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Various Types of Drop Size Distributions of Rainfall Measured with Self-Designed Laser Disdrometers

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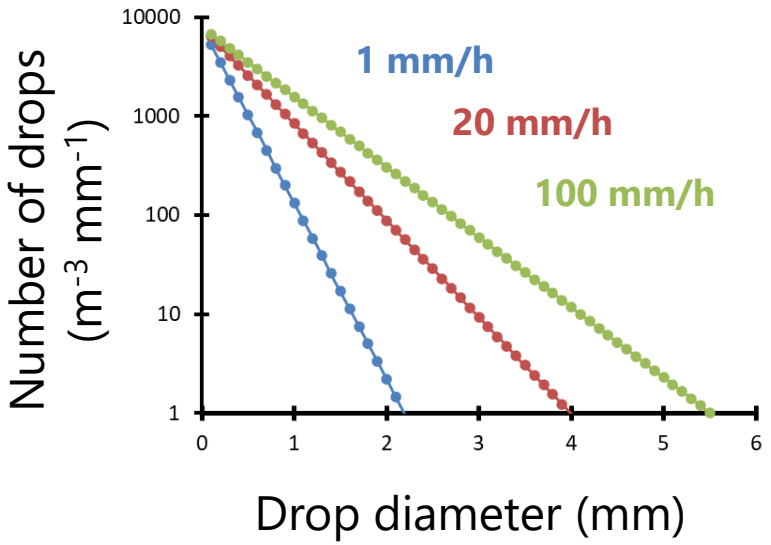
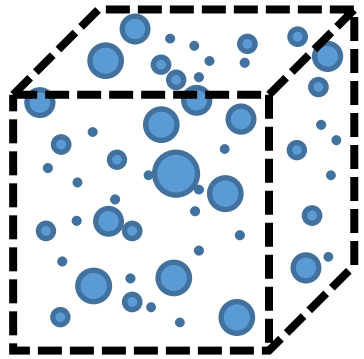
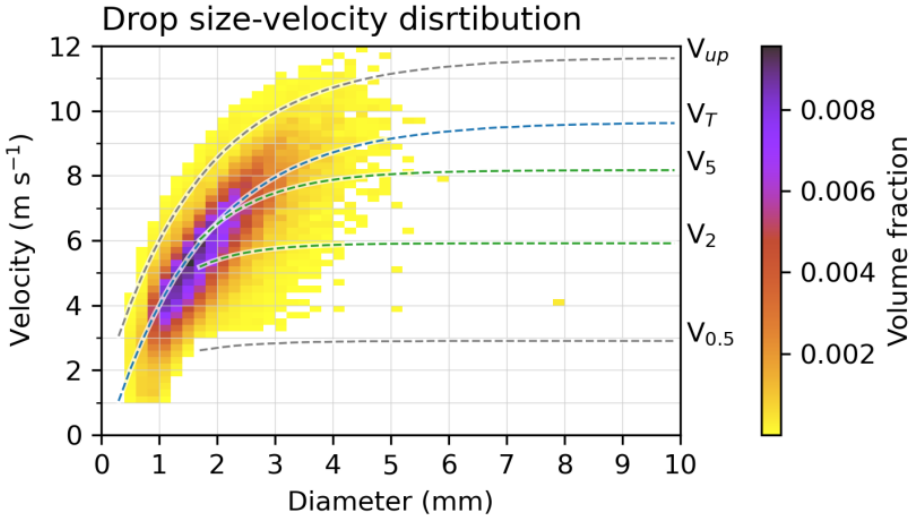
Raindrops

Raindrops are the smallest unit of rainfall.

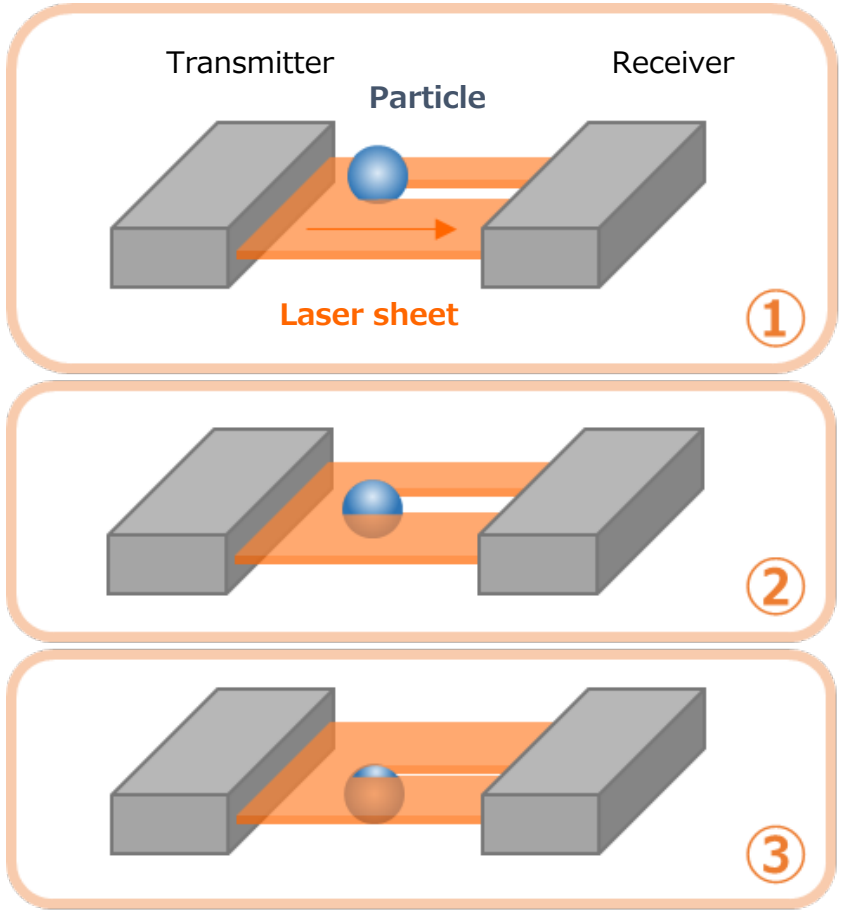
The sizes and fall velocities are necessary information
to improve rainfall prediction accuracy and soil erosion estimation.

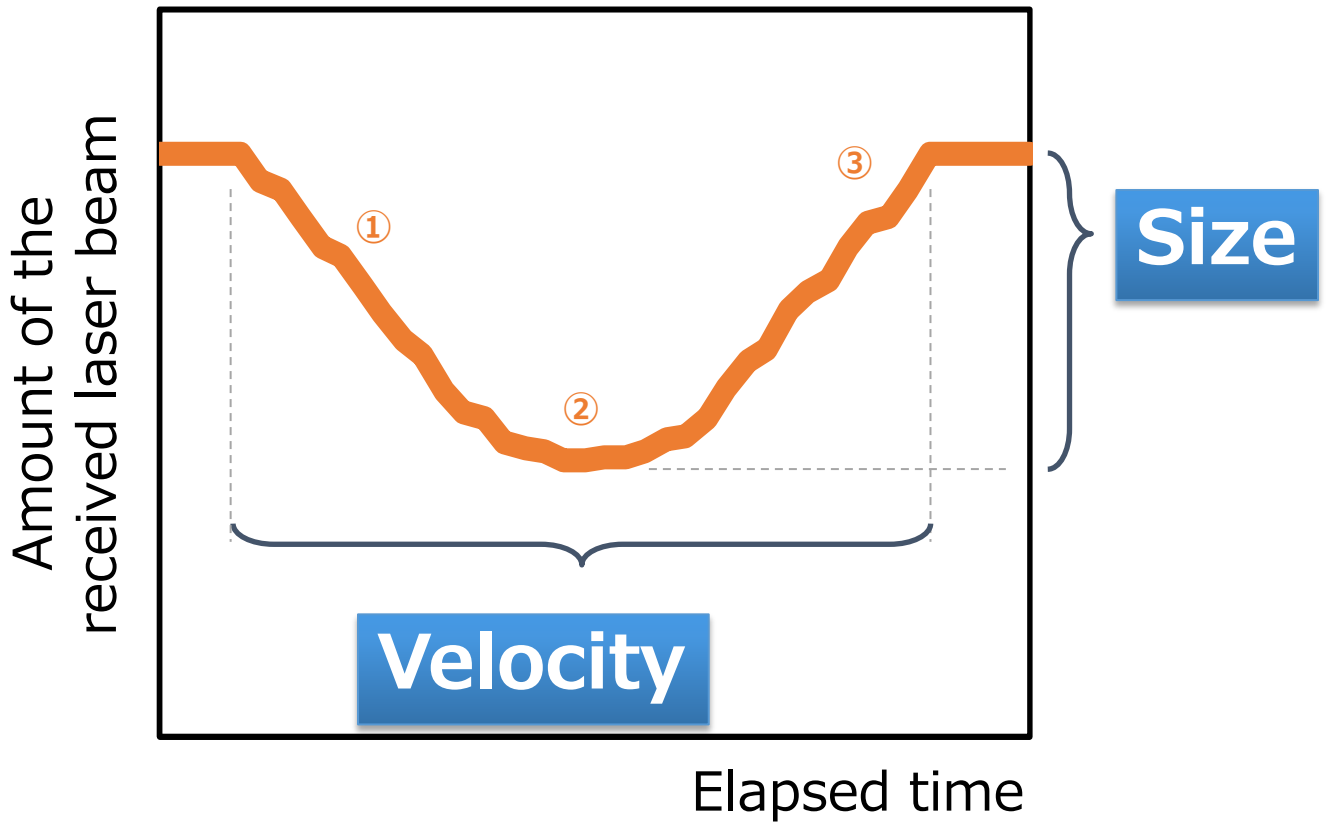






Drop measurement using laser sensors





Laser disdrometers

OTT Parsivel
(OTT Hydromet, Germany)

