SAM* (Sun and Aureole Measurement)
Examples From April 06 IOP at SGP
John DeVore, A.T. Stair, Robert McClatchey

Principal SAM Results:
SAM Operated as Designed
Aureole Shape → Particle Size, Type

1. SAM

- Similar in function to a solar coronograph
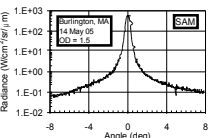- Measures solar disk and aureole radiance in a 16° cone

Figure 1. Second-generation SAM instrument.

2. SAM - AERONET Comparison

- SAM and AERONET ODs agree well (physical separation ~ 500 m)
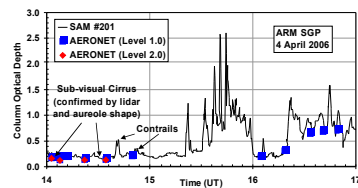- AERONET misclassified cirrus as aerosol (red diamonds below)

Figure 2. Comparison of SAM and AERONET optical depth measurements.

3. Disk and Aureole Profiles

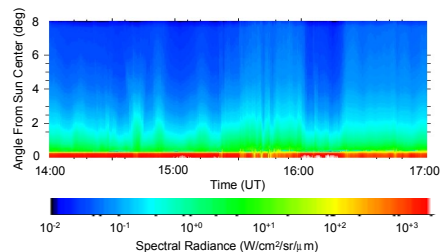- Disk and aureole intensity correspond to the OD plot in box 2 (above)

Figure 3. Color plot showing disk and aureole profiles measured by SAM approximately every 21 sec.

4. Aureole Profiles (ODs = 1.36)

- MPL, TSI confirm cloud typing
- Ac aureole opens underline downward
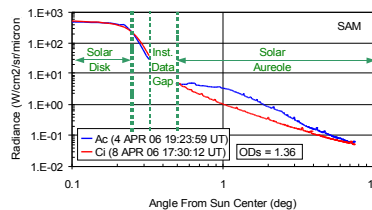- Ci aureole opens underline upward

Figure 4. Sample of SAM aureole data on a log-log plot.

5. Fitting Model Size Spectra

- Adjust analytic model parameters to minimize the chi-square (X_v^2) of the phase function

Find optical depth from solar disk radiance

Find phase function from the aureole profile

Define analytic functions to model the particle size spectrum, e.g., power law, modified gamma function, and log normal distribution

Search for model parameters to minimize X_v^2 of the model and measured phase functions

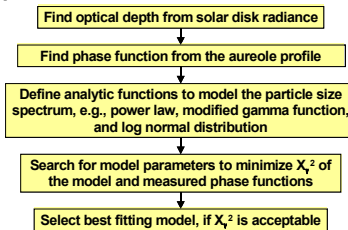Select best fitting model, if X_v^2 is acceptable

Figure 5. Steps for finding a best-fit analytic model for the size spectrum of scatterers.

6. Individual Phase Functions

- As ice plate size increases a plot of its phase function transitions from nearly flat to open downward to open upward
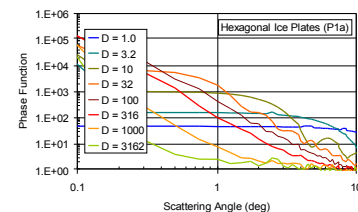

Figure 6. Phase functions for individual size particles, such as these, are used in the model fitting procedure.

7. Thin Cirrus Composite Image
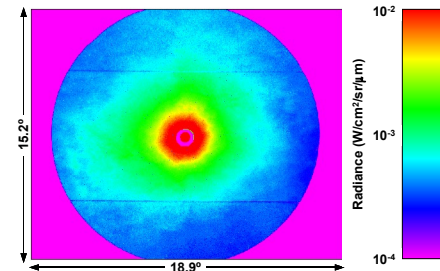
- Optical depth = 0.24

Figure 7. Plot of disk and aureole radiance from SAM #201 at 16:00:54 UT on 4 April 2006.

8. Analytic Phase Functions

- A power-law distribution of ice plates (P1a) fits much better (smaller X_v^2) than one using ice columns (C1e)
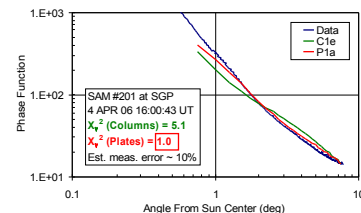

Figure 8. Comparison of SAM-retrieved phase function with two based on analytic model size distributions.

9. Retrieved Size Distributions

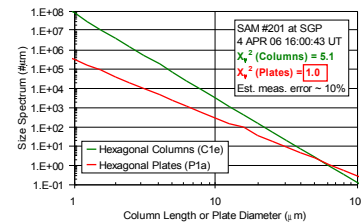- Best-fit power-law slope of –3.0 is consistent with parameterization of Heymsfield and Platt (JAS 41, 846)

Figure 9. The derived size distributions for the two particle habits are quite different.