

Measurements of precipitation particles with disdrometers

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Overview

- Introduction
- Disdrometers
- Field site Voulund and its disdrometer measurements
- Summary & Outlook

Introduction

Why do we need detail knowledge about precipitation particles?

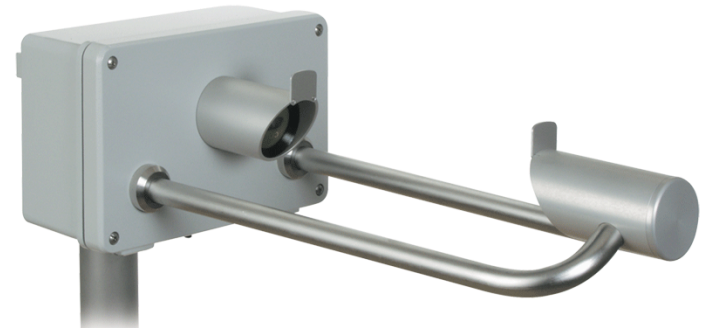
- A lot of papers assume certain size of rain droplets for modelling (e.g. Amirzadeh et al. (2017), Slot et al. (2015))
- Different sizes of rain droplets provide different kinetic energy
- Different sizes of rain droplets have a different shape
- Do not know a lot about the frequency of occurrence of hail and graupel.

Disdrometers

- Different techniques to measure drop size distributions and fall velocity of precipitation particles with an automatic device
- Frequently used disdrometers are based on an optical principle
- PARSIVEL² (PARTicle Size and VELOCITY) from OTT
- LPM (Laser Precipitation Monitor) from Thies



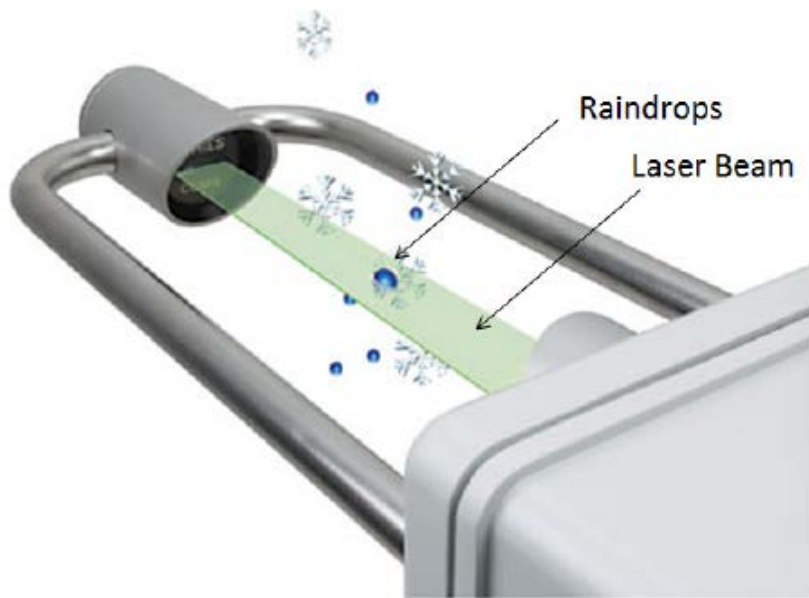
www.ott.com



www.thiesclima.com

Disdrometers

Measuring principle



Kathiravelu et al. (2016)

