Microscale Throughfall and Precipitation Heterogeneity in a Transitional Cloud Forest

Natalie Teale (ngteale@syr.edu)[1], Nicole Shibley (nicole.shibley@yale.edu)[2]
[1]*Syracuse University,* [2]*Yale University*

AGU 2012 H33E-1369

I. Introduction

A lack of understanding about how rainfall differs throughout various regions of the cloud forest motivates this research. Factors such as canopy density, variations in precipitation across a single gauge network, and certain temporal conditions are accounted for. The research is important in that it will provide a greater understanding about the amount of precipitation in the cloud forest, and the various factors of the forest that contribute to these spatial differences in precipitation.

II. Methods and Study Site

- Study site: Texas A&M Soltis Center for Research and Education, a pre-montane cloud forest in Costa Rica
- 4 hyper-dense networks of wedge-type rain gauges
  - 6 x 6 (2-m spacing)
- 3 networks under the canopy
  - 1 network adjacent to a 10-m weather station
- 1 extensive network of gauges
  - 5 x 5 (approximate 10-m spacing)
- Gauges measured and emptied approximately every 24 hours from June 17–July 18, 2012
- Leaf area index and clear sky were estimated at each site using a hemispheric camera and a LiDAR laser scanner.

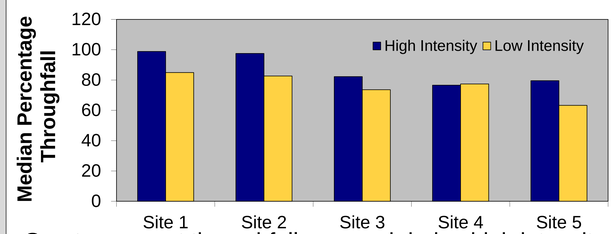
Hyper-dense network

Above: Sample hemispheric photographs used to determine leaf area index and clear sky estimations
Below: Site precipitation and throughfall statistics.

	Site 1 (control)	Site 2	Site 3	Site 4	Site 5	Tower, 10-m
Mean (mm)	6.42	6.18	5.85	5.47	5.29	6.74
Std. Dev. (mm)	0.20	2.02	2.48	2.68	2.98	N/A
# of Gauges	35	36	36	36	25	N/A
LAI	0	2.11	2.82	7.58	N/A	0
Visible Sky	1	.119	.084	.078	N/A	1

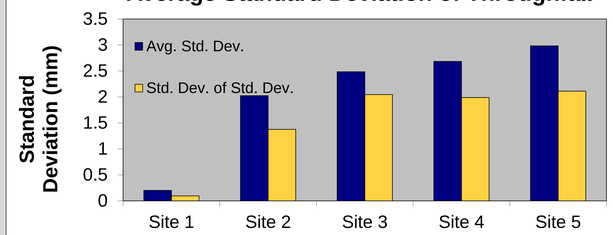
III. Results

Throughfall (%) During High vs. Low Intensity Events



Greater percent throughfall occurred during high intensity events at 4 out of 5 sites.

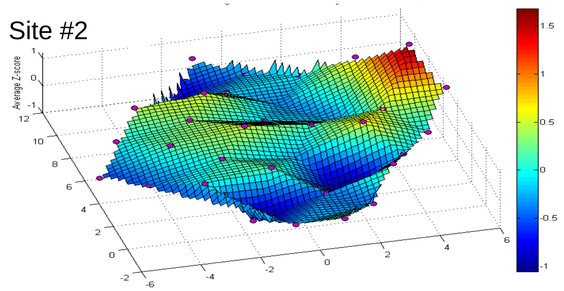
Average Standard Deviation of Throughfall



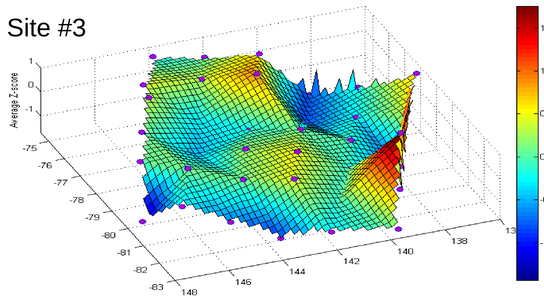
As expected, the extensive network showed the greatest degree of variation in throughfall. Yellow bars show standard deviation of variability, also measured in standard deviation.

