# Field Report

4th Surface Albedo IOP

Southern Great Plains (SGP) CART site

October 20-26, 2004

Lead Scientist: Alexander P. Trishchenko, Canada Centre for Remote Sensing,
trichtch@ccrs.nrcan.gc.ca

Participants: Y. Luo, Canada Centre for Remote Sensing
K. Khlopenkov, Canada Centre for Remote Sensing
Maureen Cribb, University of Maryland

Objectives:

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:
1) ASD FieldSpec Pro spectro-radiometer (0.35–2.5 μm, 1.5 nm resolution)
2) TRAC – PAR radiometer (Photosynthetically Active Radiation: 0.4–0.7 μm)

## *Day 1. October 20, 2004.*

**Sky-conditions**: Cloud overcast conditions (cloudiness 100%), changing to partly cloudy in the afternoon (Fig. 1). Presence of clouds may have contamination effect of albedo measurements.
**Surface conditions**: In the morning, small amount of dew was observed on the vegetation. It had completely dried out by noon.

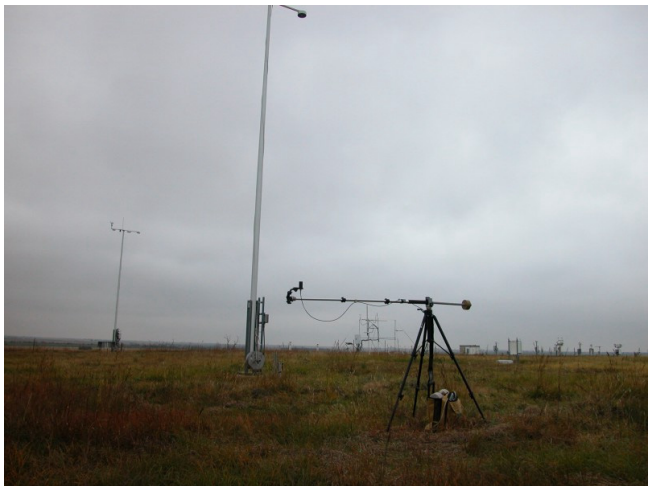

**Fig. 1. Cloud overcast conditions.**

**Fig. 2. Grass around CF10m tower.**

**Measurements and results:** Measurements have been taken by ASD FieldSpec and PAR. Surface condition at cf10m is shown in (Fig. 2). The vegetation consists of the mixture of green and dry grass. One spot near the CF10m has more reddish type of grass (Fig. 3).
In the afternoon, the measurements have also been taken at CO2 flux measurement site (south from CF). The landcover type for that area is yellowish grass (Fig. 4). A set of observed spectral curves measured for these types of grass is presented in Fig. 5.

**Fig. 3. Reddish grass near CF10m.**

**Fig. 4. Yellow grass at $CO_2$ flux measurement site.**

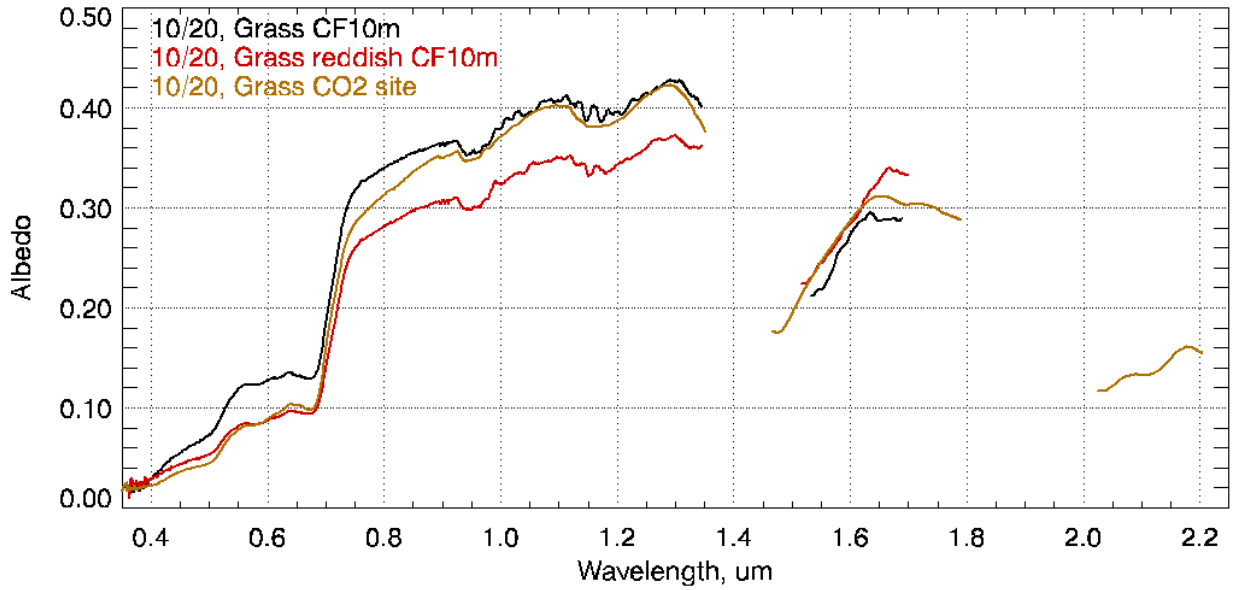


**Fig. 5 Surface albedo spectra observed for various types of grass on Oct 20, 2004.**

In the afternoon, spectra have also been measured for the wheat field at cf60m. At this time of the year, the landcover appears as baresoil with some newly appearing wheat sprouts. The surface condition is shown in Fig. 6. Some areas of that field appear more green (see for example Fig. 7).

