CHAPTER XI. OPERATION OF THE MARSHALL FLUX STATION IN THE LITTLE WASHITA RIVER BASIN SEPTEMBER 29-OCTOBER 8, 1994

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A. LOCATION

A Bowen Ratio-Energy Balance flux station and additional meteorological instruments were set up in Area 33 just outside the western boundary of the Little River watershed. The station was installed exactly half way between the eastern and western boundaries of Area 33 and 50m south of the edge of the cultivated field (Figure XI-1).

B. INSTRUMENTATION

Unless otherwise indicated, the instrumentation deployed at the site was obtained from, but not necessarily manufactured by, Campbell Scientific, Inc. (CSI) in Logan, Utah. The Bowen Ratio-Energy Balance flux station (Figure XI-2) utilizes a single cooled-mirror hygrometer and physical sample integration to provide accurate measurement of dew point temperature. Air samples were drawn continuously from l and 2 m above mean ground surface. Ten minute averages of dew point temperature and vapor pressure were based on a l second measurement frequency that alternated from one height to the other every 2 minutes and allowed 40 sec after the switch for the mirror to stabilize before sampling. Fine wire (3I dia.) thermocouple were used to measure air temperature also at l and 2 m. Ten minute averages were output based on a l second sampling frequency. Ten minute average measurements of net radiation and soil heat flux were based on a l0 second sampling frequency. The net radiometer was positioned l m above mean ground surface. Soil heat flux was determined with two heat flux plates spaced l.5 m apart and placed at a depth of 8 cm. Two averaging thermocouple were placed over each plate at depths of 2 and 6 cm.

In addition to the Bowen ratio and heat flux measurements, several meteorological and soil measurements were made at the site (Figure XI-2). Air temperature and relative humidity were measured at a height of 2 m. These were obtained as ten minute averages based on a l0 sec sampling interval. Rainfall was measured in increments of .254 mm using a Texas Electronics tipping bucket rain gage. Wind speed and direction were sampled at a height of 3 m every l0 seconds and output as 5 minute averages.

C. OPERATION

The Bowen Ratio station was on-line at l7:30 CDT on Day 273 (9/30/94). All other instruments, except the pyranometer and pyrgeometer, were on-line at l9:30 CDT on Day 273. The

pyranometer and pyrgeometer were put on-line at ll:30 CDT on Day 274. All sensors ran continuously until Day 280 at 8:00 CDT with one exception. The thermocouple were removed from the Bowen Ratio station on 279 at 8:35 CDT because of the excessively high winds (Ö 12 m/s). Since Bowen Ratio calculations were then no longer possible the pump associated with the vapor pressure measurements was turned off as well.

D. CONDITIONS

Skies were very clear and the air was dry at the beginning of the experiment, but grew progressively cloudier towards the middle of the experiment with thunderstorms developing late in the day. Most, however, did not result in rainfall in the watershed. The latter half of the experiment was generally overcast. South- southeasterly winds were strong all week long.

The field at Area 33 had been well prepared and planted with winter wheat probably about five to seven days prior to the beginning of the field campaign. The soil was very dry overall (3.9 wt. % water), but there was a notable contrast in the distribution of moisture (Figure XI-3a). The ridges were dry all through, but there was a noticeable increase in moisture about 1-2 cm below the surface in the troughs (Fig. XI-3b). At the onset of the campaign, very few (ù 1%) of the seeds had germinated and those that had done so had only sprouted a single blade about 2 cm long. By the end of the experiment, most of the seeds had germinated and produced sprouts about 6-8 cm long.

E. DATA EXAMPLES (This section added by editors).

In addition to describing the conditions and experimental site, Laymon also provided graphic summaries of the data he collected. We thought it valuable to add these examples to the data report, and the summaries are found in Figs. XI-4 through XI- 15.

