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Rainfall measurement comparison between two types of disdrometers

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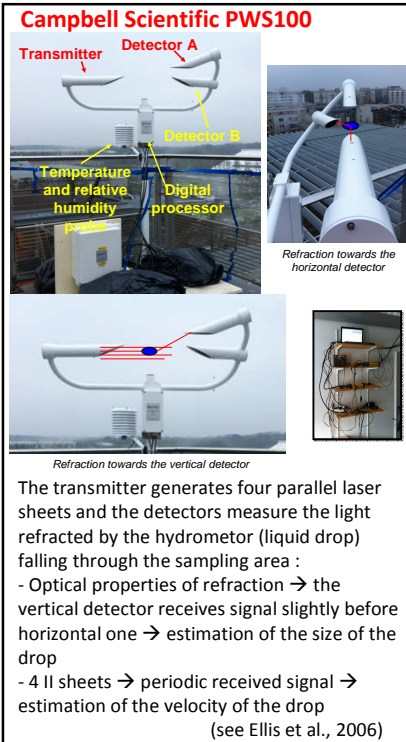
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Introduction
 Rainfall point measurements:
 - Tipping bucket rain gauges (usually 0.2 mm tips)
 - Disdrometers (binned size and velocity)
 → The quantification of the uncertainty associated with these devices is still an open question.
 → Preliminary results of a comparison campaign between two disdrometers types (Parsivel OTT and Campbell Scientific PWS100) are presented here.



Multifractal analysis
 Estimating statistics across scales
 Definition of the fractal dimension D_f
 number of pixels with rain = λ^{D_f}

If multifractal:
 $\langle R_\lambda^q \rangle = \lambda^{K(q)}$
 $\Pr(R_\lambda \geq \lambda^\gamma) \approx \lambda^{-c(\gamma)}$

Scaling moment function
 Codimension function

resolution = $\lambda = \frac{L}{l} = \frac{\text{outer_scale}}{\text{observation_scale}}$

