SMEX05 Meteorological Network Data: Iowa

Summary

This data set includes the meteorological data collected as part of the Soil Moisture Experiment 2005 (SMEX05) in the Walnut Creek watershed area of Iowa, USA from 01 June 2005 through 17 July 2005. The total volume of this data set is approximately 14 megabytes. Data are provided in comma-delimited ASCII text format and are available via FTP.

The Advanced Microwave Scanning Radiometer - Earth Observing System (AMSR-E) is a mission instrument launched aboard NASA's Aqua satellite on 04 May 2002. AMSR-E validation studies linked to SMEX are designed to evaluate the accuracy of AMSR-E soil moisture data. Specific validation objectives include: assessing and refining soil moisture algorithm performance; verifying soil moisture estimation accuracy; investigating the effects of vegetation, surface temperature, topography, and soil texture on soil moisture accuracy; and determining the regions that are useful for AMSR-E soil moisture measurements.

Citing These Data:

The following example shows how to cite the use of this data set in a publication. List the principal investigators, year of data set release, data set title and version number, dates of the data you used (for example, September to October 2003), and publisher.

Jackson, Thomas, John Prueger, and Michael Cosh. 2010. *SMEX05 Meteorological Network Data: Iowa.* Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center.

Overview Table

Category	Description

Data format	Comma-delimited ASCII text
Spatial coverage	41.932° to 41.99° N, 93.48° to 94.03° W
Temporal coverage	01 June 2005 - 17 July 2005
File naming convention	701WSdaily.dat 701WShour.dat 704.dat 704_LW.dat TB_Lat_Long.dat VITEL_10.DAT WC10_Flux.dat WC10_LW.dat
File size	Files range in size from 3 KB to 2.4 MB
Procedures for obtaining data	Data are available via FTP.

Table of Contents

1. Contacts and Acknowledgments:

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Acknowledgements:

The investigators would like to thank USDA ARS National Laboratory for Agriculture and the Environment, and the many graduate students and volunteers who collected the field data.

2. Detailed Data Description:

Format:

The data files are comma-delimited ASCII text format.

File Naming Convention:

The data files employ a variety of naming conventions. All file name variables are listed and described in Table 1.

Table 1. Description of File Name Variables

Variable	Description
NNN	Site ID for National Soil Tilth Laboratory (NSTL) location: 701, 702, 704-708, 710, 713, 714, 719-723, 726, 727
WS	Weather Station
daily	Measurements taken daily
hour	Measurements taken hourly
TB	Tipping Bucket
LW	Leaf Wetness
Lat	Latitude
Long	Longitude
VITEL_XX	Stevens-Vitel Water Monitoring System at Walnut Creek site XX: VITEL_10, VITEL_11, VITEL_15, VITEL_34, VITEL_36, VITEL_52
WCXX	Walnut Creek site ID: WC10, WC11, WC15, WC34, WC36, WC52
Flux	Turbulent fluxes from measured data
Field Notes	Instrumentation field notes on towers at Walnut Creek locations

.dat	ASCII text data file

File Size:

Files range in size from 3 KB to 2.4 MB

Spatial Coverage:

Northernmost Latitude: 41.99º N
Southernmost Latitude: 41.932º N
Westernmost Longitude: 94.03º W
Easternmost Longitude: 93.48º W

Temporal Coverage:

Data span 01 June 2005 to 17 July 2005.

Parameter or Variable:

Data set parameters include:

- Maximum Temperature
- Minimum Temperature
- Total Rain, Maximum Wind
- Air Temperature
- Standard Ambient Temperature and Pressure
- Actual Vapor Pressure
- Solar Radiation
- Wind Direction
- Standard Deviation of Wind Direction
- Wind Speed
- Barometric Pressure
- Photosynthetically Active Radiation
- Rainfall
- Leaf Wetness
- Soil Type
- Soil Temperature
- Volumetric Soil Moisture
- Soil Conductivity
- Carbon Dioxide Flux
- Carbon Dioxide Density
- Heat Flux
- Average Horizontal Wind
- Average Vertical Wind

Water Vapor Density
Sonic Temperature
Air Density
Cumulative Evaporation.

The following sections list the name contents of each data file.

