



Photo: Katie Muchan

Insights into rainfall undercatch in differing gauge types and heights: the impact of wind speed and rainfall event intensity

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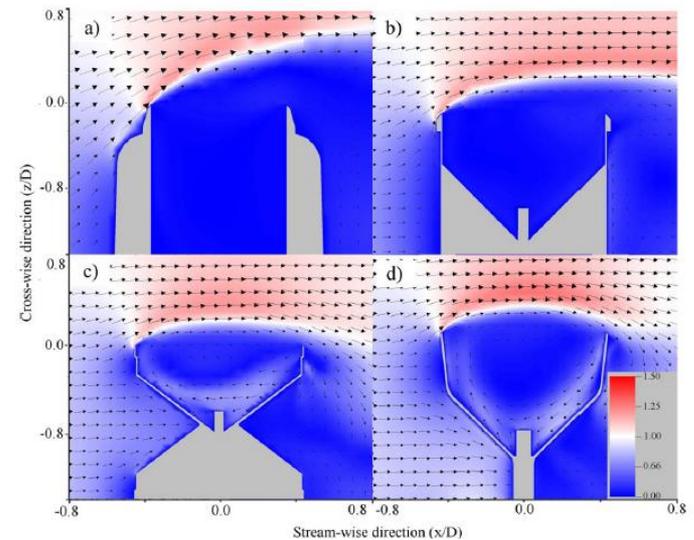
The problem – rainfall measurement

- Rainfall measurement has a long history, but instruments are not perfect!
 - Underestimation in high intensity events
 - Coarse measurement resolution
 - Poor at snow measurement
- Newer technology – weighing gauges
 - Finer resolution in time and precipitation amount
 - Large capacity, reduced maintenance
 - Better at snow measurement



The problem – operational network

- Gauges generally installed at 30cm height
- Less rainfall recorded than at ground level (undercatch)
 - Wallingford 5.6%; Plynlimon 16%; Slaidburn 2%
- Wind-induced rainfall losses
- Replacement of 30cm gauges with 1m gauges
 - TBR → OTT Pluvio
 - Operational in EA, SEPA



Rodda & Smith (1986); Rodda & Dixon (2012); Colli et al (2018)

The research – questions

- What is the impact of changing from tipping bucket gauge (TBR) to weighing gauge?
- What is the impact of changing from a 30cm mounting height to 1m?
- What is driving any observed undercatch?
- Is there a way to correct rainfall data recorded at 1m to a lower mounting height?

The research – raingauge trials

- 7 raingauges on site
- Undercatch at monthly and event timescales
- Investigation into drivers of undercatch (wind speed and rainfall intensity)

2 tipping bucket
2002/11 - present
(0.0m, 0.3m)

2 storage
1962/72 - present
(0.0m, 0.3m)

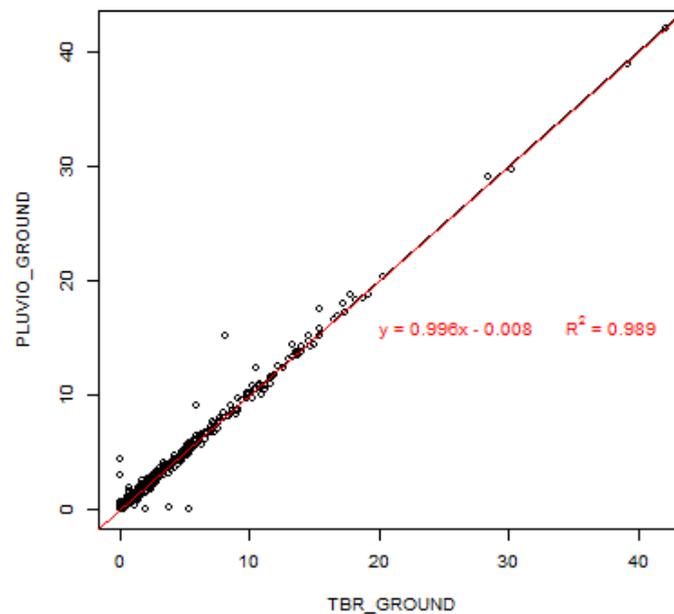
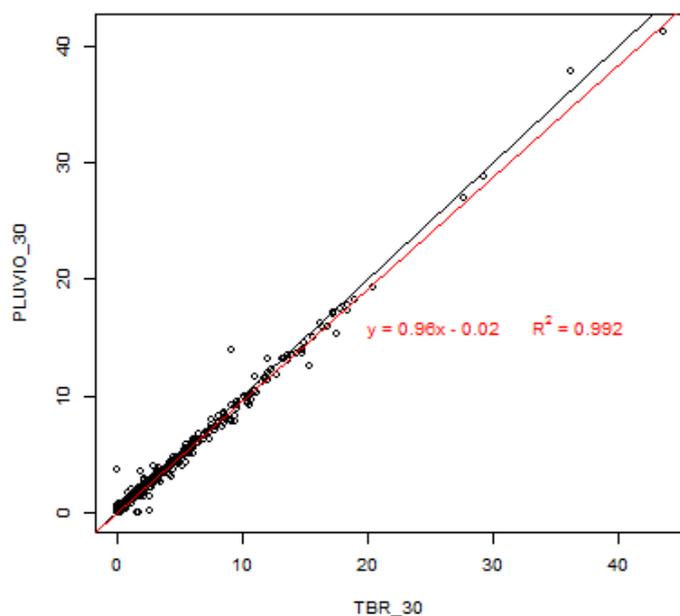


