Comparison of SGP Surface Albedo for August 1998

(1) Footprint surveys based on CARE helicopter data
(2) CERES SARB Operation Retrievals

Co-I Report to CERES Science Team Meeting
GFDL, Princeton N.J., 19 Sept. 2002

David A. Rutan, Thomas P. Charlock, Fred G. Rose, and Ken Rutledge

Goal: Survey surface albedo of area near size of CERES footprint centered at ARM Central facility August 18 – 20, 1998.

Instrumentation:

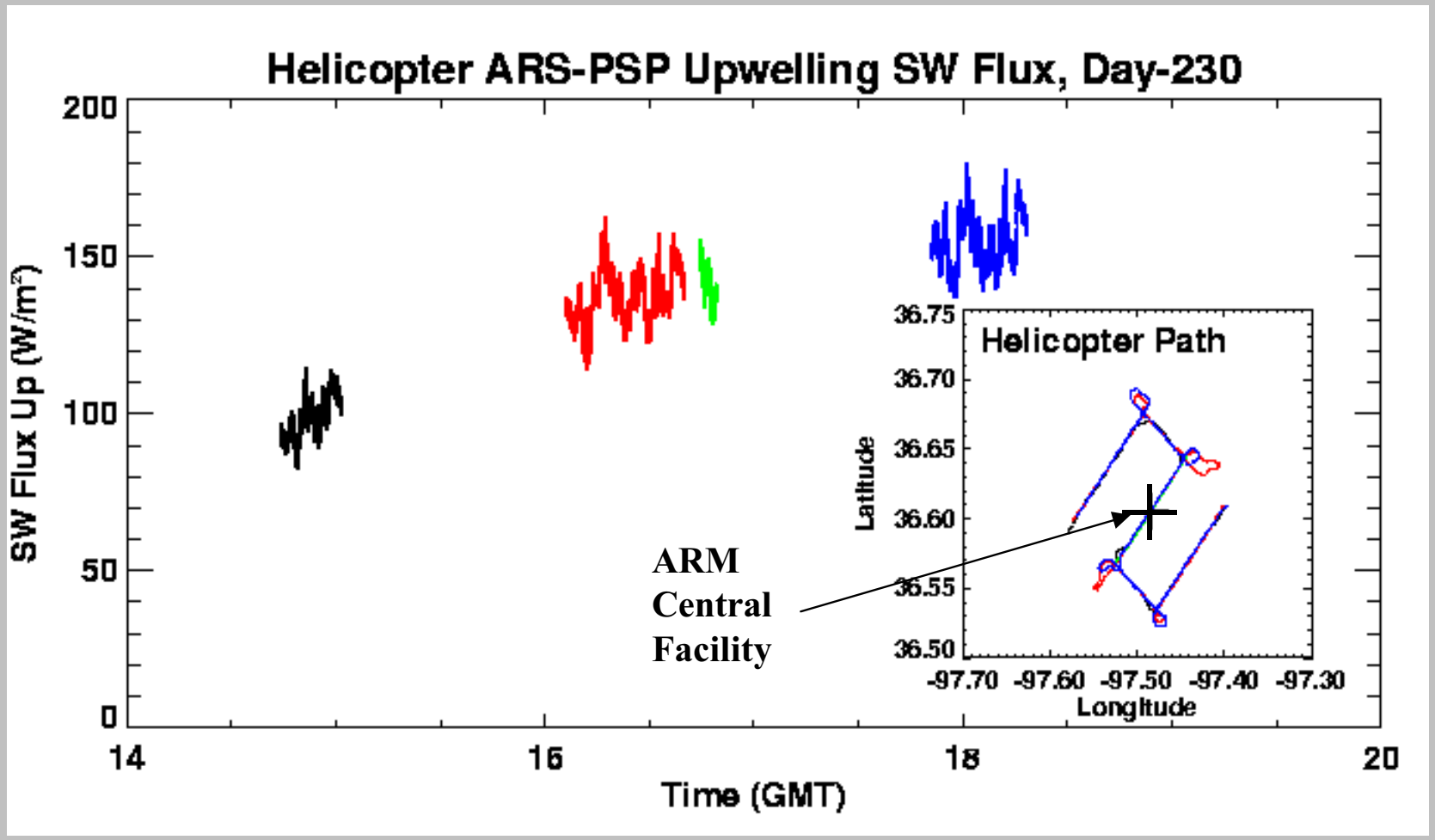
- ARM/E13 radiometry
- GOES/AERI atmospheric profiles.
- AERONET Cimel sun photometer.
- CARE helicopter observations of upward SW flux.
  - 18th – 4 flights
  - 19th – 2 flights
  - 20th – 1 flight
- Gulfstream profiles of aerosol extinction.

CERES/SARB observations/calculations.

