The Multi-Angle Snowflake Camera at the ARM AMF3 Site at Oliktok Point, Alaska

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Background

The Multi-Angle Snowflake Camera (MASC) is actively capturing images of hydrometeors and calculating fall speeds since its installation in April 2015 at the ARM AMF3 site at Oliktok Point, Alaska. The MASC data can be accessed via the ARM Data Management Facility.
The MASC allows for studies of snowflake microphysical properties including crystal form, size, and fall speed.

The MASC instrument is positioned within a snow fence to minimize the effect of wind on particles passing through the ring of cameras.

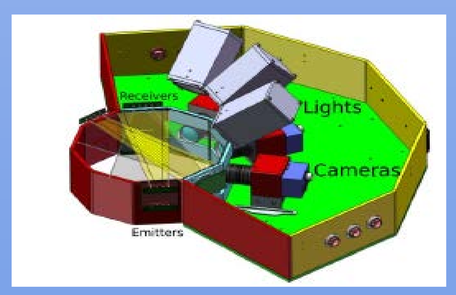
The three 40w lights in the top left of the image illuminate, and three cameras are triggered upon detection of precipitation by the near infrared motion sensors within the ring.

Instrument Design

Three angled Unibrain cameras photograph and measure the fall speed of hydrometeors as they enter the field of view (2.5 cm² detection range), and trip near infrared motion sensors.

- ★ Captures snowflakes between 100 µm and 3cm
- ★ Image resolution from 9 - 37 microns
- ★ Hydrometeor speed calculated from the travel time between the series of motion sensors
- ★ Photographs taken up to 1/40,000th of a second
- ★ The aperture and focus of all three cameras are adjusted for ideal image conditions

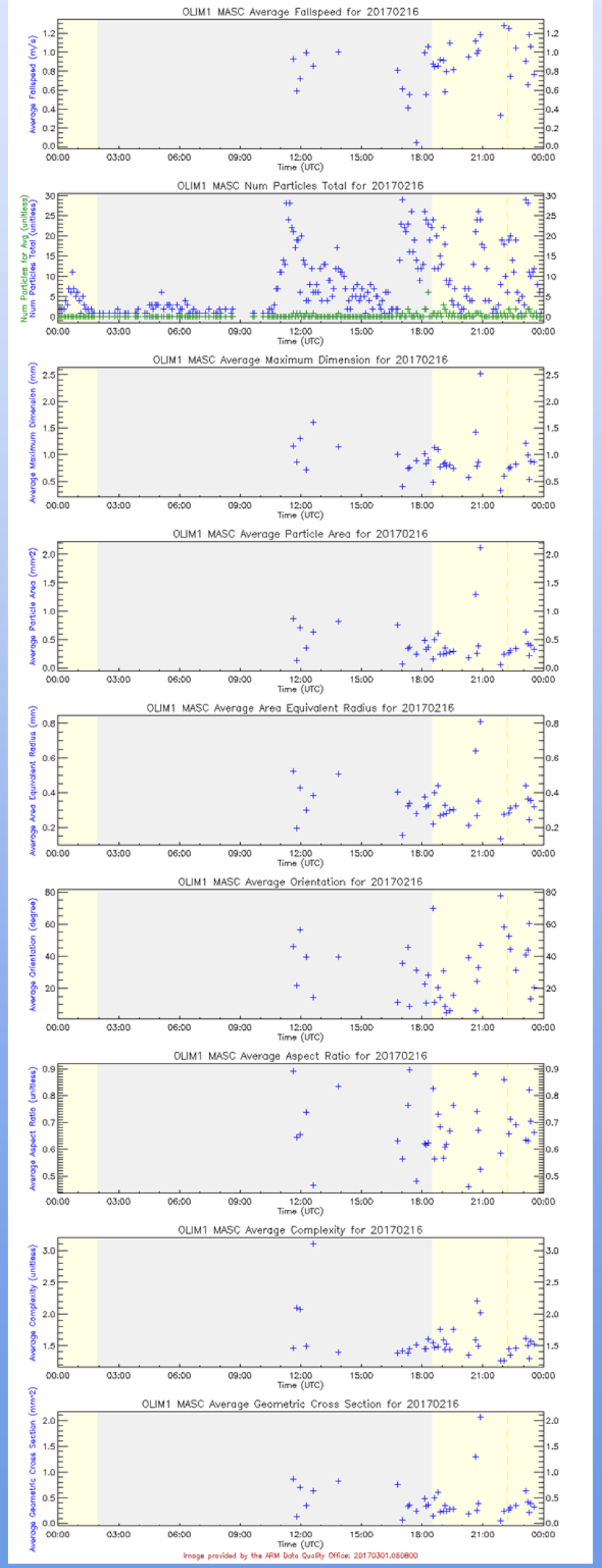
The hatched region represents the cross-section of the MASC's near-infrared motion detector trigger area.