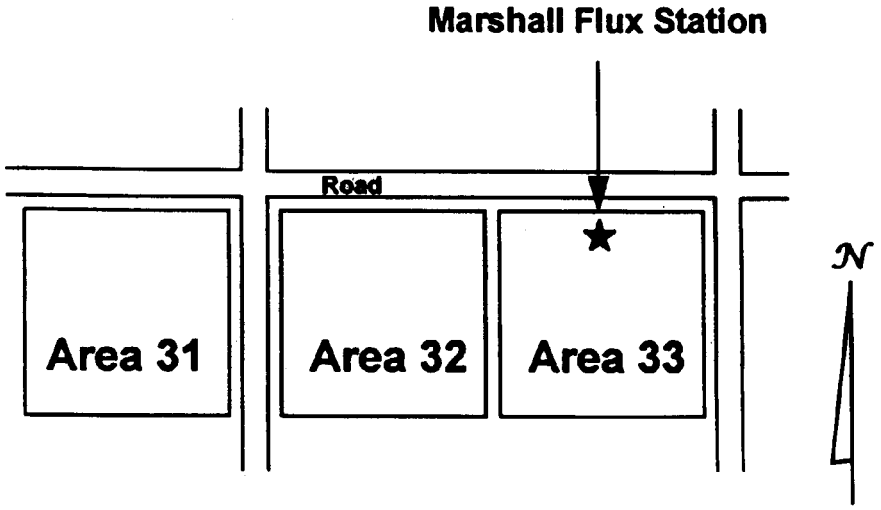

Figure XI-1. Map showing the location of the Marshall Flux Station in Area 33.

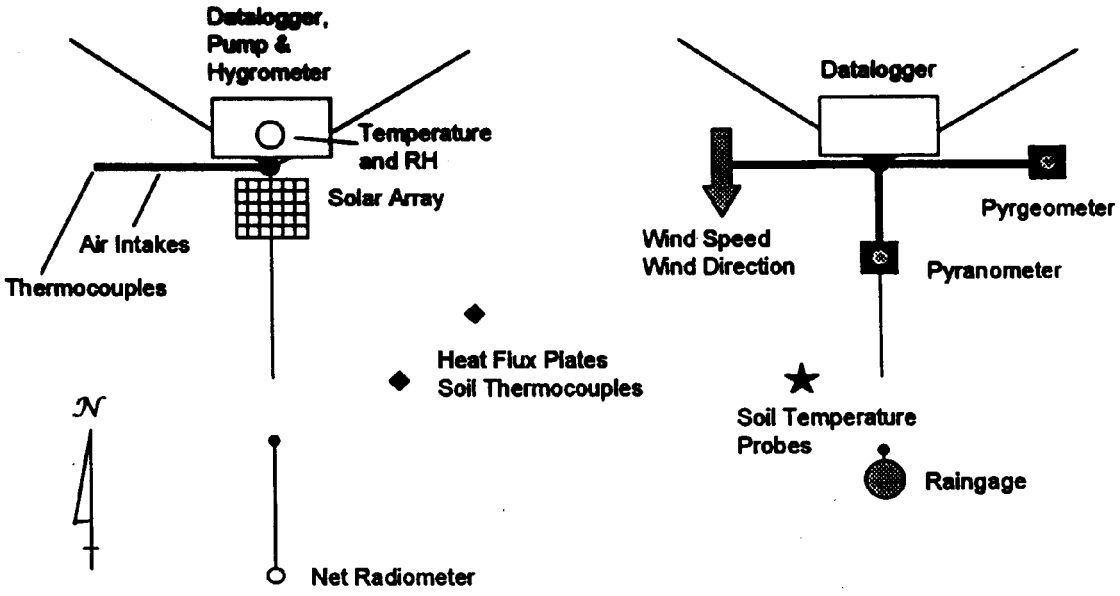

Figure XI-2. Diagram showing the distribution of instruments at the Marshall Flux Station.