Laser Precipitation Monitor
(Thies Clima, Germany)

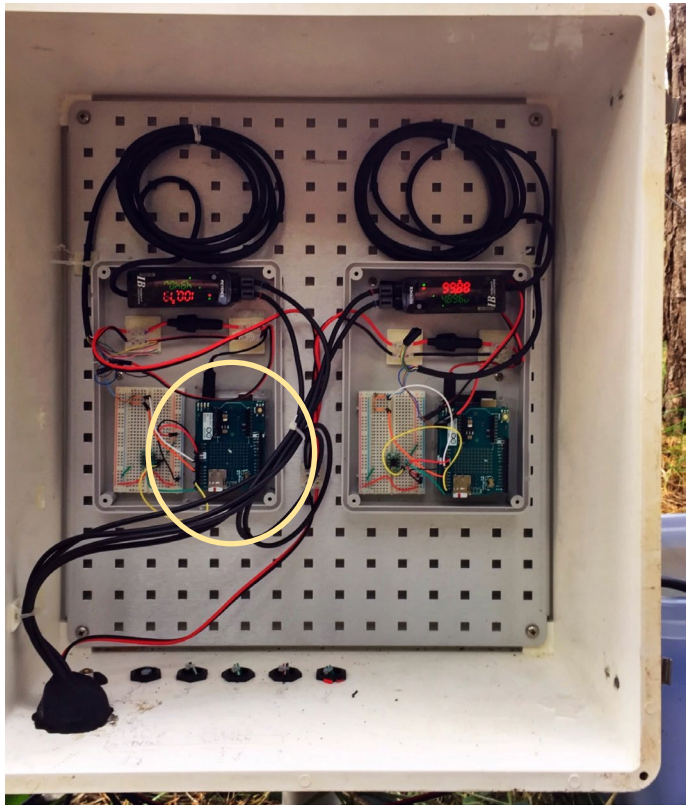
Nanko et al. (2006)

Nanko-type disdrometers (Japan)

Data logging

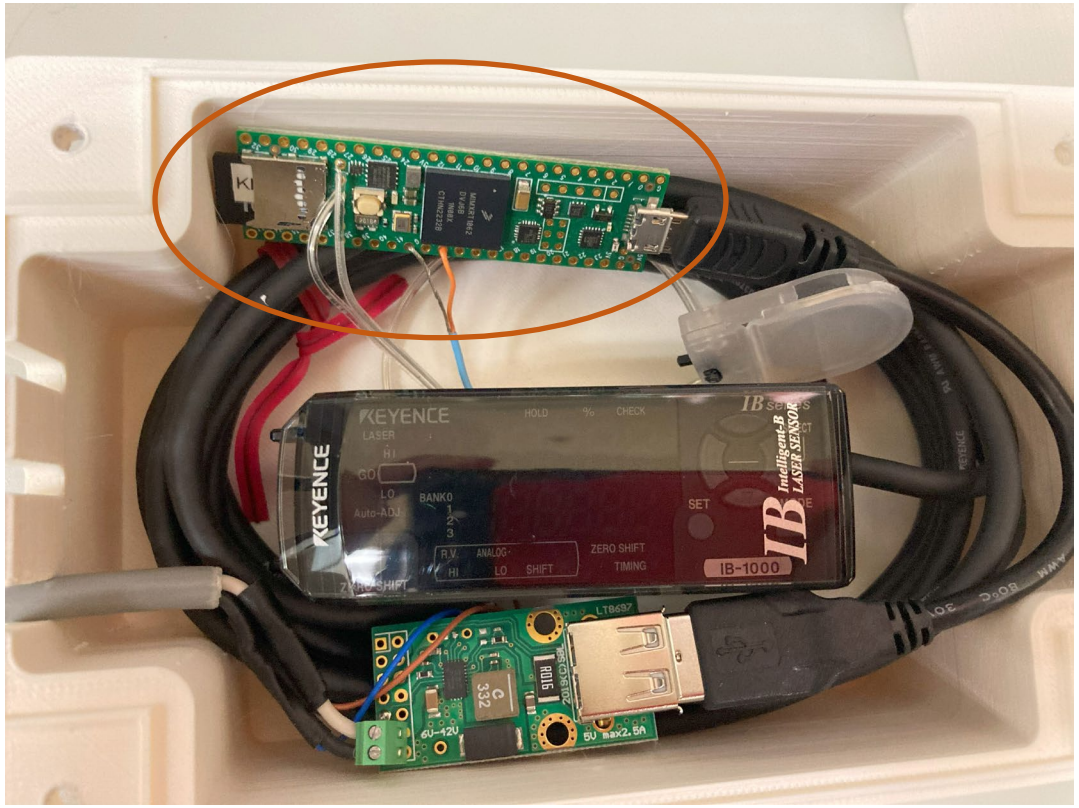
Microcontrollers are used for data loggers.

Arduino UNO

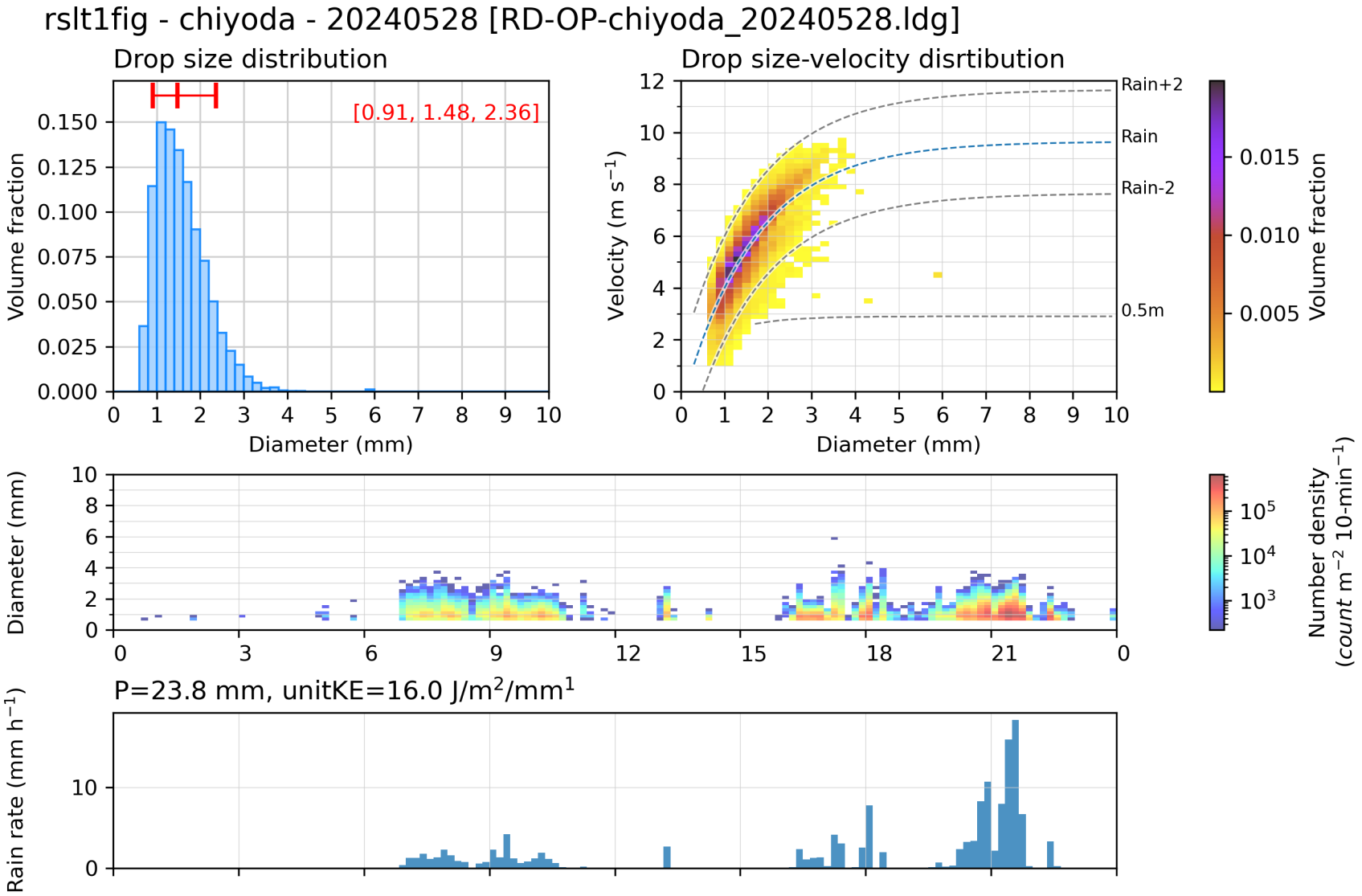


Feather Adalogger (Adafruit)

Teensy 4.1 (PJRC)



Raindrop data



Ex1) Raindrops of heavy rainfall

Nanko et al. (2016)

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Rainfall erosivity–intensity relationships for normal rainfall events and a tropical cyclone on the US southeast coast

Kazuki Nanko [a,*], Susanne M. Moskalski [b,1], Raymond Torres [b]

Salt Marsh

Nanko et al. (2016)