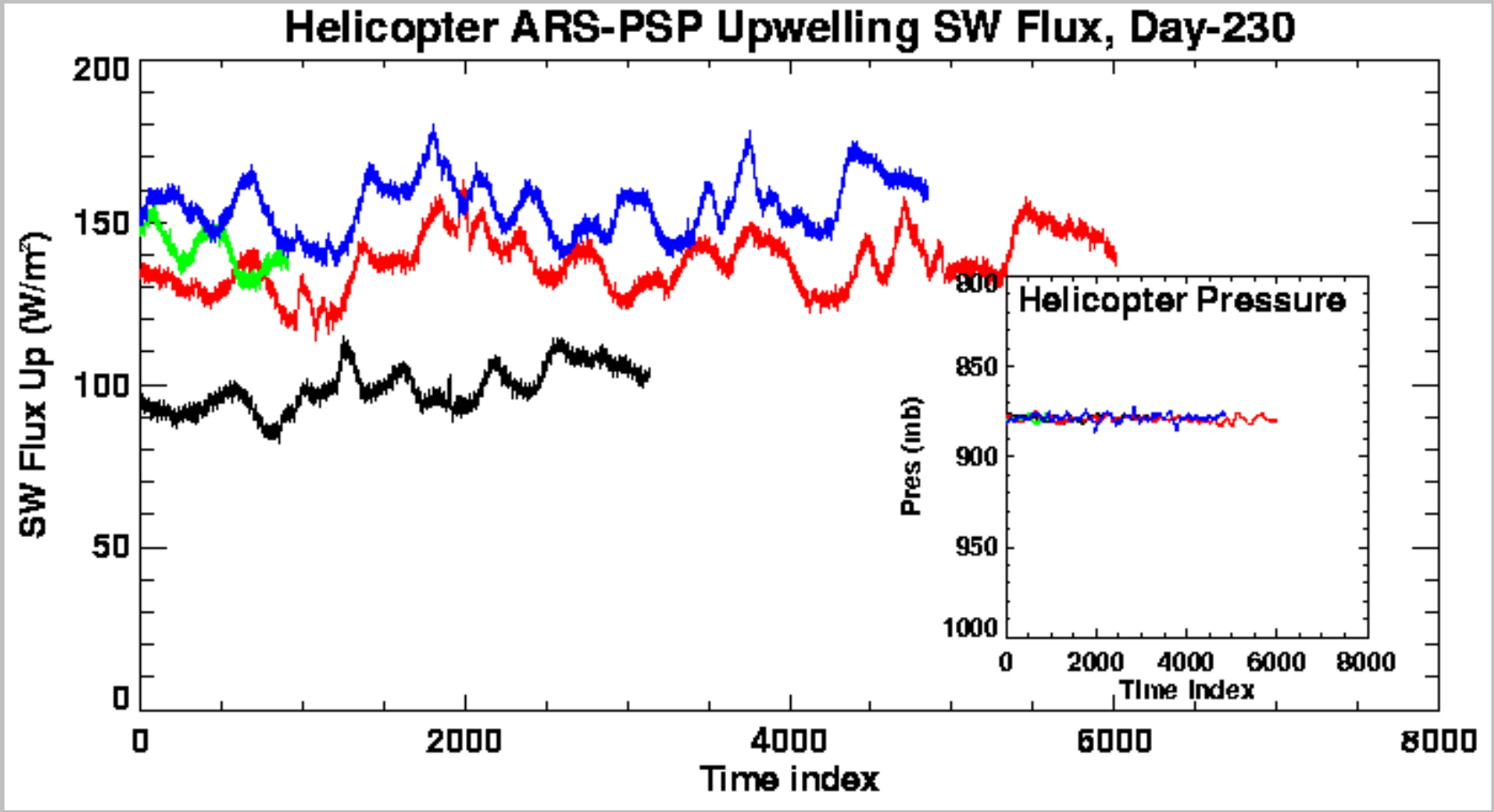
Model: CERES CRS Ed2B Old Fu&Liou

Offline model: New Fu&Liou (2002/08)

Fluxes at helicopter altitude during 4 flights on Aug. 18, 1998. Inset shows flight paths nearly identical.



Helicopter flux observations shown temporally.
PSP sampled at 3 Hz.
Inset show helicopter altitude for each flight ~850mb.

