D06 FIU Site Characterization
Supporting Data

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1 DESCRIPTION

1.1 Purpose

Data collected, analyzed and described here are used to inform the site design activities for NEON project Teams: EHS (permitting), FCC, ENG and FSU. This report was made based on actual site visit to the 3 NEON sites in Domain 06. This document presents all the supporting data for FIU site characterization at D06.

1.2 Scope

FIU site characterization data and analysis results presented in this document are for the three D06 tower locations: Konza Prairie Biological Station (Advanced), The University of Kansas Field Station (Relocatable 1) and Konza Prairie Biological Station (Agricultural Lowland, Relocatable 2). Issues and concerns for each site that need further review are also addressed in this document according to our best knowledge.

Disclaimer: all latitude and longitude points are subject to the tolerances of our measurement system, i.e., GPS, typically approximately ±3 m.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

AD[01]	NEON.DOC.011008	FIU Tower Design Science Requirements
AD[02]	NEON.DOC.011000	FIU Technical and Operation Requirements
AD[03]		
AD[04]	NEON.DOC.011029	FIU Precipitation Collector Site Design Requirements

2.2 Reference Documents

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]		
RD[04]		

2.3 Acronyms

2.4 Verb Convention

"Shall" is used whenever a specification expresses a provision that is binding. The verbs "should" and "may" express non-mandatory provisions. "Will" is used to express a declaration of purpose on the part of the design activity.

3 KONZA PRAIRIE BIOLOGICAL STATION (ADVANCED TOWER SITE)

3.1 Site description

The Konza advance tower site was at 39.100596°, -96.562988° (Figure 1). We micro-sited this location to 39.10077, -96.56309, which is only 20 m and still inside the property boundary of Konza Prairie Biological Station. The Konza Prairie Biological Station is a 3,487-hectare (8,616 acre, 13.5 sq mi) preserve of native tallgrass prairie in the Flint Hills of northeastern Kansas. It is located south of Manhattan, Kansas and its southern boundary parallels Interstate 70 (info source: http://en.wikipedia.org/wiki/Konza_Prairie). The Konza Prairie is owned by The Nature Conservancy and Kansas State University, and is operated as a field research station by the university's Division of Biology. It is one of 26 sites within the Long Term Ecological Research Network.

This site has a continental climate characterized by warm, wet summers and dry, cold winters. Average annual precipitation (32.9 in, 835 mm) is sufficient to support woodland or savanna vegetation; consequently, drought, fire and grazing are important in maintaining this grassland. The site is topographically complex with an elevation range from 1050 to 1457 ft (320 to 444 m). In addition to the dominant tallgrass prairie, Konza contains forest, claypan, shrub and riparian communities. Limestone outcrops are found throughout the landscape.

Konza Prairie is located within the largest remaining area of unplowed tallgrass prairie in North America, the Flint Hills. Konza supports a diverse mix of species including 576 vascular plants, 31 mammals, 208 bird species, 34 types of reptiles and amphibians, 20 kinds of fish, and over 700 types of invertebrates. A herd of approximately 300 bison is maintained on the Konza, and native White-tailed Deer and Wild Turkey are often present in large numbers. The public is allowed onto portions of the Konza Prairie through three loop hiking trails (approximately 3, 5, and 7 miles).

The land within Konza Prairie Biological Station is managed with various combinations of grazing (by bison) and managed fire (return intervals of 1, 2, 4, 10, or 20 years). The NEON site is located in Konza research treatment K2A (K = North Branch Kings Creek, ungrazed; 2 = 2 years between managed burns; A = replicate A).

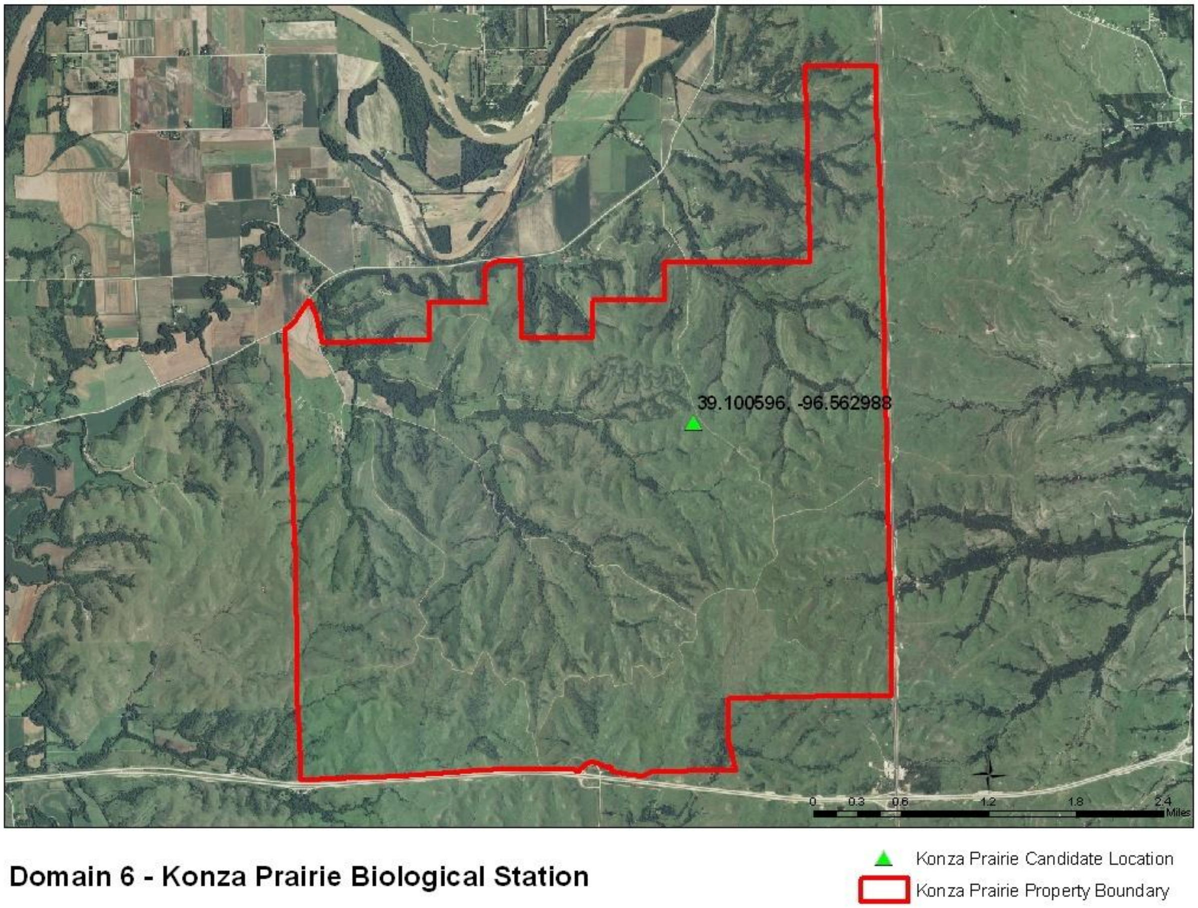


Figure 1. Konza Prairie Biological Station property boundary map and NEON candidate site tower location.

3.2 Ecosystem

Vegetation and land cover information at surrounding region of NEON site are presented below:

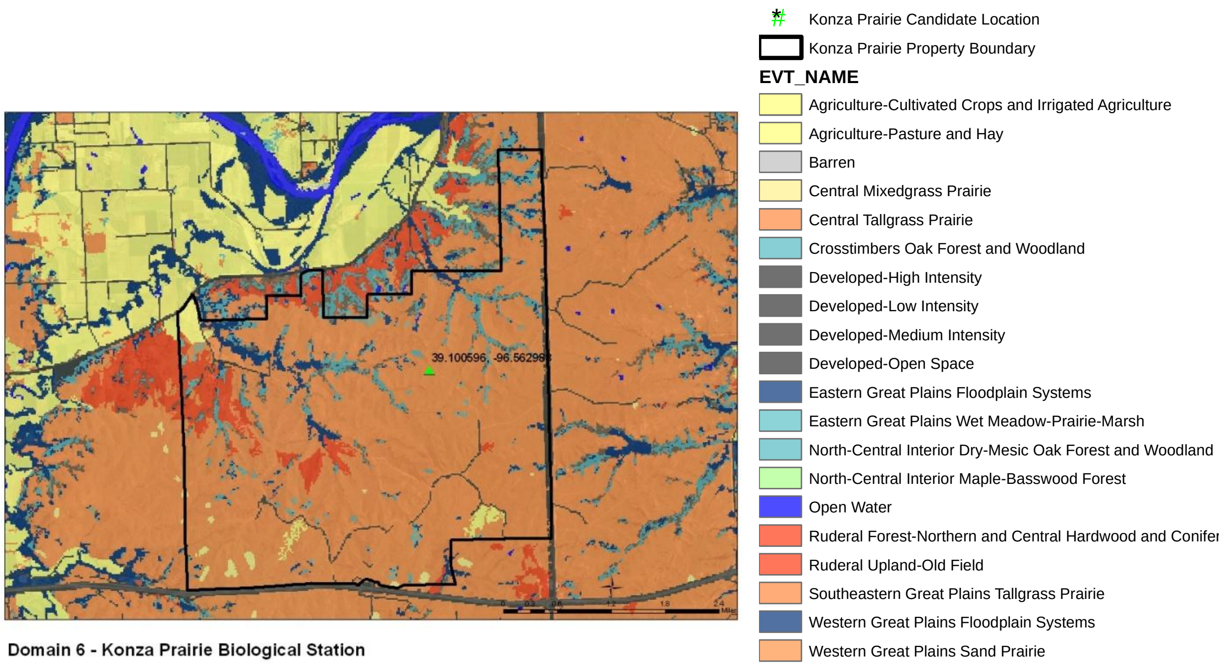


Figure 2. Vegetative cover map of Konza Advance site and surrounding areas (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

Table 1. Percent Land cover type at Konza Advance site (information is from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Vegetation Type	Area	Percent
Agriculture-Cultivated Crops and Irrigated Agriculture	0.52	1.49
Central Mixedgrass Prairie	0.20	0.58
Developed-Low Intensity	0.02	0.07
Developed-Medium Intensity	0.01	0.02
Developed-Open Space	0.73	2.09
Eastern Great Plains Floodplain Systems	1.18	3.39
Eastern Great Plains Wet Meadow-Prairie-Marsh	0.14	0.40
North-Central Interior Dry-Mesic Oak Forest and Woodland	1.68	4.81
Open Water	0.01	0.02
Ruderal Forest-Northern and Central Hardwood and Conifer	0.04	0.11
Ruderal Upland-Old Field	1.83	5.25
Southeastern Great Plains Tallgrass Prairie	27.87	79.98
Western Great Plains Floodplain Systems	0.01	0.02
Western Great Plains Wooded Draw and Ravine	0.62	1.77
Total Area sq km	34.84	100.00

The ecosystem at Konza Advanced site is unplowed tallgrass prairie. The mean canopy height was ~20 cm during FIU site characterization, but can reach 1-1.5 m at the end of the growing season. Ground cover is ~80-90%. The landscape at site is rolling hills, with trees in the valley near streams. Chiggers and ticks are prevalent. Site is not grazed, but managed by fire and burned every 2 years. The plot ~100 m north of the tower is burned every 20 years and, as a result of the lower fire frequency, it is dominated by shrubs and small trees. The tower location is on a hilltop. The soil around the tower is relatively free of rocks, but rocks are common on hillslopes (e.g. ~75 southwest of the tower).

Figure 3. Ecosystem at the Konza advanced site is prairie.

Table 2. Ecosystem and site attributes for Konza Advanced tower site.

Ecosystem attributes	Measure and units
Mean canopy height	1.5 m
Surface roughness[a]	0.3 m
Zero place displacement height[a]	1.0 m
Structural elements	unplowed tallgrass prairie, uniform
Time zone	Central time zone
Magnetic declination	3° 51' E changing by 0° 7' W/year

Note, [a] From field observation.

3.3 Soils

3.3.1 Soil description

Soil data and soil maps below for the Konza - Core site were collected from 2.2 km^2 NRCS soil maps (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) to determine the dominant soil types in the larger tower foot print. This was done to assure that the soil array is in the dominant (or in the co-dominant) soil type present in the tower footprint.

Figure 4. Soil map of the Konza - Core site and surrounding areas.

Soil Map Units Description: The map units delineated on the detailed soil maps in a soil survey represents the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit. A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils. Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called non-contrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas. An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. T he name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series. Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example. An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example. An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, are an example. Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Table 3. Soil series and percentage of soil series within 2.2 km^2 at the Konza - Core site

Riley County, Kansas (KS161)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
4051	Ivan silt loam, channeled	29.9	5.5%
4530	Benfield-Florence complex, 5 to 30 percent slopes	312.6	57.1%
4550	Clime silty clay loam, 20 to 40 percent slopes, very stony	2.6	0.5%
4590	Clime-Sogn complex, 3 to 20 percent slopes	169.7	31.0%
4625	Dwight-Irwin complex, 1 to 3 percent slopes	33.1	6.0%
Totals for Area of Interest		**547.9**	**100.0%**

Riley County, Kansas 4530—Benfield-Florence complex, 5 to 30 percent slopes Map Unit Setting Elevation: 600 to 1,300 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 50 to 57 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Benfield and similar soils: 45 percent Florence and similar soils: 30 percent Minor components: 0 percent **Description of Benfield Setting** Landform: Hillslopes Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey residuum weathered from limestone and shale **Properties and qualities** Slope: 5 to 20 percent Depth to restrictive feature: 22 to 39 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 25 percent Available water capacity: Moderate (about 6.4 inches) **Interpretive groups** Land capability (nonirrigated): 6e Ecological site: Loamy Upland (Draft) (PE 30-36) (R076XY015KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 12 inches: Silty clay loam 12 to 26 inches: Silty clay 26 to 35 inches: Silty clay loam 35 to 39 inches: Bedrock **Description of Florence Setting** Landform: Hillslopes Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey residuum weathered from cherty limestone **Properties and qualities** Slope: 5 to 15 percent Depth to restrictive feature: 24 to 39 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 2.8 inches) **Interpretive groups** Land capability (nonirrigated): 6e Ecological site: Loamy Upland (Draft) (PE 30-36) (R076XY015KS) **Typical profile** 0 to 5 inches: Gravelly silt loam 5 to 10 inches: Very gravelly silty clay loam 10 to 14 inches: Very gravelly silty clay 14 to 30 inches: Extremely cobbly clay 30 to 34 inches: Unweathered bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4550—Clime silty clay loam, 20 to 40 percent slopes, very stony Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Clime and similar soils: 75 percent Minor components: 0 percent **Description of Clime Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Silty and clayey residuum weathered from shale, calcareous **Properties and qualities** Slope: 20 to 40 percent Surface area covered with cobbles, stones or boulders: 0.1 percent Depth to restrictive feature: 20 to 40 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 35 percent Available water capacity: Low (about 5.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Limy Upland (Draft) (PE 30-36) (R076XY012KS) **Typical profile** 0 to 2 inches: Silty clay loam 2 to 9 inches: Silty clay 9 to 27 inches: Silty clay 27 to 33 inches: Silty clay 33 to 37 inches: Bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4590—Clime-Sogn complex, 3 to 20 percent slopes Map Unit Setting Elevation: 1,000 to 1,540 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 50 to 57 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Clime and similar soils: 62 percent Sogn and similar soils: 20 percent Minor components: 0 percent **Description of Clime Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Convex Parent material: Silty and clayey residuum weathered from shale, calcareous **Properties and qualities** Slope: 5 to 20 percent Depth to restrictive feature: 20 to 39 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 35 percent Available water capacity: Low (about 5.2 inches) **Interpretive groups** Land capability (nonirrigated): 6e Ecological site: Limy Upland (Draft) (PE 30-36) (R076XY012KS) **Typical profile** 0 to 12 inches: Silty clay loam 12 to 26 inches: Silty clay 26 to 30 inches: Silty clay 30 to 34 inches: Bedrock **Description of Sogn Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Convex Parent material: Loamy residuum weathered from limestone, unspecified **Properties and qualities** Slope: 3 to 20 percent Depth to restrictive feature: 4 to 20 inches to lithic bedrock Drainage class: Somewhat excessively drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Very low (about 2.0 inches) Interpretive groups Land capability (nonirrigated): 6s Ecological site: Shallow Limy (Draft) (PE 30-36) (R076XY028KS) **Typical profile** 0 to 9 inches: Silty clay loam 9 to 13 inches: Bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4625—Dwight-Irwin complex, 1 to 3 percent slopes Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Dwight and similar soils: 45 percent Irwin and similar soils: 40 percent **Description of Dwight Setting** Landform: Depressions on ridges Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Convex, concave Across-slope shape: Convex, concave Parent material: Silty and clayey residuum weathered from limestone, cherty **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: 39 to 59 inches to lithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Maximum salinity: Nonsaline to slightly saline (0.0 to 8.0 mmhos/cm) Available water capacity: Low (about 5.6 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Sodic Claypan (Draft) (Peer Review) (PE 30-36) (R076XY005KS) **Typical**

profile 0 to 4 inches: Silt loam 4 to 17 inches: Silty clay 17 to 43 inches: Silty clay 43 to 79 inches: Unweathered bedrock **Description of Irwin Setting** Landform: Ridges Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey pedisediment derived from limestone and shale **Properties and qualities** Slope: 1 to 4 percent Depth to restrictive feature: 39 to 59 inches to paralithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Clay Upland (PE 25-34) (R075XY007KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 11 inches: Silty clay loam 11 to 35 inches: Silty clay 35 to 50 inches: Silty clay 50 to 55 inches: Silty clay 55 to 59 inches: Unweathered bedrock

Riley County, Kansas 4051—Ivan silt loam, channeled Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Ivan and similar soils: 99 percent Minor components: 0 percent **Description of Ivan Setting** Landform: Flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Loamy alluvium **Properties and qualities** Slope: 0 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Frequent Frequency of ponding: None Calcium carbonate, maximum content: 15 percent Available water capacity: Very high (about 12.4 inches) **Interpretive groups** Land capability (nonirrigated): 5w Ecological site: Loamy Lowland (PE 25-34) (R075XY013KS) **Typical profile** 0 to 7 inches: Silt loam 7 to 26 inches: Silty clay loam 26 to 39 inches: Silty clay loam 39 to 64 inches: Silty clay loam **Minor Components Aquolls, ponded** Percent of map unit: 0 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave **Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways, hillslopes Down-slope shape: Concave Across-slope shape: Concave

3.3.2 Soil semi-variogram description

The goal of this aspect of the site characterization is to determine the minimum distance between the soil plots in the soil array such that data farther apart can be considered spatially independent. The collected field data will be used to produce semivariograms, which is a geostatistical technique to characterize spatial autocorrelation between mapped samples of a quantitative variable (*e.g.*, soil property data in our case). In an empirical semivariogram, the average of the squared differences of a response variable is computed for all pairs of points within specified distance intervals (lag classes). The output is presented graphically as a plot of the average semi-variance versus distance class (Figure 5). For the theoretical variogram models considered here, the semivariance will converge on the total variance at distances for which values are no longer spatially auto-correlated (this is referred to as the range, Figure 5).

For the theoretical variograms considered here, three parameters estimated from the data are used to fit a semivariogram model to the empirical semivariogram. This model is then assumed to quantitatively represent the correlation as a function of distance (Figure 5), the range, the sill (the sill is the asymptotic value of semi-variance at the range), and the nugget (which describes sampling error or variation at distances below those separating the closest pairs of samples). The range, sill and nugget are estimated from theoretical models that are fitted to the empirical variograms using non-linear least squares methods.

The variogram analysis will be used, to determine the spatial scales at which we can consider soil measurements spatially independent. This characterization will directly inform the minimum distance between *i*) soil plots within each soil array, *ii*) the soil profile measurements, *iii*) EP plots, and *iv*) the microbial sampling locations. These data will directly inform NEON construction and site design activities.

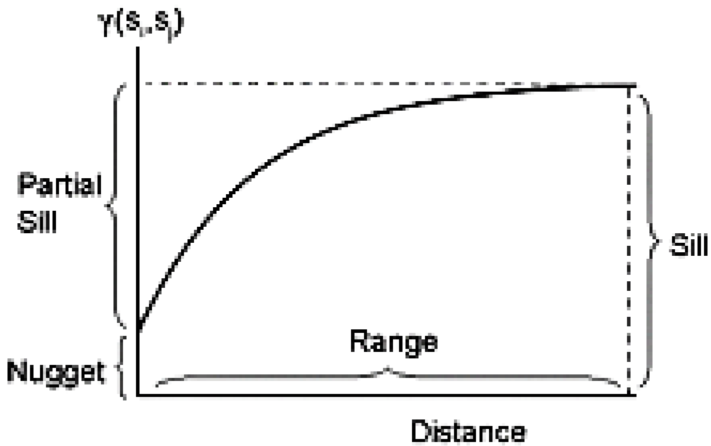


Figure 5. Example semivariogram, depicting range, sill, and nugget.

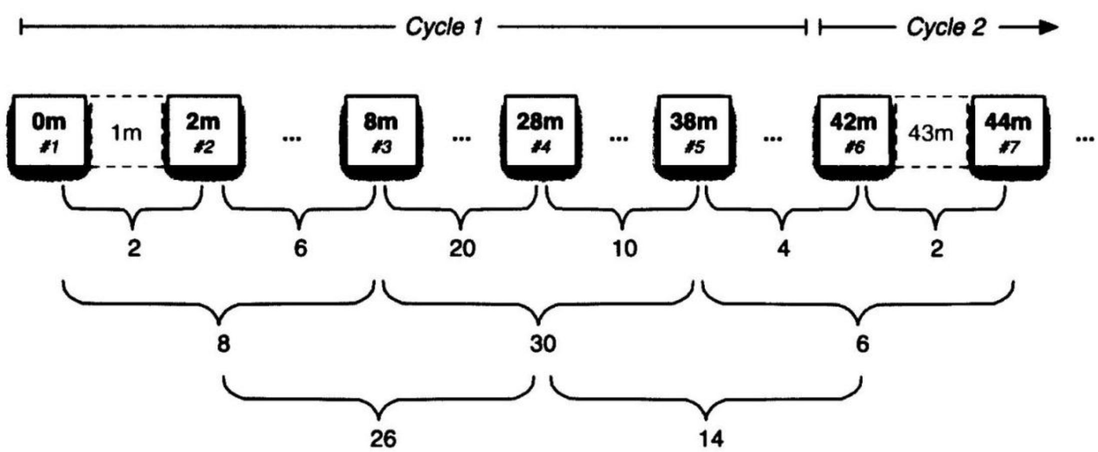


Figure 6. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 12 May 2010 at the Konza - Core site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 6). Soil temperature and moisture measurements were collected along three transects (210 m, 84 m, and 84 m) located in the expected airshed at Konza - Core. Details of how the airshed was determined are provided below. Soil temperature was measured with platinum resistance temperature sensors (RTD 810, Omega Engineering Inc., Stamford CT) and soil moisture was measured with time domain diaelectric sensors (CS616, Campbell Scientific Inc., Logan UT).

As well as measuring soil temperature and moisture at each sample point in Figure 6, measurements were also taken 30 cm in front and behind the sampling point along the axis of the transect. For example, at the 2 m sampling point, soil temperature and moisture was measured at 1.7 m, 2 m, and 2.3 m; this data is referred to as mobile data, since the measurements were taken at many different locations. In addition, soil temperature and moisture were continuously recorded at a single fixed location (stationary data) throughout the sampling time to correct for changes in temperature and moisture throughout the day.

Data collected were used for geospatial analyses of variograms in the R statistical computing language with the geoR package to test for spatial autocorrelation (Trangmar *et al.* 1986; Webster & Oliver 1989; Goovaerts 1997; Riberiro & Diggle 2001) and estimate the distance necessary for independence among soil plots in the soil array. To correct for changes in temperature and moisture over the sampling period, the stationary data was subtracted from the mobile data. In many instances a time of day trend was still apparent in the data even after subtracting the stationary data from the mobile data. This time of day trend was corrected for by fitting a linear regression and using the residuals for the semivariogram analysis. There was still evidence of trends in the data after these corrections, so trends related to elevation, aspect, and slope were also corrected for if significant ($p < 0.05$) prior to producing the semivariogram. Soil temperature and moisture data, R code, graphs, and R output can be found at: P:\FIU\FIU_Site_Characterization\DXX\YYYYYYY_Characterization\Soil Measurements\Soil Data Analysis (where XX = domain number and YYYYYYY = site name).

3.3.3 Results and interpretation

3.3.3.1 Soil Temperature

Soil temperature data residuals, after accounting for changes in temperature in the stationary data, any remaining time of day trend, and trends related to elevation and aspect, were used for the semivariogram analysis (Figure 7). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 8, left graph) and directional semivariograms do not show anisotropy (Figure 8, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 8, right graph). The model indicates a distance of effective independence of 18 m for soil temperature.

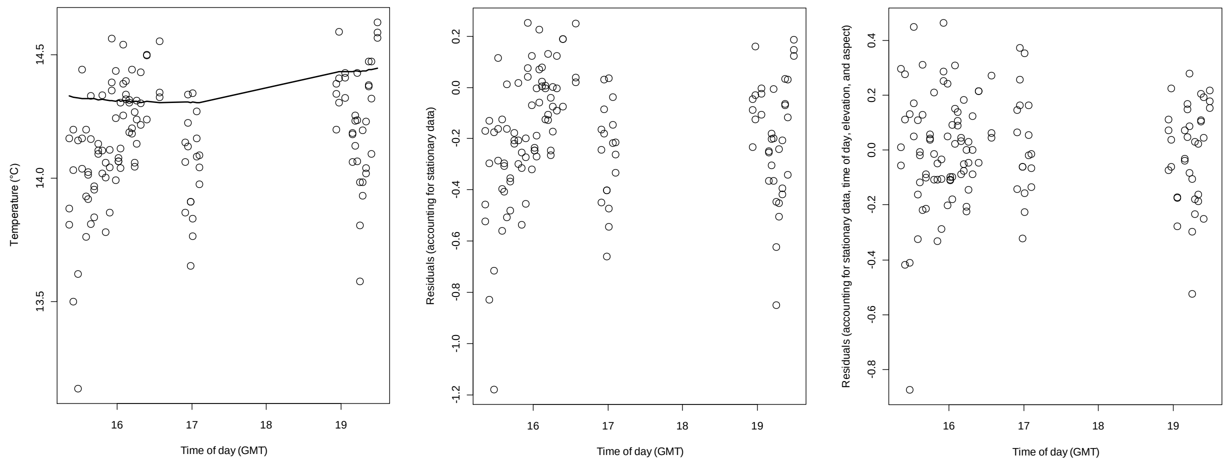


Figure 7. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

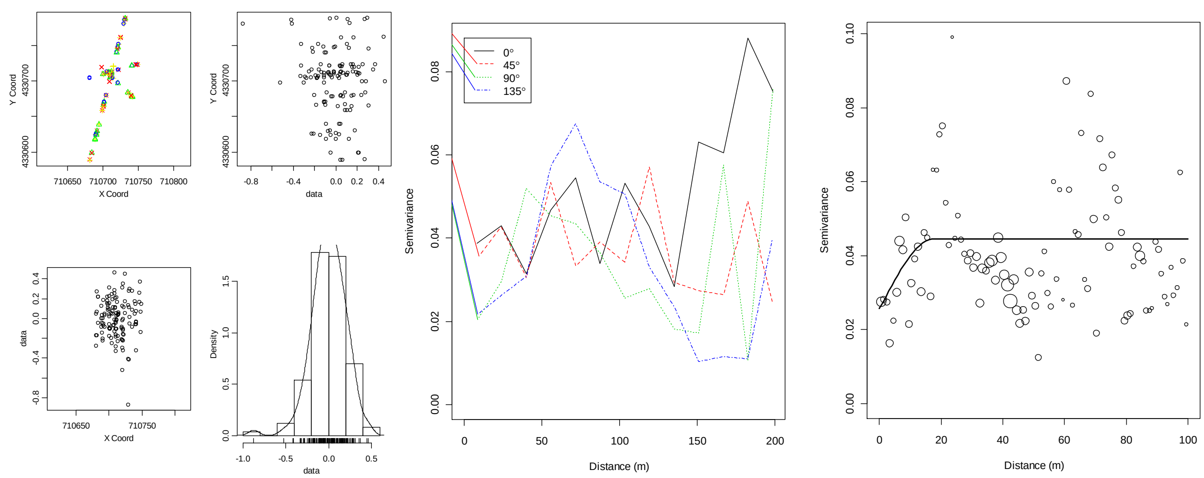


Figure 8. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

3.3.3.2 Soil water content

Soil water content data residuals, after accounting for changes in water content in the stationary data, any remaining time of day trend, and trends related to elevation and slope, were used for the semivariogram analysis (Figure 9). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 10, left graph) and directional semivariograms do not show anisotropy (Figure 10, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 10, right graph). The model indicates a distance of effective independence of 52 m for soil water content.

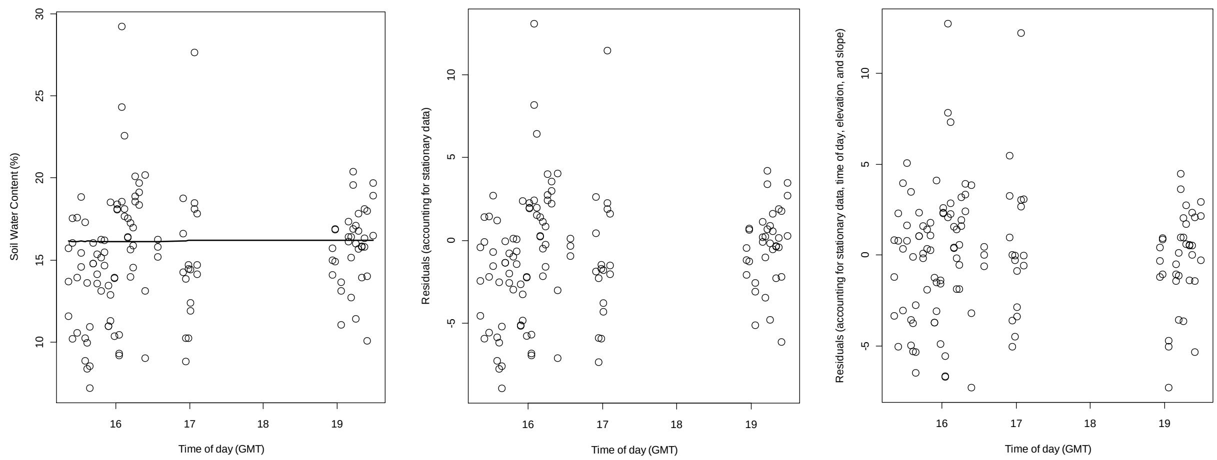


Figure 9. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting for changes water content in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

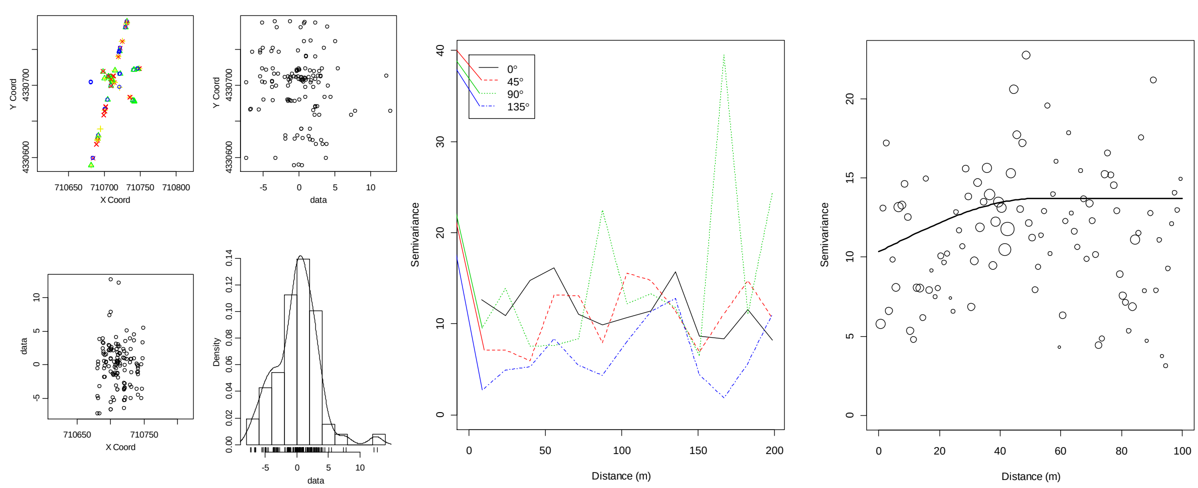


Figure 10. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

3.3.3.3 Soil array layout and soil pit location

The minimum distance allowable between soil plots is 25 m to ensure a degree of spatial independence in non-measured soil parameters (i.e., other than temperature and water content) and the maximum distance between soil plots is 40 m due to cost constraints. The estimated distance of effective independence was 18 m for soil temperature and 52 m for soil moisture. Based on these results and the site design guidelines the soil plots at Konza - Core shall be placed 52 m apart (cost variance needed). The distance between soil plots is 52 m, rather than 40 m, since this is what the semivariograms show as the most appropriate distance and it is only a little larger than the typical maximum distance of 40 m. The soil array shall follow the linear soil array design (Soil Array Pattern B) with the soil plots being 5 m x 5 m. The direction of the soil array shall be 185° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 39.100890°, -96.563110°. The exact location of each soil plot may be microsited to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc). The FIU soil pit for characterizing soil horizon depths, collecting soil for site-specific sensor calibration, and collecting soil for the FIU soil archive will be located at 39.103957, -96.563219 (primary location); or 39.104414, -96.563204 (alternate location 1 if primary location is unsuitable); or 39.104735, -96.563349 (alternate location 2 if primary location is unsuitable). A summary of the soil information is shown in Table 4 and site layout can be seen in Figure 11.