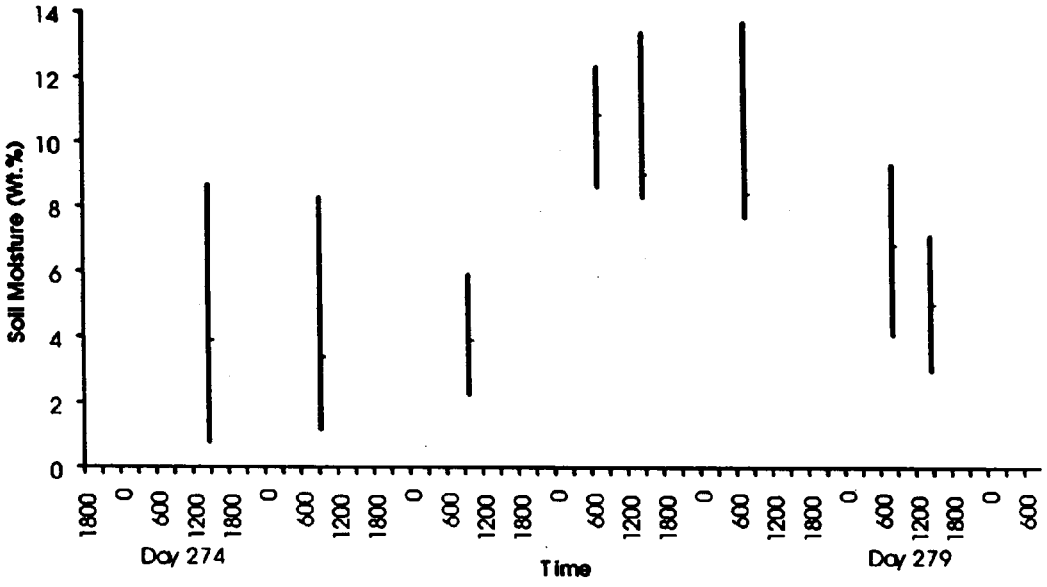

Figure XI-3a. Water content of the soil based on 16 samples from 0-5 cm at the Marshall flux station determined using gravimetry. The verticle bar shows the range of water content for 16 samples with the horizontal tick being the mean.

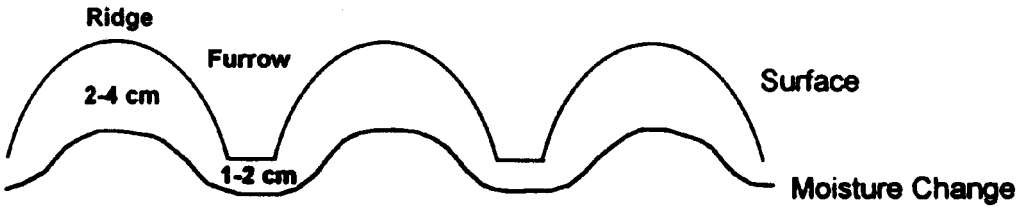

Figure XI-3b. Surface morphology of the cultivated field at Area 33 showing the approximate depth to significant moisture.

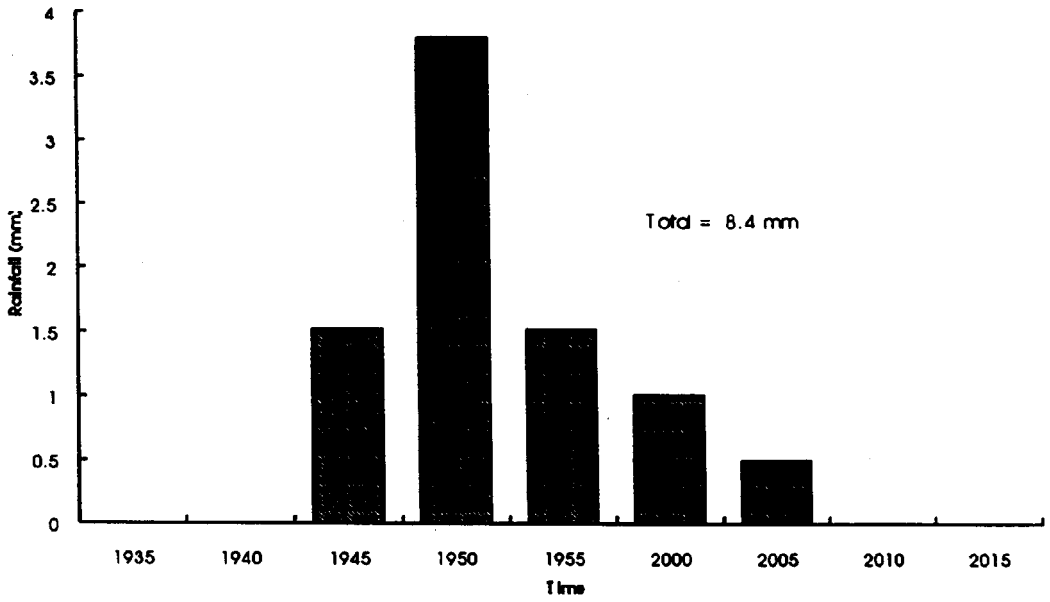

Figure XI-4. Rainfall on DOY 276 at the Marshall flux station at area 33. Total rainfall was 8.4 mm.