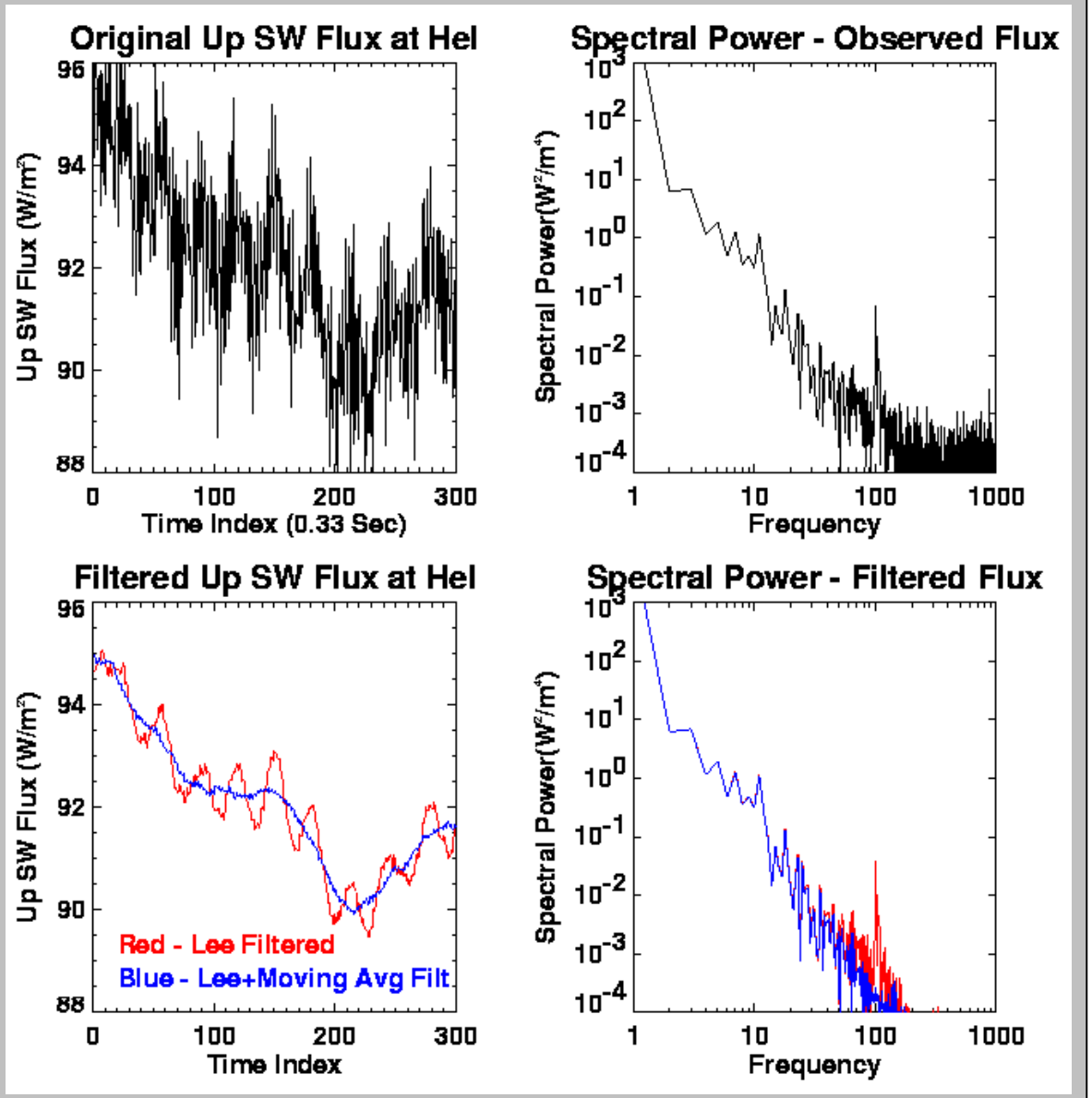


First 300 Observations Of SW Flux, Aug 18, 1998, Flight #1.

Original measured flux includes noise from electronics and helicopter motion (fugoid).

"Lee" filter is used to remove electronic noise.

"Moving Average" filter is used to remove noise from fugoid motion.



Modeling to retrieve surface albedos from helicopter observations.