Later in the afternoon, the albedo spectra have also been measured at the $CO_2$ flux measurement site located east from CF. The vegetation type for that field is matured milo (see Fig. 8).

Summary of the obtained spectra is shown in Fig. 9.

**Fig. 6. Wheat field (baresoil) at CF60m tower.**

**Fig. 7. Baresoil with more wheat at CF60m.**

**Fig. 8. Milo field near the $CO_2$ site west from CF.**

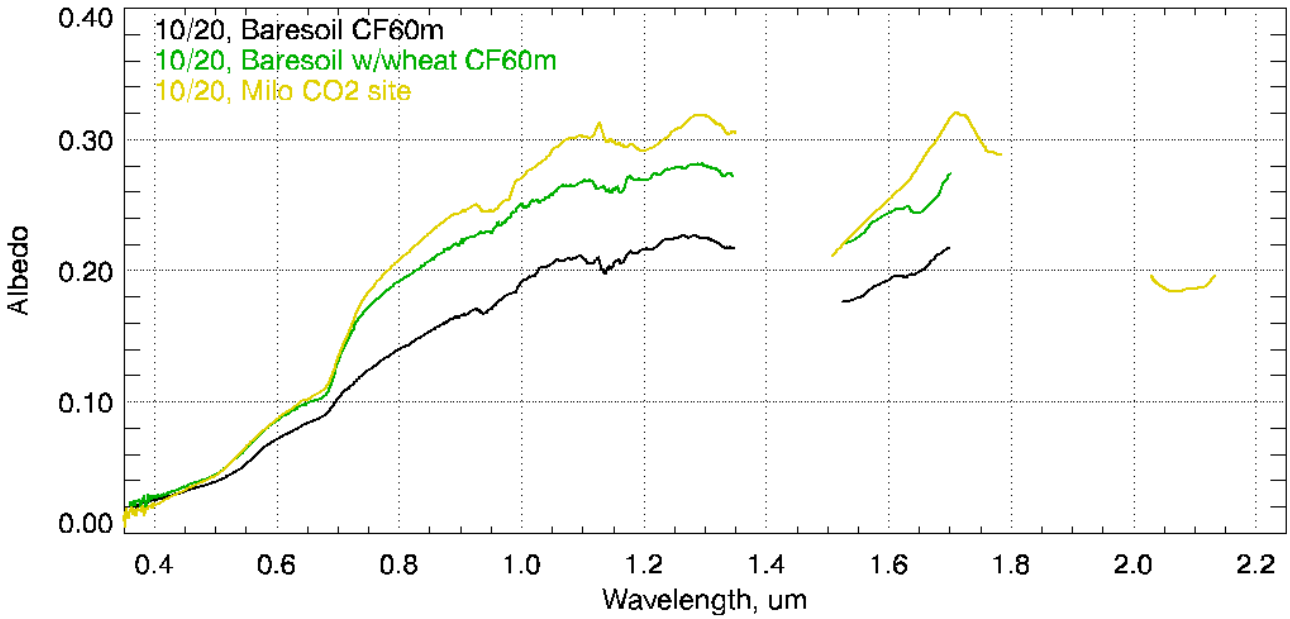


**Fig. 9. Several spectra measured for baresoil near CF-60m and milo at $CO_2$ site on Oct. 20, 2004.**

## *Day 2. October 21, 2004*

**Fig. 10. Foggy condition in the morning at CF-10m.**

**Sky conditions**: Heavy fog in the morning. Slowly changing to partly cloudy at noon. Light conditions were very unstable, which prevented us from taking the reliable measurements of surface albedo in the morning.
**Measurements**: Measurements have been taken by ASD FieldSpec and PAR radiometer over several locations at the CF and surrounding fields including $CO_2$ milo site (Fig. 11).
The surface conditions at the milo field is shown in Fig. 12.
The spectra have also been measured at one of wheat fields south from CF, which was a typical representative of the landcover for that season (See Fig. 13), as well as for the grass field at $CO_2$ site.

**Fig. 11. $CO_2$ site west from CF.**

**Fig. 12. Milo field near the CO2 site west from CF.**

**Fig. 13. Typical wheat field south from CF.**

**Fig. 14. Yellow grass at $CO_2$ site.**

Later in the afternoon, the spectra were measured at the baresoil field near CF60m (See Fig. 15).
Summary of the all albedo spectra obtained on October 21 are shown in Fig. 16.