3 weighing
2015 – present
(0.0m, 0.3m, 1.0m)



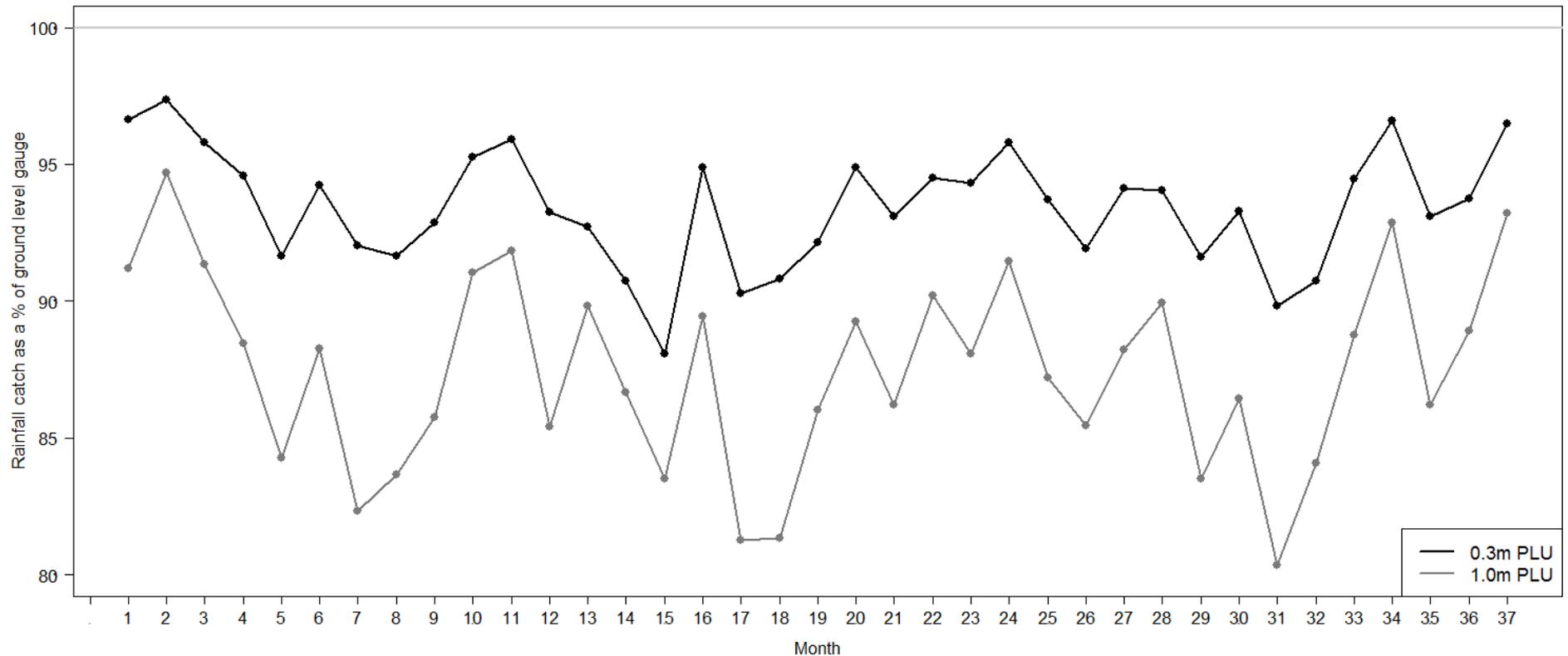
The research – results (gauge type)

