Influence of disdrometer type on rainfall kinetic energy measurement

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Session HS7.6

Lisbeth Lolk Johannsen (1), Nives Zambon (1), Peter Strauss (2), Tomas Dostal (3), Martin Neumann (3), David Zumr (3), Thomas A. Cochrane (4), and Andreas Klik (1)

lisbeth.johannsen@boku.ac.at

(1) Institute for Soil Physics and Rural Water Management, University of Natural Resources and Life Sciences, Vienna, Austria,

(2) Institute of Land and Water Management Research, Petzenkirchen, Austria,

(3) Faculty of Civil Engineering, Czech Technical University in Prague, Prague, Czech Republic,

(4) Department of Civil and Natural Resources Engineering, University of Canterbury, Christchurch, New Zealand.

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Der Wissenschaftsfonds.

Aim of study

- Investigation of the influence of the disdrometer-specific drop size and velocity measurements on 1) the formulation of new KE-I relationships, 2) the fit of existing equations from literature, and 3) the implications on rainfall erosivity estimation.

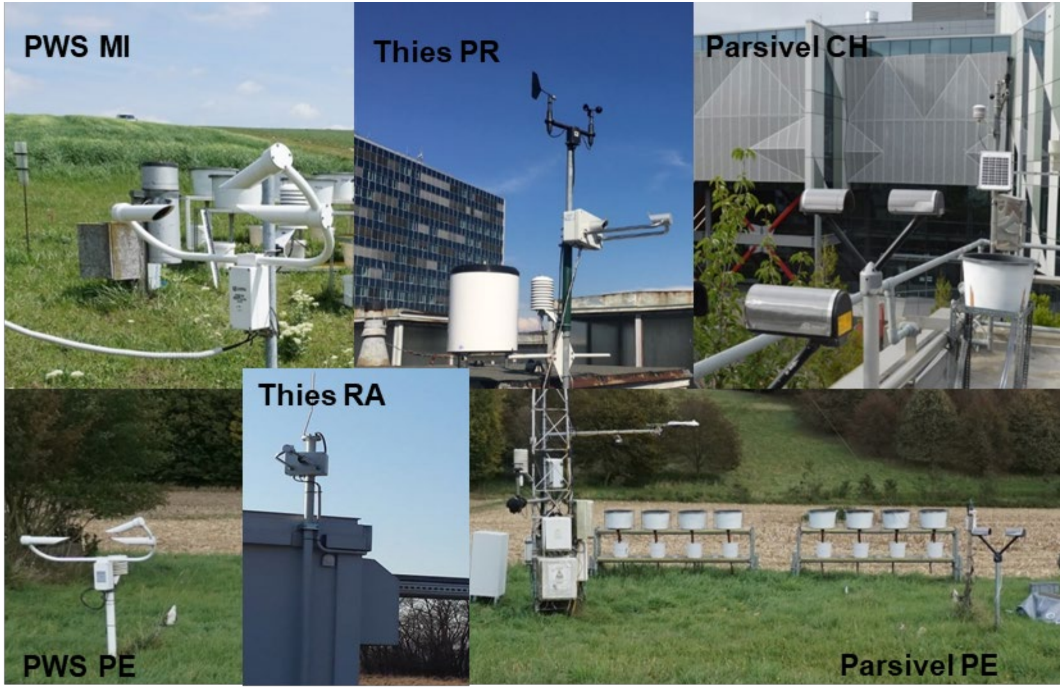

Figure 1. Measurement sites with disdrometers. Modified after Johannsen et al. (2020).

Methods and materials

- Disdrometer data from 3 sites in Austria, 1 site in Czech Republic and 1 site in New Zealand.
- 2 disdrometers of each of the following types were used:
  - PWS100 Campbell Scientific
  - LPM Thies Clima
  - OTT Parsivel
- Varying amounts of 1-min data from 2014 to 2019.
- Data filtered according to terminal velocity line.