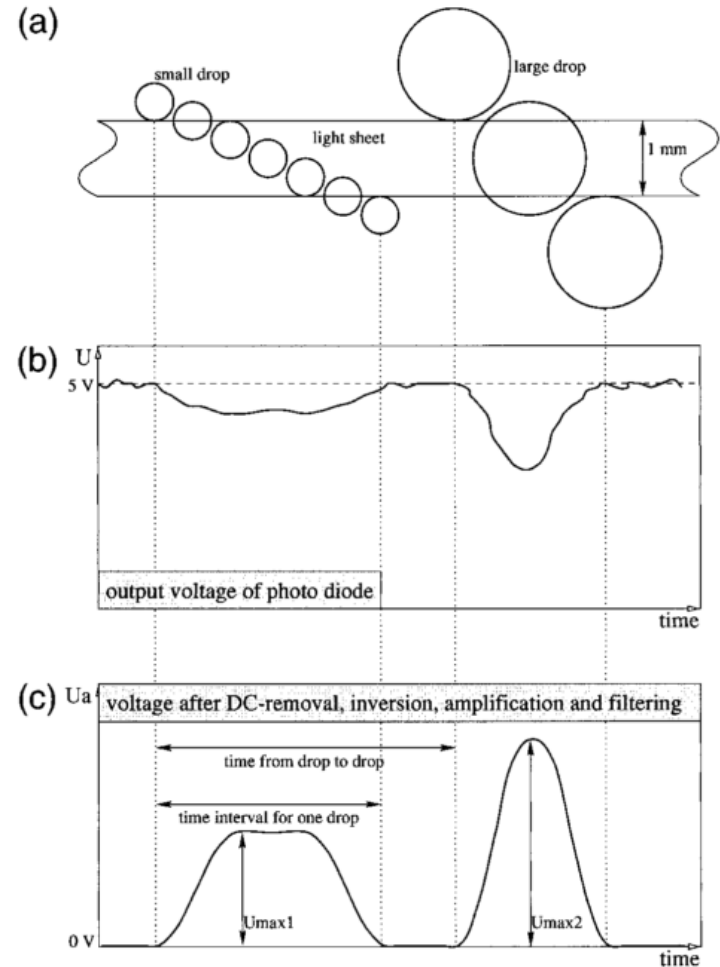


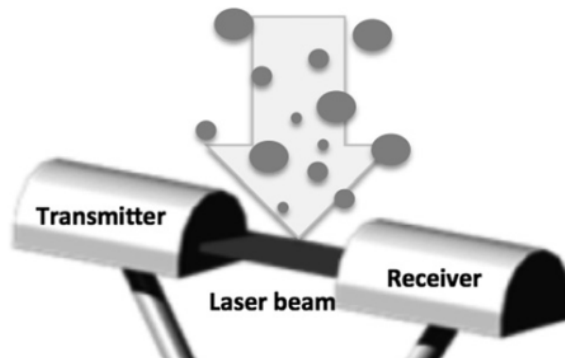
FIG. 1. Signals of particles falling through the light sheet. (a) Small and large particles, (b) raw signal from the sensor, and (c) inverted and amplified signal after thresholding for measuring purposes.