- Changing gauge type does not have a big effect on rainfall totals
 - Daily totals in paired tipping bucket and weighing gauges
 - At 30cm, slight tendency for TBRs to record more, but skewed by small amount of data >20mm



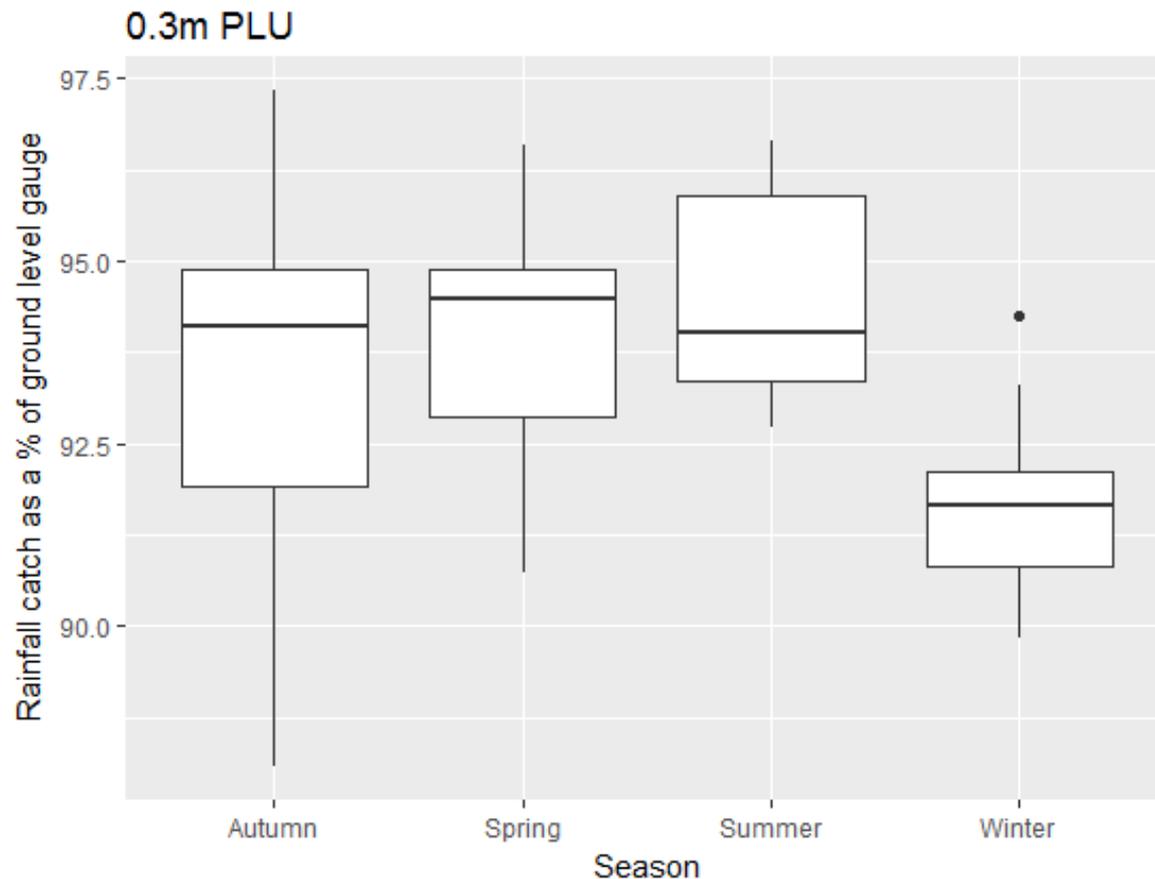
The research – results (gauge height)

- 0.3m - avg. 6.7% undercatch (2.7% - 11.9%)
- 1.0m - avg. 12.7% undercatch (5.5% - 19.6%)