**Fig. 15 Wheat field at CF60m.**

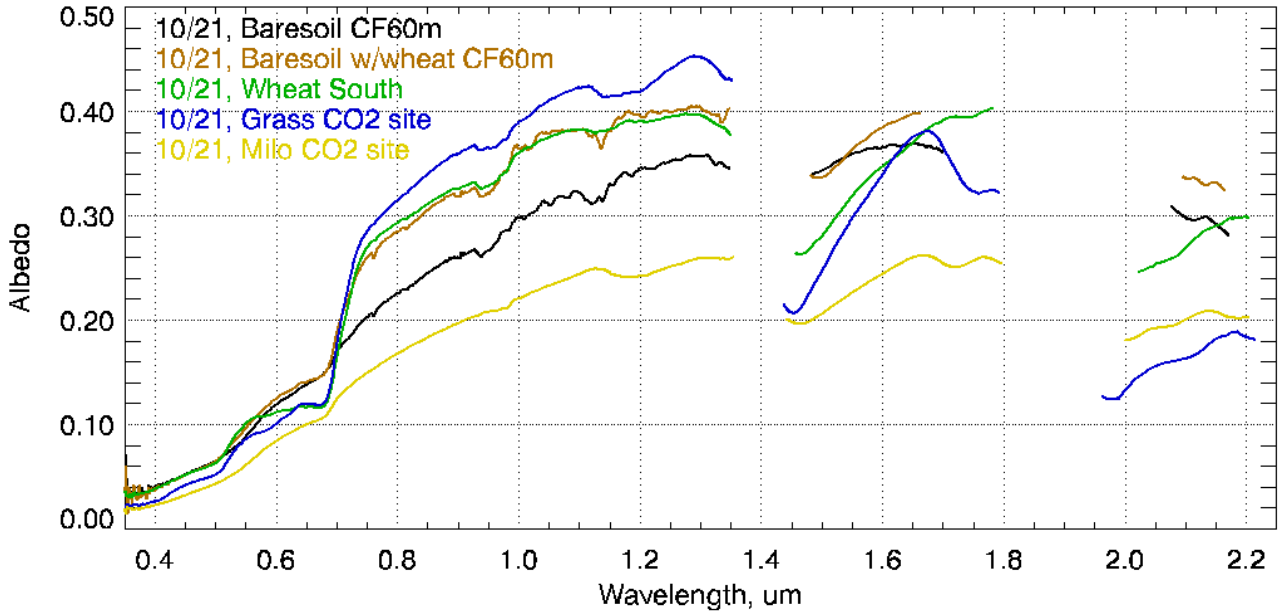


**Fig. 16 Albedo spectra measured for various landcover types on Oct. 21.**

## *Day 3. October 22, 2004*

During that day it was raining most of the day. The main activity was aimed at conducting the field survey for the surrounding areas. We had completed the field survey for almost the whole area around CF (11x8 miles), except for the regions along the river from the north side, and the south-west corner of the area.

## *Day 4. October 23, 2004*

**Sky conditions**: Mostly sunny for the whole day, with minor clouds in early morning.
The albedo spectra were measured for the following grass fields:

1. Grass near 10m tower (gray and red): Fig. 17.
2. Three types of grass at CO2 site: yellow, dominant (Fig. 18), white (Fig. 19), and green (Fig. 20).

The summary of the albedo spectra obtained for these five types of grass is shown in Fig. 21.