701WSdaily.dat
702WSdaily.dat

Each file contains the following fields:

```
SITE_ID
DATE
MAXTEMP (Deg C)
MINTEMP (Deg C)
TOTRAIN (mm)
MAXWIND (m/s)
```

701WShour.dat

This file contains the following data fields:

```
SITE_ID
DATE (CST)
TIME
SOLRAD (MJ/m^2)
ATEMP2 (Deg C)
SATVP (kPa)
ACTVP (kPa)
STM4 (Deg C)
STM10 (Deg C)
STM20 (Deg C)
WSP2 (m/s)
WNDDIR (Deg.)
WNDSTD (St. Dev.)
RAINH (mm)
```

702WShour.dat

This file contains the following data fields:

```
site_id
date
time (CST)
solrad (MJ/m^2)
atemp2 (Deg C)
satvp (kPa)
actvp (kPa)
stm4 (Deg C)
stm20 (Deg C)
wsp2 (m/s)
wnddir (Deg)
wndstd (St. Dev.)
```

stm10 (Deg C)
bpress (mbar)
rainh (mm)
par (umol/m^2/s)

NNN.dat

Includes files: 704.dat, 705.dat, 706.dat, 707.dat, 708.dat, 710.dat, 713.dat, 714.dat, 719.dat, 720.dat, 721.dat, 722.dat, 723.dat, 726.dat, 727.dat

These files contain rainfall measurements in millimeters using tipping bucket rain gauges in five minute intervals during rain events. Site IDs used in file names, such as 704, are unique identifiers for National Soil Tilth Laboratory (NSTL) locations. Each file contains the following data fields:

SITE_ID
DATE
TIME (CST)
RAIN5 (mm)

NNN_LW.dat

Includes files: 704_LW.dat, 706_LW.dat 707_LW.dat 708_LW.dat, 710_LW.dat, 713_LW.dat, 714_LW.dat, 719_LW.dat, 720_LW.dat, 721_LW.dat, 722_LW.dat

These files contain leaf wetness measurements. The leaf wetness sensors were installed at 1/3 and 2/3 of the canopy height. The leaf wetness sensors were placed at each flux system location near each of the tipping buckets and at some regional and Walnut Creek field locations. The values recorded represent the duration of dew. The percentage-of-time-wet values represent the number of scans during the output period that had dew formation. The resistance values in Ohms denote the amount of dew present. The value 6999 represents infinite resistance indicated by dry sensors. The value -6999 represents no data, usually indicating a logger malfunction. Lower resistance values represent heavier dew formation. Each file contains the following fields:

Array ID
YEAR
DOY
HOUR
Percentage of time wet
Resistance (Ohms)

Field_Notes.txt

Instrumentation configurations used on all towers were identical except for net radiometers. Sites WC10 and WC11 each used a CNR-1 Kipp & Zonen 4-way net radiometer. All other sites used a Radiation & Energy Balance Systems (REBS) Q7 net radiometer. This file contains each Walnut Creek site identifier, such as WC10, followed by the following information:

Crop

Row direction
Row Spacing
EC Height
Rn Height
Crop Height by Day of Year (DOY)

TB_Lat_Long.dat

This file contains tipping bucket locations for sites in decimal degrees Latitude and Longitude, and in Universal Transverse Mercatur (UTM) Easting X and Northing Y, North American Datum 1983 (NAD83). The file contains the following fields.

ID
LONG
LAT
X
Y

VITEL_XX.DAT

Includes files: VITEL_10.DAT, VITEL_11.DAT, VITEL_15.DAT, VITEL_34.DAT, VITEL_36.DAT, VITEL_52.DAT

Calculated values are based on a conversion program provided by Stevens-Vitel Water Monitoring Systems, Inc. Values were measured at one-hour intervals. Values and calculations are listed in Table 2.