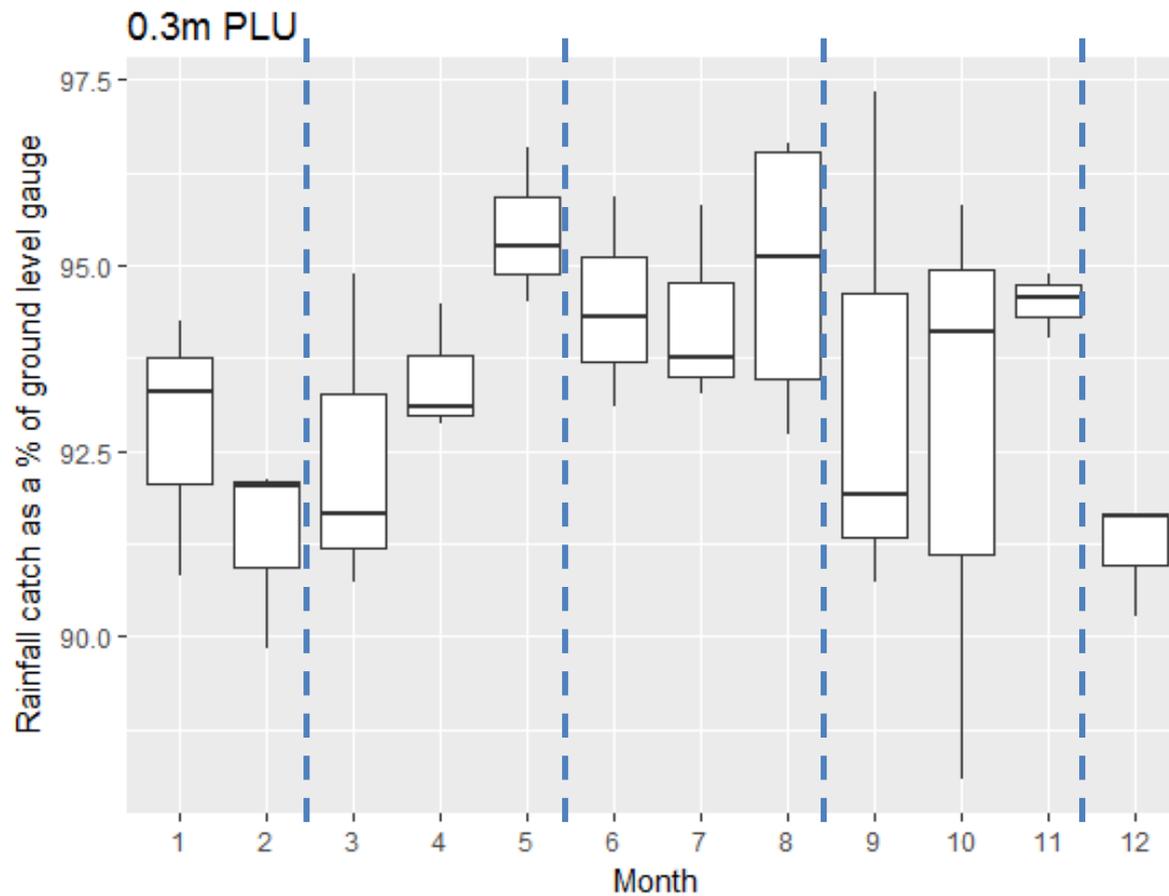
The research – results (gauge height)

- Largest amount of undercatch occurred in winter
- Monthly shows variation within the seasons