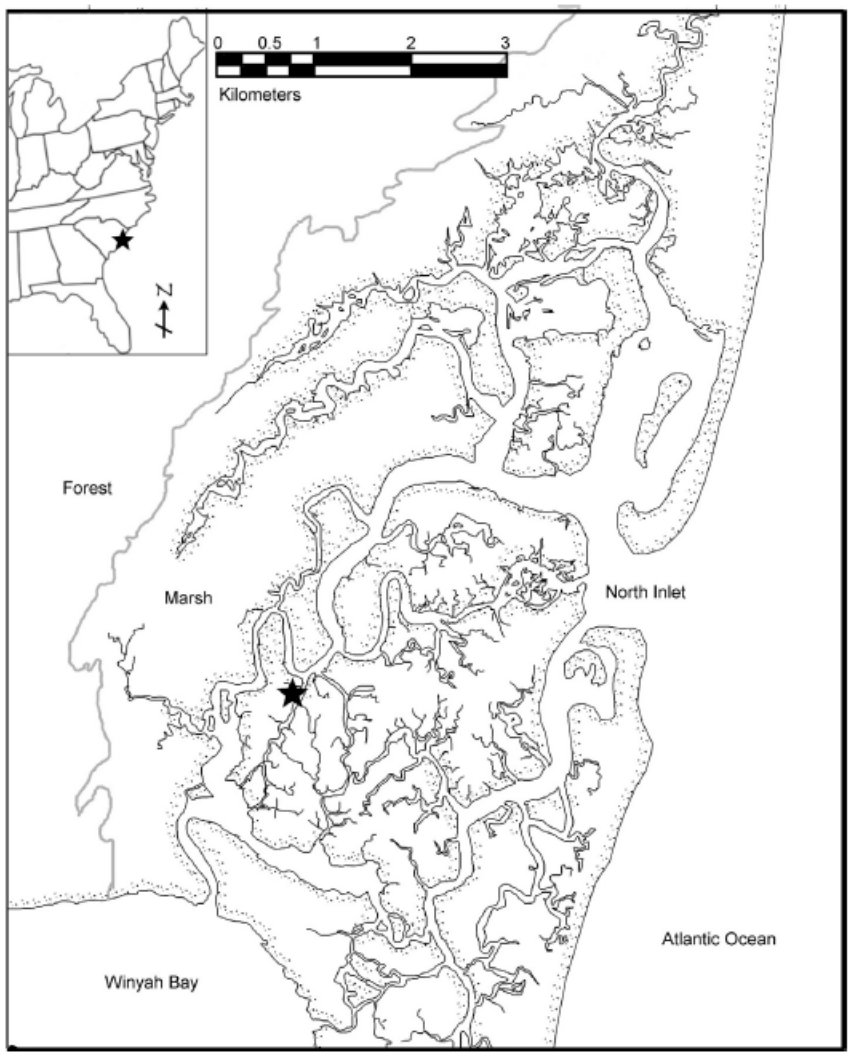
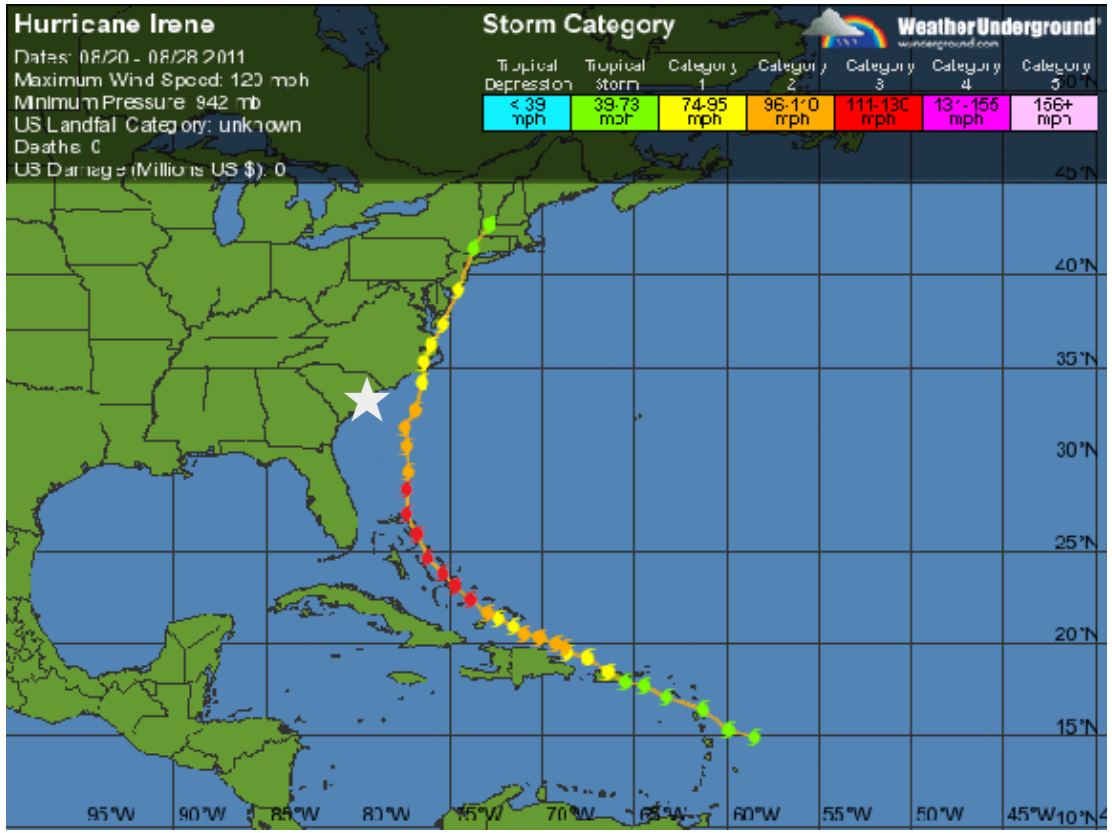


Fig. 1. Location of weather station in North Inlet.

Deploy OTT Parsivel

Hurricane Irene (2011)



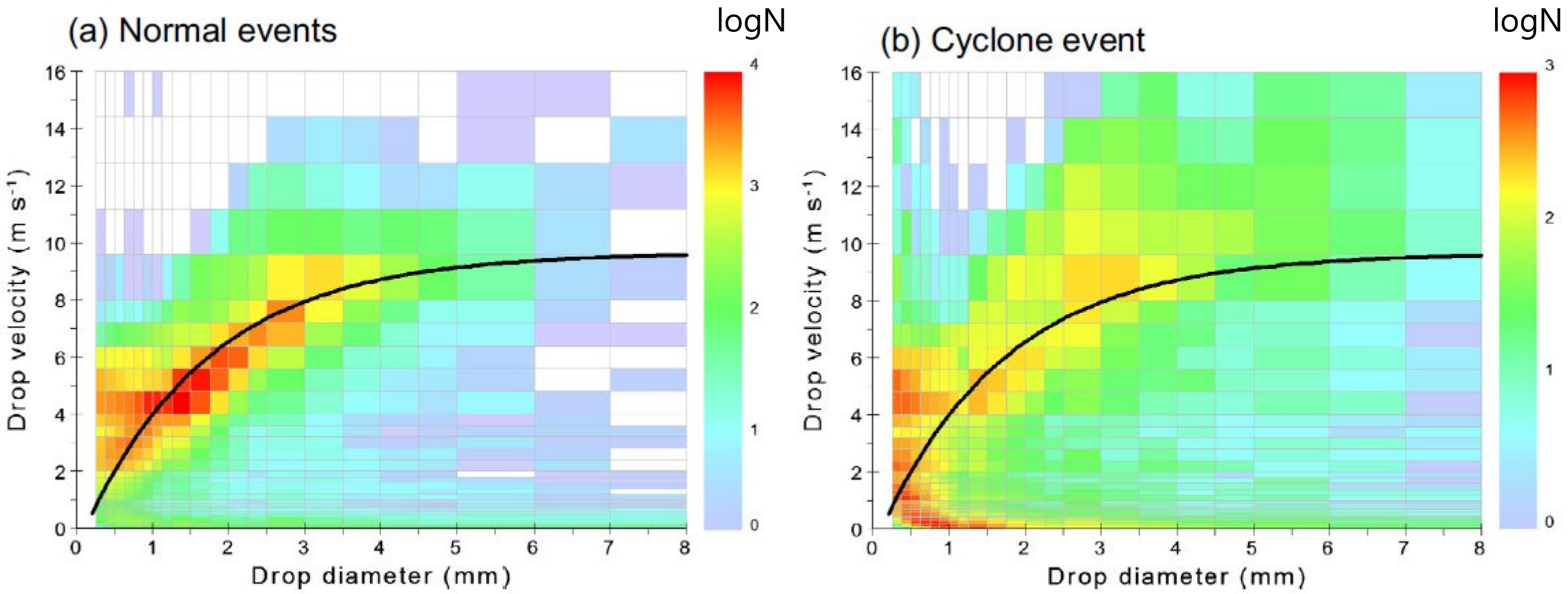
Satellite image of Hurricane Irene

https://www.livingoceansfoundation.org/emily-and-irene-a-tale-of-two-storms/

Drop velocity related to drop size

Nanko et al. (2016)

