Methods for Filtering Parsivel\textsuperscript{2} Data from Different Rain Regimes
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ARM now deploys 9 Parsivel\textsuperscript{2} disdrometers and will likely increase this number this year. Disdrometers contribute significant observations of the drop size distribution of rainfall and they help to improve our understanding of precipitation processes. The Parsivel\textsuperscript{2} devices have proven to:
1) be very reliable - lots of data to work with
2) produce better small drop counts than the Joss-Waldvogel disdrometers
3) be relatively inexpensive
The data from the Parsivel disdrometers have some documented issues (Tokay et al., 2014)
1) the number of large drops for diameters greater than 5 mm tend to be overestimated
2) observed fall velocities for drops with diameters less than 1.0 mm tend to be too low
3) observed fall velocities for drops with diameter greater than 3.35 mm tend to be too high

Hence the observations need filtering, note example below

Filtering Techniques
The standard method for filtering Parsivel\textsuperscript{2} data relies upon
- Identifying outliers as those points with observed drop fall velocities widely different from Gunn and Kinzer (1949, Gk49) or similarly published drop fall velocities
This analysis goes further and evaluates the use of a
- maximum drop diameter threshold in conjunction with drop fall velocity to identify outlier observations

The hours long rainfall events of 20150906 in Brazil (MAO) and 20160115 from Graciosa Island (ENA) provided many Parsivel\textsuperscript{2} observations with rain rates greater than 3 mm/hr and with 500 or more drops counted. Each event offered good contrast beginning with heavy rainfall and ending with weak rainfall.

Each observed drop size spectrum was varied by
1) Incrementally limiting the maximum drop size (0.062 mm to 2.4 mm)
2) Restricting the acceptable range in fall velocity (+ - 10\% of Gk49 to + - 50\% of Gk49)
3) Limiting both maximum drop size and fall velocity range simultaneously

SKILL
Skill in filtering is determined by the correlation coefficient between rain rate as observed by the optical rain gauge and rain rate as calculated from filtered drop size distribution. For any given drop distribution rain rate is calculated as follows:

\[
\text{rain rate} = \frac{\pi}{6} \times 0.0036 \times \frac{1}{F \times t} \times \sum n_i \times D_i^2
\]

where
- \( F \) = measurement area
- \( t \) = accumulation time
- \( n_i \) = number of drops in diameter bin \( i \)
- \( D_i \) = the diameter of drops at center of bin \( i \)

The work carried out by the ARM aerosol program may make this analysis possible additionally acknowledged

Concluding Remarks
- Filtering to remove outlier data can improve the quality of Parsivel\textsuperscript{2} drop spectra. It will also decrease the number of drops in the spectra and will require longer accumulation times to obtain the best results.
- Filtering the Parsivel\textsuperscript{2} data will be of particular importance in using equivalent radar reflectivity factor calculated from Parsivel\textsuperscript{2} data to calibrate nearby radars.

Notes
1) ORG/Pars\textsuperscript{2} correlations for light rain at ENA roughly half that for MAO for same rain rate regimes.
2) MAO ORG/Pars\textsuperscript{2} correlations for heavy rain vs light rain are considerably higher.