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STUDY OF THE VARIABILITY IN THE RAIN DROP SIZE DISTRIBUTION OVER A 2.3 KM PATH

Rafael F. Rincon[*1], Roger Lang[1], Robert Meneghini[2], Steven Bidwell[2], and Ali Tokay[3]

[1]The George Washington University, Washington, DC
[2]NASA/GSFC, Greenbelt, MD
[3] JCET, UMBC, Baltimore, MD

Abstract- In an effort to study the drop size distribution (DSD) a state-of-the-art instrument arrangement was deployed on Wallops Island, VA. The instrumentation consisted of a 2.3-km multi-frequency microwave link, three impact disdrometers, and a network of optical and tipping bucket raingauges. A dual-frequency inversion technique was implemented with the link measurements of attenuations at 25 GHz and 38 GHz to estimate the path-average DSD. Concurrently, an X-band, dual-polarization radar, located in the vicinity, collected polarization and reflectivity measurements over the link path. The evaluation of the estimates and measurements generated some preliminary results.

I. INTRODUCTION

An accurate estimation of the drop size distribution (DSD) is essential in the retrieval of rainfall parameters from microwave measurements and in the modeling of microwave propagation through rain. The DSD is characterized by a high temporal and spatial variability that affects both microwave measurements and ground validation. To study the temporal and spatial variation of drop size distributions a state-of-the-art instrument arrangement was deployed on Wallops Island, VA. The instrumentation consisted of a 2.3-km multi-frequency microwave link, three impact (Joss-Waldvogel) disdrometers, and a network of optical and tipping bucket raingauges. Concurrently, NOAA's ground base X-band radar, located in the vicinity of the link during the March 2001 rain event, collected polarization and reflectivity measurements. The radar operates at 9.34 GHz at horizontal and vertical polarizations.

In this work inversion techniques implemented with the link measurements provided DSD estimates over the path for a highly convective event on March 21, 2001. The estimates were evaluated in conjunction with the measurements from the three disdrometers located directly under the microwave path. The results were evaluated with the radar measurements aloft. Additionally, the estimated DSD and the disdrometer measurements were used to compute path-average rain rates and rainfall accumulation. These results were compared to path-average measurements from the network of optical and tipping bucket rain gauges.

* NASA/GSFC/ 975, Bldg. 33, Rm. B409
Greenbelt, MD 20771
Phone: (301) 614-5725, Fax: (301) 614-5558
E-mail: rafael@priam.gsfc.nasa.gov

III. CONCLUSION

The link attenuation measurements at 25 and 38 GHz and the implementation of dual-frequency inversion technique yielded a path average DSDs based on an analytical Gamma model. The technique was applied during a highly convective rain event with maximum rain rates of nearly 120 mm/hr. The results showed the potential of the link DSD estimates as a validation tool as well as an accurate estimator of microwave and rainfall parameters.

The rain event presented exhibited high DSD variability over the path, affecting the agreement between the averaged point measurements. The underestimation observed with the disdrometer may also be attributed to the limited measurable drop range from 0.3 to 5 mm.

A more detailed study of the DSD variability and its effects on the rainfall retrievals is under way. The results will be presented at the conference.