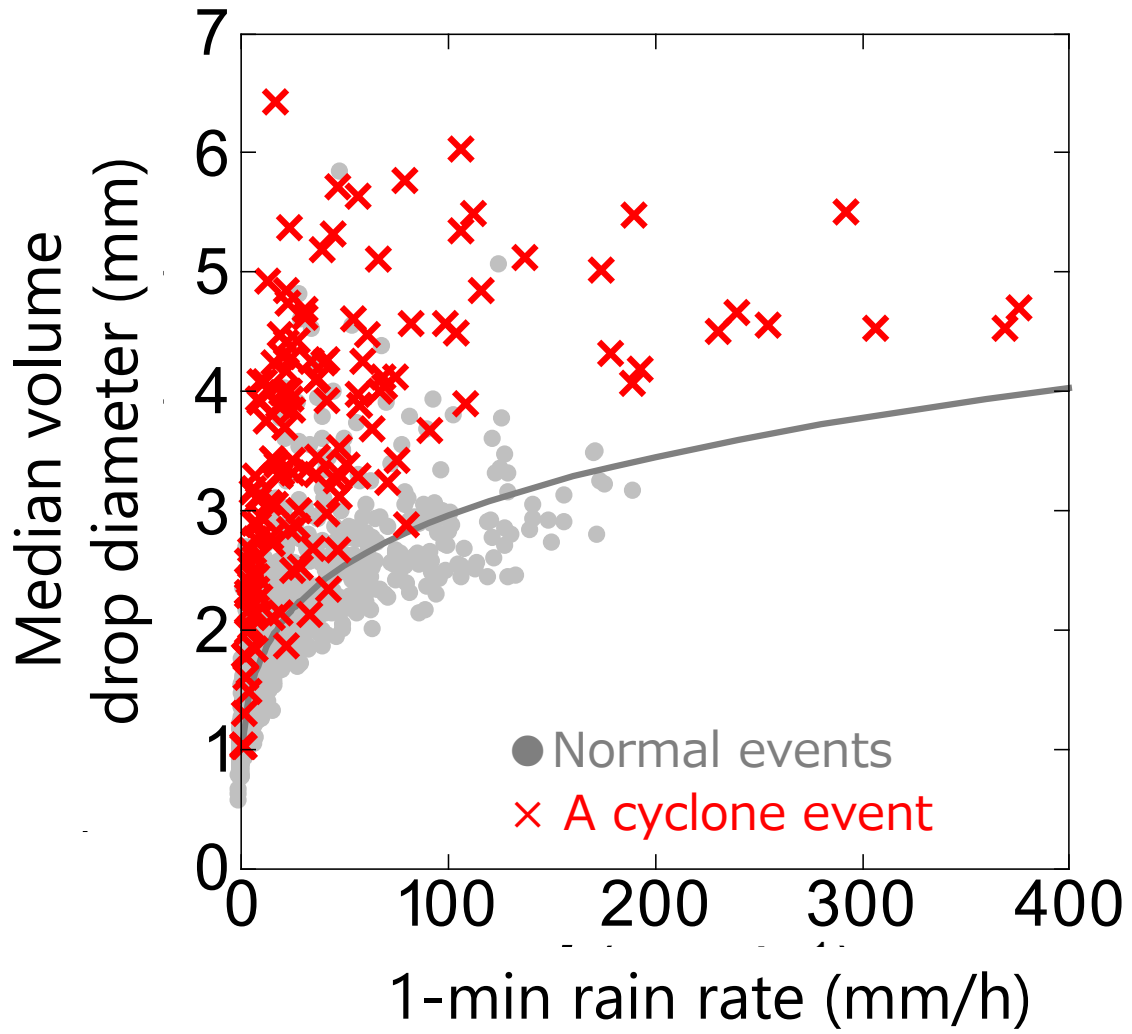
Large variation in drop fall velocity in a cyclone event



Drop size with rain rate

Nanko et al. (2016)

A cyclone event generated larger drops

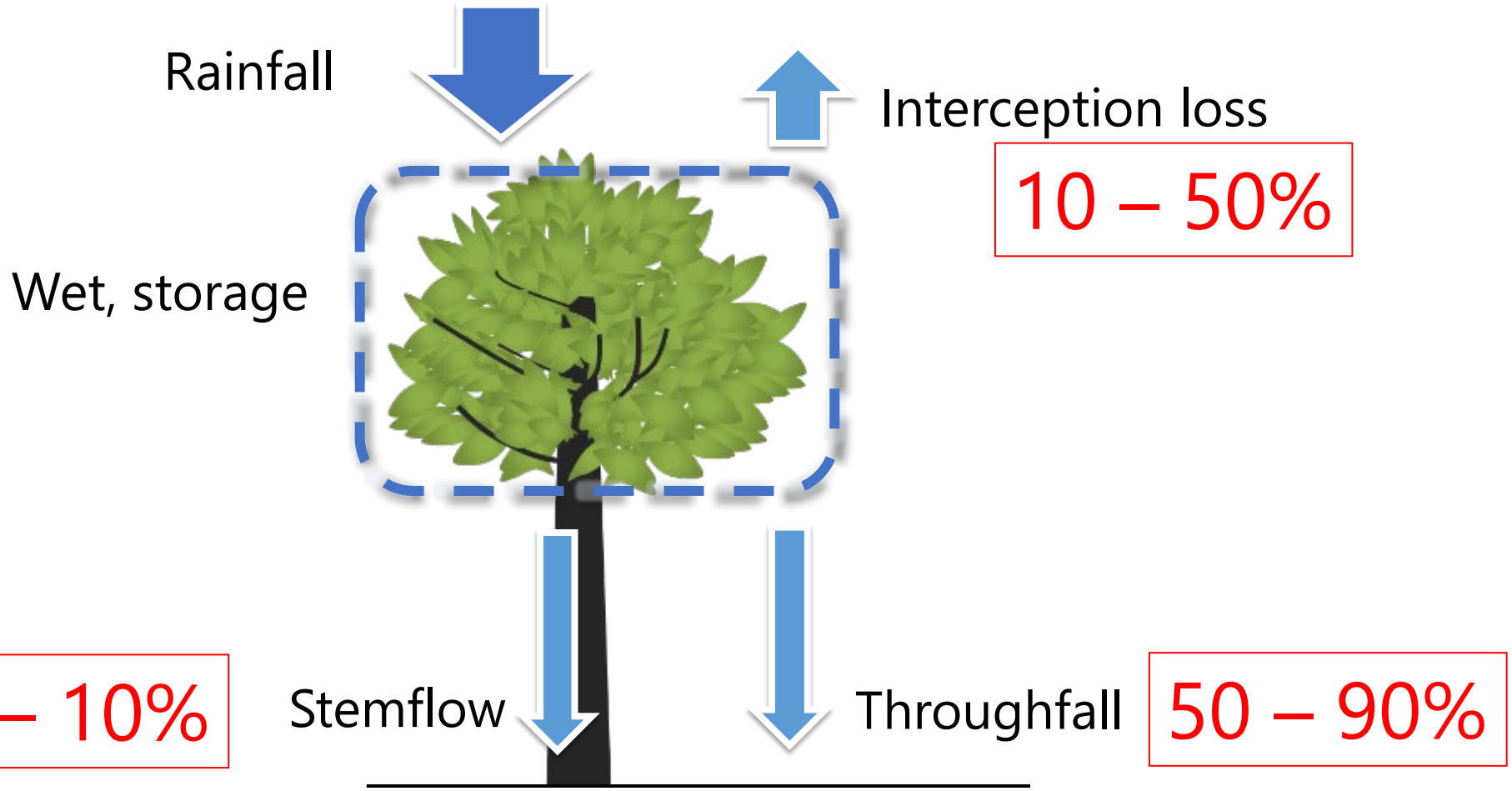


Ex2) Raindrops inside of forest

Levia, Nanko et al. (2017)

