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Influence of the drop size distribution on the collection efficiency of catching gauges as a function of rainfall intensity

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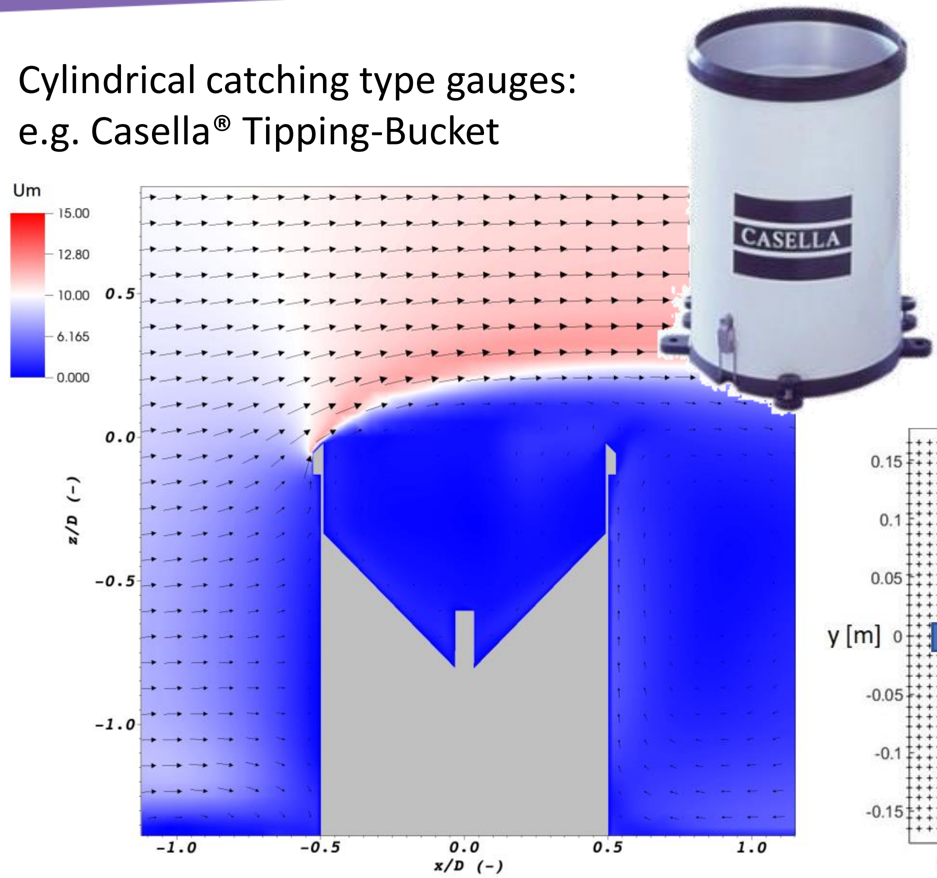
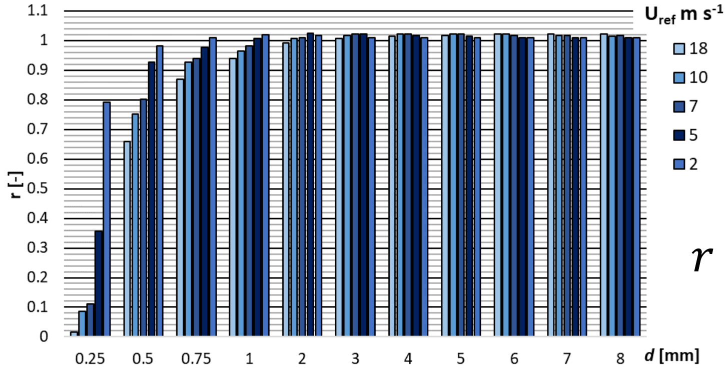
www.precipitation-intensity.it