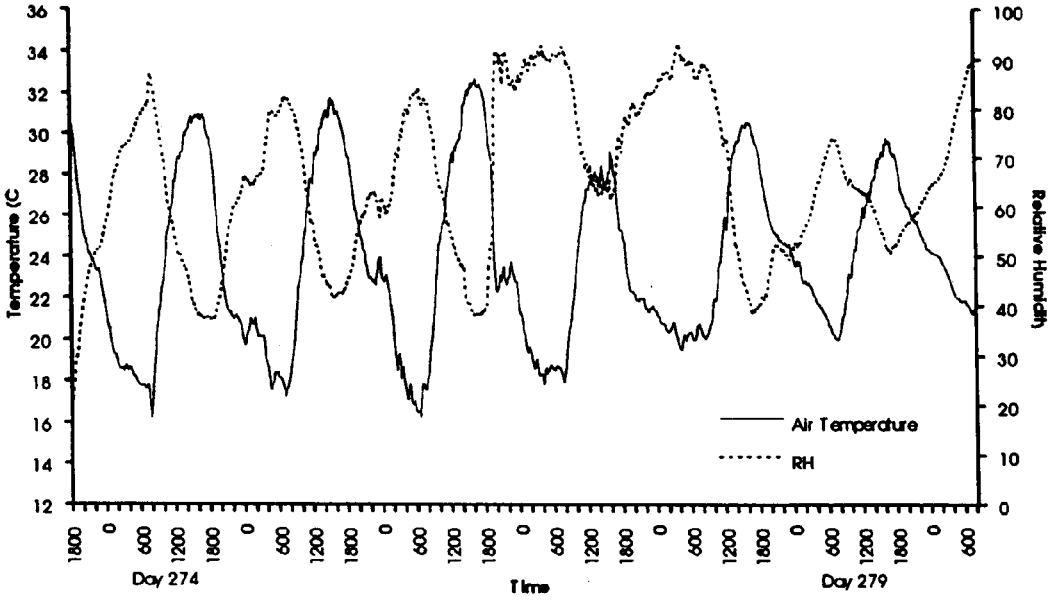

Figure XI-5. Air temperature and relative humidity at the Marshall flux station at area 33.

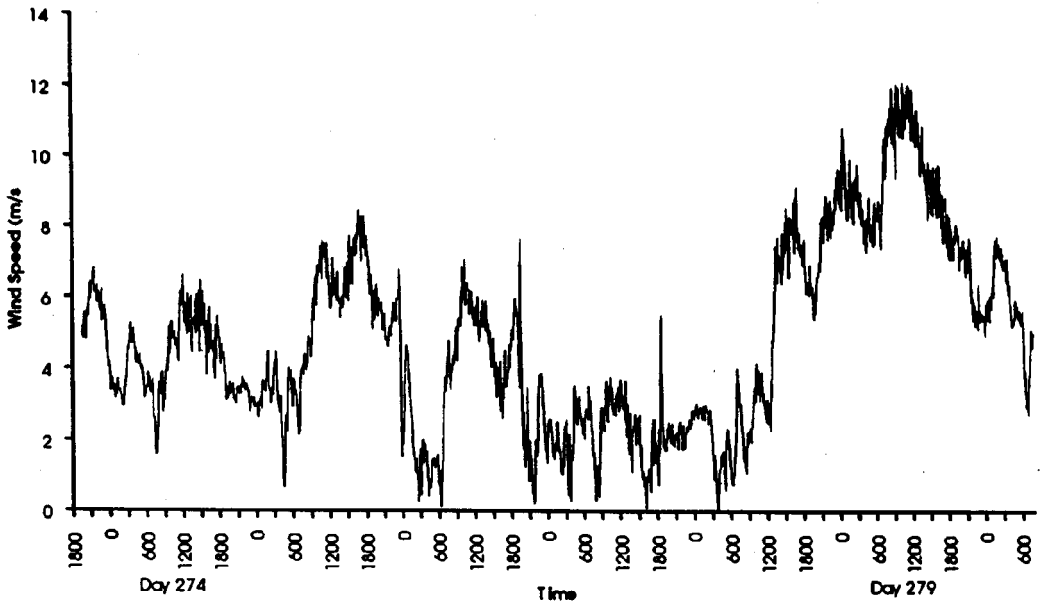

Figure XI-6. Wind speed at the Marshall flux station at area 33.