Disdrometers

Some problems of disdrometers

- Splashing of particles at sensor structure
- Edge blocking
- Influence of wind

a) Particle motion = particle fall velocity



b) Particle motion = air motion + particle fall velocity

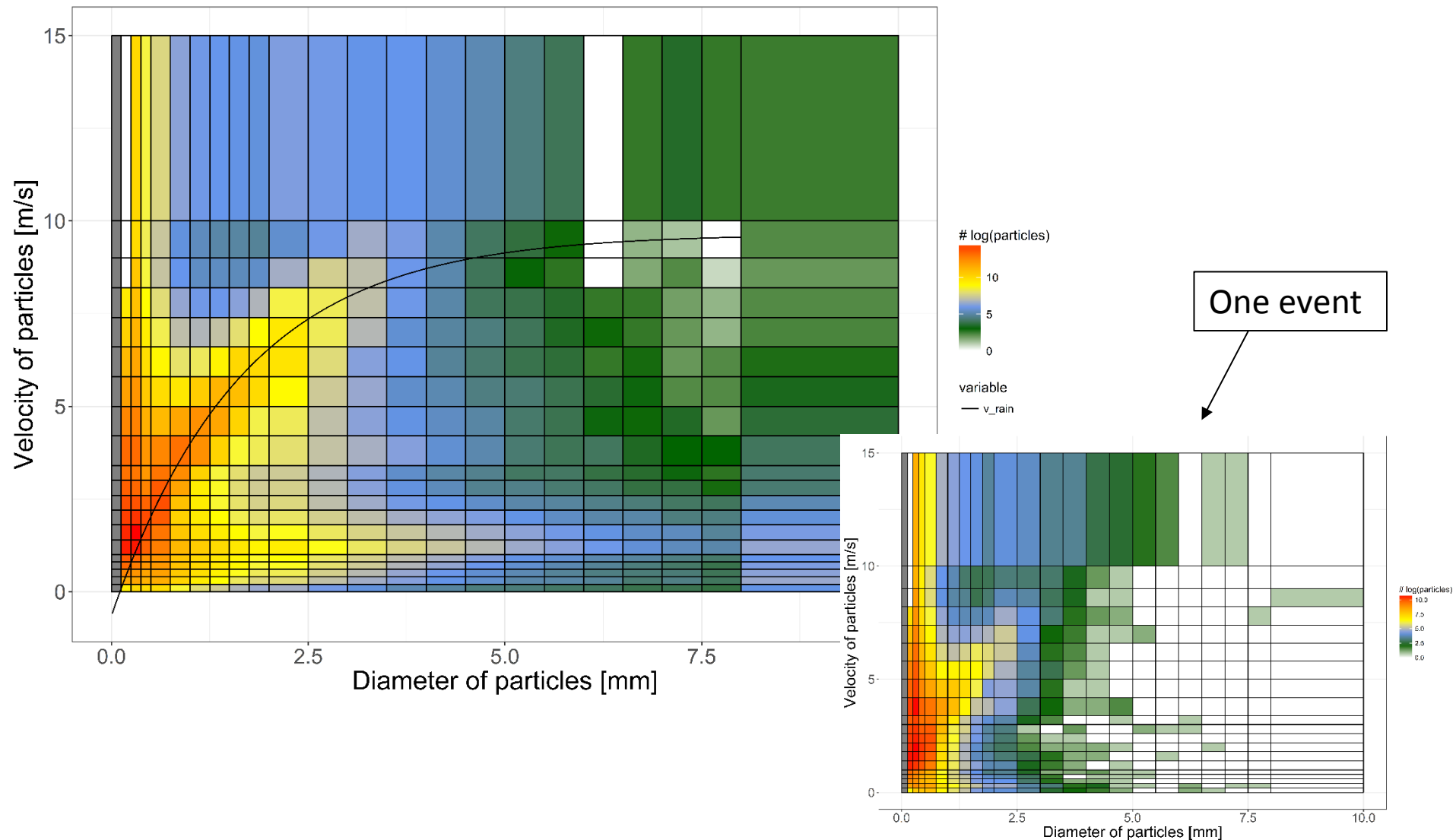


Field site Voulund and its disdrometer measurements

- HOBE field site
- Measured parameters: temperature, wind speed, wind direction, precipitation amount and disdrometer (LPM of Thies)
- Data available from 2012 to 2017 => disdrometer has a measurement interval of 1 minute