Cylindrical catching type gauges:
e.g. Casella® Tipping-Bucket

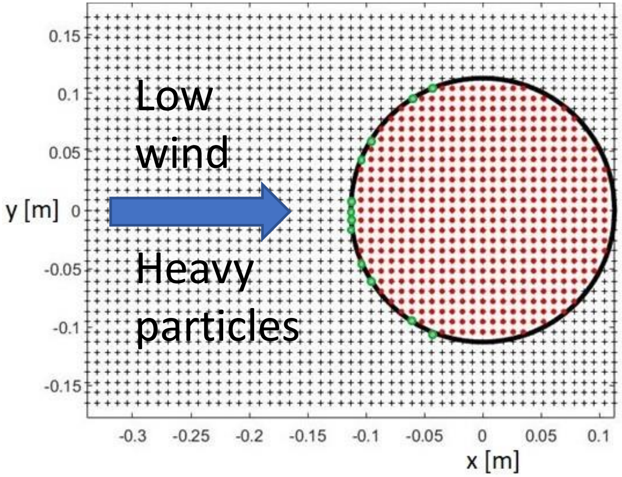


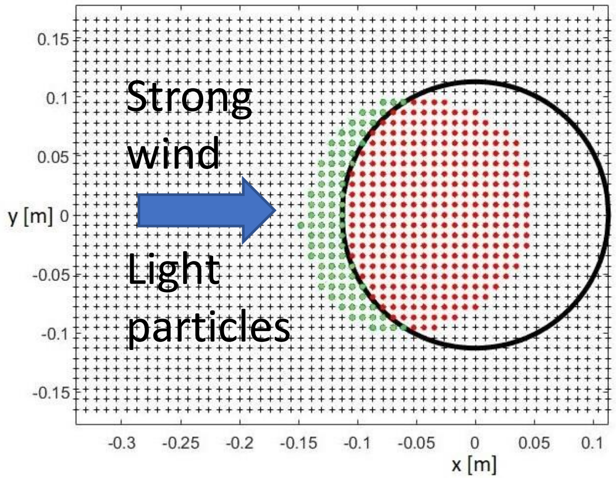
CFD simulation (RANS SST k-ω) +
Lagrangian Particle Tracking Model



Catch ratio:

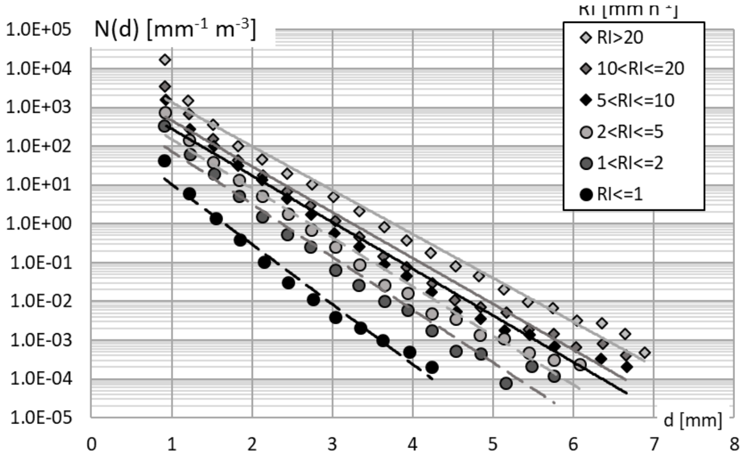
$$r = \frac{N_d(U_{ref}, d)}{N_{tot}}$$





Grid of particle releasing positions (all), those expected to enter the gauge and actually collected (red), and those not expected to enter but collected (green)