These figures show average z-scores over the gauge sites. Some patterns emerge but are not consistent. Plots are oriented to maximize visibility of variation within each array.

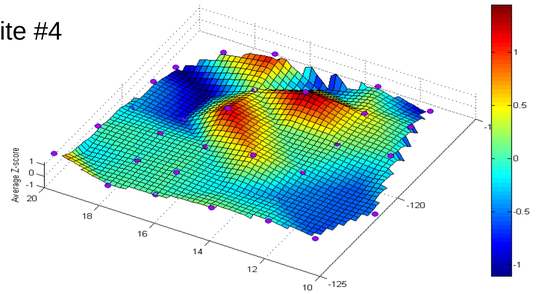
Site #2



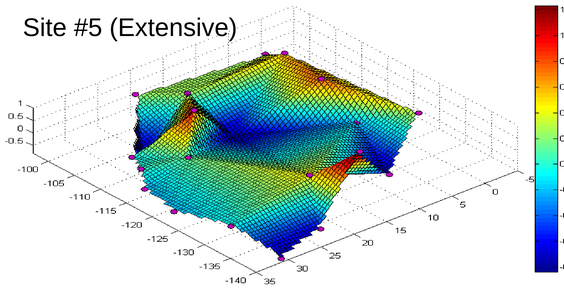
Site #3



Site #4



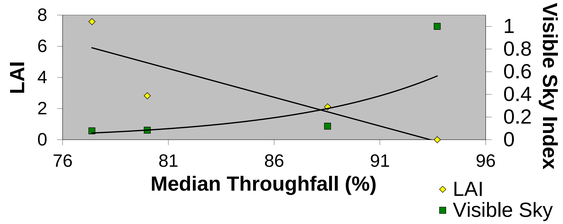
Site #5 (Extensive)



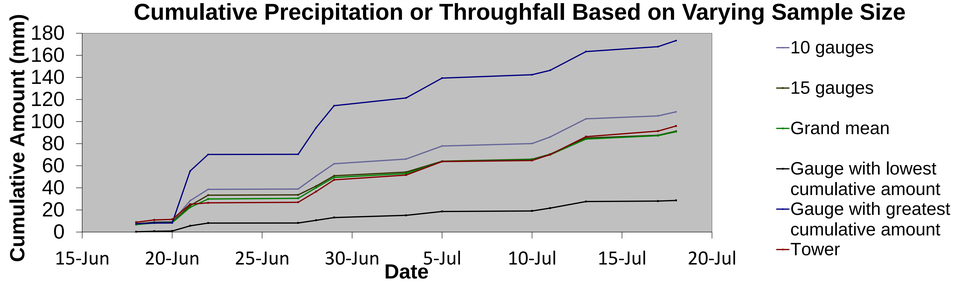
LAI and Visible Sky vs. Median Percentage Throughfall

A negative linear correlation (R^2=76%) exists between LAI and throughfall and an exponential relationship with visible sky (R^2=75%) at the hyper dense networks.

- This relationship did not exist among the extensive network.



Cumulative Precipitation or Throughfall Based on Varying Sample Size



Sample size is critical in producing accurate estimations of precipitation and throughfall, as variation is significant. Sampling 15 random gauges would produce a mean within 1% of the grand mean (164 gauges).

IV. Conclusions

- Spatial variability in precipitation and throughfall exists, but is not consistent.
- A single network did not consistently receive more or less throughfall than the other networks.
- The median percentage of throughfall averaged over all events at each hyper-dense site demonstrates a negative linear correlation with leaf area index. The same index over each extensive gauge does not yield a strong correlation.
- High intensity events generally produced a greater percentage of throughfall than low intensity events.
- 5 of the 8 days of significant spatial variability recorded winds predominantly from the north during times of precipitation.
- There were no days of insignificant variability that the wind blew predominantly from the north during precipitation.
- These results demonstrate the complexities of vegetation in characterizing throughfall.
- 15 gauges randomly-chosen gauges produce a mean throughfall within 1% of the grand mean.

V. Acknowledgements

We would like to thank Dr. Steven Quiring, Dr. Oliver Frauenfeld, Dr. Brendan Roark, Dr. Anita Rapp, Emily Morris and Alexander Peterson for all of their support and humor during the course of this research.