Table 2. Soil Moisture, Conductivity, and Temperature

Column Heading	Description
Soil Type	1 = Sand, 2 = Silt, 3 = Clay
V1	Output Voltage #1 (mV)
V2	Output Voltage #2 (mV)
V3	Output Voltage #3 (mV)
V4	Output Voltage #4 (mV)
Temperature	Calculated Soil Temperature (Deg C)
Volumetric Soil Moisture	Calculated volumetric soil moisture (wfv) water fraction by volume
Er	Real dielectric constant
Ei	Imaginary dielectric constant
Er-corr	Temperature-corrected Er
Ei-corr	Temperature-corrected Ei
Condcent	Soil Conductivity (S/m)
Condcentcorr	Temperature-corrected Soil Conductivity (S/m)
Watercondcorr	Temperature-corrected Soil Water Conductivity (S/m)

WCXX_Flux.dat

Includes files: WC10_Flux.dat, WC11_Flux.dat, WC15_Flux.dat, WC34_Flux.dat, WC36_Flux.dat, WC52_Flux.dat

Measurements taken using Campbell CR5000 Measurement and Control System and flux table output from Campbell Scientific flux program 2003. Program revisions were as follows: Revised on 01 January 03 version 1.4, E. Swiatek. Revised on 03 October 2003

revision 1.0 H. Kim. Revised on 15 October 2003 revision 1.1 H. Kim. Revised on 06 May 2005 by T. Hart USDA-ARS-NSTL to include Soil Heat Flux Plates, Soil Temperatures, IRT's and Vitel Soil Moisture probes.

The CR5000 program measures turbulence sensors at 10 or 20 Hz. The time series can be saved to a PC Card. The CR5000 also computes on line turbulent fluxes from the measured data. The flux table saves all of the cross products that are required to rotate the on line fluxes into natural wind coordinates in post processing as described in the following two publications:

Kaimal, J. C. and J. J. Finnigan. 1994. Atmospheric Boundary Layer Flows, Their Structure and Measurement. Oxford University Press, New York.

Tanner, C. B. and G. W. Thurtell. 1969. Anemoclinometer Measurements of Reynolds Stress and Heat Transport in the Atmospheric Surface Layer. Final Report, United States Army Electronics Command, Atmospheric Sciences Laboratory, Fort Huachuca, Arizona.

The files contain meteorological measurements and calculations listed in Table 3. These include: carbon dioxide, water vapor, sonic sensible heat, and momentum fluxes; the means and standard deviation (sqrt[variance]) of wind, carbon dioxide, and water vapor; and all the cross-products that are required to compute a post-processing coordinate rotation. Measurement units are described in Table 4.

Table 3. Flux Data File Columns: Meteorological Measurements and Calculations

Column	Description
Year	Year
DOY	Day Of Year
TIMESTAMP	Time stamp
Fc_wpl	Carbon dioxide flux, with Webb et al. term [mg / {m^2 s}]
LE_wpl	Latent heat flux, with Webb et al. term [W / m^2]
Hs	Sensible heat flux using sonic temperature [W / m^2]
tau	Momentum flux [kg / {m s^2}]
u_star	Friction velocity [m / s]
cov_Uz_Uz(1)	Variance of vertical wind [(m / s)^2]
cov_Uz_Ux(1)	Covariance of vertical wind and horizontal wind (x-axis) [(m / s)^2]
cov_Uz_Uy(1)	Covariance of vertical wind and horizontal wind (y-axis) [(m / s)^2]
cov_Uz_co2(1)	Covariance of vertical wind and carbon dioxide density [mg / {m^2 s}]
cov_Uz_h2o(1)	Covariance of vertical wind and water vapor density from LI-7500 [g / {m^2 s}]
cov_Uz_Ts(1)	Covariance of vertical wind and sonic temperature [m C / s]
cov_Ux_Ux(1)	Variance of horizontal wind (x-axis) [(m / s)^2]
cov_Ux_Uy(1)	Covariance of horizontal winds (x-axis and y-axis) [(m / s)^2]
cov_Ux_co2(1)	Covariance of horizontal wind (x-axis) and carbon dioxide density [mg / {m^2 s}]
cov_Ux_h2o(1)	Covariance of horizontal wind (x-axis) and water vapor density from LI-7500 [g / {m^2 s}]
cov_Ux_Ts(1)	Covariance of horizontal wind (x-axis) and sonic temperature [m C / s]
cov_Uy_Uy(1)	Variance of horizontal wind (y-axis) [(m / s)^2]
cov_Uy_co2(1)	Covariance of horizontal wind (x-axis) and carbon dioxide density [mg /

