Field test of low cost disdrometer in a Tropical environment

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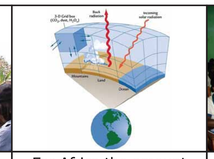
Introduction

A low cost accoustic disdrometer is under development as part of the TAHMO project (tahmo.org), which envisions to design and build a $200 weather station for the African market.
During a two month measuring campagne the current prototype of the low cost accoustic disdrometer was tested for the first time in a tropical environment; Zambia.
The goal of this field test was to gather as much data as possible to get more insight in the behavior of the disdrometer to specify points of improvement.

TAHMO

The main goal of the TAHMO project is to understand better Africa's environment through participatory sensing, scientific modeling and education.

For people in Africa acquiring modern measurement equipment is virtually impossible.



For Africa the amount of measured "ground truth" data is very scarce.

Doing measurements is not a part of the curriculum in any African country.

Disdrometer

A simple and inexpensive acoustic rain gauge is under development for large scale application. The rain gauge is based on the principle of the acoustic disdrometer and is produced with cheap and readily available parts. The total cost for the parts of the disdrometer, excluding the electronics, is below €10,-.

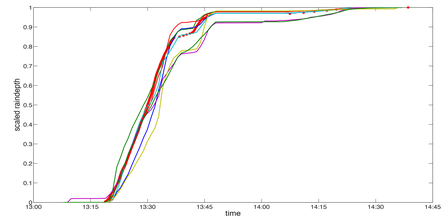
The sensor in the disdrometer is a piezo electric element. The piezo electric element converts a drop impact into an electrical signal which can be processed and logged. The extent of the recorded drop energy depends on the size of the drop and its velocity.

Results

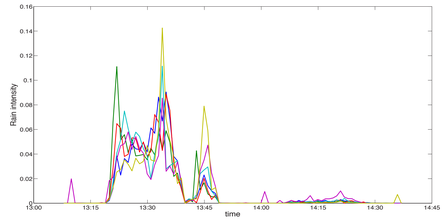
Measurements with the low cost disdrometer and a conventional tipping bucket are conducted in an open field, so the spatial variation in rainfall can be neglected. Audio recorders were used as logger for the disdrometers, during the field test it appeared that the recorders are far from consistent. Because only one laboratorium calibration curve is availabe for all the disdrometers, scaling needed to be applied to the results to allow comparisons related to the shape of the drop size distribution. The drop size distributions observed with the disdrometers during this event all have a gamma distribution.

One of the test fields.
(Left) before the rainy season. (Right) after the rainy season

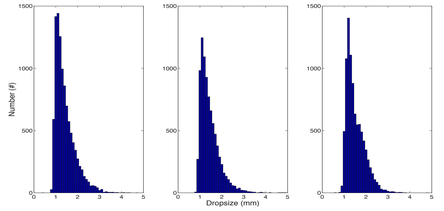
Scaled cummulative raindepth of tipping bucket (RED) and disdrometers



Scaled rain intensities measured by disdrometers

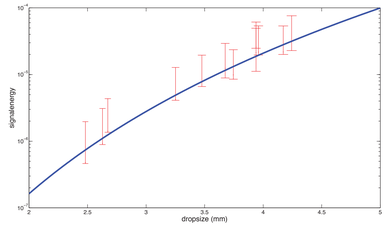


Example of observed drop size distribution



Calibration

The calibration of the disdrometer is conducted in a stairway of the faculty of Civil Engineering. Drops were released with medical needles, in a fixed position, from a height of 12 meters. With this method the disdrometer could only be calibrated for dropsizes between 2 and 5 mm in diameter.



Calibration curve with 10th and 90th percentile

Conclusions

The disdrometers and loggers used during this field test did not show consistent measurements with respect to total rainfall due to inconsistensies between different loggers and sensors. However, scaling the results shows quite some similarity with respect to the rainfall pattern. From this we can conclude that using one calibration curve for all measurements is incorrect and that all current disdrometers need to be calibrated concerning drop size and effective surface area.

The design of the disdrometer is now under revision and an improved version will be ready in the coming months. Meanwhile more students will participate in the TAHMO project for further social and technical analysis on the implementation of a cheap wheater station in Africa.

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