Field Report 3rd Surface Albedo IOP

Southern Great Plains (SGP) CART site

February 8-12, 2004

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Objectives:			
5	1)	To conduct measurements of surface spectral albedo and bi-directional properties for typical conditions in the end of winter (mid-February),	
	2)	To conduct survey of surface types distribution in the SGP area;	
	3)	To collect and process clear-sky satellite observations for the period of IOP;	
	4)	To combine satellite and ground observations and produce spatial map of surface spectral and angular properties suitable for radiative transfer modeling and other environmental applications;	
	5)	Provide data to the ARM archive.	
Instrumentation:		 ASD FieldSpec Pro spectro-radiometer (0.35–2.5 μm, 1.5 nm resolution) TRAC – PAR radiometer (Photosynthetically Active Radiation: 0.4–0.7 μm) 	

Day 1. February 8, 2004.

Sky-conditions: Partly cloudy conditions (cloudiness 0-20%), long intervals of clear skies, occasional thin Ci clouds. (Fig. 1)

Surface conditions: Few centimeters of snow on the surface. Surface covered by tall vegetation appear almost snow-free (Fig. 2), either due to vegetation hiding effect or snow melt, surface with short vegetation seen as continuous snow covered fields (Fig. 3).





Fig. 2. Snow free surface on Feb 8.

Measurements and results: Measurements have been collected by ASD FieldSpec and PAR radiometer* at the CF site near 10m tower (cf10m, dry grass) and 60m tower (cf60m, wheat field). Surface condition at cf10m is shown in Fig. 4. A set of observed spectral curves measured at cf10m is presented in Fig. 5.

Spectra obtained for wheat field at cf60m are shown in Fig. 6. Corresponding surface conditions are shown in Fig. 7 (in the morning) and Fig. 8 (in the afternoon). It's seen that even for fully snow covered vegetation, NDVI is not equal to 1 (black colored curve in Fig. 6).



Fig. 3. Snow covered wheat field at CF.

Fig. 4. Surface condition for dry grass near CF10m.

^{*} On all figures, the albedo observed by PAR will be shown as horizontal segments (covering effective bandwidth of PAR) with vertical error bars showing the standard deviation of the data within a series. As a reference, spectral albedo observed by MFR at 10m tower (dry grass) and 60m tower (wheat field) will also be plotted as open circles.



Fig. 5 Several spectra observed for dry grass with snow at CF10m.



Fig. 6. Spectra observed for wheat covered with snow.



Fig. 7. Wheat field near CF60m, a.m.

Fig. 8. Wheat field near CF60m, p.m.

Day 2. February 9, 2004

Sky conditions: Partly cloudy (cloudiness 0-15%). Presence of thin Ci (Fig.8). Presence of clouds may have contamination effect of albedo measurements. To significant extent Ci were from high-flying aircraft contrails.

Surface conditions: Snow has been rapidly melting during the day and disappeared for the most of the area by the end of day (Fig. 14), except for very smooth surfaces.

Measurements: Measurements have been taken by ASD FieldSpec and PAR radiometer over several location at the CF and surrounding fields.

Spectra for dry grass are shown in Fig. 9.

Spectra for various wheat fields are shown in Fig. 10, Fig. 11, Fig. 12.

Comparison of all spectra is shown in Fig. 13.



Fig. 9. Several spectra measured for dry grass with snow near CF-10m on Feb/09/2004.



Fig. 10. Spectra measured for wheat field at the east side of CF.







Spectra measured for wheat field near 60m tower. Fig. 12.



Fig. 13. Summary of all spectra measured on Feb/09/2004.



Fig. 14. Surface condition at CF10m on Feb 08.



Fig. 15. Surface condition at CF60m on Feb 09.



Fig. 16 Wheat field at CF entrance (near the gates).



Fig. 18 Grassland near AOS.



Fig. 17 Wheat field east of CF.

- 1. Grass near 10m tower (still partly covered by snow): Fig. 14.
- 2. Wheat field at 60m tower (almost snow free): Fig. 15.
- 3. Wheat field near the CF entrance (snow free): Fig. 16.
- 4. Wheat field just outside CF (in the East direction): Fig. 17.
- 5. Pasture/grassland near AOS : Spectral Albedo Fig. 18.

Day 3. February 10, 2004

Sky-conditions in the morning: Perfect clear-skies, with occasional Ci near horizon, very far from direction toward the sun. Ci clouds were slowly moving from south to north, but have never blocked direct beam. Good clear-sky for entire day.

Surface conditions: Snow has melted almost entirely over the area. Measurements have been conducted over snow-free surfaces. Summary of albedo spectra is shown in Fig. 21

1. Measurements at the CF 10m tower location. In general no snow, but small snow spots were present in the shadow of tall grass (Fig. 19).



Fig. 19 Snow remaining on dry grass.

Fig. 20 Field with baresoil.