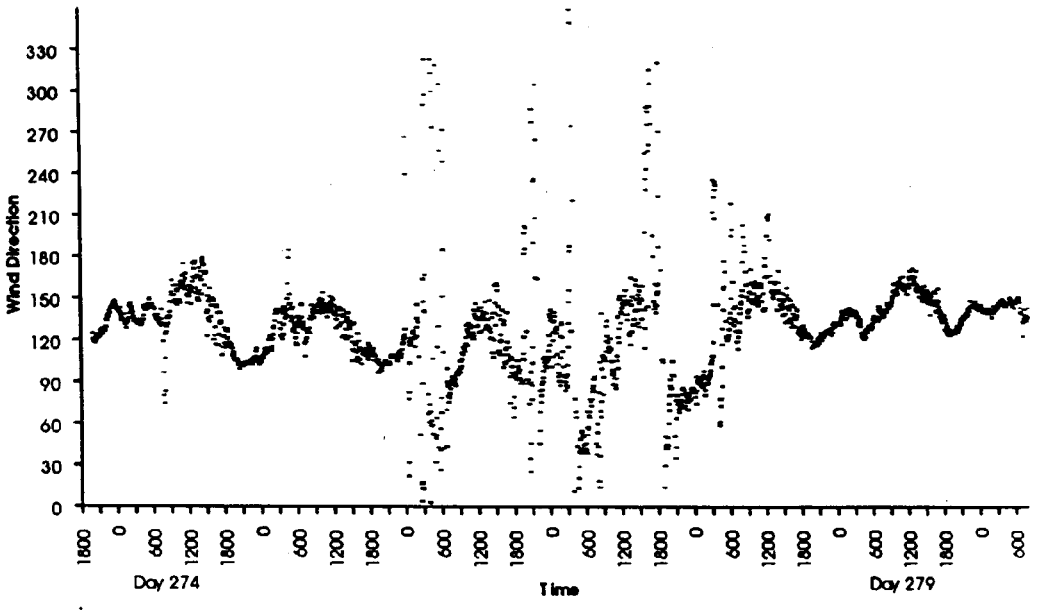

Figure XI-7. Wind direction at the Marshall flux station at area 33.

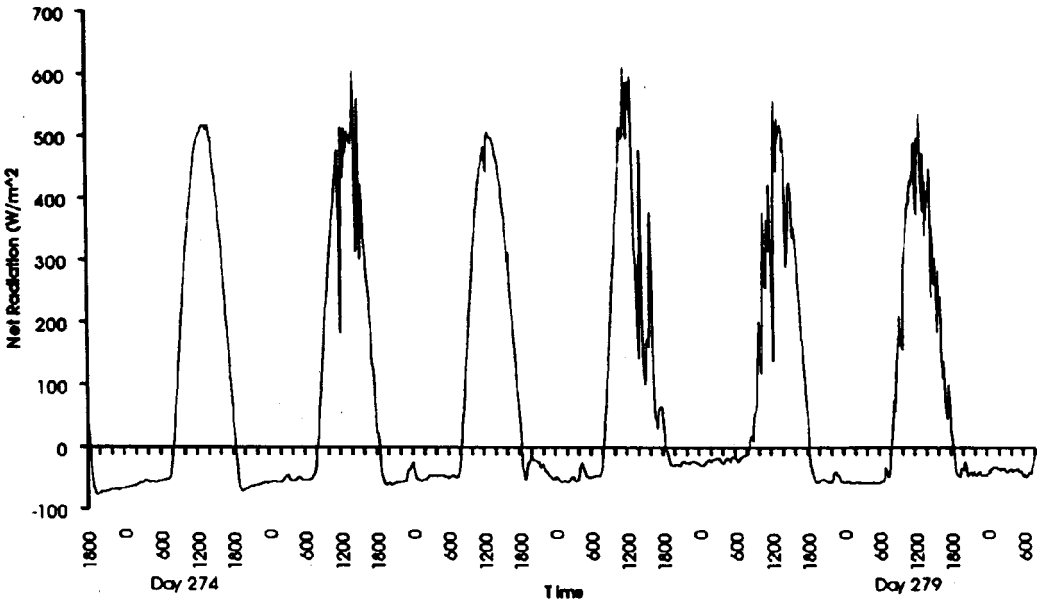

Figure XI-8. Net radiation at the Marshall flux station at area 33.