Dominant soil series at the site: Benfield-Florence complex, 5 to 30 percent slopes. The taxonomy of this soil is shown below:
Order: Mollisols
Suborder: Ustolls
Great group: Argiustolls
Subgroup: Udertic Argiustolls- Udic Argiustolls
Family: Fine, mixed, superactive, mesic Udertic Argiustolls- Clayey-skeletal, smectitic, mesic Udic Argiustolls
Series: Benfield-Florence complex, 5 to 30 percent slopes

Table 4. Summary of soil array and soil pit information at Konza - Core. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	52 m
Distance from tower to closest soil plot: y	20 m
Latitude and longitude of 1st soil plot OR direction from tower	39.100590°, -96.563110°
Direction of soil array	185°
Latitude and longitude of FIU soil pit 1	39.103957, -96.563219 (primary location)
Latitude and longitude of FIU soil pit 2	39.104414, -96.563204 (alternate 1)
Latitude and longitude of FIU soil pit 3	39.104735, -96.563349 (alternate 2)
Dominant soil type	Benfield-Florence complex, 5 to 30 percent slopes
Expected soil depth	0.56-0.99 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.15 m (Silty clay loam)	0.08 m†
0.15-0.30 m (Silty clay loam)	0.30 m†
0.30-0.66 m (Silty clay)	0.48 m†
0.66-0.89 (Silty clay loam)	0.78 m

	0.89 m
0.89-0.99 m (Bedrock)	

*Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.
†Expected depth of soil CO_2 sensors (actual depth will be based on findings from the FIU soil pit)

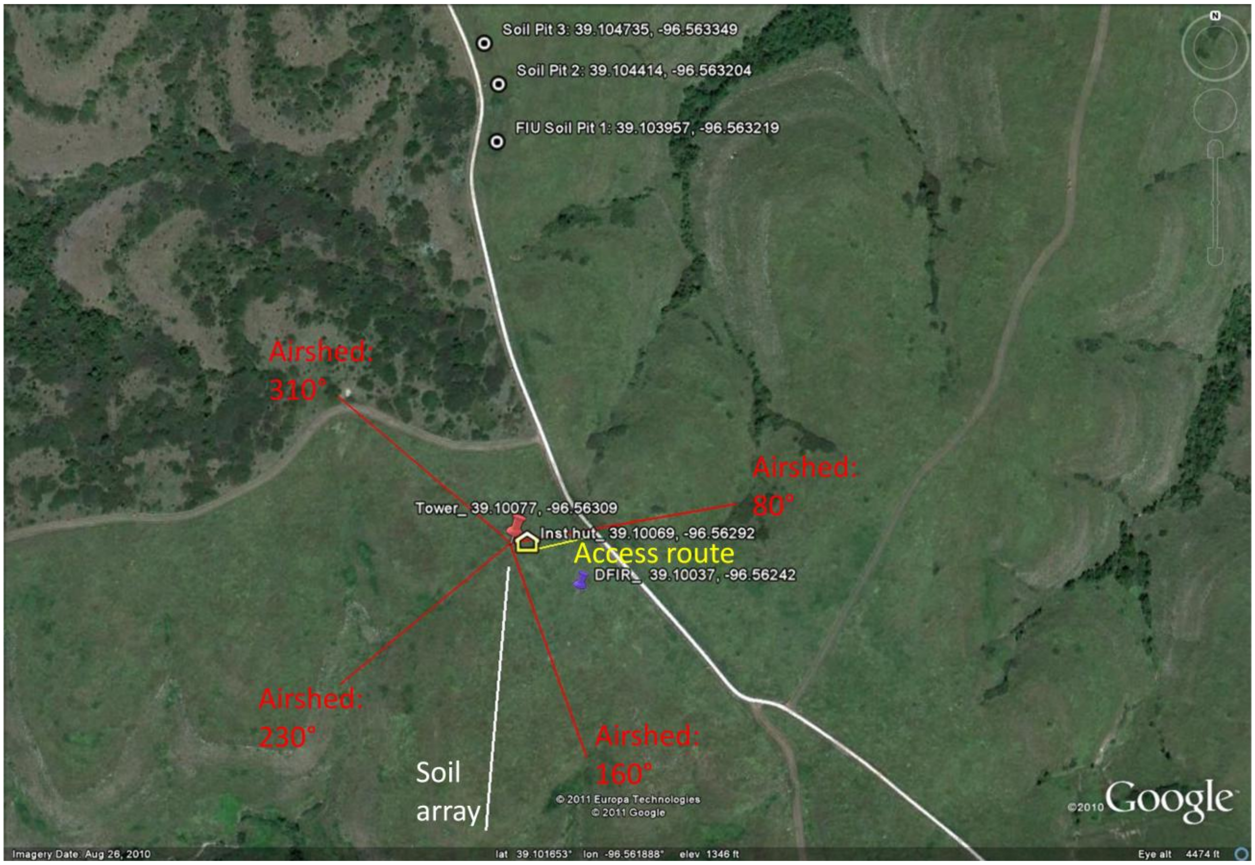


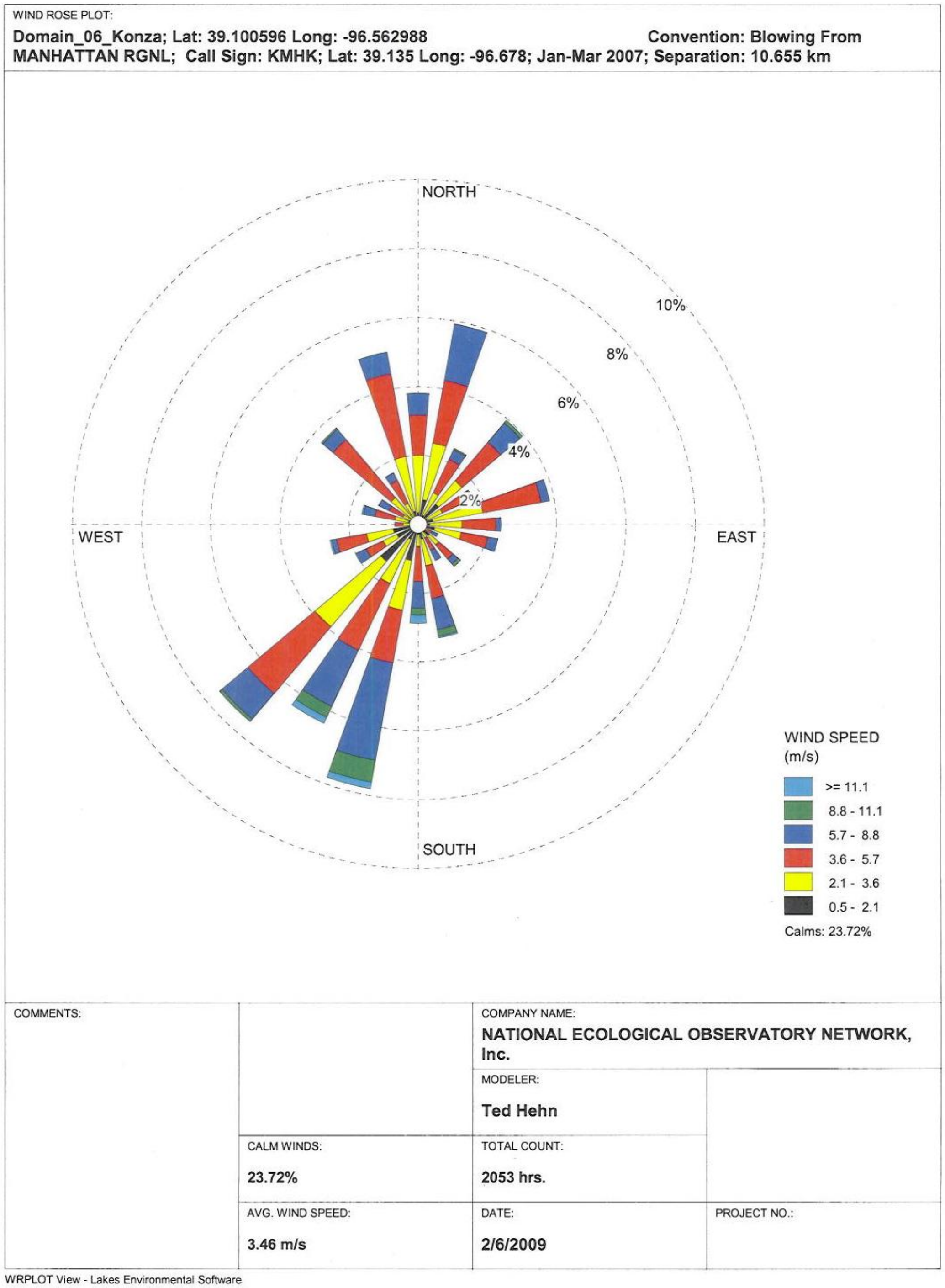
Figure 11. Site layout at Konza - Core showing soil array and location of the FIU soil pit.

3.4 Airshed

3.4.1 Seasonal windroses

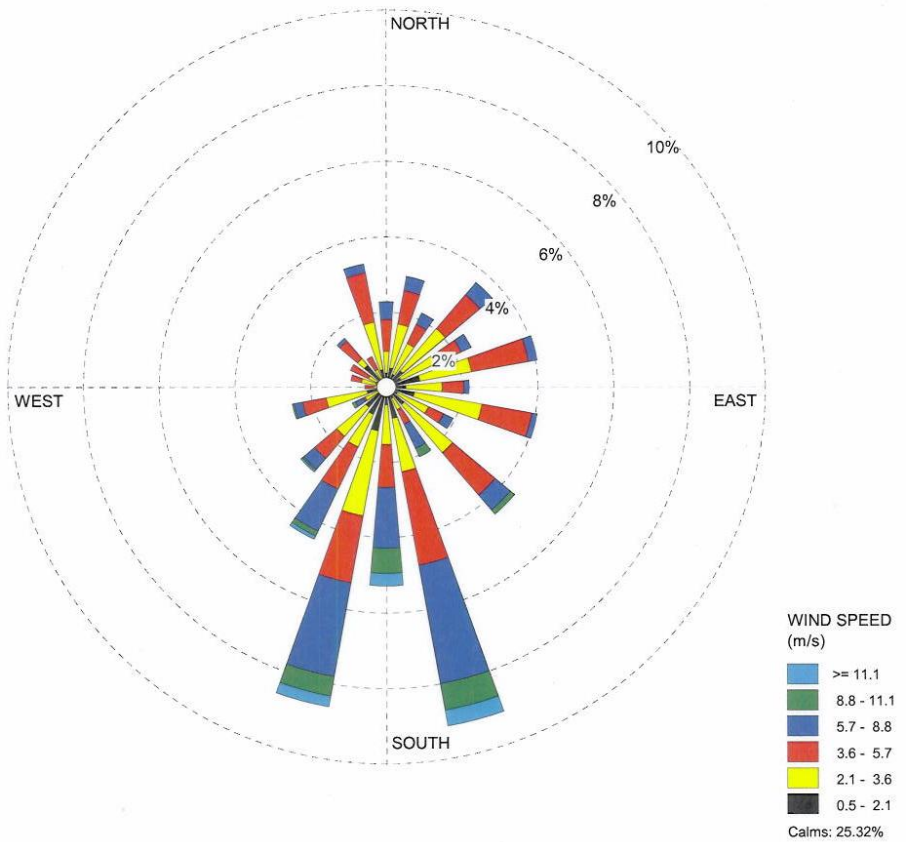
Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries. The data used to make the wind roses below are 2007 data from Manhattan Regional airport at 39.135, -96.678, which is ~ 11 km away from the NEON tower site. The orientation of the windrose follows that of a compass (assume declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. The directions of the rose with the longest spoke show wind directions with the largest frequency. These wind roses are subdivided into as 24 cardinal directions in this case.

3.4.2 Results (graphs for wind roses)



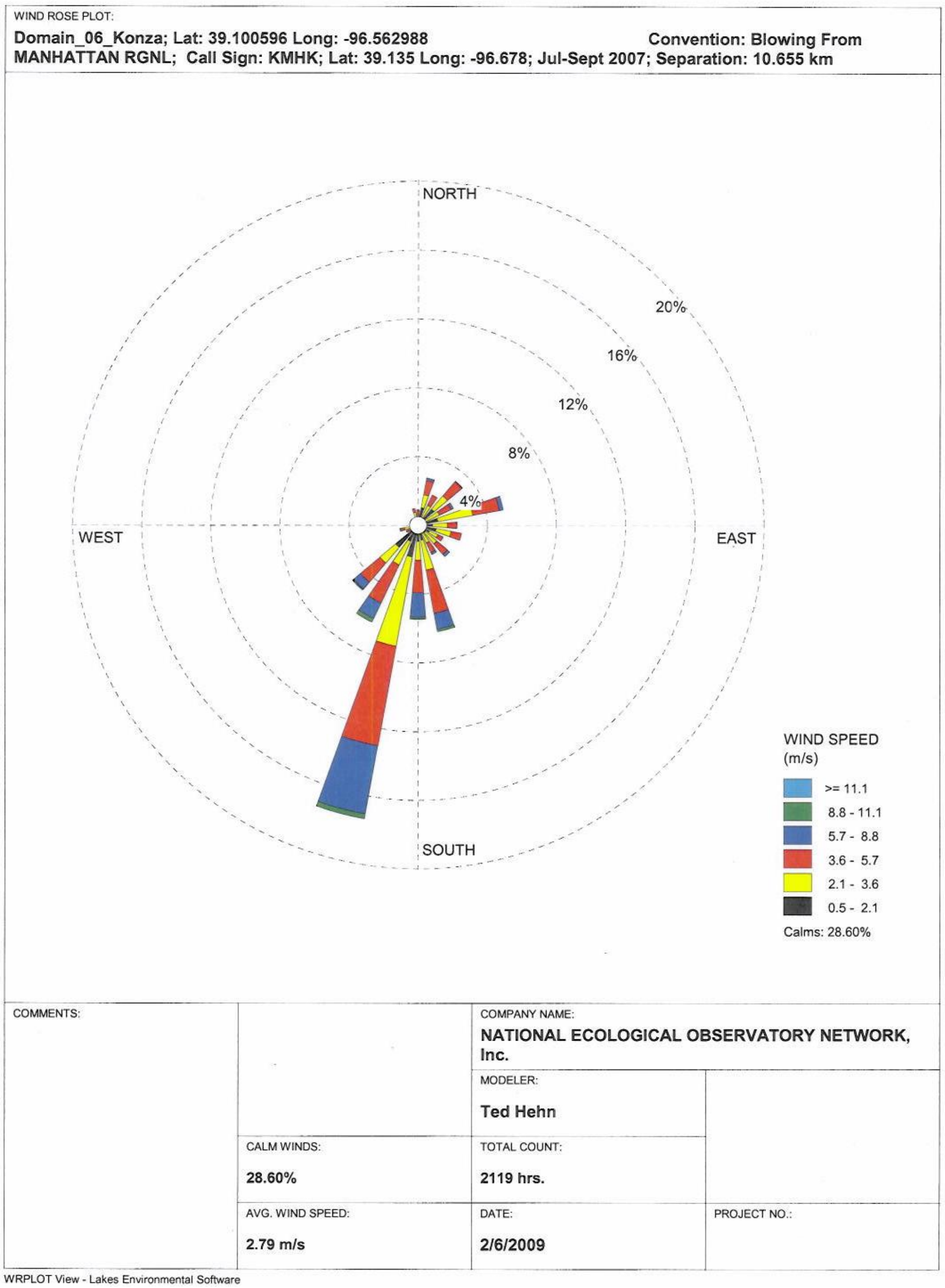
WIND ROSE PLOT:

Domain_06_Konza; Lat: 39.100596 Long: -96.562988 **Convention: Blowing From**
MANHATTAN RGNL; Call Sign: KMHK; Lat: 39.135 Long: -96.678; Arp-Jun 2007; Separation: 10.655 km



COMMENTS:		COMPANY NAME: **NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.**	
		MODELER: **Ted Hehn**	
	CALM WINDS: **25.32%**	TOTAL COUNT: **2105 hrs.**	
	AVG. WIND SPEED: **3.35 m/s**	DATE: **2/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software



WIND ROSE PLOT:
Domain_06_Konza; Lat: 39.100596 Long: -96.562988
Convention: Blowing From
MANHATTAN RGNL; Call Sign: KMHK; Lat: 39.135 Long: -96.678; Jul-Sept 2007; Separation: 10.655 km
NORTH
WEST
EAST
SOUTH
4%
8%
12%
16%
20%
WIND SPEED (m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 28.60%
COMMENTS:
COMPANY NAME:
NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.
MODELER:
Ted Hehn
CALM WINDS:
28.60%
TOTAL COUNT:
2119 hrs.
AVG. WIND SPEED:
2.79 m/s
DATE:
2/6/2009
PROJECT NO.:
WRPLOT View - Lakes Environmental Software

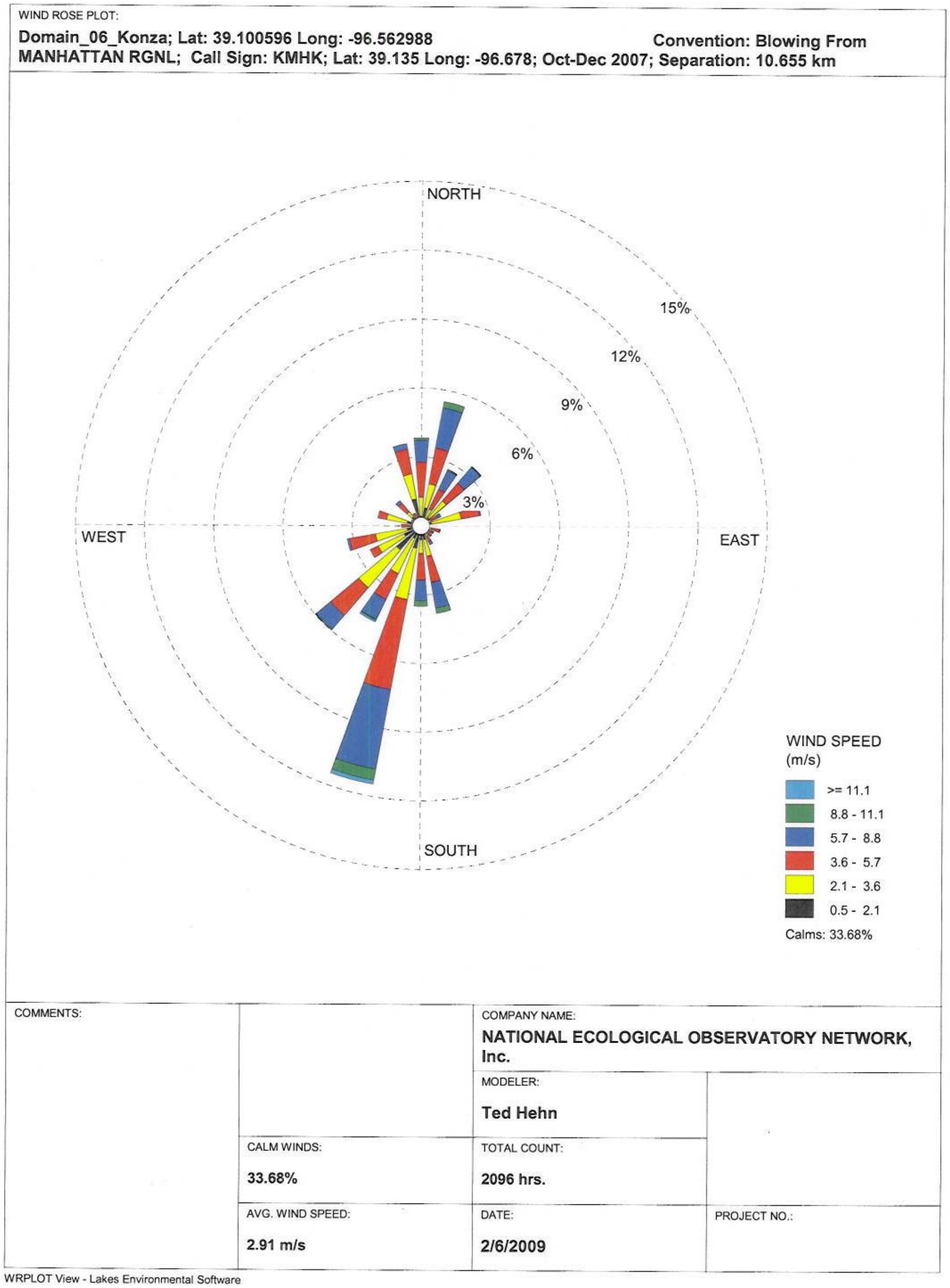


Figure 12. Windroses for Konza Advanced tower site

The data used to make these wind roses are 2007 data from Manhattan Regional airport at 39.135, -96.678, which is ~ 11 km away from the NEON tower site. It is assumed that the wind data was corrected for declination. Panels are (from top to bottom) January to December.

3.4.3 Resultant vectors

Not available.

3.4.4 Expected environmental controls on source area

Two types of models were commonly used to determine the shape and extent of the source area under different and contrasting atmospheric stability classes. An inverted plume dispersion model with modeled cross wind solutions were used for convective conditions (Horst and Weil 1994). For strongly stable conditions, and Lagrangian solution was used (Kormann and Meixner 2001). The source area models where bounded by the expected conditions depict the extreme conditions. Convective conditions typically have strong vertical mixing between the ecosystem and atmosphere (surface layer). Stable conditions typically have long source area and associated waveforms. Convective turbulence is often characterized by short mixing scales (scalar) and moderate daytime wind speeds, *e.g.,* 1-4 m s^{-2}. Higher wind speeds, like those experienced over the Rockies, are often the product of mechanical turbulence with long waveforms. Because thermal stratification is very efficient in suppressing vertical mixing, stable conditions also have typically very long waveforms.

As a general rule, shorter and less structurally complex ecosystems have good vertical mixing during all atmospheric stabilities. Taller and more structurally complex ecosystems have well mixed upper canopies during the daytime, and can be decoupled below the canopy under neutral and stable conditions. The type of turbulence (mechanical verse convective) and the physical attributes of the ecosystem control the degree of mixing, and the length and size of the source area.

Here, we used a web-based footprint model to determine the footprint area under various conditions (model info: http://www.geos.ed.ac.uk/abs/research/micromet/EdiTools/). Winds used to run the model and generate following model results are extracted from the wind roses. Vegetation information, temperature and energy information were either from the RFI document, previous site visit report, available data files or best estimated from experienced expert. Measurement height was determined from the Tower Height Info document provided by ENG group, then verify according to the real ecosystem structure after FIU site characterization at site. Runs 1-3 and 4-6 represents the expected conditions for summer and winter conditions, respectively, with maximum and mean windspeeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was estimated from wind roses and is placed as a centerline in the site map included in the graphics. The width of the footprint was also estimated using the length between the isopleth of 80% cumulative flux and center line to calculate the angle from centerline. This information, along with distance of the cumulative flux isopleths and wind direction, will define the source area for the flux measurements on the top of the tower.

Table 5. Expected environmental controls to parameterize the source area model, and associated results for Konza advanced site.

Parameters	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	
Approximate season	summer			winter			Units
	Day (max WS)	Day (mean WS)	Night	Day (max WS)	Day (mean WS)	night	qualitative
Atmospheric stability	Convective	convective	Stable	Convective	convective	Stable	qualitative

Measurement height	6	6	6	6	6	6	m
Canopy Height	1.7	1.7	1.7	1.7	1.7	1.7	m
Canopy area density	0.7943	0.7943	0.794 3	0.2512	0.2512	0.2512	m
Boundary layer depth	3500	3500	1701	600	600	501	m
Expected sensible heat flux	381	381	90	180	180	10	W m^{-2}
Air Temperature	30	30	24	15	15	3	°C
Max. windspeed	11	3.8	1.8	13	5.6	2.4	m s^{-1}
Resultant wind vector	195	195	195	210	210	16	degrees
Results							
(z-d)/L	-0.01	-0.18	-0.32	0	-0.05	-0.04	m
d	1.1	1.1	1.1	0.78	0.78	0.78	m
Sigma v	3.2	2.2	1.1	2.8	1.5	0.59	m^2 s^{-2}
Z0	0.14	0.14	0.14	0.1	0.1	0.1	m
u*	1.2	0.48	0.25	1.3	0.6	0.25	m s^{-1}
Distance source area begins	0	0	0	0	0	0	m
Distance of 90% cumulative flux	500	250	200	600	480	500	m
Distance of 80% cumulative flux	250	200	150	300	250	280	m
Distance of 70% cumulative flux	200	150	100	250	200	200	m
Peak contribution	35	25	25	45	45	45	m