**Fig. 17 Pasture at CF10m.**

**Fig. 18 Yellow grass at $CO_2$ site.**

**Fig. 19 White grass at $CO_2$ site.**

**Fig. 20. Green grass at $CO_2$ site.**

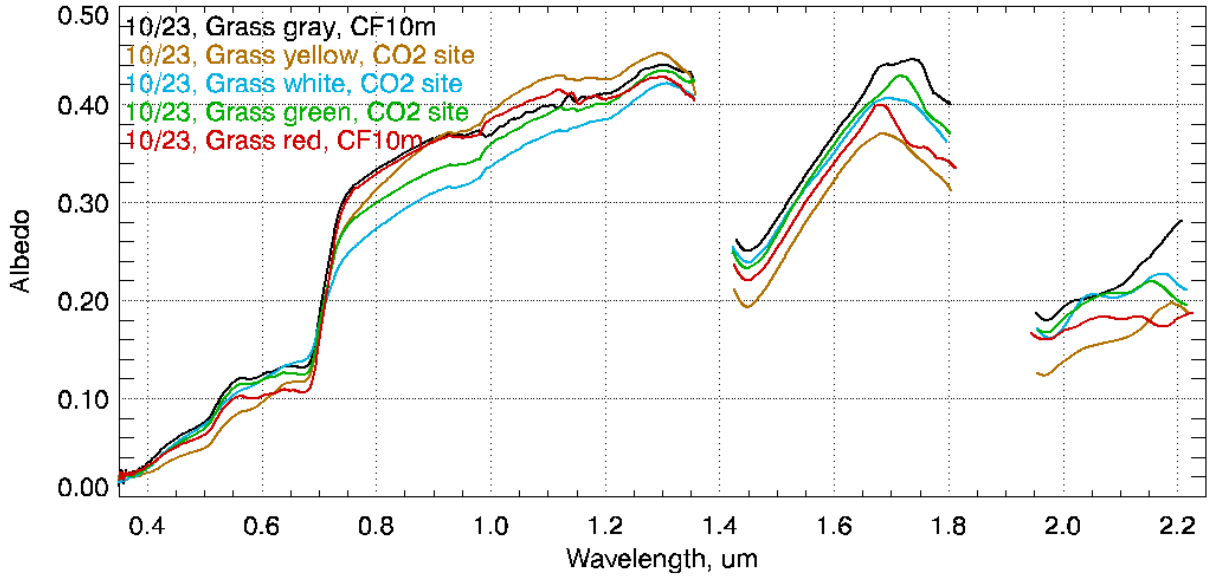


**Fig. 21 Albedo spectra measured for various grass fields.**

Also, the albedo spectra have been measured for the following cropland fields:

3. Baresoil at CF60m (Fig. 22), as well as the more green area of that field.
4. The wheat field south from CF (Fig. 23).
5. Wheat field with a higher wheat located just west of CF (Fig. 24).
6. Corn stocks at north-west from CF (Fig. 26).
7. Milo at the $CO_2$ site west from CF (Fig. 25).

**Fig. 22 Wheat field near CF60m.**

**Fig. 23 Wheat field south from CF.**

**Fig. 24 Wheat field just west of CF.**

**Fig. 25 Milo field near the $CO_2$ site west from CF.** **Fig. 26 Corn stocks field north-west from CF.**

Summary of the obtained spectra for the cropland fields is shown in Fig. 27.

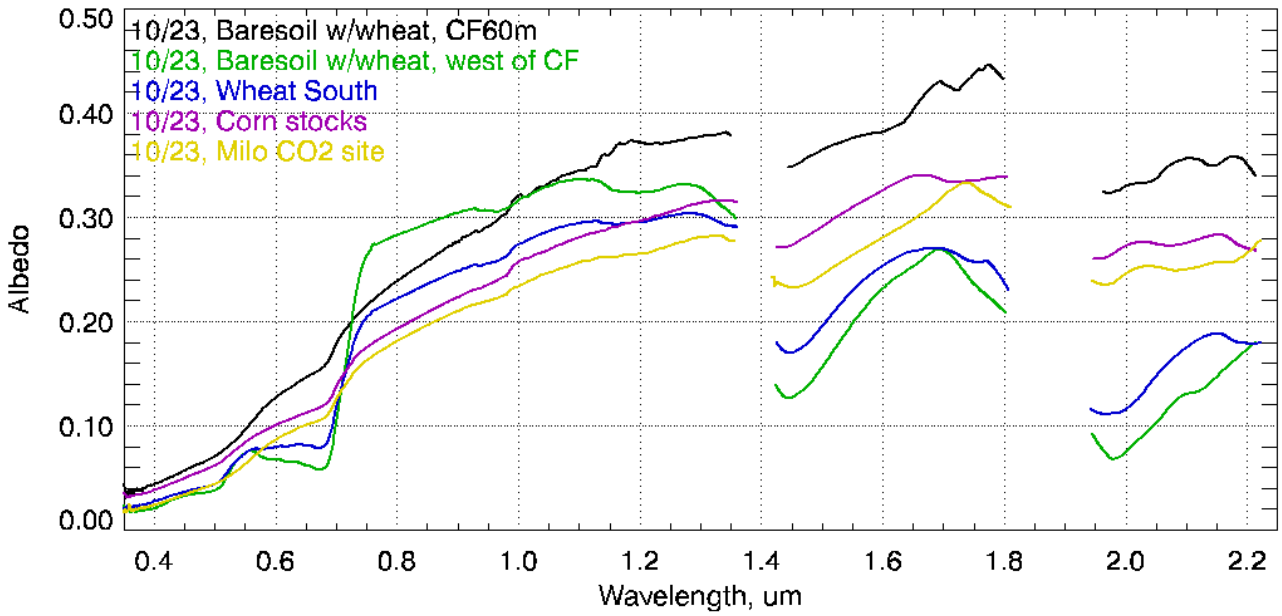


**Fig. 27 Albedo spectra measured on Oct. 23 for various croplands.**

## *Day 5. October 24, 2004*

**Sky conditions**: Sunny for the whole day.
The series of measurements was repeated in general, in order to reproduce the albedo spectra and to take simultaneous measurements with the Terra/ASTER.
The albedo spectra were measured for the following grass fields:

1. Pasture near 10m tower (gray and red grass) (Fig. 28).
2. Grassland at $CO_2$ site. As before, that was the yellow, white and green grass (Fig. 29).