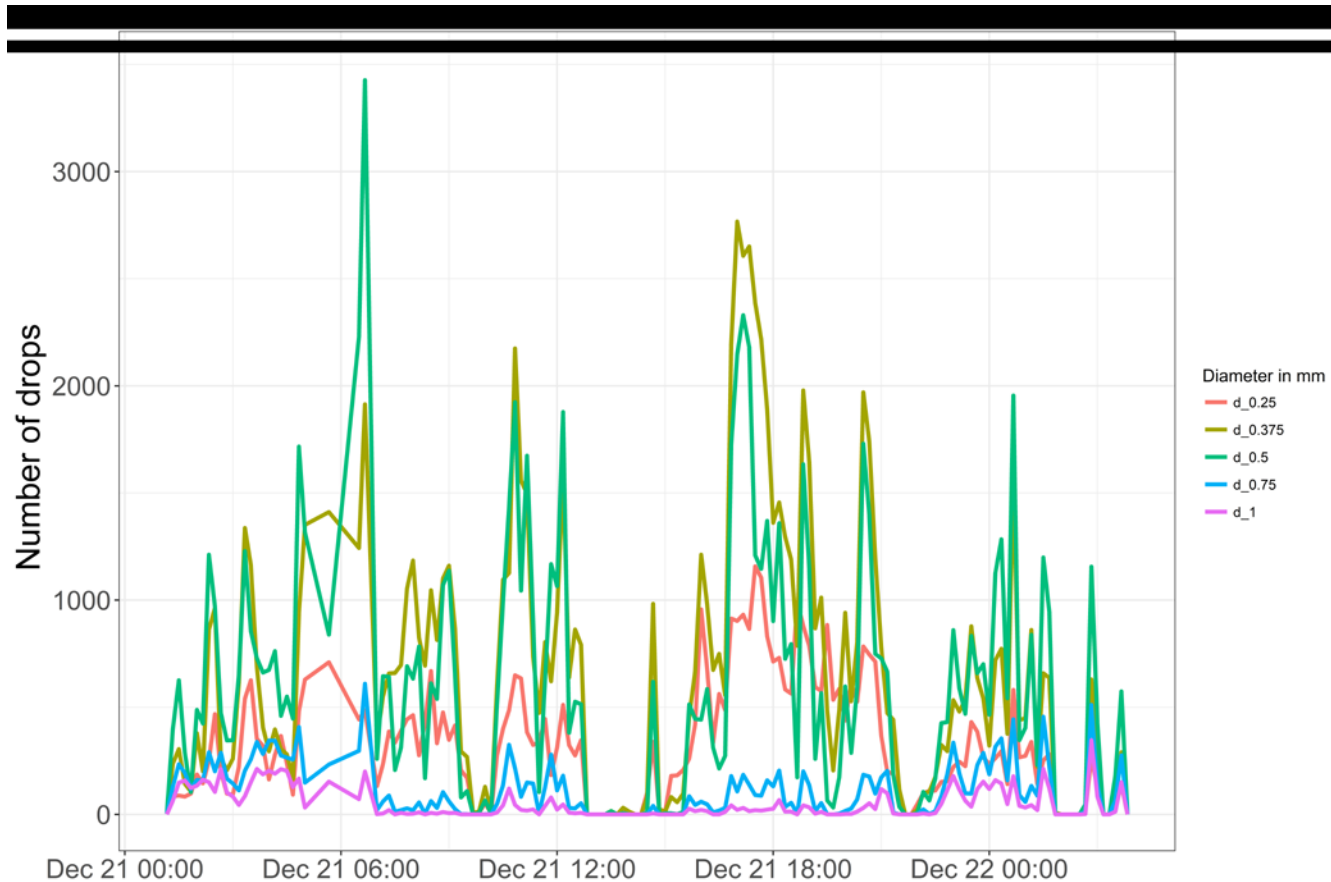
Field site Voulund and its disdrometer measurements