3.4.5 Results (source area graphs)

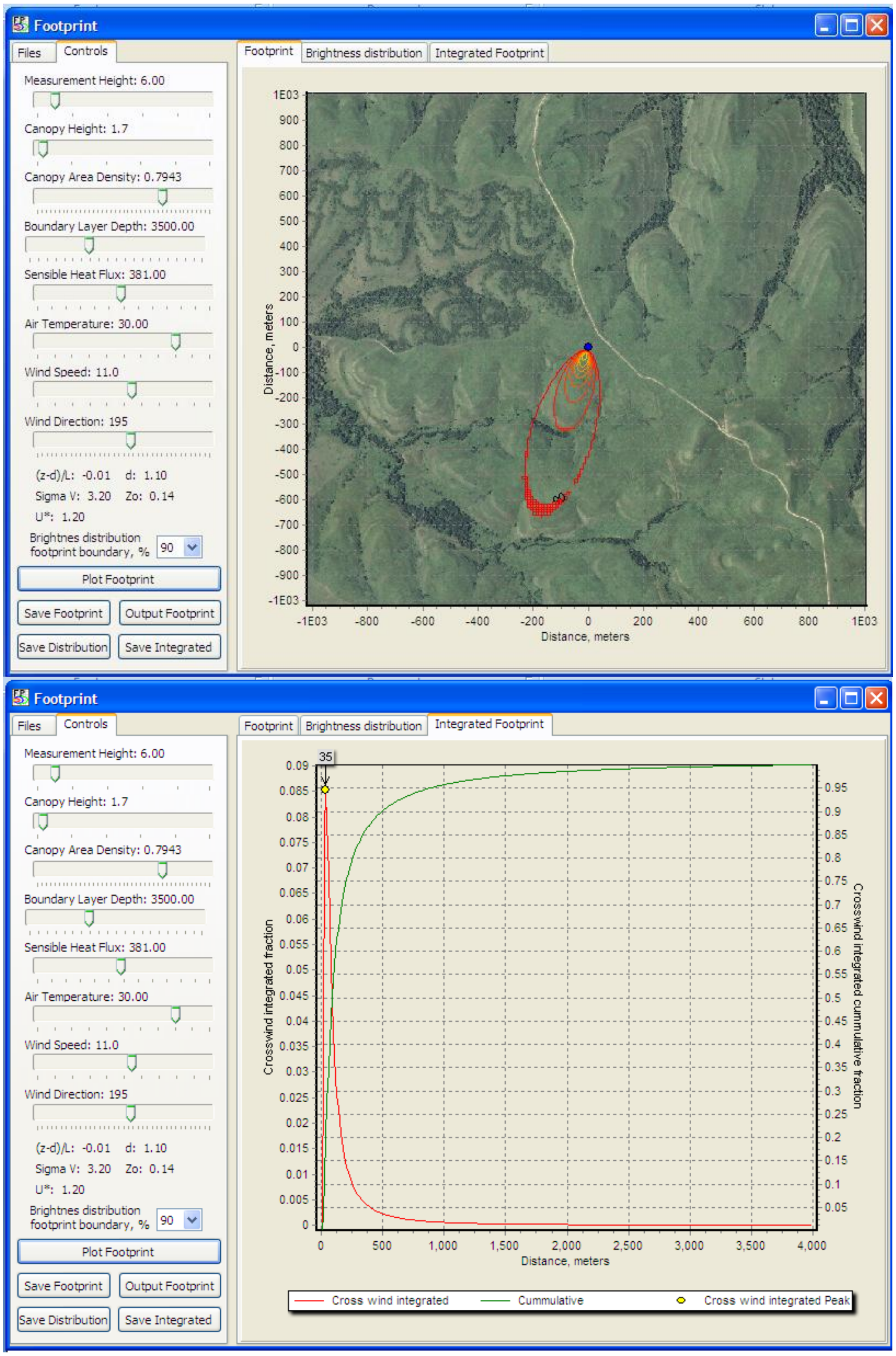


Figure 13. summer, daytime, max wind speed

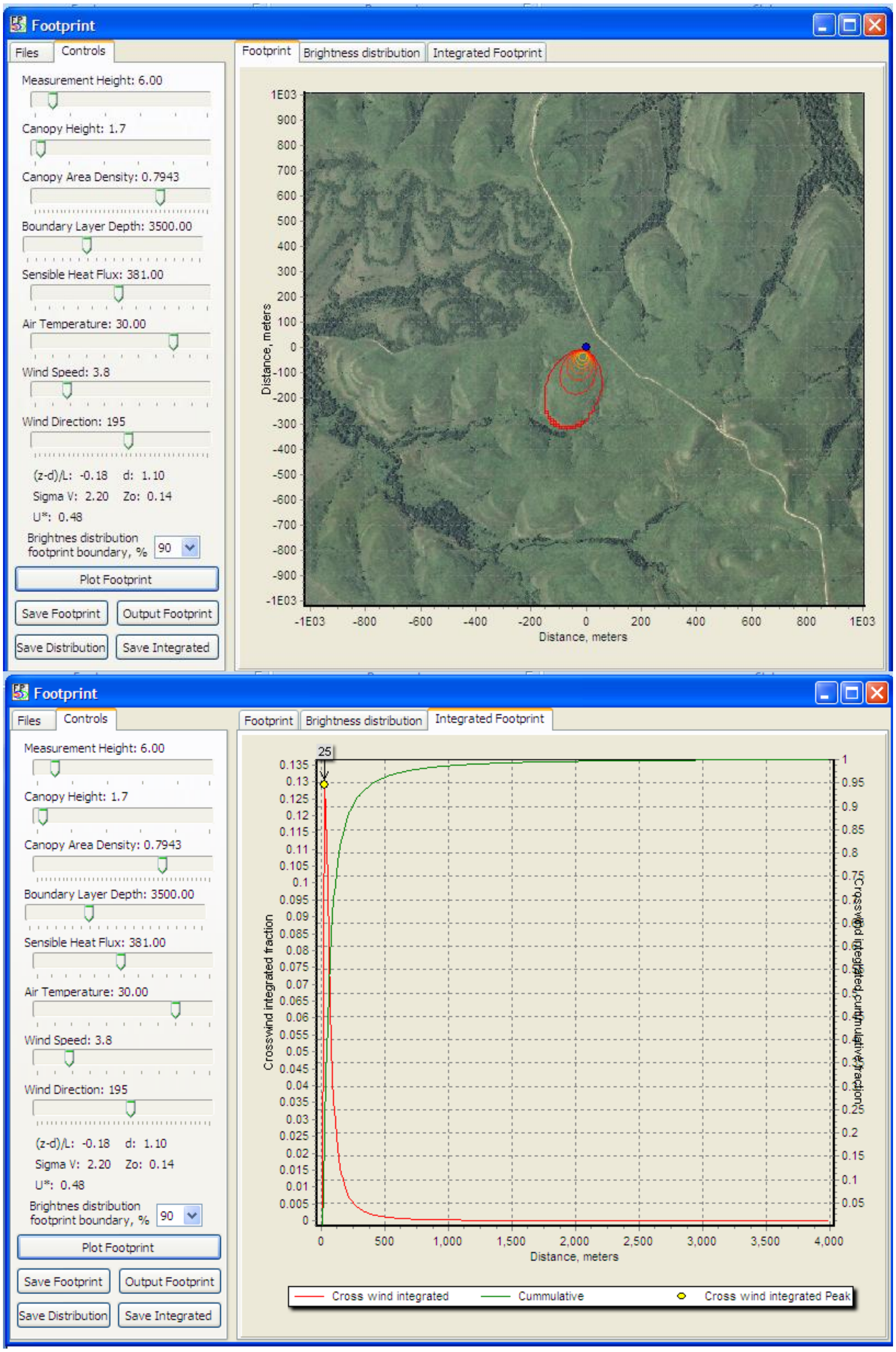


Figure 14. summer, daytime, mean wind speed

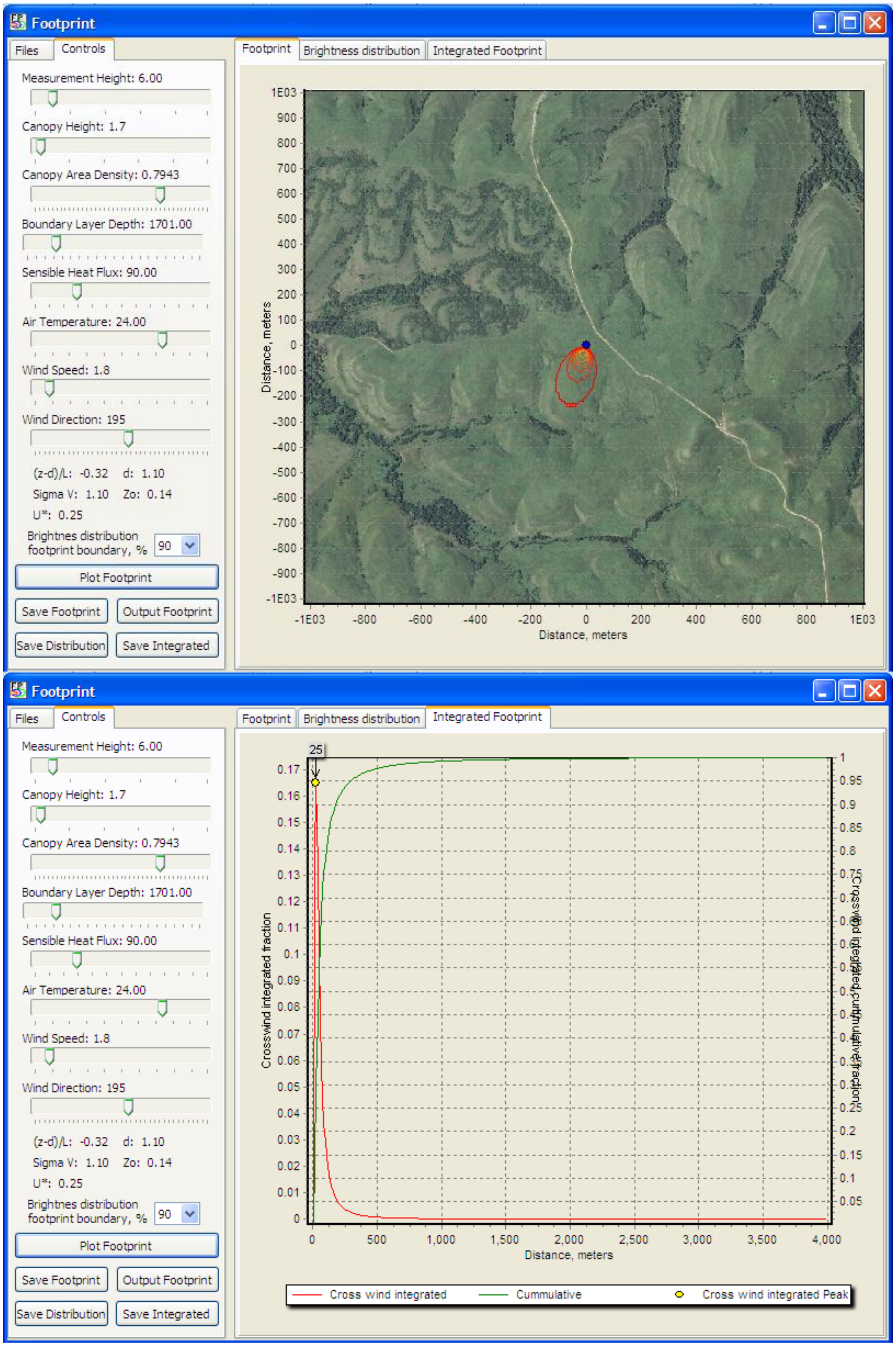


Figure 15. summer, nighttime, mean wind speed

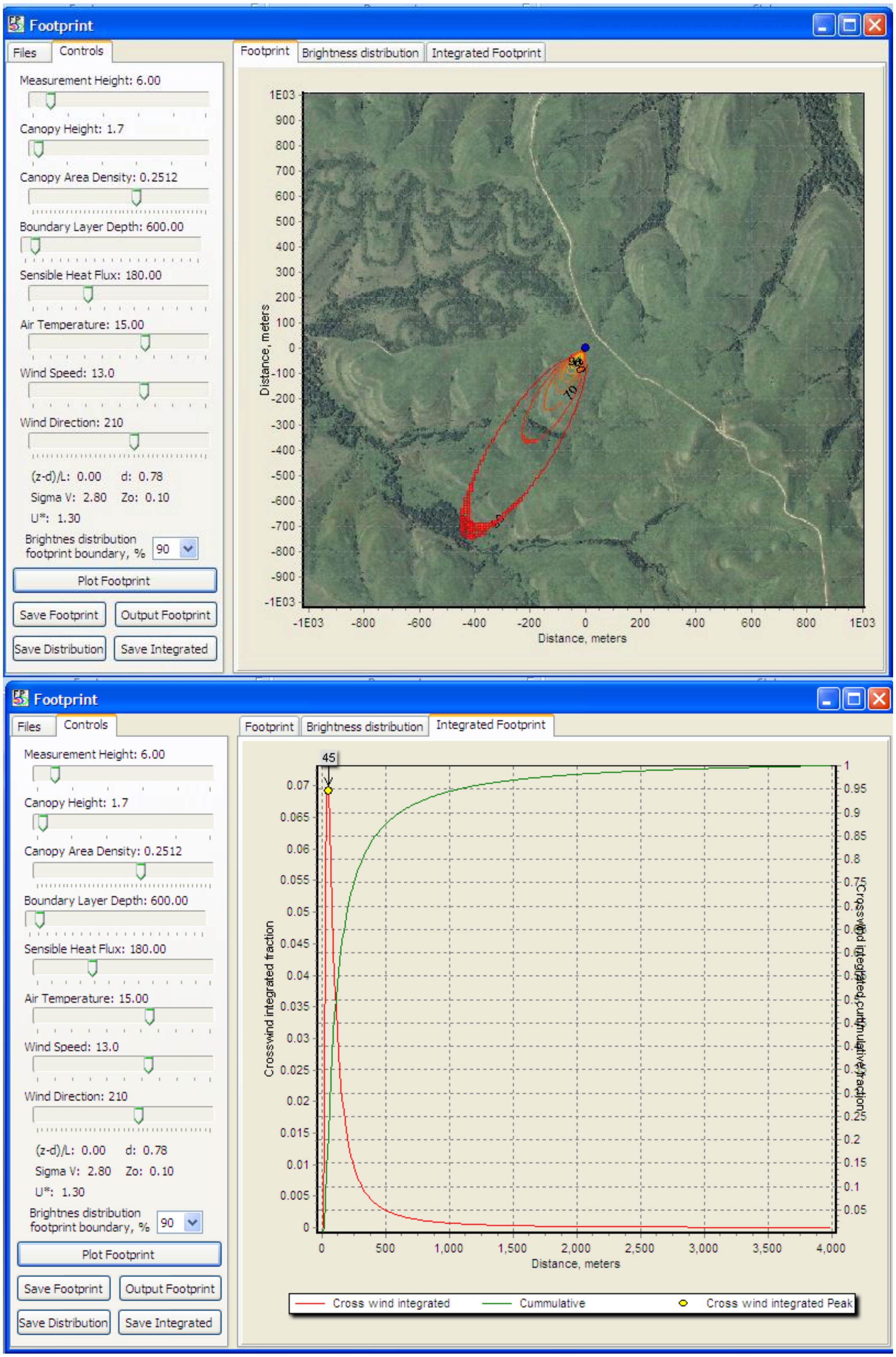


Figure 16. winter, daytime, max wind speed

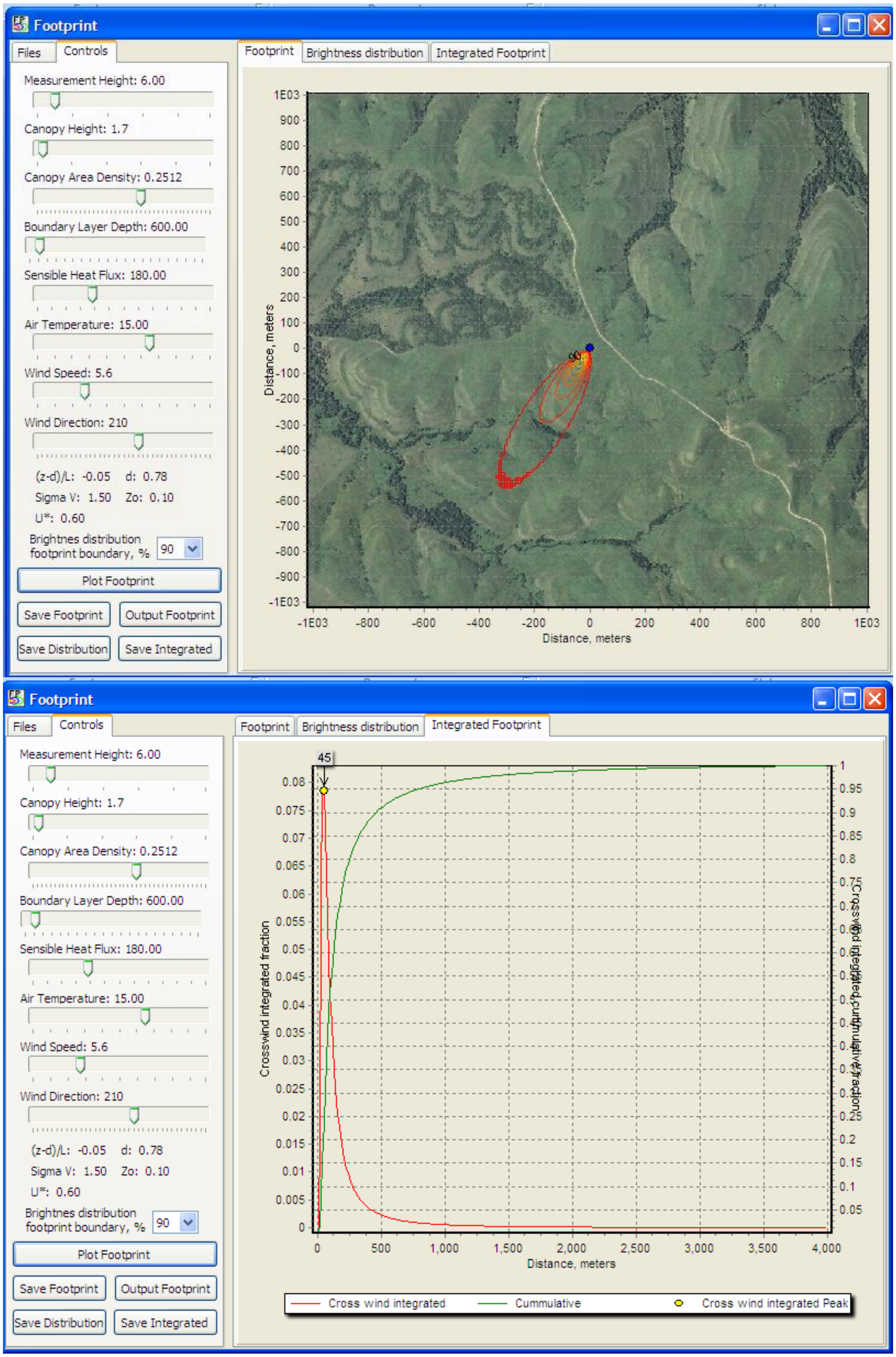


Figure 17. Winter daytime, mean wind speed

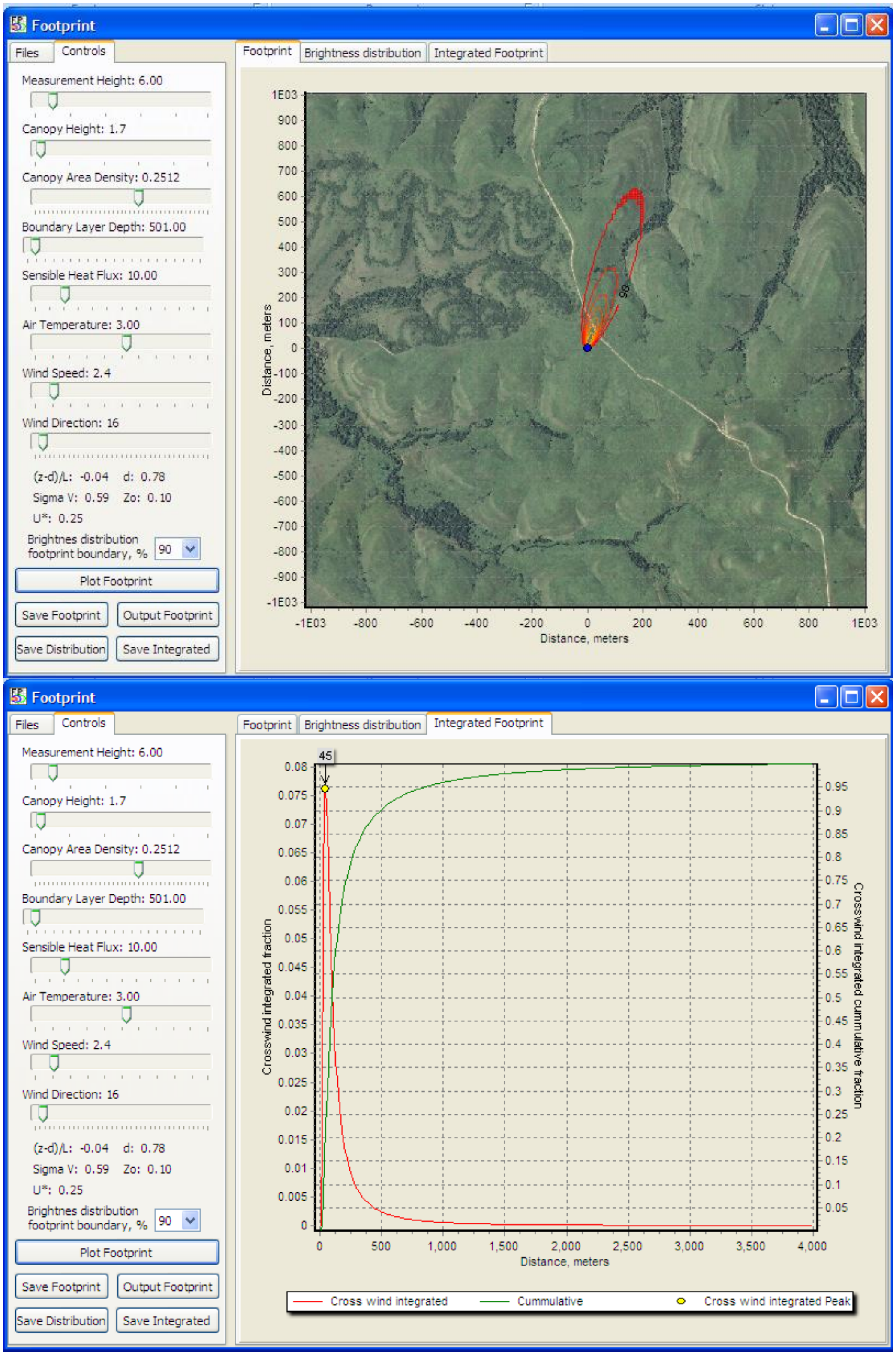


Figure 18. winter, nighttime, mean wind speed

3.5 Site design and tower attributes

According to the wind roses, wind can blow from any direction throughout the year. But wind blows most frequently from the airshed between 160° and 230° (clockwise from 160°, major airshed), and between 310° and 80° (clockwise from 310°, secondary airshed). **Tower** should be placed to a location to best catch the signals from the airshed of the ecosystem in interest, which is unplowed tallgrass prairie at this site. The Konza advance tower site was at 39.100596°, -96.562988°. We micro-sited this site to 39.10077, -96.56309 (which is only 20 m from the original site) and still inside the property boundary of Konza Prairie Biological Station.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the northwest will be best to capture signals from all wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

An **instrument hut** should be outside the prevailing wind airshed to avoid disturbance in the measurements of wind and should be positioned to have the longer side parallel to frequent wind direction to minimize the wind effects on instrument huts and to minimize the disturbances of wind regime by instrument hut. At this site, we determined the instrument hut location at 39.10069, -96.56292. The instrument hut should be positioned to have the longer side parallel to SW-NE direction.

The ecosystem at Konza Advanced site is unplowed tallgrass prairie. The mean canopy height was ~20 cm during FIU site characterization, but can reach 1-1.5 m at the end of the growing season. The canopy is uniform and terrain is relative flat. We require 4 **measurement layers** on the tower with top measurement height at 6 m, and remaining levels are 3.8 m, 1.5 m, and 0.2 m, respectively, to best characterize the fluxes on the tower top and environmental conditions in profile.

DFIR location is at 39.10037, -96.56242, which is ~70 m southeast to tower. **Wet deposition collector** will collocate at the top of the tower. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

The site layout is summarized in the table below. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 6. Site design and tower attributes for Konza Advanced site.

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan to best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed area			160° to 230° (major), and 310° to 80°		Clockwise from first angle

			(secondary)		
Tower location	39.10077,	-96.56309	--	--	
Instrument hut	39.10069,	-96.56292			
Instrument hut orientation vector	--	--	200° - 20°		Longwise
Instrument hut distance z	--	--	--	17	meter
Anemometer/Temperature boom orientation	--	--	290°	--	
DFIR	39.10037,	-96.56242			
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				1.5	m.a.g.l.
Level 3				3.8	m.a.g.l.
Level 4				6.0	m.a.g.l.
Tower Height				6.0	m.a.g.l.

See AD 03 for technical requirement to determine the boom height for the bottom most measurement level.

Figure below shows the proposed tower location, instrument hut location, DFIR, airshed area and access road.

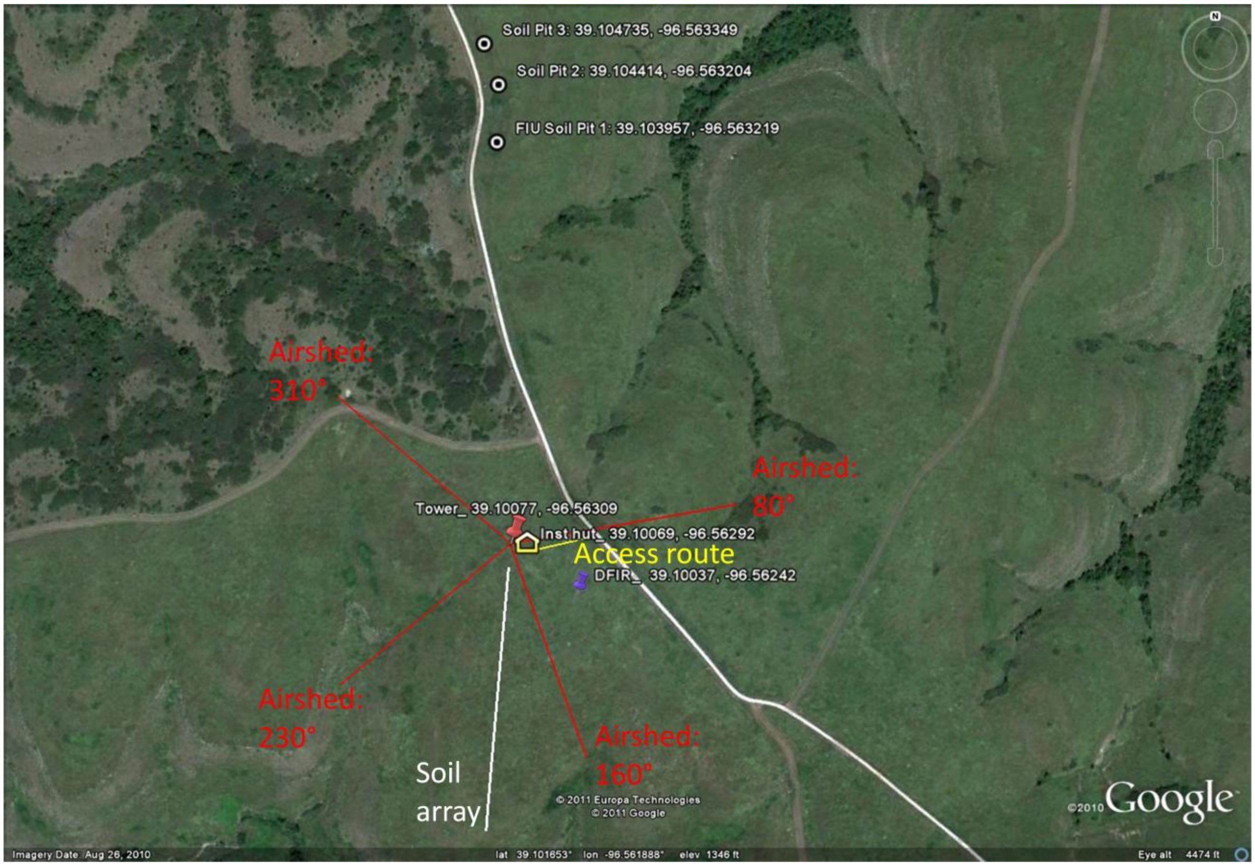


Figure 19. Site layout for Konza Advanced tower site.
i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 160^o to 230^o (major airshed, clockwise from 160^o) and 310^o to 80^o (clockwise from 310^o, secondary) would have quality wind data without causing flow distortions, respectively, iii) Yellow line is the suggested access road to instrument hut, and iv) Purple pin is DFIR location

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36" (0.914 m). The boardwalk to access the tower is not on any side that has a boom.
Specific Boardwalks at this site:

- Boardwalk from access point to instrument hut
- Boardwalk from instrument hut to tower and access tower on the north face.
- Boardwalk to the soil array.
- No boardwalk from the soil array boardwalk to the individual soil plots.
- No boardwalk or path needed to DFIR site.

The relative locations between tower, instrument hut and boardwalk can be found in the Figure below:

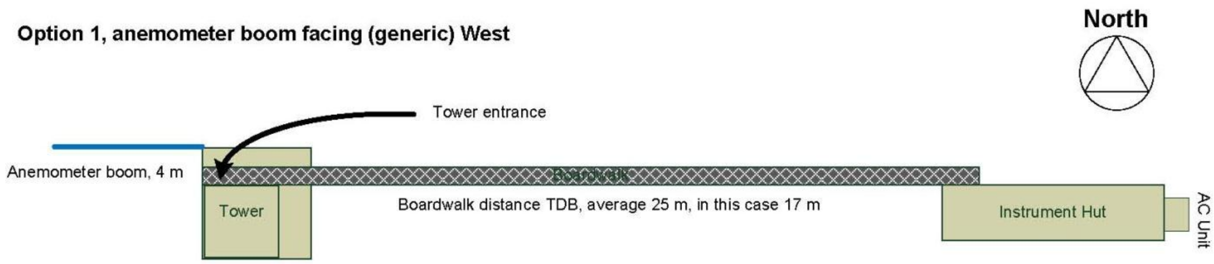


Figure 20. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram. The actual layout of boardwalk (or path if no boardwalk required) and instrument hut position will be the joint responsibility of FCC and FIU. At this site, the boom angle will be 290 degrees, instrument hut location is on the southeast toward tower, the distance between instrument hut and tower is 17 m. The instrument hut vector will be SW-NE (200^{o}-20^{o}, longwise).

3.6 Information for ecosystem productivity plots

The tower at this site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (tallgrass prairie). Wind can blow from any direction during the year, but has higher frequency from the airshed between 160^{o} and 230^{o} (clockwise from 160^{o}, major airshed), and between 310^{o} and 80^{o} (clockwise from 310^{o}, secondary airshed). 90% signals for flux measurements are within 600 m from tower, and 80% within 300 m. We suggest FSU Ecosystem Productivity plots are placed within the boundaries of 160^{o} to 230^{o} (clockwise from 160°, major) and 310^{o} to 80^{o} (clockwise from 310^{o}, secondary) from tower.

3.7 Issues and attentions

The land where the tower, instrument hut, soil array, and DFIR are located is burned every 2 years by managed fires. In addition, wildfires or managed burns in other areas may occasionally spread to this location (i.e. unmanaged fires). The site design, construction, and operation must be able to tolerate frequent fires. Chiggers and ticks are prevalent. Konza PrairieBiological Station is heavily used for ecological research. Coordination with land managers is required to ensure that the NEON site does not interfere with other research in the area and vice versa.

4 UNIVERSITY OF KANSAS BIOLOGICAL STATION, RELOCATEABLE TOWER 1

4.1 Site description

The original tower location was 39.040, -95.192. During the site characterization visit the tower location was microsited ~50 m north (39.04043, -95.19215), which brings it closer to both power and access. The new NEON tower location is at the site of an old snag (dead tree) that is ~7 m tall, and is approximately equidistant between nearby live trees. There is an old tower that is no longer used ~180 m east (39.04055, -95.19003) of the NEON tower.

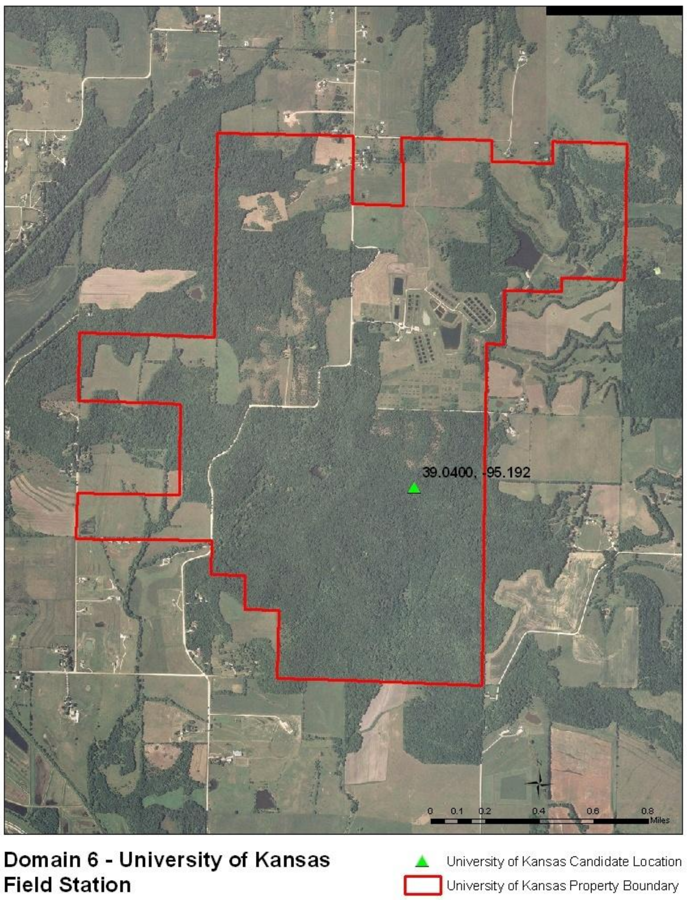


Figure 21. University of Kansas Field Station property boundary and original candidate tower location.

4.2 Ecosystem

Vegetation type and land cover information at this relocatable site are presented below:

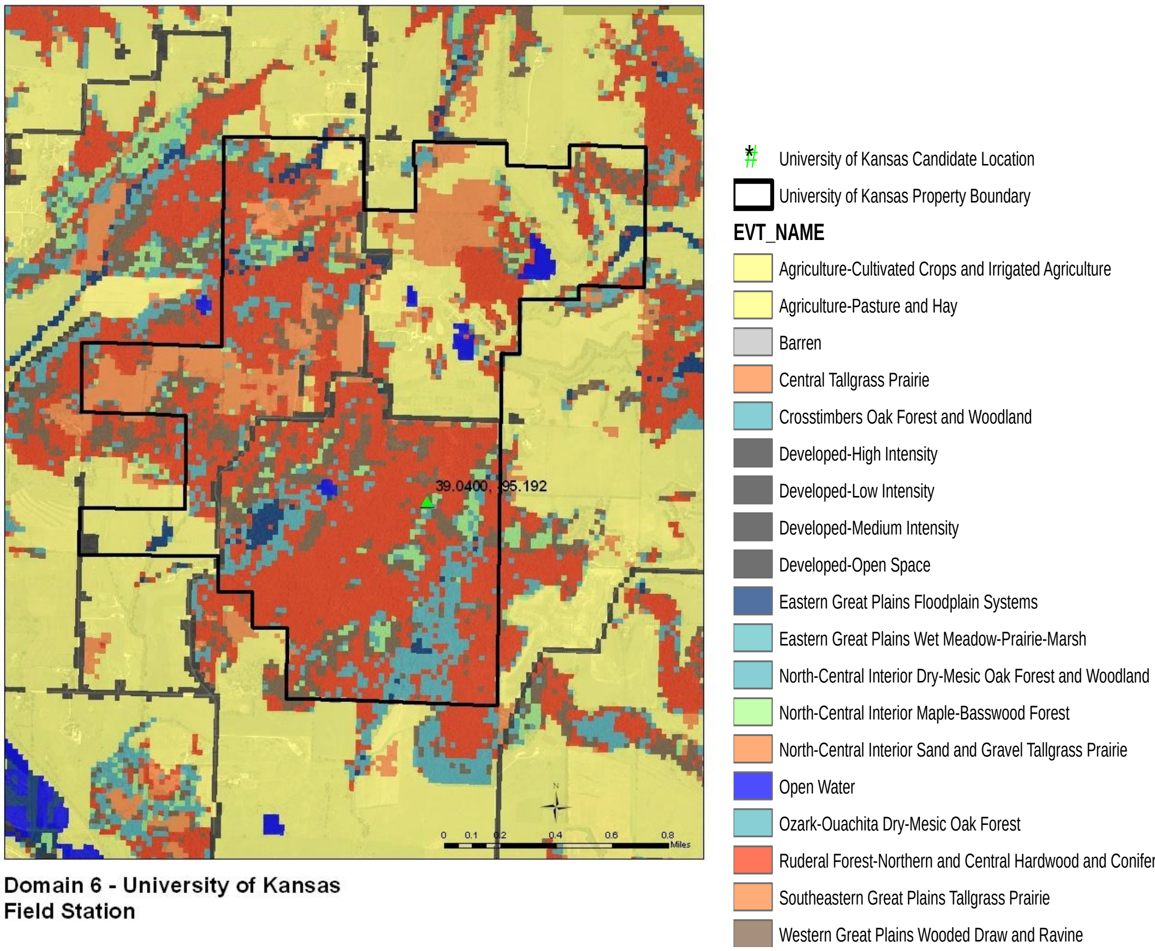


Figure 22. Vegetative cover map of the University of Kansas Field Station relocatable site and surrounding areas
(from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm).

Table 7. Percent Land cover information at the University of Kansas Field Station relocatable site (from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Vegetation Type	**Area (km²)**	**Percent**
Agriculture-Cultivated Crops and Irrigated Agriculture	0.00	0.01
Agriculture-Pasture and Hay	1.19	19.30
Central Tallgrass Prairie	0.78	12.57
Crosstimbers Oak Forest and Woodland	0.00	0.07
Developed-Open Space	0.16	2.59
Eastern Great Plains Floodplain Systems	0.12	1.94
North-Central Interior Dry-Mesic Oak Forest and Woodland	0.57	9.25
North-Central Interior Maple-Basswood Forest	0.21	3.34
Open Water	0.06	1.02
Ozark-Ouachita Dry-Mesic Oak Forest	0.00	0.04

Ruderal Forest-Northern and Central Hardwood and Conifer	2.45	39.66
Western Great Plains Wooded Draw and Ravine	0.63	10.20
Total Area sq km	6.17	100.00

The ecosystem around tower and inside the major airshed is mixed hardwood forest with canopy height at ~19 m. Major species include oak and hickory, with some elm. Small trees form the understory with canopy height 4-8m. Lowest branch level is at 1.5 m. Vegetation at floor level is dense and consists of annuals or bi-annuals with height ~ 1 m. This site was tallgrass prairie in 1850, but since then, forest has invaded and expanded due to fire suppression.

The tower and soil array location was not plowed. However, several nearby areas were plowed and then abandoned and are now dominated by cedar (e.g. the area ~50 m north of the tower location).

The Biological Station is characterized by rolling hills. The tower is located at a relatively high location, with small valleys to the west, south, and east. The tower location was microsited ~50 m north to maximize the airshed in relatively flat areas, but is likely that the some night time air drainage will occur at this site due to its topography. There are limestone outcrops throughout the area (e.g. ~100 south of the tower), which sometimes form small cliffs/steep slopes (~3 m high). There are many small (<1 m wide) ephemeral streams near the tower location. Soils are shallow in many places around the tower (e.g. 10-15 cm).

Figure 23. Ecosystem and surrounding environment at the University of Kansas Field Station relocatable site.

Table 8. Ecosystem and site attributes for the University of Kansas Field Station Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height at construction [a]	19.0 m
Surface roughness at construction [a]	3.0 m
Zero place displacement height at construction [a]	14.5 m
Structural elements	Mixed hardwood forest, young tree understory, dense vegetation on forest floor
Time zone	central time zone
Magnetic declination	2° 52' E changing by 0° 7' W/year

Note, [a] From field survey

4.3 Soils

4.3.1 Description of soils

Soil data and soil maps below for the University of Kansas Biological Station tower site were collected from 2.2 km^2 NRCS soil maps (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) to determine the dominant soil types in the larger tower foot print. This was done to assure that the soil array is in the dominant (or in the co-dominant) soil type present in the tower footprint.

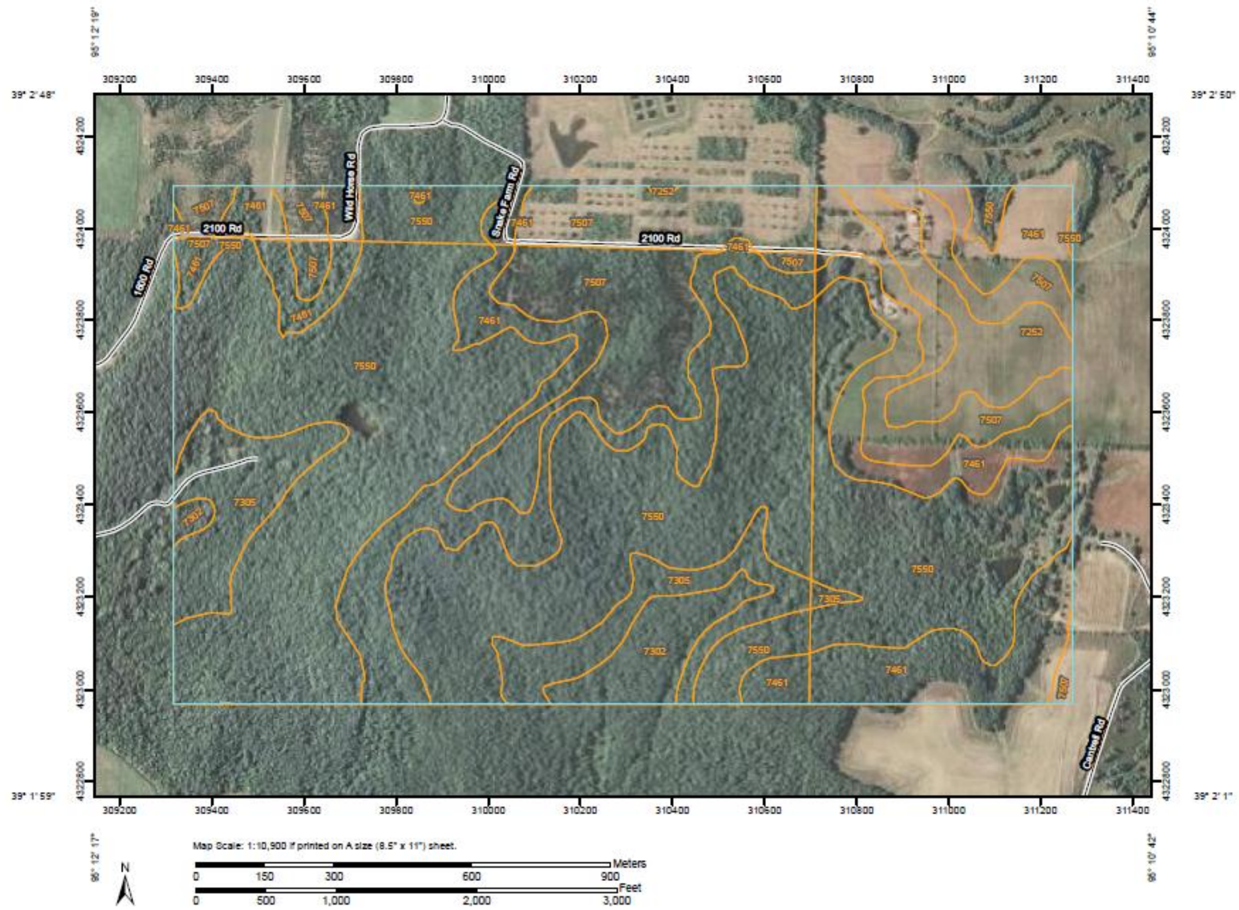


Figure 24. Soil map of the University of Kansas Biological Station site and surrounding areas.