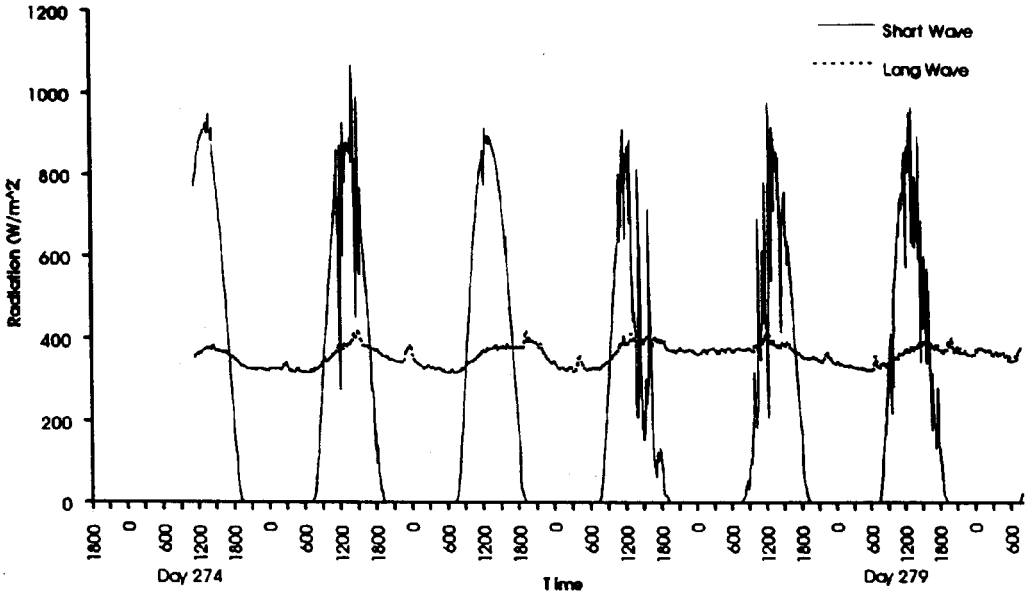

Figure XI-9. Short and long wave radiation at the Marshall flux station at area 33.

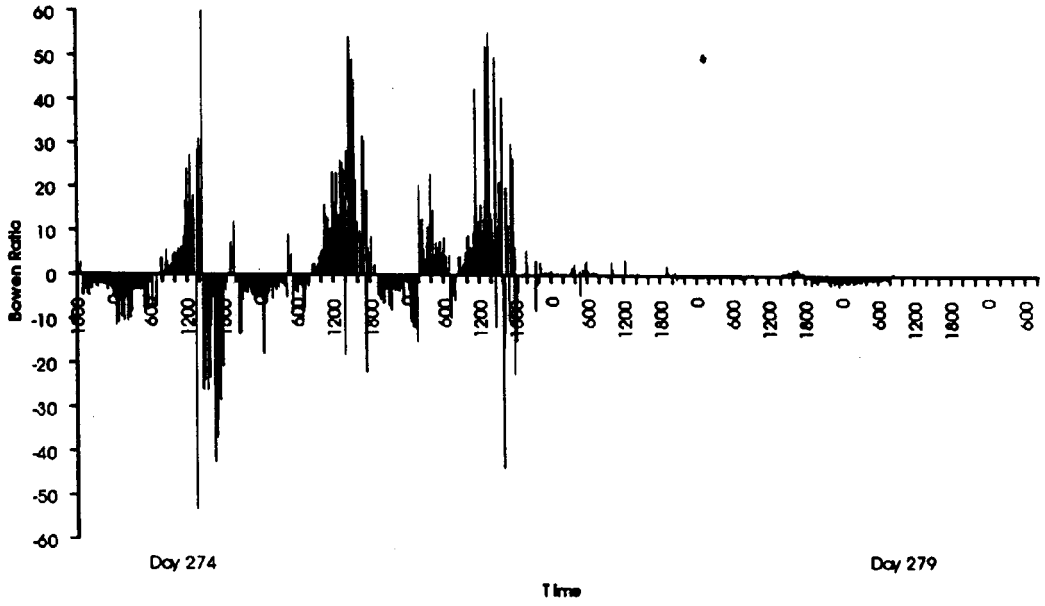

Figure XI-10. Bowen Ratio at the Marshall flux station at area 33.