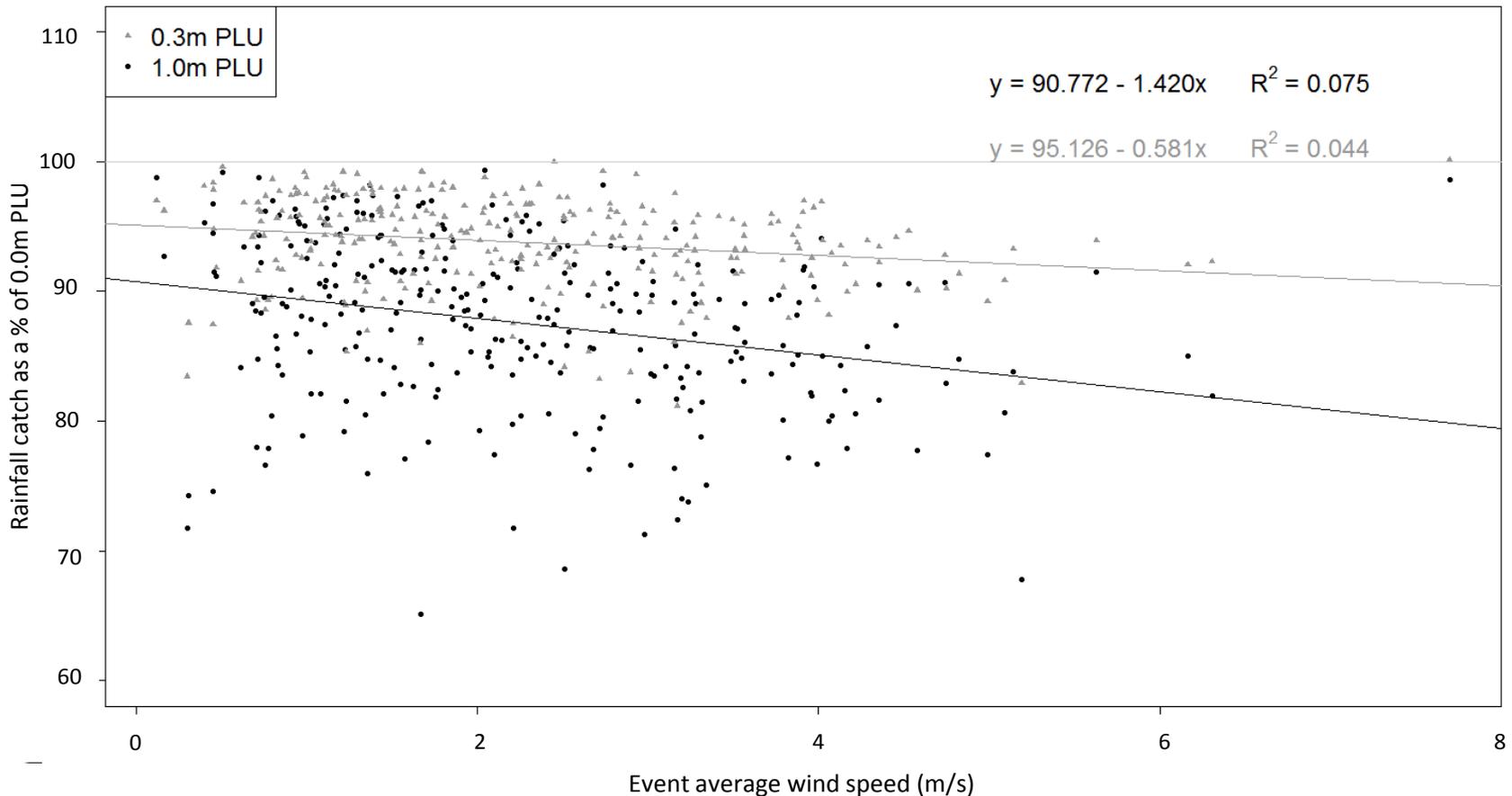
The research – results (gauge height)