Drop size and velocity distribution

- PWS100 followed the terminal velocity line (black) well.
- Thies measured many small drops with overestimated velocity.
- Parsivel overestimated velocity of smaller drops.
- Disdrometers of the same type showed similar distributions even when placed at different sites.
- Disdrometers of different type placed at the same site showed different distributions (PWS PE and Parsivel PE).

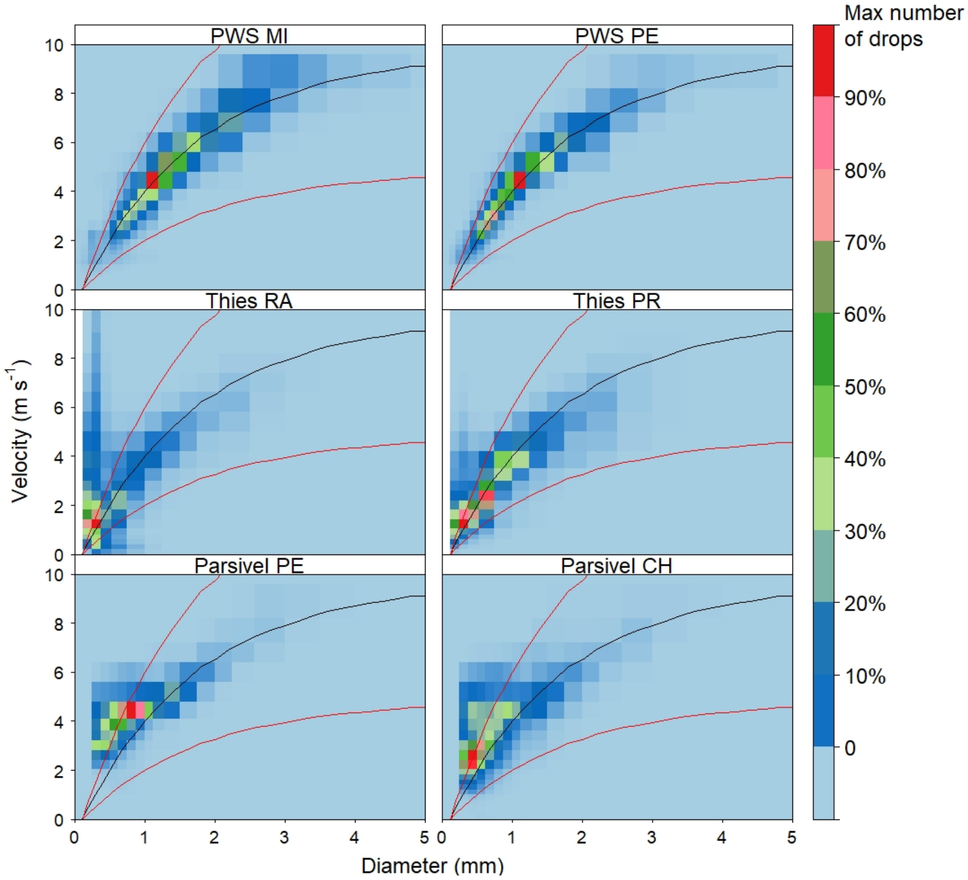

Figure 2. Drop size and velocity distribution of each disdrometer. From Johannsen et al. (2020).