The summary of the albedo spectra obtained for these five types of grass is shown in Fig. 30.

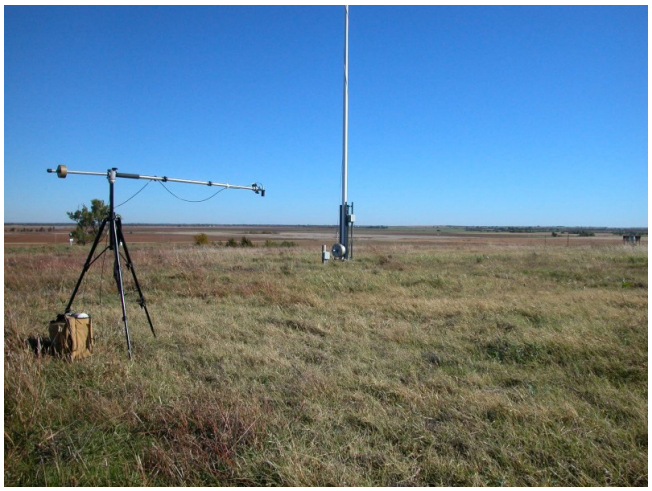

**Fig. 28 Pasture near CF10m tower.**

**Fig. 29 Surface conditions at $CO_2$ grass field.**

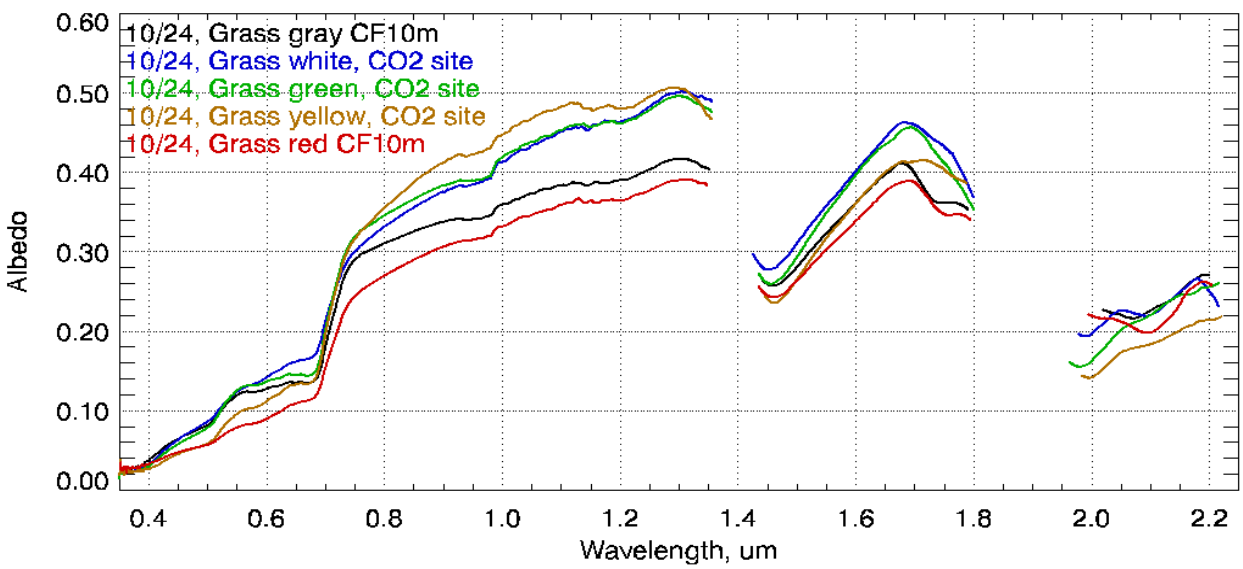


**Fig. 30 Surface albedo spectra measured for pasture at CF10m and $CO_2$ grass field.**

Also, the albedo spectra have been measured for the following cropland fields:

1. Baresoil at CF60m (Fig. 31), as well as the more green area of that field.
2. The wheat field south from CF (Fig. 32).
3. Wheat field with a higher wheat located just west of CF (Fig. 34).
4. Milo at the $CO_2$ site west from CF (Fig. 33).

The summary of the albedo spectra obtained for these croplands is shown in Fig. 35.