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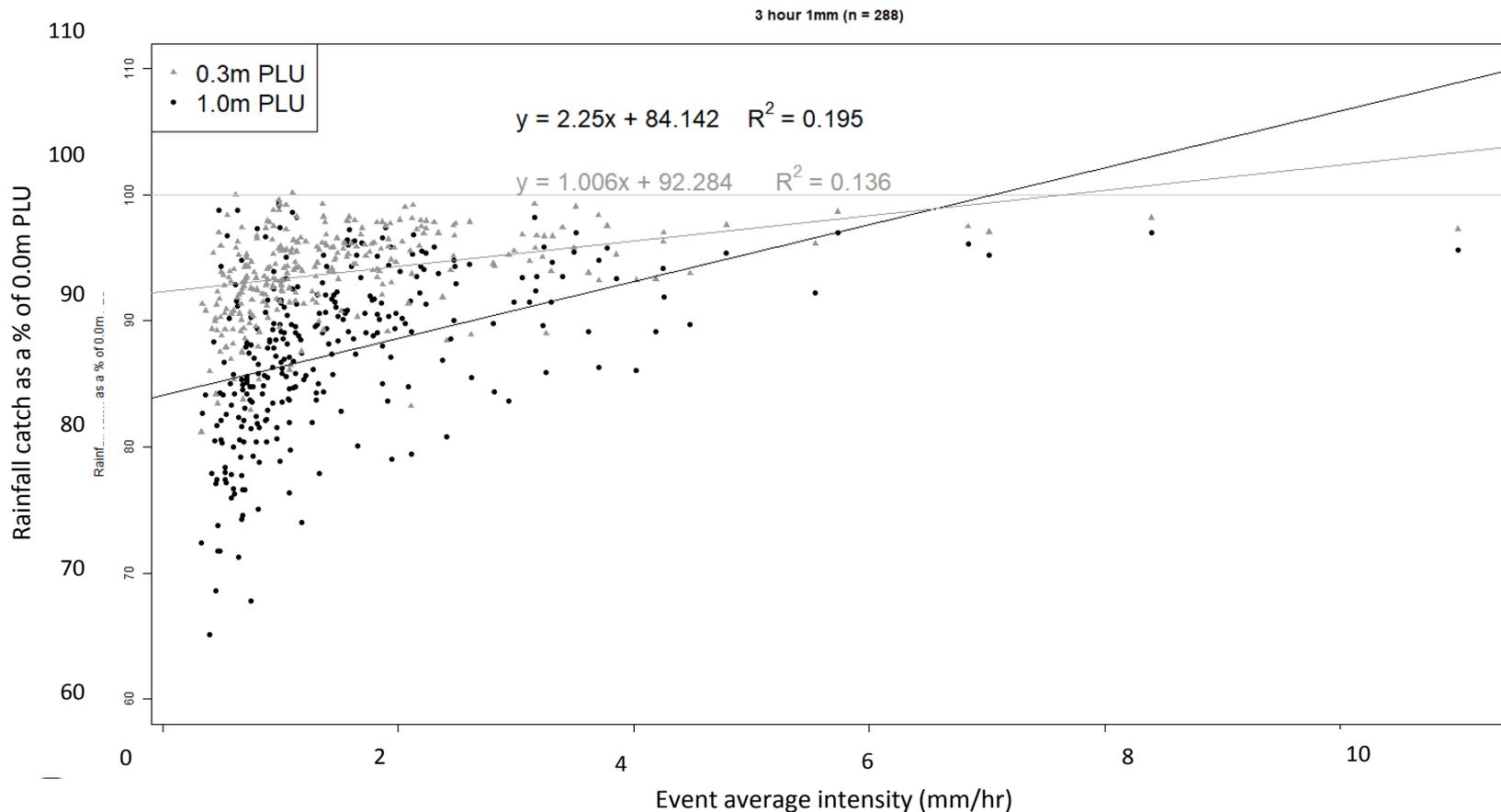
The research – results (undercatch)

- Event average wind speed
 - Positive relationship, although with a large amount of scatter



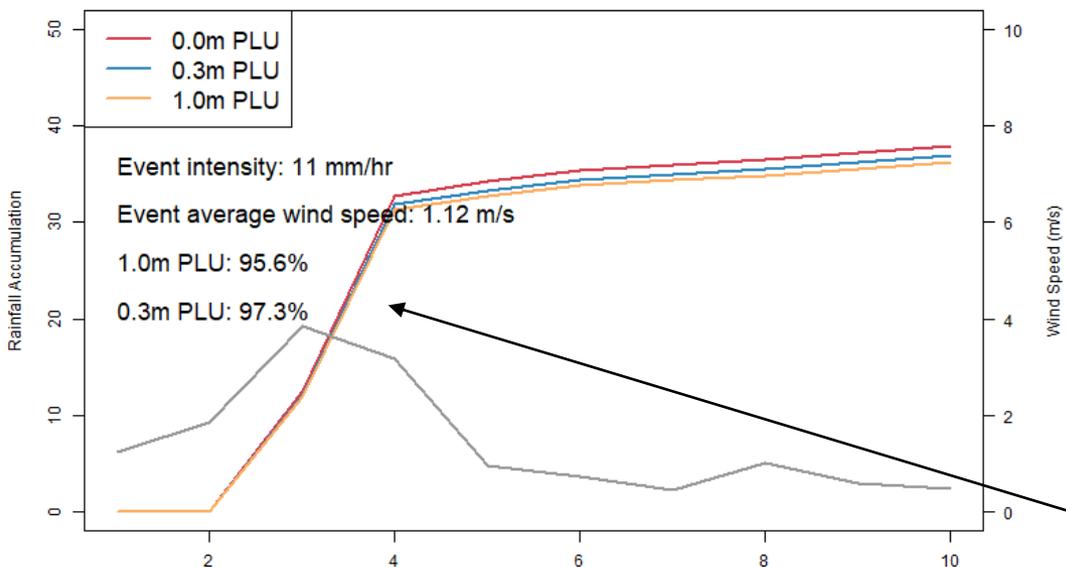
The research – results (undercatch)

