Precipitation and DSD Variability Studies at the GPM Precipitation Research Facility

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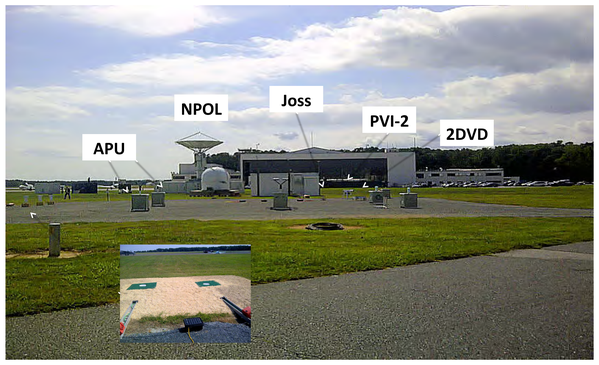
INTRODUCTION

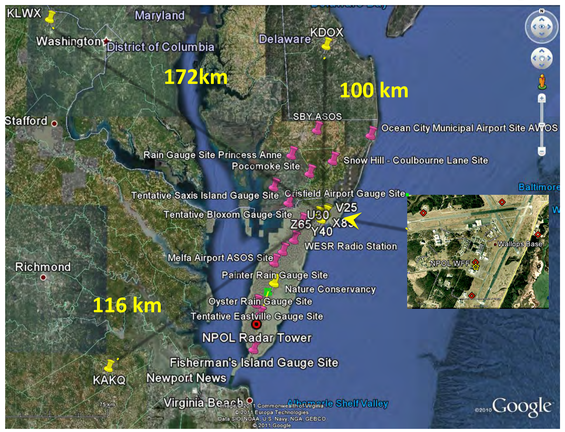
Precipitation estimates from satellite instruments such as the TRMM Precipitation Radar (PR) and the future GPM Dual-frequency Precipitation Radar (DPR) are often biased by non-uniform precipitation structure within the satellite footprint. For both the PR and DPR, at nadir, the footprint is roughly 5 km. In support of GPM Ground Validation, a Precipitation Research Facility (PRF) is being developed to address this and other common sources of uncertainty in satellite precipitation estimates. There are three principal components to the Wallops PRF:

1) Rain gauge measurements from tipping bucket gauges, including a high-density grid (5 km x 5 km) of 25 dual-gauge platforms near Nassawadox, VA.

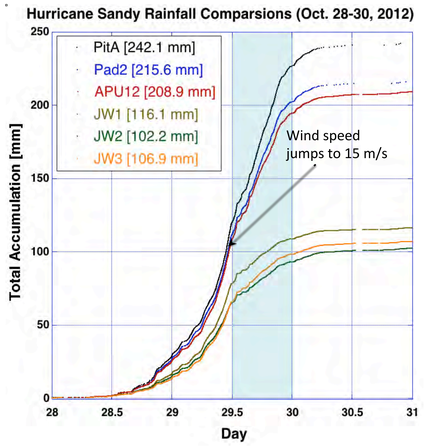
2) A network of Two-dimensional Video Disdrometers (2DVD), Parsivel laser disdrometers, and Joss-Waldvogel disdrometers, currently deployed around the main Wallops base.

3) NPOL dual-polarization, TOGA C-band and a dual-frequency, dual-polarization, Doppler radar (D3R) to provide rain and DSD estimates over scales of order O[150 km].

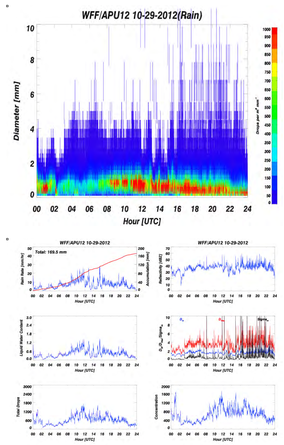




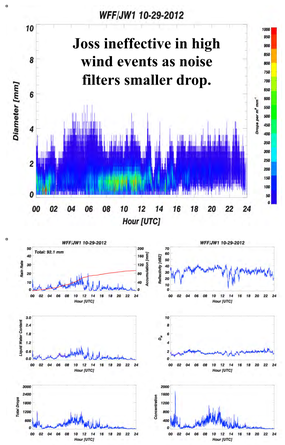
Sampling Opportunities, from Hurricanes…

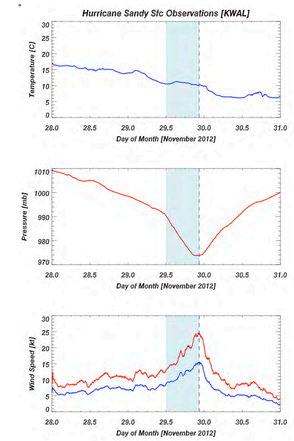


Parsivel



Joss-Waldvogel



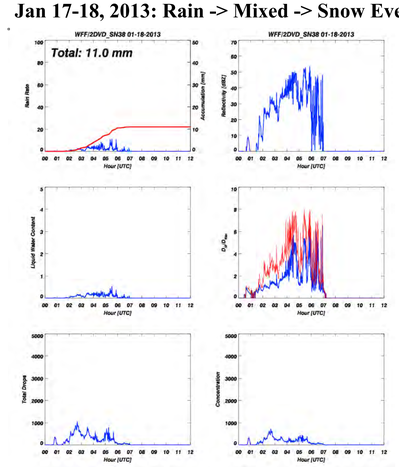


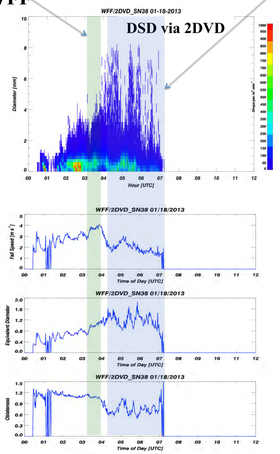
…to Winter Storms…

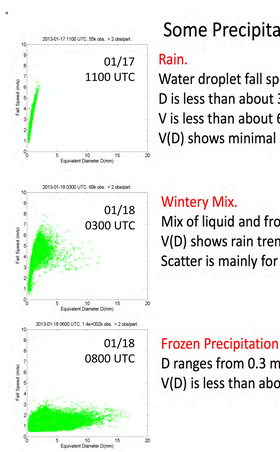
Mixed precipitation: moderate velocities, increased diameters