	{m^2 s}]
cov_Uy_h2o(1)	Covariance of horizontal wind (y-axis) and water vapor density from LI-7500 [g / {m^2 s}]
cov_Uy_Ts(1)	Covariance of horizontal wind (y-axis) and sonic temperature [m C / s]
cov_co2_co2(1)	Variance of carbon dioxide density [(mg / m^3)^2]
cov_h2o_h2o(1)	Variance of water vapor density from LI-7500 [(g / m^3)^2]
cov_Ts_Ts(1)	Variance of sonic temperature [C^2]
Ux_Avg(1)	Average horizontal wind (x-axis) [m / s]
Uy_Avg(1)	Average horizontal wind (y-axis) [m / s]
Uz_Avg(1)	Average vertical wind [m / s]
co2_ Avg(1)	Average carbon dioxide density [mg / m^3]
h2o_ Avg(1)	Average water vapor density from LI-7500 [g / m^3]
Ts_ Avg(1)	Average sonic temperature [C]
rho_a_Avg	Average air density [kg / m^3]
press_Avg(1)	Average barometric pressure from LI-7500 [kPa]
panel_temp_Avg	Average CR5000 panel temperature [C]
wnd_dir_compass(1)	Wind direction using compass coordinate system [degrees]
wnd_dir_csat3(1)	Wind direction using the CSAT3's right handed coordinate system [degrees]
wnd_spd(1)	Horizontal wind speed [m / s]
rslt_wnd_spd(1)	Resultant horizontal wind speed [m / s]
batt_volt_Avg	Average battery voltage [V]
std_wnd_dir(1)	Standard deviation of wind direction [degrees]
n_Tot(1)	Number of samples in the statistics (fluxes, variances, means, etc.) [samples]
csat_warning_Tot(1)	Number of times any CSAT3 warning flag was set high [samples]
irga_warnings	Number of times any LI-7500 warning flag was set high [samples]
del_T_f_Tot(1)	Number of delta temperature warnings from CSAT3 [samples]
track_f_Tot(1)	Number of poor signal lock warnings from CSAT3 [samples]
amp_h_f_Tot(1)	Number of amplitude high warnings from CSAT3 [samples]
amp_l_f_Tot(1)	Number of amplitude low warnings from CSAT3 [samples]
chopper_f_Tot(1)	Number of chopper warnings from LI-7500 [samples]
detector_f_Tot(1)	Number of chopper detector from LI-7500 [samples]
pll_f_Tot(1)	Number of chopper pll from LI-7500 [samples]
sync_f_Tot(1)	Number of chopper synchronization warnings from LI-7500 [samples]
agc_Avg(1)	Average AGC from LI-7500 [unitless]
Fc_irga	Carbon dioxide flux without the Webb et al. term [mg / {m^2 s}]
LE_irga	Latent heat flux without the Webb et al. term [W / m^2]
co2_wpl_LE	Carbon dioxide Webb et al. term due to latent heat flux [mg / {m^2 s}]
co2_wpl_H	Carbon dioxide Webb et al. term due to (sonic) sensible heat flux [mg / {m^2 s}]
h2o_wpl_LE	Water vapor Webb et al. term due to latent heat flux [W / m^2]
h2o_wpl_H	Water vapor Webb et al. term due to (sonic) sensible heat flux [W / m^2]
h2o_hmp_Avg(1)	Average water vapor density from HMP45C [g / m^3]
t_hmp_Avg(1)	Average HMP45C temperature [C]
SHF1_Avg(1)	Soil Heat Flux in row [W/M^2]
SHF2_Avg(1)	Soil Heat Flux in between rows [W/M^2]
SoilTC1_Avg(1)	Soil Temperature 2cm [Deg C]
SoilTC2_Avg(1)	Soil Temperature 5cm [Deg C]
SoilTC3_Avg(1)	Soil Temperature 2cm [Deg C]
SoilTC4_Avg(1)	Soil Temperature 5cm [Deg C]
Rad_short_Up_Avg(1)	Upwelling Shortwave Radiation
Rad_short_Dn_Avg(1)	Downwelling Shortwave Radiation
Rad_long_Up_Avg(1)	Upwelling Longwave Radiation Raw