- Event average intensity
 - Negative relationship, although with a large amount of scatter, particularly at low intensities



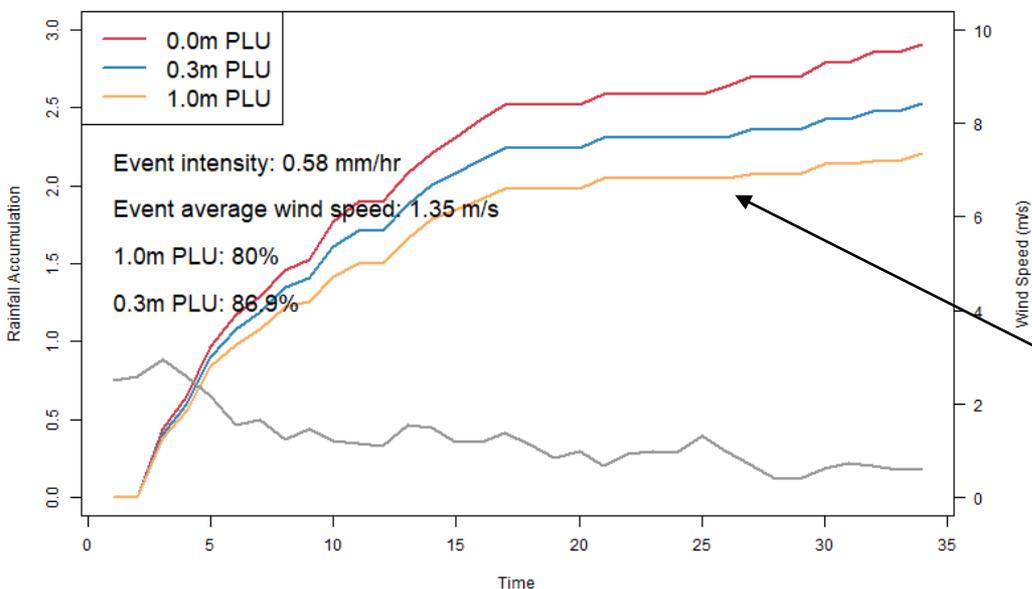
The research – results (undercatch)

High Intensity Event 16/06/2016 (#102)



- Still a complex picture within events!
- High wind speed doesn't have much impact at high intensities

Low Intensity Event 13/12/2015 (#44)



- Largest amounts of undercatch occur at the low intensity periods within events

The solution?

- Produce a correction factor? 
 - Complex relationship between undercatch and wind speed / rainfall intensity
 - Particularly at low intensities (78% of events here were <2 mm/hr)
 - If possible, it would only be location specific
 - Need a national network of pit-installed Pluvio gauges
- Gain a better understanding of the relationship 
 - Installation of high resolution wind speed measurement at gauge height

Conclusions

- What is the impact of changing from tipping bucket gauge (TBR) to weighing gauge?
 - Minimal impact (if the gauge is installed at the same height)
- What is the impact of changing from a 30cm mounting height to 1m?
 - Average 6.6% (2.8% - 10.6%).
- What is driving any observed undercatch?
 - Complex relationship between wind speed and rainfall intensity
- Is there a way to correct rainfall data recorded at 1m to a lower mounting height?
 - Not based on these trials, further research needed / investigation with higher resolution data



Photo: Katie Muchan

Thank you

Any other questions: katmuc@ceh.ac.uk