Parsivel (Laser Optical) Disdrometer
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Measures size and fall velocity of hydrometeors
Present weather sensor
Sampling area: ~50 cm², varies with drop diameter
Number of size and velocity bins: 32 x 32 matrix
Drop size range: 0.06-24.5 mm
Velocity range: 0.05-20.8 m/sec
Operation period at Wallops Island: Spring 2002 - present
Manufacturer: OTT in Germany www.ott-hydrometry.de

Shortcomings

- Measures maximum diameter of the 1-D projection of the particle.
- Spurious drops - rain drops falling at velocities that differ ±50% from terminal fall speed are rejected.
- Spurious drops - two particle in the light sheet at the same time (raindrops larger than 8 mm are rejected).
- Fall velocities are underestimated at mid-size drops.
- Underestimates the drop concentration at diameters < 1 mm.
- Quantization error due to binning the observed maximum diameter and velocity.

C3vp Field Campaign
CARE Precipitation Observation Site
Case Study #1: December 5, 2006
Particle Size Distribution

December 5, 2006
Precipitation total = 48 mm (Parsivel 3)

December 5, 2006
Precipitation total = 58 mm (Parsivel 4)
Case Study #2: December 5-6, 2006
Particle Size Distribution

Precipitation total = 41 mm (Parsivel 3)

Precipitation total = 42 mm (Parsivel 4)

Concentration ($m^{-3} mm^{-1}$)
$10^{-2}$ $10^{-1}$ $10^{0}$ $10^{1}$ $10^{2}$ $10^{3}$ $10^{4}$
Case Study #2: December 5-6, 2006
Particle Size Distribution

Precipitation total = 41 mm (Parsivel 3)

Precipitation total = 42 mm (Parsivel 4)
Case Study #3: December 6, 2006
Particle Size Distribution

December 6, 2006
Precipitation total = 104 mm (Parsivel 3)

Maximum Width (mm)

08 09 10 11 12 13 14 15 16 17 18 19 20

December 6, 2006
Precipitation total = 124 mm (Parsivel 4)

Maximum Width (mm)

08 09 10 11 12 13 14 15 16 17 18 19 20

Concentration (m$^{-3}$ mm$^{-1}$)

$10^{-2}$  $10^{-1}$  $10^{0}$  $10^{1}$  $10^{2}$  $10^{3}$  $10^{4}$
Case Study #4: December 6-7, 2006
Particle Size Distribution

Time (UTC)

Maximum Width (mm)

December 6-7, 2006
Precipitation total = 45 mm (Parsivel 3)

December 6-7, 2006
Precipitation total = 52 mm (Parsivel 4)

Concentration (m\(^{-3}\) mm\(^{-1}\))

\[ 10^{-2} \quad 10^{-1} \quad 10^{0} \quad 10^{1} \quad 10^{2} \quad 10^{3} \quad 10^{4} \]
Case Study #1-4: December 5-7, 2006
Particle Composite Spectra

December 5, 2006
14:15 UTC
Density = 0.039, 0.034 g cm$^{-3}$
Snow water content = 0.427, 0.389 g m$^{-3}$
Mass mean diameter = 5.31, 5.37 mm

Precipitation rate = 38.9, 45.6 mm h$^{-1}$
Melted precipitation rate = 1.5, 1.5 mm h$^{-1}$
Rayleigh Reflectivity = 52.5, 31.7 dBZ
Normalized intercept parameter ($N_0^* = 398, 487$ m$^2$ mm$^{-1}$)
Normalized intercept parameter ($N_p = 1128, 1122$ m$^{-3}$ mm$^{-1}$)

December 6, 2006
12:13 UTC
Density = 0.043, 0.044 g cm$^{-3}$
Snow water content = 0.196, 0.206 g m$^{-3}$
Mass mean diameter = 4.16, 4.05 mm

Precipitation rate = 21.0, 21.2 mm h$^{-1}$
Melted precipitation rate = 0.9, 0.9 mm h$^{-1}$
Rayleigh Reflectivity = 26.4, 26.6 dBZ
Normalized intercept parameter ($N_0^* = 237, 308$ m$^2$ mm$^{-1}$)
Normalized intercept parameter ($N_p = 1243, 1453$ m$^{-3}$ mm$^{-1}$)

December 6, 2006
12:13 UTC
Density = 0.019, 0.021 g cm$^{-3}$
Snow water content = 0.277, 0.297 g m$^{-3}$
Mass mean diameter = 0.01, 0.04 mm

Precipitation rate = 50.6, 56.9 mm h$^{-1}$
Melted precipitation rate = 0.9, 0.9 mm h$^{-1}$
Rayleigh Reflectivity = 25.0, 28.3 dBZ
Normalized intercept parameter ($N_0^* = 402, 409$ m$^2$ mm$^{-1}$)
Normalized intercept parameter ($N_p = 932, 1136$ m$^{-3}$ mm$^{-1}$)

December 6, 2006
22:00 UTC
Density = 0.051, 0.046 g cm$^{-3}$
Snow water content = 0.388, 0.395 g m$^{-3}$
Mass mean diameter = 2.13, 2.22 mm

Precipitation rate = 27.8, 31.5 mm h$^{-1}$
Melted precipitation rate = 1.4, 1.4 mm h$^{-1}$
Rayleigh Reflectivity = 21.3, 21.1 dBZ
Normalized intercept parameter ($N_0^* = 2965, 3062$ m$^2$ mm$^{-1}$)
Normalized intercept parameter ($N_p = 29784, 28713$ m$^{-3}$ mm$^{-1}$)
Case Study #1-4: December 5-7, 2006
Particle Mean Fall Velocity

December 5, 2006
14 - 15 UTC
temperature = -0.3 C
wind = 3.6 m/sec
humidity = 100%

December 6, 2006
12 - 13 UTC
temperature = 0.0 C
wind = 1.9 m/sec
humidity = 99%

December 6, 2006
12 - 13 UTC
temperature = -0.4 C
wind = 2.7 m/sec
humidity = 95%

December 6, 2006
22 - 00 UTC
temperature = -1.4 C
wind = 2.4 m/sec
humidity = 91%

December 7, 2006
22 - 00 UTC
temperature = -1.1 C
wind = 2.4 m/sec
humidity = 91%