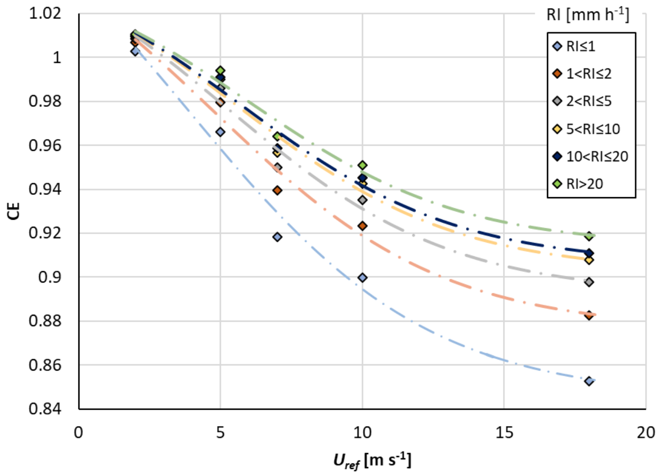
$$CE(U_{ref}) = \frac{\int_0^d \rho_p \, V_p \, n(d) \, N(d) \, \mathrm{d}d}{\int_0^d \rho_p \, V_p \, n_{max}(d) \, N(d) \, \mathrm{d}d}$$



Pludix distrometer -
Florence experimental site

a) CE curve as a function of U_{ref} from numerical simulation results by fitting a four-parameter sigmoidal function

$$CE(U_{ref}) = y_0 + \frac{a}{1 + e^{-\frac{(U_{ref} - x_0)}{b}}}$$

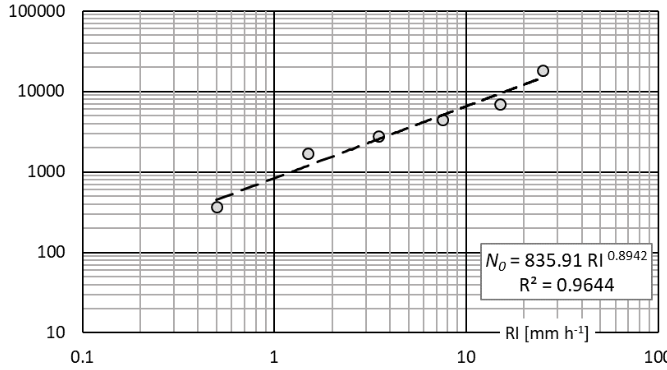


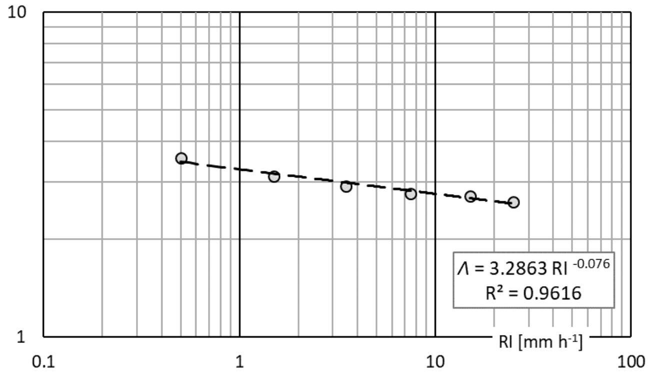
b) MP parameters fitted using power law curves as a function of RI