Field site Voulund and its disdrometer measurements

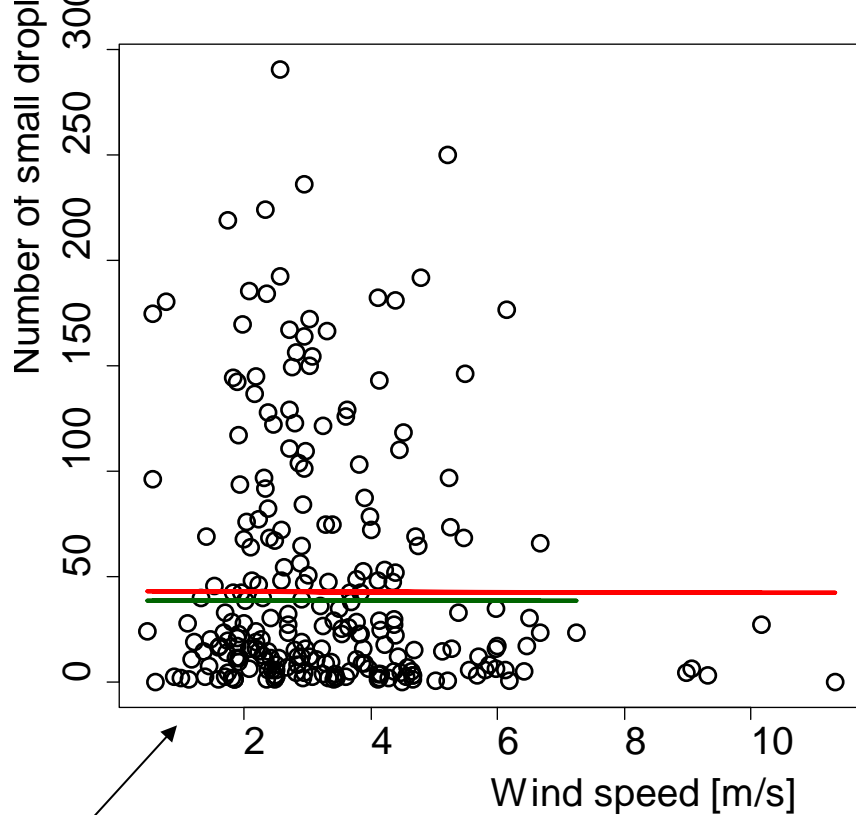
Detail look in an event

21.12.2013 01:10:00 to 22.12.2013 03:50:00

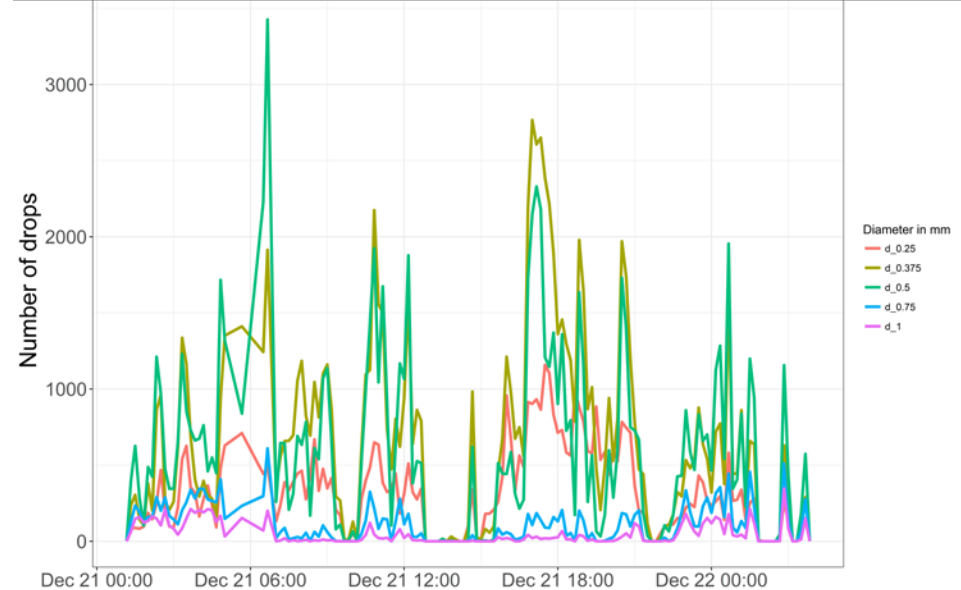
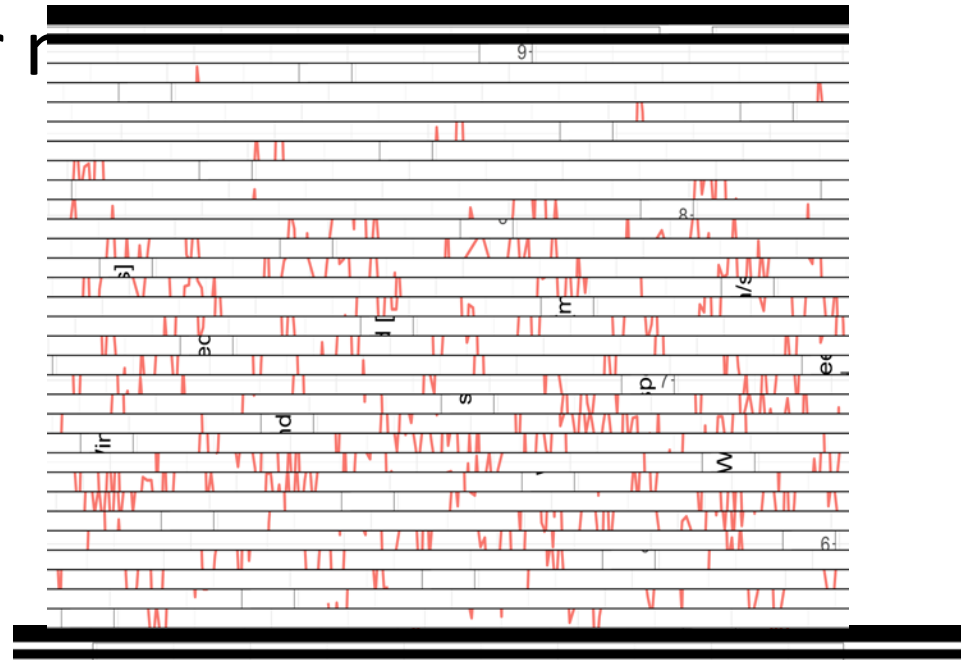


Field site Voulund and its disdrometer r

Influence of wind (event based)



Only rain events with a duration between 11 and 120 minutes (mean wind speed vs. standardized number of droplets of event)



Summary and Outlook

- Disdrometers are useful sensors to measure precipitation size distributions
- Field site Voulund provides long-term series of measurements covering different kinds of events
- Size distributions vary during events

- Measurements of precipitation particles onshore and offshore with disdrometers
- Calculation of kinetic energy of precipitation particles
- Influence of blade rotation on size and kinetic energy of precipitation particles

Thank you!