Rad_long_Dn_Avg(1)	Downwelling Longwave Radiation Raw
Rad_long_Up__Avg(1)	Upwelling Longwave Radiation Temperature corrected
Rad_long_Dn__Avg(1)	Downwelling Longwave Radiation Temperature corrected
Rn_short_Avg(1)	Shortwave Radiation
Rn_long_Avg(1)	Longwave Radiation
Rn_total_Avg(1)	Total Radiation
Rn_Total_TCo_Avg(1)	Total Radiation Temperature corrected
Temp_C1_Avg(1)	Temperature in Celsius
Temp_K1_Avg(1)	Temperature in Kelvin
Hydra_V1	Voltage 1 of Hydra [mV]
Hydra_V2	Voltage 2 of Hydra [mV]
Hydra_V3	Voltage 3 of Hydra [mV]
Hydra_V4	Voltage 4 of Hydra [mV]
Leaf Wet1_HST(1)	Histogram of Leaf Wetness East of Tower ½ Canopy Height [Ohms]
Leaf Wet2_HST(1)	Histogram of Leaf Wetness East of Tower ¾ Canopy Height [Ohms]
Leaf Wet3_HST(1)	Histogram of Leaf Wetness West of Tower ½ Canopy Height [Ohms]
Leaf Wet4_HST(1)	Histogram of Leaf Wetness West of Tower ¾ Canopy Height [Ohms]
Leaf Wet1_Avg(1)	Average of Leaf Wetness East of Tower ½ Canopy Height [Ohms]
Leaf Wet2_Avg(1)	Average of Leaf Wetness East of Tower ¾ Canopy Height [Ohms]
Leaf Wet3_Avg(1)	Average of Leaf Wetness West of Tower ½ Canopy Height [Ohms]
Leaf Wet4_Avg(1)	Average of Leaf Wetness West of Tower ¾ Canopy Height [Ohms]
Evaporation	15 min Evaporation total [mm]
Cumulative	Cumulative Evaporation for dataset [mm]

Table 4. Measurement Units

Measurement Unit	Description
C	Celsius
degrees	degrees (angle)
g	grams
kg	kilograms
kPa	kilopascals
m	meters
mg	milligrams
s	seconds
W	Watts
V	Volts

WCXX_LW.dat

Includes files: `WC10_LW.dat, WC11_LW.dat, WC15_LW.dat, WC34_LW.dat, WC36_LW.dat, WC52_LW.dat`

Leaf wetness in Walnut Creek (WC) watershed areas. Each file contains the following leaf wetness data fields:

```
Year
DOY
Hour
Timestamp
Histogram
Ohm-Avg
```

3. Data Access and Tools:

Data Access:

Data are available via FTP at:
ftp://sidads.colorado.edu/pub/DATASETS/AVDM/data/soil_moisture/
SMEX05/meteorological/nsidc0455_met_network_data_v01/

Software and Tools:

No special tools are required to view these data. A text reader that recognizes comma-delimited text files is recommended. A word-processing program or Web browser also will display the data.

Related Data Collections:

For related data collections, please see the AMSR-E Validation Data - Soil Moisture Data Web site: http://nsidc.org/data/amsr_validation/soil_moisture/index.html

4. References and Related Publications:

Please see the National Snow and Ice Data Center (NSIDC) SMEX05 Data Web site for more information and access to data:
http://nsidc.org/data/amsr_validation/soil_moisture/smex05/index.html

5. Document Information:

List of Acronyms& Abbreviations

The following acronyms and abbreviations are used in this document:

AMSR-E - Advanced Microwave Scanning Radiometer – Earth Observing System
ASCII - American Standard Code for Information Interchange
CIRES – Cooperative Institute for Research in Environmental Sciences
DAAC - Distributed Active Archive Center
FTP - File Transfer Protocol

NAD83 – North American Datum 1983
NASA - National Aeronautics and Space Administration
NSTL - National Soil Tilth Laboratory
NSIDC – National Snow and Ice Data Center
REBS - Radiation & Energy Balance Systems
SMEX05 – Soil Moisture Experiment 2005
USDA ARS - United States Department of Agriculture Agricultural Research Service
UTM - Universal Transverse Mercator
WC – Walnut Creek

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