$$MP: \; N(d) = N_0 \exp(-\Lambda d)$$

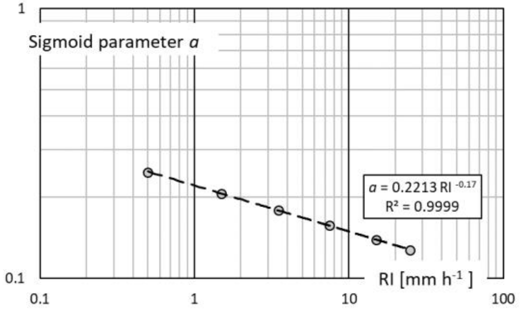
$$N_0 = N_0(RI)$$

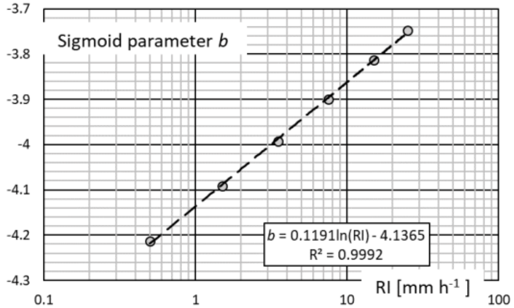
$$\Lambda = \Lambda(RI)$$

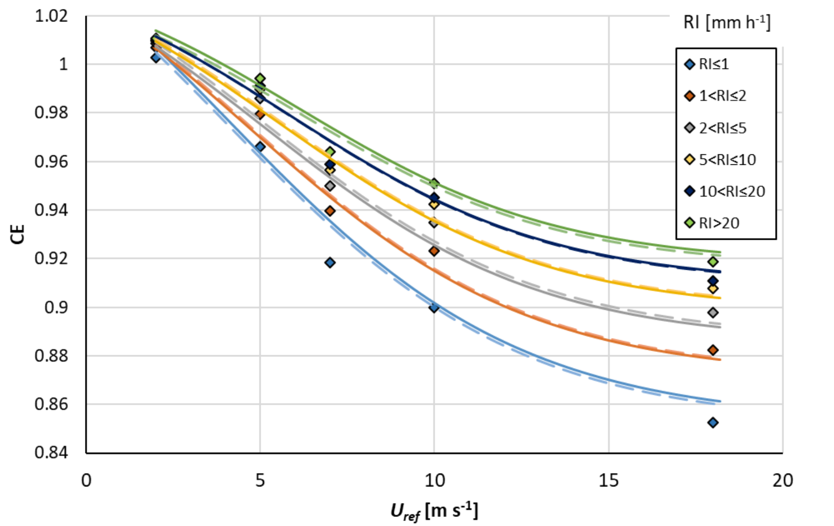




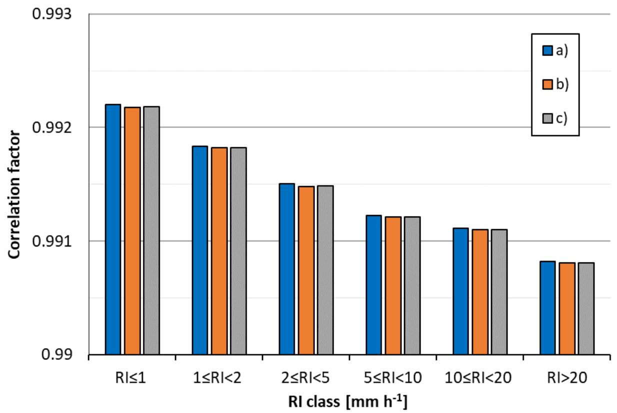
c) parameters of the sigmoidal function also fitted with power laws or logarithmic curves as a function of RI

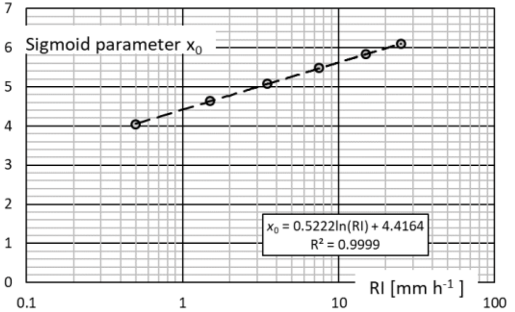


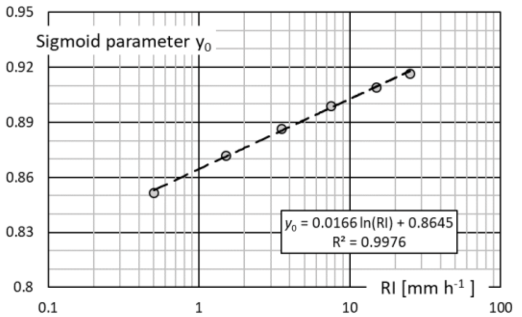




$$CE(U_{ref}) = \frac{RI_{meas}(U_{ref})}{RI} = y_0(RI) + \frac{a(RI)}{1 + e^{-\frac{(U_{ref} - x_0(RI))}{b(RI)}}}$$







Using *RI* as a controlling factor for the CE has sound physical bases in the relationship between RI and the PSD, and the role of RI can be quantified using numerical simulations of both the airflow field (CFD) and the particle motion (LPT)

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Further references

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