Soil Map Units Description: The map units delineated on the detailed soil maps in a soil survey represents the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit. A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils. Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called non-contrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas. An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. T he name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series. Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example. An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example. An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, are an example. Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Table 9. Soil series and percentage of soil series within 2.2 km^2 at the University of Kansas Biological Station site

Douglas County, Kansas (KS045)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
7302	Martin silty clay loam, 3 to 7 percent slopes	14.7	2.7%
7305	Martin silty clay loam, 7 to 12 percent slopes, eroded	37.9	7.0%
7461	Oska silty clay loam, 3 to 8 percent slopes, eroded	55.3	10.2%
7507	Pawnee clay loam, 4 to 8 percent slopes, eroded	38.1	7.0%
7550	Rosendale-Bendena silty clay loams, 3 to 40 percent slopes	195.8	36.1%
Subtotals for Soil Survey Area		**341.8**	**63.0%**
Totals for Area of Interest		**542.7**	**100.0%**

Jefferson County, Kansas (KS087)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
7252	Grundy silty clay loam, 1 to 3 percent slopes	0.3	0.0%
7461	Oska silty clay loam, 3 to 8 percent slopes, eroded	8.6	1.6%
7507	Pawnee clay loam, 4 to 8 percent slopes, eroded	26.8	4.9%
7550	Rosendale-Bendena silty clay loams, 3 to 40 percent slopes	8.4	1.6%
Subtotals for Soil Survey Area		**44.1**	**8.1%**
Totals for Area of Interest		**542.7**	**100.0%**

Leavenworth County, Kansas (KS103)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
7252	Grundy silty clay loam, 1 to 3 percent slopes	20.0	3.7%
7305	Martin silty clay loam, 7 to 12 percent slopes, eroded	0.9	0.2%
7461	Oska silty clay loam, 3 to 8 percent slopes, eroded	49.5	9.1%
7507	Pawnee clay loam, 4 to 8 percent slopes, eroded	29.3	5.4%
7550	Rosendale-Bendena silty clay loams, 3 to 40 percent slopes	57.1	10.5%
Subtotals for Soil Survey Area		**156.8**	**28.9%**
Totals for Area of Interest		**542.7**	**100.0%**

Douglas County, Kansas 7302—Martin silty clay loam, 3 to 7 percent slopes Map Unit Setting Elevation: 800 to 1,600 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 59 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Martin and similar soils: 85 percent **Description of Martin Setting** Landform: Hillslopes Landform position (two-dimensional):

Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Silty and clayey colluvium derived from limestone and shale over silty and clayey residuum weathered from limestone and shale **Properties and qualities** Slope: 3 to 7 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 21 to 26 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 1 percent Available water capacity: High (about 9.8 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Loamy Upland (Draft) (PE 35-42) (R112XY015KS) **Typical profile** 0 to 9 inches: Silty clay loam 9 to 14 inches: Silty clay loam 14 to 37 inches: Silty clay 37 to 48 inches: Silty clay 48 to 60 inches: Silty clay

Douglas County, Kansas 7305—Martin silty clay loam, 7 to 12 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Martin, eroded, and similar soils: 88 percent **Description of Martin, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Linear Parent material: Colluvium derived from limestone and shale **Properties and qualities** Slope: 7 to 12 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: About 12 to 17 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 8.9 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 8 inches: Silty clay loam 8 to 14 inches: Silty clay loam 14 to 56 inches: Silty clay 56 to 65 inches: Silty clay 65 to 79 inches: Silty clay loam

Douglas County, Kansas 7461—Oska silty clay loam, 3 to 8 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Oska, eroded, and similar soils: 80 percent **Description of Oska, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Crest Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 3 to 8 percent Depth to restrictive feature: 20 to 39 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.1 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 10 inches: Silty clay loam 10 to 30 inches: Silty clay 30 to 34 inches: Silty clay 34 to 38 inches: Unweathered bedrock

Douglas County, Kansas 7507—Pawnee clay loam, 4 to 8 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Pawnee, eroded, and similar soils: 90 percent **Description of Pawnee, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Till **Properties and qualities** Slope: 4 to 8 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 7 to 18 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 10 percent Available water capacity: Moderate (about 8.9 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Clay Upland (PE 30-37) (R106XY007KS) **Typical profile** 0 to 6 inches: Clay loam 6 to 10 inches: Clay loam 10 to 49 inches: Clay 49 to 57 inches: Clay loam 57 to 79 inches: Clay loam

Douglas County, Kansas 7550—Rosendale-Bendena silty clay loams, 3 to 40 percent slopes Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Rosendale and similar soils: 55 percent Bendena and similar soils: 27 percent **Description of Rosendale Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from shale **Properties and qualities** Slope: 10 to 40 percent Depth to restrictive feature: 20 to 40 inches to paralithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 8 inches: Silty clay 8 to 13 inches: Silty clay 13 to 20 inches: Silty clay 20 to 30 inches: Silty clay 30 to 40 inches: Silty clay 40 to 55 inches: Weathered bedrock **Description of Bendena Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from limestone **Properties and qualities** Slope: 10 to 40 percent Depth to restrictive feature: 4 to 20 inches to lithic bedrock Drainage class: Somewhat excessively drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 1.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Shallow Limy (PE 30-37) (R106XY028KS) **Typical profile** 0 to 8 inches: Silty clay 8 to 12 inches: Unweathered bedrock

Jefferson County, Kansas 7252—Grundy silty clay loam, 1 to 3 percent slopes Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Grundy and similar soils: 90 percent **Description of Grundy Setting** Landform: Hillslopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Parent material: Loess **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Somewhat poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 9 to 16 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 1 percent Available water capacity: Moderate (about 7.7 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Clay Upland (PE 30-37) (R106XY007KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 11 inches: Silty clay loam 11 to 42 inches: Silty clay 42 to 51 inches: Silty clay loam 51 to 79 inches: Silty clay loam

Jefferson County, Kansas 7507—Pawnee clay loam, 4 to 8 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Pawnee, eroded, and similar soils: 90 percent **Description of Pawnee, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Till **Properties and qualities** Slope: 4 to 8 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 7 to 18 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 10 percent Available water capacity: Moderate (about 8.9 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Clay Upland (PE 30-37) (R106XY007KS) **Typical profile** 0 to 6 inches: Clay loam 6 to 10 inches: Clay loam 10 to 49 inches: Clay 49 to 57 inches: Clay loam 57 to 79 inches: Clay loam

Jefferson County, Kansas 7550—Rosendale-Bendena silty clay loams, 3 to 40 percent slopes Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Rosendale and similar soils: 55 percent Bendena and similar soils: 27 percent **Description of Rosendale Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from shale **Properties and qualities** Slope: 10 to 40 percent Depth to restrictive feature: 20 to 40 inches to paralithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 8 inches: Silty clay 8 to 13 inches: Silty clay 13 to 20 inches: Silty clay 20 to 30 inches: Silty clay 30 to 40 inches: Silty clay 40 to 55 inches: Weathered bedrock **Description of Bendena Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Linear Parent material: Residuum weathered from limestone **Properties and qualities** Slope: 10 to 40 percent Depth to restrictive feature: 4 to 20 inches to lithic bedrock Drainage class: Somewhat excessively drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Very low (about 1.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Shallow Limy (PE 30-37) (R106XY028KS) **Typical profile** 0 to 8 inches: Silty clay 8 to 12 inches: Unweathered bedrock

Jefferson County, Kansas 7461—Oska silty clay loam, 3 to 8 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Oska, eroded, and similar soils: 80 percent **Description of Oska, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Crest Down-slope shape: Convex Across-slope shape: Convex Parent material: Residuum weathered from limestone and shale **Properties and qualities** Slope: 3 to 8 percent Depth to restrictive feature: 20 to 39 inches to lithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (about 5.1 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 10 inches: Silty clay loam 10 to 30 inches: Silty clay 30 to 34 inches: Silty clay 34 to 38 inches: Unweathered bedrock

Leavenworth County, Kansas 7252—Grundy silty clay loam, 1 to 3 percent slopes Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Grundy and similar soils: 90 percent **Description of Grundy Setting** Landform: Hillslopes Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Convex Across-slope shape: Convex Parent material: Loess **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Somewhat poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 9 to 16 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 1 percent Available water capacity: Moderate (about 7.7 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Clay Upland (PE 30-37) (R106XY007KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 11 inches: Silty clay loam 11 to 42 inches: Silty clay 42 to 51 inches: Silty clay loam 51 to 79 inches: Silty clay loam

Leavenworth County, Kansas 7305—Martin silty clay loam, 7 to 12 percent slopes, eroded Map Unit Setting Elevation: 770 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Martin, eroded, and similar soils: 88 percent **Description of Martin, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Linear Parent material: Colluvium derived from limestone and shale **Properties and qualities** Slope: 7 to 12 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: About 12 to 17 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 8.9 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Loamy Upland (PE 30-37) (R106XY015KS) **Typical profile** 0 to 8 inches: Silty clay loam 8 to 14 inches: Silty clay loam 14 to 56 inches: Silty clay 56 to 65 inches: Silty clay 65 to 79 inches: Silty clay loam

4.3.2 Soil semi-variogram description

The goal of this aspect of the site characterization is to determine the minimum distance between the soil plots in the soil array such that data farther apart can be considered spatially independent. The collected field data will be used to produce semivariograms, which is a geostatistical technique to characterize spatial autocorrelation between mapped samples of a quantitative variable (*e.g.*, soil property data in our case). In an empirical semivariogram, the average of the squared differences of a response variable is computed for all pairs of points within specified distance intervals (lag classes). The output is presented graphically as a plot of the average semi-variance versus distance class (Figure 25). For the theoretical variogram models considered here, the semivariance will converge on the total variance at distances for which values are no longer spatially auto-correlated (this is referred to as the range, Figure 25).

For the theoretical variograms considered here, three parameters estimated from the data are used to fit a semivariogram model to the empirical semivariogram. This model is then assumed to quantitatively represent the correlation as a function of distance (Figure 25), the range, the sill (the sill is the asymptotic value of semi-variance at the range), and the nugget (which describes sampling error or variation at distances below those separating the closest pairs of samples). The range, sill and nugget are estimated from theoretical models that are fitted to the empirical variograms using non-linear least squares methods.

The variogram analysis will be used, to determine the spatial scales at which we can consider soil measurements spatially independent. This characterization will directly inform the minimum distance between *i*) soil plots within each soil array, *ii*) the soil profile measurements, *iii*) EP plots, and *iv*) the microbial sampling locations. These data will directly inform NEON construction and site design activities.

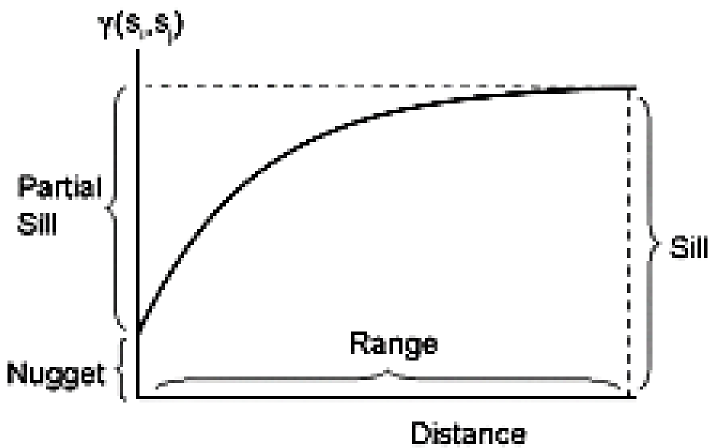


Figure 25. Example semivariogram, depicting range, sill, and nugget.

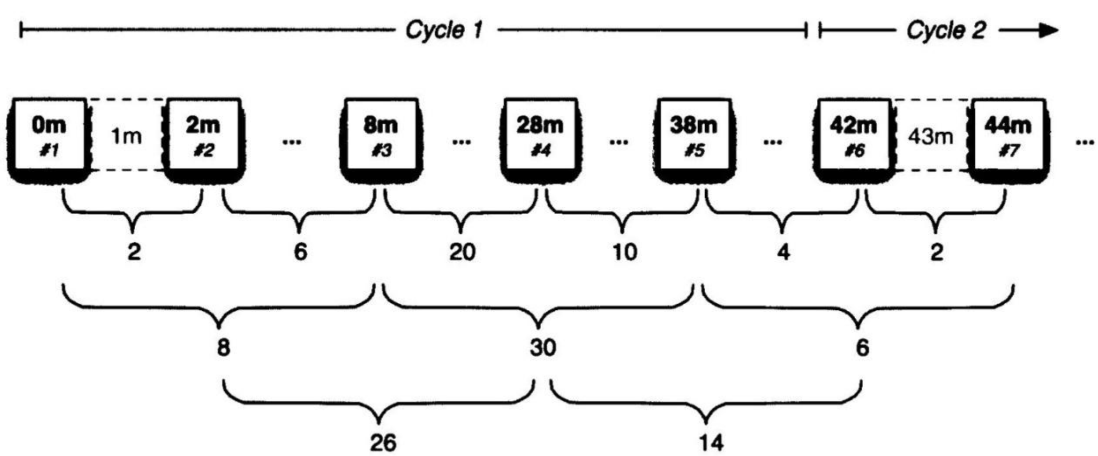


Figure 26. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 11 May 2010 at the University of Kansas Biological Station site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 26). Soil temperature and moisture measurements were collected along three transects (168 m, 84 m, and 84 m) located in the expected airshed at University of Kansas Biological Station. Details of how the airshed was determined are provided below. Soil temperature was measured with platinum resistance temperature sensors (RTD

810, Omega Engineering Inc., Stamford CT) and soil moisture was measured with time domain diaelectric sensors (CS616, Campbell Scientific Inc., Logan UT).

As well as measuring soil temperature and moisture at each sample point in Figure 26, measurements were also taken 30 cm in front and behind the sampling point along the axis of the transect. For example, at the 2 m sampling point, soil temperature and moisture was measured at 1.7 m, 2 m, and 2.3 m; this data is referred to as mobile data, since the measurements were taken at many different locations. In addition, soil temperature and moisture were continuously recorded at a single fixed location (stationary data) throughout the sampling time to correct for changes in temperature and moisture throughout the day.

Data collected were used for geospatial analyses of variograms in the R statistical computing language with the geoR package to test for spatial autocorrelation (Trangmar *et al.* 1986; Webster & Oliver 1989; Goovaerts 1997; Riberiro & Diggle 2001) and estimate the distance necessary for independence among soil plots in the soil array. To correct for changes in temperature and moisture over the sampling period, the stationary data was subtracted from the mobile data. In many instances a time of day trend was still apparent in the data even after subtracting the stationary data from the mobile data. This time of day trend was corrected for by fitting a linear regression and using the residuals for the semivariogram analysis. Topographic trends relating to elevation, aspect, and slope were also corrected for when significant ($p < 0.05$). Soil temperature and moisture data, R code, graphs, and R output can be found at: P:\FIU\FIU_Site_Characterization\DXX\YYYYYYY_Characterization\Soil Measurements\Soil Data Analysis (where XX = domain number and YYYYYYY = site name).

4.3.3 Results and interpretation

4.3.3.1 Soil Temperature

Soil temperature data residuals, after accounting for changes in temperature in the stationary data, any remaining time of day trend, and trends relating to elevation, aspect, and slope, were used for the semivariogram analysis (Figure 27). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 28, left graph) and directional semivariograms do not show anisotropy (Figure 28, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 28, right graph). The model indicates a distance of effective independence of 7 m for soil temperature.

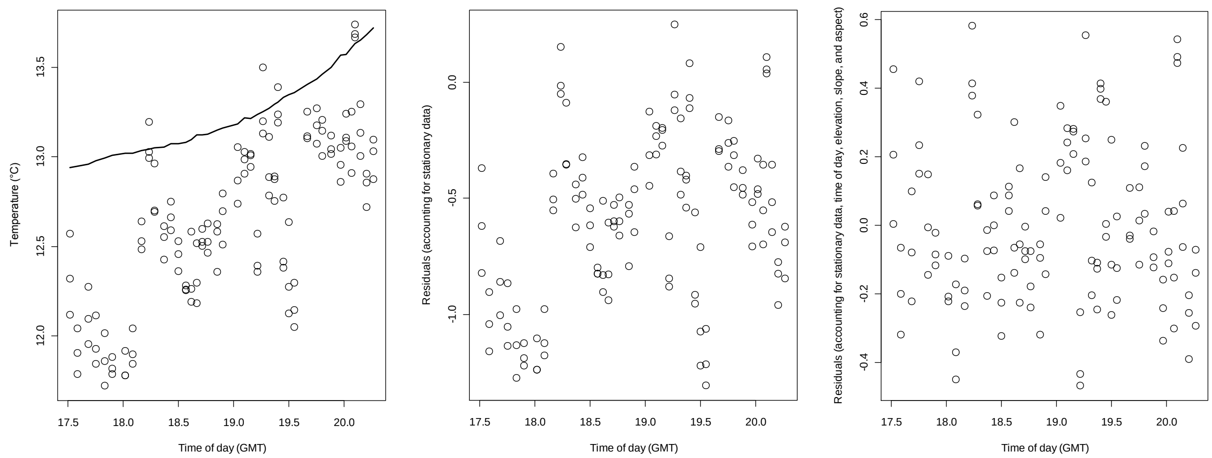


Figure 27. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

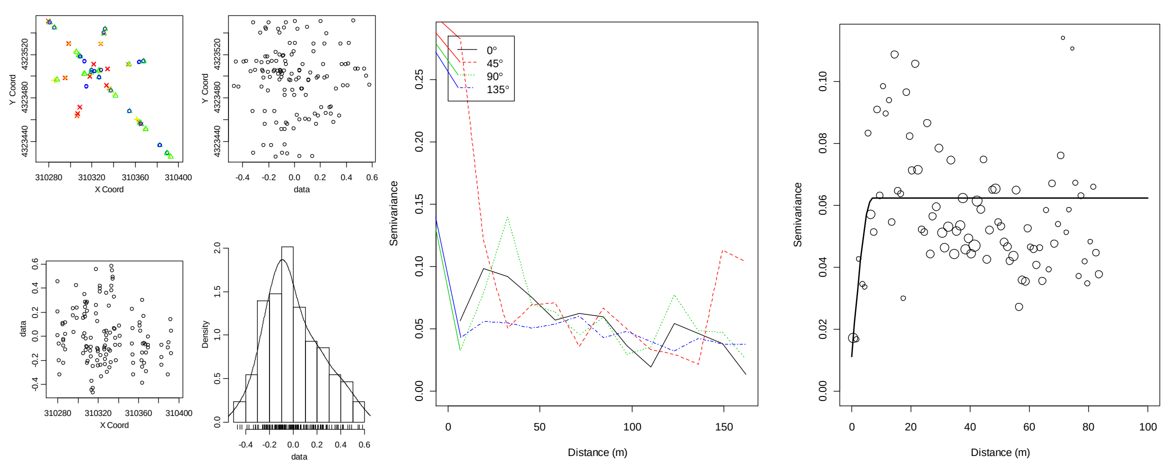


Figure 28. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

4.3.3.2 Soil water content

Soil water content data residuals, after accounting for changes in water content in the stationary data, any remaining time of day trend, and trends relating to elevation, aspect, and slope, were used for the semivariogram analysis (Figure 29). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 30, left graph) and directional semivariograms do not show anisotropy (Figure 30, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 30, right graph). The model indicates a distance of effective independence of >84 m for soil water content.

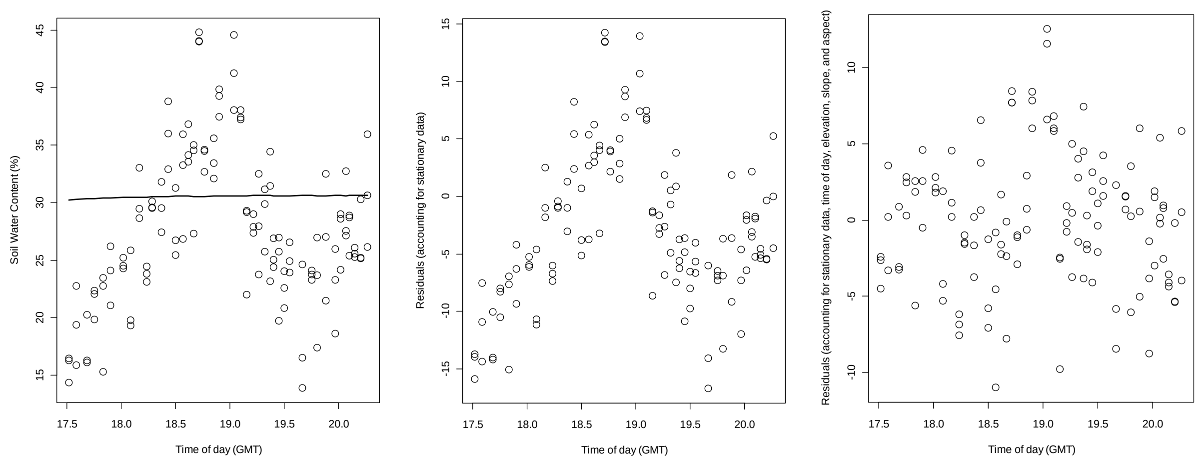


Figure 29. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting for changes water content in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

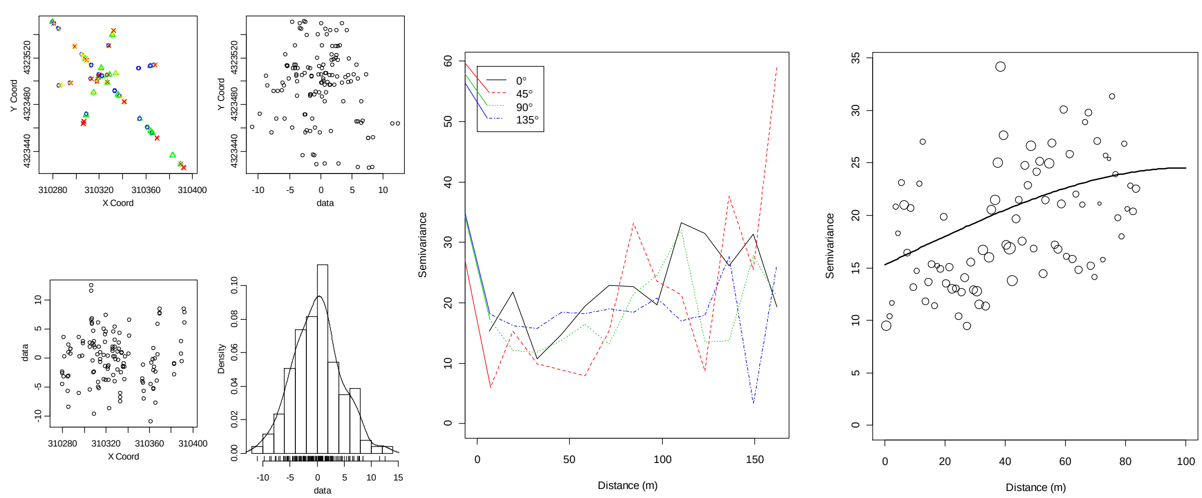


Figure 30. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

4.3.3.3 Soil array layout and soil pit location

The minimum distance allowable between soil plots is 25 m to ensure a degree of spatial independence in non-measured soil parameters (i.e., other than temperature and water content) and the maximum distance allowable between soil plots is 40 m due to cost constraints. The estimated distance of effective independence was 7 m for soil temperature and >84 m for soil moisture. Based on these results and the site design guidelines the soil plots at University of Kansas Biological Station shall be placed 40 m apart. The soil array shall follow the linear soil array design (Soil Array Pattern B) with the soil plots being 5 m x 5 m. The direction of the soil array shall be 175° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 39.040275, -95.192033. The exact location of each soil plot may be microsited to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc). The FIU soil pit for characterizing soil horizon depths, collecting soil for site-specific sensor calibration, and collecting soil for the FIU soil archive will be located at 39.041719, -95.204740 (primary location); or 39.042100, -95.204418 (alternate location 1 if primary location is unsuitable); or 39.041435, -95.205241 (alternate location 2 if primary location is unsuitable). A summary of the soil information is shown in Table 10 and site layout can be seen in Figure 31.

Dominant soil series at the site: Rosendale-Bendena silty clay loams, 3 to 40 percent slopes. The taxonomy of this soil is shown below:
Order: Inceptisols-Mollisols
Suborder: Udepts-Udolls
Great group: Eutrudepts-Hapludolls
Subgroup: Typic Eutrudepts- Lithic Hapludolls
Family: Fine, mixed, superactive, mesic Typic Eutrudepts- Clayey, smectitic, mesic Lithic Hapludolls
Series: Rosendale-Bendena silty clay loams, 3 to 40 percent slopes

Table 10. Summary of soil array and soil pit information at University of Kansas Biological Station. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	40 m
Distance from tower to closest soil plot: y	20 m
Latitude and longitude of 1st soil plot OR direction from tower	39.040275, -95.192033
Direction of soil array	175°
Latitude and longitude of FIU soil pit 1	39.041719, -95.204740 (primary location)§
Latitude and longitude of FIU soil pit 2	39.042100, -95.204418 (alternate 1) §
Latitude and longitude of FIU soil pit 3	39.041435, -95.205241 (alternate 2) §
Dominant soil type	Rosendale-Bendena silty clay loams, 3 to 40 percent slopes
Expected soil depth	0.10-1.02 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.20 m (Silty clay)	0.10 m†
0.20-0.33 m (Silty clay)	0.27 m†
0.33-0.51 m (Silty clay)	0.42 m†
0.51-0.76 m (Silty clay)	0.64 m

0.76-1.02 m (Silty clay)	0.89 m
1.02-1.40 m (Weathered bedrock)	1.21 m
1.40 m	1.40 m

[*]Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.
[†]Expected depth of soil CO_2 sensors (actual depth will be based on findings from the FIU soil pit).
[§]Soil pits are ~1 km from tower as this was the closest location to the tower with good road access for a bobcat-type excavator with the same soil type.

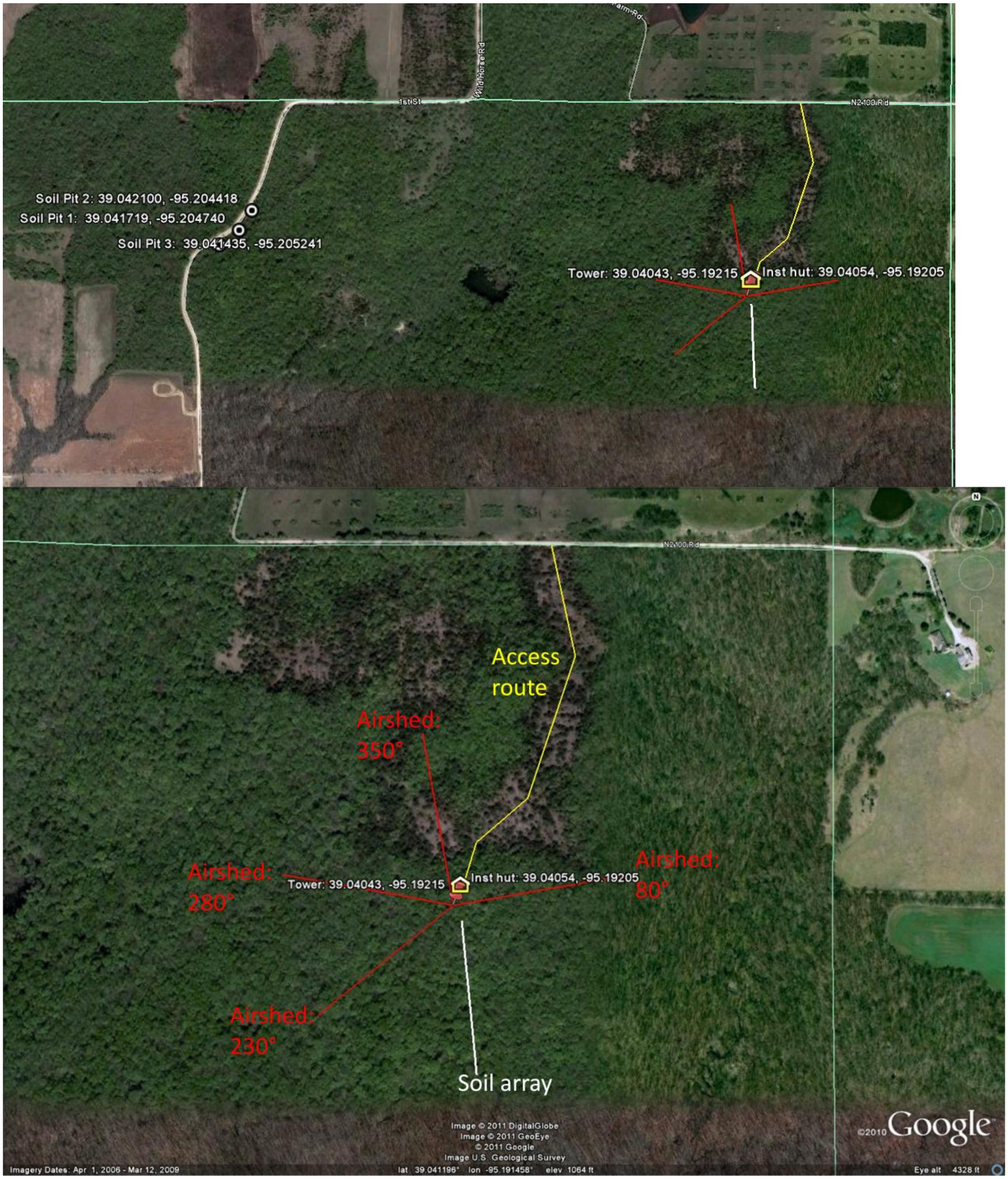


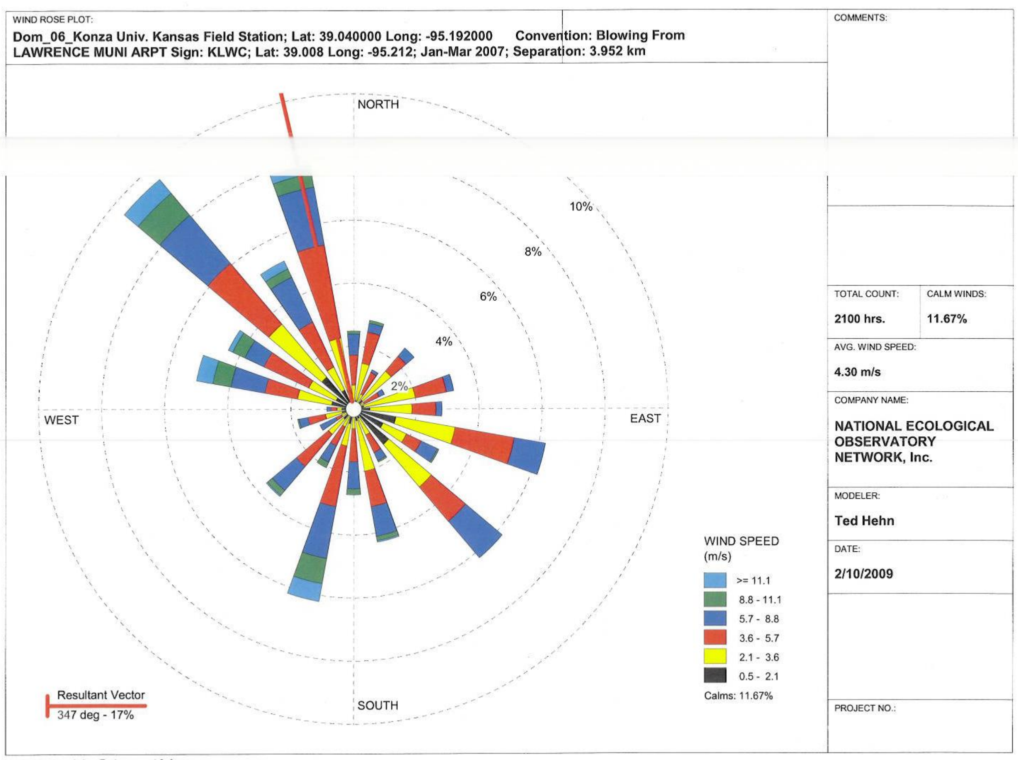
Figure 31. Site layout at University of Kansas Biological Station showing soil array and location of the FIU soil pit. Soil pits are ~1 km from tower as this was the closest location to the tower with good road access for a bobcat-type excavator with the same soil type

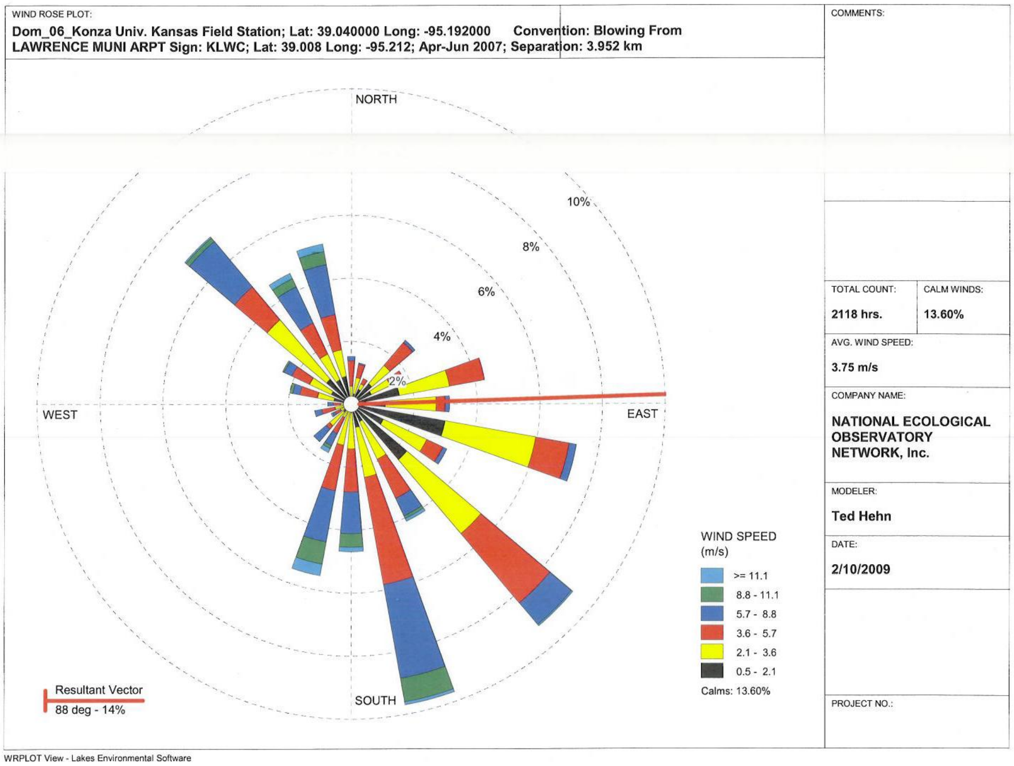
4.4 Airshed

4.4.1 Seasonal windroses

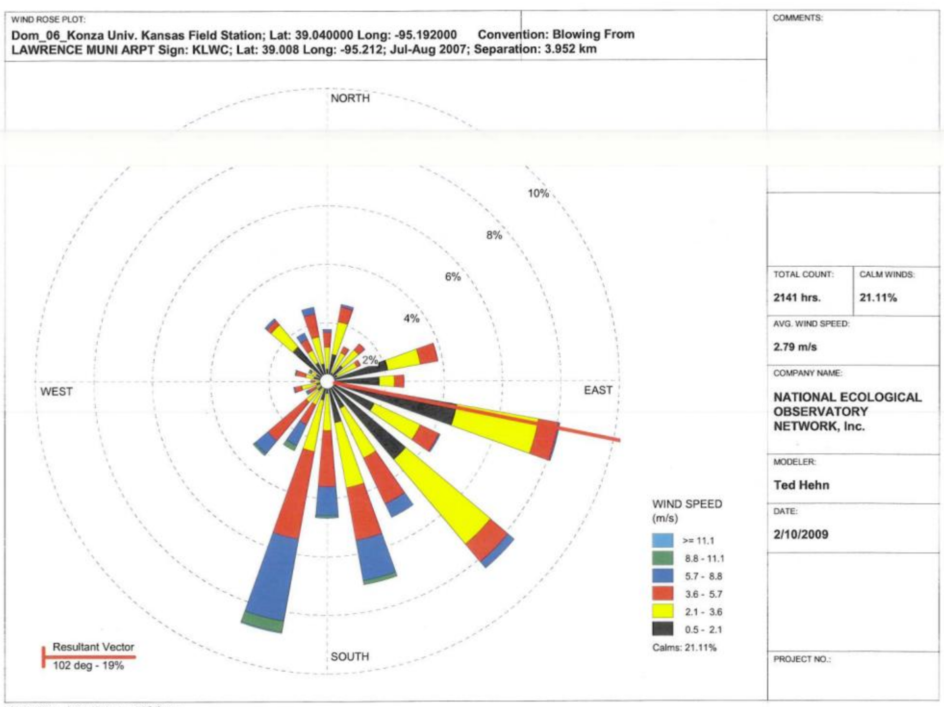
Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries. The weather data used to generate the following wind roses are 2007 data from Lawrence Municipal Airport at 39.008, -95.212, which is ~4 km from tower site. The orientation of the wind rose follows that of a compass (assume declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. The directions of the rose with the longest spoke show wind directions with the largest frequency. These wind roses are subdivided into as 24 cardinal directions.