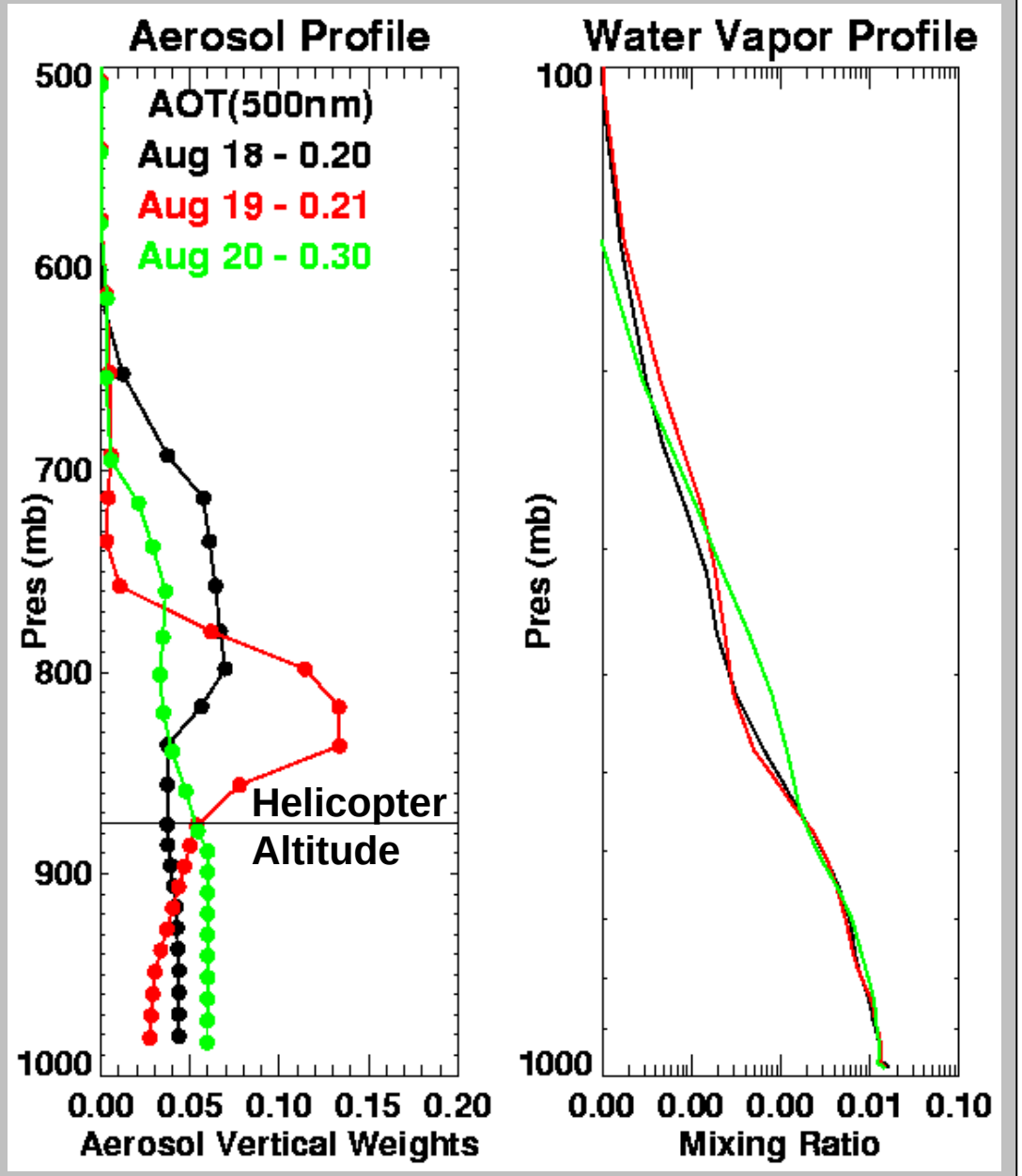
- Temperature, Water vapor, height, from GOES/AERI, ozone from MOA.
- Gulfstream in-situ measurements (Kato et al. 2000) of total extinction give vertical profile of weights to distribute AERONET Cimel spectral aerosol optical depths.
- Assume aerosol is 95% continental, 5% soot
- Use Fu & Liou to derive surface albedo.
  - Input initial guess of surface albedo.
  - Assume we know the aerosol.
  - Tune surface albedo so that model flux equals that measured by the helicopter
- Compare modeled fluxes
  - Surface with ARM/E13 Central Facility observations