Results

KE-I relationships

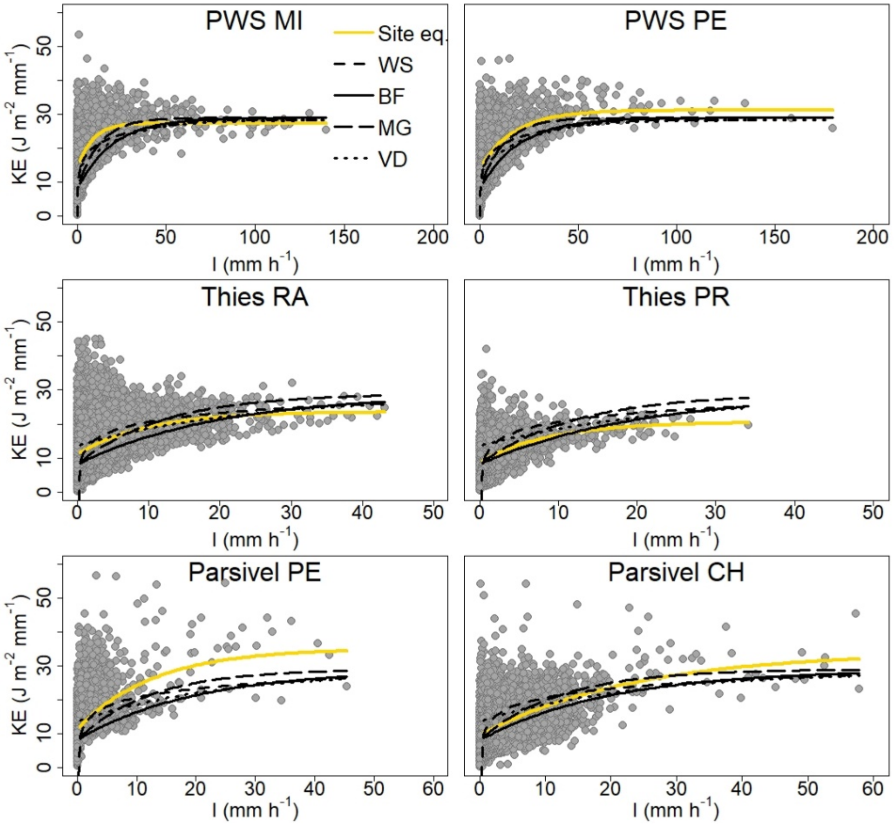

Figure 3. Comparison of the developed KE-I relationships for each disdrometer (Site eq.) and the literature KE-I relationships of Wischmeier and Smith (1978) (WS), Brown and Foster (1987) (BF), McGregor et al. (1995) (MG) and van Dijk et al. (2002) (VD). From Johannsen et al. (2020).

- The developed exponential KE-I relationships had varying parameters depending on disdrometer and site.
- Comparison of best fit of literature KE-I relationships varied among disdrometers and sites.

Table 1. Developed KE-I relationships for each disdrometer and specifics of the used data. Modified after Johannsen et al. (2020).

Disdrometer and site	Rainfall Kinetic Energy–Intensity Relationship ($J\ m^{-2}\ h^{-1}$)	R^2	Minutes Analysed	Total Rain (mm)
PWS MI	$27.4 \cdot I \cdot (1-0.49 \cdot e^{-0.121 \cdot I})$	0.98	18001	582
PWS PE	$31.2 \cdot I \cdot (1-0.55 \cdot e^{-0.057 \cdot I})$	0.97	85605	1255
Thies RA	$23.6 \cdot I \cdot (1-0.53 \cdot e^{-0.103 \cdot I})$	0.95	152284	1397
Thies PR	$20.6 \cdot I \cdot (1-0.57 \cdot e^{-0.111 \cdot I})$	0.96	15708	190
Parsivel PE	$35.0 \cdot I \cdot (1-0.68 \cdot e^{-0.079 \cdot I})$	0.91	19059	181
Parsivel CH	$34.0 \cdot I \cdot (1-0.72 \cdot e^{-0.043 \cdot I})$	0.90	47058	787

Conclusions

Conclusions

- This study showed that the rainfall kinetic energy estimation is influenced by the disdrometer type.
- Drop size and velocity distributions were device-specific. Disdrometers of the same type showed similar distributions despite installation at different sites.
- Exponential KE-I relationships were developed with varying parameters for each site and disdrometer.
- Fit of literature KE-I relationships varied among disdrometers and sites. No one KE-I relationship could be recommended for all sites.
- Deviations in measured rainfall and KE between disdrometers at the same site, showed the impact of using different disdrometer types on rainfall erosivity estimation.
- Investigation into spatial differences in rainfall characteristics and erosivity hindered by use of different disdrometer types.

- For further details please see **Johannsen et al. (2020)**: Impact of Disdrometer Types on Rainfall Erosivity Estimation, *Water*, 12:4, 963, https://doi.org/10.3390/w12040963