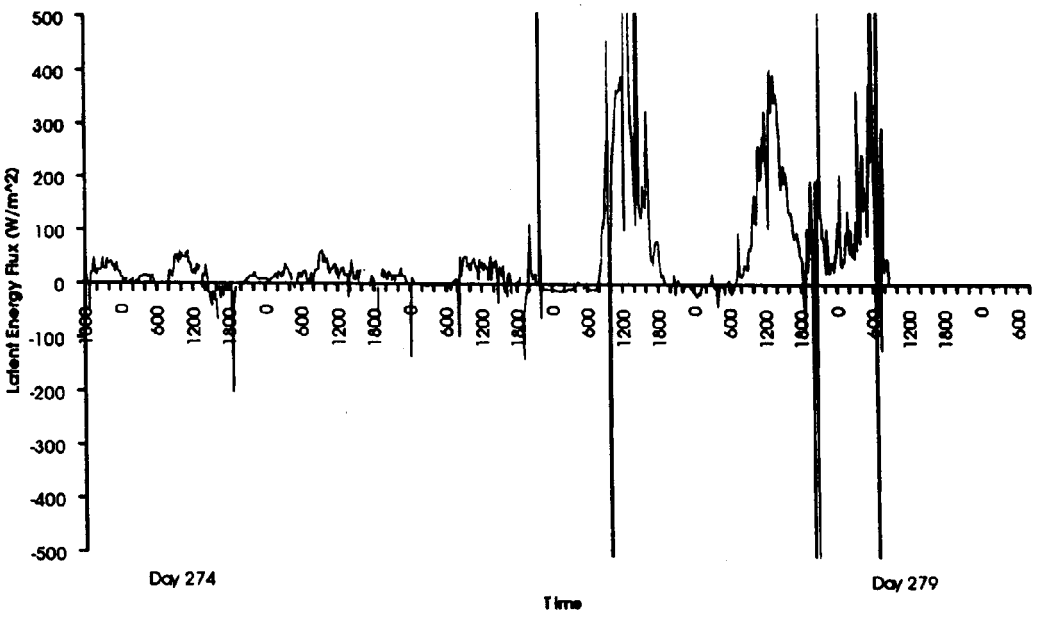

Figure XI-12. Latent energy flux at the Marshall flux station at area 33.

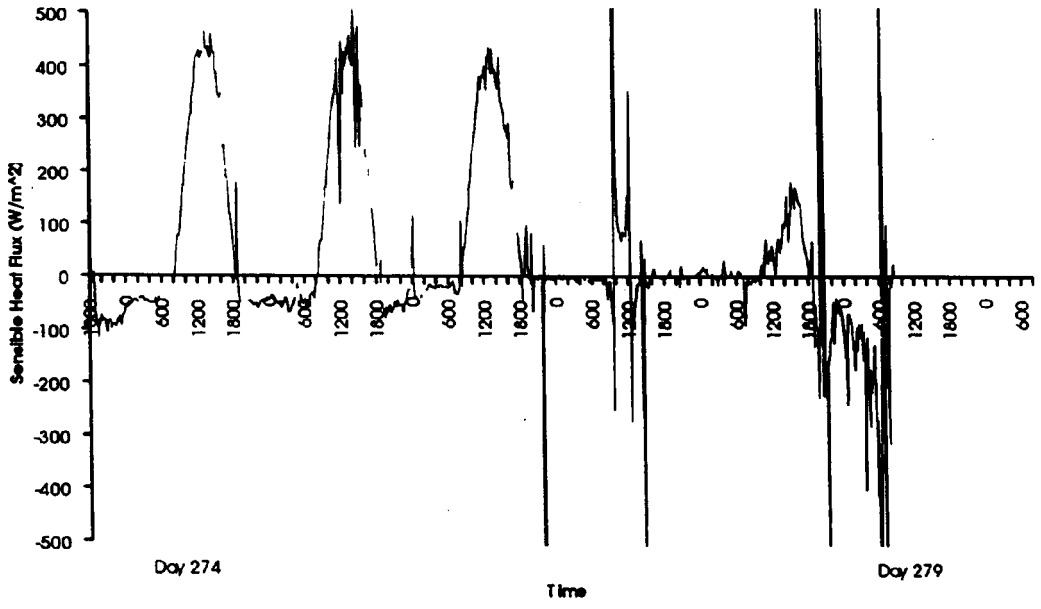

Figure XI-13. Sensible heat flux at the Marshall flux station at area 33. Gaps in the record occur when there is no temperature gradient.