  - TOA with CERES Observation

Then compare areal average of derived surface albedo with CERES/SARB CRS surface albedo.

This Ed 2B used **old** Fu-Liou and **no** surface data.

Vertical weight profiles were developed using in-situ observations of total extinction taken by the Gulfstream aircraft on Aug 18, 19, and 20. Aerosol optical depth measured by AERONET cimel sun-photometer is then distributed vertically using these profiles.

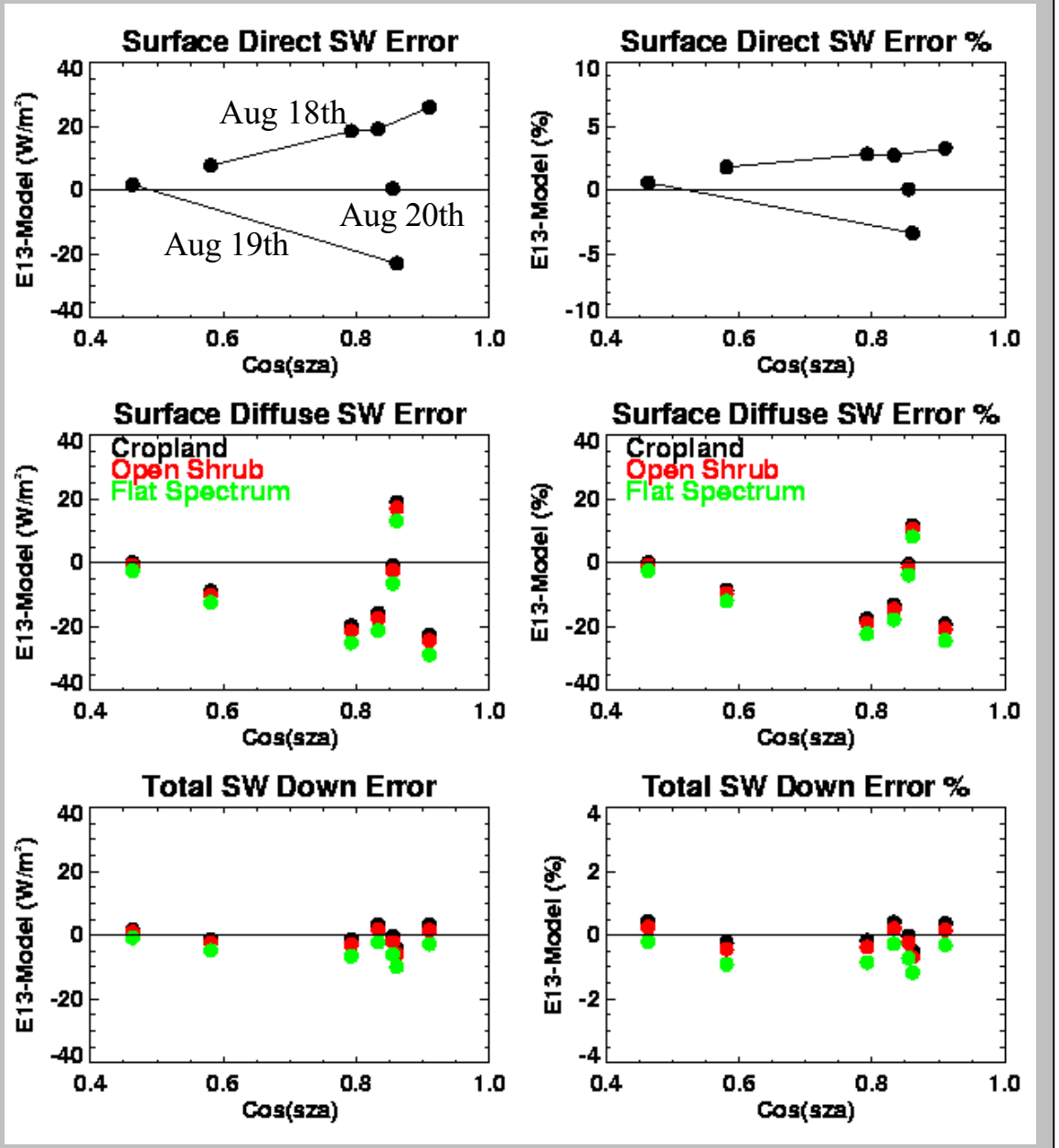
Weight profiles show that on the 18th and 19th most of the aerosol was above the level of the helicopter.