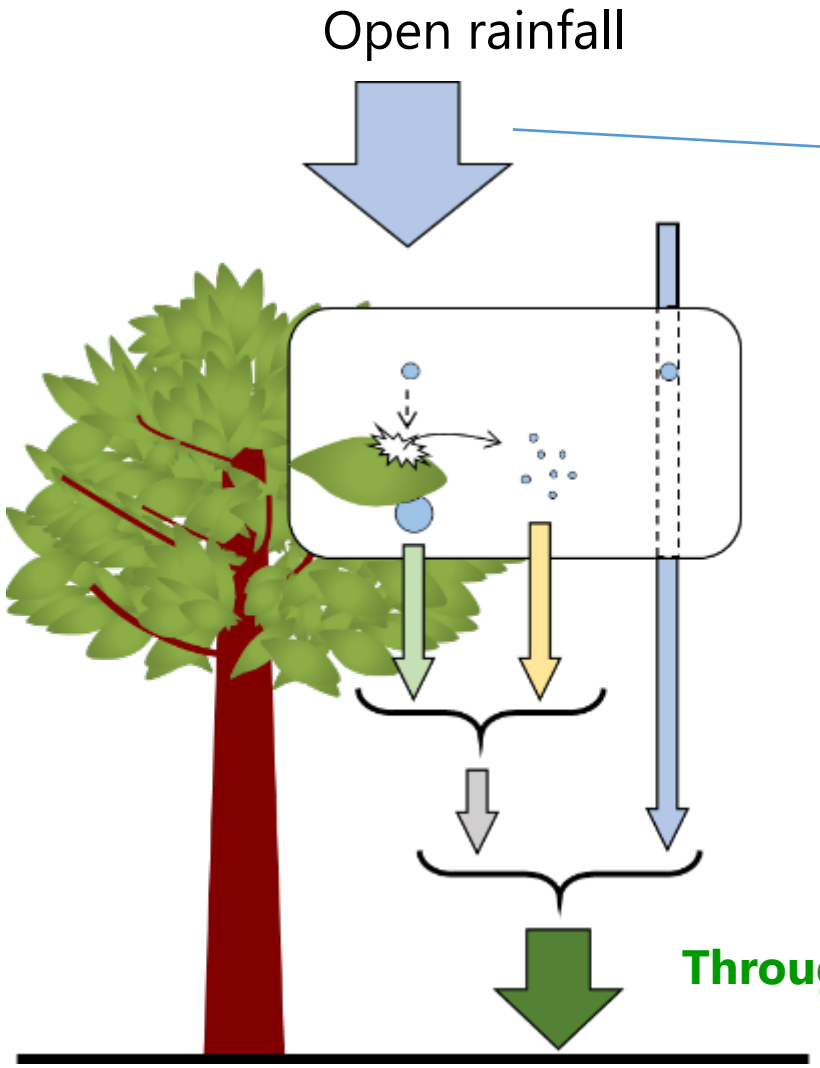
Rainfall partitioning by forest canopy

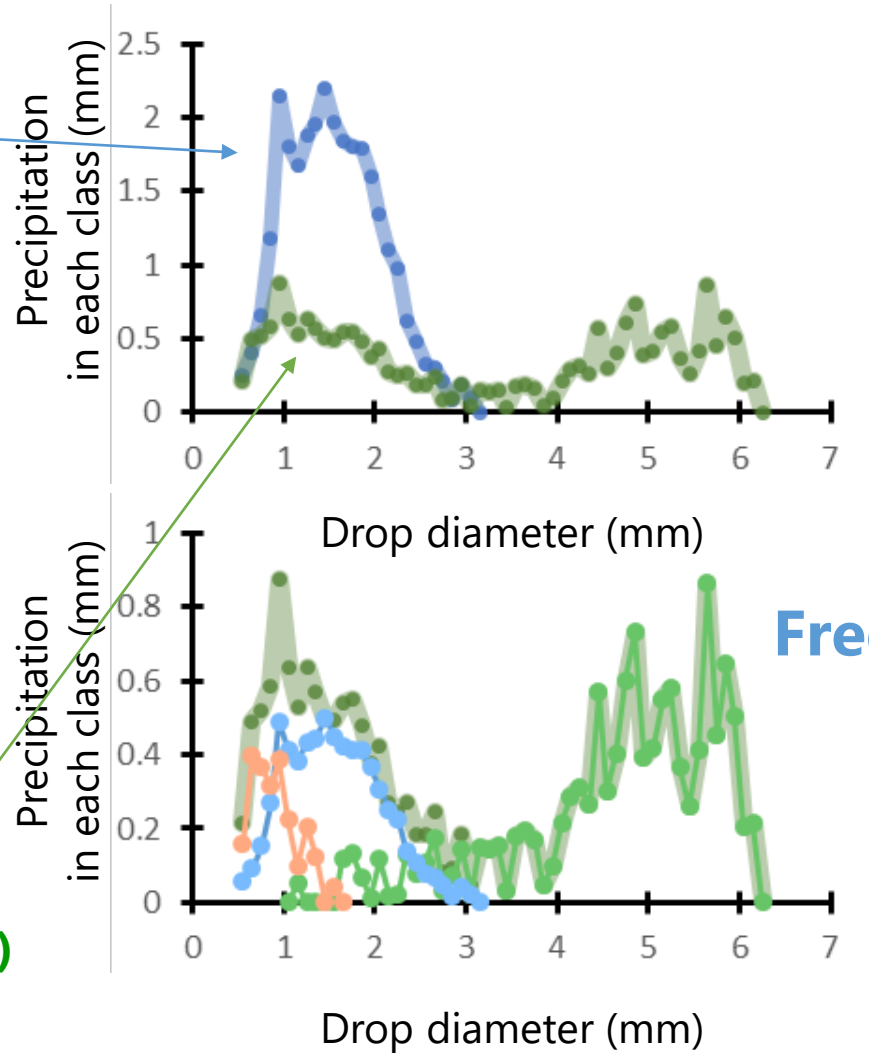
Forests cover about 30% of the world's land area.



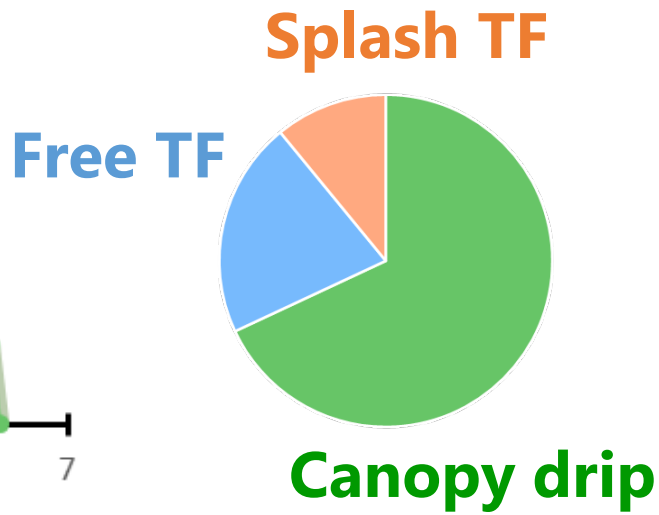
Difference of drop size distributions

Levia, Nanko et al. (2017; 2019)





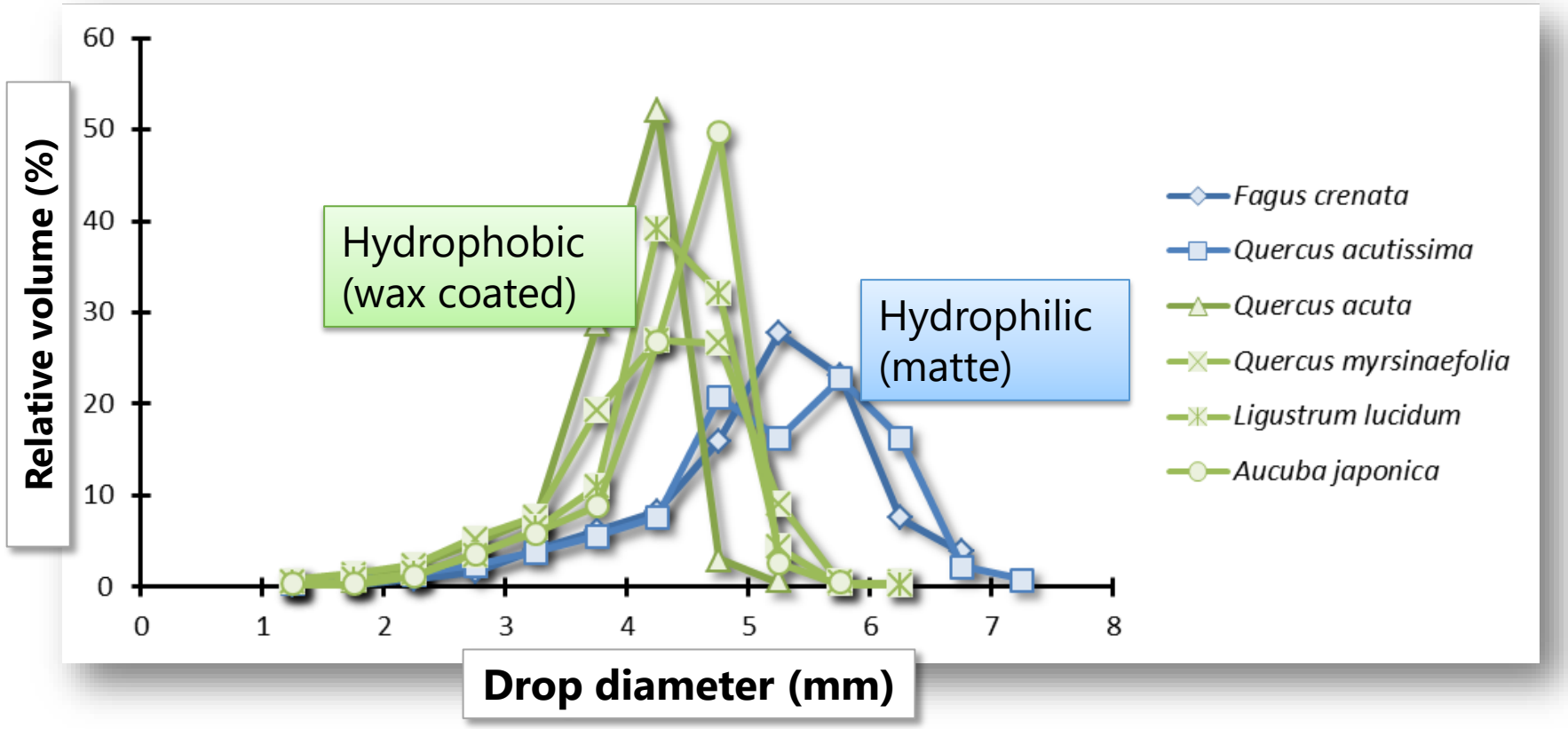
Volume ratio of three TF types



Drop sizes of canopy drips (broadleaved)

Nanko et al. (2013)