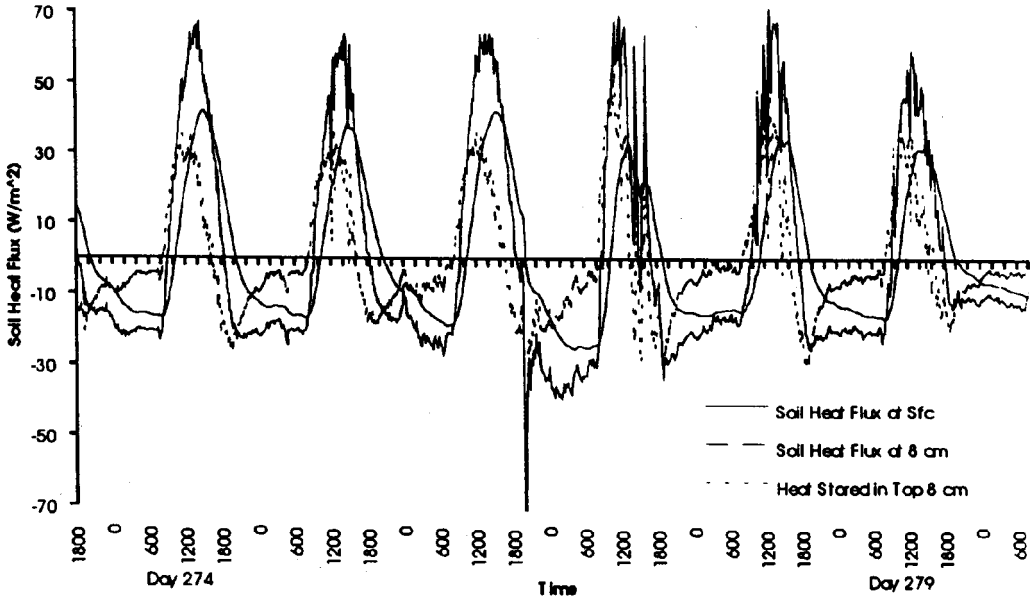

Figure XI-14. Soil heat flux at the Marshall flux station at area 33. The large negative spike on day 276 is a result of rain.

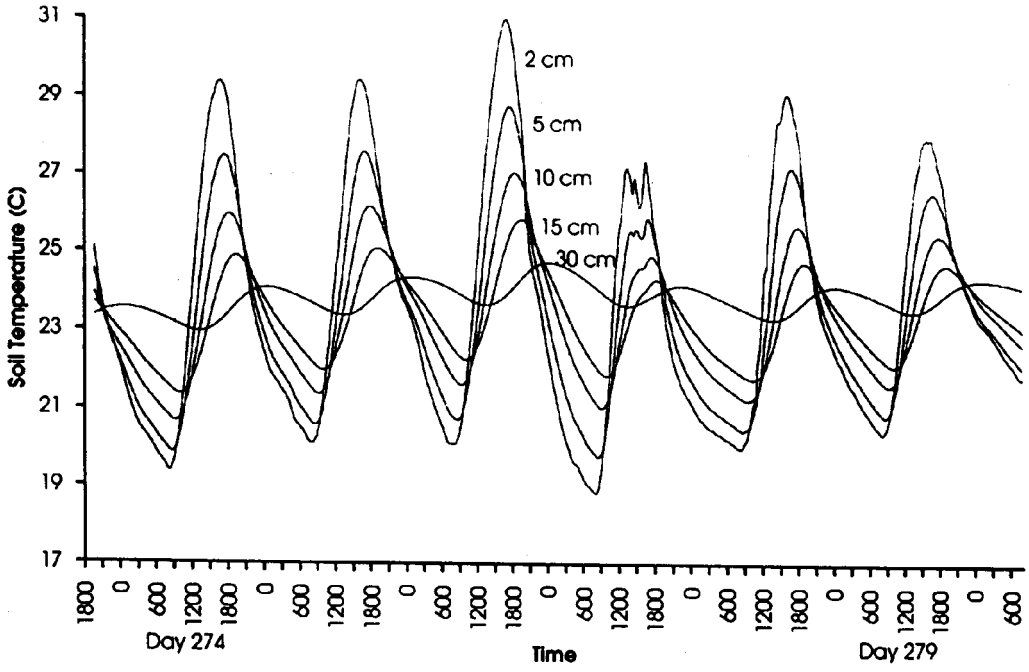

Figure XI-15. Soil temperature profile at the Marshall flux station at area 33.