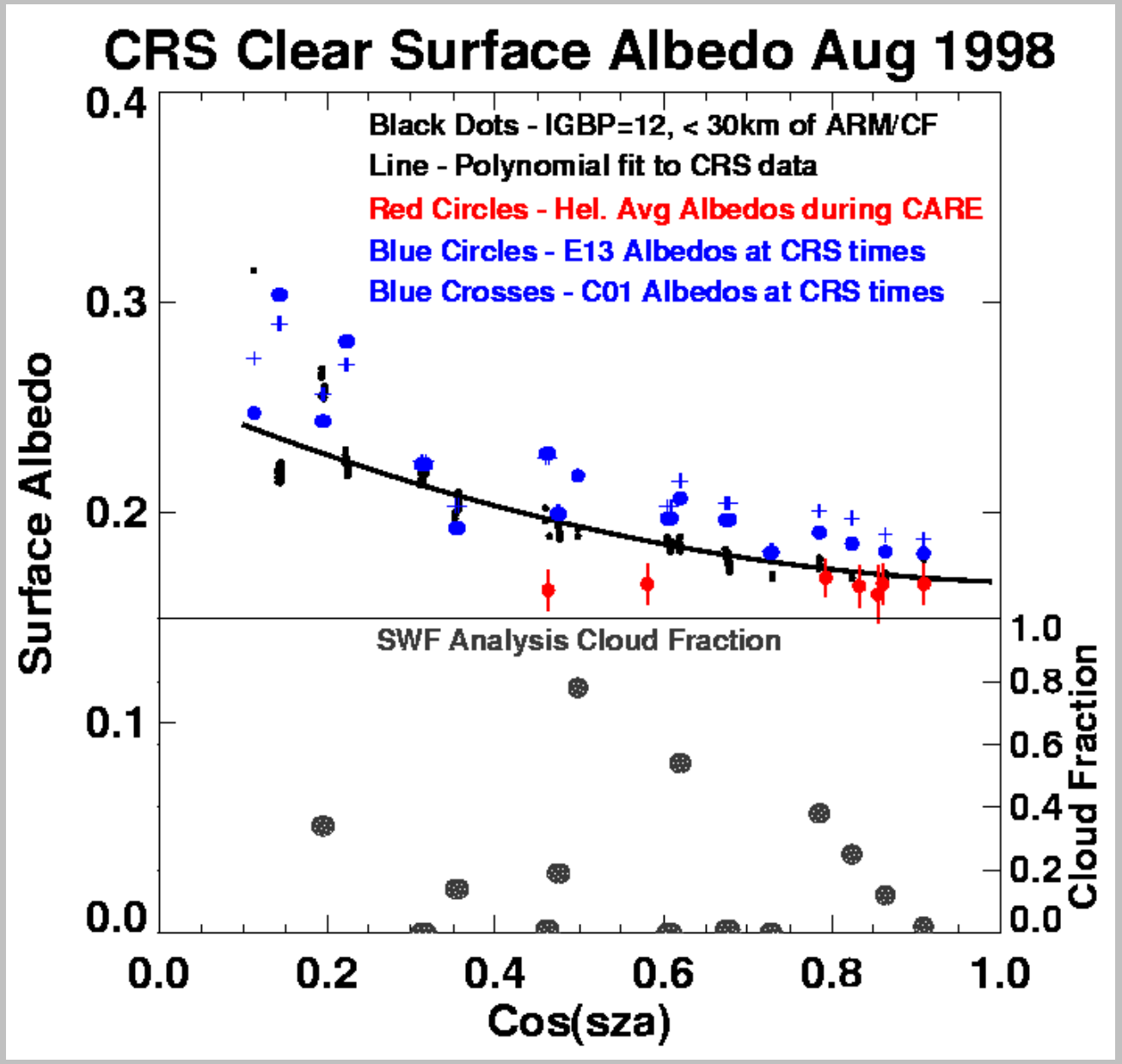


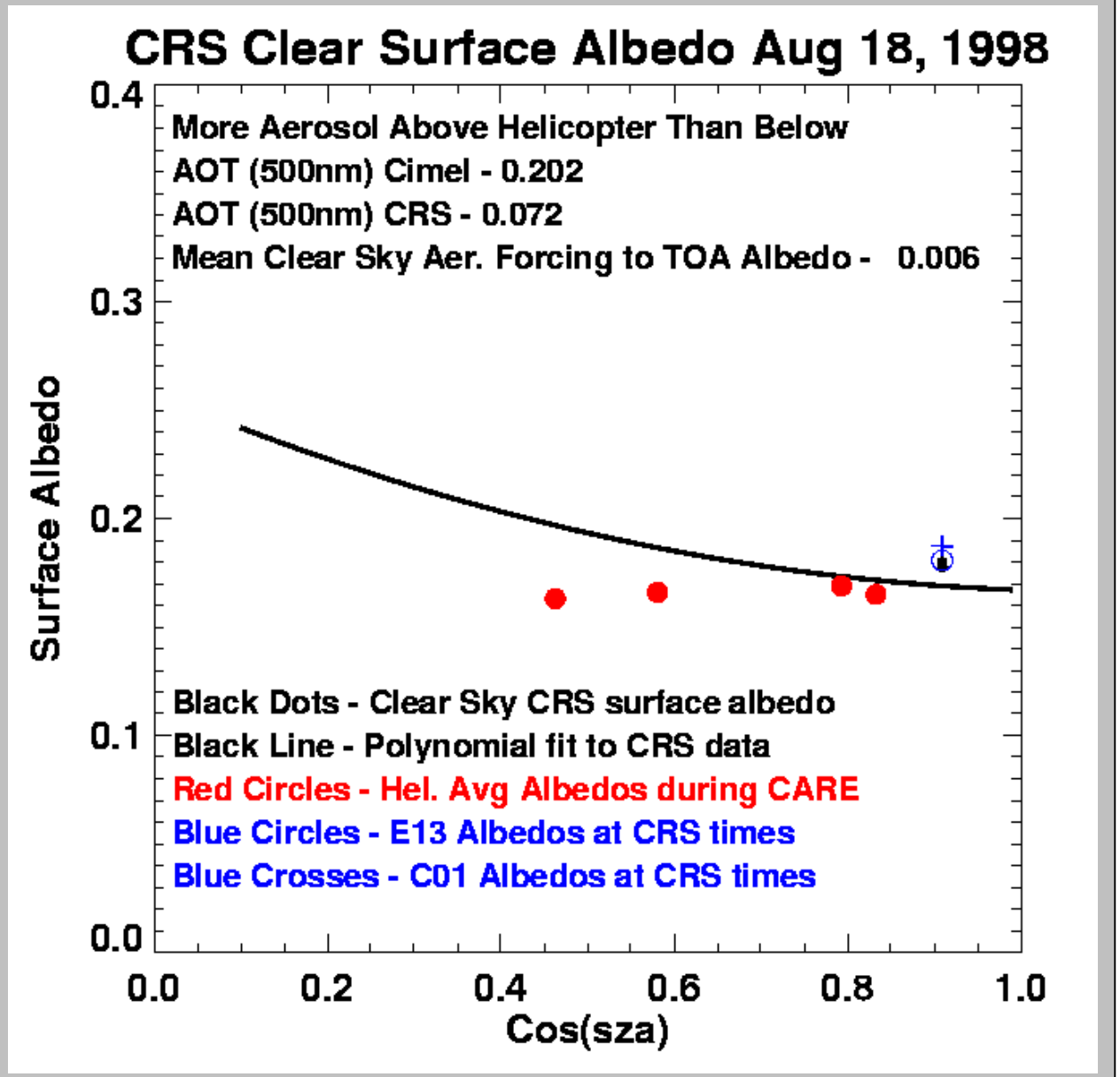
The model is run for three spectral albedo shapes, “cropland”, “open shrub” and a flat spectral shape.