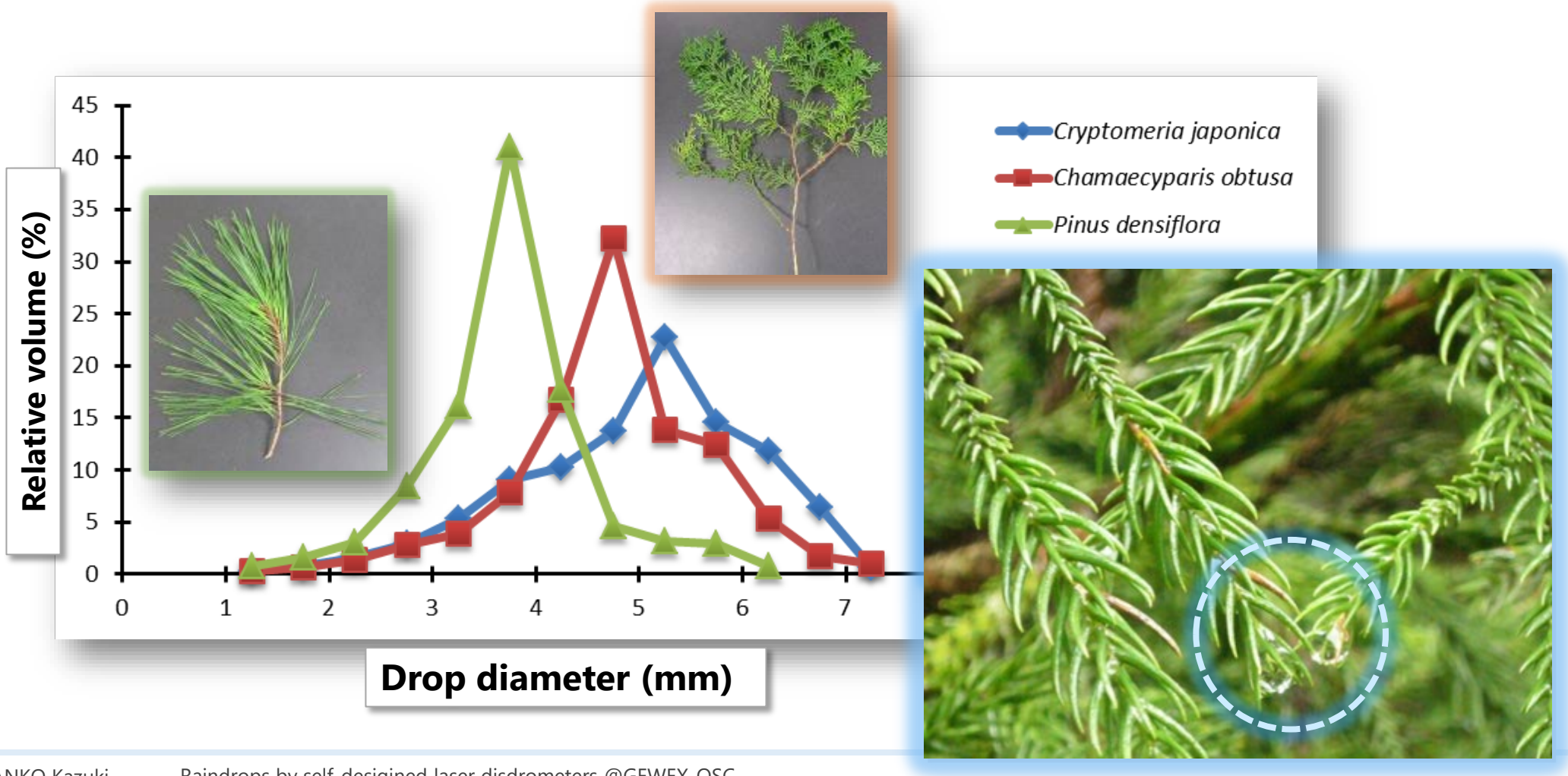
Hydrophilic leaves generated larger drops



Drop sizes of canopy drips (conifer)

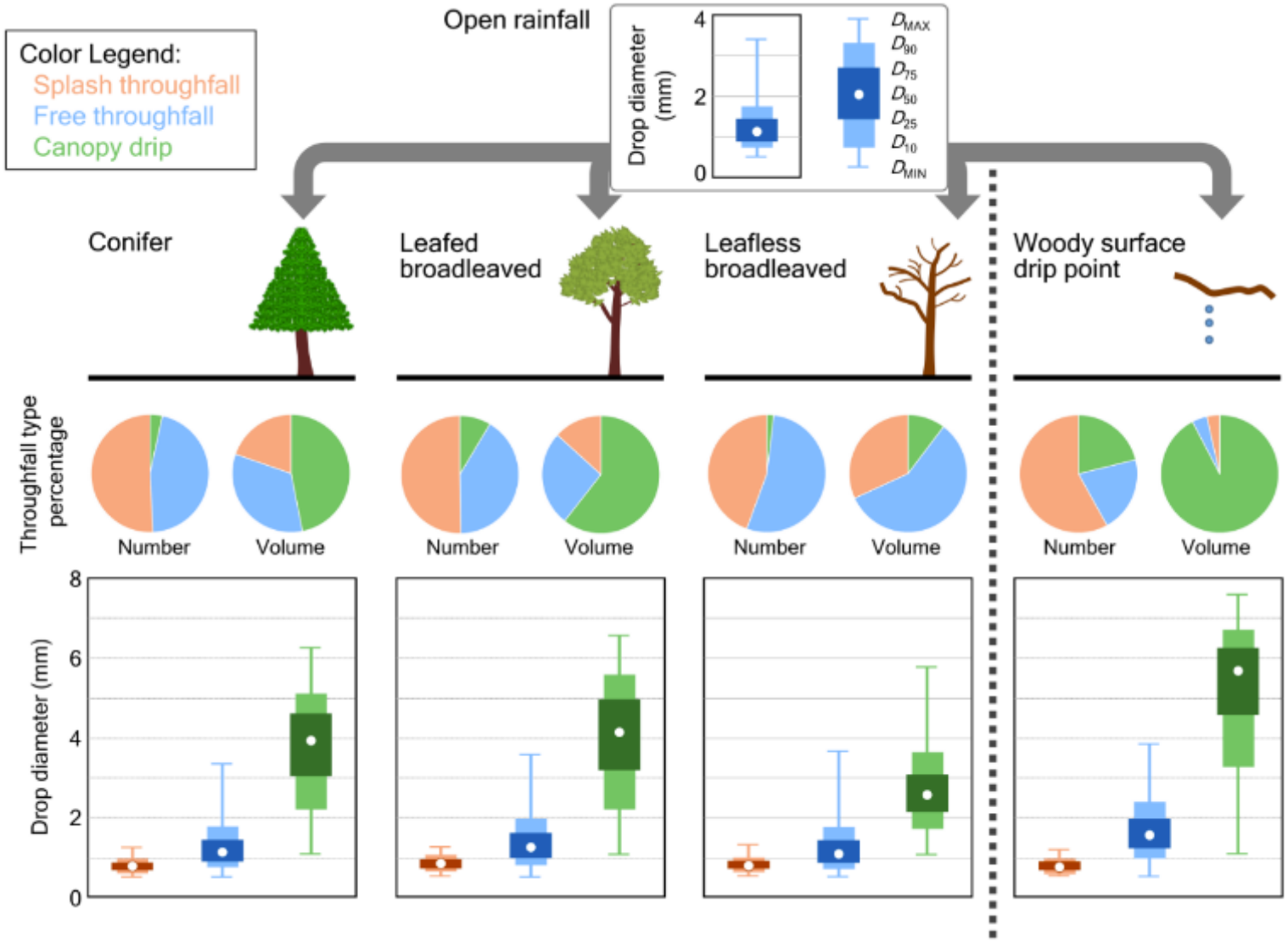
Nanko et al. (2013)

Shorter and dense needles generated larger drops



Throughfall components among trees

Levia, Nanko et al. (2019)

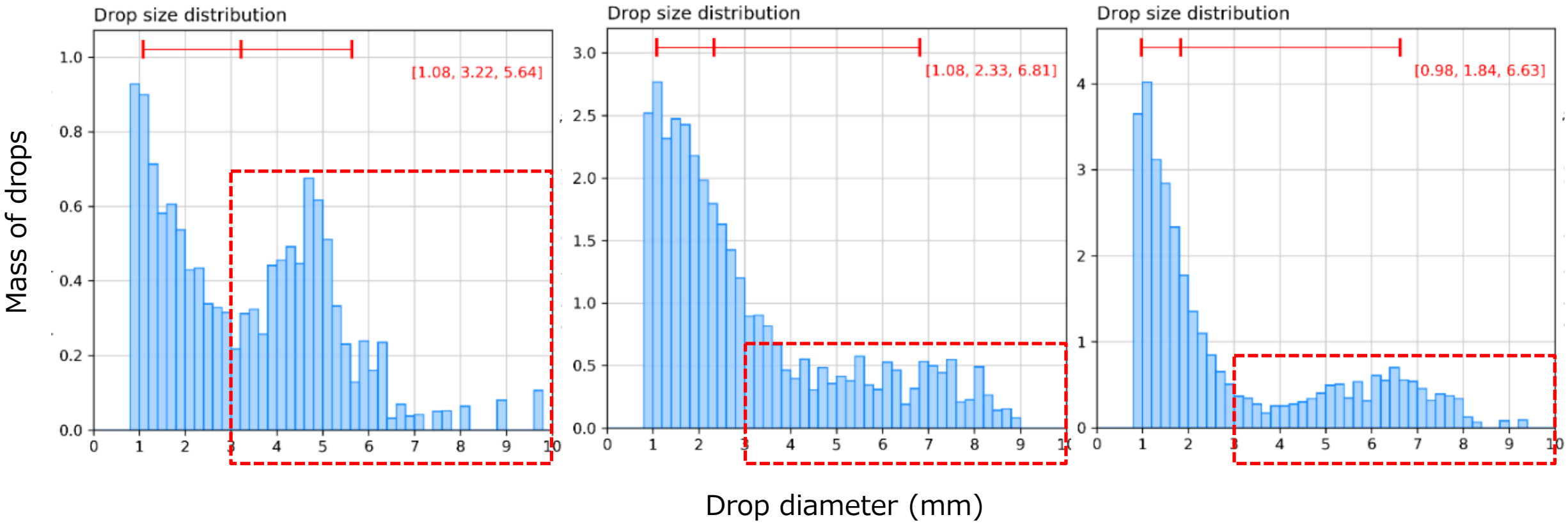


Throughfall drop size with defoliation

Nanko et al. (2022)