EROSION

Backup

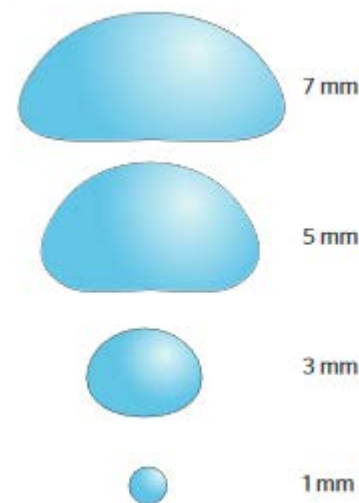
precipitation particles

When we talk about precipitation particles, what kinds and sizes of precipitation particles are measured?

- Rain: from 0.1 to ~8mm (typical < 0.5mm called drizzle)
- Snowflakes: > 0.2mm ("diamond dust")
- Hail: > 5mm (~15cm possible)
- Graupel (snow pellets / soft hail) – 2-5mm



b



Other disdrometers

- Displacement disdrometers => Joss-Waldvogel disdrometer
- Optical disdrometers => 2DVD disdrometer



distromet.com



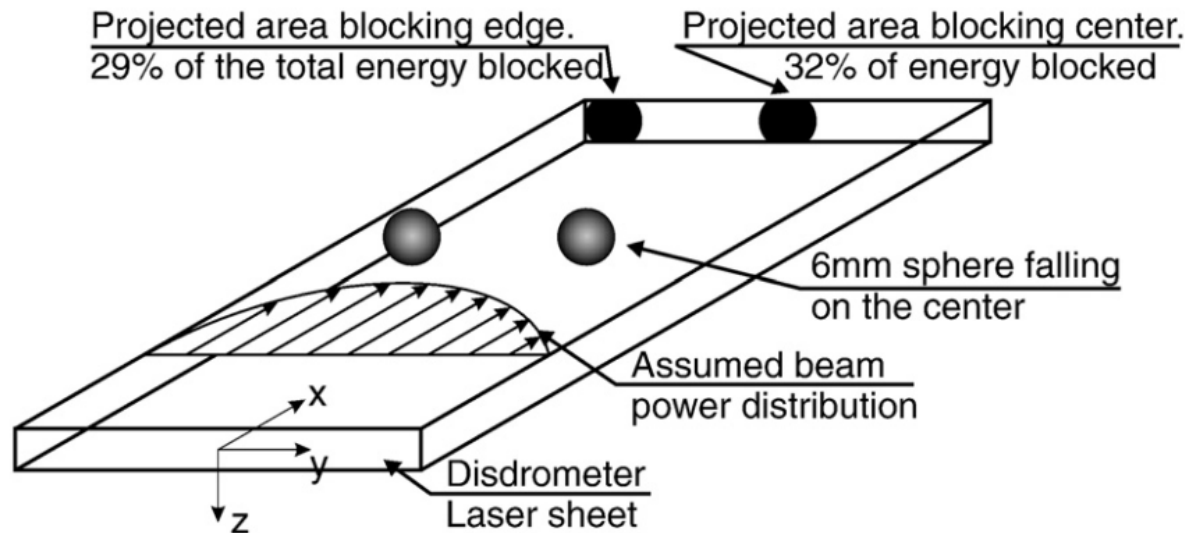
www.distrometer.at/

Other problems of disdrometers

- Oscillations in the laser current and temperature & non-homogeneous beam power distribution (especially LPM Thies)
 - Multiple drops appearing at the same time
 - Unsuppressed 50 Hz rumble noise in power supply – interfered with particles $< 0.3\text{mm}$
- => Effects increase with precipitation intensity

Other problems of disdrometers

- Edge blocking



Frasson et al. (2011)

Hail in Voulund in 2013

