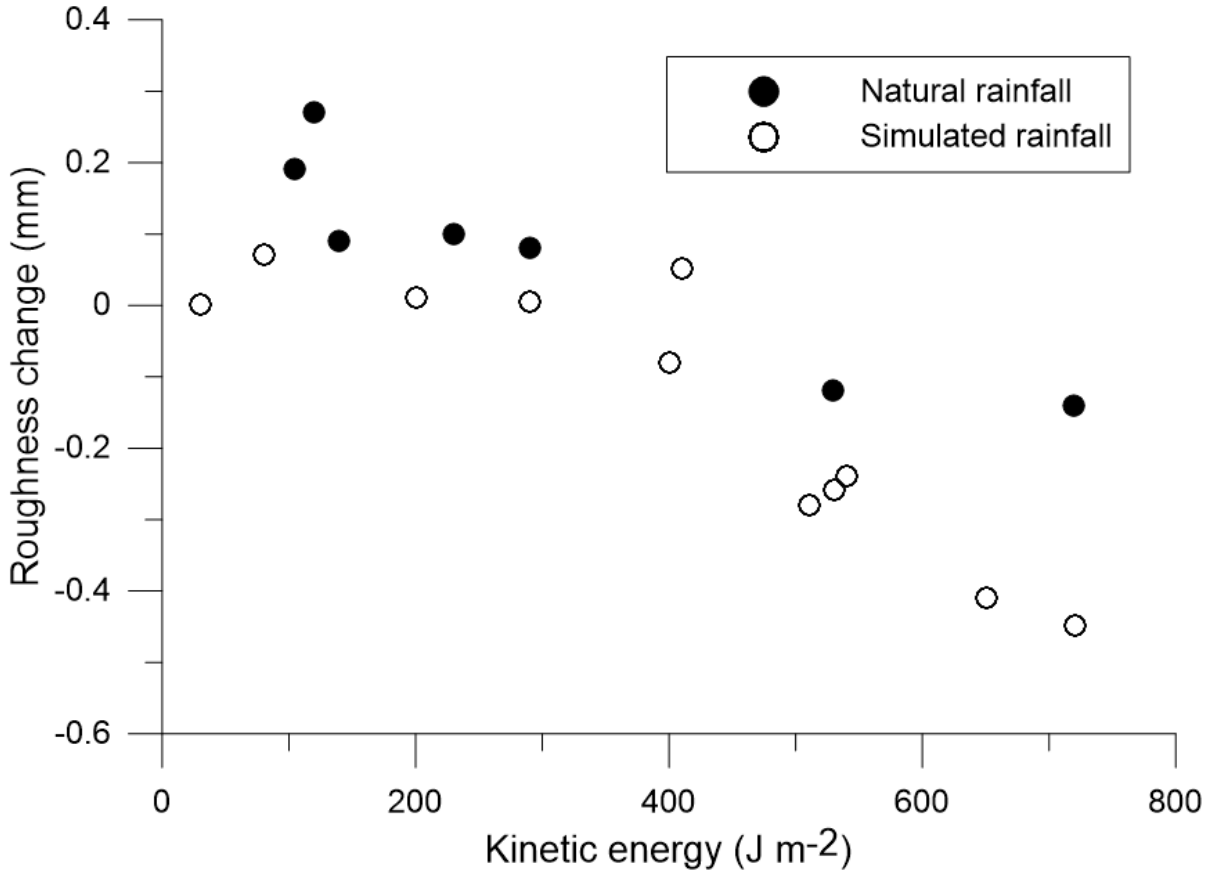
KE = 122 J/m^2

KE = 348 J/m^2

KE = 597 J/m^2

Soil roughness decay





Conclusion

- Different disdrometers provide different results. Large difference in the case of artificial rainfall

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- Simulated rainfall has lower kinetic energy than natural rainfall

BUT

- Soil detachment and surface roughness changes are overestimated under simulated rainfall

THANK YOU

Kinetic energy of rainfall as driving force of soil detachment and transport (**KERS**)

The research has been carried out within the framework of projects GA17-33751L and FWF I 3049-N29.