American beech

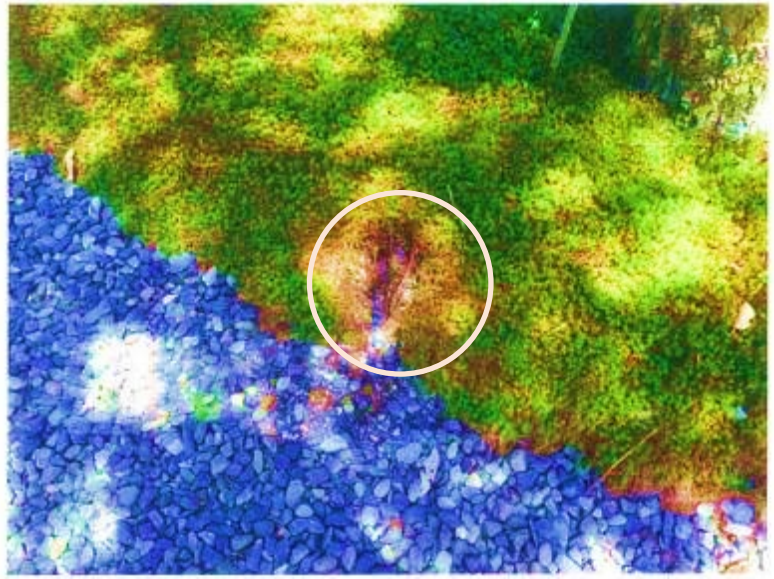
October (with leaves) November December (no leaves)

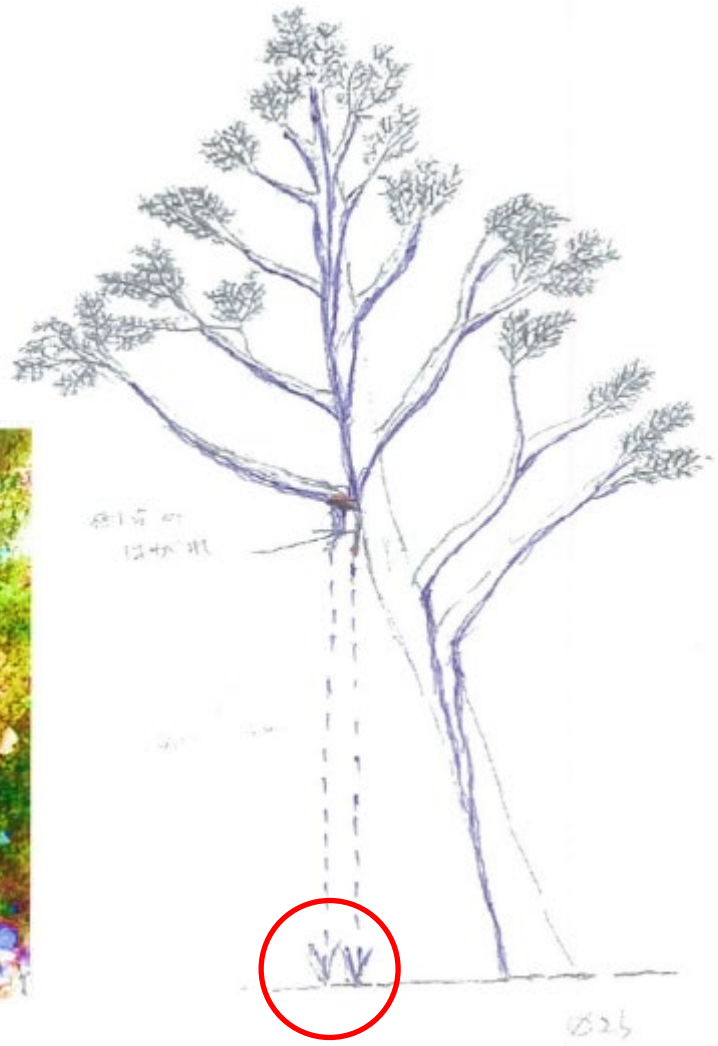


Canopy drip from structurally-mediated drip point

Yamada, Nanko et al. (unpublished)

Southern Japanese Hemlock



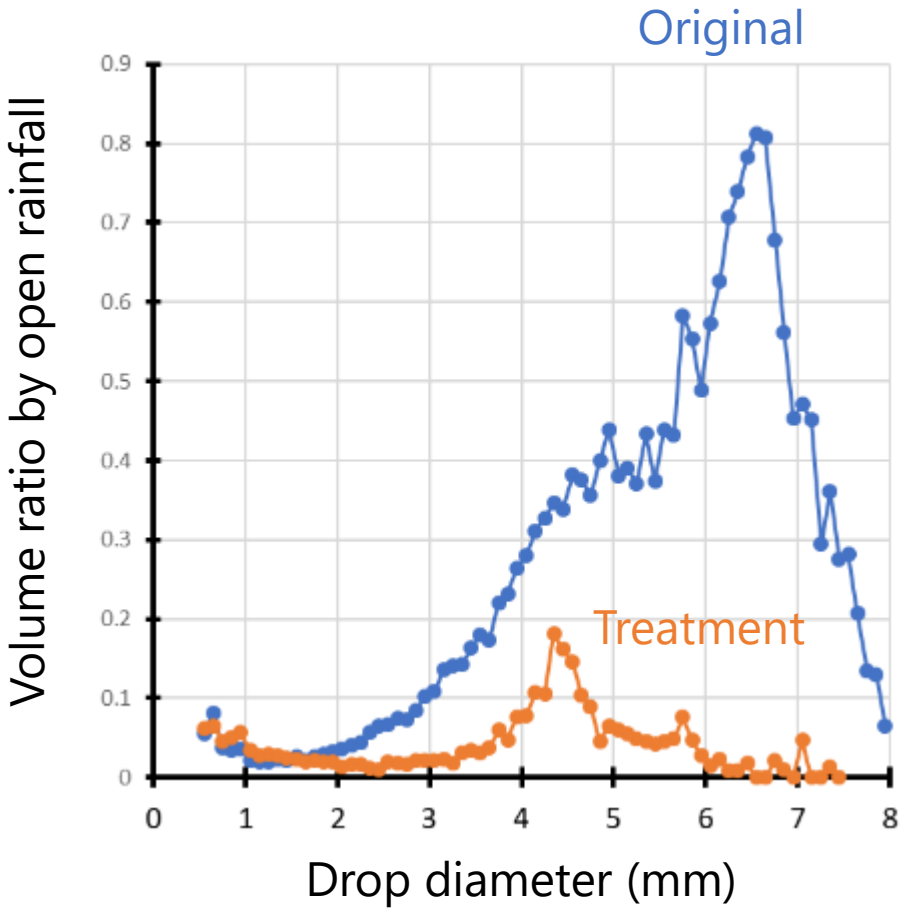


Canopy drip from structurally-mediated woody surface

Yamada, Nanko et al. (unpublished)