**Fig. 31 Wheat field near CF60m.**

**Fig. 32 Wheat field south from CF.**

**Fig. 33 Wheat field just west of CF.**

**Fig. 34 Milo field at the $CO_2$ site.**

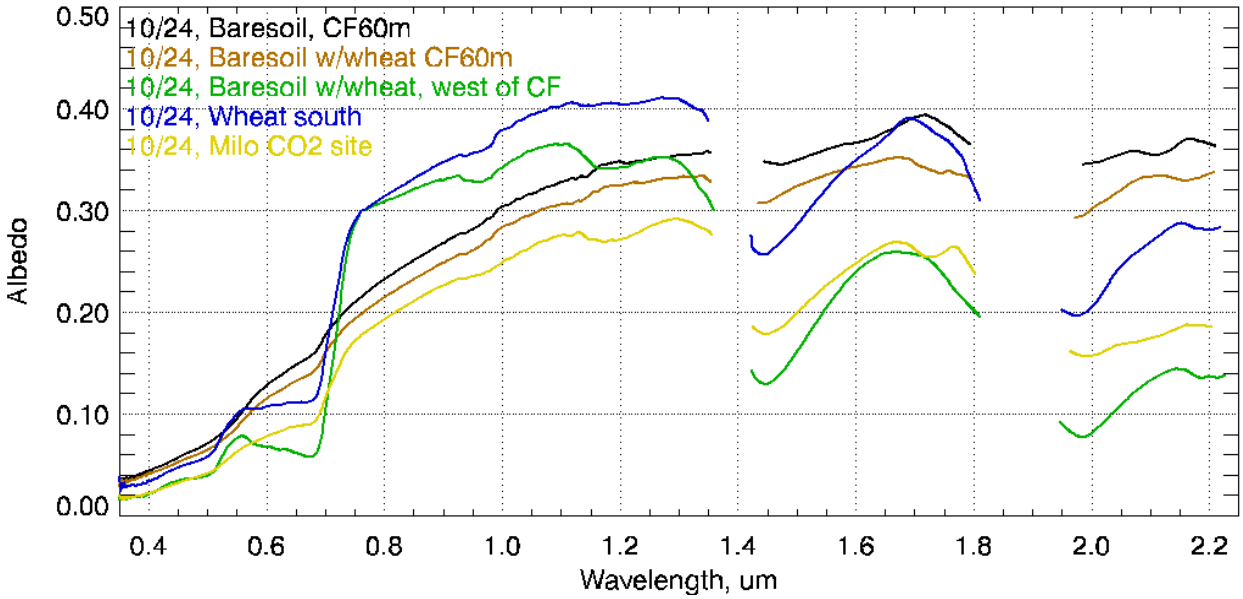


**Fig. 35 Surface albedo spectra measured for croplands on Oct. 24, 2004.**

## *Day 6. October 25, 2004*

Sky conditions: Overcast cloudy skies with light rain in early morning, changing to partly cloudy in the afternoon.

This day was assigned to the visit to the extended observation facilities.

In order to take all the measurements during the high sun conditions within one day, we limited our survey to 4 extended facilities: Tyro (Fig. 36), Elk Falls (Fig. 37), Towanda (Fig. 38), and Ashton (Fig. 38). All of these sites are located on the grasslands, although some differences in the type of grass are present, which can be seen on the pictures.

At Ashton site, the observation equipment is located on a small rectangular area with shorter grass, whereas all the surrounding pasture is covered with a taller dry grass. We took the measurements for both spots, with the spectra curves referred to as Ashton1 (short grass) and Ashton2 (tall grass) in the figure. The summary of the observed spectra is shown in Fig. 40.