4.4.2 Results (graphs for wind roses)





WIND ROSE PLOT:
Dom_06_Konza Univ. Kansas Field Station; Lat: 39.040000 Long: -95.192000 Convention: Blowing From
LAWRENCE MUNI ARPT Sign: KLWC; Lat: 39.008 Long: -95.212; Apr-Jun 2007; Separation: 3.952 km
COMMENTS:
NORTH
WEST
EAST
SOUTH
10%
8%
6%
4%
2%
TOTAL COUNT:
2118 hrs.
CALM WINDS:
13.60%
AVG. WIND SPEED:
3.75 m/s
COMPANY NAME:
NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.
MODELER:
Ted Hehn
DATE:
2/10/2009
PROJECT NO.:
WIND SPEED (m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 13.60%
Resultant Vector
88 deg - 14%
WRPLOT View - Lakes Environmental Software



WIND ROSE PLOT:
Dom_06_Konza Univ. Kansas Field Station; Lat: 39.040000 Long: -95.192000 Convention: Blowing From
LAWRENCE MUNI ARPT Sign: KLWC; Lat: 39.008 Long: -95.212; Jul-Aug 2007; Separation: 3.952 km
COMMENTS:
NORTH
WEST
EAST
SOUTH
10%
8%
6%
4%
2%
TOTAL COUNT:
2141 hrs.
CALM WINDS:
21.11%
AVG. WIND SPEED:
2.79 m/s
COMPANY NAME:
NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.
MODELER:
Ted Hehn
DATE:
2/10/2009
PROJECT NO.:
WIND SPEED (m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 21.11%
Resultant Vector
102 deg - 19%
WRPLOT View - Lakes Environmental Software

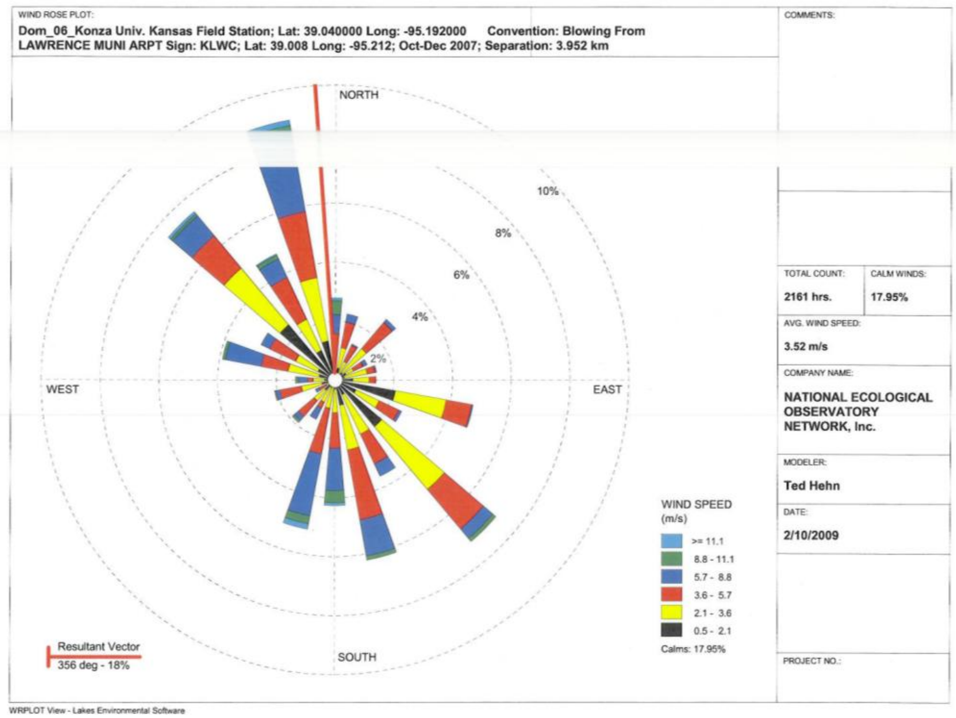


Figure 32. Windroses for the University of Kansas Field Station Relocatable site.
Data used here are 2007 data from Lawrence Municipal Airport at 39.008, -95.212, which is ~4 km from tower site. It is assumed that the wind data was corrected for declination. Panels are (from top to bottom) Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec.

4.4.3 Resultant vectors

Table 11. The resultant wind vectors for the University of Kansas Field Station Relocatable site using hourly data in 2007.

Quarterly (seasonal) timeperiod	Resultant vector	% duration
January to March	347°	17
April to June	88°	14
July to September	102°	19
October to December	356°	18
Annual mean	43.25	na.

4.4.4 Expected environmental controls on source area

Two types of models were commonly used to determine the shape and extent of the source area under different and contrasting atmospheric stability classes. An inverted plume dispersion model with modeled cross wind solutions were used for convective conditions (Horst and Weil 1994). For strongly stable conditions, and Lagrangian solution was used (Kormann and Meixner 2001). The source area models where bounded by the expected conditions depict the extreme conditions. Convective conditions typically have strong vertical mixing between the ecosystem and atmosphere (surface layer). Stable conditions typically have long source area and associated waveforms. Convective turbulence is often characterized by short mixing scales (scalar) and moderate daytime wind speeds, *e.g.,* 1-4 m s^{-2}.

Higher wind speeds, like those experienced over the Rockies, are often the product of mechanical turbulence with long waveforms. Because thermal stratification is very efficient in suppressing vertical mixing, stable conditions also have typically very long waveforms.

As a general rule, shorter and less structurally complex ecosystems have good vertical mixing during all atmospheric stabilities. Taller and more structurally complex ecosystems have well mixed upper canopies during the daytime, and can be decoupled below the canopy under neutral and stable conditions (e.g., Harvard Forest, Bartlett Experimental Forest, and Burlington Conservation Area). The type of turbulence (mechanical verse convective) and the physical attributes of the ecosystem control the degree of mixing, and the length and size of the source area.

Here, we use a web-based footprint model to determine the footprint area under various conditions (model info: http://www.geos.ed.ac.uk/abs/research/micromet/EdiTools/). Winds used to run the model and generate following model results are extracted from the wind roses. Vegetation information, temperature and energy information were either from the RFI document, previous site visit report, available data files or best estimated from experienced expert. Measurement height was determined from the Tower Height Info document provided by ENG group, then verify according to the real ecosystem structure after FIU site characterization at site. Runs 1-3 and 4-6 represent the expected conditions for summer and winter conditions, respectively, with maximum and mean windspeeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was estimated from wind roses and is placed as a centerline in the site map included in the graphics. The width of the footprint was also estimated using the length between the isopleth of 80% cumulative flux and center line to calculate the angle from centerline. This information, along with distance of the cumulative flux isopleths and wind direction, will define the source area for the flux measurements on the top of the tower.

Table 12. Expected environmental controls to parameterize the source area model and associated results from the University of Kansas Field Station Relocatable tower site.

Parameters	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	
Approximate season	summer			winter			Units
	Day (max WS)	Day (mean WS)	Night	Day (max WS)	Day (mean WS)	night	qualitative
Atmospheric stability	Convective	convective	Stable	Convective	convective	Stable	qualitative
Measurement height	33	33	33	33	33	33	m
Canopy Height	19	19	19	19	19	19	m
Canopy area density	3.5	3.5	3.5	2	2	2	m
Boundary layer depth	3501	3501	1701	600	600	501	m
Expected sensible heat flux	381	381	90	180	180	10	W m^{-2}
Air Temperature	30	30	24	16	16	3	°C
Max. windspeed	11	3.8	1.8	13	5.6	3.4	m s^{-1}
Resultant wind vector	151	151	151	330	330	135	degrees
			Results				
(z-d)/L	-0.02	-0.31	-0.46	-0.01	-0.07	-0.02	m
d	16	16	16	14	14	14	m

Sigma v	3.5	2.3	1.2	3.6	1.8	0.98	$m^2 s^{-2}$
Z0	0.75	0.75	0.75	1	1	1	m
u*	1.4	0.62	0.34	1.8	0.83	0.48	$m s^{-1}$
Distance source area begins	0	0	0	0	0	0	m
Distance of 90% cumulative flux	1150	500	400	1200	800	1100	m
Distance of 80% cumulative flux	700	350	250	700	500	700	m
Distance of 70% cumulative flux	450	250	200	480	400	450	m
Peak contribution	95	65	45	95	85	95	m

4.4.5 Results (source area graphs)

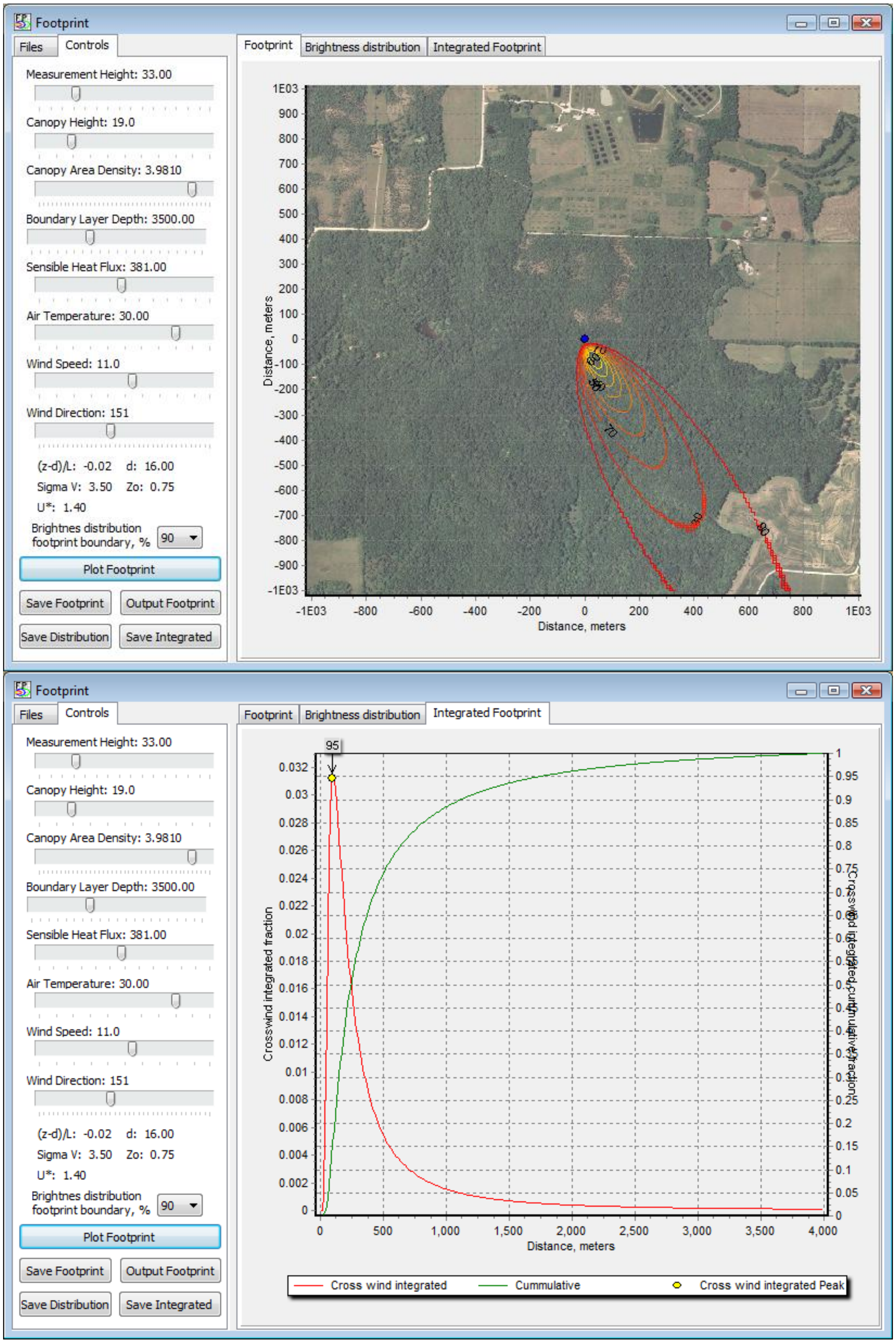


Figure 33. University of Kansas Field Station Relocatable site summer daytime (convective) footprint output with max wind speed

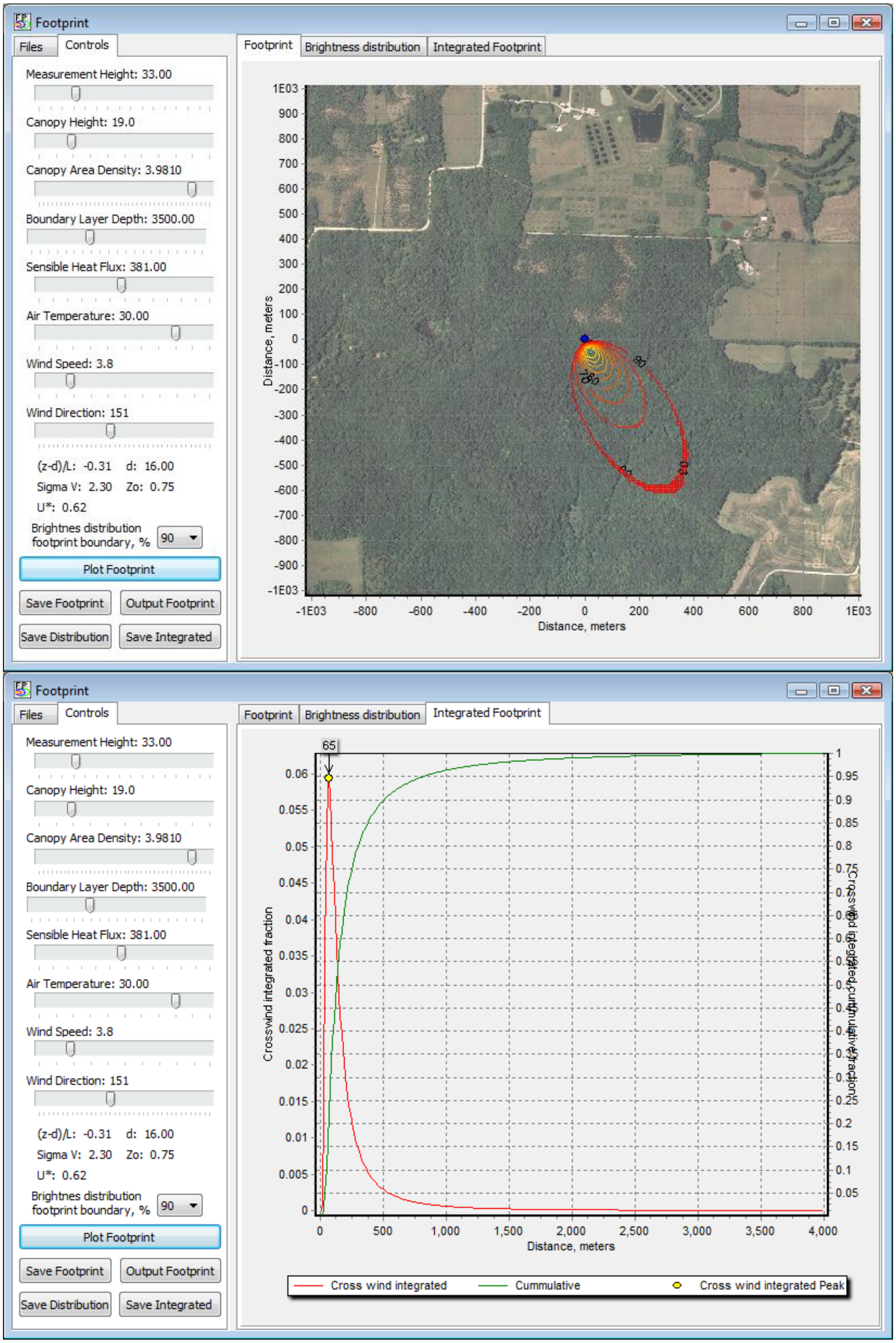


Figure 34. University of Kansas Field Station Relocatable site summer daytime (convective) footprint output with mean wind speed

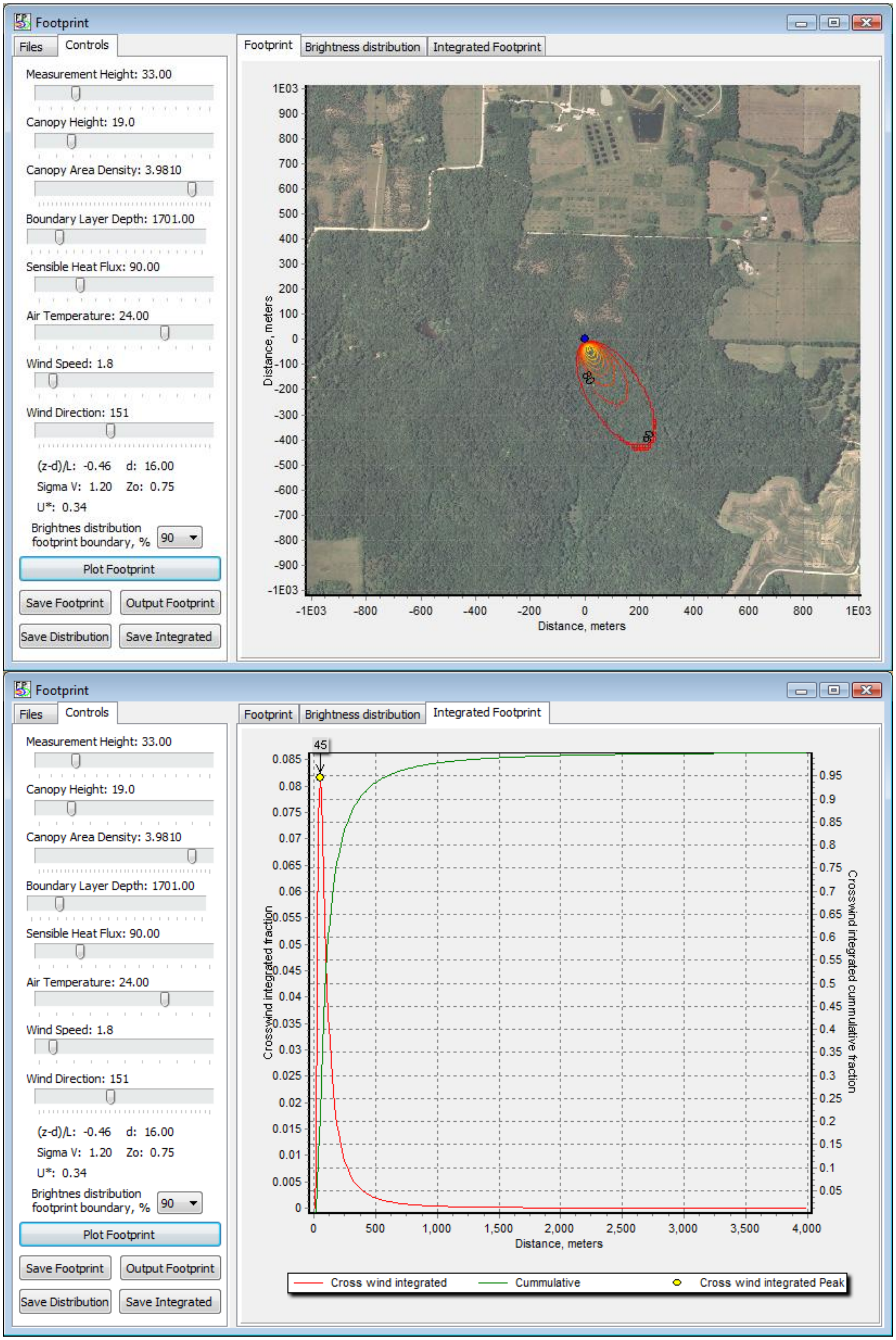


Figure 35. University of Kansas Field Station Relocatable site summer nighttime (stable) footprint output with mean wind speed

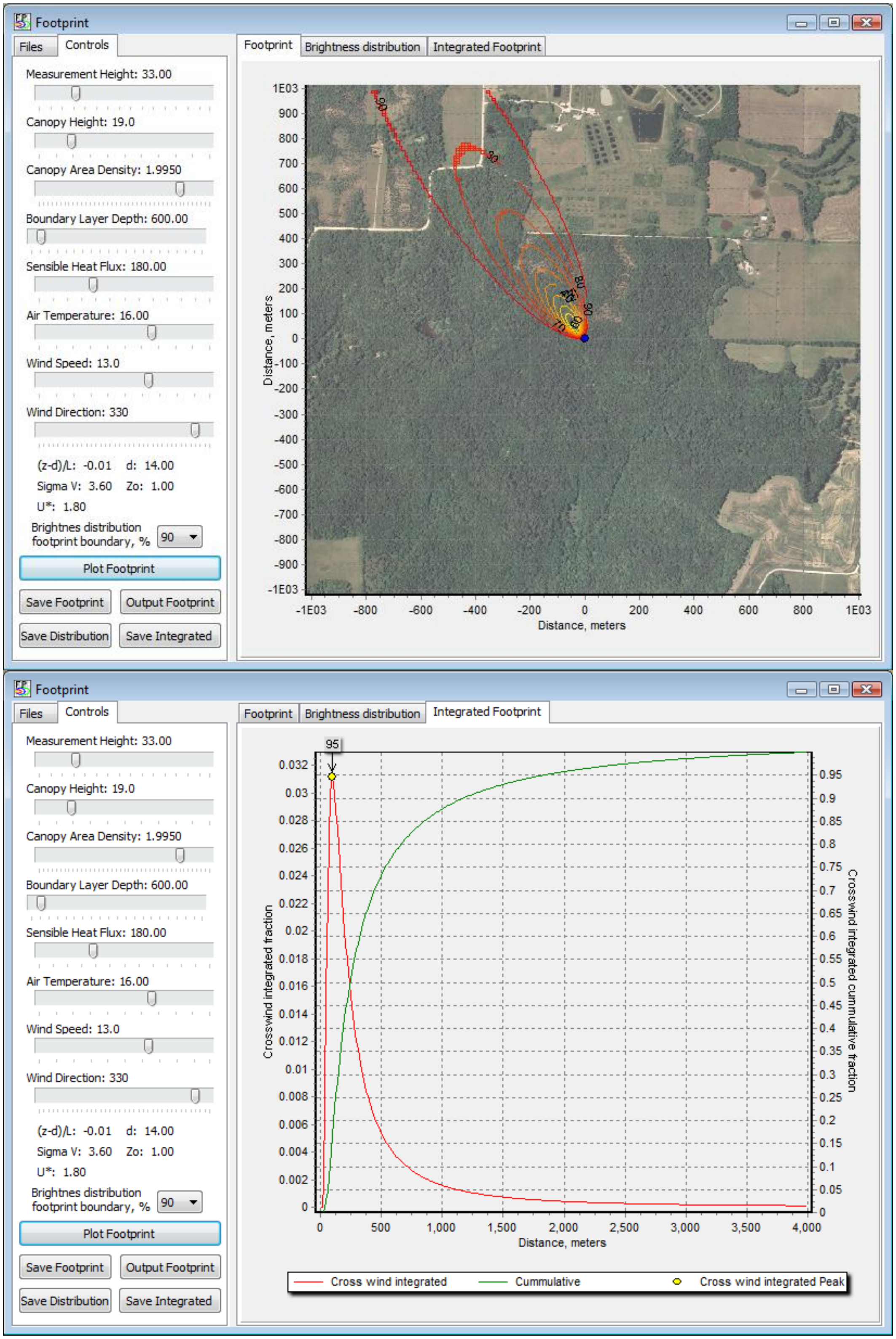


Figure 36. University of Kansas Field Station Relocatable site winter daytime (convective) footprint output with max wind speed

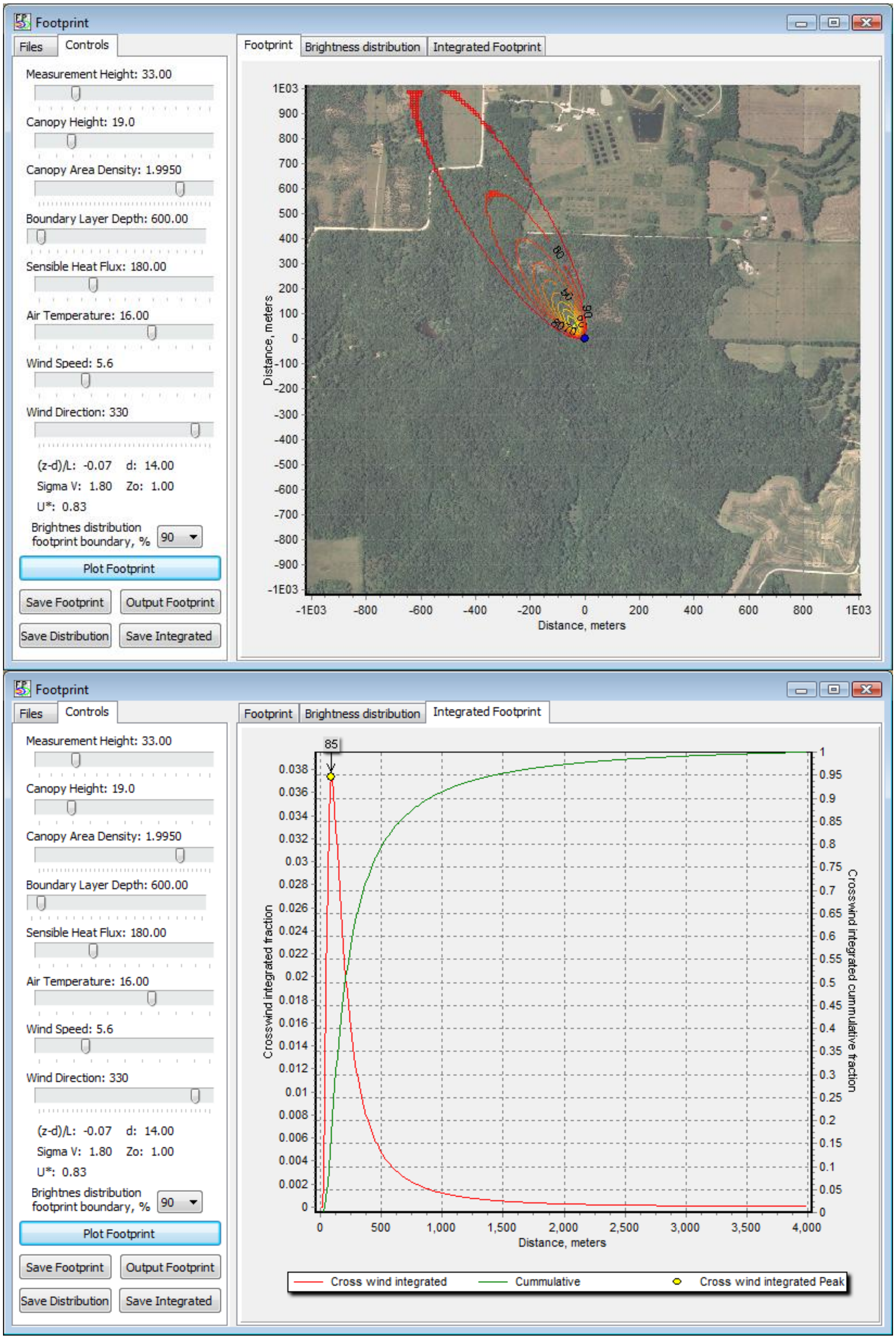


Figure 37. University of Kansas Field Station Relocatable site winter daytime (convective) footprint output with mean wind speed

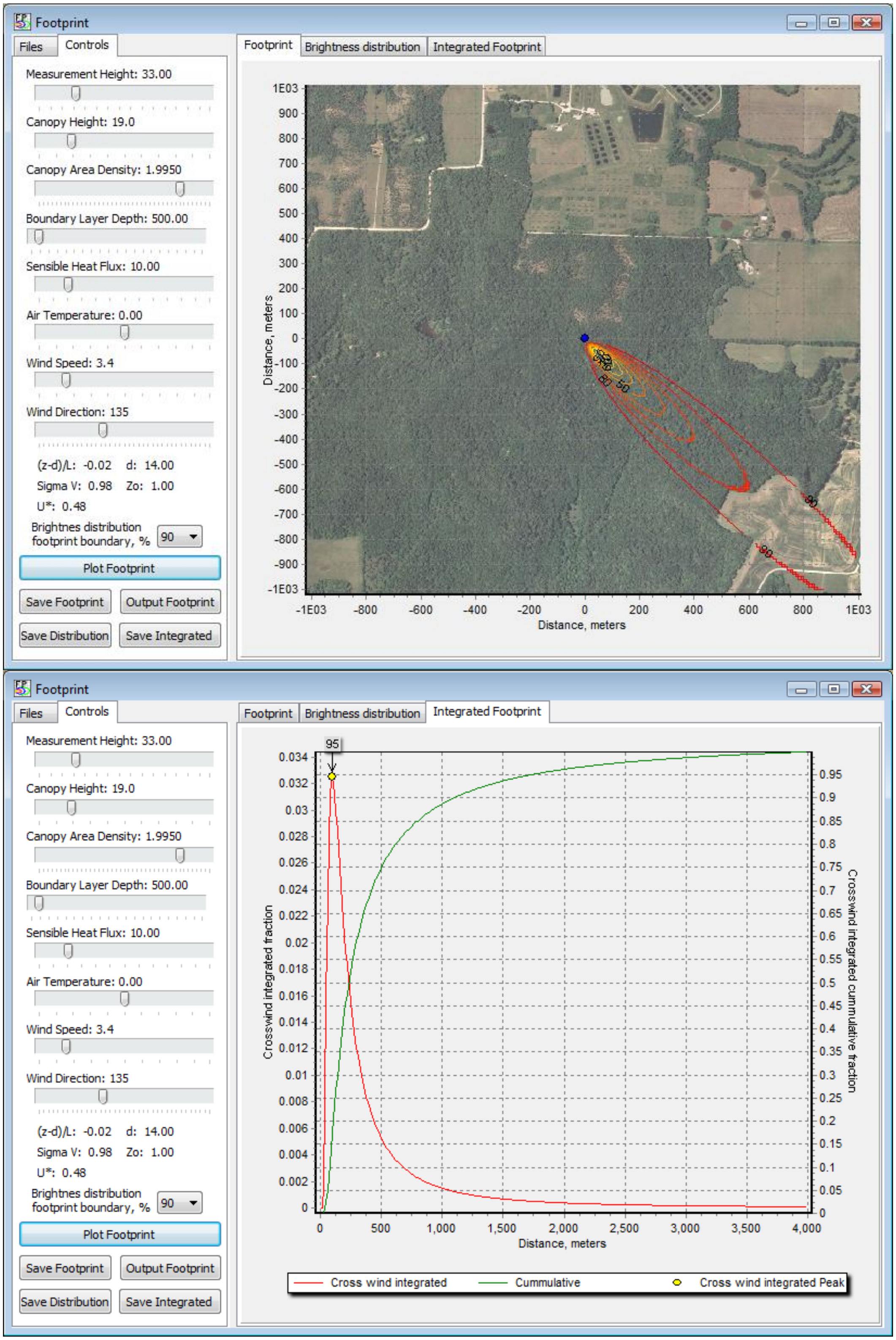


Figure 38. University of Kansas Field Station Relocatable site winter nighttime (stable) footprint output with mean wind speed

4.5 Site design and tower attributes

According to wind roses, wind can blow from any direction between 80^o to 230^o (clockwise from 80^o) and between 280^o to 350^o (clockwise from 280^o). **Tower** should be placed to a location to best catch the signals from the airshed of the ecosystem in interest, which is mixed hardwood forest at this site. The original site was at 39.040000°, -95.192000°. After FIU site characterization. We determined to move tower location to 39.04043, -95.19215, which is ~55 m toward north.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the southwest will be best to capture signals from all major wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure. An **instrument hut** should be outside the prevailing wind airshed to avoid disturbance in the measurements of wind and should be positioned to have the longer side parallel to frequent wind direction to minimize the wind effects on instrument huts and to minimize the disturbances of wind regime by instrument hut, and in this case, instrument hut should be positioned on the northeast toward tower and have the longer side parallel to SE-NW direction. Therefore, the placement of instrument hut is at 39.04054, -95.19205.

The ecosystem around tower and inside the major airshed is mixed hardwood forest with canopy height at ~19 m. Major species include oak, hickory, and elm. Small trees form the understory with canopy height 4-8m. Lowest branch level is at 1.5 m. Vegetation at floor level is dense and consists of annuals or bi-annuals with height ~ 1 m. Therefore, we require 6 **measurement layers** on the tower with top measurement height at 32.5 m, and the remaining levels are 23 m, 19 m, 8.0 m, 1.0 m and 0.3 m, respectively, to best characterize the fluxes on the tower top and environmental conditions in profile.

Secondary **precipitation collector** for bulk precipitation collection will be located the top of tower at this site. W**et deposition collector** will be collocated at this site. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

The site layout is summarized in the table below. Assume the projected area of the tower is square. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 13. Site design and tower attributes for University of Kansas Field Station Relocatable site

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan or best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed area			80^o to 230^o & 280^o to 350^o		Clockwise from first angle
Tower location	39.04043,	-95.19215	--	--	
Instrument hut	39.04054,	-95.19205			
Instrument hut orientation	--	--	150° - 330°		

vector					
Instrument hut distance z	--	--	--	15	
Anemometer/Temperature boom orientation	--	--	230°	--	
Height of the measurement levels					
Level 1				0.3	m.a.g.l.
Level 2				1.0	m.a.g.l.
Level 3				8.0	m.a.g.l.
Level 4				19.0	m.a.g.l.
Level 5				24.0	m.a.g.l.
Level 6				32.5	m.a.g.l.
Tower Height				32.5	m.a.g.l.

See AD 03 for technical requirement to determine the boom height for the bottom most measurement level.

Figure below shows the proposed tower location, instrument hut location, airshed area and access road.