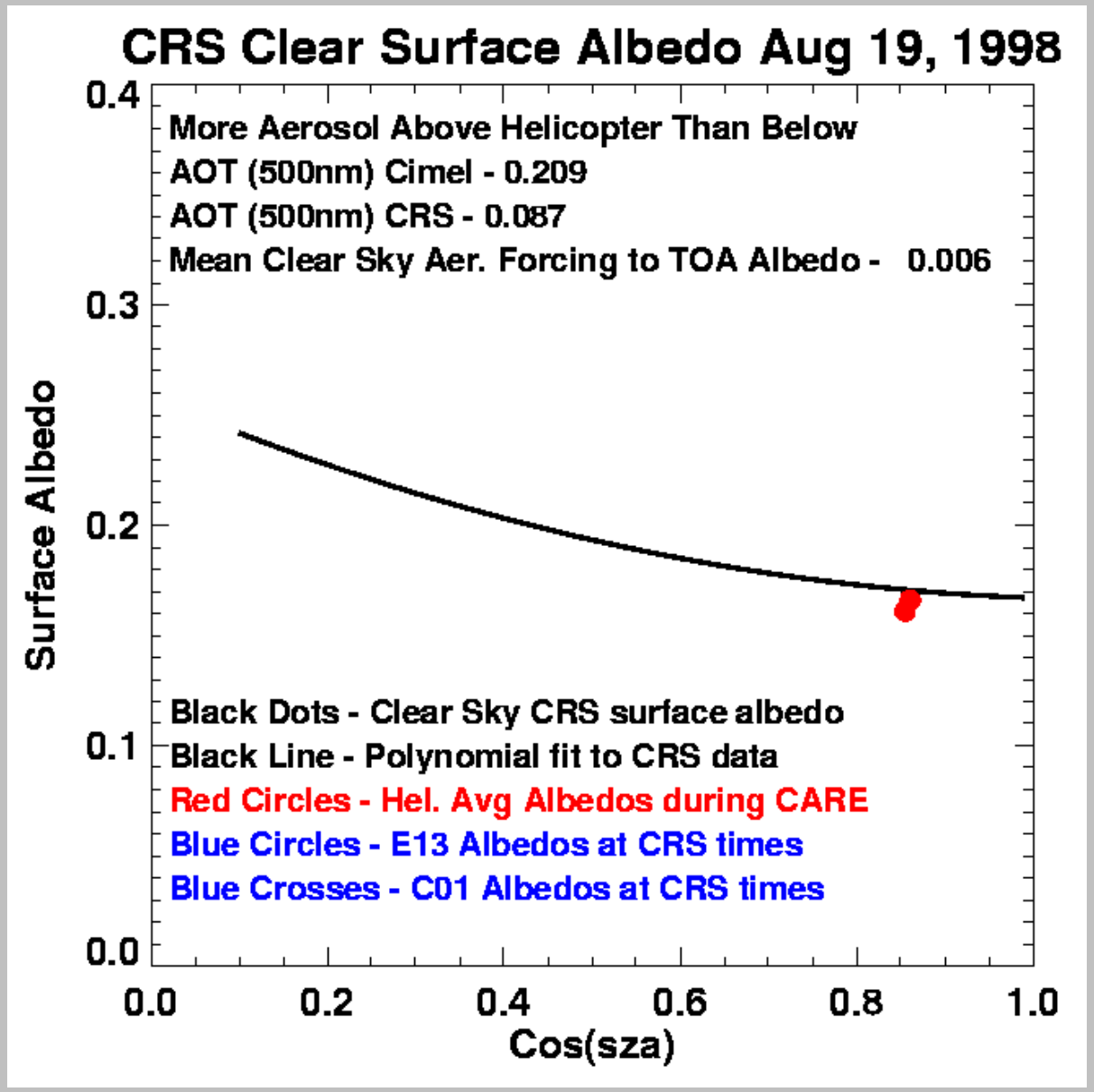
In each case as the helicopter flies over different scenes the model is run, then surface albedo is adjusted so that model flux at helicopter altitude matches the helicopter observed flux.