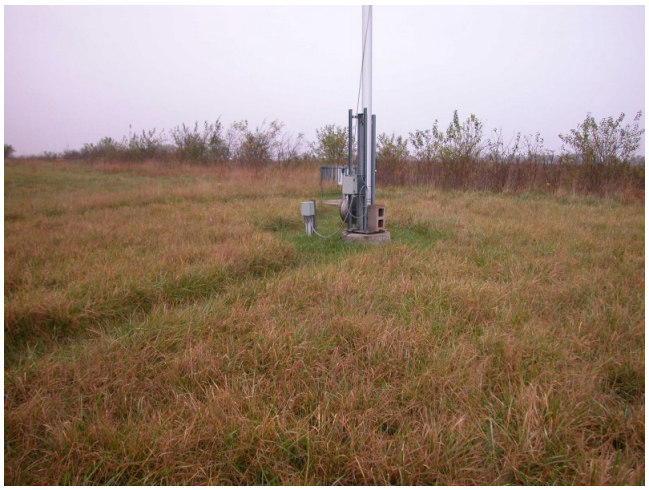

**Fig. 36 Pasture at Extended Facility at Tyro.**

**Fig. 37 Pasture at Extended Facility at Elk Falls.**

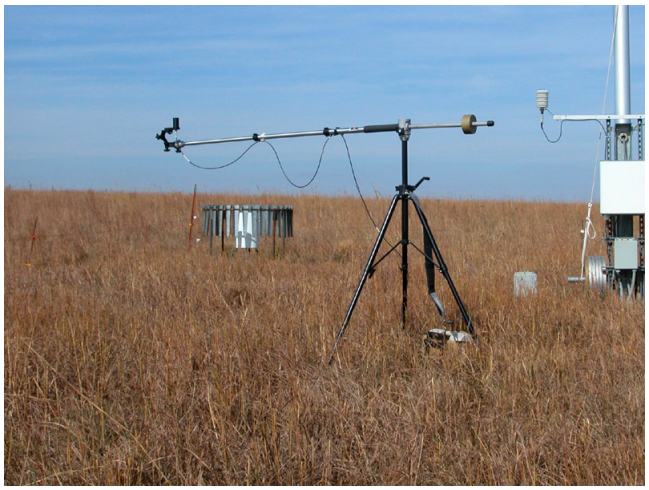

**Fig. 38 Pasture at Extended Facility at Towanda.**

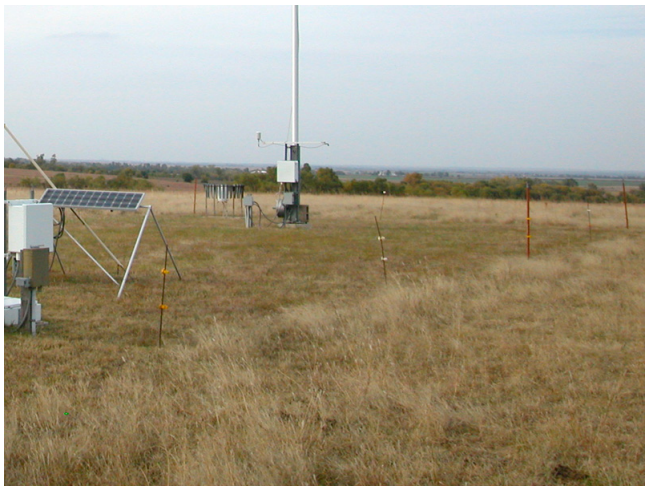

**Fig. 39 Pasture at Extended Facility at Ashton.**

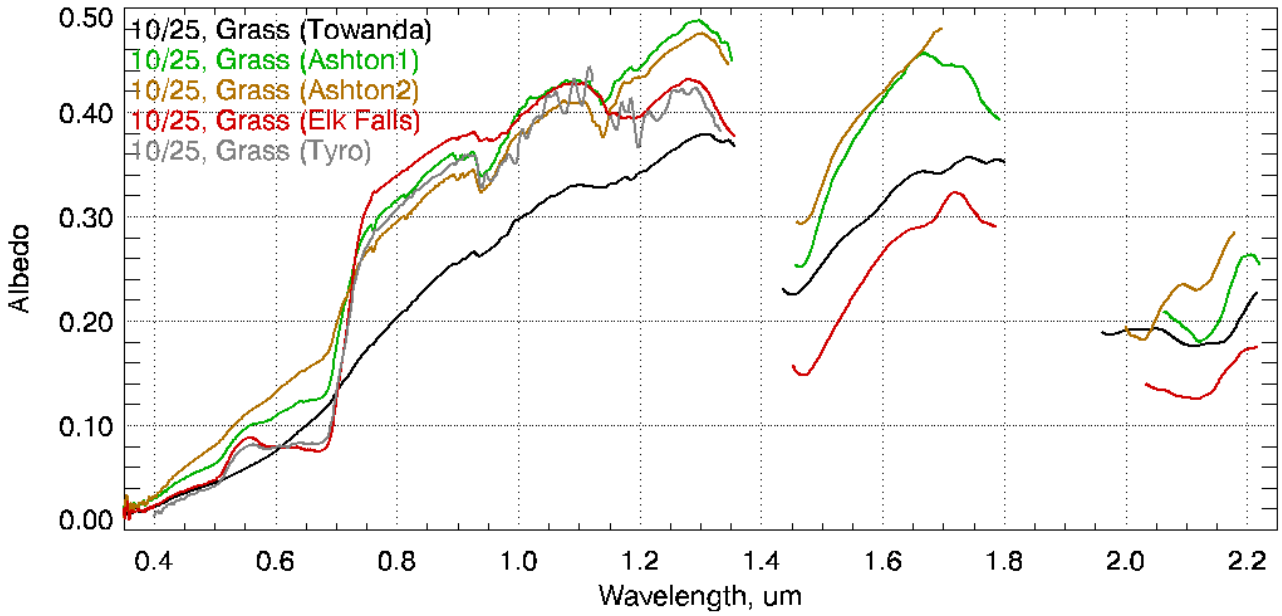


**Fig. 40 Summary of spectra measured for various grasslands at the extended facilities.**

## *Day 7. October 26, 2004.*

Sky conditions: Full overcast skies, with light rain in the morning.

In the morning, we have completed the field survey of the designated area around the CF.

In the afternoon, we have measured the albedo spectra for the following fields:

1. Grass at $CO_2$ site (Yellow grass, tall white grass, and short green grass) (Fig. 41).
2. Pasture at CF10m (Fig. 42).
3. Wheat field at CF60m. Apparently, that field was freshly processed and appeared as the baresoil only (Fig. 43).

Summary of the albedo spectra measured for these fields is shown in Fig. 44.