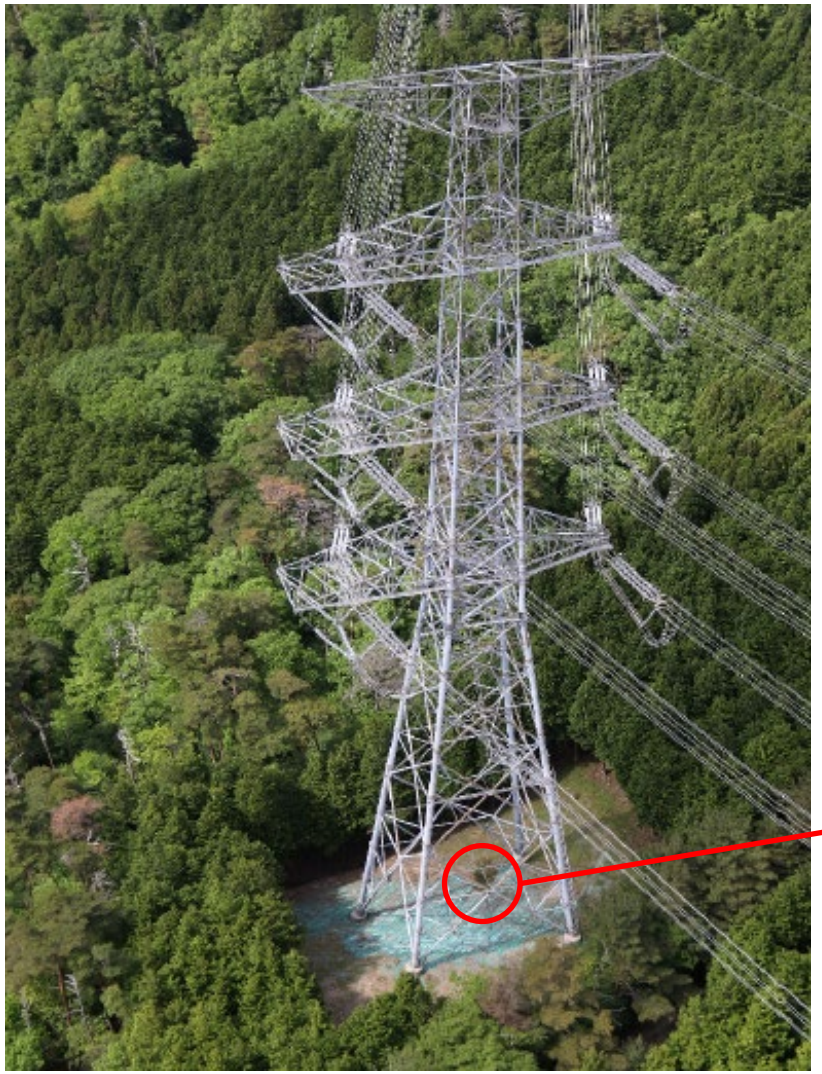
Branch pruning

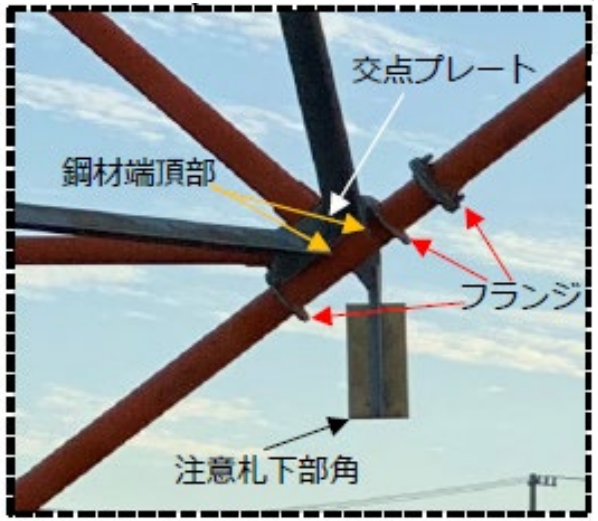
Removal of bark overhangs

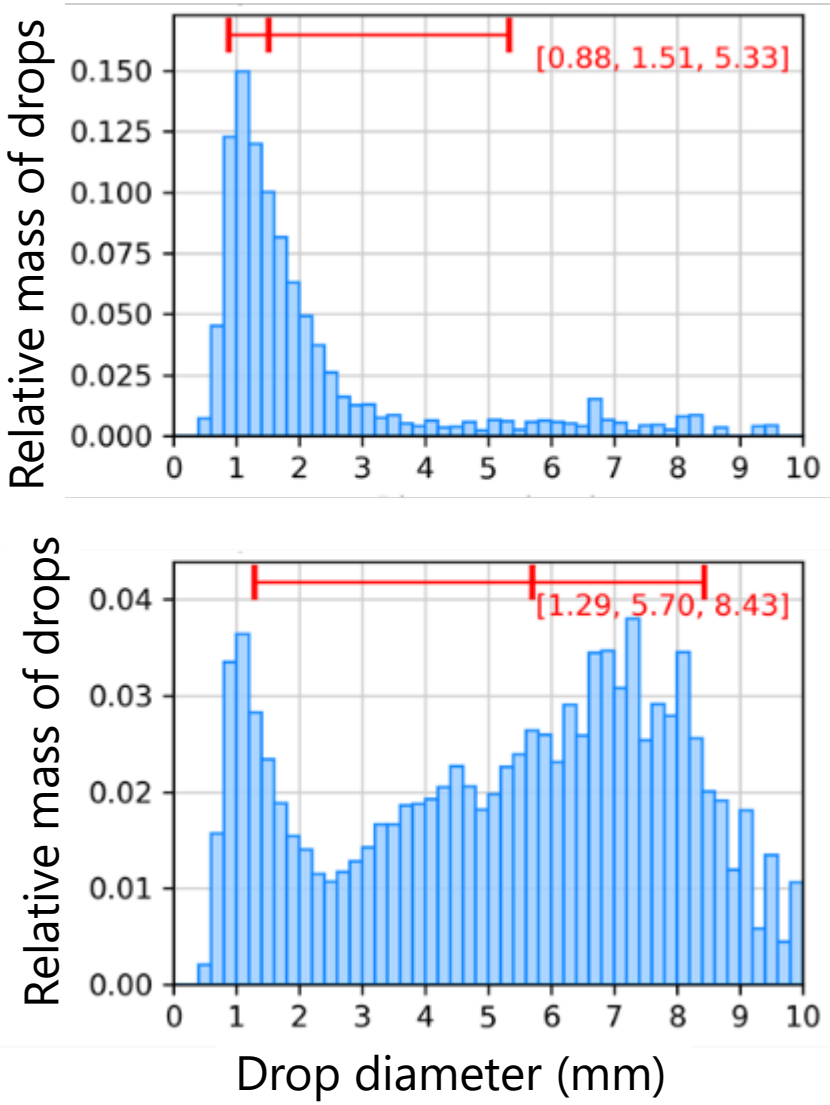


(bonus) Drips from a transmission tower

Nanko et al. (in prep.)







Large scale rainfall simulator

Nanko et al. (2008; 2010; 2011)

Japanese cypress trees were transplanted the Large-Scale Rainfall Simulator @NIED

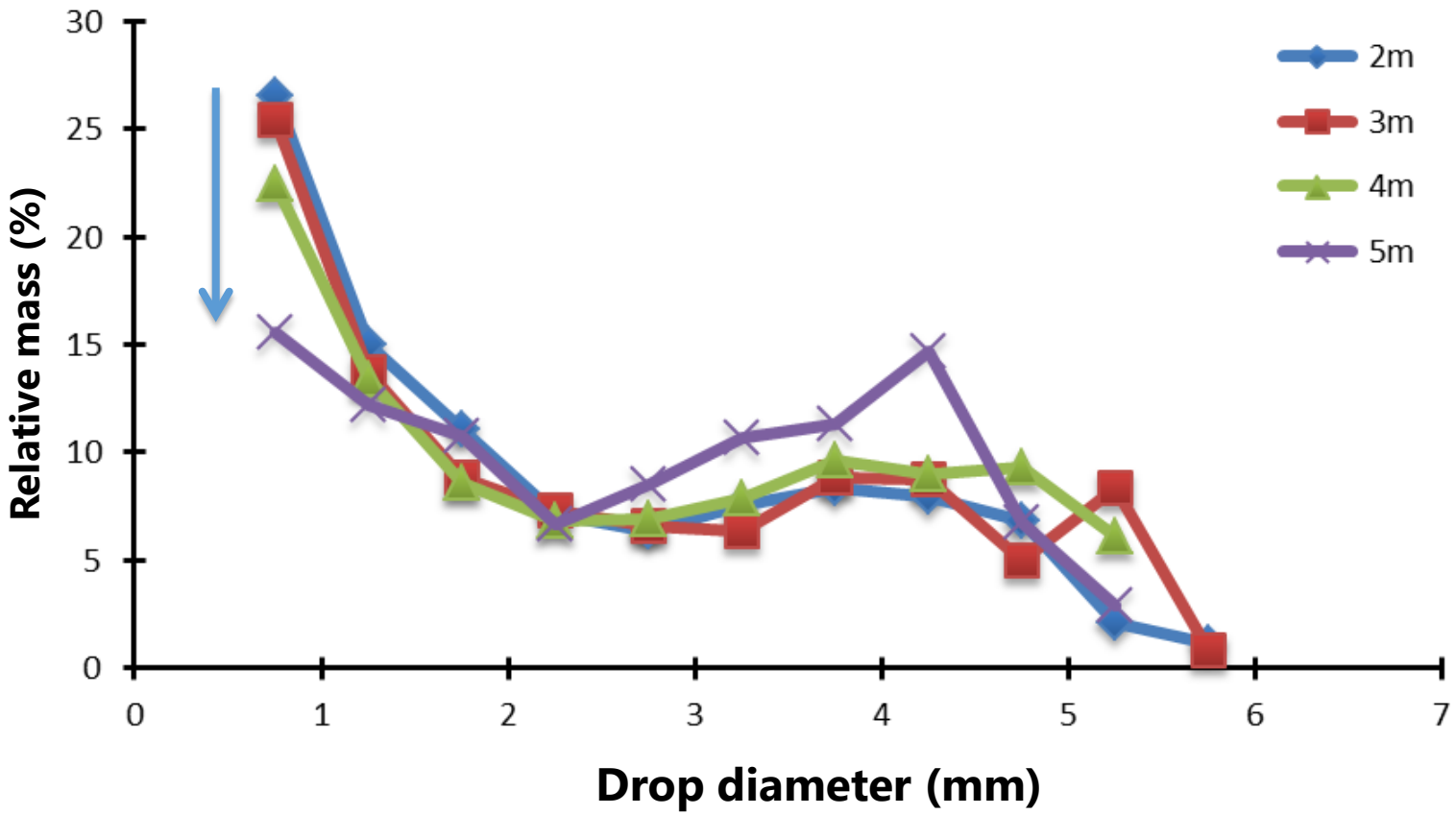
Sprinkler nozzles: 16 m

Tree height: 9.8 m

Drop size distributions with canopy length

Nanko et al. (2008)

When canopy length decreased, splash throughfall decreased.



Summary: The Significance of Raindrop Data

Understanding Rainfall by raindrop measurement

Rainfall Definition:

- Rainfall is essentially a collection of raindrops.

The Importance of Measurements:

- Raindrops provide critical data on drop size and velocity.
- This data varies with rainfall type, rain rate, and wind conditions.
- Observational data often diverges from theoretical predictions.

Call to Action:

- Let's enhance our efforts in measuring raindrops to better understand and predict rainfall patterns.

The journey of Nanko-type laser disdrometers

I have ≈40 Nanko-type laser disdrometers.
If you are interested in the disdrometers, please contact me
knanko@ffpri.affrc.go.jp
knanko.raindrop@gmail.com