

# Cirrus AAVP IOP: Remote Sensing Validation and Focus on Small Particles

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- The in situ data base for validating cirrus microphysical retrieval algorithms is insufficient for a statistically robust validation – need independent measurement of mass, extinction, Size distribution and habit
- Particle spectra collected in situ consistently demonstrate bimodality with a small particle mode dominating the number concentration and extinction.

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*D. Ivanova et al. / Atmospheric Research 59–60 (2001) 89–113*

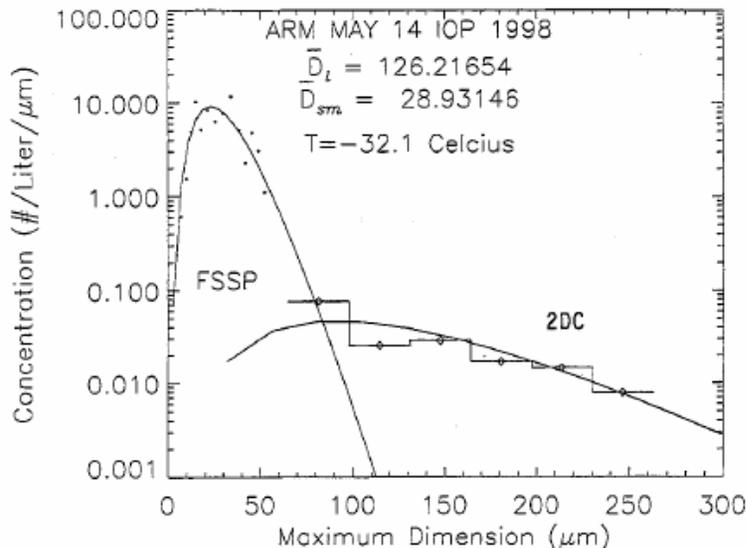


Fig. 3. Example of FSSP and 2DC size spectra, their parameterized gamma fits, and how FSSP size spectra were extrapolated to larger sizes via a gamma fit to test for continuity with 2DC spectra.

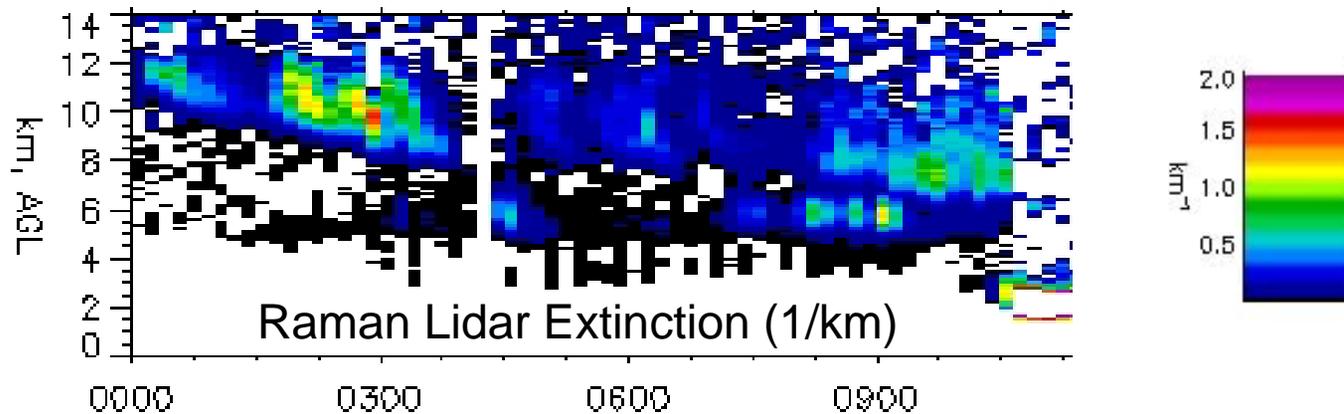
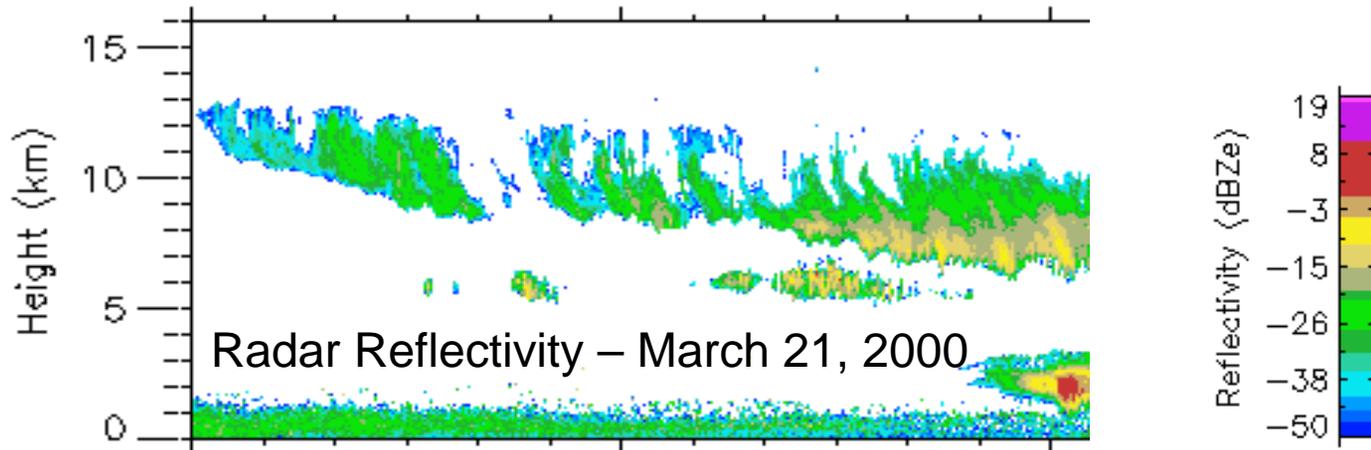
Gayett et al. Table 3:  
Northern Hemisphere  
Temp -45C