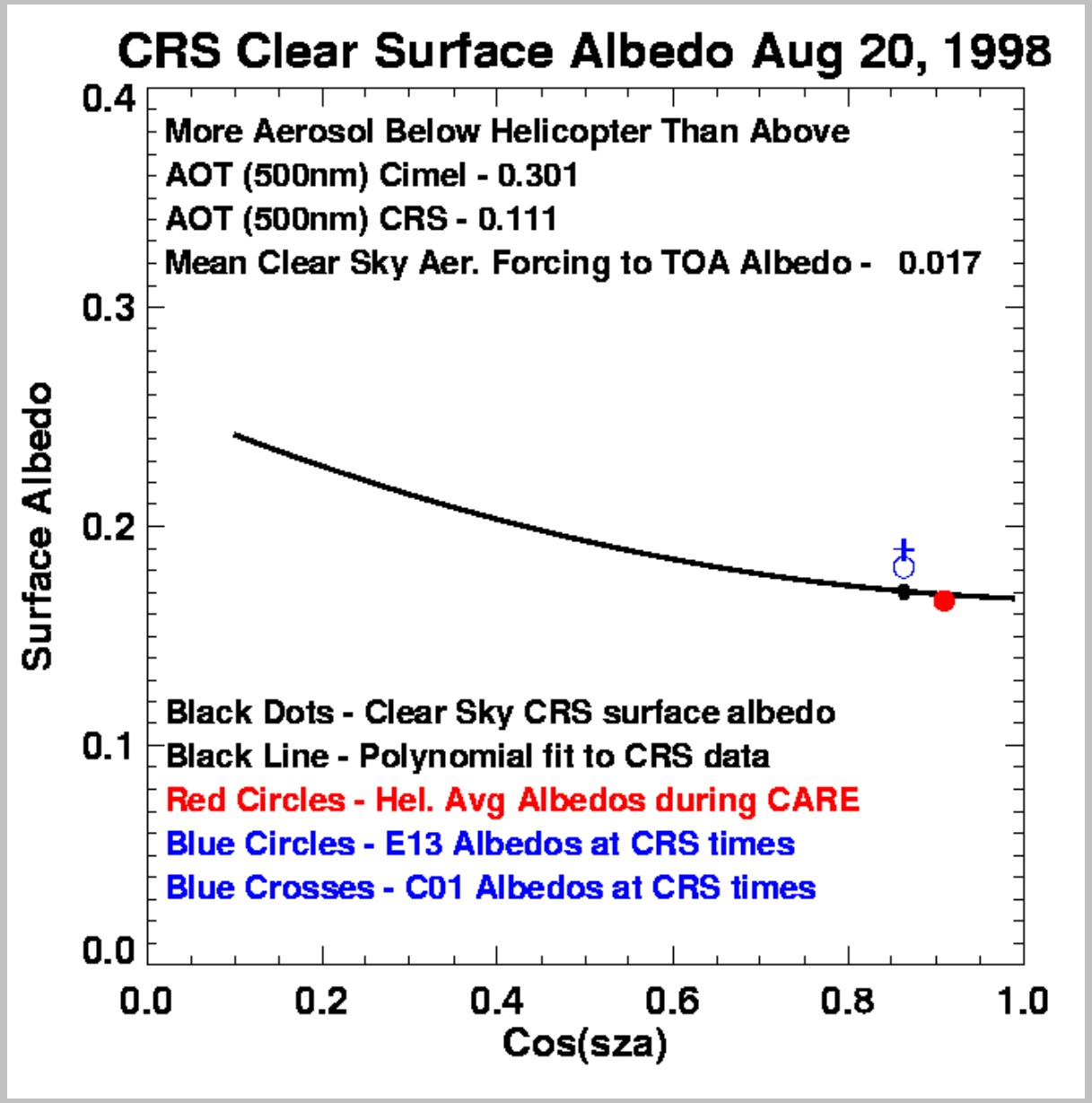
When the helicopter is directly over the ARM/SGP central facility model results are compared to observations. (These results are shown left.)




CRS Clear Surface Albedo Aug 1998
Black Dots - IGBP=12, < 30km of ARM/CF
Line - Polynomial fit to CRS data
Red Circles - Hel. Avg Albedos during CARE
Blue Circles - E13 Albedos at CRS times
Blue Crosses - C01 Albedos at CRS times
SWF Analysis Cloud Fraction
Surface Albedo
Cloud Fraction
Cos(sza)
0.0
0.1
0.2
0.3
0.4
0.6
0.8
1.0


CRS Clear Surface Albedo Aug 18, 1998
More Aerosol Above Helicopter Than Below
AOT (500nm) Cimel - 0.202
AOT (500nm) CRS - 0.072
Mean Clear Sky Aer. Forcing to TOA Albedo - 0.006
Black Dots - Clear Sky CRS surface albedo
Black Line - Polynomial fit to CRS data
Red Circles - Hel. Avg Albedos during CARE
Blue Circles - E13 Albedos at CRS times
Blue Crosses - C01 Albedos at CRS times
Surface Albedo
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
Cos(sza)


CRS Clear Surface Albedo Aug 19, 1998
More Aerosol Above Helicopter Than Below
AOT (500nm) Cimel - 0.209
AOT (500nm) CRS - 0.087
Mean Clear Sky Aer. Forcing to TOA Albedo - 0.006
Black Dots - Clear Sky CRS surface albedo
Black Line - Polynomial fit to CRS data
Red Circles - Hel. Avg Albedos during CARE
Blue Circles - E13 Albedos at CRS times
Blue Crosses - C01 Albedos at CRS times
Surface Albedo
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
Cos(sza)


CRS Clear Surface Albedo Aug 20, 1998
More Aerosol Below Helicopter Than Above
AOT (500nm) Cimel - 0.301
AOT (500nm) CRS - 0.111
Mean Clear Sky Aer. Forcing to TOA Albedo - 0.017
Black Dots - Clear Sky CRS surface albedo
Black Line - Polynomial fit to CRS data
Red Circles - Hel. Avg Albedos during CARE
Blue Circles - E13 Albedos at CRS times
Blue Crosses - C01 Albedos at CRS times
Surface Albedo
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
1.0
Cos(sza)

Helicopter survey of surface albedo near SGP Central Facility

- Aug. 18-19-20, 1998
- cosSZA ~0.45-0.9
- Samples span small fraction of typical CERES footprint

Processed with new code that matches surface insolation better

- Albedo product corrected for aerosol below helicopter
- Spatial variation mostly within +/- 0.02

Helicopter albedos < tower albedos at C01 and E13

Similar diurnal variation of CRS Ed 2B and C01, E13 albedos

Negligible diurnal variation in helicopter albedo.

- *Not yet compared with tower albedo on same dates as flights.*