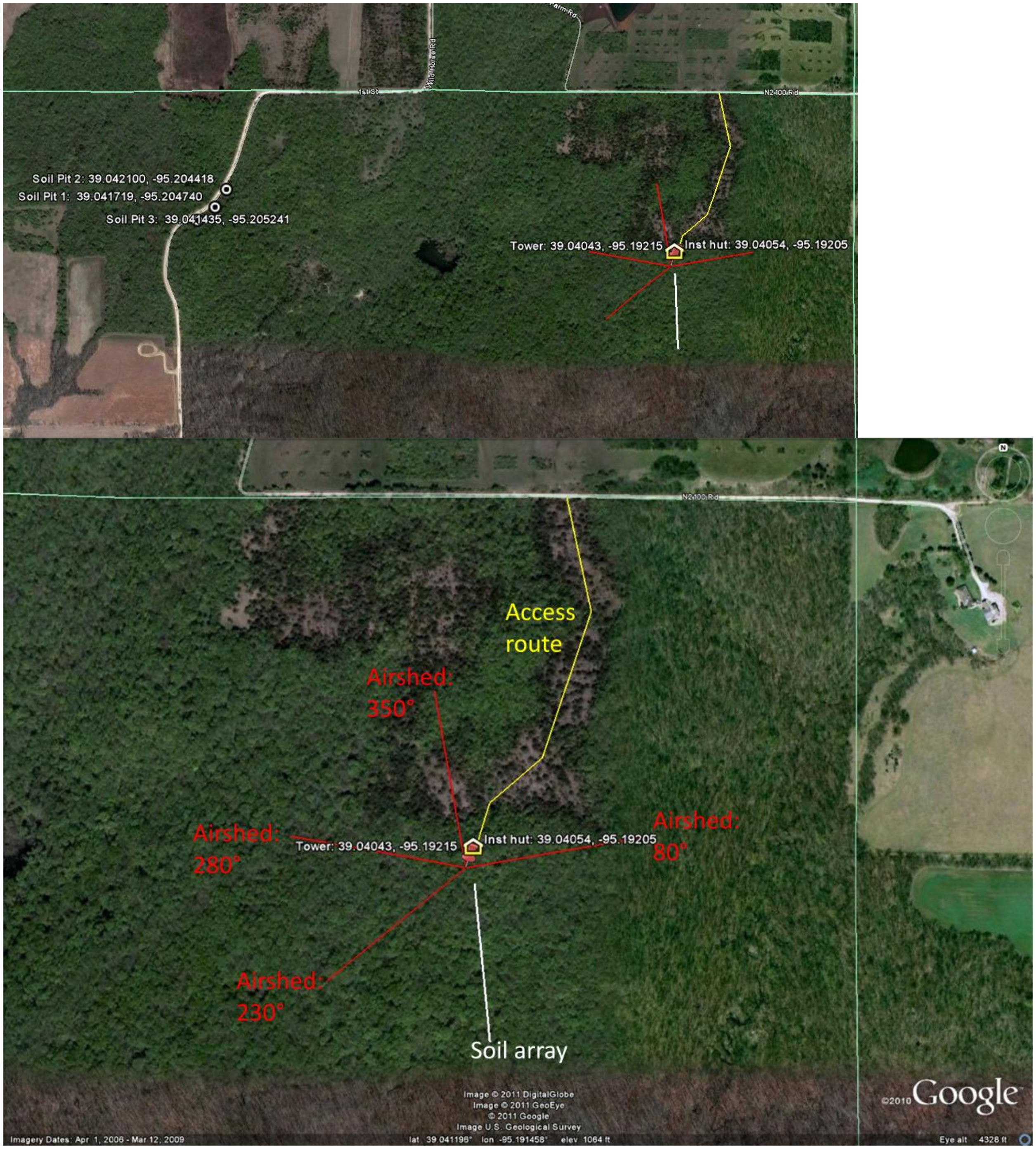


Figure 39. Site layout for University of Kansas Field Station Relocatable site.
i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 80^{o} to 230^{o} (clockwise from 80^{o}) and 280^{o} to 350^{o} (clockwise from 280^{o}) would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. Soil pits are ~1 km from tower as this was the closest location to the tower with good road access for a bobcat-type excavator with the same soil type

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. Here FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36' wide footprint. While the final design is not yet known, there are some general criteria that can be outlined. We assume that the boardwalk width is 36" (0.914 m). Material is not known, but must be fire proof, and in some locations the site is seasonally flooded and inundated with water. Boardwalks may also provide a scratching structure for grazing animals that in turn, would wear and unduly impact the site. Site by site evaluations must be done.

Specific boardwalks at this Relocatable site

- Boardwalk from the access point to the instrument hut, pending landowner decision.
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk to the soil array
- No boardwalk to individual soil plots

The relative locations between tower, instrument hut and boardwalk can be found in the diagram below:

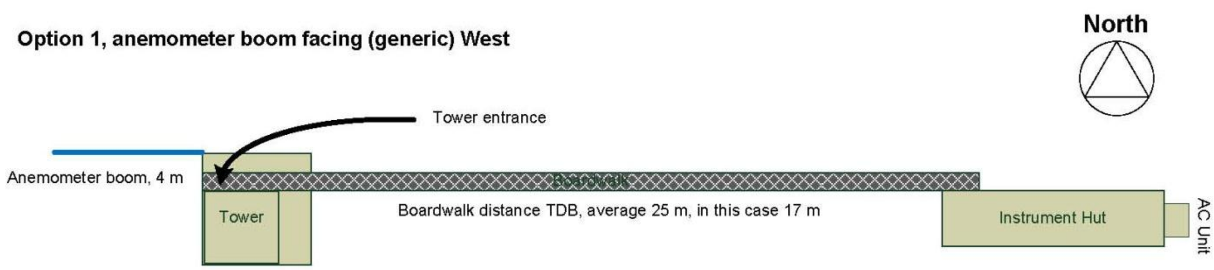


Figure 40. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram. The actual layout of boardwalk (or path if no boardwalk required) and instrument hut position will be the joint responsibility of FCC and FIU. At this Relocatable site, the boom angle will be 230°, instrument hut will be on the northeast towards the tower, the distance between instrument hut and tower is ~16 m. The instrument hut vector will be SE-NE (150°-330°, longwise).

4.6 Information for ecosystem productivity plots

The tower at this relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (mixed hardwood forest). Prevailing wind blows the airshed from 80° to 230° (clockwise from 80°) and 280° to 350° (clockwise from 280°). We expect that 90% signals for flux measurements are within a distance of 1200 m from tower, and 80% within 700 m. We suggest FSU Ecosystem Productivity plots are placed within the boundaries of 80° to 230° (clockwise from 80°) and 280° to 350° (clockwise from 280°) from tower.

4.7 Issues and attentions

The tower is located at the site of a ~7 m snag (dead tree) that was approximately equidistant between nearby living trees. The snag will have to be removed ***carefully*** to make room for the tower, but no other trees should need to be removed. T he GPS coordinates for the tower location are 39.04043, -95.19215 (±14 feet or 4.3 m).

There was an umarked dirt path leading to an abondoned tower approximately 180 m east (39.04055, -95.19003) of the NEON tower. However, this path is not suggested for access to the NEON tower since it is not well maintained and would result in a longer access route to the NEON tower than is suggested in this report.

Ticks, 2 types of pit viper, and poison oak are found at this site.

Soil pits are ~1 km from tower as this was the closest location to the tower with good road access for a bobcat-type excavator with the same soil type.

5 KONZA PRAIRIE BIOLOGICAL STATION (AGRICULTURAL LOWLAND, RELOCATEABLE TOWER 2

5.1 Site description

The Konza advance tower site was at 39.110000°, -96.613000° (Figure 41). We microsited the location to 39.11044, -96.61295,(which is only 50 m from the original site toward north) and still inside the property boundary of Konza Prairie Biological Station. The general site description about Konza Prairie Biological Station can be found in the site description for Konza - Core Advanced site above.

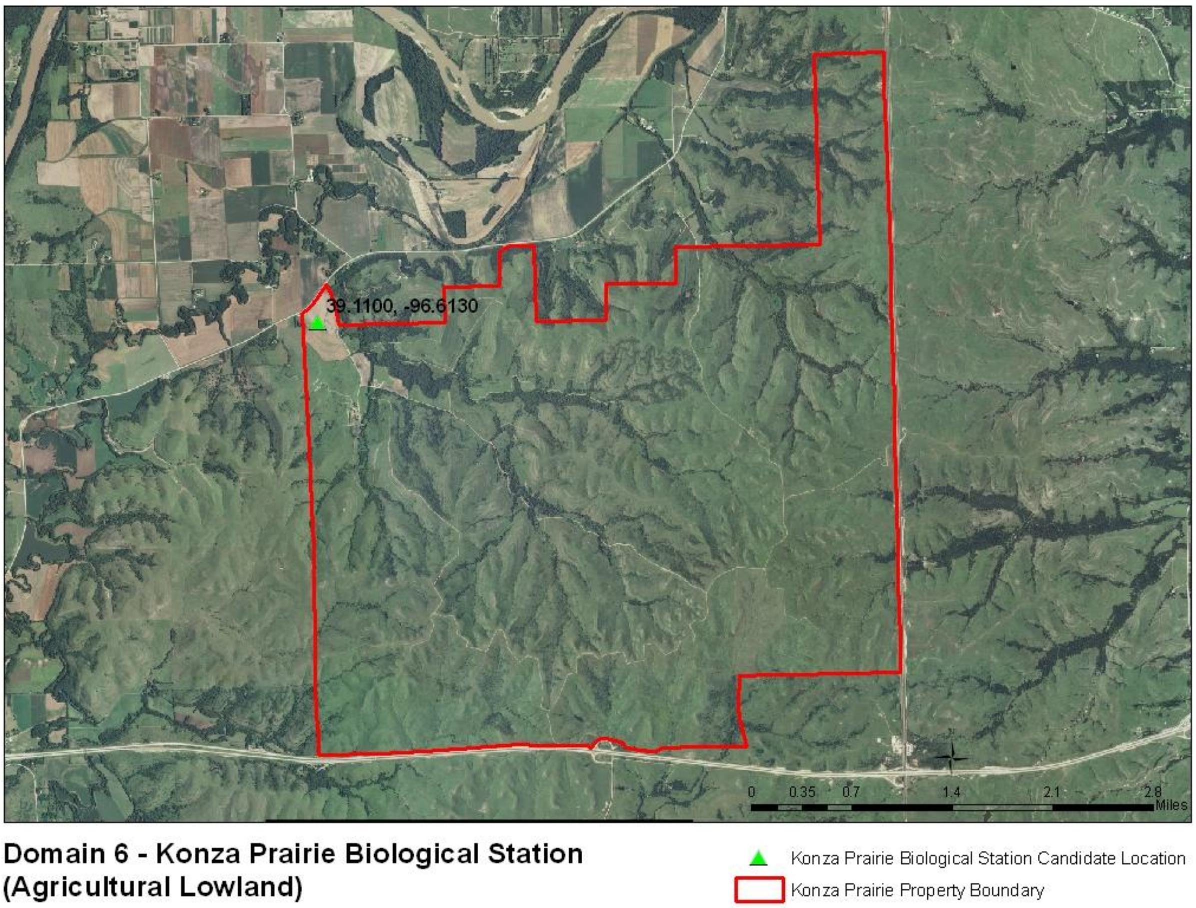


Figure 41. Konza Prairie Biological Station property boundary and original relocatable tower location.

5.2 Ecosystem

Vegetation and land cover around tower site and surrounding area are presented below:

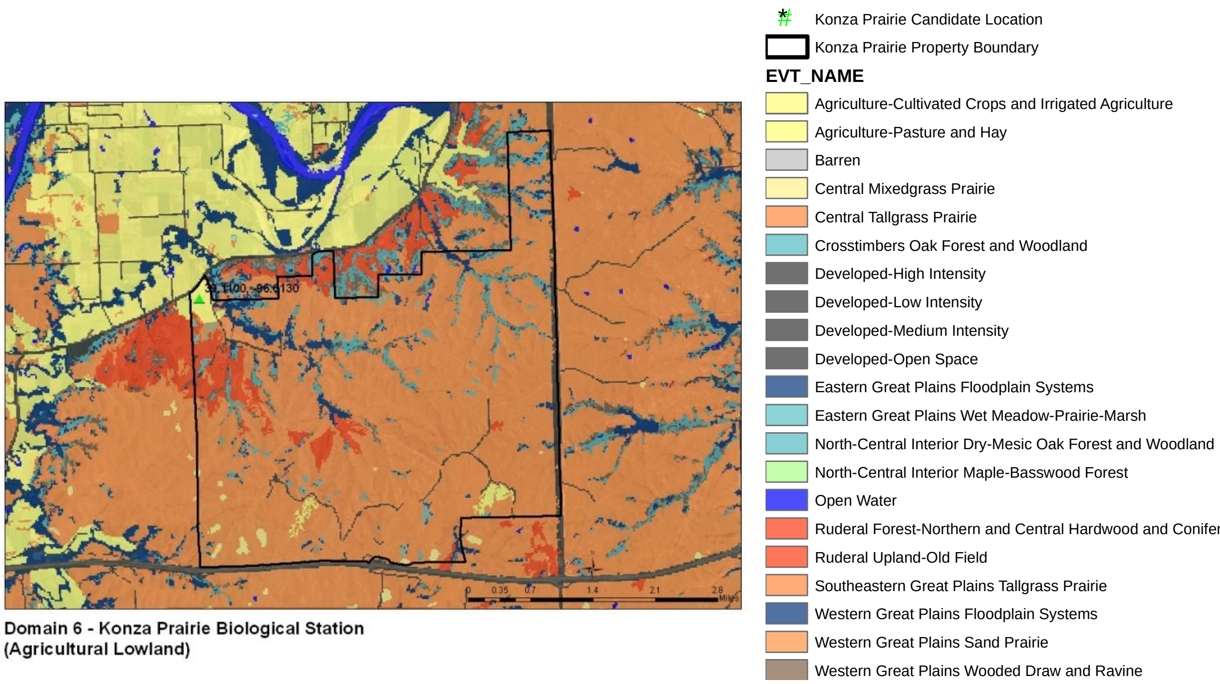


Figure 42. Vegetative cover map of the Konza relocatable site and surrounding areas (from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Table 14. Percent Land cover information at the Konza relocatable site (from USGS, http://landfire.cr.usgs.gov/viewer/viewer.htm)

Vegetation Type	Area (km^2)	Percent
Agriculture-Cultivated Crops and Irrigated Agriculture	0.52	1.49
Central Mixedgrass Prairie	0.20	0.58
Developed-Low Intensity	0.02	0.07
Developed-Medium Intensity	0.01	0.02
Developed-Open Space	0.73	2.09
Eastern Great Plains Floodplain Systems	1.18	3.39
Eastern Great Plains Wet Meadow-Prairie-Marsh	0.14	0.40
North-Central Interior Dry-Mesic Oak Forest and Woodland	1.68	4.81
Open Water	0.01	0.02
Ruderal Forest-Northern and Central Hardwood and Conifer	0.04	0.11
Ruderal Upland-Old Field	1.83	5.25
Southeastern Great Plains Tallgrass Prairie	27.87	79.98
Western Great Plains Floodplain Systems	0.01	0.02
Western Great Plains Wooded Draw and Ravine	0.62	1.77
Total Area sq km	34.84	100.00

The land around tower and inside the major airshed is currently managed as two plowed arable field. The crop in one field was wheat while the other field was fallow during FIU site characterization. However, prior to NEON site construction these fields will be begin to be restored to native tallgrass prairie, which will allow the NEON site to assess the initial phase of prairie restoration. The site is flat with the most of the surrounding land used for agriculture.

Since the restoration has not yet begun the structure of the ecosystem could not be assessed during the site visit. But it is likely that canopy height will be similar to the Konza – Core site (i.e. native tallgrass prairie), which has a canopy that can reach ~1.5 m high. Fire frequency is the restored prairie is unknown, but managed and/or unmanaged fires are likely to occur during the lifespan of the NEON site.

Table 15. Ecosystem and site attributes for the Konza Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height [a]	1.5 m
Surface roughness [a]	0.3 m
Zero place displacement height [a]	1.0 m
Structural elements	Uniform, current vegetation is crop, but will be restored native tallgrass prairie by the time NEON site is constructed
Time zone	Central time zone
Magnetic declination	3° 51' E changing by 0° 7' W/year

Note, [a] From field survey and empirical estimates

Figure 43. Agricultural land at Konza Relocatable site. The site will begin to be restored to native tallgrass prairie prior to NEON site construction.

5.3 Soils

5.3.1 Description of soils

Soil data and soil maps below for the Konza - Relocatable tower site were collected from 2.2 km^2 NRCS soil maps (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm) to determine the dominant soil types in the larger tower foot print. This was done to assure that the soil array is in the dominant (or in the co-dominant) soil type present in the tower footprint.

Figure 44. Soil map of the Konza - Relocatable site and surrounding areas.

Soil Map Units Description: The map units delineated on the detailed soil maps in a soil survey represents the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit. A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils. Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called non-contrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas. An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series. Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example. An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example. An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, are an example. Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Table 16. Soil series and percentage of soil series within 2.2 km^2 at the Konza - Relocatable site

Riley County, Kansas (KS161)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
4050	Ivan and Kennebec silt loams, occasionally flooded	13.2	2.5%
4053	Ivan silty clay loam, channeled	63.4	11.8%
4151	Kahola silt loam, occasionally flooded	4.8	0.9%
4350	Chase silty clay loam, rarely flooded	163.3	30.4%
4550	Clime silty clay loam, 20 to 40 percent slopes, very stony	18.4	3.4%
4590	Clime-Sogn complex, 3 to 20 percent slopes	121.8	22.7%
4625	Dwight-Irwin complex, 1 to 3 percent slopes	8.8	1.6%
4673	Irwin silty clay loam, 3 to 7 percent slopes	0.1	0.0%
4674	Irwin silty clay loam, 3 to 7 percent slopes, eroded	30.8	5.7%
4700	Ivan silty clay loam, 1 to 3 percent slopes	2.5	0.5%
4783	Tully silty clay loam, 3 to 7 percent slopes	33.9	6.3%
4784	Tully silty clay loam, 3 to 7 percent slopes, eroded	5.8	1.1%
7170	Reading silt loam, rarely flooded	13.3	2.5%
7171	Reading silt loam, moderately wet, rarely flooded	1.2	0.2%
7174	Reading silt loam, 1 to 3 percent slopes	55.9	10.4%
Totals for Area of Interest		**537.2**	**100.0%**

Riley County, Kansas 4350—Chase silty clay loam, rarely flooded Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Chase and similar soils: 84 percent Minor components: 0 percent **Description of Chase Setting** Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Silty and clayey alluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Somewhat poorly drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: About 24 to 48 inches Frequency of flooding: Rare Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Moderate (about 8.3 inches) **Interpretive groups** Land capability (nonirrigated): 2w Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 13 inches: Silty clay loam 13 to 40 inches: Silty clay 40 to 50 inches: Silty clay 50 to 60 inches: Silty clay **Minor Components Aquolls, ponded** Percent of map unit: 0 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4550—Clime silty clay loam, 20 to 40 percent slopes, very stony Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Clime and similar soils: 75 percent Minor components: 0 percent **Description of Clime Setting** Landform: Hillslopes Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Silty and clayey residuum weathered from shale, calcareous **Properties and qualities** Slope: 20 to 40 percent Surface area covered with cobbles, stones or boulders: 0.1 percent Depth to restrictive feature: 20 to 40 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 35 percent Available water capacity: Low (about 5.3 inches) **Interpretive groups** Land capability (nonirrigated): 7e Ecological site: Limy Upland (Draft) (PE 30-36) (R076XY012KS) **Typical profile** 0 to 2 inches: Silty clay loam 2 to 9 inches: Silty clay 9 to 27 inches: Silty clay 27 to 33 inches: Silty clay 33 to 37 inches: Bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4590—Clime-Sogn complex, 3 to 20 percent slopes Map Unit Setting Elevation: 1,000 to 1,540 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 50 to 57 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Clime and similar soils: 62 percent Sogn and similar soils: 20 percent Minor components: 0 percent **Description of Clime Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Convex Parent material: Silty and clayey residuum weathered from shale, calcareous **Properties and qualities** Slope: 5 to 20 percent Depth to restrictive feature: 20 to 39 inches to paralithic bedrock Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 35 percent Available water capacity: Low (about 5.2 inches) **Interpretive groups** Land capability (nonirrigated): 6e Ecological site: Limy Upland (Draft) (PE 30-36) (R076XY012KS) **Typical profile** 0 to 12 inches: Silty clay loam 12 to 26 inches: Silty clay 26 to 30 inches: Silty clay 30 to 34 inches: Bedrock **Description of Sogn Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Convex Parent material: Loamy residuum weathered from limestone, unspecified **Properties and qualities** Slope: 3 to 20 percent Depth to restrictive feature: 4 to 20 inches to lithic bedrock Drainage class: Somewhat excessively drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Very low (about 2.0 inches) Interpretive groups Land capability (nonirrigated): 6s Ecological site: Shallow Limy (Draft) (PE 30-36) (R076XY028KS) **Typical profile** 0 to 9 inches: Silty clay loam 9 to 13 inches: Bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4625—Dwight-Irwin complex, 1 to 3 percent slopes Map Unit Setting Elevation: 1,000 to 1,450 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 51 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Dwight and similar soils: 45 percent Irwin and similar soils: 40 percent **Description of Dwight Setting** Landform: Depressions on ridges Landform position (two-dimensional): Summit Landform position (three-dimensional): Interfluve Down-slope shape: Convex, concave Across-slope shape: Convex, concave Parent material: Silty and clayey residuum weathered from limestone, cherty **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: 39 to 59 inches to lithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Maximum salinity: Nonsaline to slightly saline (0.0 to 8.0 mmhos/cm) Available water capacity: Low (about 5.6 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Sodic Claypan (Draft) (Peer Review) (PE 30-36) (R076XY005KS) **Typical**

profile 0 to 4 inches: Silt loam 4 to 17 inches: Silty clay 17 to 43 inches: Silty clay 43 to 79 inches: Unweathered bedrock **Description of Irwin Setting** Landform: Ridges Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey pedisediment derived from limestone and shale **Properties and qualities** Slope: 1 to 4 percent Depth to restrictive feature: 39 to 59 inches to paralithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Moderate (about 7.5 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Clay Upland (PE 25-34) (R075XY007KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 11 inches: Silty clay loam 11 to 35 inches: Silty clay 35 to 50 inches: Silty clay 50 to 55 inches: Silty clay 55 to 59 inches: Unweathered bedrock

Riley County, Kansas 4674—Irwin silty clay loam, 3 to 7 percent slopes, eroded Map Unit Setting Elevation: 1,000 to 1,600 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Irwin and similar soils: 85 percent Minor components: 0 percent **Description of Irwin Setting** Landform: Hillslopes Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey pedisediment derived from shale **Properties and qualities** Slope: 4 to 8 percent Depth to restrictive feature: 40 to 60 inches to paralithic bedrock Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.7 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Clay Upland (PE 25-34) (R075XY007KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 31 inches: Silty clay 31 to 55 inches: Silty clay 55 to 59 inches: Unweathered bedrock **Minor Components Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4050—Ivan and Kennebec silt loams, occasionally flooded Map Unit Setting Elevation: 100 to 1,300 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Ivan and similar soils: 45 percent Kennebec and similar soils: 45 percent Minor components: 0 percent **Description of Ivan Setting** Landform: Flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Calcareous fine-silty colluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Occasional Frequency of ponding: None Calcium carbonate, maximum content: 10 percent Available water capacity: Very high (about 12.6 inches) **Interpretive groups** Land capability (nonirrigated): 2w Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 26 inches: Silty clay loam 26 to 39 inches: Silty clay loam 39 to 64 inches: Silty clay loam **Description of Kennebec Setting** Landform: Flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Fine-silty alluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: About 36 to 60 inches Frequency of flooding: Occasional Frequency of ponding: None Available water capacity: Very high (about 12.9 inches) **Interpretive groups** Land capability (nonirrigated): 1 Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 18 inches: Silt loam 18 to 46 inches: Silty clay loam 46 to 60 inches: Silty clay loam **Minor Components**

Aquolls, ponded Percent of map unit: 0 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave **Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways, hillslopes Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4700—Ivan silty clay loam, 1 to 3 percent slopes Map Unit Setting Elevation: 100 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Ivan and similar soils: 88 percent **Description of Ivan Setting** Landform: Flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Calcareous fine-silty colluvium **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 10 percent Available water capacity: Very high (about 12.6 inches) **Interpretive groups** Land capability (nonirrigated): 2e Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 6 inches: Silty clay loam 6 to 20 inches: Silty clay loam 20 to 33 inches: Silty clay loam 33 to 64 inches: Silty clay loam

Riley County, Kansas 4053—Ivan silty clay loam, channeled Map Unit Setting Elevation: 100 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 50 to 57 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Ivan and similar soils: 80 percent Minor components: 0 percent **Description of Ivan Setting** Landform: Flood plains Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Calcareous fine-silty alluvium **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Frequent Frequency of ponding: None Calcium carbonate, maximum content: 10 percent Available water capacity: Very high (about 12.7 inches) **Interpretive groups** Land capability (nonirrigated): 5w Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 6 inches: Silt loam 6 to 21 inches: Silt loam 21 to 36 inches: Silt loam 36 to 60 inches: Silt loam **Minor Components Aquolls, ponded** Percent of map unit: 0 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave **Aquolls** Percent of map unit: 0 percent Landform: Depressions, drainageways, hillslopes Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 4151—Kahola silt loam, occasionally flooded Map Unit Setting Elevation: 1,000 to 1,540 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 50 to 57 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Kahola and similar soils: 90 percent Minor components: 0 percent **Description of Kahola Setting** Landform: Flood plains Down-slope shape: Linear Across-slope shape: Linear Parent material: Silty alluvium **Properties and qualities** Slope: 0 to 2 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Occasional Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: Very high (about 13.0 inches) **Interpretive groups** Land capability (nonirrigated): 2w Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 24 inches: Silt loam 24 to 36 inches: Silt loam 36 to 44 inches: Silt loam 44 to 60 inches: Silt loam **Minor Components Aquolls** Percent of map unit: 0 percent Landform:

Depressions Down-slope shape: Concave Across-slope shape: Concave **Aquolls, ponded** Percent of map unit: 0 percent Landform: Depressions Down-slope shape: Concave Across-slope shape: Concave

Riley County, Kansas 7174—Reading silt loam, 1 to 3 percent slopes Map Unit Setting Elevation: 1,000 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Reading and similar soils: 90 percent **Description of Reading Setting** Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Fine-silty alluvium **Properties and qualities** Slope: 1 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Rare Frequency of ponding: None Available water capacity: High (about 11.1 inches) **Interpretive groups** Land capability (nonirrigated): 2e Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 8 inches: Silt loam 8 to 18 inches: Silty clay loam 18 to 49 inches: Silty clay loam 49 to 60 inches: Silty clay loam

Riley County, Kansas 7171—Reading silt loam, moderately wet, rarely flooded Map Unit Setting Elevation: 920 to 1,080 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Reading and similar soils: 85 percent Minor components: 5 percent **Description of Reading Setting** Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Fine-silty alluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr) Depth to water table: About 40 to 44 inches Frequency of flooding: Rare Frequency of ponding: None Available water capacity: High (about 11.6 inches) **Interpretive groups** Land capability (nonirrigated): 2w Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS) **Typical profile** 0 to 8 inches: Silt loam 8 to 14 inches: Silt loam 14 to 21 inches: Silty clay loam 21 to 29 inches: Silty clay loam 29 to 42 inches: Silty clay loam 42 to 60 inches: Silty clay loam 60 to 80 inches: Silty clay loam **Minor Components Wabash** Percent of map unit: 5 percent Landform: Flood-plain steps Landform position (three-dimensional): Tread Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS)

Riley County, Kansas 7213—Reading silt loam, moderately wet, very rarely flooded Map Unit Setting Elevation: 920 to 1,080 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 55 degrees F Frost-free period: 175 to 215 days **Map Unit Composition** Reading and similar soils: 85 percent **Description of Reading Setting** Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Fine-silty alluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Moderately well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr) Depth to water table: About 40 to 44 inches Frequency of flooding: Very rare Frequency of ponding: None Available water capacity: High (about 11.6 inches) **Interpretive groups** Land capability (nonirrigated): 2w Ecological site: Loamy Lowland (PE 30-37) (R106XY013KS) **Typical profile** 0 to 8 inches: Silt loam 8 to 14 inches: Silt loam 14 to 21 inches: Silty clay loam 21 to 29 inches: Silty clay loam 29 to 42 inches: Silty clay loam 42 to 60 inches: Silty clay loam 60 to 80 inches: Silty clay loam

Riley County, Kansas 7170—Reading silt loam, rarely flooded Map Unit Setting Elevation: 1,000 to 1,200 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Reading and similar soils: 90 percent **Description of Reading Setting** Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear Across-slope shape: Linear Parent material: Fine-silty alluvium **Properties and qualities** Slope: 0 to 1 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr) Depth to water table: More than 80 inches Frequency of flooding: Rare Frequency of ponding: None Available water capacity: High (about 11.2 inches) **Interpretive groups** Land capability (nonirrigated): 1 Ecological site: Loamy Lowland (Draft) (PE 30-36) (R076XY013KS) **Typical profile** 0 to 11 inches: Silt loam 11 to 20 inches: Silty clay loam 20 to 52 inches: Silty clay loam 52 to 60 inches: Silty clay loam

Riley County, Kansas 4784—Tully silty clay loam, 3 to 7 percent slopes, eroded Map Unit Setting Elevation: 1,000 to 1,600 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 43 to 66 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Tully, eroded, and similar soils: 85 percent **Description of Tully, Eroded Setting** Landform: Hillslopes Landform position (two-dimensional): Footslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey colluvium **Properties and qualities** Slope: 4 to 8 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (about 7.9 inches) **Interpretive groups** Land capability (nonirrigated): 4e Ecological site: Clay Upland (PE 25-34) (R075XY007KS) **Typical profile** 0 to 7 inches: Silty clay loam 7 to 37 inches: Silty clay 37 to 60 inches: Silty clay

Riley County, Kansas 4783—Tully silty clay loam, 3 to 7 percent slopes Map Unit Setting Elevation: 1,000 to 1,540 feet Mean annual precipitation: 31 to 47 inches Mean annual air temperature: 52 to 59 degrees F Frost-free period: 190 to 225 days **Map Unit Composition** Tully and similar soils: 85 percent **Description of Tully Setting** Landform: Hillslopes Landform position (two-dimensional): Footslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Clayey colluvium **Properties and qualities** Slope: 3 to 7 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum content: 5 percent Available water capacity: High (about 9.1 inches) **Interpretive groups** Land capability (nonirrigated): 3e Ecological site: Loamy Upland (Draft) (PE 30-36) (R076XY015KS) **Typical profile** 0 to 12 inches: Silty clay loam 12 to 21 inches: Silty clay loam 21 to 31 inches: Silty clay 31 to 40 inches: Silty clay 40 to 52 inches: Silty clay 52 to 60 inches: Silty clay

5.3.2 Soil semi-variogram description

The goal of this aspect of the site characterization is to determine the minimum distance between the soil plots in the soil array such that data farther apart can be considered spatially independent. The collected field data will be used to produce semivariograms, which is a geostatistical technique to characterize spatial autocorrelation between mapped samples of a quantitative variable (*e.g.*, soil property data in our case). In an empirical semivariogram, the average of the squared differences of a response variable is computed for all pairs of points within specified distance intervals (lag classes). The output is presented graphically as a plot of the average semi-variance versus distance class (Figure 45). For the theoretical variogram models considered here, the semivariance will converge on the total variance at distances for which values are no longer spatially auto-correlated (this is referred to as the range, Figure 45).

For the theoretical variograms considered here, three parameters estimated from the data are used to fit a semivariogram model to the empirical semivariogram. This model is then assumed to quantitatively represent the correlation as a function of distance (Figure 45), the range, the sill (the sill is the asymptotic value of semi-variance at the range), and the nugget (which describes sampling error or variation at distances below those separating the closest pairs of samples). The range, sill and nugget are estimated from theoretical models that are fitted to the empirical variograms using non-linear least squares methods.

The variogram analysis will be used, to determine the spatial scales at which we can consider soil measurements spatially independent. This characterization will directly inform the minimum distance between *i*) soil plots within each soil array, *ii*) the soil profile measurements, *iii*) EP plots, and *iv*) the microbial sampling locations. These data will directly inform NEON construction and site design activities.

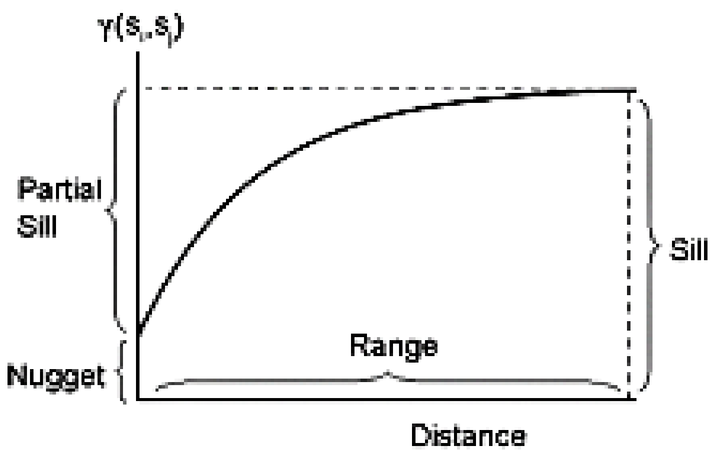


Figure 45. Example semivariogram, depicting range, sill, and nugget.

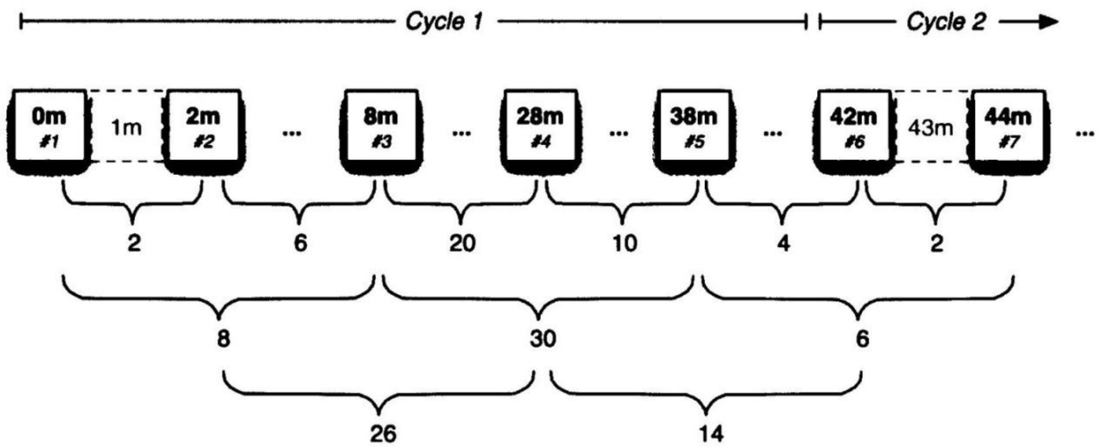


Figure 46. Spatially cyclic sampling design for the measurements of soil temperature and soil water content.