Median Value  
Conc 2.0 /cm<sup>3</sup>  
IWC 7.5 mg/m<sup>3</sup>  
Ext 0.57 /km

75<sup>th</sup> percentile  
Conc 4.4 /cm<sup>3</sup>  
IWC 16.6 mg/m<sup>3</sup>  
Ext 1.19 /km

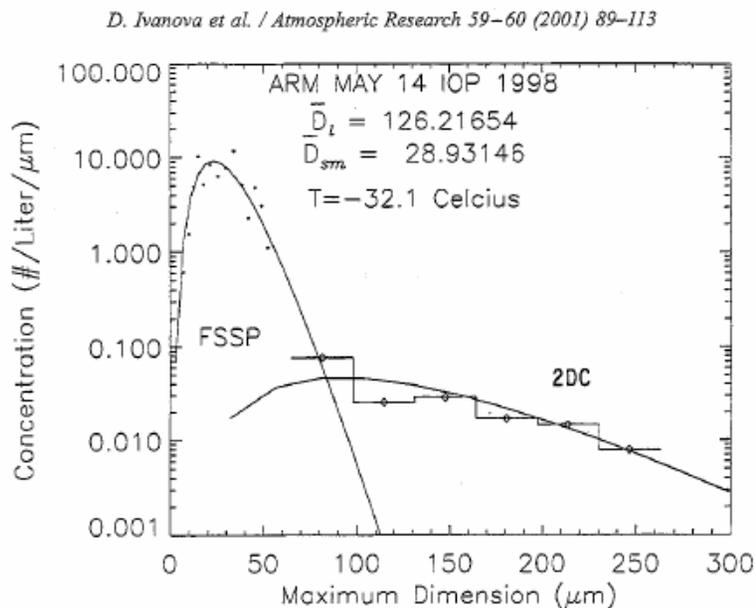
## Implications:

- Cirrus parameterizations that do not explicitly account for this feature will not be able to model the cirrus mass and the extinction – (Ivanova and Mitchell, 2001)
- Cirrus Retrieval Algorithms (satellite or ground-based) based on a single mode PSD assumption will be unable to simultaneously capture the extinction and the mass



Existing cirrus retrieval algorithms assume a single mode 2-parameter PSD and use remote sensing measurements that are sensitive to two moments of that PSD for retrieval.

i.e. Z-Lidar. Z-Radiance. Z-Vd. etc.



**An algorithm that allows for bimodality:**  
Similar to Ivanova and Mitchell, we assume the bimodal PSD is composed of two gamma distributions of specified order (4 unknowns)

Fig. 3. Example of FSSP and 2DC size spectra, their parameterized gamma fits, and how FSSP size spectra were extrapolated to larger sizes via a gamma fit to test for continuity with 2DC spectra.

## Preliminary Findings:

An assumption of bimodality is often (>60%) required to explain the radar and raman lidar data at SGP

Concentrations > 1/cc is diagnosed less than 0.5% of the time (1 year of data)

## AAVP IOP Proposal:

Conduct routine measurements of cirrus over the ARM remote sensors

Measurement suite: condensed mass, extinction, habit, redundant measurements of small and large particle PSD

Flight profiles – primarily spirals up and down in the raman/radar beams (at night)

1 flight per week in appropriate conditions for a period of 1 year spanning many genre of cirrus over a seasonal transitions