Spectral albedo and BRDF measurements. Location close to road may have some impact, but in general quality should be acceptable. (Some surface inhomogenity may contribute to data scattering). PAR radiometer measurements: point and transect.

2. Baresoil for low sun condition (Fig. 20).

The measured spectra with overlapped PAR data and MFRSR 10m data are shown in Fig. 21.



Fig. 21 Albedo spectra measured for baresoil and dry grass near cf10m.



Fig. 22 Wheat field near CF60m on Feb 10.

Fig. 23 Field with corn stocks.

- 3. Measurements of the wheat field near 60m tower. No snow (Fig. 22). Green short wheat plants. Spectral albedo, spectral BRDF and PAR radiometer measurements. Good clear-sky conditions.
- 4. PAR radiometer over short grass near the gate to 60m field and over pasture.
- 5. Field with corn stocks. Surface covered by pieces of corn plants (Fig. 23). Surface albedo, BRDF and PAR measurements. For BRDF measurements there is certain sensitivity of calibration (appearance of jumps at the boundaries of spectral bands when moving detector from one position to another).





Fig. 24 Albedo spectra measured on Feb 10 for the wheat field and corn stocks.

Day 4. February 11, 2004

Sky conditions: Overcast cloudy skies and variable optical depth so that solar flux may fluctuate significantly.

Surface conditions: similar to day before February, 10, 2004. Snow has disappeared for the most of the area, with small spots left in the shadow.

Measurements:

- 1. Grass short near the gate to the wheat field with 60m tower (Fig. 26).
- 2. Pasture on the other side of road (3 spots, 2nd spot had reddish color, Fig. 27). Spectral albedo and PAR.
- 3. Grass around 10 meter towers: two spots near the road and between towers . Cloud Optical depth fluctuations lead to quite strong fluctuations of solar flux.
- 4. Pasture with cuffs (Fig. 29). Quite similar to CF 10m spot but more uniform. PAR and Spectral albedo. Overcast cloudy conditions.

Summary of albedo spectra for these types of grass is shown in Fig. 25.



Fig. 25 Summary of albedo spectra for various types of grass.



Fig. 26 Grass near AOS.

Fig. 27 Grass spot with reddish color.





Fig. 30 Albedo spectra of wheat near CF60m and the wheat field far east of CF.

- 5. Spectral albedo (Fig. 30) for wheat field near 60 m tower (Fig. 31) under overcast conditions.
- 6. PAR and Spectral albedo over wheat (far east of CF, corner turn to Ponca City) (Fig. 32).
- 7. Land cover types distribution survey in the eastern part of area.



Fig. 31 Wheat field near CF60m.

Fig. 32 Wheat field far east of CF.

Day 5. February 12, 2004.

Sky conditions: Scattered clouds. Cold and windy. Good clear-sky conditions afternoon Surface conditions: Frozen snow free surface.

Measurements taken:

1. Spectral albedo, BRDF and PAR measurements of the wheat field around 60m tower (Fig. 33). MFR should have provided synchronous measurement for the wheat field near 60m tower. MFR was down partially of Monday, completely on Tuesday. It should be working on Wednesday but Wednesday was overcast unstable conditions. As such we may have range of measurements over wheat field 60m during snow covered and snow-free conditions.

- 2. Wheat stubbles, road to hwy 60 (Fig. 34). PAR and spectral albedo.
- 3. PAR and Spectral albedo over baresoil with planted wheat (just started to grow, muddy road south of CF) (Fig. 35).
- 4. PAR and Spectral albedo (Fig. 36) over wheat field far east of CF (at the turn/corner second point, 1st one was on Wednesday on the other side of the field).
- 5. PAR measurements over the field with corn stocks and wheat stubbles.

Summary of albedo spectra measured for these fields is shown in Fig. 37.



Fig. 33 Wheat field near CF60m.



Fig. 34 Wheat stubbles.



Fig. 35 Young wheat on reddish soil.

Fig. 36 Wheat field far east of CF.



Fig. 37 Summary of spectra measured for various wheat fields on Feb. 12.

- 6. Measurements over baresoil field (Fig. 38). Spectral albedo and PAR.
- 7. PAR measurements over wheat field across the road to bare soil.
- 8. PAR measurements over the ice-covered pool in the wheat field.
- 9. PAR and spectral albedo of the field with tall corn stocks (Fig. 40) and wheat stubbles.
- 10. CF 10 m towers spectral albedo and PAR over dry grass (Fig. 39)
- 11. PAR of the short grass lawn near the gate to 60m tower
- 12. PAR of the pasture on the other side of the road at CF location

Summary of albedo spectra measured for these

fields is shown in Fig. 37.

Fig. 38 Baresoil field.



Fig. 40 Corn stocks.

Fig. 39 Grass near CF10m.



Fig. 41 Summary of albedo spectra measured on Feb 12.