Field measurements of soil temperature (0-12 cm) and moisture (0-15 cm) were taken on 13 May 2010 at the Konza - Relocatable site. The sampling points followed the spatially cyclic sampling design by Bond-Lamberty et al. (2006) (Figure 46). Soil temperature and moisture measurements were collected along three transects (144 m, 81 m, and 84 m) located in the expected airshed at Konza - Relocatable. Details of how the airshed was determined are provided below. Soil temperature was measured with platinum resistance temperature sensors (RTD 810, Omega Engineering Inc., Stamford CT) and soil moisture was measured with time domain diaelectric sensors (CS616, Campbell Scientific Inc., Logan UT).

As well as measuring soil temperature and moisture at each sample point in Figure 46, measurements were also taken 30 cm in front and behind the sampling point along the axis of the transect. For example, at the 2 m sampling point, soil temperature and moisture was measured at 1.7 m, 2 m, and 2.3 m; this data is referred to as mobile data, since the measurements were taken at many different locations. In addition, soil temperature and moisture were continuously recorded at a single fixed location (stationary data) throughout the sampling time to correct for changes in temperature and moisture throughout the day.

Data collected were used for geospatial analyses of variograms in the R statistical computing language with the geoR package to test for spatial autocorrelation (Trangmar *et al.* 1986; Webster & Oliver 1989; Goovaerts 1997; Riberiro & Diggle 2001) and estimate the distance necessary for independence among soil plots in the soil array. To correct for changes in temperature and moisture over the sampling period, the stationary data was subtracted from the mobile data. In many instances a time of day trend was still apparent in the data even after subtracting the stationary data from the mobile data. This time of day trend was corrected for by fitting a linear regression and using the residuals for the semivariogram analysis. Soil temperature and moisture data, R code, graphs, and R output can be found at: P:\FIU\FIU_Site_Characterization\DXX\YYYYYYY_Characterization\Soil Measurements\Soil Data Analysis (where XX = domain number and YYYYYYY = site name).

5.3.3 Results and interpretation

5.3.3.1 Soil Temperature

Soil temperature data residuals, after accounting for changes in temperature in the stationary data and any remaining time of day trend, were used for the semivariogram analysis (Figure 47). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 48, left graph) and directional semivariograms do not show anisotropy (Figure 48, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 48, right graph). The model indicates a distance of effective independence of 35 m for soil temperature.

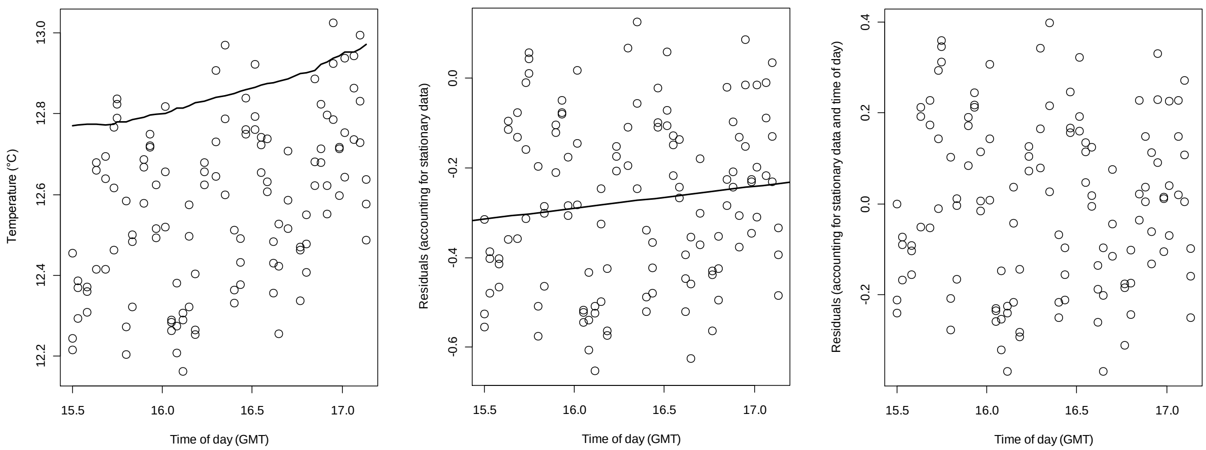


Figure 47. Left graph: mobile (circles) and stationary (line) soil temperature data. Center graph: temperature data after correcting for changes in temperature in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual temperature data after correcting for changes temperature in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

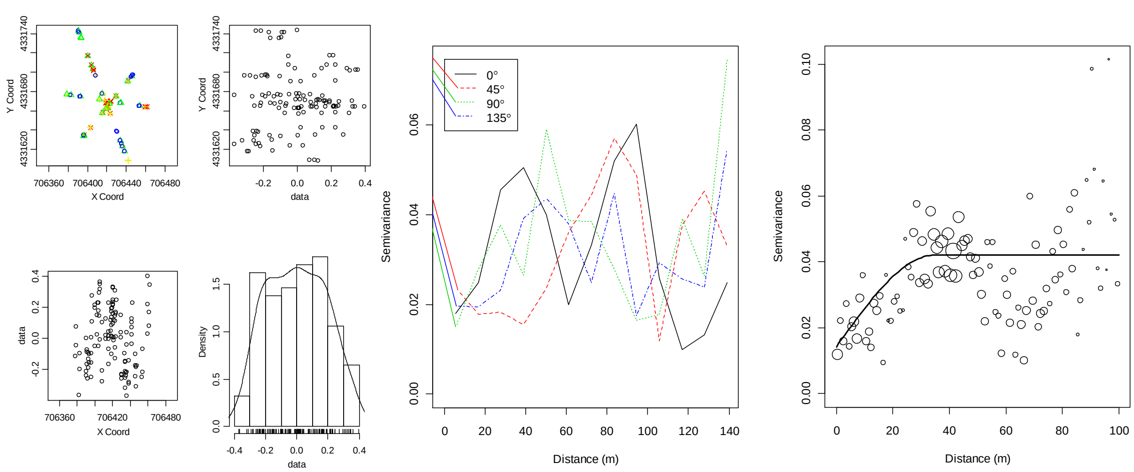


Figure 48. Left graphs: exploratory data analysis plots for residuals of temperature. Center graph: directional semivariograms for residuals of temperature. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of temperature.

5.3.3.2 Soil water content

Soil water content data residuals, after accounting for changes in water content in the stationary data and any remaining time of day trend, were used for the semivariogram analysis (Figure 49). Exploratory data analysis plots show that there was no distinct patterning of the residuals (Figure 50, left graph) and directional semivariograms do not show anisotropy (Figure 50, center graph). An isotropic empirical semivariogram was produced and a spherical model was fitted using Cressie weights (Figure 50, right graph). The model indicates a distance of effective independence of 67 m for soil water content.

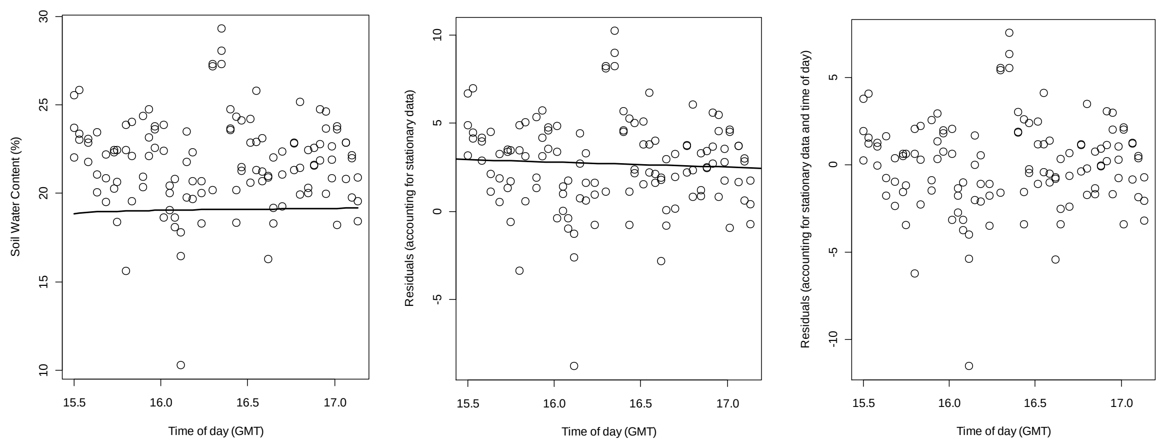


Figure 49. Left graph: mobile (circles) and stationary (line) soil water content data. Center graph: water content data after correcting for changes in water content in the stationary data (circles) and a linear regression based on time of day (line). Right graph: residual water content data after correcting for changes water content in the stationary data and the time of day regression. Data in the right graph were used for the semivariogram analysis.

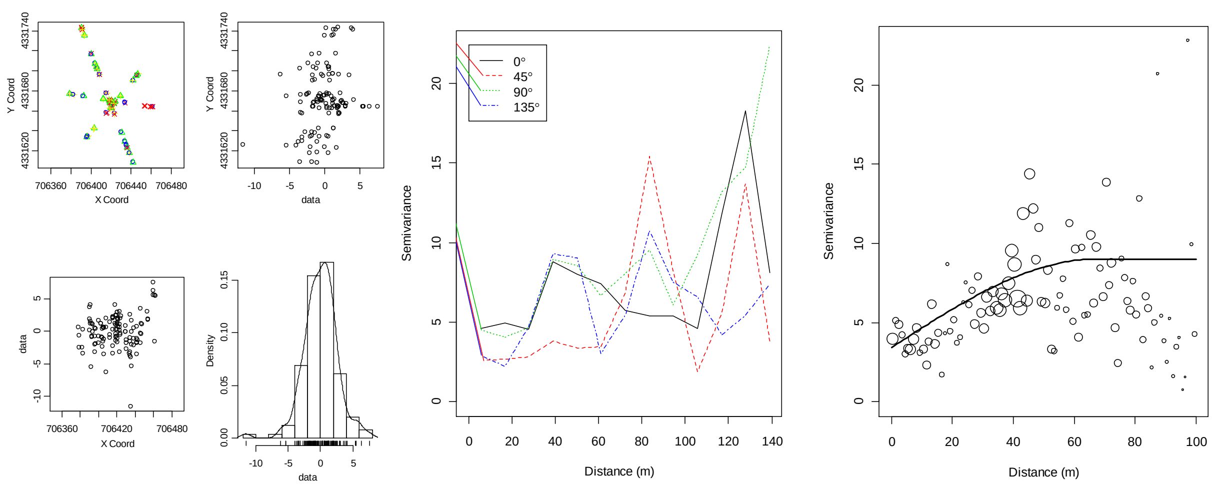


Figure 50. Left graphs: exploratory data analysis plots for residuals of soil water content. Center graph: directional semivariograms for residuals of water content. Right graph: empirical semivariogram (circles) and model (line) fit to residuals of water content.

5.3.3.3 Soil array layout and soil pit location

The minimum distance allowable between soil plots is 25 m to ensure a degree of spatial independence in non-measured soil parameters (i.e., other than temperature and water content) and the maximum distance allowable between soil plots is 40 m due to cost constraints. The estimated distance of effective independence was 35 m for soil temperature and 67 m for soil moisture. Based on these results and the site design guidelines the soil plots at Konza - Relocatable shall be placed 40 m apart. The soil array shall follow the linear soil array design (Soil Array Pattern B) with the soil plots being 5 m x 5 m. The direction of the soil array shall be 161° from the soil plot nearest the tower (i.e., first soil plot). The location of the first soil plot will be approximately 39.110269°, -96.612876°. The exact location of each soil plot may be micrsited to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc). T he FIU soil pit for characterizing soil horizon depths, collecting soil for site-specific sensor calibration, and collecting soil for the FIU soil archive will be located at 39.108313, -96.610380 (primary location); or 39.107913, -96.610067 (alternate location 1 if primary location is unsuitable); or 39.108703, -96.610668 (alternate location 2 if primary location is unsuitable). A summary of the soil information is shown in Table 17 and site layout can be seen in Figure 51.

Dominant soil series at the site: Chase silty clay loam, rarely flooded. The taxonomy of this soil is shown below:
Order: Mollisols
Suborder: Udolls
Great group: Argiudolls
Subgroup: Aquertic Argiudolls
Family: Fine, smectitic, mesic Aquertic Argiudolls
Series: Chase silty clay loam, rarely flooded

Table 17. Summary of soil array and soil pit information at Konza - Relocatable. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	40 m
Distance from tower to closest soil plot: y	20 m
Latitude and longitude of 1st soil plot OR direction from tower	39.110269°, -96.612876°
Direction of soil array	161°
Latitude and longitude of FIU soil pit 1	39.108313, -96.610380 (primary location)
Latitude and longitude of FIU soil pit 2	39.107913, -96.610067 (alternate 1)
Latitude and longitude of FIU soil pit 3	39.108703, -96.610668 (alternate 2)
Dominant soil type	Chase silty clay loam, rarely flooded
Expected soil depth	>2 m
Depth to water table	0.61-1.22 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.18 m (Silty clay loam)	0.09 m†
0.18-0.33 m (Silty clay loam)	0.26 m†
0.33-1.02 m (Silty clay)	0.68 m†
1.02-1.27 m (Silty clay)	1.15 m
1.27-1.52 (Silty clay)	1.40 m
2.00 m	2.00 m

*Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.

†Expected depth of soil CO_2 sensors (actual depth will be based on findings from the FIU soil pit)

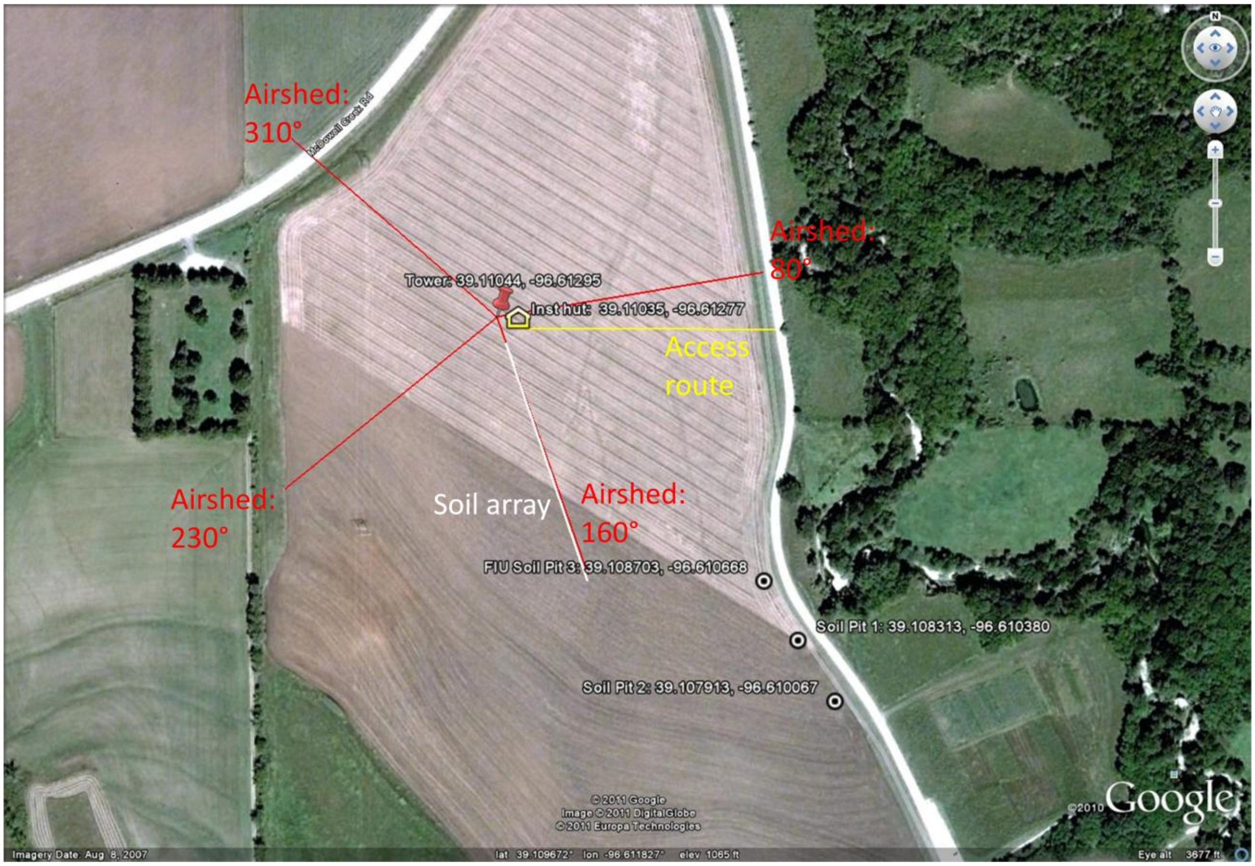


Figure 51. Site layout at Konza - Relocatable showing soil array and location of the FIU soil pit.

5.4 Airshed

5.4.1 Seasonal windroses

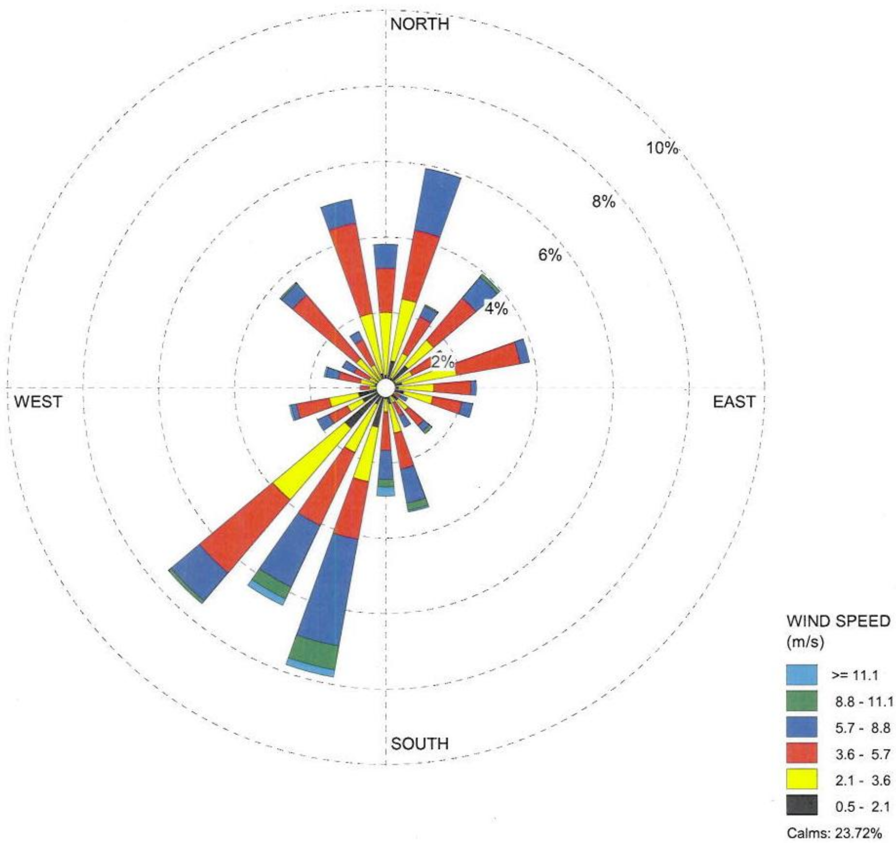
Wind roses analytically determine and graphically represent the frequencies of wind direction and wind speed over a given timeseries. The data used to make the wind roses below are 2007 data from Manhattan Regional airport at 39.135, -96.678, which is ~ 6.2 km away from the NEON tower site. The orientation of the windrose follows that of a compass (assumed declination applied). When we describe the wind directions it should be noted that they are the cardinal direction that wind blows from. The directions of the rose with the longest spoke show wind directions with the largest frequency. These wind roses are subdivided into as 24 cardinal directions in this case.

5.4.2 Results (graphs for wind roses)

WIND ROSE PLOT:

Domain_06_Konza; Lat: 39.100596 Long: -96.562988 **Convention: Blowing From**

MANHATTAN RGNL; Call Sign: KMHK; Lat: 39.135 Long: -96.678; Jan-Mar 2007; Separation: 10.655 km

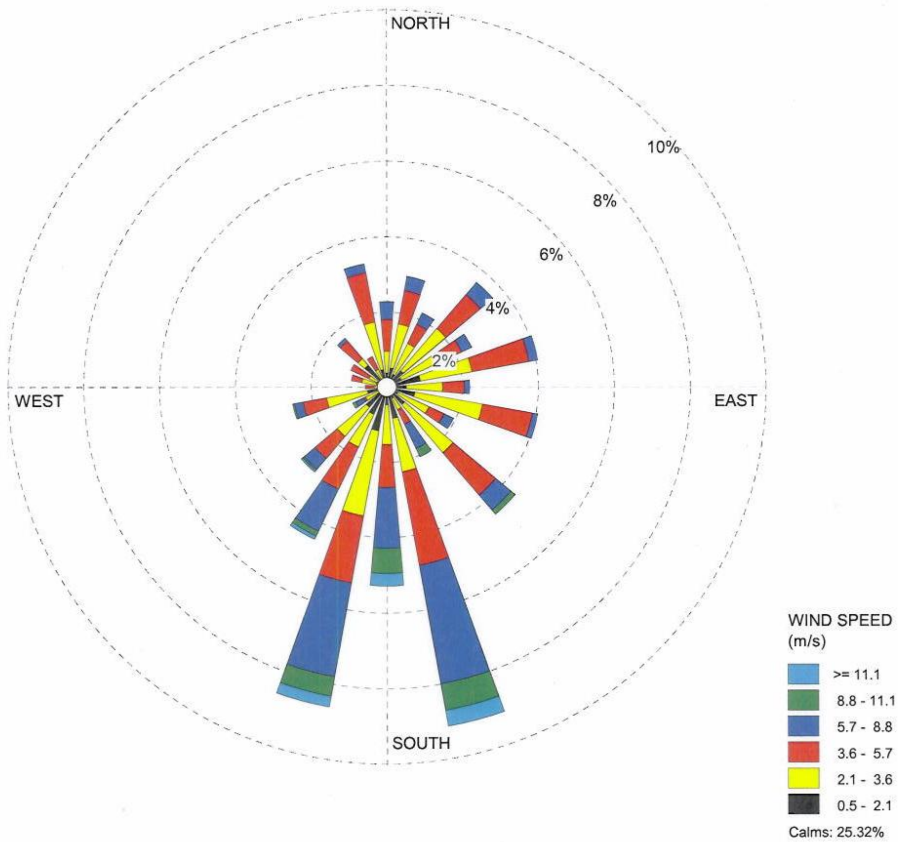


COMMENTS:		COMPANY NAME: **NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.**	
		MODELER: **Ted Hehn**	
	CALM WINDS: **23.72%**	TOTAL COUNT: **2053 hrs.**	
	AVG. WIND SPEED: **3.46 m/s**	DATE: **2/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Domain_06_Konza; Lat: 39.100596 Long: -96.562988 **Convention: Blowing From**
MANHATTAN RGNL; Call Sign: KMHK; Lat: 39.135 Long: -96.678; Arp-Jun 2007; Separation: 10.655 km

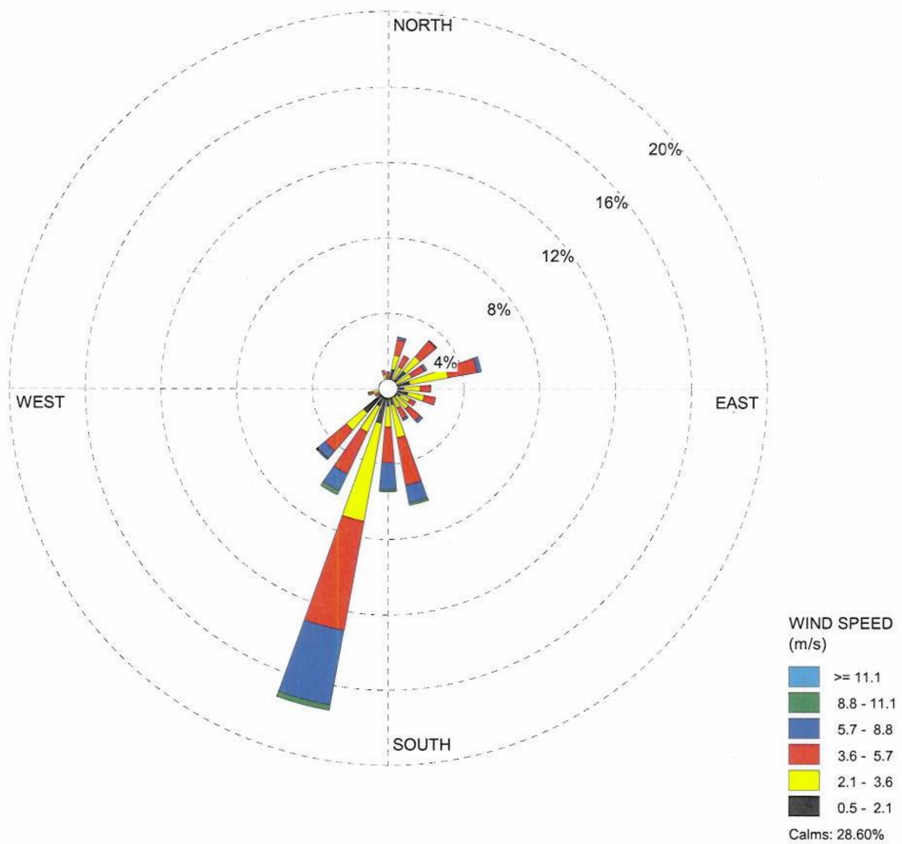


COMMENTS:		COMPANY NAME: **NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.**	
		MODELER: **Ted Hehn**	
	CALM WINDS: **25.32%**	TOTAL COUNT: **2105 hrs.**	
	AVG. WIND SPEED: **3.35 m/s**	DATE: **2/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

WIND ROSE PLOT:

Domain_06_Konza; Lat: 39.100596 Long: -96.562988 **Convention: Blowing From**
MANHATTAN RGNL; Call Sign: KMHK; Lat: 39.135 Long: -96.678; Jul-Sept 2007; Separation: 10.655 km



COMMENTS:		COMPANY NAME: **NATIONAL ECOLOGICAL OBSERVATORY NETWORK, Inc.**	
		MODELER: **Ted Hehn**	
	CALM WINDS: **28.60%**	TOTAL COUNT: **2119 hrs.**	
	AVG. WIND SPEED: **2.79 m/s**	DATE: **2/6/2009**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

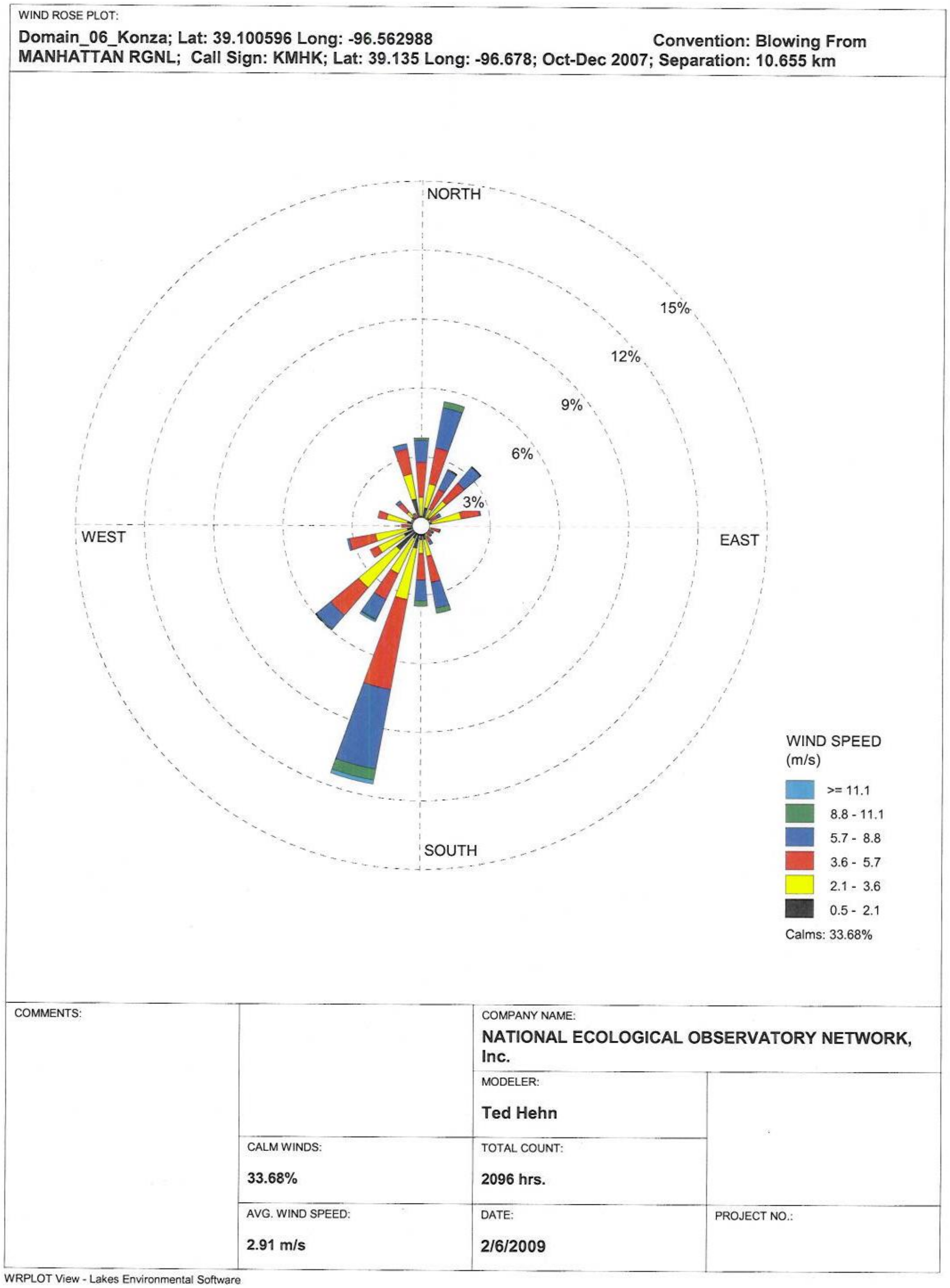


Figure 52. Windroses for Konza Relocatable tower site

The data used to make these wind roses are 2007 data from Manhattan Regional airport at 39.135, -96.678, which is ~ 6.2 km away from the NEON tower site. This is the same set of wind roses that is used for Konza Advanced site. It is assumed that the wind data was corrected for declination. Panels are (from top to bottom) January to December.

5.4.3 Resultant vectors

Not available.

5.4.4 Expected environmental controls on source area

Two types of models were commonly used to determine the shape and extent of the source area under different and contrasting atmospheric stability classes. An inverted plume dispersion model with modeled cross wind solutions were used for convective conditions (Horst and Weil 1994). For strongly stable conditions, and Lagrangian solution was used (Kormann and Meixner 2001). The source area models where bounded by the expected conditions depict the extreme conditions. Convective conditions typically have strong vertical mixing between the ecosystem and atmosphere (surface layer). Stable conditions typically have long source area and associated waveforms. Convective turbulence is often characterized by short mixing scales (scalar) and moderate daytime wind speeds, *e.g.,* 1-4 m s^{-2}. Higher wind speeds, like those experienced over the Rockies, are often the product of mechanical turbulence with long waveforms. Because thermal stratification is very efficient in suppressing vertical mixing, stable conditions also have typically very long waveforms.

As a general rule, shorter and less structurally complex ecosystems have good vertical mixing during all atmospheric stabilities. Taller and more structurally complex ecosystems have well mixed upper canopies during the daytime, and can be decoupled below the canopy under neutral and stable conditions (e.g., Harvard Forest, Bartlett Experimental Forest, and Burlington Conservation Area). The type of turbulence (mechanical verse convective) and the physical attributes of the ecosystem control the degree of mixing, and the length and size of the source area.

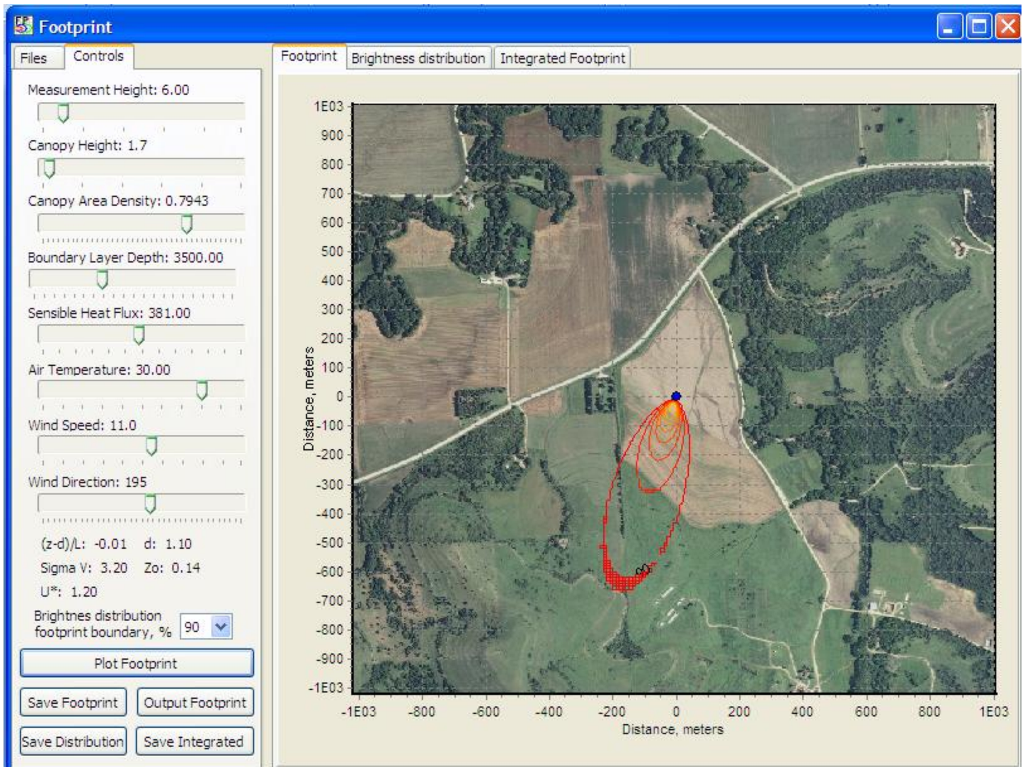
Here, we use a web-based footprint model to determine the footprint area under various conditions (model info: http://www.geos.ed.ac.uk/abs/research/micromet/EdiTools/). Winds used to run the model and generate following model results are extracted from the wind roses. Vegetation information, temperature and energy information were either from the RFI document, previous site visit report, available data files or best estimated from experienced expert. Measurement height was determined from the Tower Height Info document provided by ENG group, then verify according to the real ecosystem structure after FIU site characterization at site. Runs 1-3 and 4-6 represent the expected conditions for summer and winter conditions, respectively, with maximum and mean windspeeds (daytime convective) and nighttime (stable atmospheres) conditions. The wind vector for each run was estimated from wind roses and is placed as a centerline in the site map included in the graphics. The width of the footprint was also estimated using the length between the isopleth of 80% cumulative flux and center line to calculate the angle from centerline. This information, along with distance of the cumulative flux isopleths and wind direction, will define the source area for the flux measurements on the top of the tower.