MASC Value-Added-Products

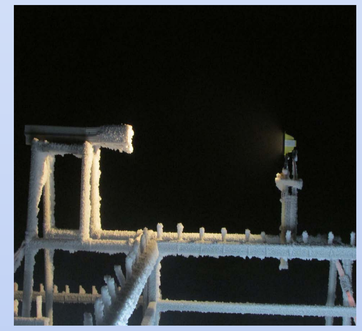
New ARM VAP datastreams: **olimascparticles.c1** and **olimascparticlesavg.c1**
Scientifically-important parameters:

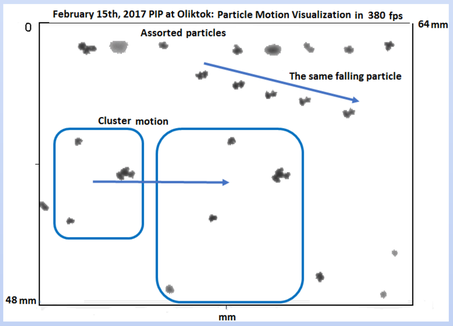
- ★ Size
- ★ Orientation
- ★ Cross-section
- ★ Complexity



Opportunities for Comparison

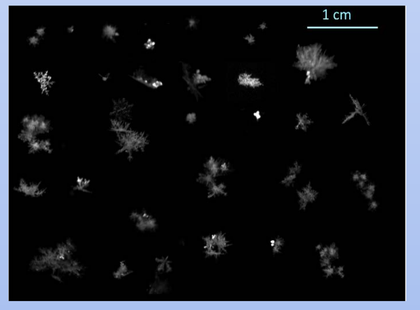
The NASA Precipitation Imaging Package (PIP) currently collects data at AMF3 as a guest instrument. The PIP offers opportunities to cross-check snowflake microphysics. The PIP offers a visualization of hydrometeor motion by continuously recording video at ~380 frames per second.

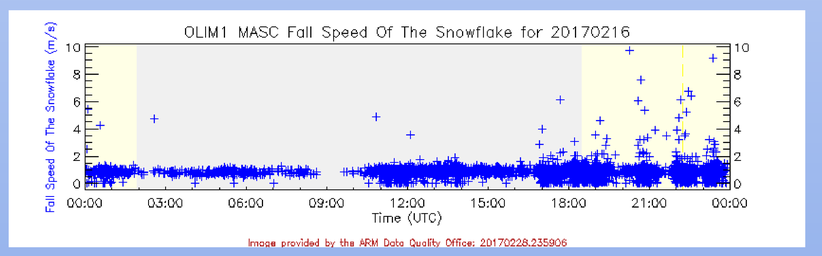




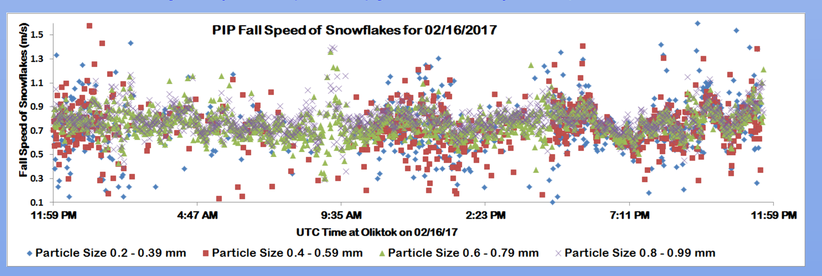
Left: The PIP installed at AMF3. Right: A screenshot from a PIP recording on February 15, 2017.

The MASC captures high quality imagery of particles, while the PIP captures particle motion information that can otherwise be lost in snapshots. Right: A compilation of MASC images from AMF3.





MASC observed snowflake fall speeds (above) and PIP observed fall speeds (below) for February 16th, 2017.



Radar Reflectivity

The microphysics of snowfall events are compared with radar reflectivities. In this example the NSA-C1 KAZR (Ka-band ARM Zenith Radar) radar reflectivity profile from April 23rd, 2014 shows distinct changes due to snowflake microphysics.

Snowflake images captured by the MASC with rime droplets (left) return a signature distinct from dendritic and aggregate snowflakes (right). Image analysis by Steven J. Cooper.