Snow: decreased velocities, large diameters

Jan 17-18, 2013: Rain -> Mixed -> Snow Event at WFF







Some Precipitation Classes Recorded by PVI-2.

Rain.
Water droplet fall speed increases with particle size.
D is less than about 3 mm.
V is less than about 6 m/s.
V(D) shows minimal scatter from the trend.

01/17
1100 UTC

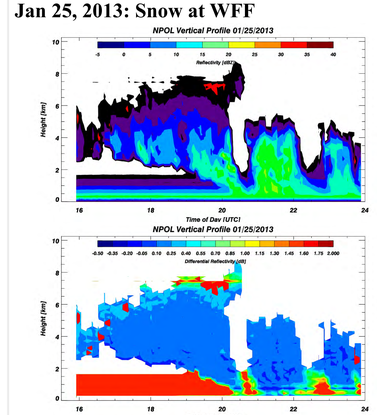
Wintery Mix.
Mix of liquid and frozen precipitation produces V(D) variability.
V(D) shows rain trend with scatter.
Scatter is mainly for D > 5 mm, for which V is lower.

01/18
0300 UTC

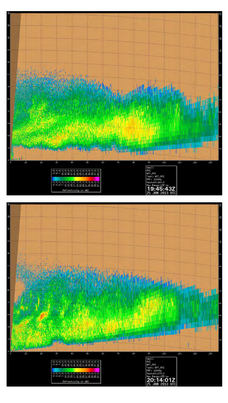
Frozen Precipitation – Snow.
D ranges from 0.3 mm to greater than 15 mm.
V(D) is less than about 2.5 m/s.

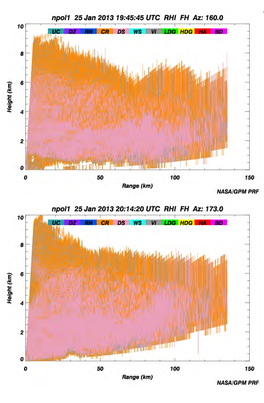
01/18
0800 UTC

Jan 25, 2013: Snow at WFF



Snow event begins with virga, until column is moistened, then snow reaches the ground. Images to the left show the time v. height progression of the precipitation (via the reflectivity [top] and differential reflectivity [bottom] fields), using NPOL in vertically pointing mode. Near zero Z_{DR} in snow indicates good calibration

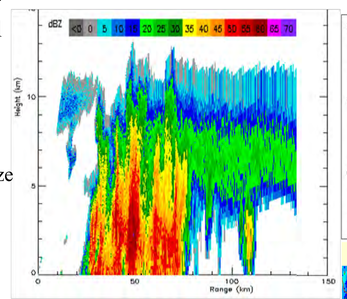


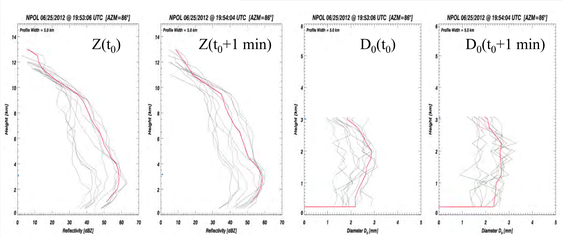


These images show RHI at 160° (reflectivity left [dBZ]); hydrometeor classification right [HID]) before (top) and after (bottom) snow reaches the surface. The HID is classified as drizzle [CR] while virga present, but correctly changes to "Dry Snow" [DS] when the precipitation reaches the surface.

Profile Variability over DPR/GPM time/spatial scales

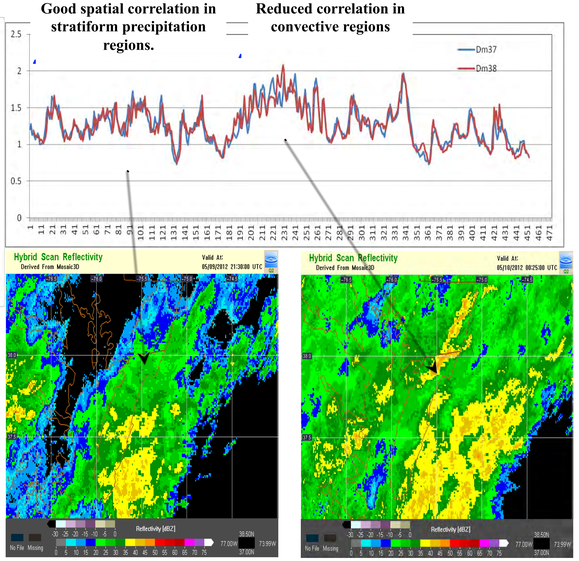
- Significant Z and D_0 changes evident over 5 km/1-minute time scales.
- NPOL used to characterize high spatio-temporal changes in microphysics below the mixed phase region (liquid)





Good spatial correlation in stratiform precipitation regions.

Reduced correlation in convective regions



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