Table 18. Expected environmental controls to parameterize the source area model and associated results for Konza Relocatable tower site at construction.

Parameters	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	
Approximate season	summer			winter			Units
	Day (max WS)	Day (mean WS)	Night	Day (max WS)	Day (mean WS)	night	qualitative

Atmospheric stability	Convective	convective	Stable	Convective	convective	Stable	qualitative
Measurement height	6	6	6	6	6	6	m
Canopy Height	1.7	1.7	1.7	1.7	1.7	1.7	m
Canopy area density	0.7943	0.7943	0.7943	0.2512	0.2512	0.2512	m
Boundary layer depth	3500	3500	1701	600	600	501	m
Expected sensible heat flux	381	381	90	180	180	10	W m^{-2}
Air Temperature	30	30	24	15	15	3	°C
Max. windspeed	11	3.8	1.8	13	5.6	2.4	m s^{-1}
Resultant wind vector	195	195	195	210	210	16	degrees
Results							
(z-d)/L	-0.01	-0.18	-0.32	0	-0.05	-0.04	m
d	1.1	1.1	1.1	0.78	0.78	0.78	m
Sigma v	3.2	2.2	1.1	2.8	1.5	0.59	m^2 s^{-2}
Z0	0.14	0.14	0.14	0.1	0.1	0.1	m
u*	1.2	0.48	0.25	1.3	0.6	0.25	m s^{-1}
Distance source area begins	0	0	0	0	0	0	m
Distance of 90% cumulative flux	500	250	200	600	480	500	m
Distance of 80% cumulative flux	250	200	150	300	280	300	m
Distance of 70% cumulative flux	200	150	100	250	200	200	m
Peak contribution	35	25	25	45	45	45	m

5.4.5 Results (source area graphs)



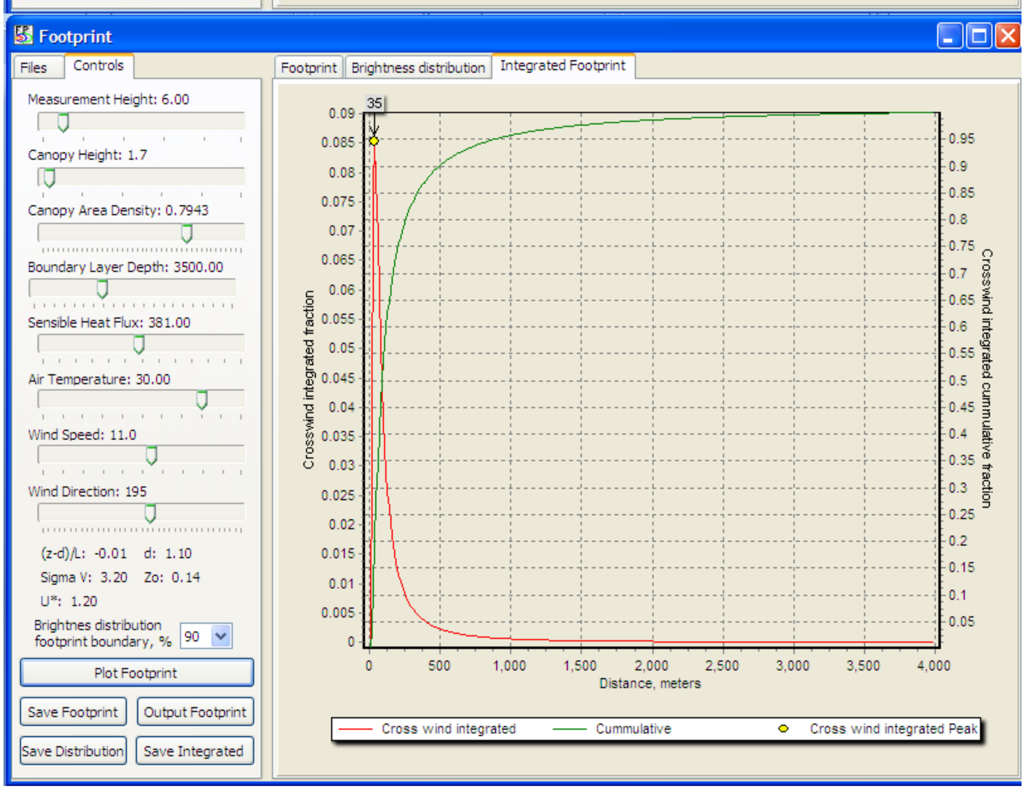
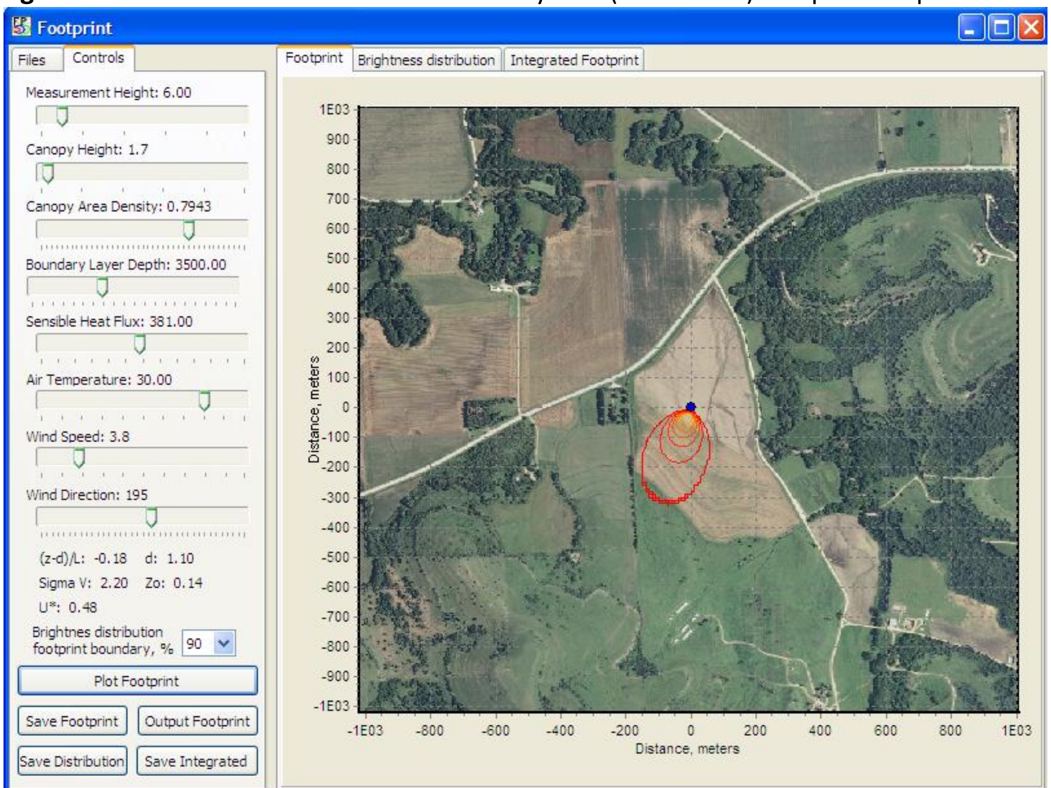


Figure 53. Konza Relocatable site summer daytime (convective) footprint output with max wind speed .



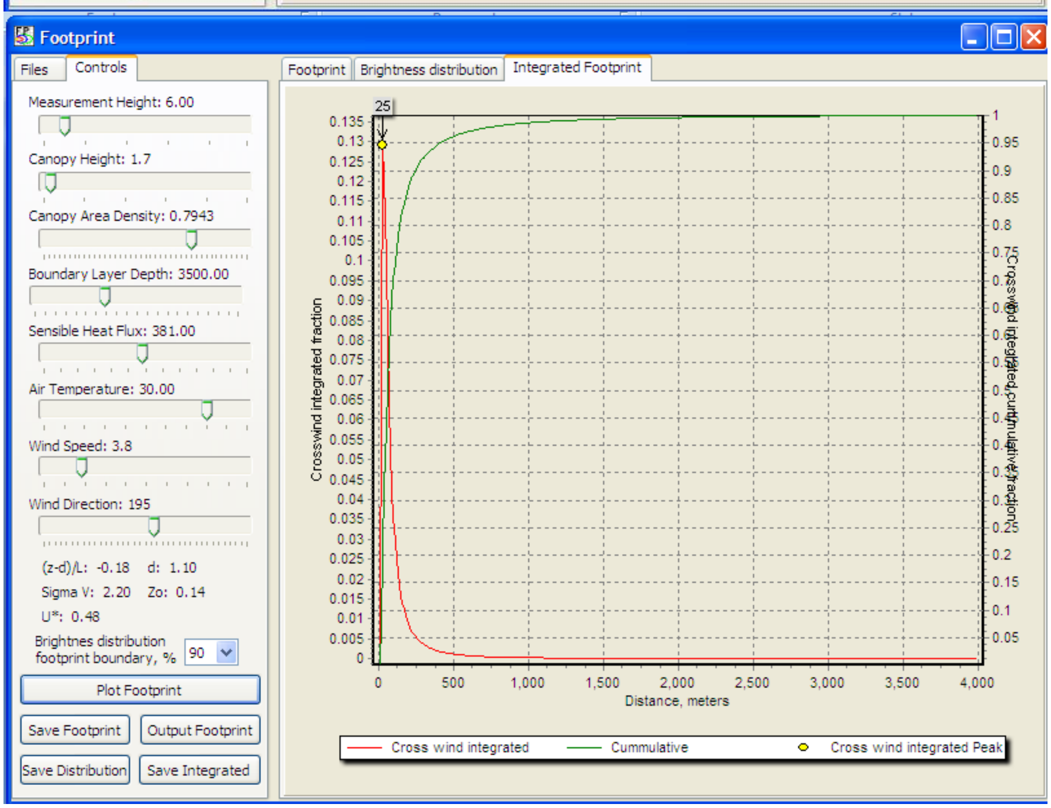


Figure 54. Konza Relocatable site summer daytime (convective) footprint output with mean wind speed

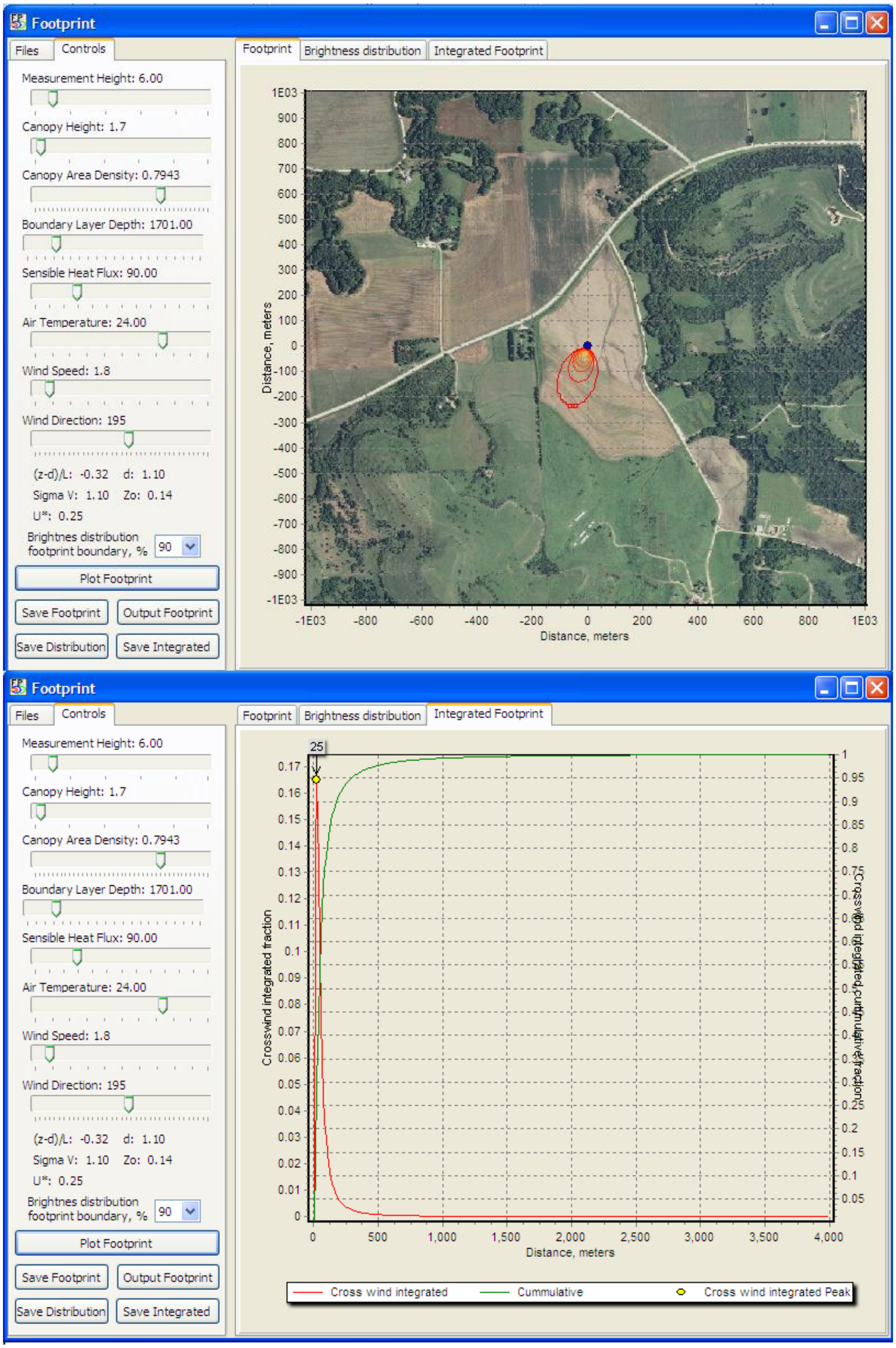


Figure 55. Konza Relocatable site summer nighttime (stable) footprint output with mean wind speed

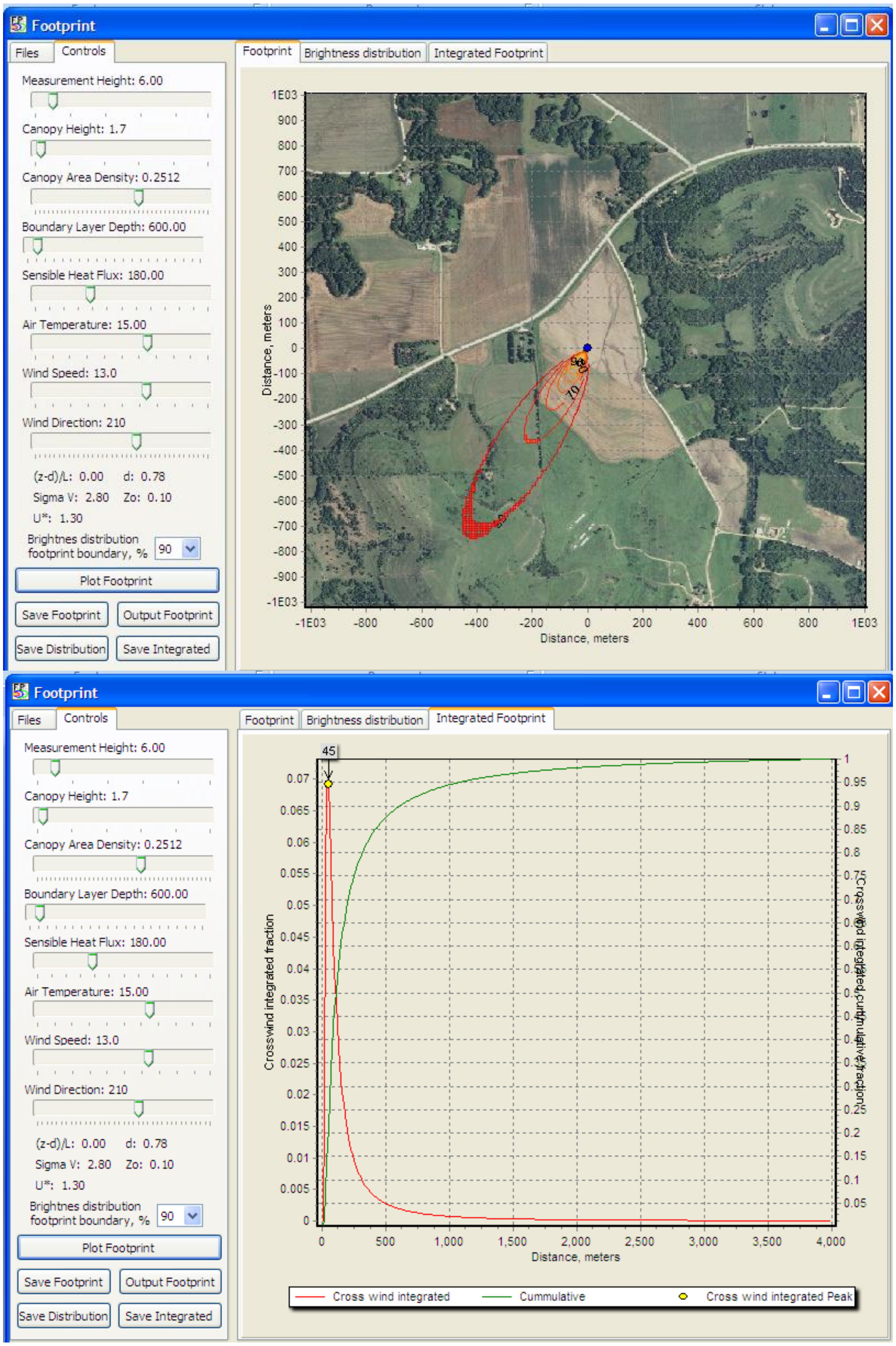


Figure 56. Konza Relocatable site winter daytime (convective) footprint output with max wind speed

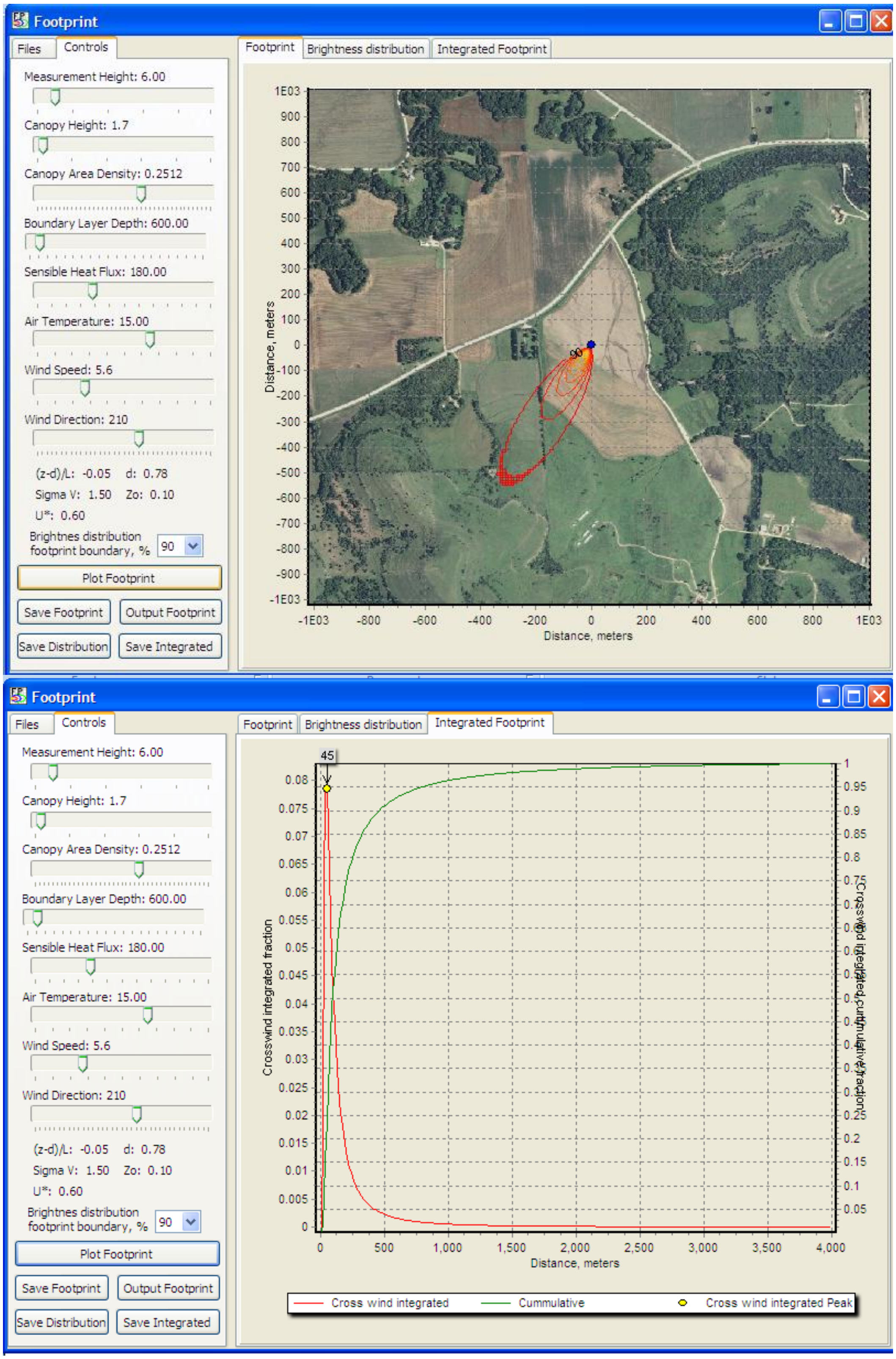


Figure 57. Konza Relocatable site winter daytime (convective) footprint output with mean wind speed

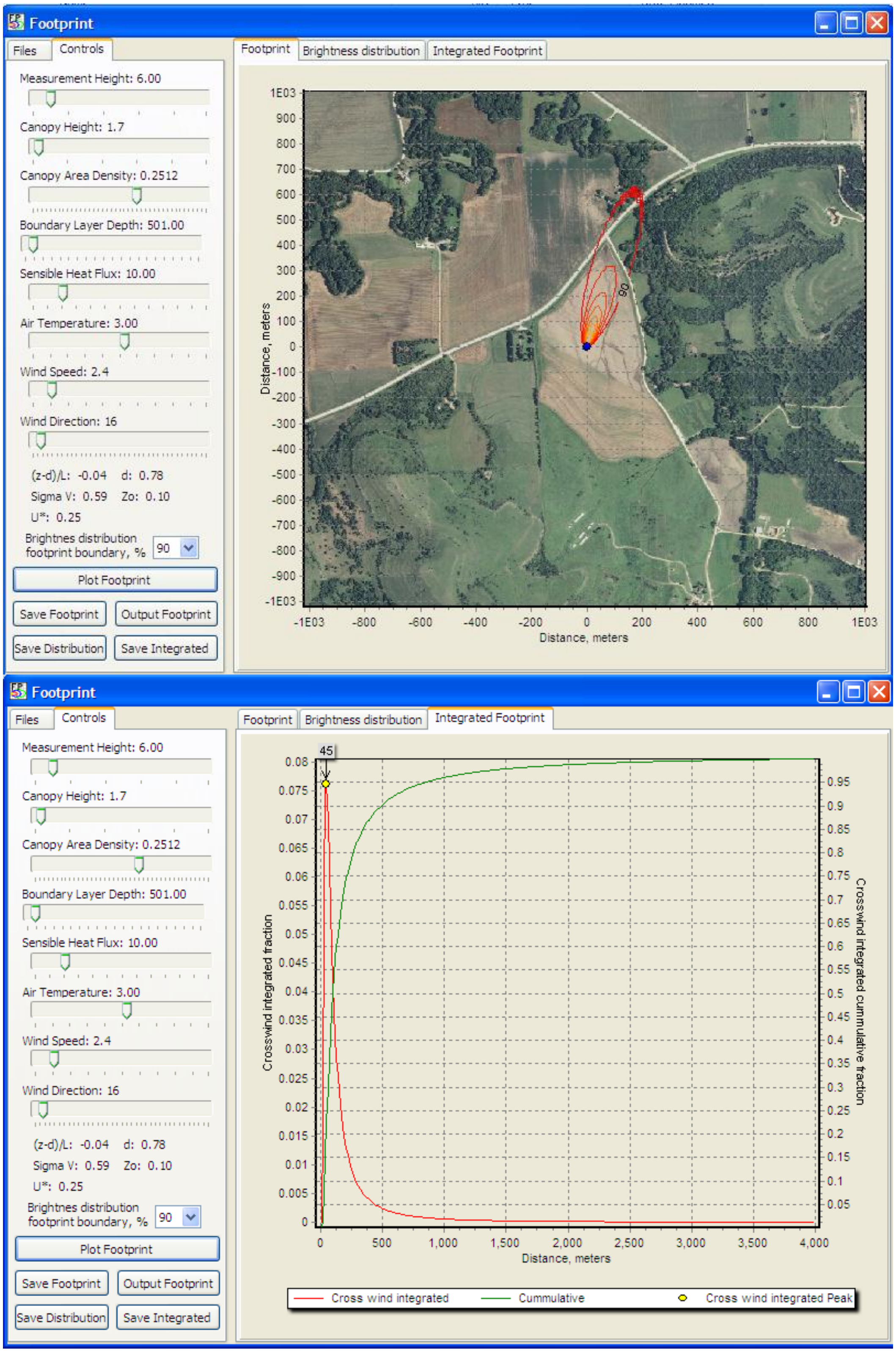


Figure 58. Konza Relocatable site winter nighttime (stable) footprint output with mean wind speed

5.5 Site design and tower attributes

According to the wind roses, wind can blow from any direction throughout the year. But wind blows most frequently from the airshed between 160^{o} and 230^{o} (clockwise from 160^{o}, major airshed), and between 310^{o} and 80^{o} (clockwise from 310^{o}, secondary airshed). **Tower** should be placed to a location to best catch the signals from the airshed of the ecosystem in interest, which is agricultural ecosystem at this site. The Konza advance tower site was at 39.110000°, -96.613000°. We adjusted it to 39.11044, -96.61295, which is ~50 m toward north to have longer fetch area in the major airshed over the crop field.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the northwest will be best to capture signals from all wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

An **instrument hut** should be outside the prevailing wind airshed to avoid disturbance in the measurements of wind and should be positioned to have the longer side parallel to frequent wind direction to minimize the wind effects on instrument huts and to minimize the disturbances of wind regime by instrument hut. At this site, we determined the instrument hut location at 39.11035, -96.61277. The instrument hut should be positioned to have the longer side parallel to SW-NE direction.

The land around tower and inside the major airshed is currently managed as two plowed arable field. However, prior to NEON site construction these fields will be begin to be restored to native tallgrass prairie, which will allow the NEON site to assess the initial phase of prairie restoration. It is likely that canopy height will be similar to the Konza – Core site (i.e. native tallgrass prairie), which has a canopy that can reach ~1.5 m high. Therefore, we require 4 **measurement layers** on the tower with top measurement height at 6 m, and the remaining levels are 3.8 m, 1.5 m, and 0.2 m, respectively, to best characterize the fluxes on the tower top and environmental conditions in profile.

Secondary **precipitation collector** for bulk precipitation collection will be located the top of tower at this site. No **wet deposition collector** will be deployed at this site. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

The site layout is summarized in the table below. Assume the projected area of the tower is square. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 19. Site design and tower attributes for Konza Relocatable site

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan or best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed area			160^{o} to 230^{o}		Clockwise from

			(major), and 310° to 80° (secondary)		first angle
Tower location	39.11044,	-96.61295	--	--	
Instrument hut	39.11035,	-96.61277			
Instrument hut orientation vector	--	--	200° - 20°		longwise
Instrument hut distance z	--	--	--	18	
Anemometer/Temperature boom orientation	--	--	290°	--	
Height of the measurement levels					
Level 1				0.2	m.a.g.l.
Level 2				1.5	m.a.g.l.
Level 3				3.8	m.a.g.l.
Level 4				6.0	m.a.g.l.
Tower Height				6.0	m.a.g.l.

See AD 03 for technical requirement to determine the boom height for the bottom most measurement level.

Figure below shows the proposed tower location, instrument hut location, airshed area and access road.

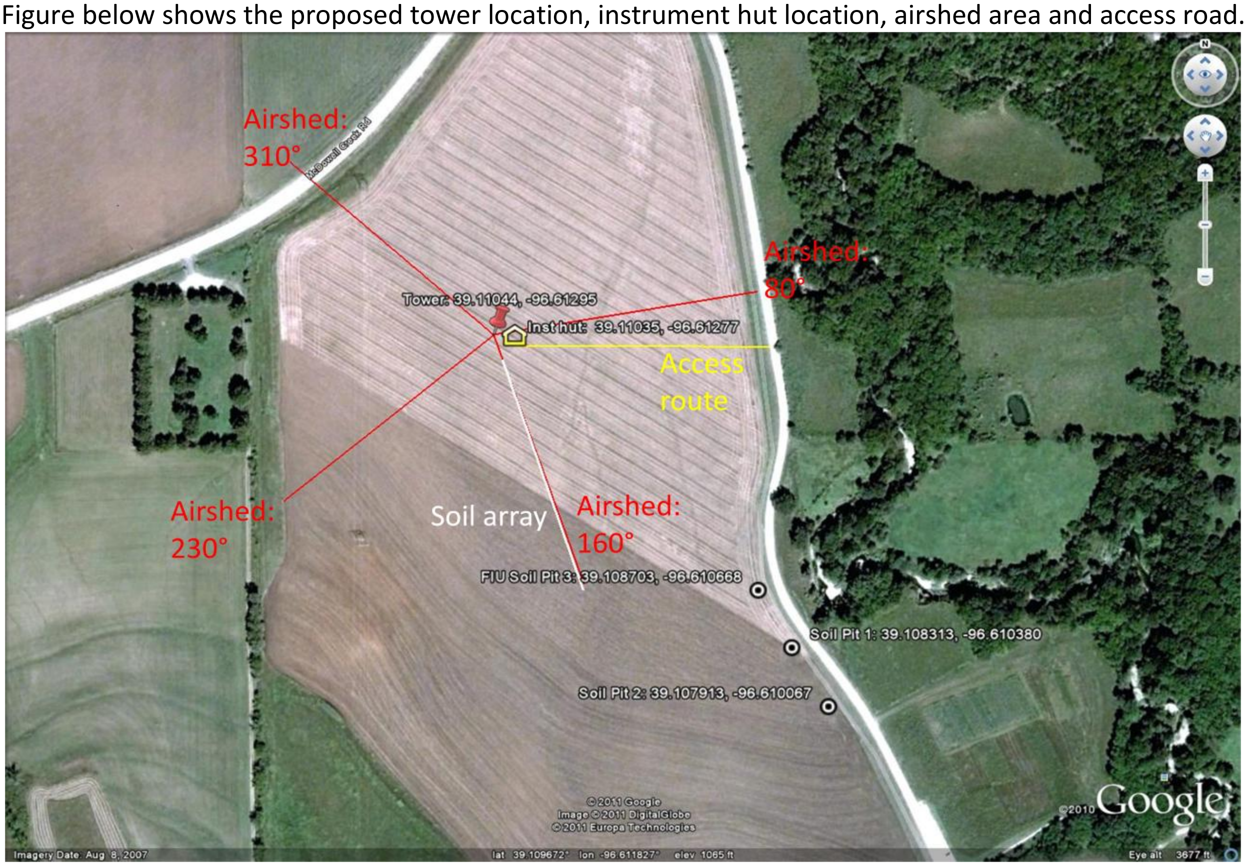


Figure 59. Site layout for Konza Relocatable site.

i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 160° to 230° (major airshed, clockwise from 160°) and 310° to 80° (clockwise from 310°, secondary) would have quality wind data without causing flow distortions, respectively.iii) Yellow line is the suggested access road to instrument hut.

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36' wide footprint. While the final design is not yet known, there are some general criteria that can be outlined. We assume that the boardwalk width is 36" (0.914 m). Material is not known, but must be fire proof, and in some locations the site is seasonally flooded and inundated with water. Boardwalks may also provide a scratching structure for grazing animals that in turn, would wear and unduly impact the site. Site by site evaluations must be done.
Specific boardwalks at this site:

- Boardwalk from access point to instrument hut
- Boardwalk from instrument hut to tower and access tower on the north face.
- Boardwalk to the soil array.
- No boardwalk from the soil array boardwalk to the individual soil plots.

The relative locations between tower, instrument hut and boardwalk can be found in the diagram below:

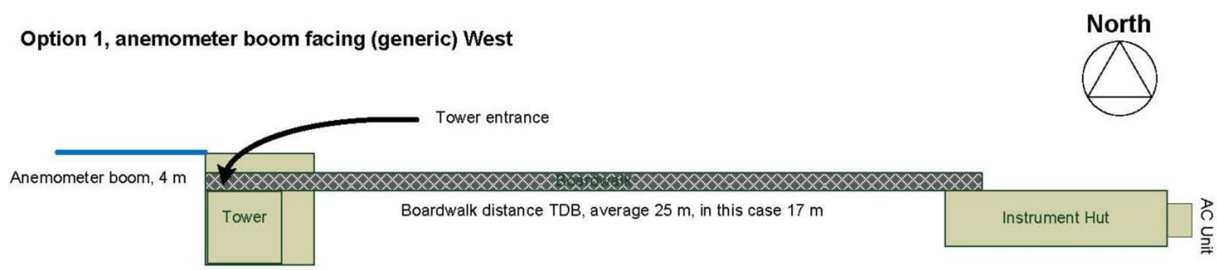


Figure 60. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram. The actual layout of boardwalk (or path if no boardwalk required) and instrument hut position will be the joint responsibility of FCC and FIU. At this site, the boom angle will be 290 degrees, instrument hut location is on the southeast toward tower, the distance between instrument hut and tower is ~17 m. The instrument hut vector will be SW-NE (200°-20°, longwise).

5.6 Information for ecosystem productivity plots

The tower at this site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (agricultural ecosystem). Wind can blow from any direction during the year, but has higher frequency from the airshed between 160° and 230° (clockwise from 160°, major airshed), and between 310° and 80° (clockwise from 310°, secondary airshed). 90% signals for flux measurements are within 600 m from tower, and 80% within 300 m. We suggest FSU Ecosystem Productivity plots are placed within the boundaries of 160° to 230° (clockwise from 160°, major) and 310° to 80° (clockwise from 310°, secondary) from tower.

5.7 Issues and attentions

Fire frequency is unknown at the site as the restoration to tallgrass prairie has not yet begun. However, the site design, construction, and operation should be done with the expectation that fire (managed and/or unmanaged) may be frequent, e.g. annually.

Chiggers and ticks will likely be prevalent in the restored prairie.

Konza PrairieBiological Station is heavily used for ecological research. Coordination with land managers is required to ensure that the NEON site does not interfere with other research in the area and vice versa.

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