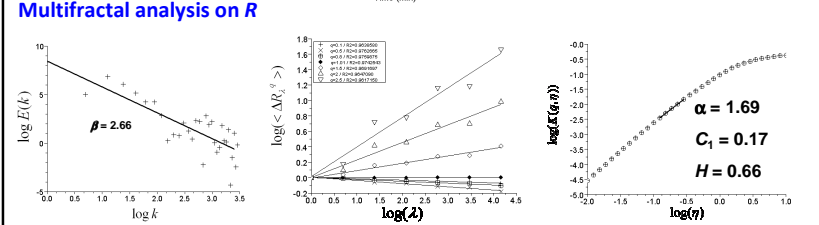
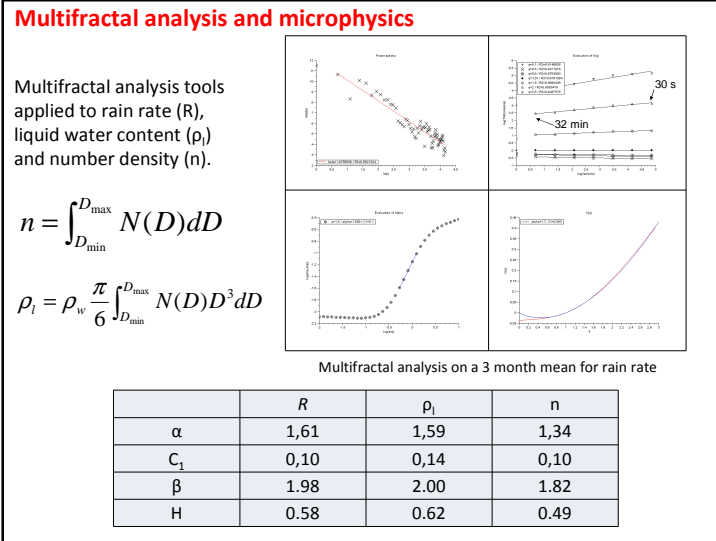
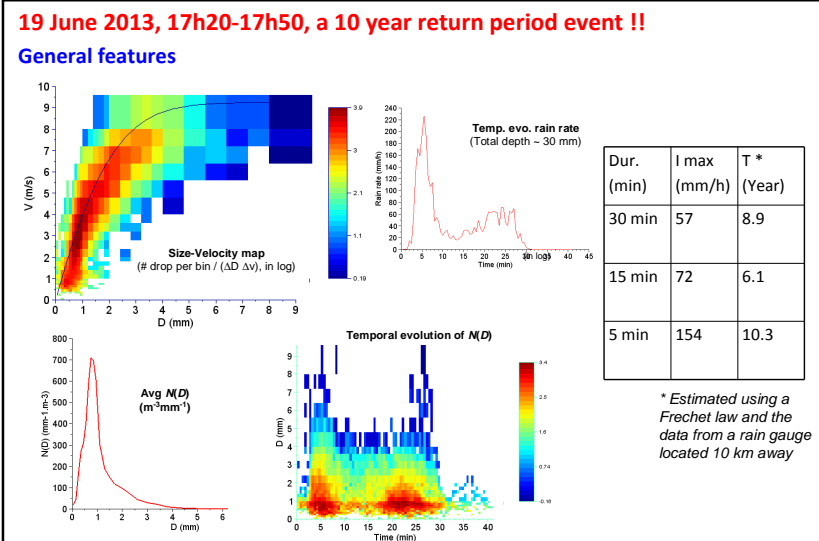
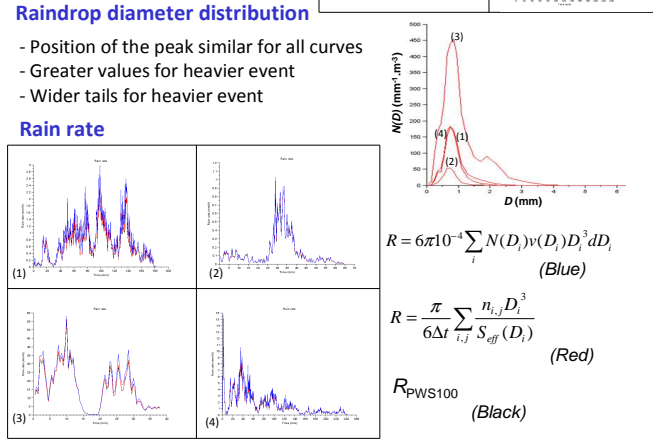
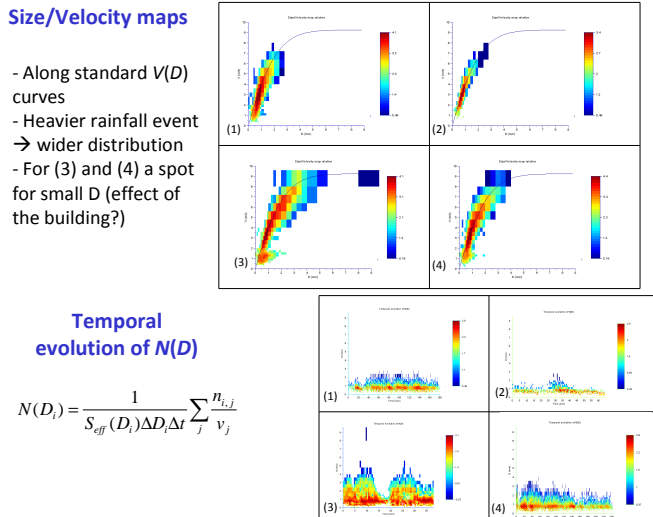
Quantifying the scaling variability
 In the framework of universal multifracts:
 $K(q) = \begin{cases} C_1(q^\alpha - q) + Hq & \alpha \neq 1 \\ C_1 \ln q + Hq & \alpha = 1 \end{cases}$
 $c(\gamma + H) = \begin{cases} C_1 \left(\frac{\gamma}{C_1 \alpha} + \frac{1}{\alpha} \right)^\alpha & \alpha \neq 1 \\ C_1 \exp\left(\frac{\gamma}{C_1} - 1 \right) & \alpha = 1 \end{cases}$

Only three parameters (based on the behavior of the average field)
 - H: degree of non-conservation ($K'(1) = C_1 + H$)
 - C_1 : mean intermittency ($K''(1) = C_1 + H$)
 - α : multifractality index ($K'''(1) = \alpha C_1$)

Straightforward consequences on the extremes
 - Large α and C_1 → strong extremes

Estimation of the three exponents with the help of the double trace moment technique (DTM)

Comparison of 4 events
 (1): 15th May 2013 3h15 Light rain / long duration
 (2): 16th May 2013 10h18 Very light rain / Average duration
 (3): 29th May 2013 21h18 Intense rain / short duration
 (4): 9th June 2013 4h43 Average intensity rain / long duration



Conclusion
 - Some standard values of α (1.6-1.7), C_1 (0.1-0.2) and H (0.5-0.6) during a rainfall event
 - Multifractal tools can be used on disdrometers data to give an insight into the microphysical processes
 - Only preliminary results, the two OTT parsivel still need to be installed...!

References
 Ellis, R.A. et al., 2006. New laser technology to determine present weather parameters. *Measurement Science & Technology*, 17(7): 1715-1722.
 Gires et al., 2013. Influence of small scale rainfall variability on standard comparison tools between radar and rain gauge data. Submitted to *Atm. Res.*
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