**Fig. 41 Wheat field near CF60m.**

**Fig. 42 Wheat stubbles.**

**Fig. 43 Baresoil field.**

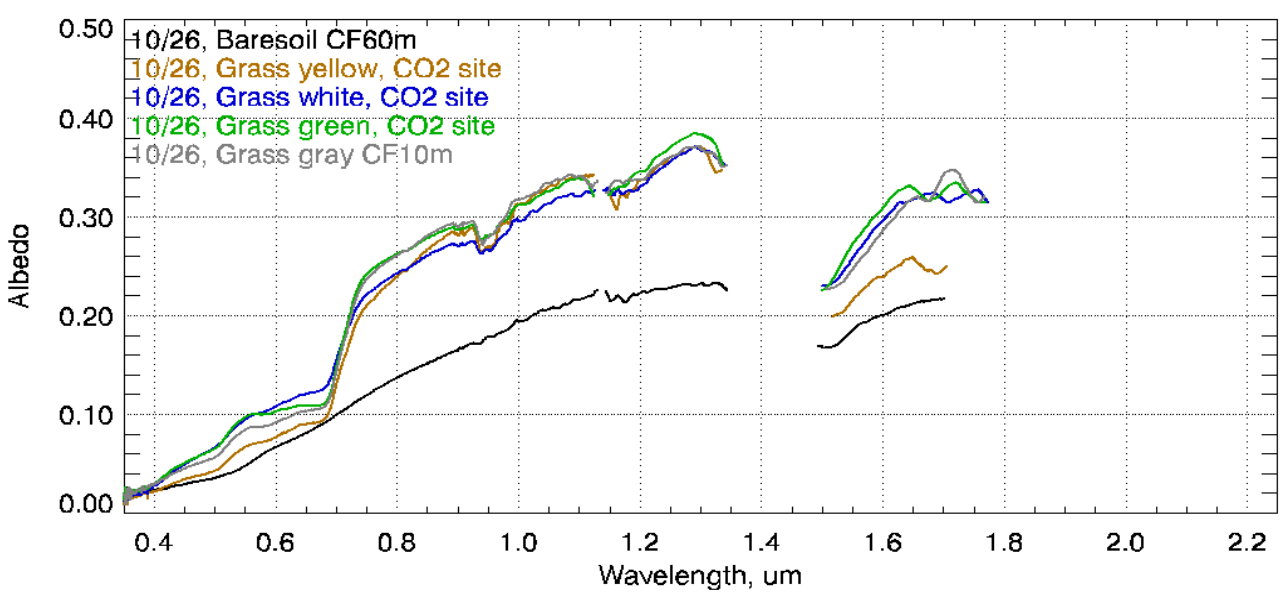


**Fig. 44 Summary of spectra measured on Oct. 26, 2004.**

## *Appendix.*

List of the files of Surface Albedo Spectra produced in the NetCDF format:

1. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Baresoil_CF60m.cdf
2. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Baresoil_w_wheat_CF60m.cdf
3. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Grass_CF10m.cdf
4. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Grass_CO2_site.cdf
5. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Grass_reddish_CF10m.cdf
6. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041020.Milo_CO2_site.cdf
7. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041021.Baresoil_CF60m.cdf
8. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041021.Baresoil_w_wheat_CF60m.cdf
9. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041021.Grass_CO2_site.cdf
10. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041021.Milo_CO2_site.cdf
11. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041021.Wheat_South.cdf
12. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Baresoil_w_wheat_CF60m.cdf
13. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Baresoil_w_wheat_west_of_CF.cdf
14. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Corn_stocks.cdf
15. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Grass_gray_CF10m.cdf
16. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Grass_green_CO2_site.cdf
17. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Grass_red_CF10m.cdf
18. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Grass_white_CO2_site.cdf
19. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Grass_yellow_CO2_site.cdf
20. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Milo_CO2_site.cdf
21. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041023.Wheat_South.cdf
22. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Baresoil_CF60m.cdf
23. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Baresoil_w_wheat_CF60m.cdf
24. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Baresoil_w_wheat_west_of_CF.cdf
25. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Grass_gray_CF10m.cdf
26. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Grass_green_CO2_site.cdf
27. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Grass_red_CF10m.cdf
28. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Grass_white_CO2_site.cdf
29. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Grass_yellow_CO2_site.cdf
30. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Milo_CO2_site.cdf
31. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041024.Wheat_south.cdf
32. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041025.Grass_Ashton1.cdf
33. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041025.Grass_Ashton2.cdf
34. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041025.Grass_Elk_Falls.cdf
35. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041025.Grass_Towanda.cdf
36. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041025.Grass_Tyro.cdf
37. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041026.Baresoil_CF60m.cdf
38. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041026.Grass_gray_CF10m.cdf
39. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041026.Grass_green_CO2_site.cdf
40. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041026.Grass_white_CO2_site.cdf
41. sgpSurfaceSpectralReflectanceASDFieldSpecPro.b1.20041026.Grass_yellow_CO2_site.cdf